DBM20

RELIABILITY DATA

TDK-Lambda

PA640-57-01B

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

(1) MTBF Parts stress reliability projection MTBF

MODEL : DBM20

Calculating Method

Calculated based on parts stress reliability projection of Telcordia (*1).
Individual failure rate λss is calculated by the electric stress and temperature rise of each part.

Formula :

*1 : Telcordia document (Bellcore) "Reliability Prediction Procedure for Electronic Equipment".
(Document number TR-332, Issue 5)

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

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

Where :

λ_{equip}	:	Total equipment failure rate (FITs = Failures in 10^9 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 : 24Vdc
Buffer Current : 100%
Ambient Temperature : 25ºC

Environmetal Factor GF (GROUND, FIXED)
Mounting Method : Standard mounting A

MTBF 1,026,962 (Hours)

2. Components Derating

MODEL : DBM20

(1) Calculating Method

(a) Measuring Conditions

Input	:	24Vdc	Ambient temperature	:	70°C
Load	:	100%	Mounting method	:	Standard mounting A

(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

$$\theta_{j\text{-}c} = \frac{T_{j(max)} - T_c}{P_{ch(max)}} \qquad \theta_{j\text{-}l} = \frac{T_{j(max)} - T_l}{P_{ch(max)}}$$

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

T_l : Lead temperature at start point of derating ; 25°C in general

$P_{ch(max)}$: Maximum channel dissipation

$T_{j(max)}$ ($T_{ch(max)}$) : Maximum junction (channel) temperature

$\theta_{j\text{-}c}$ ($\theta_{ch\text{-}c}$) : Thermal impedance between junction (channel) and case

$\theta_{j\text{-}l}$ ($\theta_{ch\text{-}l}$) : Thermal impedance between junction (channel) and lead

(2) Components Derating List

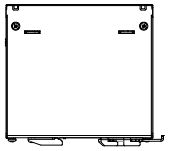
Location No.	**READY MODE** Vin = 24Vdc Load = 100% Ta = 70ºC					
Q400 TPCA8046-H TOSHIBA	Tj(max) = 150 °C	θ j-c = 2.78 °C/W	Pdmax = 2.8 W
	Pd = 0.7774 W	ΔTc = 6.1 °C	Tc = 76.1 °C
	Tj = Tc + ((θ j-c) x Pd) = 78.26 °C		
	D.F. = 52.2%		
Q500 TPCA8046-H TOSHIBA	Tj(max) = 150 °C	θ j-c = 2.78 °C/W	Pdmax = 2.8 W
	Pd = 0.0001 W	ΔTc = 20 °C	Tc = 90 °C
	Tj = Tc + ((θ j-c) x Pd) = 90.00 °C		
	D.F. = 60.0%		
Q102 IPD50R380CE INFINEON	Tj(max) = 150 °C	θ j-c = 1.27 °C/W	Pdmax = 98 W
	Pd = 0.2348 W	ΔTc = 17.9 °C	Tc = 87.9 °C
	Tj = Tc + ((θ j-c) x Pd) = 88.20 °C		
	D.F. = 58.8%		
Q105 MJD44H11RLG ON SEMI.	Tj(max) = 150 °C	θ j-c = 6.25 °C/W	Pdmax = 20 W
	Pd = 1.1 W	ΔTc = 28.7 °C	Tc = 98.7 °C
	Tj = Tc + ((θ j-c) x Pd) = 105.26 °C		
	D.F. = 70.2%		
D106 MURS360BT3G ON SEMI.	Tj(max) = 175 °C	θ j-a= 125 °C/W	
	Pd = 0.01 W	ΔTc= 19.1 °C	Tc = 89.1 °C
	Tj = Tc + ((θ j-a) x Pd) = 89.81 °C		
	D.F. = 51.3%		
PC1 TLP241AF(D4,F(O TOSHIBA	Tj(max) = 125 °C	θ j-c = 30 °C/W	Pdmax = 0.05 W
	Pd = 0.0001 W	ΔTc = 18.1 °C	Tc = 88.1 °C
	Tj = Tc + ((θ j-c) x Pd) = 88.10 °C		
	D.F. = 70.5%		
PC601 TLP785F(D4GRT7,F(C TOSHIBA	Tj(max) = 125 °C	θ j-c = 150 °C/W	Pdmax = 0.09 W
	Pd = 0.02 W	ΔTc = 10.3 °C	Tc = 80.3 °C
	Tj = Tc + ((θ j-c) x Pd) = 82.80 °C		
	D.F. = 66.2%		
A100 AP3843CMTR-E1 DIODES	Tj(max) = 150 °C	θ j-c = 18 °C/W	Pdmax = 0.460 W
	Pd = 0.216 W	ΔTc = 27.7 °C	Tc = 101.2 °C
	Tj = Tc + ((θ j-c) x Pd) = 105.09 °C		
	D.F. = 70.1%		

(2) Components Derating List

Location No.	**BUFFER MODE** Vin = 24Vdc Load = 100% Ta = 70ºC
Q203 FMP60N079S2HF FUJI ELECTRIC	Tj(max) = 150 °C θ j-c = 0.46 °C/W Pdmax = 270 W Pch = 53.4 W ΔTc = 15.2 °C Tc = 85.2 °C Tj = Tc + ((θ j-c) x Pch) = 109.93 °C D.F. = 73.3%
Q209 FMP60N079S2HF FUJI ELECTRIC	Tj(max) = 150 °C θ j-c = 0.46 °C/W Pdmax = 270 W Pch = 31.6 W ΔTc = 19.5 °C Tc = 89.5 °C Tj = Tc + ((θ j-c) x Pch) = 104.13 °C D.F. = 69.4%
D215 YG985C3R FUJI ELECTRIC	Tj(max) = 150 °C θ j-c = 1.75 °C/W Pd = 15.83 W ΔTc = 16.6 °C Tc = 86.6 °C Tj = Tc + ((θ j-c) x Pd) = 114.30 °C D.F. = 76.2%
D216 MBR2545CTG ON SEMI.	Tj(max) = 175 °C θ j-c = 1.5 °C/W Pd = 13.00 W ΔTc = 17.8 °C Tc = 87.8 °C Tj = Tc + ((θ j-c) x Pd) = 107.30 °C D.F. = 61.3%
PC600 TLP785F(D4GRT7,F(C TOSHIBA	Tj(max) = 125 °C θ j-c = 150 °C/W Pdmax = 0.09 W Pd = 0.02 W ΔTc = 10.3 °C Tc = 80.3 °C Tj = Tc + ((θ j-c) x Pd) = 82.80 °C D.F. = 66.2%
A200 AP3843CMTR-E1 DIODES	Tj(max) = 150 °C θ j-c = 18 °C/W Pdmax = 0.460 W Pd = 0.216 W ΔTc = 7.3 °C Tc = 77.3 °C Tj = Tc + ((θ j-c) x Pd) = 81.19 °C D.F. = 54.1%

3. Main components temperature rise ΔT list

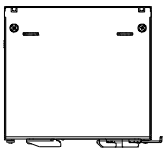
MODEL : DBM20

Mounting Method	Mounting A	Mounting B	Mounting C
			
Input Voltage (VDC)	24		
Load (A)	20		
Operation	Ready mode (Fixed Mode)		

Output Derating		Iout = 100% Ta = 70°C		
Location No	Parts Name	ΔT Temperature rise (°C)		
A100	CHIP IC	27.7	30.4	31.7
A101	CHIP IC	20.1	22.1	23.5
A200	CHIP IC	7.2	8.2	10.1
A201	CHIP IC	19.1	17.5	19.6
A202	CHIP IC	17.5	17.8	19.2
A204	CHIP IC	14.5	13.2	15.1
A205	CHIP IC	14.0	16.1	18.5
A207	CHIP IC	18.5	17.0	19.0
A209	CHIP IC	22.5	21.7	22.1
C112	E.CAP.	12.8	14.8	16.2
C113	E.CAP.	7.9	10.7	10.9
C114	E.CAP.	10.4	10.2	11.9
C115	E.CAP.	9.0	7.0	9.1
C121	E.CAP.	14.4	18.1	20.1
C215	E.CAP.	15.9	12.2	17.7
C238	E.CAP.	13.4	13.6	17.0
C502	E.CAP.	15.4	16.1	19.8
C503	E.CAP.	16.4	15.3	19.0
D106	F.R. DIODE	19.1	22.9	23.6
D215	F.R. DIODE	14.4	11.3	14.5
D216	S.B. DIODE	16.6	15.5	19.6
L100	CHOKE COIL	8.2	16.5	15.5
L200	CHOKE COIL	12.0	7.2	12.7
PC1	PHOTO RELAY	18.1	17.2	20.8
PC601	PHOTOCOUPLER	10.3	17.5	20.7
PD100	LED	12.5	13.4	18.0
Q102	MOSFET	17.9	22.2	22.4
Q105	CHIP TRANSISTOR	28.7	29.3	30.6
Q203	MOSFET	12.6	8.9	12.3
Q209	MOSFET	16.0	13.9	18.3
Q400	CHIP MOSFET	6.1	10.0	11.5
Q500	CHIP MOSFET	20.0	18.4	22.2
SA500	VARISTOR	19.5	17.2	21.5
SW1	SWITCH	10.8	10.7	16.8
T200	TRANSFORMER	9.9	5.2	7.9
Z100	CHIP ZENER DIODE	26.7	27.3	28.6

3. Main components temperature rise ΔT list

MODEL : DBM20

Mounting Method	Mounting A	Mounting B	Mounting C
			
Input Voltage (VDC)	24		
Buffer Current (A)	20		
Operation	Buffering mode (Fixed Mode)		

Output Derating		Iout = 100% Ta = 70°C		
Location No	Parts Name	ΔT Temperature rise (°C)		
A100	CHIP IC	27.1	29.8	30.9
A101	CHIP IC	20.2	22.0	23.1
A200	CHIP IC	7.3	8.1	9.7
A201	CHIP IC	19.1	17.3	19.2
A202	CHIP IC	17.3	17.5	18.7
A204	CHIP IC	14.8	13.2	14.9
A205	CHIP IC	13.9	15.9	18.0
A207	CHIP IC	18.3	16.7	18.6
A209	CHIP IC	22.4	21.5	21.7
C112	E.CAP.	12.8	14.7	15.8
C113	E.CAP.	7.9	10.6	10.5
C114	E.CAP.	10.4	10.1	11.6
C115	E.CAP.	8.9	7.0	8.7
C121	E.CAP.	14.3	18.1	19.7
C215	E.CAP.	16.0	12.1	17.4
C238	E.CAP.	13.4	13.5	16.7
C502	E.CAP.	15.4	16.0	19.4
C503	E.CAP.	16.4	15.2	18.6
D106	F.R. DIODE	19.0	22.7	23.0
D215	F.R. DIODE	16.6	13.5	16.3
D216	S.B. DIODE	17.8	16.7	20.4
L100	CHOKE COIL	8.2	16.4	15.1
L200	CHOKE COIL	12.5	7.6	12.8
PC1	PHOTO RELAY	18.1	17.1	20.4
PC601	PHOTOCOUPLER	10.3	17.4	20.3
PD200	LED	12.5	13.4	17.6
Q102	MOSFET	17.8	22.0	21.9
Q105	CHIP TRANSISTOR	28.5	29.1	30.1
Q203	MOSFET	15.2	11.4	14.5
Q209	MOSFET	19.5	17.3	21.3
Q400	CHIP MOSFET	6.9	10.7	11.9
Q500	CHIP MOSFET	20.8	19.0	22.8
SA500	VARISTOR	19.5	17.1	21.1
SW1	SWITCH	10.7	10.6	16.4
T200	TRANSFORMER	10.1	5.3	7.6
Z100	CHIP ZENER DIODE	26.3	26.9	27.8

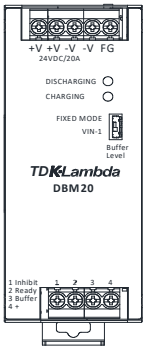
4. Electrolytic capacitor lifetime

MODEL : DBM20

Cooling condition : Convection cooling

Ready Mode

Mounting A



Conditions Ta : 40°C
: 50°C
: 60°C
: 70°C
Load : 20A

Vin : 24VDC

Load \ Ta	Life Time (years)			
	40ºC	50ºC	60ºC	70ºC
100%	15.0	8.5	4.3	2.1

Vin : 30VDC

Load \ Ta	Life Time (years)			
	40ºC	50ºC	60ºC	70ºC
100%	14.6	7.3	3.7	1.8

Mounting B

Conditions Ta : 40°C
: 50°C
: 60°C
: 70°C
Load : 20A

Vin : 24VDC

Load \ Ta	Life Time (years)			
	40ºC	50ºC	60ºC	70ºC
100%	14.8	7.4	3.7	1.9

Vin : 30VDC

Load \ Ta	Life Time (years)			
	40ºC	50ºC	60ºC	70ºC
100%	11.9	5.9	3.0	1.5

Note:

The lifetime is calculated based on our method and doesn't include seal degradation effect etc.

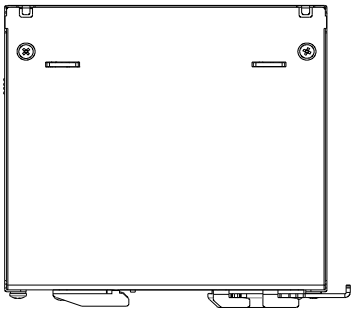
4. Electrolytic capacitor lifetime

MODEL : DBM20

Cooling condition : Convection cooling

Ready Mode

Mounting C



Conditions Ta : 40°C
: 50°C
: 60°C
: 70°C
Load : 20A

Vin : 24VDC

Load \ Ta	Life Time (years)			
	40ºC	50ºC	60ºC	70ºC
100%	13.4	6.7	3.4	1.7

Vin : 30VDC

Load \ Ta	Life Time (years)			
	40ºC	50ºC	60ºC	70ºC
100%	11.0	5.5	2.7	1.4

Note:
The lifetime is calculated based on our method and doesn't include seal degradation effect etc.

5. Abnormal test

MODEL : DBM20

(1) Test Conditions

Input Voltage: 24Vdc Load : 20A Ta : 25°C

(2) Test Results

(Da: Damaged)

No.	Test Position		Test Mode		Test Results													
					a	b	c	d	e	f	g	h	i	j	k	l		
	LOCATION No.	TEST POINT	SHORT	OPEN	FIRE	SMOKE	BURST	SMELL	RED HOT	DAMAGE	FUSE BLOW	OVP	OCP	NO OUTPUT	NO CHANGE	OTHERS		NOTE
1	Q500	D-S	○												○			
		D-G	○												○			
		G-S	○												○			
		D		○										○		○		Unit discharged & charging disabled
		S		○										○		○		Unit discharged & charging disabled
		G		○											○			
2	Q102	D-S	○								○			○				Da: F1
		D-G	○								○			○				Da: F1
		G-S	○											○		○		Charging disabled.
		D		○										○		○		Charging disabled.
		S		○										○		○		Charging disabled.
		G		○						○	○			○				Da: F1, Q102
3	Q203	D-S	○									○		○				Unit latched.
		D-G	○							○		○		○				Unit latched & Da: Q203, Z204, A204, A200
		G-S	○											○				
		D		○										○				
		S		○						○		○		○				Unit latched & Da: Q203
		G		○						○		○		○				Unit latched & Da: Q203
4	Q209	D-S	○												○	○		Buffer time increased.
		D-G	○													○		Buffer time reduced
		G-S	○											○				
		D		○										○				
		S		○										○				
		G		○											○			
5	D106	A-K	○												○			
		A-K		○										○		○		Charging disabled.
6	D112	A-K	○												○			
		A-K		○										○		○		Charging disabled.
7	D215	A-K	○							○	○			○				Da: F2, Q203
		A-K		○						○				○				Da: Z204

5. Abnormal test

MODEL : DBM20

(1) Test Conditions

Input Voltage: 24Vdc Load : 20A Ta : 25°C

(2) Test Results

(Da: Damaged)

No.	Test Position		Test Mode		Test Results												
					a	b	c	d	e	f	g	h	i	j	k	l	
	LOCATION No.	TEST POINT	SHORT	OPEN	FIRE	SMOKE	BURST	SMELL	RED HOT	DAMAGE	FUSE BLOW	OVP	OCP	NO OUTPUT	NO CHANGE	OTHERS	NOTE
8	D216	1 - 2	○												○		
		2 - 3	○												○		
		1		○											○		
		2		○										○			
		3		○											○		
9	L100	pin 1 - 4	○													○	Charging disabled.
		pin 1/4		○										○			
10	L200	pin 1 - 2	○													○	Ripple voltage increased
		pin 1/2		○										○			
11	T200	pin 1 - 2	○												○		
		pin 3 - 4	○													○	Ripple voltage increased & buzzing sounds.
		pin 1		○										○			
		pin 2		○										○			
		pin 3		○											○	○	OCP disabled.
		pin 4		○											○	○	OCP disabled.
12	C112		○											○			
				○											○		
13	C114		○											○			
				○											○		
14	C115		○											○			
				○											○		
15	C116		○											○			
				○											○		

6. Vibration Test

MODEL : DBM20

(1) Vibration Test Class

Frequency Variable Endurance Test

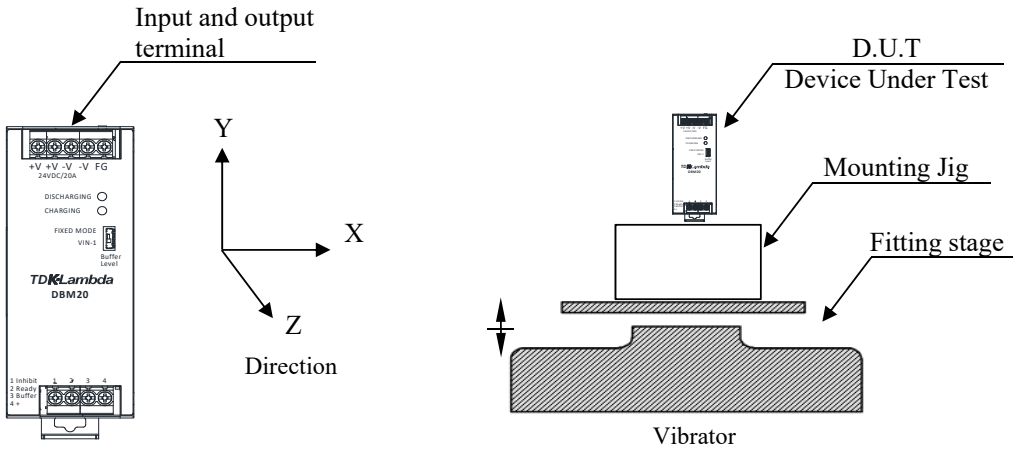
(2) Equipment Used

Controller	:	F-400-BM-E47 (EMIC CORP.)
Vibrator	:	905-FN (EMIC CORP.)
Serial no.	:	22964

(3) Test Conditions

Sweep Frequency	:	10 - 55Hz	Direction	:	X, Y, Z
Sweep Time	:	1 minute	Sweep count	:	1 hour each axis
Acceleration	:	19.6m/s^2 (2G)			

(4) Test Method



(5) Acceptable Conditions

1. No abnormalities on the apprearance.
2. No abnormality on buffer voltage after test.

(6) Test results

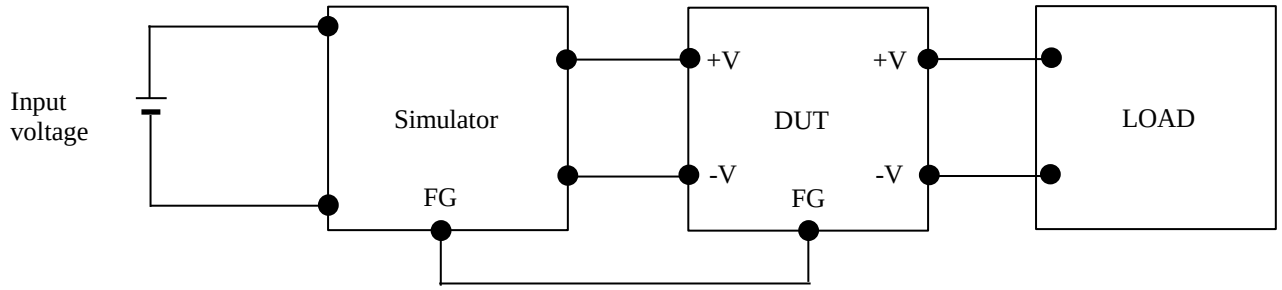
OK

7. Noise Simulate Test

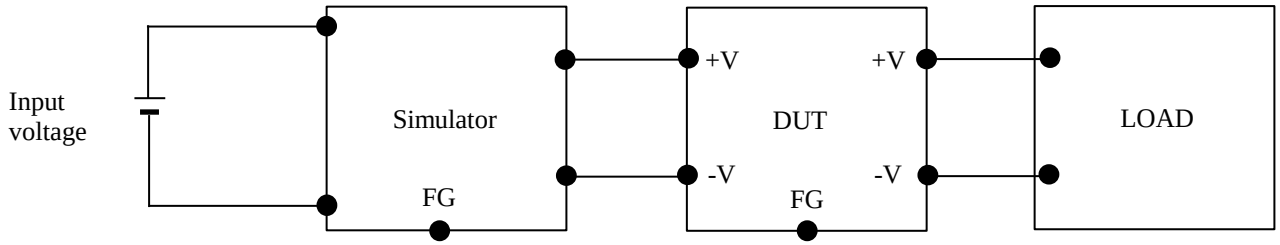
MODEL : DBM20

(1) Test Circuit and Equipment

a) Common Mode Noise Test



b) Normal Mode Noise Test



Simulator : INS-400L

(2) Test Conditions

Input voltage :	24Vdc	Noise level :	0V ~ 2kV
Output current :	0%, 100%	Phase shift :	0^{o} ~ 360^{o}
Ambient temperature :	25 ^{o}C	Polarity :	+, -
Pulse width :	50ns ~ 1000ns	Mode :	Common Normal
		Trigger select :	Line

(3) Acceptable Conditions

1. Input/Output voltage regulation not exceed +/- 5% of initial (before test) value during test.
2. Input/Output voltage must be within the regulation specification after the test.
3. No change on signals.
4. No blinking on LEDs.
5. Smoke and fire are not allowed.

(4) Test results

OK

8. Thermal Shock Test

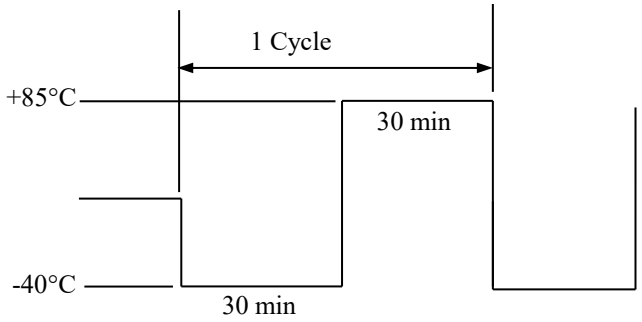
MODEL : DBM20

(1) Equipment Used

TSA-71S-A : ESPEC

(2) Test Conditions

Ambient Temperature	: -40°C ~ +85°C
Test Time	: Refer to Drawing
Test Cycle	: 902 Cycles
Not Operating	: -



(3) Test Method

Before the test, check if there is no abnormality on buffer voltage and put the D.U.T in the testing chamber. Then test it in above cycles. After the test is completed, leave it for 1 hour at room temperature and check to make sure that there is no abnormality on buffer voltage.

(4) Acceptable Conditions

No abnormality on buffer voltage after test

(5) Test results

OK