AA-H378C-TC

July 1984

This manual is a reference document for advanced RT-11 users, including FORTRAN-IV and MACRO-11 assembly language programmers.


Operating System: RT-11 Version 5.1
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Preface

The RT-11 Programmer's Reference Manual describes the programmed requests and subroutines that are available in the system macro library (SYSMAC.SML) and system subroutine library (SYSLIB.OBJ). It provides programming examples that show how to use programmed requests and subroutines.

Chapter 1, Introduction to Advanced RT-11 Programming, describes the implementation and use of the programmed requests and the FORTRAN-callable subroutines.

Chapter 2, Programmed Request Description and Examples, describes the individual programmed requests in detail. Program examples are included for each request. In addition, macros and subroutines that are used in implementing device handlers and interrupt service routines are described.

Chapter 3, System Subroutine Description and Examples, describes in detail all the RT-11 FORTRAN-callable subroutines. This chapter also contains examples of the use of the calls to the system subroutine library.

Appendix A, Display File Handler, describes the graphics support for the RT-11 operating system. Program examples are included to help you develop your own display program.

Appendix B, System Macro Library, is a listing of the RT-11 System Macro Library (SYSMAC.SML).

This manual is written for an advanced-level user. If you have no RT-11 experience, or very little, read:

Introduction to RT-11
RT-11 System User's Guide
RT-11 System Utilities Manual

In addition, FORTRAN programmers should read:

RT-11/RSTS/E FORTRAN IV User's Guide

If you are interested in additional programming techniques or other system programming topics, read the RT-11 Software Support Manual.
Chapter 1
Introduction to Advanced RT–11 Programming

Programmed requests and system subroutines are available as part of the RT–11 Operating System and can aid you in writing reliable and efficient programs.

Programmed requests provide a number of services to application programs. The requests function as calls to routines in the RT–11 monitor that perform these services. As system macros, they are defined in a system macro library that is stored on the system volume and named SYSMAC.SML. In addition, macro routines are available in the system macro library that can help you write device handlers and interrupt service routines.

The file SYSMAC.MAC is not provided on the RT–11 distribution kit. However, you will need this file if you want to modify the system macro library.

You can create SYSMAC.MAC from the distributed file SYSMAC.SML by running the SPLIT utility. Type this CCL command:

```
.SPLIT ,SYSMAC.MAC=SYSMAC.SML/B...SYSM
```

This command creates the file SYSMAC.MAC on your default device. The variable ..SYSM represents the boundary along which to split SYSMAC.SML. Refer to the file CUSTOM.TXT on your distribution kit for the value to substitute for ..SYSM in the command line. Refer to the file UNSUP.TXT for more information on using the SPLIT utility.

If you are a FORTRAN programmer, you can access the RT–11 monitor services through calls to the system subroutine library called SYSLIB.OBJ, which is stored on the system volume. A character string manipulation package and two-word integer support routines are included in this library. The SYSLIB subroutines allow you to write almost all application programs in FORTRAN without having to do any assembly language coding.

This chapter tells you how to use programmed requests and subroutines effectively in your programs. Examples are provided to demonstrate their flexibility and value in working programs.

1.1 Programmed Requests

You issue a programmed request in your source program when a certain monitor service is required. The programmed request expands into the appropriate machine language code during assembly time. During program execution, this code requests the resident monitor to supply the service represented by the programmed request.
The services involve the following processes:

1. Initialization and control of operating system characteristics
2. Allocating system resources and reporting status
3. Command interpretation
4. File operations
5. Input/output operations
6. Foreground/background communications
7. Timer support
8. Program termination or suspension
9. System job communications
10. Extended memory functions

The system macro library (SYSMAC.SML) also contains several macros that are not programmed requests. These macros are provided to aid you in writing:

1. Interrupt service routines
2. Device handlers
3. Memory management control blocks

They are described in Chapter 2 along with the programmed requests.

Components of the RT-11 Operating System that support programmed requests are as follows:

1. Single-Job Monitor
   The single-job (SJ) monitor supports most of the programmed requests. Table 1-4 lists the programmed requests that are supported by the SJ monitor. These programmed requests can manipulate files, perform input and output, set timer routines, check system resources and status, and terminate program operations.

2. Foreground/Background Monitor
   Some programmed requests are provided for the foreground/background (FB) monitor only. Table 1-5 lists the programmed requests that are supported by the FB monitor in addition to those listed in Table 1-4. These programmed requests allow a program to set timer routines, suspend and resume jobs, and send messages and data between foreground and background jobs.

3. Extended Memory Monitor
   The extended memory (XM) monitor provides additional programmed requests and features above those found in the FB monitor. The XM monitor extends the memory support capability of RT-11 beyond the
28K-word (plus I/O page) restriction imposed by the 16-bit address size. The XM monitor’s programmed requests extend a program’s effective logical addressing space (see Table 1–5).

4. Multiterminal Feature
The multiterminal feature of RT–11 allows your program to perform character input/output on up to 16 terminals. Programmed requests are available to perform input/output, attach and detach a terminal for your program, set terminal and line characteristics, and return system status information.

5. System Job Support
System job support allows users in a foreground/background or extended memory environment to extend the present standard foreground/background system to include up to eight jobs. Four system jobs are presently provided with the RT–11 system: the error logger, the device queue program (QUEUE), the transparent spooler package (SPOOL), and the communication package (VTCOM). Programmed requests allow programs to copy channels from other jobs, obtain job status information about jobs in the system, and send messages and data between any jobs in the system. The RT–11 Software Support Manual describes the system job feature in more detail.

Programmed requests perform most system resource control and interrogation functions. However, some communication is accomplished by directly accessing two memory areas: the system communication area and the monitor fixed-offset area.

The system communication area resides in locations 40 to 57(octal) and contains parameters that describe and control execution of the current job. This area holds information such as the Job Status Word, starting address of the job, User Service Routine (USR) swapping address, and the address of the start of the resident monitor. Some of this information is supplied by your program, while other data is supplied by the monitor and may not be changed.

The second memory communication area, the fixed-offset area, is accessed by a fixed-address offset from the start of the resident monitor. This area contains system values used to control monitor operation. Your program can examine or modify these values to determine the condition of the operating environment while a job is running. The RT–11 Software Support Manual describes in detail both the system communication area and the fixed-offset area.

This manual specifically describes programmed requests for RT–11 Version 5. Programmed requests for earlier versions of RT–11 and guidelines for their conversion are treated in Sections 1.1.4 and 1.1.5.

1.1.1 Programmed Request Implementation

1.1.1.1 EMT Instructions — A programmed request is a macro call followed by the necessary number of arguments. The macro code that corresponds to
the macro call of a programmed request is expanded by the MACRO assem-
blor when the programmed request appears in your program. The expan-
sion arranges the arguments of the programmed request for the monitor
and generates an EMT (emulator trap) instruction.

When an EMT instruction is executed, control passes to the monitor. The
low-order byte of the EMT code provides the monitor with the information
that tells it what monitor service is being requested.

The execution of the EMT generates a trap through vector location 30. This
vector location is loaded at boot time with an address pointing to a location
in the monitor. The monitor location contains the EMT processing code that
services the interrupt caused by the EMT instruction.

Table 1–1 shows the codes that may appear in the low-order byte of an EMT
instruction and the interpretation of these codes by the monitor.

Table 1–1: EMT Codes

<table>
<thead>
<tr>
<th>Low-Order Byte</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>377</td>
<td>Reserved; RT–11 ignores this EMT and returns control to the user program immediately.</td>
</tr>
<tr>
<td>376</td>
<td>Used internally by the RT–11 monitor; your programs should not use this EMT since its use would lead to unpredictable results.</td>
</tr>
<tr>
<td>375</td>
<td>Programmed request with several arguments; R0 points to a block of arguments that supports the user request.</td>
</tr>
<tr>
<td>374</td>
<td>Programmed request with one argument; R0 contains a function code in the high-order byte and a channel code in the low-order byte.</td>
</tr>
<tr>
<td>360–373</td>
<td>Used internally by the RT–11 monitor; your programs should never use these EMT codes since their use would lead to unpredictable results.</td>
</tr>
<tr>
<td>340–357</td>
<td>Programmed requests with the arguments on the stack and/or in R0.</td>
</tr>
<tr>
<td>0–337</td>
<td>Version 1 programmed requests with arguments both on the stack and in R0. They are supported for binary compatibility with Version 1 programs.</td>
</tr>
</tbody>
</table>

EMT instructions should never appear in your programs except through programmed requests.

1.1.1.2 System Control Path Flow — Figure 1–1 shows system flow when a programmed request is executed.

In Figure 1–1, a programmed request in an application (or system utility) program is implemented with an EMT instruction. When your program is executed, the EMT instruction transfers control to the EMT processor code in the monitor. The user program counter (PC) and processor status word (PSW) are pushed onto the stack, and the contents of location 30 are placed
in the program counter. Location 30 points to the EMT processor code in the monitor. Location 32 contains the PSW for the EMT trap. Byte 52 of the system communication area is loaded with an error code by the monitor if the monitor detects any errors during the EMT processing. In addition, the EMT processor uses R0 to pass back information to the program. All other registers except SP are preserved; .CSIGEN and .CSISPC return information on the stack.

The monitor either processes a programmed request entirely when it is issued or it performs partial processing and queues the request for further processing. The requests that require queued processing support completion routines (see Section 1.1.3.5). If a request results in an error prior to being queued, the completion routine is not entered, and the monitor returns to the user program with the carry bit set. If the request is queued, the completion routine is entered upon completion of further processing, regardless of the outcome.

**Figure 1–1: System Flow During Programmed Request Execution**
1.1.2 System Conventions

This section describes the system conventions that must be followed for the correct operation of programmed requests.

1.1.2.1 Programmed Request Format — To issue programmed requests from assembly language programs, you must set up the arguments in correct order and issue the appropriate EMT instruction. Macros have been created to help you do this. They are contained in the system macro library named SYSMAC.SML. Their use is recommended for maintaining program compatibility with future releases of RT–11 and for program readability. The macro names for all programmed requests except SOB start with a period (.) to distinguish them from symbols and macros you define.

Arguments supplied to a programmed request must be valid assembler expressions since the arguments are used as source fields in the instructions (such as a MOV instruction) when the macros are expanded at assembly time. All programmed requests that appear in your program must appear in a .MCALL directive to make the macro definition available from the system macro library, SYSMAC.SML. If the programmed request is specified by a .MCALL directive, the programmed request is obtained from the system macro library at assembly time. Alternatively, you can enable the automatic .MCALL feature of MACRO by using the .ENABL MCL directive.

Programmed requests have two formats that are accepted by the monitor. The first format specifies the programmed request followed by the arguments required by the request. The second format specifies the programmed request, the address of the argument block, and the arguments that will be contained in the argument block. Because the way you can set up the argument block and specify arguments to a programmed request can vary, read the sections on programmed request format and on blank arguments to be sure of correct programmed request operation.

FORMAT 1
The first format for programmed requests is as follows:

```
.PRGREQ Arg1,Arg2,...,Argn
```

where:

```
.PRGREQ  is the name of the programmed request
Arg1,Arg2,...,Argn  are the arguments used with the request
```

Programmed requests using this format generate either an EMT 374 instruction or EMT 340 through 357 instructions.

Programmed requests that use an EMT 374 instruction set up R0 with the channel number in the even (low-order) byte and the function code in the odd (high-order) byte, as shown in Figure 1–2.
Figure 1-2: EMT 374 Argument

<table>
<thead>
<tr>
<th>15</th>
<th>87</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0 =</td>
<td>Function Code</td>
<td>Channel Number (if applicable)</td>
</tr>
</tbody>
</table>

One programmed request that generates an EMT 374 is .DATE. The macro for this programmed request appears in the system macro library as:

```
.MACRO .DATE
    MOV #10,"0400",Z0
    EMT "0374
 .ENDM
```

The function code, which in this case is 10(decimal) is placed in the high-order byte of R0. A channel code of 0 is placed in the low-order byte.

For EMT 340 through 357, if there are arguments, they are placed either on the stack, in R0, or in R0 and on the stack.

The programmed request .CSIGEN is an example of a programmed request that generates an EMT 344. A simplified macro expansion of this programmed request is:

```
.MACRO .CSIGEN DEVS PC,DEFE XT,CSTR N G,LINBUF
   IIF NB <LINBUF> MOV LINBUF,-(6,
    MOV DEVSPC,-(6,
    IIF NB <LINBUF> INC (6,
    MOV DEFE XT,-(6,
   IF B CSTR NG CLR -(6,
    IFF
    IF IDN CSTR NG,#0 CLR -(6,
    IFF
    ENDC
    ENDC
 .ENDM
```

When this programmed request is executed, all the specified arguments are placed on the user stack. Thus, the user stack would appear as shown in Figure 1-3.

Figure 1-3: Stack Set by .CSIGEN Programmed Request

<table>
<thead>
<tr>
<th>High Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINBUF</td>
</tr>
<tr>
<td>DEVSPC</td>
</tr>
<tr>
<td>DEFE XT</td>
</tr>
<tr>
<td>CSTR NG</td>
</tr>
</tbody>
</table>

Stack Pointer =>

<table>
<thead>
<tr>
<th>Low Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSTRING</td>
</tr>
</tbody>
</table>
The EMT processor then uses these arguments in performing the function of the programmed request .CSIGEN.

FORMAT 2
The second format for programmed requests is as follows:

```
.PRGREQ Area,Arg1,Arg2,..,Argn
```

where:

```
.PRGREQ
Area
Arg1,Arg2,..,Argn
```

- is the name of the programmed request
- is the address of an argument block
- are the arguments that will be contained in the argument block

This format generates an EMT 375 instruction. Programmed requests that call the monitor via an EMT 375 use R0 as a pointer to an argument block. In general, the argument block appears as shown in Figure 1–4.

**Figure 1–4: EMT 375 Argument Block**

![Argument Block Diagram](image)

The programmed request format uses Area as a pointer to the argument block that contains the arguments Arg1 through Argn.

```
.PRGREQ Area,Arg1,..,Argn
```

Blank fields are permitted. However, if the Area argument is empty, the macro assumes that R0 points to a valid argument block. If any of the fields Arg1 to Argn are empty, the corresponding entries in the argument list are left untouched. Thus,

```
.PRGREQ Area,Arg1,Arg2
```

points R0 to the argument block at Area and fills in the first and second arguments, while

```
.PRGREQ Area
```

1–8 Introduction to Advanced RT–11 Programming
points R0 to the block and fills in the first word — that is, the function code and channel number — without filling in any other arguments. Arguments that are left blank are discussed in the following section.

1.1.2.2 Blank Arguments — Any programmed request that uses an argument block assumes that any argument left blank has been previously loaded by your program into the appropriate memory location (exceptions to this are the .CHCOPY and .GTJB requests). For example, when the programmed request

```plaintext
.PRGREQ Area, Arg1, Arg2
```

is assembled, R0 will point to the first word of the argument block. The first word has the function code in the high-order byte and the channel number in the low-order byte. Arg1 is in the second word of the argument block (that is, in address R0 plus 2), while Arg2 is in R0 plus 4.

There are two ways to account for arguments. You can let the MACRO assembler generate the instructions needed to fill up the argument block at run time, or you can write these instructions in your program, leaving the arguments in the programmed request blank for those that you have written in. DIGITAL recommends that you let MACRO generate the instructions, both for program clarity and for reduced chance of programming error.

The following examples are all equivalent in that the arguments have been accounted for either in the program instructions or in the programmed request.

```plaintext
MOV #ARG1, AREA+2
MOV #ARG2, AREA+4
.PRGREQ #AREA
```

is equivalent to

```plaintext
MOV #AREA, R0
.PRGREQ, #ARG1, #ARG2
```

and also to

```plaintext
MOV #AREA, R0
MOV #ARG1, 2(R0)
MOV #ARG2, 4(R0)
MOV #CODE#4001 CHANNEL, (R0)
.PRGREQ
```

This last example sets up all the arguments for the programmed request prior to executing the programmed request.

The following example shows how arguments are specified to the .TWAIT programmed request.
The .TWAIT programmed request suspends a program and requires two arguments. The first argument is an area, which points to the address of a two-word EMT argument block; the second argument is Time, which is a pointer to two words of time (high-order first, low-order second) expressed in ticks. In the example shown above, EMTLST is specified as an argument with the programmed request that points to the address of the EMT argument block. The first word of the argument block has a zero stored in the low-order byte representing the channel number and a function code of 24 stored in the high-order byte. The second word contains a symbolic pointer to the location (the second argument), which specifies the amount of time that the program will be suspended. It is defined as two words and, in this example, represents a 10-second interval. When run, the example program prints its message every ten seconds.

1.1.2.3 Addressing Modes — You must make certain that the arguments specified are valid source fields and that the address accurately represents the value desired. If the value is a constant or symbolic constant, use the immediate addressing mode [#]. If the value is in a register, use the register symbol [Rn]. If the value is in memory, use the label of the location whose value is the argument.

A common error is to use n rather than #n for numeric arguments. For example, when a direct numerical argument is required, the immediate mode causes the correct value to be put into the argument block. Thus

```
.PRGREQ #Area,#4
```

is correct, while

```
.PRGREQ #Area,4
```

is not correct since the contents of location 4 are placed into the argument block instead of the desired value 4.

However, the form

```
.PRGREQ LIST,NUMBER
```

```
LIST: .WORD AREA
NUMBER: .WORD 4
```

is correct since the contents of LIST are the argument block pointer and the contents of NUMBER are the data value.
NOTE

All registers except R0 are preserved across a programmed request. In certain cases, R0 contains information passed back by the monitor; however, unless the description of a request indicates that a specific value is returned in R0, the contents of R0 are unpredictable upon return from the request. Also, with the exception of calls to the Command String Interpreter, the position of the stack pointer is preserved across a programmed request.

You must be sure that the selected mode generates the correct value as a source operand in a MOV instruction. Check the programmed request macro in the Macro Library (SYSMAC.SML) and expand the programmed request by hand or with the macro assembler (by using the .LIST MEB directive) to be sure of correct results.

1.1.2.4 Keyword Macro Arguments — The RT-11 MACRO assembler supports keyword macro arguments. All the arguments used in programmed request calls can be encoded in their keyword form (see the PDP-11 MACRO–11 Language Reference Manual for details).

In EMT 375 programmed requests, the high byte of the first word of the area (pointed to by R0) contains an identifying code for the request. Normally, this byte is set if the macro invocation of the programmed request specifies the area argument, and it remains unaffected if the programmed request omits the area argument. If the macro invocation contains CODE = SET, the high byte of the first word of the area is always set to the appropriate code, whether or not area is specified.

If CODE = NOSET is in the macro invocation, the high byte of the first word of area remains unaffected. This is true whether or not area is specified. This allows you to avoid setting the code when the programmed request is being set up. This might be done because it is known to be set correctly from an earlier invocation of the request using the same area, or because the code was statically set during the assembly process.

1.1.2.5 Channels and Channel Numbers — A channel is a data structure that is a logical connection between your program and a file on a mass storage device or on a serial device such as the line printer or terminal. The system provides 16(decimal) channels by default. When a file is opened on a particular device, a channel number is assigned to that file. The channel number can have an octal value from 0 to 376 (0 to 254 decimal). Thus, your program first opens a channel through a programmed request by specifying the device and/or file name, file type, and a channel number to the monitor. Your program refers to that file or device in all I/O operations thereafter by the assigned channel number. You can specify a device (non-file-structured) or a device and file name (file-structured).

Channel 255(decimal) is reserved for system use. Channel 15(decimal) is used by the system's overlay handler.
1.1.2.6 **Device Blocks** — A device block is a four-word block of Radix-50 information. You set up the block to specify a physical or logical device name, file name, and file type for use with a programmed request. This information is passed to the monitor when your program opens a file. The monitor uses the information to locate the referenced device and the file name in the corresponding directory.

For example, a device block representing the file FILE.TYP on device DK: could be written as

```plaintext
.RAD50 /DK /
.RAD50 /FIL/
.RAD50 /E /
.RAD50 /TYP/
```

The first word contains the device name, the second and third words contain the file name, and the fourth word contains the file type. Device, file name, and file type must each be left-justified in the appropriate field. This string could also have been written as

```plaintext
.RAD50 /DK FILE TYP/
```

Spaces must fill out each field. Also, the colon and period separators must not appear in the string since they are only used by the Command String Interpreter to delimit the various fields.

If the first word of a device block is the name of a mass-storage device such as a disk and the second word of the block is 0, the device block refers to an entire volume of the mass storage device in a non-file-structured manner.

1.1.2.7 **Programmed Request Errors** — Programmed requests use three methods of reporting errors detected by the monitor:

1. Setting the carry bit of the processor status word (PSW)
2. Reporting the error code in byte 52 of the system communications area
3. Generating a monitor error message

If a programmed request has been executed unsuccessfully, the monitor returns to your program with the carry bit set. The carry bit is returned clear after the normal termination of a programmed request. Almost all requests should be followed by a Branch Carry Set (BCS) or Branch Carry Clear (BCC) instruction to detect a possible error.

Because some programmed requests have several error codes — that is, errors can be generated for different reasons — byte 52 in the system communications area is used to receive the error code. Thus, when the carry bit is set, check byte 52 to find out the kind of error that occurred in the programmed request. The meanings of values in the error byte are described individually for each request. The error byte is always zero when the carry bit is clear. Your program should reference byte 52 with absolute addressing. Always address location 52 as a byte, never as a word, since byte 53 has a different usage. The following example shows how byte 52 can be tested for the error code.
Error messages generated by the monitor are caused by fatal errors, which cause your program to terminate immediately. Some fatal errors can be intercepted and have their values returned in byte 52 (see the .HERR/.SERR programmed requests).

1.1.2.8 User Service Routine (USR) Requirement — Many programmed requests require the USR to be in memory. Some of these requests always require a fresh copy of the USR to be read in because the code to execute them resides in the USR buffer area. Since the buffer area gets overlaid by data used to perform other system functions, the USR must be read in from the system device even if there is a copy of the USR presently in memory. Table 1–2 shows the programmed requests that require the USR.

### Table 1–2: Programmed Requests Requiring the USR

<table>
<thead>
<tr>
<th>Request</th>
<th>Monitor</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SJ</td>
<td>FB</td>
<td>XM</td>
</tr>
<tr>
<td>.CDFN</td>
<td>yes*</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>.CLOSE (see Note 1)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.CSIGEN</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.CSISPC</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.DELETE</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.DSTATUS</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.ENTER</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.EXIT</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.FETCH</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.FPROT</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.GTIGIN</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.HRESET</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>.LOCK (see Note 2)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.LOOKUP</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.QSET</td>
<td>yes*</td>
<td>yes*</td>
<td>yes</td>
</tr>
<tr>
<td>.RELEASE</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.RENAME</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.SFDAI</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>.SRESET</td>
<td>yes*</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>.TLOCK (see Note 3)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Note 1: Only if channel was opened with an .ENTER programmed request

Note 2: Only if the USR is in a swapping state

Note 3: Only if the USR is not in use by another job

* The requests marked with an asterisk always require a fresh copy of the USR to be read in before they can be executed.
USR requirements for programmed requests differ between the SJ and FB monitors as shown in the table. The .CLOSE programmed request on non-file-structured devices, such as a line printer or terminal, does not require the USR under any monitor.

The USR is not reentrant and cannot be shared by concurrent jobs. Thus, when the USR is in use by one job, another job requiring it must queue up for it. This is particularly important for concurrent jobs when devices such as magnetic tape or cassette are active. For example, USR file operations on tape devices require a sequential search of the tape. When a background program is running the USR, the foreground job is locked out until the tape operation is completed. You should be aware that this operation may take considerable time. The .SPFUN request can be used to perform asynchronous directory operations on tape. In the FB and XM monitors, the .TLOCK request can be used by a job to check USR availability.

Any request that requires the USR to be in memory can also require that a portion of your program be saved temporarily in the system device swap file (that is, "swapped out" and stored in the file SWAP.SYS to provide room for the USR). The USR is then read into memory. Although swapping is invisible to you in normal operation, you must be aware of it and take some care in your programming. For example, the argument block being passed to the USR must not be in the area that is swapped over. You can optimize programs so that they require little or no swapping, thereby saving time.

Consider the following items if a swap operation is necessary.

1. The background job
   If a .SETTOP request in a background job specifies an address beyond the point at which the USR normally resides, a swap is required when the USR is called. Section 2.79 details the operation of the .SETTOP request. This case is not encountered in XM because the USR is always resident.

2. The value of location 46
   If you assemble an address into word 46 or move a value there while the program is running, RT-11 uses the contents of that word as an alternate place to swap the USR. If location 46 is zero, this indicates that the USR will be at its normal location in high memory. If the USR does not require swapping, this value is ignored.

   A foreground job must always have a value in location 46 unless it is certain that the USR will never be swapped. If the foreground job does not allow space for the USR and a swap is required, a fatal error occurs. The SET USR NOSWAP command makes the USR permanently resident.

   If you specify an alternate address in location 46, the SJ monitor does not verify the validity of the USR swap address. Thus, if the area to be swapped overlays the resident monitor, the system is destroyed.

3. Monitor offset 374
   The contents of monitor offset 374 indicate the size of the USR in bytes.
Programs should use this information to dynamically determine the size of the region needed to swap the USR.

4. Protecting program areas
Make sure that certain areas of your program do not get overlaid when you swap in the USR. These areas are the program stack, any parameter block for calls to the USR, the EMT instruction that invoked the USR, I/O buffers, device handlers, interrupt service routines, queue elements, defined channels, and completion routines in use when the USR is being called.

The *RT–11 Software Support Manual* provides additional information on the USR.

**1.1.3 Using Programmed Requests**

This section describes how to use and implement programmed requests to access the various monitor services. Chapter 2 contains, in alphabetical order, detailed descriptions of each request, including examples.

**1.1.3.1 Initialization and Control** — Typically, you use several programmed requests to control the operating environment in which your program is running. These requests can include control of memory allocation, I/O access, devices, and error processing.

**MEMORY ALLOCATION**
The memory needs of a program are specified to the monitor by the .SETTOP request. When loaded, a program occupies the memory specified by its image created at link time. To obtain more memory, a .SETTOP request is executed, with R0 containing the highest address desired. The monitor returns the highest address available. Resident handlers or foreground jobs can prevent all the memory that is desired from being available to the program. If the memory requirements of the running program permit, the monitor retains the User Service Routine (USR) in memory, which reduces swapping. Otherwise, the monitor will automatically remove the USR from memory and then swap part of the user program to the swap file called SWAP.SYS on the system device whenever the USR must be reloaded to process a request. The .SETTOP request then allows you to determine how much memory is available and to control monitor swapping characteristics. See the .SETTOP programmed request in Chapter 2 for special optional features provided in an extended memory environment. Additional information on the .SETTOP request is also given in the *RT–11 Software Support Manual*.

If a program needs so much memory that the USR must swap, swapping will automatically occur whenever a USR call is made. However, if a program knows what file operations are necessary, and if these operations can be consolidated and performed at one time, the efficiency of the system can be enhanced in the following manner: request the USR to be swapped in, have it remain resident while a series of consecutive USR operations is performed, then swap the USR out when the sequence of operations is completed.
Three programmed requests control USR swapping. The request .LOCK causes the USR to be made resident for a series of file operations. It can operate by: (1) requiring a portion of your program to be written to the swap blocks prior to reading in the USR; (2) only requiring a fresh copy of the USR if the USR buffer is overwritten; or (3) not requiring the USR to be read in if it finds the USR intact. The request .UNLOCK swaps your program back in if it was swapped out, and the USR is overwritten; otherwise, no swapping occurs. The request .TLOCK makes the USR resident in foreground/background programs, but only if the USR is not currently servicing another job's file requests at the time the .TLOCK request is issued. This check prevents a job from becoming blocked while the USR is processing another job's request. When a .TLOCK succeeds, the USR is ready to perform an operation immediately. In a single-job environment, the .TLOCK request performs exactly like the .LOCK request.

RT-11 provides 16(decimal) channels as part of the job's impure area — that is, 16 files can be active at one time. Up to 255(decimal) channels can be activated with the .CDFN request. This request sets aside memory inside the job area to provide the storage required for the status information on the additional channels. Once the .CDFN request has been executed, as many channels as specified can be active simultaneously. Use the .CDFN request during the initialization phase of your program. The keyboard monitor command CLOSE does not work if you define new channels with the .CDFN programmed request.

The .CNTXSW request allows the job to add memory locations to the list of items to be context-switched. The request itself does not cause a context switch to occur.

INPUT/OUTPUT ACCESS
Each pending I/O, message, or timer request must be placed into one of the monitor queues. These are then processed by the monitor on a first-in first-out basis, by job priority, or by time of expiration. In RT-11, all I/O transfers are queued to allow asynchronous processing of the request. A queue is a list of elements, each element being seven words long (ten words [decimal] long when using the extended memory monitor). When your program issues a data transfer programmed request, the information specifying the transfer is stored by the monitor in a queue element. This information is passed to the device handler, which then processes the I/O transfer.

Each job, whether background or foreground, initially has only a single queue element available. Additional queue elements may be set aside with a .QSET request. The .QSET request declares where in memory the additional queue elements will go and how many elements there will be. If you do not include a .QSET request in your program, the monitor uses the queue element set aside in the job's impure area. In this case, since only one element is available for each job, all operations would be synchronous. That is, any request issued when the available queue element list is empty has to wait for that element to become free. The number of queue elements necessary equals the number of asynchronous operations pending at any time.
DEVICES
The .DEVICE request turns off any special devices that are being used by
the running program upon program termination. This request (available
only in FB or XM) allows you to specify a set of device control register
addresses and a value to be set in each register on job exit. When a job is
terminated — either normally, by an error condition, or by a
CTRL/C — the specified values are set in the specified locations.

In SJ, a hard reset is done at .EXIT or CTRL/C. This clears all devices.

Loading a background job with a GET, R, or RUN command, or loading a
foreground or system job with a FRUN and SRUN command, respectively,
alters most locations in the vector area 0 to 476. RT–11 automatically
prevents alteration of all locations used by the system, such as the clock,
the console terminal, and all vectors used by handlers that are loaded. If a
foreground job in a foreground/background environment accesses a device
directly through an in-line interrupt service routine, the foreground job
must notify the monitor that it must have exclusive use of the vectors. You
use the .PROTECT programmed request to allow the foreground job to gain
exclusive use of a vector. The .PROTECT request can also be used by either
the foreground or background job, prior to setting the contents of a vector,
to test whether the vectors are already controlled by a job. This serves as
further protection against jobs interfering with each other. An .UNPRO-
TECT programmed request relinquishes control of a vector, making the
vector available to both the background and foreground jobs.

The request .SPFUN is available for performing special functions on de-
vices such as magnetic tape. .SPFUN requests are used for such functions
as rewind or space-forward operations.

ERROR PROCESSING
During the course of program execution, errors can occur that cause the
monitor to stop the program and print a MON–F error message. Examples
include directory I/O errors, monitor I/O errors on the system device, or I/O
requests to non-existent devices. Some programs cannot afford to allow the
monitor to abort the job because of such errors. For example, in the case of
RT–11 multi-user BASIC, a directory I/O error affecting only one of the
users should not cause the whole program to abort. For such applications, a
pair of requests is provided, .HERR and .SERR. A .HERR request (normal
default) indicates that the monitor will handle severe errors and stop the
job. A .SERR request causes the monitor to return most errors to your
program in byte 52 for appropriate action.

In addition to processing I/O errors through .HERR and .SERR requests,
you can also handle certain fatal errors through the .TRPSET or .SFPA
requests. You use these requests to prevent your program from aborting
due to a trap to location 4 or 10(octal), or to the exception traps of the
Floating Point Processor (FPP) or Floating Point Instruction Set (FIS). A
.TRPSET request specifies the address of a routine that the monitor enters
when a trap to location 4 or 10 occurs. A .SFPA request specifies the ad-
dress of a floating-point exception routine that is called when an exception
trap occurs.
1.1.3.2 Examining System Information and Reporting Status — Several pro-
grammed requests interrogate the system for specific details about a device
or file that your program may be using.

The .DATE request obtains the system date, which then can be printed on a
report or entered as a data record in a file. The time-of-day can be obtained
with a .GTIM request and used in the same way. A program can set the
system date and/or time by using the .SDTTM programmed request.
Changing the date or time has no effect on any outstanding mark time or
timed wait requests.

With a .GTJB request you can obtain information on whether the job is
running in the foreground or background, the memory limits of the job, the
virtual high limit for a job created with the linker /V option (XM only), the
unit number of the job's console terminal (if you are using the multitermi-
nal feature), the address of the job's channel area, the address of the job's
impure area, and the job's logical job name (if you are using a monitor with
the system job feature).

Status information on a file — such as its starting block, its length, and
the device it is located on — can be obtained with a .CSTATUS request.
Status information on a device — such as its block length and controller-
assignment number — can be obtained with a .DSTATUS request.

The .MTGET and .MTSTAT programmed requests provide multiterminal
status information when the multiterminal feature is being used.

The programmed requests .MFPS and .MTPS read the priority bits and set
the priority and T-bits in the processor status word (PSW). These requests
allow a program to run without change on any processor from an LSI–11 to
a PDP–11/60.

1.1.3.3 Command Interpretation — Two of the most useful programmed re-
quests are .CSIGEN and .CSISPC. These requests call the Command String
Interpreter (CSI), which is part of the USR. They are used to process stand-
ard RT–11 command strings in the following general form:

*Dev:Output/Option = Dev:Input/Option

The asterisk is printed on the terminal by the monitor. The RT–11 system
programs use the same command string (see the RT–11 System Utilities
Manual).

The .CSIGEN request analyzes the string for correct syntax, automatically
loads the required device handlers into memory, opens the files specified in
the command, and returns to your program with option information. Thus,
with one request, a language processor such as the FORTRAN compiler is
ready to input from the source files and output the listing and binary files.
You can specify options in the command string to control the operation of
the language processor. The .CSIGEN request uses channels 0 through 2 to
accommodate three output file specifications and channels 3 through 10(oc-
tal) to accommodate six input file specifications.
The .CSISPC request provides you with the services of the command processor, but allows you to do your own device and file manipulation. When you use .CSISPC, the CSI obtains a command string, analyzes it syntactically, places the results in a table, and passes the table to your program for appropriate action.

The .GTLIN request obtains one line of input at a time instead of one character. These three requests support the indirect file function and allow your program to obtain one line at a time from an indirect file. Thus, if your program was started through an indirect file, the line is taken from the indirect file and not the terminal. The .GTLIN request has an optional argument which forces input to come from the terminal. The feature is useful if your program requires information which can be supplied only at run time.

1.1.3.4 File Operations — A device handler is the normal RT-11 interface between the monitor and the peripheral device on which file operations are performed. The console terminal handlers (in FB and XM) and the interjob message handlers are part of the resident monitor and require no attention on your part. All other device handlers are loaded into memory with either a .FETCH request from the program or a LOAD command from the keyboard before any other request can access that device. Section 1.1.3.5 of this manual describes the use of programmed requests for performing I/O operations. The RT-11 Software Support Manual describes how to write device handlers for RT-11.

Once the handler is in memory, a .LOOKUP request can locate existing files and open them for access. New files are created with an .ENTER request. Space for the file can be defined and allocated as:

1. One-half the size of the largest unused space or all of the second largest space, whichever is larger (the default)
2. A space of a specific size
3. As much space as possible

The way the system allocates the space depends upon the parameter specified by you as the file size argument of the .ENTER request or specified in a .CSIGEN command string.

When file operations are completed, a .CLOSE request makes the new file permanent in the directory. A .PURGE request can free the channel without making the file permanent in the directory. Existing permanent files can be renamed with a .RENAME request or deleted with a .DELETE request.

Two other requests, .SAVESTATUS and .REOPEN, add to the flexibility of file operations. The .SAVESTATUS request stores the current status of a file that has been opened with a .LOOKUP request and makes the file temporarily inactive, thus freeing the channel for use by another file. The .REOPEN request causes the inactive file to be reactivated on the specified
channel, and I/O continues on that channel. In this manner, you can open more files than there are channels. If, in addition, you lock the USR in memory, you can open all the files your job needs while maintaining system swapping efficiency. The procedure is:

1. Lock the USR in memory, and open the files that are needed.
2. Issue the .SAVESTATUS request.
3. Release the USR.
4. Issue a .REOPEN request each time a file is needed.
5. Lock USR, and use the .CLOSE request to make the files permanent.

Because a .REOPEN request does not require any I/O, all USR swapping and directory motion can be isolated in the initialization code for an application, improving program efficiency.

The creation date and protection status of a file can be modified by using the .SFDAT and .FPROT requests, respectively.

The .SFDAT request allows you to change the date that appears in a file's directory entry listing. You may want to do this for a file that you update in place, for example, or if the original creation date was in error.

The .FPROT request protects a file against deletion, or removes protection so that a file can be deleted by a .DELETE, .ENTER, or .RENAME request. The contents of a protected file are not protected against modification.

1.1.3.5 Input/Output Operations — You can perform I/O in three different modes:

- synchronous
- asynchronous
- event-driven

These modes allow you to optimize the overlap of CPU and I/O processing.

The programmed requests .READW and .WRITW perform synchronous I/O — that is, the instruction following the request is not executed until the I/O transfer is completely finished; thus the program and the I/O process are synchronized.

The program requests .READ, .WRITE, and .WAIT perform asynchronous I/O — that is, the .READ or .WRITE request adds the transfer request to the queue for the device; if the device is inactive, the transfer begins; control returns to the user program before the transfer is completed. The .WAIT programmed request, however, blocks the program until the transfer is completed. This allows the I/O operation to be completed before any further processing is done. Asynchronous I/O is most commonly used for double buffering.
Program requests such as .READC and .WRITC perform event-driven I/O — that is, they initiate a completion routine when the transfer is finished.

Event-driven I/O is practical for conditions where system throughput is important, where jobs are divided into overlapping processes, or where processing timings are random. The last condition is the most attractive case for using event-driven I/O because processor timing may range up to infinity in that a process is never completed.

Since the completion routine is essential to event-driven I/O, the next section presents general guidelines for writing completion routines.

**COMPLETION ROUTINES**

Completion routines are part of your program. They execute following the completion of some external operation, interrupting the normal program flow. On entry to an I/O completion routine, Register 0 contains the contents of the Channel Status completion Word and Register 1 contains the channel number for the operation. The carry bit is not significant.

Completion routines are handled differently, depending on whether the program is being run under the SJ monitor or the FB and XM monitors. Under the SJ monitor, completion routines are totally asynchronous and can interrupt each other. An interrupted completion routine is resumed when the interrupting routine is finished. Unlike completion routines run under FB and XM monitors, which are serialized and run at priority 0, completion routines run under an SJ monitor are nested. In addition, they execute not at priority 0, but at the same priority as the device whose interrupt scheduled them. For example, the completion routine resulting from a .WRITC programmed request to device TT: runs at priority 4. Completion routines from timer requests run at the same priority as the system clock. This is particularly important on LSI-11 and PDP 11/03 systems that have only two interrupt levels, ON and OFF, because clock interrupts may be lost while lengthy completion routines execute. Under the FB and XM monitors, completion routines do not interrupt one another. Instead, they are queued, and the next routine is not entered until the first is completed.

If the foreground job is running and a foreground I/O transfer completes and wants a completion routine, that routine is entered immediately if the foreground job is not already executing a completion routine. If it is in a completion routine, that routine continues to termination, at which point other completion routines are entered in a first-in first-out order. If the background job is running (even in a completion routine) and a foreground I/O transfer completes with a specified completion routine, execution of the background job is suspended and the foreground routine is entered immediately.

Also under the FB and XM monitors, it is possible to request a completion routine from an in-line interrupt service routine through a .SYNCH programmed request. This allows the interrupt service routine to issue other programmed requests to the monitor.
Restrictions that must be observed when writing completion routines are as follows:

1. Requests that require the USR must not be issued within a completion routine. A fatal monitor error is generated if the USR is called from a completion routine.

2. Completion routines should never reside in memory space that is used for the USR, since the USR can be interrupted when I/O terminates and the completion routine is entered. If the USR has overlaid the routine, control passes to a random place in the USR, with a HALT or error trap being the likely result.

3. Registers other than R0 and R1 must be saved upon entry to completion routines and restored upon exiting. Registers cannot transfer data between the mainline program and the completion routine.

4. Under the XM monitor, completion routines must remain mapped while the request is active and the routine can be called.

5. The completion routine must exit with an RTS PC instruction because the routine was called from the monitor with a JSR PC, ADDR, where ADDR is the user-supplied entry point address. If you exit completion routines with an .EXIT request, your job will abort. An exit from a completion routine in FB or XM can be done by using an .SPCP request to change the mainline PC to point to an .EXIT in the main code. As soon as all completion routines are done, the exit will be executed.

6. Under the XM monitor, completion routines scheduled as a result of a .SYNCH run in kernel mapping, not user mapping.

Frequently, a program’s completion routine needs to change the flow of control of the mainline code. For example, you may wish to establish a schedule among the various tasks of an application program after a certain time has elapsed, or after an I/O operation is complete. Such an application needs to redirect the mainline code to a scheduling subroutine when the application’s timer or read/write completion routine runs. The .SPCP request, which can only be used in a foreground/background or extended memory environment, saves the mainline code program counter and processor status word, and changes the mainline code program counter to a new value. If the mainline code is performing a monitor request, that request finishes before rerouting can occur.

TERMINAL INPUT/OUTPUT
Several programmed requests are available to provide an I/O capability with the console terminal: a .TTYIN request obtains a character from the console; a .TTYOUT request prints a character on the terminal; long strings of characters — even multiple lines — are output with the .PRINT request. Programs can also issue .TTINR and .TTOUSTR requests, which indicate that a character is not available or that the output buffer is full. The program can then resume operation and try again at a later time. A .RCTRLO request forces the terminal output to be reactivated after a CTRL/O has been typed to suppress it, so that urgent messages will be printed.
You can use the .TTYIN/.TTINR requests in special (single-character) mode by setting bit 12 of the Job Status Word. See the .TTYIN programmed request for a description of special mode.

MULTITERMINAL REQUESTS
The RT–11 multiterminal feature allows your program to perform input/output on up to 17 terminals. Several programmed requests allow you to perform I/O on these terminals. Before issuing any of these programmed requests to a terminal, you must issue the .MTATCH request, which reserves the specified terminal for exclusive use by your program. The terminal cannot then be used by any other job until you issue the .MTDTCH request to detach the terminal.

The .MTIN request returns to a program characters that are typed at the terminal, while the .MTOUT and .MTPRNT requests send characters to a terminal. These requests are analogous to the .TTYIN, .TTYOUT, and .PRINT requests. Note that the .TTYIN/.TTINR, .TTYOUT/.TTOUTR, and .PRINT requests can only be used with the console terminal.

You can set terminal and line characteristics with the .MTSET request. You provide a four-word status block that contains the terminal status word, the character of the terminal requiring fillers and the number of fillers required for this character, the width of the carriage (80 characters by default), and system terminal status. The status of a terminal can be obtained by issuing the .MTGET request. The .MTSTAT request provides multiterminal system status information.

1.1.3.6 Foreground/Background Communications — Communication between foreground and background jobs is obtained through the programmed requests .SDAT and .RCVD. These requests also have three modes (synchronous, asynchronous, and event driven) that allow transfer of buffers between the two jobs as if I/O were being done. The sending job treats a .SDAT request as a write, and the receiving job treats .RCVD as a read. In the case of .RCVD requests, the receiving buffer must be one word longer than the number of words expected. When the data transfer is completed, the first word of the buffer contains the number of words actually sent.

Jobs receiving messages can be activated when messages are sent through .RCVDC completion routines, while the sending jobs use .SDATC completion routines. The .MWAIT request is used for synchronizing message requests. It is similar to the .WAIT request that is used for normal I/O.

If you want one job in a foreground/background environment to read or write data in a file opened by the other job, use the .CHCOPY request. For example, when the background job is processing data that is being collected by the foreground job, the .CHCOPY request allows you to obtain channel information from the foreground job and to use that channel information to control a read or write request.

The foreground/background monitor always causes a context switch of critical items such as machine registers, the job status area, and floating-point processor registers when a different job is scheduled to run because it has a
higher priority, or because the current job is blocked and a lower priority job is runnable. When the monitor saves a job's context, it saves the job-dependent information on the job's stack so that this information can be restored when the job is runnable again.

1.1.3.7 Timer Support — Timer support by the monitor is provided through the .MRKT request. With the .MRKT request, you specify the address of a routine that is to be entered after a specified number of clock ticks. Like I/O completion routines, .MRKT routines are asynchronous and independent of the main program. After the specified time elapses, the main program is interrupted, the timer completion routine executes, and control returns to the interrupted program.

Pending .MRKT requests — as many as the queue can hold — are identified by number. Pending timer requests can be canceled with a .CMKT request. .MRKT requests are normally used as a scheduling tool where jobs are scheduled on the basis of clock events, detected by timer completion routines.

The programmed requests .MRKT/.CMKT and .TIMIO/.CTIMIO require request identification words as an argument. Certain ranges of values are reserved for different uses as shown in the following table.

<table>
<thead>
<tr>
<th>Range</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–176777</td>
<td>For user applications with .MRKT/.CMKT. Values in this range are canceled if a .CMKT request is issued with a value of 0.</td>
</tr>
<tr>
<td>177000–177377</td>
<td>For use in device handler .TIMIO/.CTIMIO requests. To ensure a unique value for each handler, DIGITAL suggests that the value be assigned as 177000 + devcod, where devcod represents the device identifier value used in the .DRDEF macro at the beginning of the handler.</td>
</tr>
<tr>
<td>177400–177477</td>
<td>Reserved for multiterminal support.</td>
</tr>
<tr>
<td>177500–177677</td>
<td>Reserved.</td>
</tr>
<tr>
<td>177700</td>
<td>Used by the .TWAIT request.</td>
</tr>
<tr>
<td>177701–177766</td>
<td>Reserved.</td>
</tr>
<tr>
<td>177767–177777</td>
<td>DECnet.</td>
</tr>
</tbody>
</table>

Values in the range 177000 to 177677 must be canceled individually by the routine that issued the .TIMIO request. This would occur, for example, in handler abort code.

Values in the range 177700 to 177777 are automatically canceled whenever a program terminates or aborts.

A job can be suspended for a specified time interval with a .TWAIT request. For example, the .TWAIT request will allow a compute-bound job to relinquish CPU time to the rest of the system, permitting other jobs to run.
1.1.3.8 Program Termination or Suspension — Many jobs come to an execution point where there is no further processing necessary until an external event occurs. In the FB or XM environment such a job can issue a .SPND request to suspend the execution of that job. While the foreground job is suspended, the background job runs. When the desired external event occurs, it is detected by a previously requested completion routine, which executes a .RSUM request to continue the job at the point where it was suspended.

When a job is ready to terminate or reaches a serious error condition, it can reset the system with the .SRESET and .HRESET requests. .SRESET is a soft reset. That is, the monitor data base for the job is reinitialized, but queued I/O is allowed to run to completion. .HRESET is a hard reset where all I/O for the job is stopped (by a RESET instruction in the SJ monitor or by calls to the handlers in an FB environment).

Use the programmed request .EXIT in a background job to return control to the keyboard monitor by causing program termination. If Register 0 contains a zero upon execution of this request, a hard reset is performed, and the commands REENTER, CLOSE, and START are disabled. If Register 0 contains a non-zero value upon exit from your program, a soft reset is done, and these commands are not disabled. In a foreground job, an .EXIT programmed request stops the job but does not return control to the keyboard monitor. The job can be removed from memory by the UNLOAD command.

You may initiate the execution of another program with a .CHAIN request from a background job. Files remain open across a .CHAIN request and data is passed in memory to the chained job, so that it can adjust processing. In FORTRAN, channel information is stored in the job's impure area, and this information is not preserved across a .CHAIN request. Thus, close any channels in the first program, and reopen them in the program being chained to.

1.1.3.9 System Job Communications — System job support allows communications between any two jobs in the system. The background job, designated by the logical job name 'B', and the foreground job, designated by the logical job name 'F', can send and receive messages between each other by using the .RCVD and .SDAT programmed requests.

All jobs (that is, background, foreground, and system jobs) can communicate with each other by using the Message Handler (MQ). The MQ handler performs like an ordinary RT-11 device handler in the way it accepts and dispatches I/O requests from the queued I/O system. This permits .READ and .WRITE requests to send messages between any two jobs as if they were data transfers to files. Both the sending and receiving job must issue a .LOOKUP request on a channel and use 'MQ' as the device specification and the logical job name of the job with which they are communicating as the file specification. In the case of .READ requests, the receiving buffer must be one word longer than the number of words expected. When the data transfer is completed, the first word of the buffer contains the number of words actually sent (identical to the .RCVD requests). This does not
apply to the .WRITE requests; the first word of the sending buffer is the first word of the message to be sent. Note that the Message Handler (MQ) can also be used under the distributed FB monitor; it does not require the system job special feature.

Care should be taken when assigning logical job names to system jobs. Programmed requests such as .LOOKUP, .CHCOPY, and .GTJB must use the job's current logical job name (see the RT-11 System User's Guide).

1.1.3.10 Extended Memory Functions — The RT-11 extended memory (XM) monitor permits MACRO programs to access extended memory by mapping their virtual addresses to physical locations in memory. This is done in conjunction with a hardware option called the Memory Management Unit that converts a 16-bit virtual address to an 18- or 22-bit physical address.

You access extended memory in a program through programmed requests. In accessing extended memory, you must first establish window and region definition blocks. Next, you must specify the amount of physical memory the program requires and describe the virtual addresses you plan to use. Do this by creating regions and windows. Then, associate virtual addresses with physical locations by mapping the windows to the regions. You can remap a window to another region or part of a region, or you can eliminate a window or a region. Once the initial data structures are set up, you can manipulate the mapping of windows to regions that best meet your requirements.

There are four types of extended memory programmed requests:

1. Window requests
2. Region requests
3. Map requests
4. Status requests

The window and region requests have their own data structures. RT-11 provides the macro .WDBBK to create a window definition block and the macro .RDBBK to create a region definition block. Both macros automatically define offsets and bit names. Two other macros, .WDBDF and .RDBDF, define only the offsets and bit names.

The programmed request .CRAW is used to create a window. To eliminate a window, use the .ELAW request. A region is created using the .CRRG request. You return a region to the free list of memory with the .ELRG request.

You map a window to a region with the .MAP request. If a window is already mapped to a region, this window is unmapped and the new one is mapped. Use the .UNMAP request to unmapping a window. You obtain the mapping status of a window with the .GMCX request.

Certain programmed requests are restricted when they are in an extended memory environment. These programmed requests and their restrictions are as follows:

.CDFN All channels must be in the lower 28K of memory (but not in the PAR1 region, 20000–37776 octal).

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.QSET All queue elements must be 10(decimal) words long and in the lower 28K of memory (but not in the PAR1 region, 20000–37776 octal).

.SETTOP Effective only in the virtual address space that is mapped at the time the request is issued, unless the job was linked with the /V option (see the RT–11 System Utilities Manual).

.CNTXSW Not usable in virtual jobs.

Detailed information on programmed requests in an extended memory environment is given in the RT–11 Software Support Manual.

1.1.3.11 Interrupt Service Routines — The system macro library (SYSMAC.SML) contains some macros that are not programmed requests, but are used like programmed requests in interrupt service communication to the monitor. The first macro call in every interrupt routine is .INTEN, which causes the system to use the system stack for interrupt service and allows the monitor scheduler to make note of the interrupt. If device service is all the routine does, .INTEN is the only call it need make. If you need to issue one or more programmed requests, such as .READ or .WRITE from the interrupt service routine, you must issue the .SYNCH call. The .INTEN call described above switches execution to the system state, and since programmed requests can only be made in the user state, the .SYNCH call handles the switch back to the user state. The code following the .SYNCH call executes as a completion routine. When the .SYNCH is finished, the completion routine can execute programmed requests, initiate I/O, and resume the mainline code. The first word after the .SYNCH call is the return address on error, while the second word is the return on success. The RT–11 Software Support Manual contains a detailed description of interrupt service routines.

1.1.3.12 Device Handlers — The system macro library (SYSMAC.SML) contains several macros that simplify the writing of a device handler. A device handler is divided into several sections. These sections are as follows:

- Preamble section
- Header section
- I/O initiation section
- Interrupt service section
- I/O completion section
- Termination section

The .DRDEF macro is used near the beginning of your device handler, and performs much of the work in the preamble section. The .DRBEG macro sets up the first five words in the header section, stores information in block 0 of the handler file, and creates some global symbols. The .DRAST macro sets up the interrupt entry point and the abort entry point in the interrupt service section, and lowers the processor priority. The .DRFIN macro generates the instructions for the jump back to the monitor at the end of the handler I/O completion routine. The .DRENDR macro generates handler termination code. The .DRBOT macro sets up the primary driver. A primary driver must be added to a standard handler for a data device to...
create a system device handler. The .DRINS macro sets up the install code area by generating the CSR words used by INSTALL and RESORC. The .DRSET macro sets up the option table for the SET command in block 0 of the device handler file. The .DRVTB macro sets up a table of vectors for devices that require more than one vector.

Each of the device handler macros is described in Chapter 2. The RT-11 Software Support Manual details the use of these macros in writing a device handler.

### 1.1.4 Compatibility With Previous RT-11 Versions

Programmed requests were implemented differently in each major release of RT-11. The following sections outline the changes that were made to the programmed requests from version to version.

#### 1.1.4.1 Version 1 Programmed Requests

Programmed requests provided with the first release of RT-11, such as .READ and .WRITE, were designed for a single-user, single-job environment. As such, they differ significantly from the programmed requests of the later versions. For Version 1 requests, arguments were pushed on the stack instead of being stored, as they are presently, in an argument block. The channel number was limited to the range 0 through 17 (octal), while later versions can allocate an additional number of channels. Also, no arguments could be omitted in the macro call.

Programs written for use under Version 1 assemble and execute properly under Versions 3, 4, and 5 when the ..V1.. macro call is used. The ..V1.. macro call causes all Version 1 programmed requests to expand exactly as they did in Version 1. The ..V2.. macro call expands all requests in Version 2 format. However, it is to your advantage to convert Version 1 and Version 2 programs to the current format for programmed requests (see Section 2.7). Future versions of RT-11 may no longer support the older formats.

#### 1.1.4.2 Version 2 Programmed Requests

The release of RT-11 Version 2 included new programmed requests and a different way of handling arguments. The new programmed requests reflected RT-11’s ability to run a foreground job as well as a background job. They included requests to suspend/resume the foreground job and to share messages and data between the two jobs.

Arguments in Version 2 programmed requests were stored in an argument block instead of on the stack. Another difference in Version 2 was that arguments could be omitted from macro calls. If the Area argument — that is, the pointer to the argument block — was omitted, the macro assumed that R0 pointed to a valid argument block. If any of the optional arguments were not present, the macro placed a zero in the argument block for the corresponding argument. Version 1 programmed requests were modified to incorporate these changes, and the ..V1.. macro was provided to allow Version 1 programmed requests to execute under Version 2 without further modification.
Programs written for use under Version 2 assemble and execute properly under Versions 3 and 4 when the .V2. macro call is used. The .V2. macro call causes all programmed requests prior to Version 3 to expand in Version 2 format.

1.1.4.3 Version 3 Programmed Requests — The programmed requests for Version 3 provide means for user programs to access regions in extended memory and to use more than one terminal. The chief difference between Version 2 and Version 3 programmed requests is the way in which omitted arguments are handled. In Versions 3, 4, and 5, blank arguments in the macro calls do not cause zeros to be entered into the argument block, but leave the corresponding argument block entry for the missing argument untouched.

This change can have a significant impact on user programs. If an argument block within a program is to be used many times for similar calls, you can save instructions by setting up the argument block entries only once (at assembly or run time), and leaving the corresponding fields blank in the macro call.

However, you should keep in mind that you may not substitute zeroes for missing fields. Programs written with this assumption operate incorrectly and exhibit a wide range of symptoms that can be hard to diagnose. Therefore, you must write the necessary instructions to fill the argument block if a programmed request is issued with fields left blank in the argument list.

Programmed requests from previous versions were modified to incorporate this change, and the .V2. macro call was provided so that Version 2 programs could execute properly under Version 3 without further modification.

1.1.4.4 Version 4 Programmed Requests — Certain programmed requests have taken on additional functions to support the system job feature. These programmed requests and their additional functions follow:

<table>
<thead>
<tr>
<th>Programmed Request</th>
<th>Added Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>.GTJB</td>
<td>Returns logical job name.</td>
</tr>
<tr>
<td>.CHCOPY</td>
<td>May specify logical job name.</td>
</tr>
<tr>
<td>.LOOKUP</td>
<td>Opens message channel to any job; issues .READ/C/W, .WRITE/C/W, and .WAIT requests to communicate between jobs.</td>
</tr>
</tbody>
</table>

1.1.4.5 Version 5 Programmed Requests — Version 5 added several new programmed requests and modified others. The requests added for Version 5 are .ABTIO, .FPROT, .PEEK, .POKE, .PVAL, and .SFDAT. Although the XM monitor was expanded to support 22-bit Q-bus addressing, from a program’s point of view the extended memory programmed requests are unchanged from Version 4. Channel number 377 is now reserved for system use and is always unavailable to user programs. The programmed requests which have changed between Version 4 and Version 5 are summarized below:
Programmed Request               Added Function
   .CSTAT                      Available under SJ monitor.
   .TWAIT                      Available under SJ monitor.
   .FETCH                      Available under XM monitor.
   .GTLIN                      Optional argument to force terminal input.

1.1.5 Programmed Request Conversion
The previous sections describe the modified format of programmed requests that were developed after those of Version 1. This section describes the conversion process from the Version 1 format to Version 3.

1.1.5.1 Macro Calls Not Requiring Conversion — Version 1 macro calls that do not require any conversion are as follows:

<table>
<thead>
<tr>
<th>Macro Name</th>
<th>Converted Name</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>.CSIGEN</td>
<td>.LOCK</td>
<td></td>
</tr>
<tr>
<td>.CSISPC</td>
<td>.PRINT</td>
<td>.SRESET (Note 2)</td>
</tr>
<tr>
<td>.DATE</td>
<td>.QSET</td>
<td>.TTINR (Note 2)</td>
</tr>
<tr>
<td>.DSTATUS</td>
<td>.RCTRL0</td>
<td>.TTYIN</td>
</tr>
<tr>
<td>.EXIT</td>
<td>.RELEAS</td>
<td>.TTYOUT</td>
</tr>
<tr>
<td>.FETCH</td>
<td>.SETTOP (Note 1)</td>
<td>.UNLOCK</td>
</tr>
<tr>
<td>.HRESET</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1: Provided that location 50 is examined for the maximum value.

Note 2: Except in FB or XM systems.

1.1.5.2 Macro Calls That Can Be Converted — Version 1 macro calls that can be converted are as follows:

<table>
<thead>
<tr>
<th>Macro Name</th>
<th>Converted Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.CLOSE</td>
<td>.RENAME</td>
</tr>
<tr>
<td>.DELETE</td>
<td>.REOPEN</td>
</tr>
<tr>
<td>.ENTER</td>
<td>.SAVESTATUS</td>
</tr>
<tr>
<td>.LOOKUP</td>
<td>.WAIT</td>
</tr>
<tr>
<td>.READ</td>
<td>.WRITE</td>
</tr>
</tbody>
</table>

The general format of the ..V1.. system macro is

```
.PRGREQ Chan,Arg1,..,Argn
```

In this form, Chan is an integer between 0 and 17(octal) and is not a general assembler argument. The channel number is assembled into the EMT instruction itself. The arguments Arg1 through Argn are either moved into R0 or pushed on the stack.

The ..V2.. equivalent of the above call is

```
.PRGREQ Area,Chan,Arg1,..,Argn
```

In this form, the Chan argument can be any legal assembler argument and can be in the range from 0 to 377(octal). Area points to an argument block where the arguments Arg1 through Argn will be placed.
For example, consider a .READ programmed request in both forms:

Version 1:  .READ 5,*BUFF,*256,*BLOCK

Version 2:  .READ *AREA,*5,*BUFF,*256,*BLOCK

, , , , , 

AREA: .WORD 0 :CHANNEL/FUNCTION CODE HERE
, .WORD 0 :BLOCK NUMBER HERE
, .WORD 0 :BUFFER ADDRESS HERE
, .WORD 0 :WORD COUNT HERE
, .WORD 0 :A 1 GOES HERE

Thus, the difference in the two macro calls is that Version 2 declares the channel number as a legal assembler argument and adds an Area argument.

Table 1–3 shows a complete list of conversions for the programmed requests that can be converted. Version 1 and Version 2 formats are given. In Versions 3 and later, this function is performed automatically. The arguments shown inside the square brackets ([ ]) are optional. Refer to the appropriate section in Chapter 2 for more details on each request.

**Table 1–3: Programmed Request Conversions (Version 1 to Version 2)**

<table>
<thead>
<tr>
<th>Version</th>
<th>Programmed Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1:</td>
<td>.DELETE chan,dblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.DELETE area,chan,dblk,[count]</td>
</tr>
<tr>
<td>V1:</td>
<td>.LOOKUP chan,dblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.LOOKUP area,chan,dblk,[count]</td>
</tr>
<tr>
<td>V1:</td>
<td>.ENTER chan,dblk,[length]</td>
</tr>
<tr>
<td>V2:</td>
<td>.ENTER area,chan,dblk,[length,[count]]</td>
</tr>
<tr>
<td>V1:</td>
<td>.RENAME chan,dblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.RENAME area,chan,dblk</td>
</tr>
<tr>
<td>V1:</td>
<td>.SAVESTAT chan,clblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.SAVESTAT area,chan,clblk</td>
</tr>
<tr>
<td>V1:</td>
<td>.REOPEN chan,clblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.REOPEN area,chan,clblk</td>
</tr>
<tr>
<td>V1:</td>
<td>.CLOSE chan</td>
</tr>
<tr>
<td>V2:</td>
<td>.CLOSE chan</td>
</tr>
<tr>
<td>V1:</td>
<td>.READ/.READW chan,buff,wcnt,clblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.READ/.READW area,chan,buff,wcnt,clblk</td>
</tr>
<tr>
<td>V1:</td>
<td>.READC chan,buff,wcnt,crtn,clblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.READC area,chan,buff,wcnt,crtn,clblk</td>
</tr>
<tr>
<td>V1:</td>
<td>.WRITE/.WRTW chan,buff,wcnt,clblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.WRITE/.WRTW area,chan,buff,wcnt,clblk</td>
</tr>
<tr>
<td>V1:</td>
<td>.WRITC chan,buff,wcnt,crtn,clblk</td>
</tr>
<tr>
<td>V2:</td>
<td>.WRITC area,chan,buff,wcnt,crtn,clblk</td>
</tr>
<tr>
<td>V1:</td>
<td>.WAIT chan</td>
</tr>
<tr>
<td>V2:</td>
<td>.WAIT chan</td>
</tr>
</tbody>
</table>

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Several important features of Version 3 calls to be kept in mind when using them are as follows:

1. Version 3 calls require the *area* argument, which points to the area where the other arguments will be (unless R0 already points to it and the first word is set up).

2. Enough memory space must be allocated to hold all the required arguments.

3. The *chan* argument must be a legal assembler argument, not just an integer between 0 and 17(octal).

4. Blank fields are permitted in the Version 3 calls. Any field not specified (left blank) is not modified in the argument block.

### 1.1.6 Programmed Request Summary

Many programmed requests operate only in a specific RT–11 environment, such as under a foreground/background monitor or when using a special feature such as multiterminal operation. Table 1–4 lists the programmed requests that can be used in all RT–11 environments, including multiterminal operation. Table 1–5 lists the additional programmed requests that can be used under the foreground/background monitor and extended memory monitor. The EMT and function code for each request are shown in octal. Although only the first six characters of the programmed request are significant to the Macro assembler, the longer forms are shown to provide a better understanding of the request function. Also, the purpose of each request is described.

Macros that are used in interrupt service routines and in writing device handlers are listed since they are a part of the system macro library.

Table 1–4 summarizes the programmed requests that work in all RT–11 environments. The programmed requests followed by (MT) work only under the multiterminal feature of RT–11.

#### Table 1–4: Programmed Requests for All RT–11 Environments

<table>
<thead>
<tr>
<th>Name</th>
<th>EMT</th>
<th>Code</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.ABTIO</td>
<td>374</td>
<td>13</td>
<td>Aborts I/O in progress on the specified channel</td>
</tr>
<tr>
<td>.ADDR</td>
<td></td>
<td></td>
<td>Computes a specified address in a position-independent manner</td>
</tr>
<tr>
<td>.ASSUME</td>
<td></td>
<td></td>
<td>Tests for a specified condition; if test is false, generates assembly error and prints descriptive message</td>
</tr>
<tr>
<td>.BR</td>
<td></td>
<td></td>
<td>Warns if code which belongs together is separated during assembly</td>
</tr>
<tr>
<td>.CDFN</td>
<td>375</td>
<td>15</td>
<td>Defines additional channels for I/O</td>
</tr>
<tr>
<td>.CHAIN</td>
<td>374</td>
<td>10</td>
<td>Chains to another program (in background job only)</td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Name</th>
<th>EMT</th>
<th>Code</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.CLOSE</td>
<td>374</td>
<td>6</td>
<td>Closes the specified channel</td>
</tr>
<tr>
<td>.CMKT</td>
<td>375</td>
<td>23</td>
<td>Cancels an unexpired mark time request (special feature in single-job environment)</td>
</tr>
<tr>
<td>.CSIGEN</td>
<td>344</td>
<td>—</td>
<td>Calls the Command String Interpreter (CSI) in general mode</td>
</tr>
<tr>
<td>.CSISPC</td>
<td>345</td>
<td>—</td>
<td>Calls the Command String Interpreter (CSI) in the special mode</td>
</tr>
<tr>
<td>.CSTAT</td>
<td>375</td>
<td>27</td>
<td>Returns the status of the specified channel</td>
</tr>
<tr>
<td>.CTIMIO</td>
<td>—</td>
<td>—</td>
<td>Used within a device handler as a macro call to cancel a mark time request (special feature)</td>
</tr>
<tr>
<td>.DATE</td>
<td>374</td>
<td>12</td>
<td>Moves the current date information into R0</td>
</tr>
<tr>
<td>.DELETE</td>
<td>375</td>
<td>0</td>
<td>Deletes the file from the specified device</td>
</tr>
<tr>
<td>.DRAST</td>
<td>—</td>
<td>—</td>
<td>Used with device handlers to create the asynchronous entry points to the handler</td>
</tr>
<tr>
<td>.DRBEG</td>
<td>—</td>
<td>—</td>
<td>Used with device handlers to create a five-word header, and .ASECT locations 52 through 60</td>
</tr>
<tr>
<td>.DRBOT</td>
<td>—</td>
<td>—</td>
<td>Used with system device handlers to set up the primary driver</td>
</tr>
<tr>
<td>.DRDEF</td>
<td>—</td>
<td>—</td>
<td>Used with device handlers to set up handler parameters, call driver macros from the library, and define useful symbols</td>
</tr>
<tr>
<td>.DREND</td>
<td>—</td>
<td>—</td>
<td>Used with device handlers to generate the table of pointers into the resident monitor</td>
</tr>
<tr>
<td>.DRFIN</td>
<td>—</td>
<td>—</td>
<td>Used with device handlers to generate the code required to exit to the completion code in the resident monitor</td>
</tr>
<tr>
<td>.DRINS</td>
<td>—</td>
<td>—</td>
<td>Sets up installation code area in block 0 of a device handler, and defines system and data device installation entry points</td>
</tr>
<tr>
<td>.DRSET</td>
<td>—</td>
<td>—</td>
<td>Used with device handlers to create the list of SET options for a device</td>
</tr>
<tr>
<td>.DRV TB</td>
<td>—</td>
<td>—</td>
<td>Used with multivector device handlers to generate a table that contains the vector location, interrupt entry point, and processor status word for each device vector</td>
</tr>
<tr>
<td>.DSTATUS</td>
<td>342</td>
<td>—</td>
<td>Returns the status of a particular device</td>
</tr>
<tr>
<td>.ENTER</td>
<td>375</td>
<td>2</td>
<td>Creates a new file for output</td>
</tr>
<tr>
<td>.EXIT</td>
<td>350</td>
<td>—</td>
<td>Exits the user program and optionally passes a command to KMON</td>
</tr>
<tr>
<td>.FETCH</td>
<td>343</td>
<td>—</td>
<td>Loads a device handler into memory</td>
</tr>
</tbody>
</table>

(continued on next page)
Table 1–4: Programmed Requests for All RT–11 Environments (Cont.)

<table>
<thead>
<tr>
<th>Name</th>
<th>EMT</th>
<th>Code</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.FORK</td>
<td>—</td>
<td>—</td>
<td>Generates a subroutine call in an interrupt service routine that permits long but not critical processing to be postponed until all other interrupts are dismissed</td>
</tr>
<tr>
<td>.FPROT</td>
<td>375</td>
<td>43</td>
<td>Sets or removes a file’s protection</td>
</tr>
<tr>
<td>.GTIM</td>
<td>375</td>
<td>21</td>
<td>Gets the time of day</td>
</tr>
<tr>
<td>.GTJB</td>
<td>375</td>
<td>20</td>
<td>Gets parameters of a job</td>
</tr>
<tr>
<td>.GTLIN</td>
<td>345</td>
<td>—</td>
<td>Accepts an input line from either an indirect command file or the console terminal</td>
</tr>
<tr>
<td>.GVAL</td>
<td>375</td>
<td>34</td>
<td>Returns contents of a monitor fixed offset</td>
</tr>
<tr>
<td>.HERR</td>
<td>374</td>
<td>5</td>
<td>Specifies termination of a job on fatal errors</td>
</tr>
<tr>
<td>.HRESET</td>
<td>357</td>
<td>—</td>
<td>Terminates I/O transfers and does a .SRESET operation</td>
</tr>
<tr>
<td>.INTEN</td>
<td>—</td>
<td>—</td>
<td>Generates a subroutine call to notify the monitor that an interrupt has occurred, requests system state, and sets processor priority to the specified value</td>
</tr>
<tr>
<td>.LOCK</td>
<td>346</td>
<td>—</td>
<td>Makes the monitor User Service Routine (USR) permanently resident until an .EXIT or .UNLOCK is executed; the user program is swapped out, if necessary</td>
</tr>
<tr>
<td>.LOOKUP</td>
<td>375</td>
<td>1</td>
<td>Opens an existing file for input and/or output via the specified channel; opens a message channel to a specified job</td>
</tr>
<tr>
<td>.MFPS</td>
<td>—</td>
<td>—</td>
<td>Reads the priority bits in the processor status word, but does not read the condition codes</td>
</tr>
<tr>
<td>.MRKT</td>
<td>375</td>
<td>22</td>
<td>Marks time, that is, sets an asynchronous routine to be entered after specified interval (special feature in single-job environment)</td>
</tr>
<tr>
<td>.MTATCH (MT)</td>
<td>375</td>
<td>37</td>
<td>Attaches a terminal for exclusive use by the requesting job</td>
</tr>
<tr>
<td>.MTDTCH (MT)</td>
<td>375</td>
<td>37</td>
<td>Detaches a terminal from one job and frees it for use by other jobs</td>
</tr>
<tr>
<td>.MTGET (MT)</td>
<td>375</td>
<td>37</td>
<td>Returns the status of a specified terminal to the user</td>
</tr>
<tr>
<td>.MTIN (MT)</td>
<td>375</td>
<td>37</td>
<td>Operates as a .TTYIN request for a multiterminal configuration</td>
</tr>
<tr>
<td>.MTOUT (MT)</td>
<td>375</td>
<td>37</td>
<td>Operates as a .TTYOUT request for a multiterminal configuration</td>
</tr>
<tr>
<td>.MTPRNT (MT)</td>
<td>375</td>
<td>37</td>
<td>Operates as a .PRINT request for a multiterminal configuration</td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Name</th>
<th>EMT</th>
<th>Code</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.MTPS</td>
<td></td>
<td></td>
<td>Sets the priority bits, condition codes, and T-bit in the processor status word</td>
</tr>
<tr>
<td>.MTRCTO (MT)</td>
<td>375</td>
<td>37</td>
<td>Resets the CTRL/O flag for the designated terminal</td>
</tr>
<tr>
<td>.MTSET (MT)</td>
<td>375</td>
<td>37</td>
<td>Modifies terminal status in a multiterminal configuration</td>
</tr>
<tr>
<td>.MTSTAT (MT)</td>
<td>375</td>
<td>37</td>
<td>Provides multiterminal system status</td>
</tr>
<tr>
<td>.PEEK</td>
<td>375</td>
<td>34</td>
<td>Examines memory locations</td>
</tr>
<tr>
<td>.POKE</td>
<td>375</td>
<td>34</td>
<td>Changes memory locations</td>
</tr>
<tr>
<td>.PRINT</td>
<td>351</td>
<td></td>
<td>Outputs an ASCII string terminated by a zero byte or a 200 byte</td>
</tr>
<tr>
<td>.PURGE</td>
<td>374</td>
<td>3</td>
<td>Clears out a channel for reuse</td>
</tr>
<tr>
<td>.PVAL</td>
<td>375</td>
<td>34</td>
<td>Replaces contents of a monitor fixed offset</td>
</tr>
<tr>
<td>.QELDF</td>
<td></td>
<td></td>
<td>Used with device handlers to define offsets in the I/O queue element</td>
</tr>
<tr>
<td>.QSET</td>
<td>353</td>
<td></td>
<td>Increases the size of the monitor I/O queue</td>
</tr>
<tr>
<td>.RCTRLRO</td>
<td>355</td>
<td></td>
<td>Enables output to the terminal, overriding any previous CTRL/O</td>
</tr>
<tr>
<td>.READ</td>
<td>375</td>
<td>10</td>
<td>Transfers data on the specified channel to a memory buffer and returns control to the user program when the transfer request is entered in the I/O queue; no special action is taken upon completion of I/O</td>
</tr>
<tr>
<td>.READC</td>
<td>375</td>
<td>10</td>
<td>Transfers data on the specified channel to a memory buffer and returns control to the user program when the transfer request is entered in the I/O queue; upon completion of the read, control transfers asynchronously to the completion routine specified in the .READC request</td>
</tr>
<tr>
<td>.READW</td>
<td>375</td>
<td>10</td>
<td>Transfers data via the specified channel to a memory buffer and returns control to the user program only after the transfer is complete</td>
</tr>
<tr>
<td>.RELEASE</td>
<td>343</td>
<td></td>
<td>Removes a device handler from memory</td>
</tr>
<tr>
<td>.RENAME</td>
<td>375</td>
<td>4</td>
<td>Changes the name of the indicated file to a new name; if this request is attempted when using magtape, the handler returns an invalid operation code</td>
</tr>
<tr>
<td>.REOPEN</td>
<td>375</td>
<td>6</td>
<td>Restores the parameters stored via a .SAVE-STATUS request and reopens the channel for I/O</td>
</tr>
<tr>
<td>.SAVESTATUS</td>
<td>375</td>
<td>5</td>
<td>Saves the status parameters of an open file in user memory and frees the channel for use</td>
</tr>
<tr>
<td>.SCCA</td>
<td>375</td>
<td>35</td>
<td>Enables intercept of CTRL/C commands</td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Name</th>
<th>EMT</th>
<th>Code</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.SDTMM</td>
<td>375</td>
<td>40</td>
<td>Sets the system date and/or time</td>
</tr>
<tr>
<td>.SERR</td>
<td>374</td>
<td>4</td>
<td>Inhibits most fatal errors from aborting the current job</td>
</tr>
<tr>
<td>.SETTOP</td>
<td>354</td>
<td>—</td>
<td>Specifies the highest memory location to be used by the user program</td>
</tr>
<tr>
<td>.SFDAT</td>
<td>375</td>
<td>42</td>
<td>Changes a file creation date in a directory entry</td>
</tr>
<tr>
<td>.SFPA</td>
<td>375</td>
<td>30</td>
<td>Sets user interrupt for floating-point processor exceptions</td>
</tr>
<tr>
<td>SOB</td>
<td>—</td>
<td>—</td>
<td>Simulates the SOB instruction</td>
</tr>
<tr>
<td>.SPFUN</td>
<td>375</td>
<td>32</td>
<td>Performs special functions on magtape, cassette, diskette, and some disk devices</td>
</tr>
<tr>
<td>.SRESET</td>
<td>352</td>
<td>—</td>
<td>Resets all channels and releases the device handlers from memory</td>
</tr>
<tr>
<td>.SYNCH</td>
<td>—</td>
<td>—</td>
<td>Generates a subroutine call that enables your program to perform programmed requests from within an interrupt service routine</td>
</tr>
<tr>
<td>.TIMIO</td>
<td>—</td>
<td>—</td>
<td>Generates a subroutine call in a handler to schedule a mark time request (special feature in all environments)</td>
</tr>
<tr>
<td>.TLOCK</td>
<td>374</td>
<td>7</td>
<td>Indicates if the USR is currently used by another job and performs exactly as a .LOCK request in a single-job environment</td>
</tr>
<tr>
<td>.TRPSET</td>
<td>375</td>
<td>3</td>
<td>Sets a user intercept for traps to monitor locations 4 and 10</td>
</tr>
<tr>
<td>.TTINR</td>
<td>340</td>
<td>—</td>
<td>Reads one character from the keyboard buffer</td>
</tr>
<tr>
<td>TTYIN</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>.TTIOUT</td>
<td>341</td>
<td>—</td>
<td>Transfers one character to the terminal input buffer</td>
</tr>
<tr>
<td>TTOUTR</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>.TWAIT</td>
<td>375</td>
<td>24</td>
<td>Suspends the running job for a specified amount of time</td>
</tr>
<tr>
<td>.UNLOCK</td>
<td>347</td>
<td>—</td>
<td>Releases the USR after execution of a .LOCK and swaps in the user program, if required</td>
</tr>
<tr>
<td>.V1..</td>
<td>—</td>
<td>—</td>
<td>Provides compatibility with Version 1 format</td>
</tr>
<tr>
<td>.V2..</td>
<td>—</td>
<td>—</td>
<td>Provides compatibility with Version 2 format</td>
</tr>
<tr>
<td>.WAIT</td>
<td>374</td>
<td>0</td>
<td>Waits for completion of all I/O on a specified channel</td>
</tr>
<tr>
<td>.WRITC</td>
<td>375</td>
<td>11</td>
<td>Transfers data on the specified channel to a device and returns control to the user program when the transfer request is entered in the I/O queue; upon completion of the write, control transfers asynchronously to the completion routine specified in the .WRITC request</td>
</tr>
</tbody>
</table>

(continued on next page)
Table 1–4: Programmed Requests for All RT–11 Environments (Cont.)

<table>
<thead>
<tr>
<th>Name</th>
<th>EMT</th>
<th>Code</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.WRITE</td>
<td>375</td>
<td>11</td>
<td>Transfers data on the specified channel to a device and returns control to the user program when the transfer request is entered in the I/O queue; no special action is taken upon completion of the I/O</td>
</tr>
<tr>
<td>.WRTW</td>
<td>375</td>
<td>11</td>
<td>Transfers data on the specified channel to a device and returns control to the user program only after the transfer is complete</td>
</tr>
</tbody>
</table>

Table 1–5 lists the additional programmed requests that can be used only in a foreground/background and extended memory environment. The programmed requests followed by (XM) operate only in an extended memory environment.

Table 1–5: Foreground/Background and Extended Memory Programmed Requests

<table>
<thead>
<tr>
<th>Name</th>
<th>EMT</th>
<th>Code</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.CHCOPY</td>
<td>375</td>
<td>13</td>
<td>Allows one job to access another job's channel</td>
</tr>
<tr>
<td>.CNTXSW</td>
<td>375</td>
<td>33</td>
<td>Requests that the indicated memory locations be part of FB or XM context switch process</td>
</tr>
<tr>
<td>.CRAW (XM)</td>
<td>375</td>
<td>36</td>
<td>Creates a window in virtual memory</td>
</tr>
<tr>
<td>.CRRG (XM)</td>
<td>375</td>
<td>36</td>
<td>Creates a region in extended memory</td>
</tr>
<tr>
<td>.DEVICE</td>
<td>375</td>
<td>14</td>
<td>Allows device interrupts in FB or XM to be disabled upon program termination</td>
</tr>
<tr>
<td>.ELAW (XM)</td>
<td>375</td>
<td>36</td>
<td>Eliminates an address window in virtual memory</td>
</tr>
<tr>
<td>.ELRG (XM)</td>
<td>375</td>
<td>36</td>
<td>Eliminates an allocated region in extended memory</td>
</tr>
<tr>
<td>.GMCX (XM)</td>
<td>375</td>
<td>36</td>
<td>Returns mapping status of a specified window</td>
</tr>
<tr>
<td>.MAP (XM)</td>
<td>375</td>
<td>36</td>
<td>Maps a virtual address window to extended memory</td>
</tr>
<tr>
<td>.MWAIT</td>
<td>374</td>
<td>11</td>
<td>Waits for messages to be processed</td>
</tr>
<tr>
<td>.PROTECT</td>
<td>375</td>
<td>31</td>
<td>Requests that specified vectors in the area from 0 to 476 be given exclusively to the current job</td>
</tr>
<tr>
<td>.RCVD</td>
<td>375</td>
<td>26</td>
<td>Receives data — allows a job to read messages or data sent by another job in an FB environment. The three modes correspond to the .READ, .READC, and .READW requests</td>
</tr>
<tr>
<td>.RCVDC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.RCVDW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.RDBBK (XM)</td>
<td>—</td>
<td>—</td>
<td>Reserves space in a program for a region definition block and sets up the region size and region status word</td>
</tr>
<tr>
<td>.RDBDF (XM)</td>
<td>—</td>
<td>—</td>
<td>Defines the offsets and bit names associated with a region definition block</td>
</tr>
</tbody>
</table>

(continued on next page)
Table 1–5: Foreground/Background and Extended Memory Programmed Requests (Cont.)

<table>
<thead>
<tr>
<th>Name</th>
<th>EMT</th>
<th>Code</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.RSUM</td>
<td>374</td>
<td>2</td>
<td>Causes the mainline code of the job to be resumed after it was suspended after a .SPND request</td>
</tr>
<tr>
<td>.SDAT</td>
<td>375</td>
<td>25</td>
<td>Sends messages or data to the other job in an FB environment. The three modes correspond to the .WRITE, .WRITC, and .WRITW requests</td>
</tr>
<tr>
<td>.SDATC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.SDATW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.SPCPS</td>
<td>375</td>
<td>41</td>
<td>Used in a completion routine to change the flow of control of the mainline code (special feature)</td>
</tr>
<tr>
<td>.SPND</td>
<td>374</td>
<td>1</td>
<td>Causes the running job to be suspended</td>
</tr>
<tr>
<td>.UNMAP (XM)</td>
<td>375</td>
<td>36</td>
<td>Unmaps a virtual address memory window</td>
</tr>
<tr>
<td>.UNPROTECT</td>
<td>375</td>
<td>31</td>
<td>Cancels the .PROTECT vector protection request</td>
</tr>
<tr>
<td>.WDBBK (XM)</td>
<td></td>
<td></td>
<td>Reserves space in a program for a window definition block and sets up the associated data</td>
</tr>
<tr>
<td>.WDBDF (XM)</td>
<td></td>
<td></td>
<td>Defines the offsets and bit names associated with a window definition block</td>
</tr>
</tbody>
</table>

1.2 Using the System Subroutine Library

The system subroutine library is a collection of FORTRAN-callable routines that allow various RT–11 system features to be used by a FORTRAN programmer. There are no FORTRAN routines in SYSLIB to access extended memory under the extended memory (XM) monitor.

This collection of subroutines is placed in a system library called SYSLIB.OBJ. This library file also contains the overlay handlers, utility functions, a character string manipulation package, and two-word integer support routines. The linker uses this library to resolve undefined globals. It is resident on the system device (SY:).

You should be familiar with the PDP–11 FORTRAN Language Reference Manual and the RT–11/RSTS/E FORTRAN IV User’s Guide before using the material in this chapter.

The system subroutine library provides the following capabilities:

1. Complete RT–11 I/O facilities, including synchronous, asynchronous, and event-driven modes of operation. FORTRAN subroutines can be activated upon completion of an input/output operation.
2. Timed scheduling of completion routines. This feature is standard in the FB and XM monitors, and is a special feature in the SJ monitor.
3. Facilities for communication between foreground and background jobs.
4. FORTRAN language interrupt service routines for user devices.
5. Complete timer support facilities, including timed suspension of execution in a FB or XM environment, conversion of different time formats,
and time-of-day information. The timer support facilities can use either 50- or 60-cycle clocks.

6. All RT–11 auxiliary input/output functions, including the capabilities of opening, closing, renaming, and creating or deleting files on any device.

7. All monitor-level information functions, such as job partition parameters, device statistics, and input/output channel statistics.


10. INTEGER*4 support routines that allow two-word integer computations.

NOTE

When variables are described or mentioned, and unless otherwise specified, INTEGER means INTEGER*2, (16-bit integer) and REAL means REAL*4 (single-precision floating point). Integer and real arguments to subprograms are indicated in this section as follows:

- \( i = \) INTEGER*2 arguments
- \( j = \) INTEGER*4 arguments
- \( a = \) REAL*4 arguments
- \( d = \) REAL*8 arguments

In general, the routines in SYSLIB were written for use with RT–11 V2 or later and FORTRAN IV V1B or later versions. The use of SYSLIB with prior versions of RT–11 or FORTRAN may lead to unpredictable results.

1.2.1 System Conventions

This section describes system conventions that must be followed for proper operation of calls to the system subroutine library. Certain restrictions that apply are described in Section 1.2.1.7.

1.2.1.1 Channel Numbers — A channel number is a logical identifier for a file used by FORTRAN. Thus, when you open a file on a particular device, you assign a channel number to that file. To refer to an open file, it is only necessary to refer to the appropriate channel number.

The FORTRAN system has 16(decimal) channels available for your use. The call IGETC assigns a channel to your program and notifies the FORTRAN I/O system, which also uses these channels, that the channel is in use. When there is no longer need for a channel, the program should close the channel with a CLOSEC, ICLOSE or a PURGE SYSLIB call. The channel should also be freed and returned to the FORTRAN I/O system with a IFREEC call.
Up to 254(decimal) channels can be activated with the ICDFN call. This function sets aside memory in the job area to accommodate status information for the extra channels. Use the ICDFN call during the initialization phase of your program. You can use all channels numbered higher than 15(decimal). The FORTRAN I/O system uses channels 0 through 15(decimal).

Channels must be allocated in the main program routine or its subprograms. Do not allocate channels in routines that are activated as the result of I/O completion events or ISCHED or ITIMER calls.

1.2.1.2 Completion Routines — Completion routines can be written in FORTRAN or assembly language, depending upon the function called.

A completion routine is a subprogram that executes asynchronously with a main program and is scheduled to run as soon as possible after the completion of an associated event, such as an I/O transfer or the passing of a specified time interval. All completion routines of the current job have higher priority than other parts of the job. Therefore, once a completion routine becomes runnable because of its associated event, it interrupts execution of the job and continues to execute until it relinquishes control.

Completion routines are handled differently in the SJ and the FB and XM monitors. In the SJ monitor, these routines are totally asynchronous and can interrupt one another. Unlike completion routines run under FB and XM monitors, which are serialized and run at priority 0, completion routines run under an SJ monitor are nested and can interrupt each other. In addition, they execute not at priority 0, but at the same priority as the device whose interrupt scheduled them. For example, the completion routine resulting from a .WRITC programmed request to device TT: runs at priority 4. Completion routines from timer requests run at the same priority as the system clock. This is particularly important on LSI–11 and PDP/03 systems that have only two interrupt levels, ON and OFF, because clock interrupts may be lost while lengthy completion routines execute. In the FB and XM monitors, completion routines do not interrupt each other but are queued and have to wait until the correct job is running. They are then scheduled on a first-in first-out basis.

Assembly language completion routines exit with an RTS PC instruction. FORTRAN completion routines exit by the execution of a RETURN or END statement in the subroutine. All names of completion routines external to the routine being coded that are passed to scheduling calls must be specified in an EXTERNAL statement in the FORTRAN program unit issuing the call.

A completion routine written in FORTRAN can have a maximum of two arguments as follows:

Form: SUBROUTINE crtn [(iarg1,iarg2)]

where:

- crtn is the name of the completion routine
iarg1 is equivalent to R0 on entry to an assembly language completion routine

iarg2 is equivalent to R1 on entry to an assembly language completion routine

If an error occurs in a completion routine or in a subroutine at completion level, the error handler traces back through to the original interruption of the main program. Thus, the traceback is shown as though the completion routine were called from the main program. This lets you know where the main program was executing, so that when an error is fatal, it can be diagnosed and corrected.

Certain restrictions apply to completion routines that are activated by the following calls:

| INTSET    | IREADF | ISPFNC | IWRITC |
| IRCVDC    | ISCHED | ISPFNF | IWRITF |
| IRCVDF    | ISDATC | ITIMER | MRKT   |
| IREADC    | ISDATF |

The restrictions that apply when using these calls are as follows:

- No channels can be allocated by calls to IGETC or freed by calls to IFREEC from a completion routine. Channels to be used by completion routines should be allocated and placed in a COMMON block for use by the routine.

- The completion routine cannot perform any call that requires the use of the USR, such as LOOKUP and ENTER. See Section 1.2.1.5 for a list of the SYSLIB functions that call the USR.

- Files that are used by the completion routine must be opened and closed by the main program. There are, however, no restrictions on the input or output operations that can be performed in the completion routine. If many files must be made available to the completion routine, they can be opened by the main program and saved for later use (without tying up RT-11 channels) by an ISAVES call. The completion routine can later make them available by reattaching the file to a channel with an IRE-OPN call.

Even if the completion routine itself does not issue any programmed requests, but does perform I/O to a logical unit number through the OTS, that logical unit number must be opened from the main level. To accomplish this, either the first I/O access or an OPEN statement must be issued from main level. A completion routine may not call CLOSE to close a logical unit.

- FORTRAN subroutines are reusable but not reentrant. That is, a given subroutine can be used many times as a completion routine or as a routine in the main program, but a subroutine executing as main program code does not work properly if it is interrupted and then called again at the completion level. This restriction applies to all subroutines that can be invoked at the completion level while they are active in the main program.
• FORTRAN completion routines can be called only by SYSLIB functions that end in F. Conversely, MACRO completion routines cannot be called by SYSLIB functions that end in F. Refer to Section 1.1.3.5 for details of other restrictions on MACRO completion routines.

• Under the SJ monitor, only one completion function should be active at any time.

1.2.1.3 Device Blocks — A device block is a four-word block of Radix–50 information that specifies a physical device and a file name. In FORTRAN, you can use one of three different methods to set up this block as follows:

1. You can use the DIMENSION and DATA statements. For example,

    DIMENSION IFILE (4)
    DATA IFILE/3RSY,3RFIL,3RE,3RXYZ/

2. You can translate the available ASCII file description string into Radix–50 format, using the SYSLIB calls IRAD50, R50ASC, and RAD50. For example,

    REAL*8 FSPEC
    CALL IRAD50 (12,'SY FILE XYZ',FSPEC)

3. You can use the SYSLIB call ICSI to call the Command String Interpreter (CSI) to accept and parse standard RT–11 command strings.

1.2.1.4 INTEGER*4 Support Functions — This section discusses the initialization of INTEGER*4 variables for the FORTRAN programmer. Section 1.2.6.3 describes the use of INTEGER*4 functions for use by the MACRO programmer.

When the DATA statement is used to initialize INTEGER*4 variables, it must specify both the low- and high-order parts. For example, the code

    INTEGER*4 J
    DATA J/3/

Initializes only the first word. The correct way to initialize an INTEGER*4 variable to a constant such as 3 is as follows:

    INTEGER*4 J
    INTEGER*2 I(2)
    EQUIVALENCE (J,I)
    DATA I/3,0/  !INITIALIZE J TO 3

If you are initializing an INTEGER*4 variable to a negative value such as -4, the high-order (second word) part must be the continuation of the two’s complement of the low-order part. For example,

    INTEGER*4 J
    INTEGER*2 I(2)
    EQUIVALENCE (J,I)
    DATA I/-4,-1/  !INITIALIZE J TO -4
The following example is suitable for initializing INTEGER*4 arguments to subprograms:

\[
\text{INTEGER*2 J(2)} \\
\text{DATA J/3,0/! LOW ORDER, HIGH ORDER}
\]

1.2.1.5 User Service Routine (USR) Requirements — User-written routines that interface to the FORTRAN Object Time System (OTS) must account for the location of the RT-11 User Service Routine (USR). The USR occupies 2K words. When your program calls a SYSLIB routine that requests a USR function (such as IENTER or LOOKUP), or when the USR is invoked by the FORTRAN OTS, the USR is swapped into memory if it is nonresident. The FORTRAN OTS is designed so that the USR can swap over it.

If you permit the USR to swap over certain kinds of data and code, you will obtain unpredictable results. In particular, you should restrict interrupt service routines and completion routines to locations outside the USR swapping area. To find the limits of this swapping area, examine the link map and, if necessary, change the order of object modules and libraries as specified to the Linker.

Subroutines that require the USR are as follows:

- CLOSE,CICLOSE
- GETSTR (only if first I/O operation on logical unit)
- ICFN (single job only)
- GTLIN
- ICSI
- IDELET
- IDSTAT
- IENTER
- IFETCH
- IQSET
- IRENAME
- IITLOCK (only if USR is not in use by another job)
- LOCK (only if USR is in a swapping state)
- LOOKUP
- PUTSTR (only if first I/O operation on logical unit)

CONTROLLING USR SWAPPING
You can control USR swapping by using the KMON commands SET USR NOSWAP and SET USR SWAP. The SET USR NOSWAP command prevents swapping and freezes the USR in memory. The command SET USR SWAP reverses this, allowing the USR to swap under program control.

Alternatively, you can compile your FORTRAN main program with the /NOSWAP option if you are sure that there is space just below the foreground partition or RMON to make the USR permanent for the duration of your program. Use this option if your program does not need the 2K words of memory that the USR occupies. If the /NOSWAP option is not specified, the USR swaps over the 2K words of your program above the base.
address — that is, from location 1000(octal) to 11000(octal), which is the part of a FORTRAN program least likely to violate the USR restrictions.

To prevent USR swapping for part of the program execution time and allow the USR to swap out at other times, use the LOCK, UNLOCK, and ITLOCK calls.

The LOCK call locks the USR into main memory and attaches it to the requesting job. The UNLOCK call allows the USR to swap again and to be used by another job. The ITLOCK call is used to determine whether another job is already using the USR. If so, the ITLOCK call returns immediately with an error code. This allows the program to try for a lock, but to continue with other action if it fails. The LOCK and UNLOCK calls are used in a foreground program to prevent interference from the background during initialization and completion phases and to minimize the number of swaps.

STRATEGIES IN USR SWAPPING
If you decide to change the position of code or data to avoid the USR swapping area, or if you want to move the USR itself, you must consider the concept of PSECT (program section) ordering.

PSECTs contain code and data and are identified by names as segments of the object program. The attributes associated with each PSECT direct the Linker to combine several separately compiled FORTRAN program units, assembly language modules, and library routines into an executable program.

The order in which program sections are allocated in the executable program is the order that they are presented to the Linker. Applications that are sensitive to this ordering typically separate those sections containing read-only information (such as executable code and pure data) from impure sections containing variables.

The main program unit of a FORTRAN program (normally the first object module in sequence presented to LINK) declares PSECT ordering as shown in Table 1–6.

The USR can swap over pure code, but must not be loaded over constants or impure data that can be used as arguments to the USR. The ordering shown in Table 1–6 collects all pure sections before impure data in memory. The USR can safely swap over sections OTS$I$, OTS$P$, SYS$I$, USER$I$, and $CODE$. When a FORTRAN program is running, the USR will normally swap starting at the base of section OTS$I$. Location 46 of the System Communication Area contains the address where the USR will swap. If location 46 is zero, the USR will swap at its default location, below RMON and any handlers.

### Table 1-6: FORTRAN Program PSECT Ordering

<table>
<thead>
<tr>
<th>Section Name</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTS$1</td>
<td>RW,I,LCL,REL,CON</td>
</tr>
<tr>
<td>OTS$8P</td>
<td>RW,D,GBL,REL,OV</td>
</tr>
<tr>
<td>SYS$1</td>
<td>RW,I,LCL,REL,CON</td>
</tr>
<tr>
<td>USER$1</td>
<td>RW,I,LCL,REL,CON</td>
</tr>
<tr>
<td>$CODE</td>
<td>RW,I,LCL,REL,CON</td>
</tr>
<tr>
<td>OTS$0</td>
<td>RW,I,LCL,REL,CON</td>
</tr>
<tr>
<td>SYS$0</td>
<td>RW,I,LCL,REL,CON</td>
</tr>
<tr>
<td>$DATAP</td>
<td>RW,D,LCL,REL,CON</td>
</tr>
<tr>
<td>OTS$D</td>
<td>RW,D,LCL,REL,CON</td>
</tr>
<tr>
<td>OTS$S</td>
<td>RW,D,LCL,REL,CON</td>
</tr>
<tr>
<td>SYS$S</td>
<td>RW,D,LCL,REL,CON</td>
</tr>
<tr>
<td>$DATA</td>
<td>RW,D,LCL,REL,CON</td>
</tr>
<tr>
<td>USER$D</td>
<td>RW,D,LCL,REL,CON</td>
</tr>
<tr>
<td>$$$</td>
<td>RW,D,GBL,REL,OV</td>
</tr>
<tr>
<td>Other COMMON Blocks</td>
<td>RW,D,GBL,REL,OV</td>
</tr>
</tbody>
</table>

### USR LOCKOUT AND TIMING

If one job is using the USR and another job requests it, the second job will become blocked until the first job releases the USR. The second job may be locked out for seconds or minutes at a time. Interrupt service and completion routines can run, but not the mainline code. The timing problems that arise as a result can be eliminated, or minimized, in one of the following four ways:

1. Do not use devices with slow directory operations, such as cassettes and magtapes.
2. Code real-time operations as completion and interrupt service routines in your foreground job so that a locked out mainline program does not impact real-time operations.
3. Separate USR and real-time operations.
4. Use the ITLOCK call and avoid SYSLIB calls that request the USR while the USR is owned by another job.

Typically, a real-time foreground job can be constructed of (1) an initialization phase that opens all required channels and begins a real-time operation, (2) a real-time phase that performs interrupt service and I/O operations, and (3) a completion phase that halts real-time activity and then closes the channels. Maintaining this structure in the foreground allows the background task to do USR operations during the real-time phase without locking out the foreground. This also simplifies USR swapping since the USR can swap over the interrupt routines and I/O buffers as long as they are inactive.

### 1.2.1.6 Subroutines Requiring Additional Queue Elements —

Certain subroutines require queue elements for their proper operation. These subroutines are as follows:
IRCVD/IRCVDC/IRCVDF/IRCVDW
IREAD/IREADC/IREADF/IREADW
ISCHED
ISDAT/ISDATC/ISDATF/ISDATW
ISLEEP
ISPFN/ISPFNC/ISPFNF/ISPFNW
ITIMER
ITWAIT
IUNTL
IWRITC/IWRITE/IWRITF/IWRITW
MRKT
MWAIT

One queue element per job is automatically allocated. Issuing more than one request from the list requires extra queue elements. Additional queue elements can be allocated through a call to the IQSET function.

1.2.1.7 System Restriction — The following restrictions must be considered when coding a FORTRAN program that uses SYSLIB.

1. Programs using IPEEK, IPOKE, IPEEKB, IPOKEB, or ISPY to access system-specific addresses, such as FORTRAN, monitor, or hardware addresses, are not guaranteed to run under future releases or on different configurations. When using these functions, you should document their use precisely so that you can check your references against the current documentation. Also, these routines may act differently under the XM monitor. NOTE: IPEEK and IPOKE are not equivalent to the programmed requests .PEEK and .POKE.

2. Various functions in SYSLIB return values that are of type integer, real, and double precision. If you specify an implicit statement that changes the defaults for external function types, you must explicitly declare the type of those SYSLIB functions that return integer or real results. You must also be sure that the arguments to the SYSLIB routines are the correct type for the routine. Double-precision functions must always be declared to be type DOUBLE PRECISION (or REAL*8). Failure to observe this restriction leads to unpredictable results.

3. All names of completion routines external to the routine being coded that are passed to scheduling calls (such as ISCHED, ITIMER, and IREADC) must be specified in an EXTERNAL statement in the FORTRAN program issuing the call.

4. Certain arguments to SYSLIB calls must be located in such a manner as to prohibit the RT-11 User Service Routine (USR) from swapping over them at execution time. This kind of swapping can occur when the OTS$1 section (which contains the all-pure code and data for the module) is less than 2K words in length. Swapping in this uncommon situation can be avoided either by typing the SET USR NOSWAP command to make the USR resident before starting the job, or by compiling the
mainline routine with a /NOSWAP option. You can also use the linker /BOUNDARY option to make OTS$O start at word boundary 11000 (octal). (This problem generally occurs only with small FORTRAN programs.)

In FORTRAN IV, program sections (PSECTs) are used to collect code and data into appropriate areas of memory. If the RT–11 USR is needed and is not resident, it swaps over a FORTRAN program starting at the symbol OTS$1 for 2K words of memory.

5. Certain restrictions apply when using completion or interrupt routines. See Section 1.2.1.2 for a description of these restrictions.

6. Unless explicitly stated, null arguments should not be used in calls to SYSLIB routines.

7. If several arguments to a call are listed as being optional, they must either be all present or all omitted.

### 1.2.2 Calling SYSLIB Subroutines

SYSLIB includes both function subprograms and callable subroutines, which are called in the same manner as user-written subroutines.

Function subprograms receive control by means of a function reference as follows:

\[
i = \text{function name } ((\text{arguments}))
\]

The returned function value may be an error code, or it may be information that is useful to the calling routine. See the description of the particular function for the meaning of the returned function value.

Call subroutines are invoked by means of a CALL statement as follows:

\[
\text{CALL subroutine name } ((\text{arguments}))
\]

All subroutines in SYSLIB can be called as FUNCTION programs if a return value is desired, or as SUBROUTINE programs if no return value is desired. For example, the LOCK subroutine can be referenced as either

\[
\text{CALL LOCK}
\]

or

\[
I = \text{LOCK( )}
\]

Some subroutines have two acceptable formats. For example, the subroutine CLOSEC can also be specified as ICLOSE because error codes are returned by the subroutine and require an integer return to be useful.

Quoted-string literals are useful as arguments of calls to routines in SYSLIB, notably the character string routines. These literals are allowed in subroutine and function calls (see Section 1.2.7.3).
1.2.3 FORTRAN/MACRO Interface

FORTRAN calling routines and subroutines follow a well-defined set of conventions regarding transfer of control, transfer of information, memory usage, and register usage. By adhering to these conventions a MACRO programmer can write FORTRAN-callable routines such as those in SYS-LIB.

Control is transferred to a subroutine by

```
JSR PC, SUBR
```

When control passes to the subroutine SUBR, Register 5 (R5) points to an argument block that has the format shown in Figure 1–5.

**Figure 1–5: Subroutine Argument Block**

```
<table>
<thead>
<tr>
<th>R5 =&gt;</th>
<th></th>
<th>No. of arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Address of Argument 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Address of Argument 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Address of Argument n</td>
<td></td>
</tr>
</tbody>
</table>
```

Null arguments in CALL statements must be entered with successive commas, for example, CALL SUBR (A,,B). The value -1 is stored in the argument block as the address of a null argument.

The lower byte of the first word of the argument block contains the number of arguments that are passed to the subroutine. The rest of the argument block contains the addresses of those arguments. The argument block is \( n + 1 \) words long for \( n \) arguments.

The program counter is the linkage register. The subroutine obtains its arguments through R5. In FORTRAN, the calling program saves the registers, and the subroutine leaves the contents of the stack pointer intact before returning to the calling program. The RETURN statement of the subroutine is replaced by

```
RTS PC
```
The name of the subroutine must be declared global with the .GLOBL directive in the calling program or with the double colon (::) construction in the called program.

**NOTE**

You must make sure that the called program does not modify the argument block passed by the calling program to a subprogram.

1.2.3.1 **Subroutine Register Usage** — A subroutine that is called by a FORTRAN program does not have to preserve any registers. However, each push onto the stack must be matched by a pop off the stack before exiting from the routine.

User-written assembly language programs must preserve any pertinent registers before calling FORTRAN subprograms or SYSLIB routines. They must then restore registers after the subroutine returns.

Function subroutines return a single result in a register. Table 1–7 shows the register assignments for returning the different variable types.

**Table 1–7: Return Value Conventions for Function Subroutines**

<table>
<thead>
<tr>
<th>Type</th>
<th>Result Placed In</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTEGER*2</td>
<td>R0</td>
</tr>
<tr>
<td>LOGICAL*1</td>
<td></td>
</tr>
<tr>
<td>INTEGER*4</td>
<td>R0  low-order result</td>
</tr>
<tr>
<td>LOGICAL*4</td>
<td>R1  high-order result</td>
</tr>
<tr>
<td>REAL</td>
<td>R0  high-order result (including sign and exponent)</td>
</tr>
<tr>
<td></td>
<td>R1  low-order result</td>
</tr>
<tr>
<td>DOUBLE PRECISION</td>
<td>R0  highest-order result (including sign and exponent)</td>
</tr>
<tr>
<td></td>
<td>R1  next higher order</td>
</tr>
<tr>
<td></td>
<td>R2  next higher order</td>
</tr>
<tr>
<td></td>
<td>R3  lowest-order result</td>
</tr>
<tr>
<td>COMPLEX</td>
<td>R0  high-order real result</td>
</tr>
<tr>
<td></td>
<td>R1  low-order real result</td>
</tr>
<tr>
<td></td>
<td>R2  high-order imaginary result</td>
</tr>
<tr>
<td></td>
<td>R3  low-order imaginary result</td>
</tr>
</tbody>
</table>

Note that floating-point results are returned in the general purpose registers and not in the FPU registers. Assembly language subprograms that use the FP11 Floating Point Unit may be required to save and restore the FPU status.

1.2.3.2 **FORTRAN Programs Calling MACRO Subroutines** — FORTRAN programs can call MACRO subroutines, but several rules must be followed. For example, the following program named INIARR is a MACRO subroutine that can be called from a FORTRAN program.
A FORTRAN program calls the preceding routine with

CALL INIARR (IAR,IVAL,N)

where:

INIARR is the name of the subroutine
IAR is the name of the array to initialize
IVAL is the value the array is initialized to
N is the number of elements to initialize

This program illustrates the rules that must be observed when calling a MACRO program. The name of the subroutine is made global by using the .GLOBL directive.

Register 5 (R5) is used to pass the arguments. Thus, in the program INIARR, the argument block would appear as shown in Figure 1–6.

**Figure 1–6: Argument Block for Program INIARR**

```
R5 =>

<table>
<thead>
<tr>
<th>0</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address of IAR</td>
<td></td>
</tr>
<tr>
<td>Address of IVAL</td>
<td></td>
</tr>
<tr>
<td>Address of N</td>
<td></td>
</tr>
</tbody>
</table>
```

Registers R0 through R4 can be freely used since the calling program saves them. Once the arguments are retrieved, you can also use R5.
On completion, the subroutine returns to the calling program through an RTS PC. If your MACRO program pushes data on the stack, you must make sure that all data is popped off the stack before the RTS PC is executed.

The following FORTRAN program named DOFOR calls the subroutine INIARR.

```fortran
PROGRAM DOFOR

C
INTEGER*2 ARRAY
DIMENSION ARRAY(10)
N=2
DO 20 IVAL=1,10
   CALL INIARR (ARRAY,IVAL,N)
   WRITE (5,100) (ARRAY(I),I=1,N)
20 CONTINUE
100 FORMAT (I3)
STOP
END
```

After you compile and link both programs, run the program by typing

```
.RUN DOFOR \n
```

The initialized array will be output to the terminal as follows:

```
1
1
2
2
3
3
4
4
5
5
6
6
7
7
8
8
9
9
10
10
```

1.2.3.3 MACRO Routines Calling FORTRAN Programs — If you want to call FORTRAN subroutines from a MACRO program, create a dummy main program such as

```fortran
PROGRAM FORINT
CALL CALMAC
STOP
END
```

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where CALMAC is the name of a MACRO program that can call FORTRAN or MACRO routines.

Creating a dummy program causes the FORTRAN main program to perform the initialization necessary for FORTRAN subroutines.

The following MACRO program named CALMAC calls a FORTRAN subroutine named MAXMIN.

```
.TITLE CALMAC
.GLOBL MAXMIN

CALMAC:

    MOV  #ARGBLK,R5
    JSR  PC,MAXMIN
    RTS  PC

I:
    .WORD 28,
J:
    .WORD 76,
ARGBLK:
    .WORD 2
    .WORD I
    .WORD J
.END
```

You must set up the argument block either on the stack or in a separate area in your MACRO program. You then point R5 to the top of the argument block prior to calling the FORTRAN subroutine with a JSR PC,MAXMIN. In the above program, the argument block is set up in a area of your program.

The following program named STAKEM performs the same operation as the program CALMAC, except that it places the arguments on the stack.

```
.TITLE STAKEM
.GLOBL MAXMIN,STAKEM

STAKEM:  MOV  #J,-(SP)
         MOV  #I,-(SP)
         MOV  #2,-(SP)
         MOV  SP,R5
         JSR  PC,MAXMIN
         ADD  #6,SP
         RTS  PC

I:
    .WORD 28,
J:
    .WORD 76,
.END
```

If the argument block is set up on the stack, be sure that you remove the arguments from the stack prior to the execution of the RTS PC. In general, before calling the FORTRAN subroutine, you must save all pertinent registers. You do not know which registers the FORTRAN subroutine is using. The stack pointer remains unchanged across the call.

The name of the FORTRAN subroutine that the MACRO program calls must be defined as a global. In the FORTRAN subroutine, execute normal FORTRAN statements and return to the MACRO program with a RETURN statement.
The following program is the FORTRAN subroutine MAXMIN.

```
SUBROUTINE MAXMIN(IN1,IN2)
INTEGER BIG,SMALL
IF (IN1.LT.IN2) GO TO 10
BIG=IN1
SMALL=IN2
TYPE 20,BIG
TYPE 30,SMALL
RETURN
10 BIG=IN2
SMALL=IN1
TYPE 20,BIG
TYPE 30,SMALL
20 FORMAT (' THE BIGGER NUMBER IS ',I2)
30 FORMAT (' THE SMALLER NUMBER IS ',I2)
RETURN
END
```

After assembling and linking the programs, using either the program CALMAC or STAKEEM, type

```
, RUN FORINT OK
```

The program executes as follows:

```
THE BIGGER NUMBER IS 76
THE SMALLER NUMBER IS 28
STOP --
```

1.2.4 FORTRAN Programs in a Foreground/Background Environment

FORTRAN programs can be run in a foreground/background environment, which permits efficient use of CPU execution time. (See Chapter 15 of Introduction to RT-11 for a description of running in an FB environment.) The basic steps in running FORTRAN programs that use the FB monitor are described in this section.

Before running your foreground program, you must use the LOAD command to load the device handlers required by the foreground job. The device handlers are placed in memory between RMON and the USR and KMON, which causes USR and KMON to move down in memory.

Next, you use the FRUN command to load your foreground program in memory between the device handlers and the USR, which causes the USR and KMON to move further down in memory. It is important that you allocate workspace when running a FORTRAN program in the foreground. You do this with the /BUFFER:n option of the FRUN command. Also make sure that any FORTRAN program you run in the foreground has adequate stack space. You can use one of the options supported by the linker (see the RT-11 System Utilities Manual).

The background area must be at least 4K words long to accommodate the USR and KMON. Until you run a background job with the RUN command, KMON is the background job.
When the USR is required, a 2K-word area must be set up in each job for the swapping to occur correctly — that is, there must be space for 2K words in the background area and 2K words in the foreground area. USR swapping is explained in Section 1.2.1.5.

1.2.4.1 Calculating Workspace for a FORTRAN Foreground Program — Additional workspace must be allocated in memory when running a FORTRAN program in the foreground of a foreground/background environment. For a foreground job, the space is allocated by the /BUFFER:n option of the FRUN command. (A background job uses whatever space is available between its high limit and the system's low limit.) When you allocate additional workspace in memory to run a FORTRAN program in the foreground, calculate the space required by using the following formula:

\[ n = \frac{1}{2}[504 + (35 \times N) + (R-136) + A \times 512] \]

where:

- \( n \) = number of decimal words
- \( A \) = the maximum number of files open at any one time. If double buffering is used, \( A \) should be multiplied by 2
- \( N \) = the maximum number of simultaneously open channels (logical unit numbers); the default is 6
- \( R \) = maximum formatted record length; the default is 136 characters

This formula must be modified for certain SYSLIB functions.

The IQSET function requires the formula to include additional space for queue elements (qcount) as follows:

\[ n = \frac{1}{2}[504 + (35 \times N) + (R-136) + A \times 512] + [10 \times qcount] \]

The ICDFN function requires the formula to include additional space for the integer number of channels (num) as follows:

\[ n = \frac{1}{2}[504 + (35 \times N) + (R-136) + A \times 512] + [6 \times \text{num}] \]

The INTSET function requires the formula to include additional space for the number of INTSET calls issued in the program as follows:

\[ n = \frac{1}{2}[504 + (35 \times N) + (R-136) + A \times 512] + [25 \times \text{INTSET}] \]

Any calls, including INTSET, that invoke completion routines must include 64(decimal) words plus the number of words needed to allocate the second record buffer (default is 68(decimal) words). The length of the record buffer is controlled by the /RECORD option to the FORTRAN compiler. If the /RECORD option is not used, the allocation in the formula must be 136(decimal) bytes, or the length that was set at FORTRAN installation time. This modifies the formula as follows:

\[ n = \frac{1}{2}[504 + (35 \times N) + (R-136) + A \times 512] + [64 + R/2] \]
If the /BUFFER option does not allocate enough space in the foreground on the initial call to a completion routine, the following message appears:

?Err 0 Non-FORTRAN error call

This message also appears if there is not enough free memory for the background job or if a completion routine in the single-job monitor is activated during another completion routine. In the latter case, the job aborts; you should use the FB monitor to run multiple active completion routines.

1.2.4.2 Running a FORTRAN Program in a Foreground/Background Environment — This section briefly describes the procedure for running two FORTRAN programs, one in the background and one in the foreground.

The background program named BACK is as follows:

```
PROGRAM BACKGROUND
IMPLICIT INTEGER(0)
CALL IPOKE("44","10000,OR, IPEEK("44))
100 CALL PRINT('HELLO FROM THE BACKGROUND')
   ICHAR=ITINIR()
   OCHAR=ITTOUR(CHAR)
   GO TO 100
END
```

This program prints the message "HELLO FROM THE BACKGROUND" and will print the message each time you input a character at the terminal.

The foreground program named FORE is as follows:

```
PROGRAM FOREGROUND
IMPLICIT INTEGER(0)
CALL IPOKE("44","10000, OR, IPEEK("44))
100 CALL PRINT('HELLO FROM THE FOREGROUND')
   ICHAR=ITINIR()
   OCHAR=ITTOUR(CHAR)
   GO TO 100
END
```

After compiling both programs, link them. Link the foreground program using the LINK command with the /FOREGROUND option. This option produces a relocatable load module with a .REL file type. For example,

```
.LINK/FOREGROUND FORE
```

Then you can assign the device that will be used for the output of the foreground program. You must also load into memory the peripheral device handlers needed by the foreground program.

The command FRUN loads and starts execution of a .REL program as the foreground job. If the command

```
FRUN FORE
```

is typed at this point, the error message

```
?Err 62 FORTRAN start fail
```

will be displayed. This message indicates that additional workspace allocation is required and that the /BUFFER option must be used. (Refer to the
previous section for the formula to calculate the additional space needed.) Thus, the command would be typed as follows:

```.RUN FORE/BUFFER:760```

Execution of this command results in the following output at the terminal:

```
F>
HELLO FROM THE FOREGROUND
```

```
B>
```

The system first identifies the message as foreground output. Then the foreground job executes and outputs its message. The background monitor next prints the characters B> and a period, indicating that control has returned to monitor command mode. Command input remains directed to the background job. By typing

```.RUN BACK```

the message from the background job will be displayed

```
HELLO FROM THE BACKGROUND
```

Each time a character is input to the terminal, say an "L", the message will be repeated.

```
HELLO FROM THE BACKGROUND
```

Use the CTRL/F command to direct terminal input to the foreground job. The system prints F> to remind you that you are now directing input to the foreground job. When you type a character, such as "Y", the foreground job message will be displayed.

```
F>
YHELLO FROM THE FOREGROUND
```

Type a CTRL/B to return to the background job or a CTRL/C to return to monitor command mode. If you are returning to a background environment, you should unload the foreground job and any handlers to reclaim memory space for background use.

### 1.2.5 Linking with FORLIB

Normally, the default system library file (SYSLIB.OBJ) also includes the overlay handlers and the appropriate FORTRAN run-time system routines.

To add FORLIB.OBJ modules to the default library SYSLIB.OBJ, use the following command:

```
.LIBRARY/INSERT/REMOVE SYSLIB FORLIB
Global? #OVRH
Global? #
```

### 1.2.6 SYSLIB Services Not Provided by Programmed Requests

SYSLIB provides many services that are not provided by programmed requests. Such services are as follows:
• Time conversion and date access
• Program suspension
• Two-word integer support (INTEGER*4)
• Radix–50 conversion
• Character string manipulation

1.2.6.1 Time Conversion and Date Access — Several calls allow you to perform time conversions and access the system date.

You use the CVTTIM call to convert a two-word internal format time to hours, minutes, seconds, and ticks. The JTIME call converts a time given in hours, minutes, seconds, and ticks into the internal two-word time format.

If you need to print out the time, the TIMASC call converts the time returned by the .GTIM programmed request into an eight-character ASCII string; the TIME call returns the current time of day as an eight-character ASCII string.

The current system date can be accessed by your program with a DATE call. The date is returned as a string value. IDATE performs similarly, but returns an integer value. DATE and IDATE are part of FORLIB.OBJ.

1.2.6.2 Program Suspension — You suspend execution of a running program for a specified number of ticks with the ITWAIT call. You use the ISLEEP call to suspend a running program for a specified number of hours, minutes, seconds, and ticks. The IUNITIL call allows you to suspend job execution until a specific time of day, which is given to the routine in hours, minutes, seconds, and ticks. You can use this function to periodically collect data and to stop processing between acquisitions.

1.2.6.3 Two-Word Integer Support (INTEGER*4) — You can make calls to SYSLIB to manipulate a 32-bit integer that uses two words of storage. The first word contains the low-order part of the value and the second word contains the sign and the high-order part of the value. The range of numbers that is represented is $-2^{31}$ to $2^{31} - 1$. This format differs from the two-word internal time format that stores the high-order part of the value in the first word and the low-order part in the second word. Table 1–8 shows the calls that you can use to convert from one format to another.

Table 1–8: SYSLIB Conversion Calls

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Call</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTEGER*2 (16-bit integer)</td>
<td>INTEGER*4</td>
<td>JICVT</td>
</tr>
<tr>
<td>INTEGER*4 (32-bit integer)</td>
<td>INTEGER*2</td>
<td>LICVT</td>
</tr>
<tr>
<td>INTEGER*4</td>
<td>REAL*4</td>
<td>AJFLT/IAJFLT</td>
</tr>
<tr>
<td>INTEGER*4</td>
<td>REAL*8</td>
<td>DJFLT/IDJFLT</td>
</tr>
<tr>
<td>REAL*4 (2-word floating point)</td>
<td>INTEGER*2</td>
<td>JAFIX</td>
</tr>
<tr>
<td>REAL*8 (4-word floating point)</td>
<td>INTEGER*4</td>
<td>JDFIX</td>
</tr>
</tbody>
</table>
Calls are also available for you to perform arithmetic operations on INTEGER*4 values, move a value to a variable, and convert a two-word internal time format to and from an INTEGER*4 value.

1.2.6.4 Radix–50 Conversion — You can convert ASCII characters to or from Radix–50.

IRAD50 converts a specified number of characters of Radix–50 and returns the number of characters converted as a function result. RAD50 encodes RT–11 file descriptors in Radix–50 notation. R50ASC converts a specified number of Radix–50 characters to ASCII.

1.2.6.5 Character String Operations — SYSLIB provides character string functions that perform string operations such as concatenation, comparison, copying, replacing, and computing the number of characters in a string. For example, the following program will concatenate two character strings.

```
.TITLE GETTOO
.GLOBL CONCAT
.MCALL .PRINT,.EXIT

START:   MOV    #ARGBLK,R5
          JSR    PC,CONCAT
          .PRINT  #STRCON
          .EXIT

ARGBLK:  .WORD 3
          .WORD STRNG1
          .WORD STRNG2
          .WORD STRCON

STRNG1:  .ASCIZ /RESEARCH AND/

STRNG2:  .ASCIZ /DEVELOPMENT/

STRCON:  .BLK0 31
          .EVEN
          .END START
```

Running this program results in the concatenation of string 1 and string 2, and the output at the terminal is

```
RESEARCH AND DEVELOPMENT
```

The following section describes character string functions in detail.

1.2.7 Character String Functions

The SYSLIB character string functions and routines provide variable-length string support for RT–11 FORTRAN and for MACRO programs. SYSLIB calls perform the following character string operations:

<table>
<thead>
<tr>
<th>Call</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GETSTR</td>
<td>Reads character strings from a specified FORTRAN logical unit</td>
</tr>
<tr>
<td>PUTSTR</td>
<td>Writes character strings to a specified FORTRAN logical unit</td>
</tr>
<tr>
<td>CONCAT</td>
<td>Concatenates variable-length strings</td>
</tr>
</tbody>
</table>
INDEX  Returns the position of one string in another
INSERT  Inserts one string into another
LEN  Returns the length of a string
REPEAT  Repeats a character string
SCOMP  Compares two strings
SCOPY  Copies a character string
STRPAD  Pads a string with blanks on the right
SUBSTR  Copies a substring from a string
TRANS  Performs character modification
TRIM  Removes trailing blanks
VERIFY  Verifies the presence of characters in a string

Strings are stored in LOGICAL*1 arrays that you define and dimension. These arrays store strings in ASCII format as one character per array element plus a zero element to indicate the current end of the string.

The length of a string can vary at execution time from zero characters to one less than the size of the array that stores the string. The maximum size of any string is 32767 characters. Strings can contain any of the seven-bit ASCII characters except null(0), since the null character is used to mark the end of the string. The inclusion of a terminating zero byte constitutes an "ASCIZ" format, which is the format set up by a MACRO assembler directive .ASCIZ. This directive automatically sets up strings with a terminating zero byte. Bit 7 of each character must be cleared. Therefore, the valid characters are those whose decimal representations range from 1 to 127, inclusive.

The ASCII code used in this string package is the same as that employed by FORTRAN for A-type FORMAT items, ENCODE/DECODE strings, and object-time format strings. Whenever quoted strings are used as arguments in the CALL statement, ASCIZ strings are generated for these routines by the FORTRAN compiler. Note that a null string (a string containing no characters) can be represented in FORTRAN by a variable or constant of any type that contains the value zero, or by a LOGICAL variable or constant with the .FALSE. value.

In many routines, it is difficult to predict the length of the string produced. To prevent a string from overflowing the array that contains it, you can specify an optional integer argument to the subroutine. This argument, called len, limits the length of an output string to the value specified for len plus one (for the null terminator), so that the array receiving the result must be at least len plus one elements in size.

NOTE
If the string is larger than the array, other data may be destroyed and cause unpredictable results.
When `len` is specified, you can also include the optional argument called `err`. `Err` is a logical variable that should be initialized by the FORTRAN program to the .FALSE. value. If a string function is given the arguments `len` and `err`, and `len` is actually used to limit the length of the string result, then `err` is set to the .TRUE. value. If `len` is not used to truncate the string, `err` is unchanged — that is, it retains a .FALSE. value.

The argument `len` can appear alone. However, `len` must appear if `err` is specified. The `err` argument should be used for GETSTR and PUTSTR.

Several routines use the concept of character position. Each character in a string is assigned a position number. The first character in a string is in position one. Each subsequent character has a position number one greater than the character that precedes it.

### 1.2.7.1 Allocating Character String Variables

A one-dimensional LOGICAL*1 array can contain a single string whose length can vary from zero characters to one fewer than the dimensioned length of the array. For example,

```fortran
LOGICAL*1 A(45)  ! ALLOCATE SPACE FOR STRING VARIABLE A
```

allows array A to be used as a string variable that can contain a string of 44 or fewer characters. Similarly, a two-dimensional LOGICAL*1 array can be used to contain a one-dimensional array of strings. Each string in the array can have a length up to one less than the first dimension of the LOGICAL*1 array. There can be as many strings as the number specified for the second dimension of the LOGICAL*1 array. For example,

```fortran
LOGICAL*1 W(21,10)  ! ALLOCATE AN ARRAY OF STRINGS
```

creates string array W that has ten string elements, each of which can contain up to 20 characters. String I in array W is referenced in subroutine or function calls as W(I,I).

The following example allocates a two-dimensional string array.

```fortran
LOGICAL*1 T(14,5,7)  ! ALLOCATE A 5 BY 7 ARRAY OF 13-CHARACTER STRING
```

Each string in array T may vary in length to a maximum of 13 characters. String I,J of the array can be referenced as T(I,J). Note that T is the same as T(1,1,1). This dimensioning process can create string arrays of up to six dimensions (represented by LOGICAL*1 arrays of up to seven dimensions).

### 1.2.7.2 Passing Strings to Subprograms

There are three ways to pass strings to subprograms.

1. LOGICAL*1 arrays that contain strings can be placed in a COMMON block and referenced by any or all routines with a similar common declaration. However, when you place a LOGICAL*1 array in a common block, make sure that the array is even in length, that odd-length arrays are paired to result in an overall even length, or that the strings are together as the last elements in the COMMON block. Otherwise, all
succeeding variables in the COMMON block may be assigned odd addresses.

A LOGICAL*1 array has an odd length only if the product of its dimensions is odd. For example,

\[
\begin{align*}
&\text{LOGICAL*1 B(10,7)} \quad ! (10*7) = 70 \text{; EVEN LENGTH} \\
&\text{LOGICAL*1 H(21)} \quad ! 21 \text{ IS AN ODD LENGTH}
\end{align*}
\]

These might be handled as follows:

\[
\begin{align*}
&\text{COMMON A1, A2, A3(10), H(21)} \quad ! \text{PLACE ODD-SIZED ARRAY AT END} \\
or \\
&\text{COMMON A1, A2, H(21), H1(7), A3(10)} \quad ! \text{PAIR ODD-SIZE ARRAYS H AND H1}
\end{align*}
\]

These restrictions apply only to LOGICAL*1 variables and arrays.

2. A single string can be passed by using its array name as an argument. For example,

\[
\begin{align*}
&\text{LOGICAL*1 A(21)} \quad ! \text{STRING VARIABLE A, 20 CHARACTERS MAXIMUM} \\
&\text{CALL SUBR(A)}
\end{align*}
\]

passes string A to subroutine SUBR.

3. If the calling program has declared a multidimensional array, and only one string of that array is to be passed to a subroutine, then the subroutine call should specify the first element of the string to be passed (this requires that the first dimension of the array equals the maximum length of each string).

For example,

\[
\begin{align*}
&\text{LOGICAL*1 NAMES (B1,20)} \quad ! 20 \text{ NAMES, 80 CHARACTERS EACH} \\
&\text{LOGICAL*1 ERR} \\
&\text{DO 10 NUMNUM=1,20} \quad ! \text{GET ALL 20 NAMES} \\
&\text{10 CALL GETSTR (S,NAMES(1,NUMNUM),B0,EXPR) FROM TT}
\end{align*}
\]

If the maximum length of a string argument is unknown in a subroutine or function, or if the routine is used to handle many different lengths, the dummy argument in the routine should be declared as a LOGICAL*1 array with a dimension of one, such as LOGICAL*1 ARG(1). In this case, the string routines correctly determine the length of ARG whenever it is used, but it is not possible to determine the maximum size of any string that can be stored in ARG. If a multidimensional array of strings is passed to a routine, it must be declared in the called program with the same dimensions that were specified in the calling program.

**NOTE**

The length argument specified in many of the character string functions refers to the maximum length of the string excluding the necessary null byte terminator. The length of the LOGICAL*1 array to receive the string must be at least one greater than the length argument.
1.2.7.3 Using Quoted-String Literals — You can use quoted strings as arguments to any of the string routines that are invoked as functions or with the CALL statement. For example,

```
CALL SCOMP(NAME,'SMYTHE,R,M)
```

compares the string in the array NAME to the constant string SMYTHE, R and sets the value of the integer variable accordingly.

1.2.8 System Subroutine Summary

Table 1–9 lists the SYSLIB subroutines alphabetically within categories, the sections in which they are located, and a brief description of each subroutine. Those subroutines prefixed with an asterisk (*) are allowed only in a foreground/background environment, under either the FB or XM monitor. The SYSLIB subroutines do not support the XM monitor mapping programmed requests. Use FORTRAN virtual arrays to access extended memory.

**Table 1–9: Summary of SYSLIB Subroutines**

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>File-Oriented Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLOSEC, ICLOSE</td>
<td>3.3</td>
<td>Closes the specified channel.</td>
</tr>
<tr>
<td>IDELET</td>
<td>3.22</td>
<td>Deletes a file from the specified device.</td>
</tr>
<tr>
<td>IENTER</td>
<td>3.25</td>
<td>Creates a new file for output.</td>
</tr>
<tr>
<td>IFPROT</td>
<td>3.27</td>
<td>Changes the file’s protection.</td>
</tr>
<tr>
<td>IRENAM</td>
<td>3.46</td>
<td>Changes the name of the indicated file.</td>
</tr>
<tr>
<td>ISFDAT</td>
<td>3.53</td>
<td>Changes the file’s creation date.</td>
</tr>
<tr>
<td>LOOKUP</td>
<td>3.79</td>
<td>Opens an existing file for input and/or output via the specified channel.</td>
</tr>
<tr>
<td>Data Transfer Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IABTIO</td>
<td>3.12</td>
<td>Aborts I/O operations on a specified channel.</td>
</tr>
<tr>
<td>GTLIN</td>
<td>3.11</td>
<td>Transfers a line of input from the console terminal or indirect file (if active) to the user program.</td>
</tr>
<tr>
<td>*IRCVD</td>
<td>3.44</td>
<td>Receives data. Allows a job to read messages or data sent by another job in an FB environment. The four modes correspond to the IREAD, IREADC, IREADF, and IREADW modes.</td>
</tr>
<tr>
<td>*IRCVD C</td>
<td>3.44</td>
<td>Receives data. Allows a job to read messages or data sent by another job in an FB environment. The four modes correspond to the IREAD, IREADC, IREADF, and IREADW modes.</td>
</tr>
<tr>
<td>*IRCVD F</td>
<td>3.44</td>
<td>Receives data. Allows a job to read messages or data sent by another job in an FB environment. The four modes correspond to the IREAD, IREADC, IREADF, and IREADW modes.</td>
</tr>
<tr>
<td>*IRCVD W</td>
<td>3.44</td>
<td>Receives data. Allows a job to read messages or data sent by another job in an FB environment. The four modes correspond to the IREAD, IREADC, IREADF, and IREADW modes.</td>
</tr>
<tr>
<td>IREAD</td>
<td>3.45</td>
<td>Transfers data from a file to a memory buffer and returns control to the user program when the request is entered in the I/O queue. No special action is taken upon completion of I/O.</td>
</tr>
</tbody>
</table>

* FB and XM monitors only.  
(continued on next page)
<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IREADC</td>
<td>3.45</td>
<td>Transfers data from a file to a memory buffer and returns control to the user program when the request is entered in the I/O queue. Upon completion of the read, control transfers to the assembly language routine specified in the IREADC function call.</td>
</tr>
<tr>
<td>IREADF</td>
<td>3.45</td>
<td>Transfers data from a file to a memory buffer and returns control to the user program when the request is entered in the I/O queue. Upon completion of the read, control transfers to the FORTRAN subroutine specified in the IREADF function call.</td>
</tr>
<tr>
<td>IREADW</td>
<td>3.45</td>
<td>Transfers data from a file to a memory buffer and returns control to the program only after the transfer is complete.</td>
</tr>
<tr>
<td>*ISDAT</td>
<td>3.51</td>
<td>Allows the user to send messages or data to the other job in an FB environment. The four functions correspond to the IWRITE, IWRITC, IWRTF, and IWRTW modes.</td>
</tr>
<tr>
<td>*ISDATC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*ISDATF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*ISDATW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ITTINR</td>
<td>3.59</td>
<td>Gets one character from the console keyboard.</td>
</tr>
<tr>
<td>ITTOUR</td>
<td>3.60</td>
<td>Transfers one character to the console terminal.</td>
</tr>
<tr>
<td>IWAIT</td>
<td>3.64</td>
<td>Waits for completion of all I/O on a specified channel (commonly used with the IREAD and IWRITE functions).</td>
</tr>
<tr>
<td>IWRITC</td>
<td>3.65</td>
<td>Transfers data to a file and returns control to the user program when the request is entered in the I/O queue. Upon completion of the write, control transfers to the assembly language routine specified in the IWRITC function call.</td>
</tr>
<tr>
<td>IWRITE</td>
<td>3.65</td>
<td>Transfers data to a file and returns control to the user program when the request is entered in the I/O queue. No special action is taken upon completion of the I/O.</td>
</tr>
<tr>
<td>IWRTF</td>
<td>3.65</td>
<td>Transfers data to a file and returns control to the user program when the request is entered in the I/O queue. Upon completion of the write, control transfers to the FORTRAN subroutine specified in the IWRTF function call.</td>
</tr>
<tr>
<td>IWRTW</td>
<td>3.65</td>
<td>Transfers data to a file and returns control to the user program only after the transfer is complete.</td>
</tr>
<tr>
<td>†MTATCH</td>
<td>3.81</td>
<td>Attaches a particular terminal in a multiterminal environment.</td>
</tr>
<tr>
<td>†MTDTCH</td>
<td>3.82</td>
<td>Detaches a particular terminal in a multiterminal environment.</td>
</tr>
<tr>
<td>†MTGET</td>
<td>3.83</td>
<td>Provides information about a particular terminal in a multiterminal system.</td>
</tr>
<tr>
<td>†MTIN</td>
<td>3.84</td>
<td>Transfers characters from a specific terminal to the user program in a multiterminal system.</td>
</tr>
<tr>
<td>†MTOUT</td>
<td>3.85</td>
<td>Transfers characters to a specific terminal in a multiterminal system.</td>
</tr>
<tr>
<td>†MTPRNT</td>
<td>3.86</td>
<td>Prints a message to a specific terminal in a multiterminal system.</td>
</tr>
</tbody>
</table>

† With multiterminal support only.
* FB and XM monitors only.

(continued on next page)
Table 1–9: Summary of SYSLIB Subroutines (Cont.)

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>†MTRCTO</td>
<td>3.87</td>
<td>Enables output to terminal by canceling the effect of a previously typed CTRL/O.</td>
</tr>
<tr>
<td>†MTSET</td>
<td>3.88</td>
<td>Sets terminal and line characteristics in a multiterminal system.</td>
</tr>
<tr>
<td>†MTSTAT</td>
<td>3.89</td>
<td>Returns multiterminal system status.</td>
</tr>
<tr>
<td>*MWAIT</td>
<td>3.90</td>
<td>Waits for messages to be processed.</td>
</tr>
<tr>
<td>PRINT</td>
<td>3.91</td>
<td>Outputs an ASCII string to the console terminal.</td>
</tr>
</tbody>
</table>

Channel-Oriented Operations

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICFN</td>
<td>3.16</td>
<td>Defines additional I/O channels.</td>
</tr>
<tr>
<td>*ICHCPY</td>
<td>3.17</td>
<td>Allows access to files currently open in another job’s envi-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ronment.</td>
</tr>
<tr>
<td>ICSTAT</td>
<td>3.21</td>
<td>Returns the status of a specified channel.</td>
</tr>
<tr>
<td>IFREEC</td>
<td>3.28</td>
<td>Returns the specified RT–11 channel to the available pool of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>channels for the FORTRAN I/O system.</td>
</tr>
<tr>
<td>IGETC</td>
<td>3.29</td>
<td>Allocates an RT–11 channel and informs the FORTRAN I/O system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of its use.</td>
</tr>
<tr>
<td>ILUN</td>
<td>3.33</td>
<td>Returns the RT–11 channel number with which a FORTRAN logical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>unit is associated.</td>
</tr>
<tr>
<td>IREOPN</td>
<td>3.47</td>
<td>Restores the parameters stored via an ISAVES function and re-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>opens the channel for I/O.</td>
</tr>
<tr>
<td>ISAVES</td>
<td>3.48</td>
<td>Stores five words of channel status information into a user-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>specified array and deactivates the channel.</td>
</tr>
<tr>
<td>PURGE</td>
<td>3.92</td>
<td>Deactivates a channel.</td>
</tr>
</tbody>
</table>

Device and File Specifications

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IASIGN</td>
<td>3.15</td>
<td>Sets information in the FORTRAN logical unit table.</td>
</tr>
<tr>
<td>ICSI</td>
<td>3.20</td>
<td>Calls the RT–11 CSI in special mode to decode file specifications and options.</td>
</tr>
</tbody>
</table>

Timer Support Operations

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVTTIM</td>
<td>3.5</td>
<td>Converts a two-word internal format time to hours, minutes,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>seconds, and ticks.</td>
</tr>
<tr>
<td>GTIM</td>
<td>3.9</td>
<td>Gets time of day.</td>
</tr>
<tr>
<td>ICMKT</td>
<td>3.19</td>
<td>Cancels an unexpired ISCHED, ITIMER, or MRKT request (valid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>under FB and XM, and for SJ monitors with timer support, a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SYSGEN option).</td>
</tr>
<tr>
<td>ISCHED</td>
<td>3.49</td>
<td>Schedules the specified FORTRAN subroutine to be entered at</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the specified time of day as an asynchronous completion routine (valid under FB and XM, and for SJ monitors with timer support, a special feature).</td>
</tr>
<tr>
<td>ISDITTM</td>
<td>3.52</td>
<td>Changes the system date and time.</td>
</tr>
</tbody>
</table>

† With multiterminal support only.
* FB and XM monitors only.

(continued on next page)
<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>‡ISLEEP</td>
<td>3.54</td>
<td>Suspends main program execution of the running job for a specified amount of time; completion routines continue to run.</td>
</tr>
<tr>
<td>ITIMER</td>
<td>3.57</td>
<td>Schedules the specified FORTRAN subroutine to be entered as an asynchronous completion routine when the time interval specified has elapsed (valid under FB and XM, and for SJ monitors with timer support, a special feature).</td>
</tr>
<tr>
<td>‡ITWAIT</td>
<td>3.61</td>
<td>Suspends the running job for a specified amount of time; completion routines continue to run.</td>
</tr>
<tr>
<td>‡IUNUTIL</td>
<td>3.62</td>
<td>Suspends the main program execution of the running job until a specified time of day; completion routines continue to run.</td>
</tr>
<tr>
<td>JTIME</td>
<td>3.76</td>
<td>Converts hours, minutes, seconds, and ticks into two-word internal format time.</td>
</tr>
<tr>
<td>MRKT</td>
<td>3.80</td>
<td>Schedules an assembly language routine to be activated as an asynchronous completion routine after a specified interval (valid under FB and XM, and for SJ monitors with timer support, a special feature).</td>
</tr>
<tr>
<td>SECNDS</td>
<td>3.103</td>
<td>Returns the current system time in seconds past midnight minus the value of a specified argument.</td>
</tr>
<tr>
<td>TIMASC</td>
<td>3.108</td>
<td>Converts a specified two-word internal format time into an eight-character ASCII string.</td>
</tr>
<tr>
<td>TIME</td>
<td>3.109</td>
<td>Returns the current system time of day as an eight-character ASCII string.</td>
</tr>
</tbody>
</table>

**RT–11 Services**

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAIN</td>
<td>3.2</td>
</tr>
<tr>
<td>*DEVIcE</td>
<td>3.6</td>
</tr>
<tr>
<td>GTJB,GTJJB</td>
<td>3.10</td>
</tr>
<tr>
<td>IDSTAT</td>
<td>3.24</td>
</tr>
<tr>
<td>IFETCH</td>
<td>3.26</td>
</tr>
<tr>
<td>IQSET</td>
<td>3.42</td>
</tr>
<tr>
<td>ISPFN</td>
<td>3.55</td>
</tr>
<tr>
<td>ISPPCN</td>
<td></td>
</tr>
<tr>
<td>ISPFNF</td>
<td></td>
</tr>
<tr>
<td>ISPPNW</td>
<td></td>
</tr>
<tr>
<td>*ITLOCK</td>
<td>3.58</td>
</tr>
<tr>
<td>LOCK</td>
<td>3.78</td>
</tr>
</tbody>
</table>

‡ SYSGEN option in SJ monitor.
* FB and XM monitors only.

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### Table 1-9: Summary of SYSLIB Subroutines (Cont.)

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCHAIN</td>
<td>3.96</td>
<td>Allows a program to access variables passed across a chain.</td>
</tr>
<tr>
<td>RCTRL0</td>
<td>3.97</td>
<td>Enables output to the terminal by canceling the effect of a previously typed CTRL/O.</td>
</tr>
<tr>
<td>*RESUME</td>
<td>3.99</td>
<td>Causes the main program execution of a job to resume at the point it was suspended by a SUSPEND function call.</td>
</tr>
<tr>
<td>SCCA</td>
<td>3.100</td>
<td>Intercepts a CTRL/C command initiated at the console terminal.</td>
</tr>
<tr>
<td>SETCMD</td>
<td>3.104</td>
<td>Passes command lines to the keyboard monitor for execution after the program exits.</td>
</tr>
<tr>
<td>*SUSPEND</td>
<td>3.107</td>
<td>Suspends main program execution of the running job; completion routines continue to execute.</td>
</tr>
<tr>
<td>UNLOCK</td>
<td>3.112</td>
<td>Releases the USR if a LOCK was performed; the user program is swapped in if required.</td>
</tr>
</tbody>
</table>

**INTEGER*4 Support Functions**

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AJFLT</td>
<td>3.1</td>
<td>Converts a specified INTEGER<em>4 value to REAL</em>4 and returns the result as the function value.</td>
</tr>
<tr>
<td>DJFLT</td>
<td>3.7</td>
<td>Converts a specified INTEGER<em>4 value to REAL</em>8 and returns the result as the function value.</td>
</tr>
<tr>
<td>IAJFLT</td>
<td>3.14</td>
<td>Converts a specified INTEGER<em>4 value to REAL</em>4 and stores the result.</td>
</tr>
<tr>
<td>IDJFLT</td>
<td>3.23</td>
<td>Converts a specified INTEGER<em>4 value to REAL</em>8 and stores the result.</td>
</tr>
<tr>
<td>IJCVT</td>
<td>3.32</td>
<td>Converts a specified INTEGER<em>4 value to INTEGER</em>2.</td>
</tr>
<tr>
<td>JADD</td>
<td>3.66</td>
<td>Computes the sum of two INTEGER*4 values.</td>
</tr>
<tr>
<td>JAFIX</td>
<td>3.67</td>
<td>Converts a REAL<em>4 value to INTEGER</em>4.</td>
</tr>
<tr>
<td>JCMP</td>
<td>3.68</td>
<td>Compares two INTEGER<em>4 values and returns an INTEGER</em>2 value that reflects the signed comparison result.</td>
</tr>
<tr>
<td>JDFIX</td>
<td>3.69</td>
<td>Converts a REAL<em>8 value to INTEGER</em>4.</td>
</tr>
<tr>
<td>JDIV</td>
<td>3.70</td>
<td>Computes the quotient and remainder of two INTEGER*4 values.</td>
</tr>
<tr>
<td>JICVT</td>
<td>3.71</td>
<td>Converts an INTEGER<em>2 value to INTEGER</em>4.</td>
</tr>
<tr>
<td>JJCVT</td>
<td>3.72</td>
<td>Converts the two-word internal time format to INTEGER*4 format, and vice versa.</td>
</tr>
<tr>
<td>JMOV</td>
<td>3.73</td>
<td>Assigns an INTEGER*4 value to a variable.</td>
</tr>
<tr>
<td>JMUL</td>
<td>3.74</td>
<td>Computes the product of two INTEGER*4 values.</td>
</tr>
<tr>
<td>JSUB</td>
<td>3.75</td>
<td>Computes the difference between two INTEGER*4 values.</td>
</tr>
</tbody>
</table>

* FB and XM monitors only. (continued on next page)
Table 1-9: Summary of SYSLIB Subroutines (Cont.)

<table>
<thead>
<tr>
<th>Character String Functions</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONCAT</td>
<td>3.4</td>
<td>Concatenates two variable-length strings.</td>
</tr>
<tr>
<td>GETSTR</td>
<td>3.8</td>
<td>Reads a character string from a specified FORTRAN logical unit.</td>
</tr>
<tr>
<td>INDEX</td>
<td>3.34</td>
<td>Returns the location in one string of the first occurrence of another string</td>
</tr>
<tr>
<td>INSERT</td>
<td>3.35</td>
<td>Replaces a portion of one string with another string.</td>
</tr>
<tr>
<td>ISCOMP</td>
<td>3.50</td>
<td>Compares two character strings.</td>
</tr>
<tr>
<td>IVERIF</td>
<td>3.63</td>
<td>Indicates whether characters in one string appear in another.</td>
</tr>
<tr>
<td>LEN</td>
<td>3.77</td>
<td>Returns the number of characters in a specified string.</td>
</tr>
<tr>
<td>PUTSTR</td>
<td>3.93</td>
<td>Writes a variable-length character string on a specified FORTRAN logical unit.</td>
</tr>
<tr>
<td>REPEAT</td>
<td>3.98</td>
<td>Concatenates a specified string with itself to provide an indicated number of copies and stores the resultant string.</td>
</tr>
<tr>
<td>SCOMP</td>
<td>3.101</td>
<td>Compares two character strings.</td>
</tr>
<tr>
<td>SCOPY</td>
<td>3.102</td>
<td>Copies a character string from one array to another.</td>
</tr>
<tr>
<td>STRPAD</td>
<td>3.105</td>
<td>Pads a variable-length string on the right with blanks to create a new string of a specified length.</td>
</tr>
<tr>
<td>SUBSTR</td>
<td>3.106</td>
<td>Copies a substring from a specified string.</td>
</tr>
<tr>
<td>TRANSL</td>
<td>3.110</td>
<td>Replaces one string with another after performing character modification.</td>
</tr>
<tr>
<td>TRIM</td>
<td>3.111</td>
<td>Removes trailing blanks from a character string.</td>
</tr>
<tr>
<td>VERIFY</td>
<td>3.113</td>
<td>Indicates whether characters in one string appear in another.</td>
</tr>
</tbody>
</table>

Radix–50 Conversion Operations

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRAD50</td>
<td>3.43</td>
<td>Converts characters in ASCII format to Radix–50, returning the number of characters converted.</td>
</tr>
<tr>
<td>R50ASC</td>
<td>3.94</td>
<td>Converts characters in Radix–50 format to ASCII.</td>
</tr>
<tr>
<td>RAD50</td>
<td>3.95</td>
<td>Converts six ASCII characters, returning a REAL*4 result that is the two-word Radix–50 value.</td>
</tr>
</tbody>
</table>

Miscellaneous Services

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IADDR</td>
<td>3.13</td>
<td>Obtains the memory address of a specified entity.</td>
</tr>
<tr>
<td>IGETSP</td>
<td>3.30</td>
<td>Returns the address and size (in words) of free space obtained from the FORTRAN system.</td>
</tr>
<tr>
<td>INTSET</td>
<td>3.36</td>
<td>Establishes a specified FORTRAN subroutine as an interrupt service routine with a specified priority.</td>
</tr>
<tr>
<td>IPEEK</td>
<td>3.37</td>
<td>Returns the value of a word located at a specified absolute memory address.</td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPEEKB</td>
<td>3.38</td>
<td>Returns the value of a byte located at a specified byte address.</td>
</tr>
<tr>
<td>IPOKE</td>
<td>3.39</td>
<td>Stores an integer value in an absolute memory location.</td>
</tr>
<tr>
<td>IPOKEB</td>
<td>3.40</td>
<td>Stores an integer value in a specified byte location.</td>
</tr>
<tr>
<td>IPUT</td>
<td>3.41</td>
<td>Changes the value of the word located at an offset specified from the beginning of the RT-11 monitor.</td>
</tr>
<tr>
<td>ISPY</td>
<td>3.56</td>
<td>Returns the integer value of the word located at a specified offset from the beginning of the RT-11 resident monitor.</td>
</tr>
</tbody>
</table>
Chapter 2
Programmed Request Description and Examples

This chapter presents the programmed requests alphabetically, describing each one in detail and providing an example of its use in a program. Also described are macros and subroutines that are used to implement device handlers and interrupt service routines. The following parameters are commonly used as arguments in the various calls:

- **addr**: an address, the meaning of which depends on the request being used.
- **area**: a pointer to the EMT argument block for those requests that require a block.
- **blk**: a block number specifying the relative block in a file or device where an I/O transfer is to begin.
- **buf**: a buffer address specifying a memory location into which or from which an I/O transfer will be performed; this address has to be word-aligned — that is, located at an even address and not a byte or odd address.
- **cblk**: the address of the five-word block where channel status information is stored.
- **chan**: a channel number in the range 0–376(octal).
- **chrcnt**: a character count in the range 1–255(decimal).
- **code**: a flag used to indicate whether the code is to be set in an EMT 375 programmed request.
- **crtn**: the entry point of a completion routine.
- **dblk**: a four-word Radix-50 descriptor block that specifies the physical device, file name, and file type to be operated upon (see Section 1.1.2.6).
- **func**: a numerical code indicating the function to be performed.
- **jobblk**: a pointer to a three-word ASCII system job name.
- **jobdev**: a pointer to a four-word system-job descriptor where the first word is a Radix-50 device name and the next three words contain an ASCII system-job name (for keyword argument use, refer to this as a "dblk").
- **num**: a number, the value of which depends on the request.
seqnum a file number.

For cassette operation, a value of 0 is assumed if this argument is blank.

For magtape operation, this argument describes a file sequence number. The values that the argument can have are described under the applicable programmed requests.

unit the logical unit number of a particular terminal in a multiterminal system.

wcnt a word count specifying the number of words to be transferred to or from the buffer during an I/O operation.

Many programmed requests are qualified as special features. These requests are enabled only if you performed a system generation process, that is, they are not available in a distributed monitor.

2.1 .ABTIO

The .ABTIO programmed request allows a running job to stop all outstanding I/O operations on a channel without terminating the program.

When .ABTIO is issued, the handler for the device opened on the specified channel is entered at its abort entry point. After the handler abort code is executed, control returns to the user program.

This request cannot be issued from a completion routine.

Macro Call: .ABTIO chan

where:

chan is the channel number for which to abort I/O

Request Format:

R0 = [13] chan

Errors:

none

Example:

.TITLE ABTIO.MAC
!This is an example of the .ABTIO request. The .ABTIO request
!is useful for immediately terminating READC/WRITE or READ/
!WRITE I/O on a particular channel without issuing a .EXIT or
!HRESET which would terminate the program or stop I/O on all
!channels.

.MCALL .ABTIO, .ENTER, .SCCA

START: .SCCA #AREA#CTCWRO
      .ENTER #AREA#I#FILNAM

      !Inhibit CTRL/C
      !Open channel 1 as output file

IDLOOP:

      !Perform I/O to the file...
2.2 .ADDR

The .ADDR macro computes the address you specify in a position-independent manner.

The .ADDR macro has the following syntax:

```
.ADDR addr,reg,push
```

where:

- `addr` is the label of the address to compute, expressed as an immediate value with a number sign (#) before the label.
- `reg` is the register in which to store the computed address, expressed as a register reference Rn or @Rn. To store the address on the stack, use @SP or -(SP). The following register references are valid:

<table>
<thead>
<tr>
<th>R1</th>
<th>@R1</th>
<th>@SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2</td>
<td>@R2</td>
<td>-(SP)</td>
</tr>
<tr>
<td>R3</td>
<td>@R3</td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td>@R4</td>
<td></td>
</tr>
<tr>
<td>R5</td>
<td>@R5</td>
<td></td>
</tr>
<tr>
<td>R6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- `push` determines what to do with the original contents of the register. If you omit push, the computed address overwrites the register contents. If you use ADD for the push argument, the computed address is added to the original contents of the register. If you use PUSH for the push argument, the register contents are pushed onto the stack before the computed address is stored in the register.

If you use -(SP) for the argument reg and you omit the push argument, PUSH is automatically used.

The following sample lines from a program show all three uses of the .ADDR macro.

```
.ADDR #ABC,RO  ILOAD ADDRESS OF ABC IN RO
.ADDR #ABC,RO,ADD IADD ADDRESS OF LABEL TO CONTENTS OF RO
.ADDR #ABC,RO,PUSH  IPUSH CONTENTS OF RO ONTO STACK, THEN LOAD ADDRESS OF ABC IN RO
```
2.3 .ASSUME

The .ASSUME macro tests for a condition you specify. If the test is false, MACRO generates an assembly error and prints a descriptive message.

The .ASSUME macro has the following syntax:

```
.ASSUME a rel c [message=text]
```

where:

- `a` is an expression.
- `c` is an expression.
- `rel` is the relationship between `a` and `c` you want to test.
- `text` is the message you want MACRO to print if the condition you specified in the relationship between `a` and `c` is false. To specify your own error message, start the message with a semicolon (`;`), or start with a valid assembly expression followed by a semicolon (`;`) and the message. If you omit the message argument, the error message "`a rel c` IS NOT TRUE prints; the expressions you used appear in the message in place of `a` and `c`.

In the following example, if the location counter `()` is less than 1000, MACRO generates an assembly error and prints the message `1000 - .; LOCATION TOO HIGH`.

```
.ASSUME .LT 1000 MESSAGE=(1000-; LOCATION TOO HIGH)
```

2.4 .BR

The .BR macro warns you if code that belongs together is separated during assembly. When you call the .BR macro, you specify an address as an argument. .BR checks that the next address matches the address you specified in the .BR macro. If it does not, MACRO prints the error message `Error; not at location "addr"`. The location you specified in the .BR macro appears in place of `addr` in the message.

The .BR macro has the following syntax:

```
.BR addr
```

where `addr` is the address you want to test.

In the following example, MACRO tests the location that follows the .BR macro. Since the address does not match the address ABC, MACRO prints an error message.

```
FOO: .BR ABC .TEST THE NEXT ADDRESS FOR ABC
     ...
     ...
     ABC:
```
In the next example, no error occurs:

```
.DEF
```

2.5 .CDFN

The .CDFN request redefines the number of I/O channels. Each job, whether foreground or background, is initially provided with 16(decimal) I/O channels numbered 0–15. .CDFN allows the number to be expanded to as many as 255(decimal) channels (0–254 decimal, or 0–376 octal). Channel 377 is reserved for use by the monitor.

The space for the new channels is taken from within the user program. Each I/O channel requires five words of memory. Therefore, you must allocate $5^n$ words of memory, where $n$ is the number of channels to be defined.

It is recommended that you use the .CDFN request at the beginning of a program before any I/O operations have been initiated. If more than one .CDFN request is used, the channel areas must either start at the same location or not overlap at all. The two requests .SRESET and .HRESET cause the channels to revert to the original 16 channels defined at program initiation. Hence, you must reissue any .CDFNs after using .SRESET or .HRESET. The keyboard monitor command CLOSE does not work if your program defines new channels with the .CDFN request.

The .CDFN request defines new channels so that the space for the previously defined channels cannot be used. Thus, a .CDFN for 20(decimal) channels (while 16 original channels are defined) creates 20 new I/O channels; the space for the original 16 is unused, but the contents of the old channel set are copied to the new channel set.

If a program is overlaid, the overlay handler uses channel 17(octal) and this channel should not be modified. (Other channels can be defined and used as usual.)

In an XM monitor environment, the area supplied for additional channels specified by the .CDFN request must lie in the lower 28K words of memory. In addition, it must not be in the virtual address space mapped by Kernel PAR1, specifically the area from 20000 to 37776(octal). If you supply an invalid area, the system generates an error message.

Macro Call: .CDFN area(addr),num

where:

- `area` is the address of a three-word EMT argument block
- `addr` is the address where the I/O channels begin
- `num` is the number of I/O channels to be created
Request Format:

R0 → area:

<table>
<thead>
<tr>
<th>addr</th>
<th>num</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>0</td>
</tr>
</tbody>
</table>

Errors:

**Code**

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>An attempt was made to define fewer than or the same number of channels that already exist. In an XM environment, an attempt to violate the PAR1 restriction sets the carry bit and returns error code 0 in byte 52.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE CDFN.MAC

/* CDFN - This is an example in the use of the CDFN request. The example defines 32 new channels to reside in the body of the program. */

..MCALL CDFN,.PRINT,.EXIT

START: .CDFN #AREA,#CHANL,#32.
       BCC 1%
       .PRINT #BADCD
       .EXIT
1%:    .PRINT #GOODCD
       .EXIT

AREA: .BLKW 3

CHANL: .BLKW 5*32,

BADCD: .ASCIZ /? CDFN Failed ?/

GOODCD: .ASCIZ /? CDFN Successful/

.END START
```

2.6 .CHAIN

The .CHAIN request allows a background program to pass control directly to another background program without operator intervention. Since this process can be repeated, a long "chain" of programs can be strung together.

The area in low memory from locations 500–507 contains the device name and file name (in Radix–50) to be chained to. The area from locations 510–777 is used to pass information between the chained programs.

Macro Call: .CHAIN

Request Format:

R0 = 

| 10 | 0 |

Notes:

1. Make no assumptions about which areas of memory remain intact across a .CHAIN. In general, only the resident monitor and locations
500–777 are preserved across a .CHAIN. In a .CHAIN to or from a virtual job, locations 500–777 are not preserved.

2. I/O channels are left open across a .CHAIN for use by the new program. However, new I/O channels opened with a .CDFN request are not available in this way. Since the monitor reverts to the original 16 channels during a .CHAIN, programs that leave files open across a .CHAIN should not use .CDFN. Furthermore, nonresident device handlers are released during a .CHAIN request and must be fetched again by the new program. Note that FORTRAN logical units do not stay open across a .CHAIN.

3. An executing program determines whether it was chained to or RUN from the keyboard by examining bit 8 of the Job Status Word. The monitor sets this bit if the program was invoked with .CHAIN request. If the program was invoked with R or RUN command, this bit remains cleared. If bit 8 is set, the information in locations 500–777 is preserved from the program that issued the .CHAIN and is available for the currently executing program to use. Again, locations 500–777 are not preserved in a .CHAIN to or from a virtual job.

An example of a calling and a called program is MACRO and CREF. MACRO places information in the chain area, locations 500–777, then chains to CREF. CREF tests bit 8 of the JSW. If it is clear, it means that CREF was invoked with the R or RUN command and the chain area does not contain useful information. CREF aborts itself immediately. If bit 8 is set, it means that CREF was invoked with .CHAIN and the chain area contains information placed there by MACRO. In this case, CREF executes properly.

Errors:

.CHAIN is implemented by simulating the monitor RUN command and can produce any errors that RUN can produce. If an error occurs, the .CHAIN is abandoned and the keyboard monitor is entered.

When using .CHAIN, be careful with initial stack placement. The linker normally defaults the initial stack to 1000(octal); if caution is not observed, the stack can destroy chain data before it can be used.

Example:

```
.TITLE CHAIN,MAC

.CALL .CHAIN,,TTYIN,,PRINT

START:
MOV #500,R1
MOV #CHPTR,R2
.REPT 4
MOV (R2)+,(R1)+
.ENDOR
.PRINT #PROMT

IR1 => Chain area
IR2 => RADOS Program Filespec
IMove the Program Filespec
into the Chain area...
I
IAsk for the data to be passed
```

Programmed Request Description and Examples  2-7
2.7 .CHCOPY (FB and XM Only)

The .CHCOPY request opens a channel for input, logically connecting it to a file that is currently open by another job for either input or output. This request can be used by a foreground, background, or system job and must be issued before the first .READ or .WRITE request on that channel.

.CHCOPY is valid only on files on disk (including diskette) or DECtape. However, no errors are detected by the system if another device is used. (To close a channel following use of .CHCOPY, use either the .CLOSE or .PURGE request.)

Macro Call: .CHCOPY area,chan,ochan [,jobblk]

where:

area is the address of a three-word EMT argument block

chan is the channel the current job will use to read the data

ochan is the channel number of the other job's channel to be copied

jobblk is a pointer to a three-word ASCII logical job name that represents a system job (see the *RT-11 System Utilities Manual*)
Request Format:

R0 → area:  

<table>
<thead>
<tr>
<th>13</th>
<th>chan</th>
</tr>
</thead>
<tbody>
<tr>
<td>ochan</td>
<td></td>
</tr>
<tr>
<td>jobblk</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

1. If the other job's channel was opened with .ENTER in order to create a file, the copier's channel indicates a file that extends to the highest block that the creator of the file had written at the time the .CHCOPY was executed.

2. A channel open on a non-file-structured device should not be copied, because intermixtures of buffer requests can result.

3. A program can write to a file (that is being created by the other job) on a copied channel just as it could if it were the creator. When the copier's channel is closed, however, no directory update takes place.

4. Foreground and background jobs may optionally leave the jobblk argument blank or set it to zero. This causes the job name to default to F if the background job issued the request, or to B if the foreground job issued the request.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Other job does not exist, does not have enough channels defined, or does not have the specified channel (ochan) open.</td>
</tr>
<tr>
<td>1</td>
<td>Channel (chan) already open.</td>
</tr>
</tbody>
</table>

Example:

```plaintext
; CHCOPY - This is an example in the use of the CHCOPY request.  
; The example consists of two programs; a Foreground Job which  
; creates a file and sends a message to a Background Program  
; which copies the FG channel and reads a record from the file.  
; Both Programs must be assembled and linked separately.  

; .TITLE CHCOPF.MAC  
; This is the Foreground Program ...  

; .MCALL .ENTER,.PRINT,.SDATW,.EXIT,.RCVBD,.CLOSE,.WRTW

STARTF:  
  MOV #AREA,RS  
  ENTER R5=#0,.FILE;#5  
  WRIT  
  BCS ENTRR  
  SDATW R5=#RECORD,#256,#4  
  SEND a record BG is interested in  
  ENTRR  
  BCS .exit  
  SDATW R5=#BUFR,#2  
  SEND message with info to BG  
  .EXIT  
  .RCVBD  
  .CLOSE #0  
  .PRINT #EXIT  
  .EXIT

ENTERR:  
  .PRINT #ERRMSG  
  PRINT an error message  
  .EXIT
```

Programmed Request Description and Examples  2–9
2.8 .CLOSE

The .CLOSE request terminates activity on the specified channel and frees it for use in another operation. The handler for the associated device must be in memory if the file was created with a .ENTER programmed request.

Macro Call: .CLOSE chan

Request Format:

\[
R0 = 6 \text{ chan}
\]

A .CLOSE request specifying a channel that is not open is ignored.

A file opened with .LOOKUP does not require any directory operations when a .CLOSE is issued, and the USR does not have to be in memory for such a .CLOSE. The USR is required if, while the channel is open, a request was issued that required directory operations. The USR is always required for special structured devices such as magtape.

A .CLOSE is required on any channel opened with .ENTER if the associated file is to become permanent.
NOTE

Do not close channel 17(0ctal) if your program is overlaid, because overlays are read on that channel.

A .CLOSE performed on a file opened with .ENTER causes the device directory to be updated to make that file permanent. The first permanent file in the directory with the same name, if one exists, is deleted, provided that it is not protected. When a file that is opened with an .ENTER request is closed, its permanent length reflects the highest block written since it was entered. For example, if the highest block written is block number 0, the file is given a length of 1; if the file was never written, it is given a length of 0. If this length is less than the size of the area allocated at .ENTER time, the unused blocks are reclaimed as an empty area on the device.

In magtape operations, the .CLOSE request causes the handler to write an ANSI EOF1 label in software mode (using MM.SYS, MT.SYS, or MS.SYS) and to close the channel in hardware mode (using MMHD.SYS, MTHD.SYS, or MSHD.SYS).

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>A protected file with the same name already exists on the device. The .CLOSE is performed anyway, resulting in two files with the same name on the device. .CLOSE does not return any other errors unless the .SERR request has been issued. If the device handler for the operation is not in memory, and the .CLOSE request requires updating of the device directory, a fatal monitor error is generated.</td>
</tr>
</tbody>
</table>

Example:

Refer to the examples for the .CSISPC and .WRITW requests, which show typical uses for .CLOSE.

2.9 .CMKT (FB and XM; SJ Monitor Special Feature)

The .CMKT request causes one or more outstanding mark time requests to be canceled (see the .MRKT programmed request). The .CMKT request is a special feature in the SJ monitor, and is selected with the timer support during the system generation process.

Macro Call: .CMKT area, id[, time]

where:

- area is the address of a three-word EMT argument block
- id is a number that identifies the mark time request to be canceled. If more than one mark time request has the same id, the request with the earliest expiration time is canceled. If id = 0, all non-system mark time requests (those in the range 1 to 176777) for the issuing job are canceled
time is the address of a two-word area in which the monitor returns the amount of time (clock ticks) remaining in the canceled request. The first word contains the high-order time, the second contains the low-order. If an address of 0 is specified, no value is returned. If id = 0, the time parameter is ignored and need not be indicated

Request Format:

\[
\begin{array}{c|c}
\text{R0} & \text{area:} \\
\hline
23 & 0 \\
\hline
\text{id} & \\
\hline
\text{time} & \\
\end{array}
\]

Notes:

1. Canceling a mark time request frees the associated queue element.

2. A mark time request can be converted into a timed wait by issuing a .CMKT followed by a .TWAIT, and by specifying the same time area.

3. If the mark time request to be canceled has already expired and is waiting in the job's completion queue, .CMKT returns an error code of 0. It does not remove the expired request from the completion queue. The completion routine will eventually be run.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The id was not zero and a mark time request with the specified identification number could not be found (implying that the request was never issued or that it has already expired).</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .MRKT request.

2.10 .CNTXSW (FB and XM Only)

A context switch is an operation performed when a transition is made from running one job to running another. The .CNTXSW request is used to specify locations to be included in a list when jobs are switched. Refer to the RT-11 Software Support Manual for further details.

The system always saves the parameters it needs to uniquely identify and execute a job. These parameters include all registers and the following locations:

- 34,36 Vector for TRAP instruction
- 40–52 System Communication Area

If an .SFPA request has been executed with a non-zero address, all floating-point registers and the floating-point status are also saved.

It is possible that both jobs want to share the use of a particular location not included in normal context switch operations. For example, if a pro-
gram uses the IOT instruction to perform an internal user function (such as printing error messages), the program must set up the vector at 20 and 22 to point to an internal IOT trap handling routine. If both foreground and background wish to use IOT, the IOT vector must always point to the proper location for the job that is executing. Including locations 20 and 22 in the .CNTXSW list for both jobs before loading these locations accomplishes this. This procedure is not necessary for jobs running under the XM monitor. In the XM monitor, both IOT and BPT vectors are automatically context switched.

If .CNTXSW is issued more than once, only the latest list is used; the previous address list is discarded. Thus, all addresses to be switched must be included in one list. If the address (addr) is 0, no extra locations are switched. The list cannot be in an area into which the USR swaps, nor can it be modified while a job is running.

In the XM monitor, the .CNTXSW request is ignored for virtual jobs, since they do not share memory with other jobs. For virtual jobs, the IOT, BPT, and TRAP vectors are simulated by the monitor. The virtual job sets up the vector in its own virtual space by any of the usual methods (such as a direct move or an .ASECT). When the monitor receives a synchronous trap from a virtual job that was caused by an IOT, BPT, or TRAP instruction, it checks for a valid trap vector and dispatches the trap to the user program in user mapping mode. An invalid trap vector address will abort the job with the following fatal error message:

?MON–F–Inv SST (invalid synchronous system trap)

Macro Call: .CNTXSW area,addr

where:

area is the address of a two-word EMT argument block

addr is a pointer to a list of addresses terminated by a zero word.
The addresses in the list must be even and be one of the following:

a. in the range 2–476
b. in the user job area
c. in the I/O page (addresses 160000–177776)

Request Format:

\[
\begin{array}{c}
R0 \rightarrow \text{area: } 33 \quad 0 \\
\text{addr}
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>One or more of the conditions specified by addr was violated.</td>
</tr>
</tbody>
</table>
Example:

```assembly
.TITLE  CNTXSW.MAC

; .CNTXSW - This is an example in the use of the .CNTXSW request.
; In this example, a .CNTXSW request is used to specify that location 20
; and 22 (IDT vectors) and certain necessary EAE registers be context
; switched. This allows both jobs to use IDT and the EAE simultaneously
; yet independently.

.MCALL   ,CNTXSW,PRINT,EXIT

START:  .CNTXSW   #AREA=SWLIST   ;Issue the .CNTXSW request
        BCC   1$    ;Branch if successful
        .PRINT   #ADDERR    ;Address error (should not occur)
        .EXIT    ;Exit the program

1$:     .PRINT   #CNTOK    ;Acknowledge success with a message
        .EXIT    ;Then exit the program

SWLIST: .WORD  20    ;Addresses to include in context switch
         .WORD  22    ;IDT & EAE vectors...
         .WORD  177302 ;EAE registers...
         .WORD  177304
         .WORD  177310
         .WORD  0     ;List terminator !!!

AREA:   .BLKW  2     ;EMT argument block

ADDERR: .ASCIZ  /? ,CNTXSW Addressing Error ?/;

CNTOK:  .ASCIZ  /i,CNTXSW Successful/;

.END     START
```

2.11 .CRAW (XM Only)

The .CRAW request defines a virtual address window and optionally maps it into a physical memory region. Mapping occurs if you set the WS.MAP bit in the last word of the window definition block before you issue .CRAW. Since the window must start on a 4K word boundary, the program only has to specify which page address register to use and the window size in 32-word increments. If the new window overlaps previously defined windows, those windows are eliminated before the new window is created (except the static window reserved for a virtual program’s base segment).

Macro Call: .CRAW area,addr

where:

- **area** is the address of a two-word EMT argument block
- **addr** is the address of the window definition block

The window status word (W.NSTS) of the window definition block may have one or more of the following bits set on return from the request:

- **WS.CRW** set if address window was successfully created
- **WS.VNM** set if one or more windows were unmapped to create and map this window
- **WS.ELW** set if one or more windows were eliminated

2-14 Programmed Request Description and Examples
Request Format:

\[ R0 \rightarrow \text{area: } \begin{array}{|c|c|c|c|}
\hline
36 & 2 \\
\hline
\text{addr} & \\
\hline
\end{array} \]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Window alignment error: the new window overlaps the static window for a virtual job. The window is too large or W.NAPR is greater than 7.</td>
</tr>
<tr>
<td>1</td>
<td>An attempt was made to define more than seven windows in your program. You should eliminate a window first (.ELAW), or redefine your virtual address space into fewer windows.</td>
</tr>
</tbody>
</table>

If the WS.MAP bit was set in the window definition block status word, the following errors can also occur:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>An invalid region identifier was specified.</td>
</tr>
<tr>
<td>4</td>
<td>The combination of the offset into the region and the size of the window to be mapped into the region is invalid.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE XMCOPY

*i This is an example in the use of the RT-11 Extended Memory requests. 
*i The program is a file copy with verify utility that uses extended 
*i memory to implement 4k transfer buffers. The example utilizes most of 
i the Extended Memory requests and demonstrates other programming 
i techniques useful in utilizing the requests.

.NLIST BEX
.mcalls .UNMAP,.ELAW,.CRRG,.CRAW,.MAP,.PRINT,.EXIT,.CLOSE
.mcalls .RDDBK,.WDDBK,.TTYOUT,.WDBDF,.RDDBF,.CSIGEN,.READW,.WRITW

JSW = 44 \quad \text{JSW location}
J.VIRT = 2000 \quad \text{Virtual Job bit in JSW}
ERRBYT = 52 \quad \text{Error byte location}
APR = 2 \quad \text{IPAR/PDR for 1st window}
APR1 = 4 \quad \text{1st window}
BUF = WDB+W.NBAS \quad \text{Virtual addr of 1st buffer}
BUFI = WDBI+W.NBAS \quad \text{1st window}
CORBZ = 4096 \quad \text{Size of buffer in words}
PAGBZ = CORBZ/256 \quad \text{Page size in blocks}
WRN1D = WDB+W.NRID \quad \text{Region ID addr of 1st region}
WRN1DI = WDBI+W.NRID \quad \text{2nd window}

.ASECT 
= JSW

.WORD J.VIRT

.P Sect
.WDBDF
.RDBDF

START: .CSIGEN = ENCRE, =DEFLT, =0
BCS START
```

Programmed Request Description and Examples 2–15
INCB ERRNO
.CRRG =CAREA.,#RDB
BCC 10%
JMP ERROR
MOV RDB,WRNID
INCB ERRNO
.CRAW =CAREA.,#WDB
BCC 20%
JMP ERROR

ERR = 1x
ICreate a region
IBranch if successful
IReport error (JMP due to range!) 
IMove region id to Window Def Blk
ERR = 2x
ICreate window...
IBranch if no error
IReport error...

ERR = 3x
IExplicitly map window...
IBranch if no error
IReport error
IR1 = RT11 Block # for I/O
IR2 = # of words to read
ERR = 4x
ITry to read 4K worth of blocks
IBranch if no error
IEOF?
IBranch if yes
IMust be hard error, report it
IR2 = size of buffer Just read
IBranch if no error
ERR = 5x
IWrite out the buffer
IBranch if no error
ERR = 6x
IThen set another buffer
IBranch if no error
IBranch if no error
IReport error
IAdjust block #
IReport error
ICreate a region
IBranch if no error
IReport error
IGet region id to window def blk

IEX! EXAMPLE USING THE .CRAW REQUEST DOING
IIMPLIED .MAP REQUEST.

INCB ERRNO
.CRAW =CAREA.,#WDB1
BCC VERIFY
JMP ERROR
VERIFY:
INCB ERRNO
CLR R1
GETBLK:
MOV =CORSIZ,R2
.READW =CAREA.,#3,BUF1,R2,R1
BCC 40%
TSTB =ERRBYT
BEQ ENDIT
JMP ERROR
40%:
MOV RO,R2
.READW =CAREA.,#0,BUF2,R2,R1
BCC 50%
INC ERNNO
JMP ERROR
50%:
MOV BUF,R4
MOV BUF1,R3
MP (R4)+,(R3)+
BNE ERRDAT
BNE 70%
ADD =PAGSIZ,R1
BR GETBLK
70%:
BNE ERRDAT
DEC R2
BNE 70%
ADD =PAGSIZ,R1
BR GETBLK
ENDIT:
.PRINT =ENDPRG
.XCLOSE =O
.UNMAP =CAREA.,#WDB
.ELAW =CAREA.,#RDB
.ELRG =CAREA.,#RDB1
.ELRG =CAREA.,#RDB1
.EXIT

2-16 Programmed Request Description and Examples
2.12 .CRRG (XM Only)

The .CRRG request directs the monitor to allocate a dynamic region in physical memory for use by the current requesting program.

Macro Call: .CRRG area,addr

where:

area is the address of a two-word EMT argument block

addr is the address of the region definition block for the region to be created

Request Format:

\[
\begin{array}{c|c}
R0 & \text{area: } 36 \text { 0} \\
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>No region control blocks are available. You eliminate a region to obtain a region control block (.ELRG), or you can redefine your physical address space into fewer regions.</td>
</tr>
<tr>
<td>7</td>
<td>A region of the requested size cannot be created because not enough memory is available. The size of the largest available region is returned in R0.</td>
</tr>
<tr>
<td>10</td>
<td>An invalid region size was specified. A value of 0, or a value greater than the available amount of contiguous extended memory, is invalid.</td>
</tr>
</tbody>
</table>

Example:

Refer to example for the .CRAW request.
2.13 .CSIGEN

The .CSIGEN request calls the Command String Interpreter (CSI) in general mode to process a standard RT-11 command string. In general mode, file .LOOKUP and .ENTER requests as well as handler .FETCH requests are performed.

The .CSIGEN request accepts a command string of the form dev:output-filspec = dev:input-filspec/options, and the following operations occur:

1. The handlers for devices specified in the command line are fetched.
2. .LOOKUP and/or .ENTER requests on the files are performed.
3. The option information is placed on the stack. See the end of this section for a description of the way option information is passed. Note that this call always puts at least one word of information on the stack.

When called in general mode, the CSI closes channels 0 through 10 (octal).

.CSIGEN loads all necessary handlers and opens the files as specified. The area specified for the device handlers must be large enough to hold all the necessary handlers simultaneously. If the device handlers exceed the area available, your program can be destroyed. (The system, however, is protected.)

The three possible output files are assigned to channels 0, 1, and 2, and the six possible input files are assigned to channels 3 through 10 (octal). A null specification causes the associated channel to remain inactive. For example, the following string

*LP:=F1+F2

causes channel 0 to be inactive since the first specification is null. Channel 1 is associated with the line printer, and channel 2 is inactive. Channels 3 and 4 are associated with two files on DK:, while channels 5 through 10 are inactive. Your program can determine whether a channel is inactive by issuing a .WAIT request on the associated channel, which returns an error if the channel is not open.

Macro Call: .CSIGEN devspc,defext[,cstrng][,linbuf]

where:

devspc is the address of the memory area where the device handlers (if any) are to be loaded

defext is the address of a four-word block that contains the Radix-50 default file types. These file types are used when a file is specified without a file type (see Note 1)
cstrng is the address of the ASCIZ command string or a 0 if input is to come from the console terminal. (In an FB or XM environment, if the input is from the console terminal, an .UNLOCK of the USR is automatically performed while the string is being read, even if the USR is locked at the time.)
If the string is in memory, it must not contain a \texttt{#} (octal 15 and 12), and must terminate with a zero byte. If the 
\texttt{cstrng} field is blank, input is automatically taken from the 
console terminal. This string, whether in memory or en-
tered at the console, must obey all the rules for a standard 
RT-11 command string

\texttt{linbuf} is the storage address of the original command string. This 
is a user-supplied area, 81 decimal bytes in length. The 
command string is terminated with a zero byte. If this argu-
ment is omitted, the input command string is not copied to 
user memory

On return, R0 points to the first available location above the handlers, the 
stack contains the option information, and all the specified files have been 
opened.

Note:

1. The four-word block pointed to by \texttt{defext} is arranged as:

   Word 1: default file type for all input channels (3–10)
   Words 2,3,4: default file types for output channels 0, 1, and 2, 
   respectively

If there is no default for a particular channel, the associated word must 
contain 0. All file types are expressed in Radix–50. For example, the 
following block can be used to set up default file types for a macro 
assembler:

\begin{verbatim}
DEFE XT: .RAD 50 "MAC"
   .RAD 50 "OBJ"
   .RAD 50 "LST"
   .WORD  0
\end{verbatim}

In the command string:

\texttt{*DT0:ALPHA;DT1:BETA=DT2:INPUT}

the default file type for input is MAC; for output, OBJ and LST. The 
following cases are valid:

\texttt{*DT0:OUTPUT=}
\texttt{*DT2:INPUT}

In other words, the equal sign is not necessary if only input files are 
specified.

2. An optional argument (\texttt{linbuf}) is available in the .CSIGEN format that 
provides the user with an area to receive the original input string. The 
input string is returned as an ASCIZ string and can be printed through 
a .PRINT request.

3. The .CSIGEN request automatically takes its input line from an indi-
xrect command file if console terminal input is specified (\texttt{cstrng = \#0}) 
and the program issuing the .CSIGEN is invoked through an indirect 
command file.
Errors:

If CSI errors occur and input was from the console terminal, an error message describing the fault is printed on the terminal and the CSI retries the command. If the input was from a string, the carry bit is set and byte 52 contains the error code. In either case, the options and option-count are purged from the stack. These errors are:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Invalid command (such as bad separators, invalid file names, and commands that are too long).</td>
</tr>
<tr>
<td>1</td>
<td>A device specified is not found in the system tables.</td>
</tr>
<tr>
<td>2</td>
<td>A protected file of the same name already exists. A new file was not opened.</td>
</tr>
<tr>
<td>3</td>
<td>Device full.</td>
</tr>
<tr>
<td>4</td>
<td>An input file was not found in a .LOOKUP.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE  CSIGEN.MAC

; Example is in the use of the .CSIGEN request. The examples are
; input from the console terminal, and the input & output files opened
; via the general mode of the CSI. The file is copied using synchronous
; I/O, and the output file is made permanent via the .CLOSE request.

.MCALL .CSIGEN,.READ,.EXIT,.WRIT,.CLOSE,.RESET

ERROR=52

START:  .CSIGEN #DSPACE=#DEXT
         CLR  R0,BUFF
         MOV  INBLK
         MOV  #LIST,R5
         READ:  #READW R5,#3,BUFF,#256,.INBLK
                BCC  2$
                TSTB  #ERRBYT
                BEQ  EOF
                MOV  #INERR,R0
                1$:  .PRINT
                      CLR  R0
                      .EXIT
         2$:  .WRIT   R5,#0,BUFF,#256,.INBLK
                BCC  NDERR
                MOV  #TERR,R0
                BR   1$
         NDERR:  INC  INBLK
                BR   READ
         EOF:  .CLOSE #3
                .CLOSE #3
                .RESET
                .EXIT

DEXT:   .WORD  0,0,0,0
        .WORD  0
        .WORD  0
        .BLKW  5
        .ASCIZ /? Input error ?/  
```

2-20 Programmed Request Description and Examples
2.13.1 Passing Option Information

In both general and special modes of the CSI, options and their associated values are returned on the stack. A CSI option is a slash (/) followed by any character. The CSI does not restrict the option to printing characters, although you should use printing characters to avoid confusion. The option can be followed by a value, which is indicated by a: separator. The: separator is followed by an octal number, a decimal number, or by one to three alphanumeric characters, the first of which must be alphabetic. Decimal values are indicated by terminating the number with a decimal point (/N:14.). If no decimal point is present, the number is assumed to be octal. Options can be associated with files. For example, the command string

*DK:FOO/A,DT4:FILE.OBJ/A:100

has two A options. The first is associated with the input file DK:FOO. The second is associated with the input file DT4:FILE.OBJ and has a value of 100(octal). The format of the stack output of the CSI for options is as follows:

<table>
<thead>
<tr>
<th>Word #</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N</td>
<td>Number of options found in command string. If N=0, no options were found.</td>
</tr>
</tbody>
</table>
| 2      | Option character and file number | Even byte = seven-bit ASCII option character  
         |       | Bits 8-14 = number (0-10) of the file with which the option is associated  
         |       | Bit 15 = 1 if the option had a value  
         |       | = 0 if the option had no value |
| 3      | Option value or next option | If bit 15 of word 2 is set, word 3 contains the option value. If bit 15 is not set, word 3 contains the next option character and file number, if any. |

For example, if the input line to the CSI is

*FILE/B:20,.FIL2/E=DT3:INPUT/X:SY:20
on return, the stack is:

Stack Pointer → 4 Three options appeared (X option has two values and is treated as two options).
101530 Last option = X; with file 3, has a value.
20 Value of option X = 20 (octal).
101530 Next option = X; with file 3, has a value.
075250 Next value of option X = RAD50 code for SY.
505 Next option = E; associated with file 1, no value.
100102 Option = B; associated with file 0 and has a value of 24.
24 (octal).

As an extended example, assume the following string was input for the CSI in general mode:

*FILE[B.] LP; SY; FILE2[20.] PC; DT1: IN1/B; DT2: IN2/M: 7

Assume also that the default file type block is:

DEFEXT: .RAD50 'MAC' ; INPUT FILE TYPE
.RAD50 'OP1' ; FIRST OUTPUT FILE TYPE
.RAD50 'OP2' ; SECOND OUTPUT FILE TYPE
.RAD50 'OP3' ; THIRD OUTPUT FILE TYPE

The results of the above CSI call are as follows:

1. An eight-block file named FILE.OP1 is entered on channel 0 on device DK.; channel 1 is open for output to the device LP.; a 20-block file named FILE2.OP3 is entered on the system device on channel 2.

2. Channel 3 is open for input from device PC.; channel 4 is open for input from a file IN1.MAC on device DT1.; channel 5 is open for input from IN2.MAC on device DT2.;

3. The stack contains options and values as follows:

<table>
<thead>
<tr>
<th>Contents</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Two options found in string.</td>
</tr>
<tr>
<td>102515</td>
<td>Second option is M, associated with channel 5; has a value.</td>
</tr>
<tr>
<td>7</td>
<td>Numeric value is 7 (octal).</td>
</tr>
<tr>
<td>2102</td>
<td>Option is B, associated with channel 4; has no value.</td>
</tr>
</tbody>
</table>

If the CSI were called in special mode, the stack would be the same as for the general mode call, and the descriptor table would contain:

OUTSPC: 15270 .RAD50 'DK'
23364 .RAD50 'FIL'
17500 .RAD50 'E'
60137 .RAD50 'OP1'
10  | LENGTH OF B BLOCKS (DECIMAL)
46600 .RAD50 'LP'
Keyboard error messages that can occur when input is from the console keyboard include:

<table>
<thead>
<tr>
<th>Message</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>?CSI–F–Invalid command</td>
<td>Syntax error.</td>
</tr>
<tr>
<td>?CSI–F–file not found</td>
<td>Input file was not found.</td>
</tr>
<tr>
<td>?CSI–F–Device full</td>
<td>Output file does not fit.</td>
</tr>
<tr>
<td>?CSI–F–Invalid device</td>
<td>Device specified does not exist.</td>
</tr>
<tr>
<td>?CSI–F–Protected file</td>
<td>Output file specified already exists and is protected.</td>
</tr>
</tbody>
</table>

Notes:

1. In many cases, your program does not need to process options in CSI calls. However, you could inadvertently enter options at the console. In this case, it is wise to save the value of the stack pointer before the call to the CSI, and restore it after the call, so that no extraneous values are left on the stack. Note that even a command string with no options causes a word to be pushed onto the stack. This word indicates the number of options to follow.

2. Under an FB monitor, calls to the CSI that require console terminal input always do an implicit .UNLOCK of the USR while the string is being gathered. This should be kept in mind when using .LOCK calls.

2.14 .CSISPC

The .CSISPC request calls the Command String Interpreter in special mode to parse the command string and return file descriptors and options to the program. In this mode, the CSI does not perform any .CLOSE, .ENTER, .LOOKUP, or handler .FETCH requests.
Options and their associated values are returned on the stack. The optional argument (*linbuf*) can provide your program with the original command string.

`CSISPC` automatically takes its input line from an indirect command file if console terminal input is specified (*cstrng = #0*) and the program issuing the `CSISPC` is invoked through an indirect command file.

Note that in a foreground/background environment, calling the CSI performs a temporary and implicit .UNLOCK while the command line is being read.

Macro Call: `.CSISPC outspc,defexit,cstrng[,linbuf]`

where:

- `outspc` is the address of the 39-word block to contain the file descriptors produced by `.CSISPC`. This area can overlay the space allocated to `cstrng`, if desired
- `defexit` is the address of a four-word block that contains the Radix–50 default file types. These file types are used when a file is specified without a file type
- `cstrng` is the address of the ASCIZ input string or a #0 if input is to come from the console terminal. If the string is in memory, it must not contain a `®` (octal 15 and 12), and must terminate with a zero byte. If `cstrng` is blank, input is automatically taken from the console terminal or indirect file, if one is active
- `linbuf` is the storage address of the original command string. This is a user-specified area, 81 bytes in length. The command string is terminated with a zero byte instead of `®` (octal 15 and 12)

Notes:

1. The file description consists of 39 words, comprising nine file descriptor blocks (five words for each of three possible output files; four words for each of six possible input files), which correspond to the nine possible files (three output, six input). If any of the nine possible file names are not specified, the corresponding descriptor block is filled with zeroes.

2. The five-word blocks hold four words of Radix–50 representing `dev:file.type`, and one word representing the size specification given in the string. (A size specification is a decimal number enclosed in square brackets ([])) that follows the output file descriptor.) For example:

```
*DT3:LIST,MAC[15]=PC:
```

Using special mode, the CSI returns in the first five-word slot:

- 16101  Radix–50 for DT3
- 46173  Radix–50 for LIS
- 76400  Radix–50 for T
- 50553  Radix–50 for MAC
- 00017  Octal value of size request

2–24 Programmed Request Description and Examples
In the fourth slot (starting at an offset of 36 bytes [octal] into outspc), the CSI returns:

62170  Radix–50 for PC
0      No file name
0      specified
0      No file type given

Since this is an input file, only four words are returned.

Errors:

Errors are the same as in general mode except that invalid device specifications are checked only for output file specifications with null file names. Since .LOOKUP and .ENTER requests are not done, the valid error codes are:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Invalid command line.</td>
</tr>
<tr>
<td>1</td>
<td>Invalid device.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE CSISPC.MAC
1+  
1 ,CSISPC - This is an example in the use of the .CSISPC request.  
1 The example uses the "special" mode of CSI to set an input  
1 specification from the console terminal, then uses the .DSTATUS  
1 request to determine if the output device's handler is loaded  
1 if not, a .FETCH request is issued to load the handler into  
1 memory. Finally a .DELETE request is issued to delete the specified  
1 file.
1-

.MCALL .DSTATUS,.PRINT,.EXIT,.FETCH,.CSISPC,.DELETE

START:  
MOV SP, R5
.CSISPC #OUTSP,#DEFEXT   
MOV R5, SP
.DSTAT #STAT,#OUTSP

TST   
BNE 2$  
.FETCH #HANLOD,#INSPEC  
BCC 2$  
.PRINT #FEFAIL
.EXIT

2$:  
.DELETE #AREA,#O,#INSPEC  
BCC 3$  
.PRINT #NOFIL
 BR START

3$:  
.PRINT #FILDEL
.EXIT

AREA:  
.BLKW 2
STAT:  
.BLKW 4
.DEFEXT:  
.WORD 0:0:0:0
.FEFAIL:  
.ABCIZ /?,FETCH Failed?/  
.NOFIL:  
.ABCIZ /?File Not Found?/  
.FILDEL:  
.ABCIZ /File Deleted!/  
.EVEN

.OUTSP:  
.BLKW 5#3
.INSPEC:  
.BLKW 4#6
.HANLOD:  
.BLKW 1
.END START
```

Programmed Request Description and Examples   2–25
2.15 .CSTAT

This request furnishes you with information about a channel.

Macro Call: .CSTAT area,chan,addr

where:

area  is the address of a two-word EMT argument block
chan  is the number of the channel about which information is desired
addr  is the address of a six-word block to contain the status

Request Format:

R0 → area: 27 chan

Notes:

The six words passed back to the user correspond to the following six points of information:

1. Channel status word (see the RT-11 Software Support Manual for details)
2. Starting block number of file (0 if sequential-access device, or if channel was opened with a non-file-structured .LOOKUP or .ENTER)
3. Length of file (0 if non-file-structured device, or if channel was opened with a non-file-structured .LOOKUP or .ENTER)
4. Highest relative block written since file was opened (no information if non-file-structured device). This word is maintained by the .WRITE/.WRITC/.WRITW requests
5. Unit number of device with which this channel is associated
6. Radix–50 of the device name with which the channel is associated (this is a physical device name, unaffected by any user name assignment in effect).

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The channel is not open.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE CSTAT.MAC

; This is an example in the use of the .CSTAT request.
; In this example, .CSTAT is used to determine the .RDS0
; representation of the device with which the channel is associated.

; .MCALL .CSTAT, CSIGEN, PRINT, EXIT

START: MOV  SP, R5       ; Save current stack pointer
        CSIGEN #DEVSDC,#DEFEXT  ; Open files
        MOV  R5, SP         ; Restore SP to clear any CSI options
        .CSTAT #AREA,#0,#ADDR
        BCS NOCHAN         ; Get the status
        MOV  #ADDR+10,R5   ; Channel 0 not open
        ;Point to unit
```
2.16 .CTIMIO (Device Handler Only)

The .CTIMIO macro cancels the device time-out request in the handler interrupt service section. It is used when an interrupt occurs to disable the completion routine (see .TIMIO).

If the time interval has already elapsed and the device has, therefore, timed out, the .CTIMIO request fails. The completion routine has already been placed in the queue. The .CTIMIO call returns with the C bit set when it fails because the completion routine was already queued.

The device time-out feature must have been selected during the system generation process.

Macro Call: .CTIMIO tbk

where:

```
tbk     is the address of the seven-word timer block shown in Table 2–1
```

### Table 2–1: Timer Block Format

<table>
<thead>
<tr>
<th>Offset</th>
<th>Filled in By</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>.TIMIO</td>
<td>High-order time word (expressed in ticks).</td>
</tr>
<tr>
<td>2</td>
<td>.TIMIO</td>
<td>Low-order time word (expressed in ticks).</td>
</tr>
<tr>
<td>4</td>
<td>monitor</td>
<td>Link to next queue element; 0 indicates none.</td>
</tr>
<tr>
<td>6</td>
<td>user</td>
<td>Owner’s job number; 0 for background job, MAXJOB for foreground job, and job priority *2 for system jobs. MAXJOB is equal to (the number of jobs in the system * 2)–2. The job number for the foreground job is 2 in a system without system jobs, and 16 for a system with system jobs. The job number is set from the queue element.</td>
</tr>
<tr>
<td>10</td>
<td>user</td>
<td>Sequence number of timer request. The valid range of sequence numbers is from 177000 to 177377.</td>
</tr>
<tr>
<td>12</td>
<td>monitor</td>
<td>–1</td>
</tr>
<tr>
<td>14</td>
<td>user</td>
<td>Address of the completion routine to execute if timeout occurs. The monitor zeroes this word when it calls the completion routine, indicating that the timer block is available for reuse.</td>
</tr>
</tbody>
</table>

Programmed Request Description and Examples 2–27
The .CTIMIO macro expands as follows:

```
.CTIMIO  tbk
JSR     R5,$TIMIT ; POINTER AT END OF HANDLER
.WORD   tbk - , ; CODE FOR .CTIMIO
.WORD   1
```

Example:

Refer to the example for the .TIMIO request.

### 2.17 .DATE

This request returns the current date information from the system date word in R0. The date word returned is in the following format:

```
BIT:  15 14 13 ... 10 9 ... 5 4 ... 0

0 0 MONTH DAY YEAR
```

The year value in bits 4–0 is the actual year minus 1972. The day in bits 9 to 5 is a number from 1 to the length of the month. The month in bits 13 to 10 is a number from 1 to 12.

**NOTE**

RT–11 support of month and year rollover is a system generation special feature; otherwise, the keyboard monitor DATE command must be issued to change the month and year.

**Macro Call:** .DATE

**Request Format:**

```
R0 = 12 0
```

**Errors:**

No errors are returned. A zero result in R0 indicates that the user has not entered a date.

**Example:**

```
.TITLE DATE.MAC

; .DATE - This is an example in the use of the .DATE request.
; This example may be assembled separately and linked with
; user written programs
;
; INPUT:  none
;
; OUTPUT: R0 = MONTH (1-12)
;         R1 = DAY (1-31)
;         R2 = YEAR (Last two digits)
```

2–28 Programmed Request Description and Examples
2.18 .DELETE

The .DELETE request deletes a named file from an indicated device. The .DELETE request is invalid for magtapes. The .SERR programmed request can be used to allow the program to process any errors.

Macro Call:  .DELETE area,chan,dblk[,seqnum]

where:

- **area** is the address of a three-word EMT argument block
- **chan** is the device channel number in the range 0–376(octal)
- **dblk** is the address of a four-word Radix–50 descriptor of the file to be deleted
- **seqnum** file number for cassette operations: if this argument is blank, a value of 0 is assumed

Request Format:

```
R0 → area: 0 chan
            dblk seqnum
```

Notes:

The channel specified in the .DELETE request must not be open when the request is made, or an error will occur. The file is deleted from the device, and an empty (UNUSED) entry of the same size is put in its place. A .DELETE issued to a non-file-structured device is ignored. .DELETE requires that the handler to be used be in memory at the time the request is made. When the .DELETE is complete, the specified channel is left inactive.
Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Channel is active.</td>
</tr>
<tr>
<td>1</td>
<td>File was not found in the device directory.</td>
</tr>
<tr>
<td>2</td>
<td>Invalid operation.</td>
</tr>
<tr>
<td>3</td>
<td>The file is protected and cannot be deleted.</td>
</tr>
</tbody>
</table>

Example:

```
.MCALL .OSTATUS,.PRINT,.EXIT,.FETCH,.CSISPC,.DELETE

START: MOV SP, R5
        CSISPC #OUTSP,#DEFEXT
        MOV R5, SP
        OSTATAT #STAT,#OUTSP
        TST BNE 2%
        FETCH #HANDL00,#INSPEC
        BCC 2%
        PRINT #FEFAIL
        EXIT

2*:  DELETE #AREA,#0,#INSPEC
     BCC 3%
     PRINT #NOFIL
     BR START

3*:  PRINT #FILDEL
     EXIT

AREA:   BLKW 2
STAT:   BLKW 4
DEFEXT: WORD 0,0,0,0
FEFAIL: ASCIZ /?.FETCH Failed?/
NOFIL:  ASCIZ /?File Not Found?/
FILDEL: ASCIZ /!File Deleted!/
        EVEN
OUTSP:  BLKW 5+3
INSPEC: BLKW 4+6
HANL00: BLKW 1
        END
```

2.19 .DEVICE (FB and XM Only)

This request allows your program to load device registers with any necessary values when the program is terminated. You set up the list of addresses with the specified values. Upon issuing an .EXIT request or a CTRL/C from the terminal, this list is picked up by the system and the designated addresses are loaded with the corresponding values. This function is primarily designed to allow your program to turn off a device's interrupt enable bit when the program servicing the device terminates.
Successive calls to .DEVICE are allowed when you need to link requested tables. When the job is terminated for any reason, the list is scanned once. At that point, the monitor disables the feature until another .DEVICE call is executed. Thus, background programs that are reenterable should include .DEVICE as a part of the reenter code.

The .DEVICE request is ignored when it is issued by a virtual job running under the XM monitor.

Macro Call: .DEVICE area,addr[,link]

where:

area is the address of a two-word EMT argument block

addr is the address of a list of two-word elements, each composed of a one-word address and a one-word value to be put at that address. If addr is #0, any previous list is discarded; in this form, the argument link must be omitted

link is an optional argument that, if present, specifies linking of tables on successive calls to .DEVICE. If the argument is omitted, the list referenced in the previous .DEVICE request is replaced by the new list. The argument must be supplied to cause linking of lists; however, linked and unlinked list types cannot be mixed

Request Format:

<table>
<thead>
<tr>
<th>Nonlinking</th>
<th>Linking</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0 → area:</td>
<td>R0 → area:</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>addr</td>
<td>addr</td>
</tr>
</tbody>
</table>

NOTE

The list referenced by addr must be in either linking or nonlinking format. The different formats are shown below. Both formats must be terminated with a separate, zero-value word. Linking format must also have a zero-value word as its first word.

<table>
<thead>
<tr>
<th>Nonlinking</th>
<th>Linking</th>
</tr>
</thead>
<tbody>
<tr>
<td>addr:</td>
<td>addr:</td>
</tr>
<tr>
<td>address</td>
<td>0</td>
</tr>
<tr>
<td>value</td>
<td>address</td>
</tr>
<tr>
<td>address</td>
<td>value</td>
</tr>
<tr>
<td>value</td>
<td>address</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>address</td>
<td>address</td>
</tr>
<tr>
<td>value</td>
<td>value</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Errors:

None.

Example:

```
.TITLE DEVICE.MAC

.DEVICE - This is an example in the use of the .DEVICE request. The example shows how .DEVICE is used to disable interrupts from a device upon termination of the program. In this case the device is a DL11 Serial Line Interface.

.START
.DEVICE AREA=LIST
.PROTECT AREA=300
BCS BUSY
	.i
JSR RS,DL11
.WORD 128
.WORD BUFFR
	.i
.FINI
.UNPROTECT AREA=300
.EXIT
.BUSY
.PRINT NOVEC
.EXIT
.AREA
.BLKW 3
.LIST
.WORD 176500
.WORD 0
.WORD 0
.BUFFR
.REPT 8
.ASCII /Hello DL11... Are You There ?/
.ENDR
.NOVEC
.ASCII /?Vector already protected?/ .ERROR MESSAGE TEXT
.START
```

2.20 .DRAST (Device Handler Only)

The .DRAST macro sets up the interrupt and abort entry points, lowers the processor priority, and references a global symbol $INPTR, which contains a pointer to the $INTEN routine in the resident monitor. This pointer is filled in by the bootstrap (for a system device) or at .FETCH time (for a data device).

Macro Call: .DRAST name, pri[,abo]

where:

- **name** is the two-character device name
- **pri** is the priority of the device, and also the priority at which the interrupt service code is to execute
- **abo** is an optional argument that represents the label of an abort entry point. If you omit this argument, the macro generates an RTS PC instruction at the abort entry point, which is the word immediately preceding the interrupt entry point.
Example:

.TITLE SP.MAC

; This is an example of a simple, RT-11 device driver to illustrate
; the use of the DRASR, DRENS, DRFNS, DRENS, QELDF, FORK
; This driver can be used to output to a serial ASCII printer-termina
; l over a DLI Serial Line Interface. To use this driver as an RT-11 device
; handler, simply install it via the INSTALL command (es. 'INSTALL SP').

MCALL .DRBEG, .DRAST, .DRFIN, .DRENS, .QELDF, .FORK

MCALL .DRBEG, .DRAST, .DRFIN, .DRENS, .QELDF, .FORK

IFDEF NDF MSGST, MSGST = 0
IFDEF NDF ERLG, ERLG = 0
IFDEF NDF TILTIF, TILTIF = 0
IFDEF NDF SPVEC, SPVEC = 304
IFDEF NDF SPCSR, SPCSR = 17504
IFDEF NDF SPFRI, SPFRI = 4

IOERR = 1
SPSTS = 20000
Device Status = Write only
SPSZ = 0

 celese that in case not
assembled with SYSCRD, MAC

IFDEF default vector
IFDEF default CSR addr
IFDEF default device priority

IFDEF hard I/O error bit definition

Device Size = 0 (Char device)

IFDEF QELDF
IFDEF QELDF offsets

IFDEF offsets to Block = (SPVEC) + Q.BLNK
IFDEF offsets from Q.BLNK to QSW pointer

IFDEF "" "" "" User buffer ptr
IFDEF "" "" "" Word count

IFDEF DRBEG
IFDEF SP, SPVE, SPSIZ, SPSTS

IFDEF begin driver code with .DRBEG
IFDEF IMACRO expansion is...

IFDEF SIZE of driver (handler)
IFDEF SIZE of device
IFDEF Device status (Write only)
IFDEF Default options

IFDEF beginnings of driver
IFDEF Interrupt vector
IFDEF Offset to Int svc rme & Priority
IFDEF Queue element pointers
IFDEF Offset from 3rd word in element!

IFDEF MOV
IFDEF ASL
IFDEF BCC
IFDEF BEQ
IFDEF SPRET
IFDEF BIS
IFDEF SP

IFDEF RTS
IFDEF JSR
IFDEF MOV
IFDEF TST
IFDEF BMI
IFDEF BIC
IFDEF .FORK
IFDEF SPNX:
IFDEF TST
IFDEF BPL
IFDEF MOVB
IFDEF INC
IFDEF INC
IFDEF BEQ
IFDEF BR
IFDEF SPERR
IFDEF SPDUN

IFDEF .DRFIN

Programmed Request Description and Examples  2–33
2.21 .DRBEG (Device Handler Only)

The .DRBEG macro sets up the information in block 0 and the first five words of the handler. This macro also generates the appropriate global symbols for your handler. Before you use .DRBEG, invoke .DRDEF to define xx$CSR, xx$VEC, xxDSIZ, and xxSTS (see Section 2.23).

Macro Call: .DRBEG name

where:

name is a two-character device name

Example:

Refer to the example for .DRAST.

2.22 .DRBOT (Device Handler Only)

The .DRBOT macro sets up the primary driver. A primary driver must be added to a standard handler for a data device to create a system device handler. The .DRBOT macro invokes the .DREND macro (see Section 2.24) to mark the end of the handler so that the primary driver is not loaded into memory during normal operations.

Macro Call: .DRBOT name,entry,read[,CONTROL = arg...,arg][,SIDES = n]

where:

name is the two-character device name

entry is the entry point of the software bootstrap routine

read is the entry point of the bootstrap read routine

CONTROL defines the types of controllers supported by this handler. The values for arg can be UBUS or QBUS. If CONTROL is omitted, both Unibus and Q-bus are assumed. This is correct for all supported handlers

SIDES specifies single- or double-sided diskettes. If omitted, single-sided diskettes are assumed. This is correct for all supported handlers
The .DRBOT macro puts a pointer to the start of the primary driver into location 62 of the handler file. It puts the length (in bytes) of the primary driver into location 64. Location 66 of the handler file contains the offset from the start of the primary driver to the start of the bootstrap read routine. The .DRBOT macro is called before the .DREND macro that you issue. The code for the primary driver is placed between the .DRBOT and .DREND calls.

Example:

Refer to the RT-11 Software Support Manual for an example showing the use of .DRBOT.

2.23 .DRDEF (Device Handler Only)

The .DRDEF macro sets up handler parameters, calls the driver macros from the library, and defines useful symbols.

Macro Call: .DRDEF name,code,stat,size,csr,vec

where:

- **name** is the two-character device name
- **code** is the numeric code that is the device identifier value for the device
- **stat** is the device status bit pattern. The value for stat may use the following symbols:
  - FLIST$ = 100000
  - SPECL$ = 10000
  - ABTIO$ = 1000
  - RONLY$ = 40000
  - HNDLR$ = 4000
  - VARSZ$ = 400
  - WONLY$ = 20000
  - SPFUN$ = 2000
- **size** is the size of the device in 256-word blocks
- **csr** is the default value for the device’s control and status register
- **vec** is the default value for the device’s vector

The .DRDEF macro performs the following operations:

1. A .MCALL is done for the following macros: .DRAST; .DRBEG; .DRBOT; .DREND; .DRFIN; .DRINS; .DRSET; .DRVTB; .FORK; .QELDF.

2. If the system generation conditionals TIM$IT, MMG$T, or ERL$G are undefined in your program, they are defined as zero. If time-out support is selected, the .DRDEF macro does a .MCALL for the .TIMIO and .CTIMIO macros.

3. The .QELDF macro is invoked to define symbolic offsets within a queue element.

4. The symbols listed above are defined for the device status bits.
5. The following symbols are defined:

- HDERR$: = 1
- EOF$: = 20000
- !HARD ERROR BIT IN THE CSW
- !END OF FILE BIT IN THE CSW

6. The symbol xxDSIZ is set to the value specified in size.

7. The symbol xx$COD is set to the specified device identifier code.

8. The symbol xxSTS is set to the value of the device identifier code plus the status bits.

9. If the symbol xx$CSR is not defined, it is set to the default csr value.

10. If the symbol xx$VEC is not defined, it is set to the default vector value.

11. The symbols xx$CSR and xx$VEC are made global.

You should invoke the .DRDEF macro near the beginning of your handler, after all handler specific conditionals are defined.

Example:

Refer to the *RT-11 Software Support Manual* for an example showing the use of .DRDEF.

### 2.24 .DREND (Device Handler Only)

The .DREND macro generates the termination table for the termination section of the device handler.

Macro Call: .DREND name

where:

- name is the two-character device name

The generation of the termination table, dependent upon certain conditions, is as follows:

<table>
<thead>
<tr>
<th>Label</th>
<th>Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>$RLPTR:</td>
<td>.WORD 0 ($RELOC)</td>
</tr>
<tr>
<td>$MPPTR:</td>
<td>.WORD 0 ($MPPHY)</td>
</tr>
<tr>
<td>$GTBYT:</td>
<td>.WORD 0 ($GETBYT)</td>
</tr>
<tr>
<td>$PTBYT:</td>
<td>.WORD 0 ($PUTBYT)</td>
</tr>
<tr>
<td>$PTWRD:</td>
<td>.WORD 0 ($PUTWRD)</td>
</tr>
<tr>
<td>$ELPTR:</td>
<td>.WORD 0 ($ERLOG)</td>
</tr>
<tr>
<td>$TIMIT:</td>
<td>.WORD 0 ($TIMIO)</td>
</tr>
<tr>
<td>$INPTR:</td>
<td>.WORD 0 ($INTE$_1$)</td>
</tr>
<tr>
<td>$FKPTR:</td>
<td>.WORD 0 ($FORK)</td>
</tr>
</tbody>
</table>

The generation of the labels depends upon the special features chosen during the system generation process. All the pointers in the termination section are initialized when the handler is loaded into memory with the .FETCH request. If the device handler is a system device, the pointers are initialized at boot time with the addresses shown in the address column.
The addresses are located within the monitor. The first five addresses are
the locations of subroutines in the resident monitor that are available to
device handlers in an extended memory environment. Device I/O time-out
service is provided by $TIMIO and error logging is provided by $ERLOG.
The $INPTR and $FKPTR labels are always filled in by a .FETCH or
LOAD command.

Example:

Refer to the example for .DRAST.

2.25 .DRFIN (Device Handler Only)

The .DRFIN macro generates the instructions for the jump back to the
monitor at the end of the handler I/O completion section. The macro makes
the pointer to the current queue element a global symbol, and it generates
position-independent code for the jump to the monitor. When control passes
to the monitor after the jump, the monitor releases the current queue ele-
ment.

Macro Call: .DRFIN name

where:

    name is the two-character device name

Example:

Refer to the example for .DRAST.

2.26 .DRINS

The .DRINS macro sets up the installation code area in block 0 of a device
handler. The .DRINS macro defines addresses that contain the CSR ad-
dresses listed by RESORC (display CSRs) and the CSR checked by the
INSTALL keyboard command. The .DRINS macro also defines the system
and data device installation entry points.

The .DRINS macro has the following syntax:

    .DRINS name,<csr,csr,...>

where:

    name represents the two-letter device mnemonic for the device
    whose handler installation code you are setting up.

    csr represents a symbolic CSR address for that device. If more
    than one display CSR exists, separate them with commas
    and enclose the list in angle brackets (<>). With multiple
    display CSRs, you do not have to list the first CSR.

When the .DRINS macro is processed, the following addresses are defined
based on the CSR addresses you supply.
INCSR  Installation check CSR
DISCSR  First display CSR
DISCSn  Subsequent display CSRs if any exist (n begins at 2 and is incremented by 1 for each subsequent display CSR)

In addition, the .DRINS macro sets the location counter to 200 (INSDAT =: 200) for the data device installation entry point, and defines the label INSSSYS as 202 (INSSSYS =: 202), the system device installation entry point.

The following example shows the installation code generated by a .DRINS macro used for a DX handler with two controllers.

```
.DRINS  DX<(DX*CS2)
*172
.DISC2:  .WORD  0
.DISC3:  .WORD  DX*CS2
.INSCR:  .WORD  DX*CSR
.INSDAT:  *202
.INSSYS:  *200

GENERATE INSTALLATION CODE
FOR TWO-CONTROLLER RX01

END OF LIST
SECONDARY DISPLAY CSR
PRIMARY DISPLAY CSR
INSTALL CSR
```

The next example shows the installation code generated by a .DRINS macro used for a DU handler with three controllers.

```
.DRINS  DU<(DU*CS2,DU*CS3)
*170
.DISC2:  .WORD  0
.DISC3:  .WORD  DU*CS3
.DISC2:  .WORD  DU*CS2
.DISC3:  .WORD  DU*CS2
.INSCR:  .WORD  DU*CSR
.INSDAT:  *202
.INSSYS:  *200

GENERATE INSTALLATION CODE
FOR THREE-CONTROLLER MSOP DEVICE

END OF LIST
THIRD DISPLAY CSR
SECONDARY DISPLAY CSR
FIRST DISPLAY CSR
INSTALL CSR
```

2.27  .DRSET (Device Handler Only)

The .DRSET macro sets up the option table for the SET command in block 0 of the device handler file. The option table consists of a series of four-word entries, one entry per option. Use this macro once for each SET option that is used. When used a number of times, the macro calls must appear one after another.

Macro Call:  .DRSET option,val,rtn[,mode]

where:

- **option** is the name of the SET option, such as WIDTH or CR. The name can be up to six alphanumeric characters long and should not contain any embedded spaces or tabs
- **val** is a parameter that is passed to the routine in Register R3. It can be a numeric constant, such as minimum column
width, or any one-word instruction that is substituted for an existing one in block 1 of the handler. It must not be a zero.

rtn is the name of the routine that modifies the code in block 1 of the handler. The routine must follow the option table in block 0 and must not go above address 776.

mode is an optional argument to indicate the type of SET parameter. A NO indicates that a NO prefix is valid for the option. NUM indicates that a decimal numeric value is required. OCT indicates that an octal numeric value is required. Omitting this argument indicates that the option takes neither a NO prefix nor a numeric argument.

The .DRSET macro does an .ASECT and sets the location counter to 400 for the start of the table. The macro also generates a zero word for the end of the table and leaves the location counter there. Thus routines to modify codes are placed immediately after the .DRSET calls in the handler, and their location in block 0 of the handler file is made certain.

Example:

Refer to the RT–11 Software Support Manual for an example of .DRSET.

2.28 .DRV TB (Device Handler Only)

The .DRV TB macro sets up a table of three-word entries for each vector of a multivector device. The table entries contain the vector location, interrupt entry point, and processor status word. You must use this macro once for each device vector. The .DRV TB macros must be placed consecutively in the device handler between the .DRBEG macro and the .DREND macro. They must not interfere with the flow of control within the handler.

Macro Call: .DRV TB name, vec, int[, ps]

where:

name is the two-character device name. This argument must be blank except for the first-time use of .DRV TB

vec is the location of the vector, and must be between 0 and 474

int is the symbolic name of the interrupt handling routine. It must appear elsewhere in the handler code. It generally takes the form ddINT, where dd represents the two-character device name

ps is an optional value that specifies the low-order four bits of the new Processor Status Word in the interrupt vector. This argument defaults to zero if omitted. The priority bits of the PSW are set to 7 even if you omit this argument.

Example:

Refer to the RT–11 Software Support Manual for an example of .DRV TB.
2.29 .DSTATUS

This .DSTATUS request obtains information about a particular device.

Macro Call: .DSTATUS retspc,dnam

where:

retspc is the address of a four-word block that stores the status information
dnam is the address of a word containing the Radix–50 device name

.DSTATUS looks for the device specified by dnam and, if successful, returns four words of status starting at the address specified by retspc. The four words returned are as follows:

Word 1 Status Word

Bits 0–7: The low-order byte contains a number that identifies the device in the system. The values are currently defined in octal as follows:

0 = RK05 Disk
1 = TC11 DECTape
2 = Error Logger
3 = Line Printer
4 = Console Terminal or Batch Handler
5 = RL01/RL02 Disk
6 = RX02 Diskette
7 = PC11 High-speed Paper Tape Reader and Punch
10 = Reserved (V2 PP handler)
11 = TU10 Magtape
12 = RF11 Disk
13 = TA11 Cassette
14 = Card Reader (CR11,CM11)
15 = Reserved
16 = RJS03/RJS04 Fixed-head Disk
17 = Reserved
20 = TJU16 Magtape
21 = RP02/RP03 Disk
22 = RX01 Diskette
23 = RK06/RK07 Disk
24 = Reserved
25 = Null Handler
26–30 = Reserved (DECnet)
31–33 = Reserved (CTS–300,LQ,LR,LS)
34 = TU58 DECTape II
35 = TS11 Magtape
36 = PDT–11/130
37 = PDT–11/150
40 = Reserved
41 = Serial Line Printer Handler (LS)
42 = Message Queue Handler (MQ)
43 = DRV11–J Interface (MRRT)
44 = Down-line Load Handler (XT) (MRRT–11 only)
45 = Reserved
46 = Logical Disk Handler
47 = KT–11 VM Handler
50 = MSCP Class Disk Handler
51 = Single-line Editor
52 = RX50 Diskette (Professional 325/350)
53 = RD50/RD51 Disk (Professional 350)
54 = Professional Interface (PI)
55 = Transparent Spooler (SP)
57 = Communication Port (Professional 325/350 or DL(V)–11)

Bit 8: 1 = Handler can access variable-sized volumes and supports .SPFUN 373
       0 = All volumes used by this device are the same size

Bit 9: 1 = Enter handler at abort entry whenever program terminates for any reason
       0 = Do not enter at abort entry point unless conditions for bit 11 are satisfied

Bit 10: 1 = Handler accepts .SPFUN requests (for example, MT, CT, DX)
        0 = No .SPFUN requests accepted

Bit 11: 1 = Enter handler abort entry every time a job is aborted
        0 = Handler abort entry taken only if there is an active queue element belonging to aborted job

Bit 12: 1 = Non RT–11 directory-structured device (magtape, cassette)

Bit 13: 1 = Write-only device (line printer, serial line printer)

Bit 14: 1 = Read-only device (card reader, paper tape reader)

Bit 15: 1 = Random-access device (disk, DECTape)
        0 = Sequential-access device (line printer, paper tape, card reader, magtape, cassette, terminal)

Word 2  Handler Size
       The size of the device handler in bytes.

Word 3  Load Address +6
       Non-zero implies the handler is now in memory; zero implies that it must be fetched before it can be used. The address returned is the load address of the handler +6.
Word 4  Device Size
The size of the device (in 256-word blocks) for block-replaceable devices; 0 for sequential-access devices, the smallest-sized volume for variable-sized devices. The last block on the device is the device size -1.

The device name can be a user-assigned name. .DSTATUS information is extracted from the device handler. Therefore, this request requires the handler for the device to be present on the system device and installed on the system.

Errors:

**Code**  
0  
**Explanation**  
Device not found in tables.

Example:

```
.TITLE  DSTATUS.MAC

;DSTATUS - This is an example in the use of the DSTATUS request.
;The example uses the "special" mode of CSI to set an input
;specification from the console terminal, then uses the DSTATUS
;request to determine if the output device's handler is loaded.
;if not, a FETCH request is issued to load the handler into
;memory. Finally a DELETE request is issued to delete the specified
;file.

..MCALL  .DSTATUS,.PRINT,.EXIT,.FETCH,.CSISPC,.DELETE

START:  .CSISPC  #OUTSP,#DEFEKT
         .DSTAT  #STAT,#OUTSP
         TST  BNE  2$  ; Hanload #INSPEC 2$
         .PRINT  #FEFAIL
         .EXIT

2$:  .DELETE  #AREA,#0,#INSPEC
         BCC  3$  #NOFIL
         BR  START

3$:  .PRINT  #FIDEL
         .EXIT

AREA:  .BLKW  2
STAT:  .BLKW  4
DEFEKT:  .WORD  0,0,0,0
FEFAIL:  .ASCIIZ  /?FETCH Failed?/
NOFIL:  .ASCIIZ  /?File Not Found?/
FIDDEL:  .ASCIIZ  /?File Deleted?/
         .EVEN
OUTSP:  .BLKW  5*3
INSPEC:  .BLKW  4*6
HANLOAD:  .BLKW  1
         .END  START
```

2.30  .ELAW (XM Only)
The .ELAW request eliminates a virtual address window. An implied unmapping of the window occurs when its definition block is eliminated.
Macro Call: .ELAW area[,addr]

where:

area is the address of a two-word EMT argument block

addr is the address of the window definition block for the window to be eliminated

Request Format:

\[
R0 \rightarrow \text{area: } \begin{array}{c}
36 \\
3 \\
\text{addr}
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>An invalid window identifier was specified.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .CRAW request.

2.31 .ELRG (XM Only)

The .ELRG request directs the monitor to eliminate a dynamic region in physical memory and return it to the free list where it can be used by other jobs.

Macro Call: .ELRG area [,addr]

where:

area is the address of a two-word EMT argument block

addr is the address of the region definition block for the region to be eliminated. Windows mapped to this region are unmapped. The static region cannot be eliminated

Request Format:

\[
R0 \rightarrow \text{area: } \begin{array}{c}
36 \\
1 \\
\text{addr}
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>An invalid region identifier was specified.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .CRAW request.

2.32 .ENTER

The .ENTER request allocates space on the specified device and creates a tentative entry in the directory for the named file. The channel number specified is associated with the file.
Macro Call: .ENTER area,chan,dblk,len[,seqnum]

where:

area is the address of a four-word EMT argument block
chan is a channel number in the range 0–376(octal)
dblk is the address of a four-word Radix–50 descriptor of the file to be operated upon
len is the file size specification. If the argument is omitted, it is not set to 0 in area. An argument of #0 must be specified to accomplish this. If an argument is left blank, the corresponding location in area is assumed to be set

The value of this argument determines the file length allocation as follows:

0 either half the largest empty entry or the entire second-largest empty entry, whichever is larger. (A maximum size for nonspecific .ENTER requests can be patched in the monitor by changing resident monitor offset 314; refer to the example for .PVAL)
m a file of m blocks. The size, m, can exceed the maximum mentioned above

−1 the largest empty entry on the device

seqnum is a file number for magtape or cassette. Programming for specific devices such as magtape or cassettes is discussed in detail in Chapter 10 of the RT–11 Software Support Manual. For cassette operation, if this argument is blank, a value of 0 is assumed

For magtape, seqnum describes a file sequence number. The action taken depends on whether the file name is given or is null. The sequence number can have the following values:

0 rewind the magtape and space forward until the file name is found or until logical end-of-tape is detected. If the file name is found, an error is generated. If the file name is not found, then enter file. If the file name is a null, a non-file-structured lookup is done (tape is rewound)

n position magtape at file sequence number n if n is greater than zero and the file name is not null

−1 space to the logical end-of-tape and enter file

−2 rewind the magtape and space forward until the file name is found, or until logical end-of-tape is detected. The magtape is now positioned correctly. A new logical end-of-tape is implied

2–44 Programmed Request Description and Examples
Request Format:

\[
\begin{array}{|c|}
\hline
\text{R0} \rightarrow \text{area:} \\
\hline
\text{2 chan} \\
\text{dblk} \\
\text{len} \\
\text{seqnum} \\
\hline
\end{array}
\]

On return from this call, R0 contains the size of the area actually allocated for use.

The file created with an .ENTER request is not a permanent file until a .CLOSE request is given on that channel. Thus, the newly created file is not available to .LOOKUP, and the channel cannot be used by .SAVED-STATUS requests. However, it is possible to read data that has just been written into the file by referencing the appropriate block number. When the .CLOSE to the channel is given, any existing permanent unprotected file of the same name on the same device is deleted and the new file becomes permanent. Although space is allocated to a file during the .ENTER operation, the actual length of the file is determined when .CLOSE is requested.

Each job can have up to 255 files open on the system at any time. If required, all 255 can be opened for output with the .ENTER function.

When an .ENTER request is made, the device handler must be in memory. Thus, a .FETCH should normally be executed before an .ENTER can be done.

Notes:

When using the zero-length feature of .ENTER, keep in mind that the space allocated is less than the largest empty space. This can have an important effect in transferring files between devices (particularly DEC-tape and diskette) that have a relatively small capacity. For example, transferring a 200-block file to a diskette, on which the largest available empty space is 300 blocks, does not work with a zero-length .ENTER. Since the .ENTER allocates half the largest space, only 150 blocks are really allocated and an output error occurs during the transfer. When transferring from A to B, with the length of A unknown, do a .LOOKUP first. This request returns the length so that value can be used to do a fixed-length .ENTER. The .ENTER request generates hard errors when problems are encountered during directory operations. These errors can be detected after the operation with the .SERR request.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Channel is in use.</td>
</tr>
<tr>
<td>1</td>
<td>In a fixed-length request, no space greater than or equal to ( m ) was found; or the device or the directory was found to be full.</td>
</tr>
<tr>
<td>3</td>
<td>A file by that name already exists and is protected. A new file was not opened.</td>
</tr>
</tbody>
</table>
Example:

```
; TITLE ENTER.MAC
!
; ENTER - This is an example in the use of the ,ENTER request.
; The example makes a copy of the file 'TECO.SAV' on device BK:
!
; .MCALL .LOOKUP,.ENTER,.WRITE,.READ,.CLOSE
; .MCALL .PRINT,.EXIT
; ERRBYT=52

START: .LOOKUP AREA,0,0,TECO
BCS 5
MOV RO,R3
.ENTER AREA,1,TFILE,R3
BCS 6
BR BLK
!
READW AREA,0,BUFFR,256, BKL READ a block

BCC 2
TSTB ERRBYT
BEQ 3
MOV #RERR,RO
BR 7
!
WRITE AREA,1,BUFFR,256, BKL WRITE a block

INC BLK
BCC 1
MOV #RERR,RO
BR 7
!
CLOSE #1
MOV #DONE,RO
BR 7
!

DONE: MOV #NDFIL,RO
BR 7
!

PRINT

EXIT

AREA: .WORD 0
BLK: .WORD 0,0,0,0
BUFFR: .BLKW 256,
TECO: .RADS0 /DK/
.TECO /
.RADS0 /TECO/
.RADS0 /SAV/
TFILE: .RADS0 /DK/
.RADS0 /OLDTEC/
.RADS0 /SAV/
NDFIL: .ASCIZ ?File not found?/
NDENT: .ASCIZ ?ENTER Failed?/
WERR: .ASCIZ ?Write Error?/
RERR: .ASCIZ ?Read Error?/
DONE: .ASCIZ /TECO Copy Complete/
.END START```

2.33 .EXIT

The .EXIT request causes the user program to terminate. When used from a background job under the FB monitor or XM monitor, or in SJ, .EXIT causes KMON to run in the background area. All outstanding mark time requests are canceled. Any I/O requests and/or completion routines pending for that job are allowed to complete. If part of the background job resides where KMON and USR are to be read and SET EXIT SWAP is in effect, the user job is written onto the system swap blocks (the file SWAP.SYS). KMON and USR are then loaded and control goes to KMON in the background area. If SET EXIT NOSWAP is in effect, the user program is simply overwritten when a .EXIT is done. If R0 = 0 when the .EXIT is done, an implicit .HRESET is executed when KMON is entered, disabling the subsequent use of REENTER, START, or CLOSE.
The .EXIT request allows a user program to pass command lines to KMON in the chain information area (locations 500–777octal) for execution after the job exits. This is performed under the following conditions:

1. The word (not byte) location 510 must contain the total number of bytes of command lines to be passed to KMON.

2. The command lines are stored beginning at location 512. The lines must be .ASCIZ strings with no embedded carriage return or line feed. For example:

```
,.=510
.WORD B-A
A:  .ASCIZ /COPY A,MAC B,MAC/
    .ASCIZ /DELETE A,MAC/
B:
```

3. The user program must set bit 5 or bit 11 in the Job Status Word immediately before doing an .EXIT, which must be issued with R0 = 0.

When the .EXIT request is used to pass command lines to KMON, the following restrictions are in effect:

1. If bit 11 of the JSW is set and if the feature is used by a program that is invoked through an indirect file, the indirect file context is aborted before executing the supplied command lines. Any unexecuted lines in the indirect file are never executed.

2. If bit 5 of the JSW is set and the feature is used by a program invoked through an indirect file, the indirect file context is preserved across the .EXIT request.

3. An indirect file can be invoked, using the steps described above, only if a single line containing the indirect file specification is passed to KMON. Attempts to pass multiple indirect files or combinations of indirect command files and other KMON commands yield incorrect results. An indirect file must be the last item on a KMON command line.

The .EXIT request also resets any .CDFN and .QSET calls that were done and executes an .UNLOCK if a .LOCK has been done. Thus, the CLOSE command from the keyboard monitor does not operate for programs that perform .CDFN requests.

An attempt to use a .EXIT from a completion routine aborts the running job.

**NOTE**

You must make sure that the data being passed to KMON is not destroyed during the .EXIT request. Extreme care should be exercised so that the user stack does not overwrite this data area. If the user passes command lines to KMON, the stack pointer should be reset to 1000(octal) or above before an exit is made.
Macro Call: .EXIT

Errors:

None.

Example:

```
.TITLE EXIT.MAC

;+ .EXIT - This is an example in the use of the .EXIT request.
; The example demonstrates how a command line may be passed to
; Keyboard Monitor after job execution is stopped.
;-

.MC ALL .EXIT

CHNIFS = 4000
JSW = 44
START:  MOV  #510,RO
         MOV  #CMDSTR,R1
         MOV  #START,SP

10$:  MOVB  (R1)+,(RO)+
      CMP  R1,#CMDEND
      BNE  10$
      DIS  #CHNIFS,#JSW

CLP  RO
     .EXIT

CMDSTR: .WORD  CMDEND-CMDSTR
CMDEND: .ASCIZ "DIRECT/FULL *.MAC"

2.34 .FETCH/.RELEAS

The .FETCH request loads device handlers into memory from the system device.

Macro Call: .FETCH addr,dnam

where:

addr is the address where the device handler is to be loaded

dnam is the pointer to the Radix–50 device name

The storage address for the device handler is passed on the stack. When the
.FETCH is complete, R0 points to the first available location above the
handler. If the handler is already in memory, R0 contains the same value
that was initially specified in the argument addr. If the argument on the
stack is less than 400(octal), it is assumed that a handler .RELEAS is being
done. (.RELEAS does not dismiss a handler that was loaded from the
KMON; an UNLOAD must be done.) After a .RELEAS, a .FETCH must be
issued in order to use the device again.

Several requests require a device handler to be in memory for successful
operation. These include:

.CLOSE .READC .READ .SFDAT
.LOOKUP .WRITC .WRITE .FPROT
.ENTER .READW .SPFUN
.RENAME .WRITW .DELETE

2–48 Programmed Request Description and Examples
When running under the foreground/background monitor, handlers for the foreground program or a system job must be loaded with the LOAD command before execution.

NOTE
I/O operations cannot be executed on devices unless the handler for that device is in memory.

Errors:

Code | Explanation
--- | ---
0 | The device name specified is not installed in the system, or there is no handler for that device in the system.

Example:

```
.TITLE FETCH.MAC

/* FETCH - This is an example in the use of the FETCH request.
* The example uses the "special" mode of CSI to set an input
* specification from the console terminal, then uses the DSTATUS
* request to determine if the output device's handler is loaded.
* If not, a FETCH request is issued to load the handler into
* memory. Finally a DELETE request is issued to delete the specified
* file.
*/

.MCALL DSTATUS,PRINT,EXIT,FETCH,CSISPC,DELETE

START: .CSISPC #OUTS,#DEFEXT #Use CSISPC to set output spec
   .DSTAT #STAT,OUTSP #Check on the output device
   TST STAT+4 #See if the device is resident
      .NE 2# (CSISPC catches illegal devices!)
      .FETCH #HANLOD,#INSPEC #Branch if already loaded
      .BCC 2# (It's not loaded...bring it into memory
      .PRINT #FEFAIL #Branch if successful
      .EXIT #Fetch failed...print error message

2#: .DELETE #AREA,#0,#INSPEC #Then exit program
      .BCC 3# #Now delete the file
      .PRINT #NOFIL #Branch if successful
      .OK START #Print error message
      .PRINT #FILDEL #Then try again
      .EXIT #Acknowledged successful deletion

AREA: .BLKW 2 #EMT Argument block
STAT: .BLKW 4 #Block for status
DEFEXT: .WORD 0,0,0,0 #No default extensions
FEFAIL: .ASCIZ /*.FETCH Failed?*/ #Fetch failed message
NOFIL: .ASCIZ /*File Not Found?*/ #File not found
FILDEL: .ASCIZ /*File Deleted!*/ #Delete acknowledgment
.EVEN #Fix boundary

OUTSP: = .BLKW 5*3 #Output specs so here
INSPEC: = .BLKW 4*6 #Input specs so here
HANLOD: = .BLKW 1 #Handlers begin loading here (if necessary)
.END START
```

The .RELEAS request notifies the monitor that a fetched device handler is no longer needed. The .RELEAS is ignored if the handler is (1) the system device, (2) not currently resident, (3) resident because of a LOAD command.
to the keyboard monitor. .RELEAS from the foreground or system job under
the FB monitor or the XM monitor is always ignored, since the foreground
job in a FB environment or extended memory environment can only use
handlers that have been loaded by the LOAD command.

Macro Call: .RELEAS dnam

where:

    dnam    is the address of the Radix-50 device name

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Device name is invalid.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE RELEAS.MAC

!In this example, the DECTape handler (DT) is loaded into memory,
!used, then released. If the system device is DECTape, the handler is
!always resident, and .FETCH will return HSPACE in R0.

.MCALL .FETCH,.RELEAS,.EXIT,.PRINT

START: .FETCH   #HSPACE,#DTNAME  !Load DT handler
       BCS       FERR       !Not available

!Use handler

    .RELEAS #DTNAME           !Mark DT no longer in
    BR       START

FERR: .PRINT #NODT           !DT not available
DTNAME: .RAD50 /DT/          !Name for DT handler
NODT: .ASCIZ /?DT HANDLER NOT AVAILABLE/

    .EVEN               !Beginning of handler
HSPACE:       !area

.END     START
```

2.35 .FORK (Device Handler and Interrupt Service Routine Only)

The .FORK call is used when access to a shared resource must be serialized
or when a lengthy but non-time-critical section of code must be executed.
.FORK issues a subroutine call to the monitor and does not use an EMT
instruction request.

Macro Call: .FORK fbblk

where:

    fbblk    is a four-word block of memory allocated within the driver

Errors:

    None.
The .FORK macro expands as follows:

```
.FORK fkb1k
Jsr z5,@*FKPTR
.WORD fkb1k-.
```

The .FORK call must be preceded by an .INTEN call, and the address of a four-word block must be supplied with the request. Your program must not have left any information on the stack between the .INTEN and the .FORK call. The contents of registers R4 and R5 are preserved through the call, and on return registers R0 through R3 are available for use.

If you are using a .FORK call from a device handler, it is assumed that you are also using the other macros (.QELDF, .DRBEG, .DRAST, .DRFIN, and .DREND) provided for handlers.

The .DREND macro allocates a word for $FKPTR. This word is filled in at bootstrap time for a system device or at LOAD or .FETCH time for a non-system device.

If you want to use the .FORK macro in an in-line interrupt service routine rather than in a device handler, you must set up $FKPTR. The recommended way to do this is as follows:

```
SYSPTR=54
FORK=402
.GVAL @AREA, @FORK
ADD @SYSPTR, R0
MOVE R0, $FKPTR
```

Once the pointer is set up, use the macro in the usual way as follows:

```
.FORK fkb1k
```

This method permits you to preserve both R4 and R5 across the fork.

The .FORK request is linked into a queue and serviced on a first-in first-out basis. On return to the driver or interrupt service routine following the call, the interrupt has been dismissed and the processor is executing at priority 0. Therefore, the .FORK request must not be used where it can be reentered using the same fork block by another interrupt. It also should not be used with devices that have continuous interrupts that cannot be disabled. The *RT–11 Software Support Manual* gives additional information on the .FORK request.

Notes:

For use within a user interrupt service routine, monitor fixed offset 402 (FORK) contains the offset from the start of the resident monitor to the .FORK request processor. A .FORK can be done by computing the address
of the .FORK request processor and using a subroutine instruction. (Under the XM monitor, only privileged jobs can contain user interrupt service routines.) For example:

```
SYSPTR=54  iAddress containing base
FORK=402   iAddress of RMON
.iValid   iMonitor offset containing
         iOffset to fork processor
        iReturn offset in R0
ADD @SYSPTR, R0  iAdd RMON base address
MDV R0, R4
JSR R5, (R4)
.WORD BLOCK-
```

```
AREA:  .BLKW 2
BLOCK: .BLKW 4
```

This method destroys the contents of R4.

Example:

Refer to the example following the description of .DRAST.

2.36 .FPROT

The .FPROT programmed request sets or removes file protection on individual RT–11 files. A file marked as protected cannot be deleted by .CLOSE, .DELETE, .ENTER, or .RENAME requests. However, the contents of a protected file are not protected against modification. For example, a .LOOKUP of a protected file followed by a .WRITE to the file is permitted.

Protection is enabled by setting bit 15 of a file’s directory entry status word.

Macro Call: .FPROT area, chan, dblk, prot

where:

- area is the address of a four-word EMT argument block
- chan is a channel number in the range 0–376(octal)
- dblk is the address of a four-word block containing the filespec in Radix–50 of the file
- prot = #1 — to protect the file from deletion
  = #0 — to remove protection so that the file can be deleted

Request Format:

```
R0 area | 43 | chan
       |   | dblk
       |   | prot
```

2–52 Programmed Request Description and Examples
Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Channel in use</td>
</tr>
<tr>
<td>1</td>
<td>File not found</td>
</tr>
<tr>
<td>2</td>
<td>Invalid operation</td>
</tr>
<tr>
<td>3</td>
<td>Invalid value for PROT</td>
</tr>
</tbody>
</table>

Example:

```
; FPROT, .SFDAT example.
; This is an example of the use of the FPROT and .SFDAT
; programmed requests. It uses the "special" mode of the CSI to
; set an input file spec from the console terminal. .DSTATUS is
; used to determine if the device handler is loaded. If not, a
; FGET request is used to load the handler into memory. Finally,
; the file is marked as protected using the FPROT request and
; the file date is changed to the current system date using the
; .SFDAT request.

; .MCALL .FPROT, .FGET, .CSISPC, .DSTATUS, .SFDAT, .PRINT, .EXIT

START: .CSISPC  ; OUTSP, .DEFEXT  ; Use CSI to set input filespec
            ; #DSTAT, #INSPEC  ; Check the device
            ; #TST, #INSPEC+4 ; see if the handler is resident
            ; #BNE 1§         ; Branch if it is
            ; #BNE .FGET      ; otherwise, load that handler
            ; #BNE .PRINT     ; Hank it
            ; #BNE .PRINT     ; otherwise, print load error message
            ; #BNE .FGET      ; and try again
            ; #BNE .PRINT     ; and try again
            ; #BNE .PRINT     ; and try again
            ; #BNE .EXIT      ; and try again

1§: .FPROT  ; EMTBLK, 0, #INSPEC, #1 ; Mark file as protected
            ; #BCC 2§          ; and branch if okay
            ; #BCC .PRINT      ; otherwise, print protect error message
            ; #BCC .PRINT      ; and try again
            ; #BCC .EXIT       ; and try again

2§: .SFDAT  ; EMTBLK, 0, #INSPEC, #0 ; Finally, set current date
            ; #BCC 10§         ; IA date of 0 means "use current system date"
            ; #BCC .PRINT      ; Branch if everything is okay
            ; #BCC .PRINT      ; otherwise, print date error message
            ; #BCC .PRINT      ; and try again
            ; #BCC .EXIT       ; and try again

10§: .EXIT  ; Everything okay - exit to KMON

EMTBLK: .BLKW 4 ; The EMT argument block is built here
DEFEXT: .WORD 0:0:0.0 ; No default extensions
STAT: .BLKW 4 ; Block for .DSTATUS to use
LOFAIL: .ASCIZ ; Error in LOAD request/
PRFAIL: .ASCIZ ; Error in FPROT request/
SFFAIL: .ASCIZ ; Error in .SFDAT request/
.EVEN
OUTSP: .BLKW 5:3 ; Output specs so here
INSPEC: .BLKW 4:6 ; Input specs so here
HANLOAD: .BLKW 1 ; Handlers begin loading here (if necessary)
.END
```

2.37 .GMCX (XM Only)

The .GMCX request returns the mapping status of a specified window. Status is returned in the window definition block and can be used in a subsequent mapping operation. Since the .CRAW request permits combined window creation and mapping operations, entire windows can be changed by modifying certain fields of the window definition block.
The .GMCX request modifies the following fields of the window definition block:

- W.NAPR: base page address register of the window
- W.NBAS: window virtual address
- W.NSIZ: window size in 32-word blocks
- W.RID: region identifier

If the window whose status is requested is mapped to a region, the .GMCX request loads the following additional fields in the window definition block:

- W.NOFF: offset value into the region
- W.NLEN: length of the mapped window
- W.NSTS: state of the WS.MAP bit is set to 1 in the window status word

Otherwise, these locations are zeroed.

Macro Call: .GMCX area[,addr]

where:

- area: is the address of a two-word EMT argument block
- addr: is the address of the window definition block where the specified window's status is returned

Request Format:

\[
R0 \rightarrow \text{area}: \begin{array}{c|c|c}
36 & 6 \\
\hline
\text{addr}
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>An illegal window identifier was specified.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .CRAW request.

2.38 .GTIM

.GTIM allows user programs to access the current time of day. The time is returned in two words and given in terms of clock ticks past midnight.

Macro Call: .GTIM area,addr

where:

- area: is the address of a two-word EMT argument block
- addr: is the address of the two-word area where the time is to be returned
Request Format:

\[
\begin{array}{c|c}
R0 & \text{area:} \\
& 21 \quad 0 \\
& \text{addr}
\end{array}
\]

The high-order time is returned in the first word, the low-order time in the second word. Your program must perform the conversion from clock ticks to hours, minutes, and seconds.

The basic clock frequency (50 or 60 Hz) can be determined from the configuration word in the monitor (offset 300 relative to the start of the resident monitor). In the FB monitor, the time of day is automatically reset after 24:00, when a .GTIM request is done and the date is changed if necessary. In the SJ monitor, the time of day is not reset unless SJ timer support was selected during the system generation process. The month is not automatically updated in either monitor. (Proper month and year rollover is a special feature that you enable through the system generation process.)

The default clock rate is 60 cycles, that is, 60 ticks per second. Consult the \textit{RT-11 System Generation Guide} if conversion to a 50-cycle rate is necessary.

Because day rollover is done only through a .GTIM request, make sure that your program receives the correct time and day by issuing a .GTIM request before using the .DATE request. Nearly all RT-11 system utility programs issue a .GTIM request to make sure that rollover occurs daily. If you do not use a system utility program regularly, issue a .GTIM request at least once during a 24-hour period.

\begin{center}
\textbf{NOTE}
\end{center}

There are also several SYSLIB routines that perform time conversion (see Chapter 3). They are CVTTIM, TIMASC, TIME, and SECNDS.

Errors:

None.

Example:

\begin{verbatim}
.TITLE GTIM.MAC

;GTIM - This is an example in the use of the .GTIM request.
;This example is a subroutine that can be assembled separately
;and linked with a user program.
;CALLING SEQUENCE: CALL TIME
;INPUT: none
;OUTPUT: RD = Minutes in hi byte / hours in lo byte
;        RS = Ticks in hi byte / seconds in lo byte
;       (in that order for ease of removal !)
;ERRORS: none possible
;NOTE: This example calls SYSLIB functions 'DIVTK' & 'DIVSGO'

.GLOBAL $DIVTK,$DIVSGO
.MCALL .GTIM
\end{verbatim}
2.39 .GTJB

The .GTJB request returns information about a job in the system.

Macro Call: .GTJB area,addr[,jobblk]

where:

area is the address of a three-word EMT argument block

addr is the address of an eight-word or twelve-word block into which the parameters are passed. The values returned are:

Word 1  Job Number = priority level *2 (background job is 0; system jobs are 2, 4, 6, 10, 12, 14; and foreground job is 16 in system job monitors; background job is 0 and foreground job is 2 in FB and XM monitors; job number is 0 in a SJ monitor)

2 High-memory limit of job partition (highest location available to a job in low memory if the job executes a privileged .SETTOP #–2 request)

3 Low-memory limit of job partition (first location)

4 Pointer to I/O channel space

5 Address of job's impure area in FB and XM monitors

6 Low byte: unit number of job's console terminal (used only with multiterminal option; 0 when multiterminal feature is not used)

High byte: reserved for future use

7 Virtual high limit for a job created with the linker /V option (XM only; 0 when not running under the XM monitor or if /V option is not used)

8–9 Reserved for future use

10–12 ASCII logical job name (system job monitors only; contains zeroes for non-system jobs in FB and XM, not defined in SJ)

jobblk is a pointer to a three-word ASCII logical job name for which data is being requested

2–56 Programmed Request Description and Examples
Word 4 of \textit{addr}, which describes where the I/O channel words begin, normally indicates an address within the job's impure area. However, when a .CDFN is executed, the start of the I/O channel area changes to the user-specified area.

If the \textit{jobblk} argument to the .GTJB request is between 0 and 16 when the status of a job is requested, it is interpreted as a job number. If the \textit{jobblk} argument is 'ME', or equals -1, information about the current job is returned. If the \textit{jobblk} argument is omitted, or equals -3 (a V03B-compatible parameter block), only eight words of information (corresponding to words 1-8 of \textit{addr}) are returned.

In an F/B environment without the system job feature, you can get another job's status only by specifying its job number (0 or 2).

Request Format:

\[
\begin{array}{c|c}
0 & 20 \\
\hline
1 & 1 \\
\hline
\text{addr} & \\
\hline
\text{jobblk} & \\
\end{array}
\]

Errors:

\begin{tabular}{|c|c|}
\hline
\textbf{Code} & \textbf{Explanation} \\
\hline
0 & No such job currently running. \\
\hline
\end{tabular}

Example:

See the program GTJB.MAC in the example listing.

\begin{verbatim}
.MCALL ,GVAL, ,GTJB, ,PRINT, ,EXIT
SYSGEN=  372
SYSJOB=  40000

START: MOV  #2,  R1
       .GVAL  #LIST,  #SYSGEN
       BIT  #SYSJOB,  R0
       BEO  1%
       MOV  #16,  R1

1%:   .GTJB  #LIST,  #JOBARG,  R1
       BCS  2%
       .PRINT  #FGLOAD
       .EXIT

2%:   .PRINT  #NOFG
       .EXIT

LIST:  .BLKW  3
JOBARGL:  .BLKW  12

FGLOAD:  .ASCIZ  /!FG Loaded!/  IFG loaded message
NOFG:    .ASCIZ  /?No FG Job?/  INo FG message

.END  START
\end{verbatim}

Programmed Request Description and Examples  2-57
2.40 .GTLIN

The .GTLIN request collects a line of input from either the console terminal or an indirect command file, if one is active. This request is similar to .CSIGEN and .CSISPC in that it requires the USR, but no format checking is done on the input line. Because the .GTLIN command is implemented in the USR, the CSI will generate an error message if you attempt to input more than 80 characters to a .GTLIN request. Normally, .GTLIN collects a line of input from the console terminal and returns it in the buffer specified by you. However, if there is an indirect command file active, .GTLIN collects the line of input from the indirect command file just as though it were coming from the terminal.

When bit 3 of the Job Status Word is set and your program encounters a CTRL/C in an indirect command file, the .GTLIN request collects subsequent lines from the terminal. Note that if you then clear bit 3 of the Job Status Word, the next line collected by the .GTLIN request is the CTRL/C in the indirect command file; this causes the program to abort. Further input will come from the indirect command file, if there are any more lines in it. When bit 14 of the Job Status Word is set, the .GTLIN request passes lowercase letters.

An optional prompt string argument (similar to the CSI asterisk) allows your program to query for input at the terminal. The prompt string argument is an ASCIZ character string in the same format as that used by the .PRINT request. If input is from an indirect command file and the SET TT QUIET option is in effect, this prompt is suppressed. If SET TT QUIET is not in effect, the prompt is printed before the line is collected, regardless of whether the input comes from the terminal or an indirect file. The prompt appears only once. It is not reissued if an input line is canceled from the terminal by CTRL/U or multiple DELETE characters, unless the single-line editor is running.

If your program requires a nonstandard command format, such as the user identification code (UIC) specification for FILEX, you can use the .GTLIN request to accept the command string input line. .GTLIN tracks indirect command files and your program can do a pre-pass of the input line to remove the nonstandard syntax before passing the edited line to .CSIGEN or .CSISPC.

NOTE

In an F/B environment, .GTLIN performs a temporary implicit unlock while the line is being read from the console.

Macro Call: .GTLIN linbuf[,prompt][,type]

where:

linbuf is the address of the buffer to receive the input line. This area must be at least 81 bytes in length. The input line is stored in this area and is terminated with a zero byte.
prompt is an optional argument and is the address of a prompt string to be printed on the console terminal. The prompt string has the same format as the argument of a .PRINT request. Usually, the prompt string ends with an octal 200 byte to suppress printing the carriage return/line feed at the end of the prompt.

type is an optional argument which forces .GTLIN to take its input from the terminal rather than from an indirect file.

NOTE

The only requests that can take their input from an indirect command file are .CSIGEN, .CSISP, and .GTLIN. The .TTYIN and .TINIR requests cannot get characters from an indirect command file. They get their input from the console terminal (or from a BATCH file if BATCH is running). The .TTYIN and .TINIR requests and the .GTLIN request with the optional type argument are useful for information that is dynamic in nature — for example, when all files with a .MAC file type need to be deleted or when a disk needs to be initialized. In these circumstances, the response to a system query should be collected through a .TTYIN or a .GTLIN with the type argument so that confirmation can be done interactively, even though the process may have been invoked through an indirect command file. However, the response to the linker's Transfer Symbol? query would normally be collected through a .GTLIN, so that the LINK command could be invoked and the start address specified from an indirect file. Also, if there is no active indirect command file, .GTLIN simply collects an input line from the console terminal by using .TTYIN requests.

Errors:

None.

Example:

.TITLE GTLIN.MAC

1+ 1.GTLIN - This is an example in the use of the .GTLIN request.
1 The example merely accepts input from the console terminal and
1 echoes it back.
1-

.MCALL .GTLIN, PRINT, EXIT

START: .GTLIN
      TS75
      BEQ 1%
      .PRINT
      CLR
      BR
1%: .EXIT
    .BLKW 41,
BUFF: .ASCIIZ /Enter something>/<200>
PROMT: .END
      START
2.41 .GVAL/.PVAL

The .GVAL request returns in R0 the contents of a monitor fixed offset; the .PVAL request changes the contents of a monitor offset. The .PVAL request also returns the old contents of an offset in R0 to simplify saving and restoring an offset value. .GVAL and .PVAL must be used in an XM environment to read or change any fixed offset, and should be used with other RT–11 monitors for compatibility with XM and possible future releases of RT–11.

Chapter 3 of the *RT–11 Software Support Manual* contains a table of the monitor's fixed offset locations.

Macro Calls: .GVAL area, offset

.PVAL area, offset, value

where:

area is the address of a two- or three-word EMT argument block

offset is the displacement from the beginning of the resident monitor to the word to be returned in R0

value is the new value to be placed in the fixed offset location

Request Format for .GVAL:

R0 → area:

<table>
<thead>
<tr>
<th>34</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>offset</td>
<td></td>
</tr>
</tbody>
</table>

Request format for .PVAL:

R0 → area:

<table>
<thead>
<tr>
<th>34</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>offset</td>
<td></td>
</tr>
<tr>
<td>value</td>
<td></td>
</tr>
</tbody>
</table>

Errors:

**Code** | **Explanation**
---|---
0 | The offset requested is beyond the limits of the resident monitor.

Example:

```
.TITLE .GVAL, MAC

; .GVAL - This is an example of the .GVAL request. It finds out
; if the foreground job is active. Compare this example with the
; .GTJB example.

; .MCALL .GVAL, .PRINT, .EXIT

CONFIG= 300  1 Offset in monitor of configuration word
FJDB$= 200  1 Bit in config word is on if FG active
```
2.42 .HERR/.SERR

.HERR and .SERR are complementary requests used to govern monitor behavior for serious error conditions. During program execution, certain error conditions can arise that cause the executing program to be aborted (see Table 2–2).

Normally, these errors cause program termination with one of the ?MON-F-error messages. However, in certain cases it is not feasible to abort the program because of these errors. For example, a multi-user program must be able to retain control and merely abort the user who generated the error. .SERR accomplishes this by inhibiting the monitor from aborting the job and causing an error return to the offending EMT. On return from that request, the carry bit is set and byte 52 contains a negative value indicating the error condition that occurred. In some cases (such as the .LOOKUP and .ENTER requests), the .SERR request leaves channels open. It is your responsibility to perform .PURGE or .CLOSE requests for these channels, otherwise subsequent .LOOKUP/.ENTER requests will fail.
.HERR turns off user error interception. It allows the system to abort the job on fatal errors and generate an error message. (.HERR is the default case.)

Macro Calls:  .HERR  
              .SERR

Request Formats:

  .HERR Request R0 = 5 0
  .SERR Request R0 = 4 0

Errors:

  Table 2–2 contains a list of the errors that are returned if soft error recovery is in effect. Traps to locations 4 and 10, floating-point exception traps, and CTRL/C aborts are not inhibited. These errors have their own recovery mechanism.

Table 2–2: Soft Error Codes (.SERR)

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>−1</td>
<td>Called USR from completion routine.</td>
</tr>
<tr>
<td>−2</td>
<td>No device handler; this operation needs one.</td>
</tr>
<tr>
<td>−3</td>
<td>Error doing directory I/O.</td>
</tr>
<tr>
<td>−4</td>
<td>.FETCH error. Either an I/O error occurred while the handler was being used, or an attempt was made to load the handler over USR or RMON.</td>
</tr>
<tr>
<td>−5</td>
<td>Error reading an overlay.</td>
</tr>
<tr>
<td>−6</td>
<td>No more room for files in the directory.</td>
</tr>
<tr>
<td>−7</td>
<td>Invalid address (FB only); tried to perform a monitor operation outside the job partition.</td>
</tr>
<tr>
<td>−10</td>
<td>Invalid channel number; number is greater than actual number of channels that exist.</td>
</tr>
<tr>
<td>−11</td>
<td>Invalid EMT; an invalid function code has been decoded.</td>
</tr>
<tr>
<td>−12</td>
<td>Reserved for monitor internal use.</td>
</tr>
<tr>
<td>−13</td>
<td>Reserved for monitor internal use.</td>
</tr>
<tr>
<td>−14</td>
<td>Invalid directory.</td>
</tr>
<tr>
<td>−15</td>
<td>Unloaded XM handler.</td>
</tr>
<tr>
<td>−16</td>
<td>Reserved for monitor internal use.</td>
</tr>
<tr>
<td>−17</td>
<td>Reserved for monitor internal use.</td>
</tr>
<tr>
<td>−20</td>
<td>Reserved for monitor internal use.</td>
</tr>
<tr>
<td>−21</td>
<td>Reserved for monitor internal use.</td>
</tr>
<tr>
<td>−22</td>
<td>Reserved for monitor internal use.</td>
</tr>
</tbody>
</table>
Example:

```
.TITLE HERR.MAC

! .HERR / .SERR - This is an example in the use of the .HERR & .SERR
! requests. Normally fatal errors will cause a return to the user
! program for processing and printing of an appropriate error message.
!
.MCALL .HERR, .SERR, .LOOKUP, .PURGE
.MCALL .EXIT, .PRINT, .CSISFC

START: .SERR .CSISFC .DUTSP, .DEFEXT .PURGE .LOOKUP .AREA, .DUTSP+36
.BCS .ERROR .HERR .PRINT .LUPDK .EXIT
.ERROR: .MOV8 .BMI .PRINT .NOFIL .BR .START
.FTLERR: .NEG .DEC .ASL .MOV .TBL(.RO), .RO .PRINT .BR .START


Error Messages...
M2: .ASCIIZ /*Invalid Device -or- No Handler?*/
M3: .ASCIIZ /*Directory I-O Error?*/
M7: .ASCIIZ /*Address Check Error?*/
M10: .ASCIIZ /*Invalid Channel?*/
M11: .ASCIIZ /*Invalid EMT?*/
M12: .ASCIIZ /*Trap to 4*/
M13: .ASCIIZ /*Trap to 10*/
M14: .ASCIIZ /*Invalid directory?*/
M17: .ASCIIZ /*Memory error*/

Programming Request Description and Examples 2-63
2.43 .HRESET

The .HRESET request stops all I/O transfers in progress for the issuing job, and then performs an .SRESET request. (.HRESET is not used to clear a hard-error condition.) In an SJ environment, a hardware RESET instruction is used to terminate I/O. In an FB or XM environment, only the I/O associated with the job that issued the .HRESET is affected by entering active handlers at the abort entry point of the handler. All other transfers continue.

Macro Call: .HRESET

Errors:

None.

Example:

Refer to the example for .SRESET for format.

2.44 .INTEN

.INTEN is used by interrupt service routines to:

1. Notify the monitor that an interrupt has occurred and to switch to system state.

2. Set the processor priority to the correct value.

3. Save the contents of R4 and R5 before returning to the Interrupt Service Routine. Any other registers must be saved by you.

.INTEN issues a subroutine call to the monitor and does not use an EMT instruction request.

All external interrupts must cause the processor to go to priority level 7. .INTEN is used to lower the priority to the value at which the device should be run. On return from .INTEN, the device interrupt can be serviced, at which point the interrupt routine returns with an RTS PC.

**NOTE**

An RTI instruction does not return correctly from an interrupt routine that specifies an .INTEN.

Macro Call: .INTEN prio[.pic]
where:

- **prio** is the processor priority at which to run the interrupt routine, normally the priority at which the device requests an interrupt.

- **pic** is an optional argument that should be non-blank if the interrupt routine is written as a PIC (position-independent code) routine. Any interrupt routine written as a device handler must be a PIC routine and must specify this argument.

**Errors:**
None.

**Example:**

```assembly
.TITLE SL11.MAC

; SL11.MAC - This is an example in the use of the .INTEN request.
; The example is an in-line interrupt service routine, which may
; be assembled separately and linked with a mainline program.
; The routine transfers data from a user specified buffer to a DL11
; Serial Line Interface.

; CALLING FORMAT: JSR R5:SL11 ; Initiate Output
; .WORD wordcount ; # words to transfer
; .WORD BUFFER ; Address of Data Buffer

; BUFFER: .BLKW wordcount

.MCALL .INTEN

DLVEC = 304
DLCR = 178504
DLPR1 = 4

SL11: MOV (R5)+,(PC)+
Wcnt: .WORD 0
MOU (R5)+,(PC)+
BUFAD: .WORD 0
ASL NDCNT
BEQ 1
MOU #DLINT,#DLVEC
BIS #100,#DLCSR
1: RETURN

DLINT: .INTEN DLPR1
; I/O Initiation - Get word count
MOV #BUFAD,#DLCSR+2
INC BUFAD
DEO WCNT
BEQ DLDUN
RETURN

DLDUN: BIC #100,#DLCSR
; Get address of Data Buffer
IMake word count byte count
IJust leave if zero word count
IInitialize DL11 interrupt vector
IEnable interrupts
IReturn to caller

; Interrupt service - Notify RT-11
IMake priority to that of DL11
ITransfer a byte
IBump buffer pointer
IAll bytes transferred?
IBranch if yes
INo return from interrupt thru RT-11
IAAll done - disable DL11 interrupts
IREturn thru RT-11
```

### 2.45 .LOCK/.UNLOCK

**LOCK**
The `.LOCK` request keeps the USR in memory to provide any of its services required by your program. If all the conditions that cause swapping are satisfied, the part of the user program over which the USR swaps is written.
into the system swap blocks (the file SWAP.SYS) and the USR is loaded. Otherwise, the copy of the USR in memory is used, and no swapping occurs. (Note that certain calls always require a fresh copy of the USR.) A .LOCK request always causes the USR to be loaded in memory if it is not already in memory. The USR is not released until an .UNLOCK request is given. (Note that under an FB monitor, calling the CSI or using a .GTLIN request can also perform an implicit and temporary .UNLOCK.) A program that has many USR requests to make can .LOCK the USR in memory, make all the requests, and then .UNLOCK the USR.

In an FB environment, a .LOCK inhibits the other job from using the USR. Note that the .LOCK request reduces time spent in file handling by eliminating the swapping of the USR in and out of memory. .LOCK causes the USR to be read into memory or swapped into memory. After a .LOCK has been executed, an .UNLOCK request must be executed to release the USR from memory. The .LOCK/.UNLOCK requests are complementary and must be matched. That is, if three .LOCK requests are issued, at least three .UNLOCK requests must be done, otherwise the USR is not released. More .UNLOCK than .LOCK requests can be issued without error.

Macro Call: .LOCK

Notes:

1. It is vital that the .LOCK call not come from within the area into which the USR will be swapped. If this should occur, the return from the .LOCK request would not be to the user program, but to the USR itself, since the .LOCK function inhibits the user program from being re-read. Also, none of the executable code should be in the area or reference anything in the area that the USR will occupy while it is locked.

2. Once a .LOCK has been performed, it is not advisable for the program to destroy the area the USR is in, even if no further use of the USR is required, because this causes unpredictable results when an .UNLOCK is done.

3. If a foreground job performs a .LOCK request while the background job owns the USR, foreground execution is suspended until the USR is available. In this case, it is possible for the background to lock out the foreground (see the .TLOCK request).

Errors:

None.

Example:

Refer to the example for the .UNLOCK request.

.UNLOCK

The .UNLOCK request releases the User Service Routine (USR) from memory if it was placed there with a .LOCK request. If the .LOCK required a swap, the .UNLOCK loads the user program back into memory. There is a .LOCK count. Each time the user does a .LOCK, the lock count is incremented. When the user does an .UNLOCK, the lock count is decremented. When the lock count goes to 0, the user program is swapped back in (see Note 1).
Macro Call: .UNLOCK

Notes:

1. The number of .UNLOCK requests must at least match the number of .LOCK requests that were issued. If more .LOCK requests are done, the USR remains locked in memory. Extra .UNLOCK requests in your program do no harm since they are ignored.

2. With two running jobs in an FB environment use .LOCK/.UNLOCK pairs only where absolutely necessary. When a job locks the USR, the other job cannot use it until it is unlocked, which can degrade performance in some cases.

3. In an FB environment, calling the CSI with input coming from the console terminal results in an implicit (though temporary) .UNLOCK.

4. Make sure that the .UNLOCK request is not in the area that the USR swaps into. Otherwise, the request can never be executed.

Errors:

None.

Example:

```
.TITLE LOCK.MAC

; This is an example in the use of the .LOCK and .UNLOCK requests. This example tries to obtain as much memory as possible (using the .SETTOP request), which will force the USR into a swapping mode. The .LOCK request will bring the USR into memory (over the high 2K of our little program !) and force it to remain there until an .UNLOCK is issued.

; Pointer to beginning of RMON

.START: .SETTOP @SYSPTR
         .LOCK
         .LOOKUP
         #AREA,#0,#FILE1
         .EXIT
         .PRINT
         #LMSG
         .EXIT

2#: .PRINT
    #FIFND
    #AREA,.R0
    .MOV
    #FILE2,2(R0)
    .PRINT
    #F2FND
    .UNLOCK
    .EXIT

AREA: .BLKW
       3
       /DK/
       /RAD50
       /RAD50
       /RAD50
       /SAV/
       /RAD50
       /RAD50
       /RAD50
       /SAV/
       /RAD50
       /RAD50
       /RAD50
       /SAV/
       /RAD50
       /RAD50
       /TECO
       /RAD50
       /RAD50
       /SAV/
       /ASCIZ
       /ASCIZ
       /ASCIZ
       /ASCIZ
       .EVEN
       .END

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```

```
"ERROR on .LOOKUP?" ERROR MESSAGE
"...Found PIP,SAV/
"...Found TECO,SAV/
```

"Another file we might find
"A File we're sure to find
"EMT Argument Block
"Pointer to beginning of RMON
"Try to allocate all of memory (up to RMON)
"Bring USR into memory
"LOOKUP a file on channel 0
"Branch if successful
"Announce our success
"R0 => EMT Argument Block
"Increment low byte of 1st arg (chan #)
"Fill in pointer to new filespec
"Do the .LOOKUP from filled in arg block
"Pointed to by R0.
"Branch on error
"Save we found it
"Now release the USR
"End exit program
```

"ERROR on .LOOKUP?" ERROR MESSAGE
"...Found PIP,SAV/
"...Found TECO,SAV/
```
2.46 .LOOKUP

A .LOOKUP request can be used in two different ways. The first way is to use the request as a standard lookup, which occurs under the SJ, FB, and XM monitors. The second way is to use the request when the system job feature is implemented. Both ways are described in this section.

2.46.1 Standard Lookup

The .LOOKUP request associates a specified channel with a device and existing file for the purpose of performing I/O operations. The channel used is then busy until one of the following requests is executed:

CLOSE
.SAVESTATUS
.SRESET
.HRESET
.PURGE
.CSIGEN    (if the channel is in the range 0–10 octal)

Note that if the program is overlaid, channel 17(octal) is used by the overlay handler and should not be modified.

If the first word of the file name (the second word of dblk) is 0 and the device is a file-structured device, absolute block 0 of the device is designated as the beginning of the file. This technique is called a non-file-structured .LOOKUP and allows I/O operations to access any physical block on the device. If a file name is specified for a device that is not file structured (such as LP:FILE.TYP), the name is ignored.

The handler for the selected device must be in memory for a .LOOKUP. On return from the .LOOKUP, R0 contains the length in blocks of the file just opened. On a return from a .LOOKUP for a non-directory, file-structured device (typically magtape), R0 contains 0 for the length.

NOTE

Care should be exercised when doing a non-file-structured .LOOKUP on a file-structured device, since if your program writes data, corruption of the device directory can occur and effectively destroy the disk. (The RT-11 directory starts in absolute block 6.)

In particular, avoid doing a .LOOKUP or .ENTER with a file specification where the file value is missing. If the device type is not known in advance and is to be entered from the keyboard, include a dummy file name with the .LOOKUP or .ENTER, even when it is assumed that the device is always non-file structured.

Macro Call: .LOOKUP area,chan,dblk[,seqnum]
where:

area is the address of a three-word EMT argument block
chan is a channel number in the range 0–377 (octal)
dblk is the address of a four-word Radix–50 descriptor of the file to be operated upon
seqnum is a file number for magtape and cassette

If this argument is blank, a value of 0 is assumed.

For magtape, it describes a file sequence number. The action taken depends on whether the file name is given or is null. The sequence number can have the following values:

-1 means suppress rewind and search for a file name from the current tape position. If a file name is given, a file-structured lookup is performed (do not rewind). It is important that only −1 be specified and not any other negative number. If the file name is null, a non-file-structured lookup is done (tape is not moved).

0 means rewind to the beginning of the tape and do a non-file-structured lookup.

n where n is any positive number. This means position the tape at file sequence number n and check that the file names match. If the file names do not match, an error is generated. If the file name is null, a file-structured lookup is done on the file designated by seqnum.

Request Format:

\[ R0 \rightarrow \text{area:} \begin{array}{c}
1 \text{ chan} \\
\text{ dblk} \\
\text{ seqnum}
\end{array} \]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Channel already open.</td>
</tr>
<tr>
<td>1</td>
<td>File indicated was not found on the device.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE LOOKUP.MAC

/* LOOKUP - This is an example in the use of the LOOKUP request. */
/* This example determines whether or not the RT-11 Device Queue */
/* Workfile exists on device DK; and if so, prints its size in */
/* blocks on the console terminal. */
```
2.46.2 System Job Lookup

The foreground and background jobs can send messages to each other via the existing .SDAT/.RCVD/.MWAIT facility. A more general message facility is available to all jobs through the message queue (MQ) handler. By turning message handling into a formal "device" handler, and treating messages as I/O to jobs, the existing .READ/C/W-.WRITE/C/W-.WAIT mechanism can be used to transmit messages. A channel is opened to a job via a .LOOKUP request, after which standard I/O requests are issued to that channel.

Macro Call: .LOOKUP area,chan,jobdes

where:

area is the address of a two-word EMT argument block
chan is the number of the channel to open
jobdes is the address of a four-word descriptor of the job to which messages will be sent or received

jobdes → .RAD50 /MQ/
          .ASCII /logical-job-name/

where logical-job-name can be from one to six characters long. It must be padded with nulls if less than six characters long. If logical-job-name is zero, the channel will be opened for .READ/C/W requests only and such requests will accept messages from any job.
Request Format:

\[ R0 \rightarrow \text{area: } \begin{array}{c} 1 \text{ chan} \\ \text{jobdes} \end{array} \]

The `.LOOKUP` request associates a channel with a specified job for the purposes of sending inter-task messages. R0 is undefined on return from the `.LOOKUP`.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Channel already open.</td>
</tr>
<tr>
<td>1</td>
<td>No such job.</td>
</tr>
</tbody>
</table>

Example:

```
.MAC

; TITLE SJLOOK,MAC

; .LOOKUP - This is an example in the use of the .LOOKUP request
; to open a message channel to a System Job, specifically, the
; RT-11 Device Queue Foreground program. NOTE: This example assumes
; it will be run under an FB Monitor generated with System Job
; Support and that QUEUE,REL has been successfully FRUN/SRUN !!!
;

; MCALL .LOOKUP,.PRINT,.EXIT,.WRITW,.READW

START: .LOOKUP
        ; AREA:=0,;MSG
        BCC 1;
        .PRINT
        .EXIT
        .WRITW
        .READW
        BCS 2;
        .PRINT
        .EXIT
        .PRINT
        .EXIT

AREA:  .BLKW
        5
        ; EMTR Argument Block
QMSG:  .RAD50
        ;MQ/
        .ASCIZ
        ;QUEUE/
        .WORD
        0:0
        ; Dummy message...
RMSG:  .WORD
        0
        .ASCIZ
        ;SJLOOK/
MSGERR: .ASCIZ
        ; Message Error?/
        ; Error Messages, etc.
NOJOB:  .ASCIZ
        ; ?QUEUE is not running?/
GRUN:   .ASCIZ
        ; ? QUEUE is alive and running /
        .EVEN
        .END
        START

2.47 .MAP (XM Only)
```

The `.MAP` request maps a previously defined address window into a dynamic region of extended memory or into the static region in the lower 28K words of memory. If the window is already mapped to another region, an implicit unmapping operation is performed (see the `.UNMAP` programmed request).

Programmed Request Description and Examples   2-71
Macro Call: .MAP area[,addr]

where:

area is the address of a two-word EMT argument block
addr is the address of the window definition block containing a
description of the window to be mapped and the region to
which it will map

Request Format:

\[
R0 \rightarrow \begin{array}{c|c}
\text{area} & 36 \\
\text{addr} & 4 \\
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>An invalid region identifier was specified.</td>
</tr>
<tr>
<td>3</td>
<td>An invalid window identifier was specified.</td>
</tr>
</tbody>
</table>
| 4    | The specified window was not mapped because the offset is
      beyond the end of the region, the region is larger than the
      window, or the window would extend beyond the bounds of
      the region. |

Example:

Refer to example for the .CRAW request.

2.48 .MFPS/.MTPS

The .MFPS and .MTPS macro calls allow processor-independent user access
to the processor status word. The contents of the registers are preserved
across either call.

The .MFPS call is used to read the priority bits only. Condition codes are
destroyed during the call and must be directly accessed (using conditional
branch instructions) if they are to be read in a processor-independent
manner.

In the XM monitor, .MFPS and .MTPS can be used only by privileged jobs
and are not available for use by virtual jobs.

Macro Call: .MFPS addr

where:

\[
\text{addr} \quad \text{is the address into which the processor status is to be stored;}
\quad \text{if} \, \text{addr} \, \text{is not present, the value is returned on the stack. Note}
\quad \text{that only the priority bits are significant}
\]

The .MTPS call is used to set the priority bits.

Macro Call: .MTPS value
where:

value is either the value or the address of the value (depending on addressing mode) to be placed in the PSW. If value is not present, the processor status word is taken from the stack. Note that the high byte on the stack is set to 0 when value is present. If value is not present, you should set the stack to the appropriate value. In either case, the lower byte on the stack is put in the processor status word.

Note:

It is possible to perform MTPS and MFPS operations and access the condition codes by following this special technique:

1. In the beginning of your program, set up the IOT trap vector as follows:

   .ASECT     .SET UP IOT
   _ = 20
   .WORD GETPS
   .WORD 340
   .IOT SERVICE ADDRESS IN 'MFPS' SUBROUTINE
   .PRIORITY 7

2. Elsewhere in your program place the following routines:

   ; MFPS/MTPS ROUTINES ...
   MFPS: IOT    ;EXECUTE IOT
   ; WILL RETURN TO CALLER W/ PS ON STACK
   GETPS: MOV 4(SP),@SP ;PUT USER RETURN ON TOP
   ; MOVE PS SAVED BY IOT
   ; WILL RETURN TO CALLER W/ NEW PS
   MTPS: RTI

3. To get the PSW or to set the PSW to a desired value, follow this sequence of instructions:

   ; TO GET PS ...
   JSR PC,MFPS ;GET PS
   ; CONTINUE, PS IS ON STACK ...

   ; TO PUT PS ...
   MOV NEWPS,-(SP) ;PUT DESIRED PS ON STACK ...
   JSR PC,MTPS ;CALL MTPS
   ; CONTINUE PROCESS W/ NEW PS ...

Errors:

None.
Example:

```
.TITLE MFP5

.*MFP5 / LMP5 - This is an example in the use of the .MFP5 and .MTPS
requests. The example is a skeleton mainline program which calls a
subtract routine to set the next free element in an RTI-like linked queue.

.MC ALL MFP5,MTPS,EXIT,PRINT,TTINR
JSW = 44
TTSRPC = 10000

*i Job Status Word location
i TT Special bit

START:

BIS #TTSRPC,=JSW
CAL GETQUE
L CALL GETQUE

BCC 1S
.MPRINT #NOELEM
.DIC #TTSRPC,=JSW
.EXIT

1S:

NOP
NOP
.MPRINT #GOT1

2S:

.TTINR
BCS 2S
BR START

GETQUE:

MOV @QHEAD,R4
TST @R4
BEQ 1S

.MFPS
.
.MTPS #340

MOV @R4,R5
MOV @R5,=R4

.MTPS
TST (PC)+

1S:

SEC
RETURN

QHEAD:

.WORD Q1
Q1:

.WORD Q2,0,0
Q2:

.WORD Q3,0,0
Q3:

.WORD 0,0,0

NOELEM:

.ASCII /No more Queue Elements Available/

GOT1:

.ASCII /Element acquired...Press any key to continue/

.END

START
```

### 2.49 .MRKT (FB and XM; SJ Monitor Special Feature)

The .MRKT request schedules a completion routine to be entered after a specified time interval (measured in clock ticks) has elapsed. The .MRKT request is an optional feature in the SJ monitor, and is selected as a system generation option.

A .MRKT request requires a queue element taken from the same list as the I/O queue elements. The element is in use until either the completion routine is entered or a cancel mark time request is issued (see .CMKT request). The user should allocate enough queue elements to handle at least as many mark time and I/O requests as are expected to be pending simultaneously.
Macro Call: .MRKT area,time,crt, id

where:

area is the address of a four-word EMT argument block

time is the address of a two word-block containing the time interval (high order first, low order second), specified as a number of clock ticks

crt is the entry point of a completion routine

id is a non-zero number or memory address assigned by the user to identify the particular request to the completion routine and to any cancel mark time requests. The number must not be within the range 177700–177777, which is reserved for system use. The number need not be unique (several .MRKT requests can specify the same id). On entry to the completion routine, the id number is in R0

Request Format:

R0 → area:

<table>
<thead>
<tr>
<th>22</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>time</td>
<td></td>
</tr>
<tr>
<td>crtn</td>
<td></td>
</tr>
<tr>
<td>id</td>
<td></td>
</tr>
</tbody>
</table>

Errors:

Code Explanation

0 No queue element was available.

Example:

.TITLE TREAD.MAC

;MRKT/.CMKT - This is an example in the use of the .MRKT/.CMKT requests
; The example illustrates a user implemented "Timed Read" to cancel an
; input request after a specified time interval.

.MCALL .MRKT,.TTINR,.EXIT,.PRINT,.TTYOUT,.CMKT,.TWAIT,.QSET

LF = 12
JSW = 44
TCDIT$ = 100
RETURN C-bit bit in JSW
TTSC$ = 10000
TTY Special Mode bit in JSW

.START 0

QSET

.PROMT,R0

BUFF,R1

TREAD

BCS 2$ .PRINT $LINE

BR 1$ .PRINT #TIMOUT

#XQUE,'1'

#Need an extra G-Elem for this

#Mainline - R0 => Prompt

R1 => Input buffer

#Do a "timed read"

#C-bit set = Timed out

#"Process" data...

#Go back for more

#Read timed out - could "process"

#Partial data but we'll just exit

2$: #TREAD - "Timed Read" Subroutine

#Input: R0 => Prompt String / R0 = 0 if no prompt

#R1 => Input Buffer

#Output: Buffer contains input chars, if any, terminated by a null char, C-Bit set if timed out

Programmed Request Description and Examples 2–75
2.50 .MTATCH (Special Feature)

The .MTATCH request attaches a terminal for exclusive use by the requesting job. This operation must be performed before any job can use a terminal with multiterminal programmed requests, although a job can issue a .MTGET request before a .MTATCH. If .MTATCH request fails because the terminal is owned by another job, the job number of the owner is returned in R0.

Macro Call: .MTATCH area,addr,unit

where:

- **area** is the address of a three-word EMT argument block
- **addr** is the optional address of an asynchronous terminal status word, or it must be #0 (The asynchronous terminal status word is a special feature that you can select during the system generation process.)
- **unit** is the logical unit number of the terminal (The logical unit number is the number assigned by the system to a particular physical unit during the system generation process.)

Request Format:

\[
\begin{array}{|c|c|}
\hline
\text{R0} & \text{area} \\
\hline
\text{37} & \text{5} \\
\hline
\text{addr} \\
\hline
\text{0} \\
\hline
\text{unit} \\
\hline
\end{array}
\]

2–76 Programmed Request Description and Examples
Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Nonexistent logical unit number.</td>
</tr>
<tr>
<td>3</td>
<td>Invalid request; function code out of range.</td>
</tr>
<tr>
<td>4</td>
<td>Unit attached by another job (job number returned in R0).</td>
</tr>
<tr>
<td>5</td>
<td>In the XM monitor, the optional status word address is not in valid user virtual address space.</td>
</tr>
</tbody>
</table>

Example:

```
 1+ 1 MTXAMP.MAC - The following is an example program that demonstrates the use of the multiterminal
 1 programmed requests. The program attaches all the
 1 terminals on a given system, then proceeds with an
 1 input/echo exercise on all attached terminals until
 1 CTRL/C is sent to it.
 1-

.MCALL .MTATCH,.MTPRNT,.MTGET,.MTIN,.MTOUT
.MCALL .PRINT,.MRTCTO,.MTSET,.MTSTAT,.EXIT

HNGUP$ = 4000  ; Terminal off-line bit
TTSPC$ = 10000 ; ISpecial mode bit
TTLC$ = 40000 ; ILower-case mode bit
AS.INP = 40000 ; IInput available bit
M.TSTS = 0     ; ITerminal status word
M.TSTW = 7     ; ITerminal state byte
M.NLUN = 4     ; IM of LUNs word

MTXAMP:

.MTSTAT #MTA,#MSTAT
MOV MSTAT+M.NLUN,R4 ; IStart of program
BEQ MERR ; IGet MTY status
CLR R1 ; IR4 = # LUNs
MOV R2 ; INone? Not MTY!!!
R2 = AST R2 ; IInitial LUN = 0
R2 → AST word array
10$: .MTATCH MTA,R2,R1 ; IAttach terminal
BCC 20$ ; ISuccess!
BR 30$ ; ISet attach failed
CLRB TAI(R1) ; IProceed with next LUN

20$: MOVB #1,TAI(R1) ; IA t tach successful
MOVB R1,R3 ; ICopy LUN
ASL R3 ; IMultiply by 8 for offset
ASL R3 ; Ito the terminal status
ASL R3 ; Iblock...
ADD TSB,R3 ; IR3 → LUN's TSB
.MTGET MTA,R3,R1 ; IGet LUN's status
BIS TTSPC$+TTLC$,M.TSTS(R3) ; ISet special

30$: ; IM of mode and lower case
BITB HNGUP$/400,M.TSTW(R3) ; IGet line?
BNE 30$ ; INone!
.MRTCTO MTA,R1 ; IReset CTRL/D
.MTPRNT MTA,HELLO,R1 ; ISay hello...
ADD #2,R2 ; IR2 → Next AST word
INC R1 ; IGet next LUN
CMP R1,R4 ; IDone?
BLO 10$ ; INone, so attach another
```

Programmed Request Description and Examples  2-77
LOOP:
CLR R1
MOV #AST,R2
TSTB TAI(R1)
BEQ 20$
BIT #AS.INS,(R2)
BEQ 20$
.MTIN =MTA,#MTCHAR,R1,#1
BCS ERR
.MTOUT =MTA,#MTCHAR,R1,#1
BCS ERR
ADD #2,R2
INC R1
CMP R1,R4
BLO 10$
BR LOOP

ERR: .PRINT #UNEXP
.EXIT
MERR: .PRINT #NDTTY
.EXIT

AST: .BLKW 16.
.TAI: .BLKB 16.

MSTAT: .BLKW 8.
.TSB: .BLKW 16.4.

MTA: .BLKW 4
.MTCHAR: .BYTE 0

HELLO: .ASCII "33>H""33>J"
.ASCIIZ /*Hello! Characters typed will be echoed*/
.NDMTTY: .ASCIIZ /*Not multiterminal system?*/
.UNEXP: .ASCIIZ /*Unexpected error...program aborting?*/
.END MTXAMP

2.51 .MTDTCH (Special Feature)

The .MTDTCH request detaches a terminal from one job and makes it available for other jobs. When a terminal is detached, it is deactivated, and unsolicited interrupts are ignored. Input is disabled immediately, but any characters in the output buffer are printed. Attempts to detach a terminal attached by another job result in an error.

Macro Call: .MTDTCH area,unit

where:

area  is the address of a three-word EMT argument block
unit  is the logical unit number (lun) of the terminal to be detached

Request Format:

R0 → area: 37 | 6
             unused | unit

2-78 Programmed Request Description and Examples
Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Invalid unit number, unit not attached.</td>
</tr>
<tr>
<td>2</td>
<td>Nonexistent logical unit number.</td>
</tr>
<tr>
<td>3</td>
<td>Invalid request; function code out of range.</td>
</tr>
</tbody>
</table>

Example:

```
.MCALL .MTDTCH,.MTPRNT,.MTATCH,.EXIT,.PRINT

START:
  .MTATCH *MTA,*0,*3  !ATTACH TO LUN 3
  BCS 1$              !ATTACH ERROR
  .MTPRNT MTA,*MESS,*3 !PRINT MESSAGE
  .MTATCH *MTA,*3      !DETACH LUN 3
  .EXIT

1$:
  .PRINT *ATTERR      !ATTACH ERROR
  1(PRINTED ON CONSOLE)
  .EXIT

ATTERR: .ASCIZ/ATTACH ERROR/
MESS: .ASCIZ/DETACHING TERMINAL/
.EVEN
MTA: .BLKW 3
.END START
```

2.52 .MTGET (Special Feature)

The .MTGET request returns the status of the specified terminal unit to the caller. If a .MTGET request fails because the terminal is owned by another job, the job number of the owner is returned in R0. You do not need to do an .MTATCH before using the .MTGET request.

Macro Call: .MTGET area,addr,unit

where:

- **area** is the address of a three-word EMT argument block
- **addr** is the address of a four-word status block where the status information is returned
- **unit** is the logical unit number (lun) of the terminal whose status is requested. A unit need not be attached to the job issuing a .MTGET request. If the unit is attached to another job (error code 4), the terminal status will be returned and the job number will be contained in R0. In any other error condition, the contents of R0 are undefined

Request Format:

```
R0 → area: 37 1
           addr
           unit
```
The status block has the following structure:

<table>
<thead>
<tr>
<th>addr→</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M.TSTS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M.TST2</td>
<td></td>
</tr>
<tr>
<td>M.FCNT</td>
<td>M.TFIL</td>
<td></td>
</tr>
<tr>
<td>M.TSW</td>
<td>M.TWID</td>
<td></td>
</tr>
</tbody>
</table>

The following information is contained in the status block:

<table>
<thead>
<tr>
<th>Byte Offset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (M.TSTS)</td>
<td>Terminal configuration word 1</td>
</tr>
<tr>
<td>2 (M.TST2)</td>
<td>Terminal configuration word 2</td>
</tr>
<tr>
<td>4 (M.TFIL)</td>
<td>Character requiring fillers</td>
</tr>
<tr>
<td>5 (M.FCNT)</td>
<td>Number of fillers</td>
</tr>
<tr>
<td>6 (M.TWID)</td>
<td>Carriage width</td>
</tr>
<tr>
<td>7 (M.TSW)</td>
<td>Terminal status byte</td>
</tr>
</tbody>
</table>

Note that if an error occurs, and the error code is not 1 or 4, the status block will not have been modified.

**NOTE**

Use the Bit Set (BIS) and Bit Clear (BIC) instructions instead of Move (MOV) and Clear (CLR) instructions when setting terminal and line characteristics. This avoids changing other bits inadvertently.

The bit definitions for terminal configuration word 1 (M.TSTS) are as follows:

<table>
<thead>
<tr>
<th>Value</th>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>Terminal has hardware tab</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Output RET/LF when carriage width exceeded</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Terminal has hardware form feed</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>Process CTRL/F and CTRL/B (and CTRL/X if system job) as special command characters (if clear, CTRL/F and CTRL/B are treated as ordinary characters)</td>
</tr>
<tr>
<td>100</td>
<td>6</td>
<td>Inhibit TT wait (similar to bit 6 in the Job Status Word)</td>
</tr>
<tr>
<td>200</td>
<td>7</td>
<td>Enable CTRL/S–CTRL/Q processing</td>
</tr>
<tr>
<td>7400</td>
<td>8–11</td>
<td>Line speed (baud rate) mask. Bits 8 through 11 indicate the terminal baud rate (DZ11 and DZV11 only). The values are as follows:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Octal Value of Line Speed Mask (M.TSTS bits 11–8)</th>
<th>Baud Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>50</td>
</tr>
<tr>
<td>0400</td>
<td>75</td>
</tr>
<tr>
<td>1000</td>
<td>110</td>
</tr>
<tr>
<td>1400</td>
<td>134.5</td>
</tr>
<tr>
<td>2000</td>
<td>150</td>
</tr>
<tr>
<td>2400</td>
<td>300</td>
</tr>
<tr>
<td>3000</td>
<td>600</td>
</tr>
<tr>
<td>3400</td>
<td>1200</td>
</tr>
<tr>
<td>Value</td>
<td>Bit</td>
</tr>
<tr>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>4400</td>
<td></td>
</tr>
<tr>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>5400</td>
<td></td>
</tr>
<tr>
<td>6000</td>
<td></td>
</tr>
<tr>
<td>6400</td>
<td></td>
</tr>
<tr>
<td>7000</td>
<td></td>
</tr>
<tr>
<td>7400</td>
<td></td>
</tr>
<tr>
<td>10000</td>
<td>12</td>
</tr>
<tr>
<td>20000</td>
<td>13</td>
</tr>
<tr>
<td>40000</td>
<td>14</td>
</tr>
<tr>
<td>100000</td>
<td>15</td>
</tr>
</tbody>
</table>

The bit definitions for terminal configuration word 2 (M.TST2) are as follows:

<table>
<thead>
<tr>
<th>Value</th>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0–1</td>
<td>Character length, which can be 5(00), 6(01), 7(10), or 8(11) bits (DZ only)</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Unit stop, which sends one stop bit when clear, two stop bits when set (DZ only)</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>Parity enable (DZ only)</td>
</tr>
<tr>
<td>20</td>
<td>4</td>
<td>Odd parity when set; even parity when clear</td>
</tr>
<tr>
<td>140</td>
<td>5–6</td>
<td>Reserved</td>
</tr>
<tr>
<td>200</td>
<td>7</td>
<td>Read pass all</td>
</tr>
<tr>
<td>77400</td>
<td>8–14</td>
<td>Reserved</td>
</tr>
<tr>
<td>100000</td>
<td>15</td>
<td>Write pass all</td>
</tr>
</tbody>
</table>

The bit definitions for terminal status byte (M.TSTW) are as follows:

<table>
<thead>
<tr>
<th>Value</th>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>10</td>
<td>Terminal is shared console</td>
</tr>
<tr>
<td>4000</td>
<td>11</td>
<td>Terminal has hung up</td>
</tr>
<tr>
<td>10000</td>
<td>12</td>
<td>Terminal interface is DZ11</td>
</tr>
<tr>
<td>40000</td>
<td>14</td>
<td>Double CTRL/C was struck (the .MTGET request resets this bit in the terminal control block if it is on)</td>
</tr>
<tr>
<td>100000</td>
<td>15</td>
<td>Terminal is acting as console</td>
</tr>
</tbody>
</table>

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Invalid unit number, unit not attached.</td>
</tr>
<tr>
<td>2</td>
<td>Nonexistent logical unit number.</td>
</tr>
<tr>
<td>3</td>
<td>Invalid request; function code out of range.</td>
</tr>
<tr>
<td>4</td>
<td>Unit attached by another job (job number returned in R0).</td>
</tr>
<tr>
<td>5</td>
<td>In the XM monitor, the status block address is not in valid user virtual address space.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .MTATCH request.
The .MTIN request reads characters from the keyboard buffer. It is the multiterminal form of the .TTYIN request. The .MTIN request moves one or more characters from the input ring buffer to a buffer specified by you. The terminal must be attached. An updated user buffer address is returned in R0 if the request is successful. If bit 6 is set in the M.TSTS word (see the MTSET request), the .MTIN request returns immediately with the carry bit set (code 0) if there is no input available. Operation is similar for the system console if bit 6 is set in the JSW. If bit 12 in M.TSTS is clear, no line is available; if bit 12 is set, there are no characters in the buffer. If these conditions do not exist, the .MTIN request waits until input is available, and the job is suspended until input is available.

The meaning of bits 6 and 12 in the terminal configuration word (M.TSTS) for the programmed request .MTIN is as follows:

<table>
<thead>
<tr>
<th>Bit 6</th>
<th>Bit 12</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Normal mode of input (echo provided); wait for line</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Carry bit set: no line available</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Carry bit set: no character available; no echo provided</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>No echo provided</td>
</tr>
</tbody>
</table>

If a multiple-character request was made and the number of characters requested are not available, the request can either wait for the characters to become available, or it can return with a partial transfer. If bit 6 of M.TSTS is clear, the request waits for more characters. If bit 6 is set, the request returns with a partial transfer. In the latter case, R0 contains the updated buffer address (pointing past the last character transferred), the C bit is set, and the error code is 0.

The .MTIN request has the following form:

Macro Call: .MTIN area,addr,unit[,chrcnt]

where:

- area is the address of a three-word EMT argument block
- addr is the byte address of the user buffer
- unit is the logical unit number of the terminal input
- chrcnt is a character count indicating the number of characters to transfer. The valid range is from 1 to 255(decimal). A character count of zero means one character

Request Format:

R0 → area: 37 2

<table>
<thead>
<tr>
<th></th>
<th>addr</th>
<th>chrcnt</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>addr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chrnt</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No input available — bit 6 is set in the Job Status Word (for the system console) or in M.TSTS by the .MTSET request.</td>
</tr>
<tr>
<td>1</td>
<td>Invalid unit number, unit not attached.</td>
</tr>
<tr>
<td>2</td>
<td>Nonexistent logical unit number.</td>
</tr>
<tr>
<td>3</td>
<td>Invalid request; function code out of range.</td>
</tr>
<tr>
<td>5</td>
<td>In the XM monitor, the user buffer address is not in valid user virtual address space.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .MTATCH request.

2.54 .MTOOUT (Special Feature)

The .MTOOUT request transfers characters to the terminal output buffer. This request is the multiterminal form of the .TTYOUT request. The .MTOOUT request moves one or more characters from the user’s buffer to the output ring buffer of the terminal. The terminal must be attached. An updated user buffer address is returned in R0 if the request is successful. When there is no room in the output ring buffer, the carry bit is set and an error code of 0 is returned in byte 52 if bit 6 is set in M.TSTS. Otherwise, the job is suspended until room becomes available.

If a multiple-character request was made and there is not enough room in the output ring buffer to transfer the requested number of characters, the request can either wait for enough room to become available, or it can return with a partial transfer. If bit 6 in M.TSTS is clear, the request waits until it can complete the full transfer. If bit 6 is set, the request returns with a partial transfer. In the latter case, R0 contains the updated buffer address (pointing past the last character transferred), the C bit is set, and the error code is 0.

The meaning of bit 6 in the terminal configuration word (M.TSTS) for the .MTOOUT request is as follows:

<table>
<thead>
<tr>
<th>Bit 6</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal mode for output; wait for room in buffer</td>
</tr>
<tr>
<td>1</td>
<td>Carry bit set: no room in output ring buffer</td>
</tr>
</tbody>
</table>

Macro Call: .MTOOUT area,addr,unit[,chrcnt]

where:

area is the address of a three-word EMT argument block
addr is the address of the caller’s input buffer
unit is the unit number of the terminal
chrcnt is a character count indicating the number of characters to transfer. The valid range is from 1 to 255(decimal)

Request Format:

\[
\begin{array}{c|c|c}
\hline
& 37 & 3 \\
\hline
\text{chrcnt} & \text{unit} & \text{addr} \\
\hline
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No room in output buffer.</td>
</tr>
<tr>
<td>1</td>
<td>Invalid unit number, unit not attached.</td>
</tr>
<tr>
<td>2</td>
<td>Nonexistent logical unit number.</td>
</tr>
<tr>
<td>3</td>
<td>Invalid request; function code out of range.</td>
</tr>
<tr>
<td>5</td>
<td>In the XM monitor, the user buffer address is not in valid user virtual address space.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .MTATCH request.

2.55 .MTPRNT (Special Feature)

This .MTPRNT request allows one or more lines to be printed at the specified terminal in a multiterminal environment. It is equivalent to the .PRINT request (see .MTSET request for more details). The string to be printed must be terminated with a null byte or a 200 byte, similar to the string used with the .PRINT request as follows:

```
.MTSET /string/
```

or

```
.MTSET /string/\0
```

The null byte causes a carriage return/line feed combination to be printed after the string. The 200 byte suppresses the carriage return/line feed combination and leaves the carriage positioned after the last character of the string. The request does not return until the transfer is complete.

Macro Call: .MTPRNT area,addr,unit

where:

- area is the address of a three-word EMT argument block
- addr is the starting address of the character string to be printed
- unit is the unit number associated with the terminal
Request Format:

\[
\begin{array}{c}
R0 \rightarrow \text{area:} \\
37 \quad 7 \\
\text{addr} \\
- \quad \text{unit}
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Invalid unit number, unit not attached.</td>
</tr>
<tr>
<td>2</td>
<td>Nonexistent logical unit number.</td>
</tr>
<tr>
<td>3</td>
<td>Invalid request; function code out of range.</td>
</tr>
<tr>
<td>5</td>
<td>In the XM monitor, the character string address is not in valid user virtual address space.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .MTATCH request.

2.56 .MTPS

See .MFPS/.MTPS (Section 2.48).

2.57 .MTRCTO (Special Feature)

The .MTRCTO request resets the CTRL/O switch of the specified terminal and enables terminal output in a multiterminal environment. It is equivalent to the .RCTRLO request.

Macro Call: .MTRCTO area,unit

where:

- area is the address of a three-word EMT argument block
- unit is the unit number associated with the terminal

Request Format:

\[
\begin{array}{c}
R0 \rightarrow \text{area:} \\
37 \quad 4 \\
\text{unused} \\
- \quad \text{unit}
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Invalid unit number, unit not attached.</td>
</tr>
<tr>
<td>2</td>
<td>Nonexistent logical unit number.</td>
</tr>
<tr>
<td>3</td>
<td>Invalid request; function code out of range.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .MTATCH request.
2.58 .MTSET (Special Feature)

This multiterminal request sets terminal and line characteristics. It also determines the input/output mode of the terminal service requests for the specified terminal.

Macro Call: .MTSET area, addr, unit

where:

area is the address of a three-word EMT argument block

addr is the address of a four-word status block containing the line and terminal status being requested

unit is the logical unit number associated with the line and terminal

Request Format:

R0 → area:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>1</td>
</tr>
<tr>
<td>addr</td>
<td></td>
</tr>
<tr>
<td>— unit</td>
<td></td>
</tr>
</tbody>
</table>

When the program returns from the request, the status block contains the following information:

<table>
<thead>
<tr>
<th>Byte Offset</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Terminal configuration word 1 (The bit definitions are the same as those for the .MTGET request.)</td>
</tr>
<tr>
<td>2</td>
<td>Terminal configuration word 2 (The bit definitions are the same as those for the .MTGET request.)</td>
</tr>
<tr>
<td>4</td>
<td>Character requiring fillers</td>
</tr>
<tr>
<td>5</td>
<td>Number of fillers</td>
</tr>
<tr>
<td>6</td>
<td>Carriage width (byte)</td>
</tr>
</tbody>
</table>

**NOTE**

The .MTSET request sets all of the parameters listed above. The recommended procedure for using .MTSET is: (1) precede it by an .MTGET request; (2) use BIS and BIC instructions to set or clear bit fields (modify only the bits or bytes that you intend to change); (3) issue the .MTSET request to replace the previous terminal status with the updated status.

Note that if an error occurs, and the error code is not 1, the status block will not have been modified.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Invalid unit number, lun not attached.</td>
</tr>
<tr>
<td>2</td>
<td>Nonexistent logical unit number.</td>
</tr>
</tbody>
</table>
3 Invalid request, function code out of range.
5 In the XM monitor, the status block address is not in valid user virtual address space.

Example:

Refer to the example for the .MTATCH request.

2.59 .MTSTAT (Special Feature)

The .MTSTAT request returns multiterminal system status information.

Macro Call: .MTSTAT area,addr

where:

area is the address of a three-word EMT block
addr is the address of an eight-word status block where multiterminal status information is returned. The status block contains the following information:

<table>
<thead>
<tr>
<th>Byte Offset</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Offset from the base of the resident monitor to the first terminal control block (TCB)</td>
</tr>
<tr>
<td>2</td>
<td>Offset from the base of the resident monitor to the terminal control block of the console terminal for the program</td>
</tr>
<tr>
<td>4</td>
<td>The value (0–16 decimal) of the highest logical unit number (LUN) built into the system</td>
</tr>
<tr>
<td>6</td>
<td>The size of the terminal control block in bytes</td>
</tr>
<tr>
<td>10–17</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

Request Format:

\[
\begin{array}{c|c|c}
R0 & \rightarrow & \text{area:} \\
\hline
\text{37} & \text{10} & \\
\hline
\text{addr} & \\
\hline
\text{0} & \\
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Invalid request; function code out of range</td>
</tr>
<tr>
<td>5</td>
<td>In XM, the status block address is not in valid user address space</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .MTATCH request.
2.60 .MWAIT (FB and XM Only)

This request is similar to the .WAIT request. .MWAIT, however, suspends execution of the job issuing the request until all messages sent to the other job or requested from the other job have been received. It should be used with the .RCVD or .SDAT modes of message handling, where no action is taken when a message is completed.

Macro call: .MWAIT

Request Format:

\[
R0 = 11 \quad 0
\]

Errors:

None.

Example:

```
+.MWAIT - This is an example in the use of the .MWAIT request.
+ The example is actually two programs, a Background Job
+ which sends messages, and a Foreground Job, which receives them.
+ NOTE: Each program should be assembled and linked separately.
-.
.
.TITLE MWAITF.MAC
+ Foreground Program ...
-.
.
.MCALL .RCVD,.MWAIT,.PRINT,.EXIT

MWAITF: .RCVD
  #AREA,#MBUFF,#GO.
  #\n  #No error possible - always a BG
  #\n  #Do some other processing
  #like announcing FG active...
  #\n  #\n  #MWAIT
  TST MBUFF+2
  BEQ FMGS
  PRINT #MSG
  #\n  #\n  #MWAIT
  TST MBUFF+2
  BR MWAITF

FEXIT: .EXIT
.
AREA: .BLKW 5
MBUFF: .BLKW 41
.WORD 0

FGJOB: .ASCIZ /Hi - FG alive and well and waiting for a message!/
FMSG: .ASCIZ /Hey BG - Got your message it reads:/
.END MWAITF

.TITLE MWAITB.MAC
+ Background Program - Send a 'null' message to stop both programs
-.
.
.MCALL .SDAT,.MWAIT,.GTLIN,.EXIT,.PRINT

MWAITB: CLR
  #BUFF,.PROMT
  .SDAT
  #AREA,#MBUFF,#40.
  SCS 1
  #\n  #Clear list word
  #Get something to send to FG from TTY
  #Send input as message to FG
  #Branch on error - No FG
  #Wait for message to be sent
```

2-88 Programmed Request Description and Examples
2.61 .PEEK/.POKE

The .PEEK programmed request returns in R0 the contents of a memory location; .POKE changes the contents of a memory location. The .POKE request also returns the old contents of the memory location in R0 to simplify the saving and restoring of a location. .PEEK and .POKE must be used in an XM environment to change memory locations that are not defined as monitor fixed offsets, and should be used with all RT-11 monitors for compatibility.

Although .PEEK and .POKE may seem very similar to .GVAL and .PVAL, respectively, they are different in the way they refer to locations. .GVAL and .PVAL access only monitor fixed offsets. All offsets used by .GVAL and .PVAL are calculated relative to the base of the resident monitor. Addresses used by .PEEK and .POKE, on the other hand, are simply memory addresses. Although .PEEK and .POKE can be used to access monitor fixed offsets, this requires that you find the base address of RMON, add the offset value, and use the resulting address as an argument to .PEEK or .POKE.

Macro Calls: .PEEK area, address

.POEK area, address,value

where:

area is the address of a two- or three-word EMT argument block
address is the address of the location to examine or change
value is the new contents to place in the location

Request Format for .PEEK:

\[
R0 \rightarrow \text{area: } \begin{array}{c|c|c}
34 & 1 & \\
\hline
\end{array} \\
\text{address}
\]

Request Format for .POKE:

\[
R0 \rightarrow \text{area: } \begin{array}{c|c|c}
34 & 3 & \\
\hline
\end{array} \\
\text{address} \\
\text{value}
\]

Errors:
None.
Example:

This example illustrates a way of reading and setting the default file size used by the .ENTER request. Normally, this would be done using the .GVAL and .PVAL programmed requests. (Refer to the example given for the .PVAL request.) This example computes the address of the word in RMON containing the default file size used by the .ENTER request and uses .POKE both to change the default file size to 100, blocks and to return the old default file size in R0.

```
.MCALL  .PEEK,  .POKE,  .EXIT
RMON=  54
MAXBLK=  314
```

[start of code]

```
PEEK  #EMTBLK, #RMON
ADD  #MAXBLK, R0
MOV  R0,  R1
POKE  #EMTBLK, R1,  #NEWSIZ
MOV  R0,  OLDSIZ
EXIT
```

[end of code]

Pick up base of RMON from loc. 54
Add fixed offset of default file size
Set a new default file size, return old default file size in R0 and save the old size.
We'll just exit now, but presumably in a real program we'd do more processing, perhaps creating files with the new default size we just set, then before exiting we'd restore the old default size.

.EMT area
.EMT area

The old default size is saved here.

2.62 .POKE

Refer to .PEEK/.POKE (Section 2.61).

2.63 .PRINT

The .PRINT request causes output to be printed at the console terminal. The string to be printed can be terminated with either a null (0) byte or a 200 byte. If the null (ASCII) format is used, the output is automatically followed by a carriage return/line feed combination. If a 200 byte terminates the string, no carriage return/line feed combination is generated.

Control returns to the user program after all characters have been placed in the output buffer.

When a foreground job is running and the job that is producing output changes, a B> or F> appears. Any text following the message has been printed by the job indicated (foreground or background) until another B> or F> is printed.

When a system job prints a message to the terminal, the message is preceded by logical-job-name.

If the foreground job issues a message using .PRINT, the message is printed immediately, no matter what the state of the background job. Thus, for urgent messages, the .PRINT request should be used (rather than .TTYOUT or .TTOUTR). The .PRINT request forces a console switch and guarantees printing of the input line. If a background job is doing a prompt
and has printed an asterisk but no carriage return/line feed combination, the console belongs to the background and .TTYOUTs from the foreground are not printed until a carriage return is typed to the background. A foreground job can force its message through by doing a .PRINT instead of the .TTYOUT.

Macro Call: .PRINT addr

where:

addr is the address of the string to be printed

Errors:

None.

Example:

```
.TITLE PRINT.MAC

/*
  .PRINT - This is an example in the use of the .PRINT request.
  The example merely accepts input from the console terminal and
  echoes it back.
*/

.MCALL .GLTIN,.PRINT,.EXIT

START:  .GLTIN  #BUFF,#PROMT  //Get a line of input from keyboard
        BUFF
        1$  //Nothing entered?
        BEG  //Branch if nothing entered
        .PRINT  #BUFF
        CLRBUF //Echo the input back
        BR  //Clear first char of buffer
        START  //Go back for more
        1$: .EXIT //Exit program on null input
        BUFF: .BLKW  //180 character buffer (ASCIZ for .PRINT)
        PROMT: .ASCII //Enter something/<15><12>/<200>
        END  //Start

```

2.64 .PROTECT/.UNPROTECT (FB and XM Only)

.PROTECT
The .PROTECT request allows a job to obtain exclusive control of a vector (two words) in the region 0 to 474. If the request is successful, it indicates that the locations are not currently in use by another job or by the monitor. The job then can place an interrupt address and priority into the protected locations and begin using the associated device.

Macro Call: .PROTECT area,addr

where:

area is the address of a two-word EMT argument block

addr is the address of the word pair to be protected

NOTE

The argument addr must be a multiple of four, and must be less than or equal to 474 (octal). The two words at addr and addr + 2 are protected.
Request Format:

R0 → area: 31 0

addr

Errors:

Code       Explanation

0          Protect failure; locations already in use.
1          Address (addr) is greater than 474 or is not a multiple of 4.

Example:

.TITLE PROTEC.MAC

+  
|.PROTECT / .UNPROTECT - This is an example in the use of the .PROTECT 
| and .UNPROTECT requests. The example illustrates how to protect the 
| vectors of a device while an inline interrupt service routine does  
| a data transfer (in this case the device is a DL1I Serial Line Interface). 
| When the program is finished, the vectors are unprotected for possible 
| use by another Job. 
+  

.MCALL .DEVICE, EXIT, .PROTECT, .UNPROTECT, .PRINT

START: .DEVICE AREA, LIST .AREA, #300 .AREA, #300 .AREA, #300 .AREA, #300

.PROTECT .PROTECT .PROTECT .PROTECT

BGS .BGS .BGS .BGS

EXIT .EXIT .EXIT .EXIT

JSR .JSR .JSR .JSR

R5, D111 .R5, D111 .R5, D111 .R5, D111

.WORD 128

.WORD .WORD .WORD .WORD

BUFFR .BUFFR .BUFFR .BUFFR

1 .1 .1 .1

FINS: .UNPROTECT .UNPROTECT .UNPROTECT .UNPROTECT .UNPROTECT .UNPROTECT

.EXIT .EXIT .EXIT .EXIT .EXIT .EXIT

BUSY: .PRINT .NOVEC .PRINT .NOVEC .PRINT .NOVEC

.EXIT .EXIT .EXIT .EXIT .EXIT .EXIT

AREA: .BLKH 3 .BLKH 3 .BLKH 3 .BLKH 3

LIST: .WORD 176500 .WORD 176500 .WORD 176500 .WORD 176500

.WORD 0 .WORD 0 .WORD 0 .WORD 0

.BUFFR .BUFFR .BUFFR .BUFFR

.REPT .REPT .REPT .REPT

8, .8, .8, .8,

ASCZ .ASCZ .ASCZ .ASCZ

/HELLO DLII... ARE YOUI THERE??/ .HELLO DLII... ARE YOUI THERE??/ .HELLO DLII... ARE YOUI THERE??/ .HELLO DLII... ARE YOUI THERE??/

.NOVEC: .ASCZ .ASCZ .ASCZ .ASCZ

/ ?VECTOR ALREADY PROTECTED/ . ERROR MESSAGE TEXT . ERROR MESSAGE TEXT . ERROR MESSAGE TEXT . ERROR MESSAGE TEXT

.END START

.UNPROTECT
The .UNPROTECT request is the complement of the .PROTECT request. It 
cancels any protected vectors in the 0 to 476 area. An attempt to unprotect 
 a vector that a job has not protected is ignored.

Macro Call: .UNPROTECT area, addr

where:

area    is the address of a two-word EMT argument block

2–92 Programmed Request Description and Examples
addr is the address of the protected vector pair that is going to be canceled. The argument addr must be a multiple of four, and must be less than or equal to 474(octal)

Request Format:

```
R0 → area:

<table>
<thead>
<tr>
<th>31</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>addr</td>
<td></td>
</tr>
</tbody>
</table>
```

Errors:

**Code** | **Explanation**
---|---
1 | Address (addr) is greater than 474(octal) or is not a multiple of four.

Example:

Refer to the example for the .PROTECT request.

### 2.65 .PURGE

The .PURGE request deactivates a channel without performing a .HRESET, .SRESET, .SAVESTATUS, or .CLOSE request. .PURGE frees a channel without taking any other action. If a tentative file has been entered on the channel, the file is discarded. An attempt to purge an inactive channel is ignored.

**NOTE**

Do not purge channel 17(octal) if your program is overlaid because overlays are read on that channel.

Macro Call: .PURGE chan

where:

chan is the number of the channel to be freed

Request Format:

```
R0 = 3 chan
```

Errors:

None.

Example:

```
.TITLE PURGE.MAC

; This is an example in the use of the PURGE request.
; This example merges 2-6 files into 1 file, making use of .SAVESTATUS
; and .REOPEN to read all input files on one channel. The .PURGE request
; is used to free the input channel after each transfer.

.MCALL .CSIGEN,.SAVESTATUS,.REOPEN,.CLOSE,.EXIT
```

Programmed Request Description and Examples 2-93
2.66 .PVAL

See .GVAL/.PVAL (Section 2.41).

2.67 .QELDF (Device Handler Only)

The .QELDF macro symbolically defines queue element offsets for the specified set of system generation special features. The queue element offsets generated by this macro are as follows:

Q.LINK = 0  (Link to next queue element)
Q.CSW = 2   (Pointer to channel status word)
Q.BLKN = 4  (Physical block number)
Q.FUNC = 6.  (Special function code)
Q.JNUM = 7.  (Job number)
QUNIT = 7.   (Device unit number)
Q.BUFF = 'O10 (User virtual memory buffer address)
Q.WCNT = 'O12 (Word count)
Q.COMP = 'O14 (Completion routine code)

Since the handler usually deals with queue element offsets relative to
Q.BLKN, the .QELDF macro also defines the following symbolic offsets:

Q$LINK = -4
Q$CSW = -2
Q$BLKN = 0
Q$FUNC = 2
Q$JNUM = 3
Q$UNIT = 3
Q$BUFF = 4
Q$WCNT = 6
Q$COMP = 'O10

For SJ and FB systems:
Q.ELGH = 'O16  (End of queue element; used to find length)

For XM systems:
Q.PAR = 'O16   (PAR1 relocation bias)
Q$PAR = 'O12
Q.ELGH = 'O24  (End of queue element; used to find length)

Example:
Refer to the example following the description of .DRAST.

2.68 .QSET

The .QSET request allows additional entries to be made to the RT–11 I/O
queue. A general rule to follow is that each program should contain one
more queue element than the total number of I/O requests that will be
active simultaneously on different channels. Timing and message requests
such as .MRKT, .TWAIT, .SDAT/C, and .RCVD/C also require queue ele-
ments and must be considered when allocating queue elements for a pro-
gram. Note that if synchronous I/O is done (such as .READW/.WRITW) and
no timing requests are done, no additional queue elements need be allo-
cated.

Each time .QSET is called, a specified contiguous area of memory is divided
into seven-word segments (10-word [decimal] segments for the XM monitor)
and is added to the queue for that job. .QSET can be called as many times
as required. The queue set up by multiple .QSET requests is a linked list.
Thus, .QSET need not be called with strictly contiguous arguments. The
space used for the new elements is allocated from your program space. Care
must be taken so that the program in no way alters the elements once they
are set up. The .SRESET and .HRESET requests discard all user-defined
queue elements; therefore any previous .QSET requests must be reissued. However, you must not specify the same space in two separate .QSET requests if there has been no intervening .SRESET or .HRESET request.

Care should also be taken to allocate sufficient memory for the number of queue elements requested. The elements in the queue are altered asynchronously by the monitor; if enough space is not allocated, destructive references occur in an unexpected area of memory. The monitor returns the address of the first unused word beyond the queue elements. Other restrictions on the placement of queue elements are that the USR must not swap over them and they must not be in an overlay region. For jobs that run under the XM monitor, queue elements must be allocated in the lower 28K words of memory, since they must be accessible in kernel mapping. In addition, the elements must not be in the virtual address space mapped by kernel PAR1, specifically the area from 20000 to 37776(octal).

NOTE

Programs that are to run in XM as well as SJ or FB environments should allocate 10(decimal) words for each queue element. Alternatively, a program can specify the start of a large area and use the returned value in R0 as the top of the queue element.

The following programmed requests require queue elements:

.TWAIT .READW .WRITE .SDAT
.MRKT .RCVD .WRITC .SDATC
.READ .RCVDC .WRITW .SDATW
.READC .RCVDW

Macro Call: .QSET addr,len

where:

addr  is the address at which the new elements are to start
len   is the number of entries to be added. In the SJ and FB monitor, each queue entry is seven words long; hence the space set aside for the queue should be \( \text{len} \times 7 \) words. In the XM monitor, 10(decimal) words per queue element are required

On completion, R0 contains the address of the first word beyond the allocated queue elements.

Errors:

In an extended memory environment, an attempt to violate the PAR1 restriction results in a ?MON-F-addr error, which can be intercepted with a .SERR programmed request.

Example:

```plaintext
.TITLE QSET.MAC

.QSET - This is an example in the use of the .QSET request.

The example illustrates a user implemented "Timed Read" to cancel an
```
2.69 .RCTRL0

The .RCTRL0 request makes sure that the console terminal is able to print by resetting the CTRL/O switch for the terminal. A CTRL/O typed while output is directed to the console terminal inhibits the output from printing until either another CTRL/O is struck or the program resets the CTRL/O switch. Therefore, a program with a message that must appear at the console should reset the CTRL/O switch.
A program should also issue a .RCTRLO request whenever it changes the contents of the job status word (JSW). Issuing a .RCTRLO request updates the monitor's internal status information to reflect the current contents of the JSW.

Macro Call: .RCTRLO

Errors:

None.

Example:

```assembly
.TITLE RCTRLO.MAC

; .RCTRLO - This is an example in the use of the .RCTRLO request.
; In this example, the user program first calls the CSI in general mode,
; then processes the command. When finished, it returns to the CSI for
; another command line. To make sure that the prompt is 'e' typed by
; the CSI is not inhibited by a CTRL-D in effect from the last operation,
; terminal output is assured via the .RCTRLO request prior to the
; CSI call.

.MCALL .RCTRLO,.CSIGEN,.EXIT

START:
.RCTRLO
.CSIGEN
#DSpace,#DExt,0

; Make sure terminal output is enabled
; Issue a .CSIGEN request to set
; command
; (CSI will prompt with 'e')
; Process the command...
; Get another command...
JMP START

DExt: .WORD 0,0,0,0
; No default extensions

DSpace: =
; Space for handlers starts here

.END START
```

2.70 .RCVD/.RCVDC/.RCVDW (FB and XM Only)

The .RCVD (receive data) request allows a job to read messages or data sent by another job in an FB environment.

There are three forms of the .RCVD request, and they are used with the .SDAT (send data) request. The send data-receive data request combination provides a general data/message transfer system for communication between a foreground and a background job. .RCVD requests can be thought of as .READ requests where data transfer is not from a peripheral device but from the other job in the system. Additional queue elements should be allocated for buffered I/O operations in .RCVD and .RCVDC requests (see the .QSET request). Under an FB monitor with the system job feature, .RCVD/C/W requests and .SDAT/C/W requests remain valid for sending messages between background and foreground jobs in addition to the general read and write capability available to all jobs.

Be particularly careful if you use both synchronous (.RCVDW and .SDATW) and asynchronous (.RCVDC and .SDATC) requests in the same
program. If you issue a mainline .SDATW while there is a pending .RCVDC, the .SDATW will wait until the .RCVDC is satisfied. If the completion routine for the .RCVDC issues another .RCVDC, the mainline .SDATW will never complete. In general, you should avoid the use of both synchronous and asynchronous message requests in the same program.

.RCVD
This request is used to receive data and continue execution. The request is posted and the issuing job continues execution. When the job needs to have the transmitted message, an .MWAIT should be executed. This causes the job to be suspended until all .SDATx and .RCVDx requests for the job are complete.

Macro Call: .RCVD area,buf,wcnt

where:

  area   is the address of a five-word EMT argument block
  buf    is the address of the buffer into which the message length/message data is to be placed
  wcnt   is the number of words to be transferred

Request Format:

```
R0 → area:
     26 | 0
          reserved
          buf
          wcnt
          1
```

Upon completion of the .RCVD, the first word of the message buffer contains the number of words transmitted. Thus, the space allocated for the message should always be at least one word larger than the actual message size expected. If the sending job attempts to send more words than the receiver specified in the wcnt argument of the .RCVD request, the first word of the buffer will contain the number of words that the sender specified, but only wcnt words will be actually transferred. The rest of the sender’s message will be ignored.

The word count is a variable number, and as such, the .SDAT/.RCVD combination can be used to transmit a few words or entire buffers. The .RCVD operation is only complete when a .SDAT is issued from the other job.

Programs using .RCVD/.SDAT must be carefully designed to either always transmit/receive data in a fixed format or to have the capability of handling variable formats. Messages are all processed in first-in first-out order. Thus, the receiver must be certain it is receiving the message it actually wants. Message handling in the FB monitor does not check for a word count of zero before queuing a send or receive data request. Since RT-11 distinguishes a send from a receive by complementing the word count, a .SDAT of zero words is treated as a .RCVD of zero words. Avoid a word count of zero at all times when using a .RCVD request.
Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No other job exists in the system. (A job exists as long as it is loaded, whether or not it is active.)</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .SDAT request.

.RCVDC

The .RCVDC request receives data and enters a completion routine when the message is received. The .RCVDC request is posted and the issuing job continues to execute. When the other job sends a message, the completion routine specified is entered.

Macro Call: .RCVDC area,buf,wcnt,crt

where:

area is the address of a five-word EMT argument block
buf is the address of the buffer into which the message length/message data is to be placed
wcnt is the number of words to be transmitted
crt is the address of a completion routine to be entered

As in the .RCVD request, word 0 of the buffer contains the number of words transmitted when the transfer is complete.

Request Format:

\[
\begin{array}{c|c}
R0 \to \text{area:} & 26 \\ 
& 0 \\ 
& \text{reserved} \\ 
& \text{buf} \\ 
& \text{wcnt} \\ 
& \text{crt} \\
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No other job exists in the system. (A job exists as long as it is loaded, whether or not it is active.)</td>
</tr>
</tbody>
</table>
.RCVDW is used to receive data and wait. A message request is posted and the job issuing the request is suspended until all pending .SDATTx and .RCVDx requests for the job are complete. When the issuing job runs again, the message has been received, and word 0 of the buffer indicates the number of words transmitted.

Macro Call: .RCVDW area, buf, wcnt

where:

area is the address of a five-word EMT argument block
buf is the address of the buffer into which the message length/message data is to be placed
wcnt is the number of words to be transmitted

Request Format:

<table>
<thead>
<tr>
<th>R0 →</th>
<th>area:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>reserved</td>
</tr>
<tr>
<td></td>
<td>buf</td>
</tr>
<tr>
<td></td>
<td>wcnt</td>
</tr>
</tbody>
</table>

Programmed Request Description and Examples 2-101
Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No other job exists in the system. (A job exists as long as it is loaded, whether or not it is active.)</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .SDATW request.

2.71 .RDBBK (XM Only)

The .RDBBK macro defines symbols for the region definition block and reserves space for it. The .RDBBK automatically invokes .RDBDF.

Macro Call: .RDBBK rgsiz

where:

rgsiz is the size of the dynamic region needed (expressed in 32-word units)

Example:

See Chapter 4 of the RT-11 Software Support Manual for an example that uses the .RDBBK macro and a detailed description of the extended memory feature.

2.72 .RDBDF (XM Only)

The .RDBDF macro defines the symbolic offset names for the region definition block and the names for the region status word bit patterns. In addition, this macro also defines the length of the region definition block by setting up the following symbol:

R.GLGH = 6

The .RDBDF macro does not reserve space for the region definition block.

Macro Call: .RDBDF

The .RDBDF macro expands as follows:

- R.GID = 0
- R.GSIZ = 2
- R.GSTS = 4
- R.GLGH = 6
- RS.CRR = 100000
- RS.UNM = 40000
- RS.NAL = 20000

2.73 .READ/.READC/.READW

Read operations for the three modes of RT-11 I/O are done using the .READ, .READC, and READW programmed requests.
In the case of .READ and .READC, additional queue elements should be allocated for buffered I/O operations (see the .QSET request).

Upon return from any .READ, .READC, or .READW programmed request, R0 contains the number of words requested if the read is from a sequential-access device (for example, paper tape). If the read is from a random-access device (disk or DECTape), R0 contains the actual number of words that will be read (.READ or .READC) or have been read (.READW). This number is less than the requested word count if an attempt is made to read past end-of-file, but a partial transfer of one or more blocks is possible. In the case of a partial transfer, no error is indicated if a read request is shortened. Therefore, a program should always use the returned word count as the number of words available.

For example, suppose a file is five blocks long (it has block numbers 0 to 4) and a request is issued to read 512(decimal) words, starting at block 4. Since 512 words is two blocks, and block 4 is the last block of the file, this is an attempt to read past end-of-file. The monitor detects this and shortens the request to 256(decimal) words. On return from the request, R0 contains 256, indicating that a partial transfer occurred. Also, since the request is shortened to an exact number of blocks, a request for 256 words either succeeds or fails, but cannot be shortened.

An error is reported if a read is attempted starting with a block number that is beyond the end-of-file. The carry bit is set, and error code 0 appears in byte 52. No data is transferred in this case, and R0 contains a zero.

.READ
The .READ request transfers to memory a specified number of words from the device associated with the specified channel. The channel is associated with the device when a .LOOKUP or .ENTER request is executed. Control returns to the user program immediately after the .READ is initiated, possibly before the transfer is completed. No special action is taken by the monitor when the transfer is completed.

Macro Call: .READ area,chan,buf,wcnt,blk

where:

area is the address of a five-word EMT argument block
chan is a channel number in the range 0–376(octal)
buf is the address of the buffer to receive the data read
wcnt is the number of words to be read
blk is the block number to be read. For a file-structured .LOOKUP, the block number is relative to the start of the file. For a non-file-structured .LOOKUP, the block number is the absolute block number on the device. Note that the first block of a file or device is block number 0. The user program normally updates blk before it is used again. If input is from TT: and blk = 0, TT: issues an uparrow (↑) prompt (This is true for all .READ requests.)
Notes:

1. .READ and .READC requests instruct the monitor to do a read from the
device by queuing a request for the device and immediately returning
control to your program.

2. .READ and .READC requests execute as soon as all previous I/O re-
quests to the device handlers have been completed. Note that a read
from RK1: must wait for a previous read from RK0: to complete. This is
a hardware restriction common to most disks because the controller
looks at all I/O operations sequentially.

3. Read errors are returned from the .READ and .READC or the .WAIT
request. Errors can occur on the read or on the wait, but only one error
is returned. Therefore, the program must check for an error when the
read is complete (.READ/BCS) and after the wait (.WAIT/BCS). The
wait request returns an error, but it does not indicate which read
caused the error.

Errors reported on the return from the read request are as follows:

a. Nonexistent device/unit
b. Nonexistent block
c. In general, errors that do not require data transfers but are control-
er errors or EOF errors

4. During the .READ and .READC requests, the monitor keeps track of
errors in the channel status word. If an error occurs before the monitor
can return to the caller, the error is reported on the return from the
read request with the carry bit set and the error value in R0. If the
error occurs after return from the read request, the error is reported on
return from the next .WAIT, or the next .READ/.READC. Some errors
can be returned from .READ/.READC requests immediately, before any
I/O operation takes place. One condition that causes an immediate er-
ror return is an attempt to read beyond end-of-file.

5. If .READ/C/W requests are used to receive messages under a system job
monitor, the buffer must be one word longer than the number of words
expected to be read. Upon completion of the data transfer, the first word
of the buffer will contain a value equal to the number of words actually
transferred (as for .RCVD/C/W).

Request Format:

```
R0 -> area:  10  chan
            blk
            buf
            wcnt
            1
```

When the user program needs to access the data read on the specified
channel, a .WAIT request should be issued as a check that the data has
been read completely. If an error occurred during the transfer, the .WAIT
request indicates the error.
Errors:

**Code**  **Explanation**
0  Attempt to read past end-of-file.
1  Hard error occurred on channel.
2  Channel is not open.

Example:

```
;TITLE READ.MAC

; READ / WRITE - This is an example in the use of the .READ / .WRITE
; requests. The example demonstrates asynchronous I/O where a mainline
; program initiates input via .READ requests; does some other processing
; I makes sure input has completed via the .WAIT request, then outputs
; the block just read. Another .WAIT is issued before the next read
; I is issued to make sure the previous write has finished. This example
; is another example file copy program; utilizing .CSIGEN to input the
; file specs, load the required handlers and open the files.

; Error Byte location in SYSCOM
ERRBYT = 52

; Enable local symbol block
ENABL

; Start reads with Block #0
CSIGEN DBSPACE, BDEFEXT
MOU AREA, R5
CLR I0BLK

; Read a block...
READ R5,#0

; Branch on error
BEC 6

; Then simulate
:

; Some other
BIT I1, I0BLK
BNE 2

; Meaningful(?)
PRINT MESSG

; Did read finish OK?
WAIT #3

; Branch if not (must be hard error!)
BCC 5

; Now write the block just read
WRITE R5,#0

; Branch on error
BEC 3

; Bump Block #
INC I0BLK

; We could do some more processing here
:

; Wait for write to finish
WAIT #0

; Branch if write was successful
BCC 1

; Report error
PRINT WERR, RO
BR 7

; Mere to exit program
MOV #ERRBYT
BR 4

; Branch to report error
TSTB #ERRBYT
BNE 5

; Yes... announce completion
PRINT DONE
CLOSE 0

; Dismiss fetched handlers
RESET
AREA:

; Then exit program
EXIT

; I/O Area block
WORD 0

; Block #
WORD 0

; Buffer addr & word count
WORD 256

; I/O buffer
WORD 0

BUFF: DBLK 256
DEFEXT:

; No default extensions for CSIGEN
WORD 0

; I-O Transfer Complete/ Messages...
DONEN ASCIZ '/I-O Transfer Complete/ Messages...

; Simulating Mainline Processing
MESSG: ASCIZ '<Simulating Mainline Processing '/

; Write Error?
WRERR: ASCIZ '/Write Error?'

; Read Error?
READERR: ASCIZ '/Read Error?'

; Handlers may be loaded starting here
DSpace:

.END START
```

Programmed Request Description and Examples 2–105
.READC
The .READC request transfers a specified number of words from the indicated channel to memory. Control returns to the user program immediately after the .READC is initiated. Attempting to read past end-of-file also causes an immediate return, in this case with the carry bit set and the error byte set to 0. Execution of the user program continues until the .READC is complete, then control passes to the routine specified in the request. When an RTS PC is executed in the completion routine, control returns to the user program.

Macro Call: .READC area,chan,buf,wcnt,crtn,blk

where:

area is the address of a five-word EMT argument block
chan is a channel number in the range 0–376(octal)
buf is the address of the buffer to receive the data read
wcnt is the number of words to be read
crtn is the address of the user’s completion routine. The address of the completion routine must be above 500(octal)
blk is the block number to be read. For a file-structured .LOOKUP, the block number is relative to the start of the file. For a non-file-structured .LOOKUP, the block number is the absolute block number on the device. The user program normally updates blk before it is used again

When a completion routine is called, error or end-of-file information for a channel is not cleared. The next .WAIT or .READ/.READC on the channel (from either mainline code or a completion routine) produces an immediate return with the C bit set and the error code in byte 52. The completion routine will never be entered if the .READC request returns an error.

Request Format:

R0 → area: 10 chan

| blk | buf | wcnt | crtn |

When a .READC completion routine is entered, the following conditions are true:

1. R0 contains the contents of the channel status word for the operation. If bit 0 of R0 is set, a hardware error occurred during the transfer; consequently, the data may not be reliable. The end-of-file bit, bit 13, may be set.

2. R1 contains the channel number of the operation. This is useful when the same completion routine is to be used for transfers on different channels.
3. On a file-structured transfer, a shortened read is reported when the .READC request is returned, not when the completion routine is called.

4. Registers R0 and R1 can be used by the routine, but all other registers must be saved and restored. Data cannot be passed between the main program and completion routines in any register or on the stack.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Attempt to read past end-of-file; no data was read.</td>
</tr>
<tr>
<td>1</td>
<td>Hard error occurred on channel.</td>
</tr>
<tr>
<td>2</td>
<td>Channel is not open.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE READC.MAC

; .READC /.WRITC - This is an example in the use of the .READC /.WRITC requests. The example demonstrates event-driven I/O where a mainline program initiates a file transfer and completion routines continue it while the mainline proceeds with other processes. The example is another single file copy program, utilizing .CSIGEN to input the file specs, load the required handlers and open the files.

; DCALL READC,.WRITC,.CLOSE,.PRINT,.CSIGEN,.EXIT,.WAIT,.SRESET
ERBBYT = 52 Error Byte location in SYSCOM
.ENABL LS5

START: .CSIGEN #DSpace,#DEFEXT
CALL INXFER
;PRINT #MESSG
MOV #-1,R5
1$: DEC R5 (Kill some time)
BNE 1$ ; Did I/O complete?
TSTB EOF
BEQ 1$ ; No...do some more mainline work
INCB EOF
BEQ WERR ; Check for read/write error
; EODF = 0 = Write error
; EODF < 0 = Read error
; EODF > 0 = End of File
; IRO = > We're done mess
BLT RERR ; Merge to exit program
.CLOSE #0
MOV #DONE,.RO
BR GBYE
; Set up error messages here...
WERR: MOV #WRERR,.RO
BR GBYE
RERR: MOV #RDERR,.RO
GBYTE: .PRINT
; SRESET .EXIT
WROONE: .WAIT #0 ; Write compl routine...write successful?
BCS 3$ ; Branch if not...
IOXFER: .READC
BCC 7$ ; Error - is it EOF?
; User EDF Flag to indicate hard error
TSTB @ERBBYT
BEQ 6$ ; Branch if yes
2$: DECB EDF ; Queue up a read
3$: DECB EDF ; Branch if ok...
RETURN
4$: .WAIT #3
; Compl routine #2 - was read ok?
BCS 2$ ; Branch if not
```

Programmed Request Description and Examples  2–107
The .READW request transfers a specified number of words from the indicated channel to memory. When the .READW is complete or an error is detected, control returns to the user program.

Macro Call: .READW area,chan,buf,wcnt,blk

where:

- **area** is the address of a five-word EMT argument block
- **chan** is a channel number in the range 0-376(octal)
- **buf** is the address of the buffer to receive the data read
- **wcnt** is the number of words to be read; each .READ request can transfer a maximum of 32K words
- **blk** is the block number to be read. For a file-structured .LOOKUP, the block number is relative to the start of the file. For a non-file-structured .LOOKUP, the block number is the absolute block number on the device. The user program normally updates **blk** before it is used again.

Request Format:

```
R0 → area: 10 | chan
    | blk
    | buf
    | wcnt
    | 0
```

If no error occurred, the data is in memory at the specified address. In an FB environment, the other job can be run while the issuing job is waiting for the I/O to complete.
If a volume is opened with a non-file-structured lookup and the word count specified is greater than the number of words left on the volume, .READW returns a hard error.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Attempt to read past end-of-file.</td>
</tr>
<tr>
<td>1</td>
<td>Hard error occurred on channel.</td>
</tr>
<tr>
<td>2</td>
<td>Channel is not open.</td>
</tr>
</tbody>
</table>

Example:

```
* .TITLE READW.MAC

* .READW / .WRITW - This is an example in the use of the .READW / .WRITW
* requests. The example is a single file copy program. The file specs
  1 are input from the console terminal, and the input & output files opened
  1 via the general mode of the CSI. The file is copied using synchronous
  I/O, and the output file is made permanent via the .CLOSE request.

  .MCALL .CSIGEN,.READW,.PRINT,.EXIT,.WRITW,.CLOSE,.SRESET

  ERRBYT=52

  ERRBYT:      iError Byte Location

  START: .CSIGEN #DSPACE,#DEXT
  CLR #10BLK
  MOV #AREA,R5
  READ: .READW R5,#3

  BCC 2"
  TSTB #ERRBYT
  BEQ 3"
  MOV #RERR,R0

  1$: .PRINT
  BR 4"

  2$: .WRITW R5,#0
  INC 10BLK
  BCC READ
  MOV #WERR,R0
  BR 1" 

  3$: .CLOSE
  .PRINT #DONE
  .SRESET
  .EXIT

  DEXT: .WORD 0,0,0,0
  AREA: .WORD 0
  I0BLK: .WORD 0
  WORD 0
  .WORD BUFR
  .WORD 256.
  .WORD 0
  BUFR: .BLK 256.
  RERR: .ASCIZ /* Read error */
  WERR: .ASCIZ /* Write error */
  DONE: .ASCIZ /* I-O Transfer Complete */
  .EVEN

  DSPACE: =. 
```

Programmed Request Description and Examples 2–109
2.74 .RELEAS

See .FETCH/.RELEAS (Section 2.34).

2.75 .RENAME

The .RENAME request changes the name of the file specified.

Macro Call:  .RENAME area,chan,dblk

where:

area     is the address of a two-word EMT argument block
chan     is an unused channel number in the range 0–376 (octal)
dblk     is the address of a block that specifies the file to be renamed
          followed by the new file name

Request Format:

R0 → area: 4 chan 
           
           dblk 

The dblk argument consists of two consecutive Radix–50 device and file
specifications. For example:

  .RENAME
  BCS   #AREA, #7, #DBLK
  RNMERR
  #USE CHANNEL 7
  #NOT FOUND

  .
  .

  DBLK:  .RAD50 /DT3/
         .RAD50 /DLDFIL/
         .RAD50 /MAC/
         .RAD50 /DT3/
         .RAD50 /NEWFIL/
         .RAD50 /MAC/

The first string represents the file to be renamed and the device where it is
stored. The second represents the new file name. If a file with the same
name as the new file name specified already exists on the indicated device,
it is deleted. The second occurrence of the device name DT3 is necessary for
proper operation and should not be omitted. The specified channel is left
inactive when the .RENAME is complete. .RENAME requires that the han-
dler to be used be resident at the time the .RENAME request is made. If it
is not, a monitor error occurs. Note that .RENAME is legal only on files on
block-replaceable devices (disks and DECtape). In magtape operations, the
handler returns an illegal operation code in byte 52 if a .RENAME request
is attempted. A .RENAME request to other devices is ignored.

Files cannot be protected or unprotected using the .RENAME request. To
change the protection status of a file, use the .FPROT request or the PRO-
TECT and UNPROTECT commands.

File dates can be changed using the .SFDAT request.
Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Channel open.</td>
</tr>
<tr>
<td>1</td>
<td>File not found.</td>
</tr>
<tr>
<td>2</td>
<td>Invalid operation.</td>
</tr>
<tr>
<td>3</td>
<td>A file by that name already exists and is protected. A RENAME was not done.</td>
</tr>
</tbody>
</table>

Example:

```plaintext
.TITLE RENAME.MAC

+ 1.RENAME - This is an example in the use of the .RENAME request.
+ The example renames a file according to filespecs input thru the
+ .CSISPC request.
+ -

.MCALL .RENAME,.PRINT,.EXIT
.MCALL .CSISPC,.FETCH,.SRESET

ERRBYT = 52

START: .CSISPC
        .FGETCH .CSISPC,.FGETCH,.SRESET
        BCS 2$  
        MOV   #FILESP+R2
        MOV   #FILESP+R3
        MOV   @R2,FILESP+36
        .REPT 4
        MOV   (R2)+(R3)+
        .ENDR
        .RENAMES AREA,#0,#FILESP+36
        BCC 1$  
        DECB @ERRBYT
        BEQ 3$  
        MOU   #ILLOP,R0
        BR    5$  

1$: .SRESET
    .EXIT

2$: MOV   #NOHAN,R0
    BR    5$  

3$: MOV   #NOFIL,R0
    .PRINT
    BR    1$  

AREA: .BLKW 5
DEFEXT: .WORD 0,0,0,0
NOFIL: .ASCIZ ?File not found?/
ILLOP: .ASCIZ ?Illegal Operation?/
NOHAN: .ASCIZ ?FETCH Failed/
.EVEN
FILESP: .BLKW 39.*2
HANLOD =.
.END START
```

2.76 .REOPEN

The .REOPEN request associates the channel that was specified with a file on which a .SAVESTATUS was performed. The .SAVESTATUS/.REOPEN combination is useful when a large number of files must be operated on at one time. As many files as are needed can be opened with .LOOKUP, and
their status preserved with .SAVESTATUS. When data is required from a file, a .REOPEN enables the program to read from the file. The .REOPEN need not be done on the same channel as the original .LOOKUP and .SAVESTATUS.

Macro Call: .REOPEN area,chan,cblk

where:

area is the address of a two-word EMT argument block
chan is a channel number in the range 0–376(octal)
cblk is the address of the five-word block where the channel status information was stored

Request Format:

R0 → area: 6 chan
            cblk

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The specified channel is in use. The .REOPEN has not been done.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .SAVESTATUS request.

2.77 .RSUM (FB and XM Only)

See .SPND/.RSUM (Section 2.89).

2.78 .SAVESTATUS

The .SAVESTATUS request stores five words of channel status information into a user-specified area of memory. These words contain all the information RT-11 requires to completely define a file. When a .SAVESTATUS is done, the data words are placed in memory, the specified channel is freed, and the file is closed. When the saved channel data is required, the .REOPEN request is used.

.SAVESTATUS can only be used if a file has been opened with .LOOKUP. If .ENTER was used, .SAVESTATUS is invalid and returns an error. Note that .SAVESTATUS is not valid for magtape or cassette files.

The .SAVESTATUS/.REOPEN requests are used together to open many files on a limited number of channels or to allow all .LOOKUPs to be done at once to avoid USR swapping.

While the .SAVESTATUS/.REOPEN combination is useful, care must be observed when using it. In particular, the following cases should be avoided:
1. If a .SAVESTATUS is performed and the same file is then deleted before it is reopened, it becomes available as an empty space that could be used by the .ENTER command. If this sequence occurs, the contents of the file supposedly saved changes.

2. Although the device handler for the required peripheral need not be in memory for execution of a .REOPEN, the handler must be in memory when a .READ or .WRITE is executed, or a fatal error is generated.

One of the more common uses of .SAVESTATUS and .REOPEN is to consolidate all directory access motion and code at one place in the program. All files necessary are opened and their status saved, then they are re-opened one at a time as needed. USR swapping can be minimized by locking in the USR, doing .LOOKUP requests as needed, using .SAVESTATUS to save the file data, and then unlocking the USR. The user should be aware of the consequences of locking in the USR in a foreground/background environment. If the background job locks in the USR when the foreground job requires it, the foreground job is delayed until the background job unlocks the USR.

Macro Call: .SAVESTATUS area,chan,cblk

where:

area is the address of a two-word EMT argument block
chan is a channel number in the range 0–376(octal)
cblk is the address of the five-word user memory block where the channel status information is to be stored

Request Format:

\[
\begin{array}{c|c|c}
\hline
& 5 & \text{chan} \\
\hline
\text{cblk} & \text{area} & \\
\hline
\end{array}
\]

The five words returned by .SAVESTATUS contain the following information:

<table>
<thead>
<tr>
<th>Name</th>
<th>Offset</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.CSW</td>
<td>0</td>
<td>Channel status word</td>
</tr>
<tr>
<td>C.SBLK</td>
<td>2</td>
<td>Starting block number of this file, or 0 if non-file-structured</td>
</tr>
<tr>
<td>C.LENG</td>
<td>4</td>
<td>Length of file</td>
</tr>
<tr>
<td>C.USED</td>
<td>6</td>
<td>Highest block written</td>
</tr>
<tr>
<td>C.DEVQ</td>
<td>10</td>
<td>Number of pending requests</td>
</tr>
<tr>
<td>C.UNIT</td>
<td>11</td>
<td>Device unit number</td>
</tr>
</tbody>
</table>

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The channel specified is not currently associated with any files; that is, a previous .LOOKUP on the channel was never done.</td>
</tr>
</tbody>
</table>
Example:

```
.TITLE SAVEST.MAC

1: .SSTATUS / .REOPEN - This is an example in the use of the .SSTATUS
1 / .REOPEN requests. These requests are most commonly used together to
1 consolidate access to the USR at one place in the program or if the
1 program must access more files than there are I/O channels available.
1 Once a channel has been opened, its status may be saved to be re-opened
1 and used later as needed. This example merges 2-6 files into 1 file,
1 reading all input files on one channel.

.MCALL .CSISEN,.SSTATUS,.REOPEN,.CLOSE,.EXIT
.MCALL .READW,.WRITW,.PRINT,.PURGE

ERRBYT = 52

START: .CSISEN
.DSPACE,*DEFEXT

MOV #3,R4
MOV #AREA,R3
MOV #SAVLK,R5

1$: .SAVEST
R3;R4,R5

BCS 2$; MOV #SAVLK,R5
BCS 3$; MOV #SAVLK,R5
ADD #12,R5
INC R4
CMP #5,R4
BGE 1$; MOV R4

2$: MOV R5
BEQ 7$; READW R3;R3;R5
CLR BLK

5$: .READW R5;R3;R3;BUFFR;256,;BLK

BCC 6$; READW R5;R3;R3;BUFFR;256,;BLK

TSTB @ERRBYT
BNE 8$; READW R5;R3;R3;BUFFR;256,;BLK

.PURGE #3
ADD #12,R5
TST @R5
BNE 4$; PRINT DONE

5$; READW R5;R3;R3;BUFFR;256,;BLK

BCC 6$; READW R5;R3;R3;BUFFR;256,;BLK

INC WBLK
INC BLK

BCC 5$; MOVR,RO

BR 8$; PRINT R0

7$: MOVR,RO

8$: MOVR,RO

9$: PRINT R0

8$: .EXIT

1: AREA: .BLKW 5
1: BLK: .WORD 0
1: WBLK: .WORD 0
1: SAVLK: .BLKW 30.
1: DEFEAT: .WORD 0:0:0:0
1: NOINP: .ASCIZ /No input files?/
1: WERR: .ASCIZ /Write Error?/
1: RERR: .ASCIZ /Read Error?/
1: DONE: .ASCIZ /I/O Transfer Completed/
1: EVEN
1: BUFFR: .BLKW 256.

1: END

START

2–114  Programmed Request Description and Examples
The .SCCA programmed request:

Inhibits a CTRL/C abort

Indicates when a double CTRL/C is initiated at the keyboard

Distinguishes between single and double CTRL/C commands

CTRL/C characters are placed in the input ring buffer and treated as normal control characters without specific system functions. The request requires a terminal status word address (addr) that is used to report consecutive CTRL/C input sequences. Bit 15 of the status word is set when consecutive CTRL/C characters are detected. The program must clear that bit. An .SCCA request with a status word address of 0 disables the intercept and reenables CTRL/C system action.

Normally, the .SCCA request affects only the job currently running. When the program exits, CTRL/C aborts are automatically reenabled. However, if your FB or XM monitor includes global SCCA support enabled through system generation, you can choose to disable CTRL/C aborts throughout the system for as long as you need. Set the argument type to GLOBAL (type = GLOBAL) and set addr to any valid SCCA control word. Thereafter, all CTRL/C aborts will be inhibited until another global .SCCA request is issued to set addr to 0. Only background jobs can issue global .SCCA requests, and these do not affect foreground or system job operation. Global .SCCA requests issued by foreground and system jobs act as local .SCCA requests.

There are three cautions to observe when using .SCCA:

- The request can cause CTRL/C to appear in the terminal input stream, and the program must provide a way to handle it.
- The request makes it impossible to terminate program loops from the console; therefore, it should be used only in thoroughly tested, reliable programs.
- When .SCCA is in effect and the program enters an infinite loop, the system must be halted and rebootstrapped.

CTRL/Cs from indirect command files or indirect control files are not intercepted by the .SCCA.

Macro Call: .SCCA area,addr[,]type=GLOBAL]

where:

area is the address of a two-word parameter block

addr is the address of a terminal status word (an address of 0 reenables double CTRL/C aborts)

type is the mode of SCCA operation. Type is an optional argument that selects either LOCAL (default) or GLOBAL .SCCA
Request format for LOCAL:

R0 → area: \[
\begin{array}{c|c}
35 & 0 \\
\hline
\text{addr} & \end{array}
\]

Request format for GLOBAL:

R0 → area: \[
\begin{array}{c|c}
35 & 1 \\
\hline
\text{addr} & \end{array}
\]

Errors:

None.

Example:

\[
\text{
\begin{verbatim}
.MCALL .SCCA,.EXIT,.PRINT,.GTLIN

!Program to prompt for a
!name. User cannot CTRL/C
!out until entering name.

START: .SCCA #AREA,#ADDR,TYPE=GLOBAL
       .GTLIN #NAME,#PROMPT
       .SCCA #AREA,#O,TYPE=GLOBAL
       .EXIT

AREA:  .BLKHW 4
ADDR:  .WORD 0
NAME:  .BLKHW 12
PROMPT: .ASCII /Enter your name /<200>

.END START
\end{verbatim}
\]
\]

2.80 .SDAT/.SDATC/.SDATW (FB and XM Only)

The .SDAT/.SDATC/.SDATW requests are used with the .RCVD/ .RCVDW/.RCVDC calls to allow message transfers between a foreground job and a background job under the FB or XM monitors. .SDAT transfers are similar to .WRITE requests, where data transfer is not to a peripheral but from one job to another. Additional I/O queue elements should be allocated for buffered I/O operations in .SDAT and .SDATC requests (see .QSET).

Message handling in the FB monitor does not check for a word count of zero before queuing a send or receive data request. Since RT–11 distinguishes a send from a receive by complementing the word count, a .SDATW of zero words is treated as a .RCVDW of zero words. Thus, avoid a word count of zero at all times when using a .SDATW request.

Be particularly careful if you use both synchronous (RCVDW and .SDATW) and asynchronous (.RCVDC and .SDATC) requests in the same program. If you issue a mainline .SDATW while there is a pending .RCVDC, the .SDATW will wait until the .RCVDC is satisfied. If the completion routine for the .RCVDC issues another .RCVDC, the mainline .SDATW will never complete. In general, you should avoid the use of both synchronous and asynchronous message requests in the same program.

.SDAT
Macro Call: .SDAT area,buf,wcnt
where:

area  is the address of a five-word EMT argument block
buf  is the buffer address of the beginning of the message to be transferred
wcnt  is the number of words to transfer

Request Format:

| R0 → area: | 25 | 0 |
| unused     | buf | wcnt |

Errors:

Code   Explanation

0  No other job exists. (A job exists as long as it is loaded, whether or not it is active.)

Example:

```assembly
!* .SDAT/.RCVD - This is an example in the use of the .SDAT/.RCVD
! requests. The example is actually two programs: a Background Job
! which sends messages, and a Foreground Job, which receives them.
! NOTE: Each program should be assembled and linked separately.
!
   .TITLE SDATF.MAC

!* Foreground Program...
!
   .MCALL .RCVD,.MWAIT,.PRINT,.EXIT

STARTF: .RCVD

   #AREA,#MBUFF,#40.
   |Request a message up to 80 char.
   |No error possible - always a BG
   |Do some other processing
   |I like announcing FG active...
   |Wait for message to arrive...
   |Exit program
   |Reads message
   |Announce we got the message...
   |Loop to get another one
   !Exit program
   AREA: .BLKW 5.
   MBUFF: .BLKW 41.
   WORD: .WORD 0.
   ASCIZ: /Hi - FG alive and well and waiting for a message!/
   ASCIZ: /Hey BG - Got your message it reads!/
   STARTF: .EXIT

   .EXIT
   AREA: .BLKW 5.
   MBUFF: .BLKW 41.
   WORD: .WORD 0.
   ASCIZ: /Hi - FG alive and well and waiting for a message!/
   ASCIZ: /Hey BG - Got your message it reads!/
   STARTF

   .TITLE STARTB.MAC
```

Programmed Request Description and Examples  2–117
.MCALL .SDAT,.MWAIT,.GTLIN,.EXIT,.PRINT

STARTB: CLR BUFF
.GTLIN BUFF,#PROMT
.SDAT #AREA,BUFF,#40.
BCS #
.MWAIT 1#
TST BUFF
BNE STARTB
.EXIT .EXIT
1$ PRINT #NOFG
.EXIT .EXIT
AREA: .BLKW 5
.BLKW 40.
PROMT: .ASCII /Enter message to be sent to FG Job/\15<12>/<15/</200>
.NOFG: .ASCII /No FG/?/
.END .END

.SDATC
Macro Call: .SDATC area,buf,wcnt,crtn

where:

- area is the address of a five-word EMT argument block
- buf is the buffer address of the beginning of the message to be transferred
- wcnt is the number of words to transfer
- crtn is the address of the completion routine to be entered when the message has been transmitted

Request Format:

R0 → area: 25 0

unused
buf
wcnt
 crtn

Errors:

Code Explanation

0 No other job exists. (A job exists as long as it is loaded, whether or not it is active.)

Example:

See the example following .SDATW.

.SDATW
Macro Call: .SDATW area,buf,wcnt

where:

- area is the address of a five-word EMT argument block
- buf is the buffer address of the beginning of the message to be transferred
- wcnt is the number of words to transfer
Request Format:

\[
\begin{array}{c|c}
R0 & \text{area:} \\
\hline
25 & 0 \\
\hline
\text{unused} & \text{buf} \\
\hline
\text{wcnt} & 0 \\
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No other job exists. (A job exists as long as it is loaded, whether or not it is active.)</td>
</tr>
</tbody>
</table>

Example:

```assembly
1+ 1: SDATW/RCVOW - This is an example in the use of the .SDATW/.RCVOW
1 requests. The example consists of two programs: a Foreground Job
1 which creates a file and sends a message to a Background program
1 which copies the FG channel and reads a record from the file. Both
1 programs must be assembled and linked separately.
1-

1. TITLE SDATWF.MAC
1+
1: This is the Foreground program...
1-

1 MCALL .ENTER, PRINT, SDATW, EXIT, RCVOW, CLOSE, WRITW
1

STARTF: MOV #AREA.R5
1 .ENTER R5+0:FILE.R5
1 .WRITW R5+0.RECORDS.R256+0:read
1 BCS ENTERR 1Create a block file
1 .SDATW R5+6:BUF.R32
1 .RCVOW R5+6:BUF.R32
1 .CLOSE #0 1BG is done with the file
1 .PRINT *EXIT 1Tell user we're exiting
1 .EXIT
1

ENTERR: .PRINT #ERMSG 1Print error message
1 .EXIT 1Then exit
1

FILE: .RADSO /OK QFILE/
1 .RADSO /TMP/
1

AREA: .BLKW 5 1EMT argument block
1 .WORD 0 1Channel
1 .WORD 4 1Block
1 .RECORD: .BLKW 256.
1 .ERMSG: .ASCIZ /*Enter Error?/*
1 .EXIT: .ASCIZ /*FG Job exiting/*
1 END STARTF
1

1. TITLE SDATBW.MAC
1+
1: This is the Background program...
1-

1 MCALL .CHCOPY, RCVOW, READW, EXIT, PRINT, SDATW
1

STARTB: MOV #AREA,R5
1 .RCVOW R5+0:MSG.R2
1 BCS #1 1Branch if no FG
1 .CHCOPY R5+0:MSG.R2
1 .BCS 2# 1Channel = is 1st word of message
1 .READW R5+0:BUF.R256.R4+0:Read block which is 2nd word of msg
1 .BCS 3# 1Branch if read error
1 .SDATW R5+0:MSG.R1
1 .PRINT *EXIT
1 .EXIT 1Tell user we're thru with file
1

Programmed Request Description and Examples
2.81 .SDTTM

The .SDTTM (Set date and time) request allows your program to set the system date and time.

Macro Call: .SDTTM area,addr

where:

area   is the address of a two-word EMT argument block

addr   is the address of a three-word block in user memory that contains the new date and time

Request Format:

\[ R0 \rightarrow \text{area}: \begin{array}{c}
40 \\
0 \\
\text{addr}
\end{array} \]

The first word of the three-word parameter block contains the new system date in internal format (see the .DATE programmed request). If this word is –1 (represents an illegal date), the monitor ignores it. Put a –1 in the first word of the parameter block if you want to change only the system time. If the first parameter word is positive, it becomes the new system date. Note that the monitor does no further checking on the date word. To be sure of a valid system date, you must specify a value between 1 and 12(decimal) in the month field (bits 13–10) and a value between 1 and the month length in the day field (bits 9–5). Bits 14 and 15 must be zero.

The second and third words of the parameter block are the new high-order and low-order time values, respectively. This value is the double-precision number of ticks since midnight. If the high-order time word is negative, the monitor ignores the new time. Put a negative value in the second word of the parameter block if you want to change only the system date. If the second parameter word is positive, the new time becomes the system time. The monitor does no further checking on the new time. To be sure of a valid system time, you must specify a legal number of ticks for the system line frequency. For a 60 Hz clock, the high-order time may not be larger than 117(octal), and if it is equal to 117, the low-order time may not be equal to or larger than 15000(octal). For a 50 Hz clock, the high-order time may not be larger than 101(octal), and if it is equal to 101, the low-order time may not be equal to or larger than 165400(octal).
Changing the date and/or time has no effect on any outstanding mark time or timed wait requests.

Errors:
None.

Example:

```
.TITLE SDTMM.MAC

;SDTMM.MAC - This is an example in the use of the SDTMM request.
;The example is a Daylight/Standard Time utility - to switch the
;current system time from Standard to Daylight or vice versa, call
;the program as a subroutine at the proper entry point.

.MCALL SDTMM,PRINT,EXIT,GTIM
.GLOBL STD,DALITE

STD:  COM HR
      NEG HR+2
      ISwitch to STD time...
      IMake one hr in clock ticks
DALITE: .GTIM #AREA,#TIME
      CALL JADD
      IGet the current time
      IAdjust +/- 1 hour
      ISet the new system time
      IForce date rollover if any
      IReturn to caller
      .GTIM #AREA,#NEWDT
      RETURN

NEWDT: .NORD -1
      I.SDTMM arguments - No new date
      I.New time
      IOne hour in clock ticks (60 cycle
      Iclock!)
TIME:  .NORD 0:0
      I.0 new time
      I.New time
HR:    .NORD 3
      IOne hour in clock ticks (60 cycle
      Iclock!)
AREA:  .NORD 45700
      I.EMT Argument Block
      JADD: MOV #HR,R4
            MOV #AREA,R3
            MOV #HR,R1
            MOV -(R4),R2
            ADD -(R3),R2
            MOV -(R4),R5
            ADC R5
            ADD -(R3),R5
            MOV R2,...(R1)
            MOV R5(...(R1)
            RETURN
            .END
```

2.82 .SERR

See .HERR/.SERR (Section 2.42).

2.83 .SETTOP

The .SETTOP request specifies a new address as a program's upper limit. The monitor determines whether this address is legal and whether or not a memory swap is necessary when the USR is required. For instance, if the program specified an upper limit below the start address of USR (normally specified in offset 266 in the resident monitor), no swapping is necessary, as the program does not overlay the USR. If .SETTOP from the background specifies a high limit greater than the address of the USR and a SET USR
NOSWAP command has not been given, a memory swap is required. The use of .SETTOP in an extended memory environment is described at the end of this section.

Careful use of the .SETTOP request provides a significant improvement in the performance of your program. An approach that is used by several of the system-supplied programs is as follows:

1. A .SETTOP is done to the high limit of the code in a program before buffers or work areas are allocated. If the program is aborted, minimal writing of the user program to the swap blocks (SWAP.SYS) occurs. However, the program is allowed to be restarted successfully.

2. A user command line is now read through .CSISPC or .GTLIN. An appropriate USR swap address is set in location 46. Successive .DSTATUS, .SETTOP, and .FETCH requests are performed to load necessary device handlers. This attempts to keep the USR resident as long as possible during the procedure.

3. Buffers and work areas are allocated as needed with appropriate .SETTOP requests being issued to account for their size. Frequently, a .SETTOP of #–2 is performed to request all available memory to be given to the program. This can be more useful than keeping the USR resident.

4. If the process has a well-defined closing phase, another .SETTOP can be issued to cause the USR to become resident again to close files (the user should remember to set location 46 to zero if this is done, so that the USR again swaps in the normal area). On return from .SETTOP, both R0 and the word in location 50(octal) contain the highest memory address allocated for use. If the job requested an address higher than the highest address legal for the requesting job, the address returned is the highest legal address for the job rather than the requested address.

When doing a final exit from a program, the monitor writes the program to the file SWAP.SYS and then reads in the KMON. A .SETTOP #0 at exit time prevents the monitor from swapping out the program to the swap blocks (SWAP.SYS) before reading in the KMON, thus saving time. This procedure is especially useful on a diskette system when indirect command files are used to run a sequence of programs. The monitor command SET EXIT NOSWAP also disables program swapping.

Macro Call: .SETTOP addr

where:

addr is the address of the highest word of the area desired (the last word the program will modify, not the first word it leaves untouched)
Notes:

1. A program should never do a .SETTOP and assume that its new upper limit is the address it requested. It must always examine the returned contents of R0 or location 50 to determine its actual high address.

2. It is imperative that the value returned in R0 or location 50 be used as the absolute upper limit. If this value is exceeded, vital parts of the monitor can be destroyed.

Errors:

None.

Example:

```
.TITLE SETTOP.MAC

/*
1. SETTOP - This is an example in the use of the .SETTOP request. The
   example tries to obtain as much memory as possible using the .SETTOP
   request, which will force the UBR into a swapping mode. The .LOCK request
   will bring the UBR into memory (over the high 2K of our little program !)
   and force it to remain there until an UNLOCK is issued.

.MCALL .LOCK,.UNLOCK,.LOOKUP
.MCALL .SETTOP,.PRINT,.EXIT

SYSPTR=54  // Pointer to beginning of RMON

START:  .SETTOP @SYSPTR  // Try to allocate all of memory (up to
                  // RMON)
.LOCK  // bring UBR into memory
.LOOKUP #AREA,0,#FILE1  // LOOKUP a file on channel 0
BCC 1%  // Branch if successful
.EXIT  // then exit program

2%:  .PRINT #F1FND  // Announce our success
.MOV #AREA,R0  // R0 => EMT Argument Block
.INC #RO  // Increment low byte of 1st arg (chan #)
.MOV #FILE2,2(R0)  // Fill in pointer to new filespec
.LOOKUP  // Do the LOOKUP from filled in arg block
.BCS 2%  // Branch on error
.PRINT #F2FND  // Say we found it
.UNLOCK  // Now release the UBR
.EXIT  // and exit program

AREA:  .BLKW 3  // EMT Argument Block
FILE1:  .RAD50 /DK/  // A file we're sure to find
       .RAD50 /PIP /
       .RAD50 /SAV/
FILE2:  .RAD50 /DK/  // Another file we might find
       .RAD50 /TECO /
       .RAD50 /SAV/
LMRG:  .ASCIZ "Error on .LOOKUP?"  // Error message
F1FND:  .ASCIZ "...Found PIP,SAV/
F2FND:  .ASCIZ "...Found TECO,SAV/
.EVEN
.END  START
```

2.83.1 .SETTOP in an Extended Memory Environment

You can enable the extended memory feature of the .SETTOP programmed request with the linker /V option or the LINK command with the /XM
option (see Chapter 11 in the *RT–11 System Utilities Manual* or Chapter 4 of the *RT–11 System User’s Guide*). The *RT–11 Software Support Manual* describes in detail the .SETTOP request in an extended memory environment. The .SETTOP request operates in privileged and virtual jobs as follows:

**Privileged Jobs**

1. A .SETTOP that requests an upper limit below the virtual high limit of the program will always return the virtual high limit of the program. The virtual high limit is the last address in the highest PAR that the program uses. In this case, a value can never be returned below the job’s virtual high limit.

2. A .SETTOP that requests a job’s upper limit above the program’s virtual high limit will return the highest available address as follows:
   
   a. Either the address requested or SYSLOW–2 (last used address, SYSLOW is next address available) is returned, whichever is lower. SYSLOW is defined as the start of the USR in the XM monitor.

   b. If the program’s virtual high limit is greater than SYSLOW (the user program maps over the monitor or USR), the virtual high limit of the program will always be returned.

**Virtual Jobs**

1. As in privileged jobs, a .SETTOP request can never get less than the virtual high limit of the job.

2. If a .SETTOP requests an upper limit greater than the virtual high limit, the following occurs:
   
   a. If the virtual high limit equals 177776, this value is returned since this is the address limit in virtual memory. Otherwise, a new region and window will be created. The size of the region and window will be determined by the argument specified to the .SETTOP or by the amount of extended memory that is available, whichever value is smaller. The .SETTOP argument rounded to a 32-word boundary minus the high .LIMIT value for the program equals the size of the region and window (see the LINK chapter of the *RT–11 System Utilities Manual* and the *RT–11 Software Support Manual* for a description of the .LIMIT directive in extended memory). If there are no region control blocks, window control blocks, or extended memory available, the program’s virtual high limit is returned. The .SETTOP request uses one of the region and window control blocks allocated to the user, thus one less block is available to the program if the linker /V option is used.

   b. Additional .SETTOP requests can only remap the original window created by the first .SETTOP. Thus, additional re-
quests will return an address no higher than that established by the first request and no lower than the program virtual high limit. An additional .SETTOP request whose argument is higher than the first request will cause the entire first window to be mapped. An additional .SETTOP request whose argument specifies a value below the virtual high limit eliminates the region and window. If another .SETTOP request then follows, it may create a new region and window.

2.84 .SFDAT

The .SFDAT programmed request allows a program to set or modify the creation date in a file’s directory entry. Dates on protected as well as unprotected files can be changed.

Macro Call: .SFDAT area, chan, dblk, date

where:

- **area** is the address of a three-word EMT argument block
- **chan** is a channel number in the range 0–376
- **dblk** is the address of a four-word block containing a filespec in Radix–50
- **date** is the address of the new date, in RT–11 format If this argument is #0, the system date is used; bits 14 and 15 are always set to 0, but no other check is made for an illegal date

Request Format:

\[
\begin{array}{c|c|c|c}
\text{R0} & \text{area} & 42 & \text{chan} \\
 & & dblk \\
 & & date \\
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Channel in use</td>
</tr>
<tr>
<td>1</td>
<td>File not found</td>
</tr>
<tr>
<td>2</td>
<td>Invalid operation (device not file structured)</td>
</tr>
</tbody>
</table>

Example:

Refer to the example for the .FPROT request.

2.85 .SFPA (Special Feature)

The .SFPA request allows users with floating-point hardware to set trap addresses to be entered when a floating-point exception occurs. If no user trap address is specified and a floating-point (FP) exception occurs, a \(?MON–F–FPU\) trap occurs, and the job is aborted.
Macro Call: .SFPA area,addr
where:

area  is the address of a two-word EMT argument block
addr is the address of the routine to be entered when an exception occurs

Request Format:

R0 → area: 30 0
           addr

Notes:

1. The user trap routine must save and restore any registers it uses. It exits with an RTI instruction.

2. If the address argument is #0, user floating-point routines are disabled and the fatal ?MON-F-FPU trap error is produced by any further traps.

3. In the FB environment, an address value of #1 indicates that the FP registers should be switched when a context switch occurs, but no user traps are enabled. This allows both jobs to use the FP unit. An address of #1 to the SJ monitor is equivalent to an address of #0.

4. When the user routine is activated, it is necessary to re-execute an .SFPA request, as the monitor disables user traps as soon as one is serviced. It does this to prevent a possible infinite loop from being set up by repeated floating-point exceptions.

5. If the FP11 is being used, the instruction STST -(SP) is executed by the monitor before entering the user's trap routine. Thus, the trap routine must pop the two status words off the stack before doing an RTI. The program can tell if FP hardware is available by examining the configuration word in the monitor.

Errors:

None.

Example:

.TITLE SFPA.MAC

;+ 1 .SFPA - This is an example in the use of the .SFPA request. This
1 example is a skeleton program which demonstrates how to set up a
1 Floating Point trap routine, and the minimum action that routine
1 must take before dismissing the error trap.
1-

.MCALL .SFPA,EXIT

SYSPTR = 54
CONFIG = 300
FP11 = 100
START: 1
        1
        1

2-126 Programmed Request Description and Examples
The SOB macro simulates the SOB instruction (subtract one and branch if not equal) by generating the code:

`DEC register
BNE location`

You can use the SOB macro on all processors, but it is especially useful for processors that do not have the hardware SOB instruction. If you are running on a processor that supports the SOB instruction, simply eliminate the MACRO call to SOB (.MCALL SOB), and the SOB instruction executes. Note that SOB is not preceded by a dot (.).

The SOB macro has the following syntax:

`SOB reg,addr`

where:

- `reg` is the register whose contents will be decremented by 1
- `addr` is the location to branch to if the register contents do not equal 0 after the decrement

In the following example, register R0 is decremented by 1 and then tested. If the contents do not equal 0, the program branches to the label HERE.

```
SOB R0,HERE
```

Note: The SOB instruction does not change any condition codes. The SOB macro can change the N, Z, and V (but not the C) condition codes.

### 2.87 .SPCPS (FB and XM SYSGEN Option)

The .SPCPS (save/set mainline PC and PS) request allows a program's completion routine to change the flow of control of the mainline code. .SPCPS saves the mainline code PC and PS, and changes the mainline PC to a new value. If the mainline code is performing a monitor request, the
monitor allows that request to finish before doing any rerouting. The actual rerouting is deferred until the mainline code is about to run. Therefore, the .SPCPS request returns an error if it is reissued before an earlier request has been honored. Furthermore, the data saved in the user block is not valid until the new mainline code is running.

The .SPCPS request is a system generation feature and is available only in FB and XM. If a program issues this call under SJ or under a monitor not generated for the call, no action is taken and no error is returned.

Macro Call: .SPCPS area,addr

where:

area is the address of a two-word EMT argument block
addr is the address of a three-word block in user memory that contains the new mainline PC, and that is to contain the old mainline PC and PS

Request Format:

\[
\begin{array}{c}
R0 \rightarrow \text{area:} \\
\text{addr}
\end{array}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The program issued the .SPCPS call from the mainline code rather than a completion routine.</td>
</tr>
<tr>
<td>1</td>
<td>A previous .SPCPS request is outstanding.</td>
</tr>
</tbody>
</table>

When the program issues the .SPCPS request, the monitor saves the old mainline PS in the third word of the three-word block and the old mainline PC in the second word of the block. The monitor then changes the mainline PC to the contents of the first word of the block.

Example:

```plaintext
.TITLE SPCPS.MAC
.ENABL LC

; .SPCPS - This is an example in the use of the .SPCPS request. In this
; example .SPCPS is used to reroute the mainline code after an I/O
; error or EDF is detected by a completion routine.

.MCALL .READC,WRITC,CLOSE,PRINT,CSIGEN,.EXIT,.WAIT,.SRESET
.MCALL .SPCPS

ERRBYT = 52

.START
.CSIGEN #SPACE,#DEFEXT
CALL IDENT
.PPRINT #MESSG
1$: DEC R5
BR 1$

FINI: .CLOSE #O
MOV #DONE,RO
BR GBEY
WERR: MOV #WERR,RO
BR GBEY
RERR: MOV #RDERR,RO

; Error Byte location in SYSCOM

; Use CSIGEN to set handlers, files
; Start I/O
; Now simulate other mainline process
; (Kill some time)

; IEDF > 0 = End of File
; IRO = We're done message
; Use to exit program
; Set up error messages here...
```

2-128 Programmed Request Description and Examples
2.88 .SPFUN

This request is used with certain device handlers to do device dependent functions, such as rewind and backspace. It can be used with diskettes and some disks to allow reading and writing of absolute sectors. This request can determine the size of a volume mounted in a particular device unit for RX02 diskettes, RD50/RD51 disks, RK06/RK07 disks, RL01/RL02 disks, MSCP disks, and logical disks.

Macro Call: .SPFUN area,chan,func,buf,bufcnt,blk,[ctrn]

where:

area is the address of a six-word EMT argument block
chan is a channel number in the range 0 to 376(octal)
func is the numerical code of the function to be performed; these codes must be negative
buf is the buffer address; this parameter must be set to zero if no buffer is required

Programmed Request Description and Examples 2–129
wcnt is defined in terms of the device handler associated with the specified channel and in terms of the specified special function code.

blk is also defined in terms of the device handler associated with the specified channel and in terms of the specified special function code.

crtnt is the entry point of a completion routine. If left blank, 0 is automatically inserted. This value is the same as for .READ, .READC, and .READW.

0 = wait I/O (.READW)
1 = real time (.READ)

Value >500 = completion routine

Request Format:

R0 → area:

<table>
<thead>
<tr>
<th>chan</th>
<th>32</th>
</tr>
</thead>
<tbody>
<tr>
<td>blk</td>
<td></td>
</tr>
<tr>
<td>buf</td>
<td></td>
</tr>
<tr>
<td>wcnt</td>
<td></td>
</tr>
<tr>
<td>func</td>
<td>377</td>
</tr>
<tr>
<td>crtn</td>
<td></td>
</tr>
</tbody>
</table>

The chan, blk, and wcnt arguments are the same as those defined for .READ/.WRITE requests. They are only required when doing a .WRITE with extended record gap to magnetic tape. If the crtn argument is left blank, the requested operation completes before control returns to the user program. Specifying crtn as #1 is similar to executing a .READ or .WRITE in that the function is initiated and returns immediately to the user program. Use a .WAIT on the channel to make sure that the operation is completed. The crtn argument is a completion routine address to be entered when the operation is complete.

The available functions and function codes for magtape and cassette are as follows:

<table>
<thead>
<tr>
<th>Function</th>
<th>MM, MS, MT</th>
<th>CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward to last file</td>
<td>377</td>
<td></td>
</tr>
<tr>
<td>Forward to last block</td>
<td>376</td>
<td></td>
</tr>
<tr>
<td>Forward to next file</td>
<td>375</td>
<td></td>
</tr>
<tr>
<td>Forward to next block</td>
<td>374</td>
<td></td>
</tr>
<tr>
<td>Rewind to load point</td>
<td>373</td>
<td>373</td>
</tr>
<tr>
<td>Write file gap</td>
<td>372</td>
<td></td>
</tr>
<tr>
<td>Write EOF</td>
<td>377</td>
<td></td>
</tr>
<tr>
<td>Forward one block</td>
<td>376</td>
<td></td>
</tr>
<tr>
<td>Backspace one block</td>
<td>375</td>
<td></td>
</tr>
<tr>
<td>Write with extended file gap</td>
<td></td>
<td>374</td>
</tr>
<tr>
<td>Off-line rewind</td>
<td>372</td>
<td></td>
</tr>
<tr>
<td>Write</td>
<td>371</td>
<td></td>
</tr>
<tr>
<td>Read</td>
<td>370</td>
<td></td>
</tr>
<tr>
<td>Stream at 100 ips (MS only)</td>
<td>367</td>
<td></td>
</tr>
</tbody>
</table>
The available functions and function codes for diskettes, RK06/RK07 disks, RL01 and RL02 disks, the logical disk handler, MSCP disks, and RD50/RD51 disks are as follows:

<table>
<thead>
<tr>
<th>Function</th>
<th>DX</th>
<th>DZ</th>
<th>DM</th>
<th>DY</th>
<th>DL</th>
<th>LD</th>
<th>DU</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
</tr>
<tr>
<td>Write</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
</tr>
<tr>
<td>Write with deleted data mark</td>
<td>375</td>
<td>375</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Force a read by the handler of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>373</td>
</tr>
<tr>
<td>the bad block replacement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>374</td>
</tr>
<tr>
<td>table from block 1 of the disk</td>
<td></td>
<td></td>
<td>373</td>
<td>372</td>
<td>372</td>
<td>372</td>
<td>371</td>
<td>372</td>
</tr>
<tr>
<td>Return device size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>373</td>
<td>373</td>
<td>373</td>
</tr>
<tr>
<td>Read/write translation table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>373</td>
</tr>
<tr>
<td>Direct MSCP access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To use the .SPFUN request, the handler must be in memory and a channel must be associated with a file via a non-file-structured .LOOKUP request.

A .SPFUN request to write absolute blocks on RX01/RX02 diskettes should not write anything in track 0 if you want to use DUP or the COPY/DEVICE command to back up the volume. DUP does not copy data in track 0. Also, you should be careful to specify a valid buffer address and word count. The monitor checks that the buf argument is in the job area, but it does not check buf + wcnt. If you use the .SPFUN request, and the device handler for that device does not support special functions or the particular .SPFUN code used, the call simply returns to the program without reporting an error.

When using special functions 376 and 377 with DW or DZ:

- **wcnt** is the track to be read or written.
- **blk** is the sector.
- **buf** is the address of a 256-word buffer.

SPFUN 376 and 377 with DZ handler do not interleave sectors. RX50 diskettes, handled by DZ, have 80 tracks. SPFUN 376 and 377 wrap to track 0 after track 79.

When using special function 373 with DW:

- **chan** is the channel on which DW was opened with .LOOKUP.
- **buf** is the address of a one-word buffer in which the size of the volume will be returned: 9727(decimal) blocks for an RD50, 19519(decimal) blocks for an RD51.
- **blk** is not used and should be set to 0.

For the RK06/07 handler (DM), special function codes 377 and 376 require the buffer size to be one word larger than necessary for the data. The first word of the buffer contains the error information returned as a result of the .SPFUN request. The data transferred as a result of the read or write request is found in the second and following words of the buffer. The error codes and information are as follows:
Code

Meaning

100000  The I/O operation is successful.
100200  A bad block was detected (BSE error).
100001  An ECC error is corrected.
100002  An error recovered on retry.
100004  An error recovered through an offset retry.
100010  An error recovered after recalibration.
1774xx  An error did not recover.

Other device-specific information is included in the *RT–11 Software Support Manual*.

Errors:

**Code**  **Explanation**

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Attempt to read or write past end-of-file, or invalid function value.</td>
</tr>
<tr>
<td>1</td>
<td>Hard error occurred on channel.</td>
</tr>
<tr>
<td>2</td>
<td>Channel is not open.</td>
</tr>
</tbody>
</table>

Additional qualifying information for these errors is returned in the first two words of the blk argument status block. This information is given in Chapter 10 of the *RT–11 Software Support Manual*.

Example:

```
.TITLE SPFUN.MAC

;SPFUN - This is an example in the use of the SPFUN request. The example rewinds a cassette and writes out a 256-word buffer and then a file sap.

.MCALL FETCH,LOOKUP,SPFUN,WRITW
.MCALL EXIT,PRINT,WAIT,CLOSE

START:  .FETCH BCS 1# AREA,4,CT
        .LOOKUP BCS 2# AREA,4,CT
        SPFUN BCS 3# AREA,4,#373,0
        WRITW BCS 4# AREA,4,BUFF,#256,.,BLK
        SPFUN BCS 5# AREA,4,#372,0,.,1
        PRINT BCS 6# DONE
        WAIT BCS 7#
        CLOSE BCS 8#
        EXIT BCS 9#

1#:  MOV BCS 9# FERR,RO
      BR 5#
```

[2-132 Programmed Request Description and Examples]
2.89 .SPND/.RSUM (FB and XM Only)

The .SPND/.RSUM requests control execution of a job's mainline code (the code that is not executing as a result of a completion routine). .SPND suspends the mainline and allows only completion routines (for I/O and mark time requests) to run. .RSUM from one of the completion routines resumes the mainline code. These functions enable a program to wait for a particular I/O or mark time request by suspending the mainline and having the selected event's completion routine issue a .RSUM. This differs from the .WAIT request, which suspends the mainline until all I/O operations on a specific channel have completed.

Macro Calls: .SPND
              .RSUM

Request Formats:

  (.SPND) R0 = 
              1 0

  (.RSUM) R0 = 
              2 0

Notes:

1. The monitor maintains a suspension counter for each job. This counter is decremented by .SPND and incremented by .RSUM. A job is suspended only if this counter is negative. Thus, if a .RSUM is issued before a .SPND, the latter request returns immediately.

2. A program must issue an equal number of .SPND and .RSUM requests.

3. A .RSUM request from the mainline code increments the suspension counter.

4. A .SPND request from a completion routine decrements the suspension counter, but does not suspend the mainline. If a completion routine does a .SPND, the mainline continues until it also issues a .SPND, at which time it is suspended and requires two .RSUMs to proceed.

Programmed Request Description and Examples  2–133
5. Since a .TWAIT is simulated in the monitor using suspend and resume, a .RSUM issued from a completion routine without a matching .SPND can cause the mainline to continue past a timed wait before the entire time interval has elapsed.

6. A .SPND or .RSUM, like most other programmed requests, can be issued from within a user-written interrupt service routine if the .INTEN/.SYNCH sequence is followed. All notes referring to .SPND/.RSUM from a completion routine also apply to this case.

Errors:
None.

Example:

```
.TITLE SPND.MAC

; Allocate another Q-Element
irate "$n","C"C action by monitor
; Start "watchdog" completion rime
; Look for a message
; No errors - there's always BG
; Other processing here...

; Announce we're going to suspend
; Suspend to wait for message
; We've been .RSUMed... "C"C hit??
; Branch if yes
; Otherwise assume message came in...

; Loop...

; Check if "C"C entered...
; Branch if no
; Yes...wake up the mainline
; Then leave completion code

; Schedule to run again in 10 sec.
; Then leave completion code

; Announce we're aborting
; Proceed with "orderly" abort

; Exit the program

; Extra Q-Element
; Message buffer
; EMU Argument blocks
; Time out in 10 seconds
; "C"C Status word
```

2–134 Programmed Request Description and Examples
2.90 .SRESET

The .SRESET (software reset) request:

1. Cancels any messages sent by the job.
2. Waits for all job I/O to complete, which includes waiting for all completion routines to run.
3. Dismisses any device handlers that were brought into memory via .FETCH calls. Handlers loaded via the keyboard monitor LOAD command remain resident, as does the system device handler.
4. Purges any currently open files. Files opened for output with .ENTER are never made permanent.
5. Reverts to using only 16(decimal) I/O channels. Any channels defined with .CDFN are discarded. A .CDFN must be reissued to open more than 16 channels after a .SRESET is performed.
7. Resets the I/O queue to one element. A .QSET request must be reissued to allocate extra queue elements.
8. Cancels all outstanding .MRKT requests.

Macro Call: .SRESET

Errors:

None.

Example:

.TITLE SRESET.MAC

; The example renames a file according to filespecs entered using the ; .CSISPC request.

;Error byte location

.START:

;Use CSISPC to get file specs
;Get Handler from outspec
;Branch if failed
;R2 => Outspec
;R3 => Inspec
;Copy device spec to inspec
;Copy outspec behind inspec
;for .RENAME...

;Rename input file
;Operation successful
;Make error code -1:0 or +1
;Branch if File-Not-Found
;Illegal operation - set up msg
;Branch to report error
2.91 .SYNCH (Device Handler and Interrupt Service Routine Only)

This macro call enables your program to issue programmed requests from within an interrupt service routine. Code following the .SYNCH call runs at priority level 0 as a completion routine in the issuing job's context. Programmed requests issued from interrupt routines are not supported by the system and should not be performed unless a .SYNCH is used. .SYNCH, like .INTEN, is not an EMT monitor request, but rather a sub-routine call to the monitor.

Macro Call: .SYNCH area,[pic]

where:

area is the address of a seven-word block that you must set aside for use by .SYNCH. This argument, area, represents a special seven-word block used by .SYNCH as a queue element. This is not the same as the regular area argument used by many other programmed requests. The user must not confuse the two; he should set up a unique seven-word block specifically for the .SYNCH request. The seven-word block appears as:

Word 1    RT-11 maintains this word; its contents should not be altered by the user
2 The current job's number. This must be set up by the user program. It can be obtained by a .GTJB call or from the I/O queue element in a device handler
3 Unused
4 Unused
5 R0 argument. When a successful return is made from .SYNCH, R0 contains this argument
6 Must be -1
7 Must be 0

pic is an optional argument that, if non-blank, causes the .SYNCH macro to produce position-independent code for use by device drivers
Note:

.SYNCH assumes that the user has not pushed anything on the stack between the .INTEN and .SYNCH calls. This rule must be observed for proper operation.

Errors:

The monitor returns to the location immediately following the .SYNCH if the .SYNCH was rejected. The routine is still unable to issue programmed requests, and R4 and R5 are available for use. An error is returned if another .SYNCH that specified the same seven-word block is still pending.

NOTE

The monitor dismisses the interrupt without returning to the .SYNCH routine if one of the following conditions occur:

1. You specified an illegal job number.
2. The job number does not exist (for example, you specify 2, and there is no foreground job).
3. The job is exited or terminated with an .EXIT programmed request.

You can find out if the block is in use by:

1. Checking location Q.COMP (offset 14 octal). If this location contains a zero, the block is available.
2. Performing a .SYNCH call. If the block is busy, an error return will be performed.

Normal return is to the word after the error return. At this point, the routine is in user state and is thus allowed to issue programmed requests. R0 contains the argument that was in word 5 of the block. R0 and R1 are free for use without having to be saved. R4 and R5 are not free, and do not contain the same information they contained before the .SYNCH request. A long time can elapse before the program returns from a .SYNCH request since all interrupts must be serviced before the main program can continue. Exit from the routine should be done via an RTS PC.

Example:

.TITLE SYNCH.MAC

* .SYNCH - This is an example of the .SYNCH request.
  * The example is a skeleton of a program which could input data
  * from the outside world by means of an in-line interrupt service routine,
  * buffer it until a whole block's worth has been input, then use
  * a .WRITE request to store the data on an RT-11 device.
  *
2.92 .TIMIO (Device Handler Only)

The .TIMIO macro issues the device time-out call in the handler I/O initiation section. This request schedules a completion routine to run after the specified time interval has elapsed. The completion routine runs in the context of the job indicated in the timer block. In XM systems, the completion routine executes with kernel mapping, since it is still a part of the interrupt service routine. (See the RT-11 Software Support Manual for more information about interrupt service routines and the XM monitor.) As usual with completion routines, R0 and R1 are available for use. When the completion routine is entered, R0 contains the sequence number of the request that timed out.

2-138 Programmed Request Description and Examples
Macro Call: .TIMIO tbk, hi, lo

where:

tbk is the address of the timer block, a seven-word pseudo timer queue element. (The timer block format is shown in Table 2–1 under the .CTIMIO request.) You must set up the address of the completion routine in the seventh word of the timer block in a position-independent manner.

hi is the high-order word of a two-word time interval

lo is the low-order word of a two-word time interval

Example:

.TITLE TIMIO.MAC

;+ TIMIO.MAC - This is an example of a simple, RT-11 device driver, to illustrate the use of the .TIMIO/.CTIMIO requests. The timeout completion routine will be entered if a character hasn’t been successfully transmitted in 1/10 sec (approx. 110 baud). In this example the completion routine takes no explicit action; the fact that the timeout occurred is enough to be considered a “hard” error.

;=

_MASTER

;I Define these in case not assembled with SYSCND.MAC
.IIF NDF MSGST, MSGST=0
.IIF NDF ERLOG, ERLOG=0
.IIF NDF TIMST, TIMST=0

;I Define default vector
.IIF NDF SP$VEC, SP$VEC=304
.IIF NDF SP$CSR, SP$CSR=17504
.IIF NDF SP$PRI, SP$PRI=6

IDERR = 1 Hard I/O error bit definition
IDevice Status = Write only
SPSTS = 20000
IDevice Size = 0 (Char device)
TIME = 6
ITimeout interval = 1/10 sec
CDD = 377
IDevice i.d. code

;I Use .QELDF to define Q-Elem offsets
;IUse .DRBEC to define driver code with .DRBEC
;IBegin driver code with .DRBEC
SP$VEC = SP$VE6, SP$VE6 = 6
IRd = > Current Q-Element
ASL = &SP$CNT(R4)
IA make word count byte count
BCC = SP$ERR
IA read from a write-only device?
BEQ = SP$DUN
IZero word count...Just exit
SPRET:
MOV = PC,R5
ICalculate PIC address
ADD = #SP$OUT...R5
ICompletion routine
MOV = R5,TBLK+14
IMove it to argument block
.TIMIO = TBLK,0,TIME
ISchedule a marktime
BIS = #100, #SP$CSR
IEnable DL-11 interrupt
RETURN
IReturn to monitor

I INTERRUPT SERVICE ROUTINE

;I Use .DRAST to define Int Svc Sect.
;IRd = > Q-Element
;IError?
SP$PRI = SP$POI
IYes...‘hans’ until ready
TST = #SP$CSR
IIs device ready?
BMI = SP$RET
INo...so wait ’till it is
TSTB = #SP$CSR
ICancel completion routine
BPL = SP$RET
IToo late - it timed out!
.CTIMIO = TBLK
IXfer byte from buffer to DL-11
MOVB = #BUFF(R4), #SP$CSR+2
IXfer the buffer pointer
INC = #BUFF(R4)
Iand the word count (it’s negative!)
2.93 .TLOCK

The .TLOCK (test lock) request is used in an FB environment to attempt to gain ownership of the USR. It is similar to .LOCK in that, if successful, the user job returns with the USR in memory (it is identical to .LOCK in the SJ monitor). However, if a job attempts to .LOCK the USR while another job is using it, the requesting job is suspended until the USR is free. With .TLOCK, if the USR is not available, control returns immediately with the C bit set to indicate the .LOCK request failed.

Macro Call: .TLOCK

Request Format:

```
R0 = 7 0
```

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>USR is already in use by another job.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE TLOCK.MAC

; .TLOCK - This is an example in the use of the .TLOCK request.
; In this example, the user program needs the USR for a sub-job it is
; executing. If it fails to get the USR it "suspending" that sub-job and
; runs another sub-job (that perhaps doesn't need the USR for execution).
; This type of procedure is useful to schedule several sub-jobs within
; a single background or foreground program.

; Begin Mainline program
; Try to get the USR for 1st "job"
; Failed... branch to "suspend" 1st job
; Succeeded... proceed with 1st job
; Branch if error on LOOKUP
; 1st job involves file processing... do it!
; Tell user we executed...
; 1st job finished... release USR
; Check if we ran Job #2 while USR busy
; Yup - we did
; Nope - do it now

.MCALL .TLOCK,.LOOKUP,.UNLOCK,.EXIT,.PRINT

START:

.TLOCK

.SUSPEND

;AREA: #4,.FILE

.LKERR

.TPRINT

;JMSG

;PRINT

;UNLOCK

.TSMD

;J2SW

.BNE

.CALL

;J0B2

1:

.EXIT
```

2-140 Programmed Request Description and Examples
.TRPSET allows the user job to intercept traps to 4 and 10 instead of having
the job aborted with a ?MON-F-Trap to 4 or ?MON-F-Trap to 10 message.
If .TRPSET is in effect when an error trap occurs, the user-specified routine
is entered. The status of the carry bit on entry to the routine determines
which trap occurred: carry bit clear indicates a trap to 4; carry bit set
indicates a trap to 10. The user routine should exit with an RTI instruction.
Traps to 4 can also be caused by user stack overflow on some processors
(check your processor handbook). These traps are not intercepted by the
.TRPSET request, but they do cause job abort and a printout of the message
?MON-F-Stack overflow in the SJ monitor or ?MON-F-Trap to 4 in the FB
and XM monitors (see the RT-11 System Message Manual).

Macro Call: .TRPSET area,addr

where:

area is the address of a two-word EMT argument block

addr is the address of the user's trap routine. If an address of 0 is
specified, trap interception is disabled

Request Format:

\[
\begin{array}{c}
R0 \rightarrow \text{area:} \quad 3 \quad 0 \\
\text{addr}
\end{array}
\]

Notes:

1. Reissue a .TRPSET request whenever an error trap occurs and the user
routine is entered. The monitor disables user trap interception prior to
entering the user trap routine. Thus, if a trap should occur from within
the user's trap routine, an error message is generated and the job is
aborted. The last operation the user routine should perform before an
RTI is to reissue the .TRPSET request.
2. In the XM monitor, traps dispatched to a user program by .TRPSET execute in user mode. They appear as interrupts of the user program by a synchronous trap operation. Programs that intercept error traps by trying to steal the trap vectors must be carefully designed to handle two cases accurately: programs that are virtual jobs and programs that are privileged jobs.

If the program is a virtual job, the stolen vector is in user virtual space that is not mapped to kernel vector space. The proper method is to use .TRPSET; otherwise interception attempts fail and the monitor continues to handle traps to 4 and 10.

If the program is a privileged job, it is mapped to the kernel vector page. The user can steal the error trap vectors from the monitor, but the benefits of doing so must be carefully evaluated in each case. Trap routines run in the mapping mode specified by bits 14 and 15 of the trap vector PS word. With both bits set to 0, kernel mode is set. However, kernel mapping is not always equivalent to user mapping, particularly when extended memory is being used. With both bits 14 and 15 of the PS set to 1, user mode is set, and the trap routine executes in user mapping.

Errors:

None.

Example:

```
.TITLE TRPSET.MAC

;TRPSET - This is an example in the use of the .TRPSET request.
;In this example a user trap routine is set, then deliberate
;traps to 4 & 10 are caused (not very practical but it demonstrates
;that .TRPSET really works!).

;Begin example
;Begin example
;Begin example
;Begin example

.MCALL .TRPSET,.EXIT,.PRINT

DIVZ = 67

START:

;TRPSET AREA,TRPLOC

DIVZ
TST  @#166666
.EXIT

TRPLC:

BCS  1$

;PRINT TRP4

BR  2$

;PRINT TRP10

1$

;TRPSET AREA,TRPLOC

2$

RTI

AREA: .WORD 0:0

TRP4: .ASCIIZ "?Trap to 4?/

TRP10: .ASCIIZ "?Trap to 10?/

.END START
```

!Divide by zero - illegal instruction

!Begin example

!Set up a trap routine to handle traps

!to 4 & 10...

!Illegal instruction - Trap to 10

!Address non-existent memory - Trap to 4

!Exit program

!Trap routine

!IC bit set = TRAP 10

!Report Trap to 4

!Branch to reset trap routine

!Report trap to 10

!Reset trap routine address

!Return to offending code

!EMT argument block

!Error messages...

2–142 Programmed Request Description and Examples
2.95 .TTYIN/.TTINR

The requests .TTYIN and .TTINR transfer a character from the console terminal to the user program. The character thus obtained appears right-justified (even byte) in R0. The user can cause the characters to be returned in R0 only, or in R0 and other locations.

The expansion of .TTYIN is:

    EMT 340
    BCS .-2

The expansion of .TTINR is:

    EMT 340

If no characters or lines are available when an EMT 340 is executed, return is made with the carry bit set. The implication of these calls is that .TTYIN causes a tight loop waiting for a character/line to appear, while the user can either wait or continue processing using .TTINR.

If the carry bit is set when execution of the .TTINR request is completed, it indicates that no character was available; the user has not yet typed a valid line. Under the FB or XM monitor and under an SJ monitor with multiterminal support, .TTINR does not return the carry bit set unless bit 6 of the job status word (JSW) was on when the request was issued.

There are two modes of doing console terminal input. The choice is governed by bit 12 of the job status word. If bit 12 is 0, normal I/O is performed. In this mode, the following conditions apply:

1. The monitor echoes all characters typed.
2. CTRL/U and the DELETE key perform line deletion and character deletion, respectively.
3. A carriage return, line feed, CTRL/Z, or CTRL/C must be struck before characters on the current line are available to the program. When one of these is typed, characters on the line typed are passed one by one to the user program.

If bit 12 is 1, the console is in special mode. The effects are:

1. The monitor does not echo characters typed except for CTRL/C and CTRL/O.
2. CTRL/U and the DELETE key do not perform special functions.
3. Characters are immediately available to the program.

In special mode, the user program must echo the characters received. However, CTRL/C and CTRL/O are acted on by the monitor in the usual way. Bit 12 in the JSW must be set by the user program. This bit is cleared when the program terminates.
Regardless of the setting of bit 12, when a carriage return is entered, both carriage return and line feed characters are passed to the program; if bit 12 is 0, these characters will be echoed.

Lowercase conversion is determined by the setting of bit 14 in the JSW. If bit 14 is 0, lowercase characters are converted to uppercase before being echoed (if bit 12 is 0) and passed to a program; if bit 14 is 1, lowercase characters are echoed (if bit 12 is 0) and passed as received. Bit 14 is cleared when the program terminates.

CTRL/F and CTRL/B (and CTRL/X in system job monitors) are not affected by the setting of bit 12. The monitor always acts on these characters (unless the SET TT NOFB command is issued).

CTRL/S and CTRL/Q are intercepted by the monitor (unless, under the FB or XM monitor, the SET TT NOPAGE command is issued).

Under the FB or XM monitor, if a terminal input request is made and no character is available, job execution is blocked until a character is ready. This is true for both .TTYIN and .TTINR, and for both normal and special modes. If a program requires execution to continue and the carry bit to be returned, it must set bit 6 of the Job Status Word before the .TTINR request. Bit 6 is cleared when a program terminates.

If the single-line editor has been enabled by the commands SET SL ON and SET SL TTYIN, and if bits 4 and 12 of the JSW are 0, input from a .TTYIN or .TTINR request will be edited by SL. If either bit 4 or bit 12 is set, SL will not edit input. If SL is editing input, the state of bit 6 (inhibit TT wait) is ignored and a .TTINR request will not return until an edited line is available.

NOTE

The .TTYIN request does not get characters from indirect files. If this function is desired, the .GTLIN request must be used.

Macro Calls:  .TTYIN char
               .TTINR

where:

char is the location where the character in R0 is to be stored. If char is specified, the character is in both R0 and the address represented by char. If char is not specified, the character is in R0

Errors:

Code Explanation
  0  No characters available in ring buffer.

Example:

Refer to the example following the description of .TTYOUT/.TTOUTR.
The requests .TTYOUT and .TTOUTR cause a character to be transmitted to the console terminal. The difference between the two requests, as in the .TTYIN/.TTINR requests, is that if there is no room for the character in the monitor's buffer, the .TTYOUT request waits for room before proceeding, while the .TTOUTR does not wait for room and the character is not output.

If the carry bit is set when execution of the .TTOUTR request is completed, it indicates that there is no room in the buffer and that no character was output. Under the FB or XM monitor, .TTOUTR normally does not return the carry bit set. Instead, the job is blocked until room is available in the output buffer. If a job requires execution to continue and the carry bit to be returned, it must turn on bit 6 of the Job Status Word before issuing the request.

The .TTINR and .TTOUTR requests have been supplied to help those users who want to continue rather than suspend program execution until a console operation is complete. With these modes of I/O, if a no-character or no-room condition occurs, the user program can continue processing and try the operation again at a later time.

NOTE
If a foreground job leaves bit 6 set in the Job Status Word, any further foreground .TTYIN or .TTYOUT requests cause the system to lock out the background until a character is available. Note also that each job in the foreground/background environment has its own Job Status Word, and therefore can be in different terminal modes independently of the other job.

Macro Call: .TTYOUT char .TTOUTR

where:

char is the location containing the character to be loaded in R0 and printed. If not specified, the character in R0 is printed. Upon return from the request, R0 still contains the character.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Output ring buffer full.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE TTYIN.MAC

.TTYIN / .TTYOUT - This is an example in the use of the .TTYIN
& .TTYOUT requests. The example accepts a line of input from the
console keyboard; then echoes it on the terminal. Using .TTYIN &
TTYOUT requests illustrate Synchronous Terminal I/O i.e., the
Monitor retains control (the Job is blocked) until the requests
are satisfied.
```

Programmed Request Description and Examples  2-145
TITLE TTINR.MAC

;TTINR / ;TTOUTR - This is an example in the use of the ;TTINR & ;TTOUTR requests. Like TTYIN.MAC, this example accepts lines of input from the console keyboard, then echoes it on the terminal.

In the example, the user will type at the keyboard and the program will echo the input. The program also monitors the output buffer to determine if it is full. If the output buffer is full, the program will wait until space becomes available. If the output buffer is not full, the program will write the next character to the output buffer.

; MCALL ;TTINR,;TTYOUT
; MCALL ;TTINR,;TTYOUT,EXIT

JSW = 44 ; Location of Job Status Word in SYSCOM

START: MOV #BUFFER,R1 ; Point R1 to buffer
CLR R2 ; Clear character counter
BIS #100,#JSW ; Set bit #6 in JSW so ;TTINR,;TTOUTR will return C bit set if no char/no room...

; INLOOP: ;TTINR
; BCS NOCHAR ; None available
;
; CHRN: MOVB R0,(R1)+ ; Put char in buffer
INC R2 ; Increase count
CMPB R0,#12 ; Was last char = LF?
BNE INLOOP ; No...set next char
MOV #BUFFER,R1 ; Yes...point R1 to beginning of buffer

; OUTLOOP: MOVB (R1),R0 ; Put char in R0
; BCS NOCHAR ; Branch if no room in output buffer
; DEC R2 ; Decrease count
; BEQ START ; Done if count = 0
; INC R1 ; Jump buffer pointer
; BR OUTLOOP ; Then branch to print next char

; NOCHAR: ;TTINR
; BCC CHRN ; Comes here if no char avail
; i ; Try to again to set one
; ; There's one avail this time!
; i ; Do other processing
; i
; BR NOCHAR ; Try again

; NOROOM: MOVB (R1),R0 ; Comes here if no room in buffer
; .TTOUTR ; Put char in R0
; i ; Try to print it again
; ; Successful!
; ; Code to be executed while waiting
; ;
; ; Now we must hang to wait...
; BIC #100,#JSW ; Clear bit #6 in JSW
; ; Use ;TTOUT to wait for room
; BIS #100,#JSW ; Finally successful - reset bit #6
; ; Then return to output loop

; BUFFER: .BLKW 64 ; Buffer

; END START

2-146 Programmed Request Description and Examples
2.97  .TWAIT (SYSGEN Option for SJ)

The .TWAIT request suspends the user’s job for an indicated length of time. .TWAIT requires a queue element and thus should be considered when the .QSET request is issued.

Macro Call:  .TWAIT area,time

where:

  area  is the address of a two-word EMT argument block
  time  is a pointer to two words of time (high order first, low order second), expressed in ticks

Request Format:

R0  →  area:  24  0

  time

Notes:

1.  Since a .TWAIT is simulated in the monitor using suspend and resume, a .RSUM issued from a completion routine without a matching .SPND can cause the mainstream to continue to pass a timed wait before the entire time interval has elapsed. In addition, a .TWAIT issued within a completion routine is ignored by the monitor, since it would block the job from ever running again.

2.  The unit of time for this request is clock ticks, which can be 50 Hz or 60 Hz, depending on the local power supply, if your system has a line frequency clock. This must be kept in mind when the time interval is specified.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No queue element was available.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE  TWAIT.MAC

1+  .TWAIT - This is an example in the use of the .TWAIT request.
  .TWAIT is useful in applications where a program must be only
  activated periodically. This example will 'wake up' every five seconds
  to perform a simulated "task", and then 'sleep' again. (For example
  purposes this cycle will be repeated for a maximum of about 35 sec).
1-

.MCALL  .TWAIT,.QSET,.EXIT,.PRINT

START:  CALL  TASK  #Perform task...
  .TWAIT  #DAREA,#TIME  #Go to sleep for 5 seconds
  BCS  NOQ  #Branch if no queue element
  CALL  TASK  #Perform task again
  DEC  COUNT  #Bump counter - example good for 35 sec
  BNE  1#  #Branch if time's not up
  .PRINT  #BYE  #Say we're thru
  .EXIT  #Exit program
```
2.98 .UNLOCK

See .LOCK/.UNLOCK (Section 2.45).

2.99 .UNMAP (XM Only)

The .UNMAP request unmaps a window and flags that portion of the program's virtual address space as being inaccessible. When an unmap operation is performed for a virtual job, attempts to access the unmapped address space cause a memory management fault. For a privileged job, the default (kernel) mapping is restored when a window is unmapped.

Macro Call: .UNMAP area, addr

where:

area is the address of a two-word argument block

addr is the address of the window control block that describes the window to be unmapped

Request Format:

\[
\begin{align*}
R0 & \rightarrow \text{area:} & 36 & 5 \\
& \text{addr} & & 
\end{align*}
\]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>An illegal window identifier was specified.</td>
</tr>
<tr>
<td>5</td>
<td>The specified window was not already mapped.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example following the description of .CRAW.
2.100 .UNPROTECT

See .PROTECT/.UNPROTECT (Section 2.64).

2.101 .WAIT

The .WAIT request suspends program execution until all input/output requests on the specified channel are completed. The .WAIT request, combined with the .READ/.WRITE requests, makes double buffering a simple process.

.WAIT also conveys information through its error returns. An error is returned if either the channel is not open or the last I/O operation resulted in a hardware error.

If an asynchronous operation on a channel results in end-of-file, the following .WAIT programmed request will not detect it. The .WAIT request detects only hard error conditions. A subsequent operation on that channel will detect end-of-file and will return to the user immediately with the carry bit set and the end-of-file code in byte 52. Under these conditions, the subsequent operation is not initiated.

In an FB system, executing a .WAIT when I/O is pending causes that job to be suspended and another job to run, if possible.

Macro Call: .WAIT chan

Request Format:

\[ R0 = 0 \text{ chan} \]

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Channel specified is not open.</td>
</tr>
<tr>
<td>1</td>
<td>Hardware error occurred on the previous I/O operation on this channel.</td>
</tr>
</tbody>
</table>

Example:

```
.TITLE WAIT.MAC
1+ .WAIT - This is an example in the use of the .WAIT request. The example demonstrates asynchronous I/O where a mainline program initiates input via .READ requests, does some other processing, makes sure input has completed via the .WAIT request, then outputs the block just read. Another .WAIT is issued before the next read is issued to make sure the previous write has finished. This example is a single file copy program utilizing .CSIGEN to input the file specs, load the required handlers and open the files.
1-

.MCALL .READ,.WRITE,.CLOSE,.PRINT
.MCALL .CSIGEN,.EXIT,.WAIT,.SRESET

ERRBYT  = 52
ERROR Byte location in SYSCOM
```

Programmed Request Description and Examples  2–149
The .WDBBK macro defines symbols for the window definition block and reserves space for it. Information provided to the arguments of this macro permits the creation and mapping of a window through the use of the .CRAW request. Note that .WDBBK automatically invokes .WDBDF.

Macro Call: .WDBBK wnapr,wnsiz,[wnrid,wnoff,wnlen,wnsts]

where:

wnapr  is the number of the Active Page Register set that includes the window's base address. A window must start on a 4K-word boundary. The valid range of values is from 0 through 7.

wnsiz  is the size of this window (expressed in 32-word units)

wnrid  is the identification for the region to which this window maps. This argument is optional; supply it if you need to

2.102 .WDBBK (XM Only)

Handlers may be loaded starting here
map this window. Use the value of R.GID from the region definition block for this argument after you create the region to which this window must map.

wnoff is the offset into the region at which to start mapping this window (expressed in 32-word units). This argument is optional; supply it if you need to map this window. The default is 0, which means that the window starts mapping at the region’s base address.

wnlen is the amount of this window to map (expressed in 32-word units). This argument is optional; supply it if you need to map this window. The default value is 0, which maps as much of the window as possible.

wnsts is the window status word. This argument is optional; supply it if you need to map this window when you issue the .CRAW request. Set bit 8, called WS.MAP, to cause .CRAW to perform an implied mapping operation.

Example:

See Chapter 4 of the *RT-11 Software Support Manual* for an example that uses the .WDBBK macro and a detailed description of the extended memory feature.

### 2.103 .WDBDF (XM Only)

The .WDBDF macro defines the symbolic offset names for the window definition block and the names for the window status word bit patterns. In addition, this macro also defines the length of the window definition block by setting up the following symbol:

\[ W.NLGH = 16 \]

The .WDBDF macro does not reserve any space for the window definition block (see .WDBBK).

Macro Call: .WDBDF

The .WDBDF macro expands as follows:

- \[ W.NID = 0 \]
- \[ W.NAPR = 1 \]
- \[ W.NBAS = 2 \]
- \[ W.NSIZ = 4 \]
- \[ W.NRID = 6 \]
- \[ W.NOFF = 10 \]
- \[ W.NLEN = 12 \]
- \[ W.NSTS = 14 \]
- \[ W.NLGH = 16 \]
- \[ WS.CRW = 100000 \]
- \[ WS.UNM = 40000 \]
- \[ WS.ELW = 20000 \]
- \[ WS.MAP = 400 \]
2.104 .WRITE/.WRITC/.WRITW

Write operations for the three modes of RT-11 I/O are done using the .WRITE, .WRITC, and .WRITW programmed requests.

Note that in the case of .WRITE and .WRITC, additional queue elements should be allocated for buffered I/O operations (see .QSET programmed request).

Under an FB monitor with the system job feature, .WRITE/C/W requests may be used to send messages to other jobs in the system.

_Character_ WRITE_

The .WRITE request transfers a specified number of words from memory to the specified channel. Control returns to your program immediately after the request is queued.

Macro Call: .WRITE area,chan,buf,wcnt,blk

where:

- area is the address of a five-word EMT argument block
- chan is a channel number in the range 0 to 376(octal)
- buf is the address of the memory buffer to be used for output
- wcnt is the number of words to be written
- blk is the block number to be written. For a file-structured .LOOKUP or .ENTER, the block number is relative to the start of the file. For a non-file-structured .LOOKUP or .ENTER, the block number is the absolute block number on the device. The user program should normally update blk before it is used again. Some devices, such as LP, may assign the blk argument special meaning. For example, if blk = 0, LP: issues a form feed

Request Format:

\[
R0 \rightarrow \text{area:} \begin{array}{c|c}
11 & \text{chan} \\
\hline
\text{blk} & \\
\text{buf} & \\
\text{wcnt} & \\
1 & \\
\end{array}
\]

**NOTE**

When any .WRITE, .WRITC, or .WRITW programmed request is returned, R0 contains the number of words requested if the write is to a sequential-access device (for example, magtape). If the write is to a random-access device (disk or DECTape), R0 contains the number of words that will be written (.WRITE or .WRITC) or have been written (.WRITW). If a request is made to write past the end-of-file on a random-access device, the word count is shortened and an error is
returned. The shortened word count is returned in R0. If a write goes past EOT on magtape, an error is returned and R0 = 0. Note that the write is done and a completion routine, if specified, is entered, unless the request cannot be partially filled (shortened word count = 0).

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Attempted to write past end-of-file.</td>
</tr>
<tr>
<td>1</td>
<td>Hardware error.</td>
</tr>
<tr>
<td>2</td>
<td>Channel was not opened.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example following .READ.

.WRITC
The .WRITC request transfers a specified number of words from memory to a specified channel. Control returns to the user program immediately after the request is queued. Execution of the user program continues until the .WRITC is complete, then control passes to the routine specified in the request. When an RTS PC is encountered in the completion routine, control returns to the user program.

Macro Call: .WRITC area,chan,buf,wcnt,crtn,blk

where:

- area is the address of a five-word EMT argument block
- chan is a channel number in the range 0 to 376(octal)
- buf is the address of the memory buffer to be used for output
- wcnt is the number of words to be written
- crtn is the address of the completion routine to be entered
- blk is the block number to be written. For a file-structured .LOOKUP or .ENTER, the block number is relative to the start of the file. For a non-file-structured .LOOKUP or .ENTER, the block number is the absolute block number on the device. Your program should normally update blk before it is used again. See the RT-11 Software Support Manual for the significance of the block number for devices such as line printers and paper tape punchers

Request Format:

<table>
<thead>
<tr>
<th>R0 → area:</th>
<th>11</th>
<th>chan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>blk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>buf</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wcnt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>crtn</td>
<td></td>
</tr>
</tbody>
</table>
NOTE

When any .WRITE, .WRITC, or .WRITW programmed request is returned, R0 contains the number of words requested if the write is to a sequential-access device (for example, magtape). If the write is to a random-access device (disk or DECTape), R0 contains the number of words that will be written (.WRITE or .WRITC) or have been written (.WRITW). If a request is made to write past the end-of-file on magtape, the handler returns an error and R0 = 0. Note that the write is done and a completion routine, if specified, is entered, unless the request cannot be partially filled (shortened word count = 0).

When a .WRITC completion routine is entered, the following conditions are true:

1. R0 contains the contents of the channel status word for the operation. If bit 0 of R0 is set, a hardware error occurred during the transfer: Consequently, the data may be unreliable.

2. R1 contains the octal channel number of the operation. This is useful when the same completion routine is to be used for several different transfers.

3. Registers R0 and R1 are available for use by the routine, but all other registers must be saved and restored. Data cannot be passed between the main program and completion routines in any register or on the stack.

Errors:

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>End-of-file on output. Tried to write outside limits of file.</td>
</tr>
<tr>
<td>1</td>
<td>Hardware error occurred.</td>
</tr>
<tr>
<td>2</td>
<td>Specified channel is not open.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example following .READC.

.WRITW
The .WRITW request transfers a specified number of words from memory to the specified channel. Control returns to your program when the .WRITW is complete.

Macro Call: .WRITW area,chan,buf,wcnt,blk

where:

area is the address of a five-word EMT argument block
chan is a channel number in the range 0 to 376(octal)
buf is the address of the buffer to be used for output
wcnt is the number of words to be written. The number must be positive
blk is the block number to be written. For a file-structured .LOOKUP or .ENTER, the block number is relative to the start of the file. For a non-file-structured .LOOKUP or .ENTER, the block number is the absolute block number on the device. Your program should normally update blk before it is used again. See the RT–11 Software Support Manual for the significance of the block number for devices such as line printers and paper tape punchers.

Request Format:

R0 → area:  
<table>
<thead>
<tr>
<th></th>
<th>11</th>
<th>chan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>blk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>buf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>wcnt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

**NOTE**

When any .WRITE, .WRITC, or .WRITW programmed request is returned, R0 contains the number of words requested if the write is to a sequential-access device (for example, magtape). If the write is to a random-access device (disk or DECTape), R0 contains the number of words that will be written (.WRITE or .WRITC) or have been written (.WRITW). If a request is made to write past the end-of-file on a random-access device, the word count is shortened and an error is returned. The shortened word count is returned in R0. If a write goes past end-of-file on magtape, the handler returns an error and R0 = 0. Note that the write is done and a completion routine, if specified, is entered, unless the request cannot be partially filled (shortened word count = 0).

Errors:

**Code** | **Explanation**
---|---
0 | Attempted to write past EOF.
1 | Hardware error.
2 | Channel was not opened.

Example:

Refer to the example following .READW.
Chapter 3
System Subroutine Description and Examples

This chapter presents all SYSLIB functions and subroutines in alphabetical order and provides a detailed description of each one. An example of each call in a FORTRAN program is given.

3.1 AJFLT

The AJFLT function converts an INTEGER*4 value to a REAL*4 value and returns that result as the function value.

Form: \( a = \text{AJFLT}(\text{jsrc}) \)

where:

\( \text{jsrc} \) is the INTEGER*4 variable to be converted

Function Results:
The function result is a REAL*4 value.

Errors:
None.

Example:
The following example converts the INTEGER*4 value contained in JVAL to single precision (REAL*4), multiplies it by 3.5, and stores the result in VALUE.

```
REAL*4 VALUE, AJFLT
INTEGER*4 JVAL

VALUE = AJFLT(JVAL) * 3.5
```

3.2 CHAIN

The CHAIN subroutine allows a background program (or any program in the single-job system) to transfer control directly to another background program and pass specified information to it. CHAIN cannot be called from a completion or interrupt routine. The FORTRAN impure area is not preserved across a chain. Therefore, when chaining from one program to another, the information must be reset in the program being chained to. When chaining to any other program, the user should explicitly close the opened logical units with calls to the CLOSE routine. Any routines specified in a FORTRAN USEREX library call are not executed if a CHAIN is accomplished (see Appendix B in the RT-11/RSTS/E FORTRAN IV User's Guide).
Form: CALL CHAIN (dblk, var, wcnt)

where:

dblk  is the address of a four-word Radix-50 descriptor of the file specification for the program to be run (see the PDP-11 FORTRAN Language Reference Manual for the format of the file specification)

var   is the first variable (which must start on a word boundary) in a sequence of variables with increasing memory addresses to be passed between programs in the chain parameter area (absolute locations 510 to 777). A single array or a COMMON block (or portion of a COMMON block) is a suitable sequence of variables

wcnt  is a word count specifying the number of words (beginning at var) to be passed to the called program. The argument wcnt may not exceed 60. If no words are passed, then a word count of 0 must be supplied

If the size of the chain parameter area is insufficient, it can be increased by specifying the /B (or /BOTTOM) option to LINK for both the program executing the CHAIN call and the program receiving control.

The data passed can be accessed through a call to the RCHAIN routine. For more information on chaining to other programs, see the .CHAIN programmed request (Section 2.6).

Errors:

None.

Example:

The following example transfers control from the main program to PROG.SAV on DTO, and passes it variables.

```
DIMENSION SPEC(2)
INTEGER*2 DATA(10)
DATA SPEC/GROTD0PRO, 6RG SAV/
.
.
CALL CHAIN (SPEC, DATA, 10)
```

3.3 CLOSEC/ICLOSE

The CLOSEC subroutine terminates activity on the specified channel and frees it for use in another operation. The handler for the associated device must be in memory. CLOSEC cannot be called from a completion or interrupt routine.

Form: CALL CLOSEC (chan[,i])
       i = CLOSEC(chan)
       CALL ICLOSE (chan[,i])
       i = ICLOSE(chan)
where:

\[
\begin{align*}
\text{chan} & \quad \text{is the channel number to be closed. This argument must be located so that the USR cannot swap over it} \\
i & \quad \text{is the error return if a protection violation occurs}
\end{align*}
\]

A CLOSEC or PURGE must eventually be issued for any channel opened for input or output. A CLOSEC call specifying a channel that is not open is ignored.

A CLOSEC performed on a file that was opened via an IENTER causes the device directory to be updated to make that file permanent. If the device associated with the specified channel already contains a file with the same name and type, the old copy is deleted when the new file is made permanent. If the file name is protected, then a protection error is generated. A CLOSEC on a file opened via LOOKUP does not require any directory operations.

When an entered file is closed, its permanent length reflects the highest block of the file written since the file was entered; for example, if the highest block written is block number 0, the file is given a length of 1; if the file was never written, it is given a length of 0. If this length is less than the size of the area allocated at IENTER time, the unused blocks are reclaimed as an empty area on the device.

Errors:

\[
\begin{align*}
i = 0 & \quad \text{Normal return.} \\
i = -4 & \quad \text{A protected file with the same name already exists on a device. The CLOSEC is performed, resulting in two files on the device with the same name.}
\end{align*}
\]

Example:

The following example creates and processes a 56-block file.

```plaintext
REAL*4 DBLK(2)
DATA DBLK/6RSYONEW,6RFILDAT/
DATA ISIZE/56/

ICHAN=IGETC()
IF(ICHAN.LT.0) GOTO 100
IERR=IENTER(ICHAN,0DBLK,ISIZE)
IF(IERR.LT.0)GOTO 20
GOTO(110,120,130)ABS(IER)
CALL ICLOSE (ICHAN,I)
IF(I.EQ.-4) GOTO 200
CALL IFREEC(ICHAN)
CALL EXIT
100 STOP 'NO AVAILABLE CHANNELS'
110 STOP 'CHANNEL ALREADY IN USE'
120 STOP 'NOT ENOUGH ROOM ON DEVICE'
130 STOP 'DEVICE IN USE'
200 STOP 'PROTECTION ERROR'
END
```

System Subroutine Description and Examples 3–3
3.4 CONCAT

The CONCAT subroutine concatenates two character strings.

Form: CALL CONCAT (a,b,out[,len[,err]])

where:

a  is the array containing the left string. The string must be terminated with a null byte

b  is the array containing the right string. The string must be terminated with a null byte

out is the array into which the concatenated result is placed. This array must be at least one element longer than the maximum length of the resultant string (that is, one greater than the value of len, if specified)

len is the integer number of characters representing the maximum length of the output string. The effect of len is to truncate the output string to a given length, if necessary

er is the logical error flag set if the output string is truncated to the length specified by len

CONCAT sets the string in the array out to be the string in array a immediately followed on the right by the string in array b and a terminating null character.

NOTE

Any combination of string arguments is allowed, so long as b and out do not specify the same array.

Concatenation stops when a null character is detected in b, or when the number of characters specified by len has been moved.

If either the left or right string is a null string, the other string is copied to out. If both are null strings, then out is set to a null string. The old contents of out are lost when this routine is called.

Errors:

Error conditions are indicated by err, if specified. If err is given and the output string would have been longer than len characters, then err is set to .TRUE.; otherwise, err is unchanged.

Example:

The following example concatenates the string in array STR and the string in array IN and stores the resultant string in array OUT. OUT cannot be larger than 29 characters.

LOGICAL*1 IN(22),OUT(30),STR(7)

CALL CONCAT(STR,IN,OUT,29)
3.5 CVTTIM

The CVTTIM subroutine converts a two-word internal format time to hours, minutes, seconds, and ticks.

Form: CALL CVTTIM (time,hrs,min,sec,tick)

where:

- `time` is the two-word internal format time to be converted. If time is considered as a two-element INTEGER*2 array, then:
  - `time (1)` is the high-order time
  - `time (2)` is the low-order time
- `hrs` is the integer number of hours
- `min` is the integer number of minutes
- `sec` is the integer number of seconds
- `tick` is the integer number of ticks (1/60 of a second for 60-cycle clocks; 1/50 of a second for 50-cycle clocks)

Errors:

None.

Example:

```plaintext
INTEGER*4 ITIME
  
  CALL GTIM (ITIME)           !GET CURRENT TIME-OF-DAY
  CALL CVTTIM (ITIME, IHRS, IMIN, ISEC, ITCK)
  IF (IHRS .GE. 12 .AND. IHRS .LT. 13) GOTO 100! TIME FOR LUNCH
```

3.6 DEVICE (FB and XM Only)

The DEVICE subroutine allows you to set up a list of addresses to be loaded with specified values when the program is terminated. If a job terminates or is aborted with a CTRL/C from the terminal, this list is picked up by the system and the appropriate addresses are set up with the corresponding values.

This function is primarily designed to allow user programs to load device registers with necessary values. In particular, it is used to turn off a device's interrupt enable bit when the program servicing the device terminates.

Only one address list can be active at any given time; hence, if multiple DEVICE calls are issued, only the last one has any effect. The list must not be modified by the program after the DEVICE call has been issued, and the list must not be located in an overlay or an area over which the USR swaps.

The second argument of the call (link) provides support for a linked list of tables. The link argument is optional and causes the first word of the list to be processed as the link word.
Form: CALL DEVICE (i 리스트, link))

where:

- `i 리스트` is an integer array that contains two-word elements, each composed of a one-word address and a one-word value to be put at that address, terminated by a zero word. On program termination, each value is moved to the corresponding address.

- `link` is an optional argument that can be any value. This indicates that a linked list table is to be used.

If the linked list form is used, the first word of the array is the link list pointer.

For more information on loading values into device registers, see the DEVICE programmed request (Section 2.19).

Errors:

None.

Example:

```
INTEGER*2 IDR11(3) ! DEVICE ARRAY SPEC
DATA IDR11(1)/*167770/ ! IDR11 CSR ADDRESS (OCTAL)
DATA IDR11(2)/0/ ! VALUE TO CLEAR INTERRUPT ENABLE
DATA IDR11(3)/0/ ! AND END-OF-LIST FLAG
CALL DEVICE(IDR11) ! SET UP FOR ABORT
```

### 3.7 DJFLT

The DJFLT function converts an INTEGER*4 value into a REAL*8 (DOUBLE PRECISION) value and returns that result as the function value.

Form: \( d = \text{DJFLT}(\text{jsrc}) \)

where:

- `jsrc` specifies the INTEGER*4 variable to be converted.

Notes:

If DJFLT is used, it must be defined in the FORTRAN program, either explicitly (REAL*8 DJFLT) or implicitly (IMPLICIT REAL*8 (D)). Without a definition, DJFLT is assumed to be REAL*4 (single precision).

Function Results:

The function result is the REAL*8 value that is the result of the operation.

Errors:

None.

Example:

```
INTEGER*4 JVAL
REAL*8 DJFLT:D
.
.
D=DJFLT(JVAL)
```
3.8 GETSTR

The GETSTR subroutine reads a formatted ASCII record from a specified FORTRAN logical unit into a specified array. The data is truncated (trailing blanks removed) and a null byte is inserted at the end to form a character string.

GETSTR can be used in main program routines or in completion routines, but it cannot be used in both at the same time. If GETSTR is used in a completion routine, it cannot be the first I/O operation on the specified logical unit.

Form: CALL GETSTR (lun, out, len, err)

where:

lun  is the integer FORTRAN logical unit number of a formatted sequential file from which the string is to be read
out  is the array to receive the string; this array must be at least one element longer than len
len  is the integer number representing the maximum length of the string that is allowed to be input
err  is the LOGICAL*1 error flag that is set to .TRUE. if an error occurred. If an error did not occur, the flag is .FALSE.

Errors:

Error conditions are indicated by err. If err is .TRUE., the values returned are as follows:

err  =  -1  End-of-file for a read operation.
err  =  -2  Hard error for a read operation.
err  =  -3  More than len bytes were contained in a record.

Example:

The following example reads a string of up to 80 characters from logical unit 5 into the array STRING.

LOGICAL*1 STRING(80),ERR
  
CALL GETSTR(5,STRING,80,ERR)

3.9 GTIM

The GTIM subroutine returns the current time of day. The time is returned in two words and is given in terms of clock ticks past midnight. If the system does not have a line clock, a value of 0 is returned. If an RT-11 monitor TIME command has not been entered, the value returned is the time elapsed since the system was bootstrapped, rather than the time of day.
Form: CALL GTIM (itime)

where:

itime   is the two-word area to receive the time of day

The high-order time is returned in the first word, the low-order time in the second word. The CVTTIM routine (see Section 3.5) can be used to convert the time into hours, minutes, seconds, and ticks. CVTTIM performs the conversion based on the monitor configuration word for 50- or 60-cycle clocks. Under an FB or XM monitor, the time-of-day is automatically reset after 24:00 when a GTIM is executed; under the single-job monitor, it is not.

Errors

None.

Example:

        INTEGER*4 JTIME
        .
        .
        CALL GTIM(JTIME)

3.10 GTJB/IGTJB

The GTJB subroutine returns information about a job in the system.

Form: CALL GTJB (addr,[jobblk [,i]])
       i = GTJB (addr,[jobblk])
       CALL IGTJB (addr,[jobblk [,i]])
       i = IGTJB (addr,[jobblk])

where:

addr   is the address of an eight- or twelve-word block into which the parameters are passed

The parameters returned are as follows:

1   Job Number = priority level*2 (background job is 0, system jobs are 2, 4, 6, 10, 12, 14, foreground job is 16 in system job monitors; background job is 0, foreground job is 2 in FB and XM monitors; job number is 0 in SJ monitor)

2   High-memory limit of job partition (last location plus 2)

3   Low-memory limit of job partition (first location)

4   Pointer to I/O channel space

5   Address of job's impure area in FB and XM monitors (0 in SJ)
6 Low byte: unit number of job's console terminal (only if the multiterminal option is present; 0 when the multiterminal feature is not used)

7 Virtual high limit for a job created with the linker /V option (XM only; 0 in SJ and FB and where the Linker /V option is not used)

8–9 Reserved for future use

10–12 ASCII logical job name (system job monitors only)

jobblk is a pointer to a three-word ASCII job name for which data is being requested. Do not specify this argument when requesting the eight-word block

i is an error return if the job is not running

If one argument is used with the call, only the first eight parameters will be passed. For example,

INTEGER IJPARM(8)
CALL GTJB (IJPARM)
I = GTJB (IJPARM)

At least a comma must follow the argument to pass the information into a 12-word block. For example,

INTEGER IJPARM(12)
CALL GTJB (IJPARM,)
I = GTJB (IJPARM,)

Errors:

i = 0 Normal return.
   = -1 No such job currently running.

Example:

C THIS IS AN EXAMPLE UNDER A SYSTEM
C JOB MONITOR TO SEE IF THE FOREGROUND
C JOB IS RUNNING
DIMENSION JDATA(12)
.
.
I = GTJB (JDATA, 16)
IF (I.EQ.0) GOTO 20
TYPE 10
10 FORMAT ('NO FG JOB!')
STOP
20
.
.

3.11 GTLIN

The GTLIN subroutine transfers a line of input from the console terminal or an active indirect command file to the user program. This request allows
you to input information at the console terminal, and it allows the program to operate through indirect files. This subroutine requires the USR. The maximum size of the input line is 80 characters. See the .GTLIN programmed request for setting bits in the Job Status Word to pass lowercase letters and to establish a nonterminating condition.

Form: CALL GTLIN (result[,prompt])

where:

result is the array receiving the string. This LOGICAL*1 array contains a maximum of 80 characters plus 0 as the end indicator, and therefore must be dimensioned to at least 81 elements

prompt is a LOGICAL*1 array containing an optional prompt string to be printed before the input line is received. The string format is the same as that used by the PRINT subroutine. If this argument is not present, no prompt is printed

Errors:

None.

Example:

LOGICAL*1 INP(80),PROMT(6)
DATA PROMT /'N','A','M','E','?','200/ 
...
CALL GTLIN(INP,PROMT)
...

3.12 IABTIO

The IABTIO function aborts I/O on a specified channel.

Form: CALL IABTIO (chan)

where:

chan is the channel number for which to abort I/O

Errors:

None.

3.13 IADDR

The IADDR function returns the 16-bit absolute memory address of its argument as the integer function value.

Form: i = IADDR (arg)
where:

    arg  is the variable or constant whose memory address is to be obtained. The value obtained by passing an expression as arg is unpredictable

Errors:

    None.

Example:

    IADDR can be used to find the address of an assembly language global area. For example:

    EXTERNAL CAREA
    J=IADDR(CAREA)

3.14 IAJFLT

The IAJFLT function converts an INTEGER*4 value to a REAL*4 value and stores the result.

Form:  i = IAJFLT (jsrc,ares)

where:

    jsr c  is the INTEGER*4 variable to be converted
    ares  is the REAL*4 variable or array element to receive the converted value

Function Results:

    i  =  -1  Normal return; the result is negative.
          =  0  Normal return; the result is 0.
          =  1  Normal return; the result is positive.

Errors:

    i  =  -2  Significant digits were lost during the conversion.

Example:

    INTEGER*4 JVAL
    REAL*4 RESULT
    .
    .
    .
    IF(IAJFLT(JVAL,RESULT),EQ.,-2) TYPE 99
    99 FORMAT (' OVERFLOW IN INTEGER*4 TO REAL CONVERSION')

3.15 IASIGN

The IASIGN function sets information in the FORTRAN logical unit table (overriding the defaults) for use when the FORTRAN Object Time System (OTS) opens the logical unit. This function can be used with ICSI (see
Section 3.20) to allow a FORTRAN program to accept a standard CSI input specification. IASIGN must be called before the unit is opened; that is, before any READ, WRITE, PRINT, TYPE, ACCEPT, or OPEN statements are executed that reference the logical unit.

Form: \( i = \text{IASIGN}(\text{lun}, \text{idev}, \text{ifityp}, \text{isize}, \text{itype}) \)

where:

- \( \text{lun} \) is an INTEGER*2 variable, constant, or expression specifying the FORTRAN logical unit for which information is being specified.
- \( \text{idev} \) is a one-word Radix–50 device name; this can be the first word of an ICSI input or output file specification.
- \( \text{ifityp} \) is a three-word Radix–50 file name and file type; this can be words 2 through 4 of an ICSI input or output file specification.
- \( \text{isize} \) is the length (in blocks) to allocate for an output file; this can be the fifth word of an ICSI output specification. If 0, the larger of either one-half the largest empty segment or the entire second largest empty segment is allocated. If the value specified for length is –1, the entire largest empty segment is allocated.
- \( \text{itype} \) is an integer value determining the optional attributes to be assigned to the file. This value is obtained by adding the values that correspond to the desired operations:

1. Use double buffering for output.
2. Open the file as a temporary file.
4. Force a LOOKUP on an existing file during the first I/O operation. (Otherwise, the first FORTRAN I/O operation determines how the file is opened. Normally if the first I/O operation is a write, an IENTER would be performed on the specified logical unit. A read always causes a LOOKUP.)
8. Expand carriage control information (see Notes below).
16. Do not expand carriage control information.
32. File is read only.

Notes:

Expanded carriage control information applies only to formatted output files and means that the first character of each record is used as a carriage control character when processing a write operation to the given logical unit. The first character is removed from the record and converted to the appropriate ASCII characters to simulate the requested carriage control.

If carriage control information is not expanded, the first character of each record is unmodified and the FORTRAN OTS outputs a line feed, followed by the record, followed by a carriage return.

If carriage control is unspecified, the FORTRAN OTS sends expanded carriage control information to the terminal and line printer and sends unex-
panded carriage control information to all other devices and files. See the
PDP-11 FORTRAN Language Reference Manual for further carriage con-
trol information.

Errors:

\[
\begin{align*}
  i &= 0 & \text{Normal return.} \\
  <> &= 0 & \text{The specified logical unit is already in use, or there is no}
  & \quad \text{space for another logical unit association.}
\end{align*}
\]

Example:

The following example (1) creates an output file on logical unit 3, using the first output file given to the RT-11 Command String Inter-
preter (CSI), (2) sets up the output file for double buffering, (3) cre-
ates an input file on logical unit 4, based on the first input file specification
given to the RT-11 CSI, and (4) makes the input file available for read-only access.

\[
\begin{align*}
  \text{INTEGER*2 SPEC(39)} \\
  \text{REAL*4 EXT(2)} \\
  \text{DATA EXT/GRDATDAT,GRDATDAT/} \quad \text{!DEFAULT FILE TYPE IS DAT} \\
  \quad \downarrow \\
  10 \quad \text{IF(ICSSTEP,EXT,,0),NE,0) GOTO 10} \\
\end{align*}
\]

\[
\begin{align*}
  \text{C} \\
  \text{DO NOT ACCEPT ANY SWITCHES} \\
  \text{C} \\
  \text{CALL IASIGN(3,SPEC(1),SPEC(2),SPEC(5),1)} \\
  \text{CALL IASIGN(4,SPEC(16),SPEC(17),0,32)} \\
\end{align*}
\]

3.16 ICDFN

The ICDFN function increases the number of input/output channels. Note
that ICDFN defines new channels; any channels defined with an earlier
ICDFN function are not used. Thus, an ICDFN for 20(decimal) channels
(while the 16(decimal) original channels are defined) causes only 20 I/O
channels to exist; the space for the original 16 is unused. The space for
the new channel area is allocated out of the free space managed by the FOR-
TRAN system.

Form: \( i = \text{ICDFN}\ (\text{num[,area]}) \)

where:

- \textbf{num} is the integer number of channels to be allocated. The number
  of channels must be greater than 16 and can be a maximum of
  256. The program can use all new channels greater than 16
  without a call to IGETC; the FORTRAN system input/output
  uses only the first 16 channels. This argument must be posi-
tioned so that the USR cannot swap over it

- \textbf{area} is the space allocated from within the calling program. Under
  FB and SJ monitors; be sure that the space is outside the USR
  swapping area. If this argument is not specified, the space for
  the channels is allocated in the FORTRAN OTS work area
Notes:

1. ICDFN cannot be issued from a completion or interrupt routine.

2. It is recommended that the ICDFN function be used at the beginning of the main program before any I/O operations are initiated.

3. If ICDFN is executed more than once, a completely new set of channels is created each time ICDFN is called.

4. ICDFN requires that extra memory space be allocated to foreground programs (see Section 1.2.4.1).

5. Any channels that were open prior to the ICDFN are copied over to the new set of channel status tables.

Function Results:

\[
\begin{align*}
i &= 0 \quad \text{Normal return.} \\
&= 1 \quad \text{An attempt was made to allocate fewer channels than already exist.} \\
&= 2 \quad \text{Not enough free space is available for the channel area.}
\end{align*}
\]

Example:

\[\text{IF(ICDFN(24),EQ,2) STOP 'NOT ENOUGH MEMORY'}\]

3.17 ICHCPY (FB and XM Only)

The ICHCPY function opens a channel for input, logically connecting it to a file that is currently open by another job for either input or output. This function can be used by either the foreground or the background job. An ICHCPY must be done before the first read or write for the given channel.

Form: \( i = \text{ICHCPY (chan,ochan[,jobblk])} \)

where:

- \( \text{chan} \) is the channel the job will use to read the data. You must obtain this channel through an IGETC call, or you can use channel 16 or higher if you have done an ICDFN call

- \( \text{ochan} \) is the channel number of the other job that is to be copied

- \( \text{jobblk} \) is a pointer to a three-word ASCII job name

Notes:

1. If the other job’s channel was opened with an IENTER function or a .ENTER programmed request to create a file, your channel indicates a file that extends to the highest block that the creator of the file had written at the time the ICHCPY was executed.

2. A channel that is open on a sequential-access device should not be copied, because buffer requests can become intermixed.
3. Your program can write on a copied channel to a file that is being created by the other job, just as your program could if it were the creator. When your channel is closed, however, no directory update takes place.

Errors:

\[ i = 0 \quad \text{Normal return.} \]
\[ i = 1 \quad \text{Specified job does not exist or does not have the specified channel (ochan) open.} \]
\[ i = 2 \quad \text{Channel (chan) is already open.} \]

3.18 ICLOSE

See the SYSLIB subroutine CLOSEC.

3.19 ICMKT

The ICMKT function cancels one or more scheduling requests (made by an ISCHED, ITIMER, or MRKT routine). Support for ICMKT in SJ requires that timer support be created through SYSGEN.

Form: \[ i = \text{ICMKT} (\text{id},\text{time}) \]

where:

\[ \text{id} \quad \text{is the identification integer of the request to be canceled. If id is equal to 0, all scheduling requests are canceled} \]
\[ \text{time} \quad \text{is the name of a two-word area in which the monitor returns the amount of time remaining in the canceled request} \]

For further information on canceling scheduling requests, see the .CMKT programmed request (Section 2.9).

Errors:

\[ i = 0 \quad \text{Normal return.} \]
\[ i = 1 \quad \text{id was not equal to 0 and no scheduling request with that identification could be found.} \]

Example:

```
  INTEGER*4 J
  
  CALL ICMKT(0,J) !ABORT ALL TIMER REQUESTS NOW
  
END
```
The ICSI function calls the RT–11 Command String Interpreter in special mode to parse a command string and return file descriptors and options to the program. In this mode, the CSI does not perform any handler IFETCHes, CLOSECs, IENTERs, or LOOKUPS. ICSI cannot be called from a completion or interrupt routine. This subroutine requires the USR.

Form: \( i = \text{ICSI}(\text{filspc}, \text{deftyp}, \text{cstring}, [\text{option}], n) \)

where:

- **filspc** is the 39-word area to receive the file specifications. The format of this area (considered as a 39-element INTEGER*2 array) is:

  Word 1: output file number 1
  4: specification
  5: output file number 1 length
  6: output file number 2
  9: specification
  10: output file number 2 length
  11: output file number 3
  14: specification
  15: output file number 3 length
  16: input file number 1
  19: specification
  20: input file number 2
  23: specification
  24: input file number 3
  27: specification
  28: input file number 4
  31: specification
  32: input file number 5
  35: specification
  36: input file number 6
  39: specification

- **deftyp** is the table of Radix–50 default file types to be assumed when a file is specified without a file type:

  - `deftyp(1)` is the default for all input file types
  - `deftyp(2)` is the default file type for output file number 1
  - `deftyp(3)` is the default file type for output file number 2
  - `deftyp(4)` is the default file type for output file number 3

- **cstring** is the area that contains the ASCIZ command string to be interpreted; the string must end in a zero byte. If the argument is omitted, the system prints the prompt character (*) at the terminal and accepts a command string. If input is from an indirect command file, the next line of that file is used.
option is the name of an INTEGER*2 array dimensioned (4,n) where n represents the number of options defined to the program. This argument must be present if the value specified for n is non-zero. This array has the following format for the jth option described by the array:

option(1,j) is the one-character ASCII name of the option
option(2,j) is set by the routine to 0, if the option did not occur; to 1, if the option occurred without a value; to 2, if the option occurred with a value
option(3,j) is set to the file number on which the option is specified
option(4,j) is set to the specified value if option(2,n) is equal to 2

n is the number of options defined in the array option

Notes:

1. The array option must be set up to contain the names of the valid options. For example, use the following to set up names for five options:

\[
\text{INTEGER*2 SW(4,5)}
\]
\[
\text{DATA SW(1,'S'/,SW(1,'M'/,SW(1,'I'/,SW(1,'L'/,SW(1,'E'/}
\]

2. Multiple occurrences of the same option are supported by allocating an entry in the option array for each occurrence of the option. Each time the option occurs in the option array, the next unused entry for the named option is used.

3. The arguments of ICSI must be positioned so that the USR cannot swap over them. For more information on calling the Command String Interpreter, see the .CSISPC programmed request (Section 2.14).

Errors:

\[ i = 0 \text{ Normal return.} \]
\[ i = 1 \text{ Illegal command line; no data was returned.} \]
\[ i = 2 \text{ An illegal device specification occurred in the string.} \]
\[ i = 3 \text{ An illegal option was specified, or a given option was specified more times than were allowed for in the option array.} \]

Example:

The following example causes the program to loop until a valid command is typed at the console terminal.

\[
\text{INTEGER*2 SPEC(39)}
\]
\[
\text{REAL*4 EXT(2)}
\]
\[
\text{DATA EXT/6RDATDAT,6RDATDAT/}
\]
\[
\cdot
\]
\[
10 \text{ TYPE 99}
\]
\[
99 \text{ FORMAT (' ENTER VALID CSI STRING WITH NO OPTIONS')}\]
\[
\text{IF(ICSISPEC,EXT,,0).NE.0) GOTO 10}
\]
3.21 ICSTAT

The ICSTAT function obtains information about a channel.

Form: \[ i = \text{ICSTAT} (\text{chan}, \text{addr}) \]

where:

- **chan** is the channel whose status is desired
- **addr** is a six-word area to receive the status information. The area, as a six-element INTEGER*2 array, has the following format:
  
  Word 1  channel status word  
  2 starting absolute block number of file on this channel  
  3 length of file  
  4 highest block number written since file was opened  
  5 unit number of device with which this channel is associated  
  6 Radix–50 of device name with which the channel is associated

Errors:

\[ i = 0 \quad \text{Normal return.} \]
\[ = 1 \quad \text{Channel specified is not open.} \]

Example:

The following example obtains channel status information about channel I.

\[
\begin{align*}
\text{INTEGER*2 ARE(A6)} \\
\text{I}=7 \\
\text{IF(ICSTAT(I,ARE(A6),NE,0) TYPE 99,I} \\
99 \text{ FORMAT(I9,'CHANNEL',I4,'IS NOT OPEN')} \\
\end{align*}
\]

3.22 IDELET

The IDELET function deletes a named file from an indicated device. IDELET requires the USR and cannot be issued from a completion or interrupt routine.

Form: \[ i = \text{IDELET} (\text{chan}, \text{blk[,seqnum]}) \]

where:

- **chan** is the channel to be used for the delete operation. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call
- **blk** is the four-word Radix–50 specification (dev:filnam.typ) for the file to be deleted
**seqnum** is the file number for cassette operations: if this argument is blank, a value of 0 is assumed.

For magtape operation, it describes a file sequence number that can have the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>This value suppresses rewinding and searching for a file name from the current tape position. Note that if the position is unknown, the handler executes a positioning algorithm that involves backspacing until an end-of-file label is found. The user should not use any other value since all other negative values are reserved for future use.</td>
</tr>
<tr>
<td>0</td>
<td>This value rewinds the magtape and spaces forward until the file name is found.</td>
</tr>
<tr>
<td>n</td>
<td>Where ( n ) is any positive number. This value positions the magtape at file sequence number ( n ). If the file represented by the file sequence number is greater than two files away from the beginning of the tape, a rewind is performed. If not, the tape is backspaced to the file.</td>
</tr>
</tbody>
</table>

**NOTE**

The arguments of IDELET must be located so that the USR cannot swap over them.

The specified channel is left inactive when the IDELET is complete. IDELET requires that the handler to be used be resident (via an IFETCH call or a LOAD command from KMON) at the time the IDELET is issued. If the handler is not resident, a monitor error occurs.

For further information on deleting files, see the .DELETE programmed request (Section 2.18).

**Errors:**

\[ i = 0 \] Normal return.
\[ = 1 \] Channel specified is already open.
\[ = 2 \] File specified was not found.
\[ = 3 \] Device in use.
\[ = 4 \] The file is protected and cannot be deleted.

**Example:**

The following example deletes a file named FTN5.DAT from SY0.

```
REAL*4 FILNAM(2)
DATA FILNAM/GRSY0,GR5 D/A/
.
.
I=IGETC()
IF(I.LT.0) STOP 'NO CHANNEL'
CALL IDELET(I,FILNAM)
CALL IFREEC(I)
```
3.23 IDJFLT

The IDJFLT function converts an INTEGER*4 value into a REAL*8 (DOUBLE PRECISION) value and stores the result.

Form: \( i = \text{IDJFLT}(\text{jsrc}, \text{dres}) \)

where:

- \( \text{jsrc} \) specifies the INTEGER*4 variable that is to be converted
- \( \text{dres} \) specifies the REAL*8 (or DOUBLE PRECISION) variable to receive the converted value

Function Results:

- \( i = -1 \) Normal return; the result is negative.
- \( i = 0 \) Normal return; the result is 0.
- \( i = 1 \) Normal return; the result is positive.

Errors:

None.

Example:

```plaintext
INTEGER*4 JJ
REAL*8 DJ
IF(IDJFLT(JJ,DJ),LE,0) TYPE 99
99 FORMAT ('VALUE IS NOT POSITIVE')
```

3.24 IDSTAT

The IDSTAT function obtains information about a particular device. It requires the USR and cannot be issued from a completion or interrupt routine.

Form: \( i = \text{IDSTAT}(\text{devnam}, \text{cblk}) \)

where:

- \( \text{devnam} \) is the Radix-50 device name
- \( \text{cblk} \) is the four-word area used to store the status information. The area, as a four-element INTEGER*2 array, has the following format:

<table>
<thead>
<tr>
<th>Word</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>device status word (see Section 2.29)</td>
</tr>
<tr>
<td>2</td>
<td>size of handler in bytes</td>
</tr>
<tr>
<td>3</td>
<td>entry point of handler (non-zero implies that the handler is in memory)</td>
</tr>
<tr>
<td>4</td>
<td>size of the device (in 256-word blocks) for block-replaceable devices; zero for sequential-access devices</td>
</tr>
</tbody>
</table>
NOTE

The arguments of IDSTAT must be positioned so that the USR cannot swap over them.

IDSTAT looks for the device specified by devnam and, if found, returns four words of status in cblk.

Errors:

i = 0  Normal return.
       = 1  Device not found in monitor tables.

Example:

The following example determines whether the line printer handler is in memory. If it is not, the program stops and prints a message to indicate that the handler must be loaded.

INTEGER IDNAM
INTEGER*2 CBLK(4)
DATA IDNAM/3RLP /
DATA CBLK/4*0/
CALL IDSTAT(IDNAM,CBLK)
IF(CBLK(3),EQ.0) STOP 'LOAD THE LP HANDLER AND RERUN'

3.25 IENTER

The IENTER function allocates space on the specified device and creates a tentative directory entry for the named file. If a file of the same name already exists on the specified device, it is not deleted until the tentative entry is made permanent by CLOSEC or ICLOSE. The file is attached to the channel number specified. This routine requires the USR.

Form:  \[ i = \text{IENTER}(\text{chan}, \text{dblk}, \text{length}[,.\text{seqnum}]) \]

where:

\( \text{chan} \) is the integer specification for the RT-11 channel to be associated with the file. You must obtain this channel through an IGETC call, or you can use channel 16 or higher if you have done an ICDFN call.

\( \text{dblk} \) is the four-word Radix-50 descriptor of the file to be operated upon.

\( \text{length} \) is the integer number of blocks to be allocated for the file. If 0, the larger of either one-half the largest empty segment or the entire second largest empty segment is allocated. If the value specified for length is -1, the entire largest empty segment is allocated (see the .ENTER programmed request, Section 2.32).

\( \text{seqnum} \) is a file number for cassette. If this argument is blank, a value of 0 is assumed.
For magtape, it describes a file sequence number that can have the following values:

-2 Rewind the magtape and space forward until the file name is found, or until logical-end-of-tape is detected. The magtape is now positioned correctly. A new logical-end-of-tape is implied.

-1 Space to the logical-end-of-tape and enter file.

0 Rewind the magtape and space forward until the file name is found or the logical-end-of-tape is detected. If the file name is found, an error is generated. If the file name is not found, then enter file.

n Position magtape at file sequence number n if n is greater than zero and the file name is not null.

Notes:

1. IENTER cannot be issued from a completion or interrupt routine.
2. IENTER requires that the appropriate device handler be in memory.
3. The arguments of IENTER must be positioned so that the USR does not swap over them.

For further information on creating tentative directory entries, see the .ENTER programmed request (Section 2.32).

Errors:

\[
i = n \quad \text{Normal return; number of blocks actually allocated (} n = 0 \text{ for non-file-structured IENTER).}
\]

\[
i = -1 \quad \text{Channel (} chan \text{) is already in use.}
\]

\[
i = -2 \quad \text{In a fixed-length request, no space greater than or equal to } length \text{ was found.}
\]

\[
i = -3 \quad \text{Device in use.}
\]

\[
i = -4 \quad \text{A file by that name already exists and is protected.}
\]

\[
i = -5 \quad \text{File sequence number not found.}
\]

Example:

The following example allocates a channel for file TEMP.TMP on SY0. If no channel is available, the program prints a message and halts.

```
REAL*4 DBLK(2)
DATA DBLK/GRSYOTEM,GRP TMP/
ICHAN=IGETC()
IF(ICHAN,LT,0) STOP 'NO AVAILABLE CHANNEL'
C
C CREATE TEMPORARY WORK FILE
C
IF(IENTER(ICHAN,DBLK,20),LT,0) STOP 'ENTER FAILURE'
.
.
CALL PURGE(ICHAN)
CALL IFREEC(ICHAN)
```
3.26 IFETCH

The IFETCH function loads a device handler into memory from the system device, making the device available for input/output operations. The handler is loaded into the free area managed by the FORTRAN system. Once the handler is loaded, it cannot be released and the memory in which it resides cannot be reclaimed. IFETCH requires the USR and cannot be issued from a completion or interrupt routine. IFETCH issued from a foreground job will fail unless the handler is already in memory.

Form: \( i = \text{IFETCH} (\text{devnam}) \)

where:

\( \text{devnam} \) is the one-word Radix–50 name of the device for which the handler is desired. This argument can be the first word of an ICSI input or output file specification. This argument must be positioned so that the USR cannot swap over it.

For further information on loading device handlers into memory, see the \( .\text{FETCH} \) programmed request (Section 2.34).

Errors:

- \( i = 0 \) Normal return.
- \( i = 1 \) Device name specified does not exist.
- \( i = 2 \) Not enough room exists to load the handler.
- \( i = 3 \) No handler for the specified device exists on the system device.

Example:

The following example requests that the DX handler be loaded into memory; execution stops if the handler cannot be loaded.

\[
\text{REAL*4 IDNAM} \\
\text{DATA IDNAM/3RDX/} \\
\phantom{\text{REAL*4 IDNAM}}; \\
\phantom{\text{DATA IDNAM/3RDX/}}; \\
\phantom{\text{REAL*4 IDNAM}}; \\
\text{IF (IFETCH(IDNAM),NE,0) STOP 'FATAL ERROR FETCHING HANDLER'}
\]

3.27 IFPROT

The IFPROT function sets or removes file protection for a file.

Form: \( i = \text{IFPROT} (\text{chan},\text{filspc},\text{prot}) \)

where:

- \( \text{chan} \) is the channel number to be used for the protect operation. You must obtain this channel through an IGETC call, or you can use the channel 16(decimal) or higher if you have done an ICDFN call.
- \( \text{filspc} \) is the file specification of the file to be protected or unprotected, in Radix–50.
- \( \text{prot} \):
  - \( 1 \) = protect the file
  - \( 0 \) = remove protection from the file

System Subroutine Description and Examples 3–23
Errors:

\[
\begin{align*}
    i = 0 & \quad \text{Normal return.} \\
    = 1 & \quad \text{Channel is in use.} \\
    = 2 & \quad \text{File not found.} \\
    = 3 & \quad \text{Invalid operation.} \\
    = 4 & \quad \text{Invalid prot value.}
\end{align*}
\]

Example:

This example protects the file SY:RT11FB.SYS against deletion.

\[
\begin{align*}
    \text{ICHAN} &= \text{IGETC()} \quad \text{!ALLOCATE CHANNEL} \\
    \text{IF (ICHAN.LT.0) STOP 'CANNOT ALLOCATE CHANNEL'} \\
    \text{I=IFPROT(ICHAN, 'SY:RT11FB.SYS', 1)} \\
    \text{,} \\
    \text{,} \\
    \text{END}
\end{align*}
\]

3.28 **IFREEC**

The IFREEC function returns a specified RT–11 channel to the available pool of channels. Before IFREEC is called, the specified channel must be closed or deactivated with a CLOSEC or ICLOSE (see Section 3.3) or a PURGE (see Section 3.92) call. IFREEC cannot be called from a completion or interrupt routine. IFREEC calls must be issued only for channels that have been successfully allocated by IGETC calls; otherwise, the results are unpredictable.

Form: \( i = \text{IFREEC}(\text{chan}) \)

where:

\( \text{chan} \) is the integer number of the channel to be freed

Errors:

\[
\begin{align*}
    i = 0 & \quad \text{Normal return.} \\
    = 1 & \quad \text{Specified channel is not currently allocated.}
\end{align*}
\]

Example:

See the example under IGETC.

3.29 **IGETC**

The IGETC function allocates an RT–11 channel, in the range 0 to 15(decimal), to be used by other SYSLIB routines and marks it in use so that the FORTRAN I/O system will not access it. IGETC cannot be issued from a completion or interrupt routine.

Form: \( i = \text{IGETC}() \)

Function Result:

\( i = n \quad \text{Channel } n \text{ has been allocated.} \)

Error:

\( i = -1 \quad \text{No channels are available.} \)
Example:

```
ICHAN=IGETC()                      ! ALLOCATE CHANNEL
IF(ICHAN.LT.0) STOP 'CANNOT ALLOCATE CHANNEL'

CALL IFREEC(ICHAN)                ! FREE IT WHEN THROUGH

END
```

### 3.30 IGETSP

The IGETSP subroutine obtains free space from the FORTRAN system and returns the address and size (in number of words) of the allocated space. When this space is obtained, it is allocated for the duration of the program.

**Form:** \( i = \text{IGETSP} (\text{min, max, iaddr}) \)

where:

- \( \text{min} \) is the minimum space to be obtained without an error indicating that the desired amount of space is not available
- \( \text{max} \) is the maximum space to be obtained
- \( \text{iaddr} \) is the integer specifying the address of the start of the free space (buffer). Note that \( \text{iaddr} \) does not directly denote the storage area as a standard FORTRAN variable would. Rather, it denotes a word that contains the address of the storage space. It is most useful with IPEEK and IPOKE, or with assembly language subroutines

**NOTE**

Extreme caution should be exercised to avoid using all of the free space allocated by the FORTRAN system. If the FORTRAN system runs out of dynamic free space, fatal errors (Error 29, 30, 42, and so forth) occur. See the RT–11 System Message Manual.

**Function Results:**

- \( i = n \) The actual size allocated whose value is \( \text{min} \ . \text{LE.} \ n \ . \text{LE.} \ \text{max} \). The size \( (\text{min, max, n}) \) is specified in words.

**Error:**

- \( i = -1 \) Not enough free space is available to meet the minimum requirements; no allocation was taken from the FORTRAN system free space.

**Example:**

```
N=IGETSP(256,256,IBUFF)
IF(N.LT.0) STOP 'CANNOT GET BUFFER SPACE!'
```

System Subroutine Description and Examples  3–25
3.31 IGTJB

See the SYSLIB subroutine GTJB, Section 3.10.

3.32 IJCVT

The IJCVT function converts an INTEGER*4 value to INTEGER*2 format. If \textit{ires} is not specified, the result returned is the INTEGER*2 value of \textit{jsrc}. If \textit{ires} is specified, the result is stored there.

Form: \( i = \text{IJCVT}(\text{jsrc}, \text{ires}) \)

where:

\begin{itemize}
    \item \textit{jsrc} specifies the INTEGER*4 variable or array element whose value is to be converted
    \item \textit{ires} specifies the INTEGER*2 entity to receive the conversion result
\end{itemize}

Function Results (if \textit{ires} is specified):

\begin{itemize}
    \item \( i = -2 \) An overflow occurred during conversion.
    \item \( = -1 \) Normal return; the result is negative.
    \item \( = 0 \) Normal return; the result is 0.
    \item \( = 1 \) Normal return; the result is positive.
\end{itemize}

Errors:

None.

Example:

\begin{verbatim}
INTEGER*4 JVAL
INTEGER*2 IVAL
...
IF(IJCVT(JVAL,IVAL),EQ,-2) TYPE 99
99 FORMAT('NUMBER TOO LARGE IN IJCVT CONVERSION')
\end{verbatim}

3.33 ILUN

The ILUN function returns the RT–11 channel number with which a FORTRAN logical unit is associated.

Form: \( i = \text{ILUN}(\text{lun}) \)

where:

\begin{itemize}
    \item \textit{lun} is an integer expression whose value is a FORTRAN logical unit number in the range 1–99
\end{itemize}

Function Results:

\begin{itemize}
    \item \( = +n \) RT–11 channel number \( n \) is associated with \textit{lun}.
\end{itemize}

Errors:

\begin{itemize}
    \item \( i = -1 \) Logical unit is not open.
    \item \( = -2 \) Logical unit is opened to console terminal.
\end{itemize}
Example:

```
PRINT 99
99   FORMAT(1X, 'PRINT DEFAULTS TO LOGICAL UNIT 6, WHICH FURTHER DEFAULTS TO LP: ')
ICHAN=ILUN(6)               'WHICH RT-11 CHANNEL IS RECEIVING I/O?
```

3.34 INDEX

The INDEX subroutine searches a source string for the occurrence of a pattern string and returns the character position of the first occurrence of the pattern within the source.

Form: CALL INDEX (a,pattn,[i],m)

or

```
m = INDEX (a,pattn,[i])
```

where:

- `a` is the array containing the source string to be searched; it must be terminated by a null byte
- `pattn` is the string being sought; it must be terminated by a null byte
- `i` is the integer starting character position of the search in `a`. If `i` is omitted, `a` is searched beginning at the first character position
- `m` is an integer variable to store the result of the search; `m` is set to the starting character position of `pattn` in `a`, if found; otherwise `m` is 0

Errors:

- None.

Example:

The following example searches the array STRING for the first occurrence of strings EFG and XYZ and searches the string ABCABCABC for the occurrence of string ABC after position 5.

```
CALL SCOPY('ABCD123456',STRING)       'INITIALIZE STRING
CALL INDEX(STRING,'EFG',,M)           'M=5
CALL INDEX(STRING,'XYZ',,N)           'N=0
CALL INDEX('ABC123456','ABC',5,L)     'L=7
```
where:

in is the array containing the string being inserted. The string must be terminated with a null if the number of characters is less than the value of m (below), or if m is not specified

out is the array containing the string being modified. The string must be terminated with a null

i is the integer specifying the character position in out at which the insertion begins

m is the integer maximum number of characters to be inserted

If the maximum number of characters (m) is not specified, all characters to the right of the specified character position (i) in the string being modified are replaced by the string being inserted. The insert string (in) and the string being modified (out) can be in the same array only if the maximum number of characters (m) is specified and is less than or equal to the difference between the position of the insert (i) and the maximum string length of the array.

Errors:
None.

Example:

CALL SCOPY('ABCDEFHGIJ',S1) ! INITIALIZE STRING 1
CALL SCOPY(S1,S2) ! INITIALIZE STRING 2
CALL INSERT('123',S1,6,3) ! S1 = 'ABCDE123IJ'
CALL INSERT('123',S2,4) ! S2 = 'ABC123'

3.36 INTSET

The INTSET function establishes a FORTRAN subroutine as an interrupt service routine, assigns it a priority, and attaches it to a vector. INTSET requires that extra memory be allocated to foreground programs that use it (see Section 1.2.4.1).

Form: i = INTSET (vect, pri, id, crtn)

where:

vect is the integer specifying the address of the interrupt vector to which the subroutine is to be attached

pri is the integer specifying the actual priority level (4–7) at which the device interrupts

id is the identification integer to be passed as the single argument to the FORTRAN routine when an interrupt occurs. This allows a single crtn to be associated with several INTSET calls
crt

is a FORTRAN subroutine to be established as the interrupt routine. This name should be specified in an EXTERNAL statement in the FORTRAN program that calls INTSET. The subroutine has one argument:

```fortran
SUBROUTINE crtn(id)
INTEGER id
```

When the routine is entered, the value of the integer argument is the value specified for id in the appropriate INTSET call.

Notes:

1. The id argument can be used to distinguish between interrupts from different vectors if the routine to be activated services multiple devices.

2. When using INTSET in FB or XM, the SYSLIB call DEVICE must be used in almost all cases to prevent interrupts from interrupting beyond program termination.

3. If the interrupt routine (crt) has control for a period of time longer than the time in which two more interrupts using the same vector occur, interrupt overrun is considered to have occurred. The error message:

   ?SYSLIB–F–Interrupt overrun

   is printed and the job is aborted. Jobs requiring very fast interrupt response are not viable with FORTRAN, since FORTRAN overhead lowers RT–11’s interrupt response rate.

4. The interrupt routine (crt) is actually run as a completion routine by the RT–11 .SYNCH macro. The pri argument is used for the RT–11 .INTEN macro.

5. A .PROTECT request is issued for the vector, but no attempt is made to report an error if the vector is already protected; furthermore, the vector is taken over unconditionally. See the .PROTECT programmed request (Section 2.64) for more information.

6. The FORTRAN interrupt service subroutine (crt) cannot call the USR.

7. INTSET cannot be called from a completion or interrupt routine.

8. Interrupt enable should not be set on the associated device until the INTSET call has been successfully executed.

Errors:

```
i = 0  Normal return.
i = 1  Invalid vector specification.
i = 2  Reserved for future use.
i = 3  No space is available for the linkage setup.
```
Example:

EXTERNAL CLKSUB

I=INTSET("104,6,0,CLKSUB")
IF (I,NE.0) GOTO 100
END
SUBROUTINE CLKSUB(ID)
END

3.37 IPEEK

The IPEEK function returns the contents of the word located at a specified absolute 16-bit memory address. This function can examine device registers or any location in memory.

Form: i = IPEEK (iaddr)

where:

iaddr is the integer specification of the absolute address to be examined. If this argument is not an even value, a trap results (except on LSI-11 or a PDP-11/23)

Function Result:
The function result (i) is set to the value of the word examined.

Example:

ISWIT = IPEEK("177570") !GET VALUE OF CONSOLE SWITCHES

3.38 IPEEKB

The IPEEKB subroutine returns the contents of a byte located at a specified absolute byte address. Since this routine operates in a byte mode, the address supplied can be odd or even. This subroutine can examine device registers or any byte in memory. The return is zero extended, that is, the high byte is 0.

Form: i = IPEEKB (iaddr)

where:

iaddr is the integer specification of the absolute byte address to be examined. Unlike the IPEEK subroutine, the IPEEKB subroutine allows odd addresses

Function Result:
The function result (i) is set to the value of the byte examined.

Example:

IERR = IPEEKB("53") !Get error byte

3–30 System Subroutine Description and Examples
3.39 IPOKE

The IPOKE subroutine stores a specified 16-bit integer value into a specified absolute memory location. This subroutine can store values in device registers.

Form: CALL IPOKE (iaddr, ivalue)

where:

iaddr is the integer specification of the absolute address to be modified. If this argument is not an even value, a trap results (except on LSI-11 or PDP-11/23)

ivalue is the integer value to be stored in the given address specified by the iaddr argument

Errors:

None.

Example:

The following example displays the value of IVAL in the console display register (this is possible only on certain processors).

CALL IPOKE("177570",IVAL)

To set bit 12 in the JSW without zeroing any other bits in the JSW, use the following procedure.

CALL IPOKE("44",10000.OR.IPEEK("44"))

3.40 IPOKEB

The IPOKEB subroutine stores a specified eight-bit integer value into a specified byte location. Since this routine operates in a byte mode, the address supplied can be odd or even. This subroutine can store values in device registers.

Form: CALL IPOKEB (iaddr, ivalue)

where:

iaddr is the integer specification of the absolute address to be modified. Unlike the IPOKE subroutine, the IPOKEB subroutine allows odd addresses

ivalue is the integer value to be stored in the given address specified by the iaddr argument

Errors:

None.

Example:

CALL IPOKEB("53","20") ! Tell KMON unconditionally fatal error
3.41 IPUT

The IPUT function replaces the value of a monitor fixed offset. IPUT uses the monitor .PVAL programmed request.

Form: \( i = \text{IPUT} (\text{ioff, value}) \)

where:

- \( \text{ioff} \) is the offset (from the base of RMON) to be modified
- \( \text{value} \) is the integer value to replace the current contents of the offset location

Function Result:

- \( i = \) old (replaced) value of the fixed offset location.

Example:

\[ \text{ISIZE = IPUT ("314, 100") ! Change default file size used by ENTER} \]

3.42 IQSET

The IQSET function is used to make the RT−11 I/O queue larger — that is, to add available elements to the queue. These elements are allocated out of the free space managed by the FORTRAN system. IQSET cannot be called from a completion or interrupt routine.

Form: \( i = \text{IQSET} (\text{qleng[,area]}) \)

where:

- \( \text{qleng} \) is the integer number of elements to be added to the queue. This argument must be positioned so that the USR does not swap over it
- \( \text{area} \) is the space allocated from within the calling program. Under FB and SJ monitors, make sure that the space is outside the USR swapping area. If this argument is not specified, the space for the elements is allocated in the FORTRAN OTS work area

All RT−11 I/O transfers are done through a centralized queue management system. If I/O traffic is very heavy and not enough queue elements are available, the program issuing the I/O requests is suspended until a queue element becomes available. In an FB or XM system, the other job can run while the first program waits for the element. When IQSET is used in a program to be run in the foreground, the FRUN command must be modified to allocate space for the queue elements (see Section 1.2.4.1).

A general rule to follow is that each program should contain one more queue element than the total number of I/O and timer requests that will be active simultaneously. Timing functions such as ITWAIT and MRKT also cause elements to be used and must be considered when allocating queue elements for a program. Note that if synchronous I/O is done (for example, IREADW/IWRITW) and no timing functions are done, no additional queue elements need be allocated. Note also that FORTRAN IV allocates four queue elements by default.
The following subroutines require queue elements:
IRCVD/IRCVDC/IRCVDF/IRCVDW  ITIMER
IREAD/IREADC/IREADF/IREADW  ITWAIT
ISCHED  IUNTL
ISDAT/ISDATC/ISDATF/ISDATW  IWRITE/IWRITC/IWRITF/IWRITW
ISLEEP  MRKT
ISPFN/ISPFNC/ISPFNF/ISPFNW  MWAIT

For further information on adding elements to the queue, see the .QSET programmed request.

Errors:

i = 0  Normal return.
i = 1  Not enough free space is available for the number of queue elements to be added; no allocation was made.

Example:

IF(IQSET(5).NE.0) STOP 'NOT ENOUGH FREE SPACE FOR QUEUE ELEMENTS'

3.43 IRAD50

The IRAD50 function converts a specified number of ASCII characters to Radix–50 and returns the number of characters converted. Conversion stops on the first non-Radix–50 character encountered in the input, or when the specified number of ASCII characters have been converted.

Form:  \( n = \text{IRAD50}(\text{icnt, input, output}) \)

where:

\( n \) is the integer number of input characters actually connected
icnt is the number of ASCII characters to be converted
input is the area from which input characters are taken
output is the area in which Radix–50 words are stored

Three characters of text are packed into each word of output. The number of output words modified is computed by the expression (in integer words):

\( \frac{(\text{icnt} + 2)}{3} \)

Thus, if a count of 4 is specified, two words of output are written even if only a one-character input string is given as an argument.

Function Result:
The integer number of input characters actually converted \( (n) \) is returned as the function result.

Example:

\begin{verbatim}
REAL*8 FSPEC
CALL IRAD50(12, 'SYOTEMP DAT', FSPEC)
\end{verbatim}

3.44 IRCVD/IRCVDC/IRCVDF/IRCVDW (FB and XM Only)

There are four forms of the receive data function; these are used in conjunction with the ISDAT (send data) functions to allow a general data/message...
transfer system. The receive data functions issue RT–11 receive data programmed requests (see Section 2.70). These functions require a queue element; this should be considered when the IQSET function (Section 3.42) is executed.

IRCVD
The IRCVD function receives data and continues execution. The operation is queued and the issuing job continues execution. When the job has to receive the transmitted message, an MWAIT should be executed. This causes the job to be suspended until all pending messages have been received.

Form: \[ i = \text{IRCVD} \left( \text{buff,wcnt} \right) \]

where:

\begin{itemize}
  \item \text{buff} is the array to be used to buffer the data received. The array must be one word larger than the message to be received because the first word contains the integer number of words actually transmitted when IRCVD is complete
  \item \text{wcnt} is the maximum integer number of words that can be received
\end{itemize}

Errors:

\begin{itemize}
  \item \( i = 0 \) Normal return.
  \item \( i = 1 \) No such job exists in the system. (A job exists as long as it is loaded, whether or not it is active.)
\end{itemize}

Example:

\begin{verbatim}
INTEGER*2 MSG(41)
  .
  .
CALL IRCVD(MSG,40)
  .
  .
CALL MWAIT
\end{verbatim}

IRCVD
The IRCVD function receives data and enters an assembly language completion routine when the message is received. The IRCVD is queued, and program execution stays with the issuing job. When the other job sends a message, the completion routine specified is queued and run according to standard scheduling of completion routines.

Form: \[ i = \text{IRCVD} \left( \text{buff,wcnt,crtn} \right) \]

where:

\begin{itemize}
  \item \text{buff} is the array to be used to buffer the data received. The array must be one word larger than the message to be received because the first word contains the integer number of words actually transmitted when IRCVD is complete
\end{itemize}
wcnt is the maximum integer number of words to be received

crtn is the assembly language completion routine to be entered. This name must be specified in a FORTRAN EXTERNAL statement in the routine that issues the IRCVDC call

Errors:

\[
\begin{align*}
i &= 0 & \text{Normal return.} \\
    &= 1 & \text{No such job exists in the system. (A job exists as long as it is loaded, whether or not it is active.)}
\end{align*}
\]

IRCVDF
The IRCVDF function receives data and enters a FORTRAN completion subroutine when the message is received. The IRCVDF is queued, and program execution continues with the issuing job. When the other job sends a message, the FORTRAN completion routine specified is entered.

Form: \( i = \text{IRCVDF}(\text{buff,wcnt,area,crtn}) \)

where:

- \( \text{buff} \) is the array to be used to buffer the data received. The array must be one word larger than the message to be received because the first word contains the integer number of words actually transmitted when IRCVDF is complete
- wcnt is the maximum integer number of words to be received
- area is a four-word area to be set aside for linkage information. This area must not be modified by the FORTRAN program and the USR must not swap over it. This area can be reclaimed by other FORTRAN completion routines when \( \text{crtn} \) has been entered
- crtn is the FORTRAN completion routine to be entered. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the IRCVDF call

Errors:

\[
\begin{align*}
i &= 0 & \text{Normal return.} \\
    &= 1 & \text{No such job exists in the system. (A job exists as long as it is loaded, whether or not it is active.)}
\end{align*}
\]

Example:

```
INTEGER*2 MSG(41), AREA(4)
EXTERNAL RMSGR

CALL IRCVDF(MSG, 40, AREA, RMSGR)
```

IRCVDW
The IRCVDW function receives data and waits. This function queues a message request and suspends the job issuing the request until the other
job sends a message. When execution of the issuing job resumes, the mes-

sage has been received, and the first word of the buffer indicates the num-

ber of words transmitted.

Form: \( i = \text{IRCVDW} \) (buff, wcnt)\)

where:

\( \text{buff} \) is the array to be used to buffer the data received. The array

must be one word larger than the message to be received because the first word contains the integer number of words

actually transmitted when IRCVDW is complete

\( \text{wcnt} \) is the maximum integer number of words to be received

Errors:

\( i = 0 \) Normal return.

\( i = 1 \) No such job exists in the system. (A job exists as long as it

is loaded, whether or not it is active.)

Example:

\[
\text{INTEGER*2 } \text{MSG}(41) \\
\text{IF} \left( \text{IRCVDW}(\text{MSG},40),0,0 \right) \text{STOP 'UNEXPECTED ERROR'}
\]

3.45 IREAD/IREADC/IREADF/IREADW

The functions IREAD, IREADC, IREADF, and IREADW transfer a specified number of words from a file into memory. These functions require a queue element, which should be considered when the IQSET function (Section 3.42) is executed.

IREAD

The IREAD function transfers into memory a specified number of words

from the file associated with the indicated channel. Control returns to the

user program immediately after the IREAD function is initiated. No special

action is taken when the transfer is completed.

Form: \( i = \text{IREAD} \) (wcnt, buff, blk, chan)

where:

\( \text{wcnt} \) is the relative integer number of words to be transferred

\( \text{buff} \) is the array to be used as the buffer; this array must contain

at least \( wcnt \) words

\( \text{blk} \) is the integer block number of the file to be read. The first

block of a file is block number 0. The \( blk \) argument must be

updated when necessary. For example, if the program is reading two blocks at a time, \( blk \) should be updated by 2

\( \text{chan} \) is the integer specification for the RT–11 channel to be used

When the user program needs to access the data read on the specified

channel, an IWAIT function should be issued. This makes sure that the
IREAD operation has been completed. If an error occurred during the transfer, the IWAIT function indicates the error.

Errors:

\[ i = n \]

Normal return; \( n \) equals the number of words requested (0 for non-file-structured read, multiple of 256[decimal] for file-structured read). If the read is from a magtape, the number of words requested is returned. For example:

If \( wcnt \) is a multiple of 256 and less than that number of words remain in the file, \( n \) is shortened to the number of words that remain in the file; thus, if \( wcnt \) is 512 and only 256 words remain, \( i = 256 \).

If \( wcnt \) is not a multiple of 256 and more than \( wcnt \) words remain in the file, \( n \) is rounded up to the next block; thus, if \( wcnt \) is 312 and more than 312 words remain, \( i = 512 \), but only 312 are read.

If \( wcnt \) is not a multiple of 256 and less than \( wcnt \) words remain in the file, \( n \) equals a multiple of 256 that is the actual number of words being read.

\[ = -1 \]

Attempt to read past end-of-file; no words remain in the file.

\[ = -2 \]

Hardware error occurred on channel.

\[ = -3 \]

Specified channel is not open.

**NOTE**

If an asynchronous operation on a channel (for example, IREAD) results in end-of-file, the following IWAIT will not detect it. IWAIT detects only hard error conditions. A subsequent operation on that channel will detect end-of-file and returns to the user with the end-of-file error code. Under these conditions, the subsequent operation is not initiated.

**Example:**

```
INTEGER*2 BUFFER(256),RCODE,BLK
.
.
RCODE = IREAD(256,BUFFER,BLK,ICHAN)
IF(RCODE+1) 1010,1000,10
C IF NO ERROR, START HERE
10
.
.
IF(IWAIT(ICHAN),NE,0) GOTO 1010
.
.
1000 CONTINUE
C END OF FILE PROCESSING
.
.
CALL EXIT !NORMAL END OF PROGRAM
1010 STOP 'FATAL READ'
END
```
IREADC
The IREADC function transfers a specified number of words from the indicated channel into memory. Control returns to the user program immediately after the IREADC function is initiated. When the operation is complete, the specified assembly language routine (crtn) is entered as an asynchronous completion routine.

Form: \( i = \text{IREADC}(\text{wcnt}, \text{buff}, \text{blk}, \text{chan}, \text{crtn}) \)

where:

- \( \text{wcnt} \) is the integer number of words to be transferred
- \( \text{buff} \) is the array to be used as the buffer; this array must contain at least \( \text{wcnt} \) words
- \( \text{blk} \) is the integer block number of the file to be read. The user program normally updates \( \text{blk} \) before it is used again. The first block of a file is block number 0
- \( \text{chan} \) is the integer specification for the RT-11 channel to be used
- \( \text{crtn} \) is the assembly language routine to be activated when the transfer is complete. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the IREADC call

Errors:
See the errors under IREAD.

Example:

```
INTEGER*2 IBUF(256), RCODE, IBLK
EXTERNAL RDCMP

; ;
RCODE=IREADC(256, IBUF, IBLK, ICHAN, RDCMP)
```

IREADF
The IREADF function transfers a specified number of words from the indicated channel into memory. Control returns to the user program immediately after the IREADF function is initiated. When the operation is complete, the specified FORTRAN subprogram (crtn) is entered as an asynchronous completion routine (see Section 1.2.1.2).

Form: \( i = \text{IREADF}(\text{wcnt}, \text{buff}, \text{blk}, \text{chan}, \text{area}, \text{crtn}) \)

where:

- \( \text{wcnt} \) is the integer number of words to be transferred
- \( \text{buff} \) is the array to be used as the buffer; this array must contain at least \( \text{wcnt} \) words
- \( \text{blk} \) is the integer block number of the file to be used. The user program normally updates \( \text{blk} \) before it is used again. The first block of a file is block number 0
chan is the integer specification for the RT-11 channel to be used

area is a four-word area to be set aside for link information; this area must not be modified by the FORTRAN program or swapped over by the USR. This area can be reclaimed by other FORTRAN completion functions when crtn has been activated

crtn is the FORTRAN routine to be activated on completion of the transfer. This name must be specified in an EXTERNAL statement in the routine that issues the IREADF call. Section 1.2.1.2 describes completion routines

Errors:

See the errors under IREAD.

Example:

```
INTEGER*2 DBLK(4),BUFFER(256),BLKNO
DATA DBLK/3RDX0,3RINP,3RUT,3RDAT/,BLKNO/0/
EXTERNAL RCMPLT
.
.
ICHAN=ICETC()
IF(ICHAN,LT,0) STOP 'NO CHANNEL AVAILABLE'
IF(FETCH(DBLK),NE,0) STOP 'BAD FETCH'
IF(LOOKUP(ICHAN,DBLK),LT,0) STOP 'BAD LOOKUP'
.
.
20 IF(IREADF(256,BUFFER,BLKNO,ICHAN,DBLK,RCMPLT),LT,0) GOTO 100
C PERFORM OVERLAP PROCESSING
.
.
C SYCHRONIZER
CALL IWAIT(ICHAN) !WAIT FOR COMPLETION ROUTINE TO RUN
BLKNO=BLKNO+1 !UPDATE BLOCK NUMBER
GOTO 20
.
.
C END OF FILE PROCESSING
100 CALL ICLOSE(ICHAN,I)
I=ICLOSE()
CALL IFREEC(ICHAN)
.
.
CALL EXIT
END
SUBROUTINE RCMPLT(I,J)
C THIS IS THE COMPLETION ROUTINE
.
.
RETURN
END
```
IREADW

The IREADW function transfers a specified number of words from the indicated channel into memory. Control returns to the user program when the transfer is complete or when an error is detected.

Form:  \( i = \text{IREADW}(\text{wcnt,buff,blk,chan}) \)

where:

- \( \text{wcnt} \) is the integer number of words to be transferred
- \( \text{buff} \) is the array to be used as the buffer; this array must contain at least \( \text{wcnt} \) words
- \( \text{blk} \) is the integer block number of the file to be read. The user program normally updates \( \text{blk} \) before it is used again
- \( \text{chan} \) is the integer specification for the RT-11 channel to be used

Errors:

See the errors under IREAD.

Example:

```
INTEGER*2 IBUF(1024)

:       :       :
ICODE=IREADW(1024,IBUF,IBLK,ICHAN)
IF(ICODE.EQ.-1) GOTO 100       !END OF FILE PROCESSING AT 100
IF(ICODE.LT.-1) GOTO 200       !ERROR PROCESSING AT 200
C
C MODIFY BLOCKS
C
:       :       :
C WRITE THEM OUT
C
ICODE=IWRITW(1024,IBUF,IBLK,ICHAN)
```

3.46 IRENAМ

The IRENAМ function causes an immediate change of the name of a specified file.

Form:  \( i = \text{IRENAМ}(\text{chan,blk}) \)

where:

- \( \text{chan} \) is the integer specification for the RT-11 channel to be used for the operation. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call. The channel is again available for use once the rename operation is completed
- \( \text{blk} \) is the eight-word area specifying the name of the existing file and the new name to be assigned. If considered as an eight-element INTEGER*2 array, \( \text{blk} \) has the form:
Words 1–4 specify the Radix–50 file descriptor for the old file name

Words 5–8 specify the Radix–50 file descriptor for the new file name

NOTE

The arguments of IRENAME must be positioned so that the USR does not swap over them.

If a file already exists with the same name as the new file on the indicated device, it is deleted. IRENAME requires that the handler to be used be resident at the time the IRENAME is issued. If it is not, a monitor error occurs. The device names specified in the file descriptors must be the same.

For more information on renaming files, see the .RENAME programmed request (Section 2.75).

Errors:

\[
i = 0 \quad \text{Normal return.}
\]
\[
i = 1 \quad \text{Specified channel is already open.}
\]
\[
i = 2 \quad \text{Specified file was not found.}
\]
\[
i = 3 \quad \text{A file by that name already exists and is protected.}
\]

Example:

```fortran
REAL*8 NAME(2)
DATA NAME/12RDK0FTN2, 12RDK0FTN2, OLD/
  ,
ICHAN=IGETC()
IF(ICHAN,LT,0) STOP 'NO CHANNEL'
CALL IRENAME(ICHAN,NAME)  ! PRESERVE OLD DATA FILE
CALL IFREEC(ICHAN)
```

### 3.47 IREOPN

The IREOPN function reassociates a specified channel with a file on which an ISAVES was performed. The ISAVES/IREOPN combination is useful when a large number of files must be operated on at one time. Necessary files can be opened with LOOKUP and their status preserved with ISAVES. When data is required from a file, an IREOPN enables the program to read from the file. The IREOPN need not be done on the same channel as the original LOOKUP and ISAVES.

Form: \[i = \text{IREOPN}(\text{chan},cblk)\]

where:

- \text{chan} is the integer specification for the RT–11 channel to be associated with the reopened file; this channel must be initially inactive.
cblk is the five-word block where the channel status information was stored by a previous ISAVES. This block, considered as a five-element INTEGER*2 array, has the following format:

<table>
<thead>
<tr>
<th>Word</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Channel status word.</td>
</tr>
<tr>
<td>2</td>
<td>Starting block number of the file; zero for non-file-structured devices.</td>
</tr>
<tr>
<td>3</td>
<td>Length of file (in 256-word blocks).</td>
</tr>
<tr>
<td>4</td>
<td>Reserved for future use.</td>
</tr>
<tr>
<td>5</td>
<td>Two information bytes. Even byte: I/O count of the number of requests outstanding on this channel. Odd byte: unit number of the device associated with the channel.</td>
</tr>
</tbody>
</table>

Errors:

\[ i = 0 \quad \text{Normal return.} \]
\[ i = 1 \quad \text{Specified channel is already in use.} \]

Example:

```
INTEGER*2 SAVES(5,10)
DATA ISVPTR/1/
...
CALL ISAVES(ICHAN,SAVES(1,ISVPTR))
...
CALL IREDPN(ICHAN,SAVES(1,ISVPTR))
```

### 3.48 ISAVES

The ISAVES function stores five words of channel status information into a user-specified array. These words contain all the information that RT-11 requires to completely define a file. When an ISAVES is finished, the data words are placed in memory and the specified channel is closed, so that it is again available for use. When the saved channel data is required, the IREOPN function (Section 3.47) is used.

ISAVES can be used only if a file was opened with a LOOKUP call (see Section 3.79). If IENTER was used, ISAVES returns an error. Note that ISAVES is not legal on magtape or cassette files.

Form: \[ i = \text{ISAVES (chan,cblk)} \]

where:

- **chan** is the integer specification for the RT-11 channel whose status is to be saved. You must obtain this channel through an IGETC call, or you can use channel 16 or higher if you have done an ICFDN call.

- **cblk** is a five-word block in which the channel status information describing the open file is stored (see Section 3.47 for the format of this block).
The ISAVES/IREOPN combination is very useful, but care must be exercised when using it. In particular, the following cases should be avoided.

1. If an ISAVES is performed on a file and the same file is then deleted before it is reopened, the space occupied by the file becomes available as an empty space which could then be used by the IENTER function. If this sequence occurs, there is a change in the contents of the file whose status was supposedly saved.

2. Although the handler for the required peripheral need not be in memory for execution of an IREOPN, a fatal error is generated if the handler is not in memory when an IREAD or IWRITE is executed.

Errors:

i = 0   Normal return.
   = 1   The specified channel is not currently associated with any file.
   = 2   The file was opened with an IENTER call.

Example:

```
INTEGER*2 BLK(5)
    ...
    IF(ISAVES(ICHAN,BLK),NE,0) STOP 'ISAVES ERROR'
```

### 3.49 ISCHED

The ISCHED function schedules a specified FORTRAN subroutine to be run as an asynchronous completion routine at a specified time of day. Support for ISCHED in SJ requires timer support.

Form: \texttt{i = ISCHED (hrs, min, sec, tick, area, id, crtn)}

where:

- \texttt{hrs} is the integer number of hours
- \texttt{min} is the integer number of minutes
- \texttt{sec} is the integer number of seconds
- \texttt{tick} is the integer number of ticks (1/60 of a second on 60-cycle clocks; 1/50 of a second on 50-cycle clocks)
- \texttt{area} is a four-word area that must be provided for link information; this area must never be modified by the FORTRAN program, and the USR must not swap over it. This area can be reclaimed by other FORTRAN completion functions when \texttt{crtn} has been activated
- \texttt{id} is the identification integer to be passed to the routine being scheduled
crtn is the name of the FORTRAN subroutine to be entered at the time of day specified. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the ISCHED call. The subroutine has one argument. For example:

```
SUBROUTINE crtn(id)
INTEGER id
```

When the routine is entered, the value of the integer argument is the value specified for id in the appropriate ISCHED call.

Notes:

1. The scheduling request made by ISCHED can be canceled at a later time by an ICMKT function call.
2. If the system is busy, the actual time of day that the completion routine is run may be later than the requested time of day.
3. A FORTRAN subroutine can periodically reschedule itself by issuing its own ISCHED or ITIMER calls from within the routine.
4. ISCHED requires a queue element; this should be considered when the IQSET function (Section 3.42) is executed.

Errors:

```
i = 0  Normal return.
i = 1  No queue elements available; unable to schedule request.
```

Example:

```
INTEGER*2 LINK(4)
EXTERNAL NOON

! LINKAGE AREA
! NAME OF ROUTINE TO RUN
.
.
I=ISCHED(12,0,0,0,LINK,0,NOON)  ! RUN SUBR NOON AT 12 PM
  (rest of main program)
.
END
SUBROUTINE NOON(id)

C THIS ROUTINE WILL TERMINATE EXECUTION AT LUNCHTIME,
C IF THE JOB HAS NOT COMPLETED BY THAT TIME.
C
STOP      'ABORT JOB -- LUNCHTIME'
END
```

3.50 ISCOMP

(See SYSLIB subroutine SCOMP.)

3.51 ISDAT/ISDATC/ISDATF/ISDATW (FB and XM Only)

The functions ISDAT, ISDATC, ISDATF, and ISDATW are used with the IRCVD, IRCVDC, IRCVDF, and IRCVDW calls to allow message transfers under the FB or XM monitor. Note that the buffer containing the message
should not be modified or reused until the message has been received by the other job. These functions require a queue element, which should be considered when the IQSET function (see Section 3.42) is executed.

ISDAT
The ISDAT function transfers a specified number of words from one job to the other. Control returns to the user program immediately after the transfer is queued. This call is used with the MWAIT routine (see Section 3.90).

Form: \[ i = \text{ISDAT}(\text{buff,wcnt}) \]

where:

- \text{buff} is the array containing the data to be transferred
- \text{wcnt} is the integer number of data words to be transferred

Errors:

- \[ i = 0 \quad \text{Normal return.} \]
- \[ i = 1 \quad \text{No such job currently exists in the system. (A job exists as long as it is loadable, whether or not it is active.)} \]

Example:

```assembly
INTEGER*2 MSG(40)
...
CALL ISDAT(MSG,40)
...
CALL MWAIT
C PUT NEW MESSAGE IN BUFFER
```

ISDATC
The ISDATC function transfers a specified number of words from one job to another. Control returns to the user program immediately after the transfer is queued. When the other job accepts the message through a receive data request, the specified assembly language routine (crtn) is activated as an asynchronous completion routine.

Form: \[ i = \text{ISDATC}(\text{buff,wcnt,crtn}) \]

where:

- \text{buff} is the array containing the data to be transferred
- \text{wcnt} is the integer number of data words to be transferred
- \text{crtn} is the name of an assembly language routine to be activated on completion of the transfer. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the ISDATC call

Errors:

- \[ i = 0 \quad \text{Normal return.} \]
- \[ i = 1 \quad \text{No such job currently exists in the system. (A job exists as long as it is loadable, whether or not it is active.)} \]
Example:

```
INTEGER*2 MSG(40)
EXTERNAL RTN

CALL ISDATC(MSG,40,RTN)
```

**ISDATF**

The ISDATF function transfers a specified number of words from one job to the other. Control returns to the user program immediately after the transfer is queued and execution continues. When the other job accepts the message through a receive data request, the specified FORTRAN subprogram (crttn) is activated as an asynchronous completion routine (see Section 1.2.1.2).

Form: \( i = \text{ISDATF} \) (buff,wcnt,area,crttn)

where:

- **buff** is the array containing the data to be transferred
- **wcnt** is the integer number of data words to be transferred
- **area** is a four-word area to be set aside for link information; this area must not be modified by the FORTRAN program and the USR must not swap over it. This area can be reclaimed by other FORTRAN completion functions when *crttn* has been activated
- **crttn** is the name of a FORTRAN routine to be activated on completion of the transfer. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the ISDATF call

**Errors:**

- \( i = 0 \) Normal return.
- \( i = 1 \) No such job currently exists in the system. (A job exists as long as it is loaded, whether or not it is active.)

Example:

```
INTEGER*2 MSG(40),SPOT(4)
EXTERNAL RTN

CALL ISDATF(MSG,40,SPOT,RTN)
```

**ISDATW**

The ISDATW function transfers a specified number of words from one job to the other. Control returns to the user program when the other job has accepted the data through a receive data request.

Form: \( i = \text{ISDATW} \) (buff,wcnt)
where:

- `buff` is the array containing the data to be transferred
- `wcnt` is the integer number of data words to be transferred

Errors:

- `i = 0` Normal return.
- `i = 1` No such job exists in the system. (A job exists as long as it is loaded, whether or not it is active.)

Example:

```fortran
INTEGER*2 MSG(40)

IF (ISDATW(MSG,40),NE,0) STOP 'FOREGROUND JOB NOT RUNNING'
```

### 3.52 ISDTTM

The ISDTTM function sets the system date and time. An argument of `-1` leaves the corresponding value unchanged.

**Form:** CALL ISDTTM (date, hitime, lotime)

**where:**

- `date` is the new system date
- `hitime` is the high-order time of day, in ticks past midnight
- `lotime` is the low-order time of day, in ticks past midnight

Example:

```fortran

C    DEFINE NEW SYSTEM DATE BUT LEAVE TIME UNCHANGED
IDATE = IMONTH*1024+IDAY*32+(IYEAR-1972)
CALL ISDTTM (IDATE,-1,-1)
```

### 3.53 ISFDAT

The ISFDAT function allows user programs to modify the creation date of an RT-11 file. The device must have an RT-11 file structure.

**Form:** `i = ISFDAT (chan,dblk,idate)`

**where:**

- `chan` is the integer value of the RT-11 channel to be used for the operation. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call
dblk is the four word RT-11 file specification, in Radix-50, of the file whose date is being changed

idate is the integer date in RT-11 date format

Errors:

i = 0  Normal return.
  = 1  Channel in use.
  = 2  File not found.
  = 3  Invalid operation.

Example:

This example changes the date of the file DY1:OLD23.DAT to July 4, 1976.

 REAL*4 FILNAM(2)
 DATA FILNAM /BROY1OLD,6R23 DAT/
 IDATE = 7*1024 + 4*32 + (1976-1972) ! JULY 4, 1976
 ICHAN = IGETC() !ALLOCATE CHANNEL
 I = ISFDAT(ICHAN,FILNAM,IDATE) !SET THE DATE
 IF (I,NE,0) STOP 'ERROR DURING ISFDAT CALL'


3.54 ISLEEP

The ISLEEP function suspends the main program execution of a job for a specified amount of time. The specified time is the sum of hours, minutes, seconds, and ticks specified in the ISLEEP call. All completion routines continue to execute.

Form:  i = ISLEEP (hrs,min,sec,tick)

where:

hrs is the integer number of hours
min is the integer number of minutes
sec is the integer number of seconds
tick is the integer number of ticks (1/60 of a second on 60-cycle clocks; 1/50 of a second on 50-cycle clocks)

Notes:

1. SLEEP requires a queue element, which should be considered when the IQSET function (Section 3.42) is executed.

2. If the system is busy, the time for which execution is suspended may be longer than that specified.

Errors:

i = 0  Normal return.
  = 1  No queue element available.
Example:

```

CALL IQSET(2)

CALL ISLEEP(0,0,0,4)  !GIVE BACKGROUND JOB SOME TIME
```

### 3.55 ISPFN/ISPFNC/ISPFNf/ISPFNW

The functions ISPFN, ISPFNC, ISPFNf, and ISPFNW are used in conjunction with special functions to various handlers. They provide a means of doing device-dependent functions, such as rewind and backspace, to those devices. If ISPFN function calls are made to any other devices, the function call is ignored. For more information on programming for specific devices, see the *RT–11 Software Support Manual*.

To use these functions, the handler must be in memory, and a channel must be associated with a file via a non-file-structured LOOKUP call. These functions require a queue element; this should be considered when the IQSET function (Section 3.42) is executed.

**ISPFN**

The ISPFN function queues the specified operation and immediately returns control to the user program. The IWAIT function can be used to ensure completion of the operation.

**Form:** \( i = \text{ISPFN} \left( \text{code, chan[, wcnt, buff, blk]} \right) \)

where:

- **code** is the integer numeric code of the function to be performed (see Table 3–1)
- **chan** is the integer specification for the RT–11 channel to be used for the operation. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call
- **wcnt** is the integer number of data words in the operation. This parameter is optional with some ISPFN calls, depending on the particular function. Default value is 0. In magtape operations, it specifies the number of records to space forward or backward. For a backspace operation \((wcnt = 0)\), the tape drive backspaces to a tape mark or to the beginning-of-tape. For a forward space operation \((wcnt = 0)\), the tape drive forward spaces to a tape mark or the end-of-tape
- **buff** is the array to be used as the data buffer. This parameter is optional with some ISPFN calls, depending on the particular function. Default value is 0
blk is the integer block number of the file to be operated upon. This parameter is optional with some ISPFN calls, depending on the particular function. Default value is 0.

When this argument is supplied by magtape, it is the address of a four-word error and status block used for returning the exception conditions. The four words must be initialized to zero.

The error and status block must always be mapped when running in the XM monitor, and the USR must not swap over it. To obtain the address of the error block, execute the following instructions:

```
INTEGER*2 ERRADR, ERRBLK(4)
DATA ERRBLK /0:0:0:0:0/

ERRADR = IADDR (ERRBLK) ! GET THE ADDRESS OF THE 4-WORD ERROR BLOCK
ICODE = ISPFN (CODE,ICHAN,NDCT,BUF,ERRADR)
```

The three optional arguments (wcnt, buff, blk) are not individually optional. You must have all or none present.

### Table 3-1: Functions and Function Codes (Octal)

<table>
<thead>
<tr>
<th>Function</th>
<th>MS,MT,MM</th>
<th>CT</th>
<th>DX</th>
<th>DM</th>
<th>DY</th>
<th>DL</th>
<th>LD</th>
<th>DU</th>
<th>DW</th>
<th>DZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read absolute</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
<td>377</td>
</tr>
<tr>
<td>Write absolute</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
</tr>
<tr>
<td>Write absolute with deleted data</td>
<td>375</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward to last file</td>
<td>377</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward to last block</td>
<td>376</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward to next file</td>
<td>375</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward to next block</td>
<td>374</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rewind to load point</td>
<td>373</td>
<td>373</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write file gap</td>
<td>372</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write end-of-file</td>
<td>377</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward 1 block</td>
<td>376</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backspace 1 block</td>
<td>375</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initialize the bad</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>block replacement table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write with extended</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>record gap</td>
<td>374</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offline</td>
<td>372</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return volume size</td>
<td>373</td>
<td>373</td>
<td>373</td>
<td>373</td>
<td>373</td>
<td>373</td>
<td>373</td>
<td>373</td>
<td>373</td>
<td>373</td>
</tr>
<tr>
<td>Read/write translation table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write variable size blocks</td>
<td>371</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct MSCP access</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read variable size blocks</td>
<td>370</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stream at 100 ips (MS only)</td>
<td>367</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* When using special functions 376 and 377 with DW or DZ:

```
wcnt is the track to be read or written.
blk is the sector.
buf is the address of a 256-word buffer.
```

Special functions 376 and 377 with DZ handler do not interleave sectors. RX00 diskettes, handled by DZ, have 80 tracks. Special functions 376 and 377 wrap to track 0 after track 79.

* When using special function 373 with DW:

```
chan is the channel on which DW was opened with, LOOKUP.
buf is the address of a one-word buffer in which the size of the volume will be
returned: 9727(decimal) blocks for an RD50, 19519(decimal) blocks for an
RD51.
blk is not used and should be set to 0.
```

3-50 System Subroutine Description and Examples
Errors:

\[ i = 0 \quad \text{Normal return.} \]
\[ i = 1 \quad \text{Attempt to read or write past end-of-file.} \]
\[ i = 2 \quad \text{Hardware error occurred on channel.} \]
\[ i = 3 \quad \text{Channel specified is not open.} \]

Example:

\[
\text{CALL ISPFN("373,ICHAN") \quad !REWIND}
\]

ISPFNC

The ISPFNC function queues the specified operation and immediately returns control to the user program. When the operation is complete, the specified assembly language routine (crtn) is entered as an asynchronous completion routine.

Form: \( i = \text{ISPFNC (code,chan,wcnt,blk,buff,crtn)} \)

where:

- **code** is the integer numeric code of the function to be performed (see Table 3–1)
- **chan** is the integer specification for the RT–11 channel to be used for the operation. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call
- **wcnt** is the integer number of data words in the operation; the default value for this argument is 0
- **buff** is the array to be used as the data buffer; the default value for this argument is 0
- **blk** is the integer block number of the file to be operated upon; this argument must be 0 if not required

When this argument is supplied by magtape, it is the address of a four-word error and status block used for returning the exception conditions. The four words must be initialized to 0.

The error and status block must always be mapped when running in the XM monitor, and the USR must not swap over it. To obtain the address of the error block execute the following instructions:

\[
\text{INTEGER*2 ERRADR, ERRBLK(4)}
\]
\[
\text{DATA ERRBLK } 0,0,0,0,
\]
\[
!GET ADDRESS OF 4-WORD ERROR BLOCK
\]
\[
\text{ERRADR = IADDR (ERRBLK)}
\]
\[
\text{ICODE = ISPFNC (CODE,ICHAN,WDC,T,BUFF,ERRADR)}
\]
crtn is the name of an assembly language routine to be activated on completion of the operation. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the ISPFNC call.

Errors:

\[
\begin{align*}
  i &= 0 \quad \text{Normal return.} \\
  &\quad = 1 \quad \text{Attempt to read or write past end-of-file.} \\
  &\quad = 2 \quad \text{Hardware error occurred on channel.} \\
  &\quad = 3 \quad \text{Channel specified is not open.}
\end{align*}
\]

Example:

```
EXTERNAL SFCOMP
NAME OF ASSEMBLY LANGUAGE COMPLETION RTN

ICODE = ISPFNC(CODE,ICHAN,WDCT,BUF,BLK,SFCOMP)
```

ISPFNF
The ISPFNF function queues the specified operation and immediately returns control to the user program. When the operation is complete, the specified FORTRAN subprogram (crtn) is entered as an asynchronous completion routine.

Form: \( i = \text{ISPFNF} \) (code,chan,wcnt,buff,blk,area,crtn)

where:

- `code` is the integer numeric code of the function to be performed (see Table 3-1)
- `chan` is the integer specification for the RT-11 channel to be used for the operation. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call
- `wcnt` is the integer number of data words in the operation; this argument must be 0 if not required
- `buff` is the array to be used as the data buffer; this argument must be 0 if not required
- `blk` is the integer block number of the file to be operated upon; this argument must be 0 if not required

When this argument is supplied by magtape, it is the address of a four-word error and status block used for returning conditions. The four words must be initialized to 0.

The error and status block must always be mapped when running in the XM monitor, and the USR must not swap over it. To obtain the address of the error block, execute the following instructions:
INTEGER*2     ERRADR, ERRBLK(4)
DATA ERRBLK    /0,0,0,0,/
              
!GET THE ADDRESS OF THE 4-WORD ERROR BLOCK
ERRADR = IADDR(ERRBLK)
ICODE = ISPFNF(CODE,ICHAN,WDCT,BUF,ERRADR)

area is a four-word area to be set aside for linkage information;
this area must not be modified by the FORTRAN program,
and the USR must not swap over it. This area can be re-
claimed by other FORTRAN completion functions when crtn
has been activated

crtn is the name of a FORTRAN routine to be activated on com-
pletion of the operation. This name must be specified in an
EXTERNAL statement in the FORTRAN routine that issues
the ISPFNF call (Section 1.2.1.2 describes completion
routines)

Errors:

i = 0     Normal return.
i = 1     Attempt to read or write past end-of-file.
i = 2     Hardware error occurred on channel.
i = 3     Channel specified is not open.

Example:

REAL*4 MTNAME(2),AREA(2)
DATA MTNAME/3RMTO,0,/
EXTERNAL DONSUB
     
     
i=IGETC()          !ALLOCATE CHANNEL
CALL IFETCH(MTNAME) !FETCH MT HANDLER
CALL LOOKUP(I,MTNAME) !NON-FILE-STRUCTURED LOOKUP ON MTO
IERR=ISPFNF("373,I,0,0,0,AREA,DONSUB") !REWIND MAGTAPE

END
SUBROUTINE DONSUB

C
C     RUNS WHEN MTO HAS BEEN REWOUND
C
     
END

ISPFNW
The ISPFNW function queues the specified operation and returns control to
the user program when the operation is complete.

Form:   i = ISPFNW(code,chan[,wcnt,buff,blk])
where:

- **code** is the integer numeric code of the function to be performed (see Table 3-1)

- **chan** is the integer specification for the RT-11 channel to be used for the operation. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call

- **wcnt** is the integer number of data words in the operation. This parameter is optional with some ISPFNW calls, depending on the function

- **buff** is the array to be used as the data buffer. This parameter is optional with some ISPFNW calls, depending on the function

- **blk** is the integer block number of the file to be operated upon. This parameter is optional with some ISPFNW calls, depending on the function

When this argument is supplied by magtape, it is the address of a four-word error and status block used for returning the exception conditions. The four words must be initialized to 0.

The error and status block must always be mapped when running in the XM monitor, and the USR must not swap over it. To obtain the address of the error block execute the following instructions:

```assembly
INTEGER*2 ERRADR, ERRBLK(4)
DATA ERRBLK /0,0,0,0/
```

`GET THE ADDRESS OF THE 4-WORD ERROR BLOCK
ERRADR = IADDR (ERRBLK)
ICODE = ISPFN (CODE, ICHAN, WDCT, BUF, ERRADR)`

**Errors:**

- **i = 0** Normal return.
- **i = 1** Attempt to read or write past end-of-file.
- **i = 2** Hardware error occurred on channel.
- **i = 3** Channel specified is not open.

**Example:**

```assembly
INTEGER*2 BUF(65), TRACK, SECTOR, DBLK(4)
DATA DBLK/3RDX0,0,0,0/

ICHAN=IGETC()
IF(ICHAN.LT.0) STOP 'NO CHANNEL AVAILABLE'
IF(LOOKUP(ICHAN, DBLK), LT.0) STOP 'BAD LOOKUP'

C READ AN ABSOLUTE TRACK AND SECTOR FROM THE FLOPPY
```

**3-54 System Subroutine Description and Examples**
3.56 ISPY

The ISPY function returns the integer value of the word at a specified offset from the RT–11 resident monitor. This subroutine uses the .GVAL programmed request to return fixed monitor offsets. (See the RT–11 Software Support Manual for information on fixed offset references.)

Form: \( i = \text{ISPY}(\text{ioff}) \)

where:

\( \text{ioff} \) is the offset (from the base of RMON) to be examined

Function Result:
The function result \( i \) is set to the value of the word examined.

Example:

```c
C C BRANCH TO 200 IF RUNNING UNDER FB MONITOR
C IF(ISPY("300"),AND,1) GOTO 200
C C WORD AT OCTAL 300 FROM RMON IS
C THE CONFIGURATION WORD.
```

3.57 ITIMER

The ITIMER function schedules a specified FORTRAN subroutine to be run as an asynchronous completion routine after a specified time interval has elapsed. This request is supported by SJ when the timer support special feature is included during system generation.

Form: \( i = \text{ITIMER}(\text{hrs,\text{min,sec,tick,area,\text{id,\text{crtn}}}) \)

where:

\( \text{hrs} \) is the integer number of hours

\( \text{min} \) is the integer number of minutes

\( \text{sec} \) is the integer number of seconds

\( \text{tick} \) is the integer number of ticks (1/60 of a second on 60-cycle clocks; 1/50 of a second on 50-cycle clocks)

\( \text{area} \) is a four-word area that must be provided for link information; this area must never be modified by the FORTRAN program, and the USR must never swap over it. This area can be reclaimed by other FORTRAN completion functions when \( \text{crtn} \) has been activated

\( \text{id} \) is the identification integer to be passed to the routine being scheduled

\( \text{crtn} \) is the name of the FORTRAN subroutine to be entered when the specified time interval elapses. This name must be speci-
fied in an EXTERNAL statement in the FORTRAN routine that references ITIMER. The subroutine has one argument. For example:

SUBROUTINE crtn(id)
INTEGER id

When the routine is entered, the value of the integer argument is the value specified for id in the appropriate ITIMER call.

Notes:

1. This function can be canceled at a later time by an ICMKT function call.
2. If the system is busy, the actual time interval after which the completion routine is run can be longer than the time interval requested.
3. FORTRAN subroutines can periodically reschedule themselves by issuing ISCHED or ITIMER calls.
4. ITIMER requires a queue element, which should be considered when the IQSET function (Section 3.42) is executed.

For more information on scheduling completion routines, see Section 1.2.1.2 and the .MRKT programmed request, Section 2.49.

Errors:

\[
i = 0 \quad \text{Normal return.}
\]
\[
i = 1 \quad \text{No queue elements available; unable to schedule request.}
\]

Example:

\[
\text{INTEGER*2 AREA(4)}
\]
\[
\text{EXTERNAL WATCHD}
\]
\[
\text{IF THE CODE FOLLOWING ITIMER DOES NOT REACH THE ICMKT CALL}
\]
\[
\text{IN 12 MINUTES, WATCH DOG COMPLETION ROUTINE WILL BE}
\]
\[
\text{ENTERED WITH ID OF 3}
\]
\[
\text{CALL ITIMER(0,12,0,0,AREA,3,WATCHD)}
\]
\[
\text{CALL ICMKT(3,AREA)}
\]
\[
\text{END SUBROUTINE WATCHD(ID)}
\]
\[
\text{THIS IS CALLED AFTER 12 MINUTES}
\]
\[
\text{RETURN}
\]
\[
\text{END}
\]
3.58 ITLOCK (FB and XM Only)

The ITLOCK function is used in an FB or XM system to attempt to gain ownership of the USR. It is similar to LOCK (Section 3.78) in that, if successful, the user job returns with the USR in memory. However, if a job attempts to LOCK the USR while the other job is using it, the requesting job is suspended until the USR is free. With ITLOCK, if the USR is not available, control returns immediately and the lock failure is indicated. ITLOCK cannot be called from a completion or interrupt routine.

Form: \( i = \text{ITLOCK}() \)

For further information on gaining ownership of the USR, see the .TLOCK programmed request (Section 2.93).

Errors:

\[
\begin{align*}
  i &= 0 \quad \text{Normal return.} \\
  &= 1 \quad \text{USR is already in use.}
\end{align*}
\]

Example:

```
IF(ITLOCK(), NE, 0) GOTO 100  !GOTO 100 IF USR BUSY
```

3.59 ITTINR

The ITTINR function transfers a character from the console terminal to the user program. If no characters are available, system action is determined by the setting of bit 6 of the Job Status Word.

Form: \( i = \text{ITTINR}() \)

If the function result \( (i) \) is less than 0 when execution of the ITTINR function is complete, it indicates that no character was available. Under the FB or XM monitor, ITTINR does not return a result of less than zero unless bit 6 of the Job Status Word was on when the request was issued.

There are two modes of doing console terminal input, and they are governed by bit 12 of the Job Status Word (JSW). The JSW is at octal location 44. If bit 12 is 0, normal I/O is performed under the following conditions:

1. The monitor echoes all characters typed.
2. CTRL/U and RUBOUT perform line deletion and character deletion, respectively.
3. A carriage return, line feed, CTRL/Z, or CTRL/C must be struck before characters on the current line are available to the program. When one of these is typed, characters on the line typed are passed one by one to the user program.

If the console is in special mode (bit 12 set to 1), the following conditions apply:

1. The monitor does not echo characters typed except for CTRL/C and CTRL/O.
2. CTRL/U and RUBOUT do not perform special functions.
3. Characters are immediately available to the program.

4. No ALTMODE conversion is done.

In special mode, the user program must echo the characters desired. However, CTRL/C and CTRL/O are acted on by the monitor in the usual way.

Bit 12 in the JSW must be set by the user program if special console mode is desired. Bit 14 in the JSW must be set if lowercase characters are desired. These bits are cleared when control returns to RT–11.

Regardless of the setting of bit 12, when a carriage return is entered, both carriage return and line feed characters are passed to the program; if bit 12 is 0, these characters will be echoed.

Lowercase conversion is determined by the setting of bit 14. If bit 14 is 0, lowercase characters are converted to uppercase before being echoed (if bit 12 is 0) and passed to a program; if bit 14 is 1, lowercase characters are echoed (if bit 12 is 0) and passed as received. Bit 14 is cleared when the program terminates.

**NOTE**

To set and/or clear bits in the JSW, do an IPEEK and then an IPOKE (see example under IPOKE). In special terminal mode (JSW bit 12 set), normal FORTRAN formatted I/O from the console is undefined.

If the single-line editor has been enabled with the SET SL ON and SET SL TTYIN commands, input from an ITTINR request can be edited by the single-line editor if JSW bits 4 and 12 are 0. However, if either bit 4 or bit 12 is set, SL will not edit ITTINR input. If SL is editing input, the state of bit 6 (inhibit TT wait) is ignored and an ITTINR request will not return until an edited line is available.

In the FB or XM monitor, CTRL/F and CTRL/B (and CTRL/X in monitors with the system job feature) are not affected by the setting of bit 12. The monitor always acts on these characters if the SET TT FB command is in effect.

Also under the FB or XM monitor, if a terminal input request is made and no character is available, job execution is normally suspended until a character is ready. If a program requires execution to continue and ITTINR to return a result of less than zero, it must turn on bit 6 of the JSW before the ITTINR. Bit 6 is cleared when a program terminates. The results of ITTINR must be stored in an INTEGER type variable for the purposes of error checking. Once it is known that the call did not have an error return, the result can be moved into a LOGICAL*1 variable or array element. Direct placement into a LOGICAL*1 variable will lead to incorrect results, because the negative flag (bit 15 set) is lost in conversion to a LOGICAL*1 variable.

Function Results:

\[
\begin{align*}
    i > 0 & \quad \text{Character read.} \\
    < 0 & \quad \text{No character available.}
\end{align*}
\]
Example:

```
ICHAR=ITTINR()
IF(ICHAR.LT.0) GOTO 100
!READ A CHARACTER FROM THE CONSOLE
!CHARACTER NOT AVAILABLE
```

### 3.60 ITTOUR

The ITTOUR function transfers a character from the user program to the console terminal if there is room for the character in the monitor buffer. If it is not currently possible to output a character, an error flag is returned.

**Form:**  

```
i = ITTOUR(char)
```

**where:**

- `char` is the character to be output, right-justified in the integer (can be LOGICAL*1 entity if desired)

If the function result (`i`) is 1 when execution of the ITTOUR function is complete, it indicates that there is no room in the buffer and that no character was output. Under the FB or XM monitor, ITTOUR normally does not return a result of 1. Instead, the job is blocked until room is available in the output buffer. If a job requires execution to continue and a result of 1 to be returned, it must turn on bit 6 of the JSW (location 44) before issuing the request.

**NOTE**

If a foreground job has characters in the TT output buffer, they are not output under the following conditions:

1. If a background job is doing output to the console TT, the foreground job cannot output characters from its buffer until the background job outputs a line feed character. This can be troublesome if the console device is a graphics terminal and the background job is doing graphic output without sending any line feeds.

2. If no background job is running (that is, KMON is in control of background), the foreground job cannot output its characters until the user types a carriage return or a line feed. In the former case, KMON gets control again and locks out foreground output as soon as the foreground output buffer is empty.

Note that the use of PRINT eliminates these problems.

**Function Results:**

- `i = 0` Character was output.
- `i = 1` Ring buffer is full.

**Example:**

```
DO 20 I=1,5
  10 IF(ITTTOUR("007"),NE.0) GOTO 10
  !RING BELL 5 TIMES
  20 CONTINUE
```
3.61 ITWAIT (SYSGEN Option in SJ)

The ITWAIT function suspends the main program execution of the current job for a specified time interval. All completion routines continue to execute.

Form:  \( i = \text{ITWAIT}(\text{itime}) \)

where:

\[ \begin{align*}
\text{itime} & \quad \text{is the two-word internal format time interval} \\
\text{itime (1)} & \quad \text{is the high-order time} \\
\text{itime (2)} & \quad \text{is the low-order time}
\end{align*} \]

Notes:

1. WAIT requires a queue element, which should be considered when the IQSET function (Section 3.42) is executed.

2. If the system is busy, the actual time interval during which execution is suspended may be longer than the time interval specified.

Errors:

\[ \begin{align*}
i = 0 & \quad \text{Normal return.} \\
1 & \quad \text{No queue element available.}
\end{align*} \]

Example:

\[
\text{INTEGER} * 2 \text{ TIME(2)} \\
\text{CALL ITWAIT(TIME) !WAIT FOR TIME}
\]

3.62 IUNTIL (SYSGEN Option in SJ)

The IUNTIL function suspends main program execution of the job until the time of day specified. All completion routines continue to run.

Form:  \( i = \text{IUNTIL}(\text{hrs, min, sec, tick}) \)

where:

\[ \begin{align*}
\text{hrs} & \quad \text{is the integer number of hours} \\
\text{min} & \quad \text{is the integer number of minutes} \\
\text{sec} & \quad \text{is the integer number of seconds} \\
\text{tick} & \quad \text{is the integer number of ticks (1/60 of a second on 60-cycle clocks; 1/50 of a second on 50-cycle clocks)}
\end{align*} \]

Notes:

1. IUNTIL requires a queue element, which should be considered when the IQSET function (Section 3.39) is executed.
2. If the system is busy, the actual time of day that the program resumes execution may be later than that requested.

Errors:

\[ i = 0 \quad \text{Normal return.} \]
\[ i = 1 \quad \text{No queue element available.} \]

Example:

```
C      TAKE A LUNCH BREAK
CALL IUNTL(13,0,0,0)    !START UP AGAIN AT 1 P.M.
```

### 3.63 IVERIF

See SYSLIB subroutine VERIFY, Section 3.113.

### 3.64 IWAIT

The IWAIT function suspends execution of the main program until all input/output operations on the specified channel are complete. This function is used with IREAD, IWRITE, and ISPFN calls. Completion routines continue to execute.

Form: \( i = \text{IWAIT}(\text{chan}) \)

where:

- \text{chan} is the integer specification for the RT-11 channel to be used. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call.

For further information on suspending execution of the main program, see the .WAIT programmed request (Section 2.101).

Errors:

\[ i = 0 \quad \text{Normal return.} \]
\[ i = 1 \quad \text{Channel specified is not open.} \]
\[ i = 2 \quad \text{Hardware error occurred during the previous I/O operation on this channel.} \]

Example:

```
IF(IWAIT(ICHAN),NE,0) CALL IDERR(4)
```

### 3.65 IWRITE/IWRITC/IWRITF/IWRITW

The functions IWRITE, IWRITC, IWRITF, and IWRITW transfer a specified number of words from memory to the specified channel. The IWRITE functions require queue elements; this should be considered when the IQSET function (Section 3.42) is executed.

**IWRITE**

The IWRITE function transfers a specified number of words from memory to the specified channel. Control returns to the user program immediately.
after the request is queued. No special action is taken upon completion of
the operation.

Form: \( i = \text{IWRITE} (\text{wcnt}, \text{buff}, \text{blk}, \text{chan}) \)

where:

\begin{align*}
\text{wcnt} & \quad \text{is the integer number of words to be transferred} \\
\text{buff} & \quad \text{is the array to be used as the output buffer} \\
\text{blk} & \quad \text{is the integer block number of the file to be written. The user} \\
& \quad \text{program normally updates \text{blk} before it is used again} \\
\text{chan} & \quad \text{is the integer specification for the RT–11 channel to be used.} \\
& \quad \text{You must obtain this channel through an IGETC call, or you} \\
& \quad \text{can use channel 16(decimal) or higher if you have done an} \\
& \quad \text{ICDFN call}
\end{align*}

Errors:

\( i = n \) Normal return; \( n \) equals the number of words written,
rounded to a multiple of 256 (0 for non-file-structured
writes).

\textbf{NOTE}

If the word count returned is less than that re-
quested, an implied end-of-file has occurred al-
though the normal return is indicated.

\begin{align*}
= -1 & \quad \text{Attempt to write past end-of-file; no more space is available} \\
& \quad \text{in the file.} \\
= -2 & \quad \text{Hardware error occurred.} \\
= -3 & \quad \text{Channel specified is not open.}
\end{align*}

Example:

Refer to the example for IREAD.

\textit{IWRITC}

The IWRITC function transfers a specified number of words from memory
to the specified channel. The request is queued and control returns to the
user program. When the transfer is complete, the specified assembly lan-
guage routine (\textit{crtn}) is entered as an asynchronous completion routine.

Form: \( i = \text{IWRITC} (\text{wcnt}, \text{buff}, \text{blk}, \text{chan}, \text{crtn}) \)

where:

\begin{align*}
\text{wcnt} & \quad \text{is the relative integer number of words to be transferred} \\
\text{buff} & \quad \text{is the array to be used as the output buffer} \\
\text{blk} & \quad \text{is the relative integer block number of the file to be written.} \\
& \quad \text{The user program normally updates \text{blk} before it is used} \\
& \quad \text{again (for example, if the program is writing two blocks at a} \\
& \quad \text{time, \text{blk} should be updated by 2)}
\end{align*}

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chan is the relative integer specification for the RT-11 channel to be used. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call

crtm is the name of the assembly language routine to be activated upon completion of the transfer. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the IWRITC call

Errors:
See the errors under IWRITE.

Example:

```
INTEGER*2 IBUF(256)
EXTERNAL CRTN

:   
ICODE=IWRITC(256,IBUF,IBLK,ICHAN,CRTN)
```

IWRITF
The IWRITF function transfers a number of words from memory to the specified channel. The transfer request is queued and control returns to the user program. When the operation is complete, the specified FORTRAN subprogram (crtm) is entered as an asynchronous completion routine (see Section 1.2.1.2).

Form: \(i = \text{IWRITF}(\text{wcnt}, \text{buff}, \text{blk}, \text{chan}, \text{area}, \text{crtm})\)

where:

- wcnt is the integer number of words to be transferred
- buff is the array to be used as the output buffer
- blk is the integer block number of the file to be written. The user program normally updates blk before it is used again
- chan is the integer specification for the RT-11 channel to be used. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call
- area is a four-word area to be set aside for link information; this area must not be modified by the FORTRAN program, and the USR must not swap over it. This area can be reclaimed by other FORTRAN completion functions when \(\text{crtm}\) has been activated
- crtn is the name of the FORTRAN routine to be activated upon completion of the transfer. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the IWRITF call (Section 1.2.1.2 describes completion routines)
Errors:

See the errors under IWRITE.

Example:

Refer to the example under IREADF, Section 3.45.

IWRTW
The IWRTW function transfers a specified number of words from memory to the specified channel. Control returns to the user program when the transfer is complete.

Form: \( i = \text{IWRTW} (\text{wcnt, buff, blk, chan}) \)

where:

- \( \text{wcnt} \) is the integer number of words to be transferred
- \( \text{buff} \) is the array to be used as the output buffer
- \( \text{blk} \) is the integer block number of the file to be written. The user program normally updates \( \text{blk} \) before it is used again
- \( \text{chan} \) is the integer specification for the RT–11 channel to be used. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call

Errors:

See the errors under IWRITE.

Example:

Refer to the example under IREADW, Section 3.45.

3.66 JADD

The JADD function computes the sum of two INTEGER*4 values.

Form: \( i = \text{JADD} (\text{jopr1, jopr2, jres}) \)

where:

- \( \text{jopr1} \) is an INTEGER*4 variable
- \( \text{jopr2} \) is an INTEGER*4 variable
- \( \text{jres} \) is an INTEGER*4 variable that receives the sum of \( \text{jopr1} \) and \( \text{jopr2} \)

Function Results:

- \( i = -1 \) Normal return; the result is negative.
- \( i = 0 \) Normal return; the result is zero.
- \( i = 1 \) Normal return; the result is positive.
Errors:

\[ i = -2 \]  An overflow occurred while computing the result.

Example:

\[
\text{INTEGER*4 JOP1, JOP2, JRES}
\]

\[
\text{IF (JADD (JOP1, JOP2, JRES), EQ, -2) GOTO 100}
\]

### 3.67 JAFIX

The JAFIX function converts a REAL*4 value to INTEGER*4.

**Form:** \( i = \text{JAFIX (asrc, jres)} \)

where:

- **asrc** is a REAL*4 variable, constant, or expression to be converted to INTEGER*4
- **jres** is an INTEGER*4 variable that is to contain the result of the conversion

**Function Results:**

\[
\begin{align*}
    i &= -1 \quad \text{Normal return; the result is negative.} \\
    &= 0 \quad \text{Normal return; the result is zero.} \\
    &= 1 \quad \text{Normal return; the result is positive.}
\end{align*}
\]

**Errors:**

\[ i = -2 \]  An overflow occurred while computing the result.

Example:

\[
\text{INTEGER*4 JOP1}
\]

\[
\text{C READ A LARGE INTEGER FROM THE TERMINAL}
\]

\[
\text{ACCEPT 99, A}
\]

\[
\text{99 FORMAT (F15,0)}
\]

\[
\text{IF (JAFIX(A, JOP1), EQ, -2) GOTO 100}
\]

### 3.68 JCMP

The JCMP function compares two INTEGER*4 values and returns an INTEGER*2 value that reflects the signed comparison result.

**Form:** \( i = \text{JCMP (jopr1, jopr2)} \)

where:

- **jopr1** is the INTEGER*4 variable or array element that is the first operand in the comparison

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jopr2 is the INTEGER*4 variable or array element that is the second operand in the comparison

Function Results:

\[
\begin{align*}
    i &= -1 & \text{If } jopr1 \text{ is less than } jopr2. \\
    &= 0 & \text{If } jopr1 \text{ is equal to } jopr2. \\
    &= 1 & \text{If } jopr1 \text{ is greater than } jopr2.
\end{align*}
\]

Errors:

None.

Example:

```
INTEGER*4 JOPX, JOPY

IF(JCMP(JOPX, JOPY), 10, 20, 30)
```

### 3.69 JDFIX

The JDFIX function converts a REAL*8 (DOUBLE PRECISION) value to INTEGER*4.

**Form:** \( i = \text{JDFIX} (\text{dsrc}, \text{jres}) \)

**where:**

- **dsrc** is a REAL*8 variable, constant, or expression to be converted to INTEGER*4
- **jres** is an INTEGER*4 variable to contain the conversion result

**Function Results:**

\[
\begin{align*}
    i &= -1 & \text{Normal return; the result is negative.} \\
    &= 0 & \text{Normal return; the result is zero.} \\
    &= 1 & \text{Normal return; the result is positive.}
\end{align*}
\]

**Errors:**

\( i = -2 \) An overflow occurred while computing the result.

Example:

```
INTEGER*4 JNUM
REAL*8 DNUM

20 TYPE 98
98 FORMAT('ENTER POSITIVE INTEGER')
ACCEPT 98, DNUM
99 FORMAT(F20.0)
IF(JDFIX(DNUM, JNUM), LT, 0) GOTO 20
```

3–66 System Subroutine Description and Examples
3.70 JDIV

The JDIV function computes the quotient of two INTEGER*4 values.

Form:  \( i = \text{JDIV}(\text{jopr1}, \text{jopr2}, \text{jres}, \text{jrem}) \)

where:

- \( \text{jopr1} \) is an INTEGER*4 variable that is the dividend of the operation
- \( \text{jopr2} \) is an INTEGER*4 variable that is the divisor of \( \text{jopr1} \)
- \( \text{jres} \) is an INTEGER*4 variable that receives the quotient of the operation (that is, \( \text{jres} = \text{jopr1} / \text{jopr2} \))
- \( \text{jrem} \) is an INTEGER*4 variable that receives the remainder of the operation. The sign is the same as that for \( \text{jopr1} \)

Function Results:

\[
\begin{align*}
\text{i} & = -1 & \text{Normal return; the quotient is negative.} \\
    & = 0 & \text{Normal return; the quotient is 0.} \\
    & = 1 & \text{Normal return; the quotient is positive.}
\end{align*}
\]

Errors:

\[
\begin{align*}
\text{i} & = -3 & \text{An attempt was made to divide by 0.}
\end{align*}
\]

Example:

```fortran
INTEGER*4 JN1, JN2, JQUO
.
.
CALL JDIV(JN1, JN2, JQUO)
.
.
```

3.71 JICVT

The JICVT function converts a specified INTEGER*2 value to INTEGER*4.

Form:  \( i = \text{JICVT}(\text{isrc}, \text{jres}) \)

where:

- \( \text{isrc} \) is the INTEGER*2 quantity to be converted
- \( \text{jres} \) is the INTEGER*4 variable or array element to receive the result

Function Results:

\[
\begin{align*}
\text{i} & = -1 & \text{Normal return; the result is negative.} \\
    & = 0 & \text{Normal return; the result is 0.} \\
    & = 1 & \text{Normal return; the result is positive.}
\end{align*}
\]
Errors:
None.
Example:

```
INTEGER*4 JVAL
CALL JJCVT(JVAL) !FORM A 32-BIT CONSTANT
```

### 3.72 JJCVT

The JJCVT function interchanges words of an INTEGER*4 value to form an internal format time or vice versa. This procedure is necessary when the INTEGER*4 variable is to be used as an argument in a timer-support function such as ITWAIT. When a two-word internal format time is specified to a function such as ITWAIT, it must have the high-order time as the first word and the low-order time as the second word.

Form: CALL JJCVT (jsrc)

where:

- `jsrc` is the INTEGER*4 variable whose contents are to be interchanged

Errors:
None.
Example:

```
INTEGER*4 TIME
  
  CALL GTIM(TIME) !GET TIME OF DAY
  CALL JJCVT(TIME) !TURN IT INTO INTEGER*4 FORMAT
```

### 3.73 JMOV

The JMOV function assigns the value of an INTEGER*4 variable to another INTEGER*4 variable and returns the sign of the value moved.

Form: i = JMOV (jsrc,jdest)

where:

- `jsrc` is the INTEGER*4 variable whose contents are to be moved
- `jdest` is the INTEGER*4 variable that is the target of the assignment

Function Results:

The value of the function is an INTEGER*2 value that represents the sign of the result as follows:

- `i = -1` Normal return; the result is negative.
- `i = 0` Normal return; the result is 0.
- `i = 1` Normal return; the result is positive.
Errors:
None.

Example:
The JMOV function allows an INTEGER*4 quantity to be compared with 0 by using it in a logical IF statement. For example:

```
INTEGER*4 INT1
  .
  .
IF(JMOV(INT1,INT1),NE,0) GOTO 300 ! GO TO STMT 300 IF INT1 NOT 0
```

### 3.74 JMUL

The JMUL function computes the product of two INTEGER*4 values.

**Form:** \( i = JMUL (jopr1,jopr2,jres) \)

where:
- \( jopr1 \) is an INTEGER*4 variable that is the multiplicand
- \( jopr2 \) is an INTEGER*4 variable that is the multiplier
- \( jres \) is an INTEGER*4 variable that receives the product of the operation

**Function Results:**
- \( i = -1 \) Normal return; the product is negative.
- \( i = 0 \) Normal return; the product is 0.
- \( i = 1 \) Normal return; the product is positive.

**Errors:**
- \( i = -2 \) An overflow occurred while computing the result.

**Example:**

```
INTEGER*4 J1,J2,JRES
  .
  .
IF(JMUL(J1,J2,JRES)+1) 100,10,20
C GOTO 100 IF OVERFLOW
C GOTO 10 IF RESULT IS NEGATIVE
C GOTO 20 IF RESULT IS POSITIVE OR ZERO
```

### 3.75 JSUB

The JSUB function computes the difference between two INTEGER*4 values.

**Form:** \( i = JSUB (jopr1,jopr2,jres) \)

where:
- \( jopr1 \) is an INTEGER*4 variable that is the minuend of the operation

System Subroutine Description and Examples 3–69
jopr2 is an INTEGER*4 variable that is the subtrahend of the operation

jres is an INTEGER*4 variable that is to receive the difference between jopr1 and jopr2 (that is, \texttt{jres = jopr1 - jopr2})

Function Results:

\begin{align*}
  i & = -1 & \text{Normal return; the result is negative.} \\
  & = 0 & \text{Normal return; the result is 0.} \\
  & = 1 & \text{Normal return; the result is positive.}
\end{align*}

Errors:

\begin{itemize}
  \item [i=\text{-}2] An overflow occurred while computing the result.
\end{itemize}

Example:

\begin{verbatim}
INTEGER*4 JOP1, JOP2, J3
;
;
CALL JSUB(JOP1, JOP2, J3)
\end{verbatim}

### 3.76 JTIME

The JTIME subroutine converts the time specified to the internal two-word format time.

Form: \texttt{CALL JTIME (hrs, min, sec, tick, time)}

where:

\begin{itemize}
  \item [hrs] is the integer number of hours
  \item [min] is the integer number of minutes
  \item [sec] is the integer number of seconds
  \item [tick] is the integer number of ticks (1/60 of a second for 60-cycle clocks; 1/50 of a second for 50-cycle clocks)
  \item [time] is the two-word area to receive the internal format time: time(1) is the high-order time; time(2) is the low-order time
\end{itemize}

Errors:

None.

Example:

\begin{verbatim}
INTEGER*4 J1
;
;
C CONVERT 3 HRS, 7 MIN, 23 SECONDS TO INTEGER *4 VALUE
CALL JTIME(3, 7, 23, 0, J1)
CALL JJCVT(J1)
\end{verbatim}
3.77 LEN

The LEN function returns the number of characters currently in the string contained in a specified array. This number is computed as the number of characters preceding the first null byte encountered. If the specified array contains a null string, a value of 0 is returned.

Form: \( i = \text{LEN}(a) \)

where:

\( a \) specifies the array containing the string, which must be terminated by a null byte

Errors:

None.

Example:

```fortran
LOGICAL*1 STRNG(73)
  ,
  ,
  TYPE 99,(STRNG(I),I=1,LEN(STRNG))
99 FORMAT('O',132A1)
```

3.78 LOCK

The LOCK subroutine keeps the USR in memory for a series of operations involving various RT–11 file management functions.

If all the conditions that cause swapping are satisfied, a portion of the user program is written out to the disk file SWAP.SYS and the USR is loaded. Otherwise, the USR in memory is used, and no swapping occurs. The USR is not released until an UNLOCK (see Section 3.112) is given. (Note that in an FB system, calling the CSI can also perform an implicit UNLOCK.) To save time in swapping, a program that has many USR requests to make can LOCK the USR in memory, make all the requests, and then UNLOCK the USR.

In an FB or XM environment, a LOCK inhibits another job from using the USR. Thus, the USR should be locked only for as long as necessary.

**NOTE**

If any job does a LOCK, it can cause the USR to be unavailable for other jobs for a considerable period of time. The USR is not reentrant and only one job has use of the USR at a time, which should be considered for systems requiring concurrent foreground and background jobs. This is particularly true when magtape and/or cassette are active.

File operations by the USR require a sequential search of the tape for magtape and cassette. This could lock out the fore-
ground job for a long time while the background job does a tape operation. The programmer should keep this in mind when designing such systems. The FB and XM monitors supply the ITLOCK routine, which permits the foreground job to check for the availability of the USR.

Form:  CALL LOCK

After a LOCK has been executed, the UNLOCK routine must be executed to release the USR from memory. The LOCK/UNLOCK routines are complementary and must be matched. That is, if three LOCKs are issued, at least three UNLOCKs must be done, otherwise the USR is not released. More UNLOCKs than LOCKs can occur without error; the extra UNLOCKs are ignored.

Notes:

1. It is vital that the LOCK call not come from within the area into which the USR will be swapped. If this should occur, the return from the USR request would not be to the user program, but to the USR itself, since the LOCK function causes part of the user program to be saved on disk and replaced in memory by the USR. Furthermore, subroutines, variables, and arrays in the area where the USR is swapping should not be referenced while the USR is locked in memory.

2. Once a LOCK has been performed, it is not advisable for the program to destroy the area the USR is in, even though no further use of the USR is required. This causes unpredictable results when an UNLOCK is done.

3. LOCK cannot be called from a completion or interrupt routine.

4. If a SET USR NOSWAP command has been issued, LOCK and UNLOCK do not cause the USR to swap. However, in FB, LOCK still inhibits the other job from using the USR, and UNLOCK allows the other job access to the USR.

5. The USR cannot accept argument lists, such as device file name specifications, located in the area into which it has been locked.

Errors:

None.

Example:

```
INTEGER*2 DBLK(4)
DATA DBLK /3RDK,3RDT,3RFIL,3RF4 /
.
.
CALL LOCK !LOCK THE USR IN MEMORY
ICHN=IGETC() !GET A CHANNEL TO USE
IF (LOOKUP(ICHN, DBLK), LT, 0) STOP 'LOOKUP FAILED'
CALL UNLOCK !RELEASE THE USR
.
.
```

3-72  System Subroutine Description and Examples
3.79 LOOKUP

The LOOKUP function associates a specified channel with a device and/or file for the purpose of performing I/O operations. The channel used is then busy until one of the following functions is executed.

CLOSEC or ICLOSE
ISAVES
PURGE

Form: i = LOOKUP (chan,dblk[,count,seqnum,])
i = LOOKUP (chan,jobdes)

where:

chan is the integer specification for the RT-11 channel to be associated with the file. You must obtain this channel through an IGETC call, or you can use channel 16(decimal) or higher if you have done an ICDFN call.

dblk is the four-word area specifying the Radix-50 file descriptor. Note that unpredictable results occur if the USR swaps over this four-word area.

count is an optional argument used for the cassette handler; this argument defaults to 0.

seqnum is a file number. For cassette operations, if this argument is blank, a value of 0 is assumed. For magtape, it describes a file sequence number. The action taken depends on whether the file name is given or null. The sequence number can have the following values:

-1 Suppress rewind and search for the specified file name from the current tape position. If a file name is given, a file-structured lookup is performed (do not rewind). If the file name is null, a non-file-structured lookup is done (tape is not moved). You must specify a -1 and no other negative number.

0 Rewind to the beginning of the tape and do a non-file-structured lookup.

n Where n is any positive number. Position the tape at file sequence number n and check that the file names match. If the file names do not match, an error is generated. If the file name is null, a file-structured lookup is done on the file designated by seqnum.

jobdes is an argument that allows communication between jobs in a system job environment. It is a pointer to a four-word job descriptor of the job to which messages will be sent or received. The syntax is

jobdes → .RAD50 /MQ/
 .ASCII /logical-job-name/

System Subroutine Description and Examples 3–73
where the logical-job-name is six characters long. If the logical-job-name is zero, the channel will be opened only for .READ/C/W requests, and such requests will accept messages from any jobs.

If the jobdes argument is omitted, LOOKUP operates as it did for Version 3B.

NOTE

The arguments of LOOKUP must be positioned so that the USR does not swap over them.

The handler for the selected device must be in memory for a LOOKUP. If the first word of the file name in dblk is 0 and the device is a file-structured device, absolute block 0 of the device is designated as the beginning of the file. This technique, called a non-file-structured lookup, allows I/O to any physical block on the device. If a file name is specified for a device that is not file structured (such as LP:FILE,TYP), the name is ignored.

NOTE

Since a non-file-structured lookup allows I/O to any physical block on the device, the user must be aware that, in this mode, it is possible to overwrite the RT-11 device directory, thus destroying all file information on the device.

Function Results:

i = n  Indicates a successful file-structured lookup on a random-access storage volume.

i = 0  Indicates a successful non-file-structured lookup on both random-access and non-file-structured volumes, or a successful file-structured lookup on magtape.

Errors:

i = -1  Channel specified is already open.

= -2  File specified was not found on the device.

= -3  Device in use.

= -4  Tape drive is not available.

= -5  Illegal argument error with a file-structured volume.

= -6  Illegal argument error with a non-file-structured volume.

Example:

```
INTEGER*2 DBLK(4)
DATA DBLK/3RDK0,3RFTN,3R44,3RDAT/

ICHAN=IGETC()
IF(ICHAN.LT.0) STOP 'NO CHANNEL'
IF(IFETCH(DBLK),NE,0) STOP 'BAD FETCH'
IF(LOOKUP(ICHAN,DBLK),LT,0) STOP 'BAD LOOKUP'
```

3–74  System Subroutine Description and Examples
CALL ICLOSE (ICHAN, I)
I = ICLOSE()
CALL IFREEC (ICHAN)
.
.

or using LOOKUP with a system job

LOGICAL *1 JNAM (6)
DIMENSION JBLK (4)
EQUIVALENCE (JNAM(1), JBLK(2))
DATA JNAM / 'Q', 'U', 'E', 'U', 'E', 0 /
DATA JBLK(1) / 3RMQ /
.
.
C OPEN A MESSAGE CHANNEL TO 'QUEUE'
ICHN=GETC()
IF (LOOKUP (ICHN, JBLK), LT, 0) STOP 'QUEUE IS NOT RUNNING'
.
.

3.80 MRKT (SYSGEN Option in SJ)

The MRKT function schedules an assembly language completion routine to be entered after a specified time interval has elapsed. Support for MRKT in SJ requires timer support.

Form: \( i = \text{MRKT}(\text{id}, \text{crtn}, \text{time}) \)

where:

\begin{itemize}
  \item \text{id} is an integer identification number to be passed to the routine being scheduled
  \item \text{crtn} is the name of the assembly language routine to be entered when the time interval elapses. This name must be specified in an EXTERNAL statement in the FORTRAN routine that issues the MRKT call
  \item \text{time} is the two-word, internal format time interval; when this interval elapses, the routine is entered. If considered as a two-element INTEGER*2 array:
    \begin{itemize}
      \item \text{time(1)} is the high-order time.
      \item \text{time(2)} is the low-order time.
    \end{itemize}
\end{itemize}

Notes:

1. MRKT requires a queue element, which should be considered when the IQSET function (Section 3.42) is executed.
2. If the system is busy, the time interval that elapses before the completion routine is run can be greater than that requested.

For further information on scheduling completion routines, see the .MRKT programmed request (Section 2.49).
Errors:

\[
\begin{align*}
i &= 0 \quad \text{Normal return.} \\
    &= 1 \quad \text{No queue element was available; unable to schedule request.}
\end{align*}
\]

Example:

\[
\begin{align*}
\text{INTEGER*2 TINT(2)} \\
\text{EXTERNAL ARTN} \\
\vdots \\
\text{CALL MRKT(4,ARTN,TINT)}
\end{align*}
\]

### 3.81 MTATCH (Special Feature)

The MTATCH subroutine attaches a terminal for exclusive use by the requesting job. This operation must be performed before any job can use a terminal with multiterminal programmed requests.

Form: \( i = \text{MTATCH}(\text{unit}, \text{addr}, \text{jobnum}) \)

where:

- **unit** is the logical unit number \( (lun) \) of the terminal
- **addr** is the optional address of an asynchronous terminal status word. Omit this argument if the asynchronous terminal status word is not required by specifying a comma. For example:

\[
I = \text{MTATCH}(\text{unit}, \text{jobnum})
\]

- **jobnum** is the job number associated with the terminal if the terminal is not available

Errors:

\[
\begin{align*}
i &= 0 \quad \text{Normal return.} \\
    &= 3 \quad \text{Nonexistent unit number.} \\
    &= 5 \quad \text{Unit attached by another job (job number returned in \textit{jobnum})} \\
    &= 6 \quad \text{In XM monitor, the optional status word address is not in a valid user virtual address space}
\end{align*}
\]

Example:

```plaintext
C       TEST SYSLIB Multiterminal Routines
C       INTEGER*2 UNIT, SBLK(4), STAT(8), ASH, STRING(41), PROMT(8)
C       LOGICAL*1 TEND(11)
C       REAL*4 TESTM(9)
C       DATA PROMT/'EN', 'TE', 'R', 'ST', 'RI', 'NG', '/', '200/
C       DATA TEND/'*','E','N','D',' ','T','E', 'S', 'T','*','0/
C       DATA TESTM/'ST','ATC','GET','SET',' ',' ',' ',' ','','DTCH'/
C USE MTSTAT TO GET & DISPLAY NO. OF UNITS
C TYPE 106
L=1
IF(MTSTAT(STAT),NE,0)GOTO 999
C TYPE 99,STAT(3)
```

3–76 System Subroutine Description and Examples
C GET UNIT # TO TEST

TYPE 100
ACCEPT 101,UNIT
IF(UNIT.EQ.99) STOP 'END OF MULTITERMINAL TEST'! UNIT #99 STOPS TEST

C ATTACH UNIT TO THIS JOB THEN GET TCB STATUS WORDS

TYPE 110
ACCEPT 111,IASW
IF(IASW.EQ. 'Y')IER=MATCH(UNIT,ASW,JOB)
IF(IASW.NE. 'Y')IER=MATCH(UNIT,0,JOB)
L=2
IF(IER)GOTO 999
L=3
IF(MTGET(UNIT,SBLK(1)),NE.0)GOTO 999
TYPE 102,UNIT,SBLK

C GET NEW STATUS, PUT IT IN TCB, THEN DISPLAY IT

CALL SETUP(SBLK,UNIT)
L=4
IF(MTSET(UNIT,SBLK(1)),NE.0)GOTO 999
TYPE 102,UNIT,SBLK

C PERFORM TEST - FIRST ECHO INPUT THEN REPEAT IT USING MTIN & MOUT

20 TYPE 103
20 TYPE 104
20 TYPE 105
30 CALL MTIN(UNIT,J)
30 CALL MTOUT(UNIT,J)
IF(J,NE.10)GOTO 30
30 CALL MTRCTO(UNIT)

C NOW TEST W/ TTSCPC BIT ON - ECHO INPUT WITH MTOUT (DON'T REPEAT)
C THEN TURN TTSCPC BIT OFF...

40 IF(SBLK(1),AND.,"10000)GOTO 40
40 SBLK(1)=SBLK(1),OR.,"10000
40 IF(MTSET(UNIT,SBLK(1)),NE.0)GOTO 999
40 GOTO 30

C ASYNCHRONOUS STATUS WORD TEST - "POLL" TERMINAL UNTIL INPUT AVAILABLE - ECHO INPUT THEN REPEAT IT ON NEXT LINE

50 IF(.NOT.ASW.AND.,"40000)GOTO 50
50 CALL MTIN(UNIT,J)
50 CALL MTOUT(UNIT,J)
50 IF(J,NE.10)GOTO 55
50 CALL MTRCTO(UNIT)

C TEST MTPRT BY OUTPUTTING 2 STRINGS, 1 FROM USER & 1 INTERNAL

60 CALL GTLIN(STRING,PROMT)
60 CALL MTPRT(UNIT,STRING)
60 CALL MTPRT(UNIT,END)

C DETACH UNIT FROM JOB AND START OVER

L=9
60 TYPE 108,UNIT
60 IF(MTDTCH(UNIT),EQ.0)GOTO 5

System Subroutine Description and Examples  3–77
C  ERROR REPORTING

999 TYPE 909,TESTM(1),IER  ! ANNOUNCE ERROR
GOTO 5  ! THEN START OVER
99 FORMAT('OTHER ARE',I3,' UNITS ON THIS SYSTEM')
100 FORMAT(*UNIT * TO BE TESTED?')
101 FORMAT(I2)
102 FORMAT('UNIT',I3,' STATUS = ',408)
103 FORMAT('GO TO TERMINAL BEING TESTED...ENTER 2 LINES + RED')
104 FORMAT(' 1ST LINE: INPUT WILL BE ECHOED THEN REPEATED')
105 FORMAT(' 2ND LINE: TEST TTSPC$ ON - INPUT ECHOED VIA MOUT')
106 FORMAT(' 1 SYSLIB MULTITERMINAL ROUTINE TEST PROGRAM')
107 FORMAT(' 1...)"
108 FORMAT(' ABOUT TO DETACH UNIT = ',I2)
109 FORMAT(' TEST ASW - INPUT WILL BE ECHOED, THEN REPEATED')
110 FORMAT('*TEST ASYNCH STATUS WORD FUNCTION?')
111 FORMAT(A1)
909 FORMAT('OMT',A4,' ERROR CODE = ',I3)
END

C  SUBROUTINE TO GET NEW STATUS WORD VALUES

SUBROUTINE SETUP(SBLOK,UNIT)

INTEGER SBLOK(4),UNIT

TYPE 100
ACCEPT 101,J
IF(J).EQ.1 SBLOK(1)=J
TYPE 102
ACCEPT 101,J
TYPE 103
ACCEPT 101,I
IF(1.OR.J).EQ.1 SBLOK(3)=I*256+J
5 TYPE 104
ACCEPT 105,I
IF(J).EQ.1 SBLOK(4)=SBLOK(4)/256*256+I
RETURN

100 FORMAT('*CONFIG BIT MASK:')
101 FORMAT(66)
102 FORMAT('*CHAR REQUIRING FILLER:')
103 FORMAT('*# OF FILL CHAR:')
104 FORMAT('*CARRIAGE WIDTH:')
105 FORMAT(13)
END

3.82 MTDTCH (Special Feature)

The MTDTCH subroutine is the complement of the MTATCH subroutine. Its function is to detach a terminal from a particular job and make it available for other jobs.

Form:  \( i = \text{MTDTCH}(\text{unit}) \)

where:

\( \text{unit} \)  is the logical unit number (\text{lun}) of the terminal to be detached

Errors:

\( i = 0 \)  Normal return.
\( = 2 \)  Invalid unit number; terminal is not attached.
\( = 3 \)  Nonexistent unit number.

3–78 System Subroutine Description and Examples
Example:

Refer to the example under MTATCH.

3.83 MTGET (Special Feature)

The MTGET subroutine furnishes the user with information about a specific terminal in a multiterminal system. You do not need to do an MTATCH before using MTGET.

Form: \( i = \text{MTGET (unit,addr[,jobnum])} \)

where:

- **unit** is the unit number of the line and terminal whose status is desired
- **addr** is the four-word area to receive the status information. The area is a four-element INTEGER*2 array (see the .MTSET programmed request, Section 2.58, for area format)
- **jobnum** is the job number associated with the terminal if the terminal is not available

Status information including bit definitions for the terminal configuration words and the terminal state byte are described in detail under the .MTGET programmed request.

Errors:

- \( i = 0 \) Normal return.
- \( i = 2 \) Unit not attached.
- \( i = 3 \) Nonexistent unit number.
- \( i = 4 \) Unit attached by another job (job number returned in job-num).
- \( i = 6 \) In XM monitor, the address of the terminal buffer is outside the valid program limits.

Example:

Refer to the example under MTATCH.

3.84 MTIN (Special Feature)

The MTIN subroutine transfers characters from a specified terminal to the user program. This subroutine is a multiterminal form of ITTINR. If no characters are available, an error flag is set to indicate an error upon return from the subroutine. If no character count argument is specified, one character is transferred.

Form: \( i = \text{MTIN (unit,char[,chrcnt ][,ocnt])} \)

where:

- **unit** is the unit number of the terminal
- **char** is the variable to contain the characters read in from the terminal indicated by the unit number
chrnt is an optional argument that indicates the number of characters to be read

ocnt is an optional argument that indicates the number of characters actually transferred

When a request for a multiple-character transfer is requested, if the optional fourth argument (ocnt) is specified and bit 6 of the M.TSTS word is set, the variable specified as the argument will have a value equal to the actual number of characters transferred upon return from the subroutine.

Errors:

<table>
<thead>
<tr>
<th>i</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal return.</td>
</tr>
<tr>
<td>1</td>
<td>No input available.</td>
</tr>
<tr>
<td>2</td>
<td>Unit not attached.</td>
</tr>
<tr>
<td>3</td>
<td>Nonexistent unit number.</td>
</tr>
</tbody>
</table>

Example:

Refer to the example under MTATCH.

### 3.85 MTOUT (Special Feature)

The MTOUT subroutine transfers characters to a specified terminal. This subroutine is a multiterminal form of ITTOUR. If no room is available in the output ring buffer, an error flag is set to indicate an error upon return from the subroutine. If no character count argument is specified, one character is transferred.

Form: \( i = \text{MTOUT (unit, char[, chrnt][, ocnt])} \)

where:

- **unit** is the unit number of the terminal
- **char** is the variable or array containing the characters to be output, right-justified in the integer (can be LOGICAL*1 if desired)
- **chrnt** is an optional argument that indicates the number of characters to be output
- **ocnt** is an optional argument that indicates the number of characters actually transferred

When a request for a multiple-character transfer is requested, if the optional fourth argument (ocnt) is specified and bit 6 of the M.TSTS word is set, the variable specified as the argument will have a value equal to the actual number of characters transferred upon return from the subroutine.

Errors:

<table>
<thead>
<tr>
<th>i</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal return.</td>
</tr>
<tr>
<td>1</td>
<td>No room in output ring buffer.</td>
</tr>
<tr>
<td>2</td>
<td>Unit not attached.</td>
</tr>
<tr>
<td>3</td>
<td>Nonexistent unit number.</td>
</tr>
<tr>
<td>5</td>
<td>In the XM monitor, the address of the user buffer is outside the valid program limits.</td>
</tr>
</tbody>
</table>
Example:
Refer to the example under MTATCH.

3.86 MTPRNT (Special Feature)

The MTPRNT subroutine allows output to be printed at any terminal in a multiterminal environment. This subroutine has the same effect as the PRINT subroutine (Section 3.91).

Form: \( i = \text{MTPRNT}(\text{unit}, \text{string}) \)

where:

- unit is the unit number associated with the terminal
- string is the character string to be printed. Note that all quoted literals used in FORTRAN subroutine calls are in ASCII format, which ends in zero for a CR/LF or a 200 if no action is to be taken

Errors:

- \( i = 0 \) Normal return.
- \( i = 2 \) Unit not attached.
- \( i = 3 \) Nonexistent unit number.
- \( i = 5 \) In the XM monitor, the address of the character string is outside the valid program limits.

3.87 MTRCTO (Special Feature)

The MTRCTO subroutine resets the CTRL/O command typed at the specified terminal in a multiterminal environment. This subroutine has the same effect as the .MTRCTO programmed request (Section 2.57).

Form: \( i = \text{MTRCTO}(\text{unit}) \)

where:

- unit is the unit number associated with the terminal

Errors:

- \( i = 0 \) Normal return.
- \( i = 2 \) Unit not attached.
- \( i = 3 \) Nonexistent unit number.

Example:
Refer to the example under MTATCH.

3.88 MTSET (Special Feature)

The MTSET subroutine sets terminal and line characteristics. The set conditions remain in effect until the system is booted or the terminal and line characteristics are reset. See the .MTSET programmed request (Section 2.58) for more details.
Form: $i = \text{MTSET (unit,addr)}$
where:

- **unit** is the unit number of the line and terminal whose characteristics are to be changed.
- **addr** is a four-word area to pass the status information. The area is a four-element INTEGER*2 array.

Errors:

- $i = 0$ Normal return.
- $i = 2$ Unit not attached.
- $i = 3$ Nonexistent unit number.
- $i = 6$ In the XM monitor, the address of the status block is outside the valid program limits.

Example:
Refer to the example under MTATCH.

### 3.89 MTSTAT (Special Feature)

The MTSTAT subroutine returns multiterminal system status in an eight-word status block.

Form: $i = \text{MTSTAT (addr)}$
where:

- **addr** is the address of an eight-word array where multiterminal status information is returned. The status block contains the following information:

  | addr(1)     | Offset from the base of the resident monitor to the first Terminal Control Block (TCB). |
  | addr(2)     | Offset from the base of the resident monitor to the terminal control block of the console terminal for the program. |
  | addr(3)     | The value (0–16 decimal) of the highest logical unit number (LUN) built into the system. |
  | addr(4)     | The size of the terminal control block in bytes. |
  | addr(5)–(8) | Reserved. |

Errors:

- $i = 0$ Normal return.
- $i = 5$ In the XM monitor, the address of the status block is not in valid user address space.

Example:
Refer to the example under MTATCH.
3.90  MWAIT (FB and XM Only)

The MWAIT subroutine suspends main program execution of the current
job until all messages sent to or from the other job have been transmitted or
received. It provides a means for ensuring that a required message has
been processed. MWAIT is used primarily in conjunction with the IRCVD
and ISDAT calls, where no action is taken when a message transmission is
completed. This subroutine requires a queue element, which should be con-
sidered when the IQSET function (Section 3.42) is executed.

Form:  CALL MWAIT

Errors:

None.

Example:

Refer to the example under ISDAT, Section 3.51.

3.91  PRINT

The PRINT subroutine prints output from a specified string at the console
terminal. This routine can be used to print messages from completion
routines without using the FORTRAN formatted I/O system. Control re-
turns to the user program after all characters have been placed in the
output buffer.

The string to be printed can be terminated with either a null (0) byte or a
200(octal) byte. If the null (ASCIZ) format is used, the output is automati-
cally followed by a carriage return/line feed pair (octal 15 and 12). If a 200
byte terminates the string, no carriage return/line feed pair is generated.

In the FB monitor, a change in the job that is controlling terminal output is
indicated by a B> or F>. Any text following the message has been printed
by the job indicated (foreground or background) until another B> or F> is
printed. When PRINT is used by the foreground job, the message appears
immediately, regardless of the state of the background job. Thus, for urgent
messages, PRINT should be used rather than ITTOUR.

Form:  CALL PRINT (string)

where:

string     is the string to be printed. Note that all quoted literals used
in FORTRAN subroutine calls are in ASCIZ format, as are
all strings produced by the SYSLIB string-handling package
(The CONCAT routine can be used to append an octal 200 to
an ASCIZ string; see example.)

Errors:

None.
Example:

```
CALL PRINT ('THE COFFEE IS READY')
or
BYTE QUESTION(80)
!APPEND BYTE 200
CALL CONCAT('WHAT IS YOUR NAME?',"200",QUESTION)
CALL PRINT(QUESTION) !QUESTION PRINTS WITHOUT CR,LF
```

### 3.92 PURGE

The PURGE subroutine deactivates a channel without performing an ISAVES, CLOSEC, or ICLOSE. Any tentative file currently associated with the channel is not made permanent. This subroutine prevents entered (IENTER or .ENTER) files from becoming permanent directory entries.

**Form:** CALL PURGE (chan)

**where:**

*chan* is the integer specification for the RT-11 channel to be de-activated

**Errors:**

None.

**Example:**

Refer to the example under IENTER, Section 3.25.

### 3.93 PUTSTR

The PUTSTR subroutine writes a variable-length character string to a specified FORTRAN logical unit. PUTSTR can be used in main program routines or in completion routines but not in both in the same program at the same time. If PUTSTR is used in a completion routine, it must not be the first I/O operation on the specified logical unit.

**Form:** CALL PUTSTR (lun,in,char,err)

**where:**

*lun* is the integer specification of the FORTRAN logical unit number to which the string is to be written

*in* is the array containing the string to be written

*char* is an ASCII character that is appended to the beginning of the string before it is output. If 0, no extra character is output. This character is used primarily for carriage control purposes

*err* is a LOGICAL*1 variable that is .TRUE. for an error condition and .FALSE. for a no-error condition
Errors:

\[ \text{err} = \begin{cases} -1 & \text{End-of-file for write operation.} \\ -2 & \text{Hardware error for write operation.} \end{cases} \]

Example:

\[
\begin{align*}
\text{LOGICAL*1 STRING(81),ERR} \\
\text{.} \\
\text{.} \\
\text{OUTPUT STRING WITH DOUBLE SPACING} \\
\text{CALL PUTSTR(7,STRING,'0',ERR)}
\end{align*}
\]

3.94 R50ASC

The R50ASC subroutine converts a specified number of Radix–50 characters to ASCII.

Form: \( \text{CALL R50ASC (icnt,input,output)} \)

where:

- \( \text{icnt} \) is the integer number of ASCII characters to be produced
- \( \text{input} \) is the area from which words of Radix–50 values to be converted are taken. Note that \((icnt+2)/3\) words are read for conversion
- \( \text{output} \) is the area into which the ASCII characters are stored

Errors:

If an input word contains illegal Radix–50 codes — that is, if the input word is greater (unsigned) than 174777 (octal) — the routine outputs question marks for the value.

Example:

\[
\begin{align*}
\text{REAL*8 NAME} \\
\text{LOGICAL*1 OUTP(12)} \\
\text{.} \\
\text{.} \\
\text{CALL R50ASC(12,NAME,OUTP)}
\end{align*}
\]

3.95 RAD50

The RAD50 function provides a method of encoding RT–11 file descriptors in Radix–50 notation. The RAD50 function converts six ASCII characters from the specified area, returning a REAL*4 result that is the two-word Radix–50 value.

Form: \( \text{a = RAD50 (input)} \)

where:

- \( \text{input} \) is the area from which the ASCII input characters are taken
The RAD50 call:

\[ A = \text{RAD50 (LINE)} \]

is exactly equivalent to the IRAD50 call:

\[ \text{CALL IRAD50 (B,LINE,A)} \]

Function Results:

The two-word Radix-50 value is returned as the function result.

### 3.96 RCHAIN

The RCHAIN subroutine allows a program to determine whether it has been chained to and to access variables passed across a chain. If RCHAIN is used, it must be used in the first executable FORTRAN statement in a program.

Form: \( \text{CALL RCHAIN (flag, var, wcnt)} \)

where:

- **flag** is an integer variable that RCHAIN will set to \(-1\) (true) if the program has been chained to; otherwise, it is \(0\) (false)
- **var** is the first variable in a sequence of variables with increasing memory addresses to receive the information passed across the chain (see Section 3.2)
- **wcnt** is the number of words to be moved from the chain parameter area to the area specified by **var**. RCHAIN moves \(wcnt\) words into the area beginning at **var**

Errors:

None.

Example:

```fortran
INTEGER*2 PARMS(50)
CALL RCHAIN(IFLAG,PARMS,50)
IF(IFLAG) GO TO 10  !GO TO 10 IF CHAINED TO
    
```

### 3.97 RCTRLO

The RCTRLO subroutine resets the effect of any console terminal CTRL/O command that was typed. After an RCTRLO call, any output directed to the console terminal prints until another CTRL/O is typed.

Form: \( \text{CALL RCTRLO} \)

Errors:

None.
Example:

CALL RCTRL0
CALL PRINT (’PRINT UNTIL ANOTHER CTRL/D TYPED’)

3.98 REPEAT

The REPEAT subroutine concatenates a specified string with itself to produce the indicated number of copies. REPEAT places the resulting string in a specified array.

Form: CALL REPEAT (in,out,i,[:len,[:err]])

where:

in is the array containing the string to be repeated; it must be terminated with a null byte
out is the array into which the resultant string is placed. This array must be at least one element longer than the value of len, if len is specified. It also must be terminated with a null byte if len is specified
i is the integer number of times to repeat the string
len is the integer number representing the maximum length of the output string
err is the logical error flag set if the output string is truncated to the length specified by len

Input and output strings can specify the same array only if the repeat count (i) is 1 or 0. When the repeat count is 1, this routine is the equivalent of SCOPY; when the repeat count is 0, out is replaced by a null string. The old contents of out are lost when this routine is called.

Errors:

Error conditions are indicated by err, if specified. If err is given and the output string would have been longer than len characters, then err is set to .TRUE.; otherwise, err is unchanged.

Example:

LOGICAL*1 SIN(21),SOUT(101)
.
.
CALL REPEAT(SIN,SOUT,5)

3.99 RESUME (FB and XM Only)

The RESUME subroutine allows a job to resume execution of the main program. A RESUME call is normally issued from an asynchronous FORTRAN routine entered on I/O completion or because of a schedule request (see the SUSPND subroutine, Section 3.107, for more information).
Form: CALL RESUME  
Errors:  
None.  
Example:  
Refer to the example under SUSPND.

3.100 SCCA  
The SCCA subroutine provides a CTRL/C intercept to:  
1. Inhibit a CTRL/C abort  
2. Indicate that a CTRL/C command is active  
3. Distinguish between single and double CTRL/C commands  

Form: CALL SCCA ([iflag])  
where:  

iflag is an integer terminal status word that must be tested and cleared to determine if two CTRL/Cs were typed at the console terminal; the iflag must be an INTEGER*2 variable (not LOGICAL*1)  

When a CTRL/C is typed, the SCCA subroutine places it in the input ring buffer. While residing in the buffer, the character can be read by the program. The program must test and clear the iflag to determine if two CTRL/C commands were typed consecutively. The iflag is set to non-zero when two CTRL/Cs are typed together. It is the responsibility of the program to abort itself, if appropriate, on an input of CTRL/C from the terminal. The SCCA subroutine with no argument disables the CTRL/C intercept. A CTRL/C from indirect command files is not intercepted by SCCA.

Errors:  
None.  
Example:

```
PROGRAM SCCA  
C  SCCA.FOR SYSLIB TEST FOR SCCA  
C  
CALL PRINT ('PROGRAM HAS STARTED, TYPE')  
IFLAG=0  
CALL SCCA (IFLAG)  
10 I = ITTINR()  
   GET A CHARACTER  
   IF (I .NE. 3) GOTO 10  
C  A CTRL/C WAS TYPED  
CALL PRINT ('A CTRL/C WAS TYPED')  
   IF (IFLAG .EQ. 0) GOTO 10  
CALL PRINT ('A DOUBLE CTRL/C WAS TYPED')  
   TYPE 19; IFLAG  
19 FORMAT ('IFLAG = ',06,/)  
   CALL SCCA  
   !DISABLE CTRL/C INTERCEPT  
   CALL PRINT ('TYPE A CTRL/C TO EXIT')  
20 GOTO 20  
   !LOOP UNTIL CTRL/C TYPED  
END
```

3–88 System Subroutine Description and Examples
3.101 SCOMP/ISCOMP

The SCOMP routine compares two character strings and returns the integer result of the comparison.
Form 1: CALL SCOMP (a,b,i)
        or
        i = ISCOMP (a,b)
Form 2: CALL ISCOMP (a,b,i)
        or
        i = SCOMP (a,b)

where:

a  is the array containing the first string; it must be terminated with a null byte
b  is the array containing the second string; it must be terminated with a null byte
i  is the integer variable that receives the result of the comparison

The strings are compared from left to right, one character at a time, using the collating sequence specified by the ASCII codes for each character. If the two strings are not equal, the absolute value of variable i (or the result of the function ISCOMP) is the character position of the first inequality found. Strings are terminated by a null (0) character.

If the strings are not the same length, the shorter one is treated as if it were padded on the right with blanks to the length of the other string. A null string argument is equivalent to a string containing only blanks.

Function Results:

i <0  If a is less than b.
     =0  If a is equal to b.
     >0  If a is greater than b.

Example:

LOGICAL*1 INSTR(81)
.
.
CALL GETSTR(5,INSTR,B0)
CALL SCOMP('YES',INSTR,IVAL)
IF(IVAL.NE.0) GOTO 10  !IF INPUT STRING IS NOT YES GOTO 10

3.102 SCOPY

The SCOPY routine copies a character string from one array to another. Copying stops either when a null (0) character is encountered or when a specified number of characters have been moved.
Form: CALL SCOPY (in,out[,len[,err]])

where:

in  is the array containing the string to be copied; it must be terminated with a null byte if len is not specified, or if the string is shorter than len

System Subroutine Description and Examples  3–89
out is the array to receive the copied string. This array must be at least one element longer than the value of len, if len is specified. It also must be terminated with a null byte if len is specified.

len is the integer number representing the maximum length of the output string. The effect of len is to truncate the output string to a given length.

err is a logical variable that receives the error indication if the output string was truncated to the length specified by len.

The input (in) and output (out) arguments can specify the same array. The string previously contained in the output array is lost when this subroutine is called.

Errors:

Error conditions are indicated by err, if specified. If err is given and the output string was truncated to the length specified by len, then err is set to .TRUE.; otherwise, err is unchanged.

Example:

SCOPY is useful for initializing strings to a constant value, for example:

`LOGICAL*1 STRING(80)
CALL SCOPY('THIS IS THE INITIAL VALUE',STRING)`

### 3.103 SECNDS

The SECNDS function returns the current system time, in seconds past midnight, minus the value of a specified argument. Thus, SECNDS can be used to calculate elapsed time. The value returned is single-precision floating point (REAL*4).

Form: \( a = \text{SECNDS}(\text{atime}) \)

where:

atime is a REAL*4 variable, constant, or expression whose value is subtracted from the current time of day to form the result.

Notes:

This function does floating-point arithmetic. Elapsed time can also be calculated by using the GTIM call and the INTEGER*4 support functions.

Function Result:

The function result \((a)\) is the REAL*4 value returned.

Errors:

None.
Example:

```
C    START OF TIMED SEQUENCE
C T1=SECNDS(0.)
C    CODE TO BE TIMED GOES HERE
C DELTA=SECNDS(T1)  !DELTA IS ELAPSED TIME
```

### 3.104 SETCMD

The SETCMD routine allows a user program to pass a command line to the keyboard monitor to be executed after the program exits. This routine can be used in a program running under the SJ monitor, or in a program running in the background under the FB or XM monitor. The command lines are passed to the chain information area (500–777 octal) and stored beginning at location 512(octal). No check is made to determine if the string extends into the stack space. For this reason, the command line should be short and the subroutine call should be made in the main program unit near the end of the program just before completion. When several commands are involved, an indirect command file that contains several command lines should be used.

The monitor commands REENTER, START, and CLOSE are not allowed if the SETCMD feature is used.

**Form:** CALL SETCMD (string)

**where:**

- string is a keyboard monitor command line in ASCIZ format with no embedded carriage returns or line feeds

**Errors:**

- None.

**Example:**

```
LOGICAL*1 INPUT(134),PROMPT(8)
DATA PROMPT/'P','R','O','M','P','T','I','R','200/
CALL GTLIN (INPUT,PROMPT)
CALL SETCMD (INPUT)
END
```

### NOTE

Set USR NOSWAP, or specify /NOSWAP with the COMPILE, FORTRAN, or EXECUTE command to control the swapping state of the USR. A LOCK would inhibit another job from using the USR.

A STOP or CALL EXIT must also be issued after the SETCMD to cause an exit.

### 3.105 STRPAD

The STRPAD routine pads a character string with rightmost blanks until that string is a specified length. This padding is done in place; the result
string is contained in its original array. If the present length of the string is greater than or equal to the specified length, no padding occurs.

Form: CALL STRPAD (a,len,err)

where:

a is the array containing the string to be padded. This array must be one element longer than the value of len if len is specified. It will be terminated by a null byte

len is the integer length of the desired result string

err is the logical error flag that is set to .TRUE. if the string specified by a exceeds the value of len in length

Errors:

Error conditions are indicated by err, if specified. If err is given and the string indicated is longer than len characters, err is set to .TRUE.; otherwise, the value of err is unchanged.

Example:

This routine is especially useful for preparing strings to be output in A-type FORMAT fields. For example:

```
LOGICAL*1 STR(81)

CALL STRPAD(STR,80) !ASSURE 80 VALID CHARACTERS
PRINT 100,(STR(I),I=1,80) !PRINT STRING OF 80 CHARACTERS
100 FORMAT(80A1)
```

3.106 SUBSTR

The SUBSTR routine copies a substring from a specified position in a character string. If desired, the substring can then be placed in the same array as the string from which it was taken.

Form: CALL SUBSTR (in,out,i,[len])

where:

in is the array from which the substring is taken; it is terminated by a null byte

out is the array to contain the substring result. This array must be one element longer than len, if len is specified. It also is terminated by a null byte if len is specified

i is the integer character position in the input string of the first character of the desired substring

len is the integer number of characters representing the maximum length of the substring
If a maximum length (len) is not given, the substring contains all characters to the right of character position i in array in and is not terminated by a null byte. If len is given, the string is copied and terminated with a null byte. If len is equal to zero, out is replaced by the null string. The old contents of array out are lost when this routine is called.

Errors:

None.

3.107 SUSPND (FB and XM Only)

The SUSPND subroutine suspends main program execution of the current job and allows only completion routines (for I/O and scheduling requests) to run.

Form: CALL SUSPND

Notes:

1. The monitor maintains a suspension counter for each job. This count is decremented by SUSPND and incremented by RESUME (see Section 3.99). A job will actually be suspended only if this counter is negative. Thus, if a RESUME is issued before a SUSPND, the latter routine will return immediately.

2. A program must issue an equal number of SUSPND and RESUME calls.

3. A SUSPND subroutine call from a completion routine decrements the suspension counter but does not suspend the main program. If a completion routine does a SUSPND, the main program continues until it also issues a SUSPND, at which time it is suspended. Two RESUME calls are then required to proceed.

4. Because SUSPND and RESUME are used to simulate an ITWAIT (see Section 3.61) in the monitor, a RESUME issued from a completion routine and not matched by a previously executed SUSPND can cause the main program execution to continue past a timed wait before the entire time interval has elapsed.

For further information on suspending main program execution of the current job, see the .SPND programmed request (Section 2.89).

Errors:

None.

Example:

```
INTEGER IAREA(4)
COMMON /RDBLK/ IBUF(256)
EXTERNAL RDFIN
```

System Subroutine Description and Examples  3–93
3.108 TIMASC

The TIMASC subroutine converts a two-word internal format time into an ASCII string of the form:

hh:mm:ss

where:

hh is the two-digit hours indication

mm is the two-digit minutes indication

ss is the two-digit seconds indication

Form: CALL TIMASC (itime,strng)

where:

itime is the two-word internal format time to be converted.

itime(1) is the high-order time, itime(2) is the low-order time

strng is the eight-element array to contain the ASCII time

Errors:

None.

Example:

The following example determines the amount of time from the time the program is run until 5 p.m. and prints it.

```
INTEGER*4 J1,J2,J3
LOGICAL*1 STRNG(8)
```

3-94 System Subroutine Description and Examples
CALL JTIME(17,0,0,0,J1)
CALL GTIM(J2)
CALL JCVT(J1)
CALL JCVT(J2)
CALL JSUB(J1,J2,J3)
CALL JCVT(J3)
CALL TIMASC(J3,STRING)
   TYPE 99,(STRING(I),I=1,8)
   99 FORMAT( ' IT IS ',8A1,' TILL 5 P.M., ')

3.109 TIME

The TIME subroutine returns the current system time of day as an eight-character ASCII string of the form:

    hh:mm:ss

where:

    hh   is the two-digit hours indication
    mm   is the two-digit minutes indication
    ss   is the two-digit seconds indication

Form:   CALL TIME (string)

where:

    string   is the eight-element array to receive the ASCII time

Notes:

A 24-hour clock is used (for example, 1:00 p.m. is represented as 13:00:00).

Errors:

    None.

Example:

    LOGICAL*1 STRING(8)
    ,
    ,
    CALL TIME(STRING)
    TYPE 99,(STRING(I),I=1,8)
   99 FORMAT( ' IT IS NOW ',8A1)

3.110 TRANSL

The TRANSL routine performs character translation on a specified string and requires approximately 64(decimal) words on the R6 stack for its execution. This space should be considered when allocating stack space.

Form:   CALL TRANSL (in,out,rl,p)
where:

in is the array containing the input string; it is terminated by a null byte

out is the array to receive the translated string; it is not terminated by a null byte

r is the array containing the replacement string; it is terminated by a null byte

p is the array containing the characters in in to be translated; it is terminated by a null byte

The string specified by array out is replaced by the string specified by array in, modified by the character translation process specified by arrays r and p. If any character position in in contains a character that appears in the string specified by p, it is replaced in out by the corresponding character from string r. If the array p is omitted, it is assumed to be the 127 seven-bit ASCII characters arranged in ascending order, beginning with the character whose ASCII code is 001. If strings r and p are given and differ in length, the longer string is truncated to the length of the shorter. If a character appears more than once in string p, only the last occurrence is significant. A character can appear any number of times in string r.

Errors:

None.

Examples:

The following example causes the string in array A to be copied to array B. All periods within A become minus signs, and all question marks become exclamation points.

CALL TRANSL(A,B, -!, ?, ?)

The following is an example of TRANSL being used to format character data.

LOGICAL*1 STRING(27),RESULT(27),PATRN(27)
C SET UP THE STRING TO BE REFORMATTED
C
C CALL SCOPY('THE HORN BLOWS AT MIDNIGHT',STRING)
C SET UP NUMBER-CHARACTER DATA RELATIONSHIP
C
C 0000000001111111111222222
C 12345678901234567880123456
C THE HORN BLOWS AT MIDNIGHT
C NOW SET UP PATRN TO CONTAIN THE FOLLOWING PATTERN:
C 16,17,18,19,20,21,22,23,24,25,26,15,1,2,3,4,5,6,7,8,9,10,11,12,13,14,0
C
C DD 10 I=16.26
C 10 PATRN(I-15)=I
C PATRN(12)=15
C DD 20 I=1,14
C 20 PATRN(I+12)=1
C PATRN(27)=0
3.111 TRIM

The TRIM routine shortens a specified character string by removing all trailing blanks. A trailing blank is a blank that has no non-blanks to its right. If the specified string contains all blank characters, it is replaced by the null string. If the specified string has no trailing blanks, it is unchanged.

Form: CALL TRIM (a)

where:

a is the array containing the string to be trimmed; it is terminated by a null byte on input and output

Errors:

None.

Example:

LOGICAL*1 STRING(B1)
ACCEPT 100,(STRING(I),I=1,B0)
100 FORMAT(B0A1)
CALL SCOPIY(STRING,STRING,B0) !MAKE ASCIZ
CALL TRIM(STRING) !TRIM TRAILING BLANKS

3.112 UNLOCK

The UNLOCK subroutine releases the User Service Routine (USR) from memory if it was placed there by the LOCK routine. If the LOCK required a swap, the UNLOCK loads the user program back into memory. If the USR does not require swapping, the UNLOCK involves no I/O. The USR is always resident in XM.

Form: CALL UNLOCK

Notes:

1. It is important that at least as many UNLOCK calls are given as LOCK calls. If more LOCK calls were done, the USR remains locked in memory. Extra UNLOCK calls are ignored.

2. When running two jobs in the FB system, use the LOCK/UNLOCK pairs only when absolutely necessary. If one job locks the USR, the other job cannot use the USR until it is unlocked.
3. In an FB system, calling the CSI (ICSI) with input coming from the console terminal performs a temporary implicit UNLOCK.

For further information on releasing the USR from memory, see the .LOCK/.UNLOCK programmed requests (Section 2.45).

Errors:

None.

Example:

```
C GET READY TO DO MANY USR OPERATIONS
CALL LOCK  !DISABLE USR SWAPPING
C PERFORM THE USR CALLS
```

```
C FREE THE USR
CALL UNLOCK
```

### 3.113 VERIFY

The VERIFY routine checks that a given string is composed entirely of characters from a second string. If a character does not exist in the string being examined, VERIFY returns the position of the first character in the string being examined that is not in the source string. If all characters exist, VERIFY returns a 0.

Form: \( \text{CALL VERIFY (a,b,i)} \)

or

\( \text{i = IVERIF (a,b)} \)

where:

- \( a \) is the array containing the string to be scanned; it is terminated by a null byte
- \( b \) is the array containing the string of characters to be accepted in \( a \); it is terminated by a null byte

Function Result:

\( i = 0 \) If all characters of \( a \) exist in \( b \); also if \( a \) is a null string.

\( = n \) Where \( n \) is the character position of the first character in array \( a \) that does not appear in array \( b \); if \( b \) is a null string and \( a \) is not, \( i \) equals 1.
Example:

The following example accepts a one- to five-digit unsigned decimal number and returns its value.

LOGICAL*1 INSTR(81)

CALL VERIFY(INSTR,'0123456789',I)
IF(I.EQ.1) STOP 'NUMBER MISSING'
IF(I.EQ.0) I=LEN(INSTR)
IF(I.GT.5) STOP 'TOO MANY DIGITS'
NUM=IVALUE(INSTR,I)

END
Appendix A
Display File Handler

This appendix describes the assembly language support provided under RT-11 for the VT11 graphic display hardware systems.

The following manuals are suggested for additional reference:

* GT40/GT42 User's Guide
  EK-GT40-OP-002

* GT44 User's Guide
  EK-GT44-OP-001

* VT11 Graphic Display Processor
  EK-VT11-TM-001

* DECGRAPHIC-11 GT Series Reference Card
  EH-02784-73

* DECGraphic-11 FORTRAN Reference Manual
  DEC-11-GFRMA-A-D

  DEC-11-LBGEA-A-D

A.1 Description

The graphics display terminals have hardware configurations that include a display processor and CRT (cathode ray tube) display. All systems are equipped with light pens and hardware character and vector generators, and are capable of high-quality graphics. The Display File Handler supports this graphics hardware at the assembly language level under the RT-11 monitor.

A.1.1 Assembly Language Display Support

The Display File Handler is not an RT-11 device handler, since it does not use the I/O structure of the RT-11 monitor. For example, it is not possible to use a utility program to transfer a text file to the display through the Display File Handler. Rather, the Display File Handler provides the graphics programmer the means for the display of graphics files and the easy management of the display processor. Included in its capabilities are such services as interrupt handling, light pen support, tracking object, and starting and stopping of the display processor.

The Display File Handler manages the display processor by means of a base segment (called VTBASE) which contains interrupt handlers, an internal display file and some pointers and flags. The display processor cycles through the internal display file; any user graphics files to be displayed are accessed
by display subroutine calls from the Handler’s display file. In this way, the Display File Handler exerts control over the display processor, relieving the assembly language user of the task.

Through the Display File Handler, the programmer can insert and remove calls to display files from the Handler’s internal display file. Up to two user files may be inserted at one time, and that number may be increased by re-assembling the Handler. Any user file inserted for display may be blanked (the subroutine call to it bypassed) and unblanked by macro calls to the Display File Handler.

Since the Handler treats all user display files as graphics subroutines to its internal display file, a display processor subroutine call is required. This is implemented with software, using the display stop instruction, and is available for user programs. This instruction and several other extended instructions implemented with the display stop instruction are described in Section A.3.

The facilities of the Display File Handler are accessed through a file of macro definitions (VTMAC) which generate calls to a set of subroutines in VTLIB. VTMAC’s call protocol is similar to that of the RT–11 macros. The expansion of the macros is shown in Section A.6. VTMAC also contains, for convenience in programming, the set of recommended display processor instruction mnemonics and their values. The mnemonics are listed in Section A.7 and are used in the examples throughout this appendix.

VTCA1 through VTCA4 are the set of subroutines which service the VTMAC calls. They include functions for display file and display processor management. These are described in detail in Section A.2. VTCA1 through VTCA4 are distributed, along with the base segment VTBASE, as a file of five object modules called VTHDLR.OBJ. VTHDLR is built into the graphics library VTLIB by using the monitor LIBRARY command. VTHDLR only supports VT11 hardware. Section A.4.2 shows an example.

A.1.2 Monitor Display Support

The RT–11 monitor, under Version 03 and later, directly supports the display as a console device. A keyboard monitor command, GT ON (GT OFF) permits the selection of the display as console device. Selection results in the allocation of approximately 1.25K words of memory for text buffer and code. The buffer holds approximately 2000 characters.

The text display includes a blinking cursor to indicate the position in the text where a character is added. The cursor initially appears at the top left corner of the text area. As lines are added to the text the cursor moves down the screen. When the maximum number of lines are on the screen, the top line is deleted from the text buffer when the line feed terminating a new line is received. This causes the appearance of “scrolling,” as the text disappears off the top of the display.

When the maximum number of characters have been inserted in the text buffer, the scroller logic deletes a line from the top of the screen to make room
for additional characters. Text may appear to move (scroll) off the top of the screen while the cursor is in the middle of a line.

The Display File Handler can operate simultaneously with the scroller program, permitting graphic displays and monitor dialogue to appear on the screen at the same time. It does this by inserting its internal display file into the display processor loop through the text buffer. However, the following should be noted. Under the SJ Monitor, if a program using the display for graphics is running with the scroller in use (that is, GT ON is in effect), and the program does a soft exit (.EXIT with R0 not equal to 0) with the display stopped, the display remains stopped until a CTRL/C is typed at the keyboard.

This can be recognized by failure of the monitor to echo on the screen when expected. If the scroller text display disappears after a program exit, always type CTRL/C to restore. If CTRL/C fails to restore the display, the running program probably has an error.

Four scroller control characters provide the user with the capability of halting the scroller, advancing the scrolling in page sections, and printing hard copy from the scroller.

NOTE

The scroller logic does not limit the length of a line, but the length of text lines affects the number of lines which may be displayed, since the text buffer is finite. As text lines become longer, the scroller logic may delete extra lines to make room for new text, temporarily decreasing the number of lines displayed.

A.2 Description of Graphics Macros

The facilities of the Display File Handler are accessed through a set of macros, contained in VTMAC, which generate assembly language calls to the Handler at assembly time. The calls take the form of subroutine calls to the subroutines in VTLIB. Arguments are passed to the subroutines through register 0 and, in the case of the .TRACK call, through both register 0 and the stack.

This call convention is similar to Version 1 RT-11 I/O macro calls, except that the subroutine call instruction is used instead of the EMT instruction. If a macro requires an argument but none is specified, it is assumed that the address of the argument has already been placed in register 0. The programmer should not assume that R0 is preserved through the call.

A.2.1 .BLANK

The .BLANK request temporarily blanks the user display file specified in the request. It does this by bypassing the call to the user display file, which prevents the display processor from cycling through the user file, effectively
blanking it. This effect can later be canceled by the .RESTR request, which restores the user file. When the call returns, the user is assured the display processor is not in the file that was blanked.

Macro Call: .BLANK faddr

where:

faddr is the address of the user display file to be blanked

Errors:

No error is returned. If the file specified was not found in the Handler file or has already been blanked, the request is ignored.

A.2.2 .CLEAR

The .CLEAR request initializes the Display File Handler, clearing out any calls to user display files and resetting all of the internal flags and pointers.

After initialization with .LNKRT (Section A.2.4), the .CLEAR request can be used any time in a program to clear the display and to reset pointers. All calls to user files are deleted and all pointers to status buffers are reset. They must be re-inserted if they are to be used again.

Macro Call: .CLEAR

Errors:

None.

Example:

This example uses a .CLEAR request to initialize the Handler then later uses the .CLEAR to re-initialize the display. The first .CLEAR is used for the case when a program may be restarted after a CTRL C or other exit.

BR RSTRT

EX1:

RSTRT:

BIS $20000, R$44

SET REENTER BIT IN JSW

CLES RT LINK FLAG FOR RESTART

SET UP VECTORS, START DISPLAY

INITIALIZE HANDLER

INSRT $FILE1

DISPLAY A PICTURE

TTYIN

WAIT FOR A KEY STRIKE

CMPB $12, R0

LINE FEED?

NE 1$

NO, LOOP

CLEAR

YES, CLEAR DISPLAY

INSRT $FILE2

DISPLAY NEW PICTURE

FILE1:

POINT

AT POINT (0,500)

0

500

LONGV

DRAW A LINE

500!INTX

TO (500,500)

0

DRET

0

A-4 Display File Handler
FILE2:  
POINT  
500  
0  
LONGV  
DRAW A LINE  
0!INTX  
TO (500*500)  
500  
DRET  
0  
END EX1

A.2.3 .INSRT

The .INSRT request inserts a call to the user display file specified in the request into the Display File Handler's internal display file. .INSRT causes the display processor to cycle through the user file as a subroutine to the internal file. The handler permits two user files at one time. The call inserted in the handler looks like the following:

DJSR  
DISPLAY SUBROUTINE  
+4  
RETURN ADDRESS  
faddr  
SUBROUTINE ADDRESS

The call to the user file is removed by replacing its address with the address of a null display file. The user file is blanked by replacing the DJSR with a DJMP instruction, bypassing the user file.

Macro Call: .INSRT faddr

where:

faddr  is the address of the user display file to be inserted

Errors:

The .INSRT request returns with the C bit set if there was an error in processing the request. An error occurs only when the Handler's display file is full and cannot accept another file. If the user file specified exists, the request is not processed. Two display files with the same starting address cannot be inserted.

Example:

See the examples in Sections A.2.2 and A.2.4.

A.2.4 .LNKRT

The .LNKRT request sets up the display interrupt vectors and possibly links the Display File Handler to the scroll text buffer in the RT-11 monitor. It must be the first call to the Handler, and is used whether or not the RT-11 monitor is using the display for console output (that is, the KMON command GT ON has been entered).

The .LNKRT request used with Version 03 and later RT-11 monitors enables a display application program to determine the environment in which it is operating. Error codes are provided for the situations where there is no display
hardware present on the system or the display hardware is already being used by another task (for example, a foreground job in the foreground/background version).

The existence of the monitor scroller and the size of the Handler’s subpicture stack are also returned to the caller. If a previous call to .LNKRT was made without a subsequent .UNLNK, the .LNKRT call is ignored and an error code is returned.

Macro Call: .LNKRT

Errors:

Error codes are returned in R0, with the N condition bit set.

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>No VT11 display hardware is present on this system.</td>
</tr>
<tr>
<td>-2</td>
<td>VT11 hardware is presently in use.</td>
</tr>
<tr>
<td>-3</td>
<td>Handler has already been linked.</td>
</tr>
</tbody>
</table>

On completion of a successful .LNKRT request, R0 will contain the display subroutine stack size, indicating the depth to which display subroutines may be nested. The N bit will be zero.

If the RT–11 monitor scroll text buffer was not in memory at the time of the .LNKRT, the C bit will be returned set. The KMON commands GT ON and GT OFF cannot be issued while a task is using the display.

Example:

```asm
START:  .LNKRT
        .BMI  ERROR    #LINK TO MONITOR
        .BCS  CONT     #ERROR DOING LINK
        .SCROL $SBUF   #NO SCROLL IF C SET
        .INSRT $FILE1  #ADJUST SCROLL PARAMETERS
        .DISPLAY A PICTURE
        .TTYIN $12,R0  #WAIT FOR KEY STRIKE
        CMPB 1$       #LINE FEED?
        BNE  #NO, LOOP
        .UNLNK .EXIT  #YES, UNLINK AND EXIT

SBUF:  .BYTE 5       #LINE COUNT OF 5
        .BYTE 7       #INTENSITY 7 (SCALE OF 1-8)
        .WORD 1000    #POSITION OF TOP LINE

FILE1: .POINT 500
        500
        .CHAR ASCII /FILE1 THIS IS FILE1. TYPE CR TO EXIT/ .EVEN .DRET 0

ERROR: Error routine
```

A–6 Display File Handler
A.2.5 .LPEN

The .LPEN request transfers the address of a light pen status data buffer to VTBASE. Once the buffer pointer has been passed to the Handler, the light pen interrupt handler in VTBASE will transfer display processor status data to the buffer, depending on the state of the buffer flag.

The buffer must have seven contiguous words of storage. The first word is the buffer flag, and it is initially cleared (set to zero) by the .LPEN request. When a light pen interrupt occurs, the interrupt handler transfers status data to the buffer and then sets the buffer flag non-zero. The program can loop on the buffer flag when waiting for a light pen hit (although doing this will tie up the processor; in a foreground/background environment, timed waits would be more desirable). No further data transfers take place, despite the occurrence of numerous light pen interrupts, until the buffer flag is again cleared to zero. This permits the program to process the data before it is destroyed by another interrupt.

The buffer structure looks like this:

| Buffer Flag |
| Name |
| Subpicture Tag |
| Display Program Counter (DPC) |
| Display Status Register (DSR) |
| X Status Register (XSR) |
| Y Status Register (YSR) |

The Name value is the contents of the software Name Register (described in A.3.5) at the time of interrupt. The Tag value is the tag of the subpicture being displayed at the time of interrupt. The last four data items are the contents of the display processor status registers at the time of interrupt. They are described in detail in Table A-1.

Macro Call: .LPEN baddr

where:

baddr is the address of the 7-word light pen status data buffer

Errors:

None.

If a .LPEN was already issued and a buffer specified, the new buffer address replaces the previous buffer address. Only one light pen buffer can be in use at a time.

Example:

```
.LPEN          #LFILE           #DISPLAY LFILE
.INCRT         #LBUF           #SET UP LPEN BUFFER
LOOP:           TST              #TEST LBUF FLAG, WHICH
                BEQ              #WILL BE SET NON-ZERO
                           #ON LIGHT PEN HIT.
                           #PROCESS DATA IN LBUF HERE.
```

Display File Handler   A–7
Table A-1: Description of Display Status Words

<table>
<thead>
<tr>
<th>Bits</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Program Counter (DPC=172000)</td>
<td></td>
</tr>
<tr>
<td>0-15</td>
<td>Address of display processor program counter at time of interrupt.</td>
</tr>
<tr>
<td>Display Status Register (DSR=172002)</td>
<td></td>
</tr>
<tr>
<td>0-1</td>
<td>Line Type</td>
</tr>
<tr>
<td>2</td>
<td>Spare</td>
</tr>
<tr>
<td>3</td>
<td>Blink</td>
</tr>
<tr>
<td>4</td>
<td>Italics</td>
</tr>
<tr>
<td>5</td>
<td>Edge Indicator</td>
</tr>
<tr>
<td>6</td>
<td>Shift Out</td>
</tr>
<tr>
<td>7</td>
<td>Light Pen Flag</td>
</tr>
<tr>
<td>8-10</td>
<td>Intensity</td>
</tr>
<tr>
<td>11-14</td>
<td>Mode</td>
</tr>
<tr>
<td>15</td>
<td>Stop Flag</td>
</tr>
<tr>
<td>X Status Register (XSR=172004)</td>
<td></td>
</tr>
<tr>
<td>0-9</td>
<td>X Position</td>
</tr>
<tr>
<td>10-15</td>
<td>Graphplot Increment</td>
</tr>
<tr>
<td>Y Status Register (YSR=172006)</td>
<td></td>
</tr>
<tr>
<td>0-9</td>
<td>Y Position</td>
</tr>
<tr>
<td>10-15</td>
<td>Character Register</td>
</tr>
</tbody>
</table>

A.2.6 .NAME

The .NAME request has been added to the Version 03 and later Display File Handler. The contents of the name register are now stacked when a subpicture call is made. When a light pen interrupt occurs, the contents of the name register stack may be recovered if the user program has supplied the address of a buffer through the .NAME request.

The buffer must have a size equal to the stack depth (default is 10) plus one word for the flag. When the .NAME request is entered, the address of the buffer is passed to the Handler and the first word (the flag word) is cleared. When a light pen hit occurs, the stack’s contents are transferred and the flag is set non-zero.

Macro Call: .NAME baddr

where:

baddr is the address of the name register buffer
Errors:

None.

If a .NAME request has been previously issued, the new buffer address replaces the previous buffer address.

A.2.7 .REMOV

The .REMOV request removes the call to a user display file previously inserted in the handler's display file by the .INSRT request. All reference to the user file is removed, unlike the .BLANK request, which merely bypasses the call while leaving it intact.

Macro Call: .REMOV faddr

where:

faddr  is the address of the display file to be removed

Errors:

No errors are returned. If the file address given cannot be found, the request is ignored.

A.2.8 .RESTR

The .RESTR request restores a user display file that was previously blanked by a .BLANK request. It removes the by-pass of the call to the user file, so that the display processor once again cycles through the user file.

Macro Call: .RESTR faddr

where:

faddr  is the address of the user file that is to be restored to view

Errors:

No errors are returned. If the file specified cannot be found, the request is ignored.

A.2.9 .SCROL

This request is used to modify the appearance of the Display Monitor's text display. The .SCROL request permits the programmer to change the maximum line count, intensity and the position of the top line of text of the scroller. The request passes the address of a two-word buffer which contains the parameter specifications. The first byte is the line count, the second byte is the intensity, and the second word is the Y position. Line count, intensity and Y position must all be octal numbers. The intensity may be any number from 0 to 7, ranging from dimmest to brightest. (If an intensity of 0 is specified, the scroller text will be almost unnoticeable at a BRIGHTNESS knob setting less than one-half.) The scroller parameter change is temporary, since an .UNLNK or CTRL/C restores the previous values.
Macro Call: .SCROL baddr

where:

baddr is the address of the two-word scroll parameters buffer

Errors:

No errors are returned. No checking is done on the values of the parameters. A zero argument is interpreted to mean that the parameter value is not to be changed. A negative argument causes the default parameter value to be restored.

Example:

```
.SCROL
*SCBUF
;ADJUST SCROLL PARAMETERS

SCBUF: .BYTE 5
;DECREASE #LINES TO 5.
;BYTE 0
;LEAVE INTENSITY UNCHANGED.
;WORD 300
;TOP LINE AT Y=300.
```

A.2.10 .START

The .START request starts the display processor if it was stopped by a .STOP directive. If the display processor is running, it is stopped first, then restarted. In either case, the subpicture stack is cleared and the display processor is started at the top of the handler's internal display file.

Macro Call: .START

Errors:

None.

A.2.11 .STAT

The .STAT request transfers the address of a seven-word status buffer to the display stop interrupt routine in VTBASE. Once the transfer has been made, display processor status data is transferred to the buffer by the display stop interrupt routine in VTBASE whenever a .DSTAT or .DHALT instruction is encountered (see Sections A.3.3 and A.3.4). The transfer is made only when the buffer flag is clear (zero). After the transfer is made, the buffer flag is set non-zero and the .DSTAT or .DHALT instruction is replaced by a .DNOP (Display NOP) instruction.

The status buffer must be a seven-word, contiguous block of memory. Its contents are the same as the light pen status buffer. For a detailed description of the buffer and an explanation of the status words, see Section A.2.5 and Table A-1.

Macro Call: .STAT baddr

where:

baddr is the address of the status buffer receiving the data
Errors:

No errors are indicated. If a buffer was previously set up, the new buffer address is replaced as the old buffer address.

A.2.12 .STOP

The .STOP request "stops" the display processor. It actually effects a stop by preventing the DPU from cycling through any user display files. It is useful for stopping the display during modification of a display file, a risky task when the display processor is running. However, a .BLANK could be equally useful for this purpose, since the .BLANK request does not return until the display processor has been removed from the user display file being blanked.

Macro Call: .STOP

Errors:

None.

NOTE

Since the display processor must cycle through the text buffer in the Display Monitor in order for console output to be processed, the text buffer remains visible after a .STOP request is processed, but all user files disappear.

A.2.13 .SYNC/.NOSYN

The .SYNC and .NOSYN requests provide program access to the power line synchronization feature of the display processor. The .SYNC request enables synchronization and the .NOSYN request disables it (the default case).

Synchronization is achieved by stopping the display and restarting it when the power line frequency reaches a trigger point, e.g., a peak or zero-crossing. Synchronization has the effect of fixing the display refresh time. This may be useful in some cases where small amounts of material are displayed but the amount frequently changes, causing changes in intensity. In most cases, however, using synchronization increases flicker.

Macro Calls:  .SYNC  
.NOSYN

Errors:

None.

A.2.14 .TRACK

The .TRACK request causes the tracking object to appear on the display CRT at the position specified in the request. The tracking object is a diamond-shaped display figure which is light-pen sensitive. If the light pen is placed over the tracking object and then moved, the tracking object follows the light pen, trying to center itself on the pen.
The tracking object first appears at a position specified in a two-word buffer whose address was supplied with the .TRACK request. As the tracking object moves to keep centered on the light pen, the new center position is returned to the buffer. A new set of X and Y values is returned for each light pen interrupt.

The tracking object cannot be lost by moving it off the visible portion of the display CRT. When the edge flag is set, indicating a side of the tracking object is crossing the edge of the display area, the tracking object stops until moved toward the center. To remove the tracking object from the screen, repeat the .TRACK request without arguments.

The .TRACK request may also include the address of a completion routine as the second argument. If a .TRACK completion routine is specified, the light pen interrupt handler passes control to the completion routine at interrupt level. The completion routine is called as a subroutine and the exit statement must be an RTS PC. The completion routine must also preserve any registers it may use.

Macro Call: .TRACK baddr, croutine

where:

baddr is the address of the two-word buffer containing the X and Y position for the track object
croutine is the address of the completion routine

Errors:
None.

Example:
See Section A.10.

A.2.15 .UNLNK

The .UNLNK request is used before exiting from a program. In the case where the scroller is present, .UNLNK breaks the link, established by .LNKRT, between the Display File Handler’s internal display file and the scroll file in the Display Monitor. The display processor is started cycling in the scroll text buffer, and no further graphics may be done until the link is established again. In the case where no scroller exists, the display processor is simply left stopped.

Macro Call: .UNLNK

Errors:
No errors are returned. An internal link flag is checked to determine if the link exists. If it does not exist, the request is ignored.
A.3 Extended Display Instructions

The Display File Handler offers the assembly language graphics programmer an extended display processor instruction set, implemented in software through the use of the Load Status Register A (LSRA) instruction. The extended instruction set includes: subroutine call, subroutine return, display status return, display halt, and load name register.

A.3.1 DJSR Subroutine Call Instruction

The DJSR instruction (octal code is 173400) simulates a display subroutine call instruction by using the display stop instruction (LSRA instruction with interrupt bits set). The display stop interrupt handler interprets the non-zero word following the DJSR as the subroutine return address, and the second word following the DJSR as the address of the subroutine to be called. The instruction sequence is:

\[
\begin{align*}
&\text{DJSR} \\
&\text{Return address} \\
&\text{Subroutine address}
\end{align*}
\]

Example:

To call a subroutine SQUARE:

\[
\begin{align*}
&\text{POINT} \\
&100 \\
&100 \\
&\text{DJSR} \\
&+4 \\
&\text{SQUARE} \\
&DRET \\
0
\end{align*}
\]

The use of the return address preceding the subroutine address offers several advantages. For example, the BASIC-11 graphics software uses the return address to branch around subpicture tag data stored following the subpicture address. This structure is described in Section A.5.3. In addition, a subroutine may be temporarily bypassed by replacing the DJSR code with a DJMP instruction, without the need to stop the display processor to make the by-pass.

The address of the return address is stacked by the display stop interrupt handler on an internal subpicture stack. The stack depth is conditionalized and has a default depth of 10. If the stack bottom is reached, the display stop interrupt handler attempts to protect the system by rejecting additional subroutine calls. In that case, the portions of the display exceeding the legal stack depth will not be displayed.

A.3.2 DRET Subroutine Return Instruction

The DRET instruction provides the means for returning from a display file subroutine. It uses the same octal code as DJSR, but with a single argument of zero. The DRET instruction causes the display stop interrupt handler to pop its subpicture stack and fetch the subroutine return address.
Example:

```
SQUARE:
100!INTX        #DRAW A SQUARE
0
0!INTX
100
100!INTX!MINUSX
0
0!INTX
100!MINUSX
DRET       #RETURN FROM SUBPICTURE
0
```

A.3.3 DSTAT Display Status Instruction

The DSTAT instruction (octal code is 173420) uses the LSRA instruction to produce a display stop interrupt, causing the display stop interrupt handler to return display status data to a seven-word user status buffer. The status buffer must first have been set up with a .STAT macro call (if not, the DSTAT is ignored and the display is resumed). The first word of the buffer is set non-zero to indicate the transfer has taken place, and the DSTAT is replaced with a DNOP (display NOP). The first word is the buffer flag and the next six words contain name register contents, current subpicture tag, display program counter, display status register, display X register, and display Y register. After transfer of status data, the display is resumed.

A.3.4 DHALT Display Halt Instruction

The DHALT instruction (octal code is 173500) operates similarly to the DSTAT instruction. The difference between the two instructions is that the DHALT instruction leaves the display processor stopped when exiting from the interrupt. A status data transfer takes place provided the buffer was initialized with a .STAT call. If not, the DHALT is ignored.

Example:

```
.STAT MOU
.OUT
.INSTR TST
.BEO

$BUF:
.BLKW 7

$FILE:
.POINT
.WORD
.LONGV
.WORD

.STPLOC:
.DNOP
.DRET
```

A.3.5 DNAME Load Name Register Instruction

The Display File Handler provides a name register capability through the use of the display stop interrupt. When a DNAME instruction (octal code is 173520) is encountered, a display stop interrupt is generated. The display stop handler stores the argument following the DNAME instruction in an internal
software register called the "name register." The current name register contents are returned whenever a DSTAT or DHALT is encountered, and more importantly, whenever a light pen interrupt occurs. The use of a "name" (with a valid range from 1 to 77777) enables the programmer to label each element of the display file with a unique name, permitting the easy identification of the particular display element selected by the light pen.

The name register contents are stacked on a subpicture call and restored on return from the subpicture.

Example:

The SQUARE subroutine with "named" sides.

<table>
<thead>
<tr>
<th>SQUARE:</th>
<th>DNAME</th>
<th>$NAME IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>LONGV</td>
<td>$10 DRAW A SIDE</td>
</tr>
<tr>
<td>100 !INTX</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>DNAME</td>
<td>$THIS SIDE IS NAMED</td>
</tr>
<tr>
<td>0 !INTX</td>
<td>100</td>
<td>$11 STILL IS LONG VECTOR MODE</td>
</tr>
<tr>
<td>12</td>
<td>DNAMExMINUSX</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>DNAME</td>
<td></td>
</tr>
<tr>
<td>0 !INTX</td>
<td>100 !MINUSX</td>
<td>DRET</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$RETURN FROM SUB PICTURE</td>
</tr>
</tbody>
</table>

### A.4 Using the Display File Handler

Graphics programs which intend to use the Display File Handler for display processor management can be written in MACRO assembly language. The display code portions of the program may use the mnemonics described in Section A.7. Calls to the Handler should have the format described in Section A.6.

The Display File Handler is supplied in two pieces, a file of MACRO definitions and a library containing the Display File Handler modules.

**MACRO Definition File:** VTMAC.MAC

**Display File Handler:** VTLIB.OBJ (consisting of:)

- VTBASE.OBJ
- VTCAL1.OBJ
- VTCAL2.OBJ
- VTCAL3.OBJ
- VTCAL4.OBJ
A.4.1 Assembling Graphics Programs

To assemble a graphics program using the display processor mnemonics or the Display Handler macro calls, the file VTMAC.MAC must be assembled with the program, and must precede the program in the assembler command string.

Example:

Assume PICTUR.MAC is a user graphics program to be assembled. An assembler command string would look like this:

```
MACRO VTMAC+PICTUR/OBJECT
```

A.4.2 Linking Graphics Programs

Once assembled with VTMAC, the graphics program must be linked with the Display File Handler, which is supplied as a single concatenated object module, VTHDLR.OBJ. The Handler may optionally be built as a library, following the directions in A.8.5. The advantage of using the library when linking is that the Linker will select from the library only those modules actually used. Linking with VTHDLR.OBJ results in all modules being included in the link.

To link a user program called PICTUR.OBJ using the concatenated object module supplied with RT-11:

```
LINK PICTUR+VTHDLR
```

To link a program called PICTUR.OBJ using the VTLIB library built by following the directions in A.8.5, be sure to use the Version 03 Linker:

```
LINK PICTUR+VTLIB
```

VTLIB (Handler Modules):

<table>
<thead>
<tr>
<th>Module</th>
<th>CSECT</th>
<th>Contains</th>
<th>Globals</th>
</tr>
</thead>
<tbody>
<tr>
<td>VTCAL1</td>
<td>$GT1</td>
<td>.CLEAR .START</td>
<td>$VINIT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$.VSTOP .INSRT</td>
<td>$VSTRT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.REMOV</td>
<td></td>
</tr>
<tr>
<td>VTCAL2</td>
<td>$GT2</td>
<td>.BLANK .RESTR</td>
<td>$VNSRT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$VRMOV</td>
</tr>
<tr>
<td>VTCAL3</td>
<td>$GT3</td>
<td>.LPEN NAME .STAT</td>
<td>$VBLNK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.SYNC .NOSYN .TRACK</td>
<td>$VRSTR</td>
</tr>
<tr>
<td>VTCAL4</td>
<td>$GT4</td>
<td>.LNKRT .UNLNK .SCROL</td>
<td>$VLPIEN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$NAME</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$VSTPM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$SYNC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$NOSYN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$VTRAK</td>
</tr>
<tr>
<td>VBASE</td>
<td>$GTB</td>
<td>Interrupt handlers</td>
<td>$VRLK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and internal</td>
<td>$UNLK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>display file</td>
<td>$SCRL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$DFILE</td>
</tr>
</tbody>
</table>
The file modules in VTHDLR can be used in three different ways. When space is not critical, the most straightforward way is to link VTHDLR directly with a display program. The following command is an example.

```
LINK PICTUR+VTHDLR
```

It is often necessary to conserve space, however, and selective loading of modules is possible by first creating an indexed object module library from VTHDLR and then by making global calls within the display program. The following command creates an indexed object module library.

```
LIBRARY/CREATE VTLIB VTHDLR
```

To further conserve space with overlays, it is also possible to extract individual object modules from a library and create separate object module files. For example, to link a display program using overlays, the following statements are a typical sequence of creating, extracting and linking commands. (NOTE: the modules VTCAL1 and VTCAL2 must be in the same overlay if any global in either one is used.)

```

LIBRARY/CREATE VTLIB VTHDLR

LIBRARY/EXTRACT VTLIB VTCAL1
GLOBAL? $VSTRT !moves entire module with $VSTRT to VTCAL1
GLOBAL? !Terminates prompting sequence
LIBRARY/EXTRACT VTLIB VTCAL2
GLOBAL? $VBLNK !Moves the entire module to VTCAL2
GLOBAL?
LIBRARY/EXTRACT VTLIB VTCAL3
GLOBAL? $VLPEN !Moves the entire module
GLOBAL?
LIBRARY/EXTRACT VTLIB VTCAL4
GLOBAL? $URTBL !Moves the entire module
GLOBAL?
LIBRARY/EXTRACT VTLIB VBASE
GLOBAL? $DFILE !Moves the entire module
GLOBAL?

LINK/PROMPT PICTUR+VBASE
#VTCAL1,VTCAL2,VTCAL3/0:1
#VTCAL4/0:1
```


A.5 Display File Structure

The Display File Handler supports a variety of display file structures, takes over the job of display processor management for the programmer, and may be used for both assembly language graphics programming and for systems program development. For example, the Handler supports the tagged subpicture file structure used by the BASIC-11 graphics software, as well as simple file structures. These are discussed in this section.
A.5.1 Subroutine Calls

A subroutine call instruction, with the mnemonic DJSR, is implemented using the display stop (DSTOP) instruction with an interrupt. The display stop interrupt routine in the Display File Handler simulates the DJSR instruction, and this allows great flexibility in choosing the characteristics of the DJSR instruction.

The DJSR instruction stops the display processor and requests an interrupt. The DJSR instruction may be followed by two or more words, and in this implementation the exact number may be varied by the programmer at any time. The basic subroutine call has this form:

```
DJSR
Return Address
Subroutine Address
```

In practice, simple calls to subroutines could look like:

```
DJSR
.WORD +4
.WORD SUB
```

where SUB is the address of the subroutine. Control will return to the display instruction following the last word of the subroutine call. This structure permits a call to the subroutine to be easily by-passed without stopping the display processor, by replacing the DJSR with a display jump (DJMP) instruction:

```
DJMP
.WORD +4
.WORD SUB
```

A more complex display file structure is possible if the return address is generalized:

```
.DJSR
.WORD NEXT
.WORD SUB
```

where NEXT is the generalized return address. This is equivalent to the sequence:

```
DJSR
.WORD +4
.WORD SUB
DJMP
.WORD NEXT
```

It is also possible to store non-graphic data such as tags and pointers in the subroutine call sequence, such as is done in the tagged subpicture display file structure of the BASIC-11 graphics software. This technique looks like:

```
DJSR
.WORD NEXT
.WORD SUB
DATA NEXT:
.
.
```

For simple applications where the flexibility of the DJSR instruction described above is not needed and the resultant overhead is not desired, the
Display File Handler (VTBASE.MAC and VTCALL.MAC) can be conditionally re-assembled to produce a simple DJSR call. If NOTAG is defined during the assembly, the Handler will be configured to support this simple DJSR call:

```
DJSR
  .WORD SUB
```

where SUB is the address of the subroutine. Defining NOTAG will eliminate the subpicture tag capability, and with it the tracking object, which uses the tag feature to identify itself to the light pen interrupt handler.

Whatever the DJSR format used, all subroutines and the user main file must be terminated with a subroutine return instruction. This is implemented as a display stop instruction (given the mnemonic DRET) with an argument of zero. A subroutine then has the form:

```
SUB: Display Code
  DRET
  .WORD 0
```

### A.5.2 Main File/Subroutine Structure

A common method of structuring display files is to have a main file which calls a series of display subroutines. Each subroutine will produce a picture element and may be called many times to build up a picture, producing economy of code. If the following macros are defined:

```
.MACRO CALL <ARG>
DJSR
  .WORD .+4
  .WORD ARG
  .ENDM
.MACRO RETURN
DRET
  .WORD 0
  .ENDM
```

then a main file/subroutine file structure would look like:

```Assembly
; MAIN DISPLAY FILE
; MAIN: Display Code ;CALL SUBROUTINE 1
  CALL SUB1 ;CALL SUBROUTINE 2
  CALL SUB2 ;ETC
  RETURN
; DISPLAY SUBROUTINES
; SUB1: Display Code ;SUBROUTINE 1
  RETURN
; SUB2: Display Code ;SUBROUTINE 2
  RETURN ;ETC.
```

Display File Handler  A–19
A.5.3 BASIC-11 Graphic Software Subroutine Structure

An example of another method of structuring display files is the tagged subpicture structure used by BASIC-11 graphic software. The display file is divided into distinguishable elements called subpictures, each of which has its own unique tag.

The subpicture is constructed as a subroutine call followed by the subroutine. It is essentially a merger of the main file/subroutine structure into an in-line sequence of calls and subroutines. As such, it facilitates the construction of display files in real time, one of the important advantages of BASIC-11 graphic software.

The following is an example of the subpicture structure. Each subpicture has a call to a subroutine with the return address set to be the address of the next subpicture. The subroutine called may either immediately follow the call, or may be a subroutine defined as part of a subpicture created earlier in the display file. This permits a subroutine to be used by several subpictures without duplication of code. Each subpicture has a tag to identify it, and it is this tag which is returned by the light pen interrupt routine. To facilitate finding subpictures in the display file, they are made into a linked list by inserting a forward pointer to the next tag.

```
SUB1:    DJSR      #START OF SUBPICTURE 1
         .WORD  SUB2   #NEXT SUBPICTURE
         .WORD  SUB1+12 #JUMP TO THIS SUBPICTURE
         .WORD  1     #TAG = 1
         .WORD  SUB2+6 #POINTER TO NEXT TAG

#BODY OF SUBPICTURE 1

DRET     #RETURN FROM
0        #SUBPICTURE 1

SUB2:    DJSR      #START SUBPICTURE 2
         .WORD  SUB3   #NEXT SUBPICTURE
         .WORD  SUB2+12 #JUMP TO THIS SUBPICTURE
         .WORD  2     #TAG 2
         .WORD  SUB3+6 #PTR TO NEXT TAG

#BODY OF SUBPICTURE 2

DRET     #RETURN FROM
0        #SUBPICTURE 2

SUB3:    DJSR      #START SUBPICTURE 3
         .WORD  SUB4   #NEXT SUBPICTURE
         .WORD  SUB1+12 #COPY SUBPICTURE 1
         .WORD  3     #FOR THIS SUBPICTURE
         .WORD  SUB4+6 #BUT TAG IT 3.

SUB4:    DJSR      #START SUBPICTURE 4
         .WORD
         .WORD

#ETC.
```

A-20 Display File Handler
### A.6 Summary of Graphics MACRO Calls

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Function</th>
<th>MACRO Call (see Note 1)</th>
<th>Assembly Language Expansion (see Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.BLANK</td>
<td>Temporarily blanks a user display file.</td>
<td>.BLANK faddr</td>
<td>.GLOBL $VBLNK .IF NB, faddr MOV faddr, ´100 .ENDC JSR ´07, $VBLNK</td>
</tr>
<tr>
<td>.CLEAR</td>
<td>Initializes handler.</td>
<td>.CLEAR</td>
<td>.GLOBL $VINIT JSR ´07, $VINIT</td>
</tr>
<tr>
<td>.INSRT</td>
<td>Inserts a call to user display file in handler’s master display file.</td>
<td>.INSRT faddr</td>
<td>.GLOBL $VNSRT .IF NB, faddr MOV faddr, ´00 .ENDC JSR ´07, $VNSRT</td>
</tr>
<tr>
<td>.LNKRT</td>
<td>Sets up vectors and links display file handler to RT-11 scroller.</td>
<td>.LNKRT</td>
<td>.GLOBL $VRTLK JSR ´07, $VRTLK</td>
</tr>
<tr>
<td>.LPEN</td>
<td>Sets up light pen status buffer.</td>
<td>.LPEN baddr</td>
<td>.GLOBL $VL PEN .IF NB, baddr MOV baddr, ´00 .ENDC JSR ´07, $ VL PEN</td>
</tr>
<tr>
<td>.NAME</td>
<td>Sets up buffer to receive name register stack contents.</td>
<td>.NAME \ baddr</td>
<td>.GLOBL $NAME .IF NB, baddr MOV .BEDDR, ´00 .ENDC JSR ´07, $NAME</td>
</tr>
<tr>
<td>.NOSYN</td>
<td>Disables power line synchronization.</td>
<td>.NOSYN</td>
<td>.GLOBL $NOSYN JSR ´07, $NOSYN</td>
</tr>
<tr>
<td>.REMOV</td>
<td>Removes the call to a user display file.</td>
<td>.REMOV faddr</td>
<td>.GLOBL $VRMOV .IF NB, faddr MOV faddr, ´00 .ENDC JSR ´07, $VRMOV</td>
</tr>
<tr>
<td>.RESTR</td>
<td>Unblanks the user display file.</td>
<td>.RESTR faddr</td>
<td>.GLOBL $VRSTR IF NB, faddr MOV faddr, ´00 ENDC JSR ´07, $VRSTR</td>
</tr>
<tr>
<td>.SCROL</td>
<td>Adjusts monitor scroller parameters.</td>
<td>.SCROL baddr</td>
<td>.GLOBL $VSCRL .IF NB, baddr MOV baddr, ´00 .ENDC JSR ´07, $VSCRL</td>
</tr>
<tr>
<td>Mnemonic</td>
<td>Function</td>
<td>MACRO Call (see Note 1)</td>
<td>Assembly Language Expansion (see Note 2)</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>------------------------</td>
<td>----------------------------------------</td>
</tr>
</tbody>
</table>
| .START   | Starts the display. | .START | .GLOBL $VSTRT  
JSR '07, $VSTRT |
| .STAT    | Sets up status buffer. | .STAT baddr | .GLOBL $VSTPM  
.IF NB, baddr  
MOV baddr, '00  
.ENDC  
JSR '07, $VSTPM |
| .STOP    | Stops the display. | .STOP | .GLOBL $VSTOP  
JSR '07, $VSTOP |
| .SYNC    | Enables power line synchronization. | .SYNC | .GLOBL $SYNC  
JSR '07, $SYNC |
| .TRACK   | Enables the track object. | .TRACK baddr, croutine | .GLOBL $VTRAK  
.IF NB, baddr  
MOV baddr, '00  
.ENDC  
.IF NB, croutine  
MOV croutine, ('06)  
.IFF  
CLR=('06)  
.ENDC  
.NARG T  
.IF EQ, T  
CLR '00  
.ENDC  
JSR '07, $VTRAK |
| .UNLNK   | Unlinks display handler from RT-11  
if linked (otherwise leaves display stopped). | .UNLNK | .GLOBL $VUNLNK  
JSR '07, $VUNLNK |

**NOTE 1**

baddr Address of data buffer.  
faddr Address of start of user display file.  
croutine Address of .TRACK completion routine.

**NOTE 2**

The lines preceded by a dot will not be assembled. The code they enclose may or may not be assembled depending on the conditionals.
### A.7 Display Processor Mnemonics

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Value</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAR</td>
<td>100000</td>
<td>Character Mode</td>
</tr>
<tr>
<td>SHORTV</td>
<td>104000</td>
<td>Short Vector Mode</td>
</tr>
<tr>
<td>LONGV</td>
<td>110000</td>
<td>Long Vector Mode</td>
</tr>
<tr>
<td>POINT</td>
<td>114000</td>
<td>Point Mode</td>
</tr>
<tr>
<td>GRAPHX</td>
<td>120000</td>
<td>Graphplot X Mode</td>
</tr>
<tr>
<td>GRAPHY</td>
<td>124000</td>
<td>Graphplot Y Mode</td>
</tr>
<tr>
<td>RELATV</td>
<td>130000</td>
<td>Relative Point Mode</td>
</tr>
<tr>
<td>INT0</td>
<td>2000</td>
<td>Intensity 0 (Dim)</td>
</tr>
<tr>
<td>INT1</td>
<td>2200</td>
<td>Intensity 1</td>
</tr>
<tr>
<td>INT2</td>
<td>2400</td>
<td>Intensity 2</td>
</tr>
<tr>
<td>INT3</td>
<td>2600</td>
<td>Intensity 3</td>
</tr>
<tr>
<td>INT4</td>
<td>3000</td>
<td>Intensity 4</td>
</tr>
<tr>
<td>INT5</td>
<td>3200</td>
<td>Intensity 5</td>
</tr>
<tr>
<td>INT6</td>
<td>3400</td>
<td>Intensity 6</td>
</tr>
<tr>
<td>INT7</td>
<td>3600</td>
<td>Intensity 7 (Bright)</td>
</tr>
<tr>
<td>LPOFF</td>
<td>100</td>
<td>Light Pen Off</td>
</tr>
<tr>
<td>LPON</td>
<td>140</td>
<td>Light Pen On</td>
</tr>
<tr>
<td>BLKOFF</td>
<td>20</td>
<td>Blink Off</td>
</tr>
<tr>
<td>BLKON</td>
<td>30</td>
<td>Blink On</td>
</tr>
<tr>
<td>LINE0</td>
<td>4</td>
<td>Solid Line</td>
</tr>
<tr>
<td>LINE1</td>
<td>5</td>
<td>Long Dash</td>
</tr>
<tr>
<td>LINE2</td>
<td>6</td>
<td>Short Dash</td>
</tr>
<tr>
<td>LINE3</td>
<td>7</td>
<td>Dot Dash</td>
</tr>
<tr>
<td>DJMP</td>
<td>160000</td>
<td>Display Jump</td>
</tr>
<tr>
<td>DNOP</td>
<td>164000</td>
<td>Display No Operation</td>
</tr>
<tr>
<td>STATSA</td>
<td>170000</td>
<td>Load Status A Instruction</td>
</tr>
<tr>
<td>LPLITE</td>
<td>200</td>
<td>Light Pen Hit On</td>
</tr>
<tr>
<td>LPDARK</td>
<td>300</td>
<td>Light Pen Hit Off</td>
</tr>
<tr>
<td>ITAL0</td>
<td>40</td>
<td>Italics Off</td>
</tr>
<tr>
<td>ITAL1</td>
<td>60</td>
<td>Italics On</td>
</tr>
<tr>
<td>SYNC</td>
<td>4</td>
<td>Halt and Resume Synchronized</td>
</tr>
<tr>
<td>STATSB</td>
<td>174000</td>
<td>Load Status B Instruction</td>
</tr>
<tr>
<td>INCR</td>
<td>100</td>
<td>Graphplot Increment</td>
</tr>
</tbody>
</table>

**Vector/Point Mode**

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Value</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTX</td>
<td>40000</td>
<td>Intensity Vector or Point</td>
</tr>
<tr>
<td>MAXX</td>
<td>1777</td>
<td>Maximum X Component</td>
</tr>
<tr>
<td>MAXY</td>
<td>1377</td>
<td>Maximum Y Component</td>
</tr>
<tr>
<td>MINUSX</td>
<td>20000</td>
<td>Negative X Component</td>
</tr>
<tr>
<td>MINUSY</td>
<td>20000</td>
<td>Negative Y Component</td>
</tr>
</tbody>
</table>

Display File Handler  A–23
<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Value</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Vector Mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHIFTX</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>MAXSX</td>
<td>17600</td>
<td>Maximum X Component</td>
</tr>
<tr>
<td>MAXSY</td>
<td>77</td>
<td>Maximum Y Component</td>
</tr>
<tr>
<td>MISVX</td>
<td>20000</td>
<td>Negative X Component</td>
</tr>
<tr>
<td>MISVY</td>
<td>100</td>
<td>Negative Y Component</td>
</tr>
</tbody>
</table>

A.8 Assembly Instructions

A.8.1 General Instructions

All programs can be assembled in 16K, using RT-11 MACRO. All assemblies and all links should be error free. The following conventions are assumed:

1. Default file types are not explicitly typed. These are .MAC for source files, .OBJ for assembler output, and .SAV for Linker output.

2. The default device (DK) is used for all files in the example command strings.

3. Listings and link maps are not generated in the example command strings.

A.8.2 VBASE

To assemble VBASE with RT-11 link-up capability.

MACRO VBASE

A.8.3 VTCAL1 – VTCAL4

To assemble the modules VTCAL1 through VTCAL4:

MACRO VTCAL1, VTCAL2, VTCAL3, VTCAL4

A.8.4 VTHDLR

To create the concatenated handler module:

COPY/BINARY VTCAL1.OBJ, VTCAL2.OBJ, VTCAL3.OBJ, -
VTCAL4.OBJ, VBASE.OBJ, VTHDLR.OBJ

A.8.5 Building VTLIB.OBJ

To build the VTLIB library:

LIBRARY/CREATE VTLIB VTHDLR
A.9 VTMAC

.TITLE VTMAC

; THIS SOFTWARE IS FURNISHED UNDER A LICENSE AND MAY ONLY BE USED
; OR COPIED IN ACCORDANCE WITH THE TERMS OF SUCH LICENSE.
;
; COPYRIGHT (C) 1978, DIGITAL EQUIPMENT CORPORATION.
;
; VTMAC IS A LIBRARY OF MACRO CALLS AND MNEMONIC DEFINITIONS WHICH
; PROVIDE SUPPORT OF THE VT11 DISPLAY PROCESSOR. THE MACROS PRODUCE
; CALLS TO THE VT11 DEVICE SUPPORT PACKAGE, USING GLOBAL REFERENCES.

; MACRO TO GENERATE A MACRO WITH ZERO ARGUMENTS.
.MACRO MACRO NAME,CALL
  .MACRO NAME
  .GLOBL CALL
  JSR PC, CALL
  .ENDM

; MACRO TO GENERATE A MACRO WITH ONE ARGUMENT

.MACRO MAC1 NAME, CALL
  .MACRO NAME ARG
  .IF NB, ARG
  MOV ARG, $00
  .ENDIF
  .GLOBL CALL
  JSR PC, CALL
  .ENDM

; MACRO TO GENERATE A MACRO WITH TWO OPTIONAL ARGUMENTS

.MACRO MAC2 NAME, CALL
  .MACRO NAME ARG1, ARG2
  .GLOBL CALL
  .IF NB, ARG1
  MOV ARG1, $00
  .ENDIF
  .IF NB, ARG2
  MOV ARG2, -(SP)
  .ENDIF
  .NARG T
  .IF EQ, T
  CLR -(SP)
  .ENDIF
  CLR $00
  .ENDC
  .ENDIF
  .ENDC
  JSR PC, CALL
  .ENDM

; MACRO LIBRARY FOR VT11:

MAC0  <CLEAR>, <$VINIT>
MAC0  <STOP>, <$VSTOP>
MAC0  <START>, <$VSTRT>
MAC1  <INSRT>, <$UNSRT>
MAC1  <REMOV>, <$URMOV>
MAC1  <BLANK>, <$VBLNK>
MAC1  <RESTR>, <$VRSTR>
MAC1  <STAT>, <$VSTPM>
MAC1  <LPEN>, <$VLPEN>
Mnemonic Definitions for the VT11 Display Processor

DJMP=160000  $DISPLAY JUMP
DNOP=164000  $DISPLAY NOP
DJSR=173400  $DISPLAY SUBROUTINE CALL
DRET=173400  $DISPLAY SUBROUTINE RETURN
DNAME=173520  $SET NAME REGISTER
DSSTAT=173420  $RETURN STATUS DATA
DHALT=173500  $STOP DISPLAY AND RETURN STATUS DATA

CHAR=100000  $CHARACTER MODE
SHORTV=104000  $SHORT VECTOR MODE
LONGV=110000  $LONG VECTOR MODE
POINT=114000  $POINT MODE
GRAPHX=120000  $GRAPH X MODE
GRAPHY=124000  $GRAPH Y MODE
RELATV=130000  $RELATIVE VECTOR MODE

INTO=2000  $INTENSITY 0
INT1=2200
INT2=2400
INT3=2600
INT4=3000
INT5=3200
INT6=3400
INT7=3600

LPDIFF=100  $LIGHT PEN OFF
LPDIN=140  $LIGHT PEN ON
BLKOFF=20  $BLINK OFF
BLKON=30  $BLINK ON
LINE=4  $SOLID LINE
LINE=5  $LONG DASH
LINE=6  $SHORT DASH
LINE=7  $DOT DASH

STATSA=170000  $LOAD STATUS REG A
LPLITE=200  $INTENSIFY ON LPEN HIT
LPDARK=300  $DON'T INTENSIFY
ITALO=40  $ITALICS OFF
ITALI=60  $ITALICS ON
SYNC=4  $POWER LINE SYNC

STATSB=174000  $LOAD STATUS REG B
INCR=100  $GRAPH PLOT INCREMENT
INTX=40000  $INTENSIFY VECTOR OR POINT
MAXX=1777  $MAXIMUM X INCR. = LONGV
MAXY=1377  $MAXIMUM Y INCR. = LONGV
MINUSX=20000  $NEGATIVE X INCREMENT
MINUSY=20000  $NEGATIVE Y INCREMENT
MAXSX=17600  $MAXIMUM X INCR. = SHORTV
MAXSY=77  $MAXIMUM Y INCR. = SHORTV
MISUX=20000  $NEGATIVE X INCR. = SHORTV
MISUY=100  $NEGATIVE Y INCR. = SHORTV

A-26 Display File Handler
A.10 Examples Using GTON

EXAMPLE #1

MACRO X03.04 18-MAY-77 1449:44 PAGE 5

.TITLE EXAMPLE #1

;THIS EXAMPLE USES THE .LPEN STATUS BUFFER AND THE
;NAME REGISTER TO MODIFY A DISPLAY FILE WITH THE LIGHT PEN.

;LUB STATUS WORD

.START

;MCALL .TTR, ,EXIT, ,PRINT

;LINK TO MONITOR

.BLK 19

;LINK UP ERROR?

;YES, PRINT MESSAGE

;AND EXIT.

;ADJUST SCROLL

;INSERT DISPLAY FILE

;SET UP LPEN BUFFER

;SET JSN FOR TTR

;NO, ANY TT INPUT?

;YES, EXIT

;MULTIPLY BY TWO

;USE TO INDEX

;OFF TABLE TBL.

;MOVE (R1),IPTH

;MOVE ADDR INTO IPTR

;DISABLE THE CODE

;CLEAR BUFFER FLAG TO

;ENABLE ANOTHER LP HIT.

;LOOP AGAIN

;NO, GET ANOTHER

;UNLINK FROM MONITOR

;EXIT

;LUBF 7

;LPEN STATUS BUFFER
EXAMPLE #1

MACRO XP3,04 18-MAY-77 14:14:44 PAGE 5-1

; DISPLAY FILE FOR EXAMPLE #1

FILE: POINT

100
500
DNAME
1

D1: CHARLBLKUFTILPON
ASCII /ONE/

D2: CHARLBLKUFTILPON
ASCII /TWO/

POINT
100
300
DNAME
2

D3: CHARLBLKUFTILPON
ASCII /THREE/

POINT
100
100
DNAME
3

DRET
EXAMPLE #1

SYMBOL TABLE

D2  000272R  INTX = 000000  INT4 = 003000  ITAL1 = 000060  DFILE = 000248R
EXIT 000142R  INT2 = 002400  LPON = 000140  INT7 = 002400R
INT0  000200D  LINE1 = 000005  LTST = 000062R  INT5 = 003200
MAXSX = 017600  JMP = 017600  12 = 000176R  MAXXY = 021377
D3  000312R  LONGV = 110000  MINUSX = 020000  SHORTTV = 12400R
MAXSY = 000077  LDPARK = 0001500  MINUSY = 020000  O1 = 000025R
MSY = 000190  LINE2 = 000036  POINT = 114000  01 = 000252R
MSG  000224R  INT3 = 002600  EMMSG = 000214R  DSTAT = 173424
INT1  002200  RELATV = 130000  SCRUF = 00021PR  STATSA = 174400
BLKON = 000030  DRET = 173400  SYNK = 000044  STATSB = 174409
DMALT = 173500  LINE3 = 000007  $VSCL = ****** G
LINE0 = 170004  LBUF = 000156R  INT6 = 003400  $VSWK = ****** G
CHAR = 100000  INCR = 000100  JSW = 000044  LPGFF = 0001111
DTABL 000208R  LPLITE = 000200  MAYX = 001777  MIPX = 02400
   . ABS. 000003  DPE 000326  UP1  ERRORS DETECTED: 0

VIRTUAL MEMORY USED: 3564 WORDS ( 14 PAGES)
DYNAMIC MEMORY AVAILABLE FOR 64 PAGES
.LP1=VTPAC.MANEX1

EXAMPLE #2

MACRO X$v3,64 18-MAY-77 14149157 PAGE 5

.TITLE EXAMPLE #2

; THIS EXAMPLE USES THE TRACKING OBJECT AND THE TRACK
; COMPLETION ROUTINE TO CAUSE A VECTOR TO FOLLOW
; THE LIGHT PEN FROM A SET POINT AT (500,500).

R0=%0  R1=%1  S0=%6  PC=%7
R2=%0  R1=%1  S0=%6  PC=%7

;MCALL .EXIT,.TTYIN,.PRINT
START: .LNKRT .EXIT,.TTYIN,.PRINT
;LINK TO MONITOR
BPL 1S  ;LINK UP ERROR?
;PRINT #EMSG
;YES, INFORM USER
;EXIT
;AND EXIT
;INSERT #DFILE
;INSERT DISPLAY FILE
;TRACK #BUF,#TCCM
;DISPLAY TRACK OBJECT
;JMP PC,WAIT
;WAIT FOR <CR>
;UNLINK FROM MONITOR
;EXIT
;WAIT
;TTYIN
;GET CHAR FROM TTY
;CMP #12,R0
;LINE FEED?
;BNE WAIT
;NO, GET ANOTHER
;RTS PC
;TBUFF: .WORD 500,500
;TRACK BUFFER INITED TO
;START TRACK AT (500,500)

;COMPLETION ROUTINE ENTERED AT INTERRUPT LEVEL
;FROM DISPLAY FILE HANDLER WITH DISPLAY STOPPED,
;USED TO UPDATE DISPLAY FILE WITH DATA FROM TRUF.

;TCOM: MOV R1,=#(SP)
;SAVE R1
MOV TBUFF,R1
;NEW X
SUB OX,R1
;NEW X = OLD X
BPL IS
;POSITIVE DIFFERENCE?
NEG R1
;NO, MAKE POSITIVE
BIS #MINUSX,R1
;SET MINUS BIT
1S1 BIS #INTX,R1
;ALSO SET INTENSIFY BIT
MOV R1,DX
;THEN STORE IN DFILE.
MOV TBUFF+2,R1
;NEW Y
SUB OY,R1
;NEW Y = OLD Y
BPL 2S
;POSITIVE DIFFERENCE?
NEG R1
;NO, MAKE POSITIVE
BIS #MINUSX,R1
;AND SET MINUS BIT
2S1 MOV R1,DY
;THEN STORE IN DFILE
MOV (SP)+,R1
;RESTORE R1
RTS PC
;EXIT FROM COMPLETION ROUTINE

;FILE FOR EXAMPLE #2

;UFILE: POINT
;SET POINT AT
OX: 500
;500
OY: 500
;DRAW A VECTOR
LONGVINTO
;INITIALLY NOWHERE
DX: .WORD 0
;DISPLAY FILE END
DY: .WORD 0
DRET
EXAMPLE #2  MACRO X03,04 18-MAY-77 14149157 PAGE 5-1

```
+68 000174 000000
+69 000176 123 117 122  EMSG1: *ASCIZ /SORRY, THERE SEEMS TO BE A PROBLEM/
  000201 122 131 054
  000224 040 124 110
  000227 105 122 105
  000228 040 123 105
  000215 105 115 123
  000220 040 124 117
  000223 040 102 105
  000226 040 101 040
  000231 120 122 117
  000234 102 114 105
  000237 115 000
```

**EXAMPLE #2**  MACRO X03,04 18-MAY-77 14149157 PAGE 5-2

**SYMBOL TABLE**

<table>
<thead>
<tr>
<th>INT0</th>
<th>002000</th>
<th>LONGV</th>
<th>110000</th>
<th>LPLITE</th>
<th>000200</th>
<th>SHTLK</th>
<th>******</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAXS</td>
<td>017600</td>
<td>LPDARK</td>
<td>000300</td>
<td>Wait</td>
<td>000540</td>
<td>DNAM</td>
<td>173520</td>
<td></td>
</tr>
<tr>
<td>MAXS</td>
<td>000077</td>
<td>LINE2</td>
<td>000006</td>
<td>$XTRAK</td>
<td>******</td>
<td>GNP</td>
<td>164000</td>
<td></td>
</tr>
<tr>
<td>MISV</td>
<td>001000</td>
<td>DX</td>
<td>000160</td>
<td>INT4</td>
<td>003000</td>
<td>ITAL</td>
<td>000060</td>
<td></td>
</tr>
<tr>
<td>INT1</td>
<td>002200</td>
<td>INT3</td>
<td>002600</td>
<td>LPON</td>
<td>000140</td>
<td>INT5</td>
<td>003200</td>
<td></td>
</tr>
<tr>
<td>BLKON</td>
<td>000300</td>
<td>RELATV</td>
<td>130000</td>
<td>MINUSX</td>
<td>020000</td>
<td>OSTAT</td>
<td>173420</td>
<td></td>
</tr>
<tr>
<td>DHALT</td>
<td>173590</td>
<td>TCOM</td>
<td>000740</td>
<td>MINUSY</td>
<td>020400</td>
<td>SYNC</td>
<td>000240</td>
<td></td>
</tr>
<tr>
<td>LINE0</td>
<td>000004</td>
<td>ORET</td>
<td>173400</td>
<td>OINT</td>
<td>114000</td>
<td>INT6</td>
<td>003400</td>
<td></td>
</tr>
<tr>
<td>CHR</td>
<td>100000</td>
<td>LINE3</td>
<td>000007</td>
<td>EMSE</td>
<td>00176R</td>
<td>MAXX</td>
<td>001777</td>
<td></td>
</tr>
<tr>
<td>INTX</td>
<td>040000</td>
<td>DY</td>
<td>000170</td>
<td>ITAL0</td>
<td>000040</td>
<td>OX</td>
<td>000160</td>
<td></td>
</tr>
<tr>
<td>INT2</td>
<td>002400</td>
<td>TBUF</td>
<td>000070</td>
<td>$	ext{BLKOFF}$</td>
<td>001120</td>
<td>START</td>
<td>10020R</td>
<td></td>
</tr>
<tr>
<td>LINE1</td>
<td>000005</td>
<td>INCR</td>
<td>000100</td>
<td>DJSR</td>
<td>173400</td>
<td>CY</td>
<td>000160</td>
<td></td>
</tr>
</tbody>
</table>

* ABS. 000000 000
  00242 0031

ERRORS DETECTED: 0

VIRTUAL MEMORY USED: 3717 WORDS (15 PAGES)

DYNAMIC MEMORY AVAILABLE FOR 64 PAGES

`LPi=VTMAC,MANEX2`
Appendix B
System Macro Library

This appendix contains the listing of the system macro library (SYSMAC.SML) for Version 5 of RT-11. This library is stored on the system device. It is used by MACRO when expanding the programmed requests and calling the subroutines that are described in Chapter 2.

```
.MCALL .MODULE
.MODULE SYSMAC,RELEASE=Y05,VERSION=16,COMMENT=System macro library,LIB=YES
;
;
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SOFTWARE ON EQUIPMENT THAT IS NOT SUPPLIED BY DIGITAL.
;
;++
;
RESERVED SYMBOL NAMES
-------------------------
;
...V1 and ...V5 are "global" values defined in macros
;
...V1 -- controls .MCalling of ...CM* and support of V1, V2 and
V3 versions of the expansions.
...V5 -- controls generation of .Audit information.
;
...V* -- are reserved for more local and global values
;
...V2, ...V3, and ...V4 are in use currently (Y05.06) as
local symbols (reusable in each macro definition).
;
RESERVED MACRO NAMES
-----------------------
;
...V1,
...V2,
.MAC
...CM*
;++
;
Error Messages
;
?SYSMAC-W-Invalid argument, use #0, not 0

B-1
General message -- Macro arguments of "0" are almost always
errors, (Which specify an address of 0, not a value of 0.)

?SYSMAC-E-Odd or invalid vector specified

  .DRBG & .DRTB -- the 2 lower bits of the vector address must
  be 0.

?SYSMAC-E-Invalid control value - control

  .DRBGT -- an invalid controller type was specified. See definition
  of .DRBGT for valid type codes.

?SYSMAC-E-Invalid sides value - sides

  .DRBGT -- an invalid number of sides was specified, use 1 or 2.

?SYSMAC-E-Primary boot too large

  .DREN -- the primary boot code overflowed the area available to it.

?SYSMAC-E-VAL Must not be 0, !VAL!

  .DRSET -- the second argument to the macro must not be 0, if it
  is, the rest of the options in the table are ignored.

?SYSMAC-E-Invalid parameter x;

  .DRSET -- the last argument must be blank or one (or more) of
  the following: NO, NUM, OCT

?SYSMAC-F-Invalid ADR, expecting #,..., found - ADR !

  .ADDR -- the first parameter must be an immediate value,
  like #FOO.

?SYSMAC-F-Invalid REG expecting - Rx or @SP - found REG !

  .ADDR -- The second parameter must be either a simple
  register reference or @SP.
--
++

  .V1;

--

.MACRO .V1,.
.MCALL ...CM0,...,CM1,...,CM2,...,CM3,...,CM4,...,CM5,...,CM6,...,CM7
...V1=1
.EMDM
++

  .V2;

--

.MACRO .V2,.
.MCALL ...CM0,...,CM1,...,CM2,...,CM3,...,CM4,...,CM5,...,CM6,...,CM7
...V1=2.
.EMDM
++

.MACS

B-2 System Macro Library
; .MCall the support routines and set the version to [>=]3
;
; .MACRO .MACS
; .MCall ...CM0,...,CM1,...,CM2,...,CM3,...,CM4,...,CM5,...,CM6,...,CM7
; ...V1=3.
; .ENDM
;
; ; ---
; ; ...
; ; CM0
; ; Move a word to the stack. If argument blank or #0
; ; Put a 0 on the stack. If second argument present,
; ; generate an EMT with that value
; ; ---
; .MACRO ...CM0 STARG,INS
; .IF B <STARG>
; .CLR -(SP)
; .IFF
; .IF IDN <STARG>,#0
; .CLR -(SP)
; .IFF
; .IFF IDN <STARG>,<0>,ERROR!SYSMAC-W-Invalid argument, use #0, not 0;
; .MOV STARG, -(SP)
; .ENDC
; .ENDC
; .IFF NB <INS>, EMT "0<INS>
; .ENDM
;
; ; ---
; ; ...
; ; CM1
; ; Setup RO to point to AREA, set the CHAN and IC (subcode)
; ; value in first word. This macro optimises number of
; ; instructions to set up first word.
; ; IC is forced to decimal.
; ; ---
; .MACRO ...CM1 AREA,IC,CHAN,FLAG,ARG,INS,CSET,BB
; ...CM5 <AREA>
; ...V2=0
; .IF B <FLAG>
; .IFF B <AREA>,...V2=1
; .IFF
; .IFF DIF <FLAG>,SET,...V2=1
; .ENDC
; .IFF NE ...V2
; .IFF IDN <CHAN>,<#0>
; .CLR0 @RO
; .IFF
; .IFF NB <CHAN>, MDVB CHAN, @RO
; .ENDC
; .IFF
; .IFF B <CHAN>
; .MOVB #IC',1(RO)
; .IFF
; .NTYPE ...V2,CHAN
; .IFF EQ ...V2,'027
; .MOV CHAN+(IC',#0400), @RO
; .IFF
; .MOV #IC',#0400, @RO
; .MOV CHAN, @RO
; .ENDC
;ENDC
;ENDC
.IIF IDN <CHAN> <0> ,ERROR?SYSMAC-W-Invalid argument, use #0, not 0;
      ;CM2 <ARG>,2,INS,CSET,BB
;ENDM

;MACRO ...
;IF B <ARG>
;IF NB <CSET>
.IIF NE ...V1-3,,
      CLR 'BB OFFSE',(R0)
;ENDC
;IFF
;IIF IDN <ARG>,#0
      CLR 'BB OFFSE',(R0)
;IFF
;IIF IDN <ARG> <0>,ERROR?SYSMAC-W-Invalid argument, use #0, not 0;
      MOV 'BB ARG',OFFSE',(R0)
;ENDC
;ENDC
.IIF NB <INS>, EMT 0375
;ENDM

;MACRO ...
;IF B <CHAN>
      MOV #IC*0400,R0
;IFF
;NTYPE ...
;IIF EQ ...
      MOV CHAN+(IC*0400),R0
;IFF
      MOV #IC*0400,R0
      BISB CHAN,R0
 ;ENDC
;ENDC
;ENDM
;ENDC

;MACRO ...
;IFF
;IIF DDIF <CODE>,NOSET ...
      CM1 <AREA>,IC,#0,<CODE>
;ENDM

B-4 System Macro Library
...CM2 <BUF>,4
...CM2 <WCNT>,6
...CM2 <CRTN>,8,E
.ENDM

+++ ...CM5
;
; Move a (byte) value to RO unless the src is
; blank or RO. If so, then generate nothing.
; BB is blank for word operations or B for byte.
; If second argument present, generate an EMT with
; that code value.
;++

.MACRO ...CM5 SRC,INS,BB
IFDEF SRC
IFDEF SRC,RO, MOV BB SRC,RO
.ENDC
IFDEF INS, EMT "0<INS>
.ENDM

+++ ...CM6
;
; Move a code and channel to RO. This macro
; optimises the instructions needed to load RO.
; Do the first ...CM2 also.
; IC and CHAN are forced to decimal.
;++

.MACRO ...CM6 AREA,IC,CHAN,FLAG,ARG,INS,CSET,BB
...CM5 AREA
IFDEF FLAG
IFDEF AREA, MOV #IC',"0400+CHAN",,BR0
.IFF
IFDEF FLAG,SET, MOV #IC',"0400+CHAN",,BR0
.ENDC
...CM2 ARG,2,INS,CSET,BB
.ENDM

+++ ...CM7
;
; Generate READ_/WRIT_ requests
;++

.MACRO ...CM7 AREA,CHAN,BUF,WCNT,BLK,CRTN,IC,CODE,V1
IFDEF V1-1
...CM5 WCNT
...CM0 CRTN
...CM0 BUF
...CM0 CHAN',<V1+AREA
.IFF
...CM1 AREA,IC,CHAN',<CODE',<BLK
...CM2 BUF',4
...CM2 WCNT',6
...CM2 CRTN',8,E
.ENDC
.ENDM

.MACRO .ABTIO CHAN
IFDEF V1
.MCALL MACS
.MACSL

System Macro Library  B–5
.ENDC
..CM3 <CHAN>,11.
.ENDM

+ ADDR ADR, REG, TYPE
+
Used to compute an address in a position-independent manner.
+
'ADR' is the address to compute with the # included.
'REG' is the destination
'REG' may be:
RX: load address into Rx
@RO: load address into address pointed to
-(SP): load address into new top of stack

'TYPE' may be:
blank which acts like MOV #ADR,REG in a PIC manner.
'ADD' which adds the address to the old contents of the register
'PUSH' which pushes the old contents of the destination before loading

.Addr #FOO,R0 ; load address of FOO in R0
.Addr #FOO,R0,ADD ; ADD loads address of FOO+old R0 in R0
.Addr #FOO,R0,PUSH ; Push R0 on stack, then load address
 of FOO in R0
.Addr #FOO,-(SP) ; push address of FOO on stack
.Addr #FOO,-(SP),PUSH ; same as .Addr #FOO,-(SP)

.MACRO ADDR ADR, REG, TYPE
.NTYPE ..., V2, ADR
.IFF NE ..., V2-"o27 .ERROR ..., V21 ?SYSMAC-F-Invalid ADR, expecting ..., found - ADR 1
.NTYPE ..., V2, REG
.IFF EQ ..., V2-"o46
.IF IDN \TYPE, \ADD
  ADD PC, -(SP)
.IFF
  MOV PC, -(SP)
.ENDC
.MEXIT
.ENDC
.IF IDN \TYPE, \PUSH
.IF GT ..., V2-5,
  MOV REG, -(SP)
.IFF
  JSR REG, @PC
  ADD ADR-., REG
.MEXIT
.ENDC
.ENDC
.IF IDN \TYPE, \ADD
  ADD PC, REG
.IFF
  MOV PC, REG
.ENDC
.ADD ADR-., REG
.IRP x, 1, 2, 3, 4, 5, 10, 11, 12, 13, 14, 15, 16
.IFF EQ ..., V2-"o" x ..., V2=0
.ENDR
.IFF NE ..., V2, ERROR ; ?SYSMAC-F-Invalid REG expecting - RX, @RX, or -(SP) - found REG ;
.ENDM

B-6 System Macro Library
+++  .Assume
+++  ; Used to provide assembly time verification of assumptions.
+++  ; generates an Error if the expression 'A' does not bear
+++  ; the relation 'rel' to the expression 'C'; for example:
+++  ;
+++  ;  .ASSUME SYMBOL EQ 200
+++  ;
+++  ; An optional 'message' can be substituted for the standard
+++  ; error message
+++  ; The optional error message should start either with a '
+++  ; or with a valid assembly expression followed by '
+++  ; message text. Example:
+++  ;
+++  ;  .Assume .LT 1000 MESSAGE=<1000-, location too high>
+++  
+++  .MACRO  .ASSUME A,REL,C,MESSAGE
+++  .IF REL <A>-<C>
+++  .IFF
+++  .IF B <MESSAGE>
+++  .ERROR:"A REL C" is not true
+++  .IFF
+++  .ERROR MESSAGE
+++  .ENDC
+++  .ENDC
+++  .ENDM  .ASSUME

+++  .AUDIT
+++  ; macro to generate list of versions starting at abs 110
+++  ; up to 26 names
+++  ; First reference generates a Rad50 value for 110 of release
+++  
+++  .SAVE
+++  .ASECT
+++  .IF  NDF  ...V5  ...V5=^0110
+++  .=...V5
+++  .IF  EQ  ,"0110
+++  .GLOBL  .AUDIT
+++  .LIST  .WORD  .AUDIT
+++  .NLIST  .ENDC
+++  .IF  NB  <"...V2>
+++  .GLOBL  '...V2'
+++  .LIST  .WORD  '...V2'
+++  .NLIST  .ENDC
+++  .ENDR
+++  ...V5=.
+++  .LIST  .WORD  -1
+++  .NLIST  .RESTORE
+++  .ENDM  .AUDIT

System Macro Library  B–7
i++
; .BR
;
; Verify that a "drop-thru" actually works. Example:
;
; .BR Foo
.
.
; .MACRO .BR TO
; .IF DF TO
; .IF NE TO-
; .ERROR: NOT AT LOCATION "TO";
; .ENDC
; .ENDC
; .ENDM .BR
.
; .MACRO .CDFN AREA, ADDR, NUM, CODE
; .IF NDF ...V1
; .MCALL .MACS
; .MACS
; .ENDC
; .CM6 AREA>,13,0,CODE>,ADDR>
; .CM2 NUM>,4,E
; .ENDM
.
; .MACRO .CHAIN
MOV *04000,R0
EMT *0374
.
; .ENDM
.
; .MACRO .CHCP AREA, CHAN, OCHAN, JOBBLK, CODE
; .IF NDF ...V1
; .MCALL .MACS
; .MACS
; .ENDC
; .CM1 AREA>,11,CHAN>,CODE>,OCHAN>
; .IF N6 JOBBLK>
; .CM2 JOBBLK>,4,E
; .IFF
; .CM2 #0,4,E
; .ENDC
; .ENDM
.
; .MACRO .CLOSE CHAN
; .IF NDF ...,V1
; .MCALL .MACS
; .MACS
; .ENDC
; .IF EQ ...,V1-1
EMT "0<160+CHAN>
; .IFF
; .CM3 CHAN>,6.
; .ENDC
; .ENDM
.
; .MACRO .CMKT AREA,ID,TIME=*0,CODE
; .IF NDF ...,V1
; .MCALL .MACS
; .MACS
; .ENDC
; .CM6 AREA>,19,0,CODE>,ID>
; .CM2 TIME>,4,E,C
; .ENDM

B-8  System Macro Library
MACRO .CNTXS AREA, ADDR, CODE
IF NDF ...V1
MCALL .MACS
MACS
ENDC
...CM6 <AREA>, 27, 0 <CODE>, <ADDR>, E
ENDM

MACRO .CRAW AREA, ADDR, CODE
IF NDF ...V1
MCALL .MACS
MACS
ENDC
...CM6 <AREA>, 30, 2 <CODE>, <ADDR>, E
ENDM

MACRO .CRRG AREA, ADDR, CODE
IF NDF ...V1
MCALL .MACS
MACS
ENDC
...CM6 <AREA>, 30, 0 <CODE>, <ADDR>, E
ENDM

MACRO .CSIGE DEVPSC, DEFEXT, CSTRNG, LINBUF
IF NDF ...V1
MCALL .MACS
MACS
ENDC
IF NB <LINBUF>
...CM0 <LINBUF>
NTYPE ...V2, DEVPSC
IF EQ ...V2=027
...CM0 <DEVPSC+1>
IFF
...CM0 <DEVPSC>
INC (SP)
ENDC
IFF
...CM0 <DEVPSC>
ENDC
...CM0 <DEFEXT>
...CM0 <CSTRNG>, 344
ENDM

MACRO .CSISP OUTSPC, DEFEXT, CSTRNG, LINBUF
IF NDF ...V1
MCALL .MACS
MACS
ENDC
IF NB <LINBUF>
...CM0 <LINBUF>
NTYPE ...V2, OUTSPC
IF EQ ...V2=027
...CM0 <OUTSPC+1>
IFF
...CM0 <OUTSPC>
INC (SP)
ENDC
IFF
...CM0 <OUTSPC>
ENDC
...CM0 <DEFEXT>
...CM0 <CSTRNG>, 345
ENDM
MACRO .CSTAT   AREA,CHAN,ADDR,CODE
IF NDF ...,V1
MCALL .MACS
MACS
ENDC
...CM1 (AREA),23,(CHAN),(CODE),(ADDR),E
ENDM
MACRO .CTIMI   TBK
   JSR R5,@$TIMIT
   .WORD TBK-1
   .WORD 1
ENDM
MACRO .DATE
   MOV #05000,R0
   EM T #0374
ENDM
MACRO .DELET   AREA,CHAN,DBLK,SEQNUM,CODE
IF NDF ...,V1
MCALL .MACS
MACS
ENDC
IF EQ ...,V1-1
...CM5 (CHAN),(AREA)
IFF
...CM5 (AREA)
IFF IDN (CHAN),#0
   CLR @R0
   IFF
   IFF IDN (CHAN) <0> .ERROR! SYSMAC-W-Invalid argument, use #0, not 0:
   ...V2=0
   IFF B <CODE>
   IFF B <AREA>,...V2=1
   IFF
   IFF DIF <CODE>,SET,...V2=1
   ENDC
   IF NE ...,V2
   IFF NB (CHAN), MOV B CHAN,@R0
   IFF
   IFF B (CHAN) CLRB 1(R0)
   IFF
   NTYPE ...,V2,CHAN
   IF EQ ...,V2-'027
         MOV CHAN,@R0
   IFF
         CLR @R0
         MOV B CHAN,@R0
   ENDC
   ENDC
   ENDC
   ENDC
...CM2 (DBLK),2
...CM2 (SEQNUM),4,E,C
ENDC
ENDM
MACRO .DEVIC   AREA,ADDR,LINK,CODE
IF NDF ...,V1
MCALL .MACS
MACS
ENDC
IFF B LINK
.MACRO .DRAST  NAME,PRI,ABT
.GLOBL $INPTR
.IF B <ABT>
.RETURN
.IFF    BR       ABT
.ENDC
NAME 'INT::JSR  R5,.@$INPTR
      .WORD  ^C<PRI*^040>&^0340
.ENDM

.MACRO .DRBEG  NAME,VEC,DSIZ,DSTS,VTBL
.ASECT     "052
.GLOBL NAME 'END,NAME 'INT
      .WORD  <NAME 'END-NAME 'STRT>
.IF B <DSIZ>
      .WORD  NAME 'DSIZE
.IFF
      .WORD  DSIZ
.ENDC
.IF B <DSTS>
      .WORD  NAME 'STS
.IFF
      .WORD  DSTS
.ENDC
      .WORD  "O<ERL$G+<MMG$T*2>+<TIM$IT*4>+<RTE$M*10>>
="0176
.IIF DF NAME '$CSR', .WORD  NAME '$CSR
.PSECT  NAME 'DVR
NAME 'STRT::
.IF NB  VTBL
  .GLOBL VTBL
  .WORD  <VTBL-,>/2,-1+"0100000
.IFF
.IF NB  <VEC>
.IIF NE VEC&3,...ERROR  VEC?SYSMAC-E-Odd or invalid vector specified;
      .WORD  VEC&"C3.
.IFF
.IF DF NAME '$VTB
  .GLOBL NAME '$VTB
  .WORD  <NAME '$VTB-,>/2,-1+"0100000
.IFF
.IIF NE NAME '$VEC&3,...ERROR  NAME '$VEC?SYSMAC-E-Odd or invalid vector
      .WORD  NAME '$VEC&"C3.
.ENDC
.ENDC
.ENDC

NAME 'SYS::
NAME 'LQE::  .WORD  0
NAME 'CQE::  .WORD  0
.ENDM

++;  .DRBOT
++;
++  CONTROL is used to generate the controller description bits

System Macro Library  B-11
; in the boot block. The default value is correct for nearly
; all RT supported devices. As many options may be specified as
; are supported by the boot code:
;
; <UBUS> Unibus device
; <QBUS> Q-Bus device
; <CBUS> PC-Bus device
; <UMSCP> Unibus MSCP device
; <QMSCP> Q-Bus MSCP device
; <CMSCP> PC-Bus MSCP device
;
; SIDES= is used to indicate the number of sides supported in
; floppy disk drive. Valid values are 1 and 2. Hard media
; sidedness is not coded.
;
; NOTE: the definition of a code does NOT imply any present
; or future product commitment.
;
; .MACRO ,DRBOT NAME,ENTRY,READ,CONTROL=<UBUS,QBUS>,SIDES=1
; .DREND NAME
; .IIF NDF TPS,TPS="0177564"
; .IIF NDF TPB,TPB="0177566"
; LF="012"
; CR="015"
; BS$BOOT="01000"
; BS$DEVN="04716"
; BS$DEVU="04722"
; BS$READ="04730"
; .IF EQ MMG$T
; BS$DNAM="R'NAME"
; .IFF
; BS$DNAM="R'NAME'X"
; ENDC
; ASEC
; ="062"

; .WORD NAME'BOOT',NAME'BEND-NAME'BOOT',READ-NAME'BOOT
; .PSEC NAME'BOOT
; NAME'BOOT::NOP
; BR ENTRY-2.
; ...V2="0100"
; .IFR X "<CONTROL>
; ...V3=0
; .IIF IDN "(X)" "<UBUS>
; ...V3=1
; .IIF IDN "(X)" "<QBUS>
; ...V3=2
; .IIF IDN "(X)" "<CBUS>
; ...V3=4
; .IIF IDN "(X)" "<QMSCP>
; ...V3=010
; .IIF IDN "(X)" "<CMSCP>
; ...V3=020
; .IIF IDN "(X)" "<CMSCP>
; ...V3=040
; .IIF EQ "...V3",ERROR
; ..SYSMAC-E=Invalid control value -
; ..control:
; ...V2=...V2!...V3
; .ENDR
; =ENTRY-6.
; .BYTE "020,...V2,"020,"0C<20,...V2+20>
; .IF EQ "<SIDES-1>
; BR ENTRY
; .IFF .IF EQ "<SIDES-2.>
; BMI ENTRY
; .IFF .ERROR:SYSMAC-E=Invalid sides value - sides:
; .ENDC
; .ENDC
; .ENDM

B-12 System Macro Library
MACRO .DRDEF   NAME, CODE, STAT, SIZE, CSR, VEC
  .MCALL .DRAST, DRSEC, DRBOT, DREND, DRFIN, DRINS, DRSET, DRVTB, FORK, QELDF
  .IFDEF NDF RTE$M RTE$M=0
  .IFDEF NE RTE$M RTE$M=1
  .IFDEF NDF TIM$IT TIM$IT=0
  .IFDEF NE TIM$IT TIM$IT=1
  .IFDEF NDF MMG$T MMG$T=0
  .IFDEF NE MMG$T MMG$T=1
  .IFDEF NDF ERL$G ERL$G=0
  .IFDEF NE ERL$G ERL$G=1
  .IFDEF NE TIM$IT, .MCALL .TIMIO, .CTIMI
  QELDF
HDFmts=1
EDF*="020000
VARGZ="0400
ABTIO=010000
SPFUN=020000
HNDLR=04000
SPECL=010000
WONLY=020000
RONLY=04000
FILST=0100000
NAME='DSIZ=SIZE
NAME='COD=CODE
NAME='STS=(CODE)\!STAT>
  .IFDEF NDF NAME='CSR, NAME='CSR=CSR
  .IFDEF NDF NAME='VEC, NAME='VEC=VEC
  .GLOBAL NAME='CSR, NAME='VEC
.ENDM

+++
  ,DREND
  ; FORCE is used to force the generation of the vector table
  ; assigning a value to FORCE causes the associated system
  ; bit value to "forced" on for purposes of generating the table.
  ;
  ; FORCE=1 will force generation of the error logging vector
  ; for instance.
++;
+MACRO .DREND  NAME, FORCE=0, PSECT
  .IF B<PSECT>
    PSECT NAME='DVR
  .ELSE
    PSECT PSECT
  .ENDC
  .IFDEF NDF NAME='END, NAME='END:
  .ELSE NAME='END
  NAME='END:
  .IFDEF NE MMG$T<(FORCE&2,>
    $RLPTR::=WORD 0
    $MPPTR::=WORD 0
    $GTBYT::=WORD 0
    $PTBYT::=WORD 0
    $PTWRD::=WORD 0
  .ENDC
  .IFDEF NE ERL$G<(FORCE&1,>, $ELPTR::=WORD 0
  .IFDEF NE TIM$IT<(FORCE&4,>, $TIMIT::=WORD 0
  $INPTR::=WORD 0
  $FKPTR::=WORD 0
  .GLOBAL NAME='STRT
  NAME='END=,
  .IFDEF
  PSECT NAME='BOOT

System Macro Library   B–13
.IIF LT 'BOOT-*.+"0664", ERROR?SYSMAC-E-Primary boot too large;

=NAME 'BOOT-*.0664

BIOERR: JSR R1,REPORT

,WORD IOERR-NAME 'BOOT

REPORT: MOV *BOOTF-NAME 'BOOT,R0
JR R1,REP
MOV (R1) R0
JSR R1,REP
MOV *CRLFLF-NAME 'BOOT,R0
JSR R1,REP
RESET
HALT
BR -.2.

REPOR: MOVB (R0)+,@*TPB
REP: TSTB @*TBS
BPL REP
TSTB @R0
BNE REPOR
RTS R1

BOOTF: .ASCIZ <CR><LF>"?BOOT-U-"<0200
CRLFLF: .ASCIZ <CR><LF><LF
IOERR: .ASCIZ "I/O error"

NAME 'BEND::
,ENDC
,ENDM

;++
;++ .DRINS is used to setup the install code area,
;++ It generates the CSR(s) words used by INSTALL and RESORC
;++ It sets the location counter to 200 for the data device
;++ installation entry point. It optionally generates words
;++ containing the second (and more) CSRs supported for handlers
;++ that support multiple CSRs. It defines INSDAT =: 200 as
;++ the label for the data device installation and INSSYS =: 202
;++ as the label for the system device installation. It defines
;++ DISCSR as the address of the primary display CSR, INSCSR as the
;++ address of the installation check CSR, and optionally DISCSn
;++ where "n" starts at 2 and goes up as the address(es) of the
;++ additional display CSRs. For more than 2 CSRs list them within
;++ <>'s,
;++
;++ .DRINS NAME 'CSRS
;++ .DRINS CR    ;generate installation code for CR (one CSR)
;=172
; ,WORD 0     ;end of list
;DISCSR:.WORD CR*CSR    ;primary display CSR
;INSCSR:.WORD CR*CSR    ;install CSR
;INSDAT:
;=202
;INSSYS:
;=200
; ; ; .DRINS DX,<DX*CS2> ; for a 2 controller RX01
;=170
; ,WORD 0     ;end of list

B-14  System Macro Library
; DISCS2: WORD DX*CS2 ; secondary display CSR
; DISCSR: WORD DX*CSR ; primary display CSR
; INSCSR: WORD DX*CSR ; install CSR
; INSDAT:
; =202
; INSSYS:
; =200

; .DRINS XX,\<XX*CS2,XX*CS3> ; for a 3 controller XX99
;
; =166
;
; .WORD 0 ; end of list
; DISCS3: WORD XX*CS3 ; tertiary display CSR
; DISCSR: WORD XX*CS3 ; primary display CSR
; DISCSR: WORD XX*CSR ; secondary display CSR
; INSCSR: WORD XX*CSR ; install CSR
; INSDAT:
; =202
; INSSYS:
; =200

; .MACRO .DRINS NAME,CSRS
; .ASECT
; =\^0172
;
; .WORD 0
; DISCSR: .WORD NAME*\$CSR
; INSCSR: .WORD NAME*\$CSR
...

; DISCS3: .WORD 0
; DISCSR: .WORD XX,\<CSRS>
; IRP X,\<CSRS>
; IRP Y,\...V2
; =,...V3
;
; .ENR
;
; DISCS3: .WORD 0
; .WORD X
; ENR
...

; .ENDM

; .MACRO .DRFIN NAME
; .GLOBL NAME*\$CQE
; MOV PC, R4
; ADD @NAME*\$CQE-, R4
; MOV @\^054, R5
; JMP @\^0270(R5)

; ENDM

; .MACRO .DRSET OPTION,VAL,RTN,MODE
; .ASECT
; .IF LE \^0400
; =\^0400
; .IFF
; =,-2.
; ENDC
; ...V2=0
; IRP X,\<VAL>
; .IFF EQ ...,V2, .IFF EQ \<X>, .ERROR?SYSMAC-E-V A L Must not be 0, VAL;
...V2=...,V2+1
; .ENDR
; VAL
...V2=.
...V2+4.
...V2=0
...V2=!0100
...V2=!0200
...V2=!0140
.ERROR "SYSMAC-E-Invalid Parameter x"
.ENDC
.ENDC
.ENDC
.ENDR
.BYTE ...V2
.WORD 0
.ENDM
.MACRO DRVTB NAME,VEC,INT,PS=0
.IF NB NAME
.NAME *VTB::
.IFF
...-2.
.ENDC
.IFF NE VEC&3, .ERROR VEC "SYSMAC-E-Odd or invalid vector specified"
.WORD VEC&"C3. ,INT-",0340!PS,0
.ENDM
.MACRO DSTAT RETSPC,DNAM
.IF NDF ...V1
.MCALL .MACS
.MACS
.ENDC
...CMS <DNAM>
...CMO <RETPSC>,342
.ENDM
.MACRO ELAW AREA,ADDR,CODE
.IF NDF ...V1
.MCALL .MACS
.MACS
.ENDC
...CMG <AREA>,30,3, <CODE>,<ADDR>,E
.ENDM
.MACRO ELRG AREA,ADDR,CODE
.IF NDF ...V1
.MCALL .MACS
.MACS
.ENDC
...CMG <AREA>,30,1, <CODE>,<ADDR>,E
.ENDM
.MACRO ENTER AREA,CHAN,DBLK,LEN,SEQNUM,CODE
.IF EQ ...V1-1
...V1+1
...CM5 <CHAN>
...CM0 <DBLK>,<40+AREA>
.IFF
...CM1 <AREA>,2,<CHAN>,<CODE>,<DBLK>
...CM2 <LEN>,4,,C
...CM2 <SEQNUM>,6,E,C
.ENDC
.ENDM

.MACRO .EXIT
 EMT 0350
.ENDM

.MACRO .FETCH ADDR,DNAM
.IF NDF ...V1
.MCALL .MACS
.MACS
.ENDC
...CM5 <DNAM>
...CM0 <ADDR>,343
.ENDM

.MACRO .FORK FKBLK
.JSR R5,#FKPTR
.WORD FKBLK -
.ENDM

.MACRO .FPROT AREA,CHAN,DBLK,PROT=#1,CODE
.IF NDF ...V1
.MCALL .MACS
.MACS
.ENDC
...CM1 <AREA>,35,<CHAN>,<CODE>,<DBLK>
...CM2 <PROT>,4,E,,B
.ENDM

.MACRO .GMCX AREA,ADDR,CODE
.IF NDF ...V1
.MCALL .MACS
.MACS
.ENDC
...CM6 <AREA>,30,6,<CODE>,<ADDR>,E
.ENDM

.MACRO .GTIM AREA,ADDR,CODE
.IF NDF ...V1
.MCALL .MACS
.MACS
.ENDC
...CM6 <AREA>,17,0,<CODE>,<ADDR>,E
.ENDM

.MACRO .GTJB AREA,ADDR,JOBLK,CODE
.IF NDF ...V1
.MCALL .MACS
.MACS
.ENDC
...CM6 <AREA>,16,1,<CODE>,<ADDR>
.IF NB <JOBLK>
.IF IDN <JOBLK>,<ME>
...CM2 #1,4,E
.IFF
...CM2 <JOBLK>,4,E
.ENDC
.IFF

System Macro Library  B-17
**Macro**

Macro to define a standard identification for all modules.

**Inputs:**

- Module 1-5 character symbol name (KEDIO)
- Release 3 character release identification (X05)
- Version 2 character version number (09)
- Comment n character title string (I/O Module)
- TITLE=YES generate .Title (default)
- TITLE=NO do not generate .Title
- IDENT=YES generate .Ident (default)
- IDENT=NO do not generate .Ident
- AUDIT=NO generate .Audit call (default)
- AUDIT=YES generate .Audit call
- LIB=NO do not generate .Audit global value (default)
- LIB=YES generate .Audit global value
- GLOBAL not specified (default)
- GLOBAL=sname substitutes sname for 'Module'

**Outputs:**

- .Title 'Module' 'Comment' title for module
- .Ident 'Release' 'Version' ident for module
- 'Module' 'Version'
- Audit .Release release value symbol Rad50
- .MCall .Audit
- generate audit information
- definition of .NLCSI macro generate program ID string
- TYPE=Z generate .AsciZ (default)
- TYPE=I generate .Asci
- PART=ALL generate std ID (default)
- PART=NAME generate name
- PART=RLSVER generate release & version .AsciZ "KEDIO X05.09"
- PART=PREFIx generate message prefix .AsciZ "KEDIO X05.09"
- definition of .RModule macro generate Rad50 for 'Module'
"RMODULE
"

"MACRO .MODULE MODULE, RELEASE, VERSION, COMMENT,
TITLE=YES,IDENT=YES,AUDIT=NO,GLOBAL,LIB=NO,MODNAME
"MCALL .AUDIT
"IF NB <MODNAME>
"IFF IDN <TITLE><YES>, .TITLE 'MODNAME' - 'COMMENT'
"IFF IDN <TITLE><YES>, .TITLE 'MODULE' - 'COMMENT'
"ENDIF
"IFDEF IDN <IDENT><YES>, .IDENT 'RELEASE','VERSION'
"IFDEF IDN <LIB><NO>, .AUDIT=="R'RELEASE'
"IFDEF NB <GLOBAL>
"GLOBAL =='VERSION',
"IFDEF IDN <AUDIT><YES>, .AUDIT 'GLOBAL'
"IFDEF 'MODULE'=='VERSION',
"IFDEF IDN <AUDIT><YES>, .AUDIT 'MODULE'
"ENDIF
"ENDIF
"MACRO .NLCSI TYPE=Z,PART=ALL
"IFDEF IDN <PART><ALL>, .ASCI'TYPE' "'MODULE','RELEASE','VERSION' "
"IFDEF IDN <PART><NAME>, .ASCI'TYPE' "'MODULE', "
"IFDEF IDN <PART><RLSVER>, .ASCI'TYPE' "'RELEASE','VERSION' "
"IFDEF IDN <PART><PREFIX>, .ASCI'TYPE' "'MODULE'-""
"ENDIF
"ENDIF
"MACRO .RMODULE 
"V5=0110
"ENDIF
"MACRO .MRKT AREA,TIME,CRTN,ID,CODE
"IFDEF NDF ...,V1
"MCALL .MACS
"MACS
"ENDIF
"CM6 <AREA>,18,0,<CODE>,<TIME>
"CM2 <CRTN>,4
"CM2 <ID>,6,E
"ENDIF
"MACRO .MTATC AREA,ADDR,UNIT,CODE
"IFDEF NDF ...,V1
"MCALL .MACS
"MACS
"ENDIF
"CM6 <AREA>,31,5,<CODE>,<ADDR>
"CM2 <UNIT>,4,E,,B
"ENDIF
"MACRO .MTDTC AREA,UNIT,CODE
"IFDEF NDF ...,V1
"MCALL .MACS
"MACS
"ENDIF
"CM6 <AREA>,31,6,<CODE>
"CM2 <UNIT>,4,E,,B
"ENDIF
"MACRO .MTGET AREA,ADDR,UNIT,CODE
"IFDEF NDF ...,V1
"MCALL .MACS
"MACS
"ENDIF
...CM2 #0,4,E
.ENDM

.MACRO .MWAIT
  MOV $04000,R0
  EMT "0374"
.ENDM

.MACRO .PEEK AREA,ADDR,CODE
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM6 <AREA>,2B,1,<CODE>,<ADDR>,E
.ENDM

.MACRO .POKE AREA,ADDR,VALUE,CODE
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM6 <AREA>,2B,3,<CODE>,<ADDR>
  ...CM2 <VALUE>,4,E
.ENDM

.MACRO .PRINT ADDR
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM5 <ADDR>,351
.ENDM

.MACRO .PROTE AREA,ADDR,CODE
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM6 <AREA>,25,0,<CODE>,<ADDR>,E
.ENDM

.MACRO .PURGE CHAN
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM3 <CHAN>,3.
.ENDM

.MACRO .PVAL AREA,OFFSE,VALUE,CODE
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM6 <AREA>,28,2,<CODE>,<OFFSE>
  ...CM2 <VALUE>,4,E
.ENDM

.MACRO .PDEL
  IF NDF MMGT, MMGT=1
  IF NE MMGT, MMGT=1
  Q.LINK=0
  Q.CSW=2
  Q.BLKN=4
  Q.FUNC=6.
Q.JNUM=7,
Q.UNIT=7,
Q.BUFF="010
Q.WCNT="012
Q.COMP="014
.IRP X,<LINK,CSW,BLKN,FUNC,JNUM,UNIT,BUFF,WCNT,COMP>
Q$'X'=Q,'X'-4
.ENDOR
.IF EQ MMC$T
Q.ELGH="016
.IFF
Q.PAR="016
Q$PAR="012
Q.ELGH="024
.ENDC
.ENDOR

.MACRO QSET ADDR,LEN
.IF NDF ...,V1
.MCALL ,MACS
.MACs
.ENDOR
.MOV ADDR,-(SP)
...CM5 <LEN>,353
.ENDOR

.MACRO RCTRL EMT '0355
.ENDOR

.MACRO RCVD AREA,BUFF,WCNT,CRTN=1,CODE
.IF NDF ...,V1
.MCALL ,MACS
.MACs
.ENDOR
...CM4 <AREA>,<BUFF>,<WCNT>,<CRTN>,22,<CODE>
.ENDOR

.MACRO RCVD CD AREA,BUFF,WCNT,CRTN,CODE
.IF NDF ...,V1
.MCALL ,MACS
.MACs
.ENDOR
...CM4 <AREA>,<BUFF>,<WCNT>,<CRTN>,22,<CODE>
.ENDOR

.MACRO RCVD W AREA,BUFF,WCNT,CRTN=0,CODE
.IF NDF ...,V1
.MCALL ,MACS
.MACs
.ENDOR
...CM4 <AREA>,<BUFF>,<WCNT>,<CRTN>,22,<CODE>
.ENDOR

.MACRO RDBBK RGSIZ
.MCALL RDBDF
.RDBDF
.WORD
.WORD RGSIZ
.WORD
.ENDOR

.MACRO RDBDF R.GID=0
R.GSIZ=2.
R.GSTS=4,
R.GLGH=6,
RS.CRR="0100000"
RS.UNM="040000"
RS.NAL="020000"
.ENDM

.MACRO .READ AREA,CHAN,BUF,WCNT,BLK,CRTN=1,CODE
.IF NDF ...V1
.MCALL .MACS
.ENDC
...CM7 <AREA>,<CHAN>,<BUF>,<WCNT>,<BLK>,<CRTN>,B,<CODE>,200
.ENDM

.MACRO .READC AREA,CHAN,BUF,WCNT,CRTN,BLK,CODE
.IF NDF ...V1
.MCALL .MACS
.ENDC
...CM7 <AREA>,<CHAN>,<BUF>,<WCNT>,<BLK>,<CRTN>,B,<CODE>,200
.ENDM

.MACRO .READW AREA,CHAN,BUF,WCNT,BLK,CRTN=0,CODE
.IF NDF ...V1
.MCALL .MACS
.ENDC
...CM7 <AREA>,<CHAN>,<BUF>,<WCNT>,<BLK>,<CRTN>,B,<CODE>,200
.ENDM

.MACRO .REGDEF
.ENDM

.MACRO .RELEA DNAM
.IF NDF ...V1
.MCALL .MACS
.ENDC
...CM5 <DNAM>
...CM0 \ 343
.ENDM

.MACRO .RENAME AREA,CHAN,DBLK,CODE
.IF NDF ...V1
.MCALL .MACS
.ENDC
.IF EQ ...V1-1
...CM5 <CHAN>,<100+AREA>
.IFF
...CM1 <AREA>,4,<CHAN>,<CODE>,<DBLK>,E
.ENDC
.ENDM

.MACRO .REOPE AREA,CHAN,CBLK,CODE
.IF NDF ...V1
.MCALL .MACS
.ENDC
.IF EQ ...V1-1
...CM5 <CHAN>,<140+AREA>
.IFF
...CM1 <AREA>,6,<CHAN>,<CODE>,<CBLK>,E

B-24 System Macro Library
.ENDC
.ENDM

.MACRO RSUM
  MOV #01000, R0
  EMT '0374
.ENDM

.MACRO SAVES AREA, CHAN, CBLK, CODE
  .IF NDF ...V1
    .MCALL .MACS
  .MACS
  .ENDC
  .IF E0 ...V1-1
    ...CM5 <CHAN>,<120+AREA>
  .IFF
    ...CM1 <AREA>,5,<CHAN>,<CODE>,<CBLK>,E
  .ENDC
  .ENDM

.MACRO SCCA AREA, ADDR, TYPE, CODE
  .IF NDF ...V1
    .MCALL .MACS
  .MACS
  .ENDC
  .IF NB <TYPE>
    ...CMS<AREA>,29,1,<CODE>,<ADDR>,E
  .IFF
    ...CMS <AREA>,29,0,<CODE>,<ADDR>,E
  .ENDM

.MACRO SDAT AREA, BUF, WCNT, CRTN=1, CODE
  .IF NDF ...V1
    .MCALL .MACS
  .MACS
  .ENDC
  ...CM4 <AREA>,<BUF>,<WCNT>,<CRTN>,21,<CODE>
  .ENDM

.MACRO SDATC AREA, BUF, WCNT, CRTN, CODE
  .IF NDF ...V1
    .MCALL .MACS
  .MACS
  .ENDC
  ...CM4 <AREA>,<BUF>,<WCNT>,<CRTN>,21,<CODE>
  .ENDM

.MACRO SDATW AREA, BUF, WCNT, CRTN=0, CODE
  .IF NDF ...V1
    .MCALL .MACS
  .MACS
  .ENDC
  ...CM4 <AREA>,<BUF>,<WCNT>,<CRTN>,21,<CODE>
  .ENDM

.MACRO SDTTM AREA, ADDR, CODE
  .IF NDF ...V1
    .MCALL .MACS
  .MACS
  .ENDC
  ...CMS <AREA>,32,0,<CODE>,<ADDR>,E
  .ENDM

.MACRO SERR MOV #02000, R0
EMT  '0374

MACRO  SETTO ADDR
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM5 <ADDR>,354
ENDM

MACRO  SFDAT AREA,CHAN,DBLK,DATE=0,CODE
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM1 <AREA>,34,<CHAN>,<CODE>,<DBLK>
  ...CM2 <DATE>,4,E
ENDM

MACRO  SFPA AREA,ADDR,CODE
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM6 <AREA>,24,0,<CODE>,<ADDR>,E
ENDM

++;  SOB
; SOB macro is used to retro-fit code written with the SOB
; instruction to processors that do not support that instruction.
; To substitute a universally applicable "SOB" just .MCALL SOB
--;

MACRO  SOB  R,DST
  DEC  R
  BNE  DST
ENDM

MACRO  SPCPS AREA,ADDR,CODE
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM6 <AREA>,33,0,<CODE>,<ADDR>,E
ENDM

MACRO  SPFUN AREA,CHAN,FUNC,BUF,WCNT,BLK,CRTN=0,CODE
  IF NDF ...V1
  MCALL .MACS
  ENDC
  ...CM1 <AREA>,26,<CHAN>,<CODE>,<BLK>
  ...CM2 <BUF>,4
  ...CM2 <WCNT>,6
  IF N=FUNC
    NTYPE ...V2,FUNC
  IF NE ...V2-`027
    IF DIF <CODE>,NOSET,...CM2 #`0377,8,,B
    ...CM2 <FUNC>,9,,B
    IFF
    ...CM2 <FUNC,#'04000377>,8
ENDC

B-26  System Macro Library
.MCALL .MACS
.MACs
.ENDC
...CMS  <CHAR>,341,B
 BCS     -2,
.ENDM

.MACRO  .TWAIT  AREA,TIME,CODE
  .IF NDF ...,V1
  .MCALL .MACS
  .MACS
  .ENDC
...CMS  <AREA>,30,0,<CODE>,<TIME>,E
  .ENDM

.MACRO  .UNLOC
  EMT     '0347
  .ENDM

.MACRO  .UNMAP  AREA,ADDR,CODE
  .IF NDF ...,V1
  .MCALL .MACS
  .MACS
  .ENDC
...CMS  <AREA>,30,5,<CODE>,<ADDR>,E
  .ENDM

.MACRO  .UNPRO  AREA,ADDR,CODE
  .IF NDF ...,V1
  .MCALL .MACS
  .MACS
  .ENDC
...CMS  <AREA>,25,1,<CODE>,<ADDR>,E
  .ENDM

.MACRO  .WAIT  CHAN
  .IF NDF ...,V1
  .MCALL .MACS
  .MACS
  .ENDC
...CMS  <CHAN>,0,E
  .IFF
  .IF B  <CHAN>
    EMT     '0<240+CHAN>
  .IFF
  .IFF
  .NTYPE ...,V2,CHAN
  .IF EQ ...,V2,'027
  .IF IDN <CHAN>,#0
    CLR     R0
  .IFF
  .IFF IDN <CHAN>,<0>, .ERROR?SYSMAC-W-Invalid argument, use #0, not 0;
  .MOV     CHAN,R0
  .ENDC
  .IFF
  .clr     R0
  .BISB    CHAN,R0
  .ENDC
  .ENDC
  EMT     '0374
  .ENDM

B–28  System Macro Library
.MACRO  WDBBK       WNAPR,WNSIZ,WNRID,WNOFF,WNLEN,WNSTS
.MCALL  WDBDF
.WDBDF
.BYTE           WNAPR
.BYTE             
.WORD             WNSIZ
.WORD             WNRID
.WORD             WNOFF
.WORD             WNLEN
.WORD             WNSTS

.ENDM

.MACRO  WDBDF
W.NID=0
W.NAPR=1
W.NBAS=2.
W.NSIZ=4.
W.NRID=6.
W.NOFF=010
W.NLEN=012
W.NSTS=014
W.NLGH=016
WS.CRW=0100000
WS.UNM=040000
WS.ELW=020000
WS.MAP=0400
.ENDM

.MACRO  WRITC  AREA,CHAN,BUF,WCNT,CRTN,BLK,CODE
.IF NDF ...V1
.MCALL  MACS
.MACS
.ENDC
...CM7 <AREA>,<CHAN>,<BUF>,<WCNT>,<BLK>,<CRTN>,9,<CODE>,220
.ENDM

.MACRO  WRITE  AREA,CHAN,BUF,WCNT,BLK,CRTN=#1,CODE
.IF NDF ...V1
.MCALL  MACS
.MACS
.ENDC
...CM7 <AREA>,<CHAN>,<BUF>,<WCNT>,<BLK>,<CRTN>,9,<CODE>,220
.ENDM

.MACRO  WRITW  AREA,CHAN,BUF,WCNT,BLK,CRTN=#0,CODE
.IF NDF ...V1
.MCALL  MACS
.MACS
.ENDC
...CM7 <AREA>,<CHAN>,<BUF>,<WCNT>,<BLK>,<CRTN>,9,<CODE>,220
.ENDM
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