BSTTR28S05(F)

DC/DC Converter

Data Sheet

I. Product Overview

This specification specifies the detailed requirements for the hybrid integrated circuit BSTTR28S05(F) DC/DC converter (hereinafter referred to as the circuit).

II. References

The relevant clauses in the following documents become clauses of this specification through reference. For referenced documents with a date or edition, any subsequent amendments (excluding errata) or revisions are not applicable to this specification. However, parties using this specification are encouraged to explore the possibility of using the latest version. For referenced documents without a date or edition, the latest version applies to this specification.

- GB/T 1804-2000 General tolerances for linear and angular dimensions without tolerance indication
- GB/T 15138-1994 Dimensions of thin film integrated circuits and hybrid integrated circuits
- GJB 151B-2013 Requirements and measurements of electromagnetic emissions and susceptibility of military equipment and subsystems
- GJB 360B-2009 Test methods for electronic and electrical components
- GJB 548B-2005 Test methods and procedures for microelectronic devices
- GJB 2438B-2017 General Specifications for Hybrid Integrated Circuits

III. Requirements

3.1. General Principles

The circuit shall comply with all requirements specified in this specification and GJB 2438B-2017. When the requirements of this specification are inconsistent with the general specifications, this specification shall prevail.

3.2. Design, Structure and Dimensions

3.2.1. Process Structure

This circuit adopts thick film hybrid integrated circuit technology, fully sealed metal shell package, 4J50 copper core composite lead as rigid lead, shell lead (7 pins) is nickel-plated, and all functional leads (1 pin to 6 pins, 8 pin to 10 pins) are gold-plated.

3.2.2. Absolute Maximum Ratings

- Input voltage range (V_I) 15V～ 52V
- Lead soldering temperature (T_h) (10s): 300℃
- Storage temperature range (T_{stg}) -65℃～150℃.

3.2.3. Recommended operating conditions

Input voltage range (V_I) 15 V ～ 50 V

Operating temperature range (T_C) -55℃ ～ 125℃

3.2.4. Dimensions

The overall dimensions shall comply with GB/T 15138 and Figure 1.

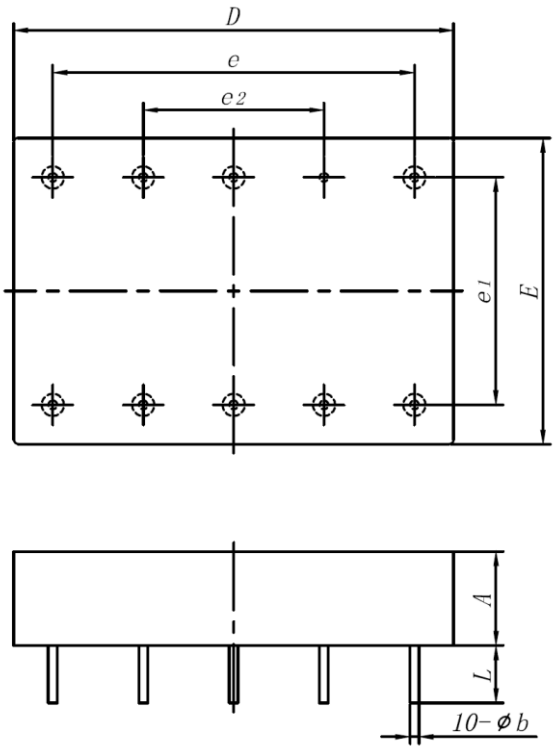


Figure 1a. BSTTR28S05 dimensions

Table 1

Unit is millimeter

NUMBER	NUMERICAL		
	MINIMUM	NOMINAL	MAXIMUM
A	—	—	10.60
ϕb	0.90	—	1.10
e	—	40.64	—
e_1	—	25.40	—
e_2	—	20.32	—
D	—	—	49.55
E	—	—	34.31
L	5.40	—	7.40

Notes:
1. For tolerances not specified, the M level in GB/T 1804-2000 shall apply;
2. The interchangeability of dimensions *e, e1* and *e2* is guaranteed by the manufacture and inspection of the housing and is not subject to assessment requirements.

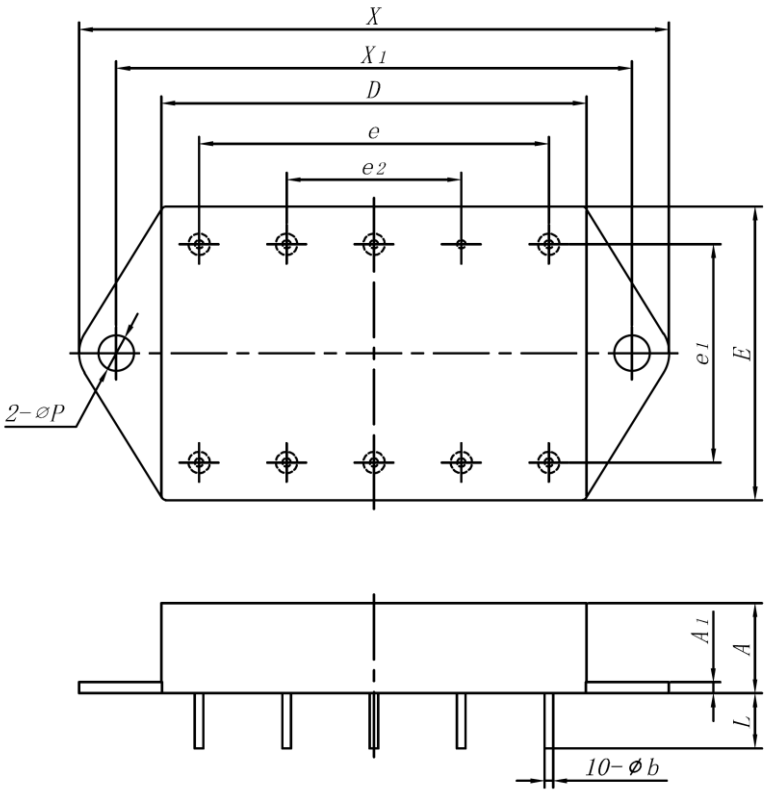


Figure 1b. BSTTR28S05F dimensions

Table 2

Unit is millimeter

NUMBER	NUMERICAL		
	MINIMUM	NOMINAL	MAXIMUM
A	—	—	10.60
A_1	1.10	—	1.50
ϕb	0.90	—	1.10
e	—	40.64	—
e_1	—	25.40	—
e_2	—	20.32	—
D	—	—	49.55
E	—	—	34.31
L	5.40	—	7.40
ϕP	—	4.10	—
X	—	—	69.09
X_1	—	59.94	—

Notes:
1. For tolerances not specified, the M level in GB/T 1804-2000 shall apply;
2. The interchangeability of dimensions *e, e1* and *e2* is guaranteed by the manufacture and inspection of the housing and is not subject to assessment requirements.

3.2.5. Terminal Arrangement

The terminal arrangement should be as shown in Figure 2.

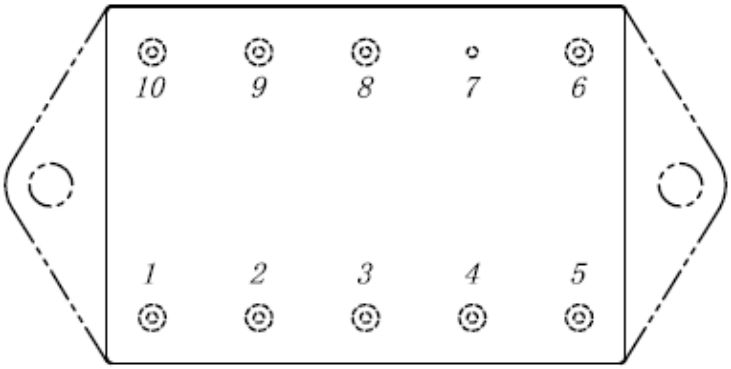


Figure 2. Terminal arrangement (top view, pins facing downwards)

Table 3

PIN NUMBER	SYMBOL	FUNCTION	PIN NUMBER	SYMBOL	FUNCTION
1	V_I	Positive input	6	+S	Positive sensing terminal
2	INH	Prohibited End	7	GND_C	Shell
3	-S	Negative sensing terminal	8	NC	Empty end
4	GND_O	Output	9	NC	Empty end
5	V_0	Output	10	GND_I	Input ground

3.3. Electrical Characteristics

The electrical characteristics shall be as specified in Table 4.

Table 4. Electrical characteristics

SPECIAL SEX	SYMBOL	CONDITION (UNLESS OTHERWISE SPECIFIED, -55℃≤ T_C ≤125℃, V_I = 28 V ± 0. 5 V, C_L = 0.1 M F, DO NOT LEAVE THE TERMINAL HANGING)	GROUP A GROUPING	LIMIT VALUE		UNIT
				MINIMUM	MAXIMUM	
Output voltage	V_O	V_I =15V～50V, full load	1	4.95	5.05	V
			2,3	4.90	5.10	
Output current	I_O	V_I =15V～50V	1,2,3	-	6	A
Output ripple voltage (peak-to-peak)	V_{RIP}	BW ≤20MHz, full load	1,2,3	-	50	mV
Voltage regulation	S_V	V_I =15V～50V, full load	1,2,3	-	20	mV
Load regulation	S_I	10% load → 100% load	1,2,3	-	50	mV
Input current	I_I	No load or full load, the prohibit terminal is connected to the input ground terminal	1,2,3	-	6	mA
		No load		-	90	
Startup threshold voltage	V_{ION}	Input voltage V_I : 0V→28V, full load	1,2,3	12.0	14.8	V
Shutdown threshold voltage	V_{IOFF}	Input voltage V_I : 28V→0V, full load	1,2,3	11.0	14.5	V
efficiency	η	fully loaded	1,2,3	70	-	%
Insulation resistance	R_I	DC between the input and output, any lead (except pin 7) and the shell, T_A =25℃	1	100	-	MΩ
Short-circuit power consumption	P_D	Output short circuit, T_A =25℃	1	-	16	W
Capacitive load b	C_{LOAD}	Full load, T_A =25℃	4	-	1000	μF
Switching frequency	f_e	fully loaded	4,5,6	450	550	kHz

SPECIAL SEX	SYMBOL	CONDITION (UNLESS OTHERWISE SPECIFIED, -55℃≤ T_C ≤125℃, V_I = 28 V ± 0. 5 V, C_L = 0.1 M F, DO NOT LEAVE THE TERMINAL HANGING)	GROUP A GROUPING	LIMIT VALUE		UNIT
				MINIMUM	MAXIMUM	
ac during load transient (peak value)	V_{LOR}	50% load → full load or full load → 50% load	4,5,6	-500	500	mV
Output voltage recovery time acd during load transients	t_{LOR}	50% load → full load or full load → 50% load	4,5,6	-	500	μs
Output voltage change (peak value) ae when input voltage changes transiently	V_{VOR}	Input voltage V_I : 16V→40V, full load	4,5,6	-600	600	mV
Output voltage recovery time ade when input voltage transient	t_{VOR}	Input voltage V_I : 16V→40V, full load	4,5,6	-	500	μs
Startup delay af	t_{TR}	Input voltage V_I : 0V→28V, full load	4,5,6	-	20	ms
Start-up overshoot (peak)	V_{TO}	Input voltage V_I : 0V→28V, full load	4,5,6	-	50	mV
a. This parameter is guaranteed by design and is tested only during qualification inspection and design or process changes; b. Capacitive load does not affect DC parameters; c. The load transition time should be greater than 10 μs; d. Recovery time refers to the time from the start of the jump until the output voltage returns to the corresponding stable value within ±1%; e. The transition time of the input voltage should be greater than 10 μs; f. can be calculated from the start of the power supply jump or from the disconnection of the grounded inhibit terminal.						

3.4. Electrical Test Requirements

The electrical test requirements shall be grouped as specified in Table 5.

Table 5. Electrical test requirements

Test conditions	Group (According to Table C11 of GJB 2438B-2017)
Final electrical test (after aging)	A1[a], A2, A3, A4, A5, A6
A test requirements	A1, A2, A3, A4, A5, A6
Endpoint electrical test in group C	A1
a. PDA is suitable for A1 group	

3.5. Device Marking

The device models are BSTTR28S05 and BSTTR28S05F.

The product logo is shown in Figure 3.

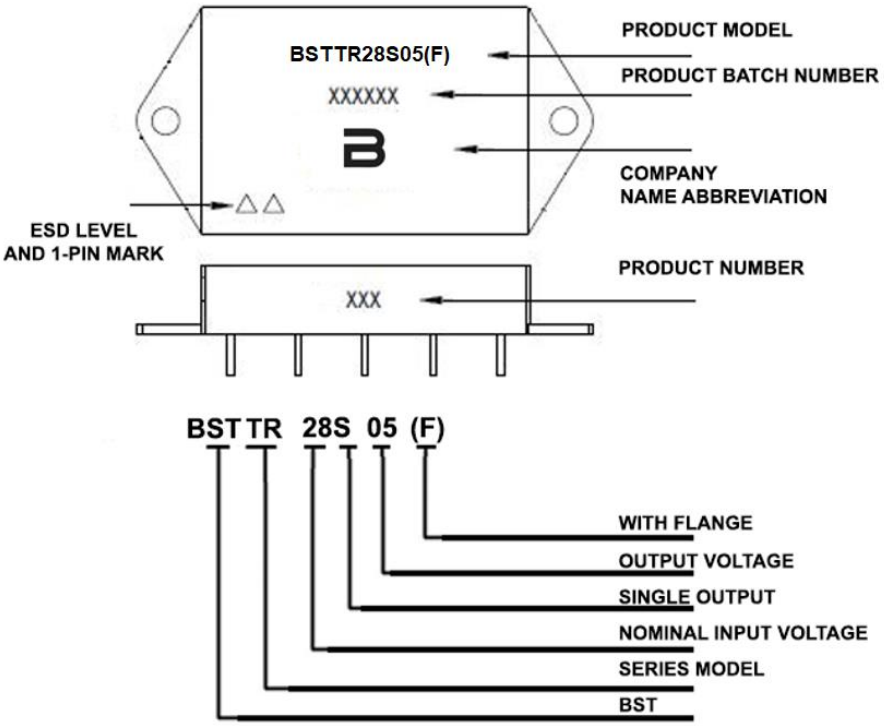


Figure 3. Product logo

IV. Quality Assurance Regulations

4.1. Sampling and Inspection

Unless otherwise specified, sampling and inspection procedures shall be in accordance with GJB 2438B-20 17 and this specification.

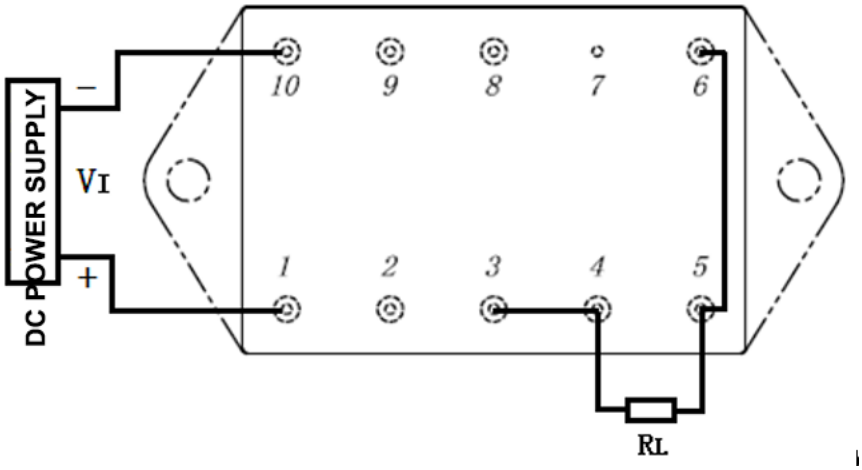
4.2. Filter

Before identification and quality consistency inspection, all circuits should be screened in accordance with C.4 of GJB 2438B-2017 and Table 6 of this specification.

Table 6. Screening

TRY TEST	GJB 548B-2005		WANT BEG
	SQUARE LAW	STRIP PIECES	
Internal visual inspection	2017		100%
Temperature Cycle	1010	Condition C, -65^{0}_{-10}°C to 150^{+15}_{0}°C, 10 times, *t1* = 15 min ± 1 min, $t_2 \leq 1$ min	100%
constant acceleration	200 1	Acceleration 29400m/s^{2,} Y1 direction, 1min	100%
PIND	2020	Condition A	100%

TRY TEST	GJB 548B-2005		WANT BEG
	SQUARE LAW	STRIP PIECES	
Aging	1015	T_C = 125℃, 160 h (Aging diagram see Figure 4)	100%
Surge test	6.5 of this specification	Full load, surge voltage: 80V, time: 1s, T_A =25℃	100%
Final electrical test	-	Should comply with the requirements of Table 2	100%
seal a. Detailed leak inspection b. Rough leak detection	1014	Detailed inspection test conditions A1, pressure: 310kPa, time: 10h, $R_1 \leq 5x10^{-3}$ (Pa·cm $^{3)}$ /s (He) Rough test conditions C1, pressure: 310kPa, time: 8h	100%
External visual inspection	2009		100%



V_I =28V±0.5V, R_L =0.85Ω±0.02Ω (resistance power not less than 60W)

Figure 4. Frame diagram of aging and steady-state life test

4.3. Identification and Inspection

Identification tests shall be carried out in accordance with the provisions of this specification and the tests carried out shall comply with the requirements of Groups A, B, C and D of this specification. The minimum number of samples required for Group A tests shall not be less than the sum of the number of samples specified for Groups B, C and D.

4.4. Quality consistency inspection

4.4.1. Overview

Quality consistency inspection shall be carried out in accordance with the provisions of C.5 of GJB 2438B-2017 and this specification, and the inspections carried out shall comply with the A, B, C and D group inspections specified in this specification.

4.4.2. Group A test

Group A inspection shall be carried out in accordance with Table 7 of this specification; when the required sample size exceeds the batch size, 100% inspection shall be carried out.

Table 7. Group A test

GROUPING	PARAMETER	NUMBER OF SAMPLES (NUMBER OF RECEPTIONS)
1	25℃Static test	116(0)
2	125℃Static test	76(0)
3	-55℃Static test	45(0)
4	25℃Dynamic test	116(0)
5	125℃Dynamic test	76(0)
6	-55℃Dynamic test	45(0)

4.4.3. Group B test

Group B inspection shall be in accordance with Table 8 of this specification.

Table 8. Group B test

GROUPING	TEST	GJB 548B-2005		Sample size (Number of Received)
		METHOD	CONDITION	
1	Dimensions	2016	Comply with Article 3.2.4	2 (0)
2	Solvent resistance	2015	—	3 (0)
3	Internal visual inspection and Structural inspection	2014	—	1 (0)
4	Bond strength a) Hot pressure welding b) Ultrasonic welding	2011	D	2 (0)
5	Die shear strength	2019	—	2 (0)
6	Solderability b	2003	Solder temperature 245℃± 5℃, Water vapor aging 8h	1 (0)
a. This test item is not applicable to laser marking products; b. Nickel-plated leads allow for tinning pre-treatment.				

4.4.4. Group C test

Group C inspection shall be carried out in accordance with Table 9 and the following provisions in GJB 2438B-2017.

Table 9. Group C test

GROUPING	TEST	GJB 548B-2005		SAMPLE SIZE (NUMBER OF RECEIVED)
		METHOD	CONDITION	
1	Resistance to welding heat	GJB360B Method 210	Condition A	5 (0)
	External visual inspection	2009	—	
	Temperature Cycle	1010	Same as table 3	
	constant acceleration	2001	Same as table 3	
	Random vibration	2026	Test condition Ⅰ (F), no power is applied during the test	
	seal	1014	Same as table 3	
	PIND	2020	Same as table 3	
	Visual inspection	1010	—	
	Endpoint electrical testing	—	Should comply with the requirements of Table 2 of this specification	
2	Steady-state life	1005	T_C = 125℃, 1000h (see Figure 4 for the test block diagram)	5 (0)
	Endpoint electrical testing	—	Should comply with the requirements of Table 2 of this specification	
3	Internal water vapor content	1018	—	3 (0) or 5 (1)
5	ESD Electrical parameters ESDS Electrical parameters	3015	A1 Group 2000V A1 Group	3 (0)
6	Electromagnetic compatibility Test a (CE102)	GJB151B	-	2(0)
a. This test is only performed for identification inspection or design change.				

4.4.5. D Group Test

The Group D test shall be conducted in accordance with the following provisions. The Group D test may be conducted on products with unqualified electrical properties or sealed empty shells that have been screened out from the same inspection batch, and shall be repeated for subsequent inspection batches at intervals not exceeding 26 weeks. If the product shell passes

the shell evaluation test upon entering the factory and the test items can cover the tests specified in the identification inspection Group D, the Group D test does not need to be repeated.

Table 10. Group D test

GROUPING	TEST	GJB 548B-2005		SAMPLE SIZE (NUMBER OF RECEIVED)
		METHOD	CONDITION	
1	Thermal shock	1011	C, 15 cycles	5 (0)
	Stability baking	1008	150℃, 1 h	
	Lead firmness	2004	Condition B $_{1,}$ 6.3.5 in 2004	1 (0)
	Seal	1014	Same as Table 3	5 (0)
2	Salt spray	1009	Condition A	5 (0)
3	Insulation resistance	1003	500V, 80nA max	3 (0)

V. Delivery preparation

Packaging requirements should comply with the provisions of Article 5.1 of GJB 2438B-2017.

VI. Notes

6.1. Intended use

Circuits conforming to the requirements of this specification are intended for use in the design of new equipment and for the maintenance of existing equipment.

6.2. Order document contents

The contents of the contract and order form shall comply with the provisions of Article 6.2 of GJB 2438B-2017.

6.3. Quality control level

Product quality control is carried out in accordance with the H-level requirements in GJB 2438B-2017.

6.4. Other function parameter descriptions

a) Disable function parameter description (when the disable function is not used, leave the disable terminal unconnected)

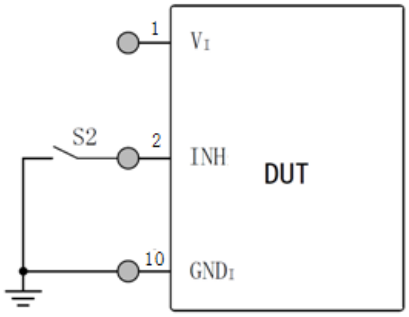
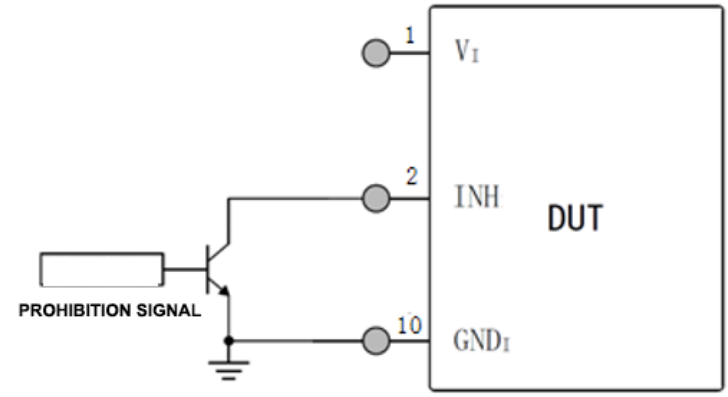


Figure 5a. Schematic diagram of low-level inhibit wiring



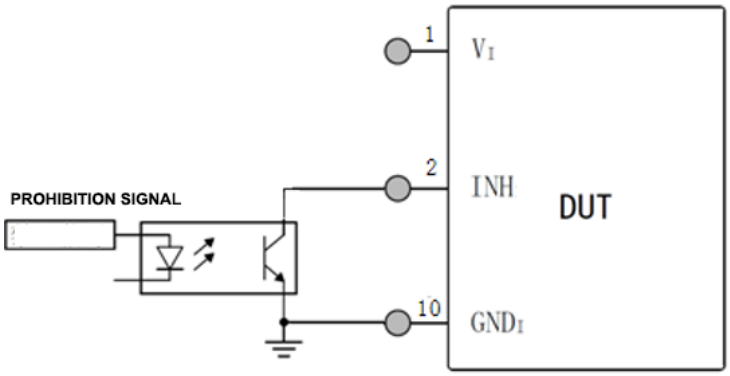


Figure 5b. High level inhibit wiring diagram

b) SENSE function parameter description

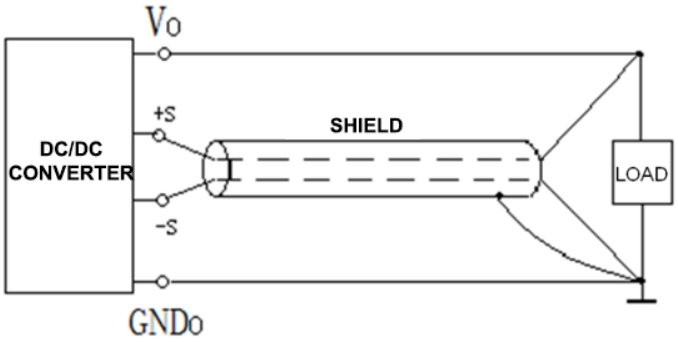


Figure 6. Schematic diagram of SENSE terminal wiring

When the load current is high, a certain voltage drop occurs in the wires connecting the DC/DC converter output to the load, causing a drop in the actual voltage at the load. Therefore, during normal operation, SEN+ must be connected to the positive voltage terminal of the load (i.e., V_O of the DC/DC converter), and SEN- must be connected to the negative voltage terminal of the load (i.e., GND_O of the DC/DC converter). These terminals serve as load voltage sensing terminals (see Figure 6). This ensures that the load receives the nominal output voltage. Failure to connect these terminals correctly or incorrectly can cause permanent damage to the DC/DC converter module.

Note that if the SEN+ and SEN- cables to the load are too long, they can easily cause self-excitation. If the cables are too long, you can directly connect SEN+ to V_O and SEN- to GND_O at the module end.

6.5. Surge Test Method

The connection diagram of the surge voltage test fixture is shown in Figure 7:

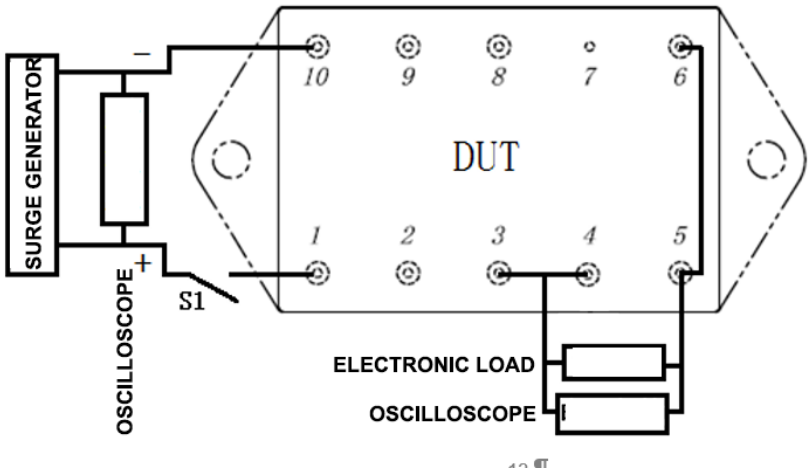


Figure 7. Surge voltage test fixture connection diagram

6.5.1. Test conditions

- V_I = 28V, V_{IM} = 80V, output by the surge generator, single surge lasts 1s (T = 1s);
- The electronic load is adjusted to a constant current of the specified current value;
- Switch S1 is in the OFF position.

6.5.2. Test procedures

- Connect the device under test to the test system;
- Set the switch S1 shown in Figure 7 to the ON position;
- After the surge test, test the output voltage at room temperature.

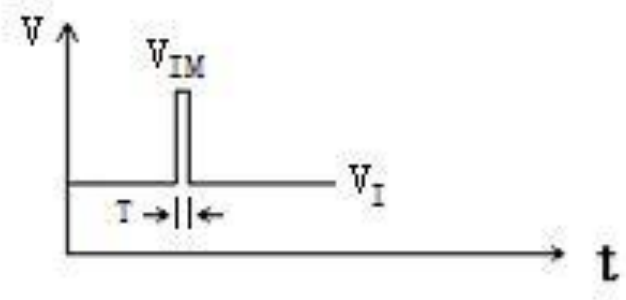


Figure 8. Surge voltage diagram