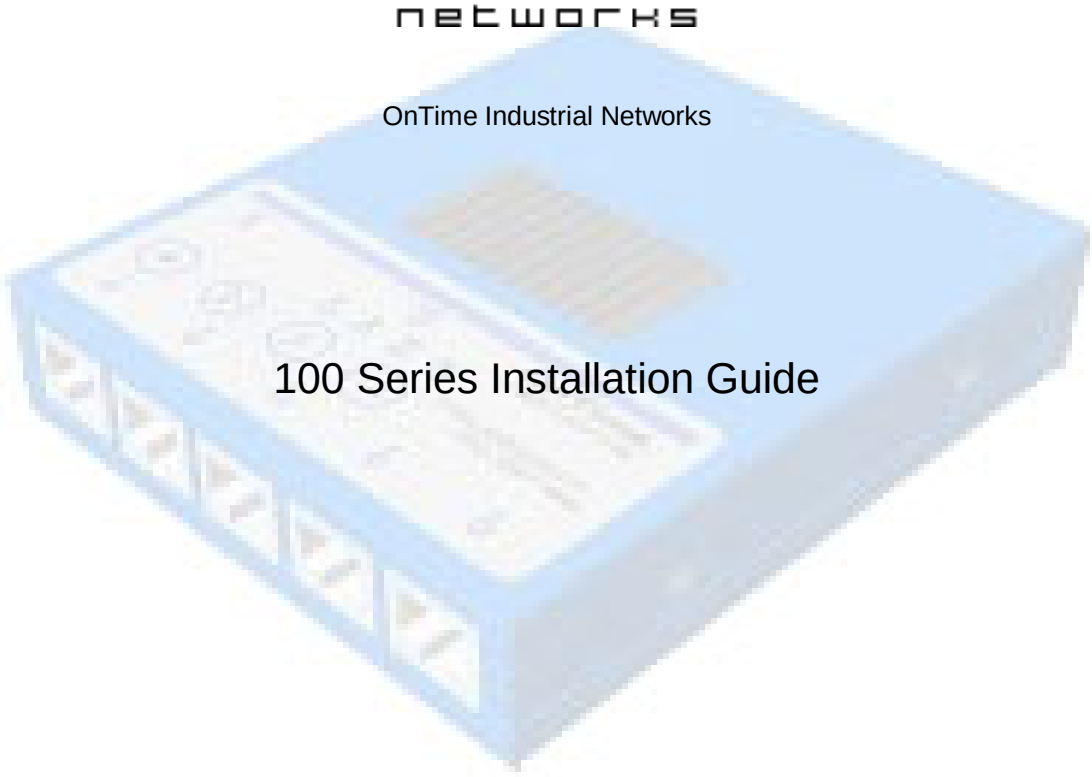
OnTime networks

OnTime Industrial Networks



100 Series Installation Guide

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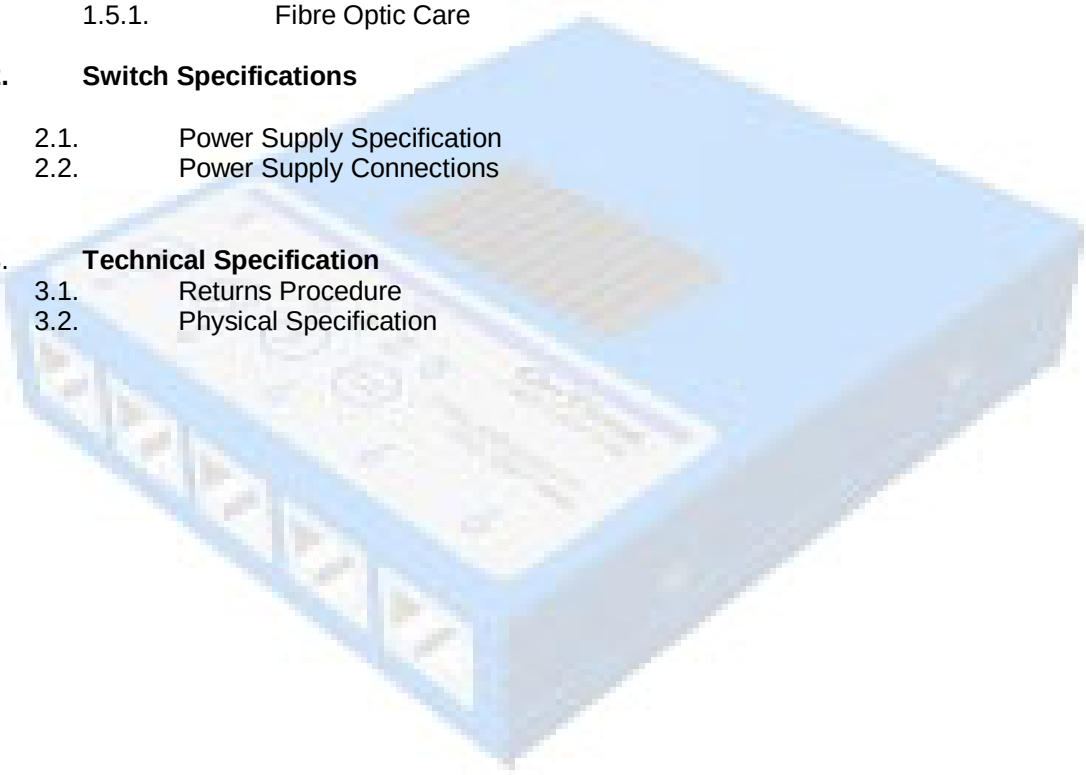


Section 1

Introduction to OnTime

Company History

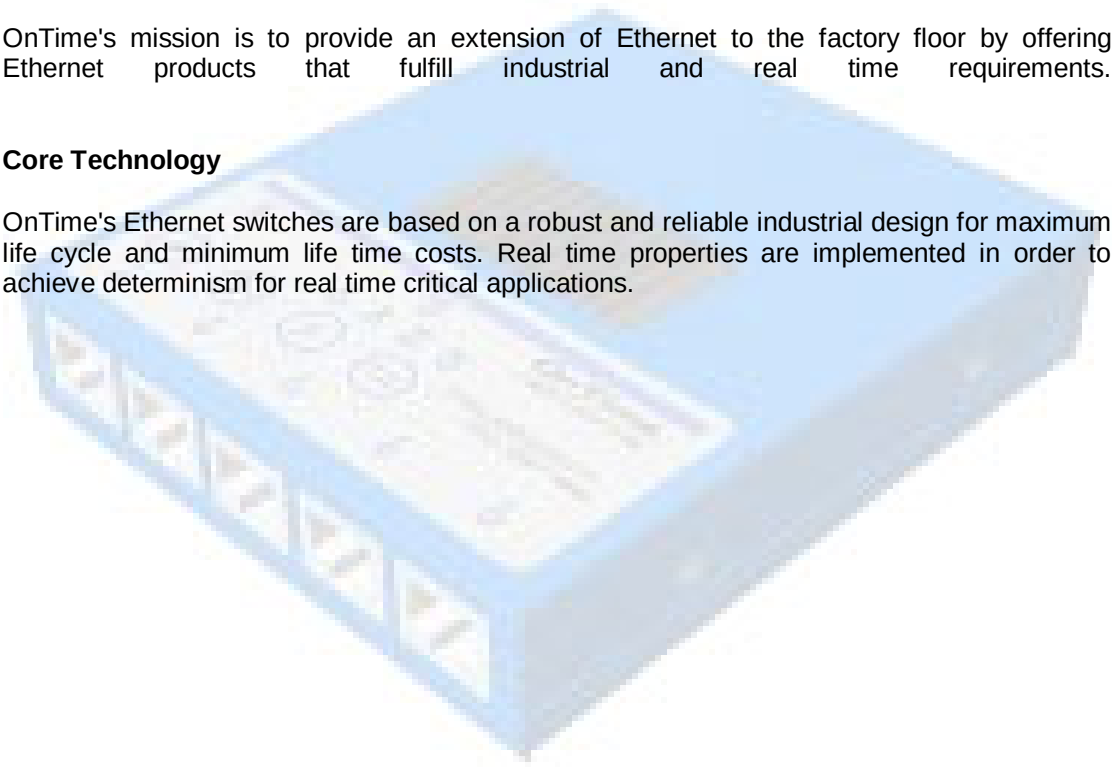
OnTime is dedicated to the implementation of industrial and deterministic Ethernet infrastructure. OnTime Networks is a privately held company based in Norway and Sweden. We work closely with a number of large automation companies; enhancing older proprietary networks and working in partnership developing new network technology.

Mission Statement

OnTime's mission is to provide an extension of Ethernet to the factory floor by offering Ethernet products that fulfill industrial and real time requirements.

Core Technology

OnTime's Ethernet switches are based on a robust and reliable industrial design for maximum life cycle and minimum life time costs. Real time properties are implemented in order to achieve determinism for real time critical applications.



Section 1.1

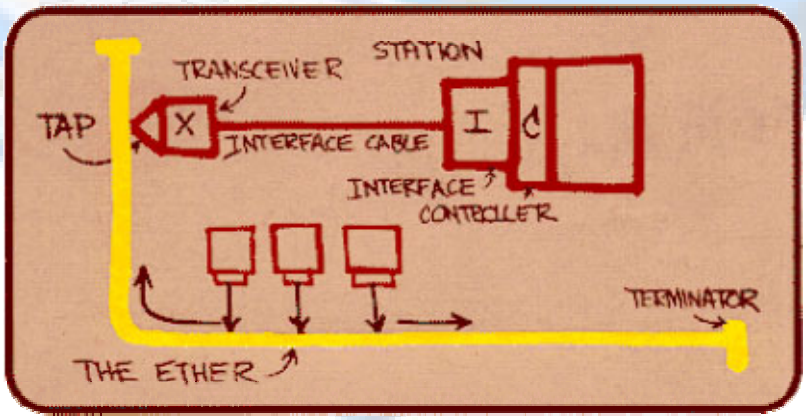
History of Ethernet

In late 1972, Metcalfe and his Xerox PARC colleagues developed the first experimental Ethernet system to interconnect the Xerox Alto, a personal workstation with a graphical user interface. The experimental Ethernet network was used to link Altos to each other, and to servers and laser printers.

The signal clock for the experimental Ethernet interface was derived from the Alto's system clock, which resulted in a data transmission rate on the experimental Ethernet of 2.94 Mbps.

Robert Metcalfe's first experimental network was called the Alto Aloha Network.

In 1973, Robert Metcalfe changed the name to "Ethernet," to make it clear that the system could support any type of computer; not just the Xerox Altos and to point out that his new network mechanisms had evolved well beyond the Aloha system. He chose to base the name on the word "ether" as a way of describing an essential feature of the system: the physical medium (i.e., a cable) carries bits to all stations, much the same way that the old "luminiferous ether" was once thought to propagate electromagnetic waves through space. Thus, Ethernet was born."



``*The diagram ... was drawn by Dr. Robert M. Metcalfe in 1976 to present Ethernet ... to the National Computer Conference in June of that year. On the drawing are the original terms for describing Ethernet. Since then other terms have come into usage among Ethernet enthusiasts."*

Section 1.2

Industrial Ethernet – What Are The Differences?

Within the UK Market, and possibly the majority of Europe, Ethernet is moving into the Automation Industry. Manufacturers are exporting their legacy protocols onto Ethernet, designing new IP based communication protocols and providing embedded Web-Pages within PLCs to provide real-time information using simple tools like Internet Explorer and Netscape.

However, the domain of Ethernet has always been controlled by the IT department who configured office networks normally with an iron fist and dictated to the company how the network would be designed with complex recovery protocols like spanning tree and SNMP to help with fault finding and system analysis. If a network failure occurred the IT department would casually look at repairing the equipment - there was no real rush as it was an office network. However, with Industrial Ethernet you need very fast repair time, and, with an IT department not present on the factory floor the maintenance personnel need to be made aware of the fault, find the error and repair it - quickly.

Industrial rated Switches are intended to be installed in harsh conditions and electrical environments with the added benefit of fast recovery of a network failure. The On-Time switches are an excellent example of how such Switches should be designed – very high operating temperatures, fast repair of redundant ring, layer 2 and layer 3 priority switching etc. Without doubt, On-Time switches are technically superior to many similar models available on the market.

Section 1.3

Switches vs. Hubs

A hub consists of a number of ports normally with either RJ-45 (copper) sockets and / or fibre optic ports that have a number of different styles of fibre optic sockets. Usually a 'patch cable' is connected to the hub; the other end is normally connected to a device (PC, Printer etc).

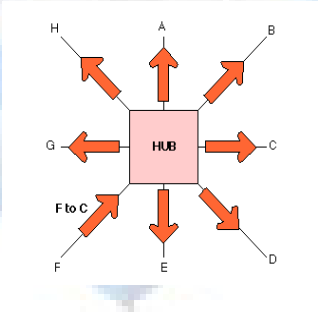
Note: It should be noted that when a hub requires an 'up-link' connection to a further hub a cross-over style cable is required.

A hub has no intelligence and therefore is unable to identify addresses or any information contained within the Header frame of an Ethernet packet. This means that it is not capable of determining which port to send the frame to. Therefore, every frame is sent to every port.

Note: Industrial hubs can only connect to equipment that operates at the same speed.

A network of repeaters and hubs is called a 'Shared Ethernet' or 'Collision Domain'. Various systems will all compete with each other using 'Carrier Sense Multiple Access / Collision Detect' (CSMA/CD) protocol. ***This means that only one system is allowed to proceed with a transmission of a frame within a Collision Domain at any one time.*** This is a major disadvantage when using Hubs and Repeaters within a network.

If a hub sees a collision on a cable segment, it is detected and a 'jam' signal is generated. The 'jam' signal is sent to *all* connected devices. This ensures that every device is aware of the collision and they do not attempt to transmit during the collision.



All Ports Receive the Same Ethernet Frame

To summarise, hubs operate with the following limitations:

- Only a single speed of operation – no ability to automatically change between 10M or 100M.
- Only one system is allowed to proceed with a transmission of a frame within a Collision Domain at any one time.
- Hubs require special 'crossed' cables to enables links from Hub to Hub. (If no up-link port is present)

Section 1.3.1

Switch Operation

Introduction

A switch has to forward and receive packets from one LAN or device to another. The switch could forward all packets, but if this was the case it would have similar behavior to a hub.

It would be more intelligent if the switch only forwarded packets which need to travel from one LAN or device to another. To do this, the switch must learn which devices or LANs are connected to each port. In simplistic terms; it needs to learn the destination and source ports of each and every packet received on each individual Switch port. Once learnt, any identically addressed packet will be automatically be forwarded.

Error Detection

The switch stores every incoming packet and scans this for errors, usually by checking the frame CRC (cyclic redundancy check sum). If any errors are found or detected the packet is discarded. In addition each frame is checked for size. Undersized packets (less than 64 Bytes) and oversized packets (more than 1518 bytes)***** are also discarded.
Once these basic checks have been carried out the switch can then start learning packet source and destination information.

Note: When implementing Packet Priority this increases to 1522 or 1536 Bytes.

Flooding

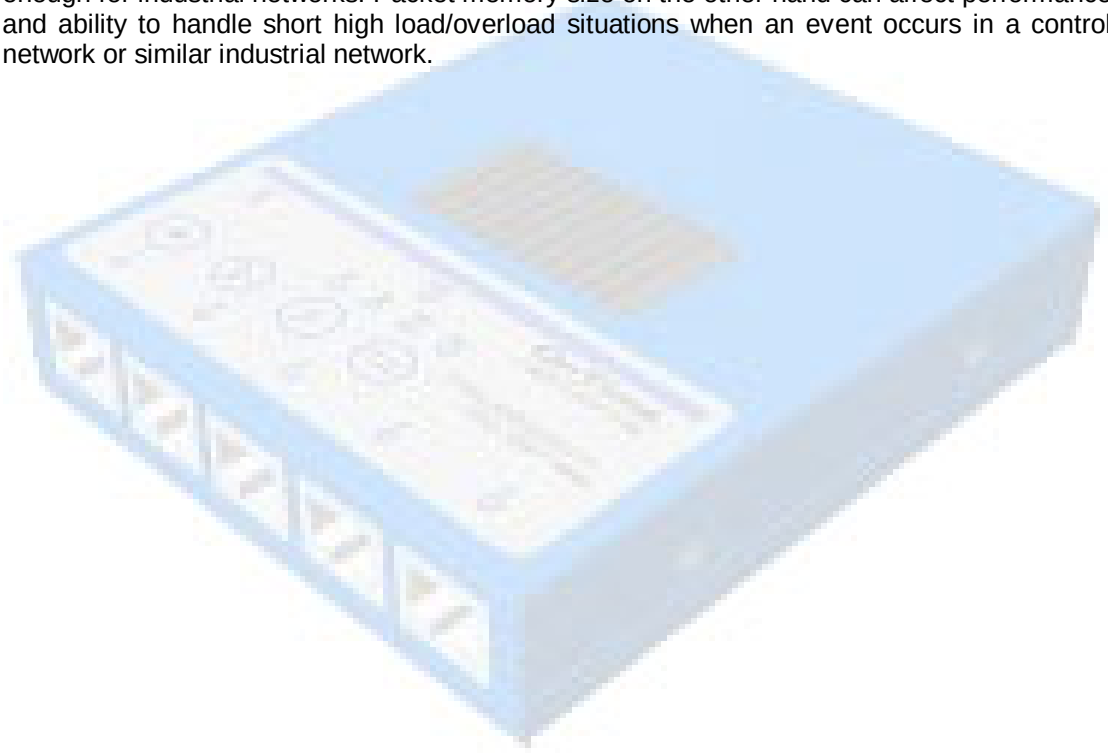
The switch needs to make a decision regarding which port(s) the packet is to be forwarded to. This decision is based upon the MAC tables that are maintained and updated automatically by the Switch. The process is known as Layer 2 Switching.
When first powered on the MAC tables within the Switch are empty. When a packet is received on a port the Switch does not know where the destination MAC address is located. The Switch learns the address by 'flooding' the packet out to all ports. Eventually, the destination node responds, the address is located and the Switch remembers the destination port. In simplistic terms; when a Switch receives a packet on a port it stores the source MAC address in the MAC table that corresponds to that Port. The flooding technique is always used with Broadcast and Multicast packets. If the switch is equipped with multicast management then multicast packets will not be flooded.

Section 1.3.1

Switch Operation (Cont..)

MAC Table

A MAC table can hold up to 8000 entries; and with a total packet memory of over 1MB this is adequate for normal networks. Naturally, devices will be disconnected from Ports during the life of a network. If the MAC table did not automatically monitor for idle nodes the table would become full. If a node has been idle for more than a few seconds the source and destination information for that node will be deleted from the table. This is commonly known as the 'age time'. To reset the table power cycle the Switch.MAC table size is normally always large enough for industrial networks. Packet memory size on the other hand can affect performance and ability to handle short high load/overload situations when an event occurs in a control network or similar industrial network.



Section 1.3.1

Switch Operation (Cont..)

Full Wire Speed

The Switch supports full wire speed. This equates to 100Mbit/s full duplex on every port. In detail 100Mbit/s in each direction on all ports equals 200Mbit/s per port.

Section 1.4

Twisted Pair Port Specification

Introduction

The 200 Series Switch is available with up to eight copper ports. The copper ports support the long cable specification that enables standard CAT5e copper cables to run up to 150 Meters when used with devices that also support this specification. **This highlights the enhanced design specification the switch employs when used in noisy electrical environments. In industrial networks long cables should be avoided but equipment specified according to long cable specification gives more margins for disturbances.**

MDX/MDIX

There are two types of copper Ethernet ports available; MDI (Medium Dependant Interface) and MDIX (Medium Dependant Interface Crossover). The MDI port types are associated with copper interfaces available on NICs (Network Interface Cards), PLCs, VSDs and DCSs etc. The latter type of interface (MDIX) is found on Hubs or Switches.
In addition there are two types of Ethernet cable available. These are referred to as a 'straight through cable' or 'crossed cable'.

STRAIGHT CONNECTION –Switch-PLC, Hub-PLC, Switch-NIC etc.

		Connector A			Connector B		
Pair 1		pin	4	<------->	Pin	4	
		pin	5	<------->	Pin	5	
Pair 2	TD +	pin	3	<------->	Pin	3	TD +
	TD -	pin	6	<------->	Pin	6	TD -
Pair 3	RD +	pin	1	<------->	Pin	1	RD +
	RD -	pin	2	<------->	Pin	2	RD -
Pair 4		pin	7	<------->	Pin	7	
		pin	8	<------->	Pin	8	

CROSSED CONNECTION – Switch-Switch, Hub-Hub, Switch-Hub etc.

		Connector A			Connector B		
Pair 1		pin	4	<------->	Pin	7	
		pin	5	<------->	Pin	8	
Pair 2	TD +	pin	3	<------->	Pin	1	RD +
	TD -	pin	6	<------->	Pin	2	RD -
Pair 3	RD +	pin	1	<------->	Pin	3	TD +
	RD -	pin	2	<------->	Pin	6	TD -
Pair 4		pin	7	<------->	Pin	4	
		pin	8	<------->	Pin	5	

Section 1.4 (Cont)

Twisted Pair Port Specification

Auto MDX/MDIX

The complete range of OnTime Switches automatically detects the transmit and receive copper pairs used in a patch cable. This eliminates the need to source the two types of patch cable (crossed and straight through) highlighted above and therefore reduces the cost of carrying two types of spares. **This feature cannot be deactivated.**

Electrical Isolation

The copper (TX) ports incorporate high electrical isolation between the signal lines and the internal electronics. In addition, the switch can also withstand over 500 Amps through the shield for short periods of time (20-30mS) without effecting the operation and communication of the Switch. However, this is not advisable. Fibre optical cables should be used in such environments. Each TX port is isolated to chassis and other ports. Isolation is rated 1500Vrms (1 minute).

Auto-Negotiation

Auto-Negotiation is a protocol that controls the speed and duplex of a copper cable when a connection is established between two Ethernet devices. Auto-Negotiation detects the various modes that exist in the device on the other end of the cable and highlights its own abilities to automatically configure itself. Therefore, it will automatically operate at the highest performance in relation to speed and duplex. This allows simple and automatic connection of devices that support a variety of modes from a variety of manufacturers. The auto-negotiation protocol only functions on copper ports.

As standard the range of OnTime Switches are shipped with the Auto-Negotiation feature enabled. **However, if required a manual configuration process is possible using the push buttons. These are located on the front panel of the Switch.**

Section 1.4 (Cont)

Twisted Pair Port Specification

Manual Configuration

The front panel LEDs provides indication on the Status of each port. In addition, each port can be manually configured for speed, duplex and auto-negotiation using the push button panel located on the front of the Switch.

Normal Indication Mode

When the unit is first powered on the Switch front panel will operate in normal mode. In this condition the port LED will indicate link and traffic status.

Select Port Mode

The front panel will enter Select Port Mode when the Select Port button is pressed. Pressing the Select Port button once will illuminate Port 1 LED – manual control of this port is now available. Pressing the Select Port button a second time will illuminate Port 2 LED – manual control of this port is now available. Each additional port can be placed into Manual mode by subsequent pressing of the Select Port button.

If no buttons are pressed for 30 seconds the unit will return to Normal Mode.

Speed Button

Pressing the Speed Button once selects 10M, twice enables 100M and three enables auto-negotiation mode.

Duplex Button

Pressing the Duplex Button changes the Port duplex mode from full duplex to half duplex or vice versa.

Save Button

Newly configured settings are stored in non-volatile memory when the Save Button is pressed.

Note: Manual configuration of fibre ports is not possible.

Section 1.5

Fibre Optic Port Specification

Fibre Optic Communications

The fibre optic (FX) ports are available with either multi-mode or single mode fibre transceivers. Multi-mode transceivers are available with MTRJ, SC or ST style connectors. Single mode transceivers are only available with LC style connectors.

Transceiver Type	Light Wavelength	Fibre Diameter	Maximum Distance
Multi Mode 2KM	1300 nM	50/125 uM or 62.5/125uM	3 KM
Single Mode 15KM	1300 nM	9/125 uM	15 KM

Note: The fibre distance specified must take into account loss budgets as detailed below.

Section 1.5

Fibre Optic Port Specification (Cont..)

Fibre Optic Power Budgets

Single Mode Transceiver

SINGLE MODE (xx/125)	MTRJ 15km[dBm]
Max. Receive Power	-8
Min. Receive Power	-31
Max. Optical Power	-14
Min. Optical Power	-20

Multi Mode Transceiver

MULTI MODE (50/125)	MTRJ [dBm]
Max. Receive Power	-14
Min. Receive Power	-31
Max. Optical Power	-14
Min. Optical Power	-23,4

MULTI MODE (62.5/125)	MTRJ [dBm]
Max. Receive Power	-14
Min. Receive Power	-31
Max. Optical Power	-14
Min. Optical Power	-20

Note: Fibre Ports are always configured for 100 Mbit/s and full duplex.

Section 1.5.1

Fibre Optic Port Specification (Cont..)

Fibre Optic Care

Fibre optic transmission medium is usually made of Glass. In addition, the diameter of the fibre can be as low as 9um. In comparison, the diameter of an average piece of Human hair is 40 um.
Therefore, a small piece of dust or contaminate located on the end of a patch cable could easily disrupt communications.

The fibre optic transceivers and associated patch cables must be treated with great care. Therefore, the following rules should be adhered to during any commissioning work and fibre optic installation.

- Dust caps must be replaced immediately after removal of patch cable from transceiver or patch box. Failure to comply could result in damage to transceivers or patch cables.
- Keep hands clean when touching fibre optic cable.
- Patch cables should be cleaned with IPA and dried with a lint-free cloth before installation.
- Once patch cables have been installed dust will not ingress the transceiver

NOTE: Permanent damage to both fibre patch cords and fiber optic transceiver components may be the result of just a small invisible piece of dust!

Section 2.0

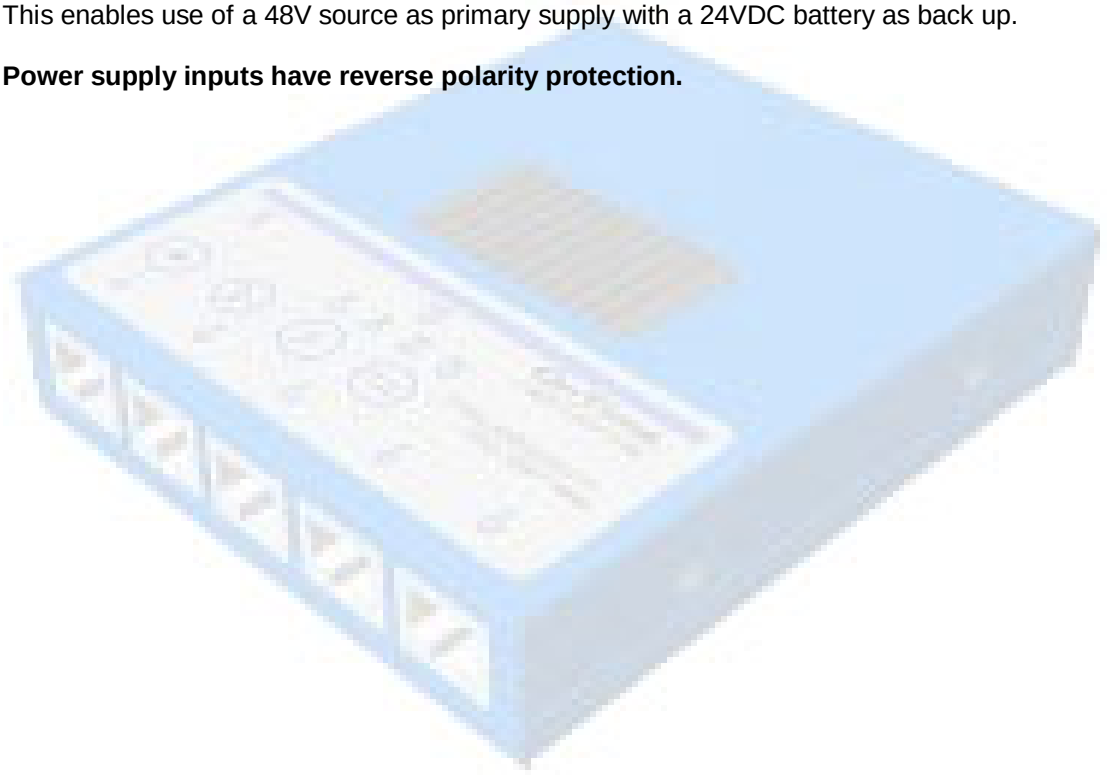
Switch Specifications

Power Supply Connector

The switch is designed to operate permanently over a very wide range of power (19 V DC to 72 V DC). Two redundant inputs are provided to provide enhanced redundancy if either supply fails.
The power supply draws power from the input that has the highest potential difference when compared to the alternate supply.

This enables use of a 48V source as primary supply with a 24VDC battery as back up.

Power supply inputs have reverse polarity protection.



Section 3.0

Switch Technical Specification

Interface Specifications

RJ-45 Ports	10/100 BaseT(x)
	Auto Negotiation Feature Speed Full and Half Duplex mode Auto MDI/MDI-X
	Manual Negotiation Speed Full and Half Duplex mode
Fibre Ports	100BaseFX Ports

Fibre Specifications

Distances	Multi mode Single mode	2-3KM 15KM
Wavelength	1300nM	

Power Specification

Input Voltage	19VDC..72VDC
Input Current (@24VDC)	Typical 3 Watts
Inrush Current	Not Greater Than Input Current.
Maximum Current	Maximum 5Watts (Model Dependant)

Section 5.0

Switch Technical Specification

Environmental Specification

Indoor use or corresponding environment
Altitude up to 2000M
Operating temperature (-40 .. +70°C)
Humidity 5-95'C RHD Non Condensing
Enclosure IP40

Climatic

Cold	IEC 68-2-1 Ad (-25 'C operational 16 Hours)
Storage	IEC 68-2-1 Ad (-40 'C 16 Hours)
Dry Heat	IEC 68-2-2 Bd (+70 'C operational 16 Hours)
Humidity	IEC 68-2-30 Db (25 'C .. 55 'C 95% 6 Cycles 24 Hours)

Mechanical

Oscillation	IEC 255-21-1 Class 1
Shock	IEC 255-21-2 Class 1
Enclosures	IEC 529, IP 40

Electromagnetic Compatibility (EMC)

Industrial Immunity	EN 61000-6-2
Industrial Emission	EN 50081-2
Home / Office Emission	EN 50081-1

Radiated Immunity

ESD	EN 61000-4-2 (4/8 kV)
Magnetic Field	EN 61000-4-8 (30A/m)
RF Field Disturbance	EN 61000-4-3 10 V/m 80% AM 80 .. 1000MHz

Section 5.0

Switch Technical Specification

Test Standards

Conducted Immunity

Fast Transients	EN 6100-4-4 AC/DC 2kV, Signal 1kV
Surge Immunity	EN 6100-4-5 AC: 2kV/1kV DC: 0.5kV/0.5kV Signal 1kV/-
Voltage Dips Voltage Interruptions	EN 6100-4-11 for AC Supply
Conduced RF Disturbance	EN 6100-4-6 10V, 80% AM, 0, 15-80 MHz

Radiated Immunity

ESD	EN 61000-4-2 (4/8 kV)
Magnetic Field	EN 61000-4-8 (30A/m)
RF Field Disturbance	EN 61000-4-3 10 V/m 80% AM 80 .. 1000MHz

Safety

Low Voltage Directive Standard	EN 60950

Class 1 equipment, in which exposed conductive parts are bonded to a connecting means for a protective conductor.

Eye Safety	IEC 825-1 Class 1

Section 5.1

Switch Technical Specification

Returns Procedure

Contact your equipment supplier before returning any equipment.

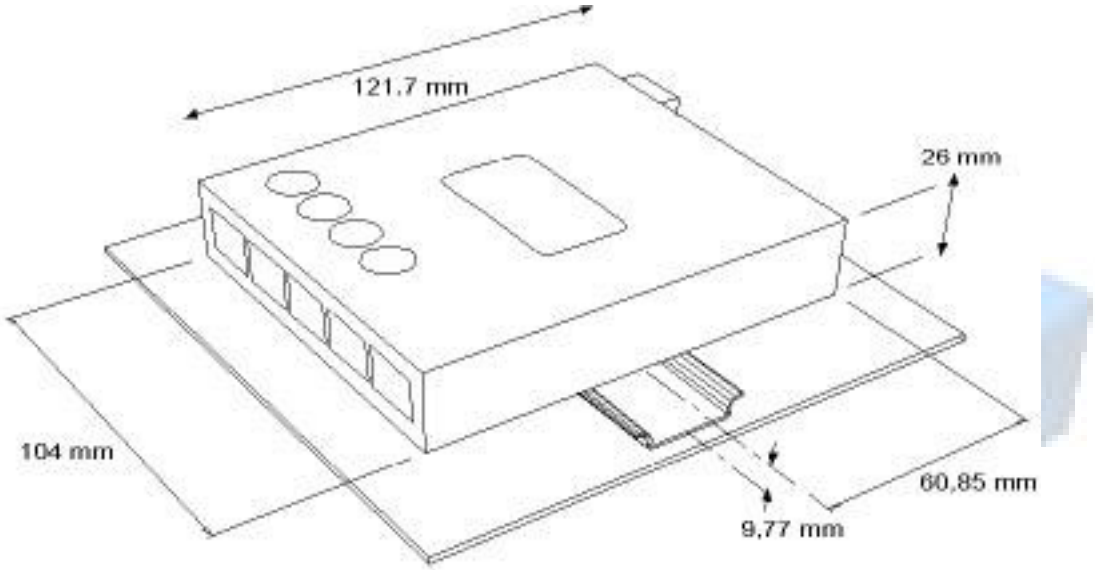
Equipment will not be accepted without an allocated returns number.

Section 5.2

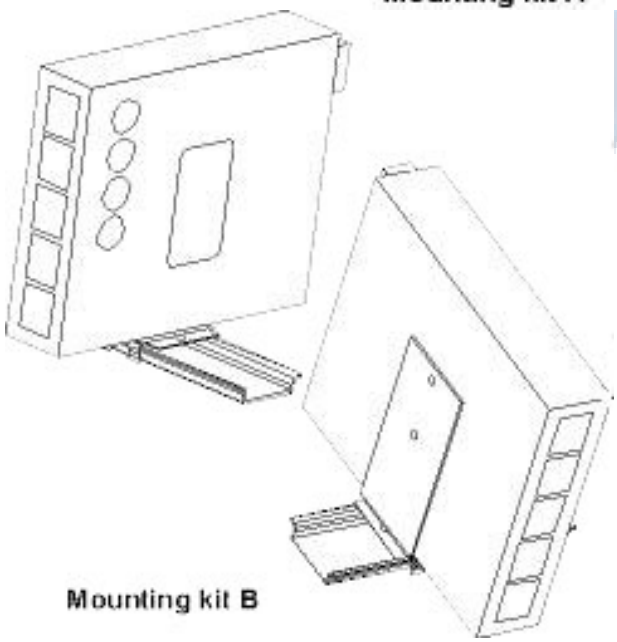
Physical Specification

In addition to the four rubber feet for desktop installation, two DIN Rail mounting options are available. Using the supplied screws the DIN clip can be attached to the bottom base plate of the switch. An additional mounting accessory is available for vertical DIN rail mounting.

Note that if the DIN clip is not mounted the switch will not fulfill ingress IP40 protection.



Mounting kit A



Mounting kit B