

**FEATURES**

- ▶ Smallest Encapsulated 3W Converter
- ▶ Ultra-compact DIP-8 Package
- ▶ Wide 2:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ I/O Isolation 1500 VDC
- ▶ Operating Ambient Temp. Range -40°C to +80°C
- ▶ No Min. Load Requirement
- ▶ Under-voltage, Overload and Short Circuit Protection
- ▶ UL/cUL/IEC/EN 62368-1 (60950-1) Safety Approval & CE Marking


**PRODUCT OVERVIEW**

The MINMAX MFW03 series is the latest generation of high performance DC-DC converter modules setting a new standard concerning power density. The product offers a full 3W isolated DC-DC converter within an encapsulated DIP-8 package which occupies only 0.3 in<sup>2</sup> of PCB space. There are 28 models available for 5, 12, 24, 48VDC input with wide 2:1 input voltage range. Further features include under-voltage protection, overload protection, short circuit protection and no min. load requirement as well. An high efficiency allows operating temperatures range of -40°C to +80°C. These DC-DC converters offer an economical solution for many cost critical applications in battery-powered equipment, instrumentation, distributed power architectures in communication, industrial electronics, energy facilities and many other critical applications where PCB space is limited.

**Model Selection Guide**

| Model Number | Input Voltage (Range)<br>VDC | Output Voltage<br>VDC | Output Current | Input Current          |                      | Max. capacitive Load<br>μF | Efficiency (typ.) |
|--------------|------------------------------|-----------------------|----------------|------------------------|----------------------|----------------------------|-------------------|
|              |                              |                       | Max.<br>mA     | @Max. Load<br>mA(typ.) | @No Load<br>mA(typ.) |                            | @Max. Load<br>%   |
| MFW03-05S033 | 5<br>(4.5 ~ 10)              | 3.3                   | 600            | 501                    | 45                   | 100                        | 79                |
| MFW03-05S05  |                              | 5                     | 600            | 741                    |                      |                            | 81                |
| MFW03-05S12  |                              | 12                    | 250            | 706                    |                      |                            | 85                |
| MFW03-05S15  |                              | 15                    | 200            | 706                    |                      | 85                         |                   |
| MFW03-05D05  |                              | ±5                    | ±300           | 732                    |                      | 82                         |                   |
| MFW03-05D12  |                              | ±12                   | ±125           | 714                    |                      | 84                         |                   |
| MFW03-05D15  |                              | ±15                   | ±100           | 706                    |                      | 85                         |                   |
| MFW03-12S033 | 12<br>(9 ~ 18)               | 3.3                   | 600            | 206                    | 27                   | 100                        | 80                |
| MFW03-12S05  |                              | 5                     | 600            | 301                    |                      |                            | 83                |
| MFW03-12S12  |                              | 12                    | 250            | 287                    |                      |                            | 87                |
| MFW03-12S15  |                              | 15                    | 200            | 287                    |                      | 87                         |                   |
| MFW03-12D05  |                              | ±5                    | ±300           | 298                    |                      | 84                         |                   |
| MFW03-12D12  |                              | ±12                   | ±125           | 291                    |                      | 86                         |                   |
| MFW03-12D15  |                              | ±15                   | ±100           | 287                    |                      | 87                         |                   |
| MFW03-24S033 | 24<br>(18 ~ 36)              | 3.3                   | 600            | 103                    | 16                   | 100                        | 80                |
| MFW03-24S05  |                              | 5                     | 600            | 151                    |                      |                            | 83                |
| MFW03-24S12  |                              | 12                    | 250            | 144                    |                      |                            | 87                |
| MFW03-24S15  |                              | 15                    | 200            | 144                    |                      | 87                         |                   |
| MFW03-24D05  |                              | ±5                    | ±300           | 149                    |                      | 84                         |                   |
| MFW03-24D12  |                              | ±12                   | ±125           | 145                    |                      | 86                         |                   |
| MFW03-24D15  |                              | ±15                   | ±100           | 144                    |                      | 87                         |                   |
| MFW03-48S033 | 48<br>(36 ~ 75)              | 3.3                   | 600            | 52                     | 10                   | 100                        | 79                |
| MFW03-48S05  |                              | 5                     | 600            | 76                     |                      |                            | 82                |
| MFW03-48S12  |                              | 12                    | 250            | 73                     |                      |                            | 86                |
| MFW03-48S15  |                              | 15                    | 200            | 73                     |                      | 86                         |                   |
| MFW03-48D05  |                              | ±5                    | ±300           | 76                     |                      | 82                         |                   |
| MFW03-48D12  |                              | ±12                   | ±125           | 74                     |                      | 85                         |                   |
| MFW03-48D15  |                              | ±15                   | ±100           | 74                     |                      | 85                         |                   |

# For each output

| Input Specifications              |                    |                    |      |      |      |
|-----------------------------------|--------------------|--------------------|------|------|------|
| Parameter                         | Conditions / Model | Min.               | Typ. | Max. | Unit |
| Input Surge Voltage (1 sec. max.) | 5V Input Models    | -0.7               | ---  | 12   | VDC  |
|                                   | 12V Input Models   | -0.7               | ---  | 25   |      |
|                                   | 24V Input Models   | -0.7               | ---  | 50   |      |
|                                   | 48V Input Models   | -0.7               | ---  | 100  |      |
| Start-Up Threshold Voltage        | 5V Input Models    | ---                | ---  | 4.5  |      |
|                                   | 12V Input Models   | ---                | ---  | 9    |      |
|                                   | 24V Input Models   | ---                | ---  | 18   |      |
|                                   | 48V Input Models   | ---                | ---  | 36   |      |
| Short Circuit Input Power         | All Models         | ---                | ---  | 0.5  | W    |
| Input Filter                      |                    | Internal Capacitor |      |      |      |

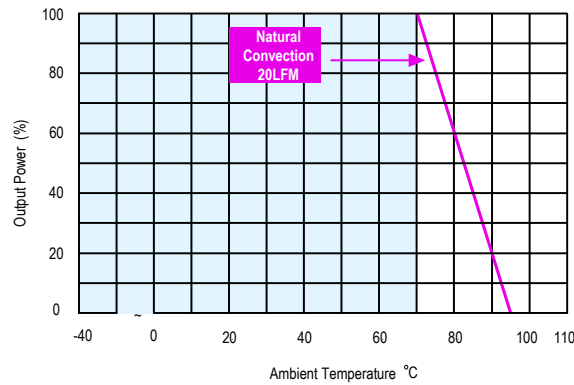
| Output Specifications           |                                 |      |       |       |                   |
|---------------------------------|---------------------------------|------|-------|-------|-------------------|
| Parameter                       | Conditions                      | Min. | Typ.  | Max.  | Unit              |
| Output Voltage Setting Accuracy |                                 | ---  | ---   | ±1.5  | %Vnom.            |
| Output Voltage Balance          | Dual Output, Balanced Loads     | ---  | ---   | ±2.0  | %                 |
| Line Regulation                 | Vin=Min. to Max. @Full Load     | ---  | ---   | ±0.2  | %                 |
| Load Regulation                 | Io=0% to 100%                   | ---  | ---   | ±1.0  | %                 |
| Minimum Load                    | No minimum Load Requirement     |      |       |       |                   |
| Cross Regulation (Dual)         | Asymmetrical load 25% / 100% FL | ---  | ---   | ±5.0  | %                 |
| Ripple & Noise                  | 0-20 MHz Bandwidth              | ---  | 70    | ---   | mV <sub>P-P</sub> |
| Transient Recovery Time         | 25% Load Step Change            | ---  | 250   | 500   | μsec              |
| Transient Response Deviation    |                                 | ---  | ±3    | ±5    | %                 |
| Temperature Coefficient         |                                 | ---  | ±0.01 | ±0.02 | %/°C              |
| Over Load Protection            | Foldback                        | ---  | 170   | ---   | %                 |
| Short Circuit Protection        | Continuous, Automatic Recovery  |      |       |       |                   |

| General Specifications    |  |           |      |      |       |
|---------------------------|--|-----------|------|------|-------|
| Parameter                 | Conditions   | Min.      | Typ. | Max. | Unit  |
| I/O Isolation Voltage     | 60 Seconds   | 1500      | ---  | ---  | VDC   |
|                           | 1 Second   | 1800      | ---  | ---  | VDC   |
| I/O Isolation Resistance  | 500 VDC  | 1000      | ---  | ---  | MΩ    |
| I/O Isolation Capacitance | 100KHz, 1V   | ---       | 100  | ---  | pF    |
| Switching Frequency       |  | 100       | ---  | ---  | KHz   |
| MTBF (calculated)         | MIL-HDBK-217F@25°C, Ground Benign                                      | 3,450,000 | ---  | ---  | Hours |
| Safety Approvals          | UL/cUL 60950-1 recognition (UL certificate), IEC/EN 60950-1(CB-report) |           |      |      |       |
|                           | UL/cUL 62368-1 recognition (UL certificate), IEC/EN 62368-1(CB-report) |           |      |      |       |

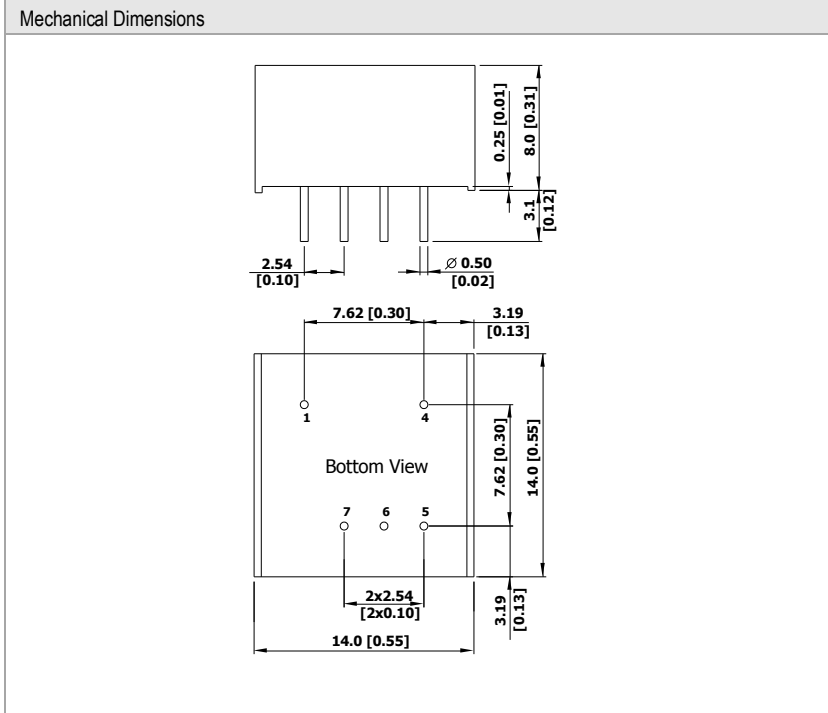
| Environmental Specifications                                      |                    |      |      |          |
|---|--------------------|------|------|----------|
| Parameter   | Conditions         | Min. | Max. | Unit     |
| Operating Ambient Temperature Range<br>(See Power Derating Curve) | Natural Convection | -40  | +80  | °C       |
| Case Temperature  |                    | ---  | +95  | °C       |
| Storage Temperature Range   |                    | -50  | +125 | °C       |
| Humidity (non condensing)   |                    | ---  | 95   | % rel. H |
| Cooling   | Natural Convection |      |      |          |
| 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, B <sub>(5)</sub> |
| EMS       | EN 55024                      |  |                           |
|           | ESD                           | EN 61000-4-2 Air $\pm$ 8kV , Contact $\pm$ 6kV | A                         |
|           | Radiated immunity             | EN 61000-4-3 10V/m                             | A                         |
|           | Fast transient <sup>(4)</sup> | EN 61000-4-4 $\pm$ 2kV                         | A                         |
|           | Surge <sup>(4)</sup>          | EN 61000-4-5 $\pm$ 1kV                         | A                         |
|           | Conducted immunity            | EN 61000-4-6 10Vrms                            | A                         |
|           | PFMF                          | EN 61000-4-8 3A/M                              | A                         |

**Power Derating Curve**

**Notes**

- 1 Specifications typical at Ta=+25°C, resistive load, nominal input voltage and rated output current unless otherwise noted.
- 2 We recommend to protect the converter by a slow blow fuse in the input supply line.
- 3 Other input and output voltage may be available, please contact factory.
- 4 To meet EN 61000-4-4 & EN 61000-4-5 an external capacitor across the input pins is required, please contact MINMAX.
- 5 To meet EN 55032 Class A,B an external filter, please contact MINMAX.
- 6 That "natural convection" is about 20LFM but is not equal to still air (0 LFM).
- 7 Specifications are subject to change without notice.

**Package Specifications**


Pin Connections

| Pin | Single Output | Dual Output |
|-----|---------------|-------------|
| 1   | -Vin          | -Vin        |
| 4   | +Vin          | +Vin        |
| 5   | +Vout         | +Vout       |
| 6   | No Pin        | Common      |
| 7   | -Vout         | -Vout       |

- ▶ All dimensions in mm (inches)
- ▶ Tolerance: X.X±0.5 (X.XX±0.02)  
X.XX±0.25 ( X.XXX±0.01)
- ▶ Pin diameter  $\varnothing 0.5 \pm 0.05$  (0.02±0.002)

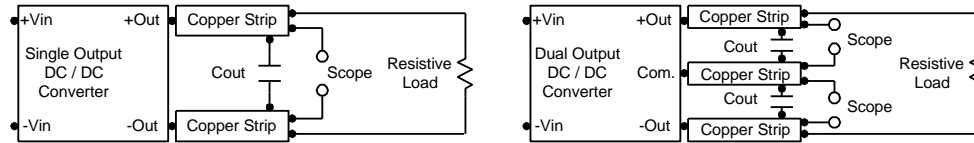
**Physical Characteristics**

|               |   |
|---------------|---|
| Case Size     | : 14.0x14.0x8.0mm (0.55x0.55x0.31 inches)                       |
| Case Material | : Non-Conductive Black Plastic (flammability to UL 94V-0 rated) |
| Pin Material  | : Tinned Copper   |
| Weight        | : 3.9g  |

### Test Setup

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

Use a  $C_{out}$  0.47 $\mu$ 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

#### Maximum Capacitive Load

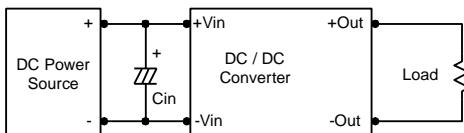
The MFW03 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

#### 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.

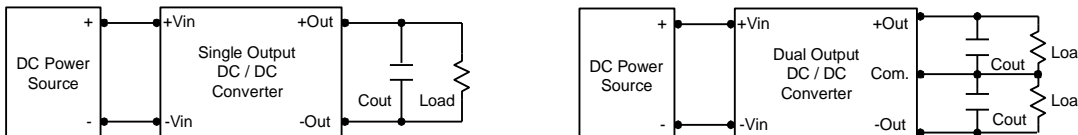
#### Input Source Impedance

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. Capacitor mounted close to the power module helps ensure stability of the unit, it is commended to use a good quality low Equivalent Series Resistance (ESR < 1.0 $\Omega$  at 100 KHz) capacitor of a 8.2 $\mu$ F for the 5V input device, a 3.3 $\mu$ F for the 12V input devices and a 1.5 $\mu$ F 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 3.3 $\mu$ F capacitors at the output.



#### 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.

