DLP180-24-1

RELIABILITY DATA

DWG No. CA735-57-01			
QA APPD	APPD	CHK	DWG
T. Murayama 4/Jun/03	[illegible] 30.May.2003	[illegible] 14/May/03	John 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 : DLP180-24-1

(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> :

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

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 = 390,388 (Hours)

2. COMPONENT DERATING

MODEL : DLP180-24-1

(1) Calculating Method

(a) Measuring Conditions

Input	:	100VAC	• Ambient temperature	: 50°C
Output	:	24V 7.5A(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

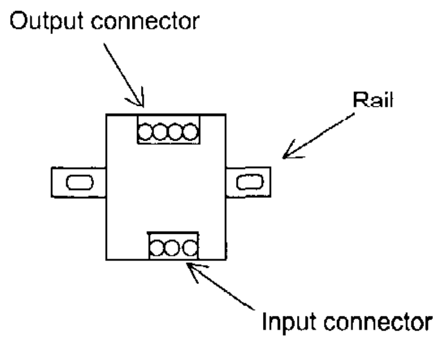
Location No.	Vin = 100VAC Load = 100% Ta = 50°C
Q1 2SK2837 TOSHIBA	Tchmax = 150 °C, θ ch-c = 0.833 °C/W, Pch(max) = 150 W, Pch = 5.85 W, Δ Tc = 48.5 °C, Tc = 98.5 °C Tch = Tc + ((θ ch-c) × Pch) = 103.4°C D.F. = 68.9%
Q2 2SK2611 TOSHIBA	Tchmax = 150 °C, θ ch-c = 0.833 °C/W, Pch(max) = 150 W, Pch = 5.82 W, Δ Tc = 47.9 °C, Tc = 97.9 °C Tch = Tc + ((θ ch-c) × Pch) = 102.7 °C D.F. = 68.5%
D1 D3SB60 SHINDENGEN	Tjmax = 150 °C, θ j-c = 5.5 °C/W, Pd = 3.78 W, Δ Tc = 53.7°C, Tc = 103.7 °C Tj = Tc + ((θ j-c) × Pd) = 124.5 °C D.F. = 83.0%
D2 10JL2CZ47A TOSHIBA	Tjmax = 150 °C, θ j-c = 3.6 °C/W, Pd = 2.40W, Δ Tc = 41.9 °C, Tc = 91.9 °C Tj = Tc + ((θ j-c) × Pd) = 100.5 °C D.F. = 67.0%
D51 ESAD92M-02R FUJI.ELE.	Tjmax = 150 °C, θ j-c = 2.0 °C/W, Pd = 7.13 W, Δ Tc = 55.0 °C, Tc = 105.0 °C Tj = Tc + ((θ j-c) × Pd) = 119.3 °C D.F. = 79.5%
Q101 2SC2712-Y -TE85L TOSHIBA	Tjmax = 125 °C, θ j-a = 667 °C/W, Pc(max) = 150 mW, Pd = 1 mW, Δ Ta = 23.4 °C, Ta = 73.4 °C Tj = Ta + ((θ j-a) × Pd) = 74.1 °C D.F. = 59.3%
Q102 2SK2177-4061 SHINDENGEN	Tchmax = 150 °C, θ ch-c = 12.5 °C/W, Pch(max) = 10 W, Pd = 25 mW, Δ Tc = 18.2 °C, Tc = 68.2 °C Tch = Tc + ((θ ch-c) × Pd) = 68.5 °C D.F. = 45.7%
Q201 2SC2712-Y -TE85L TOSHIBA	Tjmax = 125 °C, θ j-a = 667 °C/W, Pc(max) = 150 mW, Pd = 1 mW, Δ Ta = 44.7 °C, Ta = 94.7 °C Tj = Ta + ((θ j-a) × Pd) = 95.4 °C D.F. = 76.3%
PC101 PS2581L2-E3(D) (LED) NEC	Tjmax = 125 °C, θ j-a = 667 °C/W, Pd(max) = 150 mW, Id = 0 mA, Δ Ta = 41.9 °C, Ta = 91.9 °C ALLOWABLE I_F(max) = 32.0mA (at Ta = 91.9°C) D.F. = 0%
PC101 PS2581L2-E3(D) (Transistor) NEC	Tjmax = 125 °C, θ j-a = 667 °C/W, Pc(max) = 150 mW, Pd = 0 mW, Δ Ta = 41.9 °C, Ta = 91.9 °C Tj = Ta + ((θ j-a) × Pd) = 91.9 °C D.F. = 73.5%
PC102 PS2581L2-E3(D) (LED) NEC	Tjmax = 125 °C, θ j-a = 667 °C/W, Pd(max) = 150 mW, Id = 1.2 mA, Δ Ta = 40.3 °C, Ta = 90.3°C ALLOWABLE I_F(max) = 32.0mA (at Ta = 90.3°C) D.F. = 3.75%
PC102 PS2581L2-E3(D) (Transistor) NEC	Tjmax = 125 °C, θ j-a = 667 °C/W, Pc(max) = 150 mW, Pd = 25 mW, Δ Ta = 40.3 °C, Ta = 90.3 °C Tj = Ta + ((θ j-a) × Pd) = 107.0°C D.F. = 85.6%
A101 FA5502M-TE1 FUJI-ELE.	Tjmax = 150 °C, θ j-c = 50 °C/W, Pd(max) = 650 mW, Pd = 66.5 mW, Δ Tc = 48.2 °C, Tc = 98.2 °C Tj = Tc + ((θ j-c) × Pd) = 101.5 °C D.F. = 67.7%
A102 M51995AFP-600C MITSUBISHI	Tjmax = 150 °C, θ j-c = 40 °C/W, Pd(max) = 1.5 W Pd = 286 mW, Δ Tc = 62.5 °C, Tc = 112.5 °C Tj = Tc + ((θ j-c) × Pd) = 123.9 °C D.F. = 82.6%
D101, D102 D1FL20U-4063 SHINDENGEN	Tjmax = 150 °C, θ j-a = 108 °C/W, Pd = 0 W, Δ Ta = 24.9 °C, Ta = 74.9 °C Tj = Ta + ((θ j-a) × Pd) = 74.9 °C D.F. = 49.9%

Location No.	Vin = 100VAC Load = 100% Ta = 50°C
D103 D1FL20U-4063 SHINDENGEN	Tjmax = 150 °C, θ j-a = 108 °C/W, Pd = 0 W, Δ Ta = 47.5 °C, Ta = 97.5 °C Tj = Ta + ((θ j-a) × Pd) = 97.5 °C D.F. = 65.0%
D104 CRH01-TE85L TOSHIBA	Tjmax = 150 °C, θ j-a = 130 °C/W, Pd = 18.4 mW, Δ Ta = 43.2 °C, Ta = 93.2 °C Tj = Ta + ((θ j-a) × Pd) = 95.6 °C D.F. = 63.7%
D105 CRH01-TE85L TOSHIBA	Tjmax = 150 °C, θ j-a = 130 °C/W, Pd = 8 mW, Δ Ta = 51.0 °C, Ta = 101.0 °C Tj = Ta + ((θ j-a) × Pd) = 102.0 °C D.F. = 68.0%
D106 CRH01-TE85L TOSHIBA	Tjmax = 150 °C, θ j-a = 130 °C/W, Pd = 40 mW, Δ Ta = 51.1 °C, Ta = 101.1 °C Tj = Ta + ((θ j-a) × Pd) = 106.3 °C D.F. = 70.9%
D201 CRH01-TE85L TOSHIBA	Tjmax = 150 °C, θ j-a = 130 °C/W, Pd = 10 mW, Δ Ta = 35.5 °C, Ta = 85.5 °C Tj = Ta + ((θ j-a) × Pd) = 86.8°C D.F. = 57.9%
D202 1SS184-TE85L TOSHIBA	Tjmax = 125 °C, θ j-a = 667 °C/W, P(max) = 150 mW Pd = 0 mW, Δ Ta = 35.7 °C, Ta = 85.7 °C Tj = Ta + ((θ j-a) × Pd) = 85.7 °C D.F. = 68.6%
Z101 U1ZB27-TE12L TOSHIBA	Tjmax = 150 °C, θ j-a = 125 °C/W, P(max) = 1.0 W Pd = 0 mW, Δ Ta = 43.2 °C, Ta = 93.2 °C Tj = Ta + ((θ j-a) × Pd) = 93.2 °C D.F. = 62.1%
Z102 U1ZB27-TE12L TOSHIBA	Tjmax = 150 °C, θ j-a = 125 °C/W, P(max) = 1.0 W Pd = 0 mW, Δ Ta = 41.4 °C, Ta = 91.4 °C Tj = Ta + ((θ j-a) × Pd) = 91.4 °C D.F. = 60.9%
Z104 02CZ15-Y-TE85L TOSHIBA	Tjmax = 150 °C, θ j-a = 625 °C/W, Pd(max) = 200 mW Pd = 25 mW, Δ Ta = 31.6 °C, Ta = 81.6 °C Tj = Ta + ((θ j-a) × Pd) = 97..2 °C D.F. = 64.8%
Z105 02CZ11-X-TE85L TOSHIBA	Tjmax = 150 °C, θ j-a= 625 °C/W, Pd(max) = 200 mW Pd = 0 mW, Δ Ta = 29.9 °C, Ta = 79.9°C Tj = Ta + ((θ j-a) × Pd) = 79.9 °C D.F. = 53.3%
Z201 MA3330-L-TX MATSUSHITA	Tjmax = 150 °C, θ j-a = 625 °C/W, Pd(max) = 200 mW Pd = 0 mW, Δ Ta = 46.6 °C, Ta = 96.6 °C Tj = Ta + ((θ j-a) × Pd) = 96.6 °C D.F. = 64.4%
Z202 02CZ18-Y-TE85L TOSHIBA	Tjmax = 150 °C, θ j-a = 625 °C/W, Pd(max) = 200 mW Pd = 36 mW, Δ Ta = 38.3 °C, Ta = 88.3 °C Tj = Ta + ((θ j-a) × Pd) = 110.8 °C D.F. = 73.9%
A201 μPC1093-E1 NEC	Tjmax = 150 °C, θ j-a = 315 °C/W, Pd(max) = 400 mW Pd = 30 mW, Δ Ta = 53.2 °C, Ta = 103.2 °C Tj = Ta + ((θ j-a) × Pd) = 112.7°C D.F. = 75.1%

3. MAIN COMPONENTS TEMPERATURE RISE ΔT LIST

MODEL : DLP180-24-1

Measuring Conditions

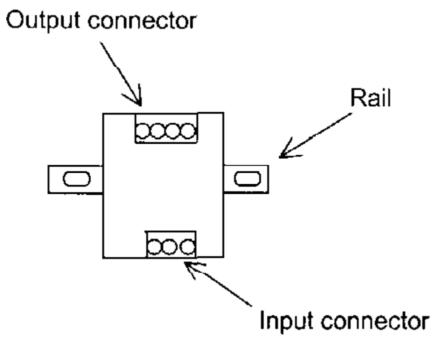
Mounting Method (Standard Mounting)	

Input Voltage (VAC)	100
Output Voltage (VDC)	24
Output Current (A)	7.5

※ 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	33.2
L2	BALUN COIL	40.0
L3	CHOKE COIL	50.8
D1	BRIDGE DIODE	53.7
D2	FRD	41.9
Q1	MOS FET	48.5
Q2	MOS FET	47.9
D51	LLD	55.0
T1	TRANS PULSE	60.4
L55	CHOKE COIL	70.8
A101	CHIP IC	48.2
A102	CHIP IC	62.5
C6	E. CAP.	37.1
C7	E. CAP.	24.7
C9	E. CAP.	46.8
C10	E. CAP.	48.5
C51	E. CAP.	38.2
C52	E. CAP.	37.9
C57	E. CAP.	47.6

Measuring Conditions

Mounting Method (Standard Mounting)	
Input Voltage (VAC)	230
Output Voltage (VDC)	24
Output Current (A)	7.5

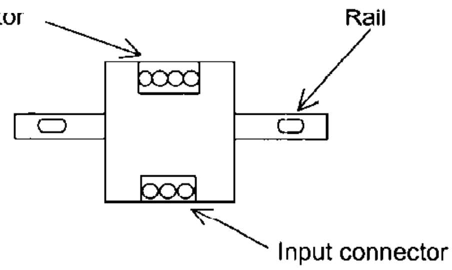
※ Condition Ta = 50°C , Convection cooling .

Output Derating (100%) Ta = 50°C		Standard Mounting
Location No.	Parts Name	ΔT Temperature rise (°C)
L1	BALUN COIL	21.3
L2	BALUN COIL	21.7
L3	CHOKE COIL	37.6
D1	BRIDGE DIODE	34.9
D2	FRD	36.2
Q1	MOS FET	40.6
Q2	MOS FET	42.7
D51	LLD	50.9
T1	TRANS PULSE	57.3
L55	CHOKE COIL	69.1
A101	CHIP IC	44.0
A102	CHIP IC	60.5
C6	E. CAP.	32.9
C7	E. CAP.	22.0
C9	E. CAP.	41.8
C10	E. CAP.	42.3
C51	E. CAP.	31.4
C52	E. CAP.	31.3
C57	E. CAP.	43.2

4. ELECTROLTIC CAPACITOR LIFETIME

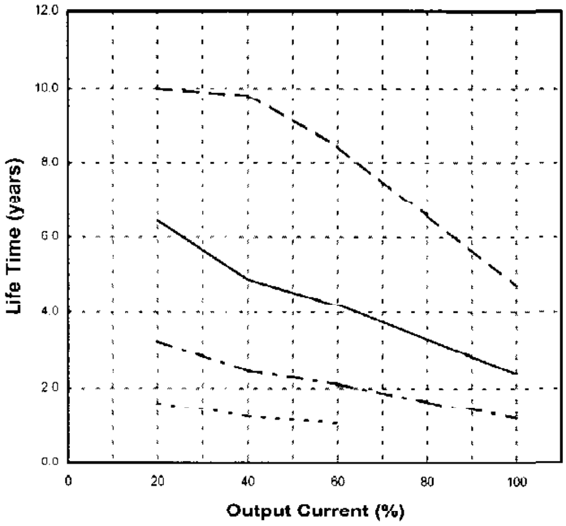
MODEL: DLP180-24-1

STANDARD MOUNTING



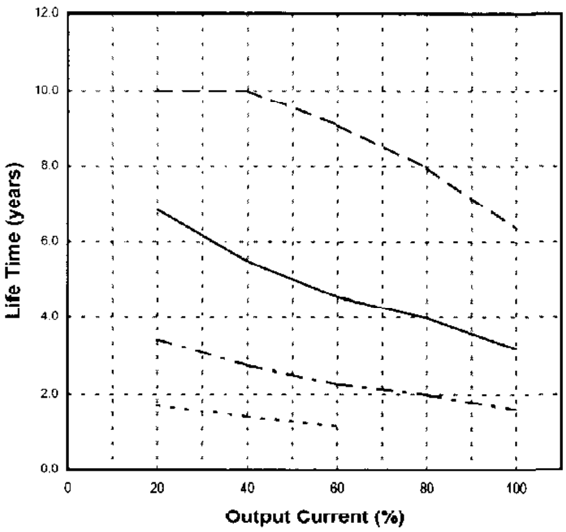
Vin = 100VAC

Load (%)	Life Time (years)			
	Ta = 30°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
20	10.0	6.4	3.2	1.6
40	9.8	4.9	2.5	1.2
60	8.4	4.2	2.1	1.1
80	6.6	3.3	1.6	---
100	4.7	2.4	1.2	---



Vin = 230VAC

Load (%)	Life Time (years)			
	Ta = 30°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
20	10.0	6.8	3.4	1.7
40	10.0	5.5	2.7	1.4
60	9.1	4.5	2.3	1.1
80	8.0	4.0	2.0	---
100	6.3	3.2	1.6	---



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

5. ABNORMAL TEST

MODEL : DLP180-24-1

(1) Conditions

Input : 230VAC　　Output : 24V / 7.5A　　Ta : 25°C , 70%RH

(2) Test Results

(Da : Damaged)

No.	Test position		Test Mode		Test Results												
	Location No.	Test Point	Short	Oper	1 Fire	2 Smoke	3 Burst	4 Smel	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,D101,D102,R105, R106,R107,Q1
2		D-S	O							O	O			O			Da:D101,D102,R105,R106, R107
3		G-S	O													O	Input Power Increase(5W)
4		D		O												O	Input Power Increase(5W)
5		S		O												O	Input Power Increase(5W)
6		G		O												O	Input Power Increase(5W)
7	Q2	D-G	O							O	O			O			Da:Z102,D103,D101,D102, R105,R106,R107,Q2
8		D-S	O							O	O			O			Da:D103,R171,D101,D102, R105,R106,R107
9		G-S	O											O			
10		D		O										O			
11		S		O										O			
12		G		O						O	O			O			Da :D103,D101,D102,R105, R106,R107,Q2
13	D1	AC-AC	O								O			O			
14		AC-DC	O								O			O			
15		AC		O										O			
16		DC		O										O			
17	D2		O											O			
18				O						O	O			O			Da :D101,D102,R105,R106, R107,Q1
19	D51	K-A1	O													O	Output Voltage Low
20		K-A2	O													O	Output Voltage Low
21		K		O										O			
22		A1		O												O	Output Voltage Low
23		A2		O						O	O			O			Da:D101,D102,D103,R105, R106,R107,Q2
24	C6(C7)		O								O			O			Da:D101,D102,R105,R106, R107
25				O											O		

No.	Test position: Location No.	Test position: Test Point	Test Mode: Short	Test Mode: Open	Test Results: 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
26	C51		O										O	O			
27	(C52)			O												O	Output Ripple Increase
28	L3	11-12	O													O	Input Power Increase (18W)
29		1,2 – 9,10	O							O	O			O			Da:Q1,D101,D102,R105,R106, R107
30		1,2		O										O			
31		11		O												O	Input Power Increase (6W)
32		12		O												O	Input Power Increase (6W)
33	L55		O													O	Output Voltage Low
34				O										O			
35	T1	1-3	O											O			
37		5-6	O											O			
38		7,8-9,10	O										O	O			
39		10-11	O							O	O			O			Da:Q2,D101,D102,D103,R105, R106,R107
40		11-12	O										O	O			
41		1		O										O			
42		3		O										O			
43		5		O										O			
44	D104		O													O	Input Power Increase (12W)
45				O												O	Input Power Increase (5W)
46	D105		O													O	Input Power Increase (7W)
47				O												O	Input Power Increase (5W)
48	D106		O											O			
49				O												O	Output Voltage Unstable (2V)
50	R112		O												O		
51				O											O		
54	R117		O												O		
55				O						O	O			O			Da:Q2,D101,D102,D103,R105, R106,R107
56	PC101	1-2	O												O		
57		3-4	O									O		O			
58		1,2		O											O		
59		3,4		O											O		
60	PC102	1-2	O									O		O			
61		3-4	O											O			
62		1,2		O								O		O			
61		3,4		O								O		O			

6. VIBRATION TEST

MODEL : DLP180-24-1

(1) Vibration Test Class

Frequency Variable Endurance Test

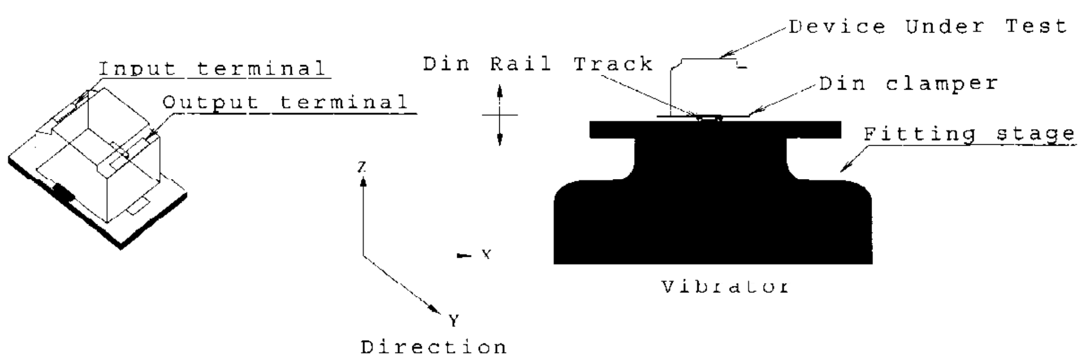
(2) Equipment Used

- 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

OK

Vin : 100VAC

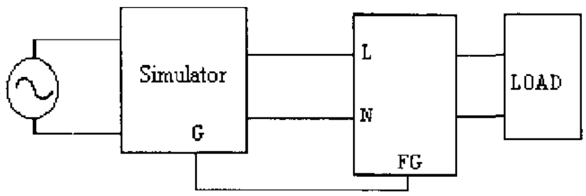
Iout : 100%

Check item		Output Voltage (V)	Ripple Voltage (mVp-p)	D.U.T.State
Before Test		24.024	55	————
After Test	X	24.033	50	O.K.
	Y	24.034	50	O.K.
	Z	24.035	50	O.K.

7. NOISE SIMULATE TEST

MODEL : DLP180-24-1

(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	• 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 : DLP180-24-1

(1) Equipment Used

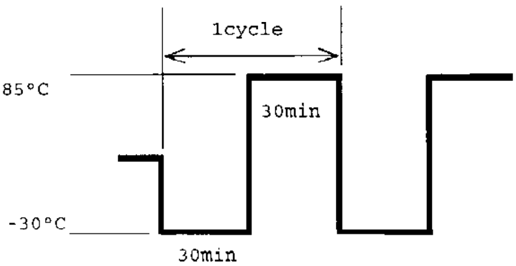
THERMAL SHOCK CHAMBER TSV-40 (TABAI ESPEC CORP.)

(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		24V TO	
Ripple Noise		mV	55		40	
Spike Noise		mV	60		64	
Line Regulation	MIN	V	23.950	0mV	23.979	1mV
	MAX	V	23.950		23.980	
Load Regulation	0%	V	23.990	40mV	24.010	31mV
	100%	V	23.950		23.979	
Efficiency	Pin	W	214.7	83.7%	216.4	83.1%
	Vout	V	23.950		23.979	
	Iout	A	7.5		7.5	
Solder Condition • etc.			————		OK	