COSEL

Qualification of DHS50A,100A to Railway applications

(General Standard EN50155)
(Shock and Vibration Standard EN61373)

Contents

1. Purpose

To verify compliance of our product to shock and vibration standard EN61373, parts of general standard EN50155 for electronic equipment used in Railway applications by existing test data and additional test.

2. Scope

The following products which have the input voltage range suited to railway market are as follows.

- DHS50A05
- DHS50A12
- DHS50A15
- DHS50A24
- DHS100A05
- DHS100A12
- DHS100A15
- DHS100A24

3. Qualification to EN 50155

3.1 Visual inspection

No marked damage appears during or after the following test mentioned on this document.

3.2 Performance test

Refer to Performance data for each product on web site.

Address: Cosel HP ▸ Technical Data ▸ Technical data down load
▸ DHS series ▸ Performance data for each product

To continue operation under 10ms interruptions, input electrical capacitor is required.
Example for calculation is shown below.

In case of DHS100A05 75% load,
Pin : Input Power from "Input power(by Load Current) test data" on performance data
V1 : Rated input voltage
V2 : 60V(Minimum operating Input voltage)
T : Interruption time

$$Cin = \frac{2 \times Pin \times T}{V1^2 - V2^2} = \frac{2 \times 90 \times 0.01}{(110^2 - 60^2)} = 210 \ [uF] \ \text{or more}$$

3.3 Cooling test

Refer to Performance data for each product.
Test data at -35 °C is shown on Ambient Temperature Drift and Minimum Input for Regulated Output Voltage test data.

3.4 Dry heat test

Refer to High temp./overload test of Safety test results on appendix 1.
No failure with overload at 85 °C on base plate during 48 hours is confirmed.

The base plate and ambient temperature are different. Therefore the design, in which the base plate temperature is within specification even if ambient temperature goes up, is required.

3.5 Damp heat test, cyclic

Refer to High temp./High humidity bias test of Reliability Test results on appendix 2.
No degradation of electric characteristics after 1000h at 85 °C and 85%Rh is confirmed.

3.6 Supply overvoltages

Refer to High temp./overload test of Safety test results on appendix 1.
No smoke, and no fire at 220Vdc input is confirmed.
Input voltage 154V (rated voltage 110Vdc x 1.4) is within specification.

3.7 Surges, electrostatic discharge and transient burst susceptibility

Refer to EMI/EMS test results on appendix 3.

3.7.1 Surges

By Surge immunity test (EN61000-4-5), no stop, no drop down, no abnormality, and no degradation under condition of Line to Line 2kV, Line to earth 4kV is confirmed.

3.7.2 Electrostatic discharge susceptibility test

By Static electricity immunity test (EN61000-4-2), no function failure under condition of contact discharge 8kV is confirmed.

3.7.3 Transient burst susceptibility test

By Electrical fast transient/burst immunity test(EN61000-4-4), no function failure under condition of 4 kV peak voltage is confirmed.

3.8 Radio interference test

By Radiated, radio-frequency, electromagnetic field immunity test on EMI/EMS test results, no function failure under condition of 10V/m field strength is confirmed.
By Immunity to conducted disturbances, induced by radio - frequency fields test, no function failure under voltage level 10V is confirmed.
Concerning other condition, contact us. The each condition is dealt with.

3.9 Insulation test

By Withstand voltage test on Safety test results, no insulation breakdown, no flashover under condition of 4200Vac and 700Vdc is confirmed.

3.10 Salt mist test

Water proof design is required in order to prevent water infiltration.
Especially be careful when the PCB board under the product, because it is weak.

3.11 Vibration, shock and bump test

Refer to 4. Qualification to EN 61373.

3.12 Water tightness test

Basically not required as equipment inside rolling stock. Water proof design may be required depending on equipment.

4. Qualification to EN 61373

4.1 Shock test

By Impact test on Reliability test results, no degradation of electric characteristics, no crack at solder joint and no marked damage of appearance under condition of 20G(196.1m/s2) one time each X, Y and Z axis is confirmed.

4.2 Vibration test

4.2.1 Test conditions

Vibration condition: 5G(49m/s2) 5-150Hz X, Y, Z axis 5hour/axis
Input Voltage: 140V
Output: No load
Model: ■ DHS100A05 ■ DHS100A12
■ DHS100A15 ■ DHS100A24 each 1 piece
External component: Input rectifier circuit only against 100Vac input

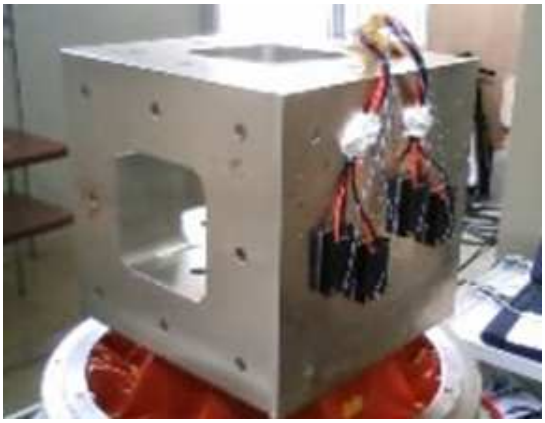


Fig.4.2.1 X axis

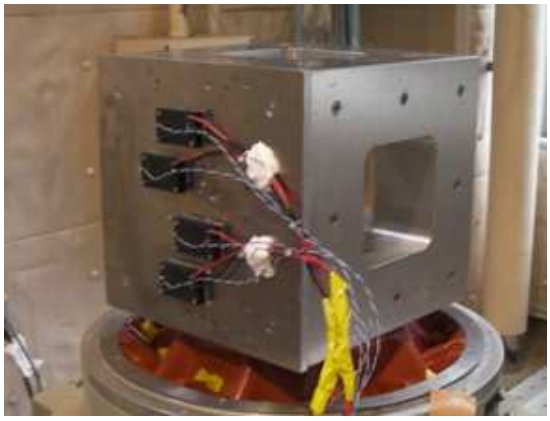


Fig.4.2.2 Y axis

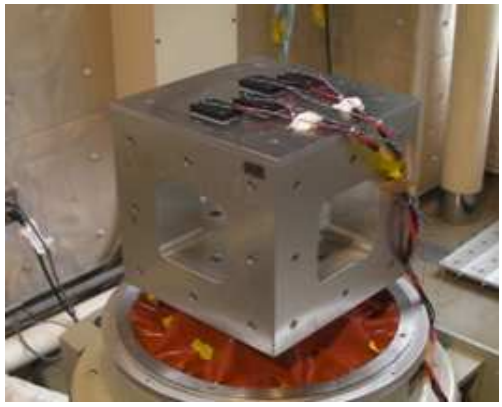


Fig.4.2.3 Z axis

4.2.2 Test result

Table 4.2 Test result

Model	Apparent condition	Output voltage monitoring
DHS100A05	Pass	Pass
DHS100A12	Pass	Pass
DHA100A15	Pass	Pass
DHA100A24	Pass	Pass

No degradation of electric characteristics no marked damage of appearance after test is confirmed. And no interruption of output voltage during and after test is confirmed.

5. External circuit for RIA12 Surge Protection

- The surge protection circuit for Railway application is shown in Fig.5.1.

Fig.5.1
Surge protection circuit

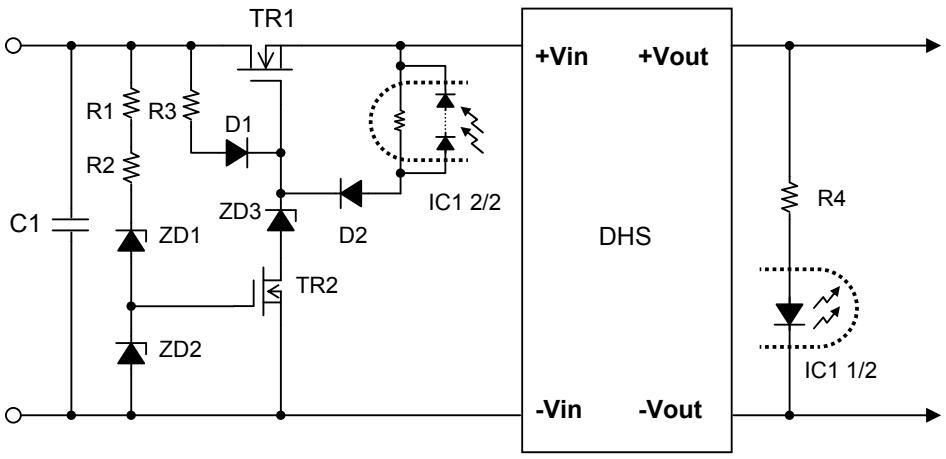
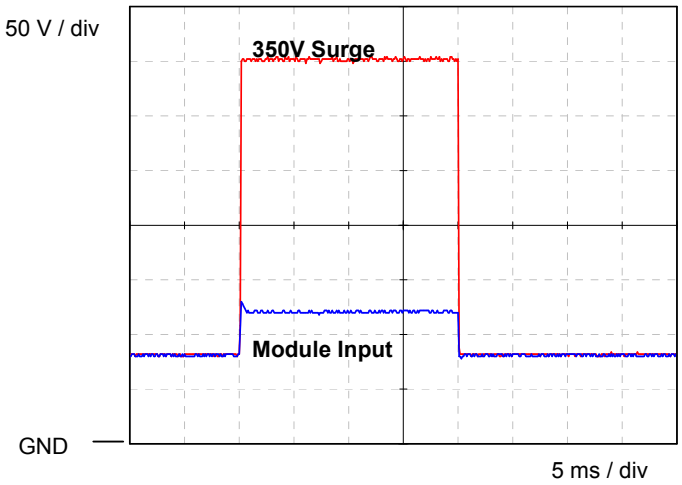


Table 5.1
Example of value

C1	400V, 1μF	ZD1	1/2W, 160V
R1	1/4W, 22kΩ	ZD2	1/4W, 10V
R2	1/4W, 22kΩ	ZD3	1/2W, 160V
R3	1/4W, 33kΩ	IC1	TLP591B (TOSHIBA)
D1	1N4148	TR1	IRFP450
D2	1N4148	TR2	IRFD110
R4	1/4W, (Output voltage / 5) kΩ		

Fig.5.2
Clamped surge voltage



- Input transient surge voltage (20 ms max) is clamped to the module's input range, through the circuit in Fig.5.1.

6. Life sycle by Heat cycle

- Quality design notification. It is necessary to note product lifetime caused by thermal fatigue of solder connection. The thermal fatigue is accelerated by heat cycle (rise/fall in heat) .

  Especially, assumed regular heat cycle need to be minimized rise/fall temperature difference for longer product life time expectancy. please reduce the difference as much as possible when the rise/fall in heat are frequently repeated

  Times of ON/OFF is one of generator to make rise/fall temperature difference. Fig. 6.4 is for your design reference which indicating lifetime expectancy against the difference and times of ON/OFF standardized on base plate temperature.

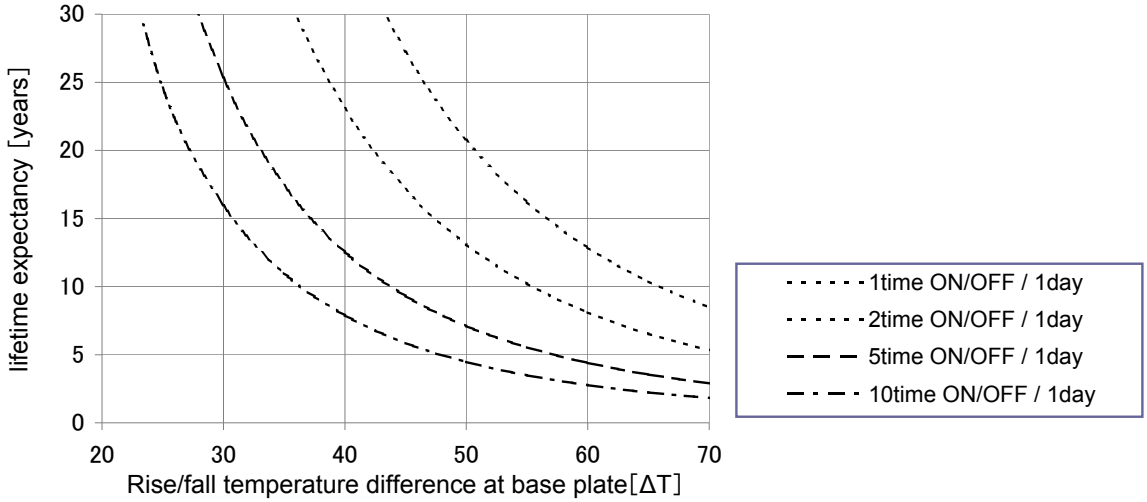


Fig. 6.4 Lifetime expectancy against rise/fall temperature difference

- Fig.6.4 is calculated based on the following conditions.

  Acceleration test : Heat cycle tes -40°C ~ 125°C 30 minutes, 800 cycles
  No degradation of electric characteristics is found.

  Formula : Modified Coffin-Manson Equation

$$= \left(\frac{f_1}{f_2} \right)^{\frac{1}{3}} \times \left(\frac{\Delta T_2}{\Delta T_1} \right)^2 \times e^{\left(1414 \times \left(\frac{1}{T_1 \max} - \frac{1}{T_2 \max} \right) \right)} \times n_2$$

  f : Times of ON/OFF / 1day
  ⊿T : Base plate temperature difference between Ton and Toff (K)
  Tmax : Maximum temperature of base plate
  n : Count of Heat cycles
  1, 2 : Subscription to denote Field and Lab conditions, respectively

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DHS50A,DHS100A Safety test results

April 16, 2010
OS DESIGN DEPT.

Approved Tatsuya Mano
Tatsuya Mano

Prepared: Tetsuro Hirata
Tetsuro Hirata

No.	Test item	Test conditions	Conditions of acceptability	Result
1	High temp./overload test	(1) Input Max.voltage, Min.voltage (2) Overload (3) Baseplate temp. 100℃ (4) Test period 48 hours (5) Testing circuitry Fig.1	(1) Power supply is not failed.	OK
2	Capacitance reduction test	(1) Rated input (DC110V) (2) Rated output (3) Ambient temp. 25±10℃	(1) No smoke, no fire. (2) No rise of the output voltage.	OK
3	high voltage input test	(1) Input (DC220V) (2) Rated output (3) Ambient temp. : 25±10℃ (4) Testing circuitry Fig.1	(1) No smoke, no fire.	
4	Low voltage input test	(1) Input Min. regulation voltage (2) Rated output (3) Baseplate temp. 100℃ (4) Test period 48 hours (5) Testing circuitry Fig.1	(1) Power supply is not failed.	OK
5	Input ON/OFF test	(1) Input : Max.voltage T= 2sec Duty= 50% (2) Output : Rated output (3) Ambient temp. : 25±10℃ (4) On/off period : 1,000 (5) Test circuit : Fig.1	(1)Power supply is not failed. (2)The surge current of each components should not exceed the rated value.	OK
6	Output ON/OFF test	(1) Rated input (DC110V) (2) Output 0%←→100% T= 2sec Duty= 50% (3) Ambient temp. 25±10℃ (4) On/Off period 1,000 (5) Testing circuitry Fig.1	(1) Power supply is not failed.	OK
7	Output-short start test	(1) Rated input (DC110V) (2) Output Short start (3) Ambient temp. 25±10℃ (4) Testing circuitry Fig.1	(1) Power supply is not failed.	OK
8	Output short test	(1) Rated input (DC110V) (2) Output Short (3) Ambient temp. 25±10℃ (4) Test period 48 hours (5) Testing circuitry Fig.1	(1) Power supply is not failed.	OK
9	Withstand voltage test (High-pot test)	(1) Input Not applied. (2) Ambient temp. 25±10℃ (3) The applied voltage is 1.4 times of specifications.	(1) Insulation breakdown ,flashover or electric arc is not occurred.	OK
10	Isolation resistance test	(1) Input Not applied. (2) Ambient temp. 25±10℃	(1) When a regulation voltage is applied, isolation resistance is 1.4 times of specifications.	OK
11	Vibration/impact test	Vibration (1)f=10～55Hz : 49.0m/s² (2)3 minutes period (3)60 minutes along X, Y and Z axis Impact (1)196.1m/s² 11ms (2)Once each X, Y and Z axis	(1) No degradiation of electric characteristics after test. (2) No crack at solder joint. (3) No marked damage of appearance.	OK
12	Line Noise Tolerance test	(1) Input (AC90V) (2) Rated Output (3) Ambient temp. 25±10℃ (4) Test Voltage ±1 kV (5) Pulse width 50～1000nS (6) Mode Normal and Common (7) Testing circuitry Fig.2	(1) No protection circuit failure. (2) No output voltage drop with control circuit failure. (3) No any other function failure.	OK

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●Safety testing circuitry

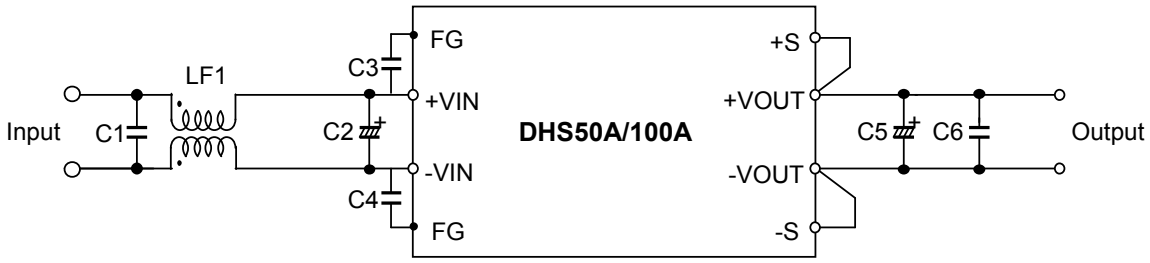

Fig.1 testing circuitry (from No.1 to No.7)

C1 : 0.1uF 250V Ceramic capacitor
C2 : 22uF 250V Electric Capacitor(DHS50A/100A)
C3, C4 : 2200pF 250V Ceramic capacitor
C5 : 2200uF 10V Electric capacitor (DHS50A05/100A05)
: 470uF 35V Electric capacitor(DHS50A12,15/DHS100A12,15)
: 220uF 35V Electric capacitor (DHS50A24/DHS100A24)
C6 : 0.1uF 50V Ceramic capacitor
LF1 : 1mH 3A Common mode Choke Coil

or equivalent.

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DHS50A,DHS100A Reliability Test results

Apr 23, 2010
OS Design DEPT.

Approved : Tatsuya Mano
Tatsuya Mano

Prepared : Tetsuro Hirata
Tetsuro Hirata

No.	Test Item	Testing conditions	Conditions of acceptability	Number of samples	Number of failures
1	Heat cycle test	(1) -40°C ~ 125°C 30minutes each (2) 600cycles	(1)No degradation of electric characteristics after test.	5	0
2	High temperature/ High humidity bias test	(1) Ta=85℃,RH=85% (2) At rated input (3) Load 0% (4) 1000hours	(1)No degradation of electric characteristics after test.	3	0
3	Vibration test	(1) f=10～55Hz,49.0m/s^2(5G) (2) 3minutes period (3) 1hour each X,Y and Z axis	(1)No degradation of electric characteristics after test. (2)No crack at solder joint. (3)No marked damage of appearance.	3	0
4	Impact test	(1) 196.1m/s^2(20G),11ms (2) Once each X,Y and Z axis	(1)No degradation of electric characteristics after test. (2)No crack at solder joint. (3)No marked damage of appearance.	3	0
5	Soldering heat test	(1) 260℃,15seconds (2) Mounting board : t=1.6mm / FR-4	(1)No crack at solder joint. (2)No marked damage of appearance.	1	0
6	Soldering test	(1) Pre-process Vapor agein(100℃/100%),1H Flux treatment (2) Soldering 235℃±5℃,2seconds	(1)Over 95% of dipped part is covered with solder.	1	0
7	Pin strength test immunity test	(1) Weight φ1 pin : 2kg φ2 pin : 4kg (2) Bending angle:90 deg., total 180 deg. (3) 1 cycle	(1)No degration of electric characteristics after test. (2)No broken or bent pin.	5	0
8	Static electricity immunity test	(1) Applied voltage ±8kV (2) At rated input and load	(1)No protection circuit fail. (2)No output voltage drop with control circuit fail. (3)No any other function fail.	1	0

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May 17, 2010
OS DESIGN DEPT.

DHS50A,DHS100A EMI／EMS Test result

Approved : Tatsuya Mano
Tatsuya Mano

Prepared : Tetsuro Hirata
Tetsuro Hirata

No.	Test item	Conditions	Conditions of Acceptability	Result
1	Line conduction	(1) Rated input(DC110V/AC90V) (2) Rated load (3) Ambient temp. 25±10℃ (4) Testing circuitry Fig.1	(1)Meets the undermentioned standard. FCC Part15 classA , VCCI classA CISPR11 classA , EN55011-A	
2	Radiated emission	(1) Rated input(DC110V/AC90V) (2) Rated load (3) Ambient temp. 25±10℃ (4) Testing circuitry Fig.1	(1)Meets the undermentioned standard. FCC Part15 classA , VCCI classA CISPR11 classA , EN55011-A	
3	Static electricity immunity test (EN61000-4-2)	(1) Rated input(DC110V/AC90V) (2) Rated load (3) Ambient temp. 25±10℃ (4) Contact discharge voltage 8[kV] (EN61000-4-2 Level 4) (5) Testing circuitry Fig.1	(1)No protection circuit failure. (2)No output voltage drop with control circuit failure. (3)No any other function failure	
4	Radiated, radio-frequency, electromagnetic field immunity test (EN61000-4-3)	(1) Rated input(DC110V/AC90V) (2) Rated load (3) Ambient temp. 25±10℃ (4)Testing field strength 10[V/m] (EN61000-4-3 Level 3) (5) Testing circuitry Fig.1	(1)No protection circuit failure. (2)No output voltage drop with control circuit failure. (3)No any other function failure	
5	Electrical fast transient/ burst immunity test (EN61000-4-4)	(1) Rated input(DC110V/AC90V) (2) Rated load (3) Ambient temp. 25±10℃ (4) Test peak voltage 4[kV] (IEC61000-4-4 Level 4) (5) Testing circuitry Fig.1	(1)No protection circuit failure. (2)No output voltage drop with control circuit failure. (3)No any other function failure	
6	Surge immunity test (EN61000-4-5)	(1) Rated input(DC110V/AC90V) (2) Rated load (3) Ambient temp. 25±10℃ (4) Test voltage Line to line 2[kV] (Level 3) Line to earth 4[kV] (Level 4) (5) Testing circuitry Fig.2	(1)The power supply is not stop (2)Circuit does not malfunction. (3)No abnormality of the insulation destruction etc. (4)Parts are no damaged.	
7	Immunity to conducted disturbances, induced by radio-frequency fields (EN61000-4-6)	(1) Rated input(DC110V/AC90V) (2) Rated load (3) Ambient temp. 25±10℃ (4) Voltage level (e.m.f.) 10[V] (Level 3) (5) Testing circuitry Fig.1	(1)No protection circuit failure. (2)No output voltage drop with control circuit failure. (3)No any other function failure	

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●EMI/EMS testing circuitry

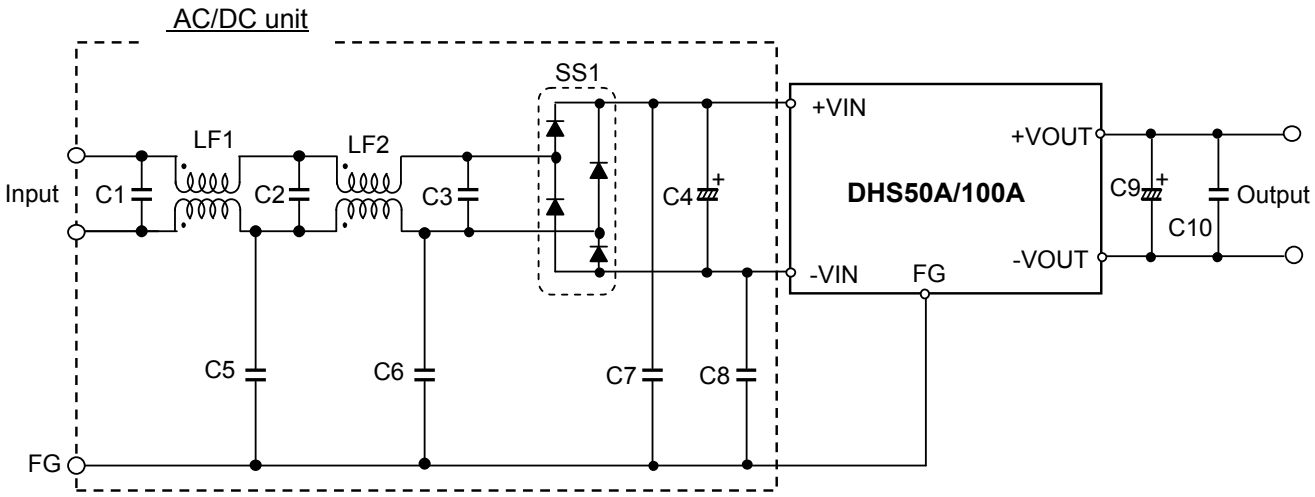

Fig.1 testing circuitry (from No.1 to No.5, No.7)

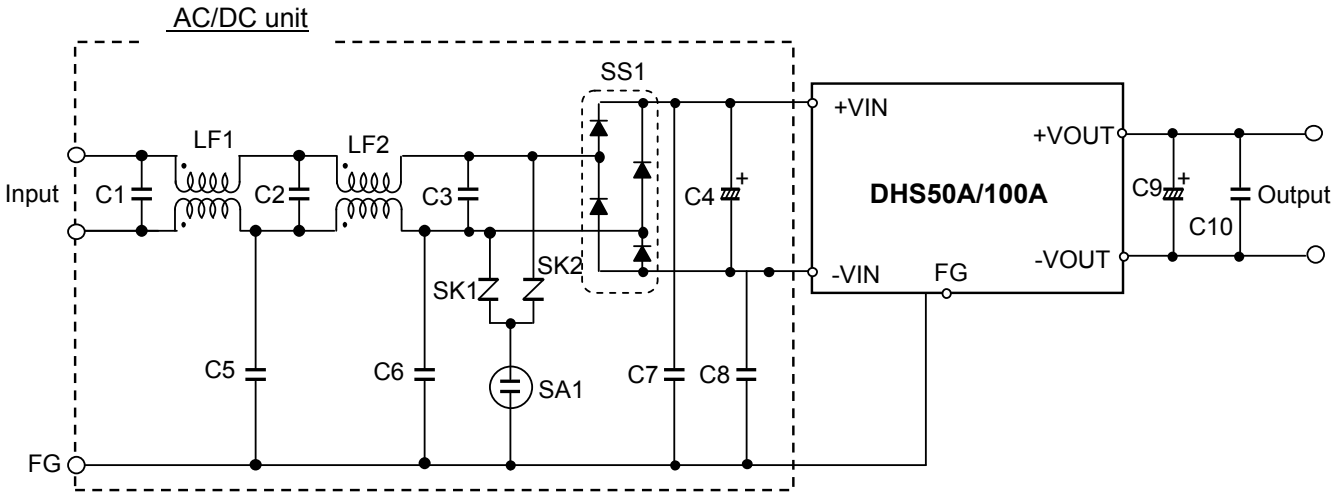

Fig.2 testing circuitry (No.6)

C1, C2, C3	:	0.1uF 250V Ceramic capacitor
C4	:	270uF 250V Electric capacitor
C5, C6, C7, C8	:	2200pF 250V Ceramic capacitor
LF1	:	2mH 5A Common mode Choke Coil
LF2	:	2mH 5A Common mode Choke C
SA1	:	DSA302 (MITSUBISHI MATERIALS CORP.)
SK1, SK2	:	ENE471D-10A(FUJI ELECTRIC CO,. LTD)
SS1	:	4A 600V Bridge diode
C9	:	2200uF 10V Electric capacitor (DHS50A05/DHS100A05)
		: 470uF 35V Electric capacitor(DHS50A12,15/DHS100A12,15)
		: 220uF 35V Electric capacitor (DHS50A24/DHS100A24)
C10	:	10uF 50V Ceramic capacitor(DHS50A05,12,15/DHS100A05,12,15)
		4.7uF 50V Ceramic capacitor(DHS50A24/DHS100A24)

or equivalent.