DRB240-24-1

RELIABILITY DATA

TDK-Lambda

PA635-57-01

INDEX

※ Test results are typical data. Nevertheless the following results are considered to be actual capability data because all units have nearly the same characteristics.

1. Calculated values for MTBF

MODEL : DRB240-24-1

1. Calculation Method

Calculated based on parts stress reliability projection of Tellcordia (*1).
Individual failure rate λ_{ss} is calculated by the electric stress and temperature rise of each device.

*1 : Tellcordia (Bellcore) "Reliability Prediction Procedure for Electronic Equipment".
(Document number TR-332, Issue 5)

$$MTBF = \frac{1}{\lambda_{equip}} = \frac{1}{\sum_{i=1}^{m} N_i \cdot \lambda_{ssi}} \times 10^9 \left(\text{hours}\right)$$

$$\lambda_{ssi} = \lambda_{Gi} \cdot \pi_{Qi} \cdot \pi_{Si} \cdot \pi_{Ti}$$

Where :

λ_{equip}	:	Total equipment failure rate (FITs = Failures in 10^9 hours).
λ_{Gi}	:	Generic failure rate for the ith device.
π_{Qi}	:	Quality factor for the ith device.
π_{Si}	:	Stress factor for the ith device.
π_{Ti}	:	Temperature factor for the ith device.
m	:	Number of different device types.
N_i	:	Quantity of ith device type.
π_E	:	Equipment environmental factor.

2. MTBF Values

Conditions :

Input Voltage	: 230Vac	Output Voltage & Current	: 24VDC, 10A (100%)
Environmental Factor	: GB (Ground, Benign)	Mounting Method	: Mouting A

MTBF (Ta=25°C)	**≈**	**443,841**	**Hours**
MTBF (Ta=40°C)	**≈**	**178,966**	**Hours**

2. Component derating

MODEL : DRB240-24-1

(1) Calculating method

(a) Measuring Conditions

Input	:	115VAC, 230VAC	Ambient temperature	:	55°C
Output	:	24V, 10A (100%)	Mounting method	:	Standard Mounting A

(b) Semiconductors

Compared with maximum junction temperature and actual one which is calculated based on case temperature, power dissipation and thermal impedance.

(c) IC, Resistors, Capacitors, etc.

Ambient temperature, operating condition, power dissipation and so on are within derating criteria.

(d) Calculating Method of Thermal Impedance

$$\theta_{j-c} = \frac{T_{j(max)} - T_c}{P_{c(max)}} \qquad \theta_{j-a} = \frac{T_{j(max)} - T_a}{P_{c(max)}} \qquad \theta_{j-l} = \frac{T_{j(max)} - T_l}{P_{c(max)}}$$

T_c **:** Case temperature at start point of derating ; 25°C in general

T_a **:** Ambient temperature at start point of derating ; 25°C in general

T_l **:** Lead temperature at start point of derating ; 25°C in general

$P_{c(max)}$ ($P_{ch(max)}$) **:** Maximum collector(channel) dissipation

$T_{j(max)}$ ($T_{ch(max)}$) **:** Maximum junction(channel) temperature

(θ_{j-c}) (θ_{ch-c}) **:**Thermal impedance between junction(channel) and case

θ_{j-a} **:**Thermal impedance between junction and air

θ_{j-l} **:**Thermal impedance between junction and lead

(2) Component Derating List

MODEL : DRB240-24-1

Location No.	Vin = 115VAC Load = 100% Ta = 55°C		
Q1, Q2 IPD65R250C6 INFINEON	Tjmax = 150°C, Pd = 2.62W, Tj = Tc + ((θ j-c) × Pd) = 104.47°C D.F. = 69.65%	θ j-c = 0.6°C/W Δ Tc = 47.9°C	Pd(max) = 208.3W Tc = 102.9°C
Q3 IPD60R400CE INFINEON	Tjmax = 150°C, Pd = 0.55W, Tj = Tc + ((θ j-c) × Pd) = 100.82°C D.F. = 67.21%	θ j-c = 1.12°C/W, Δ Tc = 45.2°C,	Pd(max) = 112W Tc = 100.2°C
Q4 IPD60R400CE INFINEON	Tjmax = 150°C, Pd = 0.60W, Tj = Tc + ((θ j-c) × Pd) = 106.37°C D.F. = 70.91%	θ j-c = 1.12°C/W, Δ Tc = 50.7°C,	Pd(max) = 112W Tc = 105.7°C
Q101 2SC2873-Y TOSHIBA	Tjmax = 150°C, Pd = 0.101W, Tj = Tc + ((θ j-c) × Pd) = 114.3°C D.F. = 76.2%	θ j-c =125°C/W Δ Tc = 46.7°C,	Pd(max) = 1W Tc = 101.7°C
Q200 TPH8R80ANH,L1Q(M TOSHIBA	Tjmax = 150°C, Pd = 0.66W, Tj = Tc + ((θ j-c) × Pd) = 96.45°C D.F. = 64.28%	θ j-c = 2.04°C/W Δ Tc = 40.1°C,	Pd(max) = 61W Tc = 95.1°C
Q201 TPH8R80ANH,L1Q(M TOSHIBA	Tjmax = 150°C, Pd = 0.56W, Tj = Tc + ((θ j-c) × Pd) = 97.44°C D.F. = 64.96%	θ j-c = 2.04°C/W Δ Tc = 41.3°C,	Pd(max) = 61W Tc = 96.3°C
D1 GBJ2506 LITE-ON	Tjmax = 150°C, Pd = 3.78W, Tj = Tc + ((θ j-c) × Pd) = 100.6°C D.F. = 67.05%	θ j-c = 0.6°C/W, Δ Tc = 43.3°C,	Tc = 98.3°C
D3, D4 STTH506B-TR ST	Tjmax = 175°C, Pd = 0.74W, Tj = Tc + ((θ j-c) × Pd) = 105°C D.F. = 59.99%	θ j-c = 3.5°C/W Δ Tc = 47.4°C	Tc = 102.4°C
A100 TEA1716T/2,518 NXP	Tjmax = 150°C, Pd = 0.261W, Tj = Tc + ((θ j-a) × Pd) = 122.5°C D.F. = 81.68%	θ j-a = 90°C/W Δ Tc = 44°C	Tc = 99°C
A200 TEA1995T/1J NXP	Tjmax = 150°C, Pd = 0.137W, Tj = Tc + ((θ j-a) × Pd) = 115.3°C D.F. = 76.85%	θ j-a = 140°C/W Δ Tc = 41.1°C,	Tc = 96.4°C
A201 TL431BQDBZR,215 NEXPERIA	Tjmax = 150°C, Pd = 0.010W, Tj = Tc + ((θ j-a) × Pd) = 102°C D.F. = 68%	θ j-a = 360°C/W, Δ Tc = 46.5°C,	Tc = 101.5°C
PC101 TLP385(D4GR-TL,E TOSHIBA	Tjmax = 125°C, Pd = 0.032W, Tj = Tc + ((θ j-c) × Pd) = 98.6°C D.F. = 78.91%	θ j-c = 130°C/W Δ Tc = 39.5°C,	Tc = 94.5°C
PC200 TLP385(D4GR-TL,E TOSHIBA	Tjmax = 125°C, Pd = 0.014W, Tj = Tc + ((θ j-c) × Pd) = 90.8°C D.F. = 72.62%	θ j-c = 130°C/W Δ Tc = 34°C,	Tc = 89°C

(2) Component Derating List

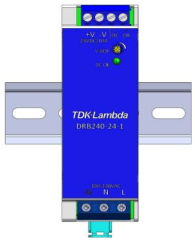
MODEL : DRB240-24-1

Location No.	Vin =230VAC Load = 100% Ta = 55°C		
Q1, Q2 IPD65R250C6 INFINEON	Tjmax = 150°C, Pd = 1.11W, Tj = Tc + ((θ j-c) × Pd) = 88.37°C D.F. = 58.91%	θ j-c = 0.6°C/W Δ Tc = 32.7°C	Pd(max) = 208.3W Tc = 87.7°C
Q3 IPD60R400CE INFINEON	Tjmax = 150°C, Pd = 0.57W, Tj = Tc + ((θ j-c) × Pd) = 94.04°C D.F. = 62.69%	θ j-c = 1.12°C/W, Δ Tc = 38.4°C,	Pd(max) = 112W Tc = 93.4°C
Q4 IPD60R400CE INFINEON	Tjmax = 150°C, Pd = 0.60W, Tj = Tc + ((θ j-c) × Pd) = 99.97°C D.F. = 66.65%	θ j-c = 1.12°C/W, Δ Tc = 44.3°C,	Pd(max) = 112W Tc = 99.3°C
Q101 2SC2873-Y TOSHIBA	Tjmax = 150°C, Pd = 0.101W, Tj = Tc + ((θ j-c) × Pd) = 109.1°C D.F. = 72.73%	θ j-c = 125°C/W Δ Tc = 41.5°C,	Pd(max) = 1W Tc = 96.5°C
Q200 TPH8R80ANH,L1Q(M TOSHIBA	Tjmax = 150°C, Pd = 0.66W, Tj = Tc + ((θ j-c) × Pd) = 90.65°C D.F. = 60.42%	θ j-c = 2.04°C/W Δ Tc = 34.3°C,	Pd(max) = 61W Tc = 89.3°C
Q201 TPH8R80ANH,L1Q(M TOSHIBA	Tjmax = 150°C, Pd = 0.56W, Tj = Tc + ((θ j-c) × Pd) = 91.96°C D.F. = 61.30%	θ j-c = 2.04°C/W Δ Tc = 35.8°C,	Pd(max) = 61W Tc = 90.8°C
D1 GBJ2506 LITE-ON	Tjmax = 150°C, Pd = 1.70W, Tj = Tc + ((θ j-c) × Pd) = 82.8°C D.F. = 55.21%	θ j-c = 0.6°C/W, Δ Tc = 26.8°C,	Tc = 81.8°C
D3, D4 STTH506B-TR ST	Tjmax = 175°C, Pd = 0.78W, Tj = Tc + ((θ j-c) × Pd) = 92.83°C D.F. = 53.05%	θ j-c = 3.5°C/W Δ Tc = 35.1°C	Tc = 90.1°C
A100 TEA1716T/2,518 NXP	Tjmax = 150°C, Pd = 0.255W, Tj = Tc + ((θ j-a) × Pd) = 115.6°C D.F. = 77.06%	θ j-a = 90°C/W Δ Tc = 37.6°C	Tc = 92.6°C
A200 TEA1995T/1J NXP	Tjmax = 150°C, Pd = 0.137W, Tj = Tc + ((θ j-a) × Pd) = 109.9°C D.F. =73.25%	θ j-a = 140°C/W Δ Tc = 35.7°C,	Tc = 90.7°C
A201 TL431BQDBZR,215 NEXPERIA	Tjmax = 150°C, Pd = 0.010W, Tj = Tc + ((θ j-a) × Pd) = 96.9°C D.F. = 64.6%	θ j-a = 360°C/W, Δ Tc = 41.4°C,	Tc = 96.4°C
PC101 TLP385(D4GR-TL,E TOSHIBA	Tjmax = 125°C, Pd = 0.032W, Tj = Tc + ((θ j-c) × Pd) = 89.93°C D.F. = 71.94%	θ j-c = 130°C/W Δ Tc = 33.9°C,	Tc = 88.9°C
PC200 TLP385(D4GR-TL,E TOSHIBA	Tjmax = 125°C, Pd = 0.014W, Tj = Tc + ((θ j-c) × Pd) = 86.2°C D.F. = 68.94 %	θ j-c = 130°C/W Δ Tc = 29.4°C,	Tc = 84.4°C

3. Main components temperature rise ΔT list

MODEL : DRB240-24-1

Condition:

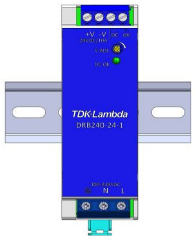
Standard Mounting Method	
Input Voltage (VAC)	115
Output Voltage (VAC)	24
Output Current (A)	10

Output Derating		DT Temperature rise (°C)	
		Io = 100% (Ta = 55°C)	Io = 50% (Ta = 70°C)
Location No	**Parts Name**	**Standard Mounting**	
Q1	MOSFET	47.9	29.6
Q2	MOSFET	45.9	27.2
Q3	MOSFET	45.2	26.4
Q4	MOSFET	50.7	29.1
Q101	MOSFET	46.7	31.3
Q200	MOSFET	40.1	23.2
Q201	MOSFET	41.3	23.2
D1	BRIDGE DIODE	43.3	26.6
D3	DIODE	47.4	28.6
D4	DIODE	45.9	27.7
A100	IC	44.0	29.7
A200	IC	41.1	24.7
A201	IC	46.5	30.0
PC101	OPTO-COUPLER	39.5	25.3
L1	COIL	33.8	19.0
L2	COIL	35.3	21.0
L3	CHOKE COIL	54.1	35.9
T1	TRANSFORMER	54.9	31.7
C10	E.CAP	37.0	25.6
C117	E.CAP	39.1	27.0
C209	E.CAP	26.3	17.5
C210	E.CAP	35.3	21.9
C211	E.CAP	35.9	22.2
C215	E.CAP	31.5	20.2
R8	CHIP RESISTOR	50.3	30.2
RL1	RELAY	35.9	23.9
SA1	VARISTOR	20.6	15.1
CN1	TERMINAL BLOCK	6.3	7.0
CN300	TERMINAL BLOCK	16.7	13.0

3. Main components temperature rise ΔT list

MODEL : DRB240-24-1

Condition:

Standard Mounting Method	
Input Voltage (VAC)	230
Output Voltage (VAC)	24
Output Current (A)	10

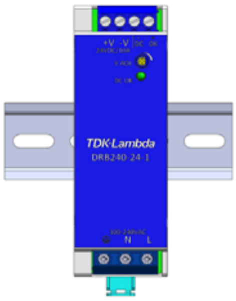
		DT Temperature rise (°C)	
Output Derating		**Io = 100% (Ta = 55°C)**	**Io = 50% (Ta = 70°C)**
Location No	**Parts Name**	**Standard Mounting**	
Q1	MOSFET	32.7	22.3
Q2	MOSFET	32.1	22.3
Q3	MOSFET	38.4	24.8
Q4	MOSFET	44.3	26.7
Q101	MOSFET	41.5	28.9
Q200	MOSFET	34.3	20.9
Q201	MOSFET	35.8	22.5
D1	BRIDGE DIODE	26.8	18.6
D3	DIODE	35.1	24.4
D4	DIODE	34.0	23.7
A100	IC	37.6	27.2
A200	IC	35.7	22.3
A201	IC	41.4	28.6
PC101	OPTO-COUPLER	33.9	22.9
L1	COIL	21.4	14.6
L2	COIL	24.7	17.1
L3	CHOKE COIL	35.4	28.0
T1	TRANSFORMER	50.3	29.3
C10	E.CAP	27.0	22.2
C117	E.CAP	34.6	24.5
C209	E.CAP	20.9	18.1
C210	E.CAP	31.0	19.8
C211	E.CAP	31.5	19.8
C215	E.CAP	26.7	17.8
R8	CHIP RESISTOR	24.7	24.7
RL1	RELAY	34.4	20.8
SA1	VARISTOR	16.4	13.1
CN1	TERMINAL BLOCK	5.1	6.3
CN300	TERMINAL BLOCK	15.1	11.8

4. Electrolytic capacitor lifetime

MODEL : DRB240-24-1

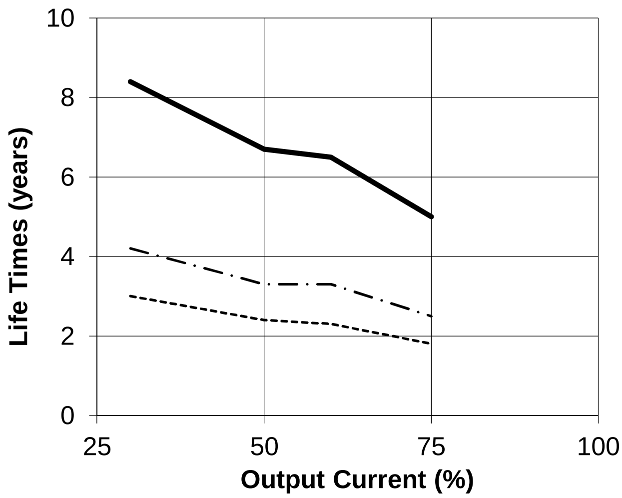
Ta = 40°C
= 50°C
= 55°C

Standard Mounting



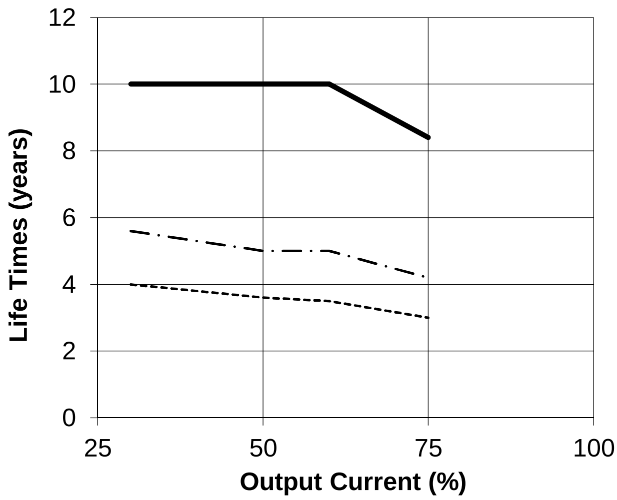
Vin = 115VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 55°C
30	8.4	4.2	3.0
50	6.7	3.3	2.4
60	6.5	3.3	2.3
75	5.0	2.5	1.8



Vin = 230VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 55°C
30	10.0	5.6	4.0
50	10.0	5.0	3.6
60	10.0	5.0	3.5
75	8.4	4.2	3.0



5. Vibration Test

MODEL : DRB240-24-1

(1) Vibration Test Class

Frequency Variable Endurance Test

(2) Equipment Used

<u>Outside Lab Test</u>
Jiangsu Electronic Information Product Quality Supervision & Inspection intitute
Address: No. 100 Jinshu Road, Wuxi Jiangsu P. R. China

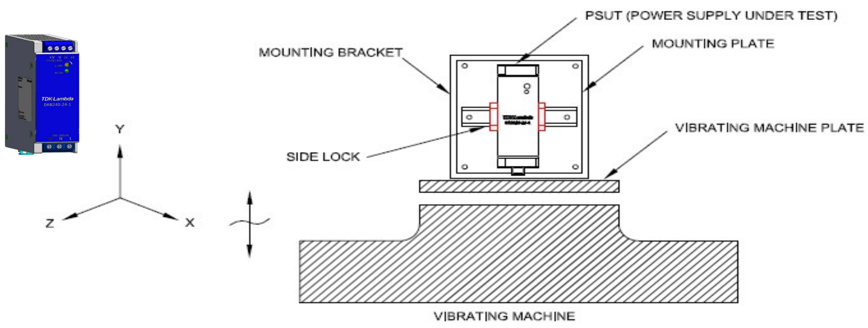
(3) The Number Of D.U.T. (Device Under Test)

1 Unit

(4) Test Conditions

Sweep Frequency	:	10 - 55Hz	Direction	:	X, Y, Z
Sweep Time	:	1 minute	Test Time	:	1 hour each axis
Acceleration	:	2.2G	Non-operation		
Mounting	:	Standard Mounting			

(5) Test Method



Fix the PSUT on the mounting rail with stopper on each corner.
Standard mounting position as per picture above.

(6) Acceptable condition

1. Not broken
2. No abnormal output after test.

(7) Test Results

PASS

6. Abnormal test

MODEL : DRB240-24-1

(1) Test Condition and Circuit

Input Voltage: 230Vac   Output: 24V, 10A   Ta : 25°C , 70%RH

(2) Test Results

(Da: Damaged)

No.	Test Position: LOCATION	Test Position: TEST POINT	Test Mode: SHORT	Test Mode: OPEN	Test Results: 1 FIRE	2 SMOKE	3 BURST	4 SMELL	5 RED HOT	6 DAMAGE	7 FUSE BLOW	8 O.V.P.	9 O.C.P.	10 NO OUTPUT	11 NO CHANGE	12 OTHERS	NOTE
1	Q1	D-S	○							○	○			○			Da : F1, A100
		D-G	○							○	○			○			Da : F1, Q1, A100
		G-S	○													○	Pin increase
		D		○												○	Pin increase
		S		○												○	Pin increase
		G		○												○	Pin increase
2	Q3	D-S	○							○				○			Da : Q4, A100
		D-G	○							○	○			○			Da : F1, Q3, Q4, A100
		G-S	○											○			Unit shutdown
		D		○										○			Unit shutdown
		S		○										○			Unit shutdown
		G		○						○				○			Da : Q3, Q4, A100
3	Q4	D-S	○							○				○			Da : Q3, A100
		D-G	○							○				○			Da : A100
		G-S	○											○			Unit shutdown
		D		○										○			Unit shutdown
		S		○										○			Unit shutdown
		G		○						○				○			Da : Q3, Q4, A100
4	Q200	D-S	○													○	Unit hiccup
		D-G	○							○				○			Da : Q200
		G-S	○												○		Pin increase
		D		○											○		Unit still operating
		S		○											○		Unit still operating
		G		○						○				○			Da : Q200
5	Q201	D-S	○													○	Unit hiccup
		D-G	○							○				○			Da : Q201
		G-S	○												○		Pin increase
		D		○											○		Unit still operating
		S		○											○		Unit still operating
		G		○						○				○			Da : Q201

No.	Test Position: LOCATION	Test Position: TEST POINT	Test Mode: SHORT	Test Mode: OPEN	Test Results: 1 FIRE	2 SMOKE	3 BURST	4 SMELL	5 RED HOT	6 DAMAGE	7 FUSE BLOW	8 O.V.P.	9 O.C.P.	10 NO OUTPUT	11 NO CHANGE	12 OTHERS	NOTE
6	D1	1-2	○								○			○			Da : F1
		2-3	○								○			○			Da : F1
		3-4	○								○			○			Da : F1
		1		○										○			Unit shutdown
		2		○										○			Unit shutdown
		3		○										○			Unit shutdown
		4		○										○			Unit shutdown
7	D3	A-K	○							○	○			○			Da: F1, Q1, Q2
		A-K		○											○		Pin increase
8	D200	A-K	○													○	Unit hiccup
		A-K		○												○	Pin increase
9	C10		○							○	○						Da : F1
				○						○	○						Da : F1, Q1, Q2
10	C17		○							○	○			○			Da : F1, Q3, A100
				○												○	Unit hiccup.
11	C117		○							○							Da: A100, TFR1, Q1, Q2
				○											○		
12	C210		○										○	○			
				○											○		Ripple and Noise increase
13	PC101	1-3	○													○	Unit hiccup
		6-4	○													○	Unit hiccup
		1		○								○		○			No feedback
		3		○								○		○			No feedback
		6		○								○		○			No feedback
		4		○								○		○			No feedback
14	T1	1-2	○													○	Unit hiccup
		4-7	○													○	Unit hiccup
		11-14	○												○		
		17-19	○													○	Unit hiccup
		19-18	○													○	Unit hiccup
		1		○												○	Unit hiccup
		2		○												○	Unit hiccup
		7		○						○	○			○			Da : F1, Q1, Q2, Q3, Q4, A100
		4		○						○	○			○			Da : F1, Q1, Q2, Q3, Q4, A100
		11		○											○		
		14		○											○		
		17		○												○	Unit hiccup
		18		○										○			
		19		○										○			

7. Thermal shock test

MODEL : DRB240-24-1

(1) Equipment used

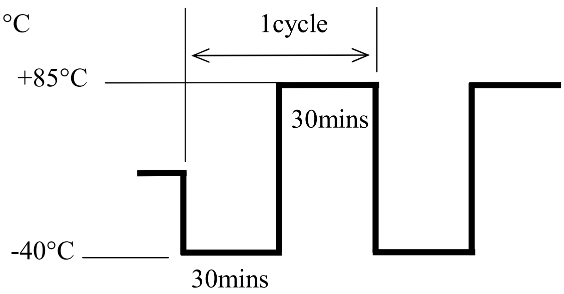
Thermal shock chamber (ESPEC CORP.)

(2) The number of PSUT. (Power Supply Under Test)

1 unit

(3) Test Conditions

- Ambient temperature : -40°C ⟷ +85°C
- Test time : 30 min each temp.
- Test cycle : 759 cycles
- Operating : No operating



(4) Test Method

Before the test, check if there is no abnormal output and put the PSUT in the testing chamber. Then test it in above cycles. After the test is completed, leave it for 1 hour at the room temperature and check to make sure that there is no abnormal output.

(5) Acceptable Condition

1. No abnormal output after the test
2. No solder crack more than half of it's circumference.
   For SMD, presence of solder crack but not longer than half of the electrode width.

(6) Test Results

PASS