

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



MicroPower Direct



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.

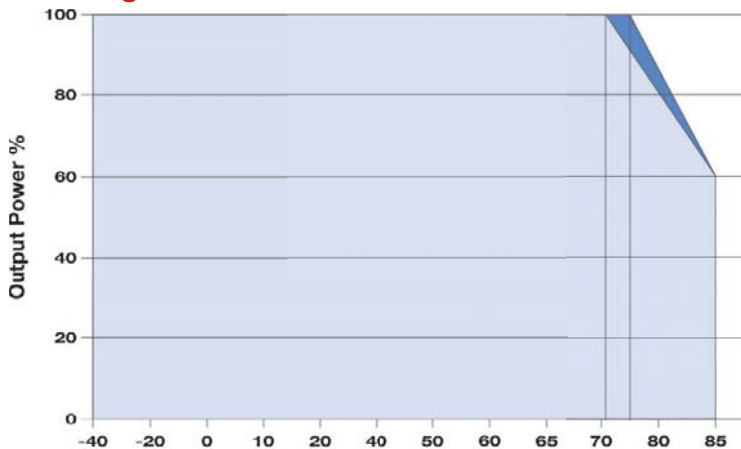
Model Selection Guide

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

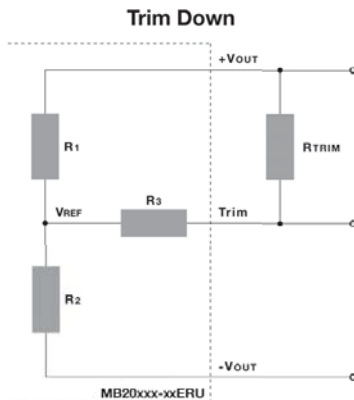
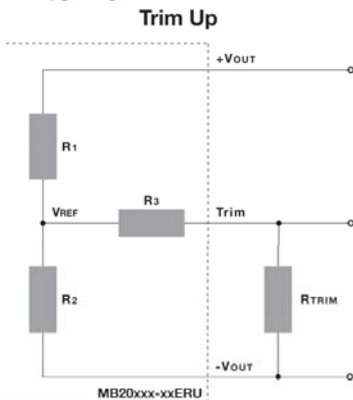
Notes:

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



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 R₁, R₂, R₃ and V_{REF} are given in the table below.

Parameter	Output Voltage (VDC)					
	3.3	5.0	9.0	12	15	24
R ₁ (kΩ)	4.801	2.883	7.500	11.000	14.494	24.872
R ₂ (kΩ)	2.870	2.870	2.870	2.870	2.870	2.870
R ₃ (kΩ)	12.40	10.00	15.00	15.00	15.00	17.80
V _{REF} (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

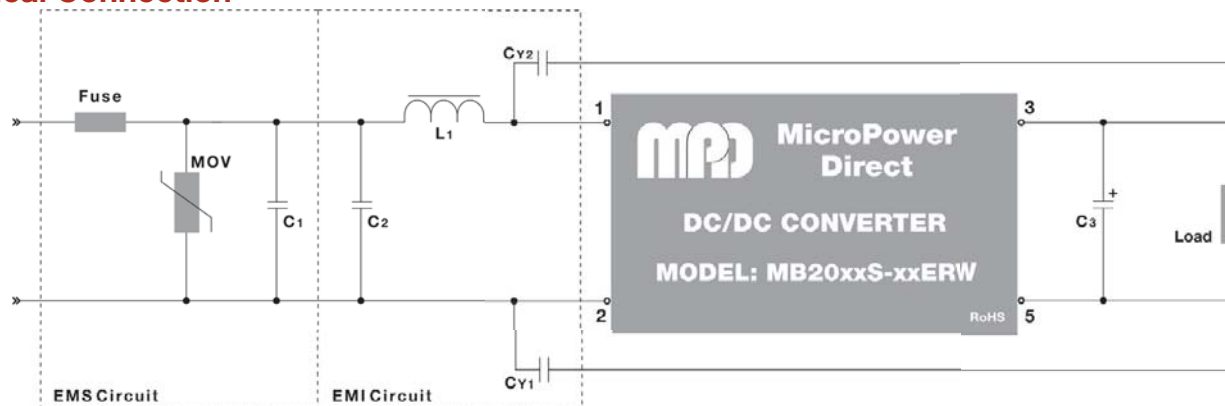
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Parameter	Standard		
Radiated Emissions	See Note 1	EN 55022	Class A
Conducted Emissions	See Note 1	EN 55022	Class A
ESD		EN 61000-4-2	Criteria B; ±4 kV Contact
RS		EN 61000-4-3	Criteria A; 10V/m
EFT	See Note 2	EN 61000-4-4	Criteria B; ±2 kV
Surge	See 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:

- 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.
- 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.
- 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:

- It is recommended that an external fuse be used. The recommended fuse is shown in the model chart on page 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.
- The output filtering capacitor (C₃) 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:

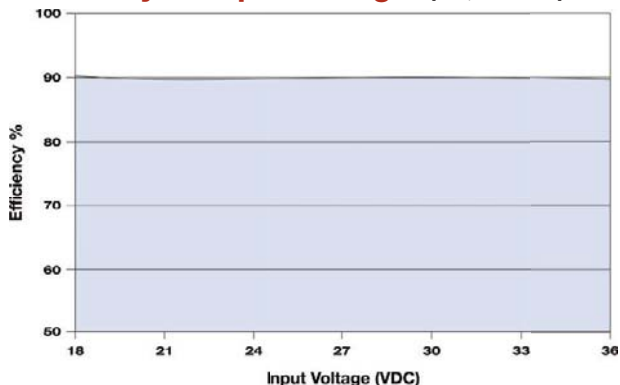
Component	24 V _{IN}	48 V _{IN}
MOV	S20K30	S14K60
C ₁	330 µF/50V	330 µF/100V
C ₂	1.0 µF/50V	1.0 µF/100V
L ₁	4.7 µH	4.7 µH
C _{y1} , C _{y2}	1,000 pF/2 kV	1,000 pF/2 kV

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.

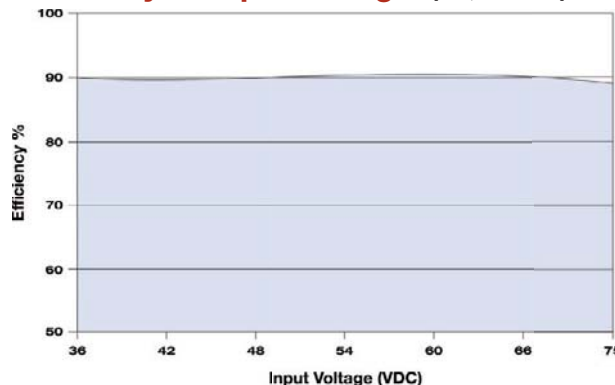
6. In many applications simply adding input/output capacitors will enhance the input surge protection and reduce output ripple sufficiently. The input capacitor C₁ and output capacitor C₃ shown in the typical connection diagram above illustrate their connection. Recommended capacitor values are given in the table at right.

V _{IN} (VDC)	Input Capacitor	V _{OUT} (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

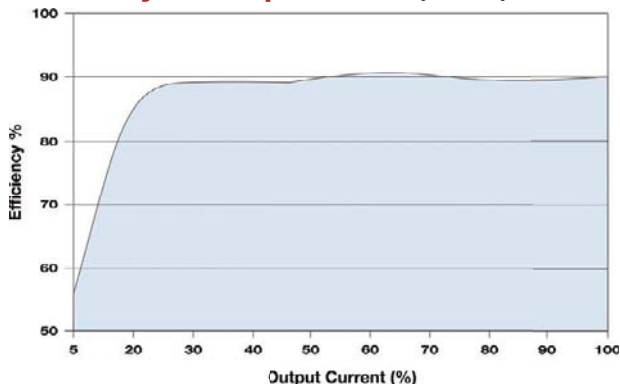
Efficiency vs Input Voltage: (FL, 24 V_{IN})



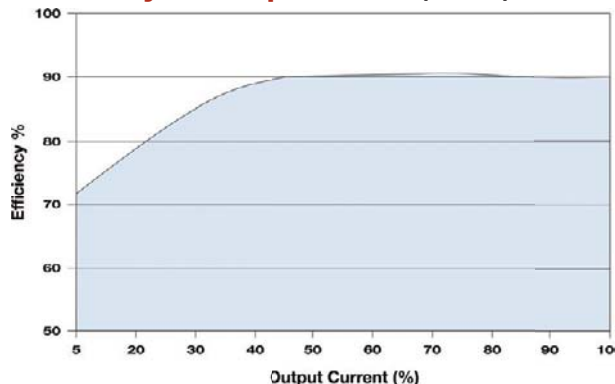
Efficiency vs Input Voltage: (FL, 48 V_{IN})



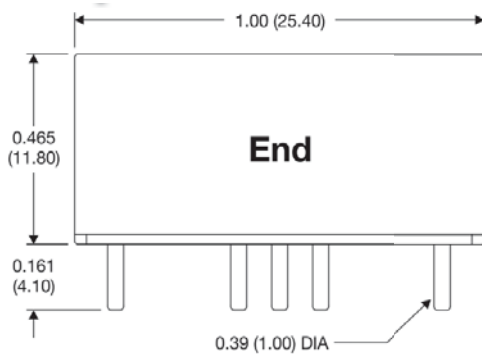
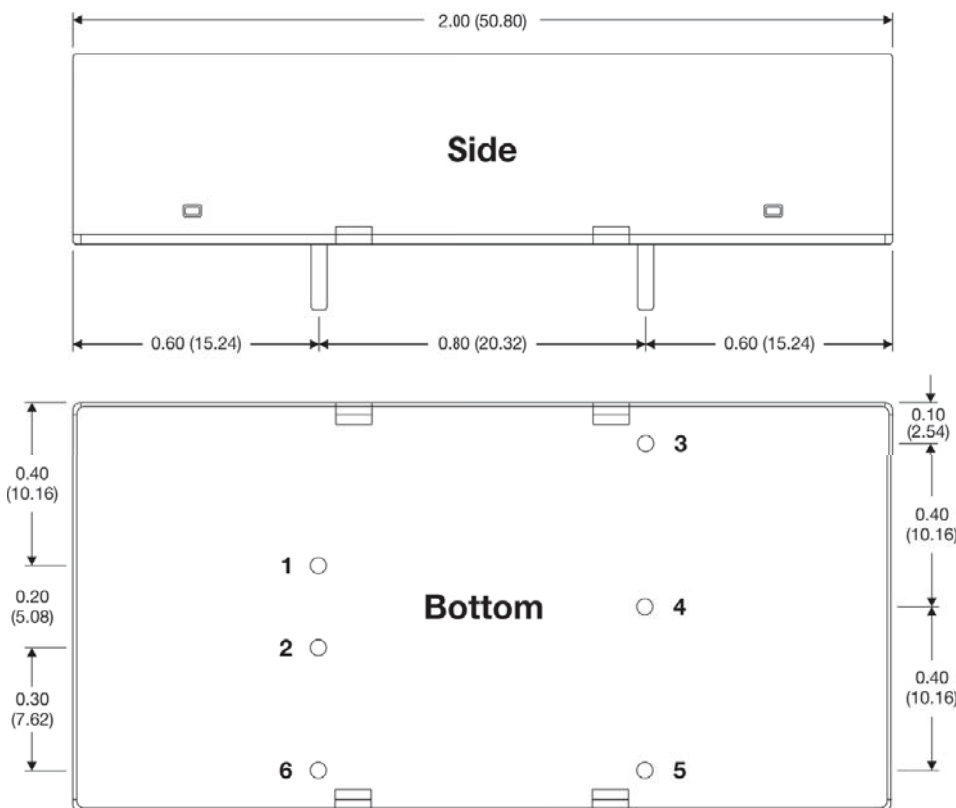
Efficiency vs Output Load: (24 V_{IN})



Efficiency vs Output Load: (48 V_{IN})



Mechanical Dimensions



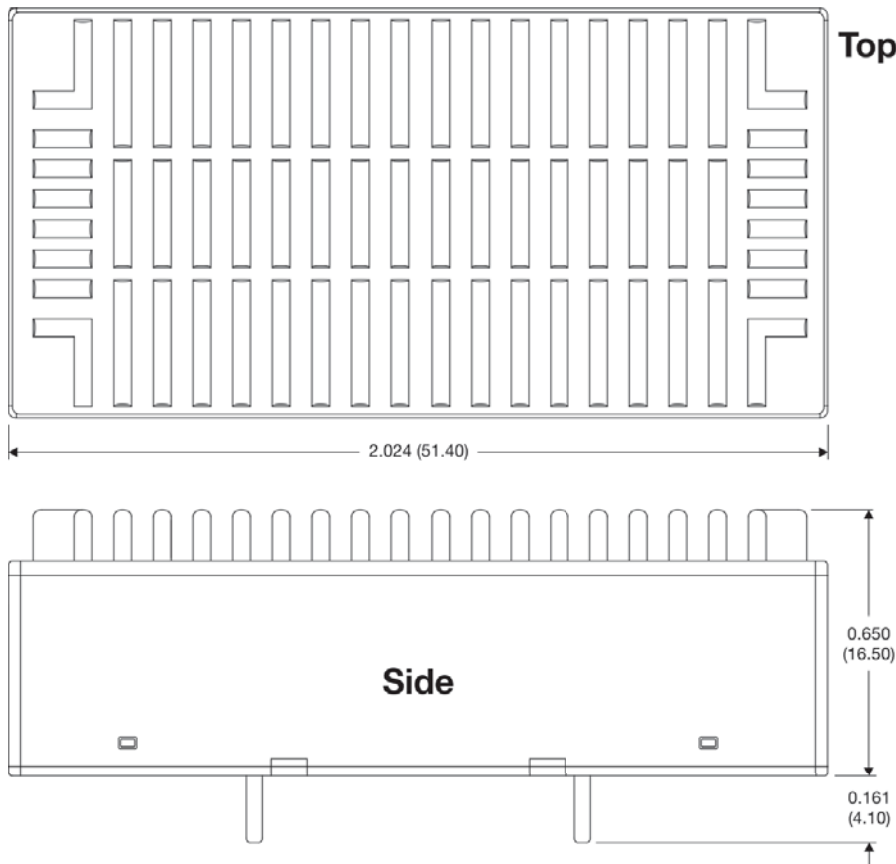
Pin Connections

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



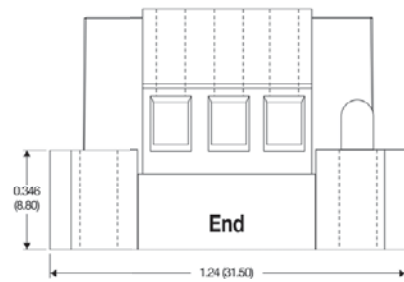
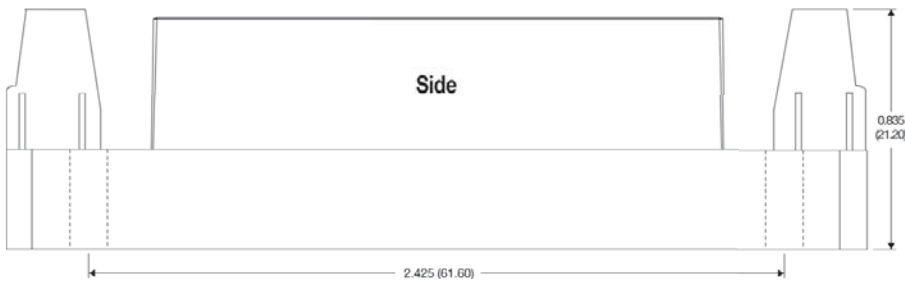
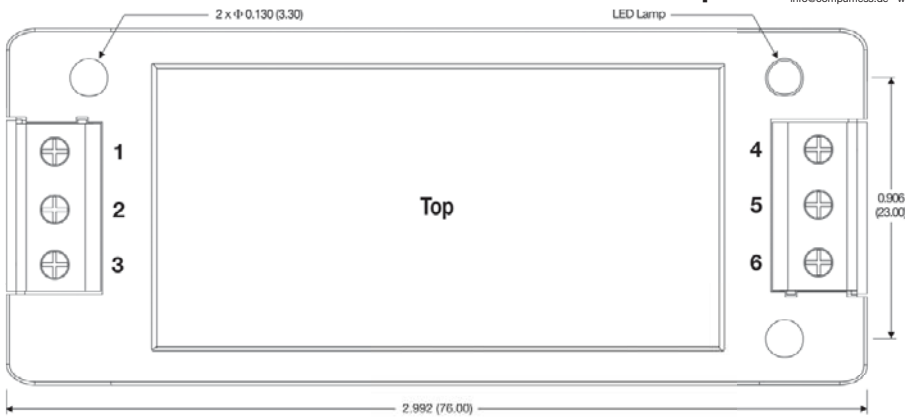
For the heatsink option, add suffix "H" to the model number (i.e. **MB2024S-05ERW-H**)

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

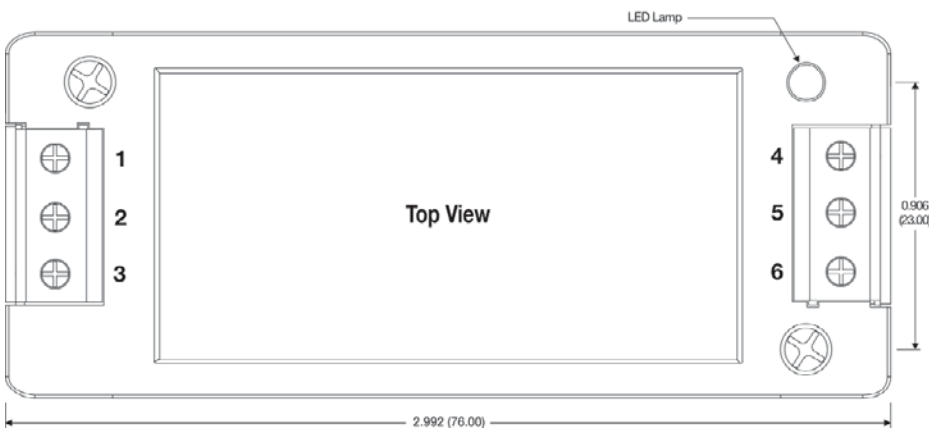
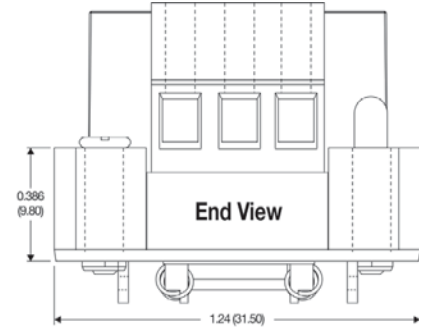
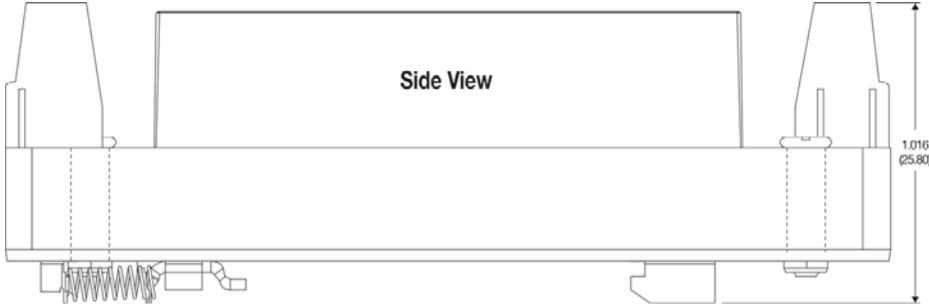
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Notes:

- 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:

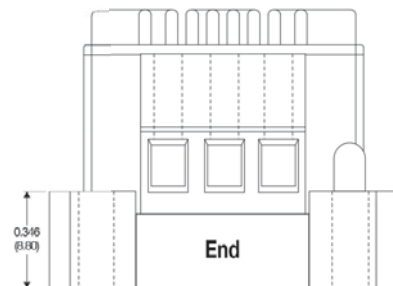
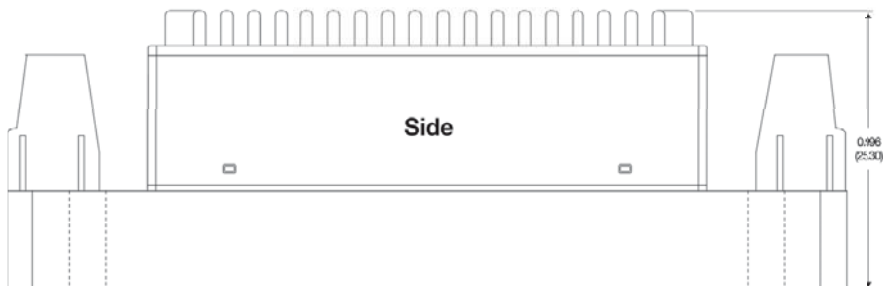
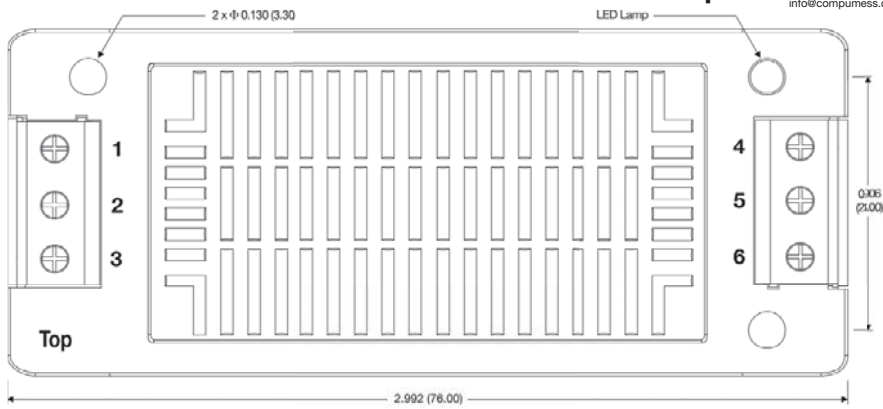
- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Weight (Typ) = 2.40 Oz (68g)

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

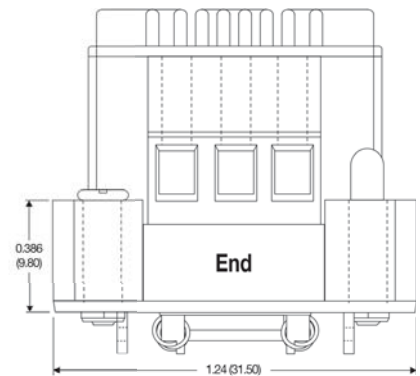
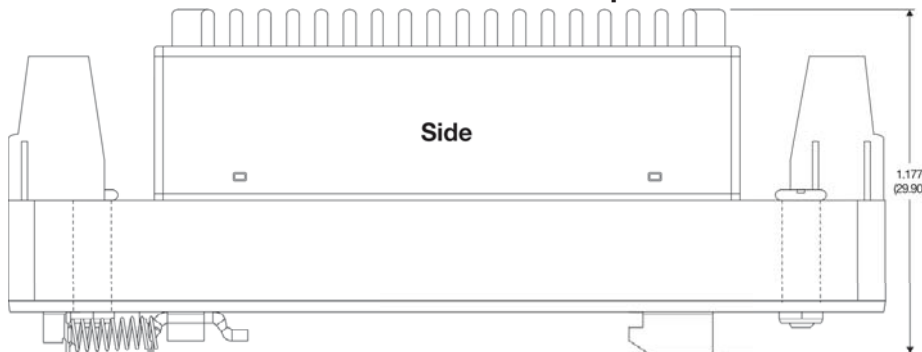
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Notes:

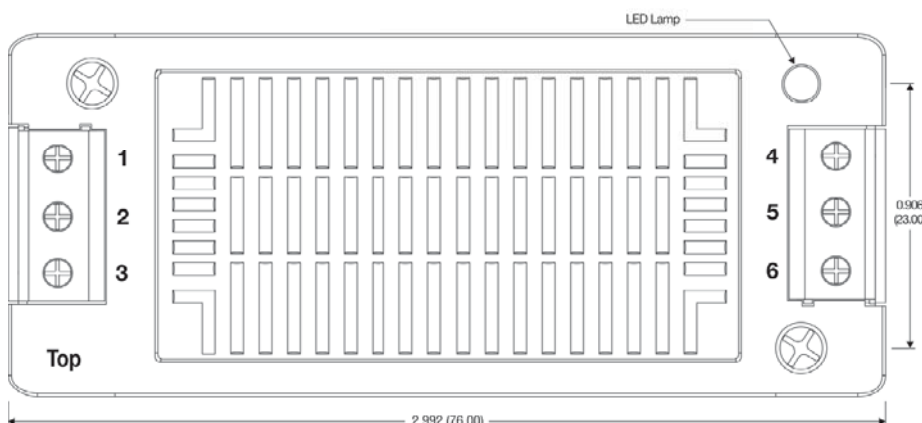
- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Weight (Typ) = 1.98 Oz (56g)

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)