

**SERIES: VHK200W | DESCRIPTION: DC-DC CONVERTER**
**FEATURES**

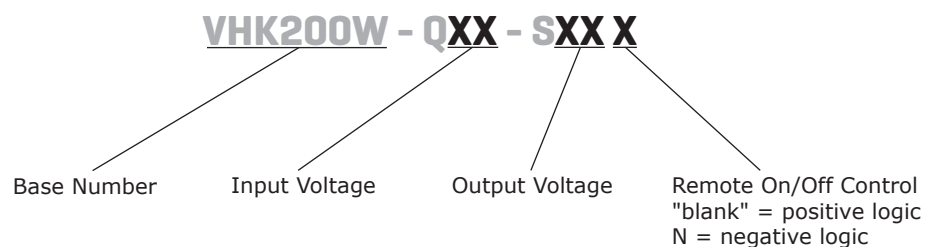
- up to 200 W isolated output
- rugged metal enclosure with integrated heat sink
- 4:1 input range (10~36 Vdc, 18~75 Vdc)
- single output from 12~48 Vdc
- 1,500 Vdc isolation
- over current, over temperature, over voltage, and short circuit protections
- remote on/off
- efficiency up to 88%

**MODEL**

|                 | <b>input<br/>voltage<br/>range<br/>(Vdc)</b> | <b>output<br/>voltage<br/>(Vdc)</b> | <b>output<br/>current<br/>max<br/>(A)</b> | <b>output<br/>power<br/>max<br/>(W)</b> | <b>ripple<br/>and noise<sup>1</sup><br/>max<br/>(mVp-p)</b> | <b>efficiency<br/><br/>typ<br/>(%)</b> |
|-----------------|----------------------------------------------|-------------------------------------|-------------------------------------------|-----------------------------------------|-------------------------------------------------------------|----------------------------------------|
| VHK200W-Q24-S12 | 10 ~ 36                                      | 12                                  | 16.7                                      | 200                                     | 150                                                         | 84                                     |
| VHK200W-Q24-S15 | 10 ~ 36                                      | 15                                  | 13.3                                      | 200                                     | 150                                                         | 84                                     |
| VHK200W-Q24-S24 | 10 ~ 36                                      | 24                                  | 8.3                                       | 200                                     | 240                                                         | 84                                     |
| VHK200W-Q24-S28 | 10 ~ 36                                      | 28                                  | 7.14                                      | 200                                     | 280                                                         | 87                                     |
| VHK200W-Q24-S48 | 10 ~ 36                                      | 48                                  | 4.2                                       | 200                                     | 480                                                         | 87                                     |
| VHK200W-Q48-S12 | 18 ~ 75                                      | 12                                  | 16.7                                      | 200                                     | 150                                                         | 86                                     |
| VHK200W-Q48-S15 | 18 ~ 75                                      | 15                                  | 13.3                                      | 200                                     | 150                                                         | 86                                     |
| VHK200W-Q48-S24 | 18 ~ 75                                      | 24                                  | 8.3                                       | 200                                     | 240                                                         | 86                                     |
| VHK200W-Q48-S28 | 18 ~ 75                                      | 28                                  | 7.14                                      | 200                                     | 280                                                         | 87                                     |
| VHK200W-Q48-S48 | 18 ~ 75                                      | 48                                  | 4.2                                       | 200                                     | 480                                                         | 88                                     |

Note:

1. Ripple and noise are measured at full load, 20 MHz BW with 10 $\mu$ F tantalum capacitor and 1 $\mu$ F ceramic capacitor across output. The 48 Vdc output models require a 10 $\mu$ F aluminum capacitor and 1 $\mu$ F ceramic capacitor across the output.
2. An external input capacitor of 470 $\mu$ F for 24 Vdc input models and 47 $\mu$ F 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                                                             |                                       | 10  | 24         | 36  | Vdc        |
|                         | 48 Vdc input models                                                             |                                       | 18  | 48         | 75  | Vdc        |
| under voltage shutdown  | 24 Vdc input                                                                    | power up<br>power down                |     | 9.5<br>8.5 |     | Vdc<br>Vdc |
|                         | 48 Vdc input                                                                    | power up<br>power down                |     | 17<br>16   |     | Vdc<br>Vdc |
| CTRL <sup>1</sup>       | positive logic                                                                  | models ON (>3.5 Vdc or open circuit)  |     |            |     |            |
|                         |                                                                                 | models OFF (0~1.2 Vdc)                |     |            |     |            |
|                         | negative logic                                                                  | models ON (0~1.2 Vdc)                 |     |            |     |            |
|                         |                                                                                 | models OFF (>3.5 Vdc or open circuit) |     |            |     |            |
| filter                  | pi filter                                                                       |                                       |     |            |     |            |
| input fuse              | 40A time delay fuse for 24 Vin models,<br>20A time delay fuse for 48 Vin models |                                       |     |            |     |            |

Note: 1. Open collector refer to -Vin

## OUTPUT

| parameter                    | conditions/description               | min | typ | max   | units  |
|------------------------------|--------------------------------------|-----|-----|-------|--------|
| maximum capacitive load      | 12, 15, & 24 V output models         |     |     | 2,200 | μF     |
|                              | 28 V output models                   | 100 |     | 2,200 | μF     |
|                              | 48 V output models                   | 47  |     | 2,200 | μF     |
| line regulation <sup>2</sup> | measured from low line to high line  |     |     | ±0.2  | %      |
| load regulation <sup>2</sup> | measured from zero load to full load |     |     | ±0.2  | %      |
| voltage accuracy             |                                      |     |     | ±1.5  | %      |
| adjustability                |                                      |     |     | ±10   | %      |
| switching frequency          |                                      |     |     | 250   | kHz    |
| transient response           | 25% step load change                 |     |     |       | 500 μs |
| temperature coefficient      |                                      |     |     | ±0.03 | %/°C   |

Note: 2. A 100 μF aluminum capacitor is required on the output for the 28 Vdc output models. A 47 μF aluminum capacitor is required on the output for 48 Vdc output models.

## PROTECTIONS

| parameter                   | conditions/description | min | typ | max | units |
|-----------------------------|------------------------|-----|-----|-----|-------|
| short circuit protection    | continuous             |     |     |     |       |
| over current protection     | at 90% output voltage  | 110 |     | 160 | %     |
| 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;<br>output to case | 1,500 |     |     | Vdc   |
| isolation resistance |                                                                 | 10    |     |     | MΩ    |
| RoHS                 | 2011/65/EU (CE)                                                 |       |     |     |       |

## ENVIRONMENTAL

| parameter             | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curve     | -40 |     | 85  | °C    |
| storage temperature   |                        | -55 |     | 105 | °C    |

MECHANICAL

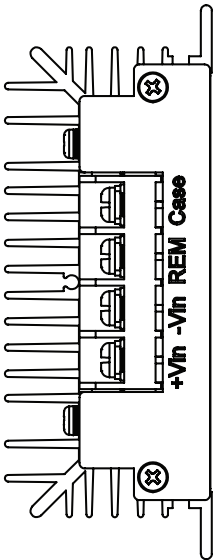
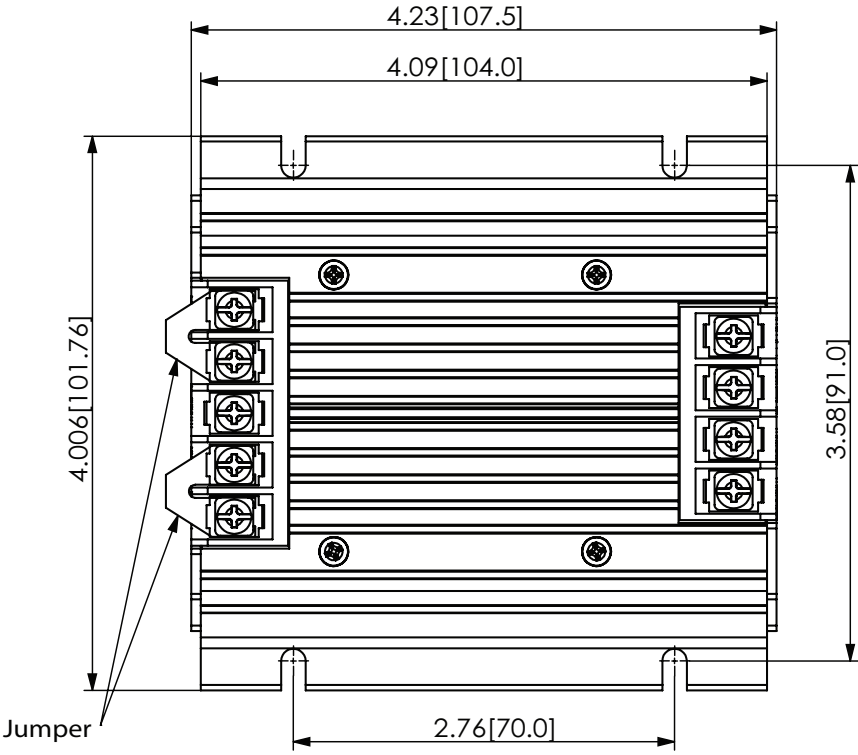
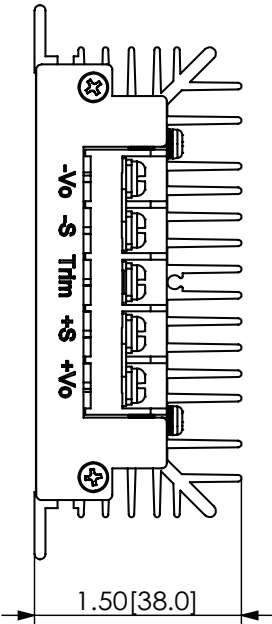
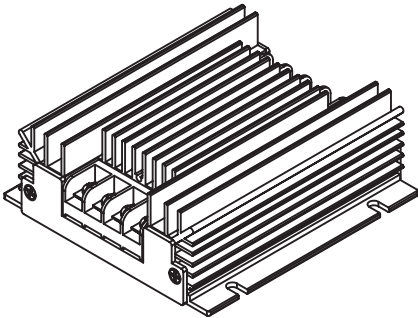
| parameter     | conditions/description                        | min | typ | max | units |
|---------------|-----------------------------------------------|-----|-----|-----|-------|
| dimensions    | 4.23 x 4.01 x 1.50 (107.5 x 101.76 x 38.0 mm) |     |     |     | inch  |
| case material | steel and aluminum extrusion                  |     |     |     |       |
| weight        |                                               |     | 502 |     | g     |

MECHANICAL DRAWING

units: inch[mm]  
tolerance: X.XX = ±0.02[±0.5]  
              X.XXX = ±0.010[±0.25]

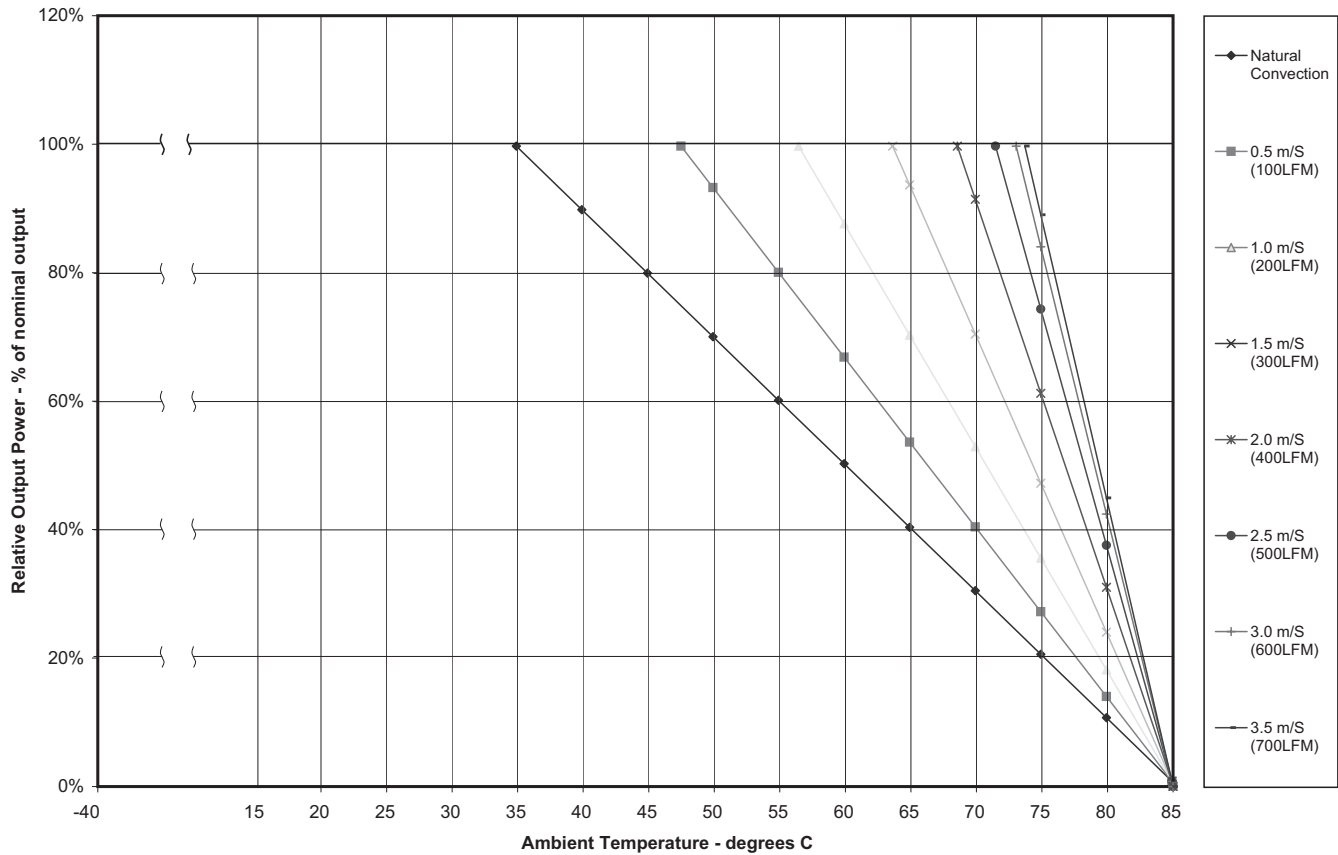
wire range: 22~12 AWG  
screw size: #6-32

| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vo      |
| 2               | -S       |
| 3               | trim     |
| 4               | +S       |
| 5               | +Vo      |
| 6               | case     |
| 7               | on/off   |
| 8               | -Vin     |
| 9               | +Vin     |



DERATING CURVES

VHK200W Power Derating Curves At Nominal Input



TEST CONFIGURATION

Figure 1

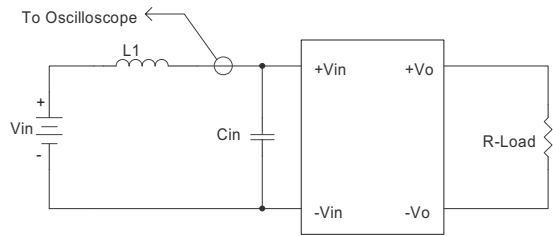


Table 1

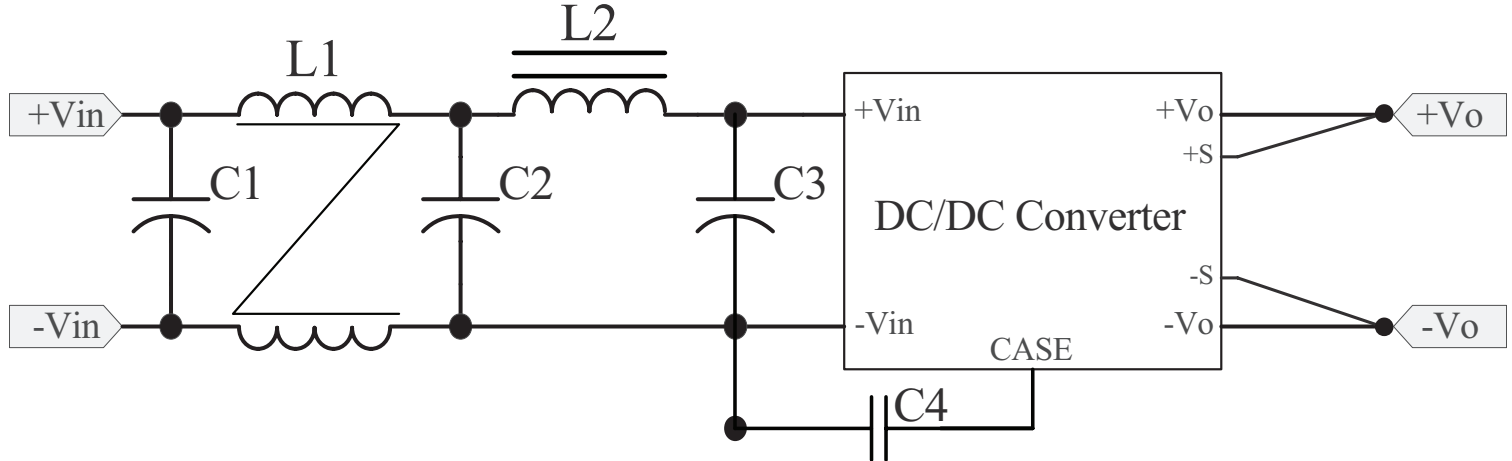
| External components     |                              |
|-------------------------|------------------------------|
| for 24 Vdc input models |                              |
| L1                      | 1.2μH                        |
| Cin                     | 470μF, ESR < 0.2Ω at 100 KHz |
| for 48 Vdc input models |                              |
| L1                      | 12μH                         |
| Cin                     | 47μF, ESR < 0.7Ω at 100 KHz  |

Note: Input reflected-ripple current is measured with an inductor L1 to simulate source impedance.

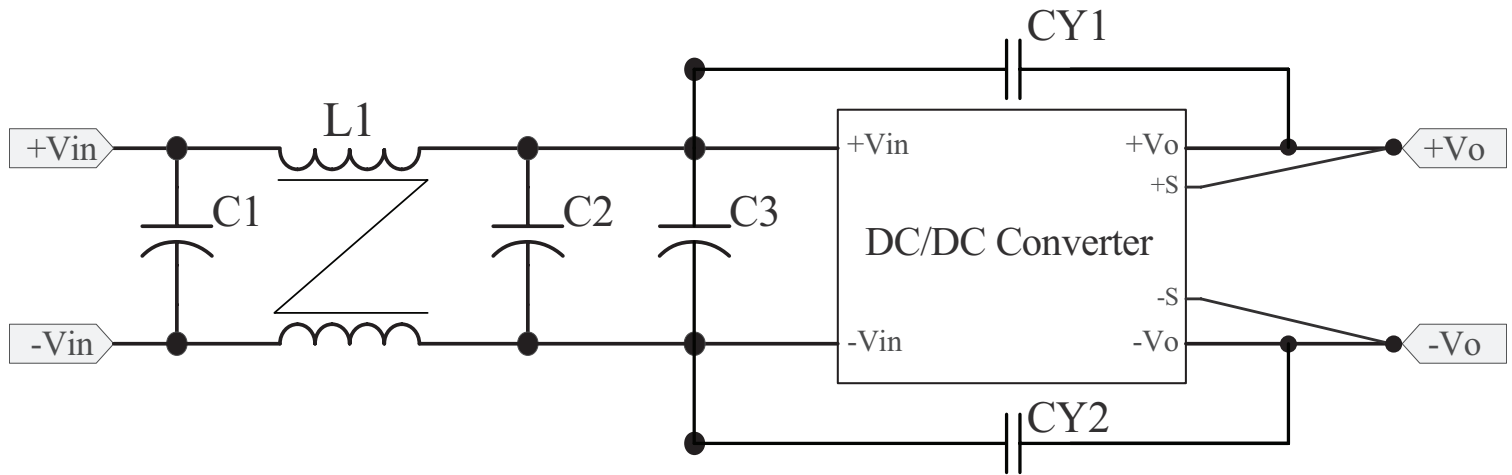
## EMC RECOMMENDED CIRCUITS

### EN55022 CLASS A

**Figure 2**  
Recommended Circuit for EN55022 Class A  
(for all 12, 15, 24, & 28 Vdc output models)



**Figure 3**  
Recommended Circuit for EN55022 Class A  
(for all 48 Vdc output models)



**Table 2**  
Class A Recommended Components

| Model           | C1 <sup>1</sup>   | C2 <sup>1</sup>   | C3 <sup>1</sup>   | CY1 <sup>2</sup> | CY2 <sup>2</sup> | L1     | L2    |
|-----------------|-------------------|-------------------|-------------------|------------------|------------------|--------|-------|
| VHK200W-Q24-S12 | 120 $\mu$ F/100 V | 120 $\mu$ F/100 V | NC                | NC               | NC               | 0.5 mH | SHORT |
| VHK200W-Q24-S15 | 47 $\mu$ F/100 V  | 47 $\mu$ F/100 V  | NC                | NC               | NC               | 0.5 mH | SHORT |
| VHK200W-Q24-S24 | 100 $\mu$ F/100 V | 100 $\mu$ F/100 V | NC                | NC               | NC               | 0.5 mH | SHORT |
| VHK200W-Q24-S28 | 100 $\mu$ F/100 V | 100 $\mu$ F/100 V | NC                | NC               | NC               | 0.5 mH | SHORT |
| VHK200W-Q24-S48 | 100 $\mu$ F/100 V | 100 $\mu$ F/100 V | 100 $\mu$ F/100 V | 680 pF/2 KV      | 680 pF/2 KV      | 1.0 mH | NC    |
| VHK200W-Q48-S12 | 82 $\mu$ F/100 V  | 82 $\mu$ F/100 V  | NC                | NC               | NC               | 0.5 mH | SHORT |
| VHK200W-Q48-S15 | 82 $\mu$ F/100 V  | 82 $\mu$ F/100 V  | NC                | NC               | NC               | 0.5 mH | SHORT |
| VHK200W-Q48-S24 | 82 $\mu$ F/100 V  | 82 $\mu$ F/100 V  | NC                | NC               | NC               | 0.7 mH | SHORT |
| VHK200W-Q48-S28 | 150 $\mu$ F/100 V | 150 $\mu$ F/100 V | NC                | NC               | NC               | 0.5 mH | SHORT |
| VHK200W-Q48-S48 | 100 $\mu$ F/100 V | 100 $\mu$ F/100 V | 100 $\mu$ F/100 V | 680 pF/2 KV      | 680 pF/2 KV      | 1.0 mH | NC    |

Notes: 1. Aluminum capacitors.  
2. Ceramic capacitors.

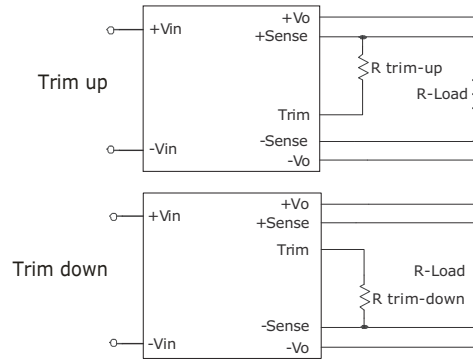
## APPLICATION NOTES

### 1. Output Voltage Trimming

Leave open if not used.

**Figure 4**

Application Circuit for Trim pin



### Formula for Trim Resistor

$$\Delta\% = \left( \frac{V_{o, nom} - V_o}{V_{o, nom}} \right) 100$$

#### Trim-Up Formula

(for all 12, 15, 24, & 28<sup>1</sup> Vdc Output Models)

$$R_{trim - up} = \left( \frac{5.11V_{o, nom}(100 + \Delta\%)}{1.225 \times \Delta\%} - \frac{511}{\Delta\%} - 10.22 \right) (K\Omega)$$

#### Trim-Up Formula

(for all 48 Vdc Output Models)

$$R_{trim - up} = \left( \frac{20V_{o, nom}(100 + \Delta\%)}{1.225 \times \Delta\%} - \frac{2000}{\Delta\%} - 40 \right) (K\Omega)$$

#### Trim-Down Formula

(for all 12, 15, 24, & 28<sup>1</sup> Vdc Output Models)

$$R_{trim - down} = \left( \frac{511}{\Delta\%} - 10.22 \right) (K\Omega)$$

#### Trim-Down Formula

(for all 48 Vdc Output Models)

$$R_{trim - down} = \left( \frac{2000}{\Delta\%} - 40 \right) (K\Omega)$$

Note:  $R_{trim-up}$  is the external resistor in  $K\Omega$   
 $R_{trim-down}$  is the external resistor in  $K\Omega$   
 $V_{o, nom}$  is the nominal output voltage  
 $V_o$  is the desired output voltage

Notes: 1. For the 28 Vdc output models, a minimum input voltage of 10.8 Vdc is required to trim the 24 Vdc input models up 10%, and a minimum input voltage of 19 Vdc is required to trim the 48 Vdc input models up 10%.  
 2. All specifications are measured at  $T_a=25^\circ\text{C}$ , nominal input voltage and full output load unless otherwise specified.

## REVISION HISTORY

| rev. | description                        | date       |
|------|------------------------------------|------------|
| 1.0  | initial release                    | 10/11/2006 |
| 1.01 | new template applied               | 12/21/2011 |
| 1.02 | misc. updates and corrections      | 03/13/2012 |
| 1.03 | updated mechanical drawing         | 03/27/2012 |
| 1.04 | V-Infinity branding removed        | 06/27/2012 |
| 1.05 | updated spec                       | 03/18/2013 |
| 1.06 | updated spec                       | 05/08/2013 |
| 1.07 | added trimming and EMI information | 12/16/2013 |

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

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