



RFL Electronics Inc.

RFL 3000 4K-16 Ethernet Switch

Installation and User Guide



April 27, 2006
RFL 3000™ 4K-Series

4K24 Switches

Installation and User Guide

Trademarks

Ethernet is a trademark of Xerox Corporation

NEBS is a trademark of Telcordia Technologies

UL is a registered trademark of Underwriters Laboratories

Important: The RFL 3000 4K24 Switches contains no user serviceable parts. Attempted service by unauthorized personnel shall render all warranties null and void. If problems are experienced with the RFL 3000 4K24 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 to 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: 4.8Gb/sec for 24 100Mbps ports
(all ports are wire speed)

Aggregate Forwarding Rate: (for RFL 3000 4K-Series Fast Ethernet ports)

(all ports are wire speed) 14.4M frames per second, 24-port units

Data Rate: 10 Mbps and 100Mbps

Address Table Capacity: 2K node addresses, self-learning with 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)

Shielded twisted pair - 150 m (492 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 100Mb Fast Ethernet Segment Lengths:

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

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

Shielded twisted pair - 150 m (492 ft)

100BASE-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 4K-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 Single-mode connector types:

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

Fiber Port, SC-type: Fiber optic "long-reach" single-mode, 100BASE-FX**Manual switch-selections and jumpers**

Fiber default: Full-duplex (Manual DIP switch settings inside of the chassis can select each of fiber ports to HDX mode. DIP switch SW4 controls fiber port # 2, whereas DIP switch SW6 controls fiber port #4. Down position will sets half-duplex, up position (default) sets full-duplex).

Copper default: Auto-negotiation

LEDs: Per Port

LK/Act: Steady ON for Link with no traffic, blinking indicates port is transmitting and receiving

FDX/Col: ON = Full-Duplex Mode
BLINKING = Half-Duplex Collision

100/10: ON = 100Mbps speed
OFF = 10 Mbps

Operating Environment

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

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

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

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

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: 7.1 lb. (3.2 Kg) rack-mount models

Cooling method: Fan cooled, @ 7 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: 20 watts typical, 35 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

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 4K24 Switches	
<u>MODEL</u>	<u>DESCRIPTION</u>
RFL 3000 4K24F	Ethernet Switch with 22 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 input is in the rear. Units with -48V power supply options available
RFL 3000 4K24FR	“Reverse” model, Same as Model 4K24F Switch except user ports and the power input connectors are in the rear. LEDs are in the front.
RFL 3000 4K24C	Same as RFL 3000 4K24F, but with all 24 RJ-45 ports “Copper”.
RFL 3000 4K24CR	“Reverse” model, Same as Model 4K24C Switch except user ports and the power input connectors are in the rear. LEDs are in the front.
Fiber port modules for RFL 3000 4K-Series (Models 4K24F and 4K16):	
FKM-2SC	Fiber module with two 100Mbps multi-mode FX SC connectors
FKM-2ST	Fiber module with two 100Mbps multi-mode FX ST connectors
FKM-2MTRJ	Fiber module with two 100Mbps multi-mode FX “MTRJ” Small Form Factor connectors
FKM-2SSC	Fiber module with two 100Mbps 20Km single-mode FX SC connectors
FKM-2SSCL	Fiber module with two 100Mbps 40 Km “long-reach” single-mode FX SC connectors
FKM-1MTRJ	Fiber module for 4K-Series Switches, with one 100Mbps multi-mode FX “MTRJ” Small Form Factor connector
FKM-1SSC	Fiber module with one 100Mbps 20Km single-mode FX SC connectors
FKM-1SSCL	Fiber module with one 100Mbps 40 Km “long-reach” single-mode FX SC connectors
FKM-BLNK	Blank face plate, included in 4K24 switch unit when no fiber port option is selected
Special Package Models – request quote for specials, such as the “Air Flow Modified” version with –48CDV power for Telco racks	

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 4K24 Switch
- 1 AC Power Cord (U.S. and other 115 VAC only)
- 1 Set of metal “Ears” for standard 19” 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 4K24 Switches

RFL 3000 4K24 Switches boost the performance of large Ethernet LANs, with the flexibility of both twisted-pair switched ports and fiber ports. Fiber ports may number zero, one or two, and may be configured from a variety of user-selected popular fiber connectors. The RFL 3000 4K24's provide the switching speed and the reliability to support multiple workgroups, each with its own switched 100Mbps or 10Mbps domain, for increased network performance and with "future-proof" fiber up-link ports built in.

The RFL 3000 24-port 4K24F Switches offer application flexibility with a series of optional fiber connector types. All applicable fiber port connector types (100Mbps FX-ST, SC, MTRJ) along with multi-mode, single and "long-haul" capability are configurable using a family of one- or two -port modules . Optional fiber ports are normally configured and tested with the RFL 3000 4K24F unit in the factory, but may be configured in the field. The 22 copper RJ-45 ports are dual speed 10/100 Mb auto-negotiating. The model 4K24C has 24 twisted-pair ports and no fiber -built-in options.

Designed for use in departments with multiple workgroups, in remote offices and in network traffic centers or multi-system power users, the RFL 3000 4K24F and 4k24C 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 4K-Series Switches provide high performance plug-and-play operation in convenient rack-mount packages.

The RFL 3000 4K24F and 4K24C switches are non-blocking on all ports and include 1MB packet buffers and a 2K-node address table for advanced performance as well as to support large networks. The RFL 3000 4K-Series Switches, with store-and-forward switching, filter all faulty packets to minimize traffic congestion.

2.2.1 RFL 3000 4K24F and 4K24C Switch chassis

RFL 3000 4K24F and 4K24C Switches come in a 24-port rack-mountable chassis. The optional fiber port is user configurable and can be selected from the offered popular fiber port connector types. The fiber-port modules are normally factory installed. (See Section 5)

The 4K24F 19” rack-mountable switches come with twenty two 10/100 RJ-45 ports and two optional 100Mbps fiber ports (ports #2 and #4) i.e., with a total capacity of 24 switched ports. These rack-mount units are typically used in larger network wiring centers.

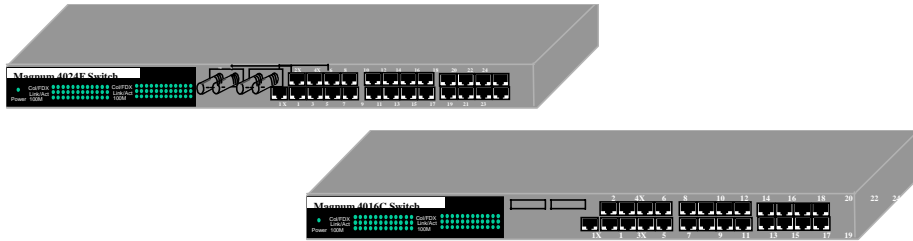


Figure 2.2.1a: Front view, 24-port RFL 3000 4K24F and 4K24C Switches

The LED status indicators and the manual switches are located on the front panel of RFL 3000 4K24F and 4K24C Switches. There are Full-duplex/Collision (FDX/COL), Link/Activity (LINK/ACT) and (100/10) LED indicators for each 10Mbps and 100Mbps domain, for visual indication of the operating status of each domain. The IEC standard AC power connector (and a manual ON - OFF power switch) is located at the rear. Fan-driven cooling air flows left to right.

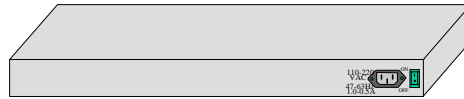
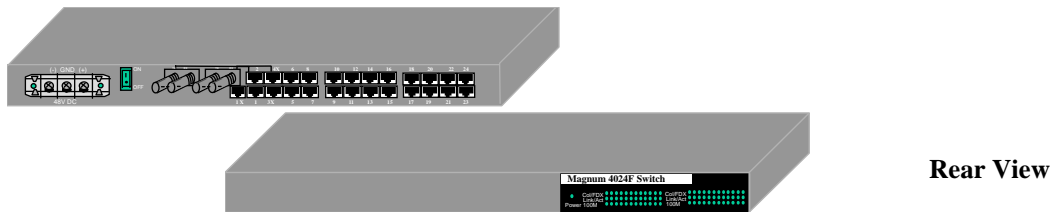


Figure 2.2.1b: Rear view - RFL 3000 table-top & rack-mount 4K24C and/or 4K24F Switch

**2.2.2: RFL 3000 4K24FR “Reverse” model, front LEDs and connections in rear
Front View, with –48V power option**



The RFL 3000 4K24FR is like the 4K24F 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 4K24FR is dual-speed 10/100Mbps switch and has two fiber connector port options. The switching capability allow the RFL 3000 4K24F to support multiple workgroups smoothly, each with its own switched 100Mbps or 10Mbps domain.

The 4K24FR may be 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 4K24FR a good high-availability choice for telcos, ISPs, broadcast equipment, medical, brokerage firm and financial facilities.

2.2.3 Up-link, port 1X for Cascading

The unit has an Up-link Port 1X, located on the left-front side of the hub. It enables the first port's RJ-45 cable to either connect to a user station (port 1) or to be cascaded to another hub (port 1X) with cross-over. (See Section 4.4 for more details about Up-link). Like all 4K24C ports, Port # 1X is a dual-speed switched port which will sense the speed of the connected device. Use port 1X on one 4K24 and port 1 (or any port) on the second, i.e., use only one crossover port for a cascaded connection.

When the Up-link port is used to cascade two 4K24C together, the auto-sensing feature will cause the connecting up-link to operate at 100Mb FDX speed.

2.2.4 Fiber-port options for 4K24F Model, 100Mb fiber

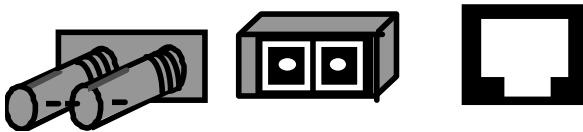


Figure 2.2.5 Fiber-Ports, FKM-1ST, FKM-1SC, FKM-1MTRJ

Two fiber ports are optional for RFL 3000 4K24F Switch. In a two-fiber port module, all of the fiber ports are of the same speed, the same multi- or single-mode type, and the same connector type. Multi-mode 100Mbps models are available with ST, SC, and MT-RJ connectors. Single-mode 100Mbps models are available with SC connectors.

The 100Mb fiber port modules on the RFL 3000 4K24F normally are set (factory default) to operate in full-duplex mode for best fiber distance and performance. On the RFL 3000 4K24F, 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 fiber FKMs, there are two LED's per fiber port mounted on the front of the chassis. 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.

2.2.5 4K24C, 10/100 F/H dual-speed switched ports, RJ-45 (copper only)

The RFL 3000 4K24C copper has 24 ports that are dual speed 10/100Mb switched RJ-45 ports Auto-negotiating. The 10/100Mb switched ports are independently N-way auto-negotiating for operation at 10 or 100Mb speed in full- or half-duplex mode (as a default setting). 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 indicates Link with no traffic, and blinking indicates the 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 enabled). The Fdx/Col LED is ON to indicate full-duplex operation and OFF to indicate half-duplex mode and collisions. 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.



2.2.6 Frame Buffering and Latency

The RFL 3000 4K24F or 4K24C 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 4K24 Switch dynamically allocates buffer space from a 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 may result.) This dynamic buffer allocation provides the capability for the maximum resources of the RFL 3000 4K24 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 4K24 Switches are constantly adapting internally to provide maximum network performance with the least dropped packets.

When the 4K24 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 4K24 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 4K24 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. The 4K24 Switch’s latency is 5 microseconds plus the packet time. See Section 1.1, Specifications.

2.3 Features and Benefits

- **100Mb switching services for high performance Ethernet LANs**
RFL 3000 4K24 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 with one or two fiber ports**
Fiber port modules are available with one or two 100Mb mm-ST, SC, MTRJ or single-mode SC. The configuration flexibility of fiber ports allows 4K24 switches to adapt to mixed and changing fiber types.
- **RJ-45 (copper) ports, with N-way auto-negotiation**

RJ-45 ports provide twisted pair segment connections, with N-way auto-negotiation and switching capability per 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.
- **Standard (ports in front) or Reverse (ports in rear) rack mounting**
The 4K24 is offered with ports and LEDs in the front, or in a “reverse” package with LEDs in front and all Ethernet and power cables in the rear. As a special feature of the 4K24 Reverse, LEDs are both front and 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 4K24 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 4K24 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 4K24 Switches offer high performance 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 4K24 Switches enables them to inter-connect a series of subnets (one subnet per 4K-Series Switch port) 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 24-ports non-blocking switching capability of RFL 3000 4K24’s support larger networks with multiple workgroups.

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 a typical application, a Switch is needed to provide a Fast Ethernet departmental backbone. The 4K24F consists of twenty-two high-speed LAN segments, each operating over 100Mb full-duplex RJ-45 lines. In addition, two fiber backbone segments interconnect with the network center. The Switch needs to provide high-speed switching support for two central servers, for a 100Mb connection to a router, and to a mix of 10 and 100Mbps local workgroups of over a dozen users, printers, etc. The RFL 3000 4K24F, equipped with two 100Mb fiber ports and 22 RJ-45 10/100 ports, provides an economical solution in a rack-mount box. No Media Converters are needed. The two-port Fiber FKM can be selected to provide the 100Mbps fiber connector type desired. FKMs with either multi-mode or single-mode fiber types are available. The fiber interconnects provide switched ports for fiber distances with high bandwidth.

The requirement for connecting local devices over twisted pair cabling is handled by the RFL 3000 4K24F with 22 RJ-45 ports.

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 many media converters do not support auto-negotiation and would not enable the fiber backbone lines to operate full-duplex. But the RFL 3000 4K24F . . . with the optional two switched fiber ports at 100Mb speed, with full-duplex mode as a default setting on fiber ports, and with a large batch of RJ-45 N-way 10/100Mb ports as well. . . handles this application readily.

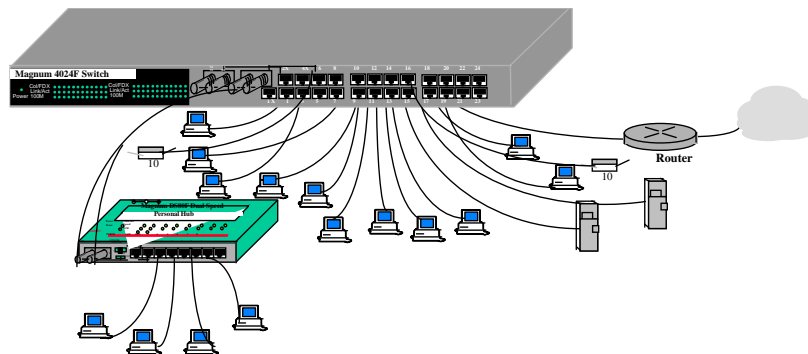


Figure 2.4b: The RFL 3000 4K24F provides 10/100Mb speed with high bandwidth and fiber interconnects for a departmental LAN

Example 2: In another situation for a small office, a central Switch is needed to provide for a 24-segment 100Mb Fast Ethernet LAN with switched copper support for 3 high speed local servers for different departments, and with 15 segmented users and three printers. In addition, the router and 3 ports are for future expansion.

The RFL 3000 4K24 Switch fits nicely in this environment, and offers future backbone expansion. The 24 switched copper ports are provided by a RFL 3000 4K24. Should the number of servers expand, more than one server can be accessed at full speed from any switched 4K24 port by any of the users simultaneously.

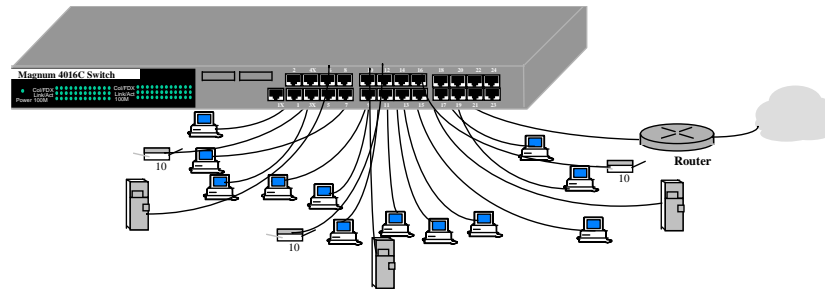


Fig 2.4c: RFL 3000 4K24 provides a 10/100Mb Switch with non-blocking performance for small a office

3.0 Installation

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.

Installation: This section describes installation of the RFL 3000 4K-Series Switches, as well as connection of the various Ethernet media types.

3.1 Locating RFL 3000 4K24 Switches

The location of a RFL 3000 4K-Series 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 they have rubber feet and 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 4K-Series site. The rugged metal case of the RFL 3000 4K-Series 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 unit so that cooling can occur from the small fan on the left side, while the unit is in operation.

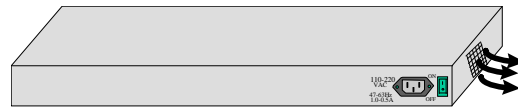


Figure 3.1: Location of RFL 3000 4K24's cooling fan exhaust

3.2 Connecting Ethernet Media

The RFL 3000 4K24 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 (FKMs) which can be individually selected and configured per-port. See Section 2.4 for a description of the FKMs.

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)	FKM-MST
	mm ¹ Fiber	2.0km (6,562 ft)	FKM-MSC
	mm ¹ Fiber	2.0km (6,562 ft)	FKM-MTRJ (SFF)
	sgl.m ² Fiber	18.0km (95K ft)	FKM-SSC
	sgl.m ² Fiber	40.0km (12K ft)	FKM-SSCL

Copper:

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 FKM with ST-type fiber connectors. This procedure applies to ports using a FKM-MST or FKM10-MST.

1. Before connecting the fiber optic cable, remove the protective dust caps from the tips of the connectors on the FKM. 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 FKM 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 FKM 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 FKM connector to remedy this situation.

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

The following procedure applies to installations using a FKM with SC-type and MTRJ-type fiber connectors, i.e., using FKM-MSC, FKM-MTRJ, FKM-SSC and –SSCL single-mode.

When connecting fiber media to SC or MTRJ connectors, simply remove (and save) the dust cover plugs and 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 than multi-mode, and may be used to connect nodes or switched ports, to 20+Km distance with the FKM-SSC and 40+Km with the “long reach” FKM-SSCL.

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

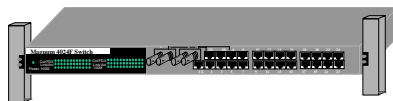
NOTE : It is recommended that high quality CAT. 5 cables (which work for both 10 Mb and 100Mb) be used whenever possible in order to provide flexibility in a mixed-speed network, since dual-speed ports are auto-sensing for either 10 and 100Mb/s.

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 4K24 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 4K24 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 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.

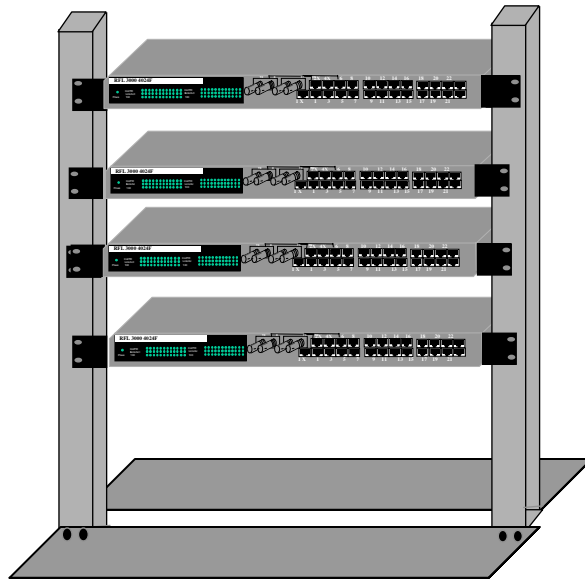


Fig 3.3 Multiple RFL 3000 4K24 units rack-mounted in a 23" Rack-mount frame

3.4 Installing and Removing FKM Fiber Port Modules

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

Changing FKM modules in a RFL 3000 4K24F Switch is a complex procedure that requires great care. Please read the Port Module Insertion Guide and this 4K24 Manual thoroughly before doing any field changes of FKM modules.

If you are installing an FKM, make sure the FKM Module package has all necessary accessories to install it properly. The FKM Module package for field installation comes along with an FKM Module and instructions enclosed, the Fiber Port Module Insertion Guide.

3.4.1 Preparation for Changing FKM Fiber Port Modules

Step 1. Remove Chassis Cover

RFL 3000 4K24F chassis has top and bottom parts that are factory assembled using 22 Phillips-head screws. There are 7 screws located on the 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 4K24F unit is exposed.

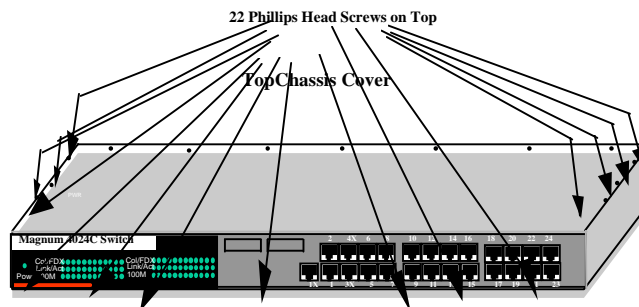


Figure 3.4.1a: Removing Chassis Cover

Caution: Be careful not to disturb the power supply.

Looking down into the RFL 3000 4K24F unit, notice that there are two FKM connector headers located inside on the main PC board, next to Port 2C, for FKM Module mounting. These headers are located directly behind the Fiber port cut-out.

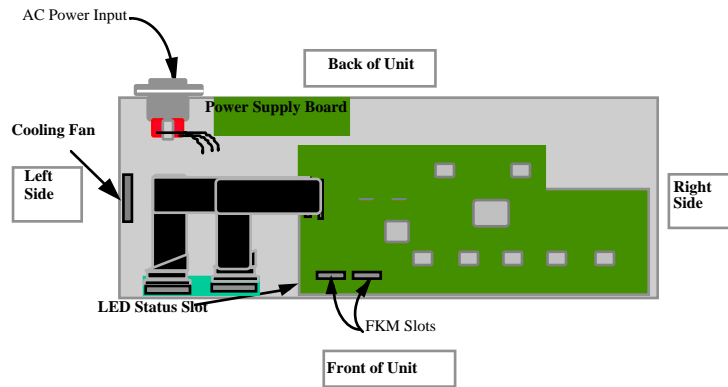


Figure 3.4.1 b: RFL 3000 4K24F Switch, Top View without Chassis Cover

Step 2. Remove Retaining Screws on top of existing FKM or Face Plates

Looking inside the unit, there is one retaining screw on the top of each FKM module. This screw is used to secure the FKM face plate in position. This screw is also used to secure the FKM module, which can be subjected to significant forces from the fiber attached cables. (See Figure 3.4.1c)

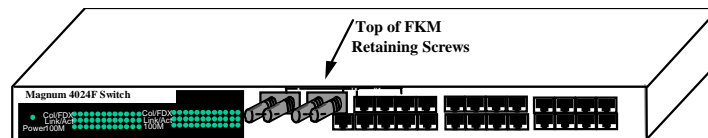


Figure 3.4.1c: Front View - FKM Retaining Screws hold Face Plate

Step 3. Change out the FKM or Face Plates

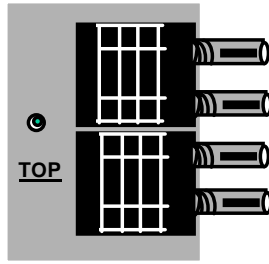
FKM module removal is covered in Sect.3.4.3, installation in Section 3.4.2.

3.4.2 Installing FKM Modules in RFL 3000 4K24F Switches

Up to two front-mounted fiber ports may be installed in one RFL 3000 4K24F Switch unit via an FKM. Follow these steps to install a FKM.

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

Step 2. The figure here illustrates the basic layout of an individual FKM module. Each FKM module fits into the selected FKM connector header. Align the connector socket on the bottom of the FKM module with the connector pins on the main board header. The pins are straight and firm to facilitate the installation.



Step 3. Be sure the pins are precisely aligned with the holes in the header, and the FKM front panel is guided into the front slot cut-out. Then, slowly and carefully apply just enough pressure to insert the FKM module socket into position, see Figure 3.4.2b. (If you force the FKM down when the pins are not properly aligned with the holes in the header, the pins may become bent and the FKM damaged accordingly).

Once inserted, the FKM module will be secured by the front panel port slot cut-out, and the retaining screw.

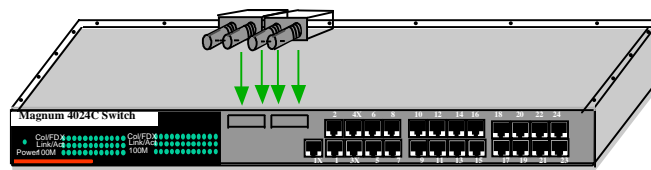


Figure 3.4.2b: Inserting PM Modules into a RFL 3000 4K24F

NOTE: *The optional FKM slots need not be filled in order for the RFL 3000 4K24F unit to be operational. When leaving FKM slots empty, always use a face plate (RFL 3000 FKM-BLNK) to cover the slot opening in the front panel. This will maintain proper cooling air flow, provide required safety, during operation as required by FCC, CE, and other regulations.*

Step 4. Once FKM modules have been installed, the chassis cover should be replaced. To do this, reverse the procedure in Section 3.4.1.

3.4.3 Removing FKM Modules from RFL 3000 4K24F Switches

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

Caution: Be sure the power cord is unplugged.

Step 2. Remove retaining screw holding the FKM and Face Plate

On top of the FKM module, there is one retaining screw for each FKM module, used to secure the FKM module in position (see Figure 3.4.3a). Remove the retaining screw of the FKM to be removed.

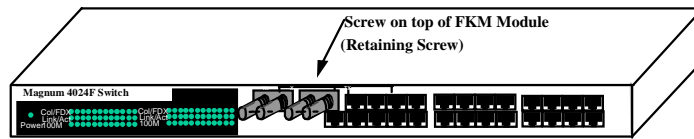


Figure 3.4.3a: Front View - Remove FKM Module Retaining Screw

Step 3. Remove FKM Module

Gently pull the FKM module up and out of the connector socket (see Figure 3.4.3b).

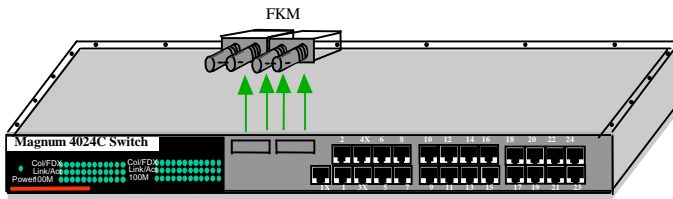


Figure 3.4.3b: Removing an FKM Module

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

Step 4. Once FKM modules have been removed, the chassis cover should be replaced. To do this, reverse the procedure in Section 3.4.1.

3.5 Manual settings for Fiber ports (HDX or FDX)

The factory default settings on RFL 3000 4K24’s optional fiber ports are at full-duplex (FDX). Each fiber port can be set as half-duplex (HDX) by manually settings the DIP switches. These are provided under the fiber ports inside of the chassis as shown in the figure 3.5. The blue DIP switches control half- duplex and full-duplex of fiber port # 2 and # 4.

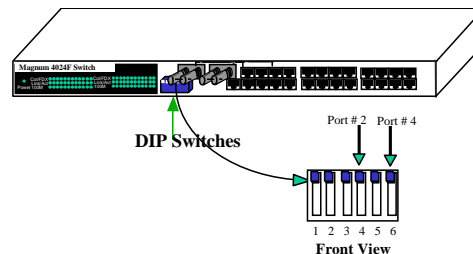



Fig 3.5 Dip Switch Settings


If a user toggles switch 4 to the **DOWN** position, then fiber port # 2 will be set to half-duplex. The factory default settings for fiber ports will be always **UP** position for full-duplex.

DIPSwitch Settings for Fiber Half Duplex

SW	Port	Down	Factory Settings UP
4	2	Half duplex	Full duplex
6	4	Half duplex	Full duplex



Half-duplex



Full-duplex

3.6 Powering the RFL 3000 4K24 Switch

RFL 3000 4K-Series Switches incorporate an internal universal power supply, and have a recessed male IEC connector for the AC

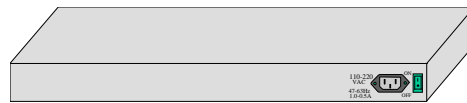


Figure 3.5: RFL 3000 4K24 AC power connector power cord at the left-rear.

A manual AC power ON-OFF switch is adjacent. A six-foot 115 VAC 60 Hz standard power cord is supplied with each unit shipped within North America. For DC power options, see Appendices.

4.0 OPERATION

This chapter describes the functions and operation of the 4K-Series.

4.1 Switching Functionality

RFL 3000 4K-Series units provide switched connectivity at Ethernet wire-speed among all of its ports simultaneously. They support 10/100Mbps for copper media and 100Mb for fiber ports to maximize bandwidth utilization and network performance. All ports can communicate to all other ports in a RFL 3000 4K-Series, but local segment 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 UP-LINK on RJ-45 port. 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 24-port RFL 3000 4K-Series units have address table capacity of 2K node addresses, suitable for use in large networks. They are self-learning, so that as nodes are added or removed or moved from one port / segment to another, the 4K24 Switch automatically keeps up with node locations.

An address-aging algorithm causes least-used addresses to fall out of the address buffer in favor of new and frequently-used addresses. To reset the address buffer, cycle power down-and-up.

4.2 Status LEDs

For RFL 3000 4K24 models :

PWR : Power LED, ON when external power is applied to the unit.

Link/Act : Steady ON for link with no traffic, blinking indicates port is transmitting and receiving.

Col/FDX : Full / Half duplex LED, steady ON when the port is running full duplex, blinking for half duplex collisions

100/10 : Speed LED, ON when the speed is 100Mbps , OFF when the speed is 10 Mbps

4.3 Up-link Port, for RJ-45 Port #1X only

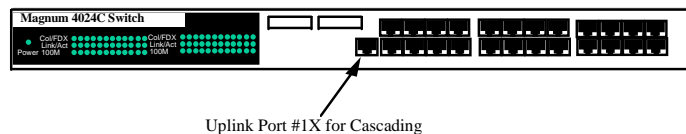


Figure 4.3 : Up-link on RJ-45 Port#1X

RFL 3000 4K24's each have one Up-link port, port # 1X, which can be used when regular port #1 is not connected. The Up-link port allows non-node (switch-to-repeater, switch-to-switch, etc.) connections without a special cross-over cable. It works the same for 10Mb or 100Mb connections.

Use port #1 (or ports 2 thru 24) for straight-through twisted pair cabling from the 4K24 switched port to a user device, or the “1X” port for cross-over or up-link segment connections from the first 4K24 port to a repeater or hub or switch. Verify proper port connection by noting the port’s LINK/ACT status, which is illuminated when a proper link is made, and is blinking when there is activity.

Note: Port # 1 and Port # 1X, both RJ45 ports, are logically one port. Only one of these ports, either # 1 or # 1X, may be used at any one time.

4.4 Auto-negotiation for RJ-45 (copper) ports

The 4K24 Switch’s RJ-45 copper ports are N-way auto-negotiation. 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 4K24-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 switched ports operating at 100Mb half-duplex, the bit time delay is 50BT.

4.5 Auto-negotiation, full-duplex mode

Full-duplex Ethernet provides separate Transmit and Receive data paths, enabling simultaneous bi-directional collision-free data movements on a port. The network topology must be a “star” type, not a “bus” type. With full-duplex mode, the cable distance is only limited by the physical layer line driver and cable attenuation. There are no collision-domain restrictions or limitations.

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 4K24 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 100Mb hub or older Switch w/ Fixed 100 Full duplex), the 4K24-Switch’s RJ-45 ports will default to operate at half-duplex after the negotiation.

4.6 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 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 switched 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 4K24-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.

4.7 Power Budget Calculations for 4K-Series 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

Worst case OPB = OPB - 1dB(for LED aging) - 1dB(for insertion loss)

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

where the “Cable Loss” for 62.5/125 and 50/125 μ m (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 (HP’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 μ m	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
FKM-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
FKM-SSC	100Mb FX	Single-mode	18+ (0.4)	1300	9/125	-15	-31	14	28	17.5	35
FKM-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
FKM-SSCL	100Mb FX	Single-mode	40 (0.4)	1300	9/125	-5	-34	27	54	32.5	65

* **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 4K24 Fiber-Port Modules (FKM’s)

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

5.1 Inspecting the Package and Product (Optional)

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

Examine the shipping container for obvious damage prior to installing a FKM; 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:

One FKM, having 1 or two fiber ports
Installation instructions, with illustrations

Remove the FKM(s) from the shipping container. Be sure to keep the shipping container should you need to ship any of the FKM's 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 6 for specific return procedures.

5.2 Product Description

An important feature of the RFL 3000 4K-Series is the use of Fiber-Port Modules (FKM's) 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 copper port interfaces are designed to support all standard Ethernet media types at 100Mps speed. Each FKM provides one port for connecting Ethernet segments with its individual connector type and media.

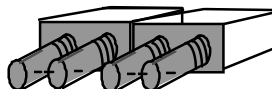
For a list of Fiber-Port Module types, refer to Section 1.2

Each FKM is individually described in the following sections.

5.2.1 FKM-MST, 100Mbps multi-mode FX-ST-type, "twist-lock" connector

The RFL 3000 FKM-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 4K24 Full-duplex Switch, it supports fiber optic cable distances up to the IEEE-specified switch distance limits, i.e., typically 2000 meters.

100BASE-FX,
FKM-2ST Connectors

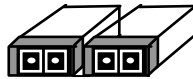


5.2.2 FKM-MSC 100Mbps multi-mode FX-SC-type, “snap-in” connector

The RFL 3000 FKM-MSC is also a multi-mode 100Mbps fiber optic transceiver module, similar to the FKM-MST.

While the functionality of these two modules is the same, the FKM-MSC is equipped with an SC-type "snap-in" connector instead of an ST-type.

100BASE-FX,
FKM-2SC Connectors



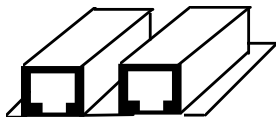
5.2.3 FKM-SSC and –SSCL 100Mbps single-mode FX-SC-type, “snap-in”

The RFL 3000 FKM-SSC (and –SSCL) 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.

To distinguish the single-mode FKM-SSC from the multi-mode FKM-MSC, the label “Sgl. M.” is at the top of the faceplate of the FKM-SSC.

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

100BASE-FX, Small Form Factor
FKM-2MTRJ Connectors



RFL 3000 FKM-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 plastic in color. The MTRJ's small size and ease of connection make it a good choice for 100Mbps Ethernet connectivity. When installed in a RFL 3000 4K24 Full-duplex Switch, it supports fiber optic cable distances up to the IEEE-specified switch distance limits, i.e., typically 2000 meters.

The functionality of this 100BASE-FX multi-mode FKM-MTRJ is the same as the ST and SC-types. Note that the other end of the fiber cable may have a different connector, not necessarily an MTRJ type.

5.2.5 FKM-Blank

The FKM-Blank is a blank face plate that must be installed in any empty FKM slot. When the RFL 3000 4K24 chassis contains less than two front-mounted FKMs, the empty front slots must be covered with the FKM-Blank face plate in order to maintain proper cooling air flow, and for safety, etc



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

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 4K24 Series Switches is a straightforward procedure (see INSTALLATION, Section 2.6); 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 4K24 Series Switch 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 4K24 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 4K24 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 4K24 Series Switches and its associated cables are functioning properly.

5. If the problem continues after completing Step 4 above, contact your supplier of the RFL 3000 4K24 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 (510) 438-9071 during business hours in California or email to *support@rfelect.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.
5. Ship the package to:

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

APPENDIX A: WARRANTY INFORMATION

RFL warrants the RFL 3000 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 4K24: 21 watt typical, 30 watts max.

Power Supply (Internal 24 VDC Option) Industrial Application

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

Input Voltage: 20 - 36 VDC

Power Consumption: Model 4K24: 21 watt typical, 30 watts max.

Power Supply (Internal 125 VDC Option) Industrial Application

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

Input Voltage: 120 - 160 VDC

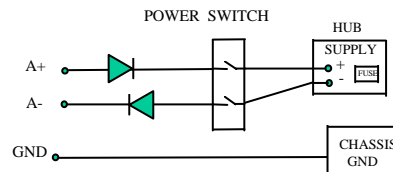
Power Consumption: Model 4K24: 21 watt typical, 30 watts max.

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).

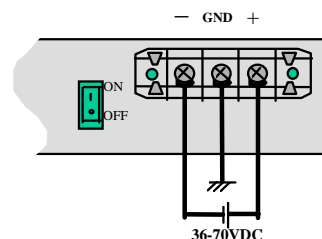


Figure B4.1: -48VDC Terminal Block on RFL 3000 Ks-48VDC

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. *For power and earthing wiring, use minimum 22 AWG size wiring.*
2. *Fastening torque of the lugs on the terminal block: 9 inch pound max.*
3. *Use only with listed 2A circuit breaker provided in the building installation.*
4. *Equipment for use in a Restricted Access Location only.*
5. *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 4K24-48VDC**.

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 4K24-24VDC** or **RFL 3000 4K24-125VDC**.

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 -4K24: 21 watt typical, 30 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 -4K24: 21 watt typical, 30 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 -4K24: 21 watt typical, 30 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”

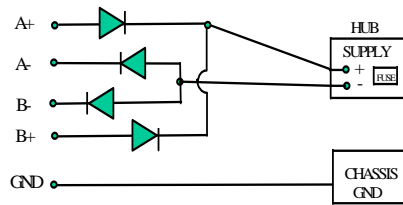
C2.0 RFL 3000 4K-SERIES , with -48VDC, 24VDC & 125VDC Dual-Source option

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

- a) 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.
- b) 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.
- c) 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.
- d) 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.
- e) 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.

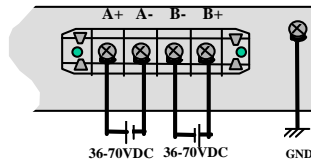


Figure C5.0: -48VDC Dual-Source, wiring connections to the External Terminal Block on a RFL 3000 48VDC with Dual-Source option

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 **C5.1 UL Requirements**

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

1. *For power and earthing wiring, use minimum 22 AWG size wiring.*
2. *Fastening torque of the lugs on the terminal block: 9 inch pound max.*
3. *Equipment for use in a Restricted Access Location only.*
4. *Use only with listed 2A circuit breaker provided in the building installation.*
5. *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 4K24-48VDC**

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 4K24-24VDC** or **RFL 3000 4K24-125VDC**

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.