

## 15 Watts 2:1 Wide Input Range DC/DC Converters

### Single and Dual Outputs

#### Key Features

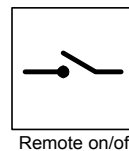
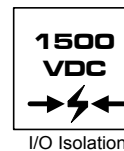
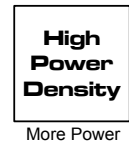
- High Efficiency up to 86%
- 2:1 Input Range
- I / O Isolation 1500VDC
- Short Circuit Protected
- Industry Standard Pinout
- Six-Side Shielded Case
- EMI Complies With EN55002 Class A  
(Only For MKW2500A Series)
- Remote on/off Control (Optional)
- MTBF > 700,000 Hours



Minmax's MKW2500 series, comprising 18 different models, has been conceived as an applications specific range of DC/DC converters, specially addressing data communication equipments, mobile battery driven equipments, distributed power systems, telecommunication equipments, mixed analog/digital subsystems, process/machine control equipments, computer peripheral systems and industrial robot systems.

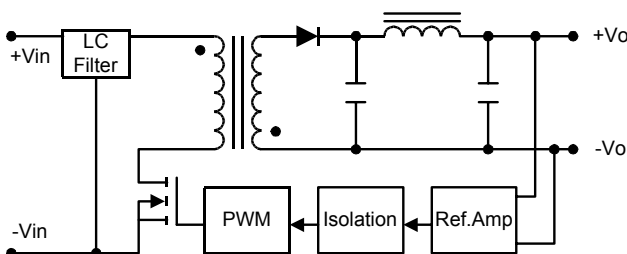
Packing up to 15W of power into a 2 x 1 x 0.4 inch package, with efficiency as high as 86%, the MKW2500 has wide input ranges of 9-18VDC, 18-36VDC and 36-75VDC, and is available in output voltages of 3.3V, 5.1V, 12V, 15V,  $\pm 12V$  and  $\pm 15V$ .

Other features include continuous short circuit protection, remote on/off, six-side shielded case and EN55022 level A conducted noise compliance minimize design-in time, cost and eliminate the need for external components.

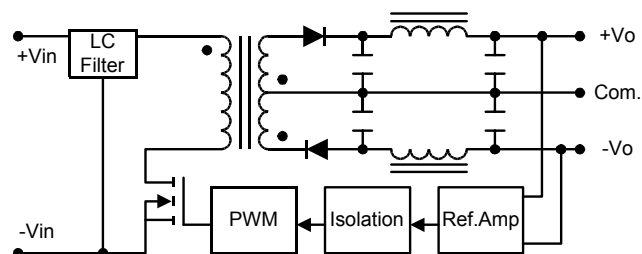


#### Block Diagram

##### Single Output



##### Dual Output



### Model Selection Guide

Model Number	Input Voltage	Output Voltage	Output Current		Input Current		Efficiency
			Max.	Min.	@Max. Load	@No Load	@Max. Load
	VDC	VDC	mA	mA	mA (Typ.)	mA (Typ.)	% (Typ.)
MKW2521	12 (9 ~ 18)	3.3	3000	300	1056	30	78
MKW2522		5.1	2950	295	1529		82
MKW2523		12	1250	125	1452		86
MKW2524		15	1000	100	1452		86
MKW2526		±12	±625	±62.5	1452		86
MKW2527		±15	±500	±50	1452		86
MKW2531	24 (18 ~ 36)	3.3	3000	300	528	20	78
MKW2532		5.1	2950	295	764		82
MKW2533		12	1250	125	726		86
MKW2534		15	1000	100	726		86
MKW2536		±12	±625	±62.5	726		86
MKW2537		±15	±500	±50	726		86
MKW2541	48 (36 ~ 75)	3.3	3000	300	264	10	78
MKW2542		5.1	2950	295	382		82
MKW2543		12	1250	125	363		86
MKW2544		15	1000	100	363		86
MKW2546		±12	±625	±62.5	363		86
MKW2547		±15	±500	±50	363		86

### Absolute Maximum Ratings

Parameter	Min.	Max.	Unit	
Input Surge Voltage (1000 mS)	12VDC Input Models	-0.7	25	VDC
	24VDC Input Models	-0.7	50	VDC
	48VDC Input Models	-0.7	100	VDC
Lead Temperature (1.5mm from case for 10 Sec.)	---	260	°C	
Internal Power Dissipation	---	5,000	mW	

Exceeding these values can damage the module. These are not continuous operating ratings.

### Note :

- Specifications typical at Ta=+25°C, resistive load, nominal input voltage, 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%.
- Ripple & Noise measurement bandwidth is 0-20 MHz.
- These power converters require a minimum output loading to maintain specified regulation.
- Operation under no-load conditions will not damage these devices; however they may not meet all listed specifications.
- All DC/DC converters should be externally fused at the front end for protection.
- Other input and output voltage may be available, please contact factory.
- To order the converter with Remote on/off function, please add suffix - RC ( EX : MK2521-RC )
- An optional internal filter is available. When the filter is added, the MKW2500 will meet EN55022-A. Add the suffix "A" to the model number, e.g. MKW2521A.
- Specifications subject to change without notice.

### Environmental Specifications

Parameter	Conditions	Min.	Max.	Unit
Operating Temperature	Ambient	-40	+60	°C
Operating Temperature	Case	-40	+100	°C
Storage Temperature		-50	+125	°C
Humidity		---	95	%
Cooling	Free-Air Convection			
RFI	Six-Side Shielded Metal Case			

## Input Specifications

Parameter	Model	Min.	Typ.	Max.	Unit
Start Voltage	12V Input Models	8	8.5	9	VDC
	24V Input Models	15	17	18	
	48V Input Models	30	33	36	
Under Voltage Shutdown	12V Input Models	7	8	8.5	
	24V Input Models	13	15	17	
	48V Input Models	25	29	34	
Reverse Polarity Input Current	All Models	---	---	1	A
Short Circuit Input Power		---	---	3500	mW
Input Filter		Pi Filter			

## Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Accuracy		---	$\pm 1.0$	$\pm 2.0$	%
Output Voltage Balance	Dual Output Balance Load	---	$\pm 0.5$	$\pm 2.0$	%
Line Regulation	$V_{in} = \text{Min. to Max.}$	---	$\pm 0.1$	$\pm 0.5$	%
Load Regulation	$I_o = 10\% \text{ to } 100\%$	---	$\pm 0.5$	$\pm 1.0$	%
Ripple & Noise (20MHz)		---	55	80	mV P-P
Ripple & Noise (20MHz)	Over Line, Load & Temp	---	---	100	mV P-P
Ripple & Noise (20MHz)		---	---	15	mV rms.
Over Power Protection		120	---	---	%
Transient Recovery Time	25% Load Step Change	---	300	500	$\mu\text{s}$
Transient Response Deviation		---	$\pm 2$	$\pm 4$	%
Temperature Coefficient		---	$\pm 0.01$	$\pm 0.02$	%/°C
Output Short Circuit	Continuous				

## General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Isolation Voltage	60 Seconds	1500	---	---	VDC
Isolation Test Voltage	Flash Tested for 1 Second	1650	---	---	VDC
Isolation Resistance	500VDC	1000	---	---	M $\Omega$
Isolation Capacitance	100KHz, 1V	---	1200	1500	pF
Switching Frequency		290	330	400	KHz
MTBF	MIL-HDBK-217F @ 25°C, Ground Benign	700	---	---	K Hours

## Remote On/Off Control

Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply On	2.5 to 5.5VDC or Open Circuit				
Supply Off		-0.7	---	0.8	VDC
Standby Input Current		---	---	10	mA
Control Input Current ( on )		---	---	50	$\mu\text{A}$
Control Input Current ( off )		---	---	-1	mA
Control Common	Referenced to Negative Input				

**Capacitive Load**

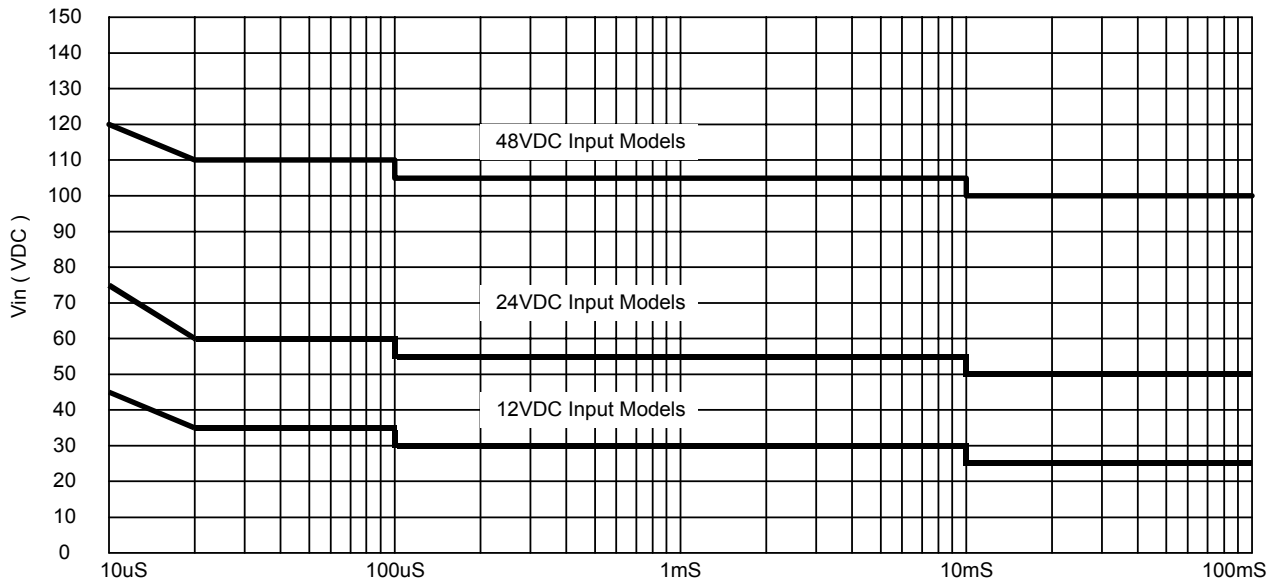
Models by Vout	3.3V	5.1V	12V	15V	±12V #	±15V #	Unit
Maximum Capacitive Load	470	470	470	470	220	220	uF

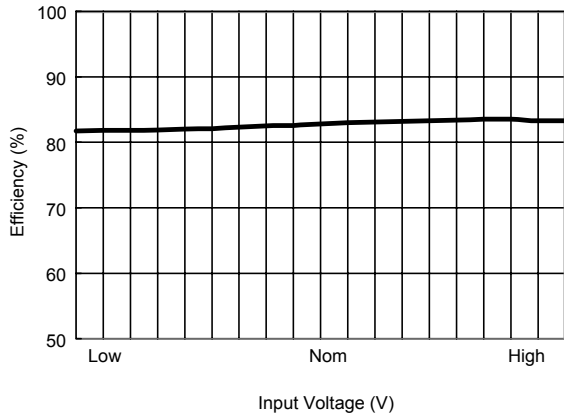
Note: # For each output .

**Input Fuse Selection Guide**

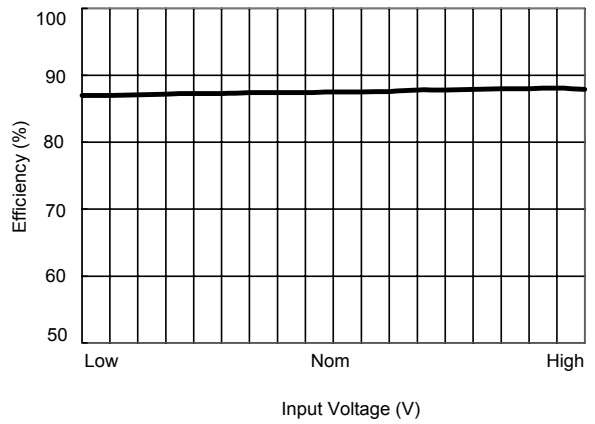
12V Input Models	24V Input Models	48V Input Models
3000mA Slow – Blow Type	1500mA Slow – Blow Type	750mA Slow – Blow Type

**Input Voltage Transient Rating**

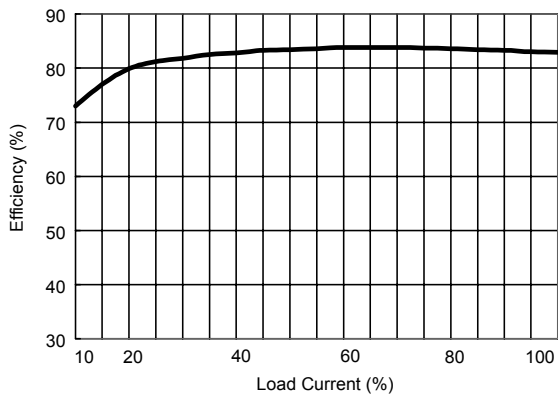




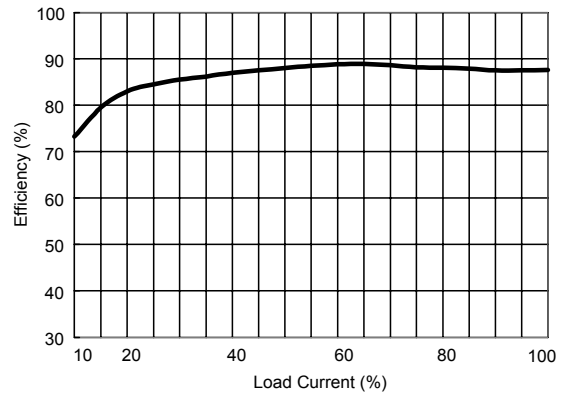
**Efficiency vs Input Voltage ( Single Output )**



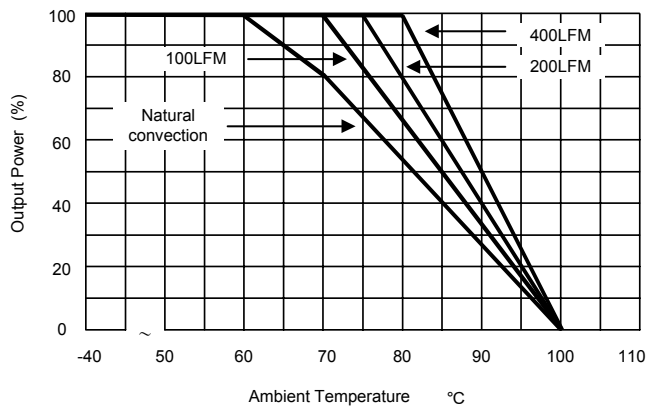
**Efficiency vs Input Voltage ( Dual Output )**



**Efficiency vs Output Load ( Single Output )**



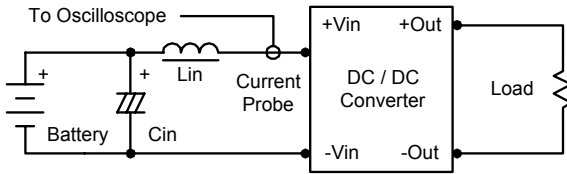
**Efficiency vs Output Load ( Dual Output )**



**Derating Curve**

## Test Configurations

### Input Reflected-Ripple Current Test Setup



Input reflected-ripple current is measured with an inductor  $L_{in}$  (4.7uH) and  $C_{in}$  (220uF, ESR < 1.0Ω at 100 KHz) to simulate source impedance.

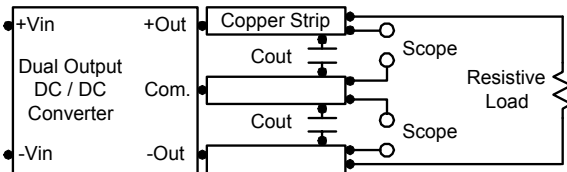
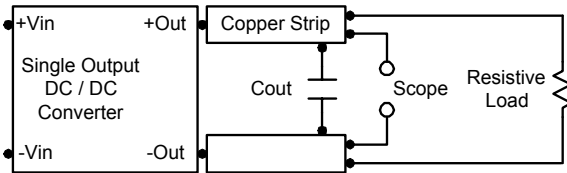
Capacitor  $C_{in}$ , offsets possible battery impedance.

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  $C_{out}$  0.47uF 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.



## Design & Feature Considerations

### 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.

Negative logic remote on/off turns the module off during a logic low and on during a logic high.

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  $-V_{in}$  terminal.

The switch can be an open collector or equivalent.

A logic low is  $-0.7V$  to  $0.8V$ .

A logic high is  $2.5V$  to  $5.5V$ .

The maximum sink current at on/off terminal during a logic low is 1 mA.

The maximum allowable leakage current of the switch at on/off terminal =  $2.5$  to  $5.5V$  is 50uA.

### Overcurrent Protection

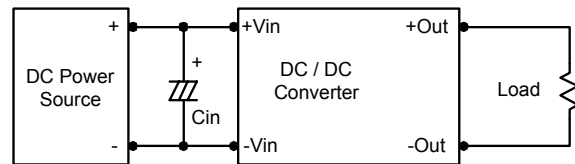
To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. The unit operates normally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

### 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.

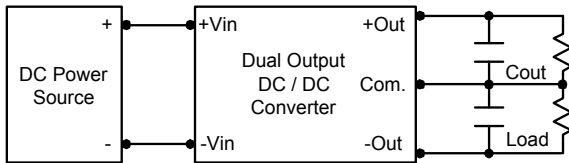
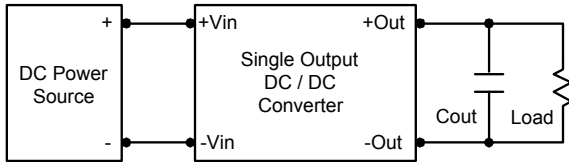
Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 KHz) capacitor of a 22uF for the 12V input devices and a 6.8uF for the 24V and 48V devices.



## 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 4.7uF capacitors at the output.



## Maximum Capacitive Load

The MKW2500 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.

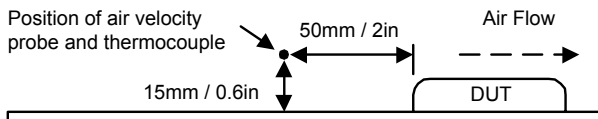
For optimum performance we recommend 220uF maximum capacitive load for dual outputs and 470uF capacitive load for single outputs.

The maximum capacitance can be found in the data.

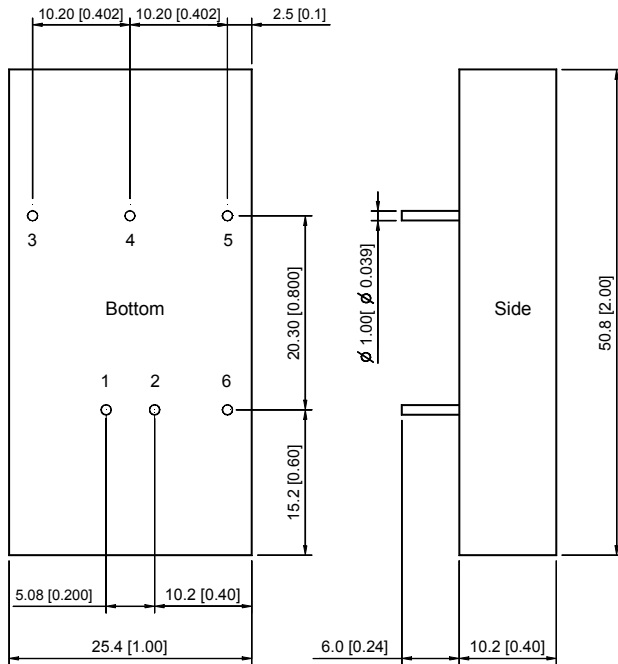
## Thermal Considerations

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 100°C.

The derating curves are determined from measurements obtained in an experimental apparatus.



**Mechanical Data**

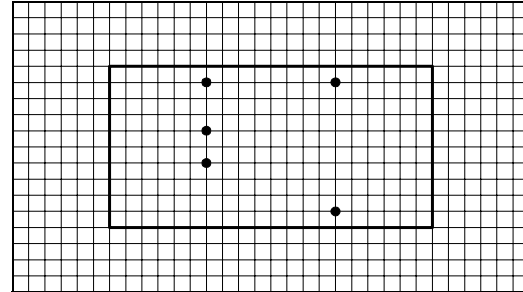


Tolerance	Millimeters	Inches
	.X±0.25	.XX±0.01
	.XX±0.25	.XXX±0.01
Pin	±0.05	±0.002

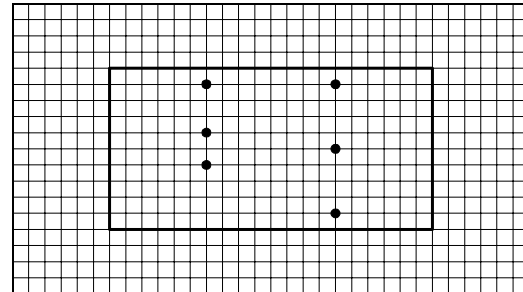
**Connecting Pin Patterns**

Top View ( 2.54 mm / 0.1 inch grids )

**Single Output**



**Dual Output**



**Pin Connections**

Pin	Single Output	Dual Output
1	+Vin	+Vin
2	-Vin	-Vin
3	+Vout	+Vout
4	No Pin	Common
5	-Vout	-Vout
6	Remote on/off (Optional)	

**Physical Characteristics**

- Case Size** : 50.8×25.4×10.2 mm  
2.0×1.0×0.4 inches
- Case Material** : Nickel-Coated Copper  
With Non-Conductive Baseplate
- Weight** : 32g
- Flammability** : UL94V-0

Units are encapsulated in a low thermal resistance molding compound which has excellent chemical resistance and electrical properties in high humidity environment and over a wide operating temperature range. The encapsulant and outer shell of the unit have UL94V-0 ratings. The leads are golden plated for better soldering.