MB6000RU

Compact, 1 x 2 Inch 60W, 4:1 Input Range DC/DC Converters

Key Features:

- 60W Output Power
- Compact 1 x 2 Inch Case
- UL 62368 Approved
- Wide 4:1 Input Range
- High Efficiency
- Wide Operating Temp Range
- 1,600 VDC Isolation
- Single and Dual Outputs
- >90% Efficiency
- Remote ON/OFF
- Over Voltage Protection
- Over Current Protection

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		8.60		VDC
	48 VDC Input		17.8		
Under Voltage Shutdown	24 VDC Input		7.90		VDC
	48 VDC Input		16.0		
Reflected Ripple Current			20.0		mA P-P
Start-Up Time	See Note 1		60		mS
Input Filter	π (Pi) Filter				

Output

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy			±1.0		%
Output Trim Range			±10		%
Line Regulation	V_{IN} = Min to Max			±0.5	%
Load Regulation, I_{OUT} = 0% to 100%	Single Output			±0.5	%
	Dual Output			±1.0	%
Cross Regulation	See Note 2		±5.0		
Ripple & Noise (20 MHz)	See Note 3			100	mV P - P
Transient Recovery Time	See Note 4		250		μSec
Transient Response Deviation				±3.0	%
Temperature Coefficient			±0.02		%/°C
Over Current Protection			140		%I_{OUT}
Output Short Circuit, See Note 5	Continuous (Autorecovery)				

General

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage, 60 Seconds	Input to Output	1,600			VDC
	Input/Output to Case	1,600			
Isolation Resistance		1,000			MΩ
Isolation Capacitance			2,200		pF
Switching Frequency			225		kHz

Environmental

Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range	Ambient	-40	+25	+100	°C
Storage Temperature Range		-55		+125	°C
Over Temperature Protection	Case		+115		°C
Cooling	Free Air Convection (30 - 65 LFM)				
Humidity	RH, Non-condensing			95	%

Physical

Case Size & Weight	See Mechanical Diagrams (Page 5)
Case Material	Copper With Non-Conductive Base (UL94-V0)

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	210			kHours
Safety Standards	UL/cUL 62368 recognition (UL certificate)				

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			260	°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)	Over Voltage Protection (VDC) See Note 6	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							
MB6024S-05RU(-H)	24	9.0 - 36.0	2,688	25	5.0	12,000	0.0	93	6.20	30,000	10
MB6024S-12RU(-H)	24	9.0 - 36.0	2,688	25	12.0	5,000	0.0	93	15.0	5,850	10
MB6024S-15RU(-H)	24	9.0 - 36.0	2,674	25	15.0	4,000	0.0	93.5	20.0	3,900	10
MB6024D-12RU(-H)	24	9.0 - 36.0	2,747	40	±12.0	±2,500	0.0	91	15.0	±3,900	10
MB6024D-15RU(-H)	24	9.0 - 36.0	2,717	50	±15.0	±2,000	0.0	92	20.0	±2,400	10
MB6048S-05RU(-H)	48	18.0 - 75.0	1,337	25	5.0	12,000	0.0	93.5	6.20	30,000	6
MB6048S-12RU(-H)	48	18.0 - 75.0	1,337	25	12.0	5,000	0.0	93.5	15.0	5,850	6
MB6048S-15RU(-H)	48	18.0 - 75.0	1,337	25	15.0	4,000	0.0	93.5	20.0	3,900	6
MB6048D-12RU(-H)	48	18.0 - 75.0	1,366	40	±12.0	±2,500	0.0	91.5	15.0	±3,900	6
MB6048D-15RU(-H)	48	18.0 - 75.0	1,359	50	±15.0	±2,000	0.0	92	20.0	±2,400	6

Notes:
1. Start up time is measured at nominal input and with a constant resistive load.
2. Measured with an asymetrical load (25%/100%) for dual output units.
3. When measuring output ripple, it is recommended that an external ceramic capacitor (approx 1 µF to 10 µF) be placed from the +VOUT to the -VOUT pins.
4. Transient recovery is measured to within a 1% error band for a load step change of 25%.
5. Short circuit protection is provided by a "hiccup mode" circuit.
6. Over voltage protection is provided by a zenor clamp circuit.
7. The control input (pin 3) is referenced to the -VIN (pin 2) input. If it is grounded, the unit will shut off.
7. Operation at no-load will not damage the unit, but they may not meet all specifications.
8. 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 Heat Sink option, add the suffix "-H" to the model number (i.e. **MB6048S-05RU-H**)

Remote ON/OFF Connection

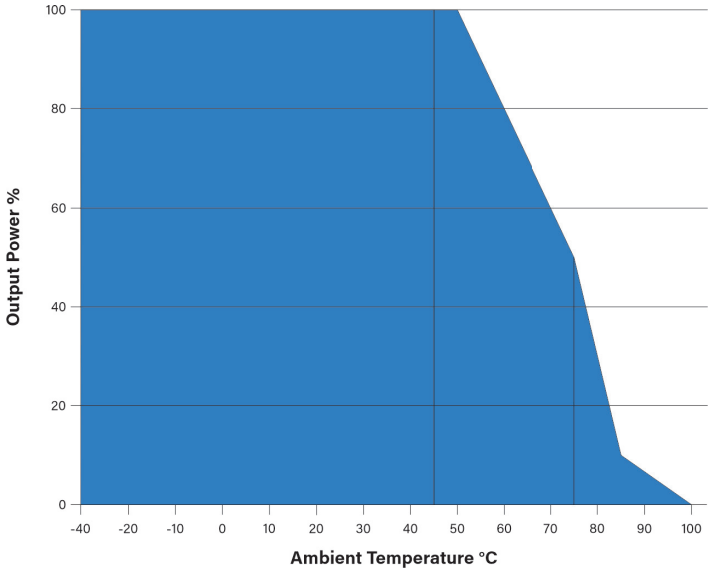
The **MB6000RU** includes a remote On/Off function. Illustrated above is a control set up using an external open collector switch. If the On/Off control feature is not required, pin 3 should be left open.

The capacitor CR is a 10 µF.

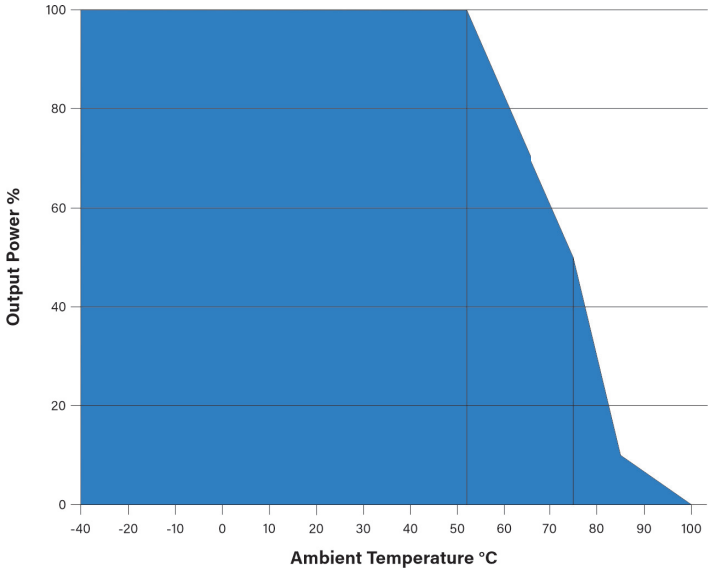
Remote On/Off

Parameter	Min.	Typ.	Max.	Units	Notes
Unit On	3.0		12.0	VDC	or Open Circuit
Unit Off	0		1.2	VDC	or Short Circuit
Off Idle Current		5.0		mA	

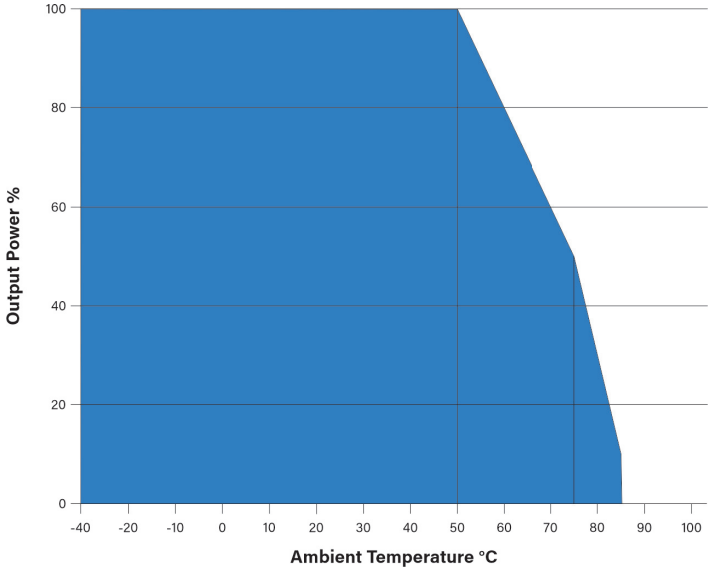
Temp Derating Curve, MB2405S No Heat Sink



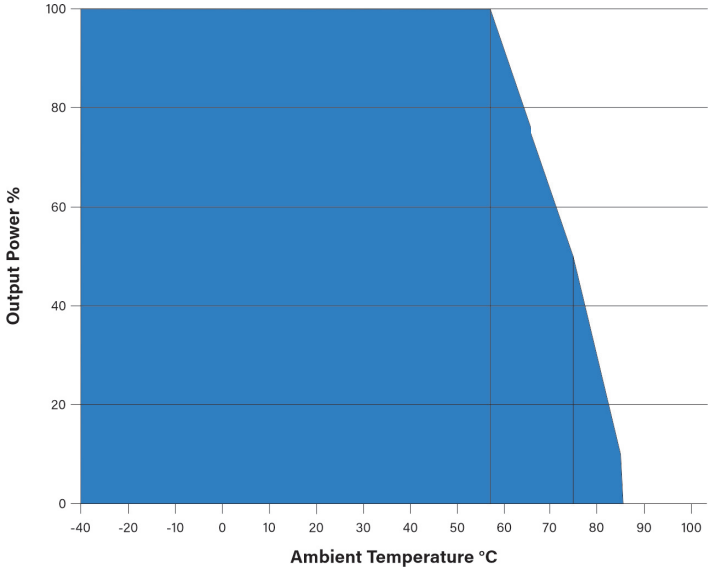
Temp Derating Curve, MB2405S With Heat Sink



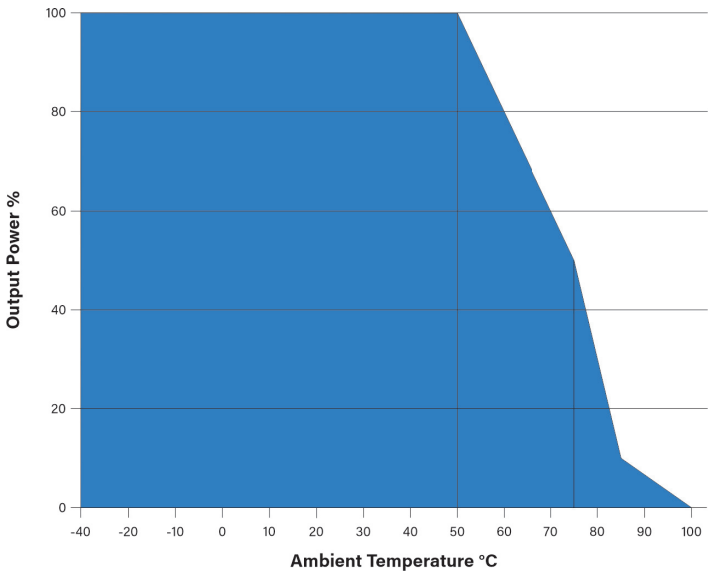
Temp Derating Curve, MB4812/15D No Heat Sink



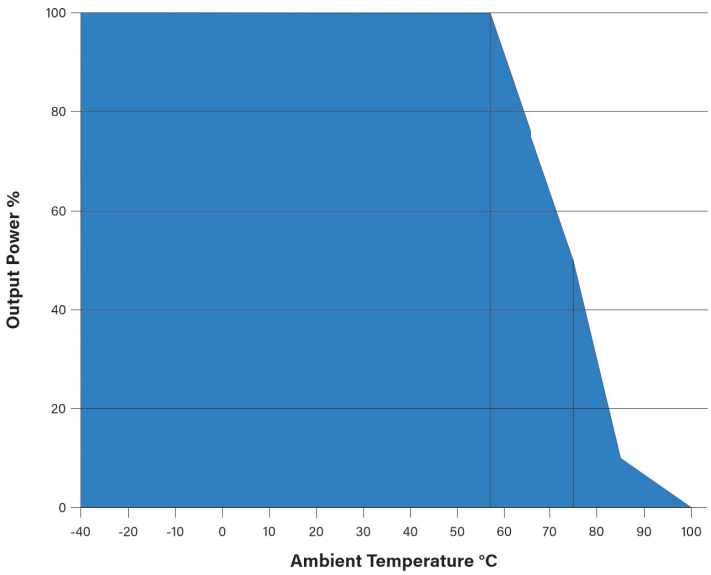
Temp Derating Curve, MB4812/15D With Heat Sink



Temp Derating Curve, All Other Models, No Heat Sink



Temp Derating Curve, All Other Models With Heat Sink

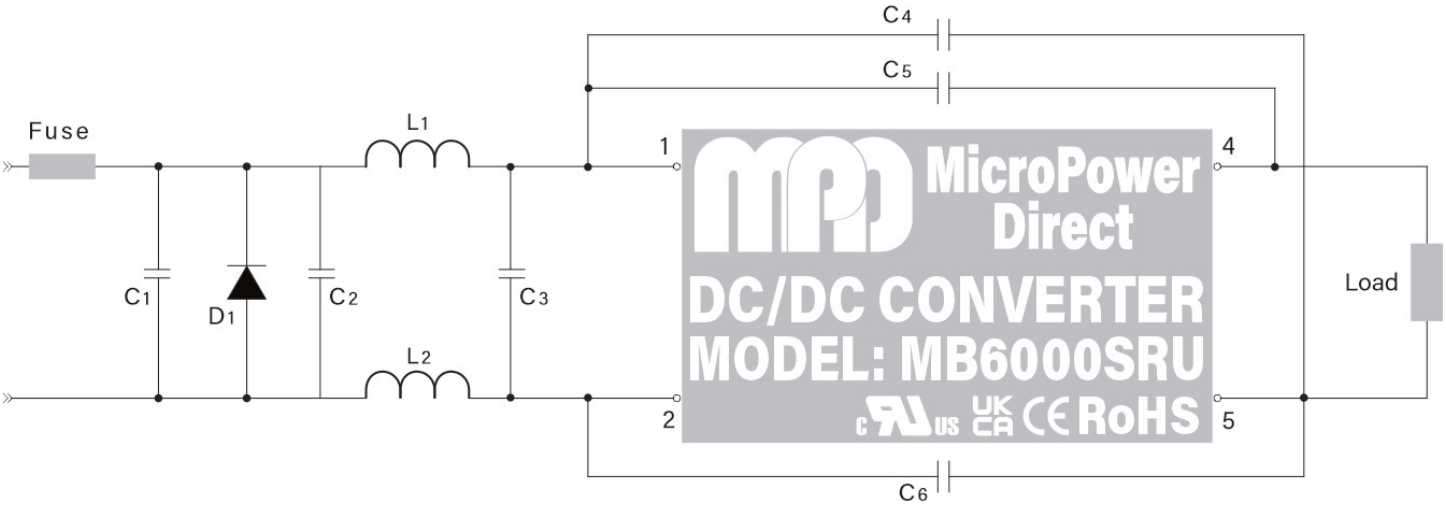


EMI/EMC Characteristics

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	20V/m
EFT, See note at left	EN 61000-4-4	A	±2 kV
Surge, See note at left	EN 61000-4-5	A	±2 kV
CS	EN 61000-4-6	A	10 Vrms
PFMF	EN 61000-4-8	A	100 A/m

These converters will meet the requirements of EN 55032, Class A conducted & radiated emmisions with the suggested external components shown in the circuit diagrams below

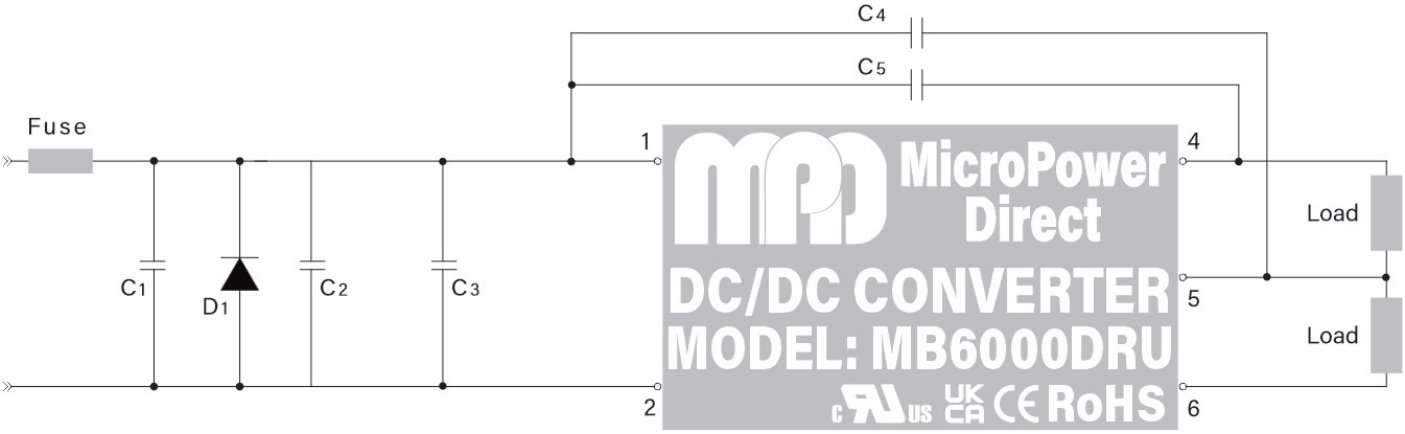
EMI Connection: Single Output



The diagram above illustrates a typical connection of the **MB6000SRU** for applications that require the circuit to meet EMI/EMC specifications. The recommended component values are given in the table at right.

Model	C1	D1	C2, C3	L1, L2	C4	C5, C6
MB6024RU	330 µF/100V KY Series	SMDJ58A	MLCC 4.7 µF, 50V	12 µH	MLCC 470 µF, 2KV	MLCC 1,000 pF, 2KV
MB6048RU	330 µF/100V KY Series	S<DJ120A	MLCC 1.5 µF, 100V	12 µH	MLCC 470 µF, 2KV	MLCC 1,000 pF, 2KV

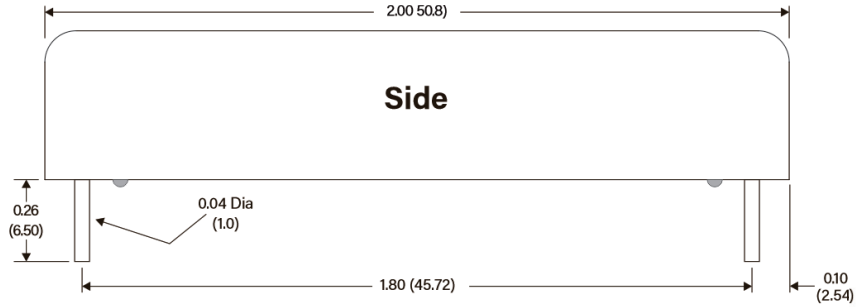
EMI Connection: Dual Output

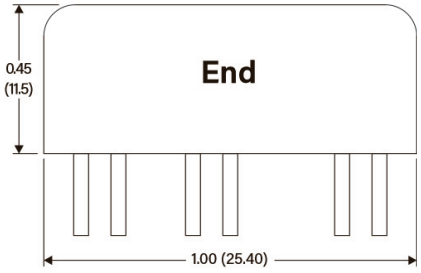


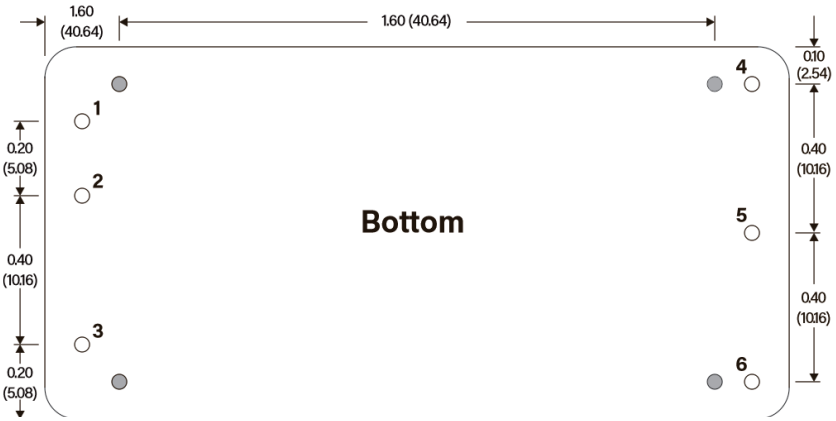
Model	C1	D1	C2, C3	C4	C5
MB6024RU	330 µF/100V KY Series	SMDJ58A	MLCC 4.7 µF, 50V	MLCC 220 pF, 2KV	MLCC 1,500 pF, 2KV
MB6048RU	330 µF/100V KY Series	S<DJ120A	MLCC 1.5 µF, 100V	MLCC 220 pF, 2KV	MLCC 1,500 pF, 2KV

The diagram above illustrates a typical connection of the **MB6000DRU** for applications that require the circuit to meet EMI/EMC specifications. The recommended component values are given in the table at left.

Mechanical Dimensions







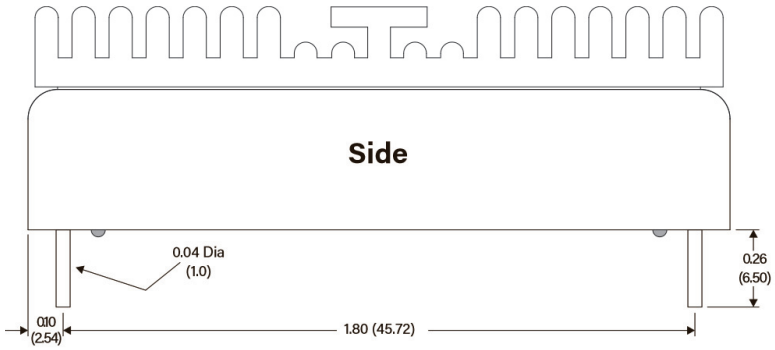
Pin Connections

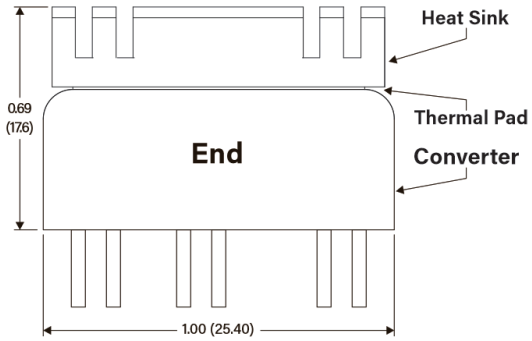
Pin	Single	Dual
1	+VIN	+VIN
2	-VIN	-VIN
3	Remote On/Off	Remote On/Off
4	+VOUT	+VOUT
5	-VOUT	Common
6	Trim	-VOUT

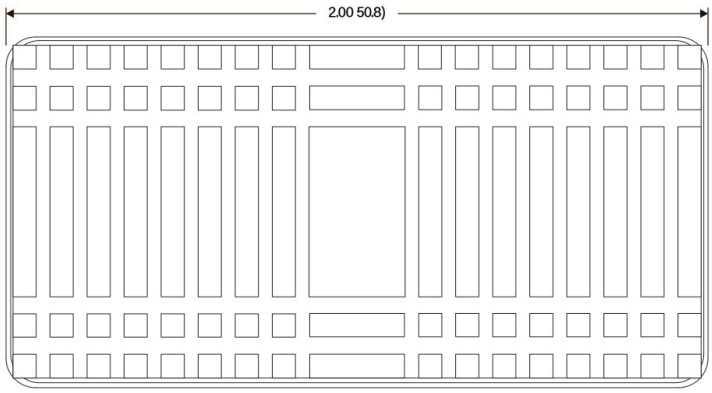
Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Pin Tolerance x.xx = ±0.014 (±0.35)
- Stand Off Height = ±0.02 (±0.50)
- Weight (Typ) = 1.59 Oz (45.0g)

Mechanical Dimensions: With Heatsink







Top

Pin Connections

Pin	Single	Dual
1	+VIN	+VIN
2	-VIN	-VIN
3	Remote On/Off	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)
- Pin Tolerance x.xx = ±0.014 (±0.35)
- Stand Off Height = ±0.02 (±0.50)
- Weight (Typ) = 1.99 Oz (56.3g)

For the Heat Sink option, add the suffix "-H" to the model number (i.e. **MB6048S-05RU-H**) These models are shipped with the heat sink attached at the factory

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