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℃ to +80℃**
- **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 MKE20-HI series is a new range of high performance 20W 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℃ to 80℃ by high efficiency up to 90%. MKE20-HI series conform to common mode transient immunity testing by 15KV/μS and UL/cUL/IEC/EN 62368-1 (60950-1) safety approvals.

The MKE20-HI series offer a economical 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)	Output Voltage	Output Current	Input Current		Reflected Ripple Current	Over Voltage Protection	Max. capacitive Load	Efficiency (typ.)
			Max.	@Max. Load	@No Load				@Max. Load
	VDC	VDC	mA	mA(typ.)	mA (typ.)	mA(typ.)	VDC	μF	%
MKE20-12S05HI	12 (9 ~ 18)	5	4000	1961	20	100	6.2	6800	85
MKE20-12S051HI		5.1	4000	2000			6.2		85
MKE20-12S12HI		12	1670	1898			15	1160	88
MKE20-12S15HI		15	1333	1893			18	750	88
MKE20-12S24HI		24	840	1888			27	295	89
MKE20-12D12HI		±12	±840	1888			±15	590#	89
MKE20-12D15HI		±15	±670	1882			±18	380#	89
MKE20-24S05HI	24 (18 ~ 36)	5	4000	958	15	50	6.2	6800	87
MKE20-24S051HI		5.1	4000	977			6.2		87
MKE20-24S12HI		12	1670	949			15	1160	88
MKE20-24S15HI		15	1333	936			18	750	89
MKE20-24S24HI		24	840	933			27	295	90
MKE20-24D12HI		±12	±840	933			±15	590#	90
MKE20-24D15HI		±15	±670	931			±18	380#	90
MKE20-48S05HI	48 (36 ~ 75)	5	4000	479	10	30	6.2	6800	87
MKE20-48S051HI		5.1	4000	489			6.2		87
MKE20-48S12HI		12	1670	474			15	1160	88
MKE20-48S15HI		15	1333	463			18	750	90
MKE20-48S24HI		24	840	472			27	295	89
MKE20-48D12HI		±12	±840	472			±15	590#	89
MKE20-48D15HI		±15	±670	465			±18	380#	90

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	Measured with a MLCC : 4.7μF	---	50	---	mV P-P
		12V,15V, ±12V, ±15Vo		---	100	---	mV P-P
		24Vo		---	150	---	mV P-P
Transient Recovery Time	25% Load Step Change(2)			---	---	300	μsec
Transient Response Deviation				---	±3	±5	%
Temperature Coefficient				---	---	±0.02	%/°C
Over Load Protection	Hiccup			---	150	---	%
Short Circuit Protection	Hiccup Mode 0.7Hz typ., Automatic Recovery						

Isolation, Safety Standards

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds Reinforced insulation, rated for 1000Vrms working voltage	4200	---	---	VACrms
	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	1,087,344	---	---	Hours

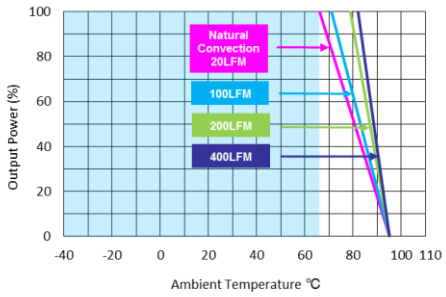
Environmental Specifications

Parameter	Conditions / Model	Min.	Max.	Unit
Operating Ambient Temperature Range Natural Convection (6) Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MKE20-24S24HI, MKE20-24D12HI, MKE20-24D15HI MKE20-48S15HI, MKE20-48D15HI	-40	66	°C
	MKE20-12S24HI, MKE20-12D12HI, MKE20-12D15HI MKE20-24S15HI, MKE20-48S24HI, MKE20-48D12HI		62	
	MKE20-12S12HI, MKE20-12S15HI, MKE20-24S12HI MKE20-48S12HI		59	
	MKE20-24S05HI, MKE20-24S051HI, MKE20-48S05HI MKE20-48S051HI		55	
	MKE20-12S05HI, MKE20-12S051HI		48	
Thermal Impedance	Natural Convection	13.0	---	°C/W
Case Temperature		---	+95	°C
Storage Temperature Range		-50	+125	°C
Humidity (non condensing)		---	95	% rel. H
Altitude		---	4000	m
Cooling	Natural Convection			
Lead Temperature (1.5mm from case for 10Sec.)		---	260	°C

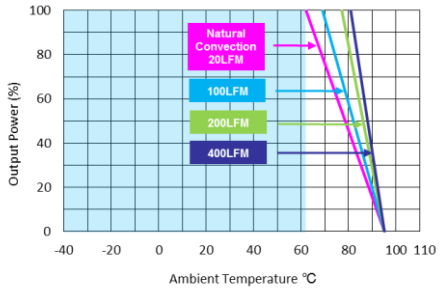
EMC Specifications

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

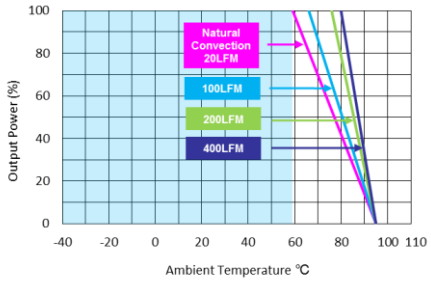
Power Derating Curve



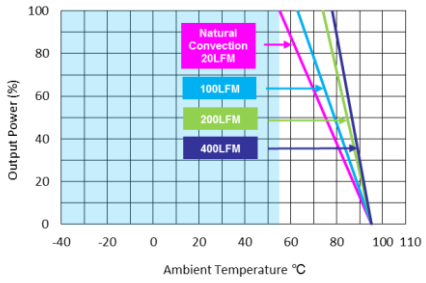
MKE20-24S24HI, MKE20-24D12HI, MKE20-24D15HI
MKE20-48S15HI, MKE20-48D15HI



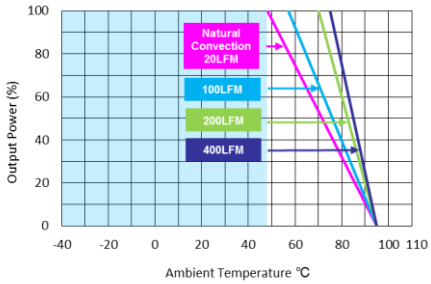
MKE20-12S24HI, MKE20-12D12HI, MKE20-12D15HI
MKE20-24S15HI, MKE20-48S24HI, MKE20-48D12HI



MKE20-12S12HI, MKE20-12S15HI, MKE20-24S12HI
MKE20-48S12HI



MKE20-24S05HI, MKE20-24S051HI, MKE20-48S05HI
MKE20-48S051HI



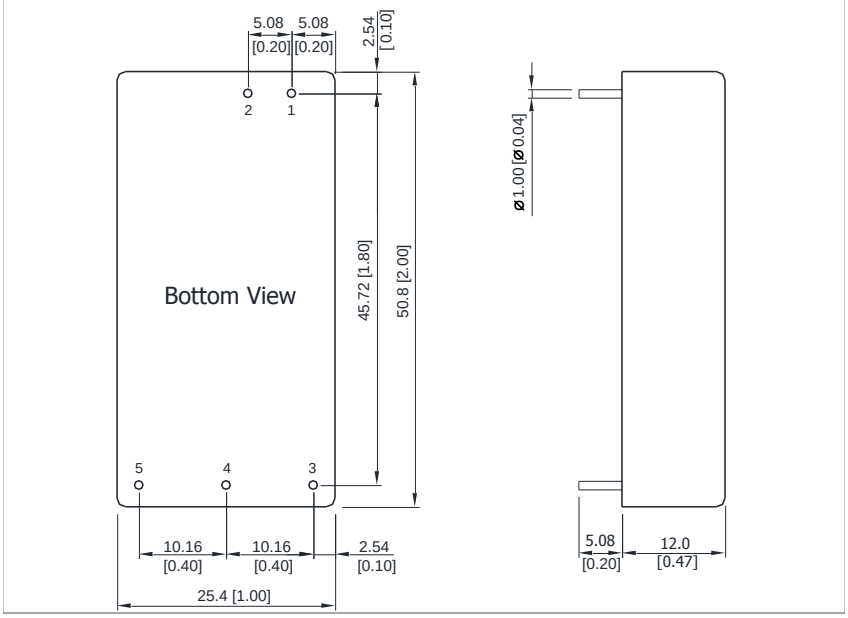
MKE20-12S05HI, MKE20-12S051HI

Notes

1 Specifications typical at Ta=+25℃, 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 capacitor across the input pins is required..
Suggested capacitor: 12XXX & 24XXX: CHEMI-CON KY Series 560μF/50V // Diode: V15P8-M3
48XXX: CHEMI-CON KY Series 560μF/100V // Diode: V15P10
6 That "natural convection" is about 20LFM but is not equal to still air (0 LFM).
7 Specifications are subject to change without notice.

Package Specifications

Mechanical Dimensions



Pin Connections

Pin	Single Output	Dual Output
1	+Vin	+Vin
2	-Vin	-Vin
3	+Vout	+Vout
4	No Pin	Common
5	-Vout	-Vout

- All dimensions in mm (inches)
- Tolerance: X.X±0.5 (X.XX±0.02)
  X.XX±0.25 (X.XXX±0.01)
- Pin diameter ∅ 1.0 ±0.05 (0.04±0.002)

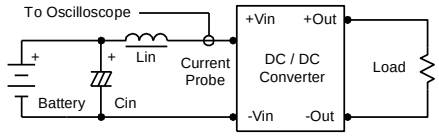
Physical Characteristics

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

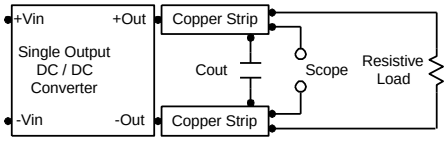
Input Reflected-Ripple Current Test Setup

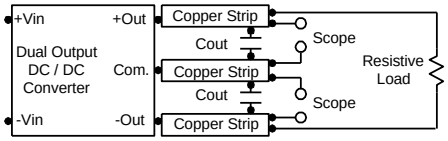
Input reflected-ripple current is measured with a inductor Lin (4.7μH) and Cin (220μF, ESR < 1.0Ω at 100 KHz) to simulate source impedance. Capacitor Cin, offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 KHz.



Peak-to-Peak Output Noise Measurement Test

Use a Cout 4.7μF 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

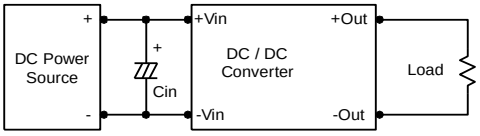
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

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.

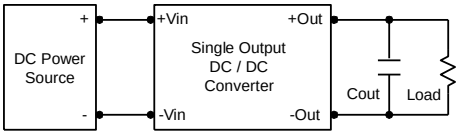
Input Source Impedance

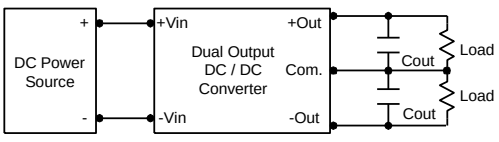
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor on the input to insure startup. By using a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 10μF for the 12V input devices and a 4.7μF for the 24V input devices and a 2.2μF 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 4.7μF capacitors at the output.





Maximum Capacitive Load

The MKE20-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.