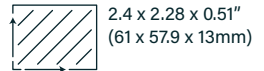


HAE150U SERIES



DIMENSIONS:



**EN50155 &
EN45545-2**

ULTRA WIDE INPUT

**TRIM 10% UP
TRIM 20% DOWN**

IEC62368-1

REMOTE ON/OFF

**-40 to 105°C
OPERATION**

Part numbers

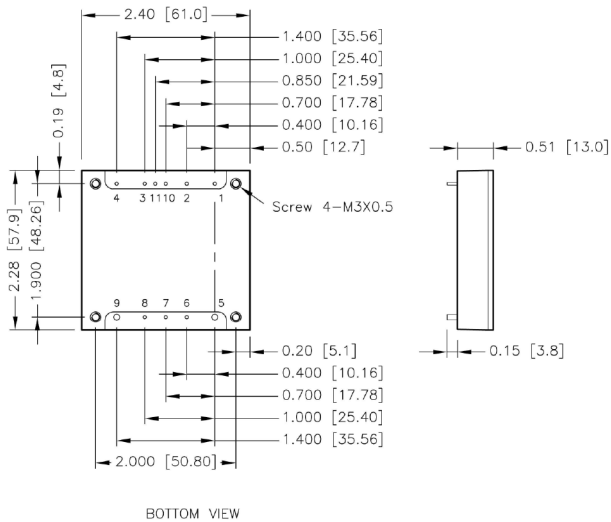
HAE	150	-	72	S	12	U	A	-	P	TH
Series	Power		Input voltage	Output	Output voltage	Input range	Pin Connection		Control	Options
			16-160VDC	S = Single	05 = 5VDC 12 = 12VDC 15 = 15VDC 24 = 24VDC 28 = 28VDC 48 = 48VDC 53 = 54VDC	10:1	A = A type (standard) B = B type		P = Positive logic Blank = Negative logic	Heat sink: HS4 HS5 Through hole: TH

Key specifications

Input range	Safety certification	Efficiency	Environmental performance
16-160VDC	UL/IEC/EN 62368-1 EN50155	Up to 92%	Operational: -40 to 105°C

HAE150U SERIES

Mechanical

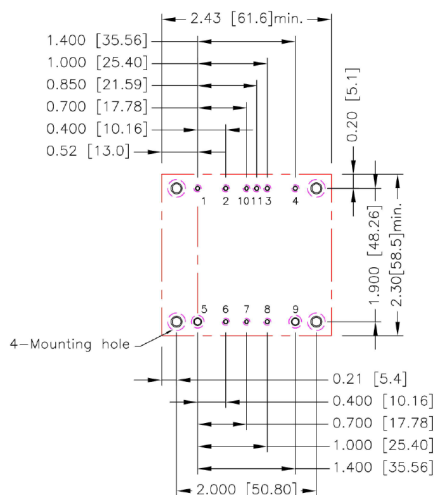


Pin	A Type	B Type	Diameter
1	-Vin	-Vin	0.04 inch
2	BUS	Bus	0.04 inch
3	Ctrl	UVLO	0.04 inch
4	+Vin	+Vin	0.04 inch
5	-Vout	-Vout	0.08 inch
6	-Sense	-Sense	0.04 inch
7	Trim	Trim	0.04 inch
7	+Sense	+Sense	0.04 inch
9	+Vout	+Vout	0.08 inch
10	ULVO	Ctrl	0.04 inch
11	Pulse Out	Pulse Out	0.04 inch

Notes

- All dimensions in inch [mm]
- Tolerance: 2DP ± 0.02 [1DP ± 0.05], 3DP ± 0.010 [2DP ± 0.025]
- Pin dimension tolerance ± 0.004 (± 0.10)
- The screw locked torque: MAX 3.5kgf-cm/0.34N-m
- For best EMI performance screw all four mounting points to shield plane

Recommended Pad layout



Notes

- All dimensions in inch [mm]
- Through holes 1,2,3,4,6,7,8,10 & 11 $\phi 0.051$ [1.3]
- Through holes 5 & 9 $\phi 0.09$ [2.3]
- Mounting through holes $\phi 0.126$ [3.2]
- Top view pad 1,2,3,4,6,7,8,10 & 11 $\phi 0.64$ [1.63]
- Top view pad 5 & 9 $\phi 0.113$ [2.88]
- Top view pad mounting $\phi 0.157$ [4]
- Bottom view pad 1,2,3,4,6,7,8,10 & 11 $\phi 0.102$ [2.6]
- Bottom view pad 5 & 9 $\phi 0.181$ [4.6]
- Bottom view pad mounting $\phi 0.252$ [6.4]

Weight

113g



Models & Ratings

Model Number ⁽¹⁾	Input Voltage	Output Voltage	Output current	No Load Current	Efficiency	Maximum Capacitive
HAE150-72S05UA	16-160VDC	5VDC	30A	33mA	91%	45000uF
HAE150-72S12UA		12VDC	12.5A	16mA	93%	8000uF
HAE150-72S15UA		15VDC	10.0A	26mA	92%	5000uF
HAE150-72S24UA		24VDC	6.3A	30mA	89%	2000uF
HAE150-72S28UA		28VDC	5.4A	32mA	89%	1470uF
HAE150-72S48UA		48VDC	3.2A	23mA	93%	470uF
HAE150-72S53UA		53VDC	2.9A	30mA	91%	390uF

1. For B type product change A to B i.e HAE150-72S24UB. For positive logic add P or leave blank for default negative logic

2. Series diode or mosfet required for reverse polarity protection

3. Input fuse required: 15A fast acting, BUS line (optional) 3A fast acting

4. CBUS must always be populated with capacitance. Recommended Nippon Chemi-con KXJ 150uF/200V capacitor



Input

Parameter	Min	Typical	Max	Unit	Notes/Conditions
Input voltage	16	72	160	VDC	
Start up voltage			16	VDC	UVLO resistor open
Shutdown voltage	10	11	12	VDC	UVLO resistor open
Start up time		350		ms	Power up, remote on/off
Input transient voltage	12			VDC	100ms max
Input filter					C type
Input surge voltage			185	VDC	1 second max
Remote on-off	0		1.2	VDC	OR OPEN = On ref -Vin (positive logic)
	3		12	VDC	OR SHORT = Off ref -Vin (positive logic)
	3		12	VDC	
	0		1.2	VDC	
Control pin current	0.5		1	mA	
Remote off input current		15		mA	

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Output

Parameter	Min	Typical	Max	Unit	Notes/Conditions
Output voltage	5		53	VDC	See models and ratings table on page 4
Set point accuracy			±1	%	
Line regulation			±0.2	%	Low line to high line
Load regulation			±0.1	%	0 to 100% load change. ±0.5 for single and ±1 for dual
Output voltage adjustability	-20		+10	%	Trim and remote sense see application note
Transient response		250		µS	25% step load
Temperature coefficient			±0.02	%/°C	
Remote sense			±10	%Vout	If not used sense lines must be connected to Vout
Noise and Ripple		75		mVp-p	5V Measured with 22µF/25V X7R MLCC & 22µF/25V POSCAP. 20MHz bandwidth
		150			12V - 15V Measured with 22µF/25V X7R MLCC & 22µF/25V POSCAP. 20MHz bandwidth
		200			24V - 28V Measured with 2.7µF/50V X7R MLCC. 20MHz bandwidth
		300			48V & 5V Measured with 1µF/100V X7R MLCC. 20MHz bandwidth

Protections

Parameter	Min	Typical	Max	Unit	Notes/Conditions
Overload	120		150	%	Hiccup mode. Automatic recovery
Short circuit					Continuous. Automatic recovery
Overvoltage	115		130	VDC	Hiccup mode. Automatic recovery
Over temperature		115		°C	

Safety

Parameter	Min	Typical	Max	Unit	Notes/Conditions
Safety standards	UL/IEC/EN 62368-1, EN50155				
Isolation: Input to output	3000			VDC	60sec
Isolation: Input (output) to case	1500			VDC	60sec
Isolation resistance	1			GOhm	At 500VDC
Isolation capacitance			1000	pF	
Switching frequency	207	230	253	kHz	

EMC: Emissions

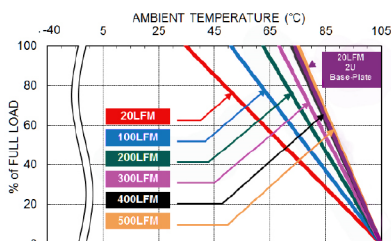
Parameter	Standard	Test level	Criteria	Notes/Conditions
Conducted / radiated	EN55032/ EN50121-3-2	A / B		With external components

EMC: Immunity

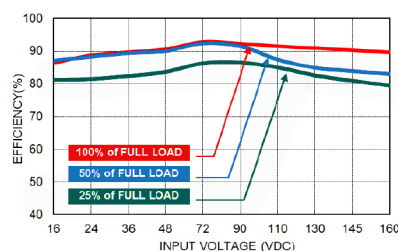
Parameter	Standard	Test level	Criteria	Notes/Conditions
ESD	EN61000-4-2	3	A	Contact: ±6kV, Air: ±8kV
Radiated	EN61000-4-3	3	A	20V/m
EFT & Surge	EN61000-4-4/5	4	A	±2kV External components
Conducted	EN61000-4-6	3	A	10Vrms
PFMF	EN61000-4-8	5	A	100A/m continuous, 1000A/m 1sec

Environmental

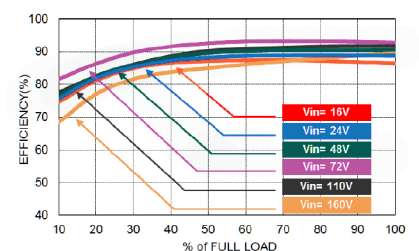
Parameter	Min	Typical	Max	Unit	Notes/Conditions
Operating temperature	-40		105	°C	Base-plate temp. See derating curve.
Storage temperature	-55		125	°C	
Max case temperature			105	°C	
Humidity	5		95	% RH	Non-condensing
Thermal impedance		6.1/2.8		°C/W	DC-DC module/ with base-plate
MTBF	309.3			Khrs	MIL-HDBK-217F, 25°C GB
Shock and vibration	EN61373, MIL-STD-810F				
Material	Case: aluminium base plate with plastic case. Base: FR4 PCB. Potting: silicone (UV94 V-0)				



HAE150-72S12UA Derating Curve
(See Thermal Considerations)



HAE150-72S12UA Efficiency vs. Input Voltage

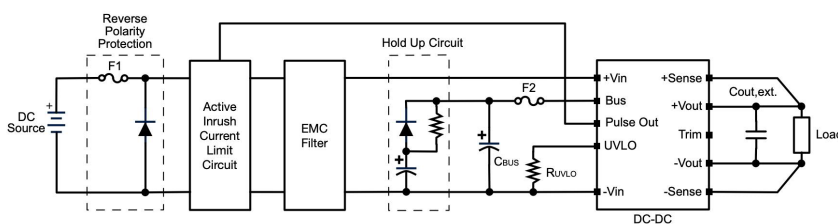
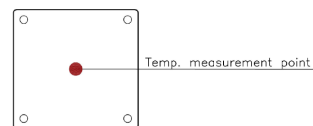


HAE150-72S12UA Efficiency vs. Output Load

Application note

Thermal considerations

Sufficient cooling should be provided to ensure reliable operation. Sufficient cooling is monitored by measuring the temperature of the centre point on the bottom of the unit as shown. This temperature should not exceed max case temperature. Base plate should be 19"x3.5"x0.063"



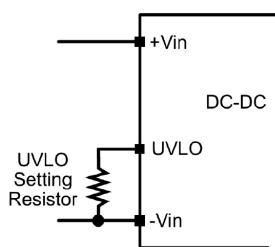
Typical Connection

UVLO

The ultra wide input can be tailored for added protection by implementing and under voltage lock out. Using the equation below an appropriate resistor can be implemented for the desired lock out voltage on the module's input:

$$V_{in, ON} = \frac{451.23}{R_{UVLO} + 3} + 13.26 \quad (V)$$

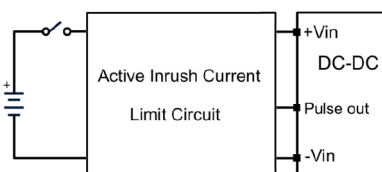
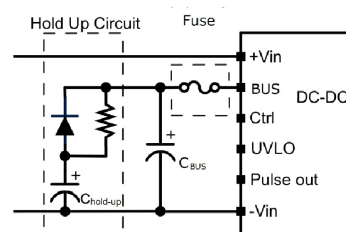
$$V_{in, OFF} = \frac{448.5}{R_{UVLO} + 3} + 11.00 \quad (V)$$



System Voltage	Start up	Shut down	R _{UVLO}
24V	13.3V	11V	Open
36V	21.6V	19.3V	51.12kΩ
48V	28.8V	26.4V	26.04kΩ
72V	43.2V	40.8V	12.07kΩ
96V	57.6V	55.1V	7.18kΩ
110V	66V	63.4V	5.56kΩ

Hold up

The hold up of the module can be tailored by adding the desired capacitance as shown in the adjacent circuit diagram. Please contact Fidus Power if you have a specific hold up requirement at a given load and voltage input. Minimum C_{BUS} 150uF/200V, recommended Nippon Chemicon KXJ Series. Fuse is advisable 5A fast blow.



Pulse out

This pin generates voltage pulse with fixed frequency. It provides the function that could achieve inrush current limit with external circuit. If pulse out pin is not to be used, leave this pin floating.

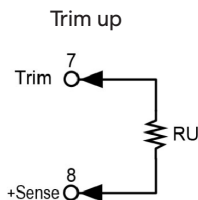
HAE150U SERIES

Output voltage adjustment

It allows the user to increase or decrease the output voltage of the module.
 This is accomplished 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 increases.
 With an external resistor between the Trim and +Sense pin, the output voltage decreases.
 The external Trim resistor needs to be at least 1/8W of rated power.

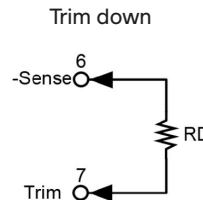
Trim up equation

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



Trim down equation

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



Trim tables

5V Output trim up

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

12V Output trim up

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20	Volts
RU	887.388	447.592	300.993	227.964	183.714	154.395	133.452	117.745	105.528	97.755	kOhms

15V Output trim up

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

24V Output trim up

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	24.24	24.48	24.72	24.96	25.20	25.44	25.68	25.92	26.16	26.40	Volts
RU	1876.776	947.184	637.320	482.388	389.429	327.456	283.190	249.990	224.468	203.510	kOhms

28V Output trim up

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

48V Output trim up

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

53V Output trim up

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	53.53	54.06	54.59	55.12	55.65	56.18	56.71	57.24	57.77	58.30	Volts
RU	4267.769	2154.531	1450.109	1097.898	886.571	745.6871	645.055	569.592	510.880	463.918	kOhms

Trim down all voltages

ΔV%	1	2	3	4	5	6	7	8	9	10	%
RD	98	48	31.333	23	18	14.667	12.286	10.5	9.111	8	kOhms
ΔV%	11	12	13	14	15	16	17	18	19	20	%
RD	7.091	6.333	5.692	5.143	4.667	4.25	3.882	3.556	3.263	3	kOhms