

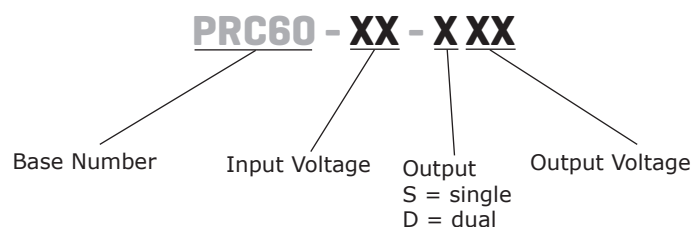
**SERIES: PRC60 | DESCRIPTION: DC-DC CONVERTER**
**FEATURES**

- up to 60 W continuous power
- single and dual regulated outputs
- 4:1 input range, 9~36 Vdc and 18~75 Vdc input voltage options
- certified to EN/IEC 62368-1
- meets EN 50155
- wide operating temperature range (-40 ~ +105°C)
- short circuit, over current, over temperature, and over voltage protection
- remote ON/OFF, output voltage trim


**MODEL**

| MODEL        | input voltage |             | output voltage | output current <sup>1</sup> | output power | ripple & noise <sup>2</sup> | efficiency <sup>3</sup> |
|--------------|---------------|-------------|----------------|-----------------------------|--------------|-----------------------------|-------------------------|
|              | typ (Vdc)     | range (Vdc) | (Vdc)          | max (mA)                    | max (W)      | max (mVp-p)                 | typ (%)                 |
| PRC60-24-S3  | 24            | 9 ~ 36      | 3.3            | 12,000                      | 39.6         | 100                         | 89                      |
| PRC60-24-S5  | 24            | 9 ~ 36      | 5              | 12,000                      | 60           | 100                         | 91                      |
| PRC60-24-S12 | 24            | 9 ~ 36      | 12             | 5,000                       | 60           | 125                         | 91                      |
| PRC60-24-S15 | 24            | 9 ~ 36      | 15             | 4,000                       | 60           | 125                         | 92                      |
| PRC60-24-S24 | 24            | 9 ~ 36      | 24             | 2,500                       | 60           | 200                         | 92                      |
| PRC60-24-D12 | 24            | 9 ~ 36      | ±12            | ±2,500                      | 60           | 125                         | 91                      |
| PRC60-24-D15 | 24            | 9 ~ 36      | ±15            | ±2000                       | 60           | 125                         | 91                      |
| PRC60-24-D24 | 24            | 9 ~ 36      | ±24            | ±1,250                      | 60           | 200                         | 90                      |
| PRC60-48-S3  | 48            | 18 ~ 75     | 3.3            | 12,000                      | 39.6         | 100                         | 89                      |
| PRC60-48-S5  | 48            | 18 ~ 75     | 5              | 12,000                      | 60           | 100                         | 91                      |
| PRC60-48-S12 | 48            | 18 ~ 75     | 12             | 5,000                       | 60           | 125                         | 92                      |
| PRC60-48-S15 | 48            | 18 ~ 75     | 15             | 4,000                       | 60           | 125                         | 92                      |
| PRC60-48-S24 | 48            | 18 ~ 75     | 24             | 2,500                       | 60           | 200                         | 92                      |
| PRC60-48-D12 | 48            | 18 ~ 75     | ±12            | ±2,500                      | 60           | 125                         | 90                      |
| PRC60-48-D15 | 48            | 18 ~ 75     | ±15            | ±2,000                      | 60           | 125                         | 90                      |
| PRC60-48-D24 | 48            | 18 ~ 75     | ±24            | ±1,250                      | 60           | 200                         | 90                      |

Notes: 1. At full load.  
 2. Measured with 20MHz bandwidth and 1μF ceramic capacitor.  
 3. The efficiency is test by nominal input and full load at 25°C.

**PART NUMBER KEY**


## INPUT

| parameter                  | conditions/description                                                                                   | min | typ | max | units |
|----------------------------|----------------------------------------------------------------------------------------------------------|-----|-----|-----|-------|
| operating input voltage    | 24 Vdc input                                                                                             | 9   | 24  | 36  | Vdc   |
|                            | 48 Vdc input                                                                                             | 18  | 48  | 75  | Vdc   |
| surge voltage              | 24 Vdc input                                                                                             |     |     | 50  | Vdc   |
|                            | 48 Vdc input                                                                                             |     |     | 100 | Vdc   |
| input undervoltage lockout | 0% ~ 100% load                                                                                           |     |     |     |       |
|                            | 24 Vdc input                                                                                             |     | 8   |     | Vdc   |
|                            | 48 Vdc input                                                                                             |     | 16  |     | Vdc   |
| no load input current      | at nominal input voltage                                                                                 |     |     | 15  | mA    |
| input filter               | Pi filter                                                                                                |     |     |     |       |
| start-up time              |                                                                                                          |     |     | 50  | ms    |
| start-up voltage           | 0% ~ 100% load                                                                                           |     |     |     |       |
|                            | 24 Vdc input                                                                                             |     |     | 9   | Vdc   |
|                            | 48 Vdc input                                                                                             |     |     | 18  | Vdc   |
| remote ON/OFF              | module on: CTRL pin open or pulled high (3~12 Vdc)<br>module off: CTRL pin pulled low to GND (0~1.2 Vdc) |     |     |     |       |

## OUTPUT

| parameter               | conditions/description                         | min | typ   | max    | units |
|-------------------------|------------------------------------------------|-----|-------|--------|-------|
| maximum capacitive load | 3.3 & 5 Vdc output                             |     |       | 28,000 | μF    |
|                         | 12 Vdc output                                  |     |       | 5,850  | μF    |
|                         | 15 Vdc output                                  |     |       | 3,900  | μF    |
|                         | 24 Vdc output                                  |     |       | 2,000  | μF    |
|                         | ±12 Vdc output                                 |     |       | ±3,900 | μF    |
|                         | ±15 Vdc output                                 |     |       | ±2,400 | μF    |
|                         | ±24 Vdc output                                 |     |       | ±1,000 | μF    |
| voltage accuracy        | at full load, nominal input                    |     | ±1    |        | %     |
| voltage adjustability   |                                                |     | ±10   |        | %     |
| line regulation         | low line to high line at full load             |     |       |        |       |
|                         | single output                                  |     | ±0.2  |        | %     |
|                         | dual output                                    |     | ±0.5  |        | %     |
| load regulation         | 0% ~ 100% load                                 |     |       |        |       |
|                         | single output                                  |     | ±0.5  |        | %     |
|                         | dual output                                    |     | ±1    |        | %     |
| cross regulation        | asymmetrical load 25%/100%, dual output models |     | ±5    |        | %     |
| operating frequency     | at full load, nominal input                    |     | 250   |        | kHz   |
| transient recovery time | 75% to 100% load step change                   |     | 500   |        | μs    |
| temperature coefficient |                                                |     | ±0.05 |        | %/°C  |

## PROTECTIONS

| parameter                   | conditions/description    | min   | typ | max   | units |
|-----------------------------|---------------------------|-------|-----|-------|-------|
| over voltage protection     | zener diode clamp         |       |     |       |       |
|                             | 3.3 Vdc output            | 3.7   |     | 5.3   | Vdc   |
|                             | 5 Vdc output              | 5.6   |     | 8.0   | Vdc   |
|                             | 12 Vdc output             | 13.4  |     | 19.2  | Vdc   |
|                             | 15 Vdc output             | 16.8  |     | 24.0  | Vdc   |
|                             | 24 Vdc output             | 26.9  |     | 38.4  | Vdc   |
|                             | ±12 Vdc output            | ±13.4 |     | ±19.2 | Vdc   |
|                             | ±15 Vdc output            | ±16.8 |     | ±24.0 | Vdc   |
|                             | ±24 Vdc output            | ±26.9 |     | ±38.4 | Vdc   |
| over current protection     |                           |       | 175 |       | %     |
| short circuit protection    | continuous, auto recovery |       |     |       |       |
| over temperature protection |                           |       |     | 115   | °C    |

## SAFETY AND COMPLIANCE (CONTINUED)

| parameter                   | conditions/description                                              | min   | typ     | max | units |
|-----------------------------|---------------------------------------------------------------------|-------|---------|-----|-------|
| isolation voltage           | input to output, for 1 minute                                       | 1,600 |         |     | Vdc   |
| isolation resistance        | at 500 Vdc                                                          | 1,000 |         |     | MΩ    |
| isolation capacitance       |                                                                     |       | 1,500   |     | pF    |
| safety approvals            | certified to 62368-1: EN, BS EN                                     |       |         |     |       |
| EMI                         | EN 55032 Class A, Class B (external circuit required, see Figure 3) |       |         |     |       |
| ESD                         | EN 61000-4-2, Air ± 8kV, Contact ± 6kV, perf. Criteria A            |       |         |     |       |
| fast transient <sup>4</sup> | EN 61000-4-4, ±2kV, perf. Criteria A                                |       |         |     |       |
| surge <sup>4</sup>          | EN 61000-4-5, ±2kV, perf. Criteria A                                |       |         |     |       |
| conducted immunity          | EN 61000-4-6, 10 Vrms, perf. Criteria A                             |       |         |     |       |
| magnetic field immunity     | EN 61000-4-8, 10 A/m, perf. Criteria A                              |       |         |     |       |
| MTBF                        | at 25°C                                                             |       | 205,000 |     | hours |
| RoHS                        | yes                                                                 |       |         |     |       |

Notes: 4. External 680μF/100V capacitor required.

## ENVIRONMENTAL

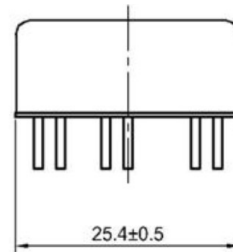
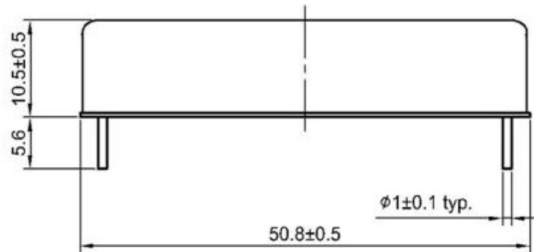
| parameter             | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curve     | -40 |     | 105 | °C    |
| storage temperature   |                        | -55 |     | 125 | °C    |
| humidity              | non-condensing         | 5   |     | 95  | %     |
| max. case temperature |                        |     |     | 110 | °C    |

## MECHANICAL

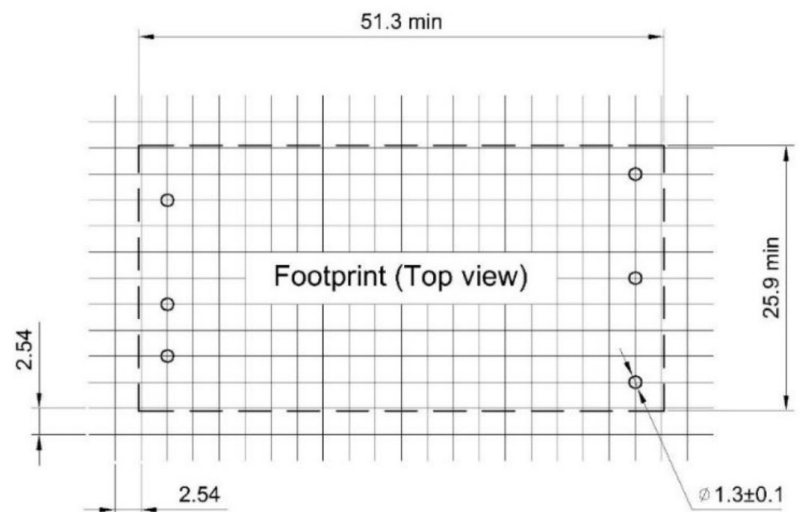
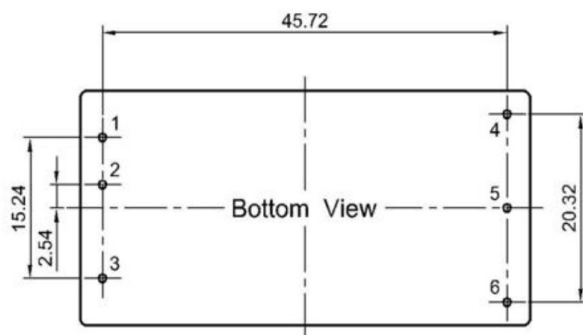
| parameter        | conditions/description | min | typ  | max | units |
|------------------|------------------------|-----|------|-----|-------|
| dimensions       | 50.80 x 25.40 x 10.50  |     |      |     | mm    |
| weight           |                        |     | 37.6 |     | g     |
| case material    | metal case             |     |      |     |       |
| potting material | silicone (UL94V-0)     |     |      |     |       |
| cooling method   | natural convection     |     |      |     |       |

## MECHANICAL DRAWING

units: inch [mm]  
general tolerance:  $\pm 0.35\text{mm}$

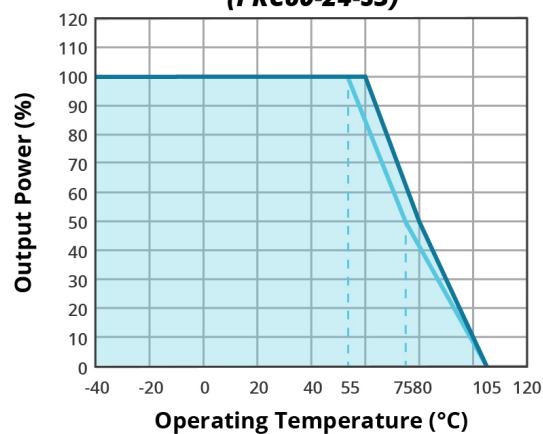


| Pin Out |                |              |
|---------|----------------|--------------|
| PIN     | Single outputs | Dual outputs |
| 1       | +Vin           | +Vin         |
| 2       | -Vin           | -Vin         |
| 3       | CTRL           | CTRL         |
| 4       | +Vout          | +Vout        |
| 5       | -Vout          | 0V           |
| 6       | Trim           | -Vout        |



## DERATING CURVES

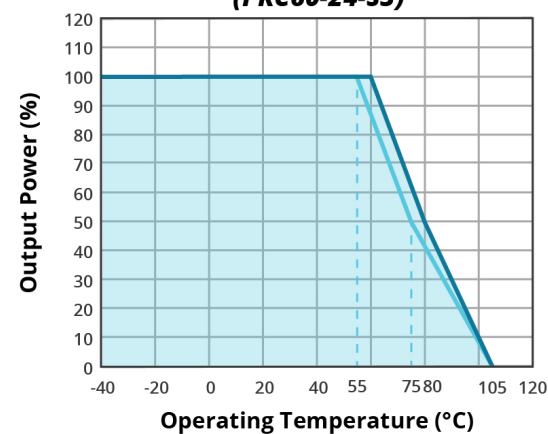
**TEMPERATURE DERATING CURVE  
(PRC60-24-S3)**



### Key

— with test board  
- - - without test board

**TEMPERATURE DERATING CURVE  
(PRC60-24-S5)**

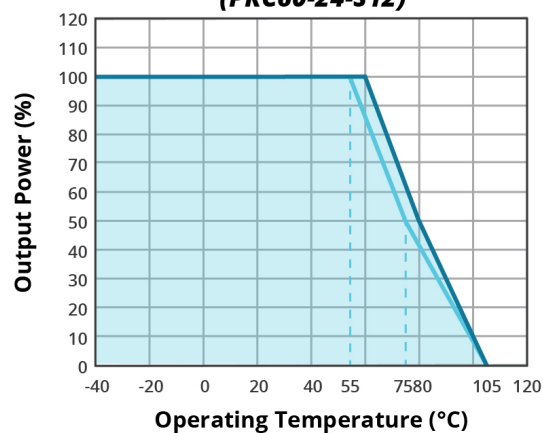


### Key

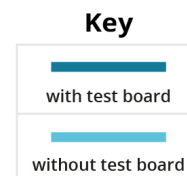
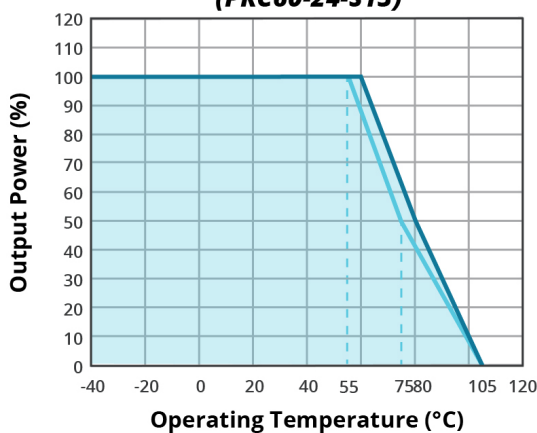
— with test board  
- - - without test board

## DERATING CURVES (CONTINUED)

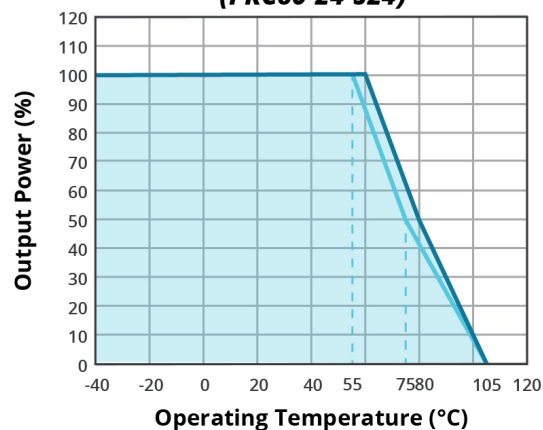
**TEMPERATURE DERATING CURVE  
(PRC60-24-S12)**



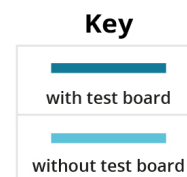
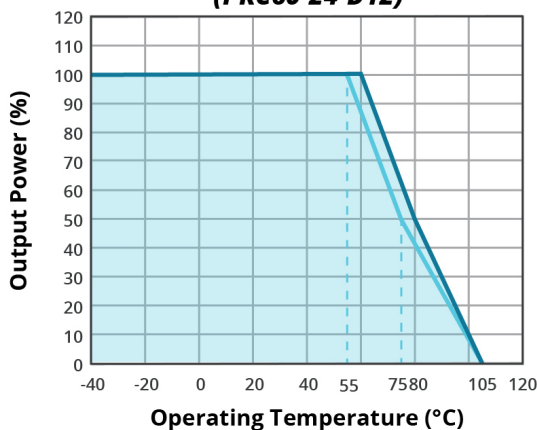
**TEMPERATURE DERATING CURVE  
(PRC60-24-S15)**



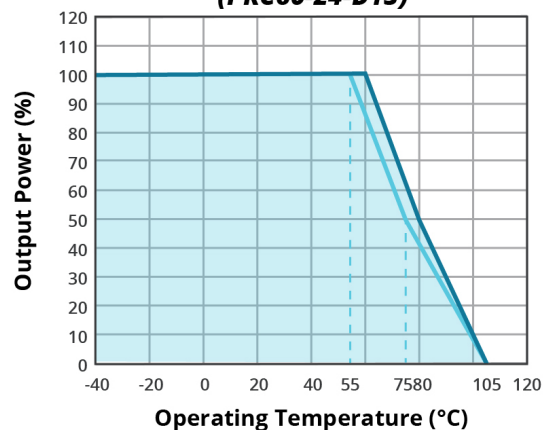
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(PRC60-24-S24)**



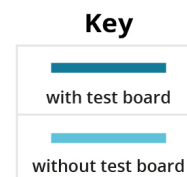
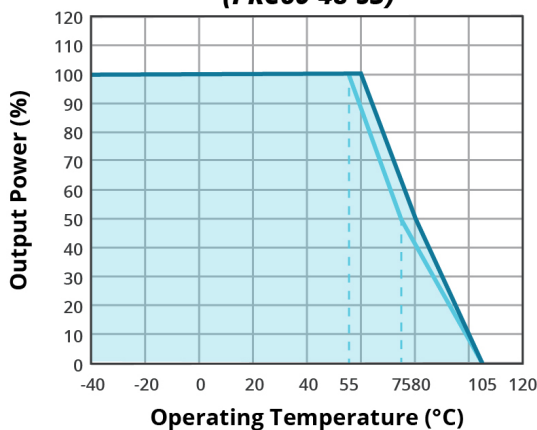
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(PRC60-24-D12)**

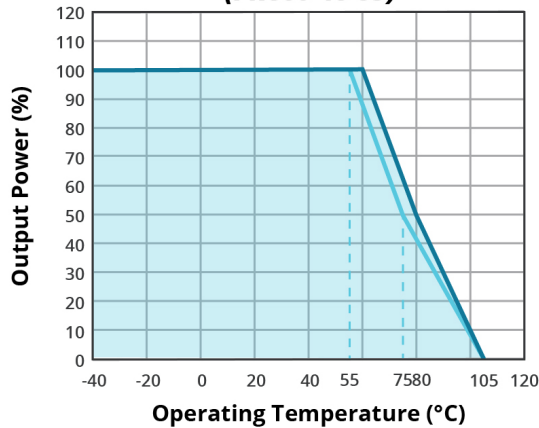


**TEMPERATURE DERATING CURVE  
(PRC60-24-D15)**



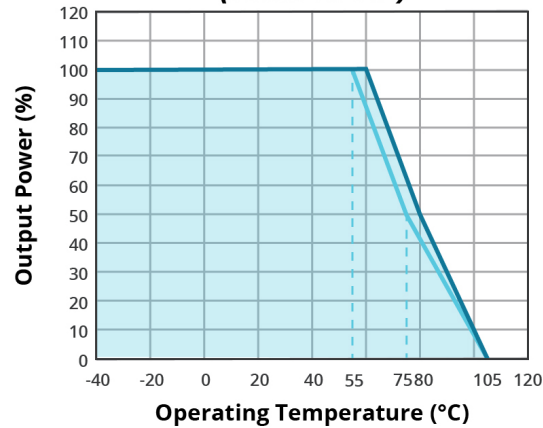
**TEMPERATURE DERATING CURVE  
(PRC60-48-S3)**



**DERATING CURVES (CONTINUED)****TEMPERATURE DERATING CURVE  
(PRC60-48-S5)****Key**

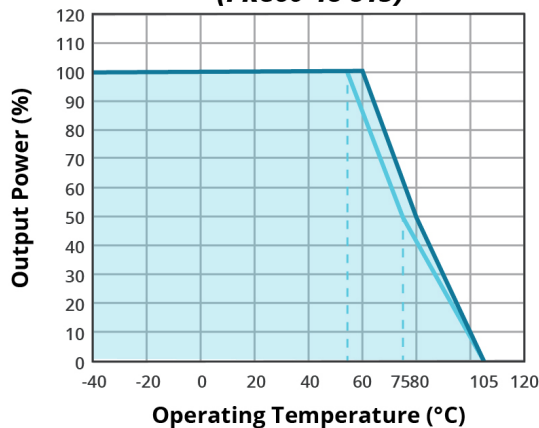
with test board

without test board

**TEMPERATURE DERATING CURVE  
(PRC60-24-S12)****Key**

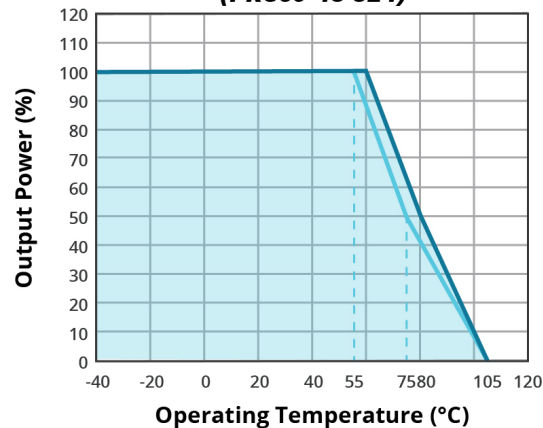
with test board

without test board

**TEMPERATURE DERATING CURVE  
(PRC60-48-S15)****Key**

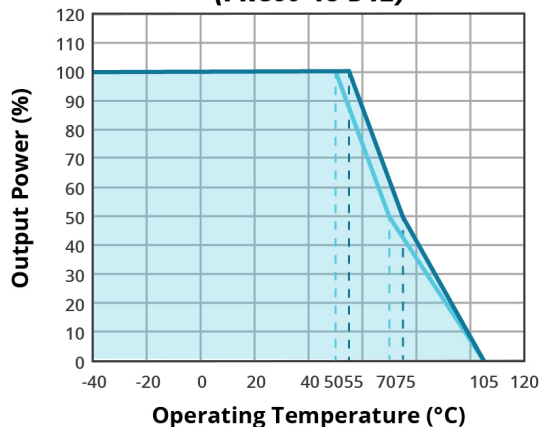
with test board

without test board

**TEMPERATURE DERATING CURVE  
(PRC60-48-S24)****Key**

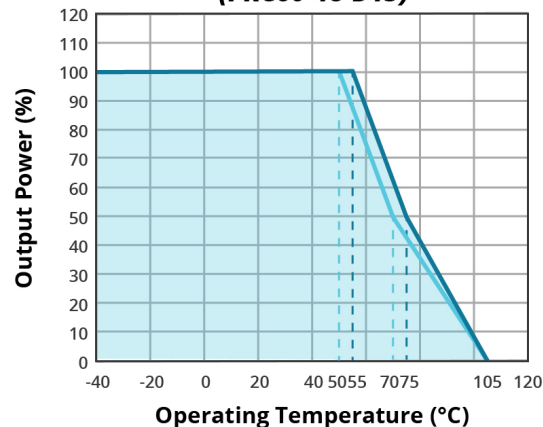
with test board

without test board

**TEMPERATURE DERATING CURVE  
(PRC60-48-D12)****Key**

with test board

without test board

**TEMPERATURE DERATING CURVE  
(PRC60-48-D15)****Key**

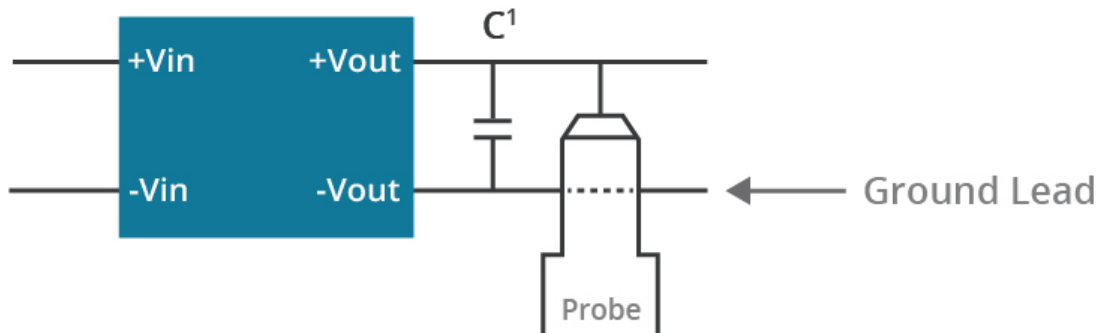
with test board

without test board

Note: The derating curve was measured at nominal  $V_{in}$  in chamber with nature convection.  
The derating curve was measured with nominal line. Mounted test board 90 x 80 mm and each power pin with 43 x 40 mm, 2oz double layer.

## RIPPLE AND NOISE MEASURE METHOD

Figure 1



Note: 1. Measured with 20MHz bandwidth, input voltage range 0~100%, and 1 $\mu$ F ceramic capacitor.

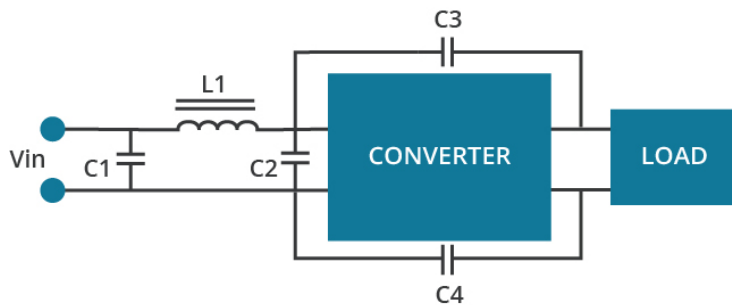
## EMI RECOMMENDED CIRCUIT

Figure 2  
EN55032 CLASS A



Figure 3

Single output  
EN55032 CLASS B



Dual output  
EN55032 CLASS B

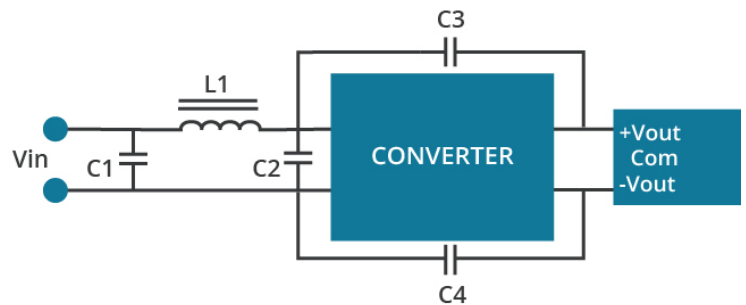


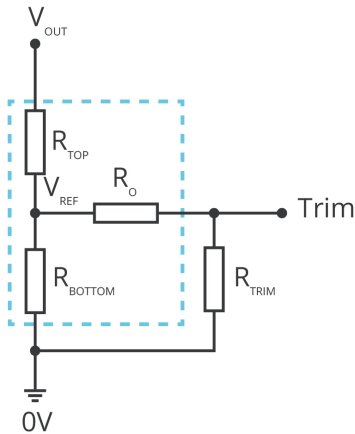
Table 2

| Vin | C1          | L1          | C2          | C3     | C4     |
|-----|-------------|-------------|-------------|--------|--------|
| 24V | 10 $\mu$ F  | 1.5 $\mu$ H | 10 $\mu$ F  | 2200pF | 2200pF |
| 48V | 4.7 $\mu$ F | 3.3 $\mu$ H | 4.7 $\mu$ F | 2200pF | 2200pF |

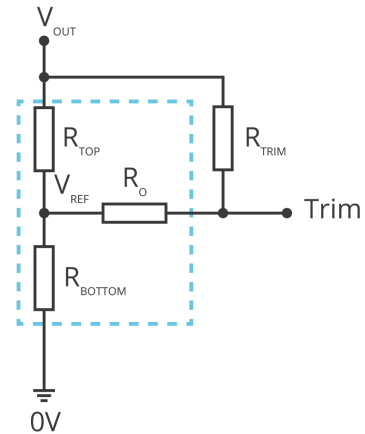
## APPLICATION NOTES

Figure 4

Trim up



Trim down



$$R_{\text{TRIM}} = \frac{a \cdot R_{\text{BOTTOM}}}{R_{\text{BOTTOM}} - a} - R_O \quad a = \frac{V_{\text{REF}}}{V_{\text{OUT}} - V_{\text{REF}}} \cdot R_{\text{TOP}}$$

Formula for Trim up

$$R_{\text{TRIM}} = \frac{a \cdot R_{\text{TOP}}}{R_{\text{TOP}} - a} - R_O \quad a = \frac{V_{\text{OUT}} - V_{\text{REF}}}{V_{\text{REF}}} \cdot R_{\text{BOTTOM}}$$

Formula for Trim down

Table 3

| $V_{\text{IN}}$ | $V_{\text{NOM}}$ | $R_{\text{TOP}}$ | $R_{\text{BOTTOM}}$ | $R_O$ | $V_{\text{REF}}$ |
|-----------------|------------------|------------------|---------------------|-------|------------------|
| (Vdc)           | (Vdc)            | (kΩ)             | (kΩ)                | (kΩ)  | (V)              |
| 24              | 3.3              | 8.5              | 5.1                 | 27.0  | 1.24             |
| 24              | 5                | 10.0             | 10.0                | 35.7  | 2.50             |
| 24              | 12               | 38.0             | 10.0                | 68.0  | 2.50             |
| 24              | 15               | 50.0             | 10.0                | 73.2  | 2.50             |
| 24              | 24               | 86.0             | 10.0                | 75.0  | 2.50             |
| 48              | 3.3              | 8.5              | 5.1                 | 27.0  | 1.24             |
| 48              | 5                | 15.47            | 5.1                 | 33.0  | 1.24             |
| 48              | 12               | 38.0             | 10.0                | 68.0  | 2.50             |
| 48              | 15               | 50.0             | 10.0                | 73.2  | 2.50             |
| 48              | 24               | 86.0             | 10.0                | 75.0  | 2.50             |

Note: Value for  $R_{\text{TOP}}$ ,  $R_{\text{BOTTOM}}$ ,  $R_O$ , and  $V_{\text{REF}}$  refer to Table 3 (fixed internal values). $R_{\text{TRIM}}$ : Trim resistance

a: User-defined parameter, no actual meanings

 $V_{\text{NOM}}$ : Nominal output voltage $V_{\text{OUT}}$ : Target output voltage



## REVISION HISTORY

| rev. | description     | date       |
|------|-----------------|------------|
| 1.0  | initial release | 06/15/2023 |

The revision history provided is for informational purposes only and is believed to be accurate.



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