

D400 Substation Data Manager

User's Manual

994-0089

Version 1.00 Revision 2




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About this Document

Purpose

This manual provides information about installing, setting up, using and maintaining your D400 Substation Data Manager. This manual does not provide any procedures for configuring the software of the D400.

Note that some product features are not yet available and so these are marked as “Future” in the manual.

Intended Audience

This manual is intended for use by field technicians and maintenance personnel who are responsible for the installation, wiring and maintenance of SCADA equipment. This guide assumes that the user is experienced in:

- Electrical utility applications
- Electrical wiring and safety procedures
- GE Energy automation products
- Related other manufacturers’ products, such as protective relays and communications equipment

Additional Documentation

For further information about the D400, refer to the following documents.

- *D400 Product Information* (PRPI-0049)
- Wiring schematics, as available
- *D400 Software Configuration Guide* (SWM0066)
- D400 online help

How to Use this Guide

This guide describes how to install the D400 and get it up and running for the first time.

Procedures are provided for all component options available for the D400. The components included in your D400 depend on what was ordered for your substation application. Follow only the procedures that apply to your D400 model.

The software-related procedures in this guide are based on using a computer running Windows® 2000. Some steps and dialog boxes may vary slightly if you are using Windows XP or Windows 2003.

Document Conventions

This manual uses the *Système International (SI)* and the *Microsoft® Manual of Style* as a basis for styles and conventions.

The following typographic conventions are used throughout this manual:

Bold face is used for:

- Names of software program menus, editors, and dialog boxes; also for the names of menu commands, keyboard keys, icons and desktop shortcuts, and buttons and fields in editors and dialog boxes
- Names of hardware components
- User input that must be typed exactly

Italic face is used for:

- Emphasis
- Cross-references to sections, figures and tables within this manual and for titles of other documents
-
- File and directory names; examples of directory paths are generally given in the Windows format
- Placeholders for user input that is specific to the user. May also include angle brackets around the placeholder if the placeholder is already in italic text. For example, c:\<product>\product.def
- References to a parameter or field value shown

`Monospace` font is used for source code examples and symbols.

Product Support

If you need help with any aspect of your GE Energy product, you have a few options.

Search Technical Support

The GE Energy Web site provides fast access to technical information, such as manuals, release notes and knowledge base topics. Visit us on the Web at:

www.ge.com/energy

Contact Customer Support

The GE Energy Customer Service Center is open 24 hours a day, seven days a week for you to talk directly to a GE representative.

In the U.S. and Canada, call toll-free: **1.800.361.3652**

International customers, please call: **+1 403.214.4600**

Or e-mail to ge4service@ge.com

Product Returns

A Return Merchandise Authorization (RMA) number must accompany all equipment being returned for repair, servicing, or for any other reason. Before you return a product, please contact GE Energy to obtain an RMA number and instructions for return shipments.

GE Energy

Have the following information ready to give to Customer Service:

- Ship to address (the address that the product is to be returned to)
- Bill to address (the address that the invoice is to be sent to)
- Contact name
- Contact phone number
- Contact fax number
- Contact e-mail address
- Product number / serial number
- Description of problem

The Customer Service centre will provide you with a case number for your reference. This case number is *not* the RMA number. You will be sent the RMA number and RMA documents via fax or e-mail. Once you receive the RMA documents, attach them to the outside of the shipping package and ship to GE.

Note: Product returns will not be accepted unless accompanied by the Return Merchandise Authorization number.

1

Before You Start

Before you begin installing and using the D400, review the information in this chapter, including the following topics:

- Safety precautions
- Product overview
- Product specifications
- Storage recommendations

Read and thoroughly understand this guide before installing and operating the unit. Save these instructions for later use and reference.

Warning! Failure to observe these instructions may result in serious injury or death.

1.1 Safety Precautions

Follow all safety precautions and instructions in this manual.









Only qualified personnel should work on the D400. Maintenance personnel should be familiar with the technology and the hazards associated with electrical equipment.

- *Never* work alone.
- Before performing visual inspections, tests, or maintenance on this equipment, isolate or disconnect all hazardous live circuits and sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of back feed.
- Turn off all power supplying the equipment in which the D400 is to be installed before installing and wiring the D400.
- Beware of potential hazards and wear personal protective equipment.

- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.
- All AC voltage and current terminals are protected from accidental contact by a mechanical safety shield.
- All electronic components within the D400 are susceptible to damage from electrostatic discharge. Observe standard precautions for handling electronic components.
- Hazardous voltages can cause shock, burns or death. To prevent exposure to hazardous voltages, disconnect and lock out all power sources before servicing and removing components.
- If the D400 is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

Warning Symbols

The following table explains the meaning of warning symbols that may appear on the D400 or in this manual.

Symbol	Meaning
	The relevant circuit is direct current.
	The relevant circuit is alternating current.
	CAUTION: Refer to the documentation for important operating and maintenance instructions. Failure to take or avoid a specified action could result in loss of data or physical damage.
	WARNING! Dangerous voltage constituting a risk of electric shock is present within the unit. Failure to take or avoid a specific action could result in physical harm to the user.
	CAUTION: Class 1M Laser (IEC 60825-1 Safety of laser products)
	CAUTION: Hot surface
	Earth (Ground) Terminal
	Protective Earth Terminal

1.2 Regulatory Compliance Information

CE Mark Compliance

The D400 is rated as CISPR 11 Group 1 Class “A” equipment.

Note: To provide higher EMC immunity and maintain CE Mark compliance, the serial cables used for permanent RS-232 and RS-485 connections must comply with the following requirements:

- Cables must be shielded
- D type connector covers must provide EMC shielding (e.g. metalized plastic or die cast metal covers)

Warning

Class “A” equipment is intended for use in an industrial environment. The equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference to other devices in the vicinity. If this equipment does cause interference with other devices, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving device
- Increase the separation between the equipment
- Connect the equipment into an outlet on a circuit different from that to which the other device(s) is connected
- Consult the manufacturer or field service technician for help

Restriction of Hazardous Substances (RoHS)



The environmental protection use period (EPUP), as defined in SJ/T11363-2006, for the D400 hardware assemblies listed in the table below is in excess of 20 years.

RoHS Material Declaration Data Content by Assembly

GE Part #	Description	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
500-0340	D400 Substation Data Manager Chassis Assy	X	O	O	TBC	TBC	TBC
520-0190	D400 Power Supply Blank Assembly	O	O	O	O	O	O
520-0191	D400 Adapter Blank Assembly	O	O	O	O	O	O
520-0204	D400 650 MHz Celeron w Single Ethernet	X	O	O	O	O	O
520-0206	D400 USB KVM Assy	X	O	O	O	O	O
520-0207	D400 RS-232 IO Assy	X	O	O	O	O	O
520-0208	D400 RS-485 IO Assy	X	O	O	O	O	O

GE Part #	Description	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
520-0209	D400 Glass Fiber Optic IO Assy	X	O	O	O	O	O
520-0210	D400 Plastic Fiber Optic IO Assy	X	O	O	O	O	O
520-0211	D400 IRIG-B Input Assy	X	O	O	O	O	O
520-0212	D400 IRIG-B Distribution Assy	X	O	O	O	O	O
520-0213	D400 Ethernet 4 Port Switch Assy	X	O	O	O	O	O
520-0214	D400 Hot Standby Ethernet Glass Fiber Optic Assy	X	O	O	O	O	O
520-0216	D400 DC-DC Supply 5V 12A Assy	TBC	O	O	TBC	TBC	TBC
520-0217	D400 AC-DC Supply 5V 12A Assy	TBC	O	O	TBC	TBC	TBC
520-0218	D400 Redundant TP Ethernet + COM2 Port Assy	X	O	O	O	O	O
520-0219	D400 COM2 Port Assy	X	O	O	O	O	O
580-2717	PC/104-Plus 10/100 Base-TX Ethernet RTL8139C	O	O	O	O	O	O
975-0122	Cable Assy, MOD IV 12SKT-12SKT	X	O	O	O	O	O
977-0209/60	Cable, UTP Patch Cord Stranded, 60 Inch	O	O	O	O	O	O
977-0529/72	Cable, Null Modem DB9F-DB9F, 80°C, 150V, 72 Inch	O	O	O	O	O	O

O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit required in PRC SJ/T11363-2006 and EU Directive 2002/95/EC (RoHS)

X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in PRC SJ/T11363-2006 and EU Directive 2002/95/EC (RoHS)

TBC: To be confirmed with third-party parts manufacturer

The maximum concentration limits (MCV's) apply.

Lead	0.1% by weight	=	1000 mg/kg	=	1000 ppm
Mercury (Hg)	0.1% by weight	=	1000 mg/kg	=	1000 ppm
Cadmium (Cd)	0.01% by weight	=	100 mg/kg	=	100 ppm
Chromium VI (Cr VI)	0.1% by weight	=	1000 mg/kg	=	1000 ppm
PBB, PBDE	0.1% by weight	=	1000 mg/kg	=	1000 ppm

1.3 Product Overview

The D400 Substation Data Manager is a secure, substation hardened and CE Marked communications gateway that polls metering, status, event and fault report data from intelligent electronic devices (IEDs). It summarizes the data from IEDs and makes it available to a master station or host computer over standard SCADA protocols. TCP/IP network connections are supported over the built-in 10/100 MB Ethernet interface and a dedicated Modem port (external modem required).

The D400 comes with a built-in human machine interface (HMI)/annunciator as part of the base software - no external software or licensing is required to operate the D400. The substation HMI can be accessed locally through the Keyboard, Video, Monitor interface, or remotely over a standard secure Web browser (HTTPS) connection.

The D400 can be configured “online” through a standard Web browser or “offline” through the Offline Configuration Manager (OCM) - Future.

Hardware Overview

The D400 is built on a flexible, high-performance, expandable platform powered by a 650 MHz processor. It is distinguished by the noticeable lack of a hard drive and fan, employing instead the rugged and reliable CompactFlash mass storage solution.

The D400 supports various communication media types through a choice of input/output (I/O) adapter cards –

- Serial (up to 8 configurable 2-port adapter cards): RS-232, RS-485, Fiber Optic (Glass or Plastic)
- Ethernet: 10/100BaseT, 10BaseFL or 100BaseSX



Features

- Secure Web server (128-bit encryption)
- Secure SCADA communications through Secure Sockets Layer or Transport Layer Security (SSL/TLS)
- Secure access using SSH (Secure Shell)/SCP (Secure Copy)/HTTPS
- Secure terminal server, gateway, and/or data concentrator using SSL/TLS
- User configurable security levels/access
- Support for remote user authentication
- Built-in alarm annunciator
- Support for time synchronization signals, including Network Time Protocol (NTP) and IRIG-B
- Support for multiple SCADA protocols for communications to multiple masters
- High-performance real-time database engine

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- Internal Mini SQL™ database for archival of SOE and alarm records
- Built-in basic math/logic functions
- IEC 61131-3 soft logic engine - Future
- Event notification (e-mail)
- Portable memory device plug-in
- Dual CompactFlash cards for system and user storage
- Dual hot swappable power supply units
- Hot swappable communication adapter cards

1.4 Product Specifications

The D400 adheres to the following system, communications, electrical, physical and environmental specifications. Additional Standards and Protection are listed in *Appendix A - Standards & Protection*.

System

Processor	650 MHz Embedded CPU with 33 MHz PCI bus
Memory	512 MB of PC133 SDRAM
Storage	No hard drive 512 MB System CompactFlash card 256 MB User CompactFlash card Both expandable to 2 GB
Operating system	Linux
Real-time database	Up to 131,072 data points/128 IEDs 16 MB NVRAM standard for persistent event storage guaranteeing no loss of events
Embedded Mini SQL database	Up to 20,000 SOE reports archived Up to 10,000 alarm records archived
LED indicators	Main module System status: Power, Ready, IRIG-B and Network port status Serial port status: Transmit and Receive status per port Power Supplies Power

Communications

Protocols supported	DNP3.0 Serial and UDP/TCP/IP, SEL Fast Meter Modbus® Serial and TCP/IP, IEC 870-5-101/104/103, Spabus, INCOM, GE Modem, BECO 2200, ASCII, SEL ASCII, IEC 61850 - Future DHCP, Telnet, NTP, HTTPS, SFTP, SSH, SSL, CHAP
Network connections	Single or dual redundant Ethernet interface Fiber Optic and/or Twisted Pair 10/100BaseT (Isolated RJ-45 connector) 10BaseFL and 100BaseSX (Fiber Optic: 820-850 nm, 50/125 µm and 62.5/125 µm multimode duplex fiber cable-ST connectors)

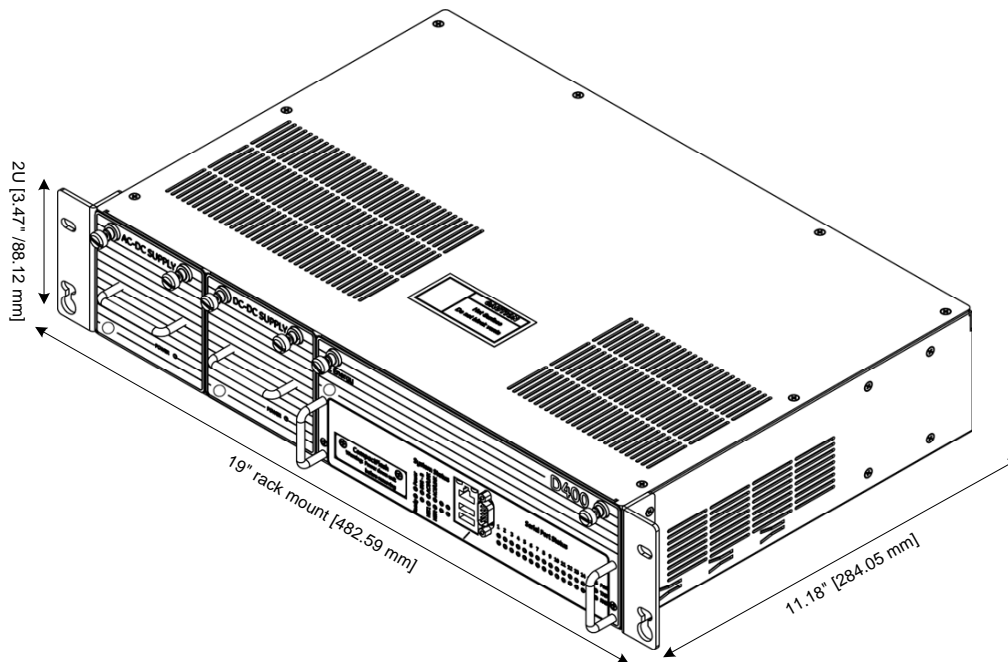
<p>Serial communications</p>	<p>16 channels: RS-232/RS-485/Fiber optic Data rate: 300 to 115.2 Kbps RS-232 Configurable for DCE/DTE operation Galvanic isolation Can drive IRIG-B signal to RS-232 ports (with optional IRIG-B Input card) RS-485 2-Wire/4-Wire support Galvanic isolation Fiber Optic Glass Optical Fiber serial port: (820-850 nm) 50/125 μm, 62.5/125 μm, 100/140 μm and 200 μm HCS multi-mode fiber with ST connectors Plastic Optical Fiber (POF) serial port: (660 nm), 1 mm core with Agilent Versatile Link Simplex connectors Software configurable ambient state (ON/OFF)</p>
<p>Time synchronization</p>	<p>Input Module HCMOS or TTL (demodulated), BNC connector (modulated), Fiber Optic (820-850 nm) ST connector CPU time sync for internal database time stamping Distribution Module Can drive IRIG-B TTL signal for 16 IEDs Signal Propagation Propagated to all 16 RS-232 ports for devices Propagated to the distribution module</p>
<p>KVM & Audio</p>	<p>Three USB v1.1 compliant Type A ports for connecting keyboard and mouse HD D-Sub 15 socket for connecting an industrial SVGA display (in accordance with VESA® Plug & Display Standard) 3.5 mm stereo audio jack for substation alarms</p>
<p>User connections</p>	<p>Front Ethernet port for local network connection Two USB v1.1 compliant Type A ports for portable memory device plug-in Front serial communication port (RS-232) for local maintenance</p>

Electrical

Rated power supplies	AC-DC	100-240 VAC ($\pm 10\%$) 127 VA maximum 100-300 VDC ($\pm 10\%$) 135 W maximum
	DC-DC	20-55 VDC ($\pm 10\%$) 135 W maximum
Peak inrush current at 25 °C on cold start	AC-DC	26.5 A _{peak} (< 145 VAC / 205 VDC)
	AC-DC	40 A _{peak} (< 264 VAC / 370 VDC)
	DC-DC	35 A _{peak} (< 60 VDC)
Rated frequency (AC-DC)	47 to 63 Hz (50/60 Hz)	
Contact closures	Solid-state photo-MOS device Output ratings at maximum ambient temperature: - Continuous current: 0.1 A continuous at 300 VAC / 300 VDC - Peak current: 0.28 A peak for 10 ms - Maximum on resistance: 35 ohm	

Physical

Overall height	2U (3.47") [88.12 mm]
Width	19" rack mount [482.59 mm]
Depth	12.24" [310.95 mm] for chassis and rear connectors 13.04" [331.34 mm] with front clearance for protruding parts



Environmental

Operating temperature	-20 °C to +65 °C Maximum ambient temperature is +50 °C for unit to fully comply with <i>IEC 61010-1 Section 10.1</i> regarding surface temperature limits for protection against burns.
Humidity rating	5 % to 95 % relative humidity, non-condensing
Environmental rating	Ingress protection: IP30 (IEC 60529)
Installation / overvoltage category	CAT III
Pollution degree	2
Use	Indoor use only
Altitude	Maximum altitude 10,000 ft [3000 m]

Software

Firmware	Embedded application dependent
Human machine interface	Built-in graphical user interface (Web browser-based)
Configuration	Built-in graphical user interface (Web browser-based) Offline Configuration Manager (PC-based) - Future
Soft logic	IEC 61131-3 soft logic engine - Future LogicLinx* Editor (if using LogicLinx)

1.5 Storage Recommendations

Storage Conditions

Always store the D400 in an environment compatible with operating conditions. Recommended environmental conditions for storage are:

- Temperature: -40 °C to +90 °C
- Relative humidity: 5 % to 95 %, non-condensing

Exposure to excessive temperature or other extreme environmental conditions might cause damage and/or unreliable operation.

Battery Life

To maintain the life of the battery, you should remove the battery if the D400 will be powered down or stored for more than six months.

See section “7.2 Replacing the Battery”.

2

Installing the D400

This chapter covers the following topics:

- Overview of the steps and tools required to install the D400
- Tour of the product features
- How to physically install the D400 in a rack or substation panel

CAUTION: Before you install and operate the D400, read and follow the safety guidelines and instructions in section “1.1 Safety Precautions”

2.1 Installation Steps

The installation procedure will vary depending on the components ordered and shipped with your D400. Follow the procedures in this manual that apply to the specific hardware configuration of your D400.

» **Follow these main steps to install and set up the D400:**

1. Mount the D400 in the rack or panel. See section “2.5 Physical Installation”.
2. Set up the communication cards. See chapter “3 Setting up Communication Cards”.
3. Make device and network connections. See chapter “4 Connecting to Devices and Networks”.
4. Make power connections and verify operation. See chapter “5 Powering Up the D400”.
5. Install the supplied battery on the D400 main board. See chapter “7.2 Replacing the Battery”.
6. Set up communications with the D400. See chapter “6 Configuring the D400”.

2.2 Required Tools

Before beginning the installation procedures, have the following tools and equipment available:

- Ethernet cable(s)
- Flathead screwdriver with 0.6 mm by 3.5 mm blade (for terminal block wiring)
- Flathead screwdriver with 0.3 mm by 2.5 mm blade (for removing and installing the adapter cards and changing switch positions)
- #1 Phillip screwdriver (for power terminal block wiring and adapter card removal)
- #2 Phillip screwdriver (for rack mounting the unit)
- Needle-nose pliers
- Wire cutters
- Wire strippers
- Wire-crimping tool (Panduit® CT-1525 or equivalent)
- 6 fork connectors, Panduit part number PV14-6F for 14-16 AWG wire or PV18-6F for 18-22 AWG wire (or equivalent) for terminal block connections
- 1 ring connector, Panduit part number PV10-14R for 12 AWG wire (or equivalent) for protective earth terminal
- Approved network settings for the device (default IP-Address: 192.168.168.81; default Subnet Mask: 255.255.255.0)
- Windows-based PC with HyperTerminal® (or any Windows-based terminal emulation software) installed

2.3 Unpacking the D400

Shipping Inspection

Inspect the shipping package before opening it to see if it has sustained any damage from impact or water. If there are visible signs of damage, *report it immediately to the carrier* without opening the box.

Unpacking

Carefully remove the D400 from its packaging. Visually inspect the unit to ensure it has not sustained any visible damage during transit. If there are visible signs of damage, *report it immediately to the carrier*.

Package Contents

The following items are provided as part of your D400 shipment:

- D400 Substation Data Manager unit (Product ID 400-XXXXXXXXXXXXXXXXXX)
- Ethernet cable (GE Part No. 977-0209/60) for local network connection
- Serial null modem cable (GE Part No. 977-0529/72) for local maintenance connection
- ½ AA 3.6 V Lithium Battery (GE Part No. 980-0038)
- User's Manual (GE Part No. 994-0089)
- Mini SQL Proof of License

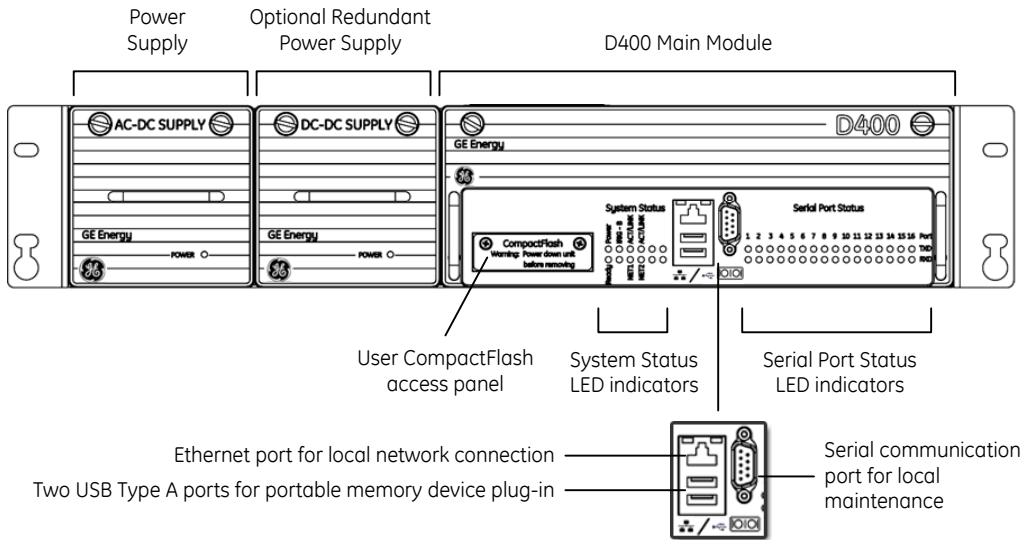
Verify that you have received all items. GE parts include a unique GE part number, typically in the format XXX-XXXX, that can be used as a reference.

Verify the hardware configuration of the D400 using the Product ID number. For an explanation of the Product ID, see Appendix B, "Ordering Guide".

2.4 First Look at the D400

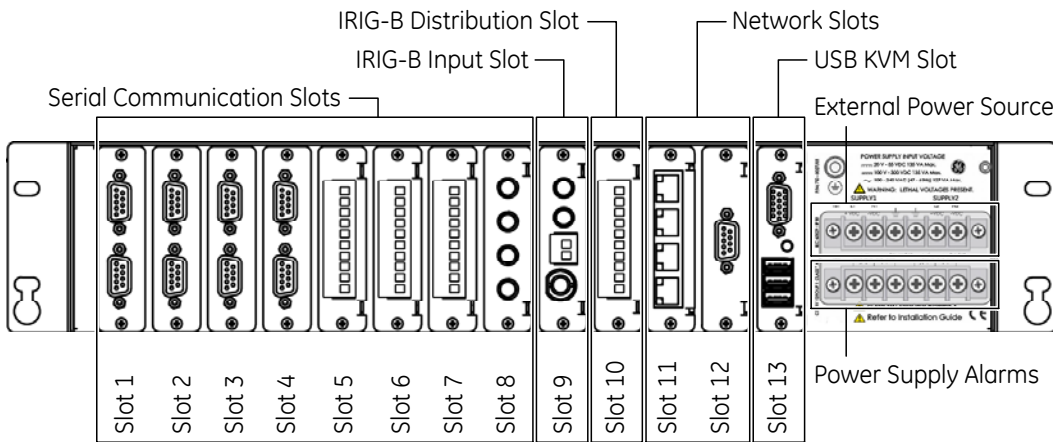
Front Panel

The front panel of the D400 provides easy access to the status indicators, user connections and power supply units.



Rear Panel

The rear panel provides access to the communication ports, field wiring connections and power connections.



The D400 contains 13 I/O adapter card slots for the communication cards. The communication cards are powered from the backplane of the D400. The types of communication cards included in your D400 depend on what was ordered for your substation application.

2.5 Physical Installation

The D400 can be installed in a standard 19-inch rack or substation panel.

Rack Mounting

The D400 mounts directly into an industry-standard 19-inch [482.6 mm] equipment mounting rack with EIA universal mounting rail hole spacing.



The top cover of the D400 can get hot during peak operation. Ensure that there is at least 1U (1.75 inch [44.45 mm]) of free space above the D400 unit for proper ventilation.

When the unit is operating above the 50 °C ambient temperature, safe handling precautions are recommended to prevent burns.

» To mount the D400 on a rack:

1. Position the D400 in the rack.
2. Holding the D400 firmly in the rails of the mounting rack, insert and tighten the four rack screws.

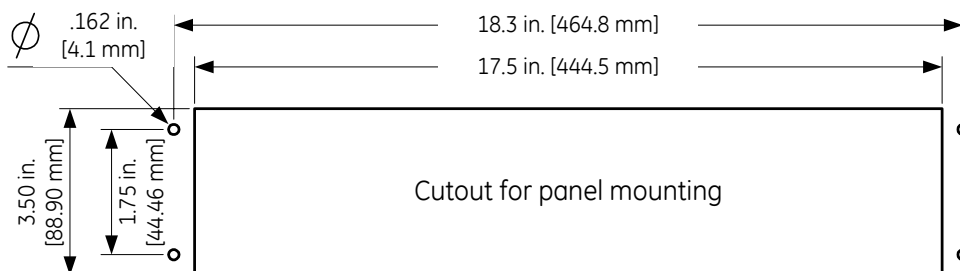
The recommended tool torque settings for zinc-plated mounting screws are:

- 10-32 UNF screws use 22.2 in-lb [2.50 Nm]
- 12-24 UNC screws use 31.0 in-lb [3.51 Nm]
- M5x0.45 screws use 18.1 in-lb [2.04 Nm]
- M6x0.5 screws use 33.3 in-lb [3.76 Nm]

Panel Mount

» To mount the D400 in a panel:

If you are using a panel cutout, use the following cutout dimensions:



3

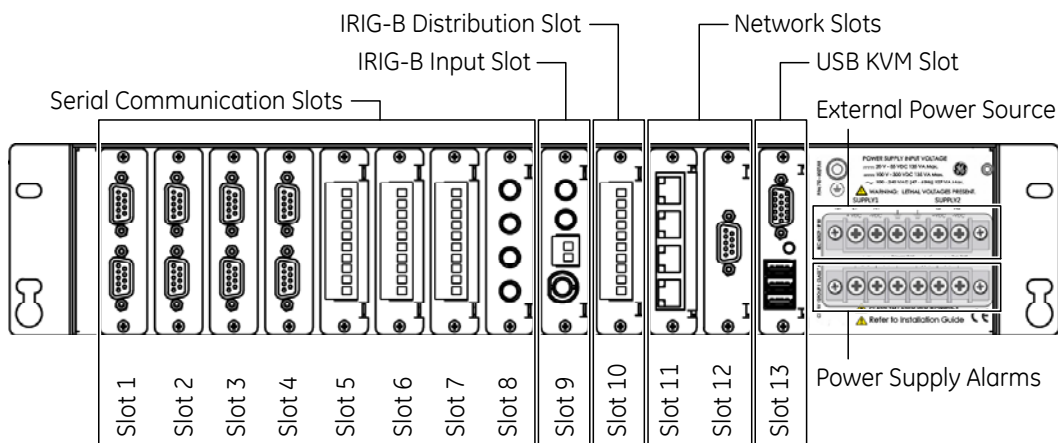
Setting up Communication Cards

This chapter describes the D400 communication cards and how to change the card settings for the different configuration options. The communication cards are factory installed in the D400 with default settings.

3.1 Communication Cards

All communication cards plug into I/O adapter card slots at the rear of the D400 chassis. The communication cards are powered from the backplane of the D400.

D400 I/O Adapter Card Slots



Types of Communication Cards

The types of communication cards included in your D400 depend on what was ordered for your substation application. The following types of communication cards are available for the D400:

Serial (Slots 1 to 8)

- RS-232
- RS-485
- Fiber Optic Serial (glass or plastic)

IRIG-B (Slots 9 and 10)

- IRIG-B Input
- IRIG-B Distribution

Network (Slots 11 and 12)

- 4-Port Twisted-Pair Ethernet Switch
- Hot Standby Fiber Optic Ethernet Switch
- Redundant Twisted-Pair Ethernet + COM2 Port
- COM2 Port

USB KVM (Slot 13)

- Keyboard, Video and Mouse

3.2 Changing Card Settings

The communication cards are factory installed with default settings. You may want to adjust individual card settings to work with your specific system set up. The communication cards are hot swappable -- this means you do *not* have to power down the D400 unit to remove and install the communication cards.

» To change the settings on a communication card:

1. At the rear panel of the D400, using a flathead or Phillips screwdriver loosen (but don't completely remove) the two screws from the top and bottom of the communication card.
2. Using the flathead screwdriver, gently pry the top of the card from the slot and remove it from the chassis.
3. Refer to the instructions in the following sections to make any required changes to the switch settings on the card.

Tip: Use a small flathead screwdriver (same as used to remove the communication card screws) to change switch positions.

4. Slide the card into the same slot you removed it from, and tighten the two screws.
CAUTION: For proper transient protection, the recommended tool torque settings for communication card screws are 2.6 in-lb [0.294 Nm].

3.3 RS-232 Adapter

The RS-232 Adapter (GE Part No. 520-0207) is a standard RS-232 serial I/O adapter card that plugs into any serial communication slot (slots 1 through 8) on the D400. It contains two independently isolated RS-232 serial ports (Port 1 **J3** and Port 2 **J2**) each with a DB-9 connector.

See section “4.3 RS-232 Connections” for typical cable connections.

Configuration Options

The RS-232 card supports the following configuration options on each port:

- DCE (Data Communications Equipment) – as a peripheral
- DTE (Data Terminal Equipment) – as a PC
- +5 V (320 mA) output

In addition, the RS-232 card is configurable to provide an IRIG-B signal (on pin 4) and Ground (on pin 6).

The signal type and pin options for each port are selectable via two sets of switches on the RS-232 card:

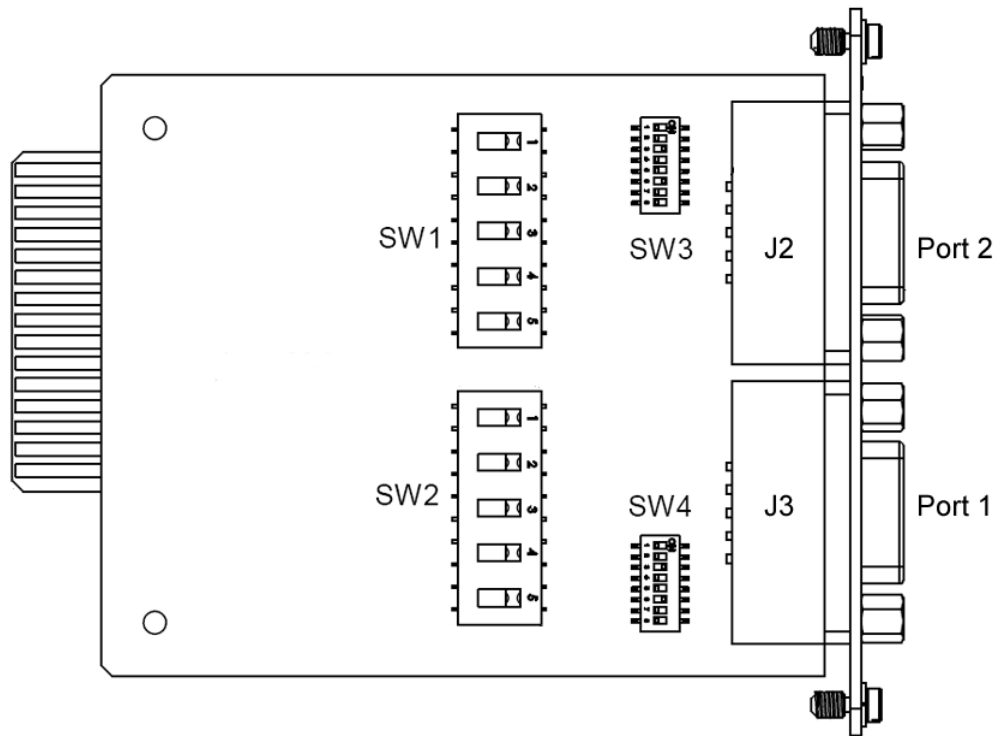
- Port 2 (**J2**) is configured by switches **SW1** and **SW3**
- Port 1 (**J3**) is configured by switches **SW2** and **SW4**

Follow instructions for setting the switches to select the appropriate functions for each port.

Factory Default

The factory default setting is DTE on each port.

RS-232 Adapter Top Side



Switch SW1/SW2 Configuration

Switches **SW1** (for Port 2) and **SW2** (for Port 1) control the signal type of the RS-232 port. Each switch contains five switch positions that can each be set to position **A** or **B** to select the appropriate port option.

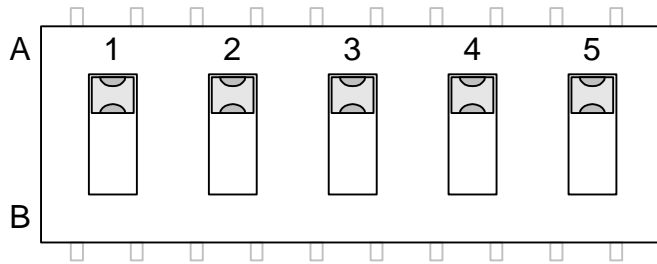
RS-232 Card Switch SW1/SW2 Settings

Port Option	SW1/SW2 Switch Positions				
	1	2	3	4	5
DTE (default)	A	A	A	A	A
DCE	A	B	B	B	B
+5 V (320 mA) isolated source	B	*	*	*	*

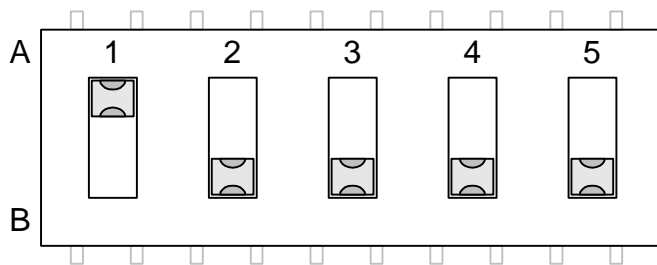
*Use DTE or DCE settings as appropriate

Note: +5 V is an independently isolated and fused output (320 mA at 65 °C).

DTE (default)



DCE



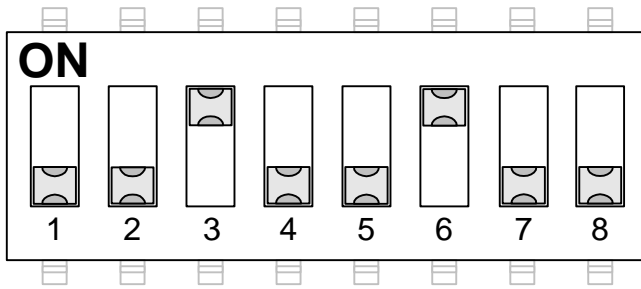
Switch SW3/SW4 Configuration

Switches **SW3** (for Port 2) and **SW4** (for Port 1) control the signals on Pins 4 and 6 of the RS-232 port. Each switch contains four switch positions that can each be set to **ON** or **OFF** to select the appropriate function for the port option. See illustrations below showing the switch positions for each setting.

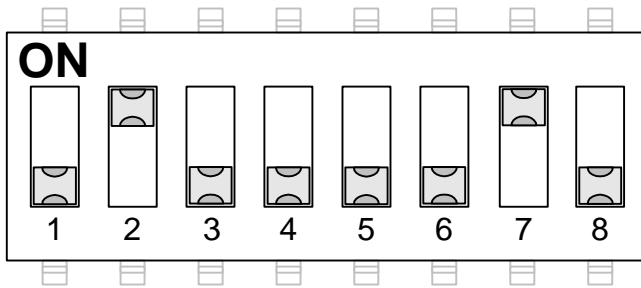
RS-232 Card Switch SW3/SW4 Settings

Function	Pin 6 Signal	SW3/SW4 Positions				Pin 4 Signal	SW3/SW4 Positions			
		1	2	3	4		5	6	7	8
DTE (default)	DSR Input	OFF	OFF	ON	OFF	DTR Output	OFF	ON	OFF	OFF
DCE	DTR Output	OFF	ON	OFF	OFF	DSR Input	OFF	OFF	ON	OFF
IRIG-B Enable	Ground	OFF	OFF	OFF	ON	IRIG-B Output	ON	OFF	OFF	OFF

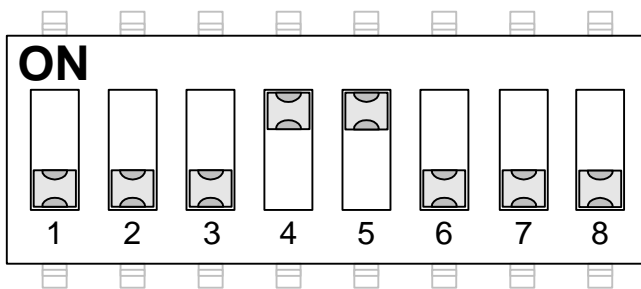
DTE (Pin 4 DTR Output and Pin 6 DSR Input)



DCE (Pin 4 DSR Input and Pin 6 DTR Output)



IRIG-B Enable (on Pin 4) and Ground (on Pin 6)



3.4 RS-485 Adapter

The RS-485 Adapter (GE Part No. 520-0208) plugs into any serial communication slot (slots 1 through 8) on the D400. It contains two independently isolated RS-485 channels on a single terminal block **TB1**: Channel 1 on terminals TB1-1 through TB1-5 and Channel 2 on terminals TB1-6 through TB1-10.

See section “4.4 RS-485 Connections” for typical cable connections.

Configuration Options

The RS-485 card supports two configuration options on each channel:

- 2-wire
- 4-wire

Pull-up/pull-down and line termination selection is available for the RS-485 signals.

The signal mode for each channel is selectable via two sets of switches on the RS-485 card:

- Channel 1 (TB1-1 to TB1-5) is configured by switches **SW2** (top side) and **SW4** (bottom side).
- Channel 2 (TB1-6 to TB1-10) is configured by switches **SW1** (top side) and **SW3** (bottom side).

Follow instructions for setting the switches to select the appropriate functions for each channel.

Factory Default

The factory default setting is 4-wire on each channel without pull-up/pull-down or line termination resistors selected.

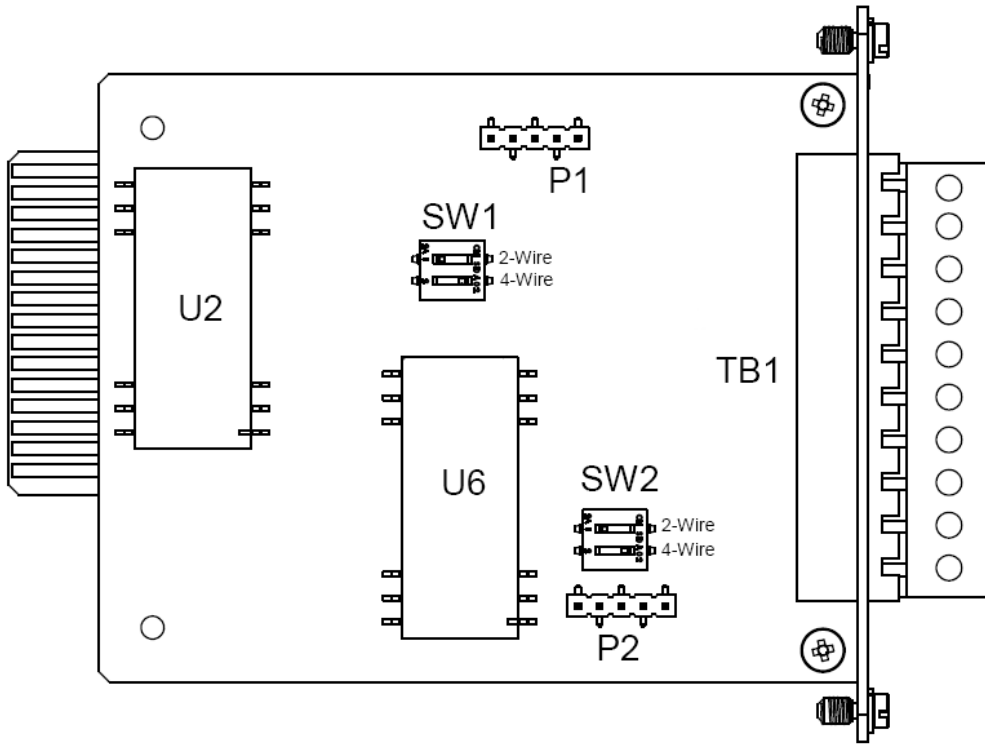
Switch SW1/SW2 Configuration

Switches **SW1** (for Channel 2 on TB1-6 through TB1-10) and **SW2** (for Channel 1 on TB1-1 through TB1-5) control the signal mode for each channel. Each switch contains two switch positions that can each be set to **ON** or **OFF** to select the appropriate channel option.

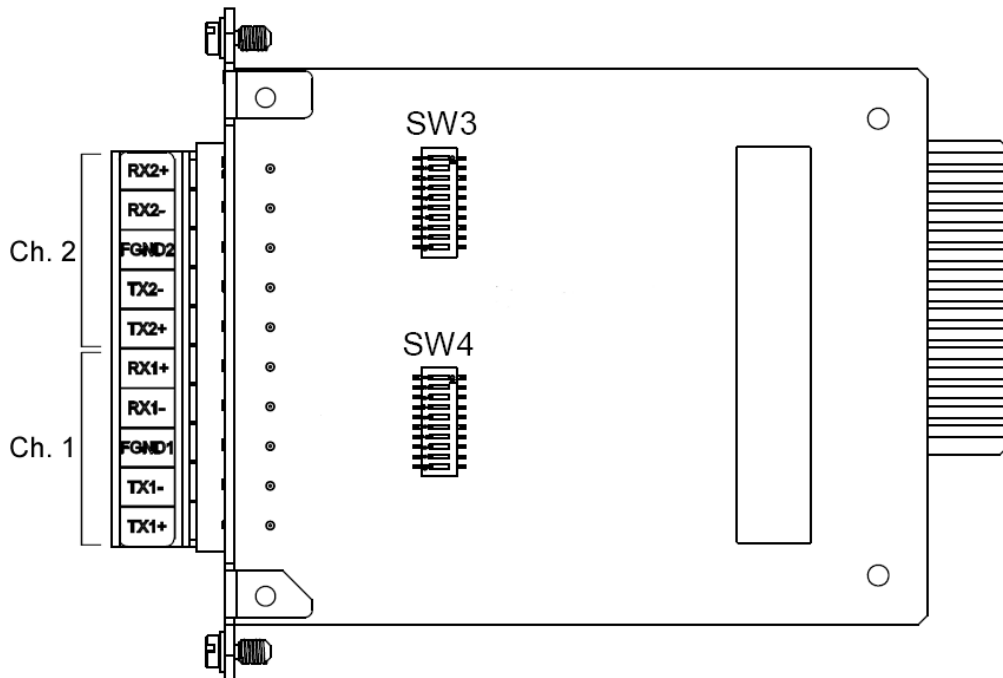
RS-485 Card Switch SW1/SW2 Settings

Channel Option	SW1/SW2 Switch Positions	
	1	2
2-Wire	ON	OFF
4-Wire (default)	OFF	ON

RS-485 Adapter Top Side



RS-485 Adapter Bottom Side



Switch SW3/SW4 Configuration

Switches **SW3** (for Channel 2 on TB1-6 through TB1-10) and **SW4** (for Channel 1 on TB1-1 through TB1-5) contain ten DIP-switches that control pull-up and pull-down resistors for the differential data lines and provide line termination between the differential data pairs. Each DIP-switch can be set to **ON** or **OFF** to select the appropriate function for the switch. That is, if all pins are set to **ON**, switch is ON. If all pins are set to **OFF**, switch is OFF.

If termination/pull up is selected, the TX+ and RX+ signals have a 680 ohm pull-up resistor, the TX- and RX- signals have a 680 ohm pull-down resistor, and the RX and TX signals have a 120 ohm termination.

RS-485 Card Switch SW3/SW4 Settings

SW3/SW4 Pin	Pin Position	Function
1	ON	Pull-up for TX+
	OFF	No pull-up for TX+
2	ON	Pull-down for TX-
	OFF	No pull-down for TX-
3	Not connected	
4	ON	Pull-up for RX+
	OFF	No pull-up for RX+
5	ON	Pull-down for RX-
	OFF	No pull-down for RX-
6	ON	Line termination between TX+ and TX-
	OFF	No Line termination between TX+ and TX-
7	ON	Line termination between TX+ and TX-
	OFF	No Line termination between TX+ and TX-
8	Not connected	
9	ON	Line termination between RX+ and RX-
	OFF	No Line termination between RX+ and RX-
10	ON	Line termination between RX+ and RX-
	OFF	No Line termination between RX+ and RX-

3.5 Fiber Optic Serial Adapter

The Fiber Optic Serial Adapter is available in two variants:

- Glass Optical Fiber (GOF) Serial with 820-850 nm ST connectors (GE Part No. 520-0209)
- Plastic Optical Fiber (POF) Serial with 660 nm Agilent Versatile Link connectors (GE Part No. 520-0210)

The Fiber Optic Serial cards include two pairs of channels for signal transmission (TX1/TX2) and reception (RX1/RX2) through ST or Versatile connectors. The cards plug into any serial communication slot (slots 1 through 8) on the D400.

See section “4.5 Fiber Optic Connections” for typical cable connections.

Configuration Options

The Fiber Optic Serial card supports the following configuration options for each channel:

- Standard state
- Inverted state

The state for each channel is selectable via a single two-position pin switch **SW1** on the Fiber Optic Serial card.

Follow instructions for setting the switch to select the appropriate state for each channel.

Note: The fiber optic channel settings on the D400 must match the set up of the other end of the fiber optic communications channel.

Factory Default

The factory default setting is Standard state on each channel.

Switch SW1 Configuration

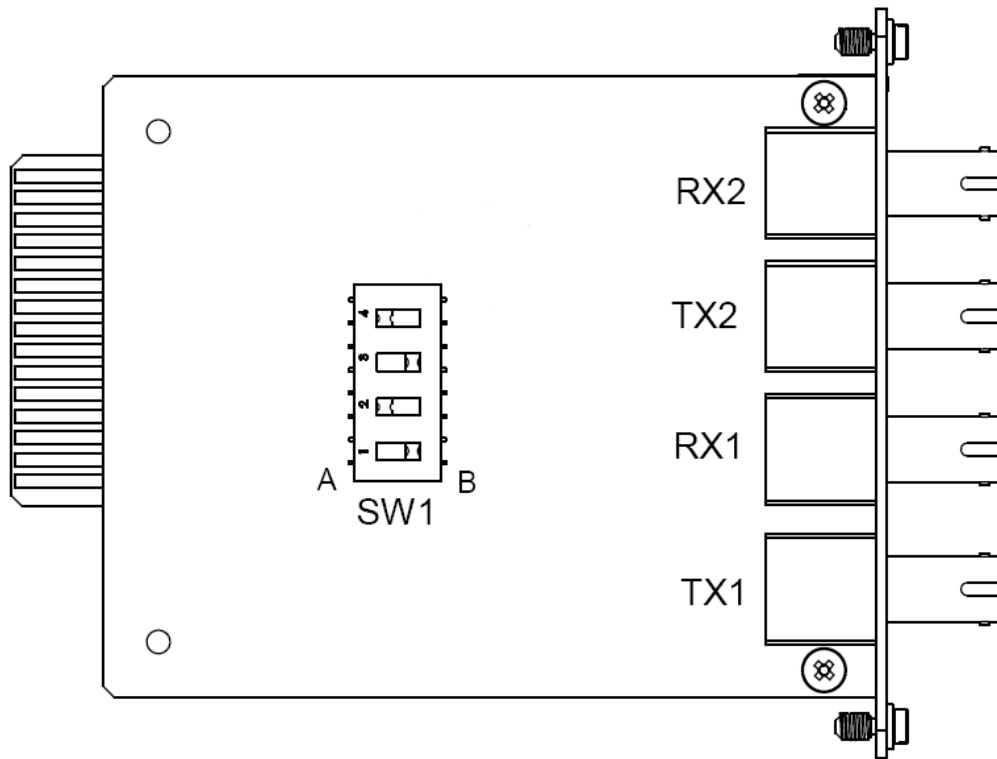
Switch **SW1** controls the state of each fiber optic channel. The switch contains four two-position pins that can each be set to **A** or **B** to select the appropriate state.

Fiber Optic Serial Card Switch SW1 Settings

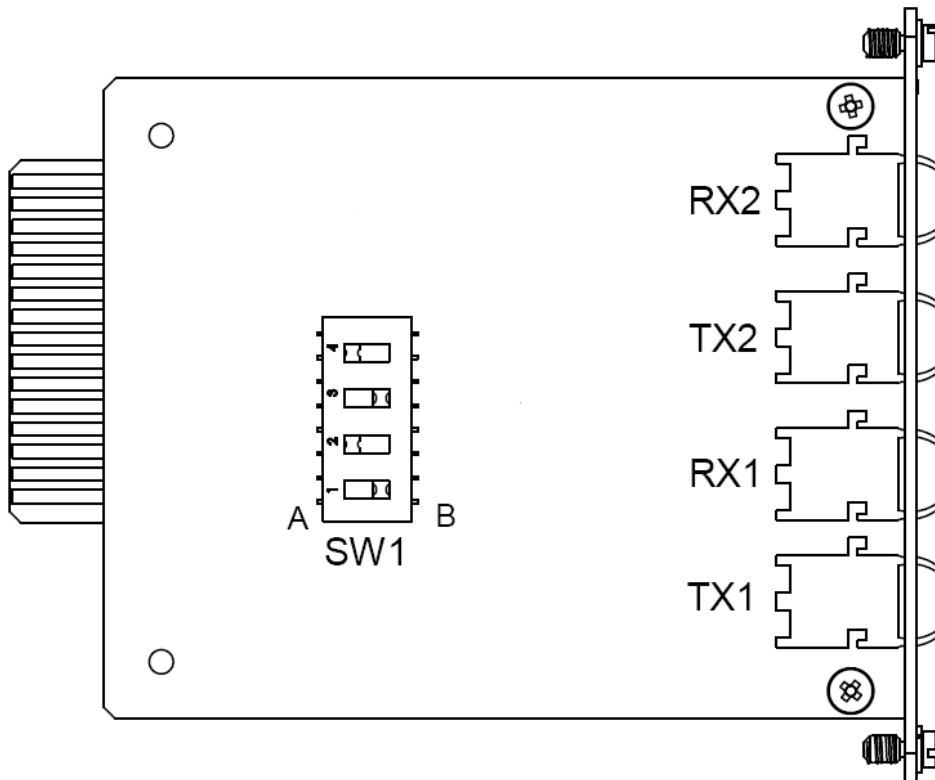
State Option	SW1 Switch Positions			
	1	2	3	4
Standard (default)	B	A	B	A
Inverted	A	B	A	B

Note: In Standard state fiber is lit when a “1” is transmitted. In Inverted state fiber is lit when a “0” is transmitted.

Glass Optical Fiber Serial Adapter



Plastic Optical Fiber Serial Adapter



3.6 IRIG-B Input Adapter

The IRIG-B Input Adapter (GE Part No. 520-0211) plugs into a dedicated IRIG-B slot (slot 9) on the D400. The IRIG-B Input card accepts an IRIG-B signal in one of three input formats through a corresponding connector type:

- Modulated IRIG-B through a **BNC** connector **J2**
- Demodulated IRIG-B (**TTL**) through a terminal block **TB1**
- Fiber Optic through a Receive (**RX**) 820-850 nm ST connector **U12**

The IRIG-B signal (TTL) can be subsequently distributed to attached IEDs through one of the following output methods:

- IRIG-B Distribution Adapter (GE Part No. 520-0212). See section “3.7 IRIG-B Distribution Adapter”
- RS-232 Adapter (GE Part No. 520-0207). See section “3.3 RS-232 Adapter”
- On-board fiber optic output (**TX**) on 820-850 nm ST connector **U13**

See section “4.6 IRIG-B Connections” for wiring instructions.

Configuration Options

The input signal formats and output options are selectable via three switches on the IRIG-B Input card:

- IRIG-B state option is configured by switch **SW1**
- Input signal format is configured by switch **SW2**
- Fiber optic TX option is configured by switch **SW3**

Follow instructions for setting the switches to select the appropriate IRIG-B signal formats and functions.

Factory Default

The factory default setting is the Standard state on each channel.

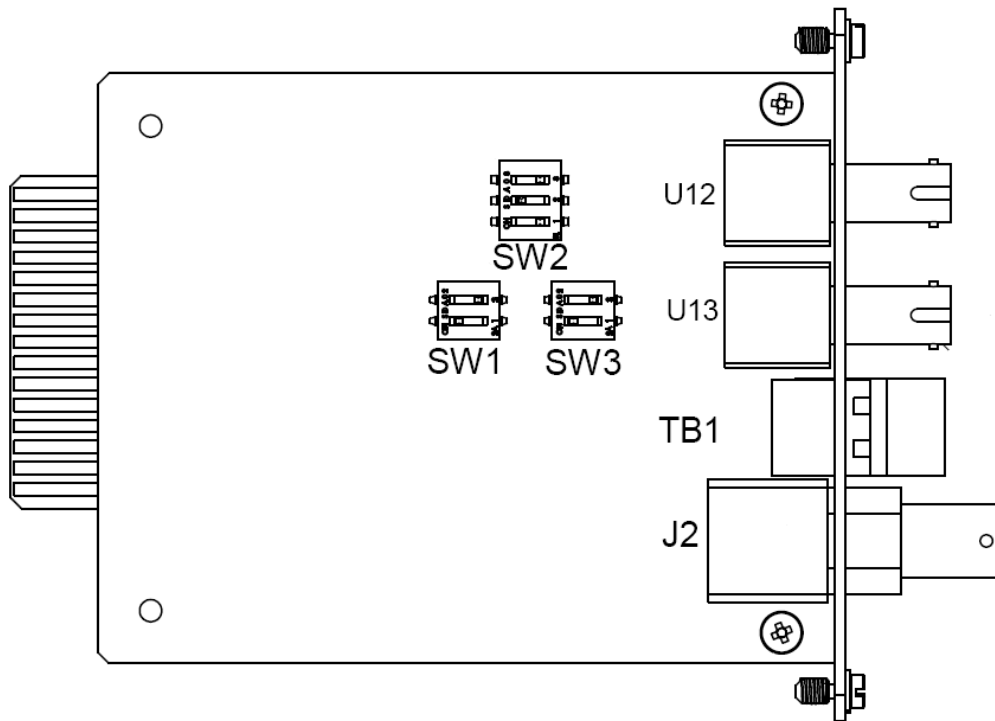
Switch SW1 Configuration

Switch **SW1** controls the state option for the IRIG-B Input card. It contains two switch positions that can be set to **ON** or **OFF** to select the appropriate IRIG-B state option.

IRIG-B Input Card Switch SW1 Settings

IRIG-B State Option	SW1 Switch Positions	
	1	2
Standard (default)	ON	OFF
Inverted	OFF	ON

IRIG-B Input Adapter



Switch SW2 Configuration

Switch **SW2** controls the signal option for the selected state option (SW1). It contains three switch positions that can be set to **ON** or **OFF** to select the appropriate signal.

IRIG-B Input Card Switch SW2 Settings

Input Signal Option	SW2 Switch Positions		
	1	2	3
Fiber Optic (RX)	ON	OFF	OFF
TTL (TB1) (default)	OFF	ON	OFF
BNC (J2)	OFF	OFF	ON

Switch SW3 Configuration

Switch **SW3** controls the state option for the IRIG-B fiber optic TX input. It contains two switch positions that can be set to **ON** or **OFF** to select the appropriate state.

IRIG-B Input Card Switch SW3 Settings

Fiber Optic TX Option	SW3 Switch Positions	
	1	2
Fiber RX (default)	ON	OFF
Inverted	OFF	ON

3.7 IRIG-B Distribution Adapter

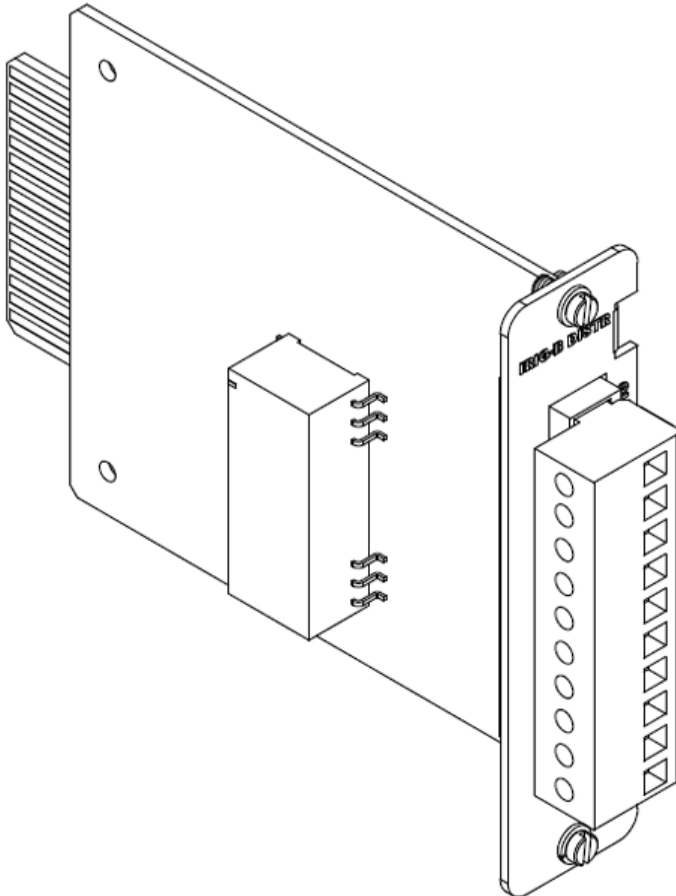
The IRIG-B Distribution Adapter (GE Part No. 520-0212) is an optional IRIG-B output card to supply an IRIG-B (TTL) signal passed from the IRIG-B Input card to attached IEDs. The IRIG-B Distribution card provides four channels on a single terminal block. Each channel is capable of supplying a signal to up to four IEDs, for a total of 16 IEDs. The IRIG-B Distribution card plugs into a dedicated IRIG-B slot (slot 10) on the D400.

See section “4.6 IRIG-B Connections” for wiring instructions.

Configuration Options

There are no selectable options on the IRIG-B Distribution card.

IRIG-B Distribution Adapter



3.8 4-Port Twisted-Pair Ethernet Switch

The 4-Port Twisted-Pair Ethernet Switch (GE Part No. 520-0213) is a 10/100BaseT network switch that plugs into the NET1 or NET2 slot (slots 11 and 12) on the D400. It provides local area network connections for up to five Ethernet connections: four RJ-45 connectors on the rear panel and one RJ-45 connector on the front panel.

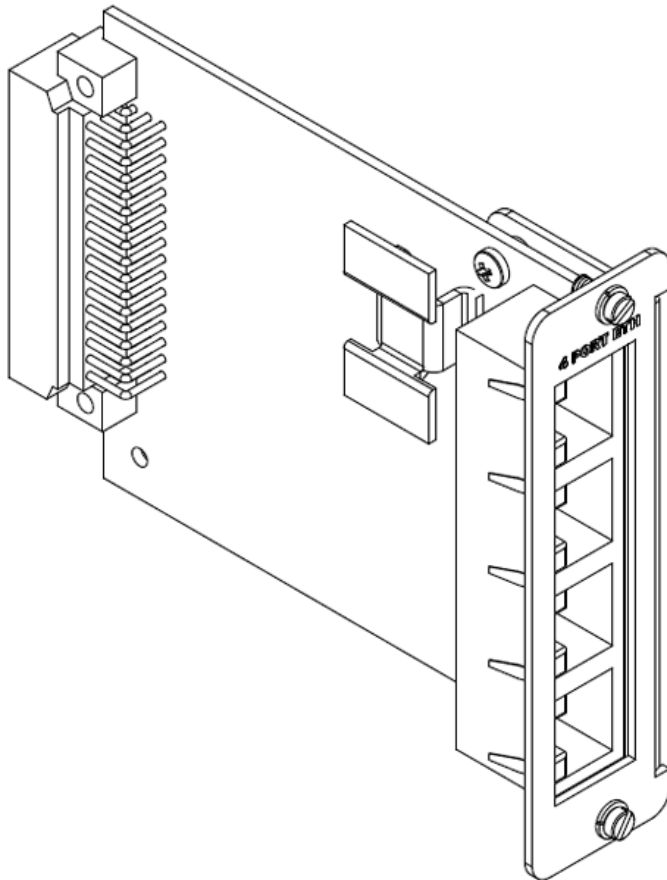
If two Ethernet switches are installed in the NET slots, the D400 may be used in a dual-IP redundancy mode. That is, each switch can be configured with a different IP address to provide a backup network connection if the primary channel fails.

See section "4.7 Network Connections" for typical cable connections.

Configuration Options

There are no selectable options on the 4-Port TP Ethernet card.

4-Port Twisted-Pair Ethernet Switch Card



3.9 Hot Standby Fiber Optic Ethernet Switch

The Hot Standby Fiber Optic Ethernet Switch (GE Part No. 520-0214) is a 100BaseSX (820-850 nm) network switch that supports single-IP redundancy for the D400. It provides automated fail over between two Ethernet fiber optic network connections (**RX1/TX1** and **RX2/TX2**) that share a single MAC address.

When the primary port (Fiber Optic Channel 1) receives no signal, or detects a fault signal from the remote link partner, the D400 switches to the secondary port (Fiber Optic Channel 2) if it has a valid link. The D400 reverts to the primary port if the primary link is restored or no signal is present on the secondary port.

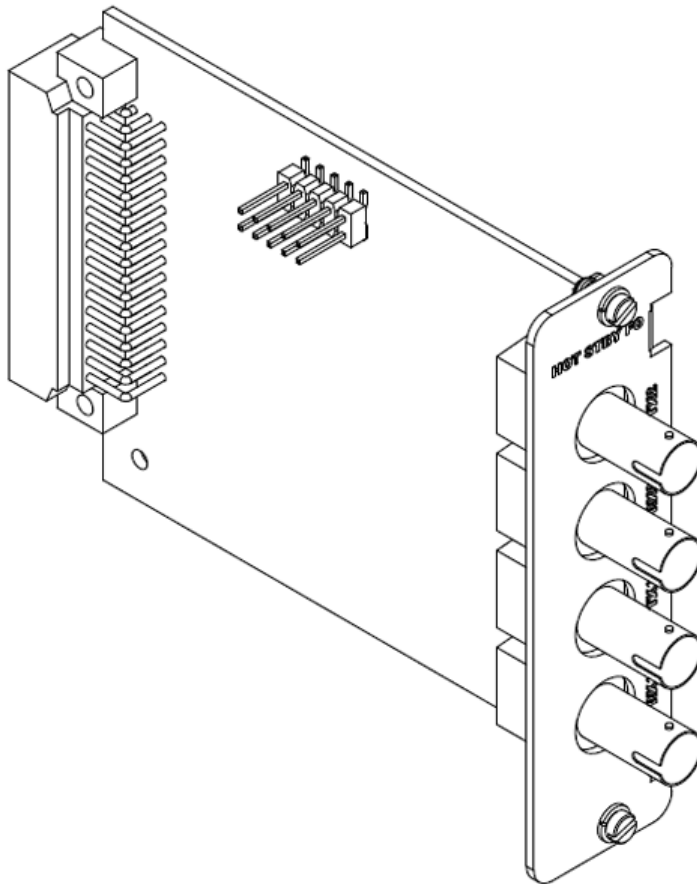
The Hot Standby Fiber Optic Ethernet Switch can be installed in the NET1 or NET2 slot (slots 11 and 12) on the D400.

See section “4.5 Fiber Optic Connections” for typical cable connections.

Configuration Options

There are no selectable options on the Hot Standby Fiber Optic Ethernet Switch card.

Hot Standby Fiber Optic Ethernet Switch Card



3.10 Redundant Twisted-Pair Ethernet + COM2 Port Adapter

The Redundant TP Ethernet + COM2 Port card (GE Part No. 520-0218) provides two local area network connections with unique MAC addresses through Ethernet RJ-45 connectors. The **LAN** input routes to a three-port Ethernet switch and the **WAN** input routes to the PC/104-Plus Ethernet Module. The Ethernet switch can support a dual-redundancy network option on the D400. The card also provides an RS-232 DCE connection through a DB-9 connector. The Redundant TP Ethernet + COM2 Port card can only be installed in the NET1 slot (slot 11) on the D400.

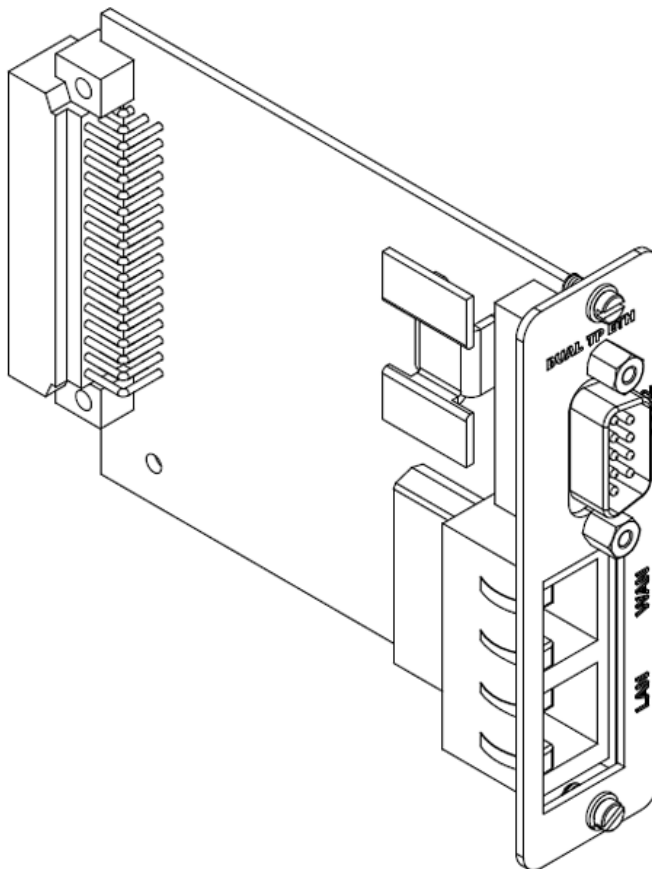
Note: Use of the Redundant TP Ethernet + COM2 Port card requires the installation of the Dual Redundant Ethernet D400 CPU option, which includes the PC/104-Plus 10/100BaseT Ethernet module (GE Part No. 580-2717). The COM2 Port requires an external modem to provide dial-up functionality.

See sections “4.7 Network Connections” and “4.8 Modem Connections” for typical cable connections.

Configuration Options

There are no selectable options on the Redundant TP Ethernet + COM2 Port card.

Redundant TP Ethernet + COM2 Port Adapter Card



3.11 COM2 Port Adapter

The COM2 Port Adapter (GE Part No. 520-0219) provides a single DB-9 connector (**P2**) wired for an RS-232 DCE signal. The COM2 Port card can support serial connections for the following dial-up interfaces:

- External modem
- Point-to-point protocol (PPP) services
- Wide area network

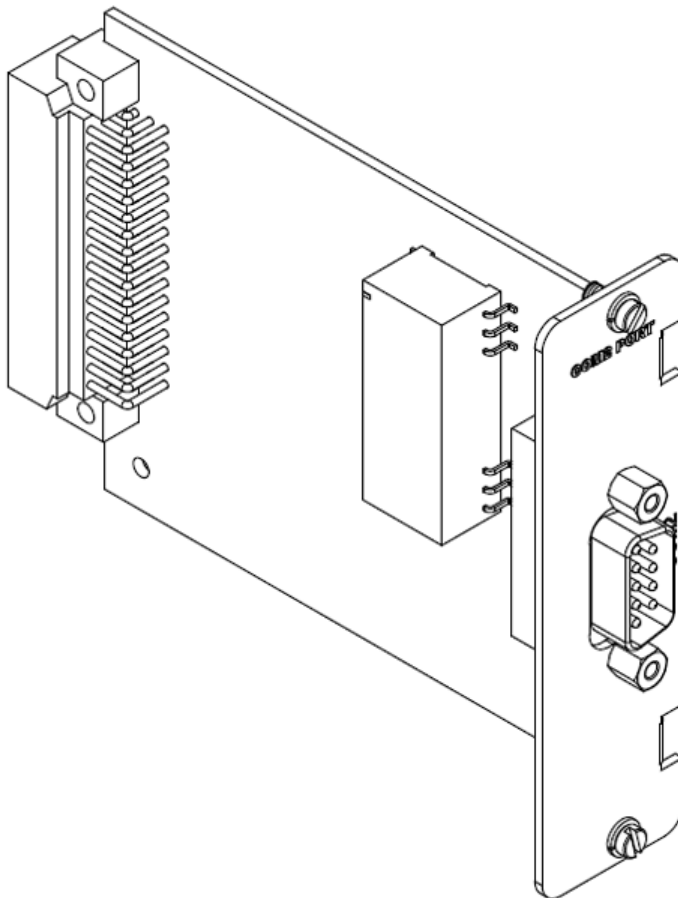
The COM2 Port Adapter plugs into any NET slot (slots 11 and 12) of the D400.

Note: The COM2 Port requires an external modem to provide dial-up functionality. See section “4.8 Modem Connections” for typical cable connections.

Configuration Options

There are no selectable options on the COM2 Port card.

COM2 Port Adapter



3.12 USB KVM & Audio Adapter

The USB Keyboard, Video, Mouse Adapter (GE Part No. 520-0206) plugs into the USB KVM slot (slot 13) on the D400. The card provides connections for setting up a permanent local workstation, including:

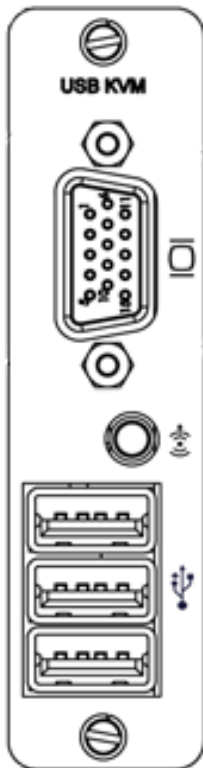
- Three USB v1.1 compliant Type A ports (**P3-P5**) for keyboard, mouse or other USB device
- Single 3.5 mm audio jack (**P2**) for stereo audio output
- High-density D-sub 15-socket connector (**J1**) for video output

See section “4.9 Local HMI Connection” for typical cable connections.

Configuration Options

There are no selectable options on the USB KVM card.

USB KVM Adapter



4

Connecting to Devices and Networks

This chapter provides guidelines for making physical connections between the D400 and substation and network devices.

4.1 Connection Types

The D400 can accommodate a wide range of devices and network connections through a variety of communication card options.

For more information about the types of communication cards and configuration options, see chapter “3 Setting up Communication Cards”.

Serial

The D400 can support up to 16 serial connections (up to 8 serial adapter cards with 2 ports each) to a variety of GE and other vendor devices, including:

- Protective relays
- Meters
- Programmable logic controllers (PLCs)
- Remote terminal units (RTUs)
- Monitoring equipment
- Digital fault recorders (DFRs)
- Sequence of event (SOE) recorders
- Load tap changers (LTCs)

The following types of serial connections are supported in single or multi-dropped set ups:

- RS-232
- RS-485 (2-wire or 4-wire)
- Fiber Optic Serial (glass or plastic)

Network

The D400 can support up to eight network connections to host and network clients, including:

The D400 can support up to eight network connections.

- SCADA master station
- Substation LAN
- Enterprise network (Corporate wide area network)

The following networking connections are supported:

- Ethernet (Twisted pair or Fiber optic)
- COM2 (for dial-up)

Time Synchronization

The D400 accepts a time synchronization input (IRIG-B) from GPS receivers that can be subsequently distributed to connected devices.

Local Substation Computer

A substation computer can be set up with the D400 through the USB KVM connections to access the HMI locally.

Optionally, a portable PC can be connected to the front Ethernet port to access the HMI locally.

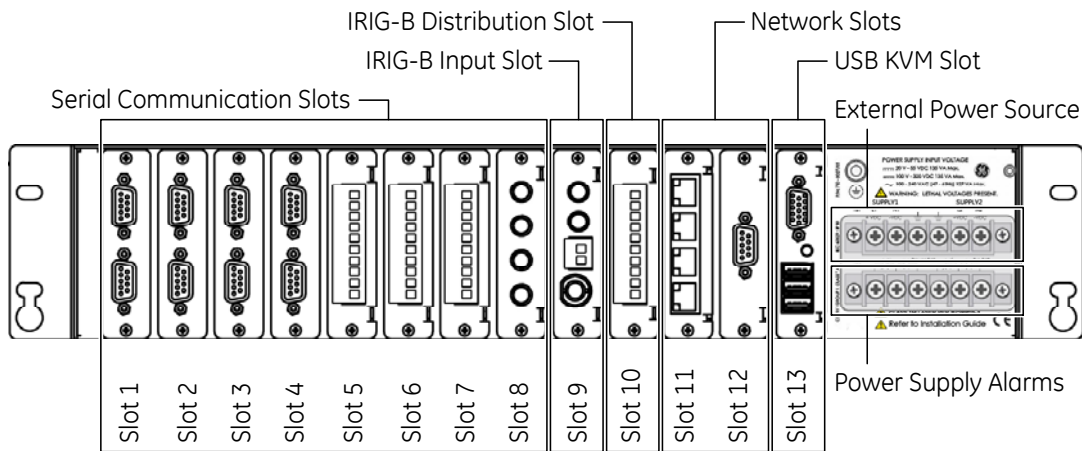
Local Maintenance

A local PC can be directly connected to the D400 through a front serial communications port to perform system maintenance.

4.2 Cabling Overview

The D400 provides a series of I/O adapter cards for connecting cables and wiring from substation devices and network interfaces. All physical connections are made to easily accessible connectors on the rear panel of the D400.

D400 Field and Network Connections



The types of communication cards included in your D400 depend on what was ordered for your substation application.

For a list and detailed description of the types of communication cards available, see chapter “3 Setting up Communication Cards”.

General Cabling Requirements

Cabling required to make physical connections to the D400 are as follows:

Media	Designation	Cabling	Connector
Single Fiber Optic Ethernet	10BaseFL 100BaseSX	62.5/125 μm or 50/125 μm multi-mode fiber cable	ST Connectors (820-850 nm)
Single Twisted Pair	10/100BaseT	UTP- Unshielded Twisted Pair - CAT 5 or better	RJ-45
Redundant Twisted Pair	10/100BaseT	UTP- Unshielded Twisted Pair - CAT 5 or better	RJ-45
PPP Serial Over External Modem V.90 (56 Kbps)	RS-232	Standard RS-232 cable	DB-9

High-Voltage Installations

To provide higher EMC immunity and maintain CE Mark compliance, the serial cables used for permanent RS-232 and RS-485 connections must comply with the following requirements:

- Cables must be shielded
- D-type connector covers must provide EMC shielding (e.g. metalized plastic or die cast metal covers).

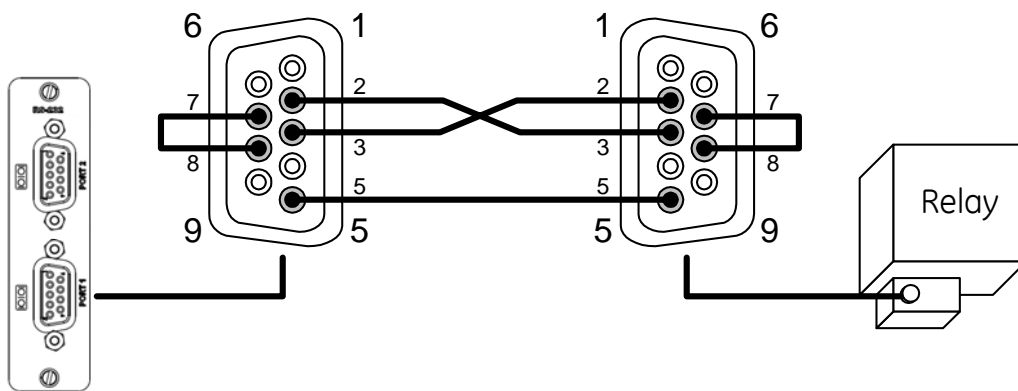
4.3 RS-232 Connections

The D400 accepts connections to RS-232 type devices through the RS-232 Adapter. The RS-232 Adapter (GE Part No. 520-0207) is a standard RS-232 serial I/O adapter card that plugs into any serial communication slot (slots 1 through 8) on the D400. It contains two independently isolated RS-232 serial ports (**Port 1** and **Port 2**) each with a DB-9 connector.

The required RS-232 cable is a serial null modem, DB-9F to DB-9M cable. The cables must be shielded and DB-9 connector covers must provide EMC shielding (e.g. metalized plastic or die-cast metal covers).

See section "3.3 RS-232 Adapter" for configuration options.

- To connect RS-232 type devices to the RS-232 Adapter, use the following cable connection:



RS-232 Port DB-9 Connector Signal Definitions

Pin Number	DTE (default)		DCE	
	Function	Signal Flow	Function	Signal Flow
1	DCD	IN	DCD	IN
2	RXD	IN	TXD	OUT
3	TXD	OUT	RXD	IN
4	DTR	OUT	DSR	IN
5	Signal GND	-	Signal GND	-
6	DSR	IN	DTR	OUT
7	RTS	OUT	CTS	IN
8	CTS	IN	RTS	OUT
9	Not connected	-	Not connected	-

4.4 RS-485 Connections

The D400 accepts connections to RS-485 2-wire and 4-wire type devices through the RS-485 Adapter. The RS-485 Adapter (GE Part No. 520-0208) plugs into any serial communication slot (slots 1 through 8) on the D400. It contains two independently isolated RS-485 channels on a single terminal block: Channel 1 on terminals TB1-1 through TB1-5 and Channel 2 on terminals TB1-6 through TB1-10.

See section “3.4 RS-485 Adapter” for configuration options.

Cabling Requirements

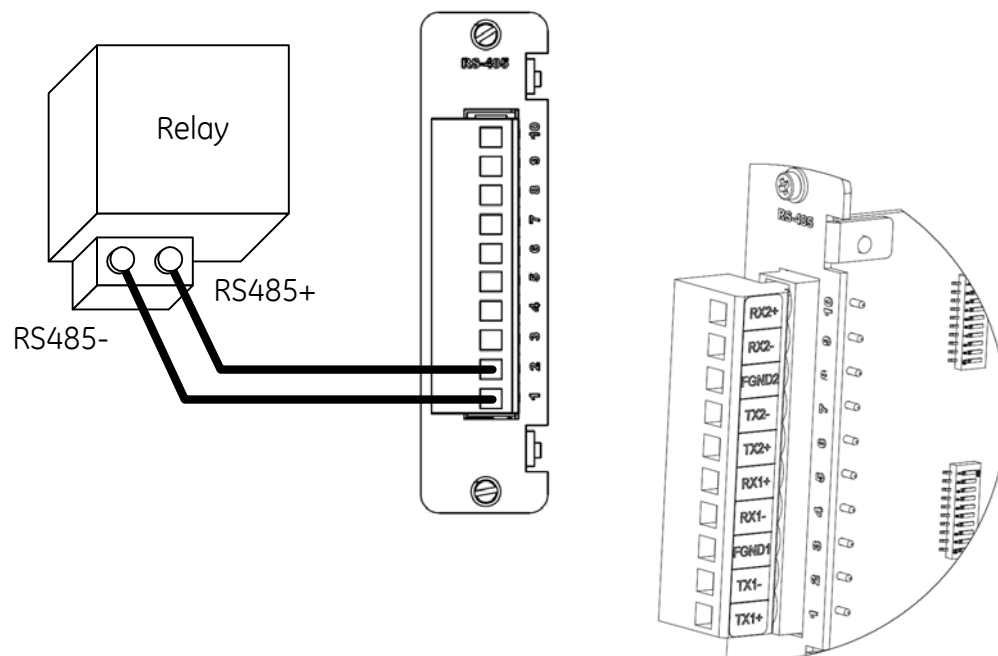
The recommended total maximum length for RS-485 cables is 4000 ft [1300 m] when operating at 115 kbps. Refer to the manual of the connecting device for its recommended maximum cable length.

The cables must be shielded and the shield of each RS-485 cable section should be grounded at one end only. This prevents circulating currents and can reduce surge-induced current on long communication lines.

2-Wire Connections

- » To connect RS-485 2-wire type devices to the RS-485 Adapter, use the following wiring connection:

Note: Before wiring devices, ensure that the RS-485 Adapter is configured to 2-wire mode (see section “3.4 RS-485 Adapter”).



RS-485 2-Wire Terminal Block Signal Definitions

RS-485 Channel	Position Number	2-Wire	
		Function	Signal Flow
Channel 1	1	TX1+	IN/OUT
	2	TX1-	IN/OUT
	3	FGND 1	-
	4	RX1-	-
	5	RX1+	-
Channel 2	6	TX2+	IN/OUT
	7	TX2-	IN/OUT
	8	FGND 2	-
	9	RX2-	-
	10	RX2+	-

Note: The terminal block positions are numbered from 1 to 10 starting from the bottom of the card.

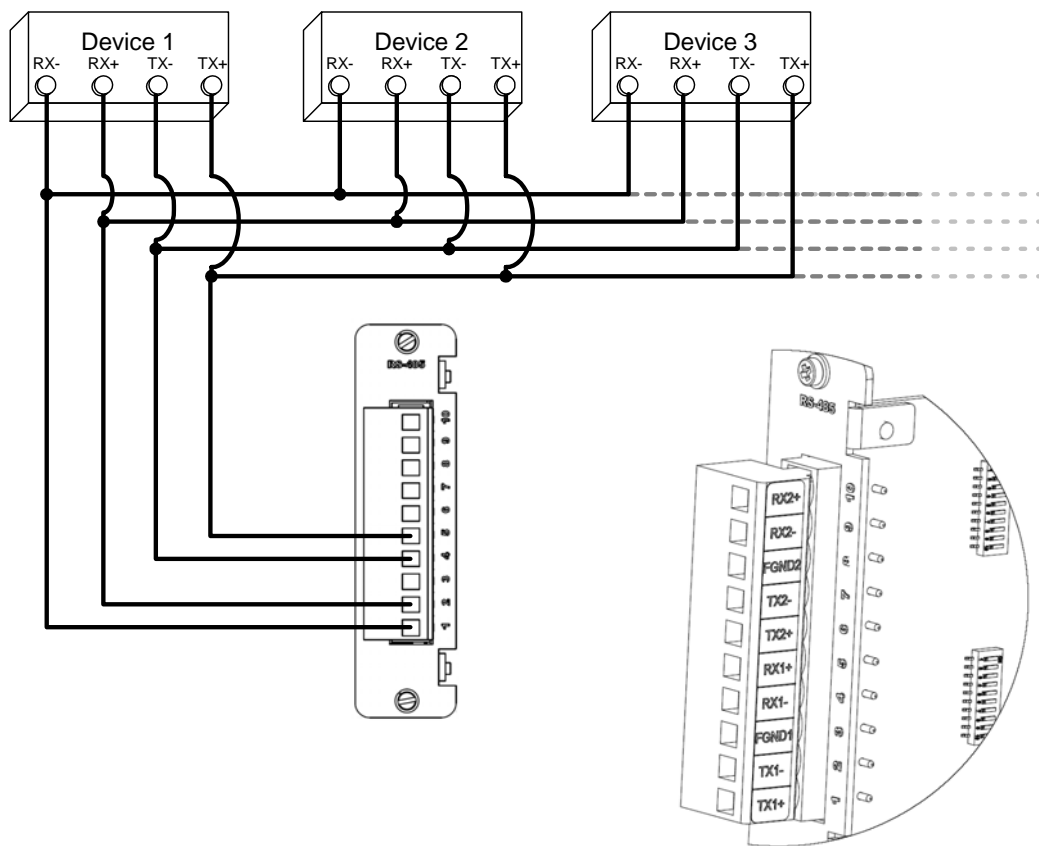
4-Wire Connections

In 4-wire mode, the RS-485 Adapter supports a maximum of 32 transceivers per channel (64 devices per RS-485 Adapter card).

See section “3.4 RS-485 Adapter” for configuration options.

» To connect RS-485 4-wire type devices to the RS-485 Adapter, use the following wiring connection:

Note: Before wiring devices, ensure that the RS-485 Adapter is configured to 4-wire mode (see section “3.4 RS-485 Adapter”).



RS-485 4-Wire Terminal Block Signal Definitions

RS-485 Channel	Position Number	4-Wire (default)	
		Function	Signal Flow
Channel 1	1	TX1+	OUT
	2	TX1-	OUT
	3	FGND 1	-
	4	RX1-	IN
	5	RX1+	IN
Channel 2	6	TX2+	OUT
	7	TX2-	OUT
	8	FGND 2	-
	9	RX2-	IN
	10	RX2+	IN

Note: The terminal block positions are numbered from 1 to 10 starting from the bottom of the card.

4.5 Fiber Optic Connections

For devices located some distance from the D400, they may be connected using glass or plastic optical fiber cables. Fiber optic cabling also offers superior performance in electrically noisy environments.

Glass Optical Fiber

You can use the following glass optical fiber (GOF) cabling with the D400 Glass Optical Fiber Serial adapter:

- 50/125 μm core/cladding multi-mode (gradient index) cable
- 62.5/125 μm core cladding multi-mode (gradient index) cable
- 100/140 μm core/cladding multi-mode (gradient index) cable
- 200 μm core Hard-Clad Silica (HCS) multi-mode (step index) cable

You can use the following fiber optic terminations for D400 cabling:

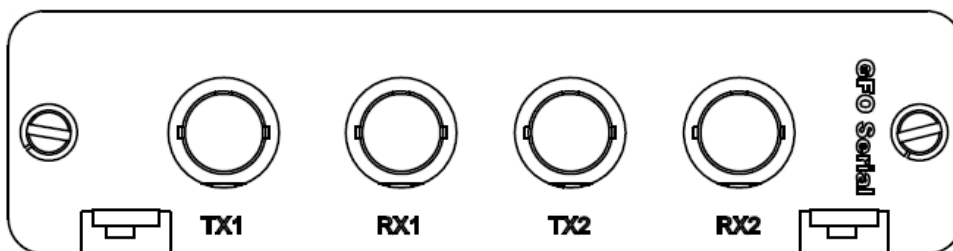
- ST Connectors

When calculating cable length, consider the following optical power levels:

- Glass optical fiber transmitter power is -19.0 ± 2 dBm
- Glass optical fiber receiver sensitivity is typically -25.4 dBm



Warning: LED transmitters are classified as IEC 60825-1 Accessible Emission Limit (AEL) Class 1M. Class 1M devices are considered eye safe to the unaided eye. **Do not view directly with optical instruments.**



Plastic Optical Fiber

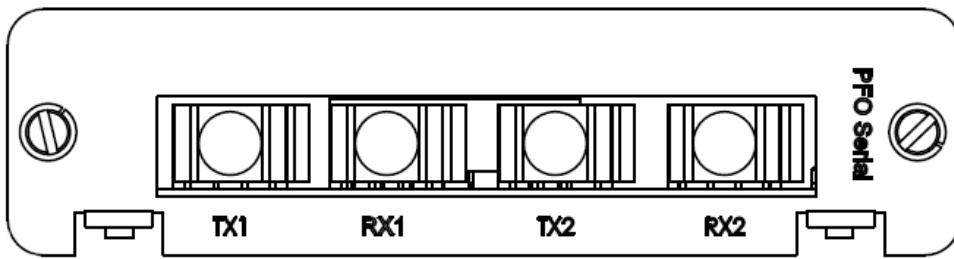
You can use 1 mm plastic optical fiber (POF) cabling with the D400 Plastic Optical Fiber Serial adapter. The recommended termination is the Agilent Versatile Link Simplex Connector.

When calculating cable length, consider the following optical power levels:

- Plastic optical fiber transmitter power is -9.0 ± 4.5 dBm
- Plastic optical fiber receiver sensitivity is typically -39 dBm



Warning: LED transmitters are classified as IEC 60825-1 Accessible Emission Limit (AEL) Class 1M. Class 1M devices are considered eye safe to the unaided eye. **Do not view directly with optical instruments.**



See section "3.5 Fiber Optic Serial Adapter" for configuration options.

- » **To connect fiber optic links to the Fiber Optic adapters, plug fiber optic cables into the corresponding TX and RX connectors.**

Hot Standby Fiber Optic Connections

The Hot Standby Fiber Optic Ethernet Switch (GE Part No. 520-0214) is a 100BaseSX (820-850 nm) network switch that supports single-IP redundancy for the D400. It provides automated fail over between two Ethernet fiber optic network connections (**RX1/TX1** and **RX2/TX2**) that share a single MAC address.

The Hot Standby Fiber Optic Ethernet Switch can be installed in the NET1 or NET2 slot (slots 11 and 12) on the D400.

If two Hot Standby Ethernet switches are installed in the NET slots, the system may be used in a dual-IP redundancy mode. That is, each switch can be configured with a different IP address to provide a back up network connection if the primary channel fails.

You can use the following glass optical fiber (GOF) cabling with the D400 Glass Optical Fiber Serial adapter:

- 50/125 µm core/cladding multi-mode (gradient index) cable
- 62.5/125 µm core cladding multi-mode (gradient index) cable
- 100/140 µm core/cladding multi-mode (gradient index) cable
- 200 µm core Hard-Clad Silica (HCS) multi-mode (step index) cable

You can use the following fiber optic terminations for D400 cabling:

- ST Connectors

When calculating cable length, consider the following optical power levels:

- Glass optical fiber transmitter power is -19.0 ± 2 dBm
- Glass optical fiber receiver sensitivity is typically -31.0 dBm



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Fiber Optic Connector Signal Definitions

Connector	Function
TX1	Primary Fiber Optic Transmit Port
RX1	Primary Fiber Optic Receive Port
TX2	Hot Standby Secondary Fiber Optic Transmit Port
RX2	Hot Standby Secondary Fiber Optic Receive Port

See section “3.9 Hot Standby Fiber Optic Ethernet Switch” for more information.

4.6 IRIG-B Connections

The D400 uses a pair of IRIG-B adapter cards, the IRIG-B Input Adapter and the IRIG-B Distribution Adapter, to accept an IRIG-B signal from a GPS receiver then distribute the signal to connected IEDs.

See sections “3.6 IRIG-B Input Adapter” and “3.7 IRIG-B Distribution Adapter” for more information.

IRIG-B Input Adapter

The IRIG-B Input Adapter (GE Part No. 520-0211) plugs into a dedicated IRIG-B slot (slot 9) on the D400. The IRIG-B Input card accepts an IRIG-B signal in one of three input formats through a corresponding connector type:

- Modulated IRIG-B through a BNC connector
- Demodulated IRIG-B (**TTL**) through a terminal block
- Fiber Optic through a Receive (**RX**) 820-850 nm ST connector

The IRIG-B signal can be distributed to an attached IED through the fiber optic output (**TX**) on 820-850 nm ST connector.

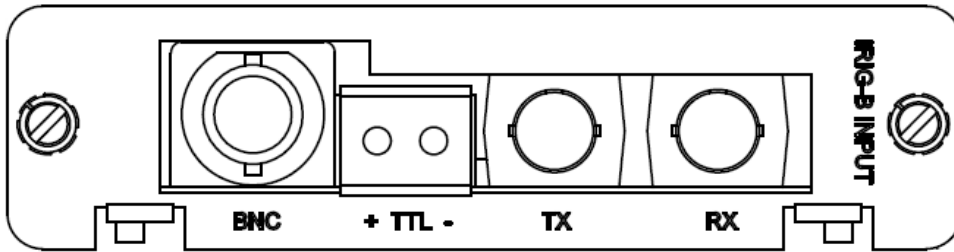
When calculating cable length, consider the following optical power levels:

- Glass optical fiber transmitter power is -19.0 ± 2 dBm
- Glass optical fiber receiver sensitivity is typically -25.4 dBm



Warning: LED transmitters are classified as IEC 60825-1 Accessible Emission Limit (AEL) Class 1M. Class 1M devices are considered eye safe to the unaided eye. **Do not view directly with optical instruments.**

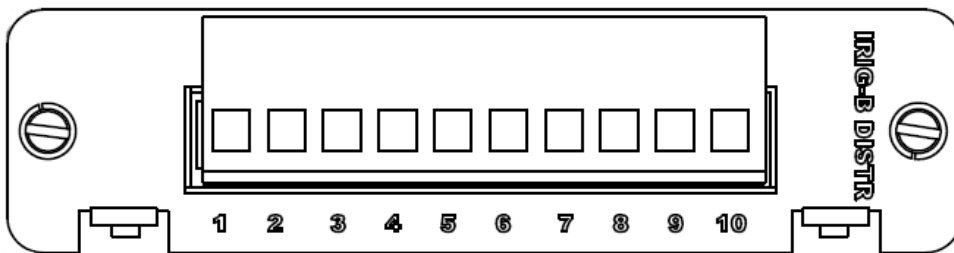
IRIG-B Input Adapter



IRIG-B Distribution Adapter

The IRIG-B Distribution Adapter (GE Part No. 520-0212) is an optional IRIG-B output card to supply an IRIG-B (TTL) signal passed from the IRIG-B Input card to attached IEDs. The IRIG-B Distribution card provides four channels on a single terminal block. Each channel is capable of supplying a signal to up to four IEDs, for a total of 16 IEDs. The IRIG-B Distribution card plugs into a dedicated IRIG-B slot (slot 10) on the D400.

IRIG-B Distribution Adapter



IRIG-B Distribution Terminal Block Signal Definitions

Channel	Terminal Block Position	Function	Signal Flow
Channel 1	1	IRIG-B TTL	OUT
	2	GND	-
	3	FGND	-
Channel 2	4	IRIG-B TTL	OUT
	5	GND	-
	6	IRIG-B TTL	OUT
Channel 3	7	GND	-
	8	FGND	-
	9	IRIG-B TTL	OUT
Channel 4	10	GND	-

Note: The terminal block positions are numbered from 1 to 10 starting from the bottom of the card.

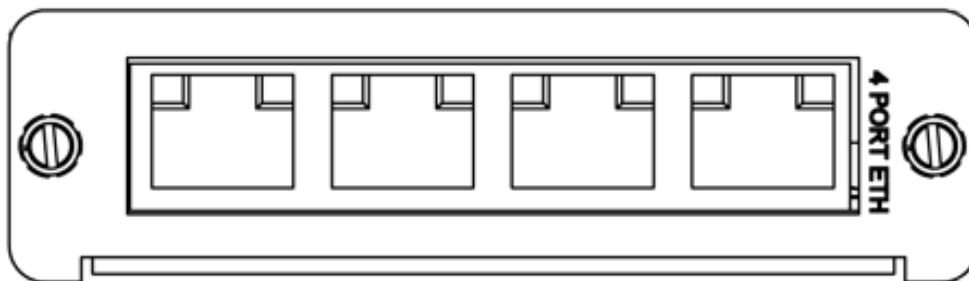
4.7 Network Connections

The D400 supports a network interface through Ethernet connections to the 4-Port Twisted-Pair Ethernet Switch or Redundant Twisted-Pair Ethernet + COM2 Port Adapter.

All RJ-45 connectors have the same signal definition. However, the rear Ethernet ports are auto MDI/MDIX and can support a straight-through or crossover cable.

See sections “3.8 4-Port Twisted-Pair Ethernet Switch” and “3.10 Redundant Twisted-Pair Ethernet + COM2 Port Adapter” for more information.

- » **To connect the D400 to network devices, plug network cables into the D400 Ethernet ports.**



Front Network Port

To access the D400's built-in HMI, a local or portable PC can be directly connected to the network port located on the front panel of the D400.

- » **To connect a local PC to the D400:**

Connect a straight-through Ethernet cable to your computer's network communications port and to the D400's front Ethernet port.

Ethernet RJ-45 Connector Signal Definitions

Position	Function	Signal Flow	Color
1	RX+	IN	White w/ Orange
2	RX-	IN	Orange
3	TX+	OUT	White w/ Green
4	P1+	-	Blue
5	P1-	-	White w/ Blue
6	TX-	OUT	Green
7	P2+	-	White w/ Brown
8	P2-	-	Brown
	Shield	-	-

Ethernet Crossover Cable (RJ-45) Pin Out

D400		Switch/Hub	
Name	Pin	Pin	Name
TX_D1+	1	3	RX_D2+
TX_D1-	2	6	RX_D2-
RX_D2+	3	1	TX_D1+
RX_D2-	4	2	TX_D1-
BI_D3+	5	7	BI_D4+
BI_D3-	6	8	BI_D4-
BI_D4+	7	4	BI_D3+
BI_D4-	8	5	BI_D3-

Ethernet Straight-Through Cable (RJ-45) Pin Out

D400		PC	
Name	Pin	Pin	Name
TX_D1+	1	1	RX_D2+
TX_D1-	2	2	RX_D2-
RX_D2+	3	3	TX_D1+
RX_D2-	4	4	TX_D1-
BI_D3+	5	5	BI_D4+
BI_D3-	6	6	BI_D4-
BI_D4+	7	7	BI_D3+
BI_D4-	8	8	BI_D3-

4.8 Modem Connections

A COM2 port is provided on the COM2 Port Adapter or the Redundant TP Ethernet + COM2 Port Adapter. The COM2 port can support serial connections for the following dial-up interfaces:

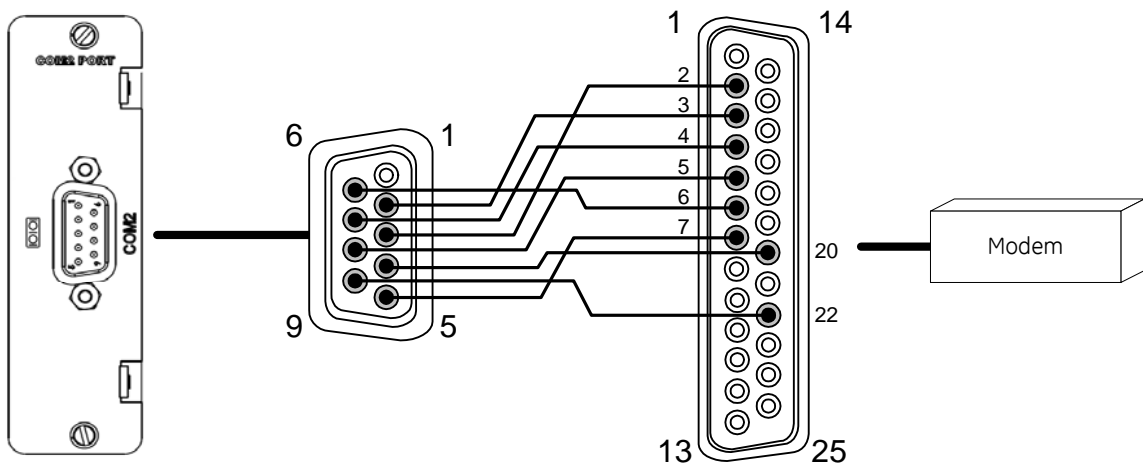
- External modem
- Point-to-point protocol (PPP) services
- Wide area network

The COM2 port provides a single DB-9 connector wired for an RS-232 DCE signal. The COM2 Port Adapter plugs into any NET slot (slots 11 and 12) of the D400. The Redundant TP Ethernet + COM2 Port Adapter plugs into the NET1 slot (slot 11).

Note: The COM2 Port requires an external modem to provide dial-up functionality.

See section “3.11 COM2 Port Adapter” for more information.

» To connect a modem to the COM2 Port Adapter, use a straight-through modem cable (not supplied with the D400):



COM2 Port DB-9 Connector Signal Definitions

Pin Number	DCE	
	Function	Signal Flow
1	DCD	IN
2	RXD	IN
3	TXD	OUT
4	DTR	OUT
5	Signal GND	-
6	DSR	IN
7	RTS	OUT
8	CTS	IN
9	Not connected	-

COM2 Port DB-9 to DB-25 Pin out

Signal	DB-9 Pin #	DB-25 Pin #
TD	2	3
RD	3	2
RTS	4	20
CTS	5	7
DSR	6	6
DCD	7	4
DTR	8	5
GND	9	22

4.9 Local HMI Connection

A permanent local workstation can be set up with the D400 to access the D400's HMI (human machine interface). The computer peripherals connect to the USB KVM Adapter located on the rear panel of the D400. The D400 supports the following peripheral connections:

- Three USB v1.1 compliant Type A ports for USB keyboard, mouse or other USB device
- Single 3.5 mm audio jack for stereo audio output to speakers
- High-density D-sub 15-socket connector for video display

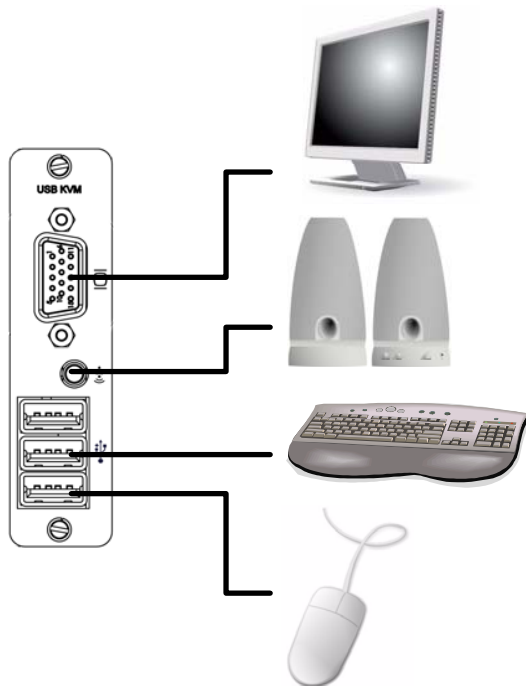
To connect to the HMI through the front Ethernet port, see section "4.7 Network Connections".

» To connect a local substation computer to the USB KVM Adapter:

Note: Ensure the D400 is powered down before connecting devices to the USB KVM card.

1. Connect the monitor to the video port.
2. Connect the keyboard and mouse to the USB ports.
3. Connect speakers (if available) to the audio jack.

Tip: If the keyboard stops responding during use, simply unplug and re-connect the keyboard cable.



4.10 Front Maintenance Port

The serial communications port on the front panel of the D400 provides a local connection with the D400 to perform the initial setup of the D400 and to carry out maintenance and diagnostic procedures. The front maintenance port provides a direct serial connection to a PC using a serial null modem cable (GE Part No. 977-0529/72), which is supplied with the D400.

See section “6.1 Connecting to the D400 for the First Time” for more information on setting up communications with the D400.

» To connect your computer to the D400:

Connect the supplied serial null modem cable (GE Part No. 977-0529/72) to your computer’s serial communications port and to the D400’s front communications port.

D400 Front Serial Port DB-9 Pin Out

Pin #	Signal
1	DCD
2	RX Data
3	TX Data
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	Not Connected

Minimal Required Connection

The minimal cable connection required to establish successful communication between your PC and the D400 is as follows:

PC Pin #	D400 Pin #	Signal
9-Pin Female	9-Pin Female (w/o Converter)	
2	3	TX
3	2	RX
5	5	GND

5

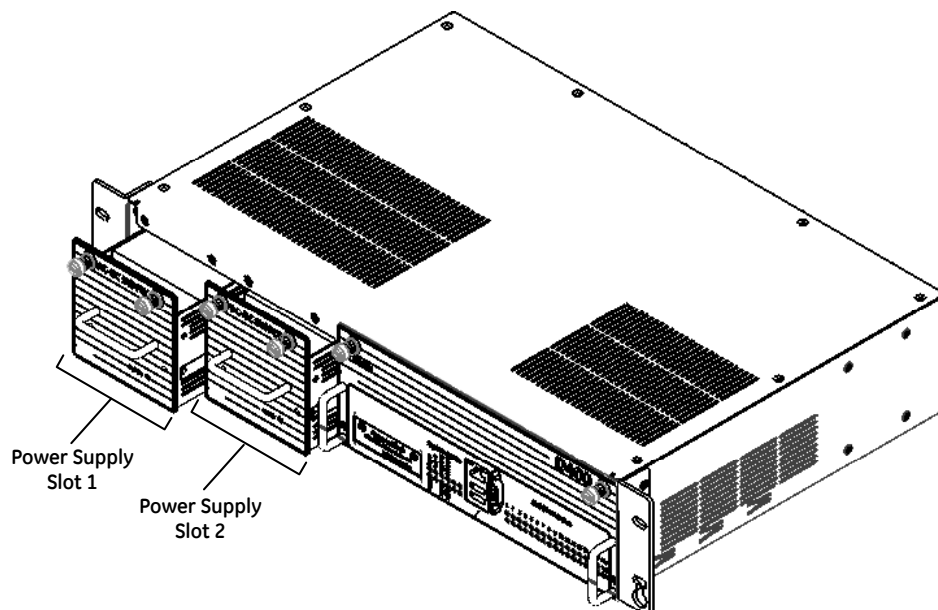
Powering Up the D400

This chapter describes the power supplies and how to make power connections.

5.1 Power Supply Options

The D400 supports one or two power supplies that provide 5 V to the D400 main module. The following power supplies may be provided in the Power Supply slots:

- AC-DC power supply (GE Part No. 520-0217)
- DC-DC power converter (GE Part No. 520-0216)



Redundant Power Supply

The D400 may be provided with an optional redundant power supply unit in Power Supply Slot 2. The second power supply provides continuous power to the D400 in the event the primary power supply unit fails.

Additional protection can be provided if a secondary external power source is available. In the event the primary power source fails, an automatic switchover will take place to the redundant power source to ensure continuous power to the D400.

Power Configurations

The D400 supports the following power configurations:

- Single External AC Power Source
- Single External DC Power Source
- Two External AC Power Sources with optional redundant D400 AC-DC Power Supplies
- Two External DC Power Sources with optional redundant D400 DC-DC Power Converters

Power Input Ranges

AC-DC Power Supply

Rated voltage range	100-240 VAC / 100-300 VDC with overvoltage protection of 110 % to 150 %	
Rated power	If the unit is...	Then the rated power is...
	AC	127 VA maximum
	DC	135 W maximum
Inrush current at 25 °C on cold start	AC-DC	26.5 A _{peak} (< 145 VAC/205 VDC)
	AC-DC	40 A _{peak} (< 264 VAC/370 VDC)
Rated frequency	47 to 63 Hz (50/60 Hz)	

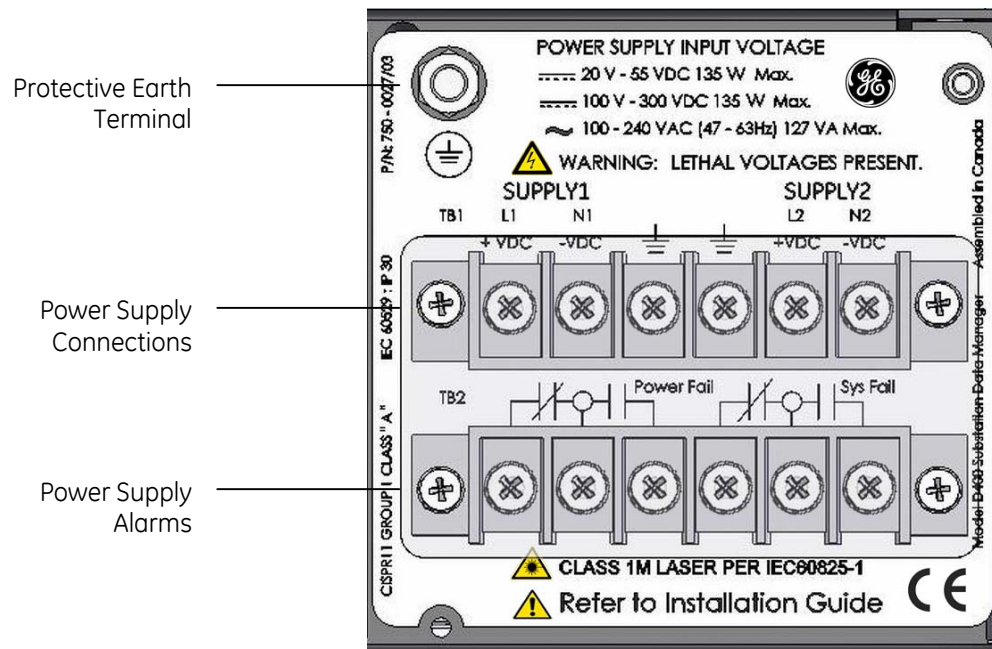
DC-DC Power Supply

Rated voltage range	20-55 VDC with overvoltage protection of 110 % to 150 %	
Rated power	DC	135 W maximum
Inrush current at 25 °C	DC-DC	35 A _{peak} (< 60 VDC)

5.2 Power Connections

The D400 accepts power connections through two terminal blocks on the rear panel:

- Terminal block **TB1** is reserved for connecting power from one or two external sources to the D400.
- Terminal block **TB2** provides contact closure outputs for power supply fail and system fail alarms.



Wiring Requirements

The supply wiring for the D400 must be a minimum of 18 AWG (0.79 mm²), 3-conductor cable with an external insulation jacket, and a minimum certified voltage rating of 600 V.

The protective conductor must be minimum 16 AWG (1.3 mm²) wire with (green-&-yellow) insulation. Recommended conductor size is 12 AWG.

The wires must be terminated with an insulated #6 Forked Terminal.

The clear plastic protective barrier provided with the terminal strip connector must be in place once wiring of the mains is completed.

External Power Requirements

Before connecting an external power source to the D400, ensure that the following external power requirements are met:

- An IEC 61010 qualified primary disconnect device and over current protection not exceeding 15 A must be externally provided in the AC/DC mains supply system.
- All current carrying conductors must be switched, including neutral (for AC) and negative (for DC).
- Primary disconnect device must be rated for the proper voltages (AC and/or DC), as well as inrush currents for the power supplies. See section “5.1 Power Supply Options” for peak inrush current.
- Protective earth conductor must be connected to the provided protective earth terminal before any mains power conductors.
- The primary disconnect device shall be in close proximity to the D400 equipment and within easy reach of the operator.
- The primary disconnect device shall be marked as the disconnecting device for the D400 equipment.

» **To connect the power source to the D400:**

1. Remove the terminal block **TB1** protective plastic cover.
2. Connect power source as follows:

If your power supply is...	then...
AC	Connect the AC line connection to the L connection point(s) and the AC neutral connection to the N connection point(s) on terminal block TB1
DC	Connect the DC power supply, observing the correct polarity, to the +VDC and -VDC connection point(s) on terminal block TB1


For proper connection, the recommended tool torque settings for power terminal screws are 10.8 in-lb [1.22 Nm]

See also wiring diagrams below for different power configurations.

Power Source Configurations

Power Source	Connection	Wiring Diagram
Single External AC Power Source	Connected to SUPPLY1 and SUPPLY2 input terminals.	
Single External DC Power Source	Connected to SUPPLY1 and SUPPLY2 input terminals.	
Two External AC Power Sources with Optional Redundant D400 AC/DC Power Supply	First source connected to SUPPLY1 terminals. Second source connected to SUPPLY2 terminals.	

Power Source	Connection	Wiring Diagram
Two External DC Power Sources with Optional Redundant D400 DC Power Converter	First source connected to SUPPLY1 terminals. Second source connected to SUPPLY2 terminals.	

3. Connect protective earth wire to the Protective Earth terminal  on the rear panel. The terminal is an M5 threaded stud with M5 nut and washers. The recommended order for stacking the washers on the chassis is: flat washer, ground wire ring terminal, toothed washer, M5 nut.

For proper transient protection, the recommended tool torque settings for M5 nut is 18.1 in-lb [2.04 Nm].

Note: It is recommended to terminate 12 AWG green & yellow wire with a Panduit PV10-14R or equivalent ring terminal.

4. Verify that Power LEDs on the power supplies and the D400 main module are lit.
5. Replace the terminal block protective plastic cover.

5.3 Power Supply Alarms

The D400 includes connections for two power supply alarms:

- Power Fail to indicate one of the two power supplies or one of the two power feeds has failed
- System Fail to indicate system operation status

Terminal block **TB2** on the rear panel of the D400 provides contact closure outputs for connection to an external circuit, for example, to connect an external LED indicator or audible alarm.

The contact closure used for alarm outputs is a solid-state photo-MOS device. Contact closure output ratings at maximum ambient temperature are:

- Continuous current: 0.1 A continuous at 300 VAC / 300 VDC
- Peak current: 0.28 A peak for 10 ms
- Maximum on resistance: 35 ohm

Power Fail Alarm

The Power Fail contact closure provides for an external LED indicator (lamp) or audible alarm upon loss of power.

The indicator or audible alarm can be wired to operate as follows:

- ON when power is present
- ON when a power failure has occurred

The Power Fail contact closure provides three contacts (terminals 1, 2 and 3) on terminal block **TB2**.



Caution: Contact closure rated for 0.1 A @ 300 V maximum.

» To connect the Power Fail contact closure:

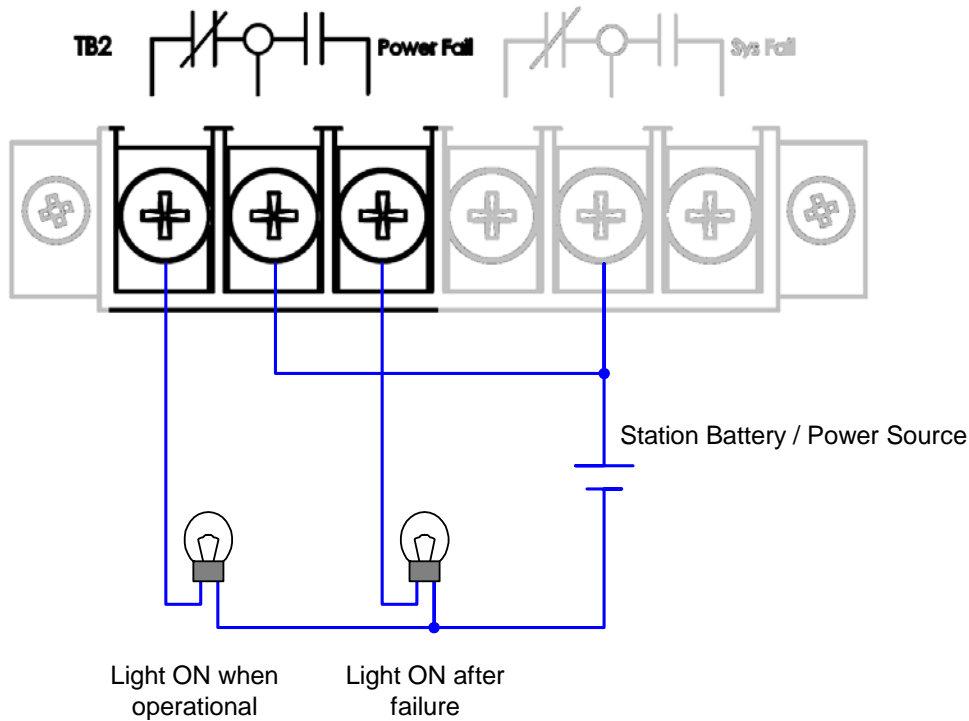
1. Remove the terminal block protective plastic cover.
2. Wire a lamp or audible alarm to terminals 1, 2 or 3 on terminal block **TB2** as follows (see figure):

To enable the indicator when power is...	Wire the lamp between...
Present	Terminals 1 and 2
Absent	Terminals 2 and 3

For proper connection, the recommended tool torque settings for power terminal screws are 10.8 in-lb [1.22 Nm].

3. Replace the terminal block protective plastic cover.

Power Fail Alarm Connection



System Fail

The D400 includes a System Fail contact closure to provide an external LED indication on the system or LAN status.

The LED notification can be wired to operate as follows:

- ON when system is functioning properly
- ON when system failure has occurred

The System Fail contact closure provides three contacts (terminals 4, 5 and 6) on terminal block **TB2**.



Caution: Contact closure rated for 0.1 A @ 300 V maximum.

>> To connect the System Fail relay:

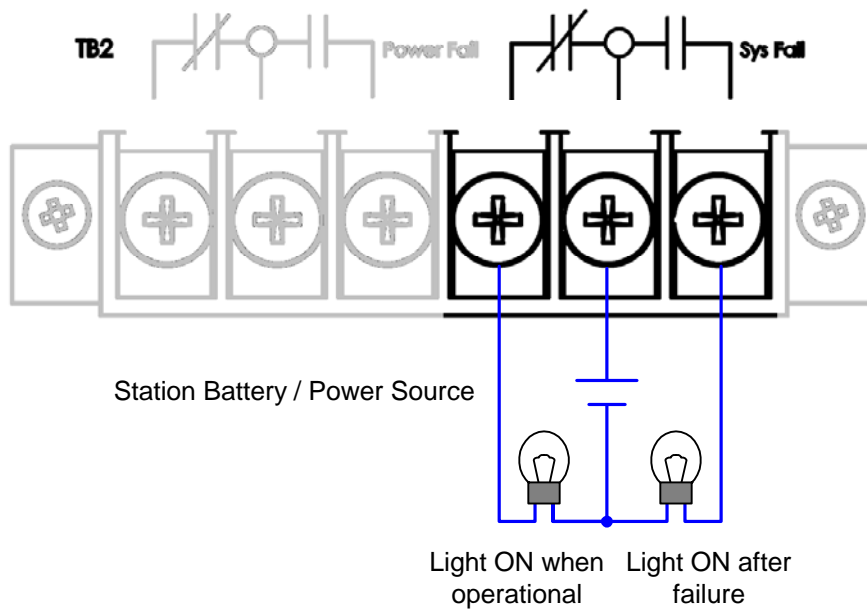
1. Remove the terminal block protective plastic cover.
2. Wire a lamp to terminals 4, 5 and 6 on terminal block **TB2** as follows:

To enable the indicator when power is...	Wire the lamp between...
Functioning properly	Terminals 4 and 5
Failed	Terminals 5 and 6

For proper connection, the recommended tool torque settings for power terminal screws are 10.8 in-lb [1.22 Nm].

3. Replace the terminal block protective plastic cover.

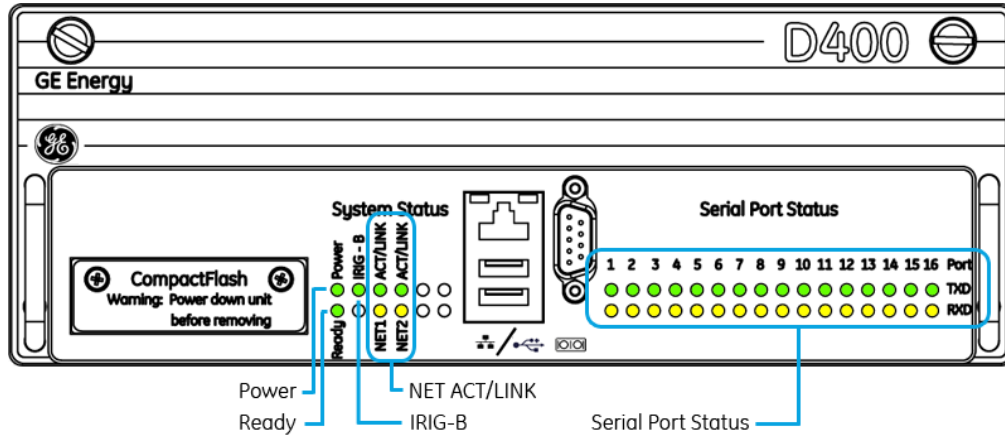
System Fail Alarm Connection



5.4 Front Panel LEDs

Once the D400 is powered up, the LED indicators on the front panel of the D400 become active. The indicators provide status information on the operation of the D400.

D400 Front LEDs





System Status LEDs

The System Status LEDs indicate the unit's operational status:

LED Display	Status Description								
<table style="border: none;"> <tr> <td style="text-align: center;">●</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> </table>	●	○	○	○	○	○	○	○	Power is correctly supplied to the unit (+5 V present on the D400 Main Board).
●	○	○	○						
○	○	○	○						
<table style="border: none;"> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">●</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> </table>	○	○	○	○	●	○	○	○	Initialization (boot-up and self-diagnostics) of the D400 is complete and the unit is ready to process data.
○	○	○	○						
●	○	○	○						
<table style="border: none;"> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">●</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> </table>	○	●	○	○	○	○	○	○	IRIG-B signal is being correctly processed.
○	●	○	○						
○	○	○	○						
<table style="border: none;"> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">●</td> <td style="text-align: center;">●</td> </tr> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> </table>	○	○	●	●	○	○	○	○	Link integrity for the Ethernet Switch in NET1 and NET2 slots.
○	○	●	●						
○	○	○	○						
<table style="border: none;"> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">●</td> <td style="text-align: center;">●</td> </tr> </table>	○	○	○	○	○	○	●	●	Transmission activity for the Ethernet Switch in NET1 and NET2 slots.
○	○	○	○						
○	○	●	●						

Serial Port Status LEDs

The Serial Port Status LEDs provide a visual indication of the status for each serial communication port. For a given serial communication port:

LED Display	Status Description
TXD 	Serial transmission activity on the serial port
RXD 	Serial reception activity on the serial port

Notes:

- If a pair of LEDs is not lit, it does not indicate a problem, only that the connected device is not active at that moment.
- If a serial communication card slot is empty, (that is, no card is installed) the serial Receive (**RXD**) LED may be lit.

6

Configuring the D400

When you receive your D400, it is configured with default communication settings. To enable the D400 to communicate over your network, you must change the settings as required by your system.

6.1 Connecting to the D400 for the First Time

To perform the initial set up of the D400, you need to plug directly into the D400 through the front serial communications port. The front communications port provides a local connection and terminal session with the D400 used to perform system administrative and maintenance procedures.

» **To connect to the D400:**

1. Connect the supplied null modem cable (GE Part No. 977-0529/72) to your computer's serial communications port and to the D400's front communications port. See section "4.10 Front Maintenance Port" for cabling information.
2. From the Windows **Start** menu, select **Programs > Accessories > Communications > HyperTerminal**.

The **HyperTerminal** window opens and a connection wizard starts.

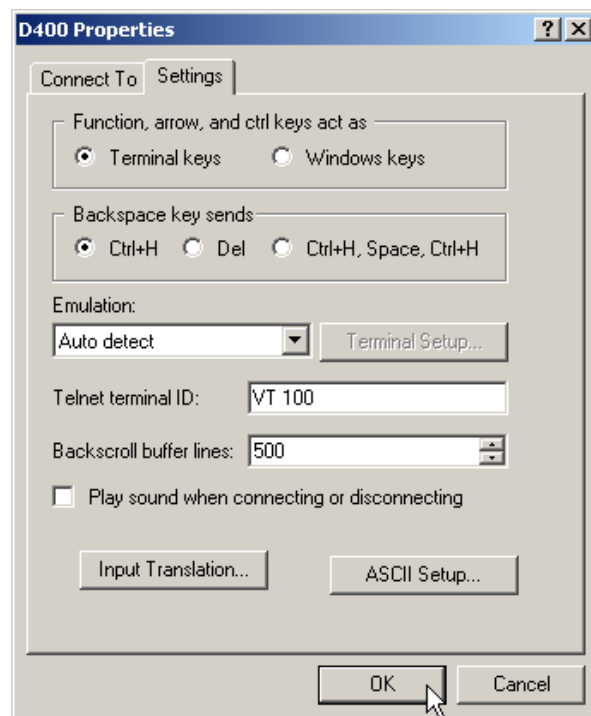
3. In the **Connection Description** dialog box, enter a **Name** for the connection. Click **OK**.
Note: The name you choose is *not* important.
4. In the **Connect to** dialog box, select your computer's communication port (typically COM1) in the **Connect using** list. Click **OK**.

5. In the **Port Settings** dialog box, select the following options, and then click **OK**:

Bits per second	19200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

6. On the **File** menu, click **Properties**. On the **Settings** tab, select the following options, and then click **OK**:

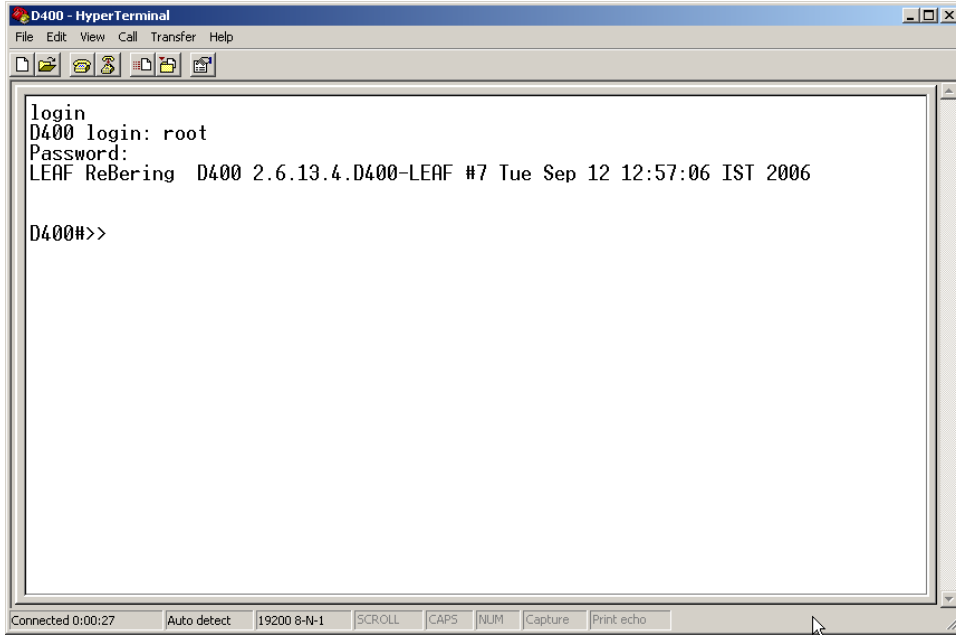
Under Function, arrow ...	Terminal keys
Emulation	Auto detect
Telnet terminal ID	VT 100
Backscroll buffer lines	500



7. In the main terminal window, type **login** and press **Enter**.
 8. At the D400 login prompt, type the default username **root** and press **Enter**, and then type the default password **geroot** and press **Enter**.

Note: When you enter the password, it may not be visible on the screen.

The **D400#>>** system prompt displays.

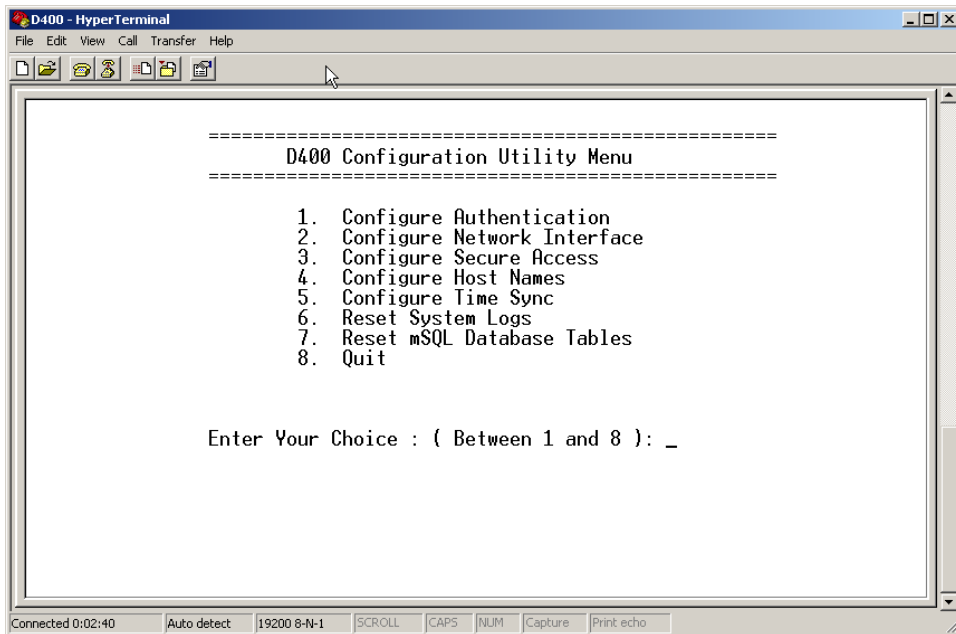


You are now online with the D400.

» **To configure the network interface:**

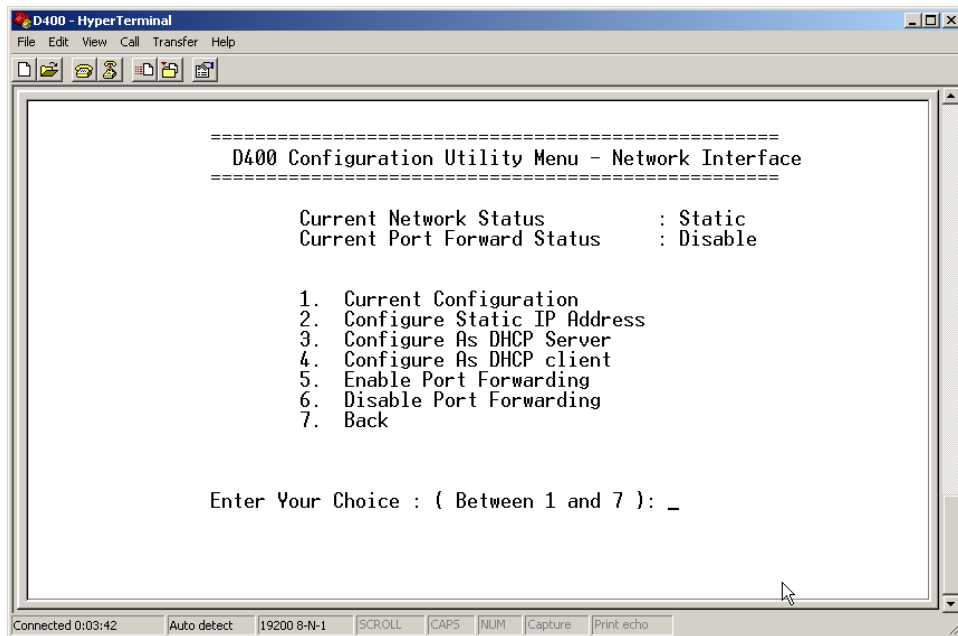
1. At the *D400* #>> prompt, type **D400cfg** and press **Enter**.

The **D400 Configuration Utility** menu appears.



2. Type **2** and press **Enter** to select **2. Configure Network Interface**.

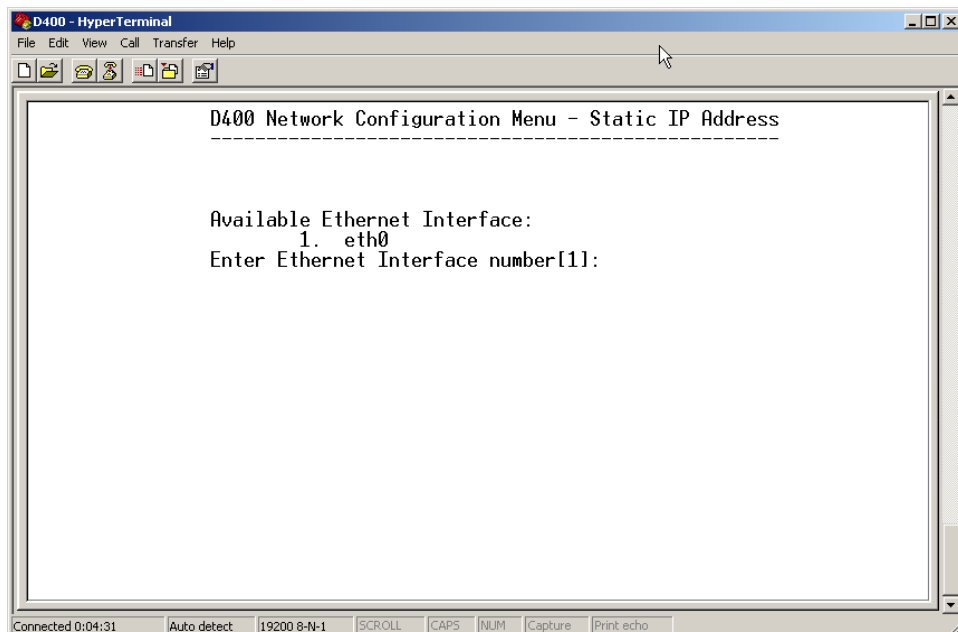
The **Network Interface** screen displays.



3. Type **2** and press **Enter** to select **2. Configure Static IP Address**.

The **Static IP Address** screen displays and lists the available Ethernet interfaces according to the number of Ethernet cards installed in the D400.

In this example, only one Ethernet interface card is installed in the D400 so only one Ethernet interface is available for configuration.



4. Select **1. eth0**.

5. Type the IP address of the D400 and press **Enter**.

The default IP address is 192.168.168.81.

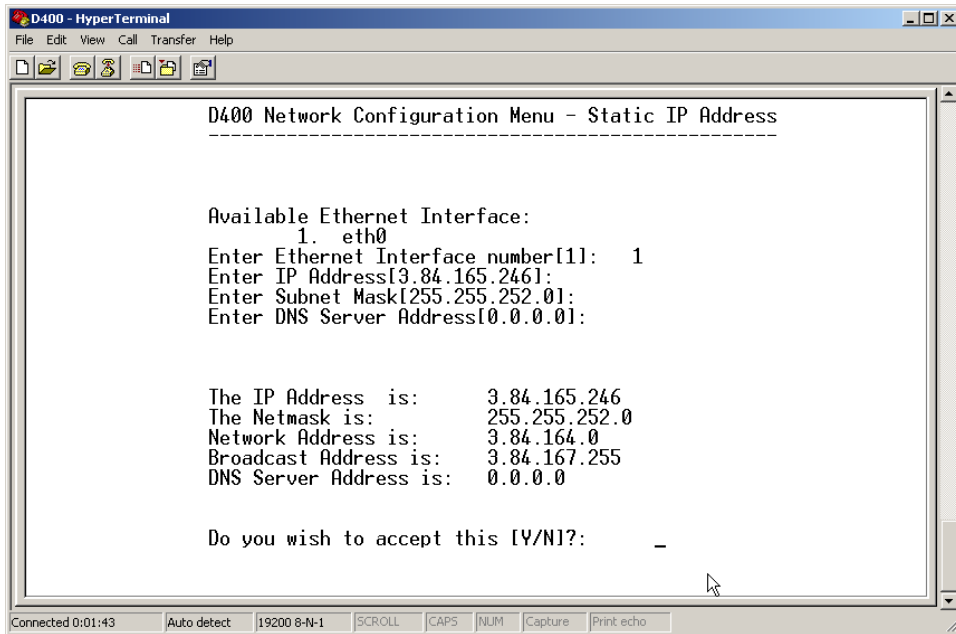
6. Enter the Subnet Mask of the D400.

The default Subnet Mask is 255.255.255.0.

7. Enter the DNS Server address. If the DNS Server address is not required, press **Enter** to continue.

8. Enter the Gateway IP address. If the Gateway IP address is not required, press **Enter** to continue.

A summary of the configured settings displays.



9. Do one of the following:

- To accept the settings, enter **Y**.
- To change the settings, enter **N** and repeat Steps 2 to 8 to make the necessary changes.

10. When you return to the D400 Configuration Utility Menu, select **8. Quit** to exit the configuration utility and return to the D400 prompt.

11. At the `D400#>>` prompt, type **reboot** and press **Enter**.

The D400 restarts and is updated with the new network settings.

Refer to the D400 online help and *D400 Software Configuration Guide* for information on configuring the D400 software.

7

Servicing the D400

The D400 does not require any scheduled maintenance. However, you may need to replace the following parts occasionally:

- System battery
- CompactFlash card

A periodic inspection is also suggested to ensure that:

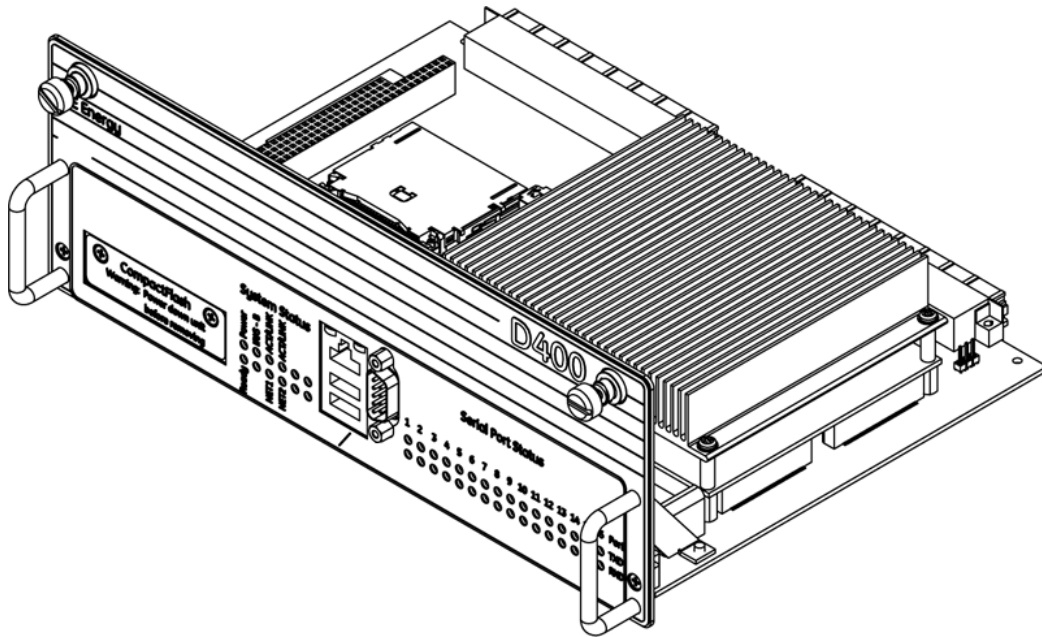
- Unit has sustained no accidental physical damage
- Airflow is not obstructed
- Connectors and cables are intact and firmly attached
- Battery condition is good

Only trained personnel should perform maintenance on the D400.

7.1 Removing the D400 Main Module

You need to remove the D400 main module from the chassis to access the system battery and the system CompactFlash card for maintenance.

D400 Main Module



» To remove and re-insert the D400 main module:

1. Power down the D400.
2. Hand-loosen the two screws on the front panel of the D400 main module.
3. Grasping the two handles, pull out the D400 main module.
4. Make the necessary changes.
5. Slide the main module back into the chassis.

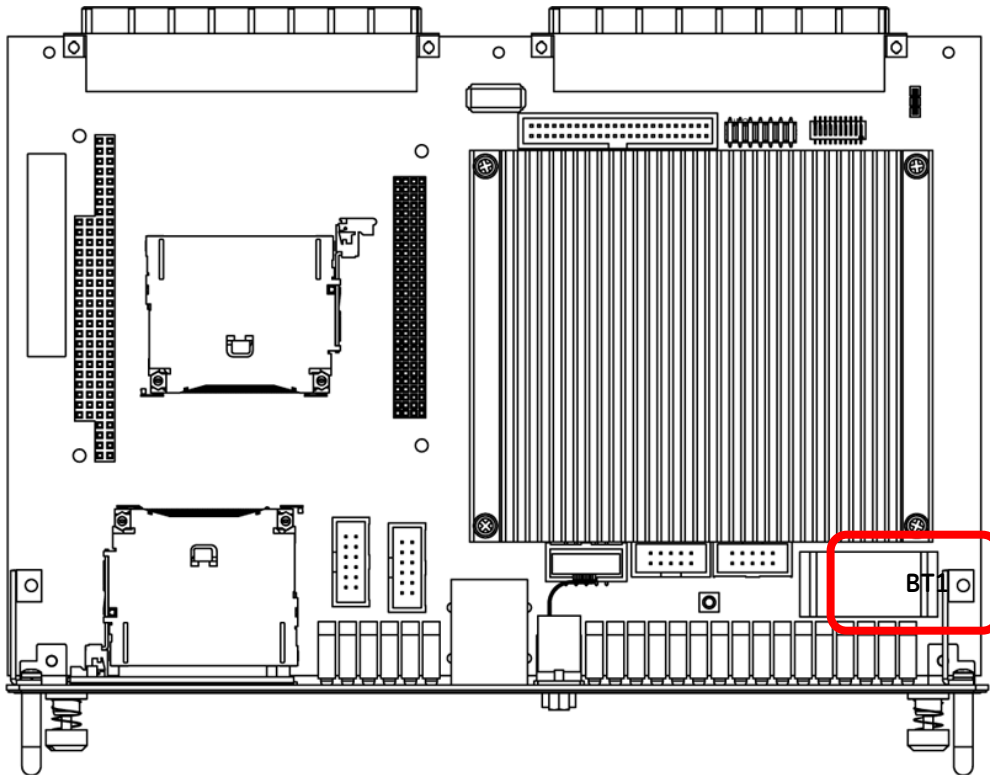
Note: Ensure the connectors at the rear of the main board are firmly seated.
6. Hand-tighten the two screws on the front panel.
7. Power up the D400 and verify that the **Power** LED is illuminated.

7.2 Replacing the Battery

The lithium battery maintains power to the D400's built-in Real-Time Clock and NVRAM if there is a power disconnect. The D400 is supplied with a 1/2AA 3.6 V 0.9 Ah Lithium battery that you must insert on the D400 main board when the D400 is installed. To ensure the battery is good, it is recommended you replace the battery every five years.

You can access the battery compartment by removing the D400 main module from the chassis. The battery holder **BT1** is located near the front corner of the board, behind the two rows of Serial Port Status LEDs.

D400 Battery Location



Before You Remove the Battery...

Note the following items before you begin battery replacement.

CAUTION

- Disconnect power to the D400 before changing the **battery**.
- Avoid exposure to high temperatures, such as soldering or spot-welding
- Avoid excessive force to terminals
- Use extreme caution and proper procedures for servicing electro statically sensitive components. Electro statically sensitive components are located near the battery.

Note: Removing the battery will cause the internal clock to reset.

Supported Battery Types

The D400 is supplied with a 1/2AA 3.6 V 0.9 Ah Lithium non-rechargeable battery. The following battery types may be used as a replacement.

Supported battery replacements

Manufacturer	Mfg. Part No.
Tadiran®	TL-2150
Tadiran	TL-4902
Tadiran	TL-5101
Tadiran	TL-5902
Toshiba®	ER3V
Toshiba	ER4V
Saft®	LS-14250
Saft	LS-14250C
Sonnenschein®	SL-350
Sonnenschein	SL-750
Maxell®	ER3
XENO Energy	XL-050F

» To insert or replace the D400 battery:



Warning! Ensure that all hazardous live circuits are isolated or disconnected before attempting battery replacement.

1. Power down the D400.
2. Remove the D400 main module from the chassis.
3. Using a plastic or other non-conductive tool, pry the black plastic clip holding the battery away from the battery holder **BT1**. When free, the battery and clip can be removed together.
4. Remove the clip from the battery and keep it.
5. Place the new battery into the battery holder, ensuring polarity is correct.
6. Replace the clip and press down until it clicks into the retaining notches in the battery holder.
7. Replace the D400 main module.
8. Power up the D400.

Checking Voltage

To check battery voltage, use a meter or other measuring device that has a high input impedance (10 Mohm or higher).

Cleaning and Handling Lithium Batteries

- Wear gloves or finger caps when handling batteries to keep them clean.
- Use non-conductive cleaning solution to prevent deterioration of battery performance
- Dry batteries at a temperature below 85 °C to prevent seal deterioration that may, in turn, result in leakage

Disposing of Batteries

The D400 lithium battery contains harmful chemicals.



Li

The Lithium battery is recyclable. Dispose of battery according to local waste management regulations.

Battery Life

If the battery is disconnected, or if the D400 is never powered down, the life of the battery should exceed five years. The life of the battery will be severely shortened if the battery is left connected while the D400 is powered down for extended periods or stored.

For long-term storage:

- Keep the equipment at temperatures and humidity below normal
- Avoid shorting or loading while stored

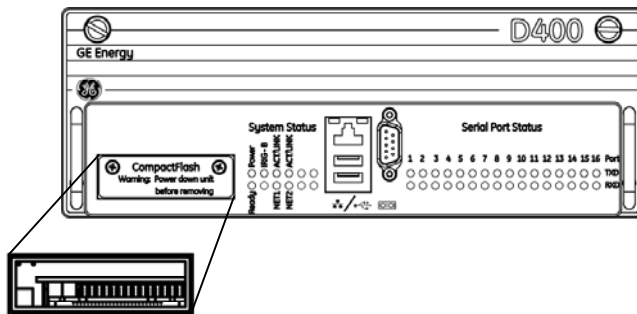
7.3 Changing the CompactFlash

CompactFlash cards are designed with flash technology, a non-volatile storage solution that can retain data indefinitely without a battery. The cards are solid state, meaning they contain no moving parts, and provide much greater protection of data than conventional magnetic disk drives.

The D400 contains two CompactFlash cards on the main board to store software and data:

- System CompactFlash card located at connector **P2** stores system firmware
- User CompactFlash card located at connector **P1** is accessible from the front panel and stores system data such as event logs

User CompactFlash Access Panel



» To change the System CompactFlash card:

1. Power down the D400.
2. Remove the D400 main module from the chassis.
3. At connector **P2**, press the **Eject** button to eject the CompactFlash card.
4. Insert the new CompactFlash card.
5. Replace the D400 main module.
6. Power up the D400.

» To change the User CompactFlash card:

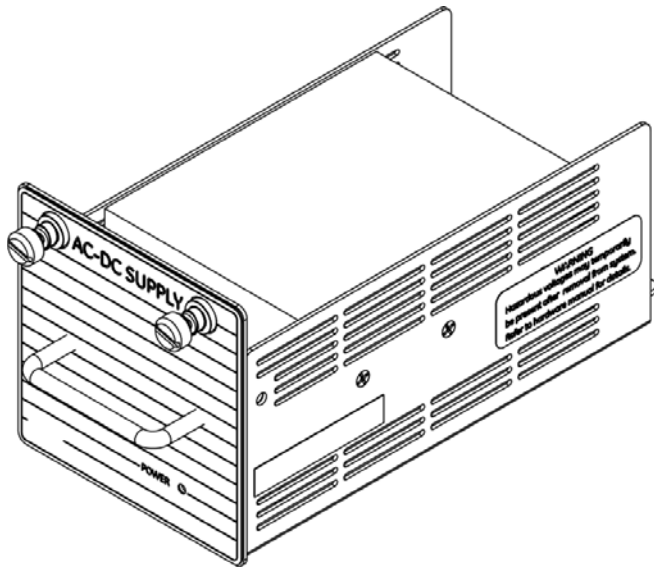
1. Power down the D400.
2. Using a Phillips Screwdriver, remove the screws from the CompactFlash slot cover located on the front panel of the D400 main module.
3. Press the **Eject** button to eject the CompactFlash card.
4. Insert the new CompactFlash card into the slot.
5. Replace the CompactFlash slot cover and secure it with the screws.
6. Power up the D400.

7.4 Replacing the Power Supply

The power supply module is accessible and easily replaced from the D400 front panel. The D400 may be supplied with an optional redundant power supply (in Slot 2) to provide dual hot swappable power supplies. If the D400 contains dual power supplies, you can replace one power supply unit without having to power down the D400, as long as the other power supply unit is operational.

Note: The D400 power supplies do not contain user replaceable fuses. The entire power supply module must be replaced if the fuse has failed.

D400 Power Supply Unit



Before You Remove the Power Supply...

Note the following items before you begin power supply replacement.

- Ensure the other power supply unit (if available) is functioning (the green **Power** LED is illuminated) to ensure that the D400 doesn't power down during replacement.
- Make sure that the unit is wired in accordance with section "5.2 Power Connections".

» To replace a D400 power supply unit:

1. If only a single power supply unit is installed (in Slot 1), power down the D400. If dual power supplies are installed (in Slot 1 and Slot 2), ensure that the secondary unit is functioning.
2. Hand-loosen the two screws on the front panel of the power supply unit.
3. Pulling on the handle, slide the power supply unit out of the chassis.
4. Slide the new power supply unit into the chassis.
5. Hand-tighten the two screws on the front panel.
6. Verify that the **Power** LED is illuminated on the replaced power supply unit.

A

Standards & Protection

This Appendix lists the standards with which the D400 has been tested for compliance.

D400 Standards and Protection

Category	Standard Name	Description
Emissions Standards	EN55011 (CISPR 11) ¹	ISM RF equipment – Electromagnetic disturbance characteristics
	IEC 60255-25	Electromagnetic emission tests for measuring relays and protection equipment
	IEC 61000-3-2	Limits for harmonic current emissions (equipment input current \leq 16 A per phase)
	IEC 61000-3-3	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with input current \leq 16 A per phase and not subject to conditional connection
Immunity Standards	IEC 61000-4-2 IEC 60255-22-2 IEEE® C37.90.3	Electrostatic discharge (ESD) immunity test
	IEC 61000-4-3 IEC 60255-22-3 IEEE C37.90.2 (10 V/m)	Radiated, radio-frequency electromagnetic field immunity test
	IEC 61000-4-4 IEC 60255-22-4 IEEE C37.90.1	Electrical fast transient/burst immunity test

Category	Standard Name	Description
	IEC 61000-4-5	Surge immunity test
	IEC 61000-4-6 IEC 60255-22-6	Immunity to conducted disturbances, induced by radio-frequency fields
	IEC 60255-22-1	1 MHz burst immunity test
	IEC 61000-4-8	Power frequency magnetic field immunity test
	IEC 61000-4-12	Ring wave immunity test
	IEC 60255-22-1 IEEE C37.90.1 Ontario Hydro A-28M-82	Damped Oscillatory and Ring wave
	IEC 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests
	IEC 61000-4-16	Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz
	IEC 61000-4-17	Ripple on DC input power port immunity test
	IEC 61000-4-29+	Voltage dips, short interruptions and voltage variations on DC input power port immunity test This standard only applies when using high voltage DC as the source (100 VDC-300 VDC).
Safety Publications	IEC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use - General requirements
	IEC 60255-5	Insulation coordination for measuring relays and protection equipment- Requirements and tests
Environmental Standards	IEC 60068-2-1	Environmental Testing - Cold
	IEC 60068-2-2 ²	Environmental Testing - Dry Heat
	IEC 60068-2-6 IEC 60255-21-1	Environmental Testing - Vibration (sinusoidal)
	IEC 60068-2-27	Environmental Testing - Shock
	IEC 60068-2-29	Environmental Testing - Bump

Category	Standard Name	Description
	IEC 60068-2-30	Environmental Testing - Damp heat, cyclic (12 h + 12h cycle)
	IEC 60068-2-31	Environmental Testing - Drop and topple
	IEC 60255-21-2	Shock and bump tests
Communication Standards	IEEE 802.3	CSMA/CD Access Method (and physical layer specifications)
	IEC 61850-3	Communication networks and systems in substation – General requirements

¹To comply, the D400 BIOS Spread Spectrum clock setting must be set to “disable”. This is the factory default.

²To comply, the D400 BIOS DRAM clock setting must be set to “HCLK-33M”. This is the factory default.

B

Ordering Guide

Product Identification

The D400 comes with an ID number that identifies the supplied options and hardware configuration of the unit. This ID number is composed of **400-** followed by 16 alphanumeric characters that are determined by the options selected. The ID number is listed on a label located next to Slot 1 on the rear panel of the D400.

D400 Ordering Guide

Product Identification Number

400-

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

CPU OPTIONS

- A – 650 MHz CPU, 512 MB RAM, SINGLE ETHERNET
- B – 650 MHz CPU, 512 MB RAM, DUAL REDUNDANT ETHERNET¹



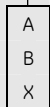
POWER SUPPLY SLOT 1

- A – 100-240 VAC (47-63 Hz), 100-300 VDC (±10 %)
- B – 20-55 VDC (±10 %)



POWER SUPPLY SLOT 2

- A – 100-240 VAC (47-63 Hz), 100-300 VDC (±10 %)
- B – 20-55 VDC (±10 %)
- X – NONE



SERIAL COMMUNICATIONS SLOTS 1-8

- 1 – RS-232 (2 CHANNELS)
- 2 – RS-485 (2 CHANNELS)
- 3 – GLASS FIBER OPTIC (2 CHANNELS, 850 nm, 62.5/125 µm) ST CONN.
- 4 – PLASTIC FIBER OPTIC (2 CHANNELS, 600 nm, 1 mm) VERSA LINK CONN.
- X – NONE

1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
X	X	X	X	X	X	X	X

IRIG-B INPUT CARD OPTIONS

- A – IRIG-B INPUT CARD
- X – NONE



IRIG-B DISTRIBUTION CARD

- B – IRIG-B DISTRIBUTION CARD (IRIG-B INPUT CARD REQUIRED)
- X – NONE



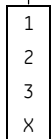
NETWORK SLOT 1

- 1 – ETHERNET 4 PORT 10/100 MB TP SWITCH
- 2 – ETHERNET FIBER OPTIC (HOT STANDBY) 2 PORT 10/100 BASE-SX
- 4 – ETHERNET REDUNDANT 10/100 MB TP¹



NETWORK SLOT 2

- 1 – ETHERNET 4 PORT 10/100 MB TP SWITCH¹
- 2 – ETHERNET FIBER OPTIC (HOT STANDBY) 2 PORT 10/100 BASE-SX¹
- 3 – COM2 PORT (REQUIRES EXTERNAL MODEM)
- X – NONE



USB KVM, AUDIO

- A – USB KEYBOARD, VIDEO, MOUSE, AUDIO CARD²
- X – NONE



¹ CPU option B is required when Network Slot 1 option 4 is selected and Network slot 2 is empty or both Network Slot 1 and Network Slot 2 are filled with option 1 or 2.
² Required for local HMI setup

Modification Record

Version	Rev.	Date	Author	Change Description
1.00	0	July 12, 2006	S. Tessari	Document created.
1.00	1	Nov. 17, 2006	E. Stuhr S. Tessari	Revisions as required by TUV. Deleted Supported Devices sections. Moved signal definitions to Chapter 4 and added more connections information. Edited whole document for consistency and correctness to current product specs. Added Chapter "Setting Up the D400."
1.00	2	Dec. 20, 2006	S. Tessari	Converted to single-source.
		Feb. 28, 2007	S. Tessari	Added RoHS and recycling info, updated RS-485 channel numbering order

Authentication Record

Version	Rev.	Date	Authenticator	Scope of Authentication
1.00	2	Feb. 28, 2007	E. Stuhr	Chapters 1-5, 7, Appendices A and B

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