



RFL Electronics Inc.

RFL 3000 4K-8 Ethernet Switch

Installation and User Guide



April 25, 2006

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Important: RFL 3000 4K-Series Fiber Switches contain no user serviceable parts. Attempted service by unauthorized personnel shall render any and all warranties null and void. If problems are experienced with a RFL 3000 4K8 Switches, consult Section 6, Troubleshooting, of this User Guide.

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Federal Communications Commission Radio Frequency Interference Statement

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference in a residential installation. This equipment generates, uses, and can radiate frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures.

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into n outlet on a ccircuit different from that of which the receiver is connected.*
- *Consult the dealer or an experienced radio TV technician for help.*

Canadian Emission

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

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1.0 SPECIFICATIONS

1.1 Technical Specifications

Performance

Aggregate Filtering Rate: (all ports are wire speed)

1,190,400 frames/sec for 8 100Mbps ports (for RFL 3000 4K8)

Aggregate Forwarding Rate: (all ports are wire speed)

595,200 frames per second

Data Rate: 10 Mbps and 100Mbps

Address Table Capacity: 16K node addresses, self-learning w/address aging

Packet buffer size : 1 MB dynamic

Latency: 5 μ s + packet time (100 to 100Mbps)

15 μ s + packet time (10 to 10 Mbps, and 10 to 100Mbps)

Network Standards

Ethernet V1.0/V2.0 IEEE 802.3: 10BASE-T,

IEEE 802.3u: 100BASE-TX, 100BASE-FX

Maximum 10 Mbps Ethernet Segment Lengths

Unshielded twisted pair - 100 m (328 ft)

10BASE-FL multi-mode fiber optic - 2 km (6,562 ft)

10BASE-FL single-mode fiber optic - 10 km (32,810 ft)

Maximum Standard Fast Ethernet Segment Lengths:

10BASE-T (CAT 3, 4, 5 UTP) - 100 m (328 ft)

100BASE-TX (CAT 5 UTP) - 100 m (328 ft)

FX, half-duplex, multi-mode - 412 m (1350 ft) 100BASE-

FX, full-duplex, multi-mode - 2.0 km (6,562 ft)

100BASE-SX, short wavelength HDX m.m. - 300 m (935 ft)

100BASE-FX, half-duplex, single-mode - 412 m (1350 ft)

100BASE-FX, full-duplex, single-mode - 20.0 km (49,215 ft)

100BASE-FX, full-duplex, s.m(Long Reach)- 40.0 km (132,215 ft)

Connectors for copper wiring

Twisted Pair at 10/100Mb: RJ-45 shielded, female, front mounted

(for RFL 3000 K-Series Fast Ethernet copper ports, use Cat 5 cable)

Fiber Multi-mode connector types:

Fiber Port, SC-type (snap-in): Fiber optic multi-mode, 100BASE-FX

Fiber Port, ST-type (twist-lock): Fiber optic multi-mode, 100BASE-FX

Fiber Port, MTRJ-type (plug-in): Fiber optic multi-mode, 100BASE-FX

Fiber Port, VF-45 type (plug-in): Fiber optic multi-mode, 100BASE-FX

Fiber Port, ST-type (twist-lock): Fiber optic multi-mode, 10BASE-FL

Fiber Single-mode connector types:

Fiber Port, SC-type: Fiber optic single-mode, 100BASE-FX

Manual switch-selections and jumpers

Up-link Push-button: Crossover switch for one RJ-45 port#1
F-H: In F Port #9(fiber port)at full 100Mbps and in H at Half-duplex
Fiber default: Full-duplex (Internal jumpers may select HDX mode)
Copper default: Auto-negotiation

LEDs: Per Port

LK/Act: **Steady ON for Link with no traffic, blinking indicates**

F/H: ON = Full-Duplex Mode

OFF = Half-Duplex Mode

100/10: ON = 100Mbps speed

OFF = 10 Mbps

Operating Environment

Ambient Temperature: 25° to 140° F (-5° to 60°C)

Storage Temperature: 0°to 185°F (-40°to 85°C)

Ambient Relative Humidity: 5% to 95% (non-condensing)

Altitude: -200 to 13,000ft (-60 to 4000m)

Conformal coating options: Request quote

Packaging

Enclosure: Rugged High strength metal. Suitable for stand-alone or rack-mounting

Dimensions: 1.75 in H x 17.0 in W x 9.0 in D

4.45cm H x 43.2cm W x 22.9cm D

Weight: 3.2 lb. (1.4 Kg) rack-mount models

Cooling method: Fan cooled, @ 9 cfm

Power Supply (Internal)

AC Power Connector: IEC-type, male recessed at rear of chassis, with adjacent manual ON-OFF switch (on AC models only)

Input Voltage: 110 to 240 VAC (auto-ranging)

Input Frequency: 47 to 63 Hz (auto-ranging)

Power Consumption: 9 watts typical, 11 watts max.

Power Supply Rating: 3Amps at 5VDC

DC Power Supply (Options)

-48VDC Power Input Voltage : 36 to 72 VDC

24VDC Power Input Voltage : 20 to 36VDC

125VDC Power Input Voltage : 120 to 160VDC

Std. Terminal Block : “ -, GND, + ”

Power Consumption: same as for AC models, see above

For Dual Source and Redundant DC for -48VDC, 24VDC & 125VDC supply options (Optional), see Appendices

Mechanical

Enclosure : Rugged high strength sheet metal. Suitable for stand-alone or 1U rack mounting.

Rack-mounting brackets: 19" included; ETSI and 23" Telco optional.

Agency Approvals

UL listed (UL1950), cUL, CE

Emissions meet FCC Part 15 Class B

Optional: ETSI and NEBS L3 Certified

Warranty Three years, return to factory, Made in USA

1.2 Ordering Information

RFL 3000 4K8 Switches

| <u>MODEL</u> | <u>DESCRIPTION</u> |
|----------------------|--|
| RFL 3000 4K8 | Ethernet Switch with 8 RJ-45 ports, each auto-sensing for 10Mbps/10Mbps FDX/HDX operation. Optional fiber port may be configured from the family of modules below. Each port is switched and provides a full-speed traffic domain with non-blocking performance. Includes internal auto-ranging power supply, cooling fan, and metal brackets for rack-mounting. LEDs and user ports are in the front, power inputs is in the rear. Units with -48V power supply options available |
| RFL 3000 4K8R | “Reverse” model, Same as Model 4K8 Switch except user ports and the power input connectors are in the rear. |

Fiber Port Modules for RFL 3000 4K-Series(4K8 Switches only)

FPM-MSC

Fiber module for 4K8 Switches, with 100Mbps multi-mode FX SC connectors

FPM-MST

Fiber module for 4K8 Switches, with 100Mbps multi-mode FX ST connectors

FPM-SSC

Fiber module for 4K8 Switches, with 100Mbps single-mode FX SC connectors

FPM-MV45

Fiber module for 4K8 Switches, with 100Mbps multi-mode FX “VF-45” connectors

FPM-MTRJ

Fiber module for 4K8 Switches, with 100Mbps multi-mode FX “MTRJ” connectors

K8PM-RJ45

RJ-45 module for 4K8 Switches, with 100Mbps fixed RJ-45 ports, full or half-duplex

FPM10-MST

Fiber module for 4K8 Switches, with 10 Mbps multi-mode FL ST-type connectors

FPM-BLNK

Blank face plate, included in 4K8 switch unit when no fiber port option is selected

See appendices B and C for information on DC-powered models and options.

RFL reserves the right to change specifications, performance characteristics and/or model offerings without notice.

2.0 Introduction

2.1 Inspecting the Package and Product

Examine the shipping container for obvious damage prior to installing this product; notify the carrier of any damage that you believe occurred during shipment or delivery. Inspect the contents of this package for any signs of damage and ensure that the items listed below are included.

This package should contain:

- 1 RFL 3000 4K8 Switches
- 1 AC Power Cord (U.S. and other 115 VAC only)
- 1 Set of metal “Ears” for rack mounting
- 1 Installation and User Guide (this manual)
- 1 Product Registration Card

Remove the items from the shipping container. Be sure to keep the shipping container should you need to re-ship the unit at a later date. To validate the product warranty, please complete and return the enclosed Product Registration Card to RFL. as soon as possible.

In the event there are items missing or damaged, contact the party from whom you purchased the product. If the unit needs to be returned, please use the original shipping container if possible. Refer to Section 6, Troubleshooting, for specific return procedures.

2.2 Product Description - RFL 3000 4K8 Switches

RFL 3000 4K8 Switches boost the performance of Ethernet LANs, and have the flexibility of both twisted-pair switched ports and a fiber port. The optional fiber port considered as the additional 9th port, may be configured from a variety of user selected popular fiber connector. The 8 dual speed RJ-45 ports are 10/100 Mb and support auto-negotiating.

The RFL 3000 4K8 Switches provide the switching speed and the reliability to smoothly support multiple workgroups at 100Mbps or 10 Mbps speed. The optional “future-proof” fiber port is normally 100Mbps speed with factory default setting to operate in full-duplex mode. Alternatively, for 10Mbps fiber, a multi-mode half-duplex ST-type port option is available. The optional fiber port is normally configured and tested with the RFL 3000 4K8 unit in the factory, but may be configured in the field

Designed for use in departments with multiple workgroups, in remote offices and in network traffic centers or multi-system power users, the RFL 3000 4K8 Switches are easy to install and use. Addresses of attached nodes are automatically learned and maintained, adapting the switching services to network changes and expansions. Front-mounted LEDs provide status information on each port. The RFL 3000 4K8 Switches provide high performance plug-and-play operation in convenient rack-mount packages.

The RFL 3000 4K8 switches are non-blocking on all ports and include 1MB packet buffers and 16K-node address table for advanced performance. The RFL 3000 4K8 Switches, with store-and-forward switching, filter all faulty packets to minimize traffic congestion.

2.2.1 RFL 3000 4K8 Switch chassis

RFL 3000 4K8 Switches come in chassis size of an 8-port rack-mount. The rack-mount units are typically used in larger network wiring centers. The optional fiber port is user configurable and can be selected from the offered popular fiber port connectors. The fiber-port modules are normally factory installed, but may be changed or added in the field. (See Section 5). The 4K8 19” rack-mountable Switches comes along with eight 10/100 RJ-45 ports and one optional 10 or 100Mbps fiber port module on the right, i.e., with a capacity of 9 switched ports.



Figure 2.2.1a: Front view, 8-port RFL 3000 4K8 Switches

All port, LED, connector and manual switches are located on the front panel of RFL 3000 4K8 Switches. There are power(PWR) and error(Error) indicators for the unit. There are Link and Activity(Link/Act) indicators for each 10Mbps and 100Mbps domain, for visual indication of the operating status of each domain, and there are Speed and F/H Full and Half duplex Leds for each port. The manual switch with (=, x) supports the port#1 for crossover port feature, whereas “F-H” manual switch for FPM port are user selectable for full fixed and half duplex. The IEC standard AC power connector (and a manual ON - OFF power switch) located at the rear. Fan-driven cooling air flows left to right.

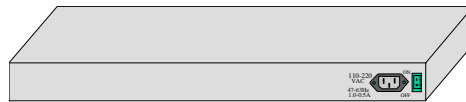
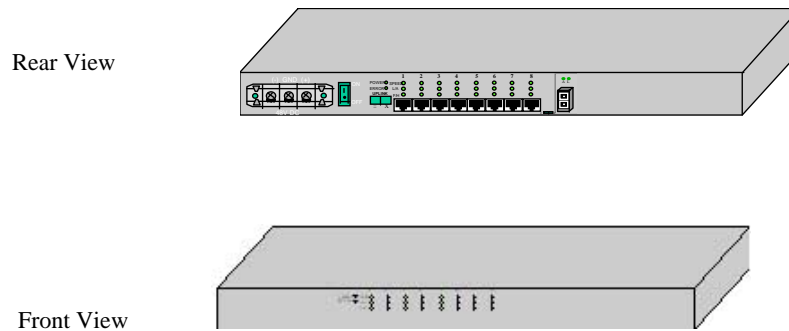


Figure 2.2.1b: Rear view - RFL 3000 table-top & rack-mount 4K8 Switch

2.2.2: RFL 3000 4K8R “Reverse” model, front LEDs and connections in rear



The RFL 3000 4K8R is like the 4K8F except that the front panel has the LEDs, and all the connecting ports and power feeds are in the back. This is convenient for rack-mounting where cabling is accessed from the rear of the rack while the operating status LEDs are monitored from the front. Typically such arrangements are found in Telco rack installations.

The RFL 3000 4K8R is dual-speed 10/100Mbps switch and has a fiber connector port options. The switching capability allow the RFL 3000 4K8R to support multiple workgroup smoothly with its own switched 100Mbps or 10Mbps domain. Normally the 4K8R is equipped with an optional internal 48VDC power supply (See Appendix A). There is an additional option of a dual-source 48V input (See Appendix B). The DC power feed options and the high quality and versatility make the RFL 3000 4K8R a good high-availability choice for Telcos, ISPs, broadcast equipment, medical, brokerage firm, financial facilities and Industrial Environment.

2.2.3 Fiber-port modules, 100Mb fiber

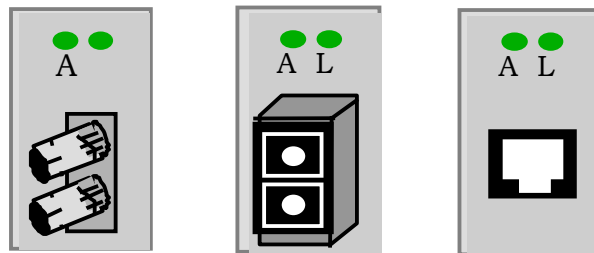


Fig.2.2.3 Fiber-Port Modules, FPM-ST, FPM-SC, FPM-MTRJ

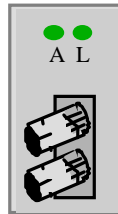
The fiber port module is optional for RFL 3000 4K8 Switch. In a fiber port module, all of the fiber ports are of the fixed speed at 100Mbps or 10Mb, either multi- or single-mode, and different connector type. Multi-mode 100Mbps models are available with ST, SC, and MTRJ connections. Single-mode 100Mbps models are available with SC connectors.

The 100Mb fiber port modules on the RFL 3000 4K8 normally are set (factory default) to operate in full-duplex mode for best fiber distance and performance. On the RFL 3000 4K8, the user may select full- or half-duplex mode per-port with an internal jumper setting (See Section 3.4) for the flexibility to adapt to any type of Fast Ethernet devices.

On RFL 3000 FPMs, there are two LED's per fiber port. The Link (LK) LED indicates "ready for operation" when lit, and an LED indicates Receiving Activity (ACT) on the port. A fiber cable must be connected to each 100Mb port and a proper link LK lit) must be made with the device at the other end of the cable in order for the LK LEDs to provide valid indications of operating conditions.

2.2.4 Fiber-port modules, 10 Mb fiber

The 10Mb model FPM10-MST fiber port module is the same as the 100Mb FPM-MST, except for 10 Mb speed rather than 100Mb speed. It supports distances according to the 10Base-FL standard, i.e., 2Km distance for multi-mode fiber. (Single-mode for 10km distance may be available as a special

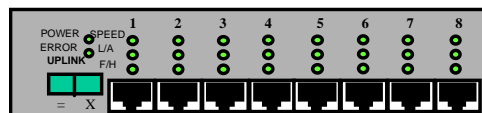


2.2.5 10/100 Dual-speed Switched ports, RJ-45 (copper)

The RFL 3000 4K8 copper has 8 port dual speed 10/100Mb switched. RJ-45 ports. The 10/100Mb switched ports are independently N-way auto-negotiating (as a default setting), for operation at 10 or 100Mb speed in full- or half-duplex mode. They independently move to half-duplex mode at 10 Mb or at 100Mb speed if the device at the other end of the twisted pair cable is half-duplex or is not an auto-negotiating device.

There are three LED's for each port. The LK/Act (Link/Activity) steady ON for Link with no traffic and blinking indicates port is receiving and transmitting. The Speed LED indicates operation at 100Mb speed when ON and at 10 Mb speed when OFF (when auto-negotiation is not disabled). The F/H LED is ON to indicate full-duplex operation and OFF to indicate half-duplex mode. A twisted pair cable must be connected into each RJ-45 10/100Mb port and a proper Link (LK lit) must be made with the device at the other end of the cable in order for the LEDs to provide valid indications of operating conditions.

The port#1 is equipped with a Media Dependent Interface-Crossover (MDI-X) push-button switch to simplify cascaded or up-link connections.



2.2.6 Frame Buffering and Latency

The RFL 3000 4K8 are store-and-forward switches. Each frame (or packet) is loaded into the Switch's memory and inspected before forwarding can occur. This technique ensures that all forwarded frames are of a valid length and have the correct CRC, i.e., are good packets. This eliminates the propagation of bad packets, enabling all of the available bandwidth to be used for valid information.

While other switching technologies such as "cut-through" or "express" impose minimal frame latency, they will also permit bad frames to propagate out to the Ethernet segments connected. The "cut-through" technique permits collision fragment frames, which are a result of late collisions, to be forwarded to add to the network traffic. Since there is no way to filter frames with a bad CRC (the entire frame must be present in order for CRC to be calculated), the result of indiscriminate cut-through forwarding is greater traffic congestion, especially at peak activity. Since collisions and bad packets are more likely when traffic is heavy, the result of store-and-forward operation is that more bandwidth is available for good packets when the traffic load is greatest.

To minimize the possibility of dropping frames on congested ports, each RFL 3000 4K8 Switches dynamically allocates buffer space from an 1MB memory pool, ensuring that heavily used ports receive very large buffer space for packet storage. (Many other switches have their packet buffer storage space divided evenly across all ports, resulting in a small, fixed number of packets to be stored per port. When the port buffer fills up, dropped packets result.) This dynamic buffer allocation provides the capability for the maximum resources of the RFL 3000 4K8 unit to be applied to all traffic loads, even when the traffic activity is unbalanced across the ports. Since the traffic on an operating network is constantly varying in packet density per port and in aggregate density, the RFL 3000 4K8 Switches are constantly adapting internally to provide maximum network performance with the least dropped packets.

When the Switch detects that its free buffer queue space is low, the Switch sends industry standard (full-duplex only) PAUSE packets out to the devices sending packets to cause "flow control". This tells the sending devices to temporarily stop sending traffic, which allows a traffic catch-up to occur without dropping packets. Then, normal packet buffering and processing resumes. This flow-control sequence occurs in a small fraction of a second and is transparent to an observer. See Section 4.6 for additional details.

Another feature implemented in RFL 3000 4K8 Switches is a collision-based flow-control mechanism (when operating at half-duplex only).

When the Switch detects that its free buffer queue space is low, the Switch prevents more frames from entering by forcing a collision signal on all receiving half-duplex ports in order to stop incoming traffic.

The latency (the time the frame spends in the Switch before it is sent along or forwarded to its destination) of the 4K8 Switches varies with the port-speed types, and the length of the frame is a variable here as it is with all store-and-forward switches. For 10 Mb-to-10 Mb or 10 Mb-to-100Mb or 100Mb-to-10 Mb forwarding, the latency is 15 microseconds plus the packet time at 10 Mb. For 100Mb-to-100Mb forwarding, the latency is 5 microseconds plus the packet time at 100Mb.

2.3 Features and Benefits

- **100Mb switching services for large, high performance Ethernet LANs**
RFL 3000 4K8 Switches provide Fast Ethernet switching on all ports. They perform high speed filter/forward operations on the traffic, giving each port's segment a full 100Mb (or 10 Mb) of bandwidth.
- **Option to configure a fiber port (port 9), all fiber connector types**
Fiber port modules are available with 100Mb mm ST, SC, VF-45, MTRJ single-mode SC, and 10 Mb ST-type connectors. The configuration of the fiber port, in the factory or in the field, allows the 4K8 Switches to adapt to mixed and changing fiber types in any application.
- **Manual Switch "F-H" for user configurable**
The Manual switch "F-H" allows the user to setup port#9(fiber port) as per their convenience to 100Mbps full-duplex at "F" and half- duplex at "H" mode by sliding the manual switch under the FPM Port.
- **Eight RJ-45 (copper) ports, 10/100 auto-negotiation**
RJ-45 ports provide twisted pair segment connections, with N-way auto-negotiation per port and full and half manual settings for optional port.
- **Full-duplex or Half-duplex operation, auto-sensing**
All fiber and RJ-45 (copper) ports are capable of half- or full-duplex, individually selected. All RJ-45 ports support 10/100 auto-negotiation.
- **Rack-mounting may be std or "reverse", 19 inch, ETSI or 23" Telco**
The standard rack mounting provides Ethernet ports and status LEDs in front, service connections (power input and Ethernet cables) in the rear. "Reverse" rack mounting provides status LEDs in front and all cabling connections in the rear. Standard 19' rack mount brackets are included, while ETSI and 23" Telco are optional.

- **Plug-and-Play installation for high performance switching**
RFL 3000 4K8 Switches are self-learning for node addresses. They can be placed into operation without complex set-up procedures, even in large networks. They operate transparent to system software.
- **Standard AC power input, -48VDC, 24VDC, or 125VDC is available**
Standard AC power input is IEC plug, auto-ranging for worldwide use. For special applications, models with -48VDC, 24VDC, or 125VDC are available. Dual source DC input can also be selected and configured on the -48VDC, 24VDC, and 125VDC input models.
- **Extended Temperature Operation**
The RFL 3000 4K8 has been tested for operation at temperatures of -5°C to 55°C. NEBS-certified models have been tested to a greater range per NEBS Level 3 requirements.

2.4 Applications

RFL 3000 4K8 Switches offer high performance and flexibility, and are easily used in a variety of applications including client/server computing, performance upgrades of departmental networks, and collapsed backbone applications. The Dual-Speed characteristic of the 4K8 Switches enables them to inter-connect a series of subnets (one subnet per 4K-Series Switch) in a LAN traffic center. The subnet connections may be via either optional fiber or twisted pair cabling, and may be 100Mbps or 10 Mbps speed and full-or half-duplex mode.

The mixed-media capability is ideal for upgrading existing Ethernet LAN networks, where existing cabling must be accommodated. The fiber-built-in media capability is ideal for integrating future-proof fiber cabling into the LAN structure.

Example1: In general application, a Switch is needed to provide a Fast Ethernet backbone. The backbone consists of four high-speed LAN segments, each operating over 100MB full-duplex fiber lines. In addition to interconnecting the fiber backbone segments in the network center, the Switch needs to provide high-speed switched support for two central servers, for a 100MB connection to a router, and for a dual-speed hub serving a local workgroup of over a dozen users, printers, etc.

The RFL 3000 4K8 equipped with one optional Fiber port and eight RJ-45 ports provides an economical solution, configured with 8 switched ports (10/100 RJ-45) in a rack-mount box. No Media Converters are needed. The Fiber FPM can be selected to provide any 100Mbps fiber media connector type desired. FPMs with multi-mode or single-mode fiber types are available.

This requirement for connecting local devices over twisted pair cabling is handled by the RFL 3000 4K8 with one optional Fiber-Port Module. The FPM provides a switched port for distance with high bandwidth throughput to the connected network away from the present network.

Since 100Mb fiber Ethernet has severe distance limitations at half-duplex, it is necessary in high speed backbones to operate fiber links in the full-duplex mode. Many low-end switches that only have RJ-45 N-way 10/100Mb ports would need to have a media converter on each fiber line. But most media converters do not support auto-negotiation and would not enable the fiber backbone lines to operate full-duplex. But the RFL 3000 4K8 . . . with optional switched fiber ports at 100Mb speed, with full-duplex mode as a default setting on fiber ports, and with some RJ-45 N-way 10/100Mb ports as well. . . handles this application readily.

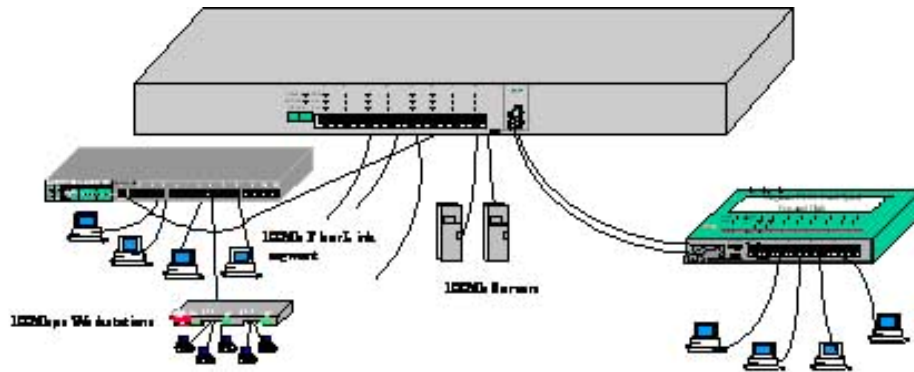


Figure 2.4a: The RFL 3000 4K8 provides a 100Mb fiber backbone with high bandwidth facility.

Example 2:

In another situation similar to Example 1 above, a central Switch is needed to provide for a 8-segment 100Mb fiber Fast Ethernet backbone with switched copper support for 1 high speed local servers and 5 personal network setup for each different departments. In addition, the router and 1 port for future expansion.

The RFL 3000 4K8 switches fit nicely in this environment with future backbone expansion. The 8 switched copper ports are handled with RFL 3000 4K8. Should the number of servers expand, more than one server can be serviced by a switched 4K8 port by using any of 10/100Mbps switched port.

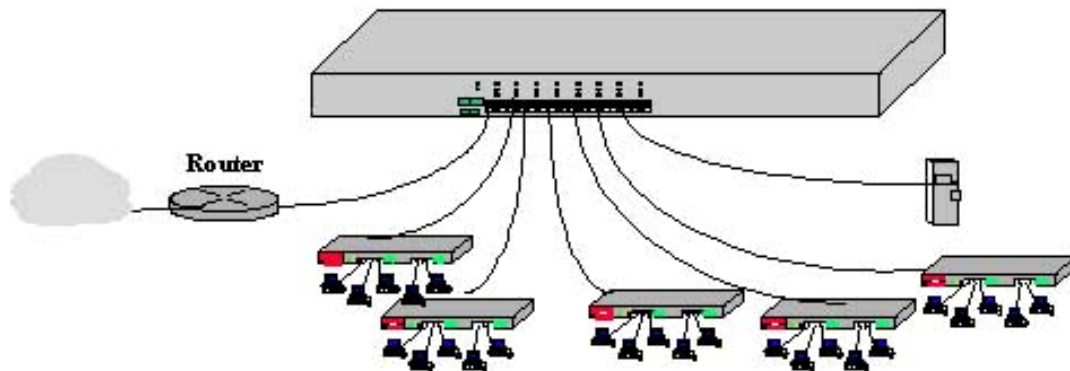


Fig 2.4b: RFL 3000 4K8 provides a 100Mb backbone Switch.

3.0 Installation:

This section describes installation of the RFL 3000 4K8 Switches, as well as connection of the various Ethernet media types.

Before installing the equipment, it is necessary to take the following precautions:

- 1.) If the equipment is mounted in an enclosed or multiple rack assembly, the environmental temperature around the equipment must be less than or equal to 50⁰C.
- 2.) If the equipment is mounted in an enclosed or multiple rack assembly, adequate air flow must be maintained for proper and safe operation.
- 3.) If the equipment is mounted in an enclosed or multiple rack system placement of the equipment must not overload or load unevenly the rack system.
- 4.) If the equipment is mounted in an enclosed or multiple rack assembly, verify the equipment's power requirements to prevent overloading of the building/s electrical circuits.
- 5.) If the equipment is mounted in an enclosed or multiple rack assembly verify that the equipment has a reliable and uncompromised earthing path.
- 6.) If the intra-building wiring (cabling) is involved with this product(NEBS), then it is recommended to have shielded cable and the shield is grounded at both ends.

3.1 Locating RFL 3000 4K8 Switches

The location of a RFL 3000 4K8 Switch is dependent on the physical layout of the network. Typically the Switch is placed in a central wiring location where groups of network devices need to be connected in order to communicate with each other. These Switches are typically rack mounted in a wiring closet (see Section 3.3.2 below), but because they have rubber feet they can also be installed on a shelf or table top.

Locate an AC receptacle that is within six feet (2 meters) of the intended RFL 3000 4K8 Switch site. The rugged metal case of the RFL 3000 4K8 Switch will normally protect it from accidental damage in a lab or workplace setting. Maintain an open view of the front to visually monitor the status LEDs. Keep an open area around the sides of the unit so that cooling can occur from the small fan on the top of the main switching chip, while the unit is in operation.

3.2 Connecting Ethernet Media

The RFL 3000 4K8 Switches are specifically designed to support all standard Ethernet media types within a single Switch unit. This is accomplished by using a family of Fiber-port Modules (FPMs) which can be individually selected and configured per-port. See Section 2.4 for a description of the FPMs.

The various media types supported along with the corresponding IEEE 802.3 and 802.3u standards and connector types are as follows:

| <u>IEEE Standard</u> | <u>Media Type</u> | <u>Max. Distance</u> | <u>Port Module</u> |
|------------------------------------|--------------------------|----------------------|--------------------|
| <u>Fiber:</u> | | | |
| 100BASE-FX | mm ¹ Fiber | 2.0km (6,562 ft) | FPM-MSC, -MST |
| | sgl.m ² Fiber | 18.0km (95K ft) | FPM-SSC |
| small form factor | mm ¹ Fiber | 2.0km (6,562 ft) | FPM-MTRJ, -MV45 |
| 10BASE-FL | mm ¹ Fiber | 2.0km(6,562 ft) | FPM10-FST |
| <u>Copper:</u> | | | |
| 10BASE-T & 100BASE-TX twisted pair | | 100m (328 ft) | RJ45 |

¹ mm = multi-mode ² sgl.m = single-mode

3.2.1 Connecting Fiber Optic ST-type, “twist-lock”

The following procedure applies to installations using a FPM with ST-type fiber connectors. This procedure applies to ports using a FPM-MST or FPM10-MST.

1. Before connecting the fiber optic cable, remove the protective dust caps from the tips of the connectors on the FPM. Save these dust caps for future use.
2. Wipe clean the ends of the dual connectors with a soft cloth or lint-free lens tissue dampened in alcohol. Make certain the connectors are clean before connecting.
Note: One strand of the duplex fiber optic cable is coded using color bands at regular intervals; you must use the color-coded strand on the associated ports at each end of the fiber optic segment.
3. Connect the Transmit (TX) port (light colored post) on the RFL 3000 FPM to the Receive (RX) port of the remote device. Begin with the color-coded strand of the cable for this first TX-to-RX connection.
4. Connect the Receive (RX) port (dark colored post on the PM) to the Transmit (TX) port of the remote device. Use the non-color coded fiber strand for this.
5. The LINK LED on the front of the FPM will illuminate when a proper connection has been established at both ends (and when power is ON in the unit). If LINK is not lit after cable connection, the normal cause is improper cable polarity. Swap the fiber cables at the FPM connector to remedy this situation.

3.2.2 Connecting Fiber Optic SC-type, "Snap-In"

The following procedure applies to installations using a FPM with SC-type fiber connectors, i.e., using FPM-MSC, FPM-SSC single-mode, and FPM10-MSC.

When connecting fiber media to SC connectors, simply snap on the two square male connectors into the SC female jacks of the FPM until it clicks and secures.

3.2.3 Connecting Single-Mode Fiber Optic

When using single-mode fiber cable, be sure to use single-mode fiber port connectors. Single-mode fiber cable has a smaller diameter than multi-mode fiber cable (9/125 microns for single-mode, 50/125 or 62.5/125 microns for multi-mode where xx/xx are the diameters of the core and the core plus the cladding respectively). Single-mode

fiber allows full bandwidth at longer distances, and may be used to connect 10 Mb nodes up to 10 Km apart, or 18Km with the FPM-SSC.

The same procedures as for multi-mode fiber applies to single-mode fiber connectors. Follow the steps listed in Section 3.2.2 above.

3.2.4 Connecting Twisted Pair (RJ-45, CAT3, CAT5, Unshielded or Shielded)

The RJ-45 ports of the RFL 3000 4K-Series can be connected to the following two media types: 100BASE-TX and 10BASE-T. CAT 5 cables should be used when making 100BASE-TX connections. When the ports are used as 10BASE-T ports, CAT 3 may be used. In either case, the maximum distance for unshielded twisted pair cabling is 100 meters (328 ft).

| <u>Media</u> | <u>IEEE Standard</u> | <u>Connector</u> |
|----------------------------|----------------------|------------------|
| Twisted Pair (CAT 3, 4, 5) | 10BASE-T | RJ-45 |
| Twisted Pair (CAT 5) | 100BASE-TX | RJ-45 |

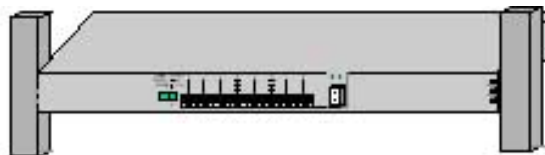
NOTE : *It is recommended that high quality CAT. 5 cables (which work for both 10 Mb and 100Mb) be used whenever possible in order to provide flexibility in a mixed-speed network, since dual-speed ports are auto-sensing for either 10 and 100Mb/s.*

The following procedure describes how to connect a 10BASE-T or 100BASE-TX twisted pair segment to the RJ-45 port. The procedure is the same for both unshielded and shielded twisted pair cables.

1. Using standard twisted pair media, insert either end of the cable with an RJ-45 plug into the RJ-45 connector of the port. Note that, even though the connector is shielded, either unshielded or shielded cables and wiring may be used.
2. Connect the other end of the cable to the corresponding device
3. Use the LINK LED to ensure proper connectivity by noting that the LED will be illuminated when the unit is powered and proper connection is established.

3.3 Rack-mounting

Installation of a RFL 3000 4K8 Switch in a 19" rack is a simple procedure. The units are 1U (1.70") high. When properly installed, the front-mounted LED status indicators should be in plain view and easy to read. Rack-mount installation requires special 19" rack-mounted brackets and screws (included with each 4K8 unit). The brackets attach to the front sides of the Switch, which is then fastened into a standard 19" RETMA rack.



The 23" brackets and ETSI brackets are also available (optional) for rack-mounting of RFL 3000 4K Series Switches. The 23" brackets are popular in the Telco industry where they are a standard for Central Office rack mounting purposes. The 23" brackets are

mainly being used for larger equipment assemblies in rack-mounting frames, and are frequently accessed in operation from both sides.

The ETSI (European Telephone Standard) brackets are similar to the 19" brackets but use metric dimensions.

The optional 23" brackets and the ETSI brackets come as a pair in a package, along with the necessary screws for attaching the brackets to the sides of the RFL 3000 Switch unit.

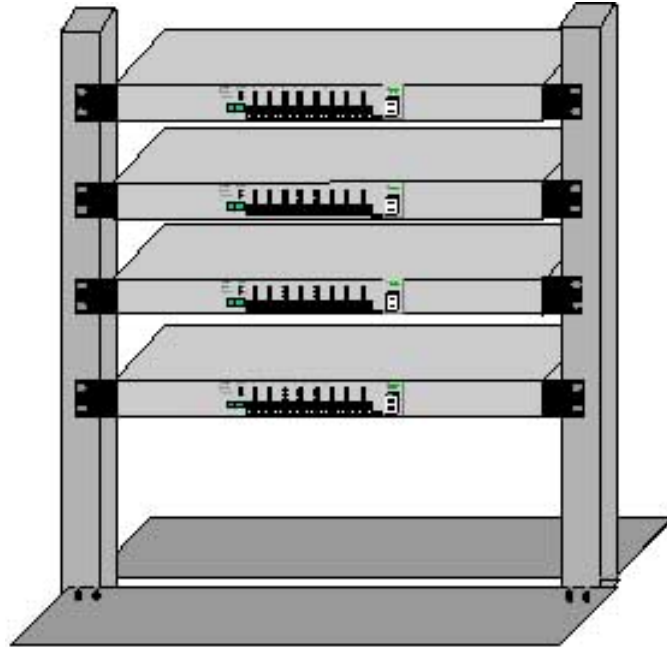


Fig 3.3 Multiple RFL 3000 4K8 units rack-mounted in a 23" frame

3.4 Fiber Port Module (FPM) Installation

The RFL 3000 4K-Series Fiber Switches are normally received from the factory with all required FPM modules installed. There may be situations where FPM cards need to be added or replaced. In cases where additional FPM cards are needed, the face plate for an available front-mounted slot must be removed. The following procedure describes this operation.

3.4.1 Preparation for Installing and Removing FPMs

STOP!!!

Be sure the power cord is unplugged from the chassis before attempting to remove and/or replace any FPM cards. Failure to do so may result in damage to the unit and will void the warranty.

Caution- Avoid Static Discharge: The Fiber port modules (like most electronic equipment) are sensitive to static discharge. Use proper ESD measures when handling port modules.

Step 1. Make sure the FPM Card package has all necessary accessories to install it properly. The FPM Card package for field installation comes along with a FPM Card, enclosed with the **Fiber Port Module Insertion guide**.

NOTE: Please read the Port Module Insertion guide and 4K8 Manual thoroughly before doing any field installation of FPM card.

Step 2. Remove Chassis Cover

The RFL 3000 4K8 chassis are combined with top and bottom part and assembled together with the help of 20 Philips head screws. There are 7 screws located on front-top of the unit and three screws each on the left and right edges. Remove these screws. Once these are removed, the top cover is easily lifted off the chassis base. When the chassis top cover has been removed, the interior of the unit is exposed.

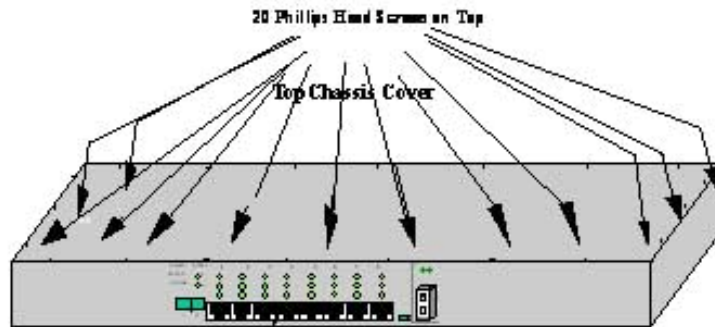
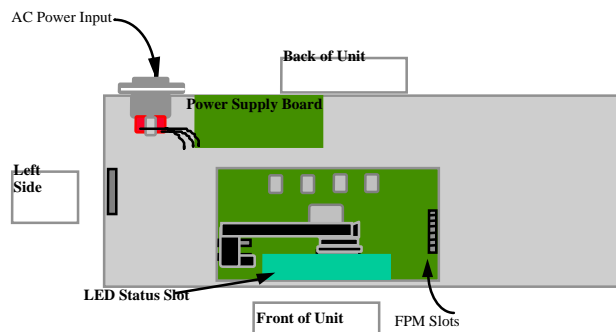


Figure 3.4.1a: Removing Chassis Cover

Caution: Be careful not to disturb the power supply.

Looking down into the RFL 3000 4K8 unit, notice that there are one FPM connector sockets located on the extreme right in front for FPM card position. The Easier way to



find the FPM socket, is to look exactly behind the Fiber port module slot. (See Figure 3.4.1b

Figure 3.4.1b: RFL 3000 4K8 Switch, Top View without Chassis Cover

Step 2. Remove bottom-front Retaining Screws in any PM or Face Plates

On the bottom-front of the unit, there is one retaining screw for FPM card slot. These screws are used to secure a FPM face plate in position. These screws are also used to secure the individual FPM cards, which can be subjected to significant forces from the attached cables. (See Figure 3.4.1c)

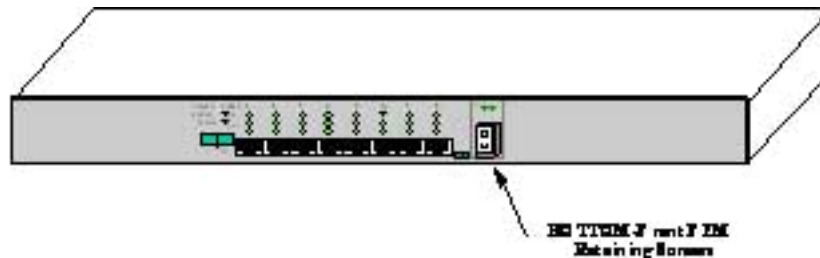


Figure 3.4.1c: Front View - FPM Retaining Screws hold Face Plates

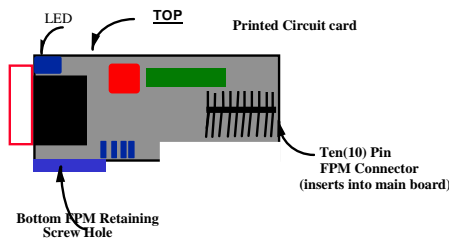
PM card installation is covered in Section 3.4.2. FPM card removal is covered in Sect.3.4.3.

3.4.2 Installing FPM Cards in the RFL 3000 4K8 Switches

Up to sixteen front-mounted FPM card may be installed in one RFL 3000 4K8 Switch unit. Follow these steps to install a FPM.

Step 1. Remove front-top chassis cover. See procedure in Section 3.4.1 above.

Step 2. The figure here illustrates the basic layout of an individual FPM card. Each FPM card fits into the selected FPM connector socket slot. Align the connector pins on the bottom of the FPM card with the connector socket inside the unit. The pins are slightly angled to facilitate the installation. **(Do NOT straighten the pins before insertion !!)**



Step 3. Be sure the pins are precisely aligned with the holes in the header, and the FPM front panel is guided into the front slot cut-out. Then, slowly and carefully apply enough pressure to insert the FPM card pins into position, see Figure 3.4.2b. (If

you force the FPM down when the pins are not properly aligned with the holes in the header, the pins will become bent and the FPM is damaged).

Once inserted, the FPM card will be secured by the header connector, the front panel port slot cut-out, and retaining screws.

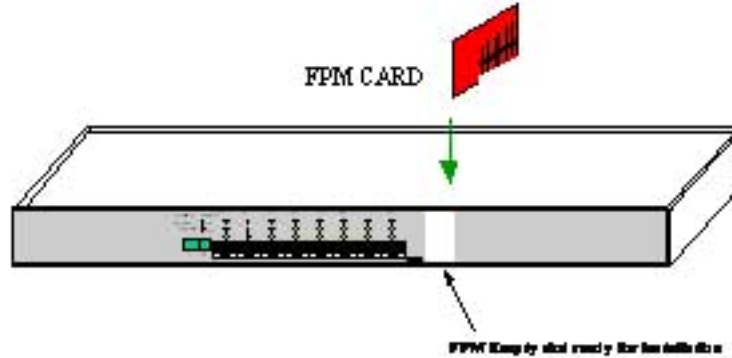


Figure 3.4.2b: Inserting PM Cards into a RFL 3000 4K8

NOTE: *The optional FPM slots need not be filled in order for the RFL 3000 4K8 unit to be operational. When leaving FPM slots empty, always use a face plate (RFL 3000 FPM-BLNK) to cover the slot opening in the front panel. This will maintain proper cooling air flow, safety, and operation as required by FCC, CE, and other regulations.*

Step 4. Once FPM cards have been installed, the chassis cover should be replaced.

3.4.3 Removing FPM Cards from RFL 3000 4K8 Switches

To properly remove an FPM card from a 4K8 Switch, follow the 3 steps below.

Step 1. Remove chassis cover See procedure in Section 3.4.1 above.

Caution: Be sure the power cord is unplugged.

Step 2. Remove bottom-front retaining screw for the FPM and Face Plate

On the bottom-front of the unit there is one retaining screws for each FPM card and face plate slot. These screws are used to secure a FPM card in position (see Figure 3.4.3a). Remove the front screw of the FPM to be removed.

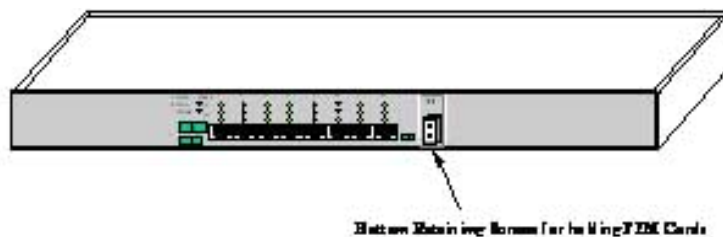


Figure 3.4.3a: Front View - Face Plate & FPM Retaining Screws

Step 3. Remove FPM Card

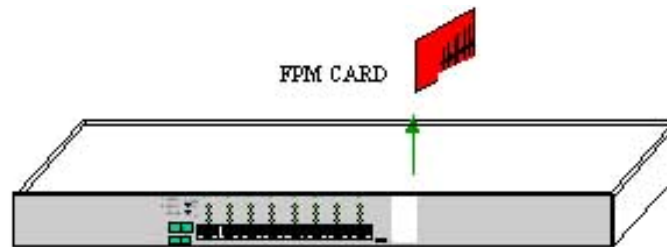


Figure 3.4.3b: Removing a FPM Card

If the slot from which the FPM card has been removed is to remain unused, be sure to install a FPM-BLNK face plate cover in it. If another FPM card is replacing the one that has been removed, follow the steps as described for installing a FPM card discussed in Section 3.4.1.

3.5 Powering the RFL 3000 4K8 Switch

The RFL 3000 4K-Series Switches incorporate an internal universal power supply, and has a recessed male IEC connector for the AC power cord at the left-rear. A manual power ON-OFF switch is adjacent. A six-foot 115 VAC 60 Hz standard power cord is supplied with each unit shipped within the United States and Canada.

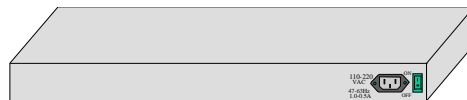


Figure 3.5: RFL 3000 4K8 AC power connector

4.0 OPERATION

This chapter describes the functions and operation of the 4K8 Switch.

4.1 Switching Functionality

A RFL 3000 4K-Series provides switched connectivity at Ethernet wire-speed among all of its ports. The RFL 3000 4K-Series supports 10/100Mbps for copper media and 10 or 100Mb separate traffic domain for fiber port to maximize bandwidth utilization and network performance. All ports can communicate to all other ports in a RFL 3000 4K8, but local traffic on a port will not consume any of the bandwidth on any other port.

RFL 3000 4K-Series units are plug-and-play devices. There is no software configuring to be done at installation or for maintenance. The only hardware configuration settings are user options for bonus port (port# 9) on RJ-45 and fiber port. Half / Full duplex mode and 10 or 100Mbps selection for the switched ports can be done through jumper settings inside the unit. The internal functions of both are described below.

Filtering and Forwarding

Each time a packet arrives on one of the switched ports, the decision is taken to either filter or to forward the packet. Packets whose source and destination addresses are on the same port segment will be filtered, constraining them to that one port and relieving the rest of the network from processing them. A packet whose destination address is on another port segment will be forwarded to the appropriate port, and will not be sent to the other ports where it is not needed. Traffic needed for maintaining the operation of the network (such as occasional multi-cast packets) is forwarded to all ports.

The RFL 3000 4K-Series Switches operate in the store-and-forward switching mode, which eliminates bad packets and enables peak performance to be achieved when there is heavy traffic on the network.

Address Learning

All 8-port RFL 3000 4K-Series units have address table capacity of 16K node addresses suitable for use in large networks. They are self-learning, so that as nodes are added or removed or moved from one segment to another, the 4K8-Port Switch automatically keeps up with node locations.

An address-aging algorithm causes least-used addresses to fall out in favor of

4.2 Status LEDs

For RFL 3000 4K8 models :

- PWR** : Power LED, ON when external power is applied to the unit.
- ERROR** : Self-test at power up failed
- LK/Act** : Steady ON for link with no traffic, blinking indicates port is transmitting and receiving.
- F/H** : Full / Half duplex LED, ON when the port is running full duplex, OFF for half duplex.
- Speed** : Speed LED, ON when the speed is 100Mbps , OFF when the speed is 10 Mbps

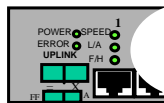


Figure 4.3 : Up-link push-button on RJ-45 Port#1

The RFL 3000 4K8 Switch has a manual Up-link sliding switch, located on the front panel next to 10/100Mb RJ-45 port # 1 which it controls. It enables the port's cable to either connect to a user station node (push in) or to be cascaded (push out) to a

10/100Mb repeater or switching hub in the network. Verify proper Up-link push-button position by noting Port 1's LK (link) LED status, which is illuminated when a proper link is made.

4.3 Manual Switches “F-H”, for FPM Port#9 only

The RFL 3000 4K8 Switch has a manual sliding switch called “F-H” located on the front panel next to Fiber port # 9 which it controls. While on “F” position enables the port # 9(Fiber port module) to full fixed 100Mbps only whereas in “H” position led the port#9 to set at half-duplex.

The RFL 3000 4K-Series Fast Ethernet bonus copper port# 9 can be set for either fixed 100Mb speed or for 10/100 F/H N-way auto-negotiation per the IEEE802.3u standard. The selection is made via an internal jumper. The factory default setting for RJ-45 port is auto-negotiation

4.4 Auto-negotiation, for Fast Ethernet copper ports

One frequently-used application for the RFL 3000 4K8-Switch copper ports is to connect one of them using a fiber media converter to another Switch in the network

backbone, or to some other remote 100Mb device. In this case, it is desirable to operate the fiber link at 100Mb speed, and at either half- or full duplex mode depending on the capabilities of the remote device. Standard commercially-available Fast Ethernet media converters mostly do not support auto-negotiation properly, and require that the switched port to which they are connected be at 100Mb fixed speed. Attachment to 10/100 auto-negotiation ports typically will not work properly.

When 4K8-Switch's RJ-45 copper ports are set for auto-negotiation and connected to an another auto-negotiating device, there are 4 different speed and F/H modes selection depending on what the other device supports. These are: (1) 100Mb full-duplex, (2) 100Mb half-duplex, (3) 10 Mb full-duplex and (4) 10 Mb half-duplex. The auto-negotiation logic will attempt to operate in descending order and will normally arrive at the highest order mode that both devices can support at that time. (Since auto-negotiation is potentially an externally-controlled process, the original “highest order mode” result can change at any time depending on network changes that may occur). If the device at the other end is not an auto-negotiating device, the 4K8-Switch's RJ-45 ports will try to detect its idle signal to determine 10 or 100 speed, and will default to half-duplex at that speed per the IEEE standard.

General information -

Auto-negotiation per-port for 802.3u-compliant switches occurs when:
the devices at both ends of the cable are capable of operation at either 10 Mb or 100Mb speed and/or in full- or half-duplex mode, and can send/receive auto-negotiation pulses, and . . .

-- when the second of the two connected devices is powered up*, i.e., when LINK is established for a port, or
when LINK is re-established on a port after being lost temporarily.

- **NOTE** – *some NIC cards only auto-negotiate when the computer system that they are in is powered up. These are exceptions to the “negotiate at LINK – enabled” rule above, but may be occasionally encountered.*

When operating in 100Mb half-duplex mode, cable distances and hop-counts may be limited within that collision domain. The Path Delay Value (PDV) bit-times must account for all devices and cable lengths within that domain. For RFL 3000 4K-Series Fast Ethernet switched ports operating at 100Mb half-duplex, the bit time delay is 50BT.

4.6 Auto-negotiation for 10/100Mb ports,

The RFL 3000 4K-Series Switches perform half- or full-duplex mode auto-negotiation independently on all switched ports. If the device or node on the other end of a port's attached cable supports auto-negotiation, the RFL 3000 4K8 Switch will negotiate to run full-duplex. If the attached device or node doesn't support auto-negotiation (for example, if it is a 10 Mb repeater or a standard 10 Mb hub), the K-Switch's RJ-45 ports will default to operate at half-duplex.

4.7 Flow-control, IEEE 802.3x standard

RFL 3000 4K- Series Switches incorporate a flow-control mechanism for Full-Duplex mode. The purpose of flow-control is to reduce the risk of data loss if a long burst of activity causes the switch to save frames until its buffer memory is full. This is most likely to occur when data is moving from a 100Mb port to a 10 Mb port, and the speed difference makes the 10Mb port unable to keep up. It can also occur when multiple 100Mb ports are attempting to transmit to one 100Mb port, and in other protracted heavy traffic situations.

RFL 3000 4K-Series Fiber Switches implement the 802.3x flow control (non-blocking) on Full-Duplex ports, which provides for a “PAUSE” packet to be transmitted to the sender when the packet buffer is nearly filled and there is danger of lost packets. The transmitting device is commanded to stop transmitting into the 4K8-switch port for sufficient time to let the Switch reduce the buffer space used. When the available free-buffer queue increases, the Switch will send a “RESUME” packet to indicate the transmitter to start sending the packets. Of course, the transmitting device must also support the 802.3x flow control standard in order to communicate properly during normal operation.

Note: When in Half-Duplex mode, the 4K8-switch implements a back-pressure algorithm on 10/100 Mb ports for flow control. That is, the switch prevents frames from

entering the device by forcing a collision indication on the half-duplex ports that are receiving. This temporary “collision” delay allows the available buffer space to improve, as the switch catches up with the traffic flow.

4.8 Power Budget Calculations for 4K-Series FPM’s with Fiber Media

Receiver Sensitivity and Transmitter Power are the parameters necessary to compute the power budget. To calculate the power budget of different fiber media installations using RFL 3000 products, the following equations should be used:

$$\text{OPB (Optical Power Budget)} = P_T(\text{min}) - P_R(\text{min})$$

where P_T = Transmitter Output Power, and P_R = Receiver Sensitivity

$$\text{Worst case OPB} = \text{OPB} - 1\text{dB}(\text{for LED aging}) - 1\text{dB}(\text{for insertion loss})$$

$$\text{Worst case distance} = \{ \text{Worst case OPB, in dB} \} / [\text{Cable Loss, in dB/Km}]$$

where the “Cable Loss” for 62.5/125 and 50/125 μm (M.m) is 2.8 dB/km,

and the “Cable Loss” for 100/140 (Multi-mode) is 3.3 dB/km,

and the “Cable Loss” for 9/125 (Single-mode) is 0.5 dB/km

The following data has been collected from component manufacturer’s (Agilent’s and Siemens’) web sites and catalogs to provide guidance to network designers and installers.

| Fiber Port Module | Speed, Std. | Mode | Std. km fdx (hdx) | Wave - length nm | Cable Size μm | X'mitr Output P_T , dB | R'cvr Sens. P_R , dB | Worst OPB, dB | Worst* distance Km, fdx | typical OPB, dB | typical* distance Km, fdx |
|---------------------|-------------|-------------|-------------------|------------------|--------------------------|--------------------------|------------------------|---------------|-------------------------|-----------------|---------------------------|
| FPM10-FST | 10 Mb FL | Multi-mode | 2 (2) | 850 | 62.5/125 | -15.0 | -31 | 14 | 5 | 17 | 6 |
| | | | | | 100/140 | -9.5 | -31 | 19.5 | 5.9 | 23.5 | 7 |
| | | | | | 50/125 | -19.5 | -31 | 9.5 | 3.4 | 13.5 | 4.8 |
| FPM10-SST | 10 Mb FL | Single-mode | 10 (5) | 1300 | 9/125 | -30 | -39 | 7 | 14 | 13 | 26 |
| FPM-MST, MSC | 100Mb FX | Multi-mode | 2 (0.4) | 1300 | 62.5/125 | -20 | -31 | 9.0 | 2.5 | 14 | 5 |
| | | | | | 50/125 | -23.5 | -31 | 5.5 | 2.0 | 12 | 4 |
| FPM-SSC | 100Mb FX | Single-mode | 18+ (0.4) | 1300 | 9/125 | -15 | -31 | 14 | 28 | 17.5 | 35 |
| FPM-SSCL Long reach | 100MB FX | single-mode | 40 (0.4) | 1300 | 9/125 | -5 | -34 | 27 | 54 | 32.5 | 65 |
| FPM-MTRJ | 100Mb FX | Multi-mode | 2 (0.4) | 1300 | 62.5/125 | -20 | -31 | 9.0 | 3.0 | 15.8 | 5.5 |
| | | | | | 50/125 | -23.5 | -31 | 5.5 | 2.0 | 12.2 | 4.0 |

* **Note:** The use of either multi-mode or single-mode fiber to operate at 100Mbps speed over long distances (i.e., in excess of approx. 400 meters) can be achieved **only** if the following factors are both applied:

- The 100Mb fiber segment must operate in full-duplex (FDX) mode, i.e. the full-duplex (factory default) setting for 100Mbps fiber ports must be used, and
- The worst-case OPB of the fiber link must be greater than the fiber cable’s passive Attenuation.

(Attenuation = Cable loss + LED aging loss + Insertion loss + safety factor)

5.0 Introduction - RFL 3000 4K8 Fiber-Port Modules (FPM)

This chapter describes each Fiber-Port Module (FPM), including appearance, functionality, and status displays.

5.1 Inspecting the Package and Product (Optional)

This section applies only to FPMs shipped as separate items, i.e., FPMs not factory installed in a RFL 3000 4K-Series FPM slot.

Examine the shipping container for obvious damage prior to installing a FPM; notify the carrier of any damage which you believe occurred during shipment or delivery. Inspect the contents of this package for any signs of damage and ensure that the items listed below are included.

This package should contain:

- 1 or more FPMs
- Installation instructions, with illustrations

Remove the FPM(s) from the shipping container. Be sure to keep the shipping container should you need to ship any of the FPMs separately at a later date. In the event there are items missing or damaged contact your supplier. If you need to return the unit, use the original shipping container if possible. Refer to Chapter 5 for specific return procedures.

5.2 Product Description

An important feature of the RFL 3000 4K-Series is the use of Fiber-Port Modules (FPMs) for flexible mixed-media connectivity to RJ-45 and fiber media. Since the RFL 3000 4K-Series Switches have dual-speed capability for copper ports, the fiber-port interfaces are designed to support all standard Ethernet media types at 10 or 100Mbps speed. Each FPM provides one port for connecting Ethernet segments with its individual connector type and media.

For a list of Fiber-Port Module types, refer to Section 1.2

Each FPM is individually described in the following sections.

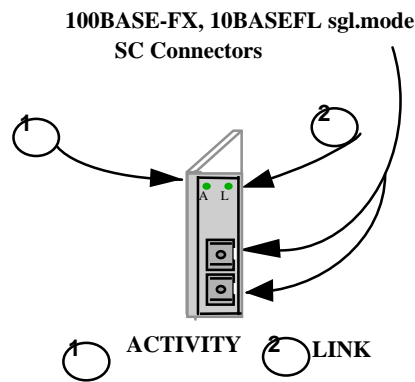
5.2.1 FPM-MST, 100Mbps multi-mode FX-ST-type, “twist-lock” connector

The RFL 3000 FPM-MST is a multi-mode 100Mbps fiber optic module equipped with a dual ST-type connector. It functions as a fiber optics transceiver to support 100BASE-FX network segments. When installed in a RFL 3000 4K8 Full-duplex Switch, it supports fiber optic cable distances up to the IEEE-specified 100Mbps at full-duplex non-collision-domain distance limits, i.e., typically 2000 meters.

The RFL 3000 FPM-SSC is a single-mode 100Mbps fiber optic module equipped with a dual SC-type connector. It functions as a full fiber optic transceiver to support single-mode fiber networks.

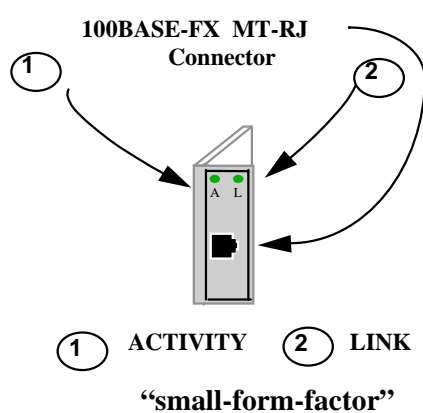
The FPM-SSC, when installed in a RFL 3000 4K8 Switch, supports fiber distances the same as 100Mbps multi-mode ports because of the 100Mbps full duplex functions capability, so it is only practical for use where single-mode fiber cable is already installed and must be used.

The FPM-SSC is equipped with an Activity (A) LED, and LINK(L) LEDs identical to those of the FPM-MSC. To distinguish the single-mode FPM-SSC from the multi-mode FPM-MSC, the label “Sgl. M.” is at the top of the faceplate of the FPM-SSC.



5.2.4 FPM-MTRJ, 100Mb multi-mode FX, MTRJ small-form-factor connector

RFL 3000 FPM-MTRJ is a multi-mode fiber optic module equipped with a small-form-factor MTRJ-type connector. It looks almost like an RJ-45 port, but it is black in color. The MT-RJ's small size and ease of connection make it a good choice for 100Mbps “fiber-to-the-desktop” Ethernet connectivity. When installed in a 4K8 Full-duplex Switch, it supports fiber optic cable distances up to 100Mbps full duplex no-collisions domain distance limits, i.e., typically 2000 meters.



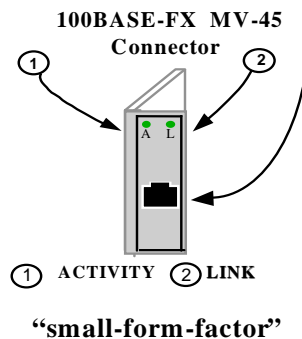
The functionality of this 100BASE-FX multi-mode FPM is same as the ST and SC-types, and it is equipped with the same ACTIVITY (A) and LINK (L) LEDs to indicate proper connectivity with the remote device. It has the same “100Mb FX” lettering on the faceplate. Note that the other end of the fiber cable may have a different connector, not necessarily an MT-RJ type.

5.2.5 FPM-MV45, 100Mbps multi-mode FX, VF-45 small-form-factor connector

RFL 3000 FPM-MV45 is a multi-mode fiber FX “small-form-factor” VF-45 connector used primarily in 100Mbps fiber-to-the-desktop links. Its size is similar to the MT-RJ port, but the VF-45 shell is slightly larger. When not in use, its appearance is distinctive because it has a tiny hinged door over the port hole to act as a dust cover.

When installed in a RFL 3000 4K8 Full-duplex Switch, it supports fiber optic cable distances up to the 100Mbps Full-duplex non-collision-domain distance limits, i.e., typically 2000 meters.

The small size, about the same as an RJ-45, reduces the size of wiring panels in wiring closets while providing the advantage of “future-proof” fiber optic technology.



5.2.6 FPM-Blank

The FPM-Blank is a blank face plate that must be installed in any empty FPM slot. When the RFL 3000 4K8 chassis contains less than twelve front-mounted FPMs, the empty front slots must be covered with the FPM-Blank face plate in order to maintain proper cooling air flow, and for safety, etc.



Note: The FPM-Blank must be installed in each empty FPM slot.

FPM-Blank

6.0 TROUBLESHOOTING

All RFL 3000 Ethernet products are designed to provide reliability and consistently high performance in all network environments. The installation of RFL 3000 4K-Series is a straightforward procedure (see INSTALLATION, Section 3); the operation is also straightforward and is discussed in Section 4.

Should problems develop during installation or operation, this section is intended to help locate, identify and correct these types of problems. Please follow the suggestions listed below prior to contacting your supplier. However, if you are unsure of the procedures described in this section or if the RFL 3000 4K-Series product is not performing as expected, do not attempt to repair the unit; instead contact your supplier for assistance or contact RFL Customer Support.

6.1 Before Calling for Assistance

1. If difficulty is encountered when installing or operating the unit, refer back to the Installation Section of the applicable chapter of this manual. Also check to make sure that the various components of the network are interoperable.
2. Check the cables and connectors to ensure that they have been properly connected and the cables/wires have not been crimped or in some way impaired during installation. (About 90% of network downtime can be attributed to wiring and connector problems.)
3. Make sure that an AC power cord is properly attached to each RFL 3000 4K-Series unit. Be certain that each AC power cord is plugged into a functioning electrical outlet. Use the PWR LEDs to verify each unit is receiving power.
4. If the problem is isolated to a network device other than the RFL 3000 RFL 3000 4K-Series product, it is recommended that the problem device is replaced with a known good device. Verify whether or not the problem is corrected. If not, go to Step 5 below. If the problem is corrected, the RFL 3000 4K-Series and its associated cables are functioning properly.
5. If the problem continues after completing Step 4 above, contact your supplier of the RFL 3000 4K-Series unit or if unknown, contact RFL. . by fax, phone or email (support@rfelect.com) for assistance.

6.2 When Calling for Assistance

Please be prepared to provide the following information.

1. A complete description of the problem, including the following points:
 - a. The nature and duration of the problem;
 - b. Situations when the problem occurs;
 - c. The components involved in the problem;
 - d. Any particular application that, when used, appears to create the problem;
2. An accurate list of RFL product model(s) involved, with serial number(s). Include the date(s) that you purchased the products from your supplier.
3. It is useful to include other network equipment models and related hardware, including personal computers, workstations, terminals and printers; plus, the various network media types being used.
4. A record of changes that have been made to your network configuration prior to the occurrence of the problem. Any changes to system administration procedures should all be noted in this record.

6.3 Return Material Authorization (RMA) Procedure

All returns for repair must be accompanied by a Return Material Authorization (RMA) number. To obtain an RMA number, call RFL Customer Service at (973)-334-3100 during business hours or email to *support@rfect.com*).

When calling, please have the following information readily available:

Name and phone number of your contact person.

Name of your company / institution

Your shipping address

Product name

Serial Number (or Invoice Number)

Packing List Number (or Sales Order Number)

Date of installation

Failure symptoms, including a full description of the problem.

RFL will carefully test and evaluate all returned products, will repair products that are under warranty at no charge, and will return the warranty-repaired units to the sender with shipping charges prepaid (see Warranty Information, Appendix A, for complete details). However, if the problem or condition causing the return cannot be duplicated by RFL, the unit will be returned as:

No Problem Found.

RFL reserves the right to charge for the testing of non-defective units under warranty. Testing and repair of product that is not under warranty will result in a customer (user) charge.

6.4 Shipping and Packaging Information

Should you need to ship the unit back to RFL, please follow these instructions:

1. Package the unit carefully. It is recommended that you use the original container if available. Units should be wrapped in a "bubble-wrap" plastic sheet or bag for shipping protection. (You may retain all connectors and this Installation Guide.)

CAUTION: Do not pack the unit in Styrofoam "popcorn" type packing material. This material may cause electro-static shock damage to the unit.

2. Clearly mark the Return Material Authorization (RMA) number on the outside of the shipping container.
3. RFL is not responsible for your return shipping charges.
4. Ship the package to:

**RFL Electronics Inc.
353 Powerville Road
Boonton TWP, NJ 07005-9151
Attn.: Customer Service**

APPENDIX A: WARRANTY INFORMATION

RFL. . warrants its products to be free from defects in materials and workmanship for a period of three (3) years from the date of shipment by RFL.

During this warranty period, RFL will repair or, at its option, replace components in the products that prove to be defective at no charge other than shipping and handling, provided that the product is returned pre-paid to RFL.

This warranty will not be effective if, in the opinion of RFL, the product has been damaged by misuse, misapplication, or as a result of service or modification other than by RFL.

RFL reserves the right to make a charge for handling and inspecting any product returned for warranty repair which turns out not to be faulty.

Please complete the warranty card as this acts as a product registration, and mail it to RFL within two weeks of your purchase.

APPENDIX B : INTERNAL DC POWER SUPPLY OPTIONS

B1.0 SPECIFICATIONS - FOR RFL 3000 4K8 DC-POWERED SWITCHES

Power Supply (Internal -48VDC Option)

DC Power Connector: 3 terminals: “-“, “GND”, “+”

Input Voltage: 36 - 70 VDC

Power Consumption: Model 4K8: 9 watt typical, 11 watts max.

Power Supply (Internal 24 VDC Option) Industrial Application

DC Power Connector: 3 terminals: “-“, “GND”, “+”

Input Voltage: 20 - 36 VDC

Power Consumption: Model 4K8: 9 watt typical, 11 watts max.

Power Supply (Internal 125 VDC Option) Industrial Application

DC Power Connector: 3 terminals: “-“, “GND”, “+”

Input Voltage: 120 - 160 VDC

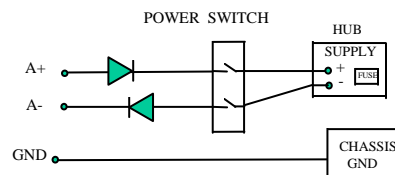
Power Consumption: Model 4K8: 9 watt typical, 11 watts max.

With the exception of the power supply, all specifications and functions of RFL 3000 4K-Series-48VDC, 24VDC and 125VDC models are identical to those listed in the main manual.

B2.0-48VDC, 24VDC & 125VDC POWER OPTION, THEORY OF OPERATION

The -48VDC, 24VDC & 125VDC power option are designed using diodes inside on each DC power input line behind the two external power connection terminals, so that the power from an external source can only flow into the hub. This allows the Switch to operate only whenever DC power is correctly applied to the two inputs. It protects the Switch from incorrect DC input connections. An incorrect polarity connection, for example, will neither affect the Switch, its internal power supply, nor will it blow the fuse in the internal power supply.

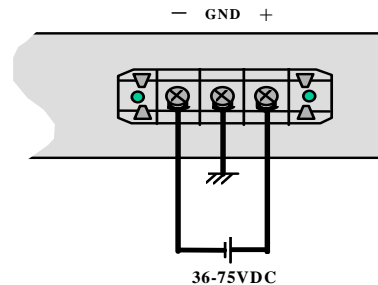
The manual power “On-Off” Switch (optional) is used for powering the unit on and off when it is placed into or taken out of service.



B3.0 APPLICATIONS FOR DC POWERED SWITCHES

RFL 3000 4K-Series Fiber Switches are easily installed in a variety of applications where -48VDC, 24VDC & 125VDC power is used as the primary power source. The -48VDC, 24VDC & 125VDC power configuration provides an Ethernet networking solution utilizing a special power supply in hubs with a proven track record. The -48VDC solution is particularly useful in the telecommunication industry, where it is common for facilities to operate on -48VDC power. Such companies include regular and wireless telephone service providers, Internet Service Providers (ISPs) and other communication companies. In addition, many high availability equipment services, such as broadcasters, publishers, newspaper operations, brokerage firms and other facilities often use a battery backup system to maintain operations in the event of a power failure. It is also frequently used for computer system backup, management and operations monitoring equipment.

The 24VDC and 125VDC solution are particularly useful in the Industrial environment, where it is common for facilities to operate on 24VDC or 125VDC power. The 125VDC solution is mainly used in Utilities Industries, such as Electric substation, Electrical generating plant etc. Whereas 24VDC application is mainly in the Industrial environment, such as chemical plants, paper mill, stone quarrying plant, wastewater treatment Plant etc.



B4.0 INSTALLATION

This section describes the installation of the -48 VDC, 24VDC & 125VDC power source leads to the -48 VDC, 24VDC & 125VDC power terminal block on the RFL 3000 Ks. (see figure at the right).

In this picture, the -48VDC terminal block on the RFL 3000 4Ks is located on the rear of the unit and is equipped with three (3) screw-down lead posts. It is similar for 24VDC and 125VDC options on RFL 3000 4Ks. The leads are identified as negative (-), positive (+), and chassis ground (GND).

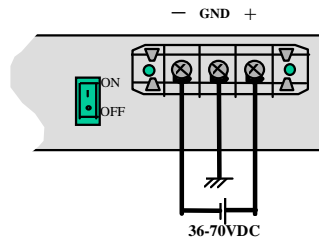


Figure B4.1: -48VDC Terminal Block on RFL 3000 Ks-48VDC

The actual connection procedure is straightforward. Simply connect the leads to the RFL 3000 unit, beginning with ground. Ensure that each lead is securely tightened.

Note: The GND should be hooked up first. The 4K unit has a floating ground, so the user may elect to Ground either + or = terminal to suit the customer's use.

Before connecting hot lines to the Terminal Block of -48VDC, 24VDC or 125VDC, always use a digital voltmeter to measure the output voltage of the power supply and determine the lead which is more "+ve potential". The more "+ve" voltage lead from 48V or -48V supply must be connected to the post labeled "+".

An ON-OFF manual switch is optional for DC power. This can be used to cut off power connections and as a RESET for the 4K-Series Switch.

B4.1 UL Requirements

1. Minimum 14 AWG cable for connection to a Centralized DC power source.
2. Fastening torque of the lugs on the terminal block: 9 inch pound max.
3. Centralized DC Power Source cable securement, use at least four cable ties to secure the cable to the rack at least 4 inches apart with the first one located within 6 inches of the terminal block.

B5.0 OPERATION

Operation of the RFL 3000 Ks with the optional -48VDC, 24VDC & 125VDC power supply is identical to that of the standard AC-powered models.

B6.0 ORDERING INFORMATION

To order the optional -48VDC power supply factory installed, add a suffix of "--48VDC" after the product's standard model #. Example: **RFL 3000 4K8-48VDC**.

Similarly, to order the optional 24VDC or 125VDC industrial specific power supply factory installed, add a suffix of “ 24VDC” or “125VDC” after the product ‘s standard model #. Example: **RFL 3000 4K8- 24VDC** or **RFL 3000 4K8- 125VDC**.

B7.0 TROUBLESHOOTING

Please refer to Section 6.0 for troubleshooting

APPENDIX C: INTERNAL DC DUAL-SOURCE POWER OPTION

C1.0 SPECIFICATIONS - FOR RFL 3000 4K-SERIES FIBER SWITCH

Power Supply (Internal, -48VDC Dual-Source, model # Dual-Src-48V)

DC Power Connector: First Source: “A+”, “A-“, 2nd Source “B-“, “B+”
GND: Terminal for “earth” or ground wire connection to the hub chassis
Input: Two separate sources, each at 36 - 70 VDC
Power Consumption: Model -4K8: 9 watt typical, 11 watts max.

Power Supply (Internal, 24VDC Dual-Source, model # Dual-Src-24V)

DC Power Connector: First Source: “A+”, “A-“, 2nd Source “B-“, “B+”
GND: Terminal for “earth” or ground wire connection to the hub chassis
Input: Two separate sources, each at 20 - 36 VDC
Power Consumption: Model -4K8: 9 watt typical, 11 watts max.

Power Supply (Internal, 125VDC Dual-Source, model # Dual-Src-125V)

DC Power Connector: First Source: “A+”, “A-“, 2nd Source “B-“, “B+”
GND: Terminal for “earth” or ground wire connection to the hub chassis
Input: Two separate sources, each at 120 - 160 VDC
Power Consumption: Model -4K8: 9 watt typical, 11 watts max.

With the exception of the dual DC input power connections and the power supply, all specifications and configuration options for the RFL 3000 4K8 -48VDC, 4K8-24VDC & 125VDC with this Dual-Source option are identical to those listed in the *RFL 3000 4K-Series Fiber Switches Installation and User Guide*, including Appendix B “Internal DC Power Supply Option”

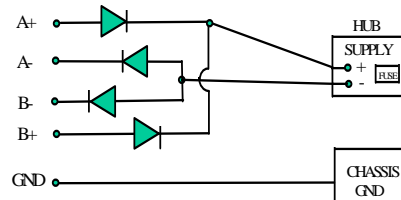
C2.0 RFL 3000 4K-SERIES , with -48VDC, 24VDC & 125VDC Dual-Source option

The 4K8-Switch models with the internal -48VDC, 24VDC & 125VDC Dual-Source power supply are designed for installations where a battery plant is the power source, and where two separate power sources are utilized in order to increase operational uptime and to simplify maintenance.

The functionality of the RFL 3000 4K-Series -48VDC, 24VDC & 125VDC Dual-Source Option units are identical to the standard AC-powered models. Refer to the main sections of this *Installation and User Guide* for a detailed description of the RFL 3000 4K-Series Switches.

C3.0 DUAL-SOURCE OPTION, THEORY OF OPERATION

The Dual-Source DC power option is designed using diodes inside of the chassis on each DC power input line. A diode is placed in each of the four input lines (behind the four external power connection terminals) so that power from an external source can only flow into the unit. This allows the unit to operate whenever DC power is correctly applied to either or both of the two inputs



C4.0 FEATURES AND BENEFITS OF THE DUAL-SOURCE DESIGN

- The Switch unit can receive power from either input, “A” or “B”. The hub will normally draw its power from the DC source with the highest voltage at a given time.
- The Switch unit will not allow power to flow from a higher voltage input to a lower voltage input, i.e. the two DC power sources are not mixed together by the hub.
- When one correct DC input is present, the Switch will receive power if the other DC input is absent, or even if it is connected with reverse polarity or shorted or grounded.
- Reverse polarity connections, if they should accidentally occur on either input, will not damage the Switch or power supply internally (nor will it blow the fuse in the internal power supply) because of the blocking action of the diodes. This is true even if one input connection is reversed while the Switch is operating from the other source.
- The Switch will not receive power (and will not work) when both inputs are simultaneously absent or are both incorrectly connected.

C5.0 INSTALLATION

This section describes the proper connection of the -48VDC, 24VDC & 125VDC dual source leads to the -48VDC, 24VDC and 125VDC power terminal block on the RFL 3000 4K-Series Switch (shown in Figure)

The -48VDC terminal block on the RFL 3000 4K-Series Switch is located on the right rear of the unit and is equipped with five (5) screw-down lead posts (see Fig C5.0). The primary terminals are identified as positive (A+), negative (A-), and the secondary power terminals as negative (B-), positive(B+). The chassis “earth” or ground (GND), is a threaded post with a #6 nut.

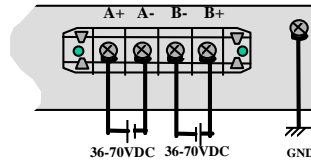


Figure C5.0: -48VDC Dual-Source, wiring connections to the External Terminal Block on a RFL 3000 48VDC with Dual-Source option

Note: The GND should be hooked up first. The 4K unit has a floating ground, so the user may elect to Ground either + or - terminal to suit the customer's use.

Before connecting to Terminal block of -48VDC, 24VDC or 125VDC, always use a digital voltmeter to measure the output voltage of the power supply and determine the lead which is more "+ve potential". The more "+ve" voltage lead from 48V or -48V supply must be connected to the post labeled "+".

The connection procedure is straightforward. Simply connect the DC leads to the Switch's power terminals, positive (+) and negative (-) screws. The use of Ground (GND) is optional; it connects to the chassis. Ensure that each lead is securely tightened. The 24VDC & 125VDC terminal block on RFL 3000 4K-Series Switch also has everything similar to -48VDC info. Described above.

C5.1 UL Requirements

The following must be adhered to in order to conform to UL requirements:

1. *Minimum 14 AWG cable for connection to a Centralized DC power source.*
2. *Fastening torque of the lugs on the terminal block: 9 inch pound max.*
3. *Centralized DC Power Source cable securement, use at least four cable ties to secure the cable to the rack at least 4 inches apart with the first one located within 6 inches of the terminal block.*

C6.0 ORDERING INFORMATION

To order the optional Dual-Source -48VDC power supply factory installed, order "Dual-Src48V" as a separate line item following the product model.

Example: **RFL 3000 4K8-48VDC**

Dual-Src-48V for regular model with no ON-OFF switch

Or **Dual-Src48V-SWITCH** for model with ON-OFF switch

Similarly, order “Dual-Src24V” or “Dual-Src125V” as a separate line item following the product model.

Example: **RFL 3000 4K8-24VDC** or **RFL 3000 4K8-125VDC**
Dual-Src24V for regular model with no ON-OFF switch
Dual-Src24V-SWITCH for model with ON-OFF switch

C7.0 OPERATION

Operation of the Dual-Source RFL 3000 4K-Series-48VDC, 24VDC & 125VDC Switch models are identical to that of the standard models.