

FEATURES

- ▶ 2" x 1" x 0.4" Metal Package
- ▶ Wide 2:1 Input Range
- ▶ Very High Efficiency up to 88%
- ▶ Adjustable Output Voltage
- ▶ Operating Temp. Range -40°C to +85°C
- ▶ Short Circuit Protection
- ▶ I/O-isolation 1500VDC
- ▶ Remote on/off (Option)
- ▶ Heatsink (Option)
- ▶ Cost optimized Design
- ▶ CSA/UL/IEC/EN 60950-1 Safety Approval
- ▶ 3 Years Product Warranty



PRODUCT OVERVIEW

The MINMAX MKW5000 series is a range of isolated 30W DC/DC converter modules featuring fully regulated output voltages and wide 2:1 input voltage ranges. The product comes in a 2" x 1" x 0.4" metal package with industry standard pinout. An excellent efficiency allows an operating temperature range of -40°C to +85°C.

These DC/DC converters offer an economical solution for many cost critical applications in battery-powered equipment and instrumentation.

Model Selection Guide

| Model Number | Input Voltage (Range) VDC | Output Voltage VDC | Output Current | | Input Current | | Reflected Ripple Current mA(typ.) | Max. capacitive Load µF | Efficiency (typ.) @Max. Load % | |
|--------------|------------------------------|-----------------------|----------------|------|---------------|----------|--------------------------------------|----------------------------|--------------------------------------|----|
| | | | Max. | Min. | @Max. Load | @No Load | | | | |
| | | | mA | mA | mA(typ.) | mA(typ.) | | | | |
| MKW5030 | 24 (18 ~ 36) | 2.5 | 6000 | 0 | 744 | 70 | 100 | 6800 | 84 | |
| MKW5031 | | 3.3 | 6000 | 0 | 959 | | | | 86 | |
| MKW5032 | | 5 | 5000 | 0 | 1185 | | | | 88 | |
| MKW5039 | | 5.1 | 5000 | 0 | 1207 | | | | 88 | |
| MKW5033 | | 12 | 2500 | 166 | 1420 | | | | 680 | 88 |
| MKW5034 | | 15 | 2000 | 133 | 1420 | | | | | 88 |
| MKW5040 | 48 (36 ~ 75) | 2.5 | 6000 | 0 | 372 | 50 | 50 | 6800 | 84 | |
| MKW5041 | | 3.3 | 6000 | 0 | 480 | | | | 86 | |
| MKW5042 | | 5 | 5000 | 0 | 604 | | | | 88 | |
| MKW5049 | | 5.1 | 5000 | 0 | 604 | | | | 88 | |
| MKW5043 | | 12 | 2500 | 166 | 710 | | | | 680 | 88 |
| MKW5044 | | 15 | 2000 | 133 | 710 | | | | | 88 |

Input Specifications

| Parameter | 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 | 17 | 17.8 | 18 | |
| | 48V Input Models | 34 | 35 | 36 | |
| Under Voltage Shutdown | 24V Input Models | 16 | 16.5 | 17 | |
| | 48V Input Models | 32 | 33 | 34 | |
| Reverse Polarity Input Current | All Models | --- | --- | 2 | A |
| Short Circuit Input Power | | --- | --- | 4500 | mW |
| Internal Power Dissipation | | --- | --- | 4500 | mW |
| Conducted EMI (with suffix A only) | | Compliance to EN 55022, class A and FCC part 15, class A | | | |

Output Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|-----------------------------|------------|-------|-------|-------------------|
| Output Voltage Setting Accuracy | At 50% Load and Nominal Vin | --- | --- | ±1.0 | %Vnom. |
| Line Regulation | Vin=Min. to Max. | --- | ±0.1 | ±0.3 | % |
| Load Regulation (2.5/3.3/5/5.1Vout) | Io=0% to 100% | --- | ±0.5 | ±1.0 | % |
| Load Regulation (12/15Vout) | Io=10% to 100% | --- | ±0.5 | ±1.0 | % |
| Ripple & Noise (20MHz) | | --- | 75 | 100 | mV _{P-P} |
| Transient Recovery Time | 25% Load Step Change | --- | 200 | 500 | μsec |
| Transient Response Deviation | | --- | ±2 | ±4 | % |
| Temperature Coefficient | | --- | ±0.01 | ±0.02 | %/°C |
| Over Load Protection | Foldback | 110 | 155 | --- | % |
| Short Circuit Protection | | Continuous | | | |

General Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|---------|------|------|-------|
| I/O Isolation Voltage (rated) | 60 Seconds | 1500 | --- | --- | VDC |
| I/O Isolation Resistance | 500 VDC | 1000 | --- | --- | MΩ |
| I/O Isolation Capacitance | 100KHz, 1V | --- | 1200 | 1500 | pF |
| Switching Frequency | | 280 | 350 | 400 | KHz |
| MTBF (calculated) | MIL-HDBK-217F@25°C, Ground Benign | 600,000 | --- | --- | Hours |
| Safety Approvals | UL/cUL 60950-1 recognition(CSA certificate), IEC/EN 60950-1(CB-scheme) | | | | |

Input Fuse

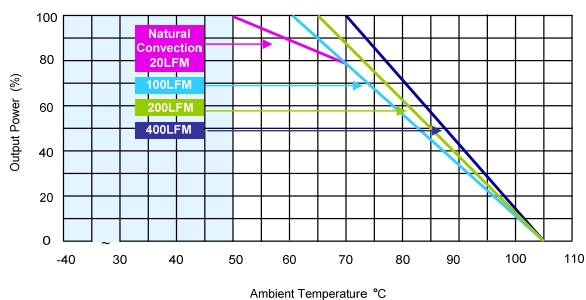
| 24V Input Models | 48V Input Models |
|-----------------------|-----------------------|
| 3000mA Slow-Blow Type | 1500mA Slow-Blow Type |

Remote On/Off Control

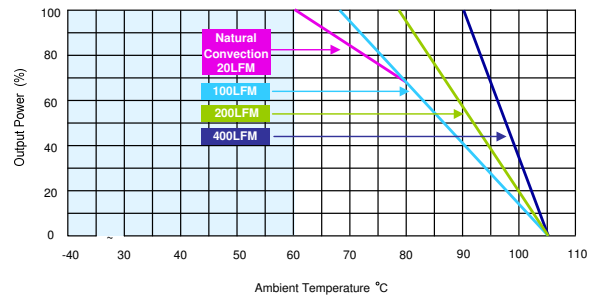
| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------|-------------------------------|------|------|------|------|
| Converter On | 2.5 to 100VDC or Open Circuit | | | | |
| Converter Off | -1V ~ 1V or Short Circuit | | | | |
| Control Input Current (on) | Vctrl = 5.0V | --- | --- | 5 | μA |
| Control Input Current (off) | Vctrl = 0V | --- | --- | -100 | μA |
| Control Common | Referenced to Negative Input | | | | |
| Standby Input Current | Nominal Vin | --- | 2 | 5 | mA |

Environmental Specifications

| Parameter | Conditions | Min. | Max. | Unit |
|--|---------------------|------|------|----------|
| Operating Ambient Temperature Range (See Power Derating Curve) | Natural Convection | -40 | +85 | °C |
| Case Temperature | | --- | +105 | °C |
| Storage Temperature Range | | -50 | +125 | °C |
| Humidity (non condensing) | | --- | 95 | % rel. H |
| Cooling | Free-Air convection | | | |
| Lead Temperature (1.5mm from case for 10Sec.) | | --- | 260 | °C |

Power Derating Curve


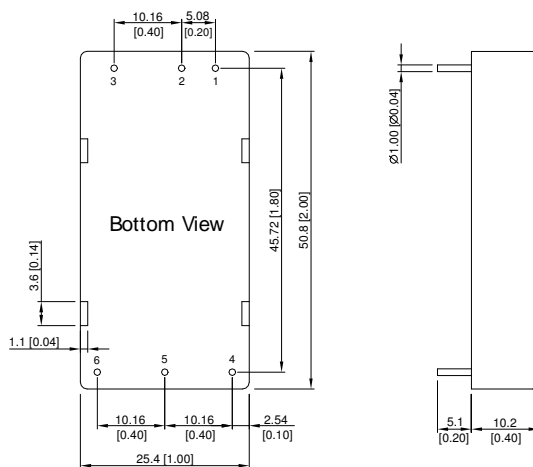
Derating Curve without Heatsink



Derating Curve with Heatsink

Notes

- 1 Specifications typical at Ta=+25°C, 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 Ripple & Noise measurement bandwidth is 0-20MHz.
- 4 These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however they may not meet all specifications listed.
- 5 All DC/DC converters should be externally fused at the front end for protection.
- 6 Other input and output voltage may be available, please contact factory.
- 7 To order the converter with Remote On/Off function, please add **suffix RC** (e.g. MKW5030-RC) to order code.
- 8 To order the converter with EN55022 Class A, please add **suffix A** (e.g. MKW5030A) to order code.
- 9 To order the converter with heatsink, please add **suffix H** (e.g. MKW5030H) to order code.
- 10 That "natural convection" is about 20LFM but is not equal to still air (0 LFM).
- 11 Specifications are subject to change without notice.

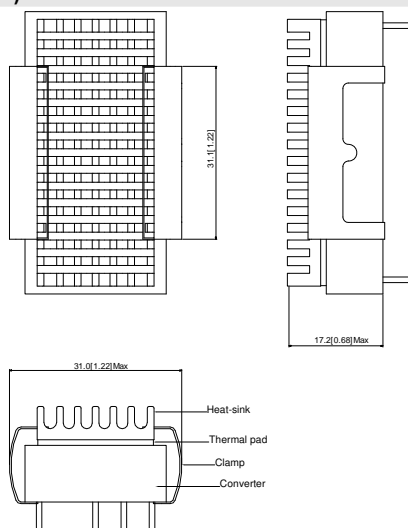
Package Specifications
Mechanical Dimensions

Pin Connections

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

- ▶ All dimensions in mm (inches)
- ▶ Tolerance: X.X±0.25 (X.XX±0.01)
X.XX±0.13 (X.XXX±0.005)
- ▶ Pin diameter \varnothing 1.0 ±0.05 (0.04±0.002)

Physical Characteristics

| | |
|---------------|---|
| Case Size | : 50.8x25.4x10.2mm (2.0x1.0x0.40 inches) |
| Case Material | : Aluminum Anodizing Treatment in Black |
| Base Material | : FR4 PCB (flammability to UL 94V-0 rated) |
| Pin Material | : Copper Alloy with Gold Plate Over Nickel Subplate |
| Weight | : 32g |

Heatsink (Option -H)

Physical Characteristics

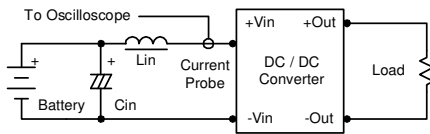
| | |
|-------------------|--------------------------|
| Heatsink Material | : Aluminum |
| Finish | : Black Anodized Coating |
| Weight | : 9g |

- ▶ The advantages of adding a heatsink are:
 1. To help heat dissipation and increase the stability and reliability of DC/DC converters at high operating temperature atmosphere.
 2. To upgrade the operating temperature of DC/DC converters, please refer to Derating Curve.

Test Setup

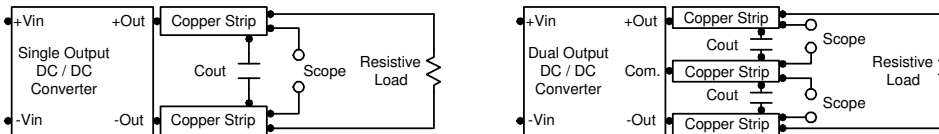
Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor L_{in} (4.7 μ H) and C_{in} (220 μ F, ESR < 1.0 Ω at 100 KHz) to simulate source impedance. Capacitor C_{in} , offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 KHz.



Peak-to-Peak Output Noise Measurement Test

Use a C_{out} 1.0 μ F 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.

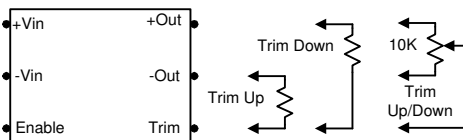
A logic low is -1V to 1.0V. A logic high is 2.5V to 100V. The maximum sink current at the on/off terminal (Pin 3) during a logic low is -100 μ A.

The maximum allowable leakage current of a switch connected to the on/off terminal (Pin 3) at logic high (2.5V to 100V) is 5 μ A.

Output Voltage Trim

Output voltage trim allows the user to increase or decrease the output voltage set point of a module.

The output voltage can be adjusted by placing an external resistor (R_{adj}) between the Trim and +Vout or -Vout terminals. By adjusting R_{adj} , the output voltage can be change by $\pm 10\%$ of the nominal output voltage.



A 10K, 1 or 10 Turn trimpot is usually specified for continuous trimming. Trim pin may be safely left floating if it is not used.

Connecting the external resistor (R_{adj-up}) between the Trim and -Vout pins increases the output voltage to set the point as defined in the following equation:

$$R_{adj-up} = \frac{(33 \times V_{out}) - (30 \times V_{adj})}{V_{adj} - V_{out}}$$

Connecting the external resistor ($R_{adj-down}$) between the Trim and +Vout pins decreases the output voltage set point as defined in the following equation:

$$R_{adj-down} = \frac{(36.667 \times V_{adj}) - (33 \times V_{out})}{V_{out} - V_{adj}}$$

V_{out} : Nominal Output Voltage V_{adj} : Adjusted Output Voltage Units: VDC/ $K\Omega$

Overcurrent Protection

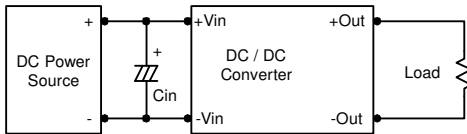
To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. The unit operates normally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

Overvoltage Protection

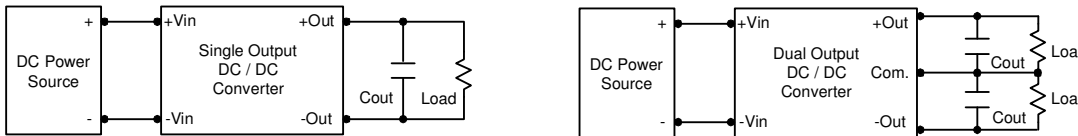
The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces 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 33μF for the 12V input devices and 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 MKW5000 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. For optimum performance we recommend 680μF maximum capacitive load for 12V & 15V outputs and 6800μF capacitive load for the other outputs. 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°C.

The derating curves are determined from measurements obtained in a test setup.

