

**SERIES:** PYB20-T & PYB20-U | **DESCRIPTION:** DC-DC CONVERTER

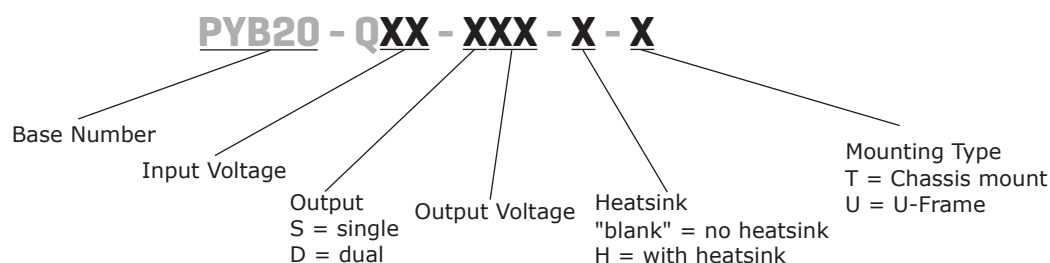
**FEATURES**

- up to 20 W isolated output
- industry standard pinout
- 4:1 input range (9~36 V, 18~75 V)
- smaller package
- single/dual regulated outputs
- 1,500 Vdc isolation
- continuous short circuit, over current protection, over voltage protection
- reverse polarity protection on chassis mount (-T) models
- temperature range (-40~85°C)
- six-sided metal shielding
- efficiency up to 90%



| MODEL         | input voltage |             | output voltage<br>(Vdc) | output current |          | output power<br>max (W) | ripple and noise <sup>1</sup><br>max (mVp-p) | efficiency <sup>2</sup><br>typ (%) |
|---------------|---------------|-------------|-------------------------|----------------|----------|-------------------------|----------------------------------------------|------------------------------------|
|               | typ (Vdc)     | range (Vdc) |                         | min (mA)       | max (mA) |                         |                                              |                                    |
| PYB20-Q24-S3  | 24            | 9~36        | 3.3                     | 250            | 5000     | 16.5                    | 100                                          | 86                                 |
| PYB20-Q24-S5  | 24            | 9~36        | 5                       | 200            | 4000     | 20                      | 100                                          | 90                                 |
| PYB20-Q24-S12 | 24            | 9~36        | 12                      | 84             | 1667     | 20                      | 100                                          | 89                                 |
| PYB20-Q24-S15 | 24            | 9~36        | 15                      | 67             | 1333     | 20                      | 100                                          | 90                                 |
| PYB20-Q24-S24 | 24            | 9~36        | 24                      | 42             | 834      | 20                      | 100                                          | 90                                 |
| PYB20-Q24-D5  | 24            | 9~36        | ±5                      | ±100           | ±2000    | 20                      | 100                                          | 86                                 |
| PYB20-Q24-D12 | 24            | 9~36        | ±12                     | ±42            | ±834     | 20                      | 100                                          | 88                                 |
| PYB20-Q24-D15 | 24            | 9~36        | ±15                     | ±33            | ±667     | 20                      | 100                                          | 88                                 |
| PYB20-Q48-S3  | 48            | 18~75       | 3.3                     | 250            | 5000     | 16.5                    | 100                                          | 86                                 |
| PYB20-Q48-S5  | 48            | 18~75       | 5                       | 200            | 4000     | 20                      | 100                                          | 90                                 |
| PYB20-Q48-S12 | 48            | 18~75       | 12                      | 84             | 1667     | 20                      | 100                                          | 89                                 |
| PYB20-Q48-S15 | 48            | 18~75       | 15                      | 67             | 1333     | 20                      | 100                                          | 90                                 |
| PYB20-Q48-S24 | 48            | 18~75       | 24                      | 42             | 834      | 20                      | 100                                          | 90                                 |
| PYB20-Q48-D5  | 48            | 18~75       | ±5                      | ±100           | ±2000    | 20                      | 100                                          | 86                                 |
| PYB20-Q48-D12 | 48            | 18~75       | ±12                     | ±42            | ±834     | 20                      | 100                                          | 88                                 |
| PYB20-Q48-D15 | 48            | 18~75       | ±15                     | ±33            | ±667     | 20                      | 100                                          | 89                                 |

Notes: 1. Ripple and noise are measured at 20 MHz BW by "parallel cable" method  
2. Efficiency is approximately 2% lower for chassis mount (-T) models.

**PART NUMBER KEY**


## INPUT

| parameter               | conditions/description                                      | min  | typ | max  | units |
|-------------------------|-------------------------------------------------------------|------|-----|------|-------|
| operating input voltage | 24 V input models                                           | 9    | 24  | 36   | Vdc   |
|                         | 48 V input models                                           | 18   | 48  | 75   | Vdc   |
| start-up voltage        | 24 V input models                                           |      |     | 9    | Vdc   |
|                         | 48 V input models                                           |      |     | 17.8 | Vdc   |
| under voltage shutdown  | 24 V input models                                           | 7.5  |     |      | Vdc   |
|                         | 48 V input models                                           | 16   |     |      | Vdc   |
| surge voltage           | for maximum of 1 second                                     |      |     |      |       |
|                         | 24 V input models                                           | -0.7 |     | 50   | Vdc   |
|                         | 48 V input models                                           | -0.7 |     | 100  | Vdc   |
| start-up time           | nominal input, constant load                                |      | 10  |      | ms    |
| filter                  | pi filter                                                   |      |     |      |       |
| CTRL <sup>1</sup>       | models ON (CTRL open or connect TTL high level, 2.5-12 Vdc) |      |     |      |       |
|                         | models OFF (CTRL connect GND or low level, 0-1.2 Vdc)       |      |     |      |       |
|                         | input current (models OFF)                                  |      | 1   |      | mA    |

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    | %     |
| cross regulation             | dual output models:<br>main output 50% load, secondary output from<br>10% to 100% load |     |      | ±5    | %     |
| voltage accuracy             |                                                                                        |     | ±1   | ±3    | %     |
| voltage balance <sup>2</sup> | dual output, balanced loads                                                            |     | ±0.5 | ±1    | %     |
| adjustability <sup>3</sup>   |                                                                                        |     | ±10  |       | %     |
| switching frequency          | PWM mode, PYB20-Q24-S24                                                                | 315 |      | 345   | KHz   |
|                              | PWM mode, all other models                                                             |     | 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  |

Note: 2. For dual output models, unbalanced load can not exceed ±5%. If ±5% is exceeded it may not meet all specifications.

3. Output trimming available on single output models only.

## PROTECTIONS

| parameter                | conditions/description                 | min | typ | max | units |
|--------------------------|----------------------------------------|-----|-----|-----|-------|
| short circuit protection | hiccup, continuous, automatic recovery |     |     |     |       |
| over current protection  |                                        |     | 160 |     | %     |
| over voltage protection  | 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   |

## SAFETY AND COMPLIANCE

| parameter                    | conditions/description                                                        | min       | typ | max | units |
|------------------------------|-------------------------------------------------------------------------------|-----------|-----|-----|-------|
| isolation voltage            | for 1 minute at 1 mA max.                                                     | 1,500     |     |     | Vdc   |
| isolation resistance         | at 500 Vdc                                                                    | 1,000     |     |     | MΩ    |
| conducted emissions          | CISPR22/EN55022, class A, class B (external circuit required, see Figure 1-b) |           |     |     |       |
| radiated emissions           | CISPR22/EN55022, class A, class B (external circuit required, see Figure 1-b) |           |     |     |       |
| 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-a)   |           |     |     |       |
| surge                        | IEC/EN61000-4-5, class B, ± 2kV (external circuit required, see Figure 1-a)   |           |     |     |       |
| 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 compliant               | yes                                                                           |           |     |     |       |

## 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, Ta=71°C                      |     |     | 105 | °C    |
| vibration             | 10~55 Hz for 30 min. along X, Y and Z axis |     | 10  |     | G     |

## MECHANICAL

| parameter     | conditions/description                          | min | typ | max | units |
|---------------|-------------------------------------------------|-----|-----|-----|-------|
| dimensions    | chassis mount: 76.0 x 31.5 x 21.2               |     |     |     | mm    |
|               | chassis mount with heatsink: 76.0 x 31.5 x 25.1 |     |     |     | mm    |
|               | U-Frame: 52.32 x 54.99 x 19.05                  |     |     |     | mm    |
|               | U-Frame with heatsink: 52.32 x 54.99 x 22.90    |     |     |     | mm    |
| case material | aluminum alloy                                  |     |     |     |       |
| weight        | chassis mount                                   |     | 50  |     | g     |
|               | chassis mount with heatsink                     |     | 58  |     | g     |
|               | U-Frame                                         |     | 58  |     | g     |
|               | U-Frame with heatsink                           |     | 66  |     | g     |

## MECHANICAL DRAWING

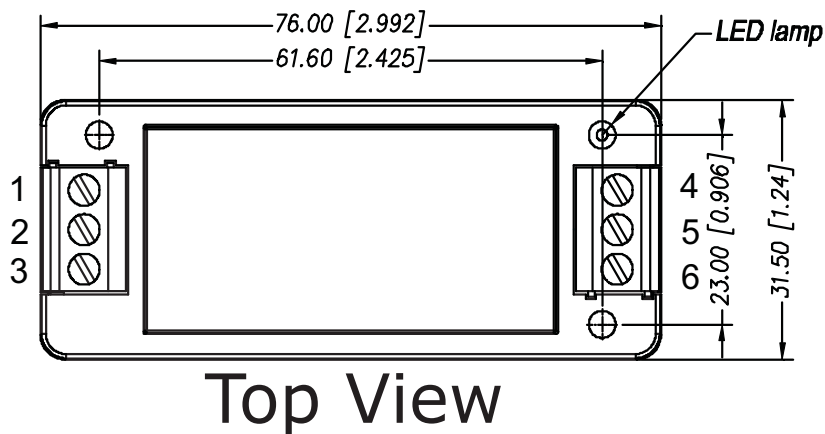
### CHASSIS MOUNT

units: mm[inch]

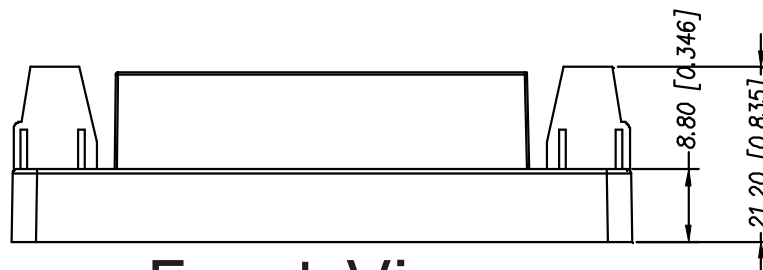
tolerance:  $\pm 0.5[\pm 0.020]$ 

wire range: 24~12 AWG

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



### Top View



### Front View

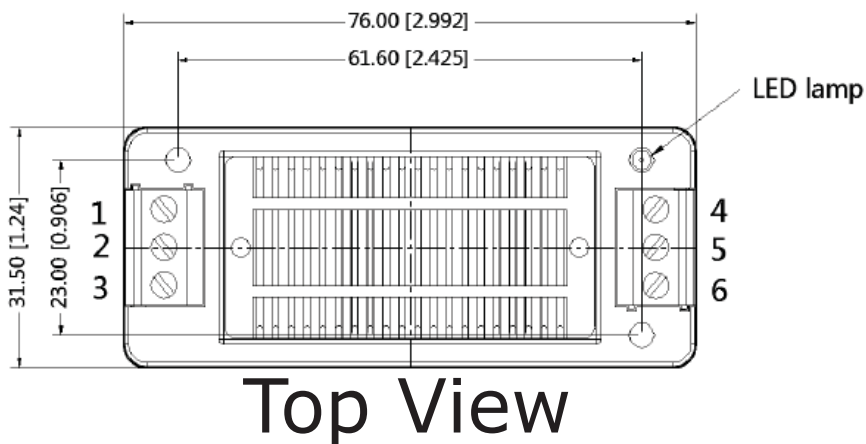
### CHASSIS MOUNT WITH HEATSINK

units: mm[inch]

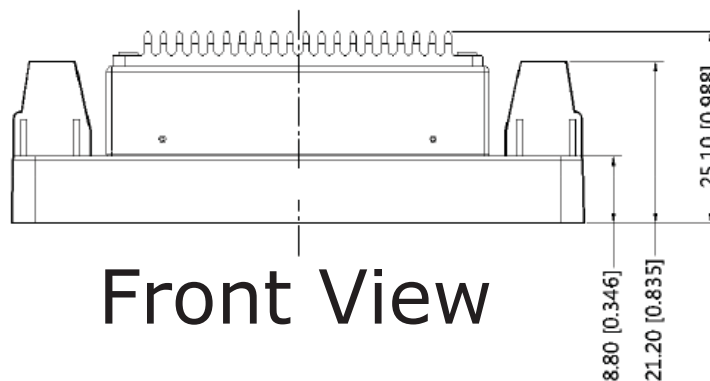
tolerance:  $\pm 0.5[\pm 0.020]$ 

wire range: 24~12 AWG

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



### Top View



### Front View

## MECHANICAL DRAWING (CONTINUED)

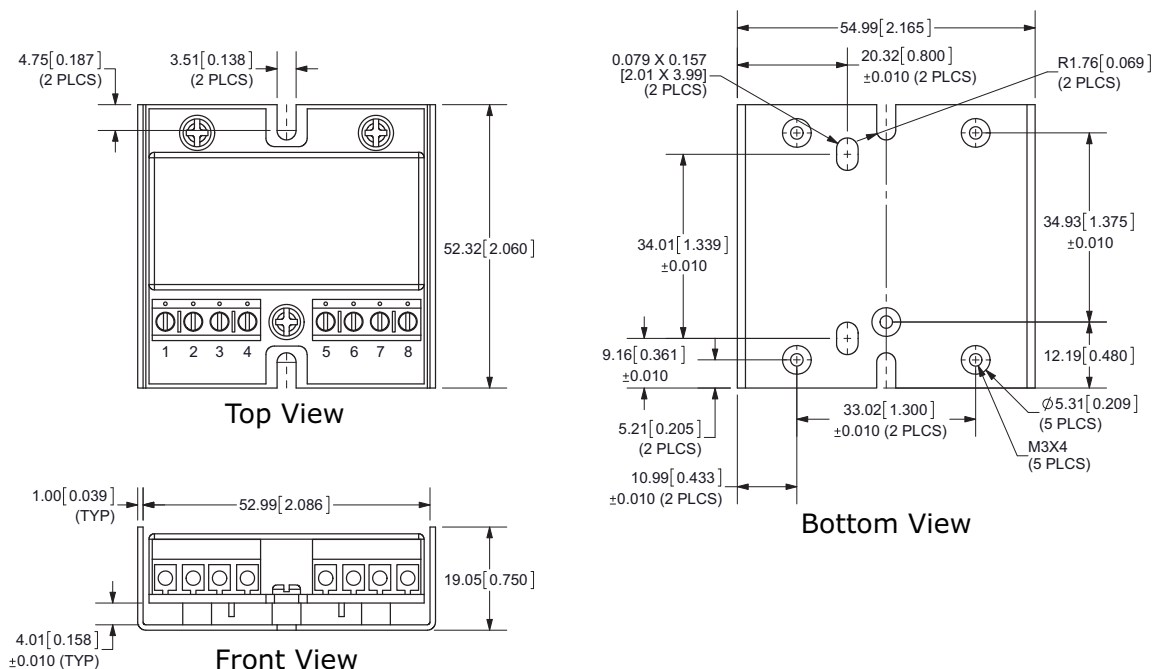
### U-FRAME

units: mm[inch]

tolerance:  $\pm 0.5[\pm 0.020]$ 

Wire range: 22~14 AWG  
DIN rail mounting kit available  
(part# STK-DIN)

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



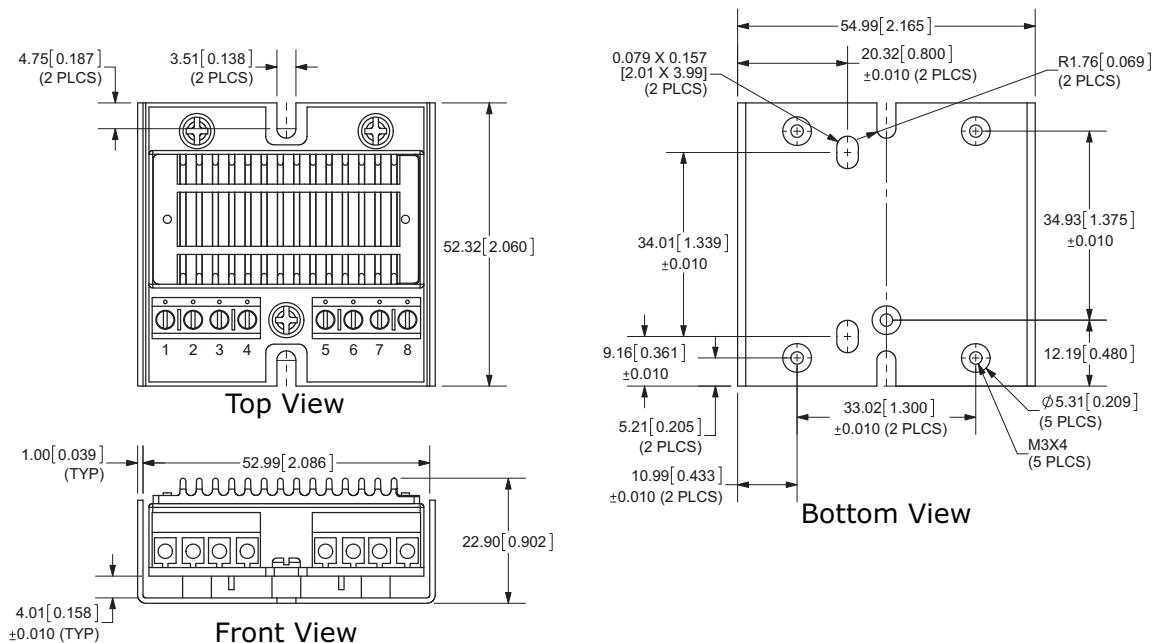
### U-FRAME WITH HEATSINK

units: mm[inch]

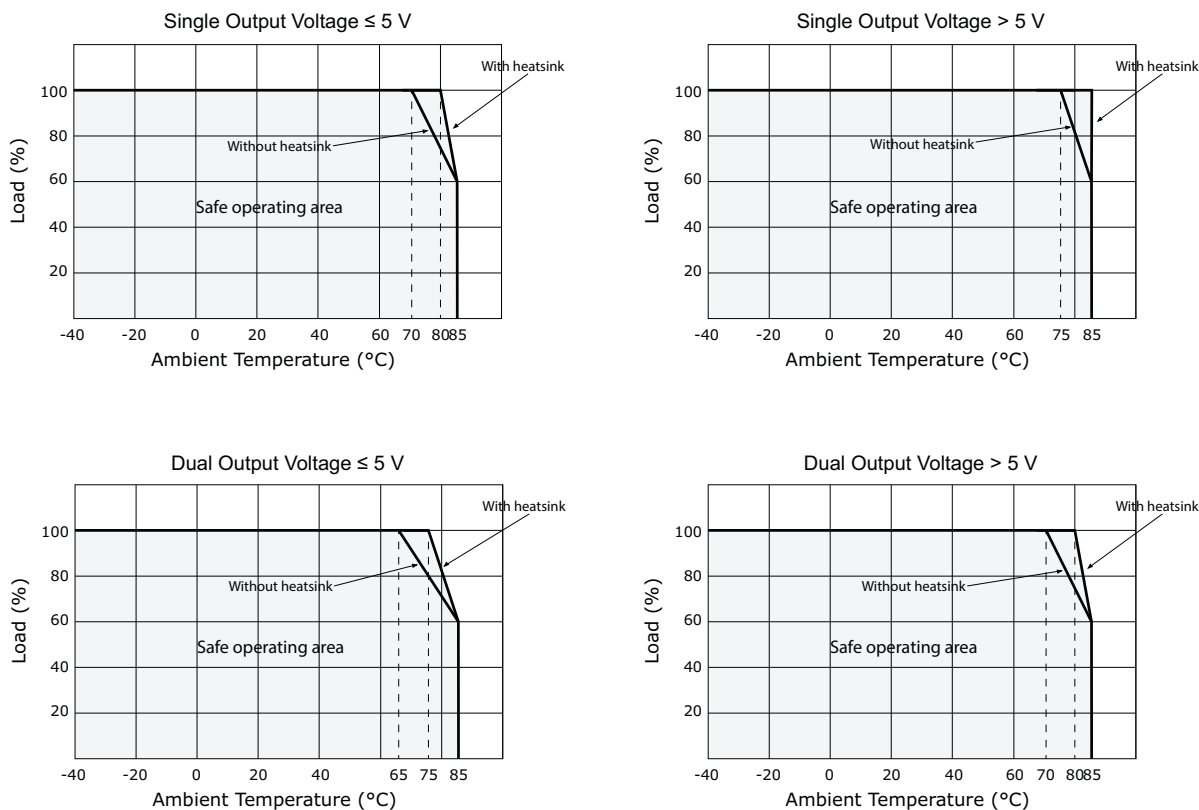
tolerance:  $\pm 0.5[\pm 0.020]$ 

Wire range: 22~14 AWG  
DIN rail mounting kit available  
(part# STK-DIN)

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



## DERATING CURVES



## EMC RECOMMENDED CIRCUIT

Figure 1

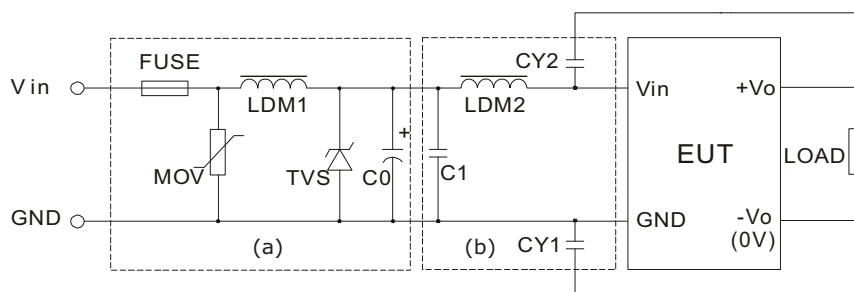


Table 1

| Recommended external circuit components |                                   |            |
|-----------------------------------------|-----------------------------------|------------|
| Vin (Vdc)                               | 24                                | 48         |
| FUSE                                    | Choose according to input current |            |
| MOV                                     | S14K35                            | S14K60     |
| LDM1                                    | 56μH                              | 56μH       |
| TVS                                     | SMCJ48A                           | SMCJ90A    |
| C0                                      | 330μF/50V                         | 330μF/100V |
| C1                                      | 1μF/50V                           | 1μF/100V   |
| LDM2                                    | 4.7μH                             | 4.7μH      |
| CY1                                     | 1nF/2KV                           | 1nF/2KV    |
| CY2                                     | 1nF/2KV                           | 1nF/2KV    |

## TEST CONFIGURATION

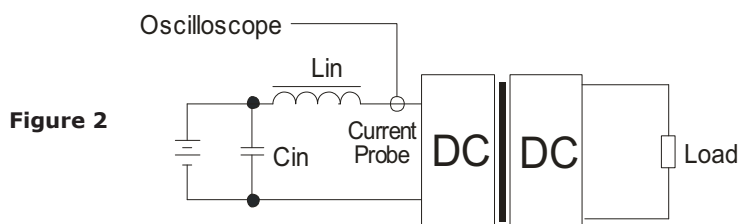


Table 2

| External components |                              |
|---------------------|------------------------------|
| Lin                 | 4.7μH                        |
| Cin                 | 220μF, ESR < 1.0Ω at 100 KHz |

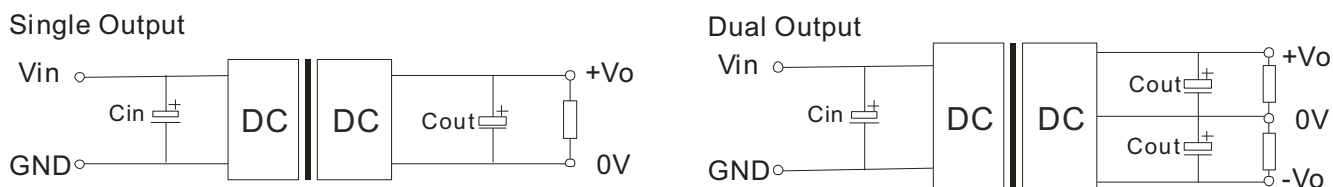
Note: Input reflected-ripple current is measured with an inductor Lin and Capacitor Cin to simulate source impedance.

## APPLICATION NOTES

### 1. 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 the capacitance accordingly or choose capacitors with low ESR (see Table 3). However, the capacitance of the output filter capacitor must be appropriate. If the capacitance is too high, a startup problem might arise. For every channel of the output, to ensure safe and reliable operation, the maximum capacitance must be less than the maximum capacitive load (see Table 4).

**Figure 3**



**Table 3**

| Single Vout (Vdc) | Cin (μF) | Cout (μF) | Dual Vout (Vdc) | Cin (μF) | Cout <sup>1</sup> (μF) |
|-------------------|----------|-----------|-----------------|----------|------------------------|
| 3.3               | 100      | 470       | ±5              | 100      | 220                    |
| 5                 | 100      | 470       | ±12             | 100      | 100                    |
| 12                | 100      | 220       | ±15             | 100      | 100                    |
| 15                | 100      | 220       | --              | --       | --                     |
| 24                | 100      | 100       | --              | --       | --                     |

Note: 1. For each output.

**Table 4**

| Single Vout (Vdc) | Max. Capacitive Load (μF) | Dual Vout (Vdc) | Max. Capacitive Load <sup>1</sup> (μF) |
|-------------------|---------------------------|-----------------|----------------------------------------|
| 3.3               | 18700                     | --              | --                                     |
| 5                 | 9600                      | 5               | 4800                                   |
| 12                | 1600                      | 12              | 800                                    |
| 15                | 1000                      | 15              | 625                                    |
| 24                | 500                       | --              | --                                     |

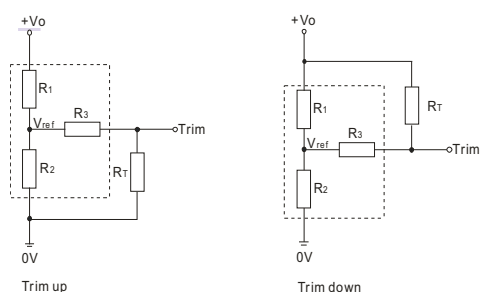
Note: 1. For each output.

### 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

$$\begin{aligned} \text{up: } R_T &= \frac{aR_2}{R_2 - a} - R_3 & a &= \frac{V_{ref}}{V_o' - V_{ref}} \cdot R_1 \\ \text{down: } R_T &= \frac{aR_1}{R_1 - a} - R_3 & a &= \frac{V_o' - V_{ref}}{V_{ref}} \cdot R_2 \end{aligned}$$

Note: Value for R1, R2, R3, and Vref refer to Table 5  
 $R_T$ : Trim Resistor  
 $a$ : User-defined parameter, no actual meanings  
 $V_o'$ : The trim up/down voltage

**Table 5**

| Vout (Vdc) | R1 (KΩ) | R2 (KΩ) | R3 (KΩ) | Vref (V) |
|------------|---------|---------|---------|----------|
| 3.3        | 4.801   | 2.863   | 15      | 1.24     |
| 5          | 2.883   | 2.864   | 10      | 2.5      |
| 12         | 10.971  | 2.864   | 17.8    | 2.5      |
| 15         | 14.497  | 2.864   | 17.8    | 2.5      |
| 24         | 24.872  | 2.863   | 20      | 2.5      |

Note: 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  $T_a = 25^\circ\text{C}$ , humidity < 75%, nominal input voltage and rated output load unless otherwise specified.

## REVISION HISTORY

| rev. | description     | date       |
|------|-----------------|------------|
| 1.0  | initial release | 06/26/2013 |
| 1.01 | updated spec    | 08/16/2013 |

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

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