

MB2000ERU

Low Cost, 1 x 2 Inch 20W, 4:1 Input Range DC/DC Converters



Key Features:

- 20W Output Power
- 4:1 Input Voltage Range
- EN 60950 Approved
- 1,500 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



RoHS



Electrical Specifications

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

Input		Min.	Typ.	Max.	Units
Parameter	Conditions				
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	14.0	15.5		
Reflected Ripple Current			30.0		mA
Start-Up Time	See Note 2		10		mS
Input Filter	π (Pi) Filter				

Output		Min.	Typ.	Max.	Units
Parameter	Conditions				
Output Voltage Accuracy			±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 3			±5.0	%
Ripple & Noise (20 MHz)	See Note 4		50	100	mV P - P
Transient Recovery Time, See Note 5			300	500	µSec
Transient Response Deviation	3.3, 5.0 & ±5.0 VDC Output Models		±5.0	±8.0	%
	All Other Outputs		±3.0	±5.0	
Over Voltage Protection		110		160	%VOUT
Output Power Protection		110		190	%IOUT
Temperature Coefficient				±0.03	%/°C
Output Short Circuit, See Note 6	Continuous (Autorecovery)				

General		Min.	Typ.	Max.	Units
Parameter	Conditions				
Isolation Voltage	60 Seconds	1,500			VDC
Isolation Resistance	500 VDC	1,000			MΩ
Isolation Capacitance	See Note 7		1,050		pF
Switching Frequency			270		kHz

Environmental		Min.	Typ.	Max.	Units
Parameter	Conditions				
Operating Temperature Range	Ambient	-40	+25	+85	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%

Physical		
Parameter	Conditions	
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		Min.	Typ.	Max.	Units
Parameter	Conditions				
Unit On	See Note 8	3.5		12.0	VDC
Unit Off	See Note 8	0		1.2	VDC
Off Idle Current			1.0		mA

Reliability Specifications		Min.	Typ.	Max.	Units
Parameter	Conditions				
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		Min.	Typ.	Max.	Units
Parameter	Conditions				
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.

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-03ERU	24	9.0 - 36.0	799	40	3.3	5,000	0.0	86	10,000	2,000
MB2024S-05ERU	24	9.0 - 36.0	925	40	5.0	4,000	0.0	90	10,000	2,000
MB2024S-09ERU	24	9.0 - 36.0	936	6	9.0	2,222	0.0	89	4,700	2,000
MB2024S-12ERU	24	9.0 - 36.0	936	6	12.0	1,667	0.0	89	1,600	2,000
MB2024S-15ERU	24	9.0 - 36.0	925	6	15.0	1,333	0.0	90	1,000	2,000
MB2024S-24ERU	24	9.0 - 36.0	925	6	24.0	834	0.0	90	500	2,000
MB2024D-05ERU	24	9.0 - 36.0	969	40	±5.0	±2,000	±0.0	86	4,800	2,000
MB2024D-09ERU	24	9.0 - 36.0	947	6	±9.0	±1,111	±0.0	88	1,000	2,000
MB2024D-12ERU	24	9.0 - 36.0	947	6	±12.0	±834	±0.0	88	800	2,000
MB2024D-15ERU	24	9.0 - 36.0	947	6	±15.0	±667	±0.0	88	625	2,000
MB2048S-03ERU	48	18.0 - 75.0	400	20	3.3	5,000	0.0	86	10,000	1,000
MB2048S-05ERU	48	18.0 - 75.0	463	20	5.0	4,000	0.0	90	10,000	1,000
MB2048S-12ERU	48	18.0 - 75.0	468	5	12.0	1,667	0.0	89	1,600	1,000
MB2048S-15ERU	48	18.0 - 75.0	463	5	15.0	1,333	0.0	90	1,000	1,000
MB2048S-24ERU	48	18.0 - 75.0	463	5	24.0	834	0.0	90	500	1,000
MB2048D-05ERU	48	18.0 - 75.0	484	20	±5.0	±2,000	±0.0	86	4,800	1,000
MB2048D-12ERU	48	18.0 - 75.0	473	5	±12.0	±834	±0.0	88	800	1,000
MB2048D-24ERU	48	18.0 - 75.0	463	5	±15.0	±667	±0.0	89	625	1,000

Notes:

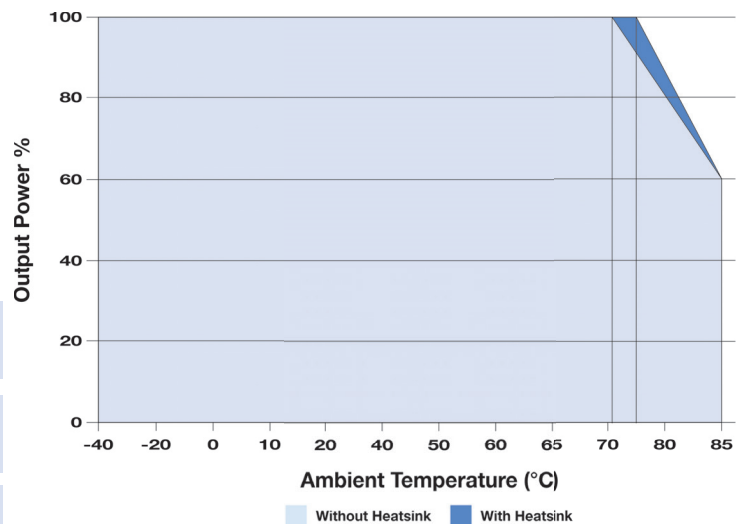
1. The specified maximum capacitive load is for each output.
2. Start up time is measured at nominal input and with a constant resistive load.
3. Cross regulation is measured with the main output set at 50% load. The second output is varied from 10% to 100% load.
4. When measuring output ripple, it is recommended that an external ceramic capacitor (approx 1 μF to 10 μF) be placed from the +V_{OUT} to the -V_{OUT} pins.
5. Transient recovery is measured to within a 1% error band for a load step change of 25%.
6. Short circuit protection is provided by a "hiccup mode" circuit.
7. Isolation capacitance for 24 VDC output models is 2,050 pF. Isolation capacitance is measured from input to output at 100 kHz/0.1V.
8. The control input (pin 6) is referenced to the -V_{IN} (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. 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 heatsink option, add the suffix "-H" to the model number (i.e. **MB2024S-05ERU-H**)

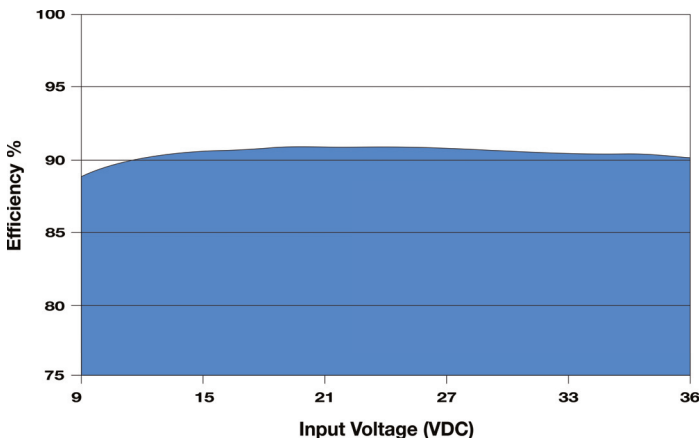
For the A2S adapter board option, add the suffix "-A2S" to the model number (i.e. **MB2048S-05ERU-A2S** or **MB2048S-05ERU-A2S-H**)

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

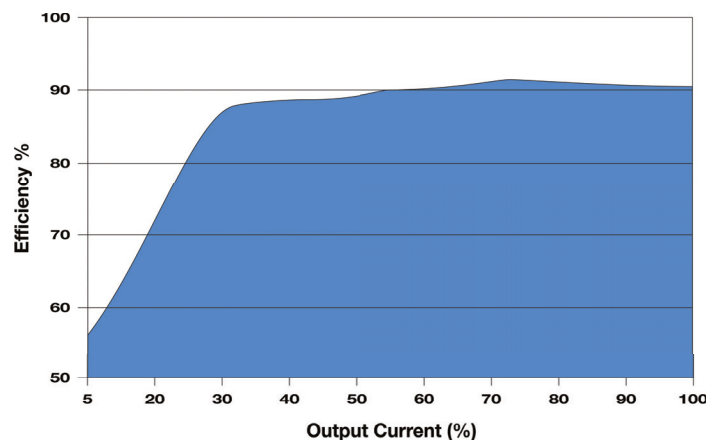
Derating Curve



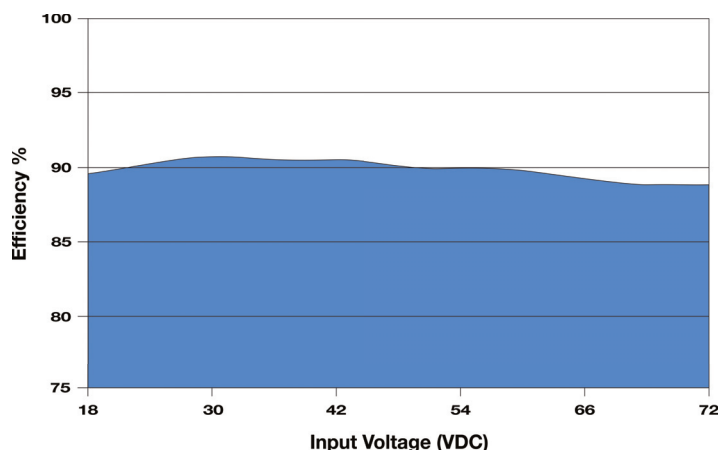
Efficiency vs Input Voltage: 24 V_{IN}



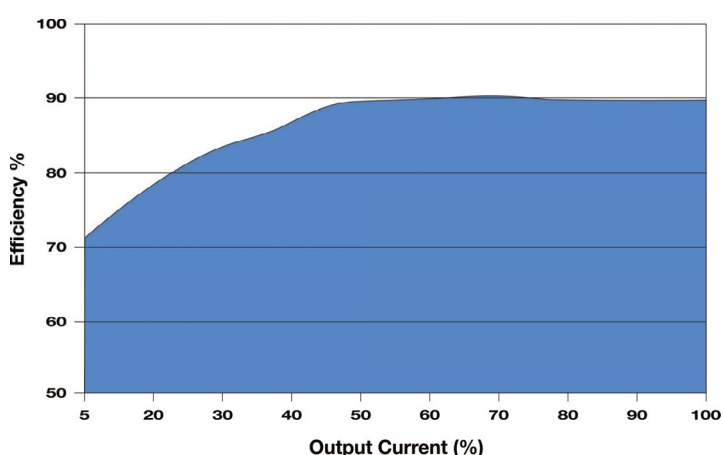
Efficiency vs Output Load: 24 V_{IN}



Efficiency vs Input Voltage: 48 VIN



Efficiency vs Output Load: 48 VIN



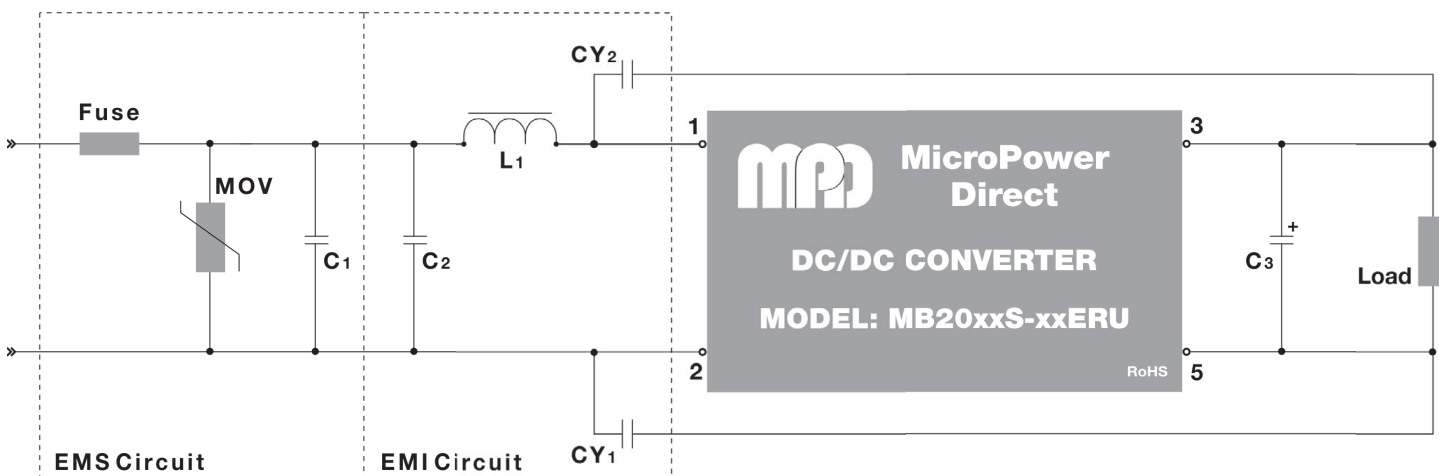
EMI Characteristics

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:

1. 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 the Simple Connection diagram and note 5 below.
2. To meet the requirements of EN 61000-4-4, external components are needed. The Typical Connection diagram below shows an external input filter that would typically achieve this. Contact the factory for more information.
3. To meet the requirements of EN 61000-4-5, external components are needed. This can be done as shown in the Typical Connection diagram below. Contact the factory for more information.

Typical Connection



For applications that require meeting EMC standards, the diagram above illustrates a typical connection of the **MB2000xERU** series. The units do not require external components to operate as specified. Some notes on this diagram (starting with the input circuit) are:

1. An external fuse should be used in all power module applications. The recommended fuse is shown in the model chart on page 2.
2. To protect against a surge, an external MOV is recommended on the input. A suggested value is given in the table at right.
3. 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.

4. Recommended values for components are:

Component	24 VIN	48 VIN
MOV	S20K30	S14K60
C1	330 μ F/50V	330 μ F/100V
C2	1 μ F/50V	1 μ F/100V
L1	4.7 μ H	4.7 μ H
CY1	1 nF/2 kV	1 nF/2 kV
CY2	1 nF/2 kV	1 nF/2 kV
C4	See chart under note 5	

5. 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	CIN	COUT
3.3/5.0 VOUT	100 μ F	470 μ F
9.0/12/15 VOUT		220 μ F
24 VOUT		100 μ F
±5.0 VOUT		220 μ F
±9.0/±12/±15 VOUT		100 μ F

External Trim

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 diagrams below. The required resistor value is calculated by the formulas:

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

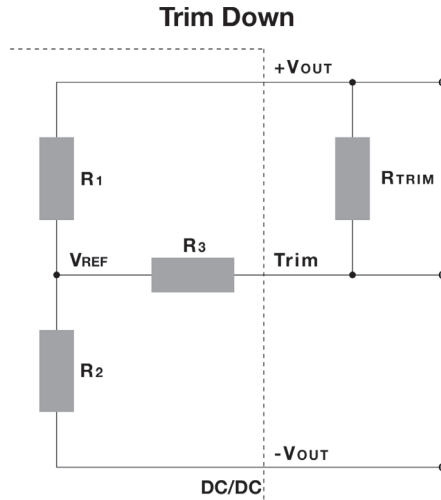
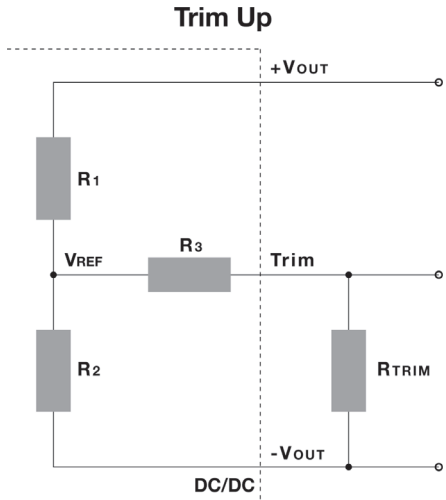
$$\text{Trim Down} = R_{\text{TRIM}} = \frac{A \times R_1}{R_1 - A} - R_3 \quad \text{Where } A = \frac{V_{\text{OUT}} - V_{\text{REF}}}{V_{\text{REF}}} \times R_2$$

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

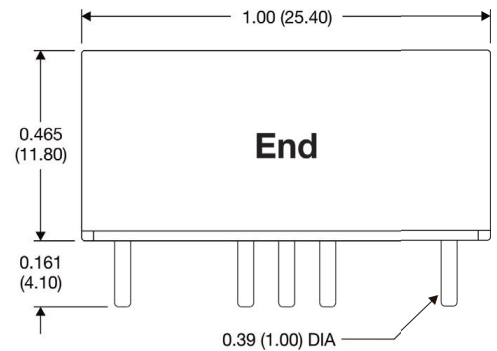
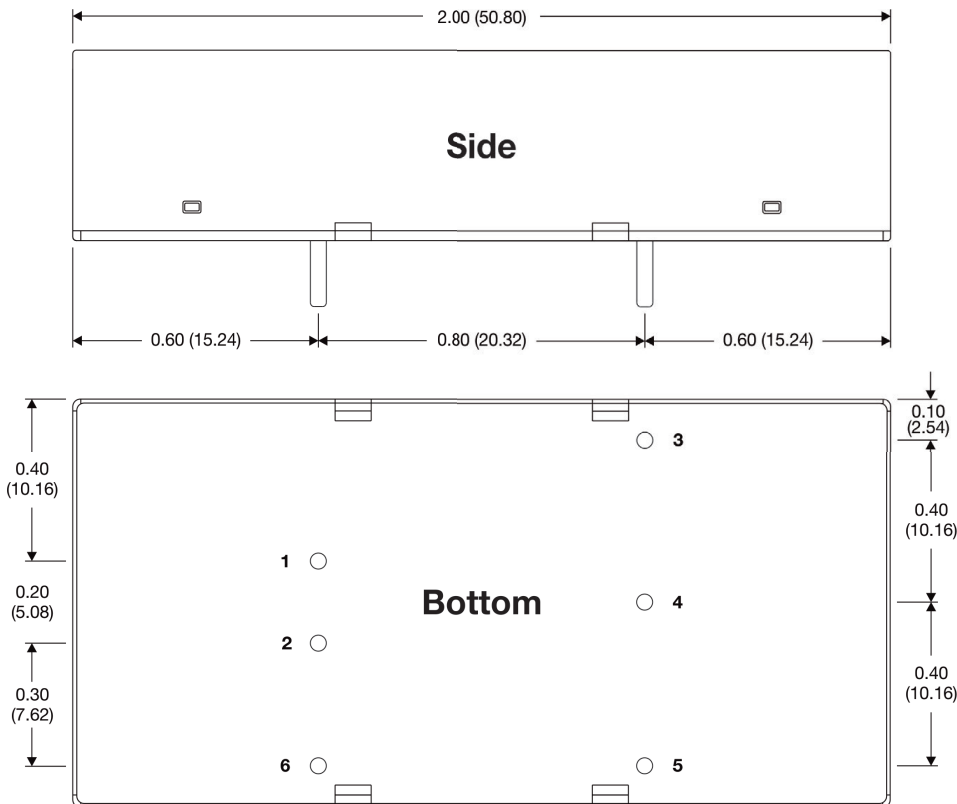
The values of R_1 , R_2 , R_3 and V_{REF} are given in the table at right.

Output Trim Resistor Values

Output Voltage	Resistor Value			
	R_1 (k Ω)	R_2 (k Ω)	R_3 (k Ω)	V_{REF} (V)
3.3 VDC	4.801	2.883	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



Mechanical Dimensions



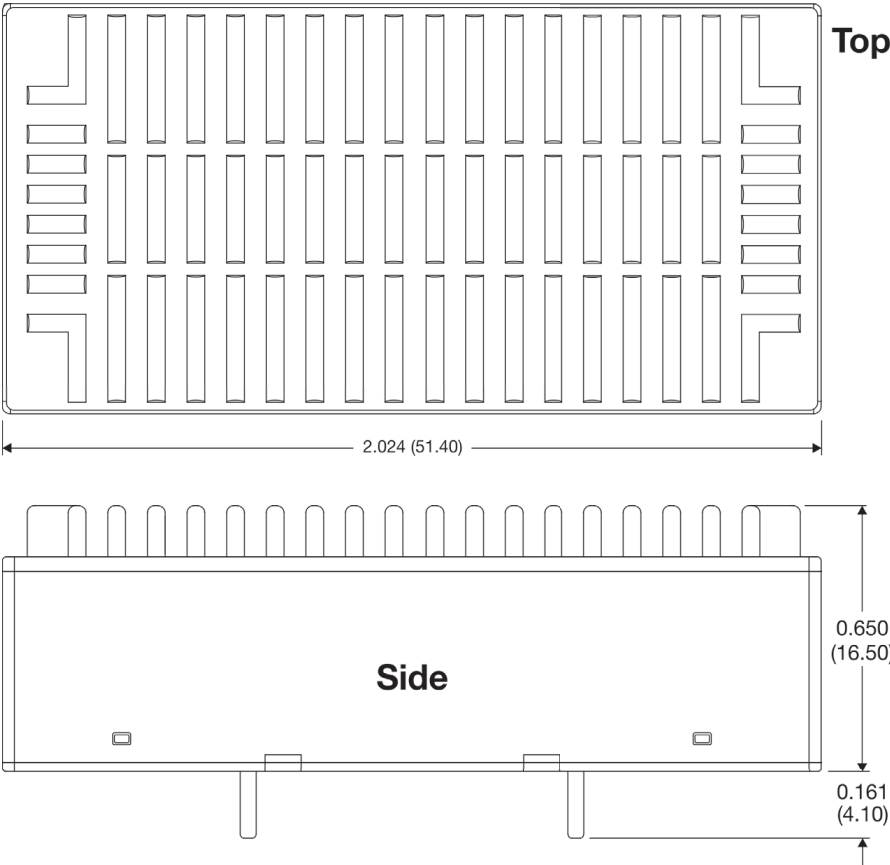
Pin Connections

Pin	Single	Dual
1	+VIN	+VIN
2	-VIN	-VIN
3	+VOUT	+VOUT
4	Trim	Common
5	-VOUT	-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)

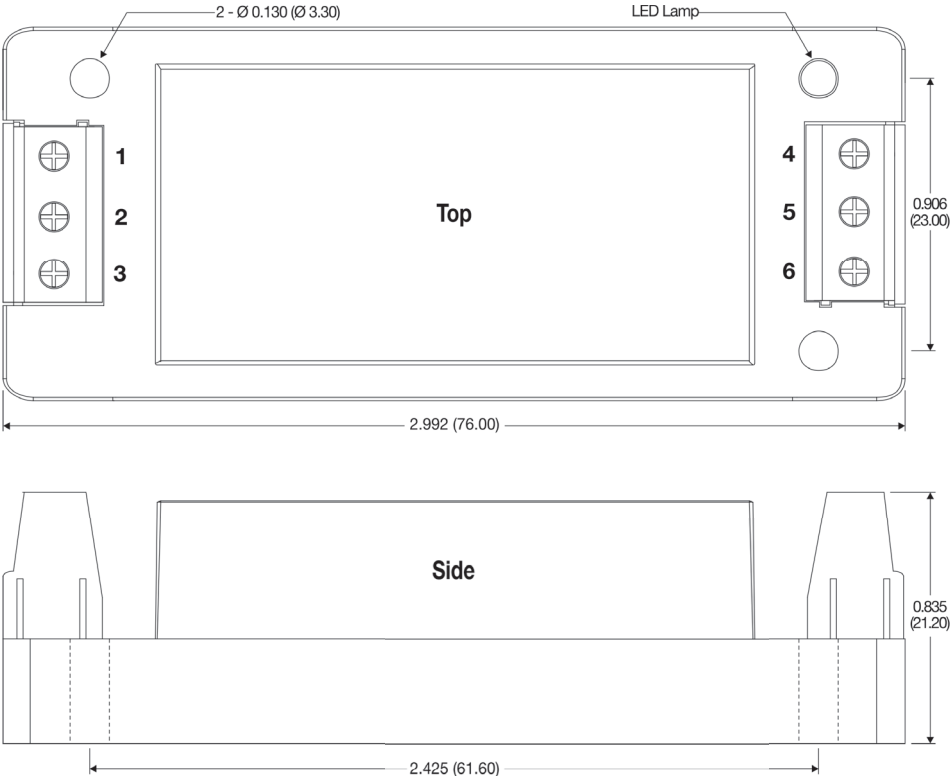
Mechanical Dimensions: With Optional Heatsink



For the heatsink option, add the 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



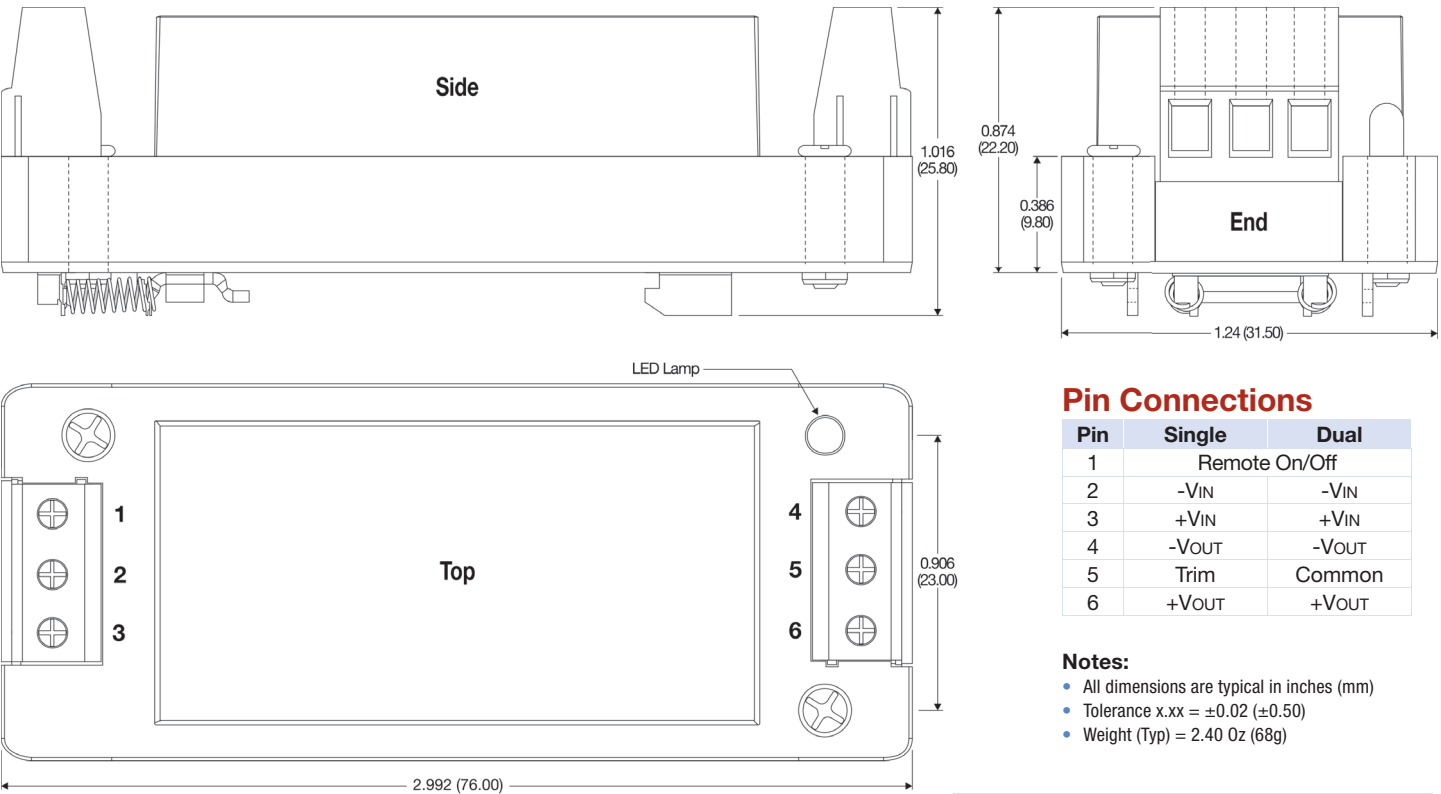
Pin Connections

Pin	Single	Dual
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) = 1.69 Oz (48g)

For the chassis mount option, add the suffix “-A2” to the model number (i.e. **MB2024U-05ERU-A2**)

Mechanical Dimensions: A4 DIN Rail Adapter



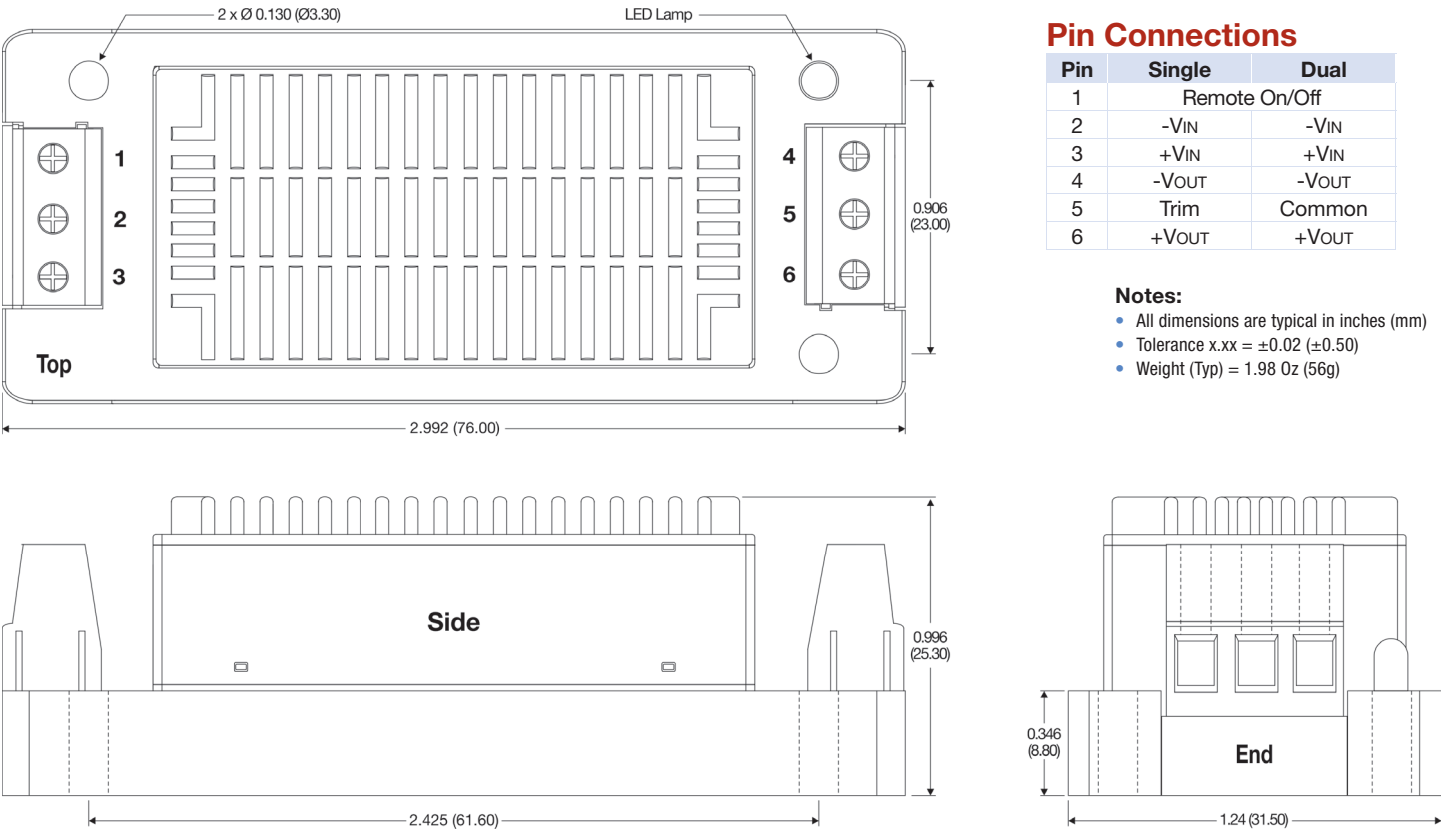
Pin Connections

Pin	Single	Dual
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 DIN rail mount option, add the suffix “-A4” to the model number (i.e. **MB2024S-05ERU-A4**)

Mechanical Dimensions: A2 Chassis Mount Adapter with Heatsink



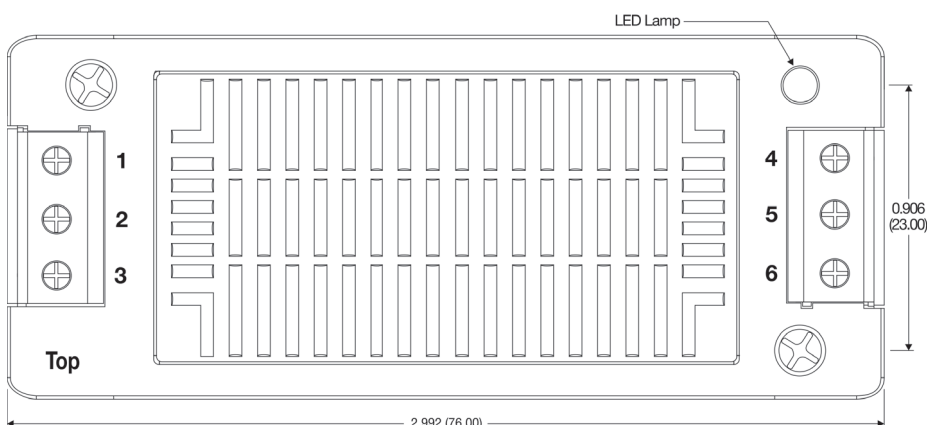
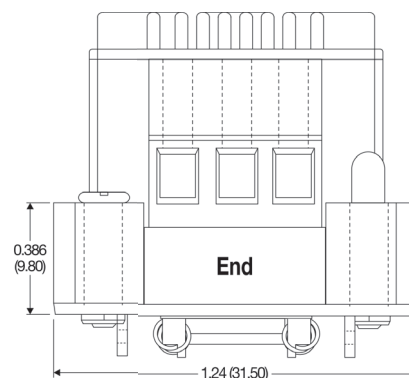
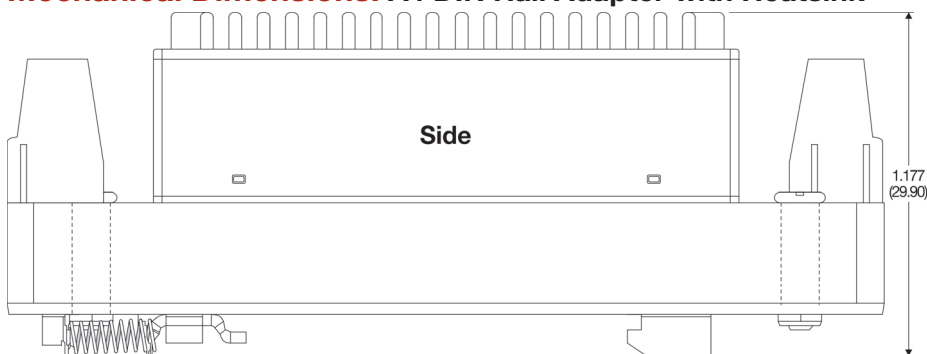
Pin Connections

Pin	Single	Dual
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) = 1.98 Oz (56g)

For the chassis mount option with heatsink, add the suffix “-A2-H” to the model number (i.e. **MB2048S-12ERU-A2-H**)

Mechanical Dimensions: A4 DIN Rail Adapter with Heatsink



Pin Connections

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

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

Notes:

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

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