Z^+800 Series

RELIABILITY

DATA

DWG No.: IA702-79-01		
APPD	CHK	DWG
24/3/13	20/03/13	D.MIRON 20-Mar-2013

TDK-Lambda

INDEX

Terminology used

FG . . . . Frame Ground

* The above data are typical values. As all units have the same characteristics, the data to be considered as ability values.

1. Calculated values of MTBF

MODEL: 10V-72A

(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 (Failure/106 hours)

λ_G = Generic failure rate for the i th generic part (Failure/106 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. Component derating

MODEL: 10V-72A

(1) Calculating method

1. Measuring conditions

Input: 100, 200Vac

Ambient temperature: 50°C

Output: 10V-72A (100%)

Mounting Method: Standard Mounting

2. Semicoductors

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

3. IC, Resistors, Capacitors, etc.

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

4. Calculating Method of Thermal Impedance

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

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

$P_{c(max)}$: Maximum power dissipation

$T_{j(max)}$: 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 =	23.1	°C	Ta =	73.1	°C
ST	Tj = Ta + (θ j-a x Pd) =>			Tj =	101.9	°C	D.F. =	67.9	%
D101	Tjmax=	150	°C	θj-c =	0.6	°C/W			
GBJ2506-F	Pd =	14.83	W	ΔTc =	55.0	°C	Tc =	105.0	°C
DIODES	Tj = Tc + (θ j-c x Pd) =>			Tj =	113.9	°C	D.F. =	75.9	%
D105	Tjmax=	150	°C	θj-c =	130.0	°C/W			
CRH01(TE85L,Q)	Pd =	0.077	W	ΔTc =	14.3	°C	Tc =	64.3	°C
TOSHINA	Tj = Tc + (θ j-c x Pd) =>			Tj =	74.3	°C	D.F. =	49.5	%
D106	Tjmax=	175	°C	θj-c =	1.5	°C/W			
IDH08SG60C	Pd =	5.26	W	ΔTc =	41.3	°C	Tc =	91.3	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	99.2	°C	D.F. =	56.7	%
D117	Tjmax=	175	°C	θj-c =	0.85	°C/W			
STPS3045CT	Pd =	10.26	W	ΔTc =	72.3	°C	Tc =	122.3	°C
ST	Tj = Tc + (θ j-c x Pd) =>			Tj =	131.0	°C	D.F. =	74.9	%
PC101	Tjmax=	125	°C	θj-c =	1.67	°C/W			
PS2801-1-F3-A(P)	Pd =	0.06	W	ΔTc =	42.2	°C	Tc =	92.2	°C
NEC	Tj = Tc + (θ j-c x Pd) =>			Tj =	92.3	°C	D.F. =	73.8	%
Q101	Tjmax=	150	°C	θj-c =	0.29	°C/W			
IPW60R045CP	Pd =	31.7	W	ΔTc =	47.4	°C	Tc =	97.4	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	106.6	°C	D.F. =	71.1	%
Q105	Tjmax=	150	°C	θj-c =	0.8	°C/W			
IPP60R099CP	Pd =	5.58	W	ΔTc =	54.0	°C	Tc =	104.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	108.5	°C	D.F. =	72.3	%
Q118	Tjmax=	150	°C	θj-c =	1.316	°C/W			
2SK3595-01MR	Pd =	1.1	W	ΔTc =	57.6	°C	Tc =	107.6	°C
FUJI	Tj = Tc + (θ j-c x Pd) =>			Tj =	109.0	°C	D.F. =	72.7	%
SC101	Tjmax=	125	°C	θj-c =	1.2	°C/W			
CR12CM-12A B00	Pd =	2.93	W	ΔTc =	35.1	°C	Tc =	85.1	°C
RENESAS	Tj = Tc + (θ j-c x Pd) =>			Tj =	88.6	°C	D.F. =	70.9	%

Location No.	Vin=100Vac Load=100% Ta=50°C									
A105	Tjmax=	150	°C	θj-c =	0.0031	°C/W				
SN65220DBVRG4	Pd =	0.246	W	ΔTc =	17.0	°C	Tc =	67.0	°C	
TI	Tj = Tc + (θ j-c x Pd) =>			Tj =	67.0	°C	D.F. =	44.7	%	
A141	Tjmax=	125	°C	θj-a =	180.0	°C/W				
LM78L15ACMNOPB	Pd =	0.1	W	ΔTa =	11.8	°C	Ta =	61.8	°C	
NATIONAL	Tj = Ta + (θ j-a x Pd) =>			Tj =	79.8	°C	D.F. =	63.8	%	
A142	Tjmax=	150	°C	θj-c =	3.0	°C/W				
MIP2E4DMY	Pd =	1.4	W	ΔTc =	17.8	°C	Tc =	67.8	°C	
MATSUSHITA	Tj = Tc + (θ j-c x Pd) =>			Tj =	72.0	°C	D.F. =	48.0	%	
A145	Tjmax=	125	°C	θj-a =	230.9	°C/W				
LM78L05ACMNOPB	Pd =	0.08	W	ΔTa =	16.2	°C	Ta =	66.2	°C	
NATIONAL	Tj = Ta + (θ j-a x Pd) =>			Tj =	84.7	°C	D.F. =	67.7	%	
A148	Tjmax=	125	°C	θj-c =	4.0	°C/W				
LM3940IT-3.3NOPB	Pd =	2	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	W	ΔTc =	11.9	°C	Tc =	61.9	°C	
ST	Tj = Tc + (θ j-c x Pd) =>			Tj =	67.9	°C	D.F. =	45.3	%	
PC114	Tjmax=	125	°C	θj-c =	0.0015	°C/W				
PS2581L2-E3-A(D)	Pd =	0.15	W	ΔTc =	17.7	°C	Ta =	67.7	°C	
NEC	Tj = Tc + (θ j-c x Pd) =>			Tj =	67.7	°C	D.F. =	54.2	%	
Q129	Tjmax=	175	°C	θj-c =	0.9	°C/W				
IPI037N06L3 G	Pd =	2.82	W	ΔTc =	56.0	°C	Tc =	106.0	°C	
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	108.5	°C	D.F. =	62.0	%	

(2) Component derating list

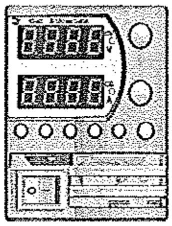
Location No.	Vin=200Vac Load=100% Ta=50°C								
A101	Tjmax=	150	°C	θj-a =	125.0	°C/W			
L4981AD013TR	Pd =	0.23	W	ΔTa =	20.6	°C	Ta =	70.6	°C
ST	Tj = Ta + (θ j-a x Pd) =>			Tj =	99.4	°C	D.F. =	66.2	%
D101	Tjmax=	150	°C	θj-c =	0.6	°C/W			
GBJ2506-F	Pd =	7.13	W	ΔTc =	36.8	°C	Tc =	86.8	°C
DIODES	Tj = Tc + (θ j-c x Pd) =>			Tj =	91.1	°C	D.F. =	60.7	%
D105	Tjmax=	150	°C	θj-c =	130.0	°C/W			
CRH01(TE85L,Q)	Pd =	0.091	W	ΔTc =	13.2	°C	Tc =	63.2	°C
TOSHINA	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 =	5.26	W	ΔTc =	25.9	°C	Tc =	75.9	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	83.8	°C	D.F. =	47.9	%
D117	Tjmax=	175	°C	θj-c =	0.85	°C/W			
STPS3045CT	Pd =	10.26	W	ΔTc =	70.1	°C	Tc =	120.1	°C
ST	Tj = Tc + (θ j-c x Pd) =>			Tj =	128.8	°C	D.F. =	73.6	%
PC101	Tjmax=	125	°C	θj-c =	1.67	°C/W			
PS2801-1-F3-A(P)	Pd =	0.06	W	ΔTc =	40.0	°C	Tc =	90.0	°C
NEC	Tj = Tc + (θ j-c x Pd) =>			Tj =	90.1	°C	D.F. =	72.1	%
Q101	Tjmax=	150	°C	θj-c =	0.29	°C/W			
IPW60R045CP	Pd =	9.8	W	ΔTc =	23.0	°C	Tc =	73.0	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	75.8	°C	D.F. =	50.6	%
Q105	Tjmax=	150	°C	θj-c =	0.8	°C/W			
IPP60R099CP	Pd =	5.58	W	ΔTc =	53.1	°C	Tc =	103.1	°C
INFINEON	Tj = Tc + (θ j-c x Pd) =>			Tj =	107.6	°C	D.F. =	71.7	%
Q118	Tjmax=	150	°C	θj-c =	1.316	°C/W			
2SK3595-01MR	Pd =	1.1	W	ΔTc =	52.6	°C	Tc =	102.6	°C
FUJI	Tj = Tc + (θ j-c x Pd) =>			Tj =	104.0	°C	D.F. =	69.4	%
SC101	Tjmax=	125	°C	θj-c =	1.2	°C/W			
CR12CM-12A B00	Pd =	2.93	W	ΔTc =	22.4	°C	Tc =	72.4	°C
RENESAS	Tj = Tc + (θ j-c x Pd) =>			Tj =	75.9	°C	D.F. =	60.7	%

Location No.	Vin=200Vac Load=100% Ta=50°C								
A105 SN65220DBVRG4 TI	Tjmax= Pd = Tj = Tc + (θ j-c x Pd) =>	150 0.246	°C W	θj-c = ΔTc = Tj =	0.0031 12.9 62.9	°C/W °C °C	 Tc = D.F. =	 62.9 41.9	 °C %
A141 LM78L15ACMNOPB NATIONAL	Tjmax= Pd = Tj = Ta + (θ j-a x Pd) =>	125 0.1	°C W	θj-a = ΔTa = Tj =	180.0 11.4 79.4	°C/W °C °C	 Ta = D.F. =	 61.4 63.5	 °C %
A142 MIP2E4DMY MATSUSHITA	Tjmax= Pd = Tj = Tc + (θ j-c x Pd) =>	150 1.4	°C W	θj-c = ΔTc = Tj =	3.0 17.6 71.8	°C/W °C °C	 Tc = D.F. =	 67.6 47.9	 °C %
A145 LM78L05ACMNOPB NATIONAL	Tjmax= Pd = Tj = Ta + (θ j-a x Pd) =>	125 0.08	°C W	θj-a = ΔTa = Tj =	230.9 15.7 84.2	°C/W °C °C	 Ta = D.F. =	 65.7 67.3	 °C %
A148 LM3940IT-3.3NOPB NATIONAL	Tjmax= Pd = Tj = Tc + (θ j-c x Pd) =>	125 2	°C W	θj-c = ΔTc = Tj =	4.0 13.5 71.5	°C/W °C °C	 Tc = D.F. =	 63.5 57.2	 °C %
A149 L4941BV ST	Tjmax= Pd = Tj = Tc + (θ j-c x Pd) =>	150 2	°C W	θj-c = ΔTc = Tj =	3.0 10.0 66.0	°C/W °C °C	 Tc = D.F. =	 60.0 44.0	 °C %
PC114 PS2581L2-E3-A(D) NEC	Tjmax= Pd = Tj = Tc + (θ j-c x Pd) =>	125 0.15	°C W	θj-c = ΔTc = Tj =	0.0015 13.3 63.3	°C/W °C °C	 Ta = D.F. =	 63.3 50.6	 °C %
Q129 IPI037N06L3 G INFINEON	Tjmax= Pd = Tj = Tc + (θ j-c x Pd) =>	175 2.82	°C W	θj-c = ΔTc = Tj =	0.9 55.5 108.0	°C/W °C °C	 Tc = D.F. =	 105.5 61.7	 °C %

3. Main components temperature rise

MODEL: 10V-72A

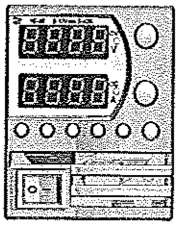
Condition:

Standard Mounting	
Output Voltage	10V
Output Current	72A
Ta	50°C

Location No.	Parts Name	ΔT Temperature Rise (°C)	
		100Vac	200Vac
A101	CHIP PFC IC	23.0	20.3
C101	FILM CAPACITOR	32.9	19.0
C102	FILM CAPACITOR	32.5	19.8
C103	CERAMIC CAPACITOR	25.1	17.7
C105	FILM CAPACITOR	30.3	23.5
C111	FILM CAPACITOR	21.8	16.7
C113	CERAMIC CAPACITOR	4.4	4.4
C116	ELEC. CAPACITOR	13.0	15.0
C140	FILM CAPACITOR	53.4	49.4
C147	ELEC. CAPACITOR	40.1	35.9
D101	BRIDGE	57.3	30.6
D106	DIODE	40.6	25.7
D118	DIODE	69.4	68.8
D119	DIODE	66.9	67.0
F101	FUSE	38.5	22.6
L101	COMMON CHOKE	43.2	24.0
L102	COMMON CHOKE	43.1	24.6
L103	PF CHOKE	40.7	34.3
L104	CHOKE	48.4	47.5
PC101	OPTO COUPLER	42.1	39.7
PC118	OPTO COUPLER	5.8	5.0
Q101	MOSFET	39.0	18.9
Q106	MOSFET	36.3	34.5
R199	RES. SHUNT	48.3	43.1
T101	TRANSFORMER	56.1	55.7
T102	TRANSFORMER	16.4	15.8
T103	TRANSFORMER	17.2	16.8
A107	DIGITAL ISOLATOR	15.0	13.6
A115	MICROCONTROLLER	12.0	9.3
A141	LINEAR REGULATOR	11.6	11.1
A142	TOP SWITCH	17.6	17.3
A145	LINEAR REGULATOR	16.1	15.4
D125	DIODE	11.6	11.1
D130	DIODE	11.6	11.1
D133	DIODE	11.6	11.1
T201	TRANSFORMER	15.2	14.5
ZD116	ZENER	13.0	11.6
ZD123	ZENER	11.6	11.1

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	9.8
40	10.0	10.0	6.9
60	10.0	10.0	5.2
80	10.0	6.5	3.2
100	6.9	4.0	2.0

5. Abnormal test

MODEL : 10V-72A

(1) Test condition and circuit:

Input Voltage: 100Vac Output: 10V 72A 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
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-72A

(1) Test condition and circuit:

Input Voltage: 100Vac Output: 10V 72A 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-72A

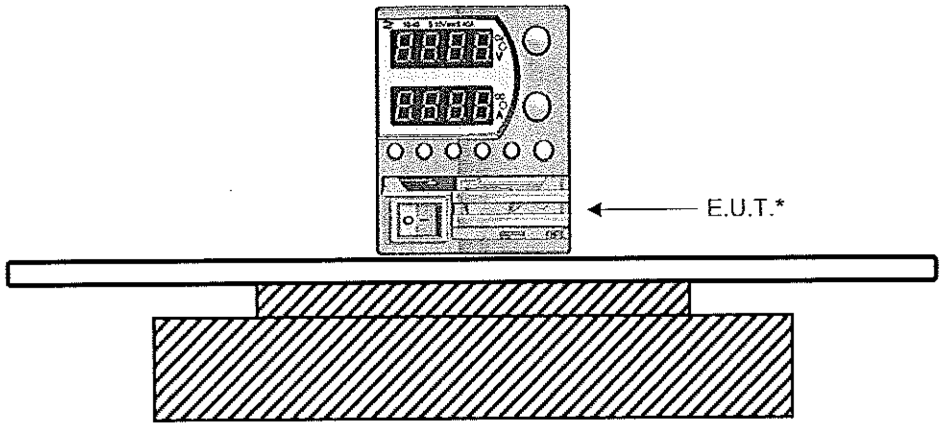
(1) Vibration test class

Frequency variable endurance test

(2) Equipment used

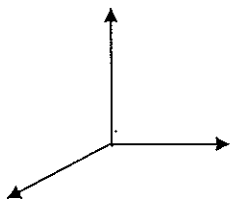
Description	Manufacturer	Model
Vibration Test System	Ling Dynamic Systems	V875
Laser Shaker Control System	DACTRON	LASER
Isotron Accelerometer 98.2 mV/g	Dytran Instruments Inc.	3256A2
Isotron Accelerometer 101.7 mV/g	Dytran Instruments Inc.	3049E3

(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 / Direction	Output Voltage (V)	Ripple (mVp-p)	E.U.T. state
Before test	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.

7. Noise simulation test

MODEL: 36V-24A

(1) Test equipment:

NoiseKen INS-4040 Impulse noise simulator
NoiseKen IJ-4050 Injection unit

(2) Acceptance criteria:

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

(3) Test condition:

Ta=25°C

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

Pulse width- 50ns ~ 1us

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

Input voltage - 230Vac

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

8. Thermal shock test

(1) Test Equipment

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

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

1 (unit)

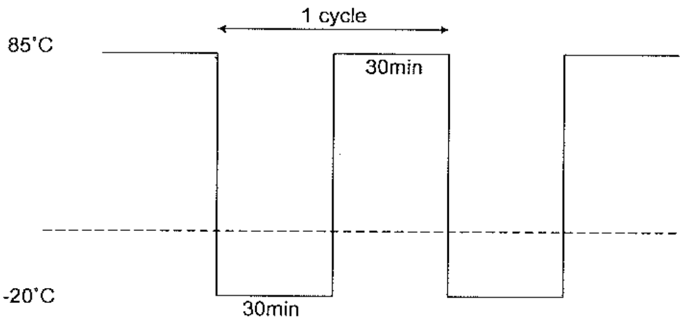
(3) Test condition

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

9. Fan life expectancy

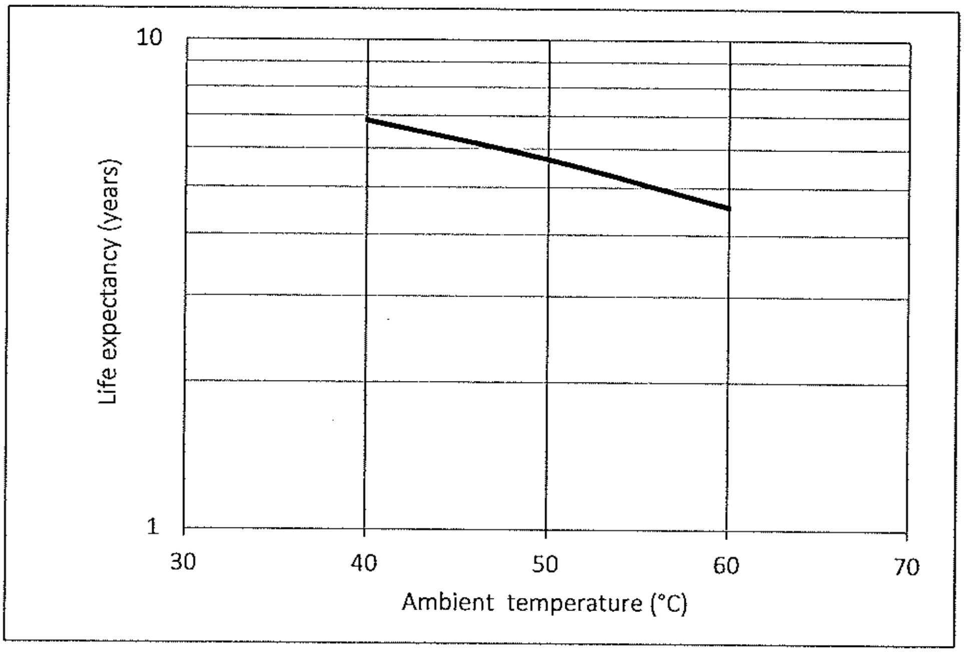
(1) Part name

San Ace 109R0612J4041 (SANYO DENKI)

(2) Life expectancy

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

Fig1. shows measuring point of ambient temperature.



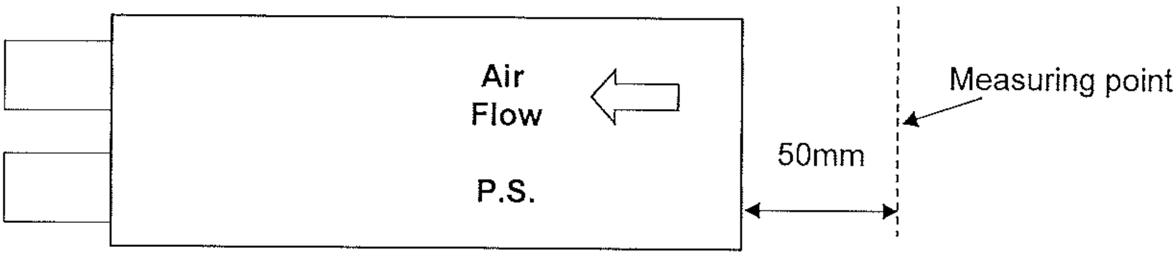


Fig1.Measuring point of fan ambient temperature.

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