

**FEATURES**

- ▶ Smallest Encapsulated 2W Converter
- ▶ Ultra-compact DIP-8 Package
- ▶ Wide 2:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ I/O Isolation 1500 VDC
- ▶ Operating Ambient Temp. Range -40°C to +80°C
- ▶ No Min. Load Requirement
- ▶ Under-voltage, Overload and Short Circuit Protection
- ▶ UL/cUL/IEC/EN 60950-1 Safety Approval & CE Marking


**PRODUCT OVERVIEW**

The MINMAX MFW02 series is the latest generation of high performance DC-DC converter modules setting a new standard concerning power density. The product offers a full 2W isolated DC-DC converter within an encapsulated DIP-8 package which occupies only 0.3 in<sup>2</sup> of PCB space. There are 28 models available for 5, 12, 24, 48VDC input with wide 2:1 input voltage range. Further features include under-voltage protection, overload protection, short circuit protection and no min. load requirement as well. An high efficiency allows operating temperatures range of -40°C to +80°C.

These DC-DC converters offer an economical solution for many cost critical applications in battery-powered equipment, instrumentation, distributed power architectures in communication, industrial electronics, energy facilities and many other critical applications where PCB space is limited.

**Model Selection Guide**

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Max. capacitive Load	Efficiency (typ.)	
				Max.	@Max. Load			@No Load
	VDC	VDC	mA	mA(typ.)	mA(typ.)	μF	%	
MFW02-05S033	5 (4.5 ~ 10)	3.3	400	334	40	100	79	
MFW02-05S05		5	400	494			81	
MFW02-05S12		12	167	472			85	
MFW02-05S15		15	134	462		87	100#	83
MFW02-05D05		±5	±200	482		85		
MFW02-05D12		±12	±83	469		85		
MFW02-05D15		±15	±67	473		85		
MFW02-12S033	12 (9 ~ 18)	3.3	400	138	27	100	80	
MFW02-12S05		5	400	201			83	
MFW02-12S12		12	167	192			87	
MFW02-12S15		15	134	193		87	100#	84
MFW02-12D05		±5	±200	198		86		
MFW02-12D12		±12	±83	193		86		
MFW02-12D15		±15	±67	195		86		
MFW02-24S033	24 (18 ~ 36)	3.3	400	70	15	100	79	
MFW02-24S05		5	400	99			84	
MFW02-24S12		12	167	97			86	
MFW02-24S15		15	134	96		87	100#	84
MFW02-24D05		±5	±200	99		86		
MFW02-24D12		±12	±83	97		86		
MFW02-24D15		±15	±67	97		86		
MFW02-48S033	48 (36 ~ 75)	3.3	400	35	8	100	79	
MFW02-48S05		5	400	50			83	
MFW02-48S12		12	167	49			85	
MFW02-48S15		15	134	49		86	100#	82
MFW02-48D05		±5	±200	51		84		
MFW02-48D12		±12	±83	49		84		
MFW02-48D15		±15	±67	50		84		

# For each output

Input Specifications					
Parameter	Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (1 sec. max.)	5V Input Models	-0.7	---	12	VDC
	12V Input Models	-0.7	---	25	
	24V Input Models	-0.7	---	50	
	48V Input Models	-0.7	---	100	
Start-Up Threshold Voltage	5V Input Models	---	---	4.5	
	12V Input Models	---	---	9	
	24V Input Models	---	---	18	
	48V Input Models	---	---	36	
Short Circuit Input Power	All Models	---	---	0.5	W
Input Filter		Internal Capacitor			

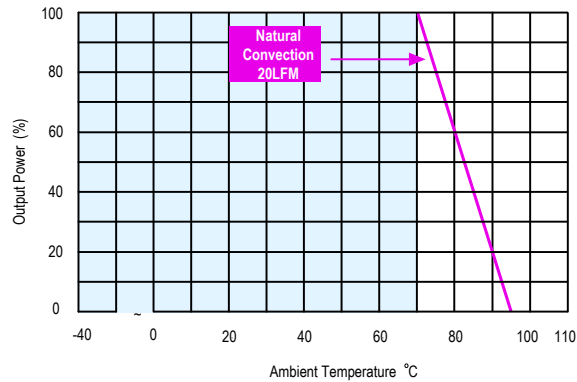
Output Specifications					
Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy		---	---	±1.5	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads	---	---	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load	---	---	±0.2	%
Load Regulation	Io=0% to 100%	---	---	±1.0	%
Cross Regulation (Dual)	Asymmetrical load 25% / 100% FL	---	---	±5.0	%
Minimum Load	No minimum Load Requirement				
Ripple & Noise	0-20 MHz Bandwidth	---	70	---	mV <sub>P-P</sub>
Transient Recovery Time	25% Load Step Change	---	250	500	μsec
Transient Response Deviation		---	±3	±5	%
Temperature Coefficient		---	±0.01	±0.02	%/°C
Over Load Protection	Foldback	---	180	---	%
Short Circuit Protection	Continuous, Automatic Recovery				

General Specifications					
Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	1500	---	---	VDC
	1 Seconds	1800	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100KHz, 1V	---	100	---	pF
Switching Frequency		100	---	---	KHz
MTBF (calculated)	MIL-HDBK-217F@25°C, Ground Benign	4,226,000	---	---	Hours
Safety Approvals	UL/cUL 60950-1 recognition (UL certificate), IEC/EN 60950-1 (CB-report)				

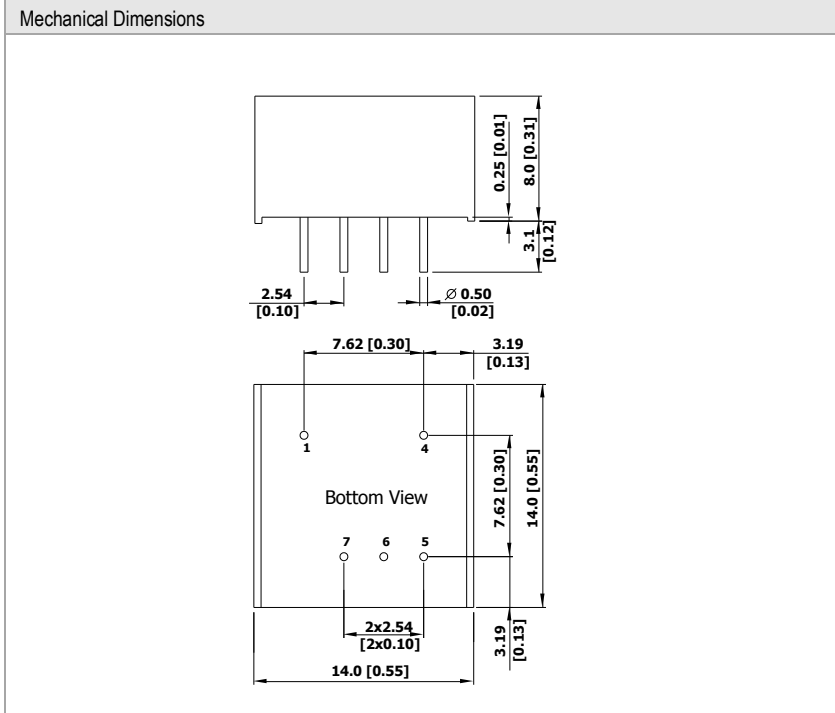
Environmental Specifications					
Parameter	Conditions	Min.	Max.	Unit	
Operating Ambient Temperature Range (See Power Derating Curve)	Natural Convection	-40	+80	°C	
Case Temperature		---	+95	°C	
Storage Temperature Range		-50	+125	°C	
Humidity (non condensing)		---	95	% rel. H	
Cooling	Natural Convection				
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, B <sup>(5)</sup>
EMS	EN 55024		
	ESD	EN 61000-4-2 Air $\pm$ 8kV , Contact $\pm$ 6kV	A
	Radiated immunity	EN 61000-4-3 10V/m	A
	Fast transient <sup>(4)</sup>	EN 61000-4-4 $\pm$ 2kV	A
	Surge <sup>(4)</sup>	EN 61000-4-5 $\pm$ 1kV	A
	Conducted immunity	EN 61000-4-6 10Vrms	A
	PFMF	EN 61000-4-8 3A/M	A

**Power Derating Curve**

**Notes**

- 1 Specifications typical at Ta=+25°C, resistive load, nominal input voltage and rated output current unless otherwise noted.
- 2 We recommend to protect the converter by a slow blow fuse in the input supply line.
- 3 Other input and output voltage may be available, please contact factory.
- 4 To meet EN 61000-4-4 & EN 61000-4-5 an external capacitor across the input pins is required, please contact MINMAX.
- 5 To meet EN 55032 Class A,B an external filter, please contact MINMAX.
- 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**


Pin Connections

Pin	Single Output	Dual Output
1	-Vin	-Vin
4	+Vin	+Vin
5	+Vout	+Vout
6	No Pin	Common
7	-Vout	-Vout

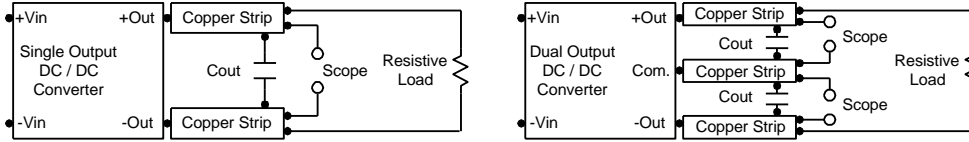
- ▶ All dimensions in mm (inches)
- ▶ Tolerance: X.X±0.5 (X.XX±0.02)  
X.XX±0.25 (X.XXX±0.01)
- ▶ Pin diameter  $\varnothing 0.5 \pm 0.05$  (0.02±0.002)

**Physical Characteristics**

Case Size	: 14.0x14.0x8.0mm (0.55x0.55x0.31 inches)
Case Material	: Non-Conductive Black Plastic (flammability to UL 94V-0 rated)
Pin Material	: Tinned Copper
Weight	: 3.9g

**Test Setup**
**Peak-to-Peak Output Noise Measurement Test**

Use a  $C_{out}$  0.47 $\mu$ 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**
**Maximum Capacitive Load**

The MFW02 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. The maximum capacitance can be found in the data sheet.

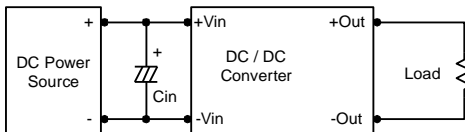
**Overload Protection**

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.

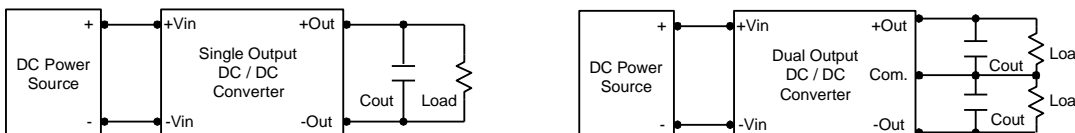
**Input Source Impedance**

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 commended to use a good quality low Equivalent Series Resistance (ESR < 1.0 $\Omega$  at 100 KHz) capacitor of a 8.2 $\mu$ F for the 5V input device, a 3.3 $\mu$ F for the 12V input devices and a 1.5 $\mu$ F 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 3.3 $\mu$ F capacitors at the output.


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

