

MB2000ERUI



High Isolation, 1" x 2" 20W, 4:1 Input Range DC/DC Converters

Key Features:

- 20W Output Power
- 4:1 Input Voltage Range
- EN 60950 Approved
- 3,000 VDC Isolation
- Efficiency to 90%
- Meets EN 55032
- Compact 1 x 2 Inch Case
- -40°C to +85°C Operation
- Industry Standard Pin-Out
- Chassis & DIN Rail Mount



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Electrical Specifications

Specifications typical @ +25°C, nominal input voltage & rated output current, unless otherwise noted. Specifications subject to change without notice.

Parameter	Conditions	Min.	Typ.	Max.	Units
Input					
Input Voltage Range	24 VDC Input	9.0	24.0	36.0	VDC
	48 VDC Input	18.0	48.0	75.0	
Input Start Voltage	24 VDC Input			9.0	VDC
	48 VDC Input			18.0	
Under Voltage Shutdown	24 VDC Input	5.5	6.5		VDC
	48 VDC Input	12.0	15.5		
Reflected Ripple Current			30.0		mA
Start-Up Time	See Note 1		10		mS
Input Filter	π (Pi) Filter				
Output					
Output Voltage Accuracy			±1.0	±3.0	%
Output Trim Range			±10		%
Line Regulation	V _{IN} = Min to Max		±0.2	±0.5	%
Load Regulation	I _{OUT} = 0% to 100%		±0.5	±1.0	%
Ripple & Noise (20 MHz)	See Note 2		50	100	mV P - P
Transient Recovery Time, See Note 3			300	500	µSec
Transient Response Deviation	3.3 & 5.0 VDC Output Models		±5.0	±8.0	%
	All Other Outputs		±3.0	±5.0	
Over Voltage Protection		110		160	%V _{OUT}
Output Power Protection		110		190	%I _{OUT}
Temperature Coefficient				±0.03	%/°C
Output Short Circuit, See Note 4	Continuous (Autorecovery)				
General					
Isolation Voltage	60 Seconds	3,000			VDC
Isolation Resistance	500 VDC	1,000			MΩ
Isolation Capacitance	100 kHz/0.1V		500		pF
Switching Frequency			270		kHz
Environmental					
Operating Temperature Range	Ambient	-40	+25	+85	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%
Physical					
Case Size	See Mechanical Diagrams (Starting Page 4)				
Case Material	Aluminum Alloy With Non-Conductive Base (UL94-V0)				
Weight	See Mechanical Diagrams (Starting Page 4)				
Remote On/Off					
Unit On	See Note 5	3.5		12.0	VDC
Unit Off	See Note 5	0		1.2	VDC
Off Idle Current			4.0	7.0	mA
Reliability Specifications					
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	1.0			MHours
Safety Standards	UL/cUL 60950-1 recognition (UL certificate)				
Vibration	10 - 55 Hz, 10G, 30 Min, on X, Y & Z Axis				
Absolute Maximum Ratings					
Input Voltage Surge (1 Sec)	24 VDC Input	-0.7		50.0	VDC
	48 VDC Input	-0.7		100.0	
Lead Temperature	1.5 mm From Case for 10 Sec			300	°C

Caution: Exceeding Absolute Maximum Ratings may damage the module. These are not continuous operating ratings.

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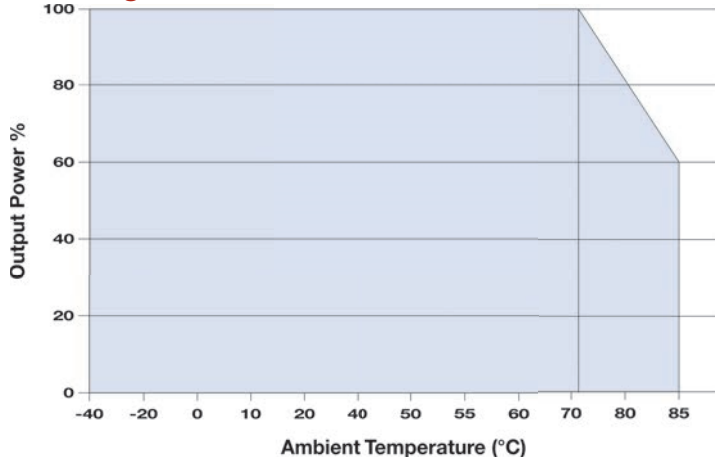
Model Number	Input				Output			Efficiency (% Typ)	Capacitive Load (µF, Max)	Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)			
	Nominal	Range	Full-Load	No-Load						
MB2024S-03ERUI	24	9.0 - 36.0	799	40	3.3	5,000	0.0	86	10,000	2,000
MB2024S-05ERUI	24	9.0 - 36.0	936	40	5.0	4,000	0.0	89	10,000	2,000
MB2024S-09ERUI	24	9.0 - 36.0	946	40	9.0	2,222	0.0	88	4,700	2,000
MB2024S-12ERUI	24	9.0 - 36.0	946	40	12.0	1,667	0.0	88	1,600	2,000
MB2024S-15ERUI	24	9.0 - 36.0	936	40	15.0	1,333	0.0	89	1,000	2,000
MB2024S-24ERUI	24	9.0 - 36.0	936	40	24.0	834	0.0	89	500	2,000
MB2048S-03ERUI	48	18.0 - 75.0	400	20	3.3	5,000	0.0	86	10,000	1,000
MB2048S-05ERUI	48	18.0 - 75.0	473	20	5.0	4,000	0.0	88	10,000	1,000
MB2048S-12ERUI	48	18.0 - 75.0	473	20	12.0	1,667	0.0	88	1,600	1,000
MB2048S-15ERUI	48	18.0 - 75.0	462	20	15.0	1,334	0.0	89	1,000	1,000
MB2048S-24ERUI	48	18.0 - 75.0	462	20	24.0	833	0.0	89	500	1,000

- Notes:
1. Start up time is measured at nominal input and with a constant resistive load.
 2. When measuring output ripple, it is recommended that an external ceramic capacitor (approx 1 µF to 10 µF) be placed from the +V_{out} to the -V_{out} pins.
 3. Transient recovery is measured to within a 1% error band for a load step change of 25%.
 4. Short circuit protection is provided by a "hiccup mode" circuit.
 5. The control input (pin 6) is referenced to the -V_{in} (pin 2) input. If it is grounded, the unit will shut off.
 6. Operation at no-load will not damage the unit, but they may not meet all specifications.
 7. It is recommended that a fuse be used on the input of a power supply for protection. See the Model Selection table above for the correct rating.

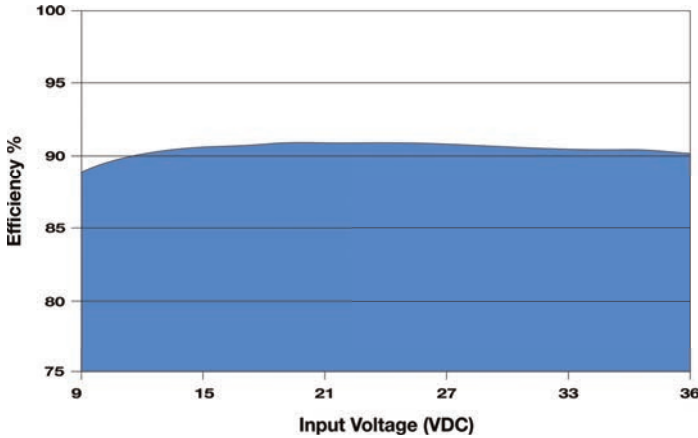
For the A2S adapter board option, add the suffix "-A2S" to the model number (i.e. **MB2048S-05ERUI-A2S**)

For the A4S adapter board option, add the suffix "-A4S" to the model number (i.e. **MB2048S-24ERUI-A4S**)

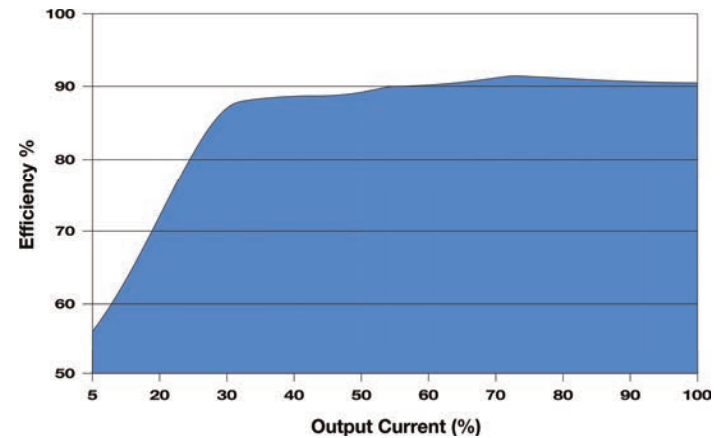
Derating Curve



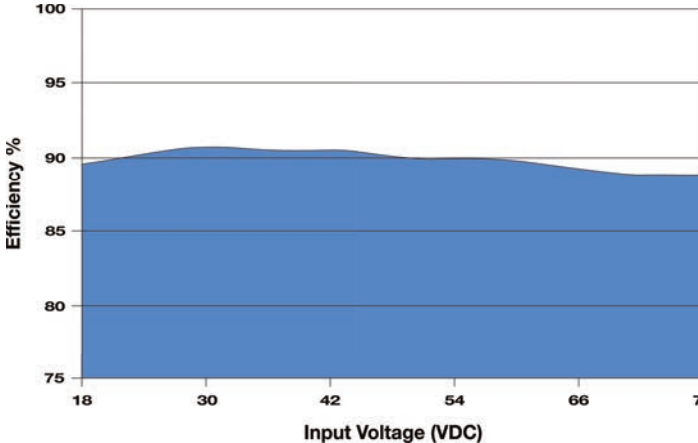
Efficiency vs Input Voltage: 24 V_{IN}



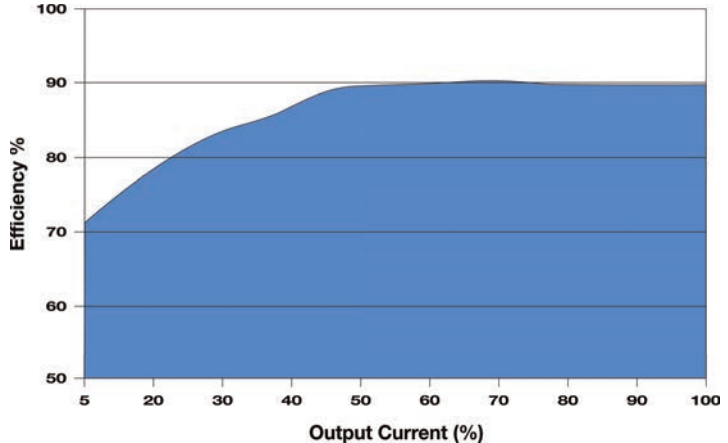
Efficiency vs Output Load: 24 V_{IN}



Efficiency vs Input Voltage: 48 V_{IN}



Efficiency vs Output Load: 48 V_{IN}



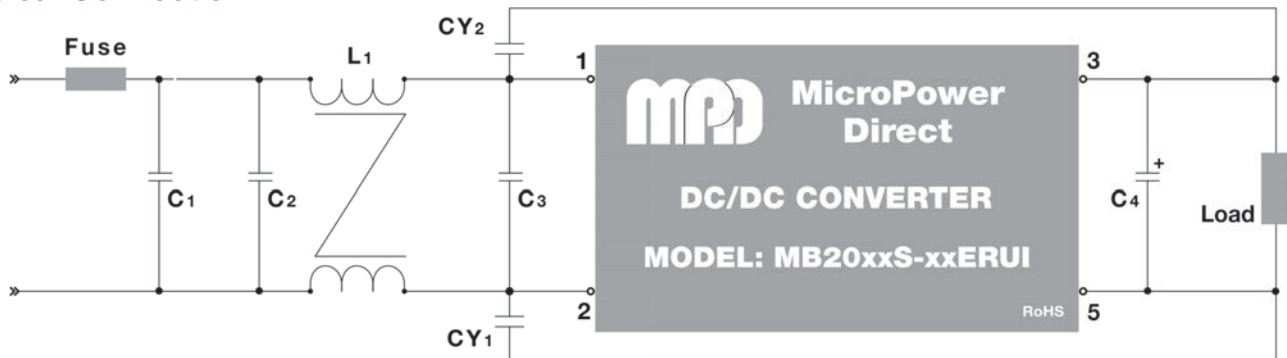
EMI Characteristics

Parameter	Standard	Criteria	Level	
Radiated Emissions (See Note 1)	CISPR 32/EN 55032		Class A (without external components)	
			Class B (See Typical Connection below)	
Conducted Emissions (See Note 1)	CISPR 32/EN 55032		Class A (without external components)	
			Class B (See Typical Connection below)	
ESD	EN 61000-4-2	B	±4 kV Contact	
RS	EN 61000-4-3	A	10V/m	
EFT	See Note 2	EN 61000-4-4	B	±2 kV
Surge	See Note 3	EN 61000-4-5	B	±2 kV
CS	EN 61000-4-6	A	3 Vrms	
Voltage Dips	EN 61000-4-29	B	0% - 70%	

Notes:

- If the application does not require that emissions meet international standards, simply adding capacitors to the input and output circuits may be sufficient to reduce ripple & noise. See note 4 below.
- To meet the requirements of EN 61000-4-4, an external input capacitor is needed. The Typical Connection diagram below shows capacitor C₁, which would typically achieve this. Contact the factory for more information.
- To meet the requirements of EN 61000-4-5, an external input capacitor is needed. The Typical Connection diagram below shows capacitor C₁, which would typically achieve this. Contact the factory for more information.

Typical Connection



For applications that require meeting EMC standards, the diagram above illustrates a typical connection of the **MB2000xERUI** series. The units do not require external components to operate as specified. Some notes on this diagram (starting with the input circuit) are:

- An external fuse should be used in all power module applications. The recommended fuse is shown in the model chart on page 2.
- All input/output filtering capacitors should have a low equivalent impedance. Any output capacitors used should be high frequency, low resistance electrolytic capacitors. Care must be taken in choosing this capacitor not to exceed the capacitive load specification for the unit. Voltage derating of all capacitors should be 60% or greater.

3. Recommended values for components are:

Component	24 V _{IN}	48 V _{IN}
C ₁	1,000 μF/50V	680 μF/100V
C ₂	1 μF/50V	1 μF/100V
L ₁	6.8 mH	6.8 mH
C ₃	1 μF/50V	1 μF/100V
CY ₁	1 nF/2 kV	1 nF/2 kV
CY ₂	1 nF/2 kV	1 nF/2 kV
C ₄	See chart under note 4	

4. In many applications simply adding input/output capacitors will enhance the input surge protection and reduce output ripple sufficiently. Suggested capacitor values are:

Output Voltage	C _{IN}	C _{OUT}
3.3/5.0 V _{OUT}	100 μF	470 μF
9.0/12/15 V _{OUT}		220 μF
24 V _{OUT}		100 μF

External Trim

An external resistor can be used to adjust the converter output up/down by about 10%. The connection is shown in the diagrams below. The required resistor value is calculated by the formulas:

$$\text{Trim Up} = R_{\text{TRIM}} = \frac{A \times R_2}{R_2 - A} - R_3 \quad \text{Where } A = \frac{V_{\text{REF}}}{V_{\text{OUT}} - V_{\text{REF}}} \times R_1$$

$$\text{Trim Down} = R_{\text{TRIM}} = \frac{A \times R_1}{R_1 - A} - R_3 \quad \text{Where } A = \frac{V_{\text{OUT}} - V_{\text{REF}}}{V_{\text{REF}}} \times R_2$$

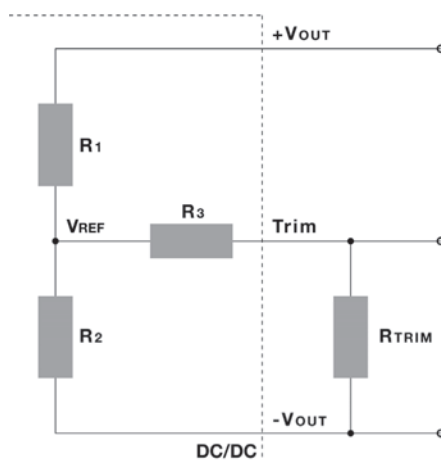
Where R_{TRIM} = The value of the external trim resistor
A = A is defined as shown above

The values of R₁, R₂, R₃ and V_{REF} are given in the table at right.

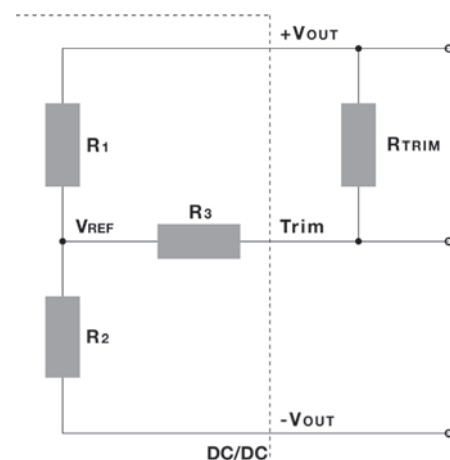
Output Trim Resistor Values

Output Voltage	Resistor Value			
	R ₁ (kΩ)	R ₂ (kΩ)	R ₃ (kΩ)	V _{REF} (V)
3.3 VDC	4.801	2.870	12.400	1.24
5.0 VDC	2.883	2.870	10.000	2.50
9.0 VDC	7.500	2.870	15.000	2.50
12 VDC	11.000	2.870	15.000	2.50
15 VDC	14.494	2.870	15.000	2.50
24 VDC	24.872	2.870	17.800	2.50

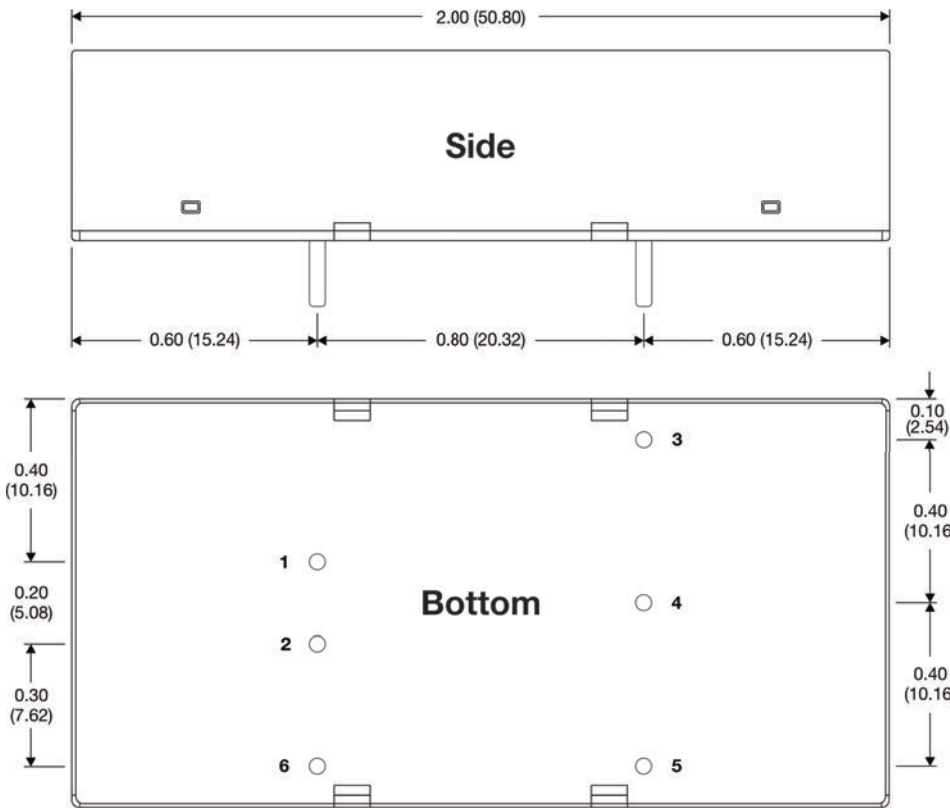
Trim Up



Trim Down



Mechanical Dimensions



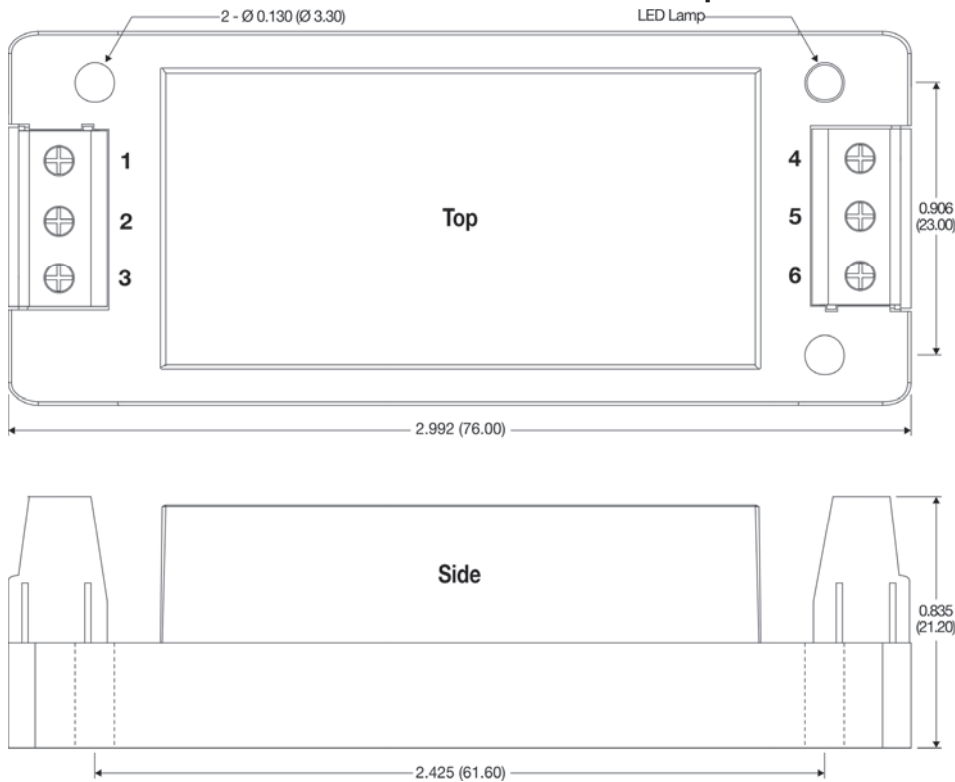
Pin Connections

Pin	Function
1	+VIN
2	-VIN
3	+VOUT
4	Trim
5	-VOUT
6	Remote On/Off

Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Weight (Typ) = 0.92 Oz (26g)

Mechanical Dimensions: A2 Chassis Mount Adapter



Pin Connections

Pin	Function
1	Remote On/Off
2	-VIN
3	+VIN
4	-VOUT
5	Trim
6	+VOUT

Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Weight (Typ) = 1.69 Oz (48g)

For the chassis mount option, add the suffix "-A2" to the model number (i.e. **MB2024S-05ERUI-A2**)

