FCC Part 15C
Measurement and Test Report

For

ATID CO., LTD

#1211 Byuksan/Kyungin Digitalvalley 11, 184, Gasan digital 2-ro,

Geumcheon-gu, Seoul, Korea

FCC ID: VUJATM2000S1

FCC Rule(s):	FCC Part 15C
Product Description:	ATM2000 Module
Tested Model:	ATM2000
Report No.:	STR16118115I
Tested Date:	2016-11-14 to 2016-12-21
Issued Date:	2016-12-22
Tested By:	Neil Wong / Engineer
Reviewed By:	Silin Chen / EMC Manager
Approved & Authorized By:	Jandy So / PSQ Manager

Prepared By:

Shenzhen SEM.Test Technology Co., Ltd.
1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road,
Bao'an District, Shenzhen, P.R.C.（518101）
Tel.: +86-755-33663308 Fax.: +86-755-33663309 Website: www.semtest.com.cn

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	ATID CO., LTD
Address of applicant:	#1211 Byuksan/Kyungin Digitalvalley 11, 184, Gasan digital 2-ro, Geumcheon-gu, Seoul, Korea
Manufacturer:	ATID CO., LTD
Address of manufacturer:	#1211 Byuksan/Kyungin Digitalvalley 11, 184, Gasan digital 2-ro, Geumcheon-gu, Seoul, Korea

General Description of EUT	
Product Name:	ATM2000 Module
Brand Name:	Atid
Model No.:	ATM2000
Adding Model:	/
Hardware Version:	Ver1.1.1
Software Version:	Ver1.0
Rated Voltage:	DC 3.7V
Rated Current:	1.5A
Power Adaptor:	/
Device Category:	Fixed or mobile Device
Note: The test data is gathered from a production sample provided by the manufacturer.	

Technical Characteristics of EUT	
Frequency Range:	902.75MHz-927.25MHz
RF Output Power:	26.75dBm(Conducted)
Modulation:	ASK
Quantity of Channels:	50
Channel Separation:	500KHz
Antenna Type:	External
Antenna Gain:	Antenna 1: 1dBi, Antenna 2: -1dBi

1.2 Test Standards

The following report is prepared on behalf of the ATID CO., LTD in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices, and ANSI C63.4-2014, 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. The measurement guide DA 00-705 for frequency hopping spread spectrum systems shall be performed also.

1.4 Test Facility

FCC – Registration No.: 934118

Shenzhen SEM.Test Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files and the Registration is 934118.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Shenzhen SEM.Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

CNAS Registration No.: L4062

Shenzhen SEM.Test Technology Co., Ltd. is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L4062. All measurement facilities used to collect the measurement data are located at 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C (518101).

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low Channel	902.75MHz
TM2	Middle Channel	914.75 MHz
TM3	High Channel	927.25 MHz

Accessories Equipment List and Details			
Description	**Manufacturer**	**Model No.**	**Serial Number**
DC power	mpja	QJ6010E	DC power
Accessories Cable List and Details			
Cable Description	**Length (m)**	**Shielded/Unshielded**	**With Core/Without Core**
Cable*2	2.0	unshielded	Without Core
EUT Cable List and Details			
Cable Description	**Length (m)**	**Shielded/Unshielded**	**With Core/Without Core**
/	/	/	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	±0.42dB
Occupied Bandwidth	Conducted	±1.5%
Conducted Spurious Emission	Conducted	±2.17dB
Conducted Emissions	Conducted	±2.88dB
Transmitter Spurious Emissions	Radiated	±5.1dB

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2016-06-04	2017-06-03
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2016-06-04	2017-06-03
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2016-06-04	2017-06-03
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2016-06-04	2017-06-03
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2016-06-04	2017-06-03
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2016-06-04	2017-06-03
SEMT-1042	Horn Antenna	ETS	3117	00086197	2016-06-04	2017-06-03
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2016-06-04	2017-06-03
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2016-06-04	2017-06-03
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2016-06-04	2017-06-03
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2016-06-04	2017-06-03
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2016-06-04	2017-06-03

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 2.1093	RF Exposure	Compliant
§ 15.203; § 15.247(b)(4)(i)	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§ 15.207(a)	Conducted Emission	Compliant
§ 15.209(a)	Radiated Spurious Emissions	Compliant
§ 15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§ 15.247(a)(1)	Channel Separation	Compliant
§ 15.247(a)(1)(iii)	Time of Occupancy (Dwell time)	Compliant
§ 15.247(a)	20dB Bandwidth	Compliant
§ 15.247(b)(1)	RF Power Output	Compliant
§ 15.247(d)	Band Edge (Out of Band Emissions)	Compliant
§ 15.247(a)(1)	Frequency Hopping Sequence	Compliant
§ 15.247(g), (h)	Frequency Hopping System	Compliant

N/A: not applicable

3. RF Exposure

3.1 Standard Applicable

According to § 1.1307 and § 2.1093, the portable transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.

4. Antenna Requirement

4.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

4.2 Evaluation Information

This module was authorized to use two external antennas, which supplied by the manufacturer and fulfill the requirement of this section.

5. Frequency Hopping System Requirements

5.1 Standard Applicable

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

5.2 Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 902-928 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 50 bands (0.5 MHz each; centred from 902 to 928 MHz) in the range 902-928 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with an bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for DA 00-705 and FCC Part 15.247 rule.

5.3 EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:
Channel: 27, 26, 2, 49, 48, 4, 50, 36, 34, 14, 33, 31, 6, 5, 46, 39, 25, 9, 23, 40, 18, 19, 3, 13,7, 20, 8, 30, 24, 10, 32, 28, 16, 17, 11, 45, 15, 35, 29, 22, 43, 12, 47, 21, 44, 38, 37, 41, 1, 42

The system receiver has input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

6. Quantity of Hopping Channels and Channel Separation

6.1 Standard Applicable

According to FCC 15.247(a)(1), frequency hopping systems operating in the 902-928 MHz 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, and frequency hopping systems in the 902-928 MHz band shall use at least 15 channels.

6.2 Test Procedure

According to the DA 00-705, the number of hopping frequencies test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Set span = the frequency band of operation (902MHz to 928MHz)
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize, observed the band of 902MHz to 928MHz, than count it out the number of channels for comparing with the FCC rules.

The channel spacing test method as follows:

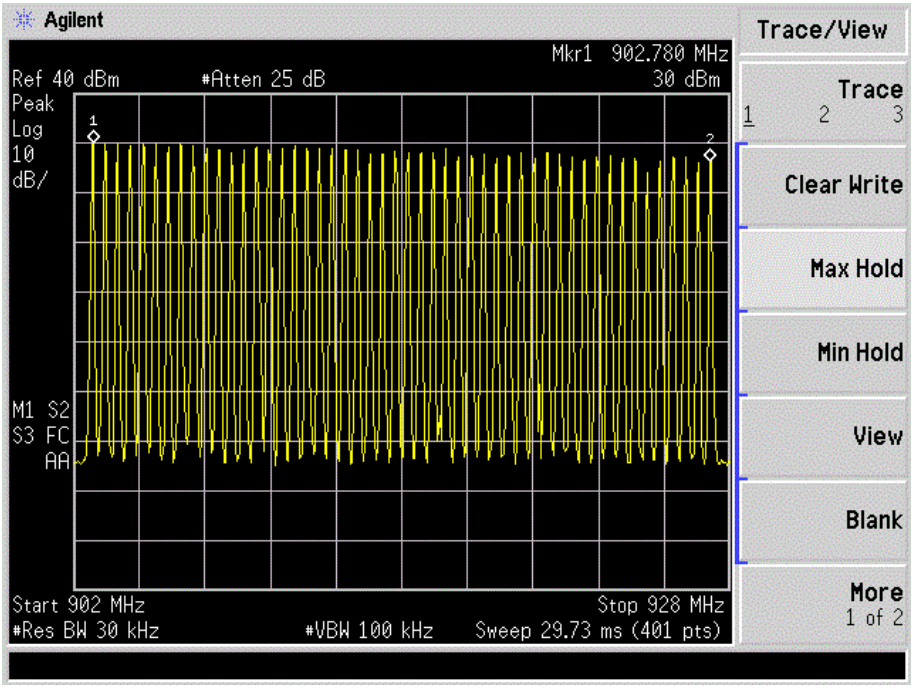
Set span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
Video (or Average) Bandwidth (VBW) ≥ RBW
Sweep = auto; Detector function = peak; Trace = max hold
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

6.3 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

6.4 Summary of Test Results/Plots

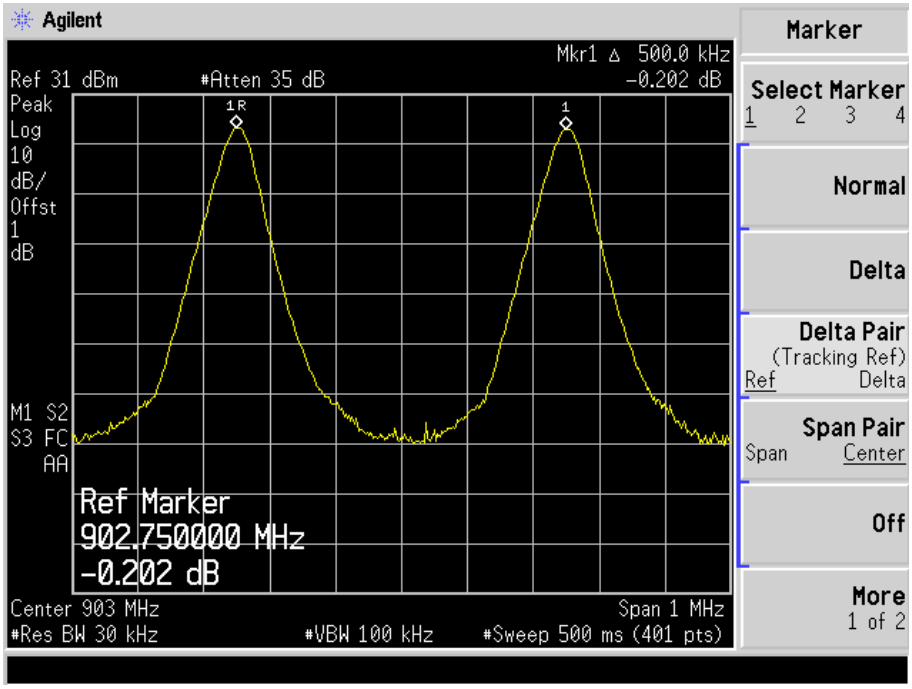
No. of Channel = 50



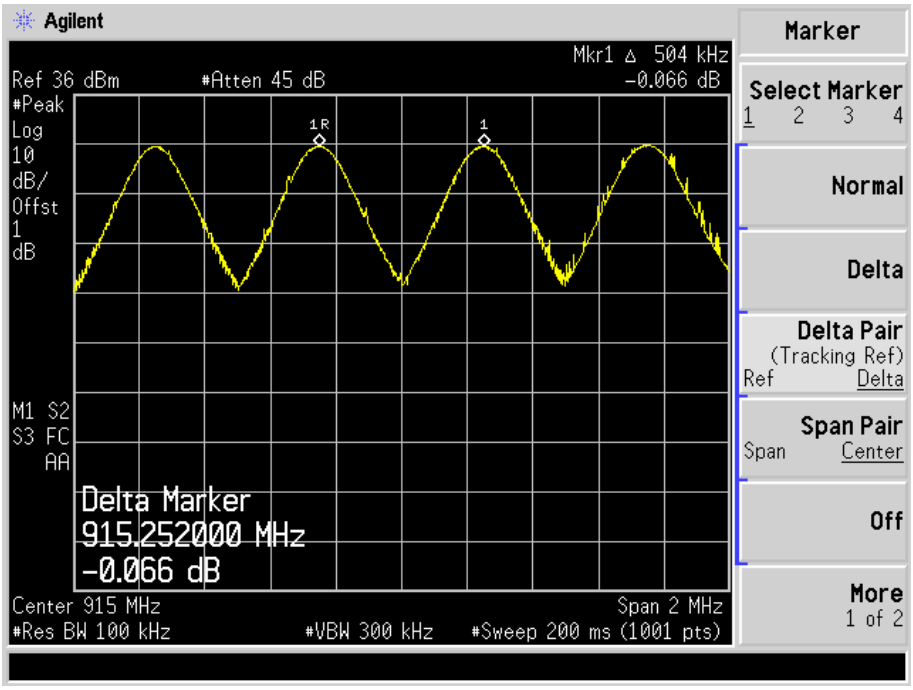
For GFSK mode

Channel Spacing

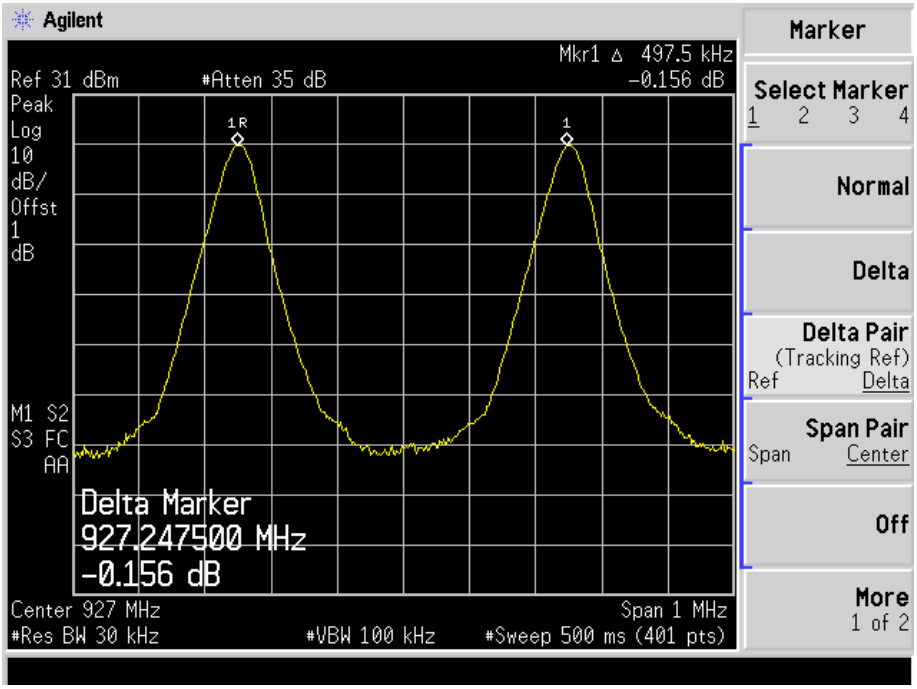
Low Channel CH=500 kHz



Middle Channel CH=504 kHz



High Channel CH=497.5 kHz



7. Dwell Time of Hopping Channel

7.1 Standard Applicable

According to 15.247(a)(1)(iii), Frequency hopping systems in the 902-928 MHz band shall use at least 15 channels. 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.

7.2 Test Procedure

According to the DA 00-705, the dwell time of a hopping channel test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold
Use the marker-delta function to determine the dwell time

7.3 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

7.4 Summary of Test Results/Plots

The dwell time within a period in data mode is independent from the packet type (packet length).
Test data is corrected with the worse case, which the packet length is DH1, DH3, and DH5.

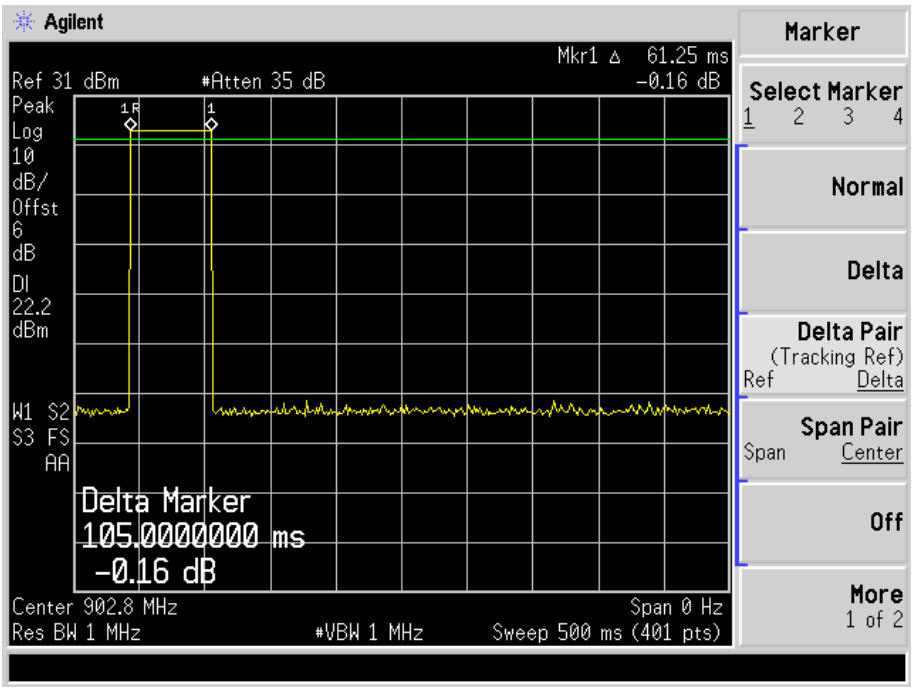
The test period: T = 0.4 Second * 50 Channel = 20 s
Dwell time = time slot length* (Number of Bursts /Sweep time) * Period

Frequency (MHz)	Test period (s)	Number of Bursts per Hopping Period	Burst Duration (s)	Dwell time (s)	Limit (s)
902.75	20	2	0.1050	0.21	0.4
914.75	20	2	0.1224	0.2448	0.4
927.25	20	2	0.1475	0.295	0.4

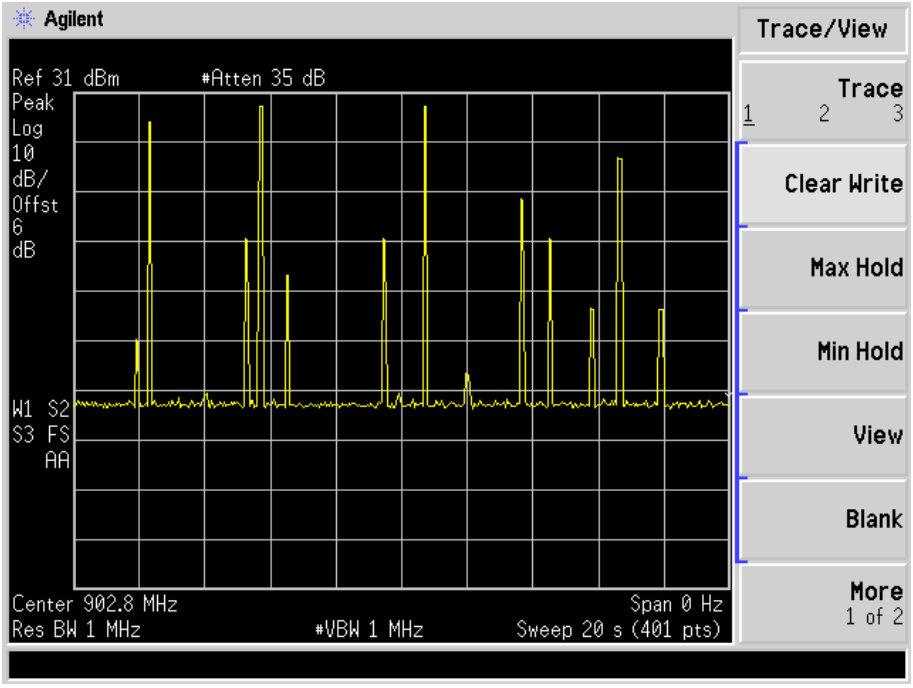
Please refer to the test plots as below:

Low Channel

Burst Duration

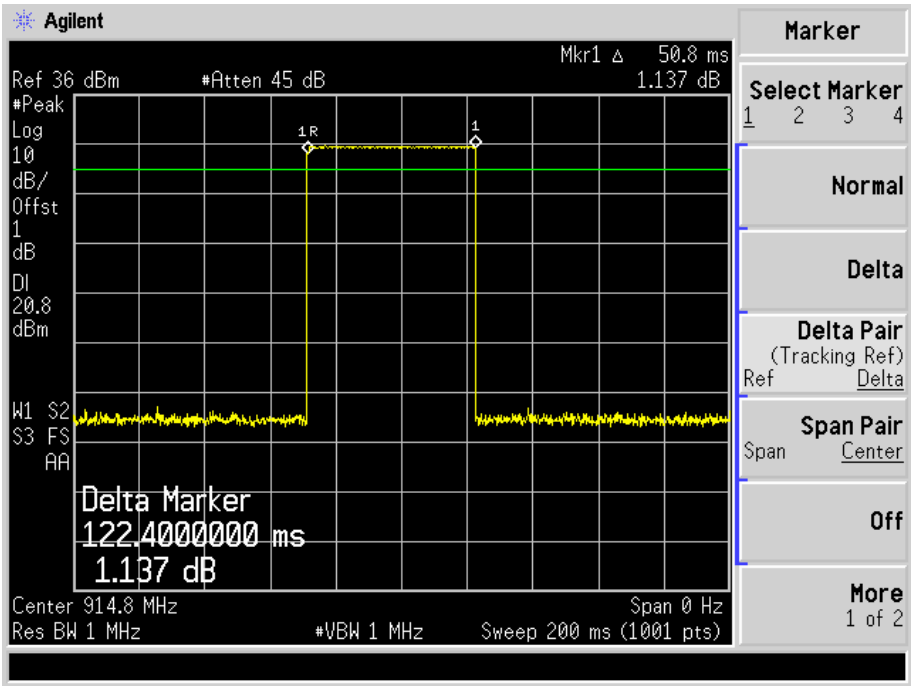


Number of Bursts

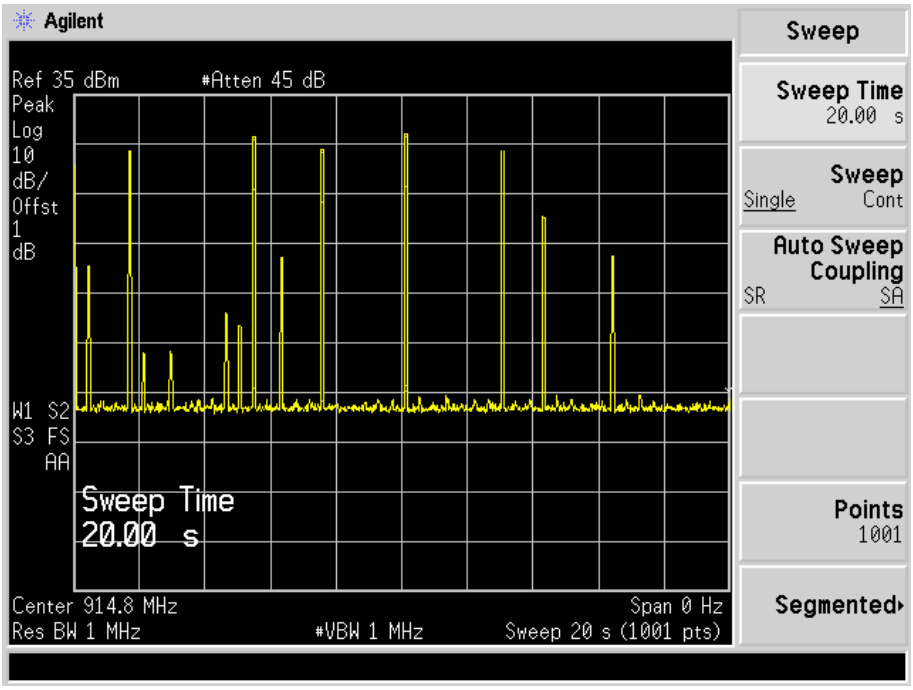


Middle Channel

Burst Durration

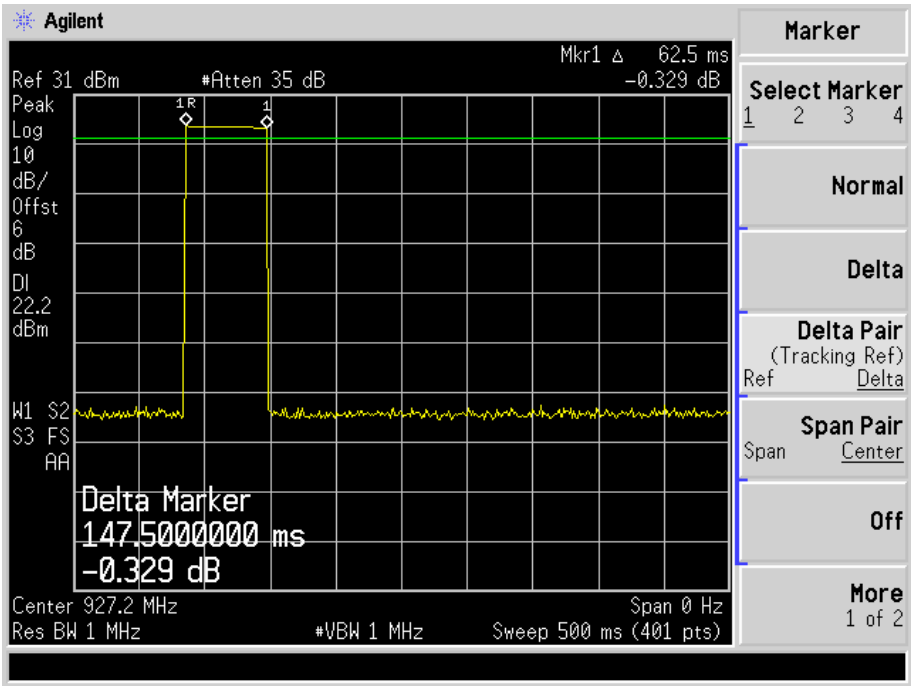


Number of Bursts

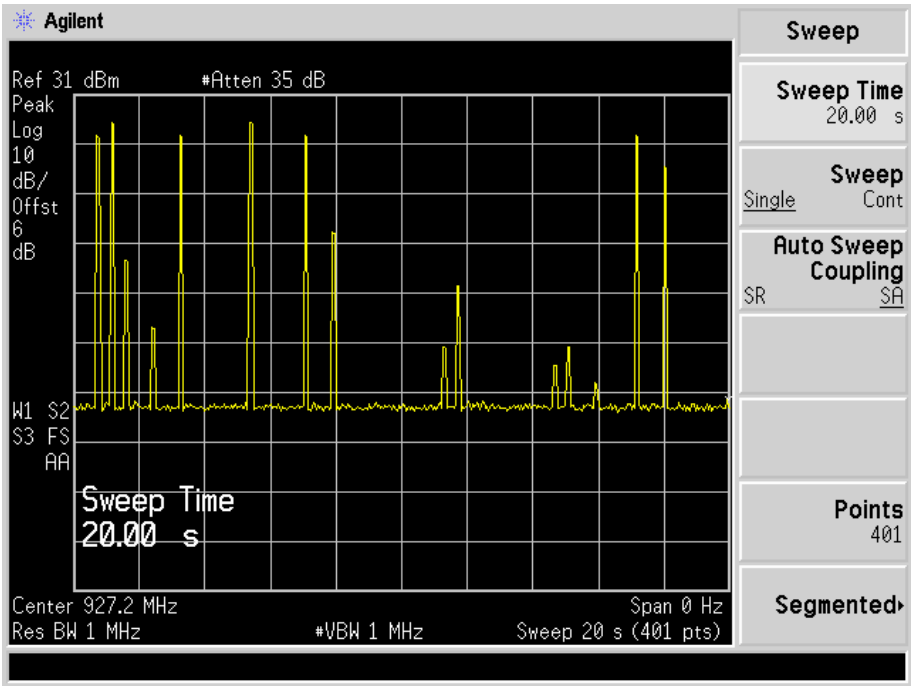


High Channel

Burst Duration



Number of Bursts



8. 20dB Bandwidth

8.1 Standard Applicable

According to 15.247(a) and 15.215(c). 20dB bandwidth is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

8.2 Test Procedure

According to the DA 00-705, the 20dB bandwidth test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto; Detector function = peak
Trace = max hold
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down bandwidth of the emission.

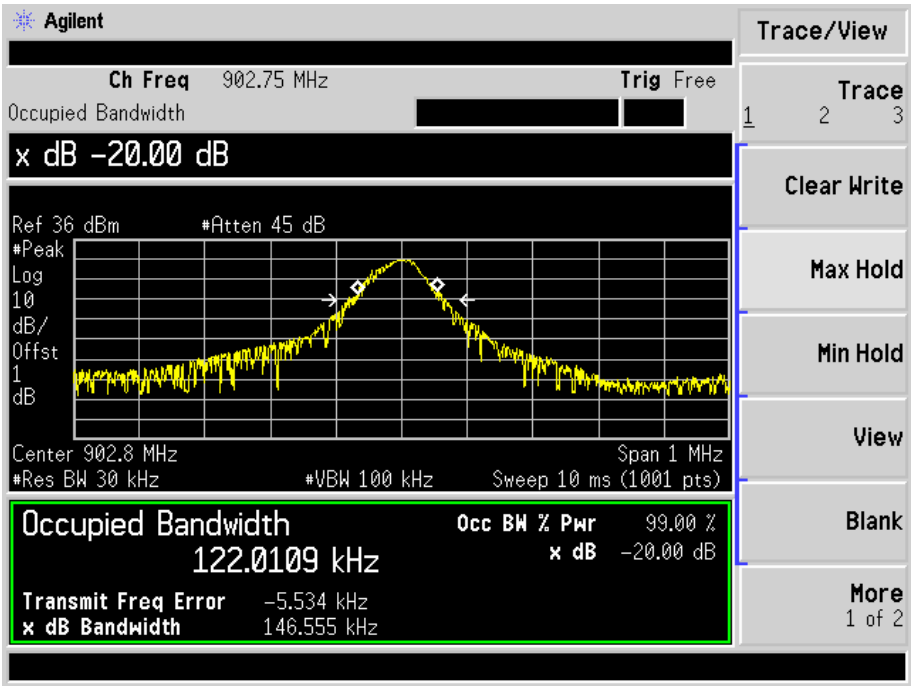
8.3 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

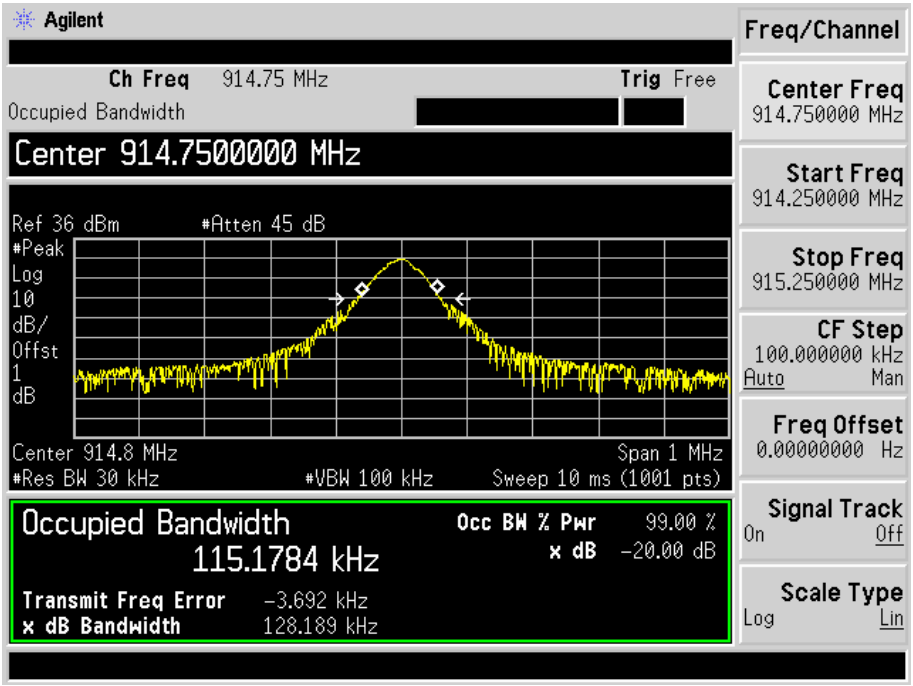
8.4 Summary of Test Results/Plots

Test Channel MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Result
902.75	146.555	122.0109	Pass
914.75	128.189	115.1784	Pass
927.25	135.379	121.4908	Pass

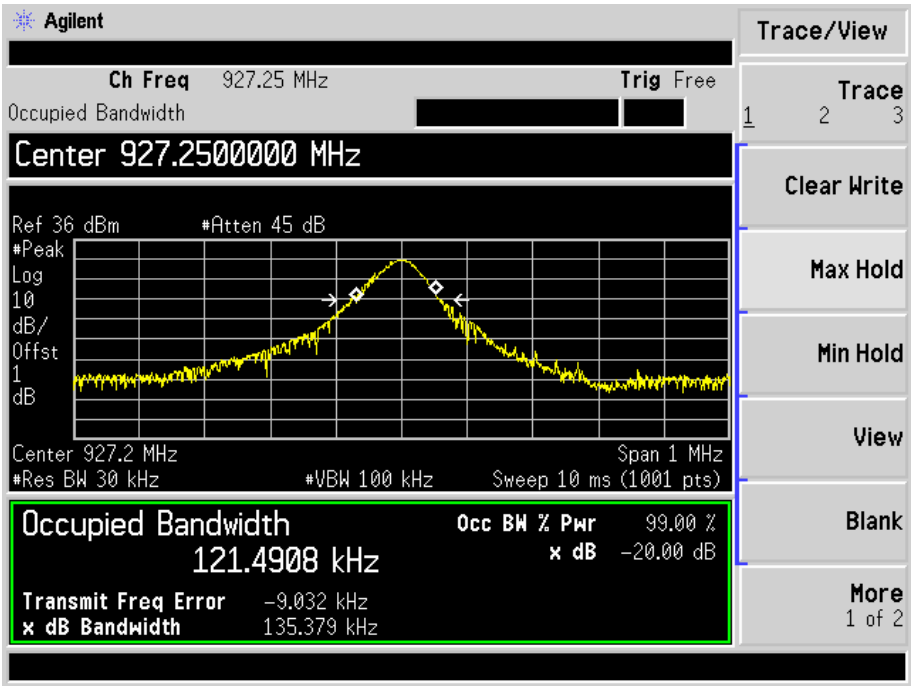
Low Channel:



Middle Channel:



High Channel:



9. RF Output Power

9.1 Standard Applicable

According to 15.247(b)(2). For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

9.2 Test Procedure

According to the DA 00-705, the peak output power test method as follows.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, the indicated level is the peak output power (the external attenuation and cable loss shall be considered).

9.3 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	55%
ATM Pressure:	1011 mbar

9.4 Summary of Test Results/Plots

Frequency MHz	Measured Value dBm	Output Power mW	Limit mW
902.75	26.75	473.15	1000
914.75	25.56	359.75	1000
927.25	25.55	358.92	1000

Note: the antenna gain is less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.

10. Field Strength of Spurious Emissions

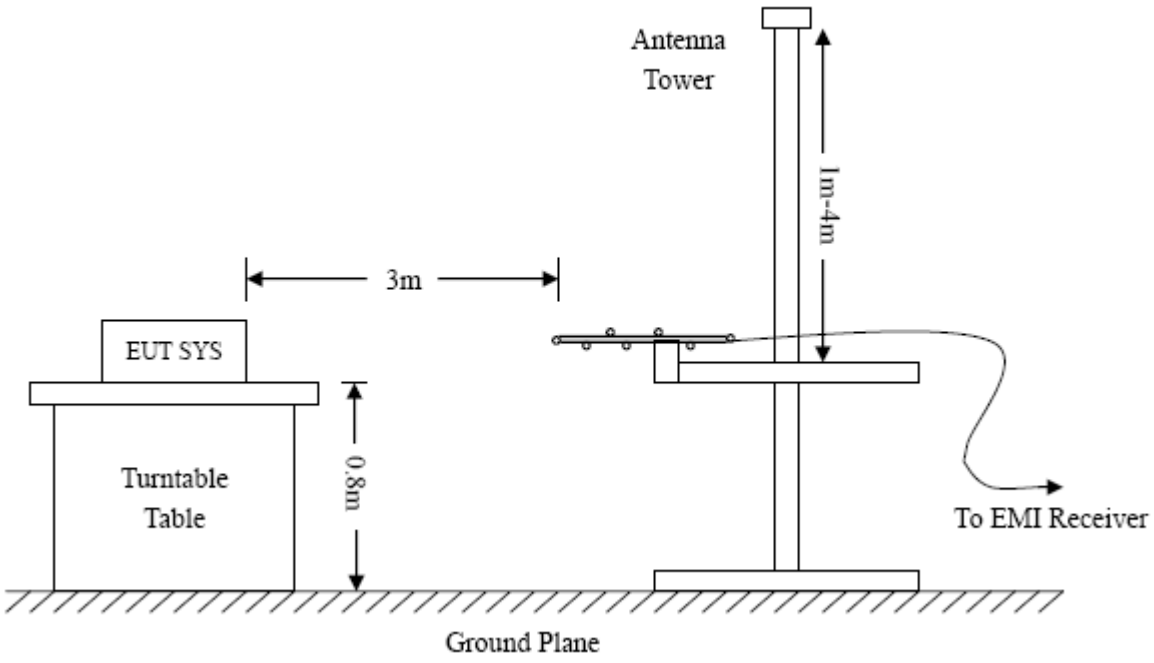
10.1 Standard Applicable

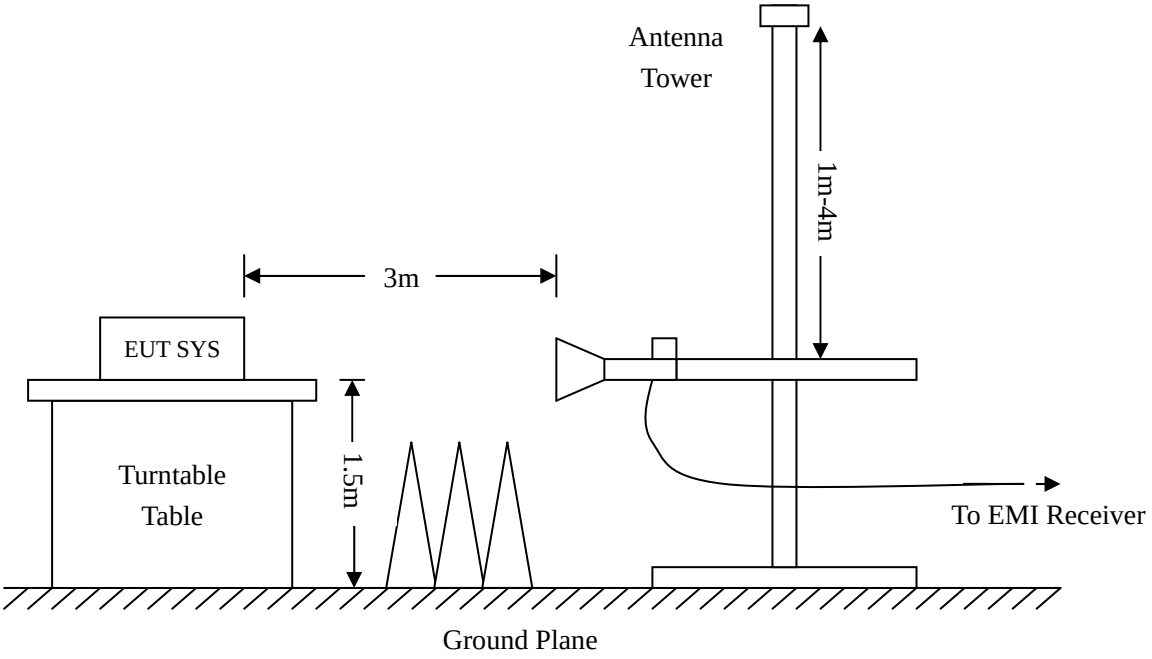
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within 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).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

10.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.





Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold
Detector function = peak	Detector function = peak, QP	Detector function = peak, AV

10.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – FCC Part 15 Limit

10.4 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

10.5 Summary of Test Results/Plots

According to the data below, the FCC Part 15.205, 15.209 and 15.247 standards, and had the worst cases:

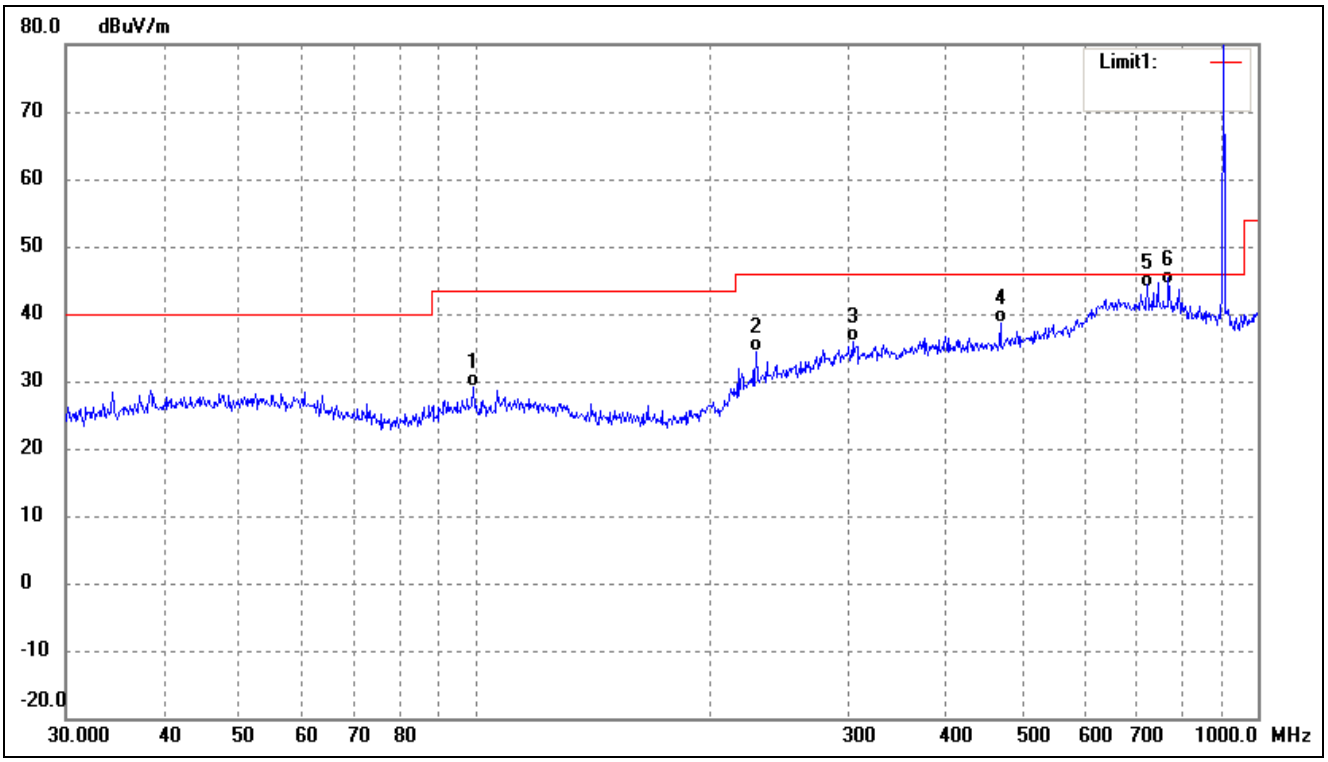
Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.
All test modes are performed, but only the worst case is recorded in this report.

Antenna 1

Plot of Radiated Emissions Test Data (30MHz to 1GHz)

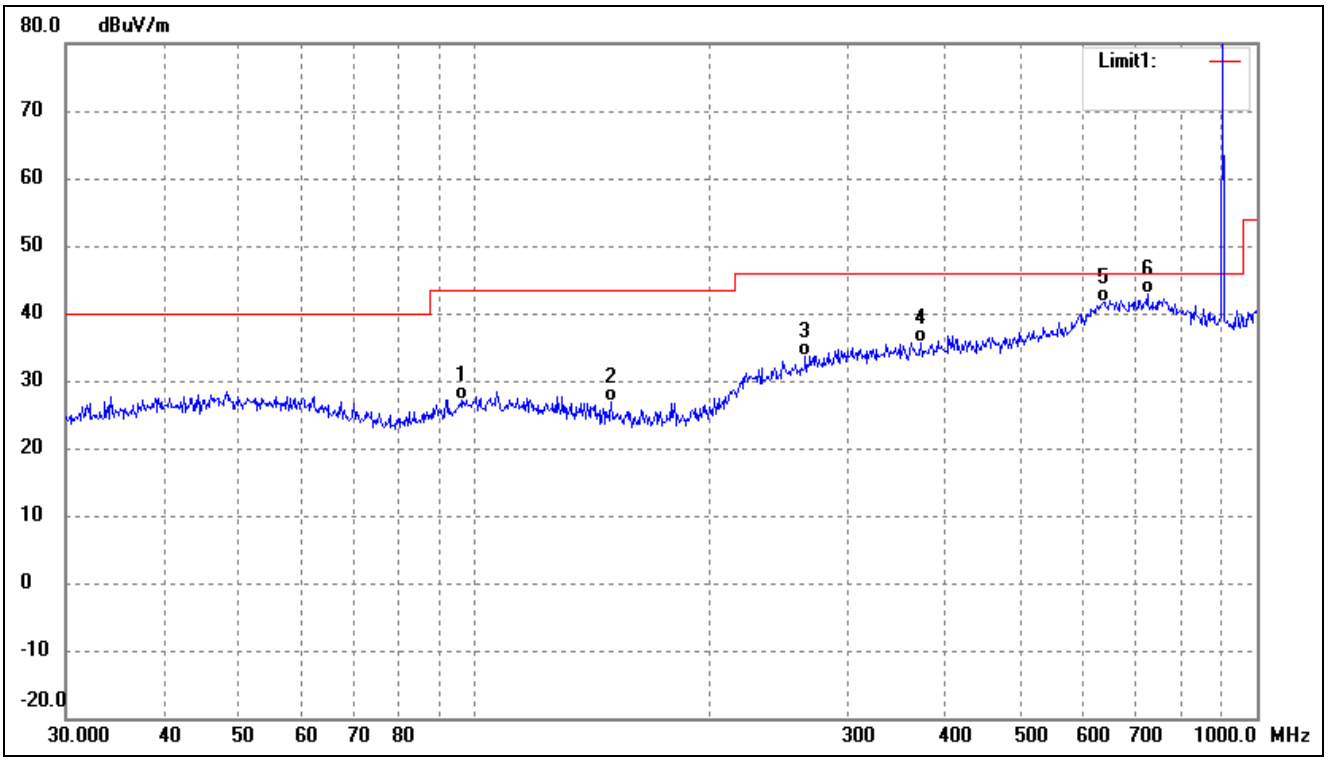
EUT: *ATM2000 Module*
Tested Model: *ATM2000*
Operating Condition: *Transmitting Low Channel (902.75MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	99.5281	24.24	4.86	29.10	43.50	-14.40	61	100	QP
2	228.4904	26.10	8.20	34.30	46.00	-11.70	96	100	QP
3	303.5437	24.04	11.94	35.98	46.00	-10.02	191	100	QP
4	468.8762	25.85	12.82	38.67	46.00	-7.33	97	100	QP
5	721.7259	25.90	17.91	43.81	46.00	-2.19	143	100	QP
6	768.7482	26.70	17.60	44.30	46.00	-1.70	256	100	QP

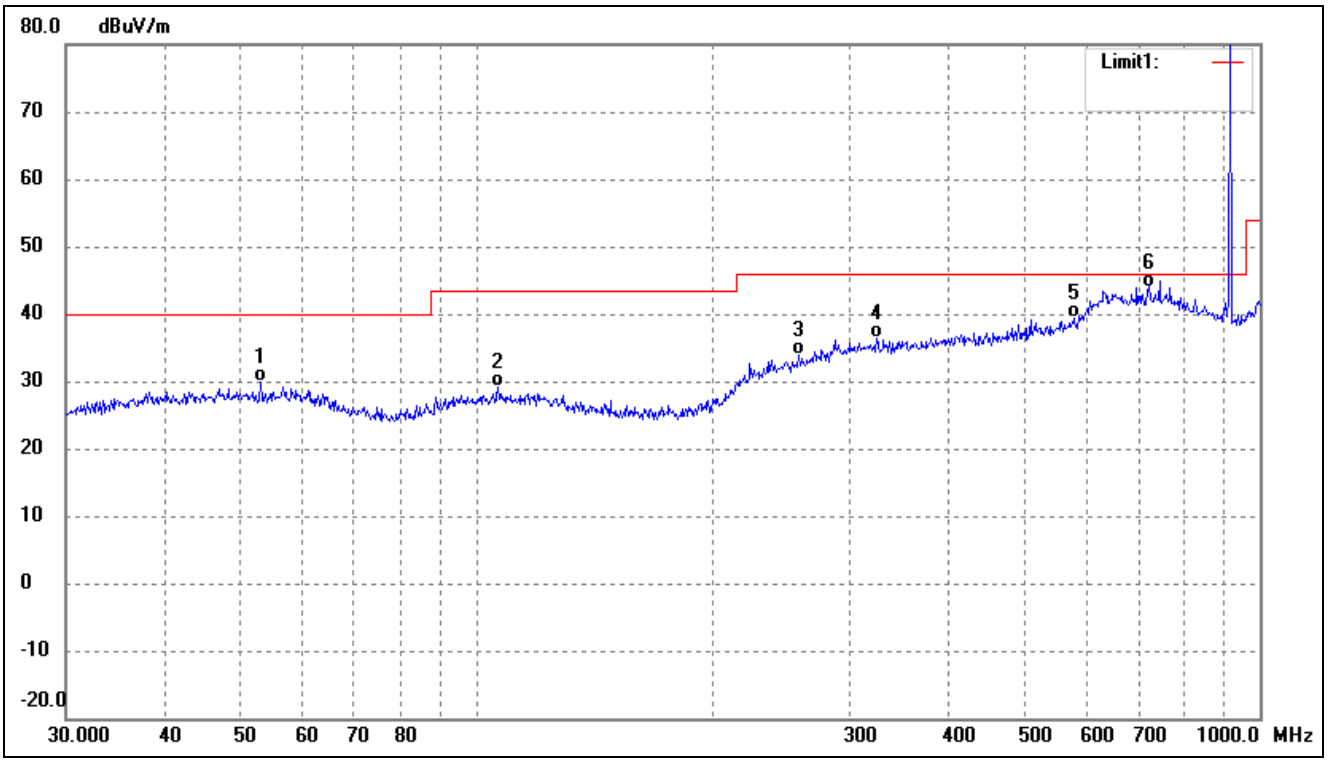
Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	96.4362	22.82	4.41	27.23	43.50	-16.27	127	100	QP
2	149.4857	24.10	2.77	26.87	43.50	-16.63	226	100	QP
3	264.7457	23.54	10.03	33.57	46.00	-12.43	90	100	QP
4	372.0045	23.79	11.84	35.63	46.00	-10.37	134	100	QP
5	636.1340	23.70	17.93	41.63	46.00	-4.37	219	100	QP
6	724.2611	24.78	18.07	42.85	46.00	-3.15	97	100	QP

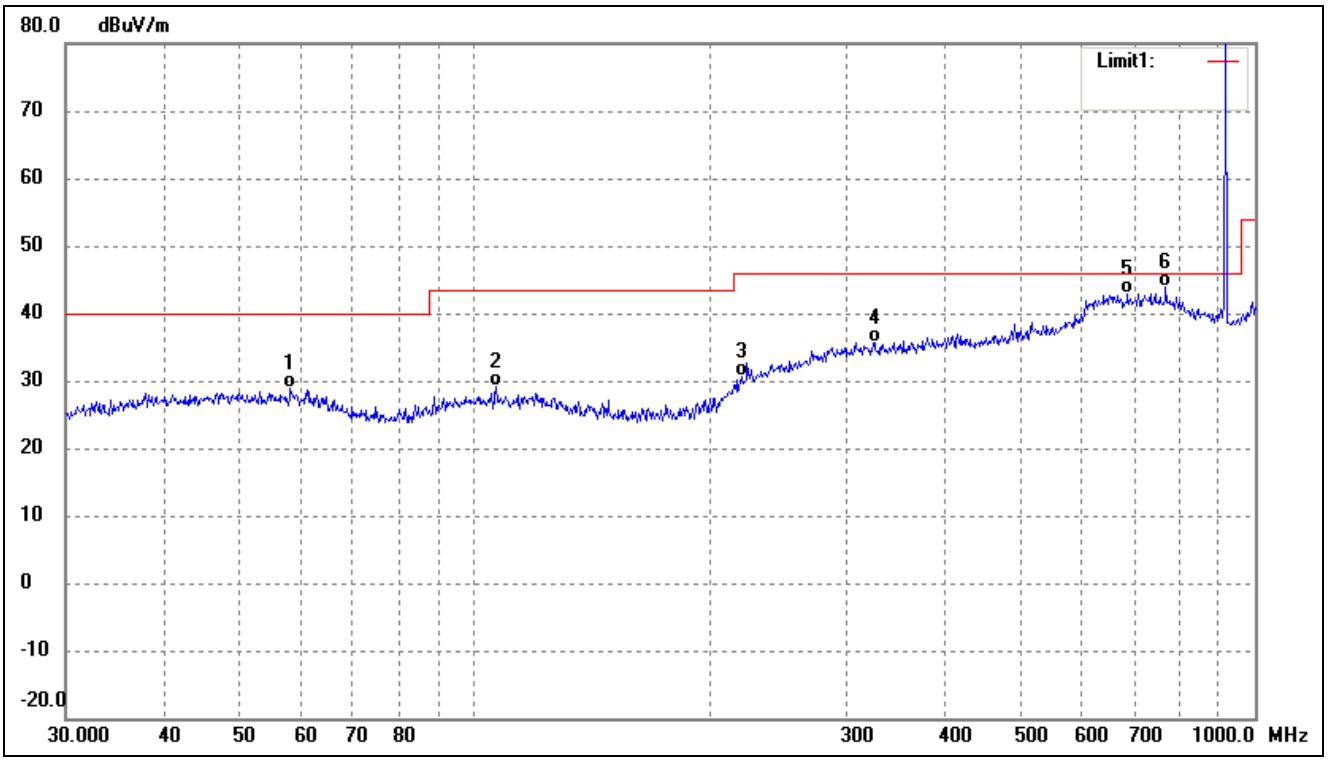
Operating Condition: *Transmitting Middle Channel (914.75MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	53.1313	24.87	5.06	29.93	40.00	-10.07	325	100	QP
2	106.7587	24.17	4.88	29.05	43.50	-14.45	320	100	QP
3	258.3264	24.30	9.62	33.92	46.00	-12.08	71	100	QP
4	324.4561	24.61	11.80	36.41	46.00	-9.59	129	100	QP
5	578.6699	24.35	14.96	39.31	46.00	-6.69	157	100	QP
6	721.7259	25.90	17.91	43.81	46.00	-2.19	109	100	QP

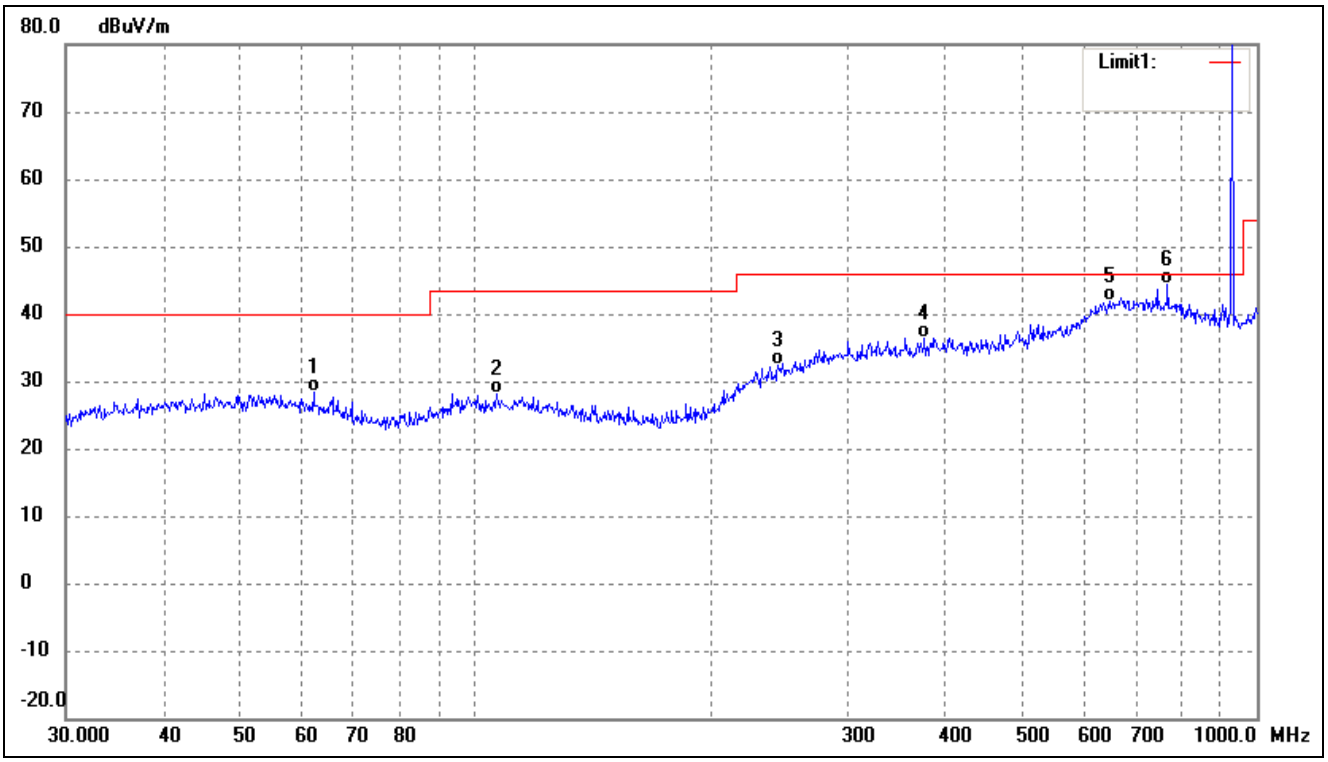
Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	58.2030	23.99	4.98	28.97	40.00	-11.03	207	100	QP
2	106.7587	24.17	4.88	29.05	43.50	-14.45	199	100	QP
3	220.6171	22.82	7.71	30.53	46.00	-15.47	78	100	QP
4	325.5958	23.88	11.77	35.65	46.00	-10.35	139	100	QP
5	687.1507	24.80	18.14	42.94	46.00	-3.06	74	100	QP
6	768.7482	26.20	17.60	43.80	46.00	-2.20	163	100	QP

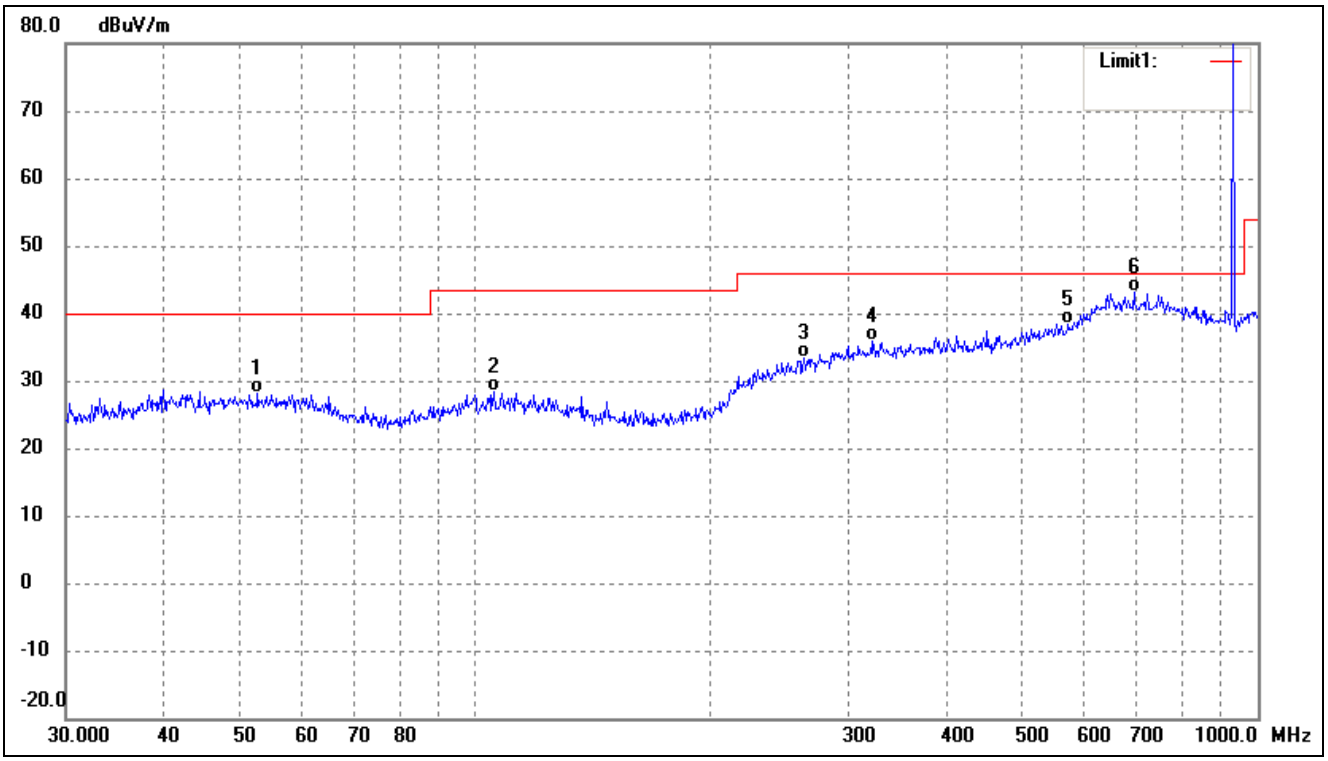
Operating Condition: *Transmitting High Channel (927.25MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	62.2128	23.69	4.58	28.27	40.00	-11.73	62	100	QP
2	106.7587	23.21	4.88	28.09	43.50	-15.41	166	100	QP
3	244.2321	23.33	9.09	32.42	46.00	-13.58	128	100	QP
4	375.9385	24.60	11.81	36.41	46.00	-9.59	116	100	QP
5	647.3856	24.09	17.90	41.99	46.00	-4.01	84	100	QP
6	768.7482	26.83	17.60	44.43	46.00	-1.57	252	100	QP

Test Specification: *Vertical*



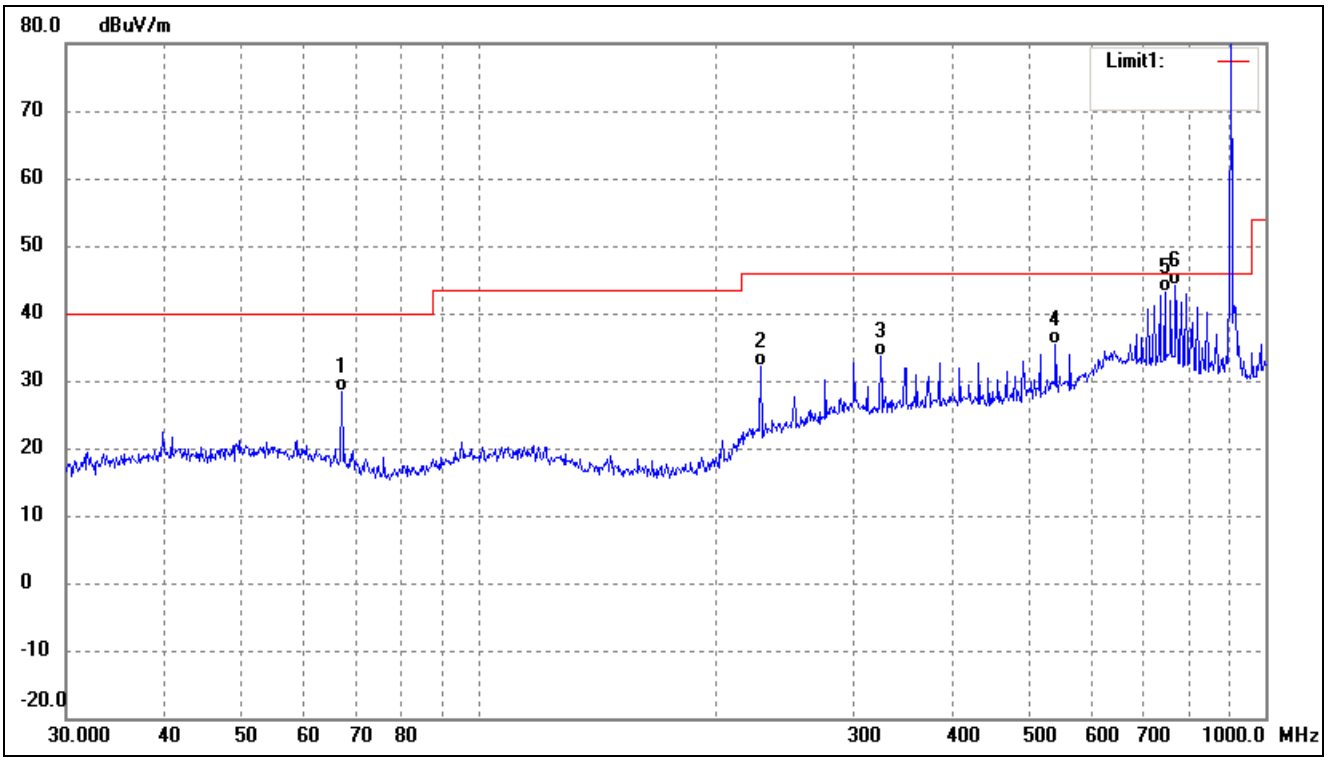
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	52.7600	22.95	5.06	28.01	40.00	-11.99	86	100	QP
2	105.6415	23.46	4.88	28.34	43.50	-15.16	192	100	QP
3	262.8955	23.43	9.90	33.33	46.00	-12.67	86	100	QP
4	321.0608	23.92	11.92	35.84	46.00	-10.16	127	100	QP
5	572.6144	23.77	14.66	38.43	46.00	-7.57	207	100	QP
6	694.4174	25.53	17.61	43.14	46.00	-2.86	248	100	QP

Antenna 2

Plot of Radiated Emissions Test Data (30MHz to 1GHz)

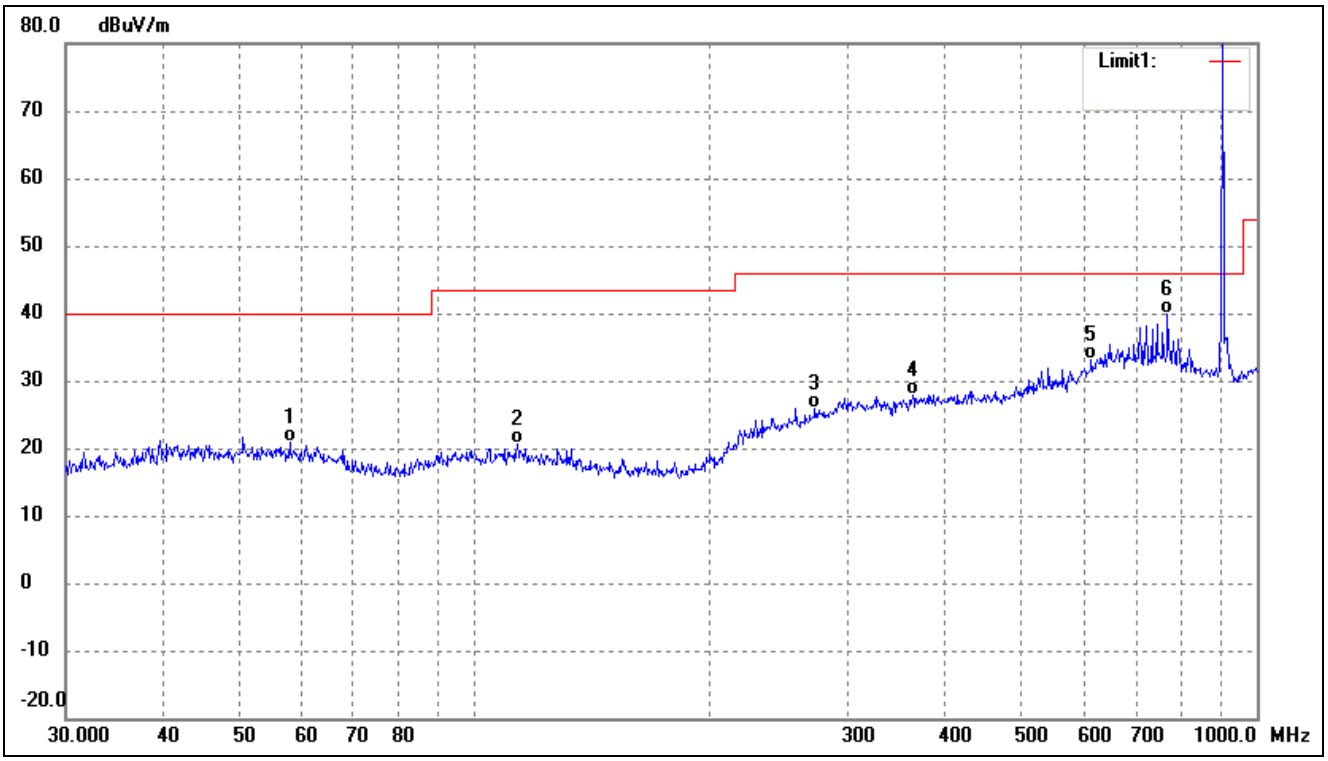
EUT: *ATM2000 Module*
Tested Model: *ATM2000*
Operating Condition: *Transmitting Low Channel (902.75MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	67.2022	24.93	3.51	28.44	40.00	-11.56	76	100	QP
2	228.4904	23.97	8.20	32.17	46.00	-13.83	186	100	QP
3	324.4561	21.72	11.80	33.52	46.00	-12.48	112	100	QP
4	541.3725	21.47	13.82	35.29	46.00	-10.71	130	100	QP
5	744.8661	24.21	18.81	43.02	46.00	-2.98	50	100	QP
6	768.7481	26.62	17.60	44.22	46.00	-1.78	196	100	QP

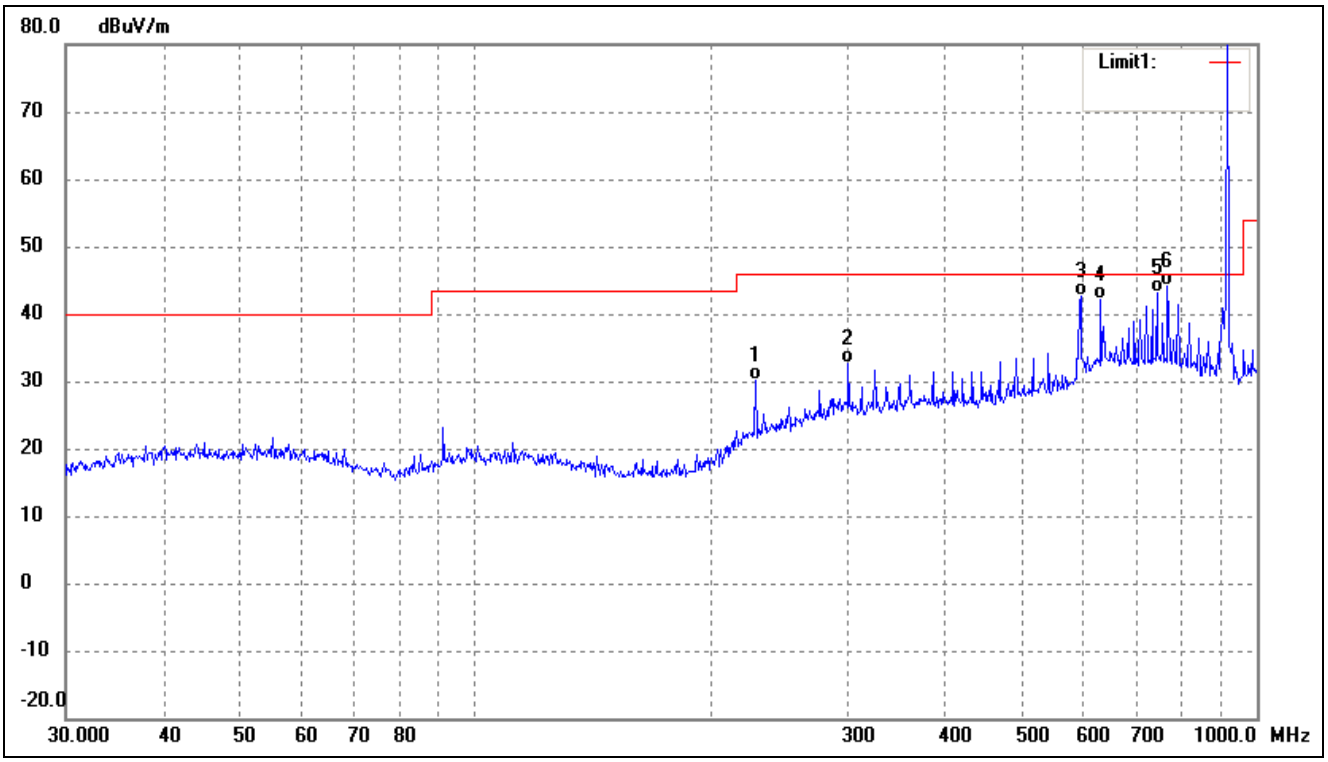
Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	57.9993	15.78	4.98	20.76	40.00	-19.24	87	100	QP
2	113.3163	15.77	4.86	20.63	43.50	-22.87	187	100	QP
3	272.2776	15.40	10.58	25.98	46.00	-20.02	147	100	QP
4	362.9845	16.11	11.89	28.00	46.00	-18.00	114	100	QP
5	614.2142	15.39	17.76	33.15	46.00	-12.85	332	100	QP
6	768.7482	22.18	17.60	39.78	46.00	-6.22	282	100	QP

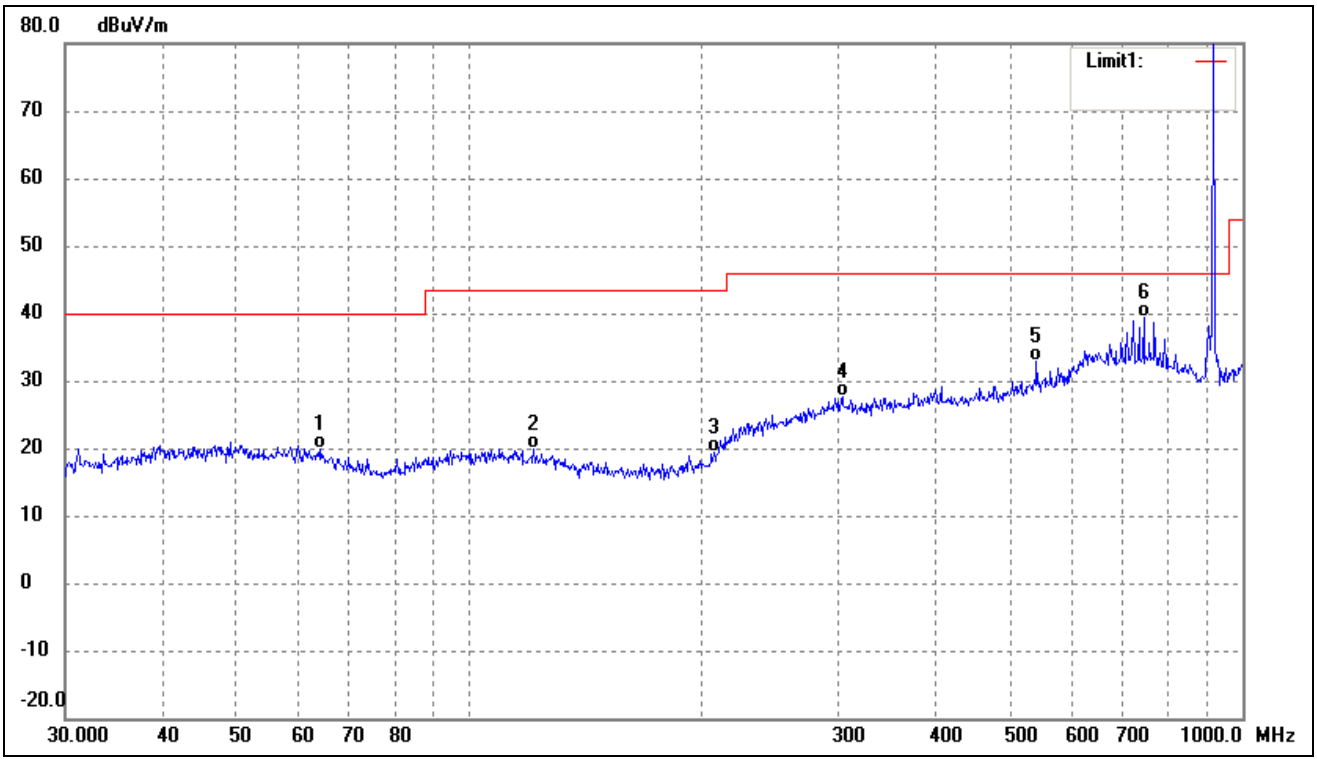
Operating Condition: *Transmitting Middle Channel (914.75MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	228.4904	21.84	8.20	30.04	46.00	-15.96	57	100	QP
2	300.3673	20.63	11.95	32.58	46.00	-13.42	225	100	QP
3	595.1329	24.90	17.85	42.75	46.00	-3.25	59	100	QP
4	631.6884	24.42	17.78	42.20	46.00	-3.80	268	100	QP
5	744.8661	24.25	18.81	43.06	46.00	-2.94	109	100	QP
6	768.7482	26.53	17.60	44.13	46.00	-1.87	216	100	QP

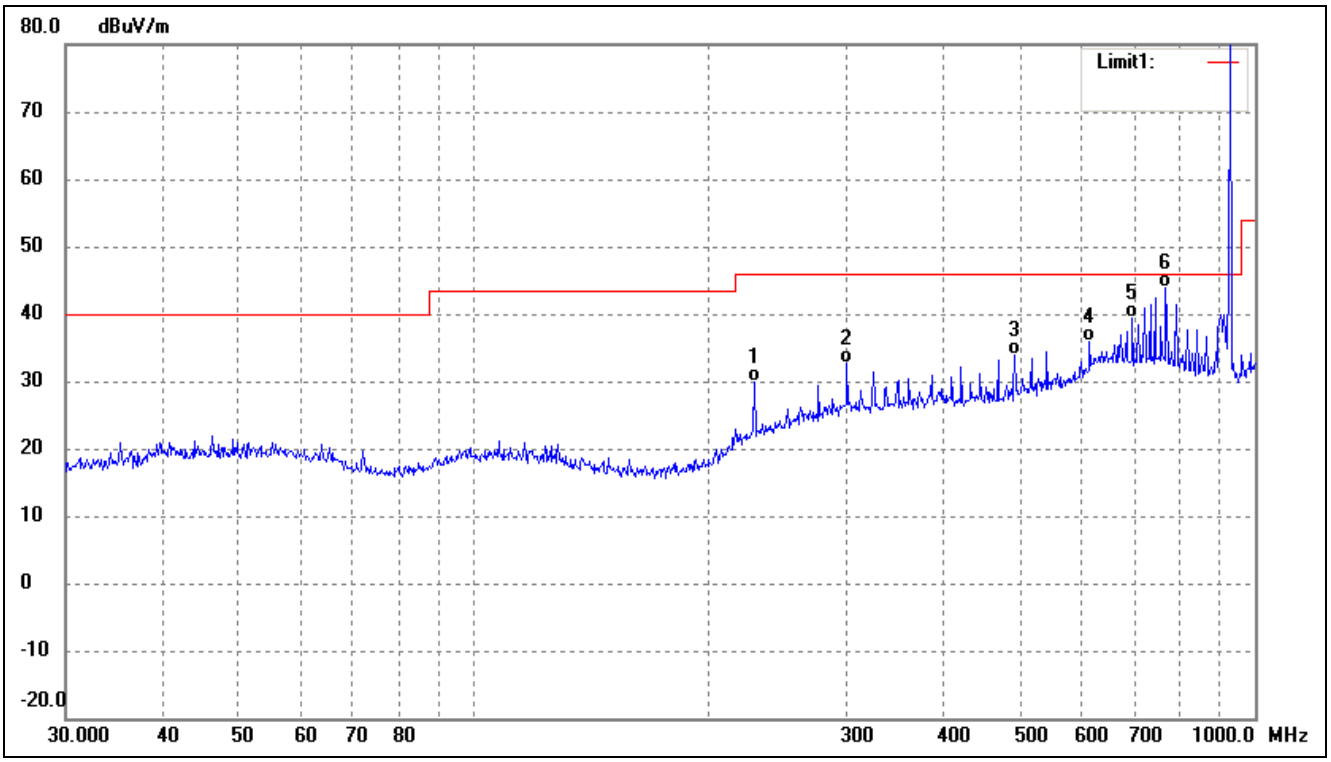
Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	64.2074	15.62	4.16	19.78	40.00	-20.22	311	100	QP
2	121.1231	15.07	4.72	19.79	43.50	-23.71	283	100	QP
3	207.1226	14.51	4.90	19.41	43.50	-24.09	64	100	QP
4	303.5437	15.77	11.94	27.71	46.00	-18.29	232	100	QP
5	541.3725	18.97	13.82	32.79	46.00	-13.21	75	100	QP
6	744.8661	20.46	18.81	39.27	46.00	-6.73	191	100	QP

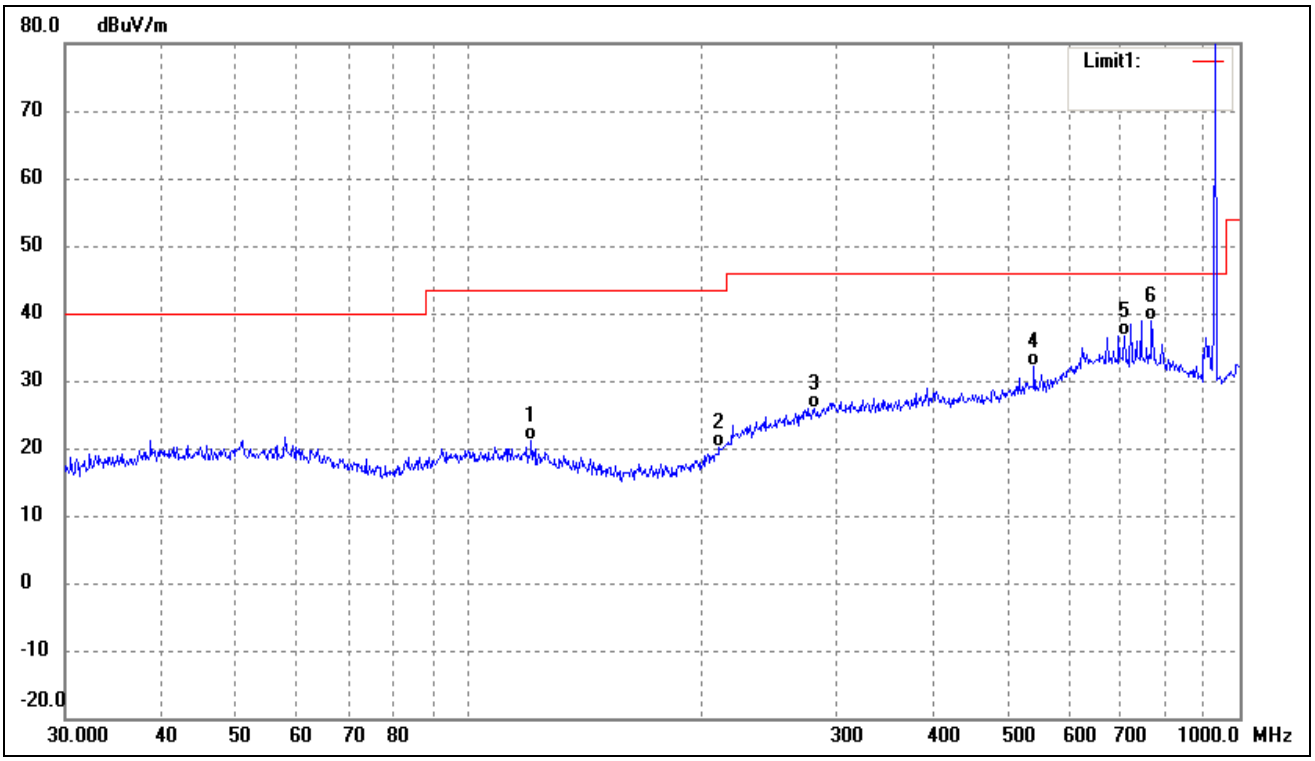
Operating Condition: *Transmitting High Channel (927.25MHz)*
Comment: *DC 3.7V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	228.4904	21.71	8.20	29.91	46.00	-16.09	120	100	QP
2	300.3672	20.64	11.95	32.59	46.00	-13.41	184	100	QP
3	492.4685	20.81	13.04	33.85	46.00	-12.15	72	100	QP
4	614.2142	18.09	17.75	35.84	46.00	-10.16	132	100	QP
5	696.8567	21.92	17.43	39.35	46.00	-6.65	243	100	QP
6	768.7481	26.20	17.60	43.80	46.00	-2.20	320	100	QP

Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	120.6991	16.31	4.76	21.07	43.50	-22.43	195	100	QP
2	211.5265	14.20	5.85	20.05	43.50	-23.45	91	100	QP
3	281.0075	14.63	11.18	25.81	46.00	-20.19	246	100	QP
4	541.3725	18.36	13.82	32.18	46.00	-13.82	100	100	QP
5	709.1823	19.10	17.48	36.58	46.00	-9.42	240	100	QP
6	768.7481	21.39	17.60	38.99	46.00	-7.01	348	100	QP

Spurious Emissions Above 1GHz

Antenna 1

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-902.75MHz							
1805.5	60.00	5.12	65.12	74	-8.88	H	PK
1805.5	41.82	5.12	46.94	54	-7.06	H	AV
2708.25	60.00	9.13	69.13	74	-4.87	V	PK
2708.25	50.00	9.13	59.13	54	5.13	V	AV
Middle Channel-914.75MHz							
1829.5	55.45	5.22	60.67	74	-13.33	H	PK
1829.5	44.55	5.22	49.77	54	-4.23	H	AV
2744.25	54.55	9.31	63.86	74	-10.14	V	PK
2744.25	50.00	9.31	59.31	54	5.31	V	AV
High Channel-927.25MHz							
1854.5	53.64	5.53	59.17	74	-14.83	H	PK
1854.5	42.73	5.53	48.26	54	-5.74	H	AV
2781.75	60.00	9.78	69.78	74	-4.22	V	PK
2781.75	50.00	9.78	59.78	54	5.78	V	AV

Antenna 2

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-902.75MHz							
1805.5	57.27	5.12	62.39	74	-11.61	H	PK
1805.5	44.55	5.12	49.67	54	-4.33	H	AV
2708.25	57.27	9.13	66.40	74	-7.60	V	PK
2708.25	50.00	9.13	59.13	54	5.13	V	AV
Middle Channel-914.75MHz							
1829.5	53.64	5.22	58.86	74	-15.14	H	PK
1829.5	40.91	5.22	46.13	54	-7.87	H	AV
2744.25	59.09	9.31	68.40	74	-5.60	V	PK
2744.25	50.00	9.31	59.31	54	5.31	V	AV
High Channel-927.25MHz							
1854.5	55.45	5.53	60.98	74	-13.02	H	PK
1854.5	41.82	5.53	47.35	54	-6.65	H	AV
2781.75	56.36	9.78	66.14	74	-7.86	V	PK
2781.75	40.00	9.78	49.78	54	-4.22	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

11. Out of Band Emissions

11.1 Standard Applicable

According to §15.247 (d) 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).

11.2 Test Procedure

According to the DA 00-705, the band-edge radiated test method as follows.

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (902MHz for low bandedge, 928MHz for the high bandedge)
RBW = 1MHz, VBW = 1MHz for peak value measured
RBW = 1MHz, VBW = 10Hz for average value measured
Sweep = auto; Detector function = peak; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation porduct outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

According to the DA 00-705, the band-edge conducted test method as follows:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (902MHz for low bandedge, 928MHz for the high bandedge)
RBW = 100kHz, VBW = 300kHz
Sweep = auto; Detector function = peak; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation porduct outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the limit specified in this section (at least 20dB attenuation).

11.3 Environmental Conditions

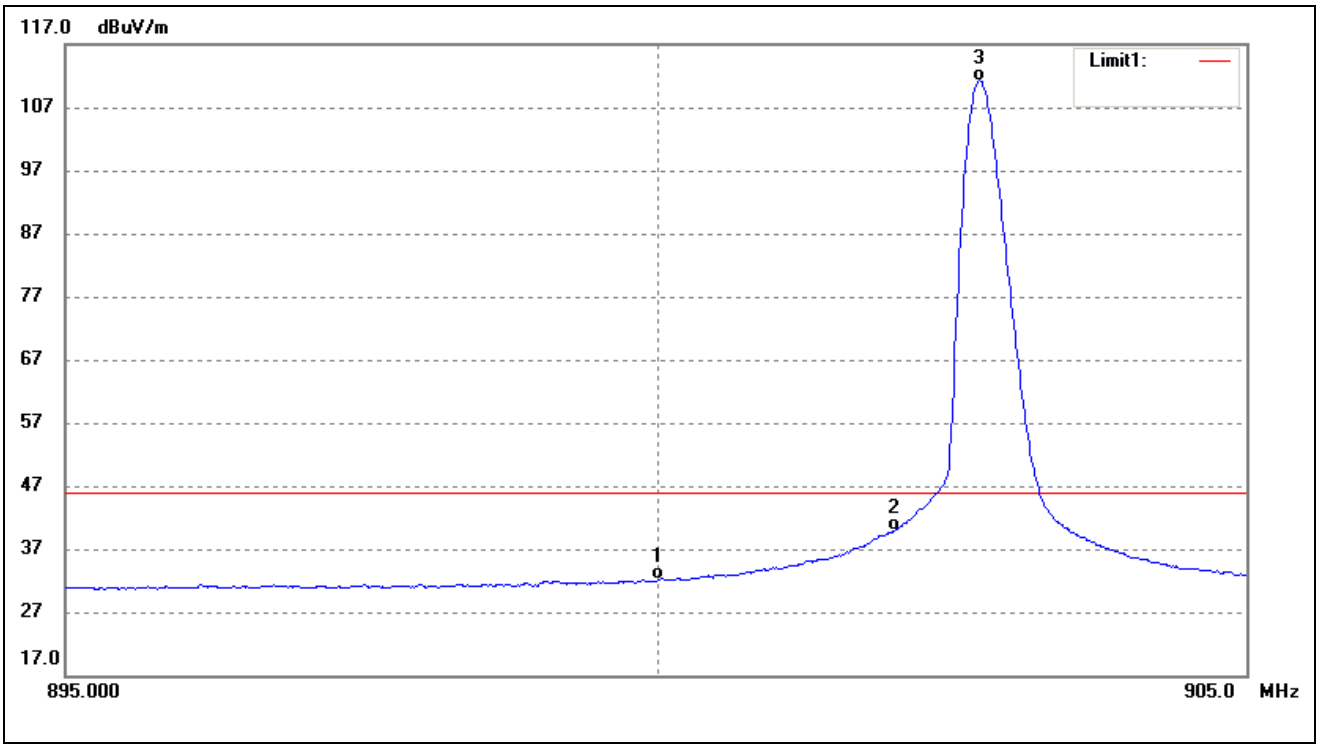
Temperature:	23°C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

11.4 Summary of Test Results/Plots

Antenna 1

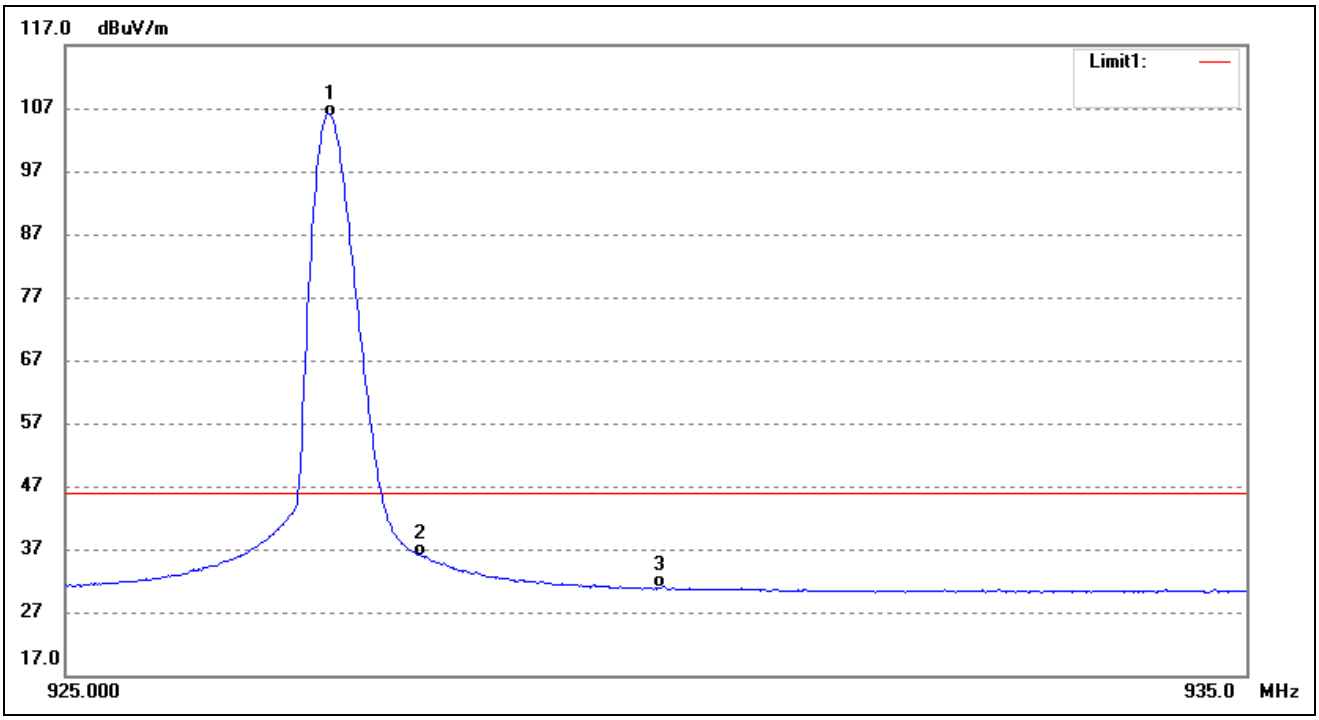
Lowest Bandedge

Vertical (Worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	900.0000	16.84	15.23	32.07	46.00	-13.93	Average Detector
	900.0000	27.67	15.23	42.90	66.00	-23.10	Peak Detector
2	902.0000	24.87	15.10	39.97	Delta=71.08dBc		Average Detector
3	902.7500	96.00	15.05	111.05			Average Detector

Highest Bandedge
Vertical (Worst case)

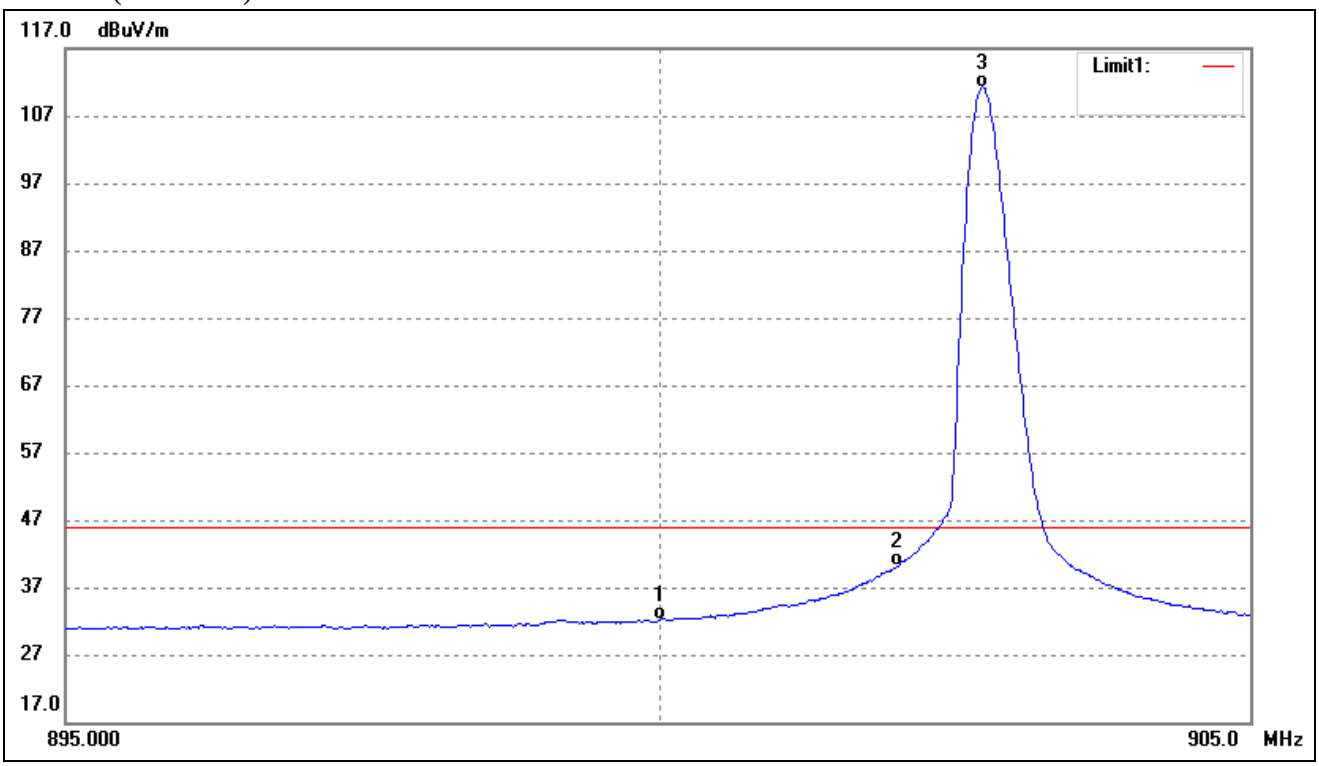


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	927.2500	91.42	14.11	105.53	/	/	Average Detector
	927.2500	93.34	14.11	107.45	/	/	Peak Detector
2	928.0000	21.82	14.14	35.96	46.00	-10.04	Average Detector
	928.0000	31.82	14.14	45.96	66.00	-20.04	Peak Detector
3	930.0000	16.57	14.21	30.78	46.00	-15.22	Average Detector
	930.0000	25.07	14.21	39.28	66.00	-26.72	Peak Detector

Antenna 2

Lowest Bandedge

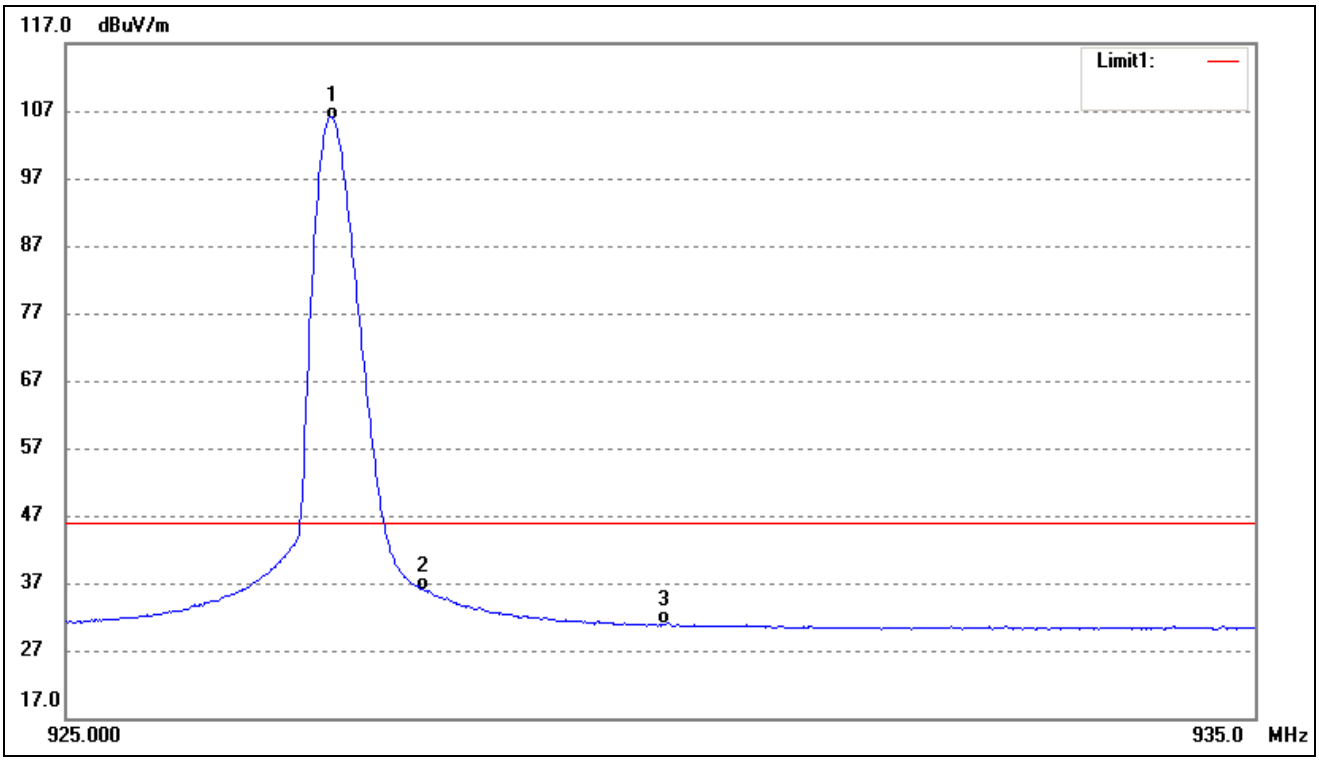
Vertical (Worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	900.0000	16.85	15.23	32.05	46.00	-13.92	Average Detector
	900.0000	27.67	15.23	42.56	66.00	-23.10	Peak Detector
2	902.0000	24.96	15.10	40.01	Delta=70.19dBc		Average Detector
3	902.7500	96.03	15.05	110.2			Average Detector

Highest Bandedge

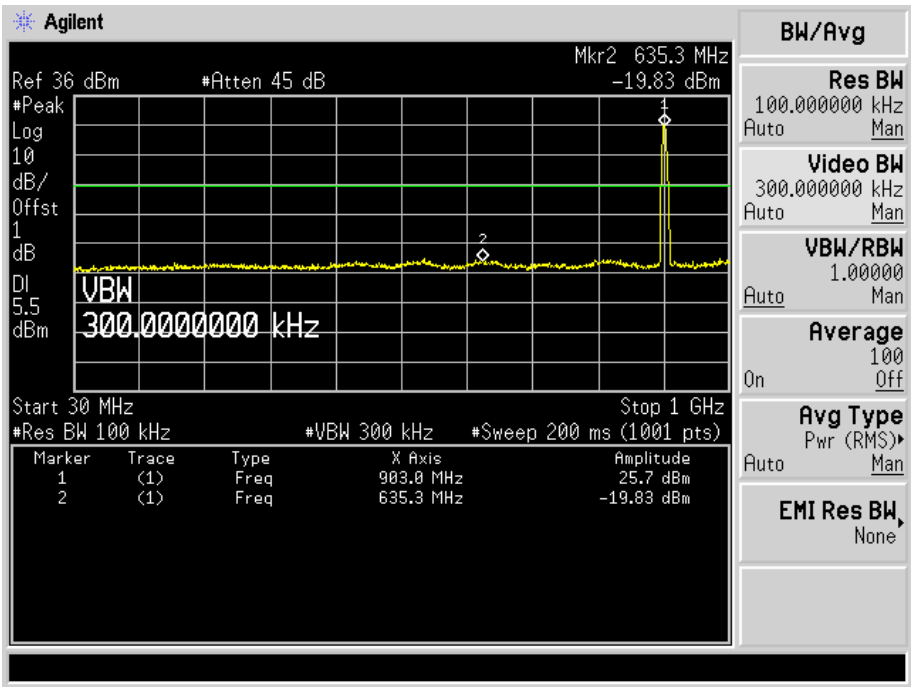
Vertical (Worst case)

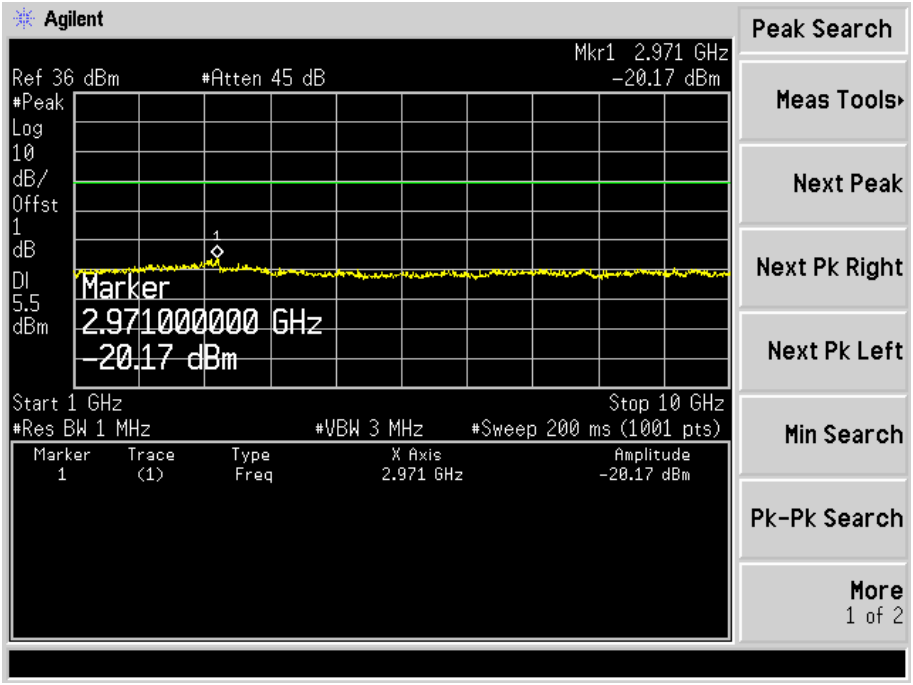


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	927.2500	87.23	14.11	101.34	/	/	Average Detector
	927.2500	88.30	14.11	102.41	/	/	Peak Detector
2	928.0000	21.07	14.14	35.21	46.00	-10.79	Average Detector
	928.0000	30.48	14.14	44.62	66.00	-21.38	Peak Detector
3	930.0000	17.21	14.21	31.42	46.00	-14.58	Average Detector
	930.0000	24.62	14.21	38.83	66.00	-27.17	Peak Detector

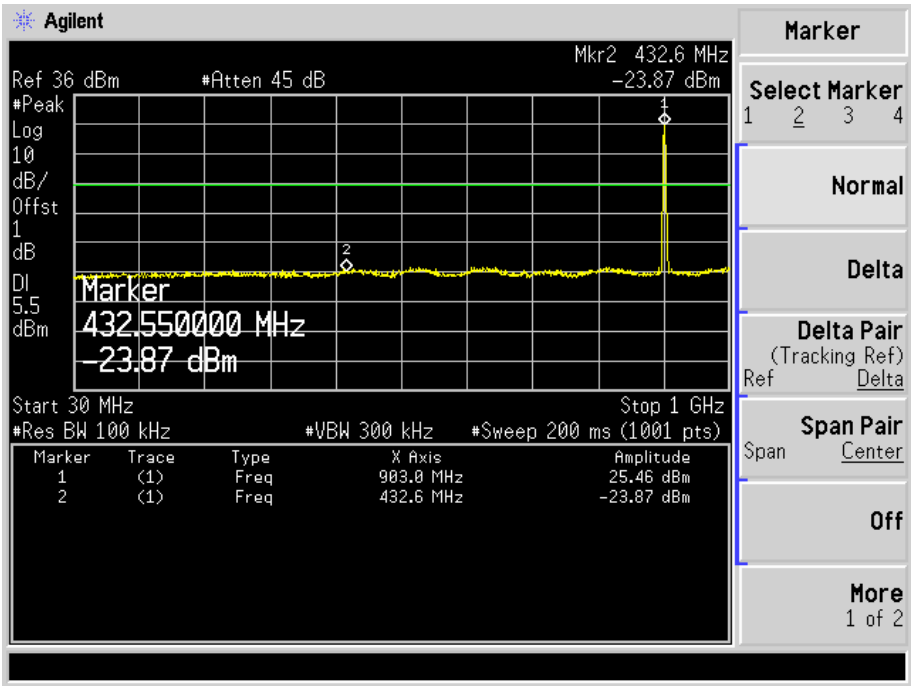
Conducted Spurious Emissions

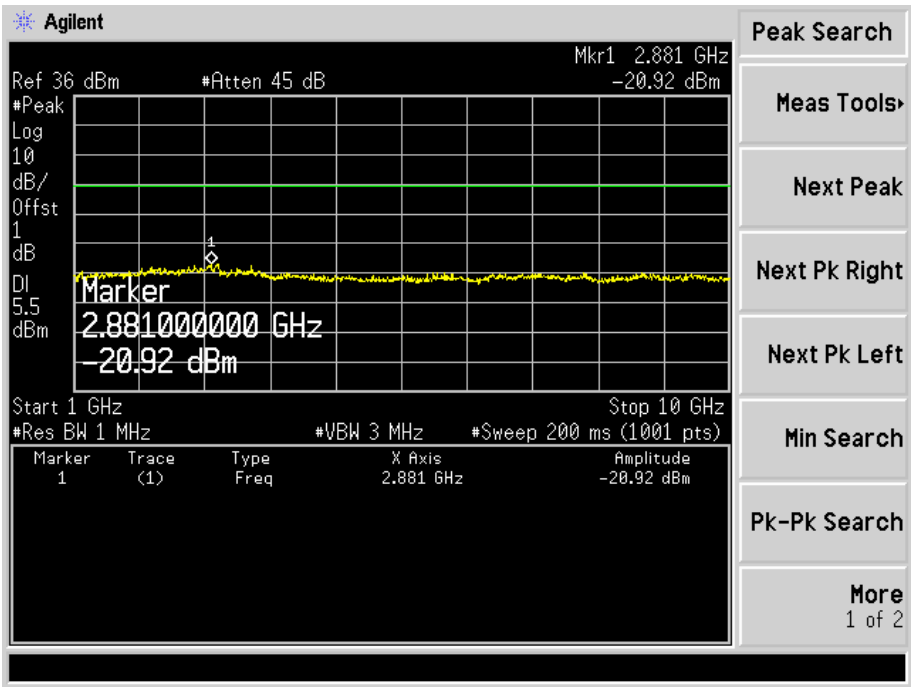
Lowest



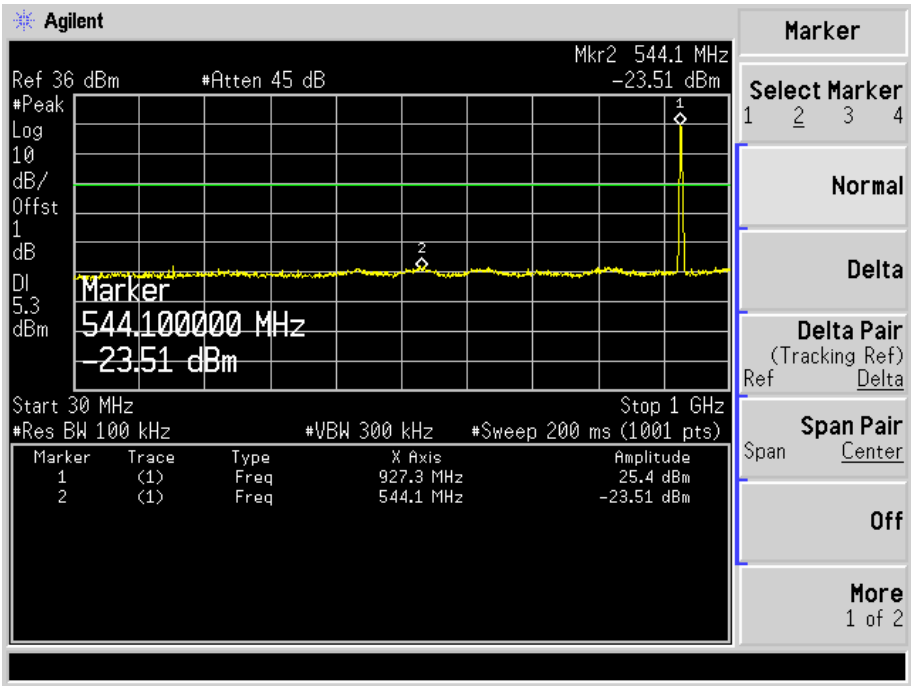


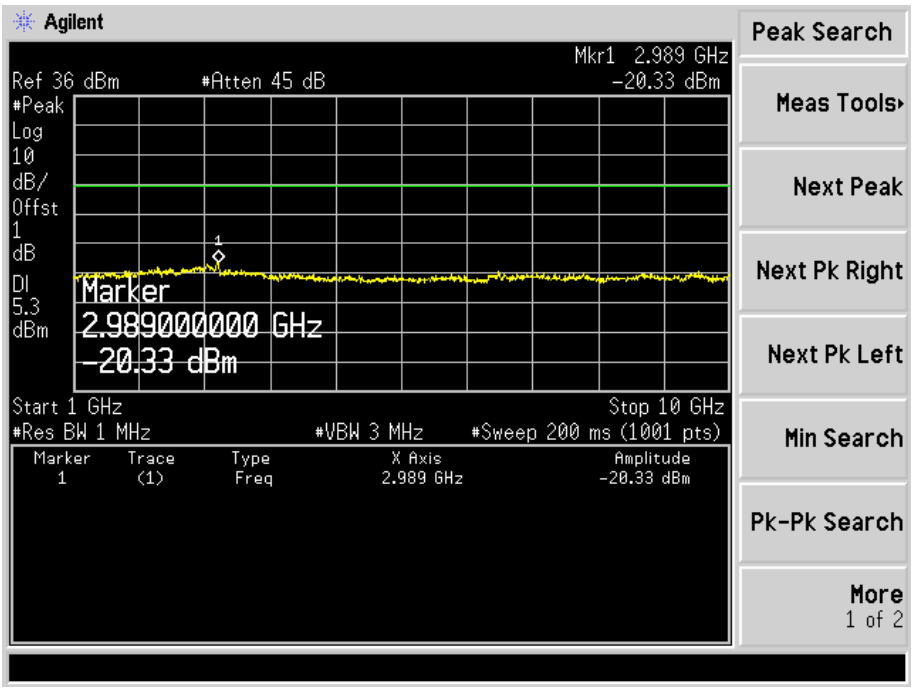
Middle Channel



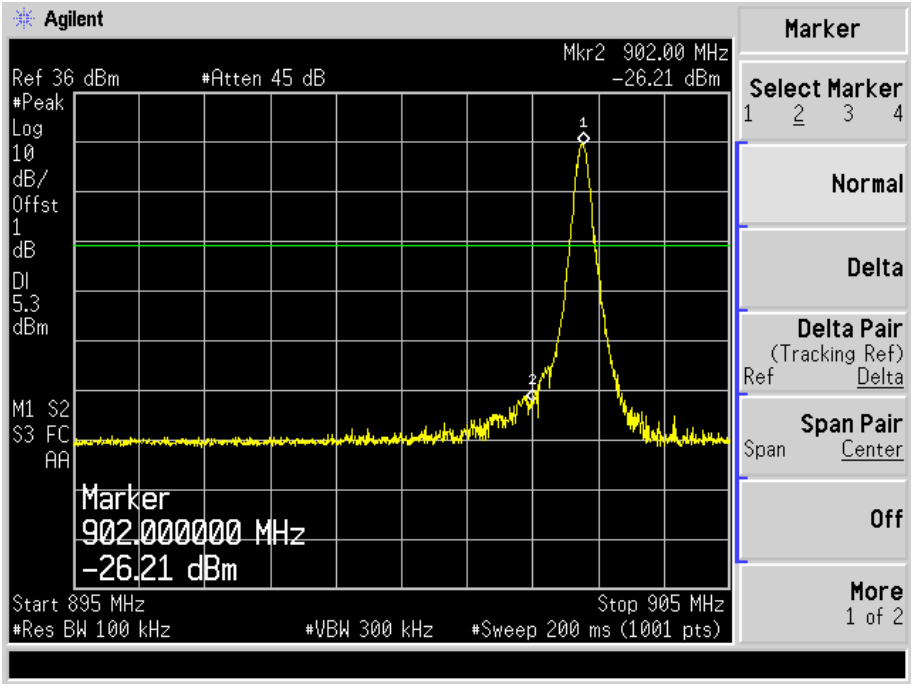


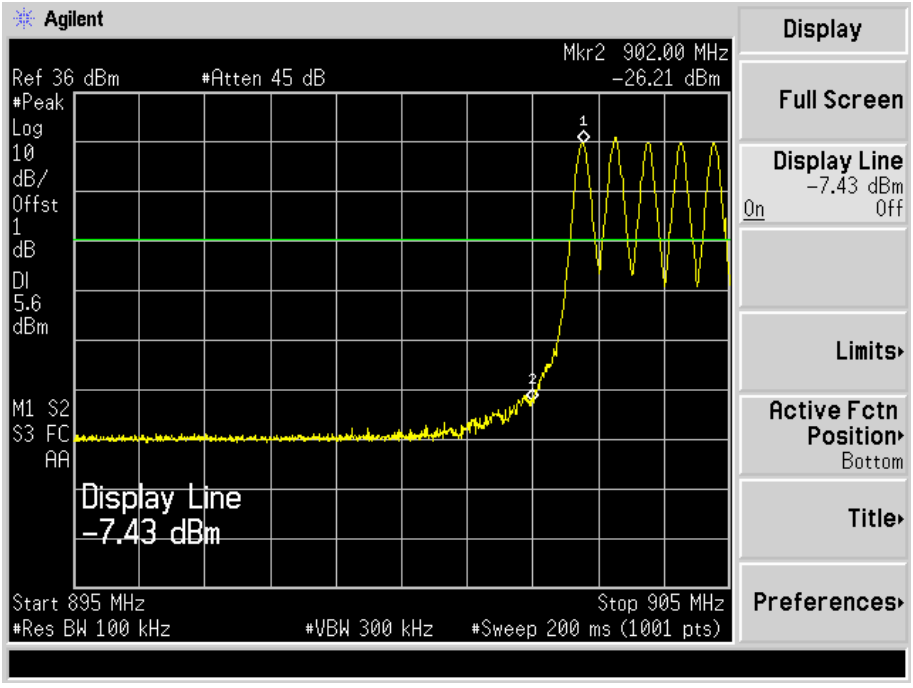
Highest


Agilent
Marker
Mkr2 544.1 MHz
Ref 36 dBm
#Atten 45 dB
-23.51 dBm
#Peak
Log
10
dB/
Offst
1
dB
Dl
5.3
dBm
Marker
544.100000 MHz
-23.51 dBm
Start 30 MHz
Stop 1 GHz
#Res BW 100 kHz
#VBW 300 kHz
#Sweep 200 ms (1001 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 927.3 MHz 25.4 dBm
2 (1) Freq 544.1 MHz -23.51 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

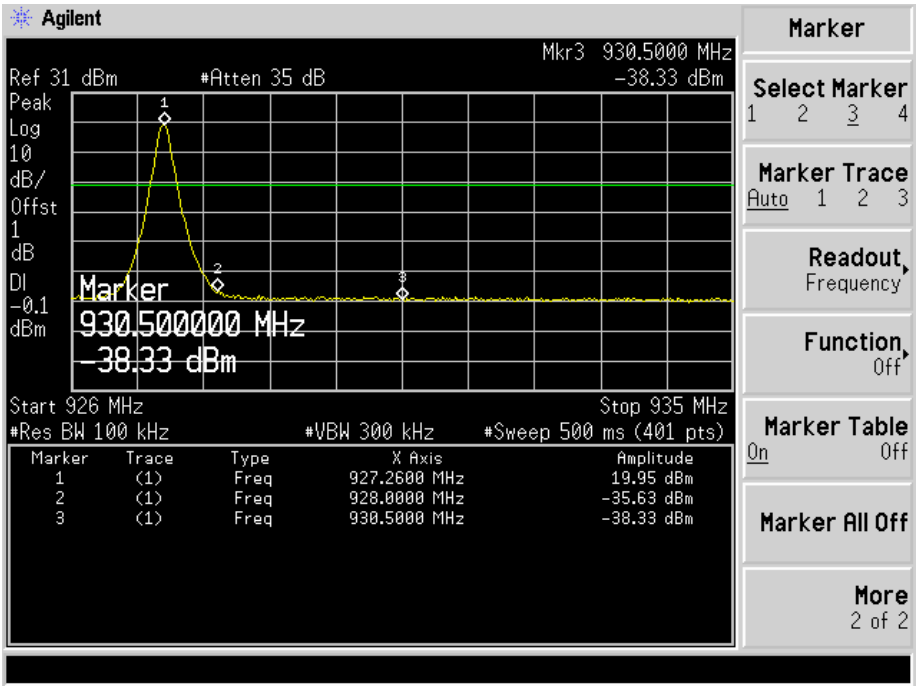

Agilent
Peak Search
Mkr1 2.989 GHz
Ref 36 dBm
#Atten 45 dB
-20.33 dBm
#Peak
Log
10
dB/
Offst
1
dB
Dl
5.3
dBm
Marker
2.989000000 GHz
-20.33 dBm
Start 1 GHz
Stop 10 GHz
#Res BW 1 MHz
#VBW 3 MHz
#Sweep 200 ms (1001 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.989 GHz -20.33 dBm
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

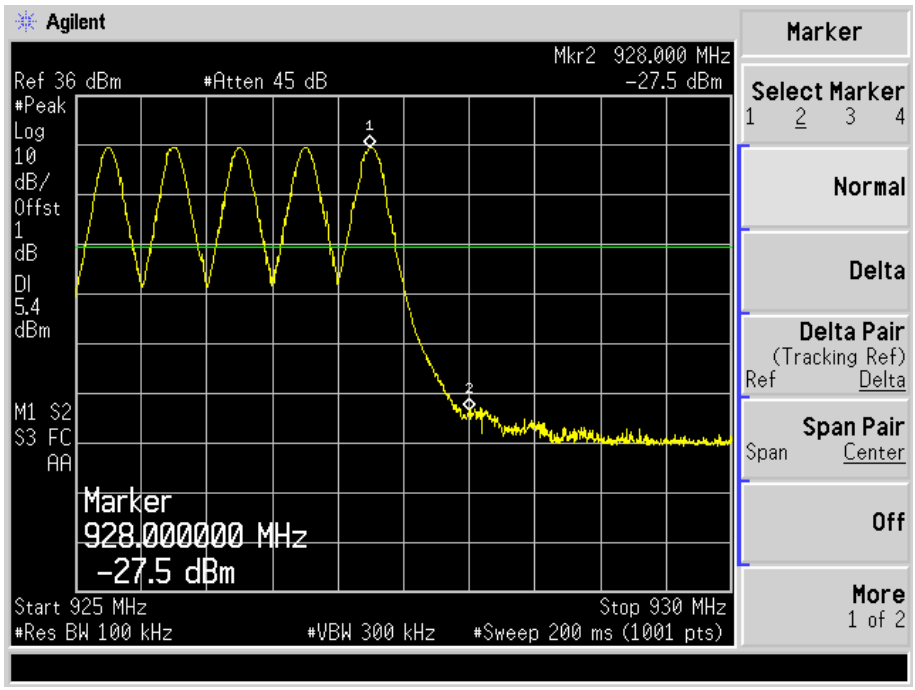
Bandedge with Conducted:
Lowest Bandedge





Highest Bandedge



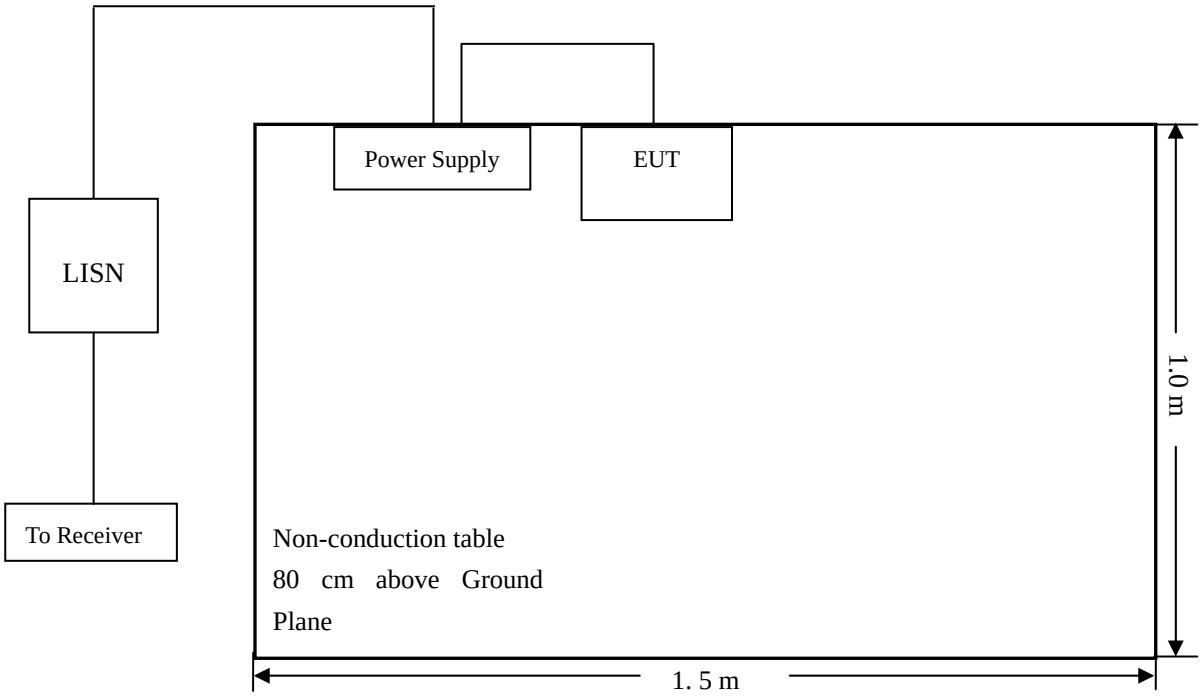


12. Conducted Emissions

12.1 Test Procedure

Test is conducting under the description of ANSI C63.4-2014, 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.

12.2 Basic Test Setup Block Diagram



12.3 Environmental Conditions

Temperature:	23 °C
Relative Humidity:	52%
ATM Pressure:	1011 mbar

12.4 Summary of Test Results/Plots

According to the data in section 12.5, the EUT complied with the FCC Part 15.107(a) Conducted margin for a Class B device, with the *worst* margin reading of:

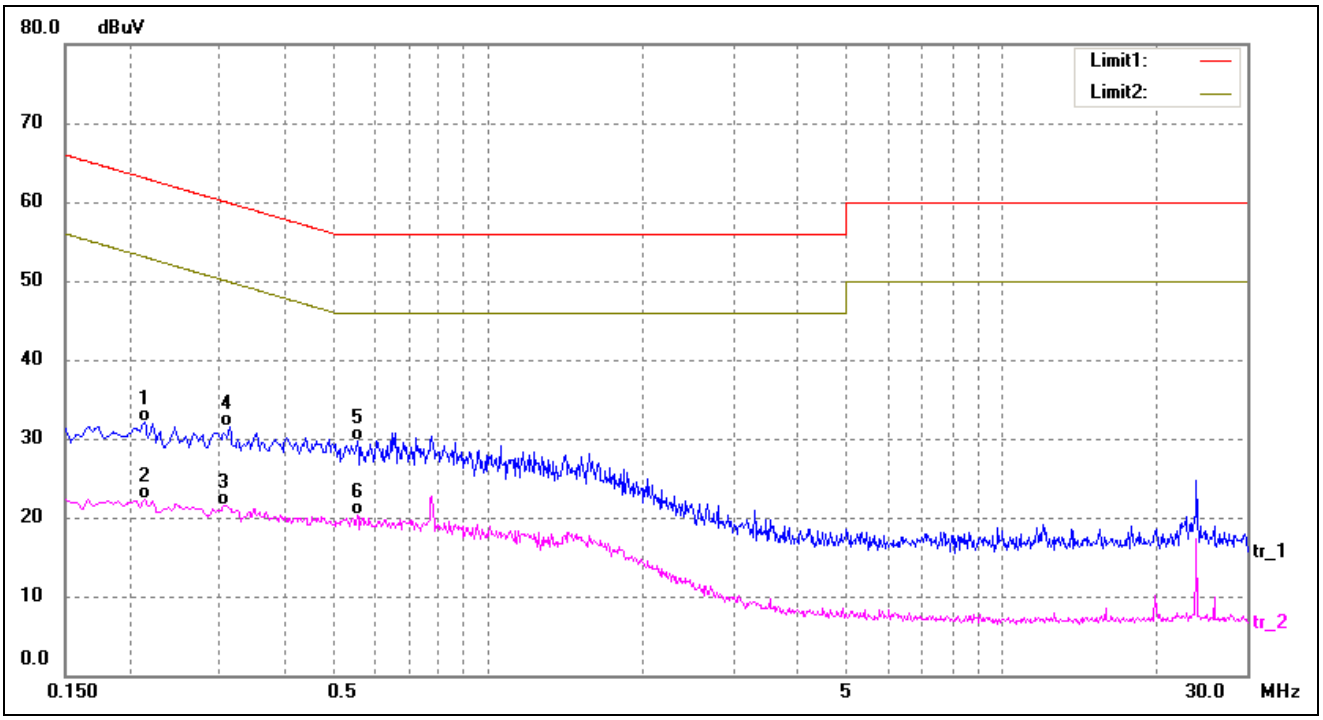
-8.43 dB at **0.1780 MHz** in the **Line**, **TM2** Mode, **QP** detector, 0.15-30MHz

12.5 Conducted Emissions Test Data

Plot of Conducted Emissions Test Data

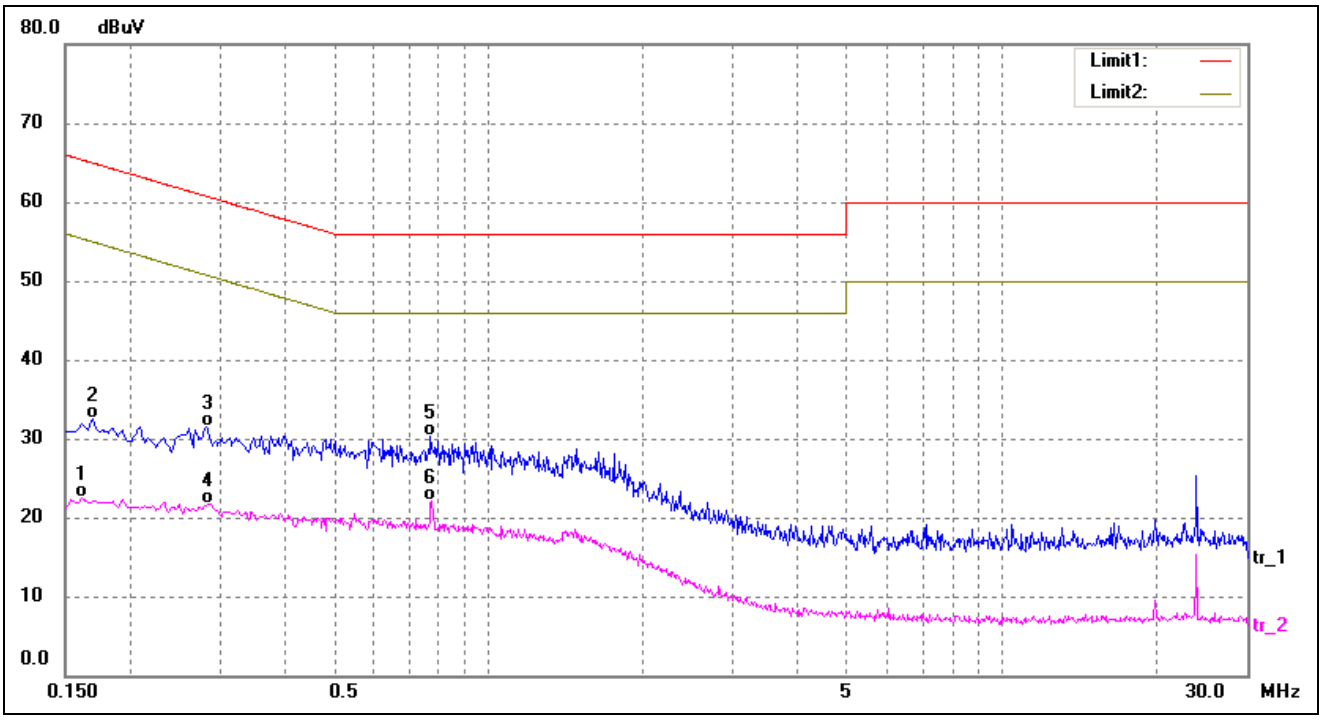
EUT: *ATM2000 Module*
Tested Model: *ATM2000*
Operating Condition: *Transmitting*
Comment: *AC 120V /60Hz; Power supply DC 3.7V*

Test Specification: *Neutral*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1	0.2140	22.32	9.80	32.12	63.05	-30.93	QP
2	0.2140	12.54	9.80	22.34	53.05	-30.71	AVG
3	0.3060	11.72	9.80	21.52	50.08	-28.56	AVG
4	0.3140	21.70	9.80	31.50	59.86	-28.36	QP
5	0.5580	19.93	9.80	29.73	56.00	-26.27	QP
6*	0.5580	10.41	9.80	20.21	46.00	-25.79	AVG

Test Specification: *Line*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1	0.1620	12.57	9.84	22.41	55.36	-32.95	AVG
2	0.1700	22.61	9.83	32.44	64.96	-32.52	QP
3	0.2820	21.77	9.80	31.57	60.76	-29.19	QP
4	0.2860	11.91	9.80	21.71	50.64	-28.93	AVG
5	0.7740	20.57	9.78	30.35	56.00	-25.65	QP
6*	0.7780	12.39	9.78	22.17	46.00	-23.83	AVG

******* END OF REPORT *******