

**SERIES:** PQA50-D | **DESCRIPTION:** DC-DC CONVERTER

**FEATURES**

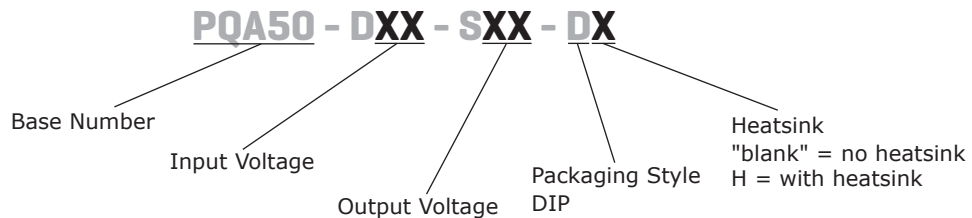
- up to 50 W isolated output
- 2:1 input range (18~36 Vdc, 36~75 Vdc)
- smaller package
- single, regulated output
- 1,500 Vdc isolation
- short circuit, over current, input under voltage protection
- remote on/off
- operating temperature range (-40~85°C)
- six sided metal shielding
- efficiency up to 93%



| MODEL           | input voltage |                | output voltage<br>(Vdc) | output current |            | output power<br>(W) | ripple and noise <sup>1</sup><br>(mVp-p) | efficiency<br>(%) |
|-----------------|---------------|----------------|-------------------------|----------------|------------|---------------------|--|-------------------|
|                 | typ<br>(Vdc)  | range<br>(Vdc) |                         | min<br>(mA)    | max<br>(A) |                     |  |                   |
| PQA50-D24-S3-D  | 24            | 18~36          | 3.3                     | 500            | 10         | 33                  | 150                                      | 91                |
| PQA50-D24-S5-D  | 24            | 18~36          | 5                       | 500            | 10         | 50                  | 150                                      | 93                |
| PQA50-D24-S12-D | 24            | 18~36          | 12                      | 208            | 4.167      | 50                  | 150                                      | 93                |
| PQA50-D24-S15-D | 24            | 18~36          | 15                      | 167            | 3.333      | 50                  | 150                                      | 93                |
| PQA50-D24-S24-D | 24            | 18~36          | 24                      | 104            | 2.083      | 50                  | 150                                      | 93                |
| PQA50-D48-S3-D  | 48            | 36~75          | 3.3                     | 500            | 10         | 33                  | 150                                      | 91                |
| PQA50-D48-S5-D  | 48            | 36~75          | 5                       | 500            | 10         | 50                  | 150                                      | 93                |
| PQA50-D48-S12-D | 48            | 36~75          | 12                      | 208            | 4.167      | 50                  | 150                                      | 93                |
| PQA50-D48-S15-D | 48            | 36~75          | 15                      | 167            | 3.333      | 50                  | 150                                      | 93                |
| PQA50-D48-S24-D | 48            | 36~75          | 24                      | 104            | 2.083      | 50                  | 150                                      | 93                |

Notes: 1. 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.

**PART NUMBER KEY**



## INPUT

| parameter                   | conditions/description                                    | min  | typ | max | units |
|-----------------------------|---|------|-----|-----|-------|
| operating input voltage     | 24 Vdc input models                                       | 18   | 24  | 36  | Vdc   |
|                             | 48 Vdc input models                                       | 36   | 48  | 75  | Vdc   |
| start-up voltage            | input under voltage protection                            |      |     |     |       |
|                             | 24 Vdc input models                                       | 18   |     |     | Vdc   |
|                             | 48 Vdc input models                                       | 36   |     |     | Vdc   |
|                             | input over voltage protection                             |      |     |     |       |
|                             | 24 Vdc input models                                       |      |     | 36  | Vdc   |
|                             | 48 Vdc input models                                       |      |     | 75  | Vdc   |
| under/over voltage shutdown | input under voltage protection                            |      |     |     |       |
|                             | 24 Vdc input models                                       |      |     | 16  | Vdc   |
|                             | 48 Vdc input models                                       |      |     | 32  | Vdc   |
|                             | input over voltage protection                             |      |     |     |       |
|                             | 24 Vdc input models                                       | 40   |     |     | Vdc   |
|                             | 48 Vdc input models                                       | 81   |     |     | Vdc   |
| surge voltage               | for maximum of 1 second                                   |      |     |     |       |
|                             | 24 Vdc input models                                       | -0.7 |     | 50  | Vdc   |
|                             | 48 Vdc input models                                       | -0.7 |     | 100 | Vdc   |
| start-up time               | nominal input, constant load                              |      | 10  |     | ms    |
| CTRL <sup>1</sup>           | 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)                                |      | 6   |     | 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              | 10% to 100% load                          |     | ±0.5  | ±1   | %     |
| voltage accuracy             |   |     | ±1    | ±3   | %     |
| adjustability                |   |     | ±10   |      | %     |
| switching frequency          | PWM mode                                  |     | 300   |      | kHz   |
| transient recovery time      | 25% load step change                      |     | 300   | 500  | µs    |
| transient response deviation | 25% load step change                      |     | ±3    | ±5   | %     |
| temperature coefficient      | 100% load                                 |     | ±0.02 |      | %/°C  |

## PROTECTIONS

| parameter                            | conditions/description                 | min | typ | max | units |
|--------------------------------------|--|-----|-----|-----|-------|
| over voltage protection <sup>2</sup> | 3.3 Vdc output models                  |     | 3.9 |     | Vdc   |
|                                      | 5 Vdc output models                    |     | 6.2 |     | Vdc   |
|                                      | 12 Vdc output models                   |     | 15  |     | Vdc   |
|                                      | 15 Vdc output models                   |     | 18  |     | Vdc   |
|                                      | 24 Vdc output models                   |     | 30  |     | Vdc   |
| over current protection              |  |     | 135 |     | %     |
| short circuit protection             | continuous, automatic recovery, hiccup |     |     |     |       |
| over temperature protection          |  |     | 110 |     | °C    |

Note 2. Module needs to be re-started after over voltage protection.

## SAFETY AND COMPLIANCE

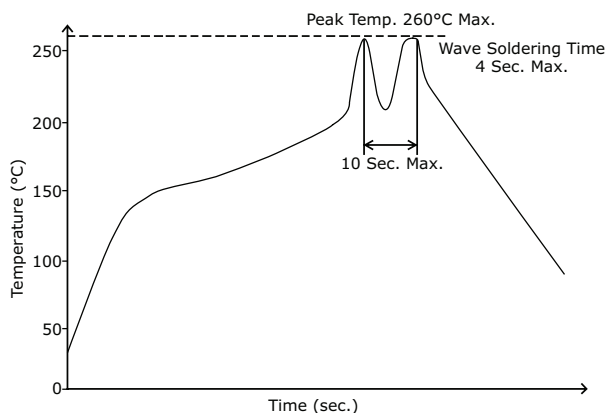
| parameter                    | conditions/description   | min       | typ   | max | units |
|------------------------------|--|-----------|-------|-----|-------|
| isolation voltage            | input to output at 1 mA for 1 minute                                     | 1,500     |       |     | Vdc   |
| isolation resistance         | input to output at 500 Vdc   | 1,000     |       |     | MΩ    |
| isolation capacitance        | input to output at 100 kHz, 0.1 Vdc                                      |           | 2,000 |     | pF    |
| conducted emissions          | CISPR22/EN55022 class B (external circuit required, see figure 1)        |           |       |     |       |
| radiated emissions           | CISPR22/EN55022 class B (external circuit required, see figure 1)        |           |       |     |       |
| ESD                          | IEC/EN61000-4-2 class B, contact ± 4kV                                   |           |       |     |       |
| radiated immunity            | IEC/EN61000-4-3 class A, 10V/m   |           |       |     |       |
| EFT/burst                    | IEC/EN61000-4-4 class B, ± 2kV (external circuit required, see figure 1) |           |       |     |       |
| surge                        | IEC/EN61000-4-5 class B, ± 2kV (external circuit required, see figure 1) |           |       |     |       |
| conducted immunity           | IEC/EN61000-4-6 class A, 3 Vr.m.s  |           |       |     |       |
| voltage dips & interruptions | IEC/EN61000-4-29 class B, 0%-70%   |           |       |     |       |
| MTBF                         | as per MIL-HDBK-217F @ 25°C  | 1,000,000 |       |     | hours |
| RoHS                         | 2011/65/EU   |           |       |     |       |

## ENVIRONMENTAL

| parameter             | conditions/description                          | min | typ | max | units |
|-----------------------|---|-----|-----|-----|-------|
| operating temperature | see derating curve                              | -40 |     | 85  | °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             |     |     | 10  | G     |

## SOLDERABILITY

| parameter      | conditions/description          | min | typ | max | units |
|----------------|---------------------------------|-----|-----|-----|-------|
| hand soldering | 1.5 mm from case for 10 seconds |     |     | 300 | °C    |
| wave soldering | see wave soldering profile      |     |     | 260 | °C    |



## MECHANICAL

| parameter     | conditions/description   | min | typ      | max | units    |
|---------------|--|-----|----------|-----|----------|
| dimensions    | board mount: 50.80 x 25.40 x 11.80<br>board mount with heatsink: 50.80 x 25.40 x 16.30 |     |          |     | mm<br>mm |
| case material | aluminum alloy   |     |          |     |          |
| weight        | board mount<br>board mount with heatsink   |     | 35<br>43 |     | g<br>g   |

## MECHANICAL DRAWING

### BOARD MOUNT

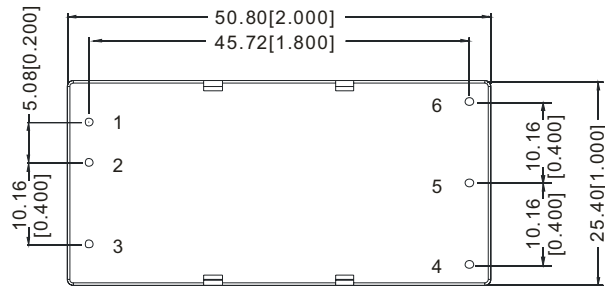
units: mm[inch]

tolerance:  $\pm 0.30[\pm 0.012]$

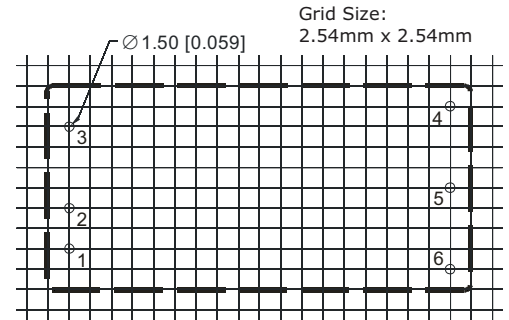
pin diameter tolerance:  $\pm 0.10[\pm 0.004]$

pin height tolerance:  $\pm 0.50[\pm 0.020]$

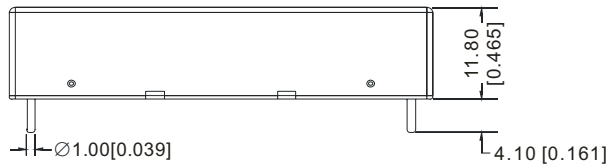
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | Function |
| 1               | Vin      |
| 2               | GND      |
| 3               | Ctrl     |
| 4               | Trim     |
| 5               | 0V       |
| 6               | +Vo      |



Bottom View



PCB Layout Top View



Front View

### BOARD MOUNT WITH HEATSINK

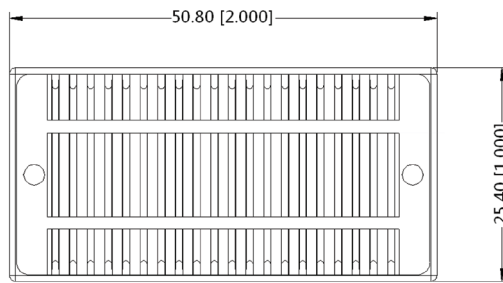
units: mm[inch]

tolerance:  $\pm 0.30[\pm 0.012]$

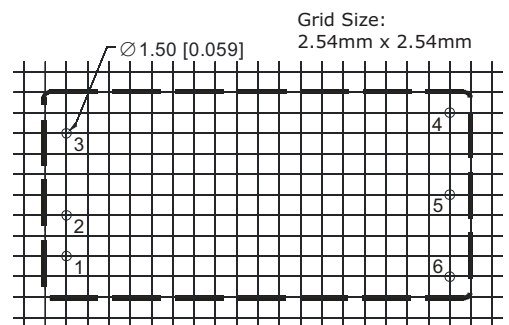
pin diameter tolerance:  $\pm 0.10[\pm 0.004]$

pin height tolerance:  $\pm 0.50[\pm 0.020]$

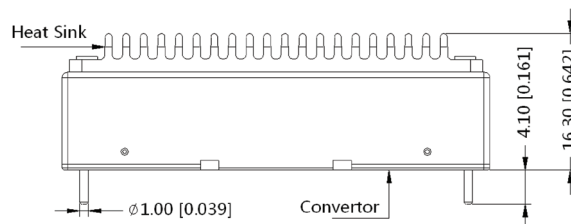
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | Function |
| 1               | Vin      |
| 2               | GND      |
| 3               | Ctrl     |
| 4               | Trim     |
| 5               | 0V       |
| 6               | +Vo      |



Top View

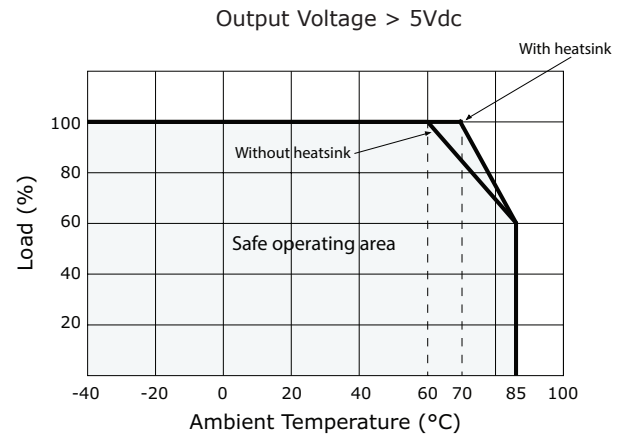
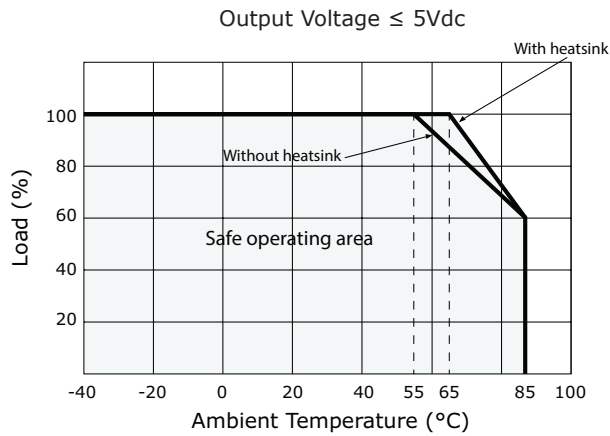


PCB Layout Top View



Front View

## DERATING CURVES



## EMC RECOMMENDED CIRCUIT

Figure 1

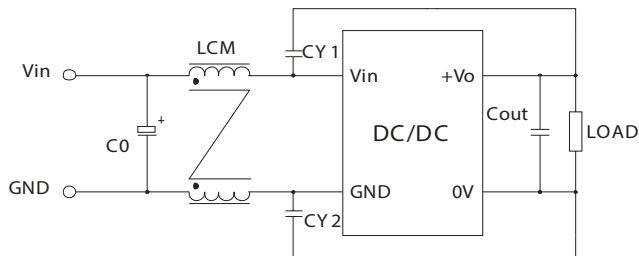


Table 1

| Recommended external circuit components |                 |                  |
|---|-----------------|------------------|
| Vin (Vdc)                               | 24              | 48               |
| C0                                      | 330 $\mu$ F/50V | 330 $\mu$ F/100V |
| CY1, CY2                                | 1nF/2kV         | 1nF/2kV          |
| LCM                                     | 2.2mH           | 2.2mH            |

Note: 1. See Table 3 for C<sub>out</sub> values.

## TEST CONFIGURATION

Figure 2

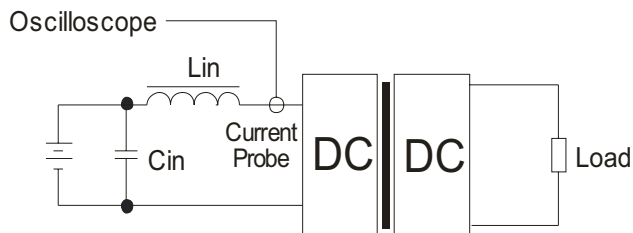


Table 2

| External components |  |
|---------------------|--|
| Lin                 | 4.7 $\mu$ H                                  |
| Cin                 | 220 $\mu$ F, ESR $<$ 1.0 $\Omega$ at 100 kHz |

Note: 1. Input reflected-ripple current is measured with an inductor Lin and Capacitor Cin to simulate source impedance.

## APPLICATION NOTES

### 1. Requirement on output load

To ensure this module can operate efficiently and reliably, the minimum output load cannot be less than 5% of the full load during operation. If the actual output power is small, please connect a resistor at the output end in parallel to increase the load.

### 2. Recommended circuit

This series has been tested according to the following recommended testing circuit before leaving the factory. This series should be tested under load (see Figure 3). If you want to further decrease the input/output ripple, you can increase capacitance properly or choose capacitors with low ESR (see table 3). However, the capacitance must not exceed the maximum capacitive load or a start-up problem might arise (see table 4).

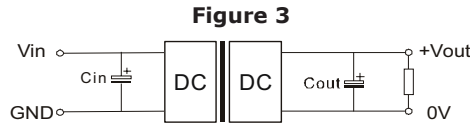


Figure 3

Table 3

| Vout (Vdc) | Cin (μF) | Cout (μF) |
|------------|----------|-----------|
| 3.3        | 100      | 220       |
| 5          | 100      | 220       |
| 12         | 100      | 100       |
| 15         | 100      | 100       |
| 24         | 100      | 47        |

Table 4

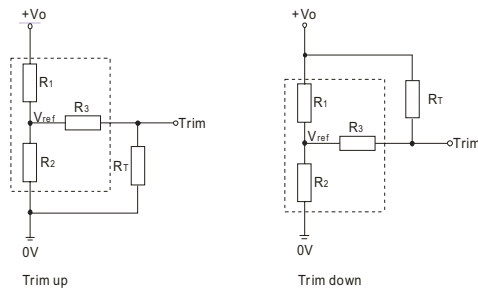
| Vout (Vdc) | Max. Capacitive Load (μF) |
|------------|---------------------------|
| 3.3        | 27000                     |
| 5          | 18900                     |
| 12         | 3700                      |
| 15         | 2000                      |
| 24         | 1000                      |

### 3. Output Voltage Trimming

Leave open if not used.

Figure 4

Application Circuit for Trim Pin  
(part in broken line is the interior of models)



Formula for Trim Resistor

$$\text{up: } R_T = \frac{aR_2}{R_2 - a} - R_3 \quad a = \frac{V_{ref}}{V_o' - V_{ref}} \cdot R_1$$

$$\text{down: } R_T = \frac{aR_1}{R_1 - a} - R_3 \quad a = \frac{V_o' - V_{ref}}{V_{ref}} \cdot R_2$$

Note: Value for R1, R2, R3, and Vref (see Table 5)

R<sub>T</sub>: Trim Resistor

a: User-defined parameter, no actual meanings

Vo': The trim up/down voltage

Table 5

| Vout (Vdc) | R1 (kΩ) | R2 (kΩ) | R3 (kΩ) | Vref (V) |
|------------|---------|---------|---------|----------|
| 3.3        | 4.788   | 2.87    | 15      | 1.24     |
| 5          | 2.87    | 2.87    | 12.1    | 2.5      |
| 12         | 11      | 2.87    | 22      | 2.5      |
| 15         | 15      | 3       | 22      | 2.5      |
| 24         | 20      | 2.308   | 15      | 2.5      |

Notes: 1. Minimum load shouldn't be less than 5%, otherwise ripple may increase dramatically. Operation under minimum load will not damage the converter, however, they may not meet all specifications listed.  
2. Maximum capacitive load is tested at input voltage range and full load.  
3. All specifications are measured at Ta=25°C, humidity<75%, nominal input voltage and rated output load unless otherwise specified.

## REVISION HISTORY

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| rev. | description                          | date       |
|------|--------------------------------------|------------|
| 1.0  | initial release                      | 07/01/2013 |
| 1.01 | added heat sink option, updated spec | 10/29/2013 |
| 1.02 | updated datasheet                    | 07/14/2015 |

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



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