

## FEATURES

- ▶ Industrial Standard DIP-24 Package
- ▶ Wide 2:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ I/O Isolation 4000VAC with Reinforced Insulation, rated for 1000Vrms Working Voltage
- ▶ Low Leakage Current < 2μA
- ▶ Operating Ambient Temp. Range -40°C to +85°C
- ▶ Overload and Short Circuit Protection
- ▶ Designed-in Conducted EMI meets EN55022 Class A & FCC Level A
- ▶ Medical EMC Standard meets 4<sup>th</sup> Edition of EMI EN55011 and EMS EN60601-1-2
- ▶ Medical Safety meets 1xMOPP & 2xMOOP per 3<sup>rd</sup> Edition of IEC/EN 60601-1 & ANSI/AAMI ES60601-1
- ▶ UL/cUL/IEC/EN 60950-1 Safety Approval & CE Marking



## PRODUCT OVERVIEW

The MINMAX MIHW1000 series is a range of high performance DC/DC converter modules with a reinforced insulation system. The I/O-isolation voltage is specified for 4000VACrms. The product comes in a small DIP-24 package. All 20 models features wide 2:1 input voltage range and fully regulated output voltage.

The MIHW1000 DC/DC converters offer an economical solution for demanding applications in industrial and medical instrumentation requesting a certified supplementary or reinforced insulation system to comply with relative industrial or medical safety standards.

### Model Selection Guide

| Model Number | Input Voltage (Range)<br>VDC | Output Voltage<br>VDC | Output Current |       | Input Current |          | Reflected Ripple Current<br>mA (typ.) | Max. capacitive Load<br>μF | Efficiency (typ.) |
|--------------|------------------------------|-----------------------|----------------|-------|---------------|----------|---------------------------------------|----------------------------|-------------------|
|              |                              |                       | Max.           | Min.  | @Max. Load    | @No Load |                                       |                            |                   |
|              |                              |                       | mA             | mA    | mA(typ.)      | mA(typ.) |                                       |                            | %                 |
| MIHW1002     | 5<br>(4.5 ~ 9)               | 5                     | 600            | 90    | 857           | 40       | 60                                    | 1000                       | 70                |
| MIHW1003     |                              | 12                    | 250            | 37.5  | 800           |          |                                       | 470                        | 75                |
| MIHW1008     |                              | 24                    | 125            | 18.8  | 800           |          |                                       | 470                        | 76                |
| MIHW1006     |                              | ±12                   | ±125           | ±18.8 | 800           |          |                                       | 220#                       | 75                |
| MIHW1007     |                              | ±15                   | ±100           | ±15   | 800           |          |                                       | 220#                       | 75                |
| MIHW1012     | 12<br>(9 ~ 18)               | 5                     | 600            | 90    | 338           | 30       | 30                                    | 1000                       | 74                |
| MIHW1013     |                              | 12                    | 250            | 37.5  | 313           |          |                                       | 470                        | 80                |
| MIHW1018     |                              | 24                    | 125            | 18.8  | 313           |          |                                       | 470                        | 81                |
| MIHW1016     |                              | ±12                   | ±125           | ±18.8 | 313           |          |                                       | 220#                       | 80                |
| MIHW1017     |                              | ±15                   | ±100           | ±15   | 313           |          |                                       | 220#                       | 80                |
| MIHW1022     | 24<br>(18 ~ 36)              | 5                     | 600            | 90    | 160           | 20       | 15                                    | 1000                       | 78                |
| MIHW1023     |                              | 12                    | 250            | 37.5  | 151           |          |                                       | 470                        | 83                |
| MIHW1028     |                              | 24                    | 125            | 18.8  | 151           |          |                                       | 470                        | 84                |
| MIHW1026     |                              | ±12                   | ±125           | ±18.8 | 151           |          |                                       | 220#                       | 83                |
| MIHW1027     |                              | ±15                   | ±100           | ±15   | 151           |          |                                       | 220#                       | 83                |
| MIHW1032     | 48<br>(36 ~ 75)              | 5                     | 600            | 90    | 80            | 10       | 10                                    | 1000                       | 78                |
| MIHW1033     |                              | 12                    | 250            | 37.5  | 75            |          |                                       | 470                        | 83                |
| MIHW1038     |                              | 24                    | 125            | 18.8  | 75            |          |                                       | 470                        | 84                |
| MIHW1036     |                              | ±12                   | ±125           | ±18.8 | 75            |          |                                       | 220#                       | 83                |
| MIHW1037     |                              | ±15                   | ±100           | ±15   | 75            |          |                                       | 220#                       | 83                |

# For each output

**Input Specifications**

| Parameter                         | Model            | Min.   | Typ. | Max. | Unit |
|-----------------------------------|------------------|--|------|------|------|
| Input Surge Voltage (1 sec. max.) | 5V Input Models  | -0.7   | ---  | 11   | 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  | 3.7  | 4    | 4.5  |      |
|                                   | 12V Input Models | 8  | 8.5  | 9    |      |
|                                   | 24V Input Models | 15   | 17   | 18   |      |
|                                   | 48V Input Models | 30   | 33   | 36   |      |
| Under Voltage Shutdown            | 5V Input Models  | ---  | ---  | 4    |      |
|                                   | 12V Input Models | ---  | ---  | 8.5  |      |
|                                   | 24V Input Models | ---  | ---  | 17   |      |
|                                   | 48V Input Models | ---  | ---  | 34   |      |
| Short Circuit Input Power         | All Models       | ---  | ---  | 2000 | mW   |
| Input Filter                      |                  | Internal Pi Type                                       |      |      |      |
| Conducted EMI                     |                  | Compliance to EN 55022,class A and FCC part 15,class A |      |      |      |

**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.               | ---                 | ±0.3  | ±0.5  | %      |                   |
| Load Regulation                 | Io=25% to 100%                 | ---                 | ±0.5  | ±1.0  | %      |                   |
| Ripple & Noise                  | 0-20 MHz Bandwidth             | 5V Output Models    | ---   | 75    | 100    | mV <sub>P-P</sub> |
|                                 |                                | Other Output Models | ---   | 100   | 150    | mV <sub>P-P</sub> |
| Transient Recovery Time         | 25% Load Step Change           | ---                 | 150   | 500   | µsec   |                   |
| Transient Response Deviation    |                                | ---                 | ±3    | ±6    | %      |                   |
| Temperature Coefficient         |                                | ---                 | ±0.02 | ±0.05 | %/°C   |                   |
| Over Load Protection            | Foldback                       | 120                 | 150   | ---   | %      |                   |
| Short Circuit Protection        | Continuous, Automatic Recovery |                     |       |       |        |                   |

**Isolation, Safety Standards**

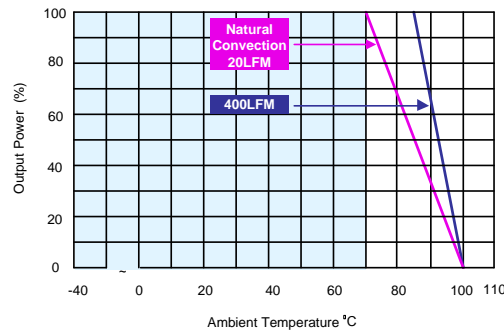
| Parameter                 | Conditions   | Min. | Typ. | Max. | Unit   |
|---------------------------|--|------|------|------|--------|
| I/O Isolation Voltage     | 60 Seconds<br>Reinforced insulation, rated for 1000Vrms working voltage  | 4000 | ---  | ---  | VACrms |
| Leakage Current           | 240VAC, 60Hz   | ---  | ---  | 2    | µA     |
| I/O Isolation Resistance  | 500 VDC  | 10   | ---  | ---  | GΩ     |
| I/O Isolation Capacitance | 100KHz, 1V   | ---  | 7    | 13   | pF     |
| Safety Standards          | UL/cUL 60950-1, CSA C22.2 No. 60950-1  |      |      |      |        |
|                           | ANSI/AAMI ES60601-1, CAN/CSA-C22.2 No. 60601-1   |      |      |      |        |
| Safety Approvals          | IEC/EN 60950-1, IEC/EN 60601-1 3 <sup>rd</sup> Edition 1xMOPP & 2xMOOP   |      |      |      |        |
|                           | UL/cUL 60950-1 recognition (UL certificate), IEC/EN 60950-1 (CB-report)  |      |      |      |        |
|                           | ANSI/AAMI ES60601-1 1xMOPP & 2xMOOP recognition (UL certificate), IEC/EN 60601-1 3 <sup>rd</sup> Edition (CB-report) |      |      |      |        |

**General Specifications**

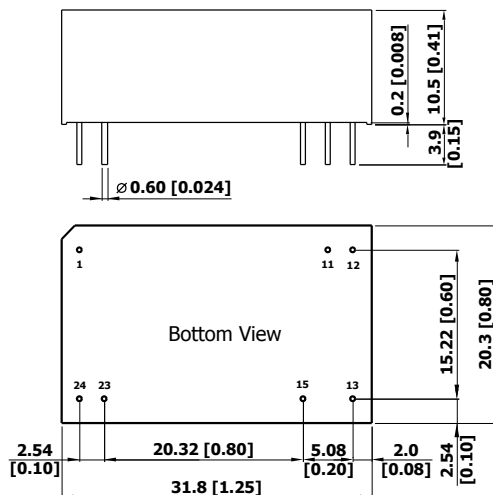
| Parameter           | Conditions                        | Min.      | Typ. | Max. | Unit  |
|---------------------|-----------------------------------|-----------|------|------|-------|
| Switching Frequency |                                   | ---       | 150  | ---  | KHz   |
| MTBF(calculated)    | MIL-HDBK-217F@25°C, Ground Benign | 1,000,000 | ---  | ---  | Hours |

**Environmental Specifications**

| Parameter  | Conditions         | Min. | Max. | Unit     |
|--|--------------------|------|------|----------|
| Operating Ambient Temperature Range (See Power Derating Curve) | Natural Convection | -40  | +85  | °C       |
| Case Temperature   |                    | ---  | +100 | °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       |

**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%.
- 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.
- 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 factory.
- That "natural convection" is about 20LFM but is not equal to still air (0 LFM).
- Specifications are subject to change without notice.

**Package Specifications**
**Mechanical Dimensions**

**Pin Connections**

| Pin | Single Output | Dual Output |
|-----|---------------|-------------|
| 1   | +Vin          | +Vin        |
| 11  | No Pin        | Common      |
| 12  | -Vout         | No Pin      |
| 13  | +Vout         | -Vout       |
| 15  | No Pin        | +Vout       |
| 23  | -Vin          | -Vin        |
| 24  | -Vin          | -Vin        |

- ▶ All dimensions in mm (inches)
- ▶ Tolerance: X.XX±0.25 (X.XX±0.01)  
X.XX±0.13 (X.XXX±0.005)
- ▶ Pin diameter  $\varnothing 0.6 \pm 0.05$  (0.024±0.002)

**Physical Characteristics**

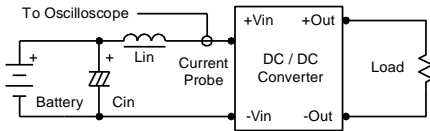
|               |   |
|---------------|---|
| Case Size     | : 31.8x20.3x10.5mm (1.25x0.8x0.41 inches)                       |
| Case Material | : Non-Conductive Black Plastic (flammability to UL 94V-0 rated) |
| Pin Material  | : Copper Alloy with Gold Plate Over Nickel Subplate             |
| Weight        | : 13g   |

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### Test Setup

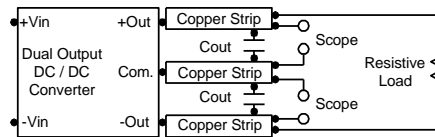
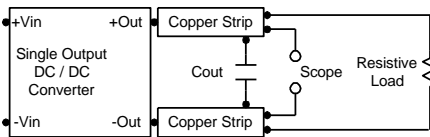
#### Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor  $L_{in}$  ( $4.7\mu\text{H}$ ) and  $C_{in}$  ( $220\mu\text{F}$ ,  $\text{ESR} < 1.0\Omega$  at  $100\text{ KHz}$ ) 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  $0\text{-}500\text{ KHz}$ .



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

Use a  $C_{out}$   $0.47\mu\text{F}$  ceramic capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is  $0\text{-}20\text{ MHz}$ . Position the load between  $50\text{ mm}$  and  $75\text{ mm}$  from the DC/DC Converter.



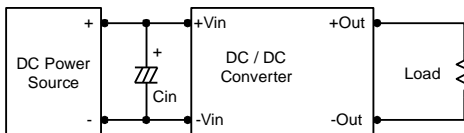
### Technical Notes

#### 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.

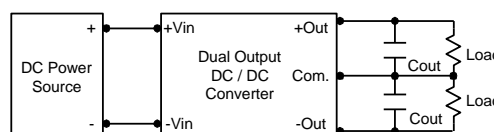
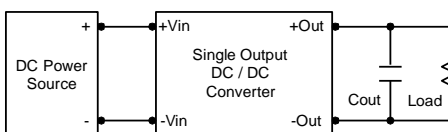
#### Input Source Impedance

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 on the input to insure 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 ( $\text{ESR} < 1.0\Omega$  at  $100\text{ KHz}$ ) capacitor of a  $10\mu\text{F}$  for the  $5\text{V}$  input devices and a  $4.7\mu\text{F}$  for the  $12\text{V}$  input devices and  $2.2\mu\text{F}$  for the  $24\text{V}$  and  $48\text{V}$  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  $3.3\mu\text{F}$  capacitors at the output.



#### Maximum Capacitive Load

The MIHW1000 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. Connect capacitors at the point of load for best performance. 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  $100^\circ\text{C}$ . The derating curves are determined from measurements obtained in a test setup.

