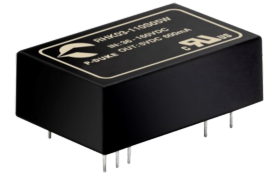


3 Watts

- EN50155 for Rail Applications
- Wide 4:1 36-160V input
- EN50121-3-2 Class A Emissions for Rail Applications without Additional Components
- Single & dual output
- -40 to 105°C Operation
- Remote on/off and optional 10% output trim
- 3 Year warranty



The wide 4:1 RHK03 series of single and dual output DC/DC converters come in a standard DIP 24 package. Units have a nominal input of 110V, single outputs from 3.3 to 24V and $\pm 5, \pm 12$ and ± 15 . The RHK03 series has both EN50155 and EN50121-3-2 approvals for rail applications. The units operate from -40 to +105°C and come complete with remote on/off function and output trim.

Dimensions:

1.25 x 0.8 x 0.42" (31.8 x 20.3 x 10.6mm)

Models & Ratings

Model Number ⁽¹⁾	Input Voltage	Output Voltage	Output Current	No Load Current	Efficiency	Maximum Capacitive Load
RHK03-110S3P3W	36-160V	3.3V	1000mA	3mA	80%	1050uF
RHK03-110S05W		5V	600mA	3mA	81.5%	750uF
RHK03-110S12W		12V	250mA	3mA	84.5%	130uF
RHK03-110S15W		15V	200mA	3mA	84%	100uF
RHK03-110S24W		24V	125mA	3mA	85%	39uF
RHK03-110D05W		$\pm 5V$	$\pm 300mA$	3mA	81%	$\pm 430uF$
RHK03-110D12W		$\pm 12V$	$\pm 125mA$	3mA	85%	$\pm 75uF$
RHK03-110D15W		$\pm 15V$	$\pm 100mA$	3mA	85%	$\pm 56uF$

Notes

1. For trim option add -T
2. Series diode or mosfet required for reverse polarity protection
3. Input fuse required 0.315A slow blow

Input

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Input voltage range	36	110	160	VDC	
Start up voltage			36	VDC	
Shut down voltage	32	34	35.8	VDC	
Startup time		30	60	ms	Power up and remote on off
Input filter					Pi type
Input surge voltage			200	VDC	1s max
Remote ON/OFF Positive logic	3		12	VDC	Or open for ON
	0		1.2		Or short for OFF
Control pin current	-0.5		0.5	mA	
Remote off input current		2.5		mA	

General

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency	80		85	%	See Model & Ratings table
Isolation	3000			VDC	Input to output
Isolation resistance	1000			M Ohm	At 500VDC
Isolation capacitance			1000	pF	
Switching frequency	215	240	265	kHz	
Power density		7.14		W/In ³	
MTBF		5.069		MHrs	As per MIL-HDBK-217F, 25°C GB
Weight			14	g	
Case & base material	Non conductive black plastic				
Potting material	Silicone (UL94 V-0)				
Safety approvals	IEC/ EN/ UL 62368-1 (UL: E193009)				
Standards	EN61375, MIL-STD-810F, EN50155, EN45545-2, EN55032 level A (with components B), EN50121-3-2				

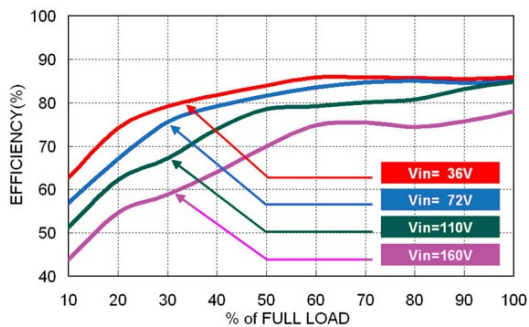
Output

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Output voltage	3.3		24	VDC	See Model & Ratings table
Set point accuracy			±1	%	
Line regulation	±0.2		±0.5	%	Low line to High line. ±0.5 for dual outputs
Load regulation	±0.2		±1	%	0 to 100% load change ±1 for dual outputs
Output voltage adjustability	-10		+10	%	3.3V, 5V, 12V models
	-10		+20	%	15V and 24V output models
	-10		+10	%	Dual output models
Ripple & Noise (20MHz bandwidth)		50		mV pk-pk	3.3V, 5V -10uF/25V X7R MLCC
		75			12/15V -10uF/25V X7R MLCC
		75			24V - 4.7uF/50V X7R MLCC
Overvoltage protection	3.7		5	V	3.3V
	5.6		7	V	5V
	13.5		16	V	12V
	18.3		22	V	15V
	29.1		34.5	V	24V
	5.6		7	V	±5V
	13.5		18.2	V	±12V
	17		22	V	±15V
Overload protection		150		V	Automatic recovery
Short circuit protection					Continuous with automatic recovery
Transient response		250		uS	For a 25% load change

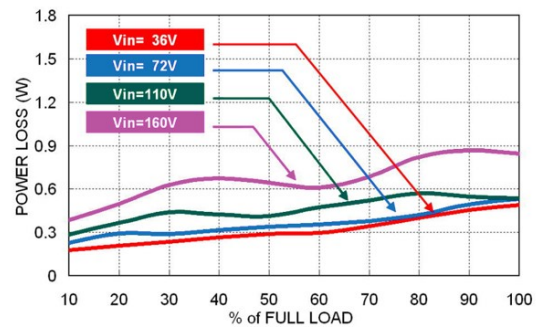
Environmental

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating temperature	-40		105	°C	See de-rating curve
Max case temp			105	°C	Measured in the centre topside
Storage temperature	-55		125	°C	
Thermal impedance		19.22		°C/W	
Humidity	5		95	% RH	Non-condensing
Thermal shock and vibration	EN61373,MIL-STD-810F				
Temperature coefficient	-0.02		+0.02	%/°C	

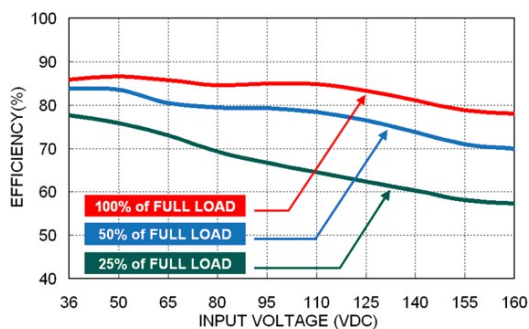
All test conditions are at 25°C. The figures are identical for RHK03-110S24W



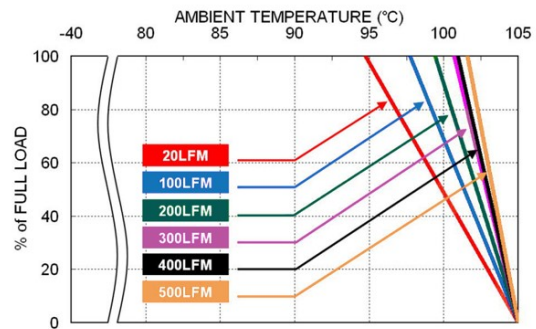
Efficiency Versus Output Load



Power Dissipation Versus Output Load



Efficiency Versus Input Voltage.



Derating Output Load Versus Ambient Temperature and Airflow
Vin(nom)

EMC: Emissions

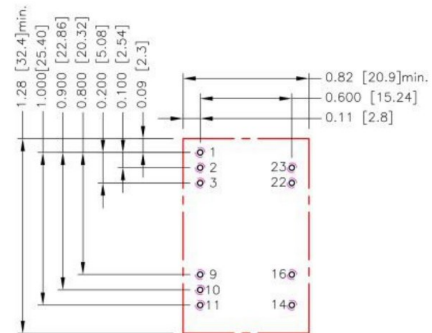
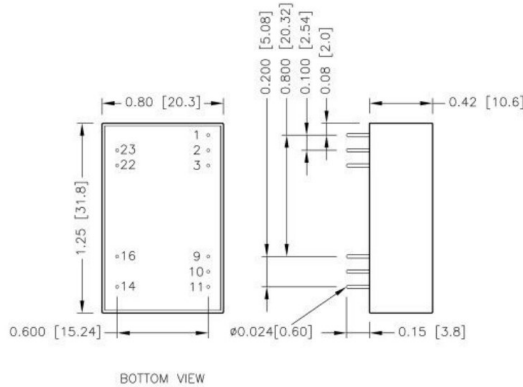
	Standard	Notes & Conditions
Conducted	EN50121-3-2, EN55032 A/B	See application note
Radiated	EN50121-3-2, EN55032 A/B	See application note

EMC: Immunity

	Standard	Criteria	Notes & Conditions
ESD	EN61000-4-2	A	Air ±8kV, Contact ±6kV
Radiated	EN61000-4-3	A	20V/m
EFT/Burst	EN61000-4-4	A	2kV: External input capacitor required: 2x in parallel 220uF/100V and TVS SMBJ220A 220v 600W peak
Surges	EN61000-4-5	A	2kV: External input capacitor required: 2x in parallel 220uF/100V and TVS SMBJ220A 220v 600W peak
Conducted	EN61000-4-6	A	10Vrms
Magnetic fields	EN61000-4-8	A	100A/m continuous. 1000A/m 1 sec

Mechanical Details

Suggested pad layout



Pin	Single	Dual
1	CTRL	CTRL
2	-Vin	-Vin
3	-Vin	-Vin
9	NC	Common
10	Trim (option)	Trim (option)
11	NC	-Vout
14	+Vout	+Vout
16	-Vout	Common
22	+Vin	+Vin
23	+Vin	+Vin

Notes

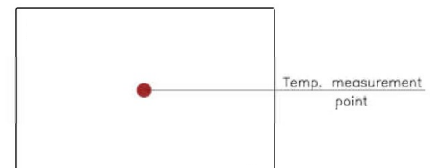
- All dimensions shown in inches [mm]
- Through hole 1,2,3,9,10,11,14,16,22,23 : $\varnothing 0.035$ [0.9]
- Top view pad 1,2,3,9,10,11,14,16,22,23 : $\varnothing 0.044$ [1.13]
- Bottom view pad 1,2,3,9,10,11,14,16,22,23 : $\varnothing 0.07$ [1.8]
- Tolerance 2DP ± 0.02 [1DP ± 0.5]
3DP ± 0.010 [2DP ± 0.25]
Pin dimension ± 0.004 [± 0.1]

Application notes

Thermal Considerations

Sufficient cooling should be provided to ensure reliable operation. Sufficient cooling is monitored by measuring the temperature of the centre point on the bottom of the unit as shown. This temperature should not exceed max case temperature.

Thermal conditions (from which graphs are derived) utilise 20LFM.



Trim

Output voltage trim function allows the user to increase or decrease the output voltage set point. The module may be connected with an external resistor of a minimum of 1/8th power (R_{trim}) between TRIM pin and either +Vout or -Vout.

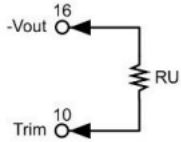
$$\text{Trim up } R_U = \left[\frac{G \times L}{(V_{o,up} - L - K)} - H \right] \Omega$$

$$\text{Trim down } R_D = \left[\frac{(V_{o,down} - L) \times G}{(V_o - V_{o,down})} - H \right] \Omega$$

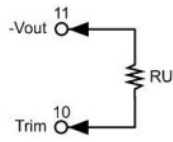
Model	G	H	K	L
RHK03-110S3P3W	5110	2050	0.8	2.5
RHK03-110S05W	5110	2050	2.5	2.5
RHK03-110S12W	10000	5110	9.5	2.5
RHK03-110S15W	10000	5110	12.5	2.5
RHK03-110S24W	56000	13000	21.5	2.5
RHK03-110D05W	3000	3000	7.5	2.5
RHK03-110D12W	56000	13000	21.5	2.5
RHK03-110D15W	30000	13000	27.5	2.5

Trim Tables

Single Output



Dual Output



3V OUTPUT TRIM UP

$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.630	Volts
RU	385.071	191.511	126.990	94.730	75.374	62.470	53.253	46.340	40.963	36.662	kOhms

5V OUTPUT TRIM UP

$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	5.050	5.100	5.150	5.200	5.250	5.300	5.350	5.400	5.450	5.500	Volts
RU	253.450	125.700	83.117	61.825	49.050	40.533	34.450	29.888	26.339	23.500	kOhms

12V OUTPUT TRIM UP

$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	12.120	12.240	12.360	12.480	12.600	12.720	12.840	12.960	13.080	13.200	Volts
RU	203.223	99.057	64.334	46.973	36.557	29.612	24.652	20.932	18.038	15.723	kOhms

15V OUTPUT TRIM UP

$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	15.150	15.300	15.450	15.600	15.750	15.900	16.050	16.200	16.350	16.500	Volts
RU	161.557	78.223	50.446	36.557	28.223	22.668	18.700	15.723	13.409	11.557	kOhms
$\Delta V\%$	11	12	13	14	15	16	17	18	19	20	%
Vout	16.650	16.800	16.950	17.100	17.250	17.400	17.550	17.700	17.850	18.000	Volts
RU	10.042	8.779	7.711	6.795	6.001	5.307	4.694	4.149	3.662	3.223	kOhms

24V OUTPUT TRIM UP

$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	24.240	24.480	24.720	24.960	25.200	25.440	25.680	25.920	26.160	26.400	Volts
RU	570.333	278.667	181.444	132.833	103.667	84.222	70.333	59.917	51.815	45.333	kOhms
$\Delta V\%$	11	12	13	14	15	16	17	18	19	20	%
Vout	26.640	26.880	27.120	27.360	27.600	27.840	28.080	28.320	28.560	28.800	Volts
RU	40.030	35.611	31.872	28.667	25.889	23.458	21.314	19.407	17.702	16.167	kOhms

±5V OUTPUT TRIM UP

$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	±5.050	±5.100	±5.150	±5.200	±5.250	±5.300	±5.350	±5.400	±5.450	±5.500	Volts
RU	72.000	34.500	22.000	15.750	12.00	9.500	7.714	6.375	5.333	4.500	kOhms

±12V OUTPUT TRIM UP

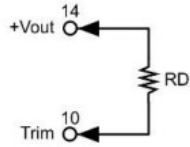
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	±12.120	±12.240	±12.360	±12.480	±12.600	±12.720	±12.840	±12.960	±13.080	±13.200	Volts
RU	570.333	278.667	181.444	132.833	103.667	84.222	70.333	59.917	51.815	45.333	kOhms

±15V OUTPUT TRIM UP

$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	±15.150	±15.300	±15.450	±15.600	±15.750	±15.900	±16.050	±16.200	±16.350	±16.500	Volts
RU	237.000	112.000	70.333	49.500	37.000	28.667	22.714	18.250	14.778	12.000	kOhms

Trim Tables

Trim down. Single & Dual output



3V OUTPUT TRIM DOWN											
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.970	Volts
RD	116.719	54.779	34.133	23.810	17.616	13.486	10.537	8.325	6.604	5.228	kOhms
5V OUTPUT TRIM DOWN											
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	4.950	4.900	4.850	4.800	4.750	4.700	4.650	4.600	4.550	4.500	Volts
RD	248.340	120.590	78.007	56.715	43.940	35.423	29.340	24.778	21.229	18.390	kOhms
12V OUTPUT TRIM DOWN											
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	11.880	11.760	11.640	11.520	11.400	11.280	11.160	11.040	10.920	10.800	Volts
RD	776.557	380.723	248.779	182.807	143.223	116.834	97.985	83.848	72.853	64.057	kOhms
15V OUTPUT TRIM DOWN											
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	14.850	14.700	14.550	14.400	14.250	14.100	13.950	13.800	13.650	13.500	Volts
RD	818.223	401.557	262.668	193.223	151.557	123.779	103.938	89.057	77.483	68.223	kOhms
24V OUTPUT TRIM DOWN											
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	23.760	23.520	23.280	23.040	22.800	22.560	22.320	22.080	21.840	21.600	Volts
RD	4947.667	2439.333	1603.222	1185.167	934.333	767.111	647.667	558.083	488.407	432.667	kOhms
$\pm 5V$ OUTPUT TRIM DOWN											
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	± 4.950	± 4.900	± 4.850	± 4.800	± 4.750	± 4.700	± 4.650	± 4.600	± 4.550	± 4.500	Volts
RD	219.000	106.500	69.000	50.250	39.000	31.500	26.143	22.125	19.000	16.500	kOhms
$\pm 12V$ OUTPUT TRIM DOWN											
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	± 11.880	± 11.760	± 11.640	± 11.520	± 11.400	± 11.280	± 11.160	± 11.040	± 10.920	± 10.800	Volts
RD	4947.667	2439.333	1603.222	1185.167	934.333	767.111	647.667	558.083	488.407	432.667	kOhms
$\pm 15V$ OUTPUT TRIM DOWN											
$\Delta V\%$	1	2	3	4	5	6	7	8	9	10	%
Vout	± 14.850	± 14.700	± 14.550	± 14.400	± 14.250	± 14.100	± 13.950	± 13.800	± 13.650	± 13.500	Volts
RD	2707.000	1332.000	873.667	644.500	507.000	415.333	349.857	300.750	262.556	232.000	kOhms