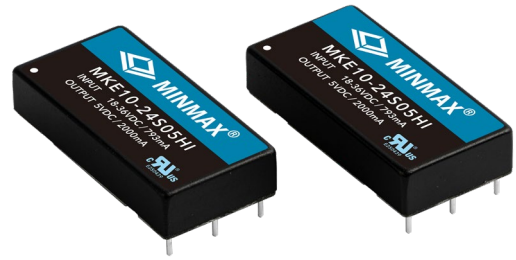


FEATURES

- ▶ Industrial Standard 2"x1" Package
- ▶ Wide 2:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ Ultra-high I/O Isolation 8000VDC with Reinforced Insulation, rate for 1000Vrms Working Voltage
- ▶ Operating Ambient Temp. Range -40°C to +75°C
- ▶ No Min. Load Requirement
- ▶ Overload and Short Circuit Protection
- ▶ EMI Emission EN 55032 Class A Approved
- ▶ UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval & CE Marking


PRODUCT OVERVIEW

The MINMAX MKE10-HI series is a range of high performance 10W DC-DC converter within encapsulated 2"x1" package which specifically design for high isolation applications where reinforced insulation and high working voltage are required. There are 15 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 8000VDC with reinforced insulation, which rated for 1000Vrms working voltage. Further features include overload and short circuit protection, no min. load requirement, EMI emission EN 55032 Class A approved, low I/O capacitance 80pF max. and operating ambient temp. range by -40°C to 75°C by high efficiency up to 82%. MKE10-HI series conform to UL/cUL/IEC/EN 62368-1 (60950-1) safety approvals. The MKE10-HI series offer a superior solution for demanding application in requesting a certified supplementary.

Model Selection Guide

| Model Number | Input Voltage (Range) | Output Voltage | Output Current | Input Current | | Reflected Ripple Current | Max. capacitive Load | Efficiency (typ.) |
|----------------|-----------------------|----------------|----------------|------------------------|-----------------------|--------------------------|----------------------|-------------------|
| | | | | Max. | @No Load | | | |
| | VDC | VDC | mA | @Max. Load mA(typ.) | @No Load mA (typ.) | mA(typ.) | μF | @Max. Load % |
| MKE10-12S05HI | 12 (9 ~ 18) | 5 | 1600 | 889 | 30 | 100 | 1000 | 75 |
| MKE10-12S051HI | | 5.1 | 1600 | 919 | | | | 74 |
| MKE10-12S12HI | | 12 | 835 | 1057 | | | | 79 |
| MKE10-12D12HI | | ±12 | ±417 | 1042 | | | | 80 |
| MKE10-12D15HI | | ±15 | ±333 | 1028 | | | | 81 |
| MKE10-24S05HI | 24 (18 ~ 36) | 5 | 2000 | 548 | 20 | 50 | 1000 | 76 |
| MKE10-24S051HI | | 5.1 | 2000 | 567 | | | | 75 |
| MKE10-24S12HI | | 12 | 835 | 522 | | | | 80 |
| MKE10-24D12HI | | ±12 | ±417 | 516 | | | | 81 |
| MKE10-24D15HI | | ±15 | ±333 | 508 | | | | 82 |
| MKE10-48S05HI | 48 (36 ~ 75) | 5 | 2000 | 274 | 10 | 25 | 1000 | 76 |
| MKE10-48S051HI | | 5.1 | 2000 | 283 | | | | 75 |
| MKE10-48S12HI | | 12 | 835 | 261 | | | | 80 |
| MKE10-48D12HI | | ±12 | ±417 | 258 | | | | 81 |
| MKE10-48D15HI | | ±15 | ±333 | 254 | | | | 82 |

For each output

| Input Specifications | | | | | |
|-----------------------------------|------------------|------------------|------|------|------|
| Parameter | 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 | 7 | 8 | 9 | |
| | 24V Input Models | 13 | 15 | 18 | |
| | 48V Input Models | 30 | 33 | 36 | |
| Under Voltage Shutdown | 12V Input Models | --- | --- | 8.5 | |
| | 24V Input Models | --- | --- | 16 | |
| | 48V Input Models | --- | --- | 34 | |
| Short Circuit Input Power | All Models | --- | --- | 3000 | mW |
| Input Filter | | 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 | --- | ±0.3 | ±0.5 | % | |
| Load Regulation | Io=15% to 100% | --- | ±0.5 | ±1.0 | % | |
| | Io=5% to 100% | --- | ±0.6 | ±1.2 | % | |
| Ripple & Noise | 0-20 MHz Bandwidth | 5V & 5.1V Output Models | --- | --- | 100 | mV _{P-P} |
| | | Other Output Models | --- | --- | 150 | mV _{P-P} |
| Minimum Load | No minimum Load Requirement | | | | | |
| Over Load Protection | | 120 | 150 | --- | % | |
| Transient Recovery Time | 25% Load Step Change | --- | 300 | 600 | μsec | |
| Transient Response Deviation | | --- | ±3 | ±5 | % | |
| Temperature Coefficient | | --- | ±0.02 | ±0.05 | %/°C | |
| Short Circuit Protection | Continuous, Automatic Recovery | | | | | |

| Isolation, Safety Standards | | | | | |
|-----------------------------|---|------|------|------|------|
| Parameter | Conditions | Min. | Typ. | Max. | Unit |
| I/O Isolation Voltage | 60 Seconds | 4200 | --- | --- | VAC |
| | Reinforced insulation, rated for 1000Vrms working voltage | | | | |
| | Tested for 1 second | | | | VDC |
| I/O Isolation Resistance | 500 VDC | 10 | --- | --- | GΩ |
| I/O Isolation Capacitance | 100kHz, 1V | --- | 60 | 80 | 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) | | | | |

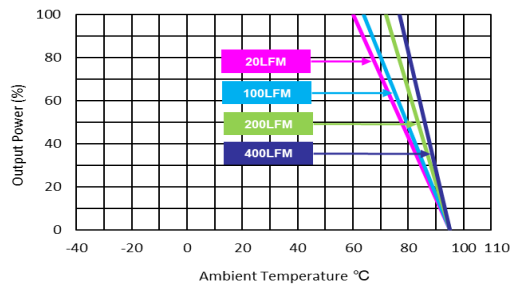
| General Specifications | | | | | |
|------------------------|-----------------------------------|-----------|------|------|-------|
| Parameter | Conditions | Min. | Typ. | Max. | Unit |
| Switching Frequency | | 120 | 150 | 180 | kHz |
| MTBF(calculated) | MIL-HDBK-217F@25°C, Ground Benign | 1,000,000 | | | Hours |

EMC Specifications

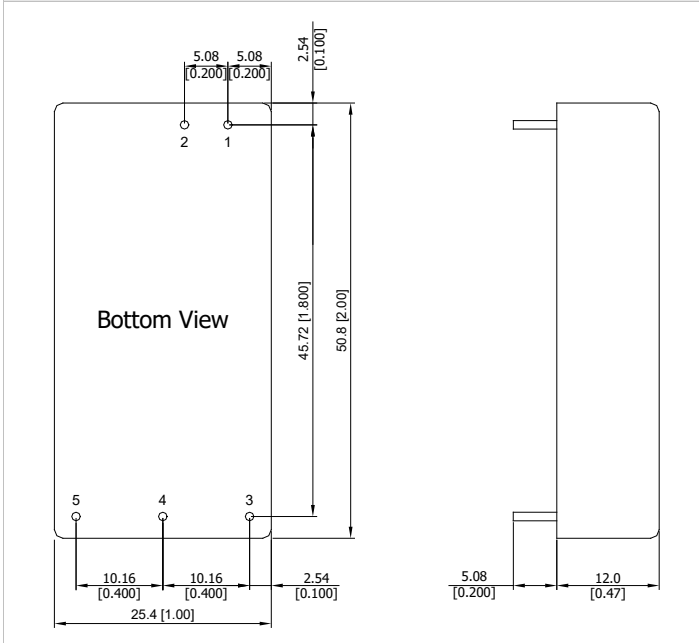
| Parameter | Standards & Level | | Performance |
|--------------------|---------------------|-------------------------|---|
| EMI | Conduction | EN 55032 | Without external components |
| | Radiation | | |
| EMS ₍₅₎ | EN 55024 | | |
| | ESD | Direct discharge | Indirect discharge HCP & VCP Contact ± 8kV |
| | | 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 ±1kV | |
| | Conducted immunity | EN 61000-4-6 10Vrms | |
| PFMF | EN 61000-4-8 100A/m | | |

Environmental Specifications

| Parameter | Min. | Max. | Unit |
|--|------|------|----------|
| Operating Ambient Temperature Range (See Power Derating Curve) | -40 | +75 | °C |
| Case Temperature | --- | +95 | °C |
| Storage Temperature Range | -50 | +125 | °C |
| Humidity (non condensing) | --- | 95 | % rel. H |
| Altitude | --- | 4000 | m |
| 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.
- The external components might be required to meet EMS standard for some of test items. Please contact MINMAX for the solution in detail.
- Specifications are subject to change without notice.

Package Specifications
Mechanical Dimensions

Pin Connections

| Pin | Single Output | Dual Output | Diameter mm (inches) |
|-----|---------------|-------------|-------------------------|
| 1 | +Vin | +Vin | ∅ 1.0 [0.04] |
| 2 | -Vin | -Vin | ∅ 1.0 [0.04] |
| 3 | +Vout | +Vout | ∅ 1.0 [0.04] |
| 4 | No Pin | Common | ∅ 1.0 [0.04] |
| 5 | -Vout | -Vout | ∅ 1.0 [0.04] |

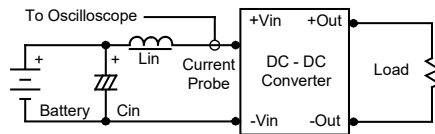
- ▶ All dimensions in mm (inches)
- ▶ Tolerance: X.X±0.5 (X.XX±0.02)
X.XX±0.25 (X.XXX±0.01)
- ▶ Pin diameter tolerance: X.X±0.05 (X.XX±0.002)

Physical Characteristics

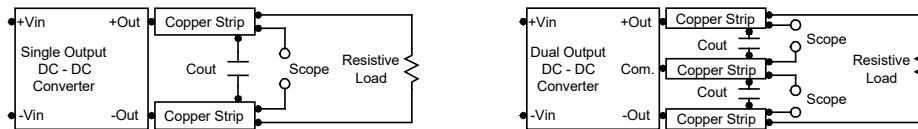
| | |
|---------------|--|
| Case Size | : 50.8x25.4x12.0mm (2.0x1.0x0.47 inches) |
| Case Material | : Plastic resin (flammability to UL 94V-0 rated) |
| Pin Material | : Copper Alloy |
| Weight | : 24.5g |

Test Setup
Input Reflected-Ripple Current Test Setup

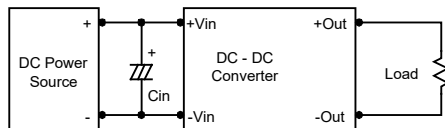
Input reflected-ripple current is measured with an inductor L_{in} (4.7 μ H) and C_{in} (220 μ F, ESR < 1.0 Ω at 100 kHz) to simulate source impedance. Capacitor C_{in} offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 kHz.


Peak-to-Peak Output Noise Measurement Test

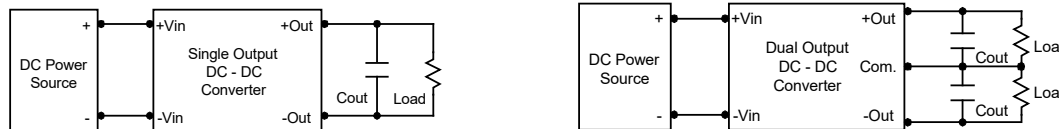
Refer to the output specifications or add 4.7 μ F capacitor if the output specifications undefine C_{out} . Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.


Technical Notes
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 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 3.3 μ F capacitors at the output.


Maximum Capacitive Load

The MKE10-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 95 $^{\circ}$ C. The derating curves are determined from measurements obtained in a test setup.

