

International Rectifier

Reliability Report

for

iPOWIR Family



iP1001, iP1201, iP1202, iP1203, iP1204, iP2001, iP2002, iP2003, iP2003A

iPOWIR Family Reliability Testing Summary

6/21/2005

1). HTOL - High Temperature Operating Life Test

Device Number	Condition	Samples	Lots	# of Fails	Failure Rate	
					Actual	Required
iP1001	1000 hours @ $V_{in}=12V$ & $I_{OUT} \sim 15A$, 118-120 °C T_{Block}	117	3	0	0.0%	≤ 1%
iP2001	1000 hours @ $V_{in}=12.1V$ & $I_{OUT} \sim 15A$, 104-131 °C T_{Block}	421	11	0	0.0%	≤ 1%
iP2002	1000 hours @ $V_{in}=11.5V$ & $I_{OUT} \sim 26A$, 105-106 °C T_{Block}	112	3	0	0.0%	≤ 1%
iP2003	1000 hours @ $V_{in}=12V$ & $I_{OUT} \sim 36A$, 103-105 °C T_{Block}	117	3	0	0.0%	≤ 1%
iP120X	1000 hours @ $V_{in}=5.2V$, 97-107 °C T_{Block}	249	7	0	0.0%	≤ 1%

2). P/C - Power Cycling Test

Device Number	Condition	Samples	Lots	# of Fails	Failure Rate	
					Actual	Required
iP1001	10,000 cycles @ $I_{OUT} \sim 18A$ and $\Delta T_{Block} \sim 71-74$ °C	169	6	0	0.0%	≤ 1%
iP2001	10,000 cycles @ $I_{OUT} \sim 20A$ and $\Delta T_{Block} \sim 63-77$ °C	506	17	2 ^a	0.4%	≤ 1%
iP2002	10,000 cycles @ $I_{OUT} \sim 26-28A$ and $\Delta T_{Block} \sim 81-91$ °C	228	7	0	0.0%	≤ 1%
iP2003	10,000 cycles @ $I_{OUT} \sim 37-38A$ and $\Delta T_{Block} \sim 70-76$ °C	117	3	0	0.0%	≤ 1%
iP120X	10,000 cycles @ $\Delta T_{Block} \sim 65-74$ °C	253	7	0	0.0%	≤ 1%

3). Other Reliability Tests

Test	Condition	iP1001			iP2001			iP2002		
		Samples	Lots	# of Fails	Samples	Lots	# of Fails	Samples	Lots	# of Fails
HT Storage	1000 hours Unbiased Storage @ 125 °C	117	3	0				117	3	0
T/C	1000 cycles @ -40 °C to 125 °C with 15 min. Dwell	335 ^b	10	0	595 ^c	18	0	117	3	0
T/C	2000 cycles @ 0 °C to 100 °C with 10 °C/min. Ramp				39	3	0			
HAST	167-272 hours Unbiased @ 130 °C/85%RH	117	3	0	39	1	0			
Autoclave	96 hours Unbiased @ 121 °C/15 PSIG				87	4	0			
THB	1000 hours Biased @ 85 °C/85%RH	279 ^b	9	0	694 ^c	18	0	171 ^d	7	0
Shock	JESD22-B104-B Condition B	8	3	0	8	3	0	8	3	0
Vibration	JESD22-B103-B Condition 2	8	3	0	8	3	0	8	3	0

Test	Condition	iP2003			iP120X		
		Samples	Lots	# of Fails	Samples	Lots	# of Fails
HT Storage	1000 hours Unbiased Storage @ 125 °C	117	3	0	117	3	0
T/C	1000 cycles @ -40 °C to 125 °C with 15 min. Dwell	117	3	0	411 ^d	10	0
T/C	2000 cycles @ 0 °C to 100 °C with 10 °C/min. Ramp						
HAST	167-272 hours Unbiased @ 130 °C/85%RH						
Autoclave	96 hours Unbiased @ 121 °C/15 PSIG						
THB	1000 hours Biased @ 85 °C/85%RH	117	3	0	396 ^d	5	0
Shock	JESD22-B104-B Condition B	8	3	0	8	3	0
Vibration	JESD22-B103-B Condition 2	8	3	0	8	3	0

Note

- a. There were 2 assembly-related failures. FA Report 01-2899. Corrective Action Plan has been implemented and validation lot shows no failures.
- b. 54 samples, 18 samples per lot, were preconditioned per JEDEC STD A113-A MSL-3.
- c. 18 samples from 1 lot were preconditioned per JEDEC STD A113-A MSL-3.
- d. 90 samples, 18 samples per lot from 5 lots, were preconditioned per JEDEC STD A113-A MSL-2.
- e. iP1201 and iP1202 devices are qualified as a family
- * iP120X family of products include iP1201, iP1202, iP1203, and iP1204

iPOWIR Family HTOL - High Temperature Operating Life Test (Q4'2005 Update)

1). Data and Calculations

6/21/2005

Device Number	Lot Number	HTOL Test Condition			Test Hours	Sample Size	Dev-Hours	Number of Failures	Acceleration Factor	Equivalent Dev-Hours
		I _{out} (Amps)	V _{in} (Volts)	T _{BLK} (°C)						
iP2001	Lot 1	15	11.25	119	1000	39	39,000	0	5.23	204,089
iP2001	Lot 3	15	11.25	110	2029	39	79,131	0	3.22	254,500
iP2001	Lot 4	15	11.25	116	2012	39	78,468	0	4.46	349,996
iP2001	RevF1-Q2	15	11.00	122	7440	14	104,160	0	6.12	637,948
iP2001	L/F1	15	11.00	116	7999	14	111,986	0	4.46	499,498
iP2001	L/F2	15	11.00	116	2516	12	30,192	0	4.46	134,667
iP2001	F1-1A ^a	15	11.50	117	1422	118	167,796	0	4.71	789,584
iP2001	F1-1A ^a	15-16	12.10	123	136	118	16,048	0	6.45	103,527
iP2001	F1-1A ^a	16-17	12.60	131	3208	118	378,544	0	9.68	3,665,243
iP2001	F1-1A ^a	16-17	12.60	131	3077	78	240,006	0	9.68	2,323,853
iP2001	F1-5A	16-17	12.60	131	3222	40	128,880	0	9.68	1,247,878
iP2001	A1	15	11.50	106	2269	41	93,029	0	2.57	239,207
iP2001	A2 ^b	15	11.50	104	2269	19	43,111	0	2.30	98,942
iP2001	A2 ^b	15	11.00	116	1239	19	23,541	0	4.46	105,001
iP2001	A3	15	11.50	107	2269	46	104,374	0	2.72	283,946
iP2002	Q4	26	11.50	105	2054	39	80,106	0	2.43	194,627
iP2002	Q5	26	11.50	105	2054	39	80,106	0	2.43	194,627
iP2002	Q6	26	11.50	106	2054	34	69,836	0	2.57	179,571
iP2002	HP1	25	12.00	116.6	13500	104	1,404,000	0	4.61	6,466,949
iP2003	Q1	36	12.00	104	2054	39	80,106	0	2.30	183,847
iP2003	Q2	36	12.00	103.6	2054	39	80,106	0	2.24	179,688
iP2003	Q3	36	12.00	102.7	2054	39	80,106	0	2.13	170,642
iP1201	Q1	9	12.00	105.6	1160	39	45,240	0	2.51	113,723
iP1201	Q2	9	5.20	105	1160	40	46,400	0	2.43	112,734
iP1201	Q3	9	5.20	107	1160	38	44,080	0	2.72	119,918
iP1201	Q5	9	5.20	99.6	2004	39	78,156	0	1.78	139,086
iP1201	Q10	9	5.20	101	3229	39	125,931	0	1.93	243,156
iP1201	Q3	9	5.20	97.3	2215	25	55,375	0	1.55	86,068
iP1202	Lot 1	9	5.20	117.6	1013	29	29,377	0	4.86	142,730
iP1001	Lot 2	15	12.00	118	2001	39	78,039	0	4.96	387,308
iP1001	Lot 3	15	12.00	120	2001	39	78,039	0	5.52	430,486
iP1001	Lot 4	15	12.00	118	2001	39	78,039	0	4.96	387,308
Total							4,171,308	0		20,670,345

Note

a. Same samples

b. Same samples

In the calculations, followings are assumed:

- 1). Use T_{Block} = 90 °C
- 2). Activation Energy = 0.7 eV
- 3). χ^2 distribution with 60% Upper Confidence Level

2). Demonstrated Reliability

Device Number	Lots	Samples	Failures	Device-hours		@ 60% UCL	
				HTOL	Use	FITs	MTBF (hours)
iP2001+iP1001 +iP2002+iP2003 +iP120X	28	1115	0	4,171,308	20,670,345	44.33	22,558,735