Reliability Test Report

Products type	**BlueRadios**	**HW status**	**01 - Pre-Production**
Panasonic number	**ENW898xxA6KF**	**SW status**	**SW Rel. 1.1.0.2.0.0-S**
Customer Part No.	**BR-LE4.0-xxx**		

Test Overview

Test No.	Name of the test	Result
	Initial Performance tests before Reliability Tests	OK
0.	MSL3 Moisture sensitivity Test (96@+ 85℃/85% r.H., then 3x reflow soldering)	Done
1.	Heat Shock Resistance Test / Temperature Cycling (TC) Test	OK
2.	Low Temperature Storage Test (@ -40℃)	OK
3.	High Temperature Storage Test / HTSL (@+125℃ /1000 h)	OK
4.	Temperature Humidity Load Life / THB (@+85℃/85%rH/1000h monitored)	OK
5.	Vibration Test (@10-55-10 Hz / 1min., 2h each direction)	OK
6.	Shock Drop Test (from height of 1m, 10 times - each side)	OK
7.	ESD Test HMB JESD-22a-114D (C=150 pF; R=330 Ω)	OK
	Final Performance tests after Reliability Tests	OK

Test Result

All tests PASSED

Remarks:

The reliability tests were made on the BlueRadios module:
- **ENW89821A6KF, BR-LE4.0-S2A,CC2540**, Single Mode

These reliability test results are also valid for the similar BlueRadios module:
- **ENW89838A6KF, BR-LE4.0-S3A, CC2541**, Single Mode.

Issue Date 18.07.2012

Approval:	X
Conditional Approval:	-
Failed:	-

Panasonic
ideas for life

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Prepared	Approved
18.07.2012	18.07.2012
V. Bay	O. Jahnke

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Reliability Tests for Wireless Modules

Procedures:

- The initial performance and the after test performance measurements shall be done at normal room/standard conditions
- Load the module into chamber or check equipment with the individual conditions as advised
- Leave the samples at least 1 hour under normal room condition between take out from chamber and measurement
- All measurements shall be done on the same day when take out parts from the chamber

- **Dependent to the requirements, it is possible to carry out only part of these tests**
- **PEDEU WM Standard tests are marked with (*)**
- **Sample quantity between 5-30 (standard 10) per test or on request**

0. MSL Test (96h 85℃ 85% H, then 3x reflow soldering peak 10 s 260℃)

Monitoring: No

Pre conditioning:			Soldering condition :
	Temperature	= +85℃	
	Humidity	= 85%	Peak 260℃ for ~10 s
	Period	=96hrs	3 times

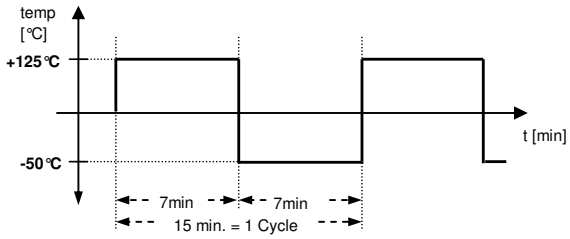
1. Heat Shock Resistance Test

Monitoring: No

Temperature Cycling (TC) Test

Temperature	= +125℃ to -50℃
Voltage	= off
Period	= 500cycle(or 1000cyc for special cases)
Temp. Cycle	= -50℃ and +125℃ each 7min.

Measurement and Solder check:
after 500cyc(and 1000cycle)



2. Low Temperature Storage Test

Monitoring: No

Temperature	= -40℃	Measurement and Solder check: after 1000hr (or request after 500hr)
Period	= 1000hrs	Power supply OFF

3. High Temperature Storage Test

Monitoring: No

Temperature	= 125℃	Measurement and Solder check: after 1000hr (or request after 500hr)
Period	= 1000hrs	Power supply Cycle = Off

4. Humidity Load Life Test

Monitoring: on request YES

Temperature	= +85℃	Measurement and Solder check: after 1000hr (or request after 500hr)	if monitoring
Humidity	= 85%	Power supply Cycle = ON	- usually current and Voltage
Period	= 1000hrs		- other need to be defined

5. Vibration Test

Monitoring: No

Vibration Ampl.	= 1,5 mm
Vibration Freq.	= 10~55~10 Hz (total 1min)
Directions	= X; Y; Z each 2hrs

6. Shock Drop Test

Monitoring: No

Drop parts onto a hard wood from height of 1m for 3 times - each side
Drop parts on concrete (mounted on application board on special frame for product simulation)
Height of 1m for 10 times - each side (weight of the frame ~150-200g or weight of final application)

7. ESD Test

Monitoring: No

Regarding JEDEC JESD-22a114D each contact with 100pF,1,5kOhm min 2 KV (Human Body Model HBM)
ESD-pulse of ±50Vmin, air-discharge with Rs=0Ω and Cs=200pF each terminal of the module (3 times) (Machine model)
Regarding EN61000-4-2 each contact with 150pF, 330Ohm min 2 KV (Human Body Model HBM)

Test requirements

The ***Performance Measurement*** shall be done always min. at end of test to check whether the unit is functional and the performance satisfies the conditions which are defined for each product in the test sheet compared with the initial value.

1. Heat Shock Resistance Test

Serial #	Test #	BD #	Module Serial numbers
	H1	ECFE7E101BB4	1202311;ECFE7E101BB4;BR-LE4.0-S2A;01;01
	H2	ECFE7E101BD4	1202311;ECFE7E101BD4;BR-LE4.0-S2A;01;01
	H3	ECFE7E101B9E	1202311;ECFE7E101B9E;BR-LE4.0-S2A;01;01
	H4	ECFE7E101BBD	1202311;ECFE7E101BBD;BR-LE4.0-S2A;01;01
	H5	ECFE7E101BB6	1202311;ECFE7E101BB6;BR-LE4.0-S2A;01;01
	H6	ECFE7E101BD0	1202311;ECFE7E101BD0;BR-LE4.0-S2A;01;01
	H7	ECFE7E101BEA	1202311;ECFE7E101BEA;BR-LE4.0-S2A;01;01
	H8	ECFE7E101B94	1202311;ECFE7E101B94;BR-LE4.0-S2A;01;01
	H9	ECFE7E101BA4	1202311;ECFE7E101BA4;BR-LE4.0-S2A;01;01
	H10	ECFE7E101BA2	1202311;ECFE7E101BA2;BR-LE4.0-S2A;01;01

2. Low Temperature Storage

Serial #	Test #	BD #	
	L1	ECFE7E101B9A	1202311;ECFE7E101B9A;BR-LE4.0-S2A;01;01
	L2	ECFE7E101BB3	1202311;ECFE7E101BB3;BR-LE4.0-S2A;01;01
	L3	ECFE7E101BD1	1202311;ECFE7E101BD1;BR-LE4.0-S2A;01;01
	L4	ECFE7E101B9F	1202311;ECFE7E101B9F;BR-LE4.0-S2A;01;01
	L5	ECFE7E101BC6	1202311;ECFE7E101BC6;BR-LE4.0-S2A;01;01
	L6	ECFE7E101BA7	1202311;ECFE7E101BA7;BR-LE4.0-S2A;01;01
	L7	ECFE7E101BDA	1202311;ECFE7E101BDA;BR-LE4.0-S2A;01;01
	L8	ECFE7E101BDE	1202311;ECFE7E101BDE;BR-LE4.0-S2A;01;01
	L9	ECFE7E101BD5	1202311;ECFE7E101BD5;BR-LE4.0-S2A;01;01
	L10	ECFE7E101BB1	1202311;ECFE7E101BB1;BR-LE4.0-S2A;01;01

3. High Temperature Storage

Serial #	Test #	BD #	
	H1	ECFE7E101B85	1202311;ECFE7E101B85;BR-LE4.0-S2A;01;01
	H2	ECFE7E101BE3	1202311;ECFE7E101BE3;BR-LE4.0-S2A;01;01
	H3	ECFE7E101BDB	1202311;ECFE7E101BDB;BR-LE4.0-S2A;01;01
	H4	ECFE7E101BCC	1202311;ECFE7E101BCC;BR-LE4.0-S2A;01;01
	H5	ECFE7E101B8D	1202311;ECFE7E101B8D;BR-LE4.0-S2A;01;01
	H6	ECFE7E101BE7	1202311;ECFE7E101BE7;BR-LE4.0-S2A;01;01
	H7	ECFE7E101BA6	1202311;ECFE7E101BA6;BR-LE4.0-S2A;01;01
	H8	ECFE7E101B93	1202311;ECFE7E101B93;BR-LE4.0-S2A;01;01
	H9	ECFE7E101BCA	1202311;ECFE7E101BCA;BR-LE4.0-S2A;01;01
	H10	ECFE7E101BC0	1202311;ECFE7E101BC0;BR-LE4.0-S2A;01;01

4. Temperature Humidity Load Life / THB

Serial #	Test #	BD #	
	L1	ECFE7E101BD8	
	L2	ECFE7E101B83	
	L3	ECFE7E101BA3	
	L4	ECFE7E101B95	
	L5	ECFE7E101BAD	
	L6	ECFE7E101BCD	
	L7	ECFE7E101B88	
	L8	ECFE7E101B8A	
	L9	ECFE7E101BD6	
	L10	ECFE7E101BE8	

5. Vibration

Serial #	Test #	BD #	
	V1	ECFE7E101BA5	1202311;ECFE7E101BA5;BR-LE4.0-S2A;01;01
	V2	ECFE7E101BB5	1202311;ECFE7E101BB5;BR-LE4.0-S2A;01;01
	V3	ECFE7E101BDF	1202311;ECFE7E101BDF;BR-LE4.0-S2A;01;01
	V4	ECFE7E101BE5	1202311;ECFE7E101BE5;BR-LE4.0-S2A;01;01
	V5	ECFE7E101B9D	1202311;ECFE7E101B9D;BR-LE4.0-S2A;01;01
	V6	ECFE7E101B9B	1202311;ECFE7E101B9B;BR-LE4.0-S2A;01;01
	V7	ECFE7E101B8F	1202311;ECFE7E101B8F;BR-LE4.0-S2A;01;01
	V8	ECFE7E101BC9	1202311;ECFE7E101BC9;BR-LE4.0-S2A;01;01
	V9	ECFE7E101B9C	1202311;ECFE7E101B9C;BR-LE4.0-S2A;01;01
	V10	ECFE7E101BBC	1202311;ECFE7E101BBC;BR-LE4.0-S2A;01;01

6. Drop Test

Serial #	Test #	BD #	
	D1	ECFE7E101B96	1202311;ECFE7E101B96;BR-LE4.0-S2A;01;01
	D2	ECFE7E101BA0	1202311;ECFE7E101BA0;BR-LE4.0-S2A;01;01
	D3	ECFE7E101B84	1202311;ECFE7E101B84;BR-LE4.0-S2A;01;01
	D4	ECFE7E101B8C	1202311;ECFE7E101B8C;BR-LE4.0-S2A;01;01
	D5	ECFE7E101BC1	1202311;ECFE7E101BC1;BR-LE4.0-S2A;01;01
	D6	ECFE7E101BE2	1202311;ECFE7E101BE2;BR-LE4.0-S2A;01;01

7. ESD

Serial #	Test #	BD #	
	E1	ECFE7E101BA9	
	E2	ECFE7E101BBF	
	E3	ECFE7E101B87	
	E4	ECFE7E101BD3	
	E5	ECFE7E101B97	
	E6	ECFE7E101BB2	
	E7	ECFE7E101BC8	
	E8	ECFE7E101BCE	

Module Type	BR-LE4.0-S2-S / BR-LE4.0-S2-M
SW Release	1.1.0.2.0.0-S / 1.1.0.1.1.9-M
HW Release	01
Tester: jl	Coupling Loss = 31.9dBm

Final Performance after Tests

Low temp. 500 h

Pass/Fail	Date	Time	Test Duration	BT Address	Current TX Mode [mA]	Transmit Power [dBm]	Transmit 2 harmonic [dBm]	Transmit 3 harmonic [dBm]	Frequency tolerance [ppm]
					<= 50	>=-2,<=6	<= -30	<= -30	<= +/-40
Pass	18.07.2012	14:28:07	00:00:10	ECFE7E101BB1	41,93	2,08	-49,85	-61,91	7,40
Pass	18.07.2012	14:28:39	00:00:11	ECFE7E101BDA	41,50	1,06	-48,89	-65,00	7,00
Pass	18.07.2012	14:29:12	00:00:11	ECFE7E101BB3	41,28	4,74	-59,46	-68,72	5,90
Pass	18.07.2012	14:29:42	00:00:11	ECFE7E101BC6	42,59	0,98	-40,71	-60,50	6,40
Pass	18.07.2012	14:30:17	00:00:11	ECFE7E101B9F	39,95	-1,63	-52,19	-67,18	5,30
Pass	18.07.2012	14:30:49	00:00:11	ECFE7E101B9A	42,01	2,19	-50,35	-62,11	7,60
Pass	18.07.2012	14:31:18	00:00:11	ECFE7E101BDE	41,79	1,99	-46,64	-60,32	6,10
Pass	18.07.2012	14:31:49	00:00:11	ECFE7E101BD5	42,04	2,14	-60,32	-67,95	4,70
Pass	18.07.2012	14:32:22	00:00:10	ECFE7E101BD1	42,91	1,84	-49,30	-59,87	5,10
Pass	18.07.2012	14:32:52	00:00:11	ECFE7E101BA7	42,54	2,49	-45,09	-61,18	6,60

Storage 125°C

Pass	18.07.2012	14:02:01	00:00:10	ECFE7E101BA6	42,34	1,70	-46,39	-60,95	-1,80
Pass	18.07.2012	14:02:40	00:00:11	ECFE7E101B93	42,80	3,42	-45,58	-61,29	3,70
Pass	18.07.2012	14:03:16	00:00:11	ECFE7E101BC0	41,58	1,06	-47,20	-54,74	5,50
Pass	18.07.2012	14:03:50	00:00:11	ECFE7E101B85	42,60	1,77	-56,12	-59,12	4,50
Pass	18.07.2012	14:04:23	00:00:10	ECFE7E101BCA	41,47	5,05	-54,14	-64,58	3,50
Pass	18.07.2012	14:04:53	00:00:11	ECFE7E101BE7	41,97	1,47	-47,35	-64,83	4,30
Pass	18.07.2012	14:05:24	00:00:11	ECFE7E101B8D	42,18	2,53	-47,31	-60,96	6,40
Pass	18.07.2012	14:05:55	00:00:11	ECFE7E101BCC	40,54	5,34	-54,60	-67,79	5,10
Pass	18.07.2012	14:06:30	00:00:10	ECFE7E101BDB	43,38	1,92	-56,32	-64,02	3,30
Pass	18.07.2012	14:07:01	00:00:11	ECFE7E101BE3	42,49	1,78	-49,05	-62,75	6,80

THB 1000 h

Pass	18.07.2012	14:11:08	00:00:11	ECFE7E000000	42,40	2,44	-48,85	-63,09	3,30
Pass	18.07.2012	14:13:51	00:00:11	ECFE7E000000	41,73	1,95	-53,07	-61,05	3,10
Pass	18.07.2012	14:15:13	00:00:11	ECFE7E000000	39,92	-0,22	-52,05	-66,40	5,90
Pass	18.07.2012	14:18:01	00:00:10	ECFE7E000000	42,16	3,10	-49,65	-67,84	5,30
Pass	18.07.2012	14:18:43	00:00:11	ECFE7E000000	42,21	2,01	-40,58	-63,02	2,30

Heat shock Test

Pass	19.07.2012	08:50:46	00:00:10	ECFE7E101BA4	41,81	1,68	-57,93	-68,1	4,7
Pass	19.07.2012	08:51:38	00:00:11	ECFE7E101B9E	41,17	2,92	-51,38	-61,77	0,4
Pass	19.07.2012	08:52:22	00:00:11	ECFE7E101BB4	41,39	2,94	-53,26	-56,75	3,5
Pass	19.07.2012	08:53:00	00:00:11	ECFE7E101BA2	43,32	2,04	-51,44	-61,65	1,6
Pass	19.07.2012	08:53:35	00:00:11	ECFE7E101BBD	41,67	1,04	-48,55	-63,65	2,9
Pass	19.07.2012	08:54:09	00:00:11	ECFE7E101B94	40,96	2,59	-56,16	-67,46	4,3
Pass	19.07.2012	08:54:51	00:00:11	ECFE7E101BD0	42,18	2,93	-51,72	-62,87	6,4
Pass	19.07.2012	08:55:29	00:00:10	ECFE7E101BEA	41,25	4,2	-51,1	-59,4	4,7
Pass	19.07.2012	08:56:12	00:00:11	ECFE7E101BD4	41,54	2,96	-50,22	-62,02	1,6
Pass	19.07.2012	08:56:43	00:00:10	ECFE7E101BB6	41,34	3,38	-49,49	-57,47	5,1

Vibration Test

Pass	19.07.2012	08:29:12	00:00:12	ECFE7E101BBC	41,77	1,58	-48,26	-65,9	5,1
Pass	19.07.2012	08:30:13	00:00:10	ECFE7E101B9B	42,81	2,83	-46,27	-64,64	7
Pass	19.07.2012	08:31:09	00:00:10	ECFE7E101BA5	42,59	1,67	-47,34	-63,94	6,8
Pass	19.07.2012	08:36:05	00:00:10	ECFE7E101BB5	42,25	1,71	-46,32	-61,8	6,6
Pass	19.07.2012	08:38:05	00:00:10	ECFE7E101B9D	42,95	1,93	-46,31	-61,84	6,6
Pass	19.07.2012	08:38:52	00:00:11	ECFE7E101BDF	42,84	1,87	-44,56	-63,08	3,9
Pass	19.07.2012	08:41:24	00:00:10	ECFE7E101B8F	41,43	-0,63	-54,59	-68,31	4,1
Pass	19.07.2012	08:42:16	00:00:11	ECFE7E101BE5	40,41	-1,1	-51,94	-65,7	8
Pass	19.07.2012	08:43:22	00:00:11	ECFE7E101BC9	43,24	5,81	-52,16	-66,72	4,9
Pass	19.07.2012	08:44:06	00:00:11	ECFE7E101B9C	43,08	2,29	-46,68	-65,12	4,3

Shock Drop Test

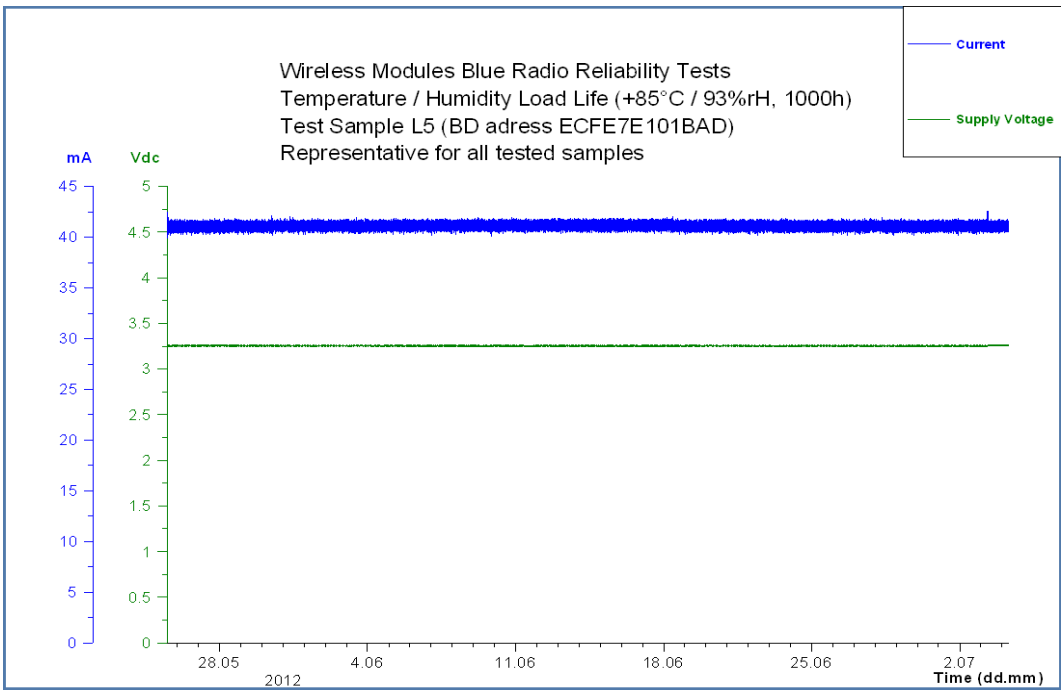
Pass	19.07.2012	09:00:35	00:00:11	ECFE7E101B96	42,86	1,49	-46,19	-64,45	5,5
Pass	19.07.2012	09:01:51	00:00:11	ECFE7E101BA0	42,65	1,87	-49,28	-66,97	7,2
Pass	19.07.2012	09:02:49	00:00:11	ECFE7E101BC1	42,18	1,89	-45,92	-61,12	4,7
Pass	19.07.2012	09:04:14	00:00:11	ECFE7E101B8C	42,26	1,29	-46,89	-59,71	7,4
Pass	19.07.2012	09:05:09	00:00:10	ECFE7E101BE2	41,81	0,8	-54,94	-65,53	5,1
Pass	19.07.2012	09:05:48	00:00:10	ECFE7E101B84	42,1	1,3	-49,45	-62,26	6,8

ESD Test

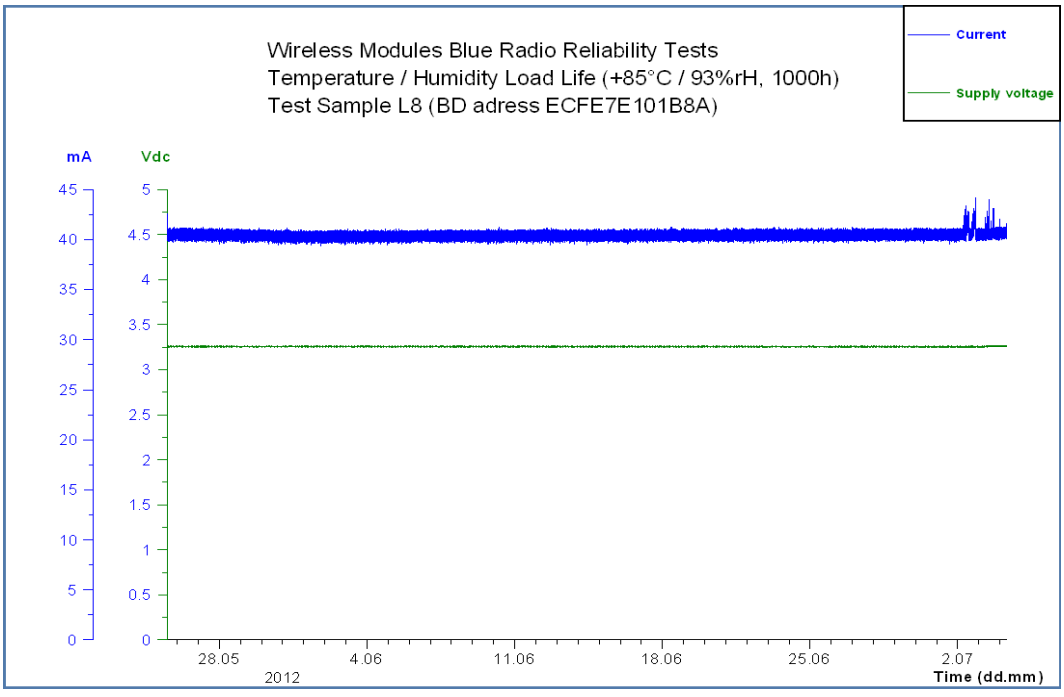
Pass	19.07.2012	09:08:05	00:00:10	ECFE7E101BCE	42,16	1,56	-48,88	-67,1	4,3
Pass	19.07.2012	09:08:44	00:00:11	ECFE7E101BB2	41,57	1,8	-52,71	-61,68	6,6
Pass	19.07.2012	09:09:17	00:00:11	ECFE7E101BA9	42,2	5,91	-45,64	-65,48	8
Pass	19.07.2012	09:09:47	00:00:11	ECFE7E101B97	43,3	2,76	-46,19	-64,44	4,9
Pass	19.07.2012	09:10:16	00:00:11	ECFE7E101BD3	42,91	1,42	-44,67	-65,58	4,5
Pass	19.07.2012	09:11:26	00:00:10	ECFE7E101B87	42,49	1,25	-54,75	-67,13	1,6
Pass	19.07.2012	09:12:18	00:00:11	ECFE7E101BC8	42,54	3,13	-46,67	-60,22	5,9
Pass	19.07.2012	09:13:02	00:00:11	ECFE7E101BBF	41,62	1,4	-54,63	-64,11	6,4

Final Performance after Tests

Panasonic ideas for life Panasonic Industrial Devices Europe GmbH	**High Temperature Load life** **Temperature Humidity Bias (THB)** **monitored with Bias** **@ +85℃ / 85% r H while 1000 hours**	Prepared: V. Bay Approved: O. Jahnke Date: 18.07.2012



These graphs are representative for all tested DUTs



Legend:

Current (mA) belongs to Current consumption
Voltage (Vdc) belongs to Unom

Conclusion: DUTs passed this test without any performance loss.
Parameter Deviations after these tests are less than the specified max allowed deviations

Remark:

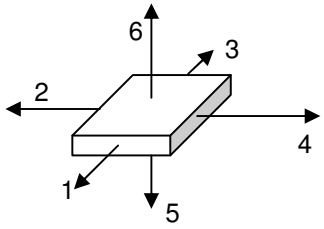
Result: OK

Panasonic ideas for life Panasonic Electronic Devices Europe GmbH	**Investigation Report** **BlueRadios Module (ENW89821A6KF)** **(Drop Test)** Test no. R-6.2	Report No.: ISM IR LG04-12 Page: 1 of 1

Drop test of 6 BlueRadios modules from normal production.
Modules drop from 1m for 10 times - each side onto concrete in a special case which simulates customer application.

Drop machine:

Fall direction:



O : OK
O : conditional OK
Δ : cover partly away
X : cover completely away
F : parts broke away (immediate fail)

		Times of drop trials (1st to 5th trial)																											
Falling times		1						2						3						4						5			
Module No.		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Falling direction	1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	3	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	4	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	6	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

		Times of drop test (6th to 10th trial)																											
Falling times		6						7						8						9						10			
Module No.		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Falling direction	1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	3	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	4	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	6	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

CONCLUSION:

There are no problems after 10 drop trials on each side, totally 60 drops.
There were no visible damages after these drops and functions were OK.

Department	Prepared	Approved	Judgement	Date
DEG	**Stutterheim**		**OK**	17.02.2012

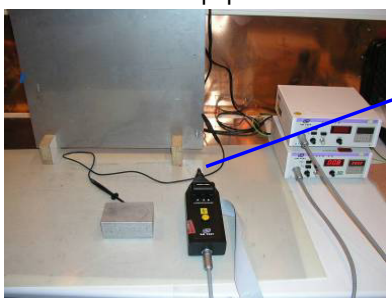
Panasonic ideas for life Panasonic Electronic Devices Europe GmbH	**Investigation Report** **BlueRadios Module** **(Reliability ESD tests)**	Report No.: **ISM IR LG06-12** Page: 1 of 1

Test: We made ESD test on 8 pcs of BlueRadios module. Three times on each pin.

Before and after each ESD test electrical test were made

ESD measure cabin

ESD measure equipment



ESD measure object

ESD test R - 8.1 conditions:
4pcs (each pin with (**+ 2,0 kV)** (**150pF & 1,5kΩ**) ascending until (**+ 3,5kV**)
4pcs (each pin with (**- 2,0 kV)** (**150pF & 1,5kΩ**) descending until (**- 3,5kV**)

modules no.	ESD	2,0 kV	2,5 kV	3,0 kV	3,5 kV
No. E1	Positive	X			
No. E2	Negative	X			
No. E3	Positive		X		
No. E4	Negative		X		
No. E5	Positive			X	
No. E6	Negative			X	
No. E7	Positive				X
No. E8	Negative				X

X = tested only with this voltage

Result:
All tested Modules are OK after these ESD shoots.

Comments:
BlueRadios wireless modules withstand at least ESD voltages of ± 3,5 kV.

Department	Checked	Approved	Judgement	Date
DEG	**Stutterheim**		**OK**	17.02.2012