

# **G+GENESYS™ 1kW**

## **RELIABILITY**

## **DATA**

DWG: IA881-57-01		
APPD	CHK	DWG
<i>Uyam</i> 31/05/20	<i>Uyam</i> 31.05.2020	Michael Goldsberg 31/05/2020

**TDK-LAMBDA**

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

**M.T.B.F.**

Calculation based on parts stress reliability projection of Telcordia (Bellcore)  
 "Reliability Prediction Procedure for Electronic Equipment" Document number TR-322,Issue5)  
 Individual failure  $\lambda_{SSi}$  is calculated from electrical stress and temperature rise of each device.

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

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

- $\lambda_{equip}$  : Total Equipment failure rate (FITs = Failures in  $10^9$  hours)
- $\lambda_{Gi}$  : Generic failure rate for the  $i$ th device
- $\pi_{Qi}$  : Quality factor for the  $i$ th device
- $\pi_{Si}$  : Stress factor for the  $i$ th device
- $\pi_{Ti}$  : Temperature factor for the  $i$ th device
- $m$  : Number of different device types
- $N_i$  : Quantity of  $i$ th device type
- $\pi_E$  : Equipment environmental factor

Conditions:

$T_a = 25^\circ\text{C}$

Gf - Ground, Fixed, Uncontrolled

**M.T.B.F. = 669305 (HOURS)**

## 2.COMPONENT DERATING

### G 1kW SERIES

#### Calculation method

##### (1) Conditions

Input:	Nominal
Output:	Vout - 100%, Iout - 100%
Ambient temperature:	50°C
Mounting Method:	Standard Mounting

##### (2) Semiconductors

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

##### (3) IC, Resistors, Capacitors, etc.

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

##### (4) Calculation method of thermal impedance:

$$\Theta_{j-a} = \frac{Tj(\max) - Ta}{Pc(\max)} \quad \Theta_{j-c} = \frac{Tj(\max) - Tc}{Pc(\max)} \quad \Theta_{j-l} = \frac{Tj(\max) - Tl}{Pc(\max)}$$

$Tc$ : 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

$\Theta_{j-c}$ : Thermal Impedance between Junction and Case

$\Theta_{j-a}$ : Thermal Impedance between Junction and Air

$\Theta_{j-l}$ : Thermal Impedance between Junction and Lead

Load = 100%

Ta=50°C

INPUT1P

**GENESYS™ 1kW**

D1 D25XB60-7000 SHINDENGEN	Tjmax= 150 °C Pd = 5.4 W Tj = Tc + (qj-c x Pd) =>	qj-c = 1.0 °C/W DTc = 63.3 °C Tj = 118.7 °C	Pmax = --- W Tc = 113.3 °C D.F. = 79.1 %
A4 TPS54202DDCR TI	Tjmax= 150 °C Pd = 0.31 W Tj = Tc + (qj-c x Pd) =>	qj-c = 39.5 °C/W DTc = 12.6 °C Tj = 74.8 °C	Pmax = --- W Tc = 62.6 °C D.F. = 49.9 %
A5 TPS54202DDCR TI	Tjmax= 150 °C Pd = 0.03 W Tj = Tc + (qj-c x Pd) =>	qj-c = 39.5 °C/W DTc = 12.6 °C Tj = 63.8 °C	Pmax = --- W Tc = 62.6 °C D.F. = 42.5 %
A6 MIP2E5DMY PANASONIC	Tjmax= 150 °C Pd = 1.85 W Tj = Tc + (qj-c x Pd) =>	qj-c = 3.0 °C/W DTc = 7.5 °C Tj = 63.1 °C	Pmax = --- W Tc = 57.5 °C D.F. = 42.0 %
A7 TPS560200DBVR TI	Tjmax= 125 °C Pd = 0.1 W Tj = Tc + (qj-c x Pd) =>	qj-c = 100 °C/W DTc = 12.6 °C Tj = 72.6 °C	Pmax = --- W Tc = 62.6 °C D.F. = 58.1 %

Load = 100%

Ta=50°C

PFC

Q3 TK39N60W,S1VF Toshiba	Tjmax= 150 °C Pd = 5.22 W Tj = Tc + (qj-c x Pd) =>	qj-c = 0.5 °C/W DTc = 34.4 °C Tj = 86.8 °C	Pmax = 270.0 W Tc = 84.4 °C D.F. = 57.9 %
Q4 TK39N60W,S1VF Toshiba	Tjmax= 150 °C Pd = 5.22 W Tj = Tc + (qj-c x Pd) =>	qj-c = 0.5 °C/W DTc = 34.4 °C Tj = 86.8 °C	Pmax = 270.0 W Tc = 84.4 °C D.F. = 57.9 %
D3 IDH10G65C5 INFINEON	Tjmax= 175 °C Pd = 4.6 W Tj = Tc + (qj-c x Pd) =>	qj-c = 1.7 °C/W DTc = 44.7 °C Tj = 102.5 °C	Pmax = 89.0 W Tc = 94.7 °C D.F. = 58.6 %

Load = 100%

Ta=50°C

DC/DC 10V

**GENESYS™ 1kW**

Q1 FMW30N60S1HF Fuji	Tjmax= 150 °C Pd = 13.2 W Tj = Tc + (q j-c x Pd) =>	qj-c = 0.57 °C/W DTc = 34.5 °C Tj = 92.0 °C	Pmax = 220.0 W Tc = 84.5 °C D.F. = 61.3 %
Q2 FMW30N60S1HF Fuji	Tjmax= 150 °C Pd = 13.2 W Tj = Tc + (q j-c x Pd) =>	qj-c = 0.57 °C/W DTc = 34.5 °C Tj = 92.0 °C	Pmax = 220.0 W Tc = 84.5 °C D.F. = 61.3 %
Q23-Q27 IPP023N04N G Infineon	Tjmax= 175 °C Pd = 0.65 W Tj = Tc + (q j-c x Pd) =>	qj-c = 0.9 °C/W DTc = 20.3 °C Tj = 70.9 °C	Pmax = 167.0 W Tc = 70.3 °C D.F. = 40.5 %

Load = 100%

Ta=50°C

DC/DC 150V

Q1 FMW30N60S1HF Fuji	Tjmax= 150 °C Pd = 13.2 W Tj = Tc + (q j-c x Pd) =>	qj-c = 0.57 °C/W DTc = 30.6 °C Tj = 88.1 °C	Pmax = 220.0 W Tc = 80.6 °C D.F. = 58.7 %
Q2 FMW30N60S1HF Fuji	Tjmax= 150 °C Pd = 13.2 W Tj = Tc + (q j-c x Pd) =>	qj-c = 0.57 °C/W DTc = 30.6 °C Tj = 88.1 °C	Pmax = 220.0 W Tc = 80.6 °C D.F. = 58.7 %
D31-D36 YG911S3R Fuji	Tjmax= 150 °C Pd = 3.5 W Tj = Tc + (q j-c x Pd) =>	qj-c = 3.5 °C/W DTc = 26.2 °C Tj = 88.5 °C	Pmax = --- W Tc = 76.2 °C D.F. = 59.0 %

Load = 100%


Ta=50°C

DC/DC 600V

Q1 FMW30N60S1HF Fuji	Tjmax= 150 °C Pd = 13.4 W Tj = Tc + (q j-c x Pd) =>	qj-c = 0.57 °C/W DTc = 29.5 °C Tj = 87.1 °C	Pmax = 220.0 W Tc = 79.5 °C D.F. = 58.1 %
Q2 FMW30N60S1HF Fuji	Tjmax= 150 °C Pd = 11.2 W Tj = Tc + (q j-c x Pd) =>	qj-c = 0.57 °C/W DTc = 29.5 °C Tj = 85.9 °C	Pmax = 220.0 W Tc = 79.5 °C D.F. = 57.2 %
D31-D36 IDH02SG120 Infineon	Tjmax= 175 °C Pd = 3.41 W Tj = Tc + (q j-c x Pd) =>	qj-c = 2.0 °C/W DTc = 16.6 °C Tj = 73.4 °C	Pmax = --- W Tc = 66.6 °C D.F. = 42.0 %


**3.Main Components Temperature Rise**

**G10-100**

Location No.		Parts Name	ΔT Temperature Rise (°C)
			Standard Mounting
DC-DC	A3	Gate Driver	25.6
	C8	EL. Capacitor	18.2
	R99	Shunt Resistor	20.5
	Q2	Buck Mosfet	34.5
	Q27	Mosfet Rectifier	20.3
PFC	L1	Choke	52.4
	D3	Diode	44.7
	Q3	Mosfet	34.4
	C24	E-Cap	5.8
OUTPUT FILTER	C3	E-Cap	15.3
	C44	E-Cap	15.8
INPUT	D1	Bridge	63.3
	RL1	Relay	18.6
	A6	Top-Switch	7.5
	T1	Transformer	12.6
	C28	E-Cap	4.1
	C45	E-Cap	10.9
	C66	E-Cap	6.9
	C76	E-Cap	11.1
Conditions:			
Standard Mounting			
Input Voltage	85V~265V		
Output Voltage	10V		
Output Current	100A		

**3.Main Components Temperature Rise**


**G150-7**

Location No.		Parts Name	$\Delta T$ Temperature Rise (°C)
			Standard Mounting
DC-DC	Q2	Buck Mosfet	30.6
	D32	Diode Rectifier	26.2
	R99	Shunt Resistor	19.1
	C7	E-Cap	16.3
OUTPUT FILTER	C4	E-Cap	14.6
	C7	E-Cap	15.2
Conditions:			
Standard Mounting			
Ta		50°C	
Input Voltage		85V~265V	
Output Voltage		150V	
Output Current		7A	



**3.Main Components Temperature Rise**

**G600-1.7**

Location No.		Parts Name	ΔT Temperature Rise (°C)
			Standard Mounting
DC-DC	Q2	Buck Mosfet	29.5
	D32	Diode Rectifier	16.6
	R99	Shunt Resistor	15.1
	C5	E-Cap	16.2
OUTPUT FILTER	C6	E-Cap	12.6
	C7	E-Cap	13.9
Conditions:			
Standard Mounting			
Ta		50°C	
Input Voltage		85V~265V	
Output Voltage		600V	
Output Current		1.7A	

**4.ELECTROLYTIC CAPACITORS LIFE TIME ESTIMATION**


MODEL	COMPUTED LIFE (year) at Tambient		
	30°C	40°C	50°C
G10V-170A	15	15	8
G60V-28A	15	15	8
G150V-11.2A	15	15	8
G600V-2.8A	15	15	8

FORMULA:  $L = L_o \times 2^{\frac{105-T_c}{10}}$  (years)

*L*: Elec.capacitor computed life (24 hours per day,365 days operation)

*L<sub>o</sub>*: Guarantee life for Elec.capacitor

*T<sub>c</sub>*: Case temperature of Elec.capacitor

Standard Mounting	
Input Voltage	Nom.
Output Voltage	100%
Output Current	100%

5. ABNORMAL TEST

INPUT 1P

Condition: Ta:25°C Input:230VAC Vout:100% Iout:100%

No.	Test Position		Failure	Study result (prediction of the phenomena)														Note			
	Location No.	Test Point		Short	Open	Fire	Sligh Smoke	Smoke	Burst	Smell	Red Hot	Damaged	Fuse Open	V < O	V C O	V T O	AC FAIL		No Output	No Change	PS functional after AC recycle
1	A4	2-3	●								●						●				Input-A4
2	A5	2-3	●								●						●				Input-A5
3	A6	1-2	●														●		●		Display stopped working
4		1		●													●		●		Display stopped working
5		2-3	●									●					●				Input-F3
6		2		●													●		●		Display stopped working
7		3-1	●								●	●					●				Input-F3;ZD4;A6
8		3		●													●		●		Display stopped working
9	A7	3-4	●								●						●			●	Input-A7,Internal Error
10	C28		●														●		●		Display stopped working
11				●														●			
12	C50	thermal:A5,L4	●														●		●	●	Internal Error. Input-A5&L4-35°C
13				●														●			
14	C70	thermal:A8,L6	●																	●	Fan's stopped working*
15				●														●			
16	D1	4		●													●		●		
17	D7	A-C	●								●						●				Input-A5
18		A		●														●			
19	D9	A-C	●														●		●	●	Internal Error
20		A		●														●			
21	D14	A-C	●														●		●		Display stopped working
22	D17	A-C	●														●		●		Display stopped working
23		A		●														●			

5. ABNORMAL TEST

PFC 1P

Condition: Ta:25°C Input:230VAC Vout:100% Iout:100%

No.	Test Position		Failure	Study result (prediction of the phenomena)														Note			
	Location No.	Test Point		Short	Open	Fire	Sligh Smoke	Smoke	Burst	Smell	Red Hot	Damaged	Fuse Open	P < O	P O O	P T O	AC FAIL		No Output	No Change	PS functional after AC recycle
1	C20;24;25		●									●					●				Input F1, F2
2				●														●			
3	D3	A-C	●									●	●				●				Input F1, F2;PFC Q4
4		A		●								●	●				●				Input F1, F2;PFC Q3
5	L1		●														●		●	●	Input Relay Clicking
6				●													●		●	●	Display shows: V - 0 and I - 0
7	Q1	B-E	●															●			
8		B		●								●	●				●				Input F1, F2;PFC Q3
9		K-E	●									●	●				●			●	Display shows: V - 0 and I - 0 ;PFC R13
10		E		●								●	●				●				Input F1, F2;PFC Q3
11		K-B	●									●	●				●		●	●	Display shows: V - 0 and I - 0
12		K		●								●	●					●			Input F2;PFC Q4
13	Q2	B-E	●															●			
14		B		●								●	●				●				After 2 min. Input F1, F2;PFC Q3
15		K-E	●									●	●							●	PFC R13 (P.S. continued to work)
16		E		●								●	●				●				Input F1, F2;PFC Q4
17		K-B	●									●	●				●				Input F1, F2;PFC Q4
18		K		●														●			
19	Q3	G-S	●									●	●				●			●	Output 4min. Not stable;PFC R13
20		G		●								●	●				●				Input F1, F2;PFC Q3
21		D-S	●									●	●				●				Input F1, F2
22		S		●																●	PFC Q4 temp enlarge from 42°C to 46°C
23		D-G	●									●	●				●				Input F1, F2;PFC Q3
24		D		●																●	PFC Q4 temp enlarge from 42°C to 46°C

5. ABNORMAL TEST

DCDC 10V

GENESYS™ 1kW

Condition: Ta:25°C Input:230VAC Vout:100% Iout:100%

No.	Test Position		Failure	Study result (prediction of the phenomena)														Note		
	Location No.	Test Point		Short	Open	Fire	Slight Smoke	Smoke	Burst	Smell	Red Hot	Damaged	Fuse Open	P < O	P O	P T O	AC FAIL		No Output	No Change
1	C8		•							•	•						•			A1, Q2, Q6-Q10, D11, D13, D14, ZD1, R6, R39, R40, R41, R42
2				•														•		
3	C17		•								•	•					•			PFC3P200 - D1; Input3P200 - F1, F3
4				•														•		
5	L3		•															•		
6				•													•		•	
7	Q1	G-S	•																•	Q2 temp enlarge from 57°C to 76°C
8		G		•										•					•	
9		D-S	•											•					•	
10		S		•															•	Q2 temp enlarge from 57°C to 76°C
11		D-G	•											•					•	
12		D		•															•	Q2 temp enlarge from 57°C to 76°C
13	Q5	G-S	•																•	Vo go down to 6V; Mode CV change to CC
14		G		•					•		•	•							•	A1, Q6, Q5, C12, C14, C20, Q1, D1, R2, ZD1, R5
15		D-S	•						•		•	•							•	A1, Q6, Q5, Q1, D1, R1, R2, ZD1, R5
16		S		•															•	Vo go down to 6V; Mode CV change to CC
17		D-G	•						•		•	•							•	A1, Q5, Q6, Q4, Q1, D1, D6, D8, R1, R2, ZD1, R5, R27, R28,
18		D		•															•	Vo go down to 6V; Mode CV change to CC
19	Q23	G-S	•																•	
20		G		•															•	
21		D-S	•						•		•	•							•	A1, Q25, Q5-Q7, Q9, Q1, D1, D6, R2, ZD1, R5, R27, R30, R39
22		S		•															•	
23		D-G	•						•		•	•							•	A1, Q22, Q23, Q25, Q5-Q7, Q9, Q1, D1, D6, R2, ZD1, R5, R27, R30, R39, R84
24		D		•															•	
25	T3	1-2	•						•		•	•							•	A1, Q5, Q9, Q10, Q7, C12, C14, C20, Q1, D1, D6, R2, ZD1, R5, R39
26		1		•															•	
27		A-C	•								•								•	A1, Q17, Q25, Q1, Q2, Q5-Q7, Q9, D1, D6, ZD1, R5, R6, R27, R30, R39
28		A		•															•	Vo go down to 6V
29		B-C	•								•								•	A1, Q17, Q25, Q1, Q2, Q5-Q7, Q9, D1, D6, ZD1, R5, R6, R27, R30, R39
30		B		•															•	Vo go down to 6V

5. ABNORMAL TEST

DCDC 600V

GENESYS™ 1kW

Condition: Ta:25°C Input:230VAC Vout:100% Iout:100%

No.	Test Position		Failure	Study result (prediction of the phenomena)															Note				
	Location No.	Test Point		Short	Open	Fire	Slight Smoke	Smoke	Burst	Smell	Red Hot	Damaged	Fuse Open	P < O	P O	P T O	AC FAIL	No Output		No Change	PS functional after AC recycle	Others	
1	C4		•																				
2				•																			
3	C7		•																				
4				•																			
5	C16		•								•	•											
6				•																			
7	D22	A-C	•																				
8		A		•																			
9	D32	A-C	•							•		•											
10		A		•							•											•	
A1, Q1, Q8, Q9, Q10, Q14, Q15, D1, D35, D13, D11, ZD1, R1, R5, R39, R40 PFC3P200 - Q1 R63~R66, R68, R71, R66, R69; Vo go down to 360V; Mode CV change to CC																							
11	L3	8.9-10,11	•																				
12		8,9		•																			
13		5,4-3,2	•																				
14		5,4		•																			
15	Q1	G-S	•																			•	
Q2 temp enlarge from 57°C to 76°C																							
16		G		•																			
17		D-S	•																				
18		S		•																			
19		D-G	•																				
20		D		•																			
21	Q5	G-S	•																			•	
Vo go down to 360V; Mode CV change to CC																							
22		G		•						•	•												
23		D-S	•							•	•												
24		S		•																		•	
Vo go down to 360V; Mode CV change to CC																							
25		D-G	•							•	•												
A1, R149, Q5, Q6, Q3, Q1, D1, D6, D8, R1, R2, ZD1, R5, R27, R28																							
26		D		•																		•	
Vo go down to 360V; Mode CV change to CC																							
27	T3	1-2	•							•	•												
A1, C11, C12, Q1, Q9, Q10, D1, ZD1, R1, R5, R39, R40 PFC3P200 - D1; Input3P200 - F1, F3																							
28		1		•																			
29		A-B	•							•	•												
A1, C11, C12, Q1, Q9, Q10, D1, ZD1, R1, R5, R39, R40 PFC3P200 - D1; Input3P200 - F1, F3																							
30		A		•																		•	
Vo go down to 360V																							
31		C-B	•							•	•												
A1, C11, C12, Q1, Q9, Q10, D1, ZD1, R1, R5, R39, R40 PFC3P200 - D1; Input3P200 - F1, F3																							
32		C		•																		•	
Vo go down to 360V																							