

**FEATURES**

- ▶ Industrial Standard DIP-24 Package
- ▶ Ultra-Wide 4:1 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 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)	Output Voltage	Output Current		Input Current		Reflected Ripple Current	Max. capacitive Load	Efficiency (typ.)
			Max.	Min.	@Max. Load	@No Load			@Max. Load
			mA	mA	mA(typ.)	mA(typ.)			%
<b>MIHW2022</b>	24 (9 ~ 40)	5	600	90	160	20	15	1000	78
<b>MIHW2023</b>		12	250	37.5	151			470	83
<b>MIHW2026</b>		±12	±125	±18.8	151			220#	83
<b>MIHW2027</b>		±15	±100	±15	151			220#	83
<b>MIHW2032</b>	48 (18 ~ 80)	5	600	90	80	10	8	1000	78
<b>MIHW2033</b>		12	250	37.5	75			470	83
<b>MIHW2036</b>		±12	±125	±18.8	75			220#	83
<b>MIHW2037</b>		±15	±100	±15	75			220#	83
<b>MIHW2042</b>	110 (36 ~ 160)	5	600	90	35	5	3	1000	78
<b>MIHW2043</b>		12	250	37.5	33			470	83
<b>MIHW2046</b>		±12	±125	±18.8	33			220#	83
<b>MIHW2047</b>		±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	
	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	
	48V Input Models	---	---	16	
	110V Input Models	---	---	32	
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. @Full Load	---	±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**

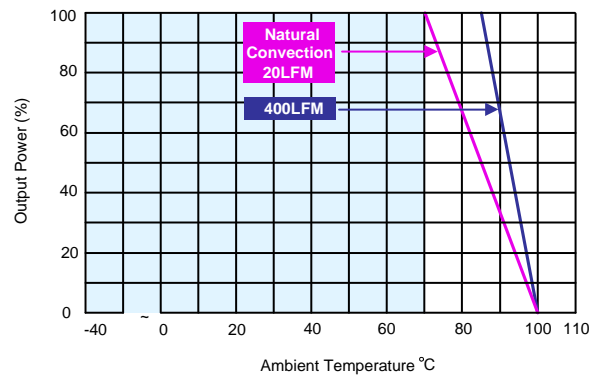
Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds Reinforced insulation, rated for 1000Vrms working voltage	4000	---	---	VACrms
Leakage Current	240VAC, 60Hz	---	---	2	µA
I/O Isolation Resistance	500 VDC	10	---	---	GΩ
I/O Isolation Capacitance	100KHz, 1V	---	7	13	pF
Safety Standards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

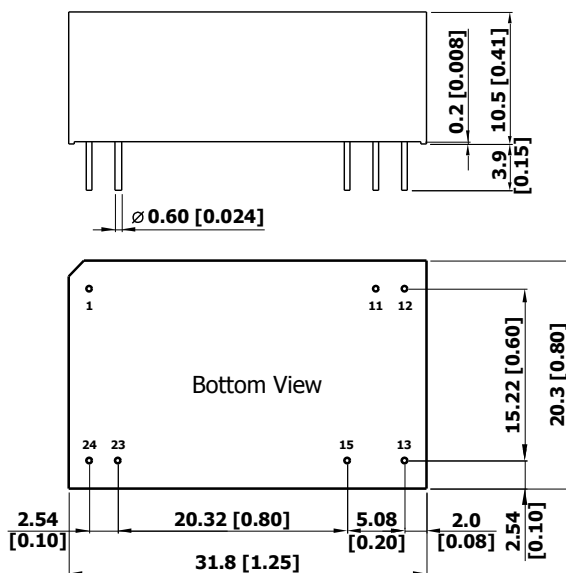
Parameter	Conditions	Min.	Typ.	Max.	Unit
Switching Frequency		---	150	---	KHz
MTBF(calculated)	MIL-HDBK-217F@25°C, Ground Benign	1,000,000	---	---	Hours

**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**

- 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 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 factory.
- 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**
**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)

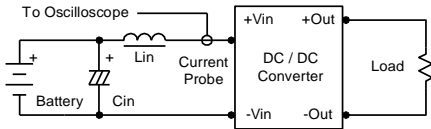
**Physical Characteristics**

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

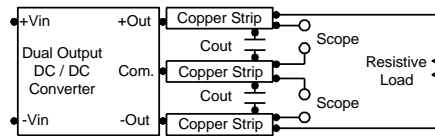
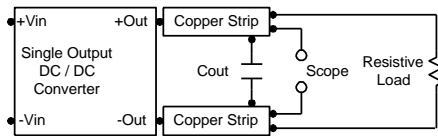
#### Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor  $L_{in}$  ( $4.7\mu H$ ) and  $C_{in}$  ( $220\mu F$ ,  $ESR < 1.0\Omega$  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  $C_{out}$   $0.47\mu F$  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.



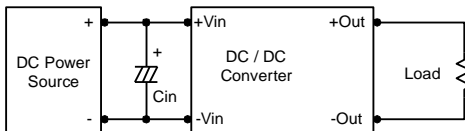
### Technical Notes

#### 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.

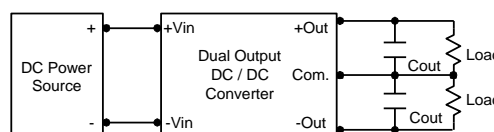
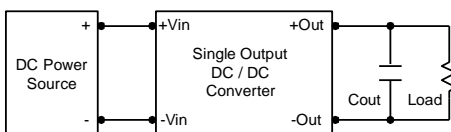
#### Input Source Impedance

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

