## FEATURES

NEW



- Fully Encapsulated Plastic Case for Chassis and DIN-Rail Mounting Version
- Ultra-wide 4:1 Input Voltage Range
- Fully Regulated Output Voltage
- High Efficiency up to 86%
- I/O Isolation 3000 VDC
- Operating Ambient Temp. Range -40°C to +92.5°C
- No Min. Load Requirement
- Under-voltage, Overload and Short Circuit Protection
- Remote On/Off Control
- EMI Emission EN 55032 Class A & FCC Level A Approved (Pending)
- EMC Immunity EN 61000-4-2,3,4,5,6,8 Approved (Pending)
- UL/cUL/IEC/EN 62368-1 Safety Approval & CE Marking

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UL 62368-1

## PRODUCT OVERVIEW

The MINMAX MKWI10C series is a new range of high performance DC-DC converters featuring a wide 4:1 input range in a chassis-mount package with terminal strip connections and optional DIN-Rail mounting offer system designers the opportunity to eliminate the power board request in the field application.

Further features including high efficiency 86%; wide operating temp. range by -40°C to +92.5°C ; I/O isolation 3000VDC for 60Sec; no min. load request; built-in EMC filter for EMI emission EN 55032 class A and EMS immunity EN 61000-4-2,3,4,5,6,8 approved; and abnormal operation protection with under-voltage, overload and short circuit protections.

All family have been qualified per CB scheme with safety approvals to UL/cUL/IEC/EN 62368-1 with 3 years warranty.

**Model Selection Guide**

| Model Number | Input Voltage (Range) | Output Voltage | Output Current | Input Current | | Max. capacitive Load | Efficiency (typ.) |
|---|---|---|---|---|---|---|---|
| | | | Max. | @Max. Load | @No Load | | @Max. Load |
| | VDC | VDC | mA | mA(typ.) | mA(typ.) | μF | % |
| **MKWI10-24S05C** | 24 (9 ~ 36) | 5 | 2000 | 496 | 30 | 1000 | 84 |
| **MKWI10-24S051C** | | 5.1 | 2000 | 506 | | 1000 | 84 |
| **MKWI10-24S12C** | | 12 | 833 | 484 | | 470 | 86 |
| **MKWI10-24S15C** | | 15 | 666 | 484 | | 330 | 86 |
| **MKWI10-24S24C** | | 24 | 416 | 484 | | 150 | 86 |
| **MKWI10-24S48C** | | 48 | 208 | 495 | | 68 | 84 |
| **MKWI10-24D12C** | | ±12 | ±416 | 484 | | 220# | 86 |
| **MKWI10-24D15C** | | ±15 | ±333 | 484 | | 150# | 86 |
| **MKWI10-24D24C** | | ±24 | ±208 | 489 | | 68# | 85 |
| **MKWI10-48S05C** | 48 (18 ~ 75) | 5 | 2000 | 248 | 20 | 1000 | 84 |
| **MKWI10-48S051C** | | 5.1 | 2000 | 253 | | 1000 | 84 |
| **MKWI10-48S12C** | | 12 | 833 | 242 | | 470 | 86 |
| **MKWI10-48S15C** | | 15 | 666 | 242 | | 330 | 86 |
| **MKWI10-48S24C** | | 24 | 416 | 242 | | 150 | 86 |
| **MKWI10-48S48C** | | 48 | 208 | 248 | | 68 | 84 |
| **MKWI10-48D12C** | | ±12 | ±416 | 242 | | 220# | 86 |
| **MKWI10-48D15C** | | ±15 | ±333 | 242 | | 150# | 86 |
| **MKWI10-48D24C** | | ±24 | ±208 | 245 | | 68# | 85 |

# For each output

## Input Specifications

| Parameter | Conditions / Model | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Input Surge Voltage (1 sec. 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 | --- | 8 | --- | |
| | 48V Input Models | --- | 16 | --- | |
| Start Up Time (Power On) | Nominal Vin and Constant Resistive Load | --- | --- | 60 | 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 | 0~1.2V or Short Circuit (Pin 1 and Pin 2) | | | | |
| Control Input Current (on) | Vctrl = 5V | --- | --- | 500 | μA |
| Control Input Current (off) | Vctrl = 0V | --- | --- | -500 | μA |
| Control Common | Referenced to Negative Input | | | | |
| Standby Input Current | | --- | 2.5 | --- | mA |

## Output Specifications

| Parameter | Conditions / Model | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Setting Accuracy | | | --- | --- | ±2.0 | %Vnom. |
| Output Voltage Balance | Dual Output, Balanced Loads | | --- | ±1.0 | ±2.0 | % |
| Line Regulation | Vin=Min. to Max. @Full Load | | --- | --- | ±0.5 | % |
| Load Regulation | Io=0% to 100% | | --- | --- | ±0.5 | % |
| Load Cross Regulation (Dual Output Models) | Asymmetrical Load 25/100% Full Load | | --- | --- | ±5.0 | % |
| Minimum Load | No minimum Load Requirement | | | | | |
| Ripple & Noise | 0-20 MHz Bandwidth | 24V & ±24V & 48V Output Models | --- | 180 | --- | mV P-P |
| | | Other Output Models | --- | 90 | --- | mV P-P |
| Transient Recovery Time | 25% Load Step Change | | --- | --- | 500 | μsec |
| Transient Response Deviation | | | --- | ±3 | ±5 | % |
| Temperature Coefficient | | | --- | ±0.01 | ±0.02 | %/°C |
| Over Load Protection | Hiccup | | --- | 150 | --- | % |
| Short Circuit Protection | Hiccup Mode 0.7Hz typ., Automatic Recovery | | | | | |

## General Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| I/O Isolation Voltage | 60 Seconds | 3000 | --- | --- | VDC |
| I/O Isolation Resistance | 500 VDC | 1000 | --- | --- | MΩ |
| I/O Isolation Capacitance | 100kHz, 1V | --- | 2200 | --- | pF |
| Switching Frequency | | --- | 330 | --- | kHz |
| MTBF (calculated) | MIL-HDBK-217F@25°C, Ground Benign | 4,132,899 | --- | --- | Hours |
| Safety Approvals | UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1 & 60950-1(CB report) | | | | |

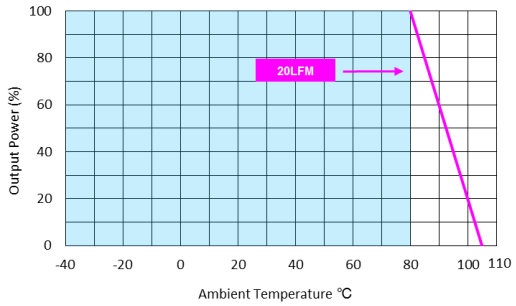
## Environmental Specifications

| Parameter | Min. | Max. | Unit |
|---|---|---|---|
| Operating Ambient Temperature Range (See Power Derating Curve) | -40 | +92.5 | °C |
| Case Temperature | --- | +105 | °C |
| Storage Temperature Range | -50 | +125 | °C |
| Humidity (non condensing) | --- | 95 | % rel. H |
| Lead Temperature (1.5mm from case for 10Sec.) | --- | 260 | °C |

## EMC Specifications

| Parameter | Standards & Level | | | Performance |
|---|---|---|---|---|
| EMI | Conduction & Radiation | EN 55032, FCC part 15 | | Class A |
| EMS | EN55035 | | | |
| | ESD | Direct discharge | Indirect discharge HCP & VCP | |
| | | EN61000-4-2 Air ± 8kV, Contact ± 6kV | Contact ± 6kV | A |
| | Radiated immunity | EN61000-4-3 10V/m | | A |
| | Fast transient | EN61000-4-4 ±2kV | | A |
| | Surge | EN61000-4-5 ±2kV | | A |
| | Conducted immunity | EN61000-4-6 10Vrms | | A |
| | PFMF | EN61000-4-8 100A/m | | A |

## Power Derating Curve

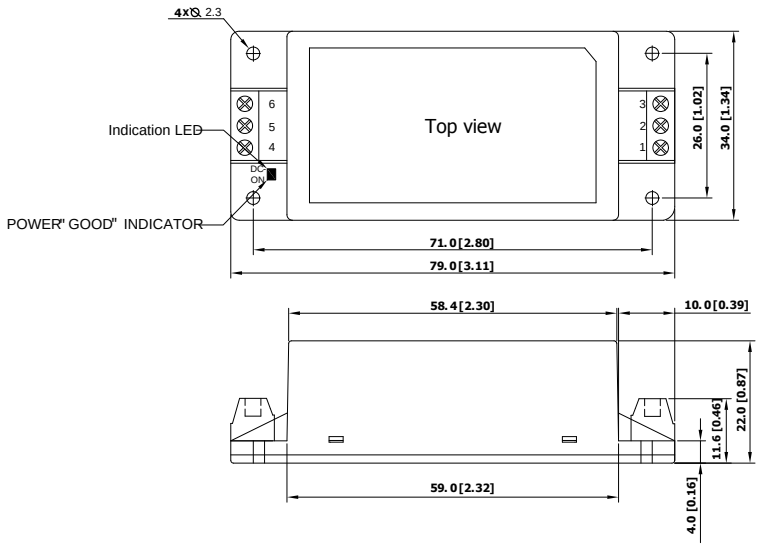



## Notes

1 Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2 Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%
3 We recommend to protect the converter by a slow blow fuse in the input supply line.
4 Other input and output voltage may be available, please contact factory.
5 Specifications are subject to change without notice.

## Package Specifications

### Mechanical Dimensions




### Pin Connections

| Pin | Single Output | Dual Output |
|---|---|---|
| 1 | Remote On/Off | Remote On/Off |
| 2 | -Vin | -Vin |
| 3 | +Vin | +Vin |
| 4 | -Vout | -Vout |
| 5 | NC | Common |
| 6 | +Vout | +Vout |

NC: No Connection

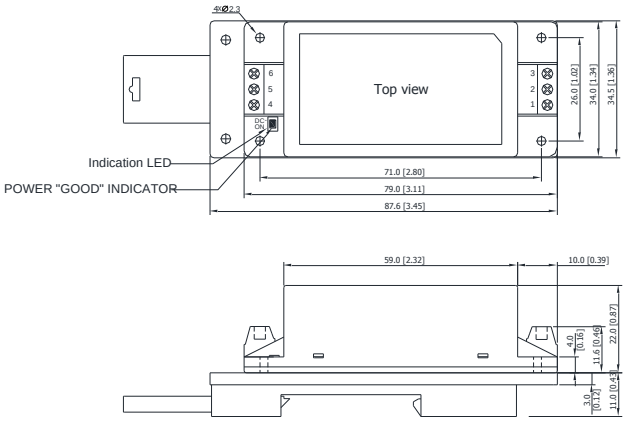
▶All dimensions in mm (inches)
▶Tolerance: X.X±0.5 (X.XX±0.02)
X.XX±0.25 ( X.XXX±0.01)

## Physical Characteristics

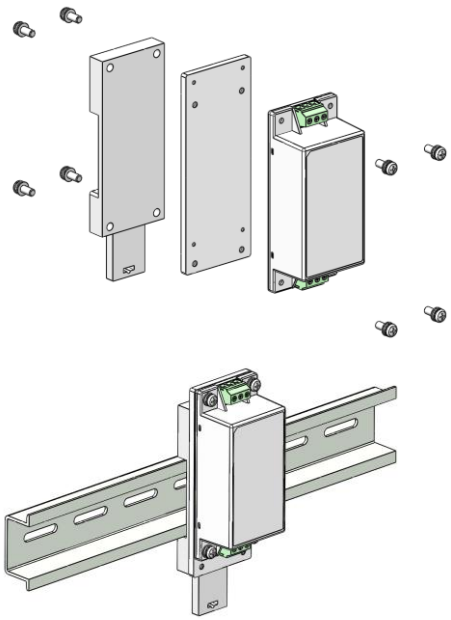
| | | |
|---|---|---|
| Case Size | : | 79.0x34.0x22.0mm (3.11x1.10x0.87 inches) |
| Case Material | : | Plastic resin (flammability to UL 94V-0 rated) |
| Weight | : | 65.76g |

## Package Specifications with DIN Rail Mounting Bracket (order code AC-DIN-05)

Mechanical Dimensions




DIN-Rail Mounting Kit



## Physical Characteristics

| | | |
|---|---|---|
| Case Size | : | 79.0x34.0x22.0mm (3.11x1.10x0.87 inches) |
| Case Material | : | Plastic resin (flammability to UL 94V-0 rated) |
| Weight | : | 108.76g |

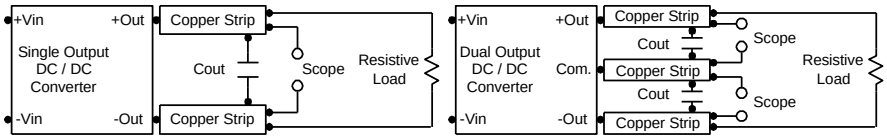
## Order Code Table

| Standard | DIN Rail | Converter With DIN Rail Mounting |
|---|---|---|
| MKWI10-24S05C | AC-DIN05 | MKWI10-24S05C-DIN05 |
| MKWI10-24S051C | AC-DIN05 | MKWI10-24S051C-DIN05 |
| MKWI10-24S12C | AC-DIN05 | MKWI10-24S12C-DIN05 |
| MKWI10-24S15C | AC-DIN05 | MKWI10-24S15C-DIN05 |
| MKWI10-24S24C | AC-DIN05 | MKWI10-24S24C-DIN05 |
| MKWI10-24S48C | AC-DIN05 | MKWI10-24S48C-DIN05 |
| MKWI10-24D12C | AC-DIN05 | MKWI10-24D12C-DIN05 |
| MKWI10-24D15C | AC-DIN05 | MKWI10-24D15C-DIN05 |
| MKWI10-24D24C | AC-DIN05 | MKWI10-24D24C-DIN05 |
| MKWI10-48S05C | AC-DIN05 | MKWI10-48S05C-DIN05 |
| MKWI10-48S051C | AC-DIN05 | MKWI10-48S051C-DIN05 |
| MKWI10-48S12C | AC-DIN05 | MKWI10-48S12C-DIN05 |
| MKWI10-48S15C | AC-DIN05 | MKWI10-48S15C-DIN05 |
| MKWI10-48S24C | AC-DIN05 | MKWI10-48S24C-DIN05 |
| MKWI10-48S48C | AC-DIN05 | MKWI10-48S48C-DIN05 |
| MKWI10-48D12C | AC-DIN05 | MKWI10-48D12C-DIN05 |
| MKWI10-48D15C | AC-DIN05 | MKWI10-48D15C-DIN05 |
| MKWI10-48D24C | AC-DIN05 | MKWI10-48D24C-DIN05 |

## Test Setup

### Peak-to-Peak Output Noise Measurement Test

Use a Cout 0.47μF ceramic capacitor. 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

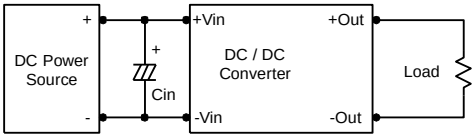
Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector 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 -500μA.

### Overload Protection

To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. The unit operates normally once the output current is brought back into its specified range.

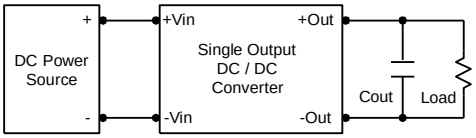
### Input Source Impedance

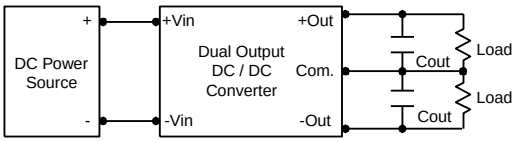
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
By using a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 4.7μF for the 24V input devices and a 2.2μF for the 48V devices, capacitor mounted close to the power module helps ensure stability of the unit.




### 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 3.3μF capacitors at the output.




### Maximum Capacitive Load

The MKWI10C series has limitation of maximum connected capacitance on the output. The power module may operate 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 105℃.
The derating curves are determined from measurements obtained in a test setup.

