

RT11-48V/2.4kW

Rectifier Specification



The RT11-48V/2.4kW is a switched mode rectifier (SMR) module that delivers up to 2.4kW of output power (and up to 50A output current) into a 48V nominal DC system. The RT11 suits AC supply voltages between 208 and 240VAC but will also operate at reduced power from supplies as low as 100VAC. The RT11 may be safely hot-plugged into a live system for convenient system expansion or module replacement.

Rectifiers convert power from an AC supply into smooth DC, and are normally used in conjunction with a battery to provide an uninterruptible DC power system. A number of SMR modules (N) are commonly used in parallel to deliver the required power, with one or more additional modules (N+1) providing redundancy.

The small dimensions of the RT11 allow high power density in 300, 400, or 600mm deep 19-inch or 23-inch racks. The addition of a supervisory and control unit (CSU) allows a sophisticated power system to be built with network connectivity and remote asset management features.



Operating characteristics of the RT11-48V/2.4KW at 25°C, 230VAC, 50Hz unless otherwise stated:

Input

Voltage	Single phase: Active, Neutral, and Earth. Rated voltage range: 100 – 240VAC; Rated voltage tolerance: 85 – 275VAC; Maximum voltage before shutdown 300VAC; Full output power available above 185VAC; Reduced output power from 85 – 185VAC (Available power varies from 970W – 2400W); At 100VAC, 1200W available; At 120VAC, 1500W available;
Current	15.5A RMS max line current at 185VAC; 12A RMS max line current at 230 VAC; Current limited to 16A or less below 185VAC;
Frequency	45 - 66Hz
Inrush Current	< 9A RMS
Soft Start	Output current ramp-up time ~8 seconds to 43A;
Protection	Fully protected up to 440VAC; Varistors provide surge protection; Two internal fuses provided; SMR is turned off if the AC voltage exceeds ~305VAC or falls to less than ~70VAC; SMR re-activates when AC voltage is within approximately 83 – 285 VAC; Input inrush limiting circuit prevents high surge currents during a hot-plug installation;
Voltage Withstand Test	1500VAC input to chassis for 1 minute; (2200VDC 100% testing on production units for 2 seconds);
Harmonic Distortion	Current THD < 5% typically at full output power when operated with mains voltage THD < 2%;
Power Factor	> 0.98 for >50% output power; > 0.99 for 100% output power; Reduced power factor above 275VAC;
Efficiency	> 90% from 50 - 100% output power; Peak efficiency 91% at 70% output power.



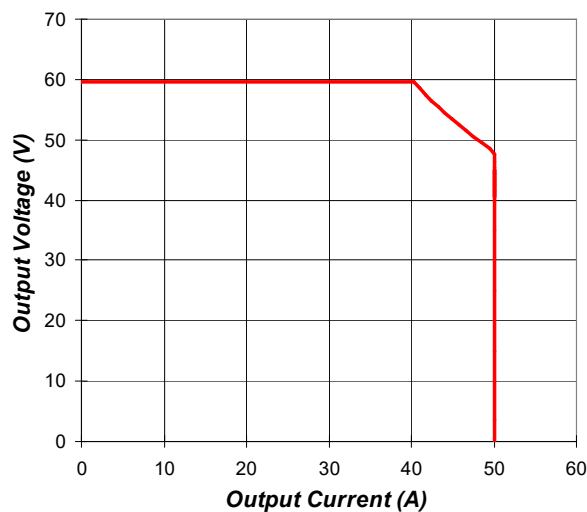
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Output

Voltage	Float: 42.0 – 58.0V Equalise: 42.0 – 59.5V
Current Limit	Range: 5 - 50A
Power Limit	Current limit is automatically reduced in inverse proportion to output voltage above 48VDC to limit output power to 2400W (minimum); Available current: <ul style="list-style-type: none">• 50A at 48.0V• 42.8A at 56.0V• 40A at 59.5V
Voltage Withstand Test	1000VAC output to chassis for 1 minute; (1500VDC 100% testing on production units for 2 seconds);
Conversion Frequency	>110kHz
Static Regulation	<i>Line:</i> better than $\pm 0.05\%$; <i>Load:</i> terminal voltage drops by $0.42V \pm 0.03V$ from zero to 42.8A load (for passive current sharing) for stand-alone units, or regulates to better than $\pm 0.05\%$ for CSU controlled units;
Dynamic Regulation	$\pm 2\%$ for 4A to 40A to 4A step load change; $\pm 1\%$ of final value within 1ms of step change; $\pm 0.2\%$ for a 25% step change in AC input voltage;
Noise	< 0.96mV RMS Psophometrically weighted; < 32dBnC < 10mV RMS (10kHz - 100MHz); < 100mV peak to peak (10kHz - 100MHz);
Load Sharing	Better than $\pm 5\%$ of full scale with active current sharing from CSU;
Protection	Internal fuse at output of SMR; <i>Overvoltage</i> - only faulty unit shuts down; <i>Overcurrent</i> - can sustain short circuit at output terminals indefinitely. <i>Over-temperature</i> - gradual reduction of power limit if heatsink temperature exceeds pre-set limit. Supplementary thermal overload protection is provided. <i>Reverse battery</i> - internal fuse opens.



Remote Controls

Equalise Mode	Equalise mode is initiated by a signal from the CSU;
Rectifier Inhibit	Rectifiers can be inhibited by a signal from a remote WinCSU terminal, transmitted via the CSU;
External Digital Voltage Control (EDVC)	The CSU uses the optically coupled communications lines to digitally control rectifier Float and Equalise voltages over a limited voltage range in order to adjust battery voltage for temperature and voltage drop in DC bus, limit the maximum battery recharging current and to achieve active current sharing;

SMR Parameters Programmed by CSU

In the SMR menu on the CSU	<ul style="list-style-type: none"> • Current Limit • High Voltage Shut-Down (HVSD) • High Voltage Alarm • Low Voltage Alarm • Latched Fault Reset
In the Battery menu on the CSU	<ul style="list-style-type: none"> • Float Voltage • Equalise Voltage
Test Function (when activated on CSU)	SMR front panel LEDs are switched on and off in the sequence Green – Yellow - Red

Alarms and Monitoring

SMR status monitoring	<p>CSU and WinCSU monitor status of the SMR:</p> <ul style="list-style-type: none"> • Output current of SMR; • Temperature of heatsink of SMR; • SMR alarms;
Current	Monitored on CSU and WinCSU with 1A resolution; Analogue measurement accuracy $\pm 1\%$ at full load;
Voltage	System voltage normally displayed on CSU alphanumeric display. Accuracy $\pm 0.5\%$
SMR address	DIP switches in the magazine set the SMR address.

Front Panel LED condition table

Green	Yellow	Red	Condition	
Off	Off	Off	No AC power	No AC Power available to SMR
Blink	Off	Off	Primary power bad	Indicates the input AC is too low or too high, or the primary circuit is faulty
ON	Off	Off	Normal	Status is normal
ON	Flash	Off	Alarm	See Alarm table
ON	ON	Off	Equalise	SMR is in equalise mode
Off	Flash	ON	Shutdown	SMR is shut down by remote control, or due to environmental conditions, or there is an internal control circuit fault
Flash	Flash	Flash	Firmware upload	SMR firmware is updating

Note: in case of microcontroller failure status of the LEDs is undefined.

SMR Alarm Monitoring: The table shows alarm conditions that are monitored by the SMR and are displayed on both CSU and WinCSU. The mnemonics listed here appear on WinCSU, but full alarm description appears on CSU;

Vh	Output voltage too high
VI	Output voltage too low
Il	Unit is in current limit
Po	Unit is in power limit
Th	Heatsink temperature high and thermal limit is active
Lo	Low output current, less than 1A. Can be disabled
Ma	Operating parameters out of range (or EEPROM fault)
No Response	SMR communication fault. Generated within CSU
Sd *	Unit is shut down by remote command - user shutdown
Mr *	Internal voltage reference faulty
Vs *	High voltage shut down (output), latched alarm. User setting or fault
Unit Off *	Unit is shut down due to AC out of range or SMR primary circuit fault. (normal operation or fault)
NC *	SMR incorrectly inserted into the magazine
Tl *	Low temperature (below -40°C)
Oh *	Overheat
Ts *	Temperature sensor fault
Dc *	DC-DC converter feedback fault, latched alarm
NF *	Fan not connected
Ff **	Fan failure

Notes: * indicates unit shut-down

** unit will shut down when H/S temperature exceeds 20°C and fan speed is over 75% of its maximum speed

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Compliances

Safety	Designed to IEC60950-1:2001; AS/NZS 60950.1:2003; UL60950-1:2003
EMC Emissions and Immunity	ETSI EN 300 386 V1.4.1 (2008); IEC61000-6-2:2005
Environmental	Designed to ETSI EN 300 019

EMC Test Levels

Emissions:		
Harmonics	IEC 61000-3-2	Class A
Flicker	IEC 61000-3-3	
Conducted RF	AC Terminals: CISPR 22; DC Terminals: CISPR 22	Class B Class A
Radiated RF	CISPR 22	Class B

Immunity:		
Electrostatic Discharge (ESD)	IEC 61000-4-2 (Level 3: Air 8kV, Contact 6kV)	Criterion A
Radiated RF	IEC 61000-4-3 (Level 4: 10V/m, 1kHz 80% AM)	Criterion A
Electrical Fast Transient (EFT)	IEC 61000-4-4 (Level 4: 4kV on AC lines) (Level 4: 4kV on DC load)	Criterion A Criterion A
Surge Protection	ANSI C62.41-1991 category B3 - AC lines (Combination Wave 6kV/3kA; Ring Wave 6kV/500A) IEC 61000-4-5 (Impulse) (Level X: 6kV/3kA Common Mode [CM] on AC lines) (Level X: 6kV/3kA Differential Mode [DM] on AC lines) (Level 2: 1kV CM, 500V DM on DC lines) IEC 61000-4-12 (Ring Wave) (Level X: 6kV/500A, 100kHz CM & DM on AC lines) (Level 3: 2kV CM, 1kV DM on DC lines)	Criterion B Criterion B Criterion B Criterion B Criterion A Criterion B
Conducted RF	IEC 61000-4-6 (Level 3: 10V on AC, load and comms lines)	Criterion A
Power-frequency magnetic field	IEC 61000-4-8 (Level 5: 100A/m continuous)	Criterion A
Voltage Dips and Interruptions	IEC 61000-4-11 (Level: 100% interruption for 10ms) (Level: 100% interruption for 20ms) (Level: 30% dip for 500ms) (Level: 60% dip for 200ms) (Level: 100% interruption for 5s)	Criterion A Criterion A Criterion A Criterion B Criterion C

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Environmental

Environmental Class (EN 300 019)	<i>Operational:</i> Class 3.3 (Stationary Use at Non-Temperature-Controlled Locations) <i>Transport:</i> Class 2.3 (Public Transportation) <i>Storage:</i> Class 1.2 (Weather Protected Non-Temperature-Controlled Locations)
Cooling	Forced convection cooling using two 40mm fans with variable speed temperature control and finger guards. The RT10 draws cool air from the front and exhausts warmed air to the back. Fans stop if AC power fails or rectifier inhibited remotely.
Temperature	<i>Operating range:</i> -40°C to +70°C <i>Full power range:</i> -40°C to +50°C <i>Derated operation:</i> 25% power at +70°C 50% power at +65°C <i>Storage:</i> -40°C to +70°C <i>Transport:</i> -40°C to +70°C The rectifier senses its internal heat-sink temperature and, if necessary, adjusts power limit in order to protect itself against over-heating;
Humidity	0 to 100% RH condensing including dripping water and icing conditions.
Altitude	Operational to 4000m (Consult factory above 4km) Derate maximum ambient temperature by 5°C per 1000m above sea level.
Vibration	<i>Operational (Class 3M5):</i> 3.0mm displacement 2-9Hz, 10m/s ² acceleration 9-200Hz, Continuous, any direction. <i>Transport (packaged):</i> 3.5mm displacement 2-9Hz, 10m/s ² acceleration 9-200Hz, 15m/s ² acceleration 200-500Hz, One hour, any direction.
Shocks	<i>Operational (Class 3M5):</i> 50m/s ² half sine, 11ms duration, Any direction <i>Transport (packaged):</i> 180m/s ² half sine, 6ms duration, Any direction
Drop Test	<i>Transport:</i> 1.2m drop when packaged

Mechanical

Dimensions	Width: 216mm (8.5") Height: 43mm (1U) (1.7") Depth: 255mm (10")
Mass	< 2.5kg (5.5 lb)
Acoustic Noise	≤ 55dB (A Weighted) typical
Powershell Magazine size	Standard Powershell magazine may be installed in 400 or 600mm deep 19-inch or 23-inch racks. Various combinations of number of SMRs and types of peripheral equipment are available on a customer request. Special magazine is required for 300mm deep racks.

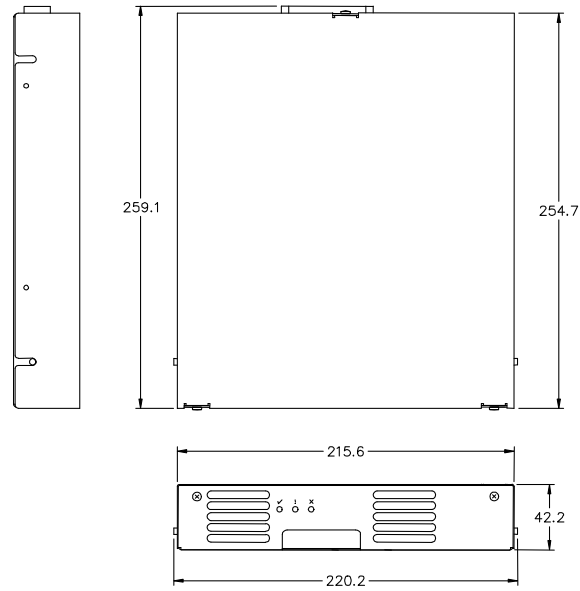
Connections

Input, Output, and Communications:

A multifunction hot-plug connector is mounted on the back of the rectifier module that carries the AC, DC and communications lines. A matching connector is located at the back of the magazine. Reliable mating is ensured by a spring latch in the magazine that mechanically secures the rectifier.



RT11-48V/2.4kW Dimensions



Example of 4U High Powershelf

