

HAE200W SERIES

HALF-BRICK DC-DC CONVERTER

4:1 ULTRA WIDE INPUT RANGE
UP TO 240Watts



FEATURES

- NO MINIMUM LOAD REQUIRED
- 2250VDC INPUT TO OUTPUT BASIC INSULATION
- SAFETY MEETS UL60950-1, EN60950-1, IEC60950-1 AND EN50155
- CE MARK MEETS 2006/95/EC, 2011/95/EC AND 2004/108/EC
- COMPLIANT TO RoHS EU DIRECTIVE 2011/65/EU

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
HAE200-24S3P3W	9 ~ 36	3.3	50	25	87	151000
HAE200-24S05W	9 ~ 36	5	36	30	90	72000
HAE200-24S12W	8.5 ~ 36	12	15	30	89	12500
HAE200-24S15W	8.5 ~ 36	15	12	30	90	8000
HAE200-24S24W	8.5 ~ 36	24	7.5	35	90	3100
HAE200-24S28W	8.5 ~ 36	28	6.5	40	90	2300
HAE200-24S48W	8.5 ~ 36	48	3.7	45	89	770
HAE200-48S3P3W	16.5 ~ 75	3.3	50	20	88	151000
HAE200-48S05W	16.5 ~ 75	5	40	20	91	80000
HAE200-48S12W	16.5 ~ 75	12	18	20	90	15000
HAE200-48S15W	16.5 ~ 75	15	14	20	91	9300
HAE200-48S24W	16.5 ~ 75	24	9	20	90	3700
HAE200-48S28W	16.5 ~ 75	28	7.5	25	91	2600
HAE200-48S48W	16.5 ~ 75	48	4.5	25	90	930
HAE200-110S3P3W	43 ~ 160	3.3	57	10	87	172000
HAE200-110S05W	43 ~ 160	5	44	10	89	88000
HAE200-110S12W	43 ~ 160	12	20	10	89	16600
HAE200-110S15W	43 ~ 160	15	16	10	90	10600
HAE200-110S24W	43 ~ 160	24	10	10	89	4100
HAE200-110S28W	43 ~ 160	28	8.5	15	90	3000
HAE200-110S48W	43 ~ 160	48	5	15	89	1000

PART NUMBER STRUCTURE

HAE200 -	48	S	05	W -	P	Y	C	TH	HS
Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Input Range	Ctrl and Pin Options	SYNC pin Option	CASE pin Option	Through hole type ⁽¹⁾	Assembly Option
	24:8.5~36 9~36 48:16.5~75 110:43~160	S:Single	3P3:3.3 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	□:NC Y:SYNC pin	□:NC C:CASE pin	□: Thread TH: No thread	□: No Heat-sink 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
			8.5	24	36	
		48Vin(nom)	16.5	48	75	
		110Vin(nom)	43	110	160	
Start up voltage	24Vin(nom) 48Vin(nom) 110Vin(nom)				9	VDC
					18	
					43	
Shutdown voltage	24Vin(nom) 48Vin(nom) 110Vin(nom)		7.3		8.1	VDC
			15.5		16.3	
			33.0		36.0	
Start up time	Constant resistive load	Power up		75		ms
		Remote ON/OFF		75		
Input surge voltage	1 second, max.	24Vin(nom)			50	VDC
		48Vin(nom)			100	
		110Vin(nom)			185	
Input filter ⁽¹⁾					Pi type	
Remote ON/OFF	Referenced to -Vin pin	Negative logic (Standard)	DC-DC ON		Short or 0 ~ 1.2VDC	mA
			DC-DC OFF		Open or 3 ~ 12 VDC	
		Positive logic (Option)	DC-DC ON		Open or 3 ~ 12 VDC	
			DC-DC OFF		Short or 0 ~ 1.2VDC	
Sync pin signal ⁽²⁾		Input current of Ctrl pin	-0.5		1	mA
		Remote off input current		3		
			-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)			10	%
	If remote sense is not being used, Sense pins should be connected to corresponding polarity OUTPUT pins.				
Ripple and noise	Measured by 20MHz bandwidth				mVp-p
	With a 1μF/25V X7R MLCC and a 22μF/25V POS-CAP 3.3Vout, 5Vout		75		
	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
	Input to Output Input (Output) to Case	1600			
Isolation resistance	500VDC	1			GΩ
Isolation capacitance				2500	pF
Switching frequency		225	250	275	kHz
Design meet safety standard					IEC60950-1, UL60950-1, EN60950-1 EN50155
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-V0)
Weight					105g (3.70oz)
MTBF	MIL-HDBK-217F, Full load				2.961×10 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				EN61373, MIL-STD-810F	
Vibration				EN61373, MIL-STD-810F	
Relative humidity				5% to 95% RH	

EMC SPECIFICATIONS

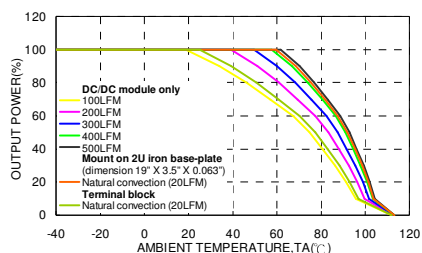
Parameter	Conditions	Level
EMI ⁽⁴⁾	EN55011, EN55022	Class A Class B
ESD	EN61000-4-2 Air ± 8kV and Contact ± 6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3 20V/m	Perf. Criteria A
Fast transient ⁽⁵⁾	EN61000-4-4 ± 2kV	Perf. Criteria A
Surge ⁽⁵⁾	EN61000-4-5 EN55024 ±2kV and EN50155 ±2kV	Perf. Criteria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

Note:

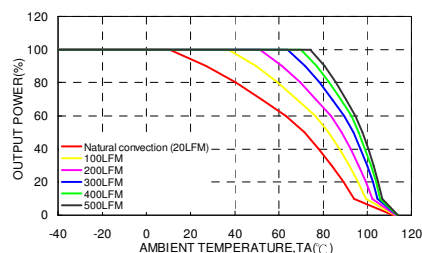
- Input source impedance: The power modules will operate as specifications without external components, assuming that the source voltage has a very low impedance and reasonable input voltage regulation. Highly inductive source impedances can affect the stability of the power module. Since real-world voltage source has finite impedance, performance can be improved by adding external filter capacitor.
The HAE200-24S□□W and HAE200-48S□□W recommended Nippon Chemi-con KY series, 100μF/100V.
The HAE200-110S□□W recommended Ruby-con BFX series, 68μF/200V.
- (1) Multiple HAE200W series module can be synchronized together simply by connecting the 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 HAE200W 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 HAE200-24S□□W and HAE200-48S□□W recommended 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KY series, 220μF/100V) to connect in parallel.
The HAE200-110S□□W recommended 3 pcs of aluminum electrolytic capacitor (Ruby-con BFX 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.

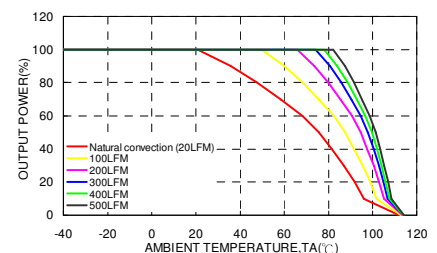
CHARACTERISTIC CURVE



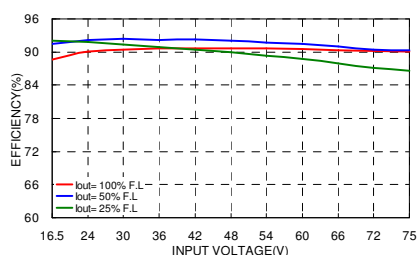
HAE200-48S05W Derating Curve (Note 3)



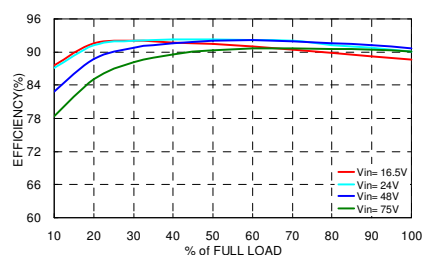
HAE200-48S05W Derating Curve (Note 3)
With 0.24" Height Heat-sink



HAE200-48S05W Derating Curve (Note 3)
With 0.45" Height Heat-sink



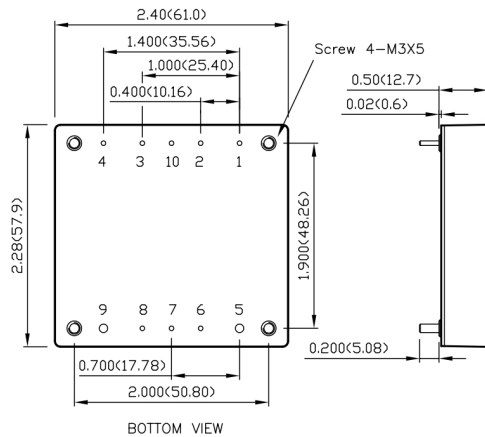
HAE200-48S05W Efficiency vs. Input Voltage



HAE200-48S05W Efficiency vs. Output Load

MECHANICAL DRAWING

HAE200-24S□□W, HAE200-48S□□W



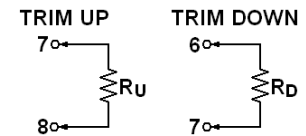
1. All dimensions in inch (mm)
2. Tolerance :x.xx±0.02 (x.x±0.5)
x.xxx±0.01 (x.xx±0.25)
3. Pin pitch tolerance ±0.01 (0.25)
4. Pin dimension tolerance ±0.004(0.1)
5. Mounting screws should always be used.
6. The screw locked torque:
MAX 5.0kgf-cm/0.49N-m

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

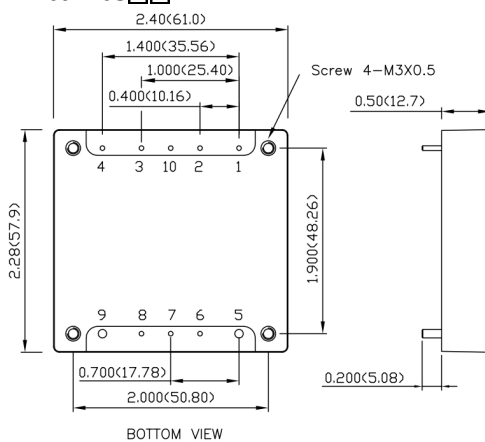
Output can be externally trimmed by using the method shown below.



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

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

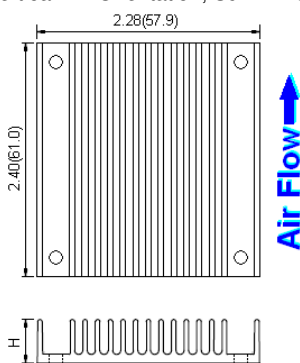
HAE200-110S□□W



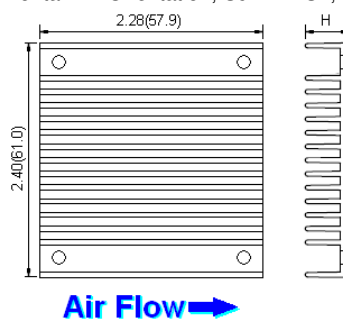
1. All dimensions in inch (mm)
2. Tolerance :x.xx±0.02 (x.x±0.5)
x.xxx±0.01 (x.xx±0.25)
3. Pin pitch tolerance ±0.01 (0.25)
4. Pin dimension tolerance ±0.004(0.1)
5. Mounting screws should always be used.
6. The screw locked torque:
MAX 3.5kgf-cm/0.34N-m

HEAT-SINK TYPE OPTIONS

Vertical Fin Orientation, Suffix:-HS, -HS2



Horizontal Fin Orientation, Suffix:-HS1, -HS3

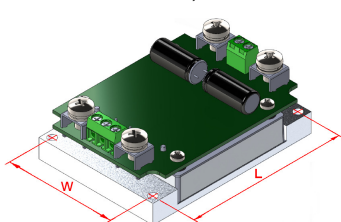


HS:	Height H=0.45" vertical fin, 7G-0021A-F
HS1:	Height H=0.24" horizontal fin, 7G-0022A-F
HS2:	Height H=0.24" vertical fin, 7G-0023A-F
HS3:	Height H=0.45" horizontal fin, 7G-0024A-F

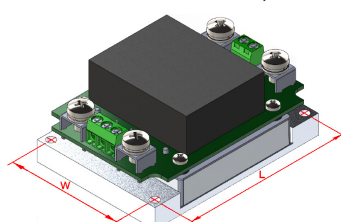
1. All dimensions in inch (mm)
2. Tolerance :x.xx±0.02 (x.x±0.5)
x.xxx±0.01 (x.xx±0.25)

TERMINAL BLOCK TYPE OPTION

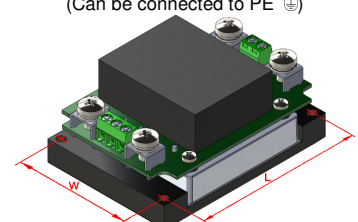
Wall mounted, Suffix: -T



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.