

Mil-spec DC-DC Converter (HNSX5S Series)

1 Features of mil-spec DC-DC converter

- High reliability
- Width input voltage range: 4.5V~5.5V, Nominal DC input voltage: 5V
- High Conversion Efficiency
- Output Power P_O : 5.2W
- Operating temperature range T_C : -55°C~+125°C
- Low Startup current
- No output overshoot
-
- Inhibit function
- output short circuit protection
- Maximum power density: 34W/in³
- Hermetically sealed metal case



Dimension: 22.0×15.00×8.00mm³

Weight: 10g

Table 1 Product models

HNSX5S1R3

2 Application of mil-spec DC-DC converter

High-reliability electronic system for ground, vehicle, radar, aviation and aerospace, etc

3 Descriptions of mil-spec DC-DC converter

This device is a high-reliability, output voltage trimmable non-isolated DC/DC Converter. Buck circuit topology and the principle of pulse width modulation are used in devices. The output voltage will regulate the pulse width of the controller by direct sampling feedback to ensure the stable output voltage. Output voltage can be 0.9V~1.3V adjustable by the variation of externally connected resistor. The series of devices use thick-film hybrid integrated process and metal sealed enclosure package. The design and manufacturing process of HNSX5S Series converters are in compliance with MIL-PRF-38534 and detailed specifications

4 Technical Specifications of mil-spec DC-DC converter

Table 2 Rated conditions and recommended operating conditions

Absolute Max. Rating	
Input voltage: 4.5V~5.5V Input voltage (Transient, 1s) : 6V Output Power: 5.5W	Mechanical Shock: 1500g Lead resistance welding temperature : 300°C (15s)

Table 3 Electrical characteristics

No.	Items	Conditions (Testing condition as per $-55^{\circ}\text{C} \leq T_c \leq 125^{\circ}\text{C}$, $V_{IN}=5V \pm 0.5$, unless otherwise specified)	HNSX5S1R3	
			Min	Max
1	Input Voltage/V	Low、High、Ambient Temperature	4.5	5.5
2	Output Voltage/V	Io=Full Load Ambient、Low、high Temperature	0.86	0.94
			0.96	1.04
			1.25	1.35
3	Output current/A	$V_{IN}=4.5V \sim 5.5V$	—	4
4	Output Power/W		0	5.2
5	Output Ripple Voltage/mV	$V_o=1.0V$, $I_o=4A$, $BW=20\text{MHz}$	—	30
6	Line Regulation/mV	$V_{IN}=4.5V \sim 5.5V$, $V_o=1.0V$, $I_o=4A$	—	30
7	Load Regulation/mV	$V_o=1.0V$, $I_o=0 \rightarrow 4A$	—	30
8	Efficiency/%	$V_o=1.0V$, $I_o=4A$	70	—
9	Isolation/M Ω	$T_A=25^{\circ}\text{C}$, any pin to case at 500V DC	500	—
10	Inhibit voltage switch-off voltage/V	$V_o=1.0V$, $I_o=4A$	0	0.8
11	Inhibit voltage open voltage/V	$V_o=1.0V$, $I_o=4A$	2.4	—
12	Inhibit Current/mA	$T_A=25^{\circ}\text{C}$, $V_o=1.0V$, $I_o=4A$, Inhibit pin to ground	—	10
13	Protection/s	$T_A=25^{\circ}\text{C}$, $V_o=1.0V$	—	2
14	Under voltage open voltage/V	$T_A=25^{\circ}\text{C}$, $V_o=1.0V$, $I_o=4A$	2.4	4.3
15	Under voltage switch-off voltage/V	$T_A=25^{\circ}\text{C}$, $V_o=1.0V$, $I_o=4A$	2.2	3.7
16	Voltage tolerance of the set point/V	$-55^{\circ}\text{C} \leq T_c \leq 85^{\circ}\text{C}$, $V_o=1.0V$, $I_o=3A$	0.96	1.04
17	Input transient Voltage/V	$V_o=1.0V$, $I_o=4A$	—	6
18	Capacitive load/ μF	$V_o=1.0V$, $I_o=4A$, No effect for DC	—	1000
19	switching frequency/kHz	$V_o=1.0V$, $I_o=4A$	600	750
20	Step Load Response Transient(mV pK)	$V_o=1.0V$, $I_o=2A \rightarrow 4A$ or $I_o=4A \rightarrow 2A$	—	300
21	Step Load Response Recovery(μs)	$V_o=1.0V$, $I_o=2A \rightarrow 4A$ or $I_o=4A \rightarrow 2A$	—	200
22	Start-up Overshoot(mV pK)	Input Voltage V_{IN} : $0 \rightarrow 5V$, $V_o=1.0V$, $I_o=4A$	—	50
23	Start-up Delay (ms)	Input Voltage V_{IN} : $0 \rightarrow 5V$, $V_o=1.0V$, $I_o=4A$	—	5

5 Circuit block diagram of mil-spec DC-DC converter

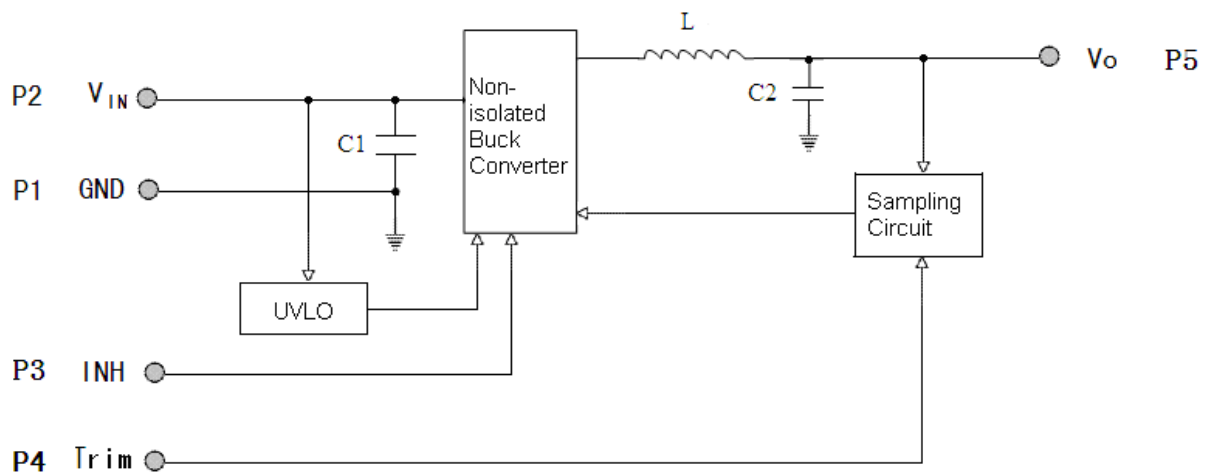


Fig. 1 HNSX5S1R3 Series circuit block diagram

6. Typical Characteristic Curve of mil-spec DC-DC converter

($T_c=25^\circ\text{C}$, $V_{IN}=5\text{V}\pm 0.15\text{V}$, $V_O=1.0\text{V}$ Full Load, unless otherwise specified)

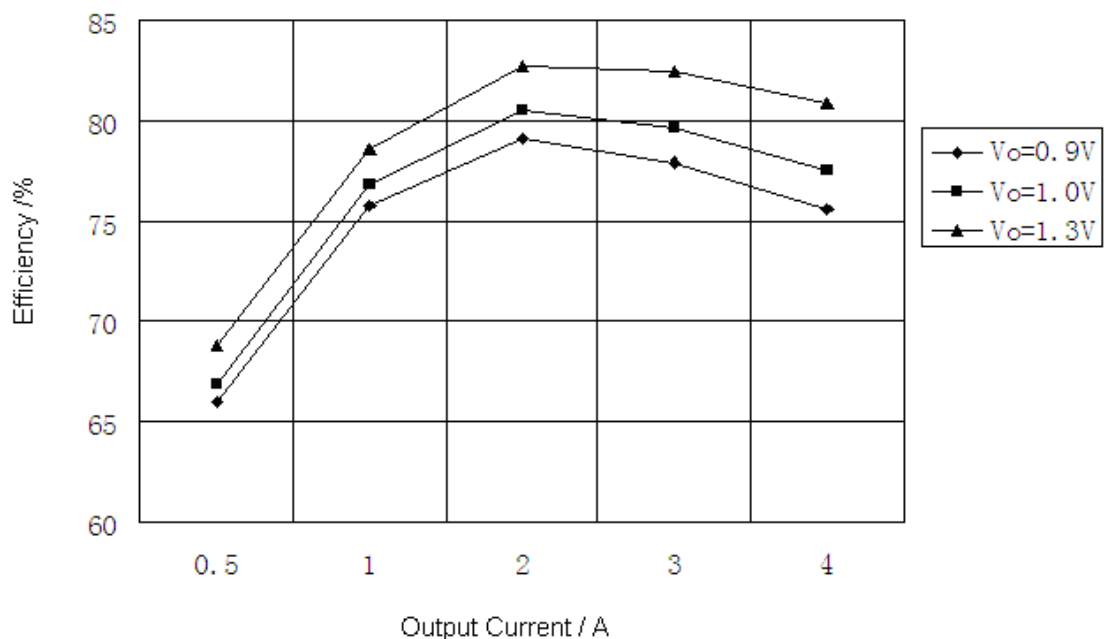


Fig. 2 HNSX5S1R3 Efficiency

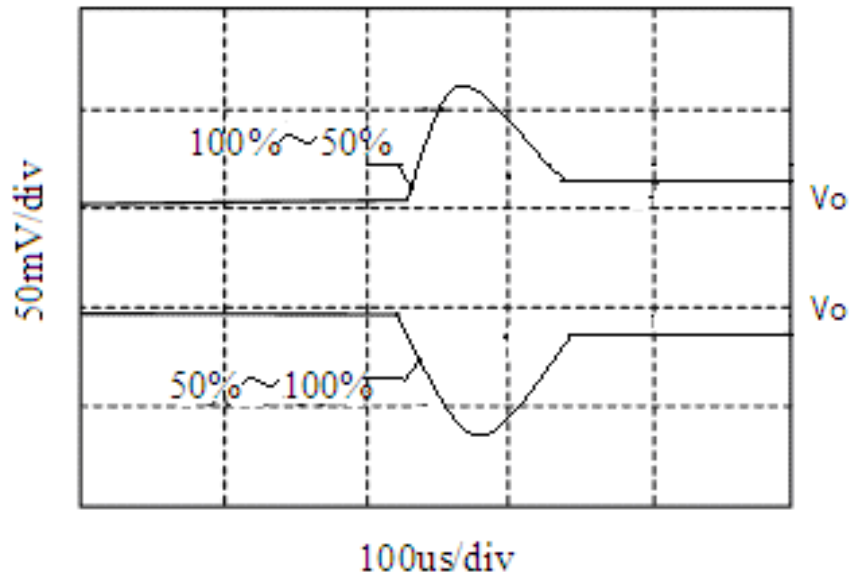


Fig. 3 HNSX5S1R3 Step Load Response

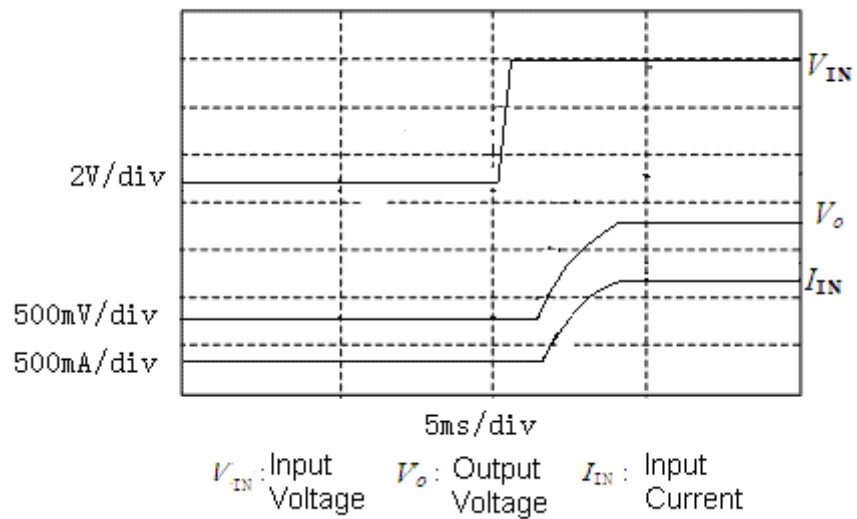


Fig. 5 HNSX5S1R3 Start-up Overshoot/Start-up Delay

7.MTBF Curve of mil-spec DC-DC converter

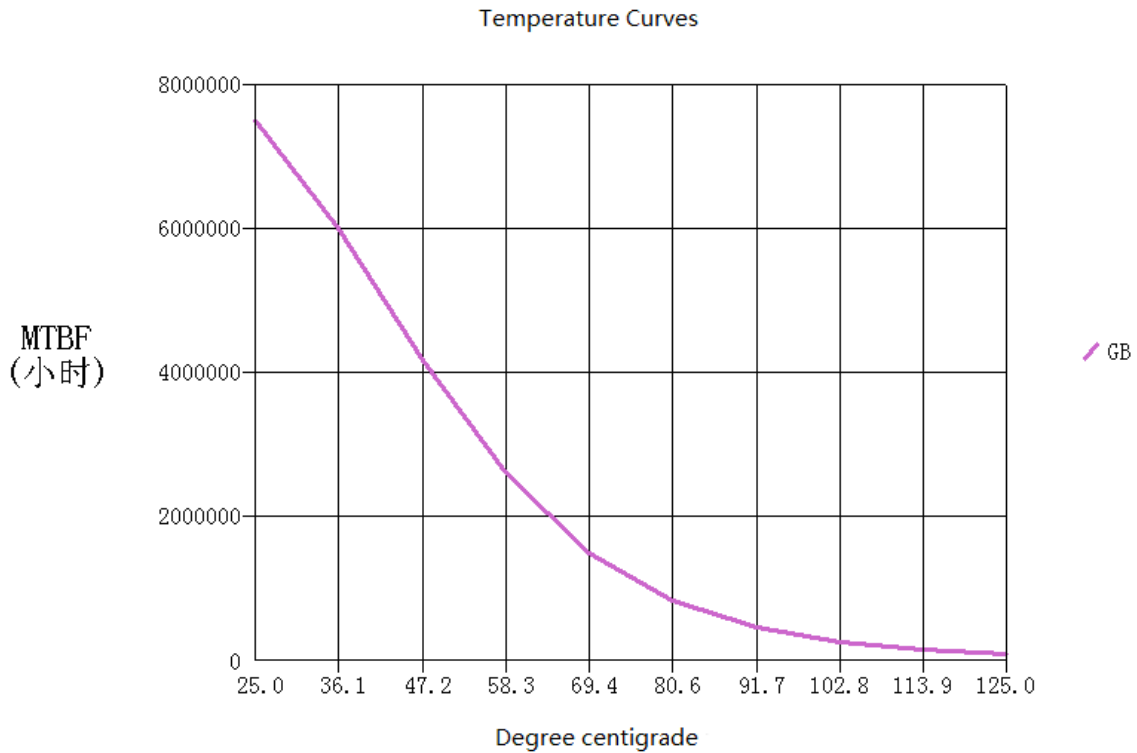


Fig. 6 MTBF Temperature Curve (HNSX5S1R3)

8 Pin Designation of mil-spec DC-DC converter



Figure 6 Pin Out Bottom View

Table 4 Pin Designation

Pin	Symbol	Designation
1	GND	Input/Output Common
2	V_{IN}	Input
3	INH	Inhibit
4	T_{rim}	Trimable Output
5	V_O	Output

9 Typical Connection Diagram of mil-spec DC-DC converter

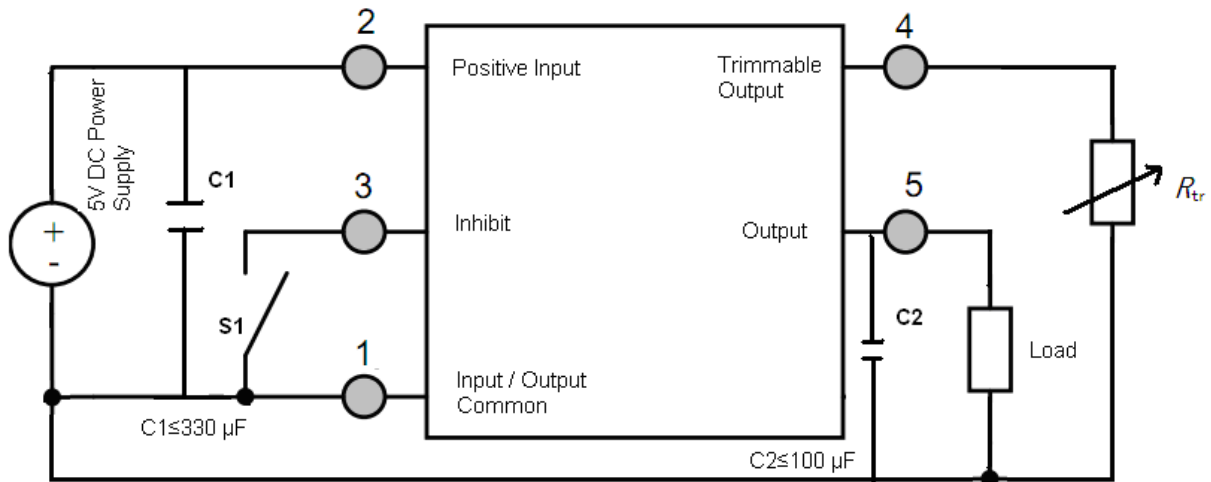


Fig. 7 Connection Diagram

In Fig. 7, By trimming external resistance R_{tr} , to achieve the different voltage, the formula shows the relationship between R_{tr} and V_o

$$R_{tr} = 10k\Omega \cdot \frac{0.891V}{V_o - 0.9V} - 2k\Omega$$

V_o (V)	R_{tr} (k Ω)
1.3	20.3
1.2	27.7
1.1	42.5
1.0	87.1
0.9	Null

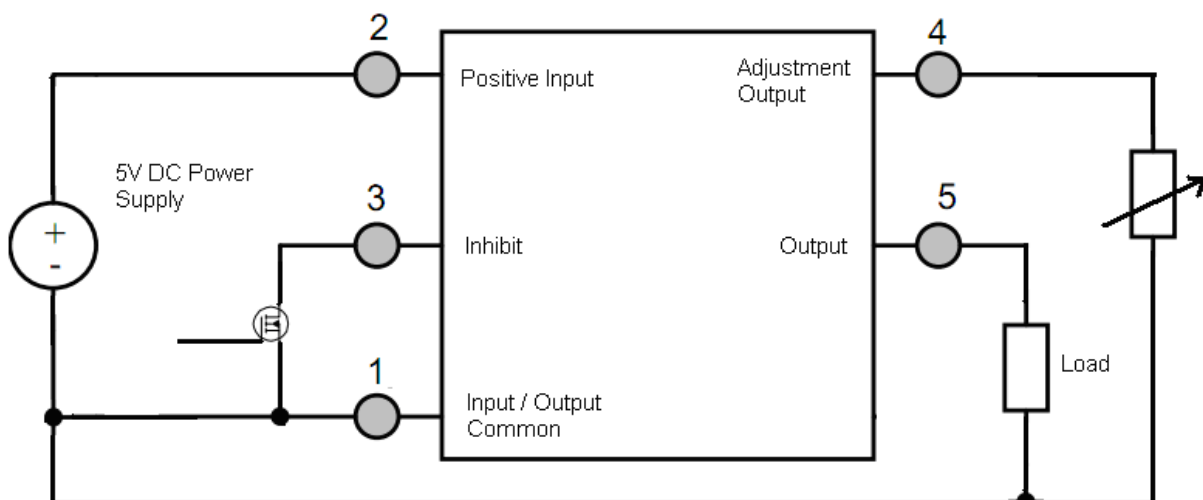


Fig. 8 High Level Inhibit Driver Circuit Diagram

10. Package Specifications of mil-spec DC-DC converter (Unit: mm)

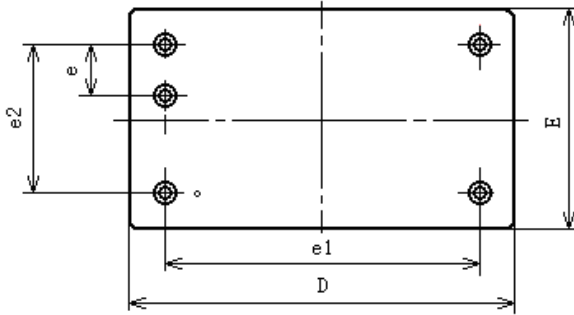


Fig. 9 Bottom View

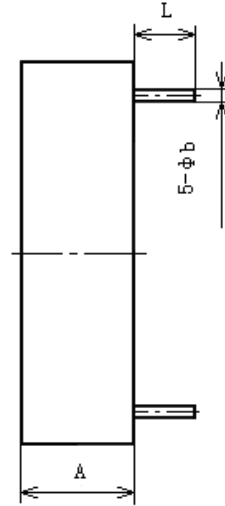


Fig. 10 Side View

Table 5 Package Outline

Symbol	Unit/mm		
	Min	Nominal	Max
A	-	7.5	8.50
ϕb	0.87	1.00	1.13
D	-	22.00	22.50
E	-	15.00	15.50
e	2.88	3.18	3.48
e1	15.58	15.88	16.18
e2	9.22	9.52	9.82
L	5.20	6.20	-

Table 6 Case Materials

Case Model	Header	Header Plating	Cover	Cover Plating	Pin	Pin Plating	Sealing	Notes
UPP2215-05	Cold Rolled Steel (10#)	Ni	Kovar (4J42)	Ni	Copper -core Compound	Ni/Au	Parallel Seam	

11 Ordering Information of mil-spec DC-DC converter

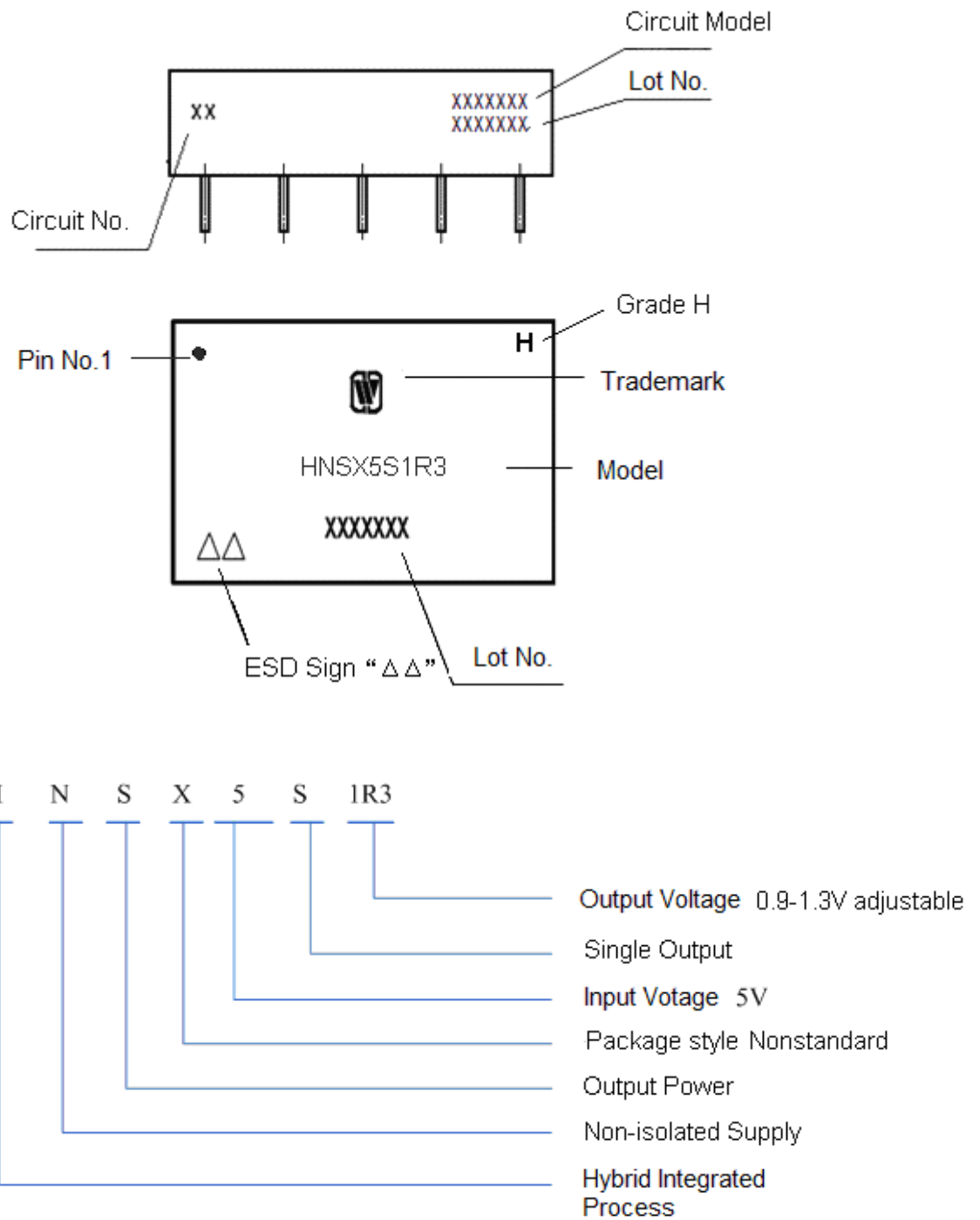


Fig. 11 Part Numbering Key



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 device when the electrical characteristic is measured.
- ☆ The base-plate 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 cracking in the glass insulator and case leaking.
- ☆ Pins at inhibit terminal shall be hung in the air during no operation.
- ☆ 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.