



FEATURES

- OUTPUT POWER RANGE UP TO 255 WATTS
- HIGH EFFICIENCY UP TO 93%
- NO MINIMUM LOAD REQUIRED
- SOFT-START
- ADJUSTABLE OUTPUT VOLTAGE
- UNDER-VOLTAGE LOCKOUT
- INDUSTRY STANDARD HALF-BRICK FOOTPRINT
- SIX-SIDED CONTINUOUS SHIELD
- INPUT TO OUTPUT BASIC INSULATION: 2250 VDC
- UL60950-1, EN60950-1 AND IEC60950-1 SAFETY APPROVALS PENDING
- COMPLIANT TO RoHS EU DIRECTIVE 2002/95/EC

OPTIONS

- Positive logic remote ON/OFF
- Synchronous
- Case pin
- Heat-sink
- Terminal block
- Terminal block with EMC filter (EN55022 Class A)
- Terminal block with Din Rail Clip

DESCRIPTION

The HAE200 series DC/DC converters provide up to 255 watts of output power in an industry standard half-brick package and footprint. All models feature a wide input range, adjustable output voltage.

APPLICATIONS

- Wireless Network
- Telecom/Datacom
- Industry Control System
- Distributed Power Architectures
- Semiconductor Equipment

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

OUTPUT SPECIFICATIONS			
Output power	165 ~ 255 Watts		
Voltage accuracy	±1%		
Voltage adjustability (Note 7)	+10%, -20%		
Minimum load	0%		
Line regulation	LL to HL at Full Load	±0.1%	
Load regulation	No Load to Full Load	±0.1%	
Remote sense (Note 8)	10% of Vout(nom)		
Ripple and noise	20MHz bandwidth	See table	
Temperature coefficient	±0.02%/°C, max.		
Transient response recovery time	25% load step change	250µS	
Over voltage protection threshold	Hiccup	115% ~ 130% of Vout(nom)	
Over current protection threshold	120% ~ 150% of Iout Rated		
Short circuit protection	Hiccup, automatic recovery		
INPUT SPECIFICATIONS			
Input voltage range	12VDC nominal input	3.3 & 5Vout	9 ~ 22VDC
		Others	8.5 ~ 22VDC
	24VDC nominal input		16.5 ~ 36VDC
Start-up voltage	12VDC input		9VDC, max.
	24VDC input		18VDC, max.
	48VDC input		34VDC, max.
Shutdown voltage	12VDC input		7.3 ~ 8.1VDC
	24VDC input		15.5 ~ 16.3VDC
	48VDC input		31.6 ~ 32.5VDC
Input filter (Note 13)	Pi type		
Input surge voltage	12VDC input		30VDC 1sec, max.
	24VDC input		50VDC 1sec, max.
	48VDC input		100VDC 1sec, max.
Start up time	Nominal input and constant resistive load	Power up	75mS
		Remote ON/OFF	75mS
Sync pin signal (Note 14)	-0.3V ~ 5.6V		
Remote ON/OFF (Note 6) (Negative logic) (Standard)	DC-DC ON	Short or 0V < Vr < 1.2V	
	DC-DC OFF	Open or 3V < Vr < 12V	
(Positive logic) (Option)	DC-DC ON	Open or 3V < Vr < 12V	
	DC-DC OFF	Short or 0V < Vr < 1.2V	
Input current of remote control pin	Nominal input	-0.5mA ~ 1mA	
Remote off state input current	Nominal input	3mA	

GENERAL SPECIFICATIONS			
Efficiency	See table		
Isolation voltage	Input to Output (Basic insulation)	2250VDC, min. 1minute	
	Input (Output) to Case	1600VDC, min. 1minute	
Isolation resistance	10 ⁹ ohms, min.		
Isolation capacitance	2500pF, max.		
Switching frequency	250KHz±10%		
Safety approvals pending	IEC60950-1, UL60950-1, EN60950-1		
Case material	Metal		
Base material	FR4 PCB		
Potting material	Silicon (UL94-V0)		
Dimensions	2.40 X 2.28 X 0.50 Inch (61.0x57.9x12.7 mm)		
Weight	105g (3.70oz)		
MTBF (Note 1)	BELLCORE TR-NWT-000332	1.010 x 10 ⁶ hrs	
	MIL-HDBK-217F	7.416 x 10 ⁴ hrs	
ENVIRONMENTAL SPECIFICATIONS			
Operating case temperature range	-40°C ~ +115°C		
Over temperature protection	+120°C		
Storage temperature range	-55°C ~ +125°C		
Thermal impedance (Note 9)	without Heat-sink	6.1°C/Watt	
	with 0.24" Height Heat-sink	5.1°C/Watt	
	with 0.45" Height Heat-sink	4.6°C/Watt	
	Only mount on the iron base-plate	2.8°C/Watt	
Thermal shock	MIL-STD-810F		
Vibration	MIL-STD-810F		
Relative humidity	5% to 95% RH		
EMC CHARACTERISTICS			
EMI Standard (Note 10)	EN55022	Class A	
	Option TF or TFDR EN55022	Class A	
ESD	EN61000-4-2	Air Contact	± 8KV Perf. Criteria A
			± 6KV
Radiated immunity	EN61000-4-3	20 V/m	Perf. Criteria A
Fast transient (Note 11)	EN61000-4-4	± 2KV	Perf. Criteria A
Surge (Note 11)	EN61000-4-5	± 2KV	Perf. Criteria A
Conducted immunity	EN61000-4-6	10 Vr.m.s	Perf. Criteria A





Model Number	Input Range	Output Voltage	Output Current		Output ^{(3) (4)} Ripple & Noise	No Load ⁽²⁾ Input Current	Eff ⁽³⁾ (%)	Capacitor ⁽⁵⁾ Load max.
			Min. load	Full load				
HAE200-12S3P3	9 ~ 22 VDC	3.3 VDC	0mA	50 A	75mVp-p	25mA	87	151000μF
HAE200-12S05	9 ~ 22 VDC	5 VDC	0mA	36 A	75mVp-p	90mA	90	72000μF
HAE200-12S12	8.5 ~ 22 VDC	12 VDC	0mA	15 A	100mVp-p	90mA	90	12500μF
HAE200-12S15	8.5 ~ 22 VDC	15 VDC	0mA	12 A	100mVp-p	55mA	90	8000μF
HAE200-12S24	8.5 ~ 22 VDC	24 VDC	0mA	7.5 A	200mVp-p	70mA	90	3100μF
HAE200-12S28	8.5 ~ 22 VDC	28 VDC	0mA	6.5 A	200mVp-p	55mA	90	2300μF
HAE200-12S48	8.5 ~ 22 VDC	48 VDC	0mA	3.7 A	300mVp-p	75mA	89	770μF
HAE200-24S3P3	16.5 ~ 36 VDC	3.3 VDC	0mA	50 A	75mVp-p	20mA	88	151000μF
HAE200-24S05	16.5 ~ 36 VDC	5 VDC	0mA	40 A	75mVp-p	35mA	91	80000μF
HAE200-24S12	16.5 ~ 36 VDC	12 VDC	0mA	18 A	100mVp-p	45mA	91	15000μF
HAE200-24S15	16.5 ~ 36 VDC	15 VDC	0mA	15 A	100mVp-p	45mA	91	10000μF
HAE200-24S24	16.5 ~ 36 VDC	24 VDC	0mA	9 A	200mVp-p	40mA	93	3700μF
HAE200-24S28	16.5 ~ 36 VDC	28 VDC	0mA	7.5 A	200mVp-p	50mA	93	2600μF
HAE200-24S48	16.5 ~ 36 VDC	48 VDC	0mA	4.5 A	300mVp-p	50mA	91	930μF
HAE200-48S3P3	33 ~ 75 VDC	3.3 VDC	0mA	60 A	75mVp-p	20mA	90	181000μF
HAE200-48S05	33 ~ 75 VDC	5 VDC	0mA	46 A	75mVp-p	20mA	91	92000μF
HAE200-48S12	33 ~ 75 VDC	12 VDC	0mA	21 A	100mVp-p	25mA	91	17500μF
HAE200-48S15	33 ~ 75 VDC	15 VDC	0mA	17 A	100mVp-p	25mA	93	11300μF
HAE200-48S24	33 ~ 75 VDC	24 VDC	0mA	10.5A	200mVp-p	25mA	92	4300μF
HAE200-48S28	33 ~ 75 VDC	28 VDC	0mA	9 A	200mVp-p	25mA	92	3200μF
HAE200-48S48	33 ~ 75 VDC	48 VDC	0mA	5.2 A	300mVp-p	25mA	92	1000μF
HAE200-48S53	33 ~ 75 VDC	53 VDC	0mA	4.7 A	300mVp-p	25mA	92	880μF

Note

- BELLCORE TR-NWT-000332. Case 1: 50% Stress, Temperature at 40°C.
MIL-HDBK-217F Notice2 @Ta=25°C, Full load(Ground, Benign, controlled environment).
- Typical value at nominal input and no load.
- Typical value at nominal input and full load.
- The ripple and noise of output voltage 24VDC/28VDC is measured with a 4.7μF/50V X7R 1812 MLCC,
The ripple and noise of output voltage 48VDC/53VDC is measured with a 2.2μF/100V X7R 1812 MLCC,
The ripple and noise of other output voltage is measured with a 1μF/25V X7R MLCC and a 22μF/25V D-type POS-CAP.
- Test by minimum input and constant resistive load.
- The CTRL pin voltage is referenced to -INPUT. The positive logic is optional.
To order positive logic ON-OFF control add the suffix -P (Ex: HAE200-48S05-P).
- Output voltage is adjustable for 10% trim up or -20% trim down of nominal output voltage by connecting a single resistor between TRIM and +SENSE pins for trim up or between TRIM and -SENSE pins for trim down. To calculate the value of the resistor Ru and Rd for a particular output voltage uses the following equation:

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

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

- Maximum output deviation is +10% inclusive of remote sense and trim. If remote sense is not being used, the +SENSE should be connected to its corresponding +OUTPUT and likewise the -SENSE should be connected to its corresponding -OUTPUT.
- (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.
- The HAE200 series meets EN55022 Class A or Class B only with external components. For more detail information, please contact with P-DUKE.
- 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, ESR 48mΩ) to connect in parallel.
- CASE GROUNDING: When connect four screw bolts to shield plane, the EMI could be reduced.
- 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, ESR 110mΩ.
- (1) Multiple HAE200 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 application note.

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





Part number structure:

<u>HAE</u>	<u>200</u>	-	<u>48</u>	<u>S</u>	<u>05</u>	-	<u>P</u>	<u>Y</u>	<u>C</u>	<u>HS</u>
SERIES NAME	Output Power		Input Voltage	Output Quantity	Output Voltage		Remote ON/OFF Options	Sync pin Options	Case pin Options	Heat-Sink Mounting Options
	200Watts		12: 8.5~22VDC 9~22VDC 24: 16.5~36VDC 48: 33~75VDC	S: Single	3P3: 3.3VDC 05: 5VDC 12: 12VDC 15: 15VDC 24: 24VDC 28: 28VDC 48: 48VDC		P: Positive	Y: Sync pin	C: Case pin	TH: Through hole type.(no thread) ⁽¹⁾ HS: H=0.45" Vertical, 7G-0021A-F HS1: H=0.24" Horizontal, 7G-0022A-F HS2: H=0.24" Vertical, 7G-0023A-F HS3: H=0.45" Horizontal, 7G-0024A-F T: Terminal block ⁽²⁾ TDR: Terminal block with Din Rail Clip ⁽²⁾ TF: Terminal block with EMC filter ⁽²⁾⁽³⁾ TFDR: Terminal block with EMC filter and Din Rail Clip ⁽²⁾⁽³⁾

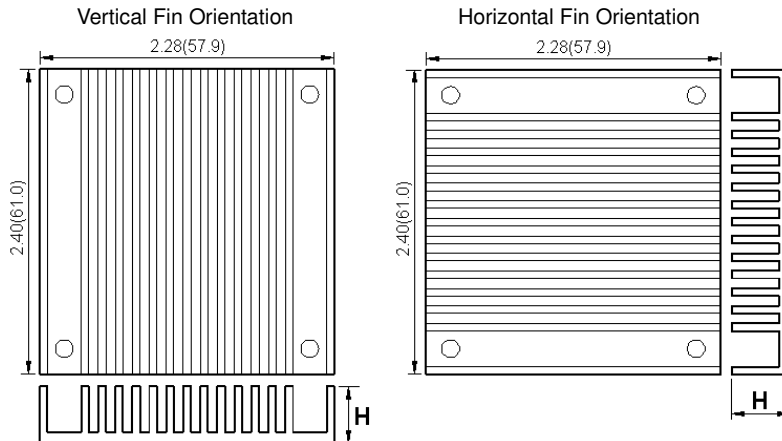
⁽¹⁾ The module can't equip Heat-sink with TH option.

⁽²⁾ No Y and C function for terminal block type.

⁽³⁾ EMI filter meet EN55011, EN55022 Class A.

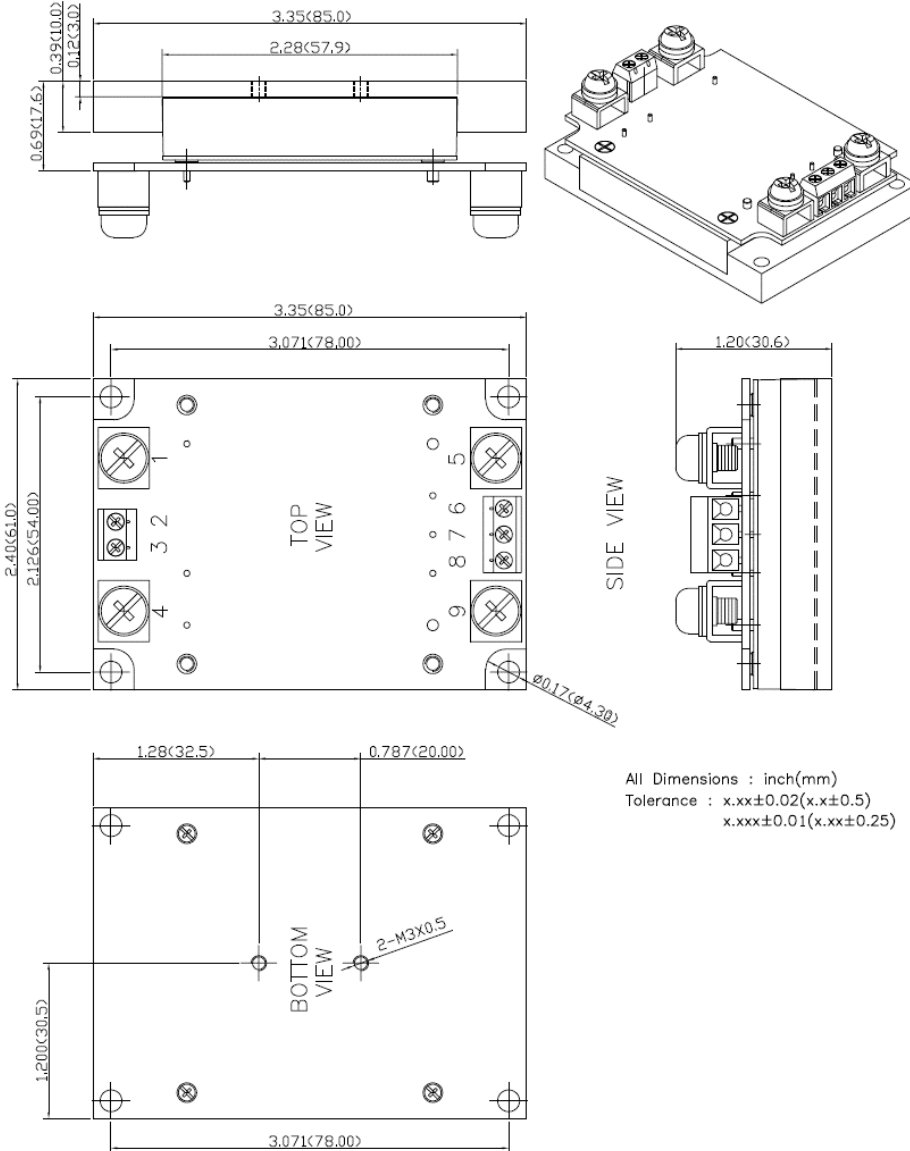
Heat-sink type:

Suffix: -HS, -HS1, -HS2, -HS3



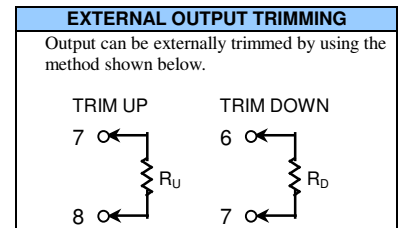
Terminal block type mechanical drawing:

1) Terminal Block without EMC Filter, Suffix: -T



All Dimensions : inch(mm)
Tolerance : x.xx±0.02(x.xx±0.5)
x.xxx±0.01(x.xx±0.25)

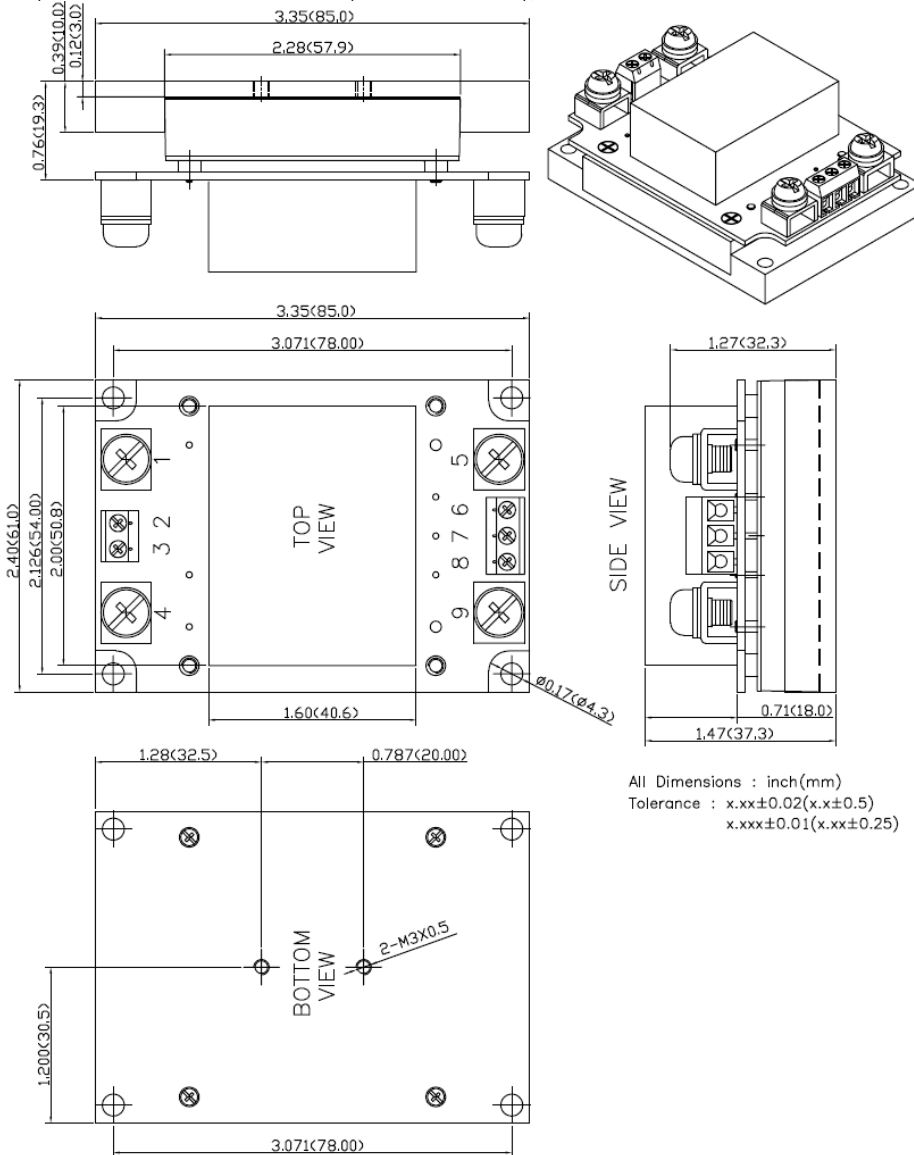
TERMINAL CONNECTION		
Terminal	Define	wire range
1	- INPUT	8 AWG to 9 AWG
2	NC	NA
3	CTRL	14 AWG to 18 AWG
4	+ INPUT	14 AWG to 18 AWG
5	- OUTPUT	4 AWG to 5 AWG
6	- SENSE	14 AWG to 18 AWG
7	TRIM	14 AWG to 18 AWG
8	+ SENSE	14 AWG to 18 AWG
9	+ OUTPUT	4 AWG to 5 AWG



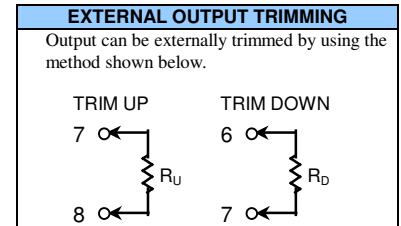
Note: These two M3x0.5 threaded holes are designed for Din Rail Clip assembly. The depth of heat-sink is allowed to be screwed into 2.8mm maximum. Customer shall take care as select the screw to avoid damaging the converter.



2) Terminal Block with EMC Filter (EN55022 Class A), Suffix: -TF



TERMINAL CONNECTION		
Terminal	Define	wire range
1	- INPUT	8 AWG to 9 AWG
2	NC	NA
3	CTRL	14 AWG to 18 AWG
4	+ INPUT	14 AWG to 18 AWG
5	- OUTPUT	4 AWG to 5 AWG
6	- SENSE	14 AWG to 18 AWG
7	TRIM	14 AWG to 18 AWG
8	+ SENSE	14 AWG to 18 AWG
9	+ OUTPUT	4 AWG to 5 AWG



Note: These two M3x0.5 threaded holes are designed for Din Rail Clip assembly. The depth of heat-sink is allowed to be screwed into 2.8mm maximum. Customer shall take care as select the screw to avoid damaging the converter.

3) Terminal Block with Din Rail Clip (Suffix -TDR, -TFDR)

