CUS600M/EF

RELIABILITY DATA

INDEX

※ Test results are typical data. Nevertheless the following results are considered to be reference data because all units have nearly the same characteristics.

1. Calculated Values of MTBF

Parts stress reliability prediction MTBF

MODEL : CUS600M-12/EF

Calculating Method

Calculated based on parts stress reliability prediction of Telcordia (*1).
Individual failure rate λ_{SS} is calculated by the electric stress and temperature rise of the each part.

*1: Telcordia document "Reliability Prediction Procedure for Electronic Equipment"
(Document number SR-332,Issue3)

<Formula>

$$MTBF = \frac{1}{\lambda_{equip}} = \frac{1}{\pi_E \sum_{i=1}^{m} (N_i \cdot \lambda_{ssi})} \times 10^9 \quad \text{(Hours)}$$

$$\lambda_{ssi} = \lambda_{Gi} \cdot \pi_{Qi} \cdot \pi_{Si} \cdot \pi_{Ti}$$

λ_{equip} : Total equipment failure rate (FITs = Failures in10^9 hours)

λ_{Gi} : Generic failure rate for the ith part

π_{Qi} : Quality factor for the ith part

π_{Si} : Stress factor for the ith part

π_{Ti} : Temperature factor for the ith part

m : Number of different part types

N_i : Quantity of ith part type

π_E : Equipment environmental factor

MTBF Values

Conditions

- Input voltage : 115VAC
- Output voltage & current : 12VDC, 50A
- Standby voltage & current : 5VDC, 1.5A
- Environmental factor : GB (Ground, Benign)
- Mounting method : Standard mounting A

SR-332,Issue3

MTBF(Ta=25℃) ≒ 849978 (Hours)

MTBF(Ta=40℃) ≒ 485806 (Hours)

2. Components Derating

MODEL： CUS600M-12/EF

(1) Calculating Method

(a) Measuring method

・Mounting method	： Standard mounting A	・ Ambient temperature	： 45℃
・Input voltage	： 115, 230VAC	・ Output voltage & current	： 12V, 50A
		・ Standby voltage & current	： 5V, 1.5A

(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

$$\theta j-c = \frac{Tj(max) - Tc}{Pch(max)} \qquad \theta j-a = \frac{Tj(max) - Ta}{Pch(max)} \qquad \theta j-l = \frac{Tj(max) - Tl}{Pch(max)}$$

Tc ： Case Temperature at Start Point of Derating；25℃ in General

Ta ： Ambient Temperature at Start Point of Derating；25℃ in General

Tl ： Lead Temperature at Start Point of Derating；25℃ in General

Pch(max) ： Maximum Channel Dissipation

Tj(max) (Tch(max)) ： Maximum Junction (channel) Temperature

θj-c (θch-c) ： Thermal Impedance between Junction (channel) and Case

θj-a ： Thermal Impedance between Junction and air

θj-l ： Thermal Impedance between Junction and Lead

(2) Component Derating List

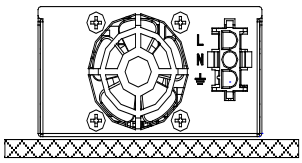
Location No.	Vin = 115VAC Load = 50A Ta = 45°C Istb = 1.5A		
BD1 D25XB60-7000 SHINDENGEN	Tch (max) = 150 °C Pch= 8.3 W Tch = Tc + ((θch-c) × Pch) = 106.5 °C D.F. = 71.0 %	θch-c = 1 °C/W ΔTc = 53.2 °C	Tc = 98.2 °C
SCR1 TN1605H-6FP STMICRO	Tch (max) = 150 °C Pch = 1.8 W Tch = Tc + ((θch-c) × Pch) = 97.4 °C D.F. = 64.9 %	θch-c = 4.5 °C/W ΔTc = 44.3 °C	Tc = 89.3 °C
D1 TRS6A65F,S1Q TOSHIBA	Tch (max) = 175 °C Pch= 3.0W Tch = Tc + ((θch-c) × Pch) = 108.9 °C D.F. = 62.2 %	θch-c = 4.24 °C/W ΔTc = 51.2 °C	Tc = 96.2 °C
Q1 IPA60R060P7 INFINEON	Tj (max) = 150 °C Pd = 5.2 W Tj = Tc + ((θj-c) × Pd) = 118.2 °C D.F. = 78.8 %	θj-c = 4.24 °C/W ΔTc = 51.2°C	Tc = 96.2 °C
Q2A,Q2B TK20A60W5 TOSHIBA	Tj (max) = 150 °C Pd = 1.8 W Tj = Tc + ((θj-c) × Pd) = 96.2 °C D.F. = 64.1 %	θj-c = 2.78 °C/W ΔTc = 46.2°C	Tc = 91.2 °C
D61 SB360-E3/73 VISHAY	Tj (max) = 150 °C Pd = 0.9 W Tj = Tc + ((θj-c) × Pd) = 86.5 °C D.F. = 57.7 %	θj-c = 10 °C/W ΔTc = 32.5 °C	Tc = 77.5 °C
Q201,Q202 TPW1R005PL,L1Q TOSHIBA	Tj (max) = 175 °C Pd = 1.5 W Tj = Tc + ((θj-c) × Pd) = 101.0 °C D.F. = 57.7%	θj-c = 0.93 °C/W ΔTc = 54.6 °C	Tc = 99.6 °C

Location No.	Vin = 230VAC Load = 50A Ta = 45°C Istb = 1.5A		
BD1 D25XB60-7000 SHINDENGEN	Tch (max) = 150 °C Pch= 4.1 W Tch = Tc + ((θch-c) × Pch) = 83.2 °C D.F. = 55.5 %	θch-c = 1 °C/W ΔTc = 34.1 °C	Tc = 79.1 °C
SCR1 TN1605H-6FP STMICRO	Tch (max) = 150 °C Pch = 1.8 W Tch = Tc + ((θch-c) × Pch) = 85.6 °C D.F. = 57.1 %	θch-c = 4.5 °C/W ΔTc = 32.5 °C	Tc = 77.5 °C
D1 TRS6A65F,S1Q TOSHIBA	Tch (max) = 175 °C Pch= 2.2 W Tch = Tc + ((θch-c) × Pch) = 88.4 °C D.F. = 50.5 %	θch-c = 4.24 °C/W ΔTc = 34.1 °C	Tc = 79.1 °C
Q1 IPA60R060P7 INFINEON	Tj (max) = 150 °C Pd = 1.9 W Tj = Tc + ((θj-c) × Pd) = 85.1 °C D.F. = 56.7 %	θj-c = 4.24 °C/W ΔTc = 32 °C	Tc = 77 °C
Q2A,Q2B TK20A60W5 TOSHIBA	Tj (max) = 150 °C Pd = 1.8 W Tj = Tc + ((θj-c) × Pd) = 86.3 °C D.F. =57.5 %	θj-c = 2.78 °C/W ΔTc = 36.3°C	Tc = 81.3 °C
D61 SB360-E3/73 VISHAY	Tj (max) = 150 °C Pd = 0.9 W Tj = Tc + ((θj-c) × Pd) = 85.9 °C D.F. = 57.3 %	θj-c = 10 °C/W ΔTc = 31.9 °C	Tc = 76.9 °C
Q201,Q202 TPW1R005PL,L1Q TOSHIBA	Tj (max) = 175 °C Pd = 1.5 W Tj = Tc + ((θj-c) × Pd) = 100.9 °C D.F. = 57.7%	θj-c = 0.93 °C/W ΔTc = 54.5 °C	Tc = 99.5 °C

3. Main Components Temperature Rise △T List

MODEL : CUS600M-12/EF

(1) Measuring Conditions

Mounting Method (Standard Mounting : A)	Mounting A 	
Input Voltage	115VAC	230VAC
Output Voltage	12V	
Output Current	50A	
Standby Current	1.5A	

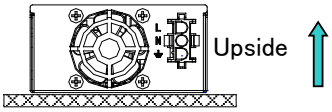
(2) Measuring Results

		ΔT Temperature Rise (°C)	
Input Voltage		115VAC	230VAC
Location No.	Part name	Mounting A	
A101	IC	42.1	26.6
A102	IC	32.1	22.8
A103	IC	33.5	31
A104	IPD	44.1	40.5
A201	IC	40.4	40.3
BD1	Diode Bridge	53.2	34.1
C51B	E.CAP.	24.1	24.1
C51C	E.CAP.	28.7	28.6
C51D	E.CAP.	24.8	25.5
C6	E.CAP.	16.1	12.4
C61	E.CAP.	14.6	13.9
D1	SBD	51.2	34.1
D61	SBD	32.5	31.9
L2	CHOKE COIL	46.3	30.4
L4	CHOKE COIL	46.4	27.4
Q1	MOS FET	51.2	32
Q2A	MOS FET	45.3	34.5
Q2B	MOS FET	46.2	36.3
Q201	MOS FET	54.6	54.5
Q202	MOS FET	53.6	53.1
R108	RESISTOR	56.9	30.3
SCR1	Thyristor	44.3	32.5
T1	TRANS	62.1	61.8
T2	TRANS	23.5	22.8

4. Electrolytic Capacitor Lifetime

MODEL : CUS600M-12/EF

Mounting A



Conditions Istb : 1.5A

Ta 30℃ : ———

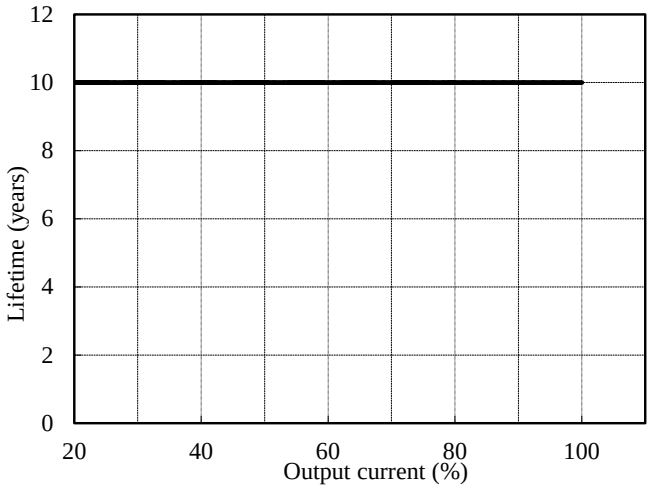
40℃ : ·····

50℃ : — — — —

60℃ : — · — · —

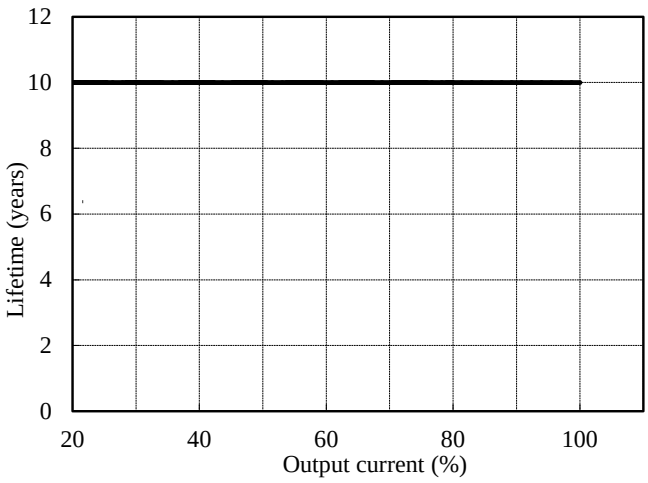
Vin=115VAC

Load (%)	Lifetime (years)			
	Ta= 30℃	Ta= 40℃	Ta= 50℃	Ta= 60℃
20	10.0	10.0	10.0	10.0
40	10.0	10.0	10.0	10.0
50	10.0	10.0	10.0	10.0
60	10.0	10.0	10.0	-
80	10.0	10.0	10.0	-
100	10.0	10.0	-	-



Vin=230VAC

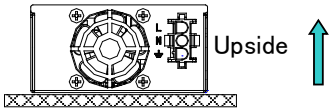
Load (%)	Lifetime (years)			
	Ta= 30℃	Ta= 40℃	Ta= 50℃	Ta= 60℃
20	10.0	10.0	10.0	10.0
40	10.0	10.0	10.0	10.0
50	10.0	10.0	10.0	10.0
60	10.0	10.0	10.0	-
80	10.0	10.0	10.0	-
100	10.0	10.0	-	-



4. Electrolytic Capacitor Lifetime

MODEL : CUS600M-24/EF

Mounting A



Conditions Istb : 1.5A

Ta 30℃ : ————

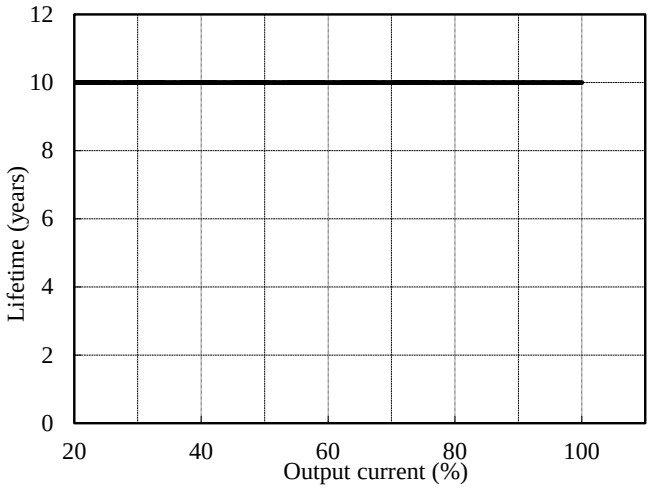
40℃ : ·····

50℃ : — — — —

60℃ : — · — · —

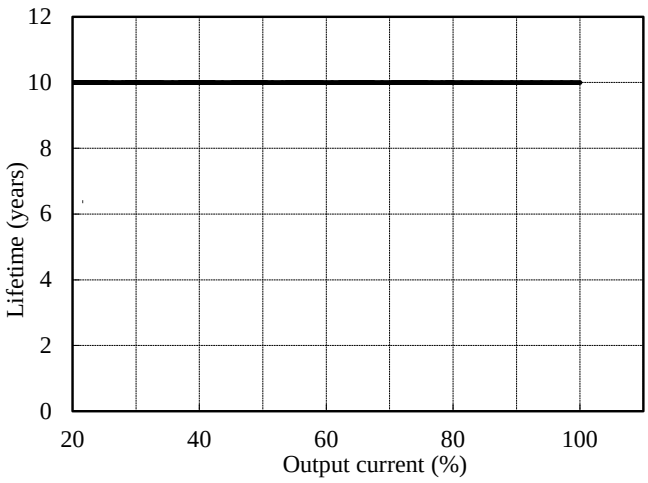
Vin=115VAC

Load (%)	Lifetime (years)			
	Ta= 30℃	Ta= 40℃	Ta= 50℃	Ta= 60℃
20	10.0	10.0	10.0	10.0
40	10.0	10.0	10.0	10.0
50	10.0	10.0	10.0	10.0
60	10.0	10.0	10.0	-
80	10.0	10.0	10.0	-
100	10.0	10.0	-	-



Vin=230VAC

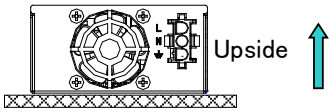
Load (%)	Lifetime (years)			
	Ta= 30℃	Ta= 40℃	Ta= 50℃	Ta= 60℃
20	10.0	10.0	10.0	10.0
40	10.0	10.0	10.0	10.0
50	10.0	10.0	10.0	10.0
60	10.0	10.0	10.0	-
80	10.0	10.0	10.0	-
100	10.0	10.0	-	-



4. Electrolytic Capacitor Lifetime

MODEL : CUS600M-48/EF

Mounting A



Conditions Istb : 1.5A

Ta 30℃ : ————

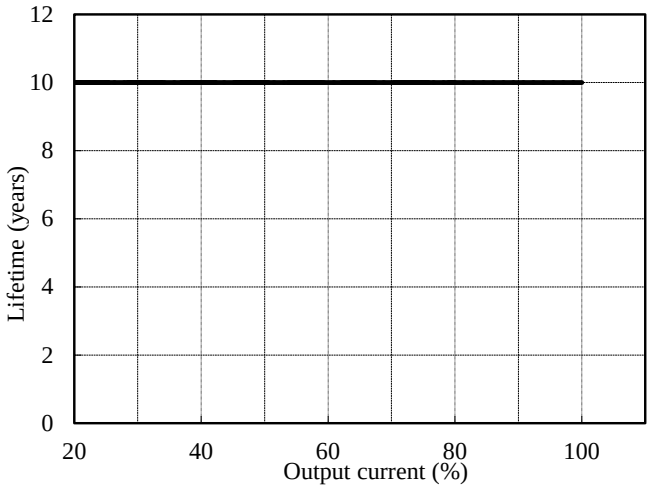
40℃ : ·····

50℃ : — — — —

60℃ : —·—·—

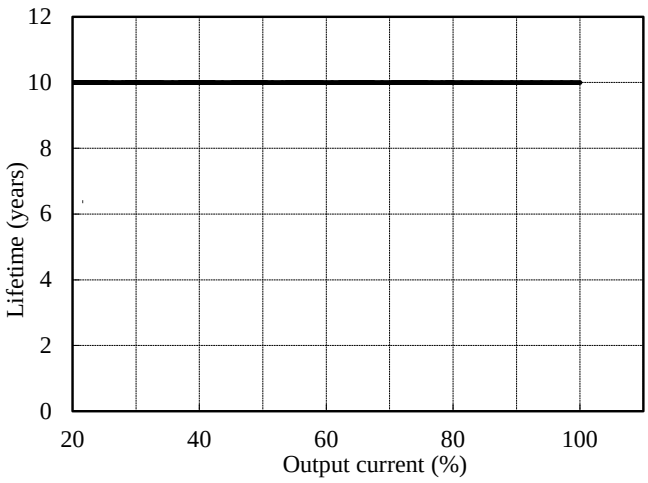
Vin=115VAC

Load (%)	Lifetime (years)			
	Ta= 30℃	Ta= 40℃	Ta= 50℃	Ta= 60℃
20	10.0	10.0	10.0	10.0
40	10.0	10.0	10.0	10.0
50	10.0	10.0	10.0	10.0
60	10.0	10.0	10.0	-
80	10.0	10.0	10.0	-
100	10.0	10.0	-	-



Vin=230VAC

Load (%)	Lifetime (years)			
	Ta= 30℃	Ta= 40℃	Ta= 50℃	Ta= 60℃
20	10.0	10.0	10.0	10.0
40	10.0	10.0	10.0	10.0
50	10.0	10.0	10.0	10.0
60	10.0	10.0	10.0	-
80	10.0	10.0	10.0	-
100	10.0	10.0	-	-



5. Abnormal Test

MODEL : CUS600M-24/EF

(1) Test Conditions

Input : 115VAC Output : 24V, 25A Istb : 1.5A Ta : 25℃

(2) Test Results

No.	Test position		Test mode		Test result *1: Equivalent one smoke less than of a cigarette														Note
					a	b		c	d	e	f	g	h	I	j	k	l		
	Location No.	Test point	Short	Open	Fire	Slight Smoke	Smoke	Burst	Smell	Red hot	Damaged	Fuse blown	O.V.P.	O.C.P.	No output	No change	Others		
1	SCR1	A		○													○		Input Power increase
		K		○													○		Input Power increase
		G		○												○			
		A-K	○														○		Input Power decrease
		A-G	○													○			
		G-K	○													○			
2	Q1	G		○							○	○			○				Da: F1A ,F1B,R108, D117
		D		○											○				
		S		○											○				
		G-S	○												○				
		G-D	○								○	○			○				Da: F1A ,F1B,Q1, R108, D117, R110
		D-S	○								○	○			○				Da: F1A ,F1B,R108, D117
3	D1		○								○	○			○				Da: F1A ,Q1, R108, D117
				○											○				Da: F1A ,Q1, R108, D117
4	L4		○								○	○			○				Da: F1A ,F1B, Q1, R108, D117
				○											○				
5	C1		○								○	○			○				Da: F1A ,F1B
				○												○			
6	SA1		○								○	○			○				Da: F1A ,F1B
				○												○			
7	C4		○								○	○			○				Da: F1A ,F1B
				○												○			
8	BD1	1		○											○				
		2		○											○				
		3		○											○				
		4		○											○				
		1-2	○								○	○			○				Da: F1A ,F1B
		2-3	○								○	○			○				Da: F1A ,F1B
		3-4	○								○	○			○				Da: F1A ,F1B
		1-4	○								○	○			○				Da: F1A ,F1B
9	Q2A	D		○											○				
		S		○							○				○				Da: Q2A, A103, Z102, Q103, A101
		G		○							○	○			○				Da: Q2A, Q2B, F1A, F1B, D117, R108
		D~S	○								○	○			○				Da: Q2B, F1A, F1B, D117, R108
		G~S	○												○				
		G~D	○								○	○			○				Da: Q2A, Q2B, F1A ,F1B, D117, R108
10	Q2B	D		○											○				
		S		○											○				
		G		○							○	○			○				Da: Q2A, Q2B, F1A, F1B, D117, R108
		D~S	○								○	○			○				Da: Q2A, F1A ,F1B, D117, R108
		G~S	○												○				
		G~D	○								○	○			○				Da: Q2A, Q2B, F1A ,F1B, D117, R108

5. Abnormal Test

MODEL : CUS600M-24/EF

(1) Test Conditions

Input : 115VAC Output : 24V, 25A Istb : 1.5A Ta : 25℃

(2) Test Results

No.	Test position		Test mode		Test result *1: Equivalent one smoke less than of a cigarette														Note
					a	b		c	d	e	f	g	h	I	j	k	l		
	Location No.	Test point	Short	Open	Fire	Slight	Smoke	Burst	Smell	Red hot	Damaged	Fuse blown	O.V.P.	O.C.P.	No output	No change	Others		
11	T2	2		○							○				○				Da: A104
		3		○							○				○				Da: A104
		5		○											○				
		6		○											○				
		7		○											○				Standby power hiccup
		8		○											○				Standby power hiccup
		2~3	○												○				Standby power OCP
		5~6	○												○				Standby power OCP
		6~7	○								○				○				Da: R177
		7~8	○												○				Standby power OCP
12	Q201	D		○										○	○				
		S		○										○	○				
		G		○							○				○				Da:Q201
		D~S	○												○				
		G~S	○															○	Input Power increase
		G~D	○												○				
13	Q202	D		○										○	○				
		S		○										○	○				
		G		○							○				○				Da:Q202
		D~S	○												○				
		G~S	○															○	Input Power increase
		G~D	○												○				
14	T1	1		○										○	○				
		2		○										○	○				
		3		○										○	○				
		4		○										○	○				
		5		○											○				
		8		○											○				
		3~4	○											○	○				
		2~3	○											○	○				
		5~8	○											○	○				

6. Vibration Test

MODEL： CUS600M-12/EF

(1) Vibration Test Class

Frequency variable endurance test

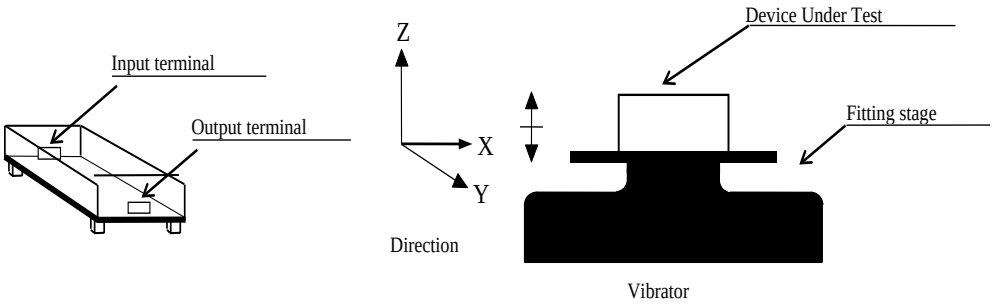
(2) Equipment Used

IMV CORP. DC-6000-65

(3) Test Conditions

･Sweep frequency	: 10～55Hz	･ Direction	: X, Y, Z
･Sweep time	: 1.0min	･ Sweep count	: 1 hour each
･Acceleration	: Constant 19.6m/s^2 (2G)		

(4) Test Method



(5) Acceptable Conditions

1. Not to be broken

2. No abnormal output after test.

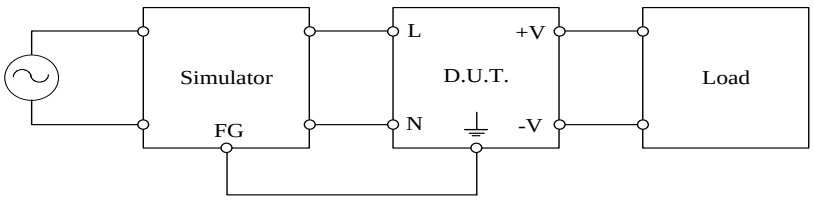
(6) Test Results

Judgement : OK

7. Noise Simulate Test

MODEL： CUS600M-12/EF

(1) Test Circuit and Equipment



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

(2) Test Conditions

・Input voltage	: 115, 230VAC	・Noise level	: 0～2kV
・Output voltage	: Rated	・Phase	: 0～360 deg
・Output current	: 0%, Full load	・Polarity	: ＋,－
・Ambient temperature	: 25℃	・Mode	: Common, Normal
・Pulse width	: 50～1000ns	・Trigger select	: Line

(3) Acceptable Conditions

1. The regulation of output voltage must not exceed 5% of initial value during test.
2. The output voltage must be within the regulation of specification after the test.
3. Smoke and fire are not allowed.

(4) Test Results

Judgement : OK

8. FAN Life Expectancy

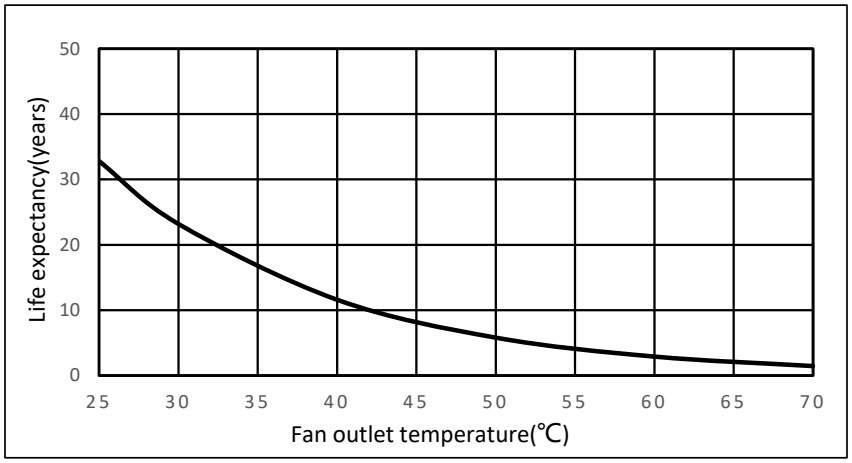
MODEL： CUS600M-12/EF

(1) Part Name

EFB0405HHDW2G (DELTA)

(2) Life Expectancy

The data shows fan life expectancy for fan only by manufacture(90% survival tate).
Fig. 1 shows measuring point of fan outlet temperature.



Temperature(℃)	Life(years)
30	23.2
40	11.6
50	5.8
60	2.9
70	1.4

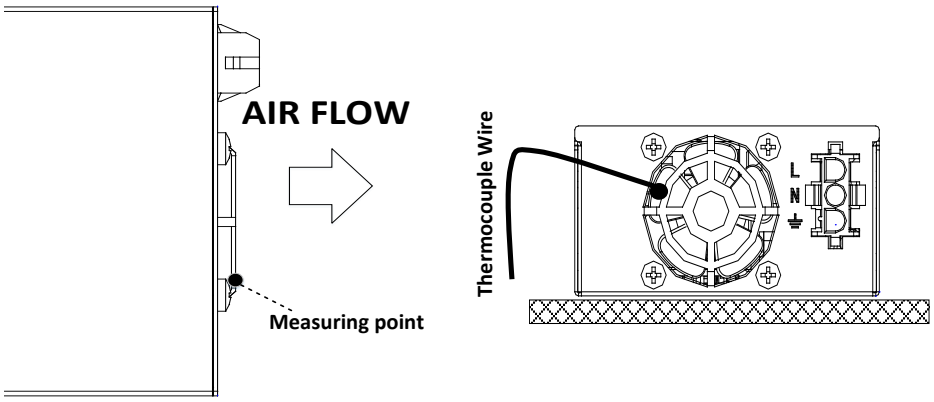


Fig.1 Measuring point of fan outlet temperature.