Z+600 Series

RELIABILITY DATA

DWG No.: IA712-79-01		
APPD	CHK	DWG
24/3/13	24/3/13	10/03/13

TDK-Lambda

INDEX

Terminology used

FG..... Frame Ground

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

1. Calculated value of MTBF

MODEL : 10V-60A

(1) Calculating Method

Method of calculation according to MIL-HDBK-217F.
Individual failure rates is given to each part, and MTBF is calculated by the count of each part.

Formula:

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

Where:

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

λ_G = Generic Failure Rate For The i th Generic Part (Failure / 10^6 Hours)

N_i = Quantity of i th Generic Part

n = Number of Different Generic Part Categories

π_Q = Generic Quality factor for the i th Generic Part (π_Q = 1)

(2) MTBF Values

G_F : (GROUND, FIXED)

MTBF = 72,221 (HOURS)

(MTBF calculation for fan isn't included.)

2. Components derating

MODEL : 10V-60A

(1) Calculation method

1. Measuring Conditions

Input: 100 , 200Vac　　Ambient temperature: 50°C

Output: 10V - 60A (100%)　　Mounting Method: Standard Mounting

2. Semiconductors

Compared with maximum junction temperature and actual one which is calculated based on on case temperature, power dissipation and thermal impedance.

3. IC, Resistors, Capasitors, etc.

Ambient temperature, operating conditions, power dissipation and so on are within derating criteria.

4. Calculation Method of Thermal Impedance:

$$\Theta_{j-c} = \frac{T_{j(\max)} - T_c}{P_{c(\max)}} \qquad \Theta_{j-a} = \frac{T_{j(\max)} - T_a}{P_{c(\max)}}$$

Tc : Case temperature at start point of derating; 25°C in general

Ta : Ambient temperature at start point of derating; 25°C in General

$Pc(\max)$: Maximum power dissipation

$Tj(\max)$: Maximum junction temperature

Θ_{j-c} : Thermal impedance between junction and case

Θ_{j-a} : Thermal impedance between junction and air

(2) Component derating list

Location No.	Vin = 100Vac Load=100% Ta=50°C								
A101	Tjmax=	150	°C	θj-a =	125.0	°C/W			
L4981AD013TR	Pd =	0.23	W	ΔTa =	26.0	°C	Ta =	76.0	°C
ST	Tj = Ta + (θ j-a x Pd) =>			Tj =	104.8	°C	D.F. =	69.8	%
D101	Tjmax=	150	°C	θj-c =	0.6	°C/W			
GBJ2506-F	Pd =	11.0	W	ΔTc =	51.0	°C	Tc =	101.0	°C
DIODES	Tj = Tc + (θ j-c x Pd) =>			Tj =	107.6	°C	D.F. =	71.7	%
D105	Tjmax=	150	°C	θj-c =	130.0	°C/W			
CRH01(TE85L,Q)	Pd =	0.077	W	ΔTc =	15.0	°C	Tc =	65.0	°C
TOSHIBA	Tj = Tc + (θ j-c x Pd) =>			Tj =	75.0	°C	D.F. =	50.0	%
D106	Tjmax=	175	°C	θj-c =	1.5	°C/W			
IDH08SG60C	Pd =	3.9	W	ΔTc =	42.0	°C	Tc =	92.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	97.8	°C	D.F. =	55.9	%
D117	Tjmax=	175	°C	θj-c =	0.85	°C/W			
STPS3045CT	Pd =	8.55	W	ΔTc =	57.0	°C	Tc =	107.0	°C
ST	Tj = Tc + (θ j-c x Pd) =>			Tj =	114.3	°C	D.F. =	65.3	%
PC101	Tjmax=	125	°C	θj-c =	1.67	°C/W			
PS2801-1-F3-A(P)	Pd =	0.06	W	ΔTc =	34.0	°C	Tc =	84.0	°C
NEC	Tj = Tc + (θ j-c x Pd) =>			Tj =	84.1	°C	D.F. =	67.3	%
Q101	Tjmax=	150	°C	θj-c =	0.29	°C/W			
IPW60R045CP	Pd =	13.51	W	ΔTc =	40.0	°C	Tc =	90.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	93.9	°C	D.F. =	62.6	%
Q105	Tjmax=	150	°C	θj-c =	0.8	°C/W			
IPP60R099CP	Pd =	3.72	W	ΔTc =	63.0	°C	Tc =	113.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	116.0	°C	D.F. =	77.3	%
Q118	Tjmax=	150	°C	θj-c =	1.316	°C/W			
2SK3595-01MR	Pd =	1.1	W	ΔTc =	51.0	°C	Tc =	101.0	°C
FUJI	Tj = Tc + (θ j-c x Pd) =>			Tj =	102.4	°C	D.F. =	68.3	%
SC101	Tjmax=	125	°C	θj-c =	1.2	°C/W			
CR12CM-12A B00	Pd =	2.0	W	ΔTc =	31.0	°C	Tc =	81.0	°C
RENESAS	Tj = Tc + (θ j-c x Pd) =>			Tj =	83.3	°C	D.F. =	66.7	%

Location No.	Vin = 100Vac			Load=100%	Ta=50°C			
A105	Tjmax=	150	°C	θj-c =	0.0031	°C/W		
SN65220DBVRG4	Pd =	0.2	W	ΔTc =	15.0	°C	Tc =	65.0 °C
TI	Tj = Tc + (θ j-c x Pd) =>			Tj =	65.0	°C	D.F. =	43.3 %
A141	Tjmax=	125	°C	θj-a =	180.0	°C/W		
LM78L15ACMNOPB	Pd =	0.04	W	ΔTa =	16.0	°C	Ta =	66.0 °C
NATIONAL	Tj = Ta + (θ j-a x Pd) =>			Tj =	73.2	°C	D.F. =	58.6 %
A142	Tjmax=	150	°C	θj-c =	3.0	°C/W		
MIP2E4DMY	Pd =	1.4	W	ΔTc =	24.0	°C	Tc =	74.0 °C
MATSUSHITA	Tj = Tc + (θ j-c x Pd) =>			Tj =	78.2	°C	D.F. =	52.1 %
A145	Tjmax=	125	°C	θj-a =	230.9	°C/W		
LM78L05ACMNOPB	Pd =	0.04	W	ΔTa =	21.0	°C	Ta =	71.0 °C
NATIONAL	Tj = Ta + (θ j-a x Pd) =>			Tj =	80.2	°C	D.F. =	64.2 %
A148	Tjmax=	125	°C	θj-c =	4.0	°C/W		
LM3940IT-3.3NOPB	Pd =	2.0	W	ΔTc =	15.0	°C	Tc =	65.0 °C
NATIONAL	Tj = Tc + (θ j-c x Pd) =>			Tj =	73.0	°C	D.F. =	58.4 %
A149	Tjmax=	150	°C	θj-c =	3.0	°C/W		
L4941BV	Pd =	2.0	W	ΔTc =	12.0	°C	Tc =	62.0 °C
ST	Tj = Tc + (θ j-c x Pd) =>			Tj =	68.0	°C	D.F. =	45.3 %
PC114	Tjmax=	125	°C	θj-c =	0.66	°C/W		
PS2581L2-E3-A(D)	Pd =	0.15	W	ΔTc =	15.0	°C	Tc =	65.0 °C
NEC	Tj = Tc + (θ j-c x Pd) =>			Tj =	65.1	°C	D.F. =	52.1 %
Q129	Tjmax=	175	°C	θj-c =	0.9	°C/W		
IPI037N06L3 G	Pd =	1.30	W	ΔTc =	36.0	°C	Tc =	86.0 °C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	87.2	°C	D.F. =	49.8 %

(2) Component derating list

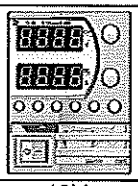
Location No.	Vin = 200Vac			Load=100%		Ta=50°C			
A101	Tjmax=	150	°C	θj-a =	125.0	°C/W			
L4981AD013TR	Pd =	0.23	W	ΔTa =	22.0	°C	Ta =	72.0	°C
ST	Tj = Ta + (θ j-a x Pd) =>			Tj =	100.8	°C	D.F. =	67.2	%
D101	Tjmax=	150	°C	θj-c =	0.6	°C/W			
GBJ2506-F	Pd =	5.4	W	ΔTc =	32.0	°C	Tc =	82.0	°C
DIODES	Tj = Tc + (θ j-c x Pd) =>			Tj =	85.2	°C	D.F. =	56.8	%
D105	Tjmax=	150	°C	θj-c =	130.0	°C/W			
CRH01(TE85L,Q)	Pd =	0.091	W	ΔTc =	17.0	°C	Tc =	67.0	°C
TOSHIBA	Tj = Tc + (θ j-c x Pd) =>			Tj =	78.8	°C	D.F. =	52.6	%
D106	Tjmax=	175	°C	θj-c =	1.5	°C/W			
IDH08SG60C	Pd =	3.15	W	ΔTc =	29.0	°C	Tc =	79.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	83.7	°C	D.F. =	47.8	%
D117	Tjmax=	175	°C	θj-c =	0.85	°C/W			
STPS3045CT	Pd =	8.55	W	ΔTc =	54.0	°C	Tc =	104.0	°C
ST	Tj = Tc + (θ j-c x Pd) =>			Tj =	111.3	°C	D.F. =	63.6	%
PC101	Tjmax=	125	°C	θj-c =	1.67	°C/W			
PS2801-1-F3-A(P)	Pd =	0.06	W	ΔTc =	31.0	°C	Tc =	81.0	°C
NEC	Tj = Tc + (θ j-c x Pd) =>			Tj =	81.1	°C	D.F. =	64.9	%
Q101	Tjmax=	150	°C	θj-c =	0.29	°C/W			
IPW60R045CP	Pd =	6.22	W	ΔTc =	24.0	°C	Tc =	74.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	75.8	°C	D.F. =	50.5	%
Q105	Tjmax=	150	°C	θj-c =	0.8	°C/W			
IPP60R099CP	Pd =	3.72	W	ΔTc =	62.0	°C	Tc =	112.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	115.0	°C	D.F. =	76.7	%
Q118	Tjmax=	150	°C	θj-c =	1.316	°C/W			
2SK3595-01MR	Pd =	1.1	W	ΔTc =	47.0	°C	Tc =	97.0	°C
FUJI	Tj = Tc + (θ j-c x Pd) =>			Tj =	98.4	°C	D.F. =	65.6	%
SC101	Tjmax=	125	°C	θj-c =	1.2	°C/W			
CR12CM-12A B00	Pd =	2.0	W	ΔTc =	22.0	°C	Tc =	72.0	°C
RENESAS	Tj = Tc + (θ j-c x Pd) =>			Tj =	74.3	°C	D.F. =	59.5	%

Location No.	Vin = 200Vac Load=100% Ta=50°C								
A105	Tjmax=	150	°C	θj-c =	0.0031	°C/W			
SN65220DBVRG4	Pd =	0.246	W	ΔTc =	11.0	°C	Tc =	61.0	°C
TI	Tj = Tc + (θ j-c x Pd) =>			Tj =	61.0	°C	D.F. =	40.7	%
A141	Tjmax=	125	°C	θj-a =	180.0	°C/W			
LM78L15ACMNOPB	Pd =	0.04	W	ΔTa =	15.0	°C	Ta =	65.0	°C
NATIONAL	Tj = Ta + (θ j-a x Pd) =>			Tj =	72.2	°C	D.F. =	57.8	%
A142	Tjmax=	150	°C	θj-c =	3.0	°C/W			
MIP2E4DMY	Pd =	1.4	W	ΔTc =	23.0	°C	Tc =	73.0	°C
MATSUSHITA	Tj = Tc + (θ j-c x Pd) =>			Tj =	77.2	°C	D.F. =	51.5	%
A145	Tjmax=	125	°C	θj-a =	230.9	°C/W			
LM78L05ACMNOPB	Pd =	0.04	W	ΔTa =	21.0	°C	Ta =	71.0	°C
NATIONAL	Tj = Ta + (θ j-a x Pd) =>			Tj =	80.2	°C	D.F. =	64.2	%
A148	Tjmax=	125	°C	θj-c =	4.0	°C/W			
LM3940IT-3.3NOPB	Pd =	2.0	W	ΔTc =	12.0	°C	Tc =	62.0	°C
NATIONAL	Tj = Tc + (θ j-c x Pd) =>			Tj =	70.0	°C	D.F. =	56.0	%
A149	Tjmax=	150	°C	θj-c =	3.0	°C/W			
L4941BV	Pd =	2.0	W	ΔTc =	12.0	°C	Tc =	62.0	°C
ST	Tj = Tc + (θ j-c x Pd) =>			Tj =	68.0	°C	D.F. =	45.3	%
PC114	Tjmax=	125	°C	θj-c =	0.66	°C/W			
PS2581L2-E3-A(D)	Pd =	0.15	W	ΔTc =	12.0	°C	Tc =	62.0	°C
NEC	Tj = Tc + (θ j-c x Pd) =>			Tj =	62.1	°C	D.F. =	49.7	%
Q129	Tjmax=	175	°C	θj-c =	0.9	°C/W			
IPI037N06L3 G	Pd =	1.30	W	ΔTc =	35.0	°C	Tc =	85.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	86.2	°C	D.F. =	49.2	%

3. Main components temperature rise

MODEL : 10V-60A

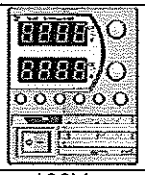
Condition:

Standard Mounting	
Output Voltage	10V
Output Current	60A
Ta	50°C

Location No.	Parts Name	ΔT Temperature Rise (°C)	
		100Vac	200Vac
A101	CHIP PFC IC	25.7	22.3
C101	FILM CAPACITOR	27.9	18.9
C102	FILM CAPACITOR	19.0	11.4
C103	CERAMIC CAPACITOR	23.4	15.3
C105	FILM CAPACITOR	16.9	13.3
C111	FILM CAPACITOR	16.7	11.5
C113	CERAMIC CAPACITOR	3.7	3.4
C116	ELEC. CAPACITOR	8.8	7.6
C140	FILM CAPACITOR	46.3	42.2
C148	ELEC. CAPACITOR	39.3	34.4
D101	BRIDGE	51.2	29.3
D106	DIODE	41.9	28.5
D120	DIODE	58.8	56.2
D117	DIODE	56.7	54.2
F101	FUSE	33.3	19.1
L101	COMMON CHOKE	30.5	17.7
L102	COMMON CHOKE	34.5	20.2
L103	PF CHOKE	40.7	34.1
L104	CHOKE	36.9	36.1
PC101	OPTO COUPLER	33.8	30.6
PC118	OPTO COUPLER	12.6	12.4
Q101	MOSFET	39.4	23.7
Q105	MOSFET	62.5	61.9
R199	RES. SHUNT	55.0	49.8
T101	TRANSFORMER	72.5	72.1
T102	TRANSFORMER	19.4	18.6
T103	TRANSFORMER	22.0	21.4
A107	DIGITAL ISOLATOR	16.8	15.4
A115	MICROCONTROLLER	15.3	13.6
A141	LINEAR REGULATOR	15.9	14.7
A142	TOP SWITCH	23.6	23.2
A145	LINEAR REGULATOR	21.0	20.5
D125	DIODE	14.1	13.7
D130	DIODE	14.1	13.7
D133	DIODE	14.1	13.7
T201	TRANSFORMER	22.2	21.6
ZD116	ZENER	15.9	14.7
ZD123	ZENER	14.1	13.7

4. Electrolytic capacitor lifetime

Condition:

Standard Mounting	
Input Voltage	100Vac

	COMPUTED LIFE (year) at T(ambient)		
LOAD (%)	**30°C**	**40°C**	**50°C**
20	10.0	10.0	10.0
40	10.0	10.0	9.0
60	10.0	10.0	5.8
80	10.0	6.6	3.3
100	10.0	5.5	2.7

5. Abnormal test

MODEL : 10V-60A

(1) Test condition and circuit:

Input Voltage: 100Vac Output: 10V 60A Ta : 50°C

(2) Test results

No.	Test Position		Test Mode		Test Result												
	Location	Test point	Short	Open	1 Fire	2 Smoke	3 Burst	4 Smell	5 Red hot	6 Damaged	7 Fuse open	8 OVP	9 OTP	10 No output	11 No change	12 Others	Note
1	A141	2-8	•											•			
2	A142	1-3	•							•	•			•			A142, ZD120 - damaged, F101 opened
		2-3	•								•			•			F102 opened
		1		•						•				•			A142, ZD120- damaged
3	A143	3-5	•											•			
4	A145	2-8	•											•			
5	A149	1-2	•											•			
6	C115		•							•	•			•			F101 opened, Q101, D103, D106- damaged
7	C147		•											•			Pin decrease
8	C301		•											•			
9	D101	1-2	•								•			•			F101 opened
		1		•										•			
10	D103	A-K	•							•	•			•			F101 opened, Q101, D106 - damaged
		A		•										•			
11	D105	A-K	•												•		
		A		•						•	•			•			F101 opened, Q101, R123, R124 - damaged
12	D106	1-2	•							•	•			•			F101 opened, Q101 damaged
		1		•						•	•			•			F101 opened, Q101 damaged
13	D107	A-K	•													•	Pin and Vout increase
14	D117	A-K	•											•			
		K		•											•		
15	D124	A-K	•											•			
16	D129	A-K	•											•			
17	D130	A-K	•											•			
18	D135	A-K	•													•	Pin increase, No display
19	D136	A-K	•											•			
20	L104	1-2	•											•			
21	Q101	D-S	•								•			•			F101 opened
		G-S	•							•				•			R135, R136, R137 -damaged
		D-G	•							•	•			•			F101 opened, Q101 damaged
		D		•										•			
		G		•						•	•			•			F101 opened, Q101 damaged
		S		•										•			
22	Q102	C-E	•							•				•			R135, R136 - damaged
		B-E	•												•		
		C-B	•							•	•			•			F101 opened, Q101 damaged
		B		•										•			

5. Abnormal test

MODEL : 10V-60A

(1) Test condition and circuit:

Input Voltage: 100Vac Output: 10V 60A Ta : 50°C

(2) Test results

No.	Test Position		Test Mode		Test Result												
					1	2	3	4	5	6	7	8	9	10	11	12	
	Location	Test point	Short	Open	Fire	Smoke	Burst	Smell	Red hot	Damaged	Fuse open	OVP	OTP	No output	No change	Others	Note
23	Q103	C-E	•							•				•			R135, R136, R137 - damaged
		B-E	•												•		
		C-B	•							•				•			R137 damaged
		B		•						•	•			•			F101 opened, Q101 damaged
24	Q104	D-S	•							•	•			•			F101 opened, Q101, Q106, D103, D106, R176, R177 - damaged
		G-S	•											•			Pin decrease
		D-G	•							•	•			•			F101 opened, Q101, D103, D106, Q104-Q107 - damaged
		D		•										•			Pin decrease
		G		•										•			Pin decrease
		S		•						•				•			Pin decrease, D107, Q104, Q107, Q108, R164, R165 - damaged
25	Q108	D-S	•											•			Pin decrease
		D-G	•											•			Pin decrease
		G		•						•	•			•			F101 opened, Q101, D103, Q104-Q107 - damaged
		S		•						•	•			•			F101 opened, Q101, D103, Q104-Q107 - damaged
26	Q112	C-E	•							•				•			R181, R182 - damaged
		C-B	•							•				•			R181, R182 - damaged
		B		•											•		
		E		•											•		
27	Q118	D-S	•								•				•		F102 opened
		D-G	•								•				•		F102 opened
		G		•											•		
		S		•											•		
28	R123			•											•		
29	T101	1-4	•							•	•			•			F101 opened, Q101, D103, D106, Q104-Q107 - damaged
		1-7	•							•	•			•			F101 opened, Q101, D103, Q104-Q107 - damaged
30	T102	1-2	•													•	Display not stable
31	T103	1-2	•							•				•			R181, R182 - damaged
32	T201	1-3	•											•			
		4-5	•											•			
		6-7	•											•			
		7-8	•											•			
		9-10	•									•		•			OVP
		A-B	•											•			
33	ZD101	A-K	•							•				•			R135, R136, R137 - damaged

6. Vibration test

MODEL: 10V-60A

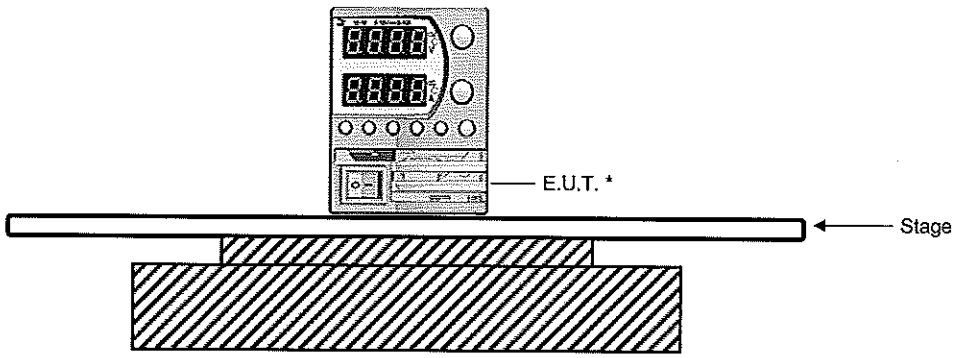
(1) Vibration test class

Frequency variable endurance test

(2) Equipment used

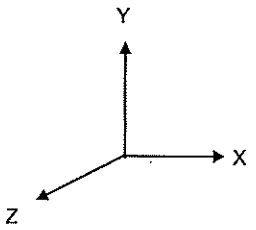
Name	Manufacturer	Model
Vibration Test System	Ling Dynamic Systems	V875
Laser Shaker Control System	DACTRON	LASER
Isotron Accelerometer 98.2 mV/g	Dytran instruments Inc.	3256A2
Isotron Accelerometer 101.7 mV/g	Dytran instruments Inc.	3049E3

(3) Testing method



Test condition:

Sweep frequency:	5~500Hz
Acceleration:	1.07G
Direction:	X, Y, Z
Test time:	1 hour per each axis



*E.U.T. is fixed to vibrator surface by mounting straps

***(4)Test result** **OK**

Check item	Output Voltage (V)	Ripple (mVp-p)	E.U.T. state
Before test / Direction	10.00	40.42	O.K.
X	10.00	40.42	O.K.
Y	10.00	39.58	O.K.
Z	10.00	40.00	O.K.

* Z+800 Test result represent also Z+600

7. Noise Simulation Test

MODEL : 36V-18A

(1) Test equipment:

NoiseKen INS - 4040 impulse noise simulator
NoiseKen IJ - 4050 coupling decoupling network

(2) Acceptance criteria:

1. No damage to PS
2. No output shutdown
3. No other abnormalities

(3) Test condition:

Ta=25°C

Noise level - ± (0.6kV,1kV,2kV, 1.8kV, 2kV) (50Ω term.)

Pulse width - 50ns ~ 1us

Injection phase (AC input only) - 0°~360° (with step 45°)

Input voltage - 230Vac 50Hz

Output Current - 100%

Output voltage - Rated

(4) Test result: **OK**

1. No damage to PS
2. No output shutdown
3. No other abnormalities

Pulse	Polarity	Line-Neutral	Line-FG	Neutral-FG
2kV	+	OK		
2kV	-	OK		
2kV	+		OK	OK
2kV	-		OK	OK

(1) Test Equipment

Thermal Shock Chamber: TSA-101S-W , ESPEC

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

1 (unit)

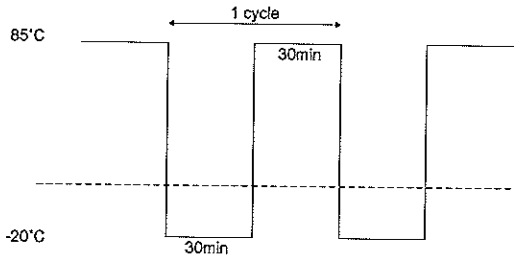
(3) Test condition

Ambient temperature: -20°C <=> +85°C

Test time: Refer to Dwg.

Test cycle: 100cycles

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. Later leave it for 1hour at room temperature, then check if there is no abnormal output.

***(5) Test Result** **OK**

Vin:100Vac

Before testing			After testing		
Vout-100%, Iout-100%	Vout-100%, Iout-0%	P-t-P	Vout-100%, Iout-100%	Vout-100%, Iout-0%	P-t-P
20.003V	20.002V	25mV	19.994V	19.991V	25.6mV

* Z+800 Test result represent also Z+600

9. Fan Life Expectancy

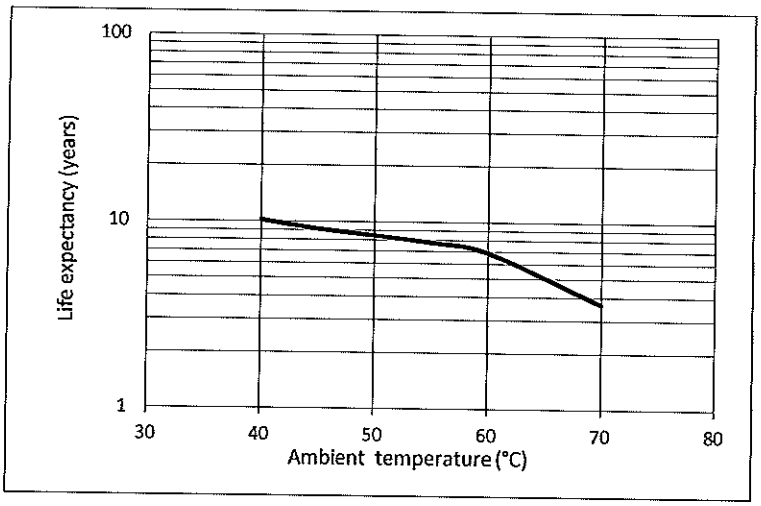
(1) Part name

109R0612G4091 (SANYO DENKI CO.)

(2) Life expectancy

The data shows fan life expectancy for fan only by manufacture (90% survival rate).

Fig1. shows measuring point of ambient temperature.



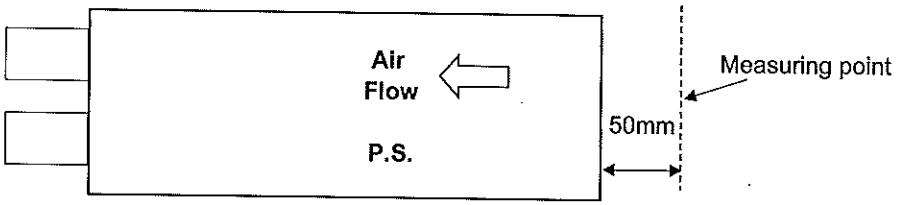


Fig1.Measuring point of fan ambient temperature.

1 year=365 day x 24 hours/day=8760 hours