

MB3000ERU



Low Cost, 1 x 2 Inch 30W, 4:1 Input Range DC/DC Converters

Electrical Specifications

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

Key Features:

- 30W Output Power
- 4:1 Input Voltage Range
- EN 60950 Approved
- 1,500 VDC Isolation
- Efficiency to 90%
- Single & Dual Outputs
- Compact 1 x 2 Inch Case
- -40°C to +80°C Operation
- Industry Standard Pin-Out
- Chassis & DIN Rail Mount



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Parameter	Conditions	Min.	Typ.	Max.	Units
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	
Input Under Voltage Protection	24 VDC Input	5.5	6.5		VDC
	48 VDC Input	12.0	15.5		
Reflected Ripple Current			40.0		mA
Start-Up Time	See Note 2		10		mS
Input Filter	π (Pi) Filter				

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy	5% - 100% I _{OUT}		±1.0	±3.0	%
	0% - 5% I _{OUT}		±1.0	±5.0	
Output Trim Range			±10		%
			±0.2	±0.5	
Line Regulation, V _{IN} = Min to Max	Positive Output		±0.5	±1.0	%
	Negative Output		±0.5	±1.0	
Load Regulation, I _{OUT} = 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	Single Output		50	100	mV P - P
	Dual Output		50	150	
Transient Recovery Time, See Note 5			300	500	μS
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	%V _{OUT}
Output Power Protection		110		190	%I _{OUT}
Temperature Coefficient				±0.03	%/°C
Output Short Circuit, See Note 6	Continuous (Autorecovery)				

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		2,000		pF
Switching Frequency			300		kHz

Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range	Ambient	-40	+25	+80	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%

Parameter	Conditions	Min.	Typ.	Max.	Units
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)				

Parameter	Conditions	Min.	Typ.	Max.	Units
Unit On	See Note 7	3.5		12.0	VDC
Unit Off	See Note 7	0		1.2	VDC
Off Idle Current			5.0	8.0	mA

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	1.0			MHours
Safety Standards, See Note 8	UL/cUL 60950-1 recognition (UL certificate)				
Vibration	10 - 55 Hz, 10G, 30 Min, on X, Y & Z Axis				

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 Number	Input				Output			Efficiency (% Typ)	Capacitive Load (µF, Max)	Certification	Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)				
	Nominal	Range	Full-Load	No-Load							
MB3024S-03ERU	24	9.0 - 36.0	970	40	3.3	6,000	0.0	85	10,000	UL/CE	2,000
MB3024S-05ERU	24	9.0 - 36.0	1,420	40	5.0	6,000	0.0	88	10,000	UL/CE	3,000
MB3024S-09ERU	24	9.0 - 36.0	1,420	40	9.0	3,333	0.0	88	4,700	UL/CE	3,000
MB3024S-12ERU	24	9.0 - 36.0	1,388	40	12.0	2,500	0.0	90	2,700	UL/CE	3,000
MB3024S-15ERU	24	9.0 - 36.0	1,388	40	15.0	2,000	0.0	90	1,680	UL/CE	3,000
MB3024S-24ERU	24	9.0 - 36.0	1,388	40	24.0	1,250	0.0	90	680	UL/CE	3,000
MB3024D-05ERU	24	9.0 - 36.0	1,450	80	±5.0	±3,000	±0.0	86	2,000	CE	3,000
MB3024D-12ERU	24	9.0 - 36.0	1,404	80	±12.0	±1,250	±0.0	89	1,250	CE	3,000
MB3024D-15ERU	24	9.0 - 36.0	1,404	80	±15.0	±1,000	±0.0	89	680	CE	3,000
MB3024D-24ERU	24	9.0 - 36.0	1,404	80	±24.0	±625	±0.0	89	470	CE	3,000
MB3048S-03ERU	48	18.0 - 75.0	479	40	3.3	6,000	0.0	86	10,000	UL/CE	1,000
MB3048S-05ERU	48	18.0 - 75.0	710	40	5.0	6,000	0.0	88	10,000	UL/CE	1,500
MB3048S-12ERU	48	18.0 - 75.0	710	40	12.0	2,500	0.0	88	2,700	UL/CE	1,500
MB3048S-15ERU	48	18.0 - 75.0	702	40	15.0	2,000	0.0	89	1,680	UL/CE	1,500
MB3048S-24ERU	48	18.0 - 75.0	702	40	24.0	1,250	0.0	89	680	UL/CE	1,500
MB3048D-05ERU	48	18.0 - 75.0	726	80	±5.0	±3,000	±0.0	86	2,000	CE	1,500
MB3048D-12ERU	48	18.0 - 75.0	710	80	±12.0	±1,250	±0.0	88	1,250	CE	1,500
MB3048D-15ERU	48	18.0 - 75.0	710	80	±15.0	±1,000	±0.0	88	680	CE	1,500

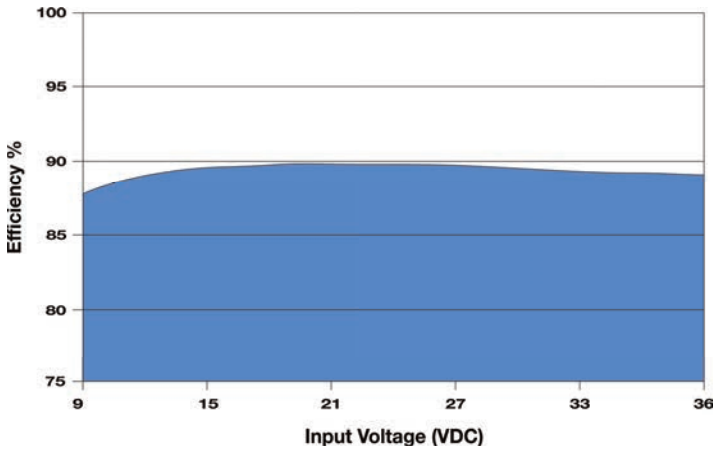
- Notes:
1. The specified maximum capacitive load is for each output.
 2. Start up time is measured at nominal input and with a constant resistive load.
 3. Cross regulation is measured with the main output set at 50% load. The second output is varied from 10% to 100% load.
 4. When measuring output ripple, it is recommended that an external ceramic capacitor (approx 10 µF) be placed from the +Vout to the -Vout 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. The control input (pin 6) is referenced to the -Vin (pin 2) input. If it is grounded, the unit will shut off.
 8. See the Model Selection Guide above to see which models have been certified by external testing agencies.
 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. **MB3024S-05ERU-H**)

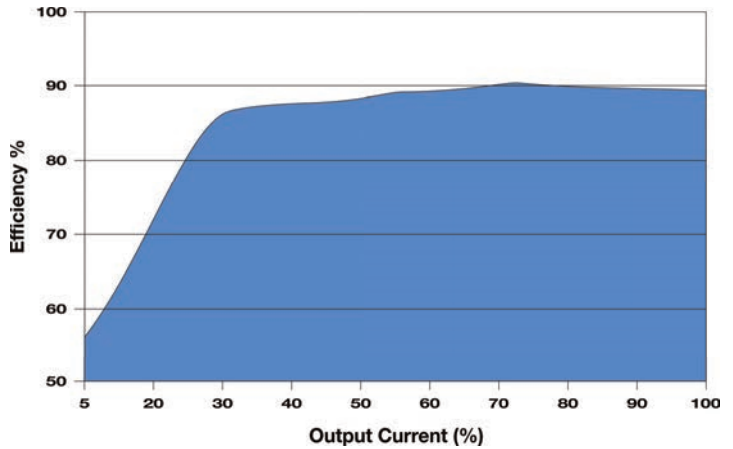
For the A2S adapter board option, add the suffix "-A2S" to the model number (i.e. **MB3048S-15ERU-A2S** or **MB3048S-15ERU-A2S-H**)

For the A4S adapter board option, add the suffix "-A4S" to the model number (i.e. **MB3048D-12ERU-A4S** or **MB3048D-12ERU-A4S-H**)

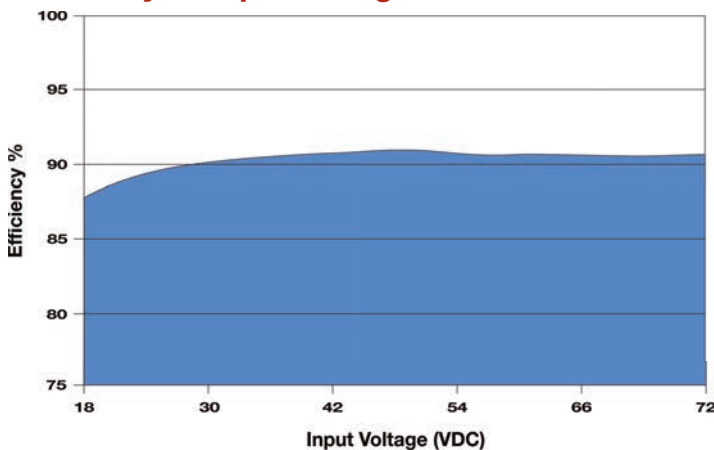
Efficiency vs Input Voltage: 24 VIN



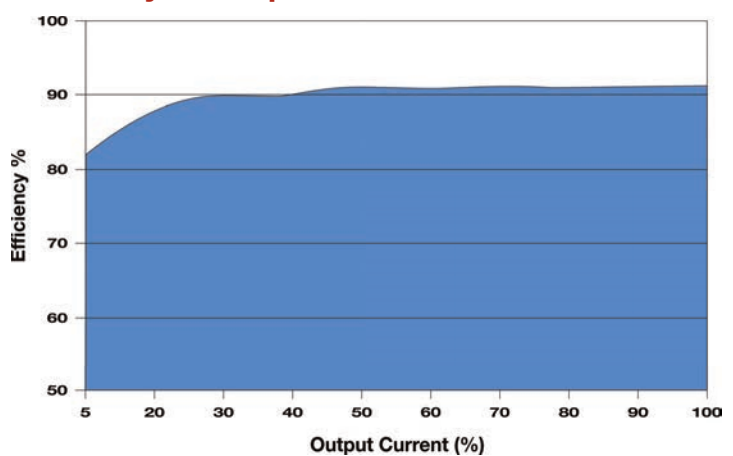
Efficiency vs Output Load: 24 VIN



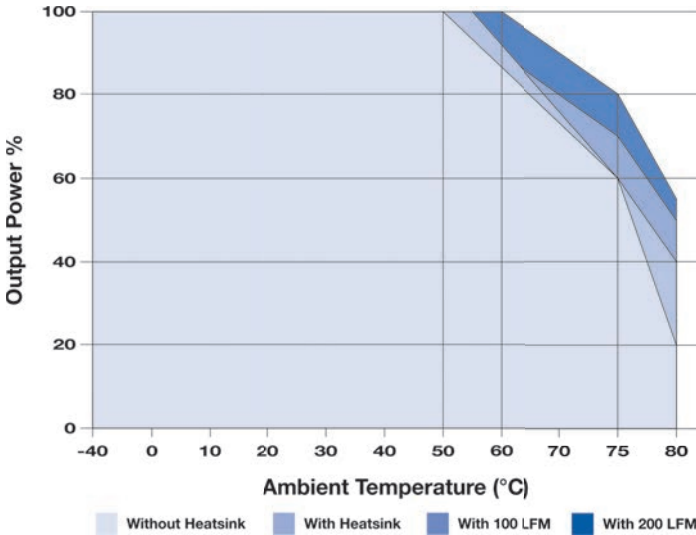
Efficiency vs Input Voltage: 48 VIN



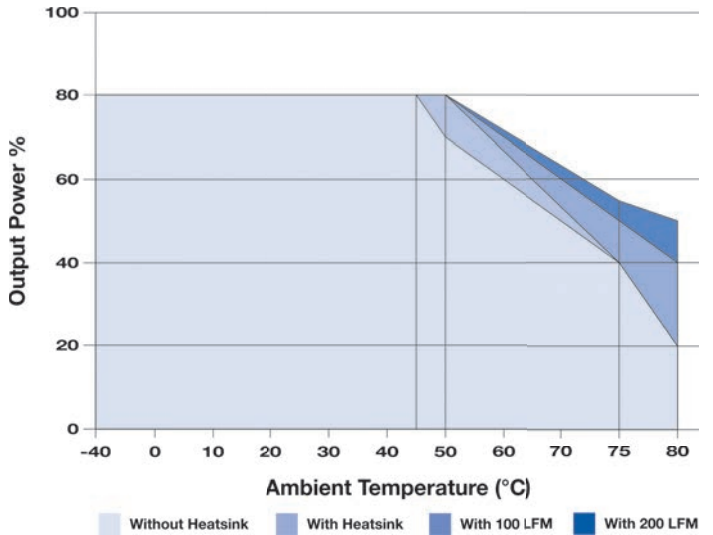
Efficiency vs Output Load: 48 VIN



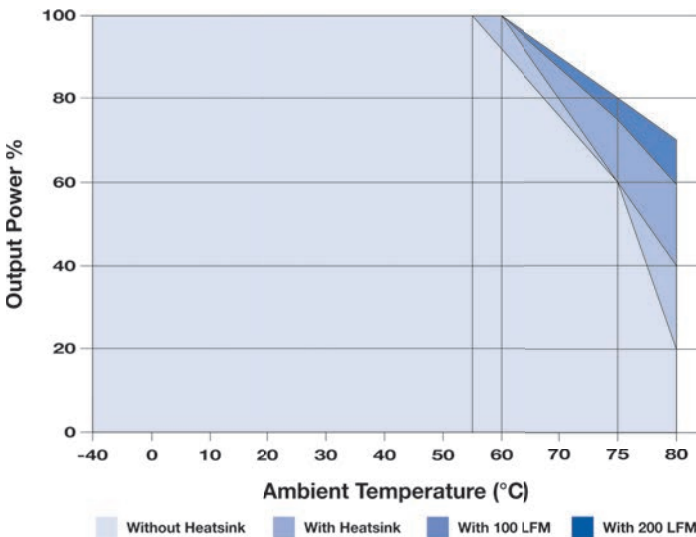
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Single Output Models MB3048S-03ERU, MB3048S-05ERU



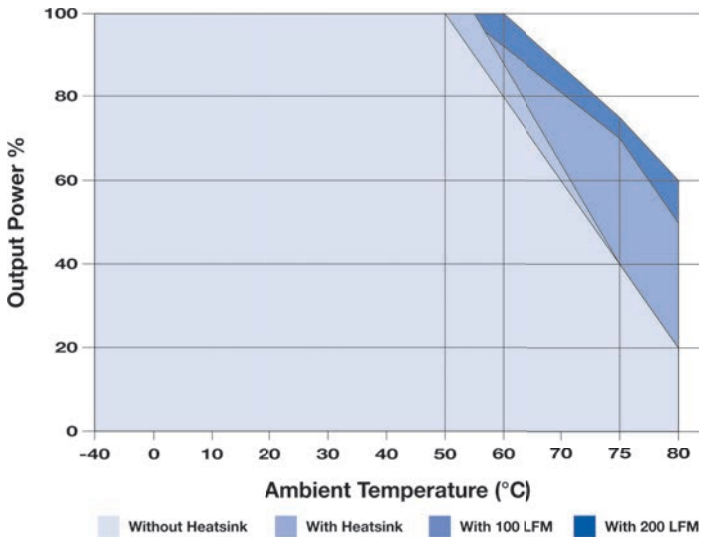
Derating Curves: MB3024D-05ERU, MB3024D-24ERU
Dual Output Models MB3048D-05ERU



Derating Curves: All Other Single Output Models



Derating Curves: All Other Dual Output Models



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 diagram at right. The required resistor value is calculated by the formulas:

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

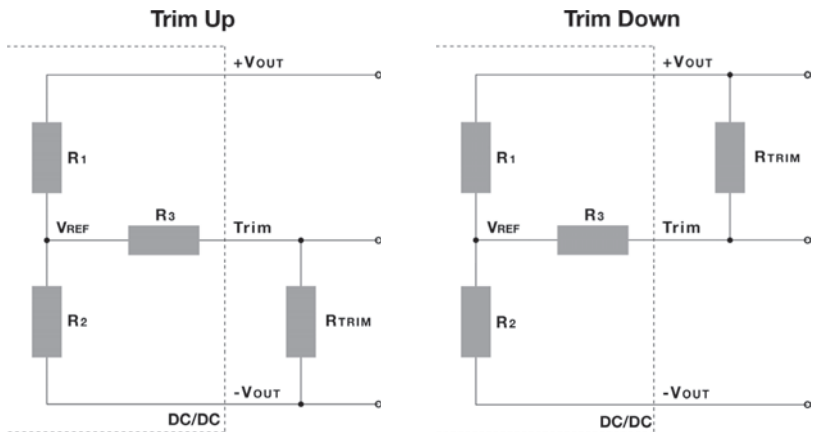
$$\text{Trim Down} = R_{\text{TRIM}} = \frac{A \times R_1}{R_1 - A} - R_3 \quad \text{Where } A = \frac{V_{\text{OUT}} - V_{\text{REF}}}{V_{\text{REF}}} \times R_2$$

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

The values of R1, R2, R3 and VREF are given in the table below.

Output Trim Resistor Values

Resistor	Output Voltage (VDC)					
	3.3	5.0	9.0	12	15	24
R1 (kΩ)	4.801	2.883	7.500	11.00	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	15.00
VREF (V)	1.24	2.50	2.50	2.50	2.50	2.50

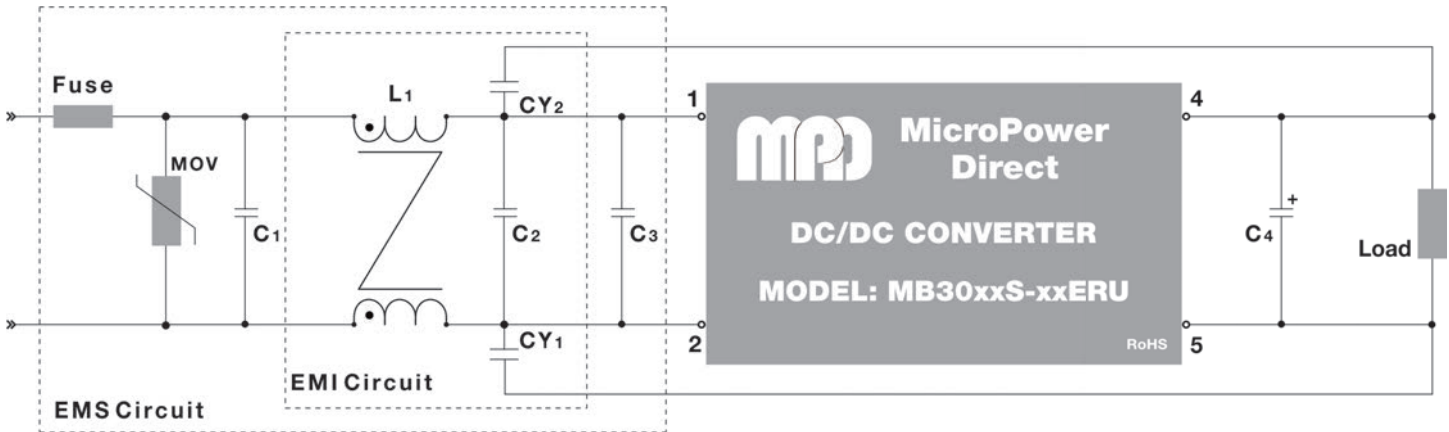


Parameter	Standard	Criteria	Level
Radiated Emissions (See Note 1)	CISPR 32/EN 55032		Class A (without external components)
			Class B (See Typical Connections below)
Conducted Emissions (See Note 1)	CISPR 32/EN 55032		Class A (without external components)
			Class B (See Typical Connections below)
ESD	EN 61000-4-2	B	±4 kV Contact
RS	EN 61000-4-3	A	10V/m
EFT	See Note 2	B	±2 kV
Surge	See Note 3	B	±2 kV
CS	Single Output	A	3 Vrms
	Dual Output	A	10 Vrms

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 diagrams and notes below.
2. To meet the requirements of EN 61000-4-4, external components are needed. The Typical Connection diagrams below show external input filtering 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 diagrams below. Contact the factory for more information.

Typical Connection : Single Output Models



For applications that require meeting EMC standards, the diagram above illustrates a typical connection of the single output models of the MB3000xERU 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.

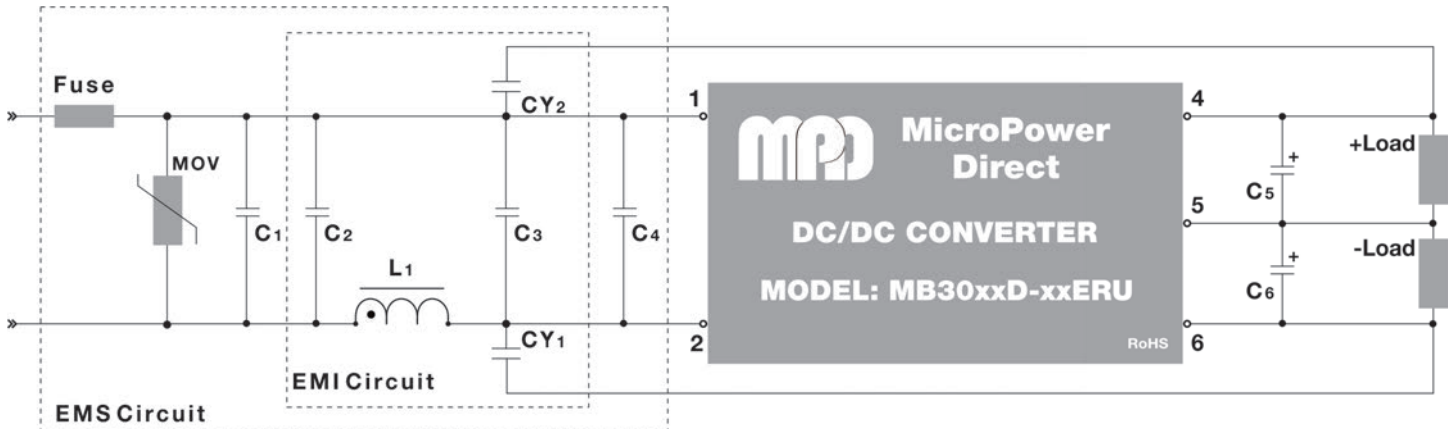
4. Recommended values for components are:

Component	24 V _{IN}	48 V _{IN}
MOV	S20K30	S14K60
C ₁	680 μF/50V	330 μF/100V
L ₁	1 mH	1 mH
C ₂	4.7 μF/50V	2.2 μF/100V
C ₃	330 μF/50V	330 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 5	

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

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

Typical Connection: Dual Output Models



For applications that require meeting EMC standards, the diagram above illustrates a typical connection of dual output models of the MB3000xERU 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.

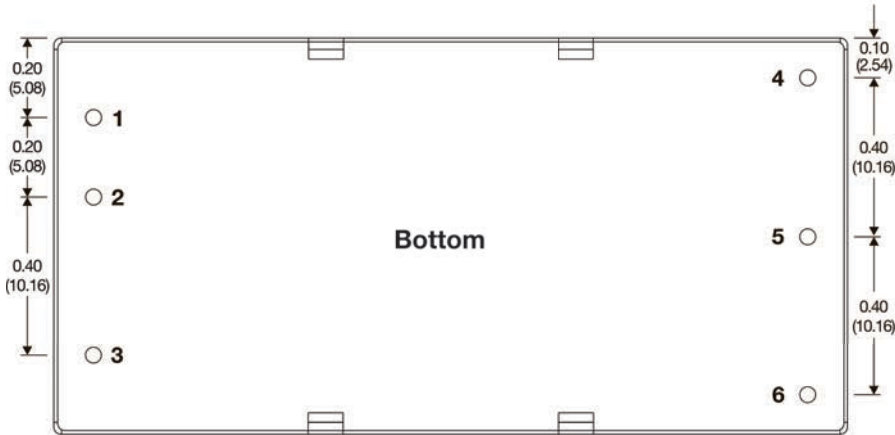
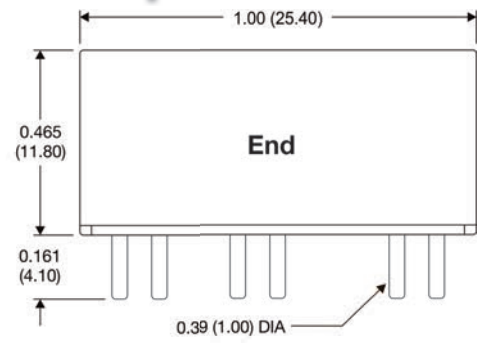
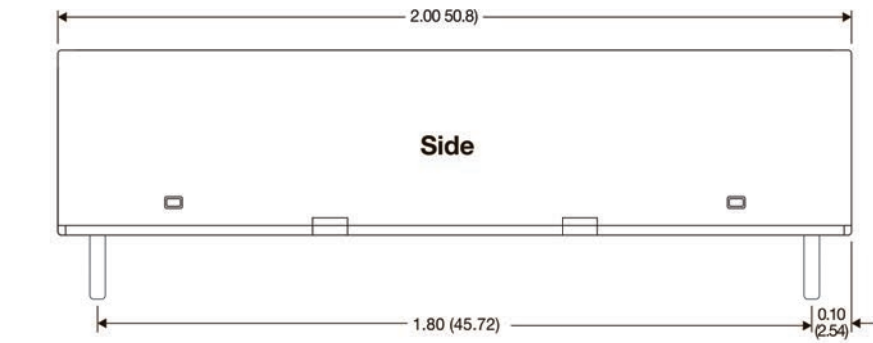
4. Recommended values for components are:

Component	24 V _{IN}	48 V _{IN}
MOV	S20K30	S14K60
C ₁	680 μF/50V	330 μF/100V
C ₂	2.2 μF/50V	2.2 μF/100V
L ₁	3.3 μH	3.3 μH
C ₃	2.2 μF/50V	2.2 μF/100V
C ₃	330 μF/50V	330 μF/100V
CY ₁	1 nF/2 kV	1 nF/2 kV
CY ₂	1 nF/2 kV	1 nF/2 kV
C ₅ , C ₆	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 for single output models are:

Output Voltage	C _{IN}	C _{OUT}
±5.0 V _{OUT}	100 μF	220 μF
±12 V _{OUT}		
±15 V _{OUT}		
±24 V _{OUT}	100 μF	100 μF

Mechanical Dimensions



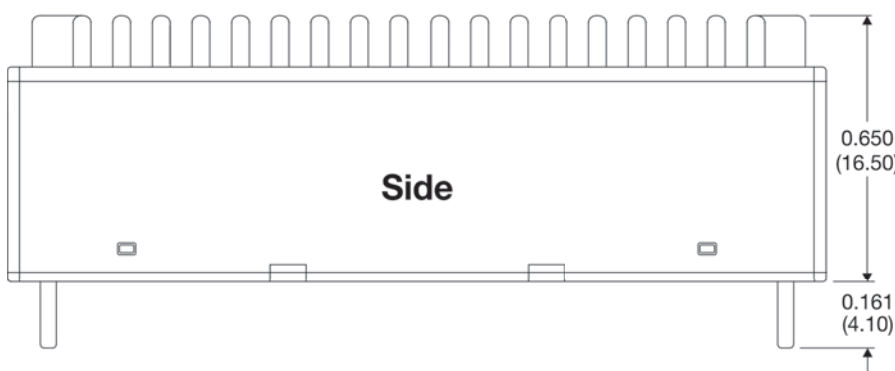
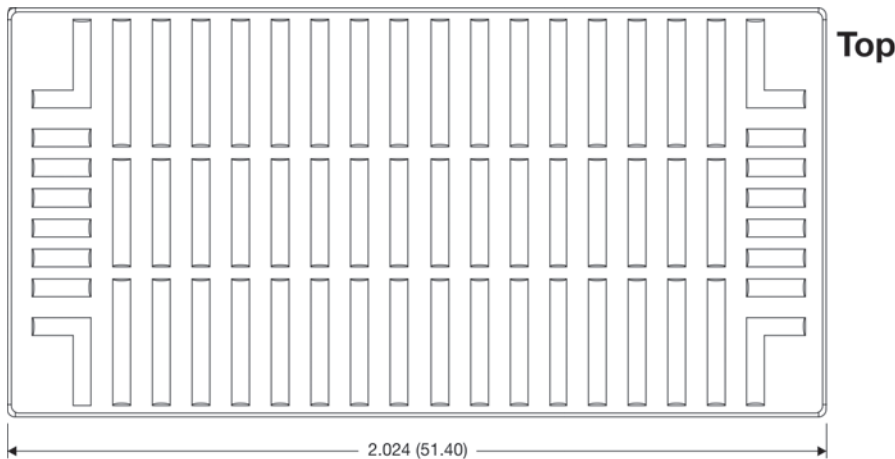
Pin Connections

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

Notes:

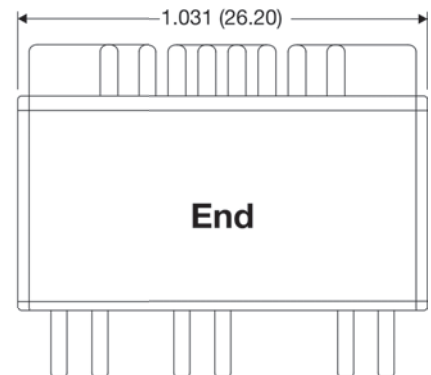
- All dimensions are typical in inches (mm)
- Tolerance x.xx = ± 0.02 (± 0.50)
- Weight (Typ) = 0.92 Oz (26g)

Mechanical Dimensions: With Optional Heatsink



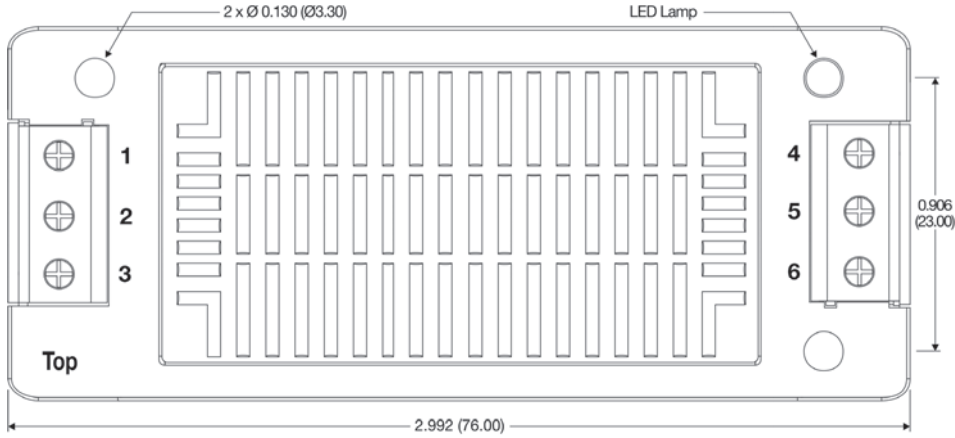
Notes:

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



For the heatsink option, add the suffix "-H" to the model number (i.e. MB3024S-05ERU-H)

Mechanical Dimensions: A2 Chassis Mount Adapter



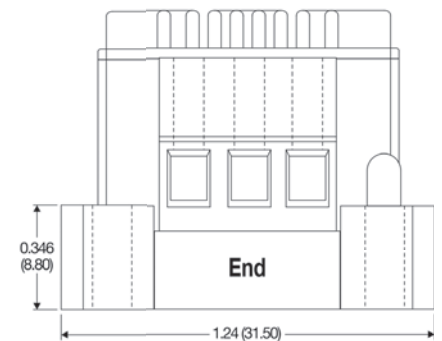
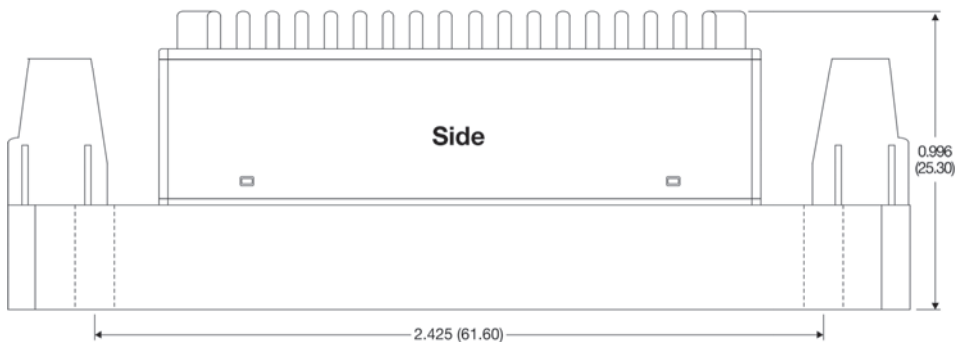
Pin Connections

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

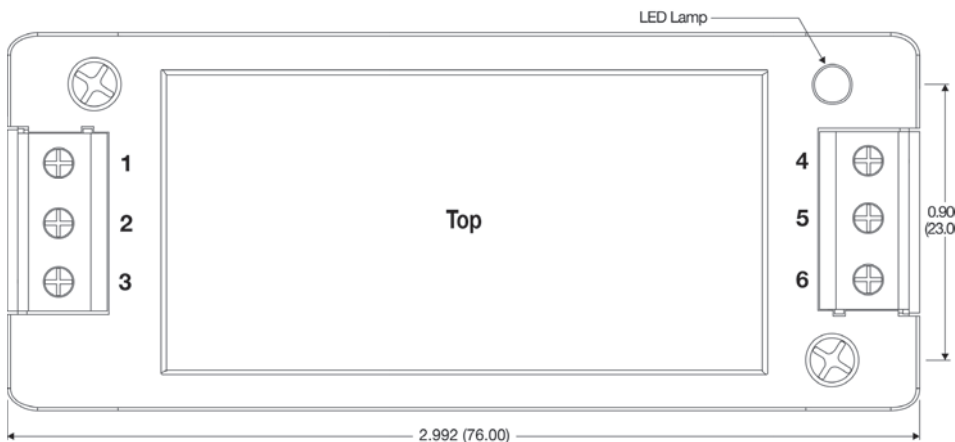
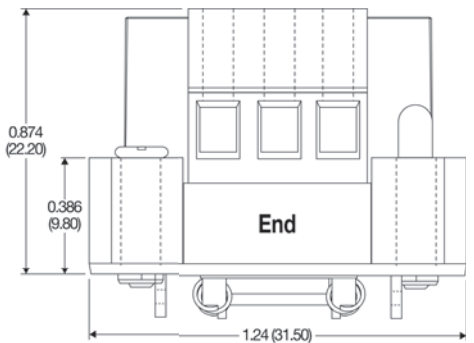
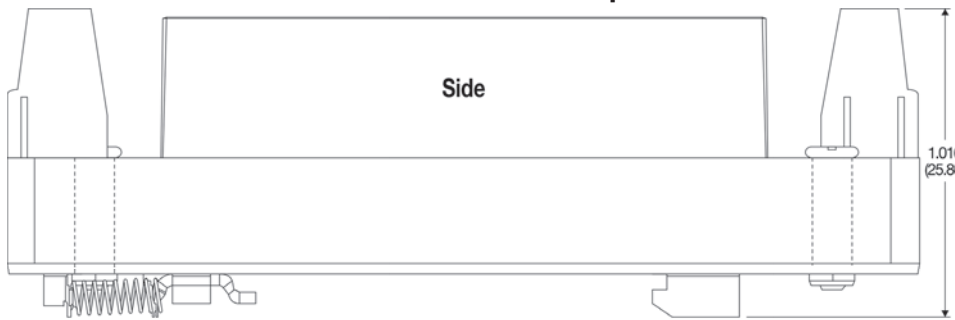
For the chassis mount option, add the suffix “-A2” to the model number (i.e. **MB3024S-05ERU-A2**)

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

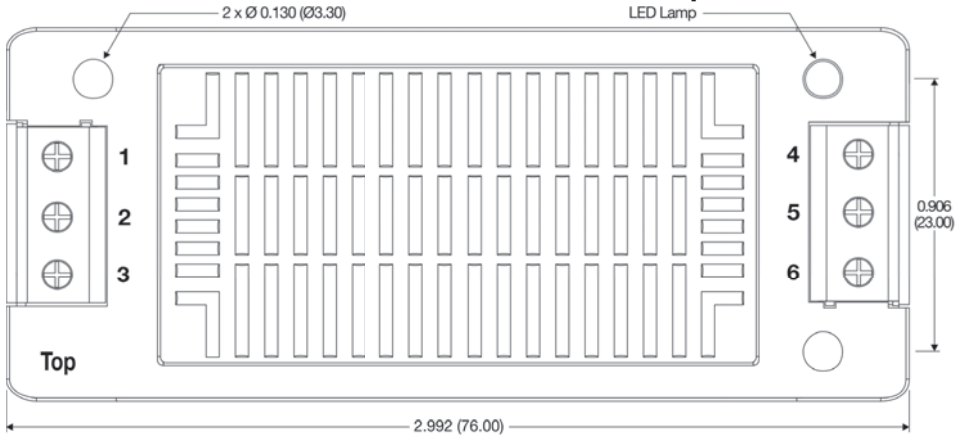
Pin	Single	Dual
1	Remote On/Off	Remote On/Off
2	-VIN	-VIN
3	+VIN	+VIN
4	Trim	-VOUT
5	-VOUT	Trim
6	+VOUT	+VOUT

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. **MB3024S-12ERU-A4**)

Mechanical Dimensions: A2 Chassis Mount Adapter with Heatsink



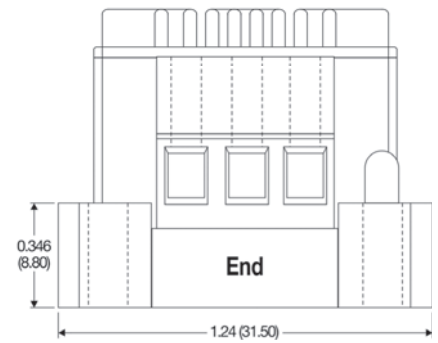
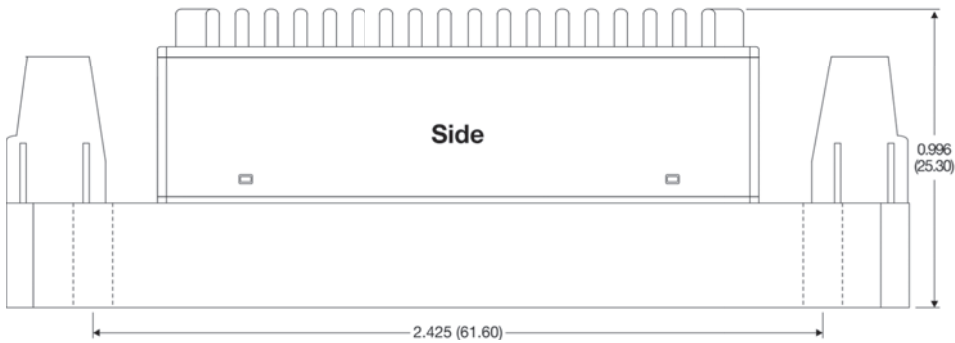
Pin Connections

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

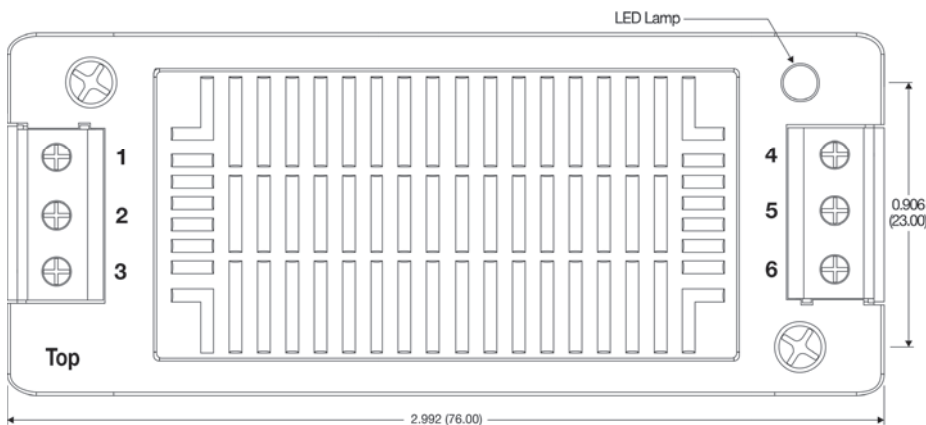
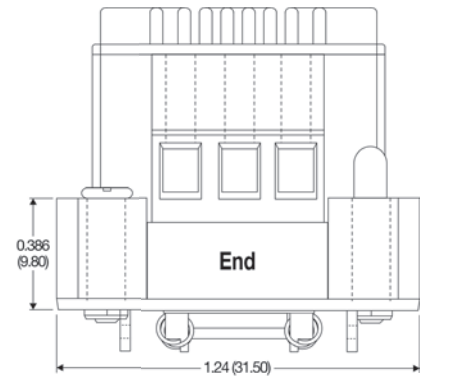
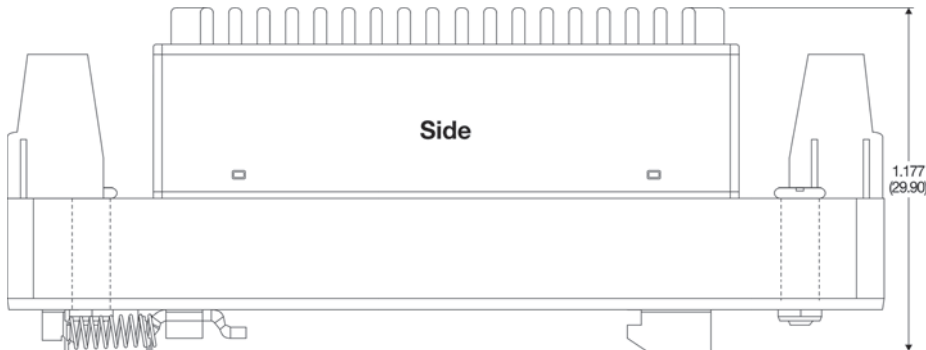
For the chassis mount option with heatsink, add the suffix "-A2-H" to the model number (i.e. MB3048S-12ERU-A2-H)

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 with Heatsink



Pin Connections

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

Notes:

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

For the DIN rail mount option with heatsink, add the suffix "-A4-H" to the model number (i.e. MB3048S-12ERU-A4-H)