



# P-DUKE POWER

## RHK10W Series

DC-DC Converter  
Up to 10 Watts

**3**  
YEARS  
WARRANTY

ROHS  
COMPLIANT

REACH  
COMPLIANT



Railway



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Charger



Medical



PV



**3000 VAC**  
Reinforced  
Insulation

**4 : 1**  
Wide  
Input  
Range

Internal  
EN55032  
Class  
**A**  
Filter

**LOW**  
Standby  
Power

**NO**  
Min. Load  
Required

**REMOTE  
ON  
OFF**

**OCP**

**OVP**

**SCP**

**UVP**

### PART NUMBER STRUCTURE

Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Input Range	Trim Options
RHK10 - 110 S 05 W - T	110:36~160	S:Single	3P3:3.3 05:5 5P1:5.1 12:12 15:15 24:24	4:1	□:No pin T:Trim
		D: Dual	05:±5 12:±12 15:±15		

**TECHNICAL SPECIFICATION** All specifications are typical at nominal input, full load and 25°C unless otherwise noted

Model Number	Input Range	Output Voltage	Output Current @ Full Load	Input Current @ No Load	Efficiency	Maximum Capacitor Load
	VDC	VDC	mA	mA	%	µF
RHK10-110S3P3W	36~160	3.3	2500	6	83	3000
RHK10-110S05W	36~160	5	2000	6	87	2500
RHK10-110S5P1W	36~160	5.1	2000	6	87	2500
RHK10-110S12W	36~160	12	830	6	87.5	430
RHK10-110S15W	36~160	15	670	6	88	350
RHK10-110S24W	36~160	24	416	6	87.5	125
RHK10-110D05W	36~160	±5	±1000	6	84	±1440
RHK10-110D12W	36~160	±12	±416	6	87	±250
RHK10-110D15W	36~160	±15	±333	6	87	±180

INPUT SPECIFICATIONS						
Parameter	Conditions		Min.	Typ.	Max.	Unit
Operating input voltage range	110Vin(nom)		36	110	160	VDC
Start up voltage	110Vin(nom)					36 VDC
Shutdown voltage	110Vin(nom)		32	34	35.8	VDC
Start up time	Constant resistive load	Power up				30 60 ms
		Remote ON/OFF				30 60 ms
Input surge voltage	1 second, max	110Vin(nom)				200 VDC
Input filter			Pi type			
Remote ON/OFF	Referred to -Vin pin	DC-DC ON	Open or 3 ~ 12VDC			mA
		DC-DC OFF	Short or 0 ~ 1.2VDC			
		Input current of Ctrl pin	-0.5			0.5 mA
		Remote off input current				2.5 mA

OUTPUT SPECIFICATIONS						
Parameter	Conditions		Min.	Typ.	Max.	Unit
Voltage accuracy			-1.0			+1.0 %
Line regulation	Low Line to High Line at Full Load	Single	-0.2			+0.2 %
		Dual	-0.5			+0.5 %
Load regulation	No Load to Full Load	Single	-0.2			+0.2 %
		Dual	-1.0			+1.0 %
Cross regulation	Asymmetrical load 25%/100% FL	Dual	-5.0			+5.0 %
Voltage adjustability	Single output	3.3Vout, 5Vout, 5.1Vout, 12Vout	-10			+10 %
		15Vout, 24Vout	-10			+20 %
	Dual output	±5Vout, ±12Vout, ±15Vout	-10			+10 %
Ripple and noise	Measured by 20MHz bandwidth With a 10µF/25V X7R MLCC	3.3Vout, 5Vout, 5.1Vout				mVp-p
		12Vout, 15Vout	50 75			
		24Vout	75			
Temperature coefficient			-0.02			+0.02 %/°C
Transient response recovery time	25% load step change					250 µs
Over voltage protection	Single	3.3Vout	3.7			5 VDC
		5Vout, 5.1Vout	6			7 VDC
		12Vout	13.5			17 VDC
		15Vout	18.3			22 VDC
		24Vout	29.1			34.5 VDC
	Dual	5Vout	5.6			7 VDC
		12Vout	13.5			18.2 VDC
		15Vout	17			22 VDC
Over load protection	% of lout rated; Hiccup mode					150 %
Short circuit protection			Continuous, automatics recovery			

## GENERAL SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Isolation voltage	1 minute (Reinforced insulation) Input to Output	3000			VAC
Isolation resistance	500VDC	1			GΩ
Isolation capacitance				1000	pF
Switching frequency		270	300	330	kHz
Safety approvals	IEC/ EN/ UL62368-1				UL:E193009 CB:UL(Demko)
Standard approvals	EN50155 EN45545-2				
Case material					Non-conductive black plastic
Base material					Non-conductive black plastic
Potting material					Silicone (UL94 V-0)
Weight					14g (0.48oz)
MTBF	MIL-HDBK-217F, Full load				1.648 x 10 <sup>6</sup> hrs

## ENVIRONMENTAL SPECIFICATIONS

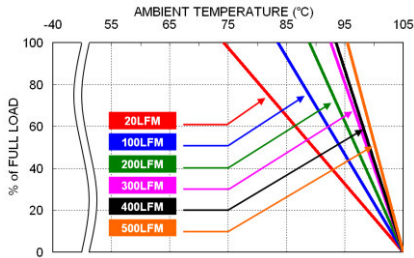
Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating ambient temperature	With derating	-40		+105	°C
Maximum case temperature				105	°C
Storage temperature range		-55		+125	°C
Thermal impedance	Natural convection		18.31		°C/W
Thermal shock					MIL-STD-810F
Shock					EN61373, MIL-STD-810F
Vibration					EN61373, MIL-STD-810F
Relative humidity					5% to 95% RH

## EMC SPECIFICATIONS

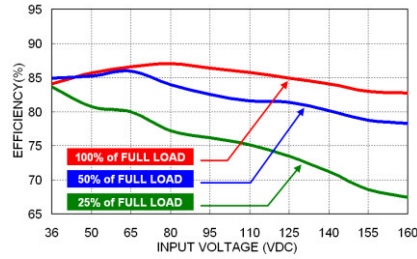
Parameter	Conditions	Level
EMI	EN55032, EN50121-3-2 Without external component With external components	Class A Class B
EMS	EN55035, EN50121-3-2	
ESD	EN61000-4-2 Air ± 8kV and Contact ± 6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3 20 V/m	Perf. Criteria A
Fast transient	EN61000-4-4 ±2kV	Perf. Criteria A
	RHK10-110□□□W With 2 pcs of aluminum electrolytic capacitor (Nippon chemi-con KXJ series, 220μF/200V) and a TVS (SMBJ220A, 220V, 600Watt peak pulse power) in parallel	
Surge	EN61000-4-5 ±2kV	Perf. Criteria A
	RHK10-110□□□W With 2 pcs of aluminum electrolytic capacitor (Nippon chemi-con KXJ series, 220μF/200V) and a TVS (SMBJ220A, 220V, 600Watt peak pulse power) in parallel	
Conducted immunity	EN61000-4-6 10 Vr.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8 100A/m continuous; 1000A/m 1 second	Perf. Criteria A

**CAUTION:** This power module is not internally fused. An input line fuse must always be used.

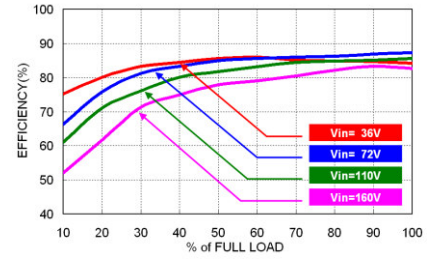
## CHARACTERISTIC CURVE



RHK10-110S05W Derating Curve



RHK10-110S05W Efficiency vs. Input Voltage



RHK10-110S05W Efficiency vs. Output Load

## FUSE CONSIDERATION

This power module is not internally fused. An input line fuse must always be used.

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture.

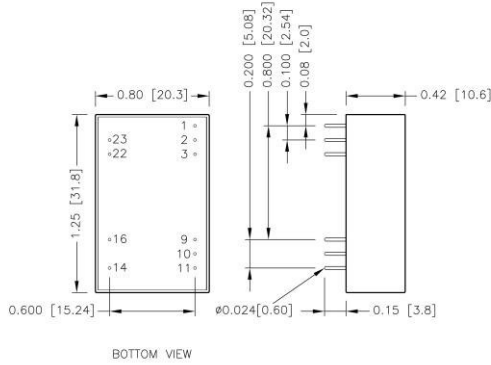
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below :

Model	Fuse Rating (A)	Fuse Type
RHK10-110□□□W	0.63	Slow-Blow

The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.

**MECHANICAL DRAWING**

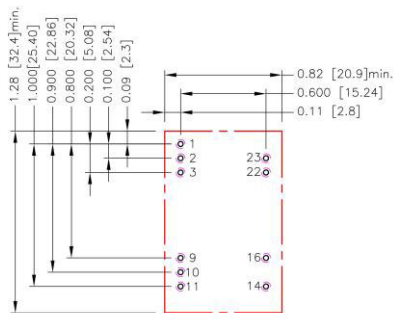


**PIN CONNECTION**

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

1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5]  
x.xxx±0.010 [x.xx±0.25]
3. Pin dimension tolerance ±0.004[0.10]

**RECOMMENDED PAD LAYOUT**

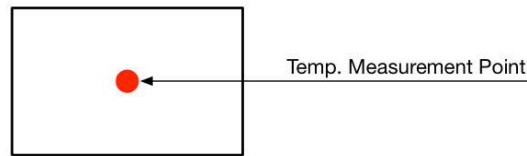


- All dimensions in inch[mm]  
 Pad size(lead free recommended)  
 Through hole 1.2.3.9.10.11.14.16.22.23:  $\Phi 0.035[0.90]$   
 Top view pad 1.2.3.9.10.11.14.16.22.23:  $\Phi 0.044[1.13]$   
 Bottom view pad 1.2.3.9.10.11.14.16.22.23:  $\Phi 0.071[1.80]$

## THEMAL CONSIDERATIONS

The power module operates in a variety of thermal environments. However, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by measuring the point as the figure below. The temperature at this location should not exceed "Maximum case temperature". When operating, adequate cooling must be provided to maintain the test point temperature at or below "Maximum case temperature". You can limit this temperature to a lower value for extremely high reliability.

- Thermal test condition with vertical direction by natural convection (20LFM).



TOP VIEW

## OUTPUT VOLTAGE ADJUSTMENT

It allows the user to increase or decrease the output voltage of the module. This is accomplished by connecting an external resistor between the Trim pin and either the +Vout or -Vout pins. With an external resistor between the Trim and -Output pin, the output voltage increases. With an external resistor between the Trim and +Output pin, the output voltage decreases. The external Trim resistor needs to be at least 1/16W of rated power.

### Trim Up Equation

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

### Trim Down Equation

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

### Trim constants

Module	G	H	K	L
RHK10-110S3P3W	5110	2050	0.8	2.5
RHK10-110S05W	5110	2050	2.5	2.5
RHK10-110S5P1W	5110	2050	2.6	2.5
RHK10-110S12W	10000	5110	9.5	2.5
RHK10-110S15W	10000	5110	12.5	2.5
RHK10-110S24W	56000	13000	21.5	2.5

Module	G	H	K	L
RHK10-110D05W	3000	3000	7.5	2.5
RHK10-110D12W	56000	13000	21.5	2.5
RHK10-110D15W	30000	13000	27.5	2.5

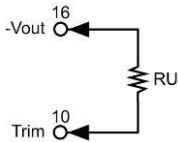
## OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)

### EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below.

#### Trim-up

#### Single Output



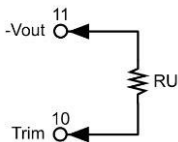
#### 110S3P3W

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

#### 110S05W

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

#### Dual Output



#### 110S5P1W

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	5.151	5.202	5.253	5.304	5.355	5.406	5.457	5.508	5.559	5.610
RU (k $\Omega$ )	248.440	123.195	81.447	60.573	48.048	39.698	33.734	29.261	25.782	22.999

#### 110S12W

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

#### 110S15W

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

#### 110S24W

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

#### 110D05W

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	$\pm 5.050$	$\pm 5.100$	$\pm 5.150$	$\pm 5.200$	$\pm 5.250$	$\pm 5.300$	$\pm 5.350$	$\pm 5.400$	$\pm 5.450$	$\pm 5.500$
RU (k $\Omega$ )	72.000	34.500	22.000	15.750	12.000	9.500	7.714	6.375	5.333	4.500

#### 110D12W

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

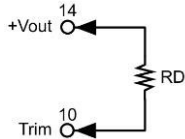
#### 110D15W

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

**OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)**

Trim-down

Single &amp; Dual Output


**110S3P3W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.970
RD (k $\Omega$ )	116.719	54.779	34.133	23.810	17.616	13.486	10.537	8.325	6.604	5.228

**110S05W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	4.950	4.900	4.850	4.800	4.750	4.700	4.650	4.600	4.550	4.500
RD (k $\Omega$ )	248.340	120.590	78.007	56.715	43.940	35.423	29.340	24.778	21.229	18.390

**110S5P1W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	5.049	4.998	4.947	4.899	4.845	4.794	4.743	4.692	4.641	4.590
RD (k $\Omega$ )	253.350	123.095	79.677	57.967	44.942	36.258	30.056	25.404	21.786	18.891

**110S12W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	11.880	11.760	11.640	11.520	11.400	11.280	11.160	11.040	10.920	10.800
RD (k $\Omega$ )	776.557	380.723	248.779	182.807	143.223	116.834	97.985	83.848	72.853	64.057

**110S15W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	14.850	14.700	14.550	14.400	14.250	14.100	13.950	13.800	13.650	13.500
RD (k $\Omega$ )	818.223	401.557	262.668	193.223	151.557	123.779	103.938	89.057	77.483	68.223

**110S24W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	23.760	23.520	23.280	23.040	22.800	22.560	22.320	22.080	21.840	21.600
RD (k $\Omega$ )	4947.667	2439.333	1603.222	1185.167	934.333	767.111	647.667	558.083	488.407	432.667

**110D05W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	$\pm 4.950$	$\pm 4.900$	$\pm 4.850$	$\pm 4.800$	$\pm 4.750$	$\pm 4.700$	$\pm 4.650$	$\pm 4.600$	$\pm 4.550$	$\pm 4.500$
RD (k $\Omega$ )	219.000	106.500	69.000	50.250	39.000	31.500	26.143	22.125	19.000	16.500

**110D12W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	$\pm 11.880$	$\pm 11.760$	$\pm 11.640$	$\pm 11.520$	$\pm 11.400$	$\pm 11.280$	$\pm 11.160$	$\pm 11.040$	$\pm 10.920$	$\pm 10.800$
RD (k $\Omega$ )	4947.667	2439.333	1603.222	1185.167	934.333	767.111	647.667	558.083	488.407	432.667

**110D15W**

$\Delta V$ (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	$\pm 14.850$	$\pm 14.700$	$\pm 14.550$	$\pm 14.400$	$\pm 14.250$	$\pm 14.100$	$\pm 13.950$	$\pm 13.800$	$\pm 13.650$	$\pm 13.500$
RD (k $\Omega$ )	2707.000	1332.000	873.667	644.500	507.000	415.333	349.857	300.750	262.556	232.000