

48V/3000W Rectifier Module

Version: 2.1

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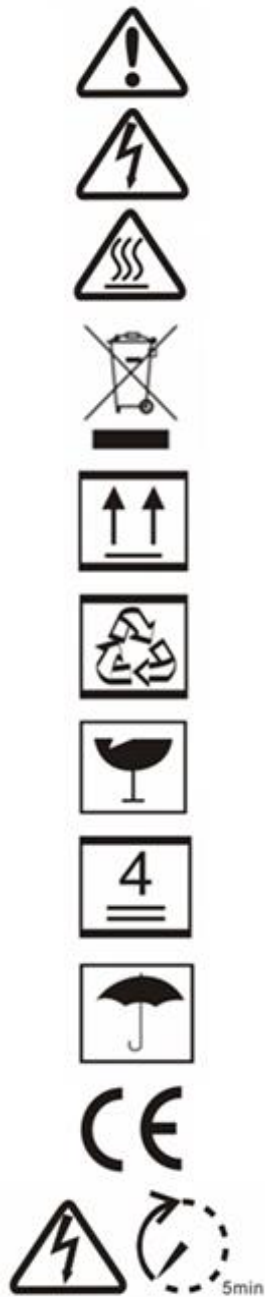
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**For your own safety, please read this manual carefully before
installation and operation.**



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1. Rectifier Module Overview

ETR⁺ 3048 is a single phase high efficiency rectifier module designed and optimized for demanding power needs in centralized or distributed architecture systems across various applications and industries.

The technically advanced rectifier module, coupled with its cost effectiveness package and reliability, ensures the overall availability of the power system solution.



The functions of the LED indicators on the rectifier front panel are described below.

Rectifier Module Status	Power Indicator (Green)	Protection Indicator (Yellow)	Fault Indicator (Red)
Normal Operation	On	Off	Off
Self-testing / Firmware upgrading	Flashing	Flashing	Flashing
Lost Communication	On	Flashing	Off
Output Overvoltage, Input Failure, Over Temperature, Fan Failure, Auxiliary Power Failure	Off	Off	On
Remote Shutdown	Off	On	Off
Current Limit, Short Circuit Fault	On	On	Off

The rectifier module is designed to be hot-swappable, facilitating ease of installation and maintenance. Please refer to figures below on the description of each socket interface.

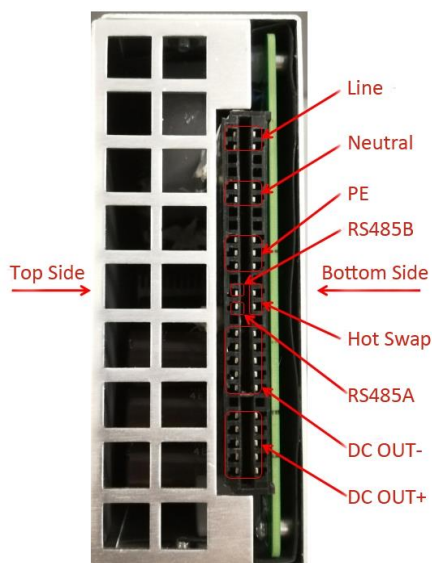


Figure 1.1: AC Input Module Terminations

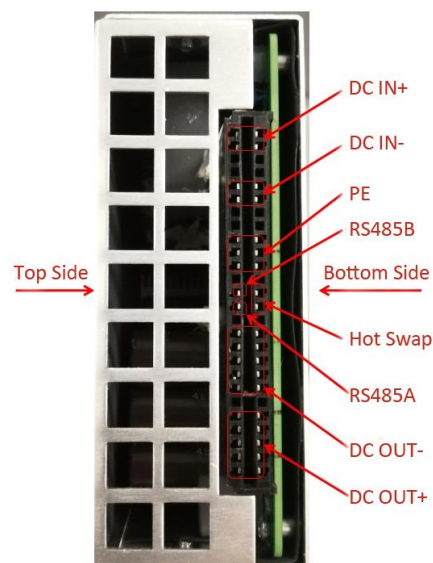


Figure 1.2: DC Input Module Termination

Description		Termination Reference	Functions	
Input	AC	Line	AC Power Line Input	
	AC	Neutral	AC Power Neutral Input	
	DC	DC IN +	DC Power +ve Input	
	DC	DC IN -	DC Power -ve Input	
Output		DC OUT +	DC Output +ve	The DC output is isolated from the module casing.
		DC OUT -	DC Output -ve	
Protective Earth		PE	Connection between rectifier module's earth and internal lightning protection earth terminations	
Communication Interface		RS485A	Communication interface between the module and the host is based on RS485 protocol.	
		RS485B		
Hot Swap Terminal		Hot Swap	Modules are designed to be hot swappable.	

1.1 Features and Functions

1.1.1 Key Features

The key features of the ETR⁺ 3048 are as detailed below.

- **Advanced Dual DSP Control Technology**
Reduces component count and improves reliability
- **Wide Input Voltage Range**
Continued operation in demanding grid conditions
- **Wide Temperature Range**
Applications in harsh climatic conditions
- **Modular, Scalable and Hot Swappable**
Flexible installations
- **Highly Efficient @ >96.3%**
Reduces losses and lowers operating costs
- **Conformal Coating for PCB**
Provides protection against moisture, dust and foreign particulates
- **Compliant with Global Standards**
Delivers quality, performance and reliability in power solutions

1.1.2 Main Functions

The main functions of the ETR⁺ 3048 rectifier module are highlighted as follows.

1. **Input Overvoltage Protection**
When the input voltage is higher than 305Vac, the module automatically goes into protection mode and DC output is off. The module will automatically recover once the AC voltage restores to 295 ± 10Vac.

2. **Input Undervoltage Protection**
When the input voltage is lower than 85Vac, the module automatically goes into protection mode and DC output is off. The module will automatically recover once the AC voltage restores to $95 \pm 10\text{Vac}$.
3. **Short Circuit Protection**
The module goes into short circuit protection mode and recovers itself automatically once the short circuit condition disappears.
4. **Output Overvoltage Protection**
The module is equipped with both hardware and software managed overvoltage protection. When the output voltage is $>59.7\text{Vdc}$, the module goes into a latched protection mode (with no automatic recovery) and shuts itself down. The module needs to be manually reset (power off and on) to continue operation (subject to the elimination of the fault condition).
5. **Fan Temperature Control Function**
The module manages the temperature-controlled fans and will increase/decrease the fan speed based on a combination of ambient temperature, input voltage and output voltage condition.
6. **Module Over Temperature Protection**
When the ambient temperature rises above 55°C , the output power is reduced linearly up to a maximum ambient temperature of 75°C . At above 75°C , the module automatically shuts down. The module will automatically recover when the ambient temperature drops below 65°C .
7. **Telemetry**
The rectifier module is designed to communicate with the host controller via RS485. This includes the transmission of measurements and data including module output voltage and current, module protection signals and module alarm information, as well as execution of commands from the host controller.

1.2 Technical Parameters

1.2.1 Environment

Operating temperature:	$-10^{\circ}\text{C} \sim 75^{\circ}\text{C}$
Storage temperature:	$-40^{\circ}\text{C} \sim 85^{\circ}\text{C}$
Relative humidity:	$\leq 95\%\text{rh}$, non-condensing
Altitude:	$\leq 2000\text{m}$
Cooling method:	Fan-cooling
Noise:	$\leq 58\text{dB}$ (@ 1m away)

1.2.2 Input

Input voltage range:	85Vac ~ 305Vac, 1-phase Linearly derated from 184Vac to 90Vac @ 1350W
Rated input current:	$\leq 13.0\text{A}$ (rms value)
Power Factor:	≥ 0.99
AC Input Frequency:	45Hz to 66Hz

1.3.3 Output

Output voltage range: 43Vdc ~ 58Vdc
 Rated output current: 56A (@ 53.5Vdc)
 Max. output current: 62.5A (@ 48.0Vdc)
 Line regulation: $\leq \pm 0.1\%$
 Load regulation: $\leq \pm 0.5\%$

1.3.4 Output current limit

Current limitation range: 0A ~ 62.5A.

1.3.5 Efficiency

Rated max efficiency $\geq 96.3\%$,

1.3.6 Insulation resistance and Dielectric strength

Condition: Ambient temp @ $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$, relative humidity @ $< 90\%$ (non-condensing), voltage=500Vdc

Insulation Resistance (AC input to Ground): $\geq 2\text{M}\Omega$
 Insulation Resistance (DC output to Ground): $\geq 2\text{M}\Omega$
 Insulation Resistance (AC input to DC output): $\geq 2\text{M}\Omega$

Dielectric Strength

Input to Output: 4242Vdc for 1 minute
 Input to Ground: 2121Vdc for 1 minute
 Output to Ground: 707Vdc for 1 minute

1.3.7 Standards

S/No	Items	Standards	Remarks
1	EMC	EN61000-6-1 EN61000-6-2 EN61000-6-3 EN61000-6-4 EN55022	
2	AC Harmonics	EN61000-3-2	
3	AC Flicker and Fluctuation	EN61000-3-3	
4	CE, ROHS	CE, ROHS	
5	Safety	EN/IEC60950 UL60950-1	

1.3.8 Dimensions and Weight

Dimension: 41.0mm (H) x 107.4mm (W) x 325.0mm (D)
 Weight: $\leq 1.7\text{kg}$

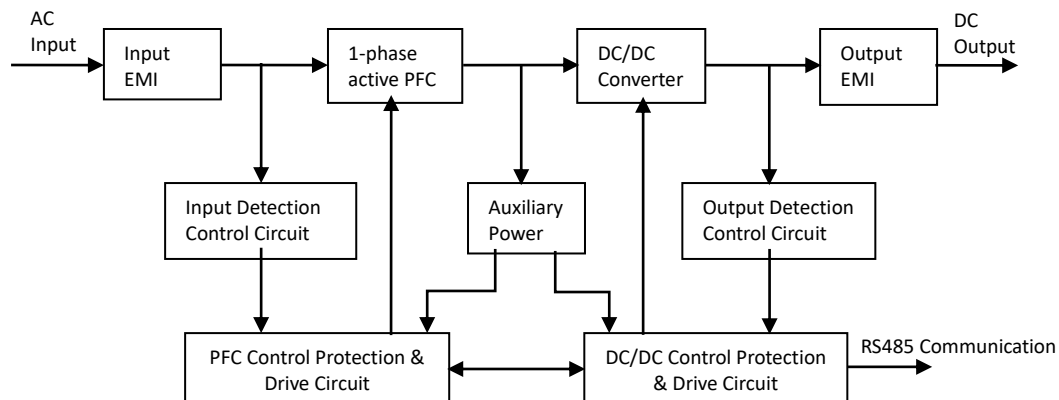
2. The Working Principle

ETR⁺ 3048 rectifier module comprises of 2 main power modules – the single-phase active PFC and the DC/DC power conversion units. In addition to the main power modules, the design is supported by the availability of the auxiliary power supply, input & output detection and protection circuit.

The single-phase active PFC circuit consists of the input EMI and active PFC for rectification of the AC input. It also includes an input current correction circuit to achieve a power factor of more than 0.99.

The DC/DC power conversion module consists of the DC/DC converter and its control circuit, rectifier filter circuit, output EMI circuit and other relevant designs necessary to convert the pre-rectified voltage into a stable DC output voltage that meets the communication industry requirements.

The auxiliary power supply required by the control circuitry is generated through the active single-phase PFC input. The input control circuit consists of the input detection circuit for input overvoltage detection and input undervoltage detection. The DC/DC detection & protection control circuit manages the output voltage and current detection as well as the temperature monitoring.

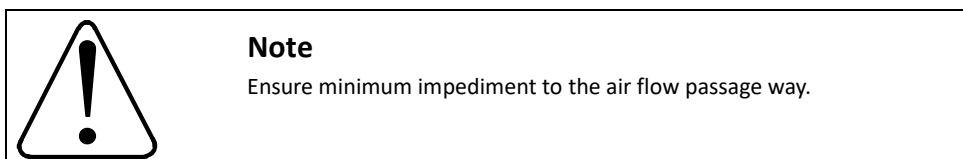


3. Installation and Operation

3.1 Installation

3.1.1 Module Cooling Design

ETR⁺ 3048 rectifier module is designed with front-to-back flow forced fan cooling. The fan is installed at the front end of the rectifier module where cool air is drawn and flow through to the back. As such, do ensure that there is minimal impediment at the front and back of the module to ensure proper air flow. In addition, minimize placement of temperature sensitive component at the back of the module due to the continuous discharge of hot air.



3.1.2 Module Hot-Swap Design

ETR⁺ 3048 rectifier module is designed to be hot-swappable. However, do take note the requirement for a time interval when removing and installing the rectifier module. The key principle is that the rectifier module has to be at 0Vdc before it can be installed. Otherwise, there may be undesired consequences which can result in damaging the module.

As a rule of thumb, when removing and installing the same rectifier module, please ensure that the front LEDs are not illuminated (in “off” condition) before installing the rectifier module.

3.1.3 Module Cable Requirements (recommended or equivalent)

Description	Current Carrying Capacity	Model / Specifications	Remarks
AC Cable	4A to 5A per sqmm	BVR, PVC insulated flexible cable, 4sqmm	
DC Cable	3A to 4A per sqmm	BVR, PVC insulated flexible cable, 16sqmm	
Ground Cable	NA	BVR, PVC insulated flexible cable, 4sqmm	
Signal Cable	NA	UL2464-26XX	

3.1.4 Module Installation

Remove the rectifier module from the package and slot it into the corresponding module position in the subrack/cabinet. Position it into the slot and slowly push in such that the plug and socket are in good contact. Secure the rectifier module onto the subrack accordingly.

3.2 Operation

3.2.1 Module Operation

Before switching on the rectifier module, ensure correct cable connections.

- 1) Turn on the AC input MCB, and when the rectifier is powered up, the green LED indicator will be lighted up.
- 2) Turn on the output MCB, and observe the rectifier module working status.
- 3) If all indicators are working normally, the rectifier module is considered to be in its normal operation. Otherwise, refer to the troubleshooting section.



Note

During normal working condition, rectifier module will be hot. Please do not touch the rectifier surface directly.

3.3 Maintenance and Troubleshooting

3.3.1 Preventive Maintenance

The maintenance procedures listed in the table below should be performed every six months to ensure optimal system operation.

Procedure Number	Procedure Description
1	Ensure that the equipment is clean and free of dust, dirt, and other debris.
2	Inspect the air intake (front) and exhaust (rear) areas in the rectifier module. Check system or cabinet ventilation openings for obstructions such as dust, papers, manuals, etc. Verify that air flows freely through the equipment. Clean ventilation openings with a vacuum cleaner whenever required.
3	Test the main operating sequences as applicable to your equipment configuration and installation.



Note

Cleaning of the rectifier module must only be conducted when the module is not in operation.

Maintenance must be performed or supervised only by technically qualified personnel

3.3.2 Troubleshooting

Refer to the table below for a list of possible causes and corrective actions.

S/No	Description of Symptoms	Possible Cause(s)	Suggested Action(s)
1	Rectifier module has no output voltage	- Missing mains input - Input voltage is outside operating range - Module is in output overvoltage protection mode - Poor connections/contacts of the Input and output terminations	- Check availability of mains input - Check whether input voltage is within operating range - Check whether module is in output overvoltage protection mode - Verify integrity of input and output connections
2	Rectifier module output is unstable (switching between on and off)	- Module is in over-temperature protection mode	- Reduce output load or lower the ambient temperature - Verify that the fans are in proper working condition
3	Rectifier module's fan is not in operation	- Module's fan is not operating	- Remove and change out the module fan
4	Rectifier module's fault LED (red) is lighted	- Module output overvoltage protection - Input failure - Module over-temperature protection - Module fan failure	- Refer to items 1, 2 and 3 above for the suggested actions