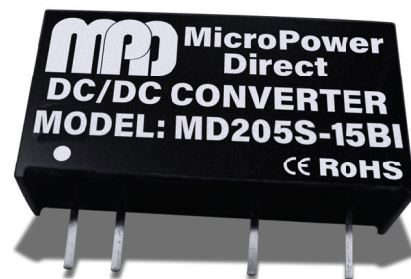
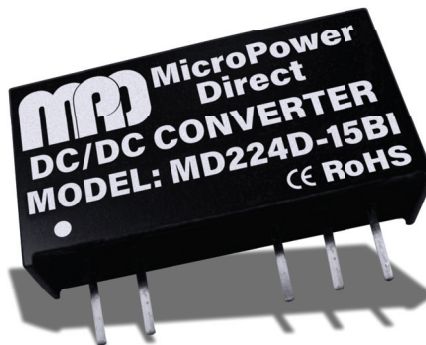


# MD200BI

## High Isolation, 2W SIP Single & Dual Output DC/DC Converters



### Key Features:

- 2W Output Power
- 3,000VDC Isolation
- Miniature SIP Case
- Efficiency to 90%
- Short Circuit Protected
- Single & Dual Outputs
- -40°C to +105°C Operation
- >3.5 MHour MTBF
- 33 Standard Models
- Industry Standard Footprint
- **LOW COST!**



### 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      | 5 VDC Input  | 4.5  | 5.0  | 5.5  |       |
|                          | 12 VDC Input | 10.8 | 12.0 | 13.2 |       |
|                          | 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 3) |              |      |       |      |          |
| Line Regulation, See Note 2 | For 1% VIN Change             | 3.3 VOUT     |      |       | ±1.5 | %        |
|                             |                               | Other Models |      |       | ±1.2 |          |
| Load Regulation, See Note 3 | See Model Selection Guide     |              |      |       |      |          |
| Ripple & Noise (20 MHz)     | See Note 4                    |              |      | 60    | 120  | mV P - P |
| Temperature Coefficient     |                               |              |      | ±0.03 |      | %/°C     |
| Output Short Circuit        | Continuous (Autorecovery)     |              |      |       |      |          |

| General               |                              |       |      |      |       |
|-----------------------|------------------------------|-------|------|------|-------|
| Parameter             | Conditions                   | Min.  | Typ. | Max. | Units |
| Isolation Voltage     | See Note 5                   | 3,000 |      |      | VDC   |
| Isolation Resistance  | 500 VDC                      | 1,000 |      |      | MΩ    |
| Isolation Capacitance | 100 kHz, 0.1V                |       | 20   |      | pF    |
| Switching Frequency   | Full Load, Nom Input Voltage |       | 220  |      | kHz   |

| EMI Characteristics |                  |          |               |
|---------------------|------------------|----------|---------------|
| Parameter           | Standard         | Criteria | Level         |
| Radiated Emissions  | CISPR32/EN 55032 |          | Class B       |
| Radiated Emissions  | CISPR32/EN 55032 |          | Class B       |
| ESD EN 61000-4-2    | EN61000-4-2      | B        | ±8 kV Contact |

| Environmental               |                     |      |      |      |       |
|-----------------------------|---------------------|------|------|------|-------|
| Parameter                   | Conditions          | Min. | Typ. | Max. | Units |
| Operating Temperature Range | Ambient, See Note 6 | -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 5)                          |
| Case Material | Flame Retardant, Non-Conductive, Black Plastic (UL94-V0) |
| Weight        | See Mechanical Drawing (Page 5)                          |

### Reliability Specifications

| Parameter | Conditions                      | Min. | Typ. | Max. | Units  |
|-----------|---------------------------------|------|------|------|--------|
| MTBF      | MIL HDBK 217F, 25°C, Gnd Benign | 3.5  |      |      | MHours |

### Absolute Maximum Ratings

| Parameter                   | Conditions                  | Min. | Typ. | Max. | Units |
|-----------------------------|-----------------------------|------|------|------|-------|
| Input Voltage Surge (1 Sec) | 5 VDC Input                 |      |      | 9.0  | VDC   |
|                             | 12 VDC Input                |      |      | 18.0 |       |
|                             | 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.

### MicroPower Direct

46 Eastman Street  
Unit 1  
Easton, MA 02375  
USA

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

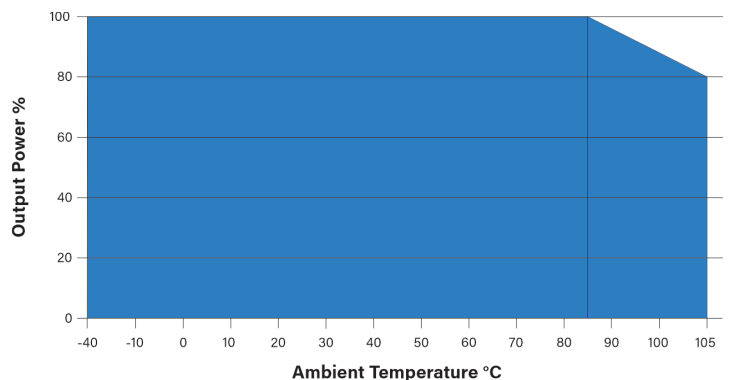


[www.micropowerdirect.com](http://www.micropowerdirect.com)

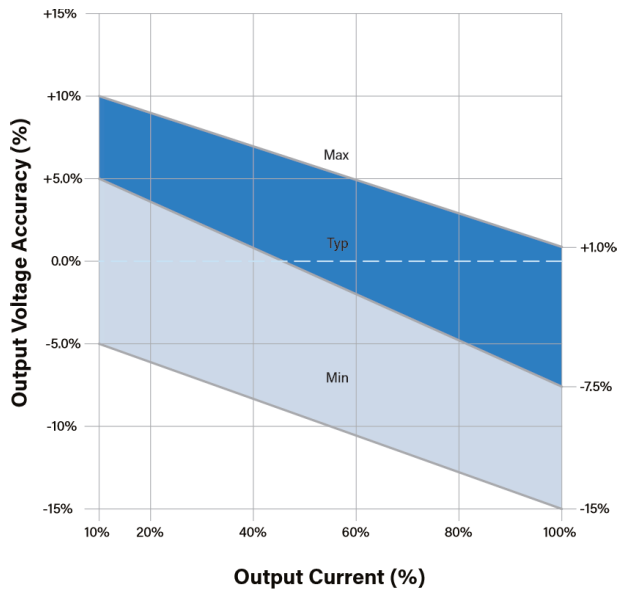
| Model Number | Input         |             |              |         | Output        |                   |                   | Load Regulation (% Typ) | Output Capacitive Load (μF Max) | Efficiency (% Typ) | Fuse Rating Slow-Blow (mA) |
|--------------|---------------|-------------|--------------|---------|---------------|-------------------|-------------------|-------------------------|---------------------------------|--------------------|----------------------------|
|              | Voltage (VDC) |             | Current (mA) |         | Voltage (VDC) | Current (mA, Max) | Current (mA, Min) |                         |                                 |                    |                            |
|              | Nominal       | Range       | Full-Load    | No-Load |               |                   |                   |                         |                                 |                    |                            |
| MD205S-03BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | 3.3           | 400.0             | 0.0               | ±14.0                   | 2,400                           | 83                 | 1,000                      |
| MD205S-05BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | 5.0           | 400.0             | 0.0               | ±10.0                   | 2,400                           | 85                 | 1,000                      |
| MD205S-09BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | 9.0           | 222.0             | 0.0               | ±9.0                    | 1,000                           | 85                 | 1,000                      |
| MD205S-12BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | 12.0          | 167.0             | 0.0               | ±8.0                    | 820                             | 86                 | 1,000                      |
| MD205S-15BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | 15.0          | 133.0             | 0.0               | ±7.0                    | 680                             | 87                 | 1,000                      |
| MD205S-24BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | 24.0          | 83.0              | 0.0               | ±6.0                    | 560                             | 88                 | 1,000                      |
| MD205D-03BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | ±3.3          | ±303.0            | 0.0               | ±14.0                   | 1,000                           | 83                 | 1,000                      |
| MD205D-05BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | ±5.0          | ±200.0            | 0.0               | ±10.0                   | 1,000                           | 85                 | 1,000                      |
| MD205D-09BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | ±9.0          | ±111.0            | 0.0               | ±9.0                    | 560                             | 85                 | 1,000                      |
| MD205D-12BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | ±12.0         | ±83.0             | 0.0               | ±8.0                    | 560                             | 86                 | 1,000                      |
| MD205D-15BI  | 5.0           | 4.5 - 5.5   | 506          | 4.0     | ±15.0         | ±67.0             | 0.0               | ±7.0                    | 220                             | 87                 | 1,000                      |
| MD212S-03BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | 3.3           | 400.0             | 0.0               | ±14.0                   | 2,400                           | 84                 | 400                        |
| MD212S-05BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | 5.0           | 400.0             | 0.0               | ±10.0                   | 2,400                           | 85                 | 400                        |
| MD212S-09BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | 9.0           | 222.0             | 0.0               | ±9.0                    | 1,000                           | 86                 | 400                        |
| MD212S-12BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | 12.0          | 167.0             | 0.0               | ±8.0                    | 820                             | 87                 | 400                        |
| MD212S-15BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | 15.0          | 133.0             | 0.0               | ±7.0                    | 680                             | 88                 | 400                        |
| MD212S-24BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | 24.0          | 83.0              | 0.0               | ±6.0                    | 560                             | 89                 | 450                        |
| MD212D-03BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | ±3.3          | ±303.0            | 0.0               | ±14.0                   | 1,000                           | 84                 | 400                        |
| MD212D-05BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | ±5.0          | ±200.0            | 0.0               | ±10.0                   | 1,000                           | 85                 | 400                        |
| MD212D-09BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | ±9.0          | ±111.0            | 0.0               | ±9.0                    | 560                             | 86                 | 400                        |
| MD212D-12BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | ±12.0         | ±83.0             | 0.0               | ±8.0                    | 560                             | 87                 | 400                        |
| MD212D-15BI  | 12            | 10.8 - 13.2 | 208          | 4.0     | ±15.0         | ±67.0             | 0.0               | ±7.0                    | 220                             | 88                 | 400                        |
| MD224S-03BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | 3.3           | 400.0             | 0.0               | ±14.0                   | 2,400                           | 84                 | 200                        |
| MD224S-05BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | 5.0           | 400.0             | 0.0               | ±10.0                   | 2,400                           | 86                 | 200                        |
| MD224S-09BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | 9.0           | 222.0             | 0.0               | ±9.0                    | 1,000                           | 87                 | 200                        |
| MD224S-12BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | 12.0          | 167.0             | 0.0               | ±8.0                    | 820                             | 88                 | 200                        |
| MD224S-15BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | 15.0          | 133.0             | 0.0               | ±7.0                    | 680                             | 89                 | 200                        |
| MD224S-24BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | 24.0          | 83.0              | 0.0               | ±6.0                    | 560                             | 90                 | 200                        |
| MD224D-03BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | ±3.3          | ±303.0            | 0.0               | ±14.0                   | 1,000                           | 84                 | 200                        |
| MD224D-05BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | ±5.0          | ±200.0            | 0.0               | ±10.0                   | 1,000                           | 86                 | 200                        |
| MD224D-09BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | ±9.0          | ±111.0            | 0.0               | ±9.0                    | 560                             | 87                 | 200                        |
| MD224D-12BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | ±12.0         | ±83.0             | 0.0               | ±8.0                    | 560                             | 88                 | 200                        |
| MD224D-15BI  | 24            | 21.6 - 26.4 | 104          | 4.0     | ±15.0         | ±67.0             | 0.0               | ±7.0                    | 220                             | 89                 | 200                        |

**Specification Notes:**

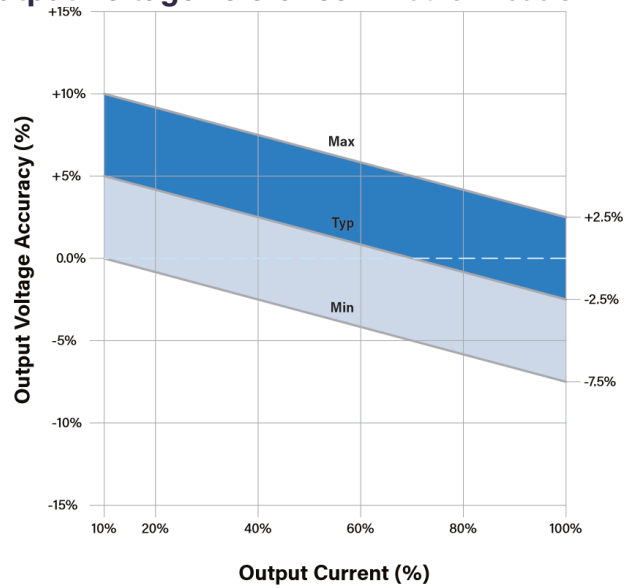
1. Output capacitive load is specified for each output.
2. Single/dual 3.3 VOUT models have a line regulation of 1.5 %/ %.
3. Output load regulation is specified for a load change of 10% to 100%.
4. When measuring output ripple, it is recommended that an external 1  $\mu$ F ceramic capacitor & a 10  $\mu$ 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.
5. Isolation voltage is specified for a period 60S with a leakage current lower than 1 mA.
6. The maximum output power derates linearly from 100% at an ambient temperature of 85°C to 80% at 105°C. Contact the factory for more information.
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. See the Model Selection table above for the correct rating.

**Temperature Derating Curve**

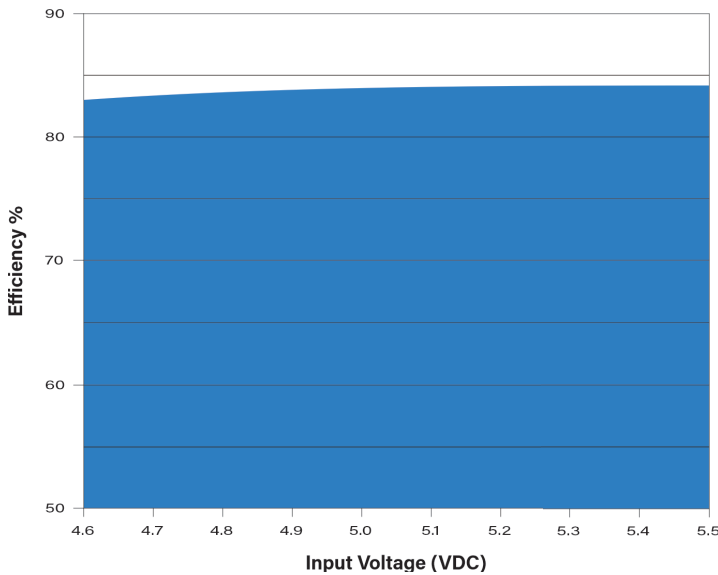
## Output Voltage Tolerance: 3.3 VDC Output Models



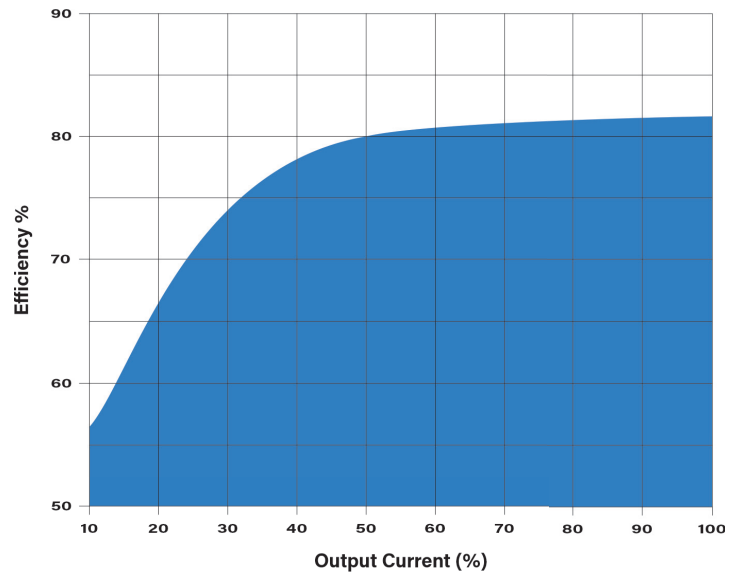
## Output Voltage Tolerance: All Other Models



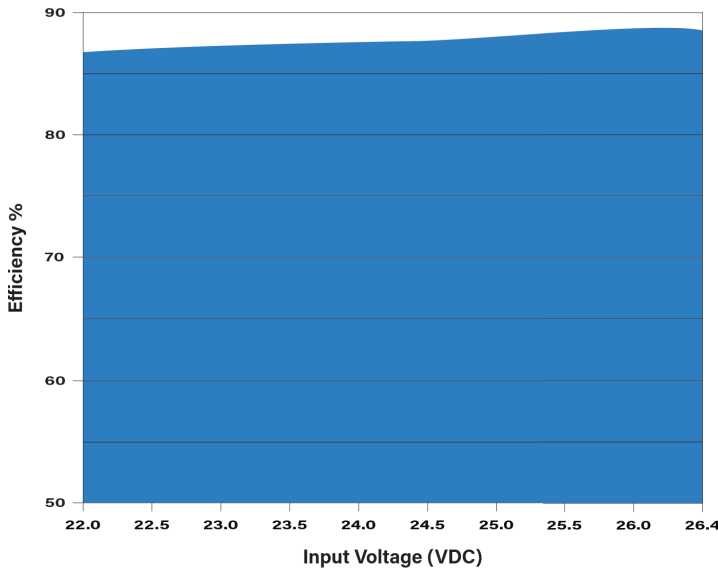
## Efficiency vs Input: MD205S-05BI



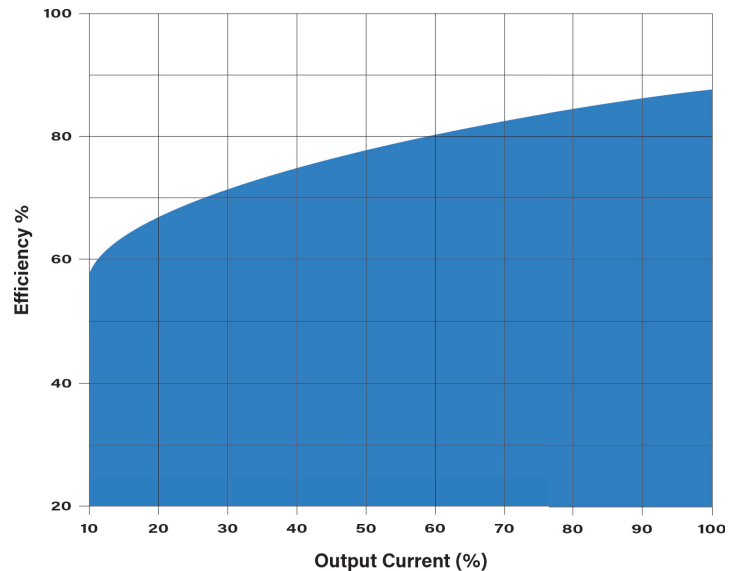
## Efficiency vs Output Load: MD205S-05BI

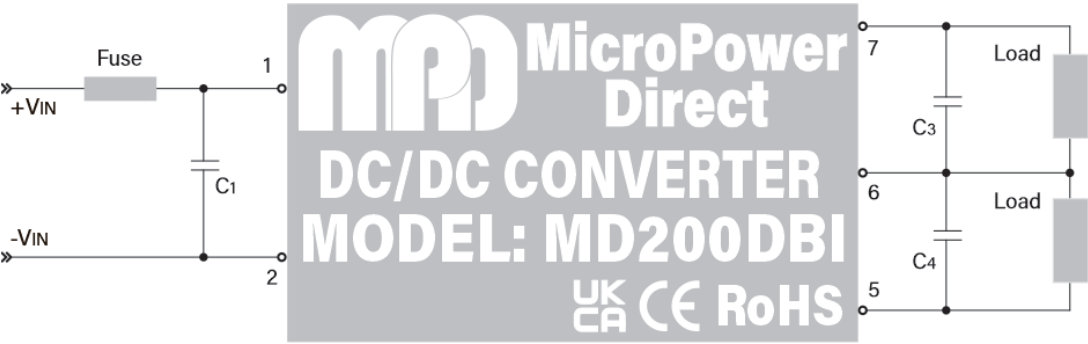


## Efficiency vs Input: MD224S-05BI



## Efficiency vs Output Load: MD224S-05BI

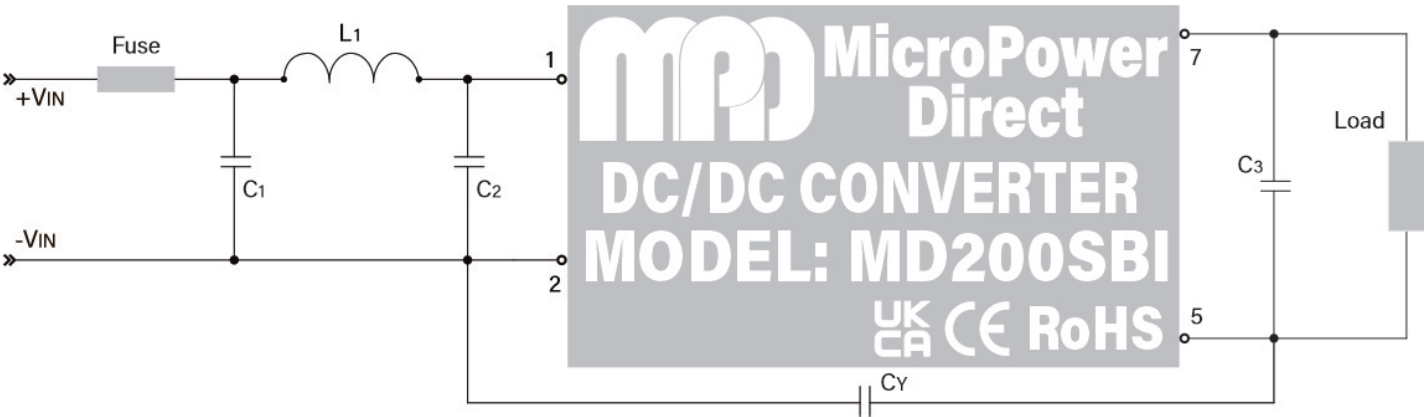




The diagram above illustrates a typical connection of the **MD200DBI**. For applications that do not require the circuit to meet EMI/EMC specifications, the capacitors C1, C3 and C4 will reduce input/output ripple and improve the converter stability over time and temperature. The recommended component values are given in the table below the diagram.

| V <sub>IN</sub> | C <sub>1</sub>  | V <sub>OUT</sub> | C <sub>3</sub> /C <sub>4</sub> |
|-----------------|-----------------|------------------|--------------------------------|
| 5 VDC           | 4.7 $\mu$ F/16V | 3.3 VDC          | 10 $\mu$ F/16V                 |
| 12 VDC          | 2.2 $\mu$ F/25V | 5 VDC            | 10 $\mu$ F/16V                 |
| 24 VDC          | 1.0 $\mu$ F/50V | 9 VDC            | 2.2 $\mu$ F/16V                |
|                 |                 | 12 VDC           | 2.2 $\mu$ F/25V                |
|                 |                 | 15 VDC           | 1.0 $\mu$ F/25V                |
|                 |                 | 24 VDC           | 1.0 $\mu$ F/50V                |
|                 |                 | $\pm$ 3.3 VDC    | 10 $\mu$ F/16V                 |
|                 |                 | $\pm$ 5 VDC      | 10 $\mu$ F/16V                 |
|                 |                 | $\pm$ 9 VDC      | 2.2 $\mu$ F/16V                |
|                 |                 | $\pm$ 12 VDC     | 2.2 $\mu$ F/25V                |
|                 |                 | $\pm$ 15 VDC     | 1.0 $\mu$ F/25V                |

EMI Connection



The diagram above illustrates a connection of the **MD200SBI** 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

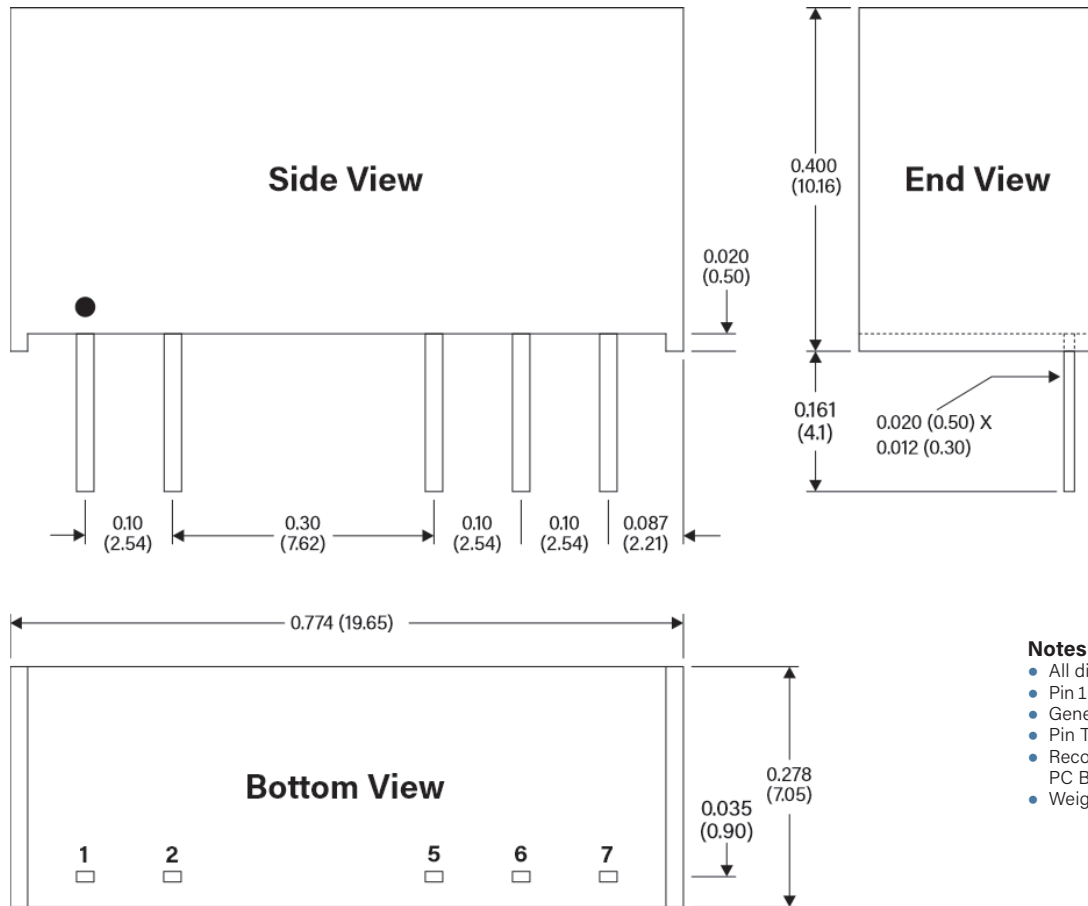
capacitor. Care must be taken in choosing this capacitor not to exceed the capacitive load specification for the unit. Voltage derating of capacitors should be 80% or above.

4. Suggested component values are:

|    | V <sub>IN</sub> : 5V         | V <sub>IN</sub> : 12V/24V |
|----|------------------------------|---------------------------|
| C1 | 4.7 $\mu$ F/25V              | 4.7 $\mu$ F/50V           |
| C2 | 4.7 $\mu$ F/25V              | 4.7 $\mu$ F/50V           |
| L1 | 6.8 $\mu$ H                  | 6.8 $\mu$ H               |
| CY | 1 nF/2kV                     | 1 nF/2kV                  |
| C3 | See Typical Connection Above |                           |

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

## Mechanical Dimensions



## Pin Connections

| Pin | Single Output |
|-----|---------------|
| 1   | +VIN          |
| 2   | -VIN          |
| 5   | -VOUT         |
| 6   | No Pin        |
| 7   | +VOUT         |

| Pin | Dual Output |
|-----|-------------|
| 1   | +VIN        |
| 2   | -VIN        |
| 5   | -VOUT       |
| 6   | Common      |
| 7   | +VOUT       |

### 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 =  $\pm 0.004$  ( $\pm 0.10$ )
- Recommended pin hole size (on the application PC Board) is  $\varnothing 0.039$  ( $\varnothing 1.00$ )
- Weight (Typ) = 0.63 Oz (1.79g)

MPD offers a very wide variety of DC/DC converters. Our standard product line includes SMT, SIP, and DIP potted modules, industry standard 1 x 1" & 1 x 2" modules. Our units are used in applications ranging from high speed gate drive circuits to instrumentation to industrial equipment and medical equipment/instrumentation. Units are available over a power range of 0.25 to 60W. Most models meet international EMC/EMI standards and many are fully approved to EN 62368. Call today, or go to our website to find the right DC/DC power module for your application.

WWW.MICROPOWERDIRECT.COM

