DLP100-24-1

RELIABILITY DATA

DWG No. CA734-57-01/2			
QA APPD	APPD	CHK	DWG
T. Murayama 26. Jun. '03	26 Jun. '03	26/Jun/'03	Xie Jun/26/'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 : DLP100-24-1

(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> :

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

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 ≒371,264 (Hours)

2. COMPONENT DERATING

MODEL DLP100-24-1

(1) Calculating Method

(a) Measuring Conditions

Input	:	100VAC	• Ambient temperature	:	50°C
Output	:	24V 4.1A(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

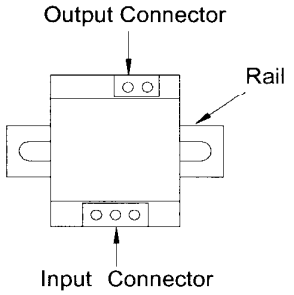
Location No.	Vin = 100VAC Load = 100% Ta = 50°C		
Q1 2SK2611 TOSHIBA	Tchmax = 150 °C, Pch = 4.36W, Tch = Tc + ((θ ch-c) × Pch) = 83.6 °C D.F. = 55.7%	θ ch-c = 0.833 °C/W, Δ Tc = 30.0 °C,	Pch(max) = 150 W, Tc = 80.0°C
D1 DS3B60 SHINDENGEN	Tjmax = 150 °C, Pd = 1.1W, Tj = Tc + ((θ j-c) × Pd) = 91.5°C D.F. = 61.0%	θ j-c = 5.5 °C/W, Δ Tc = 35.4 °C,	Tc = 85.4 °C
D51 ESAD92M-02R FUJI-ELE.	Tjmax = 150 °C, Pd = 3.9 W, Tj = Tc + ((θ j-c) × Pd) = 122.9 °C D.F. = 81.9%	θ j-c = 2 °C/W, Δ Tc =65.1°C,	Tc =115.1 °C
Q101 2SC3075 TOSHIBA	Tjmax = 150 °C, Pd = 0W, Tj = Ta + ((θ j-c) × Pd) =84.9°C D.F. =56.6%	θ j-c = 12.5 °C/W, Δ Ta =34.9 °C,	Pd(max) = 1W, Ta= 84.9°C
Q102 HN1B01F-Y SHINDENGEN	Tjmax = 125 °C, Pd = 25 mW, Tj = Ta + ((θ j-a) × Pd) = 85.3 °C D.F. = 68.2%	θ j-a = 333 °C/W, Δ Ta = 27.0°C,	Pd(max) = 300m W, Ta = 77.0 °C
Q103 2SC3075 TOSHIBA	Tjmax = 150 °C, Pd = 0.75W, Tj = Ta + ((θj-c) × Pd) = 103.4 °C D.F. = 68.9%	θ j-c = 12.5 °C/W, Δ Ta = 44.0 °C,	Pd(max) = 1W, Ta = 94.0 °C
Q301 2SC2712 TOSHIBA	Tjmax = 125 °C, Pd = 9mW, Tj = Ta + ((θ j-a) × Pd) =90.2°C D.F. =72.2%	θ j-a = 667 °C/W, Δ Ta =34.2 °C,	Pd(max) = 150mW, Ta= 84.2°C
D101 U05NU44 TOSHIBA	Tjmax = 150 °C, Pd = 14.5mW, Tj = Ta + ((θ j-a) × Pd) = 82.6 °C D.F. = 55.1%	θ j-a = 110 °C/W, Δ Ta = 31.0 °C,	Ta = 81.0 °C
D102 CRH01 SHINDENGEN	Tjmax = 150 °C, Pd = 0 W, Tj = Ta + ((θ j-a) × Pd) = 82.8 °C D.F. = 55.2%	θ j-a = 130 °C/W, Δ Ta = 32.8 °C,	Ta = 82.8 °C
D103 CRH01 TOSHIBA	Tjmax = 150 °C, Pd = 0.076 W, Tj = Ta + ((θ j-a) × Pd) = 106.2 °C D.F. = 70.8%	θ j-a = 130 °C/W, Δ Ta = 46.3 °C,	Ta = 96.3 °C
D301 CRH01 TOSHIBA	Tjmax = 150 °C, Pd = 0.083 W, Tj = Ta + ((θ j-a) × Pd) = 113.2°C D.F. = 75.5%	θ j-a = 130 °C/W, Δ Ta = 52.4°C,	Ta = 102.4 °C
D302 1SS184-TE85L TOSHIBA	Tjmax = 150 °C, Pd = 5.8 mW, Tj = Ta + ((θ j-a) × Pd) = 84.9 °C D.F. = 56.6%	θ j-a = 667°C/W, Δ Ta = 31.0 °C,	Pd(max) = 150 mW Ta = 81.0 °C
Z101 02CZ11-X TOSHIBA	Tjmax = 150 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 75.3 °C D.F. = 50.2%	θ j-a = 625 °C/W, Δ Ta = 25.3 °C,	Pd(max) = 200mW Ta = 75.3 °C
Z102 02CZ5.6-Y TOSHIBA	Tjmax = 150 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 71.7 °C D.F. = 47.8%	θ j-a = 625 °C/W, Δ Ta = 21.7 °C,	Pd(max) = 200mW Ta = 71.7 °C
Z103 U1ZB27 TOSHIBA	Tjmax = 150 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 83.9 °C D.F. = 55.9%	θ j-a = 125 °C/W, Δ Ta = 33.9 °C,	Pd(max) = 1W Ta = 83.9 °C

Location No.	Vin = 100VAC Load = 100% Ta = 50°C		
Z201 MA3330-L-TX MATSUSHITA	Tjmax = 150 °C, Pd = 0mW, Tj = Ta + ((θ j-a) × Pd) = 91.1 °C D.F. = 60.7%	θ j-a = 625 °C/W, Δ Ta = 41.1 °C,	Pd(max) = 200m W Ta = 91.1 °C
Z301 02CZ18-Y TOSHIBA	Tjmax = 150 °C, Pd = 9.9mW, Tj = Ta + ((θ j-a) × Pd) = 93.6 °C D.F. = 62.4%	θ j-a = 625 °C/W, Δ Ta = 37.4 °C,	Pd(max) = 200m W Ta = 87.4 °C
PC101 PS2581L2-E3 (LED) TOSHIBA	Tjmax = 125 °C, Id = 0mA, ALLOWABLE I_F(max) = 47.3mA (at Ta = 88.7°C) D.F. = 0%	θ j-a = 667 °C/W, Δ Ta = 38.7 °C,	Pd(max) = 150 mW, Ta = 88.7 °C
PC101 PS2581L2-E3 (Transistor) TOSHIBA	Tjmax = 125 °C, Pd = 0 mW, Tj = Ta + ((θ j-a) × Pd) = 88.7 °C D.F. = 71.0%	θ j-a = 667 °C/W, Δ Ta = 38.7 °C,	Pc(max) = 150 mW, Ta = 88.7 °C
PC102 PS2581L2-E3 (LED) TOSHIBA	Tjmax = 125 °C, Id = 1.2mA, ALLOWABLE I_F(max) = 51.2mA (at Ta = 85.1°C) D.F. = 2.34%	θ j-a = 667 °C/W, Δ Ta = 35.1 °C,	Pd(max) = 150 mW, Ta = 85.1 °C
PC102 PS2581L2-E3 (Transistor) TOSHIBA	Tjmax = 125 °C, Pd = 20mW, Tj = Ta + ((θ j-a) × Pd) = 98.4°C D.F. = 78.7%	θ j-a = 667 °C/W, Δ Ta = 35.1 °C,	Pc(max) = 150 mW, Ta = 85.1 °C
A101 M51995AFP-600C MITSUBISHI	Tjmax = 150 °C, Pd =0.274 W, Tj = Tc + ((θ j-c) × Pd) =108.1°C D.F. =72.1%	θ j-c = 40 °C/W, Δ Tc =47.1 °C,	Pd(max) = 1.5 W Tc =97.1 °C
A401 μPC1093-E1 NEC	Tjmax = 150 °C, Pd = 30 mW, Tj = Ta + ((θ j-a) × Pd) = 90.5 °C D.F. = 60.3 %	θ j-a = 315 °C/W, Δ Ta = 31.0 °C,	Pd(max) = 400 mW Ta = 81.0 °C
SR1 SM8JZ47A NEC	Tjmax = 125 °C, Pd = 1.6W, Tj = Tc + ((θ j-c) × Pd) = 93.7 °C D.F. = 75.0 %	θ j-c = 3.6°C/W, Δ Tc = 37.9 °C,	Tc = 87.9°C

3. MAIN COMPONENTS TEMPERATURE RISE ΔT LIST

MODEL : DLP100-24-1

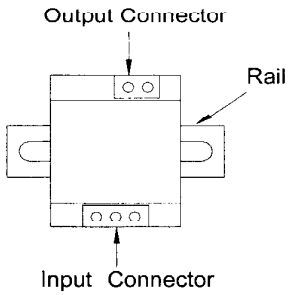
Measuring Conditions

Mounting Method (Standard Mounting)	
Input Voltage (VAC)	100
Output Voltage (VDC)	24
Output Current (A)	4.1

※ 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	47.3
L2	BALUN COIL	38.9
L51	CHOKE COIL	51.2
D1	BRIDGE DIODE	35.4
D2	DIAC	26.6
D51	LLD	65.1
Q1	MOS FET	30.0
T1	TRANS PULSE	53.4
A101	CHIP IC	47.1
A401	CHIP IC	31.0
C5	E. CAP.	20.7
C6	E. CAP.	26.2
C7	E. CAP.	18.5
C10	E. CAP.	34.5
C51	E. CAP.	37.4
C52	E. CAP.	35.3
C54	E. CAP.	40.4

Measuring Conditions

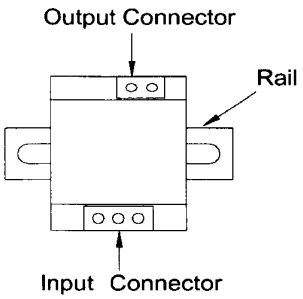
Mounting Method (Standard Mounting)	
Input Voltage (VAC)	230
Output Voltage (VDC)	24
Output Current (A)	4.1

※ 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	28.1
L2	BALUN COIL	28.3
L51	CHOKE COIL	52.6
D1	BRIDGE DIODE	34.2
D2	DIAC	19.8
D51	LLD	66.3
Q1	MOS FET	33.1
T1	TRANS PULSE	54.9
A101	CHIP IC	52.7
A401	CHIP IC	37.1
C5	E. CAP.	22.4
C6	E. CAP.	27.5
C7	E. CAP.	17.6
C10	E. CAP.	36.9
C51	E. CAP.	34.9
C52	E. CAP.	31.1
C54	E. CAP.	39.3

4. ELECTROLYTIC CAPACITOR LIFETIME

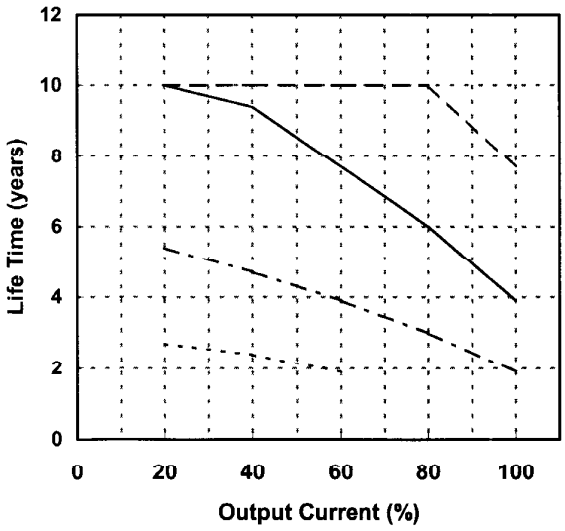
MODEL: DLP100-24-1



Standard Mounting

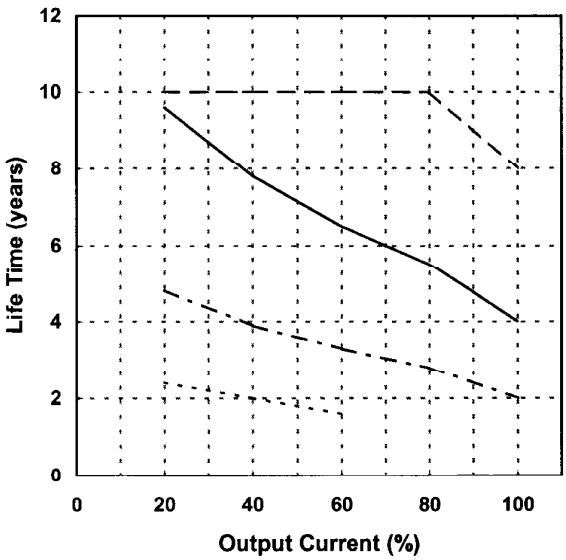
Vin = 100VAC

Load (%)	Life Time (years)			
	Ta = 30°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
20	10.0	10.0	5.4	2.7
40	10.0	9.4	4.7	2.4
60	10.0	7.7	3.9	1.9
80	10.0	6.0	3.0	---
100	7.7	3.9	1.9	---



Vin = 230VAC

Load (%)	Life Time (years)			
	Ta = 30°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
20	10.0	9.6	4.8	2.4
40	10.0	7.8	3.9	2.0
60	10.0	6.5	3.3	1.6
80	10.0	5.5	2.8	---
100	8.0	4.0	2.0	---



Ta = 30°C ------ Ta = 40°C ——————

Ta = 50°C —·—·—·— Ta = 60°C --------

5. ABNORMAL TEST

MODEL : DLP100-24-1

(1) Conditions

Input : 230VAC Output : 24V / 4.1A 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 No.	Test Point	Short	Open	Fire	Smoke	Burst	Smell	Red Hot	Damaged	Fuse Blown	OVP	OCP	No Output	No Change	Others	Note
1	Q1	D-G	O							O	O			O		O	Da : Z103,A101,Q1,D102
2		D-S	O							O	O			O		O	Da : D102
3		G-S	O											O			
4		D		O										O			
5		S		O										O			
6		G		O						O	O			O		O	Da:Q1,D102
7	A101	1-2	O							O				O		O	R148,R149 OPEN
8		2-3	O											O			
9		3-4	O												O		
10		4-5	O												O		
11		5-6	O												O		
12		6-7	O												O		
13		7-8	O												O		
14		8-9	O												O		
15		9-10	O											O			
16		11-12	O											O			
17		12-13	O													O	HICCUP
18		13-14	O												O		
19		14-15	O												O		
20		15-16	O												O		
21		16-17	O												O		
22		17-18	O												O		
23		18-19	O												O		
24		19-20	O											O			
25		1		O										O			
26		2		O						O	O			O		O	Da:Z103,Q1
27		3		O										O			

No.	Test position		Test Mode		Test Results												
					1	2	3	4	5	6	7	8	9	10	11	12	
	Location No.	Test Point	Short	Open	Fire	Smoke	Burst	Smell	Red Hot	Damaged	Fuse Blown	OVP	OCP	No Output	No Change	Others	Note
28	A101	4		O											O		
29		5		O											O		
30		6		O											O		
31		7		O											O		
32		8		O											O		
33		9		O											O		
34		10		O								O		O			
35		11		O										O			
36		12		O										O			
37		13		O									O			O	O/P LOW
38		14		O											O		
39		15		O											O		
40		16		O											O		
41		17		O										O			
42		18		O											O		
43		19		O										O			
44		20		O										O			
45	A401	K-A	O													O	O/P LOW
46		K-R	O													O	O/P LOW
47		R-A	O									O		O			
48		K		O								O		O			
49		A		O								O		O			
50		R		O								O		O			
51	PC101	1-2	O												O		
52		3-4	O									O		O			
53		1		O											O		
54		2		O											O		
55		3		O											O		
56		4		O											O		
57	PC102	1-2	O									O		O			
58		3-4	O											O			
59		1		O								O		O			
60		2		O								O		O			
61		3		O								O		O			
62		4		O								O		O			

No.	Test position		Test Mode		Test Results												
					1	2	3	4	5	6	7	8	9	10	11	12	
	Location No.	Test Point	Short	Open	Fire	Smoke	Burst	Smell	Red Hot	Damaged	Fuse Blown	OVP	OCP	No Output	No Change	Others	Note
63	D1	ONE DIODE	O								O			O			
64		ONE LEAD		O										O			
65	D2		O												O		
66				O											O		
67	D101		O							O						O	Da:R126,R127
68				O											O		
69	D102		O												O		
70				O											O		
71	D103		O											O			
72				O												O	HICCUP
73	D301		O											O			
74				O												O	PD51 OFF
75	D302		O													O	PD52 ON
76				O											O		
77	D51	RECTIFIER	O										O			O	HICCUP
78		FREEWEEL	O										O			O	HICCUP
79		RECTIFIER		O										O			
80		FREEWEEL		O										O			
81		BOTH		O										O			
82	Q101	C-E	O												O		
83		C-B	O												O		
84		B-E	O												O		
85		C		O											O		
86		E		O											O		
87		B		O											O		
88	Q103	C-E	O							O						O	Da:Q103,Q102,Z102, R138,R126,R127,R144
89		C-B	O							O						O	Da:Q103,Q102,Z102, R126,R127, R144
90		B-E	O												O		
91		C		O											O		
92		E		O											O		
93		B		O											O		
94	Z101		O												O		
95				O											O		
96	Z102		O												O		
97				O											O		

No.	Test position		Test Mode		Test Results												
					1	2	3	4	5	6	7	8	9	10	11	12	
	Location No.	Test Point	Short	Open	Fire	Smoke	Burst	Smell	Red Hot	Damaged	Fuse Blown	OVP	OCP	No Output	No Change	Others	Note
98	Z103		O											O			
99				O											O		
100	Z201		O									O		O			
101				O											O		
102	Z301		O												O		
103				O											O		
104	C5(C6)		O												O		
105				O												O	HICCUP
106	C7		O													O	
107				O						O					O		Da:R126,R127
108	C10		O											O			
109				O										O			
110	C51(C54)		O										O			O	HICCUP
111				O											O		
112	SR1	1-2	O												O		
113		2-3	O							O						O	
114		1		O												O	
115		2		O												O	
116		3		O												O	

6. VIBRATION TEST

MODEL : DLP100-24-1

(1) Vibration Test Class

Frequency Variable Endurance Test

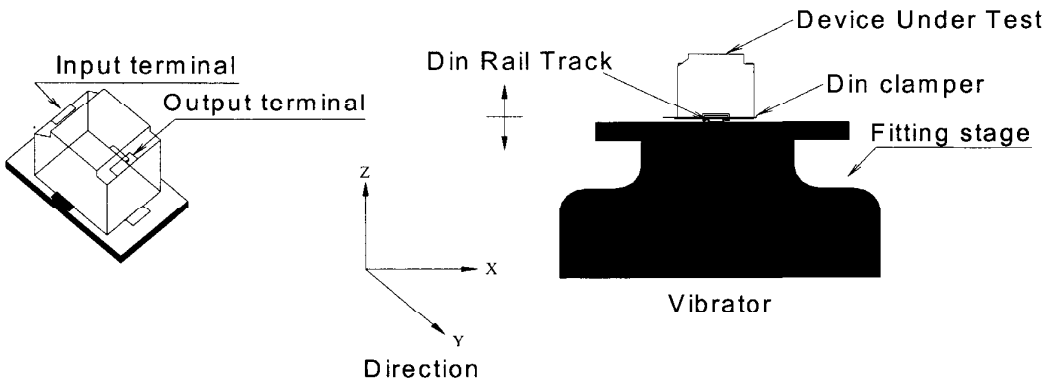
(2) Equipment Used

- 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

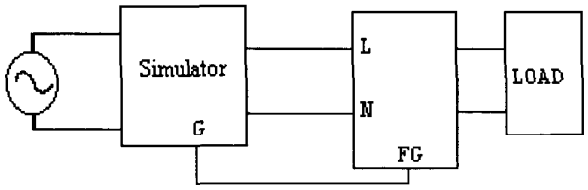
Iout : 100%

Check item		Output Voltage (V)	Ripple Voltage (mVp-p)	D.U.T.State
Before Test		24.010	39	———
After Test	X	24.011	35	O.K.
	Y	24.013	35	O.K.
	Z	24.009	35	O.K.

7. NOISE SIMULATE TEST

MODEL : DLP100-24-1

(1) Test Circuit And Equipment



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

(2) Test Conditions

• Input Voltage	:	100, 230VAC	• Noise Level	:	0V~2kV
• Output Voltage	:	Rated	• Phase Shift	:	0° ~ 360°
• Output Current	:	0%, 100%	• Polarity	:	+ , −
• Ambient Temperature	:	25°C	• Mode	:	Normal Common
• Pulse Width	:	50ns ~ 1000ns	• Trigger 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 : DLP100-24-1

(1) Equipment Used

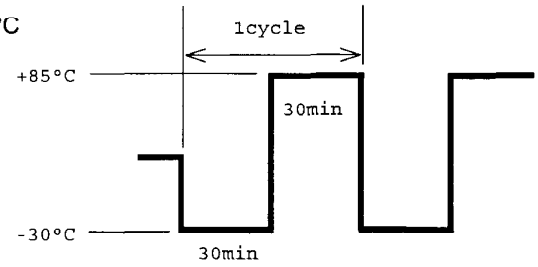
THERMAL SHOCK CHAMBER TSV-40 (TABAI ESPEC CORP.)

(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	30		36	
Spike Noise		mV	37		48	
Line Regulation	MIN	V	23.993	0mV	23.995	3mV
	MAX	V	23.993		23.998	
Load Regulation	0%	V	24.010	27mV	24.015	24mV
	100%	V	23.983		23.991	
Efficiency	Pin	W	117.3	83.8%	118.6	83.0%
	Vout	V	23.983		23.991	
	Iout	A	4.1		4.1	
Solder Condition • etc.			———		OK	