Hybrid integrated circuit HDCD / (20-50) -512-30F/T1
Detailed specifications of anti-irradiation DC / DC converter

1 Scope

This specification specifies the design, production, screening, identification, certification, quality of the hybrid integrated circuit HDCD / (20-50) -512-30/T1 type anti-irradiation DC / DC converter (hereinafter referred to as the device). Detailed requirements for consistency inspection and quality assurance such as purchase, supervision and acceptance by the user.

2 Requirements

2.1 Design, structure and dimensions

2.1.1 Absolute Maximum Ratings

a) Output power (PO) …… 36W;

b) Input voltage (VI) …… 0 ～ 60V;

c) Working temperature range (TC) …… -55 ℃ ～ 125 ℃;

d) Storage temperature range (Tstg) …… -65 ℃ ～ 150 ℃;

e) Lead soldering temperature (Th) …… 300 ℃ (10s).

Note: Two or more absolute maximum rating conditions cannot be imposed on a device at the same time.

2.1.2 Recommended working conditions

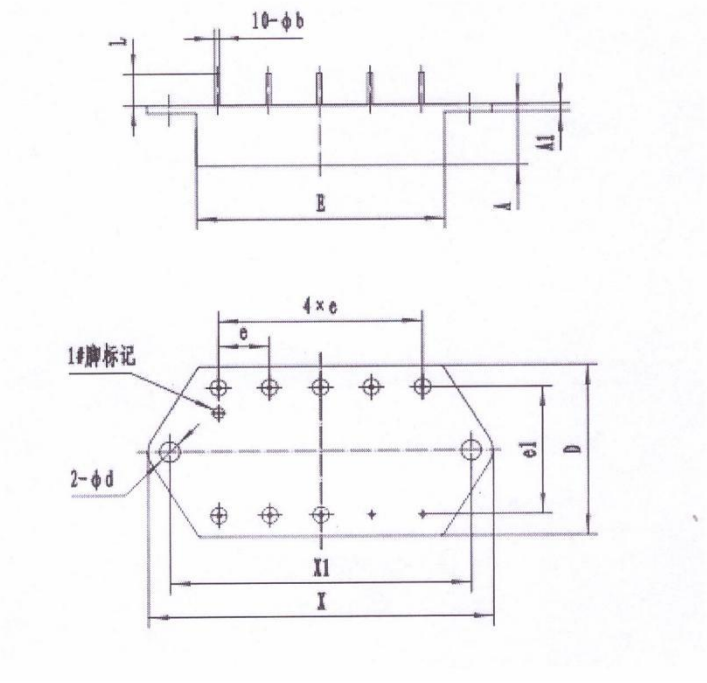
a) Input voltage (VI) …… 20V ～ 50V;

b) Working temperature range (TC) …… -55 ℃ ～ 125 ℃;

c) Output current (IO) …… 5V: 0.3A ~4A. 12V: 0~0.416A. -12V: 0~0.416A.

2.1.3 Package Form

Package type: parallel seam welding; shell shape: flat metal shell. The external dimensions of the enclosure are shown in Figure 1.



In millimeters

Size symbol	Value		
	Min	Nominal	Max
A	-	-	10.29
A1	1.30	-	1.70
ϕb	0.87	-	1.13
ϕd	3.90	-	4.30
D	-	-	34.29
E	-	-	49.53
e	-	10.16	-
e1	-	25.40	-
L	5.35	-	-
X	-	-	68.59
X1	59.74	-	60.14
Note: e and e1 are the interchangeable sizes, which is guaranteed by the manufacture and inspection of the shell. The assessmen requirements are not made in this specification.			

Figure 1 Dimensions

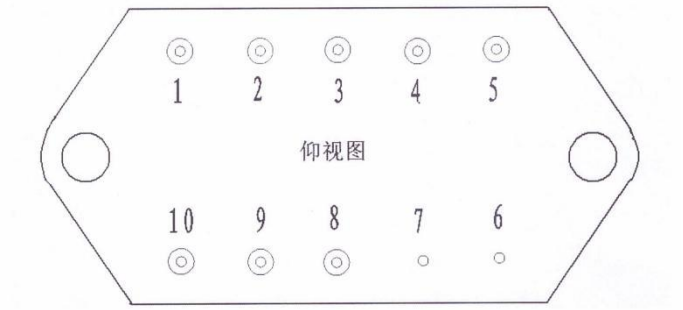
2.1.4 Lead Material and Coating

Outer terminal: material is E type, gold-plated thickness 1.3μm ～ 5.7μm;

Cold-rolled steel shell circuit: the cover plate is nickel plated, and the outer layer of the shell is plated with a thickness of not less than 1.0 μm;

2.1.5 Terminal arrangement and function

The arrangement of the lead-out ends shall be as specified in Figure 2.



Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	V_I	input positive	6	CASE	Shell ground
2	V_{01}	Output main (+5V) positive terminal	7	CASE	Shell ground
3	GND_0	Output ground terminal	8	INH	Inhibit terminal
4	V_{03}	Output auxiliary circuit negative terminal	9	SYNC	SYNCIN terminal
5	V_{02}	Output auxiliary circuit positive terminal	10	GND_I	Input ground terminal

Figure 2 Terminal arrangement

2.1.6 Functional Block Diagram

The functional block diagram shall comply with the provisions of Figure 3.

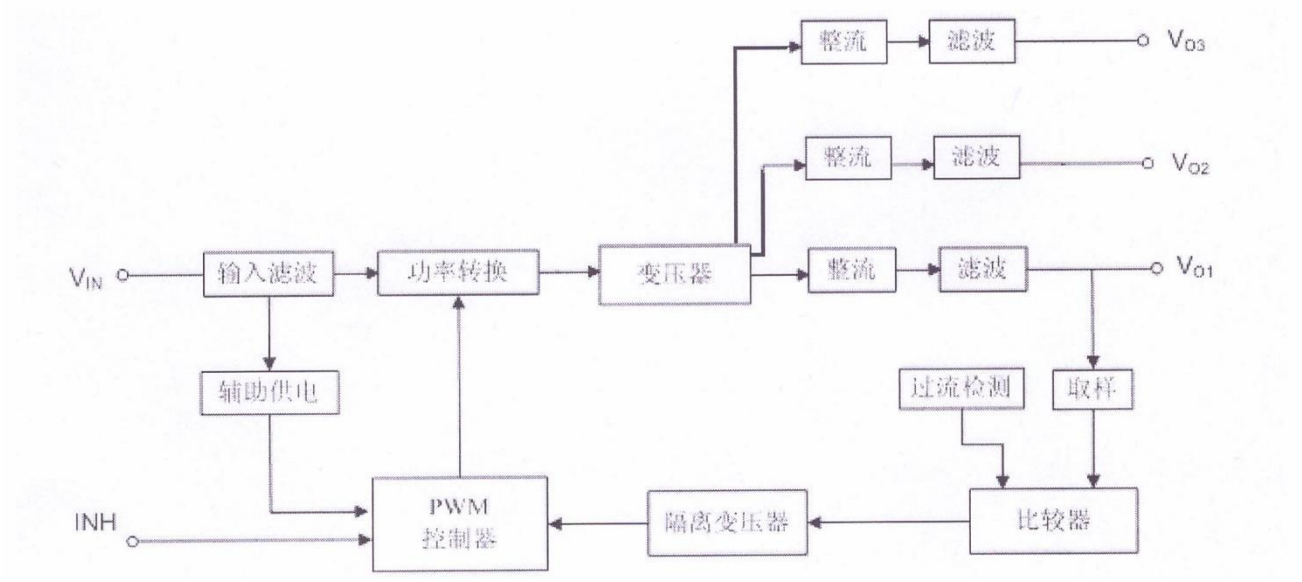


Figure 3 Functional Block Diagram

2.2 Weight

The total weight of the device does not exceed 80g.

2.3 Electrical characteristics

Unless otherwise specified, the electrical characteristics shall be as specified in Table 1 and shall apply to the full temperature range.

Table 1 Electrical characteristics

No	characteristics	Symbol	Condition （Unless otherwise specified, -55 ℃ ≤TC≤125 ℃ VI = 28V ± 0.5V and VI = 42V ± 0.5V, forbidden open circuit, C_L = 0）	Group A	Limit value		Unit
					Min	Max	
1	Output voltage	V_{01}	I_{01}=4A, I_{02}=I_{03}=416mA,	1	4.95	5.05	V
				2,3	4.85	5.15	
		V_{02}		1	11.82	12.18	
				2,3	11.58	12.42	
		V_{03}		1	-12.18	-11.82	
				2,3	-12.42	-11.58	
2	Output current	I_{01}	V_I=20V～50V	1,2,3	300	4000	mA
		I_{02}			-	416	
		I_{03}			-	416	
3	Output ripple voltage (peak-to-peak)	V_{R1}	BW=10kHz～6MHz，I_{01}=4A, I_{02} =I_{03}=416mA	1	-	180	mV
				2,3	-	180	
		V_{R2}		1	-	350	
				2,3	-	350	
		V_{R3}		1	-	180	
				2,3	-	180	
4	Voltage adjustment	S_{V1}	V_I=20V→50V，I_{01}=4A, I_{02} =I_{03}=416mA	1,2,3	-	50	mV
		S_{V2}			-	120	
		S_{V3}			-	120	
5	Load adjustment	S_{I1}	I_{01}=0.3A→4A, I_{02} =I_{03}=0→416mA	1,2,3	-	50	mV
		S_{I2}			-	150	
		S_{I3}			-	150	
6	Input Current	I_{IN}	Full load, forbidden terminal 1 connected to input ground	1,2,3	-	12	mA
			No load, no open circuit		-	110	
7	Input reflected ripple current (peak-to-peak)	I_{RIP}	BW = 20MHz, I_{01} = 4A, I_{02} =I_{03}=416mA, connect EMI filter	1	-	80	mA
				2,3	-	100	
8	Input reflected ripple voltage (peak-to-peak)	V_{RIP}	BW = 20MHz, I_{01} = 4A, I_{02} =I_{03}=416mA, connect EMI filter	1,2,3	—	500	mV
9	Switching frequency [b]	f_s	V_I=28V，I_{01} = 4A, I_{02} =I_{03}=416mA	4,5,6	350	500	kHz

10	effectiveness	η	Input voltage VI = 28V: I_{01} = 4A, I_{02} =I_{03}=416mA	1	70	-	%
				2,3	68	-	
			Input voltage VI = 42V: I_{01} = 4A, I_{02} =I_{03}=416mA	1	68	-	
				2,3	66	-	
11	Short-circuit power	P_D	VI = 28V, output short circuit	1,2,3	-	14	W
			VI = 42V, output short circuit	1,2,3		18	
12	Capacitance load [ab]	C_{L1}	VI = 28V, does not affect DC steady state parameters	4	-	330	μF
		C_{L2}				100	
		C_{L3}				100	
13	Insulation resistance	R_{ISO}	Add 500V between input and output, and between any terminal and the case(except pin 6,7)	1	100	-	MΩ
14	Output voltage change [bc] (peak) during load jump	V_{LOR1}	50% load → full load or full load → 50% load, 10% load → 50% load or 50% load → 10% load, three load changes simultaneously.	4	-	800	mV
		V_{LOR2}			-	3000	
		V_{LOR3}			-	3000	
15	Recovery time of output voltage during load jump [bcd]	t_{LOR1}	50% load → full load or full load → 50% load, 10% load → 50% load or 50% load → 10% load, three load changes simultaneously.	4	-900	900	μs
		t_{LOR2}			-800	800	
		t_{LOR3}			-800	800	
16	Output voltage change (peak value) when input voltage jumps	V_{VOR}	Input voltage VI: 20V → 50V, I_{01} = 4A, I_{02} =I_{03}=416mA Input voltage VI: 50V → 20V, I_{01} = 4A, I_{02} =I_{03}=416mA	4	-900	900	mV
					-800	800	
					-800	800	
17	Recovery time of output voltage during input voltage transition bde	t_{VOR}	Input voltage VI: 20V → 50V, I_{01} = 4A, I_{02} =I_{03}=416mA Input voltage VI: 50V → 20V, I_{01} = 4A, I_{02} =I_{03}=416mA	4	-	5000	μs
18	Start overshoot [b] (peak)	V_{T01}	Input voltage VI: 0V → 28V, I_{01} = 4A, I_{02} =I_{03}=416mA	4,5,6	-	500	mV
		V_{T02}			-	500	
		V_{T03}			500	-	
		V_{T01}	Input voltage VI: 0V → 42V, I_{01} = 4A, I_{02} =I_{03}=416mA	4,5,6	-	500	mV
		V_{T02}			-	500	
		V_{T03}			500	-	
19	Start-up delay [f]	t_{TR}	Input voltage VI: 0V → 28V, I_{01} = 4A, I_{02} =I_{03}=416mA	4,5,6	-	10	ms

			Input voltage VI: 0V → 42V, I_{01} = 4A, I_{02} =I_{03}=416mA	4,5,6	-	10	ms
20	Load failure recovery time [bd]	t_{LF}	I_{01} , I_{02} ,I_{03} are all from short circuit to full load.	4	-	10	ms
21	Prohibited open-circuit voltage	V_{INH}	Inhibit terminal opens, I_{01} = 4A, I_{02} =I_{03}=416mA	1	-	16	V
22	Protection power	P_W	I_{01}≧4.8A, I_{02} =I_{03} ≧500mA	1	36	-	W
23	Cross-adjustment rate	Sc	5V load 2A, ±12V 250mA to 582mA all the way, Yili road 582mA to 250mA change, the initial conditions 5V/4A, ±12V 416mA each way.	1	-	6	%
24	Outer synchronization frequency range [b]	f_{SYNC}	I_{01} = 4A, I_{02} =I_{03}=416mA, pin 9 connects with TTL electronic level (V_{IH}≧4.5V, V_{IL}≦0.8V), Duty cycle: 40%-60%	4	400	500	kHz

a Capacitive load does not affect DC parameters;
b This parameter is guaranteed by design and tested only during qualification inspection and design or process changes;
c The load transition time should be greater than 10μs;
d Recovery time is the time from the beginning of the transition until the output voltage returns to the range of ± 1% of the corresponding stable value;
e The jump time of the input voltage should be greater than 200μs;
f The start delay time can be calculated from the transition of the power supply or when the forbidden terminal of the ground is disconnected.

For the electrical parameters that require a change range, the allowable change range is shown in Table 2.

Table 2 Allowable variation range of electrical parameters

Features	symbol	Condition(Unless otherwise specified, C_L = 0 T_C = 25 ℃, V_I = 28V ± 0.5V, open-end is prohibited)	Electrical parameters allowed Rate of change	Unit
The output voltage	$\triangle V_O$	Full load	±1	%
effectiveness	$\triangle \eta$	Full load	±2	%

2.4 Electrical test requirements

The electrical test requirements of the device shall be the relevant groups specified in Table 3, and the test of each group shall be performed in accordance with Table 1 of this specification.

Table 3 Electrical test requirements

project	Group
Intermediate electrical test (before burn-in)	A1, A4

Final electrical test (after burn-in)	A1[a], A2, A3, A4, A5, A6
Group A test requirements	A1, A2, A3, A4, A5, A6
Group C endpoint electrical test	A1
Group E endpoint electrical test	Table 12
This group calculates PDA.	

2.5 Electrostatic Discharge Sensitivity (ESDS)

The static level is level 2 and the requirement is not less than 2000V.

2.6 Irradiation performance

The total steady-state dose is not less than 1000Gy (Si) (R grade), 500Gy (Si) (L grade), and the single particle (burnout) is not less than 75Mev.cm2 / mg (according to the actual domestic particle level assessment, not less than 65 Mev. cm2 / mg).

2.7 Device flags

2.7.1 Logo

a) device identification number;

b) anchor points;

c) batch identification code or date code；

j) the manufacturer's name or trademark;

k) serial number;

l) ESD identification number.

HDCD/（20-50）-512-30F/T1　　M　　C　　R/L

Device Model　　Package form　　Lead plating　　RHA rating(R:TID≥1000Gy(Si)

L:TID≥500Gy(Si)

In addition, each device should be marked with a unique serial number given consecutively, and an identification code that can identify the sealing circle should be marked. The equilateral triangle (Δ) can be used as a mark for electrostatic sensitive devices, and can also be used as the identification mark of first lead terminal at the same time.

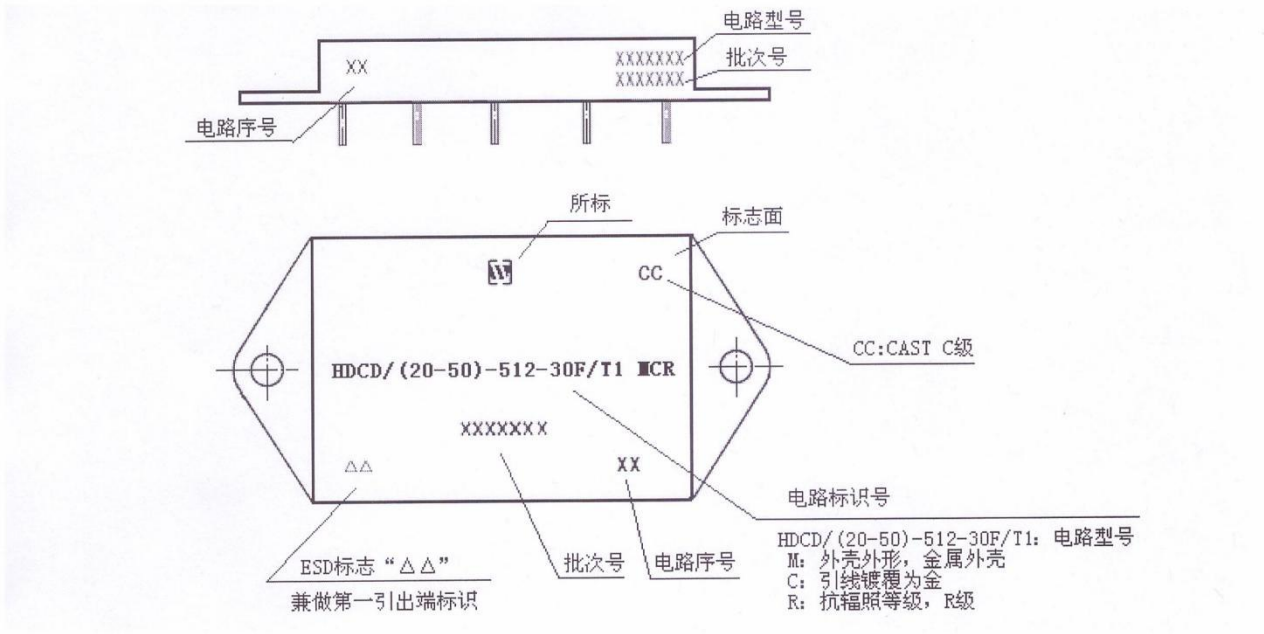
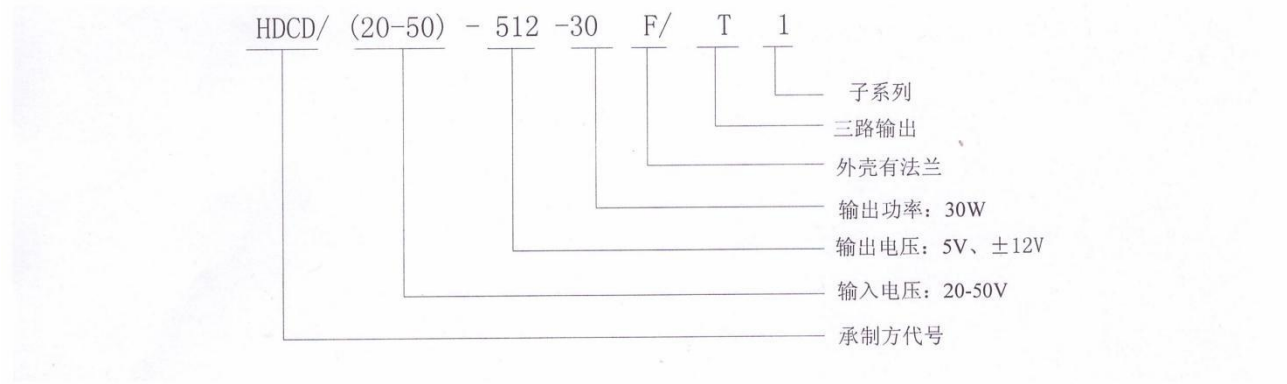


Figure 4 Logo diagram

2.7.2 Circuit Type



2.8 Contractor Outsourcing Control

The device production and quality assurance process should be completed at the device manufacturer. If some projects require outsourcing, the device manufacturer shall establish a management system for qualified outsourcing units, review the qualifications of the outsourcing units, and form a list of qualified outsourcing units. The YC-level device manufacturer shall notify the appraisal agency and the user of any changes in the subcontracting unit.

2.9 Control requirements for purchased raw materials

2.9.1 General

The manufacturer shall confirm the production and appraisal qualifications of the outsourced raw material production plant. Outsourced raw materials include at least substrates, bonding materials, bonding wires, shells, and internal components.

The manufacturer shall formulate the inspection documents for the purchase of raw materials purchased from the factory. The documents shall explain the inspection methods, sampling and inspection procedures, acceptance and rejection criteria, and the test implementation cycle.

2.9.2 Changes in the state of raw materials

When the status of the raw materials changes, the manufacturer shall notify the appraisal agency (if required) and the user of the relevant information in writing within 5 working days.

2.10 Device evaluation

Device evaluation includes device functional performance analysis, structural analysis, limit test and life assessment strengthening test.

2.10.1 Device functional performance analysis

The device contractor shall conduct device functional performance test analysis. Specific requirements are as follows:

a) Test coverage analysis. Aiming at the functional performance of the device, it conducts device test coverage analysis and provides test analysis reports. The analysis report should include test procedures and vector descriptions, and test coverage descriptions.

b) Test and result analysis of different conditions (permissible working conditions of the device), and give characteristic curves. The test results of a certain number of devices shall be counted. The number of samples shall be at least 22 (including the number of certified products). Different working conditions include:

(1) Different temperatures (-55 degrees, 25 degrees, 125 degrees).

(2) Different power supply voltages.

(3) Different load conditions. Perform full-parameter and full-function tests on the device, and issue test data and conclusions.

2.10.2 Structural analysis

The structural analysis requirements are as follows:

a) Through a series of destructive and non-destructive inspections, analysis and tests, confirm the ability of component design, process and materials to meet the evaluation requirements and related aerospace application requirements.

b) Structural analysis should be carried out at a qualified institution or at the user.

c) There are 3 samples for structural analysis, and devices with the same material, process and structure can be considered for combined sampling.

2.10.3 Limit test

Generally adopt the method of high accelerated stress and continuous stress, through the change of the characteristics of components under the stress of heat, force, electricity, etc., obtain the failure mode, weak links and other information of the device, and determine the aging or life of the identification and screening test The specific conditions of the test. Specific test items include:

a) Electrical stress

b) Temperature stress

c) Mechanical stress

2.10.4 Life test strengthening test

At least 2000h life test shall be carried out, which may include Group C inspection 1000h life test.

3 Quality assurance regulations

3.1 Inspection classification

The inspection categories specified in this specification are as follows:

a) screening by the manufacturer;

b) identification and inspection;

c) quality consistency inspection;

3.2 Manufacturer selection

Unless otherwise specified, all devices shall be screened in accordance with Table 6 of this specification prior to qualification and quality consistency testing.

Table 6 Screening

No	Project			Require
		method	condition	
1	Internal visual inspection[a]	—	Condition K-Class	100%
2	Stable baking	—	150 ℃, at least 24h or 125 ℃, at least 168h	100%
3[b]	Temperature cycling	—	Condition C, 10 times	100%
4[b]	Constant acceleration	—	Y1 direction, 19600 m / s^2	100%
5	Particle Collision Noise Detection (PIND)	—	Condition A	100%
6	Electrical test before burn-in[c]	—	As specified in Table 3 of this detailed specification	100%
7	Burn in	—	TC = 125 ℃, test plan and burn-in test circuit are in figure 5, 240h.	100%
8	Electrical test after burn-in	—	As specified in Table 3 of this detailed specification	100%
9	Calculate the amount of change and the rate of defective products	—	As specified in Table 3 of this detailed specification	100%
10	Allowed non-conforming product rate (PDA)[d]	—	—	8% or 1 (whichever is greater)
11	Consistency of three temperature parameters in batches	—	Output voltage, effeiciency, no-load current.	± 3σ, provide parameters as a reference, not as a criterion, only required when delivered.

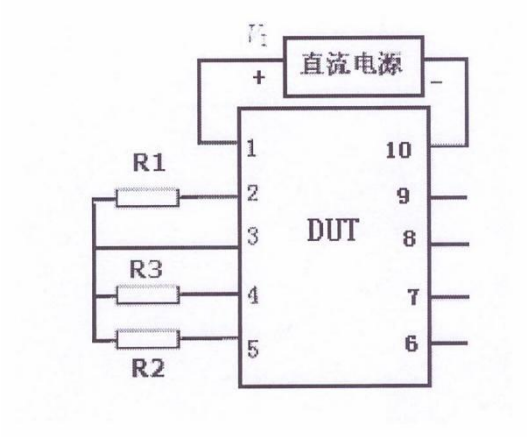
12	Sealed (fine leak detection and coarse leak detection)	—	Fine leak detection: A1, pressure: 310kPa, time 10h, R1≦5X10^{-3} (Pa.cm^3)/s (He); Rough leak detection: C1	100%
13	X-ray photography	—	—	100%
14	External visual inspection	—	—	100%

a Circuits waiting for visual inspection before sealing should be stored in a dry and controlled environment.

b After screening in group 3 and group 4, the manufacturer shall conduct external visual inspection of the circuit.

c The electrical test before ageing can eliminate circuits with unqualified electrical parameters, but the number of rejected products is not included in the rate of unqualified products; this test may not include all circuit parameters, but should include those that are most sensitive but very Valid circuit parameters.

d A typical failure is the failure of multiple circuits with the same root cause in an aged batch. PDA and typical failures only consider the static test data (group A1) of the circuit at 25 ° C. Functional failure does not exceed 5%.



Note: VI = 28V ± 3.0V, RL = 1.25Ω ± 10% / (≥20W) or load current = 4A ± 10%. R2=R3=28.8Ω±10%(≥5W) or load current=0.416A±10%

Fig. 5 Block diagram of burn-in and steady-state life test

3.3 Identification

The identification inspection shall be in accordance with the provisions of this specification. The inspections shall be in accordance with the inspection requirements of Group A, Group B, Group C, Group D, and Group E of this specification. The number of samples in Group C2 is 22 (0).

3.4 Quality Consistency Inspection (QCI)

Quality consistency inspection shall be in accordance with the provisions of this specification. The inspections shall be carried out in accordance with the inspection requirements of Group A, Group B, Group C, Group D and Group E of this code.

3.4.1 Group A inspection

Group A inspection shall be carried out in accordance with the provisions of Table 7 of this code.

Table 7 Group A inspection

Group	Pilot projects	n(0)
A1	Static test at 25 ℃	116(0)
A2	Static test at highest rated operating temperature	76(0)
A3	Static test at the lowest rated operating temperature	45(0)
A4	Dynamic test at 25 ℃	116(0)
A5	Dynamic test at maximum rated operating temperature	76(0)
A6	Dynamic test at the lowest rated operating temperature	45(0)
Note: The sample of group A test should be the circuit after screening. When the required sample size exceeds the batch size, 100% inspection is allowed. After the detection of the A1 group is completed, the detection of the other groups of the A group can be performed in an arbitrary order.		

3.4.2 Group B inspection

Group B inspection shall be in accordance with the provisions of Table 8 of this code.

Table 8 Group B inspection

Group	Pilot projects	Method	Test conditions	Sample size (number of nonconforming items allowed) n (c)
B1	Physical size and weight	This specification 3.4	-	2(0)
B2	Particle Collision Noise Detection (PIND) [a]	-	Condition A	15(0)
B3	Antisolvent	-	-	3(0)，Not applicable for laser marking
B4	Internal visual inspection and mechanical inspection[b]	-	-	1(0)
B5	Bonding strength	-	-	2(0)，22 (0) for button closure, all for shortage
B6	Chip shear strength	-	-	2(0)，The number of components is 22 (0).
B7 [c]	Solderability	-	-	1(0), 15 leads (all if not enough)
B8 [d]	Seal Fine Leak detection Rough Leak Detection	-	Same as Table 6 of this specification	15(0)
B9 [e]	ESD A1	-	ESD	

			a. Electrical parameter group A1 b.ESDS 2000V c. Electrical parameter group A1	3(0)
B10[e]	Thermal performance	-	Input voltage 28V, full load, with heat sink, TC = 60 ℃, VDMOS and Schottky diode junction temperature does not exceed 100 ℃	3(0)

a If the PIND test was performed 100% of the time in the screening, this test may not be performed.

b Internal visual inspection and structural inspection shall prove that the structure of the actual circuit meets the requirements of the archived design documents.

c. Nickel-plated leads are pre-tinned.

d If the seal screening test is performed 100% between the final electrical test and external visual inspection, this item may not be performed.

e Appraisal or product technology, design changes.

3.4.3 Group C inspection

Group C inspection shall be in accordance with the provisions of Table 9 of this code.

Table 9 Group C inspection

Group	Test	Method	Condition		Sample size (Number of receptions)
			QCI	Identification and inspection	
C1	Resistance to welding heat	-	Condition A	Condition A	5（0）
	External visual inspection	-	-	-	
	PINDa	-	Condition A, 5 passes	Condition A, 5 passes	
	Temperature cycle [b] or thermal shock	-	At least condition C, 20 cycles or at least condition A	C, 100 cycles are not applicable	
	Mechanical shock [c] and constant acceleration	-	Not applicable 29400m/s2, Y1 direction	B, Y1 direction and 49000m/s2, Y1 direction	

	Sweep frequency vibration	-	Condition A	Condition A	
	seal	-	Same as Table 6 of this specification	Same as Table 6 of this specification	
	PIND	-	Condition A, 1 pass	Condition A, 1 pass	
	Visual inspection	-	-	-	
	End point electrical test		See Table 1, Table 3 of this specification	See Table 1, Table 3 of this specification	
C2	Steady-state life	1005.1	TC=125 ℃ , 1000h (see the diagram 5 of this code for the steady state life test circuit diagram)	TC=125 ℃ , 1000h (see the diagram 5 of this code for the steady state life test circuit diagram)	22（0）或 8（0）[d]
	End point electrical test		See Table 1, Table 2 and Table 3 of this specification	See Table 1, Table 2 and Table 3 of this specification	
C3	Internal atmosphere content	1018.1	Water vapor content is not more than 5000ppm at 100℃	Water vapor content is not more than 5000ppm at 100℃	3(0)
C4	Internal visual inspection and structural inspection	2014	-	-	2(0)
	Wire bonding strength e	2011.1	-	-	
	Chip shear strength or	2019.2 2027.1	-	-	
C5	Chip bonding strength f	GJB1027A	TC: -35 ℃ ～ 70 ℃ , component identification level	TC: -35 ℃ ～ 70 ℃ , component identification level	5(0)

a When the PIND test finds that there is movable excess in the circuit, it should be analyzed. If the contractor can confirm that after taking corrective measures, the excess is controllable, and the PIND test is randomly selected from the circuit manufactured by the baseline process , The failure of PIND should not endanger the identification.

b For circuit qualification, thermal shock cannot replace temperature cycling.

c For circuit qualification, constant acceleration cannot replace mechanical shock. With the agreement of the user, the values of constant acceleration and mechanical shock can be selected according to the package perimeter according to the requirements of Note 4 of Table 4 of the general specification.

d When all the following requirements are met, QCI inspection can be carried out according to the 8 (0) sampling plan:

——Up to 100 circuits per order;

——In a certain equipment purchase contract, only 500 circuits are ordered at most;

——Order only 500 circuits within 12 months.

e Test at least 2 circuits with a sample size (reception number) of 15 leads (0).
f All chips and chip components bonded in the circuit should be subjected to a shear test.

3.4.4 Group D inspection

Group D inspection according to the provisions of Table 10 of this specification, Group D inspection can be used as a sample of the sealed empty shell subjected to screening treatment and stress conditions. Group D inspection shall be carried out on the first inspection lot submitted for inspection, and shall be repeated for every subsequent inspection lot no more than 26 weeks apart.

Table 10 Group D inspection

Group	Project	Method	Test conditions	Sample size (Number of receptions)
D1	Thermal shock	-	C	5(0)
	Stability baking	-	150℃, 1h	5(0)
	Lead tightness	-	B1	1(0)
	Sealing: fine leak detection, coarse leak detection	-	Same as Table 6 of this specification	5(0)
D3[a]	Salt spray	-	A	5(0)
D4	Metal case insulation	-	500V, maximum 80nA	3(0)
a The shell and cover can be inspected separately to test the same type of shell.				

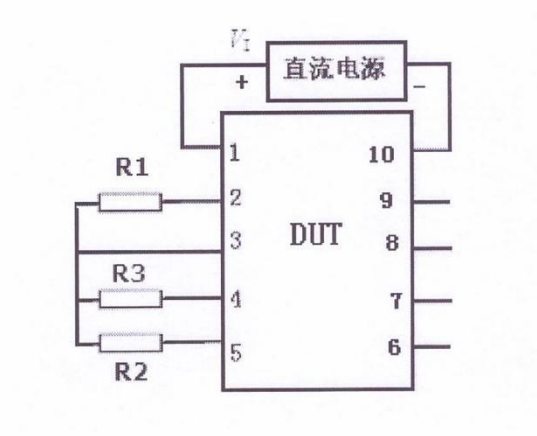
3.4.5 Group E inspection

Group E inspection shall be in accordance with Table 11 of this specification.

Table 11 Group E test

Group[a]	Test	Method	Conditions and criteria	Sample size (received number)
E2[a]	Steady State Total Dose Irradiation	-	R-level is not less than 1000Gy(Si) (L-level is not less than 500Gy(Si), the dose rate is 0.001 Gy(Si)/s, the irradiation test chart and bias conditions are shown in Figure 6.	4（0）
	End point electrical test		See table 12	

E5 [b]	Single particle effect	-	Maximum fluence rate: 10000ions/cm2·s, The failure threshold of single particle function LET≥75MeV·cm2/mg (can be evaluated according to 65 Mev.cm2/mg). Criteria for single particle transient effect failure: the amplitude of the transient waveform is relatively stable. The amplitude change is ≥ 10% of the output voltage, and the minimum pulse width is ≥ 5ms. If both conditions are met at the same time, the failure is determined. The radiation test diagram and bias conditions are shown in Figure 6.	3（0）
a Among them, 2 devices are biased, 2 devices are not biased and all pins are irradiated, and another device of the same model and specification is not irradiated for comparison test. b When the procurement documents or contract stipulates, or when the design or process changes that may affect the effect of single particles are identified and occurred.				



Note 1 For total dose test: Test bias condition VI=50V±0.5V, R1=2.5Ω±10%/(≥10W) or load current=2A±10%, R2=R3=57.7Ω±10% (≥ 2.5W) or load current=0.208A±10%.

Note 2 For single particle test: Device 1 test bias condition VI=20V±0.5V, R1=2.5Ω±10%/(≥10W) or load current=2A±10%, R2=R3=57.7Ω±10% (≥2.5W) or load current=0.208A±10%; device 2 test bias condition VI=28V±0.5V, no load; device 3 test bias condition VI=50V±0.5V, R1=1.25Ω±10 %/(≥20W) or load current=4A±10%, R2=R3=28.8Ω±10% (≥5W) or load current=0.416A±10%.

Figure 6 Irradiation test circuit diagram

Table 12 Group E test indicators

Characteristics	Symbol	Condition （Unless otherwise specified,TA=25 ℃, VI = 28V ± 0.5V and VI = 42V ± 0.5V, forbidden open circuit, C_L = 0）	Group A	Limit value		Unit
				Min	Max	
Output voltage	V_{01}	I_{01}=4A, I_{02}=I_{03}=416mA,	1	4.71	5.29	V
	V_{02}			11.44	12.74	

	V_{03}			-12.74	-11.44	
Output current	I_{01}	V_I=20V～50V	1	300	4000	mA
	I_{02}			0	416	
	I_{03}			0	416	
Output ripple voltage (peak-to-peak)	V_{R1}	BW=10kHz～6MHz，I_{01}=4A, I_{02} =I_{03}=416mA	1	-	180	mV
	V_{R2}			-	350	
	V_{R3}			-	180	
Voltage adjustment	S_{V1}	V_I=20V→50V，I_{01}=4A, I_{02} =I_{03}=416mA	1	-	60	mV
	S_{V2}			-	150	
	S_{V3}			-	150	
Load adjustment	S_{I1}	I_{01}=0.3A→4A, I_{02} =I_{03}=0→416mA	1	-	60	mV
	S_{I2}			-	180	
	S_{I3}			-	180	
Input Current	I_{IN}	Full load, forbidden terminal 1 connected to input ground	1	-	15	mA
		No load, no open circuit		-	130	
Input reflected ripple current (peak-to-peak)	I_{RIP}	BW = 20MHz, I_{01} = 4A, I_{02} =I_{03}=416mA, connect EMI filter	1	-	100	mA
Input reflected ripple voltage (peak-to-peak)	V_{RIP}	BW = 20MHz, I_{01} = 4A, I_{02} =I_{03}=416mA, connect EMI filter	1	—	500	mV
effectiveness	η	Input voltage VI = 28V: I_{01} = 4A, I_{02} =I_{03}=416mA	1	66	-	%
		Input voltage VI = 42V: I_{01} = 4A, I_{02} =I_{03}=416mA	1	64		
Short-circuit power	P_D	VI = 28V, output short circuit	1	-	16	W
		VI = 42V, output short circuit	1	-	20	
Insulation resistance	R_{ISO}	Add 500V between input and output, and between any terminal and the case(except pin 6,7)	1	100	-	MΩ
Prohibited open-circuit voltage	V_{INH}	Inhibit terminal opens, I_{01} = 4A, I_{02} =I_{03}=416mA	1	-	16	V
Protection power	P_W	I_{01}≧4.8A, I_{02} =I_{03} ≧500mA	1	36	-	W

Cross-adjustment rate	*Sc*	5V load 2A, ±12V 250mA to 582mA all the way, first way 582mA to 250mA change, the initial conditions 5V/4A, ±12V 416mA each way.	1	-	8	%

4 Delivery preparation

The packaged product storage environment should meet the requirements of temperature: 15℃～25℃, humidity: 25%～65%, there is no acid, alkali or other corrosive gas around, good ventilation, and corresponding anti-static measures.

5 Instructions

5.1 Intended use

Devices that meet this detailed specification are intended for use in the aerospace field or military equipment. In order to achieve the best cost-effectiveness of the device while maintaining its basic quality and reliability requirements, the device should be procured according to the actual needs and suitable for the level and purpose.

5.2 Purchase document requirements

The following contents should be specified in the procurement documents:

a) the number of detailed specifications;

b) Product name;

c) Quality assurance level;

d) Order quantity;

e) Requirements for production supervision and acceptance;

f) Special requirements of the user, such as radiation resistance requirements.

5.3 Application notes

Use and operation of this circuit needs to be carried out in accordance with the provisions of this specification and the application manual.

Use and operation of this circuit requires the wiring of each pin function as shown in the pin function table to ensure the correctness of the electrical connection, the effective anti-static measures, and the effective grounding of the ground terminal.

It is recommended to install on the bottom or side wall of the heat dissipation structure of the user equipment to ensure good heat dissipation.