USER GUIDE

RedFox 5728 Series

Industrial routing switches

WEOS

Table of Contents

1. General Information

1.1. Legal Information
The contents of this document are provided "as is". Except as required by applicable law, no warranties of any kind are made in relation to the accuracy and reliability or contents of this document, either expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Westermo reserves the right to revise this document or withdraw it at any time without prior notice.

Under no circumstances shall Westermo be responsible for any loss of data or income or any special, incidental, and consequential or indirect damages howsoever caused.

More information about Westermo can be found at www.westermo.com.

1.2. About This Guide
This guide is intended for installation engineers and users of the Westermo products.

It includes information on safety and regulations, a product description, installation instructions and technical specifications.

1.3. Software Tools
Related software tools are available at https://www.westermo.com/support/product-support.

1.4. License and Copyright for Included FLOSS
This product includes software developed by third parties, including Free/Libre Open Source Software (FLOSS). The specific license terms and copyright associated with the software are included in each software package respectively. Please visit the product web page for more information.

Upon request, the applicable source code will be provided. A nominal fee may be charged to cover shipping and media. Please direct any source code request to your normal sales or support channel.

1.5. WeOS
This product runs WeOS 5 (Westermo Operating System). Instructions for quick start, configuration and factory reset are found in the WeOS user documentation at www.westermo.com.

2. Safety and Regulations

2.1. Warning Levels

Warning signs are provided to prevent personal injuries and/or damages to the product. The following levels are used:

Level of warning	Description	Consequence personal injury	Consequence material damage
WARNING	Indicates a potentially hazardous situation	Possible death or major injury	Major damage to the product
CAUTION	Indicates a potentially hazardous situation	Minor or moderate injury	Moderate damage to the product
NOTICE	Provides information in order to avoid misuse of the product, confusion or misunderstanding	No personal injury	Minor damage to the product
NOTE	Used for highlighting general, but important information	No personal injury	Minor damage to the product

Table 1. Warning levels

2.2. Safety Information

Before installation:

Read this manual completely and gather all information available on the product. Make sure it is fully understood. Check that your application does not exceed the safe operating specifications for the product.

⚠ **SAFETY DURING INSTALLATION**

The product must be installed and operated by qualified service personnel and installed into an apparatus cabinet or similar, where access is restricted to service personnel only.

Refer to chapter Compliance Information to see the required level of qualified service personnel according to safety standards.

Before energising and connecting communication cables to the product, ensure a protective earthing conductor is first connected to the protective earthing terminal (only valid for metallic housings). Westermo recommends a cross-sectional area of at least 4 mm^2.

Upon removal of the product, disconnect the product from the power supply and all other communication ports before disconnecting the protective earthing conductor.

⚠ **HAZARDOUS VOLTAGE**

Do not open an energised product. Hazardous voltage may occur when connected to a power supply.

For RedFox models with a rated voltage above 48 VDC or 30 VAC: Apply the protective cap (delivered with the product) on the power cable.

WARNING - PREVENT ACCESS TO HAZARDOUS VOLTAGE CABLE

Apply the protective cap (delivered with the HV and HVHV products) on the power cable, according to the illustrated steps below.

To prevent accidentally pulling out wires, make sure the power cable and the wires are firmly attached to the protective cap.

For screw connectors, make sure the screws are properly tightened, as well as routing the wires separately from other wires. For connectors with straps, fasten the cable as strain relief, as well as routing the wires separately.
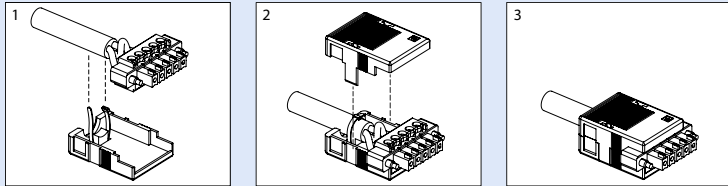
PROTECTIVE FUSE

It must be possible to disconnect manually from the power supply. Ensure compliance to national installation regulations.

Replacing the internal fuse must only be performed by Westermo qualified personnel.

POWER SUPPLY CONNECTION

There are safety regulations governing the power source that can be used in conjunction with the product. Refer to chapter Interface Specifications.

REDUCE THE RISK OF FIRE

To reduce the risk of fire, use only telecommunication line cords with a cable diameter of AWG 26 or larger. Regarding power cable dimensions, see chapter Interface Specifications.

CLASS 1 LASER PRODUCT
Do not look directly into a fibre optical port or any connected fibre, although the product is designed to meet the Class 1 Laser regulations and complies with 21 CFR 1040.10 and 1040.11.

HANDLING OF SFP TRANSCEIVERS
SFP transceivers are supplied with plugs to avoid contamination inside the optical port. They are very sensitive to dust and dirt. If the fibre optic cable is disconnected from the product, a protective plug must be used on the transmitter/receiver. The protective plug must be kept on during transportation. The fibre optic cable must be handled the same way.

CORROSIVE GASES
If the product is placed in a corrosive environment, it is important that all unused connector sockets are protected with a suitable plug, in order to avoid corrosion attacks on the gold plated connector pins.

ELECTROSTATIC DISCHARGE (ESD)
Prevent electrostatic discharge damage to internal electronic parts by discharging your body to a grounding point (e.g. use a wrist strap).

CABLE TEMPERATURE RATING FOR FIELD TERMINAL WIRES
There may be a requirement on the minimum temperature rating of the cable to be connected to the field wiring terminals, see chapter Interface Specifications.

2.3. Care Recommendations

Follow the care recommendations below to maintain full operation of the product and to fulfill the warranty obligations:

- Do not drop, knock or shake the product. Rough handling above the specification may cause damage to internal circuit boards.
- Use a dry or slightly water-damp cloth to clean the product. Do not use harsh chemicals, cleaning solvents or strong detergents.
- Do not paint the product. Paint can clog the product and prevent proper operation.

If the product is used in a manner not according to specification, the protection provided by the equipment may be impaired.

If the product is not working properly, contact the place of purchase, the nearest Westermo distributor office or Westermo technical support.

2.4. Product Disposal

This symbol means that the product shall not be treated as unsorted municipal waste when disposing of it. It needs to be handed over to an applicable collection point for recycling electrical and electronic equipment.

By ensuring the product is disposed of correctly, you will help to reduce hazardous substances and prevent potential negative consequences to both the environment and human health, which could be caused by inappropriate disposal.

Figure 1. WEEE symbol for treatment of product disposal

2.5. Compliance Information

2.5.1. Agency Approvals and Standards Compliance

Type	Approval/Compliance
EMC	• EN 50121-4/IEC 62236-4, Railway signalling and telecommunications apparatus • EN/IEC 61000-6-2, Immunity industrial environments • EN/IEC 61000-6-4, Emission industrial environments • EN/IEC 61000-6-5, Immunity power station and substation environment
EMI	• FCC Part 15.105 class A
Substation automation	• IEEE 1613, Testing Requirements for Communications Networking Devices Installed in Electric Power Substations • IEC 61850-3, Communication networks and systems for power utility automation – Part 3: General requirements
Safety	• EN/IEC/UL 61010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements • EN/IEC/UL 61010-2-201, Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements

Table 2. Agency approvals and standards compliance

2.5.2. EN/IEC/UL 61010-2-201 Notice[1]
This product has been tested and found compliant to EN/IEC/UL 61010-2-201, Safety requirements for electrical equipment for measurement, control, and laboratory use. In accordance with the definitions of the standard, this product shall be handled by skilled service personnel.

2.5.3. FCC Part 15.105 Class A Notice
This product has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the product is operated in a commercial environment.

This product generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user manual, may cause harmful interference to radio communications. Operation of this product in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the users own expense.

2.5.4. Simplified Declaration of Conformity

Hereby, Westermo declares that this product is in compliance with applicable EU directives and UK legislations. The full declaration of conformity and other detailed information is available at www.westermo.com/support/product-support.

Figure 2. The European Conformity and the UK Conformity Assessment markings

3. Product Description

3.1. Product Description

RedFox-5728 takes communication reliability for substations to a new level. We know that in critical substation automation applications, even the loss of a single piece of data can disturb the operations, and that is why RedFox-5728 brings the highest reliability to your network. Withstanding the toughest environmental conditions, including the high EMI levels derived from load switching and lightning strikes and extreme ambient temperatures, RedFox-5728 ensures 100% uptime, no matter what.

IEC 61850-3 and IEEE 1613 standards define the requirements and test levels for networking devices. They specify two different device reliability classes: Class 1 devices, which allow for communication errors; and Class 2 devices, which do not allow loss of a single transmission package even during the highest electro magnetic disturbances (EMI). RedFox-5728 meets or exceeds all test levels for Class 2 fulfilment, attaining KEMA type test gold certification, ensuring zero down-time, communication losses, delays or errors.

Superior build quality, the exclusive use of industrial grade components and extensive in-house testing results in class-leading MTBF and extended service life. Designed to run efficiently from either one or two power inputs, with dual internal power supplies fully isolated from each other and all other interfaces. The 28-port switch has all connectors located at the front for easy access and a range of different port configurations, customizable with SFP transceivers.

For resilient operations in substations not only is the most robust hardware needed, but also the most robust software. Available with both layer 2 and layer 3 functionality, RedFox-5728 is powered by the next generation WeOS operating system, which ensures continuous operation and support for an expanding range of protocols and features. Intuitive set-up and configuration enable easy and cost-efficient installation and removes the need for specialized IT support or training. Recognizing the growing sophistication of cyberattacks, an extensive suite of cyber security tools is also available.

3.2. Available Models

Art. no.	Model	No. of SFP ports	No. of copper ports	Layer
3641-4350	RedFox-5728-F4G-T24G-LV	4	24	Layer 2
3641-4355	RedFox-5728-F4G-T24G-LVLV	4	24	Layer 2
3641-4550	RedFox-5728-F4G-T24G-HV	4	24	Layer 2
3641-4555	RedFox-5728-F4G-T24G-HVHV	4	24	Layer 2
3641-4360	RedFox-5728-F16G-T12G-LV	16	12	Layer 2
3641-4365	RedFox-5728-F16G-T12G-LVLV	16	12	Layer 2
3641-4560	RedFox-5728-F16G-T12G-HV	16	12	Layer 2
3641-4565	RedFox-5728-F16-T12G-HVHV	16	12	Layer 2
3641-4250	RedFox-5728-E-F4G-T24G-LV	4	24	Layer 3
3641-4255	RedFox-5728-E-F4G-T24G-LVLV	4	24	Layer 3
3641-4450	RedFox-5728-E-F4G-T24G-HV	4	24	Layer 3
3641-4455	RedFox-5728-E-F4G-T24G-HVHV	4	24	Layer 3
3641-4260	RedFox-5728-E-F16G-T12G-LV	16	12	Layer 3
3641-4265	RedFox-5728-E-F16G-T12G-LVLV	16	12	Layer 3
3641-4460	RedFox-5728-E-F16G-T12G-HV	16	12	Layer 3
3641-4465	RedFox-5728-E-F16G-T12G-HVHV	16	12	Layer 3

3.3. Hardware Overview
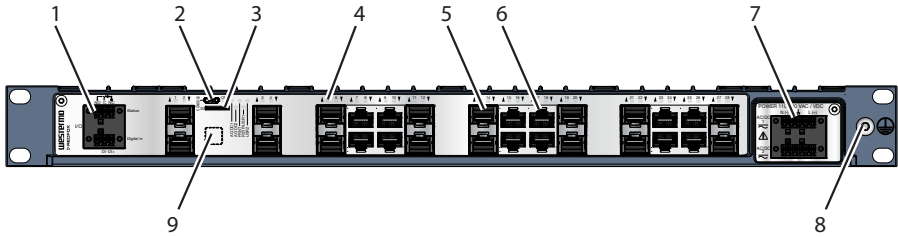
No.	Description	No.	Description
1	I/O connection	2	Console port
3	Micro SD	4	LED indicators
5	100/1000 Mbit/s SFP port (number depending on model)	6	10/100/1000 Mbit/s TX ports (number depending on model)
7	Power input	8	Protective earth
9	Label with data matrix[a]		

[a] The base MAC address and production date of the product is included in the front label data matrix.

Figure 3. Location of interface ports and LED indicators, illustrated by a RedFox-5728-F16G-T12G-HVHV

3.4. Connector Information

3.4.1. Power Input

Illustration	Position	Product marking	Direction	Description
	AC/DC1	L(+)	Input	Line/Phase (AC), positive (DC)
		N(-)	Input	Neutral (AC), negative/return (DC)
		⏚	Input	Functional earth
	AC/DC2	L(+)	Input	Line/Phase (AC), positive (DC)
		N(-)	Input	Neutral (AC), negative/return (DC)
		⏚	Input	Functional earth

Table 3. Power input HVHV

Illustration	Position	Product marking	Direction	Description
	AC/DC1	L(+)	Input	Line/Phase (AC), positive (DC)
		N(-)	Input	Neutral (AC), negative/return (DC)
		⏚	Input	Functional earth

Table 4. Power input HV

Illustration	Product marking	Direction	Description
	+DC1	Input	Supply voltage
	+DC2	Input	Supply voltage
	-COM	Input	Common
	-COM	Input	Common

Table 5. Power input LV and LVLV models

NOTE - COM TERMINALS
On LV models, COM terminals are galvanically connected together. For LVLV models, COM terminals correspond to each power supply and are isolated from each other.
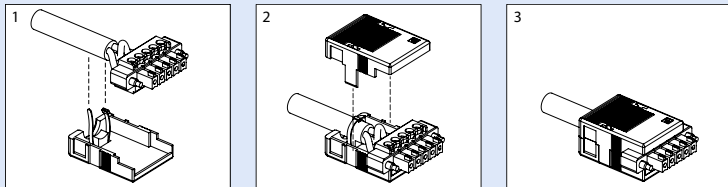
> ⚠️ **WARNING - PREVENT ACCESS TO HAZARDOUS VOLTAGE CABLE**
>
> Apply the protective cap (delivered with the HV and HVHV products) on the power cable, according to the illustrated steps below.
>
> To prevent accidentally pulling out wires, make sure the power cable and the wires are firmly attached to the protective cap.
>
> For screw connectors, make sure the screws are properly tightened, as well as routing the wires separately from other wires. For connectors with straps, fasten the cable as strain relief, as well as routing the wires separately.

> ⚠️ **CABLE TEMPERATURE RATING FOR FIELD TERMINAL WIRES**
>
> There may be a requirement on the minimum temperature rating of the cable to be connected to the field wiring terminals, see chapter Interface Specifications.

3.4.2. I/O Connection

Illustration	Position	Product marking	Direction	Description
	Digital in	DI+	Input	Digital in+
		DI-		Digital in-
	Status	Status NO	Output	Alarm (status) relay contact NO - Normally Open C - Common NC - Normally Closed
		Status C		
		Status NC		

Table 6. I/O connection

The Digital in is an opto-isolated digital input, which can be used to monitor external events.

The Status output is a potential free, opto-isolated, alternation (Form-C) solid-state relay. This can be configured to monitor various alarm events within the product, see *WeOS Management Guide*. An external load in series with an external DC voltage source is required for proper functionality.

Unit condition	Status NO- C	Status NC-C
Unpowered / pre-operational or Alarm active	OPEN	CLOSED
Operational and Alarm inactive	CLOSED	OPEN

Table 7. Status output

3.4.3. Console Port

The console port can be used to connect to the CLI (Command Line Interface). The console connector is a USB cable that connects to a FTDI FT232R USB to serial converter internally. For drivers, refer to www.ftdichip.com and download the appropriate VCP driver.

Remove the protective cover before inserting the console cable. After removing the console cable, be sure to reassemble the protective cover again.
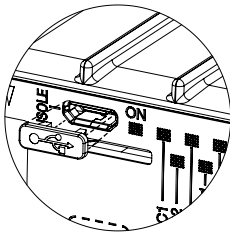

Figure 4. Remove protective cover for the console port

3.4.4. Micro SD

To insert the micro SD card correctly, turn the gold plated pins upwards.
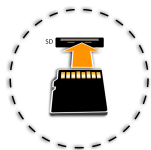
Figure 5. Insertion of micro SD card

3.4.5. SFP Transceivers

The product supports UL and Westermo labelled SA-approved transceivers only. See Westermo's modular transceivers datasheets 100 Mbit and 1 Gbit for SA-approved

SFP transceivers, which can be downloaded from the product support pages at www.westermo.com/support/product-support.

Each SFP slot can hold one SFP transceiver. See "*Transceiver User Guide 6100-0000*" for transceiver handling instructions, which also can be downloaded from the product support pages at www.westermo.com/support/product-support.

In the event of contamination, the optical connectors in the SFP transceivers should only be cleaned by the use of forced nitrogen and some kind of cleaning stick. Recommended cleaning fluids are methyl-, ethyl-, isopropyl- or isobutyl alcohol, hexane or naphtha.

> **HANDLING OF SFP TRANSCEIVERS**
> SFP transceivers are supplied with plugs to avoid contamination inside the optical port. They are very sensitive to dust and dirt. If the fibre optic cable is disconnected from the product, a protective plug must be used on the transmitter/receiver. The protective plug must be kept on during transportation. The fibre optic cable must be handled the same way.

3.5. LED Indicators

LED	Status	Description
ON	OFF	Product has no power
	GREEN	All OK, no alarm condition
	RED	Alarm condition, or until product has started up. (Alarm conditions are configurable, see *WeOS5 User Guide*)
RSTP/ USR1	OFF	RSTP disabled
	GREEN	RSTP enabled
	BLINK	Product selected as RSTP/STP root switch
	USR1	Configurable, see *WeOS5 User Guide*
FRNT	OFF	FRNT disabled
	GREEN	FRNT OK
	RED	FRNT error
	FLASH	Product configured as FRNT focal point
DC1 / AC/DC1	OFF	Product has no power
	GREEN	Power OK on DC1 / AC/DC1
	RED	DC1 / AC/DC1 input voltage is below operating voltage limit
DC2 / AC/DC2[a.]	OFF	Product has no power
	GREEN	Power OK on DC2 / AC/DC2
	RED	DC 2 / AC/DC2 input voltage is below operating voltage limit
USR2	Configurable, see *WeOS5 User Guide*	
TX/FX ports	OFF	No link
	GREEN	Link established
	GREEN FLASH	Data traffic indication
	YELLOW	Port alarm and no link. Or if FRNT or RSTP mode, port is blocked.

[a.] Only available on RedFox-5728 HVHV models

Table 8. LED indicators

3.6. Dimensions

Dimensions are stated in mm.
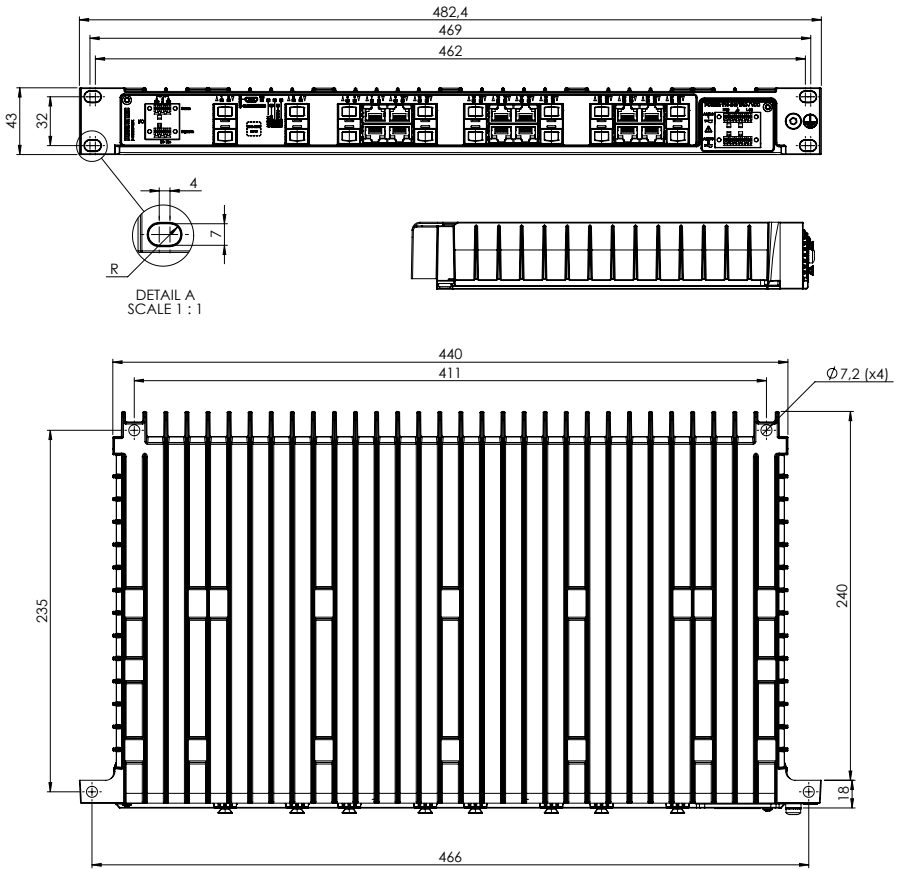
Figure 6. Dimensional drawing, illustrated by a RedFox-5728-F16G-T12G-HVHV

4. Installation

4.1. Mounting

RedFox-5728 is designed for installation in 19" rack solutions, with a shallow depth of 240 millimetres.

4.1.1. Rack Mounting

The product can be mounted in all directions inside a 19" apparatus cabinet. Use supplied M6x25 (Philips no. 3) or 1/4x1" screws.

Figure 7. Rack mounted product

4.2. Protective Earth Connection

For correct function, the earth connection needs to be properly connected to a designated PE rail. Torx: T25 and torque: 3.2 Nm.

Figure 8. Earth connection

4.3. Cooling

This product relies on convection cooling. To avoid obstruction of the airflow around the product, follow the spacing recommendations.

For mounting in 19" apparatus cabinet without forced ventilation, a minimal spacing of 1U according to IEC 60297 or 45 mm (1.75") above/below is recommended. With forced ventilation, no minimal spacing is required as long as the temperature of the rear cooling plates does not exceed +85°C (+185°F).

5. Specifications

5.1. Interface Specifications

NOTE - USE OF ANTISTATIC ARM-WRIST BAND
To minimize the risk of exposing the unit to unintentional large static electric fields - if service and maintenance need to be performed during operation, always use an antistatic arm-wrist band.

Power port	
Rated voltage[a.]	LV and LVLV models: 24-48 VDC HV and HVHV models: 110-240 VAC, 50-60 Hz, 110-240 VDC
Operating voltage	LV and LVLV models: 18-60 VDC HV and HVHV models: 85-264 VAC, 47-63 Hz, 85-264 VDC

Rated current[b.c.]	RedFox-5728-(E-)F4G-T24G-LV RedFox-5728-(E-)F4G-T24G-LVLV	1.08 A at 24 VDC 0.54 A at 48 VDC
	RedFox-5728-(E-)F4G-T24G-HV RedFox-5728-(E-)F4G-T24G-HVHV	0.13 A at 240 V AC/DC 0.26 A at 110 V AC/DC
	RedFox-5728-(E)-F16G-T12G-LV RedFox-5728-(E)-F16G-T12G-LVLV	1.22 A at 24 VDC 0.61 A at 48 VDC
	RedFox-5728-(E-)F16G-T12G-HV RedFox-5728-(E-)F16G-T12G-HVHV	0.15 A at 240 V AC/DC 0.30 A at 110 V AC/DC

Fuse rating	LV and LVLV models: 4A(T), 125 VDC, breaking capacity 100 A, UL248-14 HV and HVHV models: 4A(T), 350 VAC/VDC, breaking capacity 100 A, UL248-14
Rated frequency	LV and LVLV models: DC HV and HVHV models: DC, 50-60 Hz
Inrush current, I^2t[d.]	LV and LVLV models: 120 mA^{2}s at 24 VDC 350 mA^{2}s at 48 VDC HV and HVHV models: 4 mA^{2}s at 240 VAC, 50 HzDC, 50-60 Hz 0.4 mA^{2}s at 110 VAC, 60 Hz 2 mA^{2}s at 240 VDC 0.1 mA^{2}s at 110 VDC
Startup current[e.]	2x nominal current
Polarity	Reverse polarity protected
Redundant power input	Yes (LV models)
Redundant power supply	Yes (LVLV and HVHV models)
Shielded cable	Not required
Isolation	All other ports
Connector	Detachable screw terminal
Conductor cross section (flexible)	0.5-1.5 mm² (AWG 20-16). Use copper conductors only.
Stripping length cable	6-7 mm
Cable temperature rating	Minimum temperature rating of the cable to be connected to the field wiring terminals is +77 °C

Power port	
Tightening torque, terminal screw	0.34 Nm
Tightening torque, screw flange	0.34 Nm

a.For LV and LVLV models, only compliant Class I or Class II power supplies with SELV/PELV output shall be used with the product

b.For HVHV models, AC/DC1 shall be regarded as the primary supply input, which gives the highest efficiency. When both AC/DC1 and AC/DC2 inputs are energized, some portion of the unit's power consumption will be drawn from AC/DC2, while AC/DC1 will utilize the majority of the power consumption.

For LVLV models, the redundant power supplies works in a load sharing mode so the current consumption will be split in half.

c.Including SFP transceivers

d.Measured for 0.1 second at startup

e.Recommended external supply current capability for proper startup

I/O connection, Digital input[a]	
Isolation to	All other ports
Connector	Detachable screw terminal
Conductor cross section (flexible)	0.08-1.5 mm² (AWG 28-16). Use copper conductors only.
Stripping length cable	7 mm
Cable temperature rating	Minimum temperature rating of the cable to be connected to the field wiring terminals is +77 °C
Tightening torque, terminal screw	0.22-0.25 Nm
Terminal torque, screw flange	0.3 Nm
Circuit type	SELV
Maximum voltage/current	60 VDC, $I_{IN} \leq$ 2.9 mA at 60 VDC
Voltage levels	Logic one: >8 VDC Logic zero: <5 VDC

a.External circuits connected to I/O connectors shall be SELV-rated circuits, galvanic isolated from mains.

I/O connection, Relay output[a]	
Connect resistance	Maximum 30 Ω
Isolation to	All other ports
Connector	Detachable screw terminal
Conductor cross section (flexible)	0.08-1.5 mm² (AWG 28-16). Use copper conductors only.
Stripping length cable	7 mm
Cable temperature rating	Minimum temperature rating of the cable to be connected to the field wiring terminals is +77 °C
Tightening torque, terminal screw	0.22-0.25 Nm
Terminal torque, screw flange	0.3 Nm
Circuit type	SELV
Type of switch	Solid state, DC general use, DC Pilot duty
Maximum withstand across open contacts	60 VDC (continous)
Permissible current	80 mA (continous), 120 mA (short term 1 s.)

[a] External circuits connected to I/O connectors shall be SELV-rated circuits, galvanic isolated from mains.

Ethernet TX[a]	
Electrical specification	IEEE std 802.3
Data rate	10 Mbit/s, 100 Mbit/s, 1 Gbit/s, manual or auto
Duplex	Full or half, manual or auto
Circuit type	SELV according to EN/IEC/UL 61010-2-201 PELV according to EN/IEC 60255-27 TNV-1 according to IEC 62151
Transmission range	Up to 100 m with CAT5e cable or better
Isolation	All other ports
Cabling	Shielded cable CAT5e or better is recommended
Conductive chassis	Yes

[a] 10/100/1 Gbit/s ports are:
RedFox-5728-F4G-T24G-HV and -HVHV: 5-28
RedFox-5728-F4G-T24G-HV, -HVHV and -LV: 5-28
RedFox-5728-F4G-T24G-HV, -HVHV, -LV and -LVLV: 5-28
RedFox-5728-F16G-T12G-HV and -HVHV: 7-10, 15-18, 23-26
RedFox-5728-F16G-T12G-HV, -HVHV and -LV: 7-10, 15-18, 23-26
RedFox-5728-F16G-T12G-HV, -HVHV, -LV and -LVLV: 7-10, 15-18, 23-26

SFP ports[a.]	
Optical/Electrical specification	IEEE std 802.3
Data rate	100 Mbit/s, 1 Gbit/s
Duplex	Full or half, manual or auto
Transmission range	Depending on transceiver
Connector	SFP slot holding fibre transceiver

[a.]SFP ports are:
RedFox-5728-F4G-T24G-HV and -HVHV: **1-4**
RedFox-5728-F4G-T24G-HV, -HVHV and -LV: **1-4**
RedFox-5728-F4G-T24G-HV, -HVHV, -LV and -LVLV: **1-4**
RedFox-5728-F16G-T12G-HV and -HVHV: **1-6, 11-14, 19-22, 27-28**
RedFox-5728-F16G-T12G-HV, -HVHV and -LV: **1-6, 11-14, 19-22, 27-28**
RedFox-5728-F16G-T12G-HV, -HVHV, -LV and -LVLV: **1-6, 11-14, 19-22, 27-28**

Console port	
Electrical specification	USB 2.0 device interface
Data rate	Up to 480 Mbps (high-speed mode)
Circuit type	PELV
Maximum supply current	100 mA
Connector	USB Micro B connector in device mode

Micro SD	
Electrical specification	Secure Digital 2.0
Maximum supply current	100 mA
Connector	Micro SD connector

5.2. Type Tests and Environmental Conditions

Environmental phenomena	Basic standard	Description	Test levels
ESD	EN 61000-4-2	Enclosure	Contact: ±8 kV Air: ±15 kV
Fast transients	EN 61000-4-4	AC power port DC power port Earth port	±4 kV, direct coupling
		I/O port Ethernet ports	±4 kV, capacitive coupling clamp
Surge	EN 61000-4-5	AC power port	±4.0 kV L-E: 12 Ω/9 µF, 1.2/50 µs ±2.0 kV L-L: 2 Ω/18 µF, 1.2/50 µs
		DC power port	
		I/O port	±4.0 kV L-E: 42 Ω/0.5 µF, 1.2/50 µs ±2.0 kV L-L: 42 Ω/0.5 µF, 1.2/50 µs
		Ethernet ports	±4.0 kV L-E: 2 Ω Direct on shield
Power frequency magnetic field	EN 61000-4-8	Enclosure	100 A/m, cont. 1000 A/m, 3 s
Pulsed magnetic field	EN 61000-4-9	Enclosure	300 A/m
Damped oscillatory magnetic field	EN 61000-4-10	Enclosure	300 A/m (peak)
Voltage dips and interruptions (AC port)	EN 61000-4-11	AC power port	70% U_T, 1 period 40% U_T, 50 periods 0% U_T, 5 periods 0% U_T, 50 periods
Conducted CM disturbances	EN 61000-4-16	AC power port DC power port I/O port Ethernet ports	30V to 3V, 15 to 150 Hz 3V, 150 Hz to 1.5 kHz 3V to 10V, 1.5 to 15 kHz 30V, 15 to 150 kHz
Mains frequency voltage			30V continuous, DC, 50 and 60 Hz, 300V for 1s
Ripple on DC power supply	EN 61000-4-17	DC power port	10% of U_N, 100 Hz and 120 Hz
Damped oscillatory wave	EN 61000-4-18	AC power port DC power port	CM: ±2.5 kV 200 Ω/0.5 µF, 1 MHz CM: ±2.0 kV 50 Ω/33 nF, 10 MHz DM: ±2.5 kV 200 Ω/0.5 µF, 1 MHz
		I/O port	CM: ±2.5 kV 200 Ω/0.5 µF, 1 MHz DM: ±2.5 kV 200 Ω/0.5 µF, 1 MHz
		Ethernet ports	CM: ±2.5 kV 200 Ω/1 µF, 1 MHz direct of shield
Voltage dips and interruptions (DC port)	EN 61000-4-29	DC power port	70% U_T, 100 ms 40% U_T, 100 ms 0% U_T, 50 ms

Environmental phenomena	Basic standard	Description	Test levels
Radiated RF immunity	EN 61000-4-3 IEEE Std C37.90.2	Enclosure	20 V/m, 80% AM (1 kHz) at 80 MHz to 2 GHz, Spot freq.: 80, 160, 380, 450, 900, 1600, 1850 MHz 10 V/m, 80% AM (1 kHz) at 2 to 6 GHz, Spot freq.: 2150, 3800 MHz 20 V/m, pulse keying (2 Hz) at 80 MHz to 1 GHz, Spot freq.: 1732, 1800 MHz 10 V/m, pulse keying (2 Hz), Spot freq.: 2310, 2450, 5800 MHz
Conducted RF immunity	EN 61000-4-6	AC power port	10 V 0.15 to 80 MHz, Spot freq.: 27, 68 MHz
		DC power port	
		I/O port	
		Ethernet ports	
		Earth port	
Radiated RF emission	CISPR 16-2-3	Enclosure	Class A (FCC Part 15B)
	ANSI 63.4		
Conducted RF emission	CISPR 16-2-1	Power ports	Class A (FCC Part 15B)
	ANSI 63.4		
	CISPR 22	Ethernet ports	Class A
Dielectric strength	IEC 60255-27	Power port (AC) to all other ports	2000 VAC rms, 60 s
		Power port (DC) to all other ports	
		I/O port to all other ports	
	IEEE 802.3	Ethernet ports to all other ports	1500 VAC rms, 60 s
Impulse withstand	IEC 60255-27	Power port (AC)	5 kV
		Power port (DC)	
		I/O port	
		Ethernet ports	1 kV

Table 9. EMC and electrical conditions

Environmental phenomena	Basic standard	Description	Test levels
Temperatures	EN 60068-2-1 EN 60068-2-2 EN 60068-2-14	Operational	-40 to +70°C (-40 to +158°F)
		Storage and transport	-50 to +85°C (-58 to +185°F)
Humidity	EN 680068-2-30 EN 60068-2-78	Operational	5-95 % relative humidity
		Storage and transport	
Altitude		Operational	2000 m/80 kPa
Service life		Operational	10 years
MTBF hours	MIL-HDBK 217F		RedFox-5728-(E-)F4G-T24G-LV: 344,000 RedFox-5728-(E-)F4G-T24G-LVLV: 274,000 RedFox-5728-(E-)F4G-T24G-HV: 316,000 RedFox-5728-(E-)F4G-T24G-HVHV: 269,000 RedFox-5728-(E-)F16G-T12G-LV: 356,000 RedFox-5728-(E-)F16G-T12G-LVLV: 282,000 RedFox-5728-(E-)F16G-T12G-HV: 353,000 RedFox-5728-(E-)F16G-T12G-HVHV: 295,000
	Telcordia		RedFox-5728-(E-)F4G-T24G-LV: 645,000 RedFox-5728-(E-)F4G-T24G-LVLV: 514,000 RedFox-5728-(E-)F4G-T24G-HV: 678,000 RedFox-5728-(E-)F4G-T24G-HVHV: 549,000 RedFox-5728-(E-)F16G-T12G-LV: 674,000 RedFox-5728-(E-)F16G-T12G-LVLV: 532,000 RedFox-5728-(E-)F16G-T12G-HV: 710,000 RedFox-5728-(E-)F16G-T12G-HVHV: 570,000
Vibration	IEC 60255-21-1	Operational	Class 2, 10 to 60 Hz at ±0.075 mm, 60 to 150 Hz at 1g 1 sweep cycle in each axis, 1 octave/min.
		Non-operational, endurance test	Class 2, 10 to 150 Hz at 2g 20 sweep cycles in each axis, 1 octave/min.
	IEC 60255-21-3, method A	Operational, seismic test	Class 2 Horizontal: 1 to 8 Hz at ±7.5 mm, 8 to 35 Hz at 2g Vertical: 1 to 8 Hz at 3.5 mm, 8 to 35 Hz at 1g 1 sweep cycle in each axis (3x5), 1 octave/min
	EN 60068-3-3		5 to 8 Hz at ±7.5 mm

Environmental phenomena	Basic standard	Description	Test levels
			8 to 500 Hz at 2g 5 sweep cycles in each axis (3×5), 1 octave/min
	EN 60068-2-64	Operational	2.3 m/s^2 random, 5 to 2000 Hz, 3×1.5h
	IEEE 1613	Operational	Class V.S.3 1 to 150 Hz at <30 mm/s
Shock	IEC 60255-21-2	Operational	Class 2, 10g/11 ms, 3×6 shocks
		Non-operational	Class 2, 30g/11 ms, 3×6 shocks
Bump			Class 2, 20g/16 ms, 6×1000 bumps
Fall	IEEE 1613	Non-operational	Height of fall = 100 mm
Device Reliability Class	IEC 61850-3		Class 2: Error free, uninterrupted communication
	IEEE 1613		
Enclosure	EN/IEC/UL 61010-1	Aluminium	Fire enclosure
Weight			3.8 kg
Degree of protection	EN 60529	Enclosure	IP40
Cooling			Convection
Pollution degree	EN/IEC/UL 61010-1		PD2 Macro and Micro Environment
Overvoltage category	EN/IEC/UL 61010-1		LV and LVLV models: OVC II HV and HVHV models: OVC III
Insulation class	EN/IEC/UL 61010-1		LV and LVLV models: Class III equipment HV and HVHV models: Class I equipment
Location	EN/IEC/UL 61010-1		Indoor use

Table 10. Environmental and mechanical conditions

6. Revision Notes

Revision	Date	Change description
Rev. F	2023-04	3.5 LED Indicators updated (ON; Blink deleted)
Rev. E	2022-10	5.1 Interface Specifictions updated (rated current)
Rev. D	2022-01	2.2 Safety Information updated; (Warning Safety during installation), 2.5.1 Agency Approvals and Standards Compliance updated, 2.5.2 FCC Part 15.105 Class A Notice added, 3.2 Available Models updated, 3.4.1 Power Input updated (table 5 and note), 5.1 Interface Specifictions updated (Power port table, Ethernet TX table, SFP ports table and footnote for inrush current), 5.2 Type Tests and Environmental Conditions updated (altitude, MTBF hours, enclosure, degree of protection, overvoltage category and insulation class)
Rev. C	2021-11	Added LV models, 3.2 Available Models updated, 3.4.1 Power Input updated, 3.4.3 Console port, text added, 3.4.5 SFP Transceivers updated, 3.5 LED Indicators updated, 5.1 Interface Specification updated, 5.2 Type Tests and Environmental Conditions updated
Rev. B	2021-04	Product illustrations updated, 1.5 WeOS updated, 2.5.3 Simplified Declaration of Conformity updated, 3.4.3 Console port updated, 3.6 Dimensions updated, 5.1 Interface Specifications, Ethernet TX table updated, Console table updated, 5.2 Type Tests and Environmental Conditions updated
Rev. A	2020-11	First version of the user guide

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