

TEP200-280

RELIABILITY DATA

信頼性データ

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* 試験結果は、代表データではありますが、全ての製品はほぼ同等な特性を示します。

従いまして、以下の結果は参考値とお考え願います。

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

1. MTBF計算値 Calculated Values of MTBF

(1) 算出方法 Calculating Method

JEITA (RCR-9102B)の部品点数法で算出されています。

それぞれの部品ごとに、部品故障率 λ_G が与えられ、各々の点数によって決定されます。

Calculated based on part count reliability projection of JEITA (RCR-9102B).

Individual failure rates λ_G is given to each part and MTBF is calculated by the count of each part.

<算出式>

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

λ_{equip} : 全機器故障率 (故障数 / 10^6 時間)
Total Equipment Failure Rate (Failure / 10^6 Hours)

λ_G : i番目の同属部品に対する故障率 (故障数 / 10^6 時間)
Generic Failure Rate for The ith Generic Part (Failure / 10^6 Hours)

n_i : i番目の同属部品の個数
Quantity of ith Generic Part

n : 異なった同属部品のカテゴリの数
Number of Different Generic Part Categories

π_Q : i番目の同属部品に対する品質ファクタ ($\pi_Q=1$)
Generic Quality Factor for The ith Generic Part ($\pi_Q=1$)

(2) MTBF値 MTBF Values

GF : 地上固定 (Ground, Fixed)

RCR-9102B

$$\begin{aligned} MTBF &\doteq \frac{119,553 \text{ 時間 (Hours)}}{13.6 \text{ 年 (Years)}} \end{aligned}$$

2. 部品デイレートイング Components Derating

(1) 算出方法 Calculating Method

(a) 測定方法 Measuring method

・取付方法 Mounting method	: 標準取付 : B Standard mounting : B	・周囲温度 Ambient temperature	: 60°C
・入力電圧 Input voltage	: 650VDC	・出力電圧、電流 Output voltage & current	: 280V, 0.7A(100%)

(b) 半導体 Semiconductors

ケース温度、消費電力、熱抵抗より使用状態の接合点温度を求め最大定格、接合点温度との比較を求めました。

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

(c) IC、抵抗、コンデンサ等 IC, Resistors, Capacitors, etc.

周囲温度、使用状態、消費電力など、個々の値は設計基準内に入っています。

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

(d) 熱抵抗算出方法 Calculating method of thermal impedance

$$\theta_{j-c} = \frac{T_j(\max) - T_c}{P_{ch}(\max)} \quad \theta_{j-l} = \frac{T_j(\max) - T_l}{P_{ch}(\max)}$$

T_c : デイレートイングの始まるケース温度 一般に25°C
Case Temperature at Start Point of Derating; 25°C in General

T_l : デイレートイングの始まるリード温度 一般に25°C
Lead Temperature at Start Point of Derating; 25°C in General

$P_{ch}(\max)$: 最大チャネル損失
Maximum Channel Dissipation

$T_j(\max)$: 最大接合点(チャネル)温度
($T_{ch}(\max)$) Maximum Junction (channel) Temperature

θ_{j-c} : 接合点(チャネル)からケースまでの熱抵抗
(θ_{ch-c}) Thermal Impedance between Junction (channel) and Case

θ_{j-l} : 接合点(チャネル)からリードまでの熱抵抗
(θ_{ch-l}) Thermal Impedance between Junction (channel) and Lead

(2) 部品ディレーティング表 Components Derating List

部品番号 Location No.	$V_{in}=650VDC$	Load = 100%	$T_a=60^{\circ}C$
Q1,Q2 FQA9N90C On Semiconductor	$T_j(\max)=150^{\circ}C$ Pch = 0.032W Tch = $T_c + ((\theta_{j-c}) \times Pch) = 88.1^{\circ}C$ DF. = 58.7%	$\theta_{j-c}=0.45^{\circ}C/W$ $\Delta T_c=28.1^{\circ}C$	$T_c=88.1^{\circ}C$
Q3,Q4 STW4N150 ST	$T_j(\max)=150^{\circ}C$ Pch = 1.6 W Tch = $T_c + ((\theta_{j-c}) \times Pch) = 96.2^{\circ}C$ DF. = 64%	$\theta_{j-c}=0.78^{\circ}C/W$ $\Delta T_c=35^{\circ}C$	$T_c=95^{\circ}C$
Q5,Q6,Q7,Q8 TK5A60W TOSHIBA	$T_j(\max)=150^{\circ}C$ Pch = 0.43W Tch = $T_c + ((\theta_{j-c}) \times Pch) = 99.3^{\circ}C$ DF. = 66.2%	$\theta_{j-c}=4.17^{\circ}C/W$ $\Delta T_c=33.3^{\circ}C$	$T_c=93.3^{\circ}C$
Q51 TK5A60W TOSHIBA	$T_j(\max)=175^{\circ}C$ Pch = 0.84 W Tch = $T_c + ((\theta_{j-c}) \times Pch) = 104.5^{\circ}C$ DF. = 69.7%	$\theta_{j-c}=4.17^{\circ}C/W$ $\Delta T_c=28.6^{\circ}C$	$T_c=98.6^{\circ}C$
SR1 SK625RD Littelfuse	$T_j(\max)=125^{\circ}C$ Pj = 1 W Tj = $T_c + ((\theta_{j-c}) \times Pj) = 83.3^{\circ}C$ DF. = 66.7%	$\theta_{j-c}=1^{\circ}C/W$ $\Delta T_c=22.3^{\circ}C$	$T_c=82.3^{\circ}C$
D1 IDH02GI20C5 Infineon	$T_j(\max)=175^{\circ}C$ Pj = 1.8 W Tj = $T_c + ((\theta_{j-c}) \times Pj) = 92.6^{\circ}C$ DF. = 52.9%	$\theta_{j-c}=1.54^{\circ}C/W$ $\Delta T_c=29.8^{\circ}C$	$T_c=89.8^{\circ}C$
D51,D52,D53,D54 RFU5TF6S ROHM	$T_j(\max)=150^{\circ}C$ Pj = 2W Tj = $T_c + ((\theta_{j-c}) \times Pj) = 97.2^{\circ}C$ DF. = 64.8%	$\theta_{j-c}=4^{\circ}C/W$ $\Delta T_c=29.2^{\circ}C$	$T_c=89.2^{\circ}C$
D55 RFU5TF6S ROHM	$T_j(\max)=150^{\circ}C$ Pj = 2W Tj = $T_c + ((\theta_{j-c}) \times Pj) = 97.2^{\circ}C$ DF. = 64.8%	$\theta_{j-c}=4^{\circ}C/W$ $\Delta T_c=29.2^{\circ}C$	$T_c=89.2^{\circ}C$
PC1 TLP785F TOSHIBA	$T_j(\max)=125^{\circ}C$ Pj = 0W Tj = $T_c + ((\theta_{j-c}) \times Pj) = 80^{\circ}C$ DF. = 64%	$\theta_{j-c}=666^{\circ}C/W$ $\Delta T_c=20^{\circ}C$	$T_c=80^{\circ}C$
PC2 TLP785F TOSHIBA	$T_j(\max)=125^{\circ}C$ Pj = 0.0063W Tj = $T_c + ((\theta_{j-c}) \times Pj) = 84^{\circ}C$ DF. = 67.2%	$\theta_{j-c}=666^{\circ}C/W$ $\Delta T_c=20^{\circ}C$	$T_c=80^{\circ}C$
PC51 TLP785F TOSHIBA	$T_j(\max)=125^{\circ}C$ Pj = 0.0084W Tj = $T_c + ((\theta_{j-c}) \times Pj) = 85.6^{\circ}C$ DF. = 68.5%	$\theta_{j-c}=666^{\circ}C/W$ $\Delta T_c=20^{\circ}C$	$T_c=80^{\circ}C$

3. 主要部品温度上昇値 Main Components Temperature Rise ΔT List

Condition : Std Mounting B

 $V_{in}=650VDC$ $I_o=0.7A$ 

No.	Symbol	ΔT [deg.]
1	Q1	22.2
2	Q2	23.3
3	Q3	28.4
4	Q4	30.5
5	L3	34.4
6	D1	27.2
7	Q6	29.8
8	Q7	30.6
9	T1	37.2
10	L5	45.1
11	Q51	28.1
12	D55	28.7
13	Q101	27.7
14	Q105	21.2
15	SR1	18.6
16	C1	7.7
17	C6	4.3
18	C10	16.6
19	C11	16.6
20	C12	14.0
21	C13	13.6
22	C14	11.4
23	T2	12.2
24	C51	19.1
25	C52	17.1
26	PC51	13.7

4. 電解コンデンサ寿命計算値 Electrolytic Capacitor Lifetime

Condition : Std Mounting B

Vin=650VDC

Io=100%

24時間連続稼働での計算値

電解コンデンサの推定寿命は15年が上限

Calculated value for continuous operation for 24 hours

Electrolytic capacitor lifetime is 15 years maximum



条件 Conditions	Ta	60°C
	Io	100%
番地 Symbol	型名 Itemname	上段: ΔT 下段: 寿命
C12	ELE-500ELL101MHB5D Lo=10000[H]	16.5°C 15.7[y]
C13	ELE-500ELL101MHB5D Lo=10000[H]	16.5°C 15.7[y]
C14	ELE-500ELL101MHB5D Lo=10000[H]	16.5°C 15.7[y]
C51	EKXJ451ELL470ML25S Lo=12000[H]	19.1°C 10.8[y]

5. アブノーマル試験 Abnormal Test

(1) Conditions

Ta : 25°C 70%RH

(2) Test result

(Da : Damaged)

No.	Test position		Test mode		Test Result													Note		
	Location No.	Test point	Short	Open	*1: Equivalent one smoke less than of a cigarette															
					a	b	c	d	e	f	g	h	I	j	k	l				
					Fire	Slight Smoke Below judgment value *1	Smoke	Burst	Smell	Red hot	Damaged	Fuse blown	O.V.P.	O.C.P.	No output	No change	Others			
Q1	D-S		<input type="radio"/>									<input type="radio"/>							Da: Q1	
	D-G		<input type="radio"/>									<input type="radio"/>							Da: Q1	
	G-S		<input type="radio"/>														<input type="radio"/>			
	D			<input type="radio"/>														<input type="radio"/>		
	G			<input type="radio"/>														<input type="radio"/>		
Q2	D-S		<input type="radio"/>									<input type="radio"/>							Da: Q2	
	D-G		<input type="radio"/>									<input type="radio"/>							Da: Q2	
	G-S		<input type="radio"/>														<input type="radio"/>			
	D			<input type="radio"/>														<input type="radio"/>		
	G			<input type="radio"/>														<input type="radio"/>		
Q3	D-S		<input type="radio"/>									<input type="radio"/>	<input type="radio"/>			<input type="radio"/>			Da: F1,F2,A104,Q3,Q4 Q5,Q6(or Q7,Q8)	
	D-G		<input type="radio"/>									<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
	G-S		<input type="radio"/>									<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
	D			<input type="radio"/>								<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
	G			<input type="radio"/>								<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
Q4	D-S		<input type="radio"/>									<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
	D-G		<input type="radio"/>									<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
	G-S		<input type="radio"/>									<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
	D			<input type="radio"/>								<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
	G			<input type="radio"/>								<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
Q5	D-S		<input type="radio"/>												<input type="radio"/>					Da: Q5
	D-G		<input type="radio"/>									<input type="radio"/>			<input type="radio"/>					
	G-S		<input type="radio"/>												<input type="radio"/>					
	D			<input type="radio"/>											<input type="radio"/>					
	G			<input type="radio"/>											<input type="radio"/>					
Q6	D-S		<input type="radio"/>									<input type="radio"/>			<input type="radio"/>				Da: Q6	
	D-G		<input type="radio"/>									<input type="radio"/>			<input type="radio"/>					
	G-S		<input type="radio"/>												<input type="radio"/>					
	D			<input type="radio"/>											<input type="radio"/>					
	G			<input type="radio"/>											<input type="radio"/>					
Q7	D-S		<input type="radio"/>												<input type="radio"/>				Da: Q7	
	D-G		<input type="radio"/>												<input type="radio"/>					
	G-S		<input type="radio"/>									<input type="radio"/>			<input type="radio"/>					
	D			<input type="radio"/>											<input type="radio"/>					
	G			<input type="radio"/>											<input type="radio"/>					
Q8	D-S		<input type="radio"/>												<input type="radio"/>				Da: Q8	
	D-G		<input type="radio"/>												<input type="radio"/>					
	G-S		<input type="radio"/>									<input type="radio"/>			<input type="radio"/>					
	D			<input type="radio"/>											<input type="radio"/>					
	G			<input type="radio"/>											<input type="radio"/>					
Q51	D-S		<input type="radio"/>									<input type="radio"/>				<input type="radio"/>			Da: Q51	
	D-G		<input type="radio"/>									<input type="radio"/>				<input type="radio"/>			Da: Q51	
	G-S		<input type="radio"/>											<input type="radio"/>				出力上昇⇒OVP		
	D			<input type="radio"/>										<input type="radio"/>				出力上昇⇒OVP		
	G			<input type="radio"/>										<input type="radio"/>				出力上昇⇒OVP		
S			<input type="radio"/>										<input type="radio"/>				出力上昇⇒OVP			

(Da : Damaged)

No.	Test position		Test mode		Test result												Note	
	Location No.	Test point	Short	Open	*1: Equivalent one smoke less than of a cigarette													
					a	b	c	d	e	f	g	h	l	j	k	l		
					Fire	Slight Smoke <small>Below judgment value *1</small>	Smoke	Burst	Smell	Red hot	Damaged	Fuse blown	O.V.P.	O.C.P.	No output	No change	Others	
D1	A-K		<input type="radio"/>												<input type="radio"/>			
	A or K		<input type="radio"/>												<input type="radio"/>			
D51	A-K		<input type="radio"/>												<input type="radio"/>			
	A or K		<input type="radio"/>												<input type="radio"/>			
D52	A-K		<input type="radio"/>												<input type="radio"/>			
	A or K		<input type="radio"/>												<input type="radio"/>			
D53	A-K		<input type="radio"/>												<input type="radio"/>			
	A or K		<input type="radio"/>												<input type="radio"/>			
D54	A-K		<input type="radio"/>												<input type="radio"/>			
	A or K		<input type="radio"/>												<input type="radio"/>			
D55	A-K		<input type="radio"/>												<input type="radio"/>			
	A or K		<input type="radio"/>												<input type="radio"/>			
C1			<input type="radio"/>									<input type="radio"/>						
C2~C5			<input type="radio"/>													<input type="radio"/>		
C6~C9			<input type="radio"/>													<input type="radio"/>		
C10			<input type="radio"/>											<input type="radio"/>				
C11			<input type="radio"/>												<input type="radio"/>			
			<input type="radio"/>												<input type="radio"/>			
C12			<input type="radio"/>												<input type="radio"/>			
			<input type="radio"/>												<input type="radio"/>			
C13			<input type="radio"/>												<input type="radio"/>			
			<input type="radio"/>												<input type="radio"/>			
C14			<input type="radio"/>												<input type="radio"/>			
			<input type="radio"/>												<input type="radio"/>			
C51			<input type="radio"/>											<input type="radio"/>			<input type="radio"/>	リップル増
			<input type="radio"/>											<input type="radio"/>	<input type="radio"/>			
C52			<input type="radio"/>											<input type="radio"/>	<input type="radio"/>			
			<input type="radio"/>											<input type="radio"/>	<input type="radio"/>			
C53			<input type="radio"/>											<input type="radio"/>	<input type="radio"/>			
			<input type="radio"/>											<input type="radio"/>	<input type="radio"/>			
C54			<input type="radio"/>													<input type="radio"/>	<input type="radio"/>	リップル増
			<input type="radio"/>													<input type="radio"/>	<input type="radio"/>	2次-FG短絡
C55			<input type="radio"/>													<input type="radio"/>	<input type="radio"/>	2次-FG短絡
			<input type="radio"/>													<input type="radio"/>	<input type="radio"/>	
R1			<input type="radio"/>												<input type="radio"/>			
			<input type="radio"/>												<input type="radio"/>			
R2			<input type="radio"/>												<input type="radio"/>			
			<input type="radio"/>												<input type="radio"/>			

(Da : Damaged)

No.	Test position		Test mode		Test result											Note		
	Location No.	Test point	Short	Open	*1: Equivalent one smoke less than of a cigarette													
					a	b	c	d	e	f	g	h	I	j	k		l	
					Fire	Slight Smoke <small>Below judgment value *1</small>	Smoke	Burst	Smell	Red hot	Damaged	Fuse blown	O.V.P.	O.C.P.	No output	No change	Others	
	L1	1-2	○	○														
		1-3	○	○														
		2-4	○	○								○						
		3-4	○	○								○						
	L2	1		○														
		2		○														
		3		○														
		4		○														
	L3	1-3	○	○								○						
		2-4	○	○								○						
		3-4	○	○								○						
		1			○													
	L5	2		○														
		6		○														
		8		○														
		9		○														
	T1	1-2	○	○														
		5-7	○	○														
		10-15	○	○														
		1			○													
	T2	2		○														
		5		○														
		6		○														
		7		○														
	T3	1-2	○	○														
		2-3	○	○														
		4-6	○	○														
		1			○													

6. 振動試験 Vibration Test

(1) 振動試験種類 Vibration Test Class

掃引振動数耐久試験 Frequency variable endurance test

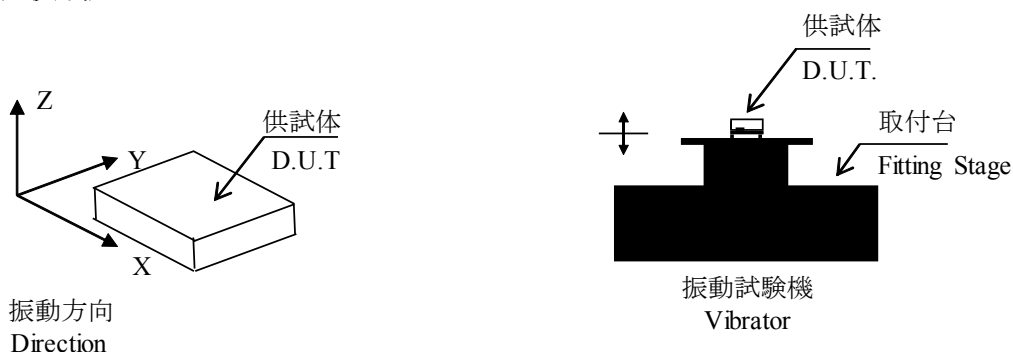
(2) 使用振動試験装置 Equipment Used

エミック(株)製	試験装置	F-16000BDH/LA16AW
EMIC CORP.	Test Equipment	

(3) 試験条件 Test Conditions

・周波数範囲 : 10-55Hz	・振動方向 : X,Y,Z(3方向)
Sweep Frequency	Direction
・掃引時間 : 1分間(10-55-10Hz:2分間)	・試験時間 : 各方向共1時間
Sweep time : 1min(10-55-10Hz:2min)	Sweep count : 1 hour each
・加速度 : 23.5m/s ²	・試験温度 : 25°C
Acceleration	Ambient Temperature

(4) 試験方法 Test method



振動方向
Direction

(5) 判定条件 Acceptable Conditions

- 1.破壊しない事
Not to be broken.
- 2.試験後の特性に異常がない事
No abnormal output after test

(6) 試験結果 Test Results

合格 OK

試験結果 Test Results		試験前 Before Test	試験後 After Test
出力電圧 Output Voltage	V	280.994	281.135
効率 Efficiency	%	0.90	0.90
入力変動 Line Regulation	mV	558.4	719.2
負荷変動 Load Regulation	mV	5511.5	5478.9
外観 Appearance	-	OK	OK