DRF120-24-1

RELIABLITY DATA

DWG. No. PA618-57-01		
APPD	CHK	DWG
28/10/14		25/Jul/14

TDK-Lambda

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.

Calculated values for MTBF

MODEL : DRF120-24-1

1. Calculating Method

Calculated based on part count reliability projection of JEITA (RCR-9102B).
Individual failure rates l_G is given to each part and MTBF is calculated by the count of each

Formula :

$$MTBF = \frac{1}{\lambda equip} = \frac{1}{\sum_{i=1}^{n} Ni\,(\lambda_G \pi_Q)_i} \times 10^6 \text{ (HOURS)}$$

where :

$\lambda equip$ = Total Equipment Failure Rate (Failure / 106 Hours)

λ_G = Generic Failure Rate For The ith Generic Part (Failure / 106 Hours)

Ni = Quantity of ith Generic Part

n = Number of Different Generic Part Categories

π_Q = Generic Quality Factor for the ith Generic Part (π_Q = 1)

2. MTBF Values

G_F : (GROUND, FIXED)

MTBF 140,001 (Hours)

2. Component derating

MODEL : DRF120-24-1

(1) Calculating method

(a) Measuring Conditions

Input	:	115 , 230VAC	□ Ambient temperature	:	60°C
Output	:	24V 5A (100%)	Mounting method	:	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_j : 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 : DRF120-24-1

Location No.	Vin = 115VAC	Load = 100%	Ta = 60°C
Q11 IPW50R250CP INFINEON	Tjmax = 150°C, Pd = 1.937W, Tj = Tc + ((θ j-c) × Pd) = 88.63°C D.F. = 59.09%	θ j-c = 1.1°C/W Δ Tc = 26.5°C	Pch(max) = 114W Tc = 86.5°C
Q101 SPA11N80C3 INFINEON	Tjmax = 150°C, Pd = 3.326W, Tj = Tc + ((θ j-c) × Pd) = 104.61°C D.F. = 69.74%	θ j-c = 3.7°C/W Δ Tc = 32.3°C,	Pch(max) = 41W Tc = 92.3°C
Q201 IPP111N15N3 INFINEON	Tjmax = 175°C, Pd = 1.485W, Tj = Tc + ((θ j-c) × Pd) = 118.3°C D.F. = 67.6%	θj-c = 0.7°C/W, Δ Tc = 57.3°C,	Pd(max) = 214W Tc = 117.3°C
D11 RS1005M RECTRON	Tjmax = 150°C, Pd = 2.64W, Tj = Tc + ((θ j-c) × Pd) = 98.34°C D.F. = 65.56%	θ j-c = 1°C/W Δ Tc = 35.7°C	Tc = 95.7°C
D12 CRF02(TE85L,Q) TOSHIBA	Tjmax = 150°C, Pd = 0.00015W, Tj = Tc + ((θ j-c) × Pd) = 82.70°C D.F. = 55.13%	θ j-c = 20°C/W Δ Tc = 22.7°C	Tc = 82.7°C
D13 CRF02(TE85L,Q) TOSHIBA	Tjmax = 150°C, Pd = 0.00015W, Tj = Tc + ((θ j-c) × Pd) = 82.70°C D.F. = 55.13%	θ j-c = 20°C/W Δ Tc = 22.7°C	Tc = 82.7°C
D15 BYC8-600,127 NXP	Tjmax = 150°C, Pd = 2.516W, Tj = Tc + ((θ j-c) × Pd) = 91.44°C D.F. = 60.96%	θ j-c = 2.2°C/W Δ Tc = 25.9°C	Tc = 85.9°C
D402 CRF02(TE85L,Q) TOSHIBA	Tjmax = 150°C, Pd = 0.078W, Tj = Tl + ((θ j-l) × Pd) = 93.16°C D.F. = 62.11%	θ j-l = 20°C/W, Δ Tl = 31.6°C,	Tl = 91.6°C
D404 CRH01(TE85L,Q) TOSHIBA	Tjmax = 150°C, Pd = 0.19W, Tj = Ta + ((θ j-a) × Pd) = 96.15°C D.F. = 64.1%	θ j-a = 65°C/W Δ Ta = 23.8°C	Ta = 83.8°C

(2) Component Derating List

MODEL : DRF120-24-1

Location No.	Vin = 115VAC	Load = 100%	Ta = 60°C
PC201 PS2861B-1Y-F3-A(L) RENESAS	Tjmax = 125°C, Pd = 0.0031W, Tj = Tc + ((θ j-c) × Pd) = 84.67°C D.F. = 67.74%	θ j-a = 150°C/W Δ Tc = 24.2°C,	Pd(max) = 0.15W Tc = 84.2°C
PC202 PS2861B-1Y-F3-A(L) RENESAS	Tjmax = 125°C, Pd = 0W, Tj = Tc + ((θ j-c) × Pd) = 87°C D.F. = 69.6%	θ j-a = 150°C/W Δ Tc = 27.0°C	Pd(max) = 0.15W Tc = 87.0°C
PC401 PS2861B-1Y-F3-A(L) RENESAS	Tjmax = 125°C, Pd = 0.006W, Tj = Tc + ((θ j-c) × Pd) = 88.0°C D.F. = 70.4%	θ j-a = 150°C/W Δ Tc = 27.1°C	Pd(max) = 0.15W Tc = 87.1°C
A11 ICE2PCS03G INFINEON	Tjmax = 150°C, Pd = 0.0538W, Tj = Tc + ((θ j-c) × Pd) = 97.95°C D.F. = 65.3%	θj-a = 185°C/W, ΔTc = 28°C,	Pd(max) = 0.67W Tc = 88.0°C
A101 ICE2QS03G INFINEON	Tjmax = 150°C, Pd = 0.03519W, Tj = Tc + ((θ j-c) × Pd) = 95.16°C D.F. = 63.44%	θ j-c = 50°C/W, Δ Tc = 33.4°C,	Pc(max) = 2.5W Tc = 93.4°C
A201 TEA1792AT/1,118 NXP	Tjmax = 150°C, Pd = 0.15W, Tj = Tc + ((θ j-c) × Pd) = 114.95°C D.F. = 76.63%	θ j-c = 95°C/W, Δ Tc = 40.7°C,	Pc(max) = 1.3W Tc = 100.7°C
A402 ICE3B0565JG INFINEON	Tjmax = 150°C, Pd = 0.413W, Tj = Tc + ((θ j-c) × Pd) = 101.51°C D.F. = 67.67%	θ j-c = 24°C/W Δ Tc = 31.6°C	Pc(max) = 5.2W Tc = 91.6°C

(2) Component Derating List

MODEL : DRF120-24-1

Location No.	Vin = 230VAC	Load = 100%	Ta = 60°C
Q11 IPW50R250CP INFINEON	Tjmax = 150°C, Pd = 0.90W, Tj = Tc + ((θ j-c) × Pd) = 77.99°C D.F. = 51.99%	θ j-c = 1.1°C/W Δ Tc = 17.0°C	Pch(max) = 114W Tc = 77.0°C
Q101 SPA11N80C3 INFINEON	Tjmax = 150°C, Pd = 3.326W, Tj = Tc + ((θ j-c) × Pd) = 98.51°C D.F. = 65.67%	θ j-c = 3.7°C/W Δ Tc = 26.2°C,	Pch(max) = 41W Tc = 86.2°C
Q201 IPP111N15N3 INFINEON	Tjmax = 175°C, Pd = 1.485W, Tj = Tc + ((θ j-c) × Pd) = 112.24°C D.F. = 64.14%	θj-c = 0.7°C/W, Δ Tc = 51.2°C,	Pd(max) = 214W Tc = 111.2°C
D11 RS1005M RECTRON	Tjmax = 150°C, Pd = 1.34W, Tj = Tc + ((θ j-c) × Pd) = 81.74°C D.F. = 54.49%	θ j-c = 1°C/W Δ Tc = 20.4°C	Tc = 80.4°C
D12 CRF02(TE85L,Q) TOSHIBA	Tjmax = 150°C, Pd = 0.00031W, Tj = Tc + ((θ j-c) × Pd) = 80.71°C D.F. = 53.81%	θ j-c = 20°C/W Δ Tc = 20.7°C	Tc = 80.7°C
D13 CRF02(TE85L,Q) TOSHIBA	Tjmax = 150°C, Pd = 0.00031W, Tj = Tc + ((θ j-c) × Pd) = 80.71°C D.F. = 53.81%	θ j-c = 20°C/W Δ Tc = 20.7°C	Tc = 80.7°C
D15 BYC8-600,127 NXP	Tjmax = 150°C, Pd = 1.79W, Tj = Tc + ((θ j-c) × Pd) = 83.24°C D.F. = 55.49%	θ j-c = 2.2°C/W ΔTc = 19.3°C	Tc = 79.3°C
D402 CRF02(TE85L,Q) TOSHIBA	Tjmax = 150°C, Pd = 0.078W, Tj = Tl + ((θ j-l) × Pd) = 86.66°C D.F. = 57.78%	θ j-l = 20°C/W, ΔT1 = 25.1°C	Tl = 85.1°C
D404 CRH01(TE85L,Q) TOSHIBA	Tjmax = 150°C, Pd = 0.19W, Tj = Ta + ((θ j-a) × Pd) = 95.21°C D.F. = 63.47%	θ j-a = 65°C/W ΔTa = 35.2°C	Ta = 95.2°C

(2) Component Derating List

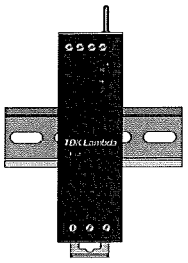
MODEL : DRF120-24-1

Location No.	Vin = 230VAC	Load = 100%	Ta = 60°C
PC201 PS2861B-1Y-F3-A(L) RENESAS	Tjmax = 125°C, Pd = 0.00484W, Tj = Tc + ((θ j-c) × Pd) = 79.27°C D.F. = 63.42%	θ j-a = 150°C/W Δ Tc = 18.8°C,	Pd(max) = 0.15W Tc = 78.8°C
PC202 PS2861B-1Y-F3-A(L) RENESAS	Tjmax = 125°C, Pd = 0W, Tj = Tc + ((θ j-c) × Pd) = 81.7°C D.F. = 65.54%	θ j-a = 150°C/W ΔTc = 21.7°C	Pd(max) = 0.15W Tc = 81.7°C
PC401 PS2861B-1Y-F3-A(L) RENESAS	Tjmax = 125°C, Pd = 0.006W, Tj = Tc + ((θ j-c) × Pd) = 82.6°C D.F. = 66.08%	θ j-a = 150°C/W ΔTc = 21.7°C	Pd(max) = 0.15W Tc = 81.7°C
A11 ICE2PCS03G INFINEON	Tjmax = 150°C, Pd = 0.0538W, Tj = Tc + ((θ j-c) × Pd) = 90.15°C D.F. = 60.1%	θj-a = 185°C/W, ΔTc = 20.2°C,	Pd(max) = 0.67W Tc = 80.2°C
A101 ICE2QS03G INFINEON	Tjmax = 150°C, Pd = 0.03519W, Tj = Tc + ((θ j-c) × Pd) = 89.16°C D.F. = 59.44%	θ j-c = 50°C/W, Δ Tc = 27.4°C,	Pc(max) = 2.5W Tc = 87.4°C
A201 TEA1792AT/1,118 NXP	Tjmax = 150°C, Pd = 0.15W, Tj = Tc + ((θ j-c) × Pd) = 109.45°C D.F. = 72.97%	θ j-c = 95°C/W, Δ Tc = 35.2°C,	Pc(max) = 1.3W Tc = 95.2°C
A402 ICE3B0565JG INFINEON	Tjmax = 150°C, Pd = 0.413W, Tj = Tc + ((θ j-c) × Pd) = 95.01°C D.F. = 63.34%	θ j-c = 24°C/W Δ Tc = 25.1°C	Pc(max) = 5.2W Tc = 85.1°C

3. Main components temperature rise ΔT list

MODEL : DRF120-24-1

Condition:

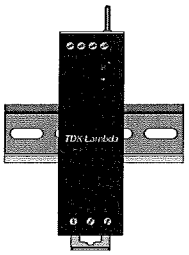
Standard Mounting Mounting Method (A)	
Input Voltage (VAC)	115
Output Voltage (VAC)	24
Output Current (A)	5

Output Derating		ΔT Temperature rise (°C)	
		Io = 100% (Ta = 60°C)	Io = 75% (Ta = 70°C)
Location No	Parts Name	Mounting (A)	Mounting (A)
L11	BALUN COIL	31.0	18.1
L12	BALUN COIL	27.0	16.5
L13	CHOKE COIL	33.5	24.4
T101	TRANS. PULSE	48.3	32.8
T401	TRANS. PULSE	24.7	16.5
D11	BRIDGE DIODE	35.7	24.6
D15	DIODE	25.9	15.1
Q11	MOS FET	26.5	15.4
Q101	MOS FET	32.3	19.2
Q201	MOS FET	57.3	38.2
A11	CHIP IC	28.0	20.1
A101	CHIP IC	33.4	22.7
A201	CHIP IC	40.7	28.4
A205	CHIP IC	22.8	13.9
A402	CHIP IC	31.6	23.2
PC201	CHIP OPTO COUPLER	24.2	15.0
PC202	CHIP OPTO COUPLER	27.0	16.7
PC401	CHIP OPTO COUPLER	27.1	17.1
C21	E. CAP	27.5	17.1
C201	E. CAP	25.4	15.2
C207	E. CAP	34.9	22.1
C208	E. CAP	31.2	19.9
C209	E. CAP	34.2	21.7
C412	E. CAP	25.6	16.2
C416	E. CAP	28.2	18.6

3. Main components temperature rise ΔT list

MODEL : DRF120-24-1

Condition:

Standard Mounting Mounting Method (A)	
Input Voltage (VAC)	230
Output Voltage (VAC)	24
Output Current (A)	5

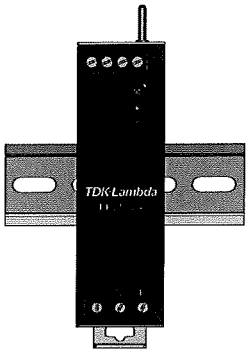
Output Derating		ΔT Temperature rise (°C)	
		Io = 100% (Ta = 60°C)	Io = 75% (Ta = 70°C)
Location No	Parts Name	Mounting (A)	Mounting (A)
L11	BALUN COIL	15.3	9.5
L12	BALUN COIL	12.8	7.8
L13	CHOKE COIL	21.9	16.6
T101	TRANS. PULSE	42.7	30.4
T401	TRANS. PULSE	18.4	13.1
D11	BRIDGE DIODE	20.4	13.4
D15	DIODE	19.3	11.6
Q11	MOS FET	17.0	10.1
Q101	MOS FET	26.2	16.3
Q201	MOS FET	51.2	35.6
A11	CHIP IC	20.2	15.1
A101	CHIP IC	27.4	19.7
A201	CHIP IC	35.2	25.8
A205	CHIP IC	17.6	11.6
A402	CHIP IC	25.1	19.4
PC201	CHIP OPTO COUPLER	18.8	12.4
PC202	CHIP OPTO COUPLER	21.7	14.3
PC401	CHIP OPTO COUPLER	21.7	14.6
C21	E. CAP	20.8	13.9
C201	E. CAP	19.3	12.1
C207	E. CAP	28.8	19.3
C208	E. CAP	25.0	16.9
C209	E. CAP	28.3	19.0
C412	E. CAP	19.5	13.1
C416	E. CAP	20.0	13.9

4. Electrolytic capacitor lifetime

MODEL : DRF120-24-1

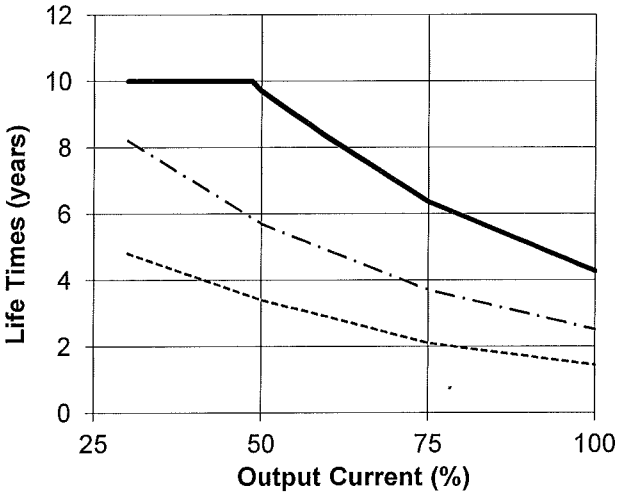
Ta = 40°C
= 50°C
= 60°C

Standard Mounting



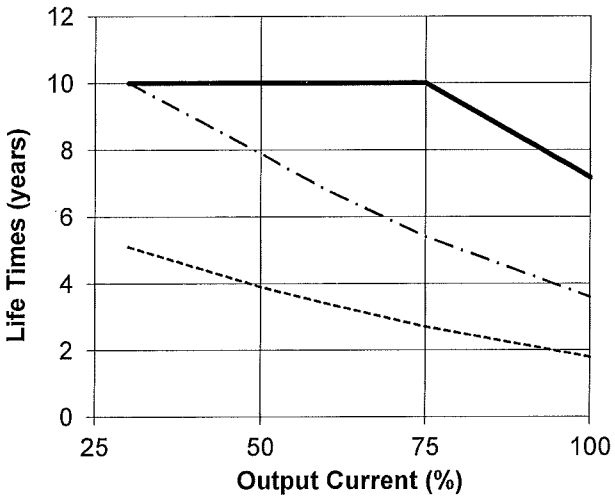
Vin = 115VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 60°C
30	10.0	8.2	4.8
50	9.7	5.7	3.4
60	8.3	4.9	2.9
75	6.4	3.7	2.1
100	4.3	2.5	1.4



Vin = 230VAC

Load (%)	Life Time (years)		
	Ta = 40°C	Ta = 50°C	Ta = 60°C
30	10.0	10.0	5.1
50	10.0	7.9	3.9
60	10.0	6.8	3.4
75	10.0	5.4	2.7
100	7.2	3.6	1.8



Note : E-cap life calculation is based on 24hrs/day operation.

5. Vibration Test

MODEL : DRF120-24-1

(1) Vibration Test Class

Frequency Variable Endurance Test

(2) Equipment Used

Controller	:	Laser USB (DACTRON) SN: 7184823
Vibrator	:	LDS V8-440 (Ling Dynamics)
Accelerometer	:	3255A4 (Dytran) SN: 11125

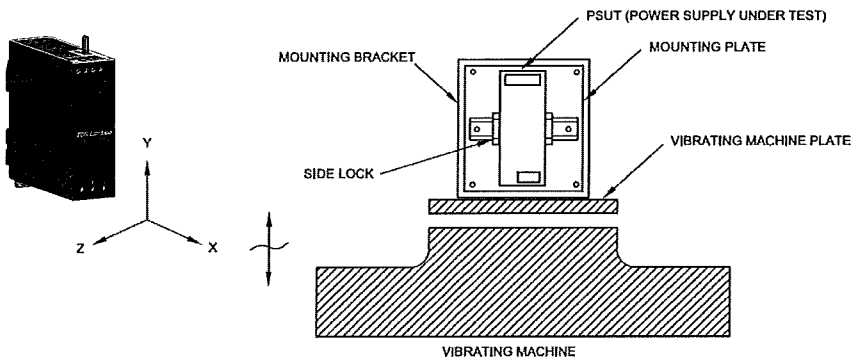
(3) The Number Of D.U.T. (Device Under Test)

1 Unit

(4) Test Conditions

Sweep Frequency	:	10 - 55Hz	Direction	:	X, Y, Z
Sweep Time	:	1 minute	Test Time	:	1.5 hour each axis
Acceleration	:	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) Test results - OK

6. Abnormal test

MODEL : DRF120-24-1

(1) Test Condition and Circuit

Input Voltage: 230Vac Output: 24V 5A Ta : 25°C , 70%RH

(2) Test Results

(Da: Damaged)

No.	Test Position		Test Mode		Test Results												
					1	2	3	4	5	6	7	8	9	10	11	12	
	LOCATION	TEST POINT	SHORT	OPEN	FIRE	SMOKE	BURST	SMELL	RED HOT	DAMAGE	FUSE BLOW	O.V.P.	O.C.P.	NO OUTPUT	NO CHANGE	OTHERS	NOTE
1	Q11	G-D	○							○	○			○			Da:F11,Q11
		G-S	○													○	increase input current
		D-S	○								○			○			Da:F11
		G		○						○	○			○			Da:F11,Q11
		D		○												○	increase input current
		S		○												○	increase input current
2	Q101	G-D	○							○	○			○			Da : F11,Z102, R108,109,110 Q101,A101
		G-S	○											○			
		D-S	○							○	○			○			Da : F11,Z102, R108,109,110 Q101
		G		○										○			
		D		○										○			
		S		○										○			
3	Q201	G-D	○											○			
		G-S	○													○	increase input power
		D-S	○										○	○			
		G		○							○			○			Da:Q201
		D		○										○			
		S		○										○			
4	D11	1-2	○								○			○			
		2-3	○								○			○			
		3-4	○								○			○			
		1		○										○			
		2		○										○			
		3		○										○			
		4		○										○			
5	D12	A-K	○								○			○			Da : F11, D13
		A-K		○											○		
6	D13	A-K	○								○			○			Da : F11, D12
		A-K		○											○		
7	D15	A-K	○							○	○			○			Da: Q11
		A-K		○						○	○			○			Da: Q11
8	D402	A-K	○											○			
		A-K		○												○	
9	D404	A-K	○											○			
		A-K		○										○			

No.	Test Position		Test Mode		Test Results												
	LOCATION	TEST POINT	SHORT	OPEN	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
10	PC201	1-2	○									○		○			
		3-4	○											○			
		1		○								○		○			
		2		○								○		○			
		3		○								○		○			
		4		○								○		○			
11	PC202	1-2	○													○	
		3-4	○									○		○			
		1		○												○	
		2		○												○	
		3		○												○	
		4		○												○	
12	PC401	1-2	○											○			
		3-4	○													○	CNT on/off cant operate
		1		○										○			
		2		○										○			
		3		○										○			
		4		○										○			
13	A11	1-2	○							○	○			○			Da:Q11
		2-3	○							○	○			○			Da:Q11
		3-4	○													○	
		5-6	○													○	
		6-7	○							○				○			Da:A11
		7-8	○											○			
		VCC-GND	○													○	
		1		○						○	○			○			Da:Q11
		2		○												○	
		3		○						○	○			○			Da:Q11
		4		○										○			
		5		○						○	○			○			Da:Q11
		6		○										○			
		7		○												○	
		8		○												○	
14	A101	1-2	○											○			latch
		2-3	○											○			latch
		3-4	○											○			latch
		5-6	○												○		
		6-7	○												○		
		7-8	○											○			
		VCC-GND	○											○			
		1		○										○			latch
		2		○										○			latch
		3		○										○			latch
		4		○										○			
		5		○										○			
		6		○											○		
		7		○												○	Hiccup
		8		○										○			latch

No.	Test Position		Test Mode		Test Results												
	LOCATION	TEST POINT	SHORT	OPEN	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
15	A201	1-2	○													○	increase input power
		2-3	○												○		
		3-4	○												○		
		5-6	○												○		
		6-7	○												○		
		7-8	○												○		
		VCC-GND	○											○			
		1		○												○	increase input power
		2		○											○		
		3		○											○		
		4		○						○				○			Da:Q201
		5		○											○		
		6		○											○		
		7		○											○		
		8		○												○	increase input power
16	A402	1-2	○												○		
		2-3	○												○		
		3-4	○											○			
		4-5	○							○				○			Da:A402,R409
		5-6	○												○		
		7-8	○												○		
		8-9	○												○		
17	A402	9-10	○												○		
		10-11	○												○		
		11-12	○											○			
		1		○											○		
		2		○										○			
		3		○										○		○	Hiccup
		4		○										○			
		5		○											○		
		6		○											○		
		7		○											○		
		8		○											○		
		9		○											○		
		10		○											○		
		11		○										○			
		12		○											○		

7. Thermal shock test

MODEL : DRF120-24-1

(1) Equipment used

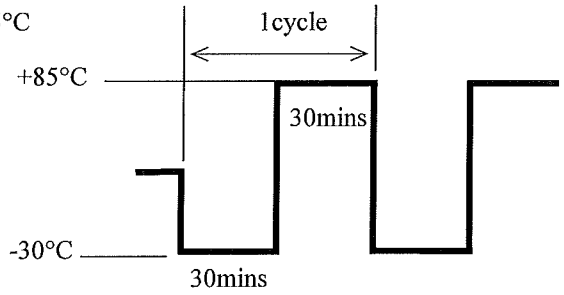
Thermal shock chamber TSA-71S-A (ESPEC CORP.)

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

1 unit

(3) Test Conditions

- Ambient temperature : -30°C ⟷ +85°C
- Test time : 30min. ~ 30min.
- Test cycle : 100 cycles
- Not 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) Test Results **OK**