MULTILINK ML1600
Guideform Specification

9" Panel Mounted Substation/Industrial Hardened Managed Ethernet Switch

The MultiLink ML1600 is a Substation/Industrial hardened Ethernet switch that is ideally suited for providing reliable network communications in harsh electrical and environmental conditions that are often found in Utility Substations or Industrial Facilities. Designed for the unique needs and requirements of the protection and control industry, the ML1600 has many unique features such as Link-Loss-Alert and SMART RSTP that allow for optimum and fast recovery of faults that can occur on a network.

The ML1600 has implemented the highest levels of Network Security available therein protecting your network by limiting access to the network and network management functions to only personnel and computers that have been authenticated through appropriate security measures.

The ML1600 is designed with a modular platform that provides for flexible configurations and multiple Ethernet media types on each Switch. This modularity allows for connections in many different applications and to many different devices that may be found in these substation or industrial locations. The ML1600 can have all communication ports mounted on the Front or Rear of the unit and supports all common copper and fiber optic Ethernet ports including ST, SC, LC, MTRJ, RJ45 with speeds of 10Mbit, 100Mbit and 1000Mbit per second.

Ethernet Ports Supported

Port Type	Quantity Available	Typical Distance	Wavelength	Transmit Power	Receive Sensitivity
10/100 Mbit RJ45 Copper	16	100 m	N/A	N/A	N/A
10 Mbit Multimode ST Fiber Optic	8	2 km	850 nm	-15 dB	-31 dB
100 Mbit Multimode ST Fiber Optic	8	2 km	1310 nm	-20 dB	-31 dB
100 Mbit Multimode SC Fiber Optic	8	2 km	1310 nm	-20 dB	-31 dB
100 Mbit Singlemode SC Fiber Optic	8	20 km	1310 nm	-20 dB	-31 dB
100 Mbit Singlemode SC Fiber Optic	12	40 km	1310 nm	-5 dB	-34 dB
100 Mbit Multimode LC Fiber Optic	12	2 km	1310 nm	-19 dB	-31 dB
100 Mbit Singlemode LC Fiber Optic	12	15 km	1310 nm	-15 dB	-28 dB
100 Mbps Multimode MTRJ Fiber Optic	12	2 km	1310 nm	-19 dB	-31 dB
1 Gbit RJ45 Copper	4	100 m	N/A	N/A	N/A
1 Gbit Multimode SC Fiber Optic	4	2 km	850 nm	-9.5 dB	-17 dB
1 Gbit Singlemode 1310nm SC Fiber Optic	4	10 km	1310 nm	-9.5 dB	-20 dB
1 Gbit Singlemode 1310nm SC Fiber Optic	4	25 km	1310 nm	-4.0 dB	-21 dB
1 Gbit Singlemode 1550nm SC Fiber Optic	4	40 km	1550 nm	-4.0 dB	-21 dB
1 Gbit Singlemode 1550nm SC Fiber Optic	4	70 km	1550 nm	-3.0 dB	-23 dB

Product Features

Security

SNMPv3 - SNMPv3 implies compliance to both SNMPv1 and SNMPv2 and includes additional functionality in the areas of Security and the ability to configure Switches remotely. SMNPv3 brings a high level of security not found in the previous versions that utilize both encryption and authentication of all management functions.

SSL - Secure Socket Layer ensures that secure access is made with the switch whenever any management functions are performed over a Web Interface connection. SSL is the same technology used by financial institutions to ensure all transactions are secure and free from eavesdropping.

Remote Access Security – Remote Access Security ensures that only specified users have access to the Switch's management functions. Once configured, SNMP commands sent to the Switch through the Web or through Telnet will only be accepted from specified MAC addresses.

CLI Password Security – Multi-Level CLI login access enhances security by defining the set of CLI commands that are accessible to the different users.

Port Security – Port Security prevents unauthorized access to the network by validating network traffic entering each port to a list of acceptable MAC addresses. The list of accepted MAC addresses can be entered by a system manager, or learned and controlled by the MultiLink Switch itself.

RADIUS (802.1x) – Remote Authentication Dial-In User Service is used to provide authentication and authorization to the network by comparing all network access attempts with a centralized RADIUS server. Using this feature enhances security of your network by protecting against access through point-to-point connections such as Wireless Access.

TACACS+ - Terminal Access Controller Access Control System provides authentication and authorization for routers and network access servers that are attempting to access the network and it's configuration.

SMTP Email Alerts – The MultiLink ML1600 can be configured to send Email notification that will provide warnings of unauthorized network access attempts to System Administration personnel. Utilizing this functionality will provide greater visibility of any attempts to breach the security of your Ethernet Network.

Network Management

SNMPv3 – Simple Network Management Protocol is an industry standard method for programming and managing Ethernet Switches. This protocol allows for configuring of switches made by different manufacturers by using standard network management system software (NMS). SNMPv1 and SNMPv2 define a set of instructions that can be used to configure settings, interrogate information from the switches, and send alerts upon detection of network problems. SNMPv3 defines the security required to prevent the switches from being accessed or altered by unauthorized users.

Web Management – The Multilink family of switches provide a simple, easy to use, graphical Web Management interface for all configuration and monitoring functions. The Web Manager allows for configuring and monitoring your Multilink switches from anywhere in your network using any standard Internet browser.
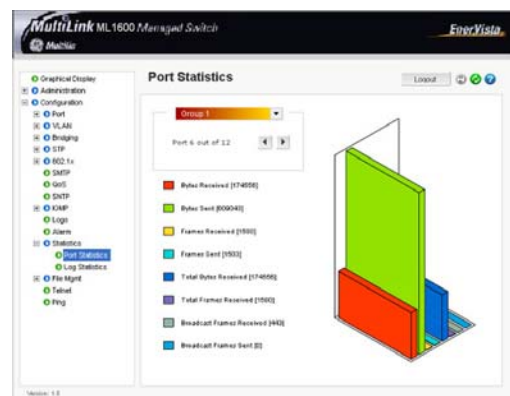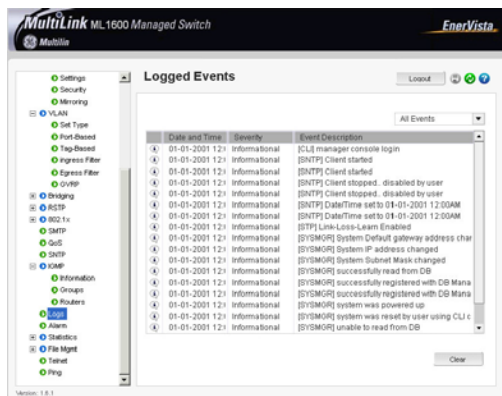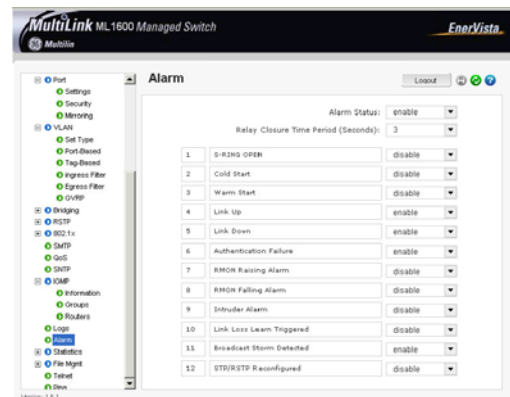
VLAN – Virtual Local Area Networks allow separation of a larger physical network in smaller Virtual networks in order to improve bandwidth allocation and optimize network efficiency. Virtual Local Area Networks will restrict broadcast, multicast and unicast traffic to only VLAN on which they reside thus preventing large amounts of broadcast traffic from degrading the entire network.

Quality of Service (802.1p) – Quality of Service (QoS) allows for prioritizing of network traffic so that critical traffic is allowed to jump ahead of normal network traffic that is buffered and transmitted on a First-Come-First-Serve basis. Network traffic priority classification can be made by Port, by Tag and by IP Type of Service (TOS).

Port Mirroring – Port Mirroring allows all of the traffic on any given port to be duplicated on a selected second port. Monitoring the traffic on this second port will help facilitate analysis or troubleshooting of selected network paths.

IGMP Snooping - Internet Group Management Protocol Snooping reduces the amount of multicast traffic passing through your switch by restricting these messages only to those ports that need to receive this traffic.

IPv6 - The ML1600 supports IPv6 that allows for addressing of a large number of devices in a single network.

RMON – Remote Monitoring is a standard monitoring specification that provides statistics and data exchange to remote sites for the purpose of network planning and network fault diagnosis.

SNTP - Simple Network Time Protocol provides a method for synchronizing the internal clocks of devices on an Ethernet LAN. Using this protocol, all MultiLink switches can have the time-tagging of events in their Event Log synchronized to allow for more accurate and precise troubleshooting of the entire network.

SMTP – Simple Mail Transfer Protocol supplies a means of instantly notifying network managers when events have occurred on the network that require immediate attention. Email alerts can be automatically sent by the MultiLink switches, indicating that part of the network may be down, an unauthorized network access attempt was made, along with many other user definable network events.

Event Log – The Event Log will store and timestamp all configuration changes and network problems that are detected by the Switch. The Multilink Switch can store up to 1000 events that can be used to analyze network problems and provide traceability to network configuration changes.

Alarm Contact – The MultiLink switches provide 2 Alarm contacts that can be used for identifying problems with the network or networking devices. The hardware alarm contact will change state upon the loss of control power or upon detecting of a critical problem with hardware within the switch. The software alarm contact can be configured to change state upon the detection of several user configurable events including, loss of one or more communication ports, detection of a broadcast storm, or illegal network access attempts.

IP Out-of-the-Box- The ML1600 is programmed to automatically have an IP address programmed when the switch is being used for the first time. The ML1600 will first detect if there is a DHCP severer is available on the network, and if so, it will receive its IP address from this server. If there is no DHCP server available, the ML1600 will assign itself the IP address 192.168.1.2.

Modbus – The Modbus protocol provides a means of integrating the data stored in the ML1600 such as the status of all ports, network data statistics, and alarm conditions, into existing HMI, SCADA, or DCS monitoring systems. Communicating to the switches using the Modbus protocol allows for retrieval of network data using the existing HMI Modbus drivers and without having to use additional SNMP or other servers.

Viewpoint Monitoring – The ML1600 is integrated into the Viewpoint Monitoring software that allows for monitoring of all network and switch data in your local HMI. Using this software, engineering staff will be able to monitor the status of all network ports, generate alarms of network problems, and identify the overall health of their entire communications network.

CLI – Command Line Interface provides a set commands that can be used for configuration and interrogation of switches. The MultiLink family of managed switches support the full set of CLI commands and also provides a help function for assisting CLI users.

Network Reliability

Link Loss Alert – The GE Multilin Universal Relay (UR) family and the F650 family of relays have redundant Ethernet ports that allow for automatic switching to their secondary ports when they detect that their primary path is broken. The MultiLink switches can compensate for situations where only the relay's Transmitter fiber cable is broken. Upon detection of the broken Transmit fiber, the ML1600 will cease sending a link pulse to the relay's Receive fiber cable, thereby allowing the relay to switch to its secondary port. The Link Loss Alert feature is available on both the **10Mbit and 100Mbit** fiber optic ports, thus allowing for recovery of a single broken fiber connected to any GE Multilin relay.

RSTP (IEEE 802.1w) – The MultiLink family of Ethernet Switches use the industry standard Rapid Spanning Tree Protocol for providing fast fault recovery of redundant ring or mesh Ethernet Networks. Using RSTP, the MultiLink switches will eliminate loops or redundant paths in network architectures and quickly reconfigure the network to these redundant paths in the event of a fault occurring in the primary path. Implementing the standards based RSTP allows the MultiLink Switches to seamlessly be used with other third party switches found in your network.

SMART RSTP – The MultiLink family of Ethernet Switches uses our SMART Rapid Spanning Tree mode for providing fault recovery of ring architecture networks with recovery times of less than 5ms per MultiLink Switch (hop). When other third party switches are found in the network or the architecture is modified into a configuration that is not a ring (i.e. mesh), the ML1600 will automatically revert to RSTP mode thus allowing interoperability with other switches on the network.

Power Supply

The High Voltage power supply on the ML1600 is dual AC and DC meaning the same power supply and power supply input terminals can be used for either AC or DC input power.

Power Supply Rating

AC Voltage	100 – 240 VAC
HI Voltage:	110 – 250VDC / 100 – 240VAC
LO Voltage:	36VDC – 60VDC

Substation/Industrial Robustness

GE Multilin brings the same degree of robustness and immunity to harsh electrical environments that we use for our protective relays to the MultiLink line of Substation and Industrial Ethernet Switches. All of the standard rigorous testing used to verify proper operation of our relays also are performed on our MultiLink Ethernet Switches while ensuring error free communications throughout the entire tests.

The MultiLink Ethernet Switches are compliant with all major International Standards for Networking Communications devices including:

IEC 61850-3   - Standards for reliability of communication networks and systems in Substations

IEEE 1613 CLASS 2   - Standards for the design of communication network equipment to be used in Substations and Industrial sites

NEBS Level 3   - Stringent test level required for high reliability in harsh environments and mission critical applications (Competitive Local Exchange Carriers)

ETSI Certified   - European Telecommunications Standards Institute that establishes requirements for operation of telecommunication equipment throughout Europe

NEMA TS2   - Stipulates the environmental requirements for traffic control equipment subjected to unregulated environmental conditions

The MultiLink Ethernet Switches have approval from the following organizations:

CSA C22.2 No 60950   - CSA us Agency Approval
EN 60950   - CE Agency Approval
21 CFR Chapter 1   - FDA Agency Approval

Environmental Type Test Standards

STANDARD COMPLIANCE	TYPE TEST	DESCRIPTION	SEVERITY LEVEL
IEC 61850-3	CISPR22	EMI & RFI	N/A
	EN55022A	EMI & RFI	N/A
	IEC 61000-4-2	ESD	Class 4
	IEC 61000-4-3	Radiated RFI	10 V/m (1)
	IEC 61000-4-4	Burst (Fast Transient)	Class 4
	IEC 61000-4-5	Surge (Signal Ports/DC Ports/AC Ports)	Class4/3/4
	IEC 61000-4-6	Conducted RFI	Class 3
	IEC 61000-4-8	Magnetic Field	N/A
	IEC 61000-4-11	Voltage Interrupts	N/A
	IEC 61000-4-12	Oscillatory Waves Immunity	Class 3
	IEC 61000-4-16	Mains Frequency Voltage	Class 4
	IEC 61000-4-17	DC Power Supply Ripple	Class 3
	IEC 61000-4-29	Voltage Dips	N/A
	IEC 60255-5	Dielectric Strength (All Ports)	1kVAC
	IEC 60255-5	H.V. Impulse (All Ports)	5 k VAC
IEC 1613 /IEEEC37 90	IEEEC37.90.1	Fast Transient (All Ports)	+/- 4kV
	IEEEC37.90.1	Oscillatory (All Ports)	1 kVAC
	IEEEC37.90.3	ESD (Contact/Air)	+/-8kV / 15kV
	IEEEC37.90	Hipot& Impulse Test	N/A
	IEEEC37.90.2	RF Susceptibility	N/A
NEMATS2	NEMATS2	Operating Voltage	89-135Vac
	NEMATS2	Operating Frequency	57-63 Hz
	NEMATS2	Power Interruption	0V, 2/3 PI withl500/300ms pause
	NEMATS2	Temperature & Humidity	O-34+74C, S-45+85C, H95%
	NEMATS2	Transients, Power Service	-/+300V, 25OOW
	NEMATS2	Transients, Input/Output Terminals	300V, 1/10, X5.
	NEMATS2	Non-destruct Transient Immunity	-/+1000V, X3
	NEMATS2	Vibration	5-30Hz, .5g, XYZ
	NEMATS2	Shock	1Og,XYZ
IEC 60068 /ENVIRONMENTAL	EC 60068-2-1	Cold Temperature	-40Celcius for 16 Hours
	IEC 60068-2-2	Dry Heat	+85Celciusfor 16 Hours
	IEC 60068-2-30	Humidity	95% (non) 55Celcius,6Cycles
	IEC 60255-21-1	Vibration	2G @ 10-150HZ
	IEC 60255-21-2	Shock	30G @ 11ms
	IP Rating	Ingress Polutant Protection	IP40

Ordering:

	Model	Power Supply	Module A	Module B	Harsh Environment	Description
Base Unit	ML1600					Base Unit
Power Supply		AC				88 - 150 VAC Power Supply
		HI				88 - 300 VDC / 85 - 265 VAC Power Supply
		LO				36 - 70 VDC Power Supply
Modules			XX	XX		
			A1	A1		4 x 10 Mbit - ST mm Fiber
			A2	A2		4 x 100 Mbit - ST mm Fiber
			A3	A3		4 x 100 Mbit - SC mm Fiber
			A4	A4		8 x 10/100 Mbit - RJ45 Copper
			A5	A5		2 x 10 Mbit - ST mm Fiber + 4 x 10/100 Mbit RJ45 Copper
			A6	A6		2 x 100 Mbit - ST mm Fiber + 4 x 10/100 Mbit RJ45 Copper
			A7	A7		2 x 100 Mbit - SC mm Fiber + 4 x 10/100 Mbit RJ45 Copper
			A8	A8		2 x 100 Mbit - SC sm Fiber 20km + 4 x 10/100 Mbit RJ45 Copper
			A9	A9		2 x 100 Mbit - SC sm Fiber 40km + 4 x 10/100 Mbit RJ45 Copper
			AA	AA		4 x 100 Mbit - LC mm Fiber + 4 x 10/100 Mbit RJ45 Copper
			AB	AB		8 x 100 Mbit - LC mm Fiber
			AC	AC		4 x 100 Mbit - LC sm Fiber 15km + 4 x 10/100 Mbit RJ45 Copper
			AD	AD		8 x 100 Mbit - LC sm Fiber 15km
			AE	AE		2 x 100 Mbit - LC sm Fiber + 6 x 10/100 Mbit - RJ45 Copper
			AE	AF		4 x 10 Mbit - ST mm Fiber + 4 x 100 Mbit - ST mm Fiber
			AG	AG		2 x 100 Mbit - SC sm Fiber 70km + 4 x 10/100 Mbit - RJ45 Copper
			G3	G3		1 x 1000 Mbit - SC mm Fiber + 2 x 100 Mbit - SC mm Fiber
			G4	G4		1 x 1000 Mbit - SC mm Fiber + 4 x 10/100 Mbit - RJ45 Copper
			G5	G5		2 x 1000 Mbit - SC mm Fiber
			GC	GC		1 x 1000 Mbit - RJ45 Copper + 2 x 100 Mbit - SC mm Fiber
			GD	GD		1 x 1000 Mbit - RJ45 Copper + 4 x 10/100 Mbit - RJ45 Copper
			GE	GE		2 x 1000 Mbit - RJ45 Copper
			GF	GF		1 x 1000 Mbit - SC sm Fiber 10km + 2 x 100 Mbit - SC mm Fiber
			GH	GH		1 x 1000 Mbit - SC sm Fiber 10km + 4 x 10/100 Mbit - RJ45 Copper
			GJ	GJ		2 x 1000 Mbit - SC sm Fiber 10km
			GK	GK		1 x 1000 Mbit - SC sm Fiber 25km + 2 x 100 Mbit - SC mm Fiber
			GL	GL		1 x 1000 Mbit - SC sm Fiber 25km + 4 x 10/100 Mbit - RJ45 Copper
			GM	GM		2 x 1000 Mbit - SC sm Fiber 25km
Harsh Chemical Environment					X	Standard Environment
					H	Harsh Chemical Environment Conformal Coating