ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT
INTENTIONAL RADIATOR CERTIFICATION

Product Name	: Car Entertainment System
Model Number	: VX400
Trade Name	: Clarion
FCC ID	: V8VCES8218CL
Report Number	: SZEE090908119758-2
Date	: October 14, 2009

Standards	Results
☒ 47 CFR FCC Part 15 Subpart C 15.247	PASS

Prepared for:

SKYPINE ELECTRONICS (SHENZHEN) CO., LTD

2/F, A Incubation Building, TaoHuaYuan High-tech Innovation Park,

Baoan District, Shenzhen City

TEL: +86-755-2794 8418

FAX: +86-755-2794 8503

Prepared by:

CENTRE TESTING INTERNATIONAL

Building C, Hongwei Industrial Zone, Baoan 70 District,

Shenzhen, Guangdong, China

TEL: +86-755-3368 3668

FAX: +86-755-3368 3385

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N/A means not applicable.

1. CERTIFICATION INFORMATION

Applicant & Address:	SKYPINE ELECTRONICS (SHENZHEN) CO., LTD. 2/F, A Incubation Building, TaoHuaYuan High-tech Innovation Park, Baoan District, Shenzhen City.
Manufacturer & Address:	SKYPINE ELECTRONICS (SHENZHEN) CO., LTD. A1 Building, No.6 Xinxing Industrial Park, Xinhe Village, Fuyong town, Baoan district, Shenzhen City.
Type of Test:	FCC Part 15 (Certification)
FCC ID:	V8VCES8218CL
Equipment Under Test:	Car Entertainment System
Test Model:	VX400
Trade Name:	Clarion
Serial Number:	Not Applicable
Technical Data:	DC 12V
Date of test:	September 08,2009 to October 14, 2009
Condition of Test Sample:	Normal

The above equipment was tested by Centre Testing International for compliance with the requirements set forth in the FCC Rules and Regulations Part 15, Subpart C and the measurement procedure according to ANSI C63.4.
The test results of this report relate only to the tested sample identified in this report.

Prepared by :   _Louisa Lu_
                             Louisa Lu

Reviewed by :   _Lily Yan_
                             Lily Yan

Approved by :   _Jim Zhang_
                             Jim Zhang
                             Manager

Date   :   October 14, 2009

2. TEST SUMMARY

Clause	Test Item	Rule	Result
1	20dB Bandwidth	15.247(a)(1)	**PASS**
2	Carrier Frequency Separation	15.247(a)(1)	**PASS**
3	Number of Hopping Frequency	15.247(a)(iii)	**PASS**
4	Time of Occupancy (Dwell Time)	15.247(a)(iii)	**PASS**
5	Maximum Peak Conducted Output Power	15.247(b)(1)	**PASS**
6	Bandedge Emission	15.247(d)	**PASS**
7	Spurious RF Conducted Emission	15.247(d)	**PASS**
8	Radiated Emission	15.247(d)	**PASS**
9	Antenna requirements	15.203	**PASS**

Note: "Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"
procedure DA 00-705.

3. MEASUREMENT UNCERTAINTY

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Measurement items	Uncertainty
Maximum Peak Conducted Output Power	0.5 dB
Radiated Emissions / Bandedge Emission	3.4 dB

4. PRODUCT INFORMATION

Items	Description
Rating	DC 12V
Intentional Transceiver	Intentional Transceiver
Modulation	Frequency Hopping Spread Spectrum (FHSS) 1. GFSK 2. π/4-DQPSK 3. 8DPSK
Data Rate (Mbps)	GFSK: 1 ; π/4-DQPSK: 2 ; 8DPSK: 3
Frequency Range	2402 ~ 2480 MHz
Channel Number	79 (at intervals of 1MHz)
	Type: PCB Inverted-F Antenna
	Connector: fixed on board
	Gain: 1.5dBi

5. SYSTEM TEST CONFIGURATION

5.1 Justification

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology.   Care was taken to ensure proper power supply voltages during testing. During testing, all cables were manipulated to produce worst case emissions.   It was powered by 12V DC. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes.   The antenna height and polarization are varied during the search for maximum signal level.   The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance.   If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz.   The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

5.2   EUT Exercising Software

The EUT exercise program CSR, (provided by client) used during testing was designed to exercise the various system components in a manner similar to a typical use.

The parameters of test software setting:
During the test, Channel and power controlling software provided by the applicant was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the application and is going to be fixed on the firmware of the end product.

Power Parameters of EUT

Channel No.	Data rate	Modulation Type
1 to 79	1 Mbps / 2 Mbps / 3 Mbps	GFSK / π/4-DQPSK / 8DPSK

6. TABLE OF TEST MODE

Preliminary tests were performed the entire possible Configuration in different modulation type and different data rate according to the following table to find the worst cases. And only one group of the worst - case data for each test item is shown in the report.

Test Items	Mode	Data Rate	Channel
20dB Bandwidth	GFSK / π/4-DQPSK / 8DPSK	1 Mbps / 2 Mbps / 3 Mbps	1 / 40 / 79
Carrier Frequency Separation	8DPSK	3 Mbps	1 and 2 / 40 and 41 / 78 and 79
Number of Hopping Frequency	8DPSK	3 Mbps	1 to 79
Time of Occupancy (Dwell Time)	GFSK / π/4-DQPSK / 8DPSK	1 Mbps / 2 Mbps / 3 Mbps	1 / 40 / 79
Maximum Peak Conducted Output Power	GFSK / π/4-DQPSK / 8DPSK	1 Mbps / 2 Mbps / 3 Mbps	1 / 40 / 79
Bandedge Emission	GFSK / π/4-DQPSK / 8DPSK	1 Mbps / 2 Mbps / 3 Mbps	1 / 79
Spurious RF Conducted Emission	GFSK	1 Mbps	1 / 40 / 79
Radiated Emission	GFSK	1 Mbps	1 / 40 / 79

This is an application for certification of: DSS- Part 15 Spread Spectrum Transmitter

Remaining portions are subject to the following procedures

Digital function: Verification (report no. SZEE090908119758-1).

7. TEST EQUIPMENT LIST

| Equipment	Manufacturer	Model Number	Serial Number	Due Date
Receiver	R&S	ESCI	100435	08/25/2010
Spectrum Analyzer	Agilent	E4443A	MY45300910	08/25/2010
Biconilog Antenna	A.H.System	SAS-521-2	487	06/05/2010
Horn Antenna	ETS-LINDGREN	3117	00057407	06/27/2010
Loop Antenna	ETS-LINDGREN	6502	00071730	08/25/2010
3M Chamber & Accessories	ETS-LINDGREN	FACT-3	N/A	05/11/2010

8.　SUPPORT EQUIPMENT LIST

Equipment	Manufacturer	Model Number	Serial Number
Ipod	Apple	A1136	JQ732022V9m
Battery	Chongqing Wanli	6-QA-105 12V 105Ah	---
Loads	---	75Ω and 1KΩ	---

9.　20DB BANDWIDTH MEASUREMENT

9.1.　LIMITS

None

9.2.　BLOCK DIAGRAM OF TEST SETUP

Spectrum Analayzer　　　　EUT
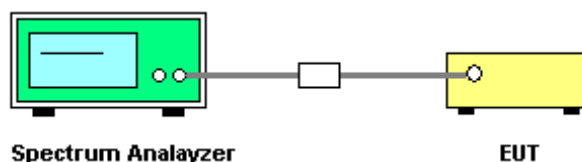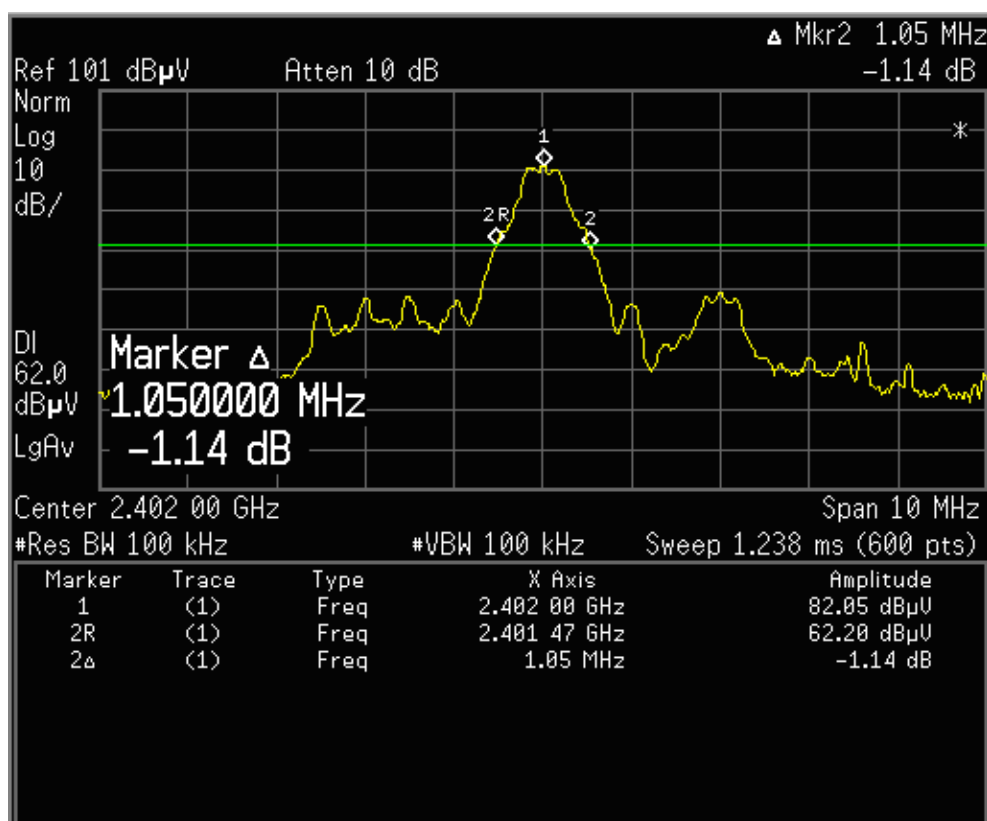
9.3.　TEST PROCEDURE

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set spectrum analyzer's RBW and VBW to applicable value with Peak in Max Hold.
3. A PEAK output reading was taken, a DISPLAY line was drawn 20 dB lower than PEAK level.
4. The 20dB bandwidth was determined from where the channel output spectrum intersected the display line.

9.4.　TEST RESULT

Worst case-- Modulation Type: 8DPSK　　Data Rate: 3Mbps

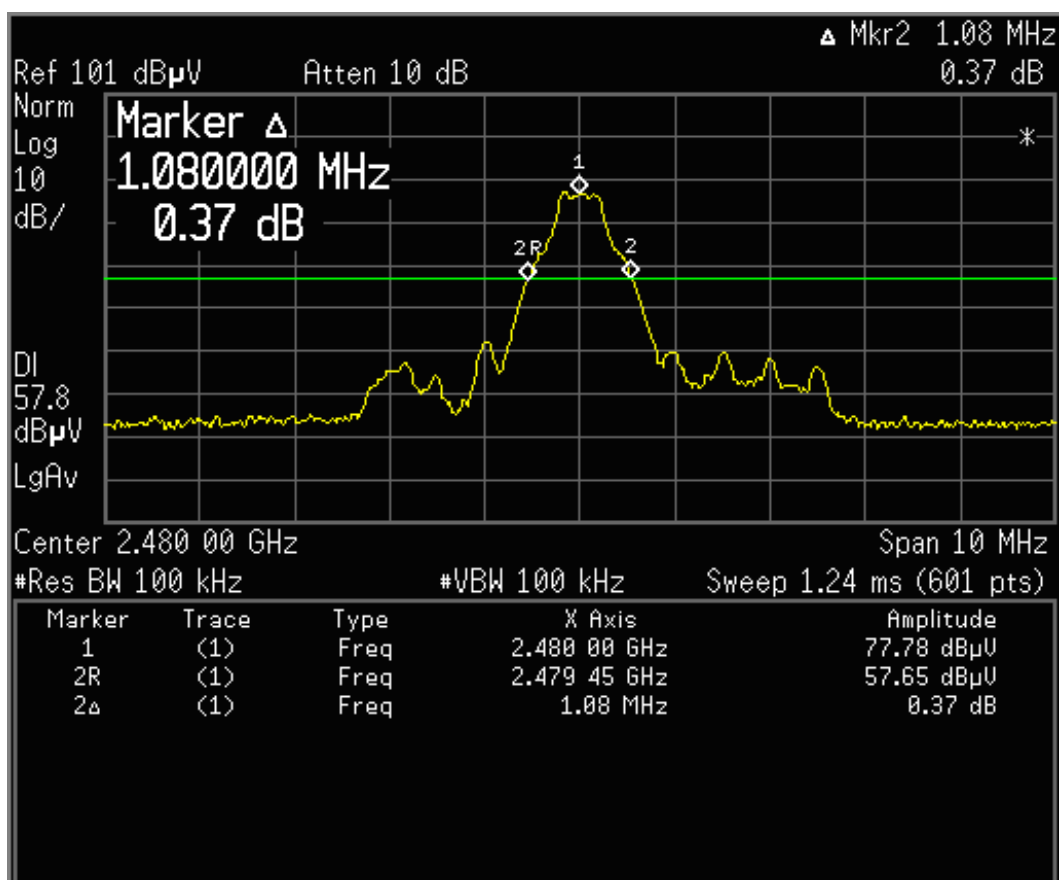| Channel	Frequency (MHz)	20 dB BW (MHz)	Result
CH1	2402	1.0500	
CH40	2441	1.0700	1.0800 MHz
CH79	2480	1.0800	

Channel 1_ 2402 MHz
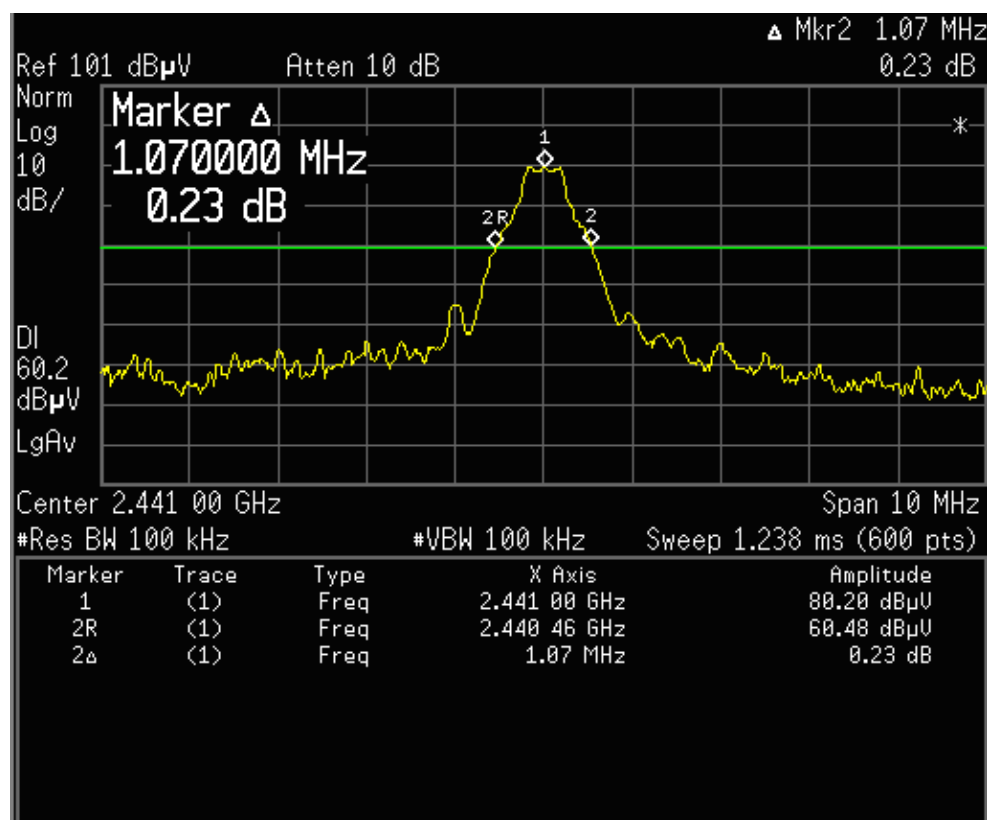
Channel 40_2441 MHz

Channel 79_ 2480 MHz

10. CARRIER FREQUENCY SEPARATION

10.1. LIMITS

Frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

As the system's 20 dB bandwidth is 1.0800 MHz,

thus, Carrier Frequency Separation should be greater than 720kHz.

10.2. BLOCK DIAGRAM OF TEST SETUP
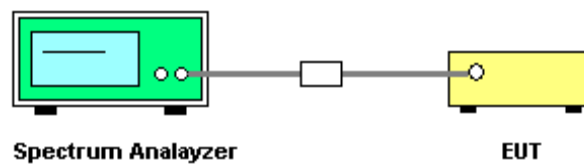
10.3. TEST PROCEDURE

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set spectrum analyzer's RBW and VBW to applicable value with Peak in Max Hold.
   The original channel 's carrier frequency was taken.
3. Make EUT transmit in adjacent channel.
4. Use the delta maker button on spectrum analyzer to read the channel separation from the adjacent channel to original channel.

10.4. TEST RESULT

Worst case-- Modulation Type: 8DPSK   Data Rate: 3Mbps

Carrier Frequency Separation: 1 MHz
Test Result: Pass

Channel 1_ 2402 MHz
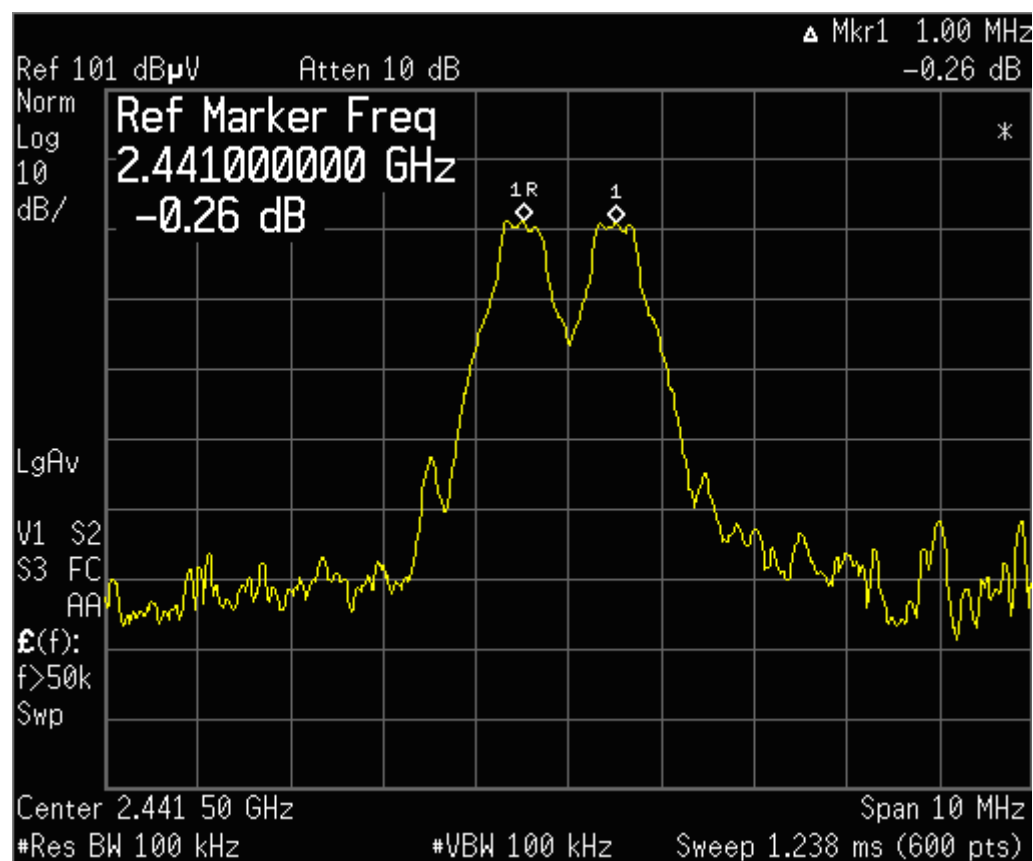
Channel 40_2441 MHz
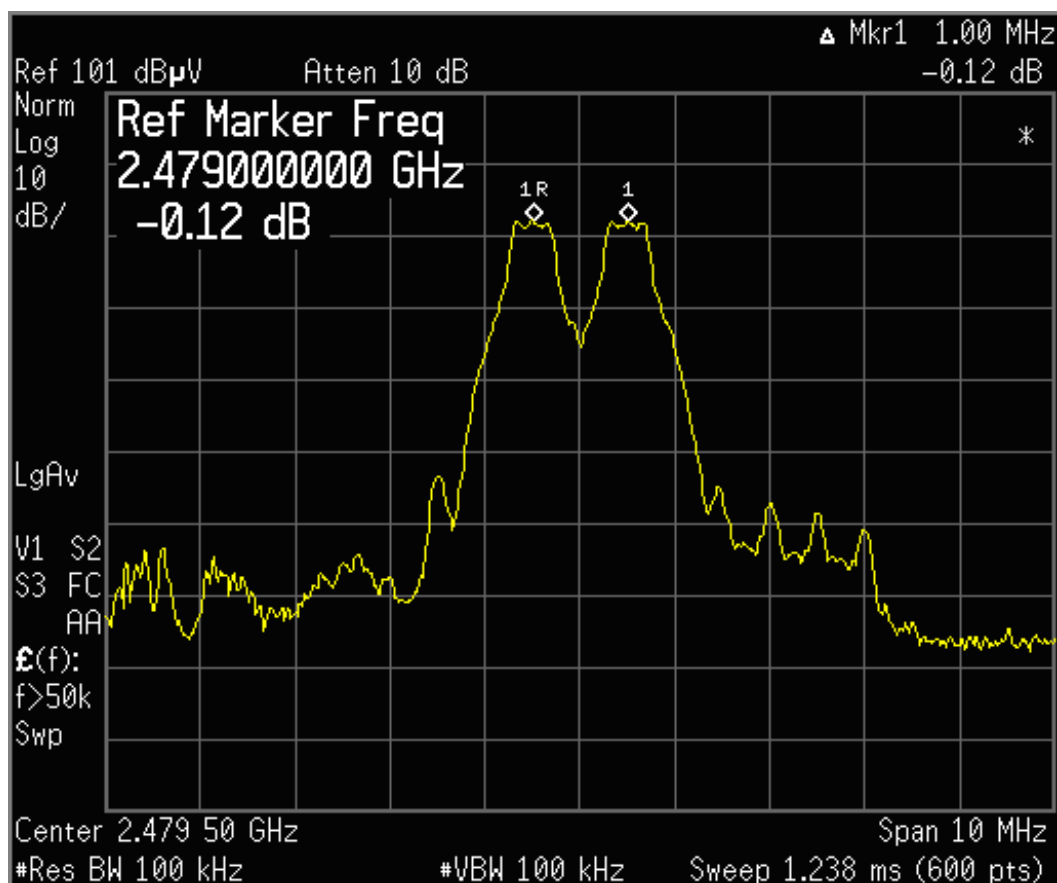
Channel 79_ 2480 MHz

11. NUMBER OF HOPPING FREQUENCY

11.1. LIMITS

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

11.2. BLOCK DIAGRAM OF TEST SETUP
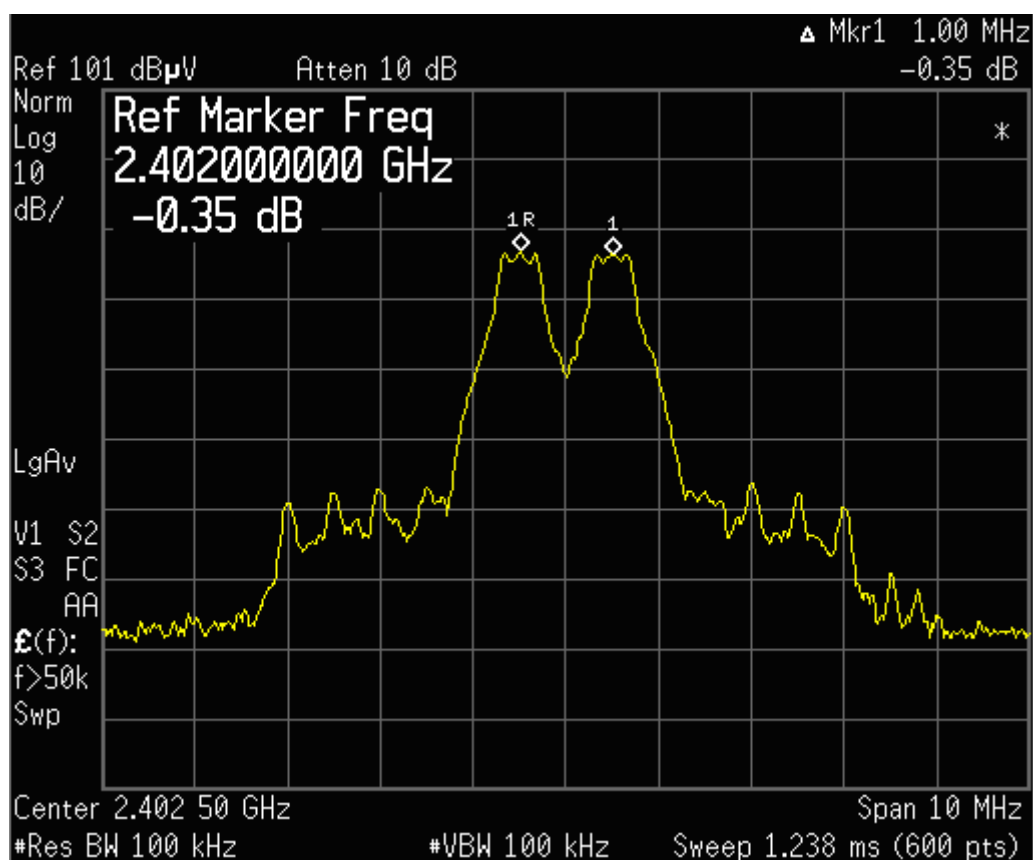

Spectrum Analayzer   EUT
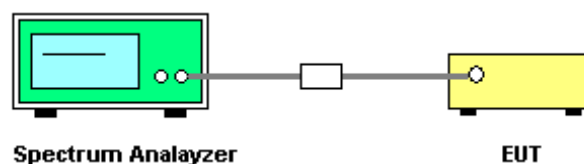
11.3. TEST PROCEDURE

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set spectrum analyzer to Peak in Max Hold.
3. Make EUT work continually, till all operation channels were recorded.

11.4. TEST RESULT

Worst case-- Modulation Type: 8DPSK   Data Rate: 3Mbps

Number of Hopping Frequency is 79, with frequency space = 1MHz.

12. TIME OF OCCUPANCY (DWELL TIME)

12.1. LIMITS

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

12.2. BLOCK DIAGRAM OF TEST SETUP

Spectrum Analyzer   EUT
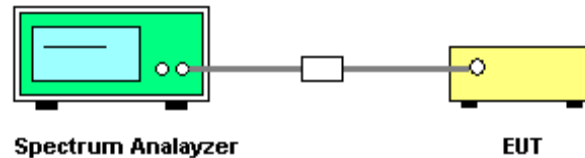
12.3. TEST PROCEDURE

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set spectrum analyzer's RBW and VBW to applicable value with Peak in Max Hold.
3. Measured pulse time and Time separation.

12.4. TEST RESULT

Worst case-- Modulation Type: 8DPSK   Data Rate: 3Mbps

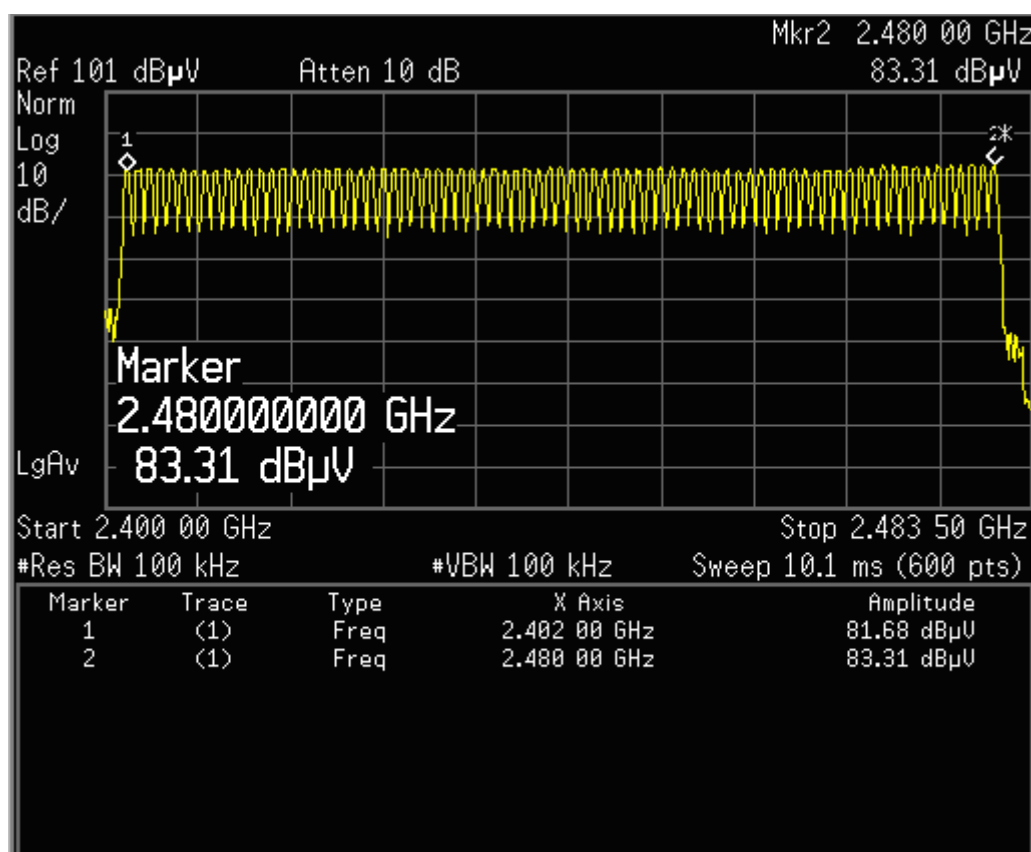| Channel _ Freq. (MHz)	Pulse Wide (ms)	Number of Hopping Pulses in 0.4*channel number	Dwell Time (s)	Limit (s)	Result (Pass / Fail)
CH0 _ 2402	0.421	316	0.133	0.4	Pass
CH39 _ 2441	0.418	316	0.132	0.4	Pass
CH78_ 2480	0.418	316	0.132	0.4	Pass

Channel 1_ 2402 MHz

Ref 107 dBµV   Atten 10 dB
#Peak
Log
10
dB/

LgAv

W1 S2
S3 FS
    AA

£(f):
FTun

Center 2.441 000 GHz   Span 0 Hz
Res BW 1 MHz   #VBW 1 MHz   Sweep 1 s (601 pts)

∆ Mkr1   418.3 µs
                                                           0.08 dB
Ref 107 dBµV   Atten 10 dB
#Peak
Log
10
dB/

Marker ∆
418.3333333 µs
   0.08 dB
LgAv

V1 S2
S3 FC
    AA
£(f):
FTun

Center 2.441 000 GHz   Span 0 Hz
Res BW 1 MHz   #VBW 1 MHz   Sweep 1 ms (601 pts)
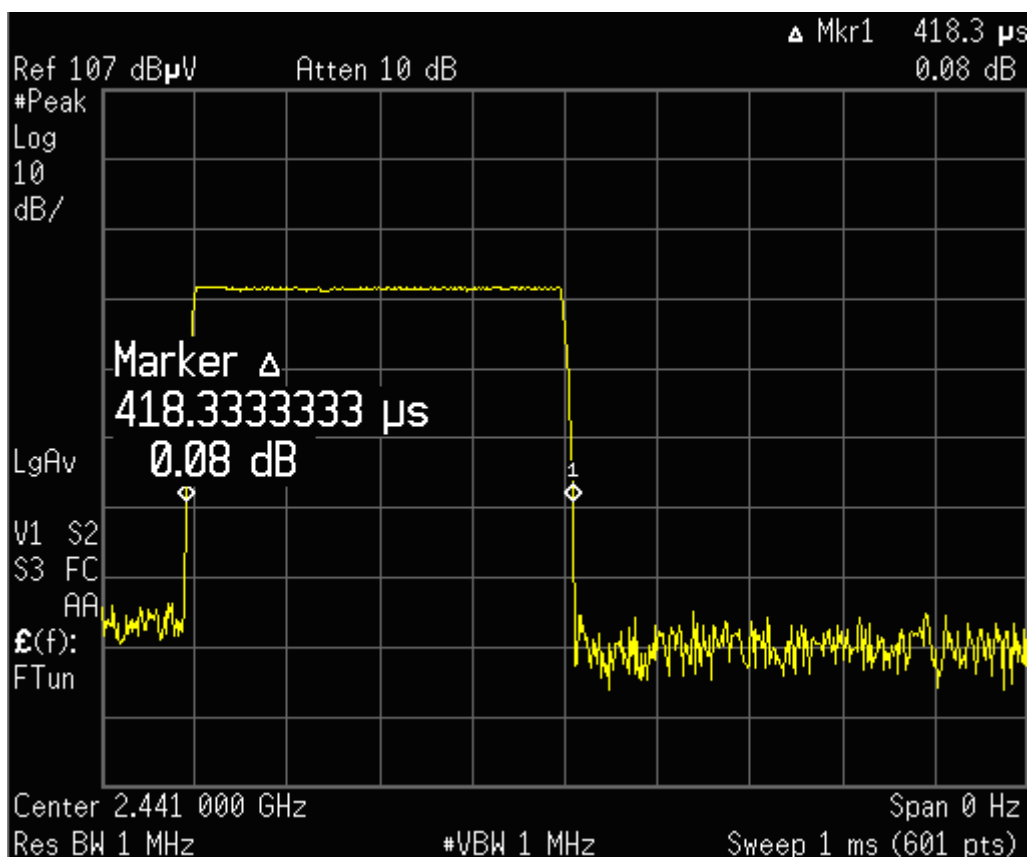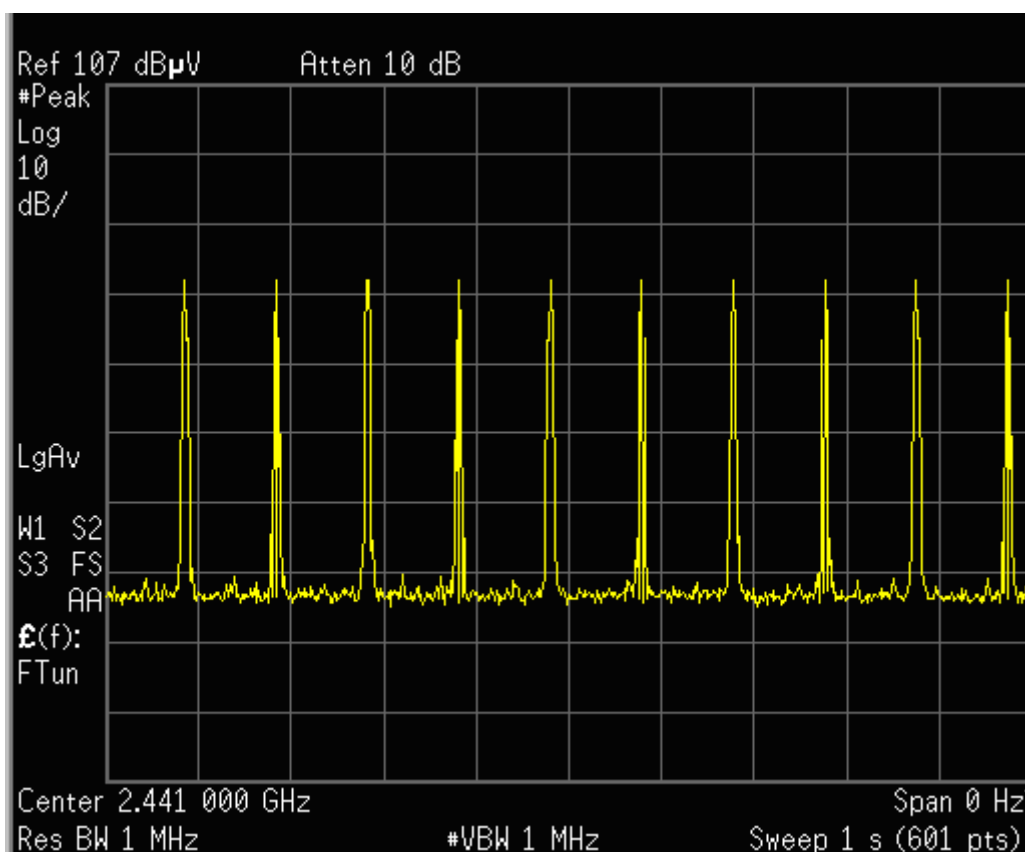
Channel 40_2441 MHz
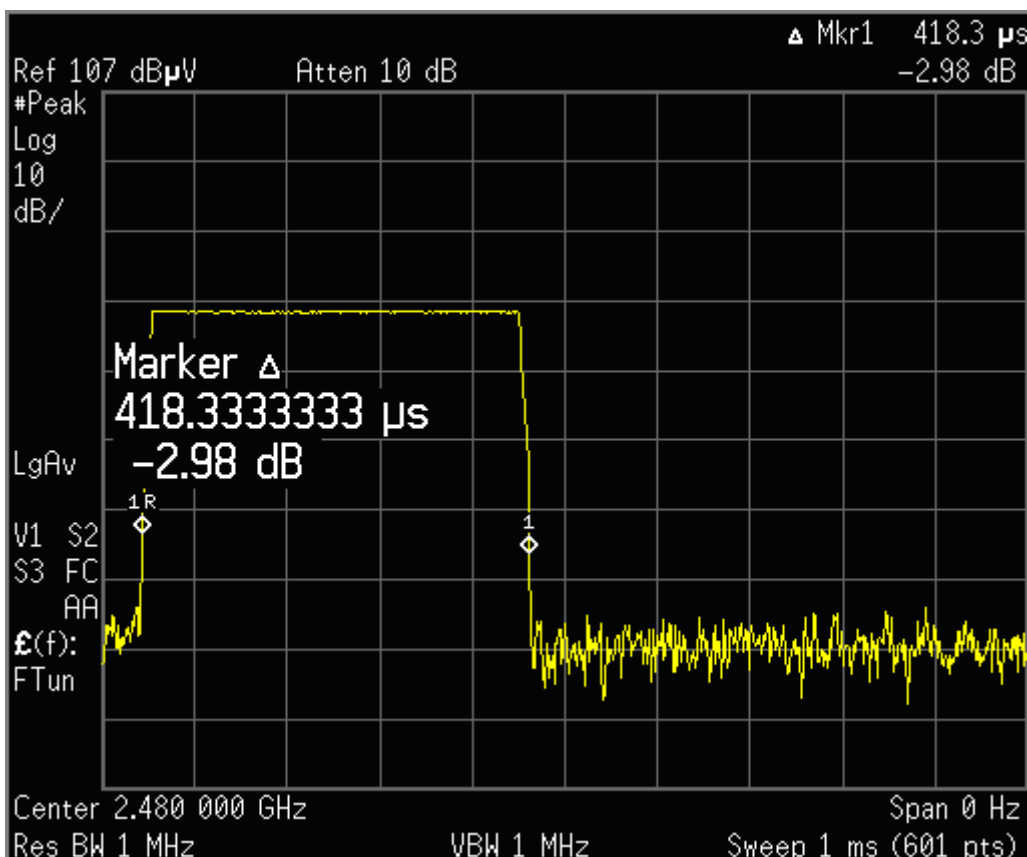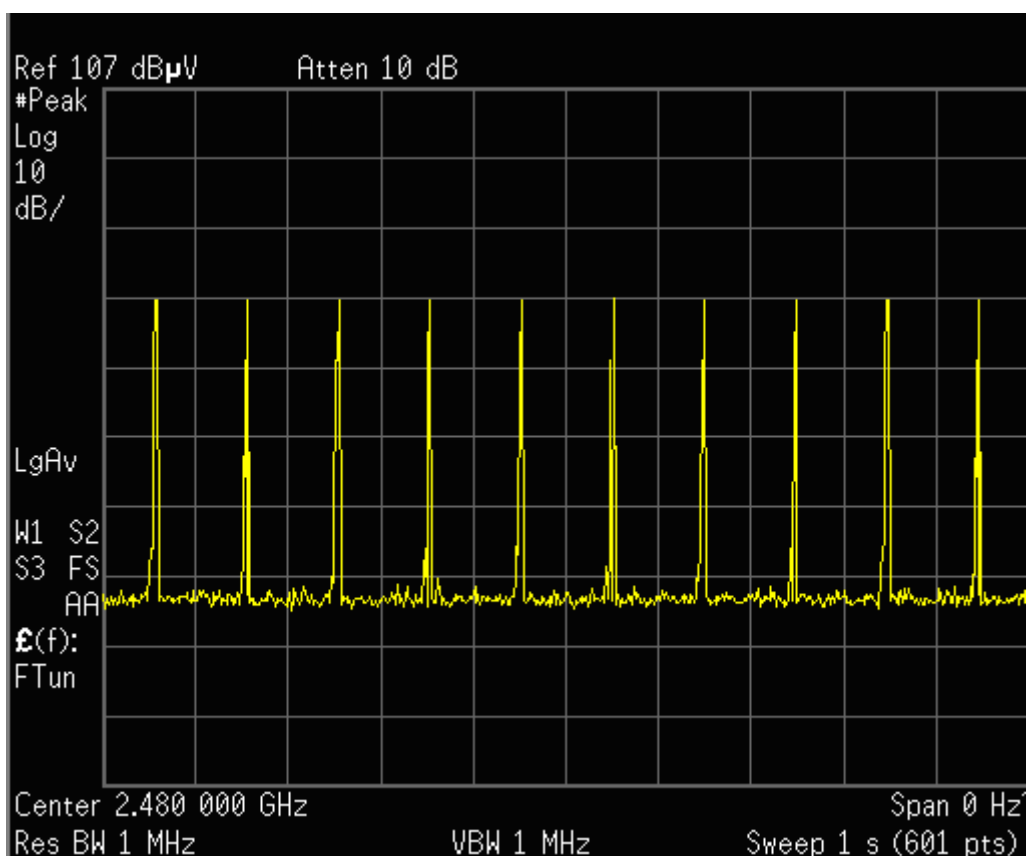
Channel 79_ 2480 MHz

13. MAXIMUM PEAK CONDUCTED OUTPUT POWER MEASUREMENT

13.1. LIMITS
The limit for peak output power is 0.125Watt (21dBm).

13.2. BLOCK DIAGRAM OF TEST SETUP

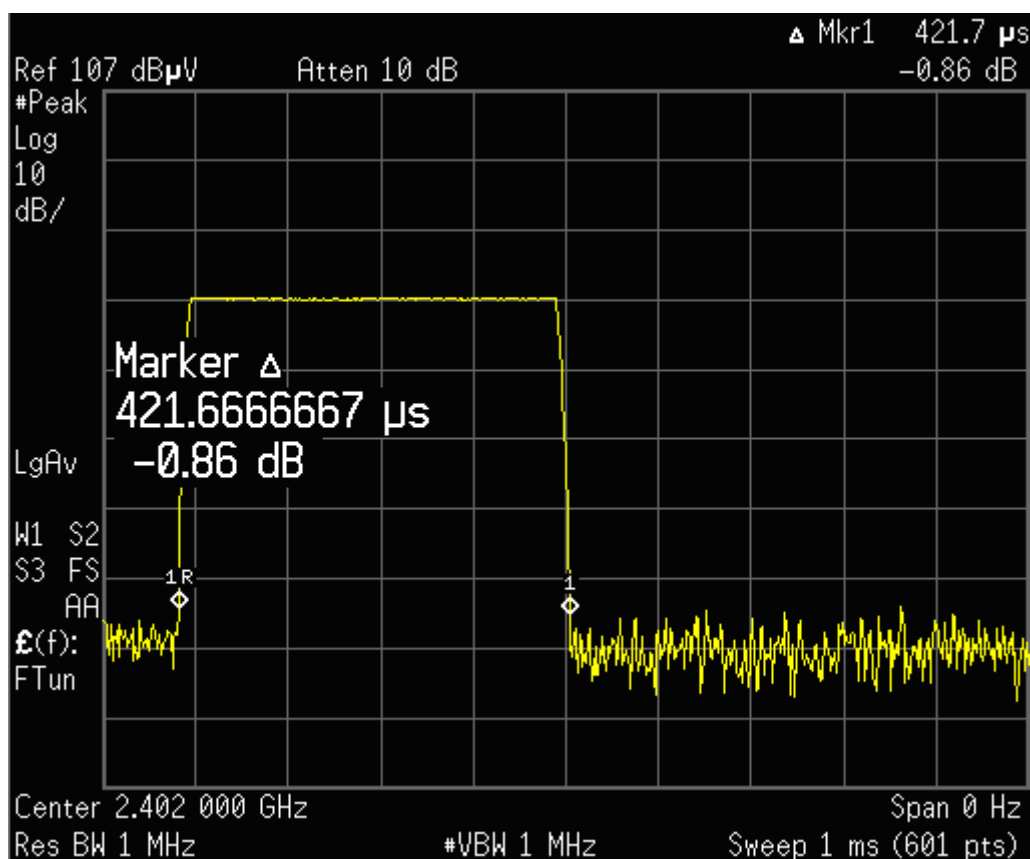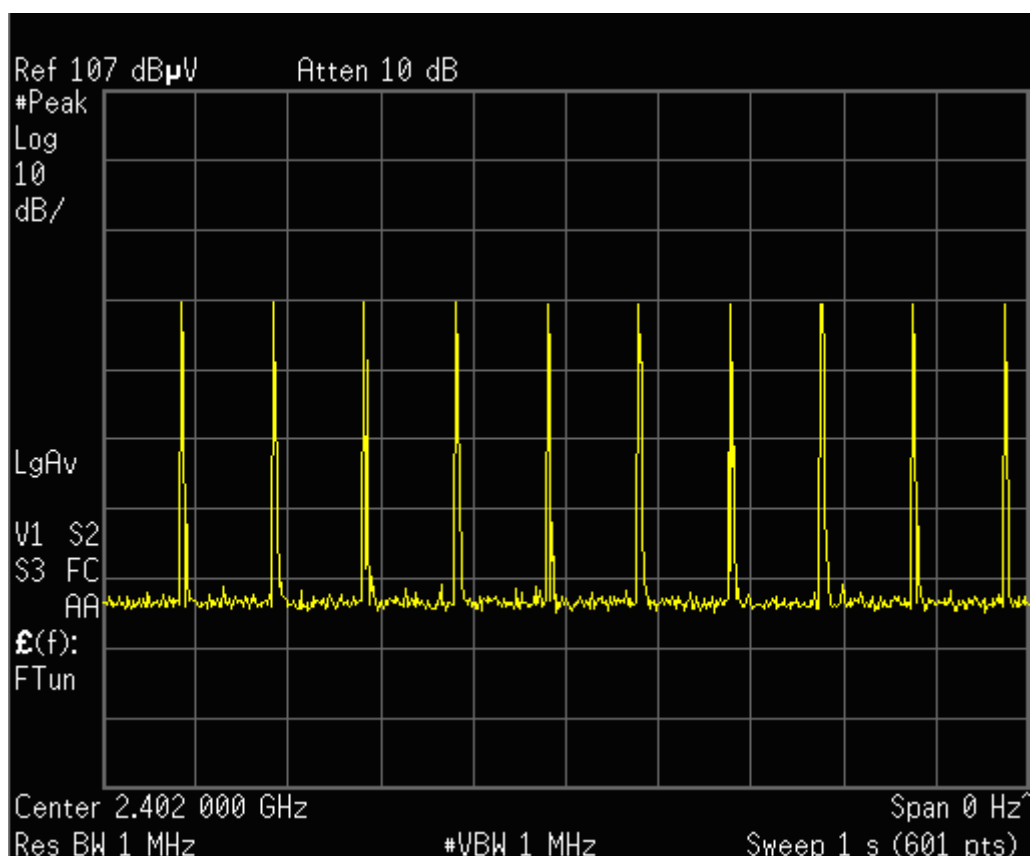Spectrum Analayzer   EUT
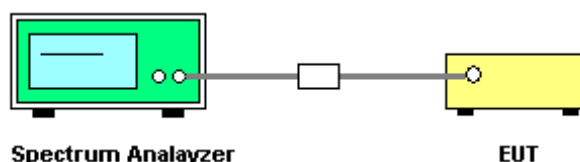
13.3. TEST PROCEDURE
1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set spectrum analyzer's RBW and VBW to applicable value with Peak in Max Hold.
3. Record the channel power directly from the spectrum analyzer.

13.4. TEST RESULT
Worst case-- Modulation Type: GFSK   Data Rate: 1Mbps

Channel _ Freq. (MHz)	Reading Power		Cable Loss (dB)	Measured Power (dBm)	Limit (dBm)	Result (Pass / Fail)
	(dBμV)	(dBm)				
CH1 _ 2402	99.6	-7.4	0.5	-6.9	21	Pass
CH40 _ 2441	99.0	-8.0	0.5	-7.5	21	Pass
CH79_ 2480	99.0	-8.0	0.5	-7.5	21	Pass
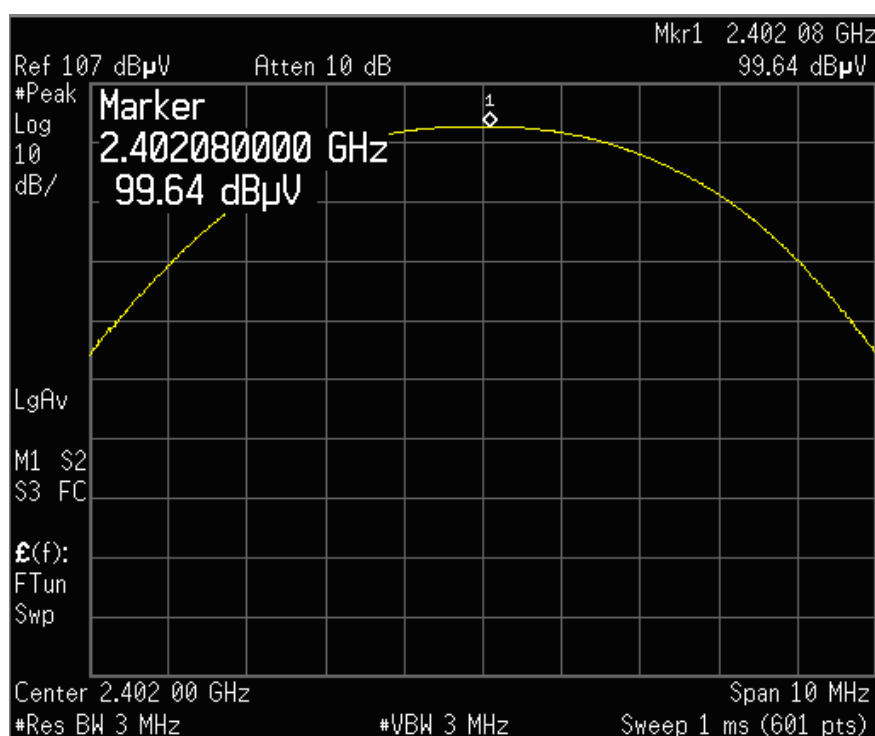
CH1 _ 2402MHz
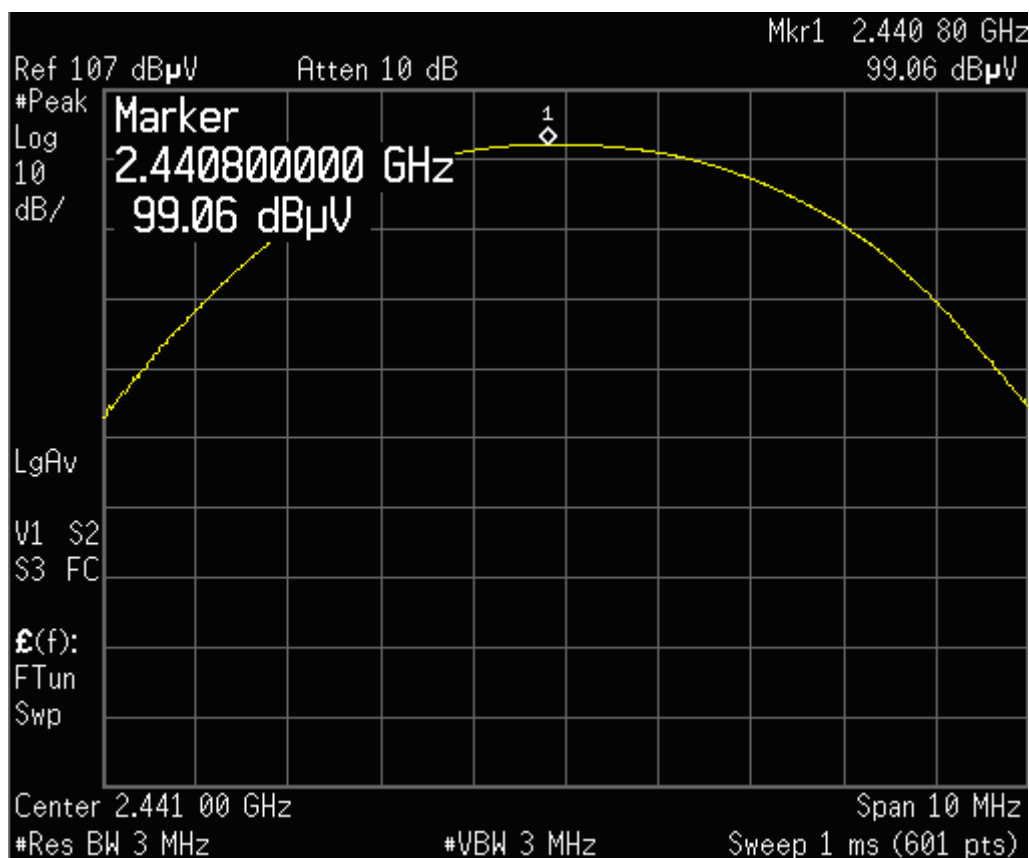
CH40 _ 2441MHz
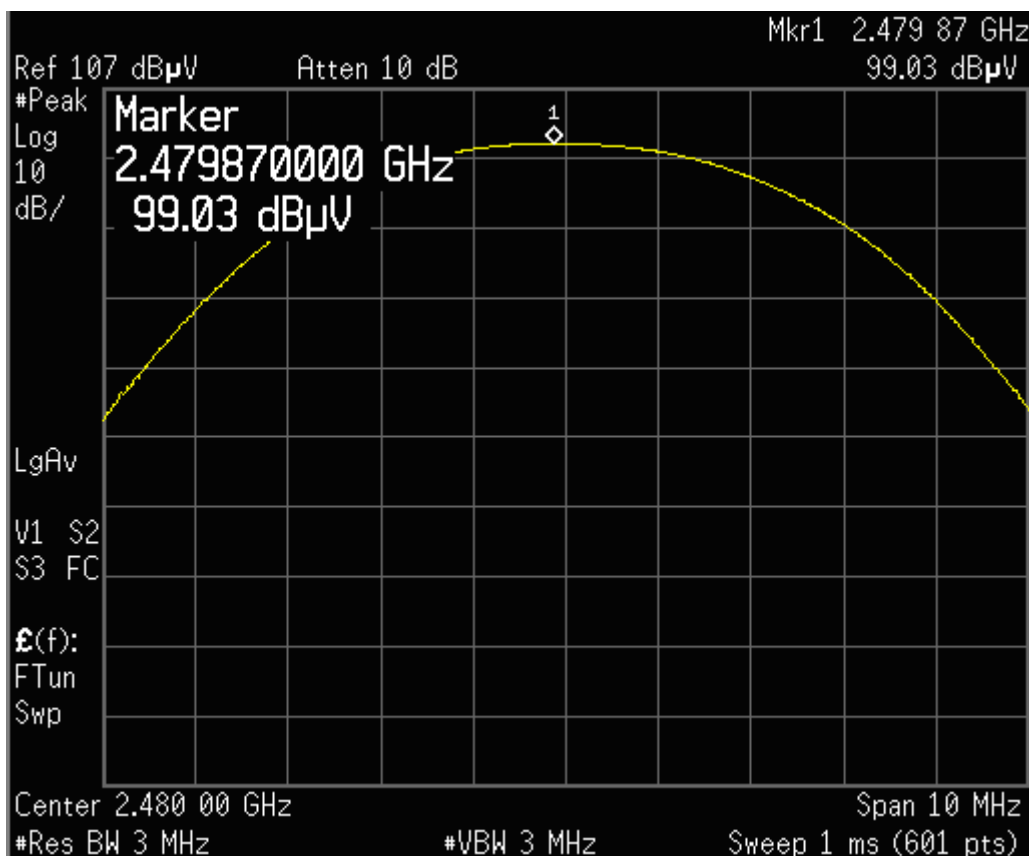
CH79_ 2480MHz

14. BAND EDGE EMISSION MEASUREMENT

14.1. LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

14.2. BLOCK DIAGRAM OF TEST SETUP

Spectrum Analayzer   EUT
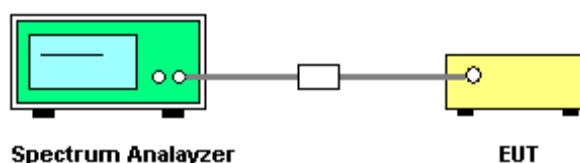
14.3. TEST PROCEDURE

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set spectrum analyzer's RBW and VBW to applicable value with Peak in Max Hold.
3. Record the emission drops at the band-edge relative to the highest fundamental emission level.
4. Use the marker-delta method to determine band-edge compliance as required.

14.4. TEST RESULT

Worst case-- Modulation Type: GFSK   Data Rate: 1Mbps

Channel _ Freq. (MHz)	Fundamental Emission (dBµV/m)	delta	Final Emission (dBµV/m)	Limit (dBµV/m)	Result (Pass / Fail)
CH1 _ 2402	92.7	-34.8	57.9	74 (PK)	Pass
CH1 _ 2402	86.6	-34.8	51.8	54 (AV)	Pass
CH79_ 2480	93.1	-51.4	41.7	74 (PK)	Pass
CH79_ 2480	87.9	-51.4	36.5	54 (AV)	Pass
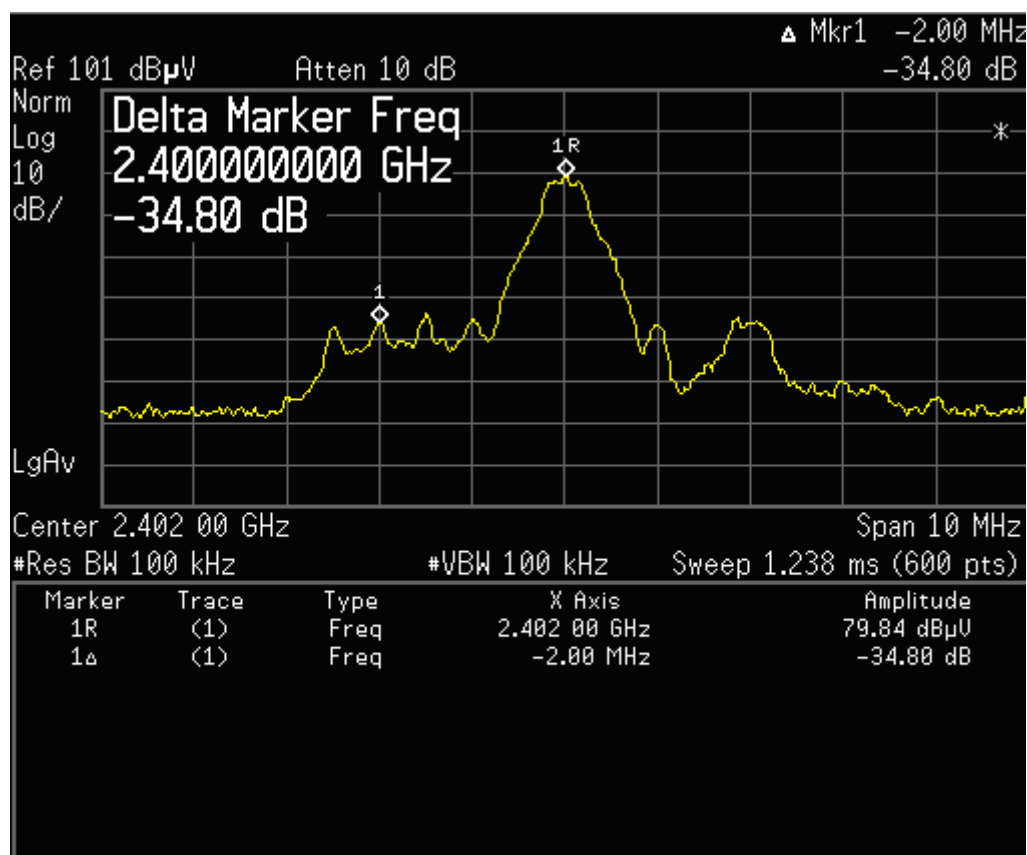
CH1 _ 2402MHz
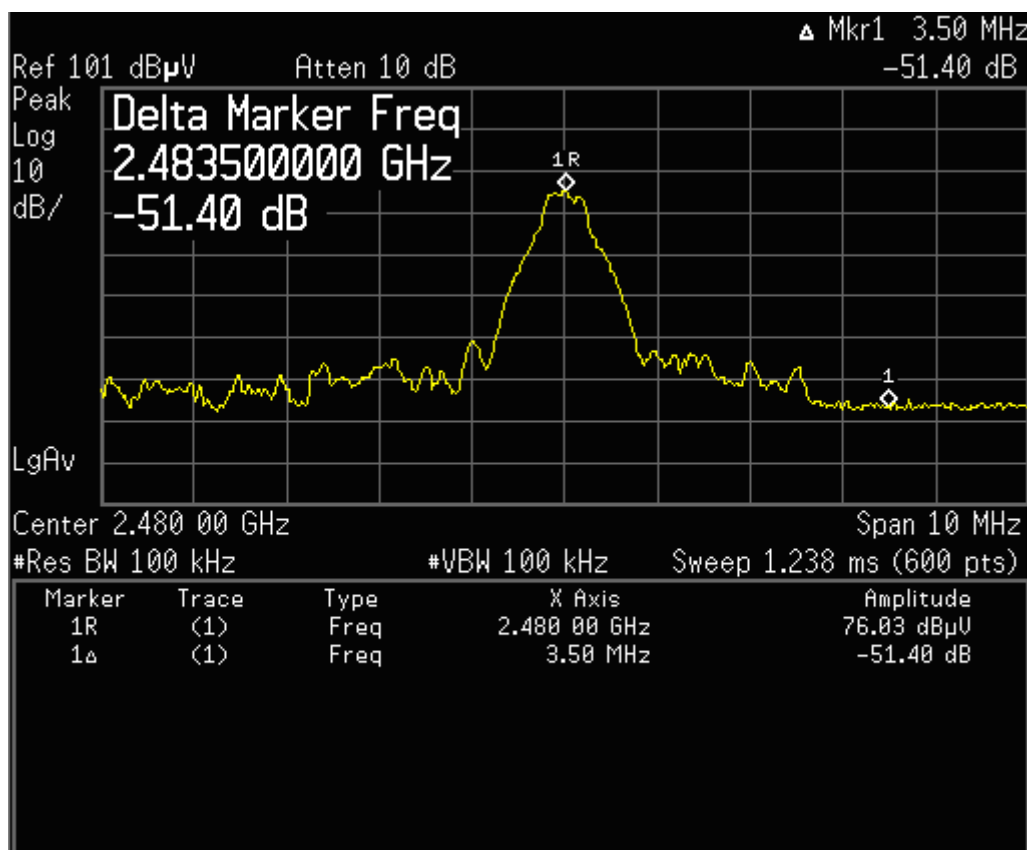
CH79_ 2480MHz

## 15. SPURIOUS RF CONDUCTED EMISSIONS MEASUREMENT

15.1. LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

15.2. BLOCK DIAGRAM OF TEST SETUP

Spectrum Analyzer   EUT
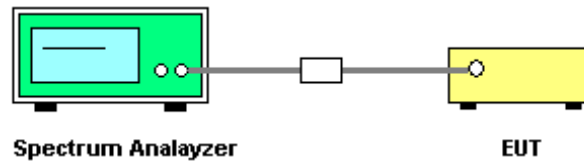
15.3. TEST PROCEDURE

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set spectrum analyzer's RBW and VBW to applicable value with Peak in Max Hold.
3. Record the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic..

15.4. TEST RESULT

Worst case-- Modulation Type: GFSK   Data Rate: 1Mbps

Please see the following plots.

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.40 GHz	99.53 dBµV
2	(1)	Freq	4.80 GHz	51.97 dBµV
3	(1)	Freq	1.60 GHz	42.25 dBµV
4	(1)	Freq	3.20 GHz	40.68 dBµV

CH1 _ 2402MHz

Ref 107 dBµV   Atten 10 dB

#Peak
Log
10
dB/

LgAv

V1 S2
S3 FC
    AA
£(f):
FTun
Swp

Start 30.0 MHz   Stop 1.000 0 GHz
#Res BW 100 kHz   VBW 100 kHz   Sweep 117 ms (601 pts)

Mkr1 2.44 GHz
Ref 107 dBµV   Atten 10 dB   99.66 dBµV

#Peak
Log   Marker
10   2.440000000 GHz
dB/   99.66 dBµV

         3   4   2

LgAv

Start 1.00 GHz   Stop 25.00 GHz
#Res BW 100 kHz   #VBW 100 kHz   Sweep 2.894 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.44 GHz	99.66 dBµV
2	(1)	Freq	4.88 GHz	45.78 dBµV
3	(1)	Freq	1.64 GHz	43.09 dBµV
4	(1)	Freq	3.24 GHz	39.56 dBµV

CH40 _ 2441MHz

Ref 107 dBμV   Atten 10 dB
#Peak
Log
10
dB/

LgAv

V1 S2
S3 FC
    AA
£(f):
FTun
Swp

Start 30.0 MHz   Stop 1.000 0 GHz
#Res BW 100 kHz   #VBW 100 kHz   Sweep 117 ms (601 pts)

                                              Mkr4 4.12 GHz
Ref 107 dBμV   Atten 10 dB   33.14 dBμV
#Peak
Log   Marker
10   4.120000000 GHz
dB/   33.14 dBμV

LgAv

Start 1.00 GHz   Stop 25.00 GHz
#Res BW 100 kHz   #VBW 100 kHz   Sweep 2.894 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.48 GHz	94.60 dBμV
2	(1)	Freq	4.96 GHz	50.14 dBμV
3	(1)	Freq	1.64 GHz	43.74 dBμV
4	(1)	Freq	4.12 GHz	33.14 dBμV

CH79 _ 2480MHz

CENTRE TESTING INTERNATIONAL CORPORATION   www.cti-cert.com   E-mail:info@cti-cert.com   Hotline 400-6788-333

16. RADIATED EMISSIONS MEASUREMENT

16.1. LIMITS

The field strength of any emissions, which appear outside of operating frequency band and restricted band specified on 15.205(a), shall not exceed the general radiated emission limits as below.

Frequency (MHz)	Field strength (μV/m)	Distance (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note: the tighter limit applies at the band edges.

16.2. BLOCK DIAGRAM OF TEST SETUP

For radiated emissions from 9kHz to 30MHz
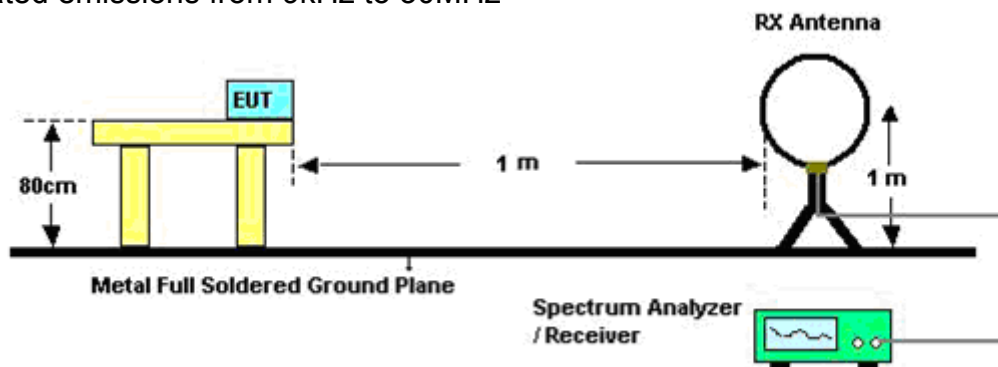
For radiated emissions from 30 - 1000MHz

For radiated emissions from 1GHz to 25GHz

16.3. TEST PROCEDURE

A. Above 30MHz

a. The EUT was placed on the top of a turntable 0.8 meters above the ground in the chamber, 3 meters away from the antenna (wideband antenna), which was mounted on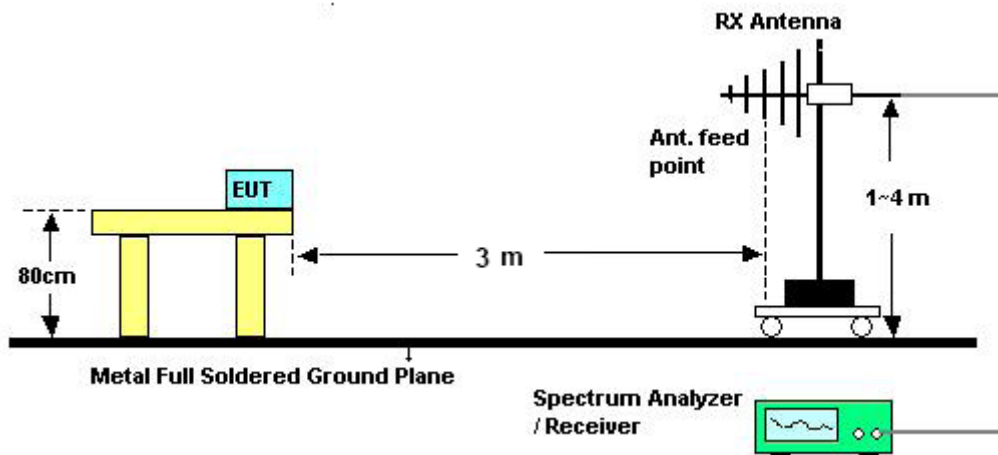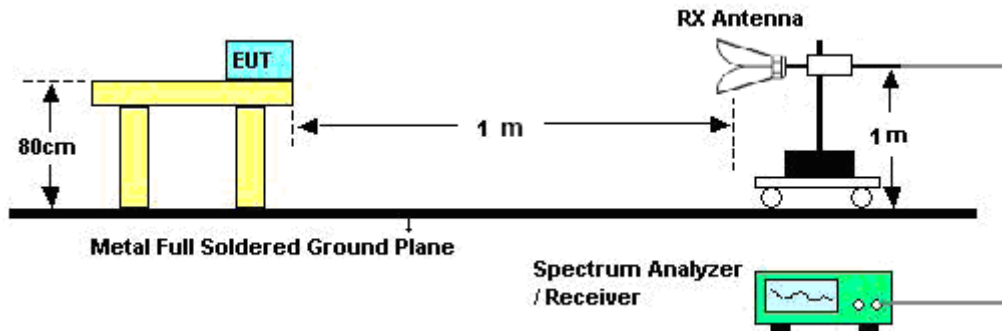 the top of a variable-height antenna tower. The maximum values of the field strength are recorded by adjusting the polarizations of the test antenna and rotating the turntable.

b. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.

c. The test frequency analyzer system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

B. Below 30MHz

a. The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 1 meter away from the antenna (loop antenna). The maximum values of the field strength are recorded by adjusting the polarizations of the test antenna and rotating the turntable.

b. For each suspected emission, the EUT was arranged to its worst case and then turn table was turned from 0 degrees to 360 degrees to find the maximum reading.

c. The test frequency analyzer system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

16.4. TEST RESULT

Worst case-- Modulation Type: GFSK   Data Rate: 1Mbps

Note: Limit dBμV/m @1m = Limit dBμV/m @300m+ 90
          Limit dBμV/m @1m = Limit dBμV/m @30m + 50
          Limit dBμV/m @1m = Limit dBμV/m @3m +10

Frequency (MHZ)	Detector (PK / QP / AV)	Final Emission (dBμV/m)	Limit (dBμV/m)	Result (Pass / Fail)
215.917	QP	38.2	43.5	Pass
539.250	QP	40.9	46.0	Pass
2402.000	PK	92.7	---	Pass
2402.000	AV	86.6	---	Pass
4804.000	PK	56.2	74.0	Pass
4804.000	AV	48.3	54.0	Pass
7206.000	PK	55.3	74.0	Pass
7206.000	AV	47.6	54.0	Pass
9608.000	PK	56.7	74.0	Pass
9608.000	AV	50.1	54.0	Pass

CH1 _ 2402MHz

Frequency (MHZ)	Detector (PK / QP / AV)	Final Emission (dBμV/m)	Limit (dBμV/m)	Result (Pass / Fail)
337.167	QP	41.2	46.0	Pass
540.866	QP	40.7	46.0	Pass
2441.000	PK	93.4	---	Pass
2441.000	AV	87.6	---	Pass
4882.000	PK	54.5	74.0	Pass
4882.000	AV	45.2	54.0	Pass
7323.000	PK	56.8	74.0	Pass
7323.000	AV	49.9	54.0	Pass
9764.000	PK	58.2	74.0	Pass
9764.000	AV	50.6	54.0	Pass

CH40 _ 2441MHz

Frequency (MHZ)	Detector (PK / QP / AV)	Final Emission (dBμV/m)	Limit (dBμV/m)	Result (Pass / Fail)
215.917	QP	38.6	43.5	Pass
396.983	QP	40.3	46.0	Pass
2480.000	PK	93.1	---	Pass
2480.000	AV	87.9	---	Pass
4960.000	PK	55.3	74.0	Pass
4960.000	AV	46.8	54.0	Pass
7440.000	PK	57.6	74.0	Pass
7440.000	AV	49.6	54.0	Pass
9920.000	PK	57.9	74.0	Pass
9920.000	AV	50.1	54.0	Pass

CH79 _ 2480MHz

**Annex
Declaration for Bluetooth
Device acc to Part 15.247**

1 Output power and channel separation of a Bluetooth device in the different operating modes:

The different operating modes (data-mode, acquisition-mode) of a Bluetooth device has no influence on the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters.
Only a different hopping sequence will be used. For this reason the check of these RF parameters in one op-mode is sufficient.

2 Frequency range of a Bluetooth device:

Hereby we declare that the maximum frequency of this device is: 2402 – 2480 MHz. This is according to the Bluetooth Core Specification (+ critical errata) for devices which will be operated in the USA.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04-E). Other frequency ranges (e.g. for Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.

3 Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:

Bluetooth units which want to communicate with other units must be organized in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

4 Example of a hopping sequence in data mode:

Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67,
56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59,
72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75,
09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06,
01, 51, 03, 55, 05, 04

5 Equally average use of frequencies in data mode and behaviour for short transmissions:

The generation of the hopping sequence in connection mode depends essentially
on two input values:
1. LAP/UAP of the master of the connection
2. Internal master clock

The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronisation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behaviour: The first connection between the two devices is established, a hopping sequencewas generated. For transmitting the wanted data the complete hopping sequencewas not used. The connection ended.

The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

6 Receiver input bandwidth and behaviour for repeated single or multiple packets:

The input bandwidth of the receiver is 1 MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master.

Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

7 Dwell time in data mode

The dwell time of 0.3797s within a 30 second period in data mode is independent from the packet type (packet length). The calculation for a 30 second period is a follows:

Dwell time = time slot length * hop rate / number of hopping channels *30s

Example for a DH1 packet (with a maximum length of one time slot) Dwell time =625 µs * 1600 1/s / 79 * 30s = 0.3797s (in a 30s period) For multislot packet the hopping is reduced according to the length of the packet.

Example for a DH5 packet (with a maximum length of five time slots Dwell time = 5 * 625 s * 1600 * 1/5 *1/s / 79 * 30s = 0.3797s (in a 30s period).

This is according the Bluetooth Core Specification V 1.0B (+ critical errata) for all Bluetooth devices. Therefor all Bluetooth devices **comply** with the FCC dwell time requirement in data mode. This was checked during the Bluetooth Qualification tests. The Dwell time in hybrid mode is measured and stated in the test report.

8 Channel Separation in hybrid mode

The nominal channel spacing of the Bluetooth system is 1Mhz independent of the operating mode.

The maximum "initial carrier frequency tolerance" which is allowed for Bluetooth is fcenter = 75 kHz.

This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/07-E) for three frequencies (2402, 2441, 2480 MHz). Additionally an example for the channel separation is given in the test report

9 Derivation and examples for a hopping sequence in hybrid mode

For the generation of the inquiry and page hop sequences the same procedures as described for the data mode are used (see chapter 5), but this time with different input vectors:
● For the inquiry hop sequence, a predefined fixed address is always used. This results in the same 32 frequencies used by all devices doing an inquiry but every time with a different start frequency and phase in this sequence.
● For the page hop sequence, the device address of the paged unit is used as input vector. This results in the use of a subset of 32 frequencies which is specific for that initial state of the connection establishment between the two units. A page to different devices would result in a different subset of 32 frequencies.

So it is ensured that also in hybrid mode the frequency use equally averaged.

Example of a hopping sequence in inquiry mode:
48, 50, 09, 13, 52, 54,41, 45, 56, 58, 11, 15, 60, 62, 43, 47, 00, 02, 64, 68, 04, 06, 17, 21, 08, 10, 66, 70, 12, 14, 19, 23

Example of a hopping sequence in paging mode:
08, 57, 68, 70, 51, 02, 42, 40, 04, 61, 44, 46, 63, 14, 50, 48, 16, 65, 52, 54, 67, 18, 58, 56, 20, 53, 60, 62, 55, 06, 66, 64

10 Receiver input bandwidth and synchronisation in hybrid mode:

The receiver input bandwidth is the same as in the data mode (1 MHz). When two Bluetooth devices establish contact for the first time, one device sends an inquiry access code, the other device is scanning for this inquiry access code. If two devices have been connected previously and want to start a new transmission, asimilar procedure takes place. The only difference is, instead of the inquiry access code, an special access code, derived from the BD_ADDRESS of the paged device will be, will be sent by the master of this connection.

Due to the fact that both units have been connected before (in the inquiry procedure) the paging unit has timing and frequency information about the page scan of the paged unit. For this reason the time to establish the connection is reduced considerable.

11 Spread rate / data rate of the direct sequence signal

The Spread rate / Data rate in inquiry and paging mode can be defined via the access code. The access code is the only criterion for the system to check if there is a valid transmission or not. If you regard the presence of a valid access code as one bit of information, and compare it with the length of the access code of 68 bits, the Spread rate / Data rate will be 68/1.

12 Spurious emission in hybrid mode

The dwell time in hybrid mode is shorter than in data mode. For this reason the spurious emissions average level in data mode is worst case. The spurious emissions peak level is the same for both modes.

13 Peak power spectral density measurement

Since the transmitter is only active for some milliseconds on one channel you would get a result with many interruptions if using a sweep time of e.g. 1s as stated in the FCC rules. Therefore a fast sweep in maxhold function is used instead and the EUT is activated several times until the measurement curve has stabilized.

APPENDIX 1 PHOTOGRAPHS OF TEST SETUP

TEST SETUP OF RADIATED EMISSION (30MHz-1GHz)

TEST SETUP OF RADIATED EMISSION (above 1GHz)

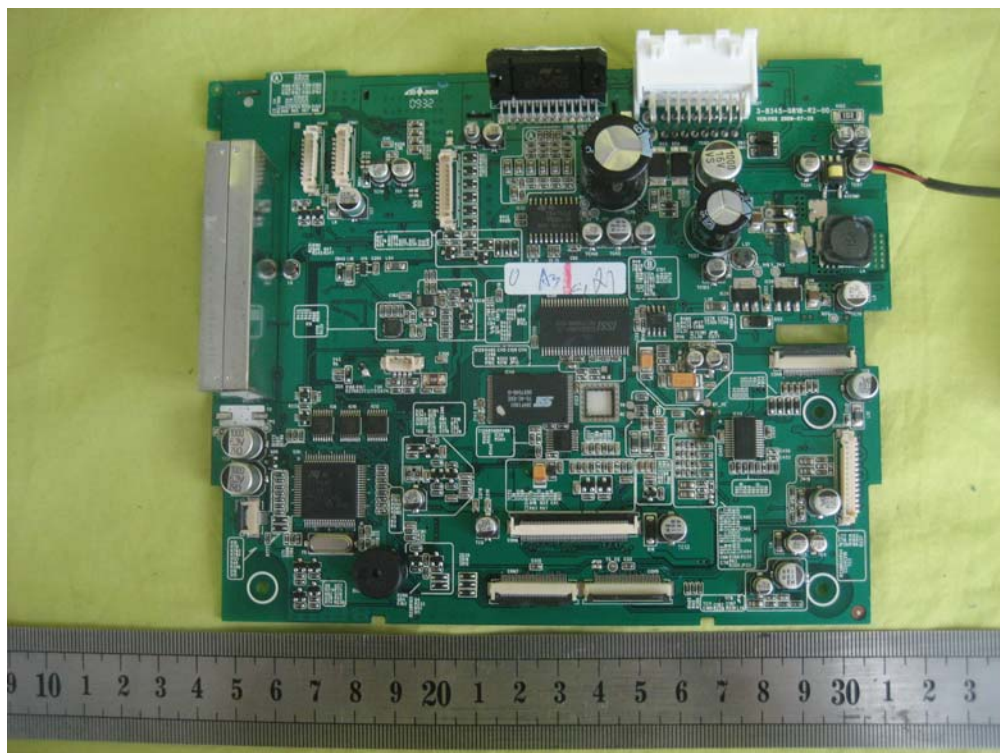# APPENDIX 2 EXTERNAL PHOTOGRAPHS OF EUT

Front View of EUT

Rear View of EUT

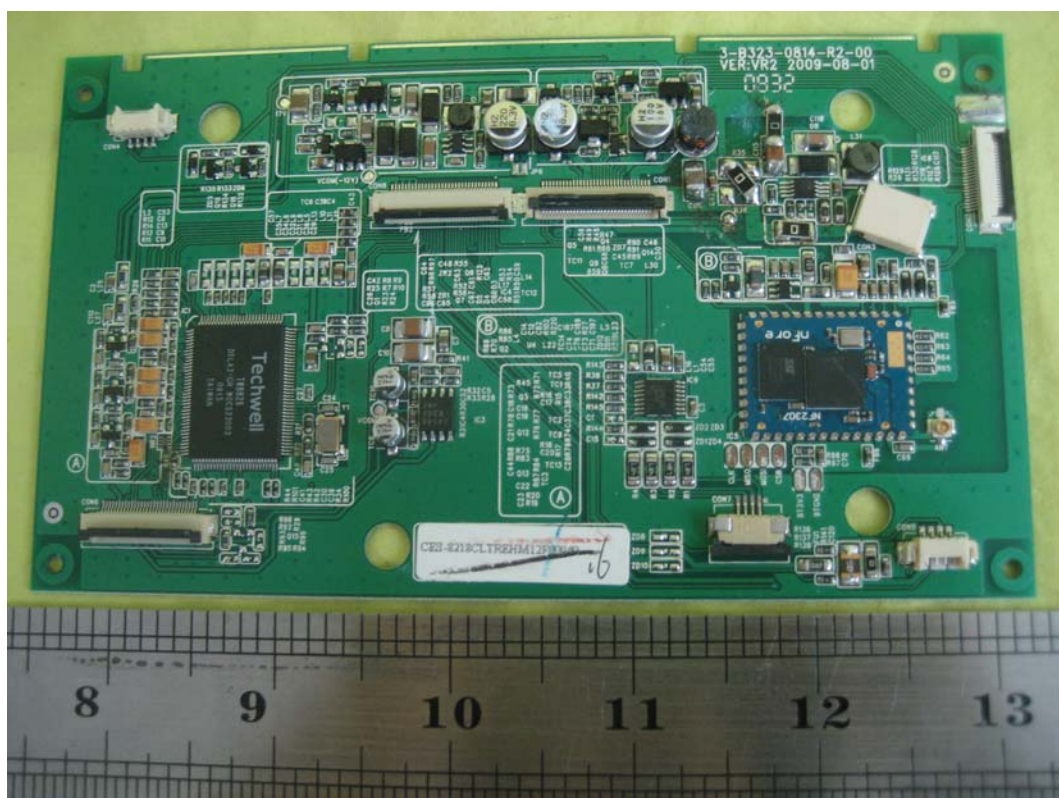# APPENDIX 3 INTERNAL PHOTOGRAPHS OF EUT
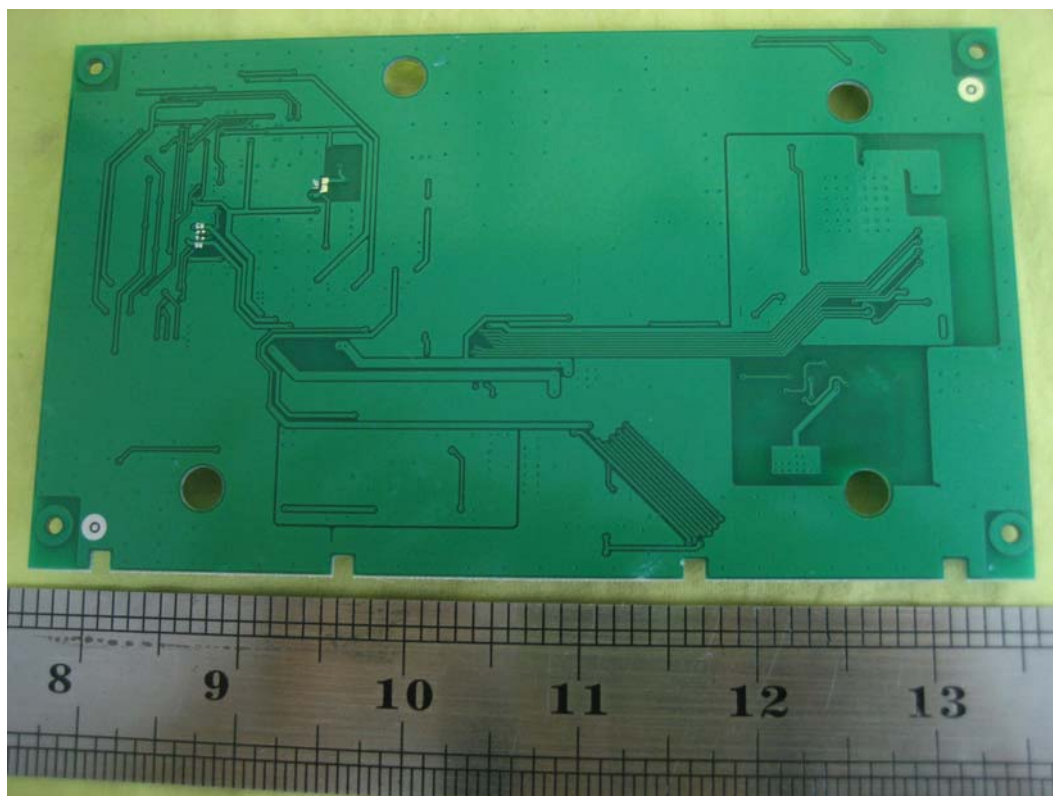

Uncovered View of EUT-1
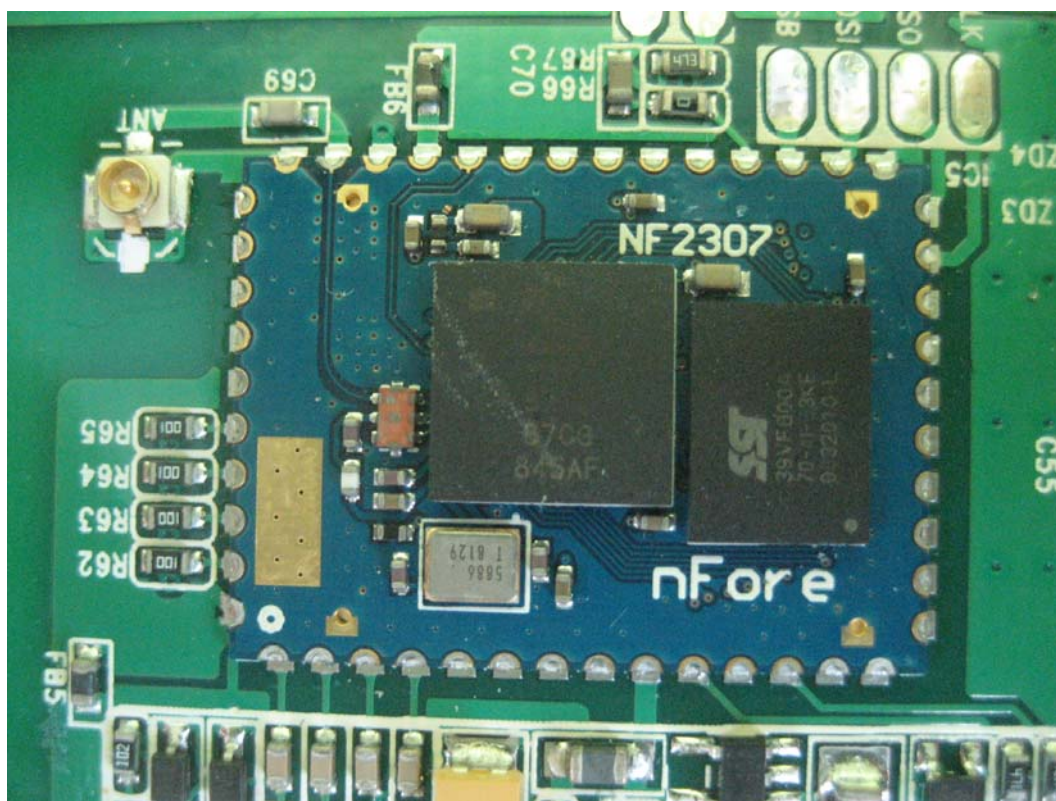

Front view of PCB1

Back view of PCB1

Front view of PCB2

Back view of PCB2

Bluetooth PCB

------- End of report -------