

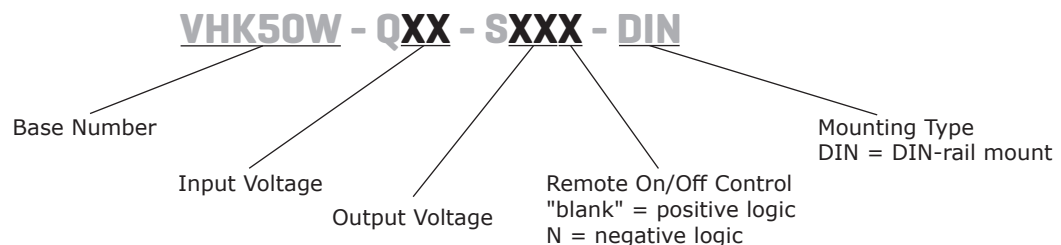
SERIES: VHK50W-DIN | DESCRIPTION: DC-DC CONVERTER
FEATURES

- 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%
- comes with DIN-rail mount



MODEL	input voltage	output voltage	output current	output power	ripple and noise ¹	efficiency
	range (Vdc)	(Vdc)	max (A)	max (W)	max (mVp-p)	typ (%)
VHK50W-Q24-S3R3-DIN	9 ~ 36	3.3	10	33	100	75
VHK50W-Q24-S5-DIN	9 ~ 36	5	10	50	100	79
VHK50W-Q24-S12-DIN	9 ~ 36	12	4.16	50	150	82
VHK50W-Q24-S15-DIN	9 ~ 36	15	3.33	50	150	82
VHK50W-Q24-S24-DIN	9 ~ 36	24	2.08	50	240	82
VHK50W-Q24-S28-DIN	9 ~ 36	28	1.78	50	280	82
VHK50W-Q24-S48-DIN	9 ~ 36	48	1.04	50	480	82
VHK50W-Q48-S3R3-DIN	18 ~ 75	3.3	10	33	100	76
VHK50W-Q48-S5-DIN	18 ~ 75	5	10	50	100	80
VHK50W-Q48-S12-DIN	18 ~ 75	12	4.16	50	150	83
VHK50W-Q48-S15-DIN	18 ~ 75	15	3.33	50	150	83
VHK50W-Q48-S24-DIN	18 ~ 75	24	2.08	50	240	83
VHK50W-Q48-S28-DIN	18 ~ 75	28	1.78	50	280	83
VHK50W-Q48-S48-DIN	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		8.8		Vdc
	power up power down		8		Vdc
	48 Vdc input		17		Vdc
	power up power down		16		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 2.07 (107.5 x 101.8 x 52.6 mm)				inch
case material	steel and aluminum extrusion				
weight			651		g

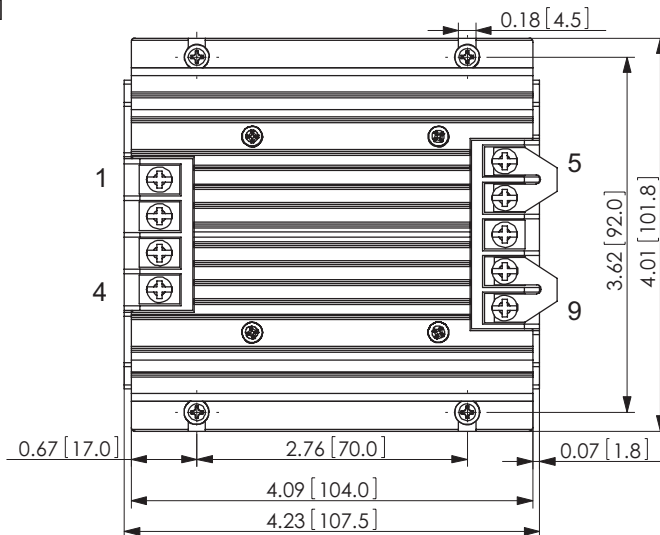
MECHANICAL DRAWING

units: inch[mm]

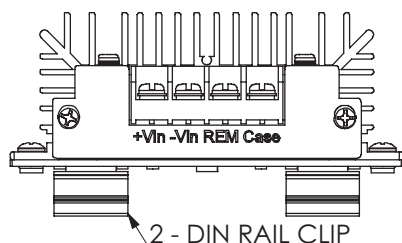
tolerance: X.XX = ±0.02[±0.5]
X.XXX = ±0.010[±0.25]

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

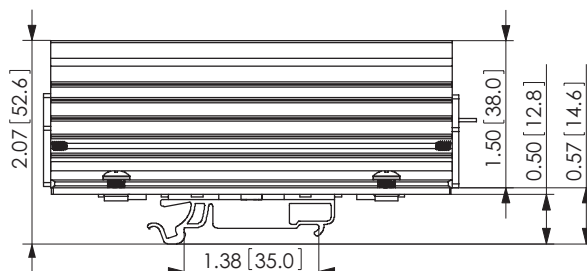
PIN CONNECTIONS	
PIN	FUNCTION
1	+Vin
2	-Vin
3	REM
4	CASE
5	+Vo
6	+S
7	TRIM
8	-S
9	-Vo



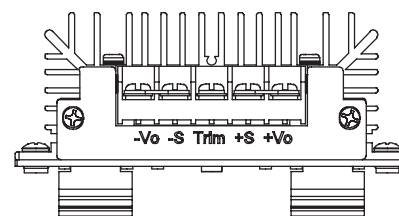
Top View



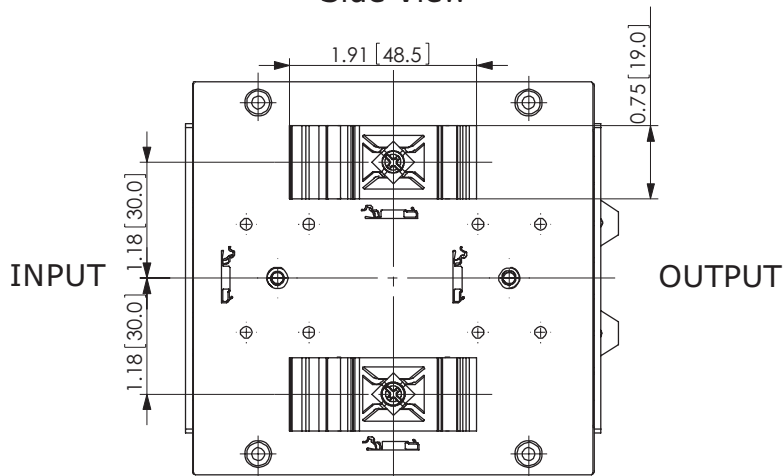
Front View



Side View

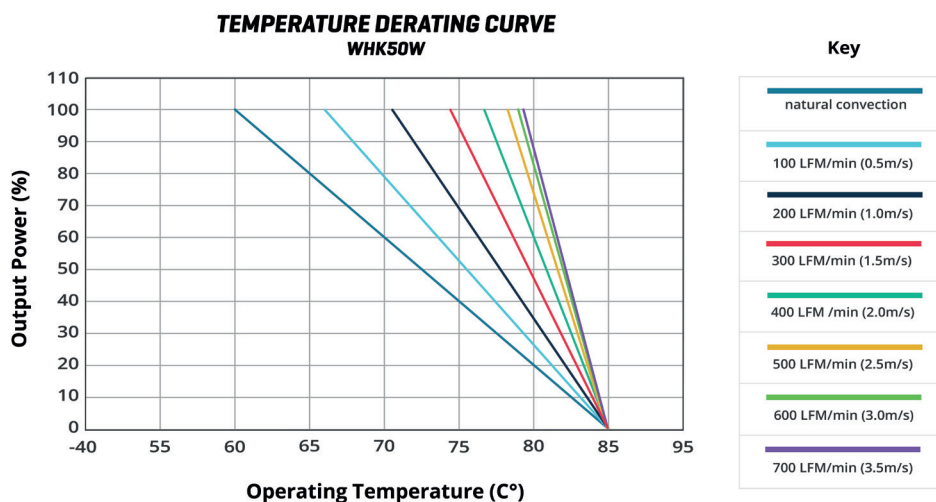


Back View



Bottom View

DERATING CURVES



TEST CONFIGURATION

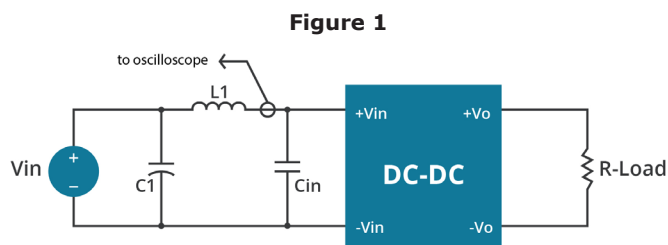


Table 1

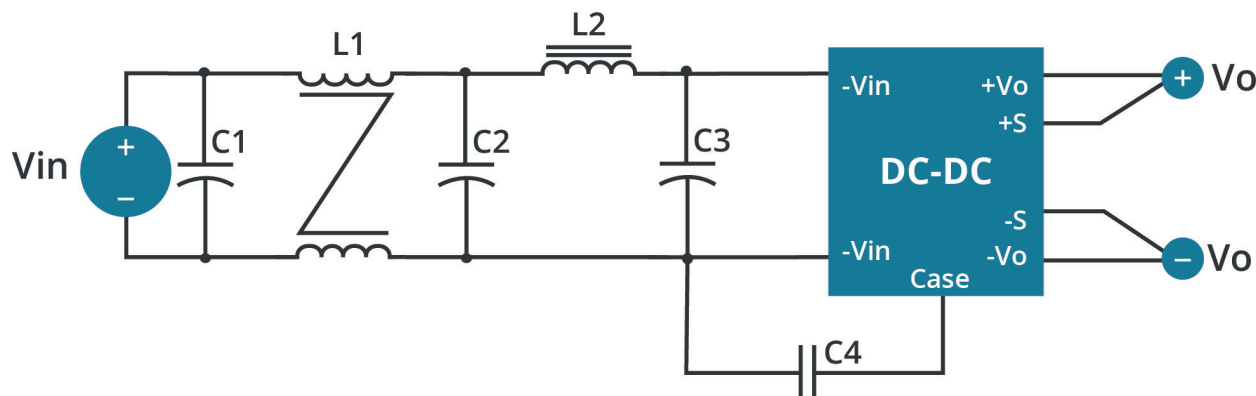
External components	
L1	12 μ H
C1	220 μ F, ESR < 0.1 Ω at 100 KHz
Cin	100 μ F, ESR < 0.1 Ω at 100 KHz

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)

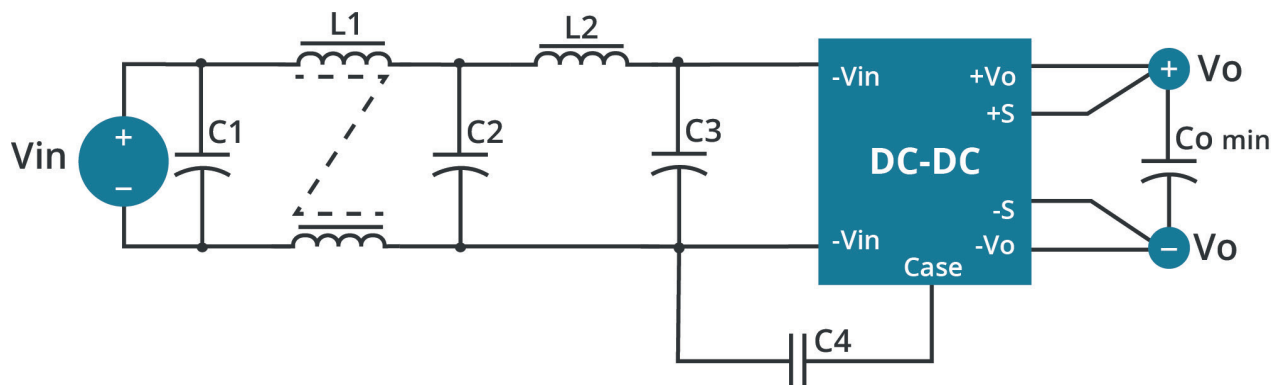


Table 2
Class A Recommended Components

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)

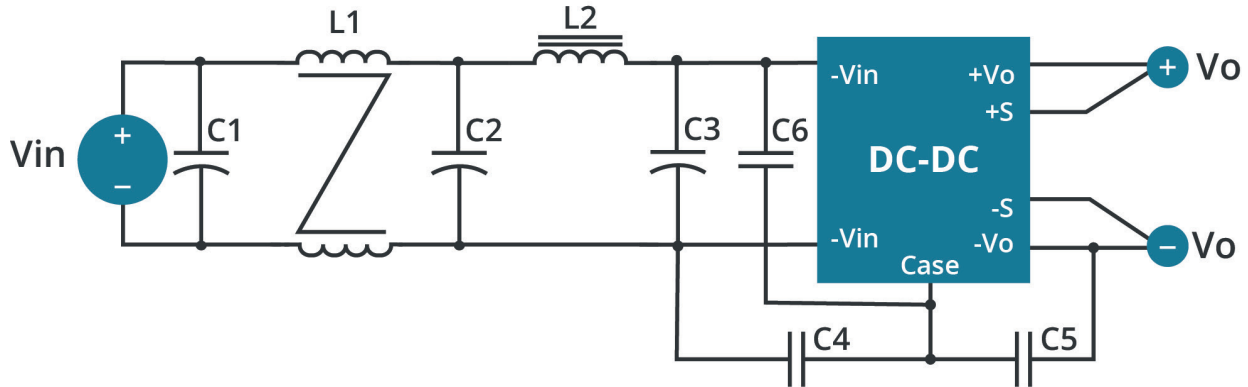


Figure 5
Recommended Circuit for EN55022 Class B
 (for all 28 Vdc output models)

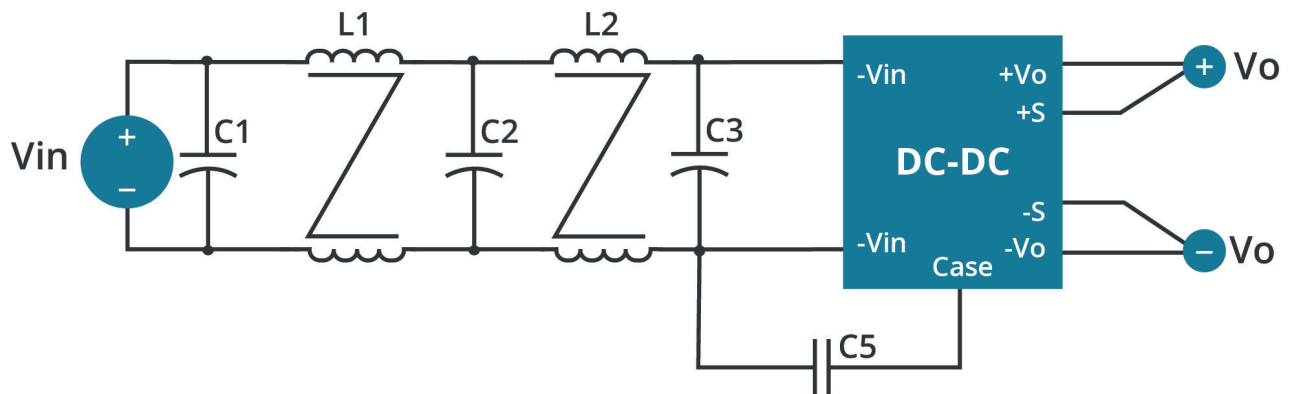
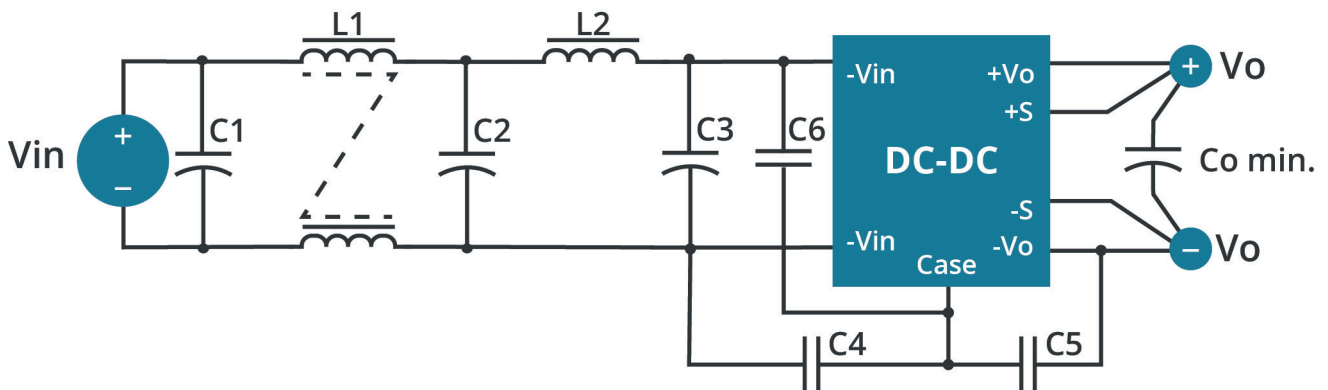


Figure 6
Recommended Circuit for EN55022 Class B
 (for all 48 Vdc output models)



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 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 ¹	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 ¹	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

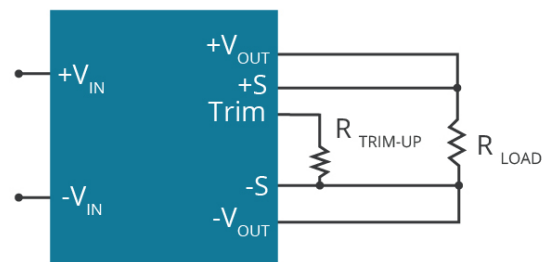
APPLICATION NOTES

1. Output Voltage Trimming

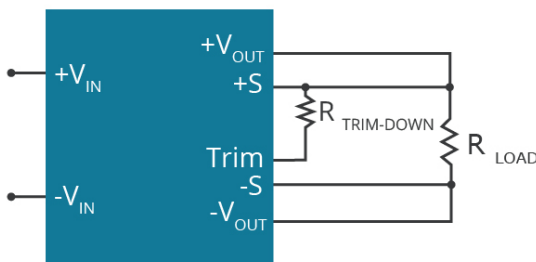
Leave open if not used.

Figure 7

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

V_{NOM}	R_{TOP}	R_{BOTTOM}	R_O	V_{REF}	V_F
(Vdc)	(k Ω)	(k Ω)	(k Ω)	(V)	(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: Value for R_{TOP} , R_{BOTTOM} , R_O , V_{REF} , and V_F refer to Table 4 (fixed internal values).
 R_{TRIM} : Trim resistance
 a: User-defined parameter, no actual meanings
 V_{NOM} : Nominal output voltage
 V_{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	company logo updated	02/08/2021
1.03	derating curve and circuit figures updated	08/31/2021
1.04	output voltage trimming updated	05/30/2023

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



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