

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 | V _{IN} = 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 | | | 250 | | µSec | |
| Transient Response Deviation | 25% Load Step Change | | ±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 | | |
| Storage Temperature Range | | -50 | | +125 | °C | |
| Cooling | Free Air Convection | | | | | |
| Humidity | RH, Non-condensing | | | 95 | % | |
| 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 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 | $\pm 1,040$ | 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 | $\pm 1,040$ | 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:**
- The specified maximum capacitive load is for each output.
 - Start up time is measured at nominal input and with a constant resistive load.
 - 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 units; or from each output to common for dual output units.
 - Transient recovery is measured to within a 1% error band for a load step change of 25%.
 - Over Power protection is provided by a "hiccup mode" current limiting circuit.
 - Short circuit protection is provided by a "hiccup mode" circuit.
 - The output over voltage protection circuit is independent of the primary regulation loop. It provides redundant protection against any possible overvoltage.
 - Operation at no-load will not damage these units.
 - 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**)

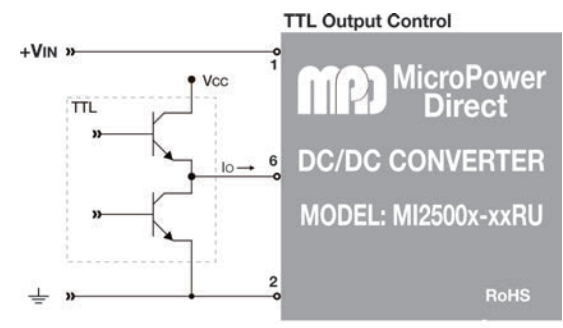
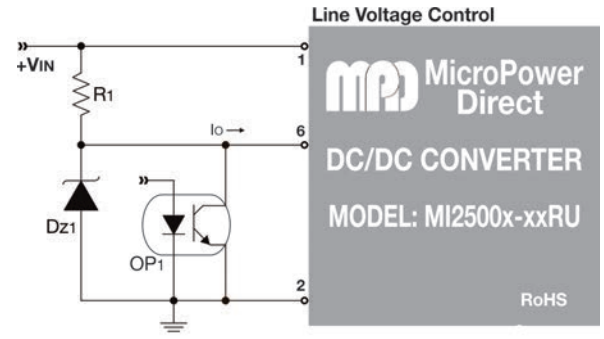
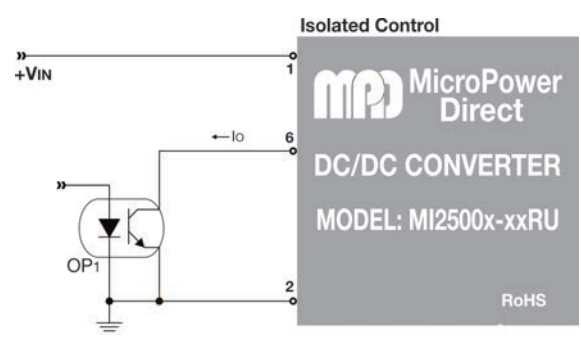
Models are also available at 25W with a 2:1 Input. See the: **MI2512S-05RW** series.

Remote On/Off

All models of the MI25000RU series can be turned on/off remotely by applying 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.



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 C1, C2 and C3 are 1210 multilayer ceramic capacitors. CY1 and CY2 are 1206 multilayer ceramic capacitors and C4 and C5 are low ESR electrolytic capacitors. The suggested value of the fuse is given in the Model Selection Tables on page 2.

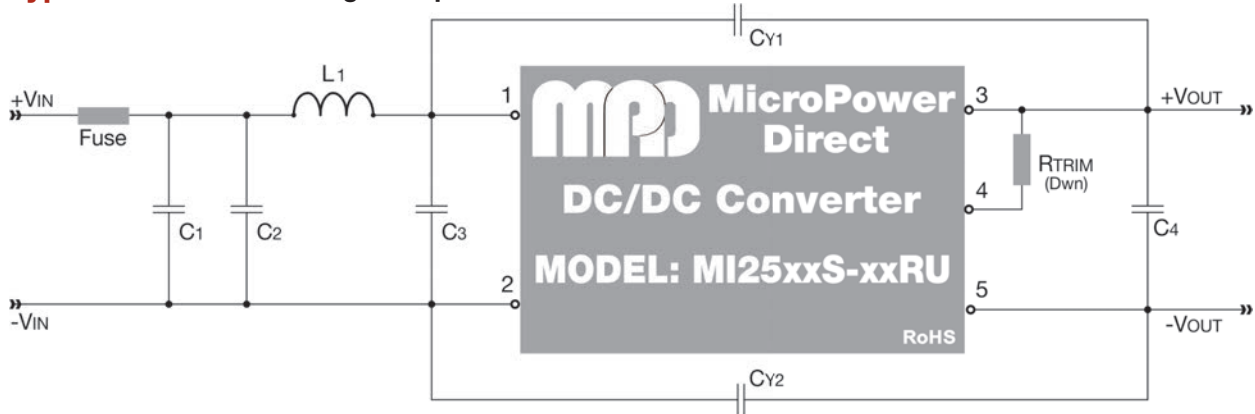
The typical connection diagrams below show the filter configuration for EN 55032 class B operation. The diagram for the single output models also shows the installation of an output trim resistor. For more information on trimming the output voltage, see page 6 of this datasheet. The typical board layout 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 C1 should be changed to 220 $\mu\text{F}/100\text{V}$. Contact the factory for more information.

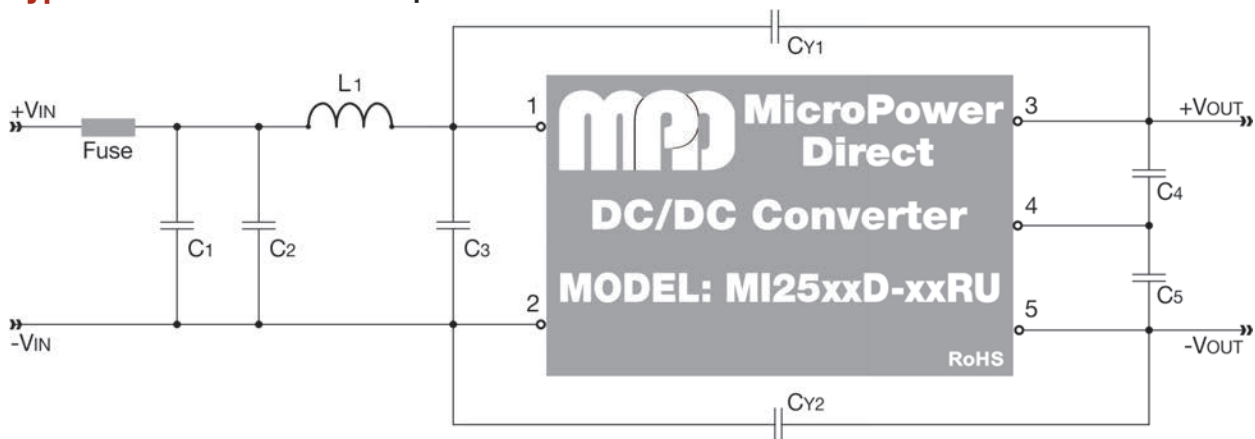
| EN 55032 Class A | | |
|------------------|------------------------------|-------------------------------|
| Component | MI2524RW | MI2548RW |
| C1 | --- | --- |
| C2 | 3.3 $\mu\text{F}/50\text{V}$ | 3.3 $\mu\text{F}/100\text{V}$ |
| L1 | 2.2 μH | 4.7 μH |
| C3 | --- | --- |
| CY1 | --- | --- |
| CY2 | --- | --- |
| C4 | 4.7 μF | 4.7 μF |
| C5 | 4.7 μF | 4.7 μF |

| EN 55032 Class B | | |
|------------------|------------------------------|-------------------------------|
| Component | MI2524RW | MI2548RW |
| C1 | 3.3 $\mu\text{F}/50\text{V}$ | 3.3 $\mu\text{F}/100\text{V}$ |
| C2 | 3.3 $\mu\text{F}/50\text{V}$ | 3.3 $\mu\text{F}/100\text{V}$ |
| L1 | 2.2 μH | 4.7 μH |
| C3 | 3.3 $\mu\text{F}/50\text{V}$ | 3.3 $\mu\text{F}/100\text{V}$ |
| CY1 | 1,800 pF/2kV | 1,800 pF/2kV |
| CY2 | 1,800 pF/2kV | 1,800 pF/2kV |
| C4 | 4.7 μF | 4.7 μF |
| C5 | 4.7 μF | 4.7 μF |

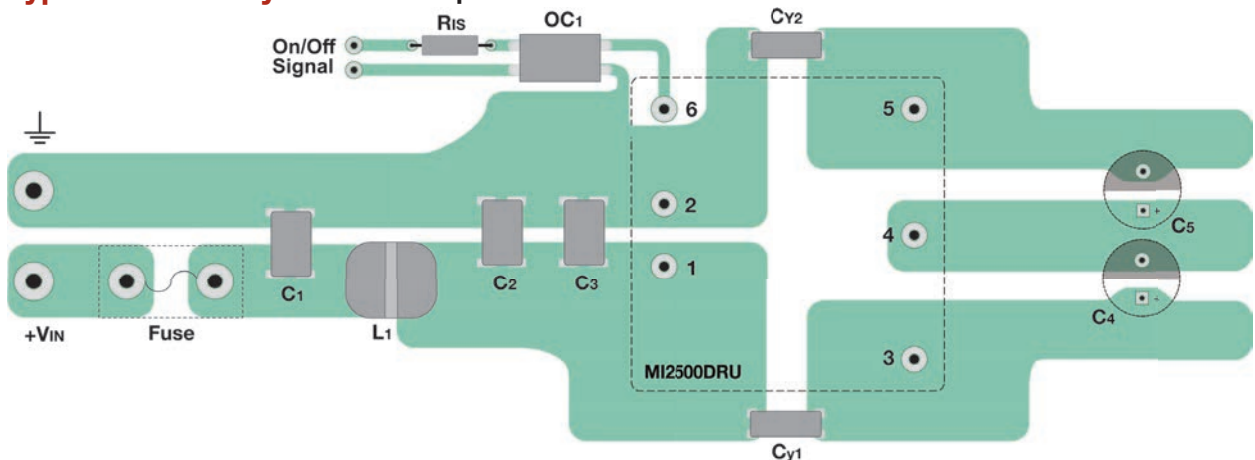
Typical EMC Filter: Single Output Model

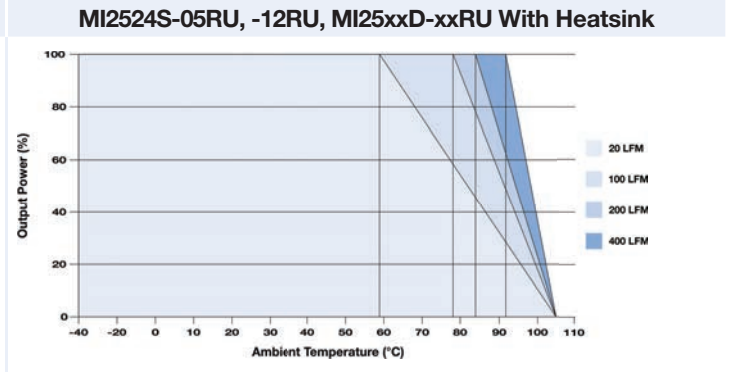
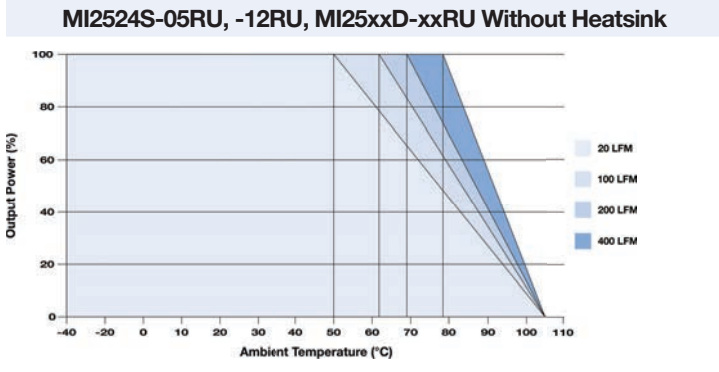
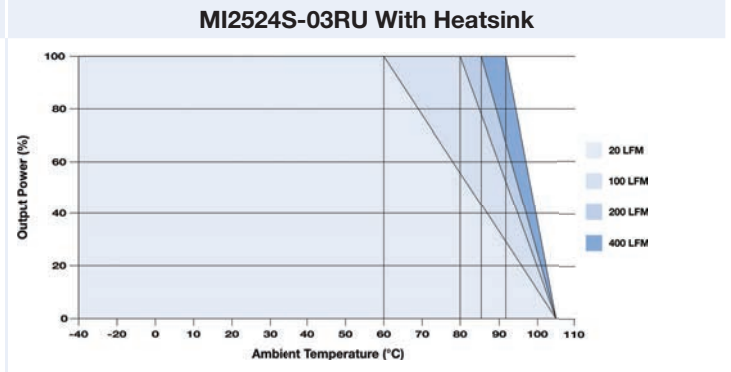
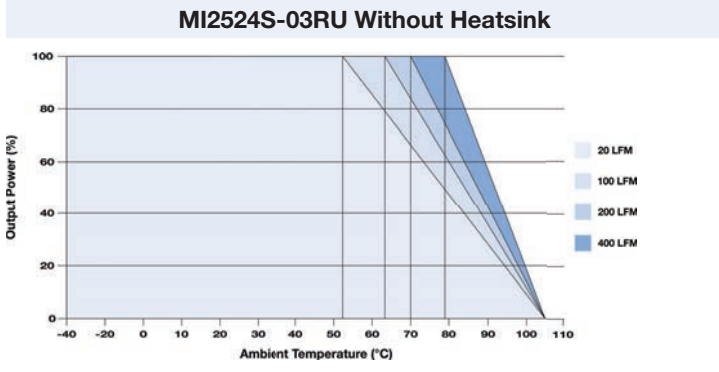
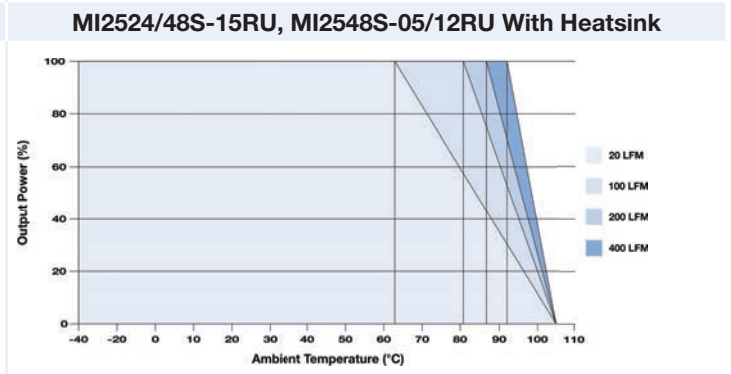
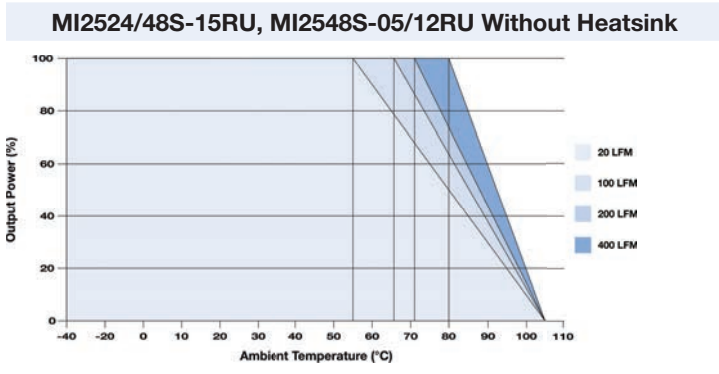
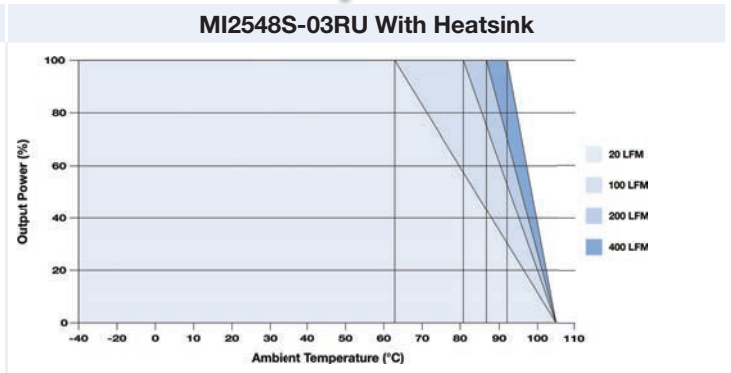
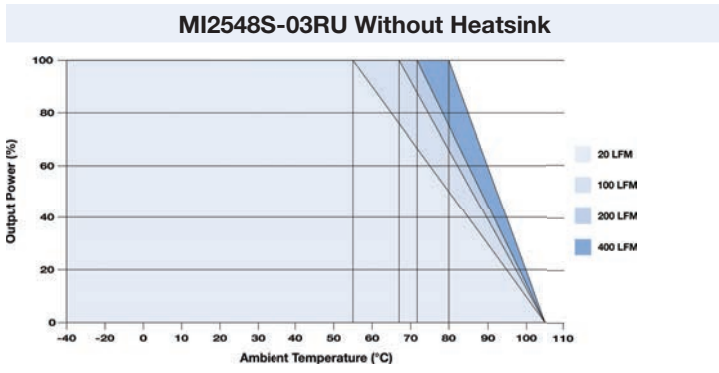


Typical EMC Filter: Dual Output Model



Typical Board Layout: Dual Output Model



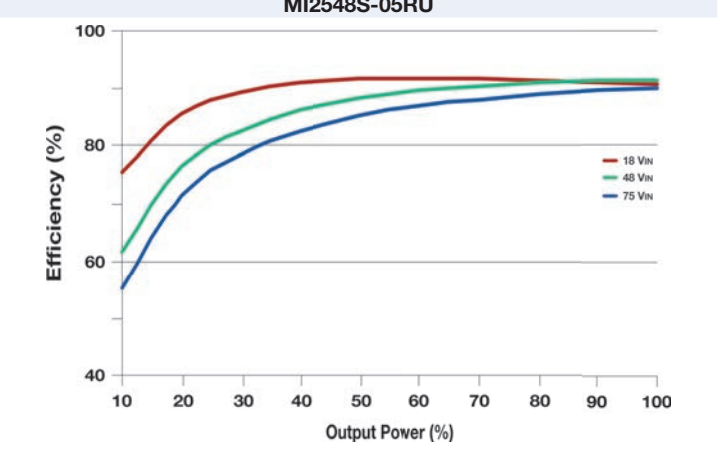
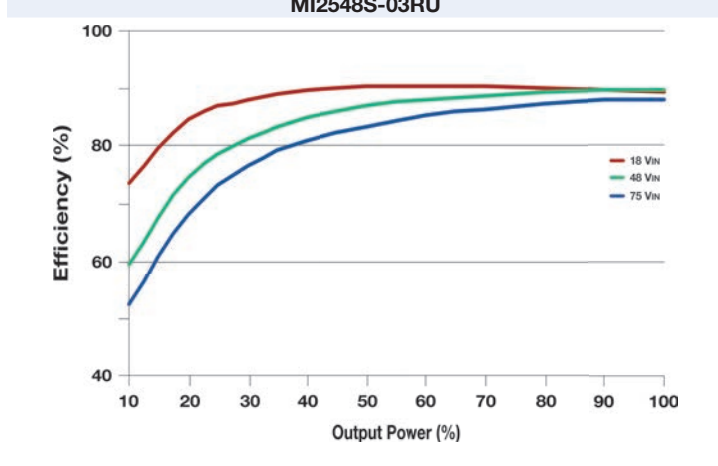
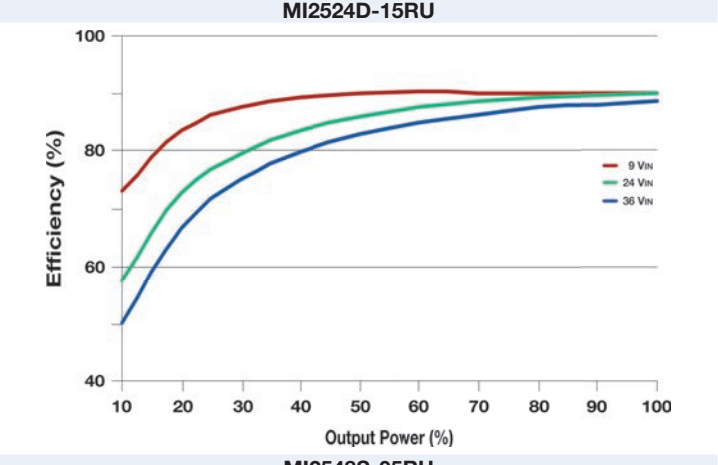
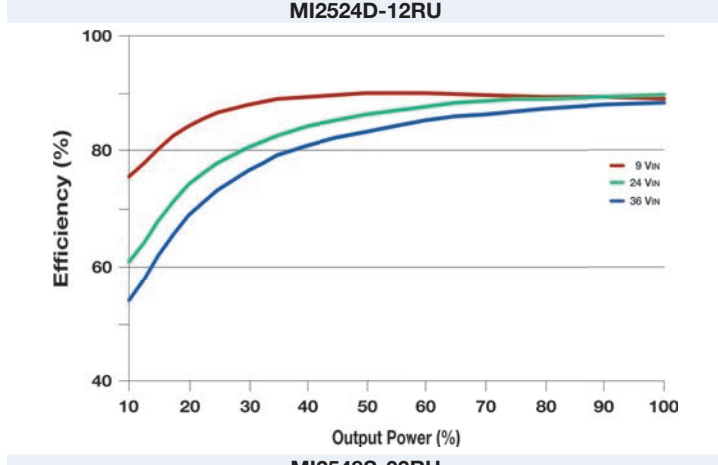
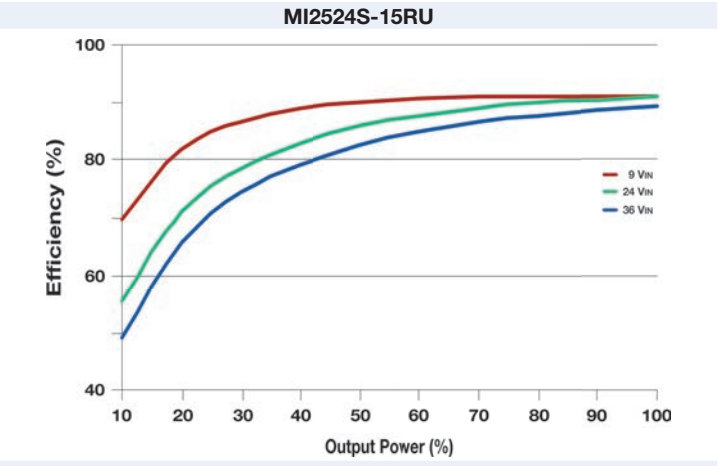
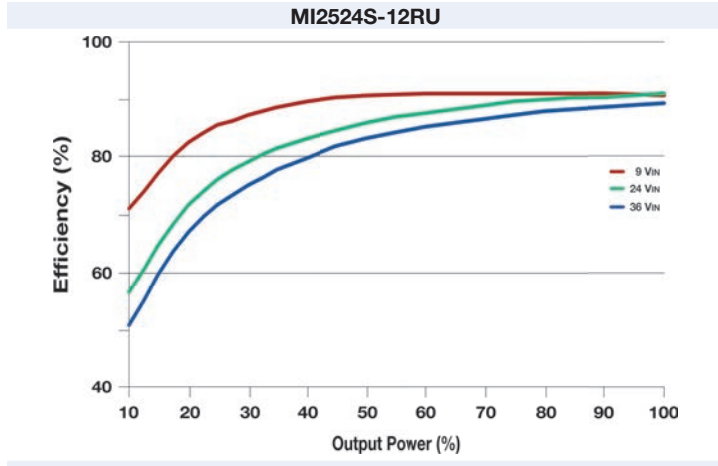
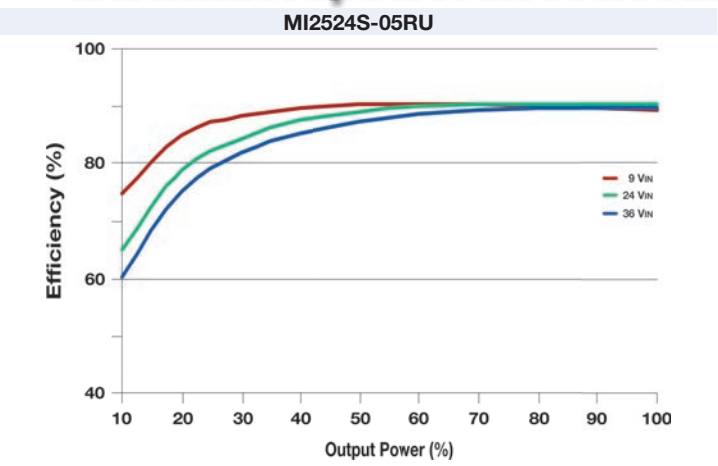
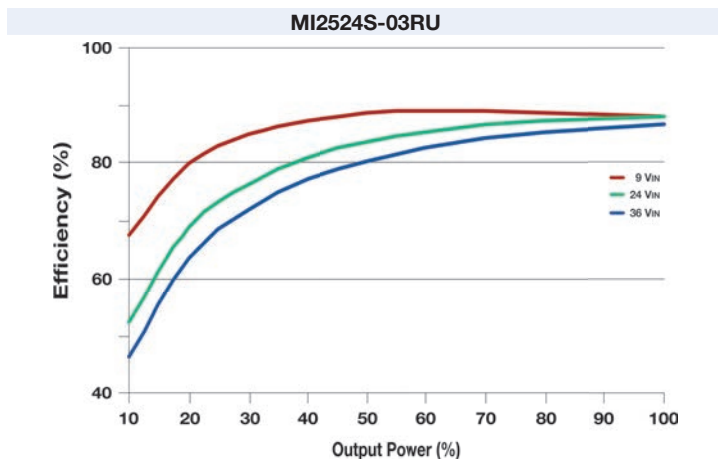


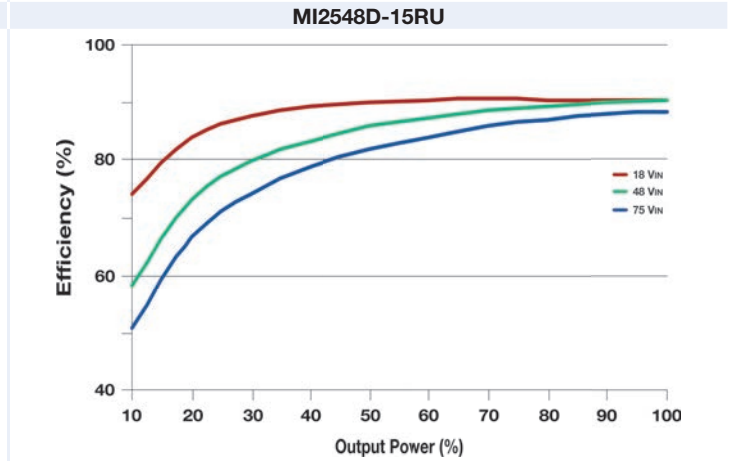
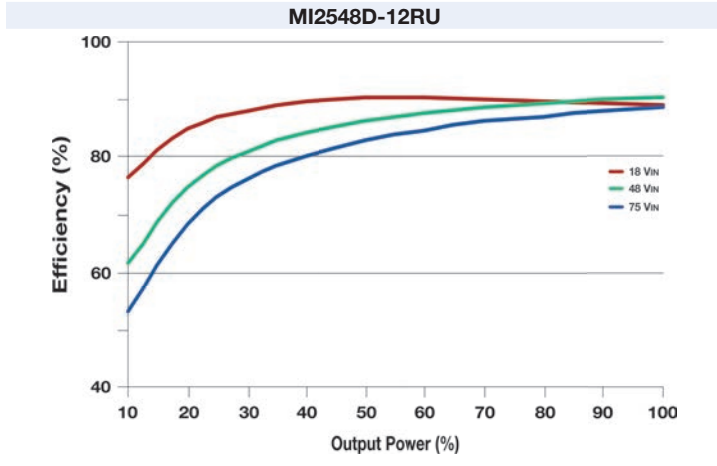
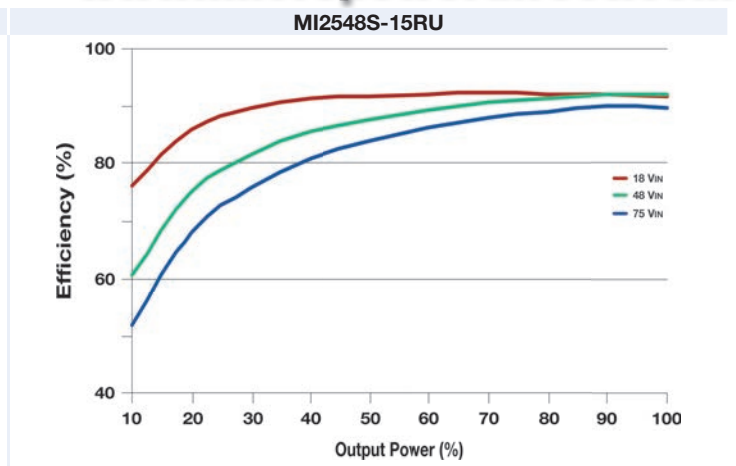
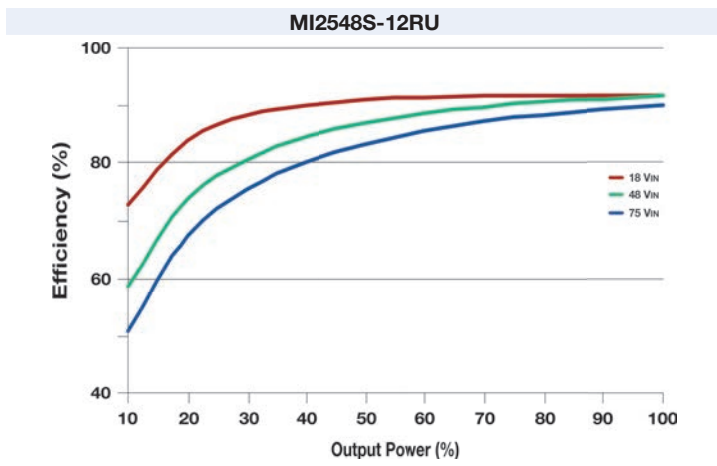
Thermal Impedance

| 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 |

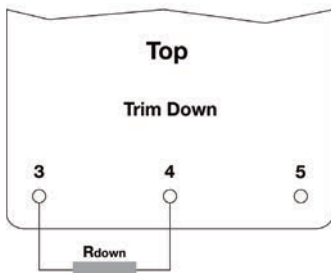
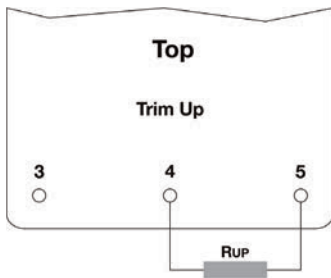
Note: Natural Convection equals 20 LFM

Efficiency Vs Output Load Curves





External Trim



An external resistor 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 |

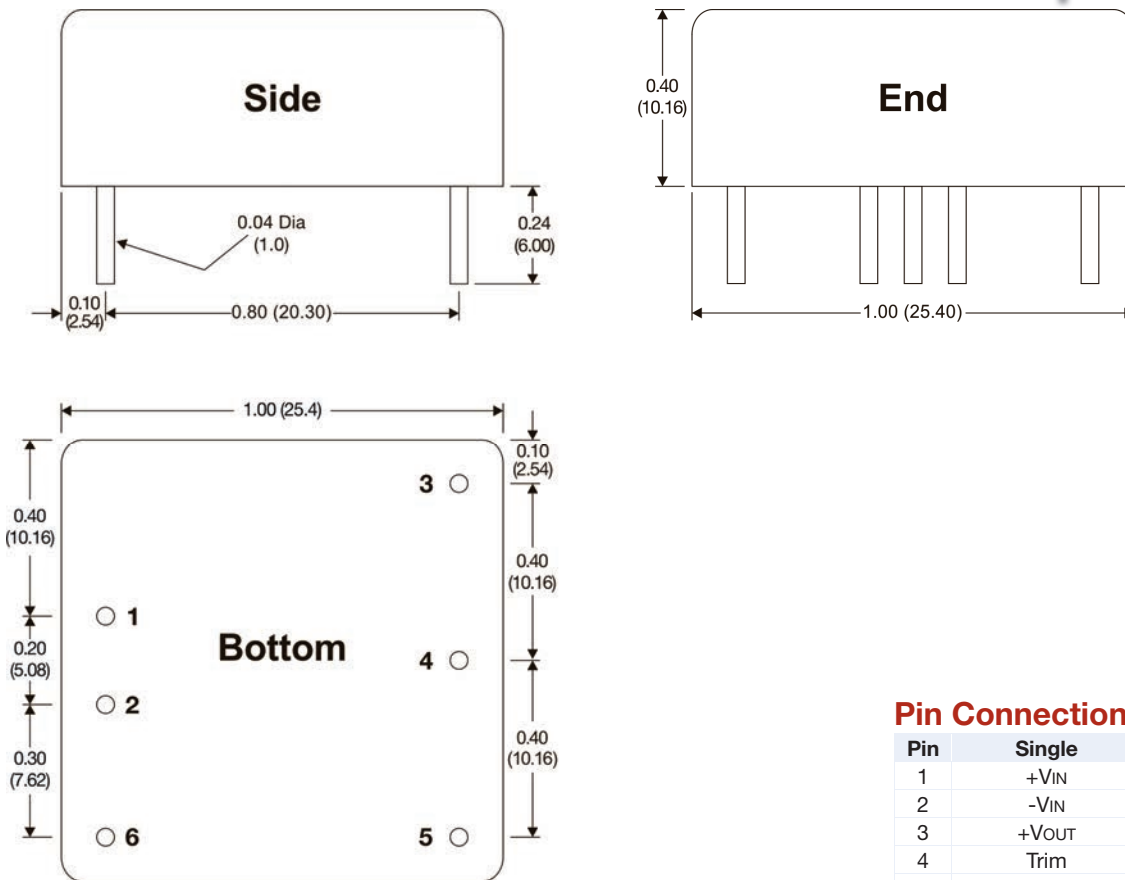
| Trim Up | | | | | | | | | | | |
|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------|
| Vout | Vo x 1.01 | Vo x 1.02 | Vo x 1.03 | Vo x 1.04 | Vo x 1.05 | Vo x 1.06 | Vo x 1.07 | Vo x 1.08 | Vo x 1.09 | Vo x 1.10 | 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 |

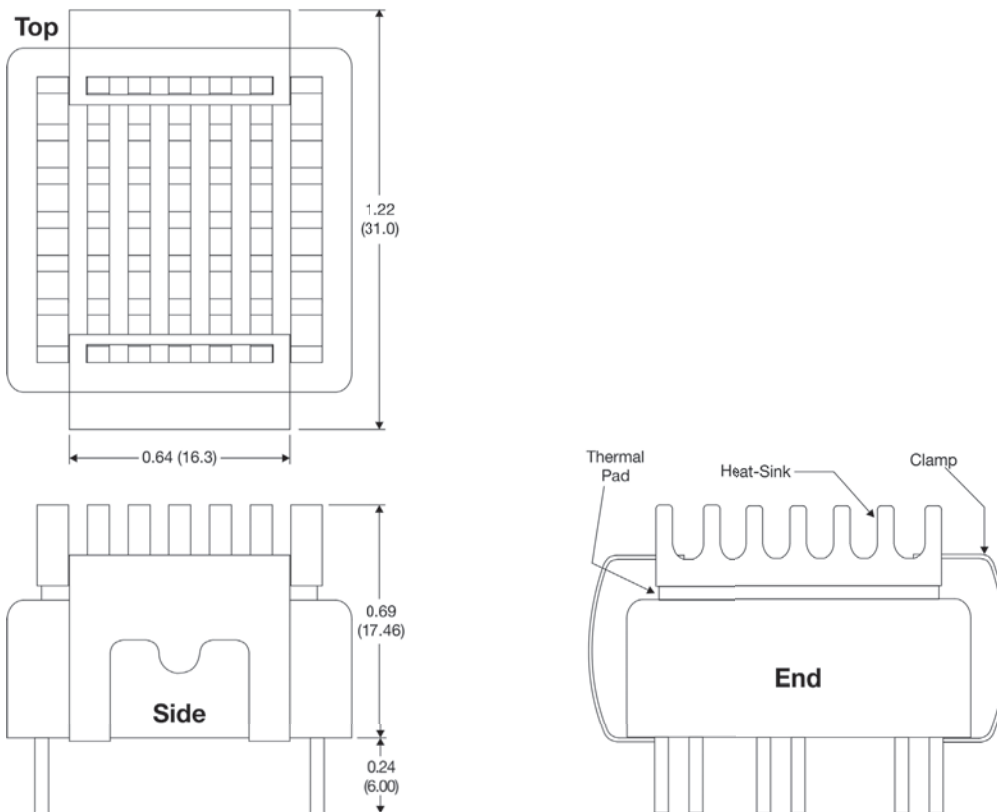
Mechanical Dimensions



Pin Connections

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