

**digital**<sup>TM</sup>

*Storage***Works** 

# Fiber-Optic UltraSCSI Extender (DWZGA)

---

User's Guide

EK-DWZGA-UG. C01

Digital Equipment Corporation  
Maynard, Massachusetts

---

**Third Edition, July 1998**

The information in this document is subject to change without notice and should not be construed as a commitment by Digital Equipment Corporation.

Digital Equipment Corporation assumes no responsibility for any errors that might appear in this document.

The software, if any, described in this document is furnished under a license and may be used or copied only in accordance with the terms of such license. No responsibility is assumed for the use or reliability of software or equipment that is not supplied by Digital Equipment Corporation or its affiliated companies.

The following are trademarks of Compaq Computer Corporation:

Alpha, DEC OSF/1, Digital UNIX, OpenVMS, StorageWorks, and the Digital logo.

The following are third-party trademarks:

Microsoft and MS-DOS are registered trademarks, and Windows and Windows NT are trademarks of Microsoft Corporation.

Intel, Intel486, and i486 are trademarks of Intel Corporation.

NetWare is a registered trademark of Novell, Inc.

SCO UNIX is a trademark of Santa Cruz Operations, Inc.

SIMM is a trademark of Wang Laboratories.

All other trademarks and registered trademarks are the property of their respective holders.

# Contents

- Revision Record** ..... v
- About This Guide** ..... vii
- 1 Introduction**
  - 1.1 Product Description..... 1-1
    - 1.1.1 Overview..... 1-1
    - 1.1.2 DWZGA Approach..... 1-1
    - 1.1.3 System Level Operation ..... 1-4
    - 1.1.4 SCSI Configuration ..... 1-4
    - 1.1.5 Optical Data Link (ODL)..... 1-5
    - 1.1.6 Special SCSI Considerations ..... 1-6
      - 1.1.6.1 Target Selection Time-Outs..... 1-6
      - 1.1.6.2 Data Transfer Disconnect Control (DTDC)..... 1-6
      - 1.1.6.3 Selection/Reselection Collisions..... 1-6
      - 1.1.6.4 SCSI Resets..... 1-7
  - 1.2 Specifications..... 1-7
  - 1.3 Switch Setting Tool..... 1-8
  - 1.4 Front Panel Equipment..... 1-9
  - 1.5 Switch Setting Information..... 1-13
  - 1.6 Rear Panel Equipment..... 1-15
- 2 Installation**
  - 2.1 Unpacking..... 2-1
  - 2.2 Tools Required..... 2-1
  - 2.3 Cabling ..... 2-1
- 3 Configuration**
  - 3.1 Setting Switches on LOCAL Unit..... 3-1
  - 3.2 Setting Switches on REMOTE Unit..... 3-2
  - 3.3 Startup ..... 3-3

## 4 Maintenance

|  |     |
|--|-----|
| 4.1 Tools and Materials Required.....  | 4-1 |
| 4.2 Fiber-Optic Cable Connectors ..... | 4-1 |
| 4.3 Fiber-Optic Port .....             | 4-3 |
| 4.3.1 Air Duster .....                 | 4-4 |
| 4.3.2 Using In-House Air Supply .....  | 4-4 |
| 4.3.3 Using Isopropyl Alcohol .....    | 4-5 |

## 5 Troubleshooting

|                             |     |
|-----------------------------|-----|
| 5.1 Equipment Required..... | 5-1 |
| 5.2 Procedure.....          | 5-1 |

## Appendix A Manufacturer's Declarations

|                           |                   |
|---------------------------|-------------------|
| Readers Comment Form..... | Inside Back Cover |
|---------------------------|-------------------|

### Figures

|   |      |
|---|------|
| 1-1 DWZGA Unit.....   | 1-2  |
| 1-2 Switch Setting Tool.....                                  | 1-8  |
| 1-3 Front Panel of DWZGA Unit.....                            | 1-9  |
| 1-4 Rear Panel of DWZGA Unit.....                             | 1-13 |
| 2-1 Typical Fiber-Optic UltraSCSI Extender Configuration..... | 2-2  |
| 2-2 Cabling Typical Configuration .....                       | 2-4  |
| 2-3 Cabling with Terminator on One SCSI Port.....             | 2-4  |
| 4-1 Cleaning Fiber-Optic Cable Connectors.....                | 4-2  |

### Tables

|  |      |
|--|------|
| 1-1 DWZGA Unit Front Panel Descriptions..... | 1-10 |
| 1-2 DWZGA Unit Rear Panel Descriptions.....  | 1-14 |
| 5-1 Troubleshooting Table.....               | 5-1  |

## *Revision Record*

---

*This Revision Record provides a concise publication history of this user's guide. It lists the guide's revision levels, release dates, and reasons for the revisions.*

---

The following revision history lists all revisions of this publication and their effective dates. The publication part number is included in the Revision Level column, with the last entry denoting the latest revision. This publication supports the StorageWorks DWZGA Fiber-Optic UltraSCSI Extender.

| <b>Revision Level</b> | <b>Date</b>   | <b>Summary of Changes</b>               |
|-----------------------|---------------|---|
| EK-DWZGA-UG. A01      | February 1998 | Original release                        |
| EK-DWZGA-UG. B01/C01  | July 1998     | Modify Table 1-1 to indicate LED colors |



# About This Guide

---

*This section defines the audience of the guide and describes its contents and structure. In addition, this section identifies the conventions used in the guide.*

---

## **The StorageWorks DWZGA Fiber-Optic UltraSCSI Extender User's Guide**

This guide describes the DWZGA and provides instructions for installing, configuring, maintaining, and troubleshooting it.

### **Intended Audience**

This guide is for system administrators and users who need to install, configure and maintain the DWZGA.

### **Organization**

This guide contains the following:

#### **Chapter 1: Introduction**

This chapter provides a description of the DWZGA and its application.

#### **Chapter 2: Installation**

This chapter contains instructions for unpacking DWZGA units and cabling two DWZGA units to implement a typical, sample configuration. It also lists tools required for the installation.

#### **Chapter 3: Configuration**

This chapter contains procedures for configuring the LOCAL and REMOTE DWZGA units.

#### **Chapter 4: Maintenance**

This chapter contains procedures for cleaning the end faces on the fiber-optic cable connectors of the fiber-optic link and the fiber-optic port on each DWZGA unit.

#### **Chapter 5: Troubleshooting**

This chapter contains procedures for troubleshooting the fiber-optic UltraSCSI extender.

## Appendix A: Manufacturer's Declarations

This appendix contains the Radio Frequency Interference (RFI) declarations for the fiber-optic UltraSCSI extender.

### Conventions

This guide uses the following conventions:

| Style                           | Meaning   |
|---------------------------------|---|
| <b>boldface mono-space type</b> | To be input by the user   |
| plain mono-space type           | Screen text   |
| <i>italic type</i>              | For emphasis, manual titles, utilities, menus, screens, and filenames |

### Special Notices

This guide uses the following to emphasize specific information.

#### WARNING

WARNING indicates the presence of a hazard that can cause personal injury if the hazard is not avoided.

#### CAUTION

CAUTION indicates the presence of a hazard that might damage hardware or corrupt software.

#### NOTE

Notes provide additional information.

### Associated Documents

| Document Title   | Order Number     |
|--|------------------|
| <i>Disaster Recovery Solutions Getting Started Guide</i> | EK-SWXDR-GS. A01 |



## Support and Services

### Who to contact in the Americas

---

|   |   |
|---|---|
| Information and Product Questions:          | Local Sales Office / StorageWorks Hotline<br>1-800-786-7967   |
| Installation Support:                       | Contact the DIGITAL Distributor where the Storage Solution was Purchased / Local Digital Sales Office.  |
| DIGITAL Multivendor Customer Service (MCS): |   |
| Installation                                | Contact the DIGITAL Customer Support Center (CSC).  |
| Warranty                                    | Contact the DIGITAL Customer Support Center (CSC) for warranty service after solution is installed and operating.   |
| Remedial                                    | Contact the DIGITAL Customer Support Center (CSC)<br><br>Note: A Service Contract is recommended when the equipment is out of warranty. Contact the local DIGITAL Sales Office. |
| Customer Support Center (CSC)               | 1 800-354-9000  |

---

### Who to contact in Europe

---

|   |   |
|---|---|
| Information and Product Questions:      | Contact the DIGITAL Distributor or reseller   |
| Installation Support, and Installation: | Contact the DIGITAL Distributor or reseller from whom the Storage Solution was purchased.   |
| For Warranty Service                    | See the Warranty Card packaged with the product.  |
| For Remedial Service                    | Contact the DIGITAL Distributor or reseller from whom the Storage Solution was purchased.<br><br>Note: A Service Contract is recommended when the equipment is out of warranty. |

---

### Who to contact in Asia Pacific

For all services, contact the DIGITAL Distributor or reseller from whom the equipment was purchased.



# 1

## *Introduction*

---

*This chapter provides a description of the DWZGA and its application.*

---

### **1.1 Product Description**

#### **1.1.1 Overview**

The Digital Equipment Fiber Optic UltraSCSI Extender, hereafter referred to as a DWZGA unit, is used as an Ultra wide differential SCSI bus extender for extending the length of a single SCSI bus up to 15 kilometers. (See Figure 1–1.)

Two DWZGA units are connected back-to-back with a long-distance fiber-optic (FO) link between them. The DWZGA unit at each end of the FO link interfaces to the SCSI bus with one DWZGA unit at the host end, the other at the device end. The extender is transparent to the host and devices at both ends of the SCSI bus.

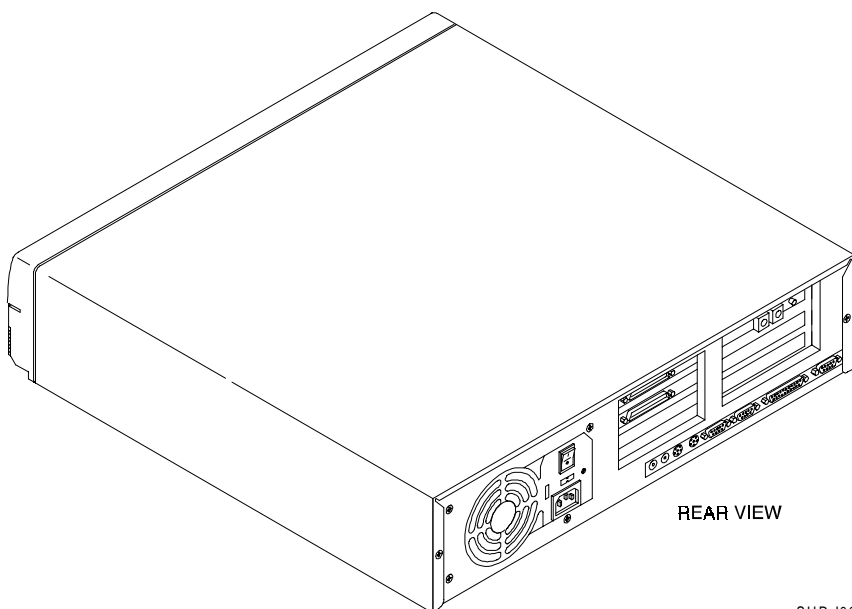
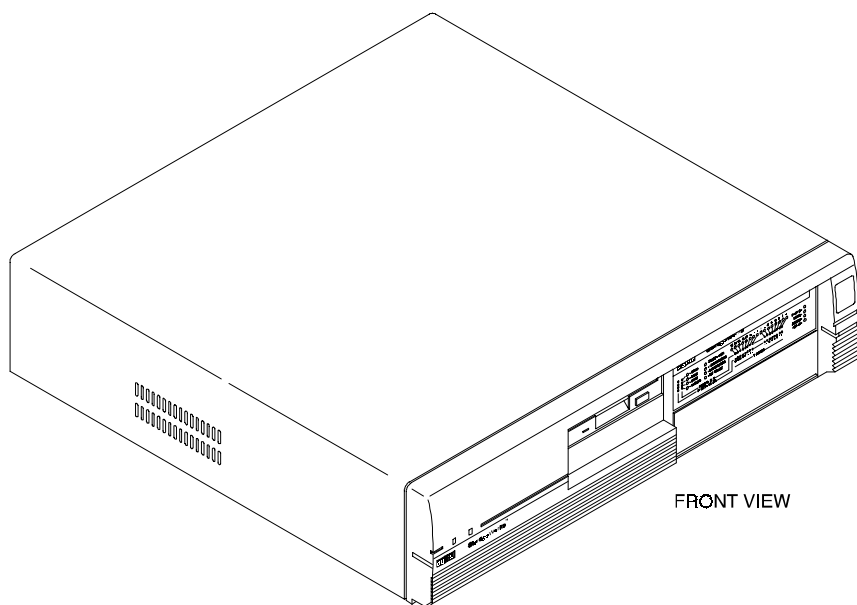
DWZGA units are Pentium-based and equipped with Differential SCSI interfaces and laser-based FO interfaces. Each DWZGA unit is packaged as a desktop enclosure and includes a rack mounting kit for users who require, or prefer, rack mounting.

#### **1.1.2 DWZGA Approach**

The simplest approach to interfacing extenders with SCSI buses is to pass signals through boxes, attempting to create at a remote connector the signals present at a local connector. The SCSI interface does not lend itself well to this approach for several reasons:

1. SCSI features which are important for overall system performance, such as arbitration and disconnect/reconnect, are dependent on the total cable lengths being short enough for control signals to reach all devices on the bus within certain maximum times.
2. SCSI features which provide for more complex system architectures, such as multi-initiator configurations, also depend on the cable length being short enough for control signals to reach all devices within certain maximum times.

**Figure 1-1 DWZGA Unit**



SHR-I001

3. Because SCSI data transfers are not protected by error codes, such as ECC, it is critical that we have an effective method for protecting the validity of data as it is transferred and converted; that is, differential SCSI to fiber optic, fiber optic to differential SCSI.

Rather than serving as a simple electrical converter, the DWZGA uses industry standard SCSI controllers to perform SCSI transactions at each DWZGA unit, preserving the integrity of SCSI system timing requirements by establishing an effective cable length that does not extend across the fiber, and is within the SCSI specifications (25 meters for differential systems). The DWZGA unit attached to a Host assumes the characteristics of a string of peripherals, while the DWZGA unit attached to the remote string of peripherals assumes the characteristics of a Host.

Additionally, DWZGA provides a number of features designed to ensure data integrity during transfer, including:

1. Every byte of data transferred by a DWZGA unit across the FO link is echoed by the receiving unit and then checked against a copy of the data which was sent. During SCSI reads, peripheral data is sent from the REMOTE unit to the LOCAL unit, and echoed back to the REMOTE unit for comparison. During SCSI writes, HOST data is sent from the LOCAL unit to the REMOTE unit and echoed back to the LOCAL unit for comparison. In order for a SCSI operation to complete successfully, all data must match. Because the fiber optic interface is full duplex (data can be transferred in both directions simultaneously) and the SCSI interface is half duplex (data is only transferred in one direction at a time) there is no impact on system performance.
2. All data buses are protected by vertical parity, as well as other circuitry which detects conditions such as under/over-run.
3. The fiber optic interface uses 8B/10B encoding, and any single invalid code detected by the fiber optic receiver will cause an operation to be flagged and reported as being in error.
4. The transfer count in both DWZGA units (REMOTE and LOCAL) are compared at the end of an operation, and must match.

At the end of each operation, the LOCAL DWZGA unit attached to the HOST checks that no errors were reported by the peripheral, the REMOTE DWZGA unit attached to the peripheral, or the LOCAL DWZGA unit itself. Any errors detected are reported using standard SCSI check status/sense data reporting techniques, and can therefore be diagnosed as required.

### 1.1.3 System Level Operation

The following discussion of typical operations serves to illustrate how DWZGA works at the system level.

The HOST selects the LOCAL DWZGA unit attached to it. Then the HOST transfers a command to the selected LOCAL DWZGA unit, with the LOCAL DWZGA unit acting as a string of peripherals. If the HOST allows disconnects, the LOCAL DWZGA unit disconnects from the SCSI bus, allowing additional SCSI commands to be transferred, either to different peripheral addresses or from different initiators. Commands are immediately stored and forwarded from the LOCAL DWZGA unit attached to the HOST to the REMOTE DWZGA unit attached to the peripherals, then the peripherals are selected and the commands transferred to them in the order received.

When a peripheral indicates it is ready for data transfer, either by responding with data phase immediately following selection and command transfer, or after a disconnect/reconnect sequence, the LOCAL DWZGA unit attached to the HOST is instructed to reconnect to the appropriate HOST for data transfer. Once all of the connections are in place (peripheral to REMOTE DWZGA, and LOCAL DWZGA to HOST) data transfer is enabled. At this point, DWZGA serves as a long data path, allowing data to flow through from HOST to peripheral (SCSI write) or peripheral to HOST (SCSI read). SCSI data handshakes are handled locally by each DWZGA unit, and do not extend across the fiber, thereby eliminating potential performance impacts due to propagation delays in driving control signals back and forth across the fiber, even when transferring data asynchronously.

This flow-through technique is used rather than store-and-forward (as in the case of SCSI commands) to avoid latency. This way, data transfer occurs in almost the same time as with the peripheral directly connected to the HOST.

### 1.1.4 SCSI Configuration

A DWZGA link, two DWZGA units create one DWZGA link, can be inserted anywhere in a typical SCSI cabling topology with one caveat: *SCSI commands can only be extended in one direction*; that is, from a HOST, or HOSTS, at a LOCAL DWZGA unit to a peripheral or peripherals at a REMOTE DWZGA unit.

Each DWZGA unit has a front panel with 4 switches for setting certain DWZGA SCSI features, and 16 switches for setting the SCSI addresses of the targets (peripherals) which are being extended by the DWZGA. Each of the 16 switches represents one of the possible SCSI physical unit addresses in a wide SCSI subsystem.

All Digital Equipment Corporation DWGZAs support both wide and narrow SCSI buses as defined by the SCSI specifications, and will respond to synchronous data transfer negotiations to a maximum rate of 20 million transfers per second and a maximum offset of 16, and wide data transfer negotiations to a maximum of 16 bits per transfer (ULTRA Wide). All other lesser negotiations, such as slower synchronous, asynchronous, and narrow data transfers are also supported.

### **1.1.5 Optical Data Link (ODL)**

The DWZGA currently provides LASER-based ODL w/ Duplex SC connector.

The ODL uses a 1300nm wavelength. DIGITAL recommends singlemode fiber. When choosing components for a laser-based cabling system using singlemode fiber, ensure that all components are designed for use with singlemode cable (9 micron).

## 1.1.6 Special SCSI Considerations

### 1.1.6.1 Target Selection Time-Outs

When a DWZGA unit detects a selection time-out while attempting to select a target, it will instruct the other DWZGA (attached to the HOST) to respond to one additional SCSI command for that target address — which should be a Request Sense in response to the check status returned for the original command — and then not respond to that target address for a short period of time (10 seconds), causing a selection time-out at that target address for the HOST. This is required by some systems which only recognize a target's *absence* by selection time-outs, as opposed to a reported Not Ready condition.

### 1.1.6.2 Data Transfer Disconnect Control (DTDC)

Because of the method employed by the DWZGA in establishing a flow-through data transfer, the DWZGA will attempt to set the DTDC field in mode page 02 (Disconnect-Reconnect Page) to 01b for any device attached to the DWZGA which reports itself to be a Direct Access Storage Device (disk drive), instructing the peripheral not to disconnect in the middle of a data transfer. Note that the peripheral may disconnect between command transfer and data transfer, and between data transfer and ending status, thus ensuring support for performance-minded events such as overlapping seeks).

### 1.1.6.3 Selection/Reselection Collisions

It is possible, and in fact quite likely in systems with multiple targets, that an initiator could select a LOCAL DWZGA at the same time that a target has reselected a REMOTE DWZGA for data transfer. In most, cases, the LOCAL DWZGA will simply accept and queue the incoming SCSI command, disconnect, and then reconnect to the appropriate initiator for the data transfer which is indicated by the target's reconnection to the REMOTE DWZGA.

In the case where an initiator has selected a LOCAL DWZGA without allowing disconnects (by setting Disconnect OK [DOK] false in the identify message), the LOCAL DWZGA will return busy status to the initiator so that it may then begin arbitration for the bus and subsequent reconnection for data transfer with the target. The initiator should re-attempt the selection after the subsequent reselection.



### 1.1.6.4 SCSI Resets

SCSI resets which are detected at a DWZGA unit are propagated across the fiber to, and regenerated by, the other DWZGA unit. Additionally, a DWZGA unit may generate its own SCSI reset to recover from serious error conditions.

## 1.2 Specifications

| Characteristic      | Value   |
|---------------------|---|
| SCSI                |   |
| Number of channels: | 1   |
| Maximum data rates: | 10 MB/sec, 8-bit synchronous                        |
|                     | 20 MB/sec, 16-bit synchronous                       |
|                     | 5 MB/sec, 8-bit asynchronous                        |
|                     | 10 MB/sec, 16-bit asynchronous                      |
| Bus width:          | Narrow, 8-bit or wide, 16-bit                       |
| Electrical:         | Differential  |
| Connector:          | (2) 68-pin high density SCSI P-type (female)        |
| Termination:        | External differential                               |
|                     | Terminator power optionally supplied by DWZGA unit. |
| Fiber               |   |
| Type:               | 9 micron/1300nm singlemode                          |
| ODLs/connectors:    | 1300 nm laser/duplex SC                             |
| Encoding:           | 8B/10B  |
| Data rate:          | 260 MBaud/ 26 MB/sec maximum                        |

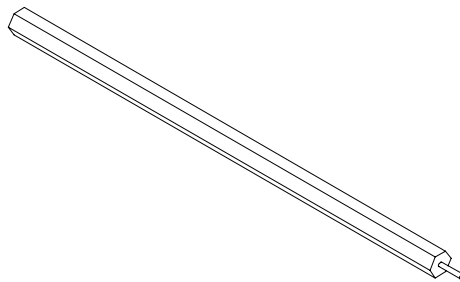
| Characteristic | Value  |
|----------------|--|
| Platform       |  |
| Processor:     | Intel Pentium  |
| Power supply:  | 100 – 120V ac, 6-amp maximum, or<br>200 – 240V ac, 4-amp maximum;<br>switch selectable |
| Dimensions:    | 6.5 in., height<br>16.5 in., width<br>17.0 in., depth                                  |
| KVA:           | 0.360  |
| BTU:           | 1200   |

### 1.3 Switch Setting Tool

Figure 1–2 shows the switch setting tool supplied with each DWZGA unit. Use this tool to set the rocker-type DIP switches mounted behind holes drilled in the front panel of each DWZGA unit. Insert the switch setting tool into the desired hole and push until you feel the switch move and the associated front panel LED change. If the switch doesn't move easily, do not force the tool into the hole. Instead, move the tool to align it with the switch.

If the switch setting tool is unavailable, a paper clip may be substituted. Re-form the exposed end of the paper clip 90 degrees and insert the re-formed end into the desired hole.

**Figure 1–2 Switch Setting Tool**



SHR-1005



**Table 1–1 DWZGA Unit Front Panel Descriptions**

| No. | Designation   | State   | Description  |
|-----|---------------|---------|--|
| 1   | PUSH TO SET   | Pressed | 4 rocker-type DIP switches — Each switch enables an associated function described below (No. 2, 3, 4, and 5) and lights that function's green LED indicator adjacent to the switch.                        |
|     | PUSH TO CLEAR | Pressed | Disables associated function and turns off its adjacent green LED indicator.   |
| 2   | TPWR          | On      | Green LED indicates DWZGA-supplied diode-protected terminator power enabled when associated PUSH TO SET switch is pressed. (See No. 9, below.)   |
|     |               | Off     | Indicates DWZGA-supplied diode-protected terminator power disabled when associated PUSH TO CLEAR switch is pressed. (See No. 9, below.)  |
| 3   | WIDE*         | On      | Green LED indicates DWZGA-initiated wide data transfer request enabled when associated PUSH TO SET switch is pressed   |
|     |               | Off     | Indicates DWZGA-initiated wide data transfer request disabled by pressing PUSH TO CLEAR switch   |
| 4   | SYNC*         | On      | Green LED indicates DWZGA-initiated synchronous data transfer request enabled when associated PUSH TO SET switch is pressed.   |
|     |               | Off     | Indicates DWZGA-initiated synchronous data transfer request disabled when associated PUSH TO CLEAR switch is pressed.  |
| 5   | UA/DISC*      | On      | Green LED indicates DWZGA unit attention request enabled when associated PUSH TO SET switch is pressed (target role). Can also show <i>special</i> DWZGA data transfer disconnect control (initiator role) |
|     |               | Off     | Shows DWZGA unit attention request disabled when associated PUSH TO CLEAR switch is pressed (target role). Can also show <i>standard</i> DWZGA data transfer disconnect control (initiator role)           |

**Table 1–1 DWZGA Unit Front Panel Descriptions (Cont.)**

| No. | Designation                | State     | Description  |
|-----|----------------------------|-----------|--|
| 6   | DIFFSENSE                  | On        | Red LED indicates single-ended device connected to differential SCSI bus. DWZGA drivers are disabled. Situation must be corrected.   |
| 7   | DIFFERENTIAL               | On        | Green LED indicates DWZGA is configured for use on differential SCSI bus. This configuration is factory set and cannot be field modified.  |
| 8   | SINGLE-ENDED<br>(not used) | Off       | Green LED off to be consistent with DIFFERENTIAL LED on, above. (If on, LED would indicate DWZGA unit incorrectly configured at factory for single-ended SCSI bus.)  |
| 9   | TERMPower                  | On        | Green LED indicates that DWZGA detects SCSI terminator power.  |
| 10  | TARGETS                    | On        | Green LEDs 0 through 15 driven directly from associated switches. Each LED indicates corresponding PUSH TO SET target ID switch is pressed. (See No. 15.)  |
|     |                            | Off       | Each unlit LED indicates its corresponding PUSH TO CLEAR switch is pressed.  |
| 11  | POWER                      | On        | Green LED indicates DWZGA unit power is on. (See No. 16, below.)   |
| 12  | FIBER                      | Off       | Green LED indicates no fiber-optic power detected. DWZGA units load firmware from floppy diskette. (See No. 17, below.) Within 60 seconds of turn on, DWZGA should be operational and LED indicates state of DWZGA unit's connection to other DWZGA unit as follows: |
|     |                            | Blinks 1x | Fiber-optic power detected — waiting for receiver synchronization.   |
|     |                            | Blinks 2x | Fiber-optic power detected and receiver synchronized — waiting for fiber interface state change.   |
|     |                            | Blinks 3x | Other DWZGA unit reporting itself non-operational.   |
|     |                            | Blinks 4x | Other DWZGA unit reporting itself off-line.  |
|     |                            | Blinks 5x | Other DWZGA unit resetting its fiber-optic interface.  |

**Table 1–1 DWZGA Unit Front Panel Descriptions (Cont.)**

| No. | Designation                                      | State                  | Description  |
|-----|--|------------------------|--|
|     |  | Blinks 6x              | Waiting for fiber-optic interface reset to complete.   |
| 12  | FIBER (cont.)                                    | On (solid)             | Power on self test successfully completed.   |
| 13  | ACTIVE   | On                     | Green LED indicates DWZGA unit is initiating commands, responding to commands, or transferring data  |
| 14  | ERROR  | On                     | Red LED indicates an internal DWZGA unit error has occurred.   |
| 15  | TARGETS PUSH TO SET<br><br>TARGETS PUSH TO CLEAR | Pressed<br><br>Pressed | 15 rocker-type DIP switches tell the initiators attached to the DWZGA unit which target ID addresses are attached to the DWZGA unit on the other side of the fiber. Each switch lights a corresponding target ID indicator. (See No. 10, above.)<br><br>Each switch turns off its associated LED to show the state of switch and deselect the DWZGA unit initiator for that target ID. |
| 16  | (Power Switch)                                   | Pressed to on          | Alternate action push-button switch connected to ac source in series with 1/0 rocker-type switch on rear panel — Energizes DWZGA unit when 1/0 switch is at 1 (on).  |
| 17  | (Floppy Drive)                                   | --                     | 3.5-in. floppy diskette drive used for firmware diskette — DWZGA unit may be started by pressing power switch on with firmware diskette in drive. Firmware will load automatically and DWZGA unit will be fully operational in 60 seconds.   |

\*See section 1.5, Switch Setting Information for recommendations.

## 1.5 Switch Setting Information

DIGITAL strongly recommends setting SYNC to on, WIDE to on, and UA/DISC to off for all applications. Other settings may be used with older target equipment; that is, disk and tape drives, but efficiency may be degraded.

Table 1–2 provides additional information on the SYNC and WIDE settings for both LOCAL and REMOTE DWZGA units.

Table 1–3 provides additional information for UA/DISC settings. As defined in the table, the effect of these settings differs with application; that is, whether the DWZGA unit is used as a LOCAL or REMOTE.

**Table 1–2 SYNC and WIDE Switch Settings for Both LOCAL and REMOTE DWZGA Unit Applications**

| Switch | Position | Effect   |
|--------|----------|--|
| SYNC   | On       | DWZGA unit <i>can</i> initiate data transfer in synchronous mode, or support it if initiated elsewhere.  |
|        | Off      | DWZGA unit <i>cannot</i> initiate data transfer in synchronous mode, but <i>can</i> support synchronous mode if initiated elsewhere.   |
| WIDE   | On       | DWZGA unit <i>can</i> initiate wide data transfer and support wide data transfer if initiated elsewhere.   |
|        | Off      | In combination with SYNC off (SYNC off / WIDE off), DWZGA unit supports wide data transfer if initiated elsewhere.<br><br>In combination with SYNC on (SYNC on / WIDE off), DWZGA unit completely disables wide data transfer, and does not support wide data transfer if initiated elsewhere. This combination (SYNC on / WIDE off), could be useful when a wide device is configured into a narrow cabling scheme. |

**Table 1–3 Unit Attention/Disconnect Control (UA/DISC) Switch Settings for Both LOCAL and REMOTE DWZGA Unit Applications**

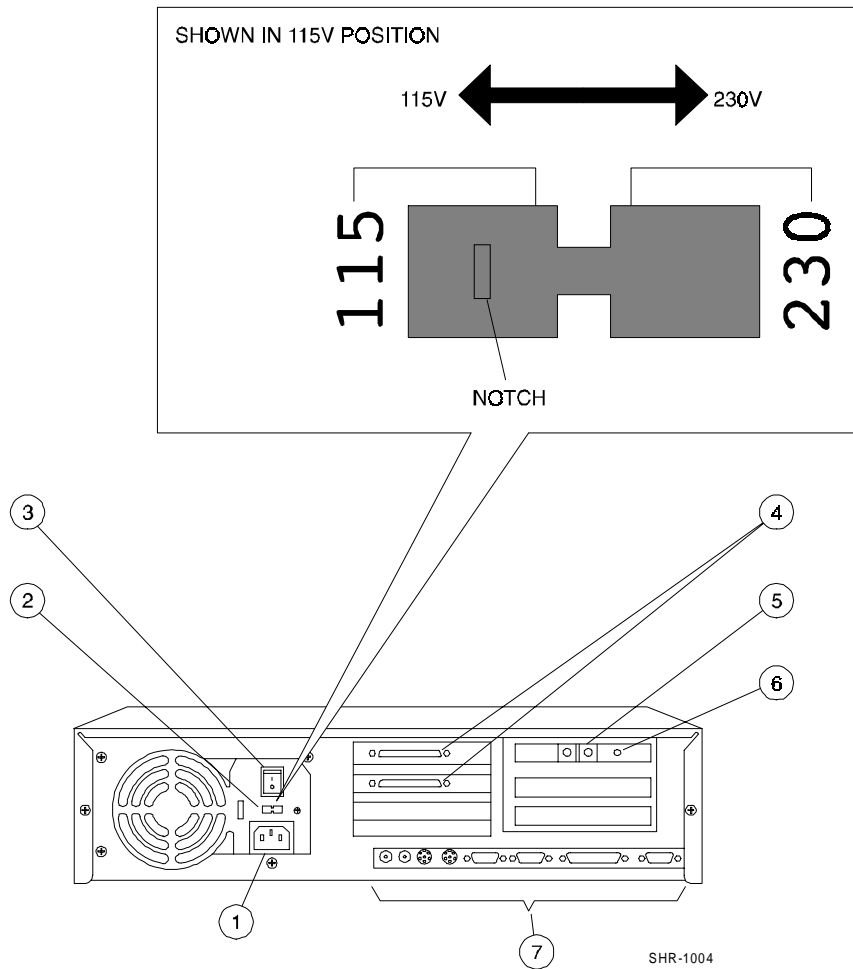
| <b>DWZGA Unit Application</b> | <b>UA/DISC Switch Position</b> | <b>Effect</b>   |
|-------------------------------|--------------------------------|---|
| LOCAL                         | On                             | <p><b>Unit Attention feature of switch</b> — DWZGA reports unit attention check on DWZGA power cycle; that is, when DWZGA is powered off, then on again. UA report helps recovery from power cycle, but can be a problem if target also issues UA.</p> <p><b>Disconnect Control feature of switch</b> — Prevents DWZGA unit from disconnecting regardless of state of disconnect bit in identification (ID) message. Forces input/output (I/O) from HOST to be single threaded.</p> |
|                               | Off                            | <p><b>Unit Attention feature of switch</b> — DWZGA does not report unit attention check on DWZGA power cycle. Allows target-initiated negotiation to re-establish coordinated state with first command issued.</p> <p><b>Disconnect Control feature of switch</b> — DWZGA passes on disconnect bit in ID message, thereby permitting disconnection for increased data transfer efficiency.</p>  |
| REMOTE                        | On                             | <p><b>Unit Attention feature of switch</b> — Has no effect on REMOTE DWZGA.</p> <p><b>Disconnect Control feature of switch</b> — DWZGA disables disconnect bit in ID message. This permits disconnection and allows multiple operations from HOST to LOCAL side DWZGA, but single threads I/O from REMOTE DWZGA to target.</p>  |
|                               | Off                            | <p><b>Unit Attention feature of switch</b> — DWZGA does not report unit attention check on DWZGA power cycle. Allows target-initiated negotiation to re-establish coordinated state with first command issued.</p> <p><b>Disconnect Control feature</b> — DWZGA unit passes on disconnect bit in ID message, thereby permitting disconnection to allow multiple operations and improve data transfer efficiency.</p>  |



## 1.6 Rear Panel Equipment

Figure 1-4 shows the rear panel of a DWZGA unit containing switches, connectors, and an LED indicator. Numbered callouts on Figure 1-4 are keyed to the descriptions in Table 1-4.

Figure 1-4 Rear Panel of DWZGA Unit



**Table 1–4 DWZGA Unit Rear Panel Descriptions**

| No. | Designation  | State                 | Description   |
|-----|--|-----------------------|---|
| 1   | AC POWER INLET   | --                    | Connector receptacle — Accepts power cord supplied with each DWZGA unit to connect unit to a 100 – 120V ac, 6-amp maximum, or 200 – 240V ac, 4-amp maximum power source.  |
| 2   | 115/230  | 115<br><br>230        | Voltage selector slide switch — Notch at 115 designates 115V position. Switch is factory set to this position to power DWZGA unit from a 115V ac source<br><br>Moving notch to 230 position conditions DWZGA unit for 230V ac source.                             |
| 3   | 1/0 (Power Switch)   | 1 (on)<br><br>0 (off) | Rocker-type switch supplies ac power to power switch on DWZGA unit front panel. (See section 1.5.)<br><br>Removes ac power, and therefore on/off power control, from power switch on front panel.   |
| 4   | (SCSI Connectors)  | --                    | 2, 68-pin high-density SCSI P-type, female SCSI connectors  |
| 5   | (Fiber-Optic Port)   | --                    | Duplex SC connector equipped with removable rubber plug — Designed to accept laser-based optical data link (ODL), 1300-nanometer wavelength, singlemode cable with 9-micron core diameter — polarization of the fiber-optic connector ensures correct connection. |
| 6   | (Green LED)  | On<br><br>Off         | Indicates that module within DWZGA unit is operational with no problems.<br><br>When DWZGA unit is energized, indicates that module is defective, or fiber link is open.  |
| 7   | AUDIO<br>MIC IN<br>KEYBD<br>MOUSE<br>COM 1<br>COM 2<br>PARALLEL<br>VIDEO | --                    | 8 connectors presently unused: audio, microphone input, keyboard, mouse, communications 1, communications 2, parallel, and video  |

# 2

## *Installation*

---

*This chapter contains procedures for unpacking and cabling the LOCAL and REMOTE DWZGA units. It also lists tools required for the installation.*

---

### **2.1 Unpacking**

Inspect the package to ensure it contains a DWZGA unit, power cord, switch setting tool, SCSI bus terminator, firmware diskette, diagnostic diskette and user's guide. Contact the distributor for a replacement if any item is missing or damaged.

### **2.2 Tools Required**

- Switch setting tool for operating PUSH TO SET/PUSH TO CLEAR switches on DWZGA unit front panel — If you misplace this tool, substitute a re-formed paper clip as explained in section 1.3, Switch Setting Tool.
- Small, slotted-head screwdriver for connecting and removing SCSI connector(s) and terminator

### **2.3 Cabling**

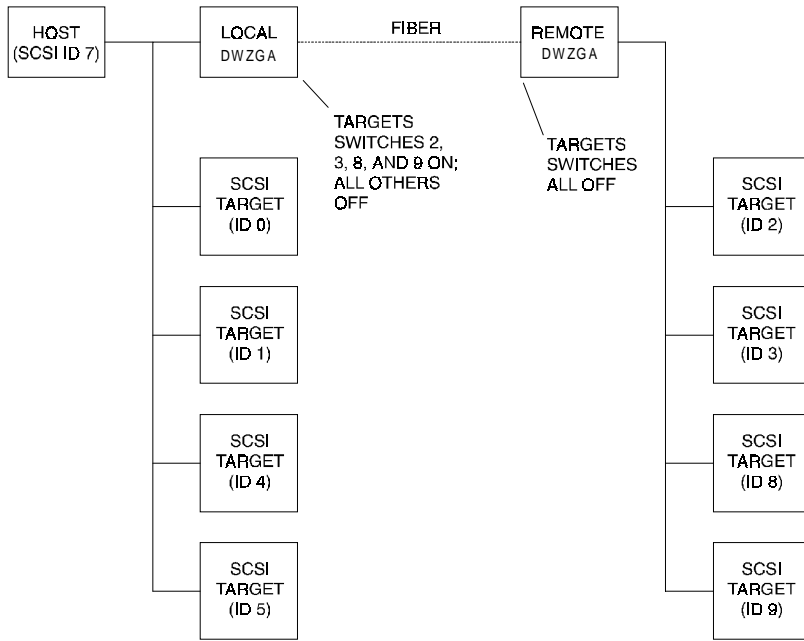
Figure 2–1 shows a typical fiber-optic UltraSCSI extender configuration. The following procedure contains the cabling required to implement this configuration. The LOCAL and REMOTE DWZGA units are physically identical, but configured differently. You may need to modify the procedure to match your own configuration.

#### **NOTE**

If necessary, identify controls, connectors, and indicators specified in the following procedures by referring to sections 1.4, Front Panel Equipment, and 1.5, Rear Panel Equipment.

1. Shut down any host(s) to be connected to the LOCAL DWZGA unit.

Figure 2-1 Typical Fiber-Optic UltraSCSI Extender Configuration



SHR-1003

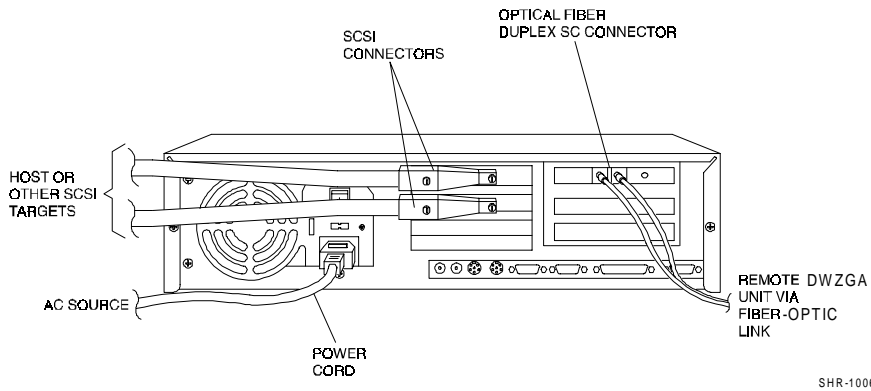
2. Press 0 on the 0/1 power switch on the rear panel of the LOCAL DWZGA unit.
3. If your power source is 115V ac, verify that the notch in the 115/230 voltage selector slide switch is at the factory-set 115 position.
4. If the power cord supplied with the DWZGA is not compatible with the ac wall outlet in your region, obtain a suitable power cord that meets the following criteria:
  - Rated for use at the available ac voltage with a current rating of at least 125% of the current rating of the DWZGA; that is, 7.5 amperes at 100 to 120V ac, or 5 amperes at 200 to 240V ac.
  - The Ac plug must be terminated in a grounding-type male plug designed for use in your region. The plug ends must be labeled or marked to indicate they have been certified by an agency acceptable in your region.
  - The connector at the DWZGA end must be an IEC 320, sheet C13, female connector (or equivalent EN 60 320 connector).
  - The cord must be less than 14.8 feet (4.5 meters) long and, for use in Europe, be created with <HAR> (harmonized) or VDE certified cordage.
5. Connect the power cord to the rear of the LOCAL DWZGA unit as shown in Figure 2–2, and connect the other end of the power cord to an ac source.
6. Connect the SCSI cable from the host to either of the SCSI connectors on the rear panel of the LOCAL DWZGA unit.

**NOTE**

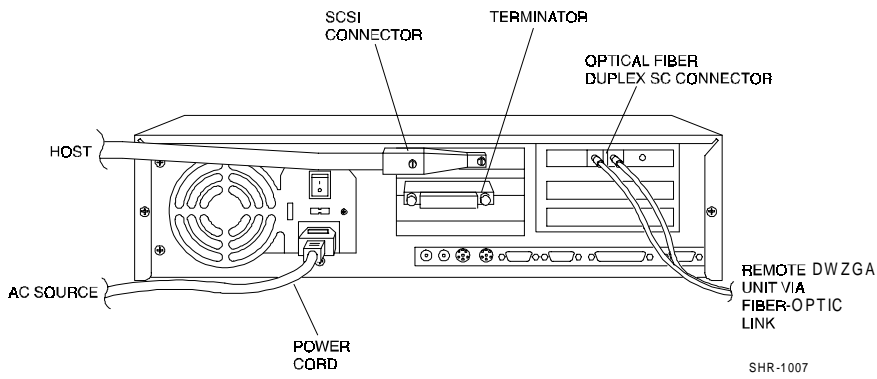
If your configuration has no SCSI targets on the LOCAL DWZGA side of the fiber channel link, omit the following step and put a terminator on the remaining SCSI connector as shown in Figure 2-3.

7. Connect the SCSI cable from SCSI target Ids 0, 1, 4, and 5 to the remaining SCSI connector on the rear panel of the LOCAL DWZGA unit.

**Figure 2-2 Cabling Typical Configuration**



**Figure 2-3 Cabling with Terminator on One SCSI Port**



8. Remove the rubber plug from the rear of the LOCAL DWZGA unit and insert the optical fiber duplex SC connector from the fiber channel link into the mating connector on the LOCAL DWZGA unit. Align the connector keyways to ensure the correct polarity.
9. Repeat steps 1 through 5 for the REMOTE DWZGA unit on the other side of the fiber channel link.
10. Connect the SCSI cable from SCSI target Ids 2, 3, 8, and 9 to either of the SCSI connectors on the rear panel of the REMOTE DWZGA unit.
11. Put a terminator on the remaining SCSI connector on the rear panel of the REMOTE DWZGA unit.
12. Remove the rubber plug from the rear of the REMOTE DWZGA unit and insert the optical fiber duplex SC connector from the fiber channel link into the mating connector on the REMOTE DWZGA unit. Align the connector keyways to ensure the correct polarity.





# 3

## Configuration

---

*This chapter contains procedures for configuring the LOCAL and REMOTE DWZGA units.*

---

### 3.1 Setting Switches on LOCAL Unit

The procedure below specifies the switch settings needed to obtain the typical configuration identified in section 2.3, Cabling. If necessary refer to sections 1.4, Front Panel Equipment, and 1.5, Rear Panel Equipment for information on the DWZGA unit controls and indicators.

1. Press 1 on the I/O rocker-type power switch on the rear panel of the LOCAL DWZGA unit. If the front panel POWER indicator lights, go directly to step 3; otherwise, continue with step 2.
2. Press the alternate action push-button switch on the front panel and verify that the front panel POWER indicator lights. If not, refer to section 5, Troubleshooting.
3. Check the TARGETS LED indicators 0 through 15 to ensure they are all out. If one or more indicators are lit, use the switch setting tool to press the TARGETS PUSH TO CLEAR switch associated with each lighted TARGETS indicator until all are out.
4. Using the switch setting tool, press the TARGETS PUSH TO SET switch to light indicators: 2, 3, 8, and 9.
5. If the TPWR indicator is out, press the associated PUSH TO SET switch to light TPWR, enabling terminator power.
6. If the WIDE indicator is out, press the associated PUSH TO SET switch to light WIDE, enabling wide (16 bit) data transfer. In unusual cases where narrow (8 bit) data transfer is required, leave the WIDE indicator out to enable narrow data transfer.
7. If the SYNC indicator is out, press the associated PUSH TO SET switch to light SYNC, enabling synchronous data transfer. In unusual cases where asynchronous data transfer is required, leave the SYNC indicator out to enable asynchronous data transfer.

8. If the UA/DISC indicator is lit, press the associated PUSH TO CLEAR switch to put out UA/DISC, disabling DWZGA unit attention. In unusual cases where you know unit attention must be enabled, press the associated PUSH TO SET switch, if necessary, to turn on the UA/DISC indicator.
9. Verify that both TERMPOWER and DIFFERENTIAL indicators are lit.
10. Verify that both SINGLE-ENDED and DIFFSENSE indicators are out.
11. Press the alternate action push-button power switch on the front panel and verify that the front panel POWER indicator goes out, de-energizing the whole DWZGA unit.

### **3.2 Setting Switches on REMOTE Unit**

1. At the REMOTE unit, repeat steps 1 through 3 in section 3.1, Setting Switches on LOCAL Unit, above.
2. Check the TARGETS LED indicators 0 through 15 to ensure they are all out.
3. If one or more indicators are lit, use the switch setting tool to press the TARGETS PUSH TO CLEAR switch associated with each lighted indicator until all are out.
4. If the TPWR indicator is out, press the associated PUSH TO SET switch to light TPWR, enabling terminator power.
5. If the WIDE indicator is out, press the associated PUSH TO SET switch to light WIDE, enabling wide (16 bit) data transfer.
6. If the SYNC indicator is out, press the associated PUSH TO SET switch to light SYNC, enabling synchronous data transfer.
7. If the UA/DISC indicator is lit, press the associated PUSH TO CLEAR switch to put out UA/DISC, disabling DWZGA unit attention. In unusual cases where you know unit attention must be enabled, press the associated PUSH TO SET switch, if necessary, to turn on the UA/DISC indicator.
8. Verify that both TERMPOWER and DIFFERENTIAL indicators are lit.
9. Verify that both SINGLE-ENDED and DIFFSENSE indicators are out.

10. Press the alternate action push-button power switch on the front panel and verify that the front panel POWER indicator goes out, de-energizing the whole DWZGA unit.

### 3.3 Startup

1. Complete the cabling procedure in section 2.3, and the switch setting procedures of sections 3.1 and 3.2.
2. Insert the firmware diskette shipped with each DWZGA unit into the 3.5-inch floppy drive in the front panel of the LOCAL DWZGA unit.
3. Repeat step 2 for the REMOTE DWZGA unit.
4. Press the alternate-action push-button power switch on the front panel of the LOCAL DWZGA unit and verify that the front panel POWER indicator lights.
5. Press the alternate-action push-button power switch on the front panel of the REMOTE DWZGA unit and verify that the front panel POWER indicator lights.
6. Verify that within 60 seconds after turning on the last DWZGA unit, the FIBER indicator lights and stays lit, signifying a successful startup.
7. If the FIBER indicator remains off for either or both DWZGA units, or the FIBER indicator blinks in an endlessly repeating cycle, or an ERROR indicator flashes rapidly for 15 seconds followed by the DWZGA unit(s) performing a complete reset, or the DIFFSENSE indicator lights: refer to Chapter 5, Troubleshooting.



# 4

## *Maintenance*

---

*This chapter contains procedures for cleaning the end faces on the fiber-optic cable connectors of the fiber-optic link and the fiber-optic port on each DWZGA unit.*

---

### **4.1 Tools and Materials Required**

Tools and materials required are:

- 3-inch by 3-inch lens paper or soft, lint free cotton cloth
- 91% pure isopropyl alcohol
- Canned air
- 200X viewer (optional)

### **4.2 Fiber-Optic Cable Connectors**

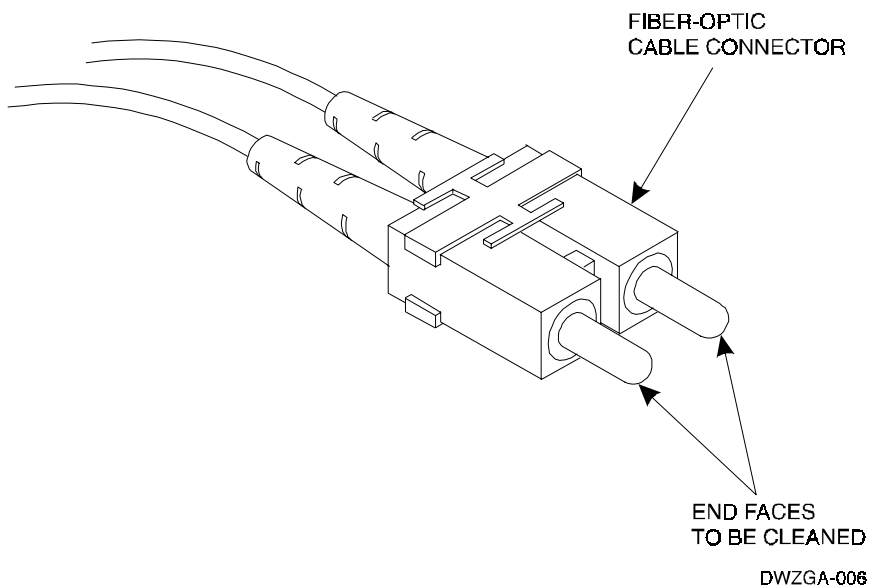
#### **WARNING**

To avoid personal injury, make sure the equipment is de-energized when cleaning the fiber-optic cable connectors.

1. De-energize the equipment.
2. Fold the lens paper or cloth in half.
3. Lightly dampen the lens paper or cloth with the alcohol. Don't saturate the paper or cloth.
4. Lay the dampened paper or cloth on a clean flat surface.
5. Take an additional dry piece of lens paper or cloth, fold it in half, and lay it down adjacent to the piece in the last step.

6. Grasp the fiber-optic cable connector by its locking mechanism and place its end faces near the top of the alcohol dampened lens paper or cloth. The end faces of the connector (Figure 4-1) should be squarely in contact with the lens paper or cloth.

**Figure 4-1 Cleaning Fiber-Optic Cable Connectors**



7. Using the connector's locking mechanism, apply a slight downward pressure on the connector and simultaneously drag and rotate the connector along the length of the lens paper or cloth.
8. Perform this operation two or three times, making sure not to cover the same area of lens paper or cloth previously contacted.
9. While maintaining your grip on the connector, lift it up and move it over to the dry lens paper or cloth adjacent to the alcohol dampened piece.
10. Repeat step 6 using the dry lens paper or cloth instead of the alcohol dampened piece.
11. Repeat step 9 two or three times, making sure not to cover the same area of lens paper or cloth previously contacted.

**WARNING**

The contents of the air duster can used in the following step is under pressure. Do not puncture the container and don't store it near heat or an open flame. Exposure to a temperature above 120 degrees F (49 degrees C) may cause bursting.

12. Blow the connector dry with the canned air to remove any lint.
13. Inspect the connector end faces using the 200X viewer. Check to ensure there are no streaks or debris on the end faces.

**WARNING**

To avoid personal injury while cleaning the fiber-optic ports, make sure the equipment is de-energized as a first step in the following procedures.

### 4.3 Fiber-Optic Port

When the fiber-optic port on the rear panel of a DWZGA unit (Figure 1-4) gets contaminated, the port must be cleaned using one of the three techniques detailed below; namely:

- Air duster (canister),
- In-House air supply, or
- Isopropyl alcohol.

**WARNING**

The contents of the air duster can used in the following procedure is under pressure. Do not puncture the container and don't store it near heat or an open flame. Exposure to a temperature above 120 degrees F (49 degrees C) may cause bursting.

### 4.3.1 Air Duster

1. De-energize the equipment.
2. Hold the can upright.

**NOTE**

In the following step, do not tilt, invert, or shake the can. Tilting or inverting will dispense the contents as liquid instead of air.

3. Direct the nozzle or extension tube of the air duster toward the port opening. Keep the tip of the nozzle or extension tube 2 to 3 inches from the port opening.
4. Press the trigger to dispense the air. Use short, quick blasts.
5. Spray each opening three times.

### 4.3.2 Using In-House Air Supply

The in-house supply used for this procedure must be either:

- Nitrogen, or
- Fully filtered air, water free.

Proceed as follows:

1. De-energize the equipment.
2. Set the air pressure to 15 psi.
3. Direct the air gun nozzle towards the port opening. Keep a distance of 2 to 3 inches between the nozzle tip and the receptacle opening.
4. Repeat steps 4 and 5 in Section 4.3.1.



### 4.3.3 Using Isopropyl Alcohol

**NOTE**

Limit the use of this technique to a maximum of three successive applications.

In an extreme case, where air spraying is not sufficient to clean the contaminants away from inside the port, proceed as follows:

1. De-energize the equipment.
2. With a syringe, or the equivalent, dispense isopropyl alcohol (IPA) inside the module port.
3. Let the IPA stay for at least 10 seconds.
4. Blow dry the inside of the port. Use any of the air spray methods described above.



# 5

## *Troubleshooting*

---

*This chapter contains procedures for troubleshooting the fiber-optic UltraSCSI extender.*

---

### **5.1 Equipment Required**

No equipment is required except the front panel indicators, and one rear panel indicator, on each of the two (LOCAL and REMOTE) DWZGA units.

If you wish to troubleshoot using the diagnostic diskette shipped with each DWZGA unit, refer to the instructions in the Disaster Recovery Solutions Getting Started Guide, fully identified under Associated Documents in the About This Guide section of this document.

### **5.2 Procedure**

Refer to Table 5-1. Identify in the Symptom column the entry that best describes your problem. Then use the corresponding entries in the Probable Cause and Remedy columns to correct the problem. All switches, indicators, and connectors named in Table 5-1 are located on the front panel of the DWZGA unit unless another location is specified.

#### **NOTE**

Do not remove the cover from a DWZGA unit, doing so will void the warranty.

**Table 5–1 Troubleshooting Table**

| Symptom  | Probable Cause   | Remedy   |
|--|--|--|
| POWER indicator stays off when push-button power switch is pressed.  | 0 position on rear panel 1/0 power switch is selected.<br><br>DWZGA power cord connects to outlet with no power because of blown fuse or open circuit breaker. | Select 1 position on 1/0 power switch. If POWER indicator doesn't light, press push-button power switch again.<br><br>Replace fuse or reset circuit breaker and check POWER indicator again. |
| Normal startup, as described in section 3.3, Startup, does not occur. Instead, the DIFFSENSE indicator lights.   | Single-Ended device connected to differential SCSI bus   | Replace single-ended device with device set up for differential signaling.   |
| Normal startup, as described in section 3.3, Startup, does not occur. Instead, the ERROR indicator flashes rapidly for 15 seconds, followed by a pause while the DWZGA unit resets, then the ERROR indicator flashes again in a repeating cycle. | The DWZGA unit is defective.   | Replace the DWZGA unit.  |

Table 5–1 Troubleshooting Table (Cont.)

| Symptom  | Probable Cause  | Remedy   |
|--|---|--|
| Data can't be transferred between the LOCAL HOST and the REMOTE targets through the DWZGA units and the fiber-optic link. The equipment has been started as described in section 3.3, Startup. | <p>The fiber-optic link is open (defective), or the connections to it are dirty.</p> <p>There's a problem with the switch settings on one of the DWZGA units.</p> | <p>Use a telephone to coordinate with a person at the REMOTE end of the fiber-optic link. Check the green LEDs on the rear panel of both the LOCAL and REMOTE DWZGA units. If the LEDs are both lit, the fiber-optic link, and the connections to it, are good. Consider another probable cause.</p> <p>If the green LEDs are other than both on (out or blinking in any combination), shut down the DWZGA units by pressing the front panel power switch on both units. Clean the fiber-optic connectors and ports as described in section 4, Maintenance. Reconnect the fiber-optic cables and power on the DWZGA units again.</p> <p>If the green LEDs are other than both on, the fiber-optic link is probably defective*. Contact the agency that owns or maintains the fiber-optic link and ask them to check it.</p> <p>Repeat the procedures in section 3, Configuration, allowing for differences between the typical configuration and the configuration you require.</p> <p>Check the WIDE indicator. In most cases, it should be lit. If the indicator is out, narrow data transfer is enabled.</p> <p>Check the SYNC indicator. In most cases, it should be lit to enable synchronous data transfer. If the indicator is out, asynchronous data transfer is enabled.</p> <p>Check the UA/DISC indicator. In most installations, it should be out.</p> |

**Table 5-1 Troubleshooting Table (Cont.)**

| Symptom     | Probable Cause   | Remedy   |
|-------------|--|--|
| (Continued) | There's a cabling problem in the installation, or one of the SCSI connectors or terminators has bent pins. | Repeat the procedure in section 2.3, Cabling, allowing for differences between the typical configuration and the configuration you require.<br><br>Remove each SCSI bus connector and terminator to check it for bent pins. If any are found, replace the cable or terminator with a new one. When reconnecting, ensure that each connector is evenly seated with the connector screws securely tightened. |

\* If the rear panel green LED on either DWZGA unit is out, not blinking, there's a possibility that the fiber module in one of the DWZGA units, and not the fiber-optic link, is defective. If a fiber digital data interface (FDDI) duplex SC patch cable is available, you can verify that the fiber-optic link is defective. Shut down the DWZGA unit at either end of the fiber-optic link, disconnect it and take it to the site where the other DWZGA unit is installed. With both units shut down and the SCSI equipment disconnected, use the FDDI duplex SC patch cable to connect the fiber-optic ports on the two DWZGA units together. Then power both DWZGA units on. If one of the green LEDs is out, the fiber module on that DWZGA unit is bad. Replace the DWZGA unit. If the green LEDs both light, the fiber-optic link between the two sites is defective.



## *Manufacturer's Declarations*

---

*This appendix contains the Radio Frequency Interference (RFI) declarations for the StorageWorks Fiber-Optic UltraSCSI Extender.*

---

### **NOTE**

The following statements are applicable to the StorageWorks Fiber-Optic UltraSCSI Extender.

### **USA**

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of FCC rules, which are designed to provide reasonable protection against such radio frequency interference.

Operation of this equipment in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Any modifications to this device — unless expressly approved by the manufacturer — can void the user's authority to operate this equipment under part 15 of the FCC rules.

Shielded interface cables are required.

### **Japan**

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

**CAUTION!**

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures

**ACHTUNG!**

Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkstörungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

**ATTENTION!**

Ceci est un produit de Classe A. Dans un environnement domestique, ce produit risque de créer des interférences radioélectriques, il appartiendra alors à l'utilisateur de prendre les mesures spécifiques appropriées.



## *Reader's Comments*

**Manual Order Number:**

EK-DWZGA-UG. C01

Digital is committed to providing the best products and services. Since our manuals are important components of our products, we value your comments, corrections, and suggestions for improvements. Please take a few minutes to fill out and return this form. Attach additional sheets, if necessary. Thank you.

| <b>Manual Rating</b>                           | Excellent | Good | Fair | Poor |
|--|-----------|------|------|------|
| Accuracy (correct presentation of facts)       | [ ]       | [ ]  | [ ]  | [ ]  |
| Completeness (adequate information)            | [ ]       | [ ]  | [ ]  | [ ]  |
| Clarity (easy to understand)                   | [ ]       | [ ]  | [ ]  | [ ]  |
| Organization (logical sequence of information) | [ ]       | [ ]  | [ ]  | [ ]  |
| Layout (easy to follow subject matter)         | [ ]       | [ ]  | [ ]  | [ ]  |
| Indexing (easy to locate desired information)  | [ ]       | [ ]  | [ ]  | [ ]  |

**Errors Noted** (include page, paragraph, table or figure number) \_\_\_\_\_

**Most-Liked Features:** \_\_\_\_\_

**Least-Liked Feature** \_\_\_\_\_

**Suggestions for Improvement** \_\_\_\_\_

|   |                             |       |       |
|---|-----------------------------|-------|-------|
| <b>Return Address:</b><br>Digital Equipment Corporation<br>Customer Research<br>Response Center<br>ATTN: Nan Andrews Amish<br>334 South Street, SHR3-2/W3<br>Shrewsbury, MA 01545 | Name                        |       | Phone |
|   | Title                       |       |       |
|   | Company                     |       |       |
|   | Street Address              |       |       |
|   | Mail Stop                   |       |       |
|   | City                        | State | ZIP   |
|   | Country (if other than USA) |       |       |

