

MiCOM H15x

Ethernet Switches

H15x/EN GL/C24

Global Documentation

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1. SAFETY AND HANDLING

1.1 Introduction

This Safety Section and the relevant equipment documentation provide full information on safe handling, commissioning and testing of this equipment.

The technical data in this Safety Section is typical only; see the technical data section of the relevant equipment documentation for data specific to a particular piece of equipment.



Before carrying out any work on the equipment the user should be familiar with the contents of this Safety Section and the ratings on the equipment's rating label.

Reference should be made to the external connection diagram before the equipment is installed, commissioned or serviced.

1.2 Health and safety

The information in the Safety Section of the equipment documentation is intended to ensure that equipment is properly installed and handled in order to maintain it in a safe condition.

It is assumed that everyone who will be associated with the equipment will be familiar with the contents of this Safety Section.

When electrical equipment is in operation, dangerous voltages will be present in certain parts of the equipment. Failure to observe warning notices, incorrect use, or improper use may endanger personnel and equipment and also cause personal injury or physical damage.

Before working on the equipment it must first be electrically isolated.

Proper and safe operation of the equipment depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing. For this reason only qualified personnel may work on or operate the equipment.





Qualified personnel are individuals who:

- Are familiar with the installation, commissioning, and operation of the equipment and of the system to which it is being connected;
- Are trained in the care and use of safety apparatus in accordance with safety engineering practices;
- Are trained in emergency procedures (first aid).

The equipment documentation gives instructions for its installation, commissioning, and operation. However, the manuals cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact the appropriate Schneider Electric technical sales office and request the necessary information.

1.3 Symbols

For safety reasons the following symbols, which may be used on the equipment or referred to in the equipment documentation, should be understood before it is installed or commissioned.

	
Caution: refer to equipment documentation	Caution: risk of electric shock
	
Protective Conductor (*Earth) terminal	Functional/Protective Conductor (*Earth) terminal
	Note: This symbol may also be used for a Protective Conductor (Earth) terminal if that terminal is part of a terminal block or sub-assembly e.g. power supply.

*NOTE: THE TERM EARTH USED THROUGHOUT THIS TECHNICAL MANUAL IS THE DIRECT EQUIVALENT OF THE NORTH AMERICAN TERM GROUND.

1.4 Installing, commissioning and servicing



Equipment connections

Personnel undertaking installation, commissioning or servicing work for this equipment should be aware of the correct working procedures to ensure safety.

The equipment documentation should be consulted before installing, commissioning, or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

Any disassembly of the equipment may expose parts at hazardous voltage, also electronic parts may be damaged if suitable electrostatic voltage discharge (ESD) precautions are not taken.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

The equipment must be connected in accordance with the appropriate connection diagram.

Protection Class I Equipment

- Before energizing the equipment it must be earthed using the protective conductor terminal, if provided, or the appropriate termination of the supply plug in the case of plug-connected equipment.
- The protective conductor (earth) connection must not be removed since the protection against electric shock provided by the equipment would be lost.
- When the protective (earth) conductor terminal (PCT) is also used to terminate cable screens, etc., it is essential that the integrity of the protective (earth) conductor is checked after the addition or removal of such functional earth connections. For M4 stud PCTs the integrity of the protective (earth) connections should be ensured by use of a locknut or similar.

The recommended minimum protective conductor (earth) wire size is 2.5 mm² (3.3 mm² for North America) unless otherwise stated in the technical data section of the equipment documentation, or otherwise required by local or country wiring regulations.

The protective conductor (earth) connection must be low-inductance and as short as possible.

Before energizing the equipment, the following should be checked:

- Voltage rating/polarity (rating label/equipment documentation);
- Protective fuse rating;
- Integrity of the protective conductor (earth) connection (where applicable);
- Voltage rating of external wiring, applicable to the application.



Equipment use

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



Equipment operating conditions

The equipment should be operated within the specified electrical and environmental limits.



Insulation and dielectric strength testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.



Insertion of modules and PCB cards

Modules and PCB cards must not be inserted into or withdrawn from the equipment whilst it is energized, since this may result in damage.



Fiber optic communication

Where fiber optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.



Cleaning

The equipment may be cleaned using a lint-free cloth dampened with clean water, when no connections are energized. Contact fingers of test plugs are normally protected by petroleum jelly, which should not be removed.

1.5 De-commissioning and disposal



De-commissioning

The supply input (auxiliary) for the equipment may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the equipment (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to de-commissioning.



Disposal

It is recommended that incineration and disposal to water courses is avoided. The equipment should be disposed of in a safe manner. Any equipment containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation may apply to the disposal of the equipment.

1.6 Technical specifications for safety

Unless otherwise stated in the equipment technical manual, the following data is applicable.

1.6.1 Protective fuse rating

The recommended maximum rating of the external protective fuse for equipment is 16 A, high rupture capacity (HRC) Red Spot type NIT, or TIA, or equivalent. The protective fuse should be located as close to the unit as possible.

1.6.2 Protective class

IEC 60255-27: 2005
EN 60255-27: 2005

Class I (unless otherwise specified in the equipment documentation). This equipment requires a protective conductor (earth) connection to ensure user safety.

1.6.3 Installation category

IEC 60255-27: 2005
EN 60255-27: 2005

Installation category III (Overvoltage Category III):
Distribution level, fixed installation.

Equipment in this category is qualification tested at 5 kV peak, 1.2/50 μ s, 500 Ω , 0.5 J, between all supply circuits and earth and also between independent circuits.

1.6.4 Environment

The equipment is intended for indoor installation and use only. If it is required for use in an outdoor environment then it must be mounted in a specific cabinet or housing allowing it to meet the requirements of IEC 60529 with the classification of degree of protection IP54 (dust and splashing water protected).

Pollution Degree - Pollution Degree 2
Altitude - Operation up to 2000m

Compliance is demonstrated by reference to safety standards.

IEC 60255-27:2005
EN 60255-27: 2005

1.7 Handling of Electronic Equipment

A person's normal movements can easily generate electrostatic potentials of several thousand volts.

Discharge of these voltages into semiconductor devices when handling circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits of Schneider Electric products are immune to the relevant levels of electrostatic discharge when housed in their cases. Do not expose them to the risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practical protection for its semiconductor devices. However, if it becomes necessary to withdraw a module, the following precautions should be taken in order to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.
2. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit track or connectors.
3. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.
4. Place the module on an antistatic surface, or on a conducting surface that is at the same potential as you.
5. Store or transport the module in a conductive bag.

More information on safe working procedures for all electronic equipment can be found in IEC 60147-0F and BS5783.

If you are making measurements on the internal electronic circuitry of any equipment in service, it is preferable that you are earthed to the case with a conductive wrist strap.

Wrist straps should have a resistance to ground between 500k – 10M Ohms. If a wrist strap is not available you should maintain regular contact with the case to prevent the build up of static. Instruments used for making measurements should be earthed to the case whenever possible.

Schneider Electric strongly recommends that detailed investigations on the electronic circuitry, or modification work, should be carried out in a Special Handling Area such as described in IEC 60147-0F or BS5783.

1.8 Packing and Unpacking

All MiCOM Hxxx devices are packaged separately in their own cartons and shipped inside outer packaging. Use special care when opening the cartons and unpacking the device, and do not use force. In addition, make sure to remove from the inside carton the supporting documents supplied with each individual device and the type identification label.

The design revision level of each module included with the device in its as-delivered condition can be determined from the list of components. This list should be carefully saved.

After unpacking the device, inspect it visually to make sure it is in proper mechanical condition.

If the MiCOM Hxxx device needs to be shipped, both inner and outer packaging must be used. If the original packaging is no longer available, make sure that packaging conforms to ISO 2248 specifications for a drop height $\leq 0.8\text{m}$.

1.9 Guarantees

The media on which you received Schneider Electric software is guaranteed not to fail executing programming instructions, due to defects in materials and workmanship, for a period of 90 days from date of shipment, as evidenced by receipts or other documentation. Schneider Electric will, at its option, repair or replace software media that do not execute programming instructions if Schneider Electric receive notice of such defects during the warranty period. Schneider Electric does not guarantee that the operation of the software shall be uninterrupted or error free.

A Return Material Authorization (RMA) number must be obtained from the factory and clearly marked on the package before any equipment acceptance for guarantee work. Schneider Electric will pay the shipping costs of returning to the owner any parts that are covered by warranty.

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In any application, including the above, reliability of operation of the software products can be impaired by adverse factors, including - but not limited to - fluctuations in electrical power supply, computer hardware malfunctions, computer operating system malfunctions, software suitability, suitability of compilers and development software used to develop an application, installation errors, software and hardware compatibility problems, malfunctions or failures of electronic monitoring or control devices, transient failures of electronic systems (hardware and/or software), unanticipated uses or misuses, or errors by the user or application designer (adverse factors such as these are collectively termed "System failures").

Any application where a system failure would create a risk of harm to property or persons (including the risk of bodily injuries and death) should not be reliant solely upon one form of electronic system, due to the risk of system failure. To avoid damage, injury or death, the user or application designer must take reasonable steps to protect against system failure, including - but not limited - to back-up or shut-down mechanisms, not because the end-user system is customized and differs from Schneider Electric testing platforms but also because a user or application designer may use Schneider Electric products in combination with other products.

These actions cannot be evaluated or contemplated by Schneider Electric D. Thus, the user or application designer is ultimately responsible for verifying and validating the suitability of Schneider Electric products whenever they are incorporated in a system or application, even without limitation of the appropriate design, process and safety levels of such system or application.

2. INTRODUCTION

The MiCOM Ethernet range is designed to deal with the needs of a wide range of electric plants. Emphasis has been placed on strong compliance with standards, scalability, modularity and open architecture.

These features facilitate the use of MiCOM products in several applications, from the most basic to the most demanding. They also ensure interoperability with existing components.

The Schneider Electric philosophy is to provide a range of Ethernet products such as switches, taking into account the compulsory requirements of electrical substations, including power supply and immunity to environmental constraints.

It also provides solutions to specific requirements such as network redundancy management.

Each of these products can be used independently, or can be integrated to form a PACiS system, which is a Digital Control System (DCS).

2.1 MiCOM Switches

Driven by calls from all over the world for advanced substation applications for Automation control and monitoring, Schneider Electric is committed to provide a comprehensive range of Ethernet-based products that respond to our customers' needs.

Standard Ethernet products rarely meet the constraints of electrical plants: environmental, power supply, redundancy, etc.

The new MiCOM Hxxx series has been specially tailored to respond to all of these requirements, and is compatible with the PACiS system. The MiCOM Hxxx range is designed to address different kinds of architectures and installations.

2.2 MiCOM Ethernet Switch names

Basically the naming of Ethernet devices is composed of its mechanical arrangement and its number of port copper or optical.

- MiCOM H1xx PCI Board (the power supply is from the PCI BUS)

2.3 MiCOM H15x

The MiCOM H15x range is a set of switches with a PCI connector, and is embedded with the Self Healing Mechanism to provide redundancy.

The MiCOM H15x range relies on managed switches that are easy to install and operate, designed to be implemented in an electrical plant environment (IEC 61000-4 & 60255-5).

On the media side, MiCOM H15x supports 10BaseT, 100BaseTX and 100BaseFX as specified by the IEEE 802.3 standard.

The MiCOM H15x is a plug-and-play device. It can run with the factory settings. However, to adapt the switch to your application, you only need to configure the switch number using the DIP switches. (see section 8: settings)

3. FUNCTIONAL DESCRIPTION

The MiCOM H15x is designed to be an Ethernet switch on a PCI board. The board uses a single or double slot, depending on whether the optional 3*RJ45 Kit is used or not.

3.1 MiCOM H15x Product Range

The MiCOM H15x range is dedicated to ultra fast redundant Ethernet rings, and is defined by the type of Ethernet connector. All the MiCOM H15x equipment range has four copper connections via RJ45 connectors, with speed automatically adjusted by the external emitters to 10 or 100 Mbps.

Ethernet copper links are limited in distance and subject to interference. The redundant Ethernet ring is based on optical inter-switch connections. The user has the choice between using Multimode Fiber optic for short distances, or Single mode Fiber Optic for long distances.

The table below describes the MiCOM H15x range, detailing the connectivity used.

Model	Description	Connectors
MiCOM H 152	Fast Ethernet industrial switch Multimode 1310 nm	4 x RJ45 2 x ST
MiCOM H 154	Fast Ethernet industrial switch Single mode 1310 nm	4 x RJ45 2 x SC

3.2 Fast redundant ring capability

3.2.1 Self-healing ring principle

Ethernet redundancy is usually managed by protocols that calculates another path to a destination (by sending BPDUs) when the main link breaks. This could take from hundreds of milliseconds to seconds. But the automation processes and applications require a network reconfiguration of the order of 1 millisecond.

The Schneider Electric self-healing mechanism fulfils automation requirements by delivering a very fast recovery time for the entire network (<1 ms).

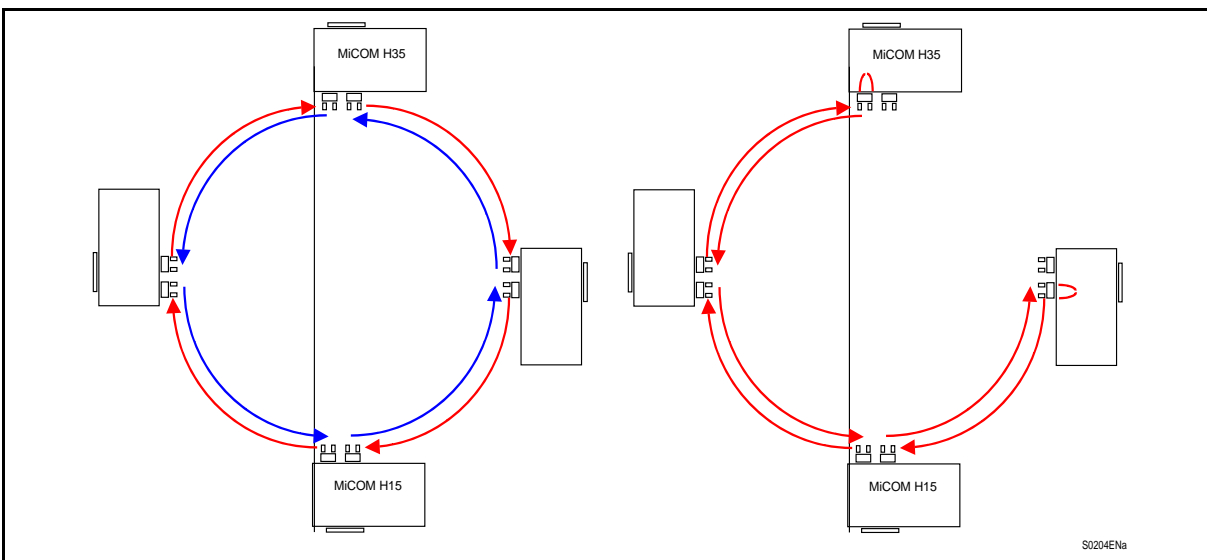


FIGURE 1: SELF-HEALING RING MECHANISM

3.2.2 MiCOM Hx5x Ethernet switch with self-healing ring facilities

The MiCOM Hx5x is a standard IEEE802.3 Ethernet switch enhanced with the self-healing manager (SHM). The diagram below describes the internal architecture of such a device.

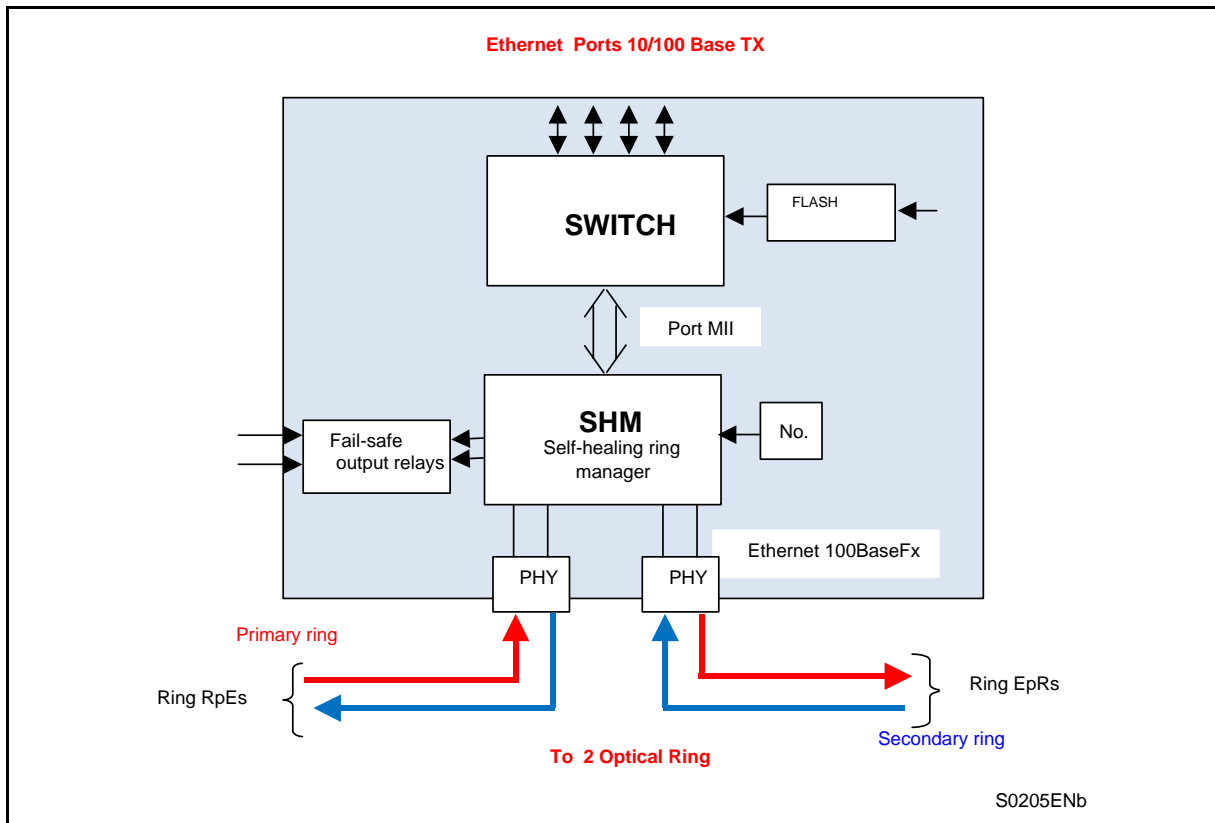


FIGURE 2: INTERNAL ARCHITECTURE OF MiCOM H15X

3.2.3 Schneider Electric Ethernet ring redundancy

The SHM functions manage the ring. If the optical fiber connection between two devices is broken the network continues to run correctly.

Normally Ethernet packets travel on the primary fiber in the same direction, and only a control frame (4 bytes) is sent every 5 μ s on the secondary fiber in the opposite direction.

If the link is down, both SHMs immediately start network self-healing. On one side of the break, received messages are no longer sent to the primary fiber but are sent to the secondary fiber. On the other side of the break, messages received on the secondary fiber are sent to the primary fiber and the new topological loop is closed in less than 1 ms.

It is therefore possible to extend the number of devices, or the size of a sub-station, without stopping the network. The loop is opened and new equipment is connected (which closes the loop).

To increase reliability, some specific mechanisms are used:

- The quality of transmission is monitored. Each frame (Ethernet packet or control frame) is controlled by the SHM. If a high error rate is detected, self-healing starts and the fault is eliminated.
- Even if there is no traffic on the primary link, the secondary link is still supervised by sending out control frames every 5 μ s.

Initially, the network architecture is as shown on figure 3.

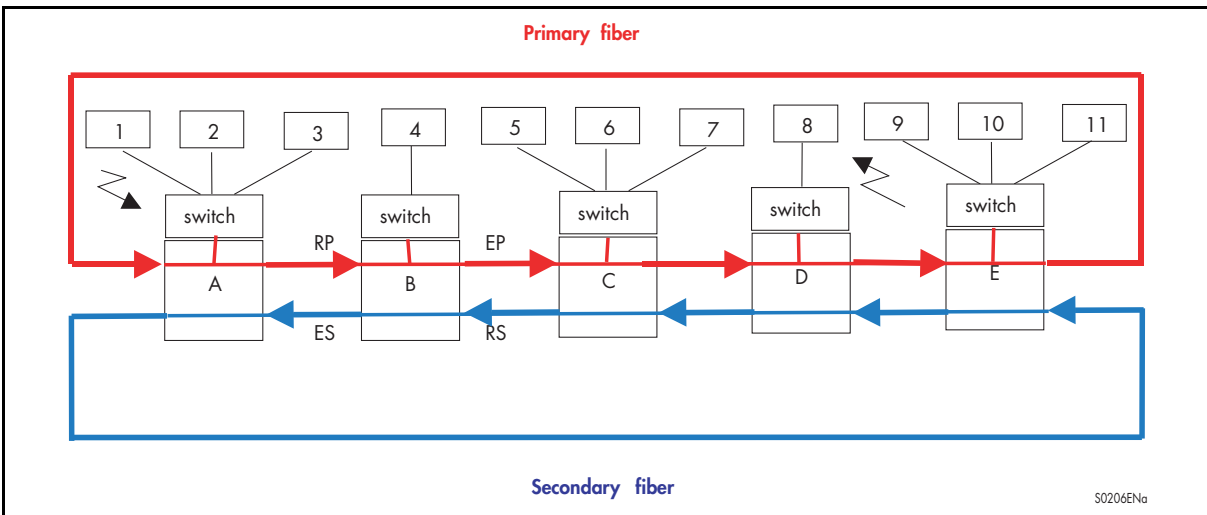


FIGURE 3: NOMINAL REDUNDANT ETHERNET RING ARCHITECTURE WITH MiCOM HX5X SWITCHES

In figure 4, the link between switches C and D is down; then switch C is on RsEp default, and switch D on RpEs default.

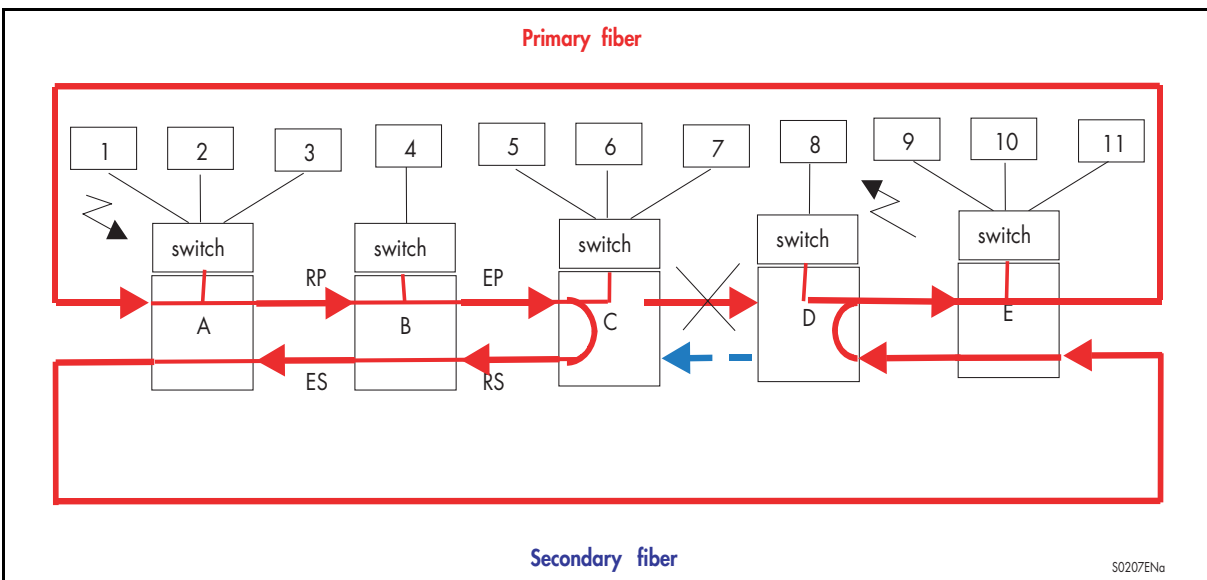


FIGURE 4: ETHERNET RING ARCHITECTURE WITH MiCOM HX5X SWITCHES AFTER FAILURE

3.2.4 Performance

To calculate the time end to end, use the following table based on the nominal situation:

Send a Goose frame from.... to...	Time at 100 Mbps	Abbr.	Comments
IED 1 to Switch A	22 μs		262 bytes + inter-frame
Switch A to IED 2	22 μs		Store and forward mechanism
Switch A to the network	2 μs	tl	Repeater latency time
Propagation time to the fiber	μs		4.8 μs /km
Network to network	2 μs	tl	Repeater latency time

When the frame circulates on the ring, the transit time is only tl.

3.2.5 Benefits

- Ultra fast ring redundancy capability (<1 ms reconfiguration)
- Ultra fast propagation in the ring
- Specific frame checking mechanism (store and forward)
- Ring management
- Watchdog relay for supervision

3.3 MiCOM H15x functional composition

The figure below shows the MiCOM H15x main functional blocks.

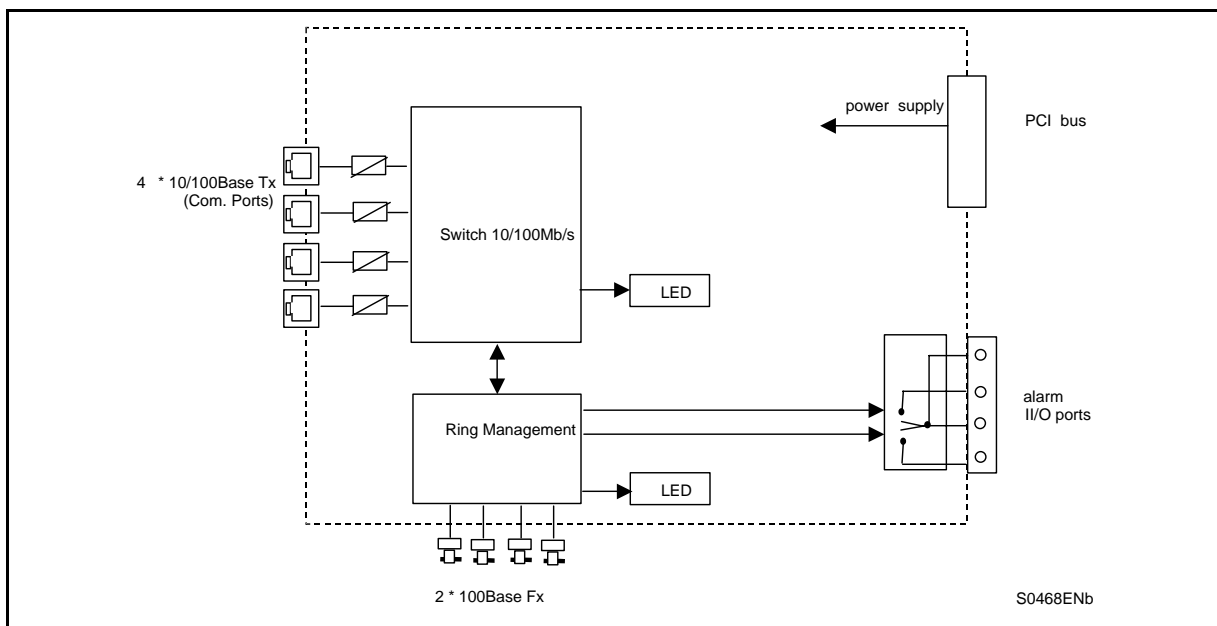


FIGURE 5: MiCOM H15X

The central part manages the switching of up to 4 Ethernet links. FLASH Memory stores the switching algorithm and manages the minimum parameters of Ethernet switching algorithm.

The board has 4 copper connections and 2 optical connections (multimode or single mode).

LEDs and alarm contacts are defined to check that the product operates correctly.

3.4 Power management

If a cable is not connected to a port, most of the circuitry for that port is disabled to save power.

3.5 Ethernet Port Switching Features

Due to auto-negotiation, MiCOM H15x automatically determines the speed of its transmission layer, 10/100 Mbps, half or full duplex.

3.5.1 10Base Tx and 100Base Tx

The copper ports are half/full duplex and auto-sense the transmission speed. They will auto-negotiate with the connected device to determinate the optimal speed. When the connected device is only capable of transmitting at 10 Mbps, the MiCOM H15x follows at 10 Mbps.

3.5.2 100Base Fx

The optical fiber ports are full duplex at 100 Mbps.

3.6 Ethernet Management

3.6.1 Address lookup (Branding evolution: MAC address range)

For MiCOM Switches Hxxx & SWx products, a range of MAC addresses are allocated.

By Schneider Electric, the new MAC address range is included on the domain from 00:80:F4:7A:43:00 to 00:80:F4:7A:FF:FF values. The Address Base is allocated with 00:80:F4 value.

The old MAC address range was included on the domain from 00:02:84:03:00:00 to 00:02:84:05:FF:FF values. The Address Base was allocated with 00:02:84 value.

Each Ethernet device inserts its unique "MAC address" into each message it send out. The port on the switch used for a given MAC address is automatically learned when a frame is received from that address.

Once an address is learned, the switch will route messages to only the appropriate port.

Up to 1024 MAC addresses can be stored and monitored at any time.

3.6.2 Auto-Negotiation and Speed-Sensing

All four RJ45 ports of the MiCOM H15x independently support auto-negotiation for speeds in the 10BaseT and 100BaseTx modes. Operation is according to the IEEE 802.3u standard.

3.6.3 Forwarding

MiCOM H15x supports the store and forward mechanism. MiCOM H15x forwards messages with known addresses to the appropriate port. Messages with unknown addresses, broadcast messages and multicast messages are forwarded out to all ports except the source port.

The MiCOM H15x does not forward error packets or 802.3x pause frames.

3.6.4 Priority tagging

802.1p priority is enabled on all ports.

3.6.5 SNMP v2

Simple Network Management Protocol is the network protocol developed to manage devices in an IP network. SNMP v2 relies on a Management Information Base (MIB) that contains information about parameters to supervise. A MIB's format is a tree structure with each node identified by a numerical Object IDentifier (OID). Each OID identifies a variable that can be read or set via SNMP with the appropriate software. The information in MIBs is standardized.

3.6.5.1 H15x MIB Structure

The SNMP MIB consists of distinct OIDs, each of which refers to a defined collection of specific information used to manage devices on the Schneider Electric ring. The Schneider Electric MIB uses three types of OID.

System:

Address										Name	
0										Ccitt	
	1									ISO	
		3								Org	
			6							DOD	
				1						Internet	
					2					mgmt	
						1				Mib-2	
							1			sys	
								1		sysDescr	Schneider Electric switch
									3	sysUpTime	xday yh:zm:zzs:yym
									4	sysName	MiCOM H15

RMON:

Address											Name	
0												Ccitt
	1											ISO
		3										Org
			6									DOD
				1								Internet
					2							mgmt
						1						Mib-2
							16					Rmon
								1				stat
									1			etherstat
									1	9		Port number (*)
										10		etherStatsIndexetherStatsUndersizePkts
										12		etherStatsIndexetherStatsOversizePkts
										13		etherStatsIndexetherStatsJabbers
										14		etherStatsIndexetherStatsCollisions
										15		etherStatsIndexetherStatsPkts64Octets
										16		etherStatsIndexetherStatsPkts65to127Octets
										17		etherStatsIndexetherStatsPkts128to255Octets
										18		etherStatsIndexetherStatsPkts256to511Octets
										19		etherStatsIndex etherStatsPkts512to1023Octets

*Port number: 1 to 4 for the RJ45, port 7 management, port 8 ring

3.6.5.2 SNMP Client Software

Various “SNMP Client software” tools can be used with the MiCOM H15x range. Schneider Electric does not provide such tools.

Any MIB Browser Software performing the basic SNMP operations (such as GET, GETNEXT, GETRESPONSE...) can work with the MiCOM H range.

4. TECHNICAL DATA

4.1 MiCOM H15x Range

Ports	10/100BaseTx Copper	100 BaseFx Multimode	100 BaseFx Single Mode
MiCOM H152-V2	4	2 (ST)	-
MiCOM H154-V2	4	-	2 (SC)

4.2 Ethernet Port Characteristics

4.2.1 10/100BaseTx Port

Connector type	Shielded RJ45 jack
Twisted pair cable	Cat 5
Max. cable length with Cat 5	100 m

4.2.2 100BaseFx Multimode Port

Fiber port connector	ST
Optimal fiber cable	62.5/125 μm or 50/125 μm
Center wavelength	1310 nm
TX output power	-19 dBm
RX input sensitivity	-34 dBm
Fiber max distance	2000 m *

4.2.3 100BaseFx Single Mode Port

Fiber port connector	SC
Optimal fiber cable	9/125 or 10/125 μm
Centre wavelength	1300 nm
TX output power	-15 dBm
RX input sensitivity	-25 dBm
Fiber max distance	10 km*

* See the Fiber optical budget calculation in section 10.1.

4.3 General Characteristics

4.3.1 Auxiliary fault indication relay

Relay AC/DC operating voltage	< 75 Vdc or < 50 Vac
Relay AC/DC voltage capability	Up to 250 Vac or 250 Vdc
Maximum AC current	4 A at 250 V
Maximum DC current	1.5 A at 48 V

WARNING: FOR SAFETY REASONS AND FOR COMPLIANCE WITH THE EUROPEAN COMMISSION LOW VOLTAGE DIRECTIVE (2006/95/EC), THE AUTHORIZED VOLTAGE RATING TO BE APPLIED ON THE "FAULT INDICATION RELAY" IS LIMITED TO 75 VDC OR 50 VAC.

4.3.2 Ethernet Management

Standards	IEEE802.3, 802.3u, 802.3x, 802.1p
Forwarding mode	Store and Forward
Memory bandwidth	2 Gbps
MAC Address	1K
Address learning	Automatic
Broadcast storm protection	Limited to 5%
Illegal frame	Dropped per 802.3
Late collision	Dropped after 512 bit times
Latency	4 μ s measured at 75% load between two ports at 100 Mbs

4.4 Environmental Characteristics

4.4.1 Isolation

Type Test Name	Conditions	Type Test Standard
Dielectric strength Fault indication Relay RJ45 ports	2 kV _{AC} for 1 minute 1.5 kV _{DC} for 1 minute	IEC 60255-5
Insulation resistance	100 M Ω at 500 V	IEC 60255-5
Impulse voltage Fault indication Relay RJ45 ports	5 kV common mode 2 kV common mode	IEC 60255-5

4.4.2 Climatic

Type Test Name	Conditions	Type Test Standard
Extended dry heat – Operating	Test Ca: +55 C / 20d, +70°C 24h	IEC 60068-2-2 / 1993
Cold Test - Operating	Test Ab: -25 C / 96h	IEC 60068-2-1 / 1993
Cold Test - Storage	Test Ad: -25 C / 96h	IEC60068-2-1 / 1993
Dry Heat Test – Storage	Test Bd: +85 C / 96h	IEC 60068-2-1 / 1993
Humid Heat Test - Operating	40 C, 93% RH, 10 day	NFC 20-703 / 1986

4.4.3 Electromagnetic Compatibility

Type Test Name	Conditions	Type Test Standard
Electrostatic discharge	Class 4: 8 kV contact / 15 kV air	IEC 61000-4-2 /2001
Radio frequency impulse	Class 4: 35 V/m – 25 to 1000 MHz	IEC 801.3 / 1984
Fast transient burst	Class 4: 4 kV – 2.5 kHz (CM)	IEC 61000-4-4 / 2001
Surge immunity	Class 4: 4 kV (CM) – 2kV (DM)	IEC 61000-4-5 / 2001
High frequency conducted immunity	Class 3: 10 V, 0.15 – 80 MHz	IEC 61000-4-6 / 2001
Power frequency magnetic field immunity	Class 5: 100 A/m 1000 A/m	IEC 61000-4-8 / 2001
Pulse magnetic field immunity	Class 5: 1000 A/m	IEC 61000-4-9 / 2001
Damped oscillatory magnetic field immunity	Class 5: 100 kHz & 1 MHz – 100 A/m	IEC 61000-4-10 /2000
Oscillatory waves immunity	Class 4: 2.5 kV (CM) – 1 kV (DM)	IEC 61000-4-12 /2001
Conducted emission	Gr. I, class A and B: from 0.15 to 30 MHz	EN 55022 / 2003

5. HUMAN MACHINE INTERFACE

Several LEDs are used to indicate the status of the MiCOM H15x ports and links.

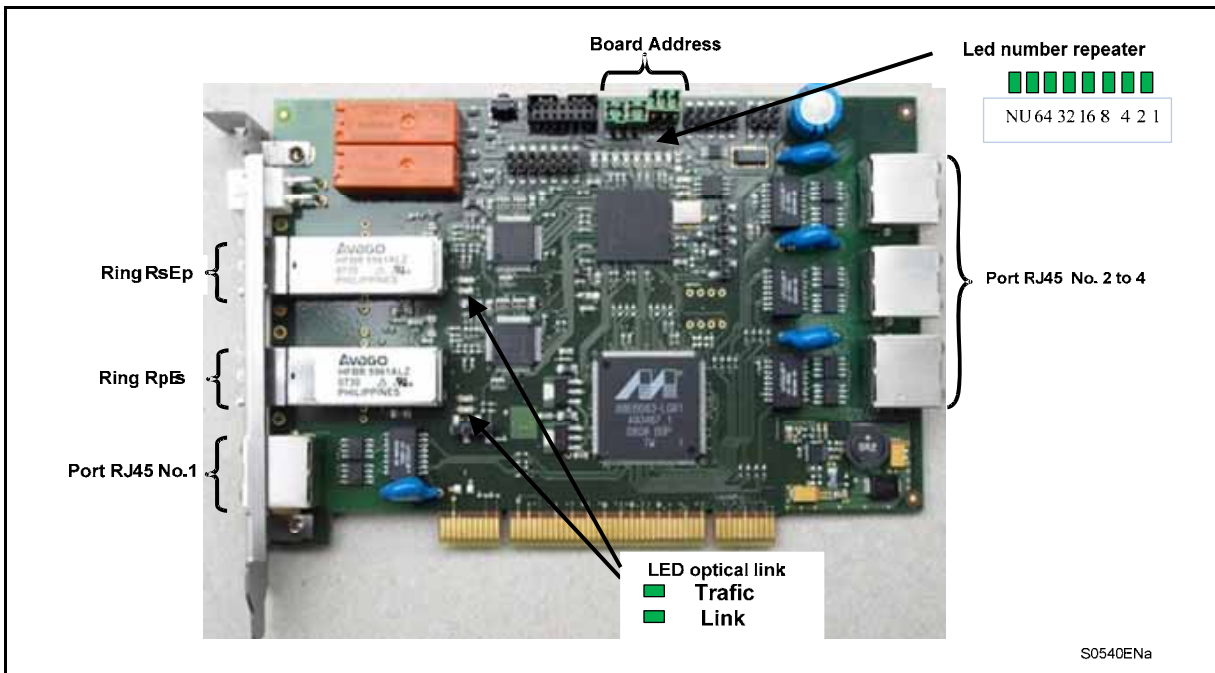



FIGURE 6: MiCOM H15X

The table below describes the function of each LED:

LED	N°	Color	Description	Comments
Ring RsEp	D4	GREEN OFF	Reception of data	LED OFF in case of RsEp failure
	D3	GREEN OFF	Optical link No link	
Ring RpEs	D2	GREEN OFF	Reception of data	LED OFF in case of RpEs failure
	D1	GREEN OFF	Optical link No link	
RJ45 port		GREEN OFF Flash	Link ON Link OFF Traffic	
		YELLOW OFF	Speed 100 Mbps Speed 10 Mbps	
Number of repeater on the Ring	D17 to D24	GREEN		All LEDs are ON if the repeater is not connected to the ring

At power up, the MiCOM H1xx goes through a series of self-tests. The 6 LEDs will flash for a few seconds.

6. INSTALLATION

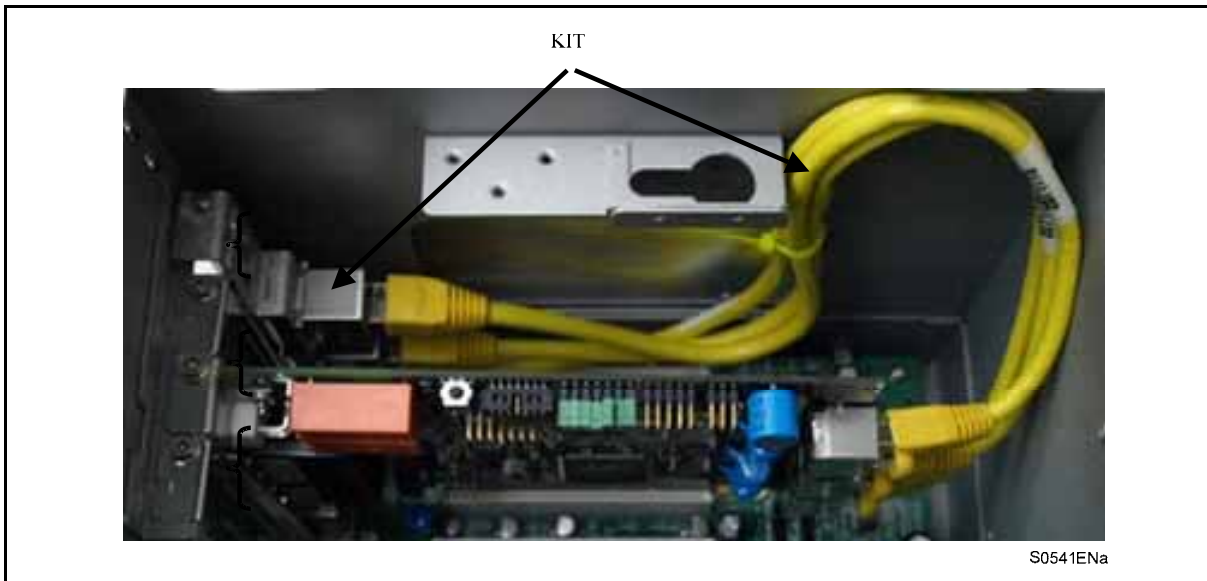


FIGURE 7: MiCOM H1XX BOARD IN AN INDUSTRIAL PC

Prior to any handling, please ensure a correct ElectroStatic Discharge procedure.

Installation of the MiCOM H15x board in the PC:

- **STEP 1:** Power off the PC (remove the power supply connector). Remove the PC cover
- **STEP 2:** Insert the board into a free PCI slot
- **STEP 3 (optional):** Insert the Ethernet 3*RJ45 optional kit into a free PCI slot
- **STEP 4:** Fasten the holding screw to retain the boards
- **STEP 5:** Connect the 4 optical fibers for the redundant optical Rings
- **STEP 6:** Connect the External/internal Ethernet cables on the RJ45 connectors (optionally the 3*RJ45 kit)
- **STEP 7:** Install the PC cover
- **STEP 8:** Power on the PC

The MiCOM H1xx board is "Plug-and-Play": No additional driver software is needed.

7. CONNECTION

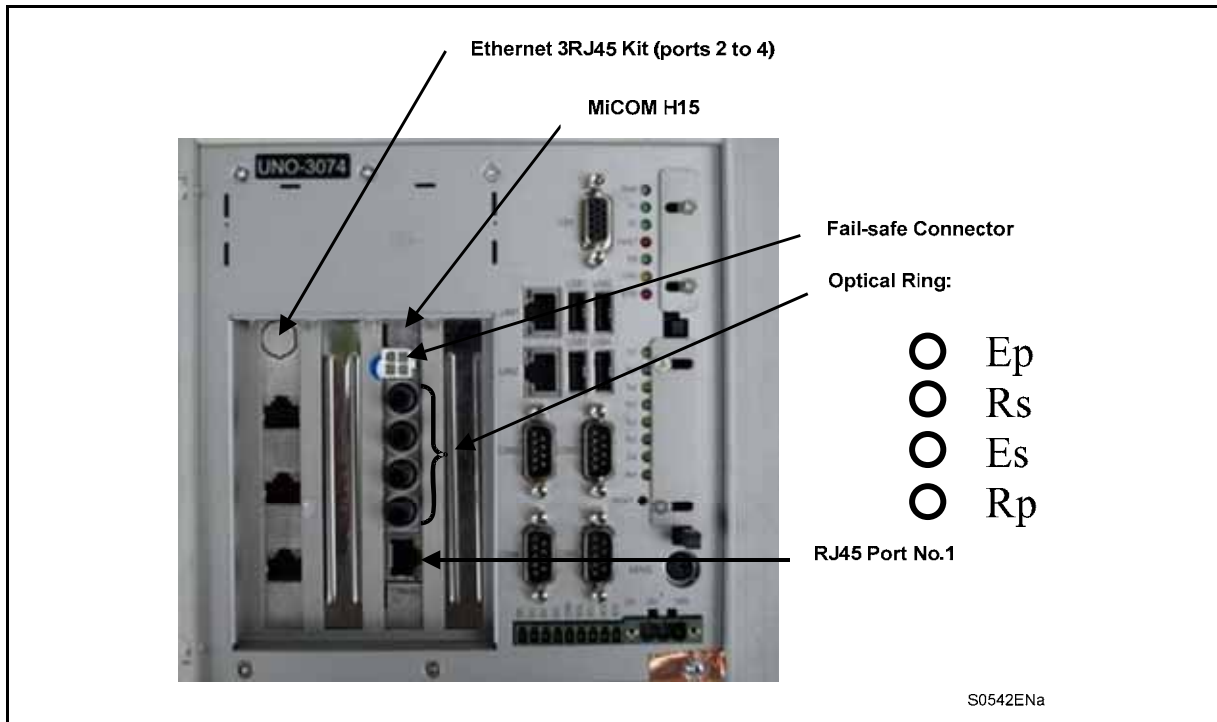


FIGURE 8: MiCOM H1XX CONNECTION (IN INDUSTRIAL PC)

7.1 Fault indication contacts

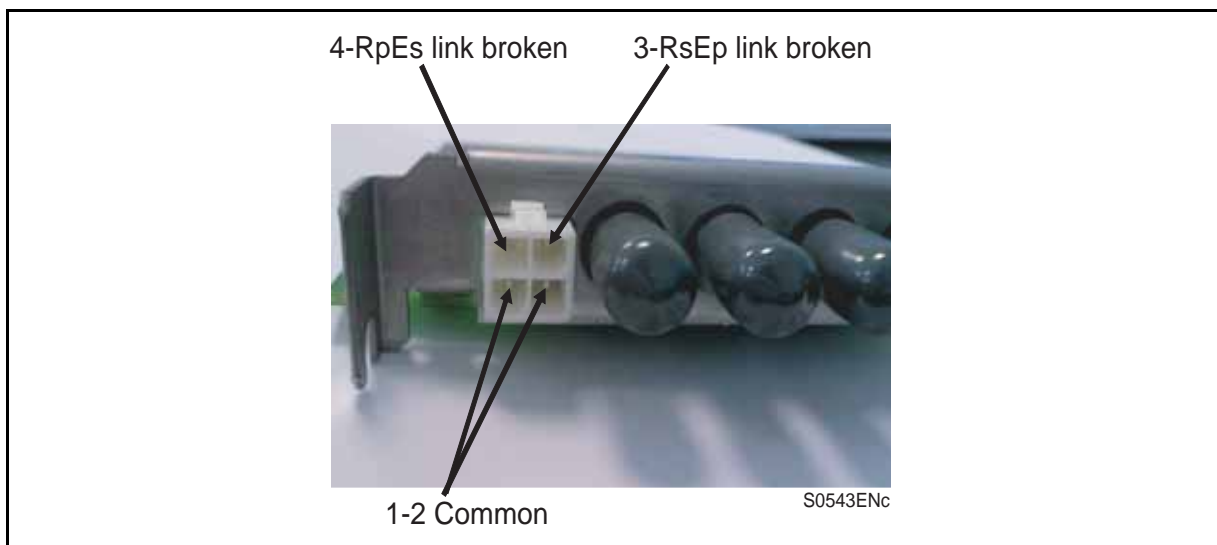


FIGURE 9: FAULT INDICATION CONTACTS

Pin No.	Contact meaning
1	Common Vdc
2	Common Vdc
3	RsEp link broken
4	RpEs link broken

A closed contact means an alarm or a fault.

WIRING RECOMMENDATION: For safety reasons and for compliance with the European Commission Low Voltage Directive (2006/95/EC), the authorized voltage rating to be applied on the "Fault Indication relay" is limited to 75 Vdc or 50 Vac and should not exceed 5A.

7.2 Ethernet Connection

The Ethernet-based communication available in the MiCOM H15x uses either optical fiber media (ST/SC connector) or 4 twisted pair cable.

If the equipment is located at a long distance (>100 m for RJ45) from the communication equipment or multiplexer, or if the cables run through a noisy area, then optical communication should be used to interconnect the IEDs and the communication equipment.

7.2.1 Ethernet cable type

Only the cable insulated category 5 (FTP: Foil Twisted Pair) or insulated (STP – Shielded Twisted Pair) with RJ45 connectors must be used.

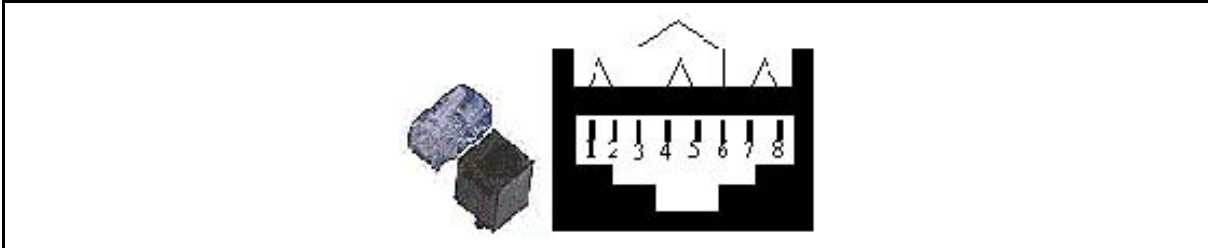


FIGURE 10: RJ45 CONNECTOR

The standard is:

- 1 = white / orange
- 2 = orange
- 3 = white / green
- 4 = blue (not used)
- 5 = white / blue (not used)
- 6 = green
- 7 = white / brown (not used)
- 8 = brown (not used)

Looking at the RJ45 connector head on, flat side on bottom and side tab on top, then pin 1 is on the left and pin 8 on the right.

The maximum authorized cable length for 10/100BaseTx without using a repeater is 100 meters.

7.2.2 Ethernet optical fiber

The optical fiber cables are connected to the corresponding optical fiber elements.

The H152-V2 P/N 2071767 A01 (**multimode** fiber) has a type **ST** connector.



FIGURE 11: ETHERNET OPTICAL FIBER – ST

The H154-V2 P/N 2071767 A02 (**single mode fiber**) has a type **SC** connector.

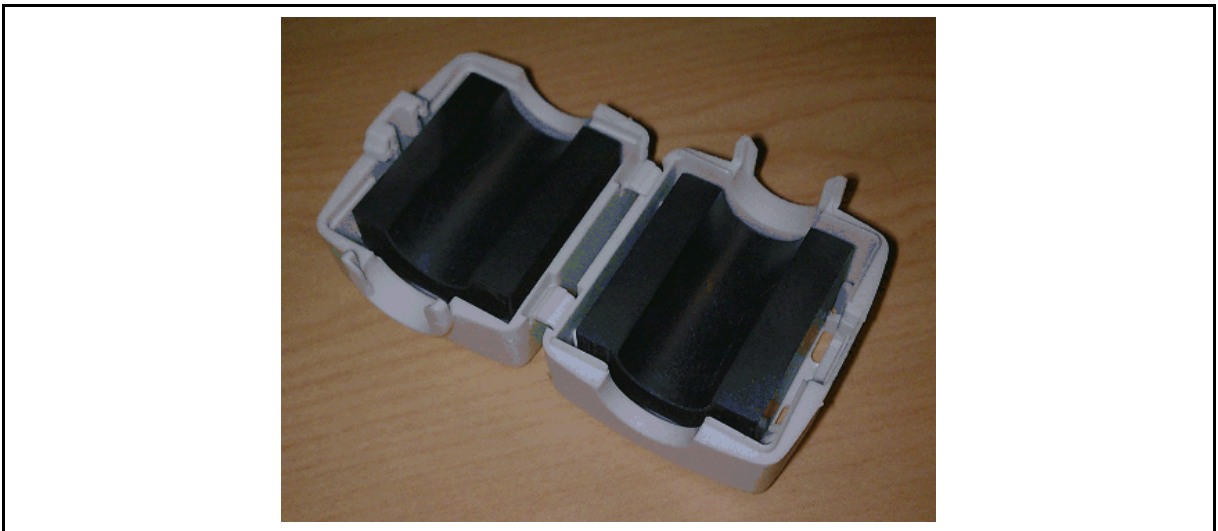


FIGURE 12: ETHERNET OPTICAL FIBER – SC

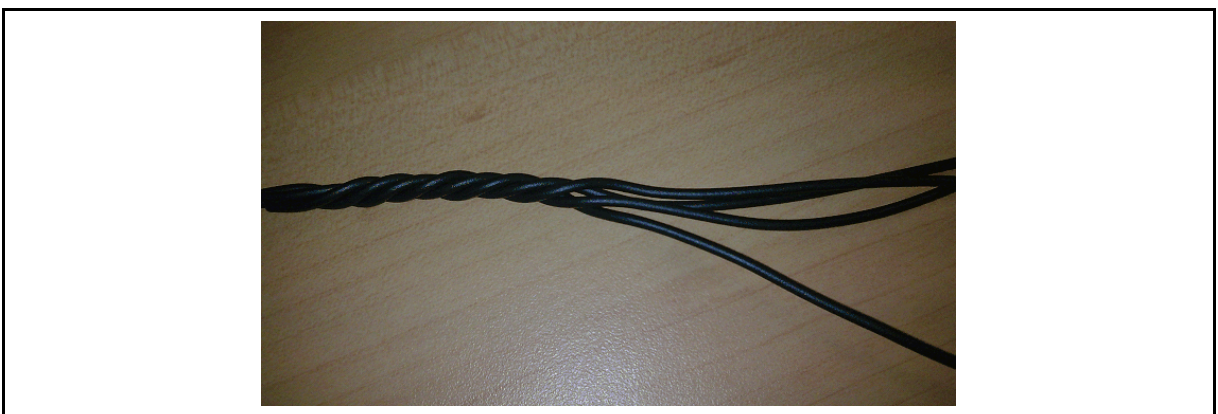
7.3 Inline Surge Arrester Connection

Make sure the alarm cable is twisted. To prevent the surge arrester from moving, loop the alarm cable through and around the surge arrester.

The picture below shows the surge arrester provided:



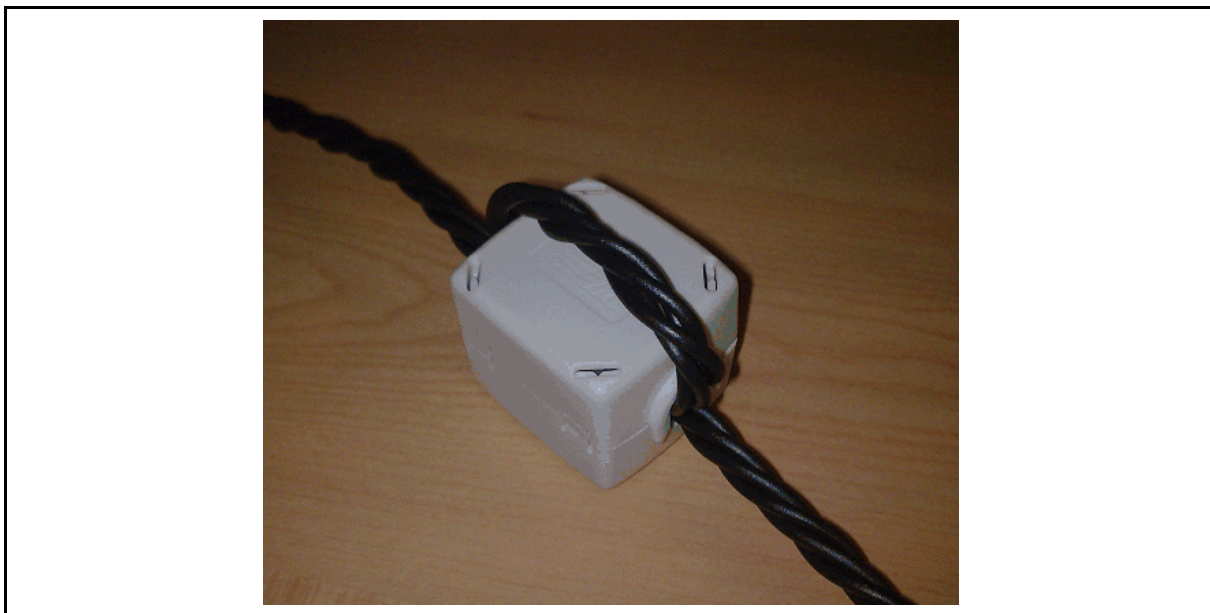
Make sure the alarm cable is twisted.



To prevent the surge arrester from moving, loop the alarm cable through and around the surge arrester as shown below:



Finally clip the surge arrester:



It is recommended to use the crimping tool from "Würth Elektronik", reference 600 649 122 161.

8. SETTINGS

8.1 Setting the address of the switch

Each repeater in the ring has a specific address. Each address must be unique and included between 1 and 127.

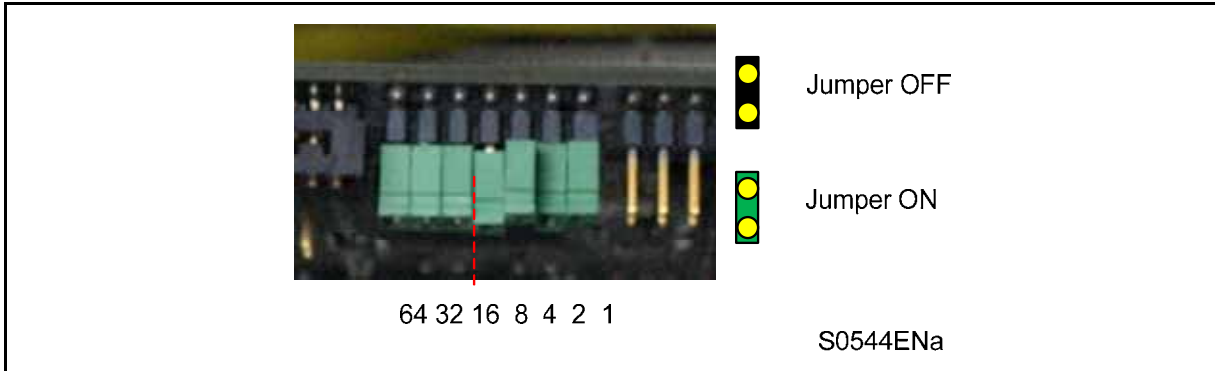


FIGURE 13: JUMPERS

8.1.1 Configuring the address

The address is equal to the sum of the "open bits".

At the beginning, address = 0

If 1 = off	address = address + 1	else address = address + 0
If 2 = off	address = address + 2	else address = address + 0
If 3 = off	address = address + 4	else address = address + 0
If 4 = off	address = address + 8	else address = address + 0
If 5 = off	address = address + 16	else address = address + 0
If 6 = off	address = address + 32	else address = address + 0
If 7 = off	address = address + 64	else address = address + 0

8.1.2 Example: defining address "4"

J7-1 = on	address = address + 0
J7-2 = on	address = address + 0
J7-3 = off	address = address + 4
J7-4 = on	address = address + 0
J7-5 = on	address = address + 0
J7-6 = on	address = address + 0
J7-7 = on	address = address + 0

Address = 04

8.2 IP Address of the switch

The switch IP address is established in the following way:

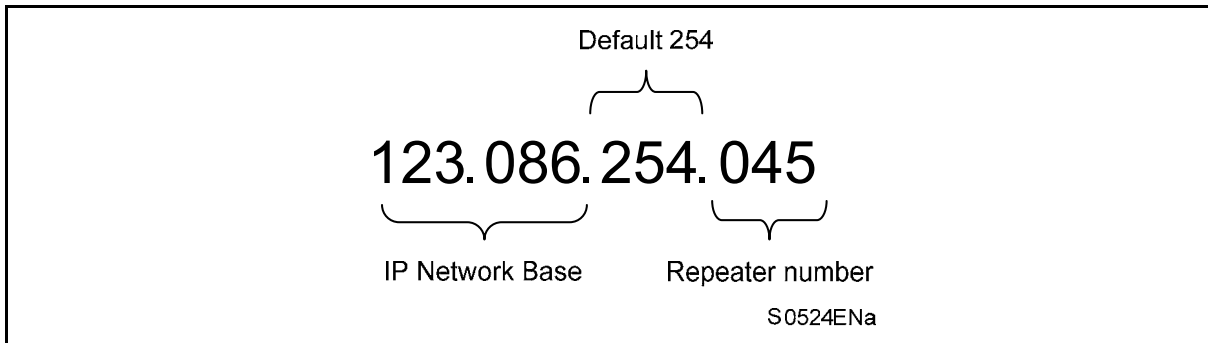


FIGURE 14: IP ADDRESS

There are two tools to configure the IP address, the Schneider Electric _Switch_Manager Software or the Schneider Electric _Switch_Ip_Repeater Software.

NOTE: It is important to note that the Schneider Electric_Switch_Manager Software forces the third IP byte field to take the value "254".

9. MAINTENANCE

9.1 Scope

This chapter describes the maintenance procedure for the MiCOM H1xx.

9.2 Recommendation before maintenance operations



BEFORE CARRYING OUT ANY WORK ON THE EQUIPMENT, THE USER SHOULD BE FAMILIAR WITH THE CONTENTS OF THE SAFETY AND TECHNICAL DATA CHAPTERS (SCHNEIDER ELECTRIC SAFETY GUIDE: SFTY/4L M/C11 OR LATER ISSUE) AND THE RATINGS ON THE EQUIPMENT'S RATING LABEL.

READING THE "SAFETY AND HANDLING" CHAPTER OF THIS DOCUMENT IS MANDATORY BEFORE ANY MAINTENANCE OPERATION.



THE POWER SUPPLY CONNECTOR(S) IS (ARE) TO BE DISCONNECTED FROM THE DEVICE PRIOR TO ALL MAINTENANCE OPERATION.

9.3 Maintenance period

Schneider Electric products should be monitored periodically after their installation. Deterioration may occur over time. Because of the electrical and heavy-interference environment, the MiCOM Hxx should be checked at regular intervals to confirm that it is operating correctly.

The Schneider Electric MiCOM Hxx has been designed for a life cycle of over 15 years.

MiCOM H1xx is self-supervising and therefore requires less maintenance than previous products. Most problems will lead to an alarm so that fast and appropriate action can be taken. However, some periodic checks should be done to ensure the MiCOM H1xx is operating correctly **and that the external wiring is in proper condition.**

If the customer's organization has a Preventive Maintenance Policy, then the recommended product checks should be included in the regular program.

9.4 Diagnosis facilities

When maintenance action is planned, the operator should prepare, act and report.

The minimum preparation is to obtain the commissioning Record Sheet of installed device in order to check the product configuration and its history. The user should also apply personal experience in addition to this manual.

On a first level, the product provides several methods to identify the context of the fault. The main ones are:

- Power LEDs
- Fail-Safe alarm indication

The LEDs and fail-Safe indications are described in the chapter Human Machine Interface.

9.5 Method of repair

IN CASE OF DEVICE FAILURE, THE PREFERRED METHOD IS TO REPLACE THE COMPLETE MiCOM H1XX, AS THIS ENSURES THAT THE INTERNAL CIRCUITRY IS PROTECTED AGAINST ELECTROSTATIC DISCHARGE AND PHYSICAL DAMAGE AT ALL TIMES.

9.5.1 Replacing the MiCOM H1xx

The board and connectors have been designed to facilitate removal of the complete MiCOM H1xx.

9.5.1.1 Uninstalling the MiCOM H1xx

Before any disconnection, check that the labels correctly define the connectors and match the description you have.

Otherwise, note the IP address dip-switch position in order to prepare the new MiCOM H1xx installation.

1. Turn off the PC
2. Disconnect the MiCOM H1xx Fail-Safe Alarm Connector:
3. Disconnect the Ethernet RJ45 connectors
4. Disconnect the Ethernet optical connectors
5. Withdraw the MiCOM H1xx

9.5.1.2 Installing a fresh MiCOM H1xx

To reinstall the repaired or new MiCOM H1xx:

- Set the new MiCOM H1xx IP address (dip switches)
- Follow the above procedure in reverse.

10. APPLICATIONS

10.1 Fiber Optic budget calculations

Optical power is expressed in Watts. However, the common unit of power measurement is the dBm and defined by the following equation: $\text{Power (dBm)} = 10 \log \text{Power (mW)} / 1 \text{ mW}$.

The fiber optic budget is the difference between the power emitted into the fiber and the sensitivity (minimum amount of power required) of the receiver connected through the fiber optic cable.

$$\text{Link Power Budget} = \text{Transmitter Power (dBm)} - \text{Receiver Sensitivity (dBm)}$$

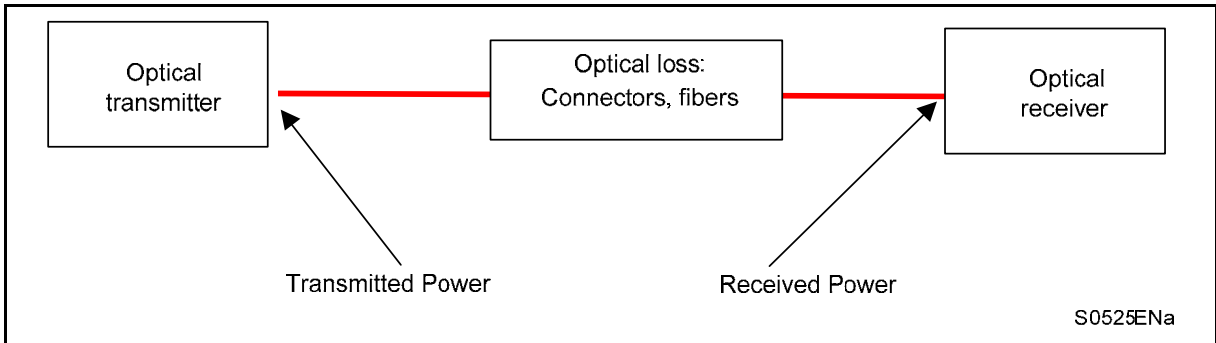


FIGURE 15: FIBER BUDGET

Example:

The following example shows the calculation of the maximum range for various types of fiber.

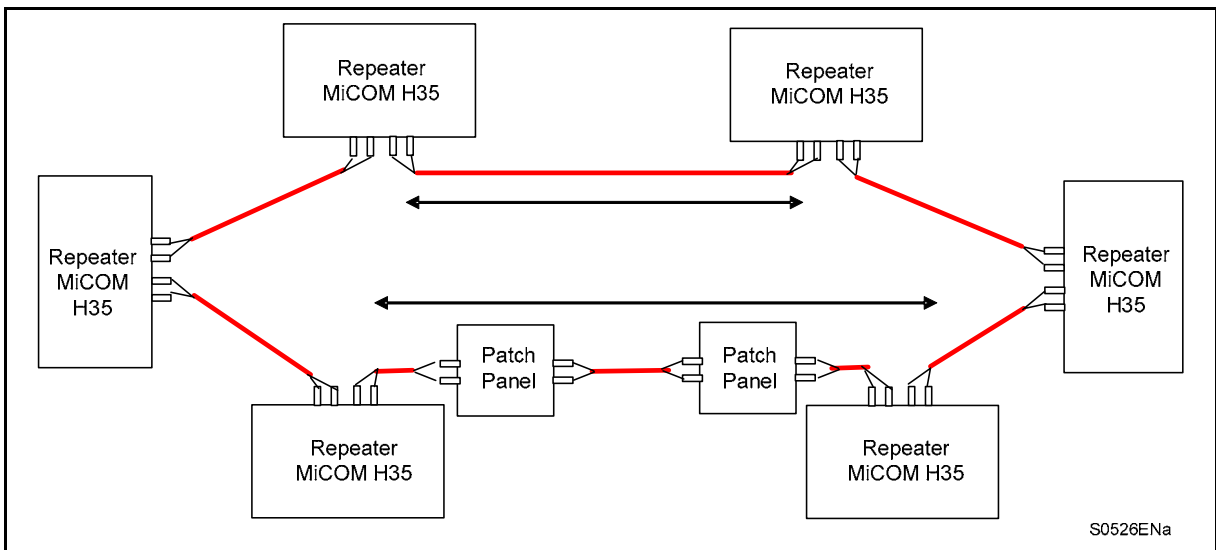


FIGURE 16: FIBER BUDGET EXAMPLE

Fiber type	Multi mode	Single mode
	62.5/125 micron	9/125 micron
Power coupled into fiber	-20 dBm	-15 dBm
Sensitivity	-34 dBm	-31 dBm
Link budget	14 dB	16 dB

10.1.1 Example 1: between repeaters

Link budget	14 dB	10 dB
Connector loss (2)	0.8 dB	0.8 dB
Safety Margin	4 dB	4 dB
Allowed link attenuation	8.4 dB	10.4 dB
Typical cable attenuation	1 dB/km	0.4 dB/km
Maximum range	8.4 km	26 km

10.1.2 Example 2: between repeaters with patch panel

Link budget	14 dB	19 dB
Connector loss (6)	0.8 dB	0.8 dB
Patch loss (2)	2 dB	1 dB
Safety Margin	4 dB	4 dB
Allowed link attenuation	1.2 dB	8.2 dB
Typical cable attenuation	1 dB/km	0.4 dB/km
Maximum range	1.2 km	20 km

The values given above are only approximate ones. Always use cable and connector losses as specified by the manufacturer.

11. GLOSSARY

100Base Fx	The fiber optic ports are full/half duplex at 100Mbps only.
10Base Tx and 100Base TX	The copper ports are full/half duplex and auto-sense the transmission speed. They will auto-negotiate with the connected device to determine the optimal speed. When the connected device is only capable of transmitting at 10Mbps, the MiCOM H35x follows the 10Mbps.
Cat. 5	Category 5 unshielded twisted pair (UTP) cabling. An Ethernet network operating at 10 Mbits/second (10BASE-T) will often tolerate low quality cables, but at 100 Mbits/second (10BASE-Tx) the cable must be rated as Category 5, or Cat 5 or Cat V by the Electronic Industry Association (EIA). This rating is printed on the cable jacket. Cat 5 cable contains eight conductors, arranged in four twisted pairs, and terminated with an RJ45 type connector. In addition, there are restrictions on maximum cable length for both 10 and 100 Mbits/second networks.
Fast Ethernet	An Ethernet system that is designed to operate at 100 Mbps.
Half-duplex	A system that allows packets to be transmitted and received, but not at the same time. Contrast with full-duplex.
NU	Not used.
MAC address	The Media Access Control address is a unique 48-bit hardware address assigned to every network interface card. Usually written in the form 01:23:45:67:89:ab.
MIB	See "Management Information Base" in section 4.6.5.1.
PHY	The OSI Physical Layer: The physical layer provides for transmission of cells over a physical medium.
Power management	If there is no cable on a port, most of the circuitry for that port is disabled to save power.
RMON	Short for remote monitoring, a network management protocol that allows network information to be gathered at a single workstation. Whereas SNMP gathers network data from a single type of Management Information Base (MIB), RMON 1 defines nine additional MIBs that provide a much richer set of data about network usage. For RMON to work, network devices, such as hubs and switches, must be designed to support it. The newest version of RMON, RMON 2, provides data about traffic at the network layer in addition to the physical layer. This allows administrators to analyze traffic by protocol.
Simple Network Management Protocol	SNMP is the protocol governing network management and the monitoring of network devices and their functions.

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