FEATURES

- Industrial Standard 2" X 1" Package
- Wide 2:1 Input Voltage Range
- Fully Regulated Output Voltage
- High Efficiency up to 88%
- I/O Isolation 1500 VDC
- Operating Ambient Temp. Range -40℃ to +85℃
- Overload and Short Circuit Protection
- Remote On/Off Control(option), Output Voltage Trim
- Shielded Metal Case with Insulated Baseplate
- Designed-in Conducted EMI meets EN55022 Class A & FCC Level A
- UL/cUL/IEC/EN 60950-1 Safety Approval



CSA 60950-1 CB Scheme

PRODUCT OVERVIEW

The MINMAX MKW5000 series is a range of isolated 30W DC/DC converter modules featuring fully regulated output voltages and wide 2:1 input voltage ranges. The product comes in a 2"x 1"x 0.4" metal package with industry standard pinout. An excellent efficiency allows an operating temperature range of –40°C to +85°C.

These DC/DC converters offer an economical solution for many cost critical applications in battery-powered equipment and instrumentation.

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current		Input Current		Reflected Ripple Current	Max. capacitive Load	Efficiency (typ.)
			Max.	Min.	@Max. Load	@No Load			@Max. Load
	VDC	VDC	mA	mA	mA(typ.)	mA(typ.)	mA(typ.)	μF	%
MKW5030	24 (18 ~ 36)	2.5	6000	0	744	70	100	6800	84
MKW5031		3.3	6000	0	959				86
MKW5032		5	5000	0	1185				88
MKW5039		5.1	5000	0	1207				88
MKW5033		12	2500	166	1420			680	88
MKW5034		15	2000	133	1420				88
MKW5040	48 (36 ~ 75)	2.5	6000	0	372	50	50	6800	84
MKW5041		3.3	6000	0	480				86
MKW5042		5	5000	0	604				88
MKW5049		5.1	5000	0	604				88
MKW5043		12	2500	166	710			680	88
MKW5044		15	2000	133	710				88

Input Specifications

Parameter	Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (1 sec. max.)	24V Input Models	-0.7	---	50	VDC
	48V Input Models	-0.7	---	100	
Start-Up Threshold Voltage	24V Input Models	17	17.8	18	
	48V Input Models	34	35	36	
Under Voltage Shutdown	24V Input Models	16	16.5	17	
	48V Input Models	32	33	34	
Short Circuit Input Power	All Models	---	---	4500	mW
Input Filter		Internal LC Type			
Conducted EMI (with suffix A only)		Compliance to EN 55022,class A and FCC part 15,class A			

Remote On/Off Control

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	2.5 to 100VDC or Open Circuit				
Converter Off	-1V ~ 1V or Short Circuit				
Control Input Current (on)	Vctrl = 5.0V	---	---	5	μA
Control Input Current (off)	Vctrl = 0V	---	---	-100	μA
Control Common	Referenced to Negative Input				
Standby Input Current	Nominal Vin	---	2	5	mA

Output Specifications

Parameter	Conditions		Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy			---	---	±1.0	%Vnom.
Line Regulation	Vin=Min. to Max. @Full Load		---	±0.1	±0.3	%
Load Regulation	Io=0% to 100%	2.5, 3.3, 5/5.1Vout Models	---	±0.5	±1.0	%
	Io=10% to 100%	12,15Vout Models	---	±0.5	±1.0	%
Ripple & Noise	0-20 MHz Bandwidth		---	75	100	mV_{P-P}
Transient Recovery Time	25% Load Step Change		---	200	500	μsec
Transient Response Deviation			---	±2	±4	%
Temperature Coefficient			---	±0.01	±0.02	%/℃
Trim Up / Down Range	% of Nominal Output Voltage		---	---	±10	%
Over Load Protection	Foldback		110	155	---	%
Short Circuit Protection	Continuous, Automatic Recovery					

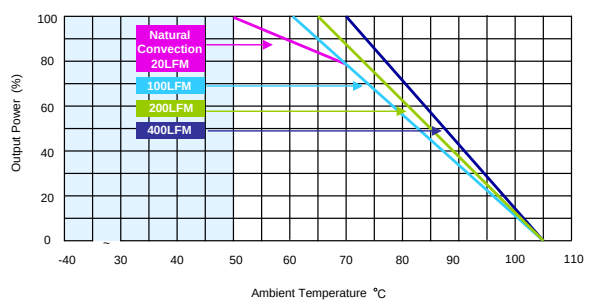
General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	1500	---	---	VDC
	1 Second	1800	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100KHz, 1V	---	1200	1500	pF
Switching Frequency		280	350	400	KHz
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	600,000			Hours
Safety Approvals	UL/cUL 60950-1 recognition (CSA certificate), IEC/EN 60950-1(CB-report)				

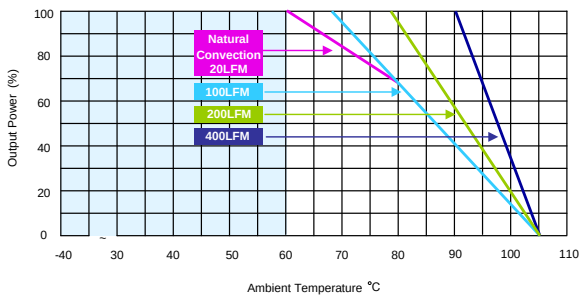
Environmental Specifications

Parameter	Conditions	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	Natural Convection	-40	+85	℃
Case Temperature		---	+105	℃
Storage Temperature Range		-50	+125	℃
Humidity (non condensing)		---	95	% rel. H
Cooling	Natural Convection			
Lead Temperature (1.5mm from case for 10Sec.)		---	260	℃

Power Derating Curve



Derating Curve without Heatsink



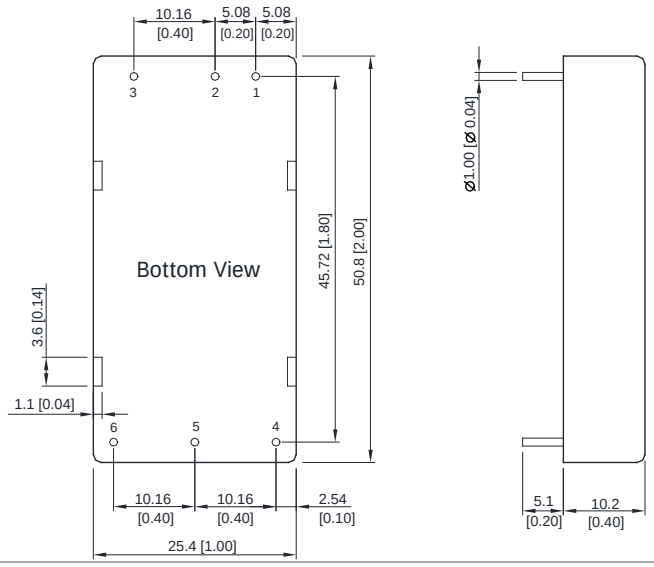
Derating Curve with Heatsink

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 These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however they may not meet all specifications listed.
4 We recommend to protect the converter by a slow blow fuse in the input supply line.
5 Other input and output voltage may be available, please contact factory.
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	Function
1	+Vin
2	-Vin
3	Remote On/Off
4	+Vout
5	-Vout
6	Trim

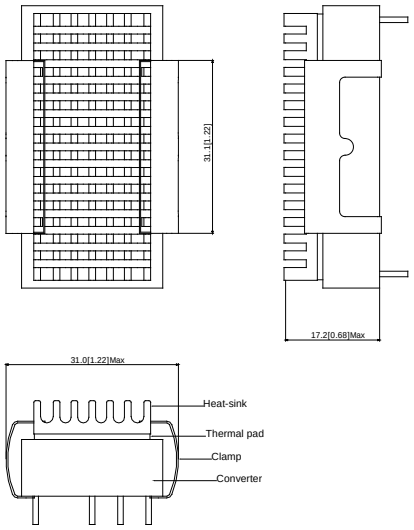
▶ All dimensions in mm (inches)
▶ Tolerance: X.X±0.25 (X.XX±0.01)
X.XX±0.13 (X.XXX±0.005)

▶ Pin diameter ∅ 1.0 ±0.05 (0.04±0.002)

Physical Characteristics

Case Size	:	50.8x25.4x10.2mm (2.0x1.0x0.40 inches)
Case Material	:	Aluminum Anodizing Treatment in Black
Base Material	:	FR4 PCB (flammability to UL 94V-0 rated)
Pin Material	:	Copper Alloy with Gold Plate Over Nickel Subplate
Weight	:	32g

Heatsink (Option –H)



Physical Characteristics

Heatsink Material	:	Aluminum
Finish	:	Black Anodized Coating
Weight	:	9g

▶ The advantages of adding a heatsink are:
1. To improve heat dissipation and increase the stability and reliability of the DC/DC converters at high operating temperatures.
2. To increase operating temperature of the DC/DC converter, please refer to Derating Curve.

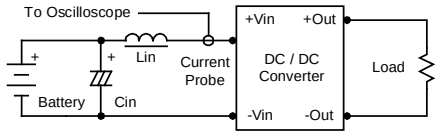
Order Code Table

Standard	With EMI	With heatsink	With Remote On/Off	With EMI & heatsink	With EMI & Remote On/Off	With heatsink & Remote On/Off	With EMI, heatsink & Remote On/Off
MKW5030	MKW5030A	MKW5030H	MKW5030-RC	MKW5030AH	MKW5030A-RC	MKW5030H-RC	MKW5030AH-RC
MKW5031	MKW5031A	MKW5031H	MKW5031-RC	MKW5031AH	MKW5031A-RC	MKW5031H-RC	MKW5031AH-RC
MKW5032	MKW5032A	MKW5032H	MKW5032-RC	MKW5032AH	MKW5032A-RC	MKW5032H-RC	MKW5032AH-RC
MKW5039	MKW5039A	MKW5039H	MKW5039-RC	MKW5039AH	MKW5039A-RC	MKW5039H-RC	MKW5039AH-RC
MKW5033	MKW5033A	MKW5033H	MKW5033-RC	MKW5033AH	MKW5033A-RC	MKW5033H-RC	MKW5033AH-RC
MKW5034	MKW5034A	MKW5034H	MKW5034-RC	MKW5034AH	MKW5034A-RC	MKW5034H-RC	MKW5034AH-RC
MKW5040	MKW5040A	MKW5040H	MKW5040-RC	MKW5040AH	MKW5040A-RC	MKW5040H-RC	MKW5040AH-RC
MKW5041	MKW5041A	MKW5041H	MKW5041-RC	MKW5041AH	MKW5041A-RC	MKW5041H-RC	MKW5041AH-RC
MKW5042	MKW5042A	MKW5042H	MKW5042-RC	MKW5042AH	MKW5042A-RC	MKW5042H-RC	MKW5042AH-RC
MKW5049	MKW5049A	MKW5049H	MKW5049-RC	MKW5049AH	MKW5049A-RC	MKW5049H-RC	MKW5049AH-RC
MKW5043	MKW5043A	MKW5043H	MKW5043-RC	MKW5043AH	MKW5043A-RC	MKW5043H-RC	MKW5043AH-RC
MKW5044	MKW5044A	MKW5044H	MKW5044-RC	MKW5044AH	MKW5044A-RC	MKW5044H-RC	MKW5044AH-RC

Test Setup

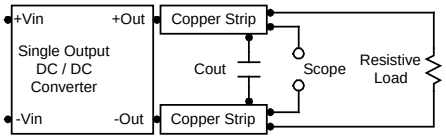
Input Reflected-Ripple Current Test Setup

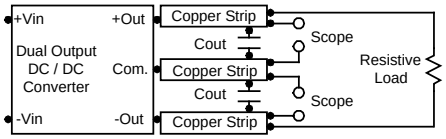
Input reflected-ripple current is measured with a inductor Lin (4.7μH) and Cin (220μF, ESR < 1.0Ω at 100 KHz) to simulate source impedance.
Capacitor Cin, offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 KHz.



Peak-to-Peak Output Noise Measurement Test

Use a Cout 1.0μF 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.





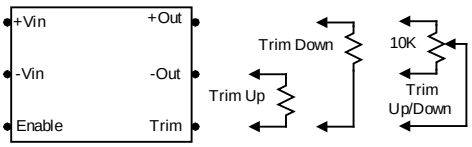
Technical Notes

Remote On/Off

Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent.
A logic low is -1V to 1.0V. A logic high is 2.5V to 100V. The maximum sink current at the on/off terminal (Pin 3) during a logic low is -100μA.
The maximum allowable leakage current of a switch connected to the on/off terminal (Pin 3) at logic high (2.5V to 100V) is 5μA.

Output Voltage Trim

Output voltage trim allows the user to increase or decrease the output voltage set point of a module.
The output voltage can be adjusted by placing an external resistor (Radj) between the Trim and +Vout or -Vout terminals. By adjusting Radj, the output voltage can be change by ±10% of the nominal output voltage.



A 10K, 1 or 10 Turn trimpot is usually specified for continuous trimming. Trim pin may be safely left floating if it is not used.
Connecting the external resistor (Radj-up) between the Trim and -Vout pins increases the output voltage to set the point as defined in the following equation:

$$Radj\text{-}up = \frac{(33 \times Vout) - (30 \times Vadj)}{Vadj - Vout}$$

Connecting the external resistor (Radj-down) between the Trim and +Vout pins decreases the output voltage set point as defined in the following equation:

$$Radj\text{-}down = \frac{(36.667 \times Vadj) - (33 \times Vout)}{Vout - Vadj}$$

Vout: Nominal Output Voltage Vadj: Adjusted Output Voltage Units: VDC/ KΩ

Overload Protection

To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. The unit operates normally once the output current is brought back into its specified range.

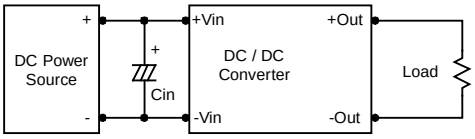
Overvoltage Protection

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

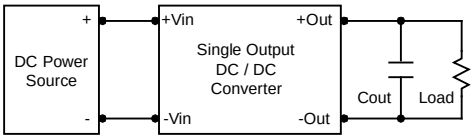
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup. Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 KHz) capacitor of a 33μF for the 12V input devices and a 10μF for the 24V and 48V devices.

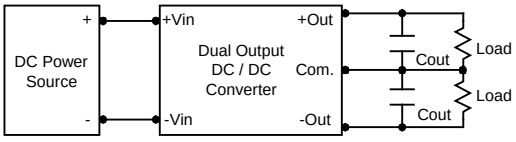
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Output Ripple Reduction

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 MKW5000 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. For optimum performance we recommend 680μF maximum capacitive load for 12V & 15V outputs and 6800μF capacitive load for the other outputs. 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℃.
The derating curves are determined from measurements obtained in a test setup.

