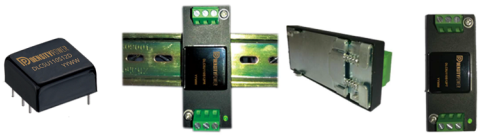
Technical Specification

DLC5U110 Series

10:1 Ultra Wide Input 5Watts DC/DC Converters



FEATURES

- 10:1 Ultra wide input range: 16-160VDC
- 5W isolated output
- Single output: 12Volts DC
- Efficiency up to 81.5% @24Vin
- Adjustable Vout (-10% to +30%)
- Six sides shielding
- Build-in EMI filter and input anti-reverse options
- Remote on/off control
- 1600VDC I/O isolation
- Standard 1.0"×1.0"×0.4" DIP footprint, Din-rail & wall mount type options
- Extensive self-protection, UVLO, OTP, OVP, OCP and short protection
- Operation temperature range: -40°C to +105°C
- Fully encapsulated, high reliability
- MTBF ⩾ 1 MHrs

PRODUCT OVERVIEW

DLC5U110 series high reliability, high performance, industry standard 1.0"x1.0" footprint DC/DC converter are designed specifically for railway applications. The 10:1 ultra-wide input voltage features a 16Vdc to 160Vdc input that complies with the European EN50155 standard for electronic equipment used on railway rolling stock. Ultra wide input voltage range is suitable for 110VDC, 96VDC, 72VDC, 48VDC, 36VDC and 24VDC bus voltage which offers a flexible, universal and total cost-effective solutions for customers.

A wealth of self-protection features included input under-voltage lockout, over temperature shutdown, overcurrent protection with “hiccup” autorestart technique, provides short-circuit protection, along with output OVP. The operation temperature is -40°C to 105°C, the module delivers full output power @ 105°C case temperature.

Advanced fully encapsulated package technology with six sides shielding and build-in EMI filter provides outstanding EMC and thermal performance, which is ideal for ruggedized applications involving harsh environments. Wall mount and Din-rail mount type are available for maximum design-in flexibility.

The DLC5U110 series are designed to safety standards UL/IEC/CSA 60950, 2nd edition.

Models Selections

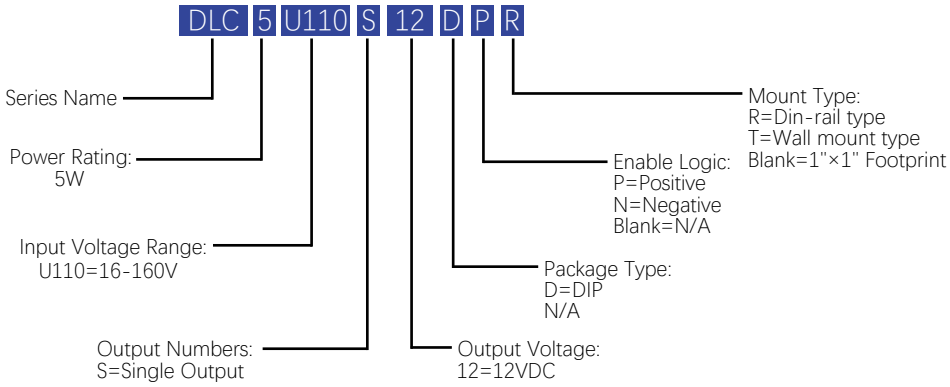
Basic Models	Input Voltage [VDC]	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [A]	Efficiency Typ. [%]	Capacitive Load Max [μF]	Package [inch]
DLC5U110S12	72	16-160	12	0.42	72	1000	1.0"×1.0"×0.4"

Technical Specification

DLC5U110 Series

10:1 Ultra Wide Input 5Watts DC/DC Converters

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	Referred to -Vin			15	VDC
Remote Control Source Current		0		1.5	mA
Remote Control Sink Current		0		1.5	mA
Operating Case Temperature		-40		105	°C
Operating Environment Temperature		-40		85	°C
Storage Temperature Range		-55		125	°C
Soldering Temperature	Wave soldering < 10s			300	°C

Safety and EMC Compliance		
Conducted Emission	EN50121-3-2	With external filter
Radiated Emission	EN50121-3-2	With external filter
Conducted Susceptibility	IEC6100-4-6	10Vrms Criteria A
Radiated Susceptibility	IEC6100-4-3	10V/m Criteria A
EFT	IEC6100-4-4	±2KV Criteria A (With external filter)
Surge	IEC6100-4-5	±2KV Criteria A (With external filter)
ESD	IEC6100-4-2	Contact: ±6KV Air: ±8KV Criteria A
Isolation Safety Rating	Basic insulation	

General Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage (Test for 1 minute)	Input to output	1600			VDC
	Input to case	1000			VDC
	Output to case	1000			VDC
Isolation Resistance (Viso=500VDC)	Input to output	100			MΩ
	Input to case	100			MΩ
	Output to case	100			MΩ
Isolation Capacitance	Input to output		1000		pF
Switching Frequency			245		KHz
Start-up Delay	From undervoltage shutdown recovery to 10% Vout			30	mS
Rise Time	From 10% Vout to 90% Vout capacitive load			30	mS
Remote On/Off Control					
"P" suffix					
Positive Logic, ON state		3.0		15	VDC
Positive Logic, OFF state		0		1.2	VDC
"N" suffix					
Negative Logic, ON state		0		1.2	VDC
Negative Logic, OFF state		3.0		15	VDC
Vibration	IEC61373:1999 Category I, Class B, Body mounted				
Shock (Operational)	IEC61373:1999 Category I, Class B, Body mounted				

Input Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Operating Voltage Range		16	110	160	VDC
Start-up Threshold		14		16	VDC
Under Voltage Shutdown		13.5		15.5	VDC
Input Current @ No Load			10	30	mA
Input Current @ Min. Line				0.6	A
Input Current @ Shutdown Mode			2.0	10	mA
Reflected Ripple Current (Peak-Peak)	Measured at input pin with 4.7μH inductor and 100μF capacitance		30		mA
Power Loss @ No Load				2	W
Recommended Input Fuse				1	A
Recommended External Input Capacitance	1μF CBB and 100μF E-cap used in combination		100		μF

Output Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Power				5	W
Vout Accuracy	50% Load, Vin=110V	-1.5		+1.5	%

Output Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Adjustable Range	Trim up/ Trim down	-10		+30	%
Line Regulation	Vin=16-160VDC, half load	-0.5		+0.5	%
Load Regulation	Vin=110VDC, load=0%-100% of full load	-0.5		+0.5	%
Temperature Coefficient		-0.02		+0.02	% of Vout /°C
Total Regulation		-2.5		+2.5	%
Thermal Shutdown	Case temperature	110	115	125	°C
Thermal Shutdown Recover	Case temperature	85	95	105	°C
Over Voltage Protection	Hiccup, Auto-recover	130		165	%
Over Current Protection	Hiccup, Auto-recover	0.46		2.0	A
Short Circuit Protection	Hiccup, Auto-recover				
Minimum Load	No minimum load required				

Output Specifications		
Parameters		Module
		S12
Output Voltage Normal(VDC)		12
Ripple & Noise Typ. (mV pk-pk) ①		100
Dynamic Load Peak Deviation Max. (%Vout) ②		±5
Dynamic Load Response Typ. (μS)		500
Capacitive Load (μF)	Min.	100
	Max.	220

Notes

① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 9 for more details.

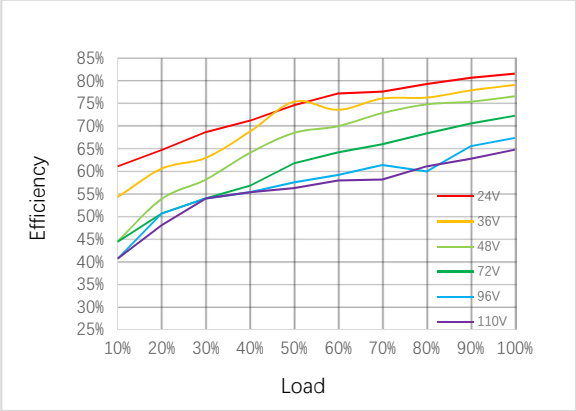
② Load is set from 50%-75%-50% of Imax, di/dt=0.1A/μS. Please refer to dynamic waveforms in performance data on page 5 for details.

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

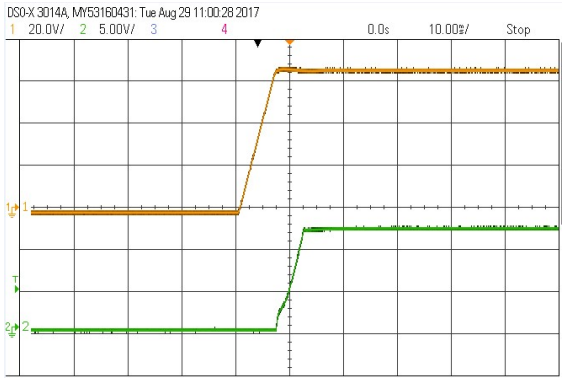
Performance Data

DLC5U110S12

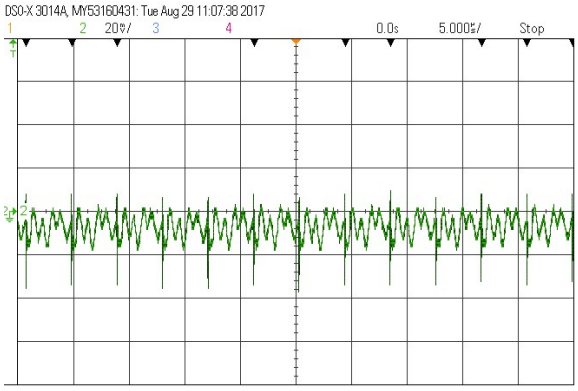
EFFICIENCY VS LOAD



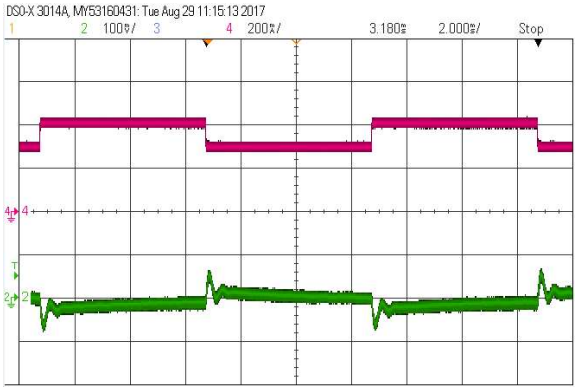
START UP Ch1: Vin Ch2: Vout



RIPPLE & NOISE 20MHz Bandwidth

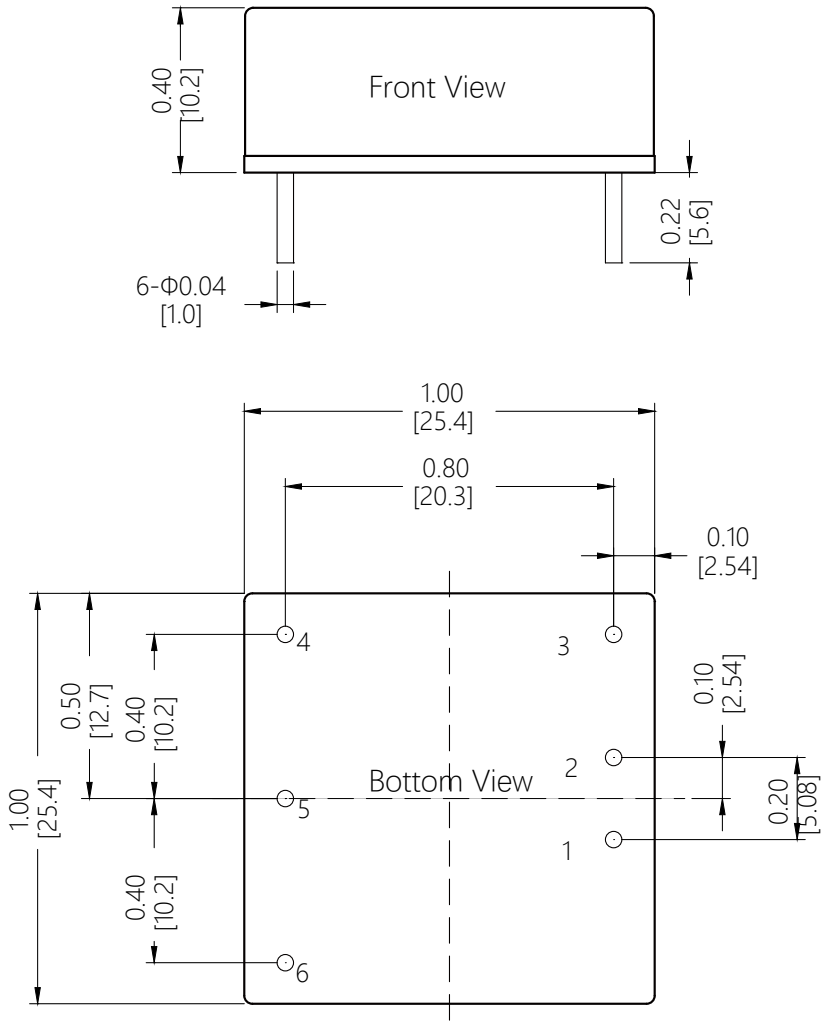


DYNAMIC RESPONSE (50%~75%~50% of $I_{max.}$,di/dt=0.1A/μs) Ch2: Vout Ch4: Iout Cout=100μF



Mechanical Specifications

DLC5U110 SERIES: DIP TYPE



PIN:
Pin1, PIN2, PIN3, PIN4, PIN5, PIN6: Φ0.040
Force: Applied force not exceed 4.9N
Material: Copper alloy
Finish: Gold 3 ~ 5μm(min.) over nickel 50μm(Min.)

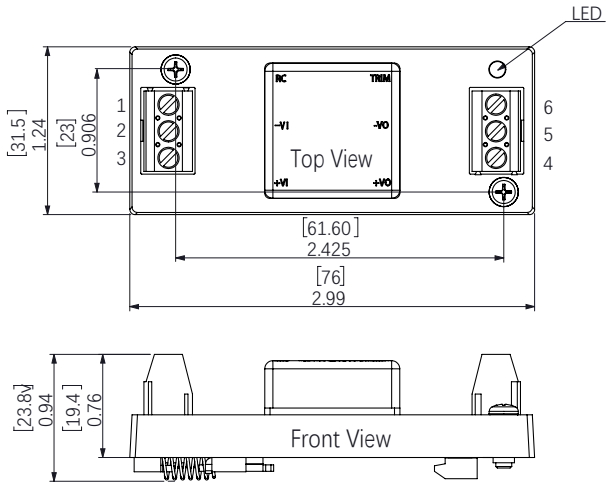
Tolerance:
X.XX=±0.02 (0.5)
X.XXX= ±0.010 (0.25)

Dimensions are in inches [mm]
Weight: ~16.5g.

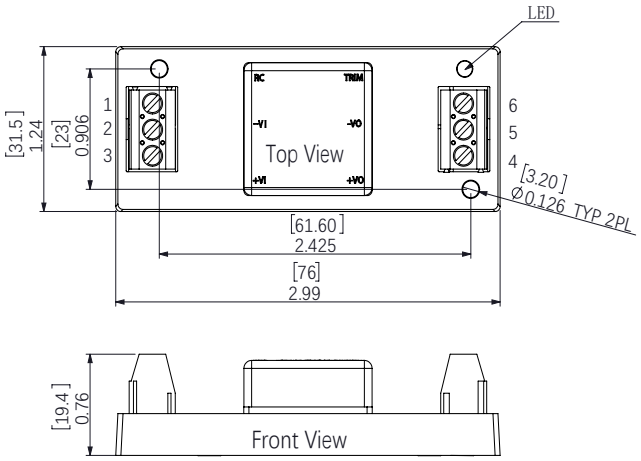
PIN CONNECTIONS	
Pin	Function
1	+Vi
2	-Vi
3	RC
4	-Vo
5	TRIM
6	+Vo

Mechanical Specifications

DLC5U110 SERIES: DIN-RAIL TYPE



DLC5U110 SERIES: WALL MOUNT TYPE



Hole screw locked torque: 0.4N·m Max
Terminal screw locked torque: 0.25N·m Max

Tolerance:
X.XX=±0.02 (0.5)
X.XXX= ±0.10 (0.25)

Dimensions are in inches [mm]
Weight:
Din-rail Type: ~56g
Wall Mount Type: ~36g.

PIN CONNECTIONS	
Pin	Function
1	RC
2	-Vi
3	+Vi
4	+Vo
5	-Vo
6	TRIM

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 DLC5U110 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

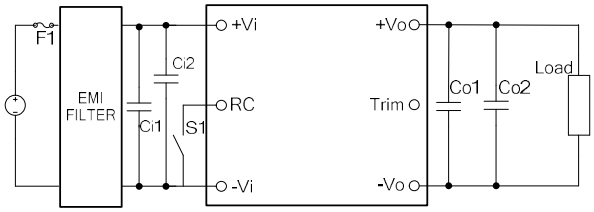


Figure 1· Typical Application Connection

In order to prevent the input line from causing the input oscillation, it is recommended to add the input capacitor close to the input 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. Please refer to capacitive load for details.

REFLECTED RIPPLE CURRENT

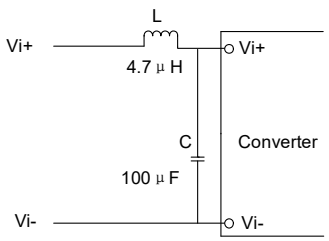


Figure 2· Reflected Ripple Current

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: 4.7μH; C: 100μF.

REMOTE CONTROL FUNCTION

Module Power Remote Control or called ON/OFF pin is for the user to control the power output. There are two general control logics, positive logic or negative logic control. Recommend to use optocoupler to control remote pin as below.

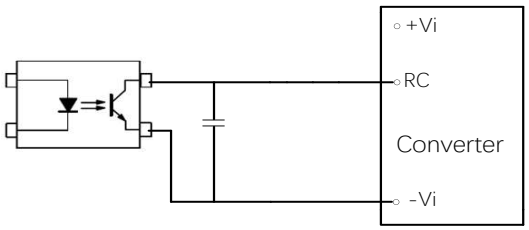


Figure 3· Remote Control Circuit

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 opto-coupler 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.

THERMAL SHUTDOWN

These DLC5U110 converters are equipped with thermal-shutdown circuitry. If environmental conditions cause the internal temperature of the 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.

Technical Notes

OUTPUT RIPPLE & NOISE

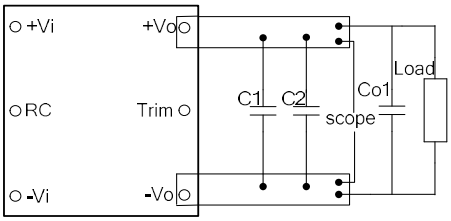


Figure 4· Output Ripple & Noise

These DLC5U110 converters' output ripple and noise is measured at the rated input voltage and output current, along with 10uF tantalum 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

Once operating, module will not turn off until the input voltage drops below the Undervoltage Shutdown threshold. 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 Current Limit Shutdown Voltage, the converter turns off.

The converter then enters into “hiccup mode” where it repeatedly turns on and off until the overload 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 DLC5U110 converters' 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 voltage to decrease. Following a time-out 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.

TRIMMING OUTPUT VOLTAGE

The DLC5U110 converters have a trim capability that allow 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 volatge can be increased or decreased depending on its connection. The maximum output voltage adjustment range is -10% to +30%. If the trim function is not used, keep TRIM pin floating.

Technical Notes

Trim up:
Increase the output voltage by connecting an appropriate value resistor between Trim Pin and -Vo Pin. Show as below:

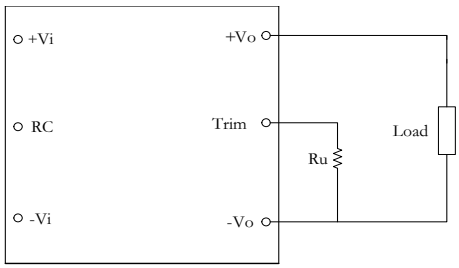


Figure 5· Trim Up Connection

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

Vout =12V

$$R_u = \left(10 \times \frac{2.5}{\Delta\,\% \times Voset} - 5.11\right) k\Omega$$

"Voset "is the output voltage when TRIM is floating, " Δ% "is the amount of change of output voltage, for example: For normal output 12VDC modules, trim up output voltage from 12VDC to 13.2VDC.
Δ% = (13.2-12) / 12 * 100% = 10%.

Trim down:
Decrease the output voltage by connecting an appropriate value resistor between Trim Pin and +Vo Pin. Show as below:

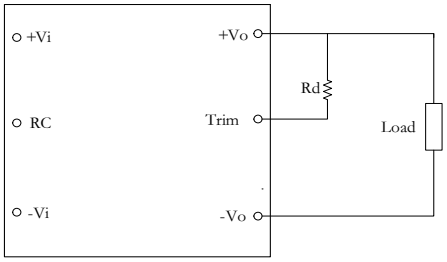


Figure 6· Trim Down Connection

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

Vout=12V

$$R_u = \left(10 \times \frac{Voset - \Delta\,\% \times Voset - 2.5}{\Delta\,\% \times Voset} - 5.11\right) k\Omega$$

"Voset" is the output voltage when TRIM is floating, "Δ%" is the amount of change in output voltage, for example: For normal output 12VDC modules, trim down output voltage from 12VDC to 10.8VDC.
Δ% = (12-10.8) / 12% = 10%.

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

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