

**SERIES: PDQE15-D | DESCRIPTION: DC-DC CONVERTER**
**FEATURES**

- 15 W isolated output
- ultra-wide input voltage range
- single/dual regulated outputs
- 1500 Vdc isolation
- extended temperature range (-40~105°C)
- input under-voltage protection
- output short circuit, over-current, over-voltage protection
- DIP package
- EN 62368-1, UL 62368-1



| MODEL                         | input voltage |             | output voltage | output current |          | output power | ripple & noise <sup>1</sup> | efficiency <sup>2</sup> |
|-------------------------------|---------------|-------------|----------------|----------------|----------|--------------|-----------------------------|-------------------------|
|                               | typ (Vdc)     | range (Vdc) |                | min (mA)       | max (mA) | max (W)      | max (mVp-p)                 | typ (%)                 |
| PDQE15-Q24-S3-D <sup>3</sup>  | 24            | 9~36        | 3.3            | 0              | 4000     | 13.2         | 100                         | 88                      |
| PDQE15-Q24-S5-D <sup>3</sup>  | 24            | 9~36        | 5              | 0              | 3000     | 15           | 100                         | 90                      |
| PDQE15-Q24-S12-D <sup>3</sup> | 24            | 9~36        | 12             | 0              | 1250     | 15           | 100                         | 90                      |
| PDQE15-Q24-S15-D <sup>3</sup> | 24            | 9~36        | 15             | 0              | 1000     | 15           | 100                         | 91                      |
| PDQE15-Q24-S24-D <sup>3</sup> | 24            | 9~36        | 24             | 0              | 625      | 15           | 100                         | 91                      |
| PDQE15-Q24-D5-D <sup>3</sup>  | 24            | 9~36        | ±5             | 0              | ±1500    | 15           | 200                         | 87                      |
| PDQE15-Q24-D12-D <sup>3</sup> | 24            | 9~36        | ±12            | 0              | ±625     | 15           | 200                         | 90                      |
| PDQE15-Q24-D15-D <sup>3</sup> | 24            | 9~36        | ±15            | 0              | ±500     | 15           | 200                         | 90                      |
| PDQE15-Q24-D24-D <sup>3</sup> | 24            | 9~36        | ±24            | 0              | ±312     | 15           | 200                         | 89                      |
| PDQE15-Q48-S3-D               | 48            | 18~75       | 3.3            | 0              | 4000     | 13.2         | 100                         | 88                      |
| PDQE15-Q48-S5-D               | 48            | 18~75       | 5              | 0              | 3000     | 15           | 100                         | 90                      |
| PDQE15-Q48-S12-D              | 48            | 18~75       | 12             | 0              | 1250     | 15           | 100                         | 91                      |
| PDQE15-Q48-S15-D              | 48            | 18~75       | 15             | 0              | 1000     | 15           | 100                         | 91                      |
| PDQE15-Q48-S24-D              | 48            | 18~75       | 24             | 0              | 625      | 15           | 100                         | 91                      |
| PDQE15-Q48-D5-D               | 48            | 18~75       | ±5             | 0              | ±1500    | 15           | 200                         | 86                      |
| PDQE15-Q48-D12-D              | 48            | 18~75       | ±12            | 0              | ±625     | 15           | 200                         | 90                      |
| PDQE15-Q48-D15-D              | 48            | 18~75       | ±15            | 0              | ±500     | 15           | 200                         | 90                      |
| PDQE15-Q48-D24-D              | 48            | 18~75       | ±24            | 0              | ±312     | 15           | 200                         | 90                      |

Notes: 1. From 5~100% load, nominal input, 20 MHz bandwidth oscilloscope, with 10  $\mu$ F tantalum and 1  $\mu$ F ceramic capacitors on the output. From 0~5% load, ripple and noise is <5%  $V_o$ .  
 2. Measured at nominal input voltage, full load.  
 3. Model is not CE or UKCA certified.  
 4. All specifications are measured at  $T_a=25^\circ\text{C}$ , humidity < 75%, 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   |
| start-up voltage                  | 24 Vdc input models   |  |      | 9   | Vdc   |
|                                   | 48 Vdc input models   |  |      | 18  | Vdc   |
| surge voltage                     | for maximum of 1 second   |  |      |     |       |
|                                   | 24 Vdc input models   | -0.7   |      | 50  | Vdc   |
|                                   | 48 Vdc input models   | -0.7   |      | 100 | Vdc   |
| under voltage shutdown            | 24 Vdc input models   | 5.5  | 6.5  |     | Vdc   |
|                                   | 48 Vdc input models   | 12   | 15.5 |     | Vdc   |
| current                           | 24 Vdc input models   | 3.3 Vdc output models<br>5, 12 Vdc output models<br>15, 24 Vdc output models<br>all dual output models |      | 640 | mA    |
|                                   |   |  |      | 710 | mA    |
|                                   |   |  |      | 703 | mA    |
|                                   |   |  |      | 958 | mA    |
|                                   | 48 Vdc input models   | 3.3 Vdc output models<br>5 Vdc output models<br>12, 15, 24 Vdc output models<br>all dual output models |      | 320 | mA    |
|                                   |   |  |      | 356 | mA    |
|                                   |   |  |      | 352 | mA    |
|                                   |   |  |      | 703 | mA    |
| remote on/off (CTRL) <sup>5</sup> | turn on (CTRL pin open or pulled high (3.5~12 Vdc))<br>turn off (CTRL pin pulled low to GND (0~1.2 Vdc))<br>input current when switched off |  | 2    | 7   | mA    |
| filter                            | Pi filter   |  |      |     |       |

Notes: 5. The voltage of the CTRL pin is referenced to input GND pin.

## OUTPUT

| parameter                            | conditions/description                | min | typ  | max   | units |
|--------------------------------------|---------------------------------------|-----|------|-------|-------|
| maximum capacitive load <sup>6</sup> | 3.3, 5 Vdc output models              |     |      | 4,700 | μF    |
|                                      | 12 Vdc output models                  |     |      | 1,000 | μF    |
|                                      | 15 Vdc output models                  |     |      | 820   | μF    |
|                                      | 24 Vdc output models                  |     |      | 270   | μF    |
|                                      | ±5 Vdc output models                  |     |      | 1,500 | μF    |
|                                      | ±12 Vdc output models                 |     |      | 470   | μF    |
|                                      | ±15 Vdc output models                 |     |      | 330   | μF    |
|                                      | ±24 Vdc output models                 |     |      | 200   | μF    |
| voltage accuracy <sup>7</sup>        | single output models: 0% to full load |     | ±1   | ±3    | %     |
|                                      | dual output models: 5% to full load   |     | ±1   | ±3    | %     |
| line regulation                      | from low line to high line, full load |     |      |       |       |
|                                      | positive outputs                      |     | ±0.2 | ±0.5  | %     |
|                                      | negative outputs                      |     | ±0.4 | ±1    | %     |
| load regulation <sup>8</sup>         | from 5% to full load                  |     | ±0.5 | ±1    | %     |

Note: 6. Tested at input voltage range and full load.

7. At 0~5% load, the max output voltage accuracy for the dual output models is ±4%.

8. At 0~100% load, the max load regulation for the dual output models is ±5%.

## OUTPUT (CONTINUED)

| parameter                         | conditions/description  | min | typ            | max            | units       |
|-----------------------------------|---|-----|----------------|----------------|-------------|
| cross regulation                  | dual output models:<br>main output 50% load<br>secondary output from 10~100% load                                   |     |                | ±5             | %           |
| start-up time                     | nominal input, constant resistive load  |     | 10             |                | ms          |
| adjustability <sup>9</sup>        | see application notes   |     | ±10            |                | %           |
| switching frequency <sup>10</sup> | PWM mode<br>3.3, 5 Vdc output models<br>all other models  |     | 300<br>270     |                | kHz<br>kHz  |
| transient recovery time           | 25% load step change, nominal input voltage   |     | 300            | 500            | µs          |
| transient response deviation      | 25% load step change, nominal input voltage<br>3.3, 5 Vdc output models<br>±5 Vdc output models<br>all other models |     | ±3<br>±3<br>±3 | ±7<br>±8<br>±5 | %<br>%<br>% |
| temperature coefficient           | at full load  |     |                | ±0.03          | %/°C        |

Note: 9. For single output models only.

10. Value is based on full load. At loads &lt;50%, the switching frequency decreases with decreasing load

## PROTECTIONS

| parameter                | conditions/description                     | min        | typ        | max        | units  |
|--------------------------|--|------------|------------|------------|--------|
| over voltage protection  |  | 110        |            | 160        | %      |
| over current protection  | single output models<br>dual output models | 110<br>110 | 150<br>200 | 190<br>270 | %<br>% |
| short circuit protection | hiccup, continuous, self recovery          |            |            |            |        |

## SAFETY AND COMPLIANCE

| parameter                      | conditions/description  | min            | typ   | max | units      |
|--------------------------------|---|----------------|-------|-----|------------|
| isolation voltage              | input to output for 1 minute at 1 mA<br>input/output to case for 1 minute at 1 mA   | 1,500<br>1,000 |       |     | Vdc<br>Vdc |
| isolation resistance           | input to output at 500 Vdc  | 1,000          |       |     | MΩ         |
| isolation capacitance          | input to output, 100 kHz / 0.1 V  |                | 2,000 |     | pF         |
| safety approvals <sup>11</sup> | certified to 62368-1: IEC, EN, UL   |                |       |     |            |
| conducted emissions            | CISPR32/EN55032, class A (no external circuit); class B (external circuit required, see Figure 3-b, 4-b)                                  |                |       |     |            |
| radiated emissions             | CISPR32/EN55032, class A (no external circuit); class B (external circuit required, see Figure 3-b, 4-b)                                  |                |       |     |            |
| ESD                            | IEC/EN61000-4-2, contact ±6 kV; air ±8 kV, class B (single output models)<br>IEC/EN61000-4-2, contact ±4 kV, class B (dual output models) |                |       |     |            |
| radiated immunity              | IEC/EN61000-4-3, 10 V/m, class A  |                |       |     |            |
| EFT/burst                      | IEC/EN61000-4-4, ±2 kV, class B (external circuit required, see Figure 3-a, 4-a)  |                |       |     |            |
| surge                          | IEC/EN61000-4-5, line-line ±2 kV, class B (external circuit required, see Figure 3-a, 4-a)  |                |       |     |            |
| conducted immunity             | IEC/EN61000-4-6, 3 Vrms, class A  |                |       |     |            |
| MTBF                           | as per MIL-HDBK-217F, 25°C  | 1,000,000      |       |     | hours      |
| RoHS                           | yes   |                |       |     |            |

Note: 11. UL approval only on single output models.

**ENVIRONMENTAL**

| parameter             | conditions/description                         | min | typ | max | units |
|-----------------------|--|-----|-----|-----|-------|
| operating temperature | see derating curves                            | -40 |     | 95  | °C    |
|                       | 3.3, 5 Vdc output models                       | -40 |     | 105 | °C    |
|                       | all other models                               |     |     |     |       |
| storage temperature   |  | -55 |     | 125 | °C    |
| storage humidity      | non-condensing                                 | 5   |     | 95  | %     |
| vibration             | 10~150 Hz, 0.75 mm for 90 minutes on each axis |     | 5   |     | G     |

**DERATING CURVES**

**TEMPERATURE DERATING CURVE**  
**3.3, 5 Vdc input models**



**TEMPERATURE DERATING CURVE**  
**12, 15, 24 Vdc input models**



**TEMPERATURE DERATING CURVE**  
**all other input models**



## 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    | 25.40 x 25.40 x 11.70 [1.000 x 1.000 x 0.461 inch] |     |     |     | mm    |
| case material | aluminum alloy                                     |     |     |     |       |
| weight        |  |     | 15  |     | g     |

## MECHANICAL DRAWING

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

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



## APPLICATION CIRCUIT

This series has been tested according to the following recommended circuits (Figures 1 & 2) before leaving the factory. If you want to further reduce the input and output ripple, you can increase the input and output capacitors or select capacitors of low equivalent series resistance provided that the capacitance is less than the maximum capacitive load of the model.

**Figure 1**  
Single Output Models



**Table 1**

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

**Figure 2**  
Dual Output Models



**Table 2**

| Vin (Vdc) | Cin (μF) | Cout (μF) |
|-----------|----------|-----------|
| 24        | 100      | 10        |
| 48        | 10~47    | 10        |

## EMC RECOMMENDED CIRCUIT

**Figure 3**  
Single Output Models



**Table 3**

| Recommended External Circuit Components |  |                |
|---|--|----------------|
| Vin (Vdc)                               | 24                                       | 48             |
| FUSE                                    | choose according to actual input current |                |
| C0, C4                                  | 330 μF / 50 V                            | 330 μF / 100 V |
| C1, C2                                  | 4.7 μF / 50 V                            | 4.7 μF / 100 V |
| C3                                      | Refer to the Cout in Table 1             |                |
| LDM1                                    | 2.2 μH / 4 A                             | 2.2 μH / 2 A   |
| CY1, CY2                                | 1 nF / 2 kV                              |                |

**Figure 4**  
Dual Output Models



**Table 4**

| Recommended External Circuit Components |  |                |
|---|--|----------------|
| Vin (Vdc)                               | 24                                       | 48             |
| FUSE                                    | choose according to actual input current |                |
| C0, C4                                  | 330 μF / 50 V                            | 330 μF / 100 V |
| C1, C2                                  | 4.7 μF / 50 V                            | 4.7 μF / 100 V |
| C3                                      | Refer to the Cout in Table 2             |                |
| LDM1                                    | 4.7 μH                                   |                |
| CY1, CY2                                | 1 nF / 2 kV                              |                |

## APPLICATION NOTES

Leave open if not used.

**Figure 5**

*Trim up*



*Trim down*



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

Formula for Trim up

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

Formula for Trim down

**Table 5**

| $V_{\text{OUT}}$ | $R_{\text{TOP}}$ | $R_{\text{BOTTOM}}$ | $R_{\text{O}}$ | $V_{\text{REF}}$ |
|------------------|------------------|---------------------|----------------|------------------|
| (Vdc)            | (kΩ)             | (kΩ)                | (kΩ)           | (V)              |
| 3.3              | 4.801            | 2.87                | 15             | 1.25             |
| 5                | 2.894            | 2.87                | 10             | 2.5              |
| 12               | 11.000           | 2.87                | 17.4           | 2.5              |
| 15               | 14.494           | 2.87                | 17.4           | 2.5              |
| 24               | 24.872           | 2.87                | 20             | 2.5              |

Note: Value for  $R_{\text{TOP}}$ ,  $R_{\text{BOTTOM}}$ ,  $R_{\text{O}}$ , and  $V_{\text{REF}}$  refer to Table 3 (fixed internal values).

$R_{\text{TRIM}}$ : Trim resistance

$a$ : User-defined parameter, no actual meanings

$V_{\text{OUT}}$ : Nominal output voltage

## REVISION HISTORY

| rev. | description   | date       |
|------|---|------------|
| 1.0  | initial release                                     | 05/16/2019 |
| 1.01 | features and safety line updated, packaging removed | 01/14/2021 |
| 1.02 | derating curves and circuit figures updated         | 07/29/2021 |
| 1.03 | Vref updated for 3.3 Vdc output model               | 02/07/2022 |
| 1.04 | CE certification updated for 24V models             | 10/27/2022 |

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



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