

EMC TEST REPORT for Intentional Radiator No. SH12111056-001

Applicant : TELE RADIO AB
Datavägen 21, SE-436 32 Askim, Sweden

Manufacturer : TELE RADIO AB
Datavägen 21, SE-436 32 Askim, Sweden

Equipment : Wireless Transceiver Radio Modular

Type/Model : D00005-09

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2010): Radio Frequency Devices

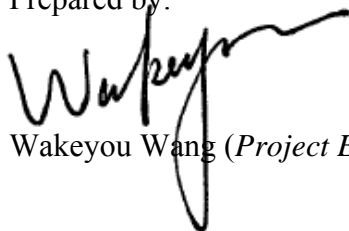
ANSI C63.4 (2003): American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

RSS-210 Issue 8 (December 2010): Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment

RSS-Gen Issue 3 (December 2010): General Requirements and Information for the Certification of Radiocommunication Equipment

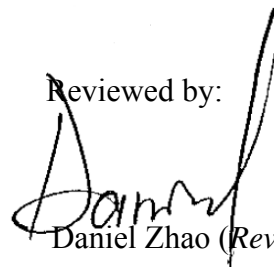
Date of issue: Feb 4, 2013

Prepared by:



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Reviewed by:



Daniel Zhao (*Reviewer*)



FCC ID: ONFC1203B
IC: 4807A-C1203B

Description of Test Facility

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1. General Information

1.1 Applicant Information

Applicant: TELE RADIO AB
Datavägen 21, SE-436 32 Askim, Sweden

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Manufacturer: TELE RADIO AB
Datavägen 21, SE-436 32 Askim, Sweden

Sample received date : Dec 17, 2012

Sample Identification No : *0121217-22-001*

Date of test : Dec 17, 2012 ~ Feb 4, 2013

1.2 Identification of the EUT

Equipment: Wireless Transceiver Radio Modular

Type/model: D00005-09

FCC ID: ONFC1203B

IC: 4807A-C1203B



1.3 Technical specification

Frequency Range: 2405 - 2480 MHz
Modulation: O-QPSK
Gain of Antenna: Chip antenna, un-detachable, 3.0dBi max
Rating: DC 3.3V powered by the host device indirectly
Rating of host device:
Li-ion Battery DC 3.7V 1600mAh;
AC/DC adapter input AC 100-240V, 50/60Hz,
250mA; Output DC 5V, 1200mA)

Description of EUT: The EUT is a wireless module working in the 2.4GHz ISM band.

Channel Description:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	2475
18	2440	26	2480

1.4 Mode of operation during the test / Test peripherals used

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

The lowest, middle and highest channel were tested as representatives (2405MHz, 2440MHz and 2480MHz).

Except powered line conducted emission, all tests were performed with radiated method.

2. Test Specification

2.1 Instrument list

Test Receiver	ESIB 26	R&S	EC 3045	2012-10-21	2013-10-20
Semi-anechoic chamber	-	Albatross project	EC 3048	2012-10-21	2013-10-20
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2011-5-16	2013-5-15
Horn antenna	HF 906	R&S	EC 3049	2011-5-13	2013-5-12
Horn antenna	3117	ETS	EC 4792-1	2012-4-17	2014-4-16
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2012-4-12	2013-4-11
Pre-amplifier	Tpa0118-40	R&S	EC 4792-2	2012-4-12	2013-4-11
Test Receiver	ESCS 30	R&S	EC 2107	2012-10-21	2013-10-20
A.M.N.	ESH2-Z5	R&S	EC 3119	2013-1-9	2014-1-8
A.M.N.	ESH3-Z5	R&S	EC 2109	2013-1-10	2014-1-9
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2012-2-8	2013-2-7
High Pass Filter	WHKX 2.8/18G-12SS	Wainwright	EC4297-2	2012-2-8	2013-2-7
High Pass Filter	WHKX 7.0/1.8G-8SS	Wainwright	EC4297-3	2012-2-8	2013-2-7
Band Reject Filter	WRCGV 2400/2483- 2390/2493- 35/10SS	Wainwright	EC4297-4	2012-2-8	2013-2-7
Test Receiver	FSV40	R&S	/	2012-10-21	2013-10-20

2.2 Test Standard

47CFR Part 15 (2010)
ANSI C63.4 (2003)
RSS-210 Issue 8 (December 2010)
RSS-Gen Issue 3 (December 2010)

2.3 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Minimum 6dB Bandwidth	15.247(a)(2)	RSS-210 Issue 8 Annex 8	Pass
Maximum peak output power	15.247(b)	RSS-210 Issue 8 Annex 8	Pass
Power spectrum density	15.247(e)	RSS-210 Issue 8 Annex 8	Pass
Radiated emission	15.205 & 15.209	RSS-210 Issue 8 Clause 2	Pass
Emission outside the frequency band	15.247(d)	RSS-210 Issue 8 Annex 8	Pass
Power line conducted emission	15.207	RSS-Gen Issue 3 Clause 7.2.4	Pass
Occupied bandwidth	-	RSS-Gen Issue 3 Clause 4.6.1	Tested

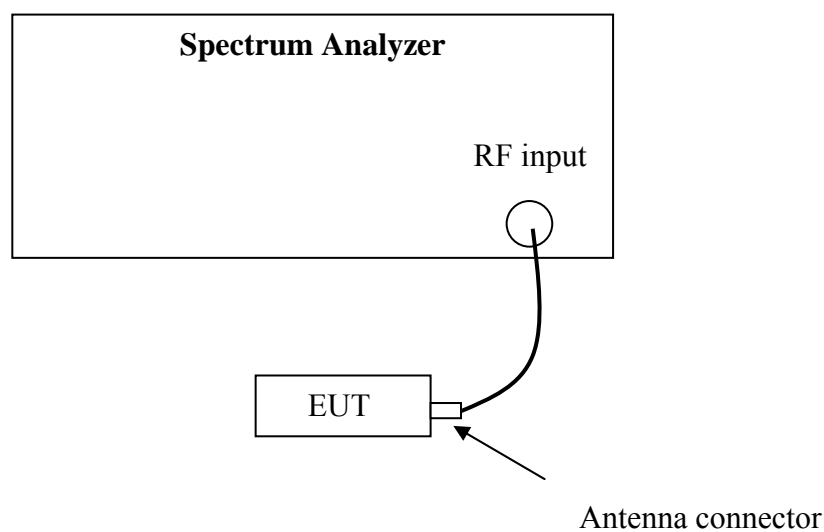
3. Minimum 6dB Bandwidth

Test result: PASS

3.1 Limit

For systems using digital modulation techniques that may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz bands, the minimum 6 dB bandwidth shall be at least 500 kHz.

3.2 Test Configuration



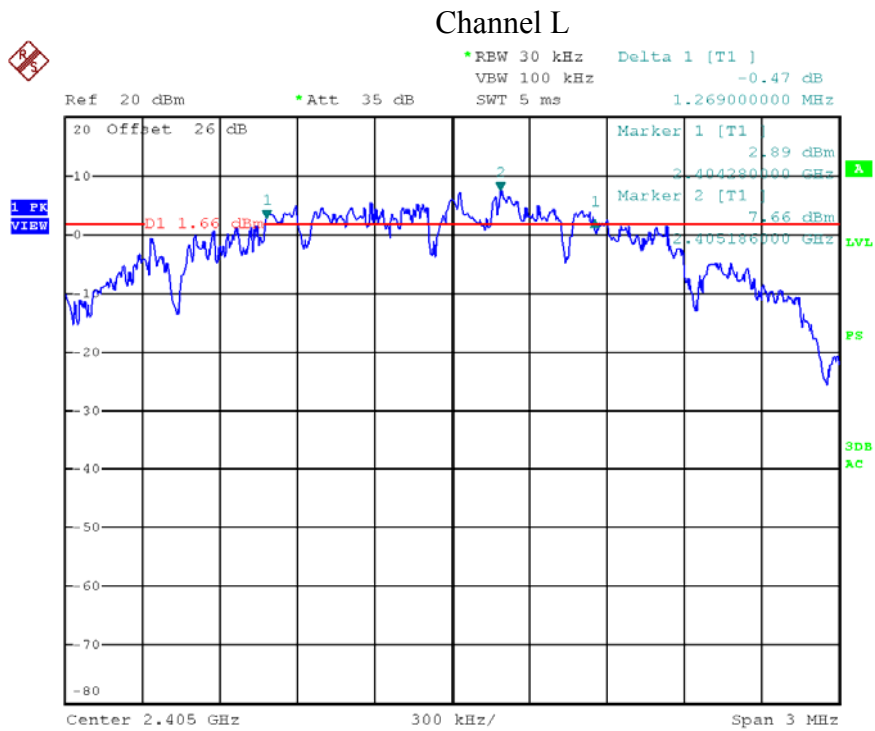
3.3 Test Procedure and test setup

The minimum 6dB bandwidth per FCC §15.247(a)(2) is measured using the Spectrum Analyzer according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v02" for compliance to FCC 47CFR 15.247 requirements.

3.4 Test Protocol

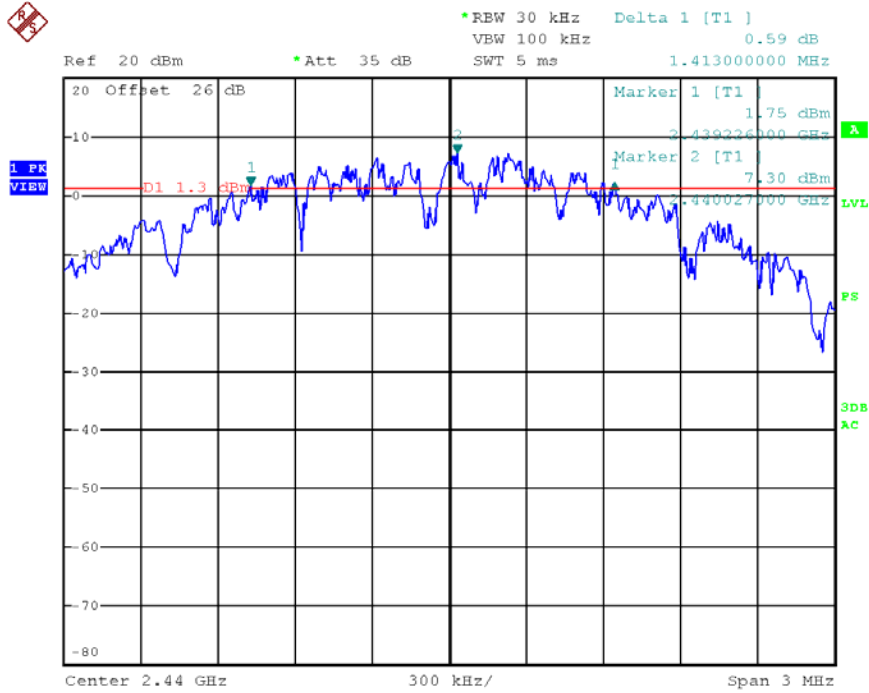
Temperature : 25°C
Relative Humidity : 55%

Mode	CH	Bandwidth (MHz)	Limit (MHz)
Operating	L	1.27	≥0.5
	M	1.41	
	H	1.55	



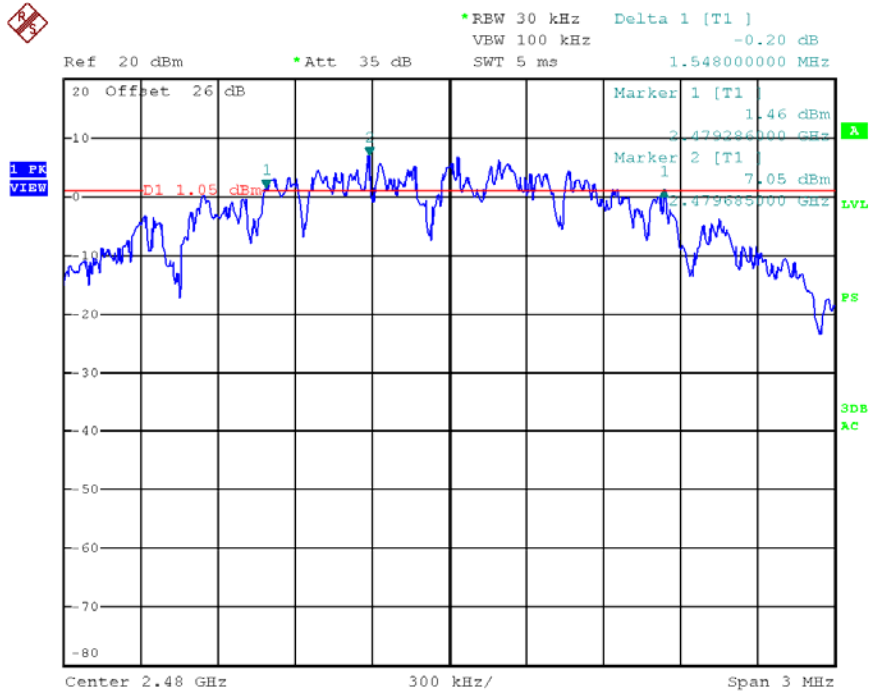
Date: 31.JAN.2013 14:51:51

Channel M



Date: 31.JAN.2013 14:56:34

Channel H



Date: 31.JAN.2013 15:05:00

4. Maximum peak output power

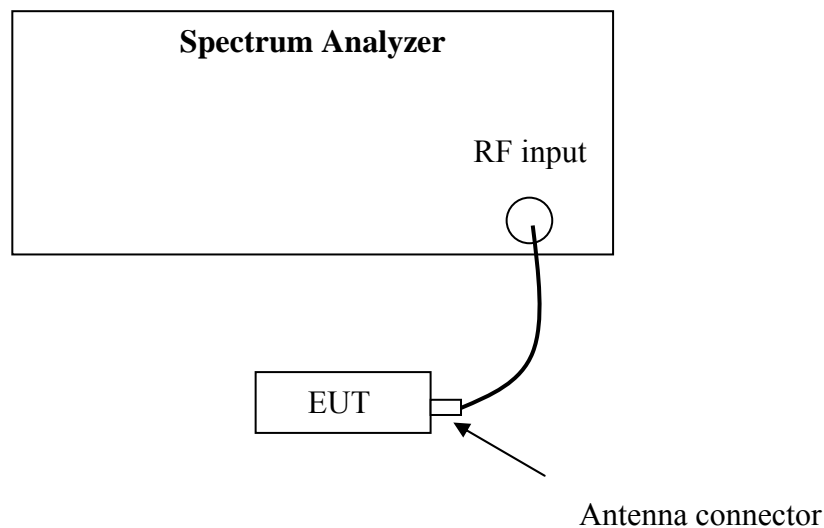
Test result: Pass

4.1 Test limit

- For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt
- For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts
- For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

4.2 Test Configuration



4.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v02" for compliance to FCC 47CFR 15.247 requirements (clause 8.1.1).

4.4 Test protocol

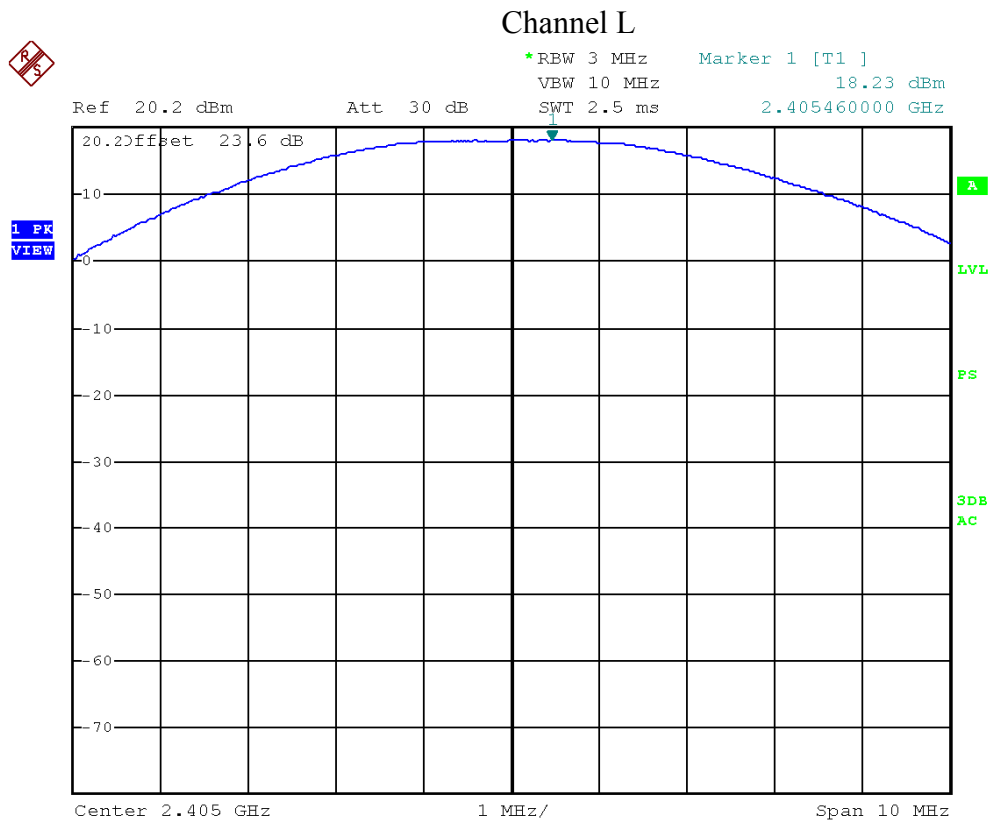
Temperature : 25 °C

Relative Humidity : 55 %

Mode	CH	Radiated Power (dBm)	Ant Gain (dBi)	Conducted Power (dBm)	Limit (dBm)
Operating	L	18.23	3.00	15.23	≤30
	M	17.81		14.81	
	H	16.96		13.96	

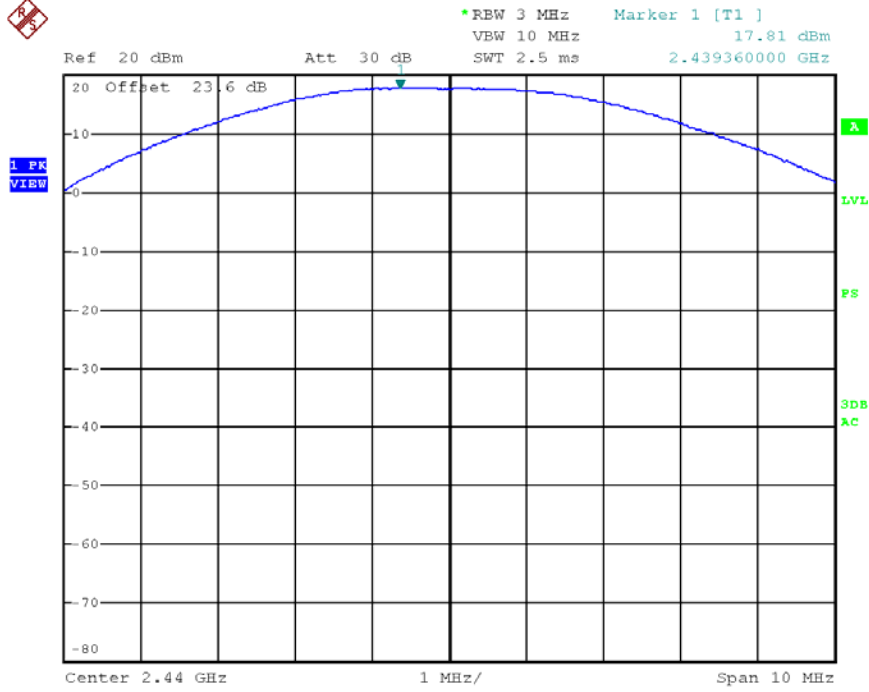
Note: 1. Conducted Power = Radiated Power –Gain of antenna

2. All the test graphs showed below are radiated reading.



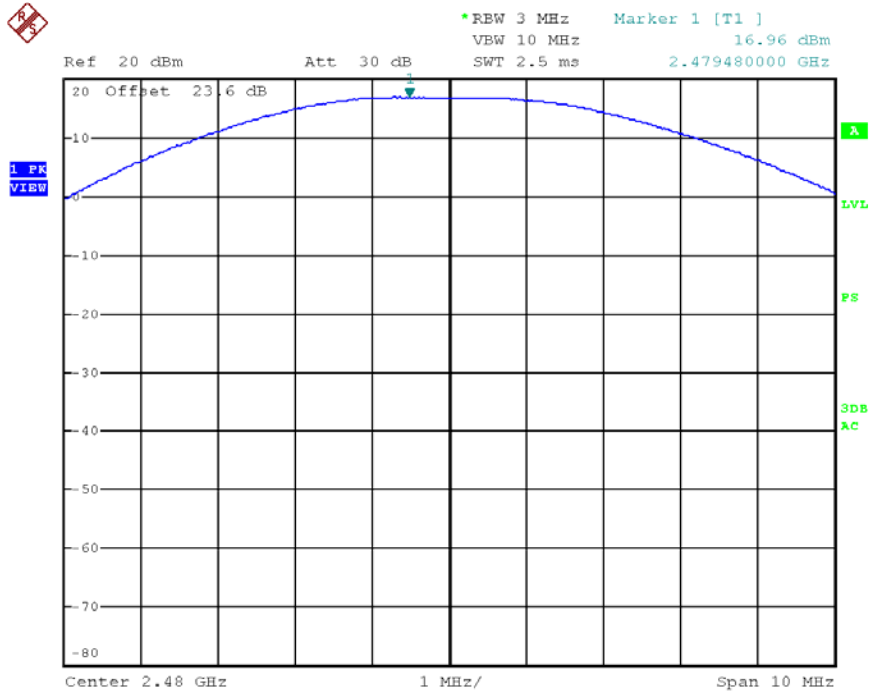
Date: 4.FEB.2013 15:13:33

Channel M



Date: 4.FEB.2013 15:21:31

Channel H



Date: 4.FEB.2013 15:30:25

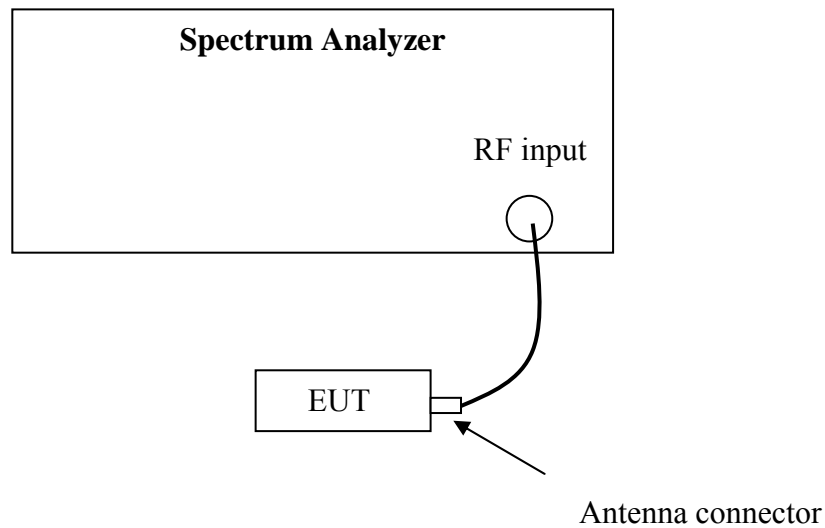
5. Power spectrum density

Test result: Pass

5.1 Test limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

5.2 Test Configuration



5.3 Test procedure and test setup

The power output per FCC §15.247(e) was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance v02” (clause 9.1) for compliance to FCC 47CFR 15.247 requirements.

5.4 Test Protocol

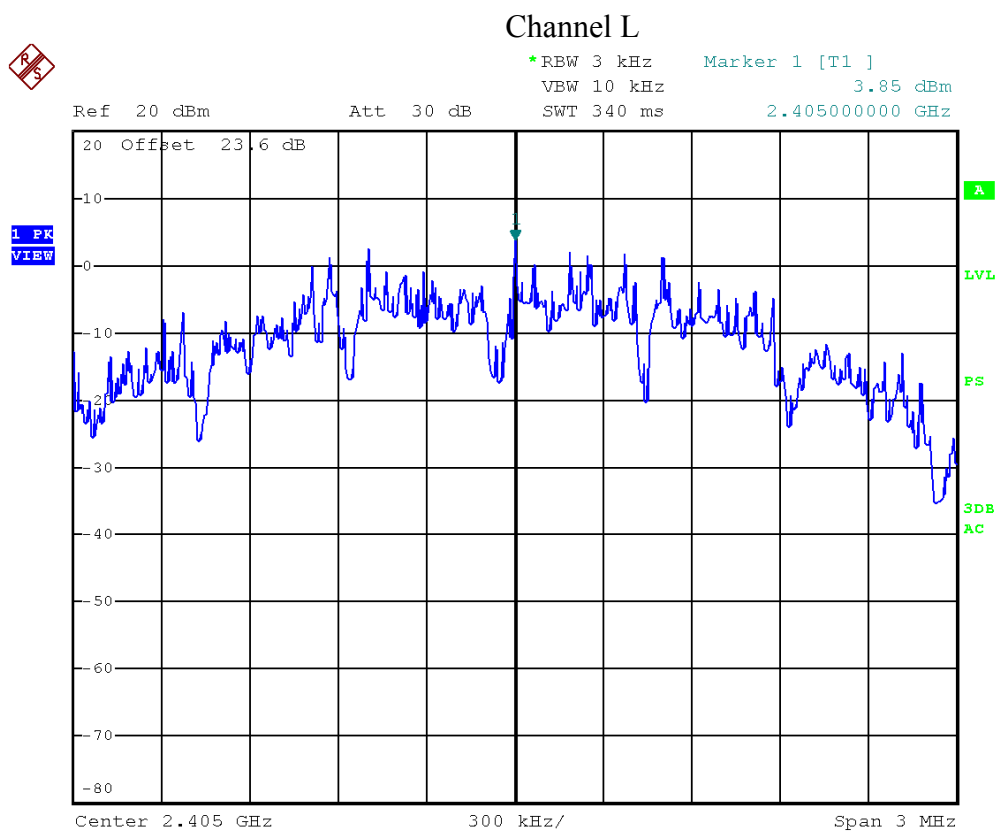
Temperature : 25 °C

Relative Humidity: 55 %

Mode	CH	Radiated reading (dBm)	Ant Gain (dBi)	Spectrum Density (dBm/3kHz)	Limit (dBm/3kHz)
Operating	L	3.85	3.00	0.85	≤8.00
	M	2.95		-0.05	
	H	2.28		-0.72	

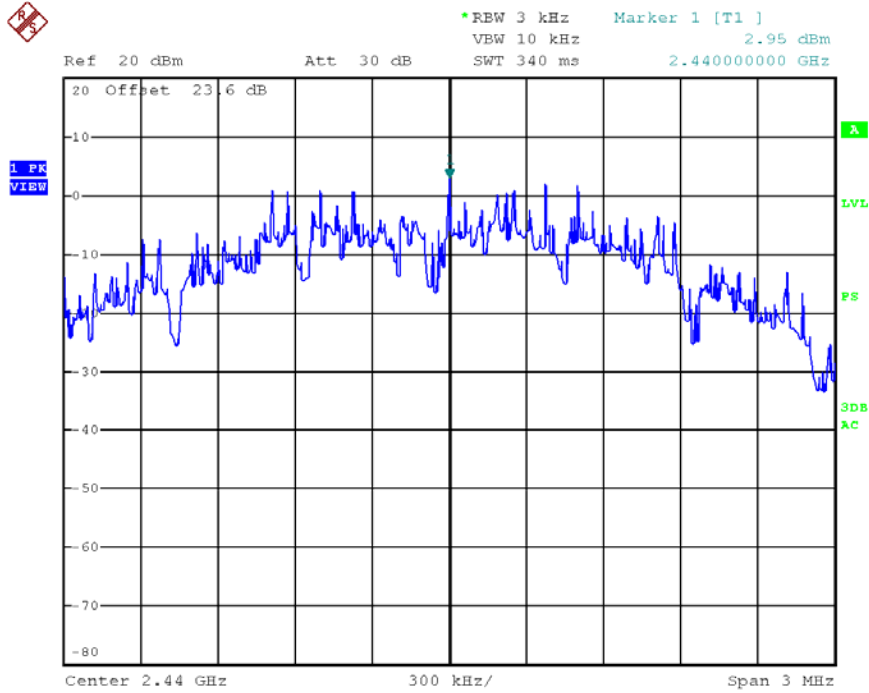
Note: 1. Spectrum Density = Radiated reading – Gain of antenna

2. All the test graphs showed below are radiated reading.



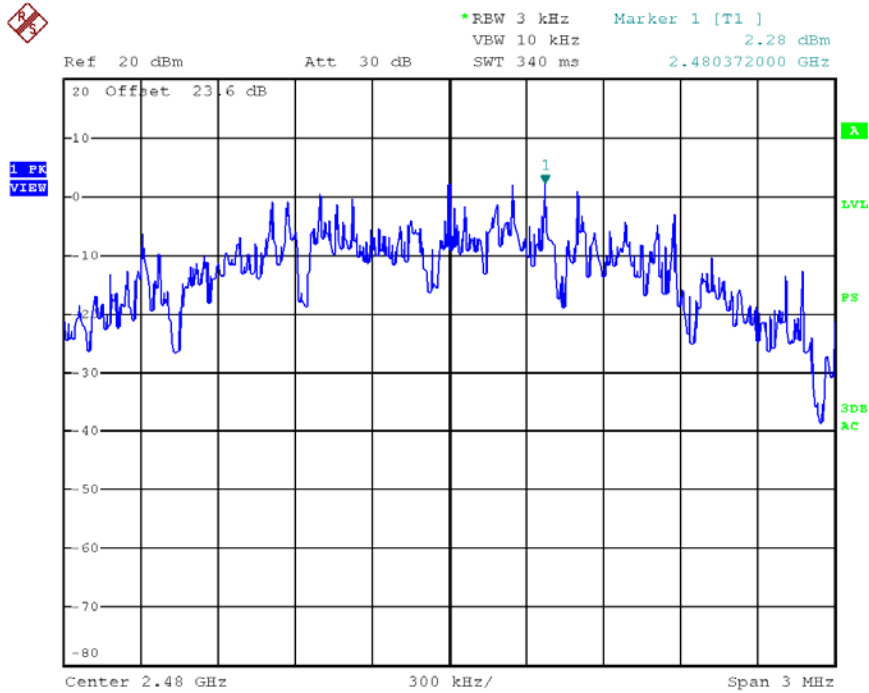
Date: 4.FEB.2013 15:16:54

Channel M



Date: 4.FEB.2013 15:23:05

Channel H



Date: 4.FEB.2013 15:31:53

6. Radiated emission

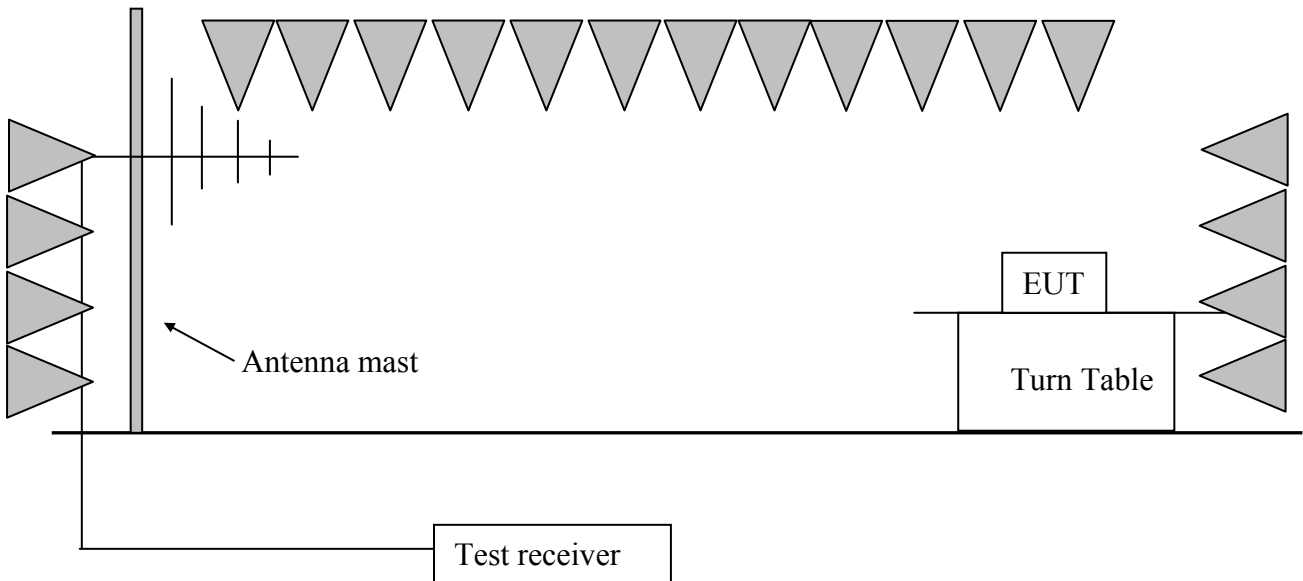
Test result: **PASS**

6.1 Test limit

The 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) showed as below:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

6.2 Test Configuration



6.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.

The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The EUT was tested according to DTS test procedure of KDB558074 D01 DTS “Meas Guidance v02” for compliance to FCC 47CFR 15.247 requirements.

6.4 Test protocol

CH	Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2406.13	28.80	108.50	Fundamental	/	PK
	V	38.06	16.10	23.40	40.00	16.60	PK
	V	55.27	9.20	27.00	40.00	13.00	PK
	H	601.50	21.40	27.90	46.00	18.10	PK
	V	887.25	24.10	31.60	46.00	14.40	PK
	H	2390.00	-7.60	43.20	54.00	10.80	PK
	H	7219.44	6.20	61.90	74.00	12.10	PK
	H	7218.36	6.20	36.70	54.00	17.30	AV
	H	12023.04	11.30	55.70	74.00	18.30	PK
	H	12022.76	11.30	35.60	54.00	18.40	AV
M	H	2441.35	28.80	107.70	Fundamental	/	PK
	V	38.06	16.10	23.40	40.00	16.60	PK
	V	55.27	9.20	27.00	40.00	13.00	PK
	H	601.50	21.40	27.90	46.00	18.10	PK
	V	887.25	24.10	31.60	46.00	14.40	PK
	H	7322.19	6.80	61.60	74.00	12.40	PK
	H	7320.85	6.80	36.10	54.00	17.90	AV
	H	12198.43	11.70	54.20	74.00	19.80	PK
	H	12199.10	11.70	34.70	54.00	19.30	AV
H	H	2481.93	28.80	107.00	Fundamental	/	PK
	V	38.06	16.10	23.40	40.00	16.60	PK
	V	55.27	9.20	27.00	40.00	13.00	PK
	H	601.50	21.40	27.90	46.00	18.10	PK
	V	887.25	24.10	31.60	46.00	14.40	PK
	H	2483.54	28.80	48.60	54.00	5.40	PK
	H	7443.42	7.20	61.00	74.00	13.00	PK
	H	7442.68	7.20	35.40	54.00	18.60	AV

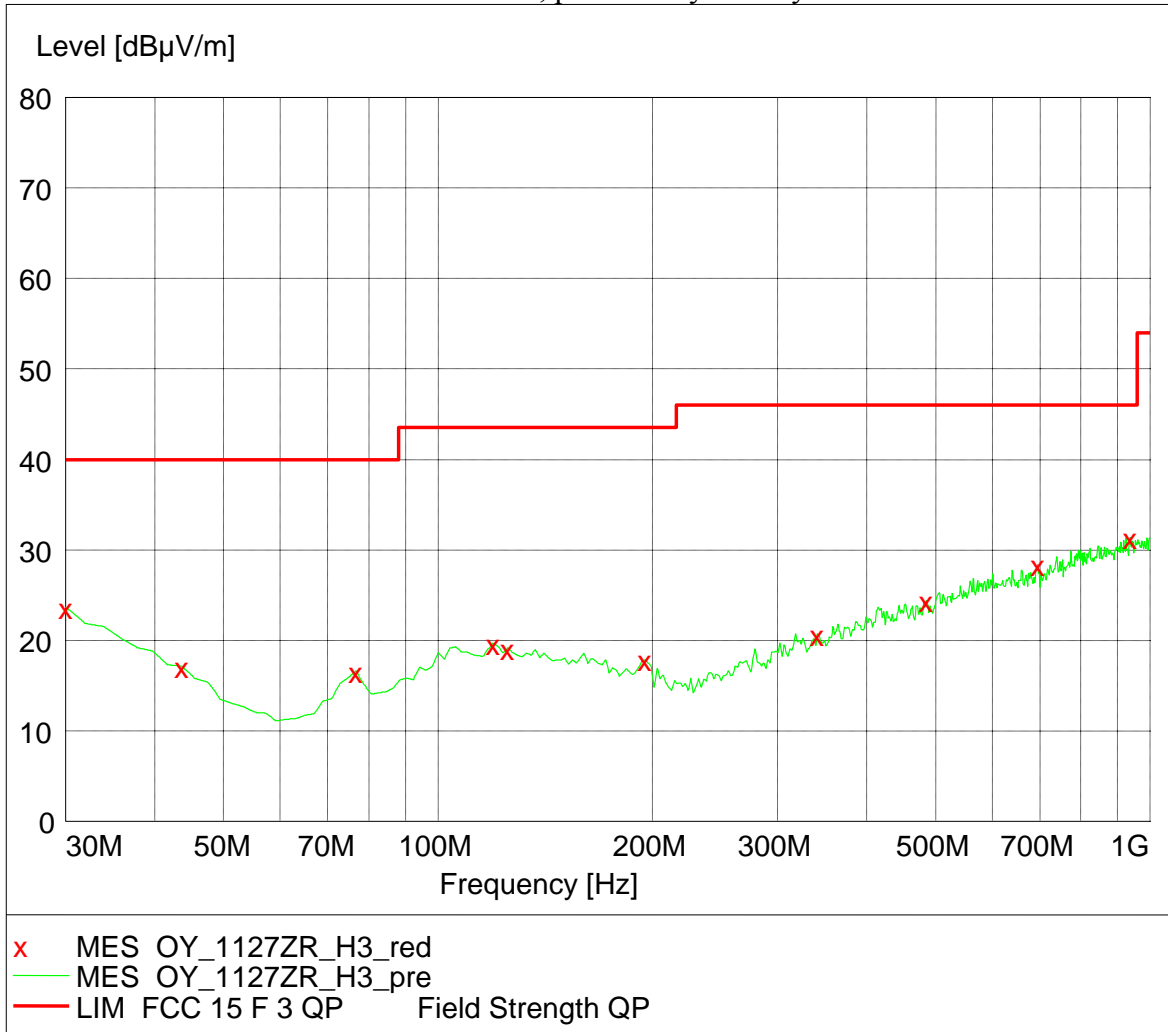


	H	12398.05	11.80	55.40	74.00	18.60	PK
	H	12398.87	11.80	35.50	54.00	18.50	AV

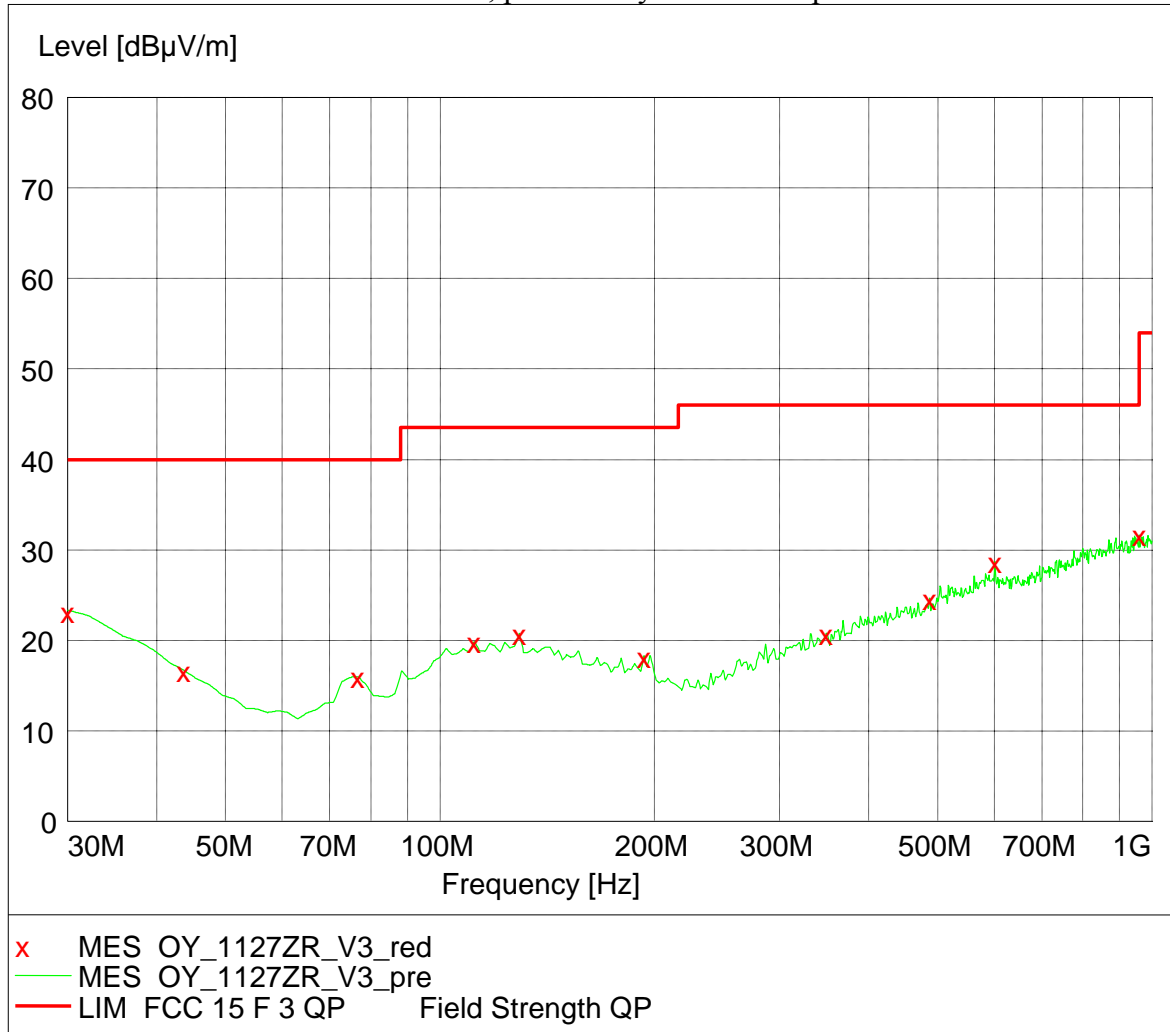
- Remark:
1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
 2. Corrected Reading = Original Receiver Reading + Correct Factor
 3. Margin = limit – Corrected Reading
 4. If the PK reading is lower than AV limit, the AV test can be elided.
 5. For all the frequencies assessed with QP detector, it is found they have pulse-repetition frequency higher than 20 Hz.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading =
10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m, Corrected Reading = 10.20dBuV/m, then Margin =
54 -10.20 = 43.80dBuV/m

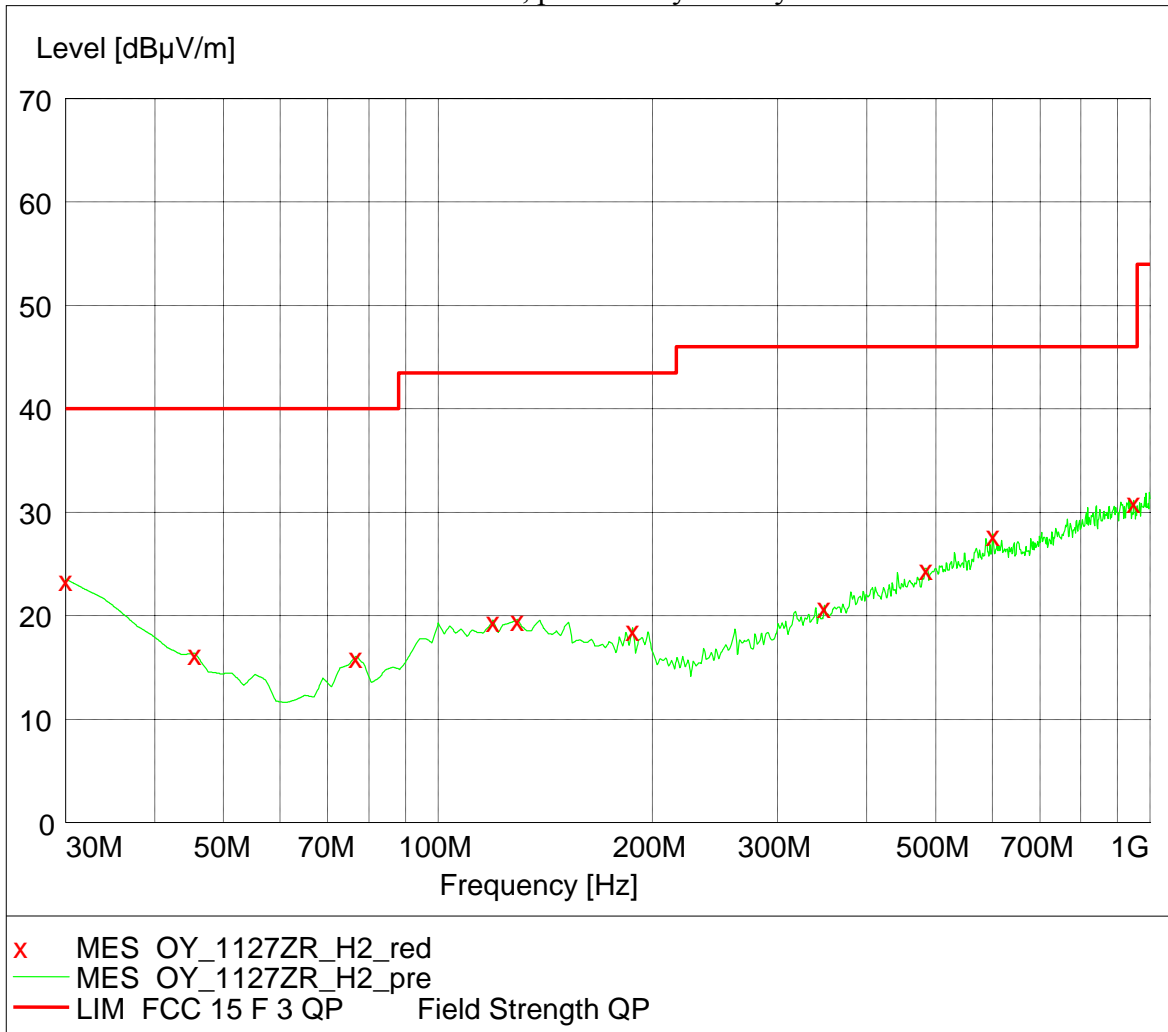
Horizontal, powered by Battery



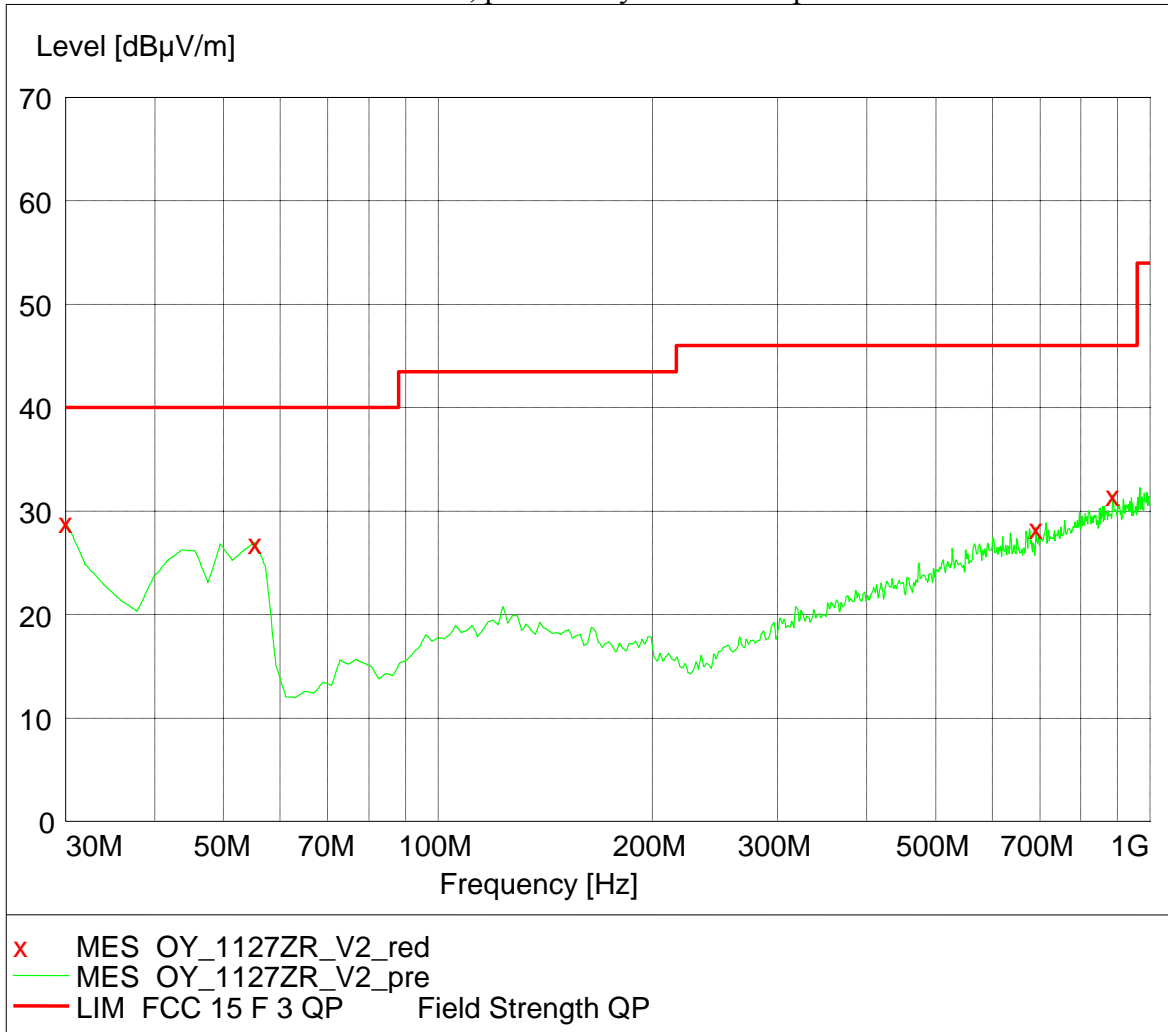
Horizontal, powered by AC/DC adapter



Vertical, powered by Battery



Vertical, powered by AC/DC adapter



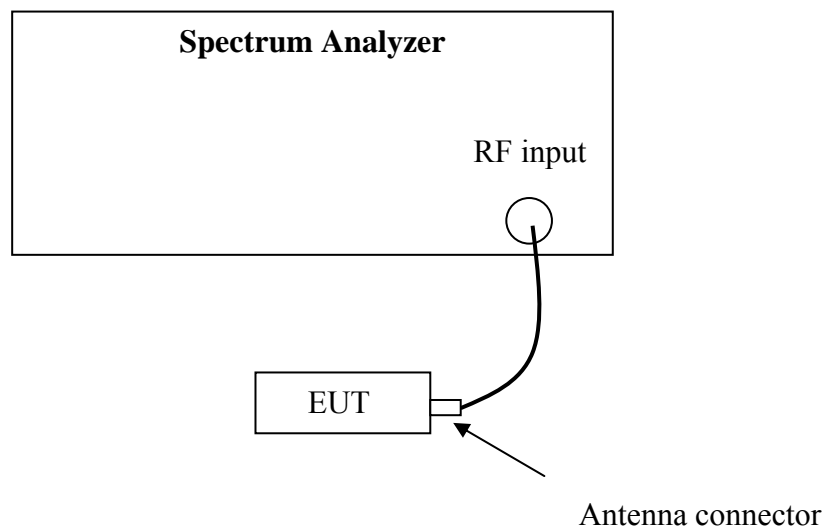
7. Emission outside the frequency Band

Test result: PASS

7.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

7.2 Test Configuration



7.3 Test procedure and test setup

The Emission outside the frequency Band per FCC §15.247(d) is measured using the Spectrum Analyzer with the resolutions bandwidth set at 100kHz, the video bandwidth set at 300kHz, and the SPAN>>RBW.

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance v02” for compliance to FCC 47CFR 15.247 requirements.

7.4 Test protocol

Mode	CH	Max reading among band (dBm)	The most restrict Attenuation outside band (dB)	Limit (dB)
Operating	L	12.20	45.32	≥20
	M	11.60	48.18	
	H	11.10	44.59	

Note: The test was performed from 9kHz to 26GHz and the worst test data is listed here.

8. Power line conducted emission

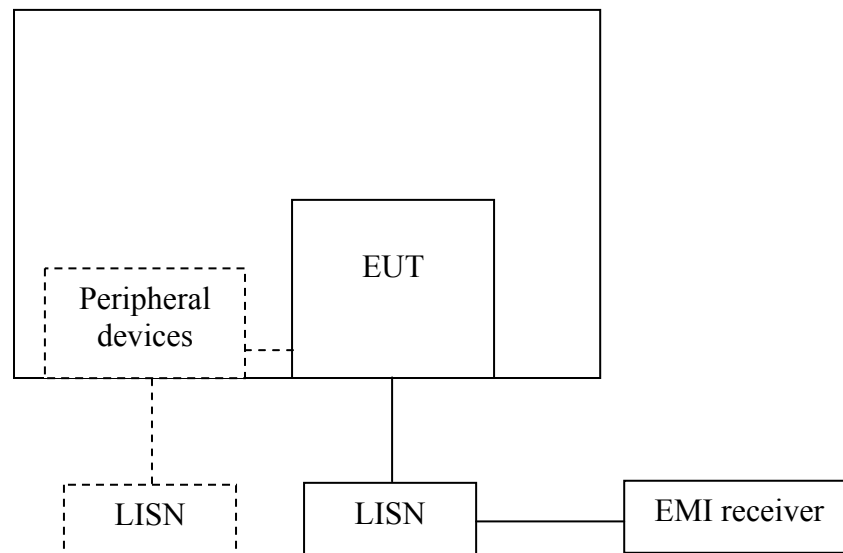
Test result: Pass

8.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

8.2 Test configuration



For table top equipment, wooden support is 0.8m height table

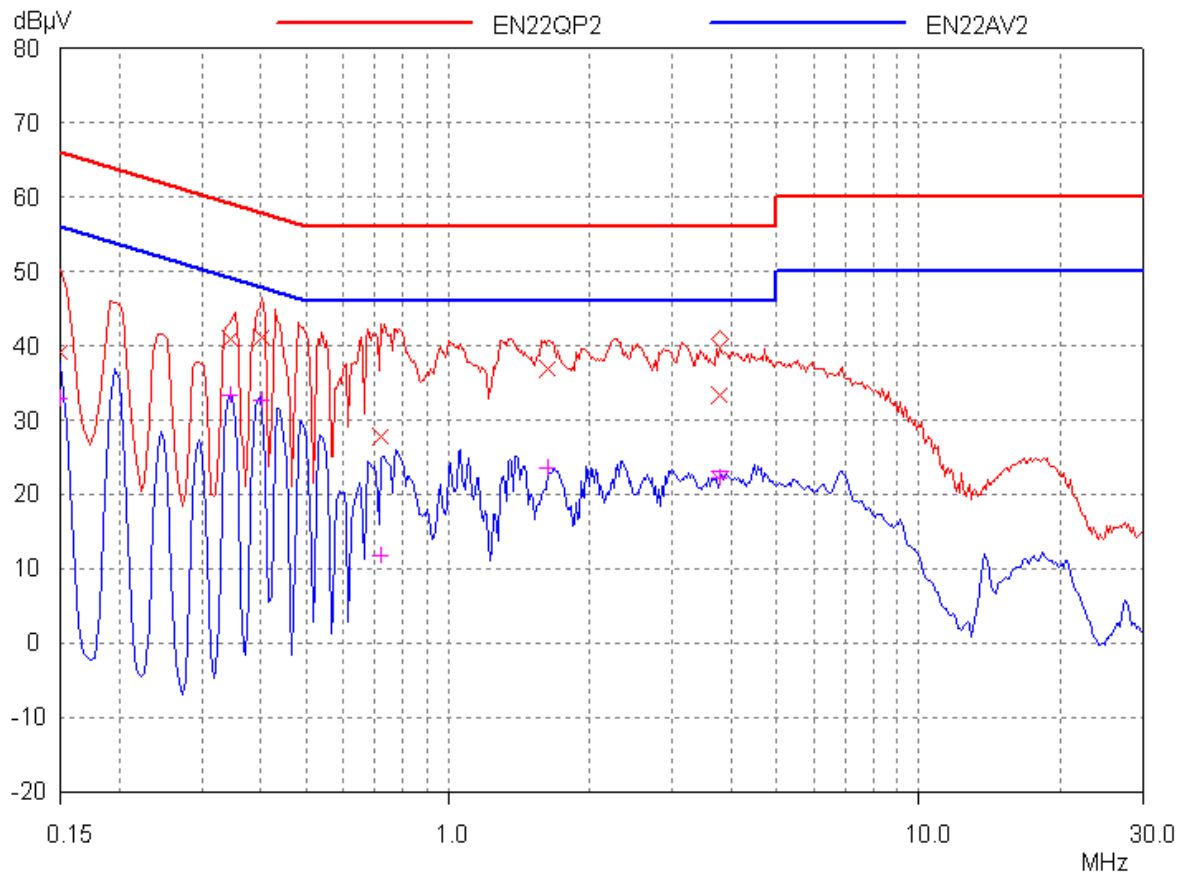
For floor standing equipment, wooden support is 0.1m height rack.

8.3 Test procedure and test set up

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a $50\Omega/50\mu\text{H}$ coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a $50\Omega/50\mu\text{H}$ coupling impedance with 50Ω termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4 on conducted measurement. The bandwidth of the test receiver is set at 9 kHz.

8.4 Test protocol



Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.15 (L)	3.00	39.21	32.90	66.00	56.00	26.79	23.10
0.34 (N)	3.00	41.01	33.31	59.12	49.12	18.11	15.81
0.40 (N)	3.00	41.08	32.68	57.81	47.81	16.73	15.13
0.72 (N)	3.00	27.75	11.71	56.00	46.00	28.25	34.29
1.64 (N)	3.00	36.95	23.52	56.00	46.00	19.05	22.48
3.74 (L)	3.00	33.25	22.24	56.00	46.00	22.75	23.76

Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB).
2. Margin (dB) = Limit - Corrected Reading.

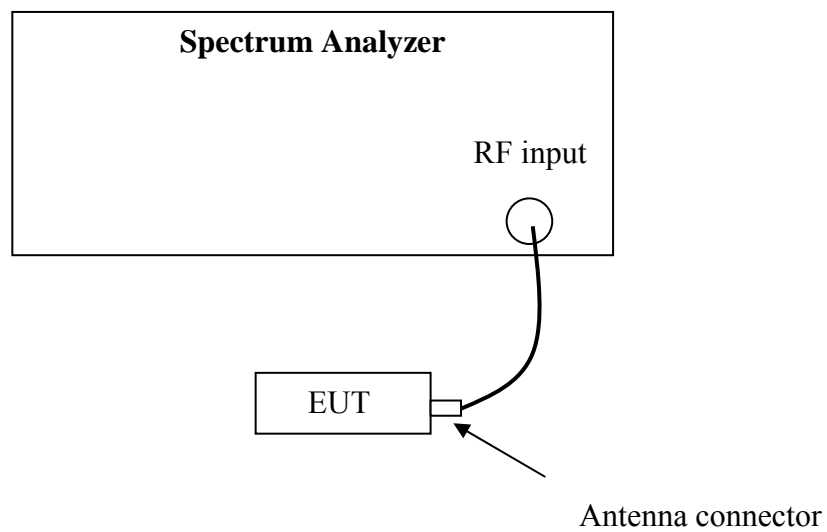
9. Occupied Bandwidth

Test Status: Tested

9.1 Test limit

None

9.2 Test Configuration



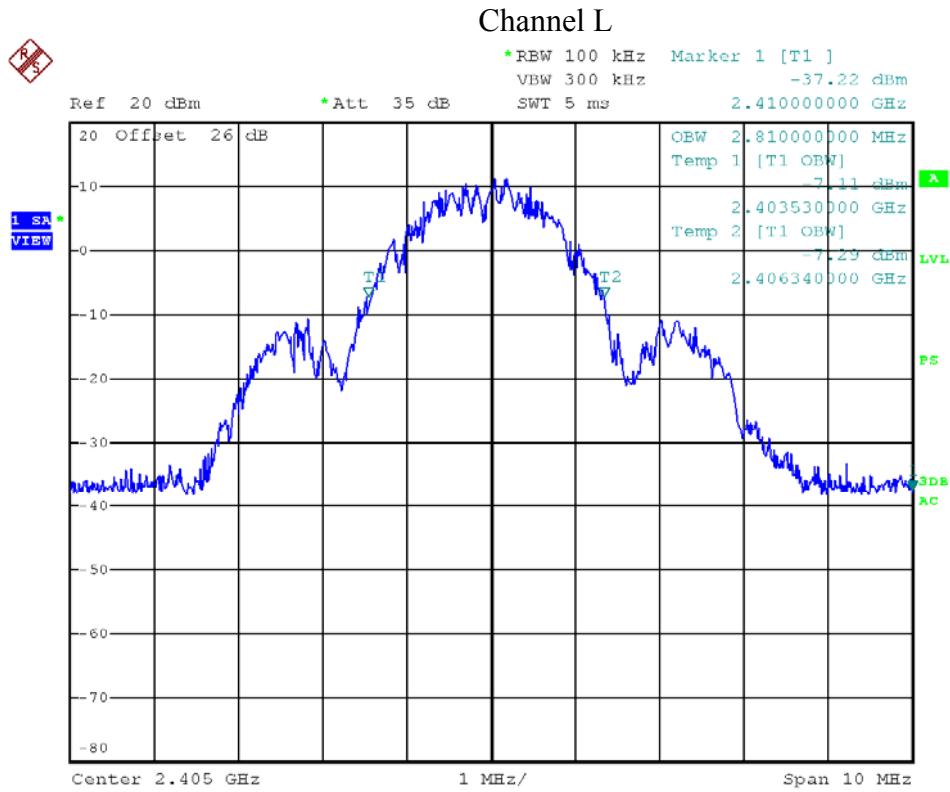
9.3 Test procedure and test setup

The occupied bandwidth per RSS-Gen Issue 3 Clause 4.6.1 was measured using the Spectrum Analyzer.

9.4 Test protocol

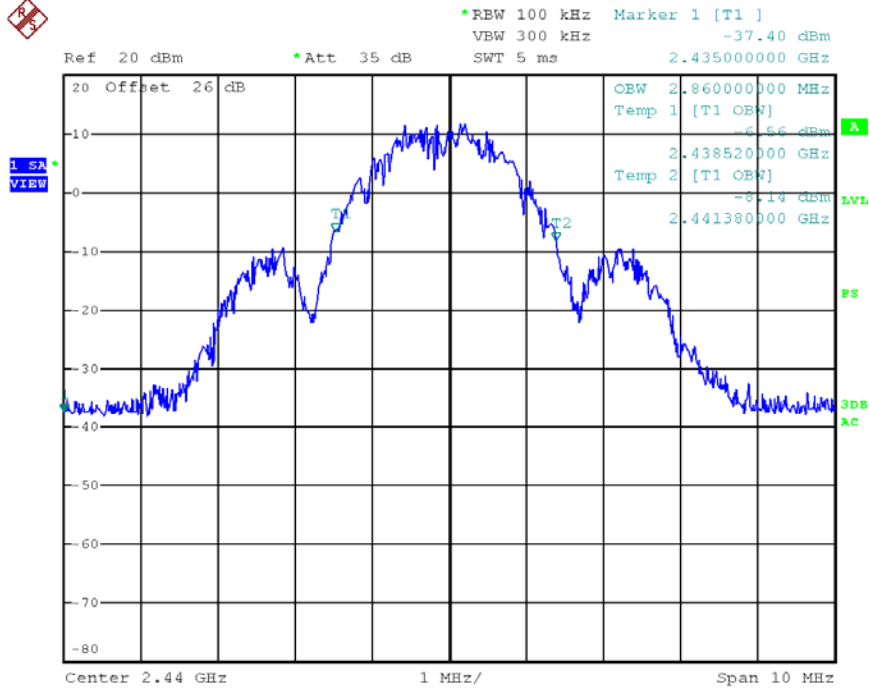
Temperature : 25 °C
Relative Humidity : 55 %

Mode	CH	99% Bandwidth (MHz)
Operating	L	2.81
	M	2.86
	H	2.83



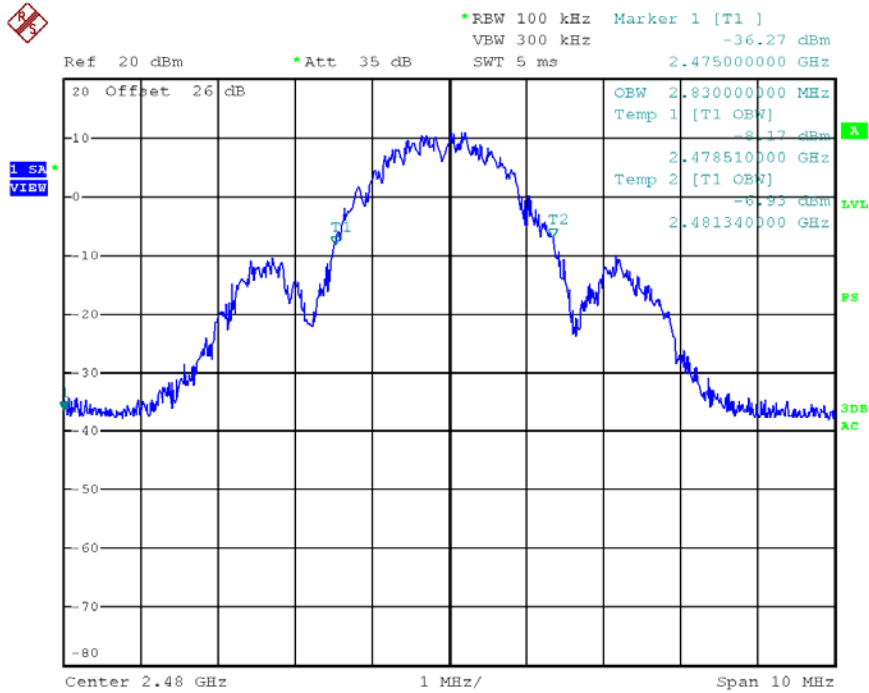
Date: 31.JAN.2013 15:15:36

Channel M



Date: 31.JAN.2013 15:17:22

Channel H



Date: 31.JAN.2013 15:19:52