CUI INC
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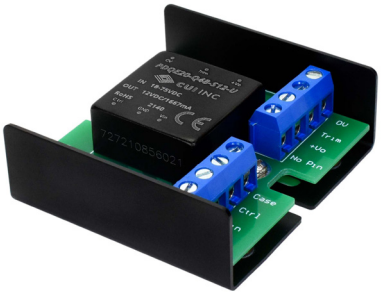
# SERIES: PDQE20-U | DESCRIPTION: DC-DC CONVERTER

## FEATURES

- up to 20 W isolated output
- 1,500 Vdc isolation
- ultra-wide 4:1 input range (9~36 Vdc, 18~75 Vdc)
- same side input/output connections
- single/dual regulated outputs
- input under-voltage, output short-circuit, over-current, & over-voltage protections
- wide operating temperature range (-40~105°C)
- efficiency up to 91%
- EN/BS EN 62368-1
- meets UL 62368

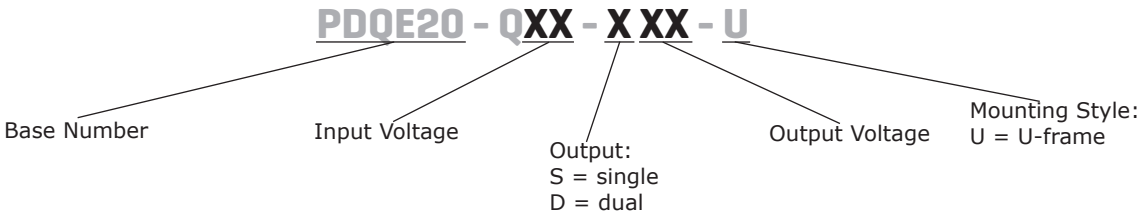


RoHS CE

| MODEL | input voltage | | output voltage | output current | | output power | ripple & noise[1] | efficiency[2] |
|---|---|---|---|---|---|---|---|---|
| | typ (Vdc) | range (Vdc) | (Vdc) | min (mA) | max (mA) | max (W) | max (mVp-p) | typ (%) |
| PDQE20-Q24-D5-U[3] | 24 | 9~36 | ±5 | 0 | ±2000 | 20 | 200 | 87 |
| PDQE20-Q24-D12-U[3] | 24 | 9~36 | ±12 | 0 | ±833 | 20 | 200 | 90 |
| PDQE20-Q24-D15-U[3] | 24 | 9~36 | ±15 | 0 | ±667 | 20 | 200 | 90 |
| PDQE20-Q24-D24-U[3] | 24 | 9~36 | ±24 | 0 | ±417 | 20 | 200 | 89 |
| PDQE20-Q24-S3-U[3] | 24 | 9~36 | 3.3 | 0 | 5000 | 16.5 | 100 | 88 |
| PDQE20-Q24-S5-U[3] | 24 | 9~36 | 5 | 0 | 4000 | 20 | 100 | 90 |
| PDQE20-Q24-S6-U[3] | 24 | 9~36 | 6 | 0 | 3333 | 20 | 100 | 89 |
| PDQE20-Q24-S12-U[3] | 24 | 9~36 | 12 | 0 | 1667 | 20 | 100 | 90 |
| PDQE20-Q24-S15-U[3] | 24 | 9~36 | 15 | 0 | 1333 | 20 | 100 | 91 |
| PDQE20-Q24-S24-U[3] | 24 | 9~36 | 24 | 0 | 833 | 20 | 100 | 91 |
| PDQE20-Q48-D5-U | 48 | 18~75 | ±5 | 0 | ±2000 | 20 | 200 | 86 |
| PDQE20-Q48-D12-U | 48 | 18~75 | ±12 | 0 | ±833 | 20 | 200 | 90 |
| PDQE20-Q48-D15-U | 48 | 18~75 | ±15 | 0 | ±667 | 20 | 200 | 90 |
| PDQE20-Q48-D24-U | 48 | 18~75 | ±24 | 0 | ±417 | 20 | 200 | 90 |
| PDQE20-Q48-S3-U | 48 | 18~75 | 3.3 | 0 | 5000 | 16.5 | 100 | 88 |
| PDQE20-Q48-S5-U | 48 | 18~75 | 5 | 0 | 4000 | 20 | 100 | 90 |
| PDQE20-Q48-S12-U | 48 | 18~75 | 12 | 0 | 1667 | 20 | 100 | 91 |
| PDQE20-Q48-S15-U | 48 | 18~75 | 15 | 0 | 1333 | 20 | 100 | 91 |
| PDQE20-Q48-S24-U | 48 | 18~75 | 24 | 0 | 833 | 20 | 100 | 91 |

Notes:
1. From 5~100% load, 20 MHz bandwidth oscilloscope, using the "parallel cable" method for testing. From 0~5% load, ripple and noise is <5% Vo.
2. Measured at nominal input voltage and rated load.
3. Model is not CE certified.
4. All specifications are measured at Ta=25°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<br>48 Vdc input models | | | 9<br>18 | 24<br>48 | 36<br>75 | Vdc<br>Vdc |
| start-up voltage | 24 Vdc input models<br>48 Vdc input models | | | | | 9<br>18 | 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>100 | <br>Vdc<br>Vdc |
| under voltage shutdown | 24 Vdc input models<br>48 Vdc input models | | | 5.5<br>12 | 6.5<br>15.5 | | Vdc<br>Vdc |
| current (full load/no load) | dual output models | 24 Vdc input models | | | 958/10 | 980/20 | mA |
| | | 48 Vdc input models | | | 484/5 | 496/11 | mA |
| | single output models | 24 Vdc input models | 3.3 Vdc output | | 782/30 | 800/50 | mA |
| | | | 5 Vdc output | | 926/35 | 947/55 | mA |
| | | | 6 Vdc output | | 936/50 | 958/70 | mA |
| | | | 12 Vdc output | | 926/6 | 947/15 | mA |
| | | | 15 Vdc output | | 916/6 | 937/15 | mA |
| | | | 24 Vdc output | | 916/10 | 937/20 | mA |
| | | 48 Vdc input models | 3.3 Vdc output | | 391/15 | 400/30 | mA |
| | | | 5 Vdc output | | 463/20 | 474/30 | mA |
| | | | 12, 15 Vdc output | | 458/3 | 469/15 | mA |
| | | | 24 Vdc output | | 458/4 | 469/15 | mA |
| remote on/off (CTRL) | module ON (3.5~12 Vdc or CTRL pin open circuit or pulled high)<br>module OFF (0~1.2 Vdc CTRL pin pulled low to GND)<br>input current when switched off | | | | 2 | 7 | mA |
| start-up time | nominal input, constant resistance load | | | | 10 | | ms |
| filter | Pi filter | | | | | | |

## OUTPUT

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| maximum capacitive load[5] | 3.3, 5, 6 Vdc output models | | | 10,000 | µF |
| | ±5 Vdc output models | | | 2,000 | µF |
| | 12 Vdc output models | | | 1,600 | µF |
| | ±12 Vdc output models | | | 800 | µF |
| | 15 Vdc output models | | | 1,000 | µF |
| | ±15 Vdc output models | | | 600 | µF |
| | 24 Vdc output models | | | 500 | µF |
| | ±24 Vdc output models | | | 300 | µF |
| voltage accuracy[5] | 0% to full load | | ±1 | ±3 | % |
| line regulation | from low line to high line, full load<br>positive outputs<br>negative outputs | | <br>±0.2<br>±0.4 | <br>±0.5<br>±1 | <br>%<br>% |
| load regulation[7] | from 5% to full load | | ±0.5 | ±1 | % |

## OUTPUT (CONTINUED)

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| cross regulation | dual output models:<br>positive output 50% load<br>secondary output from 10~100% load | | | ±5 | % |
| switching frequency[8] | PWM mode<br>3.3, 5, 6 Vdc output models<br>all other output 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, ±5, 6 Vdc output model<br>all other output models | | ±3<br>±3 | ±8<br>±5 | %<br>% |
| temperature coefficient | at full load | | | ±0.03 | %/°C |

Note: 5. Specified maximum capacitive load for positive and negative outputs is identical.
6. Output voltage accuracy of dual output models for 0%~5% load is ±4%.
7. Load regulation for 0%~100% load is ±5%.
8. Switching frequency is measured at full load. Module reduces switching frequency at light load (blow 50%), to increase efficiency.

## 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>150 | 190<br>200 | %<br>% |
| short circuit protection | continuous, auto recovery | | | | |

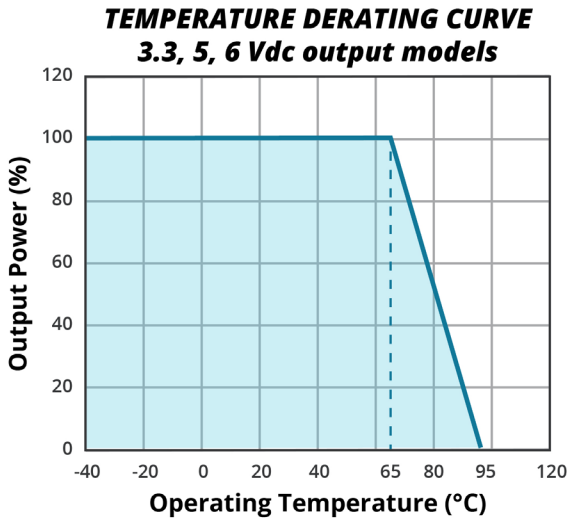
## SAFETY AND COMPLIANCE

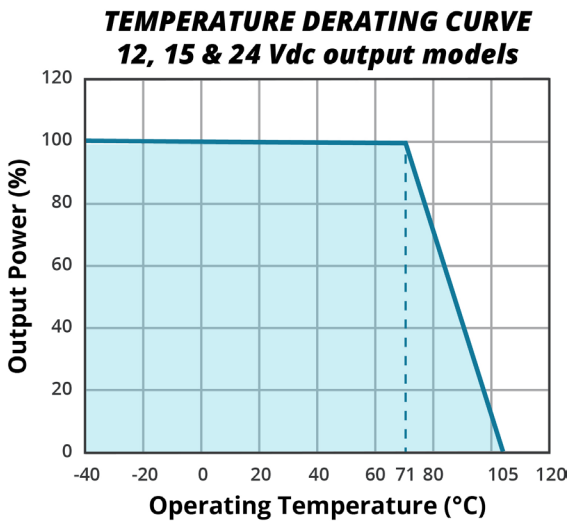
| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| isolation voltage | input to output for 1 minute at 1 mA<br>input to output-case for 1 minute at 1 mA | 1,500<br>1,000 | | | Vdc<br>Vdc |
| isolation resistance | input to output at 500 Vdc | 1,000 | | | MΩ |
| isolation capacitance | input to output, 100 kHz / 0.1 V | | 2,000 | | pF |
| safety approvals | certified to 62368: EN, BS EN | | | | |
| conducted emissions | CISPR32/EN55032 CLASS B (see Fig. 3-2)<br>EN50121-3-2 150kHz-500kHz 99dBuV (see Fig. 3-2)<br>EN55016-2-1 500kHz-30MHz 93dBuV (see Fig. 3-2) | | | | |
| radiated emissions | CISPR32/EN55032 CLASS B (see Fig. 3-2)<br>EN50121-3-2 30MHz-230MHz 40dBuV/m at 10m (see Fig. 3-2)<br>EN55016-2-1 230MHz-1GHz 47dBuV/m at 10m (see Fig. 3-2) | | | | |
| ESD | IEC/EN61000-4-2 Contact ±4kV, perf. Criteria B<br>EN50121-3-2 Contact ±6kV/Air ±8kV, perf. Criteria A | | | | |
| radiated immunity | IEC/EN61000-4-3 10V/m, perf. Criteria A<br>EN50121-3-2 20V/m, perf. Criteria A | | | | |
| EFT/burst | IEC/EN61000-4-4 ±2kV (see Fig. 3-1), perf. Criteria B<br>EN50121-3-2 ±2kV 5/50ns 5kHz (see Fig. 3-1), perf. Criteria A | | | | |
| surge | IEC/EN61000-4-4 ±2kV (see Fig. 3-1), perf. Criteria B<br>EN50121-3-2 line to line ±1kV (42Ω , 0.5µF)) (see Fig. 3-1), perf. Criteria A | | | | |
| conducted immunity | IEC/EN61000-4-6 3 Vr.m.s, perf. Criteria A<br>EN50121-3-2 0.15MHz-80MHz 10V r.m.s, perf. Criteria A | | | | |
| MTBF | as per MIL-HDBK-217F, 25°C | 1,000,000 | | | hours |
| RoHS | yes | | | | |

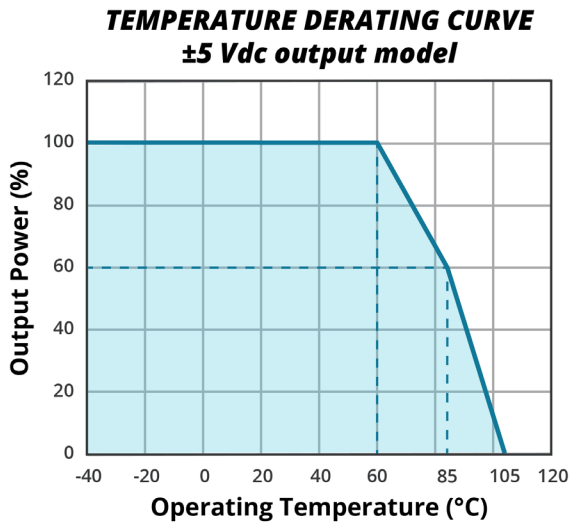
## ENVIRONMENTAL

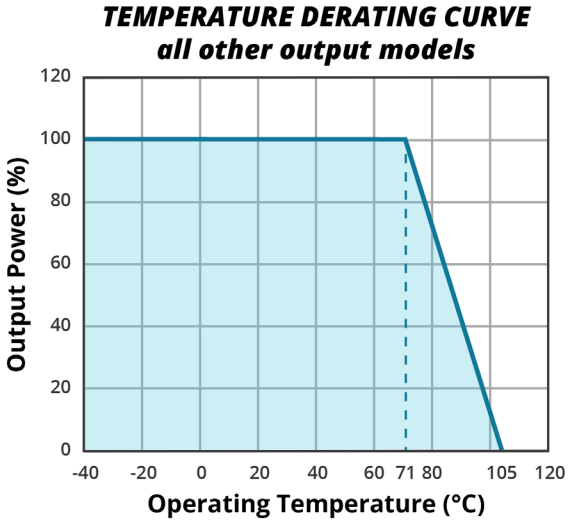
| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| operating temperature | see derating curve<br>3.3, 5, 6 Vdc output<br>all other output models | <br>-40<br>-40 | | <br>95<br>105 | <br>°C<br>°C |
| storage temperature | | -55 | | 125 | °C |
| storage humidity | non-condensing | 5 | | 95 | % |

## DERATING CURVES




## SOLDERABILITY

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| pin soldering resistance temperature | 1.5 mm from case for 10 seconds | | | 300 | °C |

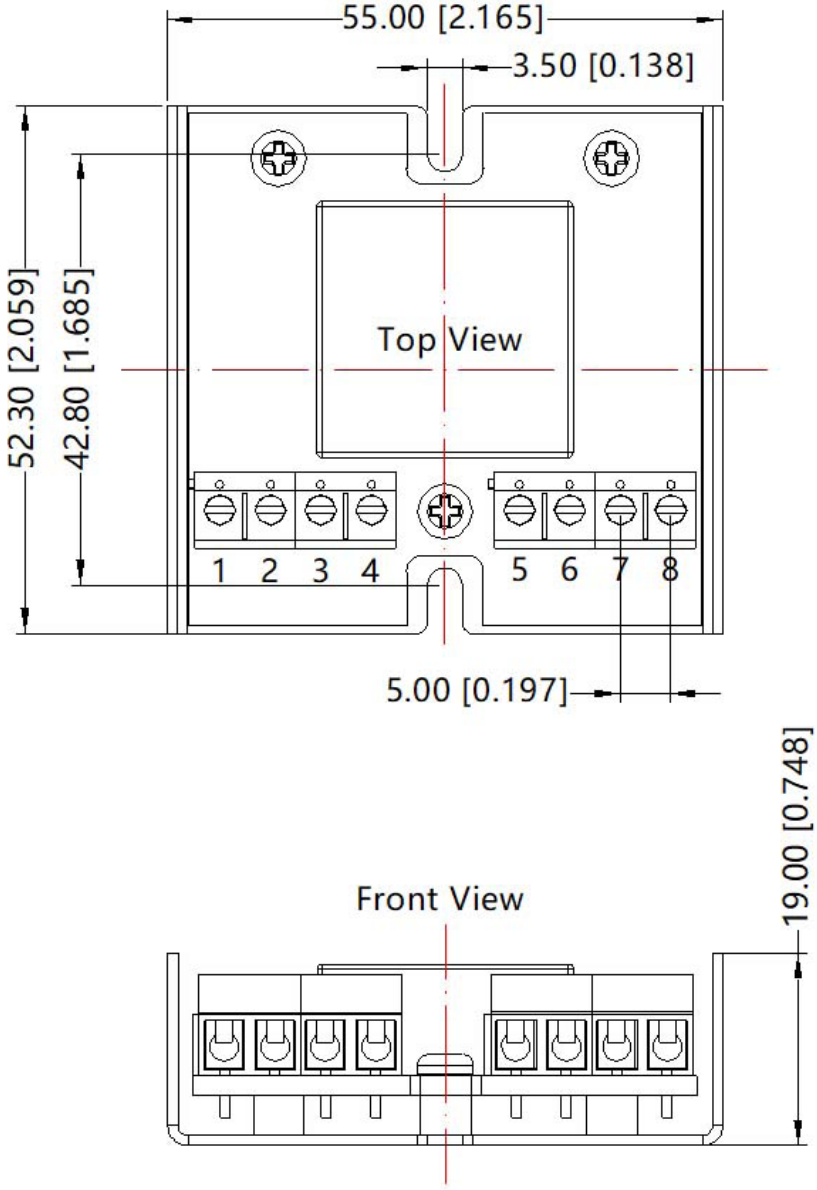
## MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| dimensions | 55.00 x 52.30 x 19.00 [2.165 x 2.059 x 0.748 inch] | | | | mm |
| case material | aluminum alloy | | | | |
| weight | | | 46 | | g |

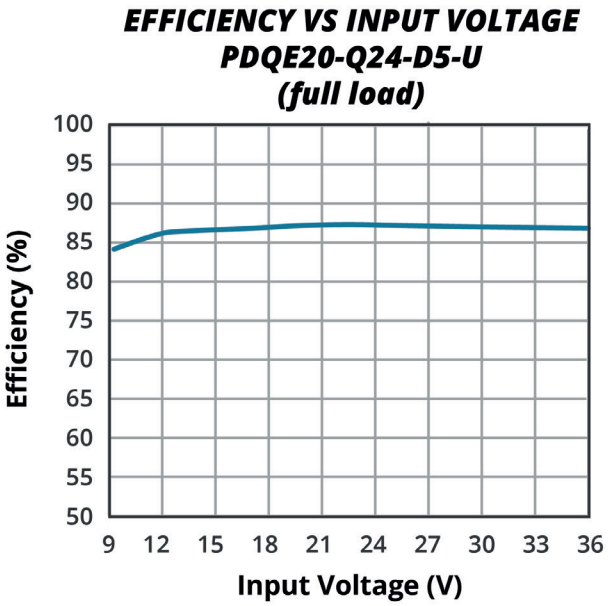
## MECHANICAL DRAWING

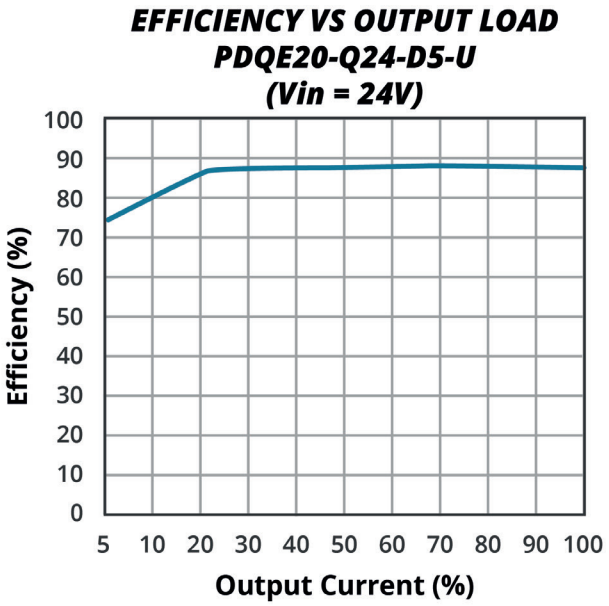
units: mm [inch]
wire range: 24-12 AWG
tolerance: ±1.00[±0.039]
tightening torque: Max 0.4 N·m

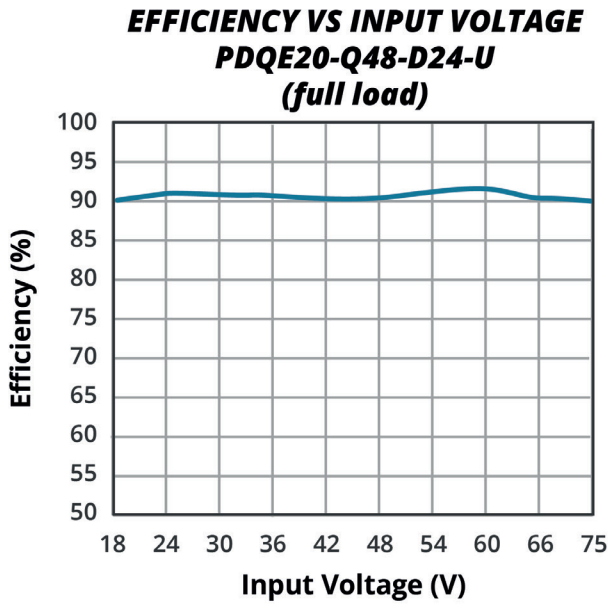
| PIN CONNECTIONS | | |
|---|---|---|
| PIN | Function | |
| | Single | Dual |
| 1 | GND | GND |
| 2 | Vin | Vin |
| 3 | Ctrl | Ctrl |
| 4 | Case | Case |
| 5 | NC | NC |
| 6 | +Vo | +Vo |
| 7 | Trim | 0V |
| 8 | 0V | -Vo |

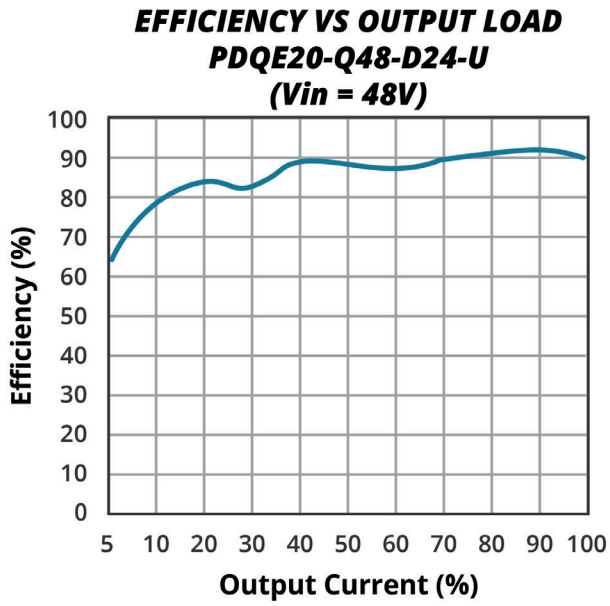


## EFFICIENCY CURVES

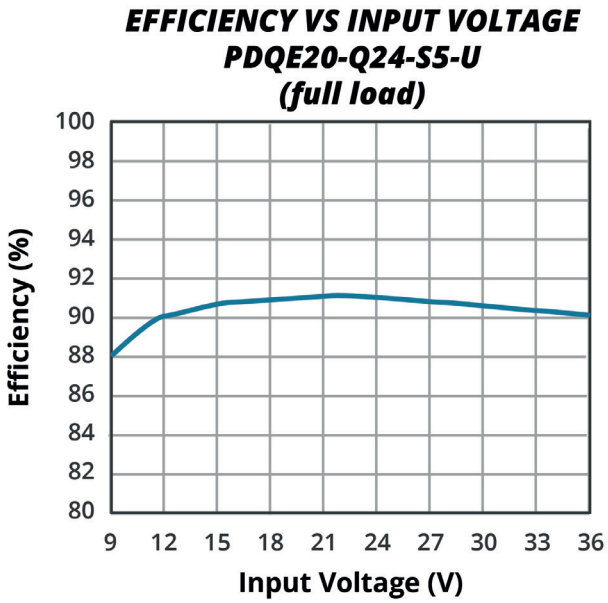


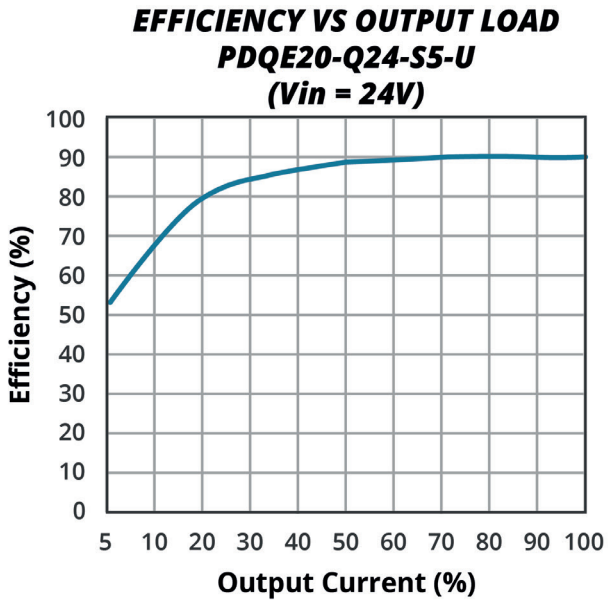



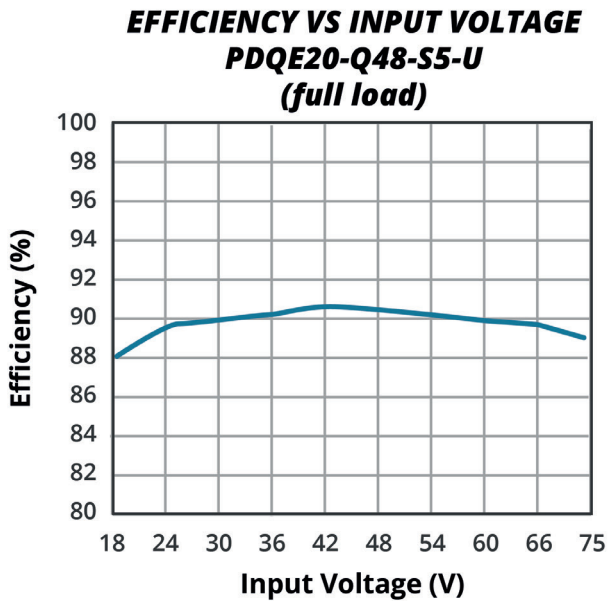



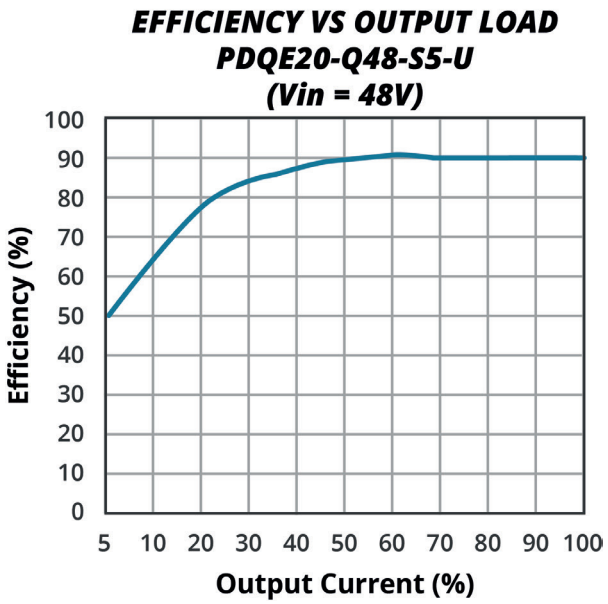



## EFFICIENCY CURVES (CONTINUED)



## 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 (ESR) provided that the capacitance is less than the maximum capacitive load of the model.

**Figure 1**
**Single Output Models**

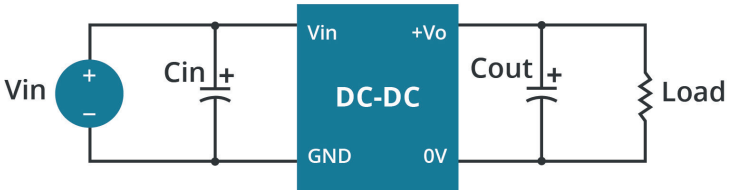



**Figure 2**
**Dual Output Models**

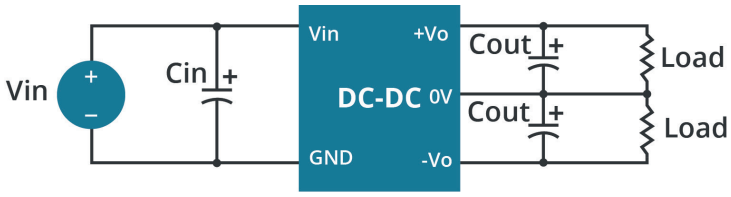



**Table 1**

| Vin (Vdc) | Cin (μF/V) | Vout (Vdc) | Cout (μF/V) |
|---|---|---|---|
| 24 | 100/50 | ±5 | 10/16 |
| | | ±12/±15 | 10/25 |
| | | ±24 | 10/50 |
| | | 3.3/5/6 | 100/16 |
| | | 12/15 | 100/25 |
| | | 24 | 47/50 |
| 48 | 10~47/50 | ±5 | 10/16 |
| | | ±12/±15 | 10/25 |
| | | ±24 | 10/50 |
| | 100/100 | 3.3/5 | 100/16 |
| | | 12/15 | 100/25 |
| | | 24 | 47/50 |

## EMC RECOMMENDED CIRCUIT

**Figure 3**

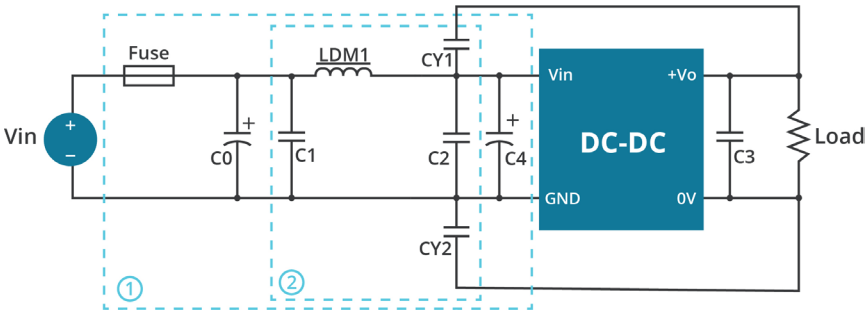



**Table 2**

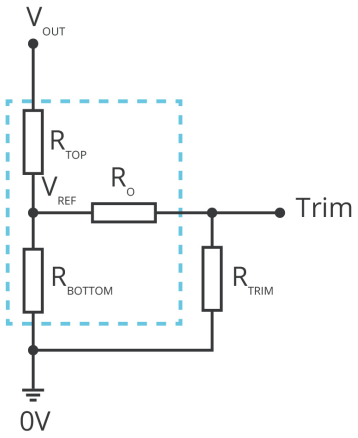
| Recommended External Circuit Components | | | |
|---|---|---|---|
| Vin (Vdc) | | 24 | 48 |
| FUSE | | choose according to actual input current | |
| C0/C4 | | 330μF / 50V | 330μF / 100V |
| C1/C2 | | 4.7μF / 50V | 4.7μF / 100V |
| C3 | | refer to the Cout in Figure 1 & 2 | |
| LDM1 | single | 2.2uH/4A | 202uH/2A |
| | dual | 4.7μH | |
| CY1, CY2 | | 1nF / 2kV | |

## APPLICATION NOTES

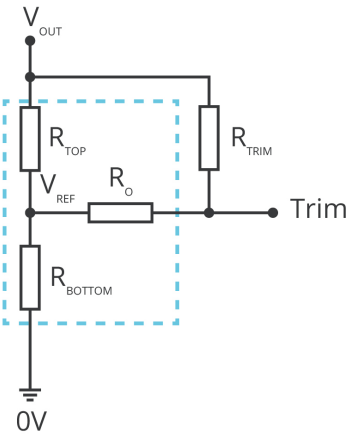
Open if unused.

**Figure 4**

*Trim up*




*Trim down*




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

*Formula for Trim up*

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

*Formula for Trim down*

**Table 3**

| $V_{OUT}$ | $R_{TOP}$ | $R_{BOTTOM}$ | $R_O$ | $V_{REF}$ |
|---|---|---|---|---|
| (Vdc) | (kΩ) | (kΩ) | (kΩ) | (V) |
| 3.3 | 4.80 | 2.87 | 15 | 1.25 |
| 5 | 2.894 | 2.87 | 10 | 2.5 |
| 6 | 4.064 | 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 $R_{TOP}$, $R_{BOTTOM}$, $R_O$, 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 | 12/06/2021 |
| 1.01 | Vref updated for 3.3 Vdc output model | 02/07/2022 |
| 1.02 | CE certification updated for 24V models | 11/29/2022 |

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

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