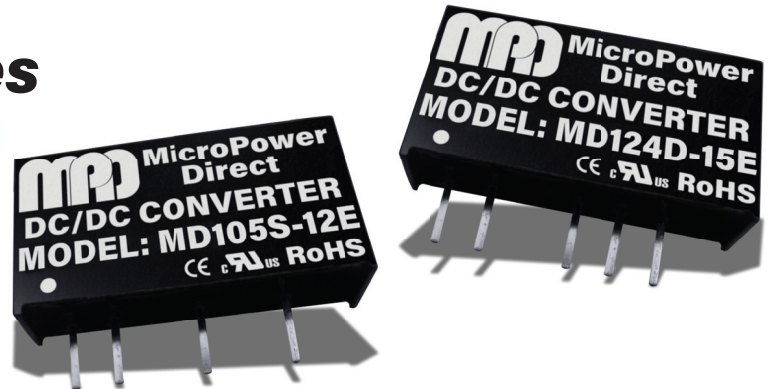


MD100E Series

Low Cost, 1W SIP Single & Dual Output DC/DC Converters



Key Features:

- 1W Output Power
- 1,500 VDC Isolation
- Miniature SIP Case
- EN 62368 Approved
- Short Circuit Protected
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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	3.3 VDC Input	2.97	3.3	3.63	VDC	
	5 VDC Input	4.5	5.0	5.5		
	12 VDC Input	10.8	12.0	13.2		
	15 VDC Input	13.5	15.0	16.5		
	24 VDC Input	21.6	24.0	26.4		
Reflected Ripple Current			15		mA	
Input Filter	Capacitor					

Output						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Output Voltage Accuracy	See Tolerance Graphs (Page 2 & 3)					
Line Regulation, See Note 3	For V_{IN} Change of 1%			±1.2	%	
Load Regulation, See Note 4	See Model Selection Guide					
Ripple & Noise (20 MHz), See Note 5	24 Vout Models		50	100	mV P - P	
	All Other Models		30	75		
Temperature Coefficient			±0.02		%/°C	
Output Short Circuit	Continuous (Autorecovery)					

General						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Isolation Voltage	See Note 6	1,500			VDC	
Isolation Resistance	500 VDC	1,000			MΩ	
Isolation Capacitance	100 kHz, 0.1V		20		pF	
Switching Frequency	3.3 V_{IN} Models		220		kHz	
	5 V_{IN} Models		270			
	All Other Models		260			

EMI Characteristics						
Parameter	Standard	Criteria	Level			
Radiated Emissions, See Page 5	CISPR32/EN 55032		Class B			
Radiated Emissions	CISPR32/EN 55032		Class B			
ESD EN 61000-4-2, 5 V_{IN} Models	EN 61000-4-2	B	±8 kV Air			
			±4 kV Contact			
ESD EN 61000-4-2, All Other Models	EN 61000-4-2	B	±8 kV Air			
			±6 kV Contact			

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	See Mechanical Drawing (Page 6)					
Case Material	Flame Retardant, Non-Conductive, Black Plastic (UL94-V0)					
Weight	See Mechanical Drawing (Page 6)					

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units	
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	3.5			MHours	
Safety Standards, See Note 1	UL/cUL 62368-1 recognition (UL certificate)					

Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units	
Input Voltage Surge (1 Sec)	3.3 VDC Input			5.0	VDC	
	5 VDC Input			9.0		
	12 VDC Input			18.0		
	15 VDC Input			21.0		
	24 VDC Input			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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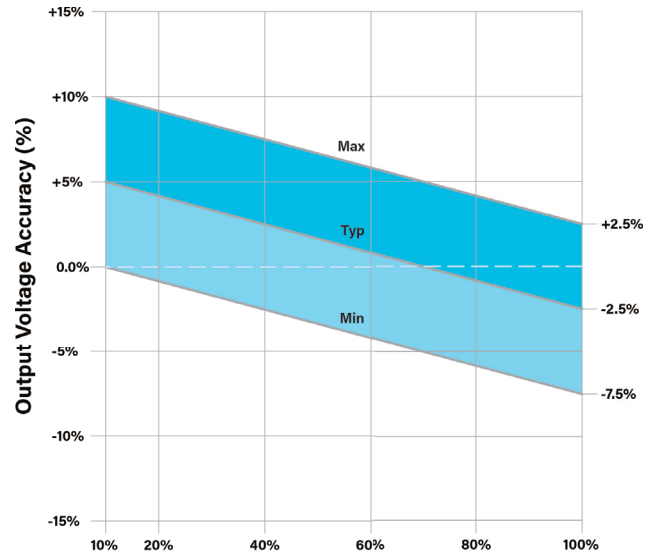
Model Number	Input				Output			Load Regulation (% Typ)	Output Capacitive Load (µF Max)	Efficiency (% Typ)	Fuse Rating Slow-Blow (mA)	Output Volt. Tol. Chart
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)					
	Nominal	Range	Full-Load	No-Load								
MD103S-03E	3.3	2.97 - 3.63	384	10	3.3	303.0	30.0	±8.0	2,400	79	800	A
MD103S-05E	3.3	2.97 - 3.63	370	18	5.0	200.0	20.0	±5.0	2,400	82	800	B
MD103S-09E	3.3	2.97 - 3.63	370	18	9.0	111.0	11.0	±3.0	1,000	85	800	B
MD103S-12E	3.3	2.97 - 3.63	370	18	12.0	83.0	8.0	±3.0	560	82	800	B
MD103S-15E	3.3	2.97 - 3.63	370	18	15.0	67.0	7.0	±3.0	560	82	800	B
MD103S-24E	3.3	2.97 - 3.63	370	18	24.0	42.0	4.0	±2.0	220	84	800	B
MD103D-03E	3.3	2.97 - 3.63	384	10	±3.3	±152.0	±15.0	±8.0	1,200	78	800	A
MD103D-05E	3.3	2.97 - 3.63	370	18	±5.0	±100.0	±10.0	±5.0	1,200	82	800	B
MD103D-09E	3.3	2.97 - 3.63	370	18	±9.0	±56.0	±6.0	±3.0	470	85	800	B
MD103D-12E	3.3	2.97 - 3.63	370	18	±12.0	±42.0	±5.0	±3.0	220	82	800	B
MD103D-15E	3.3	2.97 - 3.63	370	18	±15.0	±34.0	±4.0	±3.0	220	82	800	B
MD103D-24E	3.3	2.97 - 3.63	370	18	±24.0	±21.0	±2.0	±2.0	100	84	800	B
UL MD105S-03E	5.0	4.5 - 5.5	270	5.0	3.3	303.0	30.0	±8.0	2,400	74	600	A
UL MD105S-05E	5.0	4.5 - 5.5	270	5.0	5.0	200.0	20.0	±5.0	2,400	82	600	B
UL MD105S-09E	5.0	4.5 - 5.5	241	12	9.0	111.0	12.0	±3.0	1,000	83	600	B
UL MD105S-12E	5.0	4.5 - 5.5	241	12	12.0	84.0	9.0	±3.0	560	83	600	B
UL MD105S-15E	5.0	4.5 - 5.5	241	18	15.0	67.0	7.0	±3.0	560	83	600	B
UL MD105S-24E	5.0	4.5 - 5.5	241	18	24.0	42.0	4.0	±2.0	220	85	600	B
MD105D-03E	5.0	4.5 - 5.5	270	5.0	±3.3	±152.0	±15.0	±8.0	1,200	74	600	A
UL MD105D-05E	5.0	4.5 - 5.5	270	5.0	±5.0	±100.0	±10.0	±5.0	1,200	82	600	B
UL MD105D-09E	5.0	4.5 - 5.5	241	12	±9.0	±56.0	±6.0	±3.0	470	83	600	B
UL MD105D-12E	5.0	4.5 - 5.5	241	12	±12.0	±42.0	±5.0	±3.0	220	83	600	B
UL MD105D-15E	5.0	4.5 - 5.5	241	18	±15.0	±34.0	±4.0	±3.0	220	83	600	B
UL MD105D-24E	5.0	4.5 - 5.5	241	18	±24.0	±21.0	±3.0	±2.0	100	85	600	B
UL MD112S-03E	12	10.8 - 13.2	105	8.0	3.3	303.0	30.0	±8.0	2,400	75	200	A
UL MD112S-05E	12	10.8 - 13.2	105	8.0	5.0	200.0	20.0	±5.0	2,400	80	200	C
UL MD112S-09E	12	10.8 - 13.2	105	8.0	9.0	111.0	12.0	±3.0	1,000	80	200	C
UL MD112S-12E	12	10.8 - 13.2	105	8.0	12.0	83.0	9.0	±3.0	560	80	200	C
UL MD112S-15E	12	10.8 - 13.2	105	8.0	15.0	67.0	7.0	±3.0	560	81	200	C
UL MD112S-24E	12	10.8 - 13.2	105	8.0	24.0	42.0	4.0	±2.0	220	81	150	C
UL MD112D-03E	12	10.8 - 13.2	105	8.0	±3.3	±152.0	±15.0	±8.0	1,200	75	200	A
UL MD112D-05E	12	10.8 - 13.2	105	8.0	±5.0	±100.0	±10.0	±5.0	1,200	80	200	C
MD112D-09E	12	10.8 - 13.2	105	8.0	±9.0	±56.0	±5.0	±3.0	470	83	200	C
UL MD112D-12E	12	10.8 - 13.2	105	8.0	±12.0	±42.0	±5.0	±3.0	220	81	200	C
UL MD112D-15E	12	10.8 - 13.2	105	8.0	±15.0	±34.0	±4.0	±3.0	220	81	200	C
UL MD112D-24E	12	10.8 - 13.2	105	8.0	±24.0	±21.0	±3.0	±2.0	100	80	150	C
UL MD115S-05E	15	13.5 - 16.5	84	8.0	5.0	200.0	20.0	±5.0	2,400	80	200	C
UL MD115S-09E	15	13.5 - 16.5	84	8.0	9.0	111.0	12.0	±3.0	1,000	80	200	C
UL MD115S-12E	15	13.5 - 16.5	84	8.0	12.0	83.0	9.0	±3.0	560	80	200	C
UL MD115S-15E	15	13.5 - 16.5	84	8.0	15.0	67.0	7.0	±3.0	560	81	200	C
MD115S-24E	15	13.5 - 16.5	84	8.0	24.0	42.0	5.0	±2.0	220	81	150	C
UL MD115D-05E	15	13.5 - 16.5	84	8.0	±5.0	±100.0	±10.0	±5.0	1,200	80	200	C
MD115D-09E	15	13.5 - 16.5	84	8.0	±9.0	±56.0	±5.0	±3.0	470	80	200	C
UL MD115D-12E	15	13.5 - 16.5	84	8.0	±12.0	±42.0	±5.0	±3.0	220	80	200	C
UL MD115D-15E	15	13.5 - 16.5	84	8.0	±15.0	±34.0	±4.0	±3.0	220	81	200	C
MD115D-24E	15	13.5 - 16.5	84	8.0	±24.0	±21.0	±2.0	±2.0	100	81	150	C

Model Number	Input				Output			Load Regulation (% Typ)	Output Capacitive Load (μ F Max)	Efficiency (% Typ)	Fuse Rating Slow-Blow (mA)	Output Volt. Tol. Chart
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)					
	Nominal	Range	Full-Load	No-Load								
UL MD124S-03E	24	21.6 - 26.4	56	8.0	3.3	303.0	30.0	\pm 8.0	2,400	75	100	A
UL MD124S-05E	24	21.6 - 26.4	56	8.0	5.0	200.0	20.0	\pm 5.0	2,400	79	100	C
MD124S-07E	24	21.6 - 26.4	56	8.0	7.2	139.0	13.0	\pm 3.0	1,000	80	100	C
UL MD124S-09E	24	21.6 - 26.4	56	8.0	9.0	111.0	12.0	\pm 3.0	1,000	80	100	C
UL MD124S-12E	24	21.6 - 26.4	56	8.0	12.0	83.0	9.0	\pm 3.0	560	81	100	C
UL MD124S-15E	24	21.6 - 26.4	56	8.0	15.0	67.0	7.0	\pm 3.0	560	81	100	C
UL MD124S-24E	24	21.6 - 26.4	56	8.0	24.0	42.0	4.0	\pm 2.0	220	81	100	C
UL MD124D-05E	24	21.6 - 26.4	56	8.0	\pm 5.0	\pm 100.0	\pm 10.0	\pm 5.0	1,200	80	100	C
MD124D-09E	24	21.6 - 26.4	56	8.0	\pm 9.0	\pm 56.0	\pm 5.0	\pm 3.0	470	80	100	C
UL MD124D-12E	24	21.6 - 26.4	56	8.0	\pm 12.0	\pm 42.0	\pm 5.0	\pm 3.0	220	81	100	C
UL MD124D-15E	24	21.6 - 26.4	56	8.0	\pm 15.0	\pm 34.0	\pm 4.0	\pm 3.0	220	79	100	C
UL MD124D-24E	24	21.6 - 26.4	56	8.0	\pm 24.0	\pm 21.0	\pm 3.0	\pm 2.0	100	80	100	C

Notes:

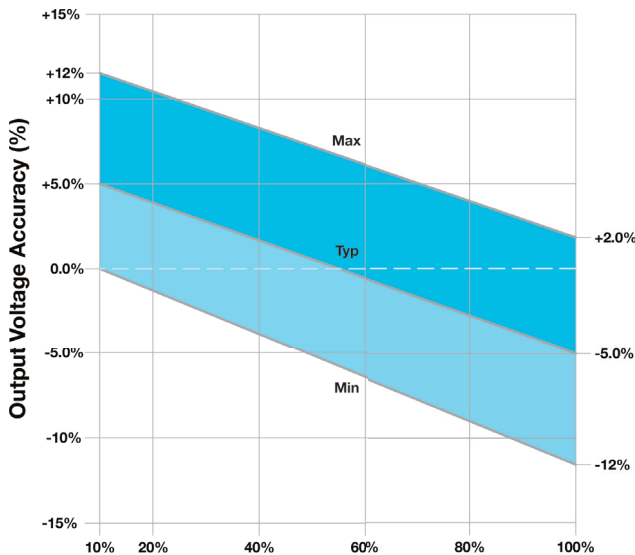
1. Units that are marked with the "UL" in the model selection table above are approved to EN 62368.
2. Output capacitive load is specified for each output.
3. Single & dual 3.3 VOUT models have a specified line regulation of 1.5 %/‰.
4. Output load regulation is specified for a load change of 10% to 100%.
5. When measuring output ripple, it is recommended that an external 1 μ F ceramic capacitor & a 10 μ F electrolytic capacitor be placed in parallel from the +VOUT pin to the -VOUT pin for single output units or from each output to common for dual output models.
6. Isolation voltage is specified for a period 60S with a leakage current lower than 1 mA.
7. Operation at no load will not damage these units, however, 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.

Output Voltage Tolerance: Chart B



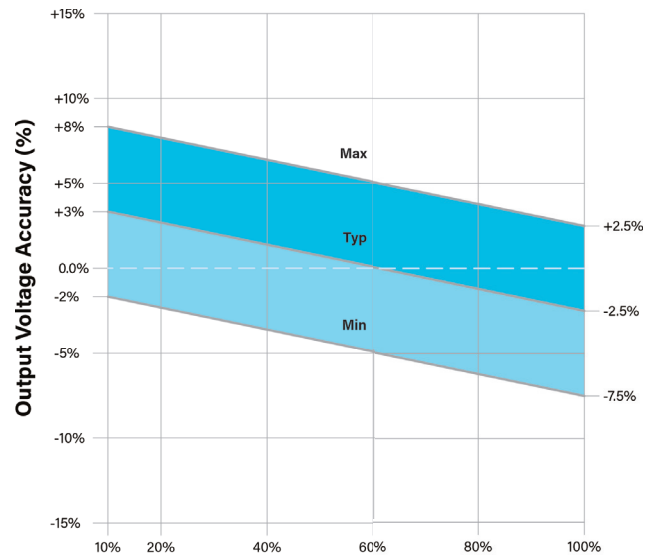
Output Current (%)

Output Voltage Tolerance: Chart A



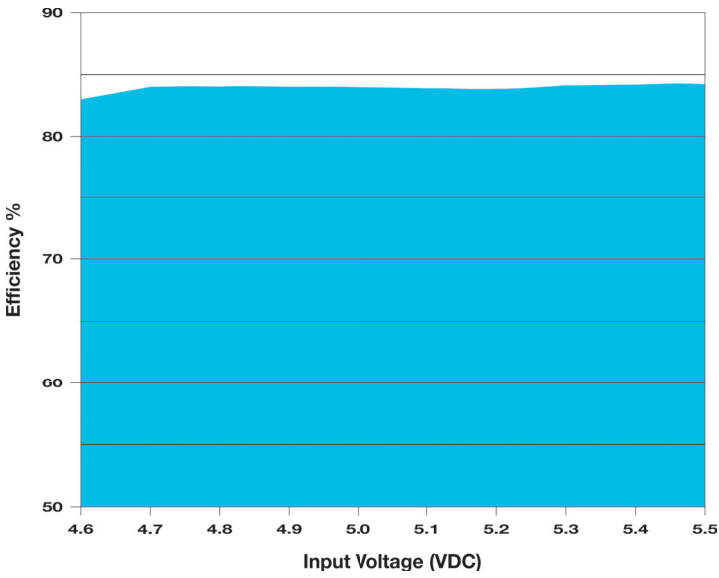
Output Current (%)

Output Voltage Tolerance: Chart C

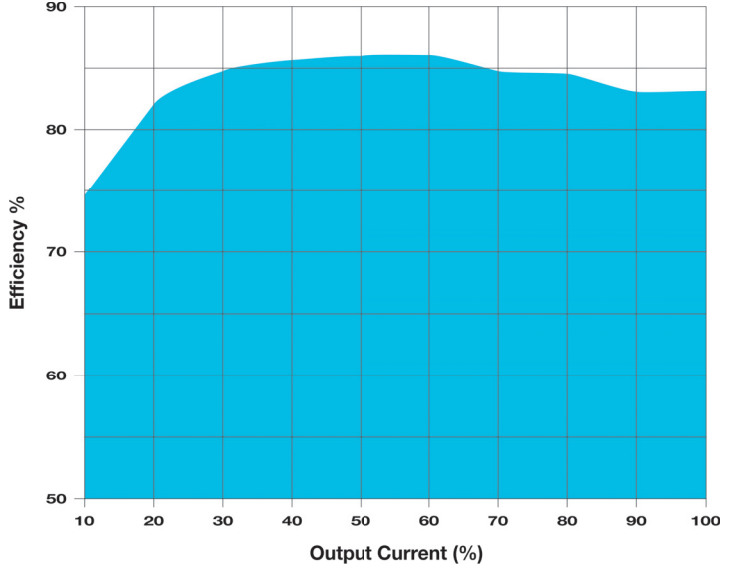


Output Current (%)

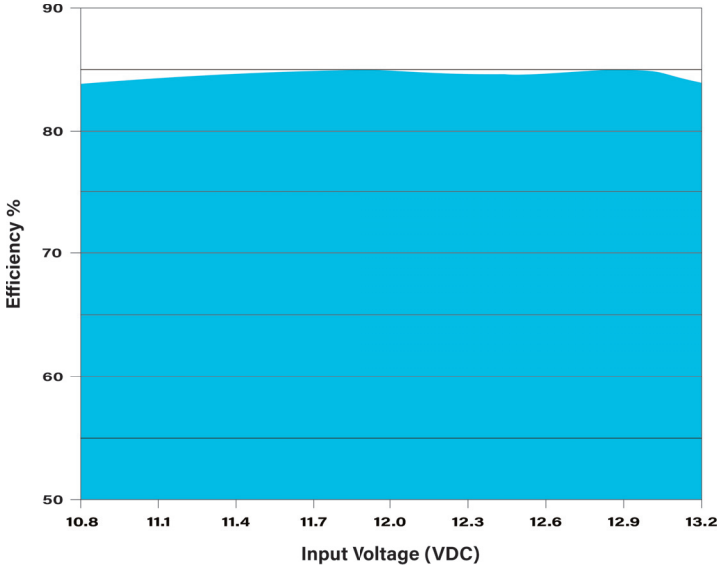
Efficiency vs Input: MD105S-05E



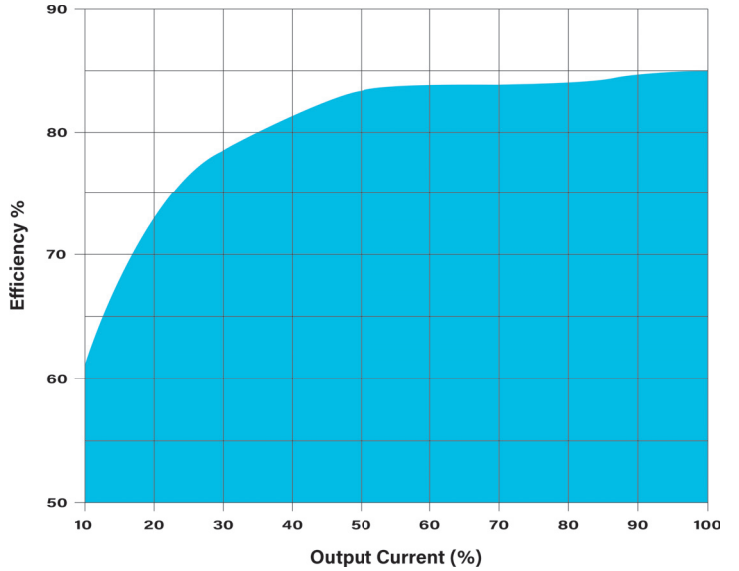
Efficiency vs Output Load: MD105S-05E



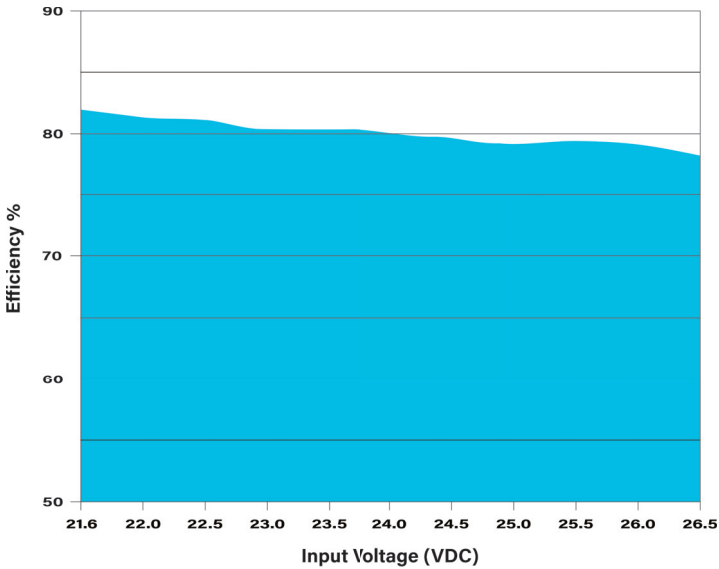
Efficiency vs Input: MD112S-05E



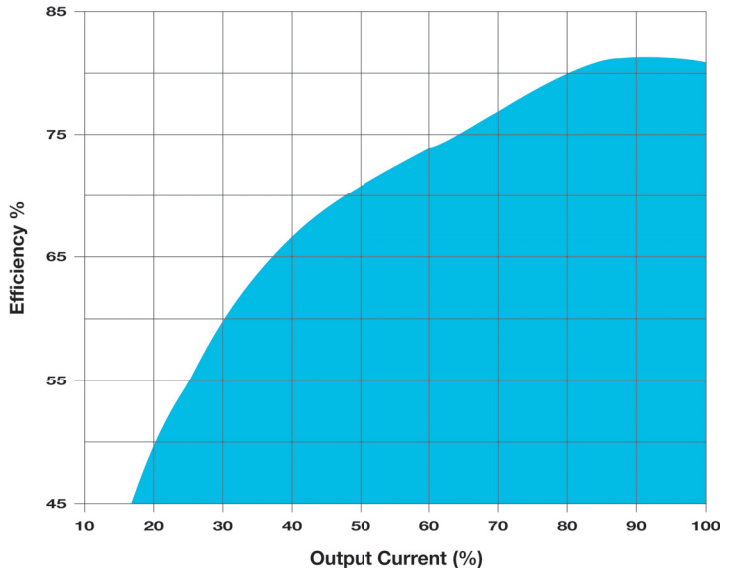
Efficiency vs Output Load: MD112S-05E



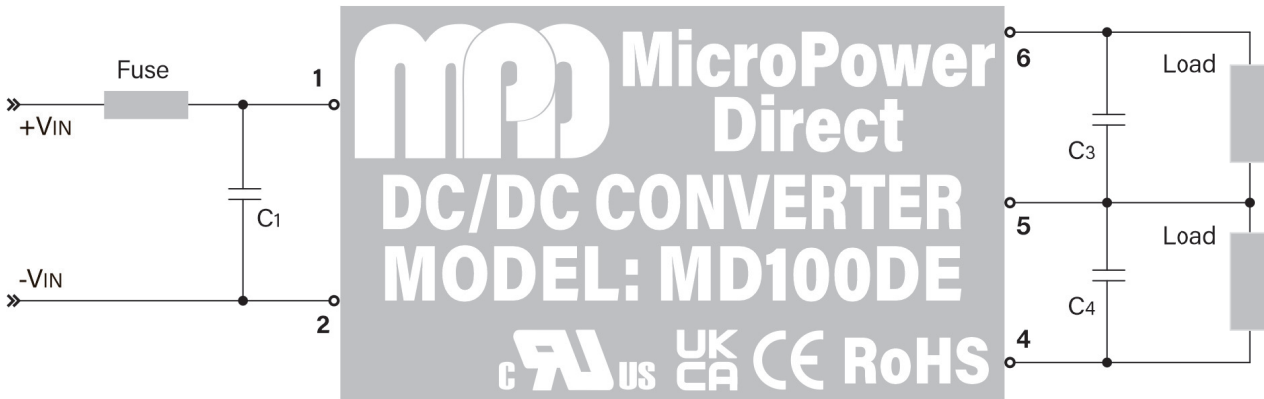
Efficiency vs Input: MD124S-05E



Efficiency vs Output Load: MD124S-05E



Typical Connection

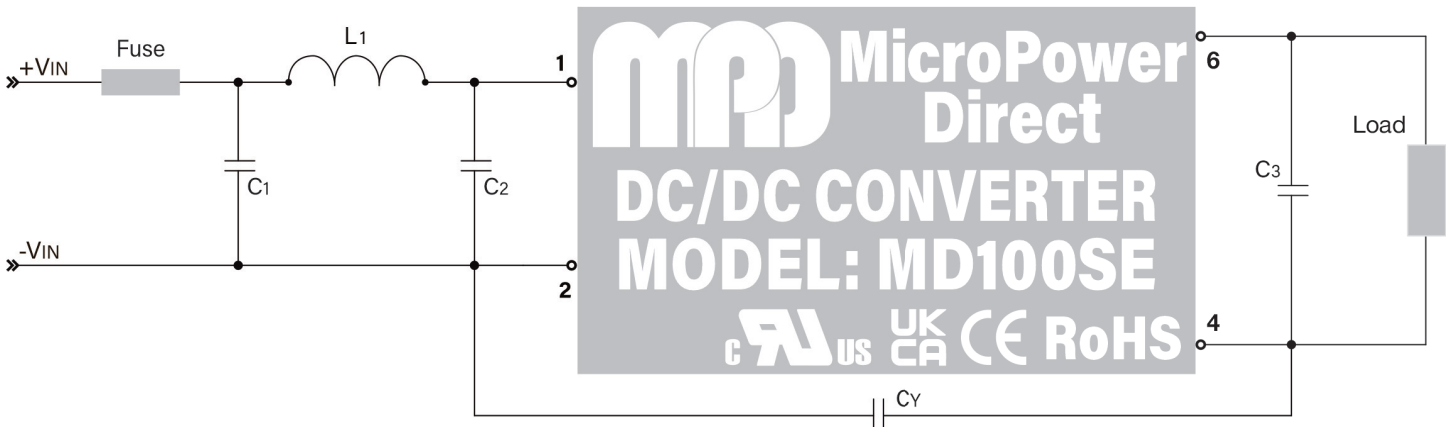


The diagram above illustrates a typical connection of the **MD100DE**. For applications that do not require the circuit to meet EMI/EMC specifications, the capacitors C1, C3 and C4 will reduce input/output ripple and improve the converter stability over time and temperature. The recommended component values are given in the table at right.

VIN	C1
3.3 VDC	10 μ F/16V
5 VDC	4.7 μ F/16V
12 VDC	2.2 μ F/25V
15 VDC	1.0 μ F/50V
24 VDC	1.0 μ F/50V

VOUT	C3/C4
3.3 VDC	10 μ F/16V
5 VDC	10 μ F/16V
9 VDC	2.2 μ F/25V
12 VDC	2.2 μ F/25V
15 VDC	1.0 μ F/25V
24 VDC	1.0 μ F/50V
\pm 3.3 VDC	10 μ F/16V
\pm 5 VDC	10 μ F/16V
\pm 9 VDC	1.0 μ F/16V
\pm 12 VDC	1.0 μ F/25V
\pm 15 VDC	1.0 μ F/25V
\pm 24 VDC	1.0 μ F/50V

EMI Connection



The diagram above illustrates a connection of the **MD100SE** for an application that requires compliance to EMI/EMC standards EN 55032 and EN 61000-4 (as specified on page 1). Some notes on these components are:

1. An external fuse is recommended to protect the unit in the event a fault occurs on the input line. A recommended value is given in the model selection table on page 2.
2. In many applications, the cap C2 may not be needed.
3. The output filtering capacitor (C3) is a high frequency, low resistance electrolytic capacitor. Care must be taken in choosing this capacitor not to exceed the capacitive

load specification for the unit. Voltage derating of capacitors should be 80% or above.

4. Suggested component values are:

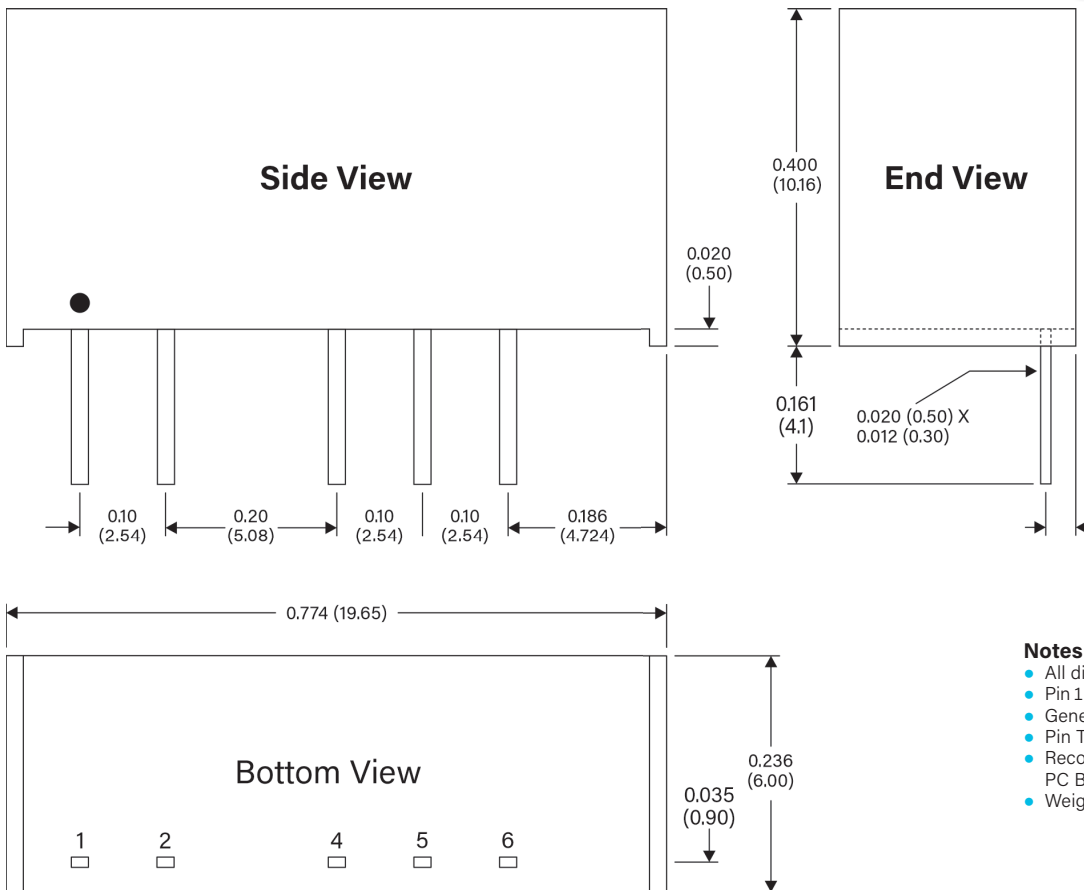
	VIN: 3.3V	VIN: 5V	VIN: 12V/15V/24V
C1	4.7 μ F/16V	4.7 μ F/25V	4.7 μ F/50V
C2	4.7 μ F/16V	4.7 μ F/25V	4.7 μ F/50V
L1	6.8 μ H	6.8 μ H	6.8 μ H
C3	See C3/C4 in Table Above		
CY	270 pF/2 kV	1 nF/2 kV	270 pF/2 kV

sufficiently. In this case, capacitors C1, C3 and C4 could be connected as shown in the typical connection above, without the other filter components. Recommended capacitor values are given in the table above.

5. In many applications, simply adding input/output capacitors will enhance the input surge protection & and reduce output ripple

Mechanical Dimensions

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Pin Connections

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

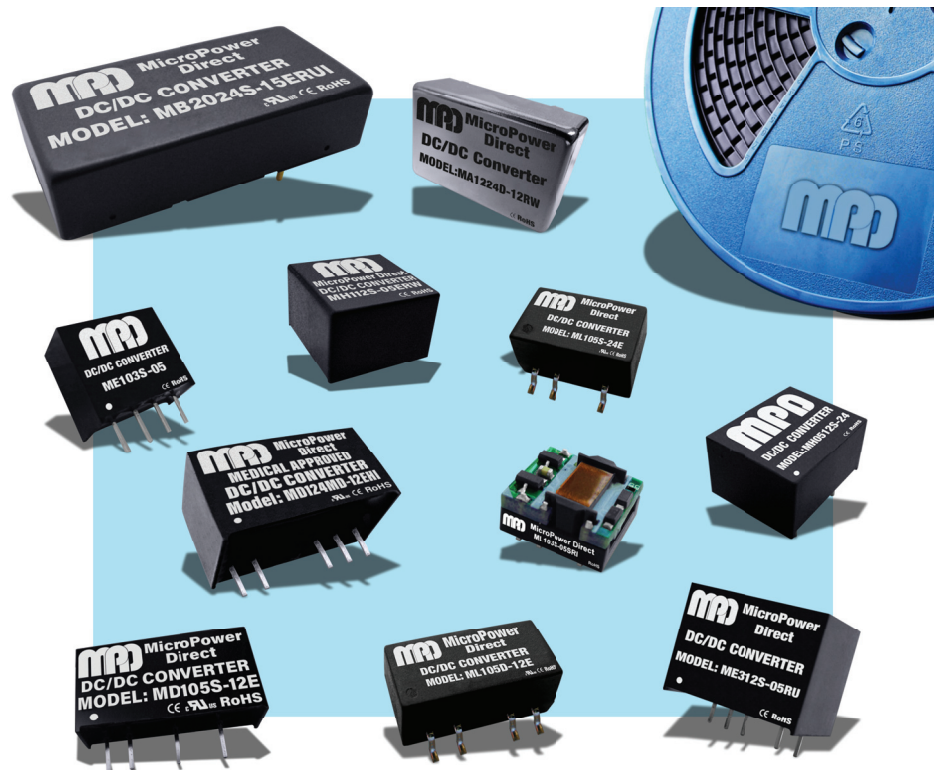
Pin	Dual Output
1	+VIN
2	-VIN
4	-VOUT
5	Common
6	+VOUT

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 = ± 0.004 (± 0.10)
- Recommended pin hole size (on the application PC Board) is $\varnothing 0.039$ ($\varnothing 1.00$)
- Weight (Typ) = 0.07 Oz (2.1g)

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