

SERIES: PYBE10 | **DESCRIPTION:** DC-DC CONVERTER**FEATURES**

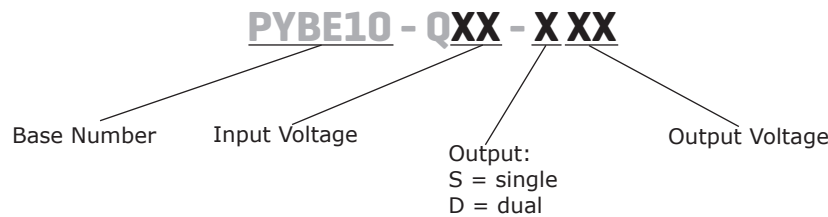
- up to 10 W isolated output
- industry standard pin-out
- 4:1 input range (9~36 Vdc, 18~75 Vdc)
- single/dual regulated outputs
- 1500 Vdc isolation
- continuous short circuit protection
- efficiency up to 88%
- operating temperature range (-40~+85°C)
- EN/BS EN 62368-1



| 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) | | | |
| PYBE10-Q24-S3 | 24 | 9~36 | 3.3 | 0 | 2400 | 7.92 | 80 | 86 |
| PYBE10-Q24-S5 | 24 | 9~36 | 5 | 0 | 2000 | 10 | 80 | 87 |
| PYBE10-Q24-S12 | 24 | 9~36 | 12 | 0 | 833 | 10 | 80 | 87 |
| PYBE10-Q24-S15 | 24 | 9~36 | 15 | 0 | 667 | 10 | 80 | 87 |
| PYBE10-Q24-S24 | 24 | 9~36 | 24 | 0 | 416 | 10 | 80 | 87 |
| PYBE10-Q24-D5 | 24 | 9~36 | ±5 | 0 | ±1000 | 10 | 80 | 83 |
| PYBE10-Q24-D12 | 24 | 9~36 | ±12 | 0 | ±416 | 10 | 80 | 87 |
| PYBE10-Q24-D15 | 24 | 9~36 | ±15 | 0 | ±333 | 10 | 80 | 87 |
| PYBE10-Q48-S3 ³ | 48 | 18~75 | 3.3 | 0 | 2400 | 7.92 | 80 | 85 |
| PYBE10-Q48-S5 ³ | 48 | 18~75 | 5 | 0 | 2000 | 10 | 80 | 86 |
| PYBE10-Q48-S12 ³ | 48 | 18~75 | 12 | 0 | 833 | 10 | 80 | 87 |
| PYBE10-Q48-S15 ³ | 48 | 18~75 | 15 | 0 | 667 | 10 | 80 | 87 |
| PYBE10-Q48-S24 ³ | 48 | 18~75 | 24 | 0 | 416 | 10 | 80 | 88 |
| PYBE10-Q48-D5 ³ | 48 | 18~75 | ±5 | 0 | ±1000 | 10 | 80 | 83 |
| PYBE10-Q48-D12 ³ | 48 | 18~75 | ±12 | 0 | ±416 | 10 | 80 | 87 |
| PYBE10-Q48-D15 ³ | 48 | 18~75 | ±15 | 0 | ±333 | 10 | 80 | 87 |

- 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 CE 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 | | 388 | mA |
| | | 5 Vdc output models | | 484 | mA |
| | | all other models | | 515 | mA |
| | 48 Vdc input models | 3.3 Vdc output models | | 197 | mA |
| 5 Vdc output models | | 245 | mA | | |
| all other models | | 258 | mA | | |
| remote on/off (CTRL) ⁵ | turn on (3.5~12 Vdc or open circuit) turn off (<1.2 Vdc) input current when switched off | | 6 | 10 | mA |
| filter | Pi filter | | | | |
| no load power consumption | | | 0.12 | | W |

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 Vdc output models | | | 1,200 | μF |
| | 5, ±5 Vdc output models | | | 1,000 | μF |
| | 12, ±12 Vdc output models | | | 470 | μF |
| | 15, ±15 Vdc output models | | | 330 | μF |
| | all other models | | | 100 | μF |
| voltage accuracy ⁷ | 0% to full load, 3.3, 5 Vdc output models | | ±0.5 | ±2 | % |
| | 0% to full load, all other models | | ±1 | ±3 | % |
| line regulation | from low line to high line, full load | | | | |
| | positive outputs | | ±0.2 | ±0.5 | % |
| | negative outputs | | ±0.5 | ±1 | % |
| load regulation ⁸ | from 5% to full load | | | | |
| | positive outputs | | ±0.5 | ±1 | % |
| | negative outputs | | ±0.5 | ±1.5 | % |

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

7. At 0~5% load, the max output voltage accuracy for the ±5 Vdc output models is ±5%, and the 3.3, and 5 Vdc models is ±3%.

8. At 0~100% load, the max load regulation is ±5%.

OUTPUT (CONTINUED)

| parameter | conditions/description | min | typ | max | units |
|----------------------------------|---|-----|-----|-------|-------|
| cross regulation | dual output models: main output 50% load secondary output from 25~100% load | | | ±5 | % |
| switching frequency ⁹ | PWM mode | | 350 | | 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 all other models | | ±3 | ±5 | % |
| temperature coefficient | at full load | | | ±0.03 | %/°C |

Note: 9. 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 | 3.3, 5 Vdc output models | 110 | 160 | 230 | % |
| | all other models | 110 | 140 | 190 | % |
| short circuit protection | continuous, self recovery | | | | |

SAFETY AND COMPLIANCE

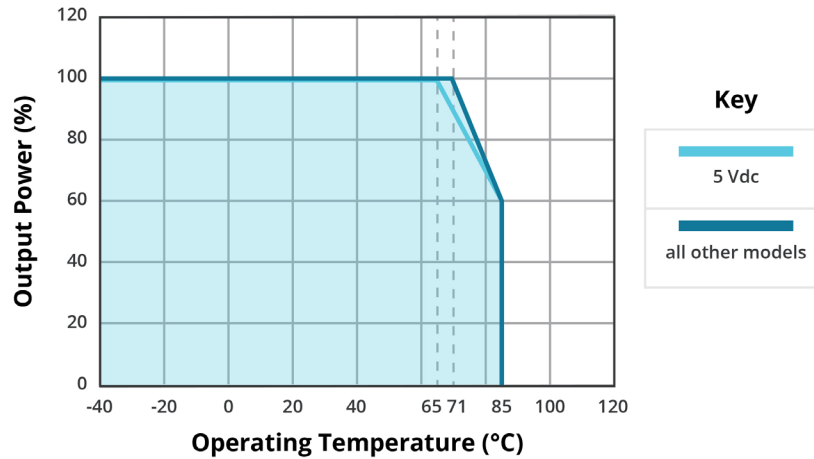
| parameter | conditions/description | min | typ | max | units |
|------------------------------|--|-----------|-------|-----|-------|
| isolation voltage | input to output for 1 minute at 1 mA | 1,500 | | | Vdc |
| isolation resistance | input to output at 500 Vdc | 1,000 | | | MΩ |
| isolation capacitance | input to output, 100 kHz / 0.1 V | | 2,000 | | pF |
| safety approvals | certified to 62368-1: EN, BS EN | | | | |
| 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 ± 4kV, class B | | | | |
| radiated immunity | IEC/EN61000-4-3, 10V/m, class A | | | | |
| EFT/burst | IEC/EN61000-4-4, ± 2kV, class B (external circuit required, see Figure 3-a, 4-a) | | | | |
| surge | IEC/EN61000-4-5, line-line ± 2kV, class B (external circuit required, see Figure 3-a, 4-a) | | | | |
| conducted immunity | IEC/EN61000-4-6, 10 Vr.m.s, class A | | | | |
| voltage dips & interruptions | IEC/EN61000-4-29, 0%-70%, class B | | | | |
| 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 curves | -40 | | 85 | °C |
| storage temperature | | -55 | | 125 | °C |
| storage humidity | non-condensing | 5 | | 95 | % |
| vibration | 10~150 Hz, 0.75 mm, on each axis | | 5 | | G |

DERATING CURVES

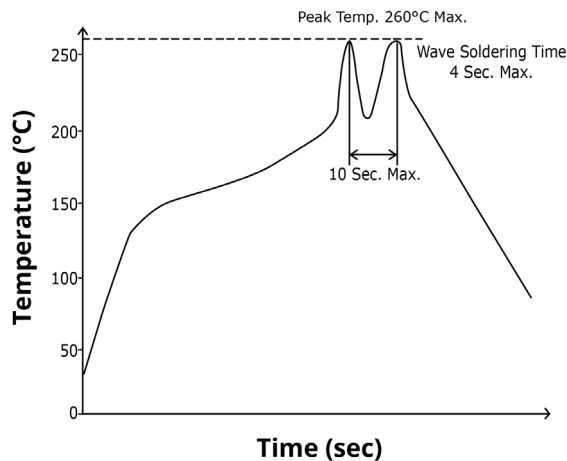
TEMPERATURE DERATING CURVE



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 |

WAVE SOLDERING PROFILE



MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|---------------|--|-----|-----|-----|-------|
| dimensions | 32.00 x 20.00 x 10.80 [1.260 x 0.787 x 0.425 inch] | | | | mm |
| case material | aluminum alloy | | | | |
| weight | | | 14 | | g |

MECHANICAL DRAWING

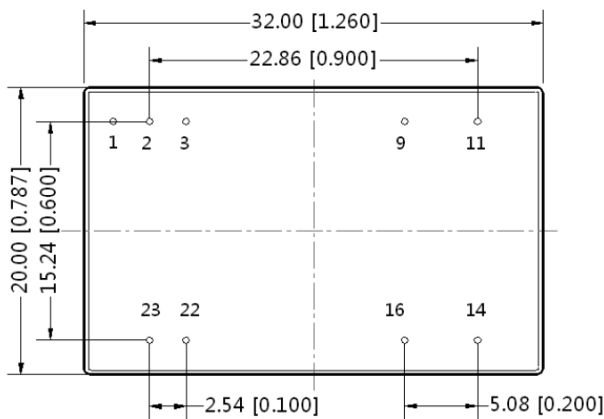
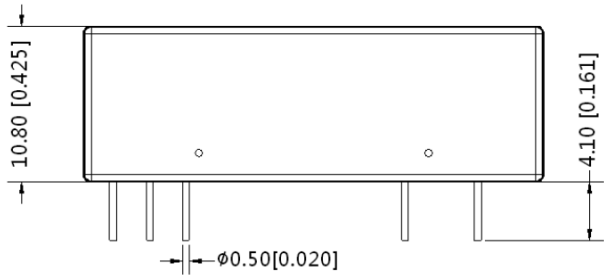
units: mm [inch]

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

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

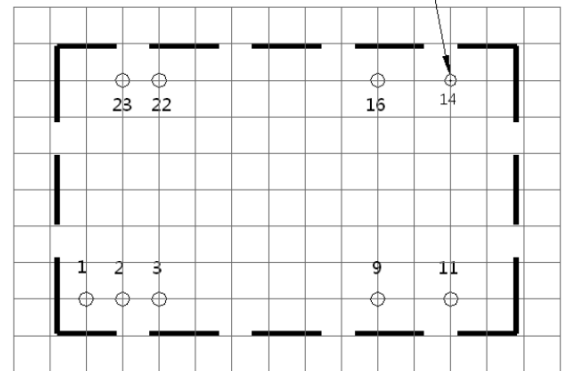
| PIN CONNECTIONS | | |
|-----------------|----------|------|
| PIN | Function | |
| | Single | Dual |
| 1 | CTRL | CTRL |
| 2, 3 | GND | GND |
| 9 | no pin | 0V |
| 11 | NC | -Vo |
| 14 | +Vo | +Vo |
| 16 | 0V | 0V |
| 22, 23 | Vin | Vin |

Note: NC = no connect



THIRD ANGLE PROJECTION

$\phi 1.00 [\phi 0.039]$



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 impedance provided that the capacitance is less than the maximum capacitive load of the model.

Figure 1
Single Output Models

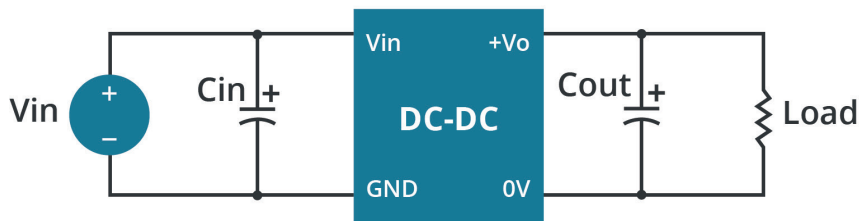


Figure 2
Dual Output Models

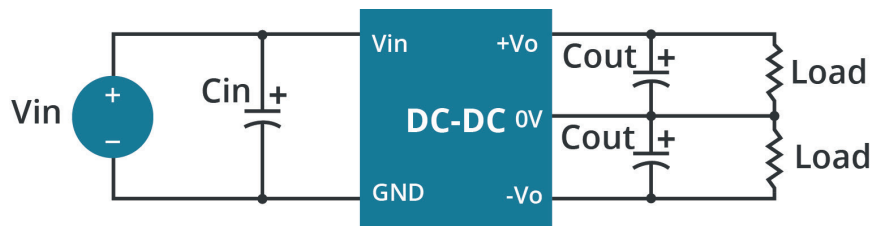


Table 1

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

EMC RECOMMENDED CIRCUIT

Figure 3
3.3 & 5 Vdc Output Models

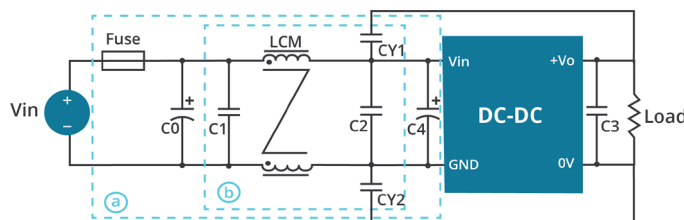


Figure 4
All Other Models

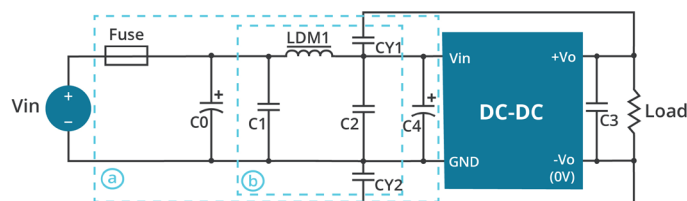


Table 2

| 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 | 10 μF / 50 V | 10 μF / 100 V |
| LDM1 | 10 μH | |
| LCM1 | 1.4~1.7 mH | |
| CY1, CY2 | 1 nF / 2 kV | |
| C3 | 10 μF | |

REVISION HISTORY

| rev. | description | date |
|------|--|------------|
| 1.0 | initial release | 01/24/2019 |
| 1.01 | features updated | 01/12/2021 |
| 1.02 | derating curve and circuit figures updated | 07/22/2021 |
| 1.03 | PYBE10-Q24-S3 is CE certified | 08/12/2022 |
| 1.04 | CE removed for 24 Vdc models | 09/07/2022 |
| 1.05 | efficiency values updated | 09/25/2022 |
| 1.06 | safeties updated | 12/01/2022 |
| 1.07 | efficiency values updated | 03/09/2023 |

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



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