

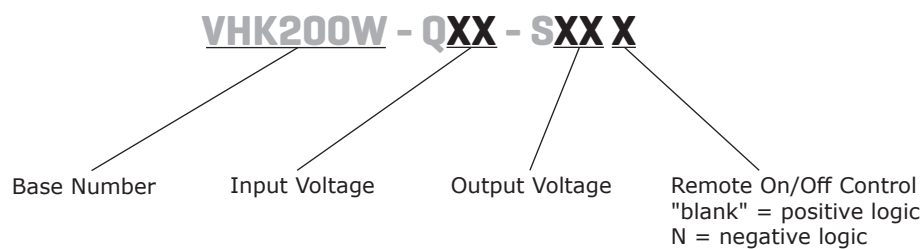
**SERIES: VHK200W | DESCRIPTION: DC-DC CONVERTER**
**FEATURES**

- 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           | input voltage range (Vdc) | output voltage (Vdc) | output current max (A) | output power max (W) | ripple and noise <sup>1</sup> max (mVp-p) | efficiency |
|-----------------|---------------------------|----------------------|------------------------|----------------------|---|------------|
|                 |                           |                      |                        |                      |   | typ (%)    |
| 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  |   | 9.5<br>8.5 |     | Vdc<br>Vdc |
|                            | 48 Vdc input  |   | 17<br>16   |     | Vdc<br>Vdc |
| remote on/off <sup>1</sup> | positive logic  | models ON (>3.5 Vdc or REM pin open circuit)  |            |     |            |
|                            |   | models OFF (REM pin 0~1.2 Vdc)                |            |     |            |
|                            | negative logic  | models ON (REM pin 0~1.2 Vdc)                 |            |     |            |
|                            |   | models OFF (>3.5 Vdc or REM pin 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    |
| safety approvals     | certified to 62368-1: EN, IEC                                   |       |     |     |       |
| RoHS                 | 2011/65/EU  |       |     |     |       |

## 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 101.8 x 38.0 mm] |     |     |     | inch  |
| case material | steel and aluminum extrusion                 |     |     |     |       |
| weight        |  |     | 502 |     | g     |

## MECHANICAL DRAWING

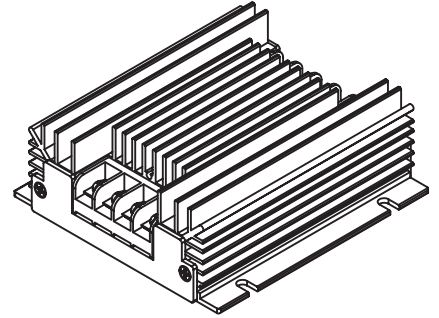
units: inch[mm]

general tolerance: ±0.04[±1.0]

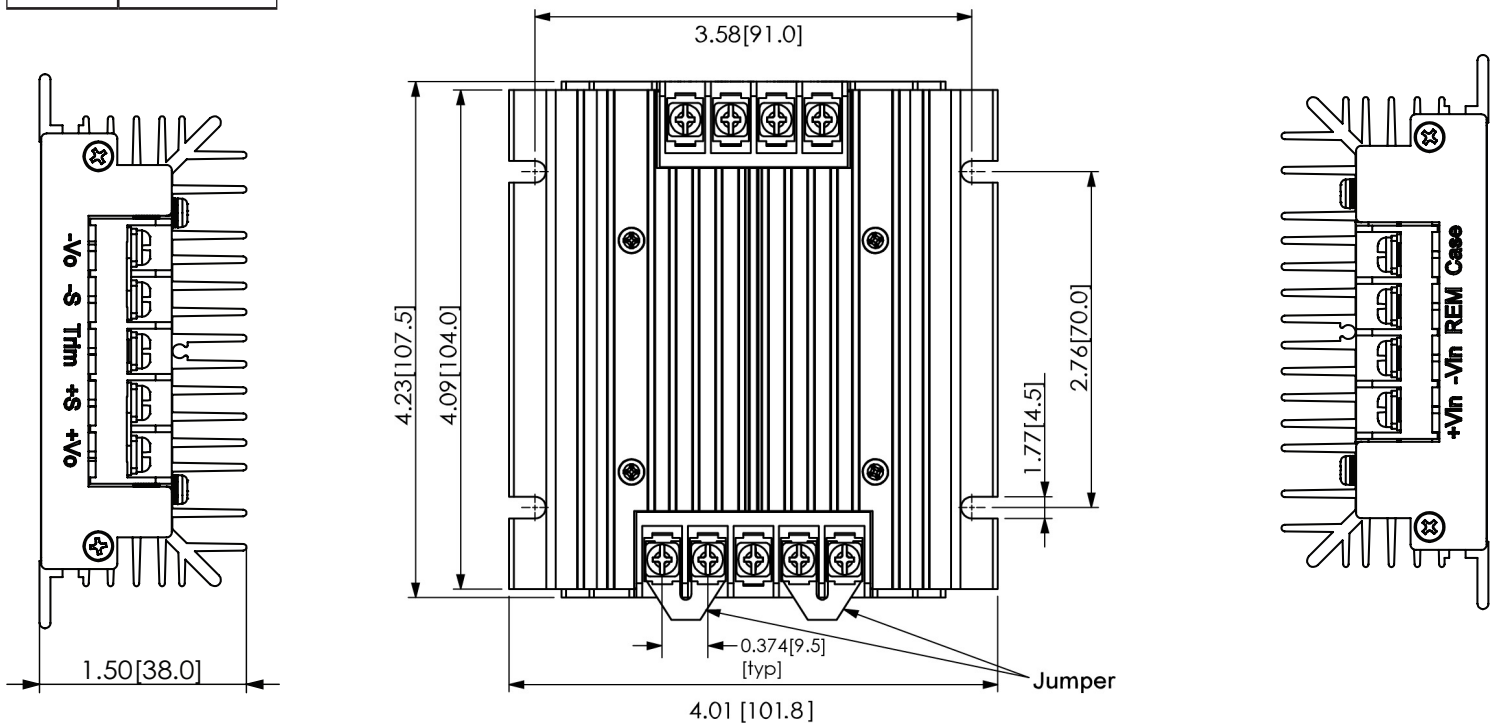
wire range: 22~12 AWG

screw size: #6-32

connector tightening torque: 1.4 N·m (max)

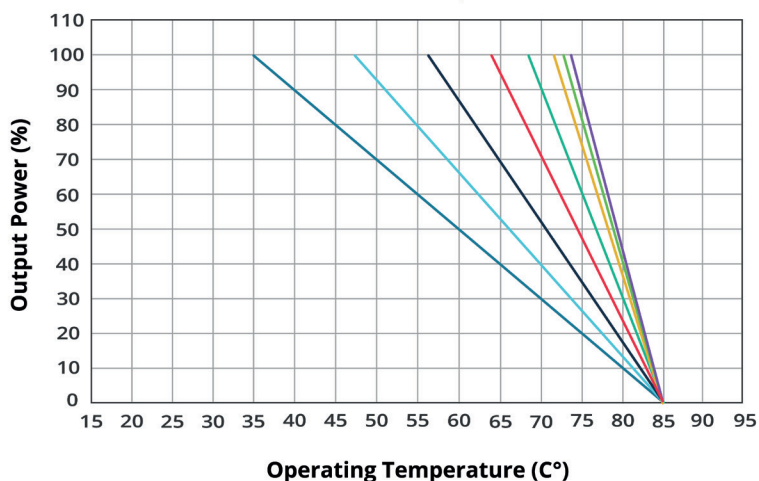


| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vo      |
| 2               | -S       |
| 3               | trim     |
| 4               | +S       |
| 5               | +Vo      |
| 6               | case     |
| 7               | REM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



## DERATING CURVES

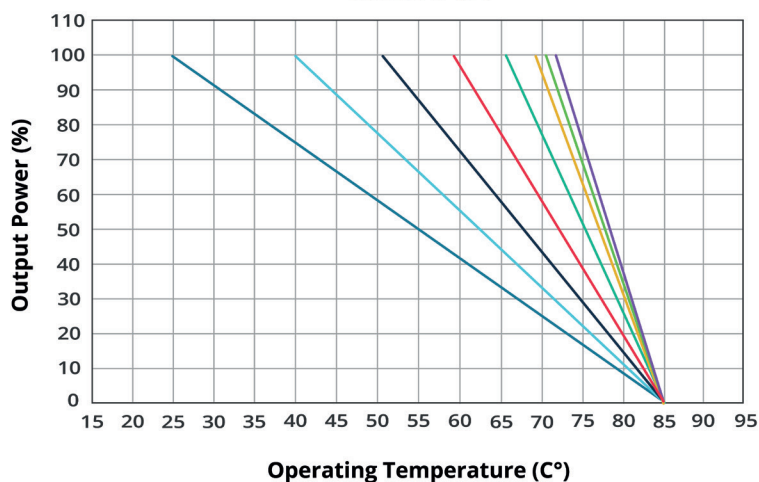
**TEMPERATURE DERATING CURVE**  
WHK200W-Q48



**Key**

|   |                    |
|---|--------------------|
| — | natural convection |
| — | 100ft/min (0.5m/s) |
| — | 200ft/min (1.0m/s) |
| — | 300ft/min (1.5m/s) |
| — | 400ft/min (2.0m/s) |
| — | 500ft/min (2.5m/s) |
| — | 600ft/min (3.0m/s) |
| — | 700ft/min (3.5m/s) |

**TEMPERATURE DERATING CURVE**  
WHK200W-Q24

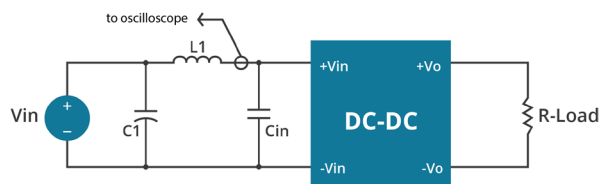


**Key**

|   |                    |
|---|--------------------|
| — | natural convection |
| — | 100ft/min (0.5m/s) |
| — | 200ft/min (1.0m/s) |
| — | 300ft/min (1.5m/s) |
| — | 400ft/min (2.0m/s) |
| — | 500ft/min (2.5m/s) |
| — | 600ft/min (3.0m/s) |
| — | 700ft/min (3.5m/s) |

## TEST CONFIGURATION

**Figure 1**



**Table 1**

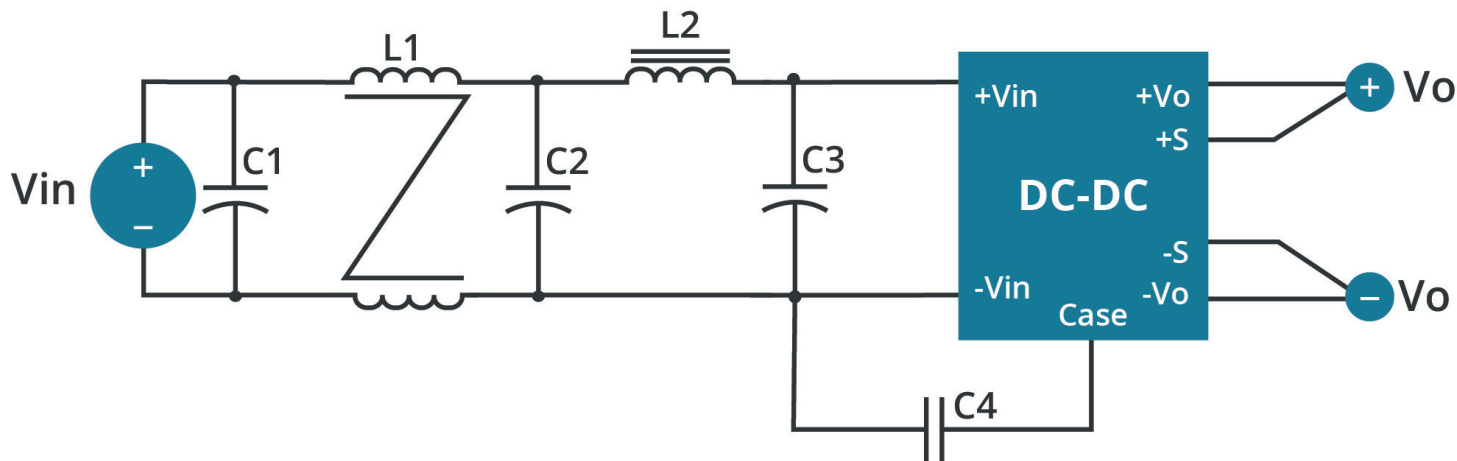
| External components     |  |
|-------------------------|--|
| for 24 Vdc input models |  |
| L1                      | 1.2 $\mu$ H                                |
| Cin                     | 470 $\mu$ F, ESR < 0.2 $\Omega$ at 100 KHz |
| for 48 Vdc input models |  |
| L1                      | 12 $\mu$ H                                 |
| Cin                     | 47 $\mu$ F, ESR < 0.7 $\Omega$ at 100 KHz  |

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

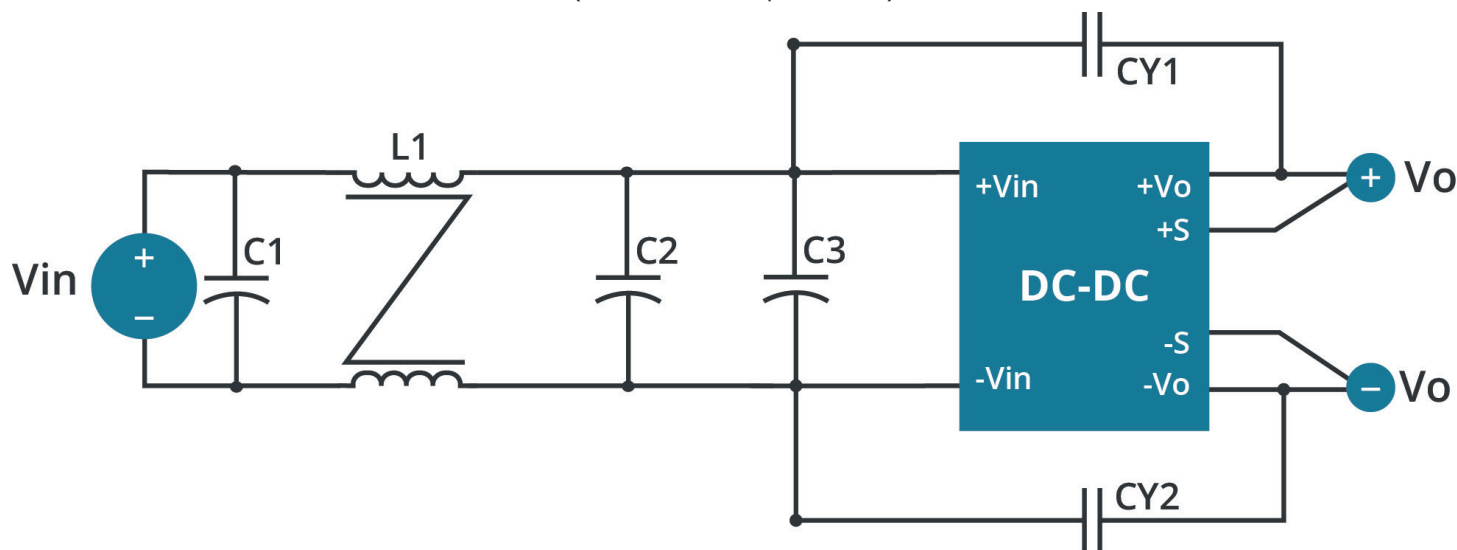
## EMC RECOMMENDED CIRCUITS

### 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**

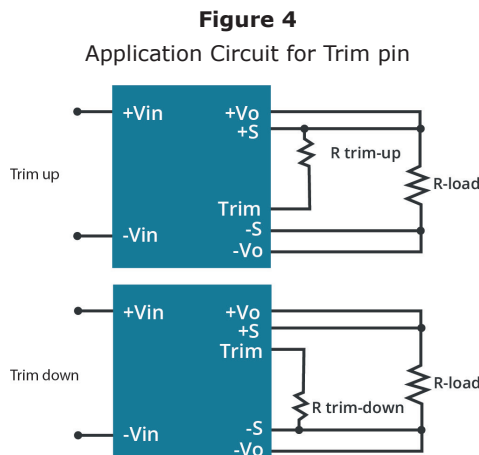
| Model           | C1 <sup>1</sup>   | C2 <sup>1</sup>   | C3 <sup>1</sup>   | CY1 <sup>2</sup> | CY2 <sup>2</sup> | L1     | L2    |
|-----------------|-------------------|-------------------|-------------------|------------------|------------------|--------|-------|
| VHK200W-Q24-S12 | 120 $\mu$ F/100 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.



#### Formula for Trim Resistor

**Trim-Up**

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

**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**

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

**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 Ta=25°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 |
| 1.08 | trim equation updated                        | 11/13/2020 |
| 1.09 | derating curves updated                      | 03/04/2021 |
| 1.10 | pin connection table & remote on/off updated | 05/20/2021 |
| 1.11 | circuit figures updated                      | 09/07/2021 |
| 1.12 | safety approvals updated                     | 03/02/2022 |
| 1.13 | mechanical tolerance updated                 | 05/09/2022 |

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



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