# THE DATASHEET OF

# PDQ10-Q24-D5-D

CUI INC
a bel group



# SERIES: PDQ10-D | DESCRIPTION: DC-DC CONVERTER

## FEATURES

- up to 10 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 86%

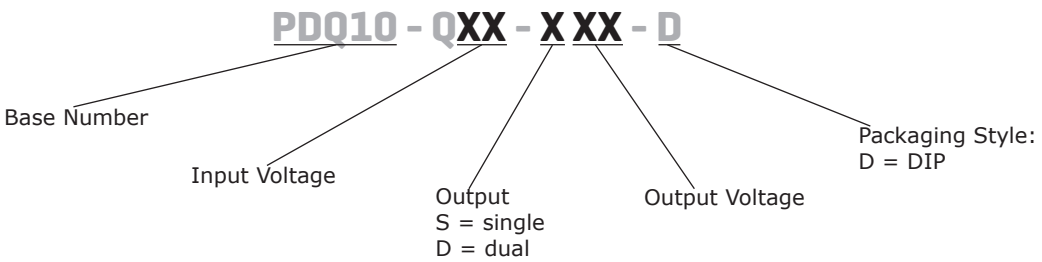
RoHS CE

## MODEL

| MODEL | input voltage typ (Vdc) | input voltage range (Vdc) | output voltage (Vdc) | output current min (mA) | output current max (mA) | output power max (W) | ripple & noise[1] max (mVp-p) | efficiency typ (%) |
|---|---|---|---|---|---|---|---|---|
| PDQ10-Q24-S3-D | 24 | 9~36 | 3.3 | 0 | 2500 | 8.25 | 75 | 81 |
| PDQ10-Q24-S5-D | 24 | 9~36 | 5 | 0 | 2000 | 10 | 75 | 84 |
| PDQ10-Q24-S12-D | 24 | 9~36 | 12 | 0 | 835 | 10 | 100 | 86 |
| PDQ10-Q24-S15-D | 24 | 9~36 | 15 | 0 | 666 | 10 | 100 | 86 |
| PDQ10-Q24-D5-D | 24 | 9~36 | ±5 | 0 | ±1000 | 10 | 75 | 84 |
| PDQ10-Q24-D12-D | 24 | 9~36 | ±12 | 0 | ±416 | 10 | 100 | 86 |
| PDQ10-Q24-D15-D | 24 | 9~36 | ±15 | 0 | ±333 | 10 | 100 | 86 |
| PDQ10-Q48-S3-D | 48 | 18~75 | 3.3 | 0 | 2500 | 8.25 | 75 | 82 |
| PDQ10-Q48-S5-D | 48 | 18~75 | 5 | 0 | 2000 | 10 | 75 | 84 |
| PDQ10-Q48-S12-D | 48 | 18~75 | 12 | 0 | 835 | 10 | 100 | 86 |
| PDQ10-Q48-S15-D | 48 | 18~75 | 15 | 0 | 666 | 10 | 100 | 86 |
| PDQ10-Q48-D5-D | 48 | 18~75 | ±5 | 0 | ±1000 | 10 | 75 | 84 |
| PDQ10-Q48-D12-D | 48 | 18~75 | ±12 | 0 | ±416 | 10 | 100 | 86 |
| PDQ10-Q48-D15-D | 48 | 18~75 | ±15 | 0 | ±333 | 10 | 100 | 86 |

Notes:
1. At full load, nominal input, 20 MHz bandwidth oscilloscope, with 10 µF tantalum and 1 µF 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<br>48 Vdc input models | 9<br>18 | 24<br>48 | 36<br>75 | Vdc<br>Vdc |
| surge voltage | for maximum of 100 ms<br>24 Vdc input models<br>48 Vdc input models | | | <br>50<br>100 | <br>Vdc<br>Vdc |
| current | 24 Vdc input models<br>48 Vdc input models | | | 1.4<br>0.7 | A<br>A |
| under voltage shutdown | 24 Vdc input models, power up<br>24 Vdc input models, power down<br>48 Vdc input models, power up<br>48 Vdc input models, power down | | 8.8<br>8.0<br>17<br>16 | | Vdc<br>Vdc<br>Vdc<br>Vdc |
| remote on/off[1] | turn on (3.5~36 Vdc or open circuit)<br>turn off (<1.2 Vdc) | | | | |
| filter | LC type | | | | |
| input reverse polarity protection | no | | | | |
| input fuse | 3 A time delay fuse for 24 Vdc input models (recommended)<br>1.5 A time delay fuse for 48 Vdc input models (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<br>5 Vdc output models<br>12 Vdc output models<br>15 Vdc output models<br>±5 Vdc output models<br>±12 Vdc output models<br>±15 Vdc output models | | | 3,300<br>2,200<br>1,000<br>680<br>1,200<br>470<br>330 | µF<br>µF<br>µF<br>µF<br>µF<br>µF<br>µF |
| voltage accuracy | | | | ±1.5 | % |
| line regulation | from high line to low line | | | ±0.5 | % |
| load regulation | from 100% load to minimum load<br>single output models<br>dual output models | | | <br>±0.5<br>±1 | <br>%<br>% |
| voltage balance | dual output models | | | ±1 | % |
| cross regulation | load cross variation 25%/100% (dual output models) | | | ±5 | % |
| turn-on delay time, from input | from Vin, min to 10% Vo | | 2 | | ms |
| turn-on delay time, from on/off control | from Von/off to 10% Vo | | 2 | | ms |
| rise time | from 10% Vo to 90% Vo | | 1.5 | | ms |
| adjustability[2] | see application notes | | ±10 | | % |
| switching frequency | at nominal Vin, full load | | 280 | | kHz |
| dynamic load response | 75%-100% step load change<br>error band (Vout)<br>recovery time | | <br>5<br>500 | | <br>%<br>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<br>3.3 Vdc output models<br>5 Vdc output models (single and dual)<br>12 Vdc output models (single and dual)<br>15 Vdc output models (single and dual) | | <br>3.9<br>6.2<br>15<br>18 | | <br>Vdc<br>Vdc<br>Vdc<br>Vdc |
| over current protection | | 120 | | | % |
| 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 & Class B (external circuit required, see Figure 3) | | | | |
| MTBF | as per MIL-HDBK-217F, GB | | 1,300,000 | | hours |
| RoHS | 2011/65/EU | | | | |

## ENVIRONMENTAL

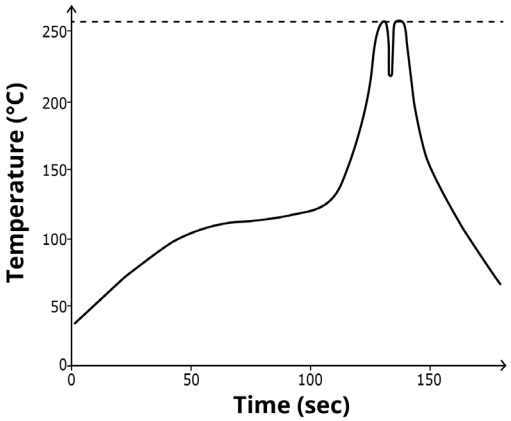
| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| operating temperature | see derating curves | -40 | | 105 | °C |
| storage temperature | | -55 | | 125 | °C |
| operating humidity | non-condensing | | | 95 | % |

## 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***



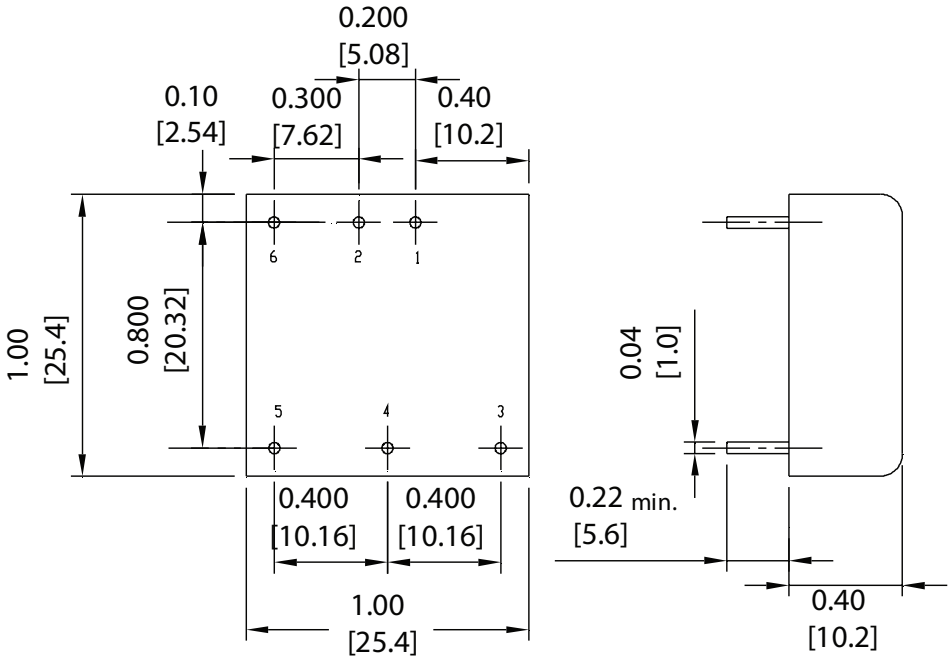
## MECHANICAL

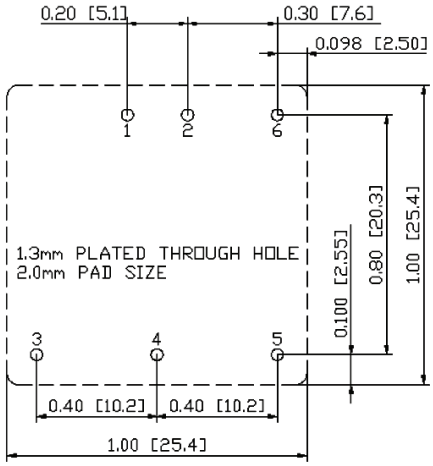
| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| dimensions | 1.00 x 1.00 x 0.4 [25.4 x 25.4 x 10.2 mm] | | | | inches |
| case material | black coated copper with non-conductive base | | | | |
| weight | | | 18 | | g |

## 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]

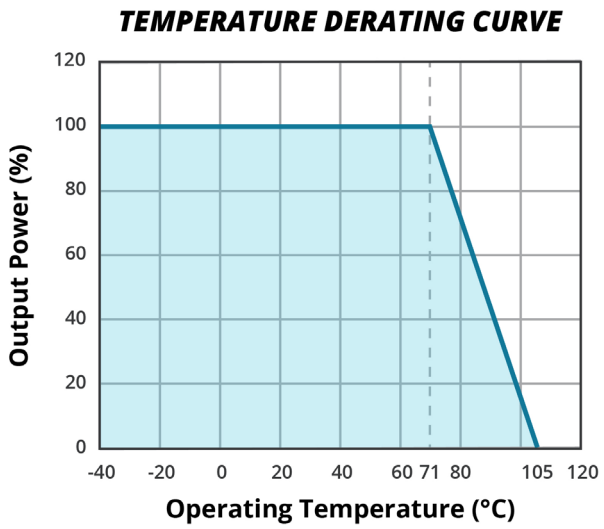
| PIN CONNECTIONS | | |
|---|---|---|
| PIN | Function | |
| | Single | Dual |
| 1 | +Vin | +Vin |
| 2 | -Vin | -Vin |
| 3 | +Vout | +Vout |
| 4 | Trim | Common |
| 5 | -Vout | -Vout |
| 6 | Remote | Remote |



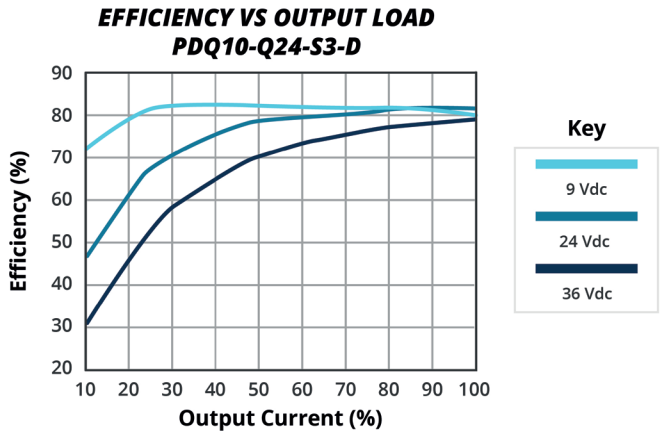



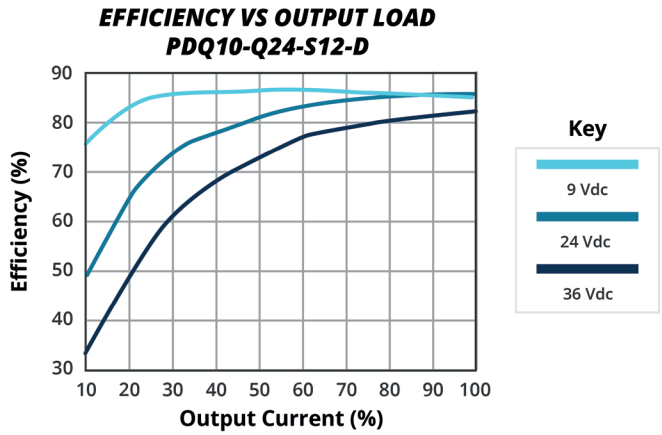

Recommended PCB Layout
Top View

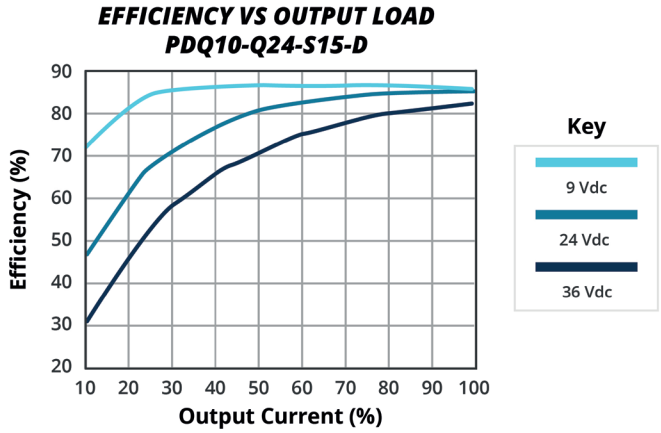
## DERATING CURVE

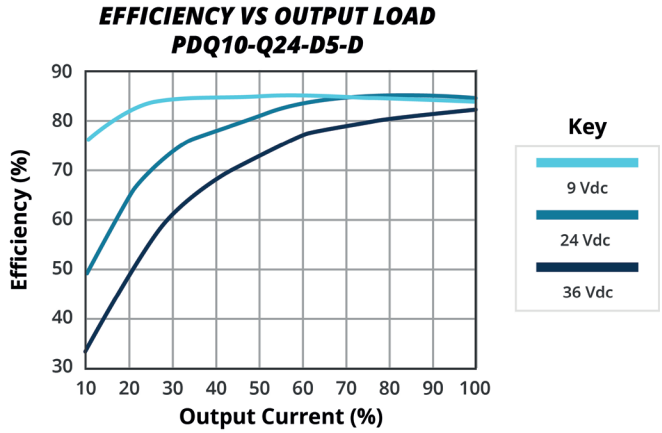



## EFFICIENCY CURVES



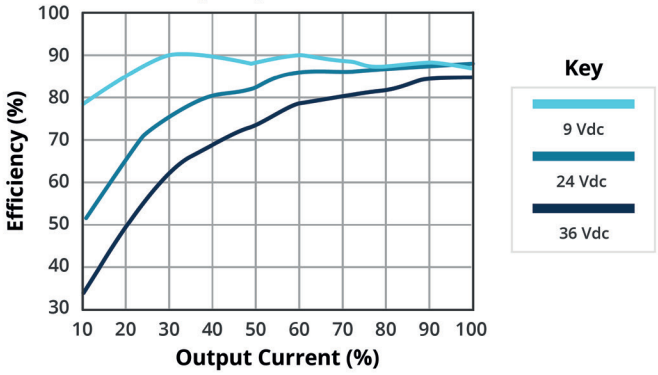



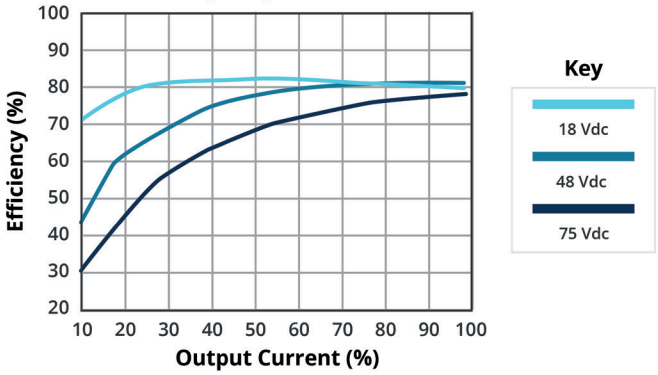



## EFFICIENCY CURVES (CONTINUED)

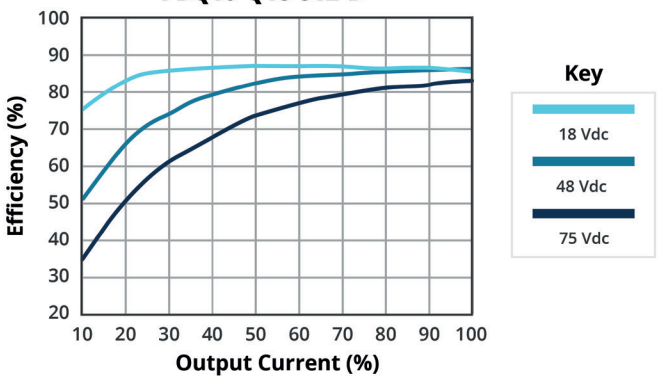
***EFFICIENCY VS OUTPUT LOAD***
***PDQ10-Q24-D15-D***



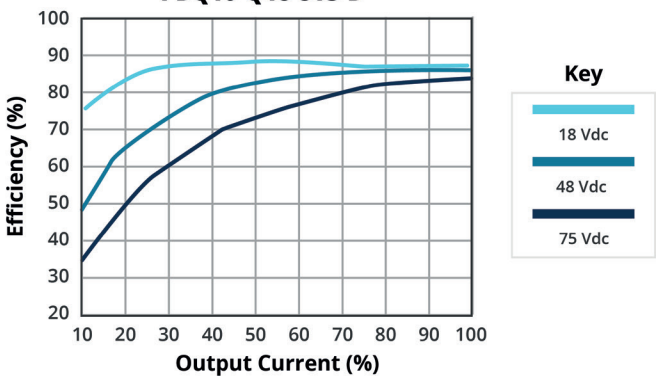

***EFFICIENCY VS OUTPUT LOAD***
***PDQ10-Q48-S3-D***



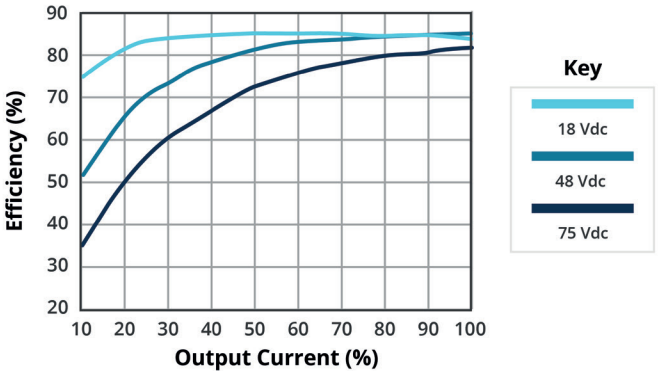

***EFFICIENCY VS OUTPUT LOAD***
***PDQ10-Q48-S12-D***



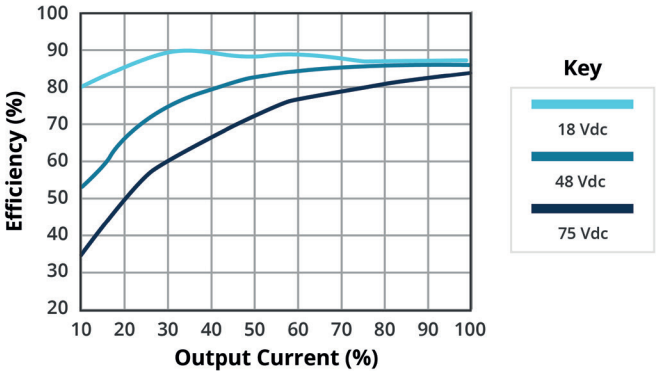

***EFFICIENCY VS OUTPUT LOAD***
***PDQ10-Q48-S15-D***




***EFFICIENCY VS OUTPUT LOAD***
***PDQ10-Q48-D5-D***




***EFFICIENCY VS OUTPUT LOAD***
***PDQ10-Q48-D15-D***



# TEST CONFIGURATIONS

## Input Ripple Current & Output Noise

**Figure 1 Measuring Input Ripple Current**

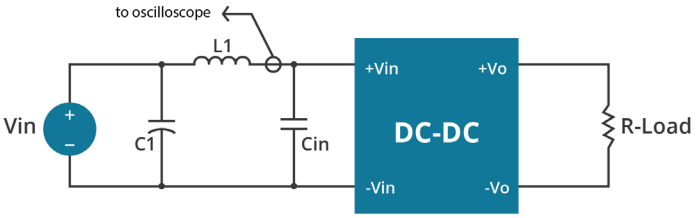



**Figure 2 Measuring Output Ripple And Noise**

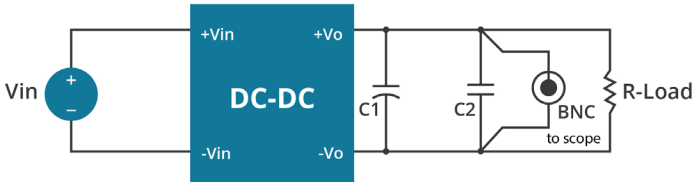



**Table 1**

| | |
|---|---|
| L1 | 1 µH |
| C1 | 6.8 µF ceramic capacitor |
| Cin | none |

**Table 2**

| | |
|---|---|
| C1 | 10 µF tantalum capacitor |
| C2 | 1 µF ceramic capacitor |

# EMC RECOMMENDED CIRCUIT

**Test Condition**

Input Voltage: Nominal

Output Load: Full Load

**Figure 3 Conducted Emissions Test Circuit**

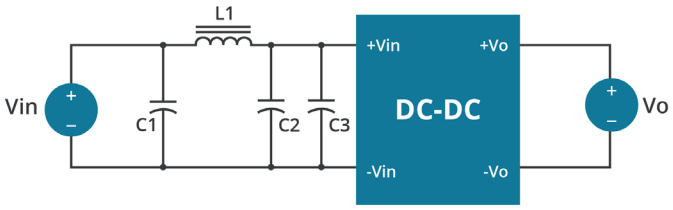



**Table 3**

| EN55022 Class A Recommended External Circuit Components | | | | |
|---|---|---|---|---|
| Input Voltage (Vdc) | C1 | C2 | C3 | L1 |
| 24 | NC | 10 µF / 50 V | 10 µF / 50 V | short |
| 48 | NC | 4.7 µF / 100 V | 4.7 µF / 100 V | short |

**Table 4**

| EN55022 Class B Recommended External Circuit Components | | | | |
|---|---|---|---|---|
| Input Voltage (Vdc) | C1 | C2 | C3 | L1 |
| 24 | 10 µF / 50 V | NC | 10 µF / 50 V | 3.3 µH |
| 48 | 4.7 µF / 100 V | NC | 4.7 µF / 100 V | 3.3 µH |

## 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**

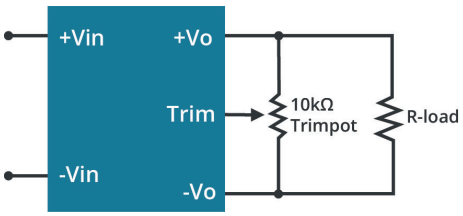



**Figure 5 Trim Adjustments To Increase Output Voltage Using A Fixed Resistor**

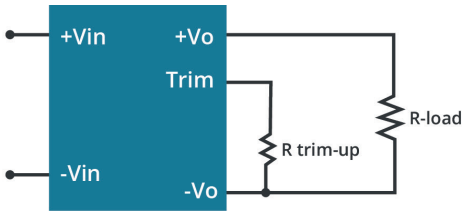
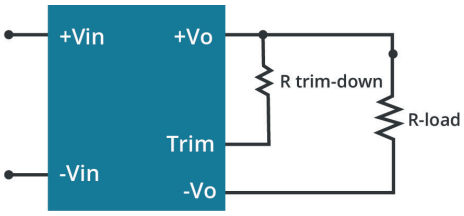



**Figure 6 Trim Adjustments To Decrease Output Voltage Using A Fixed Resistor**




**Formula for Trim Resistor**

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

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

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, Rt, and Vr are internal (see Table 5).

**Table 5**

| 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 | 07/26/2021 |

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

CUI INC
a bel group

**Headquarters**
20050 SW 112th Ave.
Tualatin, OR 97062
**800.275.4899**

Fax 503.612.2383
**cui**.com
techsupport@cui.com

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