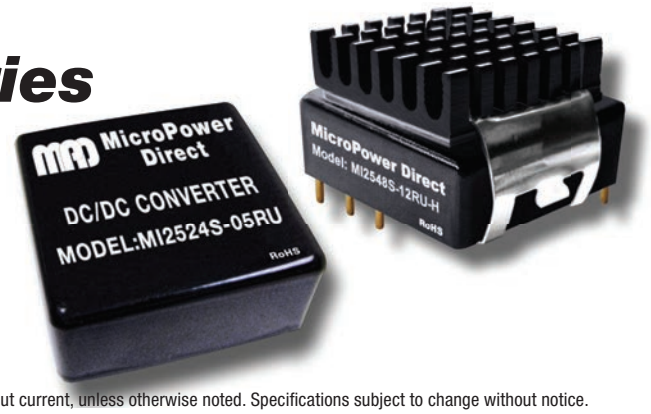
MI2500RU Series

Compact, 1 x 1 Inch 25W, 4:1 Input Range DC/DC Converters



Key Features:

- 25W Output Power
- 4:1 Input Voltage Range
- Compact 1 x 1 Inch Case
- 1,500 VDC Isolation
- 12 Standard Models
- Efficiency to 90%
- Wide Temp Operation
- Industry Standard Pin-Out

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 Start Voltage	24 VDC Input			9.0	VDC
	48 VDC Input			18.0	
Input Filter	LC Filter				
Start-Up Time	See Note 2			30	mS

Output

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy				±1.0	%
Output Voltage Balance	Dual Output, Balanced Loads			±2.0	%
Line Regulation	VIN = Min to Max			±0.2	%
Load Regulation, Min Load to Full Load	Single Output			±0.2	%
	Dual Output			±1.0	
Cross Regulation, Dual Outputs	Asymmetrical Load 25%/100%			±5.0	%
Ripple & Noise, See Note 3	3.3 & 5.0 VOUT		100		mV P - P
	12, 15 & Dual Output		150		
Transient Recovery Time, See Note 4	25% Load Step Change		250		µSec
Transient Response Deviation			±3.0	±5.0	%
Temperature Coefficient				±0.02	%/°C
Output Power Protection	See Note 5		150		%
Output Short Circuit, See Note 6	Continuous (Autorecovery)				

General

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	60 Seconds	1,500			VDC
	1 Second	1,800			
Isolation Resistance	500 VDC	1,000			MΩ
Isolation Capacitance	100 kHz, 1V			2,000	pF
Switching Frequency			285		kHz

EMI Characteristics

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

Environmental

Parameter	Conditions	Min.	Typ	Max.	Units
Operating Temperature Range	See Page 4	-40	+25	+80	°C
	Case			+105	°C
Storage Temperature Range		-50		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%

Physical

Case Size	See Mechanical Diagrams (Page 7)	
Case Material	Metal with Non-Conductive Base	
Weight	Without Heatsink	0.58 Oz (16.5g)
	With Heatsink	0.65 Oz (18.5g)

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	444			kHours

Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage Surge (100 mS)	24 VDC Input			50.0	VDC
	48 VDC Input			100.0	
Lead Temperature	1.5 mm From Case For 10 Sec			260.0	°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)	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							
MI2524S-03RU(-H)	24	9.0 - 36.0	950	85	3.3	6,000	0.0	87	3.9	10,300	5,000
MI2524S-05RU(-H)	24	9.0 - 36.0	1,170	85	5.0	5,000	0.0	89	6.2	6,800	5,000
MI2524S-12RU(-H)	24	9.0 - 36.0	1,175	85	12.0	2,090	0.0	89	15.0	1,200	5,000
MI2524S-15RU(-H)	24	9.0 - 36.0	1,160	85	15.0	1,670	0.0	90	18.0	750	5,000
MI2524D-12RU(-H)	24	9.0 - 36.0	1,170	85	±12.0	±1,040	0.0	89	±15.0	680	5,000
MI2524D-15RU(-H)	24	9.0 - 36.0	1,180	85	±15.0	±840	0.0	89	±18.0	380	5,000
MI2548S-03RU(-H)	48	18.0 - 75.0	470	45	3.3	6,000	0.0	88	3.9	10,300	2,500
MI2548S-05RU(-H)	48	18.0 - 75.0	580	45	5.0	5,000	0.0	90	6.2	6,800	2,500
MI2548S-12RU(-H)	48	18.0 - 75.0	580	45	12.0	2,090	0.0	90	15.0	1,200	2,500
MI2548S-15RU(-H)	48	18.0 - 75.0	580	45	15.0	1,670	0.0	90	18.0	750	2,500
MI2548D-12RU(-H)	48	18.0 - 75.0	585	45	±12.0	±1,040	0.0	89	±15.0	680	2,500
MI2548D-15RU(-H)	48	18.0 - 75.0	590	45	±15.0	±840	0.0	89	±18.0	380	2,500

Notes:
1. The specified maximum capacitive load is for each output.
2. Start up time is measured at nominal input and with a constant resistive load.
3. 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 pin for single output unis; or from each output to common for dual output units..
4. Transient recovery is measured to within a 1% error band for a load step change of 25%.
5. Over Power protection is provided by a "hiccup mode" current limiting circuit.
6. Short circuit protection is provided by a "hiccup mode" circuit.
7. The output over voltage protection circuit is independent of the primary regulation loop. It provides redundant protection against any possible overvoltage.
8. Operation at no-load will not damage these units.
9. 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 heatsink option, add suffix "H" to model number (i.e. **MI2512S-05RU-H**)

Models are also available at 25W with a 2:1 Input. See the: **MI2512S-05RW** series.

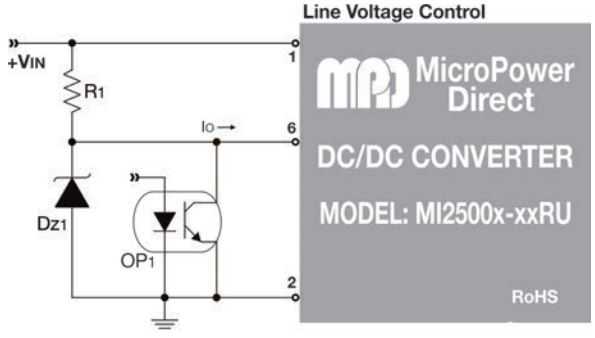
Remote On/Off

All models of the **MI25000RU** series can be turned on/off remotely by applying by applying a positive logic signal to pin 6. The specifications for the ON/OFF function are given in the table below.

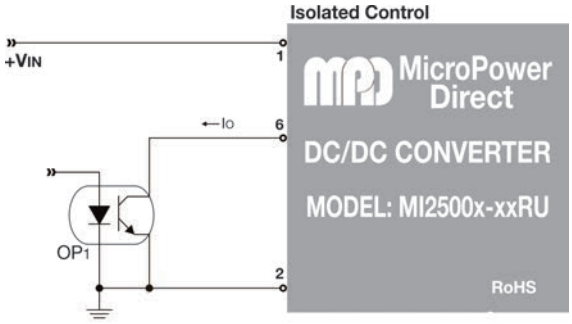
Parameter	Min	Typ	Max	Units
Supply On	3.5		12.0	VDC
Supply Off	0.0		1.2	VDC
Standby Input Current		3.0		mA
Control Common	Referenced to Negative Input (pin 2)			
Control Input Current (ON)			0.5	mA
Control Input Current (OFF)			-0.5	mA

The maximum sink current at the control pin (pin 6) during a logic low is -500 µA. The maximum allowable leakage current of a switch connected to the control pin during a logic high is 10 mA. The switch used can be an open collector transistor, FET or optocoupler. Three possible connections are illustrated in the diagrams below and at right. For more information, please contact the factory.

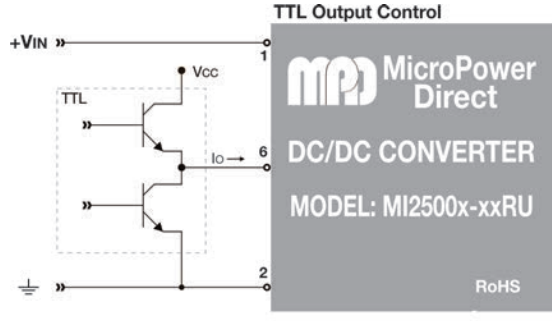
Line Voltage Control



Isolated Control



TTL Output Control



EMC Specifications

All units should meet EN 55032 & EN 55022 class A/B with the simple external circuit shown; using the component values given in the table at right.

Components C_1, C_2 and C_3 are1210 multilayer ceramic capacitors. C_{Y1} and C_{Y2} are 1206 multilayer ceramic capacitors and C_4 and C_5 are low ESR electrolytic capacitors. The suggested value of the fuse is given in the Model Selection Tables on page 2.

The typical connection diagrams below show the filter configuration for EN 55032 class B operation. The diagram for the single output models also shows the installation of an output trim resister. For more information on trimming the output voltage, see page 6 of this datasheet. The typical board layout at the bottom of this page includes the connection of an opto-isolator to enable the remote on/off function. For more information on this feature, see page 2 of this datasheet.

To meet the requirements of EN 61000-4-4 and EN 61000-4-5, the value of C_1 should be changed to 220 µF/100V. Contact the factory for more information.

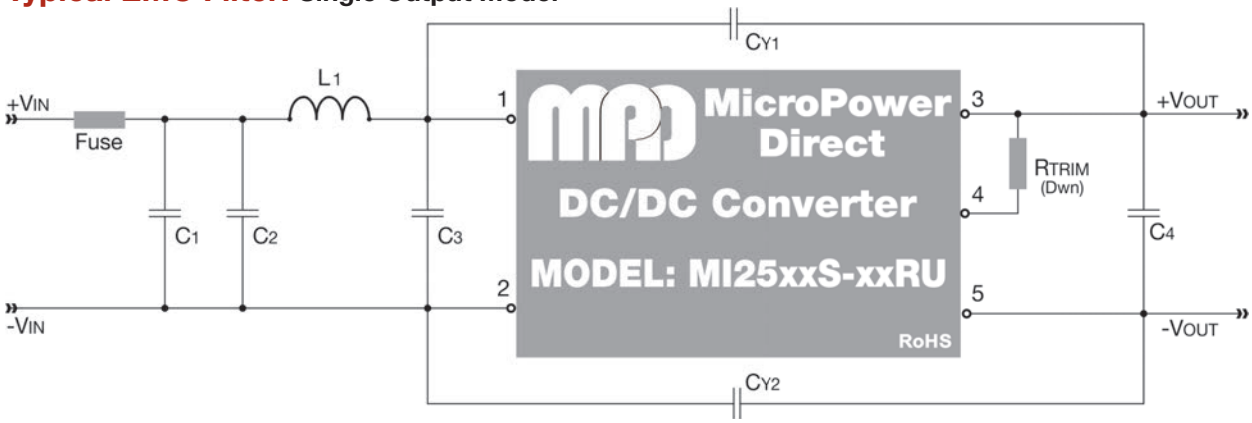
EN 55032 Class A

Component	MI2524RW	MI2548RW
C_1	---	---
C_2	3.3 µF/50V	3.3 µF/100V
L_1	2.2 µH	4.7 µH
C_3	---	---
C_{Y1}	---	---
C_{Y2}	---	---
C_4	4.7 µF	4.7 µF
C_5	4.7 µF	4.7 µF

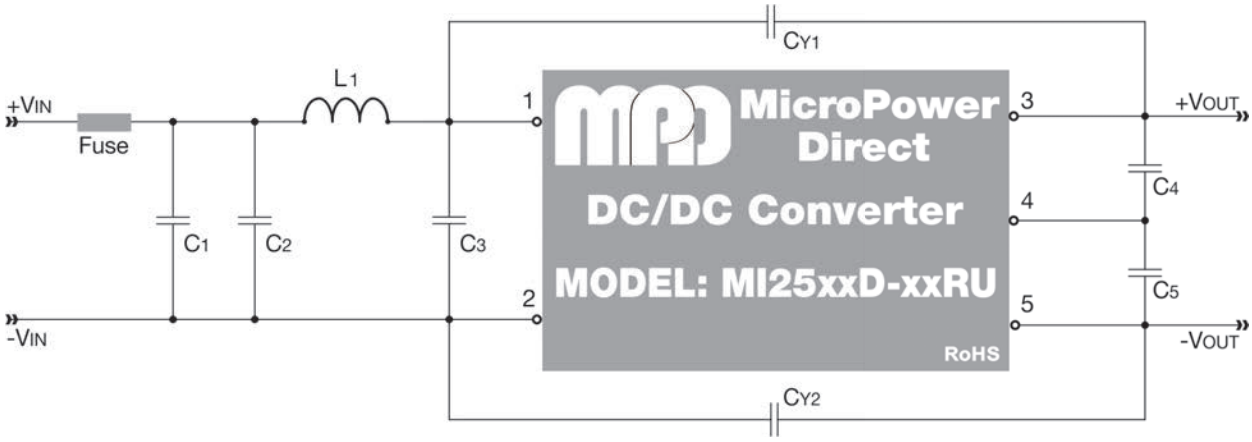
EN 55032 Class B

Component	MI2524RW	MI2548RW
C_1	3.3 µF/50V	3.3 µF/100V
C_2	3.3 µF/50V	3.3 µF/100V
L_1	2.2 µH	4.7 µH
C_3	3.3 µF/50V	3.3 µF/100V
C_{Y1}	1,800 pF/2kV	1,800 pF/2kV
C_{Y2}	1,800 pF/2kV	1,800 pF/2kV
C_4	4.7 µF	4.7 µF
C_5	4.7 µF	4.7 µF

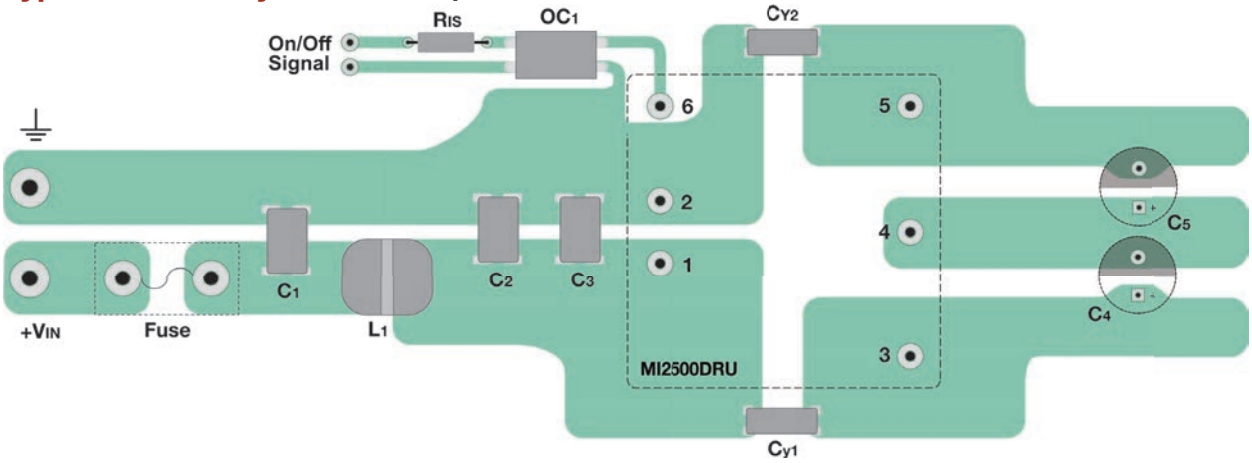
Typical EMC Filter: Single Output Model



Typical EMC Filter: Dual Output Model

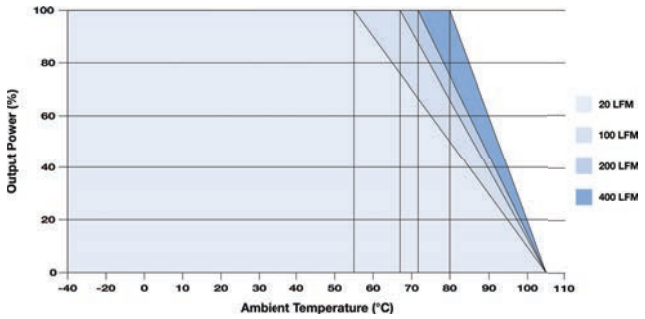


Typical Board Layout: Dual Output Model

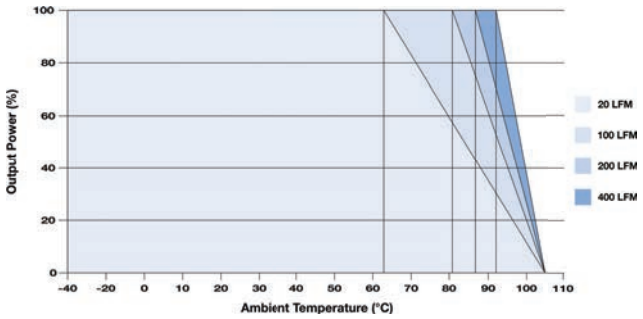


Derating Curves

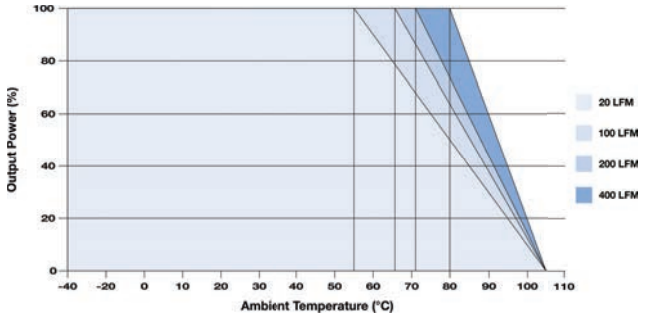
MI2548S-03RU Without Heatsink



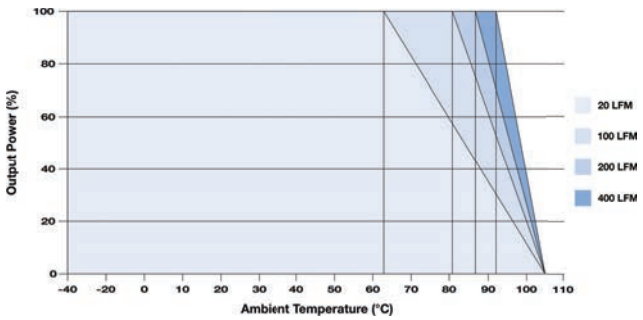
MI2548S-03RU With Heatsink



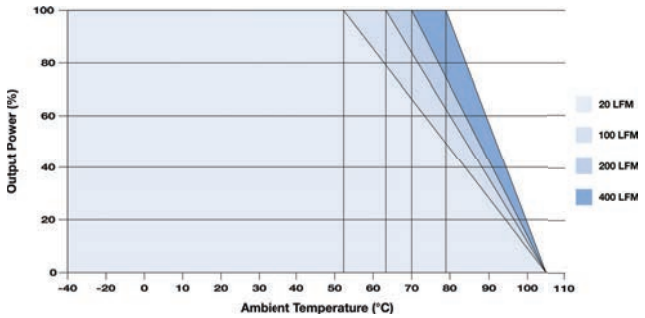
MI2524/48S-15RU, MI2548S-05/12RU Without Heatsink



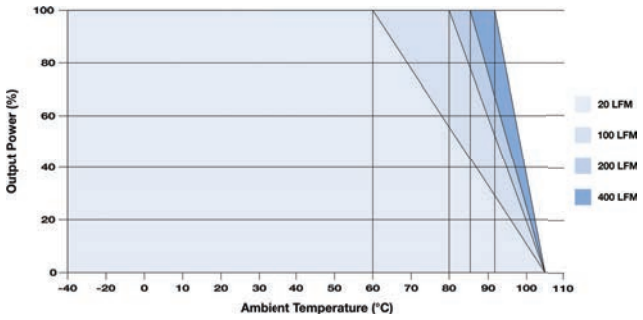
MI2524/48S-15RU, MI2548S-05/12RU With Heatsink



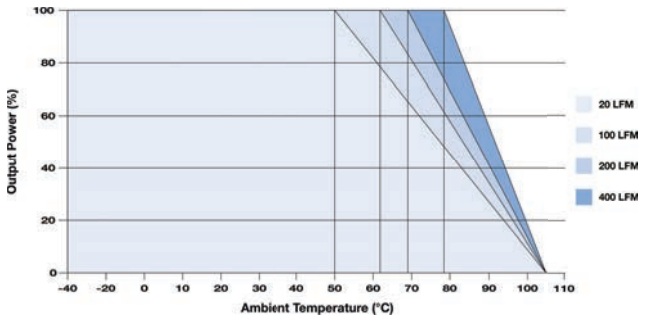
MI2524S-03RU Without Heatsink



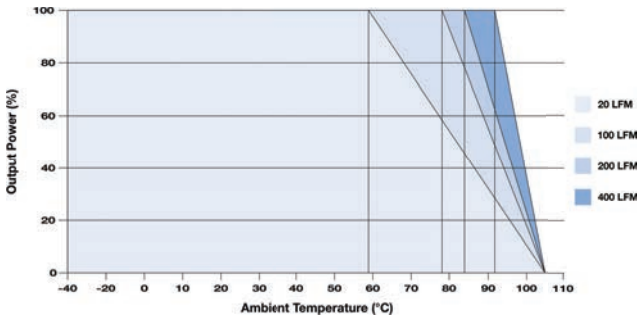
MI2524S-03RU With Heatsink



MI2524S-05RU, -12RU, MI25xxD-xxRU Without Heatsink



MI2524S-05RU, -12RU, MI25xxD-xxRU With Heatsink



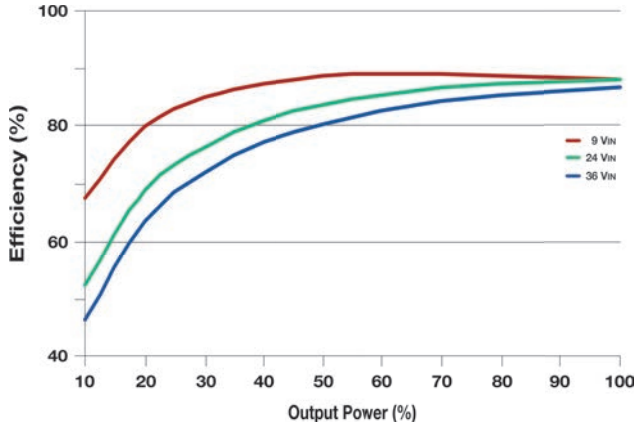
Thermal Impedance

Air Flow	Without Heatsink	With Heatsink	Units
Natural Convection	17.6	14.8	°C/W
100 LFM	13.6	8.5	°C/W
200 LFM	11.8	6.5	°C/W
400 LFM	8.8	4.3	°C/W

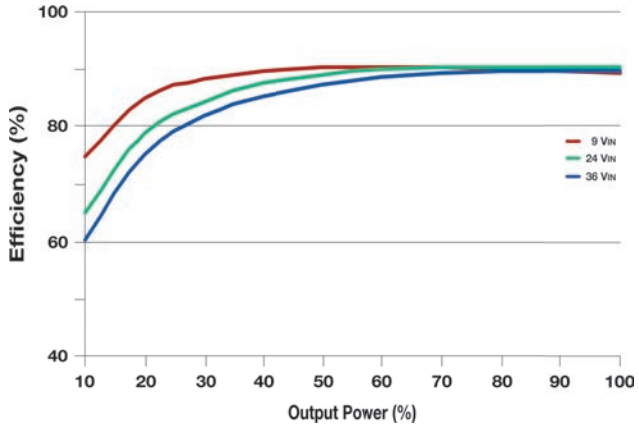
Note: Natural Convection equals 20 LFM

Efficiency Vs Output Load Curves

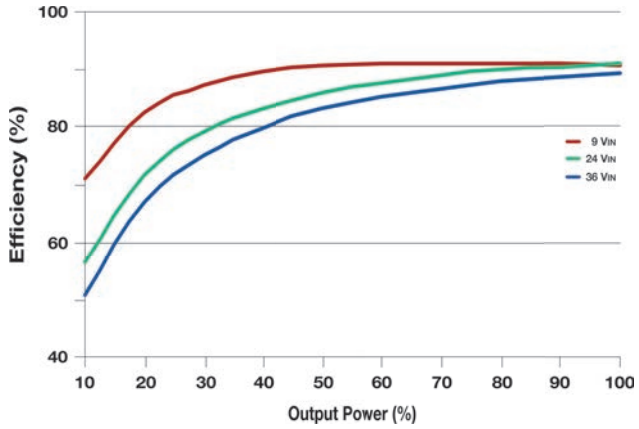
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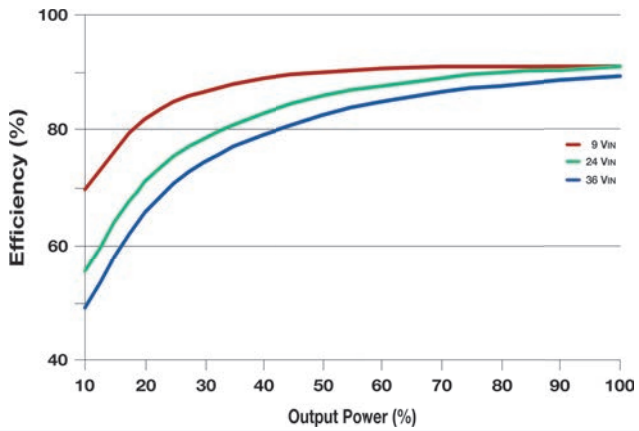
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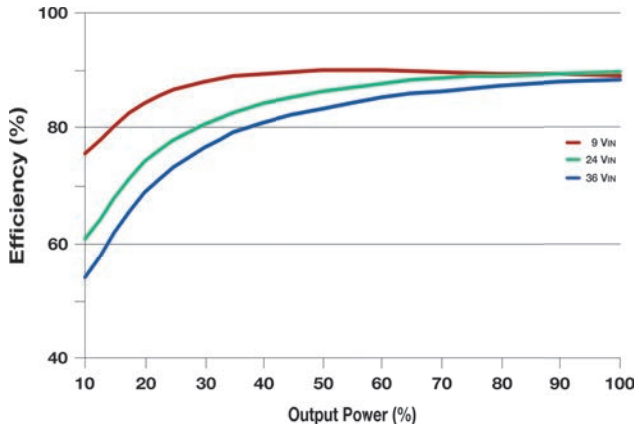
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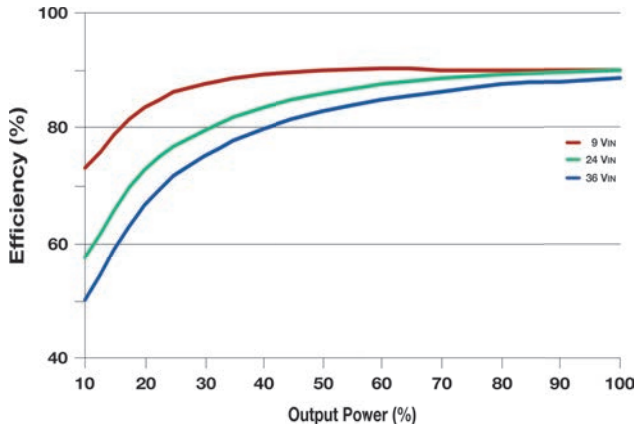
MI2524S-15RU



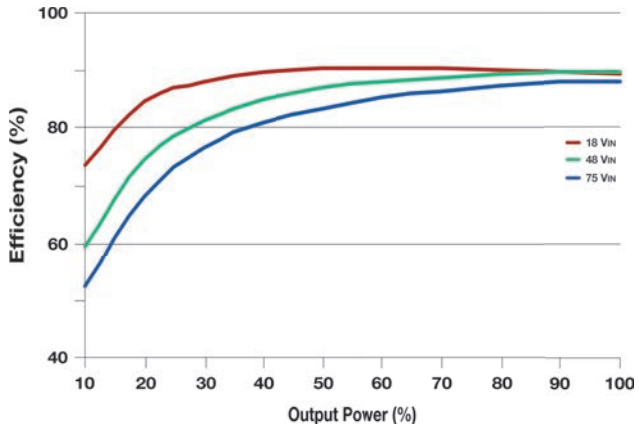
MI2524D-12RU



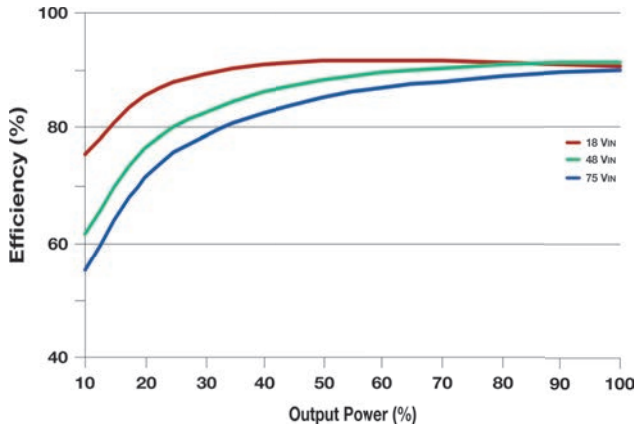
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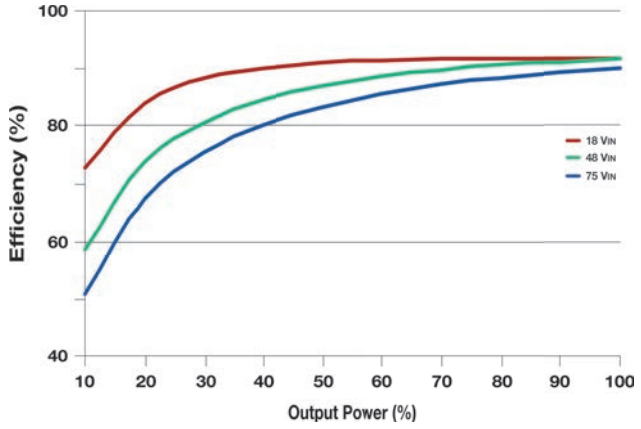
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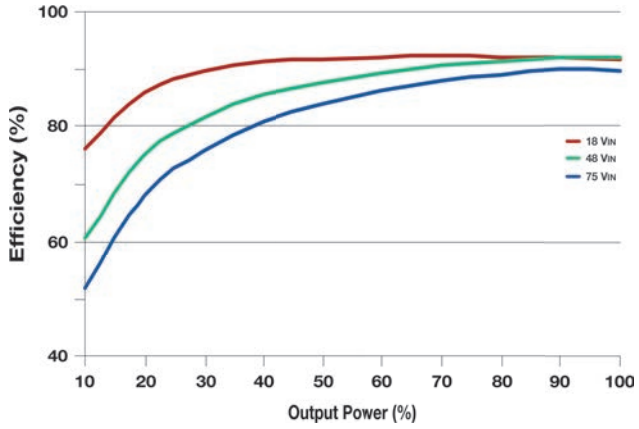
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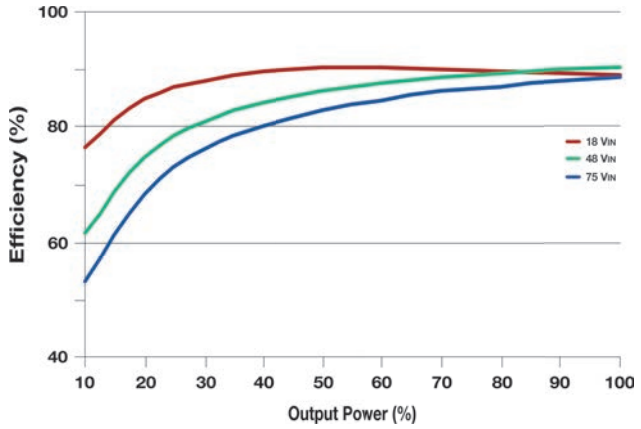
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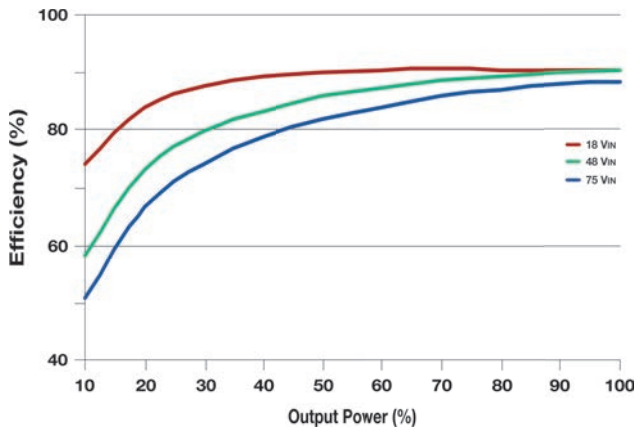
MI2548S-15RU



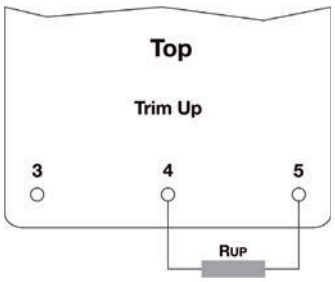
MI2548D-12RU

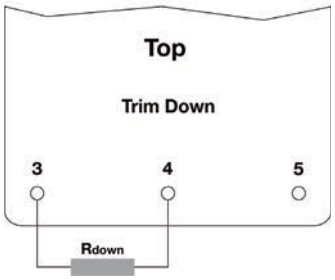


MI2548D-15RU



External Trim





An external resister may be added to adjust the converter output on single output units.

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

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

MI25xxS-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

MI25xxS-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

MI25xxS-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

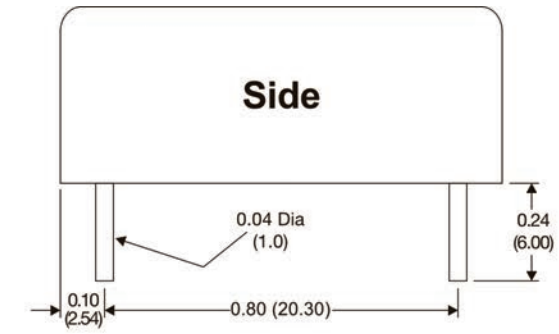
Trim Up											
Vout	Vo x 1.01	Vo x 1.02	Vo x 1.03	Vo x 1.04	Vo x 1.05	Vo x 1.06	Vo x 1.07	Vo x 1.08	Vo x 1.09	Vo x 1.10	Volts
RUP	351.00	157.50	93.00	60.75	41.40	28.50	19.29	12.37	7.00	2.70	kΩ

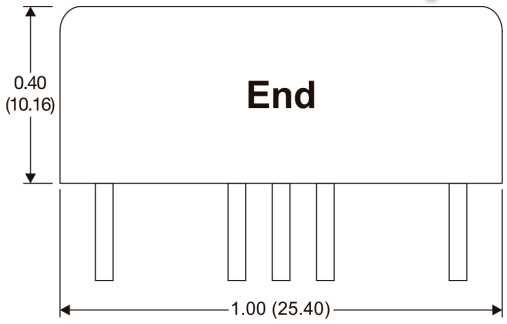
MB25xxS-15RU

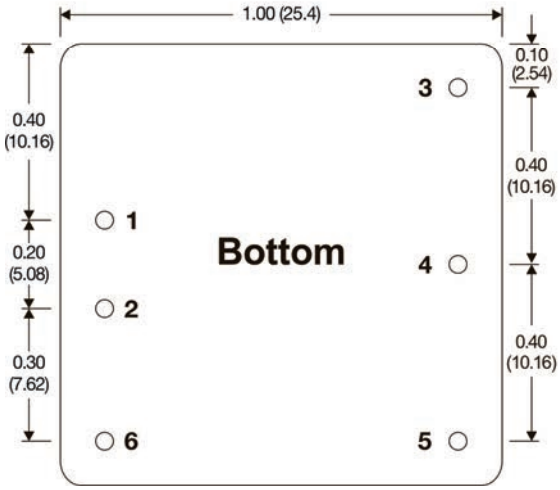
Trim Down											
Vout	Vo x 0.99	Vo x 0.98	Vo x 0.97	Vo x 0.96	Vo x 0.95	Vo x 0.94	Vo x 0.93	Vo x 0.92	Vo x 0.91	Vo x 0.90	Volts
RDOWN	530.73	238.61	141.24	92.56	63.35	43.87	29.96	19.53	11.41	4.92	kΩ

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

Mechanical Dimensions





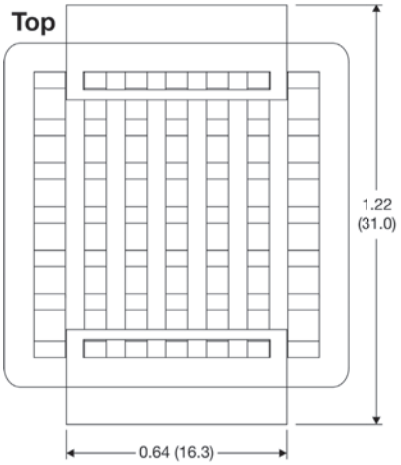


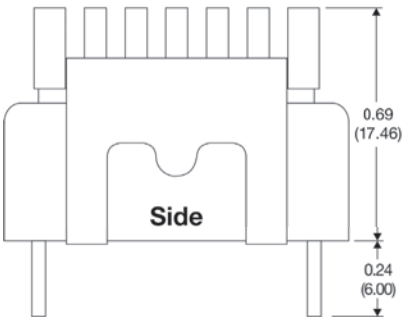
Pin Connections

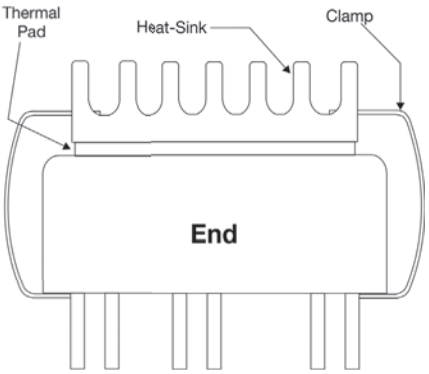
Pin	Single
1	+VIN
2	-VIN
3	+VOUT
4	Trim
5	-VOUT
6	Remote On/Off

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

Mechanical Dimensions: With Optional Heatsink







For the heatsink option, add suffix "H" to the model number (i.e. **MI2524S-12RU-H**)

Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Heatsink is black, anodized aluminum

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