

SERIES: VFB400W | **DESCRIPTION:** DC-DC CONVERTER

FEATURES

- 400 W isolated output
- industry standard full brick package
- 4:1 input range (9~36, 18~75 Vdc)
- single regulated outputs from 5Vdc to 48 Vdc
- 1,500 Vdc isolation
- over current protection, over voltage protection, input under voltage lockout protection, and over temp. protection
- remote on/off
- without tantalum capacitors inside
- efficiency up to 90%

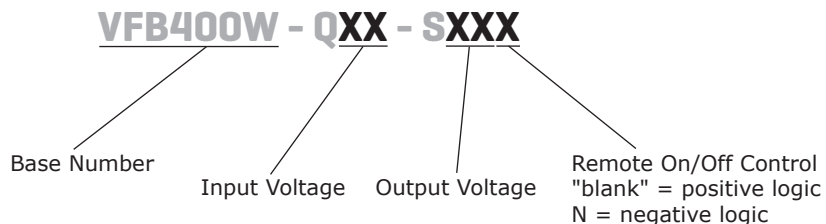


MODEL

| MODEL | input voltage | | output voltage | output current | output power | ripple and noise ¹ | efficiency |
|-----------------|---------------|-------------|----------------|----------------|--------------|-------------------------------|------------|
| | typ (Vdc) | range (Vdc) | (Vdc) | max (A) | max (W) | max (mVp-p) | typ (%) |
| VFB400W-Q24-S5 | 24 | 9~36 | 5 | 80 | 400 | 100 | 87.5 |
| VFB400W-Q24-S12 | 24 | 9~36 | 12 | 33.3 | 400 | 120 | 86 |
| VFB400W-Q24-S24 | 24 | 9~36 | 24 | 16.7 | 400 | 240 | 87 |
| VFB400W-Q24-S28 | 24 | 9~36 | 28 | 14.3 | 400 | 280 | 87 |
| VFB400W-Q24-S48 | 24 | 9~36 | 48 | 8.3 | 400 | 480 | 86.5 |
| VFB400W-Q48-S5 | 48 | 18~75 | 5 | 80 | 400 | 100 | 89 |
| VFB400W-Q48-S12 | 48 | 18~75 | 12 | 33.3 | 400 | 120 | 88.5 |
| VFB400W-Q48-S24 | 48 | 18~75 | 24 | 16.7 | 400 | 240 | 90 |
| VFB400W-Q48-S28 | 48 | 18~75 | 28 | 14.3 | 400 | 280 | 90 |
| VFB400W-Q48-S48 | 48 | 18~75 | 48 | 8.3 | 400 | 480 | 89.5 |

Notes: 1. Ripple and noise measured at full load, 20 MHz BW with 10µF tantalum capacitor and 1µF ceramic capacitor across output. The 48 Vdc output models require a 10µF aluminum capacitor and 1µF ceramic capacitor across the output
 2. An external input capacitor of 1000µF for 24 Vdc input models and 330µF for 48 Vdc input models is recommended to reduce input ripple voltage.

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 |
| under voltage shutdown | 24 Vdc input | | 8.5 7.5 | | Vdc Vdc |
| | 48 Vdc input | | 17 15 | | Vdc Vdc |
| over voltage shutdown | 24 Vdc input | | 40 42 | | Vdc Vdc |
| | 48 Vdc input | | 80 83 | | Vdc Vdc |
| start-up time | | | | 250 | ms |
| CTRL | positive logic | models ON (0~0.01 mA) | | | |
| | | models OFF (1.0~10 mA) | | | |
| | negative logic | models ON (1.0~10 mA) | | | |
| | | models OFF (0~0.01 mA) | | | |
| filter | pi filter | | | | |
| input fuse | 80A time delay fuse for 24 Vin models, 40A time delay fuse for 48 Vin models | | | | |

OUTPUT

| parameter | conditions/description | min | typ | max | units |
|----------------------------------|--|-----|-----|--------|-------|
| output capacitance ¹ | 5V output models | 680 | | 10,000 | μF |
| | 12V output models | 330 | | 10,000 | μF |
| | 24V and 28V output models | 330 | | 4,700 | μF |
| | 48V output models | 100 | | 2,200 | μF |
| line regulation ¹ | from low line to high line | | | ±0.2 | % |
| load regulation ¹ | from full load to no load | | | ±0.5 | % |
| voltage accuracy ¹ | | | | ±1.5 | % |
| load share accuracy ² | from 50~100% load | | ±10 | | % |
| adjustability | | 80 | | 110 | % |
| switching frequency | | | 230 | | KHz |
| transient response | 25% load step change | | | 500 | μs |
| temperature coefficient | | | | ±0.03 | %/°C |
| power good (IOC) | Vout ready: low level, sink current | | | 20 | mA |
| | Vout not ready: open drain output, applied voltage | | | 50 | V |
| auxiliary output voltage/current | 10 ±3 Vdc, 20 mA max. | | | | |

Note: 1. Minimum capacitor values are required on the output to maintain the specified regulation.
2. Excludes 5 Vdc output models.

PROTECTIONS

| parameter | conditions/description | min | typ | max | units |
|-----------------------------|------------------------|-----|-----|-----|-------|
| short circuit protection | continuous | | | | |
| over current protection | | 110 | | 150 | % |
| over voltage protection | | 115 | | 140 | % |
| over temperature protection | shutdown | | 110 | | °C |

SAFETY AND COMPLIANCE

| parameter | conditions/description | min | typ | max | units |
|----------------------|---|---------|-----|-----|-------|
| isolation voltage | for 1 minute, input to output, input to case, or output to case | 1,500 | | | Vdc |
| isolation resistance | | 10 | | | MΩ |
| safety approvals | UL 60950 | | | | |
| MTBF | at full load, 25 °C, as per MIL-HDBK-217F | 340,000 | | | hours |
| RoHS | 2011/65/EU (CE) | | | | |

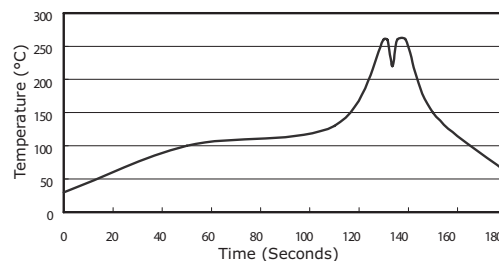
ENVIRONMENTAL

| parameter | conditions/description | min | typ | max | units |
|----------------------------|------------------------|-----|-----|-----|-------|
| operating case temperature | see derating curve | -40 | | 100 | °C |
| storage temperature | | -55 | | 110 | °C |
| humidity | non-condensing | | | 95 | % |

SOLDERABILITY

| parameter | conditions/description | min | typ | max | units |
|----------------|----------------------------|-----|-----|-----|-------|
| wave soldering | see wave soldering profile | | | 260 | °C |

- Notes:
1. Soldering materials: Sn/Cu/Ni
 2. Ramp up rate during preheat: 1.4°C/s (from 50°C to 100°C)
 3. Soaking temperature: 0.5°C/s (from 100°C to 130°C), 60±20 seconds
 4. Peak temperature: 260°C, above 250°C for 3~6 seconds
 5. Ramp down rate during cooling: -10°C/s (from 260°C to 150°C)



MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|---------------|---|-----|-----|-----|-------|
| dimensions | 4.60 x 2.40 x 0.50 (116.8 x 61.0 x 12.7 mm) | | | | inch |
| case material | aluminum baseplate with plastic case | | | | |
| weight | | | 220 | | g |

MECHANICAL DRAWING

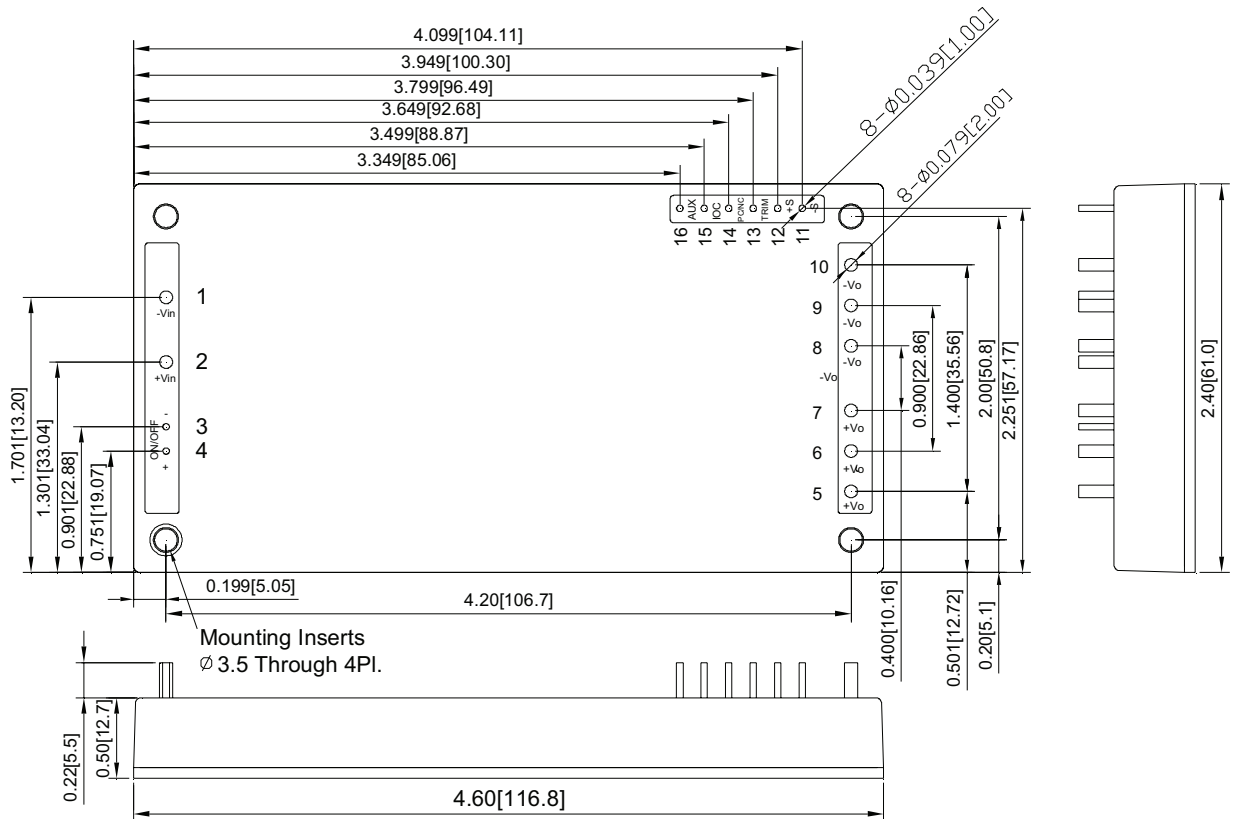
units: inch[mm]

tolerance: X.XX = ±0.02[±0.5]

X.XXX = ±0.010[±0.25]

pin diameter tolerance: ±0.004[±0.1]

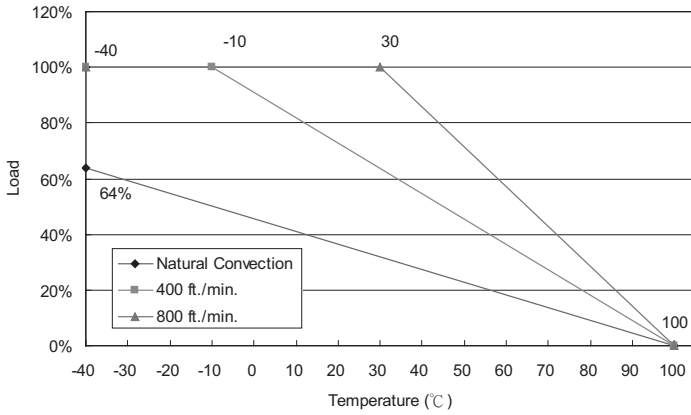
| PIN CONNECTIONS | |
|-----------------|----------|
| Pin | Function |
| 1 | -Vin |
| 2 | +Vin |
| 3 | -ON/OFF |
| 4 | +ON/OFF |
| 5 | +Vo |
| 6 | +Vo |
| 7 | +Vo |
| 8 | -Vo |
| 9 | -Vo |
| 10 | -Vo |
| 11 | -S |
| 12 | +S |
| 13 | TRIM |
| 14 | PC/NC |
| 15 | IOC |
| 16 | AUX |



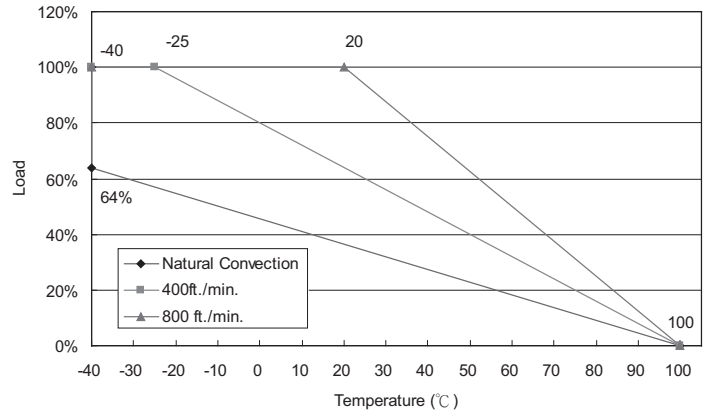
PCB Layout
Top View

DERATING CURVES

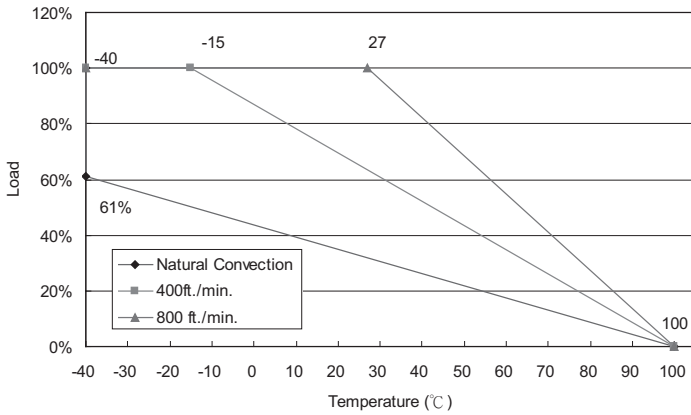
VFB400W-Q24-S5 Derating Curves



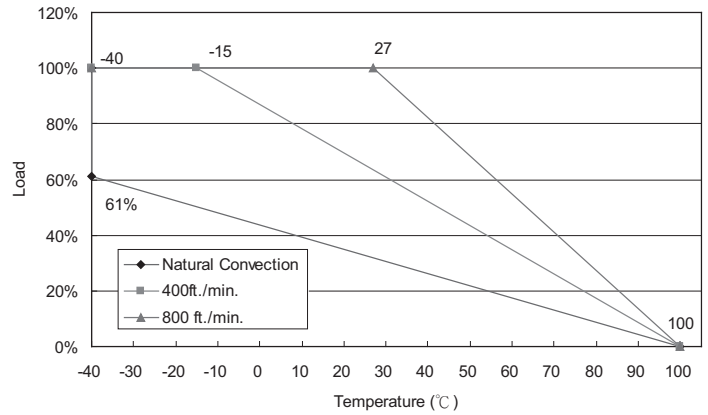
VFB400W-Q24-S12 Derating Curves



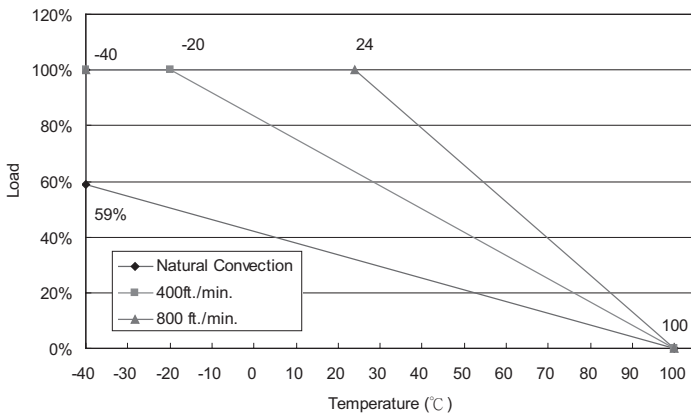
VFB400W-Q24-S24 Derating Curves



VFB400W-Q24-S28 Derating Curves

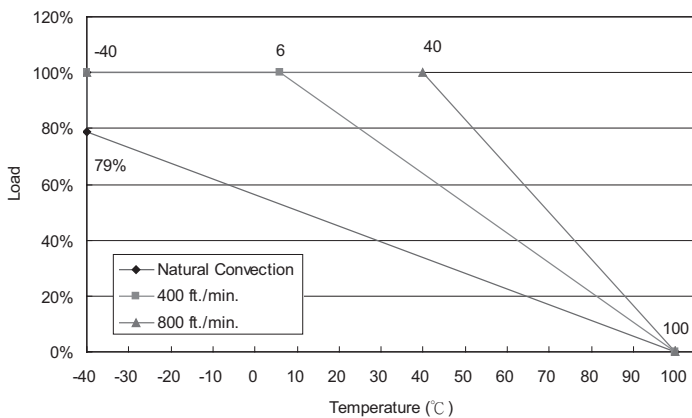


VFB400W-Q24-S48 Derating Curves

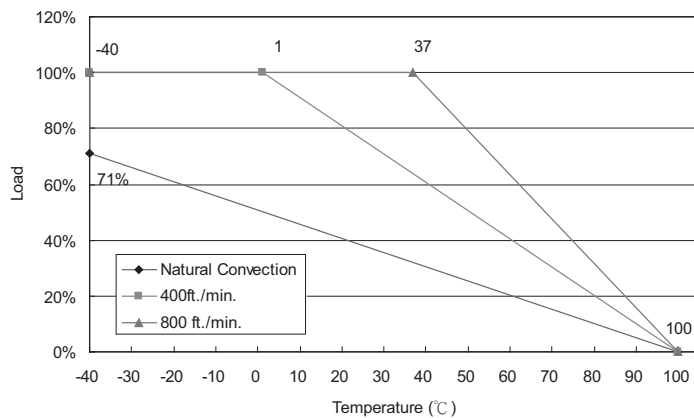


DERATING CURVES (CONTINUED)

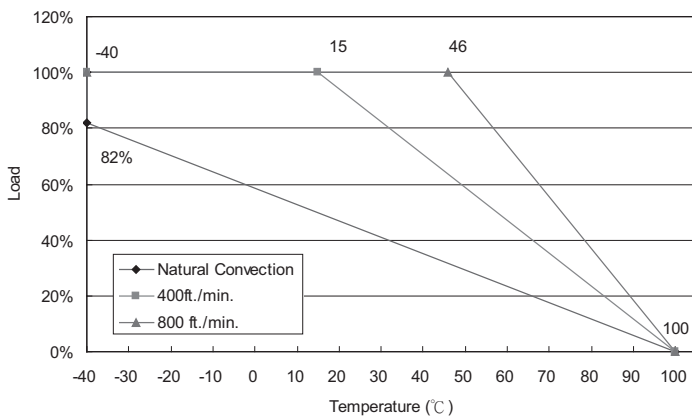
VFB400W-Q48-S5 Derating Curves



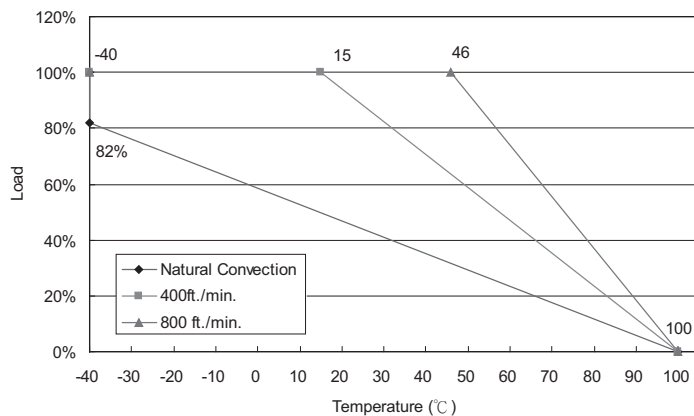
VFB400W-Q48-S12 Derating Curves



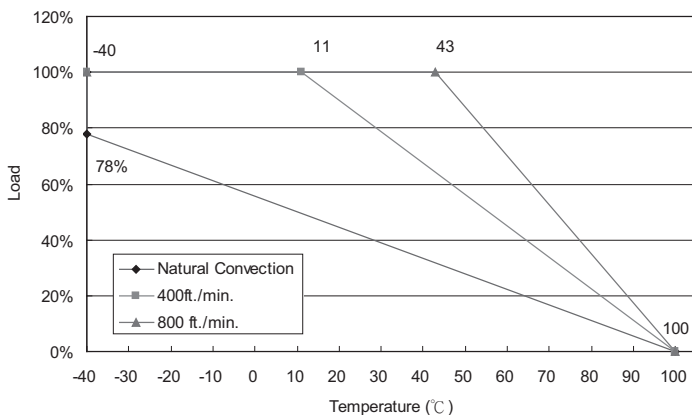
VFB400W-Q48-S24 Derating Curves



VFB400W-Q48-S28 Derating Curves



VFB400W-Q48-S48 Derating Curves



APPLICATION NOTES

1. Parallel Operation

The VFB400W series (excluding the 5 Vdc output models), are designed for parallel operation. When in parallel the load current can be shared equally between the two modules by connecting their PC pins. The VFB400W can be setup in two different modes to achieve parallel operation. The standard parallel operation is suitable when load cannot be handled by a single unit, whereas the N+1 redundant operation is suitable for loads when backup power is required.

Figure 1
Standard Parallel Connection

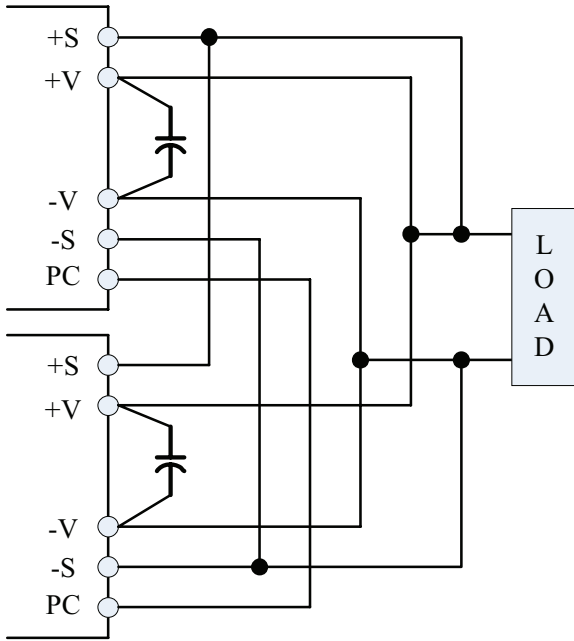


Figure 2
Parallel Connection With Programmed And Adjustable Output

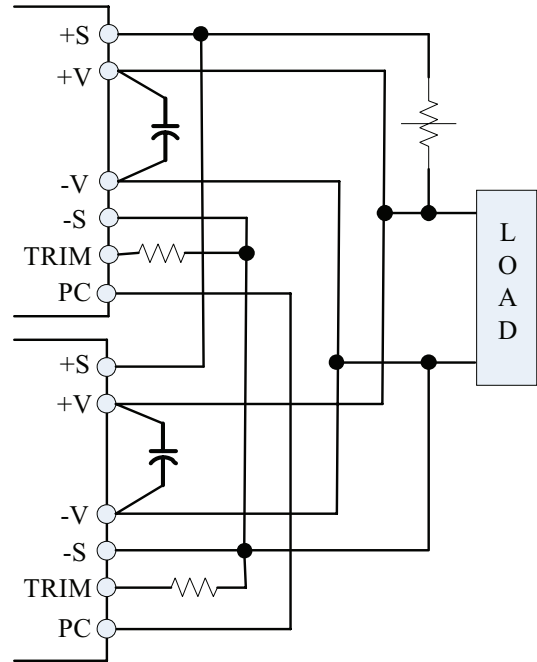


Figure 3
N+1 Redundant Connection

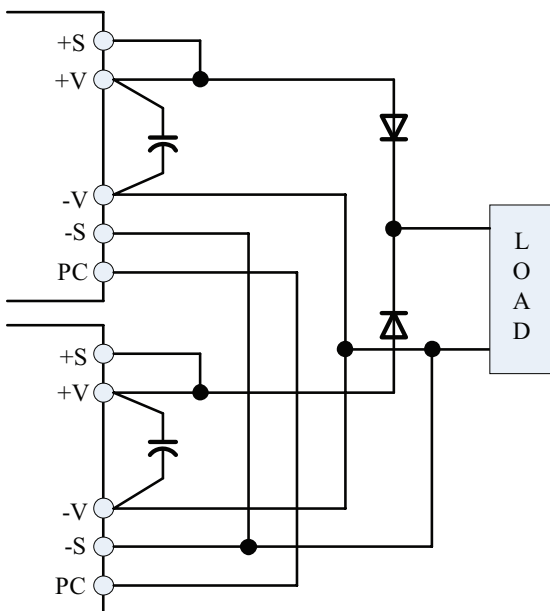
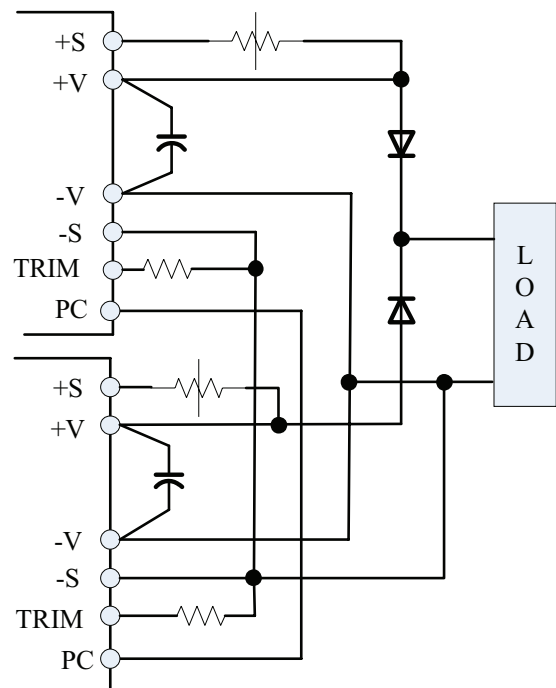


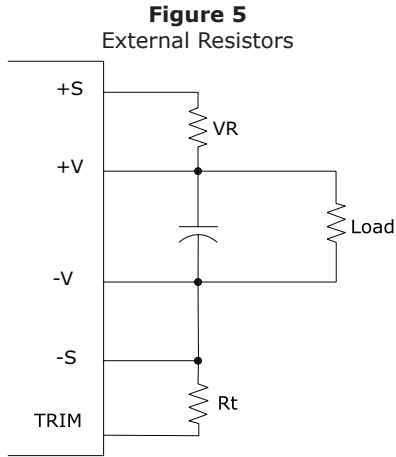
Figure 4
N+1 Redundant Connection With Programmed Output And Adjustable Output Voltage



APPLICATION NOTES (CONTINUED)

2. Output Voltage Trimming

Leave open if not used.

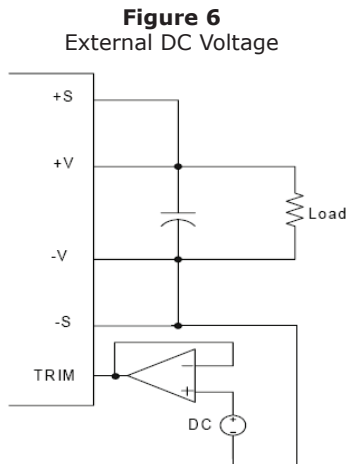


Trim-Up/Trim-Down Formulas

$$V_f = \frac{1.24 \times \left(\frac{R_t \times 33}{R_t + 33} \right)}{7.68 + \left(\frac{R_t \times 33}{R_t + 33} \right)}$$

$$V_{out} = (V_o + V_R) \times V_f$$

Note: $R_t = 6.8 \text{ K}\Omega$
 V_o is the nominal output voltage
 V_{OUT} is the desired output voltage (up or down)
 V_R is the trim resistor in $\text{K}\Omega$



Trim-Up/Trim-Down Formulas

$$V_{out} = V_T \times V_o$$

Note: V_T is the trim terminal voltage
 V_o is the nominal output voltage
 V_{OUT} is the desired output voltage (up or down)

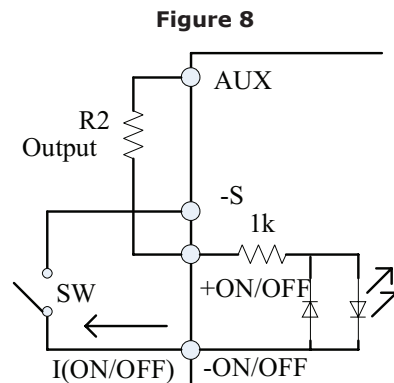
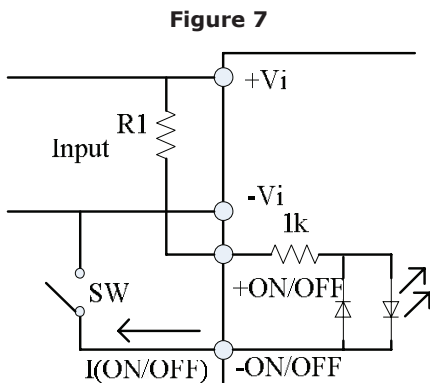
Note: 1. Models VFB400W-Q24-S24, S28 & S48 require a minimum input voltage of 13 Vdc and models VFB400W-Q48-S24, S28 & S48 require a minimum input voltage of 22 Vdc in order to trim between 100~110%.

3. ON/OFF Control

The converter's ON/OFF function can be controlled from the input side or from the output side. The maximum current through the ON/OFF pin is 10mA. The resistor value has to be set appropriately to avoid the maximum current through the ON/OFF pins.

(A) Controlling the ON/OFF terminal from the input side. Recommended R1 value is $12\text{K}\Omega$ (1.0W) for $48V_{IN}$ and $6\text{K}\Omega$ (0.5W) for $24V_{IN}$

(B) Controlling the ON/OFF terminal from the output side. Recommended R2 value is $4.3\text{K}\Omega$ (0.1W)



APPLICATION NOTES (CONTINUED)

4. IOC Signal

Normal and abnormal operation of the converter can be monitored by using the I.O.C signal. Output of this signal monitor is located at the secondary side and is open collector output, you can use the signal by the internal aux power supply or the the external DC supply as the following figures. the ground reference is the -Sense. This signal is LOW when the converter is normally operating and HIGH when the converter is disabled or when the converter is abnormally operating.

Figure 9
Internal AUX Power

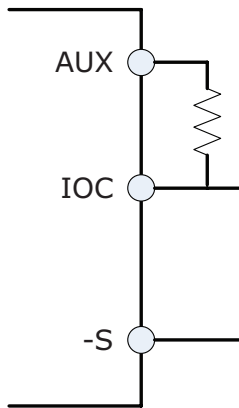
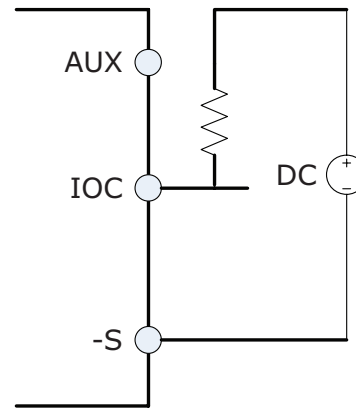


Figure 10
External DC Power



5. Test Configuration

Figure 11

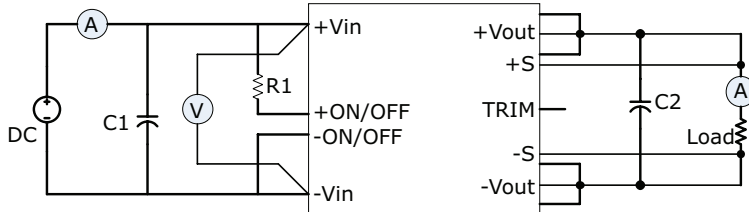


Table 1

| Recommended External components | |
|---------------------------------|--|
| C1 | < 0.7 Ω ESR 1000 μ F/50 V (24 Vin models) 330 μ F/100 V (48 Vin models) |
| C2 | Choose according to the output capacitance (see page 2) |

- Notes:
1. All specifications measured at nominal line, full load, and 25°C unless otherwise specified.
 2. Remote on/off control has to be connected for the converter to operate.
 3. If the remote sense feature is not to be used, the +sense pin should be connected to the +Vout pin and the -sense pin should be connected to the -Vout pin.

REVISION HISTORY

| rev. | description | date |
|------|-----------------|------------|
| 1.0 | initial release | 01/30/2014 |

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



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

Fax 503.612.2383
cui.com
techsupport@cui.com

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