

SERIES: PDQE20-D | **DESCRIPTION:** DC-DC CONVERTER**FEATURES**

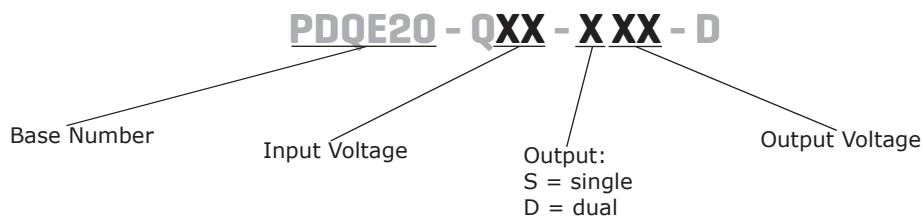
- 20 W isolated output
- ultra-wide input voltage range
- single/dual regulated outputs
- 1500 Vdc isolation
- extended temperature range (-40~105°C)
- input under-voltage protection
- output short circuit, over-current, over-voltage protection
- DIP package
- EN/BS EN 62368-1
- UL 62368-1



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

- Notes:
1. From 5~100% load, nominal input, 20 MHz bandwidth oscilloscope, with 10 μ F tantalum and 1 μ 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 | | 800 | mA |
| | | 5, 12 Vdc output models | | 947 | mA |
| | | 15, 24 Vdc output models | | 937 | mA |
| | | all dual output models | | 958 | mA |
| 48 Vdc input models | 3.3 Vdc output models | | | 400 | mA |
| | 5 Vdc output models | | | 474 | mA |
| | 12, 15, 24 Vdc output models | | | 469 | mA |
| | all dual output models | | 969 | | mA |
| remote on/off (CTRL) ⁵ | turn on (CTRL pin open or pulled high (3.5~12 Vdc)) turn off (CTRL pin pulled low to GND (0~1.2 Vdc)) 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 ⁶ | 3.3, 5 Vdc output models | | | 10,000 | μF |
| | 12 Vdc output models | | | 1,600 | μF |
| | 15 Vdc output models | | | 1,000 | μF |
| | 24 Vdc output models | | | 500 | μF |
| | ±5 Vdc output models | | | 2,000 | μF |
| | ±12 Vdc output models | | | 800 | μF |
| | ±15 Vdc output models | | | 600 | μF |
| | ±24 Vdc output models | | | 300 | μF |
| voltage accuracy ⁷ | 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 ⁸ | 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: main output 50% load secondary output from 10~100% load | | | ±5 | % |
| start-up time | nominal input, constant resistive load | | 10 | | ms |
| adjustability ⁹ | see application notes | | ±10 | | % |
| switching frequency ¹⁰ | PWM mode | | 300 | | kHz |
| | 3.3, 5 Vdc output models all other models | | 270 | | kHz |
| transient recovery time | 25% load step change, nominal input voltage | | 300 | 500 | µs |
| transient response deviation | 25% load step change, nominal input voltage | | ±5 | ±8 | % |
| | 3.3, 5 Vdc output models | | ±3 | ±8 | % |
| | ±5 Vdc output models all other models | | ±3 | ±5 | % |
| temperature coefficient | at full load | | | ±0.03 | %/°C |

Note: 9. For single output models only.

10. Value is based on full load. At loads <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 | 110 | 150 | 190 | % |
| | dual output models | 110 | 150 | 200 | % |
| 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 | 1,500 | | | Vdc |
| | input/output to case for 1 minute at 1 mA | 1,000 | | | 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 ¹¹ | certified to 62368-1: UL, EN/BS EN | | | | |
| conducted emissions | CISPR32/EN55032, class B (external circuit required, see Figure 3-b, 4-b) | | | | |
| radiated emissions | CISPR32/EN55032, 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) | | | | |
| | 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 Vr.m.s, class A | | | | |
| MTBF | as per MIL-HDBK-217F, 25°C | 1,000,000 | | | hours |
| RoHS | yes | | | | |

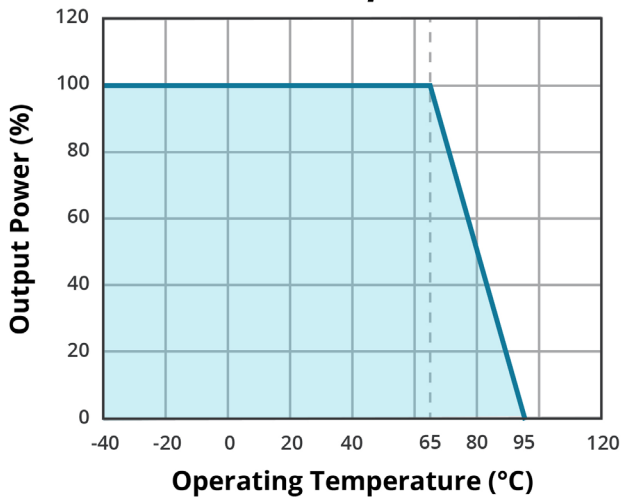
Note: 11. UL approval only on single output models.

ENVIRONMENTAL

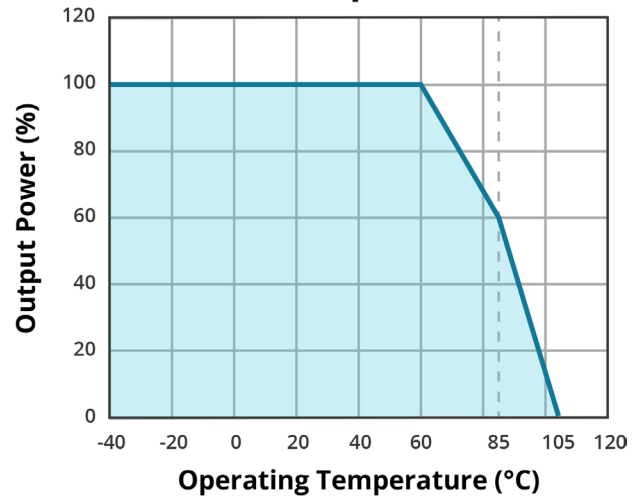
| parameter | conditions/description | min | typ | max | units |
|-----------------------|--|-----|-----|-----|-------|
| operating temperature | see derating curves | -40 | | 95 | °C |
| | 3.3, 5 Vdc output models | -40 | | 105 | °C |
| storage temperature | | -55 | | 125 | °C |
| storage humidity |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

DERATING CURVES

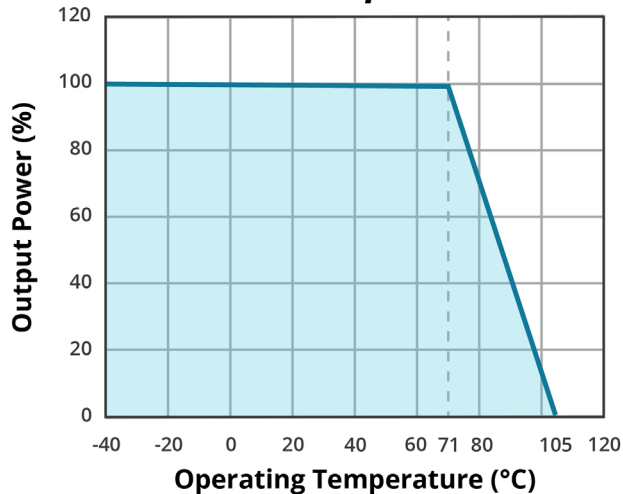
TEMPERATURE DERATING CURVE
3.3, 5 Vdc output models



TEMPERATURE DERATING CURVE
±5 Vdc output models

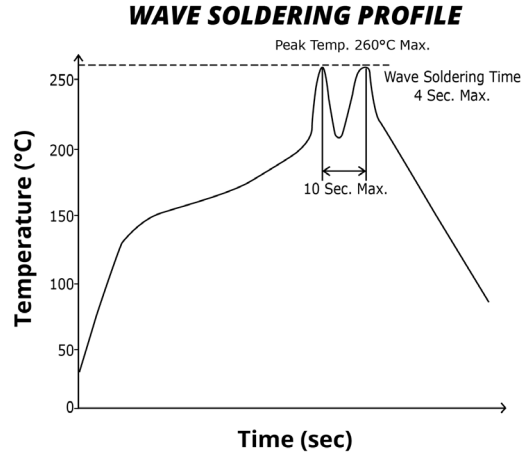


TEMPERATURE DERATING CURVE
all other output models



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 |



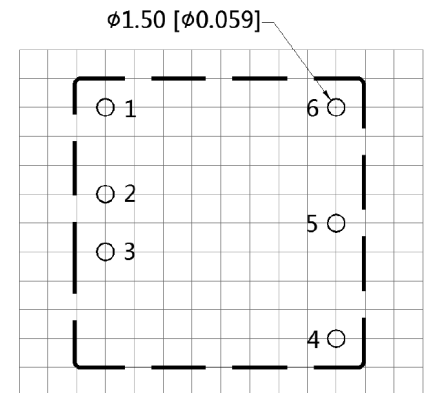
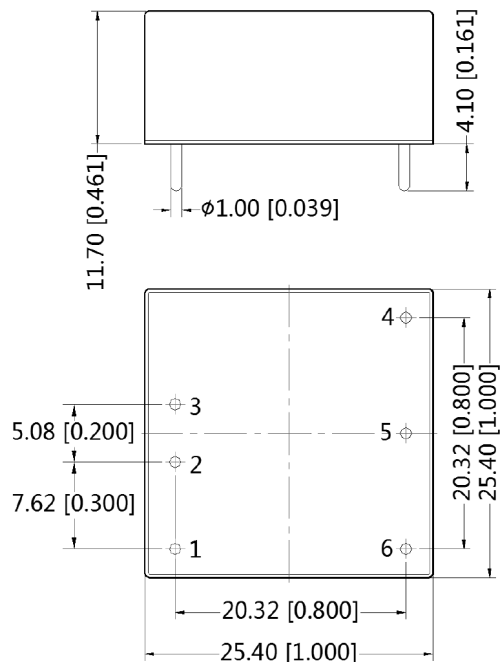
MECHANICAL

| 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: ± 0.50 [± 0.020]
pin diameter tolerance: ± 0.10 [± 0.004]

| PIN CONNECTIONS | | |
|-----------------|-----------------|-----------------|
| PIN | Function | |
| | Single | Dual |
| 1 | CTRL | CTRL |
| 2 | GND | GND |
| 3 | V _{in} | V _{in} |
| 4 | +V _o | +V _o |
| 5 | trim | 0V |
| 6 | 0V | -V _o |



Note: Grid 2.54*2.54mm
Recommended PCB Layout
Top View

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

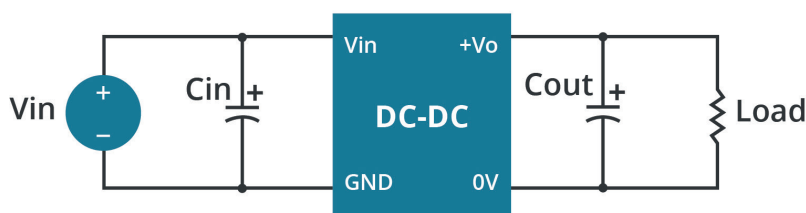


Table 1

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

Figure 2
Dual Output Models

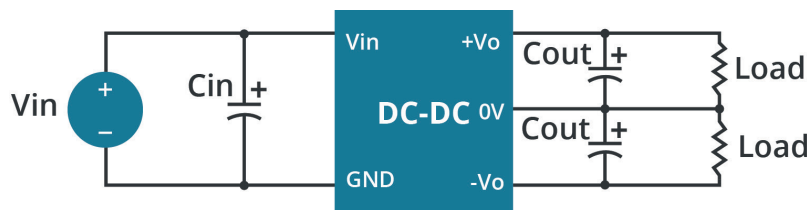


Table 2

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

EMC RECOMMENDED CIRCUIT

Figure 3
Single Output Models

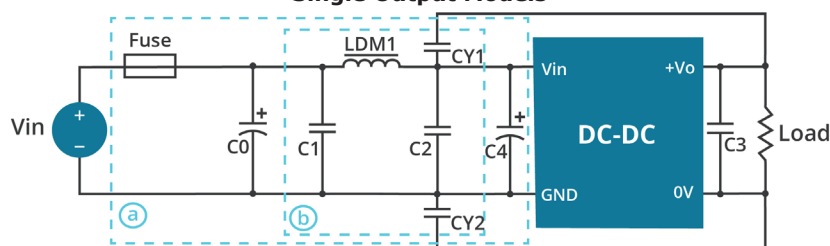


Table 3

| 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

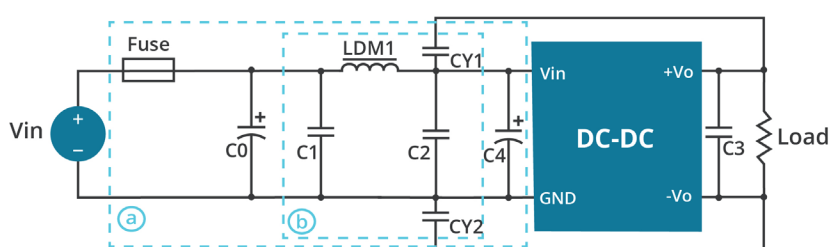


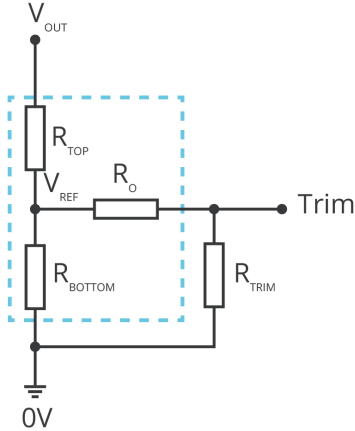
Table 4

| 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

Output voltage trimming
Leave open if not used.

Trim up

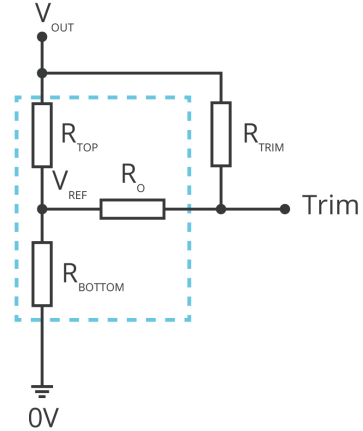


$$R_{TRIM} = \frac{a \cdot R_{BOTTOM}}{R_{BOTTOM} - a} - R_O \quad a = \frac{V_{REF}}{V_{OUT} - V_{REF}} \cdot R_{TOP}$$

Formula for Trim up

Figure 5

Trim down



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

Formula for Trim down

Table 5

| V_{OUT} (Vdc) | R_{TOP} (kΩ) | R_{BOTTOM} (kΩ) | R_O (kΩ) | V_{REF} (V) |
|--------------------|-------------------|----------------------|---------------|------------------|
| 3.3 | 4.829 | 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_{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 | 05/16/2019 |
| 1.01 | safeties updated in features and safety line, packaging removed | 01/14/2021 |
| 1.02 | derating curves and circuit figures updated | 08/23/2021 |
| 1.03 | Vref updated for 3.3 Vdc output model | 02/07/2022 |
| 1.04 | CE certification updated for 24V models | 11/07/2022 |

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



CUI INC
a bel group

Headquarters
20050 SW 112th Ave.
Tualatin, OR 97062
800.275.4899

Fax 503.612.2383
cui.com
techsupport@cui.com

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