

FEATURES

- ▶ Fully Encapsulated Plastic Case for Chassis and DIN-Rail Mounting Version
- ▶ Ultra-wide 4:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ Excellent Efficiency up to 92%
- ▶ I/O Isolation 2500 VDC
- ▶ Operating Ambient Temp. Range -40°C to +85°C
- ▶ Under-voltage, Overload/Voltage and Short Circuit Protection
- ▶ No Min. Load Requirement
- ▶ Remote On/Off Control
- ▶ Conducted EMI EN 55032 Class A Approved
- ▶ EMC Immunity EN 61000-4-2,3,4,5,6,8 Approved
- ▶ UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval & CE Marking



PRODUCT OVERVIEW

The MINMAX MRWI60C series is a range of regulated DC-DC converter modules with ultra-wide 4:1 input voltage ranges. The product comes in a fully encapsulated module with the screw terminal block and it's suitable for chassis or DIN-Rail mounting which easy to install. Featuring an extended operating temperature range from -40°C to +85°C, EMC compliance to EN 61000-6-1 standard these modules have been designed particularly for industrial applications.

Model Selection Guide

| Model Number | Input Voltage (Range) | Output Voltage | Output Current | Input Current | | Max. capacitive Load | Efficiency (typ.) |
|----------------|-----------------------|----------------|----------------|---------------|-----------|----------------------|-------------------|
| | | | | @ Max. Load | @ No Load | | @Max. Load |
| | VDC | VDC | mA | mA(typ.) | mA(typ.) | μF | % |
| MRWI60-24S051C | 24 (9 ~ 36) | 5.1 | 12000 | 2833 | 100 | 20400 | 90 |
| MRWI60-24S12C | | 12 | 5000 | 2747 | 100 | 3540 | 91 |
| MRWI60-24S24C | | 24 | 2500 | 2747 | 110 | 890 | 91 |
| MRWI60-24S48C | | 48 | 1250 | 2747 | 60 | 220 | 91 |
| MRWI60-48S051C | 48 (18 ~ 75) | 5.1 | 12000 | 1401 | 40 | 20400 | 91 |
| MRWI60-48S12C | | 12 | 5000 | 1359 | 60 | 3540 | 92 |
| MRWI60-48S24C | | 24 | 2500 | 1374 | 60 | 890 | 91 |
| MRWI60-48S48C | | 48 | 1250 | 1374 | 50 | 220 | 91 |

Input Specifications

| Parameter | | Model | Min. | Typ. | Max. | Unit |
|-----------------------------------|---------------|-----------------------------------------|------------------|------|------|------|
| Input Surge Voltage (100 ms max.) | | 24V Input Models | -0.7 | --- | 50 | VDC |
| | | 48V Input Models | -0.7 | --- | 100 | |
| Start-Up Threshold Voltage | | 24V Input Models | --- | --- | 9 | |
| | | 48V Input Models | --- | --- | 18 | |
| Under Voltage Shutdown | | 24V Input Models | --- | 7.5 | --- | |
| | | 48V Input Models | --- | 16 | --- | |
| Start Up Time | Power Up | Nominal Vin and Constant Resistive Load | --- | --- | 50 | ms |
| | Remote On/Off | | --- | --- | 50 | ms |
| Input Filter | | All Models | Internal Pi Type | | | |

Remote On/Off Control

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------|------------------------------|------|------|------|------|
| Converter On | 3.5V ~ 12V or Open Circuit | | | | |
| Converter Off | 0V ~ 1.2V or Short Circuit | | | | |
| Control Input Current (On) | Vctrl = 5.0V | --- | --- | 0.5 | mA |
| Control Input Current (Off) | Vctrl = 0V | --- | --- | -0.5 | mA |
| Control Common | Referenced to Negative Input | | | | |
| Standby Input Current | Nominal Vin | --- | 3 | --- | mA |

Output Specifications

| Parameter | Conditions / Model | Min. | Typ. | Max. | Unit |
|---------------------------------|----------------------------------------------------------|-------------------------|-------|------|-------------------|
| Output Voltage Setting Accuracy | | --- | ±1.0 | ±2.0 | %Vnom. |
| Line Regulation | Vin=Min. to Max. @Full Load | --- | ±0.2 | ±1.5 | % |
| Load Regulation | Io=0% to 100% | --- | ±0.5 | ±1.0 | % |
| Minimum Load | No minimum Load Requirement | | | | |
| Ripple & Noise | 0-20MHz bandwidth | 5.1V Output Models | --- | 100 | mV _{P-P} |
| | | 12V & 24V Output Models | --- | 150 | mV _{P-P} |
| | | 48V Output Models | --- | 200 | mV _{P-P} |
| Transient Recovery Time | 25% Load Step Change ₍₂₎ | --- | 250 | --- | μs |
| Transient Response Deviation | | --- | ±3 | ±5 | % |
| Over Voltage Protection | Zener diode clamp | --- | 120 | --- | % of Vo |
| Temperature Coefficient | | --- | ±0.02 | --- | %/°C |
| Over Load Protection | Hiccup | --- | 150 | --- | % |
| Short Circuit Protection | Continuous, Automatic Recovery (Hiccup Mode 0.25Hz typ.) | | | | |

General Specifications

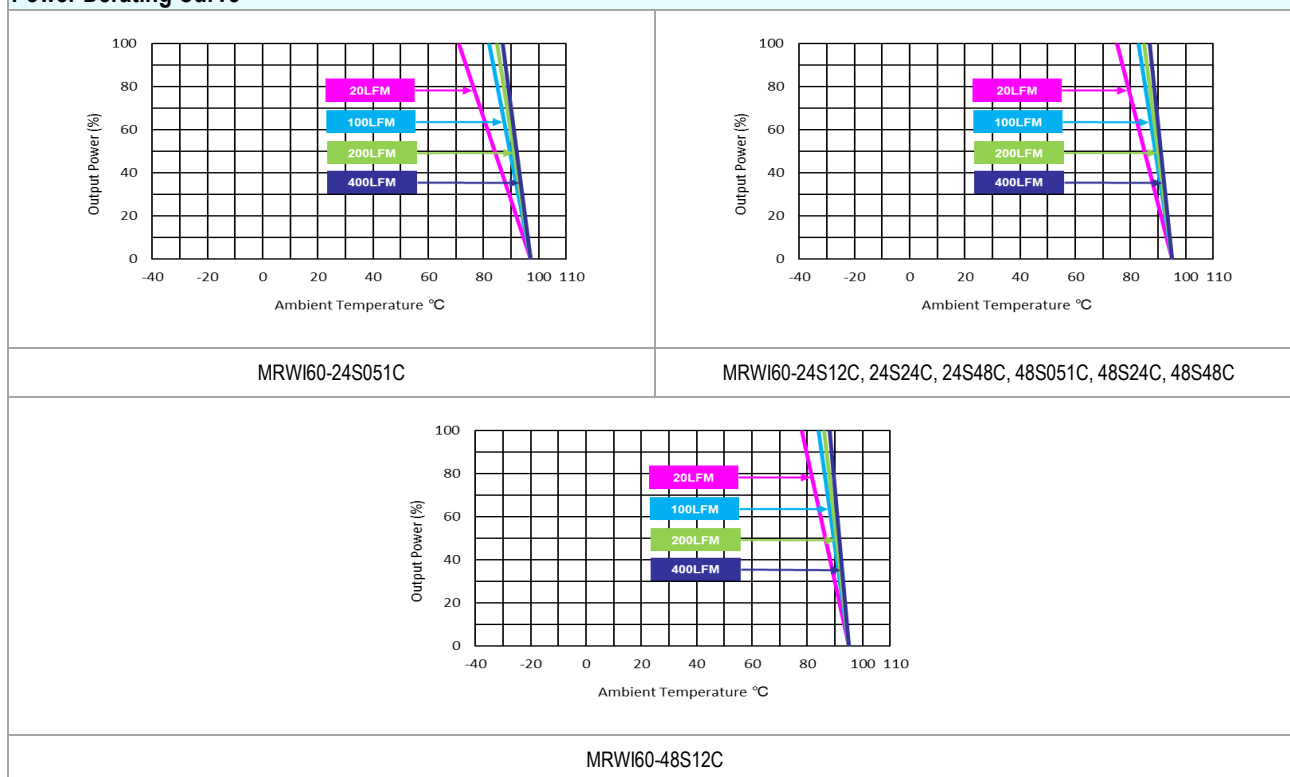
| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---------------------------|----------------------------------------------------------------------------------------|---------|------|------|-------|
| I/O Isolation Voltage | 60 Seconds | 2500 | --- | --- | VDC |
| I/O Isolation Resistance | 500 VDC | 1000 | --- | --- | MΩ |
| I/O Isolation Capacitance | 100kHz, 1V | --- | --- | 3000 | pF |
| Switching Frequency | | --- | 210 | --- | kHz |
| MTBF (calculated) | MIL-HDBK-217F@25°C, Ground Benign | 242,029 | | | Hours |
| Safety Approvals | UL/cUL 62368-1/60950-1 recognition(UL certificate), IEC/EN 62368-1/60950-1 (CB-report) | | | | |

EMC Specifications

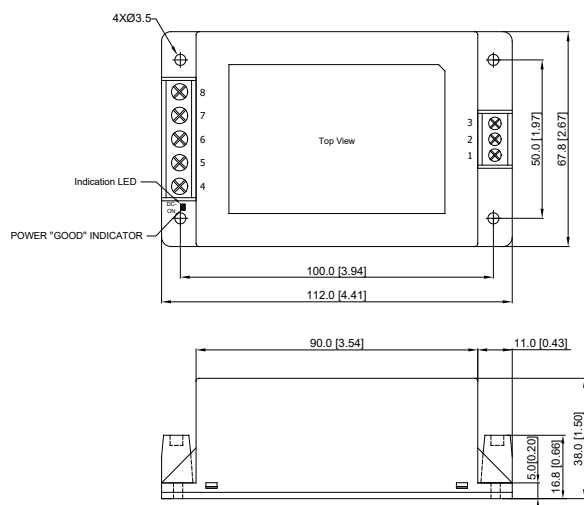
| EMC Specifications | | | | |
|--------------------|--------------------|----------------------------------------|-----------------------------|-------------|
| Parameter | | Standards & Level | | Performance |
| EMI ₍₅₎ | Conduction | EN 55032 | Without external components | Class A |
| | Radiation | | With external components | |
| EMS | EN 55035 | | | |
| | ESD | EN 61000-4-2 Air ± 8kV , Contact ± 4kV | | A |
| | Radiated immunity | EN 61000-4-3 10V/m | | A |
| | Fast transient | EN 61000-4-4 ±2kV | | A |
| | Surge | EN 61000-4-5 ±2kV | | A |
| | Conducted immunity | EN 61000-4-6 10Vrms | | A |
| | PFMF | EN 61000-4-8 30A/m for Continuous | | A |

Environmental Specifications

| Parameter | Conditions / Model | Min. | Max. | Unit |
|--------------------------------------------------------------------------------------------------------------------|--------------------------------|------|------|----------|
| Operating Ambient Temperature Range Nominal Vin, 100% Load (for Power Derating see relative Derating Curves) | MRWI60-48S12C | -40 | 76 | °C |
| | MRWI60-24S12C, 24S24C, 24S48C | | 74 | |
| | MRWI60-48S051C, 48S24C, 48S48C | | 71 | |
| | MRWI60-24S051C | | | |
| Thermal Impedance | 20LFM Convection | 3.5 | --- | °C/W |
| | 100LFM Convection | 1.95 | --- | °C/W |
| | 200LFM Convection | 1.61 | --- | °C/W |
| | 400LFM Convection | 1.33 | --- | °C/W |
| Case Temperature | | --- | +95 | °C |
| Storage Temperature Range | | -50 | +125 | °C |
| Humidity (non condensing) | | --- | 95 | % rel. H |

Power Derating Curve

Notes

- Specifications typical at Ta=+25°C, resistive load, nominal input voltage and rated output current unless otherwise noted.
- Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
- We recommend to protect the converter by a slow blow fuse in the input supply line.
- Other input and output voltage may be available, please contact MINMAX.
- The external components might be required to meet EMI standard for some of test items. Please contact MINMAX for the solution in detail.
- Specifications are subject to change without notice.
- The repeated high voltage isolation testing of the converter can degrade isolation capability, to a lesser or greater degree depending on materials, construction, environment and reflow solder process. Any material is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage. Furthermore, the high voltage isolation capability after reflow solder process should be evaluated as it is applied on system.

Package Specifications Chassis Mounting
Mechanical Dimensions

Note:

Screw type Terminal: Wires 1.5mm² max.

Recommended Terminal Screw tightening torque: 0.5Nm (3.5lb.in.) max.

Connections

| Pin | Function |
|-----|---------------|
| 1 | Remote On/Off |
| 2 | -Vin |
| 3 | +Vin |
| 4 | NC |
| 5 | +Vout |
| 6 | NC |
| 7 | -Vout |
| 8 | NC |

NC: No Connection

► All dimensions in mm (inches)

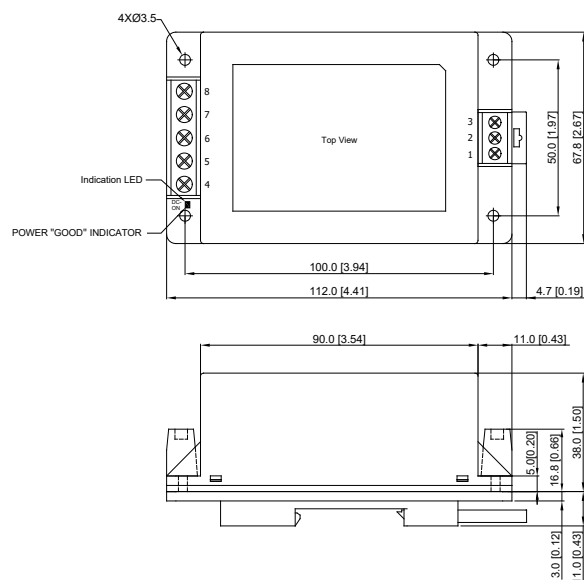
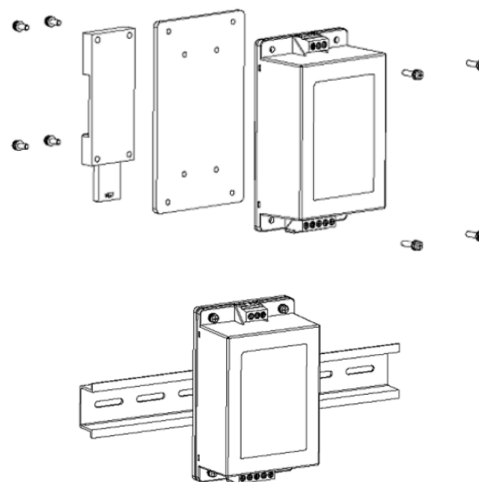
► Tolerance: ±0.5 (±0.02)

Physical Characteristics

Case Size : 112.0x67.8x38.0mm (4.41x2.67x1.50 inches)

Case Material : Plastic resin (flammability to UL 94V-0 rated)

Weight : 300g

Package Specifications with DIN Rail Mounting Bracket (order code AC-DIN-02)
Mechanical Dimensions

DIN-Rail Mounting Kit

Physical Characteristics

Case Size : 112.0x67.8x38.0mm (4.41x2.67x1.50 inches)

Case Material : Plastic resin (flammability to UL 94V-0 rated)

Weight : 353g

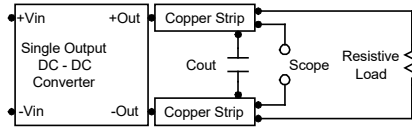
Order Code Table

| Standard | DIN Rail | Converter with DIN Rail Mounting |
|----------------|-----------|----------------------------------|
| MRWI60-24S051C | AC-DIN-02 | MRWI60-24S051C-DIN02 |
| MRWI60-24S12C | AC-DIN-02 | MRWI60-24S12C-DIN02 |
| MRWI60-24S24C | AC-DIN-02 | MRWI60-24S24C-DIN02 |
| MRWI60-24S48C | AC-DIN-02 | MRWI60-24S48C-DIN02 |
| MRWI60-48S051C | AC-DIN-02 | MRWI60-48S051C-DIN02 |
| MRWI60-48S12C | AC-DIN-02 | MRWI60-48S12C-DIN02 |
| MRWI60-48S24C | AC-DIN-02 | MRWI60-48S24C-DIN02 |
| MRWI60-48S48C | AC-DIN-02 | MRWI60-48S48C-DIN02 |

Test Setup

Peak-to-Peak Output Noise Measurement Test

Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.



Technical Notes

Remote On/Off

Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum sink current at the on/off terminal (Pin 1) during a logic low is -100μA.

Overload Protection

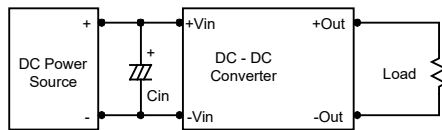
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

Overvoltage Protection

The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces the risk of output overvoltage. The OVP level can be found in the output data.

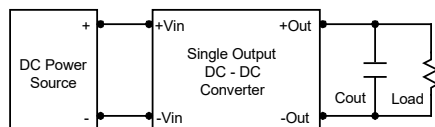
Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup. Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 10μF for the 24V and 48V devices.



Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 4.7μF capacitors at the output.



Maximum Capacitive Load

The MRWI60C series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 95°C. The derating curves are determined from measurements obtained in a test setup.

