HELIOS
POWER SOLUTIONS

HAE200U Series

3 YEARS WARRANTY

RoHS COMPLIANT

REACH COMPLIANT

Railway | Automation | Datacom

IPC | Industry | Measurement

Telecom | Automobile | Boat

Charger | Medical | PV

CE

3000 VAC Reinforced Insulation | 10:1 Ultra-Wide Input Range | HOLD UP | NO Min. Load Required | Primary PULSE OUTPUT | REMOTE ON OFF | OCP | OTP | OVP | SCP | UVP Adjustable

PART NUMBER STRUCTURE

HAE200 - 72 S 05 U A - P TH

Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Input Range	Pin Connection Option	Ctrl and Pin Options	Assembly Option
	72:16~160	**S:**Single	**05:**5 **12:**12 **15:**15 **24:**24 **28:**28 **48:**48 **53:**53	10:1	**A:** A type (Standard) **B:** B type	□:Negative logic **P:**Positive logic	□: None **Through hole type** **TH:**No thread

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HAE200U Series

TECHNICAL SPECIFICATION All specifications are typical at nominal input, full load and 25℃ 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
HAE200-72S05UA/B	16 ~ 160	5	40	35	90	60000
HAE200-72S12UA/B	16 ~ 160	12	16.8	20	92	10300
HAE200-72S15UA/B	16 ~ 160	15	13.4	25	91	6600
HAE200-72S24UA/B	16 ~ 160	24	8.4	30	90	2600
HAE200-72S28UA/B	16 ~ 160	28	7.2	30	89	1800
HAE200-72S48UA/B	16 ~ 160	48	4.2	25	92	620
HAE200-72S53UA/B	16 ~ 160	53	3.9	30	91.5	470

INPUT SPECIFICATIONS

Parameter	Conditions			Min.	Typ.	Max.	Unit
Operating input voltage range		72Vin(nom)	All	16	72	160	VDC
Start up voltage	UVLO external resistor open					16	VDC
Shutdown voltage	UVLO external resistor open			10	11	12	VDC
Start up time	Constant resistive load	Power up			350		ms
		Remote ON/OFF			350		
Input Transient voltage	100 mS, max.			12			VDC
Input surge voltage	1 second, max.					185	VDC
Input filter					C type		
Remote ON/OFF	Referred to –Vin pin	Negative logic	DC-DC ON		Short or 0 ~ 1.2VDC		
		(Standard)	DC-DC OFF		Open or 3 ~ 12VDC		
		Positive logic	DC-DC ON		Open or 3 ~ 12VDC		
		(Option)	DC-DC OFF		Short or 0 ~ 1.2VDC		
		Input current of Ctrl pin		-0.5		1	mA
		Remote off input current			15		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		-0.2		+0.2	%
Load regulation	No Load to Full Load		-0.1		+0.1	%
Voltage adjustability	Single output		-20		+10	%
Remote sense	% of Vout(nom). If remote sense is not being used, SENSE pins should connect to corresponding polarity Vout pins.				10	%
Ripple and noise	Measured by 20MHz bandwidth					
	With a 22μF/25V X7R MLCC and a 22μF/25V POS-CAP	5Vout		75		mVp-p
	With a 22μF/25V X7R MLCC and a 22μF/25V POS-CAP	12Vout, 15Vout		150		
	With a 4.7μF/50V X7R MLCC	24Vout, 28Vout		200		
	With a 1μF/100V X7R MLCC	48Vout, 53Vout		300		
Temperature coefficient			-0.02		+0.02	%/℃
Transient response recovery time	25% load step change			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, automatics recovery			

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GENERAL SPECIFICATIONS

Parameter	Conditions		Min.	Typ.	Max.	Unit
Isolation voltage	1 minute(Reinforced insulation)	Input to Output Input (Output) to Base-Plate	3000 1500			VAC
Isolation resistance	500VDC		1			GΩ
Isolation capacitance				1000		pF
Switching frequency			207	230	253	kHz
Safety approvals (Pending)						IEC /UL/ EN62368-1
Standard approvals (Pending)	Railway					EN50155 EN45545-2
Case material						Aluminum base-plate with plastic case
Potting material						Silicone (UL94 V-0)
Weight						113g (3.99oz)
MTBF	MIL-HDBK-217F, Full load					2.305 x 10^5 hrs

ENVIRONMENTAL SPECIFICATIONS

Parameter	Conditions		Min.	Typ.	Max.	Unit
Operating base-plate temperature		With derating	-40		+105	℃
Maximum case temperature					105	℃
Over temperature protection				110		℃
Storage temperature range			-55		+125	℃
Thermal impedance	Module without assembly option Only mount on the iron base-plate			6.1 2.8		℃/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	EN55032, EN50121-3-2	With external components	Class A, Class B
EMS	EN55024, EN50121-3-2		
ESD	EN61000-4-2	Air ± 8kV and Contact ± 6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3	20 V/m	Perf. Criteria A
Fast transient	EN61000-4-4	± 2kV With external components	Perf. Criteria A
Surge	EN61000-4-5	EN55024:±2kV and EN50155:±2kV With external components	Perf. Criteria A
Conducted immunity	EN61000-4-6	10 Vr.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8	100A/m continuous; 1000A/m 1 second	Perf. Criteria A

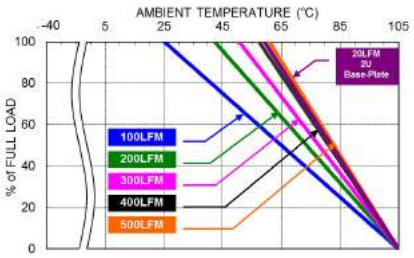
Note:

1. BASE-PLATE GROUNDING: When connect four screw bolts to shield plane, the EMI could be reduced.

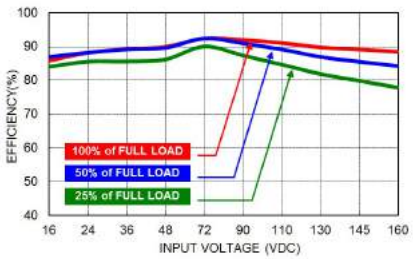
CAUTION:

1. This power module is not internally fused. An input line fuse must always be used.
2. The BUS pin is for hold-up time function, and it only can be connected to capacitor and the components that P-DUKE advised, please do not connect to load and use for any other purpose.
3. A CBUS must always be used. (CBUS:Nippon Chemi-con KXJ series, 150μF/200V)

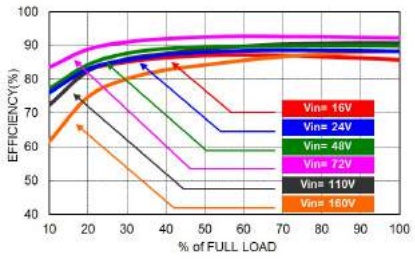
CHARACTERISTIC CURVE



HAE200-72S12UA Derating Curve
(See Thermal Considerations)



HAE200-72S12UA Efficiency vs. Input Voltage



HAE200-72S12UA Efficiency vs. Output Load

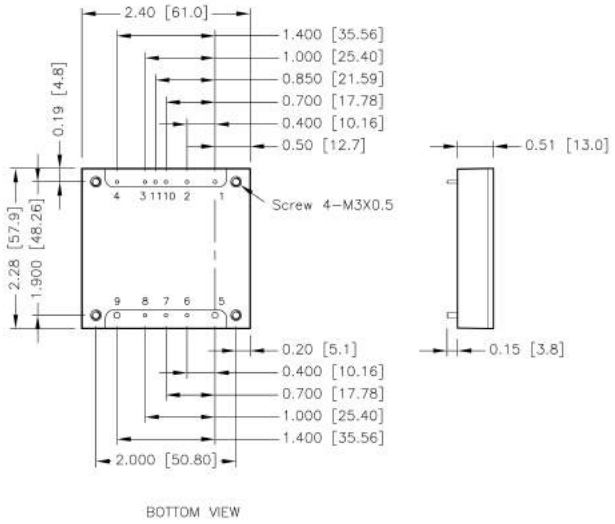
FUSE CONSIDERATION

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：

Location	Fuse Rating (A)	Fuse Type
Input Line	20	Fast-Acting
BUS Line (Option)	3	Fast-Acting

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

MECHANICAL DRAWING



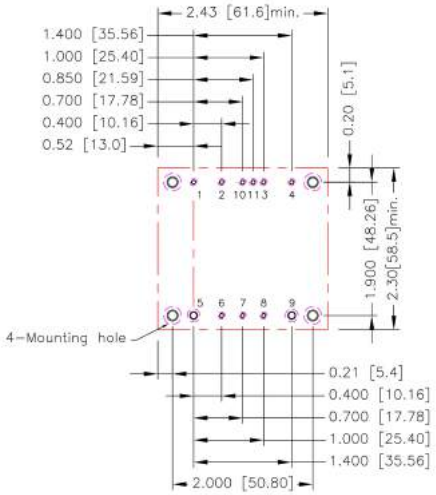
■ The screw locked torque: MAX 3.5kgf-cm/0.34N-m

PIN CONNECTION

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
8	+Sense	+Sense	0.04 Inch
9	+Vout	+Vout	0.08 Inch
10	UVLO	Ctrl	0.04 Inch
11	Pulse Out	Pulse Out	0.04 Inch

1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5]
   x.xxx±0.010 [x.xx±0.25]
3. Pin dimension tolerance ±0.004 [0.10]

RECOMMENDED PAD LAYOUT

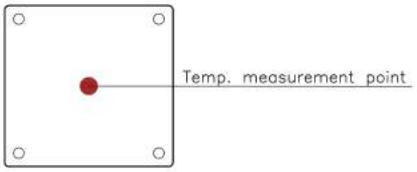


All dimensions in inch[mm]
Pad size(lead free recommended)
Through hole 1.2.3.4.6.7.8.10.11:Φ0.051[1.30]
Through hole 5.9:Φ0.091[2.30]
Through hole of mounting:Φ0.126[3.20]
Top view pad 1.2.3.4.6.7.8.10.11:Φ0.064[1.63]
Top view pad 5.9:Φ0.113[2.88]
Top view pad of mounting:Φ0.157[4.00]
Bottom view pad 1.2.3.4.6.7.8.10.11:Φ0.102[2.60]
Bottom view pad 5.9:Φ0.181[4.60]
Bottom view pad of mounting:Φ0.252[6.40]

THERMAL CONSIDERATIONS

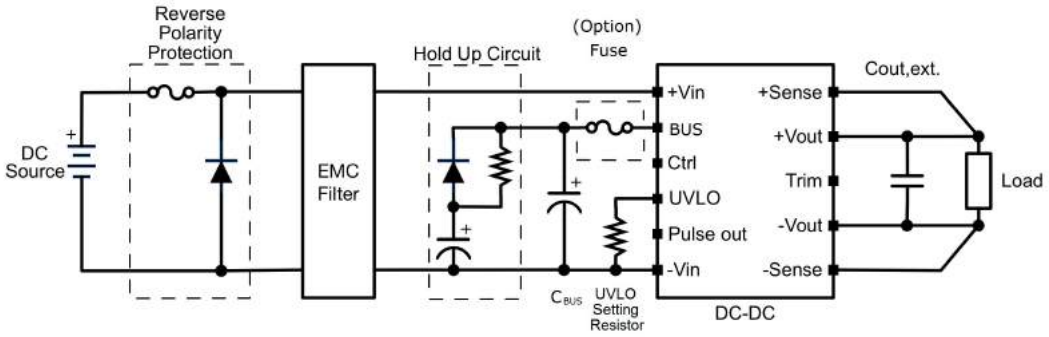
The power module operates in a variety of thermal environments.
However, sufficient cooling should be provided to help ensure reliable operation of the unit.
Heat is removed by conduction, convection, and radiation to the surrounding Environment.
Proper cooling can be verified by measuring the point 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 iron base-plate dimension is 19” X 3.5” X 0.063” (The height is EIA standard 2U).



BASE PLATE

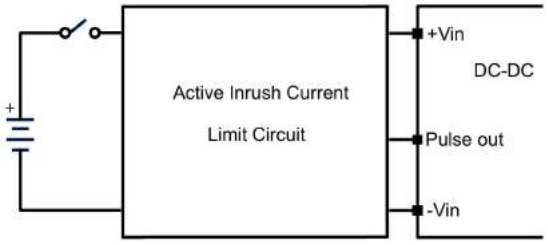
TYPICAL APPLICATION



Typical Connection

■ Pulse Out

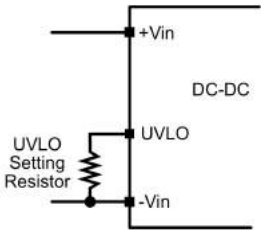
This pin generates voltage pulse with fixed frequency. It provides the function that could achieve inrush current limit with exteral circuit. If Pulse Out pin is not to be used, please left this pin floating.



■ UVLO

This series product has ultra wide input range. It could cover many kind of nominal input voltage in one module. In order to preventing incorrect operating under different input system, it offers UVLO adjustment by connecting a resistor to set UVLO threshold.

$$V_{in,on} = \left(\frac{451.23}{R_{UVLO}+3} + 15.18\right)V \qquad V_{in,off} = \left(\frac{448.5}{R_{UVLO}+3} + 10.80\right)V$$

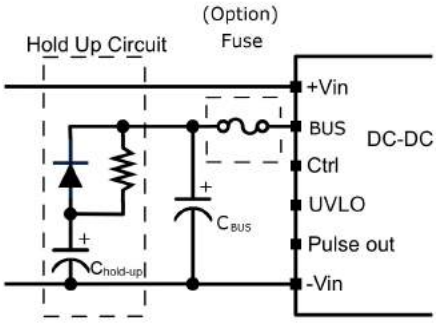


UVLO Setting

Nominal Vin	(V)	24	36	48	72	96	110
Start-up Voltage	(V)	15.0	21.6	28.8	43.2	57.6	66.0
Shutdown Voltage	(V)	11.0	17.2	24.3	38.7	53.0	61.3
UVLO Setting Resistor	(kΩ)	Open	67.2	30.2	13.1	7.64	5.88

■ Hold Up Time

Generally, connecting a large number of hold up capacitors on input are necessary to get long duration of hold up time. The external circuit connected to BUS pin provides energy that stored in $C_{hold\text{-}up}$ when input voltage shutdown. That extends duration of hold up time with less capacitance so that reduce the number of capacitors.



Hold Up Function

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.

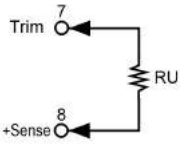
■ **Trim Up Equation**

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

■ **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



72S05UA/B

△V	(%)	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

72S12UA/B

△V	(%)	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

72S15UA/B

△V	(%)	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

72S24UA/B

△V	(%)	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

72S28UA/B

△V	(%)	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

72S48UA/B

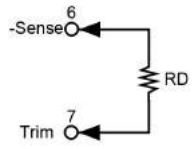
△V	(%)	1	2	3	4	5	6	7	8	9	10
Vout	(V)	48.48	48.96	49.44	49.92	50.40	50.88	51.36	51.84	52.32	52.80
RU	(kΩ)	3855.551	1946.367	1309.973	991.776	800.857	673.578	582.665	514.480	461.447	419.020

72S53UA/B

△V	(%)	1	2	3	4	5	6	7	8	9	10
Vout	(V)	53.53	54.06	54.59	55.12	55.65	56.18	56.71	57.24	57.77	58.30
RU	(kΩ)	4267.769	2154.531	1450.109	1097.898	886.571	745.6871	645.055	569.582		

OUTPUT VOLTAGE ADJUSTMENT (CONTINUED)

Trim-down



72S□□UA/B

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