

## HSK5232 Series Mil-spec DC-DC converter

### 1.1 Absolute maximum rated of Mil-spec DC-DC converter

Pulse input voltage  $V_{INP}$

(Positive pulse width 100ms, positive duty cycle 1%) ... -20V~+60V;

Input voltage  $V_{IN}$  ..... 26V;

Output current limit ..... 3.0A;

Storage temperature  $T_{stg}$  ..... -65°C ~ 150°C;

Lead welding temperature (10s)  $T_h$  ..... 300°C;

Junction temperature  $T_j$  ..... 175°C;

Thermal resistance  $R_{(th)J-C}$  ..... 6.5°C/W;

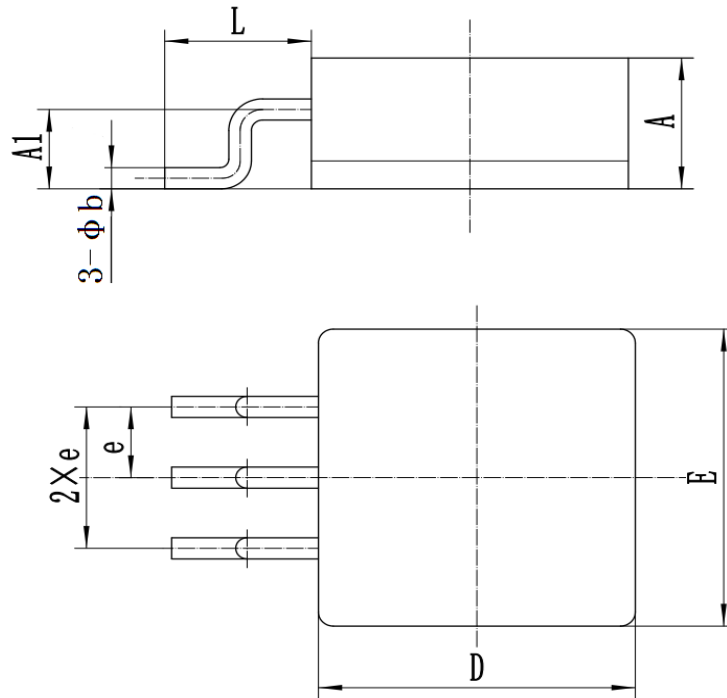
Power consumption  $P_D$  (Without heat sink) ..... 500mW.

### 11.2 Recommended operating conditions of Mil-spec DC-DC converter

Input voltage  $V_{IN}$  ..... ( $V_{OUT}+1$ )V;

Operating temperature  $T_C$  ..... -55°C ~ 125°C。

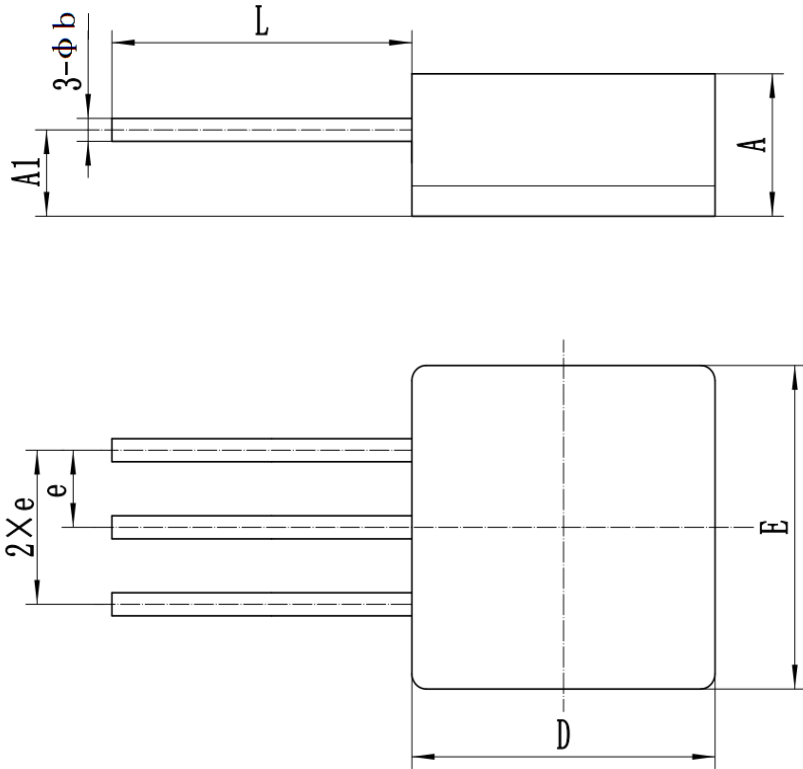
### 11.3 Package Specifications of Mil-spec DC-DC converter



Unit:mm

Symbols	Data		
	Minimum	Typical	Maxim
$A$	-	-	5.40
$AI$	2.55	-	3.15
$D$	-	-	11.17
$E$	-	-	11.17
$L$	3.94	-	-
$e$	-	2.54	-
$\phi b$	0.63	-	0.89

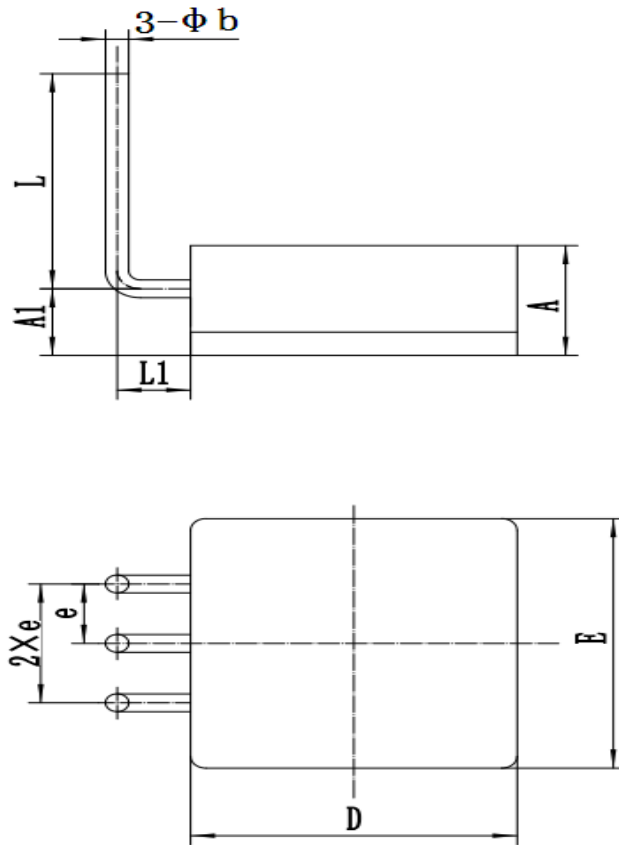
Fig 28a G Package outline drawing



Unit:mm

Symbols	Data		
	Minimum	Typical	Maxim
<i>A</i>	-	-	5.40
<i>AI</i>	2.55	-	3.15
<i>D</i>	-	-	11.17
<i>E</i>	-	-	11.17
<i>L</i>	10.06	-	-
<i>e</i>	-	2.54	-
$\varphi b$	0.63	-	0.89

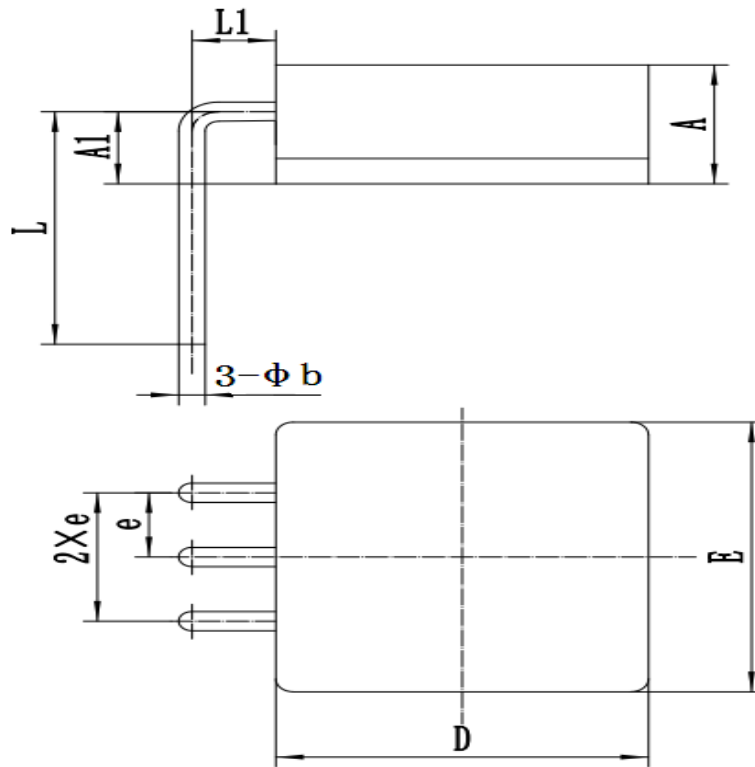
Fig 28b S Package outline drawing



Unit:mm

Symbols	Data		
	Minimum	Typical	Maxim
$A$	-	-	5.40
$AI$	2.55	-	3.15
$D$	-	-	11.17
$E$	-	-	11.17
$L$	8.70	-	-
$L1$	2.10	-	2.70
$e$	-	2.54	-
$\phi b$	0.63	-	0.89

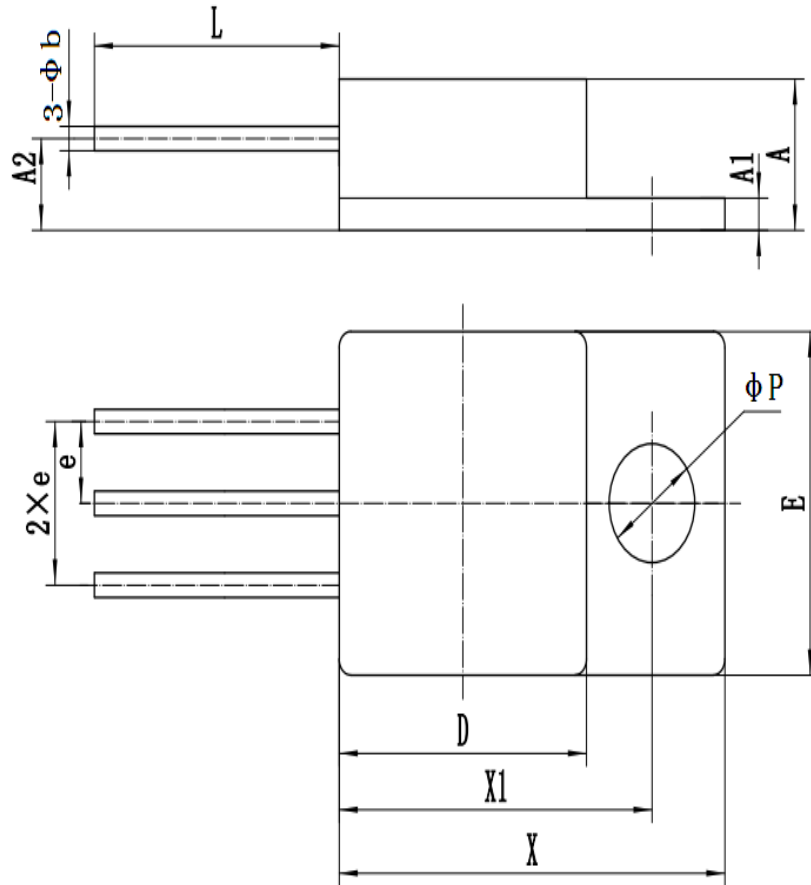
Fig 28c U Package outline drawing



Unit:mm

Symbols	Data		
	Minimum	Typical	Maxim
<i>A</i>	-	-	5.40
<i>AI</i>	2.55	-	3.15
<i>D</i>	-	-	11.17
<i>E</i>	-	-	11.17
<i>L</i>	8.70	-	-
<i>L1</i>	2.10	-	2.70
<i>e</i>	-	2.54	-
$\phi b$	0.63	-	0.89

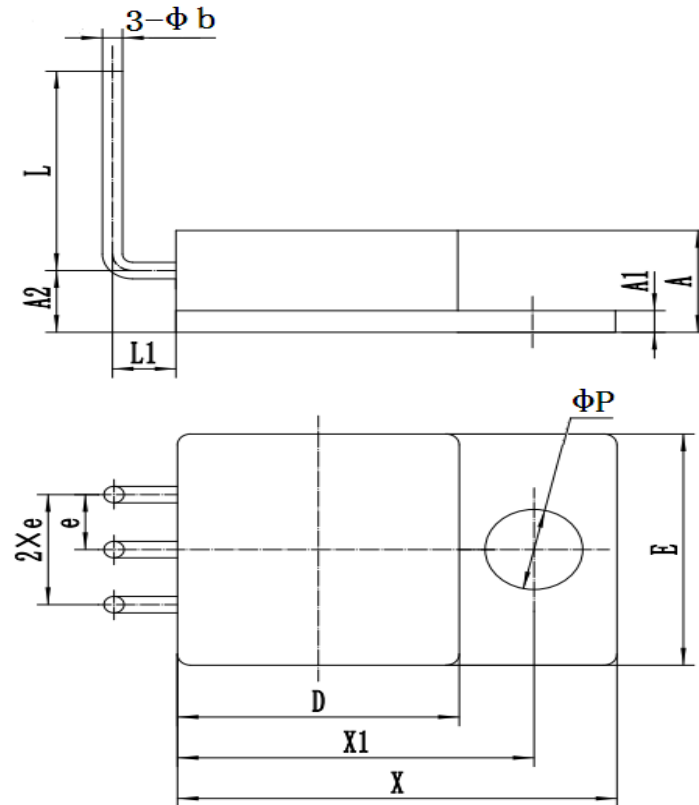
Fig 28d D Package outline drawing



Unit:mm

Symbols	Data		
	Minimum	Typical	Maxim
$A$	-	-	5.40
$A1$	0.70	-	1.30
$A2$	2.55	-	3.15
$D$	-	-	11.17
$E$	-	-	11.17
$X$	-	-	17.14
$X1$	13.0	-	14.0
$L$	10.06	-	-
$e$	-	2.54	-
$\phi b$	0.63	-	0.89
$\phi P$	3.40	-	4.0

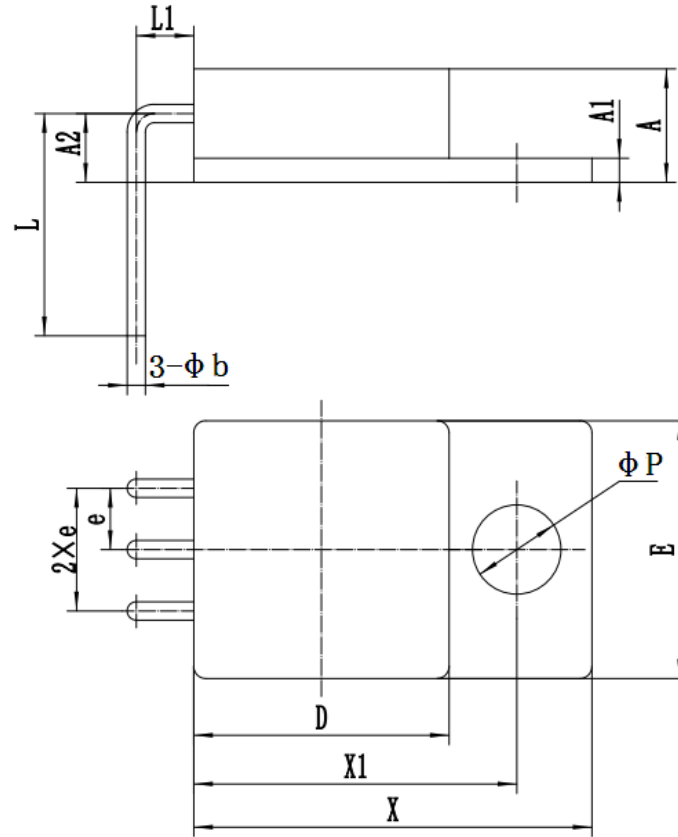
Fig 28e TS Package outline drawing



Unit:mm

Symbols	Data		
	Minimum	Typical	Maxim
$A$	-	-	5.40
$A_1$	0.70	-	1.30
$A_2$	2.55	-	3.15
$D$	-	-	11.17
$E$	-	-	11.17
$X$	-	-	17.14
$X_1$	13.0	-	14.0
$L$	8.70	-	-
$L_1$	2.10	-	2.70
$e$	-	2.54	-
$\phi b$	0.63	-	0.89
$\phi P$	3.40	-	4.0

Fig 28f TU Package outline drawing



Unit:mm

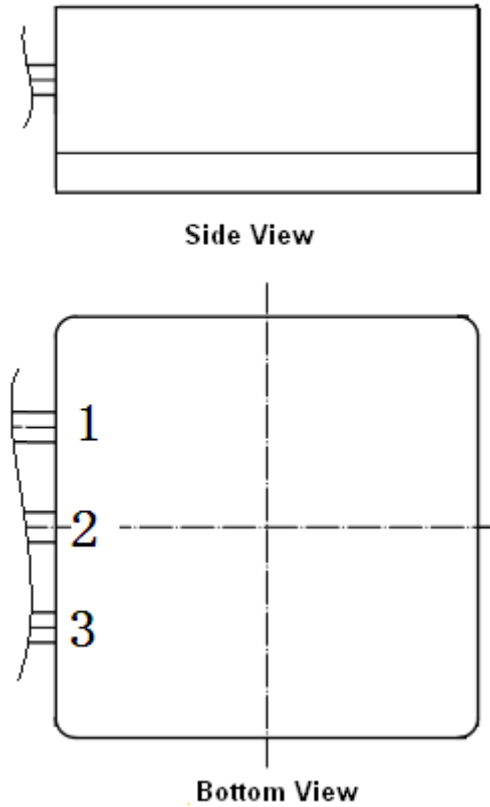
Symbols	Data		
	Minimum	Typical	Maxim
$A$	-	-	5.40
$A1$	0.70	-	1.30
$A2$	2.55	-	3.15
$D$	-	-	11.17
$E$	-	-	11.17
$X$	-	-	17.14
$X1$	13.0	-	14.0
$L$	8.70	-	-
$L1$	2.10	-	2.70
$e$	-	2.54	-
$\phi b$	0.63	-	0.89
$\phi P$	3.40	-	4.0

Fig 28g TD Package outline drawing



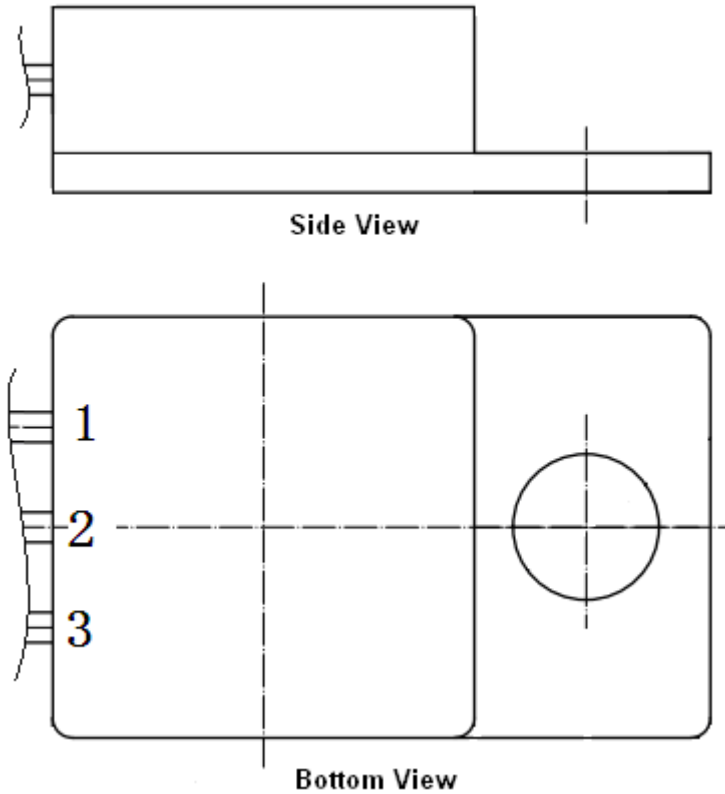
## 1.4 Pin Designations of Mil-spec DC-DC converter

The leading end arrangement shall be as specified in Fig 29. Fig 29a shows the product leading ends in the form of G, S, D, U package type. Fig 29b shows the product leading ends in the form of TS, TD, TU package type.



Pin	Symbol	Designation
1	GND	GND
2	$V_{OUT}$	Output
3	$V_{IN}$	Input

Fig 29a Pin Designations (Apply for G, S, D, U package type)

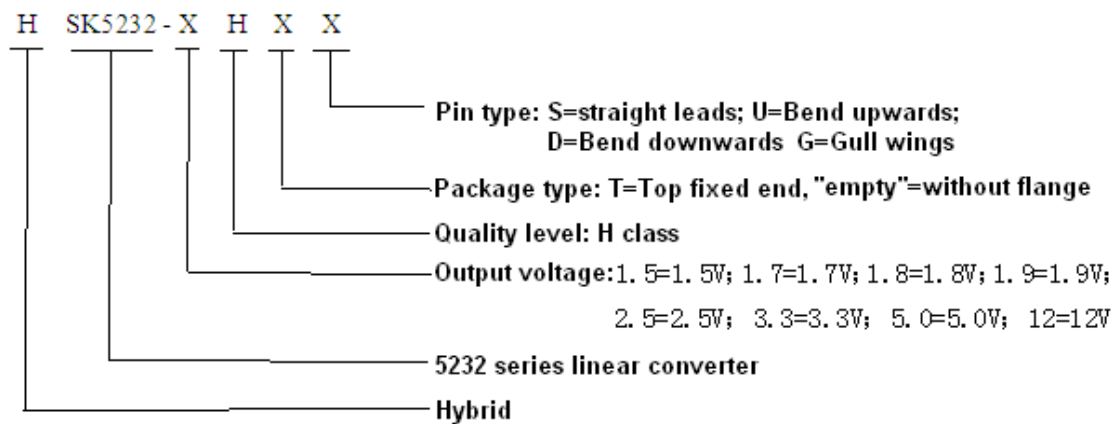


Pin	Symbol	Designation
1	GND	GND
2	$V_{OUT}$	Output
3	$V_{IN}$	Input

Fig 29b Pin Designations (Apply for TS、TD、 TU package type)

### 1.5 Ordering Information of Mil-spec DC-DC converter

Part number contains the use of the production process, serial number, output voltage, quality level and other information. As shown below:



## 1.6 Technical Specifications of Mil-spec DC-DC converter

Table 10a HSK5232-1.5 Electrical characteristics

Items	Symbol	Condition (Unless otherwise specified, $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ )	A Group	Limited value		Unit
				Min	Max	
Output voltage	$V_{OUT}$	$I_{OUT} = 10\text{mA}$ , $V_{IN} = 2.5\text{V}$	1, 2, 3	1.47	1.53	V
Input and output voltage difference	$V_{DO}$	$T_A = 25^{\circ}\text{C}$ ; $\Delta V_{OUT} = -1\%$ ; $I_{OUT} = 100\text{mA}$	1	—	600	mV
		$T_A = 25^{\circ}\text{C}$ ; $\Delta V_{OUT} = -1\%$ ; $I_{OUT} = 3.0\text{A}$		—	700	
Static (ground) current	$I_Q$	$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 2.5\text{V}$ , $I_{OUT} = 1.5\text{A}$	1	—	40	mA
		$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 2.5\text{V}$ , $I_{OUT} = 3.0\text{A}$		—	60	
Load regulation	$S_L$	$I_{OUT} = 10\text{mA} \rightarrow 2.5\text{A}$ , $V_{IN} = 2.5\text{V}$	1, 2, 3	—	2	%
Voltage regulation	$S_V$	$V_{IN} = 2.5\text{V} \rightarrow 26\text{V}$ , $I_{OUT} = 10\text{mA}$	1, 2, 3	—	1	%
Output noise voltage	$V_N$	$T_A = 25^{\circ}\text{C}$ ; $C_L = 33\mu\text{F}$ ; $f \leq 300\text{KHz}$	4	—	100	$\mu\text{V}$
Output current limit	$I_{LIM}$	$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 2.5\text{V}$ ; duty cycle=80%	1	—	10	A
Thermal shutoff temperature	$T_{SD}$	$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 3.5\text{V}$ ; $I_{OUT} = 3.0\text{A}$	4	—	165	$^{\circ}\text{C}$

Table 10b HSK5232-1.8 Electrical characteristics

Items	Symbol	Condition (Unless otherwise specified, $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ )	A Group	Limited value		Unit
				Min	Max	
Output voltage	$V_{OUT}$	$I_{OUT} = 10\text{mA}$ , $V_{IN} = 2.8\text{V}$	1, 2, 3	1.764	1.836	V
Input and output voltage difference	$V_{DO}$	$T_A = 25^{\circ}\text{C}$ ; $\Delta V_{OUT} = -1\%$ ; $I_{OUT} = 100\text{mA}$	1	—	600	mV
		$T_A = 25^{\circ}\text{C}$ ; $\Delta V_{OUT} = -1\%$ ; $I_{OUT} = 3.0\text{A}$		—	700	
Static (ground) current	$I_Q$	$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 2.8\text{V}$ , $I_{OUT} = 1.5\text{A}$	1	—	40	mA
		$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 2.8\text{V}$ , $I_{OUT} = 3.0\text{A}$		—	60	
Load regulation	$S_L$	$I_{OUT} = 10\text{mA} \rightarrow 2.5\text{A}$ , $V_{IN} = 2.8\text{V}$	1, 2, 3	—	2	%
Voltage regulation	$S_V$	$V_{IN} = 2.8\text{V} \rightarrow 26\text{V}$ , $I_{OUT} = 10\text{mA}$	1, 2, 3	—	1	%
Output noise voltage	$V_N$	$T_A = 25^{\circ}\text{C}$ ; $C_L = 33\mu\text{F}$ ; $f \leq 300\text{KHz}$	4	—	100	$\mu\text{V}$
Output current limit	$I_{LIM}$	$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 2.8\text{V}$ ; duty cycle=80%	1	—	10	A
Thermal shutoff temperature	$T_{SD}$	$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 3.8\text{V}$ ; $I_{OUT} = 3.0\text{A}$	4	—	165	$^{\circ}\text{C}$

Table 10c HSK5232-1.9 Electrical characteristics

Items	Symbol	Condition (Unless otherwise specified, $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ )	A Group	Limited value		Unit
				Min	Max	
Output voltage	$V_{OUT}$	$I_{OUT} = 10\text{mA}$ , $V_{IN} = 2.9\text{V}$	1, 2, 3	1.862	1.938	V
Input and output voltage difference	$V_{DO}$	$T_A = 25^{\circ}\text{C}$ ; $\Delta V_{OUT} = -1\%$ ; $I_{OUT} = 100\text{mA}$	1	—	500	mV
		$T_A = 25^{\circ}\text{C}$ ; $\Delta V_{OUT} = -1\%$ ; $I_{OUT} = 3.0\text{A}$		—	650	
Static (ground) current	$I_Q$	$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 2.9\text{V}$ , $I_{OUT} = 1.5\text{A}$	1	—	40	mA
		$T_A = 25^{\circ}\text{C}$ ; $V_{IN} = 2.9\text{V}$ , $I_{OUT} = 3.0\text{A}$		—	60	

Load regulation	$S_i$	$I_{OUT}=10mA \rightarrow 2.5A, V_{IN}=2.9V$	1, 2, 3	—	2	%
Voltage regulation	$S_V$	$V_{IN}=2.9V \rightarrow 26V, I_{OUT}=10mA$	1, 2, 3	—	1	%
Output noise voltage	$V_N$	$T_A=25^\circ C; C_L=33\mu F; f \leq 300KHz$	4	—	100	$\mu V$
Output current limit	$I_{LIM}$	$T_A=25^\circ C; V_{IN}=2.9V; \text{duty cycle}=80\%$	1	—	10	A
Thermal shutoff temperature	$T_{SD}$	$T_A=25^\circ C; V_{IN}=3.9V; I_{OUT}=3.0A$	4	—	165	$^\circ C$

Table 10d HSK5232-2.5 Electrical characteristics

Items	Symbol	Condition (Unless otherwise specified, $-55^\circ C \leq T_A \leq 125^\circ C$ )	A Group	Limited value		Unit
				Min	Max	
Output voltage	$V_{OUT}$	$I_{OUT}=10mA, V_{IN}=3.5V$	1, 2, 3	2.45	2.55	V
Input and output voltage difference	$V_{DO}$	$T_A=25^\circ C; \Delta V_{OUT}=-1\%; I_{OUT}=100mA$	1	—	300	mV
		$T_A=25^\circ C; \Delta V_{OUT}=-1\%; I_{OUT}=3.0A$		—	600	
Static (ground) current	$I_Q$	$T_A=25^\circ C; V_{IN}=3.5V, I_{OUT}=1.5A$	1	—	40	mA
		$T_A=25^\circ C; V_{IN}=3.5V, I_{OUT}=3.0A$		—	60	
Load regulation	$S_i$	$I_{OUT}=10mA \rightarrow 2.5A, V_{IN}=3.5V$	1, 2, 3	—	2	%
Voltage regulation	$S_V$	$V_{IN}=3.5V \rightarrow 26V, I_{OUT}=10mA$	1, 2, 3	—	1	%
Output noise voltage	$V_N$	$T_A=25^\circ C; C_L=33\mu F; f \leq 300KHz$	4	—	150	$\mu V$
Output current limit	$I_{LIM}$	$T_A=25^\circ C; V_{IN}=3.5V; \text{duty cycle}=70\%$	1	—	10	A
Thermal shutoff temperature	$T_{SD}$	$T_A=25^\circ C; V_{IN}=4.5V; I_{OUT}=3.0A$	4	—	165	$^\circ C$

Table 10e HSK5232-3.3 Electrical characteristics

Items	Symbol	Condition (Unless otherwise specified, $-55^\circ C \leq T_A \leq 125^\circ C$ )	A Group	Limited value		Unit
				Min	Max	
Output voltage	$V_{OUT}$	$I_{OUT}=10mA, V_{IN}=4.3V$	1, 2, 3	3.234	3.366	V
Input and output voltage difference	$V_{DO}$	$T_A=25^\circ C; \Delta V_{OUT}=-1\%; I_{OUT}=100mA$	1	—	300	mV
		$T_A=25^\circ C; \Delta V_{OUT}=-1\%; I_{OUT}=3.0A$		—	600	
Static (ground) current	$I_Q$	$T_A=25^\circ C; V_{IN}=4.3V, I_{OUT}=1.5A$	1	—	40	mA
		$T_A=25^\circ C; V_{IN}=4.3V, I_{OUT}=3.0A$		—	60	
Load regulation	$S_i$	$I_{OUT}=10mA \rightarrow 2.5A, V_{IN}=4.3V$	1, 2, 3	—	2	%
Voltage regulation	$S_V$	$V_{IN}=4.3V \rightarrow 26V, I_{OUT}=10mA$	1, 2, 3	—	1	%
Output noise voltage	$V_N$	$T_A=25^\circ C; C_L=33\mu F; f \leq 300KHz$	4	—	200	$\mu V$
Output current limit	$I_{LIM}$	$T_A=25^\circ C; V_{IN}=4.3V; \text{duty cycle}=70\%$	1	—	10	A
Thermal shutoff temperature	$T_{SD}$	$T_A=25^\circ C; V_{IN}=5.3V; I_{OUT}=3.0A$	4	—	165	$^\circ C$

Table 10f HSK5232-5.0 Electrical characteristics

Items	Symbol	Condition (Unless otherwise specified, $-55^\circ C \leq T_A \leq 125^\circ C$ )	A Group	Limited value		Unit
				Min	Max	
Output voltage	$V_{OUT}$	$I_{OUT}=10mA, V_{IN}=6.0V$	1, 2, 3	4.90	5.10	V
Input and output voltage difference	$V_{DO}$	$T_A=25^\circ C; \Delta V_{OUT}=-1\%; I_{OUT}=100mA$	1	—	300	mV
		$T_A=25^\circ C; \Delta V_{OUT}=-1\%; I_{OUT}=3.0A$		—	600	
Static (ground)	$I_Q$	$T_A=25^\circ C; V_{IN}=6.0V, I_{OUT}=1.5A$	1	—	40	mA

current		$T_A=25^{\circ}\text{C}; V_{IN}=6.0\text{V}, I_{OUT}=3.0\text{A}$		—	60	mA
Load regulation	$S_I$	$I_{OUT}=10\text{mA}\rightarrow 2.5\text{A}, V_{IN}=6.0\text{V}$	1, 2, 3	—	2	%
Voltage regulation	$S_V$	$V_{IN}=6.0\text{V}\rightarrow 26\text{V}, I_{OUT}=10\text{mA}$	1, 2, 3	—	1	%
Output noise voltage	$V_N$	$T_A=25^{\circ}\text{C}; C_L=33\mu\text{F}; f\leq 300\text{KHz}$	4	—	300	$\mu\text{V}$
Output current limit	$I_{LIM}$	$T_A=25^{\circ}\text{C}; V_{IN}=6\text{V}; \text{duty cycle}=50\%$	1	—	10	A
Thermal shutoff temperature	$T_{SD}$	$T_A=25^{\circ}\text{C}; V_{IN}=7\text{V}; I_{OUT}=3.0\text{A}$	4	—	165	$^{\circ}\text{C}$

Table 10g HSK5232-12 Electrical characteristics

Items	Symbol	Condition (Unless otherwise specified, $-55^{\circ}\text{C}\leq T_A\leq 125^{\circ}\text{C}$ )	A Group	Limited value		Unit
				Min	Max	
Output voltage	$V_{OUT}$	$I_{OUT}=10\text{mA}, V_{IN}=13\text{V}$	1, 2, 3	11.76	12.24	V
Input and output voltage difference	$V_{DO}$	$T_A=25^{\circ}\text{C}; \Delta V_{OUT}=-1\%; I_{OUT}=100\text{mA}$	1	—	300	mV
		$T_A=25^{\circ}\text{C}; \Delta V_{OUT}=-1\%; I_{OUT}=3.0\text{A}$		—	600	
Static (ground) current	$I_Q$	$T_A=25^{\circ}\text{C}; V_{IN}=13\text{V}, I_{OUT}=1.5\text{A}$	1	—	40	mA
		$T_A=25^{\circ}\text{C}; V_{IN}=13\text{V}, I_{OUT}=3.0\text{A}$		—	60	mA
Load regulation	$S_I$	$I_{OUT}=10\text{mA}\rightarrow 2.5\text{A}, V_{IN}=13\text{V}$	1, 2, 3	—	2	%
Voltage regulation	$S_V$	$V_{IN}=13\text{V}\rightarrow 26\text{V}, I_{OUT}=10\text{mA}$	1, 2, 3	—	1	%
Output noise voltage	$V_N$	$T_A=25^{\circ}\text{C}; C_L=33\mu\text{F}; f\leq 300\text{KHz}$	4	—	700	$\mu\text{V}$
Output current limit	$I_{LIM}$	$T_A=25^{\circ}\text{C}; V_{IN}=13\text{V}; \text{duty cycle}=50\%$	1	—	10	A
Thermal shutoff temperature	$T_{SD}$	$T_A=25^{\circ}\text{C}; V_{IN}=14\text{V}; I_{OUT}=3.0\text{A}$	4	—	165	$^{\circ}\text{C}$

### 1.7 Typical Connection Diagram of Mil-spec DC-DC converter

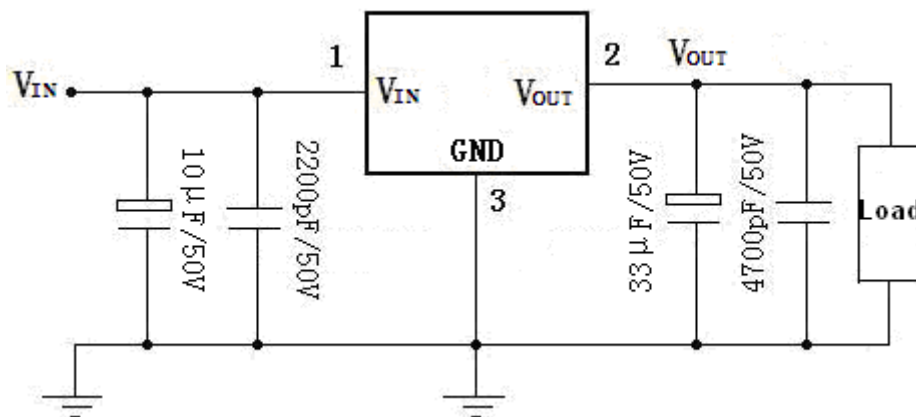


Fig 30 HSK5232 Electrical test line connection diagram

## 1.8 Application Notes of Mil-spec DC-DC converter

- ☆ The electronic inspection point should be kept as close as possible at the root of the pin;
- ☆ It is strictly forbidden to bend the pins;
- ☆ To prevent the application of two or more absolute maximum ratings on the device at the same time;
- ☆ To prevent the device from falling off;
- ☆ To prevent the output and ground short circuit;
- ☆ To prevent the device from being reversed or dislocated;
- ☆ During assembly, the bottom of the product should be attached as close as possible to the circuit board to avoid damage to the pin, take shockproof measures for necessary ;
- ☆ Focus on device power consumption, the power consumption  $P_D = I_O(V_{IN} - V_{OUT})$ , When the input/output voltage difference ( $V_{IN}-V_{OUT}$ ) is large, output current  $I_O$  should be smaller; When the input/output voltage difference ( $V_{IN}-V_{OUT}$ ) is small , output current  $I_O$  should be larger; When the device power consumption is large, be sure to configure the appropriate heat sink to prevent the device damaged due to overheating or into the overheating protection status;
- ☆ Both positive and negative terminals of power supply shall be correctly connected when power is applied so as to avoid permanent damage to the device.;
- ☆ Anti-static measures should be taken during storage and transportation.