



# Hybrid Surge Protection DC/DC Converter (HSSA28S Series)

## 1 Features

- High reliability
- Wide input voltage range: 15V~50V, Nominal  
DC input voltage: 28V
- Maximum input transient voltage: 80V, 1s
- Output Power  $P_o$ : 6W
- Operating temperature range  $T_c$ :  $-55^{\circ}\text{C} \sim +125^{\circ}\text{C}$
- Low Startup current
- No output overshoot
- Inhibit function
- Inhibit function and indefinite short circuit protection
- Maximum power density:  $19\text{W}/\text{in}^3$
- Hermetically sealed metal case



Size: 27.23×27.23×6.86mm(without flange)

Size:39.0×27.23×6.86mm (with flang)

Weight: 19g(without flange)

24g (with flange)

Table1 Product models

HSSA28S3R3、HSSA28S3R3F
HSSA28S5、HSSA28S5F
HSSA28S5R2、HSSA28S5R2F
HSSA28S12、HSSA28S12F
HSSA28S15、HSSA28S15F

## 2 Scope of application

High-reliability electronic system for aviation and aerospace, etc

## 3 Descriptions

This series product is high reliable and is featured with transient protection (80 v, 1 s) for DC/DC converter. Single ended flyback, pulse width modulated and transformer magnetic feedback topology design are used in this product. The operating principle is that the sampling signal of output voltage, coupled by the opto-coupler, works together with the sampling signal of input loop current to regulate the pulse width of the controller. The double loop control creates constant voltage output.

Thick film hybrid techniques provide the HSSA28S Series converters with high reliability and optimum miniaturization. The design and manufacturing process of HSSA28S Series

converters are in compliance with MIL-PRF-38534.

## 4 Technical Specifications

Table 2 Rated conditions and recommended operating conditions

Absolute Max. Rating
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Input voltage: 15V~50V Input voltage (Transient,1s) : 80V Output Power: 6.5W Storage temperature: -65°C~150°C	Mechanical Shock: 1500g Weight (without flange/ with flange) : 19g/24g Antistatic intensity: 2000V
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Table 3 Electrical characteristics

No.	Items	Conditions	HSSA28S3R3 HSSA28S3R3F		HSSA28S5 HSSA28S5F		HSSA28S5R2 HSSA28S5R2F		
			Min	Max	Min	Max	Min	Max	
1	Input Voltage/V	Low, High, Ambient Temperature	15	50	15	50	15	50	
2	Output Voltage/V	Io=Full Load	Ambient	3.267	3.333	4.95	5.05	5.148	5.252
			Low/high	3.25	3.35	4.925	5.075	5.122	5.278
3	Output current/A	V <sub>IN</sub> =15V~50V	—	1.21	—	1	—	1	
4	Output Power/W			4	0	5	0	5.2	
5	Output Ripple Voltage/mV	BW≤6MHz, Io=Full load	-	30	—	30	—	30	
6	Line Regulation/mV	V <sub>IN</sub> =15V~50V, Io=Full load		15	—	15	—	15	
7	Load Regulation/mV	Io=No load to Full		50	—	50	—	50	
8	Input current/mA	Inhibited		6	—	6	—	6	
		Io=no load		60	—	60	—	60	
9	Input Ripple current/mA	BW≤20MHz, Io=Full		50	—	50	—	50	
10	Efficiency/%	Io=Full	62		65	—	65	—	
11	Isolation/MΩ	Input to output or any pin to case(except pin 7、8)at 500V, T <sub>c</sub> =25°C	100		100	—	100	—	
12	Inhibit voltage		0	0.7	0	0.7	0	0.7	
13	Under voltage open voltage/V	Io=Full Load	12	14.8	12	14.8	12	14.8	
14	Under voltage cut-off voltage/V	Io=Full Load	11	14.5	11	14.5	11	14.5	
15	Short Circuit Protection								
16	Capacitive load /μF	T <sub>c</sub> =25°C	-	1000	—	1000	—	500	
17	switching frequency/kHz	Io=Full Load	350	500	350	500	350	500	
18	Step Load Response Transient(mV pK)	50%load→full load or full load→50%load	-300	300	—	500	-500	500	
19	Step Load Response Recovery(μs)	50%load→full load or full load→50%load	-	700	—	700	—	700	
20	Step Line Response Transient(mV pK)	V <sub>IN</sub> : 16V→40V, V <sub>IN</sub> : 40V→16V, Io=Full load	-500	500	-700	700	-700	700	

21	Step Line Response Recovery( $\mu$ s)	$V_{IN}$ : 16V $\rightarrow$ 40V $V_{IN}$ : 40V $\rightarrow$ 16V $I_o$ =Full load	-	1200	—	1200	—	1200
22	Start-up Overshoot(mV pK)	$V_{IN}$ : 0 $\rightarrow$ 28V, $I_o$ =Full load		15	—	25	—	25
23	Start-up Delay (ms)	$V_{IN}$ : 0 $\rightarrow$ 28V, $I_o$ =Full load		20	—	20	—	20

Table3 (2) Electrical characteristics

No.	Parameter	Conditions (Unless otherwise specified)	HSSA28S12 HSSA28S12F		HSSA28S15 HSSA28S15F	
			Min	Max	Min	Max
1	Input Voltage/V	Low、High、 Ambient Temperature	15	50	15	50
2	Output Voltage/V	$I_o$ =Full Load      Ambient Low/high	11.88 11.82	12.12 12.18	14.85 14.775	15.15 15.225
3	Output current/A	$V_{IN}$ =15V $\sim$ 50V	—	0.5	—	0.4
4	Output Power/W		0	6	0	6
5	Output Ripple Voltage/mV	BW $\leq$ 6MHz, $I_o$ =Full load	—	50	—	50
6	Line Regulation/mV	$V_{IN}$ =15V $\sim$ 50V, $I_o$ =Full	—	15	—	15
7	Lode Regulation/mV	$I_o$ =No load to full	—	50	—	50
8	Input current/mA	Inhibited	—	6	—	6
		$I_o$ =no load	—	60	—	60
9	Input Ripple current/mA	BW $\leq$ 20MHz, $I_o$ =Full load	—	50	—	50
10	Efficiency/%	$I_o$ =Full load	71	—	72	—
11	Isolation/M $\Omega$	Input to output or any pin to case(except pin 7、8) at 500V, $T_c$ =25 $^{\circ}$ C	100	—	100	—
12	Inhibit voltage		0	0.7	0	0.7
13	Undervoltage open voltage/V	$I_o$ =Full Load	12	14.8	12	14.8
14	Undervoltage cut-off voltage/V	$I_o$ =Full Load	11	14.5	11	14.5
15	Short Circuit Protection					
16	Capacitive load / $\mu$ F	$T_c$ =25 $^{\circ}$ C	—	500	—	500
17	Switching frequency/KHZ	$I_o$ =Full Load	350	500	350	500
18	Step Load Response Transient(mV )	50%load $\rightarrow$ full load or full load $\rightarrow$ 50%load	-700	700	-700	700
19	Step Load Response Recovery( $\mu$ s)	50%load $\rightarrow$ full load or full load $\rightarrow$ 50%load	—	400	—	400

20	Step Line Response Transient(mV)	$V_{IN}: 16V \rightarrow 40V,$ $V_{IN}: 40V \rightarrow 16V, I_o = \text{Full load}$	-1200	1200	-1300	1300
21	Step Line Response Recovery( $\mu s$ )	$V_{IN}: 16V \rightarrow 40V$ $V_{IN}: 40V \rightarrow 16V$ $I_o = \text{Full load}$	—	600	—	600
22	Start-up Overshoot (mV p)	$V_{IN}: 0 \rightarrow 28V,$ $I_o = \text{Full load}$	—	50	—	50
23	Start-up Delay (ms)	$V_{IN}: 0 \rightarrow 28V,$ $I_o = \text{Full load}$	—	20	—	20

## 5 Circuit block diagram

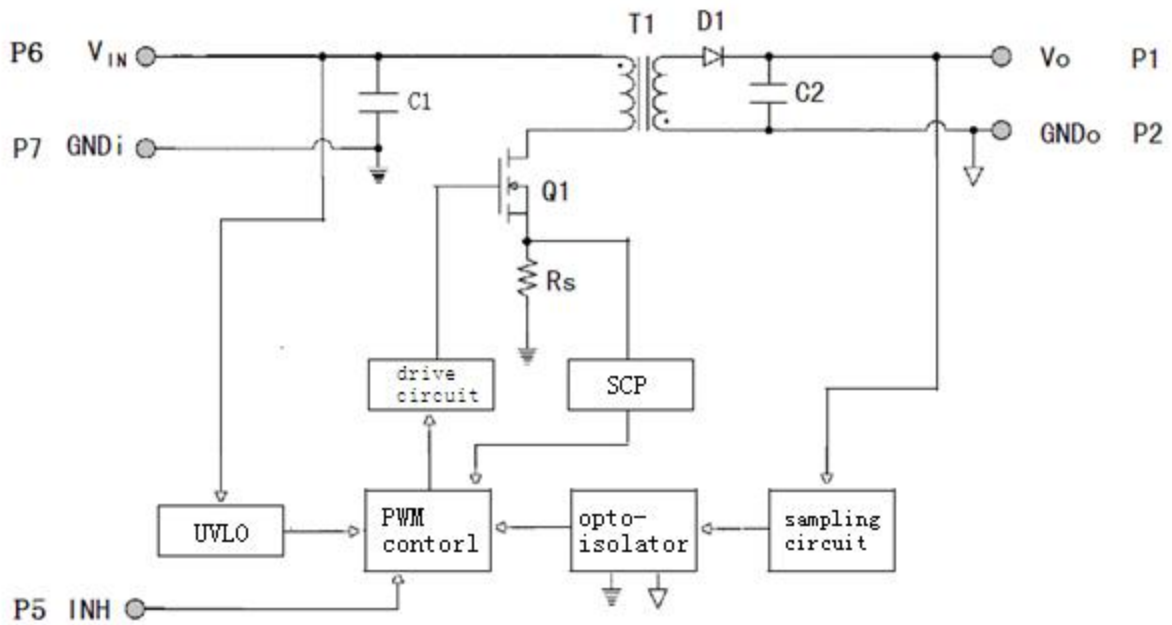


Figure 1 HSSA28S Series circuit block diagram

## 6. Typical Characteristic Curve (Testing condition as per $T_c = 25^\circ C$ , $V_{IN} = 28V \pm 5\%$ , unless otherwise specified)

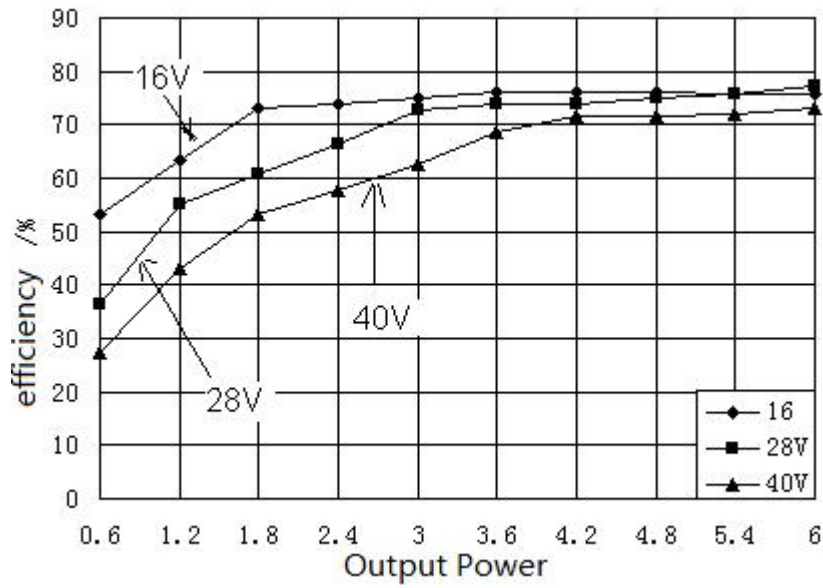


Figure 2 HSSA28S15 Efficiency

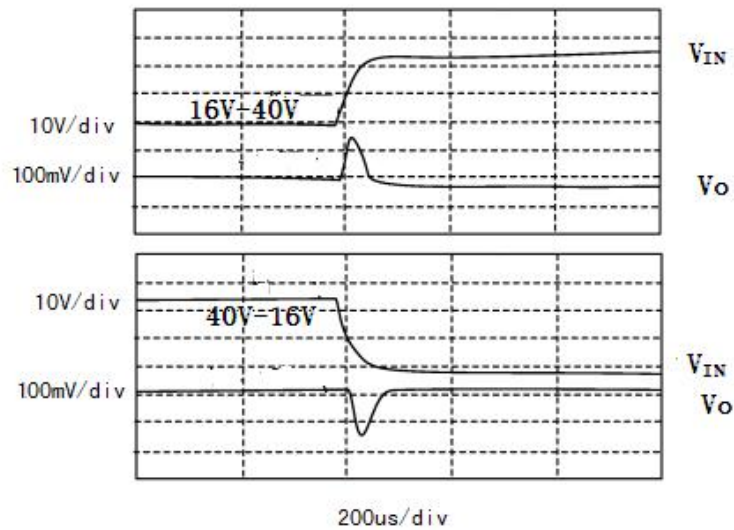


Figure 3 HSSA28S15 Step Line Response

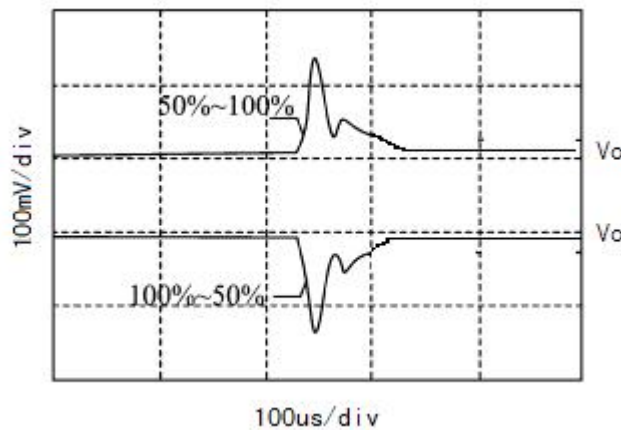


Figure 4 HSSA28S15 Step Load Response

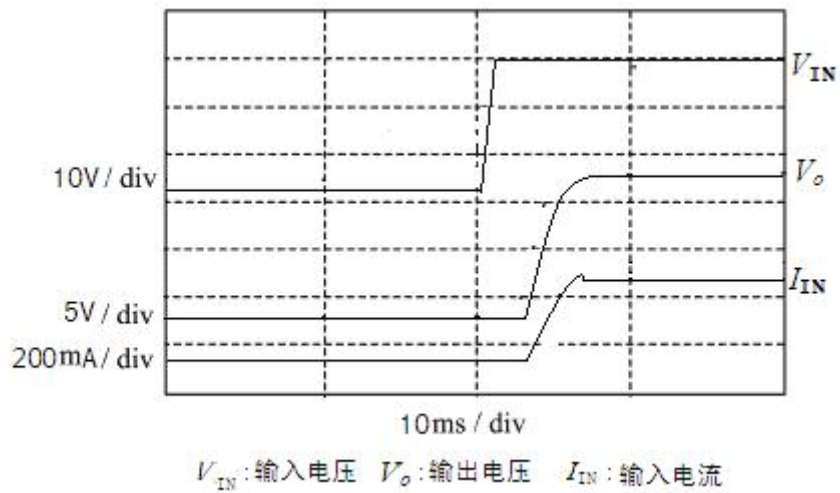


Figure 5 HSSA28S15 Start-up Overshoot/Start-up Delay

### 7.MTBF Curve

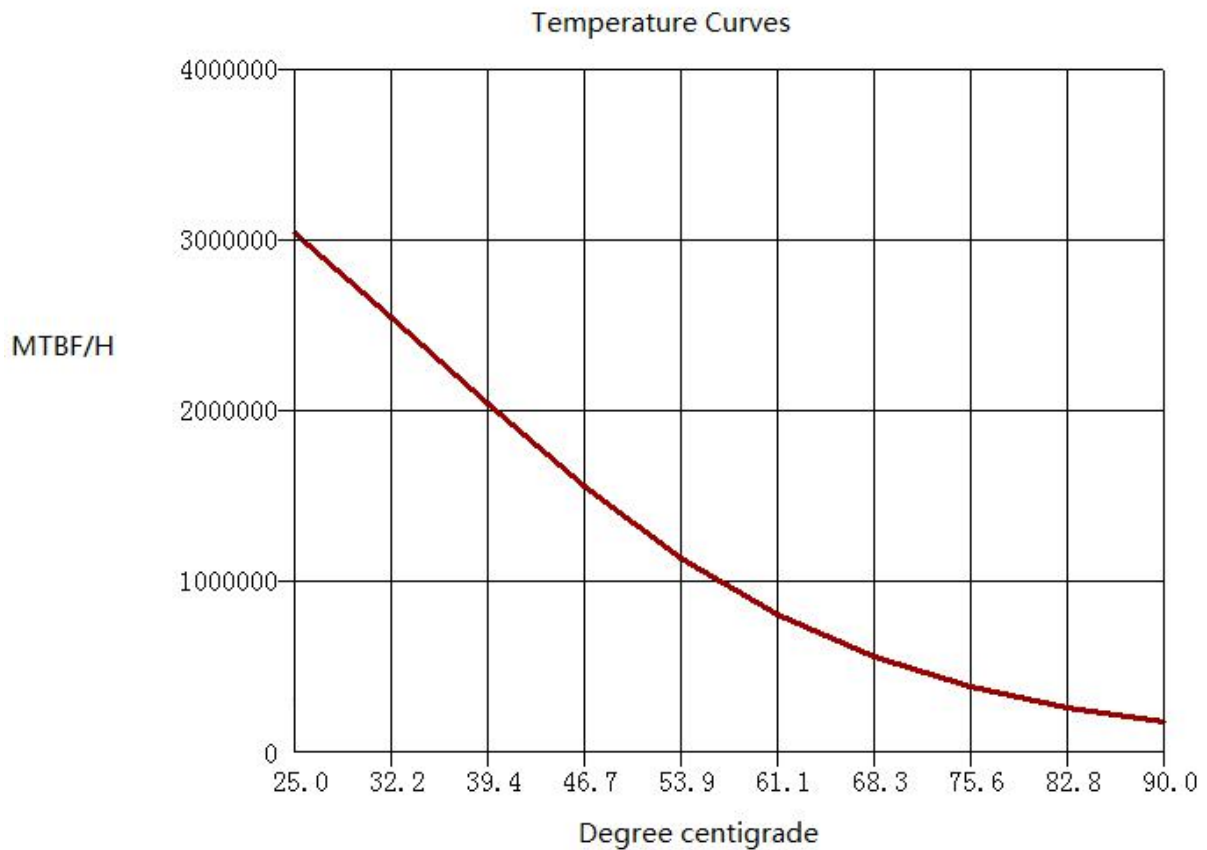


Figure 6 MTBF Temperature Curve (HSSA28S15)

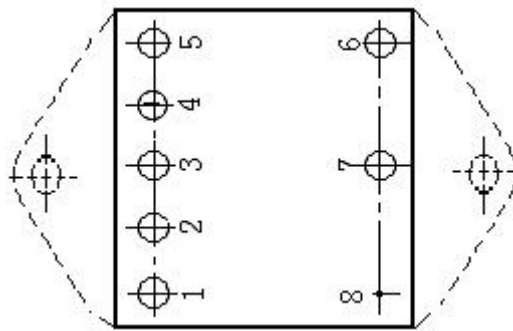


Figure 7 Pin Out Bottom View

Table 4 Pin Designation

Pin	Symbol	Designation
1	$V_O$	Positive Output
2	$GND_O$	Output Common
3	NC	No connection
4	NC	No connection
5	INH	Inhibit
6	$V_{IN}$	Positive Input
7	$GND_I$	Input Common
8	$GND_C$	Case Ground

## 9 Typical Connection Diagram

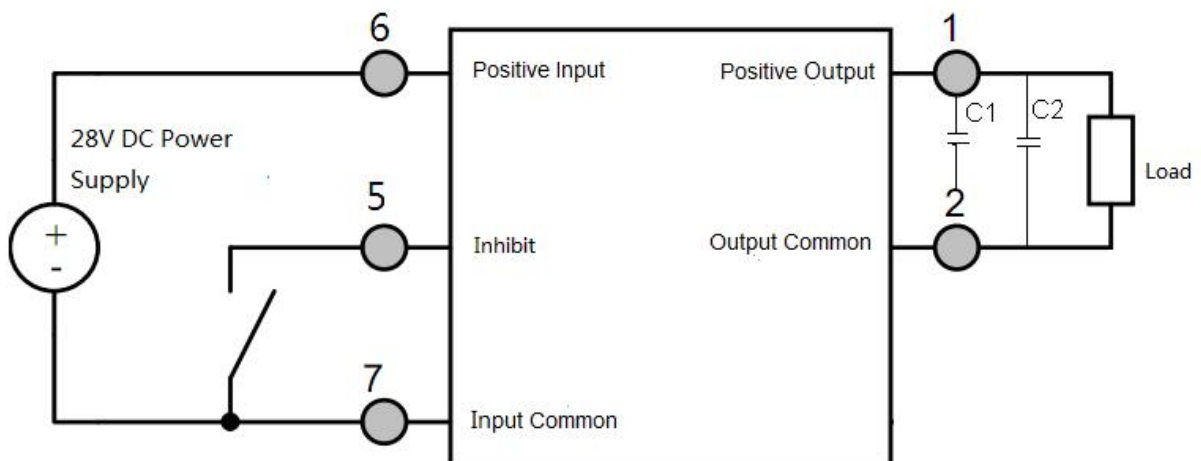


Figure 8 Connection Diagram

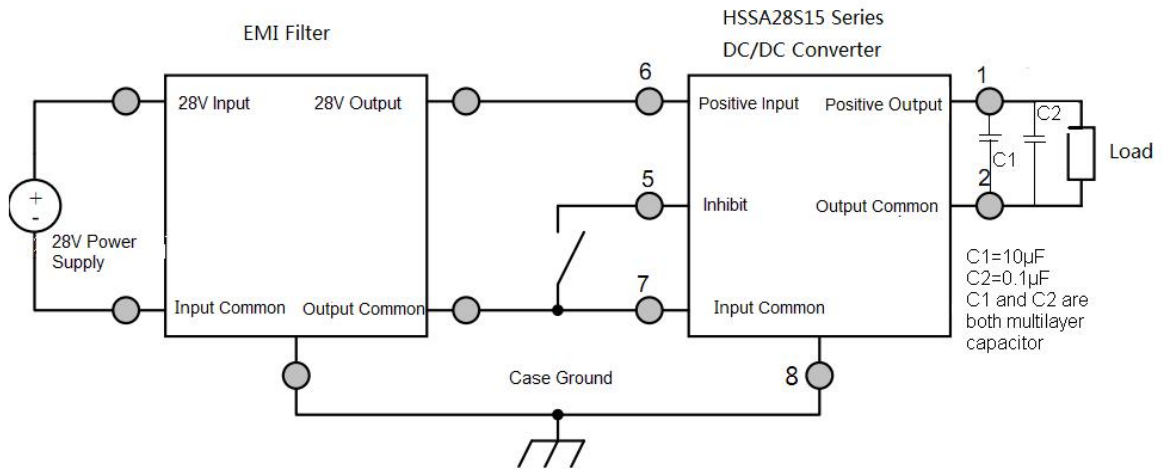


Figure 9 EMI Filter Connection Diagram

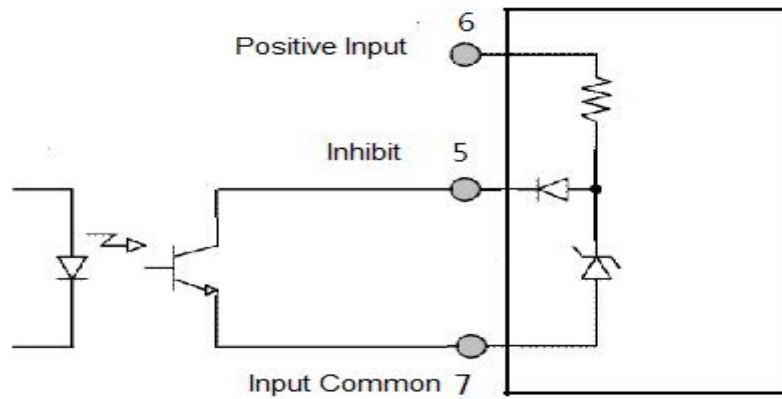


Figure 10 Inhibit Driver Circuit Diagram

## 10. Package Specifications (Unit: mm)

### ① Package without flange

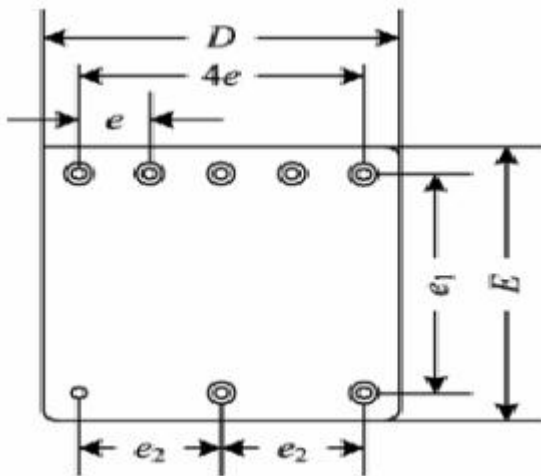


Figure 11 Bottom View

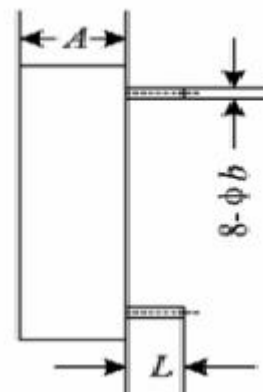


Figure 12 Side View

### ② Package with Flange



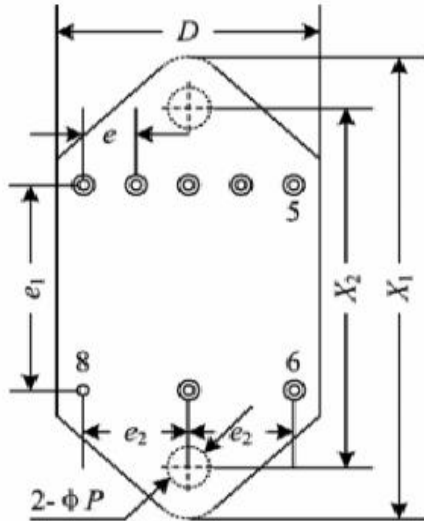


Figure 13 Bottom View

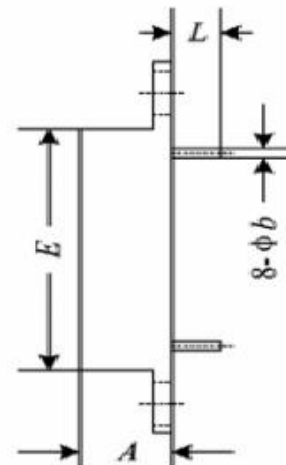


Figure 14 Side View

Table 5 Package Outline

Symbols	Unit/mm		
	Minimum	Nominal	Maximum
<i>A</i>	-	6.86	7.16
$\Phi b$	0.51	0.64	0.77
<i>D</i>	-	27.23	27.57
<i>E</i>	-	27.23	27.57
<i>e</i>	-	5.08	-
<i>e1</i>	-	20.32	-
<i>e2</i>	-	10.16	-
<i>L</i>	4.95	5.21	-
$\Phi P$	2.50	2.80	3.10
<i>X1</i>	-	39.0	39.50
<i>X2</i>	32.90	33.20	33.50

Table 6 Case Materials

Case Model	Header	Header Plating	Cover	Cover Plating	Pin	Pin Plating	Sealing	Notes
UPP2727-08a (without flange)	Cold Rolled Steel (10#)	Nickel	Kovar (4J42)	Nickel	Copper-core Compound	Ni/Au	Compression	Nickel Plating is for case ground pin
UPP2727-08u (with flange)	Cold Rolled Steel	Nickel	Kovar (4J42)	Nickel	Copper-core Compound	Ni/Au	Compression	Nickel Plating is for case

	(10#)							ground pin
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## 11 Ordering Information

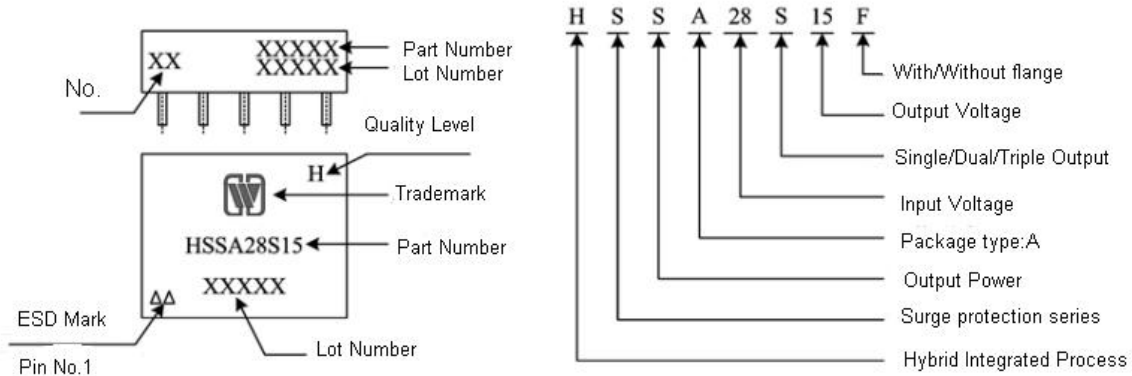


Figure 15 Part Numbering Key

### Application Notes:

- ☆ Both positive and negative terminals for power supply shall be correctly connected when power is applied so as to avoid permanent damage to the device.
- ☆ Testing position shall be the root of the pin of the device when the electrical characteristic is measured.
- ☆ The baseplate of the device shall be closely attached to the circuit board during device mounting so as to avoid the damage on pins. The shockproof actions shall be adopted when necessary.
- ☆ Pins shall not be bended to avoid the glass insulator cracking and case leaking.
- ☆ Pins at inhibit terminal shall be hung in the air during no operation.
- ☆ When the temperature of case is 125℃, the thick of cooling fin (copper) should be 3mm and the area should be more than 70mm×50mm.
- ☆ When ordering this device, the detail electrical specification shall be based on relevant standards. While data offered in this document shall be for reference only.