



MiCOM H16X

Global Documentation

H16x/EN GL/A11

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1. SAFETY & HANDLING

1.1 Introduction

The present document describes the safety, handling, packing and unpacking procedures applicable to MiCOM H16x Ethernet Switch Range and associated equipments.

1.2 Safety

WARNING: This safety section should be read before commencing any work on the equipment.

1.2.1 Health and Safety

The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

1.2.2 Explanation of symbols and labels

The meaning of symbols and labels may be used on the equipment or in the product documentation, is given below.

NOTE: The term earth used throughout the product documentation is the direct equivalent of the North American term ground.

1.2.3 Installing, Commissioning and Servicing



Equipment connections

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

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

Voltage and current connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated the correct crimp terminal and tool for the wire size should be used.

Before energising the equipment it must be earthen using the protective earth terminal, or the appropriate termination of the supply plug in the case of plug connected equipment.

Omitting or disconnecting the equipment earth may cause a safety hazard.

The recommended minimum earth wire size is 2.5mm², unless otherwise stated in the technical data section of the product documentation.

Before energising the equipment, the following should be checked:

- Voltage rating and polarity;
- CT circuit rating and integrity of connections;
- Protective fuse rating;
- Integrity of earth connection (*where applicable*)

**Equipment operating conditions**

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

**Current transformer circuits**

Do not open the secondary circuit of a live CT since the high level voltage produced may be lethal to personnel and could damage insulation.

**External resistors**

Where external resistors are fitted to MiCOM product, these may present a risk of electric shock or burns, if touched.

**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 boards**

These must not be inserted into or withdrawn from equipment whilst it is energised since this may result in damage.

**Fibre optic communication**

Where fibre 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.

1.2.4 Decommissioning and Disposal

**Decommissioning:**

The auxiliary supply circuit in the MiCOM H16x may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the MiCOM H16x (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to decommissioning.

Disposal:

It is recommended to avoid incineration and disposal to. The product should be disposed of in a safe manner. Any products containing batteries should have them removed before disposal, in order to avoid short circuits. Particular regulations within the country of operation may apply to the disposal of lithium batteries.

1.3 Specification upon device/people protection

The recommended maximum rating of the external protective fuse for this equipment is 16A, Red Spot type of equipment, unless otherwise stated in the technical data section of the product documentation.

1. Fuse rating is dependent of auxiliary voltage.
2. Differential protective switch on DC power supply is recommended
3. Differential protective switch on AC power supply is mandatory (printers, PACIS workstation...)

Insulation class	IEC 601010-1: Class I	1990/A2:	1995	This equipment requires a protective (safety) earth connection to ensure user safety.
	EN 61010-1: Class I	1993/A2:		
Insulation Category (Overvoltage):	IEC 601010-1: Class III	1990/A2:	1995	Distribution level, fixed installation.
	EN 61010-1: Class III	1993/A2:		Equipment in this category is qualification tested at 5kV peak, 1.2/50µs, 500Ω. 0.5J, between all supply circuits and earth and also between independent circuits.
Environment:	IEC 601010-1: Pollution degree 2	1990/A2:	1995	Compliance is demonstrated by reference to generic safety standards.
	EN 61010-1: Pollution degree 2	1993/A2:		
Product Safety:	72/23/EEC			Compliance with the European Commission Law Voltage Directive.
	EN 61010-1:	1993/A2:	1995	Compliance is demonstrated by reference to generic safety standards.
	EN 60950:	1992/A11:	1997	

1.4 Handling of electronic equipments

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 T&D Automation 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 practicable 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.

Before removing a module, ensure that you are a same electrostatic potential as the equipment by touching the case.

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.

Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.

Place the module on an antistatic surface, or on a conducting surface, which is at the same potential as you.

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 earthen 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. Instrumentation which may be used for making measurements should be earthen to the case whenever possible.

T&D AUTOMATION 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.

1.5 Packing and unpacking

All MiCOM H16x Ethernet Switches 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 H16x Ethernet switch 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 $\leq 0.8\text{m}$.

1.6 Guaranties

The media on which you received T&D AUTOMATION software are 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. T&D AUTOMATION will, at its option, repair or replace software media that do not execute programming instructions if T&D AUTOMATION receive notice of such defects during the guaranty period. T&D AUTOMATION does not guaranty that the operation of the software shall be uninterrupted or error free.

A Return Material Authorisation (RMA) number must be obtained from the factory and clearly marked on the package before any equipment acceptance for guaranty work. T&D AUTOMATION will pay the shipping costs of returning to the owner parts, which are covered by warranty.

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T&D AUTOMATION products are not designed with components and testing for a level of reliability suitable for use in or in connection with surgical implants or as critical components in any life support systems whose failure to perform can reasonably be expected to cause significant injuries to a human.

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, software fitness, fitness 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 from the user or applications 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 end-user system is customised and differs from T&D AUTOMATION' testing platforms but also a user or application designer may use T&D AUTOMATION products in combination with other products. These actions cannot be evaluated or contemplated by T&D AUTOMATION,; Thus, the user or application designer is ultimately responsible for verifying and validating the suitability of T&D AUTOMATION 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

MiCOM Ethernet range is designed to address the needs of a wide range of electric plant. Emphasis has been placed on strong compliance to standards, scalability, modularity and openness architecture.

These facilitate use in a range of applications from the most basic to the most demanding. They also ensure interoperability with existing components.

T&D AUTOMATION philosophy is to provide a range of Ethernet products like switch that match all general requirements needed in electric substation: power supply, immunity to environmental constraints.

It provides also solutions to specific requirement like for example network redundancy management.

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

2.1 MiCOM Switches

Driven by the requirements around the world for advanced applications in SCADA, Digital Control Systems, Automation, Control and Monitoring, T&D AUTOMATION has designed and still develop a complete range of products that communicate via Ethernet links.

The specificity of electric plant leads to constraints that are rarely full-filled by standard Ethernet products : environmental, power supply, redundancy...

This new MiCOM range of Ethernet switch, the MiCOM Hxxx has been specially tailored for the PACiS system. The MiCOM Hxxx range is designed to address the needs of a wide range of installations, from small to large and customer applications.

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.

The existing mechanical are :

- MiCOM H3xx DIN mounting case and power supply
- MiCOM H1xx PCI Board (getting power supply from PCI BUS into a PC)
- MiCOM H6xx 19' Rack with up to 4 boards switch and power supply

Reference	Description	Ethernet		Housing
		Tx	Fx	
MiCOM H 140	Switch "simple" Copper	4	0	PCI board
MiCOM H 142	Switch "simple" multi-mode	4	2	PCI board
MiCOM H 152	Switch for ring architecture multi-mode	4	2	PCI board
MiCOM H 162	Dual-Homing star architecture (double attachment) multi-mode	4	2	PCI board
MiCOM H 340	Switch "simple" Copper	6	0	DIN Rack
MiCOM H 341	Switch "simple" multi-mode	6	1	DIN Rack
MiCOM H 342	Switch "simple" multi-mode	6	2	DIN Rack
MiCOM H 343	Switch "simple" single-mode	6	1	DIN Rack
MiCOM H 344	Switch "simple" single-mode	6	2	DIN Rack
MiCOM H 352	Switch for ring architecture multi-mode	6	2	DIN Rack
MiCOM H 354	Switch for ring architecture single-mode	6	2	DIN Rack

Reference	Description	Ethernet		Housing
MiCOM H 362	Switch for Dual-Homing star architecture(double attachment) multi-mode	6	2	DIN Rack
MiCOM H 364	Switch for Dual-Homing star architecture(double attachment) single-mode	6	2	DIN Rack
MiCOM H 60x	Optical Star 19' rack with from 1 to 4 x H64x and H65x boards			19' 2U Rack
MiCOM H 621	Optical Multi-mode star-switch board	2	6	Double Europe
MiCOM H 623	Optical Single-mode star-switch board	2	6	Double Europe
MiCOM H 631	Double Multi-mode switch board	2*4	2*1	Double Europe
MiCOM H 633	Double Single-mode star switch board	2*4	2*1	Double Europe

TABLE 1 : MICOM ETHERNET AVAILABLE DEVICE LIST

2.3 MiCOM H16x

The MiCOM H16x range is composed of unmanaged switches, extremely easy to install and operate, designed to be integrated in an industrial PC or a Shoe-box and implemented in electric plant environment (IEC 61000-4 & 60255-5).

On the media side, MiCOM H16x supports 10BaseT, 100BaseTX and 100BaseFX as specified by the IEEE 802.3 committee. With the full duplex and 100BaseTx or 100BaseFx communications, each port can provide theoretically a full 200 Mbps of data throughput (2 times in duplex the 100Mbps of one link).

The MiCOM H16x is plug and play devices. It can running with the factory setting. To adapt the switch to your application you simply configure using the jumpers the necessary parameters . No supervisory processor is requires to operate properly.

3. FUNCTIONAL DESCRIPTION

The MiCOM H16x is designed to be an Ethernet switch PCI format board. The MiCOM H16x has to be integrated in a PC (industrial or not depending on environment constraints) or in a Box with a PCI connector and a Power supply.

3.1 MiCOM H16x Range

The MiCOM H16x range is defined by the kind of Ethernet connection. All equipment of the MiCOM H16x range has 4 Copper connections through RJ45 and 2 Optical fiber connections through ST connectors, with speed automatically adjusted from external emitters to 10 or 100 Mbps.

Copper Ethernet link is limited in distance and subject to perturbation. The Ethernet redundant ring is based on optical inter-switch connection, depending on the link length between the user may choose between Multi-mode Fibber optic or Single mode Fibber Optic for long distance.

Model	Description	Connectors
MiCOM H 162	Fast Ethernet industrial switch Multimode 1300 nm	4 x RJ45 2 x ST

3.2 Ultra fast redundant dual-homing capability

3.2.1 Dual-homing principles

In dual homing architecture, a device is connected to two different networks. The traffic is duplicated to the two networks:

Frames are sending at the same time on the two networks and the first arrival is used the second is thrown. That means that :

- no frame are lost
- best response time

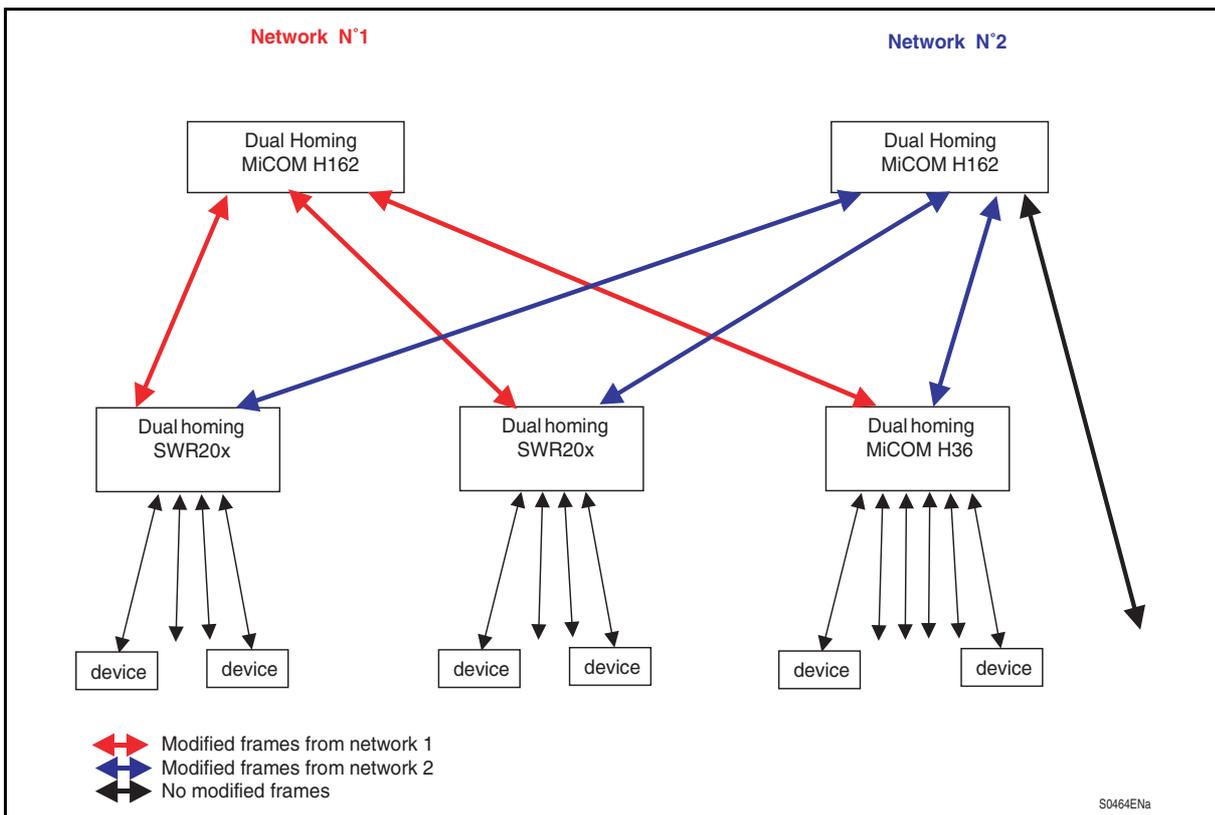


FIGURE 1 : DUAL-HOMING MECHANISM

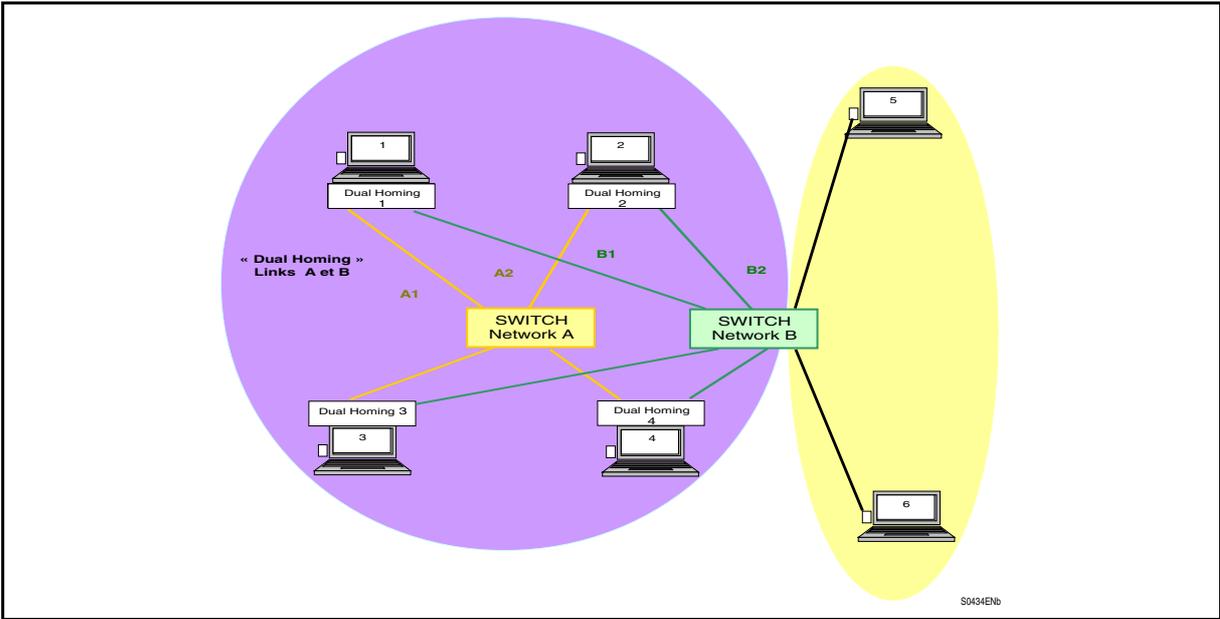


FIGURE 2 : 4 MiCOM H16x SWITCHES THROUGH 2 OPTICAL STARS

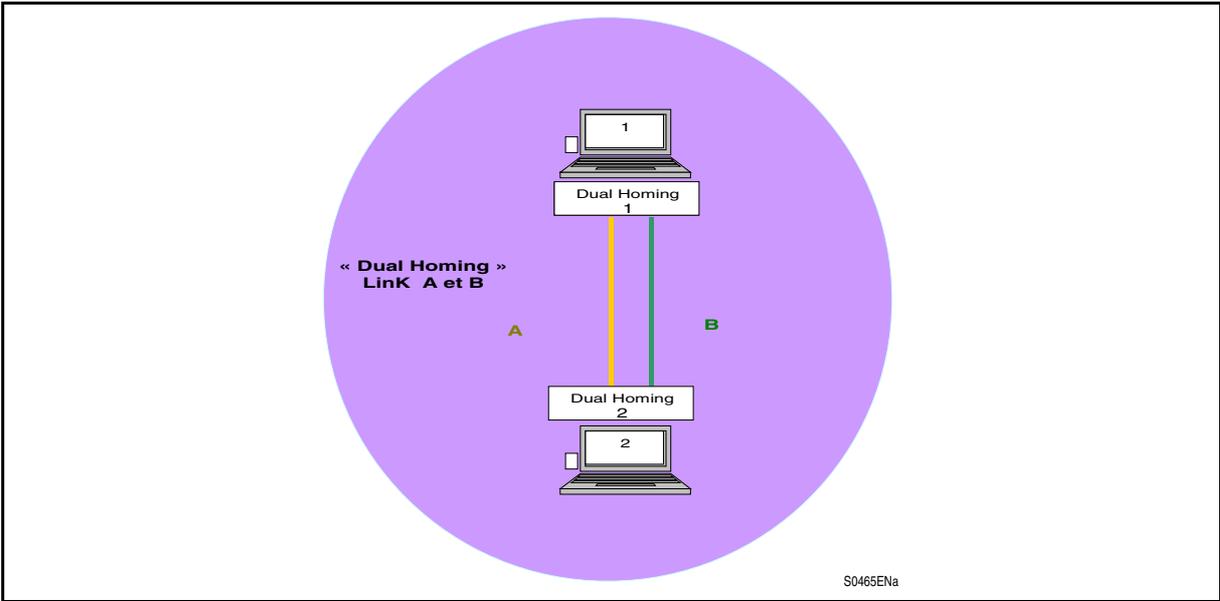


FIGURE 3 : 2 MiCOM H16x SWITCHES OPTICAL STARS NOT NEEDED

3.2.2 MiCOM H16x Ethernet switch with dual-homing facilities

The MiCOM H16x is a “repeater” with a standard 802.3 Ethernet switch plus the self healing manager (SHM). The following drawing describes the internal architecture of such device.

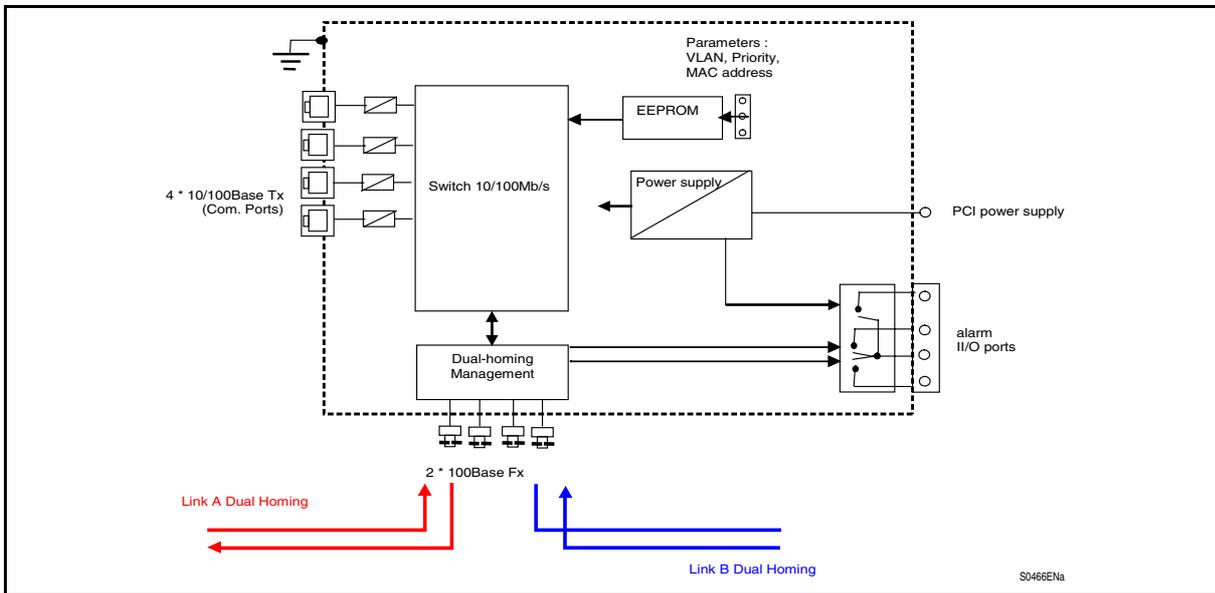


FIGURE 4 : INTERNAL ARCHITECTURE OF MiCOM H16x

3.2.3 Max time of end to end delay

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

Send a Goose frame from... To...	Time at 100Mbps	Abr.	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 fibber	μs		4,8 μs /km
Network to network	2 μs	tl	Repeater latency time

When the frame circulates on the ring it does not cross the switch the transit time is only tl.

3.2.4 Benefices

- Ultra fast dual-homing redundant capability
- Fast propagation on the Ethernet network (no transfer time (Store and forward mechanism) with the switch)
- Specific mechanism of frames checking

3.3 MiCOM H16x functional composition

With example of MiCOM H162, the Ethernet switch is composed of the function blocs given below.

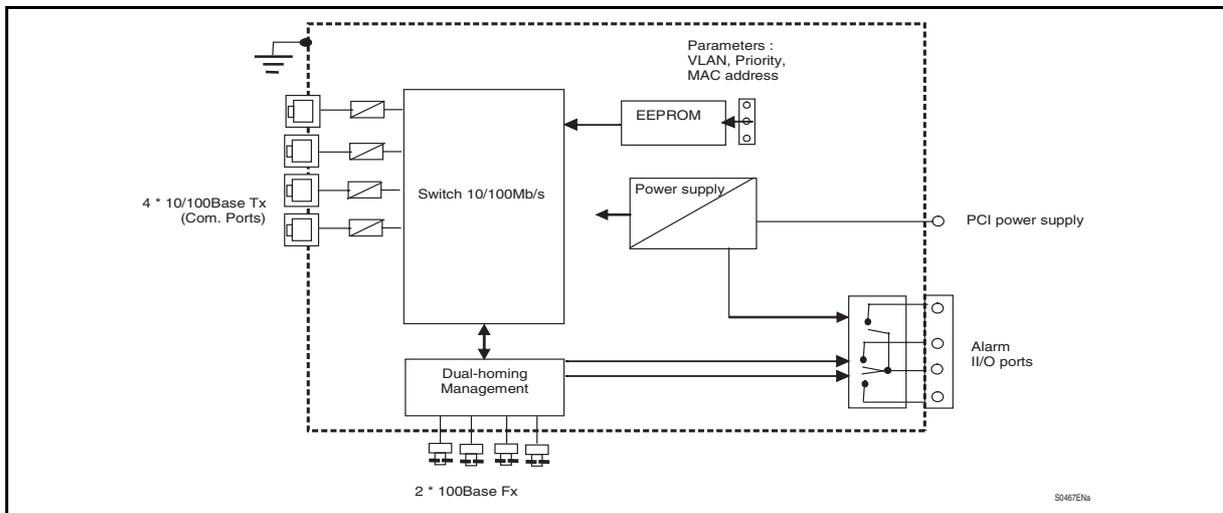


FIGURE 5 :MiCOM H162

The central part is composed by switching component managing up to 6 Ethernet links. An EEPROM stores the switching algorithm and manages (via jumpers) minimum parameters of Ethernet switching algorithm.

4 copper connection are defined in standard. 2 optic connection are defined in the range (multi-mode or single-mode).

Alarm contacts are defined in standard to check that product operate correctly.

3.4 Ethernet Port Switching Features

MiCOM H16x determines automatically at message reception the speed of its transmission layer 10 or 100 Mbps MiCOM H16x adapts automatically itself to this transmission speed and other transmission parameters like half or full duplex.

3.4.1 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 determinate the optimal speed. When the connected device is only capable of transmitting at 10Mbps, the MiCOM H16x follows the 10Mbps.

3.4.2 100Base Fx

The fiber optic ports are full/half duplex at 100Mbps only limited by . An external switch can select "half or full duplex" for the two optical ports.

3.5 Ethernet Management

3.5.1 Address look up

Each Ethernet device inserts its unique "MAC address" into each message it send out. The port on the MiCOM H16x used for given MAC address is automatically learned when a frame is received from that address. Once an address is learned, the MiCOM H16x will route messages to only the appropriate port. A time stamp is also placed in memory when a new address is learned. This time stamp is used with the aging feature, which will remove unused MAC Addresses from table after 300 seconds. The broadcasting messages are transmit in the all ports.

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

3.5.2 Buffering

An internal buffer is used for buffering the messages. There are 1024 buffers available. The factory setting mode adaptively allocates buffers up to 512 to a single port based loading.

3.5.3 Back off operation

The MiCOM H16x will drop a packet after 16 collisions (J factory setting).

3.5.4 Back pressure for half duplex

The MiCOM H16x will apply « back pressure » when necessary with half-duplex operation. This «back pressure » will reduce congestion on busy networks (J factory setting).

3.5.5 Broadcast storm protection

Broadcasts and multicasts are limited to 5% of the available bandwidth (J factory setting).

3.5.6 Auto Negotiation and Speed-Sensing

All six RJ45 ports of the MiCOM H16x independently support auto negotiation for speeds in the 10BaseT and 100BaseTx modes. Operation is according to the IEEE 802.3u standard.

3.5.7 Forwarding

MiCOM H16x supports store and forward mode. MiCOM H16x will forward messages with known addresses out only the appropriate port. Messages with unknown addresses, broadcast messages and multicast messages will get forwarded out all ports except the source port. MiCOM H16x will not forward error packets, 802.3x pause frames or local packets.

3.5.8 Priority tagging

802.1p priority is enabled on all ports. A 6 KB buffer is reserved for priority traffic.

3.5.8.1 Flow control

The MiCOM H16x automatically supports standard flow control frames on both the transmit and receive sides.

On the receive side, if MiCOM H16x receives a pause control frame it will not transmit the next normal frame until the timer, specified in the pause control frame, expires. If another pause frame is received before the current timer expires, the timer will be updated with the new value in the second pause frame. During this period (being flow controlled), only flow control packets from MiCOM H16x will be transmitted.

On the transmit side, MiCOM H16x has intelligent and efficient ways to determine when to invoke flow control. The flow control is based on availability of the system resources, including available buffers, available transmit queues and available receive queues. MiCOM H16x will flow control a port, which just received a packet, if the destination port resource is being used up. MiCOM H16x will issue a flow control frame (XOFF), containing the maximum pause time defined in IEEE standard 802.3x. A hysteresis feature is provided to prevent flow control mechanism from being activated and deactivated too many times.

MiCOM H16x will flow control all ports if the receive queue becomes full.

3.5.9 VLAN Operation

The VLAN's are setup by programming the VLAN Mask Registers in the EEPROM. The perspective of the VLAN is from the input port and which output ports it sees directly through the MiCOM H16x. For example if port 1 only participated in a VLAN with ports 2 and 9 then one would set bits 0 and 7 in register 13 (Port 1 VLAN Mask Register). Note that different ports can be setup independently.

An example of this would be where a router is connected to port 9 and each of the other ports would work autonomously. In this configuration ports 1 through 8 would only set the mask for port 9 and port 9 would set the mask for ports 1 through 8. In this way the router could see all ports and each of the other individual ports would only communicate with the router.

All multicast and broadcast frames adhere to the VLAN configuration. Unicast frame treatment is a function of register 2 bit 0. If this bit is set then unicast frames only see ports within their VLAN. If this bit is cleared unicast frames can traverse VLAN's. VLAN tags can be added or removed on a per port basis.

Further, there are provisions to specify the tag value to be inserted on a per port basis. The table below briefly summarizes VLAN features.

For more detailed settings see the EEPROM register description.

Register(s)	Bit(s)	Global / Port	Description
4-12	2	Port	Insert VLAN Tags – If specified, will add VLAN tags to frames without existing tags
4-12	1	Port	Strip VLAN Tags If specified, will remove VLAN tags from frames if they exist
2	0	Global	VLAN Enforcement – Allows unicast frames to adhere or ignore the VLAN configuration
13-21	7-0	Port	VLAN Mask Registers – Allows configuration of individual VLAN grouping.
22-39	7-0	Port	VLAN Tag Insertion Values – Specifies the VLAN tag to be inserted if enabled

4. TECHNICAL DATA

4.1 MiCOM H16x Range

Ports	10/100BaseTxCopper	100 BaseFx Multi Mode
MiCOM H162	4	2

10/100BaseT(x) Ports	
Connector type	Shielded RJ45 jack
Twisted pair cable	Cat 5
Max cable length with Cat 5	100 m

General	
Ethernet	
Forwarding mode	Store and forward
Memory bandwidth	2 Gbps
MAC Address	1K
Address learning	Automatic
Address aging	Remove old address after 300s
Collision	Drops after 16 collisions
Back pressure	Automatic for half duplex
Broadcast storm protection	Limits to 5% by strap
Buffering	128 Kb
Illegal frame	Dropped per 802.3
Late collision	Dropped after 512 bit times

Environmental			
Isolation			
Dielectric strength	I/O ports	2 kV – 50 Hz for 1 minute	IEC 60255-5
	Com. ports	1,5 kV dc for 1 minute	
Insulation resistance	I/O ports	100 MΩ at 500 V	IEC 60255-5
	Com. ports	100 MΩ at 500 V	
Impulse voltage	I/O ports	5 kV CM 3 kV DM	IEC 60255-5
	Com. ports	1 kV CM	

5. HUMAN MACHINE INTERFACE

Some LED are used to indicate the state of the links.

The table below indicates the function of each LED :

Function	LED number	Colour	Description
Ports Tx	1 - 2 - 3 - 4	GREEN GREEN slow blink (~1s) GREEN fast blink OFF	Connected without activity Activity at 10 Mbps Activity at 100 Mbps No connection

Upon power up the switch will go through a series of self-testing. The 4 "Ports LED" will flash a few seconds.

6. INSTALLATION

The MiCOM H16x can be easily mounted on a standard PCI bus connector in horizontal or vertical position.

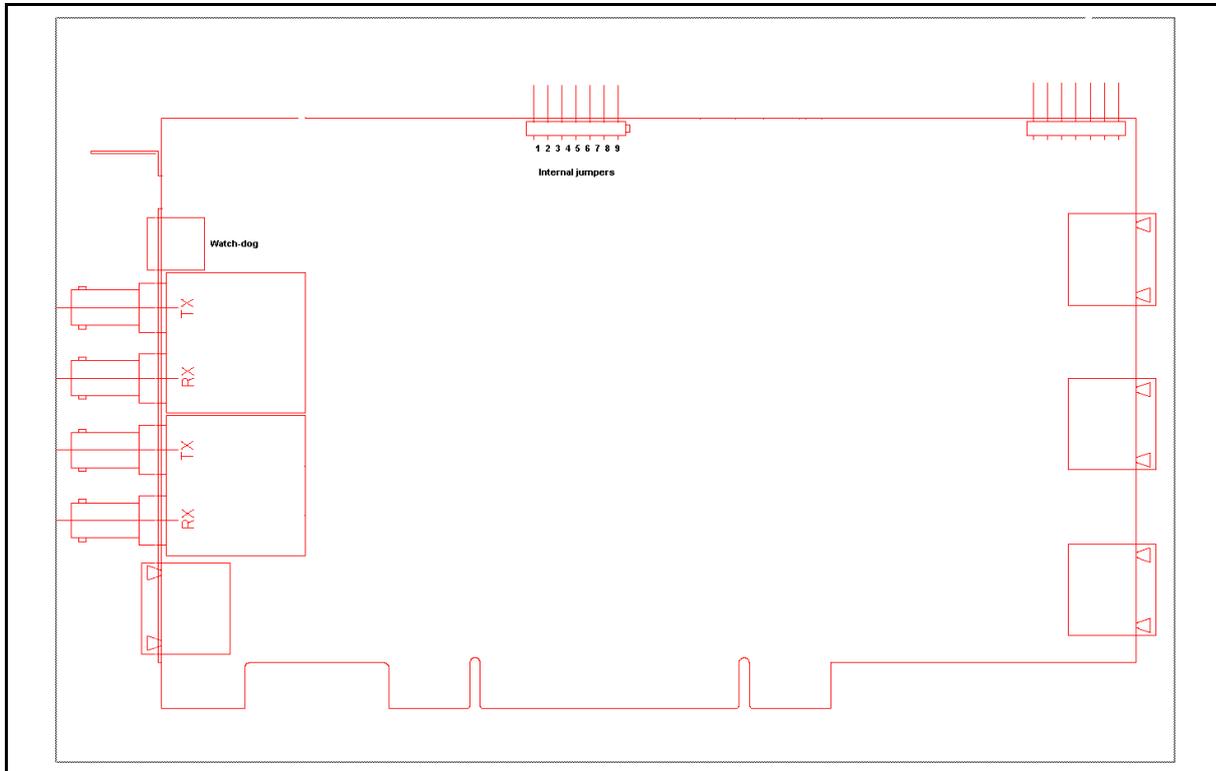
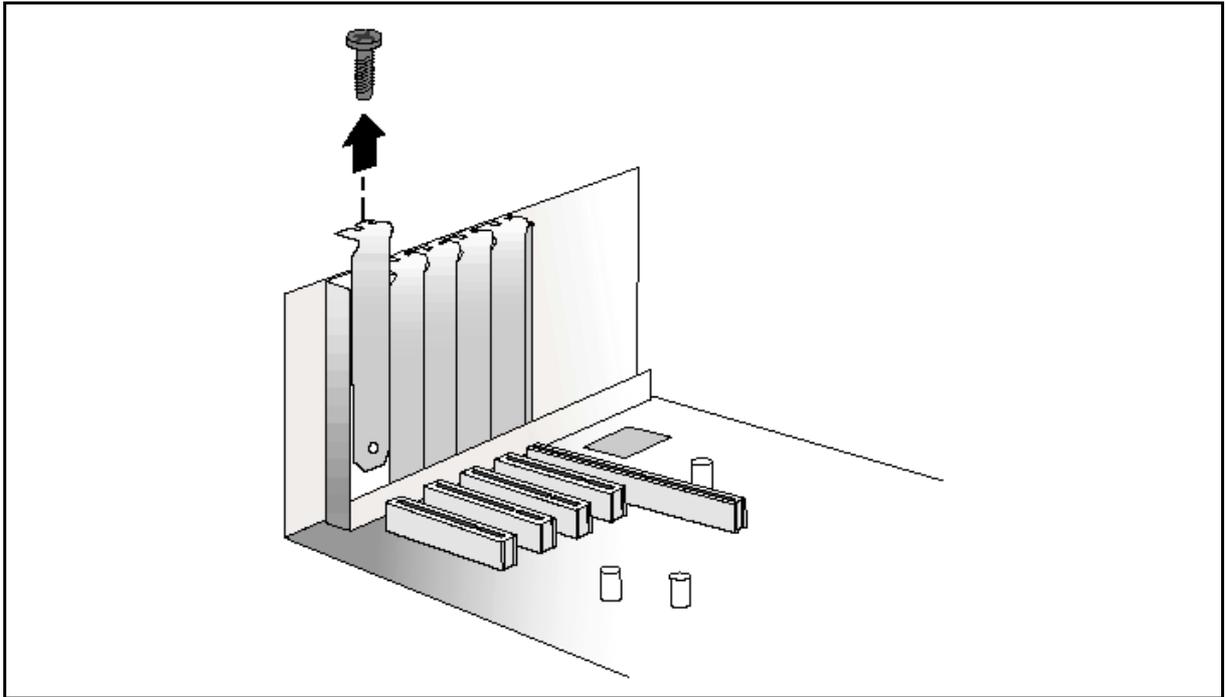


FIGURE 6 : MiCOM H162 PCI BOARD

6.1 Installing the Controller

To install the MiCOM H16x in the system cabinet:

1. Shut down your computer and disconnect the power cord.
2. Open the computer cabinet and identify an unused PCI slot.
3. Identify an unused PCI slot and remove the slot cover, as illustrated below.



4. Install the controller in the PCI slot

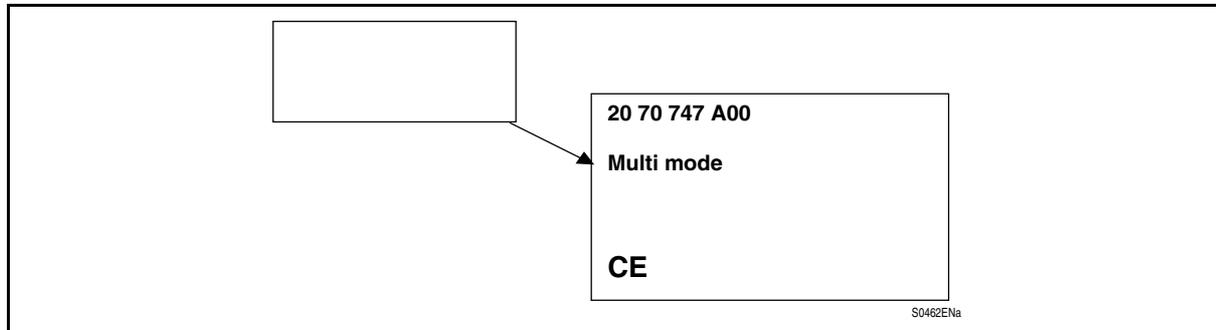


5. Close the computer cabinet and re-attach the power cord.
6. Use the Ethernet twisted pair cables to connect your MiCOM H16x to your PC Ethernet port.
7. Use the Ethernet Optical cables to connect your MiCOM H16x to the Ethernet network in respect with the Dual-Homing architecture
8. You can restart your computer

7. HARDWARE

7.1 Identification Label

- On the lower face of the MiCOM H16x a rectangular label is displayed. This stick is enlarged below. The major indication for MiCOM H16x is given with Multi (MiCOM 162) or Single-mode for the kind of optical fiber supported.



8. CONNECTION

8.1 Ethernet connection

The Ethernet-based communication available in the MiCOM H16x uses either fibre optic media (ST connector) or 4 pair twisted cable.

If equipment's are located at a long distance (>10 m for RS232, >100 m for RS422 and >1000 m for RS485) 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.

8.1.1 Ethernet cable type

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

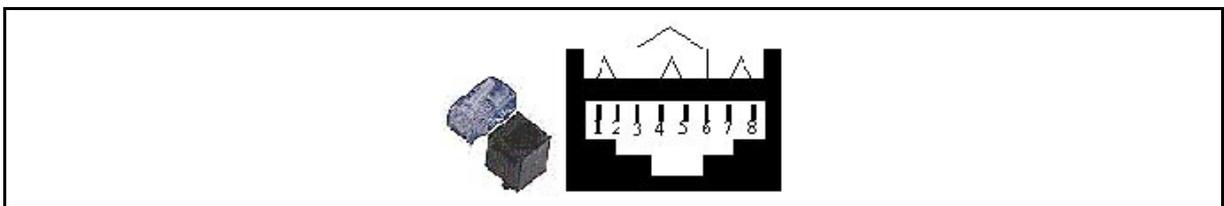


FIGURE 7 : RJ45 CONNECTOR

The norm is:

1 = white / orange

2 = orange

3 = white / green

4 = blue (non used)

5 = white / blue (non used)

6 = green

7 = white / brown (non used)

8 = brown (non used)

The RJ45 connector when seen face on, flat side on bottom, side tab on top, then pin 1 is on the left and pin 8 on the right.

The MiCOM H16x support star network topology on the Ethernet Twisted pair connectors and redundant ring network on the optical ports..

The maximum cable length for 10/100BaseTx is typically 100 meters.

8.1.2 Ethernet optical fiber

The FO cable are connected to the corresponding FO elements. The connector type for the multi mode fiber or single mode is ST.

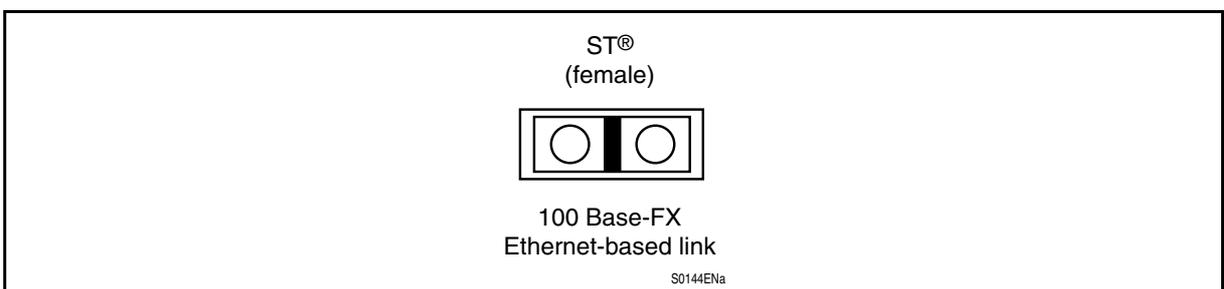


FIGURE 8 : ETHERNET OPTICAL FIBER

9. SETTINGS

9.1 Internal Jumpers Meaning

Some jumpers are used to adapt the MiCOM H16x to your network:

N°	Open	Closed	Factory setting
W1	Enable 802.1p selected by EEPROM	Enable 802.1p field for all port	Closed
W2	Enable more aggressive back-off	Enable less aggressive back-off	Open
W3	Continue sending frame regardless of number of collisions	Enable to drop frame after 16 collisions	Open
W4	Enable flow control	Disable flow control	Closed
W5	Unlimited broadcast frames	Enable 5% broadcast frame allowed	Open
W6	Share buffers up to 512 buffers on a single port	Enable equal amount of buffers per Port (113 buffers)	Open
W7	Max length is 1536 byte	Enable enforce the max frame length for VLAN is 1522	Open
W8	Enable half duplex back pressure	Disable half duplex back pressure	Open
W9	No priority reserve	Enable 6KB priority buffer reserved	Closed

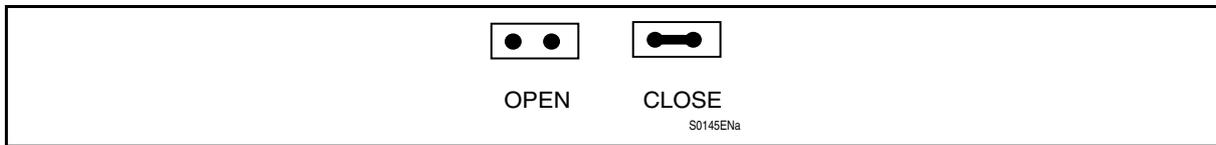


FIGURE 9 : OPEN/CLOSE SWITCH

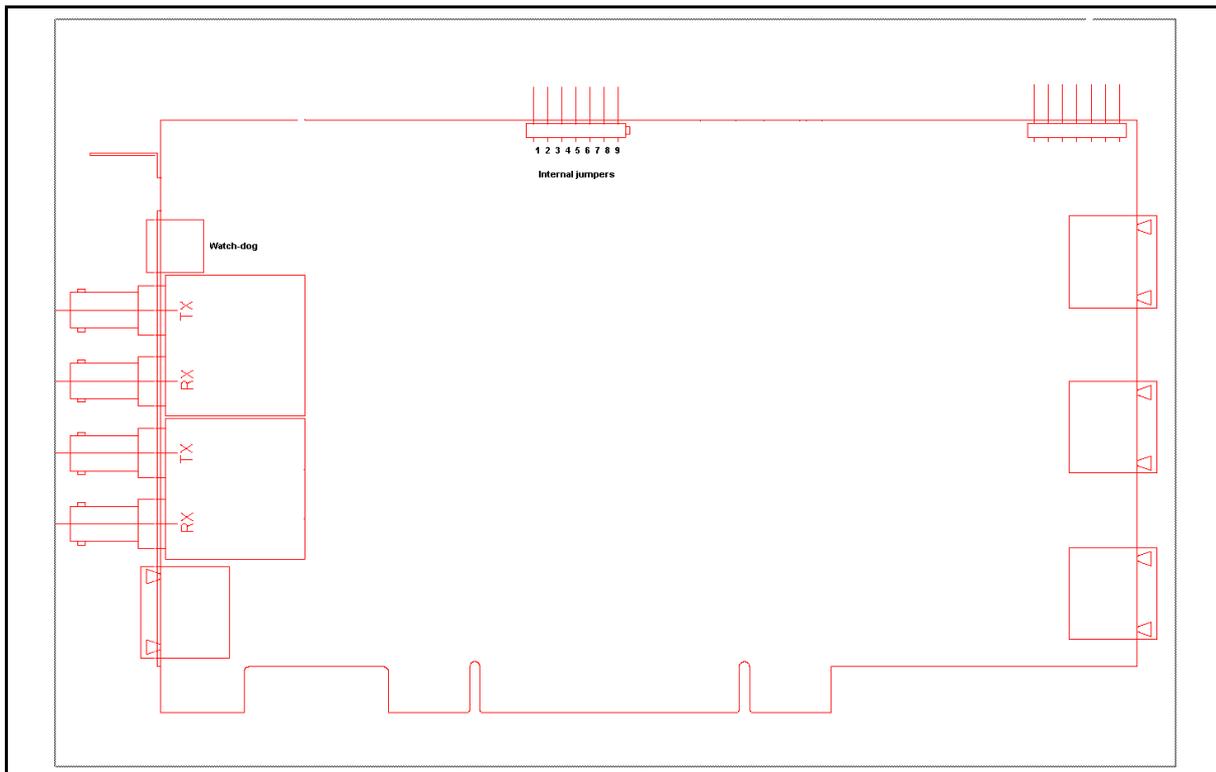


FIGURE 10 : MiCOM H16x SIDE VIEW

10. APPLICATIONS

10.1 Fiber Optic budget calculations

Optical power is expressed in Watts. However, the common unit of power measure is the dBm and defined by the following equation:

$$\text{Power (dBm)} = 10 \log \text{Power (mW)} / 1 \text{ mW.}$$

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

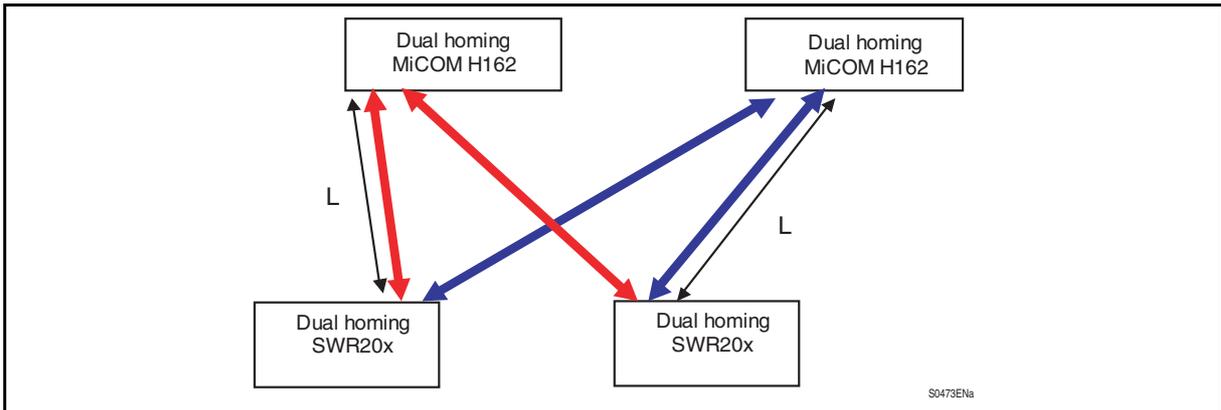


FIGURE 11 : FIBER OPTIC DISTANCE

Fiber type	Multi mode	Single mode
	62,5/125 micron	9/125 micron
Power coupled into fiber	- 19 dBm	- 15 dBm
sensitivity	- 31 dBm	- 34 dBm
Link budget	12 dB	19 dB
Connector loss (2)	0,8 dB	0,8 dB
Patch loss (2)	2 dB	1 dB
Safety Margin	4 dB	4 dB
Allowed link attenuation	2,4 dB	11,4 dB
Typical cable attenuation	1 dB/km	0,4 dB/km
Maximum range	2,4 km	28 km

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

11. LEXICAL

11.1 10Base T 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 determinate the optimal speed. When the connected device is only capable of transmitting at 10Mbps, the MiCOM H16x follows the 10Mbps.

11.2 100Base Fx

The fiber optic ports are full/half duplex at 100Mbps only. An external switch can select "half or full duplex" for the two optical ports.

11.3 Power management

If there is no cable on a port, most of the circuitry for that port is disabled to save power.

11.4 Address look up

Each Ethernet device inserts its unique "MAC address" into each message it send out. The port on the MiCOM H16x used for given MAC address is automatically learned when a frame is received from that address. Once an address is learned, the MiCOM H16x will route messages to only the appropriate port. A time stamp is also placed in memory when a new address is learned. This time stamp is used with the aging feature, which will remove unused MAC Addresses from table after 300 seconds. The broadcasting messages are transmit in the all ports.

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

11.5 Buffering

An internal buffer is used for buffering the messages. There are 1024 buffers available. The factory setting mode adaptively allocates buffers up to 512 to a single port based loading.

11.6 Back off operation

The MiCOM H16x will drop a packet after 16 collisions (W7).

11.7 Back pressure for half duplex

The MiCOM H16x will apply « back pressure » when necessary with half-duplex operation. This «back pressure » will reduce congestion on busy networks (W2).

11.8 Broadcast storm protection

Broadcasts and multicasts are limited to 5% of the available bandwidth (W5).

11.9 Auto Negotiation and Speed-Sensing

All six or eight RJ45 ports independently support auto negotiation for speeds in the 10BaseT and 100BaseTx modes. Operation is according to the IEEE 802.3u standard.

11.10 Forwarding

The MiCOM H16x support store and forward mode. It will forward messages with know addresses out only the appropriate port. Messages with unknown addresses, broadcast messages and multicast messages will get forwarded out all ports except the source port. The MiCOM H16x will not forward error packets, 802.3x pause frames or local packets.

11.11 Priority tagging

802.1p priority is enabled on all ports. A 6 KB buffer is reserved for priority traffic. You muss used the EEPROM to configure this function

11.12 Flow control

The MiCOM H16x automatically supports standard flow control frames on both the transmit and receive sides.

On the receive side, if the MiCOM H16x receives a pause control frame it will not transmit the next normal frame until the timer, specified in the pause control frame, expires. If another pause frame is received before the current timer expires, the timer will be updated with the new value in the second pause frame. During this period (being flow controlled), only flow control packets from the MiCOM H16x will be transmitted.

On the transmit side, the MiCOM H16x has intelligent and efficient ways to determine when to invoke flow control. The flow control is based on availability of the system resources, including available buffers, available transmit queues and available receive queues. The MiCOM H16x will flow control a port, which just received a packet, if the destination port resource is being used up. The MiCOM H16x will issue a flow control frame (XOFF), containing the maximum pause time defined in IEEE standard 802.3x. A hysteresis feature is provided to prevent flow control mechanism from being activated and deactivated too many times.

The MiCOM H16x will flow control all ports if the receive queue becomes full.

11.13 VLAN Operation

The VLAN's are setup by programming the VLAN Mask Registers in the EEPROM. The perspective of the VLAN is from the input port and which output ports it sees directly through the MiCOM H16x.

For example if port 1 only participated in a VLAN with ports 2 and 9 then one would set bits 0 and 7 in register 13 (Port 1 VLAN Mask Register). Note that different ports can be setup independently. An example of this would be where a router is connected to port 9 and each of the other ports would work autonomously. In this configuration ports 1 through 8 would only set the mask for port 9 and port 9 would set the mask for ports 1 through 8. In this way the router could see all ports and each of the other individual ports would only communicate with the router. All multicast and broadcast frames adhere to the VLAN configuration. Unicast frame treatment is a function of register 2 bit 0. If this bit is set then unicast frames only see ports within their VLAN. If this bit is cleared unicast frames can traverse VLAN's. VLAN tags can be added or removed on a per port basis. Further, there are provisions to specify the tag value to be inserted on a per port basis. The table below briefly summarizes VLAN features.

Register(s)	Bit(s)	Global / Port	Description
4-12	2	Port	Insert VLAN Tags – If specified, will add VLAN tags to frames without existing tags
4-12	1	Port	Strip VLAN Tags If specified, will remove VLAN tags from frames if they exist
2	0	Global	VLAN Enforcement – Allows unicast frames to adhere or ignore the VLAN configuration
13-21	7-0	Port	VLAN Mask Registers – Allows configuration of individual VLAN grouping.
22-39	7-0	Port	VLAN Tag Insertion Values – Specifies the VLAN tag to be inserted if enabled

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