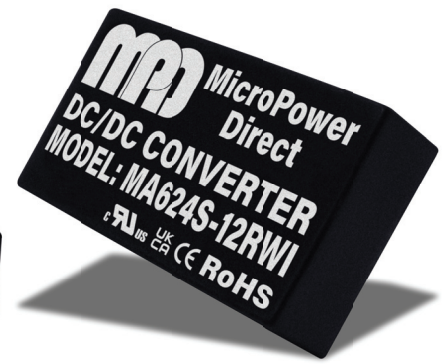
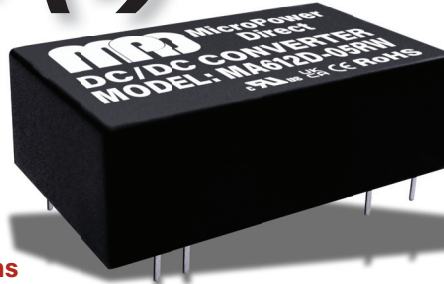


# MA600RW (I)

## 2:1 Input, 6W DIP Single & Dual Out DC/DC Converters



### Key Features:

- 6W Output Power
- Compact DIP Case
- EN 62368 Approved
- Wide 2:1 Input Range
- High Efficiency
- Wide Operating Temp Range
- 1,500 or 3,000V Isolation
- Single and Dual Outputs
- >1.0 MHour MTBF
- Industry Standard Pin Out
- Also Available with 4:1 Input
- **LOW COST**



### MicroPower Direct

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W: www.micropowerelectronics.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  | 75.0 |       |
| Input Start-up Threshold  | 12 VDC Input      | 7.0  |       | 9.0  | VDC   |
|                           | 24 VDC Input      | 14.0 |       | 18.0 |       |
|                           | 48 VDC Input      | 32.0 |       | 36.0 |       |
| Under Voltage Shutdown    | 12 VDC Input      |      | 8.5   |      | VDC   |
|                           | 24 VDC Input      |      | 16.0  |      |       |
|                           | 48 VDC Input      |      | 35.0  |      |       |
| Short Circuit Input Power |                   |      | 3,000 |      | mW    |
| Input Filter              | $\pi$ (Pi) Filter |      |       |      |       |

#### Output

| Parameter                    | Conditions                    | Min.                      | Typ.  | Max.  | Units    |
|------------------------------|-------------------------------|---------------------------|-------|-------|----------|
| Output Voltage Accuracy      |                               |                           |       | ±2.0  | %        |
| Output Voltage Balance       | Dual Output, Balanced Loads   |                           | ±1.0  | ±2.0  | %        |
| Line Regulation              | V <sub>IN</sub> = Min To Max  |                           | ±0.2  | ±0.5  | %        |
| Load Regulation              | I <sub>OUT</sub> = 0% To 100% |                           | ±0.6  | ±1.2  | %        |
| Cross Regulation             | Asymmetrical Load (25%/100%)  |                           | ±1.0  | ±5.0  | %        |
| Ripple & Noise (20 MHz)      | See Note 1                    |                           |       | 80    | mV P - P |
| Transient Recovery Time      | See Note 2                    |                           | 300   | 600   | µSec     |
| Transient Response Deviation |                               |                           | ±3.0  | ±5.0  | %        |
| Overload Protection          | Foldback                      | 110                       | 145   |       | %        |
| Temperature Coefficient      |                               |                           | ±0.01 | ±0.02 | %/°C     |
| Output Short Circuit         | See Note 3                    | Continuous (Autorecovery) |       |       |          |

#### General

| Parameter             | Conditions              | Min.  | Typ.  | Max. | Units |
|-----------------------|-------------------------|-------|-------|------|-------|
| Isolation Voltage     | 60 Seconds              | 1,500 |       |      | VDC   |
|                       | 1 Second                | 1,800 |       |      |       |
|                       | "I" Version, 60 Seconds | 3,000 |       |      |       |
| Isolation Resistance  | 500 VDC                 | 1,000 |       |      | MΩ    |
| Isolation Capacitance | 100 kHz, 1V             |       | 1,000 |      | pF    |
| Switching Frequency   |                         |       | 330   |      | kHz   |

#### Environmental

| Parameter                   | Conditions          | Min. | Typ. | Max. | Units |
|-----------------------------|---------------------|------|------|------|-------|
| Operating Temperature Range | Ambient             | -40  | +25  | +85  | °C    |
| Max Case Temperature        |                     |      |      | +100 | °C    |
| Storage Temperature Range   |                     | -50  |      | +125 | °C    |
| Cooling                     | Free Air Convection |      |      |      |       |
| Humidity                    | RH, Non-condensing  |      |      | 95   | %     |

#### Physical

|                    |                                                  |  |  |  |  |
|--------------------|--------------------------------------------------|--|--|--|--|
| Case Size & Weight | See Mechanical Diagram (Page 7)                  |  |  |  |  |
| Case Material      | Aluminum Alloy, Black Anodized Coating (UL-94V0) |  |  |  |  |

#### Reliability Specifications

| Parameter        | Conditions                                  | Min.  | Typ. | Max. | Units  |
|------------------|---------------------------------------------|-------|------|------|--------|
| MTBF             | MIL HDBK 217F, 25°C, Gnd Benign             | 1,000 |      |      | MHours |
| Safety Standards | UL/cUL 62368-1 recognition (UL certificate) |       |      |      |        |

#### Absolute Maximum Ratings

| Parameter                   | Conditions                  | Min. | Typ. | Max.  | Units |
|-----------------------------|-----------------------------|------|------|-------|-------|
| Input Voltage Surge (1 Sec) | 12 VDC Input                |      |      | 25.0  | VDC   |
|                             | 24 VDC Input                |      |      | 50.0  |       |
|                             | 48 VDC Input                |      |      | 100.0 |       |
| Lead Temperature            | 1.5 mm From Case For 10 Sec |      |      | 260   | °C    |

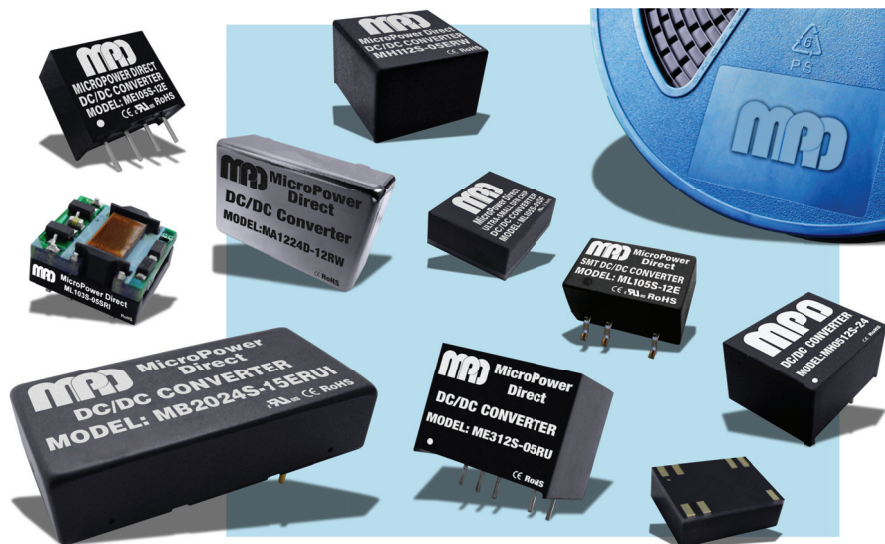
Caution: Exceeding Absolute Maximum Ratings may damage the module. These are not continuous operating ratings.

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| Model Number   | Input         |             |              |         | Output           |                      |                      | Output Capacitive Load<br>( $\mu$ F Max)<br>See Note 5 | Efficiency<br>(%, Typ) | Fuse Rating<br>Slow-Blow<br>(A) |
|----------------|---------------|-------------|--------------|---------|------------------|----------------------|----------------------|--------------------------------------------------------|------------------------|---------------------------------|
|                | Voltage (VDC) |             | Current (mA) |         | Voltage<br>(VDC) | Current<br>(mA, Max) | Current<br>(mA, Min) |                                                        |                        |                                 |
|                | Nominal       | Range       | Full-Load    | No-Load |                  |                      |                      |                                                        |                        |                                 |
| MA612S-03RW(I) | 12            | 9.0 - 18.0  | 440          | 40      | 3.3              | 1,200                | 0.0                  | 470                                                    | 75                     | 1.50                            |
| MA612S-05RW(I) | 12            | 9.0 - 18.0  | 641          | 40      | 5.0              | 1,200                | 0.0                  | 470                                                    | 78                     | 1.50                            |
| MA612S-12RW(I) | 12            | 9.0 - 18.0  | 609          | 40      | 12.0             | 500                  | 0.0                  | 100                                                    | 82                     | 1.50                            |
| MA612S-15RW(I) | 12            | 9.0 - 18.0  | 609          | 40      | 15.0             | 400                  | 0.0                  | 100                                                    | 82                     | 1.50                            |
| MA612S-24RW(I) | 12            | 9.0 - 18.0  | 595          | 40      | 24.0             | 250                  | 0.0                  | 47                                                     | 84                     | 1.50                            |
| MA605D-05RW(I) | 12            | 9.0 - 18.0  | 534          | 40      | $\pm$ 5.0        | $\pm$ 500            | $\pm$ 0.0            | 100                                                    | 78                     | 1.50                            |
| MA612D-12RW(I) | 12            | 9.0 - 18.0  | 609          | 40      | $\pm$ 12.0       | $\pm$ 250            | $\pm$ 0.0            | 100                                                    | 82                     | 1.50                            |
| MA612D-15RW(I) | 12            | 9.0 - 18.0  | 609          | 40      | $\pm$ 15.0       | $\pm$ 200            | $\pm$ 0.0            | 100                                                    | 82                     | 1.50                            |
| MA624S-03RW(I) | 24            | 18.0 - 36.0 | 214          | 20      | 3.3              | 1,200                | 0.0                  | 470                                                    | 77                     | 0.70                            |
| MA624S-05RW(I) | 24            | 18.0 - 36.0 | 313          | 20      | 5.0              | 1,200                | 0.0                  | 470                                                    | 80                     | 0.70                            |
| MA624S-12RW(I) | 24            | 18.0 - 36.0 | 298          | 20      | 12.0             | 500                  | 0.0                  | 100                                                    | 84                     | 0.70                            |
| MA624S-15RW(I) | 24            | 18.0 - 36.0 | 298          | 20      | 15.0             | 400                  | 0.0                  | 100                                                    | 84                     | 0.70                            |
| MA624S-24RW(I) | 24            | 18.0 - 36.0 | 298          | 20      | 24.0             | 250                  | 0.0                  | 47                                                     | 84                     | 0.70                            |
| MA624D-05RW(I) | 24            | 18.0 - 36.0 | 260          | 20      | $\pm$ 5.0        | $\pm$ 500            | $\pm$ 0.0            | 100                                                    | 80                     | 0.70                            |
| MA624D-12RW(I) | 24            | 18.0 - 36.0 | 298          | 20      | $\pm$ 12.0       | $\pm$ 250            | $\pm$ 0.0            | 100                                                    | 84                     | 0.70                            |
| MA624D-15RW(I) | 24            | 18.0 - 36.0 | 298          | 20      | $\pm$ 15.0       | $\pm$ 200            | $\pm$ 0.0            | 100                                                    | 84                     | 0.70                            |
| MA648S-03RW(I) | 48            | 36.0 - 75.0 | 107          | 10      | 3.3              | 1,200                | 0.0                  | 470                                                    | 77                     | 0.35                            |
| MA648S-05RW(I) | 48            | 36.0 - 75.0 | 156          | 10      | 5.0              | 1,200                | 0.0                  | 470                                                    | 80                     | 0.35                            |
| MA648S-12RW(I) | 48            | 36.0 - 75.0 | 149          | 10      | 12.0             | 500                  | 0.0                  | 100                                                    | 84                     | 0.35                            |
| MA648S-15RW(I) | 48            | 36.0 - 75.0 | 149          | 10      | 15.0             | 400                  | 0.0                  | 100                                                    | 84                     | 0.35                            |
| MA648S-24RW(I) | 48            | 36.0 - 75.0 | 149          | 10      | 24.0             | 250                  | 0.0                  | 47                                                     | 84                     | 0.35                            |
| MA648D-05RW(I) | 48            | 36.0 - 75.0 | 130          | 10      | $\pm$ 5.0        | $\pm$ 500            | $\pm$ 0.0            | 100                                                    | 80                     | 0.35                            |
| MA648D-12RW(I) | 48            | 36.0 - 75.0 | 149          | 10      | $\pm$ 12.0       | $\pm$ 250            | $\pm$ 0.0            | 100                                                    | 84                     | 0.35                            |
| MA648D-15RW(I) | 48            | 36.0 - 75.0 | 149          | 10      | $\pm$ 15.0       | $\pm$ 200            | $\pm$ 0.0            | 100                                                    | 84                     | 0.35                            |

**Notes:**

- When measuring output ripple, it is recommended that an external 4.7  $\mu$ F ceramic capacitor be placed in parallel from the +Vout pin to the -Vout pin for single output models, or from each output to common for dual output models.
- Transient recovery is measured to within a 1% error band for a load step change of 25%.
- Output short circuit protection is provided by a Hiccup circuit with auto-recovery.
- Operation at no load will not damage these units, however, they may not meet all specifications.
- The specified maximum capacitive load is for each output.
- 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.



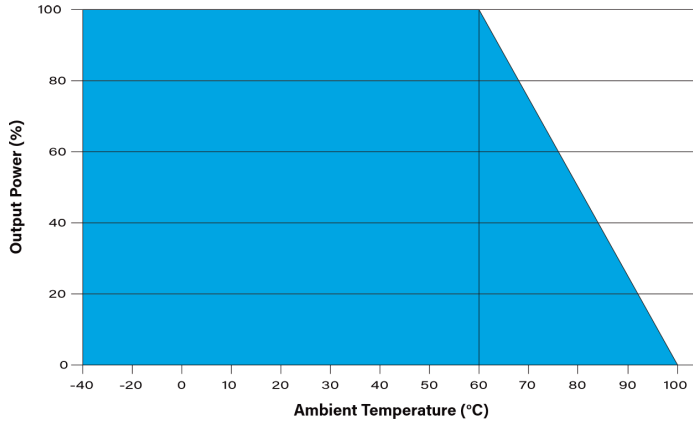
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- UL 62368 Recognition
- Single & Dual Outputs
- Wide Temperature Operation
- Tight Regulation
- Low Cost

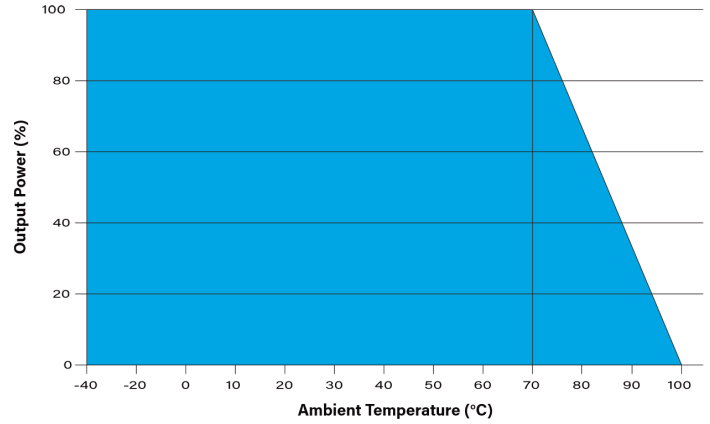
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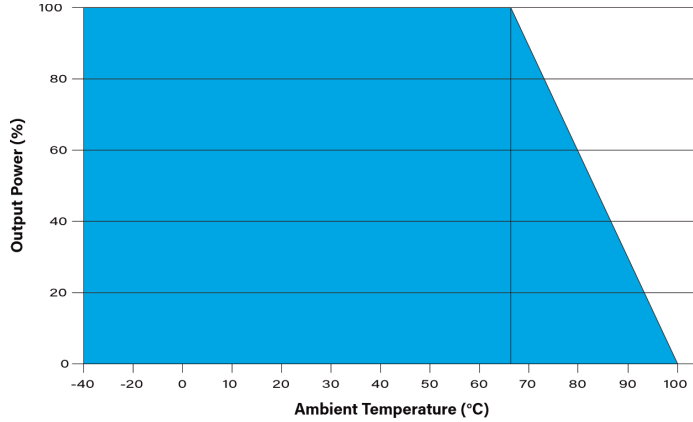
**Temperature Derating 3.3 & 5V Out: 20 LFM**



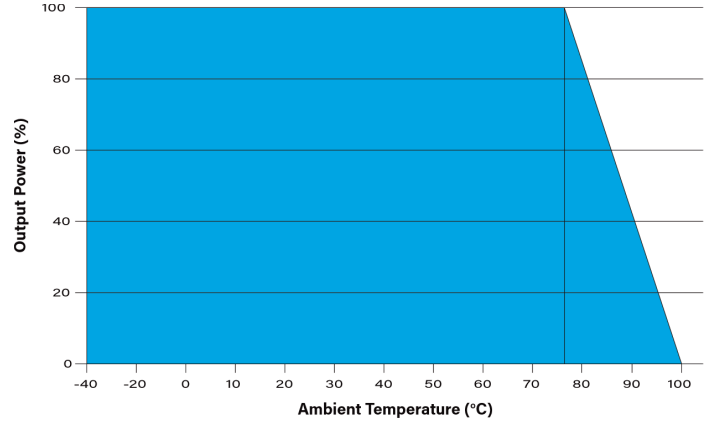
**Temperature Derating Other Out: 20 LFM**



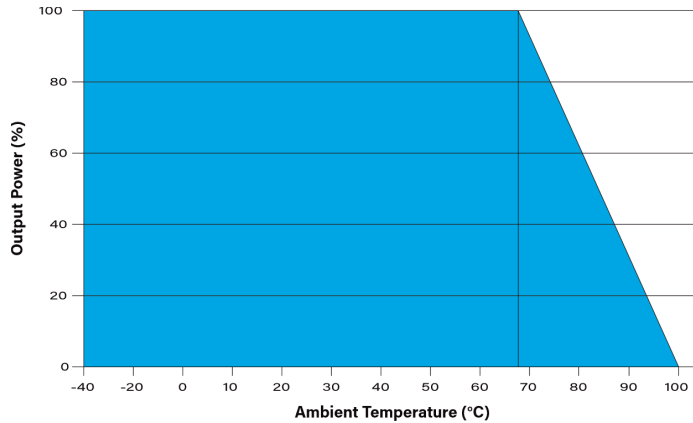
**Temperature Derating 3.3 & 5V Out: 100 LFM**



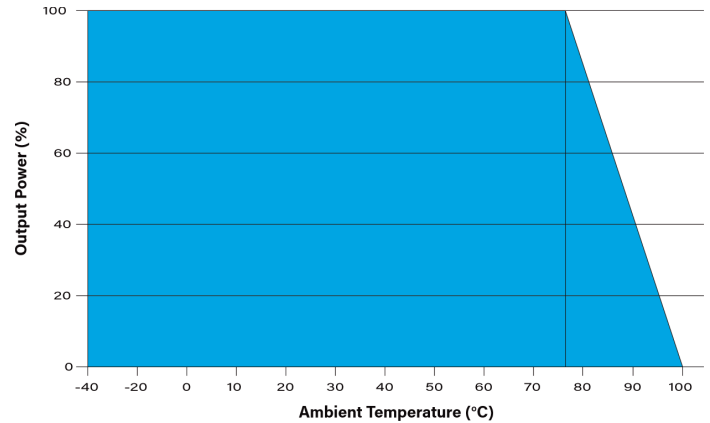
**Temperature Derating Other Out: 100 LFM**



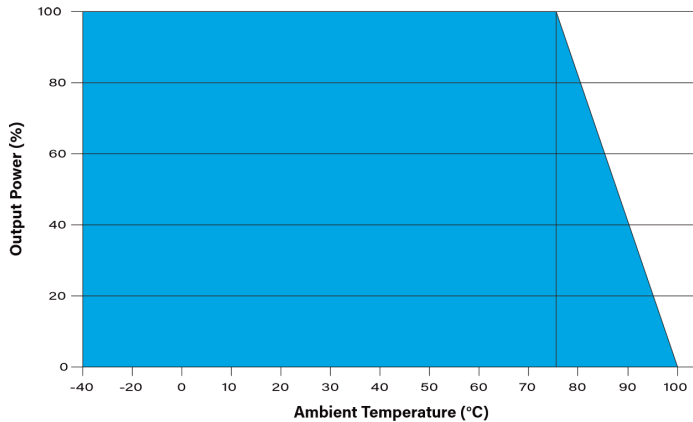
**Temperature Derating 3.3 & 5V Out: 200 LFM**



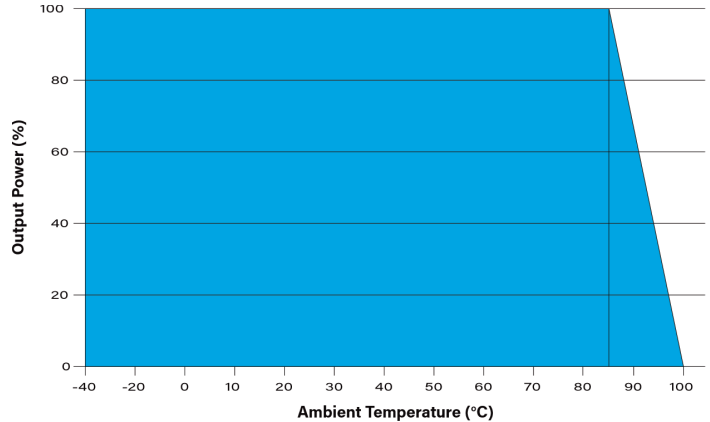
**Temperature Derating Other Out: 200 LFM**



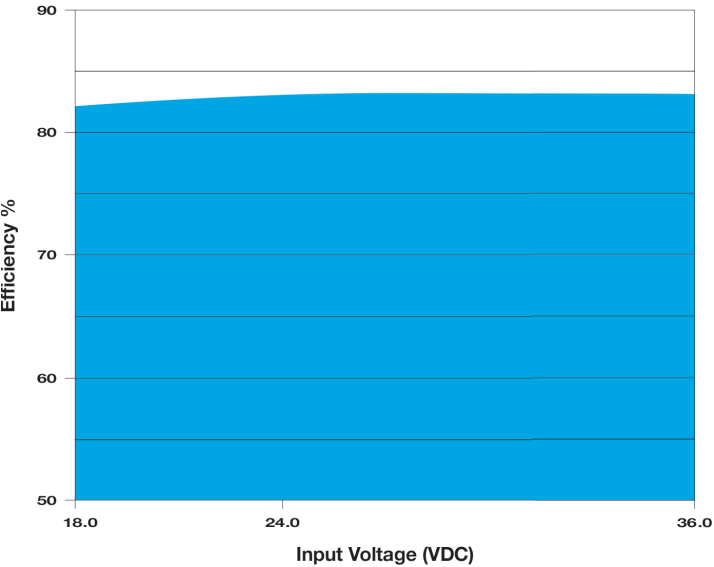
**Temperature Derating 3.3 & 5V Out: 400 LFM**



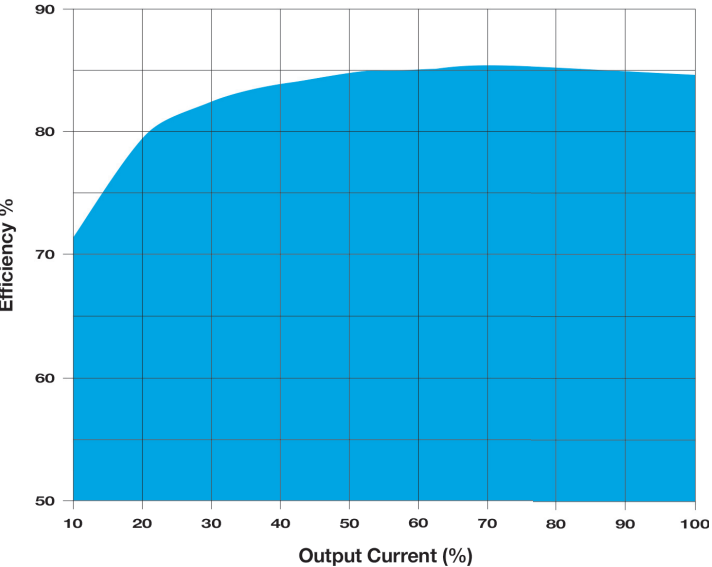
**Temperature Derating Other Out: 400 LFM**



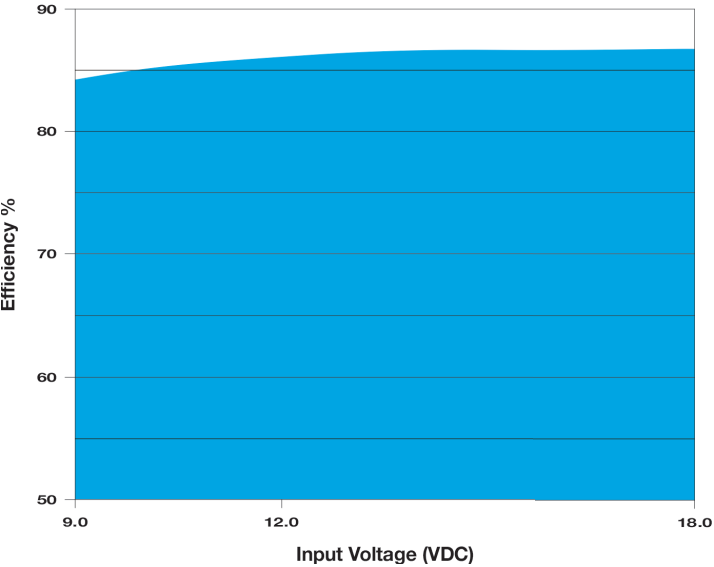
Efficiency vs Input: MA612S-05RW



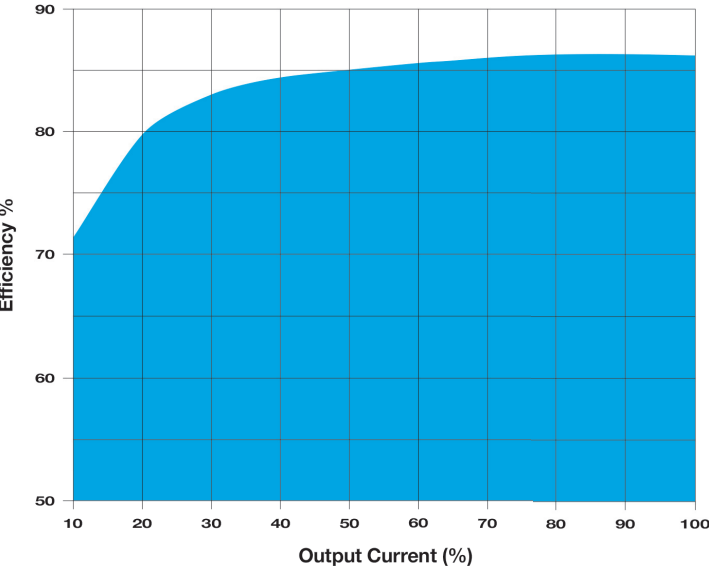
Efficiency vs Output Load: MA612S-05RW



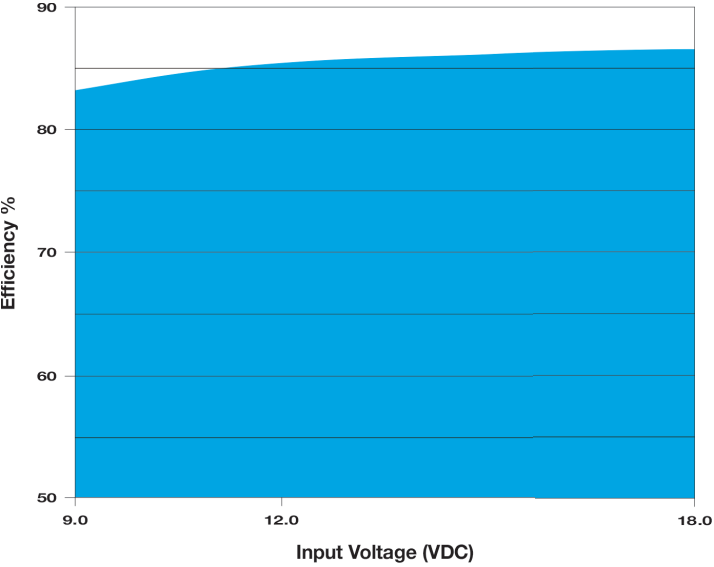
Efficiency vs Input: MA612S-12RW



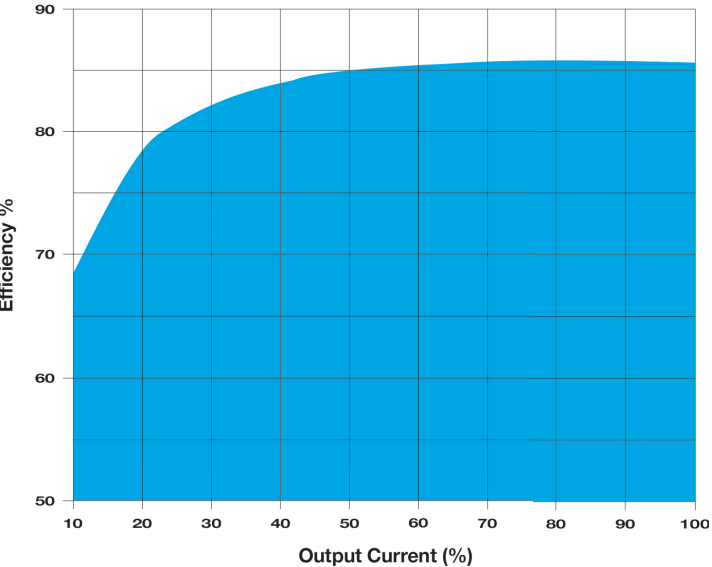
Efficiency vs Output Load: MA612S-12RW



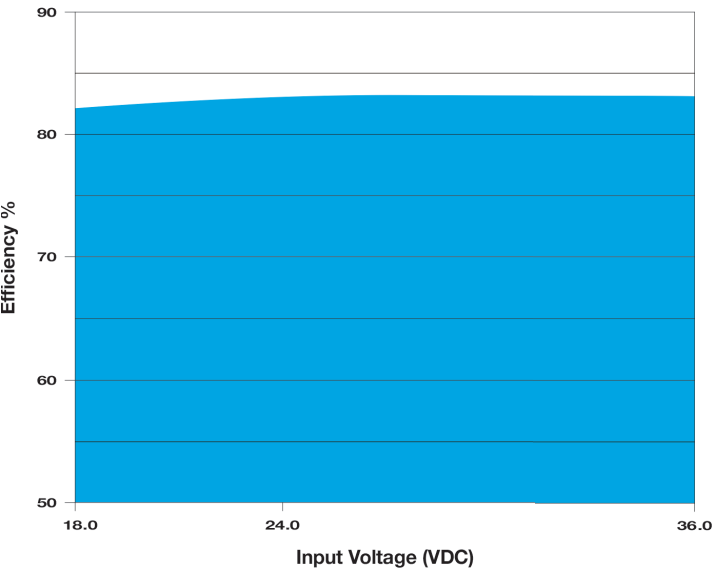
Efficiency vs Input: MA612S-24RW



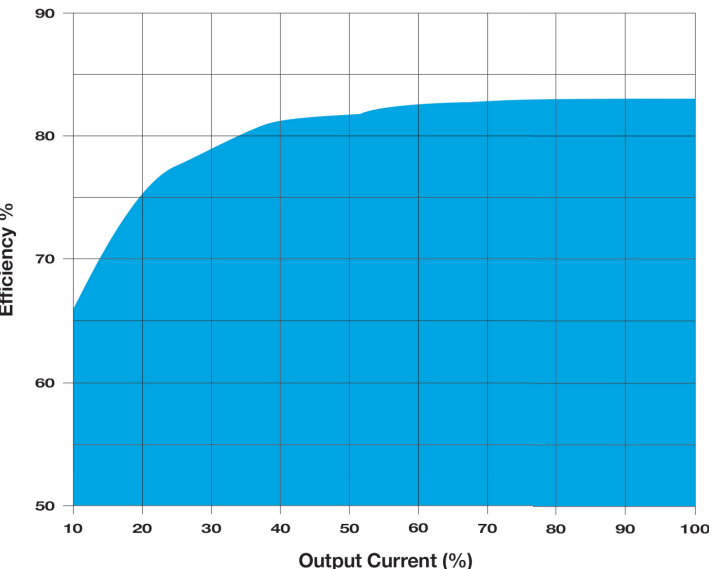
Efficiency vs Output Load: MA612S-24RW



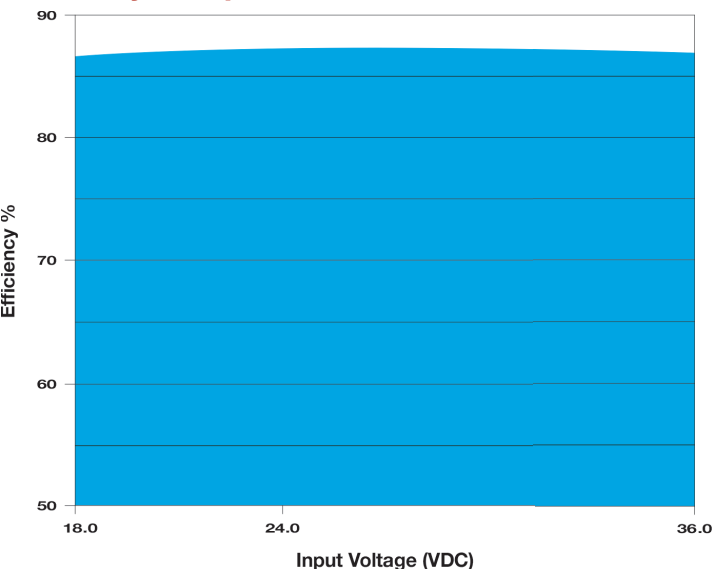
Efficiency vs Input: MA624S-05RW



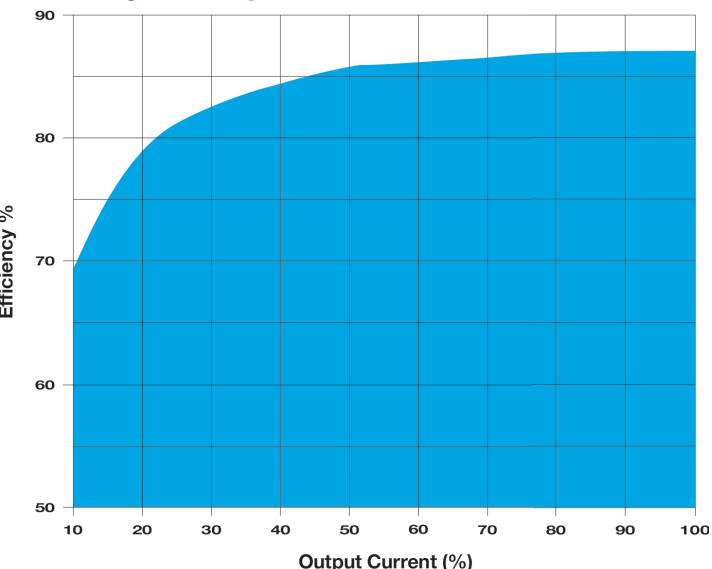
Efficiency vs Output Load: MA624S-05RW



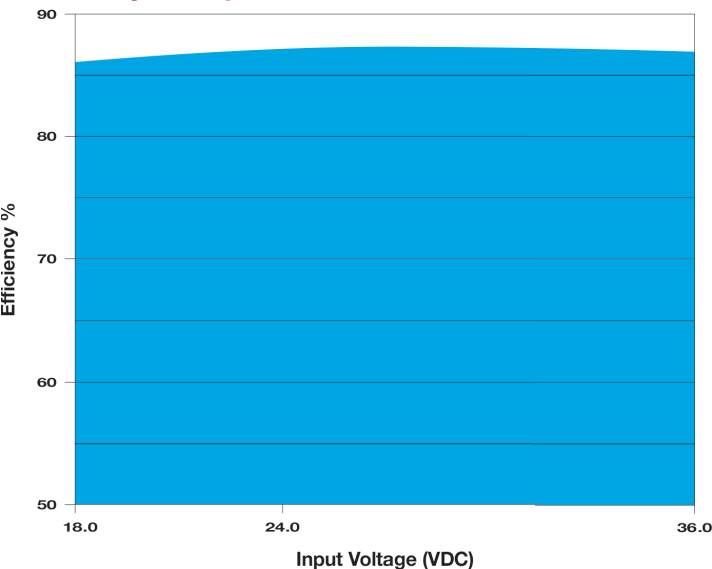
Efficiency vs Input: MA624S-12RW



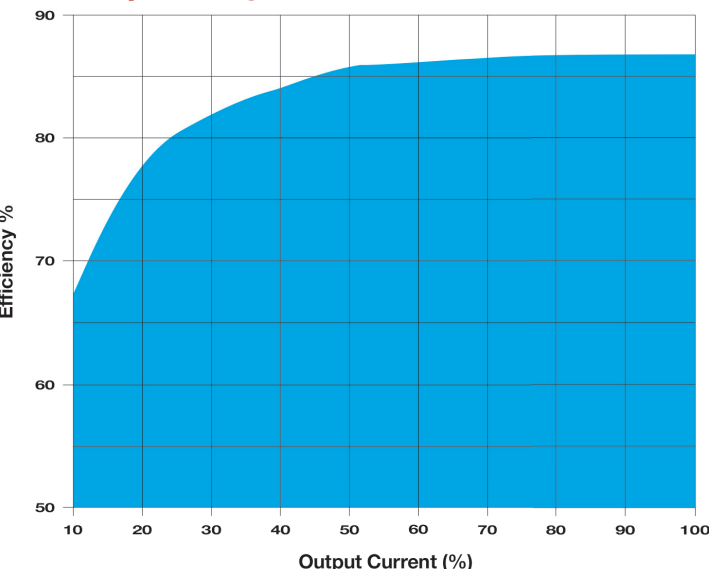
Efficiency vs Output Load: MA624S-12RW



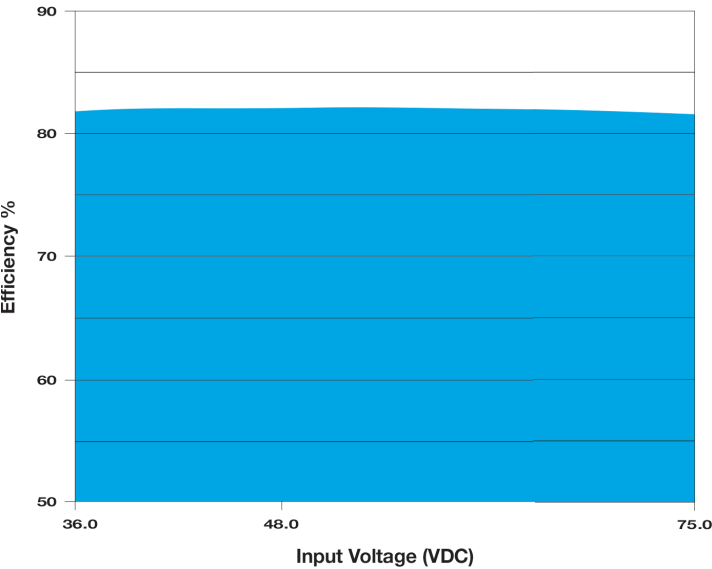
Efficiency vs Input: MA624S-24RW



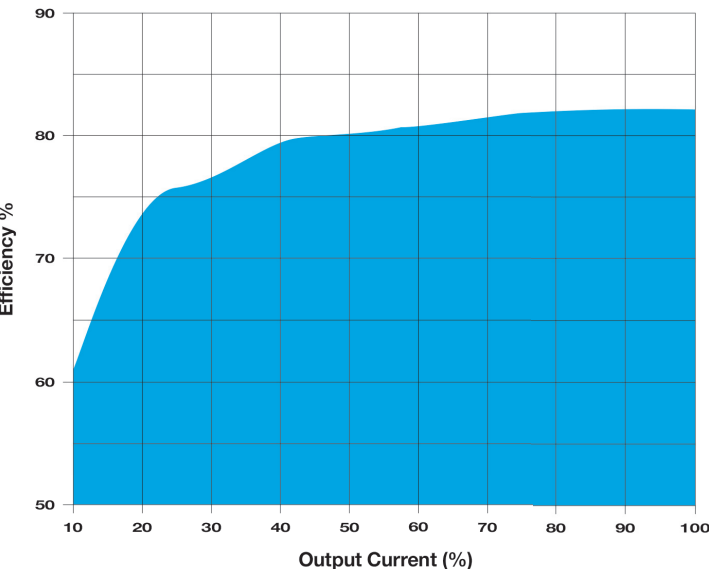
Efficiency vs Output Load: MA624S-24RW



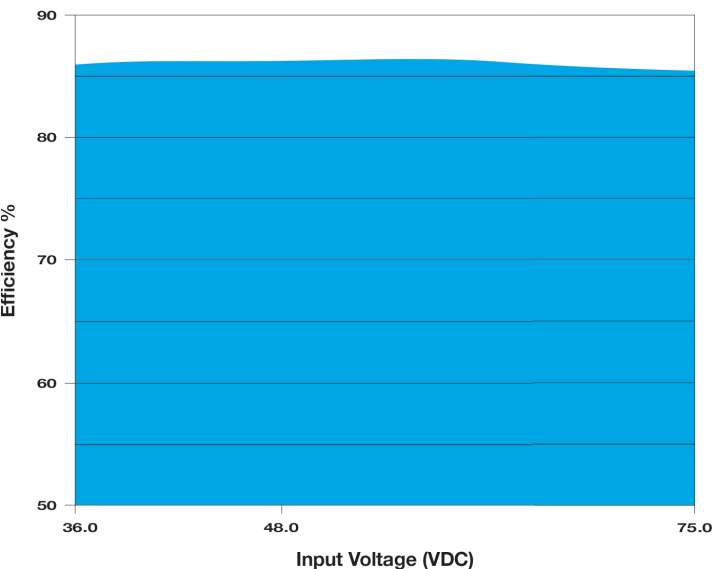
Efficiency vs Input: MA648S-05RW



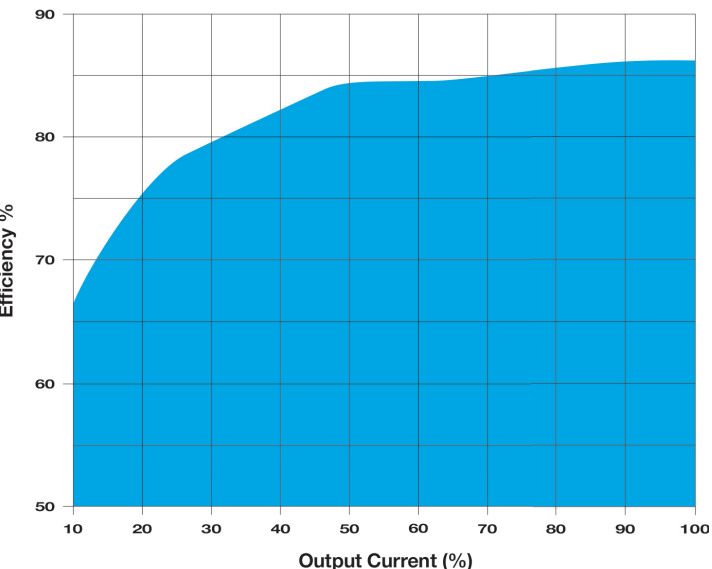
Efficiency vs Output Load: MA648S-05RW



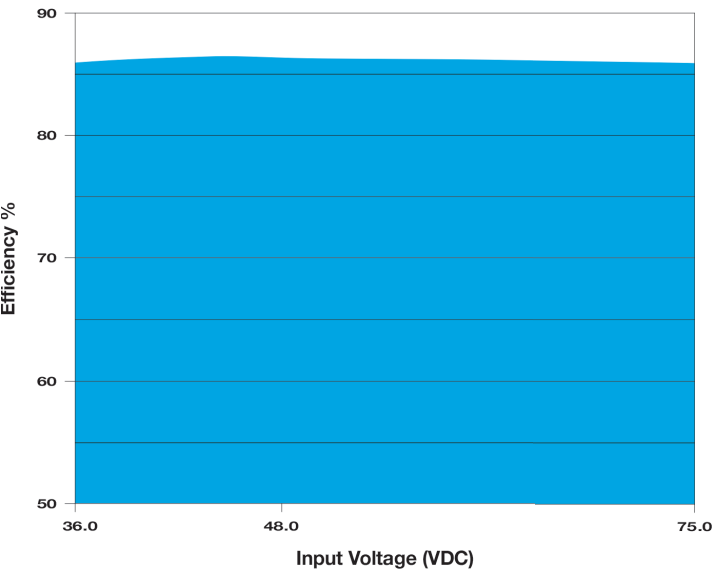
Efficiency vs Input: MA648S-12RW



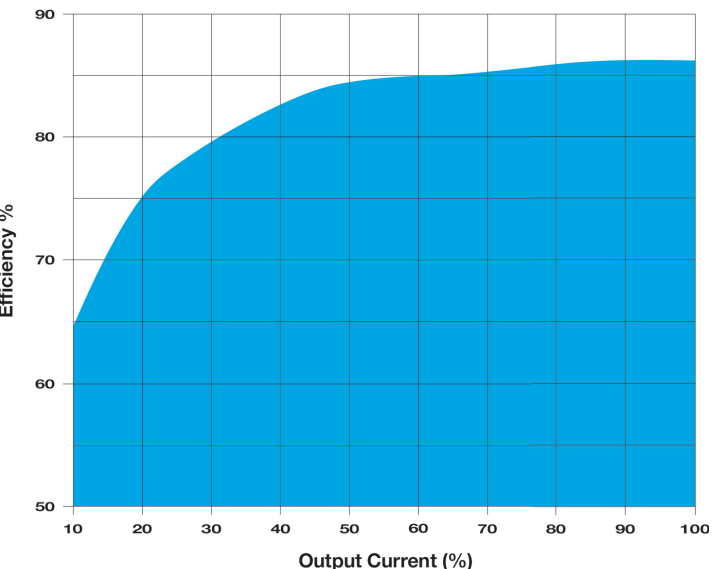
Efficiency vs Output Load: MA648S-12RW



Efficiency vs Input: MA648S-24RW



Efficiency vs Output Load: MA648S-24RW



## Typical Connection: Single Output

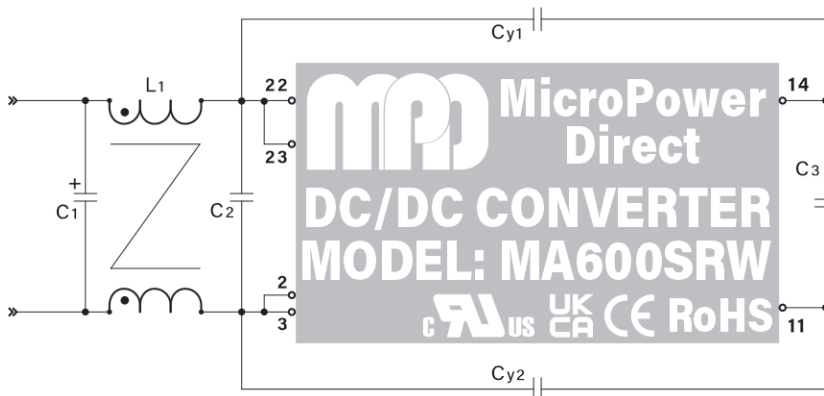
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This diagram illustrates a typical connection of the **MA600DRW**. Capacitors C2, C3 and C4 will reduce input/output ripple and improve the converter stability over time and temperature. The recommended component values are given in the table below.

| Model    | C2               | C3, C4          |
|----------|------------------|-----------------|
| MA612DRW | 3.3 $\mu$ F/50V  | 3.3 $\mu$ F/50V |
| MA624DRW | 2.2 $\mu$ F/50V  | 3.3 $\mu$ F/50V |
| MA648DRW | 2.2 $\mu$ F/100V | 3.3 $\mu$ F/50V |

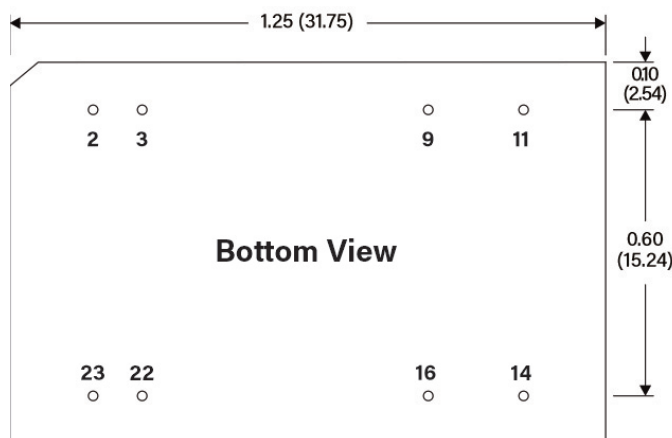
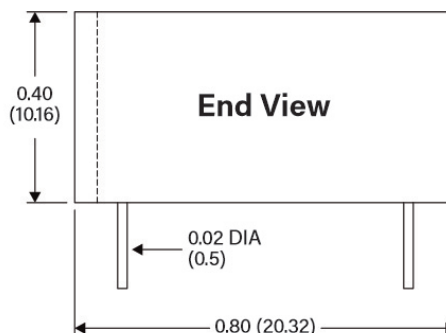
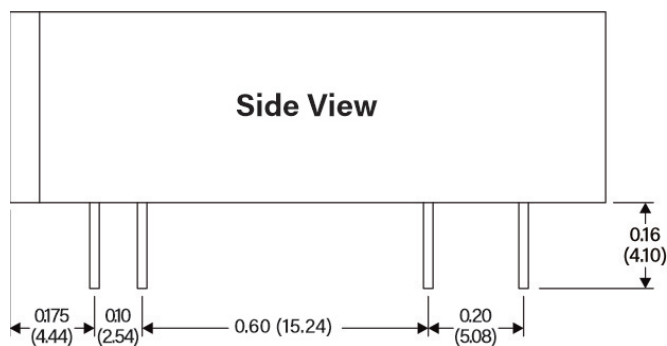
## EMI Connection: Class A, Single Output



| Model    | C1                           | L1                          | CY1, CY2                |
|----------|------------------------------|-----------------------------|-------------------------|
| MA612DRW | 47 $\mu$ F/25V<br>1206 X5R   | 0.175 mH/10A<br>74482210002 | 1500 pF/2kV<br>1206 X7R |
| MA624DRW | 10 $\mu$ F/50V<br>1206 X5R   | 0.175 mH/10A<br>74482210002 | 1500 pF/2kV<br>1206 X7R |
| MA648DRW | 2.2 $\mu$ F/100V<br>1206 X7R | 0.175 mH/10A<br>74482210002 | 1500 pF/2kV<br>1206 X7R |

To meet the requirements of EN 55032 class A with the **MA600SRW**, additional external components are required. The single output connection shown at left illustrates an external circuit (L2, CY1 & CY2) that will typically meet these requirements. Values for C2 and C3 are given in the typical connection notes above.

## Mechanical Dimensions



## Pin Connections

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

NC: No Connection

### Notes:

- All dimensions are typical in inches (mm)
- Pin 1 is marked by a "dot" or indentation on the unit
- General Tolerance =  $\pm 0.01$  ( $\pm 0.25$ )
- Pin Tolerance =  $\pm 0.02$  ( $\pm 0.05$ )
- Recommended pin hole size (on the application PC Board) is  $\varnothing 0.03$  ( $\varnothing 0.80$ )
- Weight (Typ) = 0.45 Oz (12.7g)

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