



## SERIES: VHK50W | DESCRIPTION: DC-DC CONVERTER

### FEATURES

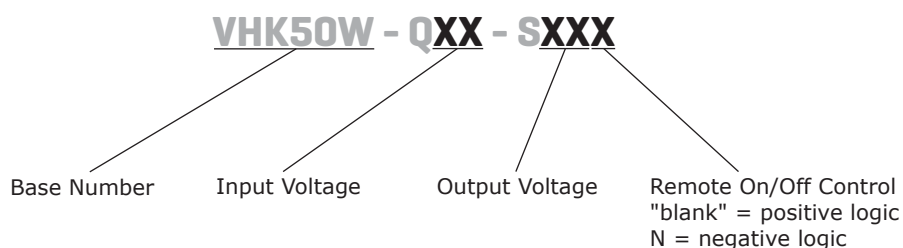
- up to 50 W isolated output
- rugged metal enclosure with integrated heat sink
- 4:1 input range (9~36 Vdc, 18~75 Vdc)
- single output from 3.3~48 Vdc
- 1,500 Vdc isolation
- over current, over temperature, over voltage, and short circuit protections
- remote on/off
- efficiency up to 83%



MODEL	input voltage	output voltage	output current	output power	ripple and noise <sup>1</sup>	efficiency
	range (Vdc)	(Vdc)	max (A)	max (W)	max (mVp-p)	typ (%)
VHK50W-Q24-S3R3	9 ~ 36	3.3	10	33	100	75
VHK50W-Q24-S5	9 ~ 36	5	10	50	100	79
VHK50W-Q24-S12	9 ~ 36	12	4.16	50	150	82
VHK50W-Q24-S15	9 ~ 36	15	3.33	50	150	82
VHK50W-Q24-S24	9 ~ 36	24	2.08	50	240	82
VHK50W-Q24-S28	9 ~ 36	28	1.78	50	280	82
VHK50W-Q24-S48	9 ~ 36	48	1.04	50	480	82
VHK50W-Q48-S3R3	18 ~ 75	3.3	10	33	100	76
VHK50W-Q48-S5	18 ~ 75	5	10	50	100	80
VHK50W-Q48-S12	18 ~ 75	12	4.16	50	150	83
VHK50W-Q48-S15	18 ~ 75	15	3.33	50	150	83
VHK50W-Q48-S24	18 ~ 75	24	2.08	50	240	83
VHK50W-Q48-S28	18 ~ 75	28	1.78	50	280	83
VHK50W-Q48-S48	18 ~ 75	48	1.04	50	480	83

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 only require the 1 $\mu$ F ceramic capacitor across the 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 power down		8		Vdc
	48 Vdc input		17		Vdc
	power up power down		16		Vdc
CTRL <sup>1</sup>	positive logic				
	models ON (open circuit)				
	models OFF (0~0.8 Vdc)				
	negative logic				
	models ON (0~0.8 Vdc)				
	models OFF (open circuit)				
filter	pi filter				
input fuse	15A time delay fuse for 24 Vin models, 8A 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	3.3 and 5 V output models			10,000	μF
	12 V output models			4,160	μF
	15 V output models			3,330	μF
	24 V output models			2,080	μF
	28 V output models			1,780	μF
	48 V output models	47		1,040	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	%
adjustability			±10		%
switching frequency			300		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		160	%
over voltage protection		115		140	%
over temperature protection	shutdown		100		°C
	restart threshold		70		°C

## SAFETY AND COMPLIANCE

parameter	conditions/description	min	typ	max	units
isolation voltage	for 1 min: input/output; input/case; output/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

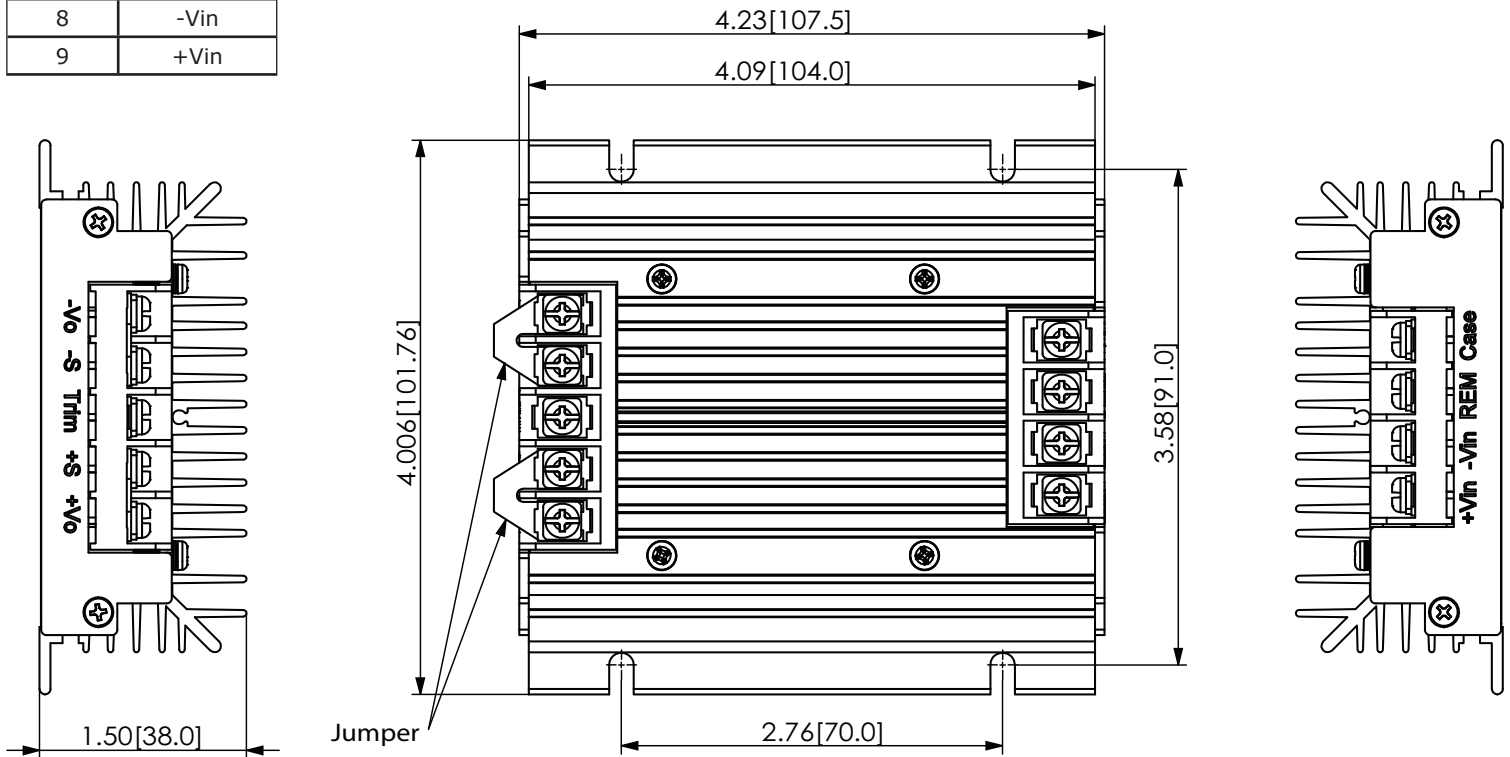
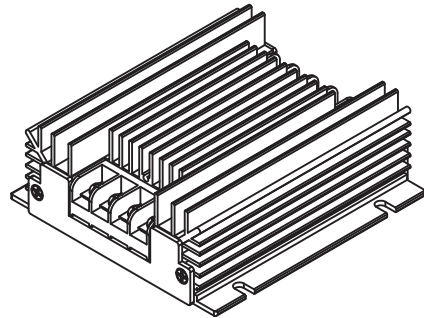
units: inch[mm]

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

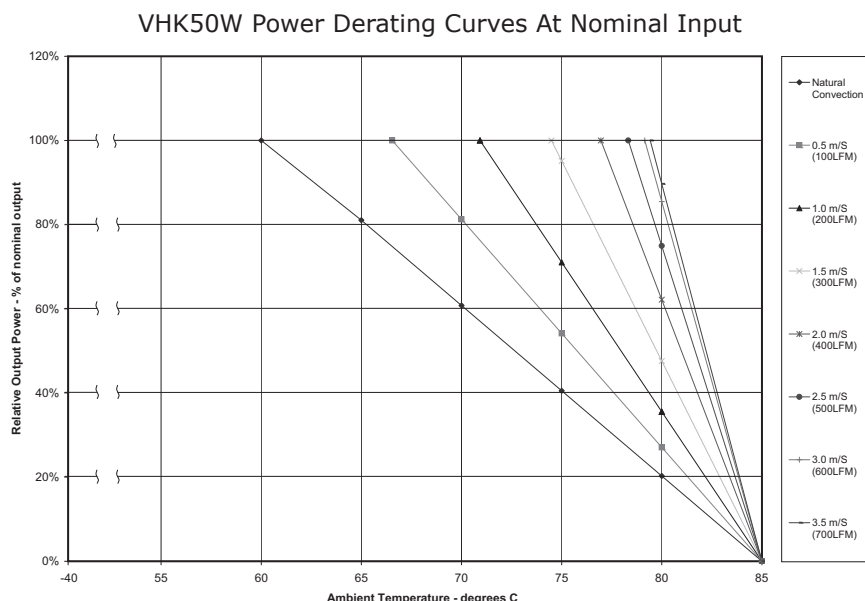
wire range: 22~12 AWG

screw size: #6-32

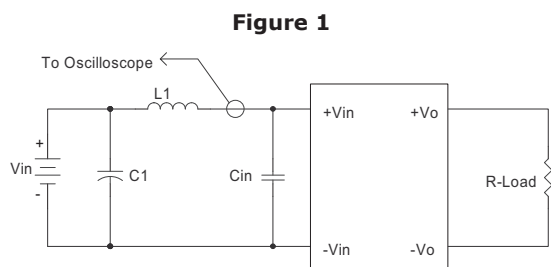
PIN CONNECTIONS	
PIN	FUNCTION
1	-Vo
2	-S
3	trim
4	+S
5	+Vo
6	case
7	on/off
8	-Vin
9	+Vin



## DERATING CURVES



## TEST CONFIGURATION



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

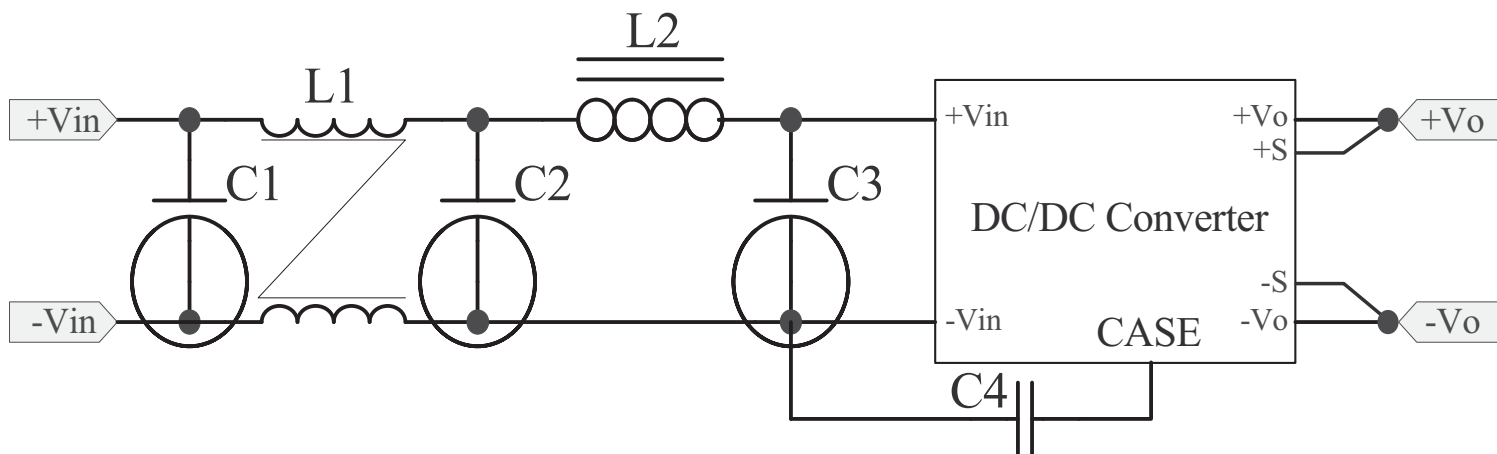
**Table 1**

External components	
L1	12μH
C1	220μF, ESR < 0.1Ω at 100 KHz
Cin	100μF, ESR < 0.1Ω at 100 KHz

## EMC RECOMMENDED CIRCUITS

### EN55022 CLASS A

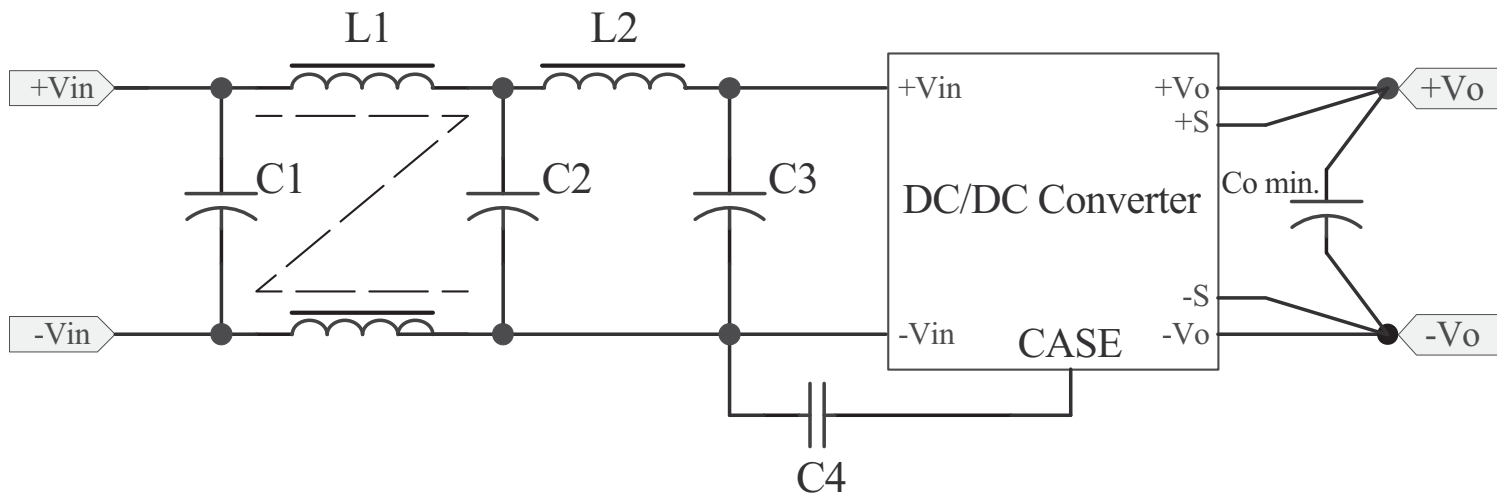
**Figure 2**  
**Recommended Circuit for EN55022 Class A**  
 (for all 3.3, 5, 12, 15, 24, & 28 Vdc output models)



## EMC RECOMMENDED CIRCUITS (CONTINUED)

### EN55022 CLASS A

**Figure 3**  
**Recommended Circuit for EN55022 Class A**  
 (for all 48 Vdc output models)



**Table 2**  
**Class A Recommended Components**

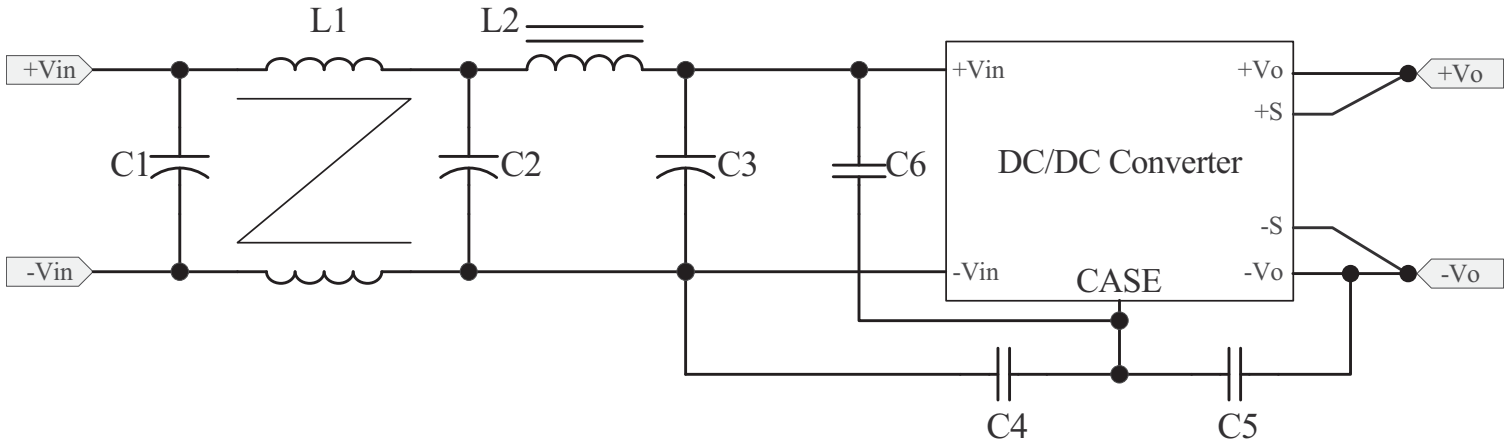
Model	C1 <sup>1</sup>	C2 <sup>2</sup>	C3 <sup>2</sup>	C4 <sup>1</sup>	L1	L2	Co min.
VHK50W-Q24-S3R3	NC	100 µF/50 V	100 µF/50 V	2200 pF/2 kV	Short	3.5 µH	NC
VHK50W-Q24-S5	NC	100 µF/50 V	100 µF/50 V	2200 pF/2 kV	Short	3.5 µH	NC
VHK50W-Q24-S12	NC	100 µF/50 V	100 µF/50 V	2200 pF/2 kV	Short	3.5 µH	NC
VHK50W-Q24-S15	NC	100 µF/50 V	100 µF/50 V	2200 pF/2 kV	Short	3.5 µH	NC
VHK50W-Q24-S24	10 µF/50 V	100 µF/50 V	100 µF/50 V	NC	1.5 mH	3.4 µH	NC
VHK50W-Q24-S28	NC	100 µF/50 V	100 µF/50 V	2200 pF/2 kV	Short	3.4 µH	NC
VHK50W-Q24-S48	NC	100 µF/50 V	100 µF/50 V	NC	Short	3.5 µH	47 µF
VHK50W-Q48-S3R3	NC	47 µF/100 V	47 µF/100 V	2200 pF/2 kV	Short	3.4 µH	NC
VHK50W-Q48-S5	NC	47 µF/100 V	47 µF/100 V	2200 pF/2 kV	Short	3.4 µH	NC
VHK50W-Q48-S12	NC	47 µF/100 V	47 µF/100 V	2200 pF/2 kV	Short	3.4 µH	NC
VHK50W-Q48-S15	NC	47 µF/100 V	47 µF/100 V	2200 pF/2 kV	Short	3.4 µH	NC
VHK50W-Q48-S24	NC	47 µF/100 V	47 µF/100 V	2200 pF/2 kV	Short	3.4 µH	NC
VHK50W-Q48-S28	NC	100 µF/100 V	100 µF/100 V	2200 pF/2 kV	Short	3.4 µH	NC
VHK50W-Q48-S48	NC	47 µF/100 V	47 µF/100 V	2200 pF/2 kV	Short	3.5 µH	47 µF

Note: 1. Ceramic capacitors  
 2. Aluminum capacitors

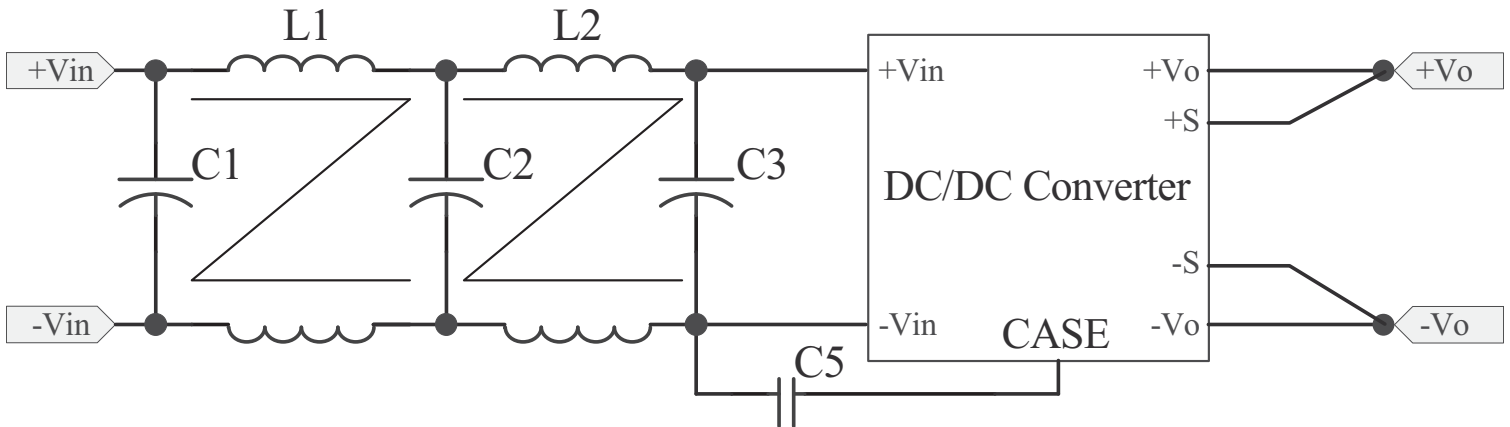
## EMC RECOMMENDED CIRCUITS (CONTINUED)

### EN55022 CLASS B

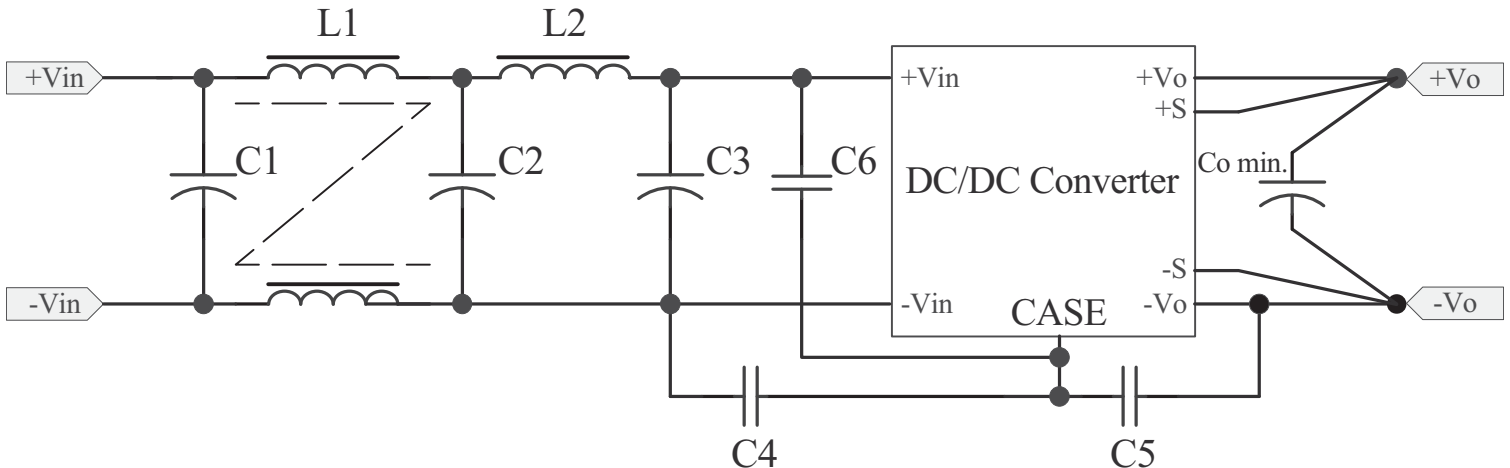
**Figure 4**  
**Recommended Circuit for EN55022 Class B**  
 (for all 3.3, 5, 12, 15, & 24 Vdc output models)



**Figure 5**  
**Recommended Circuit for EN55022 Class B**  
 (for all 28 Vdc output models)



**Figure 6**  
**Recommended Circuit for EN55022 Class B**  
 (for all 48 Vdc output models)



**EMC RECOMMENDED CIRCUITS (CONTINUED)****EN55022 CLASS B****Table 3  
Class B Recommended Components**

Model	C1 <sup>2</sup>	C2 <sup>2</sup>	C3 <sup>2</sup>	C4 <sup>1</sup>	C5 <sup>1</sup>	C6 <sup>1</sup>	L1	L2	Co min.
VHK50W-Q24-S3R3	100 µF/50 V	100 µF/50 V	100 µF/50 V	3300 pF/2 kV	NC	NC	0.65 mH	1.5 µH	NC
VHK50W-Q24-S5	100 µF/50 V	100 µF/50 V	100 µF/50 V	2200 pF/2 kV	NC	NC	0.65 mH	1.5 µH	NC
VHK50W-Q24-S12	100 µF/50 V	100 µF/50 V	100 µF/50 V	3300 pF/2 kV	NC	NC	0.65 mH	1.5 µH	NC
VHK50W-Q24-S15	100 µF/50 V	100 µF/50 V	100 µF/50 V	2200 pF/2 kV	NC	NC	0.65 mH	1.5 µH	NC
VHK50W-Q24-S24	10 µF/50 V <sup>1</sup>	100 µF/50 V	100 µF/50 V	2200 pF/2 kV	3300 pF/2 kV	1000 pF/2 kV	1.5 mH	3.4 µH	NC
VHK50W-Q24-S28	100 µF/50 V	100 µF/50 V	NC	NC	1000 pF/2 kV	NC	0.12 mH	0.34 mH	NC
VHK50W-Q24-S48	10 µF/50 V <sup>1</sup>	100 µF/50 V	100 µF/50 V	4700 pF/2 kV	2200 pF/2 kV	1000 pF/2 kV	1.5 mH	3.4 µH	47 µF
VHK50W-Q48-S3R3	47 µF/100 V	47 µF/100 V	47 µF/100 V	3300 pF/2 kV	3300 pF/2 kV	1000 pF/2 kV	1.5 mH	3.4 µH	NC
VHK50W-Q48-S5	47 µF/100 V	47 µF/100 V	47 µF/100 V	3300 pF/2 kV	3300 pF/2 kV	1000 pF/2 kV	1.5 mH	3.4 µH	NC
VHK50W-Q48-S12	47 µF/100 V	47 µF/100 V	47 µF/100 V	3300 pF/2 kV	3300 pF/2 kV	1000 pF/2 kV	1.5 mH	3.4 µH	NC
VHK50W-Q48-S15	47 µF/100 V	47 µF/100 V	47 µF/100 V	3300 pF/2 kV	3300 pF/2 kV	1000 pF/2 kV	1.5 mH	3.4 µH	NC
VHK50W-Q48-S24	47 µF/100 V	47 µF/100 V	47 µF/100 V	3300 pF/2 kV	3300 pF/2 kV	1000 pF/2 kV	1.5 mH	3.4 µH	NC
VHK50W-Q48-S28	100 µF/100 V	100 µF/100 V	NC	NC	1000 pF/2 kV	NC	0.12 mH	0.34 mH	NC
VHK50W-Q48-S48	47 µF/100 V	47 µF/100 V	47 µF/100 V	4700 pF/2 kV	2200 pF/2 kV	1000 pF/2 kV	1.5 mH	3.4 µH	47 µF

Note: 1. Ceramic capacitors  
2. Aluminum capacitors

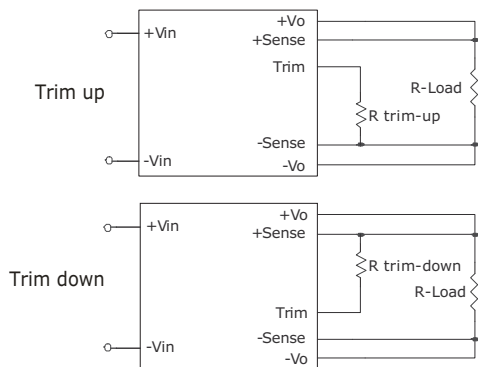
## APPLICATION NOTES

### 1. Output Voltage Trimming

Leave open if not used.

**Figure 7**

Application Circuit for Trim pin



### Formula for Trim Resistor

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

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

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  $V_f$  are internal (see Table 4).

**Table 4**

Vout (Vdc)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	Vr (V)	Vf (V)
3.3	3	12	18	1.24	0.46
5	2.32	8.2	0	2.5	0
12	9.1	51	18	2.5	0.46
15	12	82	18	2.5	0.46
24	20	100	20	2.5	0.46
28	23.7	150	16	2.5	0.46
48	36	270	14	2.5	0.46

Note: 1. All specifications are measured at  $T_a=25^\circ C$ , 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	03/14/2013
1.06	added trimming and EMI information	12/17/2013

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



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