



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%

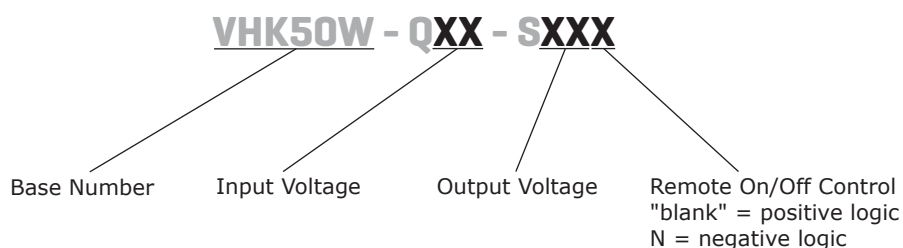


MODEL

MODEL	input voltage range (Vdc)	output voltage (Vdc)	output current max (A)	output power max (W)	ripple and noise ¹ max (mVp-p)	efficiency 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 μ F tantalum capacitor and 1 μ F ceramic capacitor across output. The 48 Vdc output models only require the 1 μ 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	power up power down		8.8 8		Vdc Vdc
	48 Vdc input	power up power down		17 16		Vdc Vdc
CTRL ¹	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 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	%
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

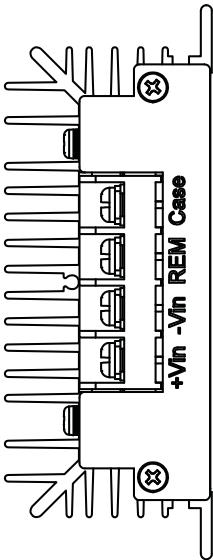
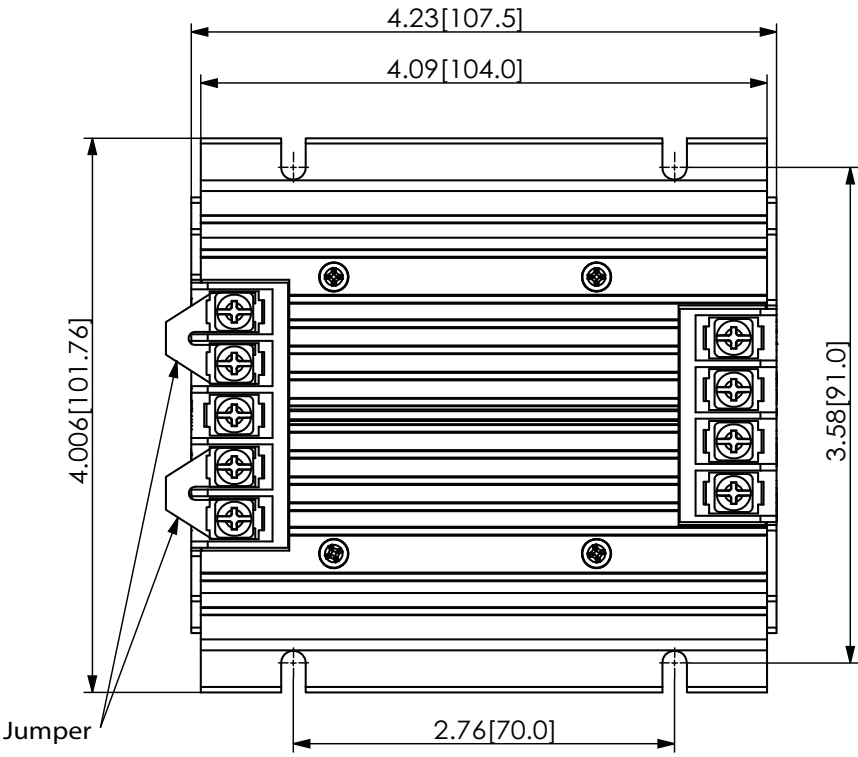
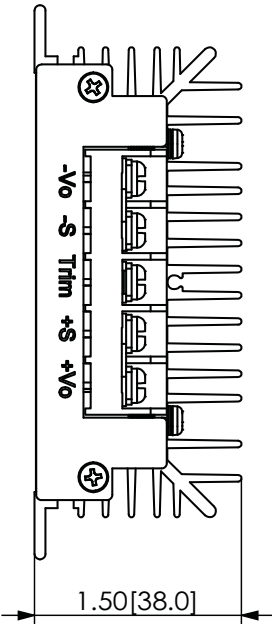
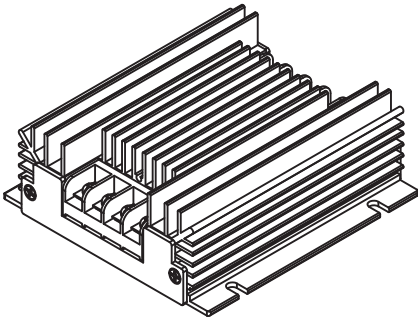
parameter	conditions/description	min	typ	max	units
dimensions	4.23 x 4.01 x 1.50 (107.5 x 101.76 x 38.0 mm)				inch
case material	steel and aluminum extrusion				
weight			502		g

MECHANICAL DRAWING

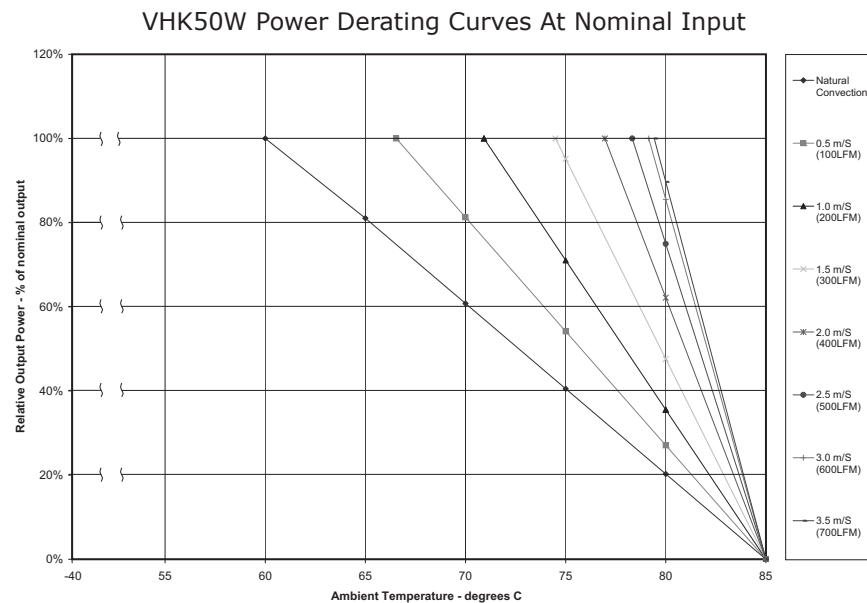
units: inch[mm]
tolerance: X.XX = $\pm 0.02[\pm 0.5]$
 X.XXX = $\pm 0.010[\pm 0.25]$

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

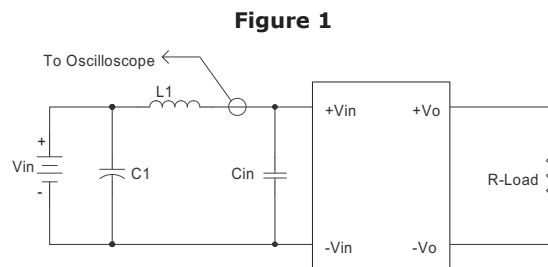


Table 1

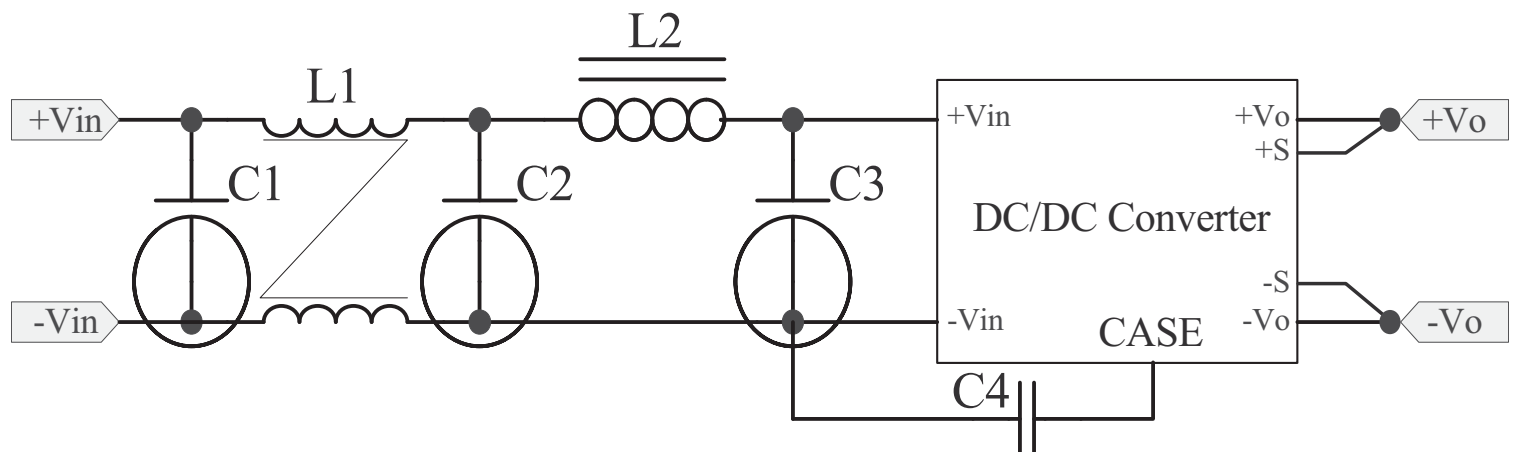
External components	
L1	12μH
C1	220μF, ESR < 0.1Ω at 100 KHz
Cin	100μF, ESR < 0.1Ω at 100 KHz

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
 (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)

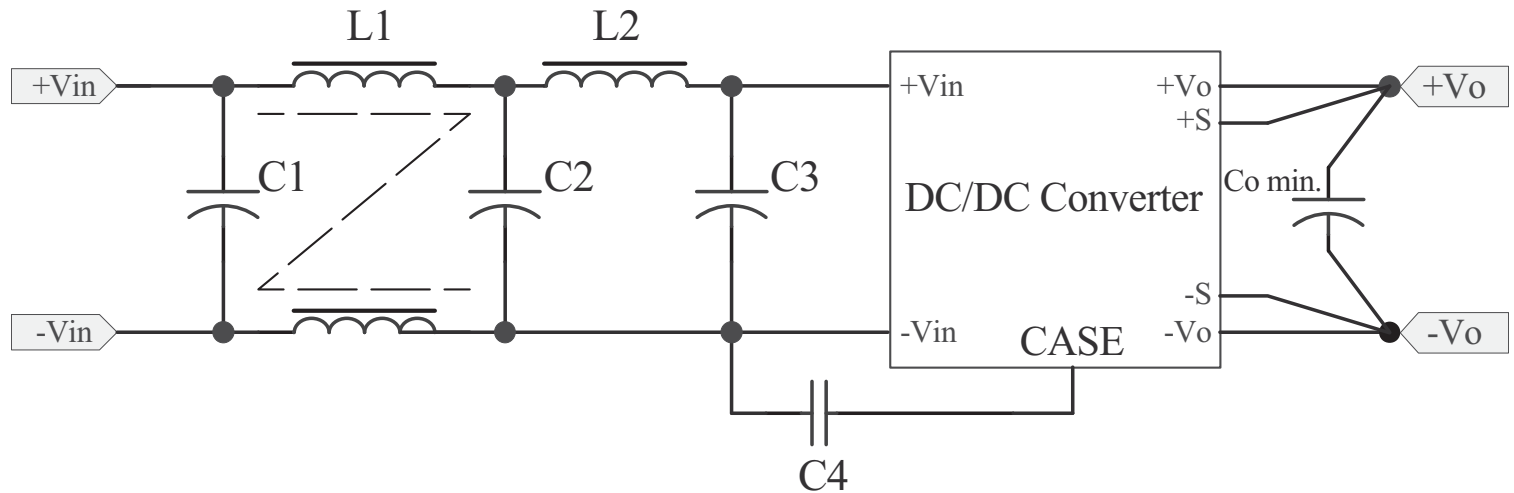


Table 2
Class A Recommended Components

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

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)

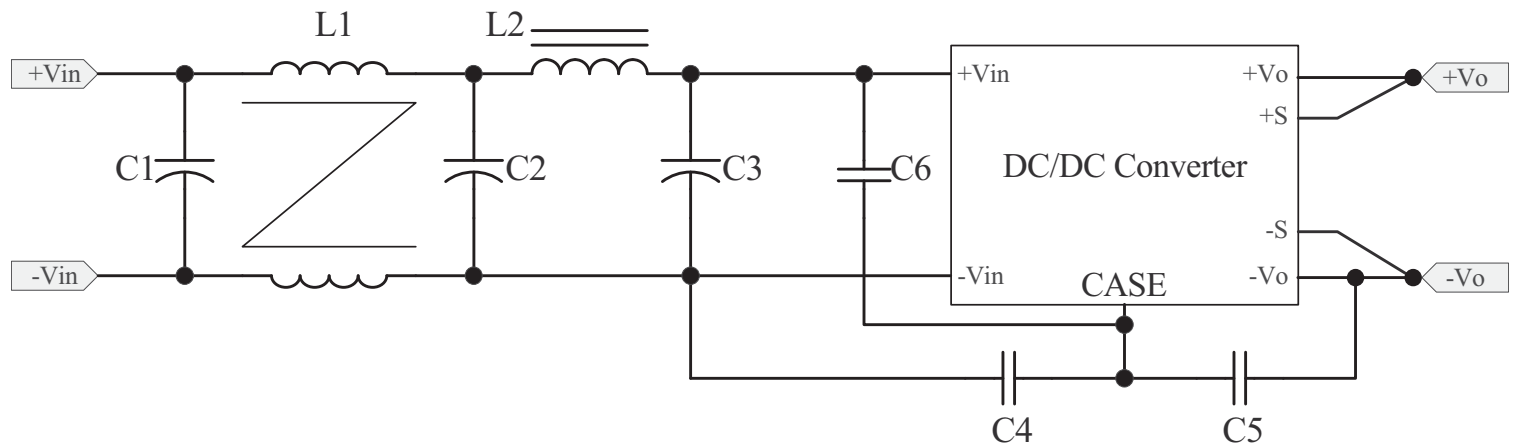


Figure 5
Recommended Circuit for EN55022 Class B
(for all 28 Vdc output models)

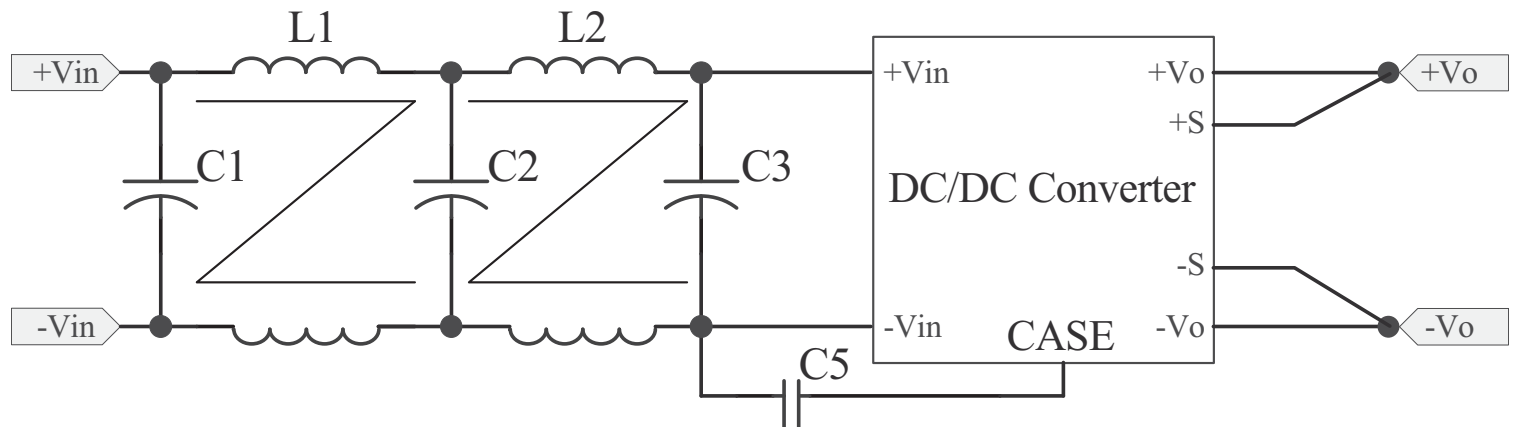
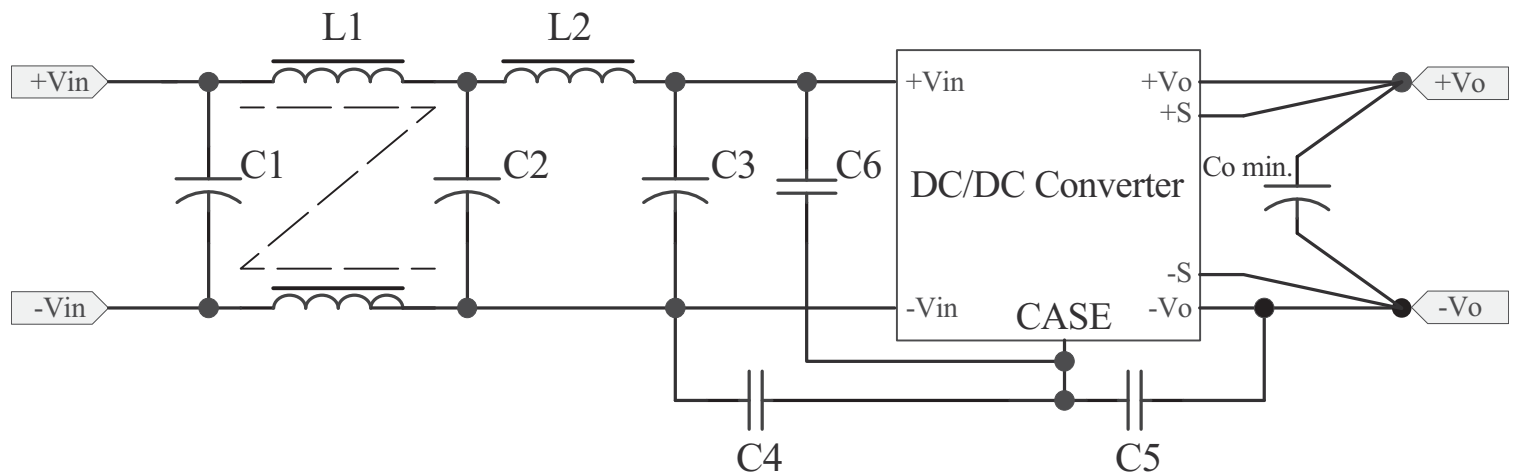


Figure 6
Recommended Circuit for EN55022 Class B
(for all 48 Vdc output models)



EMC RECOMMENDED CIRCUITS (CONTINUED)

EN55022 CLASS B

Table 3
Class B Recommended Components

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

Note:

1. Ceramic capacitors
2. Aluminum capacitors

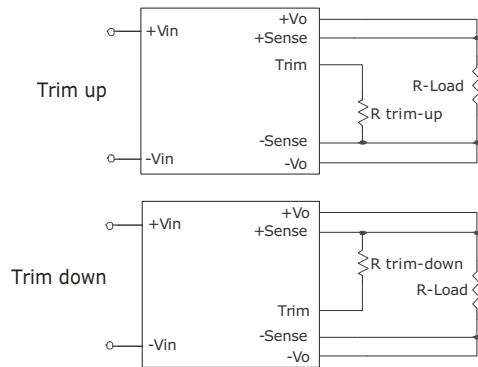
APPLICATION NOTES

1. Output Voltage Trimming

Leave open if not used.

Figure 7

Application Circuit for Trim pin



Formula for Trim Resistor

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

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

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 (K Ω)	R2 (K Ω)	R3 (K Ω)	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

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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