

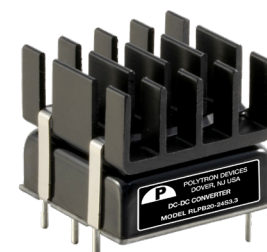


DC-DC CONVERTER

REGULATED, 4:1 WIDE INPUT RANGE UP TO 20 WATTS

RAILWAY APPLICATIONS

RLPB20W SERIES







FEATURES

- 4:1 Wide Input Voltage Range
- Miniature and Low Profile Package:
1.0" × 1.0" × 0.39"
- 3000 VDC Isolation Voltage
- Internal EN50121-3-2 Filter
- Six Sided Shielding
- Low Standby Power
- No Min. Load Required
- Remote ON/OFF
- Over Current Protection
- Over Voltage Protection
- Short Circuit Protection
- Under Voltage Protection
- Over Temperature Protection
- Safety meets UL 62368-1
- CE Mark
- Compliant to RoHS & Reach

SELECTION GUIDE

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

Input Voltage Range Vdc	Output Voltage Vdc	Output Current at Full Load mA	Input Current at No Load mA	Efficiency %	Model Number	Maximum Capacitor Load µF
9 - 36	3.3	5500	10	88	RLPB20-24S3.3	8000
9 - 36	5	4000	10	89	RLPB20-24S5	5000
9 - 36	5.1	4000	10	89	RLPB20-24S5.1	5000
9 - 36	12	1670	7	89	RLPB20-24S12	850
9 - 36	15	1330	7	89	RLPB20-24S15	700
9 - 36	24	833	10	91	RLPB20-24S24	220
18 - 75	3.3	5500	10	89	RLPB20-48S3.3	8000
18 - 75	5	4000	10	90	RLPB20-48S05	5000
18 - 75	5.1	4000	10	90	RLPB20-48S5.1	5000
18 - 75	12	1670	5	89	RLPB20-48S12	850
18 - 75	15	1330	5	90	RLPB20-48S15	700
18 - 75	24	833	8	91	RLPB20-48S24	220
36 - 160	3.3	5500	6	88	RLPB20-110S3.3	8000
36 - 160	5	4000	6	90	RLPB20-110S5	5000
36 - 160	5.1	4000	6	90	RLPB20-110S5.1	5000
36 - 160	12	1670	6	90	RLPB20-110S12	850
36 - 160	15	1330	6	90	RLPB20-110S15	700
36 - 160	24	833	6	91	RLPB20-110S24	220
9 - 36	±12	±833	7	89	RLPB20-24-12	±500
9 - 36	±15	±667	7	90	RLPB20-24-15	±350
9 - 36	±24	±417	12	91	RLPB20-24-24	±100
18 - 75	±12	±833	5	89	RLPB20-48-12	±500
18 - 75	±15	±667	5	90	RLPB20-48-15	±350
18 - 75	±24	±417	10	91	RLPB20-48-24	±100
36 - 160	±12	±833	6	90	RLPB20-110-12	±500
36 - 160	±15	±667	6	90	RLPB20-110-15	±350
36 - 160	±24	±417	6	91	RLPB20-110-24	±100

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Input Specifications		
Operating input voltage range, VDC	9 Min., 24 Typ., 36 Max.	24Vin(nom)
	18 Min., 48 Typ., 75 Max.	48Vin(nom)
	36 Min., 110 Typ., 160 Max.	110Vin(nom)
Start up voltage, Vdc	9 Max.	24Vin(nom)
	18 Max.	48Vin(nom)
	36 Max.	110Vin(nom)
Shutdown voltage, Vdc	7.5 Min., 8 Typ., 8.8 Max.	24Vin(nom)
	15.5 Min., 16 Typ., 17.5 Max.	48Vin(nom)
	32 Min., 34 Typ., 35.5 Max.	110Vin(nom)
Start up time, ms		Constant resistive load
	30 Typ., 40 Max.	Power up
	30 Typ., 40 Max.	Remote ON/OFF
Input surge voltage, Vdc		1 second, max.
	50 Max.	24Vin(nom)
	100 Max.	48Vin(nom)
	185 Max.	110Vin(nom)
Input filter	Pi type	
Remote ON/OFF		Referred to -Vin pin
	Open or 3 - 15 Vdc	Positive logic, DC-DC ON
	Short or 0 - 1.2 Vdc	(Option), DC-DC OFF
	Short or 0 - 1.2 Vdc	Negative logic, DC-DC ON
	Open or 3 - 15 Vdc	(Standard), DC-DC OFF
	-0.5 Min., 1 Max., mA	Input current of Ctrl pin
	2.5 mA Typ.	Remote off input current

Output Specifications		
Voltage accuracy, %	-1.0 Min., +1.0 Max	
Line regulation, %	-0.2 Min., +0.2 Max.	Low Line to High Line at Full Load Single
	-0.5 Min., +0.5 Max.	Dual
Load regulation, %	-0.2 Min., +0.2 Max.	No Load to Full Load, Single
	-1.0 Min., +1.0 Max.	No Load to Full Load, Dual
	-0.1 Min., +0.1 Max.	10% Load to 90% Load, Single
	-0.8 Min., +0.8 Max.	10% Load to 90% Load, Dual
Cross regulation, %	-5.0 Min., +5.0 Max.	Asymmetrical load 25%/100%FL, Dual
Voltage and adjustability, %	-10 Min., +20 Max.	Single Output, 15Vout, 24Vout
	-10 Min., +10 Max.	Others
Ripple and noise, mVp-p		Measured by 20MHz bandwidth
	75 Typ.	Single, With a 22µF/25V X7R MLCC, 3.3Vout, 5Vout, 5.1Vout
	100 Typ.	Single, With a 22µF/25V X7R MLCC, 12Vout, 15Vout
	125 Typ.	Single, With a 4.7µF/50V X7R MLCC, 24Vout
	100 Typ.	Dual, With a 10µF/25V X7R MLCC for each output, 12Vout, 15Vout
	125 Typ.	Dual, With a 4.7µF/50V X7R MLCC for each output, 24Vout
Temperature coefficient, %/°C	-0.02 Min., -0.02 Max.	
Transient response recovery time, µs	250 Typ.	25% load step change
Over voltage protection, Vdc	3.7 Min., 5.4 Max.	3.3Vout
	5.6 Min., 7.0 Max.	5Vout, 5.1Vout
	13.5 Min., 19.6 Max.	12Vout
	16.8 Min., 20.5 Max.	15Vout
	29.1 Min., 32.5 Max.	24Vout
Over load protection, %	170 Typ.	% of lout rated
Short circuit protection	Continuous, automatic recovery	

General Specifications					
Isolation voltage, Vdc	1 minute	Input to Output	3000 Min.		
		Input (Output) to Case	1600 Min.		
Isolation resistance, GΩ	500Vdc		1 Min.		
Isolation capacitance, pF			2000 Max.		
Switching frequency, kHz		3.3Vout, 5Vout	220 Min.	245 Typ.	270 Max.
		Others	270 Min.	300 Typ.	330 Max.

RLPB20 SERIES

Environmental Specifications

Operating ambient temperature, °C	Standard type, with derating	-40 Min.	+105 Max.
	M3 version, with derating	-55 Min.	+105 Max.
Maximum case temperature, °C			105 Max.
Over temperature protection			115 Typ.
Storage temperature range, °C		-55 Min.	+125 Max.
Thermal impedance, °C/W	Without heat-sink		15.5 Typ.
	With heat-sink	HC1	12.3 Typ.
		HC2	10.7 Typ.
		HC3	9.1 Typ.
Thermal shock		MIL-STD-810F	
Shock		EN61373, MIL-STD-810F	
Vibration		EN61373, MIL-STD-810F	
Relative humidity		5% to 95% RH	

Physical Specifications

Design meet safety standard	UL:E193009 CB:UL(Demko)
Case material	Copper
Base material	FR4 PCB
Potting material	Silicone (UL94 V-0)
Weight	16.5g (0.56oz)
MTBF	1.201 x 10 ⁶ hrs

EMC Specifications

Specifications	Conditions	Level	
EMI	EN50121-3-2	Without external components	
	EN55032	With an aluminum electrolytic capacitor	Class A
		Without external components	Class A
		With external components	Class B
ESD	EN61000-4-2	Air ±8kV and Contact ±6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3	20V/m	Perf. Criteria A
Fast transient	EN61000-4-4	±2kV	Perf. Criteria A
	RLPB20-24XXX	With an aluminum electrolytic capacitor a TVS in parallel	
	RLPB20-48XXX	With an aluminum electrolytic capacitor	
	RLPB20-110XXX	With an aluminum electrolytic capacitor a TVS in parallel	
Surge	EN61000-4-5	±1kV	Perf. Criteria A
	RLPB20-24XXX	With an aluminum electrolytic capacitor a TVS in parallel	
	RLPB20-48XXX	With an aluminum electrolytic capacitor	
	RLPB20-110XXX	With an aluminum electrolytic capacitor a TVS 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

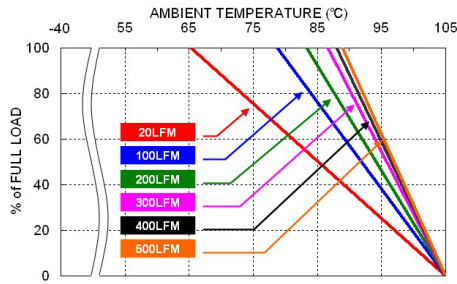
Note:

1. Test by minimum input and constant resistive load.
2. Trimming allows the user to increase or decrease the output voltage set point of the module. This is accomplished by connecting an external resistor between the Trim pin and either the +Vout pin or the -Vout pin.
3. The standard modules meet EN55032 Class A and Class B with external components. For further information, please contact Polytron Devices.

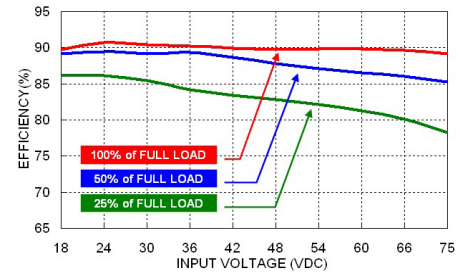
CAUTION: This power module is not internally fused. An input line fuse must always be used.

RLPB20 SERIES

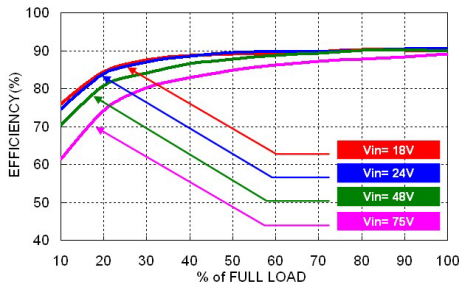
Characteristic Curve



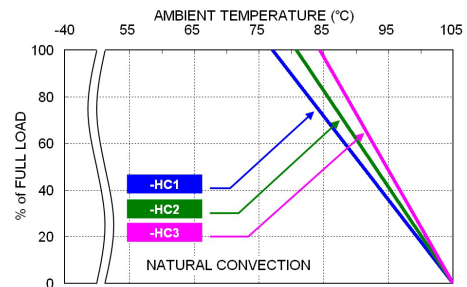
RLPB20-48S05W Derating Curve



RLPB20-48S05W Efficiency vs. Input Voltage



RLPB20-48S05W Efficiency vs. Output Load



RLPB20-48S05W Derating Curve With Heat-sink

Fuse Consideration

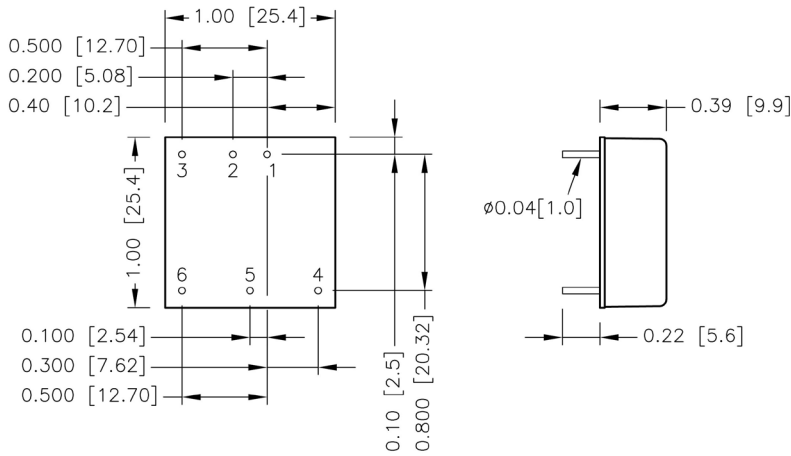
Modules	Fuse Rating (A)	Fuse Type
RLPB20-24XXX	4	Slow-Blow
RLPB20-48XXX	2	Slow-Blow
RLPB20-110XXX	1v	Slow-Blow

Note:

1. This power module is not internally fused. An input line fuse must always be used.
2. 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.
3. To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.
4. The table is based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.

RLPB15 SERIES

Mechanical Drawing



BOTTOM VIEW

PIN CONNECTION

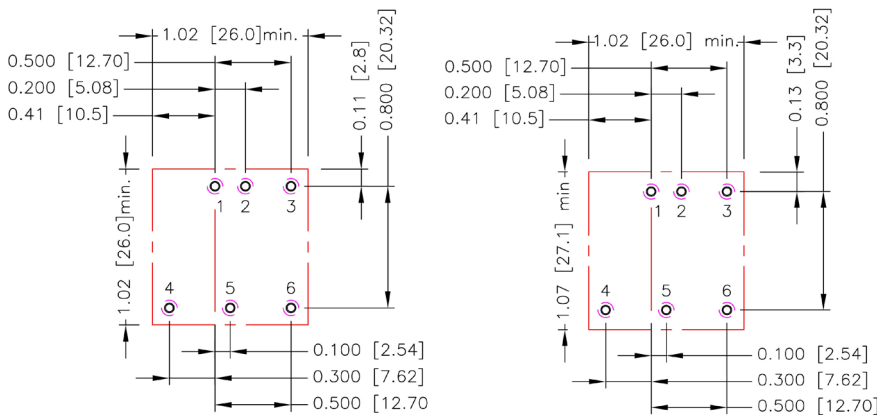
PIN	SINGLE	DUAL
1	+Vin	+Vin
2	-Vin	-Vin
3	Ctrl	Ctrl
4	+Vout	+Vout
5	Trim	Common
6	-Vout	-Vout

1. All dimensions in inch (mm)
2. Tolerance: x.xx±0.02 (x.x±0.5)x.xxx±0.01 (x.xx±0.25)
3. Pin pitch tolerance ±0.01 (0.25)
4. Pin dimension tolerance ±0.004(0.1)

Recommended Pad Layout

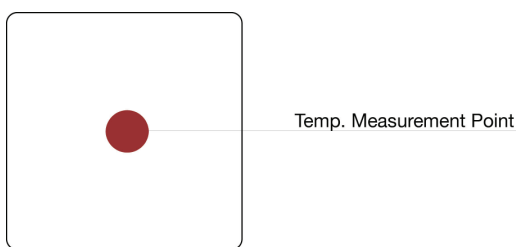
Standard

Heat Sink with clamps (Suffix "HC")



1. All dimensions in inch (mm)
2. Pad size (lead free recommended)
3. Through hole 1, 2, 3, 4, 5, 6: 0.051 (1.30)
4. Top view pad 1, 2, 3, 4, 5, 6: 0.064 (1.63)
5. Bottom view pad 1, 2, 3, 4, 5, 6: 0.102 (2.60)

Thermal Considerations



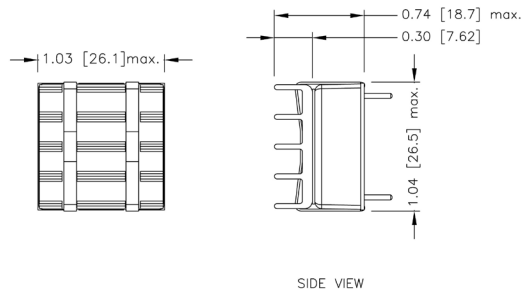
TOP VIEW

1. The power module operates in a variety of thermal environments.
2. Sufficient cooling should be provided to help ensure reliable operation of the unit.
3. Heat is removed by conduction, convection and radiation to the surrounding environment.
4. Proper cooling can be verified by measuring the point.
5. The temperature at this location should not exceed "Maximum case temperature".
6. When operating, adequate cooling must be provided to maintain the test point temperature at or below "Maximum case temperature".
7. You can limit this temperature to a lower value for extremely high reliability.
8. Thermal test condition with vertical direction by natural convection (20LFM).

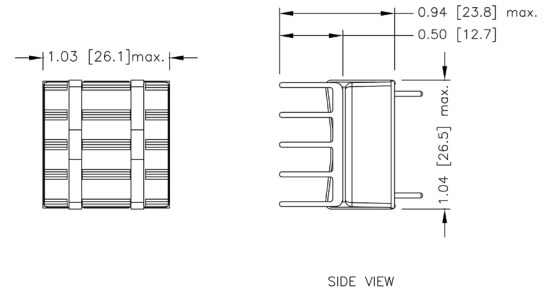
RLPB20 SERIES

Heat-Sink Type Options

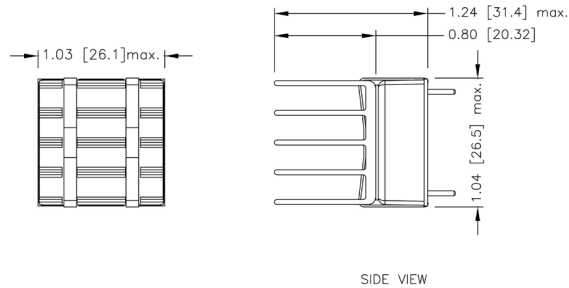
RLPB20-HC1
7GA0117P01-F



RLPB20-HC2
7GA0118P01-F



RLPB20-HC3
7GA0119P01-F



1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5] x.xxx±0.010 [x.xx±0.25]

Output Voltage Adjustment

Trim Up Equation

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

Trim Down Equation

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

1. Output voltage set point adjustment allows the user to increase or decrease the output voltage set point of the module.
2. This is accomplished by connecting an external resistor between the Trim pin and either the +Output or -Output pins.
3. With an external resistor between the Trim and -Output pin, the output voltage set point increases.
4. With an external resistor between the Trim and +Output pin, the output voltage set point decreases.
5. The external Trim resistor needs to be at least 0.0625 W of rated power.

TRIM CONSTRAINTS

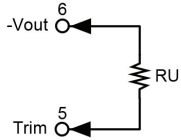
MODULE	G	H	K	L
RLPB20-S3.3	5110	2050	0.8	2.5
RLPB20-S5	5110	2050	2.5	2.5
RLPB20-S5.1	5110	2050	2.6	2.5
RLPB20-S12	10000	5110	9.5	2.5
RLPB20-S15	10000	5110	12.5	2.5
RLPB20-S24	56000	13000	21.5	2.5

RLPB20 SERIES

Output Voltage Adjustment (cont.)

EXTERNAL OUTPUT TRIMMING

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



S3.3

ΔV (%)	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 Ω)	385.071	191.511	126.990	94.730	75.374	62.470	53.253	46.340	40.963	36.662

S5

ΔV (%)	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 Ω)	253.450	125.700	83.117	61.825	49.050	40.533	34.450	29.888	26.339	23.500

S5.1

ΔV (%)	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 Ω)	248.440	123.195	81.447	60.573	48.048	39.698	33.734	29.261	25.782	22.999

S12

ΔV (%)	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 Ω)	203.223	99.057	64.334	46.973	36.557	29.612	24.652	20.932	18.038	15.723

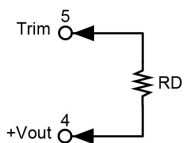
S15

ΔV (%)	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 Ω)	161.557	78.223	50.446	36.557	28.223	22.668	18.700	15.723	13.409	11.557

S24

ΔV (%)	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 Ω)	570.333	278.667	181.444	132.833	103.667	84.222	70.333	59.917	51.815	45.333

ΔV (%)	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 Ω)	40.030	35.611	31.872	28.667	25.889	23.458	21.314	19.407	17.702	16.167



S3.3

ΔV (%)	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 Ω)	116.719	54.779	34.133	23.810	17.616	13.486	10.537	8.325	6.604	5.228

S5

ΔV (%)	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 Ω)	248.340	120.590	78.007	56.715	43.940	35.423	29.340	24.778	21.229	18.390

S5.1

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	5.049	4.998	4.947	4.869	4.845	4.794	4.743	4.692	4.641	4.590
RD (k Ω)	253.350	123.095	79.677	57.968	44.942	36.258	30.056	25.404	21.786	18.891

S12

ΔV (%)	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 Ω)	776.557	380.723	248.779	182.807	143.223	116.834	97.985	83.848	72.853	64.057

S15

ΔV (%)	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 Ω)	818.223	401.557	262.668	193.223	151.557	123.779	103.938	89.057	77.483	68.223

S24

ΔV (%)	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 Ω)	4947.667	2439.333	1603.222	1185.167	934.333	767.111	647.667	558.083	488.407	432.667