



RADIO TEST REPORT

Test Report No. : 28JE0209-HO-01-A

Applicant : Mitsubishi Electric Corporation Sanda works
Type of Equipment : Navigation system
Model No. : NR-212-6U
FCC ID : UJHNR21263AF39508
Test regulation : FCC Part 15 Subpart C 2008
Section 15.207, Section 15.247
Test Result : Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Date of test:

July 28 to September 26, 2008

Tested by:

Shinya Watanabe
EMC Services

Takumi Shimada
EMC Services

Approved by :

Mitsuru Fujimura
Assistant Manager of EMC Services



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address, <http://uljapan.co.jp/emc/nvlap.htm>

UL Japan, Inc.

Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

MF060b (09.01.08)

CONTENTS	PAGE
SECTION 1: Customer information.....	3
SECTION 2: Equipment under test (E.U.T.).....	3
SECTION 3: Test specification, procedures & results.....	5
SECTION 4: Operation of E.U.T. during testing.....	9
SECTION 5: Spurious Emission	13
SECTION 6: Bandwidth	14
SECTION 7: Maximum Peak Output Power	15
SECTION 8: Carrier Frequency Separation	15
SECTION 9: Number of Hopping Frequency	15
SECTION 10: Dwell time	16
APPENDIX 1: Photographs of test setup	17
Spurious Emission (Radiated)	17
Worst Case Position (Horizontal: X-axis/ Vertical:Y-axis)	18
APPENDIX 2: Data of EMI test.....	19
Carrier Frequency Separation	19
20dB Bandwidth.....	21
Number of Hopping Frequency.....	23
Dwell time	25
Maximum Peak Output Power.....	28
Radiated Spurious Emission (below 1GHz)	29
Radiated Spurious Emission (above 1GHz)	33
Conducted Spurious Emission.....	38
99% Occupied Bandwidth	43
APPENDIX 3:Test instruments	44

SECTION 1: Customer information

Company Name : Mitsubishi Electric Corporation Sanda works
Address : 2-3-33 Miwa, Sanda-city, Hyogo, 669-1513 Japan
Telephone Number : +81-79-559-3859
Facsimile Number : +81-79-559-3875
Contact Person : Koichi Sugimoto

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : Navigation system
Model No. : NR-212-6U
Serial No. : ME395084170044
Rating : DC 12.0V
Receipt Date of Sample : July 25, 2008
Country of Mass-production : Japan
Condition of EUT : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT : No Modification by the test lab

UL Japan, Inc.

Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

2.2 Product Description

Model No: NR-212-6U (referred to as the EUT in this report) is the Navigation system.
The test in this report was performed for Bluetooth part.
As FM and WB Tuner parts, please refer to UL Japan's report No. 28JE0209-HO-01-C.

Clock frequency(ies) in the system : 26MHz

[Bluetooth (Ver. 1.2 without EDR function)]

Equipment Type : Transceiver
Frequency of Operation : 2402-2480MHz
Bandwidth & Channel Spacing : 1MHz & 1MHz
Modulation : FHSS
ITU code : F1D
Mode of operation : Simplex
Method of Frequency Generation : Crystal
Antenna Type : Pattern antenna
Antenna Connector Type : FAKRA
Antenna Gain : 2.32 dBi max
Operating voltage (inner) : DC 3.3V
Operating temperature range : -20 deg. C. to +75 deg. C.

[GPS Receiver]

Equipment Type : Receiver
Frequency of Operation : 1575.42MHz
Other Clock Frequency : 16.37MHz
Method of Frequency Generation : Crystal
Antenna Type : GPS/TELEPHONE ANTENNA
Antenna Connector Type : FAKRA
Operating voltage (inner) : DC 3.3V
Operating temperature range : -30 deg. C. to +85 deg. C.

Type of radio	Tuner		
	FM	AM MW	WB
Frequency of Operation (FO)	87.75 - 107.9MHz	530 - 1710kHz	162.400 - 162.550MHz
Local Frequency Range (LF)	196.9 - 237.2MHz	224.6 - 248.2MHz	173.1 - 173.25MHz
Method of Frequency Generation	LF(min)=RC*1969 LF(max)=RC*2372 FO=LF/2-10.7	LF(min)=RC/5*11230 LF(max)=RC/5*12410 FO=LF/20-10.7	LF(min)=RC/4*6924 LF(max)=RC/4*6930 FO=LF-10.7
Intermediate Frequency (IF)	10.7MHz		
Reference frequency	100kHz	20kHz	25kHz
Radio Module Internal Clock (RC)	No internal clock in the radio module. 100kHz reference clock is transferred to the radio from the External DSP.		
Antenna Type	Glass antenna		
Antenna Connector Type	FAKRA coding B		
Operating voltage	8 - 9V		
Operating temperaturerange	-40 to +85 deg. C.		

UL Japan, Inc.

Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part15 Subpart C: 2008, final revised on May 19, 2008
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

FCC 15.31 (e)

This EUT provides stable voltage(DC 3.3V) constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The EUT has a unique coupling/BT antenna connector. Therefore the equipment complies with the requirement of 15.203.

3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
1	Conducted emission	FCC: ANSI C63.4:2003 7. AC powerline conducted emission measurements IC: RSS-Gen 7.2.2	FCC: Section 15.207 IC: RSS-Gen 7.2.2	Conducted	N/A	N/A	N/A *1)
2	Carrier Frequency Separation	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(a)(1) IC: RSS-210 A8.1 (b)	Conducted	N/A	See data.	Complied
3	20dB Bandwidth	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(a)(1) IC: RSS-210 A8.1 (a)	Conducted	N/A		Complied
4	Number of Hopping Frequency	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(a)(1)(iii) IC: RSS-210 A8.1 (d)	Conducted	N/A		Complied
5	Dwell time	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(a)(1)(iii) IC: RSS-210 A8.1 (d)	Conducted	N/A		Complied
6	Maximum Peak Output Power	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 4.8	FCC: Section 15.247(b)(1) IC: RSS-210 A8.4 (2)	Conducted	N/A		Complied
7	Band Edge Compliance	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(d) IC: RSS-210 A8.5	Conducted	N/A		Complied
8	Spurious Emission	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 4.9 RSS-Gen 4.10	FCC: Section 15.247(d) IC: RSS-210 A8.5 RSS-Gen 7.2.1 and 7.2.3	Conducted/ Radiated	N/A	[Tx] 10.8dB 24410.00MHz, Vertical, AV 24800.00MHz, Horizontal, AV [Rx] 15.4dB 592.720MHz, Vertical, QP	Complied

Note: UL Japan, Inc.'s EMI Work Procedures No.QPM05 and QPM15.

*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

*These tests were performed without any deviations from test procedure except for additions or exclusions.

* In case any questions arise about test procedure, ANSI C63.4: 2003 is also referred.

3.3 Addition to standards

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99% Occupied Bandwidth	IC: RSS-Gen 4.6.1	IC: RSS-Gen 4.6.1	Conducted	N/A	N/A	N/A

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

Test room	Conducted emission	Radiated emission (10m*)			Radiated emission (3m*)			Radiated emission (3m*)	
	150kHz-30MHz	9kHz-30MHz	30MHz-300MHz	300MHz-1GHz	9kHz-30MHz	30MHz-300MHz	300MHz-1GHz	1GHz-18GHz	18GHz-40GHz
No.1 semi-anechoic Chamber (±)	3.7dB	3.1dB	4.4dB	4.2dB	3.2dB	3.8dB	3.9dB	5.9dB	6.1dB
No.2 semi-anechoic chamber (±)	3.7dB	-	-	-	3.2dB	4.4dB	4.0dB	5.9dB	6.1dB
No.3 semi-anechoic chamber (±)	3.7dB	-	-	-	3.2dB	4.6dB	4.0dB	5.9dB	6.1dB
No.4 semi-anechoic chamber (±)	3.7dB	-	-	-	3.2dB	3.9dB	3.9dB	5.9dB	6.1dB

*10m/3m = Measurement distance

Radiated emission test(3m)

The data listed in this test report has enough margin, more than the site margin.

Other test except Conducted Emission and Spurious Emission (Radiated)

The measurement uncertainty for this test is 3.0dB.

3.5 Test Location

UL Japan, Inc. Head Office EMC Lab. *NVLAP Lab. code: 200572-0

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

	FCC Registration Number	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	313583	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	655103	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	148738	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	134570	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	-	4.0 x 4.5 x 2.7m	4.75 x 5.4 m	-
No.6 measurement room	-	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	-	8.0 x 4.5 x 2.8m	2.0 x 2.0m	-
No.10 measurement room	-	-	2.6 x 2.8 x 2.5m	2.4 x 2.4m	-
No.11 measurement room	-	-	3.1 x 3.4 x 3.0m	2.4 x 3.4m	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test set up, Test instruments and Data of EMI

Refer to APPENDIX 1 to 3.

UL Japan, Inc.

Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Test	Mode	Tested frequency
Carrier Frequency Separation	Bluetooth Transmitting (Tx), DH5, Payload: PRBS9 (Hopping on)	2402MHz(L) 2441MHz(M) 2480MHz(H)
	Inquiry	2441MHz(M)
20dB Bandwidth	Bluetooth Transmitting (Tx), DH5, Payload: PRBS9 (Hopping off)	2402MHz(L) 2441MHz(M) 2480MHz(H)
	Inquiry	2441MHz(M)
Number of Hopping Frequency	Bluetooth Transmitting (Tx), DH5, Payload: PRBS9 (Hopping on)	-
	Inquiry	-
Dwell time	Bluetooth Transmitting (Tx), Payload: PRBS9 (Hopping on) -DH1 -DH3 -DH5	-
	Inquiry	-
Maximum Peak Output Power	Bluetooth Transmitting (Tx), DH5, Payload: PRBS9 (Hopping off)	2402MHz(L) 2441MHz(M) 2480MHz(H)
	Inquiry	2441MHz(M)
Spurious Emission (Radiated)	Bluetooth Transmitting (Tx), DH5, Payload: PRBS9 (Hopping off)	2402MHz(L) 2441MHz(M) 2480MHz(H)
	Bluetooth Receiving (Rx)	2441MHz(M)
Spurious Emission (Conducted)	Bluetooth Transmitting (Tx), DH5, Payload: PRBS9 (Hopping off)	2402MHz(L) 2441MHz(M) 2480MHz(H)
Band Edge Compliance (Conducted)	Bluetooth Transmitting (Tx), DH5, Payload: PRBS9 -Hopping on -Hopping off	2402MHz(L) 2480MHz(H)
	(Radiated)	2402MHz(L) 2480MHz(H)
99% Occupied Bandwidth	Bluetooth Transmitting (Tx), DH5, Payload: PRBS9 -Hopping on -Hopping off	2402MHz(L) 2441MHz(M) 2480MHz(H)

*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload (except Dwell time test)

Remarks: Test was not performed at AFH mode, because the decrease of number of channel (min: 20ch) at AFH mode does not influence on the output power and bandwidth of the EUT.
However, the limit level 125mWof AFH mode was used for the test.

UL Japan, Inc.

Head Office EMC Lab.

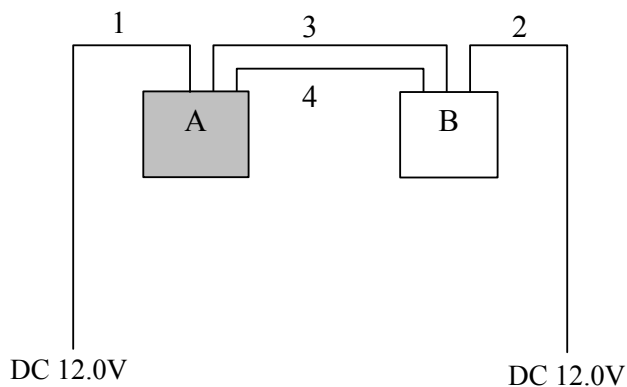
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

4.2 Configuration and peripherals

[Antenna terminal conducted tests]



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

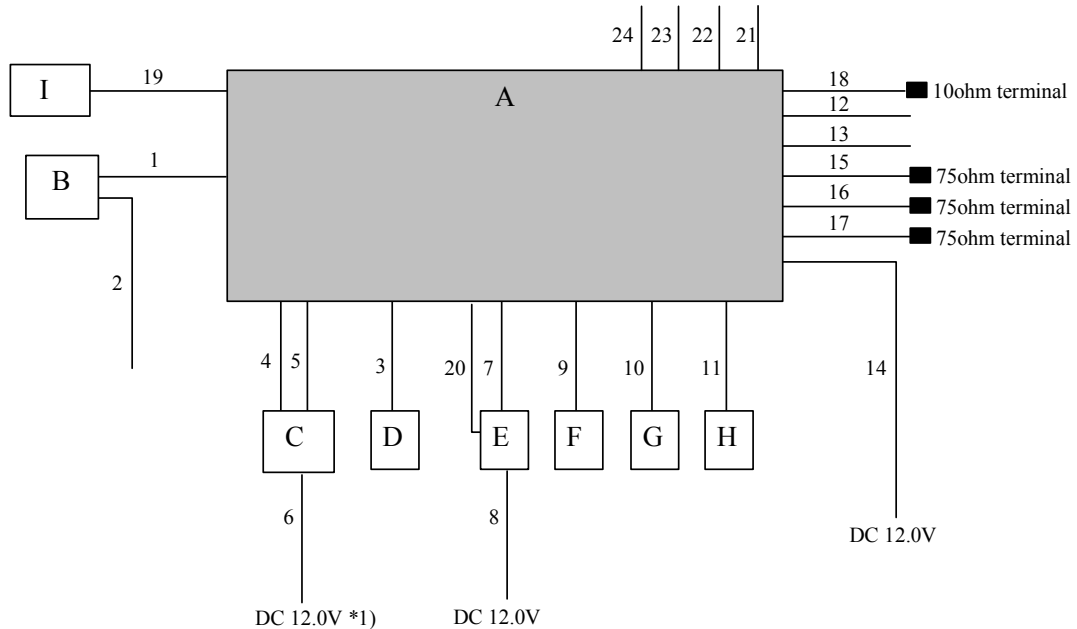
Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Navigation system	NR-212-6U	ME395084170044	MITSUBISHI	EUT
B	Display	BR204	55555/1	SIEMENS	-

List of cables used

No.	Name	Length (m)	Shield	
			Cable	Connector
1	DC Cable	6.0	Unshielded	Unshielded
2	DC Cable	1.0	Unshielded	Unshielded
3	Display Cable	1.5	Shielded	Shielded
4	CAN Cable	6.0	Unshielded	Unshielded

[Spurious Emission (Radiated) test]



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

*1) Radiated Spurious Emission (below 1GHz) test was performed without supplying with DC12.0V based on customer's request.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Navigation system	NR-212-6U	ME395084170044	mitsubishi	EUT
B	GPS Antenna	A 204 820 16 75	T-2	mitsubishi	*1)
C	Display	LN12200101F	6227/02	SIEMENS	-
D	AM/FM Antenna	LR-31R	-	mitsubishi	-
E	External AMP	9008	9008DJ07B001472	HARMAN/BECKER AUTOMOTIVE SYSTEMS	-
F	Dummy Speaker	-	-	mitsubishi	-
G	MIC	6-7-05#1	2	-	-
H	External FAN	RV40-18/12L	-	ebmpapst	-
I	BT Antenna	A 204 820 22 75	-	mitsubishi	*1)

*1) These GPS Antenna and BT Antenna for the tests are not EUT, however, this Navigation system (EUT) is limited to be installed with these GPS Antenna and BT Antenna only (including with cable length and cable type) which were used in the tests.

List of cables used

No.	Name	Length (m)	Shield	
			Cable	Connector
1	GPS Antenna Cable	1.2	Shielded	Shielded
2	Signal Cable	1.2	Shielded	Shielded
3	AM/FM Antenna Cable	5.3	Shielded	Shielded
4	Display Cable	0.8	Shielded	Shielded
5	CAN Cable	4.0	Unshielded	Unshielded
6	DC Cable	1.0	Unshielded	Unshielded
7	Most-Wake up Cable	3.5	Unshielded	Unshielded
8	DC Cable	1.8	Unshielded	Unshielded
9	Dummy Speaker Cable	3.0	Unshielded	Unshielded
10	MIC Cable	3.4	Unshielded	Unshielded
11	FAN Cable	3.2	Unshielded	Unshielded
12	H-CAN Cable	3.0	Unshielded	Unshielded
13	B-CAN Cable	3.0	Unshielded	Unshielded
14	DC Cable	1.8	Unshielded	Unshielded
15	75 ohm Terminal Cable	2.1	Shielded	Shielded
16	75 ohm Terminal Cable	2.1	Shielded	Shielded
17	75 ohm Terminal Cable	2.1	Shielded	Shielded
18	10 ohm Terminal Cable	3.0	Unshielded	Unshielded
19	BT Antenna Cable	1.2	Shielded	Shielded
20	Optical Cable	3.0	Unshielded	Unshielded
21	Signal Cable	3.0	Unshielded	Unshielded
22	Signal Cable	3.0	Unshielded	Unshielded
23	Signal Cable	3.0	Unshielded	Unshielded
24	Signal Cable	3.0	Unshielded	Unshielded

UL Japan, Inc.

Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

SECTION 5: Spurious Emission

[Conducted]

Test Procedure

The Out of Band Emission was measured with a spectrum analyzer connected to the antenna port.

The following spectrum analyzer setting was used:

- RBW: 100kHz
- VBW: 300kHz
- Sweep: Auto
- Detector: Peak
- Trace: Max Hold

Test data : APPENDIX 2

Test result : Pass

[Radiated]

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.0m by 1.5m, raised 80cm above the conducting ground plane. The Radiated Electric Field Strength intensity has been measured in a Semi Anechoic Chamber with a ground plane and at a distance of 3m(Below 10GHz) and 1m(Upper 10GHz).

The height of the measuring varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made by using peak hold.

Only for Average measurement, the test was made with adjusting span to zero.

The result also satisfied with the general limits specified in section FCC 15.209(a) / RSS-210 2.7 (IC).

Frequency	Below 1GHz	Above 1GHz (Tx)	Above 1GHz (Rx)
Instrument used	Test Receiver	Spectrum Analyzer	Spectrum Analyzer
Detector	QP: BW 120kHz	PK: RBW:1MHz/VBW: 1MHz	PK: RBW:1MHz/VBW: 1MHz
IF Bandwidth		AV: RBW:1MHz/VBW:150Hz *1)	AV: RBW:1MHz/VBW:10Hz

*1) VBW was determined that it is calculation based on the frequency of the radio transmitted signal from EUT.

Since pulse emission and duty cycle was less than 100%.

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of Antenna to see the position of maximum noise, and the test was made at the position that has the maximum noise.

The test was made on EUT at the normal use position.

Test data : APPENDIX 2

Test result : Pass

UL Japan, Inc.

Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

SECTION 6: Bandwidth

20 dB Bandwidth

Test Procedure

The bandwidth was measured with a spectrum analyzer connected to the antenna port.
The following spectrum analyzer setting was used:

- Span: 3MHz
- RBW: 30kHz
- VBW: 30kHz
- Sweep: Auto
- Detector: Peak
- Trace: Max Hold

Test data : APPENDIX 2

Test result : Pass

99% Occupied Bandwidth

Test Procedure

The bandwidth was measured with a spectrum analyzer connected to the antenna port.
The following spectrum analyzer setting was used:

- Span: Enough width to display 20dB Bandwidth
- RBW: as close to 1% of the Span as is possible without being below 1%
- VBW: Three times of RBW
- Sweep: Auto
- Detector: Peak
- Trace: Max Hold

Test data : APPENDIX 2

Test result : Pass

SECTION 7: Maximum Peak Output Power

Test Procedure

The Maximum Peak Output Power was measured with a power meter (tested bandwidth: 50MHz) connected to the antenna port.

Test data	: APPENDIX 2
Test result	: Pass

SECTION 8: Carrier Frequency Separation

Test Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna port.
The following spectrum analyzer setting was used:

- Span: 3MHz (Inquiry: 5MHz)
- RBW: 100kHz
- VBW: 300kHz
- Sweep: Auto
- Detector: Peak
- Trace: Max Hold

Test data	: APPENDIX 2
Test result	: Pass

SECTION 9: Number of Hopping Frequency

Test Procedure

The Number of Hopping Frequency was measured with a spectrum analyzer connected to the antenna port.
The following spectrum analyzer setting was used:

- Span: 30MHz
- RBW: 300kHz
- VBW: 1MHz
- Sweep: Auto
- Detector: Peak
- Trace: Max Hold

Test data	: APPENDIX 2
Test result	: Pass

SECTION 10: Dwell time

Test Procedure

The Dwell time was measured with a spectrum analyzer connected to the antenna port.
The following spectrum analyzer setting was used:

- Span: Zero Span
- RBW: 1MHz
- VBW: 3MHz
- Sweep: as necessary to capture the entire dwell time per hopping channel
- Detector: function peak
- Trace: Max Hold

Test data	: APPENDIX 2
Test result	: Pass