

RFI / EMI TEST REPORT

EUT Name	: RF 2.4G Keyboard
Model No.	: PSK-3861, ASK-3861, ACK-540ALU+RF-
FCC ID.	: RAC3861A01
Applicant	: PRECISION SQUARED TECHNOLOGY CORPORATION
Address	: 5F-7, NO. 2, JIAN BA ROAD, CHUNG HO CITY, TAIPEI HSIENG, TAIWAN, R. O. C.
Regulation	: CFR 47, Part 15 Subpart C
Test Site	: PEP Testing Laboratory
Test Engineer	: IVAN HUANG
Test Date	: JULY 17, 2008 – OCT. 08, 2008
Issued Date	: OCT. 14, 2008
Report No.	: E970183

VERIFICATION

WE HEREBY VERIFY THAT:

The EUT listed below has completed RFI testing by PEP Testing Laboratory and it does comply with the limitation of FCC Part 15 subpart C, Section 15.247 limitations.

The tested configurations and the facility comply with the radiated and AC line conducted test site criteria in ANSI C63. 4- 2003.

Any data in this RFI report is “ **reference** ” only.

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PRODUCT : RF 2.4G Keyboard

FCC ID. : RAC3861A01

MODEL NO. : PSK-3861, ASK-3861, ACK-540ALU+RF-



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1. Product Information

EUT Name:	RF 2.4G Keyboard
Model Number:	The EUT for the marketing concerned have PSK-3861, ASK-3861, ACK-540ALU+RF-. Those models have identical electrical design and construction except that they are different in model number.
Channel No. :	16 Channel
Frequency Range:	2.404GHz~2.475GHz
Modulation:	GFSK
Data Rate:	1MHz
Internal Crystal / Osc. :	6MHz, 16MHz
Power Rating:	DC 3V---From Battery
Antenna Type:	Integral
Antenna Gain:	0.5 dBi (numeric 1.12)
Case:	ABS

2. General Information

2.1 Test Mode and Procedure

Test Channel: As required by FCC Part15, Section 15.31(m) measurements on intentional radiators or receiver should be performed at three frequencies for operating frequency over 10MHz, one near top, one near middle and one near bottom.

Due to the support channels are 16 channels, the selected three frequencies for testing would be 2.404GHz near top for CH LOW, 2.440GHz near middle for CH MID and 2.475GHz near bottom for CH HIGH.

Test Mode	Channel setting and Operating condition
Channel Low Mode (2404MHz)	To press the button of PAIRING+F1 on EUT, then test under Channel Low frequency and transmit continuously.
Channel Mid Mode (2440MHz)	To press the button of PAIRING+F1 on EUT, then test under Channel Mid frequency and transmit continuously.
Channel High Mode (2475MHz)	To press the button of PAIRING+F1 on EUT, then test under Channel High frequency and transmit continuously.

Test Procedure:

1. Putting the EUT on the platform and turning on the EUT (on/off button on the bottom of the EUT).
2. Setting test channel described as "Channel setting and operating condition", and testing channel by channel.
3. For the maximum conducted output power and power spectral density followed Part 15 Subpart 15.247, Measurement of Digital Transmission Systems "Alternative Test Procedure (1) and (2), respectively.
4. For the spurious emission test based on ANSI C63.4(2003), at the frequency where below 1GHz used quasi-peak detector mode; where above 1GHz used the peak and average detector mode. IF the peak value may be under average limit, the average mode will not be performed.
5. In this RFI test report, we provided the worst case conducted emission test data or/and radiated emission test data. The entire testing data was recorded and provided in this report.

2.2 Test Software(s) Used

N/A

2.3 Modification(s)

N/A

3. Support Equipment Used

Personal Computer (PC4)	CPU : Intel P4 3.06GHz FCC ID : Declaration of Conformity(DoC) Manufacturer : ACER Model Number : Aspire T650 Power Supply : Switching Power Cord : Non-Shielded, Detachable, 1.8m Data Cable : N/A
LCD (LCD1 17")	FCC ID : Declaration of Conformity(DoC) Manufacturer : MiTAC Model Number : LC51 Power Supply : Switching Power Cord : Non-Shielded, Detachable, 1.8m Data Cable : 1 > Shielded , Detachable,1.2m 2 > Back Shell : Metal
RF 2.4G Keyboard (RX)	Manufacturer : Global Link Model Number : PSK-3861

4. Measurement Result Summary

Modulation: DSSS

Test Item	Result
§15.247 (b)(4) Antenna gain<6dBi	☒ Yes ☐ No Read: <u>0.5</u> dBi
Channel Listing	☒ Ok
§15.247(a)(1) Hopping Channel Frequency Separated Limit>25KHz or -20dB Bandwidth, whichever is greater	☒ N/A ☐ Pass ☐ Fail Read: _____ Hz
§15.247(a)(1)(iii) Dwell Time Limit(t)<0.4(s)	☒ N/A ☐ Pass ☐ Fail Read: _____ s
§15.247(a)(2) -6dB Bandwidth Limit>500KHz	☐ N/A ☒ Pass ☐ Fail Low: <u>2040</u> KHz Mid : <u>2040</u> KHz High: <u>2080</u> KHz
§15.247(b)(2) Maximum peak conducted output power Non-overlapping channel>75 Limit<1 Watt	☒ N/A ☐ Pass ☐ Fail Read: _____ W
§15.247(b)(3) Maximum peak conducted output power Limit<1 Watt	☐ N/A ☒ Pass ☐ Fail Low: <u>0.161*10⁻³</u> W (H) Mid : <u>0.216*10⁻³</u> W (H) High: <u>0.190*10⁻³</u> W (H)
§15.247(d) 100KHz outside band test (i) Band edge measurement (ii) 30MHz~24GHz spurious emission	☒ Pass ☐ Fail
§15.247(e) The power spectral density Limit<8dBm (in 3KHz)	☐ N/A ☒ Pass ☐ Fail Low: <u>-17.21</u> dBm (H) Mid : <u>-13.87</u> dBm (H) High: <u>-15.37</u> dBm (H)
§15.247(e)(i) MPE calculation	☒ Pass ☐ Fail

5. Channel Listing

a. EUT Type : RF 2.4G Keyboard		
b. EUT Model : PSK-3861		
c. TX Channel No. : 16		
Channel 01: 2404 MHz	Channel 02: 2406 MHz	Channel 03: 2408 MHz
Channel 04: 2415 MHz	Channel 05: 2420 MHz	Channel 06: 2425 MHz
Channel 07: 2430 MHz	Channel 08: 2435 MHz	Channel 09: 2440 MHz
Channel 10: 2445 MHz	Channel 11: 2450 MHz	Channel 12: 2455 MHz
Channel 13: 2460 MHz	Channel 14: 2465 MHz	Channel 15: 2470 MHz
Channel 16: 2475 MHz		

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Frequency Range: 2.4042GHz to 2.4752GHz

Note: All channels located in the frequency range as below:

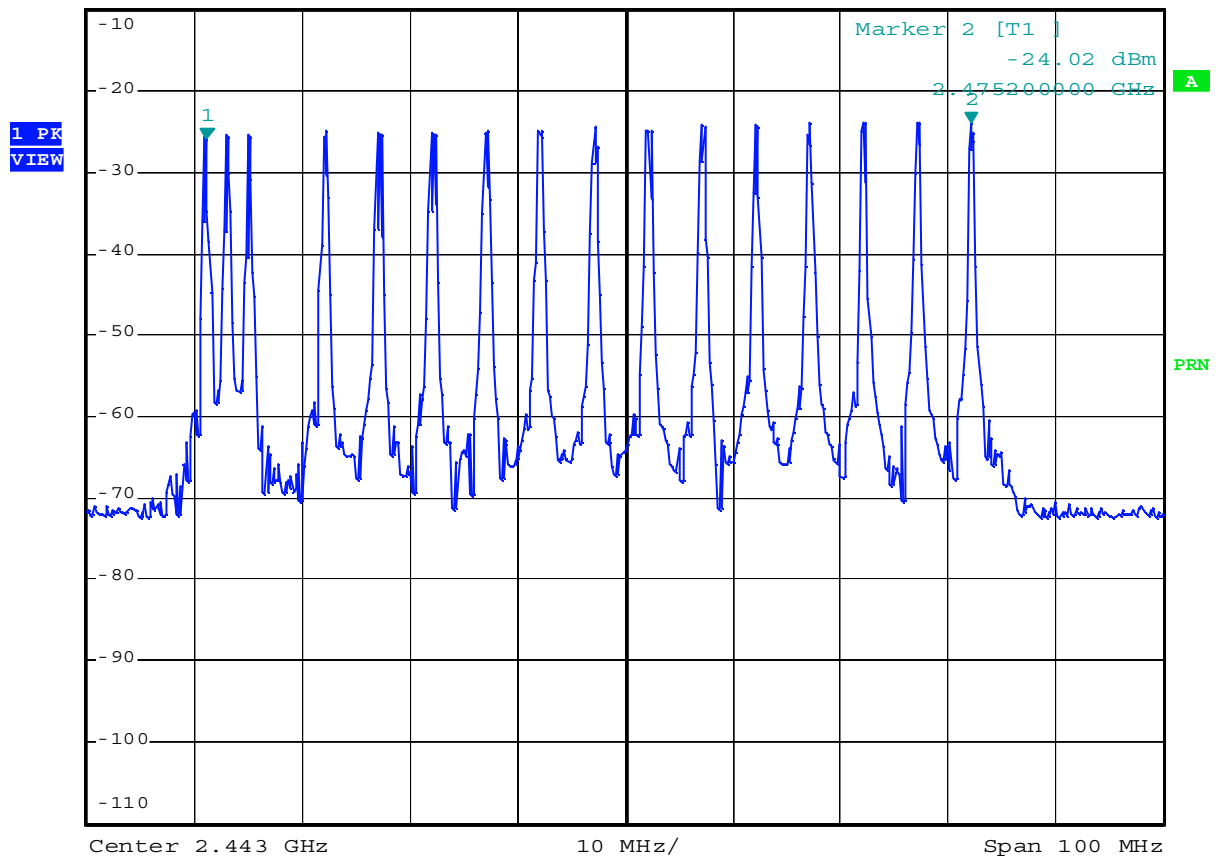
2.4 GHz --- 2.4835 GHz ☒ Yes ☐ No

Typical Channel for testing:

Channel	Channel Number	Frequency (GHz)
LOW	1	2.404
MID	9	2.440
HIGH	16	2.475



*RBW 100 kHz Marker 1 [T1]
 *VBW 100 kHz -25.77 dBm
 Ref -10 dBm Att 20 dB SWT 10 ms 2.404200000 GHz



6. §15.247(a)(2): -6dB Bandwidth

Limit > 500KHz

6.1 Test Procedure

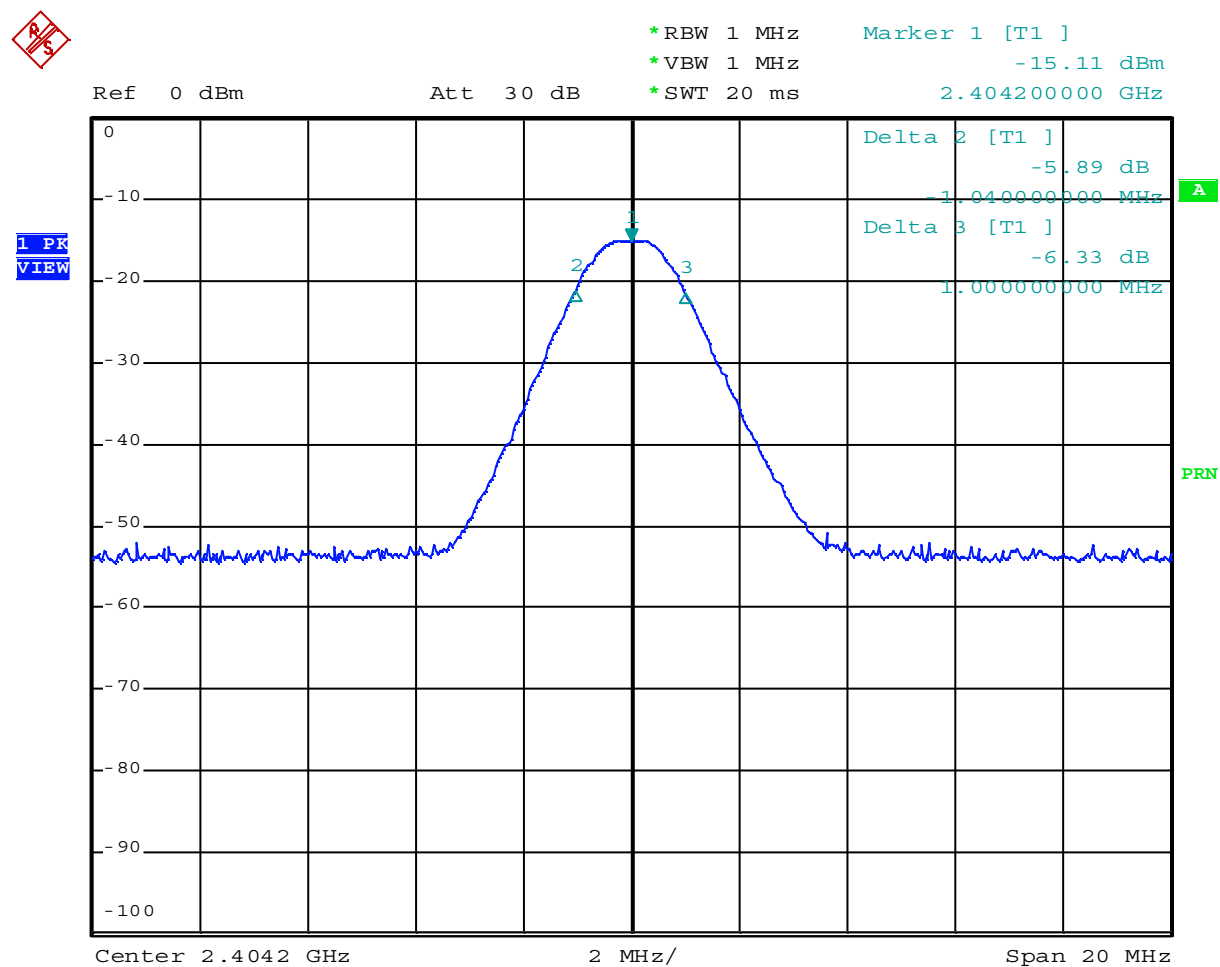
- (1)The -6dB bandwidth was measured at the EUT antenna terminal in max hold analyzer mode with span wide enough to capture the hopping channel emissions.
- (2)Set the Spectrum as RBW=VBW=1MHz
- (3)6.3 Spectrum Plot Data show the -6dB Bandwidth test results.

6.2 Test Result of Bandwidth

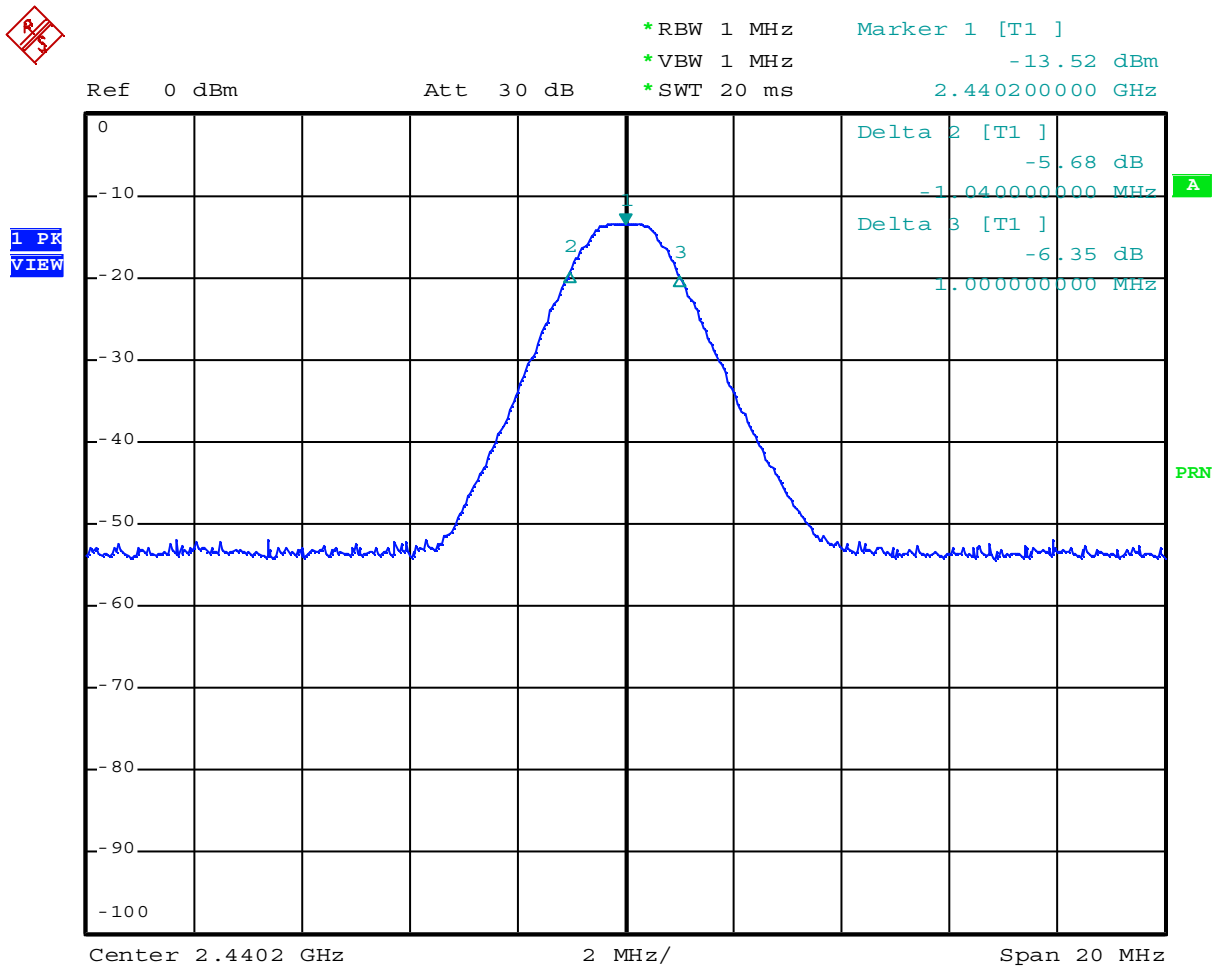
Channel	Bandwidth (KHz)	Limit (KHz)	Test Result
1	2040	>500	PASS
7	2040	>500	PASS
16	2080	>500	PASS

6.3 Spectrum Plot Data

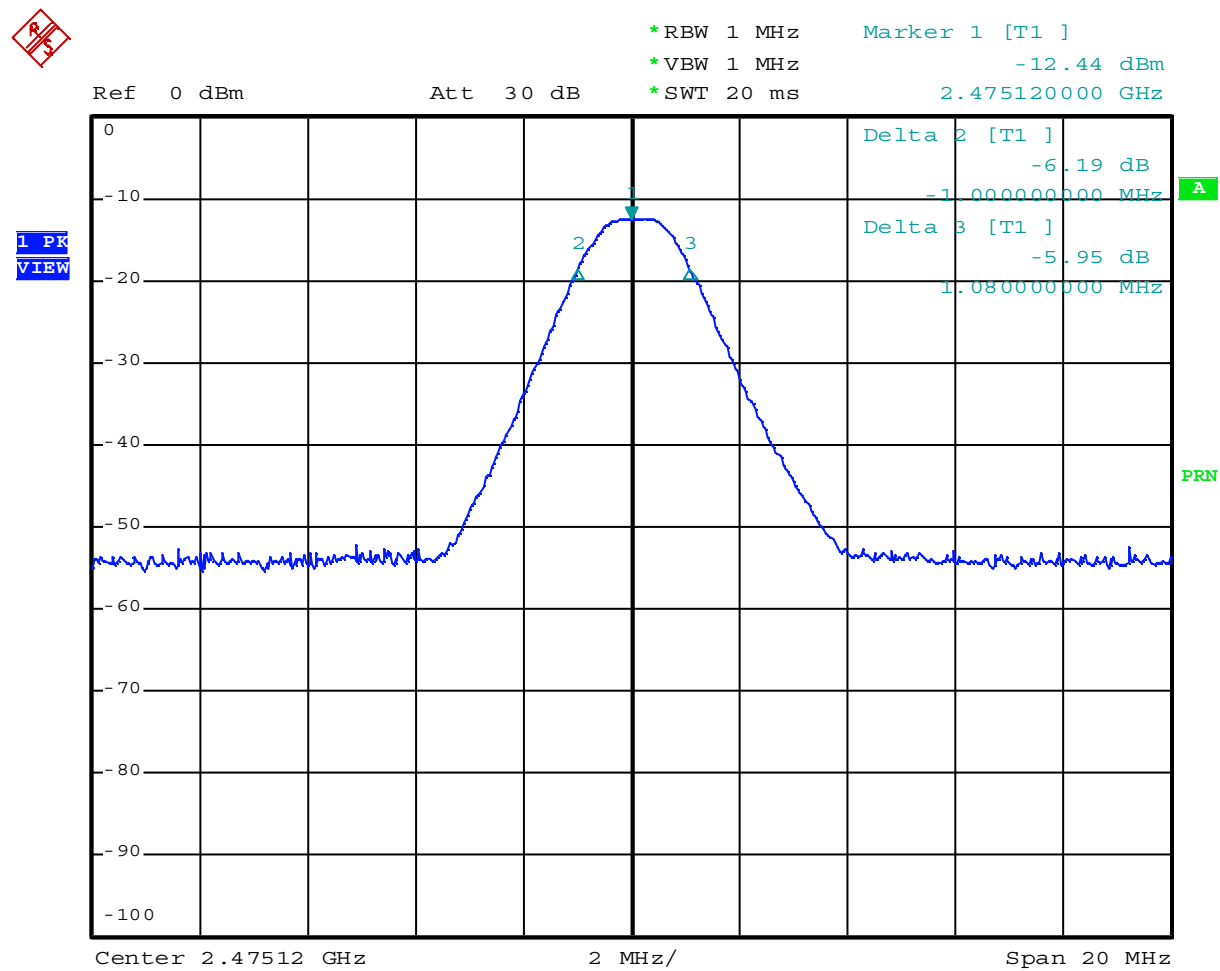
Channel : 1



Channel : 9



Channel : 16



7. §15.247(b)(3): Maximum Peak Conducted Output Power

7.1 Test Method

§15.247, Measurement of Digital Transmission Systems. Alternative Test Procedures (1).

Temperature: 27 °C Humidity: 57 %

RBW=3MHz VBW=3MHz

SWT=Auto Test distance=3m

Limit <1 Watt

7.2 Test Result of Fundamental Emissions

Channel	A.P.	Frequency (GHz)	S.A. Read (dBμV/m)	C. L. (dB)	A. F. (dB)	E (dBμV/m)	E (V/m)	P (W)	Test Result
1	H	2.404	53.85	5.46	28.48	87.79	24.49×10^{-3}	0.161×10^{-3}	PASS
	V		47.48			81.42	11.78×10^{-3}	0.033×10^{-3}	PASS
9	H	2.440	55.02	5.52	28.53	89.07	28.41×10^{-3}	0.216×10^{-3}	PASS
	V		46.79			80.84	11.02×10^{-3}	0.033×10^{-3}	PASS
16	H	2.475	54.36	5.57	28.58	88.51	26.64×10^{-3}	0.19×10^{-3}	PASS
	V		48.23			82.38	13.15×10^{-3}	0.046×10^{-3}	PASS

Note: "A.P." means Antenna Polarization

"S.A." Read" means Spectrum Analyzer Reading

"C.L." means RF Cable Loss

"A.F." means Antenna Factor

$E = \text{S.A Read} + \text{C.L.} + \text{A.F.}$

$P (W) = (E \times d)^2 / 30 \times G$

Where: E = the measured maximum field strength in V/m.

G = the numeric gain of the transmitting antenna over an isotropic radiator.

= 0.5 dBi = 1.12

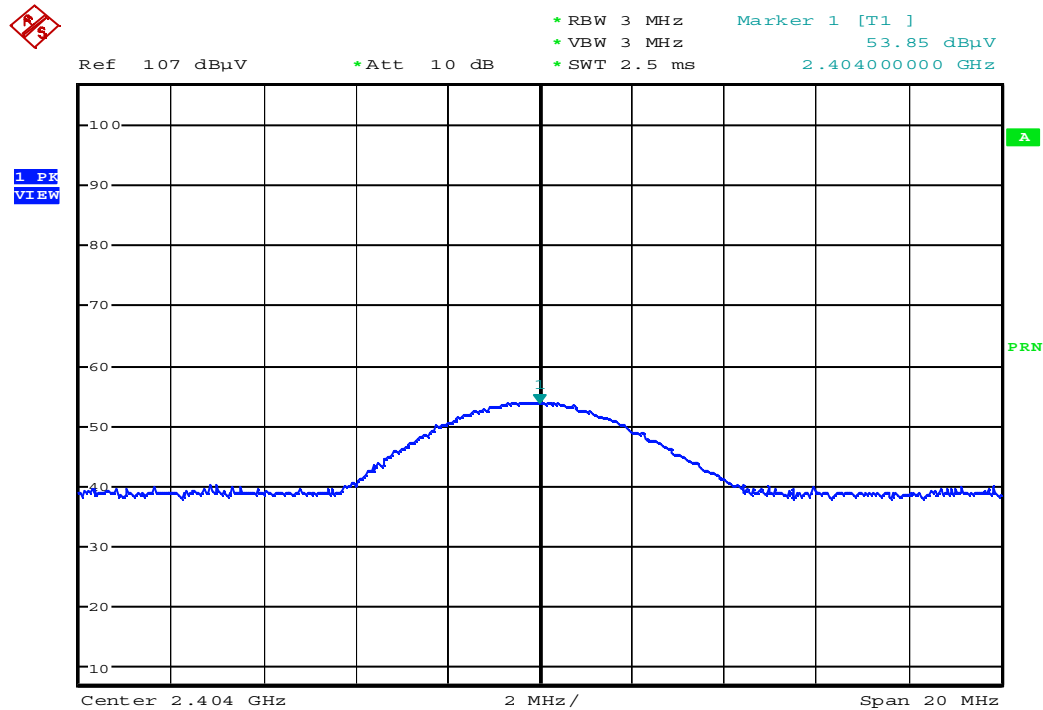
d = the distance in meters from which the field strength was measured.

= 3m

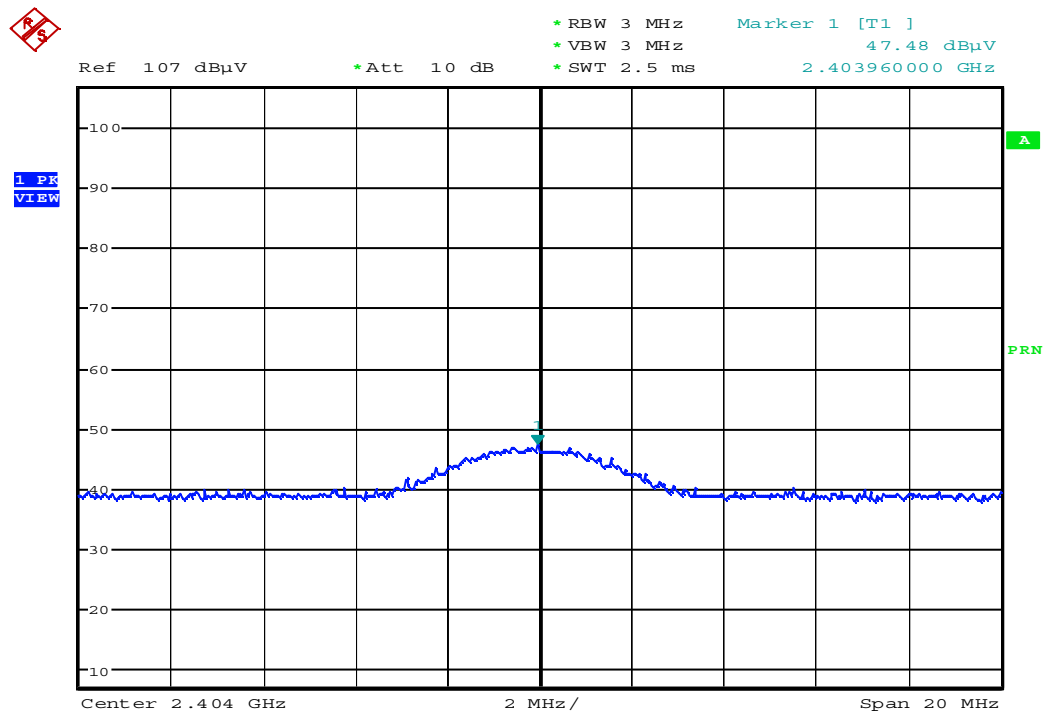
7.3 Spectrum Plot Data

Channel : 1

Horizontal

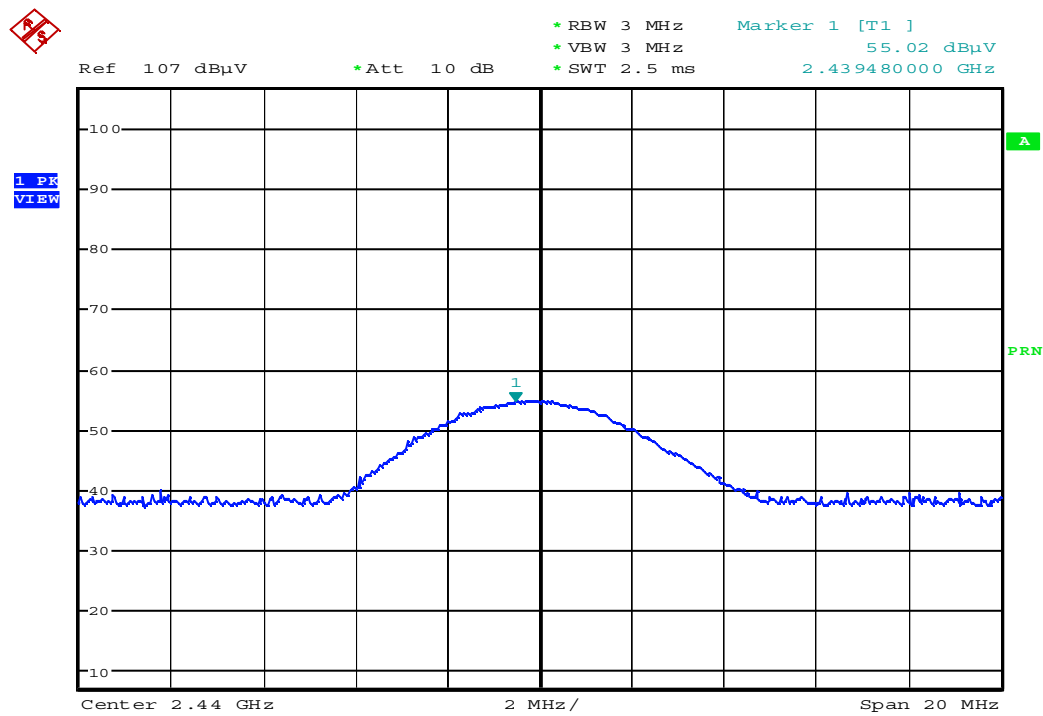


Vertical

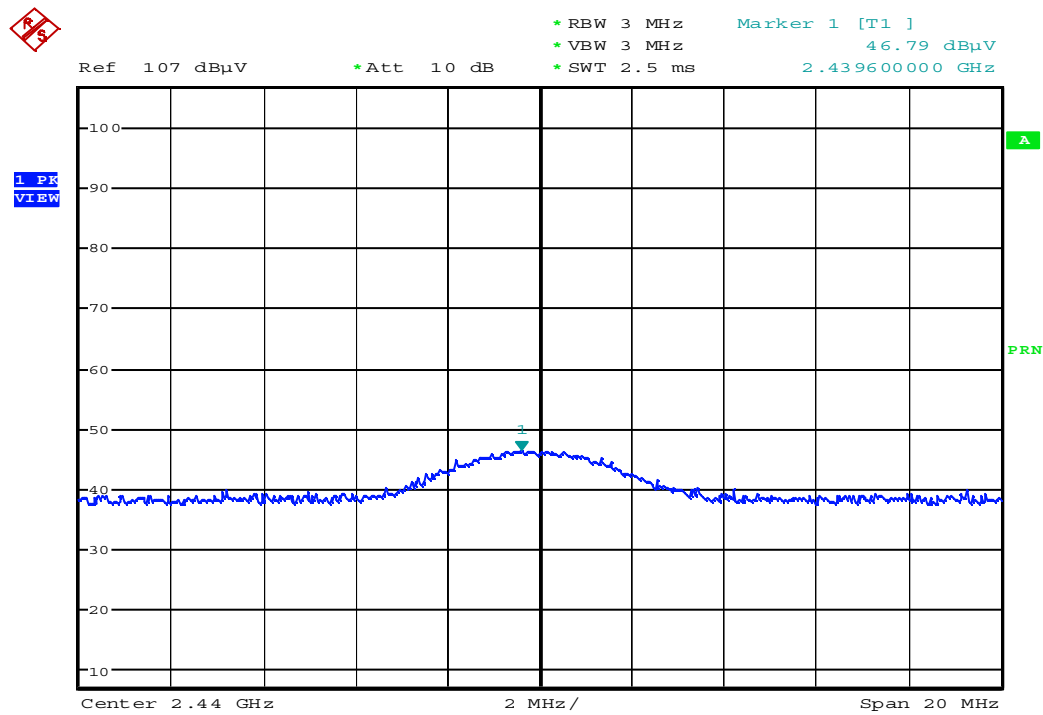


Channel : 9

Horizontal

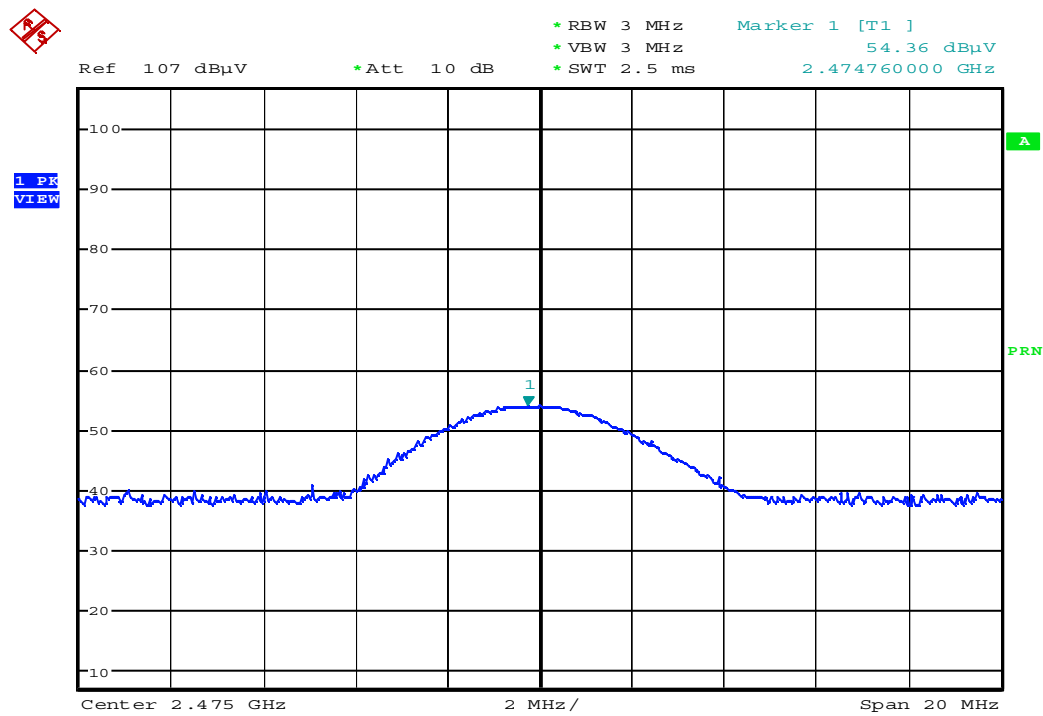


Vertical

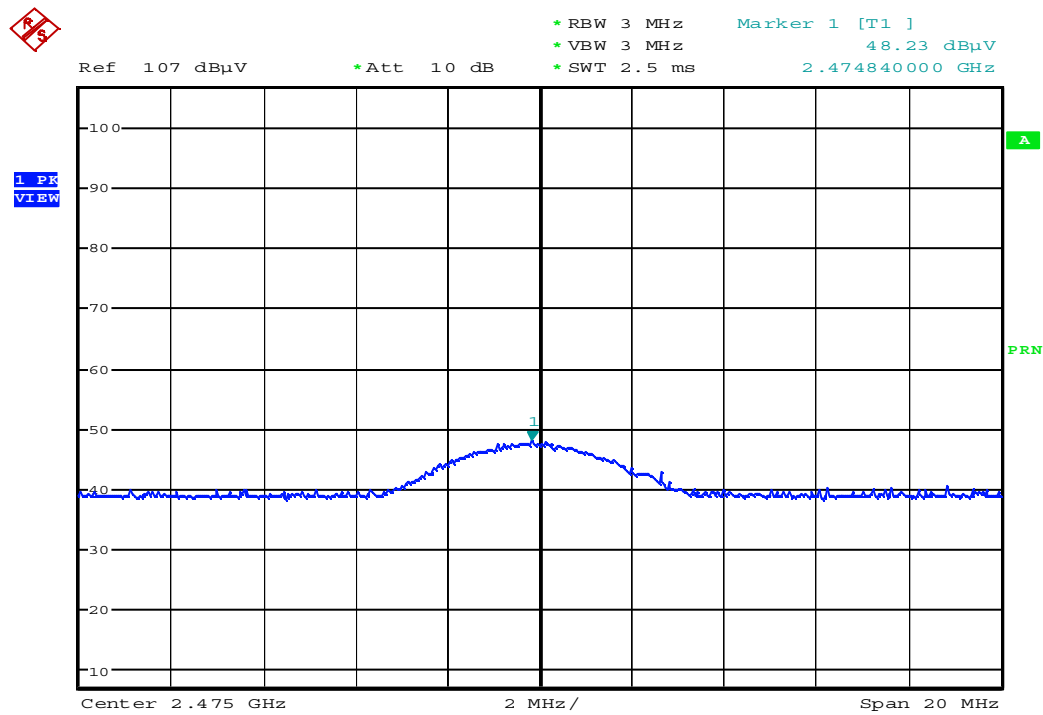


Channel : 16

Horizontal

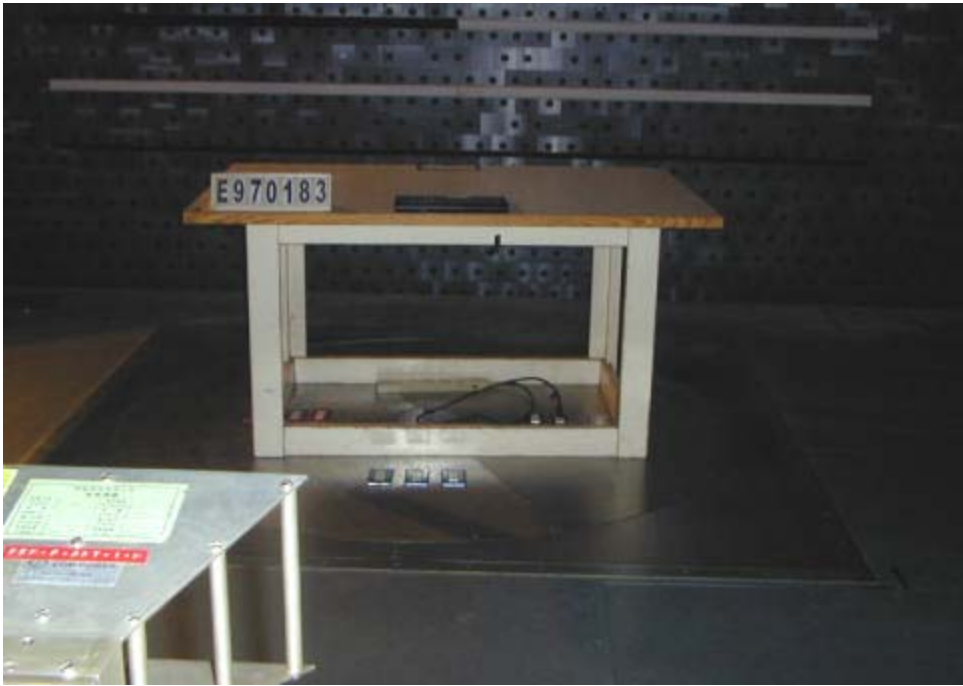


Vertical



=====

7.4 Test Setup Photo

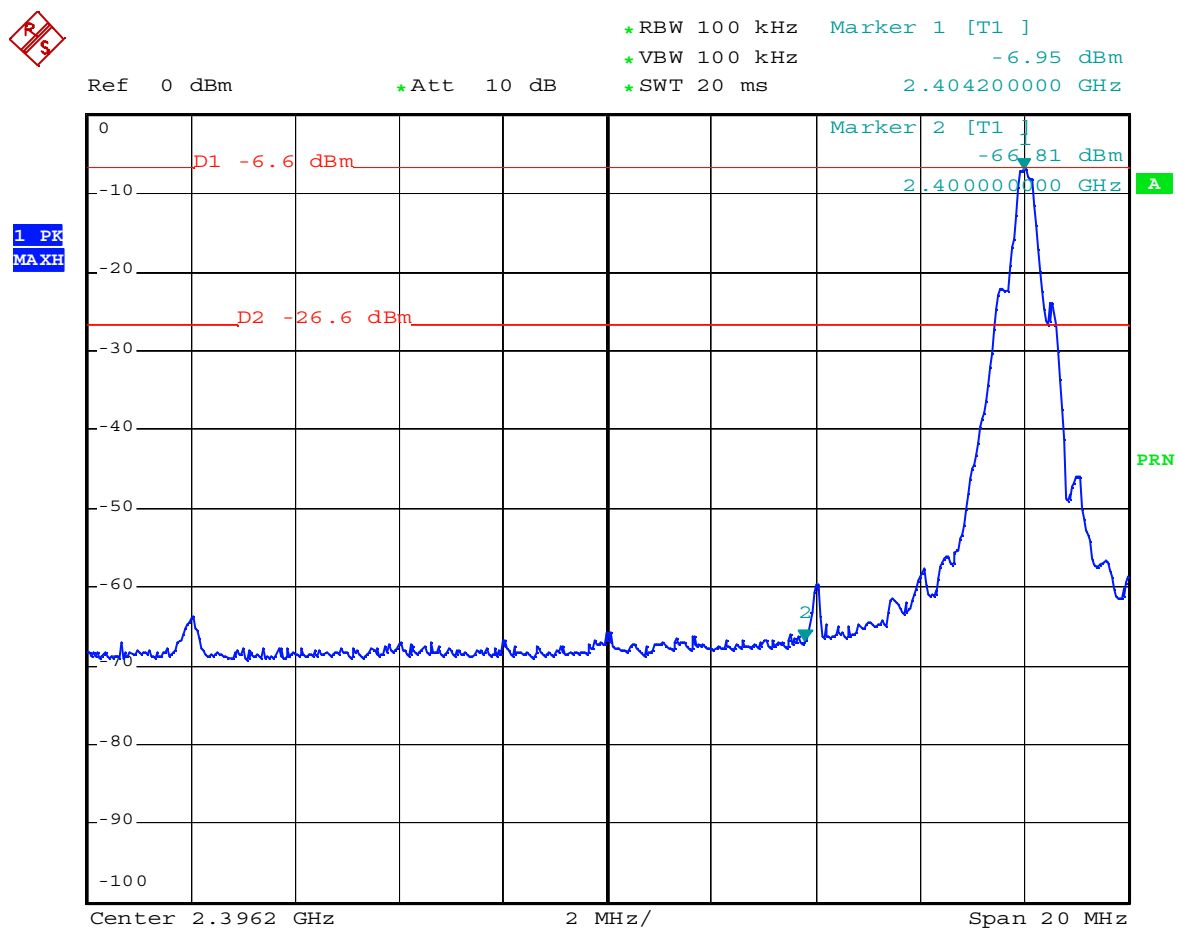


8. §15.247(d): 100KHz Outside Band Test

8.1 Band Edge Measurement

Channel: 1 Peak read: -6.95dBm, limit < -26.6dBm

Band-edges: 2.4GHz Peak read: -66.81dBm < -26.6dBm

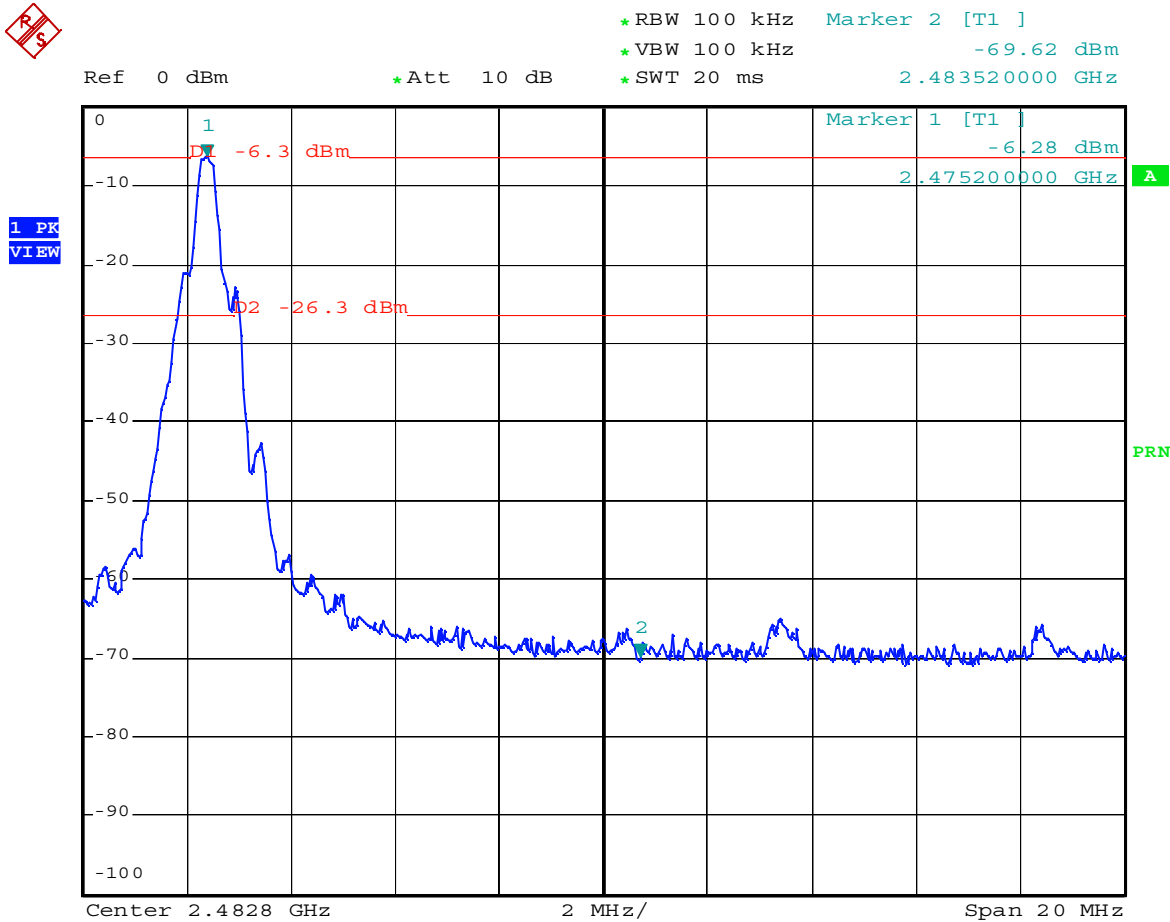


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Channel: 16 Peak read: -6.28dBm, limit < -26.3dBm
Band-edges: 2.4835GHz Peak read: -69.62dBm < -26.3dBm

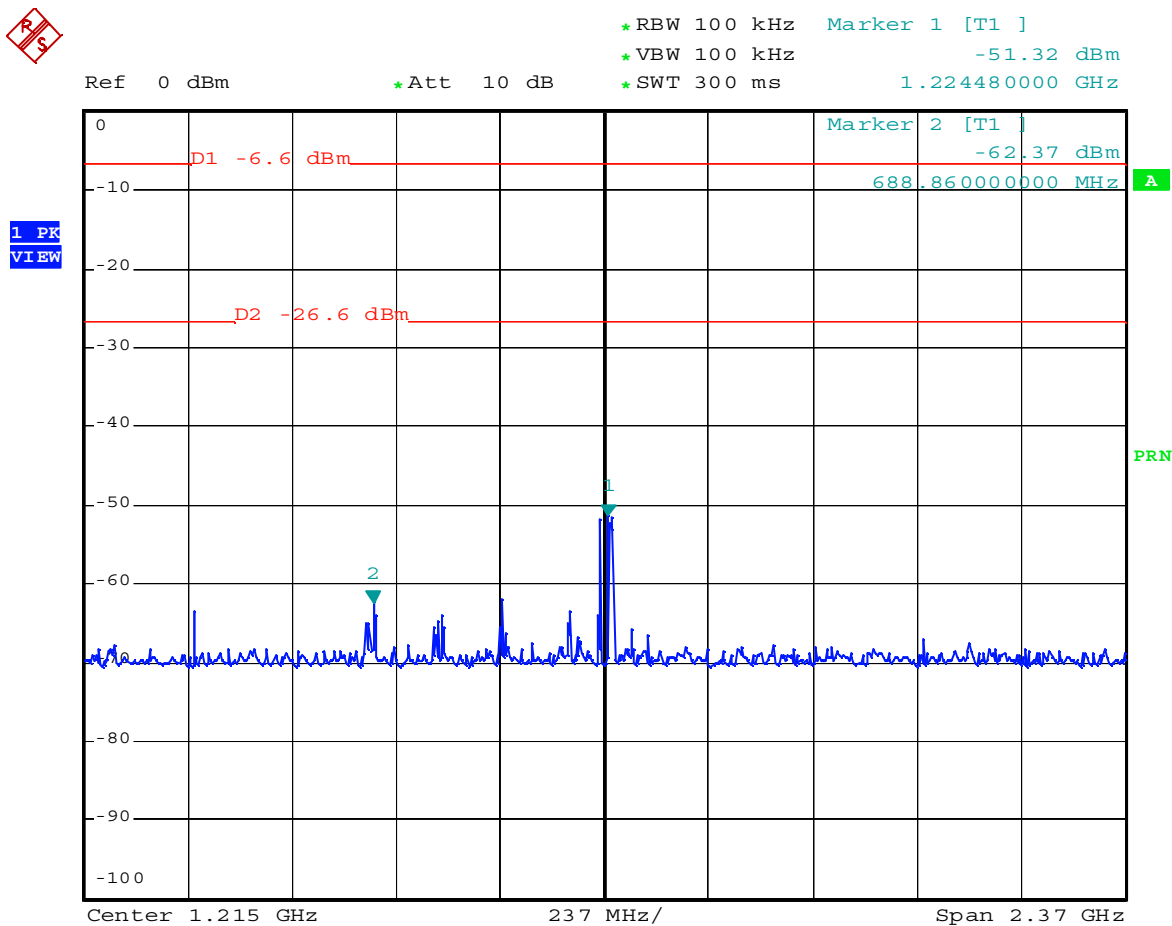


8.2 Spurious Emissions [Conducted]

Test Results:

Model No.	: PSK-3861		
Frequency range	: 30MHz to 2.4GHz	Detector	: Quasi-Peak Value
Temperature	: 27 °C	Humidity	: 57 %

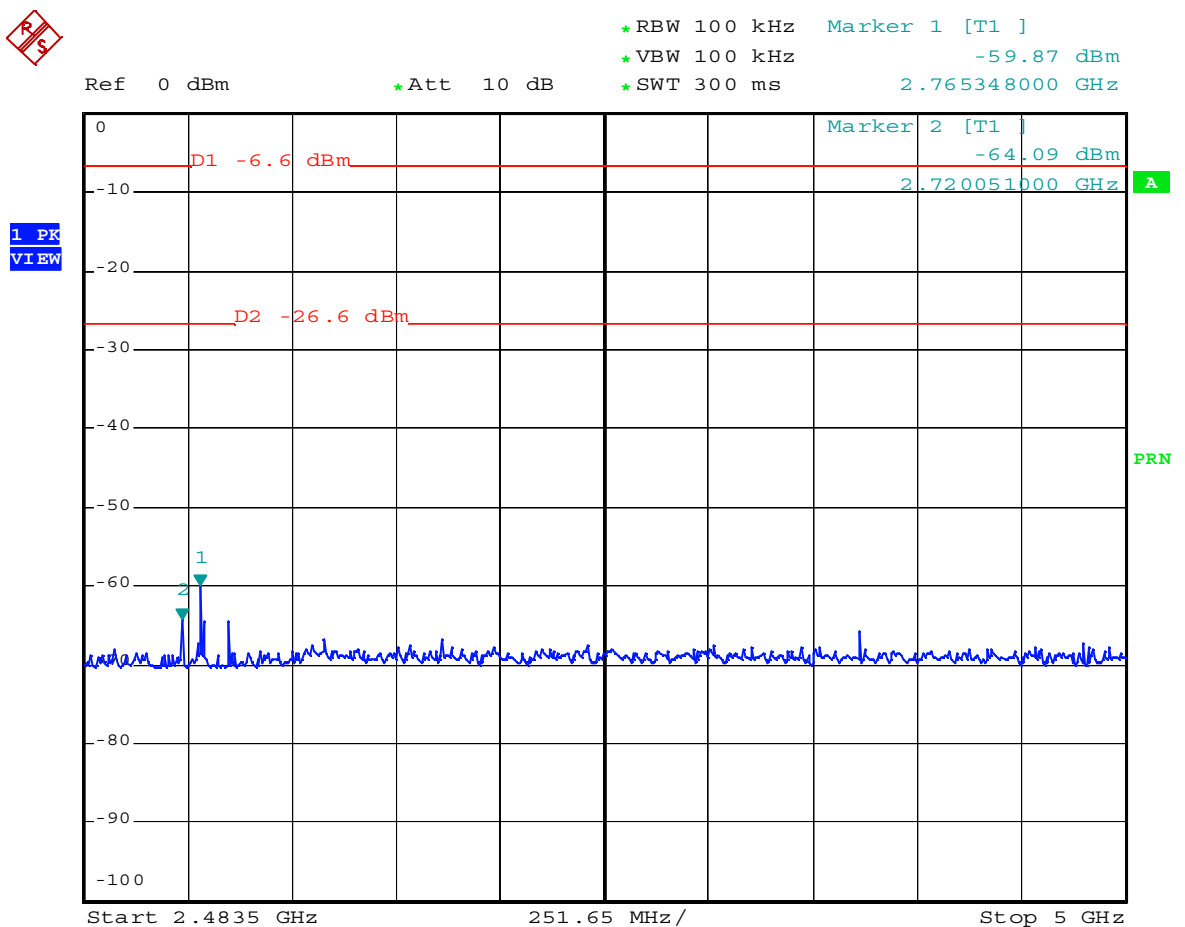
The highest value: 1.739GHz / -66.23dBm < -26.6dBm



Test Results:

Model No. : PSK-3861
 Frequency range : 2.4835GHz to 5GHz Detector : Quasi-Peak Value
 Temperature : 27 °C Humidity : 57 %

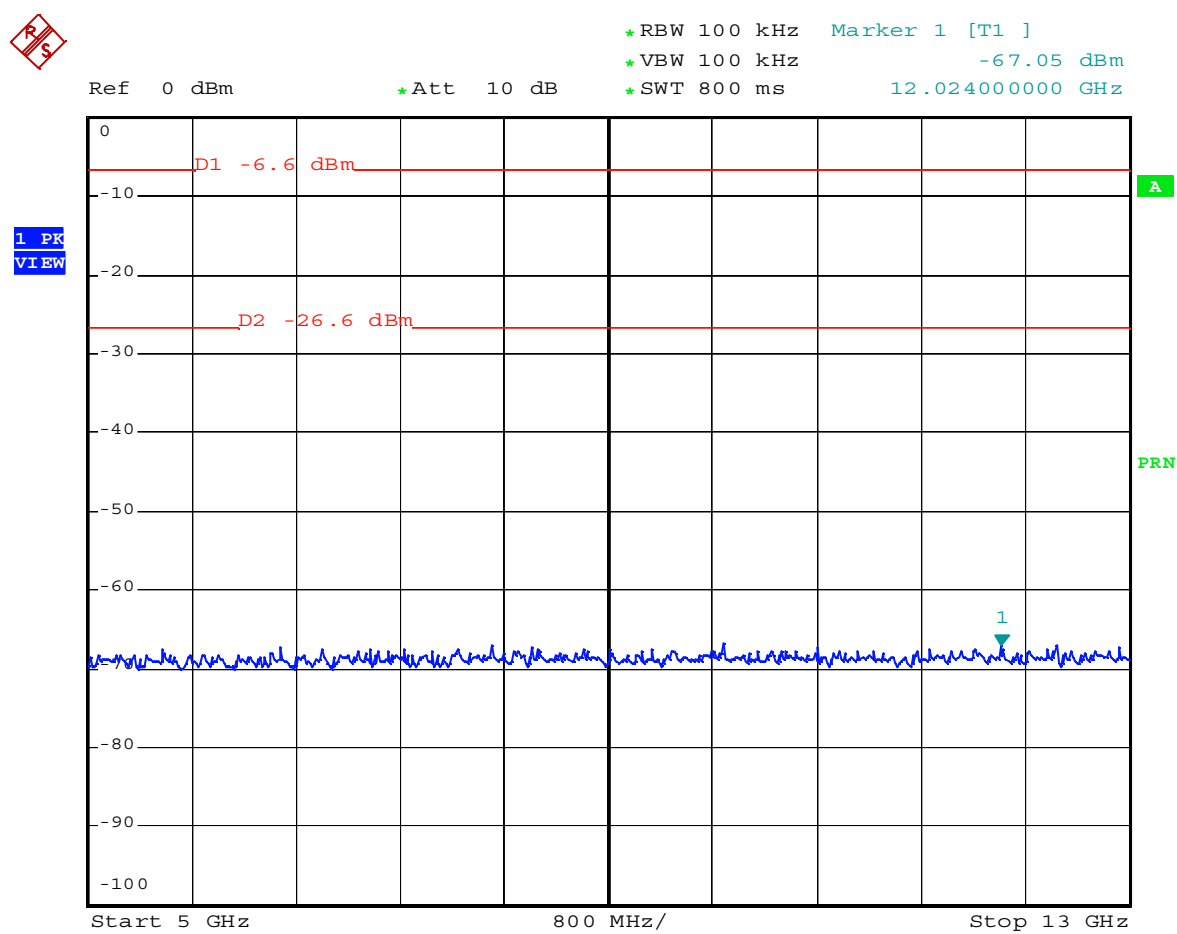
The highest value: 2.765GHz / -59.87dBm < -26.6dBm



Test Results:

Model No.	: PSK-3861		
Frequency range	: 5GHz to 13GHz	Detector	: Quasi-Peak Value
Temperature	: 27 °C	Humidity	: 57 %

The highest value: 12.024GHz / -67.05dBm < -26.6dBm



8.3 Spurious Emissions [Radiated]

Test method:

According to ANSI C63.4 (2003) paragraph 10.1.8.2, we indicate three highest spurious and three restrict band emission relative to the limit, as result.

When we performed “Spurious Radiated Emission”, the EUT was under continuous transmitting condition. It means the channel will transmit energy channel by channel, sequentially. Then the worst case data can be detected, we don't set F_L , F_M , F_H under test.

To avoid the pre-amplifier saturation by fundamental frequency, we added a “natch filter” (bandwidth from 2.4GHz to 2.4835GHz) between receiving antenna RF output and pre-amplifier's RF input to bypass fundamental frequency , and only detected spurious emission.

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Test result:

Measurement Range: 30MHz~24GHz

Resolution Bandwidth: 30MHz~1GHz, RBW=120KHz

Above 1GHz, RBW=1MHz

Temperature: 27 °C Humidity: 57 %

Antenna polarization: HORIZONTAL ; Test distance : 3m ;

Freq. (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Detector Mode
851.5	29.07	-51.33	80.40	24.47	21.79	4.81	22.00	Quasi-Peak
7210.0	44.07	-36.33	80.40	30.08	37.91	9.08	33.00	Peak
9610.0	47.20	-33.20	80.40	30.78	39.50	9.92	33.00	Peak

Restrict Band

2358.0	39.30	-14.70	54.00	38.51	28.41	5.38	33.00	Peak
4806.2	51.89	- 2.11	54.00	44.16	32.78	7.95	33.00	Peak
11989.0	48.42	- 5.58	54.00	31.11	39.81	10.50	33.00	Average

Antenna polarization: VERTICAL ; Test distance : 3m ;

Freq. (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Detector Mode
925.3	31.47	-48.93	80.40	25.24	23.08	5.15	22.00	Quasi-Peak
7190.0	44.09	-36.31	80.40	30.08	37.93	9.08	33.00	Peak
9635.0	47.05	-33.35	80.40	30.58	39.54	9.93	33.00	Peak

Restrict Band

2376.2	39.16	-14.84	54.00	38.32	28.43	5.41	33.00	Peak
4836.4	49.24	- 4.76	54.00	41.35	32.91	7.98	33.00	Peak
12145.0	48.31	- 5.69	54.00	30.82	39.96	10.53	33.00	Average

Note: If the Peak level under Average limit, the Average detector will not be perform.

9. §15.247(e): The Power Spectral Density

9.1 Test Procedure

§15.247, Measurement of Digital Transmission Systems. Alternative Test Procedures (2).

Temperature: 27 °C Humidity: 57 %
 RBW=3KHz VBW=10KHz
 SWT=100s Spectrum Line > 3KHz
 Limit < +8dBm Test distance = 3m

9.2 Test result of Peak Power Spectral Density

Channel	A.P.	Frequency (GHz)	S.A. Read (dBμV/m)	C. L. (dB)	A. F. (dB)	E (dBμV/m)	E (V/m)	P (dBm)	Test Result
1	H	2.404	44.55	5.46	28.48	78.49	8.4×10^{-3}	-17.21	PASS
	V		35.52			69.46	2.97×10^{-3}	-26.98	PASS
9	H	2.440	47.78	5.52	28.53	81.83	12.35×10^{-3}	-13.87	PASS
	V		39.7			73.75	4.87×10^{-3}	-22.21	PASS
16	H	2.475	46.2	5.57	28.58	80.35	10.41×10^{-3}	-15.37	PASS
	V		40.42			74.57	5.35×10^{-3}	-20.96	PASS

Note: "A.P." means Antenna Polarization

"S.A." Read" means Spectrum Analyzer Reading

"C.L." means RF Cable Loss

"A.F." means Antenna Factor

$E = \text{S.A Read} + \text{C.L.} + \text{A.F.}$

$P (W) = (E \times d)^2 / 30 \times G$

Where: E = the measured maximum field strength in V/m.

G = the numeric gain of the transmitting antenna over an isotropic radiator.

= 0.5 dBi = 1.12

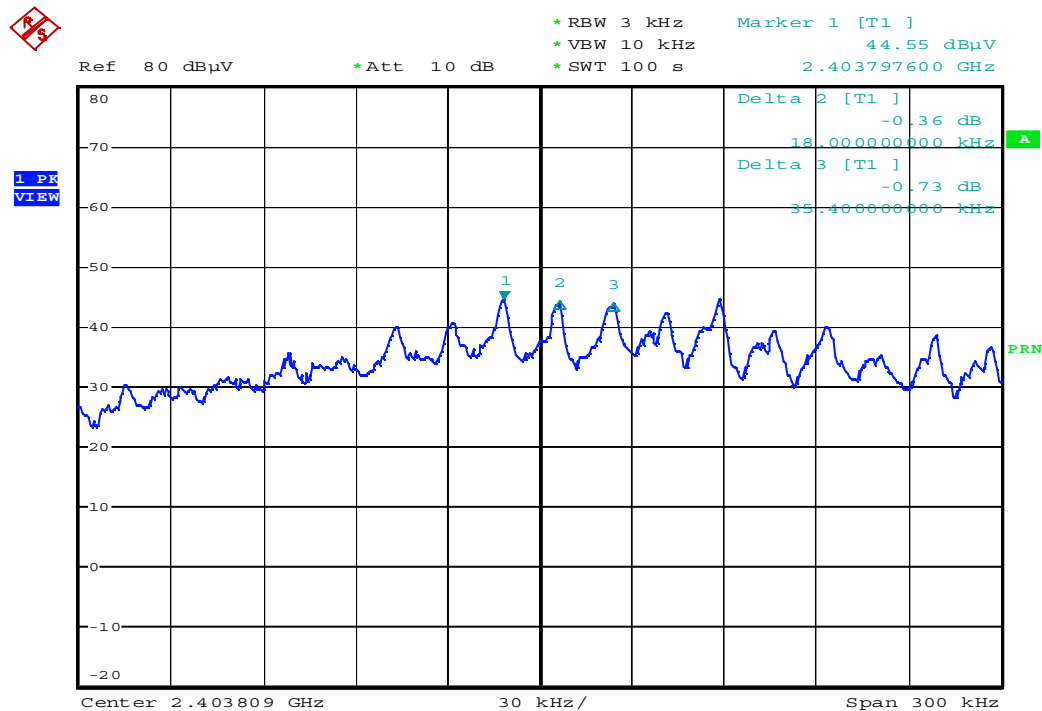
d = the distance in meters from which the field strength was measured.

= 3m

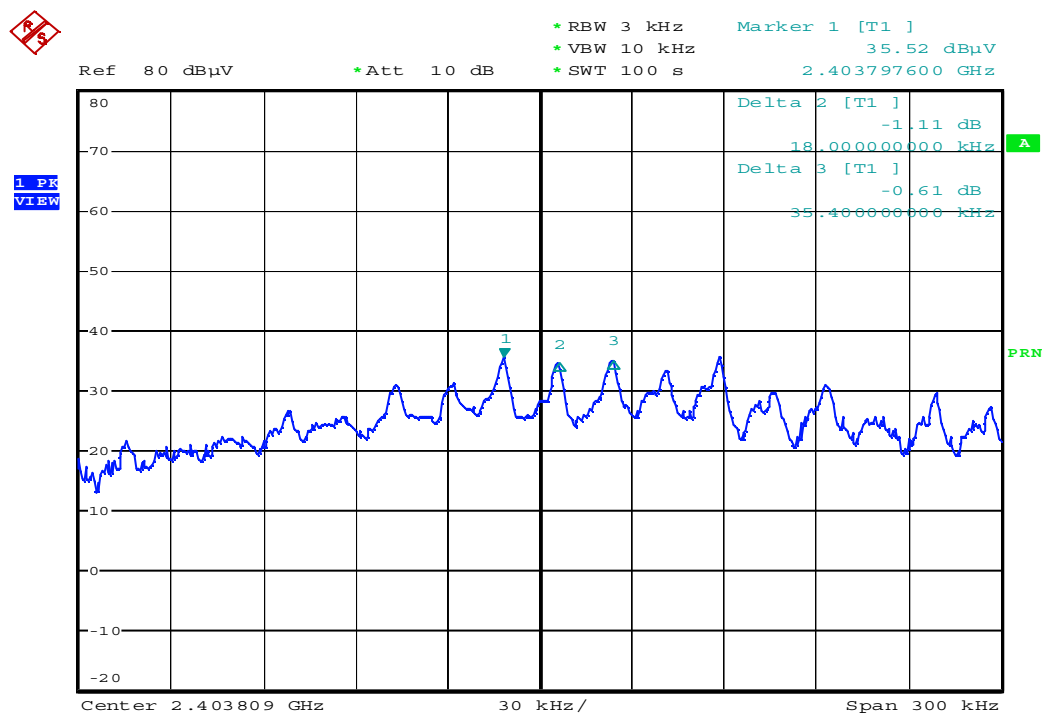
9.3 Spectrum Plot Data

Channel : 1

Horizontal

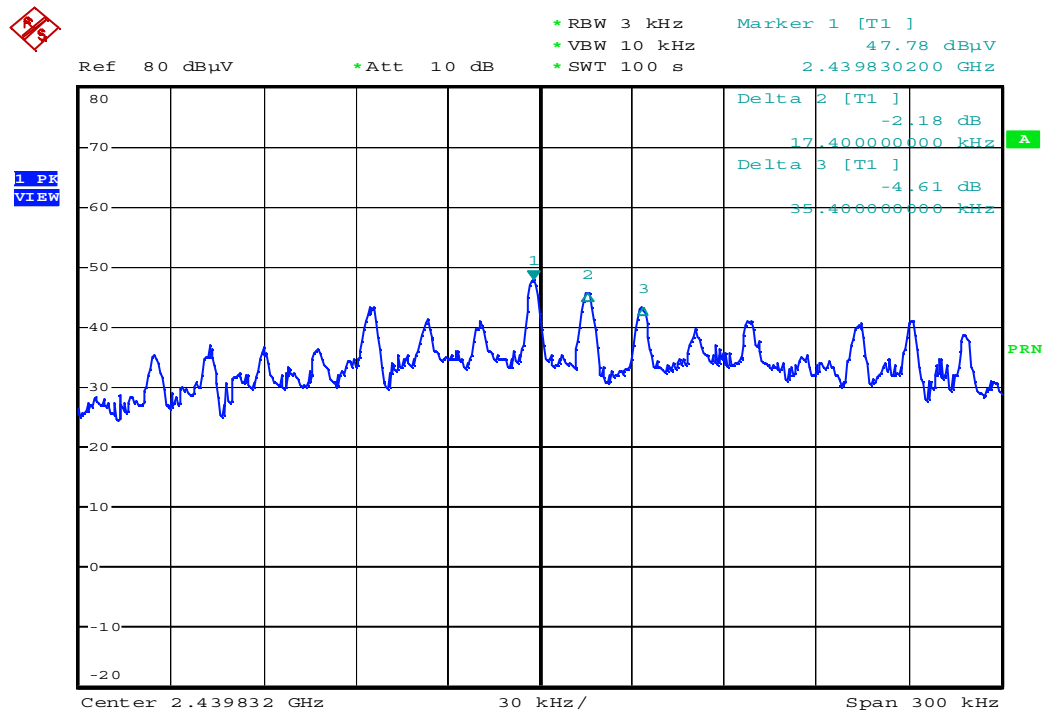


Vertical

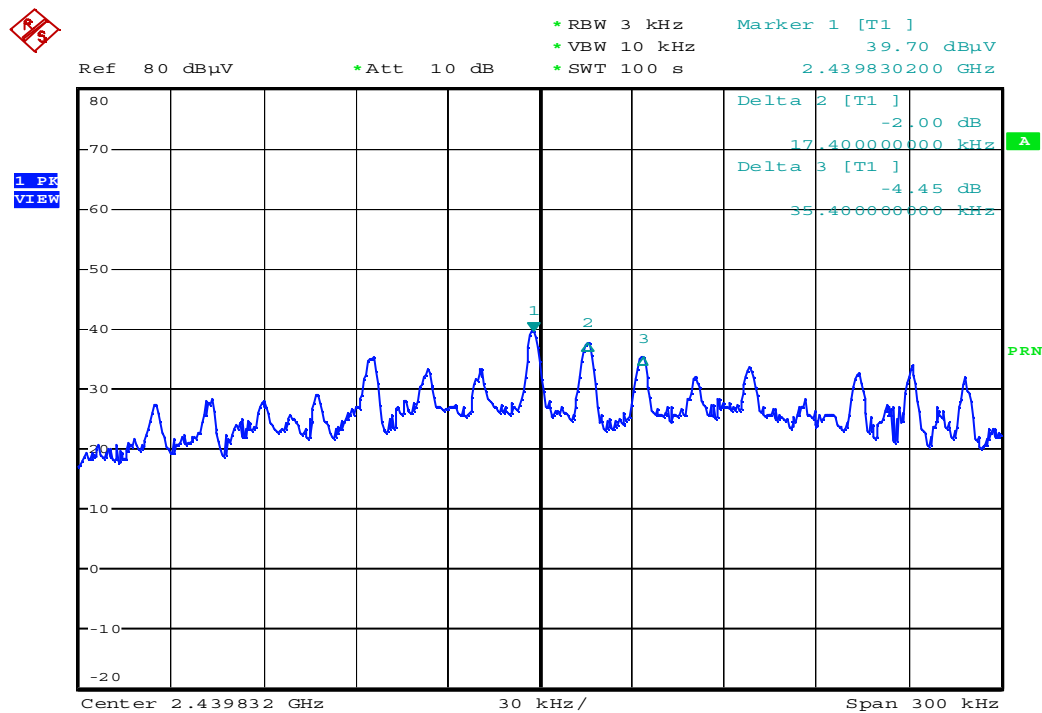


Channel : 9

Horizontal

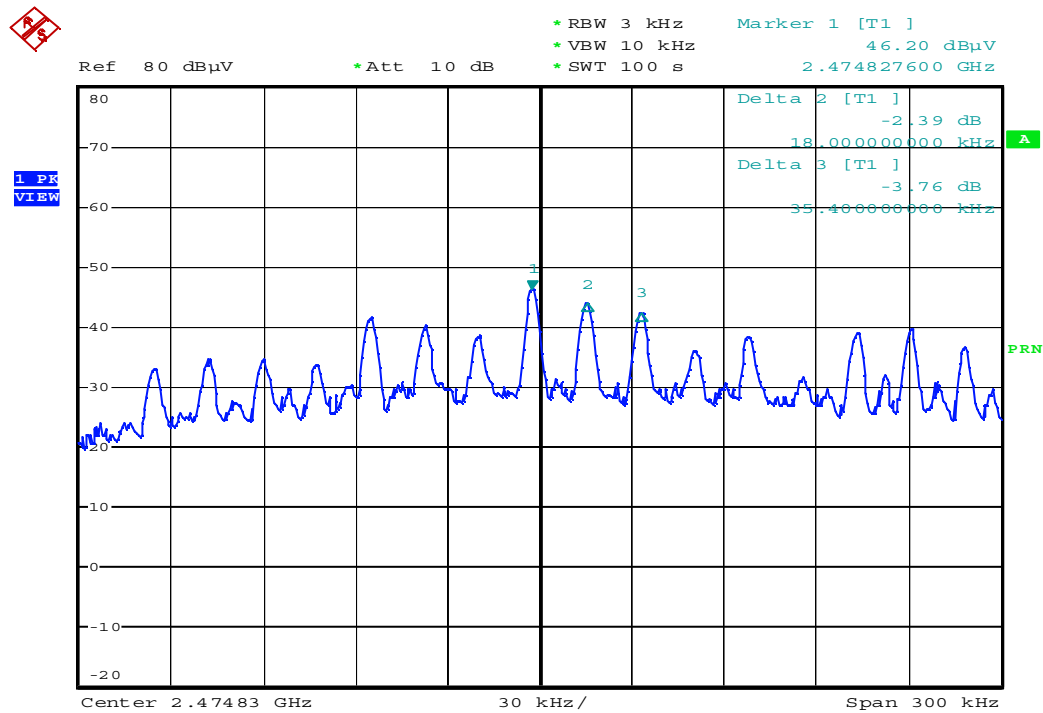


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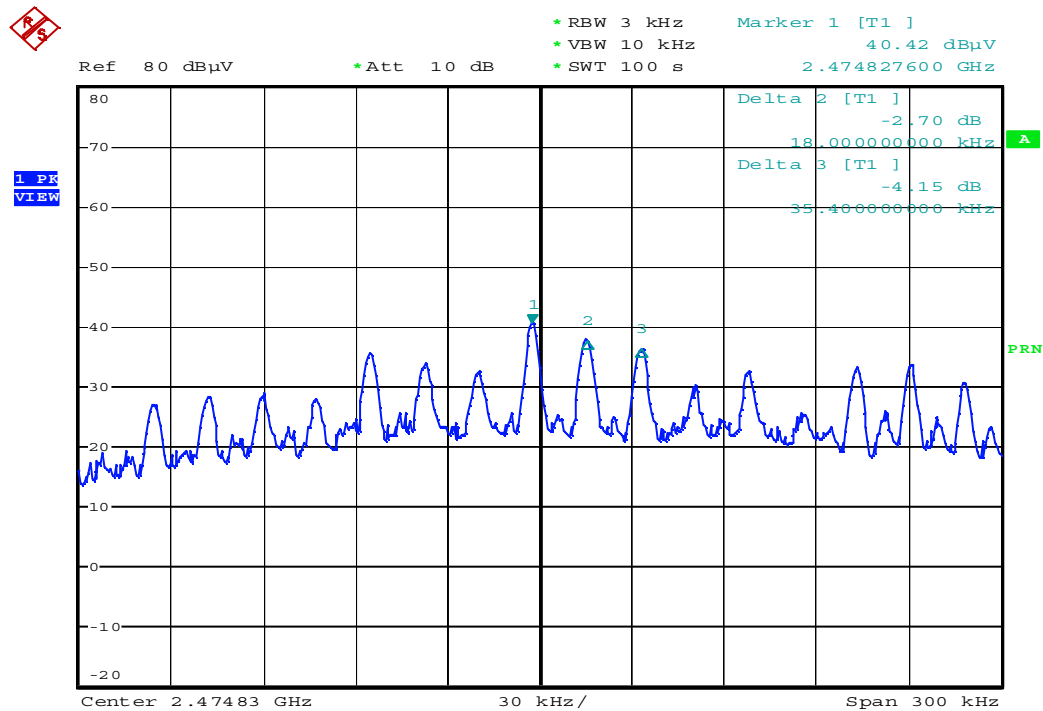


Channel : 16

Horizontal



Vertical



9.4 Test Setup Photo



10. §15.247(e)(i): Maximum Permissible Exposure (MPE)

Limit < 1 Watt

10.1 MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 \cdot P \cdot G}}{d}$$

$$\text{Power Density} = P_d \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

Mix these two formulas can be changed to

$$P_d = \frac{30 \cdot P \cdot G}{377 \cdot d^2}$$

Note:

1. "E" means Electric field (V/m)
2. "P" means Peak RF output power (W)
3. "G" means EUT Antenna numeric gain (numeric)
4. "d" means the minimum mobile separation distance is 0.2m between radiator and human body.

10.2 Calculated Result and Limit

Channel	Antenna Gain (numeric)	Peak Output Power (mW)	Power Density(S) (mW / cm ²)	Limit of Power Density(S) (mW / cm ²)	Test Result
1	1.12	0.161	0.357x10 ⁻³	<1	PASS
9	1.12	0.216	0.481x10 ⁻³	<1	PASS
16	1.12	0.19	0.423x10 ⁻³	<1	PASS

11. List of Test Instruments

Test Site	Instrument	Manufacturer	Model No.	S/N	Next Cal. Date	Cal. Interval
Chamber (No. 3)	Spectrum Analyzer	ROHDE& SCHWARZ	FSP30	100157	Sep. 01, 2009	1 Year
	30MHz~1GHz RF Cable	YEIDA WIRE CABLE	NO.3	N/A	Jan. 01, 2009	1 Year
	1GHz~26.5GHz RF Cable	MITEQ	N/A	N/A	Sep. 28, 2010	2 Years
	Horn Antenna 1GHz~18GHz	COM-POWER	AH-826	081000	Aug. 20, 2009	2 Years
	Horn Antenna 18GHz~26GHz	COM-POWER	AH-118	10056	Oct. 02, 2010	2 Years
	Preamplifier 1GHz~18GHz	MITEQ	28-5A	513015	Sep. 29, 2009	1 Year
	Preamplifier 18GHz~26GHz	MITEQ	30-5A	808329	May 15, 2009	1 Year

12. EUT Photos

FCC ID : RAC3861A01

EUT FRONT VIEW



EUT REAR VIEW



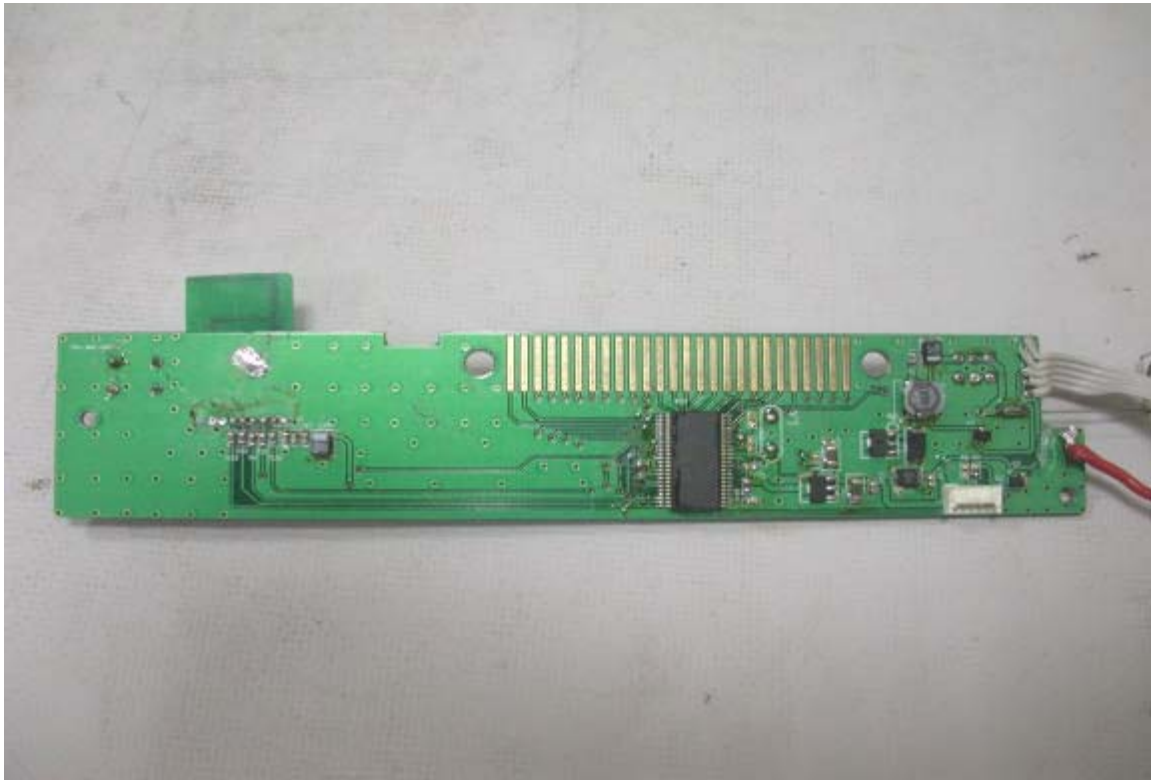
EUT INSIDE VIEW



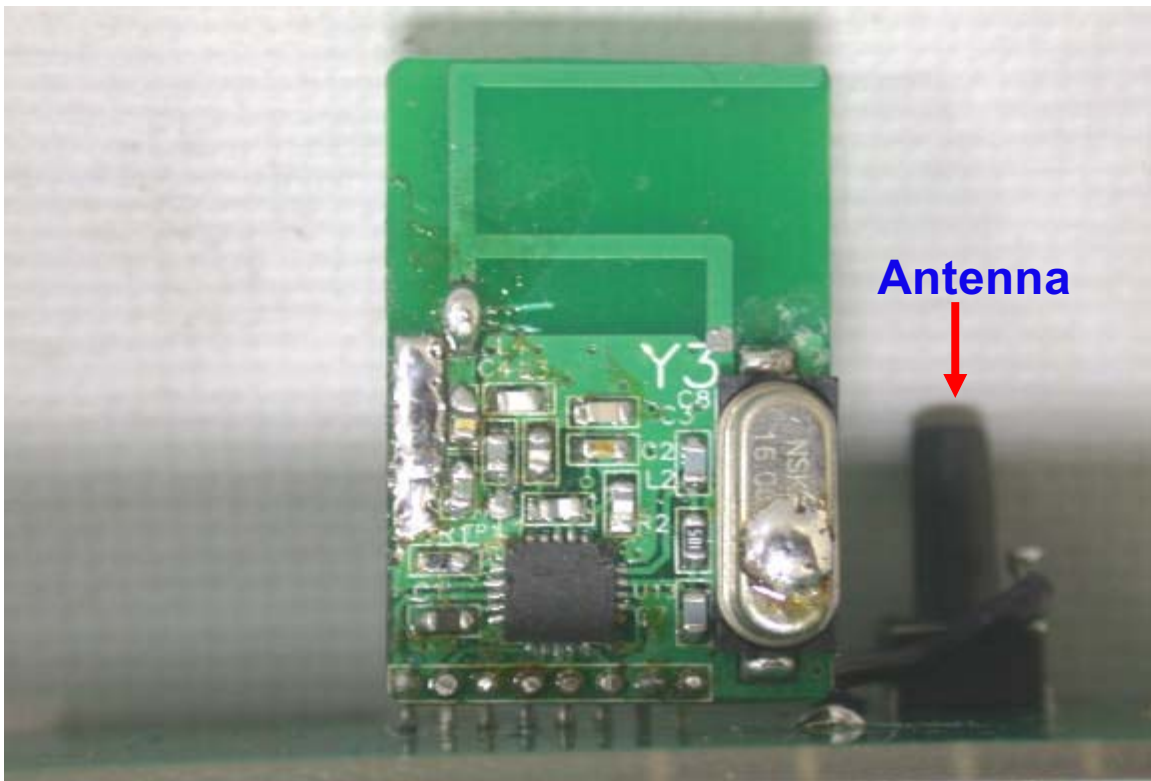
EUT MAIN BOARD VIEW



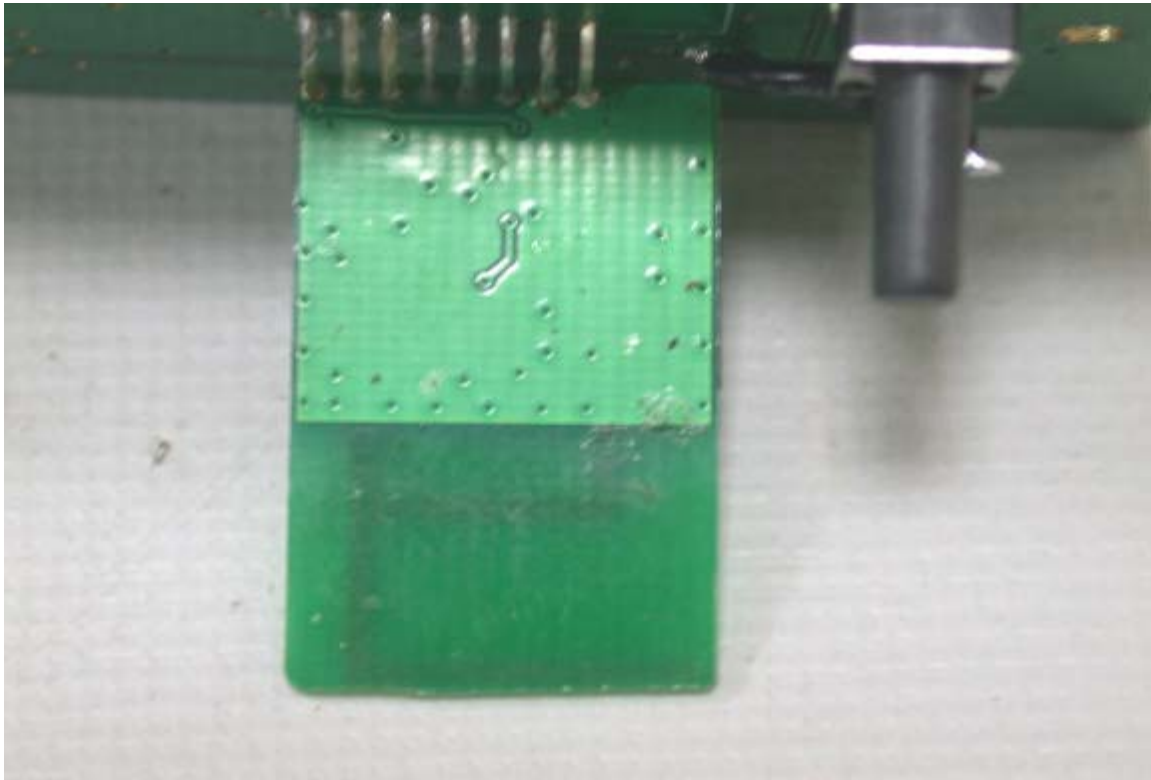
EUT SOLDERING VIEW



EUT COMPONENT VIEW



EUT SOLDERING VIEW



EUT MODULE VIEW

