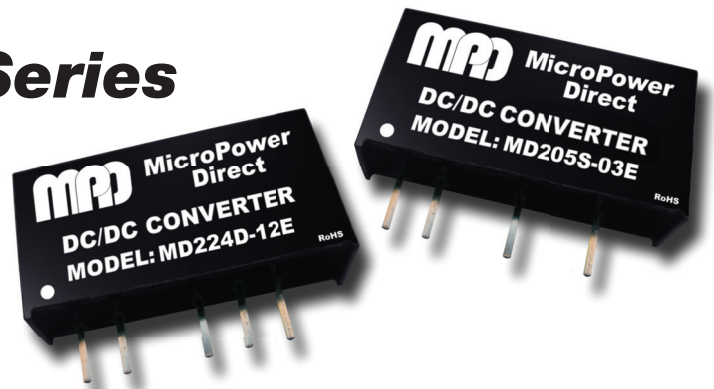


MD200xE Series

Low Cost, 2W Miniature SIP DC/DC Converters



Key Features:

- 2W Output Power
- Miniature SIP Case
- Short Circuit Protected
- 1,500 VDC Isolation
- 57 Standard Models
- Single and Dual Outputs
- >3.5 MHour MTBF
- -40°C to +105°C Operation
- LOW COST

3.0 kV Isolation
Models
Available

RoHS



Cost Cuts



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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	5 VDC Input	4.50	5.0	5.50	VDC
	9 VDC Input	8.10	9.0	9.90	
	12 VDC Input	10.80	12.0	13.20	
	15 VDC Input	13.50	15.0	16.50	
	24 VDC Input	21.60	24.0	26.40	
Input Filter	Internal Capacitor				

Output

Parameter		Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy				±2.5		%
Line Regulation	3.3 VDC Output	For VIN Change of 1%			±1.5	%
	All Other Outputs				±1.2	
Load Regulation, See Note 1		See Model Selection Guide				
Ripple & Noise (20 MHz), See Note 2		Output Voltage ≤12 VDC		60		mV P - P
		15 VDC, 24 VDC Output		75		
Temperature Coefficient					±0.03	%/°C
Output Short Circuit		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, 1V		20		pF
Switching Frequency			100	300	kHz

EMI Characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
EMI Compliance, See Note 4	Conducted	CISPR22/EN 55022 Level B			
	Radiated	CISPR22/EN 55022 Level B			
EMC Compliance, Single Output	Electrostatic Discharge (ESD)	EN 61000-4-2 Level B Contact ±8 kV			
EMC Compliance, Dual Output		EN 61000-4-2 Level B Contact ±6 kV			

Environmental

Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range	Ambient	-40	+25	+105	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%

Physical

Case Size	0.772 x 0.276 x 0.394 Inches (19.6 x 7.0 x 10.0 mm)				
Case Material	Non-Conductive Black Plastic (UL-94V0)				
Weight	0.08 Oz (2.4g)				

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	3.5			MHours

Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage Surge (1 Sec)	5 VDC Input	-0.7		9.0	VDC
	9 VDC Input	-0.7		12.0	
	12 VDC Input	-0.7		18.0	
	15 VDC Input	-0.7		21.0	
	24 VDC Input	-0.7		30.0	
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.

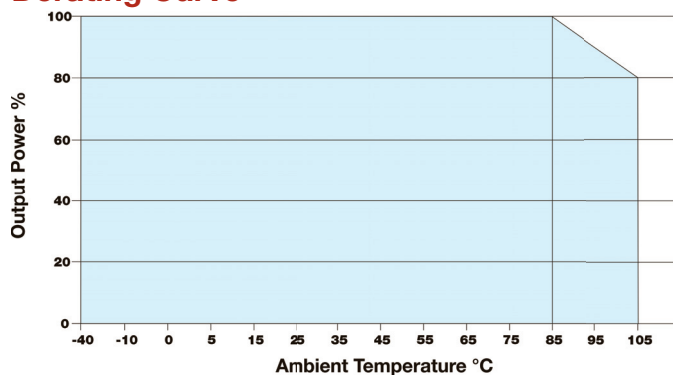
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Model Number	Input				Output			Load Regulation % Typ.	Output Capacitive Load (μF Max)	Efficiency (%)		Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)			Min.	Typ.	
	Nominal	Range	Full-Load	No-Load								
MD205S-03E	5	4.5 - 5.5	476	25	3.3	400	40.0	18.0	220	70	74	1,000
MD205S-05E	5	4.5 - 5.5	506	25	5.0	400	40.0	12.0	220	75	79	1,000
MD205S-09E	5	4.5 - 5.5	506	25	9.0	222	22.0	9.0	220	77	81	1,000
MD205S-12E	5	4.5 - 5.5	476	25	12.0	167	17.0	8.0	220	80	84	1,000
MD205S-15E	5	4.5 - 5.5	476	25	15.0	133	13.0	7.0	220	80	84	1,000
MD205S-24E	5	4.5 - 5.5	476	25	24.0	83	8.0	6.0	220	80	84	1,000
MD205D-03E	5	4.5 - 5.5	540	25	±3.3	±303	±30.0	18.0	100	70	74	1,000
MD205D-05E	5	4.5 - 5.5	500	25	±5.0	±200	±20.0	12.0	100	76	80	1,000
MD205D-09E	5	4.5 - 5.5	476	25	±9.0	±111	±11.0	9.0	100	80	84	1,000
MD205D-12E	5	4.5 - 5.5	476	25	±12.0	±83	±8.0	8.0	100	80	84	1,000
MD205D-15E	5	4.5 - 5.5	476	25	±15.0	±67	±7.0	7.0	100	80	84	1,000
MD205D-24E	5	4.5 - 5.5	476	25	±24.0	±42	±4.0	6.0	100	80	84	1,000
MD209S-05E	9	8.1 - 9.9	285	20	5.0	400	40.0	12.0	220	76	80	750
MD209S-09E	9	8.1 - 9.9	281	20	9.0	222	22.0	9.0	220	77	81	750
MD209S-12E	9	8.1 - 9.9	274	20	12.0	167	17.0	8.0	220	79	83	750
MD209S-15E	9	8.1 - 9.9	274	20	15.0	133	13.0	7.0	220	79	83	750
MD209S-24E	9	8.1 - 9.9	274	20	24.0	83	8.0	6.0	220	79	83	750
MD209D-05E	9	8.1 - 9.9	285	20	±5.0	±200	±20.0	12.0	100	76	80	750
MD209D-09E	9	8.1 - 9.9	281	20	±9.0	±111	±11.0	9.0	100	77	81	750
MD209D-12E	9	8.1 - 9.9	274	20	±12.0	±83	±8.0	8.0	100	79	83	750
MD209D-15E	9	8.1 - 9.9	274	20	±15.0	±67	±7.0	7.0	100	79	83	750
MD209D-24E	9	8.1 - 9.9	274	20	±24.0	±42	±4.0	6.0	100	79	83	750
MD212S-03E	12	10.8 - 13.2	198	15	3.3	400	40.0	18.0	220	75	79	500
MD212S-05E	12	10.8 - 13.2	213	15	5.0	400	40.0	12.0	220	86	80	500
MD212S-09E	12	10.8 - 13.2	211	15	9.0	222	22.0	9.0	220	77	81	500
MD212S-12E	12	10.8 - 13.2	198	15	12.0	167	17.0	8.0	220	80	84	500
MD212S-15E	12	10.8 - 13.2	198	15	15.0	133	13.0	7.0	220	80	84	500
MD212S-24E	12	10.8 - 13.2	198	15	24.0	83	8.0	6.0	220	81	85	500
MD212D-03E	12	10.8 - 13.2	208	15	±3.3	±303	±30.0	18.0	100	76	80	500
MD212D-05E	12	10.8 - 13.2	198	15	±5.0	±200	±20.0	12.0	100	80	84	500
MD212D-07E	12	10.8 - 13.2	198	15	±7.2	±139	±14.0	10.0	100	80	84	500
MD212D-09E	12	10.8 - 13.2	205	15	±9.0	±111	±11.0	9.0	100	79	83	500
MD212D-12E	12	10.8 - 13.2	196	15	±12.0	±83	±8.0	8.0	100	81	85	500
MD212D-15E	12	10.8 - 13.2	198	15	±15.0	±67	±7.0	7.0	100	80	84	500
MD212D-24E	12	10.8 - 13.2	196	15	±24.0	±42	±4.0	6.0	100	82	86	500
MD215S-05E	15	13.5 - 16.5	171	10	5.0	400	40.0	12.0	220	76	80	400
MD215S-09E	15	13.5 - 16.5	169	10	9.0	222	22.0	9.0	220	77	81	400
MD215S-12E	15	13.5 - 16.5	159	10	12.0	167	17.0	8.0	220	80	84	400
MD215S-15E	15	13.5 - 16.5	157	10	15.0	133	13.0	7.0	220	80	84	400
MD215S-24E	15	13.5 - 16.5	157	10	24.0	83	8.0	6.0	220	81	85	400
MD215D-05E	15	13.5 - 16.5	167	10	±5.0	±200	±20.0	12.0	100	76	80	400
MD215D-09E	15	13.5 - 16.5	167	10	±9.0	±111	±11.0	9.0	100	76	80	400
MD215D-12E	15	13.5 - 16.5	159	10	±12.0	±83	±8.0	8.0	100	80	84	400
MD215D-15E	15	13.5 - 16.5	157	10	±15.0	±67	±7.0	7.0	100	81	85	400
MD215D-24E	15	13.5 - 16.5	157	10	±24.0	±42	±4.0	6.0	100	81	85	400
MD224S-03E	24	21.6 - 26.4	99	8	3.3	400	40.0	18.0	220	75	79	250
MD224S-05E	24	21.6 - 26.4	104	8	5.0	400	40.0	12.0	220	76	80	250
MD224S-09E	24	21.6 - 26.4	100	8	9.0	222	22.0	9.0	220	79	83	250
MD224S-12E	24	21.6 - 26.4	99	8	12.0	167	17.0	8.0	220	80	84	250
MD224S-15E	24	21.6 - 26.4	99	8	15.0	133	13.0	7.0	220	80	84	250
MD224S-24E	24	21.6 - 26.4	98	8	24.0	83	8.0	6.0	220	80	84	250
MD224D-03E	24	21.6 - 26.4	104	8	±3.3	±303	±30.0	18.0	100	76	80	250
MD224D-05E	24	21.6 - 26.4	99	8	±5.0	±200	±20.0	12.0	100	80	84	250
MD224D-09E	24	21.6 - 26.4	98	8	±9.0	±111	±11.0	9.0	100	81	85	250
MD224D-12E	24	21.6 - 26.4	99	8	±12.0	±83	±8.0	8.0	100	80	84	250
MD224D-15E	24	21.6 - 26.4	99	8	±15.0	±67	±7.0	7.0	100	80	84	250
MD224D-24E	24	21.6 - 26.4	98	8	±24.0	±42	±4.0	6.0	100	81	85	250

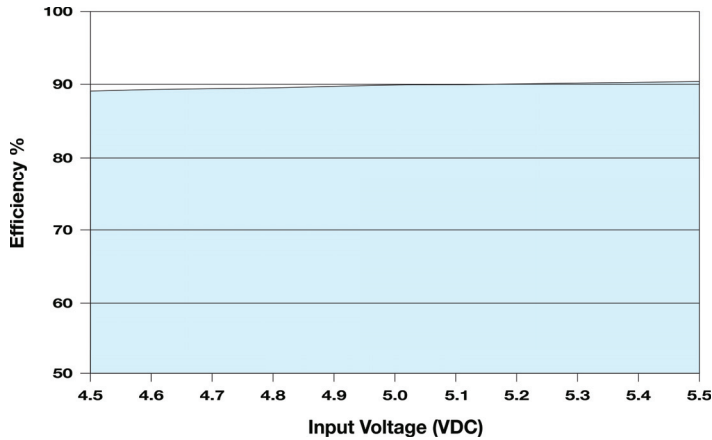
Notes:

- Output load regulation is specified for a load change of 10% to 100%.
- When measuring output ripple, it is recommended that an external 1 μ F ceramic capacitor & 10 μ F electrolytic capacitor be placed in parallel from the +Vout pin to the -Vout pin for single output models, or from each output to common for dual output models.
- Operation at no load will not damage these units, however, they may not meet all specifications.
- These converters are specified for operation without external components. However, in some applications the addition of input/output capacitors will enhance stability and reduce output ripple. The simple connection shown on page 3 will typically meet EN 55022 Class B. For dual output units, a capacitor should be connected from each output to common.

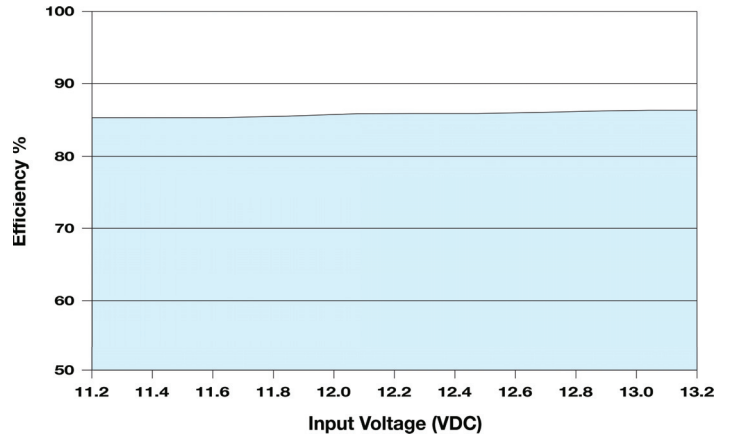
Derating Curve



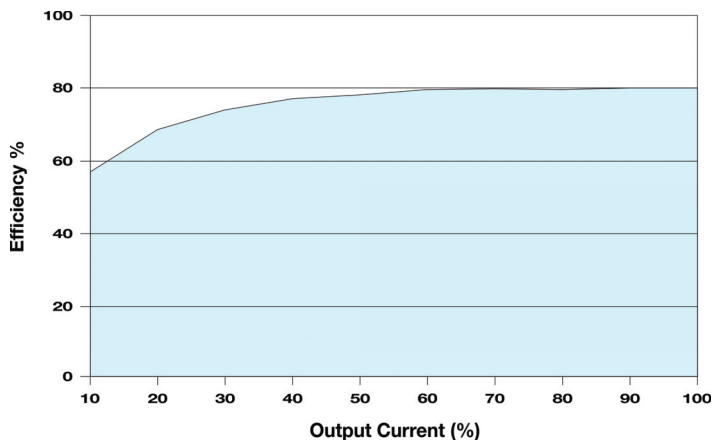
Typical Efficiency vs Input, 5 VIN Models



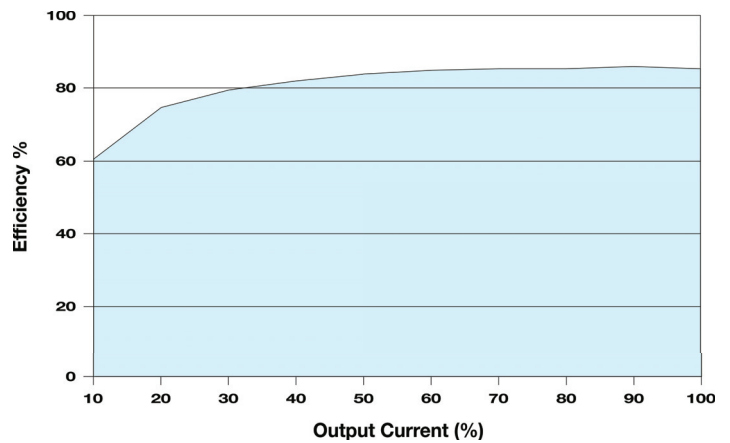
Typical Efficiency vs Input, 12 VIN Models



Typical Efficiency vs Output, 5 VIN Models

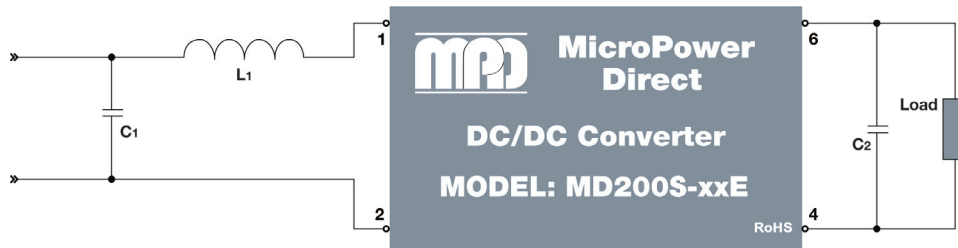


Typical Efficiency vs Output, 12 VIN Models



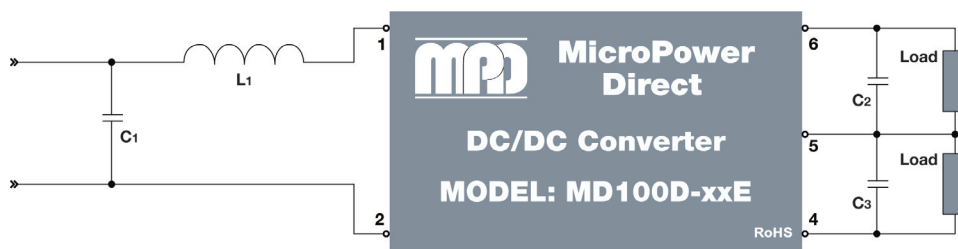
Efficiency vs input is plotted with the unit at full load. Efficiency vs output is plotted with the unit at nominal input.

Typical Connection, Single Output Models



VIN	C1	L1
3.3 VDC	4.7 μ F/50V	6.8 μ H
5 VDC	4.7 μ F/50V	6.8 μ H
12 VDC	4.7 μ F/50V	6.8 μ H
15 VDC	4.7 μ F/50V	6.8 μ H
24 VDC	4.7 μ F/50V	6.8 μ H

Typical Connection, Dual Output Models

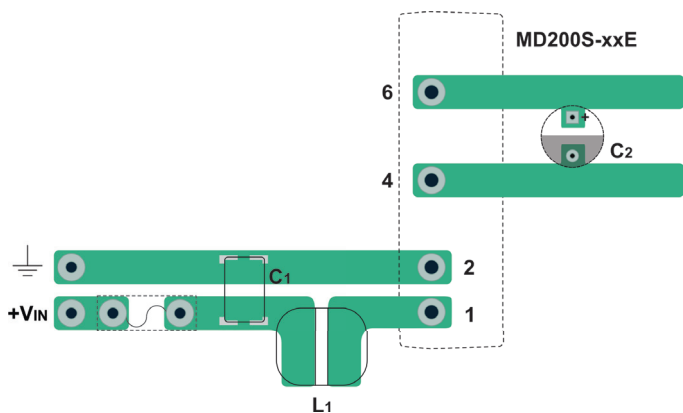


VOUT	C2	C3
3.3 VDC	10 μ F	10 μ F
5.0 VDC	10 μ F	10 μ F
9.0 VDC	2.2 μ F	2.2 μ F
12 VDC	2.2 μ F	2.2 μ F
15 VDC	1.0 μ F	1.0 μ F
24 VDC	1.0 μ F	1.0 μ F
$\pm$ 3.3 VDC	4.7 μ F	4.7 μ F
$\pm$ 5.0 VDC	4.7 μ F	4.7 μ F
$\pm$ 9.0 VDC	1.0 μ F	1.0 μ F
$\pm$ 12 VDC	1.0 μ F	1.0 μ F
$\pm$ 15 VDC	0.47 μ F	0.47 μ F
$\pm$ 24 VDC	0.47 μ F	0.47 μ F

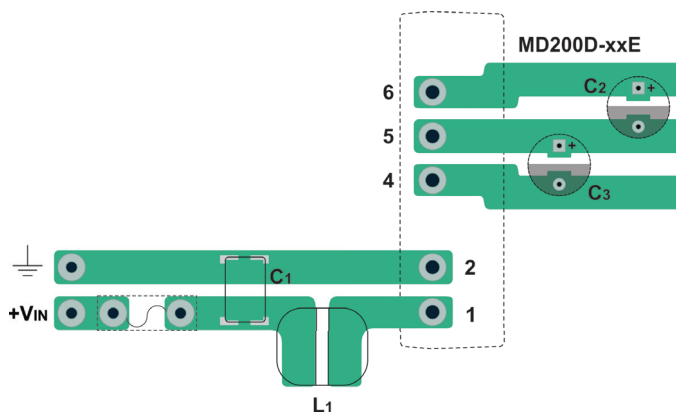
These converters are specified for operation without external components. However, in some applications the addition of input/output capacitors will enhance stability and reduce output ripple. For applications that require meeting EMC standards, the diagrams above illustrates a typical connection of the **MD200x-xxE** series. Suggested component values are given in the table at right.

Capacitors C2 and C3 are not required to meet specifications, but may be used if a lower level of output ripple is required.

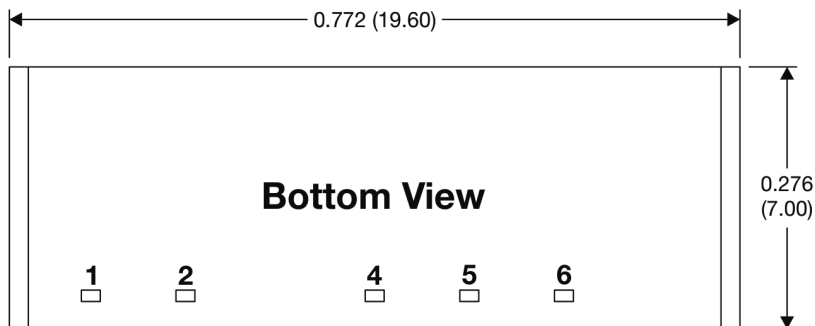
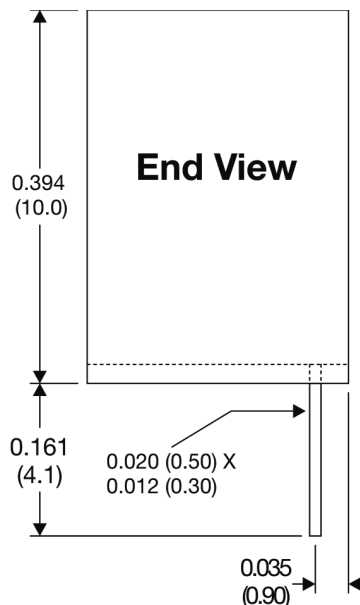
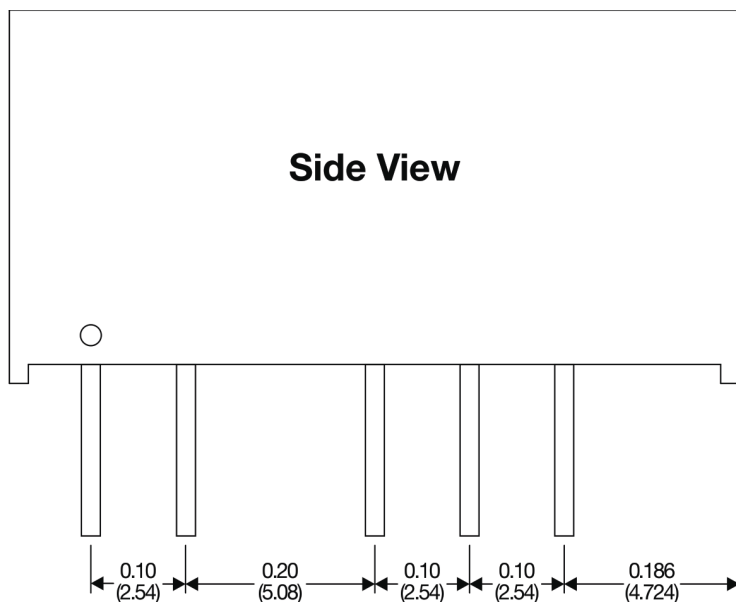
Typical Board Layout, Single Output Models



Typical Board Layout, Dual Output Models



Mechanical Dimensions



Notes:

- All dimensions are typical in inches (mm)
- General Tolerance x.xx = ± 0.02 (± 0.5)
- Pin 1 is marked by a "dot" or indentation on the unit

Pin Connections

Pin	Single Output
1	+VIN
2	-VIN
4	-VOUT
5	No Pin
6	+VOUT

Pin	Dual Output
1	+VIN
2	-VIN
4	-VOUT
5	Common
6	+VOUT



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