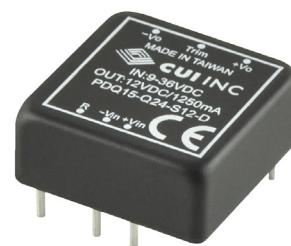


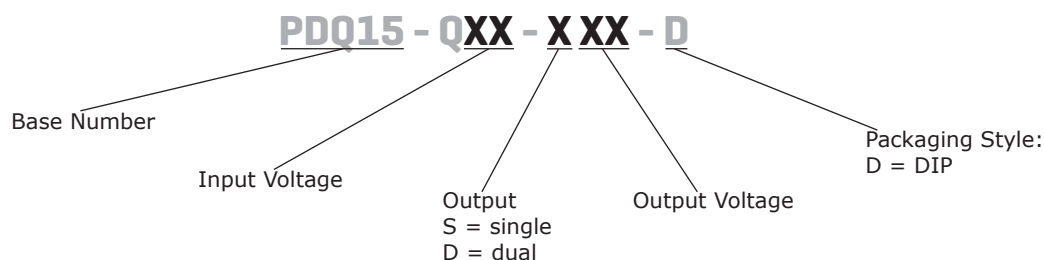
**SERIES:** PDQ15-D | **DESCRIPTION:** DC-DC CONVERTER**FEATURES**

- up to 15 W isolated output
- industry standard 1" x 1" package
- 4:1 input range
- single/dual regulated output
- over voltage, input under voltage lockout, and short circuit protections
- 1,500 Vdc isolation voltage
- five-sided shielded case
- remote on/off control
- output trim
- -40 to 105°C temperature range
- efficiency up to 88%

**MODEL**

|                 | input voltage |             | output voltage | output current |         | output power | ripple & noise <sup>1</sup> | efficiency |
|-----------------|---------------|-------------|----------------|----------------|---------|--------------|-----------------------------|------------|
|                 | typ (Vdc)     | range (Vdc) |                | min (A)        | max (A) | max (W)      | max (mVp-p)                 | typ (%)    |
| PDQ15-Q24-S3-D  | 24            | 9~36        | 3.3            | 0              | 4.0     | 13.2         | 75                          | 87         |
| PDQ15-Q24-S5-D  | 24            | 9~36        | 5              | 0              | 3.0     | 15           | 75                          | 87         |
| PDQ15-Q24-S12-D | 24            | 9~36        | 12             | 0              | 1.25    | 15           | 100                         | 87         |
| PDQ15-Q24-S15-D | 24            | 9~36        | 15             | 0              | 1.0     | 15           | 100                         | 88         |
| PDQ15-Q24-D5-D  | 24            | 9~36        | ±5             | 0              | ±1.5    | 15           | 75                          | 85         |
| PDQ15-Q24-D12-D | 24            | 9~36        | ±12            | 0              | ±0.625  | 15           | 100                         | 87         |
| PDQ15-Q24-D15-D | 24            | 9~36        | ±15            | 0              | ±0.500  | 15           | 100                         | 88         |
| PDQ15-Q48-S3-D  | 48            | 18~75       | 3.3            | 0              | 4.0     | 13.2         | 75                          | 88         |
| PDQ15-Q48-S5-D  | 48            | 18~75       | 5              | 0              | 3.0     | 15           | 75                          | 88         |
| PDQ15-Q48-S12-D | 48            | 18~75       | 12             | 0              | 1.25    | 15           | 100                         | 87         |
| PDQ15-Q48-S15-D | 48            | 18~75       | 15             | 0              | 1.0     | 15           | 100                         | 87         |
| PDQ15-Q48-D5-D  | 48            | 18~75       | ±5             | 0              | ±1.5    | 15           | 75                          | 85         |
| PDQ15-Q48-D12-D | 48            | 18~75       | ±12            | 0              | ±0.625  | 15           | 100                         | 87         |
| PDQ15-Q48-D15-D | 48            | 18~75       | ±15            | 0              | ±0.500  | 15           | 100                         | 87         |

Notes: 1. At full load, nominal input, 20 MHz bandwidth oscilloscope, with 10  $\mu$ F tantalum and 1  $\mu$ F ceramic capacitors on the output.  
 2. All specifications are measured at Ta=25°C, nominal input voltage, and rated output load unless otherwise specified.

**PART NUMBER KEY**

## INPUT

| parameter                         | conditions/description                                       | min | typ | max | units |
|-----------------------------------|--------------------------------------------------------------|-----|-----|-----|-------|
| operating input voltage           | 24 Vdc input models                                          | 9   | 24  | 36  | Vdc   |
|                                   | 48 Vdc input models                                          | 18  | 48  | 75  | Vdc   |
| surge voltage                     | for maximum of 100 ms                                        |     |     |     |       |
|                                   | 24 Vdc input models                                          |     |     | 50  | Vdc   |
|                                   | 48 Vdc input models                                          |     |     | 100 | Vdc   |
| current                           | 24 Vdc input models                                          |     |     | 2.1 | A     |
|                                   | 48 Vdc input models                                          |     |     | 1.0 | A     |
| under voltage shutdown            | 24 Vdc input models, power up                                |     | 8.8 |     | Vdc   |
|                                   | 24 Vdc input models, power down                              |     | 8.0 |     | Vdc   |
|                                   | 48 Vdc input models, power up                                |     | 17  |     | Vdc   |
|                                   | 48 Vdc input models, power down                              |     | 16  |     | Vdc   |
| remote on/off <sup>1</sup>        | turn on (3.5~75 Vdc or open circuit)<br>turn off (<1.2 Vdc)  |     |     |     |       |
| filter                            | LC type                                                      |     |     |     |       |
| input reverse polarity protection | no                                                           |     |     |     |       |
| input fuse                        | 4 A time delay fuse for 24 Vdc input models<br>(recommended) |     |     |     |       |
|                                   | 2 A time delay fuse for 48 Vdc input models<br>(recommended) |     |     |     |       |

Notes: 1. CMOS or open collector TTL, reference to -Vin.

## OUTPUT

| parameter                               | conditions/description                             | min | typ   | max   | units |
|-----------------------------------------|----------------------------------------------------|-----|-------|-------|-------|
| maximum capacitive load                 | 3.3 Vdc output models                              |     |       | 4,000 | μF    |
|                                         | 5 Vdc output models                                |     |       | 3,000 | μF    |
|                                         | 12 Vdc output models                               |     |       | 1,250 | μF    |
|                                         | 15 Vdc output models                               |     |       | 1,000 | μF    |
|                                         | ±5 Vdc output models                               |     |       | 1,500 | μF    |
|                                         | ±12 Vdc output models                              |     |       | 625   | μF    |
|                                         | ±15 Vdc output models                              |     |       | 470   | μF    |
| voltage accuracy                        |                                                    |     |       | ±1.5  | %     |
| line regulation                         | from high line to low line                         |     |       |       |       |
|                                         | single output models                               |     |       | ±0.2  | %     |
|                                         | dual output models                                 |     |       | ±0.5  | %     |
| load regulation                         | from 100% load to minimum load                     |     |       |       |       |
|                                         | single output models                               |     |       | ±0.2  | %     |
|                                         | dual output models                                 |     |       | ±1.0  | %     |
| voltage balance                         | dual output models                                 |     |       | ±2.0  | %     |
| cross regulation                        | load cross variation 10%/100% (dual output models) |     |       | ±5    | %     |
| turn-on delay time, from input          | from Vin, min to 10% Vo                            |     | 10    |       | ms    |
| turn-on delay time, from on/off control | from Von/off to 10% Vo                             |     | 10    |       | ms    |
| rise time                               | from 10% Vo to 90% Vo                              |     | 10    |       | ms    |
| adjustability <sup>2</sup>              | see application notes                              |     | ±10   |       | %     |
| switching frequency                     |                                                    |     | 400   |       | kHz   |
| dynamic load response                   | 75%-100% step load change                          |     |       |       |       |
|                                         | error band (Vout)                                  |     | 5     |       | %     |
|                                         | recovery time                                      |     | 250   |       | μs    |
| temperature coefficient                 |                                                    |     | ±0.03 |       | %/°C  |

Note: 2. For single output models only.

## PROTECTIONS

| parameter                | conditions/description                 | min | typ | max | units |
|--------------------------|----------------------------------------|-----|-----|-----|-------|
| over voltage protection  | zener or TVS clamp                     |     |     |     |       |
|                          | 3.3 Vdc output models                  |     | 3.9 |     | Vdc   |
|                          | 5 Vdc output models (single and dual)  |     | 6.2 |     | Vdc   |
|                          | 12 Vdc output models (single and dual) |     | 15  |     | Vdc   |
|                          | 15 Vdc output models (single and dual) |     | 18  |     | Vdc   |
| over current protection  | hiccup mode                            | 110 | 140 | 160 | %     |
| short circuit protection | continuous, automatic recovery         |     |     |     |       |

## SAFETY AND COMPLIANCE

| parameter             | conditions/description                                     | min   | typ       | max | units |
|-----------------------|------------------------------------------------------------|-------|-----------|-----|-------|
| isolation voltage     | input to output for 1 minute                               | 1,500 |           |     | Vdc   |
| isolation resistance  | input to output                                            | 1,000 |           |     | MΩ    |
| isolation capacitance | input to output                                            |       | 1,000     |     | pF    |
| conducted emissions   | EN 55022 Class A (external circuit required, see Figure 3) |       |           |     |       |
| MTBF                  | as per MIL-HDBK-217F, GB, full load, 25°C                  |       |           |     |       |
|                       | 3.3, 5 Vdc output models                                   |       | 950,000   |     | hours |
|                       | all other models                                           |       | 1,300,000 |     | hours |
| RoHS                  | 2011/65/EU                                                 |       |           |     |       |

## ENVIRONMENTAL

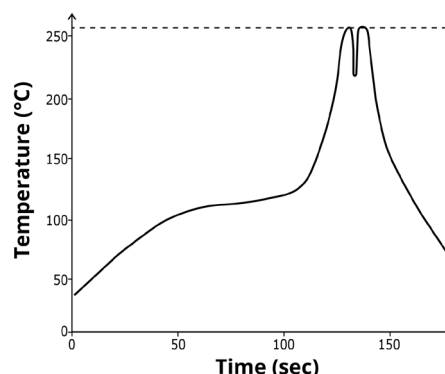
| parameter             | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curves    | -40 |     | 105 | °C    |
| storage temperature   |                        | -55 |     | 125 | °C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

## SOLDERABILITY

| parameter      | conditions/description     | min | typ | max | units |
|----------------|----------------------------|-----|-----|-----|-------|
| wave soldering | see wave soldering profile |     |     | 260 | °C    |

- Notes:
1. Soldering materials: Sn/Cu/Ni
  2. Ramp up rate during preheat: 1.4°C/s (from 50°C to 100°C)
  3. Soaking temperature: 0.5°C/s (from 100°C to 130°C), 60±20 seconds
  4. Peak temperature: 260°C, above 250°C for 3~6 seconds
  5. Ramp down rate during cooling: -10°C/s (from 260°C to 150°C)

### WAVE SOLDERING PROFILE



## MECHANICAL

| parameter     | conditions/description                       | min | typ | max | units  |
|---------------|----------------------------------------------|-----|-----|-----|--------|
| dimensions    | 1.00 x 1.00 x 0.4 [25.4 x 25.4 x 10.2 mm]    |     |     |     | inches |
| case material | black coated copper with non-conductive base |     |     |     |        |
| weight        |                                              |     | 18  |     | g      |

## MECHANICAL DRAWING

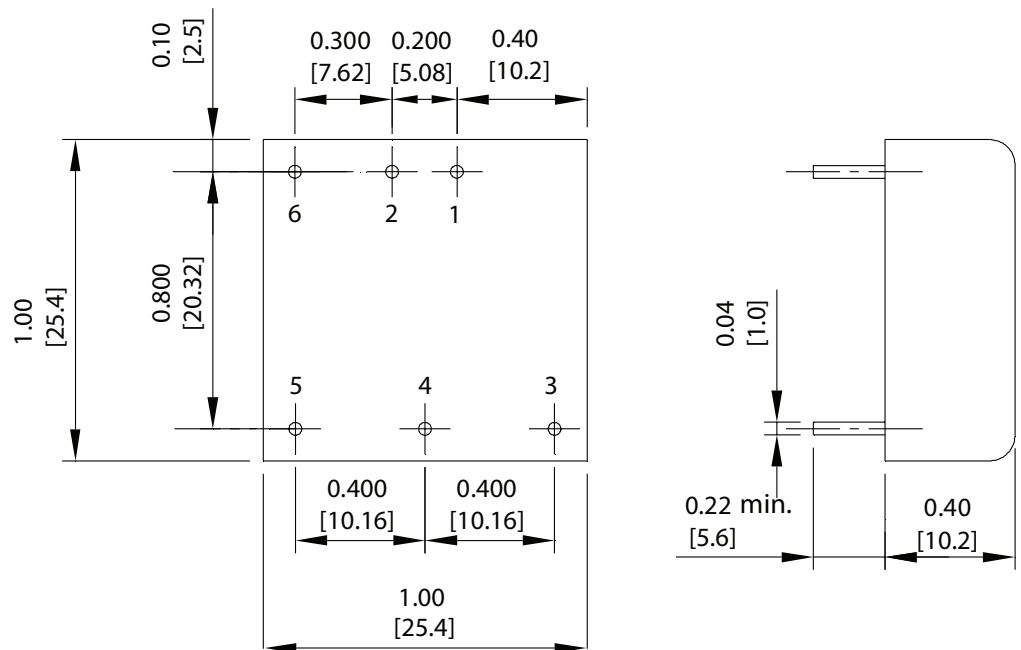
units: inches [mm]

tolerance: X.XX ±0.02 [±0.5]

X.XXX ±0.010 [±0.25]

pin diameter tolerance: ±0.004 [±0.1]

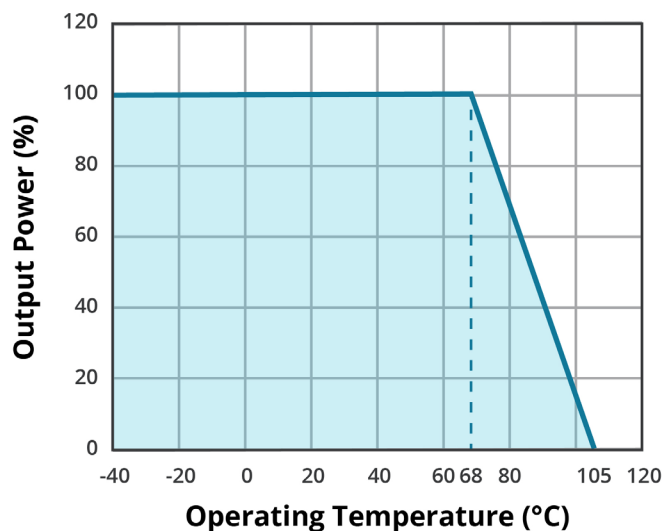
| PIN CONNECTIONS |          |        |
|-----------------|----------|--------|
| PIN             | Function |        |
|                 | Single   | Dual   |
| 1               | +Vin     | +Vin   |
| 2               | -Vin     | -Vin   |
| 3               | +Vout    | +Vout  |
| 4               | Trim     | Common |
| 5               | -Vout    | -Vout  |
| 6               | Remote   | Remote |



Recommended PCB Layout  
Top View

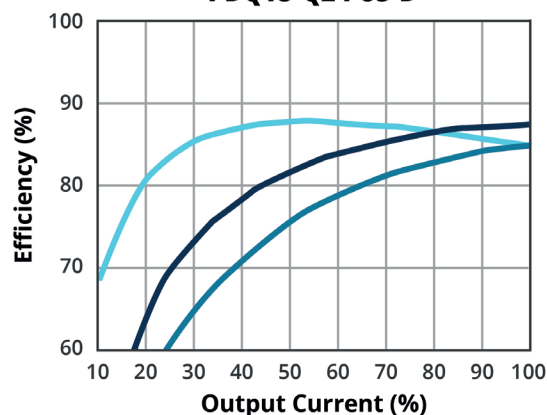
## DERATING CURVE

### TEMPERATURE DERATING CURVE

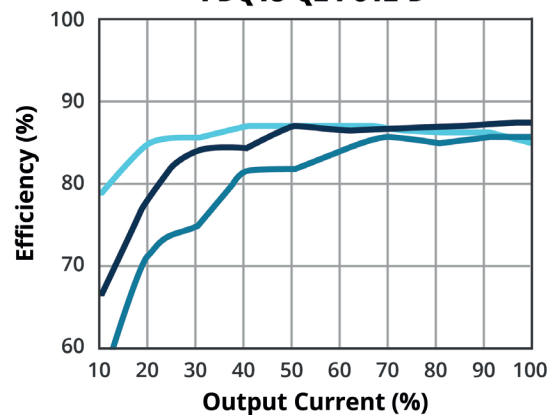


## EFFICIENCY CURVES

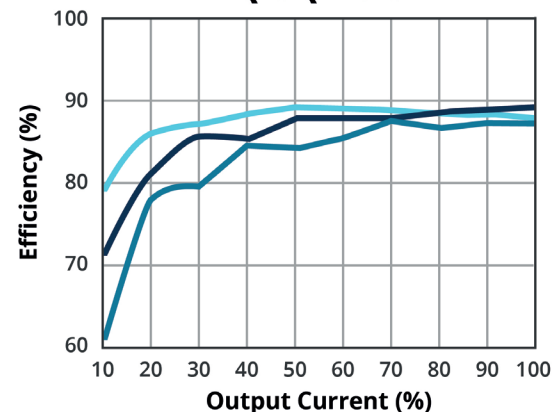
### EFFICIENCY VS OUTPUT LOAD PDQ15-Q24-S3-D



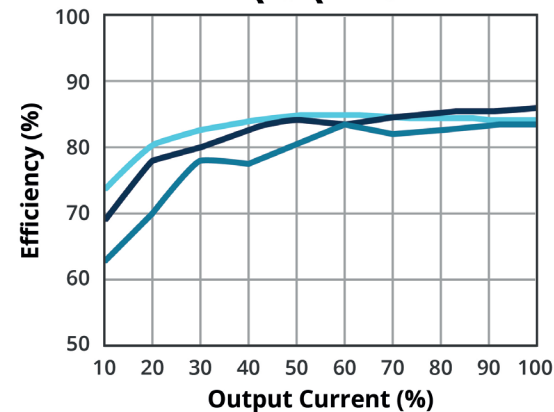
### EFFICIENCY VS OUTPUT LOAD PDQ15-Q24-S12-D



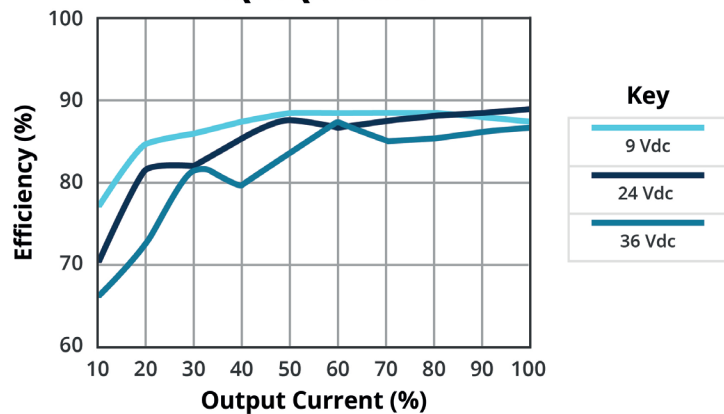
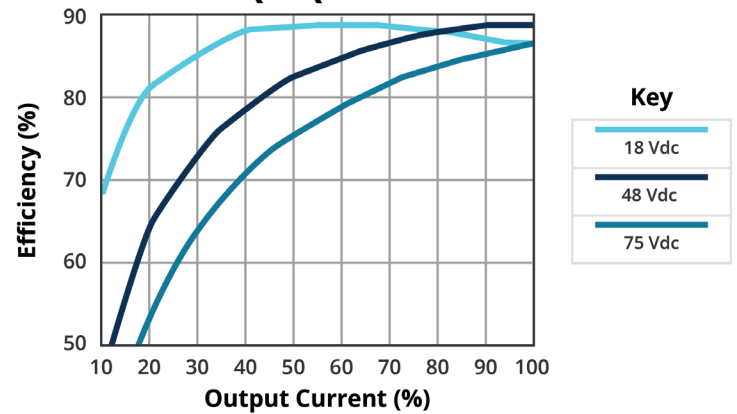
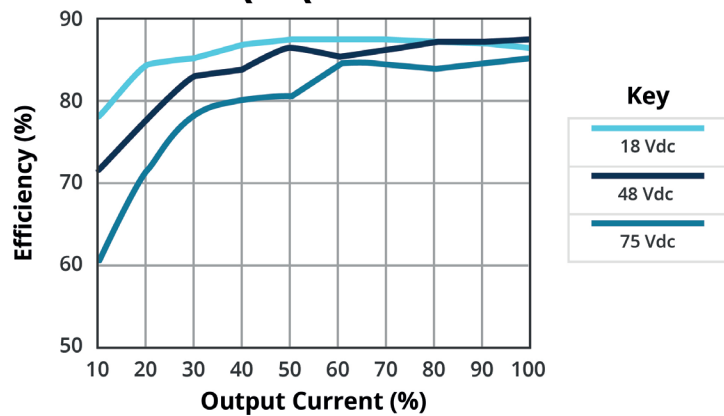
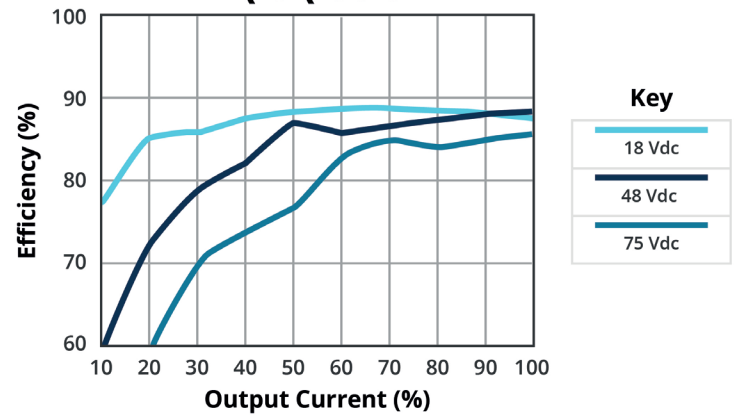
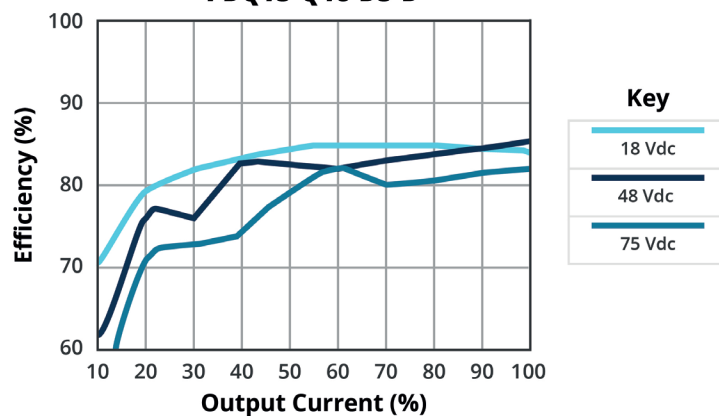
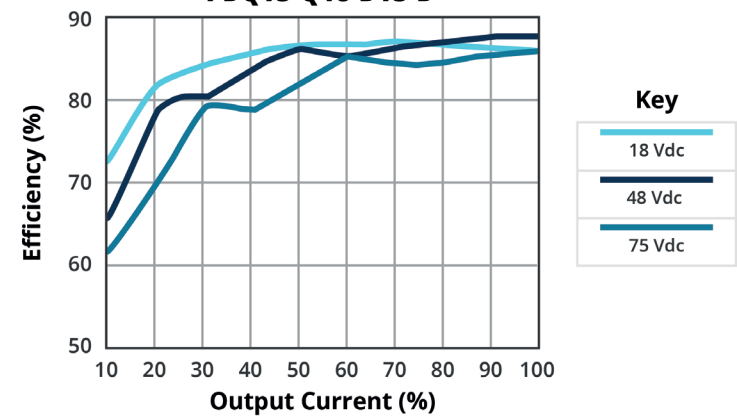
### EFFICIENCY VS OUTPUT LOAD PDQ15-Q24-S15-D



### EFFICIENCY VS OUTPUT LOAD PDQ15-Q24-D5-D



## EFFICIENCY CURVES (CONTINUED)

**EFFICIENCY VS OUTPUT LOAD  
PDQ15-Q24-D15-D****EFFICIENCY VS OUTPUT LOAD  
PDQ15-Q48-S3-D****EFFICIENCY VS OUTPUT LOAD  
PDQ15-Q48-S12-D****EFFICIENCY VS OUTPUT LOAD  
PDQ15-Q48-S15-D****EFFICIENCY VS OUTPUT LOAD  
PDQ15-Q48-D5-D****EFFICIENCY VS OUTPUT LOAD  
PDQ15-Q48-D15-D**

## TEST CONFIGURATIONS

### Input Ripple Current & Output Noise

Figure 1 Measuring Input Ripple Current

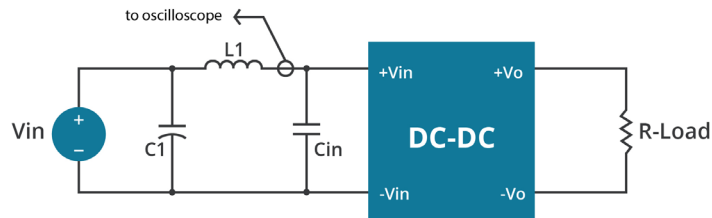


Table 1

|     |                                          |
|-----|------------------------------------------|
| L1  | 12 $\mu$ H                               |
| C1  | none                                     |
| Cin | 33 $\mu$ F ESR < 0.7 $\Omega$ at 100 kHz |

Figure 2 Measuring Output Ripple And Noise

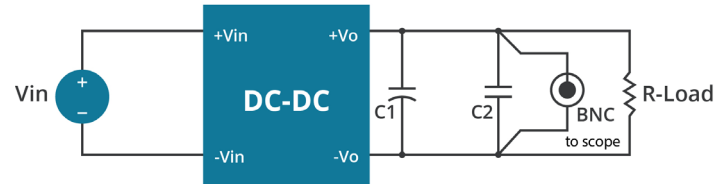


Table 2

|    |                               |
|----|-------------------------------|
| C1 | 10 $\mu$ F tantalum capacitor |
| C2 | 1 $\mu$ F ceramic capacitor   |

## EMC RECOMMENDED CIRCUIT

### Test Condition

Input Voltage: Nominal

Output Load: Full Load

Figure 3 Conducted Emissions Test Circuit

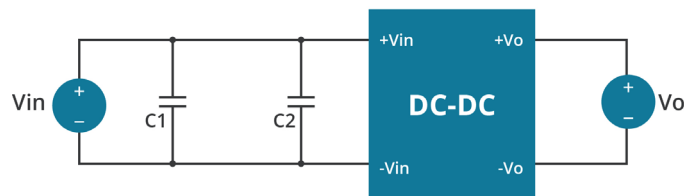


Table 3

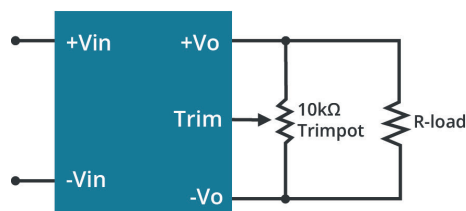
| EN55022 Class A<br>Recommended External Circuit Components |                     |                     |
|------------------------------------------------------------|---------------------|---------------------|
| Input<br>Voltage<br>(Vdc)                                  | C1                  | C2                  |
| 24                                                         | 6.8 $\mu$ F / 50 V  | 6.8 $\mu$ F / 50 V  |
| 48                                                         | 2.2 $\mu$ F / 100 V | 2.2 $\mu$ F / 100 V |

## APPLICATION NOTES

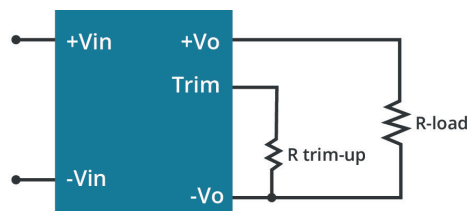
### Output Voltage Trimming

The output voltage can be adjusted (single outputs only) by using the trim pin and the use of either an external trim pot or the use of a single fixed resistor (see Figures below). If the trim function is not needed, leave the trim pin open.

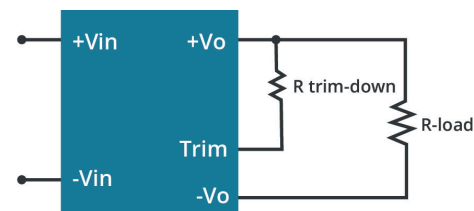
**Figure 4 Trim Adjustments Using A Trimpot**



**Figure 5 Trim Adjustments To Increase Output Voltage Using A Fixed Resistor**



**Figure 6 Trim Adjustments To Decrease Output Voltage Using A Fixed Resistor**



#### Formula for Trim Resistor

$$R_{trim-up} = \left( \frac{V_r \times R1 \times (R2 + R3)}{(V_o - V_{o,nom}) \times R2} \right) - R_t \quad (\text{k}\Omega)$$

$$R_{trim-down} = R1 \times \left( \frac{V_r \times R1}{(V_{o,nom} - V_o) \times R2} - 1 \right) - R_t \quad (\text{k}\Omega)$$

Note:  $R_{trim-up}$  is the external resistor in kΩ  
 $R_{trim-down}$  is the external resistor in kΩ  
 $V_{o,nom}$  is the nominal output voltage  
 $V_o$  is the desired output voltage  
 $R1, R2, R3, R_t$ , and  $V_r$  are internal (see Table 4)

**Table 4**

| Output Voltage (Vdc) | R1 (kΩ) | R2 (kΩ) | R3 (kΩ) | Rt (kΩ) | Vr (V) |
|----------------------|---------|---------|---------|---------|--------|
| 3.3                  | 2.74    | 1.8     | 0.27    | 9.1     | 1.24   |
| 5                    | 2.32    | 2.32    | 0       | 8.2     | 2.5    |
| 12                   | 6.8     | 2.4     | 2.32    | 22      | 2.5    |
| 15                   | 8.06    | 2.4     | 3.9     | 27      | 2.5    |

## REVISION HISTORY

| rev. | description                                | date       |
|------|--------------------------------------------|------------|
| 1.0  | initial release                            | 07/12/2016 |
| 1.01 | derating curve and circuit figures updated | 03/15/2022 |

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



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