POLYTRON DEVICES

DATA SHEET

DC-DC CONVERTERS

4:1 WIDE INPUT RANGE, UP TO 10 WATTS

RAILWAY APPLICATIONS

TRWBH10 SERIES

FEATURES

- 4:1 Wide Input Range
- Single and Dual Output
- 3,000Vac Isolation Voltage
- Low Standby Power
- No Minimum Load Required
- Remote ON/OFF
- Internal EN55032 Class A Filter
- Over Current Protection
- Over Voltage Protection
- Short Circuit Protection
- Under Voltage Protection
- RoHS Compliant
- REACH Compliant
- IEC/EN/UL 62368-1

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*	Capacitor Load max. (µF)
36~160	3.3	2500	6	83	TRWBH10-110S3.3	3000
36~160	5	2000	6	87	TRWBH10-110S5	2500
36~160	5.1	2000	6	87	TRWBH10-110S5.1	2500
36~160	12	830	6	87.5	TRWBH10-110S12	430
36~160	15	670	6	88	TRWBH10-110S15	350
36~160	24	416	6	87.5	TRWBH10-110S24	125
36~160	±5	±1000	6	84	TRWBH10-110-5	±1440
36~160	±12	±416	6	87	TRWBH10-110-12	±250
36~160	±15	±333	6	87	TRWBH10-110-15	±180

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Input Specifications

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

Output Specifications

Voltage accuracy, %	-1 Min., 1 Max.	
Line regulation, %	-0.2 Min., 0.2 Max.	LL to HL at Full Load, Single
	-0.5 Min., 0.5 Max.	Dual
Load regulation, %	-0.5 Min., 0.5 Max.	No Load to Full Load, Single
	-1 Min., 1 Max.	Dual
Cross regulation, %	-5 Min., 5 Max.	Asymmetrical Load 25%/100% FL, Dual
Voltage adjustability, %	-10 Min., 10 Max.	Single Output, 3.3Vout, 5Vout, 5.1Vout, 12Vout
	-10 Min., 20 Max.	15Vout, 24Vout
	-10 Min., 10 Max.	±5Vout, ±12Vout, ±15Vout
Ripple & noise, mVp-p	Measured by 20 MHz bandwidth, with a 10μF/25V X7R MLCC	
	50 Typ.	3.3Vout, 5Vout, 5.1Vout
	75 Typ.	12Vout, 15Vout
	with a 4.7μF/50V X7R MLCC	
	75 Typ.	24 Vout
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 Max.	Single, 3.3Vout
	6 Min., 7 Max.	Single, 5Vout, 5.1Vout
	13.5 Min., 16 Max.	Single, 12Vout
	18.3 Min., 22 Max.	Single, 15Vout
	29.1 Min., 34.5 Max.	Single, 24Vout
	5.6 Min., 7 Max.	Dual, 5Vout
	13.5 Min., 18.2 Max.	Dual, 12Vout
	17 Min., 22 Max.	Dual, 15Vout
Over Load Protection, %	Percent of Iout rated, Hiccup mode: 150 Typ.	
Short Circuit Protection	Continuous, automatic recovery	

General Specifications

Isolation voltage, Vdc	1 minute (reinforced insulation)	Input to Output	3,000 Min.		
Isolation resistance, GΩ		500Vdc	1 Min.		
Isolation capacitance, pF					1,000 Max.
Switching frequency, kHz			270 Min.	300 Typ.	330 Max.

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TRWBH10 SERIES

Environmental Specifications

Operating ambient temperature, ºC	With derating	-40 Min.		+105 Max.
Maximum case temperature, ºC				+105 Max.
Storage temperature range, ºC		-55 Min.		+125 Max.
Thermal impedance(1), ºC/W	Natural Convection, Without Heat-sink		18.31 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	IEC/ EN/ UL62368-1, EN50155, EN45545-2, UL:E193009
Case material	Non-conductive black plastic
Base material	Non-conductive black plastic
Potting material	Silicon (UL94 V-0)
Weight	14g (0.48oz)
Dimensions, in.	1.25 x 0.8 x 0.42 (31.8 x 20.3 x 10.6 mm)
MTBF	MIL-HDBK-217F, Full load, 1.648 x 10^6 hrs

EMC Specifications

Specifications	Conditions		Level
EMI	EN55032, EN50121-3-2	Without external components	Class A
		With external components	Class B
EMS	EN55024, EN50121-3-2		
ESD	EN61000-4-2	Air ±8kV and Contact ±6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3	20V/m	Perf. Criteria A
Fast transient(1)	EN61000-4-4	±2kV	Perf. Criteria A
Surge(1)	EN61000-4-5	±2kV	Perf. Criteria A
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

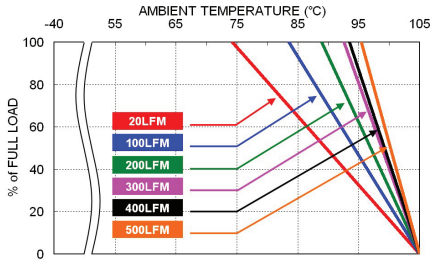
Note:

1. The TRWBH-110 recommended 2 pcs of aluminum electrolytic capacitor (Nippon chemi-con KY series, 220µF/200V) and a TVS (SMDJ220A, 220V, 600Watt peak pulse power) in parallel.

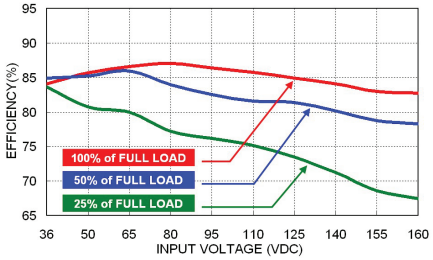
CAUTION: This power module is not internally fused. An input line fuse must always be used.

TRWBH10 SERIES

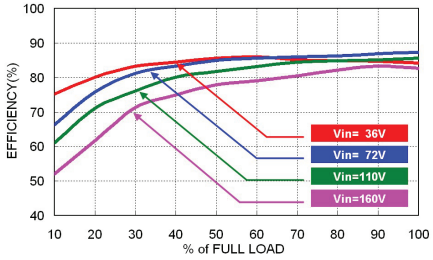
Characteristic Curve



TRWBH10-110S5 Derating Curve



TRWBH10-110S5 Efficiency vs. Input Voltage



TRWBH10-110S5 Efficiency vs. Output Load

Fuse Consideration

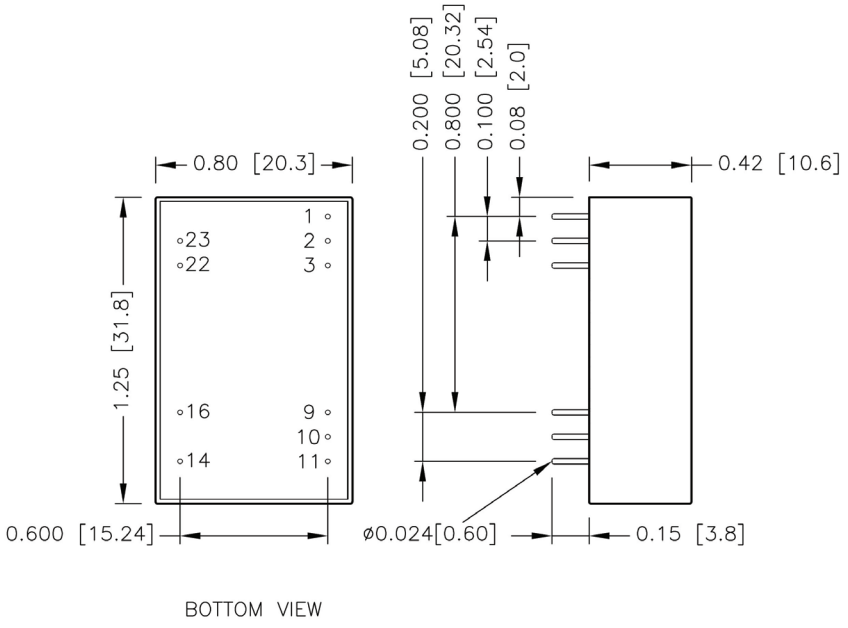
Model	Fuse Rating (A)	Fuse Type
TRWBH10-110XXX	0.63	Slow-Blow

Note:

1. 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.
2. To maximimum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

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

Mechanical Drawing



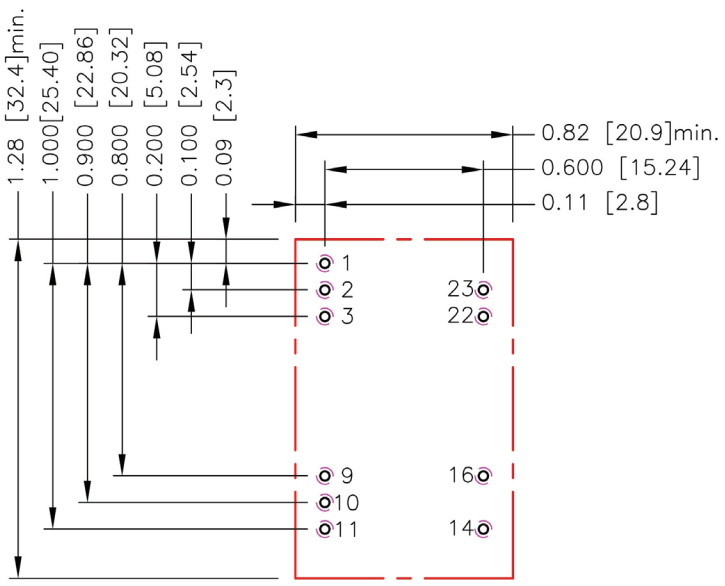
BOTTOM VIEW

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±0.01 (x.xx±0.25)**
3. **Pin pitch tolerance ±0.01 (0.25)**
4. **Pin dimension tolerance ±0.004(0.1)**

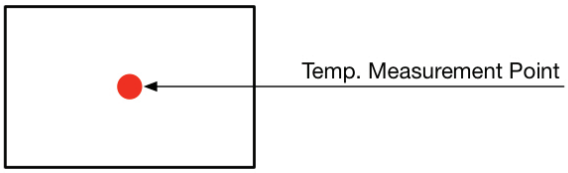
Recommended Pad Layout



1. **All dimensions in inch[mm]**
2. **Pad size(lead free recommended)**
3. **Through hole 1.2.3.9.10.11.14.16.22.23: Φ0.035[0.90]**
4. **Top view pad 1.2.3.9.10.11.14.16.22.23: Φ0.044[1.13]**
5. **Bottom view pad 1.2.3.9.10.11.14.16.22.23: Φ0.071[1.80]**

Thermal Considerations

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



1. The power module operates in a variety of thermal environments.
2. However, 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 as the figure below.
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”. You can limit this Temperature to a lower value for extremely high reliability.

Output Voltage Adjustment

EXTERNAL OUTPUT TRIMMING

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

1. 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.
2. With an external resistor between the Trim and -Vout pin, the output voltage increases.
3. With an external resistor between the Trim and +Vout pin, the output voltage decreases.
4. The external Trim resistor needs to be at least 1/8W of rated power.

■ **Trim Up Equation**

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

■ **Trim Down Equation**

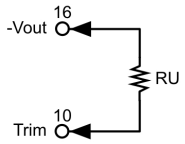
$$R_D = \left[\frac{(V_{o,down} - L) \times G}{(V_o - V_{o,down})} - H\right] \Omega$$

TRIM CONSTANTS

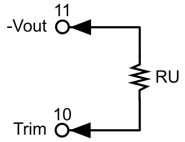
Module	G	H	K	L
TRWBH10-110S.3	5,110	2,050	0.8	2.5
TRWBH10-110S5	5,110	2,050	2.5	2.5
TRWBH10-110S5.1	5,110	2,050	2.6	2.5
TRWBH10-110S12	10,000	5,110	9.5	2.5
TRWBH10-110S15	10,000	5,110	12.5	2.5
TRWBH10-110S24	56,000	13,000	21.5	2.5
TRWBH10-110-05	3,000	3,000	7.5	2.5
TRWBH10-110-12	56,000	13,000	21.5	2.5
TRWBH10-110-15	30,000	13,000	27.5	2.5

Trim Up

Single Output



Dual Output



110S3.3

Δ 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	(kΩ)	385.071	191.511	126.990	94.730	75.374	62.470	53.253	46.340	40.963	36.662

110S5

Δ 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	(kΩ)	253.450	125.700	83.117	61.825	49.050	40.533	34.450	29.888	26.339	23.500

110S5.1

Δ 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	(kΩ)	248.440	123.195	81.447	60.573	48.048	39.698	33.734	29.261	25.782	22.999

110S12

Δ 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	(kΩ)	203.223	99.057	64.334	46.973	36.557	29.612	24.652	20.932	18.038	15.723

110S15

Δ 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	(kΩ)	161.557	78.223	50.446	36.557	28.223	22.668	18.700	15.723	13.409	11.557

Δ 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	(kΩ)	10.042	8.779	7.711	6.795	6.001	5.307	4.694	4.149	3.662	3.223

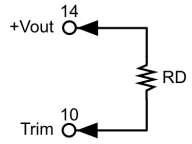
110S24

Δ 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	(kΩ)	570.333	278.667	181.444	132.833	103.667	84.222	70.333	59.917	51.815	45.333

Output Voltage Adjustment (continued)

Trim Down

Single & Dual Output



110S3.3

Δ 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	(kΩ)	116.719	54.779	34.133	23.810	17.616	13.486	10.537	8.325	6.604	5.228

110S5

Δ 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	(kΩ)	248.340	120.590	78.007	56.715	43.940	35.423	29.340	24.778	21.229	18.390

110S5.1

Δ V	(%)	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	(kΩ)	253.350	123.095	79.677	57.967	44.942	36.258	30.056	25.404	21.786	18.891

110S12

Δ 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	(kΩ)	776.557	380.723	248.779	182.807	143.223	116.834	97.985	83.848	72.853	64.057

110S15

Δ 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	(kΩ)	818.223	401.557	262.668	193.223	151.557	123.779	103.938	89.057	77.483	68.223

110S24

Δ 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	(kΩ)	4947.667	2439.333	1603.222	1185.167	934.333	767.111	647.667	558.083	488.407	432.667

110-5

Δ 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	(kΩ)	219.000	106.500	69.000	50.250	39.000	31.500	26.143	22.125	19.000	16.500

110-12

Δ 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	(kΩ)	4947.667	2439.333	1603.222	1185.167	934.333	767.111	647.667	558.083	488.407	432.667

110-15

Δ 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	(kΩ)	2707.000	1332.000	873.667	644.500	507.000	415.333	349.857	300.750	262.556	232.000