CUI INC
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# SERIES: PQAE50 | DESCRIPTION: DC-DC CONVERTER

## FEATURES

- up to 50 W isolated output
- 2:1 input range (18~36 Vdc, 36~75 Vdc)
- single, regulated output
- 1,500 Vdc isolation
- short circuit, over current, input under, voltage protection
- remote on/off
- wide operating temperature range -40~105°C
- efficiency up to 92%
- EN 62368 certified, meets UL 62368



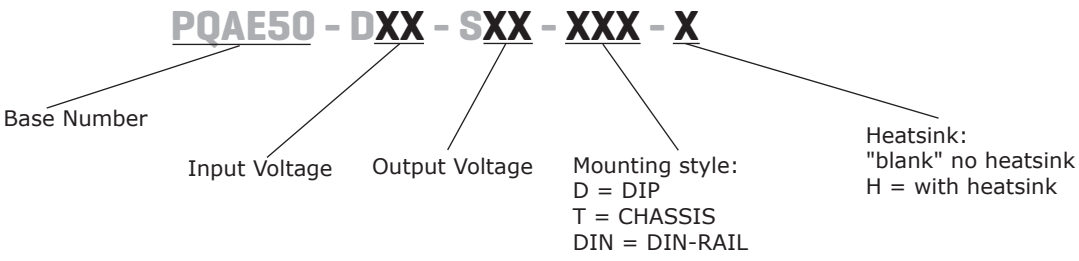
RoHS CE

## MODEL

| MODEL | input voltage | | output voltage | output current | | output power | ripple and noise[2] | efficiency[3] |
|---|---|---|---|---|---|---|---|---|
| | typ (Vdc) | range[1] (Vdc) | (Vdc) | min (A) | max (A) | max (W) | max (mVp-p) | typ (%) |
| PQAE50-D24-S3 | 24 | 18~36 | 3.3 | 0.5 | 10.0 | 33 | 200 | 91 |
| PQAE50-D24-S5 | 24 | 18~36 | 5 | 0.5 | 10.0 | 50 | 200 | 91 |
| PQAE50-D24-S12 | 24 | 18~36 | 12 | 0.208 | 4.167 | 50 | 250 | 91 |
| PQAE50-D24-S15 | 24 | 18~36 | 15 | 0.167 | 3.333 | 50 | 250 | 91 |
| PQAE50-D24-S24 | 24 | 18~36 | 24 | 0.104 | 2.083 | 50 | 300 | 91 |
| PQAE50-D48-S3 | 48 | 36~75 | 3.3 | 0 | 10.0 | 33 | 200 | 91 |
| PQAE50-D48-S5 | 48 | 36~75 | 5 | 0 | 10.0 | 50 | 200 | 91 |
| PQAE50-D48-S12 | 48 | 36~75 | 12 | 0 | 4.167 | 50 | 250 | 92 |
| PQAE50-D48-S15 | 48 | 36~75 | 15 | 0 | 3.333 | 50 | 250 | 92 |
| PQAE50-D48-S24 | 48 | 36~75 | 24 | 0 | 2.083 | 50 | 350 | 92 |

Notes:
1. Minimum input voltage is 1V greater for DIN rail and chassis mount models.
2. Ripple and noise are measured at 20 MHz BW by "parallel cable" method with 1 µF ceramic and 10 µF electrolytic capacitors on the output.
3. Measured at nominal input voltage and full load.

## PART NUMBER KEY



## INPUT

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| input voltage | 24 Vdc input models<br>48 Vdc input models | 18<br>36 | 24<br>48 | 40<br>80 | Vdc<br>Vdc |
| start-up voltage | 24 Vdc input models<br>48 Vdc input models | | | 18<br>36 | Vdc<br>Vdc |
| under voltage protection | 24 Vdc input models<br>48 Vdc input models | 11<br>26 | 13<br>30 | | Vdc<br>Vdc |
| surge voltage | for maximum of 1 second<br>24 Vdc input models<br>48 Vdc input models | <br>-0.7<br>-0.7 | | <br>50<br>80 | <br>Vdc<br>Vdc |
| start-up time | nominal input, constant load | | 10 | 120 | ms |
| CTRL[1] | models ON (CTRL open or connect TTL high level, 3~12 Vdc) | | | | |
| | models OFF (CTRL connect GND or low level, 0~1.2 Vdc) | | | | |
| | input current (models OFF)<br>24 Vdc input models<br>48 Vdc input models | | <br>6<br>2 | <br>12<br>12 | <br>mA<br>mA |
| filter | pi filter | | | | |

Note 1. CTRL pin voltage is referenced to GND.

## OUTPUT

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| line regulation | full load, input voltage from low to high | | ±0.2 | ±0.5 | % |
| load regulation | 5% to 100% load | | ±0.5 | ±1 | % |
| voltage accuracy | 5% to 100% load | | ±1 | ±3 | % |
| switching frequency | PWM mode | | 300 | | kHz |
| transient recovery time | 25% load step change | | 250 | 500 | µs |
| transient response deviation | 25% load step change<br>3.3 & 5 Vdc output models<br>other output models | | <br>±3<br>±3 | <br>±8<br>±5 | <br>%<br>% |
| temperature coefficient | 100% load | | | ±0.03 | %/°C |
| trim | | | ±10 | | % |

## PROTECTIONS

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| over voltage protection[2] | 3.3 Vdc output model<br>5 Vdc output model<br>12 Vdc output model<br>15 Vdc output model<br>24 Vdc ouput model | | 3.9<br>6.2<br>15<br>18<br>30 | | Vdc<br>Vdc<br>Vdc<br>Vdc<br>Vdc |
| over current protection | | 120 | | 160 | % |
| short circuit protection | continuous, auto recovery, hiccup | | | | |

Note: 2. The module needs to be restarted after output OVP.

## SAFETY AND COMPLIANCE

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| isolation voltage | input to output at 1 mA for 1 minute<br>input to output housing at 1 mA for 1 minute | 1,500<br>1,000 | | | Vdc<br>Vdc |
| isolation resistance | input to output at 500 Vdc | 100 | | | MΩ |
| isolation capacitance | input to output at 100 kHz, 0.1 Vdc | | 2,200 | | pF |
| safety approvals | certified to 62368: EN/IEC | | | | |
| conducted emissions | CISPR32/EN55032 CLASS B (see Fig.2 for recommended circuit) | | | | |
| radiated emissions | CISPR32/EN55032 CLASS B (see Fig.2 for recommended circuit) | | | | |
| ESD | IEC/EN61000-4-2 Contact ±4KV (for 18~36 Vdc) ±6KV (for 36~75 Vdc) perf. Criteria B | | | | |
| radiated immunity | IEC/EN61000-4-3 10V/m perf. Criteria A | | | | |
| EFT/burst | IEC/EN61000-4-4 100KHz ±2KV (see Fig.2 for recommended circuit) perf. Criteria B | | | | |
| surge | IEC/EN61000-4-5 line to line ±2KV (see Fig.2 for recommended circuit) perf. Criteria B | | | | |
| conducted immunity | IEC/EN61000-4-6 10 Vr.m.s perf. Criteria A | | | | |
| MTBF | as per MIL-HDBK-217F @ 25°C | 1,000,000 | | | hours |
| RoHS | yes | | | | |

## ENVIRONMENTAL

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| operating temperature | see derating curve | -40 | | 105 | °C |
| storage temperature | | -55 | | 125 | °C |
| storage humidity | non-condensing | 5 | | 95 | % |
| case temperature | at full load, operating temperature curve range | | | 105 | °C |
| vibration | 10~55 Hz, 30 min. along x, y, and z | | | 5 | G |

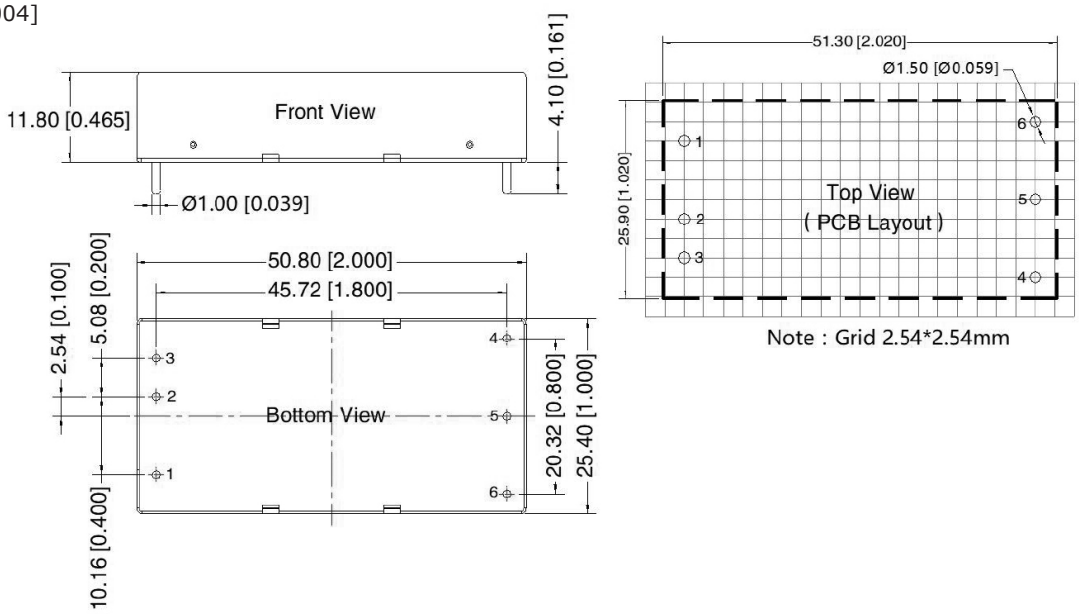
## MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| dimensions | without heatsink:<br>horizontal package 50.80 × 25.40 × 11.80<br>chassis mount 76.00 × 31.50 × 21.20<br>DIN-Rail mounting 76.00 × 31.50 × 25.80<br>with heatsink:<br>horizontal package 51.40 × 26.20 × 16.50<br>chassis mount 76.00 × 31.50 × 25.30<br>DIN-Rail mounting 76.00 × 31.50 × 29.90 | | | | <br>mm<br>mm<br>mm<br><br>mm<br>mm<br>mm |
| case material | aluminum alloy | | | | |
| weight | without heatsink<br>horizontal package<br>chassis mounting<br>DIN-Rail mounting<br>with heatsink<br>horizontal package<br>chassis mounting<br>DIN-Rail mounting | | <br>42<br>65<br>85<br><br>50<br>73<br>93 | | <br>g<br>g<br>g<br><br>g<br>g<br>g |

## MECHANICAL DRAWING

units: mm[inch]
pin diameter tolerance: ±0.10[±0.004]
general tolerance: ±0.50[±0.020]

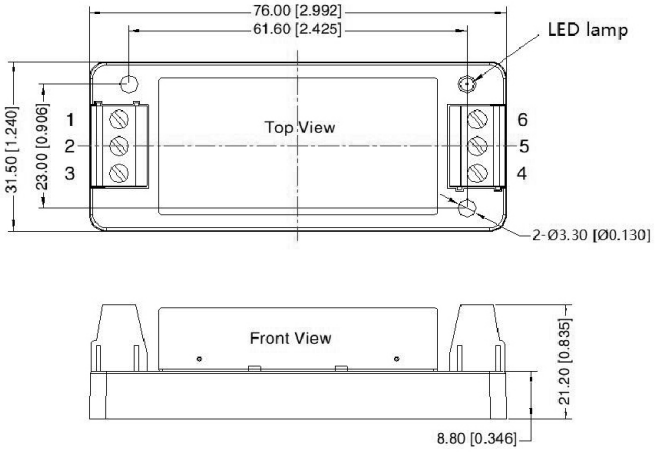
| PIN CONNECTIONS | |
|---|---|
| PIN | Function |
| 1 | CTRL |
| 2 | GND |
| 3 | Vin |
| 4 | +Vo |
| 5 | 0V |
| 6 | Trim |




### CHASSIS MOUNT

units: mm[inch]
wire range: 24-12 AWG
tightening torque: Max 0.4 N·m
general tolerance: ±1.00[±0.039]

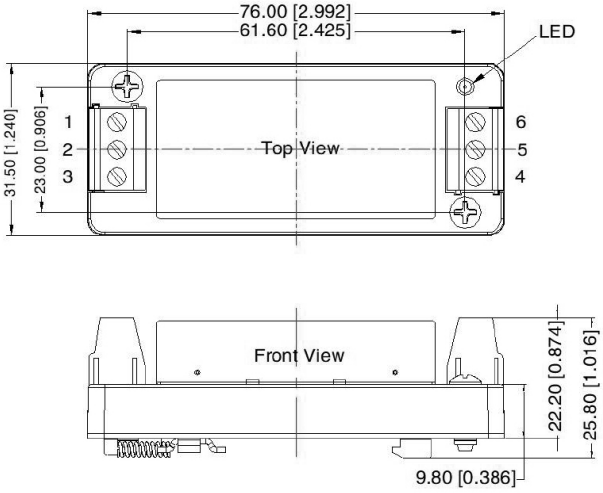
| PIN OUT | |
|---|---|
| PIN | Function |
| 1 | CTRL |
| 2 | GND |
| 3 | Vin |
| 4 | +Vo |
| 5 | 0V |
| 6 | Trim |




### DIN-RAIL MOUNT

units: mm[inch]
mounting rail: TS35
wire range: 24-12 AWG
tightening torque: Max 0.4 N·m
general tolerance: ±1.00[±0.039]

| PIN OUT | |
|---|---|
| PIN | Function |
| 1 | CTRL |
| 2 | GND |
| 3 | Vin |
| 4 | +Vo |
| 5 | 0V |
| 6 | Trim |

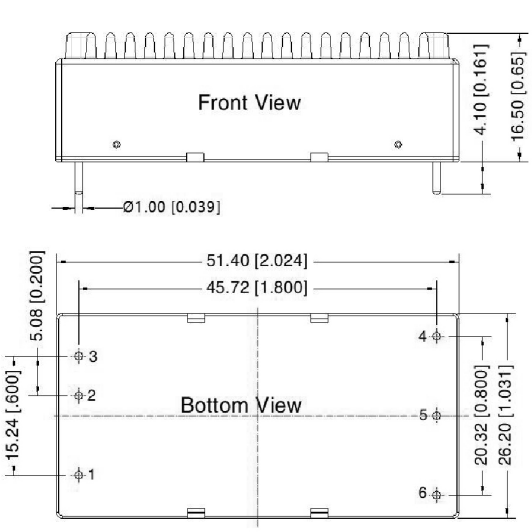


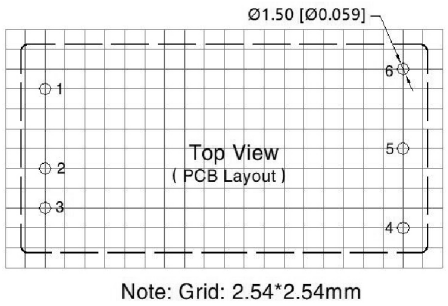
# MECHANICAL DRAWING (CONTINUED)

## WITH HEATSINK

units: mm[inch]
pin diameter tolerance: ±0.10[±0.004]
general tolerance: ±0.50[±0.020]

| PIN CONNECTIONS | |
|---|---|
| PIN | Function |
| 1 | CTRL |
| 2 | GND |
| 3 | Vin |
| 4 | +Vo |
| 5 | 0V |
| 6 | Trim |



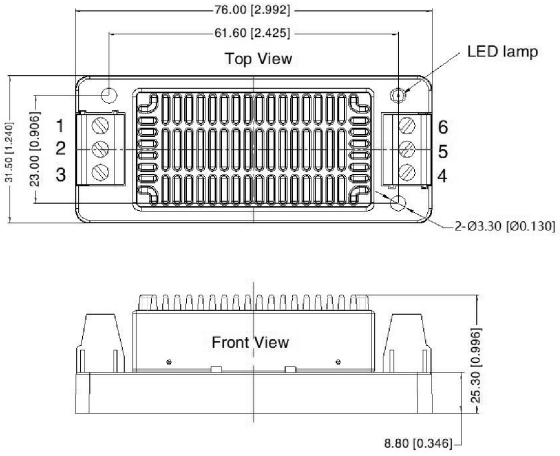




Note: Grid: 2.54*2.54mm

## CHASSIS MOUNT WITH HEATSINK

units: mm[inch]
wire range: 24-12 AWG
tightening torque: Max 0.4 N·m
general tolerance: ±1.00[±0.039]

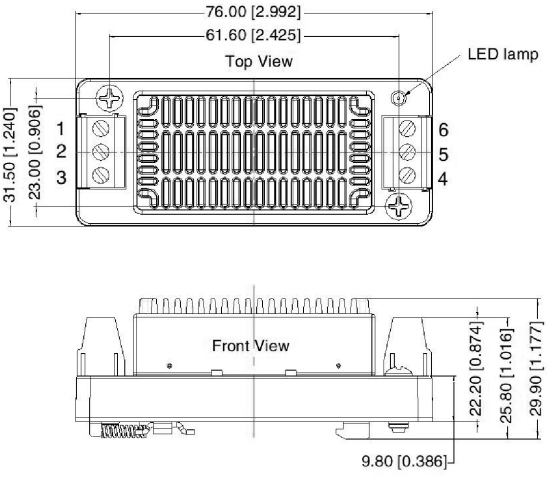
| PIN OUT | |
|---|---|
| PIN | Function |
| 1 | CTRL |
| 2 | GND |
| 3 | Vin |
| 4 | +Vo |
| 5 | 0V |
| 6 | Trim |




## DIN-RAIL MOUNT WITH HEATSINK

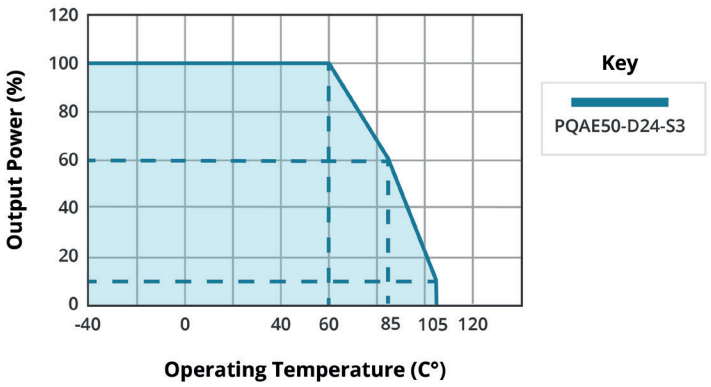
units: mm[inch]
mounting rail: TS35
wire range: 24-12 AWG
tightening torque: Max 0.4 N·m
general tolerance: ±1.00[±0.039]

| PIN OUT | |
|---|---|
| PIN | Function |
| 1 | CTRL |
| 2 | GND |
| 3 | Vin |
| 4 | +Vo |
| 5 | 0V |
| 6 | Trim |

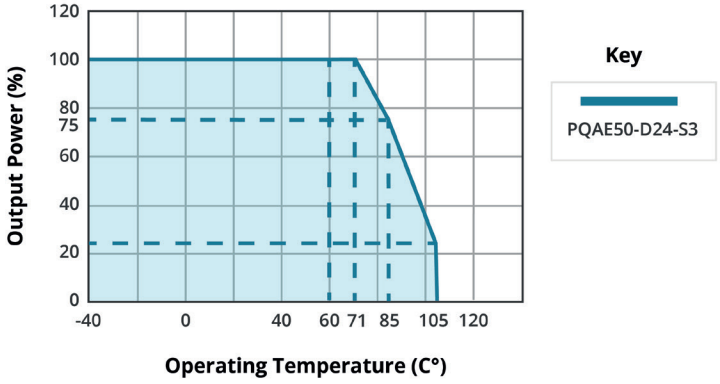


## DERATING CURVES

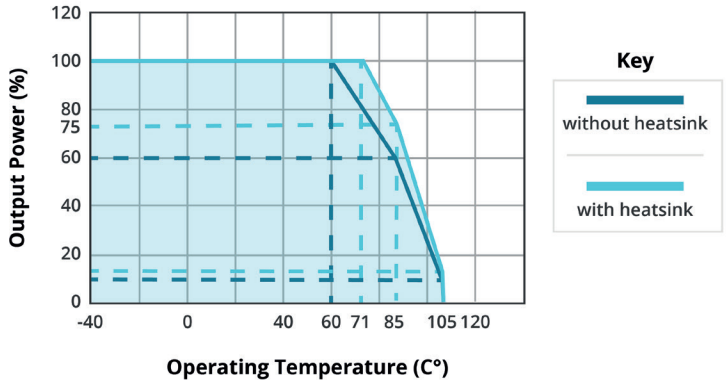
***TEMPERATURE DERATING CURVE***



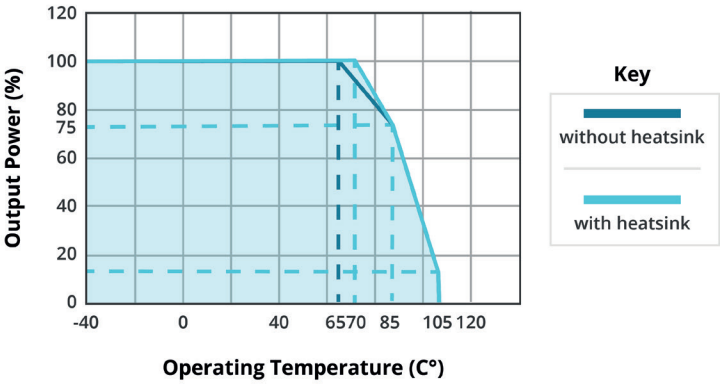

***TEMPERATURE DERATING CURVE***




***TEMPERATURE DERATING CURVE***
***3.3 Vdc & 5 Vdc output***
***48 Vdc input***




***TEMPERATURE DERATING CURVE***
***12 Vdc, 15 Vdc & 24 Vdc output***
***48 Vdc input***



## APPLICATION DESIGN REFERENCE

If you want to further reduce the input and output ripple, a filter capacitor may be connected to the input and output terminals (Figure 1) provided that the capacitance is less than the maximum capacitive load of the model, otherwise start-up problems may be caused if the capacitance is too large.

**Figure 1**

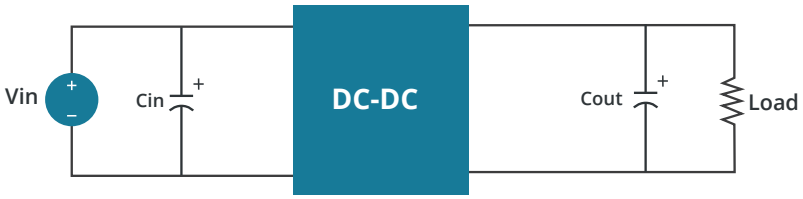



**Table 1**

| Vout (Vdc) | Cin (μF) | Cout (μF) |
|---|---|---|
| 3.3 | 100μF | 470μF/10V |
| 5 | | 470μF/10V |
| 12 | | 100μF/25V |
| 15 | | 100μF/25V |
| 24 | | 47μF/50V |

## EMC RECOMMENDED CIRCUIT

**Figure 2**

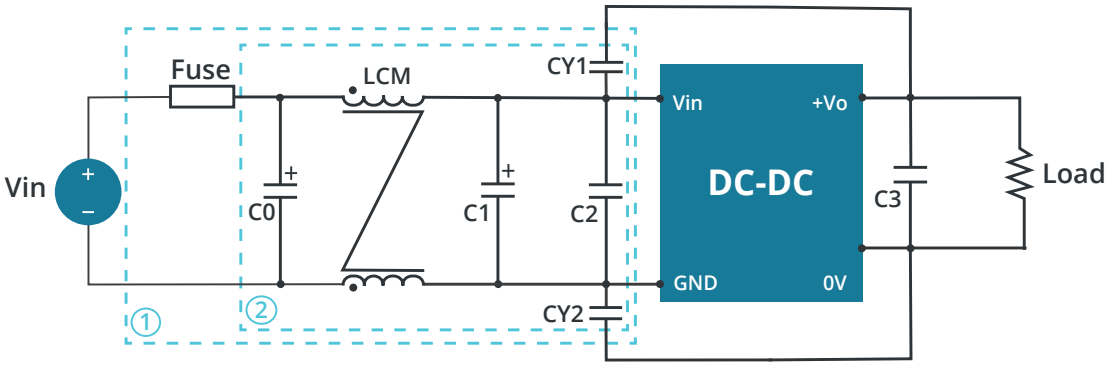



**Table 2**

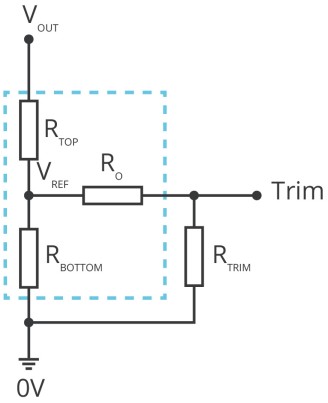
| MODEL | Vin: 24V | Vin: 48V |
|---|---|---|
| FUSE | T/4A/250Vac | T/2A/250Vac |
| C0 | 680μF/50V | 330μF/100V |
| LCM | 2.2mH | 2.2mH |
| C1 | 330μF/50V | 330μF/100V |
| C2 | 4.7μF/50V | 2.2μF/100V |
| CY1, CY2 | Y1 Safety capacitor 2.2nF/250Vac | Y1 Safety capacitor 3.3nF/250Vac |
| C3 | refer to Cout in Fig. 1 | refer to Cout in Fig. 1 |

# APPLICATION DESIGN REFERENCE (CONTINUED)

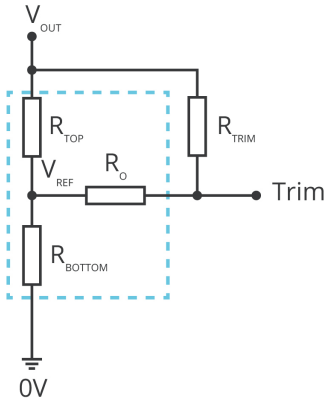
## TRIM FUNCTION FOR OUTPUT VOLTAGE ADJUSTMENT (OPEN IF UNUSED)

**Figure 3**

*Trim up*




*Trim down*




$$R_{TRIM} = \frac{a\ R_{BOTTOM}}{R_{BOTTOM} - a} - R_O \qquad a = \frac{V_{REF}}{V_O - V_{REF}} \cdot R_{TOP}$$

*Formula for Trim up*

$$R_{TRIM} = \frac{a\ R_{TOP}}{R_{TOP} - a} - R_O \qquad a = \frac{V_O - V_{REF}}{V_{REF}} \cdot R_{BOTTOM}$$

*Formula for Trim down*

Note: Trim resistor connection (dashed line shows internal resistor network).

**Table 3**

| Model number | Vout adjustable value | RT | R1 | R2 | R3 | Vref |
|---|---|---|---|---|---|---|
| | (V) | (KΩ) | (KΩ) | (KΩ) | (KΩ) | (V) |
| PQAE50-D24-S3 | Up: 3.63<br>Down: 2.97 | 15.0<br>18.7 | 4.83<br>4.83 | 2.87<br>2.87 | 4.7<br>4.7 | 1.24<br>1.24 |
| PQAE50-D24-S5 | Up: 5.5<br>Down: 4.5 | 13.3<br>5.4 | 2.97<br>2.97 | 2.87<br>2.87 | 4.7<br>4.7 | 2.5<br>2.5 |
| PQAE50-D24-S12 | Up: 13.2<br>Down: 10.8 | 7.6<br>60.7 | 10.90<br>10.90 | 2.87<br>2.87 | 15<br>15 | 2.5<br>2.5 |
| PQAE50-D24-S15 | Up: 16.5<br>Down: 13.5 | 8.9<br>90.2 | 14.35<br>14.35 | 2.87<br>2.87 | 15<br>15 | 2.5<br>2.5 |
| PQAE50-D24-S24 | Up: 26.4<br>Down: 21.6 | 21.6<br>185.9 | 24.77<br>24.77 | 2.87<br>2.87 | 5.1<br>5.1 | 2.5<br>2.5 |
| PQAE50-D48-S3 | Up: 3.63<br>Down: 2.97 | 10<br>13.5 | 4.83<br>4.83 | 2.87<br>2.87 | 10<br>10 | 1.24<br>1.24 |
| PQAE50-D48-S5 | Up: 5.5<br>Down: 4.5 | 4.3<br>1.5 | 2.87<br>2.87 | 2.87<br>2.87 | 10<br>10 | 2.5<br>2.5 |
| PQAE50-D48-S12 | Up: 13.2<br>Down: 10.8 | 7.6<br>60.7 | 10.90<br>10.90 | 2.87<br>2.87 | 15<br>15 | 2.5<br>2.5 |
| PQAE50-D48-S15 | Up: 16.5<br>Down: 13.5 | 8.9<br>90.2 | 14.35<br>14.35 | 2.87<br>2.87 | 15<br>15 | 2.5<br>2.5 |
| PQAE50-D48-S24 | Up: 26.4<br>Down: 21.6 | 21.6<br>185.9 | 48.77<br>48.77 | 2.87<br>2.87 | 5.1<br>5.1 | 2.5<br>2.5 |

Note: Value for $R_{TOP}$, $R_{BOTTOM}$, $R_O$, and $V_{REF}$ refer to Table 3 (fixed internal values).
$R_{TRIM}$: Trim resistance
a: User-defined parameter, no actual meanings
$V_{OUT}$: Nominal output voltage

## REVISION HISTORY

| rev. | description | date |
|---|---|---|
| 1.0 | initial release | 11/16/2020 |
| 1.01 | part number key updated | 12/14/2020 |
| 1.02 | mechanical drawings updated | 01/12/2021 |
| 1.03 | datasheet updated | 07/29/2021 |
| 1.04 | updated notes in model table | 10/01/2021 |
| 1.05 | application design reference section updated | 02/24/2022 |
| 1.06 | protections updated,<br>application design reference section updated | 07/22/2022 |

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

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