

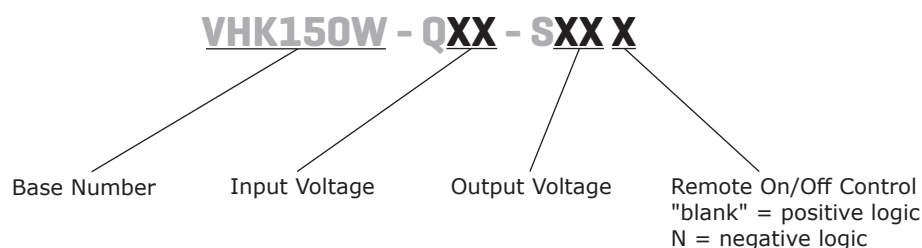
**SERIES: VHK150W | DESCRIPTION: DC-DC CONVERTER**
**FEATURES**

- 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%



| MODEL           | input<br>voltage<br>range<br>(Vdc) | output<br>voltage<br>(Vdc) | output<br>current<br>max<br>(A) | output<br>power<br>max<br>(W) | ripple<br>and noise <sup>1</sup><br>max<br>(mVp-p) | efficiency<br><br>typ<br>(%) |
|-----------------|------------------------------------|----------------------------|---------------------------------|-------------------------------|----------------------------------------------------|------------------------------|
| 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<br>power down                |     | 8.8<br>8 |     | 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 (0~1.8 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                    | 47  |       | 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                   |     |       | 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    |

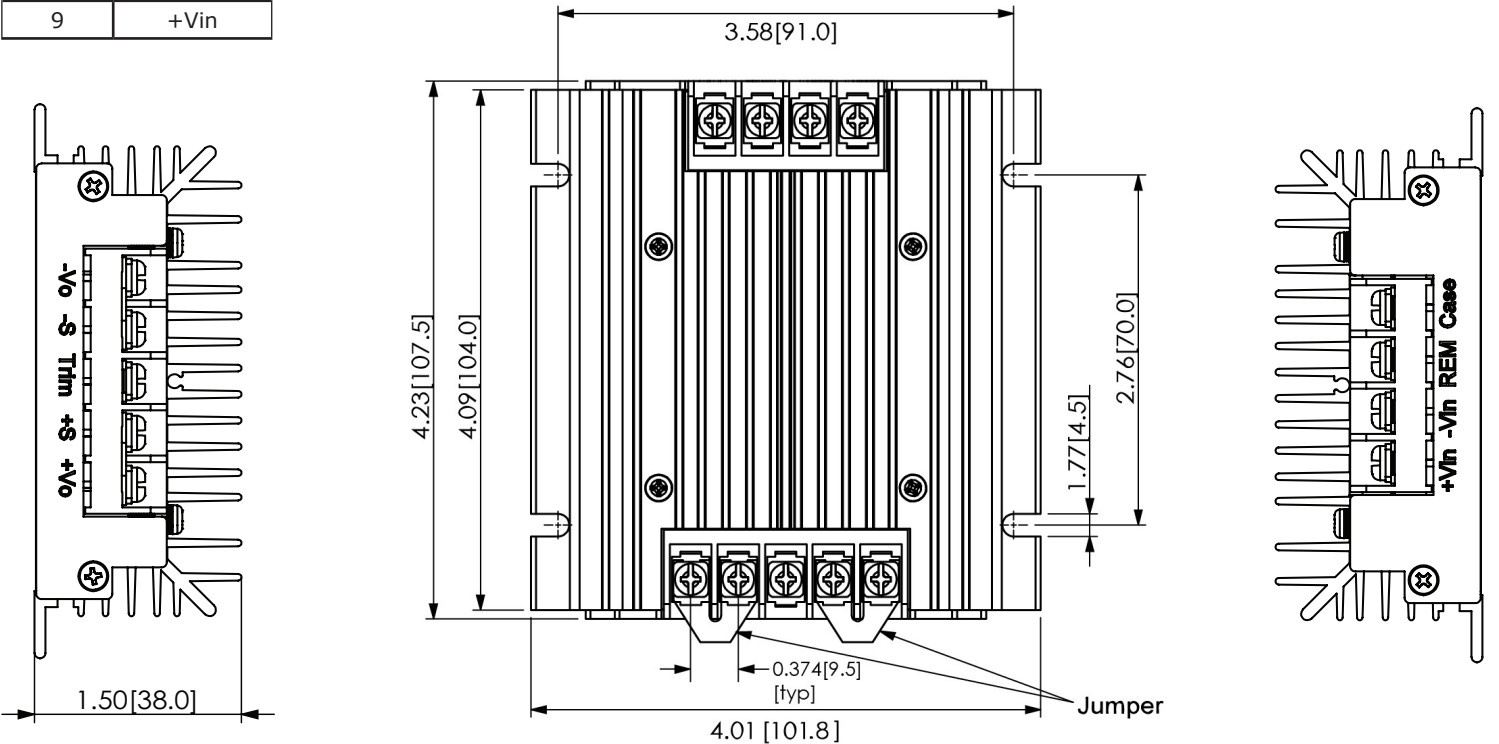
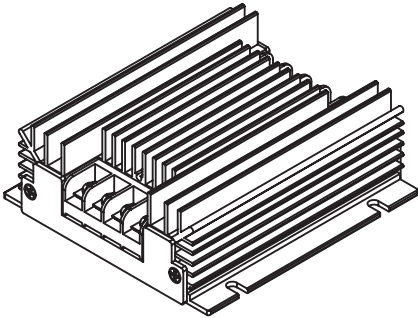
MECHANICAL

| parameter     | conditions/description                       | min | typ | max | units |
|---------------|----------------------------------------------|-----|-----|-----|-------|
| dimensions    | 4.23 x 4.01 x 1.50 [107.5 x 101.8 x 38.0 mm] |     |     |     | inch  |
| case material | steel and aluminum extrusion                 |     |     |     |       |
| weight        |                                              |     | 502 |     | g     |

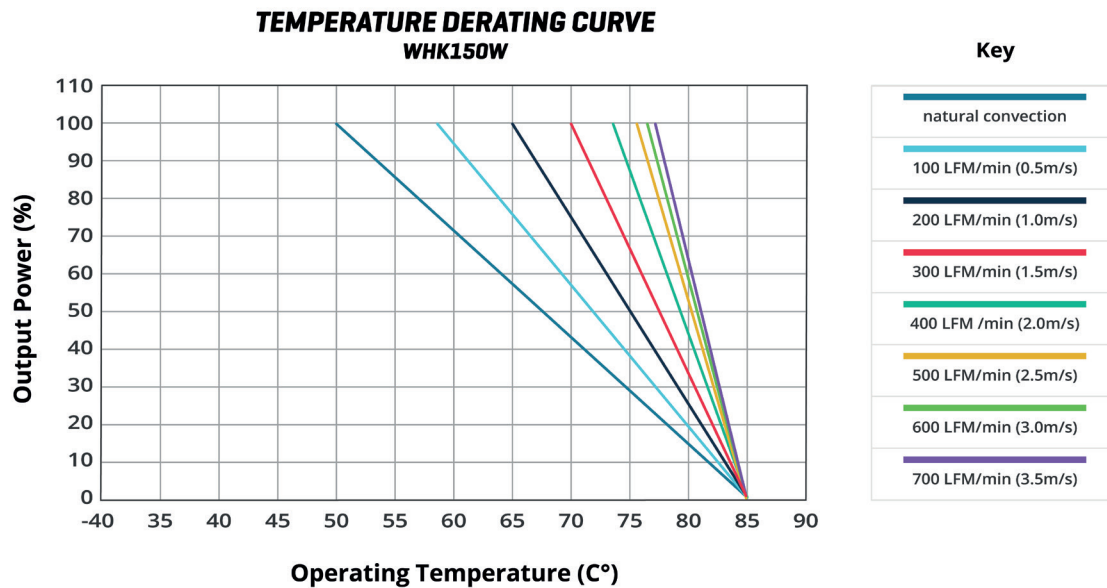
MECHANICAL DRAWING

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)

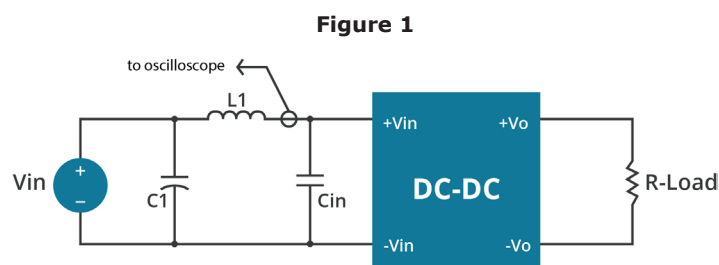
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vo      |
| 2               | -S       |
| 3               | trim     |
| 4               | +S       |
| 5               | +Vo      |
| 6               | case     |
| 7               | on/off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



## DERATING CURVES



## TEST CONFIGURATION



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

| 24 Vdc input models |                              |
|---------------------|------------------------------|
| L1                  | 1.2μH                        |
| C1                  | 220μF, ESR < 0.1Ω at 100 KHz |
| Cin                 | 330μF, ESR < 0.7Ω at 100 KHz |
| 48 Vdc input models |                              |
| L1                  | 12μH                         |
| C1                  | 220μF, ESR < 0.1Ω at 100 KHz |
| Cin                 | 33μF, ESR < 0.7Ω 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

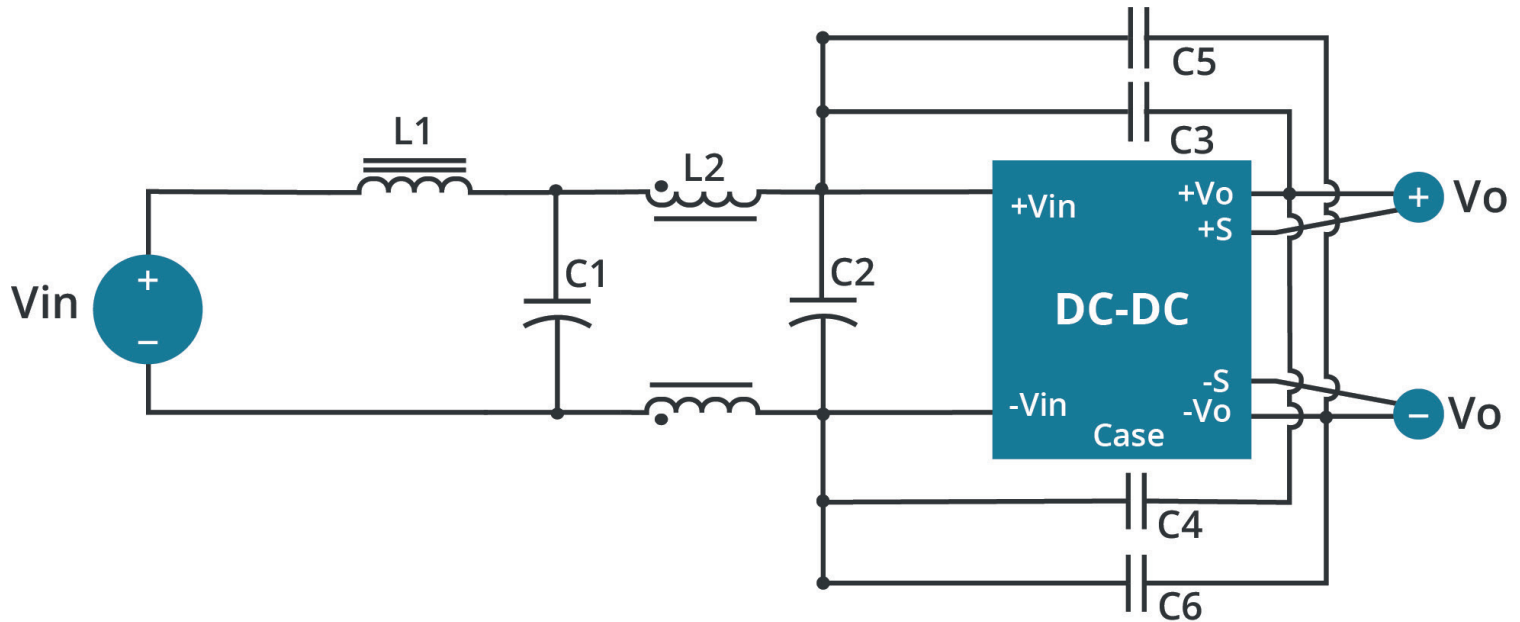


Table 2  
Class A Recommended Components

| 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

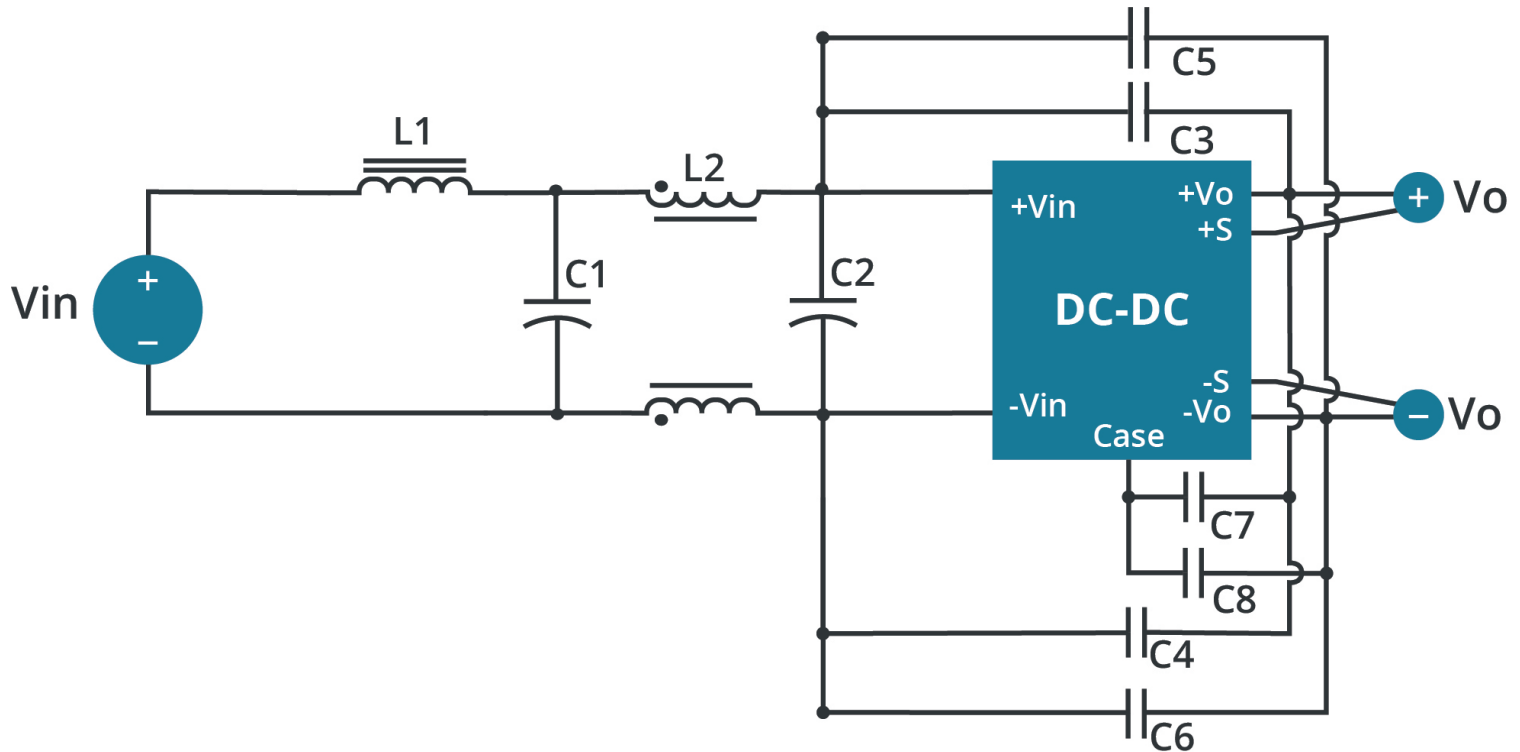


Table 3  
Class B Recommended Components

| 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

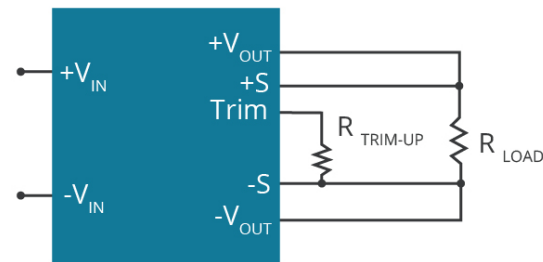
## APPLICATION NOTES

### 1. Output Voltage Trimming

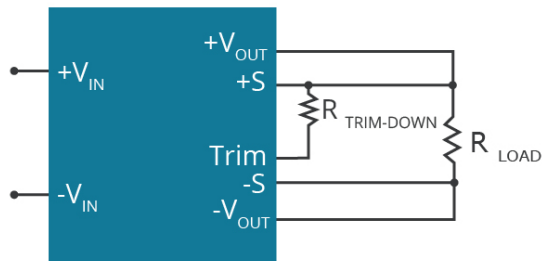
Leave open if not used.

Figure 4

Trim up



Trim down



$$R_{\text{TRIM}} = \left( \frac{R_{\text{TOP}} (V_{\text{REF}} - V_F \left( \frac{R_{\text{BOTTOM}}}{R_{\text{BOTTOM}} + R_O} \right))}{V_{\text{OUT}} - V_{\text{OUT, NOM}}} \right) - \frac{R_{\text{BOTTOM}} R_O}{R_{\text{BOTTOM}} + R_O} \quad (\text{K } \Omega)$$

Formula for Trim up

$$R_{\text{TRIM}} = \frac{R_{\text{TOP}} (V_{\text{OUT}} - V_{\text{REF}})}{V_{\text{OUT, NOM}} - V_{\text{OUT}}} - R_{\text{BOTTOM}} \quad (\text{K } \Omega)$$

Formula for Trim down

Table 4

| $V_{\text{NOM}}$ | $R_{\text{TOP}}$ | $R_{\text{BOTTOM}}$ | $R_O$         | $V_{\text{REF}}$ | $V_F$ |
|------------------|------------------|---------------------|---------------|------------------|-------|
| (Vdc)            | (k $\Omega$ )    | (k $\Omega$ )       | (k $\Omega$ ) | (V)              | (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: Value for  $R_{\text{TOP}}$ ,  $R_{\text{BOTTOM}}$ ,  $R_O$ ,  $V_{\text{REF}}$ , and  $V_F$  refer to Table 4 (fixed internal values).

$R_{\text{TRIM}}$ : Trim resistance

a: User-defined parameter, no actual meanings

$V_{\text{NOM}}$ : Nominal output voltage

$V_{\text{OUT}}$ : Target output voltage

Note: 1. 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                                        | 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 |
| 1.11 | company logo updated                                               | 02/08/2021 |
| 1.12 | derating curve and circuit figures updated                         | 09/07/2021 |
| 1.13 | mechanical tolerance updated                                       | 04/13/2022 |
| 1.14 | output voltage trimming updated                                    | 05/29/2023 |

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



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