Technical Specification

DHB250W110 Series

4:1 Input 1/2nd Brick 250Watts DC/DC Converters

FEATURES

- Wide input range: 66-160VDC
- 250W isolated outputs
- Efficiency up to 91%
- Single output: 24VDC
- Adjustable Vout (±10%)
- Fixed switching frequency, predicted EMI
- Stable @ no-load operation
- Remote On/Off control
- 3KVAC I/O isolation
- Industry standard 1/2nd brick footprint (2.40" × 2.28" × 0.50")
- Extensive self-protection, UVLO, OVP, OTP, OCP and short circuit protection
- Operating temperature range:-40°C to +100°C
- Fully encapsulated, high reliability
- Flexible extra heat-sink mount type
- Compliance with EN 50155 standard

PRODUCT OVERVIEW

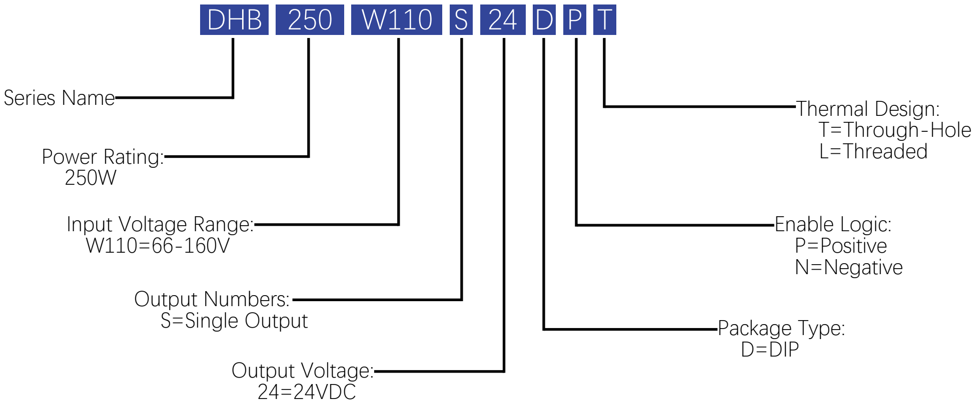
The DHB250W110 series use advanced power processing, control and packaging technologies to provide the high performance, flexibility, reliability and cost effectiveness of a mature power converter. Wide range input of 66-160V (110V nominal) that complies with the European EN50155 standard for electronic equipment used on railway rolling stock. Fully encapsulated package technology provides outstanding thermal, vibration & shock performance, is ideal for railway applications where power modules must meet rugged environment requirements.

A wealth of self-protection features included input undervoltage lockout, over temperature shutdown, over current protection with "hiccup" autorestart technique, provides indefinite short-circuit protection, along with output OVP. Threaded or through holes are provided to allow easy mount or the addition of a heat sink for extended temperature operation. The operation temperature is -40°C to 100°C, the module delivers full output power @ 100°C case temperature.

The DHB250W110 series are designed to railway standards EN 50155.

Models Selections							
Basic Models	Input Voltage [VDC]	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [A]	Efficiency typ. [%]	Capacitive Load Max [µF]	Package [inch]
DHB250W110S24	110	66-160	24	10.4	91	4000	2.40×2.28×0.50

Model Numbering



Absolute Maximum Ratings					
Parameters	Conditions	Min.	Typ.	Max.	Units
Input Voltage Continuous		-0.7		160	VDC
Input Voltage Transient	＜ 100ms			180	VDC
On/Off Remote Control Voltage	Referred to -Vin	0		75	VDC
On/Off Remote Control Current	Referred to -Vin	0	0.25	1	mA
Operating Baseplate Temperature		-40		100	°C
Operating Environment Temperature		-40		85	°C
Storage Temperature Range		-55		125	°C
Soldering Temperature	Wave Soldering ＜ 10s			260	°C

Safety and EMC Compliance		
Conducted Emission	EN50121-3-2	With external filter
Radiated Emission	EN50121-3-2	With external filter
Conducted Susceptibility	IEC/EN61000-4-6	10Vrms Criteria A
Radiated Susceptibility	IEC/EN61000-4-3	10V/m Criteria A
EFT	IEC/EN61000-4-4	±2KV Criteria A (With external filter)
Surge	IEC/EN61000-4-5	±2KV Criteria A (With external filter)
ESD	IEC/EN61000-4-2	±6KV Contact ±8KV Air Criteria A

General Specifications

Parameters	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	Input to output		3000		VAC
	Input to case		1500		VAC
	Output to case		1500		VAC
Isolation Resistance (Viso=500VDC)	Input to output	100			MΩ
	Input to case	100			MΩ
	Output to case	100			MΩ
Isolation Capacitance	Input to output		2200		pF
Isolation Safety Rating	Basic insulation				
Switching Frequency			260		KHz
Start-up Delay	From start-up threshold recover to 10% Vout		30	60	mS
Rise Time	From 10% Vout to 90% Vout capacitive load		26	50	mS
Remote On/Off Control	Positive Logic, ON state	Open or 3 ≤ Vr ≤ 75			VDC
	Positive Logic, OFF state	Short or 0 ≤ Vr ≤ 1.2			VDC
	Negative Logic, ON state	Short or 0 ≤ Vr ≤ 1.2			VDC
	Negative Logic, OFF state	Open or 3 ≤ Vr ≤ 75			VDC
Remote Control Current		0	0.25	1	mA
Vibration	IEC61373:1999 Category I, Class B, Body mounted				
Shock	IEC61373:1999 Category I, Class B, Body mounted				

Input Specifications

Parameters	Conditions	Min.	Typ.	Max.	Units
Operating Voltage Range		66	110	160	VDC
Start-up Threshold		62	64	66	VDC
Under Voltage Shutdown		58	60	62	VDC
Input Over Voltage Protection		170	178	185	VDC
Input Over Voltage Recover		162	170	178	VDC
Input Current @ No Load			30	100	mA
Input Current @ Min. Line	Vin=min.line, Iout=full load			4.5	A
Input Current @ Shutdown Mode			15	50	mA
Reflect Ripple Current (Peak-Peak)	Measured at input pin with 10μH inductor and 100μF capacitance		180	240	mA
Recommended Input Fuse			9		A
Recommended External Input Capacitance	1μF CBB and 100μF E-cap used in combination		100		μF

Performance Data (24 Vout)

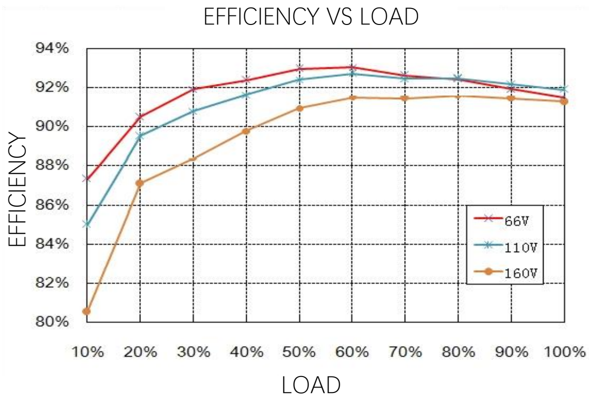
Output Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Power				250	W
Output Voltage Setpoint	Nom.line, 50% Load	23.64	24.00	24.36	V
Vout Accuracy		-1.5		+1.5	% of Vout
Adjustable Range	Trim up/ Trim down	-10		+10	% of Vout
Line Regulation		-0.2		+0.2	%
Load Regulation		-0.5		+0.5	%
Temperature Coefficient		-0.02		+0.02	% of Vout /°C
Total Regulation		-3		+3	%
Thermal Shutdown		100	105	115	°C
Over Voltage Protection	Hiccup	115		140	% of Vout
Over Current Protection	Hiccup	110		160	% of Iout
Short Circuit Protection	Hiccup				
Remote Sense Voltage				10	%
Ripple & Noise Max.①				240	mV pk-pk
Dynamic Load Peak Deviation②		-5		+5	% of Vout
Dynamic Load Response				500	μS
Capacitive Load		100		4000	μF
Minimum Load	No minimum load requirement				

Notes
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 8 for more details.
② The load is set from 75%-100%-75% of Imax, di/dt=2.5A/μS, Cout=100μF, please refer to dynamic waveforms in performance data on page 5 for details.

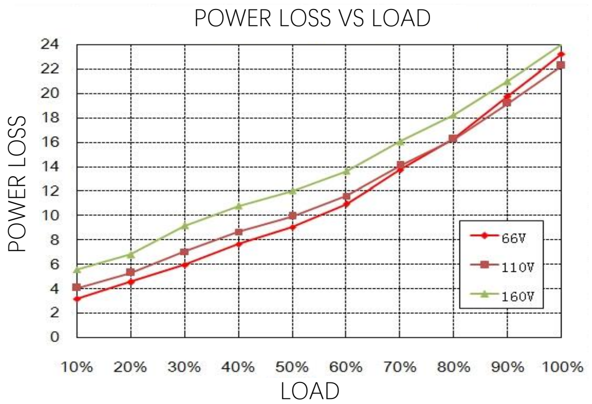
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

Performance Data (24 Vout)

EFFICIENCY VS LOAD

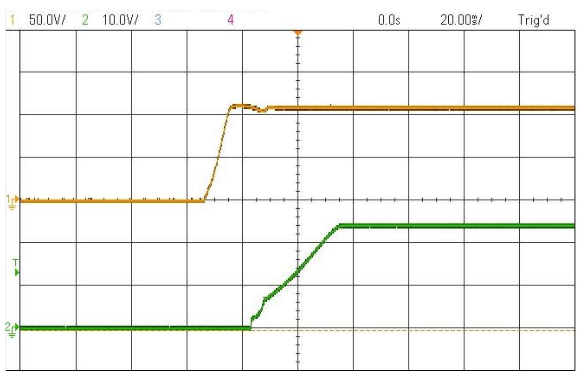


POWER LOSS VS LOAD



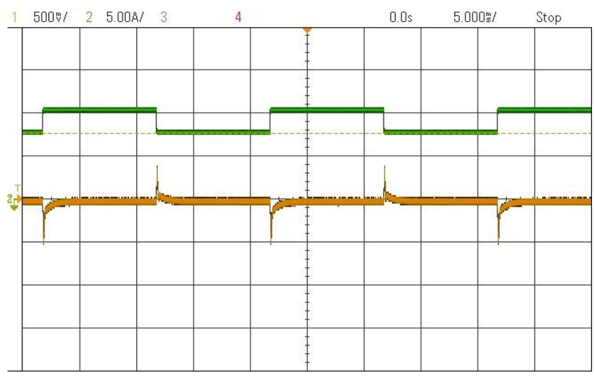
START UP

Ch1: Vin Ch2: Vout



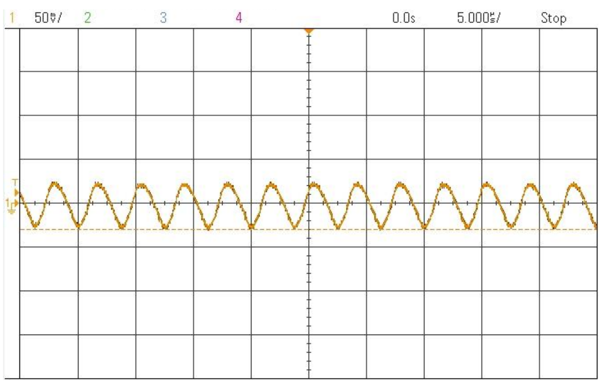
DYNAMIC RESPONSE Ch1: Vout Ch2: Iout

50%~75%~50% of I_{max}, di/dt=2.5A/μs

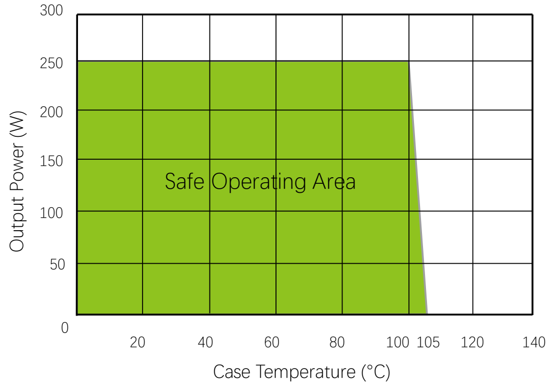


RIPPLE & NOISE 20MHz BANDWIDTH

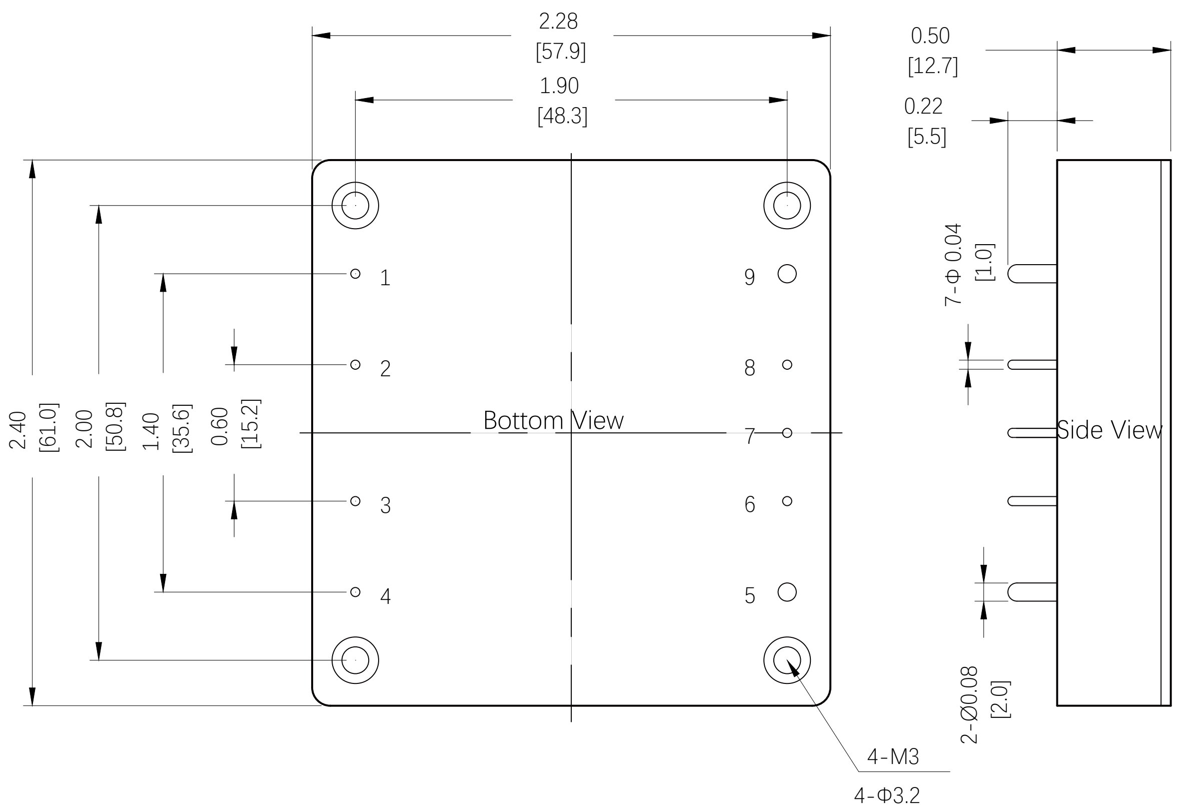
Ch1: Vout



THERMAL DERATING



Mechanical Specifications



PIN:
PIN1, PIN2, PIN3, PIN4 PIN6, PIN7, PIN8: Φ0.04inch
Force: Applied force not exceed 4.9N
PIN5, PIN9 : Φ0.08inch
Force: Applied force not exceed 9.8N
Material: Copper alloy
Finish: Gold 3 ~ 5µm(min.) over nickel 50µm(Min.)

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

Dimensions are in inches [mm]
Weight: ~115g.

PIN CONNECTIONS	
Single Output	
Pin	Function
1	-Vin
2	NC
3	RC
4	+Vin
5	+Vout
6	+Sense
7	TRIM
8	-Sense
9	-Vout

Technical Notes

INPUT FUSING

Certain applications may require fuse at the inputs of power conversion components. Fuses should also be used when there is possibility of sustained input voltage reversal which is not current limited. The DHB250W110 modules are not internally fused. We strongly recommend a slow-blown fuse to be used in the ungrounded input supply line.
For safety agency approvals, the installer must install the converter in compliance with the end user safety standard.

TYPICAL APPLICATION CONNECTION

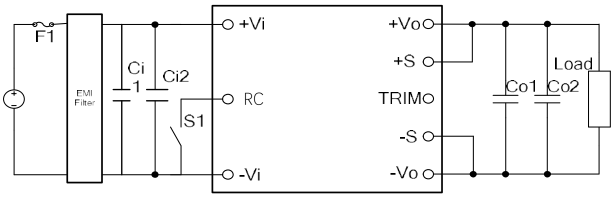


Figure 1·Typical Application Connection

Figure 1 shows the typical use of the module connection. In order to prevent the input line from causing the input oscillation, it is recommended to add the input capacitor close to the input pin of the module. Similarly, the output capacitor is added to the output of the module.Specific recommended parameters: input capacitance Ci1=100μF electrolytic capacitor, Ci2 = 1uF CBB capacitor. Output Capacitance Co1=10uF tantalum capacitor, Co2 ESR <0.1Ω.

REFLECTED RIPPLE CURRENT

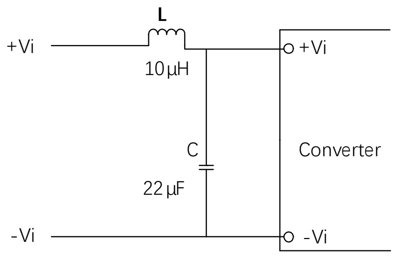


Figure 2· Reflected Ripple Current

Add LC filter at the front of the power module to reduce the interference of reflected ripple current on the DC bus, recommended value of L and C with appropriate current and voltage rating as below: L=10μH; C=100μF.

REMOTE CONTROL FUNCTION

Module Power Remote Control or called ON/OFF pin is for the user to enable or disable the output. Control use high and low level control, there are two general control logic, positive logic or negative logic control. Recommend to use optocoupler to control ON/OFF Pin as below.

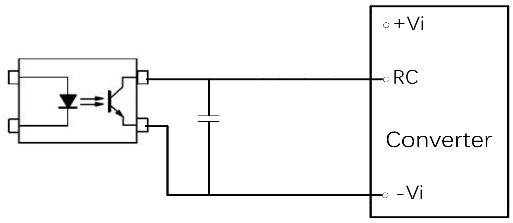


Figure 3· Remote Control

Remote Control Pin can be connected in parallel for multiple converters which with the same Remote Control characters. However, when several converters share the same remote control circuit, the total sink and source current must be taken into consideration, and make sure that the optocoupler has enough drive capability.
To reduce external PCB trace interference, it is recommended to add high frequency bypass capacitor between RC pin and -Vi, recommended capacitor value is 100-1000pF.

REMOTE COMPENSATION FUNCTION

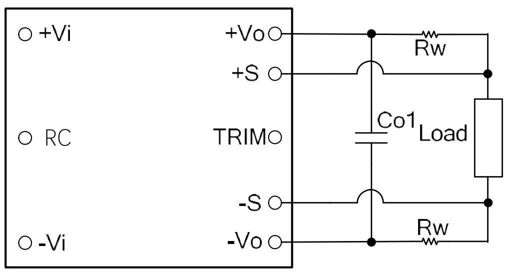


Figure 4· Remote Compensation

Technical Notes

The remote compensation function compensates for the voltage drop across the output line. Module compensation function can't exceed 10%, that is:
$[(+VO) - (-VO)]-[(+S) -(-S)] \leqslant 10\%V_{onom}$
If the remote compensation function is not used, the +Sense and +Vout pin, -Sense and -Vout pin need to be shorted directly close to the output.

OUTPUT RIPPLE & NOISE

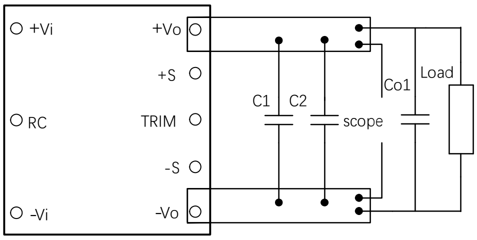


Figure 5· Output Ripple

These DHB250W110 modules' output ripple and noise is measured at the rated input voltage and output current, along with 10uF MLCC capacitor and 0.1uF MLCC used in parallel with appropriate voltage ratings and placed as C1&C2 shown in the figure above. The scope's bandwidth is set to 20MHz.
External output capacitors are required to reduce the ripple & noise. The output capacitors should be low ESR and appropriate frequency response with appropriate voltage ratings, and must be located as close to the converters as possible, also PCB layout must be taken into consideration.

INPUT UNDERVOLTAGE SHUTDOWN AND START-UP THRESHOLD

Under normal start-up conditions, module will not begin to regulate until the ramping-up input voltage exceeds the Start-Up Threshold Voltage. Once operating, module will not turn off until the input voltage drops below the Undervoltage Shutdown limit. Subsequent re-start will not occur until the input is brought back up to the Start-Up Threshold. This built in hysteresis prevents any unstable on/off situations from occurring at a single input voltage.

CURRENT LIMITING

The maximum current limit remains constant as the output voltage drops. However, once the impedance of the short across the output is small enough to make the output voltage drop below the specified Output DC Current Limit Shutdown Voltage, the converter turns off.
The converter then enters a “hiccup mode” where it repeatedly turns on and off until the short circuit condition is removed. This prevents excessive heating of the converter or the load board.

SHORT CIRCUIT CONDITION

When the converter is in current-limit mode, the output voltage will drop as the output current demand increases and then the converter will be shut down.If the short-circuit condition persists, another shutdown cycle will be initiated. This on/off cycling is referred to as "hiccup" mode. The hiccup cycling reduces the average output current, thereby preventing internal temperatures from rising to excessive levels. The module is capable of enduring an indefinite short circuit output condition.

OUTPUT OVERVOLTAGE PROTECTION

The output voltages are monitored for an overvoltage condition via magnetic feedback. The signal is coupled to the primary side and if the output voltage rises to a level which could be damaging to the load, the sensing circuitry will power down the PWM controller causing the output voltages to decrease. Following a timeout period the PWM will restart, causing the output voltages to ramp to their appropriate values. If the fault condition persists, and the output voltages again climb to excessive levels, the overvoltage circuitry will initiate another shutdown cycle. This on/off cycling is referred to as "hiccup" mode.

Technical Notes

THERMAL SHUTDOWN

These DHB250W110 converters are equipped with thermal shutdown circuitry. If environmental conditions cause the internal temperature of the DC-DC converter to rise above the designed operating temperature, a precision temperature sensor will power down the unit. When the internal temperature decreases below the threshold of the temperature sensor, the unit will auto restart.

TRIMMING OUTPUT VOLTAGE

DHB250W110 converters have a trim capability that allows users to adjust the output voltages. Output voltage can be trimmed up or down by a trim pin by connecting a single fixed resistor between Trim Pin and Vout+ or Vout-, the output voltage can be increased or decreased depending on its connection. The maximum output voltage adjustment range is -10% to +10%. If the trim function is not used, keep TRIM pin floating.

Trim up:

Add a fixed resistor between in TRIM and -Vo, you can achieve the output voltage up. Do not trim the converter above maximum trim limit (typically 10%) or the output over voltage protection circuit may be activated.

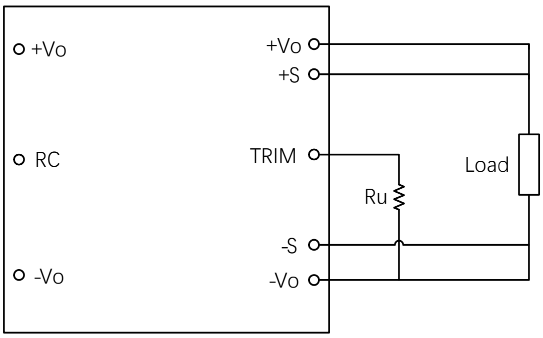


Figure 6· Trim Up Connection

Please follow up the Trim Up formula to calculate the resistor value according to the desired output voltage.

$$Ru=\frac{2.48\times[R1\times R2+5.6\times(R1+R2)]-5.6\times Voset\times(1+\Delta)\times R2}{Voset\times(1+\Delta)\times R2-2.48\times(R1+R2)}\ (k\Omega)$$

Where:
R1=20KΩ,
R2=2.32KΩ,
"Voset" is the output voltage when TRIM is floating,
"Δ"is the change of output voltage, such as: 15V output is raised to 16.5V,
Δ = (16.5-15) / 15 * 100% = 10%.

Trim down:

Add a fixed resistor between in TRIM and +Vo, you can achieve the output voltage down. Do not exceed maximum rated output load.

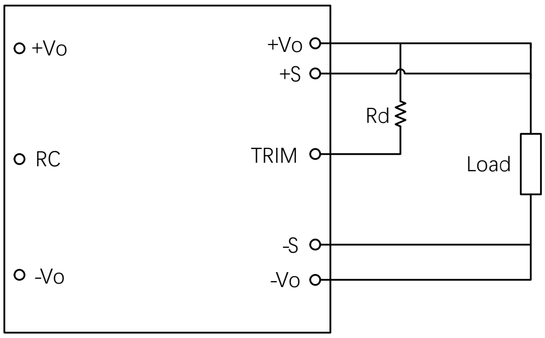


Figure 7· Trim Down Connection

Please follow up the Trim Down formula to calculate the resistor value according to the desired output voltage.

$$Rd=\frac{2.48\times5.6\times R1-R2\times(R1+5.6)\times[Voset\times(1-\Delta)-2.48]}{Voset\times(1-\Delta)\times R2-2.48\times(R1+R2)}\ (k\Omega)$$

Where:
R1=20KΩ,
R2=2.32KΩ,
"Voset" is the output voltage when TRIM is floating,
"Δ"is the change of output voltage, such as: 15V output is reduced to 13.5V,
Δ = (15-13.5) / 15 * 100% = 10%.

Technical Notes

This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy:
Refer to: http://www.densitypower.com

Density Power Group.
Queens, New York City, New York, U.S.A