GE

Grid Solution

Multilin HardFiber System

IEC 61850 Process Bus Solution

The Multilin HardFiber System is an IEC 61850 Process Bus Solution that allows the mapping of measurements made in the switchyard to protection relays located in the control house using secure communications. The HardFiber System addresses the key technical and logistic challenges affecting the labor required for substation design, construction and maintenance.

The HardFiber System is designed to reduce the overall labor associated with the tasks of designing, documenting, installing and testing protection and control systems. By specifically targeting copper wiring and all of the labor it requires, the HardFiber System allows for greater utilization and optimization of resources with the ultimate goal of reducing the Total Life Cost (TLC) for protection & control.

Key Benefits

- Eliminates majority of copper wiring to better utilize resources for the design, building, commissioning and maintenance of power system protection and control
- Robust and simple architecture for deploying IEC 61850 process bus
- Extends the Universal Relay (UR) family of products, is available for a wide array of protection applications
- Limits exposure to cyber security threats to only physical interruption
- Improves employee safety by limiting the number of high-energy signals in the control building
- Saves up to 50% in P&C labor costs

Applications

- Retrofit and greenfield installations for power generation, transmission and distribution systems
- Generator, Transformer, Transmission Line, Bus, Feeder, Motor, Capacitor Bank, Wide Area Network protection
- Distributed busbar protection and bay control, enabling centralized overcurrent backup protection
- Substation automation
- Air-insulated and GIS stations
- Multi-terminal line differential where 2 or more terminal are less than 2 km away
- Remote protection and control rooms for medium voltage switchgear to mitigate exposure of operators to arc flash hazard

imagination at work

Cost of Field Wiring

- Standardizes wiring for all protection and control applications
- Bricks are simple settings-free I/O devices that requires no configuration
- Allows entire protection and control system to be tested during factory acceptance tests

Simplifies Maintenance

- Designed for redundant Bricks for redundant analog measurements in one UR
- Continuous cross-checking of redundant measurement signals eliminates the need for routine testing of analog measurements
- Reduces maintenance testing to simple verification of contact I/O

Lifecycle Management

- Removes the cost and effort of field wiring for future relay replacement projects
- URs and Bricks can be replaced independently of each other
- Bricks are simple I/O devices that can be replaced without engineering projects
- Reduces protection and control replacement costs by 80% over conventional relays

Standard Mounting

- Rugged outdoor mounting available
- Standard case for surface, flush, and panel mounting
- Supports customer standards for fiber and copper cable

An Industrial Revolution for Protection & Control

The HardFiber Process Bus System represents a true breakthrough in the installation and ownership of protection and control systems, by reducing the overall labor required for substation design, construction, and testing. This innovative solution addresses the three key issues driving the labor required for protection and control design, construction and testing:

- Every substation is unique making design and drafting a one-off solution for every station
- Miles of copper wires needs to be pulled, spliced and terminated
- Time consuming testing and troubleshooting of thousands of connections must be performed by skilled personnel

The Multilin HardFiber System was designed to address these challenges and reduce the overall labor associated with the tasks of designing, documenting, installing and testing protection and control systems. By specifically targeting copper wiring and all of the labor it requires, the HardFiber System allows for greater utilization and optimization of resources with the ultimate goal of reducing the Total Life Cost (TLC) for protection & control.

Key Benefits of the HardFiber System

The underlying driver for the HardFiber System is the reduction of Total Life Costs of protection and control through labor and resource optimization. This optimization is achieved by replacing individual, labor-intensive, individually terminated copper wires with standardized physical interfaces and open digital communications

- Reduces up to 50% of labor for protection & control
- Replaces extensive copper wiring with pre-terminated copper and fiber cables
- Reduces specialized on-site labor by shifting spending to readily available materials
- Improves employee safety by leaving potentially dangerous high-energy signals in the switchyard
- Reduces the chances for operational mistakes made during isolation and restoration for routine maintenance

- Built on the Universal Relay (UR) family, allowing for fast transition into most protection and control applications including:
  - Generator protection
  - Transformer protection
  - Transmission Line protection
  - Bus protection
  - Feeder protection
  - Motor Protection
  - Capacitor Bank protection
  - Wide-Area network protection

Save Up To 50% Of Your Protection & Control Labor...

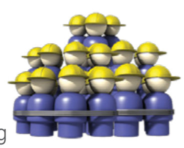
Traditional Substation

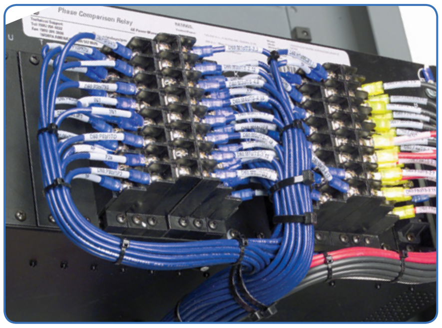
Materials

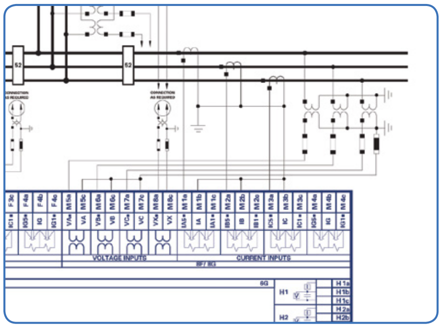
- Relays
- Copper Cabling
- Terminal Blocks
- Test Switches
- Misc. Materials

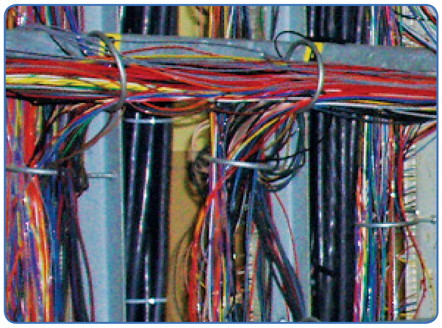
Labor

- Head Office Engineering and Drafting
- Construction & Installation
- Commissioning and Testing
- On-going Maintenance









Traditional substation designs require large amounts of skilled labor to create engineering drawings, pull and terminate miles of copper cables, and test and troubleshoot thousands of connections.

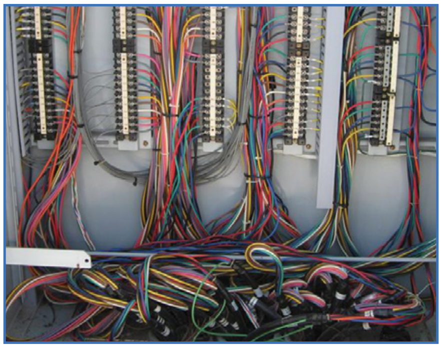
The Challenges of Copper Wiring

With the introduction and progression of microprocessor-based protection and control devices, there has been the continued integration of discrete functions into a single device. This integration has delivered cost savings in terms of materials, but the installation uses the same labor-intensive technology dating back to electromechanical relays.

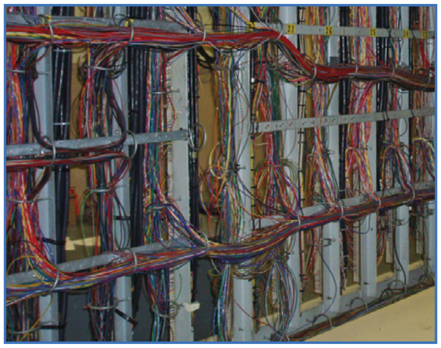
Copper wiring is installed in a substation to integrate the protection and control devices by providing a set of signal paths to move raw information, in the form of analog currents and voltages, representing the status of and controlling the operation of the primary power system. These copper wires have an extremely low signal density, and the installation details are highly dependent on each specific application.

The process of designing, installing and testing all of these copper connections is exceedingly labor-intensive, with most of the labor requirements being the on-site labor. This labor is almost exclusively manual, with very little opportunity of automation or optimization. The end result is a very labor-intensive and error-prone process that adds significant time and cost to every project and makes long-term maintenance and changes difficult to implement.

Extensive amounts of copper cables need to be distributed from each switchyard apparatus back to the control house



Many connections need to be made in each apparatus in the high voltage equipment switchyard



Thousands of terminations need to be connected and tested for each protection and control device found in the control house

Designing... Documenting... Installing... Testing...

HardFiber Substation

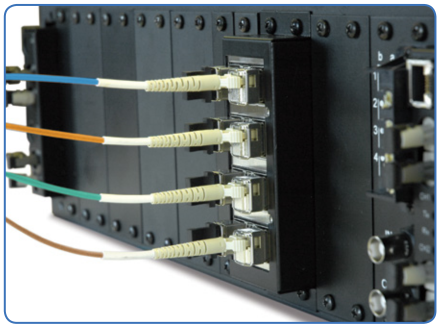
Materials

- Relays
- Cabling
- Patch Panel

Labor

- Head Office Engineering and Drafting
- Construction & Installation
- Commissioning and Testing
- On-going Maintenance

CUT P&C LABOR 50%



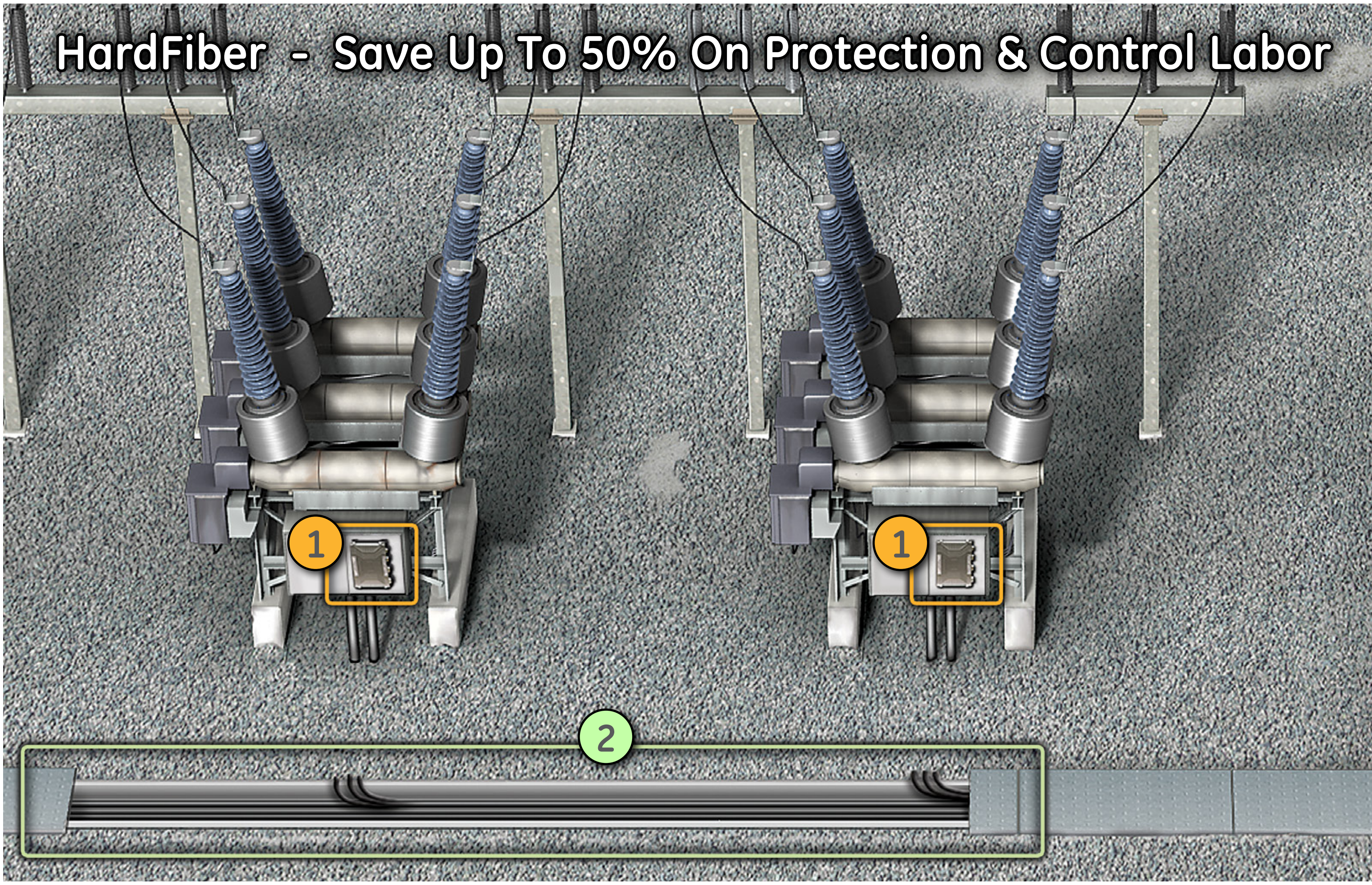
The Multilin HardFiber System replaces labor-intensive processes with quick installation, off-the-shelf equipment and made-to-order cables.

Brick - Hardened Switchyard Interface

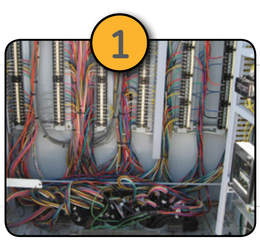
- Performs all measurement and control for primary apparatus
- Suitable for outdoor installation - IP-66, -40°C to 85°C
- Error-proof copper and fiber installation via standard connectors

Outdoor Fiber Cables

- Point-to-point fiber communications and fused power supply
- Cut to length, pre-terminated cables require no field splicing
- Extremely rugged: run in cable trays, pull through conduits, direct bury



Before



Traditional breaker wiring

- Low density copper needs 1000s of terminations
- Manual, one-by-one installation by highly skilled workers

Traditional cable trenches

- Outdoor cables carry copper wires to control building
- Miles of copper wire throughout a typical switchyard

After HardFiber

All copper wiring ends at the Brick

- Eliminate 33% of breaker terminations
- Easy replacement of Bricks reduces maintenance

Outdoor fiber cable replaces copper wiring in trenches

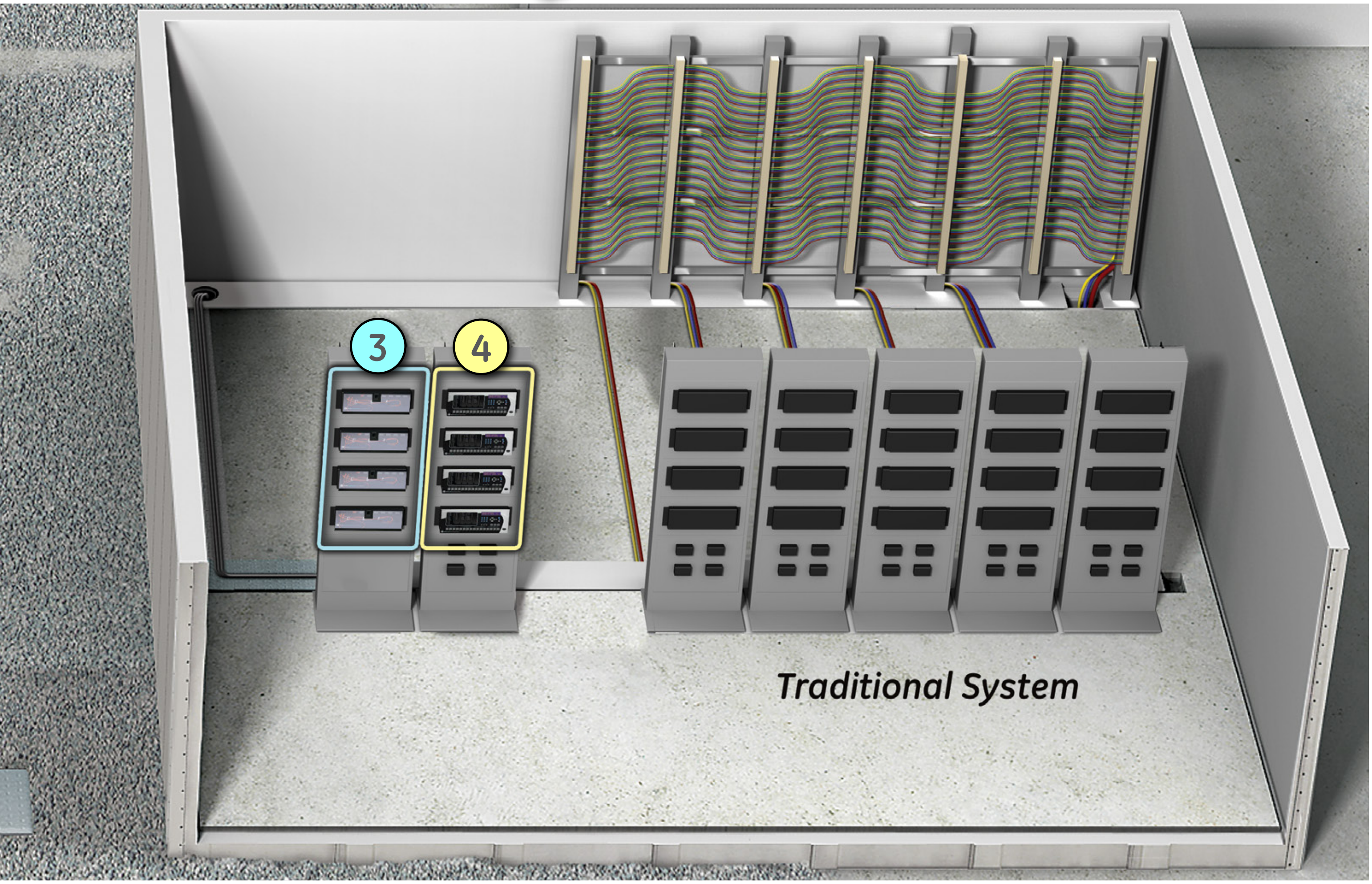
- Reduce copper cabling needed by 40%
- Pre-terminated fiber cables ensure high quality

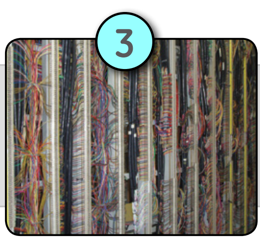
Cross Connect Panel

- Breaks out fiber communication channels from Bricks and devices
- Mapping is 'hard-fibered' using simple patch cord connections
- No firmware, settings, or maintenance required

Universal Relay IEC 61850 Process Card

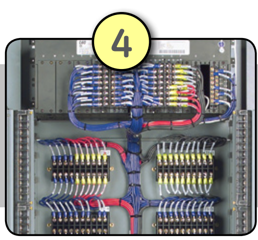
- Communications interface between the relay and up to 8 Bricks
- Communicates with Bricks to operate primary power systems apparatus
- Secure real-time system health monitoring





Thousands of individual copper wires from switchyard

- Thousands of hand wired terminations into a rack
- Labor-intensive using specialized workers

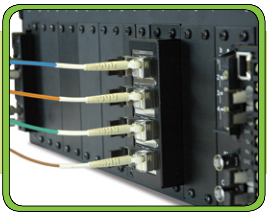


Labor-intensive copper wiring on relay panels

- Thousands of connections to protection and control devices
- Manual wiring prone to errors and extended testing

Fiber cross connect panels replace copper terminations

- Eliminate 90% of control building terminations
- Fewer high energy signals improve employee safety



Only fiber connections at the relay via the UR IEC 61850 Process Card

- Power system protection behaves as today
- Built on established Universal Relay platform

What is IEC 61850 Process Bus?

Process Bus is a term used to describe a protection and control system that uses a digital communications architecture to carry information between the switchyard and protection and control devices in the control building. This information consists of sampled values, equipment status and output commands. IEC 61850 is the international standard that defines the specific communication protocol for Process Bus implementations used for protection and control applications.

HardFiber Process Bus System

The Multilin HardFiber System is a KEMA tested IEC 61850 Process Bus Solution that allows the mapping of measurements made in the switchyard to protection relays located in the control house using secure communications. The HardFiber System addresses the key technical and logistic challenges affecting the labor required for substation design, construction and maintenance. This unique system provides a total labor saving solution and yet still adheres to the practices used today for protective relaying and control.

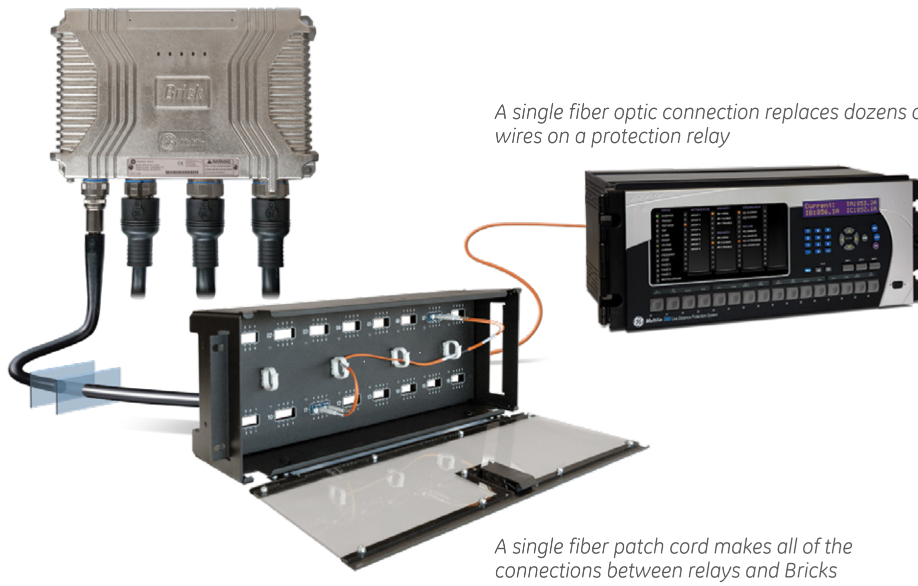
Adhering to existing practices:

- Providing a complete system with all the necessary components for measurement, control, and protection
- Covering all utility substation protection applications
- Being understood and deployed by the current utility workforce

Added benefits:

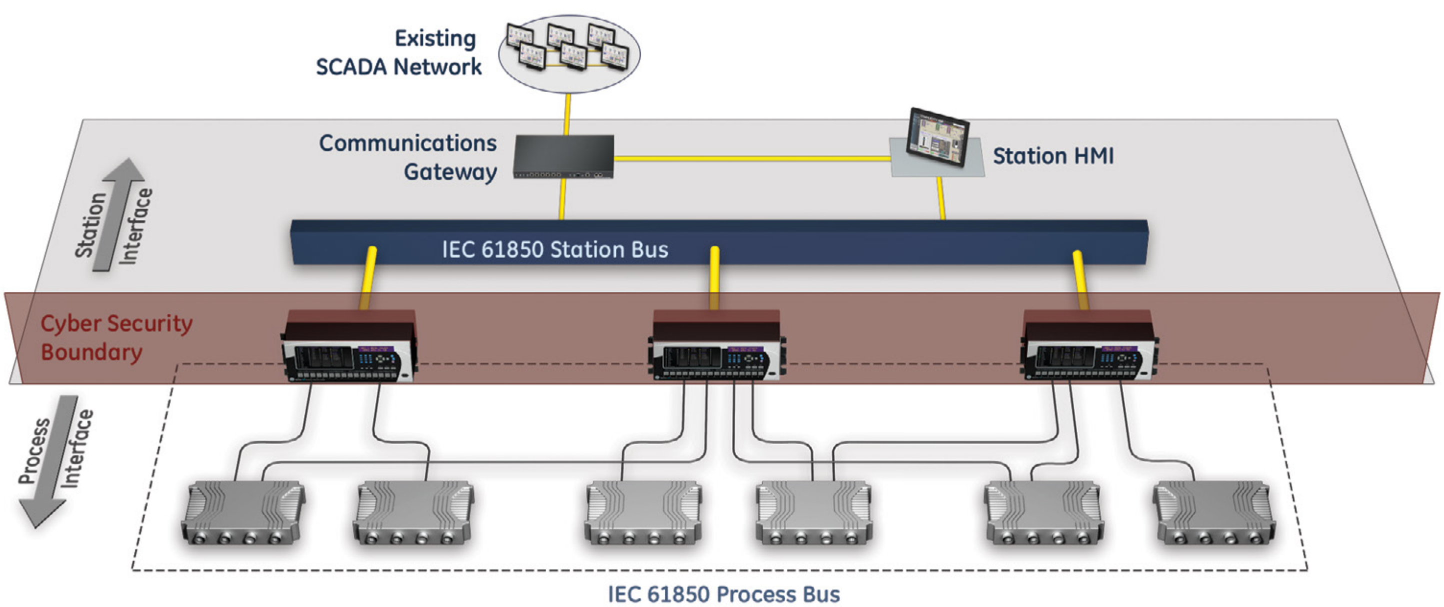
- Reduce dedicated on-site labor with pre-fabricated material to reduce costs
- Is practical to commission and maintain
- Is as reliable as existing protection and control systems
- Uses an open IEC 61850 Process Bus architecture that can supports multi-vender applications
- Is scalable and can be integrated into existing substation designs

Copper connections from apparatus are made directly to Bricks and end in the switchyard

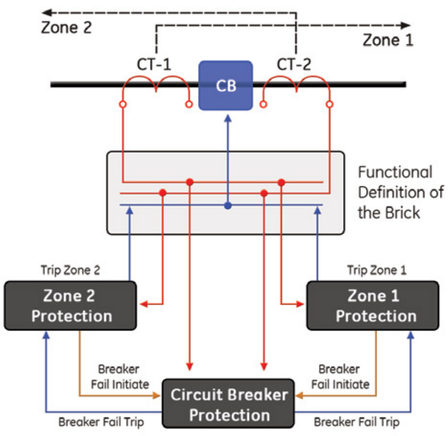


A single fiber optic connection replaces dozens of wires on a protection relay

A single fiber patch cord makes all of the connections between relays and Bricks



The HardFiber System uses IEC 61850 to communicate measurements and commands between Bricks and relays in the control building over dedicated point-to-point fiber optic connections that avoids cyber-security issues altogether.



Each Brick transmits measurements and accepts controls from up to 4 separate protection and control devices.

System Architecture

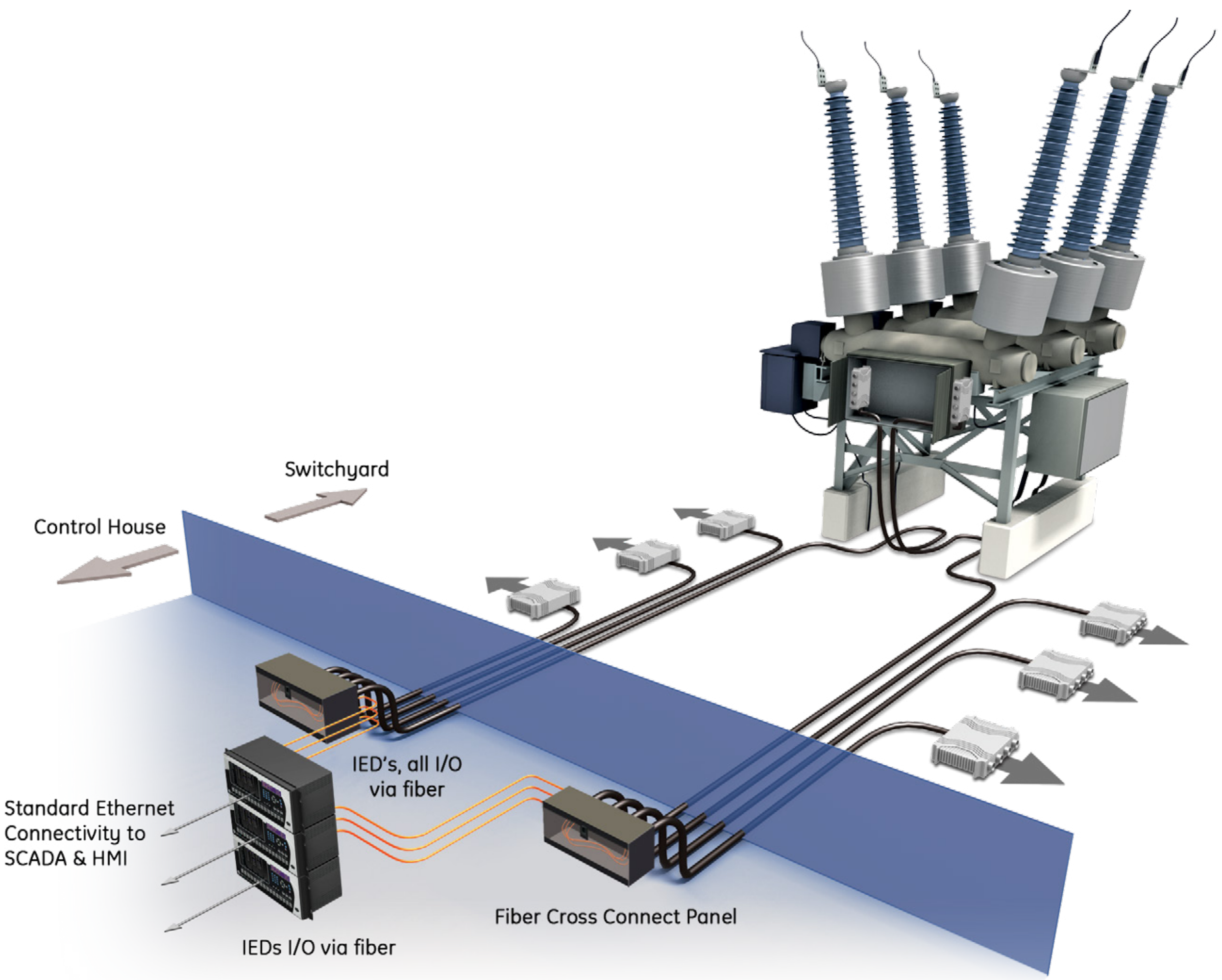
The architecture of the Multilin HardFiber System is driven by the mapping of signals between the primary apparatus and the protection and control devices.

The measurement of field signals and respective mapping of these signals, using the open IEC 61850 communications protocol, back to the control house is done through a hardened interface device called the HardFiber Brick.

Using made-to-order Outdoor Fiber Cables connecting the Brick to a Cross Connect Panel in the control house provides fast and error-proof installation without the need for on-site splicing or terminating.

Keeping true to the existing topology of traditional substations, each protection and control device included in the zone of protection will be connected directly to Bricks through dedicated fiber optic connections.

This simple, purpose-driven architecture that uses the IEC 61850 open standard for communications, provides dedicated point-to-point connections between the Brick and protective relays without introducing any issues relating to data synchronization, setting management or Cyber-Security.



The HardFiber System can easily be incrementally scaled to include new equipment as stations evolve. Duplicated Bricks in the switchyard provide a drastic improvement in reliability and security over today's technology.

Process Interface Unit Options

The Multilin HardFiber system uses Brick Process Interface Units as the I/O device. The process interface unit is available in two versions: the ruggedized Brick version,, and the standard case S-Brick version. Both models of the Brick are exactly the same in terms of performance, functionality, and I/O options. Bricks have 8 analog measurements, either 4 currents / 4 voltages, or 8 currents, along with 18 contact inputs, 3 universal DC inputs, 4 Form-A tripping contacts, 2 Form-C signalling contacts, and latching contact.

Brick

The HardFiber Brick Process Interface Unit (Order Code BRICK-4-HI-R-****-R-X-X) is ruggedized I/O device designed for mounting outdoors in utility switchyards. The Brick uses connectorized copper and fiber optic cables for ease of installation and for environmental protection. The Brick works directly with models of the GE Universal Relay (UR) family, and any compliant third party device.

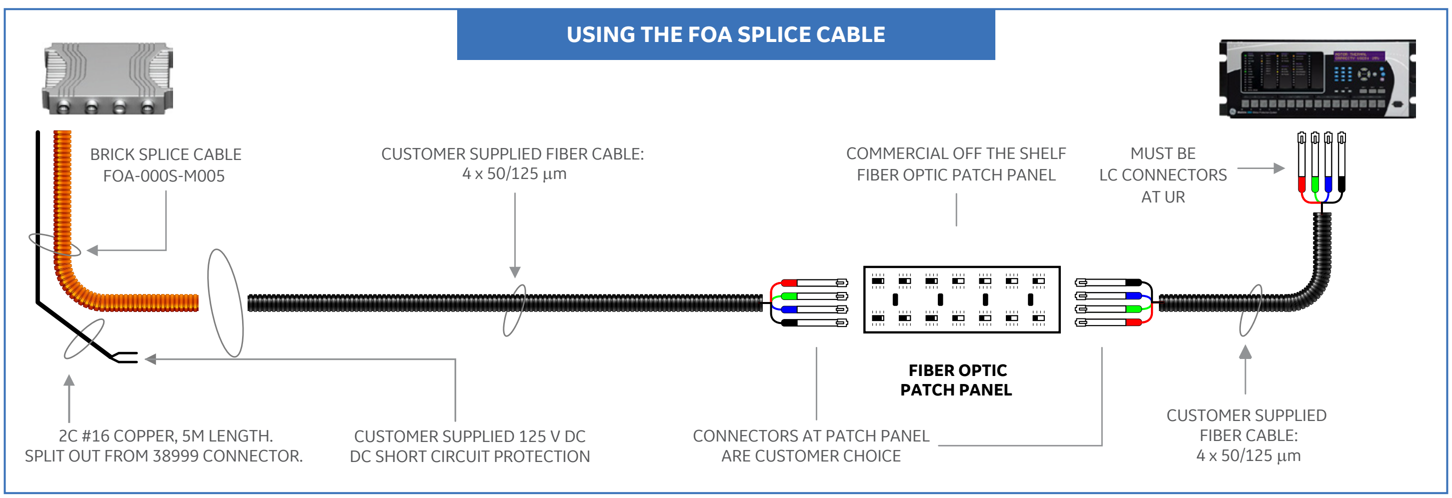
Fiber cable options for the Brick

Custom FOA cable

The custom FOA cables are ordered to length, and are connectorized at each end. These FOA cables require the use of the Cross Connect Panel, and the FOR Indoor Relay Fiber Cable, to connect to the UR or other compliant devices. DC power to the Brick is distributed by the Cross Connect Panel, and short circuit protection for the Brick power supply is included in the FOA cable.

FOA Splice cable

The FOA Splice Cable is intended to meet customer standards for fiber optic cable distribution through the switchyard. The FOA Splice Cable is connectorized at the Brick end, and ends in copper and fiber pigtails. The customer must provide their own fiber optic cables across the switchyard, DC supply to power the Brick, DC short circuit protection for the Brick power supply, and perform their own splicing to the pigtails of the FOA Splice Cable.



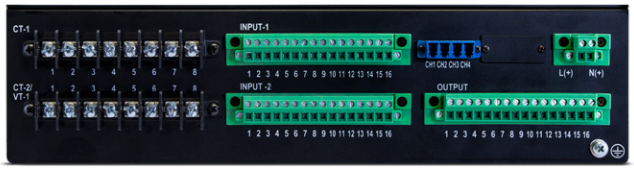
S-Brick

The HardFiber S-Brick Process Interface Unit (Order Code BRICK-4-HI-S-****-*-X-X) is intended for mounting inside marshalling cabinets, kiosks, and equipment control cabinets. The S-Brick uses standard terminal blocks for connecting copper cables to interface with primary equipment. Fiber optic cables require the use of one simplex LC connector for each of the four fiber optic cores.

The HardFiber S-Brick Process Interface Unit works directly with models of the GE Universal Relay (UR) family, and any compliant third party device. The S-Brick requires the customer to provide copper cabling to interface with primary equipment, DC supply to power the S-Brick, and fiber optic cabling and cabling management between the S-Brick and end device.

Front

Back



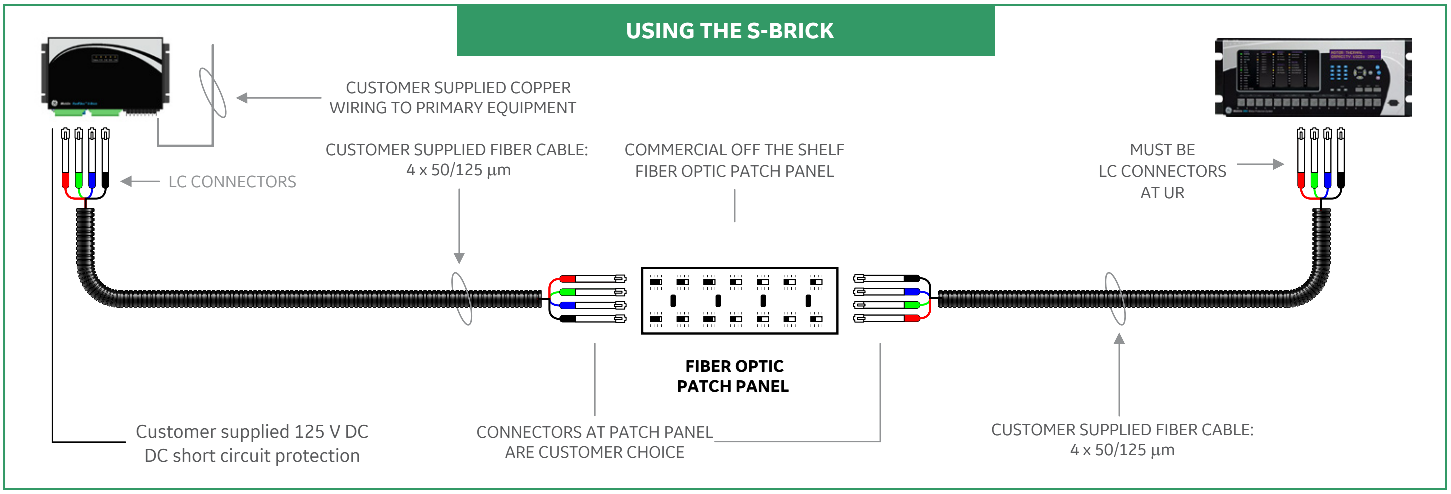
Cabling requirements for S-Brick, Brick FOA Splice Cable

Fiber optic cabling

The Multilin HardFiber System requires the use of 50/125 µm multimode fiber, that support 1310nm and 1550nm transmission. Class 1 graded index fiber is ideal. In general, OM2 and OM3 rated fibers meet these requirements. Environmental rating of the fiber cables is as per customer application. The S-Brick and the UR have female LC connectors, so cables must use male LC connectors at these ends. The S-Brick has 4 LC connectors, while the UR has 8 LC connectors. Any commercially available fiber optic patch panel may be used for cable management.

DC supply

The customer must provide a 125 or 250 VDC rated supply to power the S-Brick. The DC circuit must provide short circuit protection for the S-Brick power supply, (1A, fast acting, 10,000 A DC interrupting capacity, Littelfuse KLKD001 or equivalent). The general recommendation is to power the S-Brick separately from the associated primary equipment for good operating and maintenance practices.



Equipment cabinets for the S-Brick

The S-Brick is intended to be mounted close to primary power system equipment. When mounting in utility switchyards for example, the S-Brick must be mounted inside equipment cabinets with appropriate environmental protection. GE Grid Solutions can provide single or multiple S-Bricks mounted in environmentally secure cabinets, with all wiring, test switches, terminations, and related auxiliary equipment provided to meet customer design standards. Our cabinets can be free standing on pedestals or mounted to existing structures in the switchyard. Typical dimensions for the free standing cabinet are 1000mmH x 800mm W x 300mm D with 300mm Floor Stand.

GE Grid Solutions also provides all associated, design, setting studies, configuration, test and commissioning needed to support the installation of this equipment. Please visit our website: GEGridSolutions.com/PowerD/SubstationProjects for more information.

Scalability

The true test of any system, including a Process Bus system, is its ability to incrementally scale up to meet specific applications without adversely affecting the other devices in the system. Today's protection and control systems are already naturally scalable.

The challenge for communication-based protection systems becomes making extensions and modifications without disrupting the in-service protection and control system.

By recognizing that the mapping between power system signals and protection and control devices is fundamentally driven by the topology of the underlying substation, the HardFiber System is optimally partitioned and connected to allow for additions, modifications and upgrades to the system – without risking interruption or degradation to critical in-service protection.

Reliability, Dependability, Security

The Multilin HardFiber System provides an unprecedented level of diagnostics and self-checking, allowing critical protection and control systems to do something that they have never done before – operate without routine maintenance.

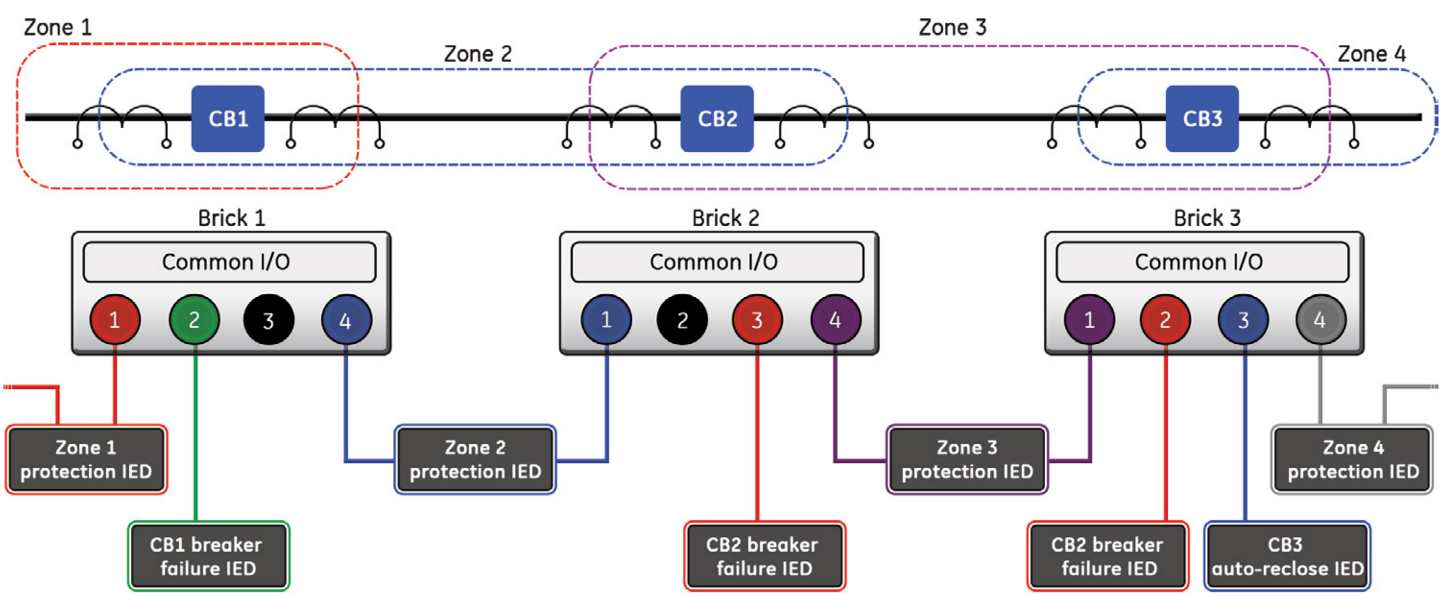
Internal diagnostics and self-tests within each Brick monitor dozens of critical internal subsystems and provide this information several hundred times per second. Duplicate Bricks can be provisioned to acquire each input signal twice, allowing protection and control devices to continuously crosscheck critical protection measurements before executing commands via fully redundant outputs.

With the HardFiber redundant architecture, each protection and control device can be configured to maximize dependability and security, addressing specific application requirements.

The Challenge for Utilities

Modern electricity companies deal with many individual challenges every day with one of the largest being the ability to address the constant inflationary pressures on both labor and materials while still having to manage their demand for increase in load by their customers.

The HardFiber IEC 61850 Process Bus System is a solution that addresses these very concerns and provides utilities with a means to reduce the labor associated with substation construction and expansion, and at the same time uses technologies and methodologies familiar to existing resources and skill sets.



Dedicated Digital Cores within each Brick allows for application additions and modifications without affecting other devices accepting information from the Brick

Technical Specifications

BRICK INPUTS

AC CURRENT

Number of Inputs	4 or 8
CT rated secondary	1A or 5A
Nominal frequency	50 Hz or 60 Hz
Relay burden	< 0.2 VA at rated secondary
Conversion range	0 to 46 × CT rating RMS symmetrical
Current withstand	20 ms at 250 times rated 1 sec. at 400A Continuous at 3 times rated

AC VOLTAGE

VT rated secondary	25.0 to 240.0 V
Number of Inputs	4 or 0
Nominal frequency	50 Hz or 60 Hz
Relay burden	< 0.25 VA at 120 V, 60 Hz
Conversion range	0 to 260 V RMS
Voltage withstand	continuous at 260 V to neutral, 1 min./hr at 420 V to neutral

CONTACT INPUTS (18)

Wetting power	Brick internal 24VDC power supply
External contacts	dry contact, dry solid state contact
Voltage threshold	6±1VDC
Speed	Refreshed at sampling rate
Current Draw	> 2.5 mA at 6VDC, 5 mA at 0VDC

UNIVERSAL DC INPUTS (3)

MODE	**RTD**
Types (3-wire)	100 Ω Platinum, 100 & 120 Ω Nickel
Sensing current	2.5 mA
Range	–50 to +250°C
Accuracy	±2°C
External lead resistance	25Ω maximum per lead
MODE	**DCMV**
Type	differential input
Range	±5VDC
Input impedance	≥500k Ω.
Accuracy	±0.2mVDC or 0.1% of reading, whichever is greater
MODE	**DCMA**
Current input (mA DC)	0 to –1, 0 to +1, –1 to +1, 0 to 5, 0 to 10, 0-20, 4-20
0 to 20, 4 to 20	
External resistor	200 Ω ± 0.2 Ω
Conversion range	–1 to + 20 mA DC
Accuracy	±0.2% of 1mA or 0.2% of reading, whichever is greater
MODE	**POTENTIOMETER**
Range	2k Ω to 20k Ω
Sensing voltage	5V
Accuracy	±5mVdc

BRICK POWER SUPPLY

Nominal DC voltage	110V to 250V
Min/Max DC voltage	88V to 300V
Nominal AC voltage	100 to 240V at 50/60Hz
Min/Max AC voltage	88/264V at 25 to 100Hz
Power consumption	<25W

VOLTAGE INTERRUPTION

Hold-Up time*	0 ms
Brick recovery time**	1 ms
Voltage withstand	2* Highest Nominal Voltage for 10ms, 220Vac+20% continuously

BRICK OUTPUTS

SOLID-STATE OUTPUT RELAY (4)

Operate and release time	<100us
Maximum voltage	280VDC
Maximum continuous current	5 A continuous at +45°C, 4 A continuous at +65°C
Make and Carry Current	300A DC, 0.03s, 25oC 30A DC, 0.2 s (ANSI C37.90) 20A DC, 1 min, 25oC

Breaking Capacity

	UL508	Utility App. (Autoreclose Scheme)	Industrial App.
Operations/ Interval	5000 ops/1 s-On, 9 s-Off 1000 ops/0.5 s-On, 0.5 s-Off	5 ops/ 0.2 s-On, 0.2 s-Off, within 1 minute	10000 ops/ 0.2 s-On 30 s-Off
Break Capability (0 to 250 VDC)	3.2 A at L/R=10 ms 1.6 A at L/R=20 ms 0.8 A at L/R=40 ms	10 A at L/ R=40 ms 30 A at L/R= 4ms	10 A at L/ R=40 ms 30 A at L/R= 4ms

LATCHING RELAY (1)

Maximum voltage	280VDC
Maximum continuous current	6A
Make and carry for 0.2s	30A as per ANSI/IEEE C37.90
Breaking capacity	(L/R=40 ms)

DC Voltage	DC Current
24 V	1 A
48 V	0.5 A
125 V	0.3 A
250 V	0.25 A

Operate time	<4ms
Min. number of operations	10,000
Control mode	Separate close and open commands. Under conflicting commands, the output shall open

FORM-C RELAY (2)

Maximum Voltage	280VDC
Maximum continuous current	8A
Make and carry for 0.2s	30A as per ANSI/IEEE C37.90
Breaking capacity	(L/R=40 ms)

DC Voltage	DC Current
24 V	1 A
48 V	0.5 A
125 V	0.3 A
250 V	0.2 A

Operate time	<8ms
Min. number of operations	10,000

BRICK COMMUNICATIONS

Brick transceiver	1310nm TX/1550 nm RX, 100Mb/s, bidirectional 1-Fiber 50/125um, complies with IEEE 802.3 100 Base-BX-U

MULTI-MODE MODULE

Optical transmit power	-14dbm~-8dbm
Maximum optical input power	-8dbm
Optical received sensitivity	-30dbm

BRICK ENVIRONMENTAL

TEMPERATURE RANGES

Storage	-40 to +85°C
Continuous Operating	-40 to +70°C

OTHER

Altitude	up to 2000m
Installation Category	II
IP rating	IP66, NEMA 4X (Rugged version only) IP40, S-Brick

BRICK TYPE TESTS

Cold	IEC 60068-2-1, 16 h at -40°C
Dry heat	IEC 60068-2-2, 16 h at +85°C
Humidity	IEC 60068-2-30, 55°C, >95%, Variant 1, 6 days
Temperature/humidity cyclic	IEC 60068-2-38, -10°C to +65°C
IP rating	IEC 60529, NEMA 250
Solar radiation	IEC 60068-2-9, MIL-STD-810F Method 505.4 procedure II worldwide deployment
Vibration	IEC 60255-21-1 2G class 2
Shock and bump	IEC 60255-21-2 class 2
Seismic	IEC 60255-21-3, ANSI/IEEE C37.98
Insulation	ANSI/IEEE C37.90, IEC 60255-5
Impulse	5kV impulse
Dielectric strength	3kVAC/1min for AC inputs, 2.3kVAC/1min for others
Insulation resistance	100MΩ at 500VDC
Electrostatic discharge	ANSI/IEEE C37.90.3, IEC 60255-22-2 Class 4, 8kV C/15kV A
Fast transient	
IEC 60255-22-4	2.5kV at 5kHz, 4kV at 2.5kV
IEEE C37.90.1	4kV for common mode test and transverse mode test
IEC 60255-22-1	2.5kV for common mode test, 1 kV for differential mode test
IEEE C37.90.1	2.5kV for common mode test and transverse mode test
IEC-1000-4-12	2.5kV for common mode test and differential mode test
Surge	IEC 60225-22-5, 4kV for common mode test, 2kV for transverse mode test
Magnetic Field Immunity	
IEC 61000-4-8	1000A/m for 3s, 100A/m for continuous
IEC 61000-4-9	1000A/m
Radiated immunity	
IEC 60255-22-3	35V/m at 80/160/450/900MHz
IEC 60255-22-3	35V/m from 80M~1000MHz
IEC 50204	35V/m at 900/1890MHz
IEEE C37.90.2	35V/m from 25M~1000MHz
IEC 60255-22-6	35V/m from 150k~80MHz
IEC 61000-4-16	30V, 300V/1s from 0~150kHz
Electromagnetic emission	IEC 60255-25/CISPR11/22 class A

BRICK PRODUCTION TESTS

Products go through an environmental test based upon an Accepted Quality Level (AQL) sampling process

APPROVALS

CE	CE LVD 2006/95/EC: EN/IEC 61010-1: 2001 / EN60255-5 2000 CE EMC 89/336/EEC: EN 60255-26 2004-08

IEC 61850 COMMUNICATIONS

Sampled Values	IEC 61850 9-2
Max. Sampling Rate	128 samples/cycle
SV Datasets per SV Frame	8
SV Fast Dataset	11 Analogue values (Type INT32)

SV Dataset	Data Items	Samples Per SV Frame
Fast	Analogue Values: 11 (INT32) Status Indications: 3 x 32 (Packed List per IEC 61850 8-1 8.135)	8
Slow	Analogue Values: 6 (INT16) Status Indications: 32 (Packed List per IEC 61850 8-1 8.1.3.5)	1

Commands	IEC 61850 8-1

Commands to Brick sent as properly configured GOOSE messages as defined in "Multilin Technical Description for Interoperability"

BRICK OUTDOOR FIBER CABLES

OPTICAL CHARACTERISTICS

Optical Fibers	4
Fiber Type	Graded Index, Multimode (50/125 mm)
Specification	MIL-PRF 49291/1-01
Maximum Distance	500 m (1650 ft)

ELECTRICAL PROPERTIES

Power Conductors	(2)
Size	1.31 mm² (16 AWG)
Voltage Rating	600 VAC
Shield	Aluminium/polyester tape
Drain Wire	0.33 mm² (22 AWG) stranded tinned copper

MECHANICAL PROPERTIES

Jacket	FR LSZH polyurethane, rodent resistant
Cable O.D.	12 mm (0.5 in) nominal
Maximum Installation Tension	1780 N (400 lbs)
Maximum Operating Tension	670 N (150 lbs)
Minimum Bend Radius (Installation)	25 cm (10 in)
Minimum Bend Radius (Operating)	12 cm (5 in)
Cable Weight	164 kg/km (110 lbs/1000 ft)

ENVIRONMENTAL

Storage Temperature	-40° to +85°C
Operating Temperature	-40° to +85°C

BRICK COPPER CABLES

ELECTRICAL PROPERTIES

Voltage Rating	600V

Conductor Information

Cable Type	Conductors
Outputs (CUB)	16 x 1.31 mm2 (16AWG)
Inputs (CUC)	29 x 1.31 mm2 (16 AWG)
CC55 AC Input Cable (CUD-CC55)	16 x 3.31 mm2 (12AWG)
CV50 AC Input Cable (CUD-CV50)	8 x 3.31 mm2 (12AWG),8 x 1.31 mm2 (16AWG)
CC11 AC Input Cable (CUD-CC11)	16 x 1.31 mm2 (16AWG)
CV10 AC Input Cable (CUD-CV10)	16 x 1.31 mm2 (16AWG)

MECHANICAL PROPERTIES

Jacket	FR PVC

Cable Sizes

Cable Type	Cable O.D.
Outputs (CUB)	18 mm (0.7 in)
Inputs (CUC)	25 mm (1.0 in)
CC55 AC Input Cable (CUD-CC55)	23 mm (0.9 in)
CV50 AC Input Cable (CUD-CV50)	23 mm (0.9 in)
CC11 AC Input Cable (CUD-CC11)	18 mm (0.7 in)
CV10 AC Input Cable (CUD-CV10)	18 mm (0.7 in)

INDOOR FIBER CABLES

OPTICAL PROPERTIES

Optical Fibers	4
Fiber Type	Graded Index, Multimode (50/125 μm)

MECHANICAL PROPERTIES

Jacket	FR LSZH polyurethane
Cable O.D.	8 mm (0.3 in) nominal
Maximum Installation Tension	2180 N (490 lbs)
Maximum Operating Tension	490 N (110 lbs)
Minimum Bend Radius (Installation)	13 cm (5 in)
Minimum Bend Radius (Operating)	6 cm (2.5 in)
Cable Weight	50 kg/km (34 lbs/1000 ft)

ENVIRONMENTAL

Storage Temperature	-40° to +85°C
Operating Temperature	-40° to +85°C

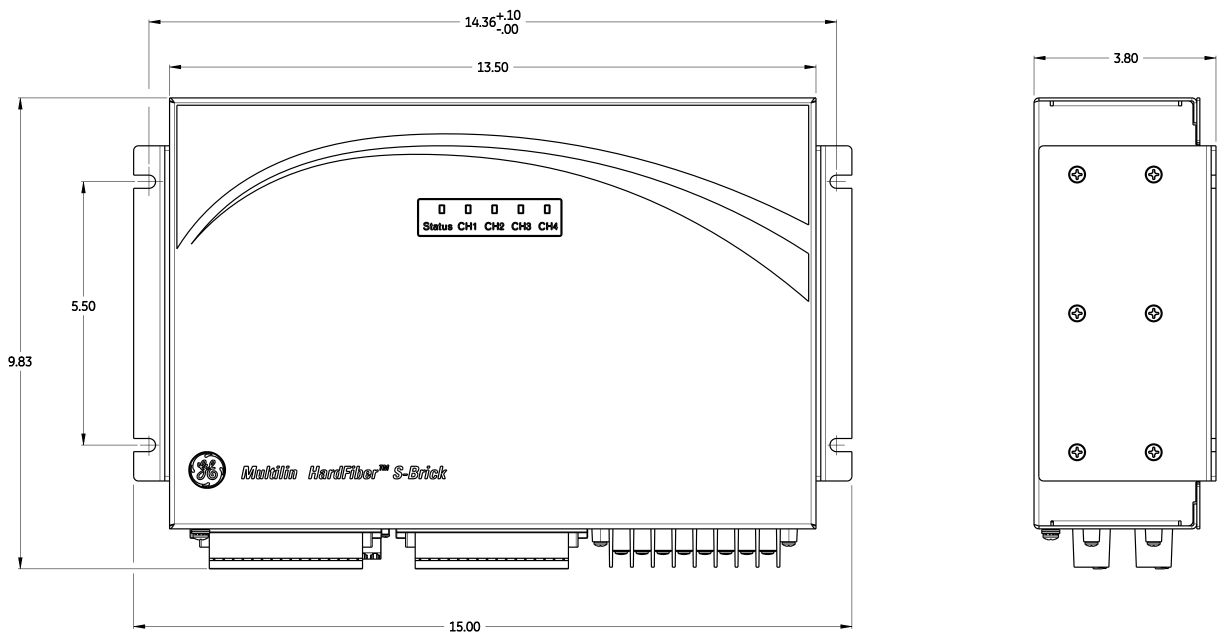
* Maximum interruption duration for which Brick operation is unaffected. The Brick complies with type tests applicable to power supply terminals.

** Maximum duration between application of rated power supply voltage and Brick ready to provide full service.

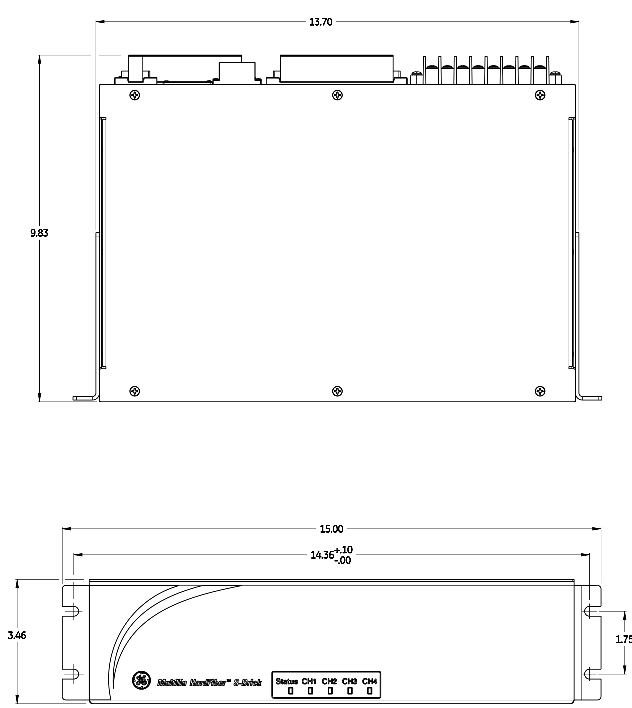
Product Dimensions

S-Brick

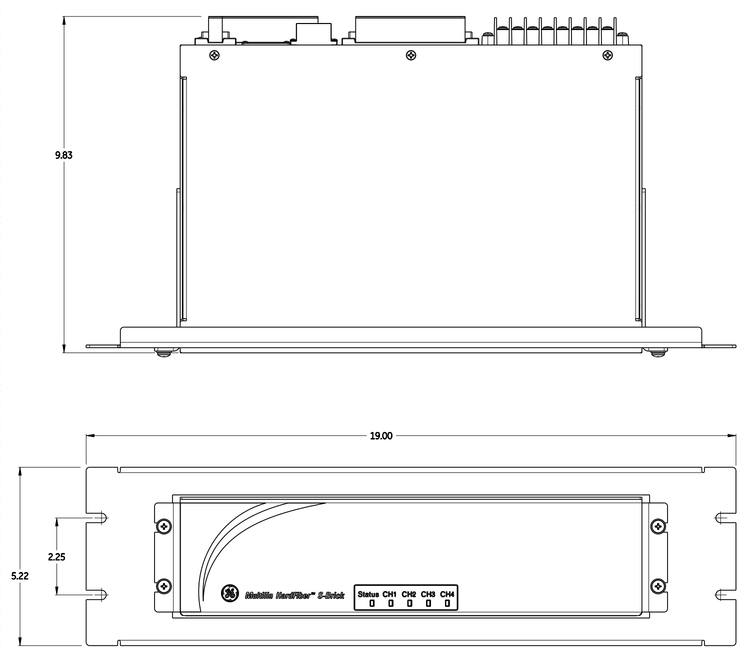
Surface Mount BRICK-4-HI-****-S-S-X-X



Flush Mount BRICK-4-HI-****-S-F-X-X

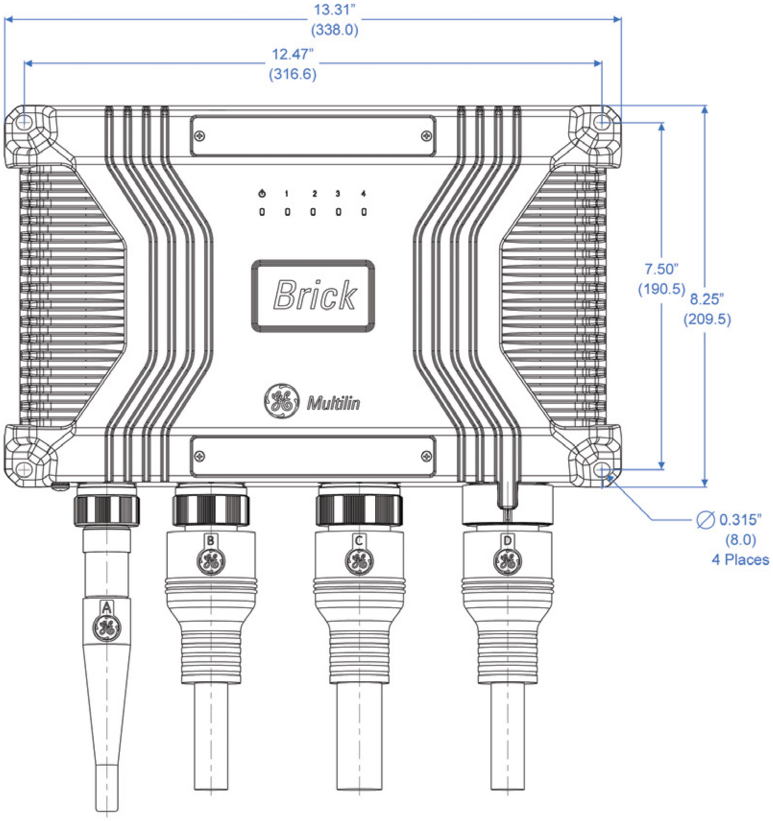


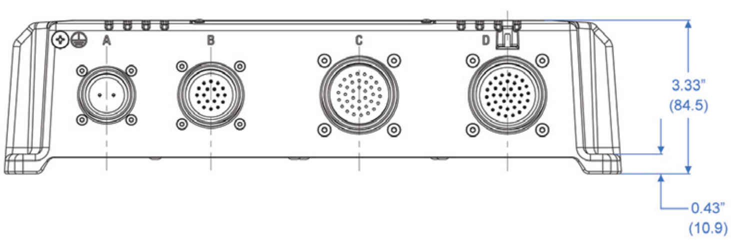
Panel Mount BRICK-4-HI-****-S-P-X-X



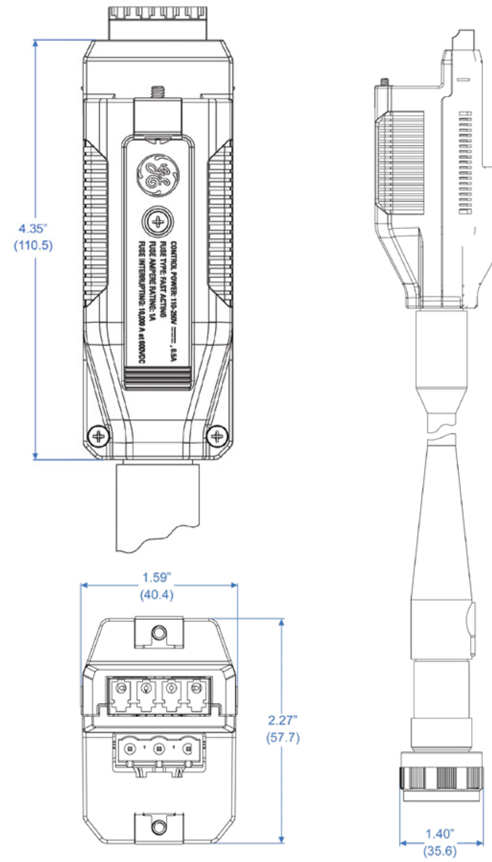
Product Dimensions

Brick



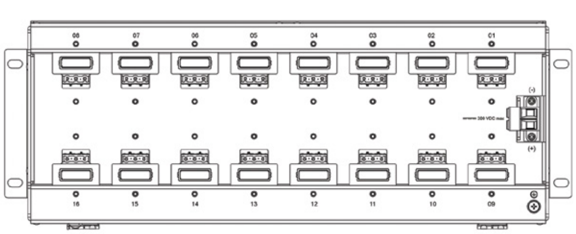


Outdoor Brick Cable

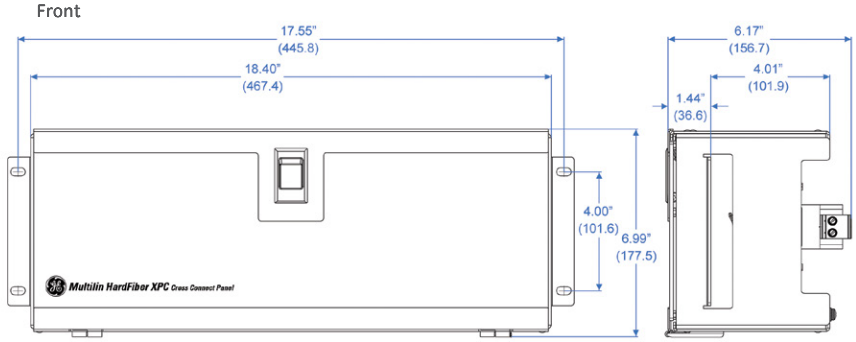


Cross Connect Panel

Back



Front

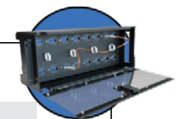


Ordering

Brick

	BRICK	*	*	*	****	*	
Base Unit	BRICK						Base Unit
Core		4					4 fiber optic cores
Power Supply			HI				125V/250V DC Power Supply
Case				S			Standard kiosk case
				R			Rugged case for outdoor mounting
CT/VT Inputs					CC55		Eight 5A CT inputs
					CV50		Four 5A CT inputs, 4 VT inputs
					CC11		Eight 1A CT inputs
					CV10		Four 1A CT inputs, 4 VT inputs
Mounting						S	Surface mount for S Case only (Case must be S)
						F	Flush mount for S Case only (Case must be S)
						P	19" Rack mount for S Case only (Case must be S)
						R	Rugged case for outdoor mounting (Case must be X)

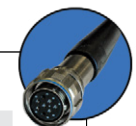
Cross Connect Panel



To be used with rugged Brick-4-HI-R-****-R-X-X only

XPC	-	16	-	HI	HardFiber Cross Connect Panel, 16 positions, 125/250 V DC Distribution

Fiber Cables



To be used with rugged Brick-4-HI-R-****-R-X-X only

FOA	-	0000	-	M***	Outdoor Brick connection cable, four fiber optic cores plus copper DC supply
Cable Length				001 - 500	1 meter to 500 meters (3 feet to 1650 feet)

FOR	-	0000	-	M***	Indoor relay fiber cable, four fiber optic cores
Cable Length				003	
				005	
				010	
				015	
				020	
				025	
				030	
				040	
				050	

Brick Copper Cables

To be used with rugged Brick-4-HI-R-****-R-X-X only

CUB	-	0000	-	M***	Contact Output Cable
Cable Length				002	2 meters (6 feet)
				005	5 meters (16 feet)
				010	10 meters (32 feet)
				020	20 meters (64 feet)

CUC	-	0000	-	M***	Contact & Transducer Input Cable
Cable Length				002	2 meters (6 feet)
				005	5 meters (16 feet)
				010	10 meters (32 feet)
				020	20 meters (64 feet)

CUD	-	****	-	M***	AC Input Cable
CT/VT Inputs		CC55			5A/5A 8xCT Inputs
		CV50			5A 4xCT & 4xVT Inputs
		CC11			1A/1A 8xCT Inputs
		CV10			1A 4xCT & 4xVT Inputs
Cable Length				002	2 meters (6 feet)
				005	5 meters (16 feet)
				010	10 meters (32 feet)
				020	20 meters (64 feet)

imagination at work

GEA-12835A(E)
English
180626