Professional™
350/380
Quad Serial Line Unit Option
Maintenance Advisory
2nd Edition, November 1985

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<table>
<thead>
<tr>
<th>DIGITAL</th>
<th>DECwriter</th>
<th>P/OS</th>
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<td>DEC</td>
<td>DIGITAL</td>
<td>Professional</td>
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<tr>
<td>DECmate</td>
<td>LA</td>
<td>Rainbow</td>
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<td>DECnet</td>
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<td>VMS</td>
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<tr>
<td>VT</td>
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<td>Work Processor</td>
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</table>
Quad Serial Line Unit Option

(SLU)

Maintenance Advisory

Prepared by Educational Services of Digital Equipment Corporation
The View From Engineering

The 4-SLU option can be used in a wide variety of ways. Some of these are listed below.

A. As a way to connect serial devices such as laboratory instruments, etc. Most machines in the PRO class have more than 1 serial port as part of the basic machine, so the 4-SLU corrects that deficiency.

B. The PRO/Partner can use the 4-SLU to "recover" the printer port which is pre-empted on the basic configuration.

C. VENIX (and other UNIX implementations such as XENIX) can use the SLU to offer multi-user UNIX. Most of these will need very little work to get to market.

D. TSX is a third party RT offering which is currently available. The SLU allows them to make a much cleaner offering by freeing up the comm and printer ports.

E. P/OS will probably do a general purpose driver that will facilitate certain applications that might need more than one modem connection.

F. The developers of MUMPS will be very happy to support as many SLU lines as we can get out of the box.

G. The additional lines should provoke a certain amount of creativity among our third parties and in-house developers. For example, various terminal concentrator products might be feasible.

Bob Clark
SLU Design Engineer
April 1985
Hello

The Quad Serial Line Unit (SLU) provides a Professional system with 4 additional serial ports. They can be used to connect modems, printers, terminals, or other serial devices. SLU can also be used to convert the PRO to a multiuser system.

The SLU functions with the following DIGITAL operating systems.

- P/OS version 3.0 or later
- PRO/Server version 1.0 and later
- VENIX version 2.0
- MUMPS

It also works with various vendor operating systems.

The SLU is an option (PC3XC-BA) which can be installed on either the PC350 or PC380. It is customer installable.

NOTE
This advisory is written with the assumption that the reader is trained to fix Professional 300 series computer systems. Procedures and references will not be clear to those without PRO training.

Certain PRO configurations may support 2 SLUs.

This advisory along with the pocket service guide provides all information on how to install, troubleshoot, and repair a SLU.

Resource Documentation

Quad Serial Line Unit Option
Installation/Owner's Manual

Professional 380 Pocket Service Guide

Quad SLU Field Maintenance Print Set
PHYSICAL DESCRIPTION

The parts which make up the Quad Serial Line Unit are shown in Figure 1.

The SLU option module installs in a card cage slot in the PRO.

The Quad SLU interconnect box installs external to the PRO. It contains 4 25-pin D-sub connectors for attaching external serial peripherals such as modems.

The SLU option cable is a 40-pin ribbon cable which connects the SLU option module with the interconnect box.

There are 2 other items which are shipped with the SLU option.

First, the PRO/QUAD SLU maintenance services diskette is used to update a system's Maintenance Services diskette. Maintenance Services can then test the SLU option.

Second, a new card cage door is shipped with the SLU option. It has a cutout to accommodate the SLU option cable.

Appendix A lists the part numbers for the SLU option.

Figure 1 Quad Serial Line Unit FRUs
FUNCTIONAL DESCRIPTION

NOTE
This advisory contains communication technical terms which are not explained. These terms are explained in several data communication courses.

The option module provides control for 4 full-duplex, data-leads only, asynchronous communication ports.

The ports are EIA RS232/RS-423A compatible. Each port has user selectable baud rates from 50 to 38.4K baud.

The four ports have modem control capabilities which can be configured in one of two ways.

1. 2 ports with full asynchronous modem support, and 2 ports with serial data transfer capabilities only. This is called the "2/2" configuration.
   
   In 2/2 channels 1 and 3 have no modem controls.

   Channels 0 and 2 have inputs (CTS, DSR, CD, RI, TI, SPDMI) and outputs (RTS, DTR, LL, RL, DSRS).

2. 4 ports with partial modem support. This is called the "4/0" configuration.
   
   In 4/0 all four channels have modem controls. But, the controls are limited to inputs (CTS, DSR, CD) and outputs (RTS AND DTR).

Appendix B lists the control port signals.

There are many types of devices which a customer may connect to the SLU. The SLU configuration and the OPERATING SYSTEM determine which devices can be used.
SLU Option Module

The module consists of the following sections.

Two 2681 Dual* Universal Asynchronous Receiver/Transmitters (DUARTs) are used for port control and to convert data from serial to parallel and vice versa. Each DUART provides control for two independant ports using status, timing, and interrupt registers.

There is a CTI bus interface and a 2732A 4K EPROM for on-board diagnostics.

Quad SLU Interconnect Box

The box is 5.5 x 3.5 x 1.25 inches.

It houses a module with four 25 pin, D-sub connectors. They're used to connect external serial devices.

The module also has two 40 pin connectors. Select one of these connectors to set the SLU for the desired configuration.
DIAGNOSTICS AND TESTS

The diagnostics for the SLU adhere to usual PRO conventions. They are run and report errors like other PRO devices.

The diagnostics test the SLU functionality. Errors encountered are isolated to the FRU.

Power Up Self Test

The self test checks the functionality of the option module. The self test does NOT check the option cable or interconnect box.

The self test runs at every system power-up. The test has completed without error when the DIGITAL logo plots on the monitor screen.

If an error occurs a graphic of the PRO is displayed. The module which reported the error is highlighted. Also, the slot number, error code, and module ID number are displayed.

The most probable cause of any error can be found in the Power Up Self Test Error Tables in the professional family pocket service guides.

Table 1 shows SLU error codes. The codes in the table are referenced when the SLU module ID number of 000064 is displayed with the error graphic.

Codes 0020 through 0040 are usually caused by the SLU option module.

0001 through 0010 and 0100 through 0162 are caused by a faulty port. The cause of port errors may be any part of the SLU. These error codes are beneficial to determine which of the four ports are usable.

Further definition of these errors can be determined by running maintenance services.
<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
<th>Probable Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>Power-up self-test completed successfully</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>Data test error, Port 0</td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>Data test error, Port 0</td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>Data test error, Port 1</td>
<td>The probable cause for errors 0001-0010 is the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLU Option module.</td>
</tr>
<tr>
<td>0004</td>
<td>Data test error, Port 1</td>
<td></td>
</tr>
<tr>
<td>0005</td>
<td>Data test error, Port 2</td>
<td></td>
</tr>
<tr>
<td>0006</td>
<td>Data test error, Port 2</td>
<td></td>
</tr>
<tr>
<td>0007</td>
<td>Data test error, Port 3</td>
<td></td>
</tr>
<tr>
<td>0010</td>
<td>Data test error, Port 3</td>
<td></td>
</tr>
<tr>
<td>0020</td>
<td>NXM trap</td>
<td></td>
</tr>
<tr>
<td>0021</td>
<td>Interrupt with no IEN asserted</td>
<td></td>
</tr>
<tr>
<td>0022</td>
<td>Bad DUART number during break change interrupt</td>
<td></td>
</tr>
<tr>
<td>0023</td>
<td>ROM reset failure</td>
<td></td>
</tr>
<tr>
<td>0024</td>
<td>DUART n timeout failure during data test</td>
<td>The probable cause for errors 0020-0040 is the SLU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Option module.</td>
</tr>
<tr>
<td>0025</td>
<td>Interrupt occurred with no interrupt-pending</td>
<td></td>
</tr>
<tr>
<td></td>
<td>flag set</td>
<td></td>
</tr>
<tr>
<td>0030</td>
<td>Counter/timer interrupt timeout</td>
<td></td>
</tr>
<tr>
<td>0031</td>
<td>Counter/timer interrupt error</td>
<td></td>
</tr>
<tr>
<td>0032</td>
<td>Input port or input port change register error</td>
<td></td>
</tr>
<tr>
<td>0034</td>
<td>Input port change interrupt error</td>
<td></td>
</tr>
<tr>
<td>0035</td>
<td>Receiver interrupt error</td>
<td></td>
</tr>
<tr>
<td>0036</td>
<td>Transmitter interrupt error</td>
<td></td>
</tr>
<tr>
<td>0040</td>
<td>False interrupt (ISR=0)</td>
<td></td>
</tr>
<tr>
<td>0100</td>
<td>Initialization error, Port 0</td>
<td>The probable causes for errors 0100-0162 are:</td>
</tr>
<tr>
<td>0102</td>
<td>Break-detection error, Port 0</td>
<td>1. SLU interconnect box</td>
</tr>
<tr>
<td>0120</td>
<td>Initialization error, Port 1</td>
<td>2. SLU option cable</td>
</tr>
<tr>
<td>0122</td>
<td>Break-detection error, Port 1</td>
<td>3. Device attached to the error port</td>
</tr>
<tr>
<td>0140</td>
<td>Initialization error, Port 2</td>
<td>4. SLU option module</td>
</tr>
<tr>
<td>0142</td>
<td>Break-detection error, Port 2</td>
<td>5. Software bug</td>
</tr>
<tr>
<td>0160</td>
<td>Initialization error, Port 3</td>
<td></td>
</tr>
<tr>
<td>0162</td>
<td>Break-detection error, Port 3</td>
<td></td>
</tr>
</tbody>
</table>
Maintenance Services

NOTE

Maintenance Services version 3.0 and later has the ability to test multiple options with the same ID code. If 2 SLU options are installed on a PRO, they both can be tested.

Earlier versions can only test one option per ID code. So, the option in the lowest numbered slot gets tested. Others are ignored.

You must remove the frontmost SLU option module from the card cage in order to test a second SLU.

This causes the PRO to recognize the second SLU (now the first) and test it.

This diagnostic tests the same functionality as the power up self test. In addition, it provides a means of looping back signals to test the option cable and the connectors on the box.

Maintenance Services must be updated to test the SLU. This is done with the PRO/Quad Maintenance Services diskette.

Briefly, the update procedure is:

1. Load diskette-based Maintenance Services as described in the PRO380 pocket service guide.

2. Insert the PRO/Quad Maintenance Services diskette into drive 2.

3. Choose Update from the Maintenance Services menu and follow the instructions.

4. After completion enter service mode (F12-F19-F5) and check for "Quad SLU" on the System Unit Test listing.

With Maintenance Services updated, the System Unit Test is run to test the SLU.

Install 4 loopback connectors before testing. One on each port. PRO Communication Port Test loopback connectors (29-24795-00) must be used.
Then select "loopback connector installed" and "4-line SLU" from the System Unit Test Selection menu. This configuration is the most complete test that can be run to test the SLU option.

If the loopback connectors are NOT installed, select only "4-line SLU" from the menu. The resulting test still determines whether errors are in the option module or box. The test will NOT test the external device connectors.

If errors occur during the System Unit Test, they are shown in the summary at the end of the test. Usually one or more faulty ports are called out. Ports which pass the test can still be used.

The option module is probably at fault if the error cannot be localized to a port.

To check for probable causes, press the HELP key for online assistance, and check the System Unit Test error table in the pocket service guide.
The option module is installed in the PRO logic cage. Any slot can be used. The module should be installed as close as possible to the back of the logic cage to give the option cable and interconnect box more position flexibility.

Figure 2 shows the option cable installed through a slot in the top of the logic cage into the connector on the module. The plastic cable egress cover is removed and the cable is routed through the black plastic cable restraint.

Two thumbscrews are tightened down on the cable hold-down bracket to optimize system grounding. This minimizes random line drops and data errors.

Figure 2  Option cable installation into module
The cable is plugged into one of the connectors in either end of the interconnect box as shown in Figure 3. Two thumbscrews are installed through the hold-down bracket to optimize grounding with the system.

Figure 3 Option cable connection to interconnect box
The interconnect box is installed as shown in Figure 4. First, peel off the velcro backing strips, then stick the box on the top cover of the PRO. Be sure that you position the box so there is room for a second SLU.

**NOTE**
If the PRO is installed in a floor stand, install the interconnect box on the rear door of the floor stand.

The option cable must be unplugged before disassembling the PRO.

Detailed installation procedures are in the Installation/Owner's manual which is shipped with each option.

*Figure 4  Interconnect box installation on PRO*
The customer can set-up and change both the baud rates and the modem control configuration.

The baud rate is set-up by software. There are no hardware switches. Ports 0 and 1 are always the same baud rate. Ports 2 and 3 are always the same baud rate. Each pair is controlled by one DUART so the baud rates for the pair must be the same.

The configuration is determined by the option cable connection at the box.

Figure 5 shows the box. Notice the orientation of the 25 pin connectors. The 13 pin row is to the left. The 12 pin row is to the right.

The option cable is plugged into the 13-pin side of the box for partial control of the connector ports (4/0 configuration). The option cable is plugged into the 12-pin side for full control (2/2 configuration).

Be careful. The box itself has no configuration or port markings. You must know which connector to use and how the ports are numbered.

Figure 5 Choosing full or partial control
All parts of an SLU option are removed by reversing the installation steps.

Points to remember are:

1. Before removing the interconnect box or option cable note the configuration.

2. Firmly connect all thumb screws when replacing the cable to optimize grounding.

Appendix A contains part numbers for the option.
**TROUBLESHOOTING HINTS AND PROCEDURES**

**Quick Fix**

The quickest means to solve some SLU option problems is to attach the external device cable to a different port. Then have the customer try to access the device through the new port.

**NOTE**

When swapping between ports make sure the new port is configured the same as the original port.

In 4/0 all ports are the same. In 2/2 ports 0 and 2 are the same and 1 and 3 are the same.

Also, check that the baud rate is set the same.

Changing ports should only be viewed as a temporary fix. It should be used only when new parts are unavailable or there are other extenuating circumstances.

**Using the Diagnostics**

Running the diagnostics cannot identify all problems associated with an SLU option.

For instance, it is possible for the power-up self test to fail because of a software bug or external device failure.

Also, it is possible, though highly improbable, for the loopback test to pass with faulty hardware. So, the test is okay, but the external device doesn't communicate or function correctly.

In either of the above cases, swap the SLU hardware using Table 1 as a guide. Swap the components in the following order if there are no error codes.

1. SLU interconnect box
2. SLU option cable
3. SLU option module
If all SLU components have been swapped for known good parts, and the problem persists, what should you do next?

The external device cable, system software, and external device may also cause problems related to the operation of the SLU option.

External Device Cable

The external device cable must be standard EIA compatible. All EIA cables have 25 pin connectors. However, the number of pins which are connected may vary with EIA cables of different part numbers. Certain types of serial devices may need most or all of the pins connected to work properly.

If there is a question of cable type see Appendix A or contact the Hotline.

The external device cable may be at fault.

Make sure the correct cable is installed for the external device. This is especially critical for a new device. Is there a mismatch? Appendix A lists the external device cables for several DIGITAL products.

Swap the cable. The external device cable is probably okay if the problem persists.

Software

Question the customer concerning the software used to drive the SLU and the external device.

You are not expected to know every operating system or application which might be used with the SLU. There are many which are used which are not DIGITAL products.

There are some generic questions you can ask if you suspect the problem is software related.

1. Is this new software or has it been used before for this exact application?

2. Have any software initialization factors or set-ups been changed for any reason?

3. Has the software been updated or revised recently.
Also, work with the customer and watch closely the procedure which is used when trying to use the SLU option. There may be key indicators which will help lead you to the cause of the problem.

External Device

The external device connected to a SLU port may be a "usual" DIGITAL product or one of innumerable other serial devices.

DIGITAL products should be tested and checked out using normal procedures.

For unknown devices, try the following steps.

1. Swap the external device cable from the suspected bad device to the working one if there are 2 identical devices connected to a SLU.

   If the second device still works correctly, the original device is probably the problem.

2. Ask the following questions. They may help to establish if the external device is a probable cause of the problem.

   o Has the external device recently been serviced?

   o Have any of the external device set-up features been changed for any reason?

   o Has the customer actually seen this device work in this exact configuration?

   If the customer indicates that there have been recent changes, encourage him to retrace the steps to discover where a critical change may have occurred causing the device not to communicate correctly through the SLU option.

Hotline

The Customer Services Hotline is available for support on the SLU option.

You may suspect that the customer has connected an incompatible device to a SLU port or doesn't have the correct cable.

If this is a question, the hotline may contact the DIGITAL consulting service for additional help.
FRU Part Numbers

SLU Option Module 54-16622-01
Quad SLU Interconnect Box 70-22026-01
SLU Option Cable 17-01042-01
PRO/Quad SLU Maintenance Services diskette v1.0 ZBA06-C3
PRO Communication Port Test Connector (4 needed) 29-24795-00

APPENDIX A

External Device Cable Listing

The following is a list of recommended cables for connecting external devices to the Quad Serial Line Unit.

<table>
<thead>
<tr>
<th>Cable Number</th>
<th>Cable Description</th>
<th>External Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC22D-XX</td>
<td>6 Conductor female to female null modem cable</td>
<td>VT100, VT240, VT220, LA100, LA120</td>
</tr>
<tr>
<td>BC22E-XX</td>
<td>16 Conductor male to female modem cable</td>
<td>DP03</td>
</tr>
<tr>
<td>BCC04-XX</td>
<td>25 Conductor Male to female modem cable</td>
<td>DP03</td>
</tr>
</tbody>
</table>
APPENDIX B COMMUNICATION PORT CONTROL SIGNALS

The following is a list of communication port control signals for both full and partial modem control set ups.

Full 2/2 Control Port Signals

<table>
<thead>
<tr>
<th>Port</th>
<th>Input Signals</th>
<th>Output Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CTS, DSR, CD, RI, TI, SPDM1 RCV DATA</td>
<td>RTS, LL, DTR, RL, DSR, XMIT DATA</td>
</tr>
<tr>
<td>2</td>
<td>RCV DATA</td>
<td>XMIT DATA</td>
</tr>
<tr>
<td>3</td>
<td>CTS, DSR, CD, RI, TI, SPDM1 RCV DATA</td>
<td>RTS, LL, DTR, RL, DSR, XMIT DATA</td>
</tr>
<tr>
<td>4</td>
<td>RCV DATA</td>
<td>XMIT DATA</td>
</tr>
</tbody>
</table>

Partial 4/0 Control Port Signals

<table>
<thead>
<tr>
<th>Port</th>
<th>Input Signals</th>
<th>Output Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>CTS, CD, DSR, RCV DATA</td>
<td>RTS, DTR, XMIT DATA</td>
</tr>
</tbody>
</table>