

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

FEATURES

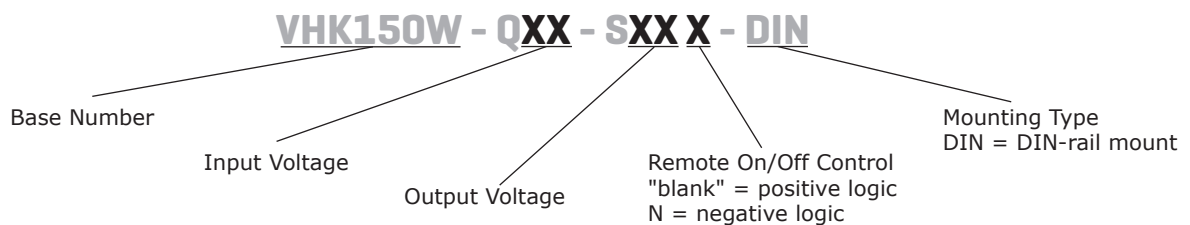
- up to 150 W isolated output
- rugged metal enclosure with integrated heat sink
- 4:1 input range (9~36 Vdc, 18~75 Vdc)
- single output from 5~48 Vdc
- 1,500 Vdc isolation
- over current, over temperature, over voltage, and short circuit protections
- remote on/off
- efficiency up to 90%
- comes with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



| MODEL | input voltage range | output voltage | output current max | output power max | ripple and noise ¹ max | efficiency typ |
|---------------------|---------------------|----------------|--------------------|------------------|-----------------------------------|----------------|
| | (Vdc) | (Vdc) | (A) | (W) | (mVp-p) | (%) |
| 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 8 | | Vdc Vdc |
| | 48 Vdc input | | 17 16 | | Vdc Vdc |
| CTRL ¹ | 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, 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 ² | measured from high line to low line | | | ±0.2 | % |
| load regulation ² | measured from full load to zero load | | | ±0.2 | % |
| voltage accuracy ² | | | | ±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; 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 |

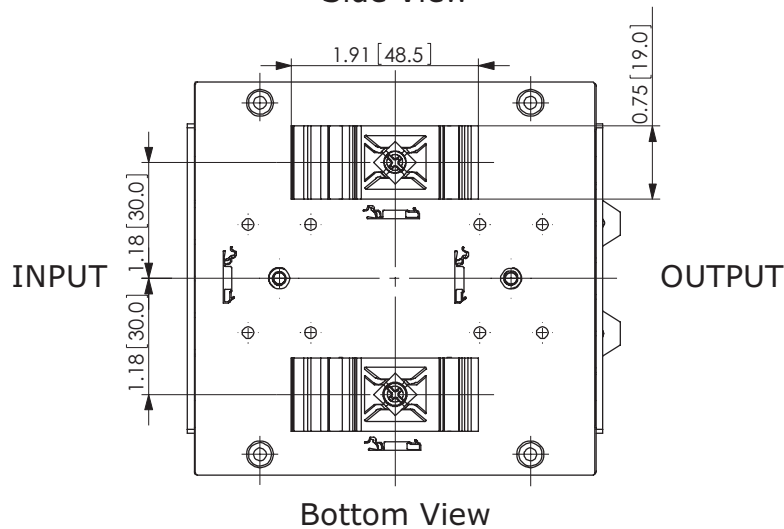
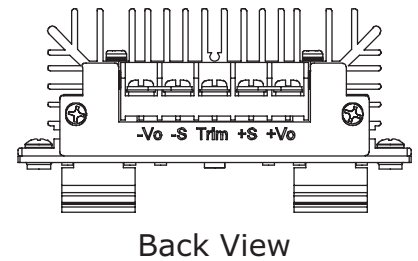
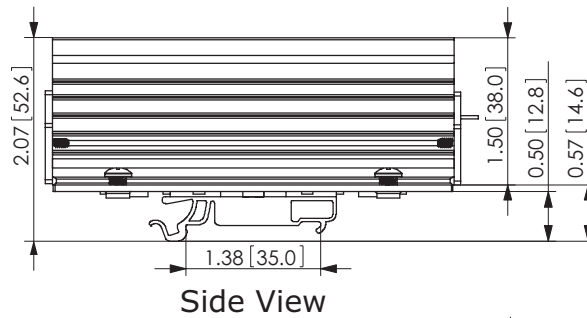
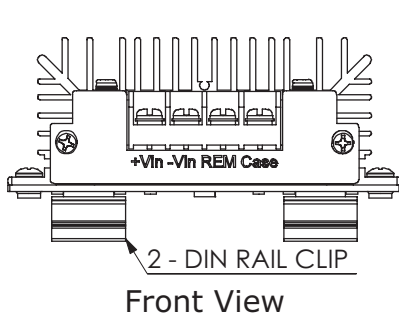
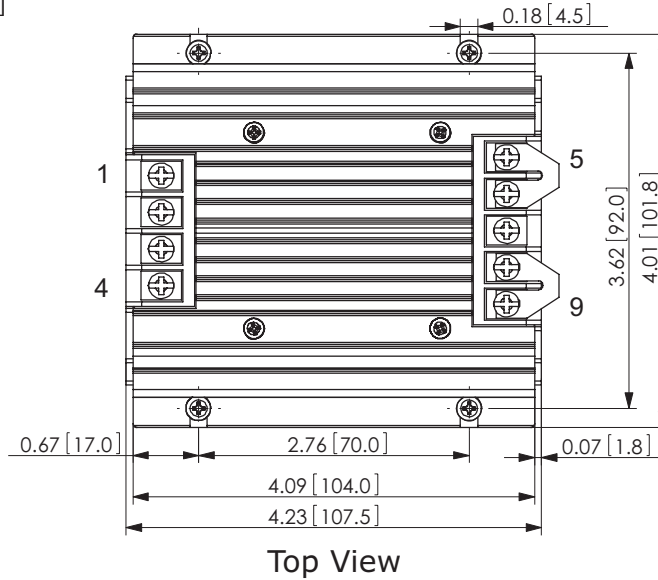
MECHANICAL DRAWING

units: inch[mm]

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

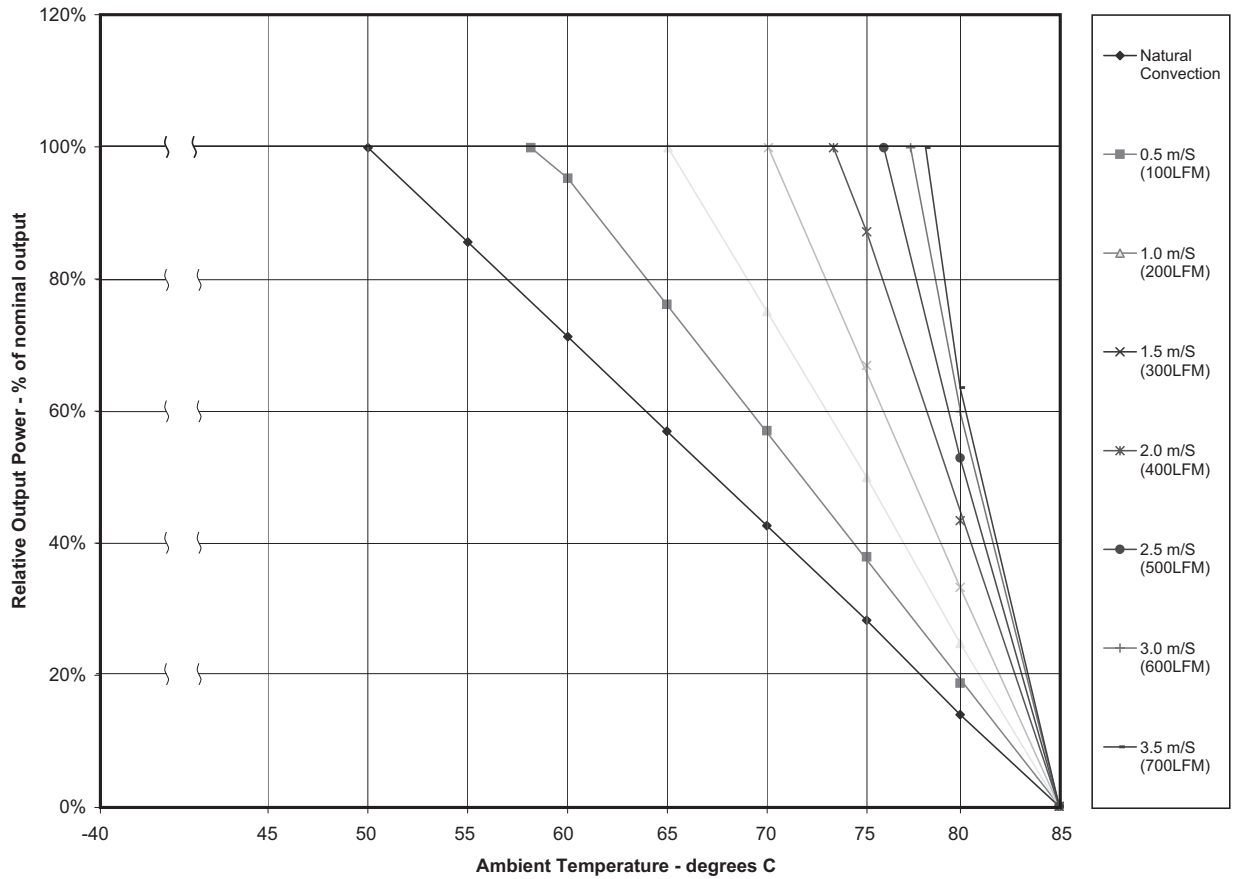
wire range: 22~12 AWG
screw size: #6-32
mounts to TS35 rails

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



DERATING CURVES

VHK150W Power Derating Curves At Nominal Input



TEST CONFIGURATION

Figure 1

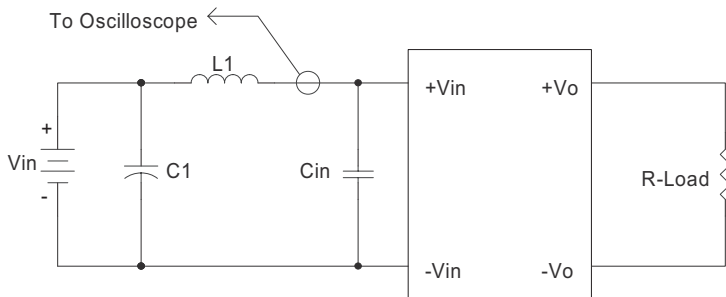


Table 1
External Components

| 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

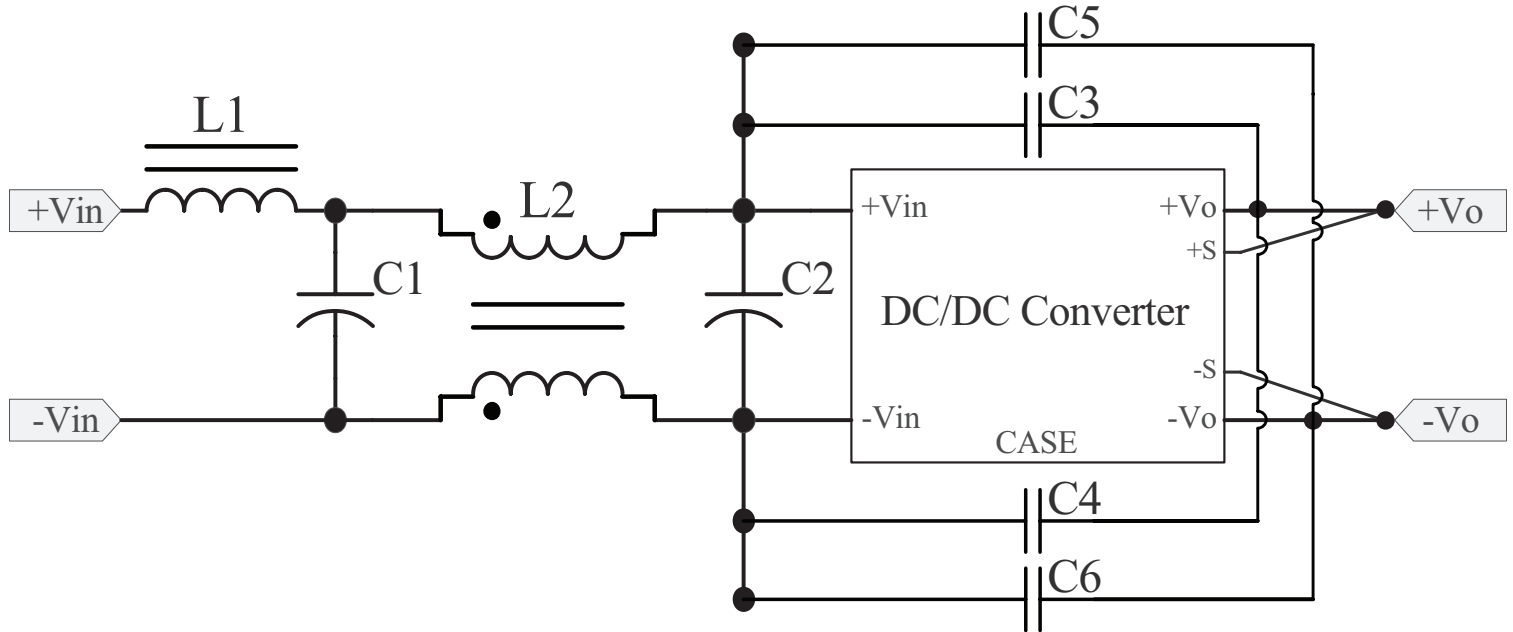


Table 2
Class A Recommended Components

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

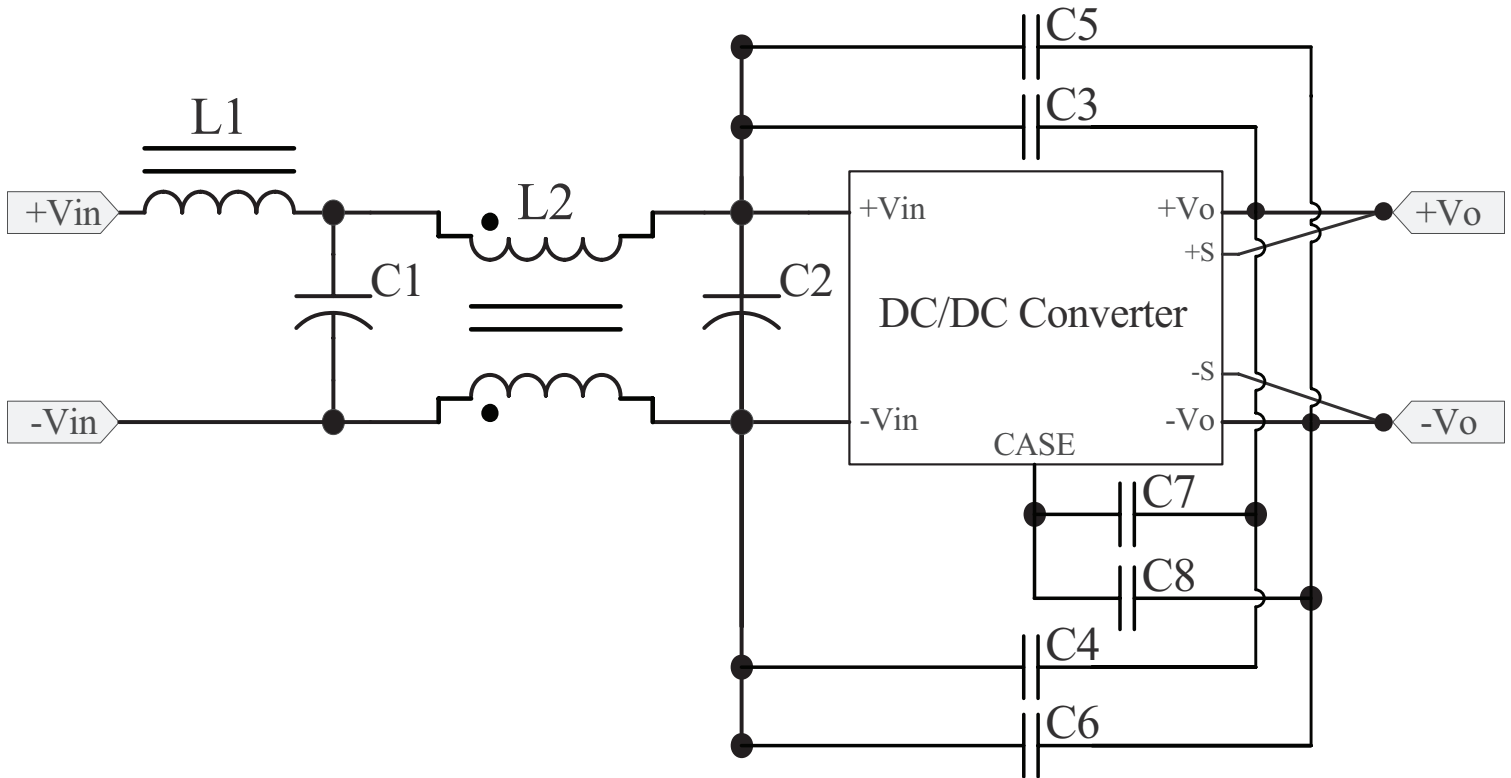


Table 3
Class B Recommended Components

| Model | C1 ¹ | C2 ¹ | C3 ² | C4 ² | C5 ² | C6 ² | C7 ² | C8 ² | 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

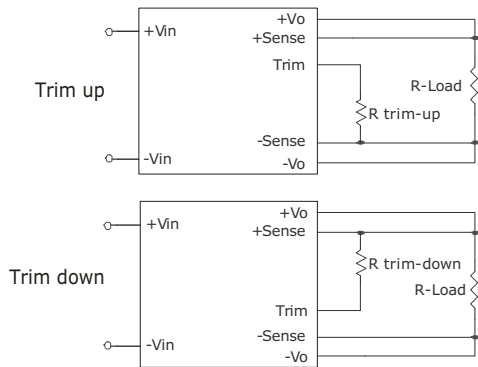
APPLICATION NOTES

1. Output Voltage Trimming

Leave open if not used.

Figure 4

Application Circuit for Trim pin



Formula for Trim Resistor

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

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

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
 $R_1, R_2, R_3,$ 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 |

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 |

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



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