

# Hybrid Surge Protection DC/D Converter (HSDF28S Series)

## 1 Features

- High reliability
- Wide input voltage range: 15V~50V, Typical  
DC input voltage: 28V
- Maximum input transient voltage: 80V, 1s    Dimensions: 36.83×28.44×8.40mm<sup>3</sup>(without flange)
- Output Power P<sub>O</sub>: 20W    50.80×28.44×8.40mm<sup>3</sup> (with flange)
- Operating temperature range T<sub>C</sub>: -55°C~+125°C    Weight: 31g (without flange)
- Low Startup current    34g (with flange)
- No output overshoot
- Inhibit function
- Input under-voltage locked function  
and output short circuit protection
- Maximum power density: 38W/in<sup>3</sup>
- Hermetically sealed metal case



Table 1 Product models

HSDF28S5, HSDF28S5F
HSDF28S12, HSDF28S12F
HSDF28S15, HSDF28S15F

## 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 (80v, 1s) 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 and short circuit protection.

Thick film hybrid techniques provides the HSDF28S Series converters with high reliability and optimum miniaturization. The design and manufacturing process of HSDF28S Series converters are in compliance with MIL-PRF-38534 and detailed specifications

## 4 Technical Specifications

Table 2 Rated conditions and recommended operating conditions

Absolute Max. Rating	
Input voltage: 15V~50V Input voltage (Transient,1s) : 80V Output Power: 22W Storage temperature: -65℃~150℃	Mechanical Shock: 1500g Weight (without flange/ with flange) : 31g/34g Lead resistance welding temperature : 300 ℃ (15s) Antistatic intensity: 2000V

Table 3 Electrical characteristics

No.	Items	Conditions	HSDF28S5 HSDF28S5F		HSDF28S12 HSDF28S12F		HSDF28S15 HSDF28S15F		
			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	4.95	5.05	11.88	12.12	14.85	15.15
			Low/high	4.92	5.08	11.82	12.18	14.77	15.23
3	Output current/A	V <sub>IN</sub> =15V~50V	—	3	—	1.67	—	1.33	
4	Output Power/W		0	15	0	20	0	20	
5	Output Ripple Voltage/mV	BW≤6MHz, Io=Full load	—	50	—	50	—	50	
6	Line Regulation/mV	V <sub>IN</sub> =15V~50V, Io=Full	—	20	—	20	—	20	
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 load	—	80	—	80	—	80	
10	Efficiency/%	Io=Full load	72	—	77	—	78	—	
11	Isolation/MΩ	Input to output or any pin to case(except pin 7, 8)at 500V, T <sub>c</sub> =25℃	100	—	100	—	100	—	
12	Inhibit Function		0	0.7	0	0.7	0	0.7	
13	Under-voltage open voltage/V	Io=Full Load	12.0	14.8	12.0	14.8	12	14.8	
14	Under-voltage cut-off voltage/V	Io=Full Load	11.0	14.5	11.0	14.5	11	14.5	
15	Short Circuit Protection								
16	Capacitive load /μF	T <sub>c</sub> =25℃	—	1000	—	500	—	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	—	700	—	500	—	500	
19	Step Load Response Recovery(μs)	50%load→full load or Full load→5 0%load	—	600	—	500	—	500	

20	Step Line Response Transient(mV pK)	$V_{IN}: 16V \rightarrow 40V,$ $V_{IN}: 40V \rightarrow 16V, I_o=Full$ load	—	900	—	900	—	900
21	Step Line Response Recovery( $\mu s$ )	$V_{IN}: 16V \rightarrow 40V$ $V_{IN}: 40V \rightarrow 16V$ $I_o=Full$ load	—	900	—	500	—	500
22	Start-up Overshoot(mV pK)	$V_{IN}: 0 \rightarrow 28V,$ $I_o=Full$ load	—	25	—	50	—	50
23	Start-up Delay (ms)	$V_{IN}: 0 \rightarrow 28V,$ $I_o=Full$ load	—	20	—	20	—	20

## 5 Circuit block diagram

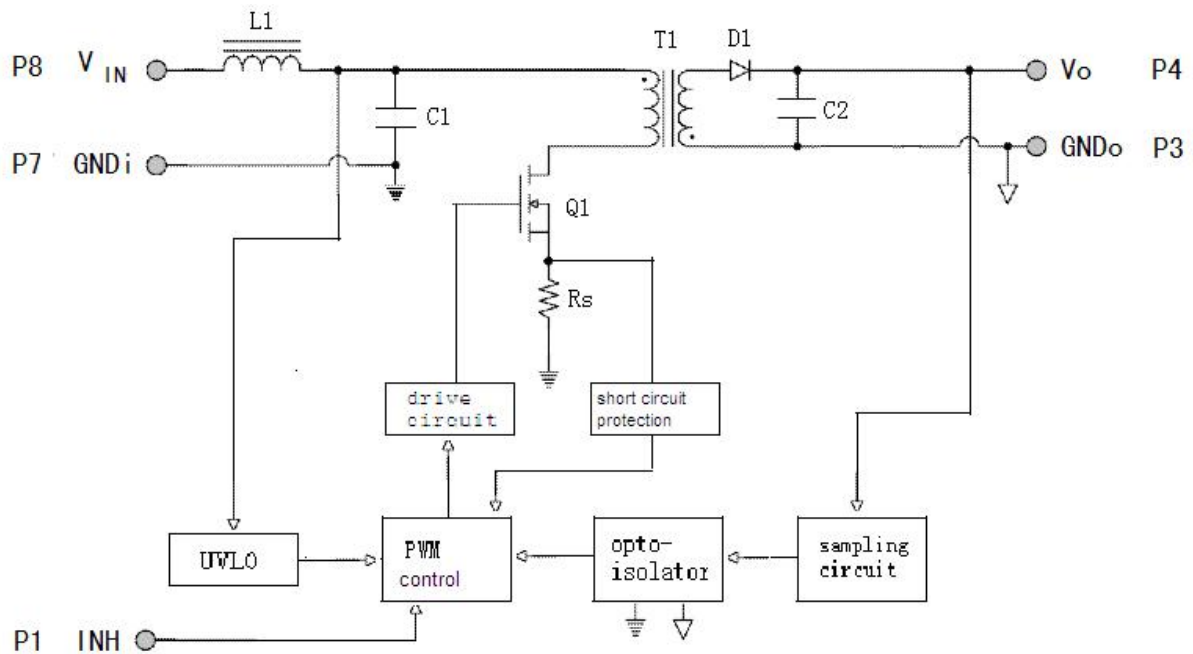


Fig 1 HSDF28S Series circuit block diagram

**6. Typical Characteristic Curve**(Testing condition as per  $T_c=25^\circ C$ ,  $V_i$   
 $N=28V \pm 5\%$ , unless otherwise specified)

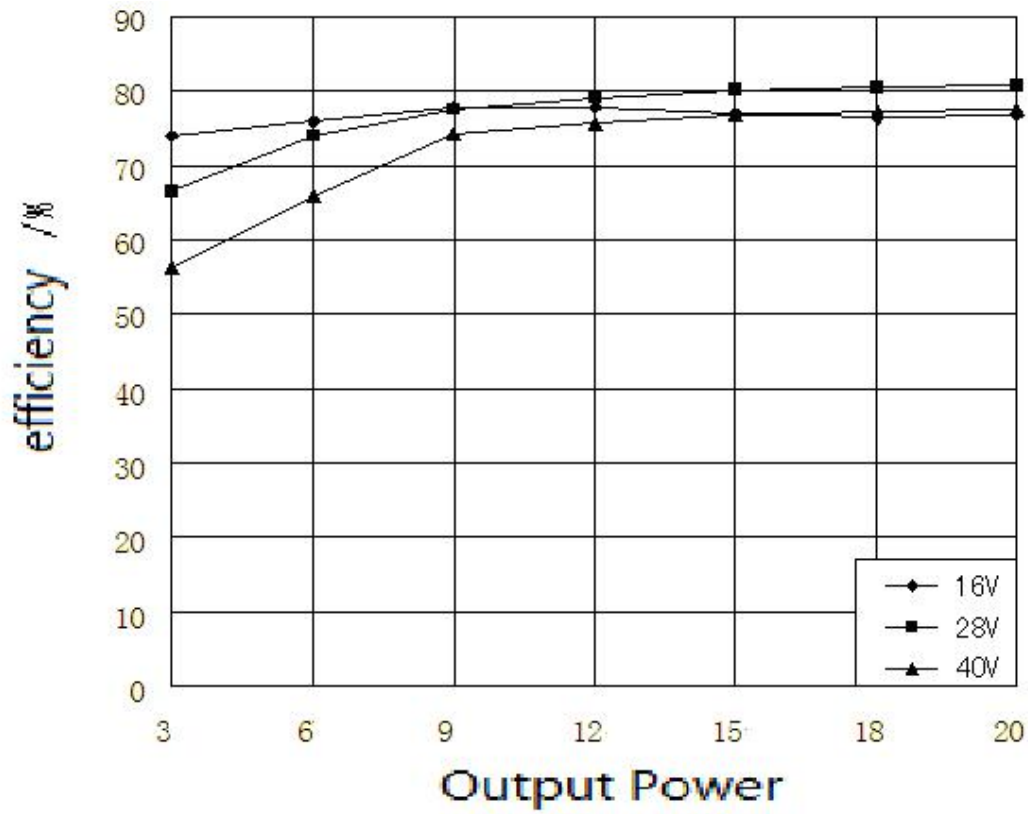


Fig. 2 HSDF28S15 Efficiency

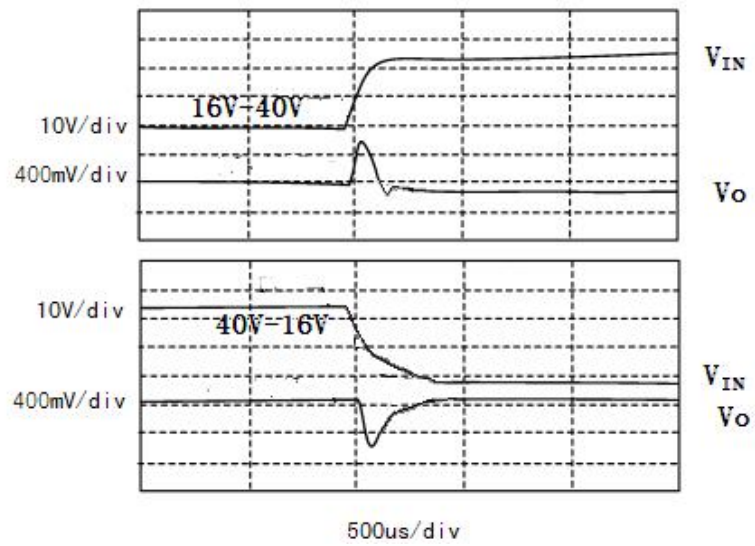


Fig. 3 HSDF28S15 Step Line Response

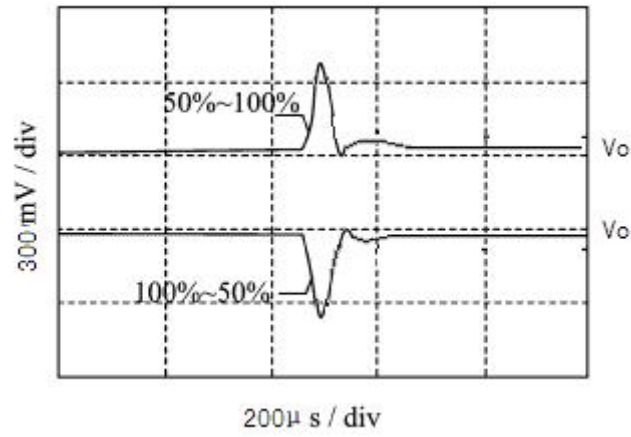


Fig. 4 HSDF28S15 Step Load Response

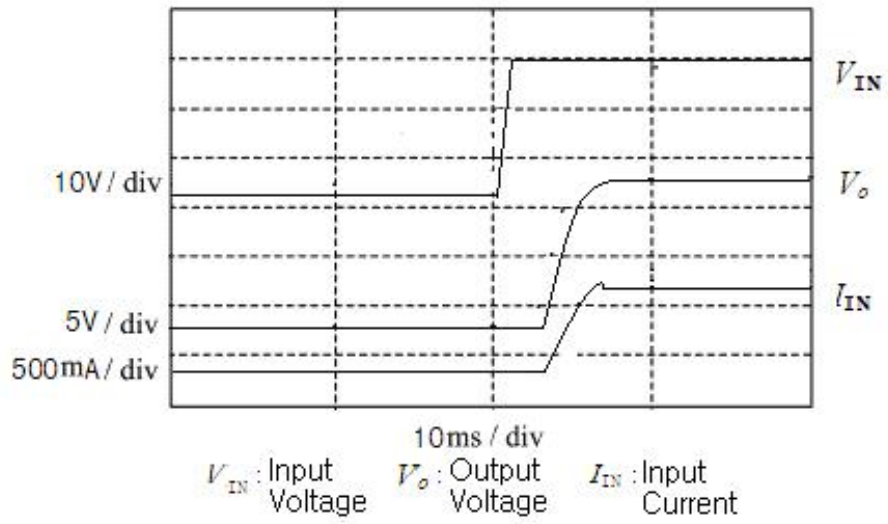


Fig. 5 HSDF28S15 Start-up Overshoot/Start-up Delay

## 7.MTBF Curve

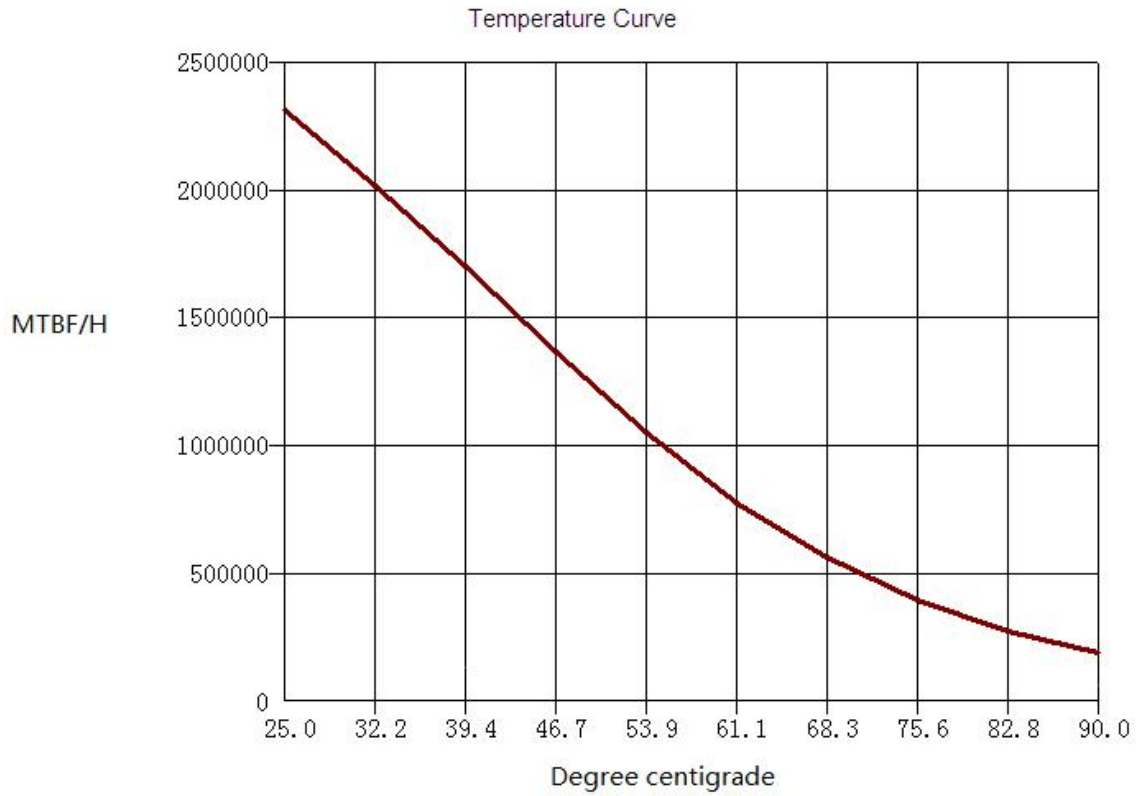


Fig. 6 MTBF Temperature Curve (HSDF28S15)

## 8 Pin Designation

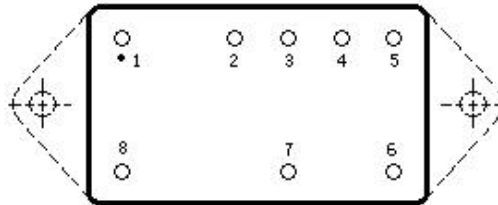


Fig 7 Pin Out Bottom View

Table 4 Pin Designation

Pin	Symbol	Designation
1	INH	Inhibit
2	NC	No connection
3	$GND_0$	Output Common
4	$V_0$	Output
5	NC	No connection
6	$GND_c$	Case Ground

7	$GND_I$	Input Common
8	$V_{IN}$	Positive Input

## 9 Typical Connection Diagram

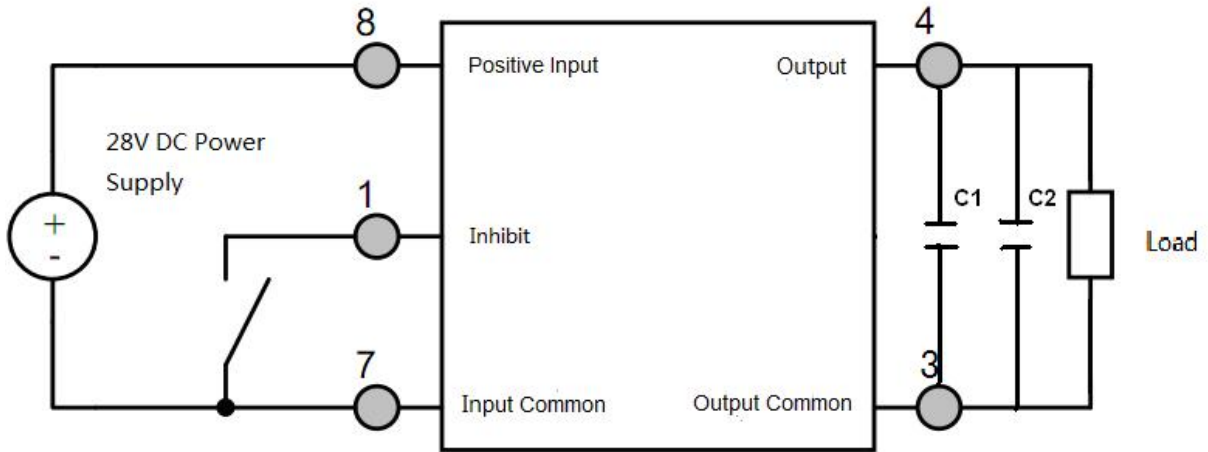


Fig. 8 Connection Diagram

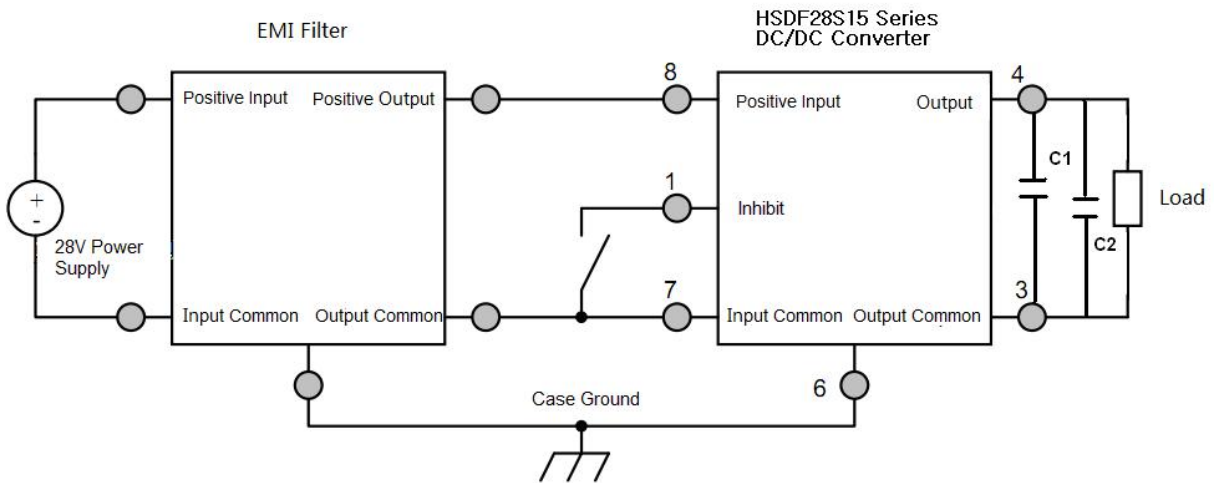


Fig. 9 EMI Filter Connection Diagram

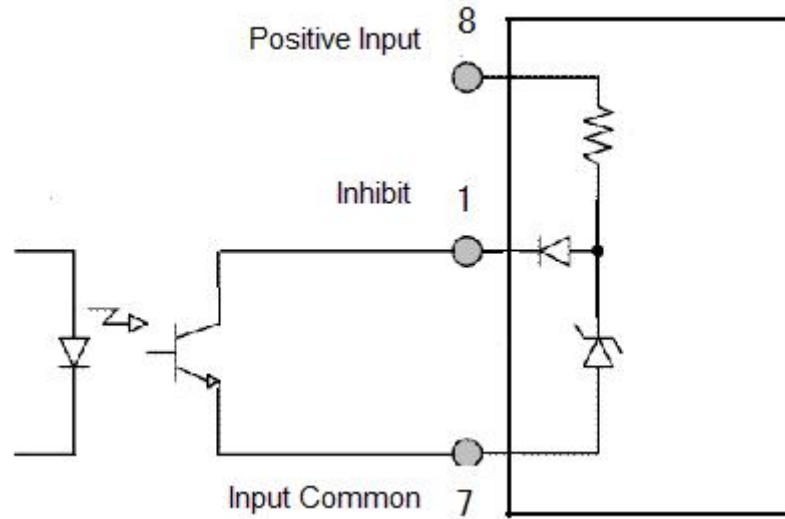


Fig. 10 Inhibit Driver Circuit Diagram

## 10. Package Specifications (Unit: mm)

### ① Package without flange

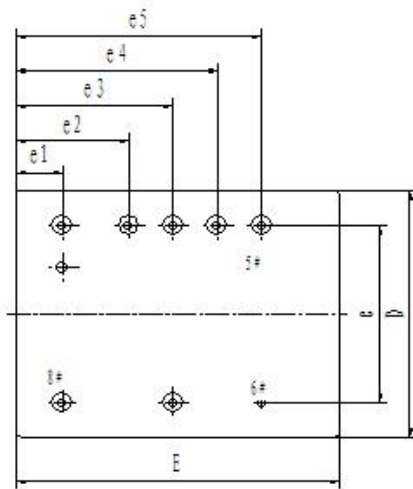


Fig. 11 Bottom View

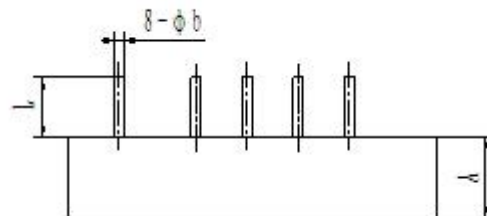


Fig. 12 Side View



② Package with Flange

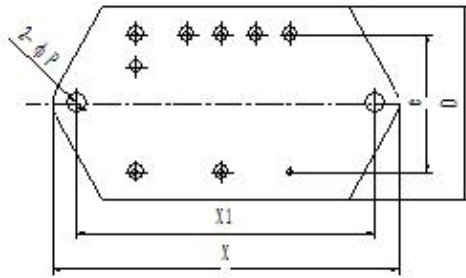


Fig. 13 Bottom View

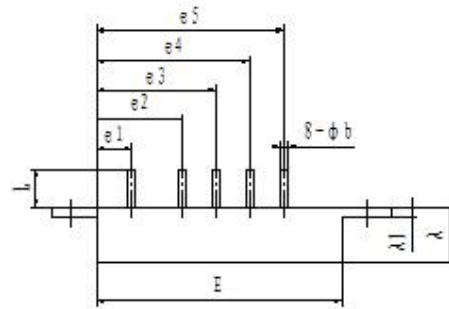


Fig. 14 Side View

Table 5 Package Outline

Symbols	Unit/mm		
	Min	Typical	Max
<i>A</i>	–	8.4	8.90
<i>A1</i>	1.20	1.50	1.80
<i>φb</i>	0.63	0.76	0.89
<i>D</i>	–	28.44	28.94
<i>E</i>	–	36.83	37.33
<i>e</i>	–	20.32	–
<i>e1</i>	–	5.21	–
<i>e2</i>	–	12.83	–
<i>e3</i>	–	17.91	–
<i>e4</i>	–	22.99	–
<i>e5</i>	–	28.07	–
<i>X</i>	–	50.8	51.30
<i>X1</i>	43.45	43.95	44.45
<i>P</i>	3.00	3.30	3.60
<i>L</i>	5.35	6.35	–

Table 6 Case Materials

Case Model	Header	Header Plating	Cover	Cover Plating	Pin	Pin Plating	Seal	Notes
UPP3728-08t (without flange)	Cold Rolled Steel (10#)	Ni	Kovar (4J42)	Ni	Cu-core Compound	Ni/Au	Parallel seam	Ni Plating is for case ground pin
UPP3728-08j (with flange)	Cold Rolled Steel (10#)	Ni	Kovar (4J42)	Ni	Cu-core Compound	Ni/Au	Parallel seam	Ni Plating is for case ground pin

## 11 Ordering Information

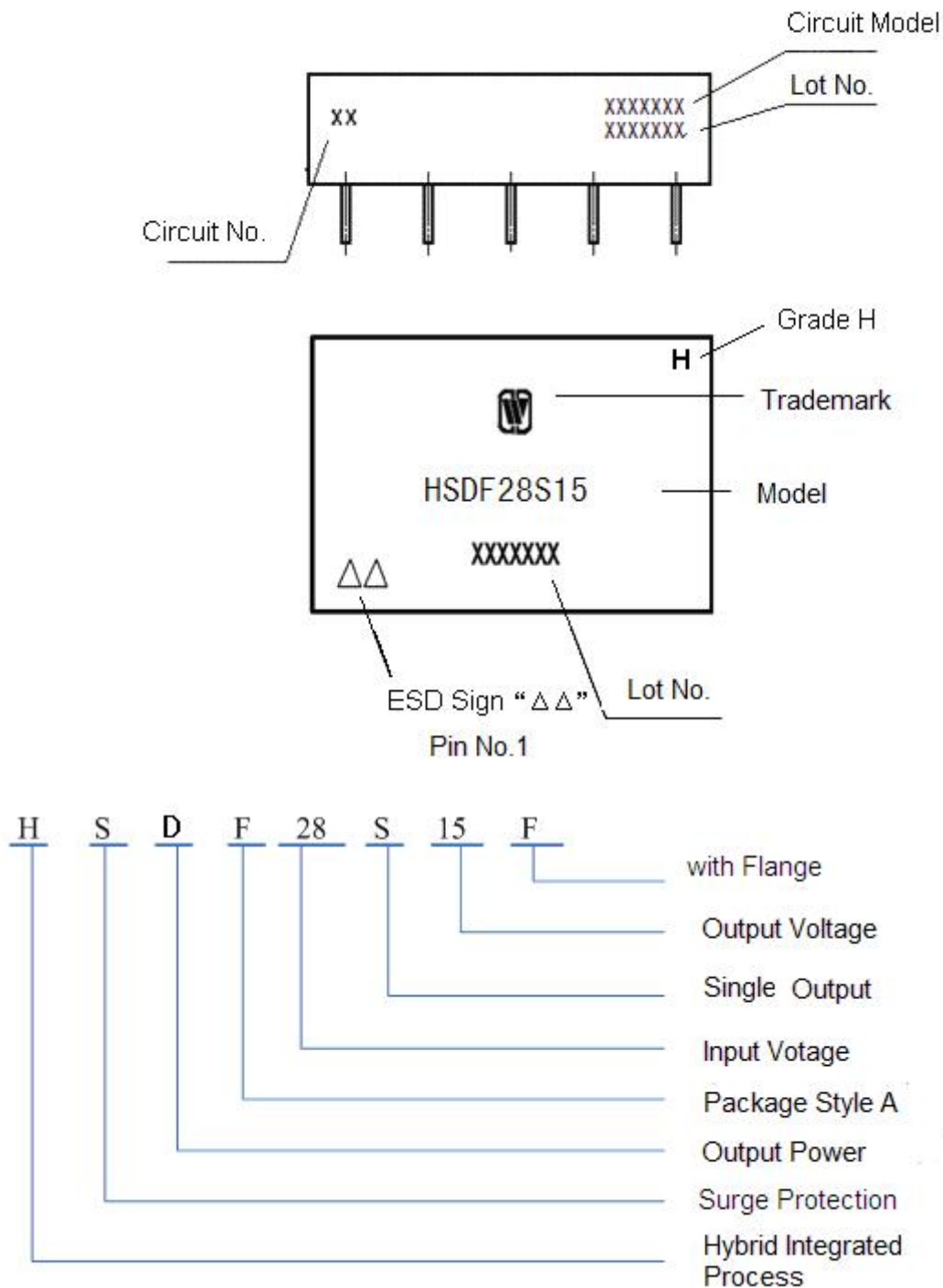


Fig. 15 Part Numbering Key

### 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 pin bottom 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°C, 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. Data offered in this document shall be for reference only.