

HAE150W SERIES

HALF-BRICK DC-DC CONVERTER

4:1 ULTRA WIDE INPUT RANGE
UP TO 182Watts



FEATURES

- NO MINIMUM LOAD REQUIRED
- 2250VDC INPUT TO OUTPUT BASIC INSULATION
- UL60950-1, EN60950-1, & IEC60950-1 SAFETY APPROVALS
- COMPLIANCE TO EN50155 AND EN45545-2 RAILWAY STANDARD
- CE MARKED
- COMPLIANT TO RoHS II & REACH

APPLICATIONS

- RAILWAY SYSTEM
- 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	%	µF
HAE150-24S3P3W	9 ~ 36	3.3	40	20	88	121000
HAE150-24S05W	9 ~ 36	5	28	25	90	56000
HAE150-24S12W	8.5 ~ 36	12	12	25	90	10000
HAE150-24S15W	8.5 ~ 36	15	9.5	25	91	6300
HAE150-24S24W	8.5 ~ 36	24	6	25	90	2500
HAE150-24S28W	8.5 ~ 36	28	5	25	90	1700
HAE150-24S48W	8.5 ~ 36	48	3	35	90	620
HAE150-48S3P3W	16.5 ~ 75	3.3	40	15	89	121000
HAE150-48S05W	16.5 ~ 75	5	30	15	91	60000
HAE150-48S12W	16.5 ~ 75	12	13	20	91	10800
HAE150-48S15W	16.5 ~ 75	15	10	20	91	6600
HAE150-48S24W	16.5 ~ 75	24	6.5	20	91	2700
HAE150-48S28W	16.5 ~ 75	28	5.5	20	91	1900
HAE150-48S48W	16.5 ~ 75	48	3.2	25	91	660
HAE150-110S3P3W	43 ~ 160	3.3	43	10	88	130000
HAE150-110S05W	43 ~ 160	5	32	10	90	64000
HAE150-110S12W	43 ~ 160	12	15	10	90	12500
HAE150-110S15W	43 ~ 160	15	12	10	90	8000
HAE150-110S24W	43 ~ 160	24	7.5	10	90	3100
HAE150-110S28W	43 ~ 160	28	6.5	10	90	2300
HAE150-110S48W	43 ~ 160	48	3.8	10	90	790

PART NUMBER STRUCTURE

Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Input Range	Ctrl and Pin Options	SYNC Option	CASE pin Option	Through hole type ⁽¹⁾	Assembly Option
HAE150 - 48 S 05 W - P Y C TH HS	24:8.5~36 9~36 48:16.5~75 110:43~160	S:Single	3P:3.3 05:5 12:12 15:15 24:24 28:28 48:48	4:1	□: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	□:No pin Y:SYNC	□:No pin C:CASE pin	□: Thread TH: No thread	□: None Heat-sink type: 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 Terminal block type⁽²⁾: T: Wall mounted TF: Wall mounted with EMC filter ⁽³⁾ TF1: Wall mounted with EMC filter can be connected to PE Ⓢ ⁽³⁾

(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 EN55011, EN55022 Class A.

INPUT SPECIFICATIONS

Parameter	Conditions		Min.	Typ.	Max.	Unit
Operating input voltage range		24Vin(nom) 3.3 & 5Vout Others	9	24	36	VDC
		48Vin(nom)	8.5	24	36	
		110Vin(nom)	16.5	48	75	
Start up voltage		24Vin(nom)			9	VDC
		48Vin(nom)			18	
		110Vin(nom)			43	
Shutdown voltage		24Vin(nom)	7.3		8.1	VDC
		48Vin(nom)	15.5		16.3	
		110Vin(nom)	33.0		36.0	
Start up time	Constant resistive load	Power up Remote ON/OFF		75 75		ms
Input surge voltage	1 second, max.	24Vin(nom)			50	VDC
		48Vin(nom)			100	
		110Vin(nom)			185	
Input filter ⁽¹⁾				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 ⁽²⁾			-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				
	With a 1µF/25V X7R MLCC and a 22µF/25V POS-CAP	3.3Vout, 5Vout	75		mVp-p
	With a 1µF/25V X7R MLCC and a 22µF/25V POS-CAP	12Vout, 15Vout	100		
	With a 4.7µF/50V X7R MLCC	24Vout, 28Vout	200		
	With a 2.2µF/100V X7R MLCC	48Vout	300		
Temperature coefficient		-0.02		+0.02	%/°C
Transient response recovery time	25% load step change		200	250	µs
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)	2250			VDC
		1600			
Isolation resistance	500VDC	1			GΩ
Isolation capacitance				2500	pF
Switching frequency		225	250	275	kHz
Safety approvals					UL60950-1 EN60950-1 IEC60950-1
Case material	24Vin(nom) and 48Vin(nom) 110Vin(nom)				Metal Aluminum base-plate with plastic case
Base material	24Vin(nom) and 48Vin(nom)				FR4 PCB
Potting material					Silicone (UL94 V-0)
Weight	Module stand alone				105g (3.70oz)
	HAE150-□□S□□W -T				235g (8.29oz)
	HAE150-□□S□□W -TF				280g (9.88oz)
	HAE150-□□S□□W -TF1				287g (10.12oz)
MTBF	MIL-HDBK-217F, Full load				3.500x10 ⁵ hrs

ENVIRONMENTAL SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating case temperature	Base-plate	-40		+115	°C
Over temperature protection			+120		°C
Storage temperature range	Terminal block type Others	-40 -55		+105 +125	°C
Thermal impedance ⁽³⁾	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
Shock					EN61373, MIL-STD-810F
Vibration					EN61373, MIL-STD-810F
Relative humidity					5% to 95% RH

EMC SPECIFICATIONS

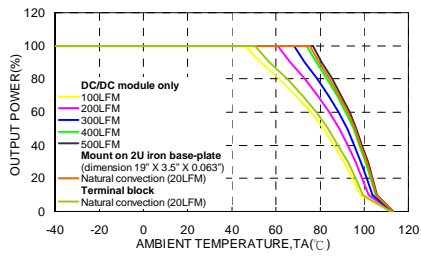
Parameter	Conditions	Level
EMI ⁽⁴⁾	EN55011, EN55022	Class A Class B
ESD	EN61000-4-2 Air ±8kV and Contact ±6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3 20V/m	Perf. Criteria A
Fast transient ⁽⁵⁾	EN61000-4-4 ±2kV	Perf. Criteria A
Surge ⁽⁵⁾	EN61000-4-5 EN55024 ±2kV and EN50155 ±2kV	Perf. Criteria A
Conducted immunity	EN61000-4-6 10Vr.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8 100A/m continuous; 1000A/m 1 second	Perf. Criteria A

Note:

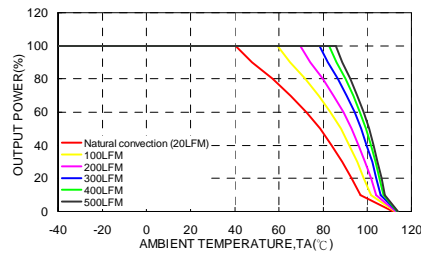
- Input source impedance: The power module will operate as specifications without external components, assuming that the source voltage has a very low impedance and reasonable input voltage regulation. Highly inductive source impedances can affect the stability of the power module. Since real-world voltage source has finite impedance, performance can be improved by adding external filter capacitor. The HAE150-24S□□W and HAE150-48S□□W recommended Nippon Chemi-con KY series, 100µF/100V. The HAE150-110S□□W recommended Ruby-con BXF series, 68µF/200V.
- (1) Multiple HAE150W 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 HAE150W series standard module meets EN55011, 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. The HAE150-24S□□W and HAE150-48S□□W recommended 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KY series, 220µF/100V) to connect in parallel. The HAE150-110S□□W recommended 3 pcs of aluminum electrolytic capacitor (Ruby-con BXF series, 100µF/250V) 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.

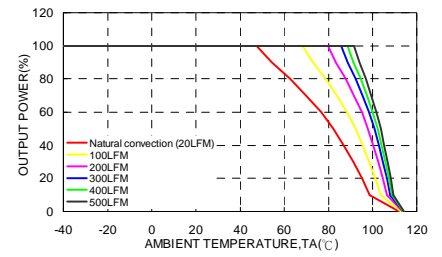
CHARACTERISTIC CURVE



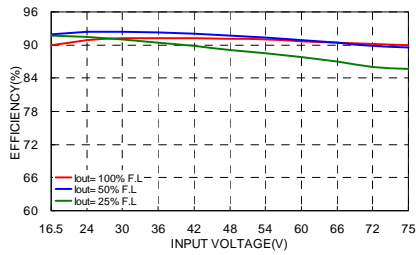
HAE150-48S05W Derating Curve (Note 3)



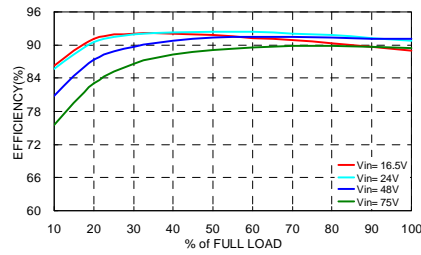
HAE150-48S05W Derating Curve (Note 3)
 With 0.24" Height Heat-sink



HAE150-48S05W Derating Curve (Note 3)
 With 0.45" Height Heat-sink



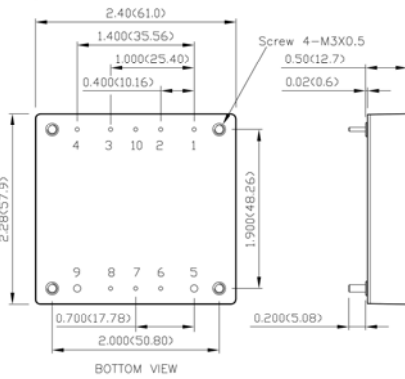
HAE150-48S05W Efficiency vs. Input Voltage



HAE150-48S05W Efficiency vs. Output Load

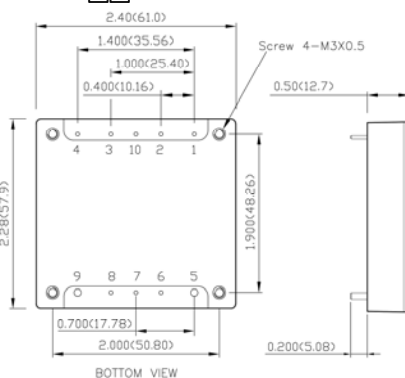
MECHANICAL DRAWING

HAE150-24S□□W, HAE150-48S□□W



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

HAE150-110S□□W



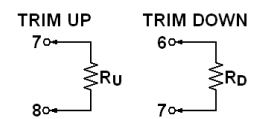
- All dimensions in inch (mm)
- Tolerance :x.xx±0.02 (x.x±0.5)
x.xxx±0.01 (x.xx±0.25)
- Pin pitch tolerance ±0.01 (0.25)
- Pin dimension tolerance ±0.004(0.1)
- Mounting screws should always be used.
- The screw locked torque:
MAX 3.5kgf-cm/0.34N-m

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.

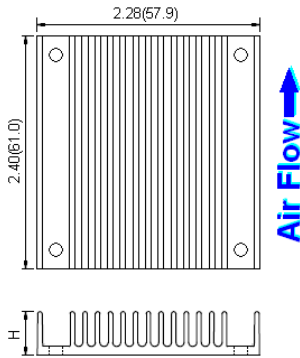


$$R_U = \left(\frac{V_{OUT} (100 + \Delta\%)}{1.225 \Delta\%} - \frac{(100 + 2\Delta\%)}{\Delta\%} \right) k\Omega$$

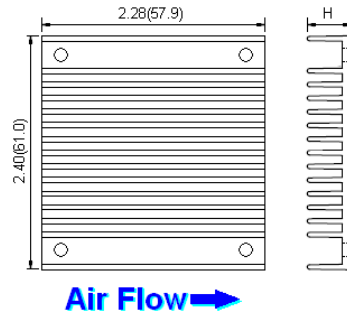
$$R_D = \left(\frac{100}{\Delta\%} - 2 \right) k\Omega$$

HEAT-SINK TYPE OPTIONS

Vertical Fin Orientation, Suffix: -HS, -HS2



Horizontal Fin Orientation, Suffix: -HS1, -HS3

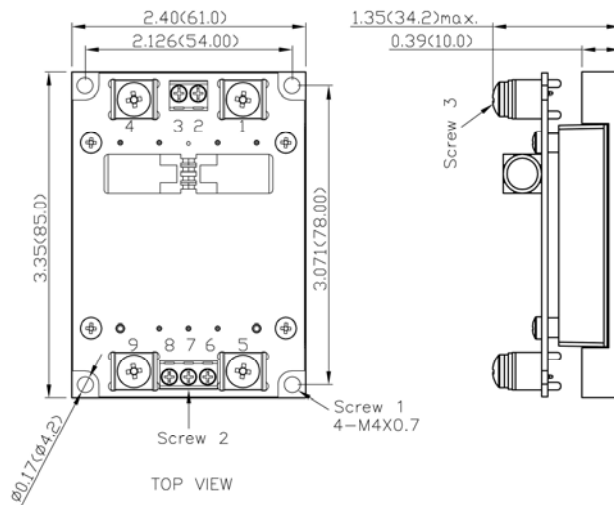


HS:	Height H=0.45" vertical fin, 7G-0021A-F
HS1:	Height H=0.24" horizontal fin, 7G-0022A-F
HS2:	Height H=0.24" vertical fin, 7G-0023A-F
HS3:	Height H=0.45" horizontal fin, 7G-0024A-F

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

HAE150-□□S□□W-T

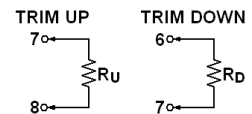


TERMINAL CONNECTION

NO.	DEFINE
1	-Vin
2	NC
3	Ctrl
4	+Vin
5	-Vout
6	-Sense
7	Trim
8	+Sense
9	+Vout

EXTERNAL OUTPUT TRIMMING

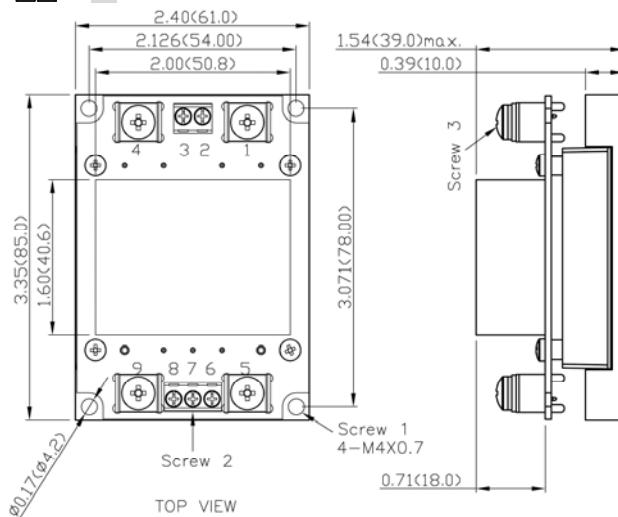
Output can be externally trimmed by using the method shown below.



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

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

HAE150-□□S□□W-TF



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. Screw 1 locked torque:
MAX 11.2kgf-cm/ 1.10N-m
4. Screw 2 locked torque:
MAX 5.2kgf-cm/ 0.51N-m
5. Screw 3 locked torque:
MAX 16.8kgf-cm/ 1.65N-m

HAE150-□□S□□W-TF1

