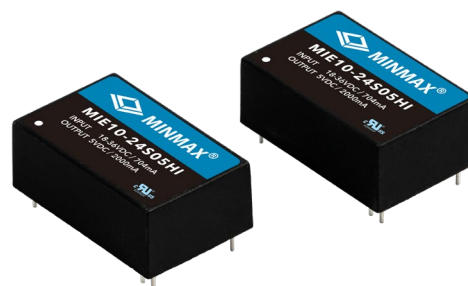


**FEATURES**

- ▶ 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


**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)<br>VDC | Output Voltage<br>VDC | Output Current<br>Max.<br>Ma | Input Current          |                      | Over Voltage Protection<br>VDC | Max. capacitive Load<br>µF | Efficiency (typ.)<br>@Max. Load<br>% |
|----------------|------------------------------|-----------------------|------------------------------|------------------------|----------------------|--------------------------------|----------------------------|--------------------------------------|
|                |                              |                       |                              | @Max. Load<br>mA(typ.) | @No Load<br>mA(typ.) |                                |                            |                                      |
|                |                              |                       |                              |                        |                      |                                |                            |                                      |
| MIE10-12S033HI | 12<br>(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<br>(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<br>(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 | ±0.02 | %/°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) |      |      |      |      |  |

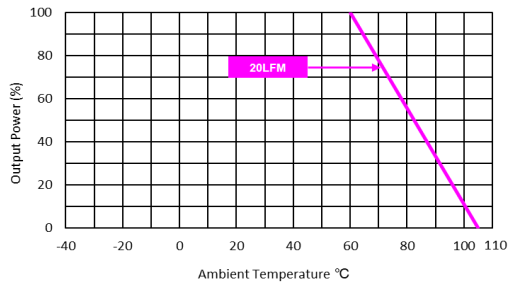
| General Specifications |                                   |           |      |      |       |  |
|------------------------|-----------------------------------|-----------|------|------|-------|--|
| Parameter              | Conditions                        | Min.      | Typ. | Max. | Unit  |  |
|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

**EMC Specifications**

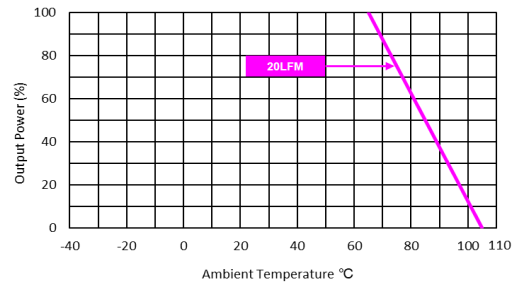
| Parameter          | Standards & Level                    |                         |                              | Performance |
|--------------------|--------------------------------------|-------------------------|------------------------------|-------------|
| EMI                | Conduction 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

**Environmental Specifications**

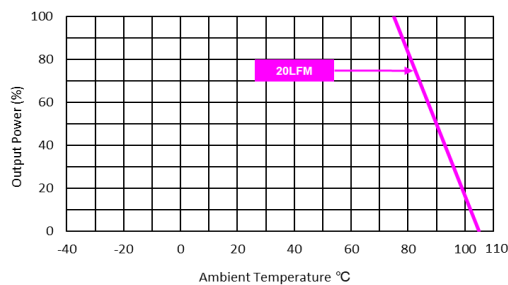
| Parameter  | Conditions   | Min. | Max. | Unit     |
|--|--|------|------|----------|
| Operating Ambient Temperature Range<br>Nominal Vin, Load 100% Inom.<br>(for Power Derating see relative Derating Curves) | MIE10-12S033HI, MIE10-12S05HI, MIE10-12S051HI, MIE10-24S033HI<br>MIE10-48S033HI  | -40  | +60  | °C       |
|  | MIE10-12S12HI, MIE10-24S05HI, MIE10-24S051HI, MIE10-48S05HI<br>MIE10-48S051HI  |      | +65  |          |
|  | MIE10-12S15HI, MIE10-12S24HI, MIE10-12D12HI, MIE10-12D15HI<br>MIE10-24S12HI, MIE10-24S15HI, MIE10-24S24HI, MIE10-24D12HI<br>MIE10-24D15HI, MIE10-48S12HI, MIE10-48S15HI, MIE10-48S24HI<br>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, MIE10-12S051HI  
MIE10-24S033HI, MIE10-48S033HI



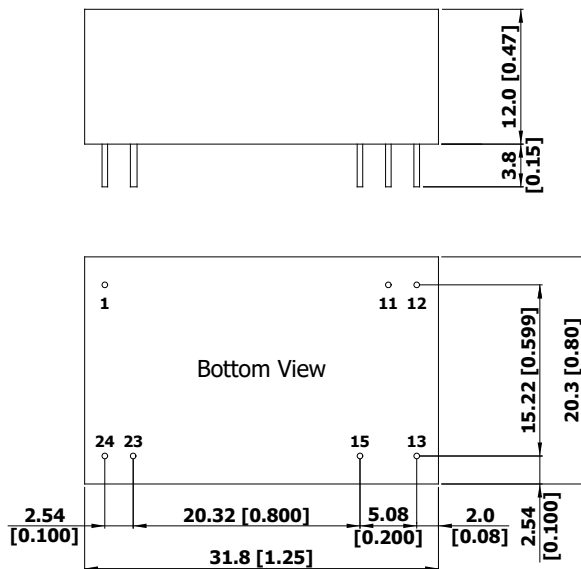
MIE10-12S12HI, MIE10-24S05HI, MIE10-24S051HI  
MIE10-48S05HI, MIE10-48S051HI



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 The external components might be required to meet EMS standard for some of test items. Please contact MINMAX for the solution in detail.
- 6 Specifications are subject to change without notice.
- 7 The repeated high voltage isolation testing of the converter can degrade isolation capability, to a lesser or greater degree depending on materials, construction, environment and reflow solder process. Any material is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage. Furthermore, the high voltage isolation capability after reflow solder process should be evaluated as it is applied on system.

**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)

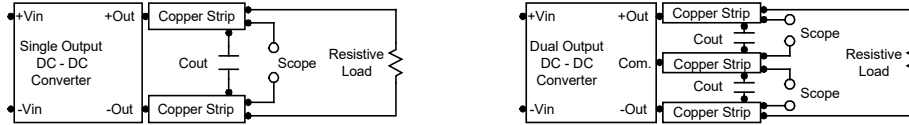
**Physical Characteristics**

|               |  |
|---------------|--|
| 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        | : 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 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

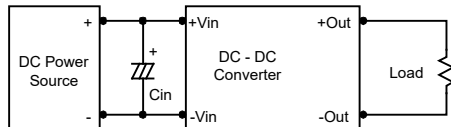
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

#### 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.

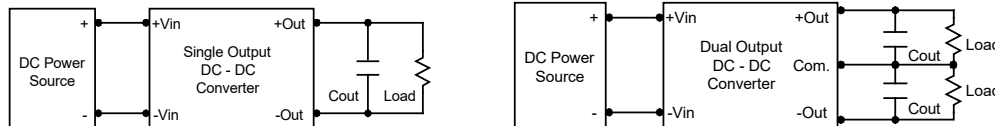
#### Input Source Impedance

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 $\Omega$  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.

