

MA400RW Series

Wide 2:1 Input, 4W, High Performance, DIP DC/DC Converters



Key Features:

- 4W Output Power
- 2:1 Input Voltage Range
- 1,500 VDC Isolation
- 30 Standard Models
- High Efficiency
- Compact DIP Case
- -40°C to +85°C Operation
- Metal Case Available
- Low Cost

Alternate Pin-Out Available

3.5 kV Isolation Models Available

RoHS



MicroPower Direct

292 Page Street
Suite D
Stoughton, MA 02072
USA

T: (781) 344-8226
F: (781) 344-8481
E: sales@micropowerdirect.com
W: www.micropowerdirect.com



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 | 12 VDC Input | 9.0 | 12.0 | 18.0 | VDC |
| | 24 VDC Input | 18.0 | 24.0 | 36.0 | |
| | 48 VDC Input | 36.0 | 48.0 | 72.0 | |
| Input Reflected Ripple Current | | | 35 | | mA P - P |
| Input Filter | π (Pi) Filter | | | | |

Output

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|-------------------------|--------------------------------|------|-------|------|----------|
| Output Voltage Accuracy | | | ±1.0 | | % |
| Line Regulation | V _{IN} = Min to Max | | ±0.5 | | % |
| Load Regulation | I _{OUT} = 25% to 100% | | ±0.5 | | % |
| Load Regulation | See Note 1 | | ±0.5 | | % |
| Ripple & Noise (20 MHz) | See Note 2 | | 60 | | mV P - P |
| Temperature Coefficient | | | ±0.02 | | %/°C |
| Output Short Circuit | Continuous (Autorecovery) | | | | |

General

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|-------------------------------|--------------|-------|------|------|-------|
| Isolation Voltage, See Note 3 | 3 Seconds | 1,500 | | | VDC |
| Isolation Resistance | 500 VDC | 1,000 | | | MΩ |
| Isolation Capacitance | 100 kHz/0.1V | | 60 | | pF |
| Switching Frequency | | 100 | | 400 | kHz |

Environmental

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|-----------------------------|---------------------|------|------|------|-------|
| Operating Temperature Range | Ambient | -40 | +25 | +85 | °C |
| Operating Temperature Range | Case | | | +100 | °C |
| Storage Temperature Range | | -40 | | +125 | °C |
| Cooling | Free Air Convection | | | | |
| Humidity | RH, Non-condensing | | | 95 | % |

Physical

| | | | | | |
|------------------------|---|--|--|--|--|
| Case Size | 1.25 x 0.80 x 0.40 Inches (31.75 x 20.32 x 10.16 mm) | | | | |
| Case Material, Plastic | Non-Conductive Black Plastic (UL94-V0) | | | | |
| Weight, Plastic Case | 0.44 Oz (12.5g) | | | | |
| Case Material, Metal | Nickel-Coated Copper With Non-Conductive Base (UL94-V0) | | | | |
| Weight, Metal Case | 0.53 Oz (15g) | | | | |

Reliability Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|-----------|---------------------------------|------|------|------|--------|
| MTBF | MIL HDBK 217F, 25°C, Gnd Benign | 1.0 | | | MHours |

Absolute Maximum Ratings

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|-----------------------------|-----------------------------|------|------|------|-------|
| Input Voltage Surge (1 Sec) | 12 VDC Input | -0.7 | | 24.0 | VDC |
| | 24 VDC Input | -0.7 | | 40.0 | |
| | 48 VDC Input | -0.7 | | 80.0 | |
| 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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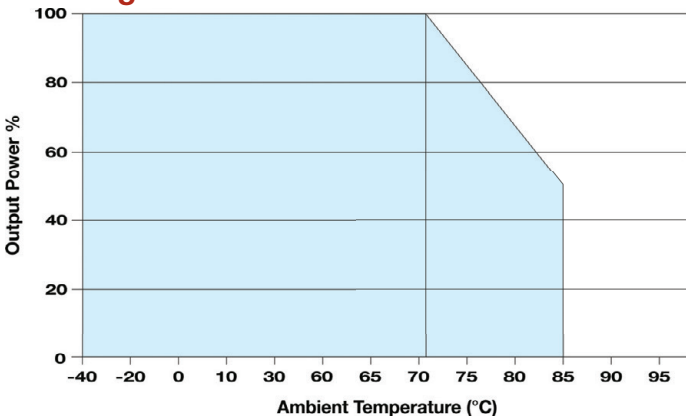
| Model Number | Input | | | | Output | | | Efficiency (% Typ) | Reflected Ripple Current (mA Typ) | Capacitive Load (µF Max) | Fuse Rating Slow-Blow (mA) |
|----------------|---------------|-------------|--------------|---------|---------------|-------------------|-------------------|--------------------|-----------------------------------|--------------------------|----------------------------|
| | Voltage (VDC) | | Current (mA) | | Voltage (VDC) | Current (mA, Max) | Current (mA, Min) | | | | |
| | Nominal | Range | Full-Load | No-Load | | | | | | | |
| MA412S-05RW-xx | 12 | 9.0 - 18.0 | 463 | 20 | 5.0 | 800.0 | 200.0 | 72 | 35.0 | 2,200 | 1,000 |
| MA412S-09RW-xx | 12 | 9.0 - 18.0 | 427 | 20 | 9.0 | 444.0 | 111.0 | 78 | 35.0 | 470 | 1,000 |
| MA412S-12RW-xx | 12 | 9.0 - 18.0 | 427 | 20 | 12.0 | 333.0 | 83.3 | 78 | 35.0 | 470 | 1,000 |
| MA412S-15RW-xx | 12 | 9.0 - 18.0 | 433 | 20 | 15.0 | 267.0 | 66.8 | 77 | 35.0 | 470 | 1,000 |
| MA412S-24RW-xx | 12 | 9.0 - 18.0 | 439 | 20 | 24.0 | 167.0 | 42.0 | 76 | 35.0 | 220 | 1,000 |
| MA412D-05RW-xx | 12 | 9.0 - 18.0 | 433 | 20 | ±5.0 | ±400.0 | ±100.0 | 77 | 35.0 | ±1,000 | 1,000 |
| MA412D-09RW-xx | 12 | 9.0 - 18.0 | 433 | 20 | ±9.0 | ±222.0 | ±56.0 | 77 | 35.0 | ±220 | 1,000 |
| MA412D-12RW-xx | 12 | 9.0 - 18.0 | 427 | 20 | ±12.0 | ±167.0 | ±42.0 | 78 | 35.0 | ±220 | 1,000 |
| MA412D-15RW-xx | 12 | 9.0 - 18.0 | 427 | 20 | ±15.0 | ±133.0 | ±33.0 | 78 | 35.0 | ±220 | 1,000 |
| MA412D-24RW-xx | 12 | 9.0 - 18.0 | 433 | 20 | ±24.0 | ±83.0 | ±21.0 | 77 | 35.0 | ±100 | 1,000 |
| MA424S-05RW-xx | 24 | 18.0 - 36.0 | 216 | 12 | 5.0 | 800.0 | 200.0 | 77 | 35.0 | 2,200 | 500 |
| MA424S-09RW-xx | 24 | 18.0 - 36.0 | 214 | 12 | 9.0 | 444.0 | 111.0 | 78 | 35.0 | 470 | 500 |
| MA424S-12RW-xx | 24 | 18.0 - 36.0 | 211 | 12 | 12.0 | 333.0 | 83.3 | 79 | 35.0 | 470 | 500 |
| MA424S-15RW-xx | 24 | 18.0 - 36.0 | 208 | 12 | 15.0 | 267.0 | 66.8 | 80 | 35.0 | 470 | 500 |
| MA424S-24RW-xx | 24 | 18.0 - 36.0 | 216 | 12 | 24.0 | 167.0 | 42.0 | 77 | 35.0 | 220 | 500 |
| MA424D-05RW-xx | 24 | 18.0 - 36.0 | 225 | 12 | ±5.0 | ±400.0 | ±100.0 | 77 | 35.0 | ±1,000 | 500 |
| MA424D-09RW-xx | 24 | 18.0 - 36.0 | 225 | 12 | ±9.0 | ±222.0 | ±56.0 | 77 | 35.0 | ±220 | 500 |
| MA424D-12RW-xx | 24 | 18.0 - 36.0 | 219 | 12 | ±12.0 | ±167.0 | ±42.0 | 78 | 35.0 | ±220 | 500 |
| MA424D-15RW-xx | 24 | 18.0 - 36.0 | 216 | 12 | ±15.0 | ±133.0 | ±33.0 | 79 | 35.0 | ±220 | 500 |
| MA424D-24RW-xx | 24 | 18.0 - 36.0 | 219 | 12 | ±24.0 | ±83.0 | ±21.0 | 76 | 35.0 | ±100 | 500 |
| MA448S-05RW-xx | 48 | 36.0 - 72.0 | 108 | 8 | 5.0 | 800.0 | 200.0 | 77 | 35.0 | 2,200 | 250 |
| MA448S-09RW-xx | 48 | 36.0 - 72.0 | 108 | 8 | 9.0 | 444.0 | 111.0 | 77 | 35.0 | 470 | 250 |
| MA448S-12RW-xx | 48 | 36.0 - 72.0 | 107 | 8 | 12.0 | 333.0 | 83.3 | 78 | 35.0 | 470 | 250 |
| MA448S-15RW-xx | 48 | 36.0 - 72.0 | 107 | 8 | 15.0 | 267.0 | 66.8 | 77 | 35.0 | 470 | 250 |
| MA448S-24RW-xx | 48 | 36.0 - 72.0 | 111 | 8 | 24.0 | 167.0 | 42.0 | 75 | 35.0 | 220 | 250 |
| MA448D-05RW-xx | 48 | 36.0 - 72.0 | 114 | 8 | ±5.0 | ±400.0 | ±100.0 | 73 | 35.0 | ±1,000 | 250 |
| MA448D-09RW-xx | 48 | 36.0 - 72.0 | 108 | 8 | ±9.0 | ±222.0 | ±56.0 | 77 | 35.0 | ±220 | 250 |
| MA448D-12RW-xx | 48 | 36.0 - 72.0 | 108 | 8 | ±12.0 | ±167.0 | ±42.0 | 77 | 35.0 | ±220 | 250 |
| MA448D-15RW-xx | 48 | 36.0 - 72.0 | 107 | 8 | ±15.0 | ±133.0 | ±33.0 | 78 | 35.0 | ±220 | 250 |
| MA448D-24RW-xx | 48 | 36.0 - 72.0 | 110 | 8 | ±24.0 | ±83.0 | ±21.0 | 76 | 35.0 | ±100 | 250 |

Notes:

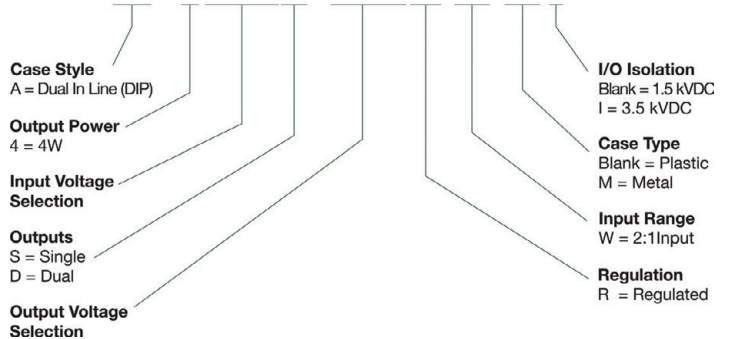
1. Cross regulation is measured with the output being tested at 100% load while the other output is varied from 25% to 100% load.
2. See the typical connection circuit on page three for typical external filtering components. For help with a specific model or layout issue, contact the factory.
3. Isolation voltage is specified for Input to output. On units with the optional metal case, the isolation voltage for Input - Case and Output - Case is 1,000 VDC.
4. Operation at no-load will not damage the unit, but they may not meet all specifications. To meet all specifications, a minimum load of 25% should be maintained.
5. 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 the alternate pin-out (see page 4) , add suffix "P2" to model number (i.e. MA424S-05RW-P2)

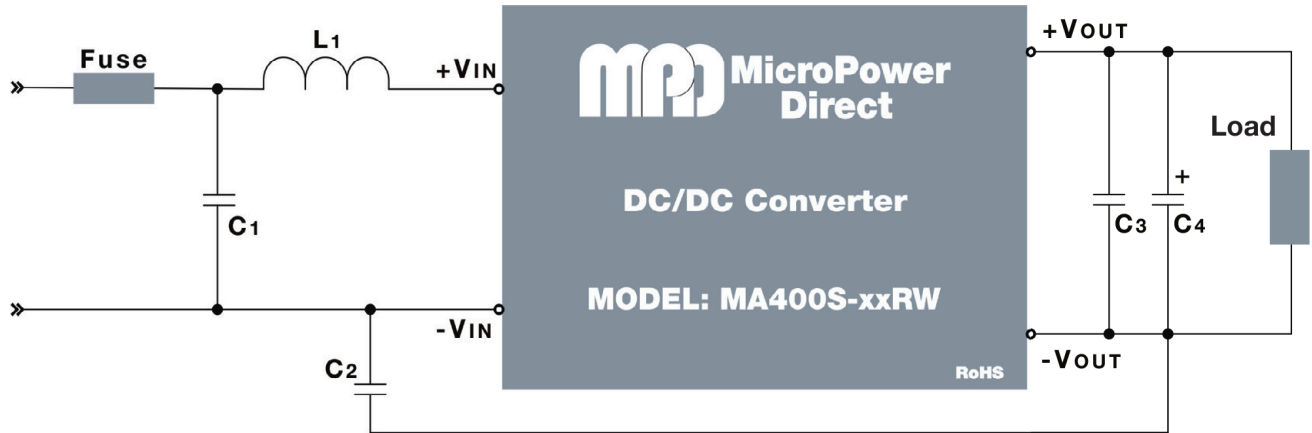
Derating Curve



Model Number
MA-4XXx-XXRWMI



Typical Connection

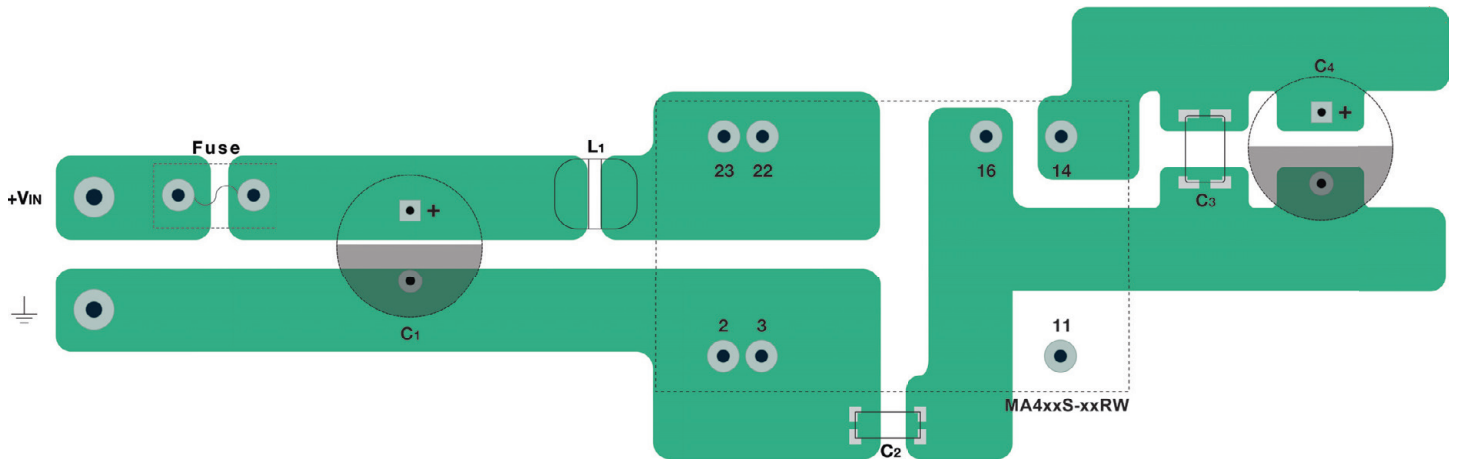


The diagram above illustrates a typical connection of the **MA400RW** series for applications that require meeting conducted EMC standards. The units do not require external components to operate as specified. For applications requiring very low output noise levels, the output filtering capacitors (C₃ is a low ESR electrolytic & C₄ is a ceramic) will often be sufficient. Care must be taken in choosing output capacitors not to exceed the capacitive load specification for the unit. For dual output units, output capacitors should be connected from each output to common. All external components should be mounted as close to the unit as possible.

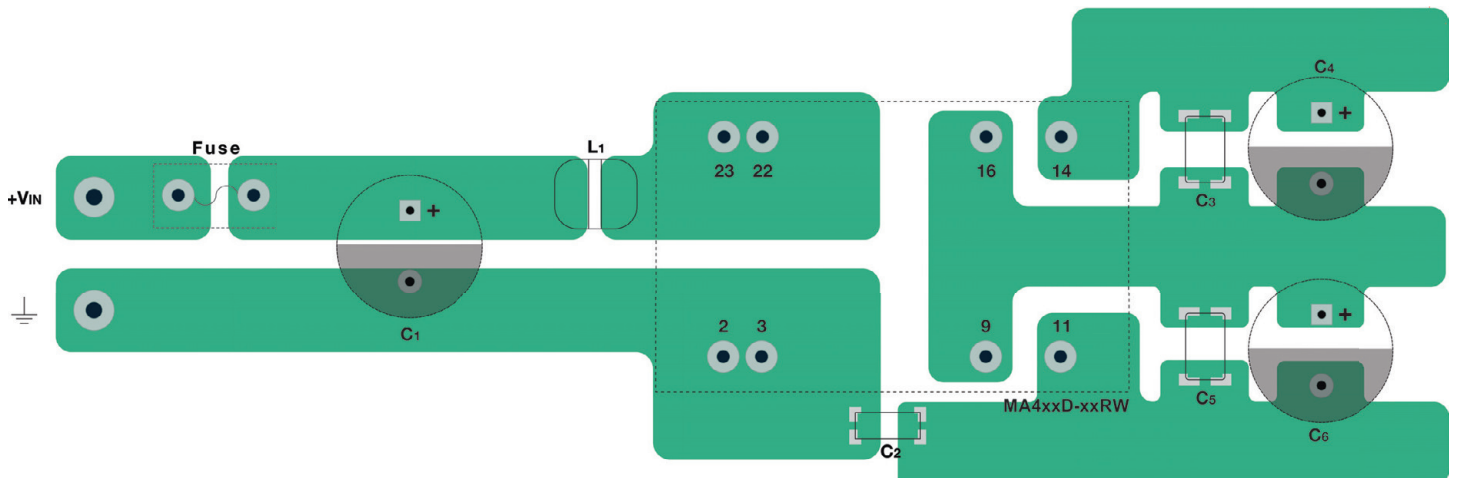
The recommended values for components are:

| Component | 12 V _{IN} | 24 V _{IN} | 48 V _{IN} |
|----------------|--------------------|--------------------|--------------------|
| C ₁ | 220 μF/50V | 220 μF/100V | 220 μF/100V |
| LCM | 12 μH | 12 μH | 12 μH |
| C ₂ | --- | 470 pF/2kV MLCC | 470 pF/2kV MLCC |
| C ₃ | 100 μF | 100 μF | 100 μF |
| C ₄ | 4.7 - 10 μF | 4.7 - 10 μF | 4.7 - 10 μF |

Typical Board Layout: With External Filter Components, Single Output

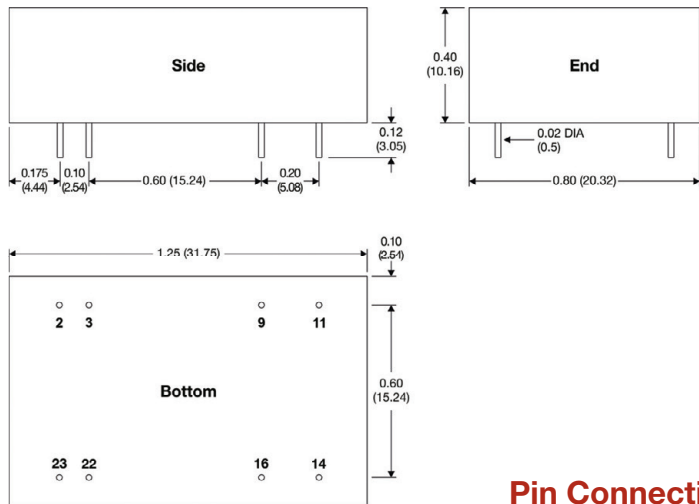


Typical Board Layout: With External Filter Components, Dual Output

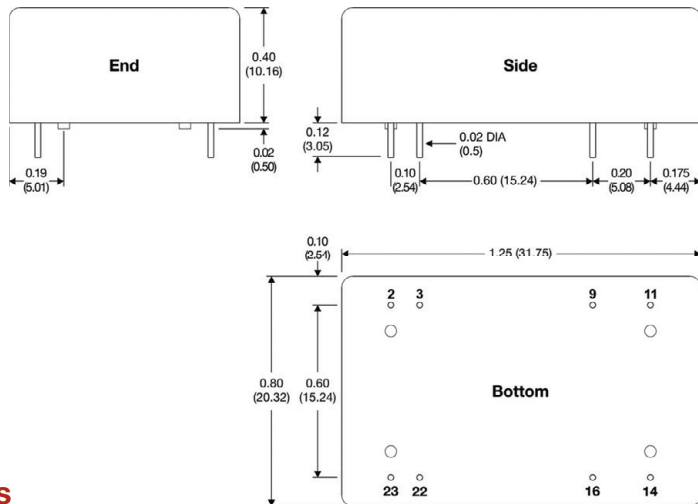


Input noise and surge suppression modules are available for a number of MPD DC/DC power supplies. Contact the factory for more information.

Standard Units - Plastic Case



Standard Units - Metal Case

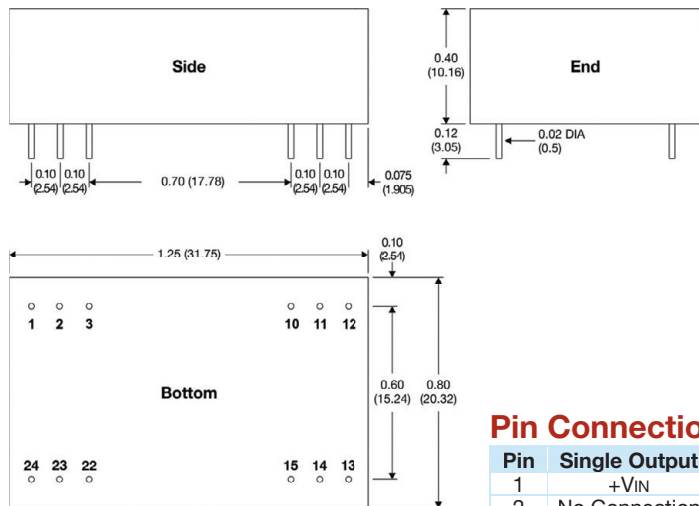


Pin Connections

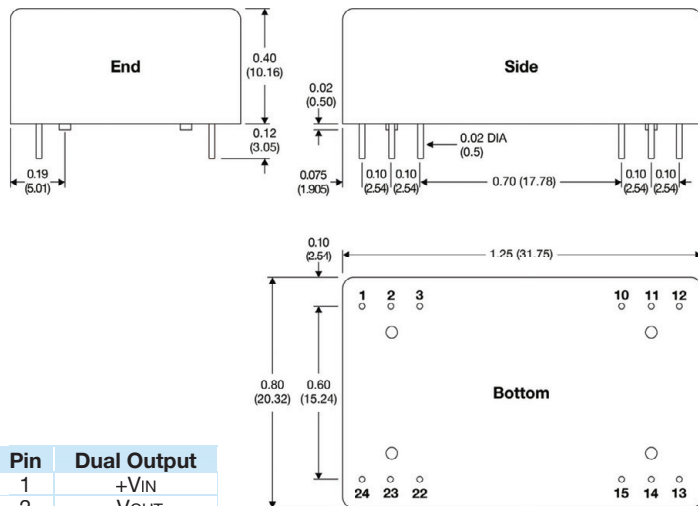
| Pin | Single Output | Pin | Dual Output |
|-----|---------------|-----|-------------|
| 2 | -VIN | 2 | -VIN |
| 3 | -VIN | 3 | -VIN |
| 9 | No Pin | 9 | Common |
| 11 | No Connection | 11 | -VOUT |
| 14 | +VOUT | 14 | +VOUT |
| 16 | -VOUT | 16 | Common |
| 22 | +VIN | 22 | +VIN |
| 23 | +VIN | 23 | +VIN |

For the alternate pin-out, add suffix "P2" to model number (i.e. MA424S-05RW-P2)

Alternate Pin-Out Units - Plastic Case



Alternate Pin-Out Units - Metal Case



Pin Connections

| Pin | Single Output | Pin | Dual Output |
|-----|---------------|-----|-------------|
| 1 | +VIN | 1 | +VIN |
| 2 | No Connection | 2 | -VOUT |
| 3 | No Connection | 3 | Common |
| 10 | -VOUT | 10 | Common |
| 11 | +VOUT | 11 | +VOUT |
| 12 | -VIN | 12 | -VIN |
| 13 | -VIN | 13 | -VIN |
| 14 | +VOUT | 14 | +VOUT |
| 15 | -VOUT | 15 | Common |
| 22 | No Connection | 22 | Common |
| 23 | No Connection | 23 | -VOUT |
| 24 | +VIN | 24 | +VIN |

Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Pin 1 is marked by a "dot" or indentation on the top of the unit



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