



RT10-32V/1.6kW Rectifier Specification

The RT10-32V/1.6kW is a switched mode rectifier (SMR) module that delivers up to 1.6kW of output power (and up to 40A output current) into a 32V nominal DC system. It is also suitable for 28V and 36V DC systems due to its wide-range of adjustment. The RT10 suits AC supply voltages between 208 and 240VAC but will also operate at reduced power from supplies as low as 100VAC. The RT10 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 RT10 allow high power density in 300, 400, or 600mm deep 19-inch or 23-inch racks. The addition of a MiniCSU-3 controller and Powershelf magazine allows a sophisticated power system to be built with network connectivity and remote asset management features.



Operating characteristics of the RT10-32V/1.6KW at 25°C, 230VAC, 50Hz unless otherwise stated:

Input AC

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 160VAC;
Reduced output power from 85 – 160VAC
(Available power varies from 750W – 1600W);
At 100VAC, 920W available (57%);
At 120VAC, 1144W available (71%);

Current:

12A RMS max line current at 160VAC;
8A RMS max line current at 230 VAC;
Current limited to 12A or less below 160VAC;

Frequency:

45 - 66Hz;

Inrush Current:

< 9A RMS;

Soft Start:

Output current ramp-up time ~8 seconds to 34A;

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;

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);

Efficiency:

> 89% from 50 - 100% output power;
Peak efficiency > 90% at 75% output power.





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Output DC

Voltage:

Float: 24.5 – 43.5V
 Equalise: 24.5 – 45.0V

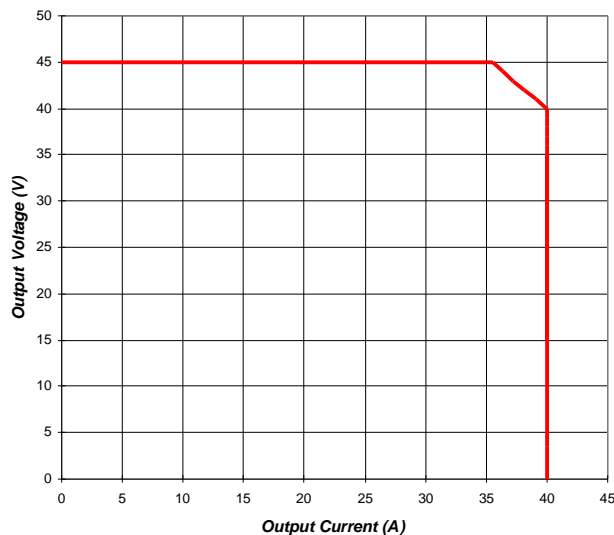
Current Limit:

Range 5 - 40A

Power Limit:

Current limit is automatically reduced in inverse proportion to output voltage above 40VDC to limit output power to 1600W⁽¹⁾;

Available current: 40A at 32V
 40A at 40V
 36A at 44.4V



Voltage Withstand Test:

1000VAC output to chassis for 1 minute;
 (1500VDC 100% testing on production units for 2 seconds);

(1) During battery recharge the current limit reduces maximum power available

Conversion Frequency:

>110kHz;

Static Regulation:

Line: better than $\pm 0.05\%$;

Load: terminal voltage drops by $0.42V \pm 0.03V$ from zero to 34A load (for passive current sharing) for stand-alone units, or regulates to better than $\pm 0.05\%$ for MiniCSU-3 controlled units;

Dynamic Regulation:

$\pm 2\%$ for 3A to 31A to 3A 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 MiniCSU;

Protection:

Internal fuse at output of SMR;

Overvoltage - only faulty unit shuts down;

Overcurrent - can sustain short circuit at output terminals indefinitely.

Over-temperature - gradual reduction of power limit if heatsink temperature exceeds pre-set limit. Supplementary thermal overload protection is provided.

Reverse battery – internal fuse opens.

Remote Controls

Equalise Mode:

Equalise mode is initiated by a signal from the MiniCSU-3;

Rectifier Inhibit:

Rectifiers can be inhibited by a signal from a remote WinCSU-2 terminal, transmitted via the MiniCSU-3;

External Digital Voltage Control (EDVC):

The MiniCSU-3 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;





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SMR parameters programmed by MiniCSU-3

In the SMR menu on the MiniCSU-3:

- Current Limit
- High Voltage Shut-Down (HVSD)
- High Voltage Alarm
- Low Voltage Alarm
- HVSD Reset

In the Battery menu on MiniCSU-3:

- Float Voltage
- Equalise Voltage

Test Function: (when activated on MiniCSU-3)

Test function causes all rectifier LEDs to flash.

Alarms and monitoring

Front Panel LED Condition Table:

| Green | Yellow | Red | Condition |
|-------|--------|-----|----------------------------|
| 0 | 0 | 0 | No AC power |
| F* | 0 | 0 | Primary power bad |
| 1 | 0 | 0 | Normal |
| 1 | F* | 0 | Alarm |
| 1 | 1 | 0 | Equalise |
| 0 | F* | 1 | Shutdown |
| F* | F* | F* | Test (MiniCSU-3 activated) |

Note: F* indicates flashing LED.

Primary power bad: Indicates the input AC is too low or too high, or the primary circuit is faulty;

Alarm: See Alarm table;

Shutdown: SMR is shut down by remote control, or not fully plugged in, or there is an internal control circuit fault;

SMR Status Monitoring:

MiniCSU-3 and WinCSU-2 monitor status of the SMR:

- Output current of SMR;
- Temperature of heatsink of SMR;
- Software version of SMR;

Current:

Monitored on MiniCSU-3 and WinCSU-2 with 1A resolution; Analog measurement accuracy $\pm 1\%$ at full load;

Voltage:

System voltage normally displayed on MiniCSU-3 alphanumeric LCD display. Accuracy $\pm 0.5\%$

SMR Address:

DIP switches in the magazine set the SMR address.

SMR Alarm Monitoring:

The table shows alarm conditions that are monitored by the SMR and are displayed on both MiniCSU-3 and WinCSU-2. The mnemonics listed here appear on WinCSU-2, but full alarm description appears on MiniCSU-3;

| | |
|-------------|--|
| 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 MiniCSU-3 |
| 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.





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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 V1.3.3 (2005-4)

Environmental: ETSI EN 300 019

EMC Test Levels

Emissions:

| Category: | Tested to comply with: | |
|--------------|-------------------------|---------|
| Harmonics | IEC 61000-3-2 | Class A |
| Flicker | IEC 61000-3-3 | |
| Conducted RF | AC Terminals: CISPR 22; | Class B |
| | DC Terminals: CISPR 22 | Class A |
| Radiated RF | CISPR 22 | Class B |

Immunity

| Category: | Tested to comply with: | |
|---------------------------------|---|--|
| Electrostatic Discharge (ESD) | IEC 61000-4-2 (Level 4: Air 15kV, Contact 8kV) | 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 Criterion B 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) | |
| Surge Protection | 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 |
| Voltage Dip, Interruptions | IEC 61000-4-11 (Level: 100% dip for 10ms) (Level: 30% dip for 500ms) (Level: 60% dip for 1000ms) (Level: 100% dropout for 5s) | Criterion A Criterion A Criterion B Criterion B |





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Environmental

Environmental Class (EN 300 019):

Operational: Class 3.3
(Stationary Use at Non-Temperature-Controlled Locations)

Transport: Class 2.3
(Public Transportation)

Storage: 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:

| | |
|--------------------|--------------------|
| Operating range: | -40°C to +70°C |
| Full power range: | -40°C to +50°C |
| Derated operation: | 25% power at +70°C |
| | 50% power at +65°C |
| Storage: | -40°C to +70°C |
| Transport: | -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:

Operational: 1.5mm displacement 2-9Hz,
5m/s² acceleration 9-200Hz,
Continuous, any direction.

Transport: 3.5mm displacement 2-9Hz,
10m/s² acceleration 9-200Hz,
15m/s² acceleration 200-500Hz,
One hour, any direction.

Shocks:

Operational: 40m/s² half sine, 11ms duration,
Any direction

Transport: 180m/s² half sine, 6ms duration,
Any direction

Drop Test:

Transport: 1.2m drop when packaged

Mechanical

Module Size:

| | | |
|---------|-----------|----------|
| Width: | 216mm | (8.5") |
| Height: | 43mm (1U) | (1.7") |
| Depth: | 255mm | (10") |
| Mass: | < 2.5kg | (5.5 lb) |

Acoustic Noise:

< 55dB (A Weighted)

Powershell Magazine Size:

The Powershell magazine may be installed in 400 or 600mm deep 19-inch or 23-inch racks and takes up 2, 3, or 4U of height while accommodating 2, 4, or 6 rectifiers. (Special magazine required for 300mm racks). In most cases no additional height needs to be left at the top and bottom of the magazine.

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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RT10-32V/1.6kW dimensions:

