

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 +96°C
- ▶ No Min. Load Requirement
- ▶ Under-Voltage, Overload/Voltage and Short Circuit Protection
- ▶ Conducted EMI EN 55032 Class A Approved
- ▶ UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval & CE Marking



PRODUCT OVERVIEW

The MINMAX MIE03-HI series is a range of high performance 3.5W 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 25 models available for input voltage of 5, 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 conduction EN 55032 Class A approved, low I/O capacitance 40pF max. and operating ambient temp. range by -40°C to 96°C by high efficiency up to 87%. MIE03-HI series conform to and UL/cUL/IEC/EN 62368-1(60950-1) safety approvals. The MIE03-HI series offer a superior solution for demanding applications 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.	@Max. Load			
			VDC	VDC	mA			mA(typ.)
MIE03-05S05HI	5 (4.5 ~ 9)	5	700	854	20	6.2	750	82
MIE03-05S058HI		5.8	600	849		6.2	560	82
MIE03-05S12HI		12	290	839		15	130	83
MIE03-05S15HI		15	235	839		18	100	84
MIE03-05S24HI		24	146	844	30	39	83	
MIE03-05D12HI		±12	±145	829	35	±15	75#	84
MIE03-05D15HI		±15	±115	821		±18	56#	84
MIE03-12S05HI	12 (9 ~ 18)	5	700	356	8	6.2	750	82
MIE03-12S12HI		12	290	337		15	130	86
MIE03-12S15HI		15	235	338		18	100	87
MIE03-12S24HI		24	146	340	30	39	86	
MIE03-12D12HI		±12	±145	333	13	±15	75#	87
MIE03-12D15HI		±15	±115	330		±18	56#	87
MIE03-24S05HI	24 (18 ~ 36)	5	700	178	6	6.2	750	82
MIE03-24S12HI		12	290	171		15	130	85
MIE03-24S15HI		15	235	169		18	100	87
MIE03-24S24HI		24	146	170	30	39	86	
MIE03-24D12HI		±12	±145	167	4	±15	75#	87
MIE03-24D15HI		±15	±115	167		±18	56#	86
MIE03-48S05HI	48 (36 ~ 75)	5	700	89	4	6.2	750	82
MIE03-48S12HI		12	290	85		15	130	85
MIE03-48S15HI		15	235	86		18	100	85
MIE03-48S24HI		24	146	88	30	39	83	
MIE03-48D12HI		±12	±145	86	4	±15	75#	84
MIE03-48D15HI		±15	±115	86		±18	56#	84

For each output

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Input Specifications							
Parameter	Conditions / Model	Min.	Typ.	Max.	Unit		
Input Surge Voltage (1 sec. max.)	5V Input Models	-0.7	---	15	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			
Under Voltage Shutdown	5V Input Models	---	4	---			
	12V Input Models	---	8	---			
	24V Input Models	---	16	---			
	48V Input Models	---	34	---			
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	---	±0.5	±2.0	%	
Line Regulation	Vin=Min. to Max. @Full Load	---	---	±0.5	%	
Load Regulation	Io=0% to 100%	---	---	±0.5	%	
Load Cross Regulation (Dual Output)	Asymmetrical Load 25%/100% Full Load	---	---	±5.0	%	
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20 MHz Bandwidth	Measured with a 1μF MLCC	---	---	70	mV _{P-P}
Transient Recovery Time	25% Load Step Change	---	300	---	μsec	
Transient Response Deviation		---	±3	±5	%	
Temperature Coefficient		---	±0.01	±0.02	%/ ^o C	
Over Load Protection		---	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	---	---	40	pF	
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)					

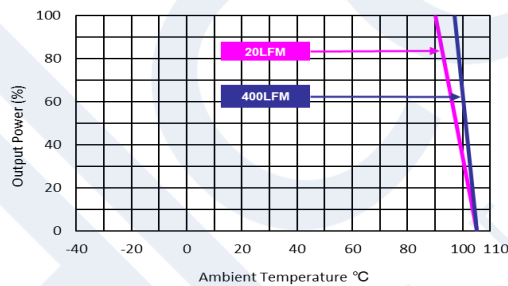
General Specifications						
Parameter	Conditions	Min.	Typ.	Max.	Unit	
Switching Frequency		---	330	---	kHz	
MTBF(calculated)	MIL-HDBK-217F@25°C, Ground Benign	5,815,448	---	---	Hours	

EMC Specifications

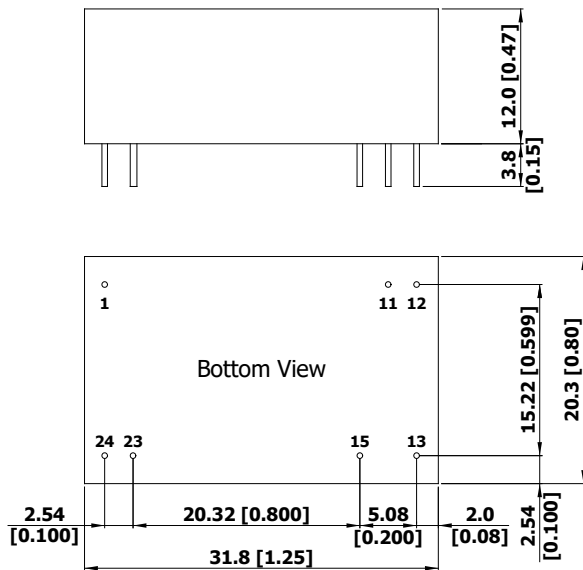
Parameter	Standards & Level		Performance	
EMI	Conduction	EN 55032	Without external components	
	Radiation		With external components	
EMS	EN 55024		Class A ⁽⁵⁾	
	ESD	Direct discharge		Indirect discharge HCP & VCP
		EN 61000-4-2 Air ± 15kV		Contact ± 6kV
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient ⁽⁶⁾	EN 61000-4-4 ±2kV		A
	Surge ⁽⁶⁾	EN 61000-4-5 ±2kV		A
	Conducted immunity	EN 61000-4-6 10Vrms		A
PFMF	EN 61000-4-8 100A/m		A	

Environmental Specifications

Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+96	°C
Case Temperature	---	+105	°C
Storage Temperature Range	-50	+125	°C
Humidity (non condensing)	---	95	% rel. H
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%.
- 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 MINMAX.
- To meet EN 55032 Class A with an external filter, please contact MINMAX.
- To meet EN 61000-4-4 & EN 61000-4-5 an external filter requested, please contact MINMAX.
- Specifications are subject to change without notice.

Package Specifications
Mechanical Dimensions

Pin Connections

Pin	Single Output	Dual Output	Diameter mm (inches)
1	+Vin	+Vin	Ø 0.6 [0.02]
11	No Pin	Common	Ø 0.6 [0.02]
12	-Vout	No Pin	Ø 0.6 [0.02]
13	+Vout	-Vout	Ø 0.6 [0.02]
15	No Pin	+Vout	Ø 0.6 [0.02]
23	-Vin	-Vin	Ø 0.6 [0.02]
24	-Vin	-Vin	Ø 0.6 [0.02]

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

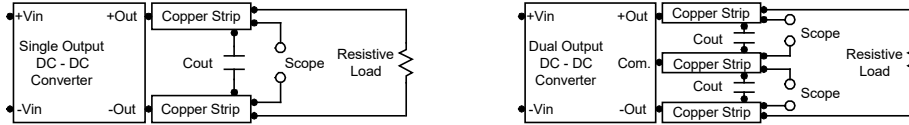
Physical Characteristics

Case Size	: 31.8x20.3x12.0mm (1.25x0.80x0.47 inches)
Case Material	: Plastic resin (flammability to UL 94V-0 rated)
Pin Material	: Copper Alloy
Weight	: 15.5g

Test Setup

Peak-to-Peak Output Noise Measurement Test

Refer to the output specifications or add 4.7 μ F capacitor if the output specifications undefine Cout. 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

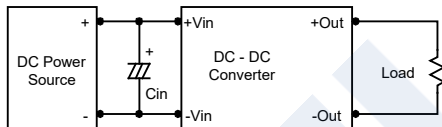
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

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.

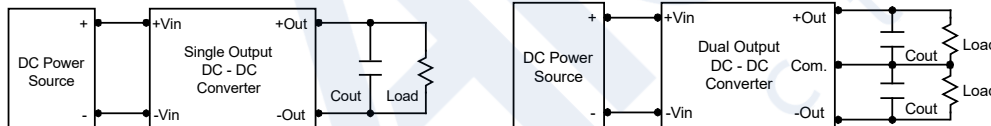
Input Source Impedance

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 Ω at 100 kHz) capacitor of a 22 μ F for the 5V input devices and a 10 μ F for the 12V input devices and a 4.7 μ F for the 24V input devices and a 2.2 μ 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 1 μ F capacitors at the output.



Maximum Capacitive Load

The MIE03-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 $^{\circ}$ C. The derating curves are determined from measurements obtained in a test setup.

