

**SERIES: PQAE50 | DESCRIPTION: DC-DC CONVERTER****FEATURES**

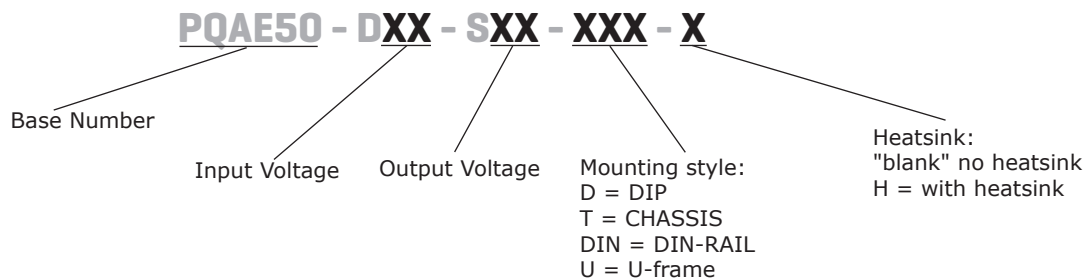
- up to 50 W isolated output
- 2:1 input range (18~36 Vdc, 36~75 Vdc)
- single, regulated output
- 1,500 Vdc isolation
- short circuit, over current, and over voltage protection
- input under voltage protection
- remote on/off
- wide operating temperature range -40~105°C
- efficiency up to 92%
- EN/BS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



| MODEL                       | input voltage |                          | output voltage<br>(Vdc) | output current |         | output power<br>max (W) | ripple and noise <sup>2</sup><br>max (mVp-p) | efficiency <sup>3</sup><br>typ (%) |
|-----------------------------|---------------|--------------------------|-------------------------|----------------|---------|-------------------------|--|------------------------------------|
|                             | typ (Vdc)     | range <sup>1</sup> (Vdc) |                         | min (A)        | max (A) |                         |  |                                    |
| PQAE50-D24-S3 <sup>4</sup>  | 24            | 18~36                    | 3.3                     | 0.5            | 10.0    | 33                      | 200  | 91                                 |
| PQAE50-D24-S5 <sup>4</sup>  | 24            | 18~36                    | 5                       | 0.5            | 10.0    | 50                      | 200  | 91                                 |
| PQAE50-D24-S12 <sup>4</sup> | 24            | 18~36                    | 12                      | 0.208          | 4.167   | 50                      | 250  | 91                                 |
| PQAE50-D24-S15 <sup>4</sup> | 24            | 18~36                    | 15                      | 0.167          | 3.333   | 50                      | 250  | 91                                 |
| PQAE50-D24-S24 <sup>4</sup> | 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  $\mu$ F ceramic and 10  $\mu$ F electrolytic capacitors on the output.
3. Measured at nominal input voltage and full load.
4. Model is not CE & UKCA certified.

**PART NUMBER KEY**

## INPUT

| parameter                   | conditions/description                                | min                  | typ     | max    | units |
|-----------------------------|---|----------------------|---------|--------|-------|
| input voltage               | 24 Vdc input models                                   | 18                   | 24      | 40     | Vdc   |
|                             | 48 Vdc input models                                   | 36                   | 48      | 80     | Vdc   |
| current (full load/no load) | 24 Vdc input models                                   | 3.3 Vdc output model | 1511/2  | 1545/- | mA    |
|                             |   | 5 Vdc output model   | 2289/3  | 2341/- | mA    |
|                             |   | 12 Vdc output model  | 2289/5  | 2341/- | mA    |
|                             |   | 15 Vdc output model  | 2289/11 | 2341/- | mA    |
|                             | 48 Vdc input models                                   | 24 Vdc output model  | 2289/4  | 2341/- | mA    |
|                             |   | 3.3 Vdc output model | 756/1   | 773/-  | mA    |
|                             |   | 5 Vdc output model   | 1145/2  | 1171/- | mA    |
|                             |   | 12 Vdc output model  | 1133/4  | 1158/- | mA    |
| start-up voltage            | 24 Vdc input models                                   |                      |         | 18     | Vdc   |
|                             | 48 Vdc input models                                   |                      |         | 36     | Vdc   |
| under voltage protection    | 24 Vdc input models                                   | 11                   | 13      |        | Vdc   |
|                             | 48 Vdc input models                                   | 26                   | 30      |        | Vdc   |
| surge voltage               | for maximum of 1 second                               |                      |         |        |       |
|                             | 24 Vdc input models                                   | -0.7                 |         | 50     | Vdc   |
| start-up time               | 48 Vdc input models                                   | -0.7                 |         | 80     | Vdc   |
|                             | nominal input, constant load                          |                      | 10      | 120    | ms    |
| CTRL <sup>1</sup>           | models ON (CTRL open or connect high level, 3~12 Vdc) |                      |         |        |       |
|                             | models OFF (CTRL connect GND or low level, 0~1.2 Vdc) |                      |         |        |       |
|                             | input current (models OFF)                            |                      |         |        |       |
| filter                      | 24 Vdc input models                                   |                      | 6       | 12     | mA    |
|                             | 48 Vdc input models                                   |                      | 2       | 12     | mA    |
| 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                      |     | ±3   | ±8    | %     |
|                              | 3.3 & 5 Vdc output models                 |     | ±3   | ±5    | %     |
| temperature coefficient      | other output models                       |     |      |       |       |
| trim                         | 100% load                                 |     |      | ±0.03 | %/°C  |
|                              |   |     | ±10  |       | %     |

## PROTECTIONS

| parameter                | conditions/description            | min | typ | max | units |
|--------------------------|-----------------------------------|-----|-----|-----|-------|
| over voltage protection  |                                   | 110 | 140 | 160 | %     |
| over current protection  |                                   | 110 | 140 | 200 | %     |
| short circuit protection | continuous, auto recovery, hiccup |     |     |     |       |

## SAFETY AND COMPLIANCE

| parameter             | conditions/description   | min       | typ   | max | units |
|-----------------------|--|-----------|-------|-----|-------|
| isolation voltage     | input to output at 1 mA for 1 minute   | 1,500     |       |     | Vdc   |
|                       | input or output to housing at 1 mA for 1 minute  | 1,000     |       |     | 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, BS EN   |           |       |     |       |
| 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  | %     |
| vibration             | 10 ~ 150Hz, 5G, 0.75mm. along X, Y and Z |     |     | 5   | G     |

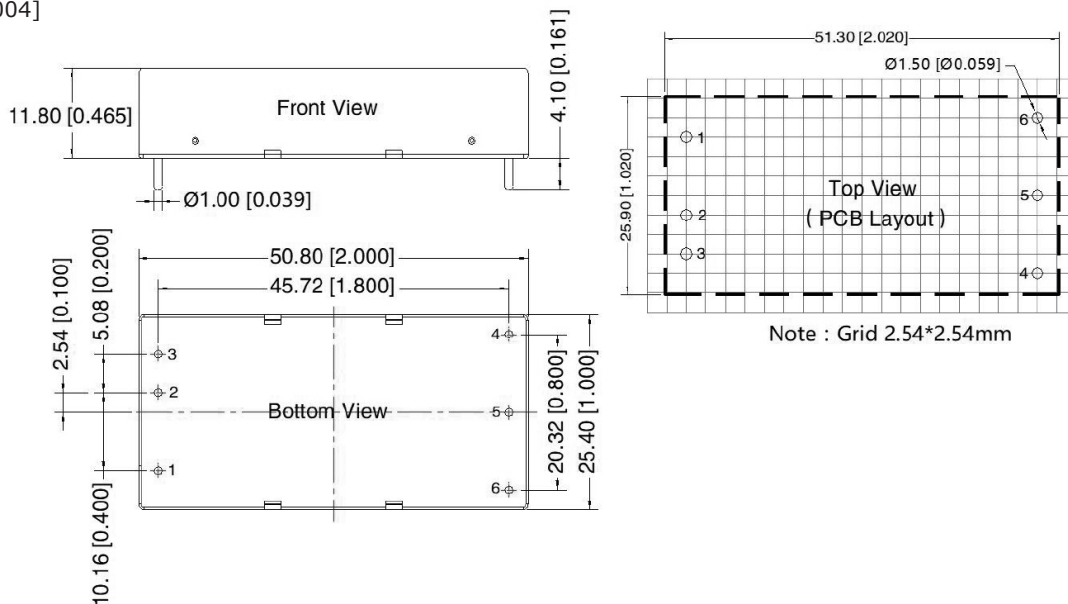
## MECHANICAL

| parameter                                | conditions/description                   | min | typ | max | units |
|--|--|-----|-----|-----|-------|
| dimensions                               | without heatsink:                        |     |     |     |       |
|  | horizontal package 50.80 × 25.40 × 11.80 |     |     |     | mm    |
|  | chassis mount 76.00 × 31.50 × 21.20      |     |     |     | mm    |
|  | DIN-Rail mounting 76.00 × 31.50 × 25.80  |     |     |     | mm    |
|  | U-frame mounting 55.00 × 52.30 × 19.00   |     |     |     | mm    |
|  | with heatsink:                           |     |     |     |       |
| horizontal package 51.40 × 26.20 × 16.50 |  |     |     |     | mm    |
| chassis mount 76.00 × 31.50 × 25.30      |  |     |     |     | mm    |
| DIN-Rail mounting 76.00 × 31.50 × 29.90  |  |     |     |     | mm    |
| case material                            | aluminum alloy                           |     |     |     |       |
| weight                                   | without heatsink:                        |     |     |     |       |
|  | horizontal package                       |     | 42  |     | g     |
|  | chassis mounting                         |     | 65  |     | g     |
|  | DIN-Rail mounting                        |     | 85  |     | g     |
|  | U-frame mounting                         |     | 70  |     | g     |
|  | with heatsink:                           |     |     |     |       |
| horizontal package                       |  | 50  |     | g   |       |
| chassis mounting                         |  | 73  |     | g   |       |
| DIN-Rail mounting                        |  | 93  |     | g   |       |

## MECHANICAL DRAWING

units: mm[inch]  
 pin diameter tolerance:  $\pm 0.10[\pm 0.004]$   
 general tolerance:  $\pm 0.50[\pm 0.020]$

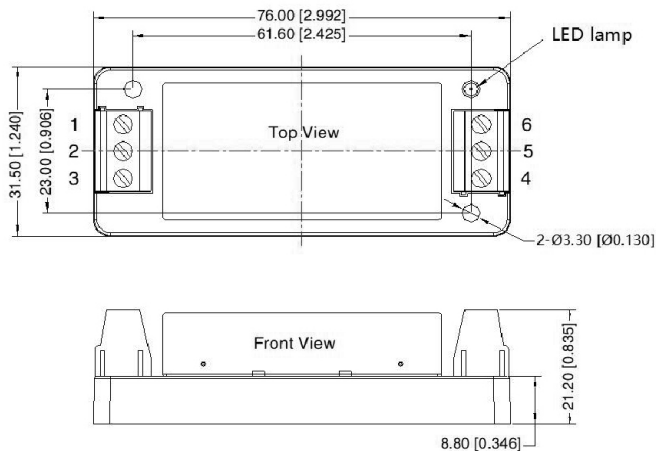
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | Function |
| 1               | CTRL     |
| 2               | GND      |
| 3               | Vin      |
| 4               | +Vo      |
| 5               | 0V       |
| 6               | Trim     |



### CHASSIS MOUNT

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

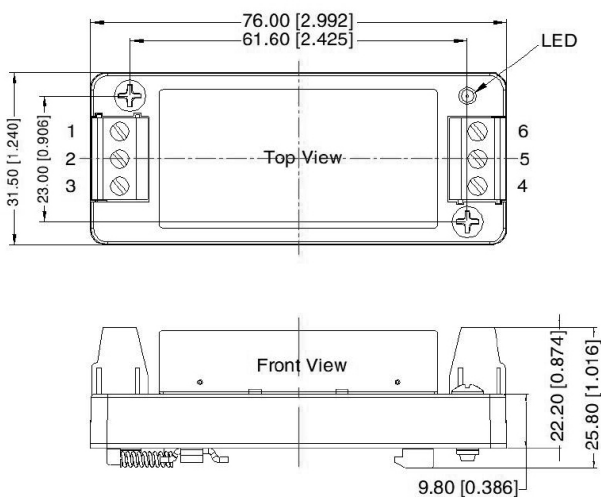
| PIN OUT |          |
|---------|----------|
| PIN     | Function |
| 1       | CTRL     |
| 2       | GND      |
| 3       | Vin      |
| 4       | +Vo      |
| 5       | 0V       |
| 6       | Trim     |



### DIN-RAIL MOUNT

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

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

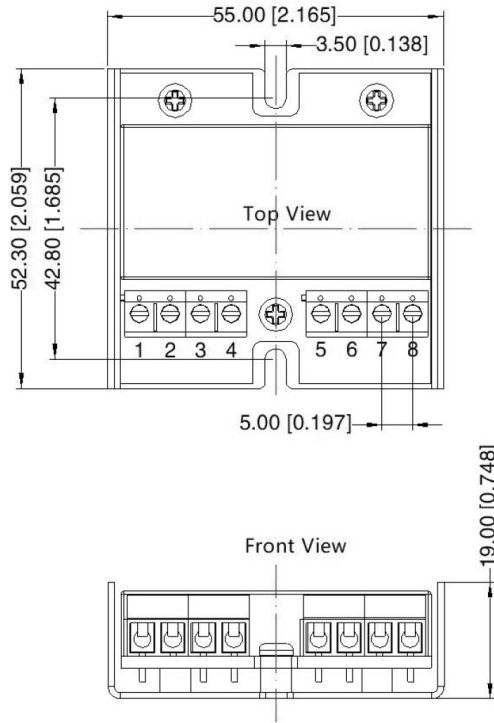


## MECHANICAL DRAWING (CONTINUED)

### U-FRAME

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

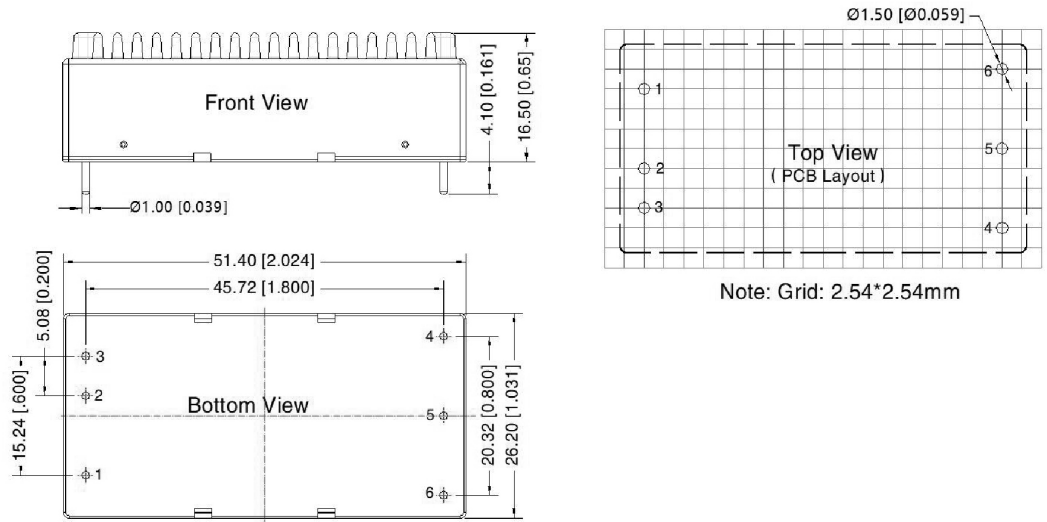
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | Function |
| 1               | GND      |
| 2               | Vin      |
| 3               | CTRL     |
| 4               | Case     |
| 5               | NC       |
| 6               | +Vo      |
| 7               | 0V       |
| 8               | Trim     |



### WITH HEATSINK

units: mm[inch]  
 pin diameter tolerance:  $\pm 0.10[\pm 0.004]$   
 general tolerance:  $\pm 0.50[\pm 0.020]$

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



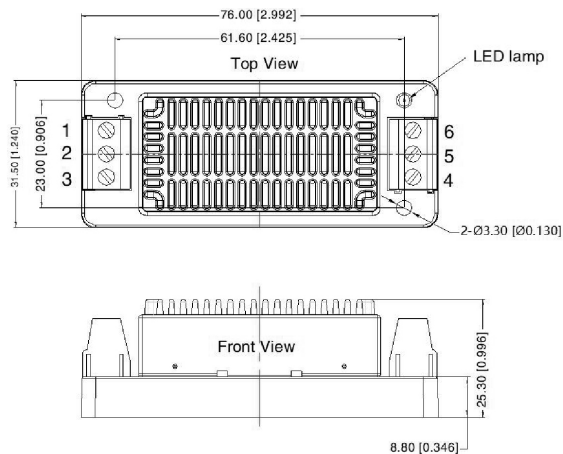
Note: Grid: 2.54\*2.54mm

## MECHANICAL DRAWING (CONTINUED)

### 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]

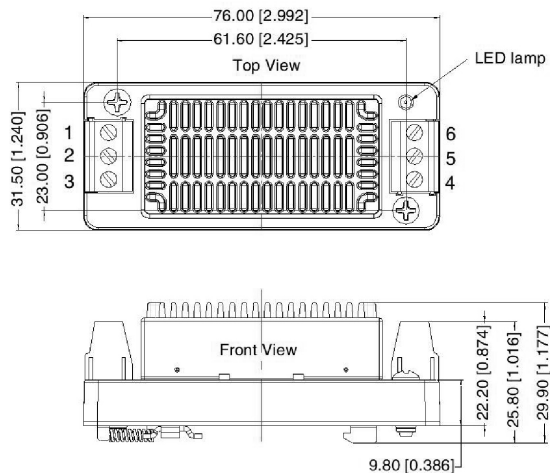
| PIN OUT |          |
|---------|----------|
| PIN     | Function |
| 1       | CTRL     |
| 2       | GND      |
| 3       | Vin      |
| 4       | +Vo      |
| 5       | 0V       |
| 6       | Trim     |



### DIN-RAIL MOUNT WITH HEATSINK

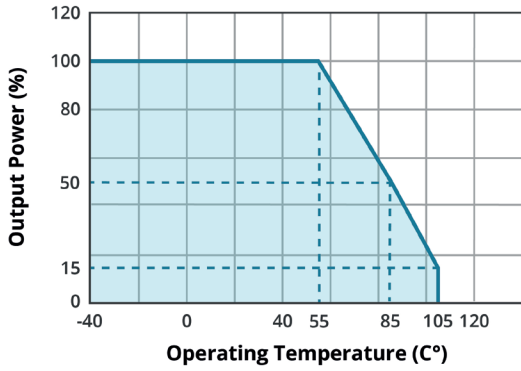
units: mm[inch]  
 mounting rail: TS35  
 wire range: 24-12 AWG  
 tightening torque: Max 0.4 N·m  
 general tolerance: ±1.00[±0.039]

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



## DERATING CURVES

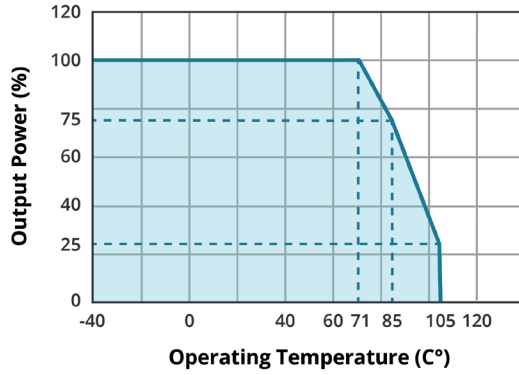
**TEMPERATURE DERATING CURVE**  
*without heatsink*



**Key**

- PQAE50-D24-S3
- PQAE50-D24-S5
- PQAE50-D24-S12
- PQAE50-D24-S15
- PQAE50-D24-S24

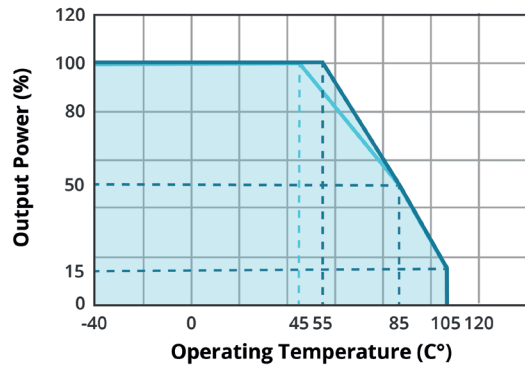
**TEMPERATURE DERATING CURVE**  
*with heatsink*



**Key**

- PQAE50-D24-S3-H
- PQAE50-D24-S5-H
- PQAE50-D24-S12-H
- PQAE50-D24-S15-H
- PQAE50-D24-S24-H

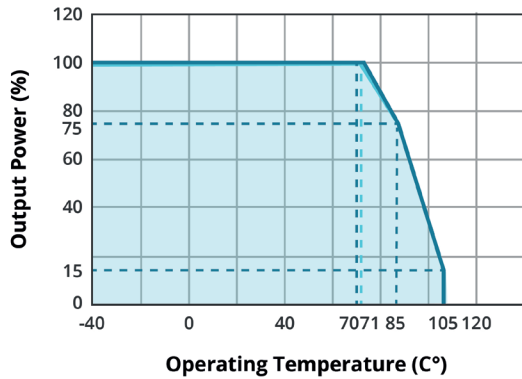
**TEMPERATURE DERATING CURVE**  
*without heatsink*



**Key**

- PQAE50-D48-S3
- PQAE50-D48-S5
- PQAE50-D48-S12
- PQAE50-D48-S15
- PQAE50-D48-S24

**TEMPERATURE DERATING CURVE**  
*with heatsink*



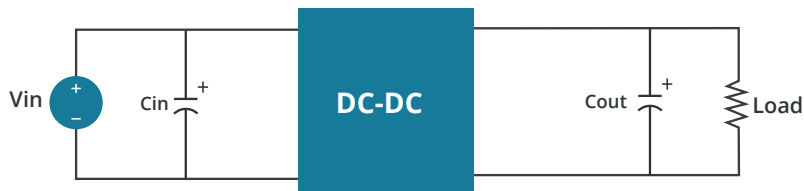
**Key**

- PQAE50-D48-S3-H
- PQAE50-D48-S5-H
- PQAE50-D48-S12-H
- PQAE50-D48-S15-H
- PQAE50-D48-S24-H

## 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**

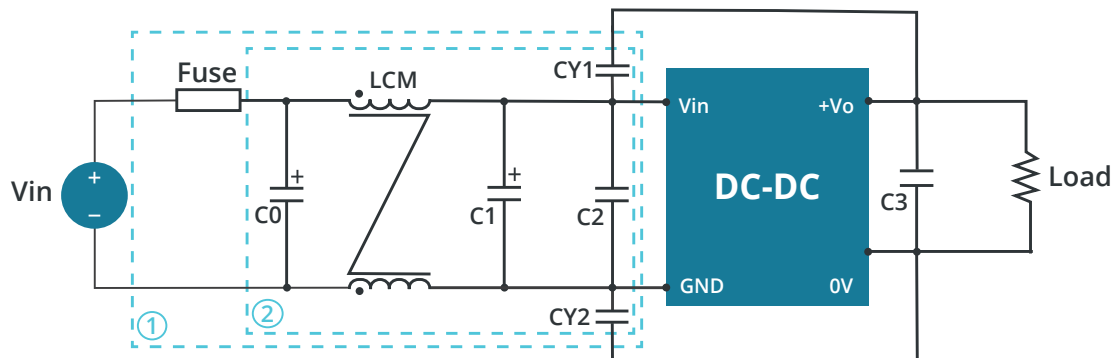


**Table 1**

| Vin (Vdc) | Vout (Vdc) | Cin (μF) | Cout (μF) |
|-----------|------------|----------|-----------|
| 24/48     | 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<br>2.2nF/250Vac | Y1 Safety capacitor<br>3.3nF/250Vac |
| C3       | refer to Cout in Table 1            | refer to Cout in Table 1            |

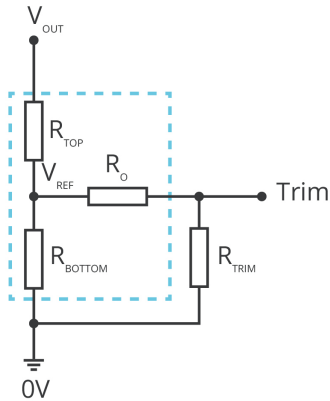


## APPLICATION DESIGN REFERENCE (CONTINUED)

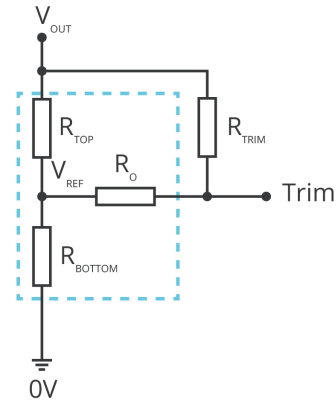
### TRIM FUNCTION FOR OUTPUT VOLTAGE ADJUSTMENT (OPEN IF UNUSED)

Figure 3

Trim up



Trim down



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

Formula for Trim up

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

Formula for Trim down

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

Table 3

| Model number   | Vout adjustable value (V) | RT (KΩ)       | R1 (KΩ)        | R2 (KΩ)      | R3 (KΩ)    | Vref (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 |
| 1.07 | U-frame option added, CE certification updated for 24V models        | 10/24/2022 |

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



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