

RT12-120V/2.4kW

Rectifier Specification



The RT12-120V/2.4kW is a switched mode rectifier (SMR) module that delivers up to 2.4kW of output power (and up to 22A output current) into a 120V nominal DC system. The RT12 suits AC supply voltages between 208 and 240VAC but will also operate at reduced power from supplies as low as 100VAC. The RT12 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 RT12 allow high power density in 400, or 600mm deep 19-inch or 23-inch racks. The addition of a MCSU-4 controller allows a sophisticated power system to be built with network connectivity and remote asset management features.



Operating characteristics 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 230VAC 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 20A
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 – 285VAC 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	> 91.5% typical from 50 - 100% output power Peak efficiency 92% at 70% output power

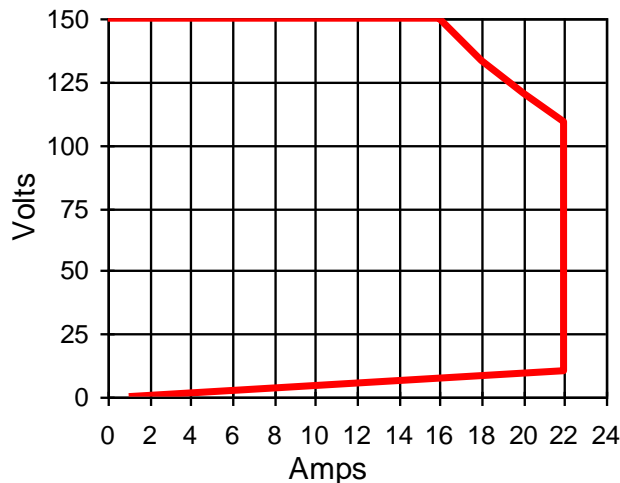
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Output

Voltage	<i>Float:</i> 102 – 145V <i>Equalise:</i> 102 – 150V
Current Limit	<i>Range:</i> 4 – 22A
Power Limit	Current limit is automatically reduced in inverse proportion to output voltage above 109VDC to limit output power to 2400W (minimum) Available current: <ul style="list-style-type: none">• 22A at 109V• 20A at 120V• 18A at 133V• 16A at 150V
Voltage Withstand Test	2800VDC output to chassis for 1 minute (3000VDC 100% testing on production units for 1 second)
Conversion Frequency	>110kHz
Static Regulation	<i>Line:</i> better than $\pm 0.05\%$ <i>Load:</i> terminal voltage drops by $1.2V \pm 0.1V$ from zero to 20A load (for passive current sharing) for stand-alone units, or regulates to better than $\pm 0.05\%$ for MCSU-4 controlled units
Dynamic Regulation	$\pm 3\%$ for 2A to 18A to 2A 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	< 500mV peak to peak (100Hz - 100MHz)
Load Sharing	Better than $\pm 5\%$ of full scale with active current sharing from MCSU
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



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Remote Controls

Equalise Mode	Equalise mode is initiated by a signal from the MCSU-4
Rectifier Inhibit	Rectifiers can be inhibited by a signal from a remote WinCSU-2 terminal, transmitted via the MCSU-4
External Digital Voltage Control (EDVC)	The MCSU-4 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 MCSU-4	<ul style="list-style-type: none">• Current Limit• High Voltage Shut-Down (HVSD)• High Voltage Alarm• Low Voltage Alarm• HVSD Reset
In the Battery menu on MCSU-4	<ul style="list-style-type: none">• Float Voltage• Equalise Voltage
Test Function: (when activated on MCSU-4)	Test function causes all rectifier LEDs to flash.

Alarms and Monitoring

SMR status monitoring	MCSU-4 & WinCSU-2 monitor status of the SMR: <ul style="list-style-type: none">• Output current of SMR• Temperature of heatsink of SMR• Software version of SMR
Current	Monitored on MCSU-4 and WinCSU-2 with 0.1A resolution; analog measurement accuracy $\pm 1\%$ at full load
Voltage	System voltage normally displayed on MCSU-4 alphanumeric LCD display, accuracy $\pm 0.5\%$
SMR address	DIP switches in the magazine set the SMR address

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Front Panel LED condition table

Green	Yellow	Red	Condition	
0	0	0	No AC power	No AC Power available to SMR
F*	0	0	Primary power bad	Indicates the input AC is too low or too high, or the primary circuit is faulty
1	0	0	Normal	Status is normal
1	0	0	Sleeping	SMR turned off by MCSU-4 to save power
1	F*	0	Alarm	See Alarm table
1	1	0	Equalise	SMR is in equalise mode
0	F*	1	Shutdown	SMR is shut down by remote control, or due to environmental conditions, or there is an internal control circuit fault
F*	F*	F*	Test (MCSU-4 activated)	

SMR Alarm Monitoring. The table shows alarm conditions that are monitored by the SMR and are displayed on both MCSU-4 and WinCSU-2. The mnemonics listed here appear on WinCSU-2, but full alarm description appears on MCSU-4

Sleeping*	SMR turned off by MCSU-4 to save power
Vh *	Output voltage too high
VI *	Output voltage too low
II *	Unit is in current limit
Po *	Unit is in power limit
Th *	Heatsink temperature high and thermal limit is active
Nd *	No demand
Lo	Low output current, less than 1A
Ma *	Operating parameters out of range or internal memory fault
Sd	Unit is shut down by remote command - user shutdown
Mr	Internal voltage reference faulty
No Response	SMR communication fault. Generated within MCSU-4
Vs	High voltage shut down (output), latched alarm. User setting or fault
Off	Unit is shut down due to AC out of range or SMR primary circuit fault. (normal operation or fault)
Ts	Temperature sensor fault
Dc	Converter feedback fault, latched alarm
Ff	Fan failure

Note: * indicates flashing of LED on SMR

Compliance

Safety	Designed to IEC60950-1, Second Edition (2005); UL60950-1, Second Edition (2007)
EMC Emissions and Immunity	Designed to IEC61000-6-4:2006; IEC61000-6-2:2005
Environmental	Designed to ETSI EN 300 019

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EMC Test Levels

<i>Emissions:</i>		
Harmonics	IEC 61000-3-2	Class A
Flicker	IEC 61000-3-3	Class A
Conducted RF	AC Terminals: CISPR 22	Class A
	DC Terminals: CISPR 22	Class A
Radiated RF	CISPR 22	Class A
<i>Immunity:</i>		
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)	Criterion B
	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)	Criterion B Criterion B Criterion B
	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 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)	Criterion A
	(Level: 100% interruption for 20ms)	Criterion A
	(Level: 30% dip for 500ms)	Criterion A
	(Level: 60% dip for 200ms)	Criterion B
	(Level: 100% interruption for 5s)	Criterion C

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Environmental

Environmental Class (ETSI EN 300 019)	<i>Operational: Class 3.4 (Stationary Use at Sites with Heat-Trap)</i> <i>Transport: Class 2.3 (Public Transportation)</i> <i>Storage: Class 1.2 (Weather Protected Non-Temperature-Controlled Locations)</i>
Cooling	Forced convection cooling using two 40mm fans with variable speed temperature control and finger guards. The RT12 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: -40°C to +70°C</i> <i>Full power range: -40°C to +50°C</i> <i>Derated operation: >25% power at +70°C</i> <i>>50% power at +60°C</i> <i>Storage: -40°C to +70°C</i> <i>Transport: -40°C to +70°C</i> 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): 3.0mm displacement 2-9Hz, 10m/s² acceleration 9-200Hz, Continuous, any direction</i> <i>Transport (packaged): 3.5mm displacement 2-9Hz, 10m/s² acceleration 9-200Hz, 15m/s² acceleration 200-500Hz, One hour, any direction</i>
Shocks	<i>Operational (Class 3M5): 50m/s² half sine, 11ms duration, Any direction</i> <i>Transport (packaged): 180m/s² half sine, 6ms duration, Any direction</i>
Drop Test	<i>Transport: 1.2m drop when packaged</i>

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
Chassis material	AlZn (ensure magazine is also AlZn)

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.

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RT12-120V/2.4kW Dimensions

