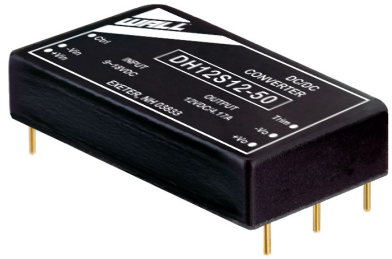
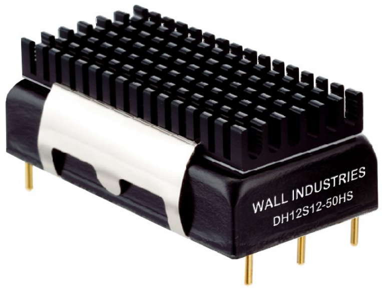
Standard Models



Size: 2.00 x 1.00 x 0.43 inches (50.8 x 25.4 x 11.0 mm)

Heatsink Models (Suffix "HS")



Size: 2.00 x 1.22 x 0.71 inches (50.8 x 31.0 x 18.0 mm)

FEATURES

- RoHS & UL 94V-0 Compliant
- Smallest Encapsulated 50W Converter
- 2:1 Wide Input Voltage Ranges
- Single Outputs
- Remote ON/OFF Control
- 1500VDC I/O Isolation
- No Minimum Load Requirements
- High Efficiency up to 92%
- 2.0" x 1.0" x 0.43" Package Size
- Trimmable Output Voltage
- Shielded Metal Case with Isolated Base-plate
- Over Load, Short Circuit, Over Voltage, & Over Temperature Protection
- -40°C to +80°C Operating Temperature Range
- UL/cUL/IEC/EN 60950-1 Safety Approvals
- Heatsink (Optional)

DESCRIPTION

The DH50 series is the latest generation of high performance DC/DC converters setting a new standard concerning power density. These converters offer 50 Watts of continuous output power in a 2.0" x 1.0" x 0.43" encapsulated, shielded metal package. All models have a 2:1 wide input voltage range and a precisely regulated single output. Advanced circuit topology provides a very high efficiency up to 92% and an operating temperature range of -40°C to +80°C. Further features include remote on/off, trimmable output voltage, under voltage lockout as well as over load, over voltage, short circuit, and over temperature protection. These converters are RoHS compliant and are ideal for use in battery operated equipment, instrumentation, distributed power architectures in communication and industrial electronics and many other space critical applications.

MODEL SELECTION TABLE

Model Number	Input Voltage	Output Voltage	Output Current	Input Current		Reflected Ripple Current (Typ)	Over Voltage Protection	Output Power	Efficiency	Maximum Capacitive Load
				No Load	Max Load					
DH12S3.3-33	12 VDC (9 – 18 VDC)	3.3 VDC	10A	85mA	3090mA	50mA	3.9 VDC	33W	89%	25800µF
DH12S5-50		5 VDC	10A	110mA	4630mA		6.2 VDC	50W	90%	17000µF
DH12S12-50		12 VDC	4.17A	160mA	4580mA		15 VDC	50W	91%	2900µF
DH12S15-50		15 VDC	3.33A	160mA	4580mA		18 VDC	50W	91%	1900µF
DH12S24-50		24 VDC	2.08A	250mA	4570mA		30 VDC	50W	91%	750µF
DH24S3.3-33	24 VDC (18 – 36 VDC)	3.3 VDC	10A	50mA	1550mA	40mA	3.9 VDC	33W	89%	25800µF
DH24S5-50		5 VDC	10A	70mA	2260mA		6.2 VDC	50W	92%	17000µF
DH24S12-50		12 VDC	4.17A	85mA	2260mA		15 VDC	50W	92%	2900µF
DH24S15-50		15 VDC	3.33A	85mA	2260mA		18 VDC	50W	92%	1900µF
DH24S24-50		24 VDC	2.08A	110mA	2290mA		30 VDC	50W	91%	750µF
DH48S3.3-33	48 VDC (36 – 75 VDC)	3.3 VDC	10A	35mA	770mA	30mA	3.9 VDC	33W	89%	25800µF
DH48S5-50		5 VDC	10A	45mA	1130mA		6.2 VDC	50W	92%	17000µF
DH48S12-50		12 VDC	4.17A	50mA	1130mA		15 VDC	50W	92%	2900µF
DH48S15-50		15 VDC	3.33A	50mA	1130mA		18 VDC	50W	92%	1900µF
DH48S24-50		24 VDC	2.08A	60mA	1150mA		30 VDC	50W	91%	750µF

NOTES

1. Transient recovery time is measured to within 1% error band for a step change in output load from 75% to 100%.
2. We recommend protecting the converter by a slow blow fuse in the input supply line.
3. The DH50 series can meet EN55022 Class A with external capacitors in parallel with the input pins.
   - 12Vin Models: 22µF/25V 1210 MLCC
   - 24Vin Models: 3.3µF/50V 1210 MLCC
   - 48Vin Models: 2.2µF/100V 1210 MLCC
4. To meet EN61000-4-4 & EN61000-4-5 an external capacitor across the input pins is required. Suggested capacitor: CHEMI-CON KY 330µF/100V
5. Do not exceed maximum power specifications when adjusting the output voltage.
6. To order the converter with a heatsink, please add the suffix "HS" to the model number. (Ex: DH12S12-50HS).
7. This product is Listed to applicable standards and requirements by UL.

Due to advances in technology, specifications subject to change without notice.

SPECIFICATIONS: DH50 SERIES

All specifications are based on 25°C, Nominal Input Voltage, and Maximum Output Current unless otherwise noted.
We reserve the right to change specifications based on technological advances.

SPECIFICATION	TEST CONDITIONS		Min	Typ	Max	Unit
INPUT SPECIFICATIONS						
Input Voltage Range	12VDC nominal input models		9	12	18	VDC
	24VDC nominal input models		18	24	36	
	48VDC nominal input models		36	48	75	
Input Surge Voltage (100ms max.)	12VDC nominal input models		-0.7		25	VDC
	24VDC nominal input models		-0.7		50	
	48VDC nominal input models		-0.7		100	
Start-up Threshold Voltage	12VDC nominal input models				9	VDC
	24VDC nominal input models				18	
	48VDC nominal input models				36	
Under Voltage Lockout (UVLO)	12VDC nominal input models			8.3		VDC
	24VDC nominal input models			16.5		
	48VDC nominal input models			33		
Start-up Time	Nominal Vin and constant resistive load	Power Up			30	ms
		Remote On/Off			30	
Input Current			See Table			
Reflected Ripple Current *(Page 10)*			See Table			
Conducted EMI	for EN55032 Class A and FCC level A compliance see Note 3		Internal LC Filter			
Short Circuit Current	Hiccup mode	24VDC output models		0.3		Hz
		Others		1.5		
OUTPUT SPECIFICATIONS						
Output Voltage			See Table			
Line Regulation	Low line to high line at full load				±0.5	%
Load Regulation	Minimum load to full load				±0.5	%
Output Voltage Setting Accuracy	At 50% load and nominal Vin				±1.0	%Vnom
Output Voltage Trim *(Page 5)*	% of nominal output voltage	24VDC output models	-10		+20	%
		Others	-10		+10	
Output Power			See Table			
Output Current			See Table			
Minimum Load			No minimum load required			
Ripple & Noise (0-20MHz) *(Page 10)*	Measured with a 1µF MLCC and a 10µF tantalum capacitor in parallel	3.3V & 5V output models			100	mVp-p
		12V, 15V, & 24V output models			150	
Transient Recovery Time *(Note 1)*	25% load step change			250		µs
Transient Recovery Deviation *(Note 1)*	25% load step change			±3	±5	%
Temperature Coefficient					±0.02	%/°C
PROTECTION						
Input Polarity Protection			none			
Over Voltage Protection *(page 10)*			For shutdown voltage see table			
Over Current Protection	Hiccup		Current limitation at 150% typ. of Iout max.			
Thermal Protection	Shutdown temperature			110		°C
Short Circuit Protection			Hiccup, automatic recovery			
GENERAL SPECIFICATIONS						
Efficiency	*(see efficiency curves on pages 7-9)*		See Table			
Switching Frequency	24VDC output models			285		KHz
	Others			320		
Isolation Voltage (Input to Output)	60 seconds		1500			VDC
	1 second		1800			
Isolation Resistance	500VDC		1000			MΩ
Isolation Capacitance	100kHz, 1V				2200	pF
Maximum Capacitive Load			See Table			

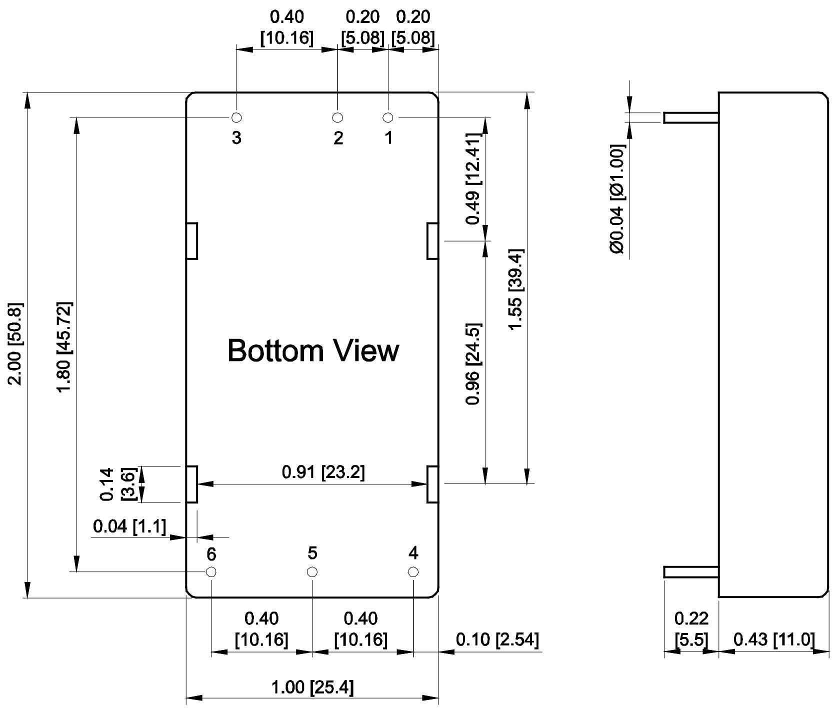
SPECIFICATIONS: DH50 SERIES

All specifications are based on 25°C, Nominal Input Voltage, and Maximum Output Current unless otherwise noted.
We reserve the right to change specifications based on technological advances.

SPECIFICATION	TEST CONDITIONS	Min	Typ	Max	Unit
REMOTE ON/OFF *(Page 10)*					
Positive Logic – Converter On		3.5 ~ 12V or open circuit			
Positive Logic – Converter Off		0V ~ 1.2 or short circuit			
Control Input Current – On	Vctrl = 5.0V		0.5		mA
Control Input Current – Off	Vctrl = 0V		-0.5		mA
Control Common		Referenced to negative input			
Stand-by Input Current	Nominal Vin		2.5		mA
ENVIRONMENTAL SPECIFICATIONS					
Operating Temperature (W/O Heatsink) *(see derating curves on pages 6-7)*	Natural air convection (20LFM) Nominal Vin and full load – 3.3VDC Output Models	-40		+56	°C
	DH24S5-50, DH24S12-50 DH24S15-50, DH48S5-50 DH48S12-50, DH48S15-50	-40		+53	°C
	DH12S12-50, DH12S15-50, DH12S24-50, DH24S24-50, DH48S24-50	-40		+46	°C
	DH12S5-50	-40		+38	°C
Operating Temperature (W/ Heatsink) *(see derating curves on pages 6-7)*	Natural air convection (20LFM) Nominal Vin and full load – 3.3VDC Output Models	-40		+64	°C
	DH24S5-50, DH24S12-50 DH24S15-50, DH48S5-50 DH48S12-50, DH48S15-50	-40		+62	°C
	DH12S12-50, DH12S15-50, DH12S24-50, DH24S24-50, DH48S24-50	-40		+56	°C
	DH12S5-50	-40		+49	°C
Thermal Impedance (W/O Heatsink)	Natural convection (20LFM)	12.1			°C/W
	100LFM convection	9.2			°C/W
	200LFM convection	7.8			°C/W
	400LFM convection	5.2			°C/W
Thermal Impedance (W/ Heatsink)	Natural convection (20LFM)	9.8			°C/W
	100LFM convection	5.4			°C/W
	200LFM convection	4.5			°C/W
	400LFM convection	3.0			°C/W
Case Temperature				+105	°C
Storage Temperature		-50		+125	°C
Humidity (non-condensing)				95	% RH
RFI		Six-sided shielding, metal case			
Cooling	Natural convection is about 20LFM but is not equal to still air (0LFM)	natural convection			
Lead Temperature	1.5mm from case for 10 seconds			260	°C
MTBF (calculated)	MIL-HDBK-217F at 25°C, Ground Benign	224,700			hours
PHYSICAL SPECIFICATIONS					
Weight		1.06oz (30g)			
Dimensions (L x W x H)		2.00 x 1.00 x 0.43 inches (50.8 x 25.4 x 11.0 mm)			
Case Material		Aluminum alloy, black anodized coating			
Base Material		FR4 PCB (flammability to UL 94V-0 rated)			
Potting Material		Epoxy (UL94-V0)			
Pin Material		Copper alloy with gold plate over nickel sub-plate			
Heatsink (optional)	"HS" suffix	See page 4			
SAFETY & EMC					
Safety Approvals		UL/cUL 60950-1 recognition (CSA certificate)(7)			
		IEC/EN 60950-1 (CB-scheme)			
EMI (See Note 3)	EN55032, FCC part 15	Class A			
EMS	EN55024				
	ESD – EN61000-4-2 – Air: ±8KV, Contact: ±6KV	A			
	Radiated Immunity – EN61000-4-3 – 10V/m	A			
	Fast Transient (See Note 4) – EN61000-4-4 – ±2KV	A			
	Surge (See Note 4) – EN61000-4-5 – ±1KV	A			
	Conducted Immunity – EN61000-4-6 – 10V/m	A			

MECHANICAL DRAWINGS

Standard Models



PIN CONNECTIONS	
Pin	**Function**
1	+Vin
2	-Vin
3	Remote On/Off
4	+Vout
5	-Vout
6	Trim

Unit: inches [mm]

Tolerance: X.XX±0.01 [X.X±0.25]
X.XXX±0.005 [X.XX±0.13]

Pin Diameter: Ø0.04±0.002 [Ø1.0±0.05]

Physical Characteristics

Case Size: 2.00 x 1.00 x 0.43 inches [50.8 x 25.4 x 11.0 mm]

Case Material: Aluminum alloy, black anodized coating

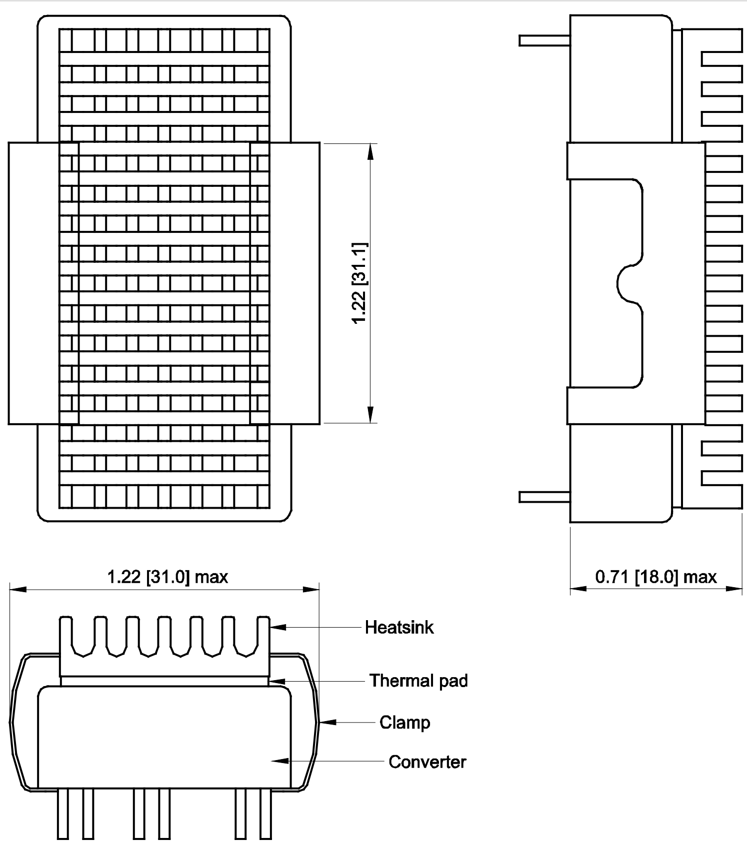
Base Material: FR4 PCB (flammability to UL 94V-0 rated)

Pin Material: Copper alloy with gold plate over nickel subplate

Potting Material: Epoxy (UL94-V0)

Weight: 1.06oz (30g)

Heatsink Models ("HS" Suffix)



Unit: inches [mm]

Physical Characteristics

Heatsink Material: Aluminum

Finish: Black Anodized Coating

Heatsink Weight: 0.3oz (9g)

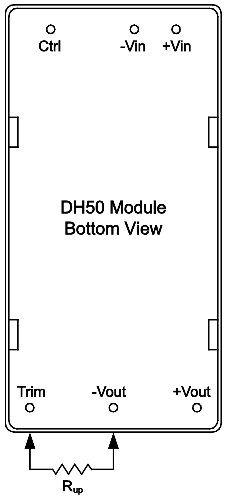
Advantages of Adding a Heatsink

1. To help heat dissipation and increase the stability and reliability of DC/DC converters at high operating temperature atmosphere.
2. To upgrade the operating temperature of DC/DC converters, please refer to Derating Curve.

OUTPUT VOLTAGE ADJUSTMENT

Output voltage trim allows the user to increase or decrease the output voltage of a module. This is accomplished by connecting an external resistor between the Trim pin and either the +Vout or –Vout pins. With an external resistor between the Trim and –Vout pins, the output voltage increases. With an external resistor between the Trim and +Vout pins, the output voltage set-point decreases.

Trim Up



DHXXS3.3-33		
Trim	$V_{out,up}$	R_{up}
1%	3.333V	60.84kΩ
2%	3.366V	27.40kΩ
3%	3.399V	16.25kΩ
4%	3.432V	10.68kΩ
5%	3.465V	7.34kΩ
6%	3.498V	5.11kΩ
7%	3.531V	3.51kΩ
8%	3.564V	2.32kΩ
9%	3.597V	1.39kΩ
10%	3.630V	0.65kΩ

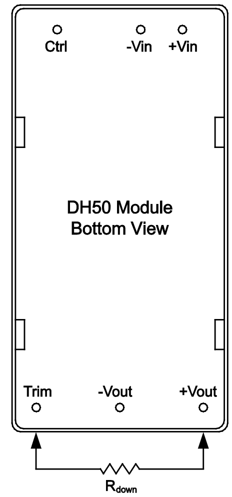
DHXXS5-50		
Trim	$V_{out,up}$	R_{up}
1%	5.05V	106.87kΩ
2%	5.10V	47.76kΩ
3%	5.15V	28.06kΩ
4%	5.20V	18.21kΩ
5%	5.25V	12.30kΩ
6%	5.30V	8.36kΩ
7%	5.35V	5.55kΩ
8%	5.40V	3.44kΩ
9%	5.45V	1.79kΩ
10%	5.50V	0.48kΩ

DHXXS12-50		
Trim	$V_{out,up}$	R_{up}
1%	12.12V	351.00kΩ
2%	12.24V	157.50kΩ
3%	12.36V	93.00kΩ
4%	12.48V	60.75kΩ
5%	12.60V	41.40kΩ
6%	12.72V	28.50kΩ
7%	12.84V	19.29kΩ
8%	12.96V	12.37kΩ
9%	13.08V	7.00kΩ
10%	13.20V	2.70kΩ

DHXXS15-50		
Trim	$V_{out,up}$	R_{up}
1%	15.15V	427.77kΩ
2%	15.30V	189.89kΩ
3%	15.45V	112.26kΩ
4%	15.60V	73.44kΩ
5%	15.75V	50.15kΩ
6%	15.90V	34.63kΩ
7%	16.05V	23.54kΩ
8%	16.20V	15.22kΩ
9%	16.35V	8.75kΩ
10%	16.50V	3.58kΩ

DHXXS24-50		
Trim	$V_{out,up}$	R_{up}
2%	24.48V	243.70kΩ
4%	24.96V	108.50kΩ
6%	25.44V	63.43kΩ
8%	25.92V	40.90kΩ
10%	26.40V	27.38kΩ
12%	26.88V	18.37kΩ
14%	27.36V	11.93kΩ
16%	27.84V	7.10kΩ
18%	28.32V	3.34kΩ
20%	28.80V	0.34kΩ

Trim Down



DHXXS3.3-33		
Trim	$V_{out,down}$	R_{down}
1%	3.267V	72.61kΩ
2%	3.234V	32.55kΩ
3%	3.201V	19.20kΩ
4%	3.168V	12.52kΩ
5%	3.135V	8.51kΩ
6%	3.102V	5.84kΩ
7%	3.069V	3.94kΩ
8%	3.036V	2.51kΩ
9%	3.003V	1.39kΩ
10%	2.970V	0.50kΩ

DHXXS5-50		
Trim	$V_{out,down}$	R_{down}
1%	4.95V	138.88kΩ
2%	4.90V	62.41kΩ
3%	4.85V	36.92kΩ
4%	4.80V	24.18kΩ
5%	4.75V	16.53kΩ
6%	4.70V	11.44kΩ
7%	4.65V	7.79kΩ
8%	4.60V	5.06kΩ
9%	4.55V	2.94kΩ
10%	4.50V	1.24kΩ

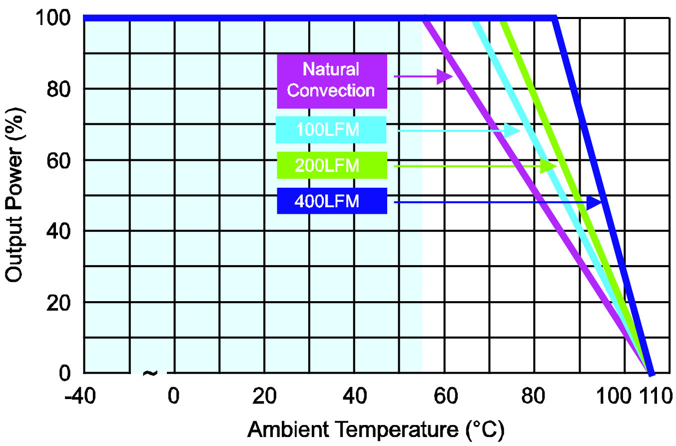
DHXXS12-50		
Trim	$V_{out,down}$	R_{down}
1%	11.88V	413.55kΩ
2%	11.76V	184.55kΩ
3%	11.64V	108.22kΩ
4%	11.52V	70.05kΩ
5%	11.40V	47.15kΩ
6%	11.28V	31.88kΩ
7%	11.16V	20.98kΩ
8%	11.04V	12.80kΩ
9%	10.92V	6.44kΩ
10%	10.80V	1.35kΩ

DHXXS15-50		
Trim	$V_{out,down}$	R_{down}
1%	14.85V	530.73kΩ
2%	14.70V	238.61kΩ
3%	14.55V	141.24kΩ
4%	14.40V	92.56kΩ
5%	14.25V	63.35kΩ
6%	14.10V	43.87kΩ
7%	13.95V	29.96kΩ
8%	13.80V	19.53kΩ
9%	13.65V	11.41kΩ
10%	13.50V	4.92kΩ

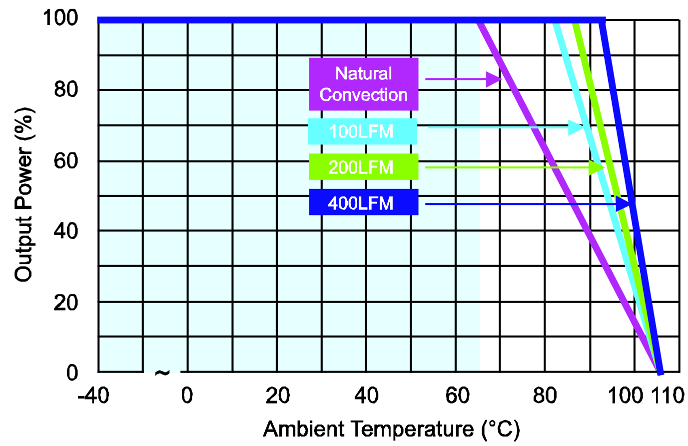
DHXXS24-50		
Trim	$V_{out,down}$	R_{down}
1%	23.760V	333.39kΩ
2%	23.520V	148.80kΩ
3%	23.280V	87.26kΩ
4%	23.040V	56.50kΩ
5%	22.800V	38.04kΩ
6%	22.560V	25.73kΩ
7%	22.320V	16.94kΩ
8%	22.080V	10.35kΩ
9%	21.840V	5.22kΩ
10%	21.600V	1.12kΩ

DERATING CURVES

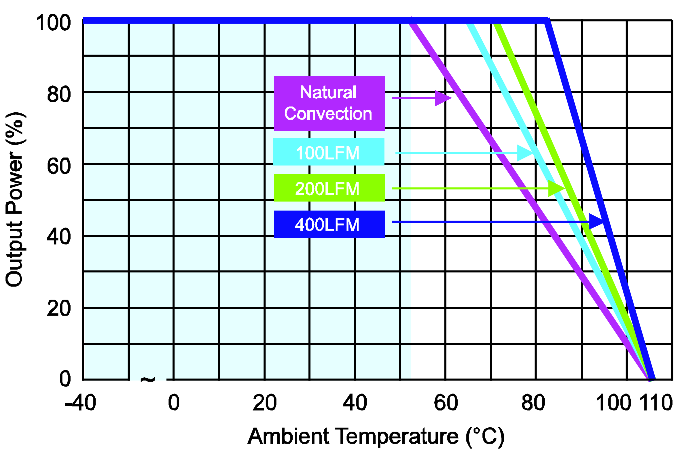
DH12S3.3-33, DH24S3.3-33, DH48S3.3-33
Derating Curve Without Heatsink



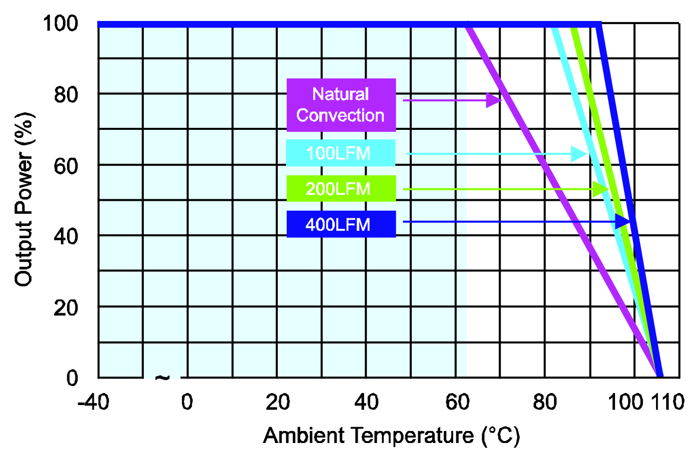
DH12S3.3-33, DH24S3.3-33, DH48S3.3-33
Derating Curve With Heatsink



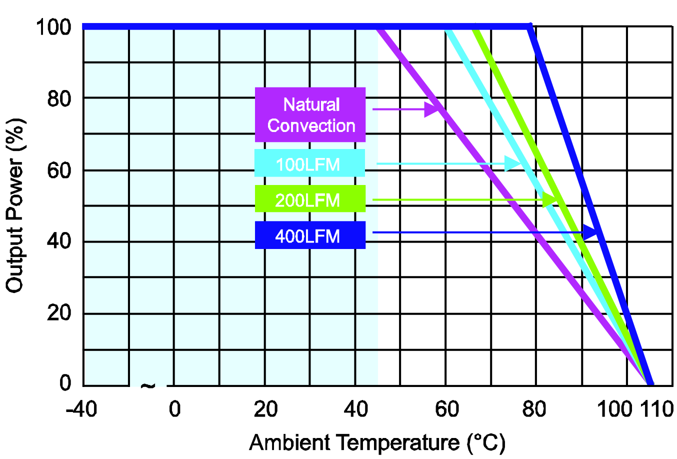
DH24S5-50, DH24S12-50, DH24S15-50, DH48S5-50, DH48S12-50, DH48S15-50 Derating Curve Without Heatsink



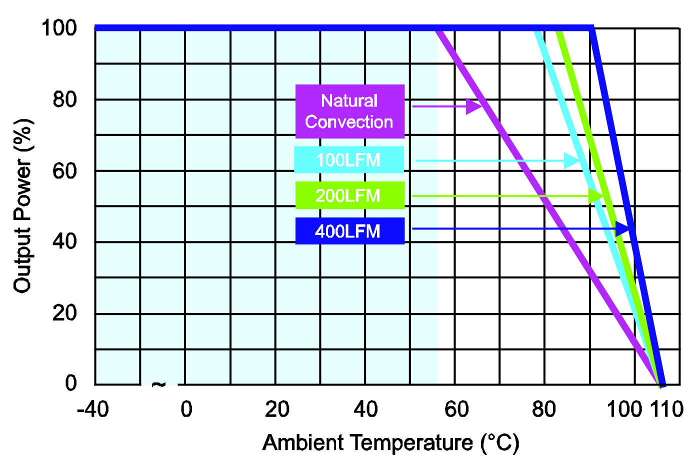
DH24S5-50, DH24S12-50, DH24S15-50, DH48S5-50, DH48S12-50, DH48S15-50 Derating Curve With Heatsink



DH12S12-50, DH12S15-50, DH12S24-50, DH24S24-50, DH48S24-50
Derating Curve Without Heatsink

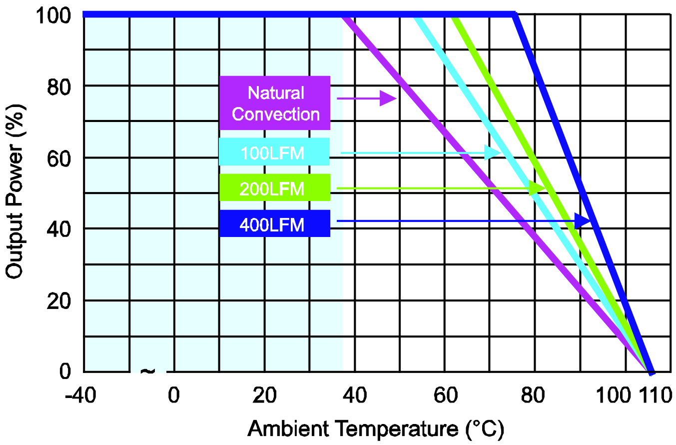


DH12S12-50, DH12S15-50, DH12S24-50, DH24S24-50, DH48S24-50
Derating Curve With Heatsink

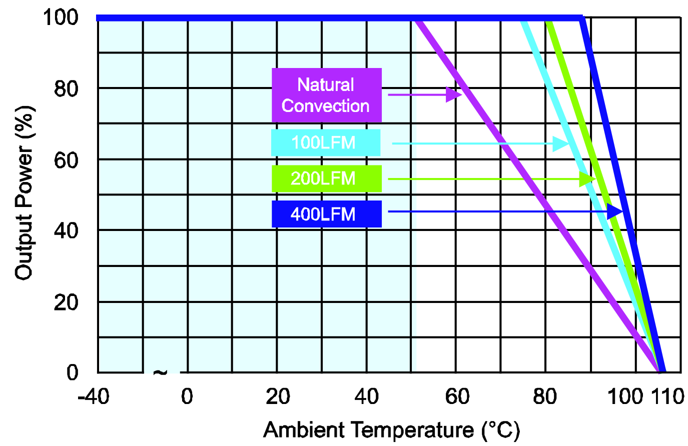


DERATING CURVES

DH12S5-50 Derating Curve Without Heatsink

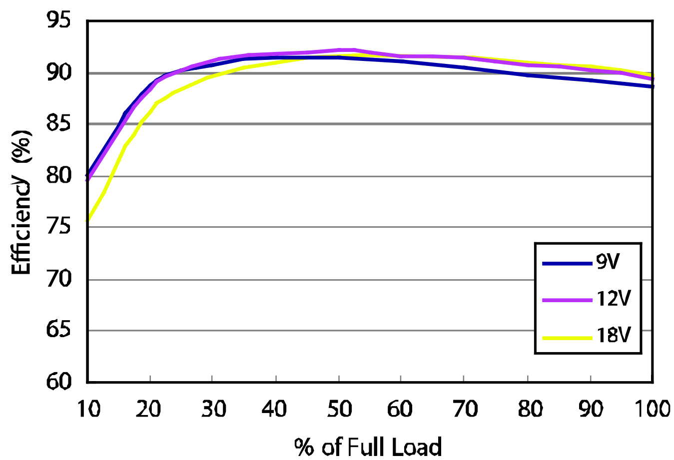


DH12S5-50 Derating Curve With Heatsink

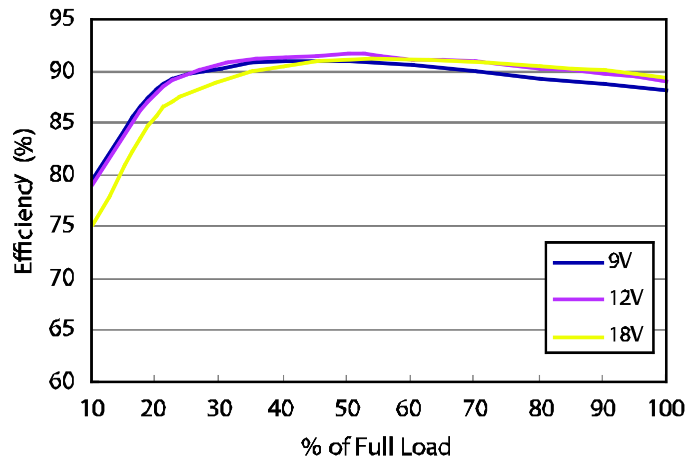


EFFICIENCY CURVES

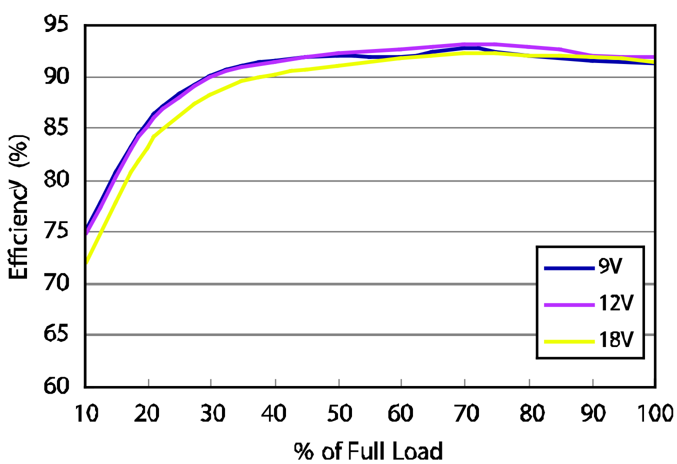
DH12S3.3-33 Efficiency vs Load Current



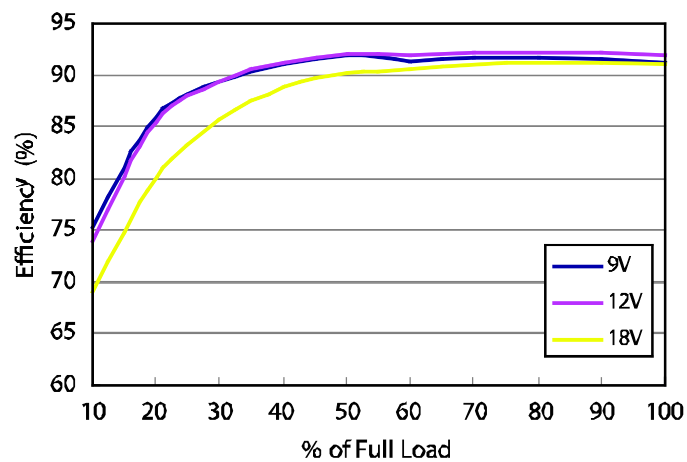
DH12S5-50 Efficiency vs Load Current



DH12S12-50 Efficiency vs Load Current

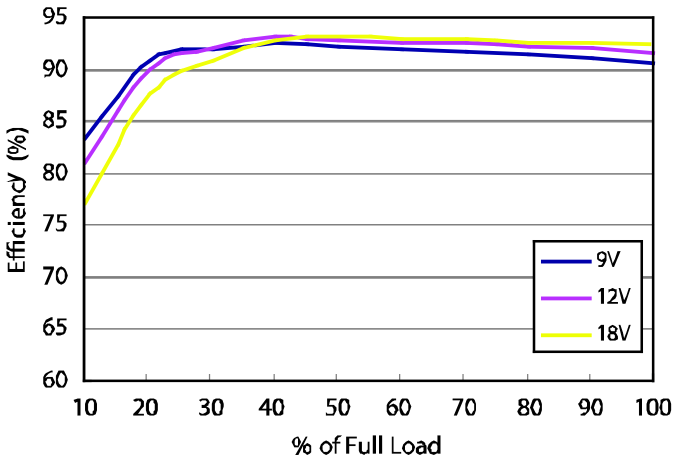


DH12S15-50 Efficiency vs Load Current

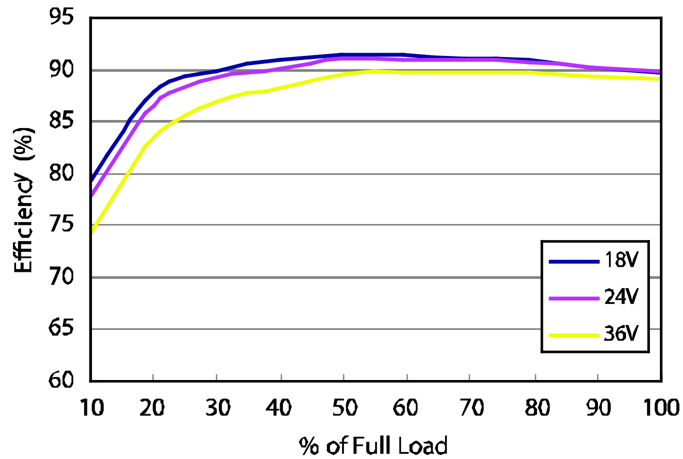


EFFICIENCY CURVES

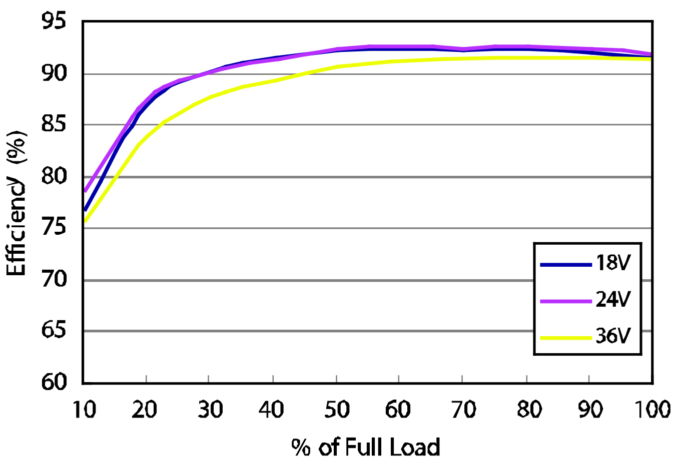
DH12S24-50 Efficiency vs Load Current



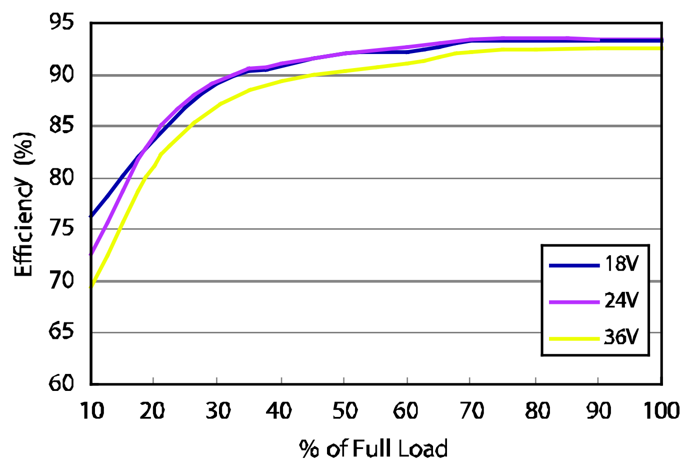
DH24S3.3-33 Efficiency vs Load Current



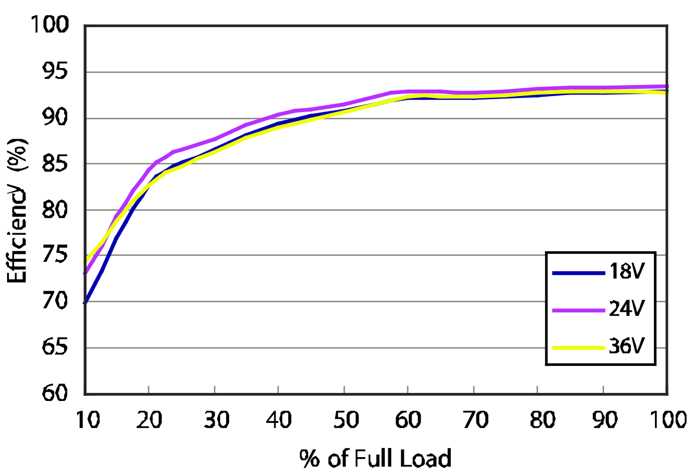
DH24S5-50 Efficiency vs Load Current



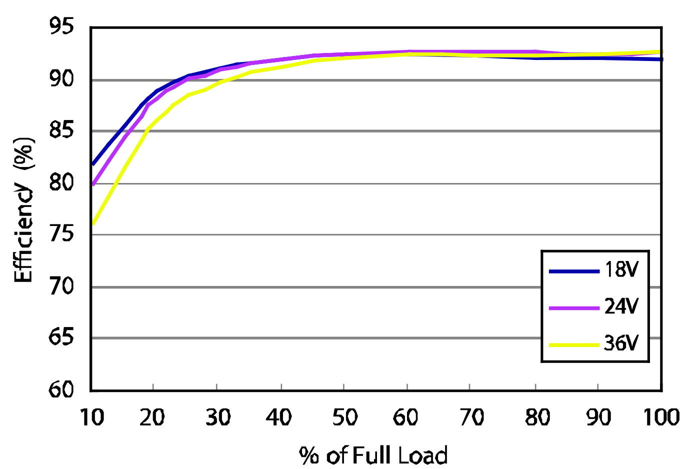
DH24S12-50 Efficiency vs Load Current



DH24S15-50 Efficiency vs Load Current

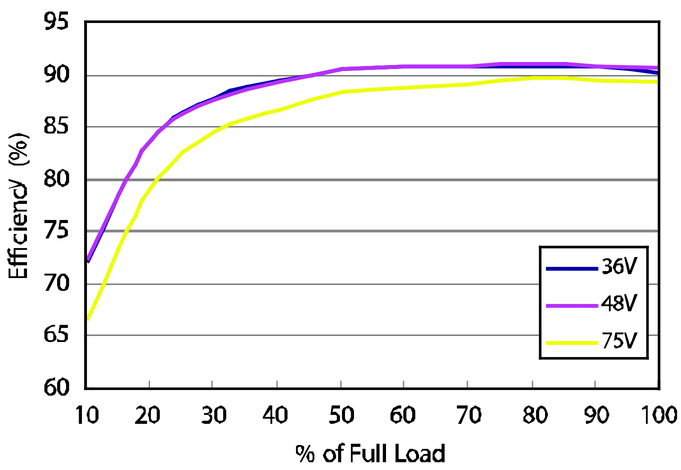


DH24S24-50 Efficiency vs Load Current

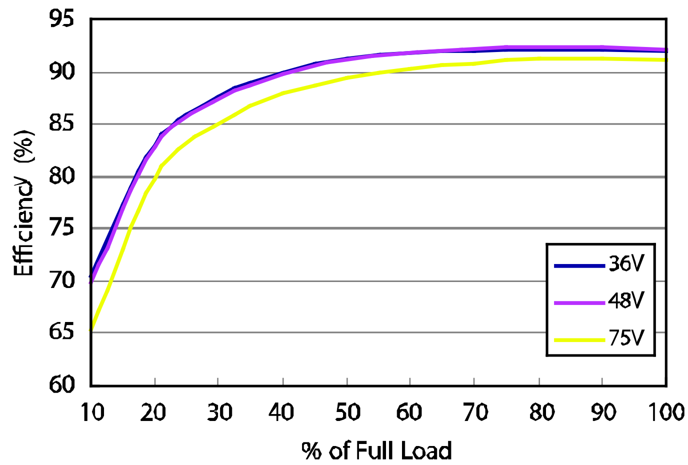


EFFICIENCY CURVES

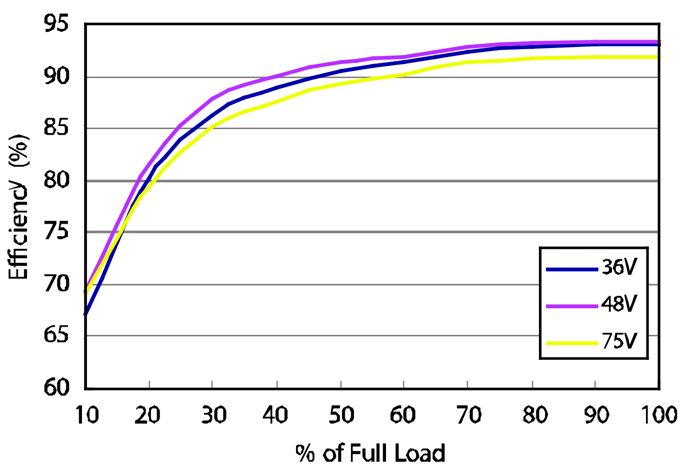
DH48S3.3-33 Efficiency vs Load Current



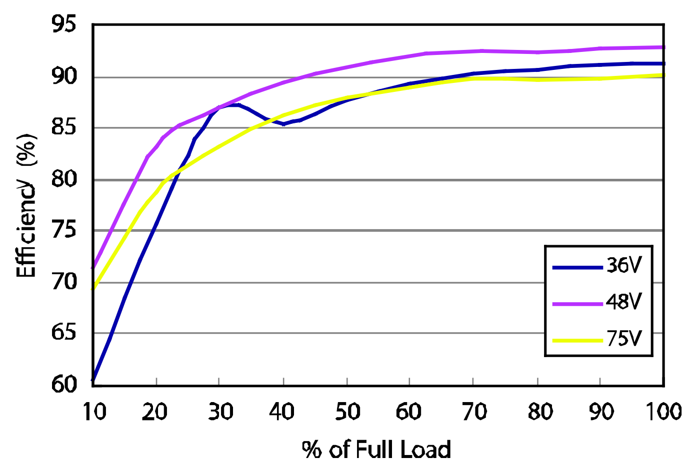
DH48S5-50 Efficiency vs Load Current



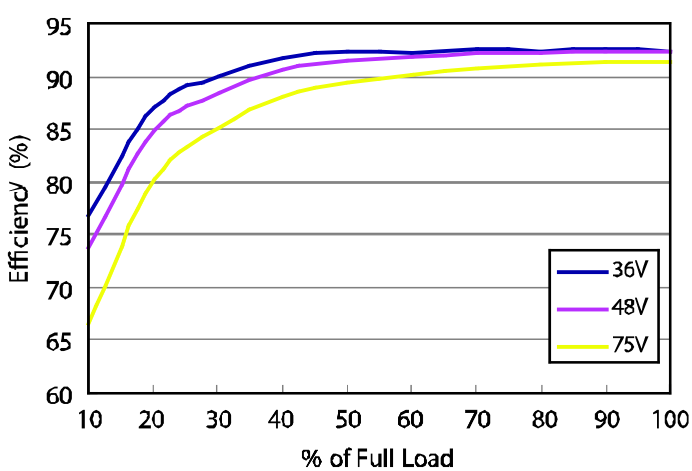
DH48S12-50 Efficiency vs Load Current



DH48S15-50 Efficiency vs Load Current



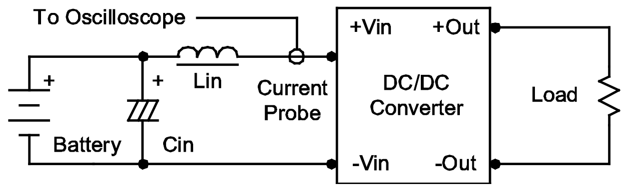
DH48S24-50 Efficiency vs Load Current



DESIGN CONSIDERATIONS

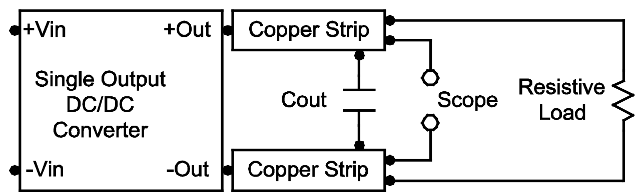
Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor Lin (4.7µH) and Cin (220µF, ESR < 1.0Ω at 100 KHz) to simulate source impedance. Capacitor Cin offsets possible battery impedance. Current ripple is measured at the input terminals of the module. Measurement bandwidth is 0-500 KHz.



Peak-to-Peak Output Noise Measurement Test

Use a 1µF ceramic capacitor and a 10µF tantalum capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20MHz. Position the load between 50mm and 75mm from the DC/DC converter.



TEST SETUP

Remote On/Off

Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin and off during a logic low. To turn the module on and off, the user must supply a switch to control the voltage between the on/off terminal and the –Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum sink current at on/off terminal (Pin 3) during a logic low is -100µA.

Over Current Protection

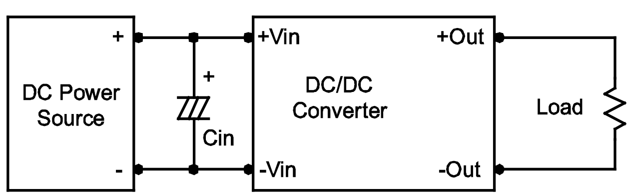
To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

Over Voltage Protection

The output over voltage clamp consists of control circuitry which is independent of the primary regulation loop that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces the risk of output over voltage. The OVP level can be found in the model selection table.

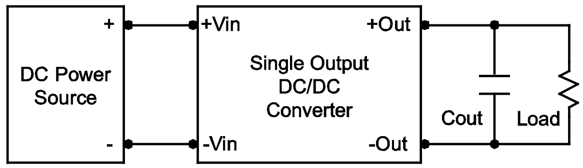
Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup. Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 KHz) capacitor of 33µF for the 12VDC input models and a 10µF for the 24VDC and 48VDC input models.



Output Ripple Reduction

A good quality low ESR capacitor placed as close as possible across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 4.7μF capacitors at the output.

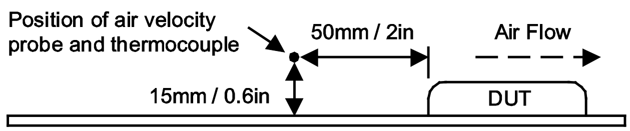


Maximum Capacitive Load

The DH50 series has a limitation of maximum connected capacitance on the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the start-up time. The maximum capacitance can be found in the Model Selection Table.

Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module, and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 105°C. The derating curves are determined from measurements obtained in a test setup.



MODEL NUMBER SETUP

DH	24	S	12	-	50	HS
Series Name	Input Voltage	Output Quantity	Ouptut Voltage		Output Power	Heatsink
	12: 9 - 18 VDC **24:** 18 - 36 VDC **48:** 36 - 75 VDC	**S:** Single Output	**3.3:** 3.3 VDC **5:** 5 VDC **12:** 12 VDC **15:** 15 VDC **24:** 24 VDC		**33:** 33 Watts **50:** 50 Watts	**None:** No Heatsink **HS:** Heatsink

COMPANY INFORMATION

Wall Industries, Inc. has created custom and modified units for over 50 years. Our in-house research and development engineers will provide a solution that exceeds your performance requirements on-time and on budget. Our ISO9001: 2015 certification is just one example of our commitment to producing a high quality, well-documented product for our customers.

Our past projects demonstrate our commitment to you, our customer. Wall Industries, Inc. has a reputation for working closely with its customers to ensure each solution meets or exceeds form, fit and function requirements. We will continue to provide ongoing support for your project above and beyond the design and production phases. Give us a call today to discuss your future projects.

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