



PowerFlow-2

Managed Ruggedized Ethernet Switch with Power over Ethernet

- Compact Industrial and ruggedized Ethernet switches with up to 16 10/100/1000BaseT, and 8x100/1000BaseFX SFPs
- Flexible deployment scenarios using xSTP, ERPS and ultra-fast recovery with PF-Ring and PF-chain
- Advanced L2 functionality like policing and traffic management, as well as security features to assure User Authentication and Device Connection Control
- Variety of input voltage and POE feeding options including POE++
- Wide Operating Temperature

PowerFlow-2 are managed and unmanaged industrial grade Gigabit Ethernet devices designed to build packet-based operational networks of Critical Infrastructure verticals. The family includes six managed switches and two unmanaged injectors (see *Ordering*).

MARKET SEGMENTS AND APPLICATIONS

PowerFlow-2 applications include power utilities, railways, traffic controllers, and safe city applications, which require advanced Layer 2 functionality and in many cases are PoE intensive. PowerFlow-2 provide a variety of redundant functions to increase the reliability and deployment flexibility of the communications system, including variety of Ethernet functions, such as xSTP, G.8032 and ultra-fast recovery using PS-ring and PF-chain unique features. PowerFlow supports IPV4/IPV6 Dual stack for transparent data transmission. Dual DC inlets and variety of isolated power supply options address a wide range of installation scenarios.

PowerFlow-2 systems are fully compliant with the requirement of EN 50121-4 for railways. Housed in rugged DIN rail or wall mountable enclosures, these switches are designed for harsh environments, such as industrial networking and intelligent transportation systems (ITS) and are also suitable for many military and utility market applications where environmental conditions exceed commercial product specifications. The wide operating temperature range models (-40°C to 75°C) fulfill the special needs of industrial applications.

INTEROPERABILITY

PowerFlow-2 is compatible with SecFlow-2 (RSTP, ERPS), Airmux (all PoE options besides Airmux-5000D), and PowerFlow-2-10G.

RESILIENCY

Ethernet Ring Protection

PowerFlow-2 supports STP, RSTP, MSTP, ITU-T G.8032 Ethernet Ring Protection Switching (ERPS), and PF-Ring for redundant cabling.

PowerFlow-2 provides five Ring instances, while each can support G.8032, PF-Ring, PF-Chain or Sub-Ring type for flexible uses. (Refer to *Installation and Operation manual* for more details).

PF-Ring can be established for Redundant Ethernet Ring, having recovery time <10ms with up to 250 units.

MANAGEMENT AND SECURITY

PowerFlow-2 can be managed using user-friendly web interface and CLI with textual database. It supports SNMPv3 and SSH using IPv4 or IPv6. Advanced L2 Ethernet functions (IGMP, VLAN, QoS) and security features (ACL, 802.1X) provide reliable secure communication. PowerFlow-2 can be conveniently managed centrally by RADview or other third-party SNMP managers.



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Data Sheet

Specifications

CAPACITY

Switching Capacity	Up to 48 Gbps
Forwarding Rate	Up to 35.7 Mpps
Max. Frame Size	Jumbo Frame: 9.6 KB
MAC Address Table	8K

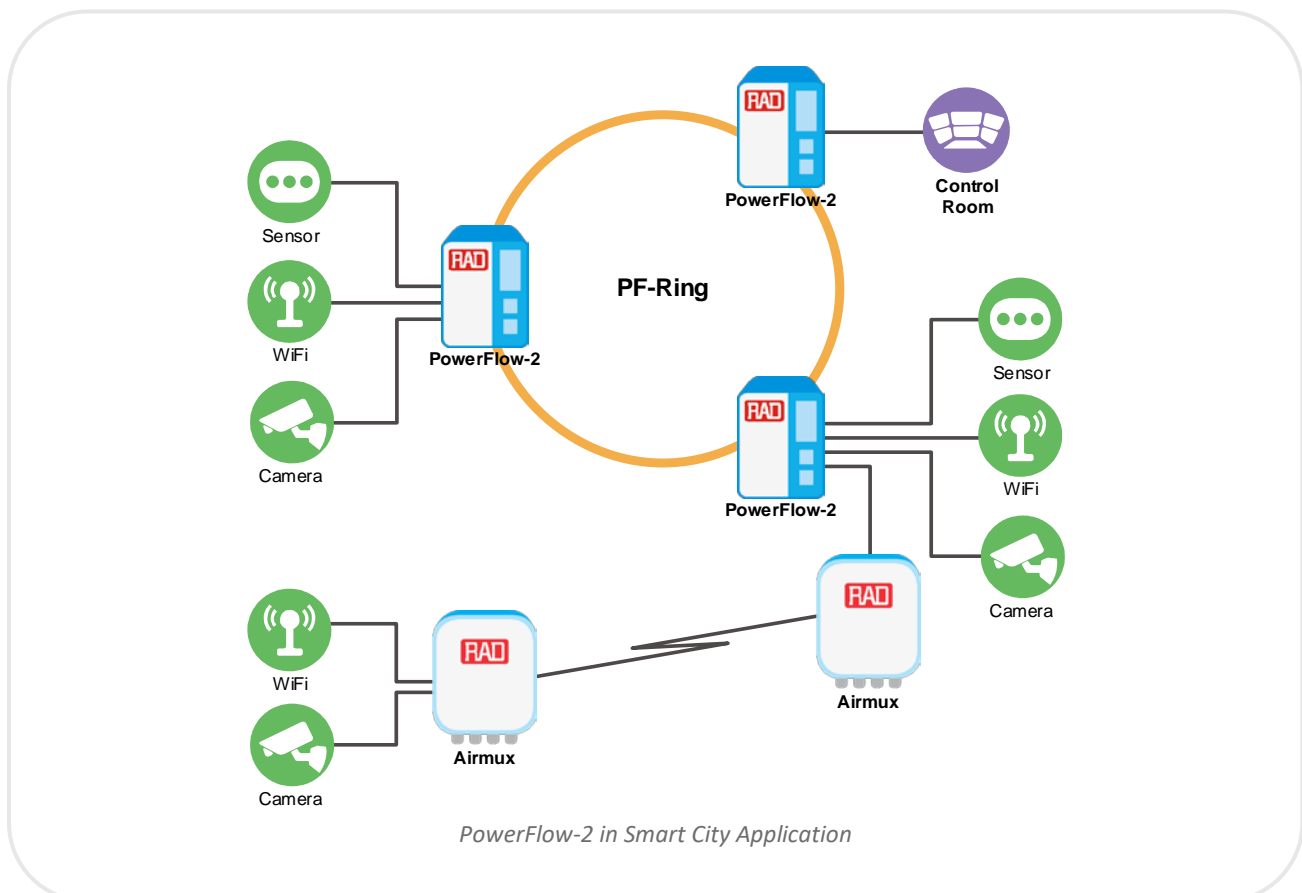
ETHERNET INTERFACES

Ports	See Table 1
Power over Ethernet (PoE)	PoE (15.4W per port): 802.3af
	PoE+ (30W per port): 802.3at
	PoE++ (60W per port): 802.3bt
	PoE for Airmux (Alternative-B, Passive)

VLAN	IEEE 802.1q VLAN, up to 4094 802.1Q VLAN VID
	IEEE 802.1ad Q-in-Q
	MAC-based VLAN, up to 256 entries
	IP Subnet-based VLAN, up to 128 entries
	Protocol-based VLAN (Ethernet, SNAP, LLC), up to 128 entries
	VLAN Translation, up to 256 entries
	MVR (Multiple VLAN Registration)
	GVRP (GARP VLAN Registration Protocol)

MANAGEMENT

Control Port	RS-232 interface, RJ-45 connector
Options	CLI with password-protected access
	Web-based
	SNMPv3
	Modbus/TCP



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TIMING*

Clients	NTP client
	SNTP client
IEEE1588 PTP V2	Transparent Clock

*Not applicable for PF-2/ETR/WDC/1UTP/1PU ordering option

SECURITY*

ACL	L2: MAC address SA/DA/VLAN
	L3: IP address SA/DA, Subnet
	L4: TCP/UDP

TACACS+

RADIUS

HTTPS, HTTP

SSL/SSH v2

IEEE 802.1X	Port-based
	MAC-based

*Not applicable for PF-2/ETR/WDC/1UTP/1PU ordering option

QUALITY OF SERVICE (QOS)*

Class of Service	IEEE802.1p 8 active priorities queues for per port
Traffic Classification QoS	IEEE802.1p based CoS
	IP Precedence based CoS
	IP DSCP based CoS
	QCL (QoS Control List): Frame Type, Source/Destination MAC, VLAN ID, PCP, DEI
	QCE (QoS Control Entry): Protocol, Source IP, IP Fragment, DSCP, TCP/UDP port number
Bandwidth Control	Scheduling algorithms: Strict Priority/ Deficit Weighted Round Robin (DWRR) 8 queues per port
	Ingress:
	<ul style="list-style-type: none">Rate in steps: 1 kbps / Mbps / fps / kfpsRange: 100 kbps to 1Gbps / 1fps to 3300kfpsRate Unit: bit or frame
	Egress:
	<ul style="list-style-type: none">Rate in steps: 1 kbps / MbpsRange: 100 kbps to 1GbpsRate Unit: bitPer queue / Per port shaper
DiffServ (RF 2474)	
Remarking	
Storm Control	Unicast, Broadcast, Multicast

GOOSE Message(for PF-2/ETR/WR/3SFP/8UTP/H)	Complies with IEC61850 standard to achieve zero packet loss
IGMP/MLD/DHCP	(Not applicable for PF-2/ETR/WDC/1UTP/1PU ordering option) IGMP Snooping v1, v2, v3 MLD Snooping v1, v2 Port Filtering Profile Throttling Fast Leave DHCP client/Relay/Snooping/ Snooping option 82/Relay option 82

*Not applicable for PF-2/ETR/WDC/1UTP/1PU ordering option

RESILIENCY

ERPS v2	Recovery time <50ms
	Single Ring, Sub-Ring, and Multiple ring topology network
	Up to 5 instances of PF-Ring. PF-Chain or Sub-Ring
Link Aggregation	Static (Hash with SA, DA, IP, TCP/UDP port), up to 5 trunk groups
	Dynamic (IEEE 802.3ad LACP), up to 5 trunk groups

DIAGNOSTICS

Alarm Relay	Relay outputs with current carrying capacity of 1 A @24VDC
Indicators	LED indicators
Event Syslog	Syslog server

GENERAL

Environment

Housing	Rugged Metal
	IP30 Protection
	Fanless
For the rest, see Table 3	

Physical

See Table 3

Power

See Tables 3, 4, 5, 6, 7, 8

Table 1. PowerFlow-2 Features (Switches)

Specifications	PF-2/ETR/ 48VDC/3SFP/ 8PH PF-2/ETR/WDC/ 3SFP/8PH	PF-2/ETR/ 48VDC/ 3SFP/ 4PH4PAM	PF-2/ETR/ 48VDC/ 2SFP/4PU	PF-2/ETR/ 48VDC/8SFP/ 8UTP/8PH	PF-2/ETR/ WR/3SFP/ 8UTP/H PF-2/ETR/ WR/3SFP/ 8UTP/HV	PF-2/ETR/ WDC/ 12SFP/ 8UTP	PF-2/ETR/ 48VDC/8SFP /16PH
Switching Capacity, non-blocking, Gbps	22	22	12	48	22	40	48
Forwarding Rate, Mpps	16.37	16.37	8.93	35.7	16.37	30	35.7
10/100/1000Base-T interfaces	-	-	4	8	8	8	-
FE/GbE SFP interfaces	3	3	2	8	3	12	8
PoE+ (30W per port)*	8	4	-	8	-	-	16 (total 360W max)
PoE++ (60W per port)	-	-	4	-	-	-	-
Airmux PoE	-	4	4	-	-	-	-
Port Mirroring	+	+	+	+	+	+	+
RMON I, RMON II	+	+	+	+	+	+	+
Modbus/TCP	+	+	+	+	-	+	+
IEEE 802.1ag CFM	+	+	+	+	+	+	+
ITU-T Y.1731 performance monitoring (PM)	+	+	+	+	+	+	+
CLI	+	+	+	+	+	+	+
Web-based	+	+	+	+	+	+	+
IPv6 Management	Telnet Server/ICMP v6, SNMP, HTTP, SSH, NTP/SNTP, TFTP, QoS, ACL, DHCP						

*Note: In order to ensure 30W per port, the device must be powered by a power source with minimum of 50 VDC.

Table 2. PowerFlow-2 Features (Injectors)

Specifications	PF-2/ETR/48VDC/ 1UTP/1PAM	PF-2/ETR/WDC/ 1UTP/1PU
10/100/1000Base-T interfaces	1	1
FE/GbE SFP interfaces	-	-
POE++ (60W per port)	-	1
Airmux PoE	1	-

Table 3. Power, Physical, and Environmental Specifications

Specifications	PF-2/ETR/48VDC/ 3SFP/8PH PF-2/ETR/WDC/ 3SFP/8PH PF-2/ETR/48VDC/ 3SFP/4PH4PAM PF-2/ETR/WDC/ 12SFP/8UTP	PF-2/ETR/ 48VDC/ 8SFP/8UTP/ 8PH	PF-2/ETR/ 48VDC/ 2SFP/4PU	PF-2/ETR/ WDC/ 1UTP/1PU	PF-2/ETR/ 48VDC/ 1UTP/1PAM	PF-2/ETR/ WR/3SFP/ 8UTP/H PF-2/ETR/ WR/3SFP/ 8UTP/HV	PF-2/ETR/ 48VDC/8SFP/ 16PH
Power Supply*	Dual inlet 48 VDC or WDC			Dual inlet 12/24/48VDC	Single inlet 48VDC	Wide range dual inlet 48VDC (/H only) or single 88~264 VAC or 85~300 VDC	Dual inlet 48 VDC
Power Consumption	See Table 7			See Table 4	See Table 6	See Table 5	See Table 7
Negative voltage power input support**	+	+	+	+	-	+	+
Height / cm(inch)	15.2 (5.9)	15.7 (6.2)	13.5 (5.3)	14.2 (5.6)	10.3 (4.1)	15.2 (5.9)	16.0 (6.3)
Width / cm(inch)	7.2 (2.9)	9.1 (3.6)	6.25 (2.5)	3.16 (1.24)	3.0 (1.2)	8.2 (3.2)	9.9 (3.9)
Depth / cm(inch)	10.6 (4.2)	11.6 (4.6)	10.6 (4.2)	10.6 (4.17)	7.0 (2.8)	10.6 (4.17)	13.6 (5.3)
Weight / kg (lb.)	1.0 (2.2)	2.06 (4.54)	0.7 (1.54)	0.425 (0.93)	0.215 (0.48)	1.085 (2.39)	1.95 (4.3)
Storage Temperature	-40 to +85°C (-40 to 185°F)						
Operating Temperature	-40 to +65°C (-40 to 149°F)****		- 40 to +75°C (-40 to 167°F)***				- 40 to +60°C (-40 to 140°F) at 360W - 40 to +65°C (-40 to 149°F) at 240W
Humidity	5% to 95% (non-condensing)						

*Since PoE is not isolated from the power supply, it is recommended to check grounding polarity along the line or to use isolated (In-Out) or floating power source

** In some telecom applications, users may need to use negative DC power to prevent wire corrosion. One power supply is enough to power up the device. In case of power source redundancy, when two negative DC power supplies are needed ("+" poles are connected together to ground), an additional kit (PF-2-48V-DUAL-INPUTS-KIT, ordered separately) should be used for protecting the batteries in case of power level difference between the 2 sources.

*** Up to +85°C for model PF-2/ETR/WR/3SFP/8UTP/H for up to 12 hours

**** Up to +75°C for model PF-2/ETR/WDC/12SFP/8UTP

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Table 4. PF-2/ETR/WDC/1UTP/1PU Power Consumption

Input Voltage	Mode	Input Power Consumption	Device Power Consumption	PoE Power Budget	Boost Efficiency
12VDC	30W (2 Pair)	33.9W	1.1W	30W	91.46%
24VDC	30W (2 Pair)	33W	1.4W	30W	94.90%
48VDC	30W (2 Pair)	33.2W	1.9W	30W	95.80%
12VDC	60W (2 Pair)	67.1W	1.1W	60W	90.90%
24VDC	60W (4 Pair)	65.2W	1.4W	60W	94.10%
48VDC	60W (4 Pair)	64.7W	1.9W	60W	95.50%

Table 5. PF-2/ETR/WR/3SFP/8UTP/H and
PF-2/ETR/WR/3SFP/8UTP/HV Power Consumption

Input Voltage	Consumption
110VAC	9.3W
220VAC	9.2W
24VDC (/H only)	9.6W
48VDC (/H only)	11.1W

Table 6. PF-2/ETR/48VDC/1UTP/1PAM Power Consumption

Input Voltage	Consumption
48VDC (2 pairs)	1.1W
48VDC (4 pairs)	2.8W

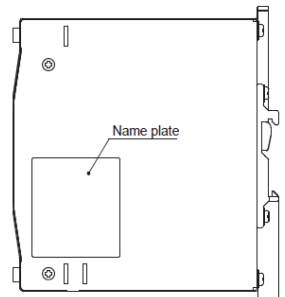
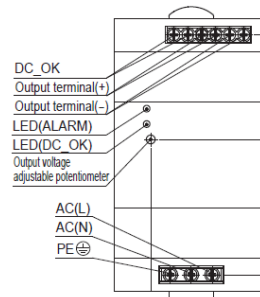
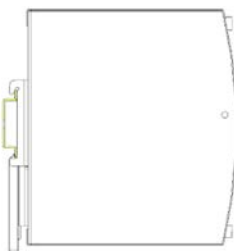
Table 7. Power Consumption for other Options

Device	Input Voltage	Total Power Consumption	Device Power Consumption	PoE Budget
PF-2/ETR/48VDC/8SFP/8UTP/8PH	48 VDC*	255.2W	15.2W	240W
PF-2/ETR/48VDC/3SFP/4PH4PAM	48 VDC*	255.2W	9.6W	240W
PF-2/ETR/48VDC/3SFP/8PH	24 VDC	194.2W	10.8W	180W
PF-2/ETR/WDC/3SFP/8PH	48 VDC	196.0W	11.5W	180W
PF-2/ETR/WDC/12SFP/8UTP	12 VDC	-	14.3	-
	24 VDC	-	14.2	-
	48 VDC	-	15.8W	-
PF-2/ETR/48VDC/8SFP/16PH	48 VDC*	387W	20W	360W
PF-2/ETR/48VDC/2SFP/4PU	48 VDC	249.6W	9.6W	240W

*Note: In order to ensure 30W per port, the device must be powered by a power source with minimum of 50 VDC.

Table 8. AC/DC Power Supplies

		SF-AC-48VDC-240W	SF-AC-48VDC-480W
Output	DC Output	48V	48V
	Maximum Rated Current	5A	10A
	Ripple and Noise	≤480mV	≤240mV
	Voltage ADJ. Range	48V~56V	45.0V~55.2V
	Voltage Accuracy	±3.0%	±1.0%
	Line Regulation	±0.5%	±0.4%
	Load Regulation	±1.0%	±0.63%
Input	Voltage Range	85 ~264 VAC or 100 ~275 VDC	85~264 VAC or 88 ~350 VDC
	Frequency Range	47~63Hz	45~66 Hz
	Efficiency (typical)	93%	93%
	AC Current (max.)	<3.0 A/100Vac <1.5A/230Vac	<4.6 A/115Vac <2.3 A/230Vac
	Inrush Current (Typical)	< 20A/110Vac < 40A/230Vac	< 20A/115Vac < 40A/230Vac
Protection	Overload protection	110%~150% of rated current, Constant current limiting for some time (150% of rated current, last 3S) then PS stop working for 7S	Works over 101% of peak current and recovers automatically
	Over voltage	58~63V, constant voltage, Auto recovery	57.6~67.2V , constant voltage, Auto recovery
	DC-OK relay contact rating	Max 30V/1A or 60V/0.3A or 30Vac/0.3A	Max 30V/1A or 30Vac/0.5A
Environ-ment	Operating amb. Temp. & Hum.	-25°C~70°C; 20%~90%RH (Non condensing)	-25°C to +70°C, 20% - 90%RH (Non condensing),
	Storage Temp. & Hum.	-40°C~85°C; 5%~95%RH (Non condensing)	-40°C to +85°C, 20% - 90%RH (Non condensing)
Safety & EMC	Safety Standards	meet UL508, UL60950, EN60950	UL60950-1, C-UL (CSA60950-1), EN60950-1, UL508, ANSI/ISA12.12.01, ATEX
	EMC Emission	Compliance to EN55022, EN55024, FCC PART 15 Class B	Compliance to FCC-B, VCCI-B, CISPR22-B, EN55011-B, EN55022-B
	Harmonic Current	Compliance to EN61000-3-2, CLASS A	Compliance to IEC61000-3-2 (Class A)
Dimensions (W*H*D)		45*124*119 mm	70*124*117 mm



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Ordering

RECOMMENDED CONFIGURATIONS

PF-2/ETR/48VDC/3SFP/8PH

Dual inlet 48VDC, three 100/1000Base-X SFP ports, eight 10/100/1000Base-T PoE+ (240W) ports

PF-2/ETR/48VDC/8SFP/16PH

Dual inlet 48VDC, eight 100/1000Base-X SFP ports, sixteen 10/100/1000Base-T PoE+ ports, maximum total 360W

PF-2/ETR/48VDC/8SFP/8UTP/8PH

Dual inlet 48VDC, eight 100/1000Base-X SFP ports, eight 10/100/1000Base-T ports, eight 10/100/1000Base-T PoE+ (240W) ports

PF-2/ETR/48VDC/2SFP/4PU

Dual inlet 48VDC, two 100/1000Base-X SFP ports, four PoE++ 10/100/1000Base-T ports, supporting up to 240W on the device

PF-2/ETR/WR/3SFP/8UTP/H

Wide range dual inlet 48VDC or single 110/220 VAC/VDC, three 100/1000Base-X SFP ports, eight 10/100/1000Base-T ports, compliant IEC61850-3 and IEEE1613

PF-2/ETR/WR/3SFP/8UTP/HV

Single 110/220 VAC/VDC, three 100/1000Base-X SFP ports, eight 10/100/1000Base-T ports, compliant IEC61850-3 and IEEE1613

PF-2/ETR/WDC/3SFP/8PH

Dual inlet 24/48VDC, three 100/1000Base-X SFP ports, eight 10/100/1000Base-T PoE+ (180W) ports

PF-2/ETR/WDC/12SFP/8UTP

Dual inlet 12/24/48 VDC, twelve 100/1000Base-X SFP ports, eight 10/100/1000Base-T ports

PF-2/ETR/48VDC/3SFP/4PH4PAM

Dual inlet 48 VDC, three 100/1000Base-X SFP ports, four 10/100/1000Base-T PoE+ ports, four 10/100/1000BaseT Airmux PoE (240W) ports

PF-2/ETR/WDC/1UTP/1PU

Unmanaged, 12/24/48 VDC, one 10/100/1000Base-T port, one 10/100/1000Base-T PoE++ (72W) port

PF-2/ETR/48VDC/1UTP/1PAM

Unmanaged, 48VDC, one 10/100/1000Base-T port, one 10/100/1000Base-T PoE+ port (30W, Airmux support)

SPECIAL CONFIGURATIONS

Please contact your local RAD partner for additional configuration options

SUPPLIED ACCESSORIES

PF-CBL-RJ45-DB9

Console cable RJ-45 to DB-9

PF-2-TB

Terminal block for power input connector as per specific device

Mounting kits for installing PowerFlow devices on a DIN rail (depending on the device type):

PF-2-DIN-RAIL-KIT-50.5x30mm

Mounting kit for installing a PF-2/ETR/WDC/1UTP/1PU or PF-2/ETR/48VDC/1UTP/1PAM device on a DIN rail – 50.5 x 30 mm with 3 screws

PF-2-DIN-RAIL-KIT-50.5x54mm

Mounting kit for installing a PF-2/ETR/48VDC/3SFP/8PH, PF-2/ETR/WDC/3SFP/8PH, PF-2/ETR/48VDC/3SFP/4PH4PAM, PF-2/ETR/WR/3SFP/8UTP/H or PF-2/ETR/48VDC/2SFP/4PU device on a DIN rail – 50.5 x 54 mm with 3 screws

PF-2-DIN-RAIL-KIT-130x52mm

Mounting kit for installing a PF-2/ETR/48VDC/8SFP/8UTP/8PH device on a DIN rail – 130 x 52mm with 8 screws, Phoenix Contact

OPTIONAL ACCESSORIES

Mounting Kits

PF-2-WALL-MOUNT-KIT-184X30MM

Mounting kit for installing PF-2/ETR/WDC/1UTP/1PU or PF-2/ETR/48VDC/1UTP/1PAM on a wall – 184 x 30 mm with 2 screws

PF-2-WALL-MOUNT-KIT-184X50MM

Mounting kit for installing PF-2/ETR/48VDC/3SFP/8PH, PF-2/ETR/WDC/3SFP/8PH, PF-2/ETR/48VDC/3SFP/4PH4PAM, PF-2/ETR/WR/3SFP/8UTP/H or PF-2/ETR/48VDC/2SFP/4PU on a wall – 184 x 50 mm with 2 screws

PF-2-WALL-MOUNT-KIT-76X75MMX2

Mounting kit for installing PF-2/ETR/48VDC/8SFP/8UTP/8PH on a wall – 2 x 76 x 75 mm with 4 screws

RM-DIN-SINGLE

Mounting kit for installing a DIN rail device in a 19/23-inch rack

RM-DIN-19

Mounting kit for installing multiple DIN rail devices in a 19-inch rack

External Power Supplies and Accessories

SF-AC-48VDC-480W

External DIN rail AC to 48 VDC power supply, 480 W

SF-AC-48VDC-240W

External DIN rail AC to 48 VDC power supply, 240 W

Notes:

For performance guaranteed operation of PF-2 product line it is recommended to use RAD SF-AC Power supplies.

SF-AC Power supplies have the possibility to work in load sharing, in applications where double SF-AC Power supplies are used per PowerFlow-2 switch.

PF-2-48V-DUAL-INPUTS-KIT

Protection kit (needed for installation of two negative -48 VDC power supplies)

PF-2-TB2

PowerFlow Terminal Block connector 2PIN for PF-2/ETR/WR/3SFP/8UTP/H

PF-2-TB6

PowerFlow Terminal Block connector 6PIN for all DIN rail type devices

CBL-PS480/250W/TBF6/OPEN/20CM

Cable for connecting two SF-AC-48VDC power supplies to one PowerFlow-2 devices with open wires at PS side, 20 cm long

CBL-PS480/250W/TBF6/OPEN/60CM

Cable for connecting two SF-AC-48VDC power supplies to one PowerFlow-2 devices with open wires at PS side, 60 cm long

Transceivers

For the list of available transceivers, see the **Pluggable Transceivers data sheet** at www.rad.com

Note: It is strongly recommended to order this device with **original RAD SFPs installed**. This will ensure that prior to shipping, RAD has performed comprehensive functional quality tests on the entire assembled unit, including the SFP devices. RAD cannot guarantee full compliance to product specifications for units using non-RAD SFPs.

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