

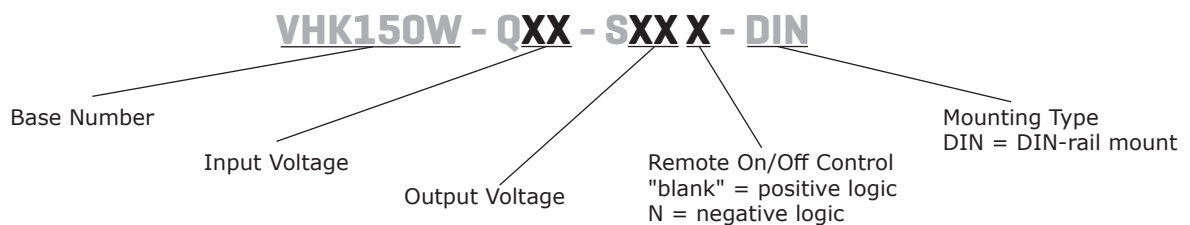
**SERIES: VHK150W-DIN | DESCRIPTION: DC-DC CONVERTER**
**FEATURES**

- 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%
- comes with DIN-rail mount



| MODEL               | input voltage range | output voltage | output current | output power | ripple and noise <sup>1</sup> | efficiency |
|---------------------|---------------------|----------------|----------------|--------------|-------------------------------|------------|
|                     | (Vdc)               | (Vdc)          | max (A)        | max (W)      | max (mVp-p)                   | typ (%)    |
| VHK150W-Q24-S5-DIN  | 9 ~ 36              | 5              | 25             | 125          | 100                           | 87         |
| VHK150W-Q24-S12-DIN | 9 ~ 36              | 12             | 12.5           | 150          | 150                           | 86         |
| VHK150W-Q24-S15-DIN | 9 ~ 36              | 15             | 10             | 150          | 150                           | 86         |
| VHK150W-Q24-S24-DIN | 9 ~ 36              | 24             | 6.5            | 156          | 240                           | 86.5       |
| VHK150W-Q24-S28-DIN | 9 ~ 36              | 28             | 5.4            | 150          | 280                           | 87         |
| VHK150W-Q24-S48-DIN | 9 ~ 36              | 48             | 3.12           | 150          | 480                           | 84         |
| VHK150W-Q48-S5-DIN  | 18 ~ 75             | 5              | 25             | 125          | 100                           | 90         |
| VHK150W-Q48-S12-DIN | 18 ~ 75             | 12             | 12.5           | 150          | 150                           | 88         |
| VHK150W-Q48-S15-DIN | 18 ~ 75             | 15             | 10             | 150          | 150                           | 88         |
| VHK150W-Q48-S24-DIN | 18 ~ 75             | 24             | 6.5            | 156          | 240                           | 87.5       |
| VHK150W-Q48-S28-DIN | 18 ~ 75             | 28             | 5.4            | 150          | 280                           | 89         |
| VHK150W-Q48-S48-DIN | 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  |                                       | 8.8 |     | Vdc   |
|                         | power up<br>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 2.07 (107.5 x 101.8 x 52.6 mm) |     |     |     | inch  |
| case material | steel and aluminum extrusion                 |     |     |     |       |
| weight        |  |     | 651 |     | g     |

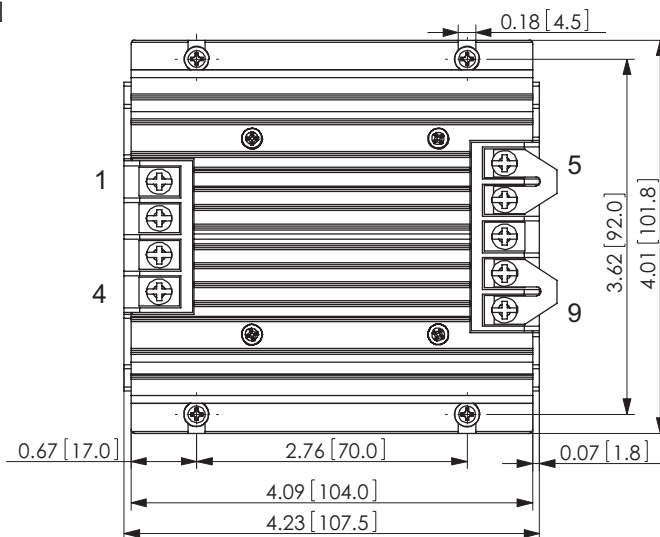
## MECHANICAL DRAWING

units: inch[mm]

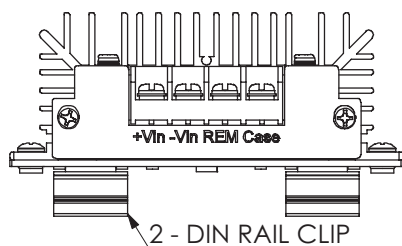
tolerance: X.XX = ±0.02[±0.5]  
 X.XXX = ±0.010[±0.25]

wire range: 22~12 AWG  
 screw size: #6-32  
 mounts to TS35 rails

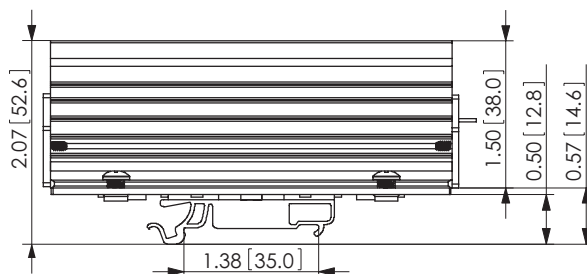
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | +Vin     |
| 2               | -Vin     |
| 3               | REM      |
| 4               | CASE     |
| 5               | +Vo      |
| 6               | +S       |
| 7               | TRIM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



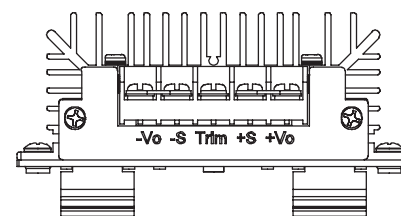
Top View



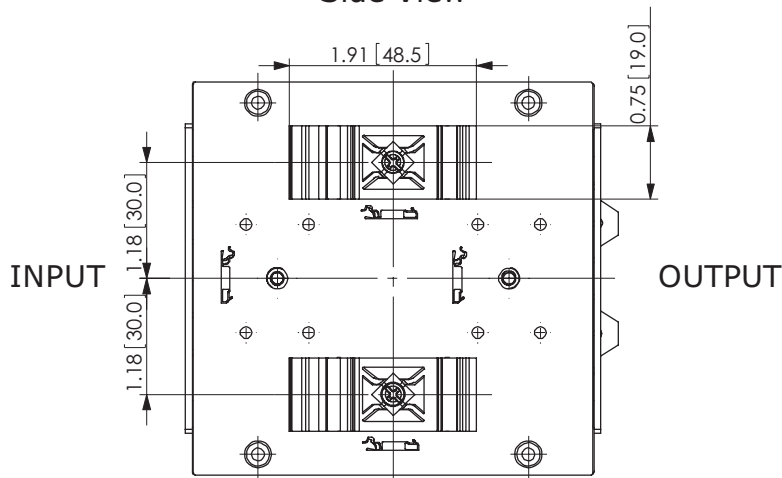
Front View



Side View

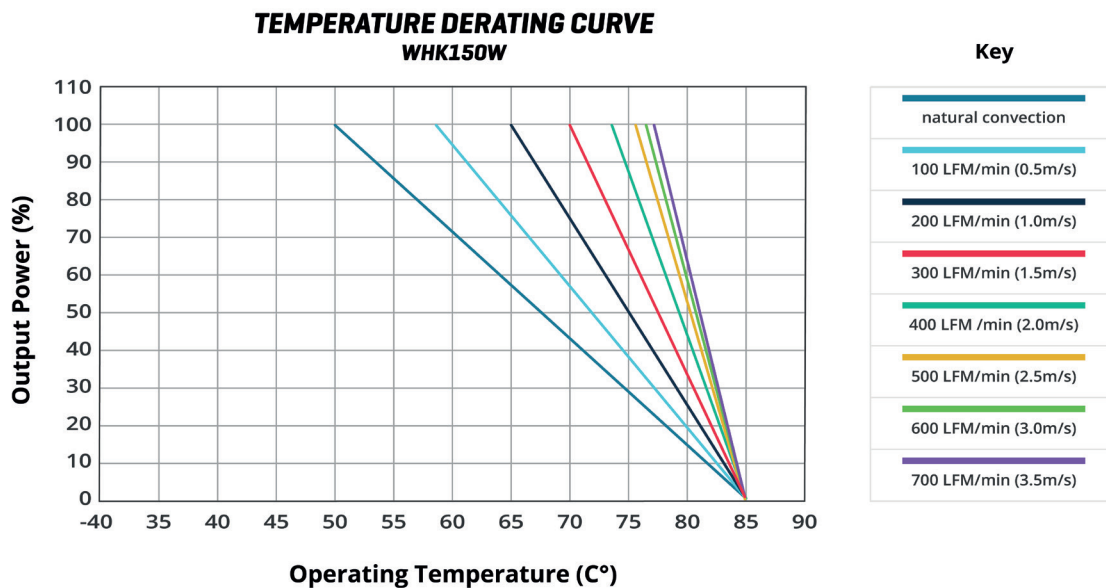


Back View

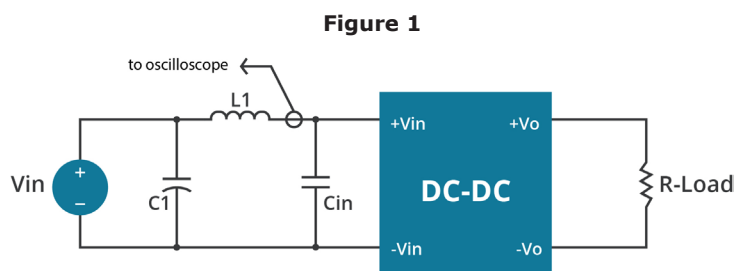


Bottom View

## 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

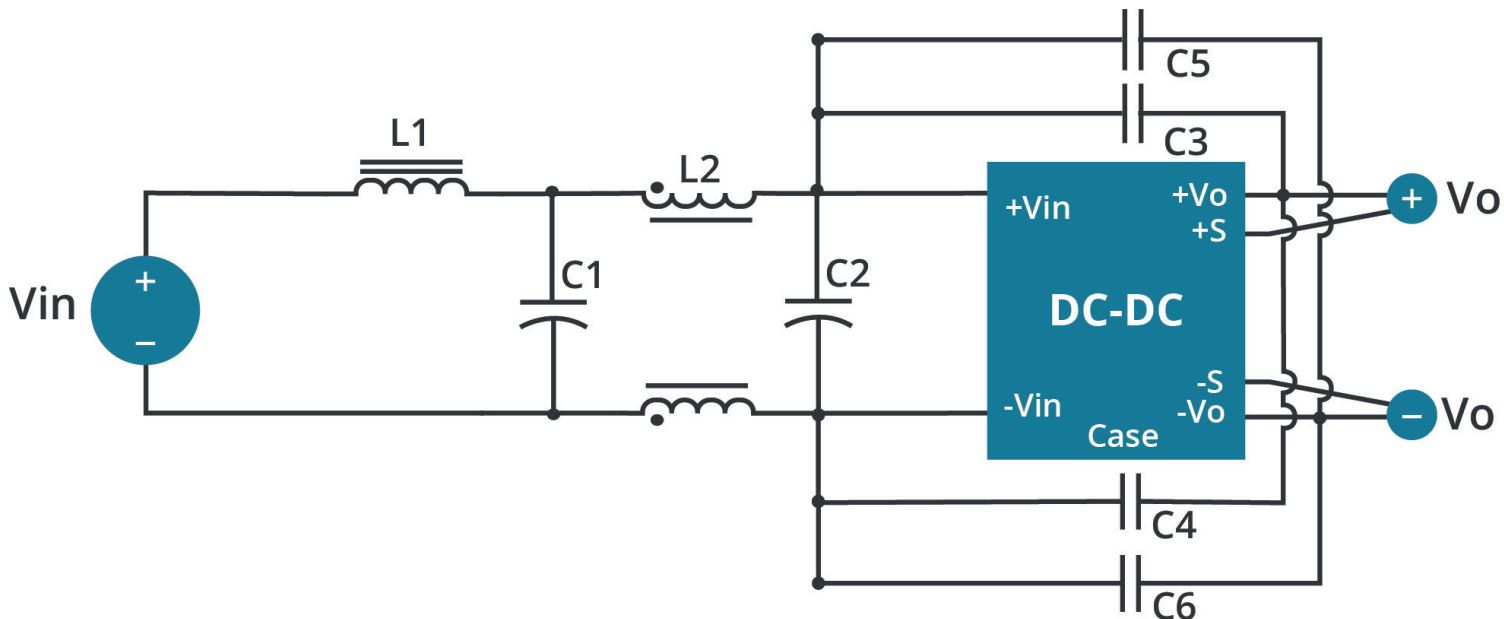


Table 2  
Class A Recommended Components

| 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 μF/50 V     | 100 μF/50 V     | NC              | NC              | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q24-S12 | 100 μF/50 V     | 100 μF/50 V     | NC              | NC              | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q24-S15 | 100 μF/50 V     | 100 μF/50 V     | NC              | NC              | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q24-S24 | 100 μF/50 V     | 100 μF/50 V     | 680 pF          | 680 pF          | 470 pF          | 680 pF          | SHORT | 0.5 mH |
| VHK150W-Q24-S28 | 100 μF/50 V     | 100 μF/50 V     | 2200 pF         | NC              | 680 pF          | 2200 pF         | SHORT | 0.6 mH |
| VHK150W-Q24-S48 | 100 μF/50 V     | 100 μF/50 V     | 1000 pF         | NC              | 470 pF          | 1000 pF         | SHORT | 0.6 mH |
| VHK150W-Q48-S5  | 47 μF/100 V     | 47 μF/100 V     | NC              | NC              | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q48-S12 | 47 μF/100 V     | 47 μF/100 V     | NC              | 680 pF          | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q48-S15 | 47 μF/100 V     | 47 μF/100 V     | 680 pF          | 1000 pF         | NC              | NC              | SHORT | 0.5 mH |
| VHK150W-Q48-S24 | 47 μF/100 V     | 47 μF/100 V     | 680 pF          | 680 pF          | 470 pF          | 680 pF          | SHORT | 0.5 mH |
| VHK150W-Q48-S28 | 47 μF/100 V     | 47 μF/100 V     | 2200 pF         | NC              | 680 pF          | 2200 pF         | SHORT | 0.6 mH |
| VHK150W-Q48-S48 | 47 μF/100 V     | 47 μF/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

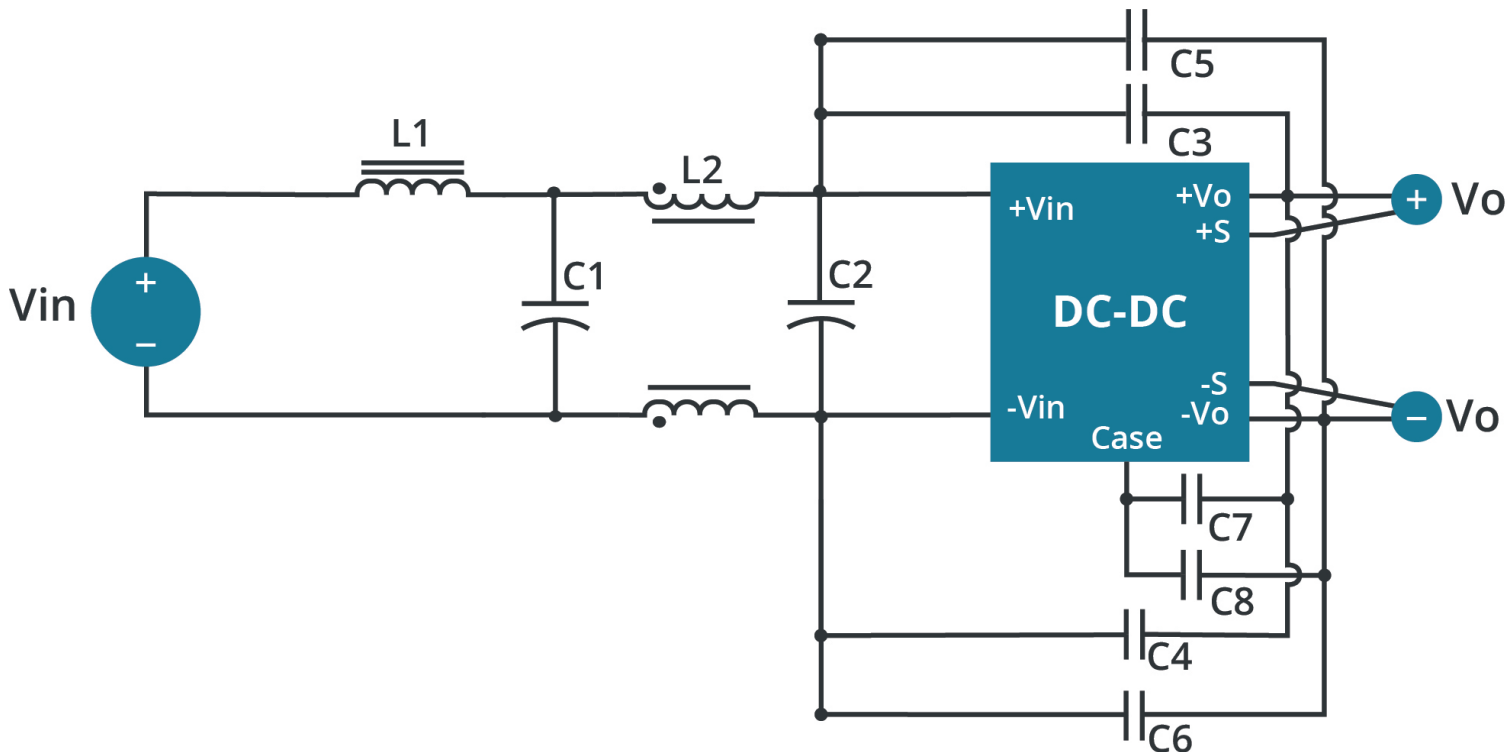


Table 3  
Class B Recommended Components

| 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 μF/50 V     | 220 μF/50 V     | 680 pF           | NC              | NC              | NC               | NC              | NC              | 3 μH   | 0.5 mH |
| VHK150W-Q24-S12 | 220 μF/50 V     | 220 μF/50 V     | 680 pF           | 680 pF          | NC              | NC               | NC              | NC              | 3 μH   | 0.5 mH |
| VHK150W-Q24-S15 | 220 μF/50 V     | 220 μF/50 V     | 680 pF           | NC              | NC              | NC               | NC              | NC              | 3 μH   | 0.5 mH |
| VHK150W-Q24-S24 | 220 μF/50 V     | 220 μF/50 V     | 1000 pF          | 1000 pF         | 470 pF          | 680 pF           | 470 pF          | 330 pF          | 3 μH   | 0.5 mH |
| VHK150W-Q24-S28 | 220 μF/50 V     | 220 μF/50 V     | 2200 pF x2       | 1000 pF         | 470 pF          | 2200 pF x2       | 470 pF          | 470 pF          | 3.4 μH | 0.6 mH |
| VHK150W-Q24-S48 | 220 μF/50 V     | 220 μF/50 V     | 2200 pF x4       | 1000 pF         | 1000 pF         | 2200 pF x4       | NC              | NC              | 3.4 μH | 0.6 mH |
| VHK150W-Q48-S5  | 120 μF/100 V    | 120 μF/100 V    | NC               | 680 pF          | NC              | NC               | NC              | NC              | 3 μH   | 0.5 mH |
| VHK150W-Q48-S12 | 120 μF/100 V    | 120 μF/100 V    | NC               | 680 pF          | NC              | NC               | NC              | NC              | 3 μH   | 0.5 mH |
| VHK150W-Q48-S15 | 120 μF/100 V    | 120 μF/100 V    | 1000 pF          | 1000 pF         | 470 pF          | 1000 pF          | 330 pF          | 680 pF          | 3 μH   | 0.5 mH |
| VHK150W-Q48-S24 | 120 μF/100 V    | 120 μF/100 V    | 1000 pF          | 1000 pF         | 470 pF          | 1000 pF          | 330 pF          | 680 pF          | 3 μH   | 0.5 mH |
| VHK150W-Q48-S28 | 120 μF/100 V    | 120 μF/100 V    | 1000 pF          | 1000 pF         | 470 pF          | 1000 pF          | 470 pF          | 470 pF          | 3.4 μH | 0.6 mH |
| VHK150W-Q48-S48 | 82 μF/100 V     | 120 μF/100 V    | 2200 pF + 470 pF | 1500 pF         | 1000 pF         | 2200 pF + 470 pF | NC              | NC              | SHORT  | 0.5 mH |

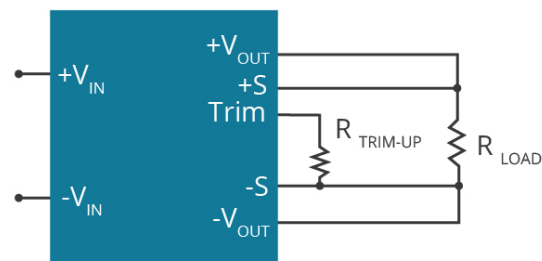
Notes: 1. Aluminum capacitor  
2. Ceramic capacitor

## APPLICATION NOTES

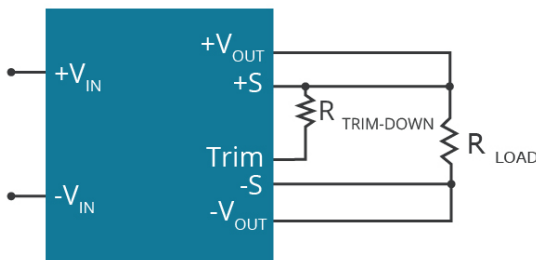
- Output Voltage Trimming**  
Leave open if not used.

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                             | 12/17/2013 |
| 1.01 | changed DIN-rail mount                      | 06/16/2014 |
| 1.02 | updated spec                                | 01/05/2015 |
| 1.03 | updated derating curves                     | 06/18/2015 |
| 1.04 | company logo updated                        | 02/08/2021 |
| 1.05 | derating curve and circuit drawings updated | 09/07/2021 |
| 1.06 | 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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