



P-DUKE POWER

HAE100 Series

Half-Brick DC-DC Converter
Up to 100 Watts

3

YEARS
WARRANTY

ROHS
COMPLIANT

REACH
COMPLIANT



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Charger



Medical



PV



Railway

UL[®] US

CB CE

2250
VDC
Basic
Insulation

2 : 1
Input
Range

NO
Min. Load
Required

REMOTE
ON
OFF

OCP

OTP

OVP

SCP

UVP

PART NUMBER STRUCTURE

DIP Type:

HAE100-	48	S	05	-	P	HS
Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Ctrl and Pin Options		Assembly Option
	12:9~18 24:18~36 48:36~75	S:Single	3P3:3.3 05:5 12:12 15:15 24:24 28:28 48:48	□:Negative logic; 0.20" pin length L:Negative logic; 0.145" pin length P:Positive logic; 0.20" pin length S:Positive logic; 0.145"pin length	□: None Through hole type TH:No thread Heat-sink type: HS:7G-0021A-F; H=0.45" HS1:7G-0022A-F; H=0.24" HS2:7G-0023A-F; H=0.24" HS3:7G-0024A-F; H=0.45"	

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

Wall Mounted Type:

Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Ctrl and Pin Options	Assembly Option	
HAE100-	48	S	05	-	P	TF
	12:9~18 24:18~36 48:36~75	S:Single	3P3:3.3 05:5 12:12 15:15 24:24 28:28 48:48	□:Negative logic; 0.20" pin length P:Positive logic; 0.20" pin length	T: Without EMC filter TF: Integrated EMC filter and meets EN55032 Class A TF1: Integrated EMC filter and meets EN55032 Class A can be connected to PE	

1. The terminal block type is only for assembly of 0.20" pin length.

TECHNICAL SPECIFICATION All specifications are typical at nominal input, full load and 25°C unless 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
HAE100-12S3P3	9 ~ 18	3.3	25	155	90	75700
HAE100-12S05	9 ~ 18	5	20	150	91	40000
HAE100-12S12	9 ~ 18	12	8.4	180	91	7000
HAE100-12S15	9 ~ 18	15	6.7	180	91	4460
HAE100-12S24	9 ~ 18	24	4.2	90	90	1750
HAE100-12S28	9 ~ 18	28	3.6	100	90	1280
HAE100-12S48	9 ~ 18	48	2.1	100	90	430
HAE100-24S3P3	18 ~ 36	3.3	25	90	91	75700
HAE100-24S05	18 ~ 36	5	20	150	93	40000
HAE100-24S12	18 ~ 36	12	8.4	185	93	7000
HAE100-24S15	18 ~ 36	15	6.7	185	93	4460
HAE100-24S24	18 ~ 36	24	4.2	85	92	1750
HAE100-24S28	18 ~ 36	28	3.6	85	92	1280
HAE100-24S48	18 ~ 36	48	2.1	85	92	430
HAE100-48S3P3	36 ~ 75	3.3	25	80	91	75700
HAE100-48S05	36 ~ 75	5	20	90	93	40000
HAE100-48S12	36 ~ 75	12	8.4	90	93	7000
HAE100-48S15	36 ~ 75	15	6.7	90	93	4460
HAE100-48S24	36 ~ 75	24	4.2	40	92	1750
HAE100-48S28	36 ~ 75	28	3.6	40	92	1280
HAE100-48S48	36 ~ 75	48	2.1	40	92	430

INPUT SPECIFICATIONS						
Parameter	Conditions			Min.	Typ.	Max. Unit
Operating input voltage range	12Vin(nom)			9	12	18
	24Vin(nom)			18	24	36
	48Vin(nom)			36	48	75
Start up voltage	12Vin(nom)					9
	24Vin(nom)					18
	48Vin(nom)					36
Shutdown voltage	12Vin(nom)			7.3	7.7	8.1
	24Vin(nom)			15.5	16	16.3
	48Vin(nom)			31.6	32	32.5
Start up time	Constant resistive load	Power up			25	
		Remote ON/OFF			25	ms
Input surge voltage	1 second, max.	12Vin(nom)				36
		24Vin(nom)				50
		48Vin(nom)				100
Input filter				Pi type		
Remote ON/OFF	Referred to -Vin pin	Negative logic (Standard)	DC-DC ON	Short or 0 ~ 1.2VDC		
			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		
		Input current of Ctrl pin		-0.5		1 mA
		Remote off input current			3	mA

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 4.7μF/50V X7R MLCC With a 4.7μF/50V X7R MLCC With a 4.7μF/50V X7R MLCC With a 2.2μF/100V X7R MLCC		75 100 200 300		mVp-p
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	110		140	%
Short circuit protection		Continuous, automatic recovery			

GENERAL SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Isolation voltage	1 minute (Basic insulation) Input to Output Input (Output) to Case	2250 1600			VDC
Isolation resistance	500VDC	1			GΩ
Isolation capacitance				2500	pF
Switching frequency		270	300	330	kHz
Safety approvals	IEC /UL/ EN60950-1			UL:E193009 CB:UL(Demko)	
Case material					Metal
Base material					FR4 PCB
Potting material					Silicone (UL94 V-0)
Weight	Module stand alone HAE100-□□S□□-T HAE100-□□S□□-TF HAE100-□□S□□-TF1			97g (3.42oz) 200g (7.05oz) 280g (9.88oz) 287g (10.12oz)	
MTBF	MIL-HDBK-217F, Full load			3.311×10 ⁵ hrs	

ENVIRONMENTAL SPECIFICATIONS

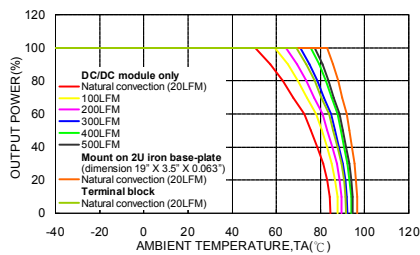
Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating case temperature		-40		+105	°C
Maximum case temperature				+105	°C
Over temperature protection			+115		°C
Storage temperature range	Terminal block type Others	-40 -55		+105 +125	°C
Thermal impedance	Module without assembly option Heat-sink type with 0.24" Height Heat-sink type with 0.45" Height		6.7 5.4 4.7		°C/W
Thermal shock					MIL-STD-810F
Vibration					MIL-STD-810F
Relative humidity					5% to 95% RH

EMC SPECIFICATIONS

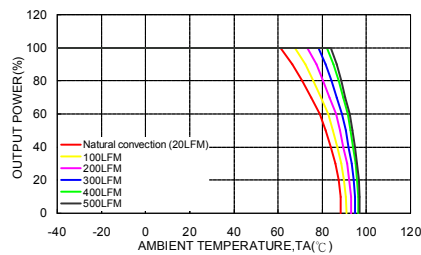
Parameter	Conditions		Level
EMI	EN55032	HAE100-□□S□□-TF HAE100-□□S□□-TF1 Other models; with external components	Class A Class A Class A, Class B
	*Connecting four screw bolts to shield plane will help to reduce the EMI.		
ESD	EN61000-4-2	Air ±8kV and Contact ±6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3	10V/m	Perf. Criteria A
Fast transient	EN61000-4-4	±2kV	Perf. Criteria A
Surge	EN61000-4-5	EN55024 ±2kV With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KY series, 220μF/100V)	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

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

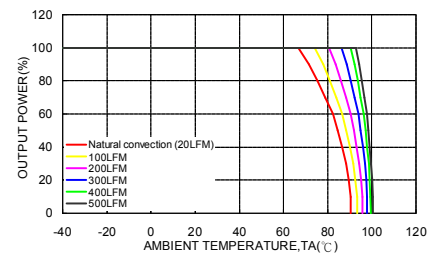
CHARACTERISTIC CURVE



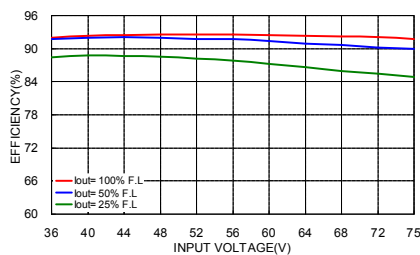
HAE100-48S05 Derating Curve
(See Thermal Considerations)



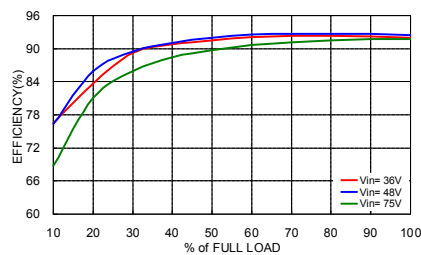
HAE100-48S05 Derating Curve
With 0.24" Height Heat-sink
(See Thermal Considerations)



HAE100-48S05 Derating Curve
With 0.45" Height Heat-sink
(See Thermal Considerations)



HAE100-48S05 Efficiency vs. Input Voltage



HAE100-48S05 Efficiency vs. Output Load

FUSE CONSIDERATION

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

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture.

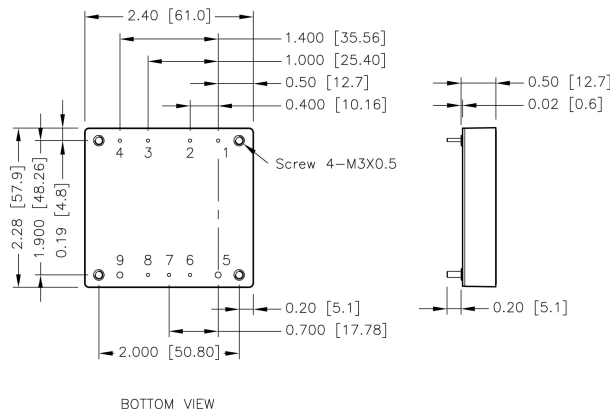
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below :

Model	Fuse Rating (A)	Fuse Type
HAE100-12S□□	20	Fast-Acting
HAE100-24S□□	10	Fast-Acting
HAE100-48S□□	5	Slow-Blow

The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.

MECHANICAL DRAWING



PIN CONNECTION

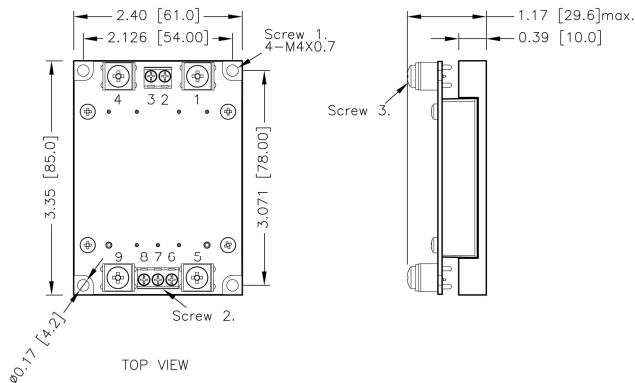
PIN	DEFINE	DIAMETER
1	-Vin	0.04 Inch
2	Case	0.04 Inch
3	Ctrl	0.04 Inch
4	+Vin	0.04 Inch
5	-Vout	0.08 Inch
6	-Sense	0.04 Inch
7	Trim	0.04 Inch
8	+Sense	0.04 Inch
9	+Vout	0.08 Inch

- 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[0.10]

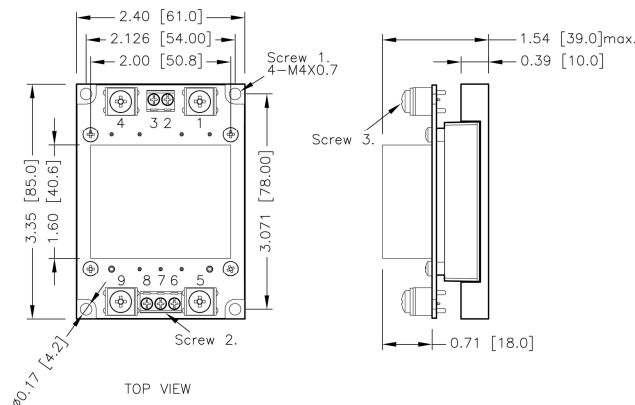
- The screw locked torque: MAX 5.0kgf-cm(0.49N-m)

TERMINAL BLOCK TYPE OPTION

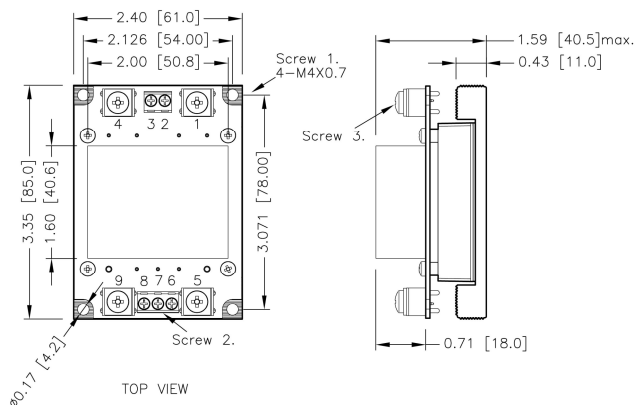
HAE100-□□S□□-T



HAE100-□□S□□-TF



HAE100-□□S□□-TF1



TERMINAL CONNECTION : -T,-TF

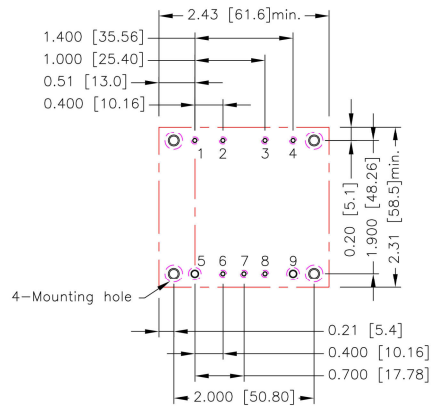
NO.	DEFINE
1	-Vin
2	Case
3	Ctrl
4	+Vin
5	-Vout
6	-Sense
7	Trim
8	+Sense
9	+Vout

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 12.0kgf-cm/ 1.18N-m

TERMINAL CONNECTION : -TF1

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

RECOMMENDED PAD LAYOUT



All dimensions in inch[mm]
 Pad size(lead free recommended)
 Through hole 1,2,3,4,6,7,8: $\Phi 0.051[1.30]$
 Through hole 5,9: $\Phi 0.091[2.30]$
 Through hole of mounting: $\Phi 0.126[3.20]$
 Top view pad 1,2,3,4,6,7,8: $\Phi 0.064[1.63]$
 Top view pad 5,9: $\Phi 0.113[2.88]$
 Top view pad of mounting: $\Phi 0.157[4.00]$
 Bottom view pad 1,2,3,4,6,7,8: $\Phi 0.102[2.60]$
 Bottom view pad 5,9: $\Phi 0.181[4.60]$
 Bottom view pad of mounting: $\Phi 0.252[6.40]$

THERMAL CONSIDERATIONS

The power module operates in a variety of thermal environments.

However, sufficient cooling should be provided to help ensure reliable operation of the unit.

Heat is removed by conduction, convection, and radiation to the surrounding Environment.

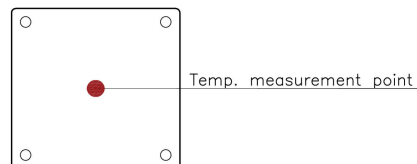
Proper cooling can be verified by measuring the point as the figure below.

The temperature at this location should not exceed "Maximum case temperature".

When Operating, adequate cooling must be provided to maintain the test point temperature at or below "Maximum case temperature".

You can limit this Temperature to a lower value for extremely high reliability.

- Thermal test condition with vertical direction by natural convection (20LFM).
- The heat-sink is optional and P/N: 7G-0021A-F , 7G-0022A-F , 7G-0023A-F , 7G-0024A-F.

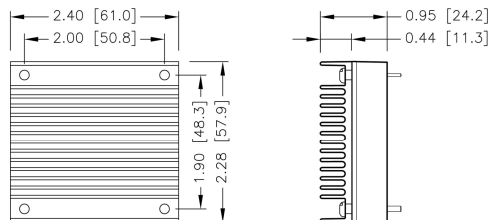


BASE PLATE

HEAT-SINK TYPE OPTIONS

HAE100-□□S□□-HS

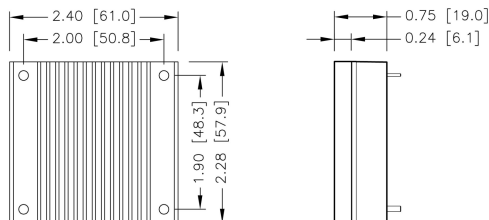
7G-0021A-F



SIDE VIEW

HAE100-□□S□□-HS1

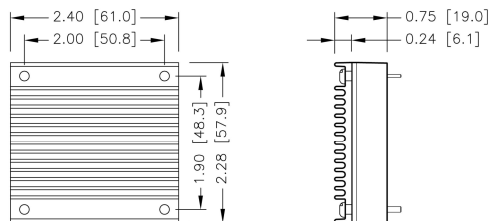
7G-0022A-F



SIDE VIEW

HAE100-□□S□□-HS2

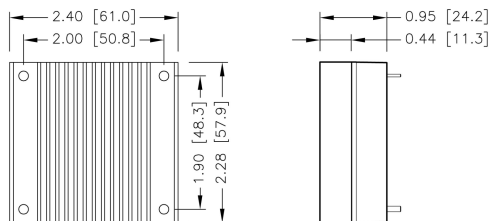
7G-0023A-F



SIDE VIEW

HAE100-□□S□□-HS3

7G-0024A-F



SIDE VIEW

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

OUTPUT VOLTAGE ADJUSTMENT

Output voltage is adjustable for 10% trim up or -20% trim down of nominal output voltage by connecting an external resistor between the Trim pin and either the +Sense or -Sense pins.

With an external resistor between the Trim and -Sense pin, the output voltage set point decreases.

With an external resistor between the Trim and +Sense pin, the output voltage set point increases.

Maximum output deviation is +10% inclusive of remote sense.

The external TRIM resistor needs to be at least 1/8W of rated power.

Trim Up Equation

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

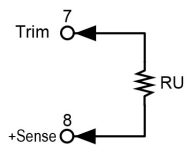
Trim Down Equation

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

EXTERNAL OUTPUT TRIMMING

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

Trim-up



□□S3P3

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.630
RU (kΩ)	170.082	85.388	57.156	43.041	34.571	28.925	24.892	21.867	19.515	17.633

□□S05

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	5.05	5.10	5.15	5.20	5.25	5.30	5.35	5.40	5.45	5.50
RU (kΩ)	310.245	156.163	104.803	79.122	63.714	53.442	46.105	40.602	36.322	32.898

□□S12

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20
RU (kΩ)	887.388	447.592	300.993	227.694	183.714	154.395	133.452	117.745	105.528	95.755

□□S15

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50
RU (kΩ)	1134.735	572.490	385.075	291.367	235.143	197.660	170.886	150.806	135.188	122.694

□□S24

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	24.24	24.48	24.72	24.96	25.20	25.44	25.68	25.92	26.16	26.40
RU (kΩ)	1876.776	947.184	637.320	482.388	389.429	327.456	283.190	249.990	224.168	203.510

□□S28

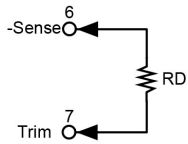
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	28.28	28.56	28.84	29.12	29.40	29.68	29.96	30.24	30.52	30.80
RU (kΩ)	2206.571	1113.714	749.429	567.286	458.000	385.143	333.102	294.071	263.714	239.429

□□S48

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	48.48	48.96	49.44	49.92	50.40	50.88	51.36	51.84	52.32	52.80
RU (kΩ)	3855.551	1946.367	1309.973	991.776	800.857	673.578	582.665	514.480	461.447	419.020

OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)

Trim-down



□□S□□

ΔV (%)	1	2	3	4	5	6	7	8	9	10
RD (k Ω)	98.000	48.000	31.333	23.000	18.000	14.667	12.286	10.500	9.111	8.000
ΔV (%)	11	12	13	14	15	16	17	18	19	20
RD (k Ω)	7.091	6.333	5.692	5.143	4.667	4.250	3.882	3.556	3.263	3.000