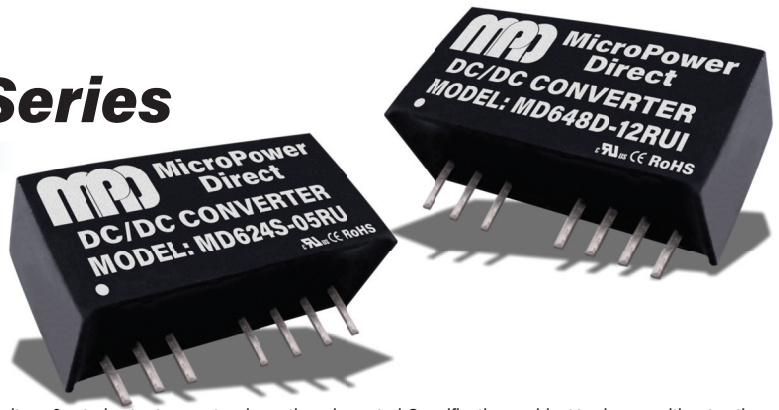


# MD600RU Series

## 4:1 Input, 6W SIP, Single & Dual Output DC/DC Converters



### Key Features:

- 6W Output Power
- EN 62368 Approved
- Compact SIP Case
- 4:1 Input Voltage Range
- 1.5k or 3.0k VDC Isolation
- 18 Standard Models
- Short Circuit Protected
- -40°C to +71°C Operation
- Single & Dual Outputs
- Industry Standard Pin-Out



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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	24 VDC Input	9.0	24.0	36.0	VDC	
	48 VDC Input	18.0	48.0	75.0		
Input Reflected Ripple Current	24 VDC Input	20			mA P - P	
	48 VDC Input	40				
Start Up Time	See Note 1	30			mS	
Input Filter	Capacitor Filter					

Output						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Output Voltage Accuracy			±1.0		%	
Line Regulation	V <sub>IN</sub> = Min to Max			±0.2	%	
Load Regulation, I <sub>OUT</sub> = 0% to 100%	±3.3V & ±5V Output Models			±0.5	%	
	All Other Models			±1.0		
Cross Regulation	See Note 2			±5.0	%	
Ripple & Noise (20 MHz)	See Note 3			125	mV P - P	
Transient Recovery Time	See Note 4		0.25		mSec	
Transient Response Deviation				±3.0	%	
Temperature Coefficient			±0.02		%/°C	
Output Short Circuit	Continuous (Autorecovery)					

General						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Isolation Voltage, 60 Seconds		1,500			VDC	
	"I" Models	3,000				
Isolation Resistance		1.0			GΩ	
Isolation Capacitance				50	pF	
Switching Frequency			580		kHz	

Environmental						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Operating Temperature Range	Ambient	-40	+25	+71	°C	
Operating Temperature Range	Case			+105	°C	
Storage Temperature Range		-55		+125	°C	
Cooling	Free Air Convection					
Humidity	RH, Non-condensing			95	%	

Physical						
Case Size	See Mechanical Drawing (Page 3)					
Case Material	Non-Conductive Black Plastic (UL94-V0)					
Weight	0.16 Oz (4.5g)					

Reliability Specifications						
Parameter	Conditions	Min.	Typ.	Max.	Units	
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	800			kHours	
Safety Standards	UL/cUL 62368-1 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

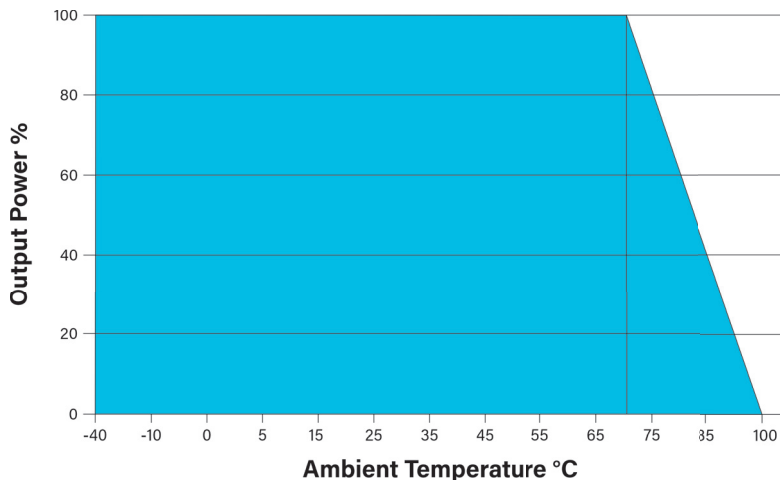
Model Number	Input				Output			Efficiency (% Typ)	Capacitive Load (µF, Max)	Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)			
	Nominal	Range	Full-Load	No-Load						
MD624S-03RU(I)	24	9.0 - 36.0	261	6	3.3	1,500	0.0	79	4,700	1,500
MD624S-05RU(I)	24	9.0 - 36.0	298	6	5.0	1,200	0.0	84	2,200	1,500
MD624S-09RU(I)	24	9.0 - 36.0	290	6	9.0	666	0.0	86	1,000	1,500
MD624S-12RU(I)	24	9.0 - 36.0	287	6	12.0	500	0.0	87	470	1,500
MD624S-15RU(I)	24	9.0 - 36.0	287	6	15.0	400	0.0	87	220	1,500
MD624S-24RU(I)	24	9.0 - 36.0	287	6	24.0	250	0.0	87	100	1,500
MD624D-05RU(I)	24	9.0 - 36.0	298	6	±5.0	±600	0.0	84	±330	1,500
MD624D-12RU(I)	24	9.0 - 36.0	291	6	±12.0	±250	0.0	86	±220	1,500
MD624D-15RU(I)	24	9.0 - 36.0	287	6	±15.0	±200	0.0	87	±100	1,500
MD648S-03RU(I)	48	18.0 - 75.0	131	6	3.3	1,500	0.0	79	4,700	800
MD648S-05RU(I)	48	18.0 - 75.0	151	6	5.0	1,200	0.0	83	2,200	800
MD648S-09RU(I)	48	18.0 - 75.0	147	6	9.0	666	0.0	85	1,000	800
MD648S-12RU(I)	48	18.0 - 75.0	144	6	12.0	500	0.0	87	470	800
MD648S-15RU(I)	48	18.0 - 75.0	144	6	15.0	400	0.0	87	220	800
MD648S-24RU(I)	48	18.0 - 75.0	144	6	24.0	250	0.0	87	100	800
MD648D-05RU(I)	48	18.0 - 75.0	152	6	±5.0	±600	0.0	82	±330	800
MD648D-12RU(I)	48	18.0 - 75.0	147	6	±12.0	±250	0.0	85	±220	800
MD648D-15RU(I)	48	18.0 - 75.0	145	6	±15.0	±200	0.0	86	±100	800

For High Isolation (3kV) Models, add suffix "I" to the model number (i.e. **MD648S-12RUI**)

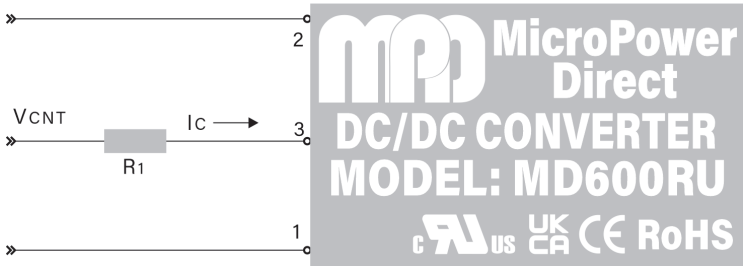
Notes:

1. Start up time is specified at nominal input and with a constant resistive load.
2. Cross regulation is measured by monitoring one output set at 100% load while varying the second output from 25% to 100% load.
3. When measuring output ripple & noise, it is recommended that an external ceramic capacitor (0.1 µF typ.) be placed from the +VOUT to the -VOUT pins for single output units and from each output to common for dual output models.
4. Transient recovery is measured to within a 1% error band for a load step change of 25%.
5. Free air convection is typically 30 - 65 LFM. The units should not be operated in still air (0 LFM).
6. Exceeding the absolute ratings could damage the unit.
7. 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.

Temperature Derating Curve



Remote ON/OFF Control



Pin 3 on the MD600RU(I) is a remote control input. This input is current controlled. The unit operates when this input is open. When the input is "high" (current is flowing into the pin), the converter shuts down. The input current to this pin should be kept between 2 mA to 4 mA.

The diagram at right shows a simple connection for the control pin.

Remote On/Off

Parameter	Min.	Typ.	Max.	Units
Supply On	Open or High Impedance			
Supply Off	2		4	mA
Standby Input Current		2.5		mA

## EMC Characteristics

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

### NOTES:

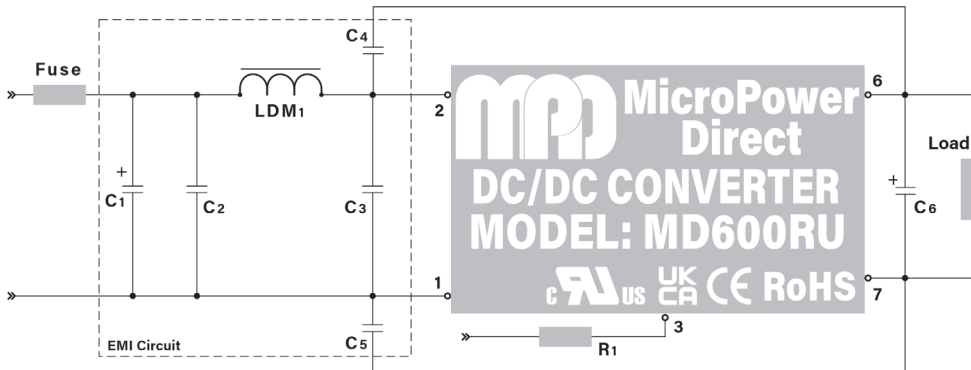
For applications that require meeting EMC standards, the diagram above illustrates a typical connection of the **MD600RU(I)** series. The units do not require external components to operate as specified. Some notes on this diagram (starting with the input circuit) are:

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. For a suggested value, contact the factory.
3. To protect against voltage spikes, it is recommended that a TVS be used on the input. For a suggested value, contact the factory.
4. The filtering components shown are needed to meet the conducted emissions requirements for EN 55032 Class A. All components should be mounted as close to the converter as possible.

5. Recommended values for components are:

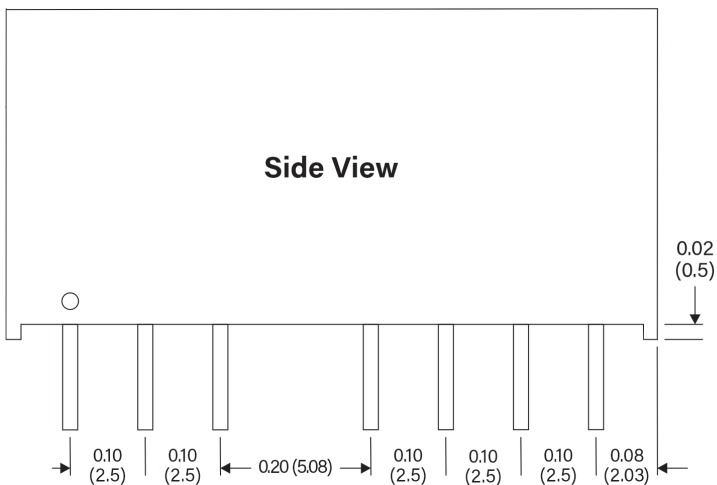
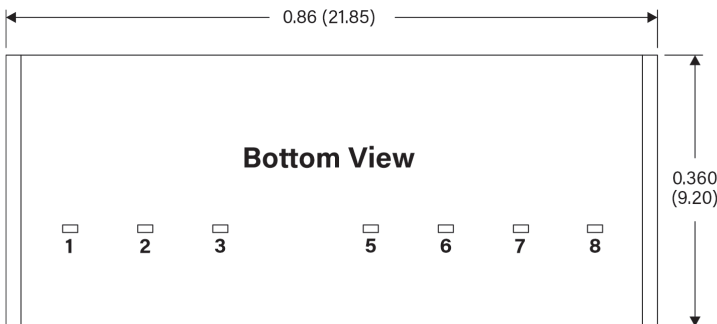
Component	24 VIN	48 VIN
C1	10 $\mu$ F/50V	2.2 $\mu$ F/100
C2	10 $\mu$ F/50V	2.2 $\mu$ F/100V
LDM1	12 $\mu$ H	12 $\mu$ H
C3	470 pF/3 kV	1,000 pF/3 kV
C4	470 pF/3 kV	1,000 pF/3 kV
C5		1,000 pF/3 kV
C6	10 $\mu$ F - 22 $\mu$ F	

## Typical Connection



6. To meet the EN 61000-4-4 and EN 61000-4-5, an external input capacitor is required for all models. The suggested value is 330  $\mu$ F/100V. Contact the factory for more information.
7. The output filtering capacitor (C6) is a high frequency, low resistance electrolytic capacitor. Care must be taken not to exceed the capacitive load specification for the unit. Capacitor voltage derating should be 80% or above.
8. In many applications simply adding input/output cap's will enhance the input surge protection and reduce output ripple sufficiently. The value of the input capacitor can range from 220  $\mu$ F to 330  $\mu$ F, depending on the needs of the application. The output capacitor would typically be 10  $\mu$ F.

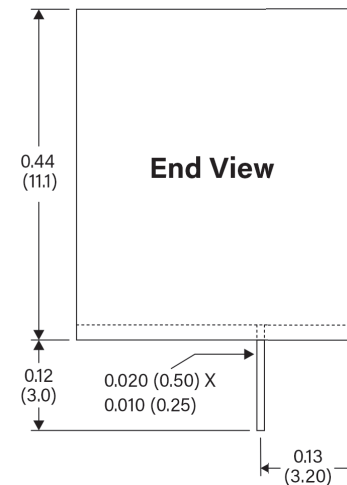
## Mechanical Dimensions



## Pin Connections

Pin	Single Output	Pin	Single Output
1	-VIN	1	-VIN
2	+VIN	2	+VIN
3	Remote On/Off	3	Remote On/Off
5	No Connection	5	No Connection
6	+VOUT	6	+VOUT
7	-VOUT	7	Common
8	No Connection	8	-VOUT

- On 3kV isolation models, pin 5 is missing



### Notes:

- All dimensions are typical in inches (mm)
- Pin 1 is marked by a "dot" or indentation on the unit
- General Tolerance =  $\pm 0.02$  ( $\pm 0.50$ )
- Pin Tolerance =  $\pm 0.002$  ( $\pm 0.05$ )
- Recommended pin hole size (on the application PC Board) is  $\varnothing 0.03$  ( $\varnothing 0.80$ )



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