



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

**FEATURES**

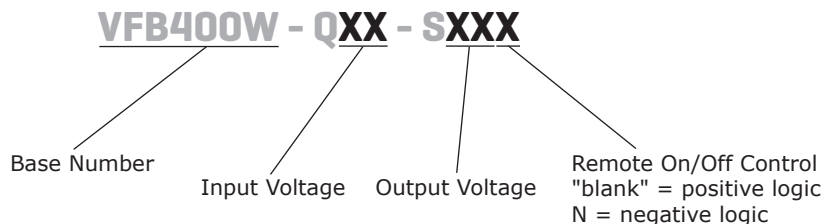
- 400 W isolated output
- industry standard full brick package
- 4:1 input range (9~36, 18~75 Vdc)
- single regulated outputs from 5Vdc to 48 Vdc
- 1,500 Vdc isolation
- over current protection, over voltage protection, input under voltage lockout protection, and over temp. protection
- remote on/off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



MODEL	input voltage		output voltage	output current	output power	ripple and noise <sup>1</sup>	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 <sup>1</sup>	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 <sup>1</sup>	from low line to high line			±0.2	%
load regulation <sup>1</sup>	from full load to no load			±0.5	%
voltage accuracy <sup>1</sup>				±1.5	%
load share accuracy <sup>2</sup>	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)				

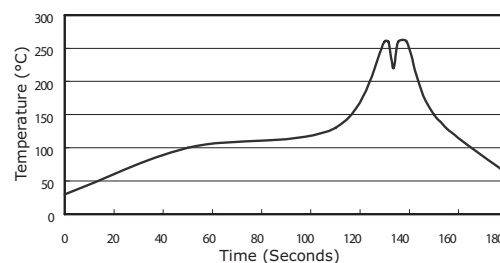
## ENVIRONMENTAL

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

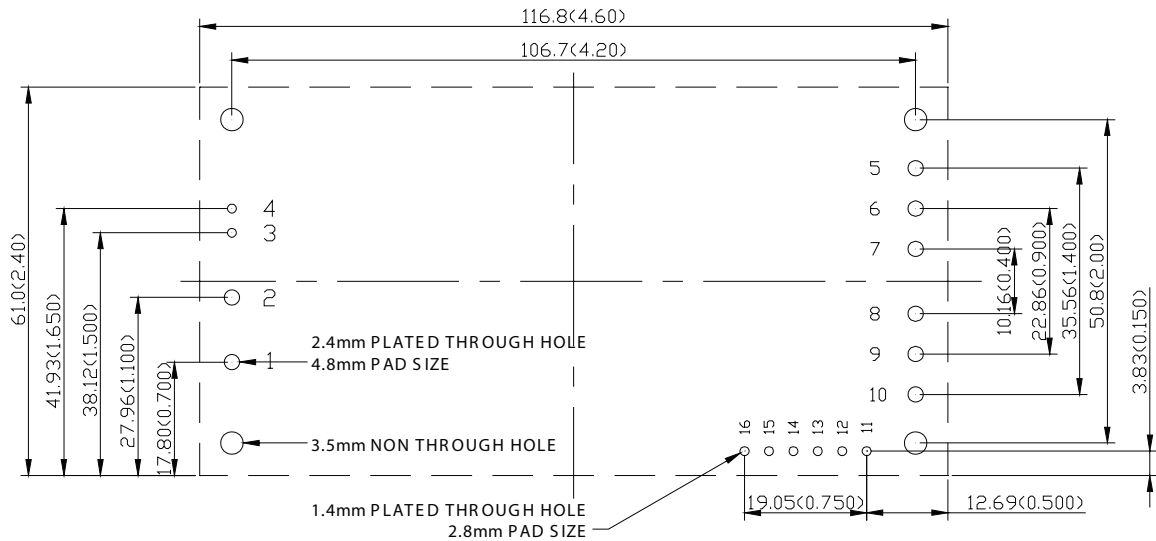
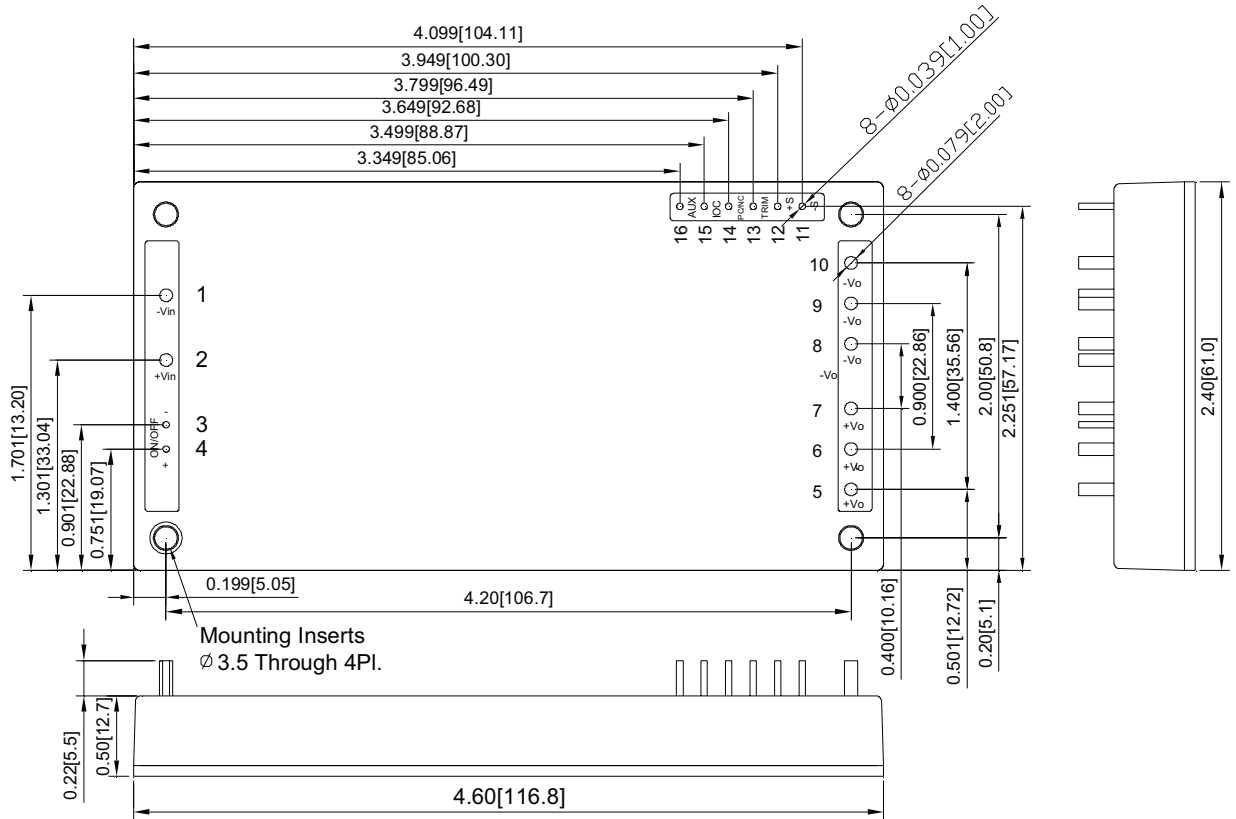
units: inch[mm]

tolerance: X.XX = ±0.02[±0.5]

X.XXX = ±0.010[±0.25]

pin diameter tolerance: ±0.004[±0.1]

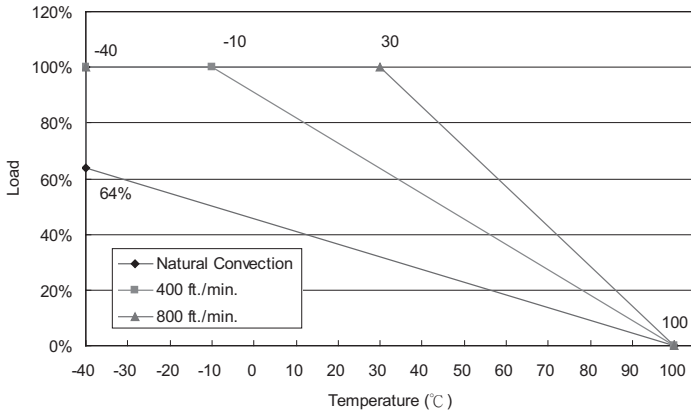
PIN CONNECTIONS	
Pin	Function
1	-Vin
2	+Vin
3	-ON/OFF
4	+ON/OFF
5	+Vo
6	+Vo
7	+Vo
8	-Vo
9	-Vo
10	-Vo
11	-S
12	+S
13	TRIM
14	PC/NC
15	IOC
16	AUX



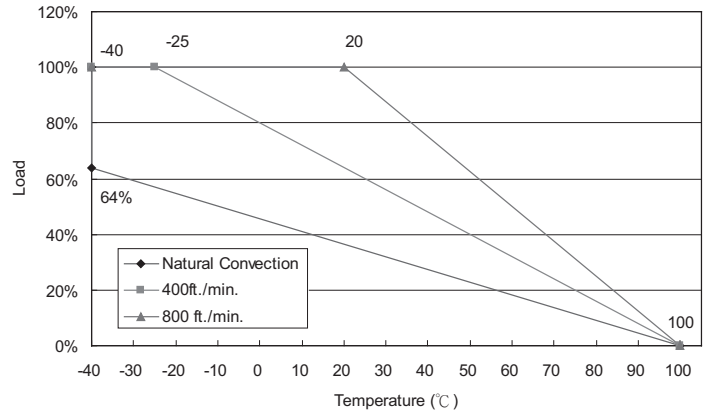
PCB Layout  
Top View

## DERATING CURVES

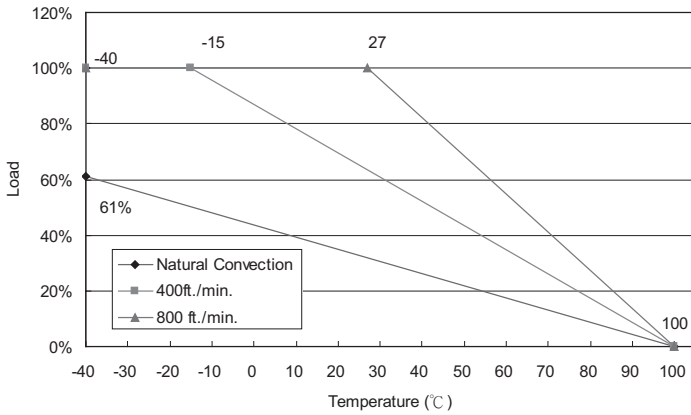
VFB400W-Q24-S5 Derating Curves



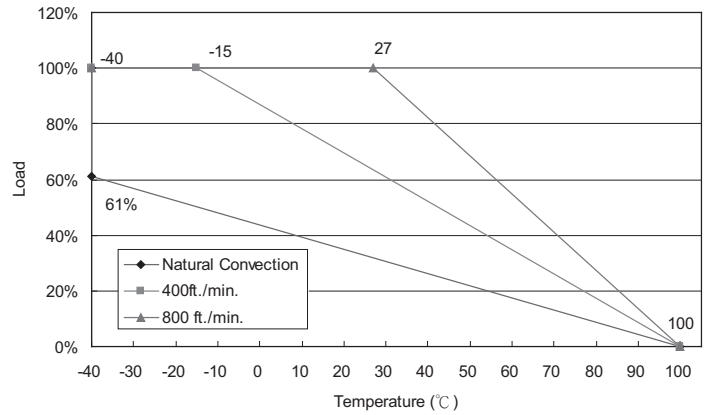
VFB400W-Q24-S12 Derating Curves



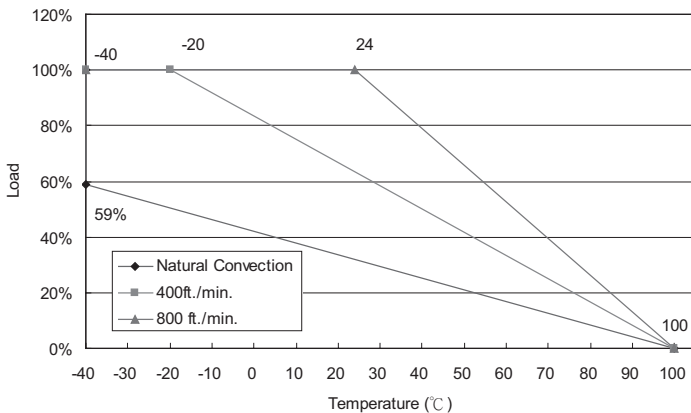
VFB400W-Q24-S24 Derating Curves



VFB400W-Q24-S28 Derating Curves

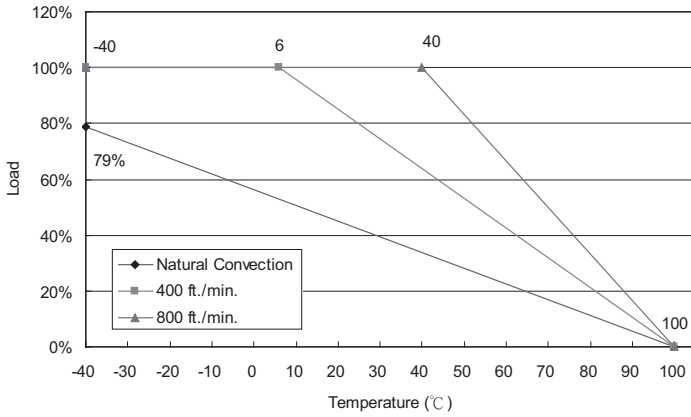


VFB400W-Q24-S48 Derating Curves

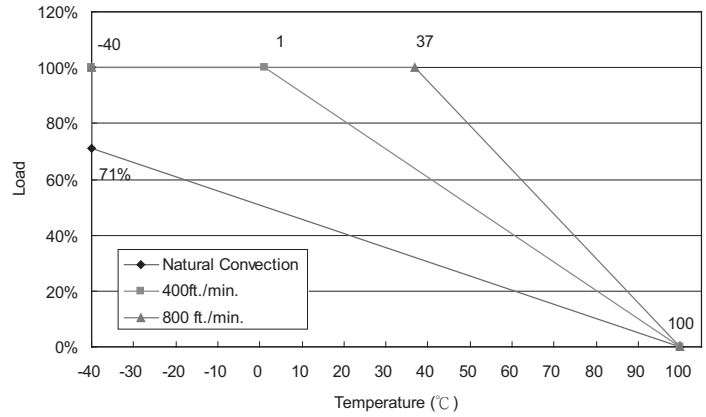


## DERATING CURVES (CONTINUED)

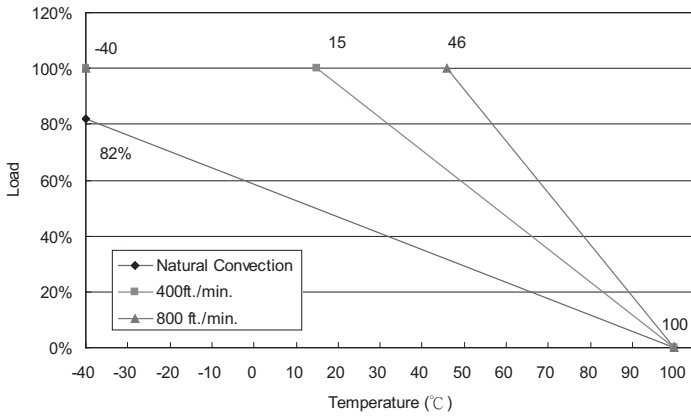
VFB400W-Q48-S5 Derating Curves



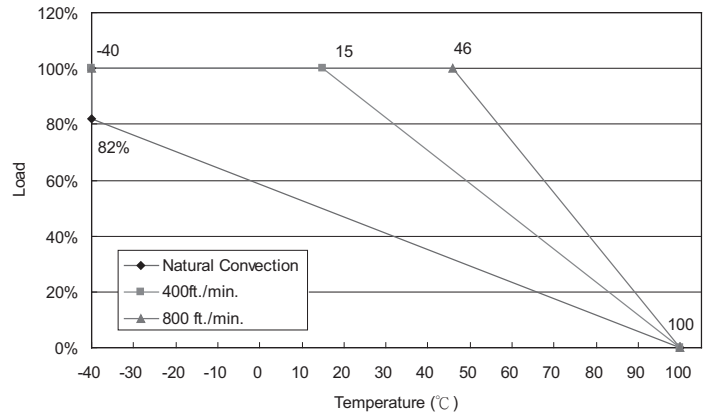
VFB400W-Q48-S12 Derating Curves



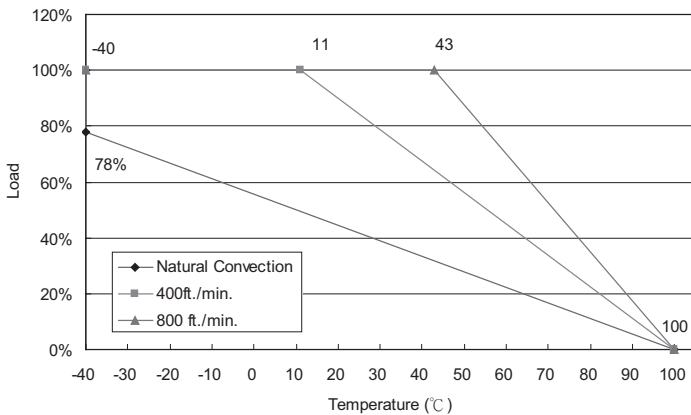
VFB400W-Q48-S24 Derating Curves



VFB400W-Q48-S28 Derating Curves



VFB400W-Q48-S48 Derating Curves

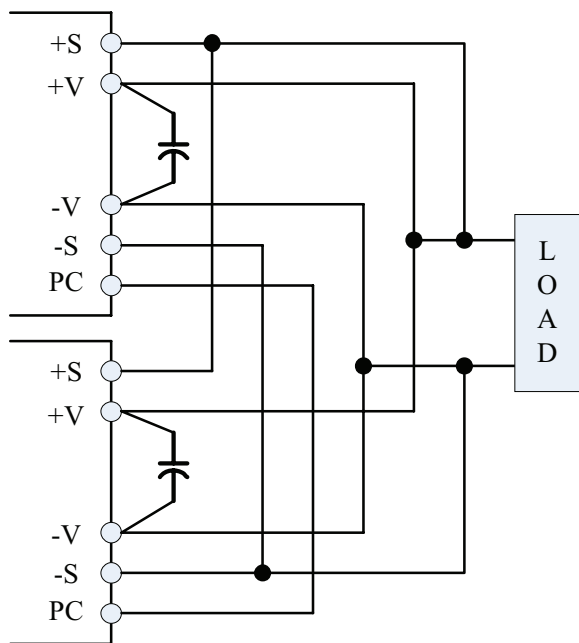


## APPLICATION NOTES

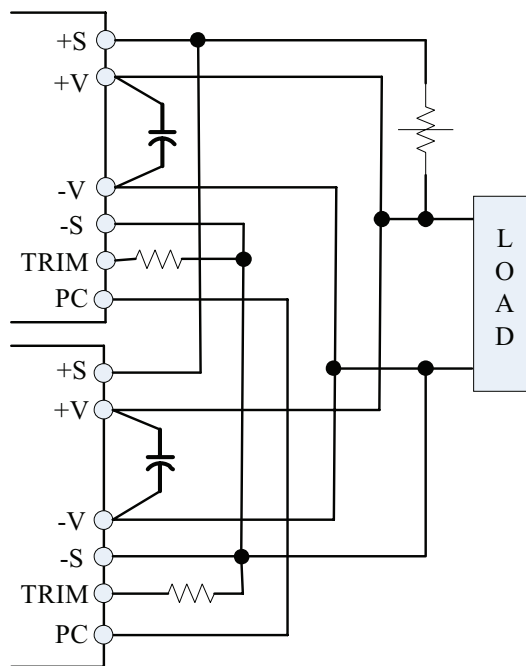
### 1. Parallel Operation

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.

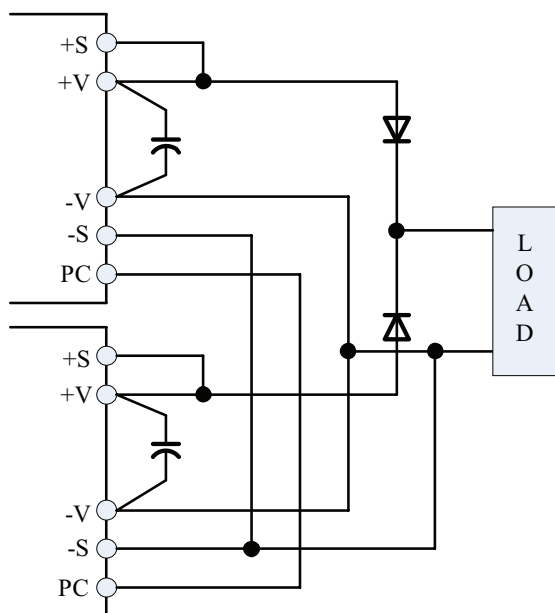
**Figure 1**  
Standard Parallel Connection



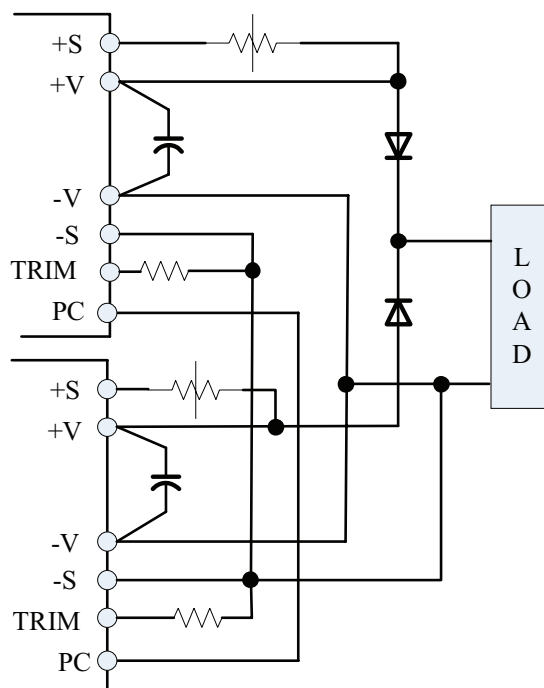
**Figure 2**  
Parallel Connection With Programmed And Adjustable Output



**Figure 3**  
N+1 Redundant Connection



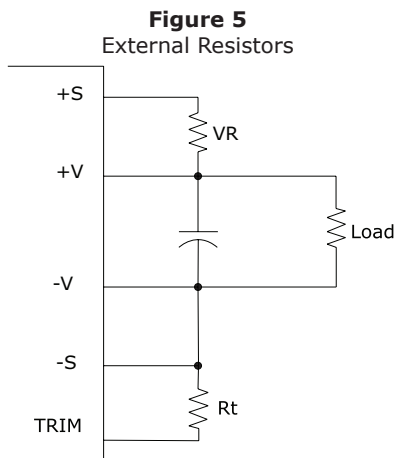
**Figure 4**  
N+1 Redundant Connection With Programmed Output And Adjustable Output Voltage



## APPLICATION NOTES (CONTINUED)

### 2. Output Voltage Trimming

Leave open if not used.



#### Trim-Up/Trim-Down Formulas

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

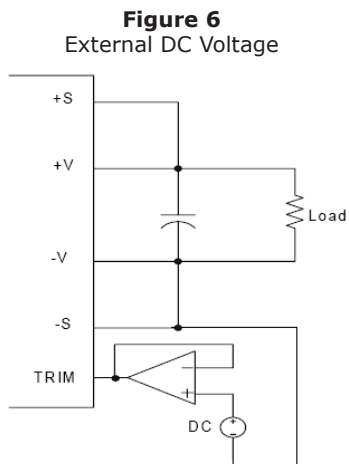
$$V_{out} = (V_o + V_R) \times V_f$$

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)

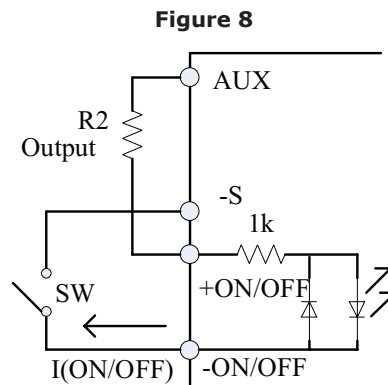
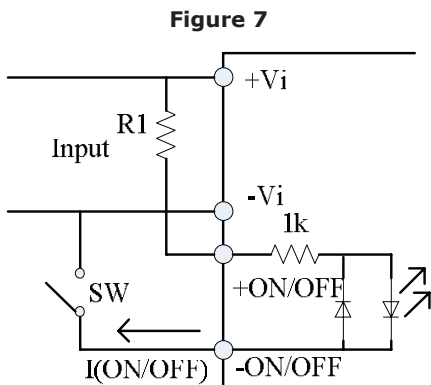
Note: 1. Models VFB400W-Q24-S24, S28 & S48 require a minimum input voltage of 13 Vdc and models VFB400W-Q48-S24, S28 & S48 require a minimum input voltage of 22 Vdc in order to trim between 100~110%.

### 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  $R_1$  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  $R_2$  value is  $4.3\text{K}\Omega$  (0.1W)



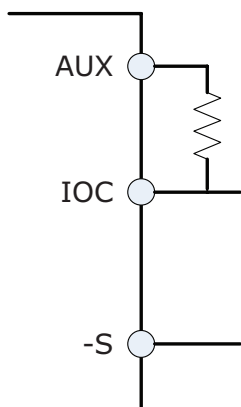


## APPLICATION NOTES (CONTINUED)

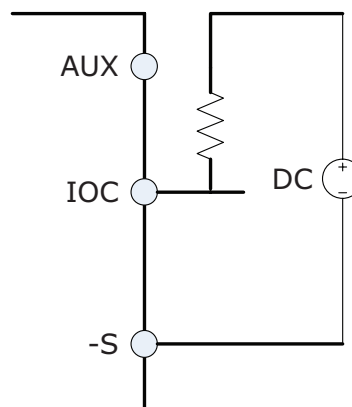
### 4. IOC Signal

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

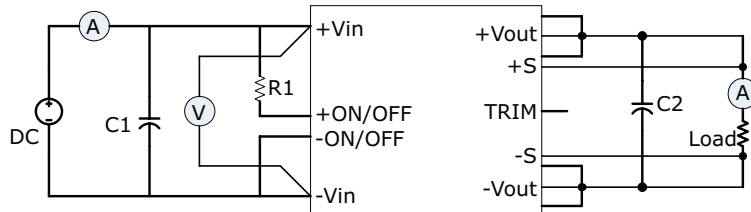


**Figure 10**  
External DC Power



### 5. Test Configuration

**Figure 11**



**Table 1**

Recommended External components	
	< 0.7 $\Omega$ ESR
C1	1000 $\mu$ F/50 V (24 Vin models) 330 $\mu$ 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

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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.



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