Technical Specification

DHB500D300 Series

2:1 Input 1/2nd Brick 500Watts DC/DC Converters

FEATURES

- Standard input range: 200-425VDC
- 500W isolated outputs
- Efficiency up to 93%
- Single outputs: 28 and 48VDC
- Adjustable Vout (-20%~+10%)
- Fixed switching frequency, predicted EMI
- Stable @ no-load operation
- Remote On/Off control
- Paralleld with current sharing
- 4.25KVDC 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 (case temperature)
- Fully encapsulated, high reliability
- Flexible extra heat-sink mount type

PRODUCT OVERVIEW

The DHB500D300 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 range input of 200-425V (300V 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 case temperature.

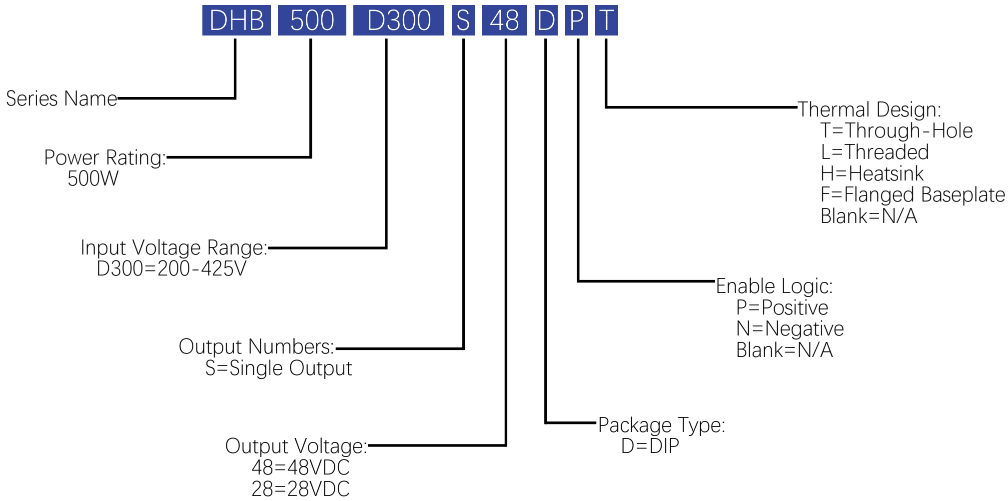
Advanced fully encapsulated package technology provides outstanding thermal performance, which is ideal for ruggedized applications involving harsh environments.

The DHB500D300 series are designed to safety standards IEC/EN 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]
DHB500D300S28D	300	200-425	28	17.8	93.0	4000	2.40×2.28×0.50
DHB500D300S48D	300	200-425	48	10.4	92.5	2200	

Model Numbering



Absolute Maximum Ratings

Parameters	Conditions	Min.	Typ.	Max.	Units
Non-operating Input Voltage	Continuous	-0.7		600	VDC
Operating Input Voltage	Continuous	-0.7		425	VDC
Input Voltage Transient	＜ 100ms			450	VDC
On/Off Remote Control Voltage	Referred to -Vin	0		36	VDC
On/Off Remote Control Current	Referred to -Vin	0		1	mA
Trim Pin Voltage	Referred to -S	0		5	V
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	±6KV Contact ±8KV Air Criteria A

General Specifications

Parameters	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	Input to output, 1 minute	4250			VDC
	Input to case, 1 minute	3535			VDC
	Output to case, 1 minute	1500			VDC
Leakage Current				3.5	mA
Isolation Resistance (Viso=500VDC)	Input to output	200			MΩ
	Input to case	200			MΩ
	Output to case	200			MΩ
Isolation Capacitance	Input to output		1000		pF
Isolation Safety Rating	Reinforced insulation				
Switching Frequency			250		KHz
Start-up Delay	From start-up threshold recover to 10% Vout		250	500	mS
Rise Time	From 10% Vout to 90% Vout capacitive load		40	100	mS
Sync Signal	Referred to -Vin	270		300	KHz
Remote On/Off Control	Positive Logic, ON state	Open or 2.4 ≤ Vr ≤ 36			VDC
	Positive Logic, OFF state	Short or 0 ≤ Vr ≤ 0.8			VDC
	Negative Logic, ON state	Short or 0 ≤ Vr ≤ 0.8			VDC
	Negative Logic, OFF state	Open or 2.4 ≤ Vr ≤ 36			VDC
Remote Control Current		0		1	mA
Thermal Shutdown	Baseplate temperature	100	110	120	℃
Thermal Shutdown Recover	Baseplate temperature	90	100	110	℃
MTBF	MIL-HDBK-217F, 80% Iout		500		KHrs
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		200	300	425	VDC
Start-up Threshold		175	185	195	VDC
Under Voltage Shutdown		160	170	180	VDC
Input Over Voltage Protection		445	460	475	VDC
Input Over Voltage Recover		430	445	460	VDC
Input Current @ No Load			15	30	mA
Input Current @ Min. Line	Vin=min.line, Iout=full load			3	A
Input Current @ Shutdown Mode			5	10	mA
Reflect Ripple Current (Peak-Peak)	Measured at input pin with 12µH inductor and 100µF capacitance		100	200	mA
Recommended Input Fuse			5		A
Recommended External Input Capacitance	1µF CBB and 100µF E-cap used in combination	22	100		µF

Performance Data (28 Vout)

Output Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Voltage Setpoint	Nom.line, 50% Load	27.72	28.00	28.28	V
Vout Accuracy		-1.0		+1.0	% of Vout
Adjustable Range	Trim up/ Trim down	-20		+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		-2.5		+2.5	%
Over Voltage Protection	Hiccup	113		140	% of Vout
Over Current Protection	First constant current, then hiccup	105		130	% of Iout
Short Circuit Protection	Hiccup				
Remote Sense Voltage				10	%
Ripple & Noise Max. ①			250	350	mV pk-pk
Dynamic Load Peak Deviation ②		-5		+5	% of Vout
Dynamic Load Response			300	500	µS
Current Share Signal Voltage	Nom.line, full Load	3.85	4.00	4.15	V
Current Share Accuracy		-8		+8	%
Capacitive Load		330	820	4000	µF
Minimum Load	No minimum load requirement				

Notes

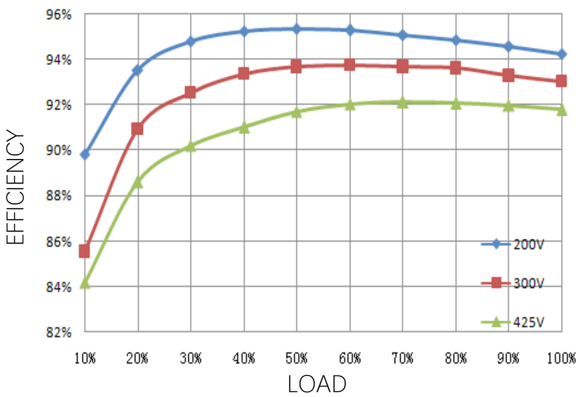
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 11 for more details.

② The load is set from 50%-75%-50% of Imax, di/dt=2.5A/µS, Cout=820µF, please refer to dynamic waveforms in performance data on page 5 for details.

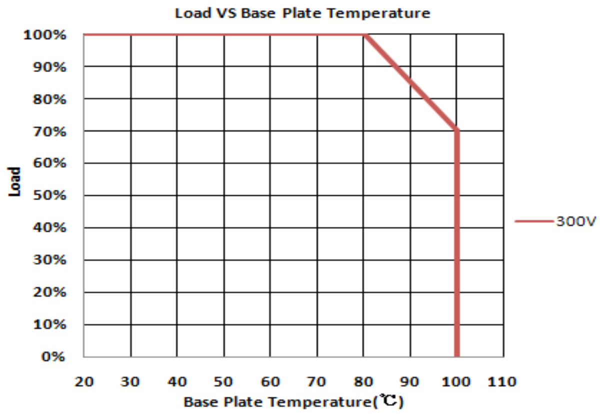
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

Performance Data (28 Vout)

EFFICIENCY VS LOAD

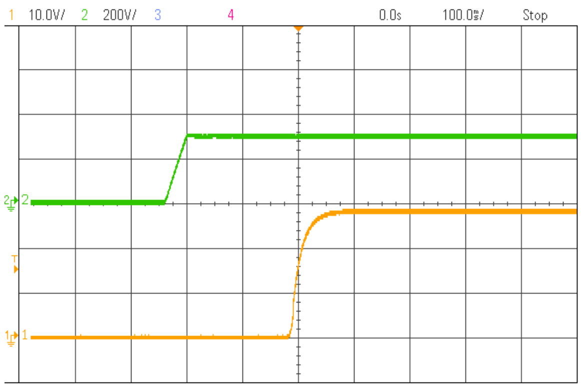


THERMAL DERATING



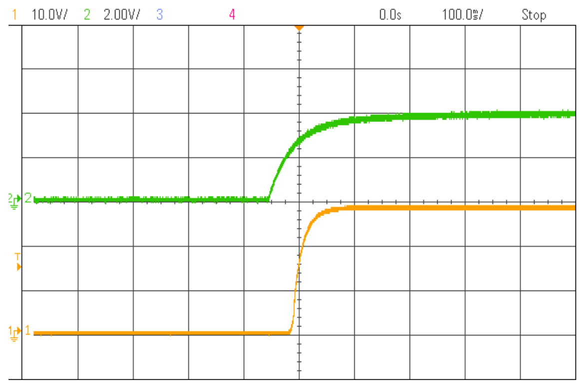
START UP VIN

Ch1: Vout Ch2: Vin



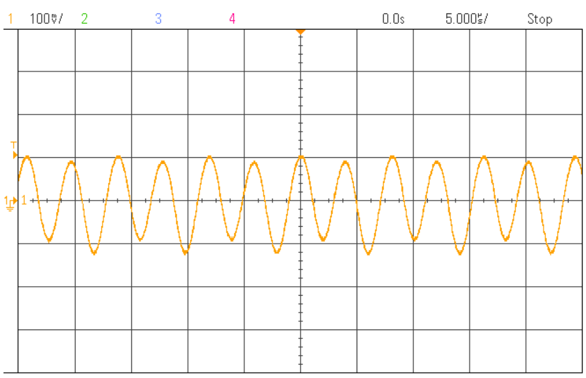
START UP ENABNLE (POSITIVE)

Ch1: Vout Ch2: Ven



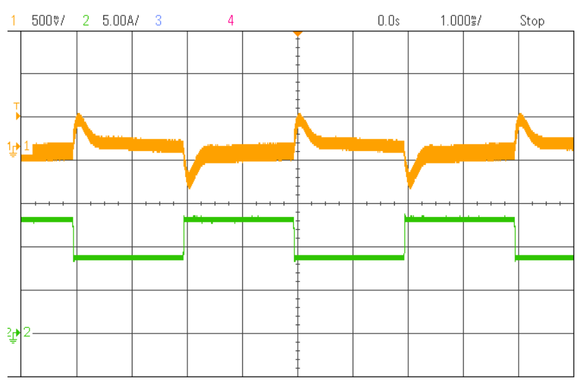
RIPPLE & NOISE 20MHz BANDWIDTH

Ch1: Vout



DYNAMIC RESPONSE Ch1: Vout Ch2: Iout

50%~75%~50% of I_{max}, di/dt=2.5A/μs



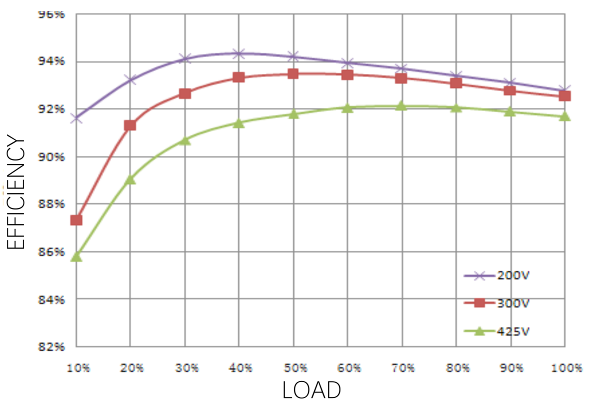
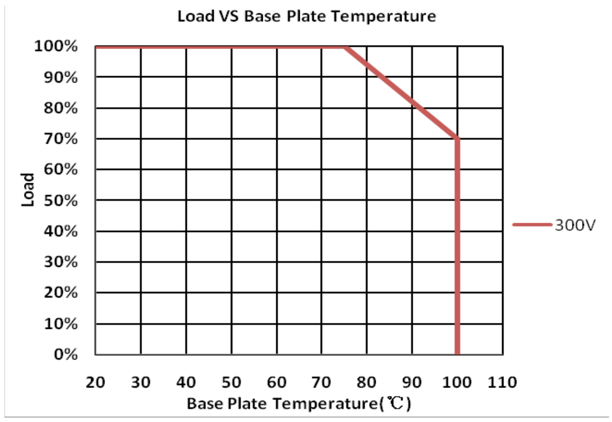
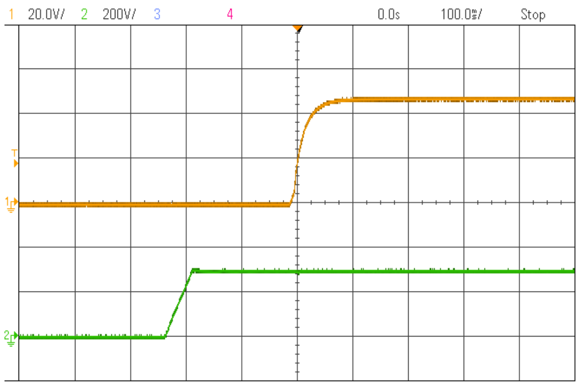
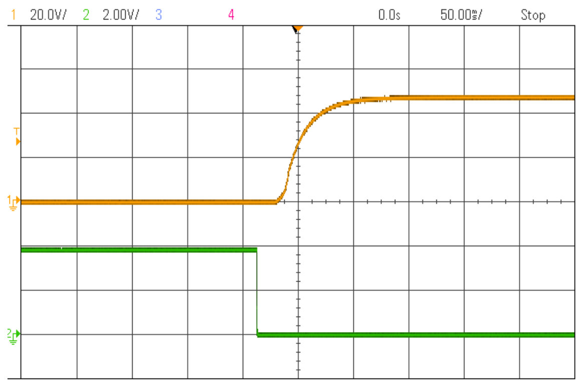
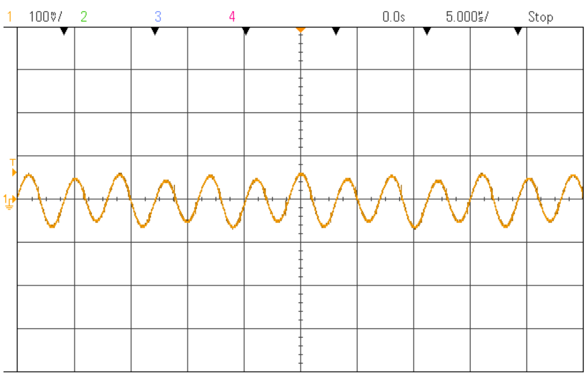
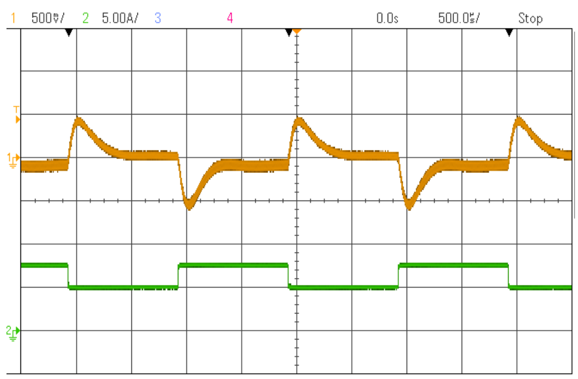
Performance Data (48 Vout)

Output Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Voltage Setpoint	Nom.line, 50% Load	47.52	48.00	48.48	V
Vout Accuracy		-1.0		+1.0	% of Vout
Adjustable Range	Trim up/ Trim down	-20		+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		-2.5		+2.5	%
Over Voltage Protection	Hiccup	113		140	% of Vout
Over Current Protection	First constant current, then hiccup	105		130	% of Iout
Short Circuit Protection	Hiccup				
Remote Sense Voltage				10	%
Ripple & Noise Max. ①			150	350	mV pk-pk
Dynamic Load Peak Deviation ②		-5		+5	% of Vout
Dynamic Load Response			100	500	µS
Current Share Signal Voltage	Nom.line, full Load	3.85	4.00	4.15	V
Current Share Accuracy		-8		+8	%
Capacitive Load		220	330	2200	µF
Minimum Load	No minimum load requirement				

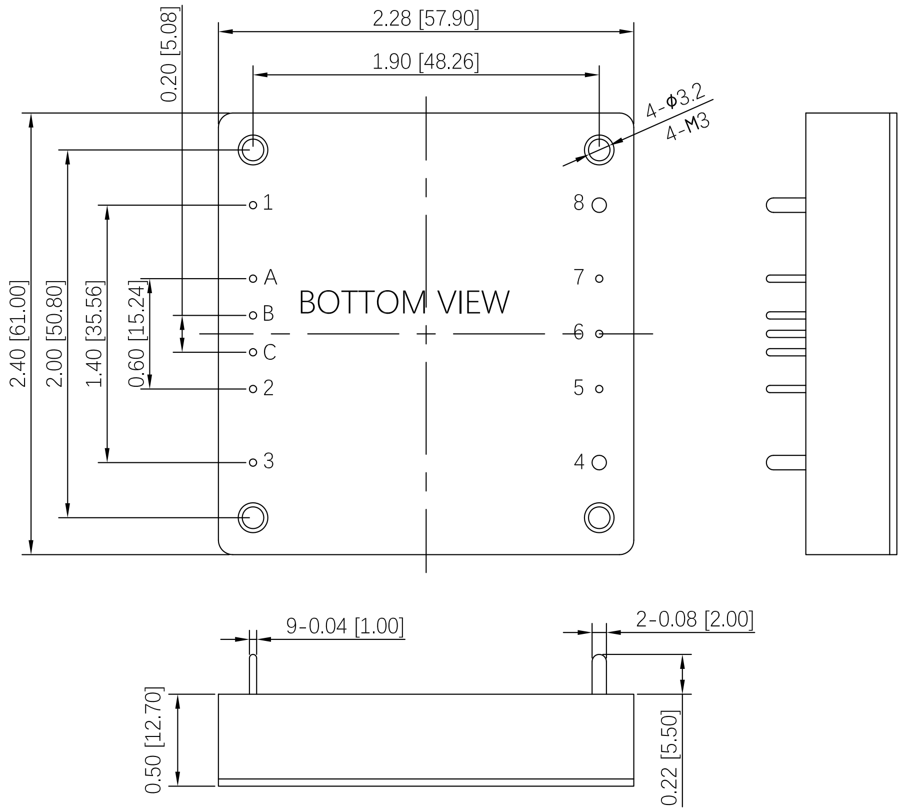
Notes
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 11 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=2.5A/µS, Cout=330µF, please refer to dynamic waveforms in performance data on page 7 for details.

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

Performance Data (48 Vout)

EFFICIENCY VS LOAD	THERMAL DERATING
	
START UP VIN	START UP ENABNLE (NEGATIVE)
Ch1: Vout Ch2: Vin	Ch1: Vout Ch2: Ven
	
RIPPLE & NOISE 20MHz BANDWIDTH	DYNAMIC RESPONSE Ch1: Vout Ch2: Iout
Ch1: Vout	50%~75%~50% of I_{max}, di/dt=2.5A/μs
	

Mechanical Specifications



PIN:

Pin1, PinA, PinB, PinC, Pin2, Pin3, Pin5, Pin6, Pin7: Φ0.04inch
Force: Applied force not exceed 4.9N
Pin4, Pin8 : 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]

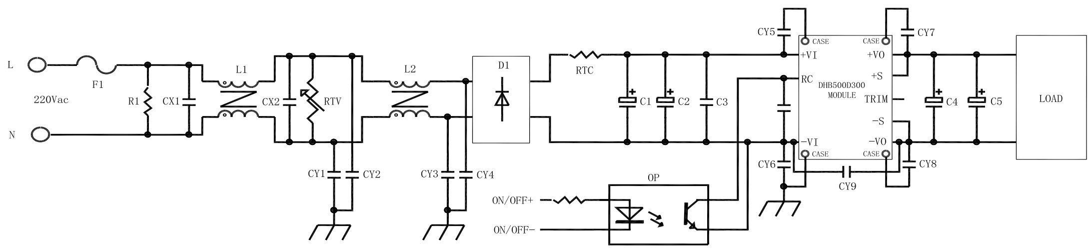
Dimensions are in inches [mm]
Weight: ~125g.

Installation method: Modules installed by M3 or Φ3 screws, each screw torque is less than 0.7 Nm.

PIN CONNECTIONS	
Pin	Function
1	-Vin (Input negative)
A	I share (Single wire parallel signal)
B	Start sync (Startup synchronization)
C	Clock sync (Clock synchronization)
2	RC (Remote control)
3	+Vin (Input positive)
4	+Vout (Output positive)
5	+Sense (Output sense positive)
6	TRIM (Output adjustable)
7	-Sense (Output sense negative)
8	-Vout (Output positive)

Typical Application Connection

Density Power measures its products for conducted emissions against the EN55032 standards. The common mode filter is added at the output of the module, and the maximum output power of the module is 500W.Input voltage is 176~264VAC, EMI filter is added outside the modules and the conduction limit can meet standards.



Conducted Emissions Test Circuit

Recommended Filter Parameters

REFERENCE	DESCRIPTION	REFERENCE	DESCRIPTION
L1	6mH	CY1, CY2	2.2nF/250VAC, Y2
L2	6mH	CY3, CY4	2.2nF/250VAC, Y2
R1	300KΩ	CY5, CY6	4.7nF/250VAC, Y2
CX1	1μF/250VAC, X2	CY7, CY8	683nF/250VAC, Y2
CX2	1μF/250VAC, X2	CY9	4.7nF/250VAC, Y2
C1, C2	470μF/450VDC	RTV	450V
C3	1μF/450VDC, CBB	RTC	10Ω
C4	560μF/50VDC	F1	5A, 250VAC
C5	220μF/50VDC	D1	10A, 250VAC

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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 DHB500D300 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

Please refer to "Typical Application Connection" on page 9.

REFLECTED RIPPLE CURRENT

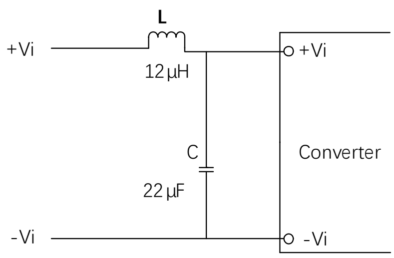

Figure 1· Reflected Ripple Current

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=12μH; C=100μF.

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.

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.

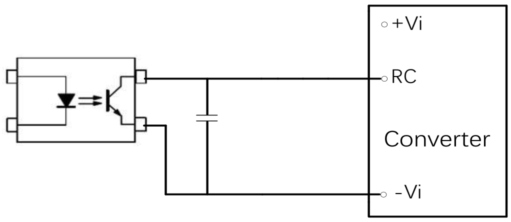

Figure 2· Remote Control

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

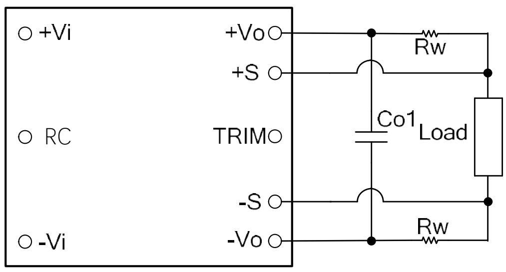

Figure 3· Remote Compensation

The remote compensation function compensates for the voltage drop across the output line. Module compensation function can't exceed 10%, that is:

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[(+VO) - (-VO)]-[(+S) -(-S)] ⩽ 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

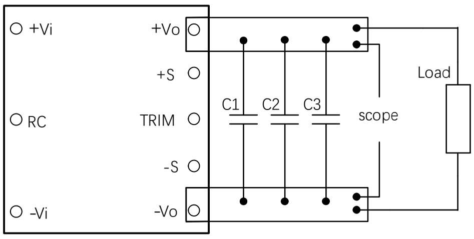

Figure 4· Output Ripple

These DHB500D300 modules' output ripple and noise is measured at the rated input voltage and output current, along with 10uF and 0.1uF MLCC used in parallel with appropriate voltage ratings and placed as C1&C2 shown in the figure above. C3 is the recommended output capacitive load. 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.

CURRENT LIMITING

The output voltage remains constant as the output current increases. However, once the output current is over the specified Output DC Current Limit, the converter turns off.
The converter then enters into “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.

THERMAL SHUTDOWN

These DHB500D300 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.

START SYNC (PIN B)

The start synchronization pin will allow a more synchronously start-up of multiple modules. It will permit immediate start-up in the high load cases. When the start synchronization signal fails, the converter will be turned off. Without this function, any set of converters attempting to start (or re-start) with a load greater than the current limit of a single module will “hiccup”.
The start synchronization signal refers to the input

Technical Notes

voltage negative (-Vin).

CLOCK SYNC (PIN C)

The external clock synchronization pin provides the ability for the user to control the EMI index and synchronize sensitive circuitry to quiet periods in the converter operation. Once this option is adopted, the converter can be synchronized to an external clock signal whose frequency is greater than that of the internal free-running clock. However, increasing the converter's clock frequency will reduce its efficiency.
With this option, the following points should be paid attention to:

• Within permitted, the converter's natural frequency can be synchronized to the given input external clock synchronization.
• All synchronization signals (including external clock) should be referenced to the input voltage negative (-Vin). The synchronization signal negative should be as close as possible to the input of the module, and it is better to wire independently with the input voltage negative.
• The high level of the signal should be between 3.5V and 5.5V, while the low level should be between -0.5V and +1.2V.
• The duty cycle of external clock synchronization signal should be maintained at 20%~80%.
• The recommended frequency range for external clock synchronization signal is 270-300KHz.
• The external synchronous source signal is fixed and stable.
• Do not apply/interrupt a clock synchronization or change frequency while converter is runnig.

CURRENT SHARE (PIN A)

To realize the current share, directly connect the I share pins and start sync pins of multiple modules. Meanwhile, to ensure the current share accuracy, the output sense positive (+Sense) and output sense negative (-Sense) should be connected to the same detection points of the corresponding output positive and negative.

With this option, the following points should be paid attention to:

• The I share pin of each module should be reliably connected together.
• The start synchronization pin of each module should be reliably connected together.
• The I share pin should be referenced to the input voltage negative (-Vin), and it is better to wire independently with the input voltage negative.
• +Sense, -Sense should be connected to the same detection point, preferably the same location on the output power bus.
• To achieve load sharing, it is necessary to use the filter, whose location should be at the end of the power bus.
• If there is no need to use the paralled function, it is suggested to short the I share pin and input voltage negative (-Vin), so as to avoid affecting the output voltage accuracy.

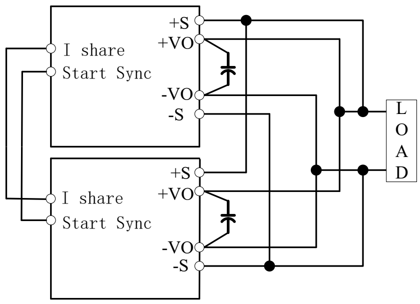

Figure 5· Typical Parallel Application

TRIMMING OUTPUT VOLTAGE

DHB500D300 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 -20% 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

Technical Notes

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.

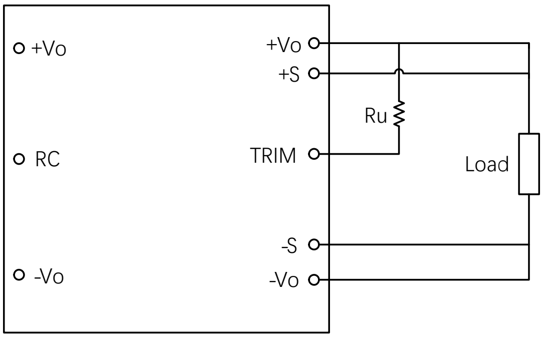

Figure 6· Trim Up Connection

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

$$R_{TRIM-UP} = \left[\frac{V_{O,SET} \times (100 + \Delta)}{2.5 \times \Delta} - \frac{100}{\Delta} - 2 \right] K\Omega$$

"Voset "is the output voltage when TRIM is floating, " Δ" is the change of output voltage, such as: 28V output is raised to 30.8V,
Δ% = (30.8-28) / 28 * 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.

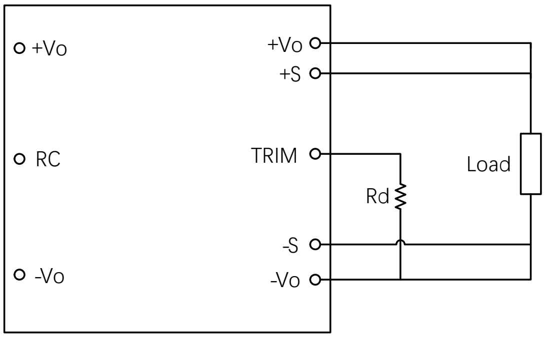

Figure 7· Trim Down Connection

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

$$R_{TRIM-DOWN} = \left[\frac{100}{\Delta} - 2 \right] K\Omega$$

"Voset" is the output voltage when TRIM is floating, "Δ" is the amount of change in output voltage, such as: 28V output is reduced to 25.2V,
Δ = (28-25.2) / 28 * 100 = 10.

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