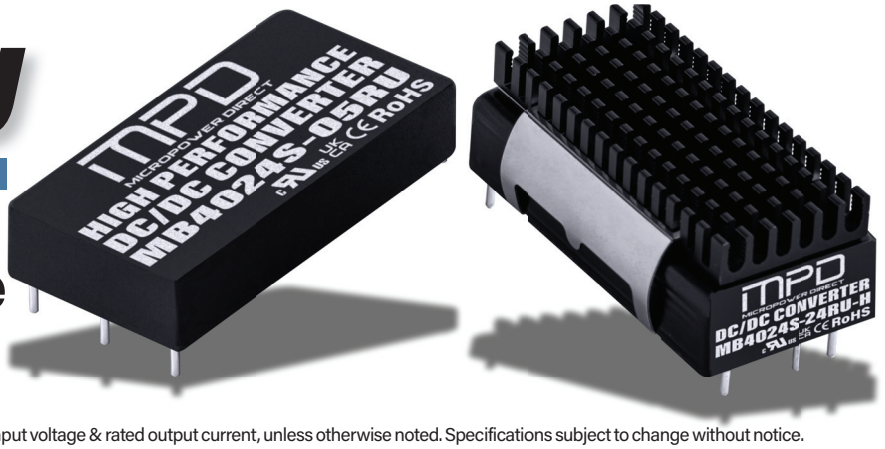
MB4000RU

Compact, 1 x 2 Inch 40W, 4:1 Input Range DC/DC Converters



Key Features:

- 40W Output Power
- Compact 2" x 1" Case
- EN 62368 Approved
- Single and Dual Outputs
- Very Wide 4:1 Input Range
- High Efficiency to 91%
- Shielded Metal Case
- 1,500 VDC Isolation
- Remote ON/OFF Control
- No Minimum Load
- Industry Standard Pin Out
- -40°C to +80°C Operation
- ***LOW COST***

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	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		8.3		VDC
	48 VDC Input		16.5		
Input Filter	LC Filter				
Start-Up Time	See Note 1		30		mS

Output

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy				±1.0	%
Output Voltage Balance	Dual Outputs, Balanced Loads			±2.0	%
Output Trim Range	See Note 3		±10		%
Line Regulation	VIN = Min to Max			±0.5	%
Load Regulation, See Note 2	Single Output			±0.5	%
	Dual Output			±1.0	
Cross Regulation	See Note 3			±5.0	%
Ripple & Noise (20 MHz), See note 4	3.3 & 5 VOUT Models		100		mV P - P
	12, 15 & 24 VOUT Models		150		
	Dual Output Models		150		
Transient Recovery Time, See Note 5	25% Load Step Change		250		µSec
Transient Response Deviation			±3.0	±5.0	%
Temperature Coefficient			±0.02		%/°C
Over Temperature Protection	Shutdown Temperature		110		°C
Output Power Protection			150		%
Output Short Circuit, See Note 6	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/1.0V			1,500	pF
Switching Frequency	See Note 7		320		kHz

Environmental

Parameter	Conditions	Min.	Typ	Max.	Units
Operating Temperature Range, Ambient Without Heatsink	MB40xxS-03RU	-40	+25	+66	°C
	MB40xxS-05RU, MB4048S-12RU, -15RU			+51	
	MB4024S-12RU, MB4024S-15RU			+45	
	MB40xxS-24RU			+57	
	MB40xxD-xxRU			+40	
Operating Temperature Range, Ambient With Heatsink	MB40xxS-03RU	-40	+25	+73	°C
	MB40xxS-05RU, MB4048S-12RU, -15RU			+61	
	MB4024S-12RU, MB4024S-15RU			+57	
	MB40xxS-24RU			+66	
	MB40xxD-xxRU			+52	
Operating Temperature Range	Case			+105	°C
Storage Temperature Range		-50		+125	°C
Humidity	RH, Non-condensing			95	%

Physical

Case Size, Weight and Material	2.0 x 1.0 x 0.40 Inches (50.8 x 25.4 x 10.2 mm)
Case Material	Aluminum Alloy With Non-Conductive Base (UL94-V0)

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	328			kHours

Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units
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			260	°C

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

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MICROPOWER DIRECT

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Model Selection Guide

Model Number	Input				Output			Efficiency (%, Typ)	Over Voltage Protection (VDC Typ)	Capacitive Load (µF, Max)	Fuse Rating Slow-Blow (A)
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)				
	Nominal	Range	Full-Load	No-Load							
MB4024S-03RU	24	9.0 - 36.0	1,240	90	3.3	8,000	0	89	3.9	21,000	8.0
MB4024S-05RU	24	9.0 - 36.0	1,850	90	5.0	8,000	0	90	6.2	13,600	8.0
MB4024S-12RU	24	9.0 - 36.0	1,870	95	12.0	3,330	0	89	15.0	2,400	8.0
MB4024S-15RU	24	9.0 - 36.0	1,870	105	15.0	2,670	0	89	18.0	1,500	8.0
MB4024S-24RU	24	9.0 - 36.0	1,835	115	24.0	1,670	0	91	30.0	600	8.0
MB4024D-12RU	24	9.0 - 36.0	1,890	65	±12.0	±1,670	±145	88	±15.0	±1,200	8.0
MB4024D-15RU	24	9.0 - 36.0	1,890	65	±15.0	±1,330	±110	88	±18.0	±750	8.0
MB4048S-03RU	48	18.0 - 75.0	620	55	3.3	8,000	0	89	3.9	21,000	4.0
MB4048S-05RU	48	18.0 - 75.0	930	55	5.0	8,000	0	90	6.2	13,600	4.0
MB4048S-12RU	48	18.0 - 75.0	930	60	12.0	3,330	0	90	15.0	2,400	4.0
MB4048S-15RU	48	18.0 - 75.0	930	65	15.0	2,670	0	90	18.0	1,500	4.0
MB4048S-24RU	48	18.0 - 75.0	918	75	24.0	1,670	0	91	30.0	600	4.0
MB4048D-12RU	48	18.0 - 75.0	950	45	±12.0	±1,670	±145	88	±15.0	±1,200	4.0
MB4048D-15RU	48	18.0 - 75.0	950	45	±15.0	±1,330	±110	88	±18.0	±750	4.0

For heatsink option, add suffix "H" to model number (i.e. **MB4024S-15RU-H**)

Notes:

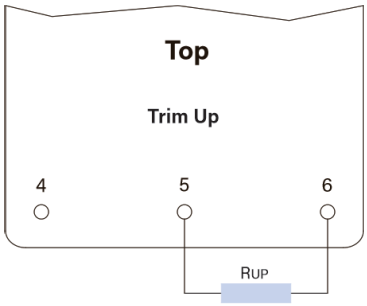
1. Start up time is measured at nominal input and with a constant resistive load.
2. Load regulation is specified for a load change of minimum load to full load.
3. Cross regulation is measured with the output being tested at 100% load. The second output is varied from 25% to 100% load.
4. When measuring output ripple, it is recommended that an external 1 µF capacitor and 10 µF capacitor be connected in parallel from the +VOUT to the -VOUT pins for single output units and from each output to common for dual output units.
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 switching frequency for 24 VDC output models is 285 kHz.
8. Operation at no-load will not damage these units. However, they may not meet all specifications if operated below the specified minimum load.
9. It is recommended that a fuse be used on the input of a power supply for protection.

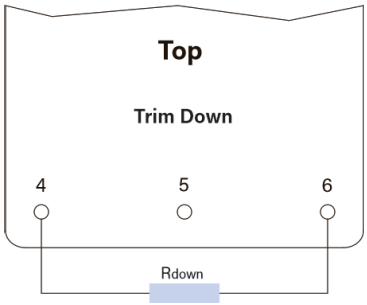
Remote On/Off

Applying a signal to pin 3 will turn the unit ON/OFF. If the pin is left open, the unit operates. If grounded, the unit will shut off. The specifications for the ON/OFF function are:

Parameter	Min	Typ	Max	Units
Supply On	3.5		12.0	VDC
Supply Off	0.0		1.2	VDC
Standby Input Current		2.5		mA
Control Common	Referenced to Negative Input (pin 2)			
Control Input Current (ON)		0.5		mA
Control Input Current (OFF)		-0.5		mA

External Trim





On single output units, an external resister may be added to adjust the converter output.

To adjust the output UP, connect a 5%, 3W resistor between the minus output pin (5) and the Vout trim pin (6). To adjust the output DOWN, connect a 5%, 3W resistor between the plus output pin (4) and the Vout trim pin (6).

The trim table at right gives suggested resistor values for this adjustment.

MB40xxS-03RU

Trim Down											
Vout	Vo x 0.99	Vo x 0.98	Vo x 0.97	Vo x 0.96	Vo x 0.95	Vo x 0.94	Vo x 0.93	Vo x 0.92	Vo x 0.91	Vo x 0.90	Volts
RDOWN	72.61	32.55	19.20	12.52	8.51	5.84	3.94	2.51	1.39	0.50	kΩ
Trim Up											
Vout	Vo x 1.01	Vo x 1.02	Vo x 1.03	Vo x 1.04	Vo x 1.05	Vo x 1.06	Vo x 1.07	Vo x 1.08	Vo x 1.09	Vo x 1.10	Volts
RUP	60.84	27.40	16.25	10.68	7.34	5.11	3.51	2.32	1.39	0.65	kΩ

MB40xxS-05RU

Trim Down											
Vout	Vo x 0.99	Vo x 0.98	Vo x 0.97	Vo x 0.96	Vo x 0.95	Vo x 0.94	Vo x 0.93	Vo x 0.92	Vo x 0.91	Vo x 0.90	Volts
RDOWN	138.88	62.41	36.92	24.18	16.53	11.44	7.79	5.06	2.94	1.24	kΩ
Trim Up											
Vout	Vo x 1.01	Vo x 1.02	Vo x 1.03	Vo x 1.04	Vo x 1.05	Vo x 1.06	Vo x 1.07	Vo x 1.08	Vo x 1.09	Vo x 1.10	Volts
RUP	106.87	47.76	28.06	18.21	12.30	8.36	5.55	3.44	1.79	0.48	kΩ

MB40xxS-12RU

Trim Down											
Vout	Vo x 0.99	Vo x 0.98	Vo x 0.97	Vo x 0.96	Vo x 0.95	Vo x 0.94	Vo x 0.93	Vo x 0.92	Vo x 0.91	Vo x 0.90	Volts
RDOWN	413.55	184.55	108.22	70.05	47.15	31.88	20.98	12.80	6.44	1.35	kΩ
Trim Up											
Vout	Vo x 1.01	Vo x 1.02	Vo x 1.03	Vo x 1.04	Vo x 1.05	Vo x 1.06	Vo x 1.07	Vo x 1.08	Vo x 1.09	Vo x 1.10	Volts
RUP	351.00	157.50	93.00	60.75	41.40	28.50	19.29	12.37	7.00	2.70	kΩ

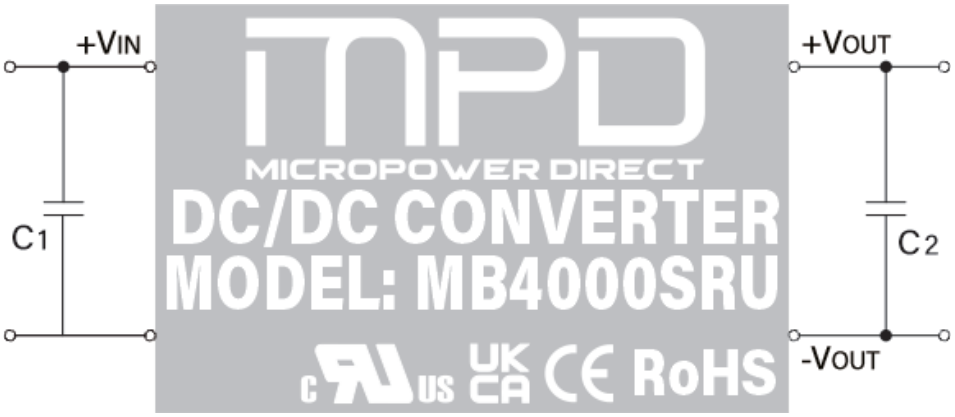
MB40xxS-15RU

Trim Down											
Vout	Vo x 0.99	Vo x 0.98	Vo x 0.97	Vo x 0.96	Vo x 0.95	Vo x 0.94	Vo x 0.93	Vo x 0.92	Vo x 0.91	Vo x 0.90	Volts
RDOWN	530.73	238.61	141.24	92.56	63.35	43.87	29.96	19.53	11.41	4.92	kΩ
Trim Up											
Vout	Vo x 1.01	Vo x 1.02	Vo x 1.03	Vo x 1.04	Vo x 1.05	Vo x 1.06	Vo x 1.07	Vo x 1.08	Vo x 1.09	Vo x 1.10	Volts
RUP	422.77	189.89	112.26	73.44	50.15	34.63	23.54	15.22	8.75	3.58	kΩ

MB40xxS-24RU

Trim Down											
Vout	Vo x 0.99	Vo x 0.98	Vo x 0.97	Vo x 0.96	Vo x 0.95	Vo x 0.94	Vo x 0.93	Vo x 0.92	Vo x 0.91	Vo x 0.90	Volts
RDOWN	333.39	148.80	87.26	56.50	38.04	25.73	16.94	10.35	5.22	1.12	kV
Trim Up											
Vout	Vo x 1.01	Vo x 1.02	Vo x 1.03	Vo x 1.04	Vo x 1.05	Vo x 1.06	Vo x 1.07	Vo x 1.08	Vo x 1.09	Vo x 1.10	Volts
RUP	---	243.70	---	108.50	---	63.43	---	40.90	---	27.38	kV

Typical Connection: Single Output



The diagram at left illustrates a typical connection of the **MB4000S**. For applications that do not require the circuit to meet EMI/EMC specifications, the capacitors C1 and C2 will reduce input/output ripple and improve the converter stability over time and temperature. The recommended component values are given in the table at left.

Model	C1	C2
MB4024SRU	10 µF	4.7 µF
MB4048SRU	10 µF	4.7 µF

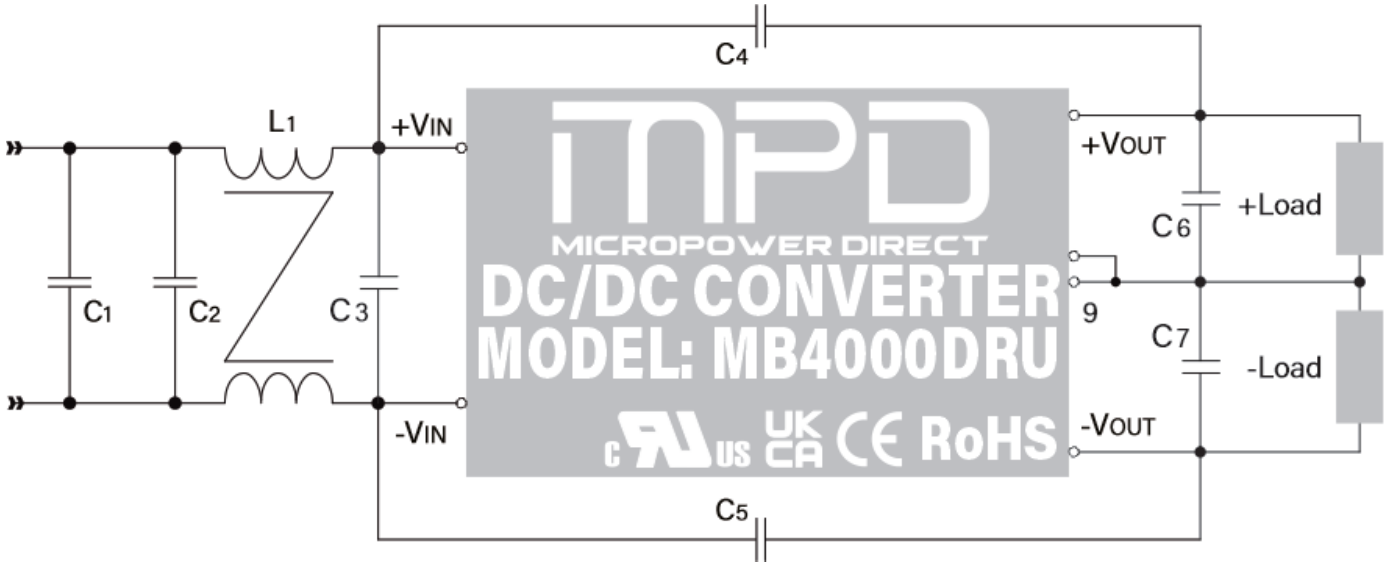
EMI/EMC Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions	EN 55032		Class A
Conducted Emissions	EN 55032		Class A
ESD	EN 61000-4-2	A	±6 kV Contact
			±8kV Air
RS	EN 61000-4-3	A	10V/m
EFT, See note at left	EN 61000-4-4	A	±2 kV
Surge, See note at left	EN 61000-4-5	A	±1 kV
CS	EN 61000-4-6	A	10 Vrms
PFMF	EN 61000-4-8	A	3 A/m

These converters will meet the requirements of EN 55032, Class A conducted emmisions with external components. The connection diagram below shows a suggested connection for Class A. Contact the factory for more information.

External input components are required to meet EN 61000-4-4 (EFT) and EN61000-4-5 (Surge). These are also illustrated below.

EMI Connection: Class A, Dual Output

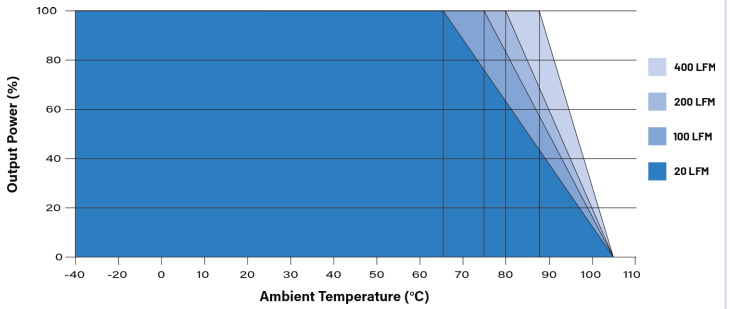


To meet the requirements of EN 55032 class A with the **MB4000DRW**, additional external components are required. The dual output connection shown above illustrates an external circuit that will typically meet these requirements.

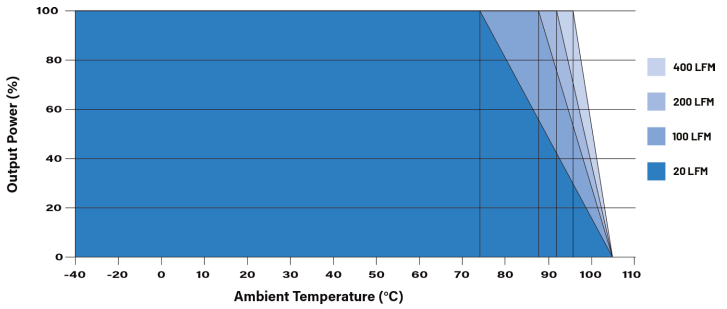
The external input components C1, C2 and L1 are required to meet EN 61000-4-4 (EFT) and EN61000-4-5 (Surge).

Model	C1	C2	L1	C3	C4, C5	C6, C7	C4
MB4000SRW	3.3 µF/100V 1210X7S MCC	4.7 µF/100V 1210X7S MCC	1 mH 7448031501	10 µF/50V	1000 pF/2 kV 1808 X7R	4.7 µF	2.2 µF/50V
MG1248SRU	3.3 µF/100V 1210X7S MCC	4.7 µF/100V 1210X7S MCC	150 µF/100V CHEMI-CON KY Series	10 µF/100V	1000 pF/2 kV 1808 X7R	4.7 µF	2.2 µF/50V

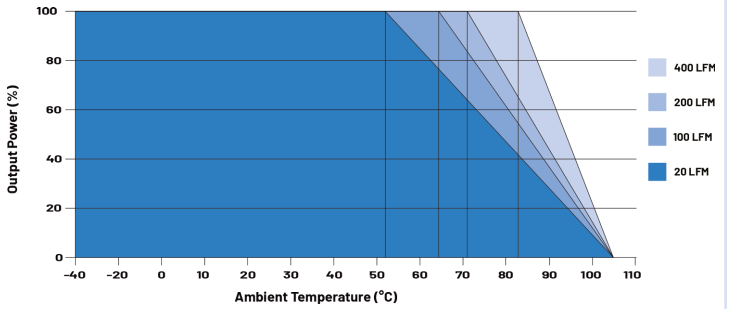
MB40xxS-03RU Without Heatsink



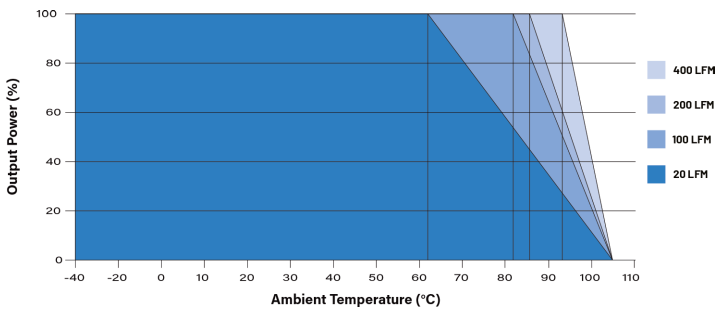
MB40xxS-03RU With Heatsink



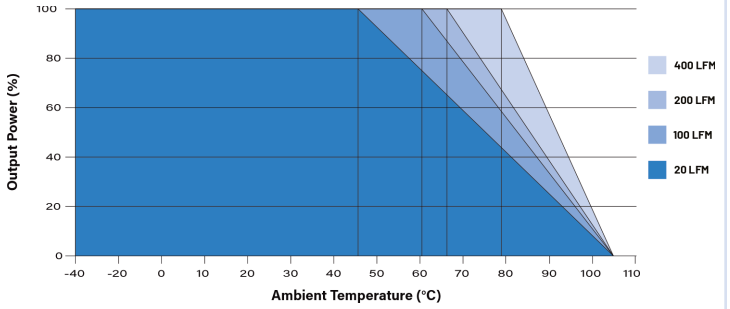
MB40xxS-05RU, MB4048S-12RU MB4048S-15RU Without Heatsink



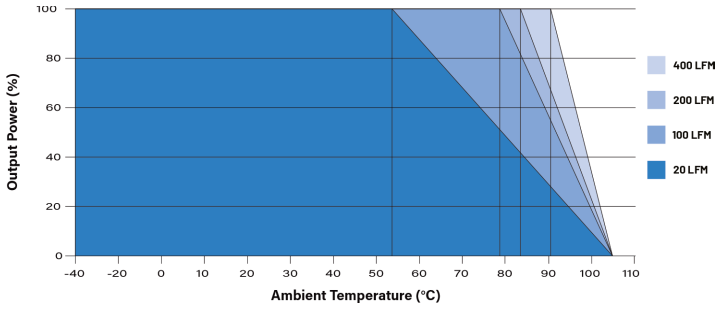
MB40xxS-05RU, MB4048S-12RU MB4048S-15RU With Heatsink



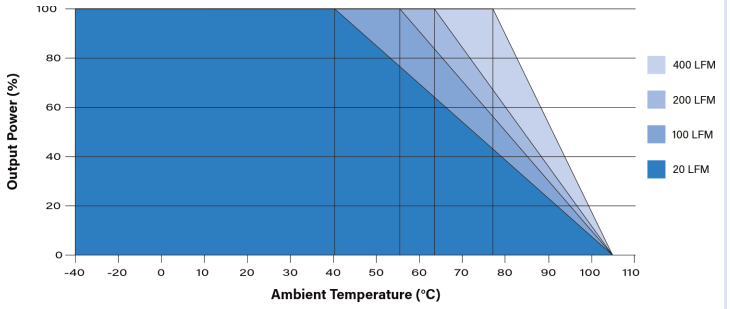
MB4024S-12RU, MB4024S-15RU Without Heatsink



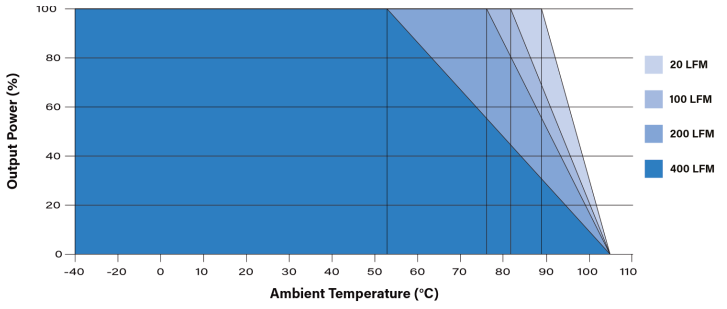
MB4024S-12RU, MB4024S-15RU With Heatsink



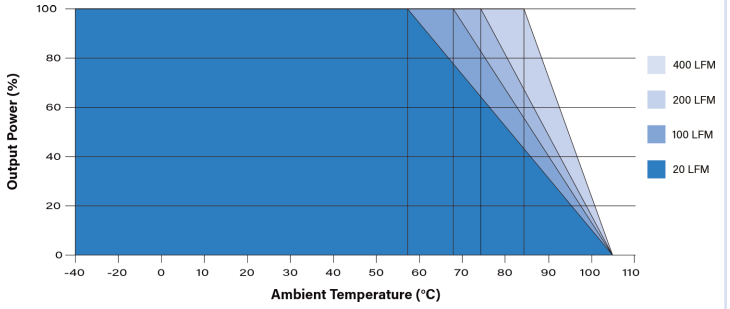
MB40xxD-12RU, MB40xxD-15RU Without Heatsink



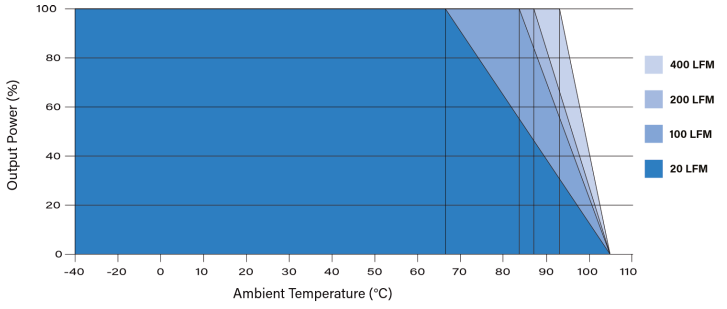
MB40xxD-12RU, MB40xxD-15RU With Heatsink



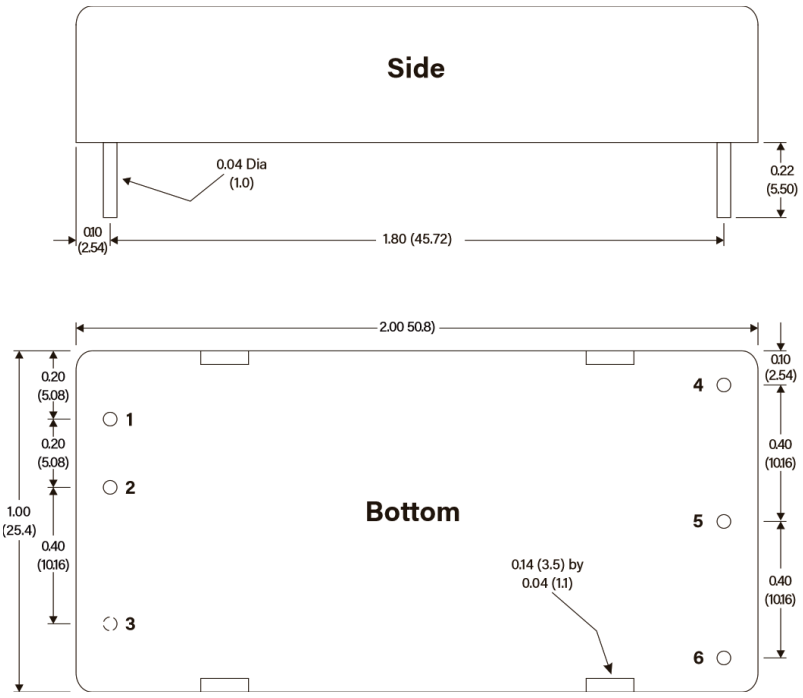
MB40xxS-24RU Without Heatsink



MB40xxS-24RU With Heatsink



Mechanical Dimensions



Pin Connections

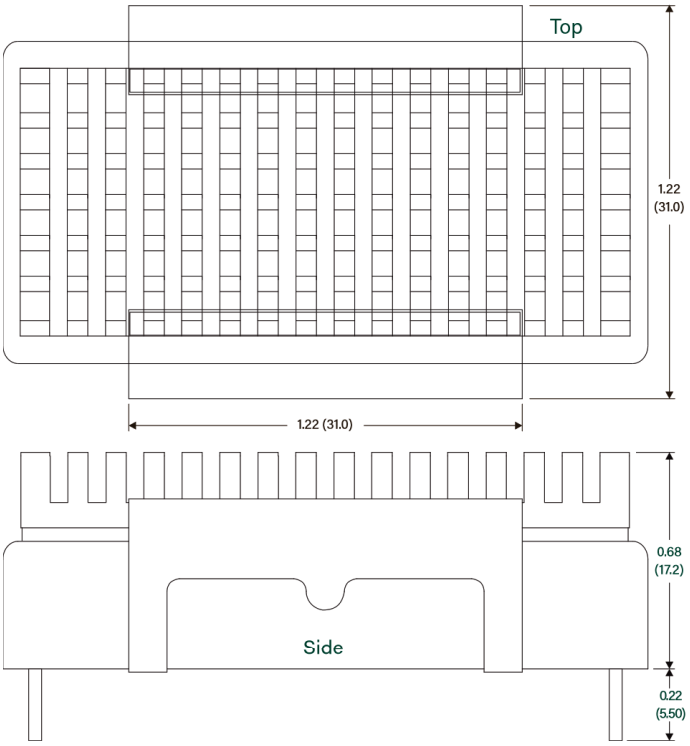
Pin	Single Output
1	+Vin
2	-Vin
3	Remote On/Off
4	+Vout
5	-Vout
6	Trim

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

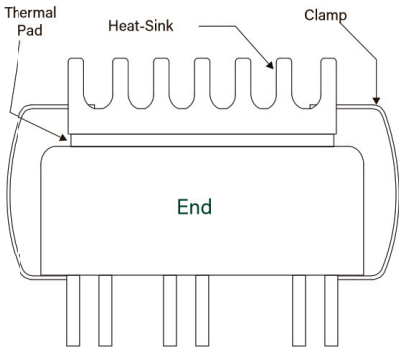
Notes:

- All dimensions are typical in inches (mm)
- Pin 1 is marked by a "dot" or indentation on the unit
- General Tolerance = ±0.01 (±0.25)
- Pin Tolerance = ±0.02 (±0.05)
- Recommended pin hole size (on the application PC Board) is Ø 0.03 (Ø 0.80)
- Weight (Typ) = 1.06 Oz (30.0g)

Mechanical Dimensions: With Optional Heatsink



For the heatsink option, add suffix "H" to the model number (i.e. **MB4048D-12RU-H**)

Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Heatsink is black, anodized aluminum
- Weight (Typ, Heat Sink Only) = 0.317 Oz (9.0g)