

**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, rated for 1000Vrms Working Voltage
- ▶ Common Mode Transient Immunity: 15kV/μS
- ▶ Qualified for IGBT and High Isolation Applications
- ▶ Operating Ambient Temp. Range -40°C to +85°C
- ▶ No Min. Load Requirement
- ▶ Under-voltage, Overload/Voltage and Short Circuit Protection
- ▶ EMI Emission EN 55032 Class A & FCC Level A Approved
- ▶ UL/cUL/IEC/EN 62368-1 (60950-1) Safety Approval & CE Marking


**PRODUCT OVERVIEW**

The MINMAX MKE15-HI series is a new range of high performance 15W 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 21 models available for input voltage of 12, 24, 48VDC with wide 2:1 input range and tight output voltage. The I/O isolation is specified for 8000VDC with reinforced insulation, which rated for 1000Vrms working voltage. Further features include under-voltage, overload, 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 85°C by high efficiency up to 90%. MKE15-HI series conform to common mode transient immunity testing by 15kV/μS and UL/cUL/IEC/EN 62368-1 (60950-1) safety approvals.

The MKE15-HI series offer a superior solution for demanding application in requesting a certified supplementary and high I/O isolation with reinforced insulation system to comply with 1000Vrms working voltage.

**Model Selection Guide**

Model Number	Input Voltage (Range) VDC	Output Voltage VDC	Output Current		Input Current		Reflected Ripple Current mA(typ.)	Over Voltage Protection VDC	Max. capacitive Load μF	Efficiency (typ.) %
			Max. mA	@Max. Load mA(typ.)	@No Load mA (typ.)					
MKE15-12S05HI	12 (9 ~ 18)	5	3000	1471	20	100	6.2	5100	85	
MKE15-12S051HI		5.1	3000	1500						85
MKE15-12S12HI		12	1250	1420						88
MKE15-12S15HI		15	1000	1420						88
MKE15-12S24HI		24	625	1420						88
MKE15-12D12HI		±12	±625	1420						88
MKE15-12D15HI		±15	±500	1404						89
MKE15-24S05HI	24 (18 ~ 36)	5	3000	718	15	50	6.2	5100	87	
MKE15-24S051HI		5.1	3000	733						87
MKE15-24S12HI		12	1250	710						88
MKE15-24S15HI		15	1000	702						89
MKE15-24S24HI		24	625	694						90
MKE15-24D12HI		±12	±625	694						90
MKE15-24D15HI		±15	±500	702						89
MKE15-48S05HI	48 (36 ~ 75)	5	3000	359	10	30	6.2	5100	87	
MKE15-48S051HI		5.1	3000	366						87
MKE15-48S12HI		12	1250	359						87
MKE15-48S15HI		15	1000	347						90
MKE15-48S24HI		24	625	351						89
MKE15-48D12HI		±12	±625	351						89
MKE15-48D15HI		±15	±500	355						88

# For each output

Input Specifications							
Parameter	Conditions / Model	Min.	Typ.	Max.	Unit		
Input Surge Voltage (100 ms 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	---	7.5	---			
	24V Input Models	---	15	---			
	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 / Model	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	%
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20 MHz Bandwidth	5V & 5.1Vo	---	50	---	mV <sub>P-P</sub>
		12V,15V, ±12V, ±15Vo	---	100	---	mV <sub>P-P</sub>
		24Vo	---	150	---	mV <sub>P-P</sub>
Transient Recovery Time	25% Load Step Change <sub>(2)</sub>	---	---	300	µsec	
Transient Response Deviation		---	±3	±5	%	
Temperature Coefficient		---	---	±0.02	%/°C	
Over Load Protection	Hiccup	---	150	---	%	
Short Circuit Protection	Continuous, Automatic Recovery (Hiccup Mode 0.7Hz typ.)					

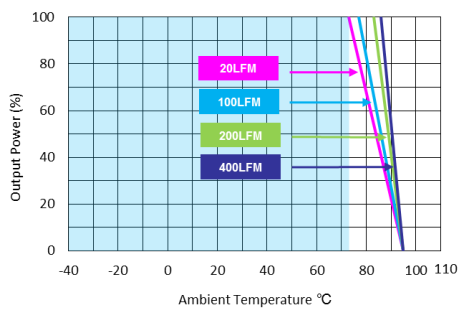
Isolation, Safety Standards						
Parameter	Conditions	Min.	Typ.	Max.	Unit	
I/O Isolation Voltage	60 Seconds	4200	---	---	VACrms	
	Reinforced insulation, rated for 1000Vrms working voltage Tested for 1 second	8000	---	---	VDC	
I/O Isolation Resistance	500 VDC	10	---	---	GΩ	
I/O Isolation Capacitance	100kHz, 1V	---	---	80	pF	
Common Mode Transient Immunity		15	---	---	kV/µs	
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		---	285	---	kHz	
MTBF(calculated)	MIL-HDBK-217F@25°C, Ground Benign	1,428,181	---	---	Hours	

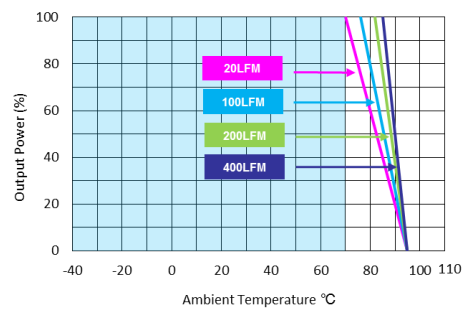
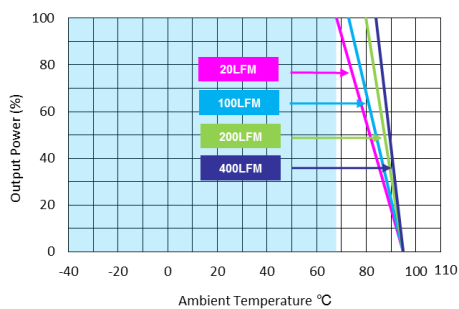
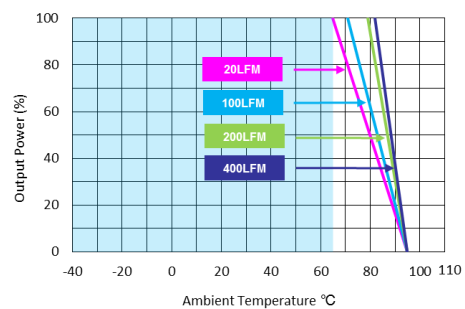
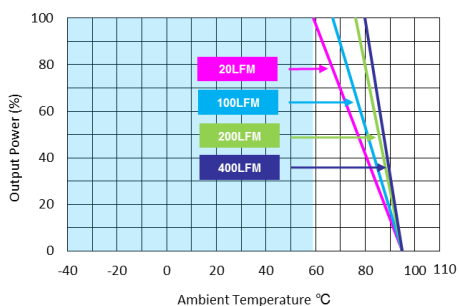
Environmental Specifications						
Parameter	Conditions / Model	Min.	Max.	Unit		
Operating Ambient Temperature Range Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MKE15-24S24HI, MKE15-24D12HI, MKE15-48S15HI	-40	73	°C		
	MKE15-12D15HI, MKE15-24S15HI, MKE15-24D15HI		70			
	MKE15-48S24HI, MKE15-48D12HI		68			
	MKE15-12S12HI, MKE15-12S15HI, MKE15-12S24HI		65			
	MKE15-12D12HI, MKE15-24S12HI, MKE15-48D15HI		59			
	MKE15-24S05HI, MKE15-24S051HI, MKE15-48S05HI					
	MKE15-48S051HI, MKE15-48S12HI					
	MKE15-12S05HI, MKE15-12S051HI					
Thermal Impedance		13	---	°C/W		
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		

**EMC Specifications**

Parameter	Standards & Level		Performance	
EMI	Conduction & Radiation	EN 55032, FCC part 15	Class A	
EMS	EN 55024			
	ESD	Direct discharge	Indirect discharge HCP & VCP Contact ± 8kV	A
		EN 61000-4-2 Air ± 15kV		
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient (s)	EN 61000-4-4 ±2kV		A
	Surge (s)	EN 61000-4-5 ±1kV		A
	Conducted immunity	EN 61000-4-6 10Vrms		A
PFMF	EN 61000-4-8 100A/m		A	

**Power Derating Curve**


MKE15-24S24HI, MKE15-24D12HI, MKE15-48S15HI

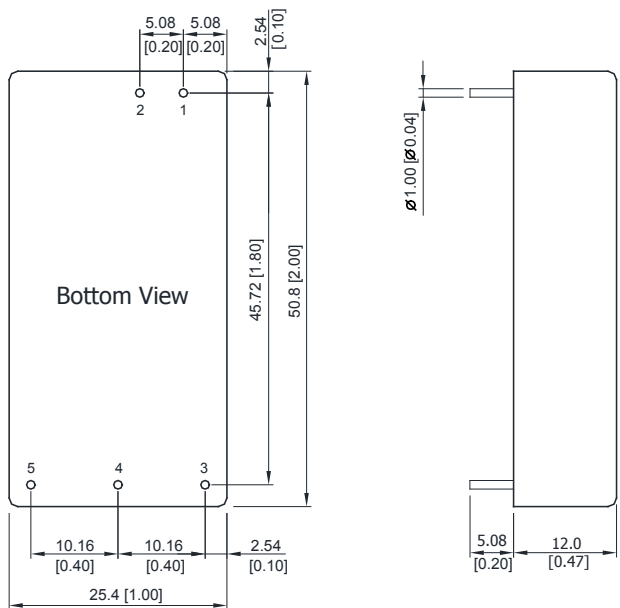

 MKE15-12D15HI, MKE15-24S15HI, MKE15-24D15HI  
 MKE15-48S24HI, MKE15-48D12HI

 MKE15-12S12HI, MKE15-12S15HI, MKE15-12S24HI  
 MKE15-12D12HI, MKE15-24S12HI, MKE15-48D15HI

 MKE15-24S05HI, MKE15-24S051HI, MKE15-48S05HI  
 MKE15-48S051HI, MKE15-48S12HI


MKE15-12S05HI, MKE15-12S051HI

**Notes**

- 1 Specifications typical at  $T_a = +25^\circ\text{C}$ , 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 factory.
- 5 To meet EN 61000-4-4 & EN 61000-4-5 an external filter requested, please contact MINMAX.
- 6 Specifications are subject to change without notice.

E-mail:sales@minmax.com.tw Tel:886-6-2923150

Package Specifications																			
<p><b>Mechanical Dimensions</b></p>  <p>The drawing shows a rectangular package with a bottom view and a side view. The bottom view shows a width of 25.4 mm (1.00 inches) and a height of 50.8 mm (2.00 inches). The distance between the two output pins (3 and 4) is 25.4 mm (1.00 inches). The distance between the two input pins (1 and 2) is 10.16 mm (0.40 inches). The distance between the input pins and the output pins is 10.16 mm (0.40 inches). The distance from the input pins to the right edge is 5.08 mm (0.20 inches). The distance from the output pins to the right edge is 2.54 mm (0.10 inches). The side view shows a height of 45.72 mm (1.80 inches) and a diameter of 1.00 mm (0.04 inches).</p>	<p><b>Pin Connections</b></p> <table border="1"> <thead> <tr> <th>Pin</th> <th>Single Output</th> <th>Dual Output</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>+Vin</td> <td>+Vin</td> </tr> <tr> <td>2</td> <td>-Vin</td> <td>-Vin</td> </tr> <tr> <td>3</td> <td>+Vout</td> <td>+Vout</td> </tr> <tr> <td>4</td> <td>No Pin</td> <td>Common</td> </tr> <tr> <td>5</td> <td>-Vout</td> <td>-Vout</td> </tr> </tbody> </table> <p>                     ▶ All dimensions in mm (inches)                      ▶ Tolerance: X.X±0.5 (X.XX±0.02)                                        X.XX±0.25 (X.XXX±0.01)                      ▶ Pin diameter <math>\varnothing 1.0 \pm 0.05</math> (0.04±0.002)                 </p>	Pin	Single Output	Dual Output	1	+Vin	+Vin	2	-Vin	-Vin	3	+Vout	+Vout	4	No Pin	Common	5	-Vout	-Vout
Pin	Single Output	Dual Output																	
1	+Vin	+Vin																	
2	-Vin	-Vin																	
3	+Vout	+Vout																	
4	No Pin	Common																	
5	-Vout	-Vout																	

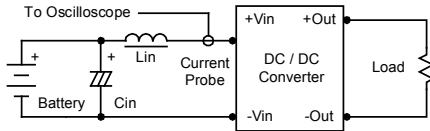
### Physical Characteristics

Case Size	: 50.8x25.4x12.0mm (2.0x1.0x0.47 inches)
Case Material	: Non-Conductive Black Plastic (flammability to UL 94V-0 rated)
Pin Material	: Tinned Copper
Weight	: 30g

### Test Setup

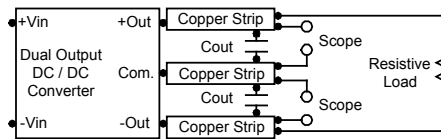
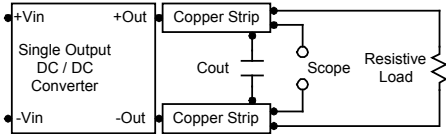
#### Input Reflected-Ripple Current Test Setup

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 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

Use a  $C_{out}$  4.7 $\mu$ F ceramic capacitor. 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

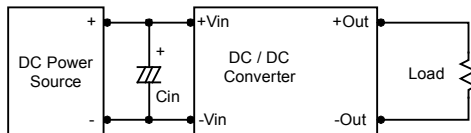
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

#### 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.

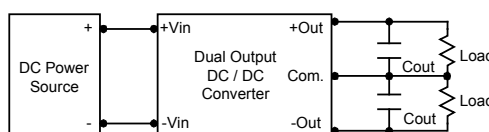
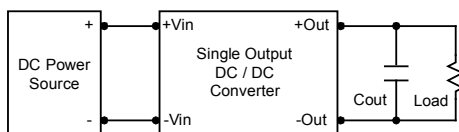
#### Input Source Impedance

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 MKE15-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°C. The derating curves are determined from measurements obtained in a test setup.

