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Efficiency Through Technology

**RELIABILITY REPORT
2008**

Power Semiconductor Devices

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QUALITY AND RELIABILITY

IXYS is committed to setting a new standard for excellence in Power Semiconductors. Reflecting our dedication to industry leadership in the manufacture of medium to high power devices, reliability has assumed a primary position in raw material selection, design, and process technology.

Reliability utilizes information derived from applied research, engineering design, analysis of field applications and accelerated stress testing and integrates this knowledge to optimize device design and manufacturing processes.

All areas that impact reliability have received considerable attention in order to achieve our goal to be the # 1 Reliability Supplier of Power Semiconductor products. We believe IXYS products should be the most reliable components in your system.

We have committed significant resources to continuously improve and optimize our device design, wafer fab processes, assembly processes and test capabilities. As a result of this investment, IXYS has realized a dramatic improvement in reliability performance on all standardized tests throughout the product line.

Excellence in product reliability is "built-in", not tested-in. Moreover, it requires a total systems approach, involving all parties: from design to raw materials to manufacturing.

In addition to qualifying new products released to the market, life and environmental tests are periodically performed on standard products to maintain feedback on assembly and fabrication performance to assure product reliability. Further information on reliability of power devices is provided on www.ixys.com.

RELIABILITY TESTS

High Temperature Reverse Bias (HTRB)

Failure Modes: Gradual degradation of break-down characteristics due to presence of foreign materials and polar/ionic contaminants disturbing the electric field termination structure.

Sensitive Parameters: BV_{DSS} , BV_{CES} , V_{DRRM} , V_{RRM} , I_{DSS} , I_{CES} , I_{DRM} , I_{RRM} , V_{TH} .

High Temperature Gate Bias (HTGB)

Failure Modes: Rupture of the gate oxide due to localized thickness variations, structural anomalies, particulates in the oxide, channel inversion due to presence of mobile ions in the gate oxide.

Sensitive Parameters: I_{GSS} , I_{GES} , V_{TH} , I_{DSS} , I_{CES} .

Temperature Cycle

Failure modes: Thermal fatigue of silicon-metal and metal-metal interfaces due to heating and cooling, causing thermal and electrical performance degradation.

Sensitive Parameters: R_{thJC} , $R_{DS(on)}$, $V_{CE(sat)}$, V_T , V_F .

Humidity Test

Failure Modes: Degradation of electrical leakage characteristics due to moisture penetration into plastic packages.

Sensitive Parameters: BV_{DSS} , BV_{CES} , V_{DRRM} , V_{RRM} , I_{DSS} , I_{CES} , I_{DRM} , I_{RRM} , I_{GSS} , I_{GES} , V_{TH} .

Power Cycle

Failure Modes: Thermal fatigue of silicon-metal and metal-metal interfaces due to heating and cooling can cause thermal and electrical performance degradation.

Sensitive Parameters: R_{thJC} , $R_{DS(on)}$, $V_{CE(sat)}$, V_T , V_F , I_{DSS} , I_{CES} , I_{DRM} , I_{RRM} , BV_{DSS} , BV_{CES} , V_{DRRM} , V_{RRM} .

TERMS IN TABLES

SUMMARY TABLES 1 AND 2:

AF: acceleration factor

$$AF = \exp \{ Ea * [(T_2 - T_1) / (T_2 * T_1)] / k \} \quad (1)$$

Ea: activation energy; @ HTRB Ea = 1.0 eV

@ HTGB Ea = 0.4 eV

k: Boltzmann's constant $8.6 \cdot 10^{-5}$ eV/K

T₁: abs. application junction temperature (273+T_j) K

T₂: abs. test junction temperature (273+T_j) K

UCL: upper confidence limit (60%)

Total Failures @ 60% UCL:

$$N = r + dr \quad (2)$$

r: number of failed devices

dr: additional term, depending on both r and UCL

MTTF: Mean Time To Failures = 1/Failure Rate

FIT: 1 FIT = 1 failure / 10⁹ hrs

TABLES 3:

ΔT: max T_j - min T_j during Test

DEFINITION OF FAILURE

Failure criteria are defined according to IEC 60747 standard series

Summary of Tables 1A - 1H: HTRB

	Table 1A MOSFET/IGBT discrete device *)	Table 1B MOSFET/IGBT Module	Table 1C Thyr./Diode Module	Table 1D Controller/ Rec. Bridge*)	Table 1E FRED *)	Table 1F Schottky Diode*)	Table 1G Thyr./Diode discrete device*)	Table 1H ISOPLUS
Failure Rate [FIT] 125°C, 60% UCL	592	12483	45956	17190	1939	845	16855	-
Failure Rate [FIT] 90°C, 60% UCL	35	747	2752	1029	116	51	1009	-
Total Lots Tested	169	13	15	17	35	24	12	20
Total Devices Tested	4932	116	160	170	645	570	210	456
Total Actual	2	0	1	0	0	0	1	1
Failures 60% UCL (eq. (2))	3	0.92	2	0.92	0.92	0.92	2	-
Total Equivalent Device Hours @ 125°C (AF eq. (1))	5066720	73702	43520	53520	474548	1089301	118658	465622
MTTF 125°C 60% UCL	193	9	2	7	59	135	7	-
(Years) 90°C 60% UCL	3220	153	41	111	983	2257	113	-

Summary of Table 2A - 2C: HTGB

	Table 2A MOSFET/IGBT discrete device *)	Table 2B MOSFET/IGBT Module	Table 2C ISOPLUS
Failure Rate [FIT] 125°C, 60% UCL	231	4606	-
Failure Rate [FIT] 90°C, 60% UCL	75	1486	-
Total Lots Tested	138	15	15
Total Devices Tested	4030	210	460
Total Actual	0	0	0
Failures 60% UCL (eq. (2))	0.92	0.92	-
Total Equivalent Device Hours @ 125°C (AF eq. (1))	3976960	199740	506800
MTTF 125°C 60% UCL	493	25	-
(Years) 90°C 60% UCL	1530	77	-

*) including ISOPLUS

Summary of Tables 3A - 3H: Power Cycle

	Table 3A MOSFET/IGBT discrete device *)	Table 3B MOSFET/IGBT Module	Table 3C Thyr./Diode Module	Table3D Controller/ Rec. Bridge*)	Table 3E FRED *)	Table 3F Schottky Diode*)	Table 3G Thyr./Diode discrete device*)	Table 3H Isoplus
Total Lots Tested	15	7	5	5	10	6	9	2
Total Devices Tested	344	139	50	50	190	224	140	100
Total Failures	0	0	0	0	0	0	0	0
Total Device Cycles	2960000	751300	850000	370000	410000	1520088	380000	280000

Summary of Tables 4A - 4J: Temperature Cycle

	Table 4A MOSFET/IGBT discrete device *)	Table 4B MOSFET/IGBT Module	Table 4C Thyr./Diode Module	Table4D Controller/ Rec. Bridge*)	Table 4E FRED *)	Table 4F Schottky Diode*)	Table 4G Thyr./Diode discrete device*)	Table 4H Isoplus	Table 4J Breakover Diode
Total Lots Tested	13	12	27	20	25	19	17	18	4
Total Devices Tested	353	119	290	210	450	614	300	532	80
Total Failures	0	0	2	0	0	0	0	0	0
Total Device Cycles	135700	8400	19500	14900	29900	302000	14300	198200	4000

Summary of Tables 5A, 5E - 5J: Humidity Test

	Table 5A MOSFET/IGBT discrete device *)	Table 5E FRED *)	Table 5F Schottky Diode*)	Table 5G Thyr./Diode discrete device*)	Table 5H Isoplus	Table 5J Breakover Diode
Total Lots Tested	4	8	9	3	2	4
Total Devices Tested	80	138	294	60	40	80
Total Failures	0	0	1	0	0	0
Total Device Cycles	24800	11088	64384	3840	1920	3840

*) including ISOPLUS

HTRB (Tables 1A .. 1J)

TABLE 1A: MOSFET/IGBT single device									
#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours	Remark
								[hrs]	
1	IXBH16N170	TP0619	960	125	1000	30	0	30000	
2	IXBH16N170	TP0619	960	125	1000	30	0	30000	
3	IXBH40N160	1513	1280	125	168	20	0	3360	
4	IXDH20N120	1436	960	125	168	20	0	3360	
5	IXDH20N120D1	2065	960	125	168	20	0	3360	
6	IXEH28N60C2D2	1578	600	125	1000	20	0	20000	
7	IXFA7N80P	K533	640	125	1000	30	0	30000	
8	IXFB100N50P	SP0737	460	125	1000	30	0	30000	
9	IXFB44N100P	SP0721	800	125	1000	30	0	30000	
10	IXFH12N120P	SP0715	960	125	1000	30	0	30000	
11	IXFH15N100P	SK0636	800	125	1000	30	0	30000	
12	IXFH20N100P	SP0716	800	125	1000	30	0	30000	
13	IXFH20N60	SK0544	480	125	1000	30	0	30000	
14	IXFH22N50P	N/A	400	125	1000	30	0	30000	
15	IXFH26N60Q	SK0604	480	125	1000	30	0	30000	
16	IXFH69N30P	SK0527	240	125	1000	30	0	30000	
17	IXFK21N100Q	SP0737	800	125	1000	30	0	30000	
18	IXFK44N55Q	SP0737	440	125	1000	30	0	30000	
19	IXFL60N80P	SP0605	640	125	1000	30	0	30000	
20	IXFN82N60P	TJ0645E	480	125	1000	30	0	30000	
21	IXFP12N50PM	K550	400	125	1000	30	0	30000	
22	IXFQ14N80P	SK0709	640	125	1000	30	0	30000	
23	IXFR12N100Q	TP0703	800	125	1000	30	0	30000	
24	IXFR14N100Q2	SP0732	800	125	1000	30	0	30000	
25	IXFR26N100P	SP0742	800	125	1000	30	0	30000	
26	IXFX48N50Q	ZP0545	400	125	1000	30	0	30000	
27	IXFX73N30Q	SK0613	240	125	1000	30	0	30000	
28	IXFX90N30	SK0613	240	125	1000	30	0	30000	
29	IXGH20N170P	K0716E1	960	125	1000	30	0	30000	
30	IXGH20N170P	TP0632	960	125	1000	30	0	30000	
31	IXGH25N250	TJ0600E	960	125	1000	30	0	30000	
32	IXGH28N60B3D1	SP0732	480	125	1000	30	0	30000	
33	IXGH30N120B3	TP0606	960	125	1000	30	0	30000	
34	IXGH36N60B3D1	SP0732	480	125	1000	30	0	30000	
35	IXGH48N60B3	SK0607	480	125	1000	30	0	30000	
36	IXGH64N60B3	SK0608	480	125	1000	30	0	30000	
37	IXGH72N60B3	SK0608	480	125	1000	30	0	30000	
38	IXGH8N100	N/N	800	125	1000	30	0	30000	
39	IXGK28N140B3H1	TP0651	960	125	1000	30	0	30000	
40	IXGN200N60A2	SP0723	480	125	1000	30	0	30000	
41	IXGP120N33TBM-A	K723	264	125	1000	30	0	30000	
42	IXGP50N33TC	K0652	264	125	1000	30	0	30000	
43	IXGP70N33TBM-A	K726	264	125	1000	30	0	30000	
44	IXGP70N33TBM-A	K728	264	125	1000	30	0	30000	
45	IXGP90N33TB	K06251	264	125	1000	30	0	30000	
46	IXGP90N33TBM-A	K06251	264	125	1000	30	0	30000	
47	IXGQ120N30TCD1	SK0631	240	125	1000	30	0	30000	
48	IXGQ120N33TB	SK0651	264	125	1000	30	0	30000	
49	IXGQ120N33TCD1	SK0639	264	125	1000	30	0	30000	
50	IXGQ150N30TCD1	SK0631	240	125	1000	30	0	30000	
51	IXGQ150N33TCD1	SK0639	264	125	1000	30	0	30000	
52	IXGQ160N30PB	SK0601	240	125	1000	60	0	60000	
53	IXGQ160N30PB	SK0601	240	125	1000	30	0	30000	
54	IXGQ160N30PB	SK0601	240	125	1000	30	0	30000	
55	IXGQ160N30PB	SK0601	240	125	1000	30	0	30000	
56	IXGQ180N33TB	SK0711	264	125	1000	30	0	30000	
57	IXGQ180N33TC	SK0649	264	125	1000	30	0	30000	
58	IXGQ180N33TCD1	SK0639	264	125	1000	30	0	30000	
59	IXGQ200N30PB	SK0631	240	125	1000	30	0	30000	
60	IXGQ240N30PB	SK0631	240	125	1000	30	0	30000	

TABLE 1A (cont'd): MOSFET/IGBT single device

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
61	IXGQ240N30PB	SK0631	240	125	1000	30	0	30000	
62	IXGQ240N30PB	SK0631	240	125	1000	30	0	30000	
63	IXGQ240N30PB	SK0631	240	125	1000	30	0	30000	
64	IXGQ70N33TB	SK0650	264	125	1000	30	0	30000	
65	IXGQ85N33PCD1	SK0613	264	125	1000	27	0	27000	
66	IXGQ85N33PCD1	SK0638	264	125	1000	30	0	30000	
67	IXGQ86N30PB	K0543	240	125	1000	30	0	30000	
68	IXGQ90N27PB	SK0621	216	125	1000	30	0	30000	
69	IXGQ90N27PB	SK0640	216	125	1000	30	0	30000	
70	IXGQ90N30TCD1	SK0631	240	125	1000	30	0	30000	
71	IXGQ90N33TC	SK0649	264	125	1000	30	0	30000	
72	IXGQ90N33TCD1	SK0639	264	125	1000	30	0	30000	
73	IXGQ90N33TCD1	SK0728	264	125	1000	30	0	30000	
74	IXGR120N60C2	SP0722	480	125	1000	30	0	30000	
75	IXGR48N60C3D1	SP0722	480	125	1000	30	0	30000	
76	IXGX120N60B	SP0719	480	125	1000	30	0	30000	
77	IXGX72N60B3H1	SP0739	480	125	1000	30	0	30000	
78	IXKC13N80C	1769	640	125	1000	20	0	20000	
79	IXKC25N80C	1590	640	125	1000	20	0	20000	
80	IXKH20N60C5	1631	480	125	1000	20	0	20000	
81	IXKH35N60CS	1984	480	125	168	20	0	3360	
82	IXKH35N60CS	1986	480	125	168	20	0	3360	
83	IXKP10N60C5M	1693	480	150	1000	20	0	20000	
84	IXKP13N60C5M	1716	480	150	1000	20	0	20000	
85	IXKP20N60C5	1653	480	125	1000	20	0	20000	
86	IXKP24N60C5	1671	480	150	800	20	0	16000	
87	IXKR25N80C	1521	640	125	168	20	0	3360	
88	IXKT70N60C5	2068	480	125	1000	20	0	20000	
89	IXSH30N60B2D1	SP0506	480	125	1000	30	0	30000	
90	IXSK40N60CD1	SK0722	480	125	1000	30	0	30000	
91	IXTA36N30P	SK0603	240	125	1000	30	0	30000	
92	IXTA36N30P	K0621	240	125	1000	30	0	30000	
93	IXTA36N30P	K640	240	125	1000	30	0	30000	
94	IXTA50N25T	K545	200	125	1000	30	0	30000	
95	IXTA50N28T	K0606	224	125	1000	30	2	30000	no deviations after 168h
96	IXTA50N28T	K634	224	125	1000	30	0	30000	
97	IXTA50N28T	K640	224	125	1000	30	0	30000	
98	IXTA60N20T	K545	160	125	1000	30	0	30000	
99	IXTA60N20T	SK0601	160	125	1000	30	0	30000	
100	IXTA75N10P	K0531	80	125	1000	30	0	30000	
101	IXTA76N25T	K0704	200	125	1000	25	0	25000	
102	IXTC110N25T	SP0721	200	125	1000	30	0	30000	
103	IXTC200N075T	SP0627	60	125	1000	30	0	30000	
104	IXTH130N20T	SP0721	160	125	1000	30	0	30000	
105	IXTH150N17T	SK0718	140	125	1000	30	0	30000	
106	IXTH160N15T	SK0721	120	125	1000	30	0	30000	
107	IXTH1N80P	TP0604	640	125	1000	30	0	30000	
108	IXTH30N50L	TK0738	400	125	1000	30	0	30000	
109	IXTH3N100P	TP0639	800	125	1000	30	0	30000	
110	IXTH76N25T	SP0613	200	125	1000	30	0	30000	
111	IXTH86N25T	SP0638	200	125	1000	30	0	30000	
112	IXTH8P50	SK0712	400	125	1000	30	0	30000	
113	IXTK180N15P	SP0552	120	125	1000	30	0	30000	
114	IXTK34N80	SP0546	640	125	1000	30	0	30000	
115	IXTK34N80	SP0603	640	125	1000	30	0	30000	
116	IXTK34N80	SP0603	640	125	1000	30	0	30000	
117	IXTP08N100P	K625	800	125	1000	30	0	30000	
118	IXTP08N120P	K0709	960	125	1000	30	0	30000	
119	IXTP14N60PM	K631	480	125	1000	30	0	30000	
120	IXTP14N60PM	K643	480	125	1000	30	0	30000	

TABLE 1A (cont'd): MOSFET/IGBT single device									
#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
121	IOTP160N075T	K0707	60	125	1000	30	0	30000	
122	IOTP17N30T	K648	240	125	1000	30	0	30000	
123	IOTP18N60PM	K631	480	125	1000	30	0	30000	
124	IOTP1N100P	K636	800	125	1000	30	0	30000	
125	IOTP1R4N100P	K636	800	125	1000	30	0	30000	
126	IOTP1R4N120P	K638	960	125	1000	30	0	30000	
127	IOTP2R4N120P	K636	960	125	1000	30	0	30000	
128	IOTP32N20T	K647	160	125	1000	30	0	30000	
129	IOTP36N15T	K648	120	125	1000	30	0	30000	
130	IOTP36N25T	K636	200	125	1000	30	0	30000	
131	IOTP36N30T	K641	240	125	1000	30	0	30000	
132	IOTP44N25T	K636	200	125	1000	30	0	30000	
133	IOTP50N25T	K738	200	125	1000	30	0	30000	
134	IOTP56N15T	K636	120	125	1000	30	0	30000	
135	IOTP62N25T	K648	200	125	1000	30	0	30000	
136	IOTP74N15T	K636	120	125	1000	30	0	30000	
137	IOTP76N075T	K640	60	125	1000	30	0	30000	
138	IOTP76N075T	K726	60	125	1000	30	0	30000	
139	IOTP76N075T	SS0728	60	125	1000	30	0	30000	
140	IOTP8N50P	K646	400	125	1000	30	0	30000	
141	IOTP8N50P	AK732	400	125	1000	30	0	30000	
142	IOTP90N15T	K647	120	125	1000	30	0	30000	
143	IOTQ182N055T	SK0612	44	125	1000	30	0	30000	
144	IOTQ22N50P	SS0633	400	125	1000	30	0	30000	
145	IOTQ22N60P	SK0539	480	125	1000	30	0	30000	
146	IOTQ22N60P	SK0604	480	125	1000	30	0	30000	
147	IOTQ22N60P	SK0609	480	125	1000	30	0	30000	
148	IOTQ22N60P	SK0608	480	125	1000	30	0	30000	
149	IOTQ22N60P	SK0608	480	125	1000	30	0	30000	
150	IOTQ22N60P	SK0609	480	125	1000	30	0	30000	
151	IOTQ22N60P	SK0609	480	125	1000	30	0	30000	
152	IOTQ26N50P	SK0604	400	125	1000	30	0	30000	
153	IOTQ28N15P	SK0653	120	125	1000	30	0	30000	
154	IOTQ36P15P	SK0652	120	125	1000	30	0	30000	
155	IOTQ44N30T	SK0629	240	125	1000	30	0	30000	
156	IOTQ64N25P	SK0535	200	125	1000	30	0	30000	
157	IOTQ74N20P	SK0515	160	125	1000	30	0	30000	
158	IOTQ76N25T	SK0613	200	125	1000	30	0	30000	
159	IOTQ82N25T	SK0603	200	125	1000	30	0	30000	
160	IOTQ88N28T	SK0545	224	125	1000	30	0	30000	
161	IOTQ88N28T	SK0641	224	125	1000	30	0	30000	
162	IOTQ88N30P	SK0605	240	125	1000	30	0	30000	
163	IOTQ88N30T	SK0638	240	125	1000	30	0	30000	
164	IOTQ96N20P	SS0631	160	125	1000	30	0	30000	
165	IOTQ96N25T	SK0648	200	125	1000	30	0	30000	
166	IOTT88N30P	SP0626	240	125	1000	30	0	30000	
167	IOTV18N60PS	SP0636	480	125	1000	30	0	30000	
168	IOTV230N085TS	SP0629	68	125	1000	30	0	30000	
169	IXUC200N055	1594	44	125	1000	20	0	20000	

TABLE 1B: MOSFET/IGBT Module

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	GWM160-0055P3	1524	240	150	168	6	0	1008	
2	MIAA20WD600TMH	1844	1120	125	1000	10	0	10000	Konverter tested
3	MIAA20WD600TMH	1844	480	125	1000	10	0	10000	Inverter tested
4	MID145-12A3	2031	960	125	168	10	0	1680	
5	MKI75-06A7T	1847	480	125	168	10	0	1680	
6	MKI80-06T6K	1818	480	125	168	10	0	1680	
7	MUBW36-12E7	1898	960	125	1000	10	0	10000	
8	MUBW50-12T8	1777	960	125	1000	10	0	10000	
9	MUBW75-17T8	2001	1540	125	1000	5	0	5000	
10	MUBW75-17T8	2001	1360	125	1000	5	0	5000	
11	MWI150-12T8T	1897	960	125	1000	10	0	10000	
12	MWI30-06A7T	2069	480	125	168	10	0	1680	
13	VMO60-05F	1552	400	125	168	10	0	1680	

TABLE 1C: Thyristor/Diode Module

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	MCC132-16io1	1509	1120	125	1000	10	0	10000	
2	MCC132-16io1	1980	1120	125	168	10	0	1680	
3	MCC162-08io1	1624	800	126	168	20	0	3360	
4	MCC162-16io1	1593	1120	125	168	10	0	1680	
5	MCC21-16io8	1812	1120	125	168	10	0	1680	
6	MCC26-16io1	1539	1120	125	168	10	0	1680	
7	MCC310-16	1696	1120	125	168	10	0	1680	
8	MCC312-16	2028	1120	125	1000	10	1	10000	I_R @ increased
9	MCC44-16io1	1747	1120	125	168	10	0	1680	
10	MCC44-16io1	2006	1120	125	168	10	0	1680	
11	MCC95-16io1	1701	1120	125	168	10	0	1680	
12	MCC95-16io1	1862	1120	125	168	10	0	1680	
13	MCD56-16io1	1587	1120	125	168	10	0	1680	
14	MDD172-16n1	1554	1120	125	168	10	0	1680	
15	MDD95-16	2032	1120	125	168	10	0	1680	

TABLE 1D: Controller/Rectifier Bridge

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	MMO75-16io1	1727	1120	125	168	10	0	1680	
2	MMO90-16	1710	1120	125	168	10	0	1680	
3	VBO19-16DT1	2011	1120	125	168	10	0	1680	
4	VBO19-16DT1	1584	1120	125	168	10	0	1680	
5	VBO40-16NO6	1860	1120	125	168	10	0	1680	
6	VHF36-16io5	1542	1120	125	168	10	0	1680	
7	VHF36-16io5	1732	1120	125	168	10	0	1680	
8	VUB72-16	1657	1120	125	168	10	0	1680	
9	VUB72-16No1	2004	1120	125	168	10	0	1680	
10	VUB72-16No1	2004	960	125	168	10	0	1680	
11	VUB72-16No1	2004	960	125	168	10	0	1680	
12	VUO190-18NO7	2026	1260	125	1000	10	0	10000	
13	VUO25-16NO8	1581	1120	125	168	10	0	1680	
14	VUO31-18	1863	1260	125	1000	10	0	10000	
15	VUO34-18NO1	1861	1260	125	168	10	0	1680	
16	VVO140-16	1684	1120	125	1000	10	0	10000	
17	VY40-16io1	1745	1120	125	168	10	0	1680	

TABLE 1E: FRED

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	DHF30IM600PN	1508	480	125	1000	20	0	20000	
2	DHF30IM600QB	1625	480	125	1000	20	0	20000	
3	DHG10I1200PM	1682	960	125	1000	20	0	20000	
4	DHG10I600PM	1685	480	125	1000	20	0	20000	
5	DHG20C600QB	1711	480	125	1000	20	0	20000	
6	DHG30I1200HA	1652	960	125	1000	20	0	20000	
7	DHG30I1200HA	1734	960	125	1000	20	0	20000	
8	DHG40C1200HB	1903	960	125	1000	20	0	20000	
9	DHG40C600PB	2037	480	125	1000	20	0	20000	
10	DHG60C600HB	1668	480	125	1000	20	0	20000	
11	DPG15I400PM	1770	320	125	1000	20	0	20000	
12	DPG20C200PN	1692	240	125	1000	20	0	20000	
13	DPG20C400PN	1768	320	125	1000	20	0	20000	
14	DPG30C300HB	1644	240	125	1000	20	0	20000	
15	DPG30C300PB	1923	240	125	1000	20	0	20000	
16	DPG60C200QB	1608	160	125	1000	20	0	20000	
17	DPG60C300HB	1525	240	125	1000	20	0	20000	
18	DPG60C300QB	1481	240	125	1000	20	0	20000	
19	DPG60C400QB	1446	320	125	1000	20	0	20000	
20	DPG60IM300PC	1643	240	125	1000	20	0	20000	
21	DSEC60-02Aq	1929	160	125	168	20	0	3360	
22	DSEI2x31-06C	1563	480	125	168	10	0	1680	
23	DSEI2x61-12B	1607	960	125	168	10	0	1680	
24	DSEP15-06A	2020	480	125	168	20	0	3360	
25	DSEP29-03	1954	240	125	168	20	0	3360	
26	DSEP29-06A	1736	480	125	168	20	0	3360	
27	DSEP2x61-12A	1984	960	125	168	10	0	1680	
28	DSEP30-06BR	1952	480	125	168	20	0	3360	
29	DSEP30-12AR	1634	960	125	168	20	0	3360	
30	DSEP60-03A	1537	240	125	168	20	0	3360	
31	DSEP60-06A	1572	480	125	168	20	0	3360	
32	DSEP75-06AR	1619	480	125	1000	20	0	20000	
33	DSEP8-03AS	1738	240	125	1000	20	0	20000	
34	MEO450-12	1826	960	125	186	6	0	1116	
35	MEO500-06DA	1934	480	125	168	9	0	1512	

TABLE 1F: Schottky Diode

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	DSA120C150QB	1507	150	125	1000	20	0	20000	
2	DSA120C150QB	1907	150	125	1000	20	0	20000	
3	DSA30C100HB	1981	100	125	1000	20	0	20000	
4	DSA30C100PN	1906	100	125	1000	20	0	20000	
5	DSA30C45HB	1714	45	125	1000	20	0	20000	
6	DSA60C100PB	1781	100	125	1000	16	0	16000	
7	DSA70C100HB	1782	100	125	1000	20	0	20000	
8	DSA90C200HB	1674	200	125	1000	20	0	20000	
9	DSB10I45PM	1942	45	100	1000	20	0	20000	
10	DSB15IM45IB	1622	36	100	1000	20	0	20000	
11	DSB30C30PB	1718	24	100	1000	20	0	20000	
12	DSB30C45PB	1783	36	100	1000	20	0	20000	
13	DSB30C60PB	1672	60	125	1000	20	0	20000	
14	DSB40C15PB	1673	12	100	1000	20	0	20000	
15	DSS10-0045B	2019	36	100	168	20	0	3360	
16	DSS20-0015B	1871	12	100	1000	20	0	20000	
17	DSS20-01AC	1709	100	125	1000	20	0	20000	
18	DSS2x41-01A	1467	100	125	168	10	0	1680	
19	DSS2x41-01A	2039	100	125	168	10	0	1680	
20	DSS6-015AS	1723	150	150	1000	77	0	77000	
21	DSS6-015AS	1838	150	150	1000	77	0	77000	
22	DSSK38-0025B	1982	20	100	168	20	0	3360	
23	DSSK60-015A	1600	150	125	168	20	0	3360	
24	DSSK60-015AR	1857	150	125	168	20	0	3360	

TABLE 1G: Thyristor/Diode single device

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	CS22-08io1M	2014	560	125	168	20	0	3360	
2	CS30-16io1	1855	1120	125	168	20	0	3360	
3	CS30-16io1DCSN	1920	1120	125	1000	20	1	20000	I_DRM increased
4	CS35-14	2008	980	125	168	10	0	1680	
5	CS45-16io1	1808	1120	125	168	20	0	3360	
6	CS60-16io1	1830	1120	125	1000	20	0	20000	
7	CS8-12io2	1605	1280	125	168	10	0	1680	
8	DSA1-16D	2023	1120	150	168	20	0	3360	
9	DSA175-16B	1858	1120	150	168	10	0	1680	
10	DSDI60-16A	1569	1280	125	168	20	0	3360	
11	DSP25-16	1564	1120	150	168	20	0	3360	
12	DSP25-16	2016	1120	150	168	20	0	3360	

TABLE 1H: ISOPLUS

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	CS45-16io1	1808	1120	125	168	20	0	3360	
2	DSEP30-06BR	1952	480	125	168	20	0	3360	
3	DSEP30-12AR	1634	960	125	168	20	0	3360	
4	DSEP75-06AR	1619	480	125	1000	20	0	20000	
5	DSS20-01AC	1709	100	125	1000	20	0	20000	
6	GWM160-0055P3	1524	240	150	168	6	0	1008	
7	IXEL40N400	1611	3000	125	168	10	0	1680	
8	IXFL60N80P	SP0605	640	125	1000	30	0	30000	
9	IXFR12N100Q	TP0703	800	125	1000	30	0	30000	
10	IXFR14N100Q2	SP0732	800	125	1000	30	0	30000	
11	IXFR26N100P	SP0742	800	125	1000	30	0	30000	
12	IXGR120N60C2	SP0722	480	125	1000	30	0	30000	
13	IXGR48N60C3D1	SP0722	480	125	1000	30	0	30000	
14	IXKC13N80C	1769	640	125	1000	20	0	20000	
15	IXKC25N80C	1590	640	125	1000	20	0	20000	
16	IXKR25N80C	1521	640	125	168	20	0	3360	
17	IXTC110N25T	SP0721	200	125	1000	30	0	30000	
18	IXTC200N075T	SP0627	60	125	1000	30	0	30000	
19	IXUC200N055	1594	44	125	1000	20	0	20000	
20	LKK47-06C5	1675	480	150	1000	20	1	20000	I_DSS increased

TABLE 1J: Breakover Diode

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	IXBOD1-08	1941	640	125	168	20	0	3360	
2	IXBOD1-09	1800	800	125	168	20	0	3360	
3	IXBOD1-10	1576	800	125	168	20	0	3360	
4	IXBOD1-10	2096	800	125	168	20	0	3360	

HTGB (Tables 2A .. 2C)

TABLE 2A: MOSFET/IGBT single device									
#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	IXBH42N170	TK0734	16	125	1000	30	0	30000	
2	IXDN75N120	1606	16	150	168	10	0	1680	
3	IXEH25N120D1	1757	16	150	168	20	0	3360	
4	IXEH40N120D1	1482	16	150	168	20	0	3360	
5	IXER35N120D1	1950	16	150	168	20	0	3360	
6	IXFA7N80P	K533	16	125	1000	30	0	30000	
7	IXFB100N50P	SP0737	16	125	1000	30	0	30000	
8	IXFB44N100P	SP0721	16	125	1000	30	0	30000	
9	IXFH12N120P	TJ1041E	16	125	1000	30	0	30000	
10	IXFH15N100P	SK0636	16	125	1000	30	0	30000	
11	IXFH20N100P	SP0716	16	125	1000	30	0	30000	
12	IXFH26N60Q	SK0604	16	125	1000	30	0	30000	
13	IXFK21N100Q	SP0737	16	125	1000	30	0	30000	
14	IXFK44N55Q	SP0737	16	125	1000	30	0	30000	
15	IXFL100N50P	SP0549	16	125	1000	30	0	30000	
16	IXFL60N80P	SP0605	16	125	1000	30	0	30000	
17	IXFL82N60P	SP0550	16	125	1000	30	0	30000	
18	IXFP12N50PM	K550	16	125	1000	30	0	30000	
19	IXFQ14N80P	SK0709	16	125	1000	30	0	30000	
20	IXFR12N100Q	TP0703	16	125	1000	30	0	30000	
21	IXFR14N100Q2	SP0732	16	125	1000	30	0	30000	
22	IXFR26N100P	TJ1159E	16	125	1000	30	0	30000	
23	IXFX73N30Q	SK0613	16	125	1000	30	0	30000	
24	IXFX90N30	SK0613	16	125	1000	30	0	30000	
25	IXGA42N30C3	K732	16	125	1000	30	0	30000	
26	IXGA60N30C3	K732	16	125	1000	30	0	30000	
27	IXGH100N30C3	SK0644	16	125	1000	30	0	30000	
28	IXGH120N30C3	SK0638	16	125	1000	30	0	30000	
29	IXGH1889	TP0736	16	125	1000	30	0	30000	
30	IXGH20N170P	K0716E1	20	125	1000	30	0	30000	
31	IXGH28N60B3	SK0608	16	125	1000	30	0	30000	
32	IXGH30N120B3	TP0606	16	125	1000	30	0	30000	
33	IXGH48N60B3	SK0607	16	125	1000	30	0	30000	
34	IXGH64N60B3	SK0608	16	125	1000	30	0	30000	
35	IXGH72N60B3	SK0608	16	125	1000	30	0	30000	
36	IXGH85N30C3	SK0644	16	125	1000	30	0	30000	
37	IXGN200N60A2	SP0723	16	125	1000	30	0	30000	
38	IXGP120N33TBM-A	K723	16	125	1000	30	0	30000	
39	IXGP24N120C3	K0652	16	125	1000	30	0	30000	
40	IXGP50N33TC	K0652	16	125	1000	30	0	30000	
41	IXGP70N33TBM-A	K726	16	125	1000	13	0	13000	
42	IXGP90N33TBM-A	K06251	16	125	1000	30	0	30000	
43	IXGQ120N30TCD1	SK0631	16	125	1000	30	0	30000	
44	IXGQ120N33TCD1	SK0639	16	125	1000	30	0	30000	
45	IXGQ150N30TCD1	SK0631	16	125	1000	30	0	30000	
46	IXGQ150N33TCD1	SK0639	16	125	1000	30	0	30000	
47	IXGQ160N30PB	SK0601	16	125	1000	30	0	30000	
48	IXGQ160N30PB	SK0601	16	125	1000	30	0	30000	
49	IXGQ160N30PB	SK0601	16	125	1000	30	0	30000	
50	IXGQ180N30TCD1	SK0632	16	125	1000	30	0	30000	
51	IXGQ180N33TB	SK0711	16	125	1000	30	0	30000	
52	IXGQ180N33TC	SK0649	16	125	1000	30	0	30000	
53	IXGQ180N33TCD1	SK0639	16	125	1000	30	0	30000	
54	IXGQ200N30PB	SK0631	16	125	1000	30	0	30000	
55	IXGQ240N30PB	SK0631	16	125	1000	30	0	30000	
56	IXGQ70N33TB	SK0650	16	125	1000	30	0	30000	
57	IXGQ85N33PCD1	SK0613	16	125	1000	27	0	27000	
58	IXGQ85N33PCD1	SK0638	16	125	1000	30	0	30000	
59	IXGQ90N27PB	SK0611	16	125	1000	30	0	30000	
60	IXGQ90N27PB	SK0640	16	125	1000	30	0	30000	

TABLE 2A (cont'd): MOSFET/IGBT single device

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
61	IXGQ90N30TCD1	SK0631	16	125	1000	30	0	30000	
62	IXGQ90N33TB	SK0651	16	125	1000	30	0	30000	
63	IXGQ90N33TC	SK0649	16	125	1000	30	0	30000	
64	IXGQ90N33TCD1	SK0639	16	125	1000	30	0	30000	
65	IXGQ90N33TCD1	SK0728	16	125	1000	20	0	20000	
66	IXGQ90N33TCD4	SK0721	16	125	1000	30	0	30000	
67	IXGR120N60C2	SP0722	16	125	1000	30	0	30000	
68	IXGR40N60C2D1	SP0635	16	125	1000	30	0	30000	
69	IXGR48N60C3D1	SP0722	16	125	1000	30	0	30000	
70	IXGX72N60B3H1	SP0739	16	125	1000	30	0	30000	
71	IXKH70N60C5	1926	16	150	168	20	0	3360	
72	IXKP13N60C5M	1716	16	150	1000	20	0	20000	
73	IXSH30N60B2D1	SP0506	16	125	1000	30	0	30000	
74	IXSK40N60CD1	SK0722	16	125	1000	30	0	30000	
75	IXTA36N30P	SK0603	16	125	1000	30	0	30000	
76	IXTA36N30P	K0621	16	125	1000	30	0	30000	
77	IXTA36N30P	K640	16	125	1000	30	0	30000	
78	IXTA50N25T	SK0604	16	125	1000	30	0	30000	
79	IXTA50N28T	K545	16	125	1000	30	0	30000	
80	IXTA50N28T	K0606	16	125	1000	30	0	30000	
81	IXTA50N28T	K634	16	125	1000	30	0	30000	
82	IXTA50N28T	K640	16	125	1000	30	0	30000	
83	IXTA60N20T	SK0601	16	125	1000	30	0	30000	
84	IXTA76N25T	K0704	16	125	1000	30	0	30000	
85	IXTC110N25T	SP0721	16	125	1000	30	0	30000	
86	IXTC200N075T	SP0627	16	125	1000	30	0	30000	
87	IXTH130N20T	SP0721	16	125	1000	30	0	30000	
88	IXTH150N17T	SK0718	16	125	1000	30	0	30000	
89	IXTH160N15T	SK0721	16	125	1000	30	0	30000	
90	IXTH1N250	TP0638	16	125	1000	30	0	30000	
91	IXTH30N50L	TK0738	16	125	1000	30	0	30000	
92	IXTH76N25T	SP0613	16	125	1000	30	0	30000	
93	IXTH86N25T	SP0638	16	125	1000	30	0	30000	
94	IXTH8P50	SK0712	16	125	1000	30	0	30000	
95	IXTK180N15P	SP0552	16	125	1000	30	0	30000	
96	IXTN79N20	2052	16	150	168	20	0	3360	
97	IXTP08N100P	K625	16	125	1000	30	0	30000	
98	IXTP08N120P	K0709	16	125	1000	30	0	30000	
99	IXTP14N60PM	K631	16	125	1000	30	0	30000	
100	IXTP14N60PM	K643	16	125	1000	30	0	30000	
101	IXTP160N075T	K0707	16	125	1000	30	0	30000	
102	IXTP17N30T	K648	16	125	1000	30	0	30000	
103	IXTP18N60PM	K631	16	125	1000	30	0	30000	
104	IXTP1R4N120P	K638	16	125	1000	30	0	30000	
105	IXTP2R4N120P	K636	16	125	1000	30	0	30000	
106	IXTP32N20T	K647	16	125	1000	30	0	30000	
107	IXTP36N15T	K648	16	125	1000	30	0	30000	
108	IXTP36N25T	K636	16	125	1000	30	0	30000	
109	IXTP36N30T	K641	16	125	1000	30	0	30000	
110	IXTP44N25T	K636	16	125	1000	30	0	30000	
111	IXTP50N25T	K738	16	125	1000	30	0	30000	
112	IXTP56N15T	K636	16	125	1000	30	0	30000	
113	IXTP62N25T	K648	16	125	1000	30	0	30000	
114	IXTP74N15T	K636	16	125	1000	30	0	30000	
115	IXTP76N075T	K640	16	125	1000	30	0	30000	
116	IXTP76N075T	K726	16	125	1000	30	0	30000	
117	IXTP76N075T	SS0728	16	125	1000	30	0	30000	
118	IXTP8N50P	K646	16	125	1000	30	0	30000	
119	IXTP8N50P	AK732	16	125	1000	30	0	30000	
120	IXTP90N15T	K647	16	125	1000	30	0	30000	

TABLE 2A (cont'd): MOSFET/IGBT single device

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
121	IXTQ182N055T	SK0612	16	125	1000	30	0	30000	
122	IXTQ182N055T	SK0612	16	150	500	30	0	15000	
123	IXTQ22N50P	SS0633	16	125	1000	30	0	30000	
124	IXTQ22N60P	SK0604	16	125	1000	30	0	30000	
125	IXTQ26N50P	SK0604	16	125	1000	30	0	30000	
126	IXTQ28N15P	SK0653	16	125	1000	30	0	30000	
127	IXTQ36P15P	SK0652	16	125	1000	30	0	30000	
128	IXTQ76N25T	SK0613	16	125	1000	30	0	30000	
129	IXTQ82N25T	SK0514	16	125	1000	30	0	30000	
130	IXTQ82N25T	SK0603	16	125	1000	30	0	30000	
131	IXTQ88N28T	SK0641	16	125	1000	30	0	30000	
132	IXTQ88N30P	SK0605	16	125	1000	30	0	30000	
133	IXTQ88N30T	SK0638	16	125	1000	30	0	30000	
134	IXTQ96N20P	SS0631	16	125	1000	30	0	30000	
135	IXTQ96N25T	SK0648	16	125	1000	30	0	30000	
136	IXTT88N30P	SP0626	16	125	1000	30	0	30000	
137	IXTV18N60PS	SP0636	16	125	1000	30	0	30000	
138	IXTV230N085TS	SP0629	16	125	1000	30	0	30000	

TABLE 2B: MOSFET/IGBT Module

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	GWM100-01X1SL	1965	16	150	168	10	0	1680	
2	GWM120-0075P3SL	1720	16	150	1000	80	0	80000	
3	MDI300-12A4	1555	16	125	126	10	0	1260	
4	MDI75-12	1931	16	125	168	10	0	1680	
5	MIAA20WD600TMH	1844	16	125	1000	10	0	10000	
6	MII300-12A4	2012	16	125	168	10	0	1680	
7	MII400-12E4	1741	16	125	168	10	0	1680	
8	MII75-12A3	1541	16	125	168	10	0	1680	
9	MIXA15WB1200TED	1992	16	125	1000	5	0	5000	
10	MIXA35WB1200TED	1991	16	125	1000	5	0	5000	
11	MUBW15-12A6K	1553	16	125	168	10	0	1680	
12	MUBW50-12E8	1469	16	125	168	10	0	1680	
13	MWI30-06A7T	1635	16	125	168	10	0	1680	
14	MWI30-06A7T	2069	16	125	168	10	0	1680	
15	VII130-06P1	2025	16	125	168	10	0	1680	

TABLE 2C: ISOPLUS

#	Part Number	Date Code or Test #	Voltage [V]	Temp. [°C]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	GWM100-01X1SL	1965	16	150	168	10	0	1680	
2	GWM120-0075P3SL	1720	16	150	1000	80	0	80000	
3	IXER35N120D1	1950	16	150	168	20	0	3360	
4	IXER35N120D1	1950	16	150	168	20	0	3360	
5	IXFL100N50P	SP0549	16	125	1000	30	0	30000	
6	IXFL60N80P	SP0605	16	125	1000	30	0	30000	
7	IXFL82N60P	SP0550	16	125	1000	30	0	30000	
8	IXFR12N100Q	TP0703	16	125	1000	30	0	30000	
9	IXFR14N100Q2	SP0732	16	125	1000	30	0	30000	
10	IXFR26N100P	TJ1159E	16	125	1000	30	0	30000	
11	IXGR120N60C2	SP0722	16	125	1000	30	0	30000	
12	IXGR40N60C2D1	SP0635	16	125	1000	30	0	30000	
13	IXGR48N60C3D1	SP0722	16	125	1000	30	0	30000	
14	IXTC110N25T	SP0721	16	125	1000	30	0	30000	
15	IXTC200N075T	SP0627	16	125	1000	30	0	30000	

POWER CYCLE (Tables 3A ..3H)
TABLE 3A: MOSFET/IGBT single device

#	Part Number	Date Code or Test #	Tj(max) [°C]	ΔT [K]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	IXBH9N160G	1759	125	80	2000	20	0	40000	
2	IXDH30N120D1	1940	125	80	2000	20	0	40000	
3	IXFN82N60P	SP0551	-	100	10000	24	0	240000	
4	IXFX73N30Q	SK0613	-	100	10000	24	0	240000	
5	IXFX90N30	SK0613	-	100	10000	24	0	240000	
6	IXGQ85N33PCD1	SK0614	-	100	10000	24	0	240000	
7	IXGQ90N27PB	SK0611	-	100	10000	24	0	240000	
8	IXKH20N60C5	1987	125	80	2000	20	0	40000	
9	IXKP13N60C5M	1716	125	80	10000	20	0	200000	
10	IXSH30N60B2D1	SP0506	-	100	10000	24	0	240000	
11	IXTP14N60PM	K643	-	50	10000	24	0	240000	
12	IXTP18N60PM	K631	-	50	10000	24	0	240000	
13	IXTQ26N50P	SK0604	-	100	10000	24	0	240000	
14	IXTQ76N25T	SK0613	-	100	10000	24	0	240000	
15	IXTQ96N20P	SS0631	-	100	10000	24	0	240000	

TABLE 3B: MOSFET/IGBT Module

#	Part Number	Date Code or Test #	Tj(max) [°C]	ΔT [K]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	GWM160-0055X1-SL	1960	150	100	3000	80	0	240000	
2	MIAA20WD600TMH	1844	125	80	10000	9	0	90000	
3	MKI75-06A7	1464	125	80	10000	10	0	100000	
4	MKI75-06A7T	1676	125	80	10000	10	0	100000	
5	MKI75-06A7T	1772	125	80	5000	10	0	50000	
6	MKI75-06A7T	1776	125	80	10000	10	0	100000	
7	MUBW20-06A7	1735	125	80	7130	10	0	71300	

TABLE 3C: Thyristor/Diode Module

#	Part Number	Date Code or Test #	Tj(max) [°C]	ΔT [K]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	MCC162-12io1	2056	125	80	10000	10	0	100000	
2	MCC56-14io1	1472	125	80	20000	10	0	200000	
3	MCD40-16io6	1474	125	80	5000	10	0	50000	
4	MDD95	1875	125	80	30000	10	0	300000	
5	MDD95-18N1	1971	125	80	20000	10	0	200000	

TABLE 3D: Controller, Rectifier Bridge

#	Part Number	Date Code or Test #	Tj(max) [°C]	ΔT [K]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	VBO19-16DT1	2011	125	80	5000	10	0	50000	
2	VBO40-16NO6	1860	125	80	5000	10	0	50000	
3	VUO121-16NO1	2071	125	80	20000	10	0	200000	
4	VUO190-18NO7	2026	125	80	2000	10	0	20000	
5	VUO80-16	1456	125	80	5000	10	0	50000	

TABLE 3E: FRED

#	Part Number	Date Code or Test #	Tj(max) [°C]	ΔT [K]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	DH60-18A	1699	125	80	2000	20	0	40000	
2	DSEC30-02A	1755	125	80	2000	20	0	40000	
3	DSEI120-12A	1928	145	100	2000	20	0	40000	
4	DSEI60-02A	1440	145	105	2000	20	0	40000	
5	DSEI60-12A	1599	150	105	2000	20	0	40000	
6	DSEP12-12A	1955	145	100	2000	20	0	40000	
7	DSEP15-12CR	1930	125	80	2000	20	0	40000	
8	DSEP29-06A	1736	150	105	2000	20	0	40000	
9	DSEP2x61-06A	1633	125	80	5000	10	0	50000	
10	DSEP60-12A	2021	145	100	2000	20	0	40000	

TABLE 3F: Schottky Diode

#	Part Number	Date Code or Test #	Tj(max) [°C]	ΔT [K]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	DSS16-0045A	2018	145	100	2000	20	0	80000	
2	DSS2x160-01A	1856	125	80	4000	10	0	40000	
3	DSS6-015AS	1723	140	100	8572	77	0	660044	
4	DSS6-015AS	1838	140	100	8572	77	0	660044	
5	DSSk60-0045A	1873	150	105	2000	20	0	40000	
6	DSSK80-006B	1575	125	80	2000	20	0	40000	

TABLE 3G: Thyristor/Diode single device

#	Part Number	Date Code or Test #	Tj(max) [°C]	ΔT [K]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	CS30-16io1	2009	125	80	2000	20	0	40000	
2	CS35-14	2008	125	80	2000	10	0	20000	
3	CS35-14io4	1473	125	80	2000	10	0	20000	
4	CS45-12io1	1601	125	80	5000	20	0	100000	
5	CS8-12io2	1605	125	80	2000	10	0	20000	
6	DSA1-18D	1435	150	105	2000	20	0	40000	
7	DSA15IM45IB	1621	125	80	4000	20	0	80000	
8	DSA75-16B	1859	150	105	2000	10	0	20000	
9	DSI45-08A	1760	150	105	2000	20	0	40000	

TABLE 3H: ISOPLUS

#	Part Number	Date Code or Test #	Tj(max) [°C]	ΔT [K]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	DSEP15-12CR	1930	125	80	2000	20	0	40000	
2	GWM160-0055X1	1960	150	100	3000	80	0	240000	

TEMPERATURE CYCLE (Tables 4A ..4J)

TABLE 4A: MOSFET/IGBT single device

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	FII50-12EL	1534	-55	150	100	20	0	2000	
2	IXBH9N160G	1574	-55	150	50	20	0	1000	
3	IXDD404SI	1913	-55	150	1000	83	0	83000	
4	IXDD404SIA	1695	-55	150	500	30	0	15000	
5	IXDN75N120	1606	-40	150	20	10	0	200	
6	IXKC13N80C	1769	-55	150	100	20	0	2000	
7	IXKC25N80C	1590	-55	150	100	20	0	2000	
8	IXKH20N60C5	2013	-40	150	50	20	0	1000	
9	IXKH70N60C5	1926	-40	150	50	20	0	1000	
10	IXKP10N60C5M	1693	-40	150	100	20	0	2000	
11	IXKP13N60C5M	1716	-55	150	100	20	0	2000	
12	IXKT70N60C5	2068	-55	150	1000	20	0	20000	
13	IXUC200N055	1802	-55	150	90	50	0	4500	

TABLE 4B: MOSFET/IGBT Module

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	MDI300-12A4	1555	-40	150	50	10	0	500	
2	MIAA20WD600TMH	1844	-40	150	100	9	0	900	
3	MII400-12E4	1741	-40	150	50	10	0	500	
4	MII75-12A3	1541	-40	150	50	10	0	500	
5	MIXA15WB1200TED	1992	-40	150	100	10	0	1000	
6	MKI75-06A7T	1562	-40	150	50	10	0	500	
7	MKI75-06A7T	1724	-40	150	50	10	0	500	
8	MKI75-06A7T	1724	-40	150	50	10	0	500	
9	MKI80-06T6K	1818	-40	150	100	10	0	1000	
10	MUBW15-12A7	1466	-40	150	50	10	0	500	
11	MUBW25-12T7	1896	-40	150	100	10	0	1000	
12	MUBW75-12T8	1731	-40	150	100	10	0	1000	

TABLE 4C: Thyristor/Diode Module

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	MCC162-14	1816	-40	150	50	10	0	500	
2	MCC162-14io1	1544	-40	150	50	10	0	500	
3	MCC162-14io1	1629	-40	150	50	10	0	500	
4	MCC200-14	1717	-40	150	50	10	0	500	
5	MCC21-16	1821	-40	150	100	20	0	2000	
6	MCC26-14	2035	-40	150	50	10	0	500	
7	MCC26-14io1	1641	-40	150	50	10	0	500	
8	MCC310-12io1	1545	-40	150	50	10	0	500	
9	MCC310-14io1	1627	-40	150	50	10	0	500	
10	MCC44-12io1	1540	-40	150	50	10	0	500	
11	MCC44-16io1	2048	-40	150	100	10	0	1000	
12	MCC44-16io8	1864	-40	150	100	10	0	1000	
13	MCC56-12io1	1449	-40	150	50	10	0	500	
14	MCC72-14io1	2007	-40	150	50	10	0	500	
15	MCC95-14io1	1788	-40	150	150	10	0	1500	
16	MCD162-16io1	1884	-40	150	50	10	0	500	
17	MCD200-14	2010	-40	150	50	10	0	500	
18	MCD250/16	2059	-40	150	50	10	0	500	
19	MCD56-16io1	1646	-40	150	50	10	0	500	
20	MCO600-16io1	1680	-40	150	50	10	0	500	
21	MDD26-18N1	1749	-40	150	100	20	1	2000	V_F increased
22	MDD56-16io1	1865	-40	150	50	10	0	500	
23	MDD56-18N1	2080	-40	150	50	10	0	500	
24	MDD95-22	1875	-40	150	100	10	1	1000	V_F increased
25	MDD95-16	1585	-40	150	50	10	0	500	
26	MDD95-18N1	1971	-40	150	100	10	0	1000	
27	MDI300-12A4	1555	-40	150	50	10	0	500	

TABLE 4D: Controller, Rectifier Bridge

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	MMO230-16	1543	-40	150	150	10	0	1500	
2	MMO230-16io7	1868	-40	150	50	20	0	1000	
3	MMO74-12io6	1615	-55	150	300	10	0	3000	
4	VBO19-16DT1	1648	-40	150	50	10	0	500	
5	VBO25-12nO2	1726	-40	150	50	10	0	500	
6	VBO25-12NO2	2005	-40	150	50	10	0	500	
7	VBO40-16NO6	1860	-40	150	50	10	0	500	
8	VBO40-16NO6	1860	-40	150	20	10	0	200	
9	VUB120-16	2034	-40	150	50	10	0	500	
10	VUB120-16NO2	1636	-40	150	50	10	0	500	
11	VUB72-16No1	1894	-40	150	50	10	0	500	
12	VUO36-12NO8	2024	-40	150	50	10	0	500	
13	VUO36-16	2036	-40	150	150	10	0	1500	
14	VUO36-16nO8	1580	-40	150	10	10	0	100	
15	VUO80-16	1778	-40	150	100	10	0	1000	
16	VUO82-16NO7	2085	-40	150	10	10	0	100	
17	VVY40-16io1	1679	-40	150	50	10	0	500	
18	VVZ40-14	1691	-40	150	100	10	0	1000	
19	VW2x60-14	1443	-40	150	50	10	0	500	
20	VWO85-12	1570	-40	125	50	10	0	500	

TABLE 4E: FRED

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	DH60-18A	1568	-40	150	50	20	0	1000	
2	DHG10I600PM	1685	-55	150	100	20	0	2000	
3	DHH55-36N1F	1604	-55	150	100	40	0	4000	
4	DPG15I400PM	1770	-55	150	100	20	0	2000	
5	DPG60C300QB	1909	-55	150	100	20	0	2000	
6	DSEE29-06CC	1771	-55	150	100	20	0	2000	
7	DSEI120-12A	1538	-40	150	50	20	0	1000	
8	DSEI120-12A	1756	-40	150	50	20	0	1000	
9	DSEI2x121-02A	2042	-40	150	20	10	0	200	
10	DSEI2x31-06C	1563	-40	150	20	10	0	200	
11	DSEI60-06A	1804	-40	150	50	20	0	1000	
12	DSEP15-06A	2020	-55	150	50	20	0	1000	
13	DSEP15-12CR	1514	-55	150	50	20	0	1000	
14	DSEP25-16AR	1712	-40	150	50	20	0	1000	
15	DSEP2x25-12C	1468	-40	150	50	10	0	500	
16	DSEP30-06BR	1700	-55	150	50	20	0	1000	
17	DSEP30-06CR	2015	-55	150	50	20	0	1000	
18	DSEP8-03AS	1738	-40	150	100	20	0	2000	
19	DSEP8-12A	1438	-55	150	50	20	0	1000	
20	DSEP8-12A	1956	-55	150	50	20	0	1000	
21	DSEP9-06CR	1437	-55	150	50	20	0	1000	
22	MEE250-12I	1887	-40	150	50	10	0	500	
23	MEE300-06DA	2064	-40	150	100	10	0	1000	
24	MEK300-06	1737	-40	150	50	10	0	500	
25	MEO450-12DA	2000	-40	150	100	10	0	1000	

TABLE 4F: Schottky Diode

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	DSA120C150QB	1907	-55	150	100	20	0	2000	
2	DSA30C100PN	1906	-55	150	100	20	0	2000	
3	DSA90C200HB	1674	-55	150	100	20	0	2000	
4	DSB15IM45IB	1622	-55	150	100	20	0	2000	
5	DSS16-0045A	2018	-55	150	50	20	0	1000	
6	DSS20-01AC	1709	-55	150	100	20	0	2000	
7	DSS2x160-01A	1856	-40	150	100	10	0	1000	
8	DSS2x61-01A	1985	-40	150	50	10	0	500	
9	DSS31-0045A	1596	-55	150	1000	80	0	80000	
10	DSS31-0045A	1596	-55	150	1000	80	0	80000	
11	DSS31-0045A SN	1492	-55	150	500	77	0	38500	
12	DSS6-015AS	1723	-55	150	1000	77	0	77000	
13	DSSK30-01A	1807	-55	150	50	20	0	1000	
14	DSSK38-0025B	1982	-55	150	50	20	0	1000	
15	DSSK40-0015B	1557	-55	150	50	20	0	1000	
16	DSSK60-0045B	1457	-55	150	50	20	0	1000	
17	DSSK60-015AR	1591	-55	150	200	40	0	8000	
18	DSSK60-015AR	1573	-55	150	50	20	0	1000	
19	DSSK80-006B	1575	-55	150	50	20	0	1000	

TABLE 4G: Thyristor/Diode single device

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	CS20-22-moF1	1888	-55	150	50	30	0	1500	
2	CS22-08io1M	1953	-40	150	50	20	0	1000	
3	CS23-12io2	1959	-40	150	20	20	0	400	
4	CS30-12io1	1977	-40	150	50	20	0	1000	
5	CS30-16io1DCSN	1820	-40	150	100	20	0	2000	
6	CS35-14io4	1473	-40	150	20	10	0	200	
7	CS45-16io1	1598	-40	150	50	20	0	1000	
8	CS60-16io1	1830	-40	150	100	20	0	2000	
9	CS8-12io2	1605	-40	150	20	10	0	200	
10	DSA1-16D	2023	-40	150	50	20	0	1000	
11	DSA17-16A	1703	-40	150	20	20	0	400	
12	DSA35-16A	1566	-40	150	20	10	0	200	
13	DSAI35-16A	2067	-40	150	20	10	0	200	
14	DSAI75-16B	1858	-40	150	20	10	0	200	
15	DSI45-12A	1805	-40	150	50	20	0	1000	
16	DSP25-16	1564	-40	150	50	20	0	1000	
17	DSP25-16A	1639	-40	150	50	20	0	1000	

TABLE 4H: ISOPLUS

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	CS20-22-moF1	1888	-55	150	50	30	0	1500	
2	DHH55-36N1F	1604	-55	150	100	40	0	4000	
3	DSEE29-06CC	1771	-55	150	100	20	0	2000	
4	DSEP15-12CR	1514	-55	150	50	20	0	1000	
5	DSEP25-16AR	1712	-40	150	50	20	0	1000	
6	DSEP30-06BR	1700	-55	150	50	20	0	1000	
7	DSEP30-06CR	2015	-55	150	50	20	0	1000	
8	DSEP9-06CR	1437	-55	150	50	20	0	1000	
9	DSS20-01AC	1709	-55	150	100	20	0	2000	
10	DSSK60-015AR	1573	-55	150	50	20	0	1000	
11	DWP25-16/18AL	1842	-55	150	100	22	0	2200	
12	FII50-12EL	1534	-55	150	100	20	0	2000	
13	GWM120-0075P3SL	1720	-55	150	1000	80	0	80000	
14	GWM160-0055X1-SL	1960	-55	150	1000	80	0	80000	
15	GWM70-01P2	1448	-55	150	1000	10	0	10000	
16	IXKC13N80C	1769	-55	150	100	20	0	2000	
17	IXKC25N80C	1590	-55	150	100	20	0	2000	
18	IXUC200N055	1802	-55	150	90	50	0	4500	

TABLE 4J: Breakover Diode

#	Part Number	Date Code or Test #	Low Temp. [°C]	High Temp. [°C]	Number of Cycles	Sample Size	Failures	Device Cycles	Remark
1	IXBOD1-08	1941	-40	150	50	20	0	1000	
2	IXBOD1-09	1800	-40	150	50	20	0	1000	
3	IXBOD1-10	1576	-40	150	50	20	0	1000	
4	IXBOD1-10	2096	-40	150	50	20	0	1000	

HUMIDITY TEST (Tables 5A, 5H..5J)
TABLE 5A: MOSFET/IGBT single device

#	Part Number	Date Code or Test #	Temp. [°C]	Rel. H. [%]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	IXDD404SIA	1695	121	100	96	30	0	2880	
2	IXKH24N60C5	2066	121	100	48	20	0	960	
3	IXKP13N60C5M	1716	85	85	1000	20	0	20000	
4	IXKP13N60C5M	1687	121	100	96	10	0	960	

TABLE 5E: FRED

#	Part Number	Date Code or Test #	Temp. [°C]	Rel. H. [%]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	DPG20C300PN	1908	121	100	96	20	0	1920	
2	DPG60C400QB	1446	121	100	96	8	0	768	
3	DSEI2x61-12B	1607	121	100	96	20	0	1920	
4	DSEI8-06AS	1535	121	100	48	20	0	960	
5	DSEP30-06BR	1536	121	100	48	20	0	960	
6	DSEP30-12CR	1927	121	100	48	20	0	960	
7	DSEP8-03AS	1837	121	100	96	20	0	1920	
8	MEO450-12DA	1742	85	85	168	10	0	1680	

TABLE 5F: Schottky Diode

#	Part Number	Date Code or Test #	Temp. [°C]	Rel. H. [%]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	DSA120C150QB	1907	121	100	96	20	0	1920	
2	DSA20C100PB	1835	85	85	1000	20	0	20000	
3	DSA20C100PB	1835	121	100	96	20	0	1920	
4	DSA20C60PN	1974	121	100	96	20	0	1920	
5	DSA90C200HB	1836	85	85	1000	20	0	20000	
6	DSA90C200HB	1836	121	100	96	20	1	1920	I_R increased
7	DSB15IM45IB	1622	121	100	96	20	0	1920	
8	DSS31-0045A SN	1492	121	100	96	77	0	7392	
9	DSS6-015AS	1723	121	100	96	77	0	7392	

TABLE 5G: Thyristor/Diode single device

#	Part Number	Date Code or Test #	Temp. [°C]	Rel. H. [%]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	CS45-12io1	1754	121	100	48	20	0	960	
2	DSDI60-14A	1806	121	100	48	20	0	960	
3	DSI45-16A	1976	121	100	96	20	0	1920	

TABLE 5H: ISOPLUS

#	Part Number	Date Code or Test #	Temp. [°C]	Rel. H. [%]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	DSEP30-06BR	1536	121	100	48	20	0	960	
2	DSEP30-12CR	1927	121	100	48	20	0	960	

TABLE 5J: Breakover diode

#	Part Number	Date Code or Test #	Temp. [°C]	Rel. H. [%]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	IXBOD1-08	1941	121	100	48	20	0	960	
2	IXBOD1-09	1800	121	100	48	20	0	960	
3	IXBOD1-10	1576	121	100	48	20	0	960	
4	IXBOD1-10	2096	121	100	48	20	0	960	