## FEATURES

- **Industrial SMD Package**
- **Wide 2:1 Input Voltage Range**
- **Fully Regulated Output Voltage**
- **I/O Isolation 1500 VDC**
- **Operating Ambient Temp. Range -40℃ to +85℃**
- **Overload and Short Circuit Protection**
- **Remote On/Off Control**
- **Qualified for Lead-free Reflow Solder Process According to IPC/JEDEC J-STD-020D.1**
- **Tape & Reel Package Available**
- **UL/cUL/IEC/EN 60950-1 Safety Approval**


UL 60950-1 CB Scheme

## PRODUCT OVERVIEW

The MINMAX MSKW2000 series is a range of isolated 5W DC-DC converter modules featuring fully regulated output voltages and wide 2:1 input voltage ranges.

These products are in a low profile SMD package with dimensions of 33.4 x 20.8 x 9.8 mm. All models are qualified for lead free reflow solder processes according IPC J-STD-020D.1. An excellent efficiency allows an operating temperature range of –40°C to +85°C (with derating).

Typical applications for these converters are battery operated equipment and instrumentation, communication and general industrial electronics.

### Model Selection Guide

| Model Number | Input Voltage (Range) | Output Voltage | Output Current | | Input Current | | Reflected Ripple Current | Max. capacitive Load | Efficiency (typ.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Max. | Min. | @Max. Load | @No Load | | | @Max. Load |
| | VDC | VDC | mA | mA | mA(typ.) | mA(typ.) | mA(typ.) | μF | % |
| **MSKW2021** | 12 (9 ~ 18) | 3.3 | 1200 | 120 | 434 | 45 | 25 | 680 | 76 |
| **MSKW2022** | | 5 | 1000 | 100 | 521 | | | | 80 |
| **MSKW2023** | | 12 | 417 | 41.7 | 502 | | | | 83 |
| **MSKW2024** | | 15 | 333 | 33.3 | 502 | | | | 83 |
| **MSKW2025** | | ±5 | ±500 | ±50 | 521 | | | 100# | 80 |
| **MSKW2026** | | ±12 | ±208 | ±20.8 | 501 | | | | 83 |
| **MSKW2027** | | ±15 | ±167 | ±16.7 | 503 | | | | 83 |
| **MSKW2031** | 24 (18 ~ 36) | 3.3 | 1200 | 120 | 212 | 15 | 15 | 680 | 78 |
| **MSKW2032** | | 5 | 1000 | 100 | 254 | | | | 82 |
| **MSKW2033** | | 12 | 417 | 41.7 | 245 | | | | 85 |
| **MSKW2034** | | 15 | 333 | 33.3 | 245 | | | | 85 |
| **MSKW2035** | | ±5 | ±500 | ±50 | 254 | | | 100# | 82 |
| **MSKW2036** | | ±12 | ±208 | ±20.8 | 245 | | | | 85 |
| **MSKW2037** | | ±15 | ±167 | ±16.7 | 246 | | | | 85 |
| **MSKW2041** | 48 (36 ~ 75) | 3.3 | 1200 | 120 | 106 | 6 | 10 | 680 | 78 |
| **MSKW2042** | | 5 | 1000 | 100 | 127 | | | | 82 |
| **MSKW2043** | | 12 | 417 | 41.7 | 123 | | | | 85 |
| **MSKW2044** | | 15 | 333 | 33.3 | 122 | | | | 85 |
| **MSKW2045** | | ±5 | ±500 | ±50 | 127 | | | 100# | 82 |
| **MSKW2046** | | ±12 | ±208 | ±20.8 | 122 | | | | 85 |
| **MSKW2047** | | ±15 | ±167 | ±16.7 | 123 | | | | 85 |

# For each output

## Input Specifications

| Parameter | Model | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Input Surge Voltage (1 sec. max.) | 12V Input Models | -0.7 | --- | 25 | VDC |
| | 24V Input Models | -0.7 | --- | 50 | |
| | 48V Input Models | -0.7 | --- | 100 | |
| Start-Up Threshold Voltage | 12V Input Models | 7.5 | 8 | 9 | |
| | 24V Input Models | 14 | 16 | 18 | |
| | 48V Input Models | 30 | 33 | 36 | |
| Under Voltage Shutdown | 12V Input Models | 6.5 | 7 | 8 | |
| | 24V Input Models | 13 | 15 | 17 | |
| | 48V Input Models | 28 | 31 | 34 | |
| Short Circuit Input Power | All Models | --- | 1000 | 3000 | mW |
| Internal Power Dissipation | | --- | --- | 2500 | mW |
| Input Filter | | Internal Pi Type | | | |
| Conducted EMI | | Compliance to EN 55022, class A | | | |

## Remote On/Off Control

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Converter On | 2.5V ~ 5.5V or Open Circuit | | | | |
| Converter Off | -0.7V ~ 0.8V | | | | |
| Control Input Current (on) | Vctrl = Min. to Max. | --- | --- | -200 | μA |
| Control Input Current (off) | Vctrl = Min. to Max. | --- | --- | -300 | μA |
| Control Common | Referenced to Negative Input | | | | |
| Standby Input Current | | --- | --- | 10 | mA |

## Output Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Output Voltage Setting Accuracy | | --- | --- | ±1.0 | %Vnom. |
| Output Voltage Balance | Dual Output, Balanced Loads | --- | ±0.5 | ±2.0 | % |
| Line Regulation | Vin=Min. to Max. | --- | ±0.1 | ±0.3 | % |
| Load Regulation | Io=20% to 100% | --- | ±0.3 | ±1.0 | % |
| Ripple & Noise | 0-20 MHz Bandwidth | --- | --- | 85 | mV P-P |
| Transient Recovery Time | 25% Load Step Change | --- | 250 | 500 | μsec |
| Transient Response Deviation | | --- | ±2 | ±6 | % |
| Temperature Coefficient | | --- | ±0.01 | ±0.02 | %/℃ |
| Over Load Protection | Foldback | 115 | 140 | 165 | % |
| Short Circuit Protection | Continuous, Automatic Recovery | | | | |

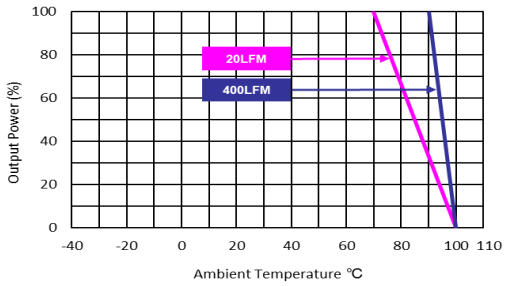
## General Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| I/O Isolation Voltage | 60 Seconds | 1500 | --- | --- | VDC |
| | 1 Seconds | 1800 | --- | --- | VDC |
| I/O Isolation Resistance | 500 VDC | 1000 | --- | --- | MΩ |
| I/O Isolation Capacitance | 100kHz, 1V | --- | 650 | 750 | pF |
| Switching Frequency | | 200 | 260 | 350 | kHz |
| MTBF (calculated) | MIL-HDBK-217F@25°C, Ground Benign | 1,000,000 | | | Hours |
| Moisture Sensitivity Level (MSL) | IPC/JEDEC J-STD-020D.1 | Level 2 | | | |
| Safety Approvals | UL/cUL 60950-1 recognition(CSA certificate), IEC/EN 60950-1(CB-report) | | | | |

## Environmental Specifications

| Parameter | Conditions | Min. | Max. | Unit |
|---|---|---|---|---|
| Operating Ambient Temperature Range (See Power Derating Curve) | | -40 | +85 | ℃ |
| Case Temperature | | --- | +100 | ℃ |
| Storage Temperature Range | | -50 | +125 | ℃ |
| Humidity (non condensing) | | --- | 95 | % rel. H |
| Lead-free Reflow Solder Process | IPC/JEDEC J-STD-020D.1 | | | |

## Power Derating Curve

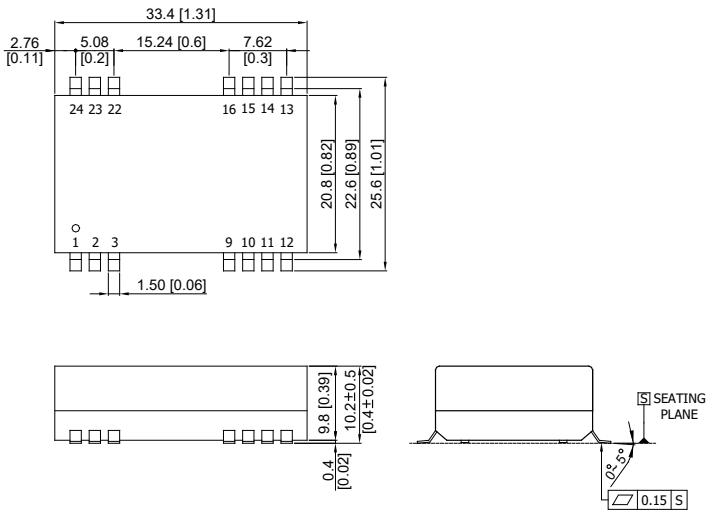



## Notes

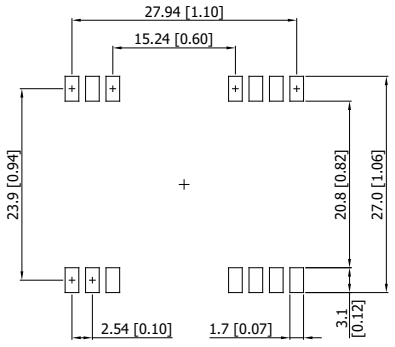
1 Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2 Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
3 These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however they may not meet all specifications listed.
4 We recommend to protect the converter by a slow blow fuse in the input supply line.
5 Other input and output voltage may be available, please contact MINMAX.
6 Specifications are subject to change without notice.

## Package Specifications

### Mechanical Dimensions




### Connecting Pin Patterns




- All dimensions in mm (inches)
- Tolerance: X.X±0.25 (X.XX±0.01)
  X.XX±0.13 (X.XXX±0.005)
- Pins ±0.05 (±0.002)

### Pin Connections

| Pin | Single Output | Dual Output |
|---|---|---|
| 1 | Remote On/Off | Remote On/Off |
| 2 | -Vin | -Vin |
| 3 | -Vin | -Vin |
| 9 | NC | Common |
| 10 | NC | NC |
| 11 | NC | -Vout |
| 12 | NC | NC |
| 13 | NC | NC |
| 14 | +Vout | +Vout |
| 15 | NC | NC |
| 16 | -Vout | Common |
| 22 | +Vin | +Vin |
| 23 | +Vin | +Vin |
| 24 | NC | NC |

NC : No Connection

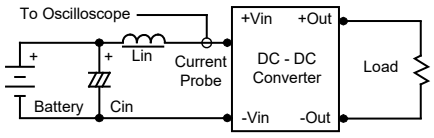
### Physical Characteristics

| | | |
|---|---|---|
| Case Size | : | 33.4x20.8x10.2mm (1.31x0.82x0.4 inches) |
| Case Material | : | Plastic resin (flammability to UL 94V-0 rated) |
| Pin Material | : | Phosphor Bronze |
| Weight | : | 14g |

## Test Setup

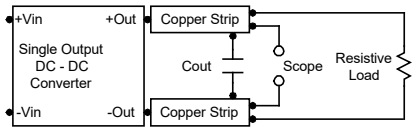
### Input Reflected-Ripple Current Test Setup

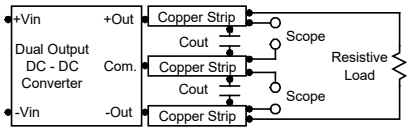
Input reflected-ripple current is measured with a inductor Lin (4.7μH) and Cin (220μF, ESR < 1.0Ω at 100 kHz) to simulate source impedance.
Capacitor Cin, offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 kHz.




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

Use a 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

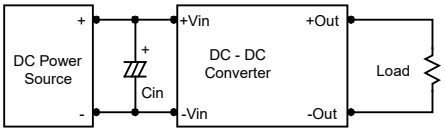
Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent.
A logic low is -0.7V to 0.8V. A logic high is 2.5V to 5.5V.
The maximum sink current of the switch at on/off terminal during a logic low is 300μA. The maximum sink current of the switch at on/off terminal = 2.5 to 5.5V is 200μA or open.

### 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.

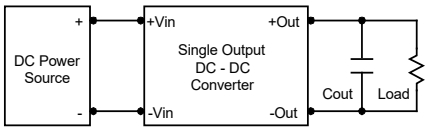
### Input Source Impedance

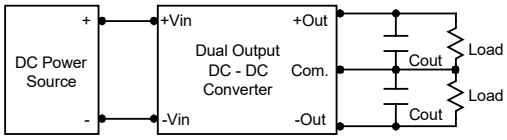
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
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 3.3μF for the 12V input devices and a 2.2μF 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 3.3μF capacitors at the output.




### Maximum Capacitive Load

The MSKW2000 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 100μF maximum capacitive load for dual outputs and 680μF capacitive load for single 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 100°C. The derating curves are determined from measurements obtained in a test setup.