Technical Specification

DHB350D24 Series

2:1 Input 1/2nd Brick Isolated 350Watts DC/DC Converters

FEATURES

- Standard input range: 18-36VDC
- 350W isolated outputs
- Efficiency up to 91%
- Single outputs: 5, 12, 15, 24, 28VDC
- Adjustable Vout (±10%)
- Fixed switching frequency, predicted EMI
- Stable @ no-load operation
- Remote On/Off control
- 1500VDC I/O isolation
- Industry standard 1/2nd brick footprint (2.40" × 2.28" × 0.50")
- Extensive self-protection, UVLO, OVP, OTP, OCP and short protection
- Operating temperature range: -40°C to +100°C
- Fully encapsulated, high reliability
- Flexible extra heat-sink mount type

PRODUCT OVERVIEW

The DHB350D24 series use advanced power processing, control and packaging technologies to provide the high performance, flexibility, reliability and cost effectiveness of a mature power converter. Standard input range of 18-36V (24V nominal) is ideal for automation, power grid, railway, semiconductor equipment, instrumentation, test and measurement, and distribution power system.

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 baseplate temperature.

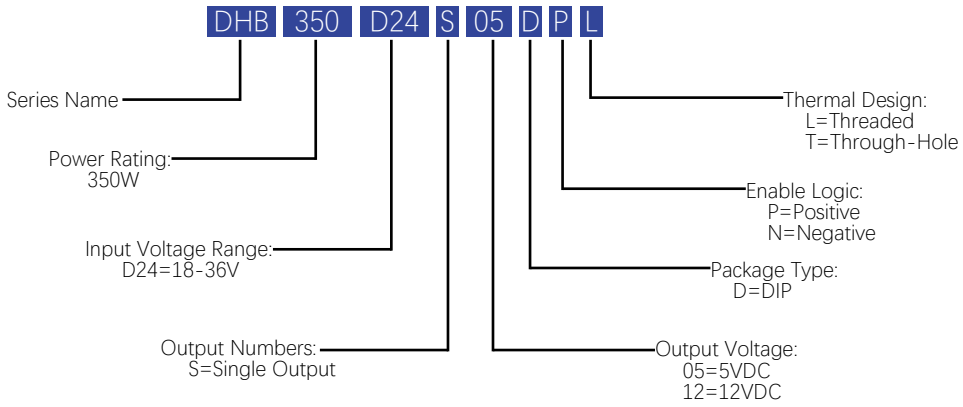
Advanced fully encapsulated package technology provides outstanding thermal performance, which is ideal for ruggedized applications involving harsh environments.

The DHB350D24 series are designed to safety standards UL 62368-1.

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]
DHB350D24S05	24	18-36	5	70	88	10000	2.40"×2.28"×0.50"
DHB350D24S12	24	18-36	12	29.2	89	10000	
DHB350D24S15	24	18-36	15	23.3	86.5	10000	
DHB350D24S24	24	18-36	24	14.6	89	4000	
DHB350D24S28	24	18-36	28	12.5	91	4000	

Model Numbering



Absolute Maximum Ratings					
Parameters	Conditions	Min.	Typ.	Max.	Units
Input Voltage Continuous		-0.7		40	VDC
Input Voltage Transient (< 100ms)	Referred to -Vin			50	VDC
On/Off Remote Control Voltage	Referred to -Vin	0		75	VDC
On/Off Remote Control Current		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	EN55032	Class B (With external filter)			
Radiated Emission	EN55032	Class B (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	±2KV Contact ±4KV Air Criteria A			
Isolation Safety Rating	Basic insulation				

General Specifications

Parameters	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	Input to output		1500		VDC
	Input to case		1500		VDC
	Output to case		1500		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		1500		pF
Switching Frequency			300		KHz
Start-up Delay	From start-up threshold recover to 10% Vout		100	150	mS
Rise Time	From 10% Vout to 90% Vout		25	50	mS
Remote On/Off Control	Positive Logic, ON state	Open or 3 ≤ Vr ≤ 15			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 ≤ 15			VDC
Remote Control Current		0	0.25	1.0	mA
Thermal Shutdown	Case temperature	100	105	115	°C
Thermal Shutdown Recover	Case temperature	80	85	95	°C
MTBF	MIL-HDBK-217F		500		KHrs
Vibration	IEC 60068-2-64, Environmental Testing - Part 2				
Shock	IEC 60068-2-27, Environmental Testing- Part 2.27				

Input Specifications

Parameters	Conditions	Min.	Typ.	Max.	Units
Operating Voltage Range		18	24	36	VDC
Start-up Threshold		16	17	18	VDC
Under Voltage Shutdown		15	16	17	VDC
Input Current @ No Load	5, 12 Vout modules		150	350	mA
	Other modules		60	80	mA
Input Current @ Min. Line	Min. Vin and full load			24	A
Input Current @ Shutdown Mode			15	50	mA
Reflect Ripple Current (Peak-Peak)	Measured at input pin with 10μH inductor and 470μF capacitance		60	100	mA
Recommended Input Fuse			40		A
Recommended External Input Capacitance		330	470		μF

Performance Data (5 Vout)

Output Specifications

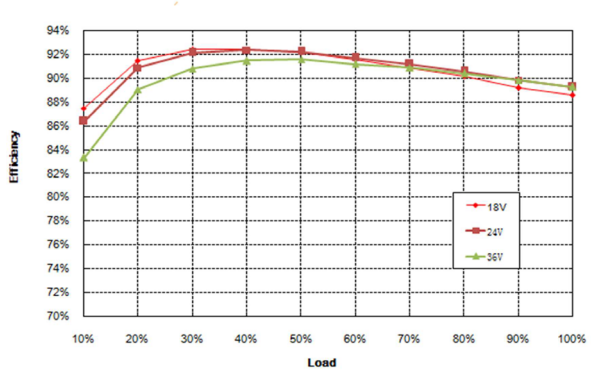
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Voltage Setpoint		4.92	5.00	5.08	W
Vout Accuracy		-1.6		+1.6	% of Vout
Adjustable Range	Trim up/ Trim down	-10		+10	% of Vout
Line Regulation		-0.2		+0.2	%
Load Regulation		-0.5		+0.5	%
Temperature Coefficient		-0.02		+0.02	%of Vout/°C
Total Regulation		-2		+2	%
Ripple & Noise Max. ①			75	100	mV pk-pk
Dynamic Load Peak Deviation ②		-5		+5	%Vout
Dynamic Load Response			400	500	μS
Over Voltage Protection	Hiccup, Auto-recover	115		140	%
Over Current Protection	Hiccup, Auto-recover	110		160	%
Short Circuit Protection	Hiccup, Auto-recover				
Remote Sense Voltage				10	%
Capacitive Load		0		10000	μF
Minimum Load	No minimum load required				

Notes
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 16 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=0.1A/μS, Cout=470μF, please refer to dynamic waveform in performance data on page 5 for details.

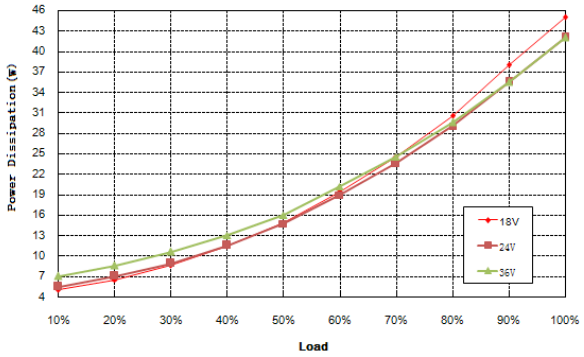
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

Performance Data (5 Vout)

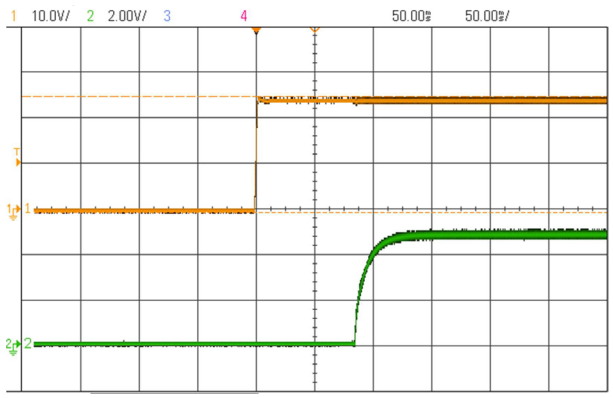
EFFICIENCY VS LOAD



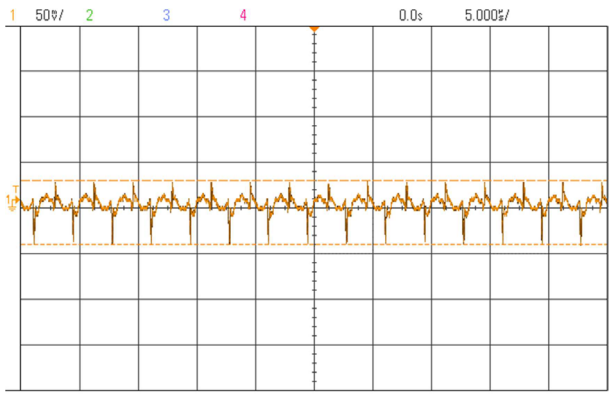
POWER DISSIPATION VS LOAD



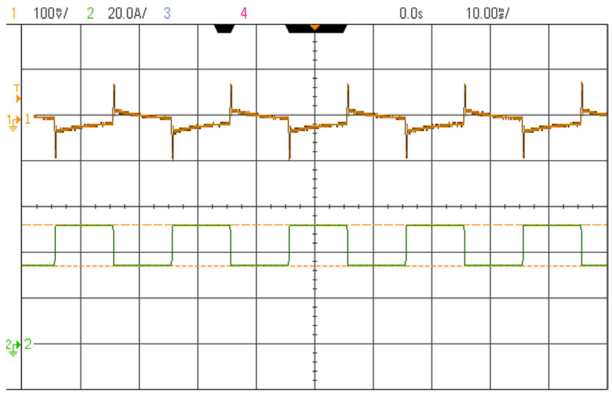
START UP Ch1:Vin Ch2:Vout



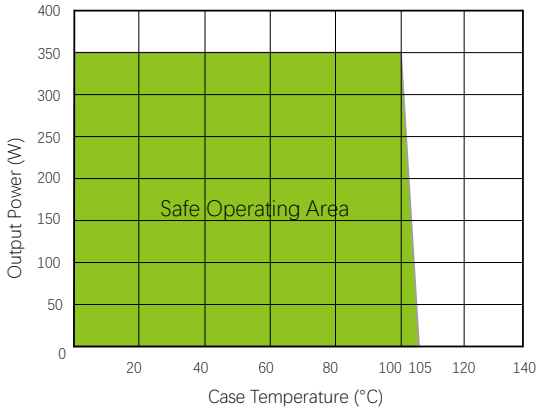
RIPPLE & NOISE BANDWIDTH 20MHz



DYNAMIC RESPONSE (50%-75%-50% of $I_{max.}$)



THERMAL DREATING CURVE



Performance Data (12 Vout)

Output Specifications

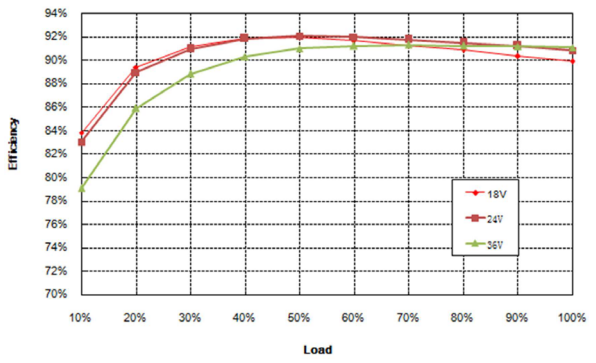
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Voltage Setpoint		11.82	12.00	12.18	W
Vout Accuracy		-1.5		+1.5	% of Vout
Adjustable Range	Trim up/ Trim down	-10		+10	% of Vout
Line Regulation		-0.2		+0.2	%
Load Regulation		-0.5		+0.5	%
Temperature Coefficient		-0.02		+0.02	%of Vout/°C
Total Regulation		-2		+2	%
Ripple & Noise Max. ①			75	120	mV pk-pk
Dynamic Load Peak Deviation ②		-5		+5	%Vout
Dynamic Load Response			400	500	μS
Over Voltage Protection	Hiccup, Auto-recover	115		140	%
Over Current Protection	Hiccup, Auto-recover	110		160	%
Short Circuit Protection	Hiccup, Auto-recover				
Remote Sense Voltage				10	%
Capacitive Load		470		10000	μF
Minimum Load	No minimum load required				

Notes
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 16 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=0.1A/μS, Cout=470μF, please refer to dynamic waveform in performance data on page 7 for details.

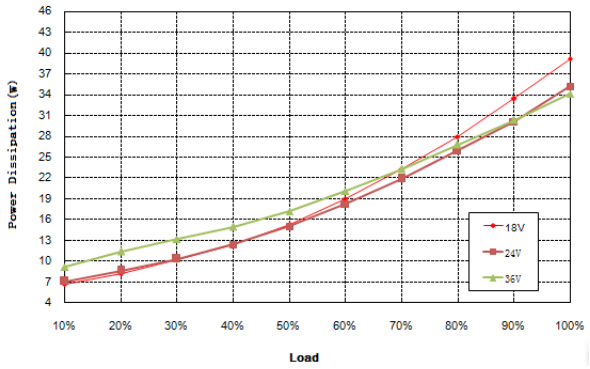
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

Performance Data (12 Vout)

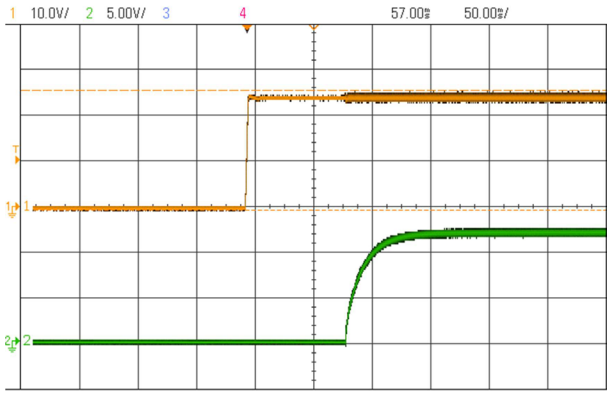
EFFICIENCY VS LOAD



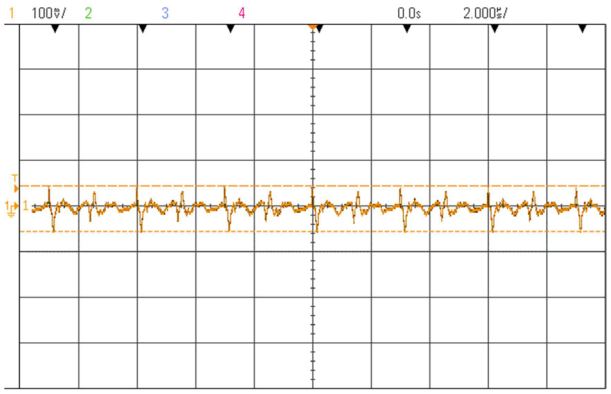
POWER DISSIPATION VS LOAD



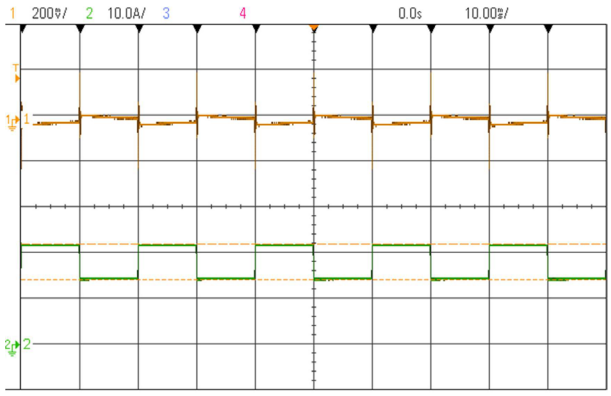
START UP Ch1:Vin Ch2:Vout



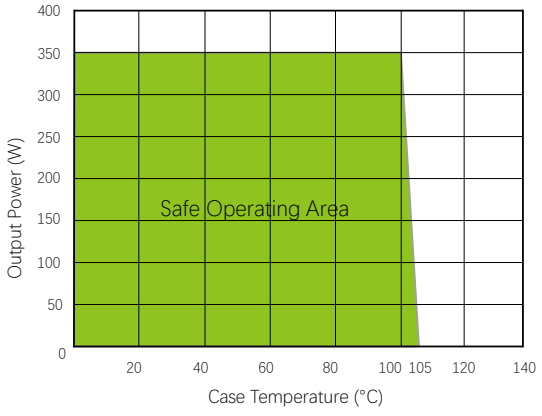
RIPPLE & NOISE BANDWIDTH 20MHz



DYNAMIC RESPONSE (50%-75%-50% of $I_{max.}$)



THERMAL DREATING CURVE



Performance Data (15 Vout)

Output Specifications

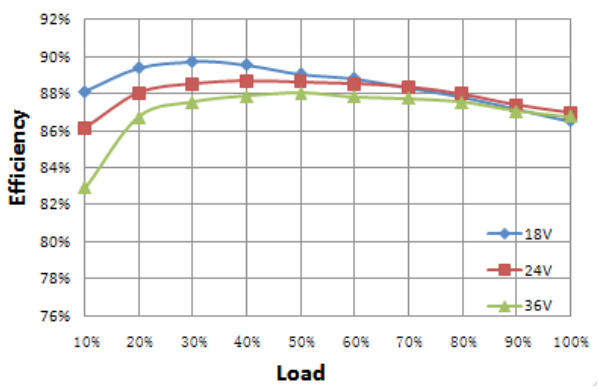
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Voltage Setpoint		14.85	15.00	15.15	W
Vout Accuracy		-1.0		+1.0	% of Vout
Adjustable Range	Trim up/ Trim down	-10		+10	% of Vout
Line Regulation		-0.2		+0.2	%
Load Regulation		-0.5		+0.5	%
Temperature Coefficient		-0.02		+0.02	% of Vout/°C
Total Regulation		-2		+2	%
Ripple & Noise Max. ①			50	100	mV pk-pk
Dynamic Load Peak Deviation ②		-5		+5	% of Vout
Dynamic Load Response			100	500	μS
Over Voltage Protection	Hiccup, Auto-recover	113		140	%
Over Current Protection	Hiccup, Auto-recover	110		160	%
Short Circuit Protection	Hiccup, Auto-recover				
Remote Sense Voltage				10	%
Capacitive Load		100		10000	μF
Minimum Load	No minimum load required				

Notes
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 16 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=0.1A/μS, Cout=220μF, please refer to dynamic waveform in performance data on page 9 for details.

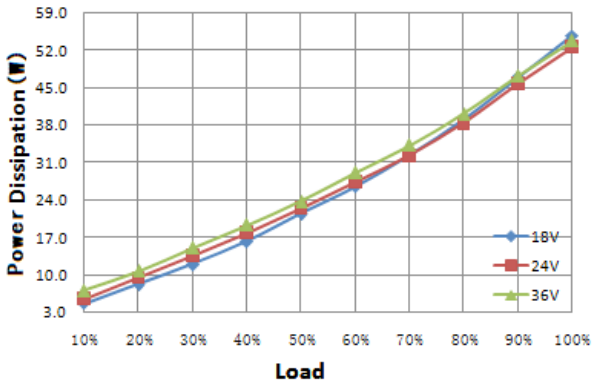
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

Performance Data (15 Vout)

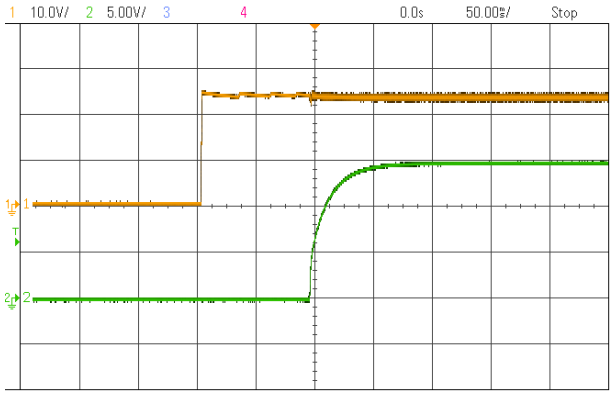
EFFICIENCY VS LOAD



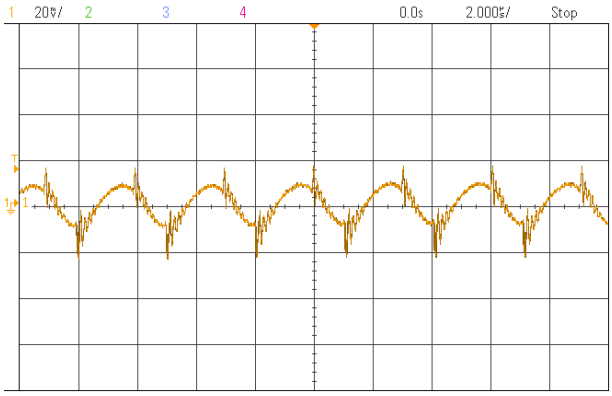
POWER DISSIPATION VS LOAD



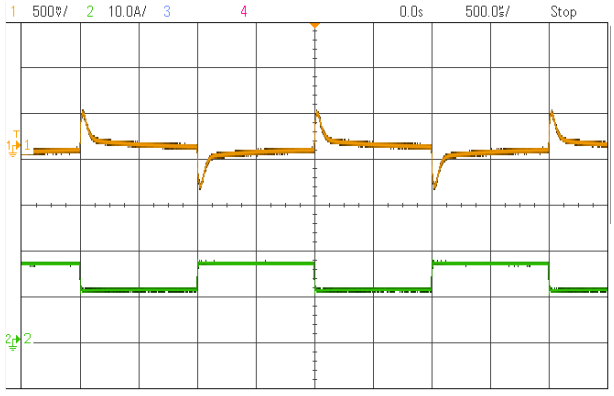
START UP Ch1:Vin Ch2:Vout



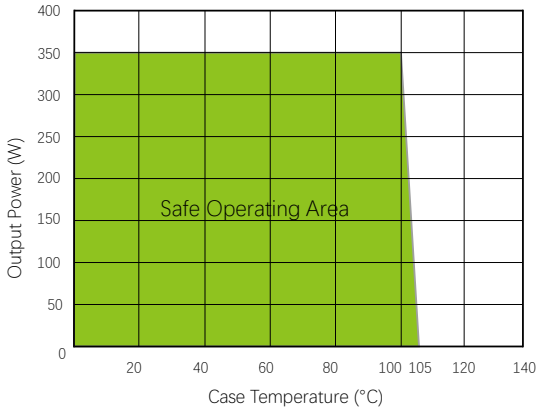
RIPPLE & NOISE BANDWIDTH 20MHz



DYNAMIC RESPONSE (50%-75%-50% of $I_{max.}$)



THERMAL DREATING CURVE



Performance Data (24 Vout)

Output Specifications

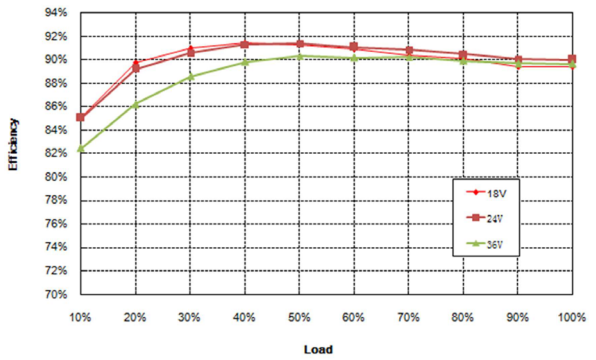
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Voltage Setpoint		23.64	24.00	24.36	W
Vout Accuracy		-1.5		+1.5	% of Vout
Adjustable Range	Trim up/ Trim down	-10		+10	% of Vout
Line Regulation		-0.2		+0.2	%
Load Regulation		-0.5		+0.5	%
Temperature Coefficient		-0.02		+0.02	% of Vout/°C
Total Regulation		-2		+2	%
Ripple & Noise Max. ①			180	240	mV pk-pk
Dynamic Load Peak Deviation ②		-5		+5	% of Vout
Dynamic Load Response			400	500	μS
Over Voltage Protection	Hiccup, Auto-recover	115		140	%
Over Current Protection	Hiccup, Auto-recover	110		160	%
Short Circuit Protection	Hiccup, Auto-recover				
Remote Sense Voltage				10	%
Capacitive Load		100		4000	μF
Minimum Load	No minimum load required				

Notes
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 16 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=0.1A/μS, Cout=220μF, please refer to dynamic waveform in performance data on page 11 for details.

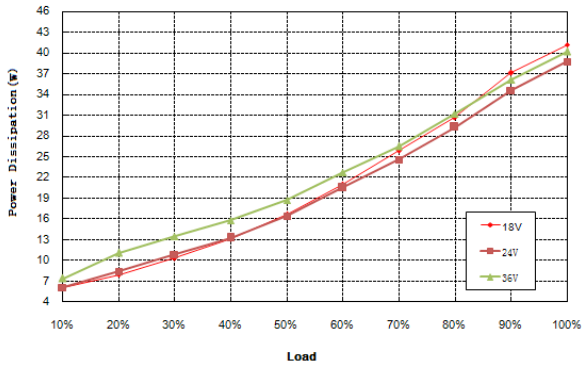
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

Performance Data (24 Vout)

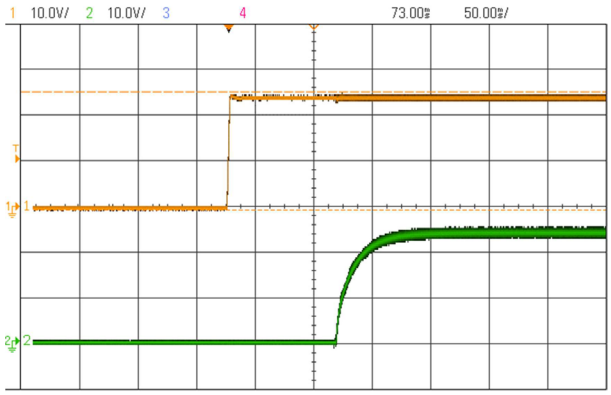
EFFICIENCY VS LOAD



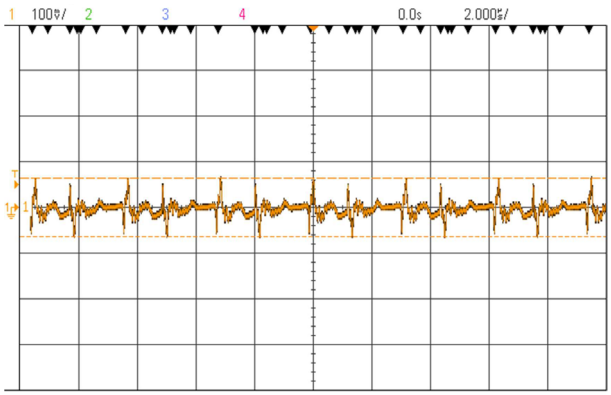
POWER DISSIPATION VS LOAD



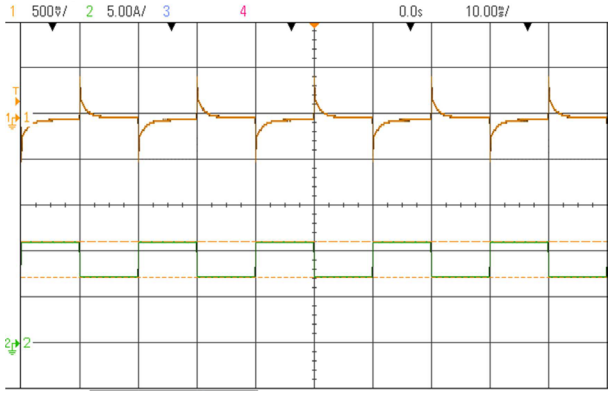
START UP Ch1:Vin Ch2:Vout



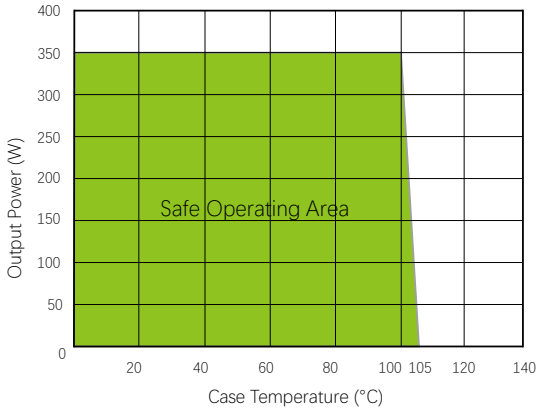
RIPPLE & NOISE BANDWIDTH 20MHz



DYNAMIC RESPONSE (50%-75%-50% of $I_{max.}$)



THERMAL DREATING CURVE



Performance Data (28 Vout)

Output Specifications

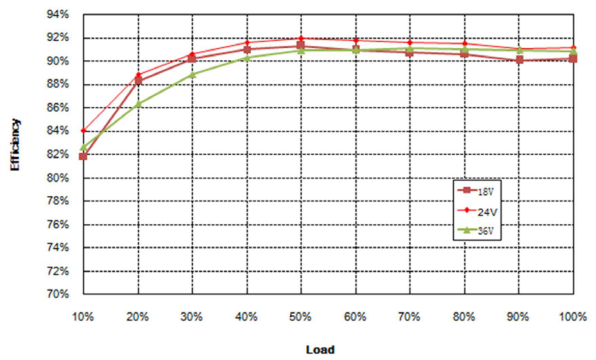
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Voltage Setpoint		27.58	28.00	28.42	W
Vout Accuracy		-1.5		+1.5	% of Vout
Adjustable Range	Trim up/ Trim down	-10		+10	% of Vout
Line Regulation		-0.2		+0.2	%
Load Regulation		-0.5		+0.5	%
Temperature Coefficient		-0.02		+0.02	% of Vout/°C
Total Regulation		-2		+2	%
Ripple & Noise Max. ①			200	280	mV pk-pk
Dynamic Load Peak Deviation ②		-5		+5	% of Vout
Dynamic Load Response			400	500	μS
Over Voltage Protection	Hiccup, Auto-recover	115		140	%
Over Current Protection	Hiccup, Auto-recover	110		160	%
Short Circuit Protection	Hiccup, Auto-recover				
Remote Sense Voltage				10	%
Capacitive Load		100		4000	μF
Minimum Load	No minimum load required				

Notes
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 16 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=0.1A/μS, Cout=220μF, please refer to dynamic waveform in performance data on page 13 for details.

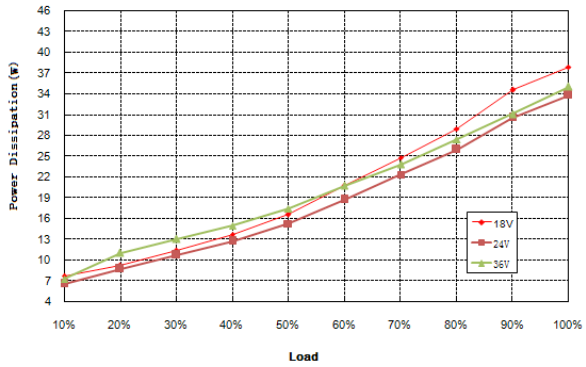
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

Performance Data (28 Vout)

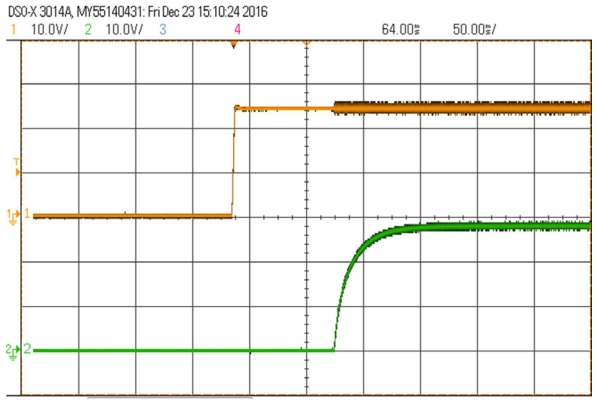
EFFICIENCY VS LOAD



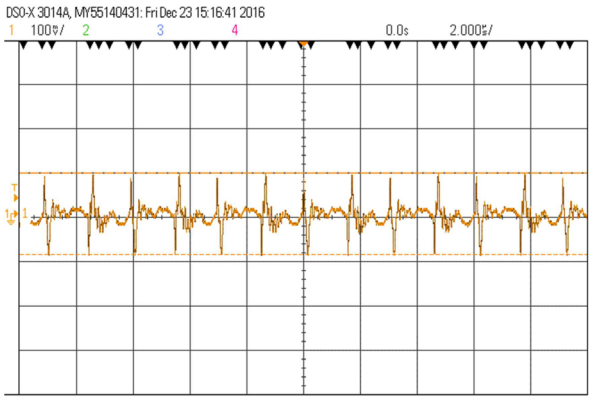
POWER DISSIPATION VS LOAD



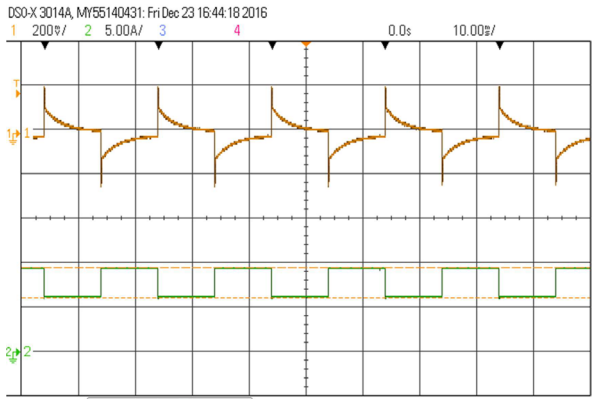
START UP Ch1:Vin Ch2:Vout



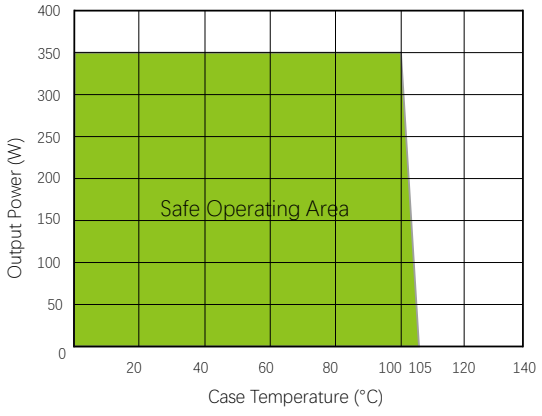
RIPPLE & NOISE BANDWIDTH 20MHz



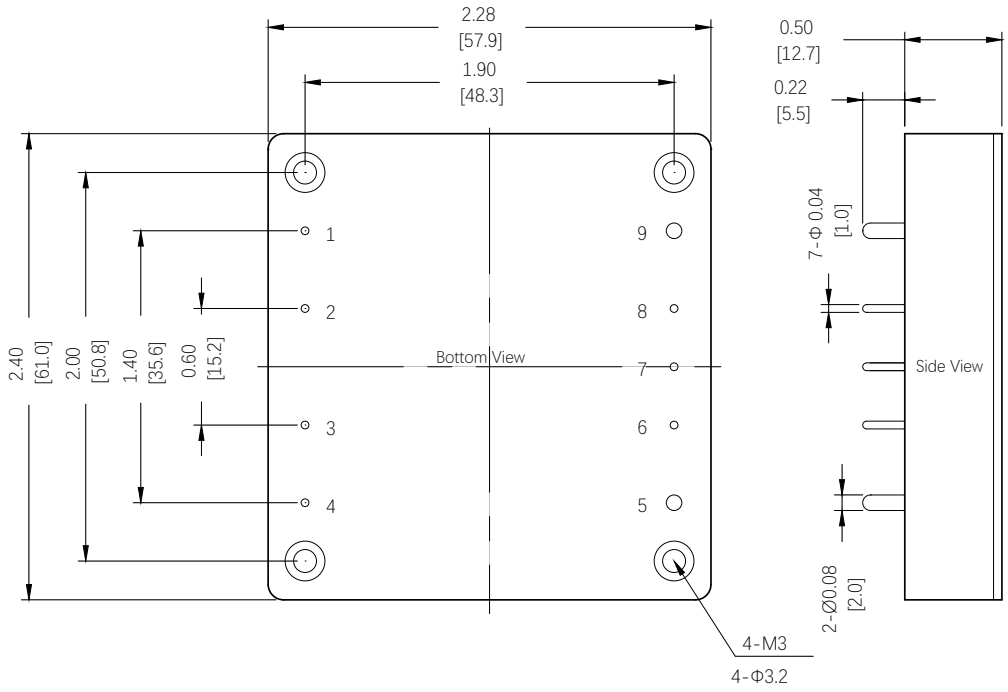
DYNAMIC RESPONSE (50%-75%-50% of $I_{max.}$)



THERMAL DREATING CURVE



Mechanical Specifications



PIN:
PIN1, 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.)
Baseplate screw locked torque: 0.3N·m Max

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

Dimensions are in inches [mm]
Weight: ~110g.

PIN CONNECTIONS	
Pin	Function
1	-Vi
2	NC
3	RC
4	+V
5	+Vo
6	+S
7	+TRIM
8	-S
9	-Vo

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 DHB350D24 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

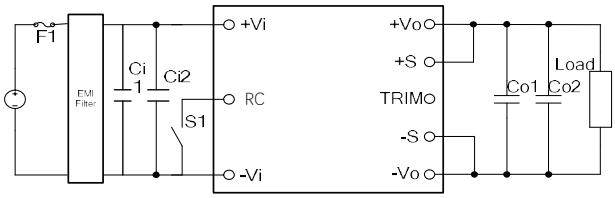


Figure 1·Typical Application Connection

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=470μF electrolytic capacitor, Ci2 = 1uF CBB capacitor. Output Capacitance Co1=10uF tantalum capacitor, Co2 ESR <0.1Ω.

REFLECTED RIPPLE CURRENT

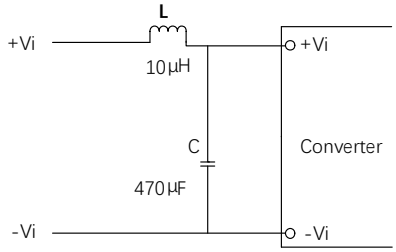


Figure 2· Reflected Ripple Current

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=470μF.

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.

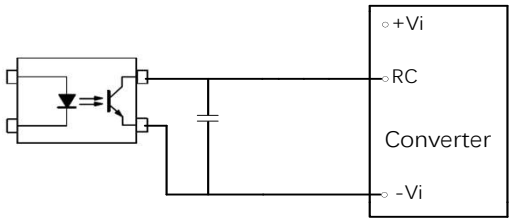


Figure 3· Remote Control

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 circuits, 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

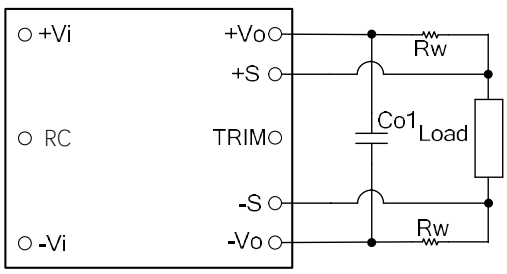


Figure 4· Remote Compensation

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

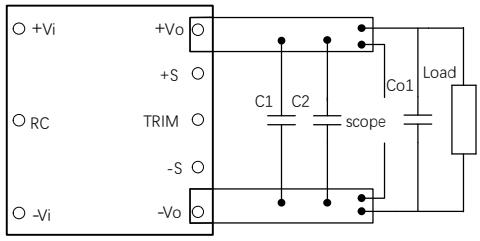


Figure 5· Output Ripple

These DHB350D24 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 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 DHB350D24 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

DHB350D24 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:

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

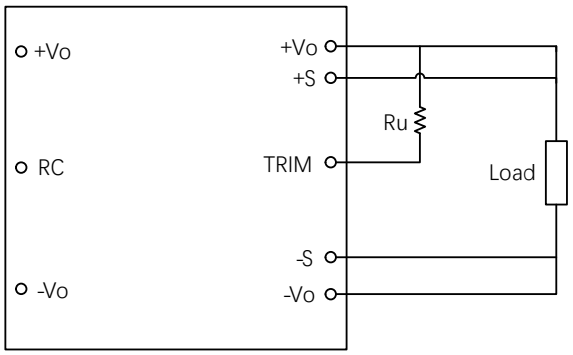


Figure 6· Trim Up Connection

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

$$Ru = [\frac{5.11 \times Voset \times (100 + \Delta)}{1.24 \times \Delta} - \frac{511}{\Delta} - 10.22]k\Omega$$

"Voset" is the output voltage when TRIM is floating, "Δ" is the change of output voltage, such as: 12V output is raised to 13.2V,
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:

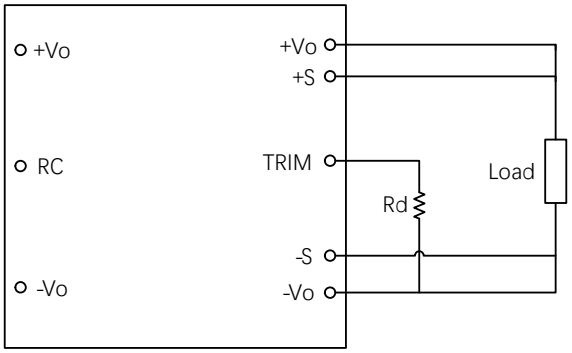


Figure 7· Trim Down Connection

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

$$Rd = (\frac{511}{\Delta} - 10.22)k\Omega$$

"Voset" is the output voltage when TRIM is floating, "Δ" is the change of output voltage, such as: 12V output is reduced to 10.8V, Δ = (12-10.8) / 12 * 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 LLC.
Queens, New York City, New York, U.S.A