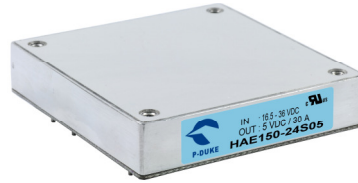


# HAE150 SERIES

## HALF-BRICK DC-DC CONVERTER



2:1 WIDE INPUT RANGE  
UP TO 196Watts



### FEATURES

- NO MINIMUM LOAD REQUIRED
- 2250VDC INPUT TO OUTPUT BASIC INSULATION
- SAFETY MEETS UL60950-1, EN60950-1, & IEC60950-1
- CE MARKED
- COMPLIANT TO RoHS II & REACH

### APPLICATIONS

- WIRELESS NETWORK
- TELECOM/DATACOM
- INDUSTRY CONTROL SYSTEM
- DISTRIBUTED POWER ARCHITECTURES
- SEMICONDUCTOR EQUIPMENT

2250VDC ISOLATION	REMOTE CONTROL	UVP	OCP	SCP	OVP	OTP	SYNC
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### TECHNICAL SPECIFICATION

All specifications are typical at nominal input, full load and 25°C otherwise noted

Model Number	Input Range	Output Voltage	Output Current @Full Load	Input Current @ No Load	Efficiency	Maximum Capacitor Load
	VDC	VDC	A	mA		
HAE150-12S3P3	9 ~ 22	3.3	40	30	88	121000
HAE150-12S05	9 ~ 22	5	28	50	90	56000
HAE150-12S12	8.5 ~ 22	12	12	50	91	10000
HAE150-12S15	8.5 ~ 22	15	9.5	80	91	6300
HAE150-12S24	8.5 ~ 22	24	6	60	90	2500
HAE150-12S28	8.5 ~ 22	28	5	60	91	1700
HAE150-12S48	8.5 ~ 22	48	3	80	90	620
HAE150-24S3P3	16.5 ~ 36	3.3	40	20	90	121000
HAE150-24S05	16.5 ~ 36	5	30	30	91	60000
HAE150-24S12	16.5 ~ 36	12	13	35	92	10800
HAE150-24S15	16.5 ~ 36	15	10	35	92	6600
HAE150-24S24	16.5 ~ 36	24	6.5	35	93	2700
HAE150-24S28	16.5 ~ 36	28	5.5	50	93	1900
HAE150-24S48	16.5 ~ 36	48	3.3	50	92	680
HAE150-48S3P3	33 ~ 75	3.3	45	20	91	136000
HAE150-48S05	33 ~ 75	5	34	20	92	68000
HAE150-48S12	33 ~ 75	12	16	25	92	13300
HAE150-48S15	33 ~ 75	15	13	25	93	8600
HAE150-48S24	33 ~ 75	24	8	25	92	3300
HAE150-48S28	33 ~ 75	28	7	25	92	2500
HAE150-48S48	33 ~ 75	48	4	25	92	830
HAE150-48S53	33 ~ 75	53	3.7	25	92	690

### PART NUMBER STRUCTURE

Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Ctrl and Pin Options	SYNC pin Option	CASE pin Option	Through hole type <sup>(1)</sup>	Assembly Option
HAE150-48S05-PYCHS	12:8.5~22 9~22 24:16.5~36 48:33~75	S:Single	3P3:3.3 05:5 12:12 15:15 24:24 28:28 48:48 53:53	□:Negative logic, 0.200" pin length L:Negative logic, 0.145" pin length P:Positive logic, 0.200" pin length S:Positive logic, 0.145" pin length	□:NC Y:SYNC pin	□:NC C:CASE pin	□: Thread TH: No thread	□: No Heat-sink <b>Heat-sink type:</b> HS: Height H=0.45" vertical fin, 7G-0021A-F HS1: Height H=0.24" horizontal fin, 7G-0022A-F HS2: Height H=0.24" vertical fin, 7G-0023A-F HS3: Height H=0.45" horizontal fin, 7G-0024A-F <b>Terminal block type<sup>(2)</sup>:</b> T: Wall mounted TF: Wall mounted with EMC filter <sup>(3)</sup> TF1: Wall mounted with EMC filter can be connected to PE ⊕ <sup>(3)</sup>

(1) The module can't equip Heat-sink with TH option.

(2) No Y and C function for terminal block type, and terminal block type only for 0.200" pin length.

(3) EMI filter meet EN55022 Class A.

## INPUT SPECIFICATIONS

Parameter	Conditions		Min.	Typ.	Max.	Unit
Operating input voltage range		12Vin(nom)      3.3 & 5Vout Others	9	12	22	VDC
		24Vin(nom)	8.5	12	22	
		48Vin(nom)	16.5	24	36	
Start up voltage		12Vin(nom)			9	VDC
		24Vin(nom)			18	
		48Vin(nom)			34	
Shutdown voltage		12Vin(nom)	7.3		8.1	VDC
		24Vin(nom)	15.5		16.3	
		48Vin(nom)	31.6		32.5	
Start up time	Constant resistive load	Power up Remote ON/OFF		75 75		ms
Input surge voltage	1 second, max.	12Vin(nom)			30	
		24Vin(nom)			50	
		48Vin(nom)			100	
Input filter <sup>(1)</sup>					Pi type	
Remote ON/OFF	Referred to -Vin pin	Negative logic      DC-DC ON (Standard)          DC-DC OFF Positive logic      DC-DC ON (Option)             DC-DC OFF Input current of Ctrl pin Remote off input current			Short or 0 ~ 1.2VDC Open or 3 ~ 12 VDC Open or 3 ~ 12 VDC Short or 0 ~ 1.2VDC	
Sync pin signal <sup>(2)</sup>			-0.3		5.6	VDC

## OUTPUT SPECIFICATIONS

Parameter	Conditions		Min.	Typ.	Max.	Unit
Voltage accuracy			-1.0		+1.0	%
Line regulation	Low Line to High Line at Full Load		-0.1		+0.1	%
Load regulation	No Load to Full Load		-0.1		+0.1	%
Voltage adjustability	Maximum output deviation is inclusive of remote sense		-20		+10	%
Remote sense	% of Vout(nom) If remote sense is not being used, Sense pins should be connected to corresponding polarity OUTPUT pins.				10	%
Ripple and noise	Measured by 20MHz bandwidth			75		mVp-p
	With a 1 $\mu$ F/25V X7R MLCC and a 22 $\mu$ F/25V POS-CAP	3.3Vout, 5Vout				
	With a 1 $\mu$ F/25V X7R MLCC and a 22 $\mu$ F/25V POS-CAP	12Vout, 15Vout		100		
	With a 4.7 $\mu$ F/50V X7R MLCC	24Vout, 28Vout		200		
	With a 2.2 $\mu$ F/100V X7R MLCC	48Vout, 53Vout		300		
Temperature coefficient			-0.02		+0.02	%/°C
Transient response recovery time	25% load step change			200	250	$\mu$ s
Over voltage protection	% of Vout(nom); Hiccup mode		115		130	%
Over load protection	% of Iout rated; Hiccup mode		120		150	%
Short circuit protection						Continuous, automatic recovery

## GENERAL SPECIFICATIONS

Parameter	Conditions		Min.	Typ.	Max.	Unit
Isolation voltage	1 minute (Basic insulation)	Input to Output	2250			VDC
		Input (Output) to Case	1600			
Isolation resistance	500VDC		1			G $\Omega$
Isolation capacitance					2500	pF
Switching frequency			225	250	275	kHz
Safety approvals						UL60950-1 EN60950-1 IEC60950-1
Case material						Metal
Base material						FR4 PCB
Potting material						Silicone (UL94 V-0)
Weight						105g (3.70oz)
MTBF	MIL-HDBK-217F, Full load					3.818 $\times$ 10 <sup>5</sup> hrs

**ENVIRONMENTAL SPECIFICATIONS**

Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating case temperature		-40		+115	°C
Over temperature protection			+120		°C
Storage temperature range	Terminal block type Others	-40 -55		+105 +125	°C
Thermal impedance <sup>(3)</sup>	Vertical direction by natural convection (20LFM) Module without assembly option Only mount on the iron base-plate Heat-sink type with 0.24" Height Heat-sink type with 0.45" Height		6.1 2.8 5.1 4.6		°C/W
Thermal shock					MIL-STD-810F
Vibration					MIL-STD-810F
Relative humidity					5% to 95% RH

**EMC SPECIFICATIONS**

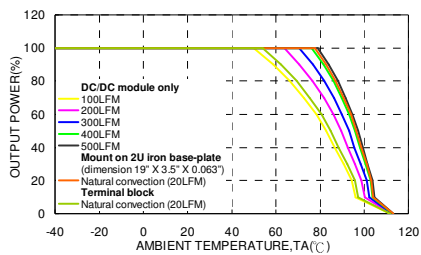
Parameter	Conditions	Level
EMI <sup>(4)</sup>	EN55022	Class A Class B
ESD	EN61000-4-2 Air ±8kV and Contact ±6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3 20V/m	Perf. Criteria A
Fast transient <sup>(5)</sup>	EN61000-4-4 ±2kV	Perf. Criteria A
Surge <sup>(5)</sup>	EN61000-4-5 EN55024 ±2kV	Perf. Criteria A
Conducted immunity	EN61000-4-6 10Vr.m.s	Perf. Criteria A

**Note:**

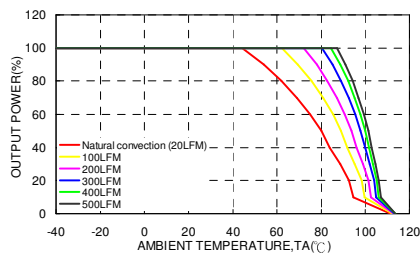
- Input source impedance: The power modules will operate as specifications without external components, assuming that the source voltage has a very low impedance and reasonable input voltage regulation. Highly inductive source impedances can affect the stability of the power module. Since real-world voltage source has finite impedance, performance can be improved by adding external filter capacitor. Recommended Nippon Chemi-con KY series, 100µF/100V.
- (1) Multiple HAE150 series module can be synchronized together simply by connecting the module SYNC pins together. Care should be taken to ensure the ground potential differences between modules are minimized.  
(2) In this configuration all of the modules will be synchronized to the highest frequency module.  
(3) Up to three modules can be synchronized using this technique.  
(4) More relevant information in datasheet.
- (1) Thermal test condition with vertical direction by natural convection (20LFM).  
(2) The iron base-plate dimension is 19" X 3.5" X 0.063" (The height is EIA standard 2U).  
(3) The heat-sink is optional and P/N: 7G-0021A-F, 7G-0022A-F, 7G-0023A-F, 7G-0024A-F. Please refer to heat-sink selection guide.
- The HAE150 series standard module meets EN55022 Class A and Class B with external components.
- An external input filter capacitor is required if the module has to meet EN61000-4-4, EN61000-4-5. Recommended 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KY series, 220µF/100V) to connect in parallel.
- CASE GROUNDING : Connecting four screw bolts to shield plane will help to reduce the EMI.
- For further information, please contact with P-DUKE.

**CAUTION:** This power module is not internally fused. An input line fuse must always be used.

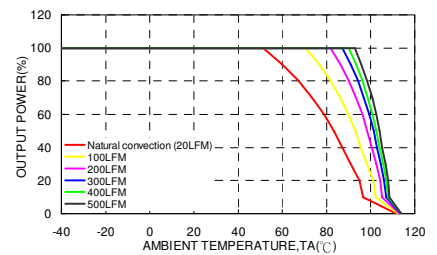
**CHARACTERISTIC CURVE**



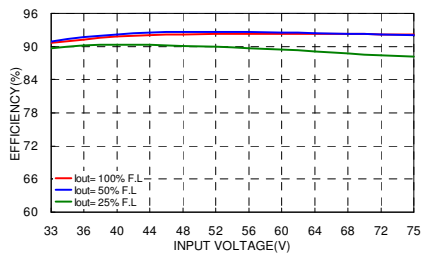
HAE150-48S05 Derating Curve



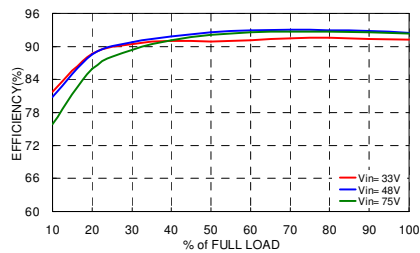
HAE150-48S05 Derating Curve With 0.24" Height Heat-sink



HAE150-48S05 Derating Curve With 0.45" Height Heat-sink

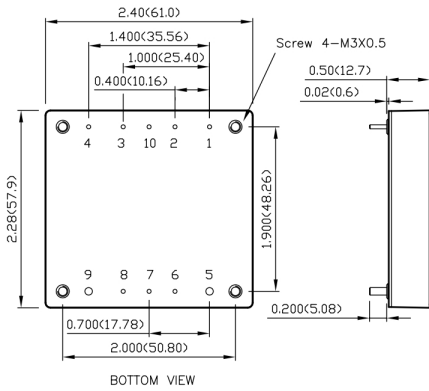


HAE150-48S05 Efficiency vs. Input Voltage



HAE150-48S05 Efficiency vs. Output Load

**MECHANICAL DRAWING**



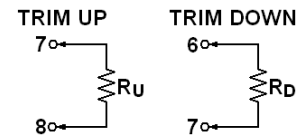
1. All dimensions in inch (mm)
2. Tolerance :x.xx±0.02 (x.x±0.5)  
x.xxx±0.01 (x.xx±0.25)
3. Pin pitch tolerance ±0.01 (0.25)
4. Pin dimension tolerance ±0.004(0.1)
5. Mounting screws should always be used.
6. The screw locked torque:  
MAX 5.0kgf-cm(0.49N-m)

**PIN CONNECTION**

PIN	DEFINE	DIAMETER
1	-Vin	0.04 Inch
2	Case (option)	0.04 Inch
3	Ctrl	0.04 Inch
4	+Vin	0.04 Inch
5	-Vout	0.08 Inch
6	-Sense	0.04 Inch
7	Trim	0.04 Inch
8	+Sense	0.04 Inch
9	+Vout	0.08 Inch
10	Sync (option)	0.04 Inch

**EXTERNAL OUTPUT TRIMMING**

Output can be externally trimmed by using the method shown below.



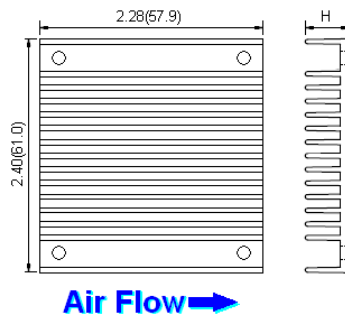
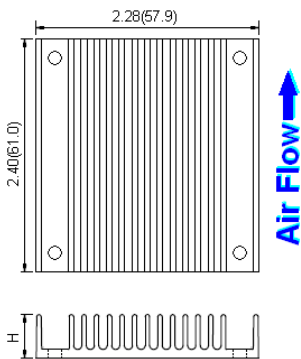
$$R_U = \left( \frac{V_{OUT} (100 + \Delta\%)}{1.225 \Delta\%} - \frac{(100 + 2\Delta\%)}{\Delta\%} \right) k\Omega$$

$$R_D = \left( \frac{100}{\Delta\%} - 2 \right) k\Omega$$

**HEAT-SINK TYPE OPTIONS**

Vertical Fin Orientation, Suffix:-HS, -HS2

Horizontal Fin Orientation, Suffix:-HS1, -HS3



<b>HS:</b> Height H=0.45° vertical fin, 7G-0021A-F
<b>HS1:</b> Height H=0.24° horizontal fin, 7G-0022A-F
<b>HS2:</b> Height H=0.24° vertical fin, 7G-0023A-F
<b>HS3:</b> Height H=0.45° horizontal fin, 7G-0024A-F

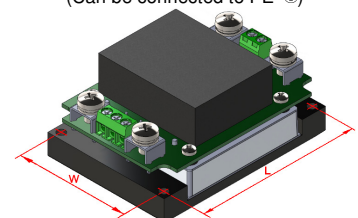
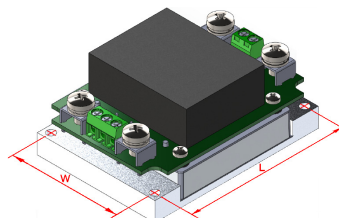
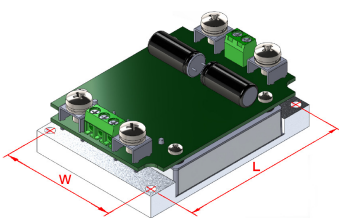
1. All dimensions in inch (mm)
2. Tolerance :x.xx±0.02 (x.x±0.5)  
x.xxx±0.01 (x.xx±0.25)

**TERMINAL BLOCK TYPE OPTION**

Wall mounted, Suffix: -T

Wall mounted with EMC Filter, Suffix: -TF

Wall mounted with EMC Filter, Suffix: -TF1  
(Can be connected to PE ☺)



Terminal block type	-T	-TF	-TF1
Weight	235g (8.29oz)	280g (9.88oz)	287g (10.12oz)
Dimensions	3.35 x 2.40 x 1.27 inch (85.0 x 61.0 x 32.3 mm)	3.35 x 2.40 x 1.47 inch (85.0 x 61.0 x 37.3 mm)	3.35 x 2.40 x 1.53 inch (85.0 x 61.0 x 38.8 mm)
Through hole (W×L)	2.126 x 3.071 inch (54.00 x 78.00 mm), 4-φ 0.17 inch (φ 4.3mm)		

For further information, please contact with P-DUKE.