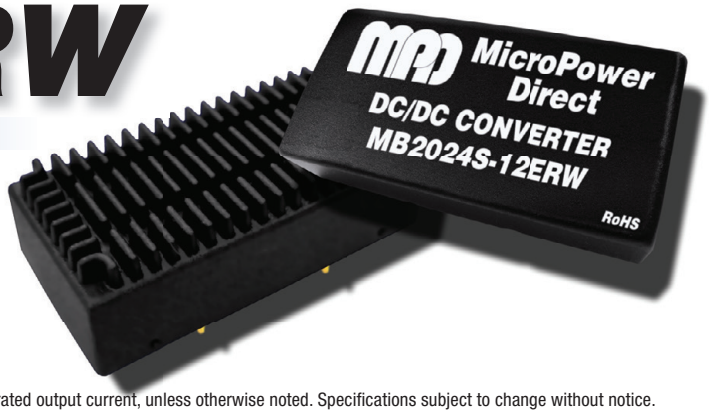
MB2000ERW

Low Cost, 1 x 2 Inch 20W, 2:1 Input Range DC/DC Converters



Key Features:

- 20W Output Power
- EN 60950 Approval (Pending)
- 2:1 Input Voltage Range
- 1,500 VDC Isolation
- Single & Dual Outputs
- Efficiency to 90%
- Compact 1 x 2 Inch Case
- -40°C to +85°C Operation
- Industry Standard Pin-Out
- Low Cost

RoHS

Electrical Specifications

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

Input

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage Range	24 VDC Input	18.0	24.0	36.0	VDC
	48 VDC Input	36.0	48.0	75.0	
Input Start Voltage	12 VDC Input			18.0	VDC
	24 VDC Input			36.0	
Input Filter	π (Pi) Filter				
Start-Up Time	See Note 2		10		mS

Output

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy	See Note 3		±1.0	±3.0	%
Output Trim Range			±10		%
Line Regulation, VIN = Min to Max	Positive Output		±0.2	±0.5	%
	Negative Output		±0.5	±1.0	
Load Regulation, IOUT = 5% to 100%	Positive Output		±0.5	±1.0	%
	Negative Output		±0.5	±1.5	
Cross Regulation	See Note 4			±5.0	%
Ripple & Noise (20 MHz)	See Note 5		50	100	mV P - P
Transient Recovery Time, See Note 6			300	500	μS
Transient Response Deviation	3.3, 5.0 & ±5.0 Output Models		±5.0	±8.0	%
	All Other Models		±3.0	±5.0	
Temperature Coefficient				±0.03	%/°C
Over Voltage Protection		110		160	%
Output Power Protection		110		190	%
Output Short Circuit, See Note 7	Continuous (Autorecovery)				

General

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	60 Seconds	1,500			VDC
Isolation Resistance	500 VDC	1,000			MΩ
Isolation Capacitance, 100 kHz, 0.1V	Model MB2024S-24ERW		2,050		pF
	All Other Models		1,050		
Switching Frequency			270		kHz

Environmental

Parameter	Conditions	Min.	Typ.	Max.	Units
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 (Pages 4,5 & 6)
Case Material	Aluminum Alloy With Non-Conductive Base (UL94-V0)
Weight	See Mechanical Diagrams (Pages 4,5 & 6)

Remote On/Off

Parameter	Conditions	Min.	Typ.	Max.	Units
Unit On	See Note 8	3.5		12.0	VDC
Unit Off	See Note 8	0		1.2	VDC
Off Idle Current			4.0	7.0	mA

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	1.0			MHours
Vibration	10 - 55 Hz, 10G, 30 Min, on X, Y & Z Axis				
Safety Standards	UL 60950, EN 60950 (Pending)				

Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage Surge (1 Sec)	24 VDC Input			50.0	VDC
	48 VDC Input			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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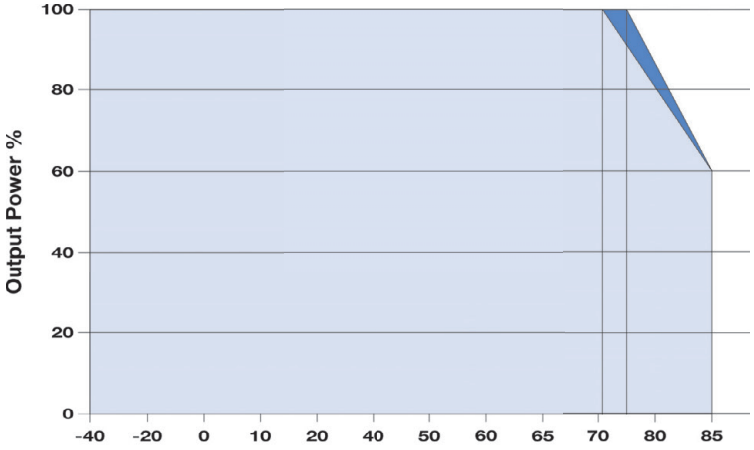
Model Selection Guide

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-03ERW	24	18.0 - 36.0	799	40	3.3	5,000	0.0	86	10,000	2,000
MB2024S-05ERW	24	18.0 - 36.0	969	40	5.0	4,000	0.0	90	10,000	2,000
MB2024S-09ERW	24	18.0 - 36.0	947	6	9.0	2,222	0.0	89	4,700	2,000
MB2024S-12ERW	24	18.0 - 36.0	947	6	12.0	1,667	0.0	89	1,600	2,000
MB2024S-15ERW	24	18.0 - 36.0	947	6	15.0	1,333	0.0	90	1,000	2,000
MB2024S-24ERW	24	18.0 - 36.0	947	6	24.0	834	0.0	90	500	2,000
MB2024D-05ERW	24	18.0 - 36.0	969	40	±5.0	±2,000	±0.0	86	4,800	2,000
MB2024D-09ERW	24	18.0 - 36.0	947	6	±9.0	±1,111	±0.0	88	1,000	2,000
MB2024D-12ERW	24	18.0 - 36.0	947	6	±12.0	±834	±0.0	88	800	2,000
MB2024D-15ERW	24	18.0 - 36.0	947	6	±15.0	±667	±0.0	88	625	2,000
MB2048S-03ERW	48	36.0 - 75.0	400	25	3.3	5,000	0.0	86	10,000	1,000
MB2048S-05ERW	48	36.0 - 75.0	485	25	5.0	4,000	0.0	90	10,000	1,000
MB2048S-09ERW	48	36.0 - 75.0	474	9	9.0	2,222	0.0	89	4,700	1,000
MB2048S-12ERW	48	36.0 - 75.0	474	9	12.0	1,667	0.0	89	1,600	1,000
MB2048S-15ERW	48	36.0 - 75.0	474	9	15.0	1,333	0.0	90	1,000	1,000
MB2048S-24ERW	48	36.0 - 75.0	474	9	24.0	834	0.0	90	500	1,000
MB2048D-05ERW	48	36.0 - 75.0	485	25	±5.0	±2,000	±0.0	86	4,800	1,000
MB2048D-12ERW	48	36.0 - 75.0	474	9	±12.0	±834	±0.0	88	800	1,000
MB2048D-15ERW	48	36.0 - 75.0	474	9	±15.0	±667	±0.0	89	625	1,000

Notes:

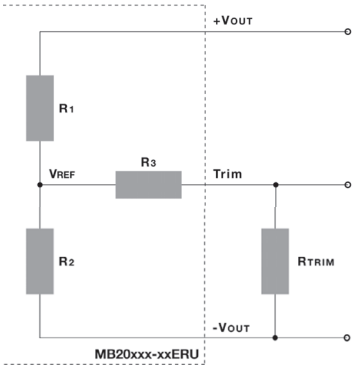
1. The specified maximum capacitive load is for each output.
2. Start up time is measured at nominal input and with a constant resistive load.
3. For ±5 and ±9 VOUT models, the output accuracy is specified as ±5%.
4. Cross regulation is measured with the main output set at 50% load. The second output is varied from 10% to 100% load.
5. When measuring output ripple, it is recommended that an external ceramic capacitor (approx 10 µF) be placed from the +VOUT to the -VOUT pins.
6. Transient recovery is measured to within a 1% error band for a load step change of 25%.
7. Short circuit protection is provided by a "hiccup mode" circuit.
8. The control input (pin 6) is referenced to the -VIN (pin 2) input. If it is grounded, the unit will shut off.
9. Operation at no-load will not damage the unit, but they may not meet all specifications.
10. These units should not be operated over +85°C. Exceeding +85°C may damage the unit.
11. 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.

Derating Curve

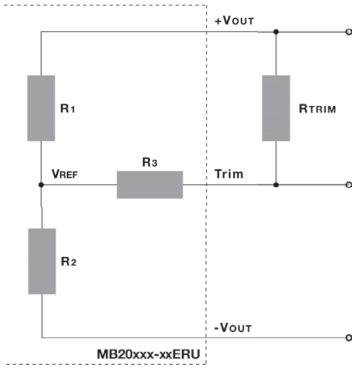


External Trim

Trim Up



Trim Down



External Trim Notes:

On single output units, an external resistor can be used to adjust the converter output up/down by about 10%. The connection is shown in the diagram at left. The required resistor value is calculated by the formulas:

$$\text{Trim UP} = R_{TRIM} = \frac{A \cdot R_2}{R_2 - A} - R_3 \quad \text{Where } A = \frac{V_{REF}}{V_{TRIM} - V_{REF}} \cdot R_1$$

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

Where R_{TRIM} = The value of the external trim resistor
V_{TRIM} = The amount of voltage adjustment required

The value of R_1, R_2, R_3 and V_{REF} are given in the table below.

Parameter	Output Voltage (VDC)					
	3.3	5.0	9.0	12	15	24
R1 (kΩ)	4.801	2.883	7.500	11.000	14.494	24.872
R2 (kΩ)	2.870	2.870	2.870	2.870	2.870	2.870
R3 (kΩ)	12.40	10.00	15.00	15.00	15.00	17.80
VREF (V)	1.24	2.50	2.50	2.50	2.50	2.50

If not used, the Trim pin (pin 4) should be left open. Please contact the factory for more information.

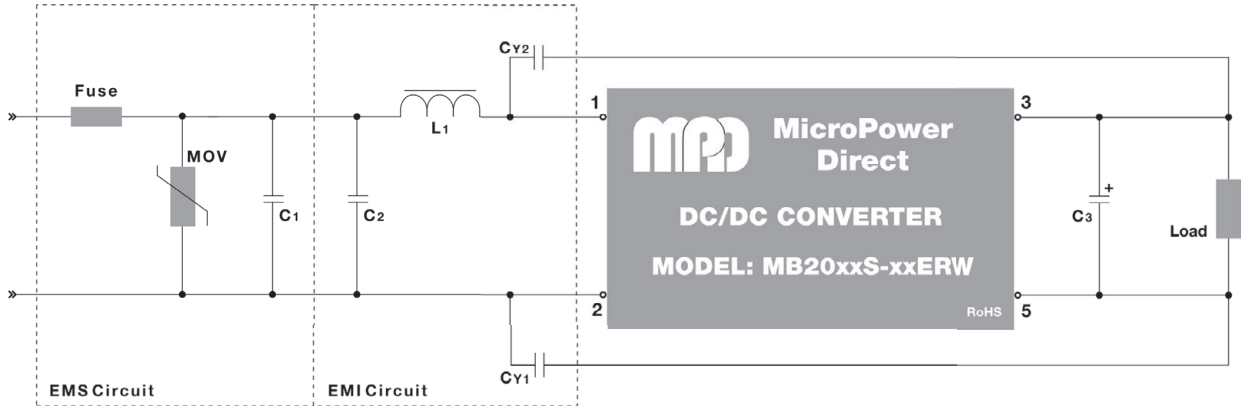
EMC Specifications

Parameter	Standard		
Radiated Emissions	See Note 1	EN 55022	Class A
Conducted Emissions	See Note 1	EN 55022	Class A
ESD		EN 61000-4-2	Criteria B; ±4 kV Contact
RS		EN 61000-4-3	Criteria A; 10V/m
EFT	See Note 2	EN 61000-4-4	Criteria B; ±2 kV
Surge	See Note 3	EN 61000-4-5	Criteria B; ±2 kV
CS		EN 61000-4-6	Criteria A; 3 Vrms
Voltage Dips		EN 61000-4-29	Criteria B; 0% - 70%

Notes:

1. All units are rated for EN 55022 (CE/RE) class A without external components. They will meet class B with the addition of the **MDCFM-xxW** (or a similar discrete filter circuit). Contact the factory for more information.
2. To meet the requirements of EN 61000-4-4 (±2 kV), external components are needed. This can be done discretely, or with the addition of the **MDCFM-xxW**. Contact the factory for more information.
3. To meet the requirements of EN 61000-4-5 (±2 kV line to line), external components are needed. This can be done discretely, or with the addition of the **MDCFM-xxW**. Contact the factory for more information.

Typical Connection



The diagram above illustrates a typical connection of the **MB2000ERW** series for applications that require meeting EMC standards. The units do not require external components to operate as specified. Some notes on this diagram (starting with the input circuit) are:

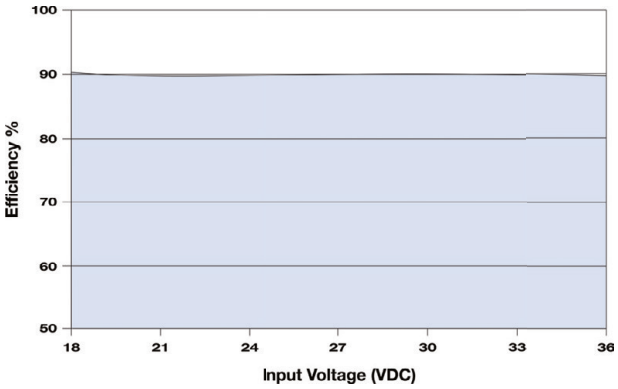
1. It is recommended that an external fuse be used. The recommended fuse is shown in the model chart on page 2.
2. An external MOV is recommended on the input to protect the unit in the event of a surge. A recommended value is given in the table at right.
3. The output filtering capacitor (C_3) is a high frequency, low resistance electrolytic capacitor. Care must be taken in choosing this capacitor not to exceed the capacitive load specification for the unit. The board layout illustration below shows a connection for dual output units. Voltage derating of capacitors should be 80% or above.
4. Recommended values for components are:

Component	24 VIN	48 VIN
MOV	S20K30	S14K60
C_1	330 µF/50V	330 µF/100V
C_2	1.0 µF/50V	1.0 µF/100V
L_1	4.7 µH	4.7 µH
C_{Y1}, C_{Y2}	1,000 pF/2 kV	1,000 pF/2 kV

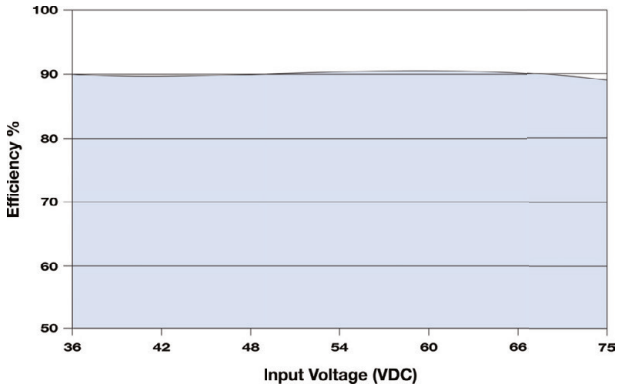
5. Input noise and surge suppression modules are available for a number of **MPD** DC/DC power supplies. For pricing or full technical information on these modules please contact the factory.
6. In many applications simply adding input/output capacitors will enhance the input surge protection and reduce output ripple sufficiently. The input capacitor C_1 and output capacitor C_3 shown in the typical connection diagram above illustrate their connection. Recommended capacitor values are given in the table at right.

Vin (VDC)	Input Capacitor	Vout (VDC)	Output Capacitor
24	100 µF	3.3	470 µF
		5.0	470 µF
48	100 µF	9.0	220 µF
		12	220 µF
		15	220 µF
		24	100 µF
		±5	±220 µF
		±9	±100 µF
		±12	±100 µF
		±15	±100 µF

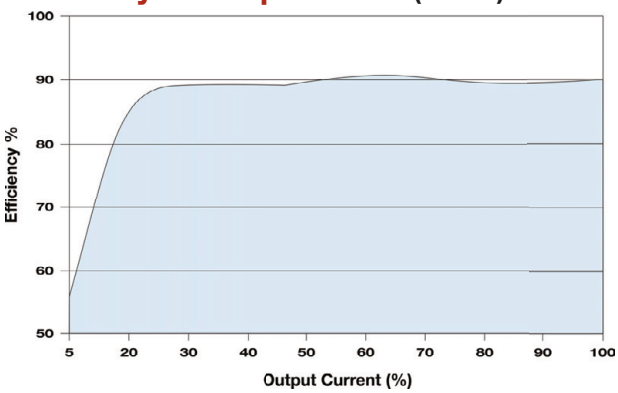
Efficiency vs Input Voltage: (FL, 24 VIN)



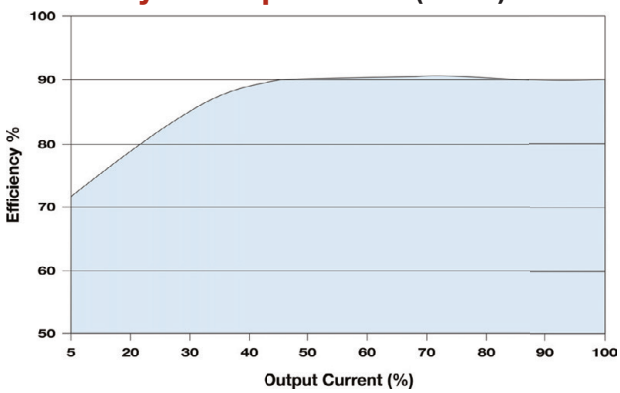
Efficiency vs Input Voltage: (FL, 48 VIN)



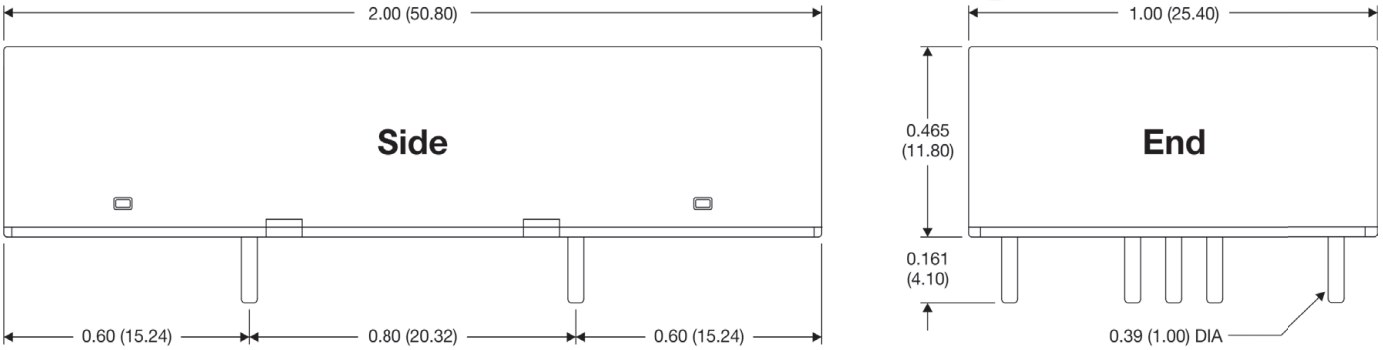
Efficiency vs Output Load: (24 VIN)

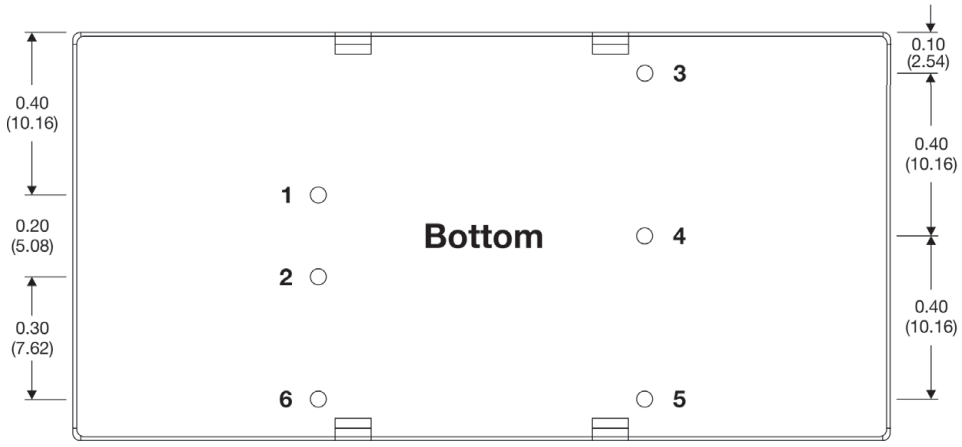


Efficiency vs Output Load: (48 VIN)



Mechanical Dimensions





Pin Connections

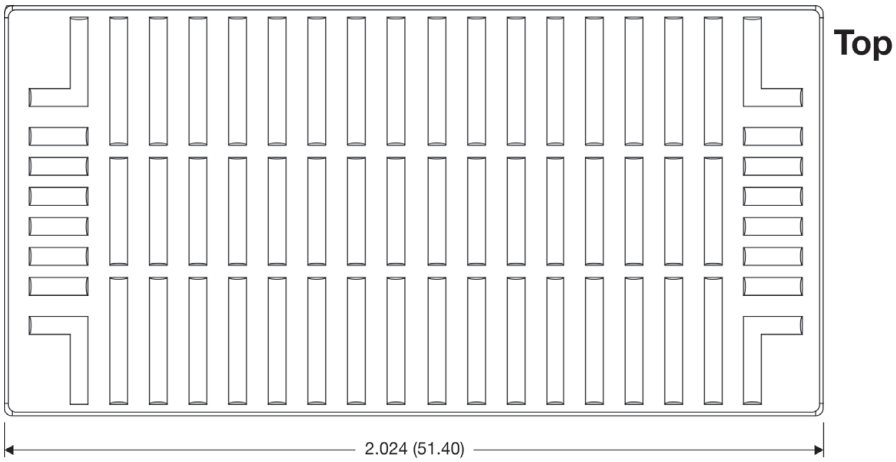
Pin	Single Output
1	+VIN
2	-VIN
3	+VOUT
4	Trim
5	-VOUT
6	Remote On/Off

Pin	Dual Output
1	+VIN
2	-VIN
3	+VOUT
4	Common
5	-VOUT
6	Remote On/Off

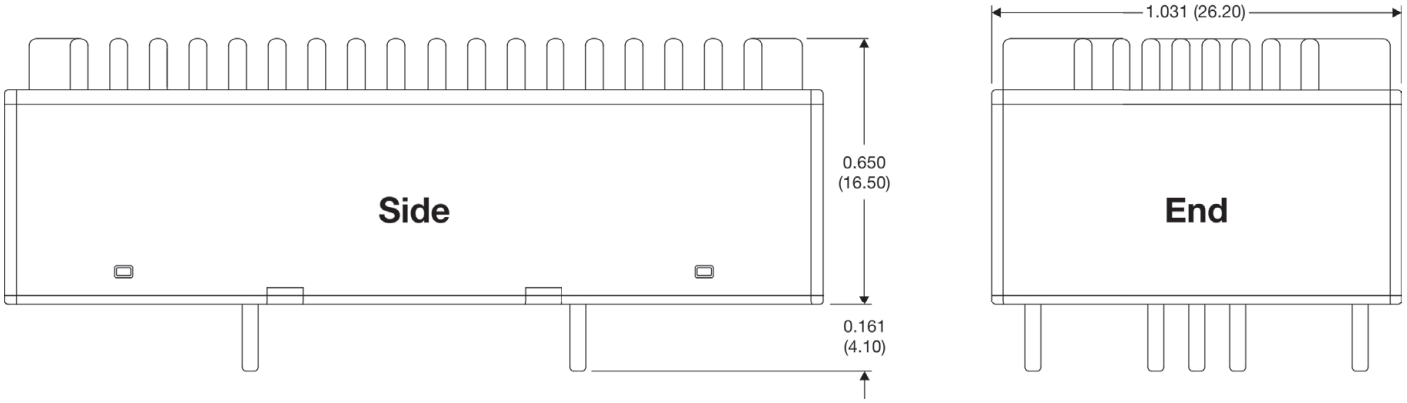
Notes:

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

Mechanical Dimensions: With Optional Heatsink



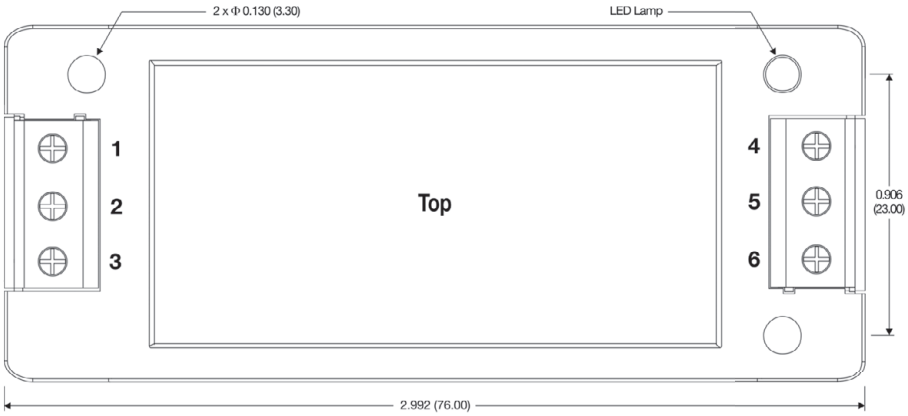
For the heatsink option, add suffix "H" to the model number (i.e. **MB2024S-05ERW-H**)

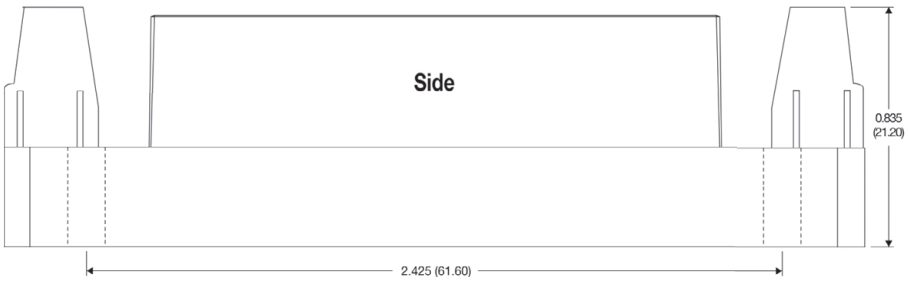


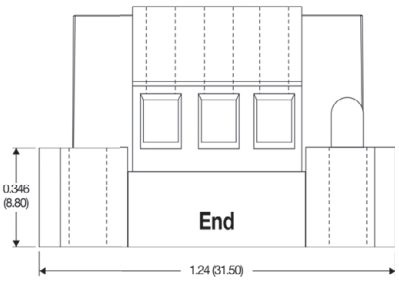
Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Weight (Typ) = 1.20 Oz (34g)

Mechanical Dimensions: A2 Chassis Mount Adapter



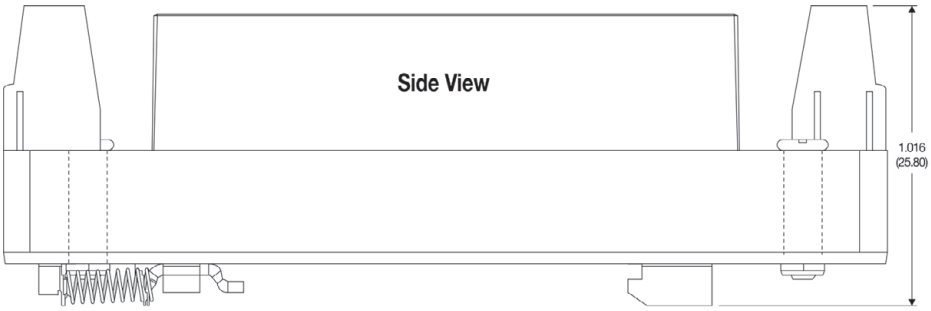


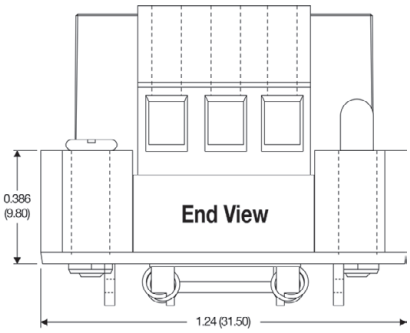


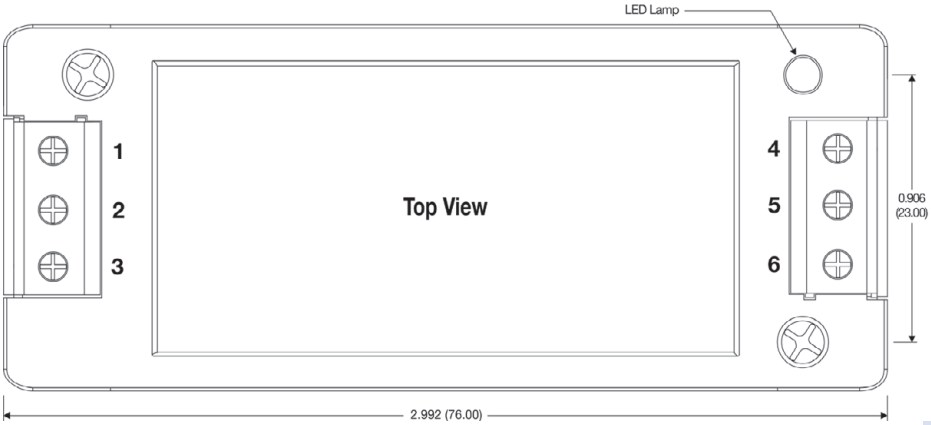
Notes:

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

Mechanical Dimensions: A4 DIN Rail Adapter







Pin Connections

Pin	Single Output	Dual Output
1	Remote On/Off	
2	-VIN	-VIN
3	+VIN	+VIN
4	-VOUT	-VOUT
5	Trim (•)	Common
6	+VOUT	+VOUT

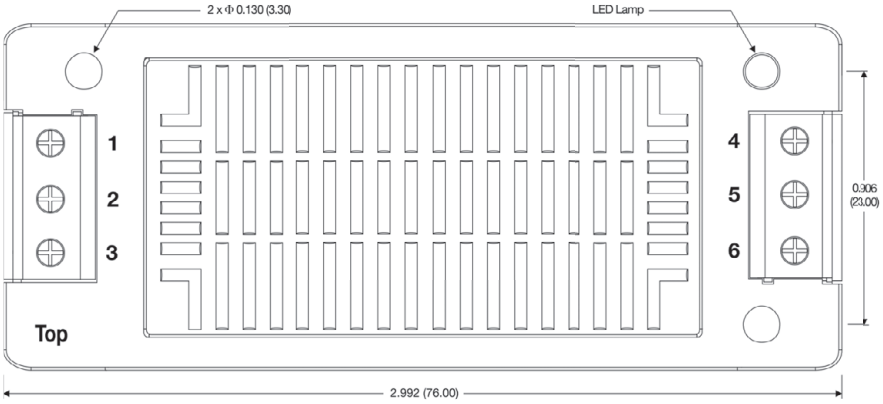
Notes:

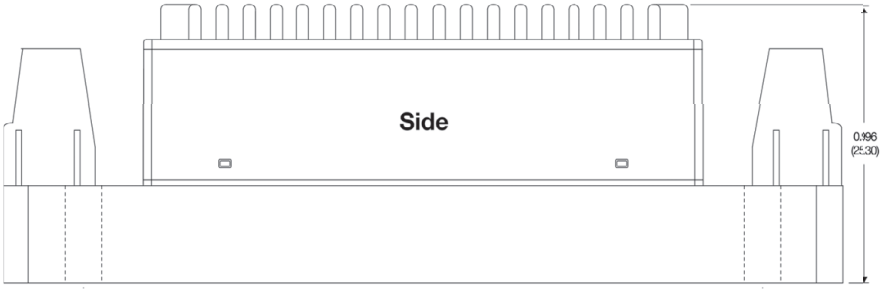
- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Weight (Typ) = 2.40 Oz (68g)

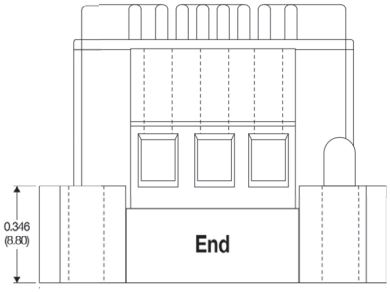
For the chassis mount option, add suffix "A2" to the model number (i.e. **MB2024D-09ERW-A2**)

For the DIN rail mount option, add suffix "A4" to the model number (i.e. **MB2024D-09ERW-A4**)

Mechanical Dimensions: A2 Chassis Mount Adapter



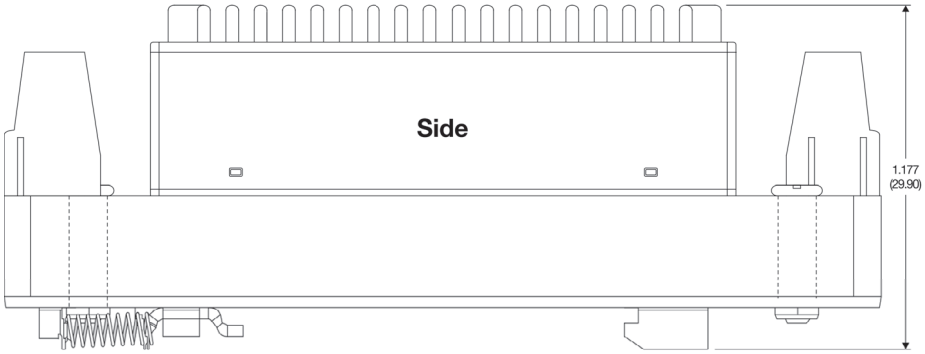


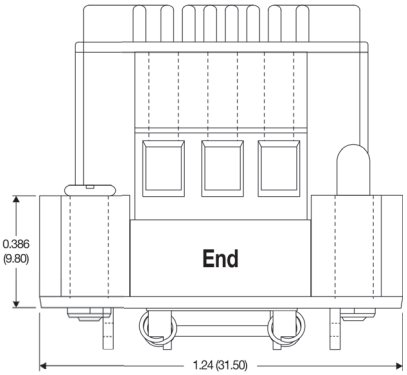


Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Weight (Typ) = 1.98 Oz (56g)

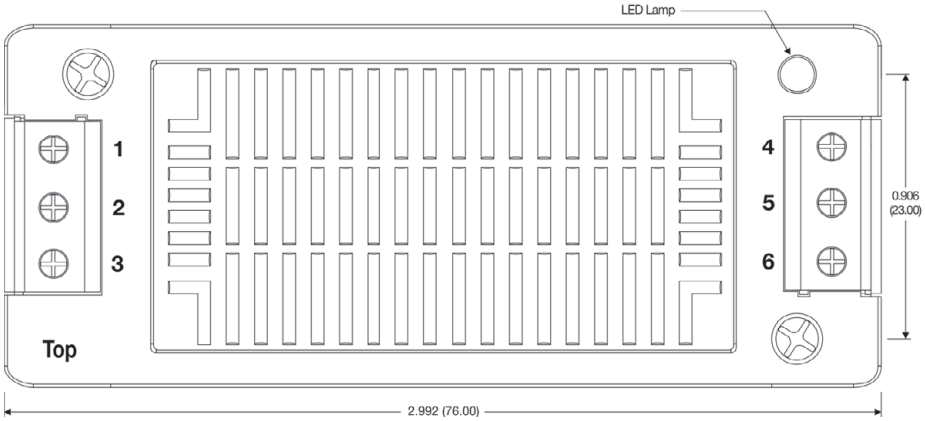
Mechanical Dimensions: A4 DIN Rail Adapter





Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Weight (Typ) = 2.68 Oz (76g)



Pin Connections

Pin	Single Output	Dual Output
1	Remote On/Off	
2	-VIN	-VIN
3	+VIN	+VIN
4	-VOUT	-VOUT
5	Trim (•)	Common
6	+VOUT	+VOUT

For the chassis mount option, add suffix "A2" to the model number (i.e. **MB2048S-12ERW-A2 -H**)

For the DIN rail mount option, add suffix "A4" to the model number (i.e. **MB2048S-12ERW-A4-H**)

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