

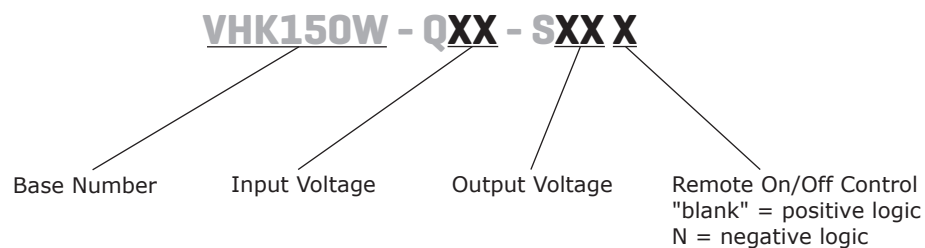
**SERIES:** VHK150W | **DESCRIPTION:** DC-DC CONVERTER
**FEATURES**

- up to 150 W isolated output
- rugged metal enclosure with integrated heat sink
- 4:1 input range (9~36 Vdc, 18~75 Vdc)
- single output from 5~48 Vdc
- 1,500 Vdc isolation
- over current, over temperature, over voltage, and short circuit protections
- remote on/off
- efficiency up to 90%



| <b>MODEL</b>    | <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> |
|-----------------|----------------------------------------------|-------------------------------------|-------------------------------------------|-----------------------------------------|-------------------------------------------------------------|----------------------------------------|
| VHK150W-Q24-S5  | 9 ~ 36                                       | 5                                   | 25                                        | 125                                     | 100                                                         | 87                                     |
| VHK150W-Q24-S12 | 9 ~ 36                                       | 12                                  | 12.5                                      | 150                                     | 150                                                         | 86                                     |
| VHK150W-Q24-S15 | 9 ~ 36                                       | 15                                  | 10                                        | 150                                     | 150                                                         | 86                                     |
| VHK150W-Q24-S24 | 9 ~ 36                                       | 24                                  | 6.5                                       | 156                                     | 240                                                         | 86.5                                   |
| VHK150W-Q24-S28 | 9 ~ 36                                       | 28                                  | 5.4                                       | 150                                     | 280                                                         | 87                                     |
| VHK150W-Q24-S48 | 9 ~ 36                                       | 48                                  | 3.12                                      | 150                                     | 480                                                         | 84                                     |
| VHK150W-Q48-S5  | 18 ~ 75                                      | 5                                   | 25                                        | 125                                     | 100                                                         | 90                                     |
| VHK150W-Q48-S12 | 18 ~ 75                                      | 12                                  | 12.5                                      | 150                                     | 150                                                         | 88                                     |
| VHK150W-Q48-S15 | 18 ~ 75                                      | 15                                  | 10                                        | 150                                     | 150                                                         | 88                                     |
| VHK150W-Q48-S24 | 18 ~ 75                                      | 24                                  | 6.5                                       | 156                                     | 240                                                         | 87.5                                   |
| VHK150W-Q48-S28 | 18 ~ 75                                      | 28                                  | 5.4                                       | 150                                     | 280                                                         | 89                                     |
| VHK150W-Q48-S48 | 18 ~ 75                                      | 48                                  | 3.12                                      | 150                                     | 480                                                         | 87                                     |

Note: 1. Ripple and noise are measured at full load, 20 MHz BW with 10μF tantalum capacitor and 1μF ceramic capacitor across output.

**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                                                                    | power up                              |     | 8.8 |     | Vdc   |
|                         |                                                                                 | power down                            |     | 8   |     | Vdc   |
|                         | 48 Vdc input                                                                    | power up                              |     | 17  |     | Vdc   |
|                         |                                                                                 | power down                            |     | 16  |     | Vdc   |
| CTRL <sup>1</sup>       | positive logic                                                                  | models ON (>3.5 Vdc or open circuit)  |     |     |     |       |
|                         |                                                                                 | models OFF (0~1.8 Vdc)                |     |     |     |       |
|                         | negative logic                                                                  | models ON (0~1.8 Vdc)                 |     |     |     |       |
|                         |                                                                                 | models OFF (>3.5 Vdc or open circuit) |     |     |     |       |
| filter                  | pi filter                                                                       |                                       |     |     |     |       |
| input fuse              | 30A time delay fuse for 24 Vin models,<br>15A 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       | 5 V output models                    |     |     | 30,000 | μF    |
|                               | 12 V output models                   |     |     | 12,500 | μF    |
|                               | 15 V output models                   |     |     | 10,000 | μF    |
|                               | 24 V input, 24 & 28 V output models  |     |     | 1,800  | μF    |
|                               | 48 V input, 24 & 28 V output models  |     |     | 2,200  | μF    |
|                               | 48 V output models                   | 47  |     | 1,000  | μF    |
| line regulation <sup>2</sup>  | measured from high line to low line  |     |     | ±0.2   | %     |
| load regulation <sup>2</sup>  | measured from full load to zero load |     |     | ±0.2   | %     |
| voltage accuracy <sup>2</sup> |                                      |     |     | ±1.5   | %     |
| adjustability                 |                                      |     |     | ±10    | %     |
| switching frequency           |                                      |     |     | 250    | kHz   |
| transient response            | 25% step load change                 |     |     | 500    | μs    |
| temperature coefficient       |                                      |     |     | ±0.03  | %/°C  |

Note: 2. 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     | % nominal output current | 110 |     | 140 | %     |
| 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

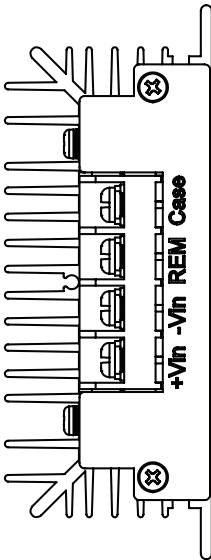
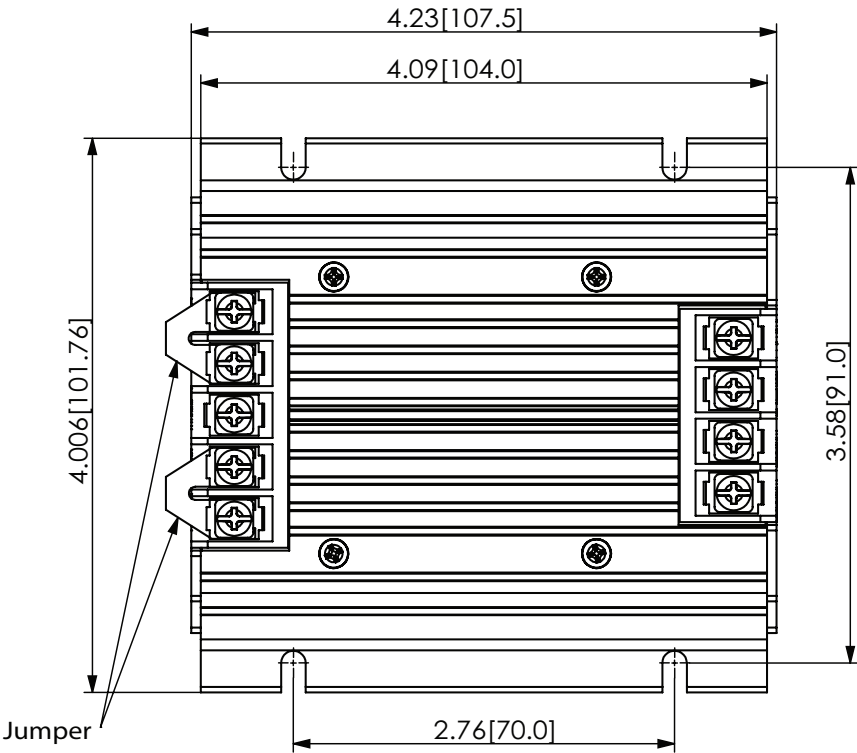
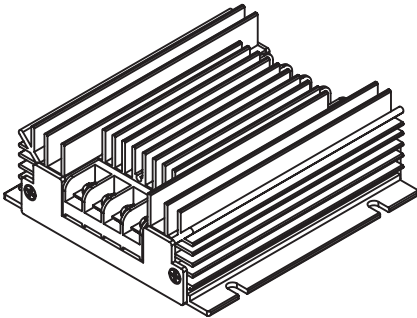
| parameter     | conditions/description                        | min | typ | max | units |
|---------------|-----------------------------------------------|-----|-----|-----|-------|
| dimensions    | 4.23 x 4.01 x 1.50 (107.5 x 101.76 x 38.0 mm) |     |     |     | inch  |
| case material | steel and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

MECHANICAL DRAWING

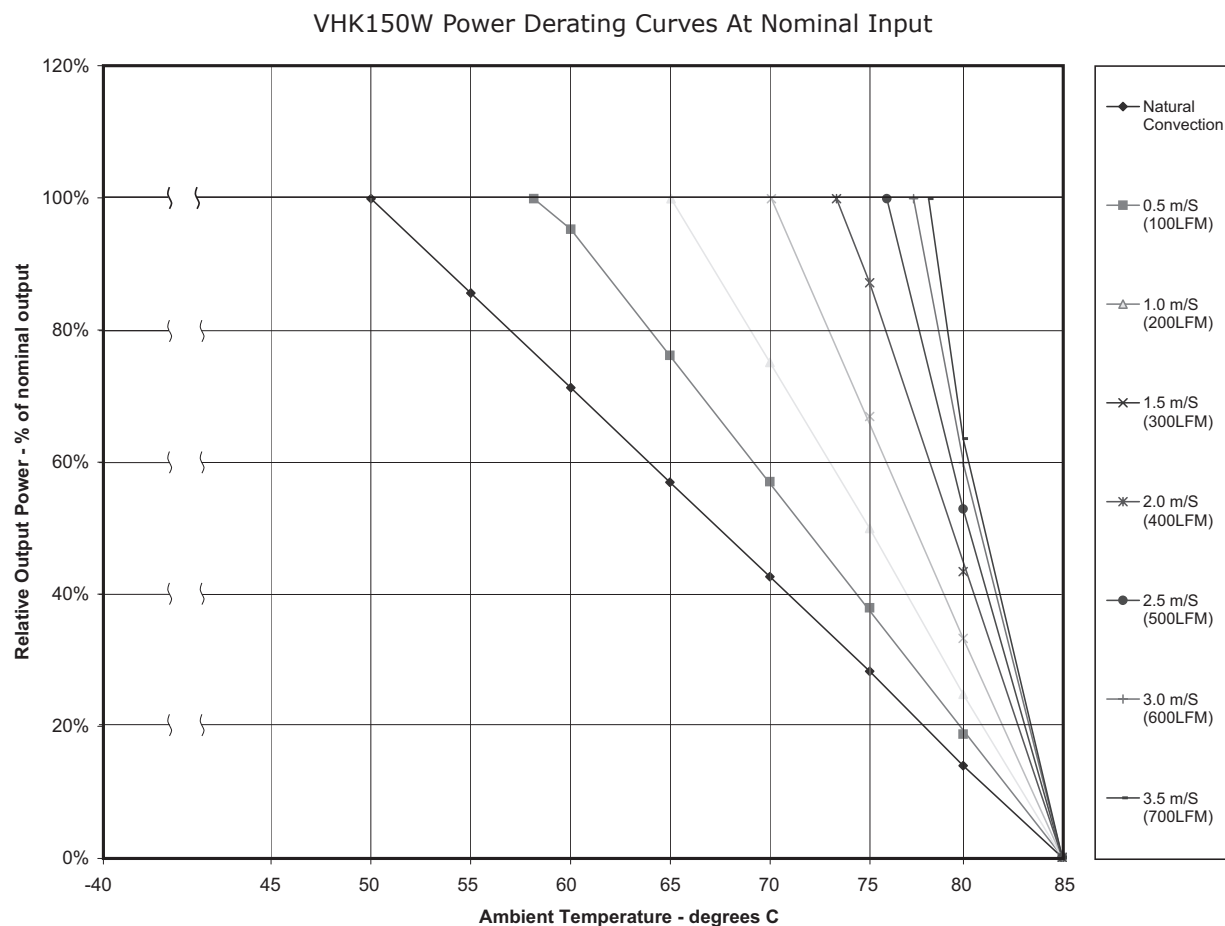
units: inch[mm]  
tolerance: X.XX =  $\pm 0.02[\pm 0.5]$   
X.XXX =  $\pm 0.010[\pm 0.25]$

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     |

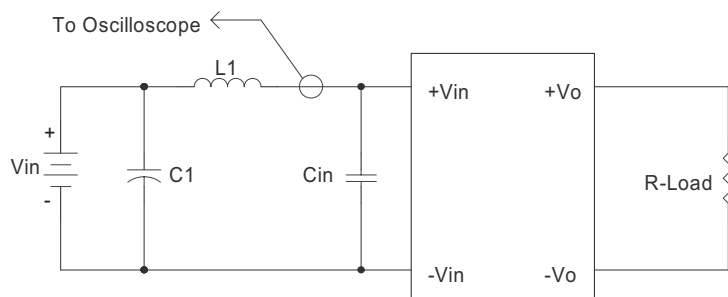


## DERATING CURVES



## TEST CONFIGURATION

**Figure 1**



**Table 1**  
**External Components**

| 24 Vdc input models |                                            |
|---------------------|--------------------------------------------|
| L1                  | 1.2 $\mu$ H                                |
| C1                  | 220 $\mu$ F, ESR < 0.1 $\Omega$ at 100 KHz |
| Cin                 | 330 $\mu$ F, ESR < 0.7 $\Omega$ at 100 KHz |
| 48 Vdc input models |                                            |
| L1                  | 12 $\mu$ H                                 |
| C1                  | 220 $\mu$ F, ESR < 0.1 $\Omega$ at 100 KHz |
| Cin                 | 33 $\mu$ F, ESR < 0.7 $\Omega$ at 100 KHz  |

Note: Input reflected-ripple current is measured with an inductor L1 and Capacitor C1 to simulate source impedance.

EMC RECOMMENDED CIRCUITS

EN55022 CLASS A

Figure 2  
Recommended Circuit for EN55022 Class A

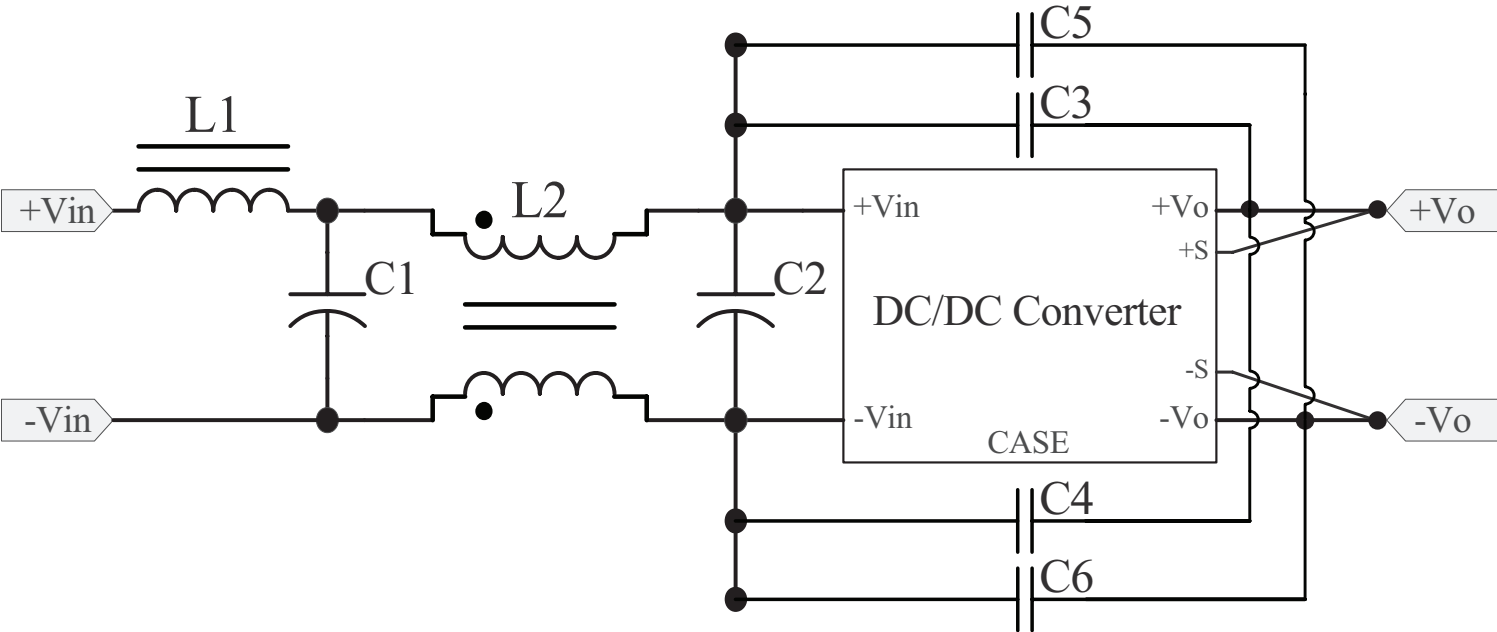


Table 2  
Class A Recommended Components

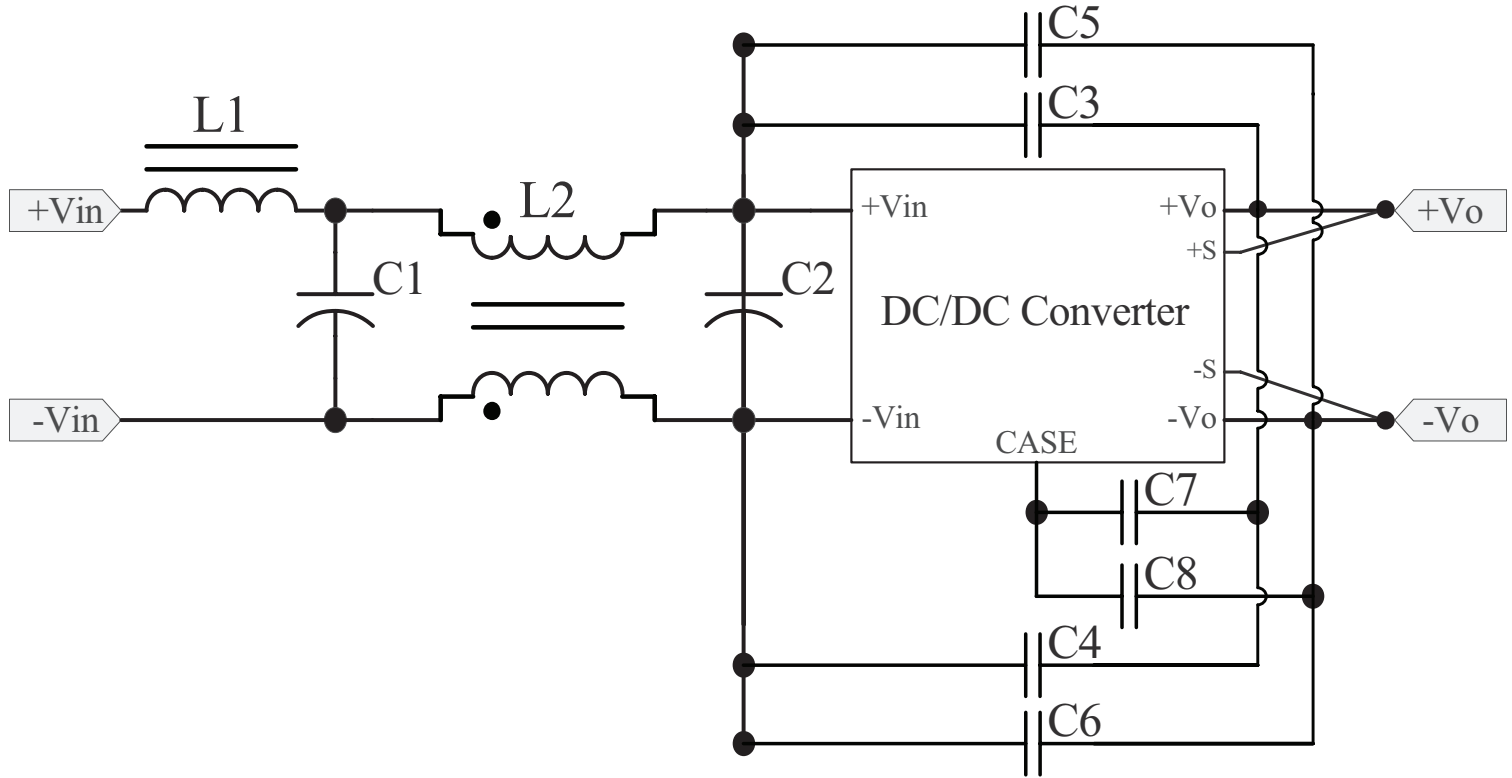
| Model           | C1 <sup>1</sup>  | C2 <sup>1</sup>  | C3 <sup>2</sup> | C4 <sup>2</sup> | C5 <sup>2</sup> | C6 <sup>2</sup> | L1    | L2     |
|-----------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|-------|--------|
| VHK150W-Q24-S5  | 100 $\mu$ F/50 V | 100 $\mu$ F/50 V | NC              | NC              | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q24-S12 | 100 $\mu$ F/50 V | 100 $\mu$ F/50 V | NC              | NC              | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q24-S15 | 100 $\mu$ F/50 V | 100 $\mu$ F/50 V | NC              | NC              | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q24-S24 | 100 $\mu$ F/50 V | 100 $\mu$ F/50 V | 680 pF          | 680 pF          | 470 pF          | 680 pF          | SHORT | 0.5 mH |
| VHK150W-Q24-S28 | 100 $\mu$ F/50 V | 100 $\mu$ F/50 V | 2200 pF         | NC              | 680 pF          | 2200 pF         | SHORT | 0.6 mH |
| VHK150W-Q24-S48 | 100 $\mu$ F/50 V | 100 $\mu$ F/50 V | 1000 pF         | NC              | 470 pF          | 1000 pF         | SHORT | 0.6 mH |
| VHK150W-Q48-S5  | 47 $\mu$ F/100 V | 47 $\mu$ F/100 V | NC              | NC              | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q48-S12 | 47 $\mu$ F/100 V | 47 $\mu$ F/100 V | NC              | 680 pF          | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q48-S15 | 47 $\mu$ F/100 V | 47 $\mu$ F/100 V | 680 pF          | 1000 pF         | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q48-S24 | 47 $\mu$ F/100 V | 47 $\mu$ F/100 V | 680 pF          | 680 pF          | 470 pF          | 680 pF          | SHORT | 0.5 mH |
| VHK150W-Q48-S28 | 47 $\mu$ F/100 V | 47 $\mu$ F/100 V | 2200 pF         | NC              | 680 pF          | 2200 pF         | SHORT | 0.6 mH |
| VHK150W-Q48-S48 | 47 $\mu$ F/100 V | 47 $\mu$ F/100 V | 2200 pF         | 1500 pF         | 1500 pF         | 2200 pF         | SHORT | 0.5 mH |

Notes: 1. Aluminum capacitor  
2. Ceramic capacitor

## EMC RECOMMENDED CIRCUITS (CONTINUED)

### EN55022 CLASS B

**Figure 3**  
Recommended Circuit for EN55022 Class B



**Table 3**  
Class B Recommended Components

| Model           | C1 <sup>1</sup>   | C2 <sup>1</sup>   | C3 <sup>2</sup>  | C4 <sup>2</sup> | C5 <sup>2</sup> | C6 <sup>2</sup>  | C7 <sup>2</sup> | C8 <sup>2</sup> | L1          | L2     |
|-----------------|-------------------|-------------------|------------------|-----------------|-----------------|------------------|-----------------|-----------------|-------------|--------|
| VHK150W-Q24-S5  | 220 $\mu$ F/50 V  | 220 $\mu$ F/50 V  | 680 pF           | NC              | NC              | NC               | NC              | NC              | 3 $\mu$ H   | 0.5 mH |
| VHK150W-Q24-S12 | 220 $\mu$ F/50 V  | 220 $\mu$ F/50 V  | 680 pF           | 680 pF          | NC              | NC               | NC              | NC              | 3 $\mu$ H   | 0.5 mH |
| VHK150W-Q24-S15 | 220 $\mu$ F/50 V  | 220 $\mu$ F/50 V  | 680 pF           | NC              | NC              | NC               | NC              | NC              | 3 $\mu$ H   | 0.5 mH |
| VHK150W-Q24-S24 | 220 $\mu$ F/50 V  | 220 $\mu$ F/50 V  | 1000 pF          | 1000 pF         | 470 pF          | 680 pF           | 470 pF          | 330 pF          | 3 $\mu$ H   | 0.5 mH |
| VHK150W-Q24-S28 | 220 $\mu$ F/50 V  | 220 $\mu$ F/50 V  | 2200 pF x2       | 1000 pF         | 470 pF          | 2200 pF x2       | 470 pF          | 470 pF          | 3.4 $\mu$ H | 0.6 mH |
| VHK150W-Q24-S48 | 220 $\mu$ F/50 V  | 220 $\mu$ F/50 V  | 2200 pF x4       | 1000 pF         | 1000 pF         | 2200 pF x4       | NC              | NC              | 3.4 $\mu$ H | 0.6 mH |
| VHK150W-Q48-S5  | 120 $\mu$ F/100 V | 120 $\mu$ F/100 V | NC               | 680 pF          | NC              | NC               | NC              | NC              | 3 $\mu$ H   | 0.5 mH |
| VHK150W-Q48-S12 | 120 $\mu$ F/100 V | 120 $\mu$ F/100 V | NC               | 680 pF          | NC              | NC               | NC              | NC              | 3 $\mu$ H   | 0.5 mH |
| VHK150W-Q48-S15 | 120 $\mu$ F/100 V | 120 $\mu$ F/100 V | 1000 pF          | 1000 pF         | 470 pF          | 1000 pF          | 330 pF          | 680 pF          | 3 $\mu$ H   | 0.5 mH |
| VHK150W-Q48-S24 | 120 $\mu$ F/100 V | 120 $\mu$ F/100 V | 1000 pF          | 1000 pF         | 470 pF          | 1000 pF          | 330 pF          | 680 pF          | 3 $\mu$ H   | 0.5 mH |
| VHK150W-Q48-S28 | 120 $\mu$ F/100 V | 120 $\mu$ F/100 V | 1000 pF          | 1000 pF         | 470 pF          | 1000 pF          | 470 pF          | 470 pF          | 3.4 $\mu$ H | 0.6 mH |
| VHK150W-Q48-S48 | 82 $\mu$ F/100 V  | 120 $\mu$ F/100 V | 2200 pF + 470 pF | 1500 pF         | 1000 pF         | 2200 pF + 470 pF | NC              | NC              | SHORT       | 0.5 mH |

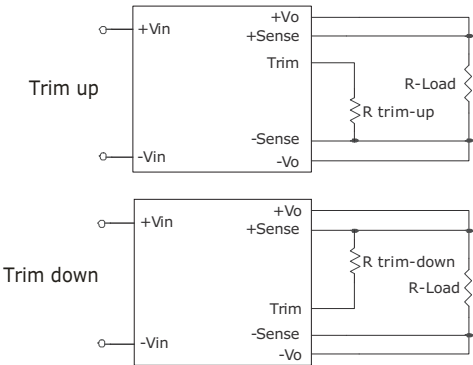
Notes: 1. Aluminum capacitor  
2. Ceramic capacitor

APPLICATION NOTES

1. Output Voltage Trimming  
Leave open if not used.

Figure 4

Application Circuit for Trim pin



Formula for Trim Resistor

$$R_{trim - up} = \left( \frac{R_1(V_r - V_f(\frac{R_2}{R_2 + R_3}))}{V_o - V_{o, nom}} \right) - \frac{R_2R_3}{R_2 + R_3} \text{ (k}\Omega\text{)}$$

$$R_{trim - down} = \frac{R_1(V_o - V_r)}{V_{o, nom} - V_o} - R_2 \text{ (k}\Omega\text{)}$$

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  
 $R_1, R_2, R_3$ , and  $V_r$  are internal (see Table 4).

Table 4

| Vout (Vdc) | R1 (kΩ) | R2 (kΩ) | R3 (kΩ) | Vr (V) | Vf (V) |
|------------|---------|---------|---------|--------|--------|
| 5          | 2.32    | 3.3     | 0       | 2.5    | 0      |
| 12         | 9.1     | 51      | 5.1     | 2.5    | 0.46   |
| 15         | 12      | 56      | 8.25    | 2.5    | 0.46   |
| 24         | 20      | 100     | 7.5     | 2.5    | 0.46   |
| 28         | 23.7    | 150     | 6.2     | 2.6    | 0.64   |
| 48         | 36      | 270     | 5.1     | 2.5    | 0.46   |

Note: 1. 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                                        | 09/06/2012 |
| 1.05 | added 28 V output models                                           | 11/05/2012 |
| 1.06 | misc. updates, added 5 V output models for both 24 and 48 V inputs | 11/16/2012 |
| 1.07 | updated spec                                                       | 03/14/2013 |
| 1.08 | added trimming and EMI information                                 | 12/17/2013 |
| 1.09 | updated spec                                                       | 01/05/2015 |
| 1.10 | updated derating curves                                            | 06/18/2015 |

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



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