DLP75-24-1

RELIABILITY DATA

DWG No. CA733-57-01			
QA APPD	APPD	CHK	DWG
J Murayama 4/Jun/03	30 May 2003	30/May/03	Li 27/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 DLP75-24-1

(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 ≒485,370(Hours)

2. COMPONENT DERATING

MODEL : DLP75-24-1

(1) Calculating Method

(a) Measuring Conditions

Input	:	100VAC	• Ambient temperature	:	50°C
Output	:	24V 3.1A(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

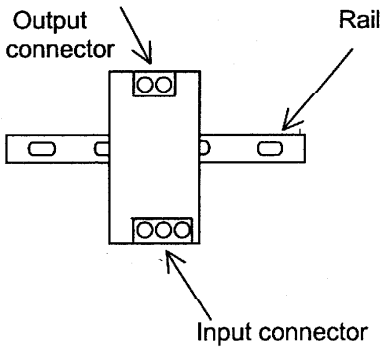
Location No.	Vin = 100VAC Load = 100% Ta = 50°C		
Q1 FS7KM-12A MITSUBISHI	Tchmax = 150 °C, Pch = 2.74W, Tch = Tc + ((θ ch-c) × Pch) = 127.18 °C D.F. = 84.8%	θ ch-c = 3.57 °C/W, Δ Tc = 67.4°C,	Pch(max) = 35W, Tc = 117.4°C
D1 D3SB60 SHINDENGEN	Tjmax = 150 °C, Pd = 0.7 W, Tj = Tc + ((θ j-c) × Pd) = 94.6 °C D.F. = 63.0%	θ j-c = 5.5 °C/W, Δ Tc = 40.7 °C,	Tc = 90.7 °C
D51 ESAD92M-02R FUJI-ELE.	Tjmax = 150 °C, Pd = 2.96 W, Tj = Tc + ((θ j-c) × Pd) = 134.9 °C D.F. = 89.9%	θ j-c = 2.0 °C/W, Δ Tc =79.0°C,	Tc =129.0 °C
Q101 HN1B01F-Y TOSHIBA	Tjmax = 125 °C, Pd =0.0 W, Tj = Ta + ((θ j-a) × Pd) =102.8°C D.F. =82.2 %	θ j-a = 333 °C/W, Δ Ta =52.8 °C,	Pd(max) = 300 mW, Ta= 102.8°C
Q102 2SD1628G-TD SANYO	Tjmax = 150 °C, Pd = 0.0 W, Tj = Ta + ((θ j-a) × Pd) = 100.4 °C D.F. = 66.9%	θ j-a = 250 °C/W, Δ Ta = 50.4°C,	Pd (max) = 500m W, Ta =100.4 °C
Q103 2SC3075 TOSHIBA	Tjmax = 150 °C, Pd = 0.0 W, Tj = Tc + ((θj-c) × Pch) = 70.0 °C D.F. = 46.7%	θ j-c = 12.5 °C/W, Δ Tc = 20.0°C,	Pd (max) = 1 W, Tc = 70.0 °C
Q104 HN1B01F-Y TOSHIBA	Tjmax = 125 °C, Pd =25.0 mW, Tj = Ta + ((θ j-a) × Pd) =82.5°C D.F. =60.5 %	θ j-a = 333 °C/W, Δ Ta =24.2 °C,	Pd(max) = 300 mW, Ta= 74.2°C
Q105 2SC3075 TOSHIBA	Tjmax = 150 °C, Pd = 0.75 W, Tj = Tc + ((θ j-c) × Pd) = 90.8 °C D.F. = 58.0%	θ j-c = 12.5 °C/W, Δ Tc = 31.4°C,	Pd (max) = 1 W, Tc = 81.4 °C
Q301 2SC2712-Y TOSHIBA	Tjmax = 125 °C, Pd = 9.0 mW, Tj = Ta + ((θ j-a) × Pd) = 89.3 °C D.F. = 71.4%	θ j-a = 667 °C/W, Δ Ta = 33.3°C,	Pd (max) = 150mW, Ta = 83.3 °C
A401 UPC1093T-E1 NEC	Tjmax = 150 °C, Pd = 24.0 mW, Tj = Ta + ((θ j-a) × Pd) =97.5°C D.F. =65.0%	θ j-a = 315 °C/W, Δ Ta = 39.9 °C,	Pd(max) = 400mW, Ta = 89.9 °C
SR1 SM8JZ47A TOSHIBA	Tjmax = 125 °C, Pd = 1.0 W, Tj = Ta + ((θ j-c) × Pd) = 92.4 °C D.F. = 73.9%	θ j-c = 3.6 °C/W, Δ Tc = 38.8°C,	Tc = 88.8 °C
PC101 PS2581L2-E3(D) (LED) NEC	Tjmax = 125 °C, Id = 0.0 mA, ALLOWABLE I_F(max) = 32.0mA (at Ta = 94.2°C) D.F. = 0%	θ j-a = 667°C/W, Δ Ta = 44.2 °C,	Pd(max) = 150mW, Ta = 94.2 °C
PC101 PS2581L2-E3(D) (Transistor) NEC	Tjmax = 125 °C, Pd = 0.0 W, Tj = Ta + ((θ j-a) × Pd) = 94.2 °C D.F. = 75.4%	θ j-a = 667 °C/W, Δ Ta = 44.2°C,	Pd(max) = 150mW, Ta = 94.2 °C
PC102 PS2581L2-E3(D) (LED) NEC	Tjmax = 125 °C, Id = 1.2 mA, ALLOWABLE I_F(max) = 32.0mA (at Ta = 95.5°C) D.F. = 3.75%	θ j-a = 667°C/W, Δ Ta = 45.5 °C,	Pd(max) = 150mW, Ta = 95.5 °C
PC102 PS2581L2-E3(D) (Transistor) NEC	Tjmax = 125 °C, Pd = 13.0 mW, Tj = Ta + ((θ j-a) × Pd) = 104.1 °C D.F. = 83.3%	θ j-a = 667 °C/W, Δ Ta = 45.5°C,	Pd(max) = 150mW, Ta = 95.5 °C

D101 1SS184 TOSHIBA	Tjmax = 125 °C, Pd= 0.0 W, Tj = Ta + ((θ j-a) × Pd) =104.8 °C D.F. = 83.8%	θ j-a = 667 °C/W, Δ Ta =54.8 °C,	Pd(max) = 150mW, Ta =104.8 °C
D102 D1F60-4063 SHINDENGEN	Tjmax = 150 °C, Pd = 14.0 mW, Tj = Tl + ((θ j-l) × Pd) = 132.2 °C D.F. = 88.1%	θ j-l = 23 °C/W, Δ Tl = 81.9°C,	Tl = 131.9 °C
D103 D1F60-4063 SHINDENGEN	Tjmax = 150 °C, Pd = 14.0 mW, Tj = Tl + ((θ j-l) × Pd) = 130.7 °C D.F. = 87.1%	θ j-l = 23 °C/W, Δ Tl = 80.4°C,	Tl = 130.4°C
D104 U05NU44-TE12L TOSHIBA	Tjmax = 150 °C, Pd = 6.0 mW, Tj = Ta + ((θ j-a) × Pd) = 85.0°C D.F. = 56.6%	θ j-a = 110 °C/W, Δ Ta = 34.3 °C,	Ta = 84.3 °C
D106 1SS184 TOSHIBA	Tjmax = 125 °C, Pd = 2.2 mW, Tj = Ta + ((θ j-a) × Pd) =101.1 °C D.F. =80.9 %	θ j-a = 667 °C/W, Δ Ta = 49.6°C,	Pd(max) = 150mW, Ta = 99.6 °C
D301 CRH01 TOSHIBA	Tjmax = 150 °C, Pd = 3.1 mW, Tj = Ta + ((θ j-a) × Pd) = 92.4 °C D.F. = 61.6%	θ j-a = 130 °C/W, Δ Ta = 42.0 °C,	Ta = 92.0 °C
D302 1SS184 TOSHIBA	Tjmax = 125 °C, Pd = 0.0W, Tj = Ta + ((θ j-a) × Pd) =81.4 °C D.F. =65.1 %	θ j-a = 667°C/W, Δ Ta = 31.4°C,	Pd(max) = 150mW, Ta = 81.4 °C
Z101 02CZ3.6-Z TOSHIBA	Tjmax = 150 °C, Pd = 0 .0W, Tj = Ta + ((θ j-a) × Pd) = 94.4 °C D.F. = 62.9%	θ j-a = 625 °C/W, Δ Ta = 44.4 °C,	Pd(max) = 0.2 W Ta = 94.4 °C
Z102 U1ZB27 TOSHIBA	Tjmax = 150 °C, Pd = 0 .0W, Tj = Ta + ((θ j-a) × Pd) = 91.8 °C D.F. = 61.2%	θ j-a = 125 °C/W, Δ Ta = 41.8 °C,	Pd(max) = 1.0 W Ta = 91.8 °C
Z103 02CZ11-X TOSHIBA	Tjmax = 150 °C, Pd = 0.0 W, Tj = Ta + ((θ j-a) × Pd) = 70.3 °C D.F. = 46.9%	θ j-a = 625 °C/W, Δ Ta = 20.3°C,	Pd(max) = 0.2 W Ta = 70.3 °C
Z104 02CZ5.6-Y TOSHIBA	Tjmax = 150 °C, Pd = 2.2 mW, Tj = Ta + ((θ j-a) × Pd) = 77.9 °C D.F. = 51.9%	θ j-a = 625 °C/W, Δ Ta = 26.6 °C,	Pd(max) = 0.2 W Ta = 76.6 °C
Z105 02CZ3.6-Z TOSHIBA	Tjmax = 150 °C, Pd = 3.7 m W, Tj = Ta + ((θ j-a) × Pd) = 103.4 °C D.F. = 68.9%	θ j-a = 625 °C/W, Δ Ta = 51.1 °C,	Pd(max) = 0.2 W Ta = 101.1 °C
Z201 MA3330-L-TX MATSUSHITA	Tjmax = 150 °C, Pd = 0.0 W, Tj = Ta + ((θ j-a) × Pd) = 87.4 °C D.F. = 58.3%	θ j-a = 625 °C/W, Δ Ta = 37.4 °C,	Pd(max) = 0.2 W Ta = 87.4 °C
Z301 02CZ18-X TOSHIBA	Tjmax = 150 °C, Pd = 9.9mW, Tj = Ta + ((θ j-a) × Pd) = 94.1 °C D.F. = 62.7%	θ j-a = 625 °C/W, Δ Ta = 37.9 °C,	Pd(max) = 0.2 W Ta = 87.9 °C

3. MAIN COMPONENTS TEMPERATURE RISE ΔT LIST

MODEL : DLP75-24-1

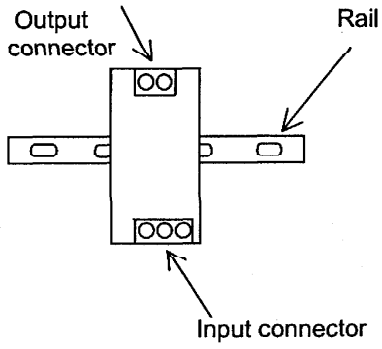
Measuring Conditions

Mounting Method (Standard Mounting)	
Input Voltage (VAC)	100
Output Voltage (VDC)	24
Output Current (A)	3.1

※ Condition Ta = 50°C , Convection cooling .

Output Derating (100%) Ta = 50°C		Standard Mounting
Location No.	Parts Name	ΔT Temperature rise (°C)
A401	SHUNT REG.	39.9
C5	CAP., ELEC.	21.3
C6	CAP., ELEC.	30.3
C7	CAP., ELEC.	18.9
C51	CAP., ELEC.	38.1
C52	CAP., ELEC.	36.7
C53	CAP., ELEC.	36.4
C54	CAP., ELEC.	34.0
D1	BRIDGE DIODE	40.7
D2	DIAC	31.6
D51	L.L.D	79.0
D102	CHIP DIODE	81.9
D103	CHIP DIODE	80.4
L1	BALUN COIL	46.9
L51	INDUCTOR	43.6
PC102	PHOTO COUPLER	45.5
Q1	MOS FET	67.4
Q102	CHIP TRANSISTER	50.4
Q103	CHIP TRANSISTER	20.0
Q105	CHIP TRANSISTER	31.4
SR1	TRIAC	38.8
T1	TRANSE PULSE	67.8

Measuring Conditions

Mounting Method (Standard Mounting)	
Input Voltage (VAC)	230
Output Voltage (VDC)	24
Output Current (A)	3.1

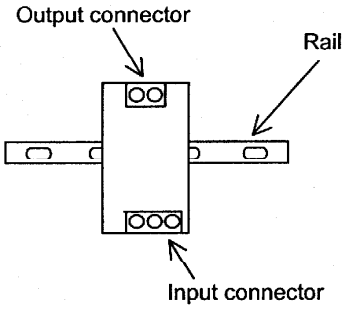
※ Condition Ta = 50°C , Convection cooling .

Output Derating (100%) Ta = 50°C		Standard Mounting
Location No.	Parts Name	ΔT Temperature rise (°C)
A401	SHUNT REG.	37.7
C5	CAP., ELEC.	19.3
C6	CAP., ELEC.	27.5
C7	CAP., ELEC.	18.6
C51	CAP., ELEC.	35.7
C52	CAP., ELEC.	34.2
C53	CAP., ELEC.	32.6
C54	CAP., ELEC.	29.0
D1	BRIDGE DIODE	33.6
D2	DIAC	20.0
D51	L.L.D	77.0
D102	CHIP DIODE	81.1
D103	CHIP DIODE	79.7
L1	BALUN COIL	30.8
L51	INDUCTOR	41.0
PC102	PHOTO COUPLER	44.6
Q1	MOS FET	65.1
Q102	CHIP TRANSISTER	49.4
Q103	CHIP TRANSISTER	35.4
Q105	CHIP TRANSISTER	35.6
SR1	TRIAC	29.2
T1	TRANSE PULSE	66.4

4. ELECTROLYTIC CAPACITOR LIFETIME

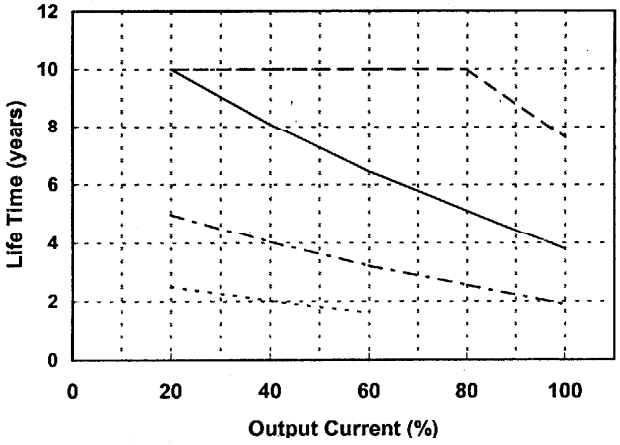
MODEL: DLP75-24-1

STANDARD MOUNTING



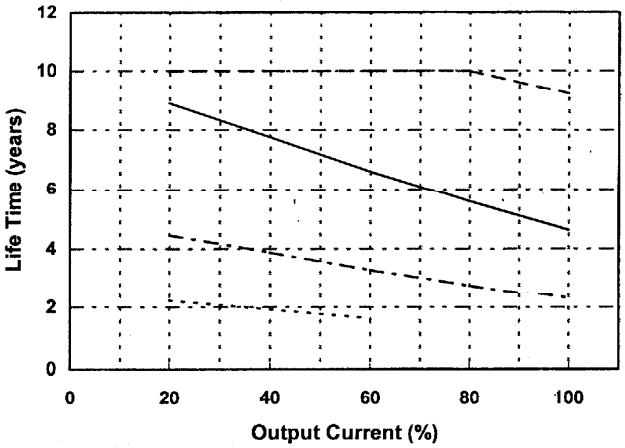
Vin = 100VAC

Load (%)	Life Time (years)			
	Ta = 30°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
20	10.0	10.0	5.0	2.5
40	10.0	8.1	4.0	2.0
60	10.0	6.4	3.2	1.6
80	10.0	5.1	2.6	---
100	7.6	3.8	1.9	---



Vin = 230VAC

Load (%)	Life Time (years)			
	Ta = 30°C	Ta = 40°C	Ta = 50°C	Ta = 60°C
20	10.0	8.9	4.5	2.2
40	10.0	7.8	3.9	1.9
60	10.0	6.6	3.3	1.7
80	10.0	5.6	2.8	---
100	9.2	4.6	2.3	---



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

5. ABNORMAL TEST

MODEL : DLP75-24-1

(1) Conditions

Input : 230VAC Output : 24V / 3.1A 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-S	O							O	O			O			Da:R122,Z102,Q1,Z101,F1
2		D-G	O							O	O			O			Da:Z102,F1,Q1,R122,Z101
3		G-S	O											O			
4		D		O										O			
5		S		O										O			
6		G		O						O	O			O			Da:R122,Z102,Z101,F1,Q1
7	Q102	C-E	O											O			
8		C-B	O											O			
9		B-E	O							O	O			O			Da:R122,Z102,Q1,F1
10		C		O						O	O			O			Da:R122,Z102,Q1,F1
11		E		O						O	O			O			Da:R122,Z102,Q1,F1
12		B		O						O	O				O		Da:Q1,R122,Z102,Z101,F1
13	Q103	C-E	O												O		
14		C-B	O												O		
15		B-E	O												O		
16		C		O											O		
17		E		O											O		
18		B		O											O		
19	Q105	C-E	O							O						O	Da:Q105,Q104,Z104, R135,R123,R124,R141
20		C-B	O							O						O	Da:Q104,Z104,R123, R124,R141
21		B-E	O												O		
22		C		O											O		
23		E		O											O		
24		B		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
25	D1	AC-AC	O								O			O			
26		AC-DC	O								O			O			
27		AC		O										O			
28		DC		O										O			
29	D2		O												O		
30				O											O		
33	D101		O												O		
34				O											O		
35	D102(D103)		O							O	O			O			Da:R122,Z102,Q1
36				O											O		
31	D104		O							O							Da:R123,R124
32				O											O		
37	D106		O							O	O			O			Da:R122,Z102,Q1,F1
38				O								O		O			
39	D51		O							O	O			O			Da:R122,Z102,Q1,F1
40				O										O			
41	D301		O											O			
42				O												O	PD51 OFF
43	D302		O													O	PD52 ON
44				O											O		
45	SR1	T1-T2	O							O	O			O			Da:Q1,R122,Z102, Z101,F1
46		T1-G	O												O		
47		T2-G	O							O	O			O			Da:Q1,R122,Z102,Z101,F1
48		T1		O											O		
49		T2		O											O		
50		G		O											O		
51	Z103		O												O		
52				O											O		
53	Z104		O												O		
54				O											O		
55	Z102		O											O			
56				O											O		
57	Z201		O									O		O			
58				O											O		
59	Z301		O												O		
60				O											O		

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
61	A401	A-K	O													O	O/P low
62		K-R	O													O	O/P low
63		R-A	O									O		O			
64		A		O								O		O			
65		K		O								O		O			
66		R		O								O		O			
67	PC101	1-2	O												O		
68		3-4	O									O		O			
69		1,2		O											O		
70		3,4		O											O		
71	PC102	1-2	O									O		O			
72		3-4	O											O			
73		1,2		O								O		O			
74		3,4		O								O		O			
75	C5(C6)		O												O	O	C6(C5) hot
76				O												O	Input power increase 10W
79	C51(C52)		O										O	O			
80				O												O	Output ripple increase
81	L51		O													O	Output ripple increase
82				O										O			
83	T1	1-2	O							O	O			O			Da:Q1,R122,Z102,Z101,F1
84		6-7	O											O			
85		7-8	O											O			
86		12-13	O							O	O			O			Da:Q1,R122,Z102,Z101,F1
87		15-16	O													O	Input power increase 24W
88		3		O										O			
89		6		O						O	O			O			Da:R122,Z102,Z101,F1,Q1
90		8		O								O		O			
91		10(11,12)		O											O		
92		16		O											O		

6. VIBRATION TEST

MODEL : DLP75-24-1

(1) Vibration Test Class

Frequency Variable Endurance Test

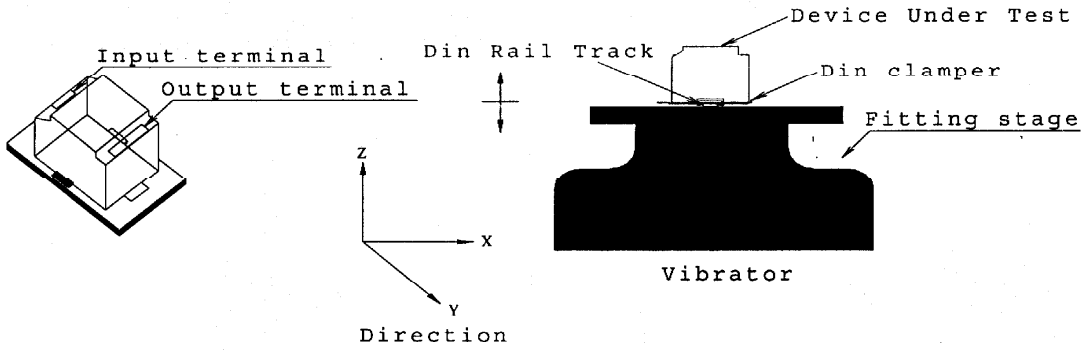
(2) Equipment Used

- 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

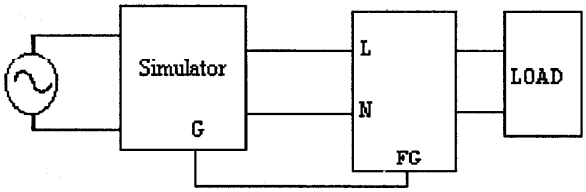
Iout : 100%

Check item		Output Voltage (V)	Ripple Voltage (mVp-p)	D.U.T.State
Before Test		24.009	.16	————
After Test	X	24.013	12	O.K.
	Y	24.015	12	O.K.
	Z	24.014	12	O.K.

7. NOISE SIMULATE TEST

MODEL : DLP75-24-1

(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
• Pulse Width	:	50ns ~ 1000ns	• Trigger Select	:	Common 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 : DLP75-24-1

(1) Equipment Used

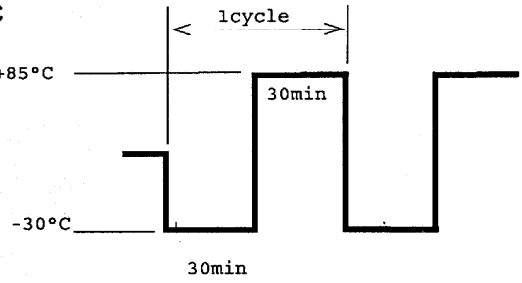
THERMAL SHOCK CHAMBER TSV-40 (TABAI ESPEC CORP.)

(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	7		8	
Spike Noise		mV	8		12	
Line Regulation	MIN MAX	V V	23.939 23.939	0mV	23.912 23.915	3mV
Load Regulation	0% 100%	V V	23.970 23.939	31mV	23.937 23.912	25mV
Efficiency	Pin Vout Iout	W V A	89.10 23.935 3.1	83.3%	89.90 23.912 3.1	82.4%
Solder Condition • etc.			———		OK	