



## Substation Based FDIR / FLISR

### KEY BENEFITS

- Enables cost-effective and staged deployment of FDIR feeder reliability improvements across a distribution network
- Reduces the length and magnitude of customer outages, reducing SAIDI and SAIFI
- Utilizes information from multiple local feeders in making switching decisions eliminating unnecessary switching when multiple faults occur in evolving or storm conditions
- Localized communications and decision making allows for feeder restoration even when wide area communications is lost
- Identifies switching capacity based on real time and historical loading levels as opposed to a rules based system thus allowing for full utilization of available capacity
  - Short term loading requirements based on a 15 minutes slide peak demand window
  - Long term loading requirements based on a rolling 30 day peak demand
- Easy to expand size of system without having to reconfigure settings in field deployed controllers
- Completely isolates faults if downstream switches are available, preventing feeding faults from distributed generators
- Increased Security through the use of an embedded operating system that is not subject to windows based security patches

### APPLICATIONS

- Substation based circuit reconfiguration for reliability improvements
- Looped feeders where the load to be restored is fed from only one source
- Multi-ended feeders where the load to be restored needs to be fed and shared by multiple sources
- Reliability optimization of up to 20 feeders utilizing up to 100 reclosers, switches and breakers

### FEATURES

- Automatic control and operator assisted reconfiguration modes of operation
- Integrates control into SCADA or DMS systems, or operates as a completely stand alone solution
- Email notification to operations and field crew notifying of:
  - Fault location
  - Reconfiguration actions taken
  - KW of customers still without power
- Supports advanced D400-DA Gateway functionality for integrating substation and distribution field equipment

#### Equipment Monitored & Controlled

- Breakers and protection relays
- Reclosers and recloser controllers
- Switches and switch controllers
- Fault circuit Indicators

#### Communications Protocols

- Protocols to distribution controllers
  - Modbus RTU
  - Modbus TCP/IP
  - DNP 3.0 RTU
  - DNP 3.0 TCP/IP
  - IEC60870-5-104

#### Advanced Gateway capability

- Data collection, concentration, visibility and media conversion
- Advanced automation utilizing IEC611331 configuration toolsets
- Logging and archiving of device Fault Records and Event Records
- Provides secure access to substation intelligent controllers

## Overview

The D400-DA is a substation based Fault Detection, Isolation, and Restoration system, designed for improving the reliability of distribution utility networks. With the ability to monitor and control reclosers and switches, the D400-DA can restore unfaulted sections of network thereby improving utility reliability indices and customer satisfaction.

## Substation Based FDIR/ FLISR - Fault Detection, Isolation & Restoration

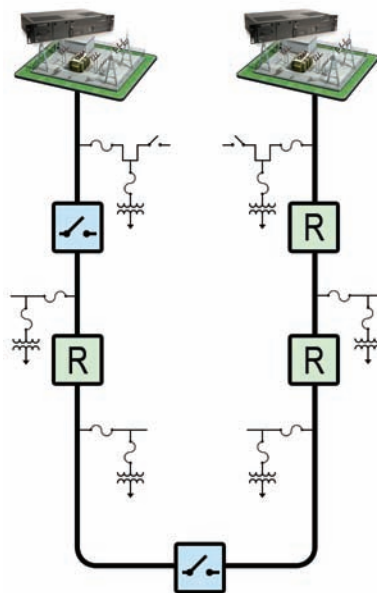
### Reliability Challenges

When faults occur on the distribution network, utility protection and control schemes normally shut down power on the feeder thus disrupting service to many customers. The size of area affected by the outage will directly translate into the number of consumers inconvenienced and some degree of economic loss.

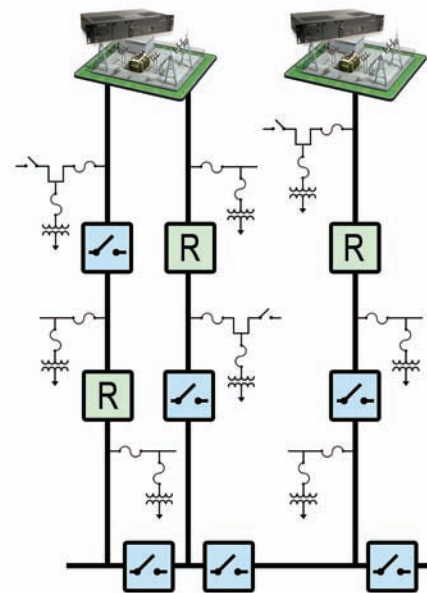
Many distribution utilities are measured as to how well they are serving their customers and may be subjected to regulatory penalties if the regulators feel their performance is not as good as it should be. There are several different measurement indices that are used to gauge utility reliability effectiveness including:

- **CML** - Measurements indicating number of Customer Minutes Lost per average 100 customers
- **CI** - Measurements indicating total number Customer Interruptions per average 100 customers
- **SAIDI** - The System Average Interruption Frequency Index measuring the average number of minutes of interruptions that a customer would experience
- **SAIFI** - The System Average Interruption Frequency Index measuring the average number of interruptions that a customer would experience
- **CAIDI** - The Customer Average Interruption Duration Index measures the average outage duration that any given customer would experience

### Looped Circuits



### Multi-Ended Circuits



The D400-DA substation based FDIR solution can automate both Looped and Multi-Ended feeder network configurations. The D400-DA can typically restore power to unfaulted sections less than 1 minute after a fault occurs, fast enough to prevent the outage affecting SAIDI and SAIFI indices.

### What FDIR Can Provide

Fault Detection, Isolation and Restoration (FDIR) schemes, also known as Fault Location Isolation and Supply Restoration (FLISR) or Circuit Reconfiguration Schemes, will greatly enhance distribution grid reliability by quickly restoring power to as many customers as possible. By quickly isolating faults and rerouting power from alternate sources to customers on healthy parts of the network, utilities can greatly reduce the number of customers affected by outages thus reducing their measurement indices and any penalties that may be associated with them.

### Methods of Performing FDIR

There are two main methodologies used to accomplish circuit reconfiguration:

- **Centralized Schemes** that utilize a system wide Distribution Management Systems (DMS) that analyzes the entire network to identify the best way to reconfigure the feeders to restore power after a fault

- **Decentralized or Substation Based Schemes** that analyze smaller sections of the network and does not require information about the larger distribution network to reconfigure local sections of the grid that are experiencing outages due to faults.

### High Degree of Reliability

Through implementing a D400-DA substation based FDIR scheme, communications needed for monitoring or reconfiguring the network only need to extend from the field recloser and switch controllers to the substation where the D400-DA is located. While communications can be sent back to a Control Center for SCADA management, the complete reconfiguration of the network can be done without a backhaul communications infrastructure. When large scale events occur that can cause multiple utility wide problems, the D400-DA substation based FDIR solution will continue to operate and reconfigure the network even if backhaul communications are lost.

### Looped and Multi-Ended Circuits

The D400-DA can be used on both looped and multi-ended distribution circuits. On looped circuits, power to re-energize healthy parts of the circuit will come from up to only two source locations that are separated by an open tie.

On multi-ended circuits, the power to restore the network circuits may come from multiple source locations. When the load to be added from a reconfiguration action is too large to be supported from one source, the D400-DA solution will create a network configuration that utilizes power from as many sources as are needed to bring back power to the maximum number of customers possible.

### Scalable, Cost-Effective Solution

This D400-DA solution provides a scalable solution for automating from as few as two and as many as twenty circuits or feeders with a single D400-DA. With this scalability, utilities have a cost effective solution that can be incrementally rolled out feeder by feeder or just installed on circuits that are causing the most reliability problems. One D400-DA can automate these twenty circuits whether or not they are emanating from one substation or from multiple

substations, as long as the D400-DA can communicate to the controllers in the field.

**Feeder Sectors** - Each D400-DA can monitor and automate up to twenty feeder sectors. Each sector is defined as a feeder begins at a breaker and ends at a normally open tie point.

The D400-DA that is monitoring a particular sector will be responsible for isolating that sector in the event a fault has occurred on it. This same D400-DA will also be responsible for controlling the tie switches to other sectors in the event that more load will be added to it to restore adjoining dead sectors.

**Devices Controlled** - Each D400-DA can communicate with and control up to 100 devices found within the sectors it is monitoring. Devices interfaced with it may include protection relays, recloser controllers, switch controllers and fault circuit indicators.

### Modes of Operation

The D400-DA has two main modes of operation for isolating and reconfiguring distribution networks: Automatic Reconfiguration and Operator Assisted Reconfiguration.

**Automatic Reconfiguration** - In Automatic Reconfiguration mode, the D400-DA will identify outages on its monitored sectors and take action to restore power to the maximum number of customers as possible. It performs the actions without any interaction required from system operators.

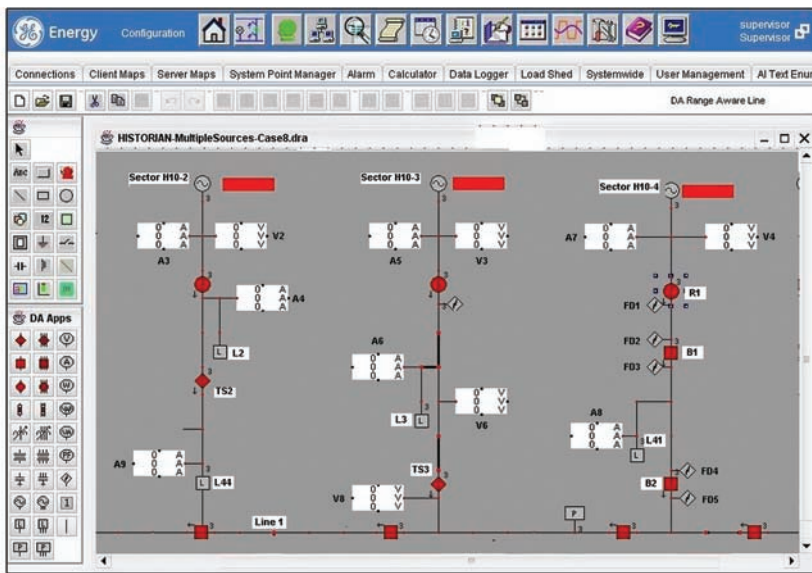
**Operator Assisted Reconfiguration** - In Operator Assisted Reconfiguration mode, the D400-DA will require confirmation that system operators agree with the recommended action before these actions are carried out. This mode of operation is often used by utilities for an initial trial period of time to have their operators get comfortable with the D400-DA recommendation before going into full Automatic Reconfiguration mode.

### Reconfiguration Triggers

While the D400-DA is monitoring its feeders, there are several sequences that will initiate a reconfiguration action:

- **Protection Lockout** - The operation of a protection function on a protection relay or recloser controller
- **Loss of Voltage** - The voltage on a sector has dropped below the programmed voltage threshold for an extended period of time defined by the utility.
- **Loss of Voltage After Fault** - An immediate loss of voltage after a downstream overcurrent detection.

## Network Topology Modeling and Sector Definition



The D400-DA system configuration software is an easy-to-use online tool that allows for system modeling and FDIR sector configuration. When being used in Operator Assisted Mode, this tool can be the operator interface for acknowledging or rejecting reconfiguration scenarios proposed by the D400-DA FDIR system.

### Isolation

When a reconfiguration action has been triggered, the first course of action the D400-DA will take is to isolate any faulted sections on the line. Isolation actions will attempt to minimize the number of customers falling within an isolated section.

When the D400-DA is in Operator Assisted Mode, it will give a recommendation to the operators on the best course of action to take to isolate the fault. If the operator does not agree with the recommended action, the D400-DA will calculate the next optimal scenario and propose that to the operators.

## Isolation on Sectors with Distributed Generation

When a fault occurs on a sector of the line, the D400-DA will open all of the available switches to completely isolate the fault. On radial feeders or laterals, if additional switches are located downstream of the fault, the D400-DA will also open those switches to prevent any other sources such as distributed generation that may back-feed the fault.

## Restoration

Once the D400-DA has ensured any faults are isolated, it will attempt reconfigure the network to restore power to as many customers as possible.

When operating in Operator Assisted Mode, the D400-DA will first ask for confirmation from the operator before taking any action. If the operator does not agree with the recommended action, the D400-DA will calculate the next optimal scenario and propose that to the operator.

## Historical Load Modeling

To ensure that the source being used to reenergize a sector of the feeder can support the additional load, the D400-DA calculates the short term power requirements based on a 15 minute sliding peak demand window with 1 minute resolution.

The D400-DA also identifies the long term load requirements using a 30 days sliding window with a 1 day resolution and a 15 minute averaging period.

## Dead Line Verification

Before reconfiguring the network, the D400-DA will verify that the voltage on the dead sector has dropped below configurable thresholds to ensure that the line is still not energized due to any residual distributed generation sources.

## Alternate Protection Groups

Before reenergizing a line, the D400-DA will alter the setting groups on any recloser or switch controllers on the line so that the protection functions will be coordinated for the new loads and direction of power flow.

## Configuration

The D400-DA has a built-in configuration tool that enables modeling of the system and configuration of the Fault Detection, Isolation and Reconfiguration features. This drag-and-drop graphical tool is used for defining zones of feeder sectors and communications to field devices.

This configuration tool also allows for adding monitoring parameters that allow users to analyze power system values and status during commissioning and real-time monitoring phases.

## Real-Time Monitoring

### SCADA Integration

The D400-DA supports most standard SCADA protocols including DNP 3.0 and IEC 60870-5-104 and Modbus for integrating into operator systems. Utilities can integrate commands for accepting FDIR action recommendations as well as other substation automation applications that are supported by standard D400-DA functions.

### Web Integration

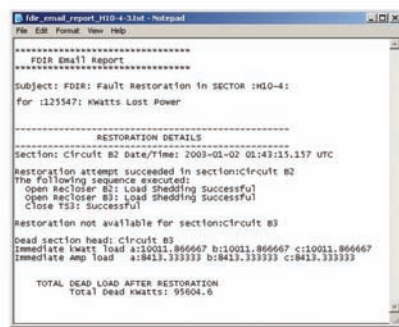
Operator monitoring and control can be done directly through the D400-DA using a standard web browser such as internet explorer. Using this interface, operators can monitor the status of all feeders and switching equipment, and send manual operator commands directly to their associated controllers. When being used in Operator Assisted Mode, this interface can directly be used by the operators to acknowledge or reject reconfiguration recommendations made by the D400-DA.

## Event Notification

### Email Notification

When an FDIR action is triggered by the D400-DA (either an isolation or reconfiguration event), an email can be sent to multiple parties giving notification of the action that occurred. Using this email, both operators and field crews can immediately be notified that a fault occurred and actions were taken to re-energize as many parts of the network as possible. Information in the email about the FDIR action includes:

- The name of the feeder that experienced the restoration attempt
- The equipment that was operated to isolate the fault and whether or not isolation was successful
- Equipment that was operated to restore the network
- The sections of the feeder not able to be restored by reconfiguration actions
- The total amount of load (kw) that were not able to be restored by the D400-DA restoration action



Email notifications sent from the D400-DA can be received directly by field crew and will immediately tell them an outage occurred, what feeder experienced the outage, what reconfiguration action happened and how many customers (kw) are still without power.



## Advanced Gateway

GE's D400-DA is a secure, substation-hardened gateway that collects metering, status, event, and fault report data from serial or LAN based Intelligent substation devices. The D400-DA summarizes data from the substation devices and makes it available locally /remotely through a standard secure web browser (HTTPS). It supports serial and/or LAN connections to SCADA masters. TCP/IP network connections are supported over the built-in Ethernet and the modem interface.



### Advanced Gateway

The D400-DA collects data from substation protection, control, monitoring, RTU, and intelligent devices, pre-processes the data and moves it up to EMS and DMS SCADA systems providing centralized substation management. Gateway features include:

- Data collection, concentration and visualization
- IEC 61850 Gateway
- Device Redundancy
- Built in Media Conversion



### Advanced Automation

The D400-DA provides the computing platform necessary to automate substation procedures, such that intricate processes are carried out safely and efficiently by creating custom automation programs using IEC 61131 compliant tools, and perform basic math functions on data points using the built-in Calculator tool. Automation features include:

- HMI, one-line viewer & Annunciator
- Mathematical Control Logic
- Programmable Logic using LogicLink
- Accumulator Freeze
- Analog Value Selection
- Control Lockout
- Double Point Association
- Input Point Suppression
- Redundant I/O
- Alarm Management

## D400-DA Applications

### Enterprise Systems



The collected substation device data is pre-processed and move it up to EMS and DMS SCADA systems providing centralized management of substation switches and breakers.

### Substation

#### D400



#### Applications:



Advanced Gateway



Advanced Automation



Fault Recording



Secure Remote Access



Device data collected from Protection, Control, Monitoring, RTU, and other intelligent equipment.



### Fault Recording/Data Logging

Using pass-through connections, users can extract valuable non-operational data such as digital fault recording (DFR) records, event and oscillography\* files. The user can also access the historical log files and upload the archived data for trending and analysis. Fault recording features include:

- Data Logger
- Trend Viewer
- Data Base Exporter



### Secure Remote Access

The D400-DA allows maintenance and relay engineers to securely access substation devices, locally or remotely, through advanced visualizations and communication tools, increasing productivity. Secure remote access features include:

- Access to operational & non-operational data
- Pass-through/Terminal Server
- Role Based Access Control
- Virtual Serial Ports



## Advanced Gateway

### Data collection, concentration and visualization

The D400-DA Substation Data Manager, when operating as a SCADA host, collects, filters, and sorts data from a wide range of intelligent devices (RTUs, relays, meters) in the substation and preserves original data time stamp for accurate sequence of event. Data can be presented to multiple SCADA hosts. The D400-DA comes with a built-in suite of protocols and security applications to facilitate communication with various substation devices and SCADA hosts, including:

- DNP3 serial and TCP/IP (client & server)
- IEC@ 61850 (client)
- Modbus™ serial & TCP/IP (client & server)

- IEC60870-5-101/103/104 client
- IEC60870-5-101/104 server
- SELFast Meter/SEL ASCII
- Hydran™ Host\*
- GE modem
- Generic ASCII protocols

### IEC 61850 Gateway

The IEC 16850 Client application allows the D400-DA to act as a powerful IEC 61850 data concentrator. The D400-DA also includes valuable features such as Dynamic Data Sets, Buffered Control blocks, Enhanced Security controls.

### Device Redundancy

Dual D400-DA units can be deployed creating a redundant system where accumulators, SOE logs, and configurations

are automatically synchronized between the two systems. Serial communication links are automatically switched between the units based on system health.

The D400-DA 100Base-FX redundant Ethernet card enables automatic switchover between two sets of Ethernet switches ensuring there is no single point of failure in the system.

### Built-in Media Conversion

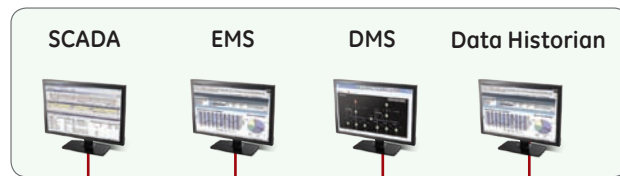
The D400-DA supports various communication media types—Serial: RS-232, RS-485, Glass Fiber, and Plastic Fiber; and Ethernet: 10/100Base-T, 10Base-FL, and 100Base-FX. Hot swappable communications modules eliminate the need for dongle type media converters used to convert to glass or plastic fiber, reducing total cost of deployment.

## Advanced Gateway Connectivity

### Enterprise Protocols:

- DNP3 Serial, DNP3 TCP/UDP
- Modbus Serial (RTU), Modbus TCP
- IEC60870-5-101
- IEC60870-5-104

### Enterprise Systems



### D400-DA Media Connectivity:

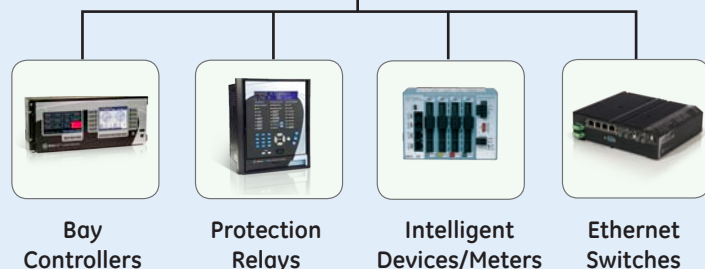
- 16 serial ports (RS232, RS485, Plastic/glass fiber)
- Support for 2 Ethernet Cards (10/100 Base-T, 100 Base-FX, 10/100 Base SX)
- 2 Front USB Ports
- Keyboard / Video /mouse



### Device Protocols:

- DNP3 Serial, DNP3 TCP/UDP
- IEC61850 Client
- Modbus Serial (RTU), Modbus TCP
- Hydran Client
- Generic ASCII Client
- SEL Binary / Fast meter / Interleaving
- IEC60870-5-101
- IEC60870-5-103
- IEC60870-5-104
- SNMP client

### Substation Devices





## Advanced Automation

The D400-DA acts as the centralized, rugged computing platform in advanced Automation systems. Using the calculator tool and/or GE's programmable logic (LogicLinx), users can create custom automation programs for a variety of applications such as:

- Sequence switching
- Interlocking
- Auto-sectionalizing
- Auto-reclosing
- Load Tap Changer Control
- Cap. Bank Control
- Reactor Switching
- Alarm grouping

### HMI, one-line viewer & Annunciator

The D400-DA supports a web based HMI/ Annunciator feature, that is accessible using a standard Internet browser or through a VGA monitor and USB keyboard/ mouse attached directly to the unit. Users have access to all data points in the systems, alarm screens, communications status screens ,and dynamic One-Line diagrams, all through the secure web interface.

### Mathematical Control Logic

Using the Calculator tool, users can create advanced solutions that group, manage and control points to produce the required automation results.

The calculator tool can perform mathematical, logical, or timer based operations on any data points stored in the D400-DA. Using a graphical interface, users can define logical expressions using mathematical functions such as; addition, multiplication, logarithm, greater than, less than, as well as other boolean functions.

### Programmable Logic (LogicLinx)

For more advanced applications, programmable logic (LogicLinx) software provides PLC functionality on the D400-DA platform. LogicLinx offers textual and graphical languages defined in the IEC 61131-3 standard for PLC programming environments, including Sequential

Functions Chart, Instruction List, Structured Text, Ladder Diagram and Function Block Diagram. In addition, a wide range of arithmetic, Boolean and logical operations are supported.

### Accumulator Freeze:

Define groups of accumulator points whose values are frozen periodically or on demand.

### Analog Value Selection:

Define a group of prioritized analog input points with the highest priority, valid input being reported to a single analog input point.

### Control Lockout:

The Control Lockout feature ensures that only a single master station can access a group of controls at one time, and can lock out groups of controls to allow for safer local maintenance. Users can create up to 8 remote control groups and up to 256 local control groups. Any digital output can be included in one remote and one local group.

### Double Point:

Associates two digital input points to form a double point indication. Also known as 4-state points.

### Input Point Suppression:

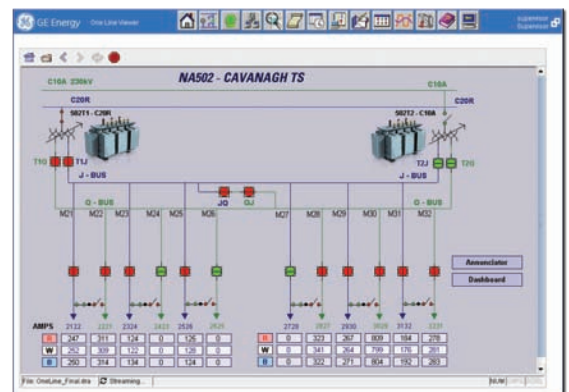
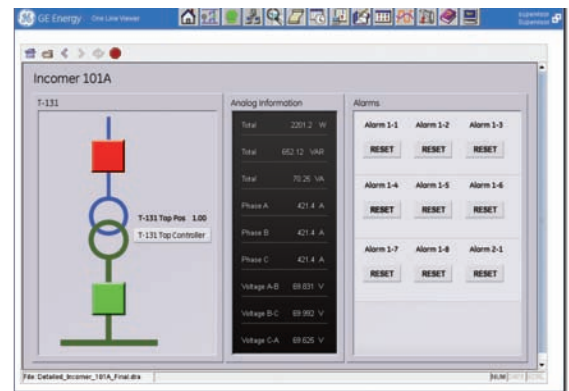
Suppress reporting of input points while they are unavailable during maintenance. This allows users to disable groups of analog and digital input points by ignoring their actual data and quality changes within selected applications. While points are suppressed, a predefined suppression value and the Point Suppressed quality flag are provided instead. This is useful during maintenance operations to prevent spurious OFFLINE alarms and false readings while devices are powered off or disconnected.

### Redundant I/O:

Specify a secondary data point for any point that is used to report the value and quality when the associated primary point is invalid or questionable.

### Alarm Management

The D400-DA Alarm groups are user-definable, with up to 256 groups allowed. Each group has its own descriptive and display parameters. Alarms may belong to more than 1 group, or none at all. "Critical" and "Default" groups are built-in. SCADA points for the alarm groups remain on-line if component alarm points go offline. SCADA points are provided to acknowledge a group of alarms. Individual alarms must be acknowledged via the D400-DA GUI.



Web based HMI/Annunciator feature, that is accessible using a standard Internet browser or through a VGA monitor and USB keyboard/mouse attached directly to the unit.



## Fault Recording / Data Logging

The D400-DA can automatically retrieve event and oscillography\* files from devices such as Multilin UR Protective Relays, GE's D25 Controllers, and IEC 61850 server devices. Using IEEE file naming standards, these event files are renamed and can be stored locally or securely sent to corporate servers using Rsync (SSH).

### Data Logger

The Analog Data Logger provides a variety of means to monitor and record any analog input point value changes into data files that can be retrieved by the user. A variety of recording methodologies are supported including, Continuous (all changes), Periodic, Time weighted, Out of range and Triggered by a digital input point.

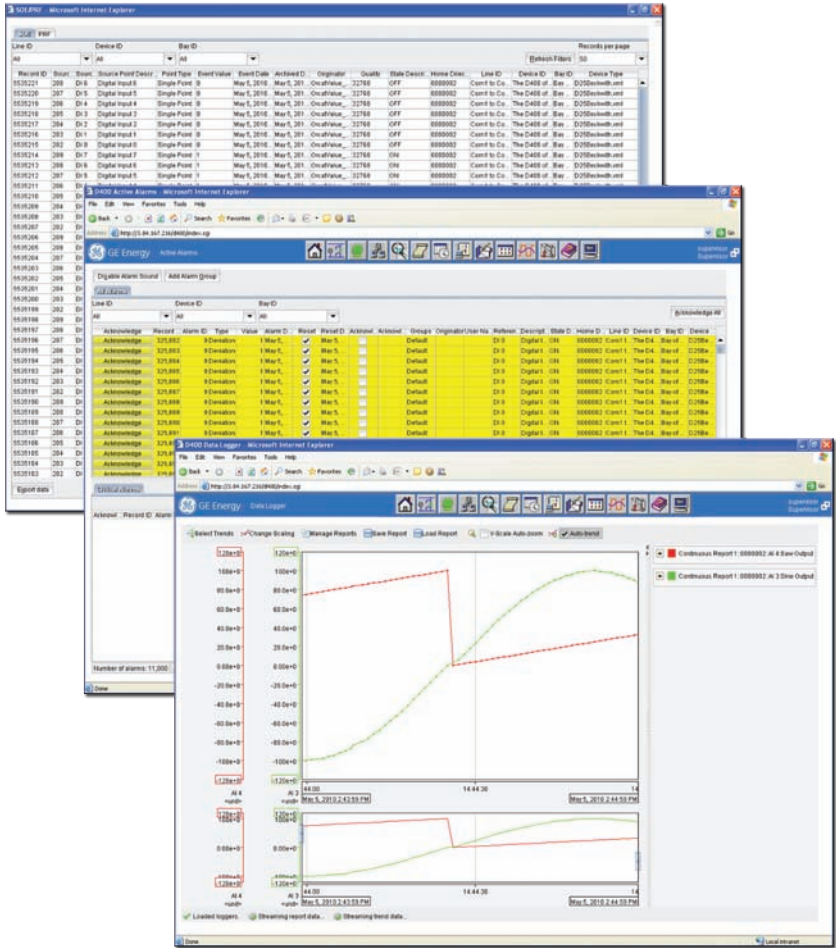
### Trend Viewer

All data recorded by the Analog/Digital Data Logger can be viewed by the Digital event recorder using the built in web-based Trend Viewer. Users can select the range of data to be used by time and date, alternately a real time streaming view can be displayed. Up to 8 data points (pens) can be displayed on a single view and support for curve fitting is available.

### Data Base Exporter

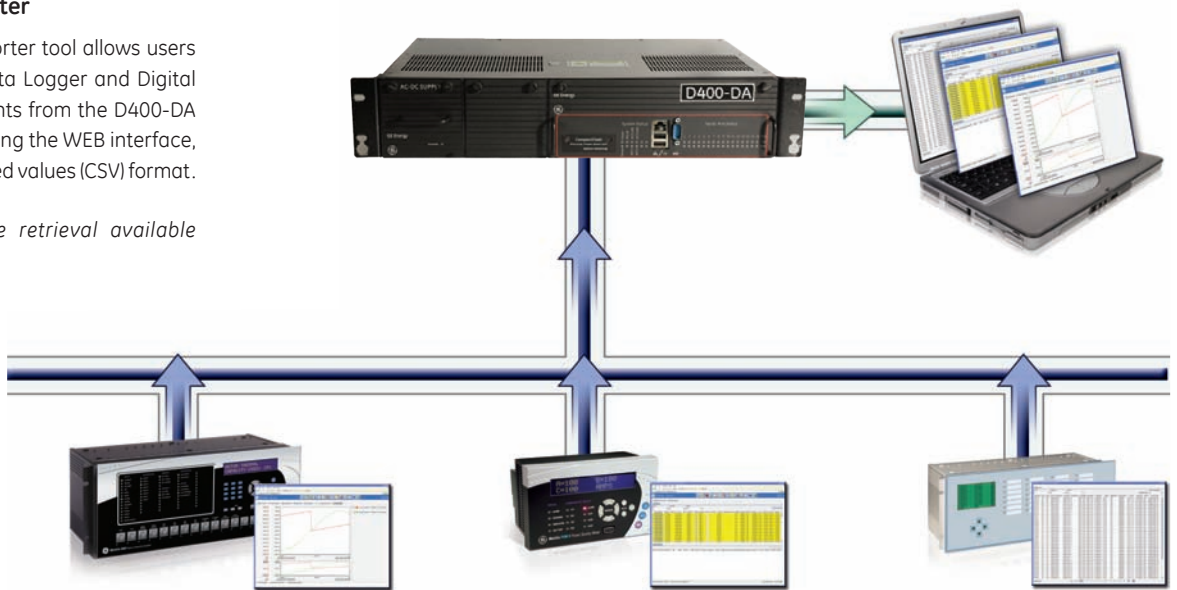
The Database Exporter tool allows users to save Analog Data Logger and Digital event recorder points from the D400-DA to your local PC, using the WEB interface, in comma-separated values (CSV) format.

\*Oscillography file retrieval available 4Q 2010.



## D400-DA Fault Recording

The D400-DA fault recording capability allows system event information to be collected and viewed using a web-based trend viewer.







## Secure Remote Access

D400-DA provides robust security environment, providing seamless integration with existing IT department policies. Role based Access Control, Secure Web Interface, Secure File Transfer, and extensive user activity logging provide a complete security toolkit required to achieve NERC-CIP compliance.

### Non-operational Data

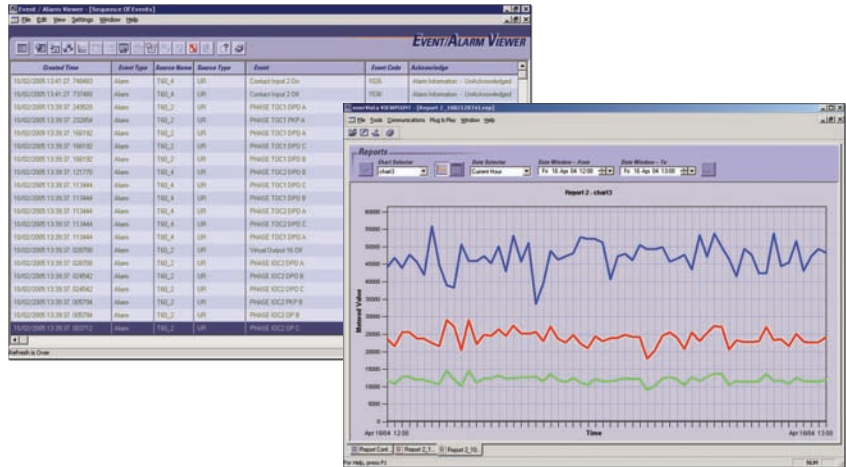
Using pass-through connections, the utility user can extract valuable non-operational data such as digital fault recording (DFR) records and event files. The user can also access the historical log files and upload the archived data for trending and analysis.

### Pass-through/Terminal Server

A built-in terminal server emulator allows pass-through connections to be initiated to substation device (relay, meter, RTU or other device). Once the connection is established, the local event records can be uploaded from the substation devices and viewed remotely.

### Virtual Serial Ports

Virtual serial ports eliminate copper wire communications to feeder bays when a



Use device software to obtain non-operational data such as trending and event records through the D400's secure remote access functionality.

serial-only device is located in the bay. A small terminal server can be placed in the bay and connected to the Ethernet network, allowing all D400-DA serial client applications to connect directly to the serial device.

### Role Based Access Control

Role Based Access Control is achieved using TACACS+, RADIUS or the D400-DA's internal database; ensuring only authenticated and authorized users gain access the system. When using TACACS+ or RADIUS, revoking user

privileges, system wide, is as simple as updating the centralized user database.

Network Security protocols:

- HTTPS
- SSH
- SCP
- Syslog
- SFTP
- CHAP
- RADIUS
- TACACS+

## Secure Remote Access

### Engineering Systems



D400-DA Substation Data Manager provides substation hardened processing platform for secure data & device access:

- SCADA data concentrator
- Device configuration tools
- Remote Device Access
- Engineering tools

### Secure Communications



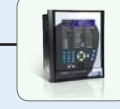
Meeting industry standards ensures compatibility with communications and IT equipment. Supported Network Protocols include:

- HTTPS
- SSH
- SCP
- Syslog
- SFTP
- CHAP
- RADIUS
- TACACS+

### D400-DA Device Connections



Bay Controllers



Protection Relays



Intelligent Devices

## Configuration Software

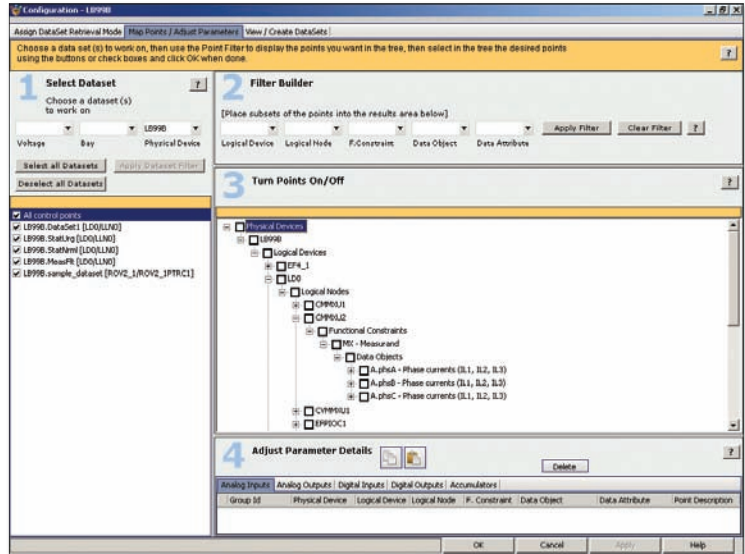
### IEC 61850 Substation Device Loader

A key benefit to using IEC 61850 based communications is the reduction in deployment costs for modern substation automation systems. The D400-DA IEC 61850 loader application guides users through a structured 4-step workflow to configure the IEC61850 client application, reducing system configuration time.

Available device data, based on logical nodes, can be retrieved from the IEC 61850 Substation Configuration file (SCL files such as ICD, CID, SCD) or directly from the intelligent substation device using the IEC 61850 self-description.

The IEC 61850 device loader allows users to pick the specific logical nodes or data sets to be used for automation tasks or to be placed in the D400-DA database for upstream communications, reducing overall network traffic and system loading for increased system efficiency.

Using the IEC 61850 Dynamic Data Sets allows the configuration software to define the exact data to be retrieved from a substation device when initializing communications with that specific device. This allows users to configure the data sets



### IEC 61850 Device Loader

The IEC 61850 client is configured using the D400-DA Device loader application.

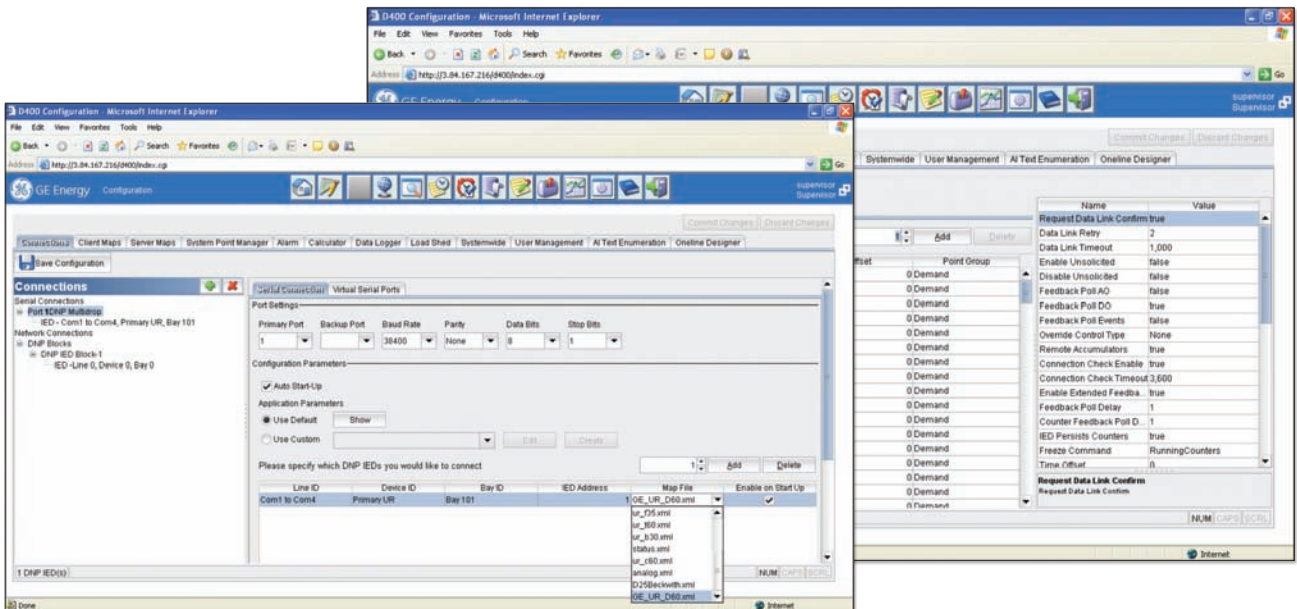
through a single application rather than manually configuring data sets in each separate device, reducing mapping errors.

### Device Configuration

Configuring the D400-DA to communicate with substation devices is simple and straightforward. Thanks to pre-configured map files, adding devices to the system only takes a few mouse clicks. Point maps

can be customized to meet your specific needs, then applied for all devices requiring the modifications.

Creating One-Line diagrams is quick and easy using the build-in, drag and drop One-Line designer application. Configuring alarm and alarm groups is simplified using a tree view point selection tool.



### Browser-based Configuration

Connecting and configuring substation devices is simple using pre defined drop down lists of device point maps.

## Hardware Overview

The D400-DA is built on a flexible, high performance, expandable diskless and fan-less platform that is powered by a 1.0Ghz processor.

Two Ethernet networks are supported with separate multiport switches. An IRIG-B format time protocol input/distribution module is also supported. Isolated serial port media is selected for each pair of ports.

### Redundant power supplies

The D400-DA has dual redundant, hot swappable power supplies, ensuring continuous uptime. Each power supply can be connected to a different source. As an example Power supply 1 can be connected to Mains, while power supply 2 is connected to the battery system. Power Supply Health Monitoring raises a SCADA point alarm when either power supply fails. This allows an alarm to be transmitted to the EMS /OMS or DMS system, where a field personnel can be dispatched to replace the failed supply, all without service disruption.

### Time Sync Support

The D400-DA has extensive support for various time sync methodologies and will accept time sync signals from SNTP/ NTP Servers, IRIG-B (un-modulated/

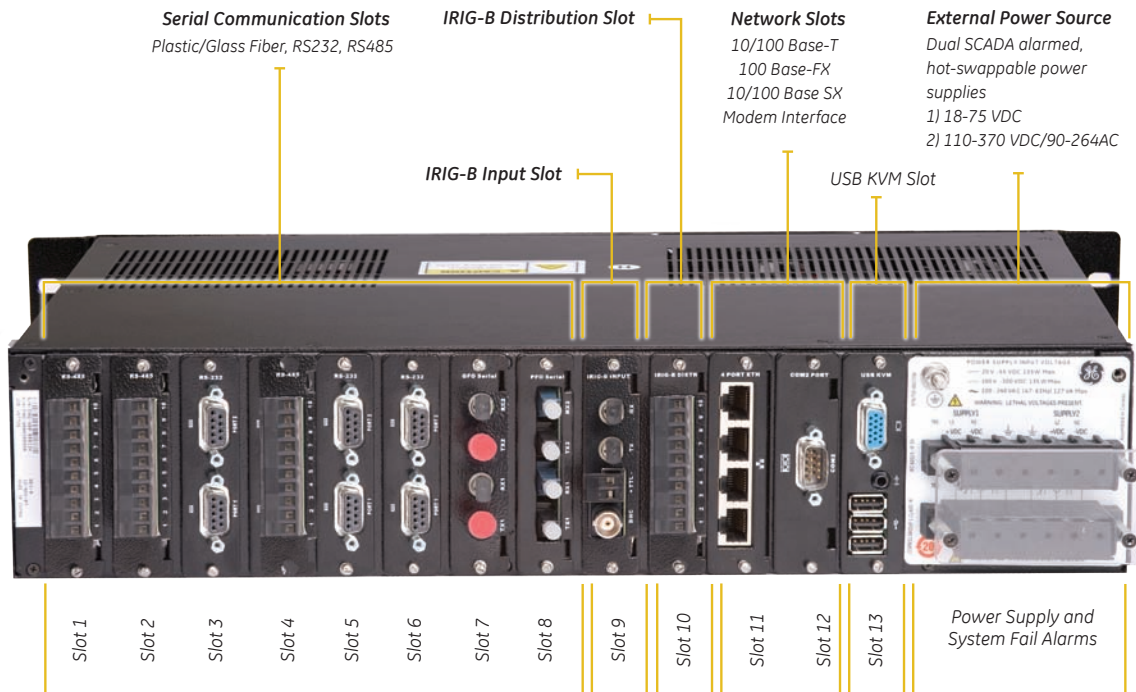
modulated), and SCADA protocols. The D400-DA can also distribute this time sync information through its built-in IRIG-B distribution interface, SCADA protocols, and/or through the RS232 ports directly.



Redundant, hot-swappable power supplies

Distribution Feeder Protection

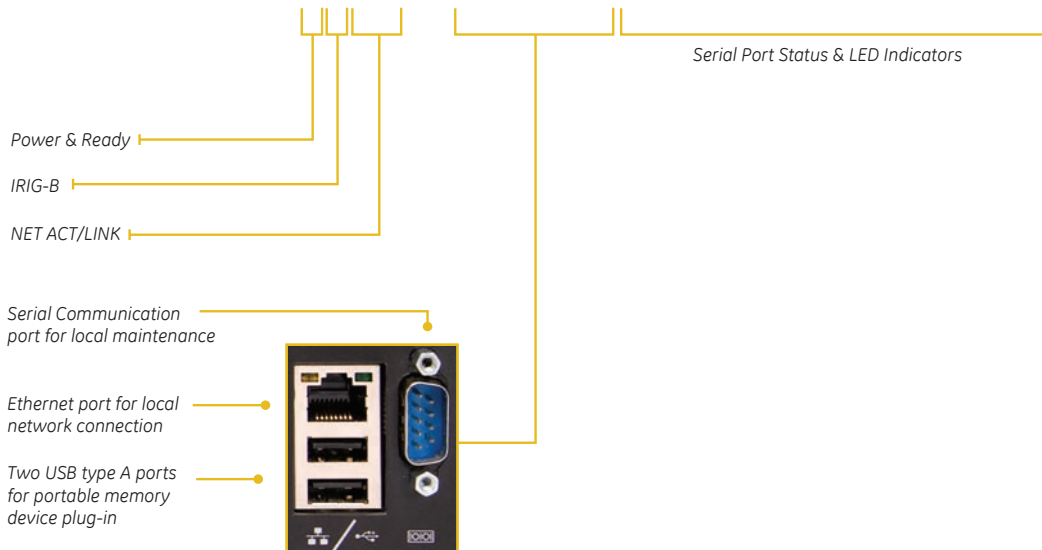
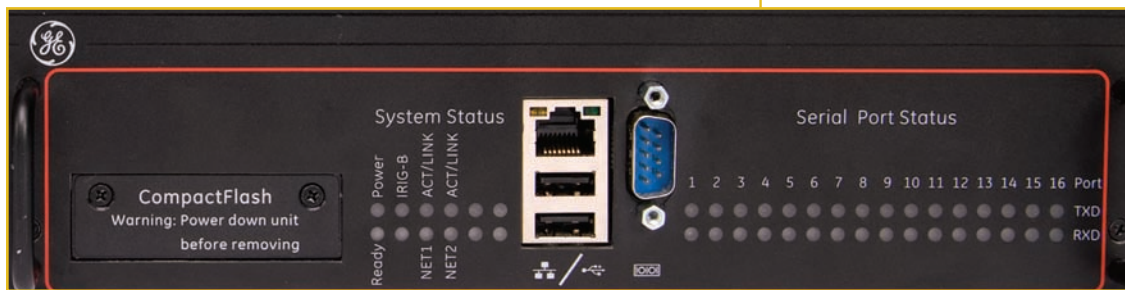
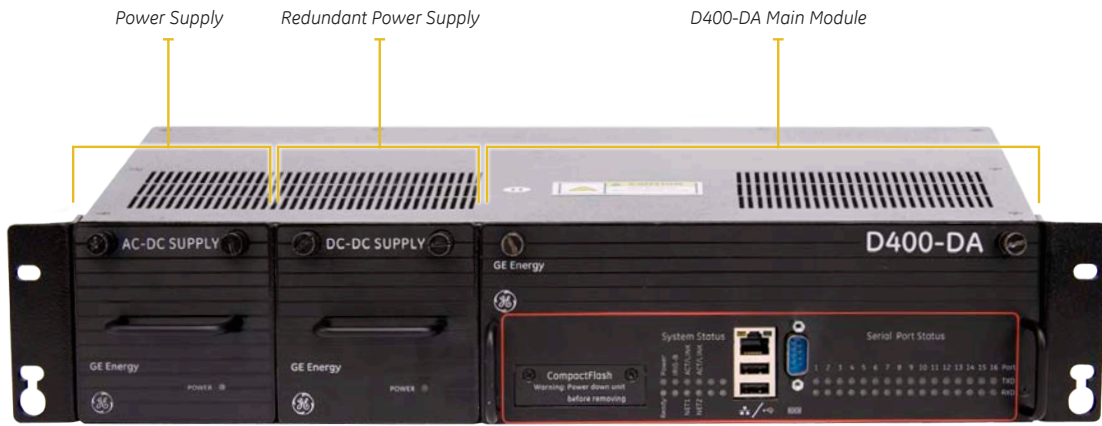
## Back Panel





## Front Panel

Distribution Feeder Protection





## Technical Specifications

### Processor, Memory, and Storage

1.0 GHz Embedded CPU with 33 MHz PCI bus

1.0 GB of DDR333 SDRAM

Industrial Grade Compact Flash Module (dual - 512 MB, expandable to dual 16 GB)

### Processor, Memory, and Storage

RTDB 10,000 SOE reports archived in an embedded SQL database  
16 MB NVRAM standard for persistent event storage guaranteeing no loss of events

### Communications

Ethernet – two Ethernet LAN supported (fiber and/or twisted pair) 10/100BaseT – 4 port integrated switch (isolated RJ-45 connector)  
10Base-FL – redundant (fiber optic: 62.5/125 µm duplex fiber cable-ST connectors)  
Wireless IP radio ready (via PPP serial port)  
100BASE-FX redundant (fiber optic 1300nm duplex fiber cable-ST connectors)

Serial Communications (16 channels of RS-232/485/fiber optic) Data rate, 300 to 115.2 Kbps  
RS-232  
• Configurable for DCE/DTE operation  
• Galvanic isolation between channels  
• Can drive IRIG-B signal to RS-232 ports (with optional IRIG-B Input card present)  
RS-485  
• 2 Wire/4 wire support  
• Galvanic isolation between channels  
• Glass or plastic serial fiber port on ST connectors

### IRIG-B

Input Module TTL (un-modulated), fiber optic (un-modulated), BNC (1 kHz modulated), CPU time sync for internal database time stamping

Distribution Module Can drive IRIG-B TTL signal for 16 Intelligent Devices

Signal Propagation Propagated to all 16 RS-232 ports for devices such as SEL® relays  
Propagated to the distribution module

### KVM

KVM Module Three USB ports for connecting keyboard and mouse  
D-Sub 15 socket for connecting an industrial SVGA display  
3.5 mm audio jack for substation alarms

### Power Supply

Input Options: 20–55 VDC (+/- 10%), 100-240 Vac/100-300 Vdc (+/- 10%), 135 Watts DC Supply, 127VA AC Supply

### Physical

Dimensions 19 Inch rack mount (482.59 mm)  
2U (3.47" / 88.12 mm) in height  
12.24" (310.95 mm) in depth  
Mounting: 4 mounting holes, 2 slotted for easy installation

### Environmental

Operating Temperature: -20° to +65°C operating range  
Humidity: 5-95% relative humidity, non-condensing  
Ingress Protection: IP30

### Maintenance Software

OCM-Offline Configuration Manager\*\*  
System Requirements: IBM® PC or compatible computer, VT100 emulator

### Configuration Software

OCM-Offline Configuration Manager  
LogicLinx\* Editor (if using LogicLinx)\*\*  
Web Browser-Based Online Configuration

### Standards and Protection

#### CE Mark

2006/95/EC	LVD Directive
EN55011 (CISPR 11)	EMC Directive
EN61326	Electrical equipment for Measurement, control and laboratory use - EMC requirements

#### Emissions Standards

EN55011 (CISPR 11)	ISM RF Equipment - electromagnetic disturbance characteristics
IEC® 60255-25	Electromagnetic emission tests for measuring relays and protection equipment
IEC 61000-3-2	EMC-limits for harmonic current emissions (equipment input current <16A per phase)
IEC 61000-3-3	EMC limits-limitations in voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with input current <16A per phase & 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* *(10V/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
IEC 61000-4-5	Surge immunity test
IEC 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields
IEC 60255-22-6	Electrical fast transient/burst immunity test
IEC 61000-4-8	Immunity to power frequency magnetic fields
IEC 61000-4-12	Oscillatory waves immunity test
IEC 60255-22-1, IEEE C37.90.1, Ontario Hydro A-28M-82	(Damped oscillatory and ringwave)

#### Safety Publications

IEC 61010-1	Harmonized safety standard
IEC 60255-5	Insulation coordination for measuring relays and protection equipment requirements and tests

#### Power Supply Standards

IEC 61000-4-11	AC power supply interruptions
IEC 61000-4-16	Immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 Hz
IEC 61000-4-17	Ripple on D.C. power supply
IEC 61000-4-29+ (+ HVDC only), IEC 60255-11	Voltage dips, short interruptions and voltage variations on D.C. input power port immunity test

#### Environmental Standards

IEC 60068-2-1	Environmental testing cold
IEC 60068-2-2	Environmental testing dry heat
IEC 60068-2-6, IEC 60255-21-1	Environmental testing vibration, Vibration tests (sinusoidal)
IEC 60068-2-27	Environmental testing shock
IEC 60068-2-29	Environmental testing bump
IEC 60068-2-30	Environmental damp heat cyclic (12+12 hour cycle)
IEC 60068-2-31	Environmental testing drop and topple
IEC 60255-21-2	Shock and bump tests

#### Communication Standards

IEC 61850-3	Substation comm. standard
IEEE 802.3	CSMA/CD access method and physical layer specifications

# Ordering

Distribution Feeder Protection

D400	*	*	*	*	-	*	*	*	*	-	*	*	*	*	-	*	*	*	*	*	*
CPU	A	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	B																				
	F																				
	G																				
	H																				
	J																				
	K																				
	L																				
Power Supply	A																				
	B																				
Power Supply (Redundant)	U																				
	A																				
	B																				
Serial Communications		U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
IRIG-B Input Card												A	U								
IRIG-B Distribution Card												B	U								
First Network Slot														1							
														2							
														5							
														4							
Second Network Slot													U								
													1								
													2								
													5								
													3								
USB KVM, Audio													U								
													A								
D400 Local HMI (one-line viewer)														U							
														A							
D400 IEC 61850															U						
														A							
D400 LOGICLINX																U					
Executor License															A						
D400 Utilities																U					
															A						
FDIR Option																U					
																1					
																2					
																3					
																4					
																4					
																5					

**Description**

650 MHz CPU, 512 MB RAM, SINGLE ETHERNET  
 650 MHz CPU, 512 MB RAM, DUAL REDUNDANT ETHERNET  
 1.0 GHz CPU, 1.0 GB DDR RAM, SINGLE ETHERNET  
 1.0 GHz CPU, 1.0 GB DDR RAM, DUAL REDUNDANT ETHERNET  
 1.0 GHz CPU, 1.0 GB DDR RAM, SINGLE ETHERNET , 1GB CF  
 1.0 GHz CPU, 1.0 GB DDR RAM, DUAL REDUNDANT ETHERNET , 1GB CG  
 1.0 GHz CPU, 1.0 GB DDR RAM, SINGLE ETHERNET , 16GB CF  
 1.0 GHz CPU, 1.0 GB DDR RAM, DUAL REDUNDANT ETHERNET , 16GB CF  
 100-240 VAC (47-63 Hz), 100-300 VDC (± 10%)  
 20-55 VDC (± 10%)  
 NONE  
 100-240 VAC (47-63 Hz), 100-300 VDC (± 10%)  
 20-55 VDC (± 10%)  
 NONE  
 D400 RS-232 IO Assy  
 D400 RS-485 IO Assy  
 D400 Glass Fiber Optic IO Assy  
 D400 Plastic Fiber Optic IO Assy  
 IRIG-B INPUT CARD  
 NONE  
 IRIG-B Distribution Card  
 NONE  
 ETHERNET 4 PORT 10/100 MB TP SWITCH  
 ETHERNET FIBER OPTIC (HOT STANDBY) 2 PORT 10BaseFL/100Base-SX  
 D400 100BASE-FX HOT STANDBY ETHERNET  
 ETHERNET REDUNDANT 10/100 MB TP  
 NONE  
 ETHERNET 4 PORT 10/100 MB TP SWITCH  
 ETHERNET FIBER OPTIC (HOT STANDBY) 2 PORT 10/100 BASE-SX  
 D400 100BASE-FX HOT STANDBY ETHERNET  
 COM2 PORT (REQUIRES EXTERNAL MODEM)  
 NONE  
 USB KVM & Audio Card  
 NONE  
 Local HMI (Basic)  
 NONE  
 IEC@61850 Client Application  
 NONE  
 D400 LogicLinX™ Executor License  
 NONE  
 D400 Utilities CD  
 No FDIR Option  
 FDIR Option - support 2 Sections, and 10 controllers  
 FDIR Option - support 4 Sections, and 20 controllers  
 FDIR Option - support 7 Sections, and 35 controllers  
 FDIR Option - support 10 Sections, and 50 controllers  
 FDIR Option - support 20 Sections, and 100 controllers

**Ordering Note:**  
 For the latest ordering information visit our online store at [www.gedigitalenergy.com/onlinestore](http://www.gedigitalenergy.com/onlinestore)

### Accessories for the D400-DA

- Compact Flash Card 2GB 160-0119
- D400-DA Touch Screen/Keyboard/Mouse Kit 501-0912
- Switch Control, External HMI 540-0255
- D400-DA Dual Ethernet Upgrade Kit 501-0612

Visit [www.GEDigitalEnergy.com/D400-DA](http://www.GEDigitalEnergy.com/D400-DA) to:



- View Specification Sheet
- Download the instruction manual
- Review applications notes and support documents
- Obtain ordering information