DLP240-24-1

RELIABILITY DATA

DWG No. CA736-57-01			
QA APPD	APPD	CHK	DWG
T.Murayama 4/Jun/03	30.May.2003	14/May/03	14/May/03

I N D E X

※ The above data is typical value. As all units have nearly the same characteristics, the data to be considered as ability value.

1. CALCULATED VALUES OF MTBF

MODEL : DLP240-24-1

(1) Calculating method

Calculated based on part count reliability projection of JEITA (RCR-9102).

Individual failure rates λ_G is given to each part and MTBF is calculated by the count of each part.

<Formula> :

$$\mathrm{MTBF} = \frac{1}{\lambda_{equip}} = \frac{1}{\sum_{i=1}^{n} N_i(\lambda_G \pi_Q)_i} \times 10^6 \text{ (Hours)}$$

λ_{equip} : Total Equipment Failure Rate (Failure/10^6 Hours)

λ_G : Generic Failure Rate for The ith Generic Part (Failure/10^6 Hours)

N_i : 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 = 338,446 (Hours)

2. COMPONENT DERATING

MODEL : DLP240-24-1

(1) Calculating Method

(a) Measuring Conditions

Input	:	100VAC	• Ambient temperature	:	50°C
Output	:	24V 10.0A(100%)	• Mounting method	:	Standard Mounting

(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

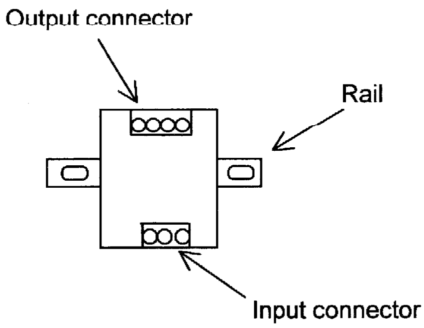
Location No.	Vin = 100VAC Load = 100% Ta = 50°C		
Q1 2SK2837 TOSHIBA	Tchmax = 150 °C, Pch = 10.47 W, Tch = Tc + ((θ ch-c) × Pch) = 117.3°C D.F. = 78.2%	θ ch-c = 0.833 °C/W, Δ Tc = 58.6 °C,	Pch(max) = 150 W, Tc = 108.6 °C
Q2 2SK2611 TOSHIBA	Tchmax = 150 °C, Pch = 11.13 W, Tch = Tc + ((θ ch-c) × Pch) = 119.9 °C D.F. = 79.9%	θ ch-c = 0.833 °C/W, Δ Tc = 60.6 °C,	Pch(max) = 150 W, Tc = 110.6 °C
D1 D15XB60 SHINDENGEN	Tjmax = 150 °C, Pd = 5.17 W, Tj = Tc + ((θ j-c) × Pd) = 114.0 °C D.F. = 76.0 %	θ j-c = 1.5 °C/W, Δ Tc = 56.2 °C,	Tc = 106.2 °C
D2 10JL2CZ47A TOSHIBA	Tjmax = 150 °C, Pd = 3.28 W, Tj = Tc + ((θ j-c) × Pd) = 109.9°C D.F. = 73.3%	θ j-c = 3.6 °C/W, Δ Tc = 48.1 °C,	Tc = 98.1 °C
D51 ESAD92M-02R FUJI.ELE.	Tjmax = 150 °C, Pd = 9.50 W, Tj = Tc + ((θ j-c) × Pd) = 131.4°C D.F. = 87.6%	θ j-c = 2.0 °C/W, Δ Tc = 62.4 °C,	Tc = 112.4 °C
Q101 2SC2712-Y -TE85L TOSHIBA	Tjmax = 125 °C, Pd = 1 mW, Tj = Ta + ((θ j-a) × Pd) = 80.2 °C D.F. = 64.2%	θ j-a = 667 °C/W, Δ Ta = 29.5 °C,	Pc(max) = 150 mW, Ta = 79.5 °C
Q102 2SK2177-4061 SHINDENGEN	Tchmax = 150 °C, Pd = 25 mW, Tch = Tc + ((θ ch-c) × Pd) = 74.6 °C D.F. = 49.7%	θ ch-c = 12.5 °C/W, Δ Tc = 24.3 °C,	Pch(max) = 10 W, Tc = 74.3 °C
Q201 2SC2712-Y -TE85L TOSHIBA	Tjmax = 125 °C, Pd = 1 mW, Tj = Ta + ((θ j-a) × Pd) = 83.2 °C D.F. = 66.6%	θ j-a = 667 °C/W, Δ Ta = 32.5 °C,	Pc(max) = 150 mW, Ta = 82.5 °C
PC101 PS2581L2-E3(D) (LED) NEC	Tjmax = 125 °C, Id = 0 mA, ALLOWABLE I_F(max) = 53.4mA (at Ta = 83.7°C) D.F. = 0%	θ j-a = 667 °C/W, Δ Ta = 33.7 °C,	Pd(max) = 150 mW, Ta = 83.7 °C
PC101 PS2581L2-E3(D) (Transistor) NEC	Tjmax = 125 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 83.7 °C D.F. = 67.0%	θ j-a = 667 °C/W, Δ Ta = 33.7 °C,	Pc(max) = 150 mW, Ta = 83.7 °C
PC102 PS2581L2-E3(D) (LED) NEC	Tjmax = 125 °C, Id = 1.2 mA, ALLOWABLE I_F(max) = 53.4mA (at Ta = 85.8°C) D.F. = 2.2%	θ j-a = 667 °C/W, Δ Ta = 35.8 °C,	Pd(max) = 150 mW, Ta = 85.8 °C
PC102 PS2581L2-E3(D) (Transistor) NEC	Tjmax = 125 °C, Pd = 25 mW, Tj = Ta + ((θ j-a) × Pd) =102.5°C D.F. = 82.0%	θ j-a = 667 °C/W, Δ Ta = 35.8 °C,	Pc(max) = 150 mW, Ta = 85.8 °C
A101 FA5502M-TE1 FUJI-ELE.	Tjmax = 150 °C, Pd = 90.0 mW, Tj = Tc + ((θ j-c) × Pd) = 94.2 °C D.F. = 62.8%	θ j-c = 50 °C/W, Δ Tc = 39.7 °C,	Pd(max) = 650 mW, Tc = 89.7 °C
A102 M51995AFP-600C MITSUBISHI	Tjmax = 150 °C, Pd = 297 mW, Tj = Tc + ((θ j-c) × Pd) = 120.3 °C D.F. = 80.2%	θ j-c = 40 °C/W, Δ Tc = 58.4 °C,	Pd(max) = 1.5 W Tc = 108.4 °C
D101, D102 D1FL20U-4063 SHINDENGEN	Tjmax = 150 °C, Pd = 0 W, Tj = Ta + ((θ j-a) × Pd) = 78.2 °C D.F. = 52.1%	θ j-a = 108 °C/W, Δ Ta = 28.2 °C,	Ta = 78.2 °C

Location No.	Vin = 100VAC Load = 100% Ta = 50°C		
D103 D1FL20U-4063 SHINDENGEN	Tjmax = 150 °C, Pd = 0 W, Tj = Ta + ((θ j-a) × Pd) = 91.6 °C D.F. = 61.0%	θ j-a = 108 °C/W, Δ Ta = 41.6 °C,	 Ta = 91.6 °C
D104 CRH01-TE85L TOSHIBA	Tjmax = 150 °C, Pd = 19.6 mW, Tj = Ta + ((θ j-a) × Pd) = 93.2 °C D.F. = 62.2%	θ j-a = 130 °C/W, Δ Ta = 40.7 °C,	 Ta = 90.7 °C
D105 CRH01-TE85L TOSHIBA	Tjmax = 150 °C, Pd = 8.1 mW, Tj = Ta + ((θ j-a) × Pd) = 94.1 °C D.F. = 62.7%	θ j-a = 130 °C/W, Δ Ta = 43.0 °C,	 Ta = 93.0 °C
D106 CRH01-TE85L TOSHIBA	Tjmax = 150 °C, Pd = 40 mW, Tj = Ta + ((θ j-a) × Pd) = 103.3 °C D.F. = 68.9%	θ j-a = 130 °C/W, Δ Ta = 48.1 °C,	 Ta = 98.1 °C
D201 CRH01-TE85L TOSHIBA	Tjmax = 150 °C, Pd = 10 mW, Tj = Ta + ((θ j-a) × Pd) = 85.3 °C D.F. = 56.9%	θ j-a = 130 °C/W, Δ Ta = 34.0 °C,	 Ta = 84.0 °C
D202 1SS184-TE85L TOSHIBA	Tjmax = 125 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 87.4 °C D.F. = 69.9%	θ j-a = 667 °C/W, Δ Ta = 37.4 °C,	P(max) = 150 mW Ta = 87.4 °C
Z101 U1ZB27-TE12L TOSHIBA	Tjmax = 150 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 83.8 °C D.F. = 55.9%	θ j-a = 125 °C/W, Δ Ta = 33.8 °C,	P(max) = 1.0 W Ta = 83.8 °C
Z102 U1ZB27-TE12L TOSHIBA	Tjmax = 150 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 89.4 °C D.F. = 59.6%	θ j-a = 125 °C/W, Δ Ta =39.4 °C,	P(max) = 1.0 W Ta = 89.4 °C
Z104 02CZ15-Y-TE85L TOSHIBA	Tjmax = 150 °C, Pd = 25 mW, Tj = Ta + ((θ j-a) × Pd) = 102.2 °C D.F. = 68.1%	θ j-a = 625 °C/W, Δ Ta = 36.6 °C,	Pd(max) = 200 mW Ta = 86.6 °C
Z105 02CZ11-X-TE85L TOSHIBA	Tjmax = 150 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 83.8 °C D.F. = 55.9%	θ j-a= 625 °C/W, Δ Ta = 33.8 °C,	Pd(max) = 200 mW Ta = 83.8 °C
Z201 MA3330-L-TX MATSUSHITA	Tjmax = 150 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 93.6 °C D.F. = 62.4%	θ j-a = 625 °C/W, Δ Ta = 43.6 °C,	Pd(max) = 200 mW Ta = 93.6 °C
Z202 02CZ18-Y-TE85L TOSHIBA	Tjmax = 150 °C, Pd = 36 mW, Tj = Ta + ((θ j-a) × Pd) = 108.1°C D.F. = 72.1%	θ j-a = 625 °C/W, Δ Ta = 35.6 °C,	Pd(max) = 200 mW Ta = 85.6 °C
A201 μPC1093-E1 NEC	Tjmax = 150 °C, Pd = 30 mW, Tj = Ta + ((θ j-a) × Pd) = 108.9 °C D.F. = 72.6 %	θ j-a = 315 °C/W, Δ Ta = 49.4 °C,	Pd(max) = 400 mW Ta = 99.4 °C

3. MAIN COMPONENTS TEMPERATURE RISE ΔT LIST

MODEL : DLP240-24-1

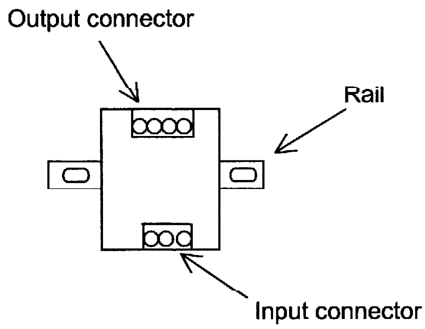
Measuring Conditions

Mounting Method (Standard Mounting)	
Input Voltage (VAC)	100
Output Voltage (VDC)	24
Output Current (A)	10.0

※ Condition Ta = 50°C , Convection cooling .

Output Derating (100%) Ta = 50°C		Standard Mounting
Location No.	Parts Name	ΔT Temperature rise (°C)
L1	BALUN COIL	50.3
L2	BALUN COIL	43.7
L3	CHOKE COIL	41.6
D1	BRIDGE DIODE	56.2
D2	FRD	48.1
Q1	MOS FET	58.6
Q2	MOS FET	60.6
D51	LLD	62.4
T1	TRANS PULSE	52.6
L55	CHOKE COIL	67.7
A101	CHIP IC	39.7
A102	CHIP IC	58.4
C6	E. CAP.	26.9
C9	E. CAP.	28.6
C10	E. CAP.	37.5
C51	E. CAP.	34.6
C52	E. CAP.	36.6
C53	E. CAP.	37.2
C57	E. CAP.	41.5

Measuring Conditions

Mounting Method (Standard Mounting)	
Input Voltage (VAC)	230
Output Voltage (VDC)	24
Output Current (A)	10.0

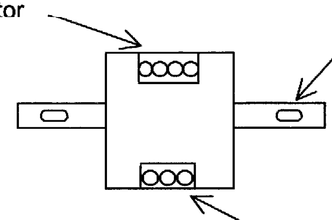
※ Condition Ta = 50°C , Convection cooling .

Output Derating (100%) Ta = 50°C		Standard Mounting
Location No.	Parts Name	ΔT Temperature rise (°C)
L1	BALUN COIL	26.5
L2	BALUN COIL	23.1
L3	CHOKE COIL	33.8
D1	BRIDGE DIODE	36.4
D2	FRD	33.3
Q1	MOS FET	35.8
Q2	MOS FET	45.1
D51	LLD	56.6
T1	TRANS PULSE	50.2
L55	CHOKE COIL	67.4
A101	CHIP IC	38.5
A102	CHIP IC	57.4
C6	E. CAP.	23.1
C9	E. CAP.	26.1
C10	E. CAP.	32.9
C51	E. CAP.	26.5
C52	E. CAP.	27.8
C53	E. CAP.	27.9
C57	E. CAP.	37.9

4. ELECTROLTIC CAPACITOR LIFETIME

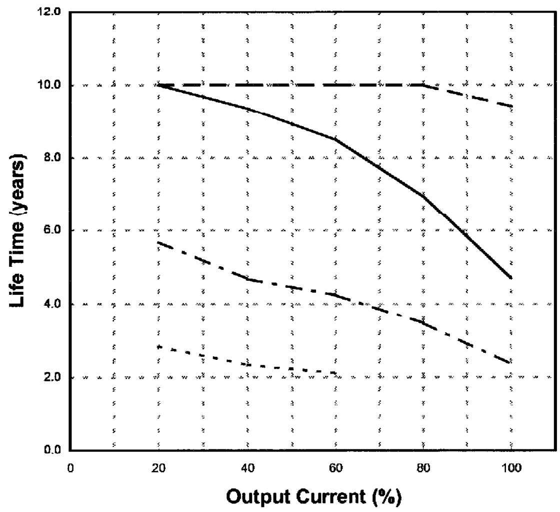
MODEL: DLP240-24-1

STANDARD MOUNTING



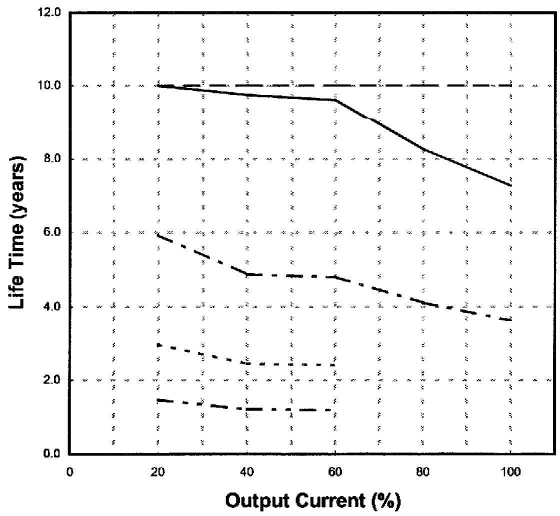
Vin = 100VAC

Load (%)	Life Time (years)			
	Ta = 30°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
20	10.0	10.0	5.7	2.8
40	10.0	9.4	4.7	2.3
60	10.0	8.5	4.2	2.1
80	10.0	7.0	3.5	---
100	9.4	4.7	2.4	---



Vin = 230VAC

Load (%)	Life Time (years)				
	Ta = 30°C	Ta = 40°C	Ta = 50°C	Ta = 60°C	Ta = 70°C
20	10.0	10.0	5.9	3.0	1.5
40	10.0	9.8	4.9	2.4	1.2
60	10.0	9.6	4.8	2.4	1.2
80	10.0	8.3	4.1	2.1	---
100	10.0	7.3	3.6	---	---



Ta = 30°C ------·
Ta = 40°C ———
Ta = 50°C —·—·—
Ta = 60°C --------
Ta = 70°C —··—··—

5. ABNORMAL TEST

MODEL : DLP240-24-1

(1) Conditions

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

(2) Test Results

(Da : Damaged)

No.	Test position		Test Mode		Test Results												
	Location No.	Test Point	Short	Open	1 Fire	2 Smoke	3 Burst	4 Smell	5 Red Hot	6 Damaged	7 Fuse Blown	8 OVP	9 OCP	10 No Output	11 No Change	12 Others	Note
1	Q1	D-G	O							O	O			O			Da:Z101
2		D-S	O								O			O			
3		G-S	O													O	Input Power Increase(8W)
4		D		O											O		
5		S		O												O	Input Power Increase(8W)
6		G		O						O	O			O			Da:Q1
7	Q2	D-G	O							O	O			O			Da:Z102
8		D-S	O							O	O			O			Da:D103,R171,R172
9		G-S	O											O			
10		D		O										O			
11		S		O										O			
12		G		O						O	O			O			Da :D103,Q2,R171,R172
13	D1	AC-AC	O							O	O			O			Da :TH1,TH2
14		AC-DC	O								O			O			
15		AC		O										O			
16		DC		O										O			
17	D2		O							O	O			O			Da : Q1
18				O						O	O			O			Da : Q1
19	D51	K-A1	O											O			
20		K-A2	O											O			
21		K		O										O			
22		A1		O										O			
23		A2		O						O	O			O			Da :D103,Q2,R171,R172
24	C6		O								O			O			
25				O						O	O			O			Da:Q1
26	C51		O										O	O			
27				O												O	Output Ripple Increase

No.	Test position: Location No.	Test position: Test Point	Test Mode: Short	Test Mode: Open	1 Fire	2 Smoke	3 Burst	4 Smell	5 Red Hot	6 Damaged	7 Fuse Blown	8 OVP	9 OCP	10 No Output	11 No Change	12 Others	Note
28	L3	1-2	O												O		
29		7,8-5,6	O							O	O			O			Da : Q1
30		5,6		O										O			
31		1		O											O		
32		2		O											O		
33	L55		O													O	Output Voltage Low
34				O										O			
35	T1	1-2	O											O			
36		2-6	O							O	O			O			Da : D103,R171,R172
37		6-8	O											O			
38		9-10	O										O			O	Output Voltage Low
39		10-13	O													O	Output Voltage Low
40		13-16	O											O			
41		1		O												O	Output Voltage Low
42		6		O										O			
43		8		O										O			
44	D104		O													O	Input Power Increase(8W)
45				O												O	Input Power Increase (4W)
46	D105		O													O	Input Power Increase (5W)
47				O												O	Input Power Increase (4W)
48	D106		O											O			
49				O												O	Output Voltage Unstable(3V)
50	R112		O												O		
51				O											O		
52	R117		O												O		
53				O						O	O			O			Da :D103,Q2,R171,R172
54	PC101	1-2	O												O		
55		3-4	O									O		O			
56		1,2		O											O		
57		3,4		O											O		
58	PC102	1-2	O									O		O			
59		3-4	O											O			
60		1,2		O								O		O			
61		3,4		O								O		O			

6. VIBRATION TEST

MODEL : DLP240-24-1

(1) Vibration Test Class

Frequency Variable Endurance Test

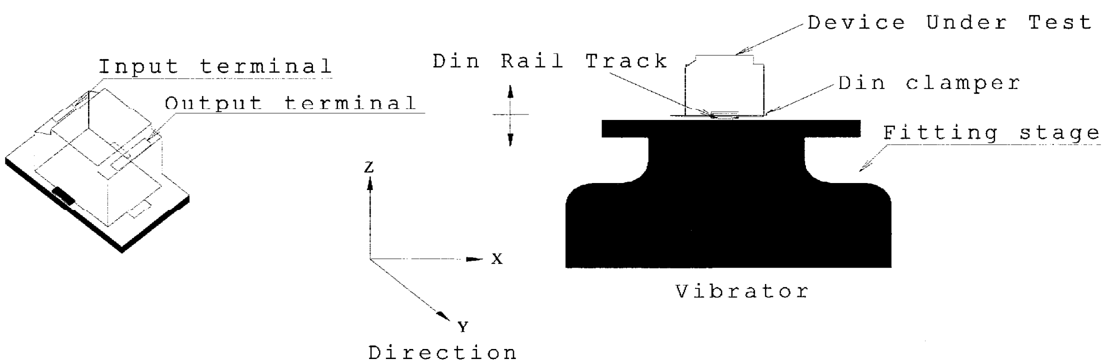
(2) Equipment Used

- Controller : DP550 (DP CORP. USA)
- Vibrator : V870 (LDS CORP. UK)

(3) Test Conditions

- Sweep frequency 10 ~ 55Hz
- Sweep time 1.0 min.
- Acceleration Constant $9.8m/s^2$ (1G)
- Direction X, Y, Z.
- Test time 1 hour each

(4) Test Method



(5) Test Results

O K

Vin : 100VAC

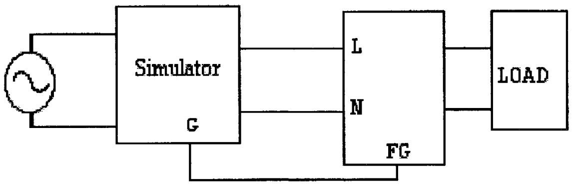
Iout : 100%

Check item		Output Voltage (V)	Ripple Voltage (mVp-p)	D.U.T.State
Before Test		24.000	55	————
After Test	X	24.006	50	O.K.
	Y	24.006	50	O.K.
	Z	24.007	50	O.K.

7. NOISE SIMULATE TEST

MODEL : DLP240-24-1

(1) Test Circuit And Equipment



Simulator : INS-400L Noise Laboratory Co.,LTD

(2) Test Conditions

- Input Voltage : 100, 230VAC
- Output Voltage : Rated
- Output Current : 0%, 100%
- Ambient Temperature : 25°C
- Pulse Width : 50ns ~ 1000ns
- Noise Level : 0V~2kV
- Phase Shift : 0° ~ 360°
- Polarity : + , −
- Mode : Normal Common
- Trig Select : Line

(3) Acceptable Conditions

1. Not to be broken.
2. Not to be shut down output.
3. No other out of orders.

(4) Test Result

O K

8. THERMAL SHOCK TEST

MODEL : DLP240-24-1

(1) Equipment Used

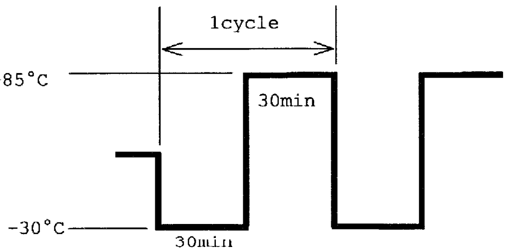
THERMAL SHOCK CHAMBER TSV-40 (TABAI ESPEC CORP.)

(2) The Number of D.U.T.(Device Under Test)

2 units

(3) Test Conditions

- Ambient Temperature : -30°C ⟷ 85°C
- Test Time : Refer to drawing
- Test Cycle : 100 Cycles
- Not Operating



(4) Test Method

Before testing, check if there is no abnormal output, then put the D.U.T. in testing chamber, and test it according to the above cycle. 100 cycles later, leave it for 1 hour at the room temperature, then check if there is no abnormal output.

(5) Test Results

O K

Vin : 100VAC / Io : 100%			24V			
			FROM		TO	
Ripple Noise		mV	65		16	
Spike Noise		mV	70		80	
Line Regulation	MIN	V	23.975	0mV	23.989	1mV
	MAX	V	23.975		23.990	
Load Regulation	0%	V	24.011	36mV	24.019	30mV
	100%	V	23.975		23.989	
Efficiency	Pin	W	290.6	82.5%	288.0	83.3%
	Vout	V	23.975		23.989	
	Iout	A	10		10	
Solder Condition • etc.			―――		OK	