

## FEATURES

- ▶ Reinforced Insulation rated for 300VAC Working Voltage
- ▶ I/O-isolation Voltage 4000VACrms
- ▶ Industrial & Medical Safety Approval
- ▶ Ultra-wide Input Voltage Ranges:  
9-40VDC, 18-80VDC and 36-160VDC
- ▶ Fully regulated Output Voltage
- ▶ Low Leakage Current
- ▶ Operating Temp. Range -40°C to +85 °C
- ▶ Input Filter meets EN 55022, class A and FCC, level A
- ▶ Short Circuit Protection
- ▶ 3 Years Product Warranty



## PRODUCT OVERVIEW

The MINMAX MIHW2000 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 models features an ultra-wide input voltage range including 36-160VDC for railroad applications.

Full SMD design with exclusive use of ceramic capacitors guarantees a high reliability with calculated MTBF of >1 million hours.

These high isolation DC/DC converters are the perfect solution solution for many demanding applications in industrial and railroad systems, in medical instrumentation, everywhere where a certified supplementary or reinforced insulation system is required to comply with specific industrial or medical safety standards.

### 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.)			
MIHW2022	24 (9 ~ 40)	5	600	90	160	20	15	1000	78
MIHW2023		12	250	37.5	151			470	83
MIHW2026		±12	±125	±18.8	151			220#	83
MIHW2027		±15	±100	±15	151			220#	83
MIHW2032	48 (18 ~ 80)	5	600	90	80	10	8	1000	78
MIHW2033		12	250	37.5	75			470	83
MIHW2036		±12	±125	±18.8	75			220#	83
MIHW2037		±15	±100	±15	75			220#	83
MIHW2042	110 (36 ~ 160)	5	600	90	35	5	3	1000	78
MIHW2043		12	250	37.5	33			470	83
MIHW2046		±12	±125	±18.8	33			220#	83
MIHW2047		±15	±100	±15	33			220#	83

# For each output

### 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	
	110V Input Models	-0.7	---	180	
Start-Up Threshold Voltage	24V Input Models	8	8.5	9	VDC
	48V Input Models	13	15	17	
	110V Input Models	26	30	34	
Under Voltage Shutdown	24V Input Models	---	---	8.5	VDC
	48V Input Models	---	---	16	
	110V Input Models	---	---	32	
Reverse Polarity Input Current	All Models	---	---	0.3	A
Short Circuit Input Power		---	---	2000	mW
Internal Power Dissipation		---	---	2500	mW
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	At 50% Load and Nominal Vin	---	---	±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 (20MHz)	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			

**Isolation, Safety Standards**

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage (rated)	60 Seconds	4000	---	---	VACrms
I/O Isolation Test Voltage	Flash tested for 1 Second	6000	---	---	V <sub>PK</sub>
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	cUL/UL60950-1, CSA C22.2 No. 60950-1-03				
	UL60601-1, CSA C22.2 No.601-1				
	IEC/EN 60950-1, IEC/EN 60601-1				
Approvals	IEC60950-1 CB report, cUL/UL 60950-1 certificate				
	UL60601-1 UL certificate				

**General Specifications**

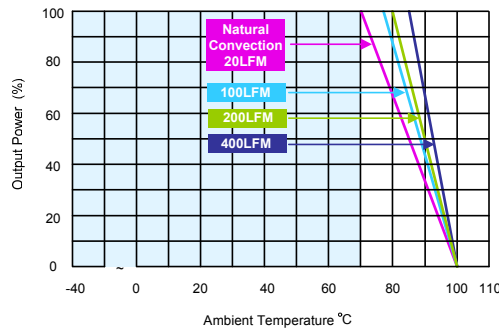
Parameter	Conditions	Min.	Typ.	Max.	Unit
Switching Frequency		---	150	---	KHz
MTBF(calculated)	MIL-HDBK-217F@25°C, Ground Benign	1,000,000	---	---	Hours

**Input Fuse**

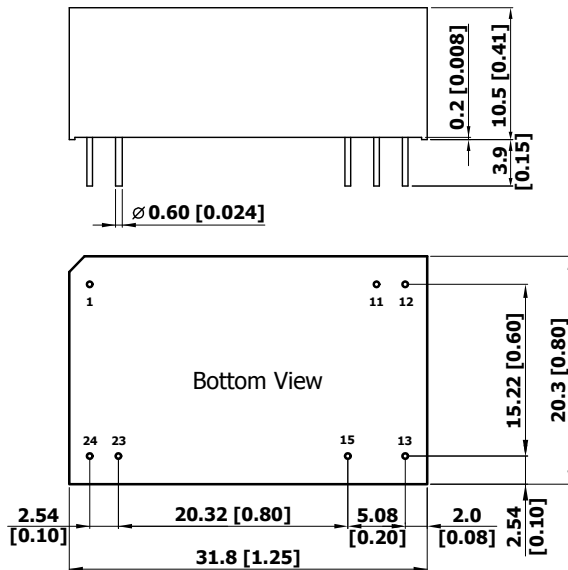
24V Input Models	48V Input Models	110V Input Models
1000mA Slow-Blow Type	500mA Slow-Blow Type	300mA Slow-Blow Type

**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	Free-Air 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%.
- Ripple & Noise measurement bandwidth is 0-20 MHz.
- 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.
- All DC/DC converters should be externally fused at the front end for protection.
- 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.X±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)

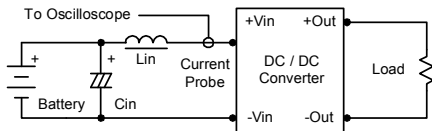
**Physical Characteristics**

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	: 16.2g

## Test Setup

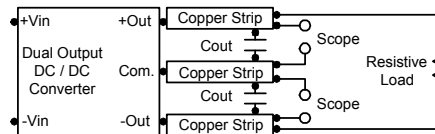
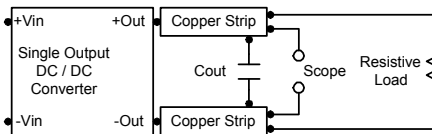
### Input Reflected-Ripple Current Test Setup

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.



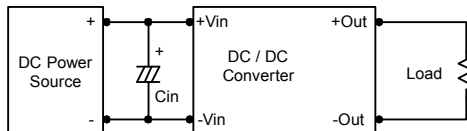
## Technical Notes

### 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.

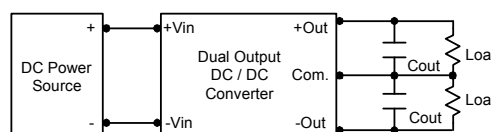
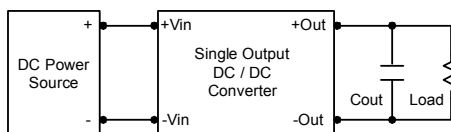
### Input Source Impedance

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 on the input to insure startup. By using a good quality low Equivalent Series Resistance ( $\text{ESR} < 1.0\Omega$  at  $100\text{ kHz}$ ) capacitor of a  $4.7\mu\text{F}$  for the  $24\text{V}$  input devices, a  $2.2\mu\text{F}$  for the  $48\text{V}$  devices and a  $1\mu\text{F}$  for the  $110\text{V}$  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  $3.3\mu\text{F}$  capacitors at the output.



### Maximum Capacitive Load

The MIHW2000 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.

