

**FEATURES**

- ▶ Industrial Standard DIP-24 Package
- ▶ Wide 2:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ Ultra-high I/O Isolation 9000VDC with reinforced Insulation, rate for 1000Vrms Working Voltage
- ▶ Operating Ambient Temp. Range -40°C to +90°C
- ▶ No Min. Load Requirement
- ▶ Under-voltage, Overload/Voltage and Short Circuit Protection
- ▶ EMI Emission EN 55032 Class A Approved
- ▶ UL/cUL/IEC/EN 62368-1 Safety Approval & CE Marking

**NEW**

**PRODUCT OVERVIEW**

The MINMAX MIE10-HI series is a new range of high performance 10W DC-DC converter within encapsulated DIP-24 package which specifically design for high isolation applications where reinforced insulation and high working voltage are required. There are 24 models available for input voltage of 12, 24, 48VDC with wide 2:1 input range and fixed output voltage. The I/O isolation is specified for 9000VDC with reinforced insulation, which rated for 1000Vrms working voltage. Further features include under-voltage, overload, over voltage, short circuit protection, no min. load requirement, EMI emission EN55032 Class A approved, low I/O capacitance 20pF max. and operating ambient temp. range by -40°C to 90°C by high efficiency up to 88%. MIE10-HI series conform to UL/cUL/IEC/EN 62368-1 safety approvals. The MIE10-HI series offer a superior solution for critical application in requesting a certified supplementary.

**Model Selection Guide**

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Over Voltage Protection	Max. capacitive Load	Efficiency (typ.)
				Max.	@No Load			
				VDC	VDC			Ma
MIE10-12S033HI	12 (9 ~ 18)	3.3	2700	917	12	3.9	4700	81
MIE10-12S05HI		5	2000	1004		6.2	3300	83
MIE10-12S051HI		5.1	2000	1024		6.2	3300	83
MIE10-12S12HI		12	833	969		15	560	86
MIE10-12S15HI		15	666	946		18	360	88
MIE10-12S24HI		24	416	945		27	140	88
MIE10-12D12HI		±12	±416	945		±15	280#	88
MIE10-12D15HI		±15	±333	957		±18	180#	87
MIE10-24S033HI	24 (18 ~ 36)	3.3	2700	458	8	3.9	4700	81
MIE10-24S05HI		5	2000	496		6.2	3300	84
MIE10-24S051HI		5.1	2000	506		6.2	3300	84
MIE10-24S12HI		12	833	479		15	560	87
MIE10-24S15HI		15	666	473		18	360	88
MIE10-24S24HI		24	416	473		27	140	88
MIE10-24D12HI		±12	±416	473		±15	280#	88
MIE10-24D15HI		±15	±333	478		±18	180#	87
MIE10-48S033HI	48 (36 ~ 75)	3.3	2700	229	6	3.9	4700	81
MIE10-48S05HI		5	2000	248		6.2	3300	84
MIE10-48S051HI		5.1	2000	253		6.2	3300	84
MIE10-48S12HI		12	833	239		15	560	87
MIE10-48S15HI		15	666	237		18	360	88
MIE10-48S24HI		24	416	239		27	140	87
MIE10-48D12HI		±12	±416	239		±15	280#	87
MIE10-48D15HI		±15	±333	239		±18	180#	87

# For each output

Input Specifications							
Parameter	Conditions / 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	---	---	9			
	24V Input Models	---	---	18			
	48V Input Models	---	---	36			
Under Voltage Shutdown	12V Input Models	---	8	---			
	24V Input Models	---	16	---			
	48V Input Models	---	33	---			
Start Up Time (Power On)	Nominal Vin and Constant Resistive Load	---	30	---	mS		
Input Filter	All Models	Internal Pi Type					

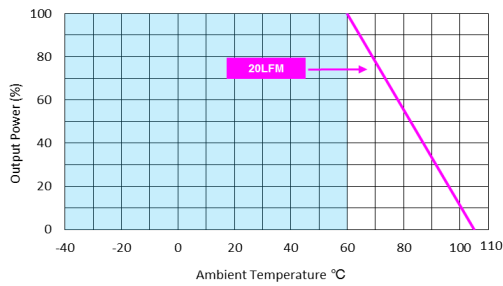
Output Specifications						
Parameter	Conditions	Min.	Typ.	Max.	Unit	
Output Voltage Setting Accuracy		---	---	±1.0	%Vnom.	
Output Voltage Balance	Dual Output, Balanced Loads	---	---	±2.0	%	
Line Regulation	Vin=Min. to Max. @Full Load	---	---	±0.5	%	
Load Regulation	Io=0% to 100%	Single Output	---	---	±0.5	%
		Dual Output	---	---	±1.0	%
Load Cross Regulation (Dual Output Models)	Asymmetrical Load 25/100% Full Load	---	---	±5.0	%	
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20 MHz Bandwidth	Measured with a 10µF MLCC	---	50	---	mV <sub>P-P</sub>
Transient Recovery Time	25% Load Step Change		---	300	---	µsec
Transient Response Deviation			---	±3	±5	%
Temperature Coefficient		---	±0.01	---	%/ <sup>o</sup> C	
Over Load Protection	Hiccup	---	150	---	%	
Short Circuit Protection	Continuous, Automatic Recovery (Hiccup Mode 0.5Hz typ.)					

Isolation, Safety Standards						
Parameter	Conditions	Min.	Typ.	Max.	Unit	
I/O Isolation Voltage	60 Seconds	5000	---	---	VAC	
	Reinforced insulation, rated for 1000Vrms working voltage					
	Tested for 1 second	9000	---	---	VDC	
I/O Isolation Resistance	500 VDC	10	---	---	GΩ	
I/O Isolation Capacitance	100kHz, 1V	---	---	20	pF	
Safety Approvals	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1 & 60950-1(CB report)					

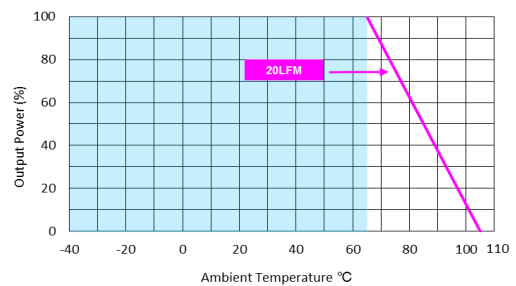
General Specifications						
Parameter	Conditions	Min.	Typ.	Max.	Unit	
Switching Frequency		---	240	---	kHz	
MTBF(calculated)	MIL-HDBK-217F@25°C, Ground Benign	3,816,975	---	---	Hours	

EMC Specifications					
Parameter	Standards & Level			Performance	
EMI	Conduction	EN 55032	Without external components	Class A	
	Radiation				
EMS	EN 55024, EN 55035				
	ESD	Direct discharge	Indirect discharge HCP & VCP		A
		EN 61000-4-2 Air ± 15kV	Contact ± 8kV		
	Radiated immunity	EN 61000-4-3 10V/m			A
	Fast transient <sub>(s)</sub>	EN 61000-4-4 ±2kV			A
	Surge <sub>(s)</sub>	EN 61000-4-5 ±2kV			A
	Conducted immunity	EN 61000-4-6 10Vrms			A
PFMF	EN 61000-4-8 100A/m, 1000A/m(1 sec.)			A	

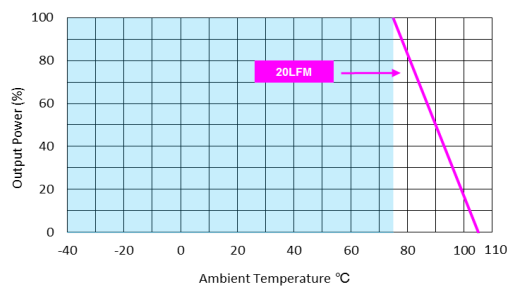
Environmental Specifications				
Parameter	Conditions	Min.	Max.	Unit
Operating Ambient Temperature Range Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MIE10-12S033HI, MIE10-12S05HI, MIE10-12S051H MIE10-24S033HI, MIE10-48S033HI	-40	+60	°C
	MIE10-24S05HI, MIE10-24S051HI, MIE10-12S12H MIE10-48S05HI, MIE10-48S051HI		+65	
	MIE10-12S15HI, MIE10-12S24HI, MIE10-12D12HI MIE10-12D15HI, MIE10-24S12HI, MIE10-24S15HI MIE10-24S24HI, MIE10-24D12HI, MIE10-24D15HI MIE10-48S12HI, MIE10-48S15HI, MIE10-48S24HI MIE10-48D12HI, MIE10-48D15HI		+75	
Case Temperature		---	105	°C
Storage Temperature Range		-50	+125	°C
Humidity (non condensing)		---	95	% rel. H
Altitude		---	5000	m
Lead Temperature (1.5mm from case for 10Sec.)		---	260	°C

**Power Derating Curve**


MIE10-12S033HI, MIE10-12S05HI, MIE10-12S051H  
MIE10-24S033HI, MIE10-48S033HI



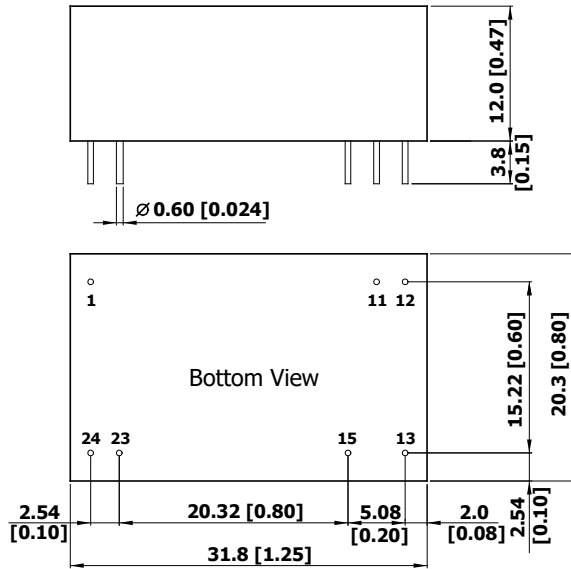
MIE10-24S05HI, MIE10-24S051HI, MIE10-12S12H  
MIE10-48S05HI, MIE10-48S051HII



MIE10-12S15HI, MIE10-12S24HI, MIE10-12D12HI, MIE10-12D15HI, MIE10-24S12HI,  
MIE10-24S15HI, MIE10-24S24HI, MIE10-24D12HI, MIE10-24D15HI, MIE10-48S12HI,  
MIE10-48S15HI, MIE10-48S24HI, MIE10-48D12HI, MIE10-48D15HI

**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 We recommend to protect the converter by a slow blow fuse in the input supply line.
- 4 Other input and output voltage may be available, please contact MINMAX.
- 5 To meet EN 61000-4-4 & EN 61000-4-5 an external capacitor across the input pins is required, please contact MINMAX.
- 6 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±0.5 (X.XX±0.02)  
X.XX±0.25 (X.XXX±0.01)
- ▶ Pin diameter  $\varnothing 0.6 \pm 0.05$  (0.02±0.002)

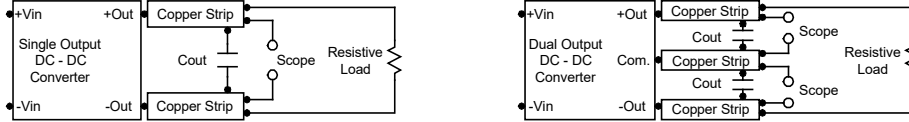
**Physical Characteristics**

Case Size	: 31.8x20.3x12.0mm (1.25x0.80x0.47 inches)
Case Material	: Non-Conductive Black Plastic (flammability to UL 94V-0 rated)
Pin Material	: Copper Alloy with Tin Plate Over Nickel Subplate
Weight	: 16g

## Test Setup

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

Refer to the output specifications or add 4.7 $\mu$ F capacitor if the output specifications undefine C<sub>out</sub>. 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

### Overload Protection

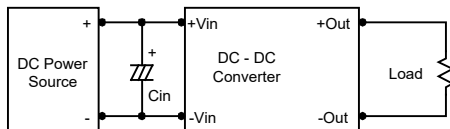
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

### Overvoltage Protection

The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces the risk of output overvoltage. The OVP level can be found in the output data.

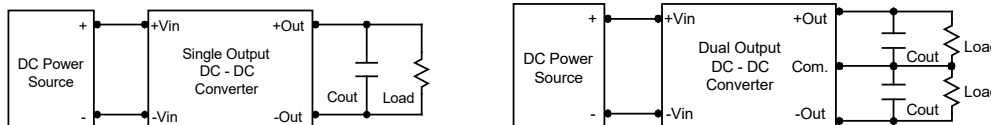
### Input Source Impedance

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 kHz) capacitor of a 10 $\mu$ F for the 12V input devices and a 4.7 $\mu$ F for the 24V input devices and a 2.2 $\mu$ F for the 48V 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 4.7 $\mu$ F capacitors at the output.



### Maximum Capacitive Load

The MIE10-HI 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 105°C. The derating curves are determined from measurements obtained in a test setup.

