



TEST REPORT

Report Number: 3144704MIN-001

Project Number: 3144704

Testing performed on the
DataGuardrf Transmitter
FCC ID: PB4DGPRG200
Industry Canada ID: 6900A-DGPRG200

to
47 CFR Part 15. 247:2007
RSS- 210, Issue 7, 2007

For
Imation Corp.

Test Performed by:
Intertek Testing Services NA, Inc.
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Oakdale, MN 55128

Test Authorized by:
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Oakdale, MN 55128

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Date: March 27, 2008

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Date: March 27, 2008

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1.0 GENERAL DESCRIPTION

Model:	66-0000-9000-2
Type of EUT:	Bar Code Reader/Writer
Serial Number:	062-002
FCC ID:	
Industry Canada ID:	
Related Submittal(s) Grants:	None
Company:	Imation Corp.
Customer:	Mr. Steve Rothermel
Address:	Discovery 2B-35 One Imation Place 304-2A-30 Oakdale, MN 55128
Phone:	651-704-3497
Fax:	651-704-5172
Test Standards:	☒ 47 CFR, Part 15:2007, §15.247 ☒ RSS-210, Issue 7, 2007 ☒ RSS-Gen, Issue 2, 2007 ☒ 47 CFR, Part 15:2007, §15.107 and §15.109, Class A ☐ Other
Type of radio:	☐ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	February 25, 2008
Test Work Started:	February 25, 2008
Test Work Completed:	February 27, 2008
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good

1.1 Product Description; Test Facility

Product Description:	RFID Transmitter
Transmitter Type:	☒ FHSS ☐ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	From 902.3 to 927.7 MHz
Number of Channels:	128
Modulation:	FSK
Emission Designator:	
Antenna(s) Info:	Internal PCB Gain: -8.8dBi Connector Type: SMA
Power settings:	27 dBm
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☐ Internal battery ☒ External power source: 100-240VAC, 50-60Hz / 9VDC Adapter Model: PSA15R-090P
Special Test Arrangement:	The EUT contains two identical RFID transmitters working simultaneously, therefore only one transmitter was tested.
Test Facility Accreditation:	A2LA (Certificate No. 1427.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.4-2003 and FCC Public Notice DA 00-705

1.2 EUT Configuration

The equipment under test was operated during the measurement under the following conditions:

- ☐ - Standby
- ☒ - Continuous transmissions with hopping function enabled
- ☒ - Continuous transmissions with hopping function disabled, modulated signal (see details below)
- ☐ - Continuous transmissions with hopping function disabled (un-modulated signal)
- ☐ - Continuous receiving
- ☐ - Test program (customer specific)
- ☐ -

Operating modes of the EUT:

No.	Description
1	Test was performed at low channel (902.3MHz), middle channel (915.0MHz), and upper channel (927.7MHz)
2	

Cables:

No.	Type	Length	Designation	Note
1	USB, shielded	1.5m	USB connection to remote PC	
2				

Support equipment/Services:

No.	Item	Description
1	Laptop computer	Remote PC
2		

1.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

☒ Normal

Temperature:	+15 to +35 ° C
Humidity:	20-75 %
Atmospheric pressure:	86-106 kPa

☐ Extreme

☐ Temperature:	-20 to +50 ° C
☐ Supply voltage:	85% to +115%

1.4 Measurement uncertainty

The expanded uncertainty ($k = 2$) for radiated measurements has been determined to be:

± 4 dB at 10m and ± 5.4 dB at 3m

The expanded uncertainty ($k = 2$) for conducted measurements at antenna terminal has been determined to be:

± 1.0 dB

The expanded uncertainty ($k = 2$) for line conducted measurements has been determined to be:

± 2.6 dB

1.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where: FS = Field Strength in dB(μ V/m)

RA = Receiver Amplitude in dB(μ V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB(m^{-1})

AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(μ V) is obtained. The antenna factor of 7.4 dB(m^{-1}) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB(μ V/m).

$$RA = 48.1 \text{ dB}(\mu\text{V})$$

$$AF = 7.4 \text{ dB}(m^{-1})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 16.0 \text{ dB}$$

$$FS = RA + AF + CF - AG$$

$$FS = 48.1 + 7.4 + 1.6 - 16.0$$

$$FS = 41.1 \text{ dB}(\mu\text{V}/m)$$

General notes:

2.0 TEST SUMMARY

Referring to the performance criteria and the operating mode during the tests specified in this report, the equipment complies with the requirements according to the following standards.

TEST SPECIFICATION	TEST PARAMETERS	RESULT
15.247(b), (c) / RSS-210 A8.4	Maximum peak output power	Pass
15.247(e) / RSS-210 A8.1	Hopping channel carrier frequencies separation	Pass
15.247(a) / RSS-210 A8.1	20dB bandwidth of the hopping channel	Pass
15.247(e) / RSS-210 A8.1	Number of hopping frequencies	Pass
15.247(e) / RSS-210 A8.1	Average time of occupancy of hopping frequency	Pass
15.247(d) / RSS-210 A8.5	Antenna conducted spurious emissions	Pass
15.247(d) / RSS-210 A8.5	Radiated spurious emissions	Pass
15.247(i) / RSS- Gen 5.5	RF Exposure Compliance	Pass
15.207 / RSS-Gen 7.2.2	Transmitter Power Line conducted emissions	Pass
15.109 / ICES-003	Receiver/digital device radiated emissions	Pass
15.107 / ICES-003	Digital device conducted emissions	Pass

3.0 TEST CONDITIONS AND RESULTS

3.1 Maximum peak output power

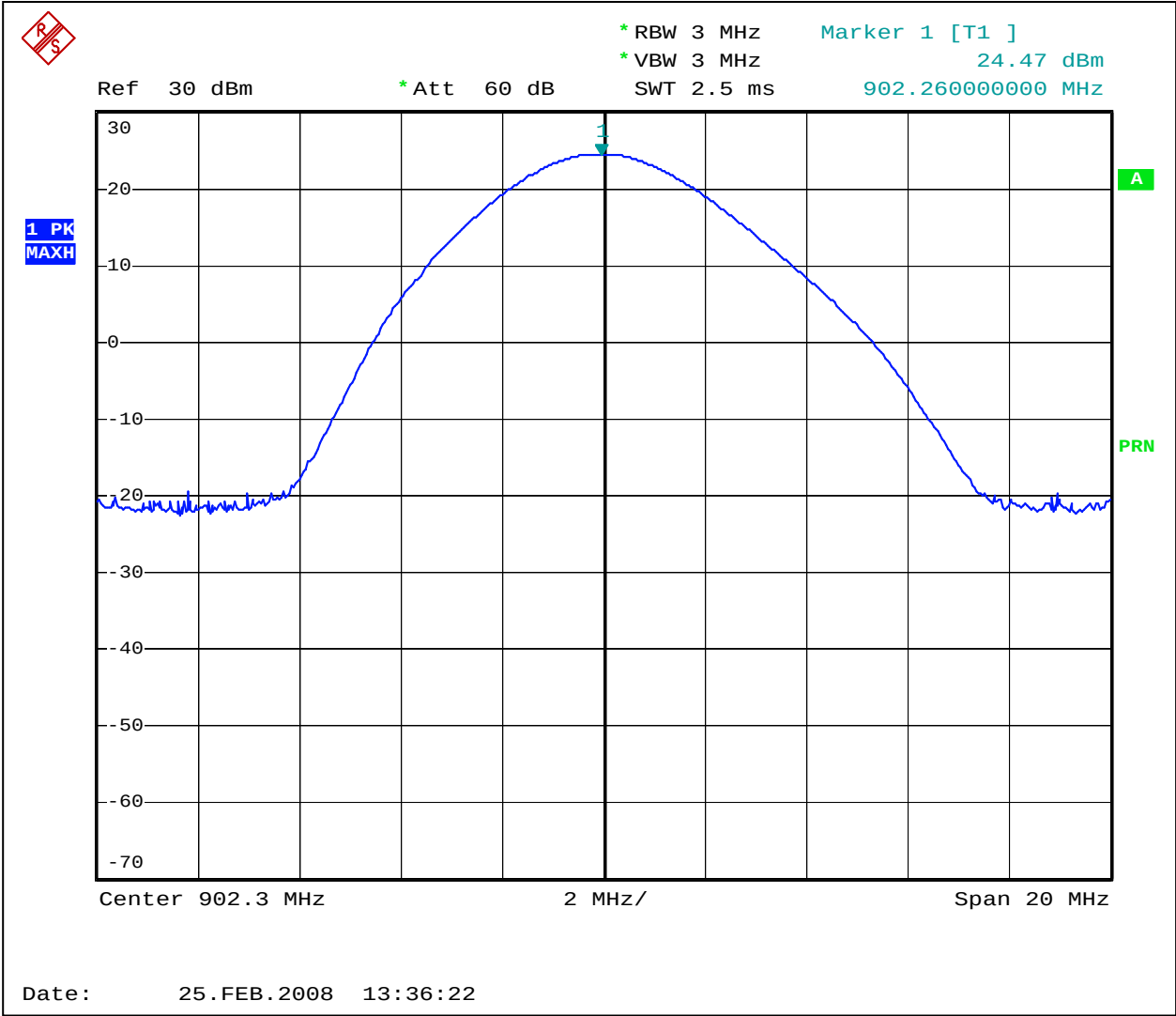
Test location: ☐ OATS ☐ Anechoic Chamber ☐ Other

Test result: **Pass**

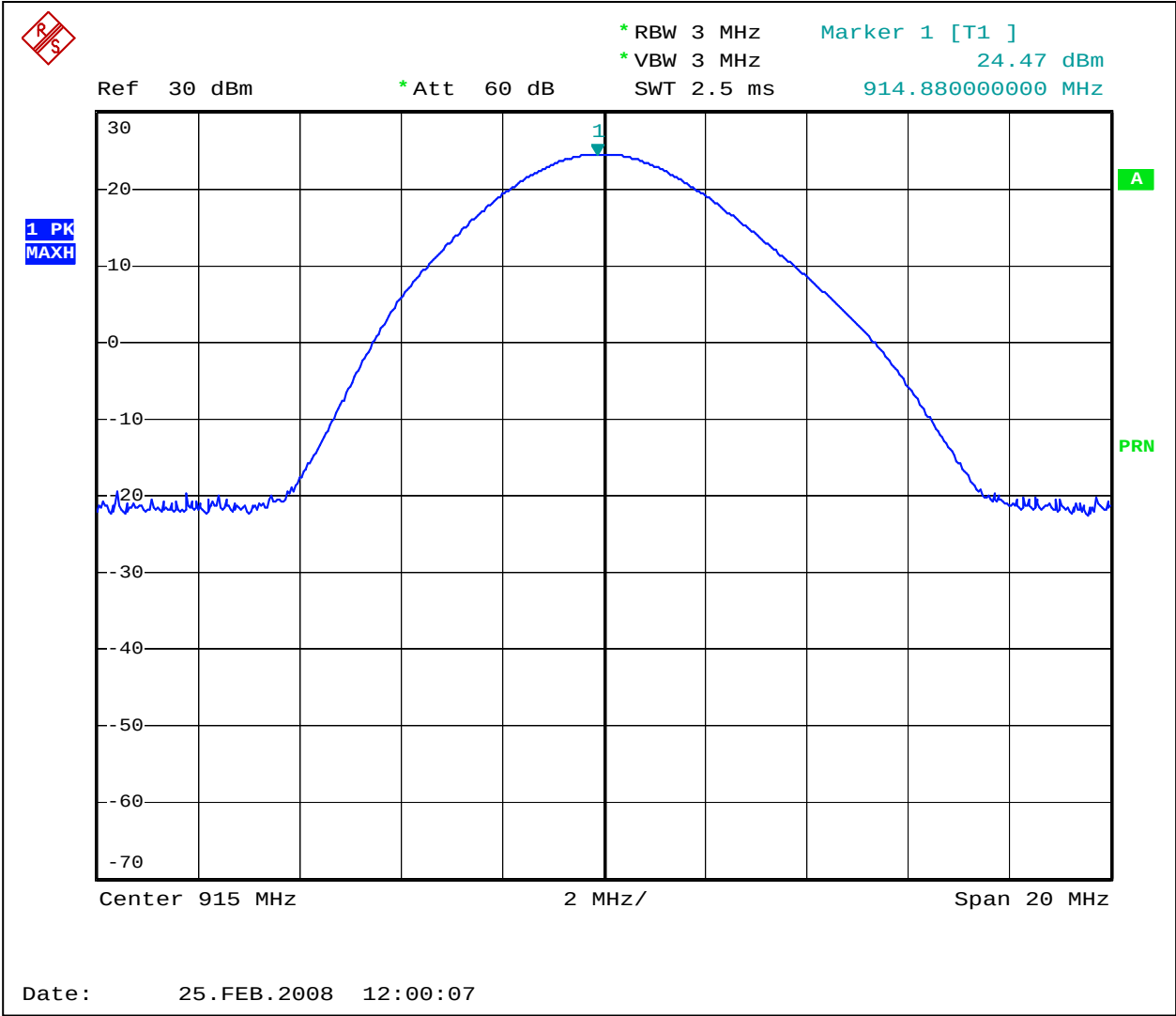
Max. Margin: 5.2 dB below the limits

Power Output:	Conducted					
Frequency Range:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 5725-5850MHz					
Low Frequency MHz	Measured power dBm	Attenuation dB	Power at Antenna dBm	Limit dBm	Limit Reduction dB	Margin dB
902.3	24.47	0.2	24.7	30.0	0	-5.3
Middle Frequency MHz						
915.0	24.47	0.2	24.7	30.0	0	-5.3
Upper Frequency MHz						
927.7	24.60	0.2	24.8	30.0	0	5.2
RBW:	☐ 1MHz ☒ 3MHz ☐ 10MHz					
VBW:	☐ 1MHz ☒ 3MHz ☐ 10MHz					
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = dB					

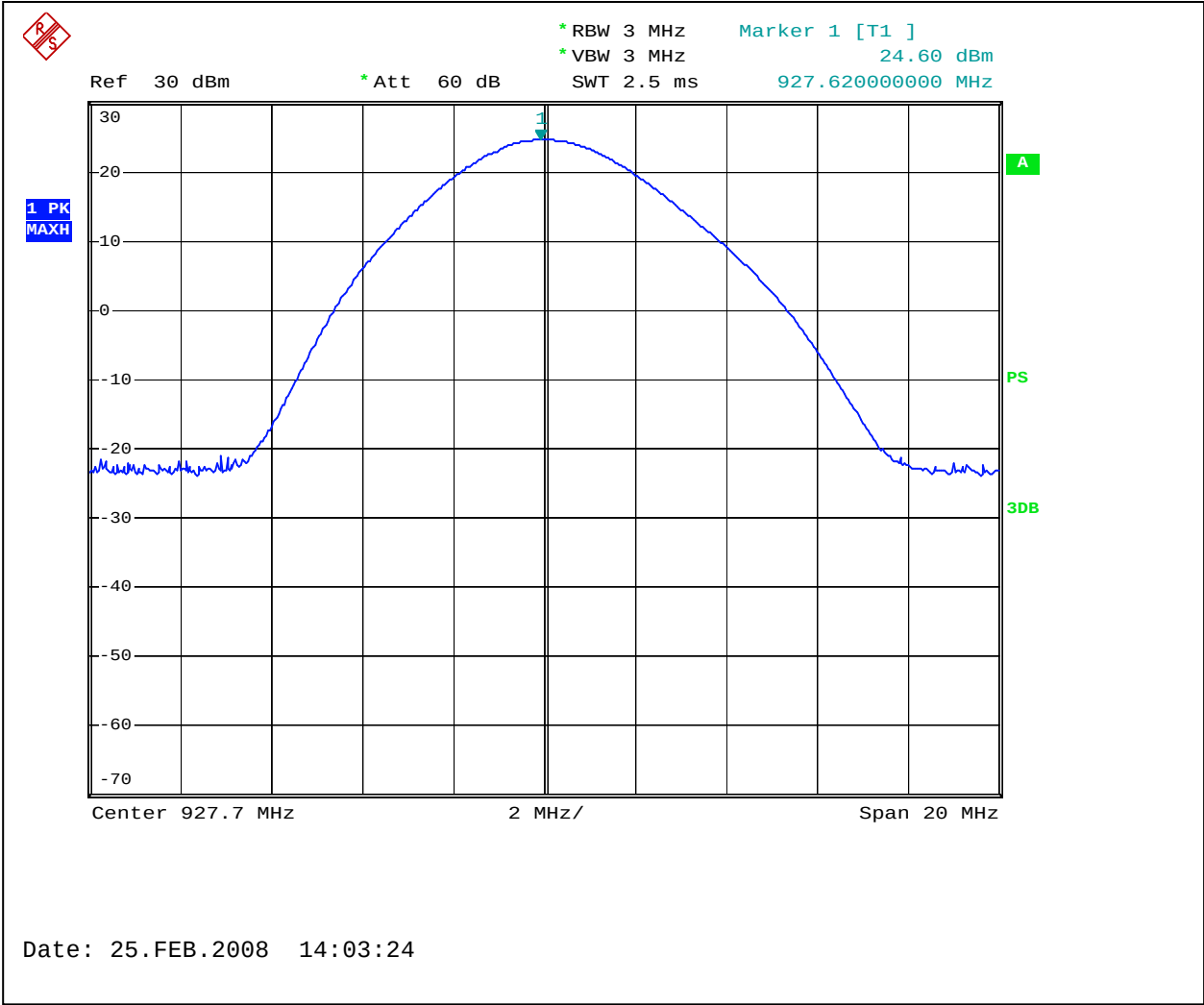
Notes: None



Graph 3.1.1



Graph 3.1.2

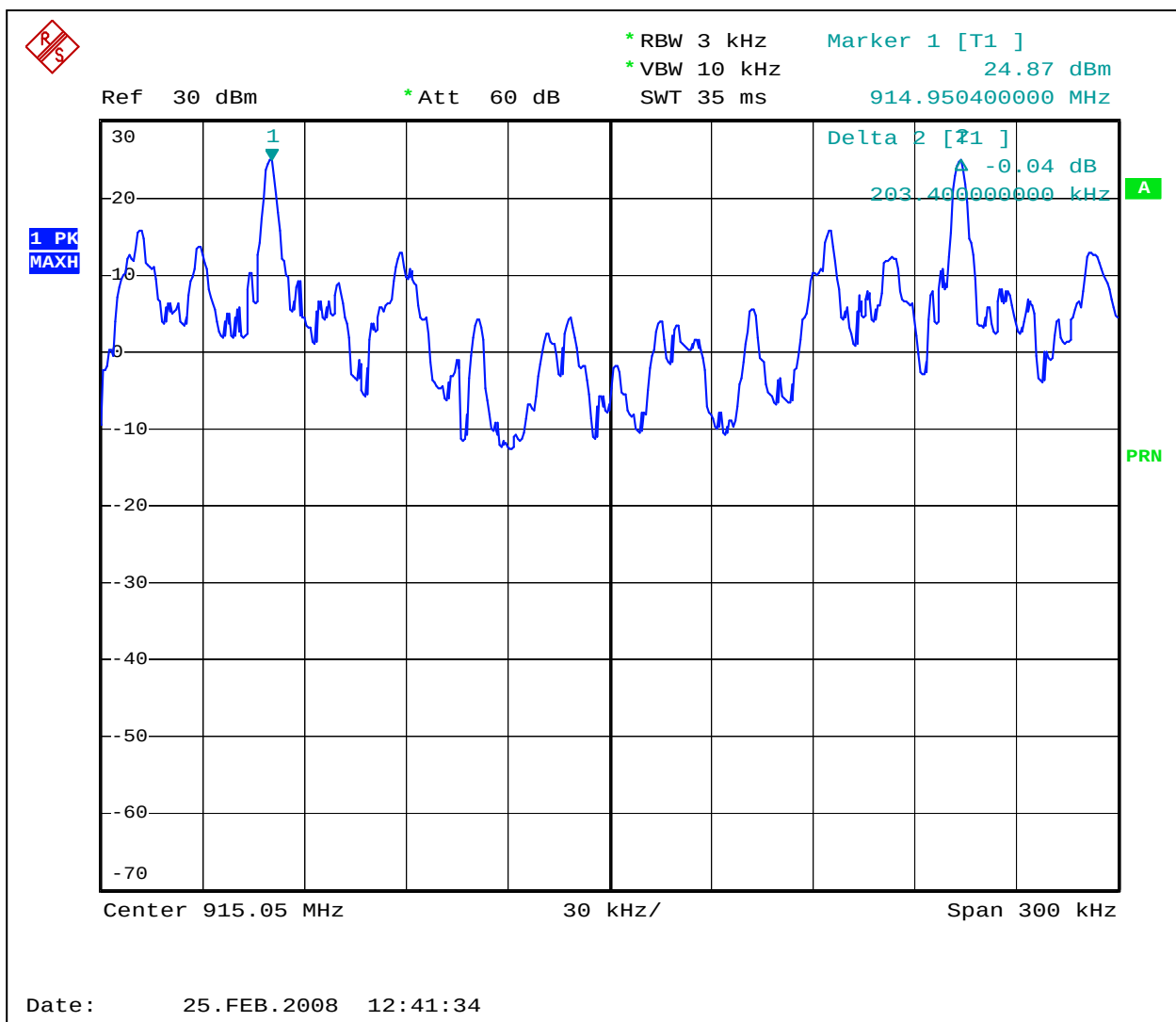


Graph 3.1.3

3.2 Hopping channel carrier frequencies separation

Frequency Range:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 5725-5850MHz			
Measured Separation (kHz)	Minimum Separation - Limit (kHz)		Result	
203.4	124.2		Pass	
Limit:	☐ 25kHz ☒ 20dB channel bandwidth ☐ 2/3 of 20dB channel bandwidth			
Span:	300kHz			
RBW:	☒ 3kHz	☐ 10kHz	☐ 100kHz	☐ other kHz
VBW:	☐ 3kHz	☒ 10kHz	☐ 100kHz	☐ other kHz

Notes: None

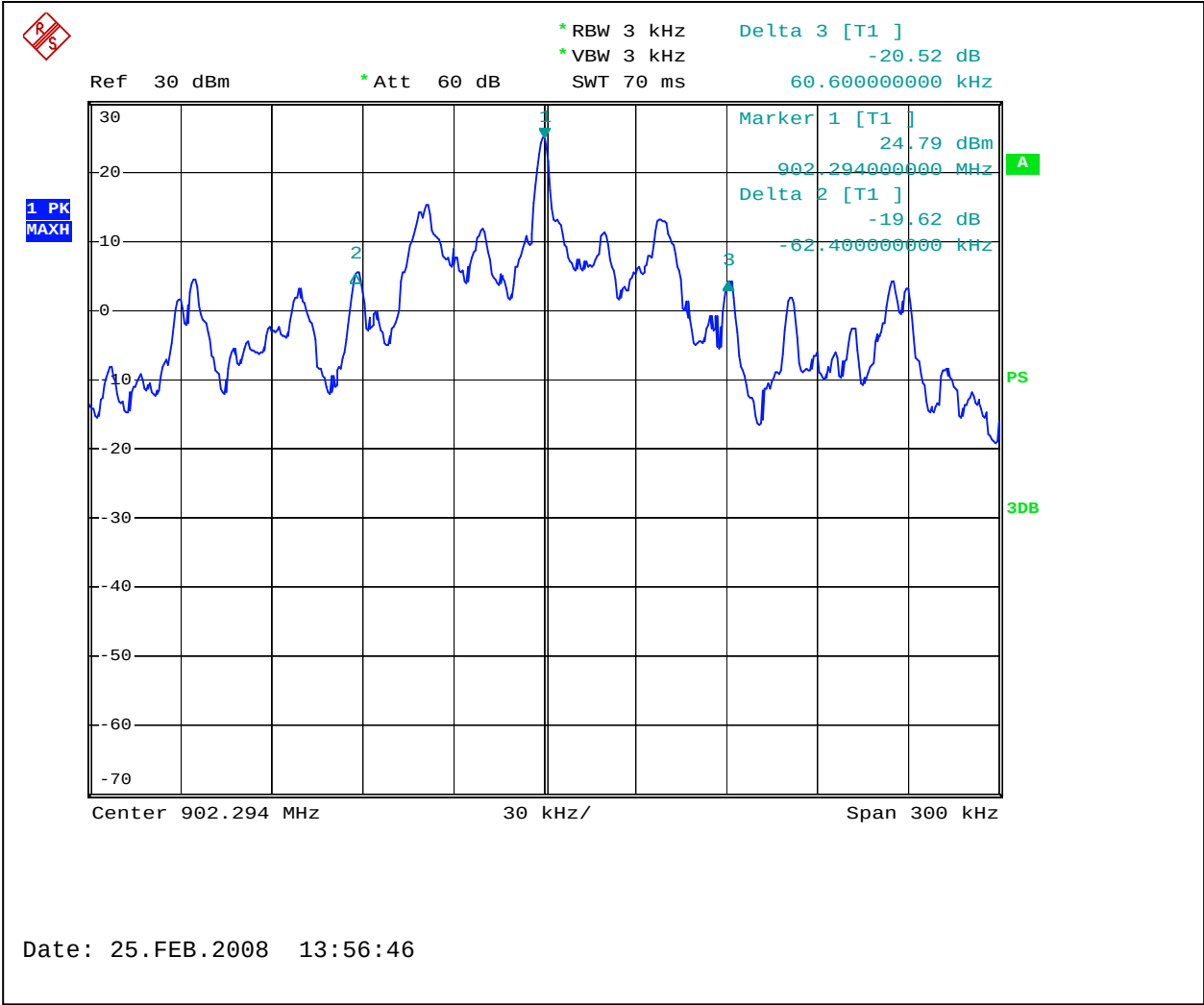


Graph 3.2.1

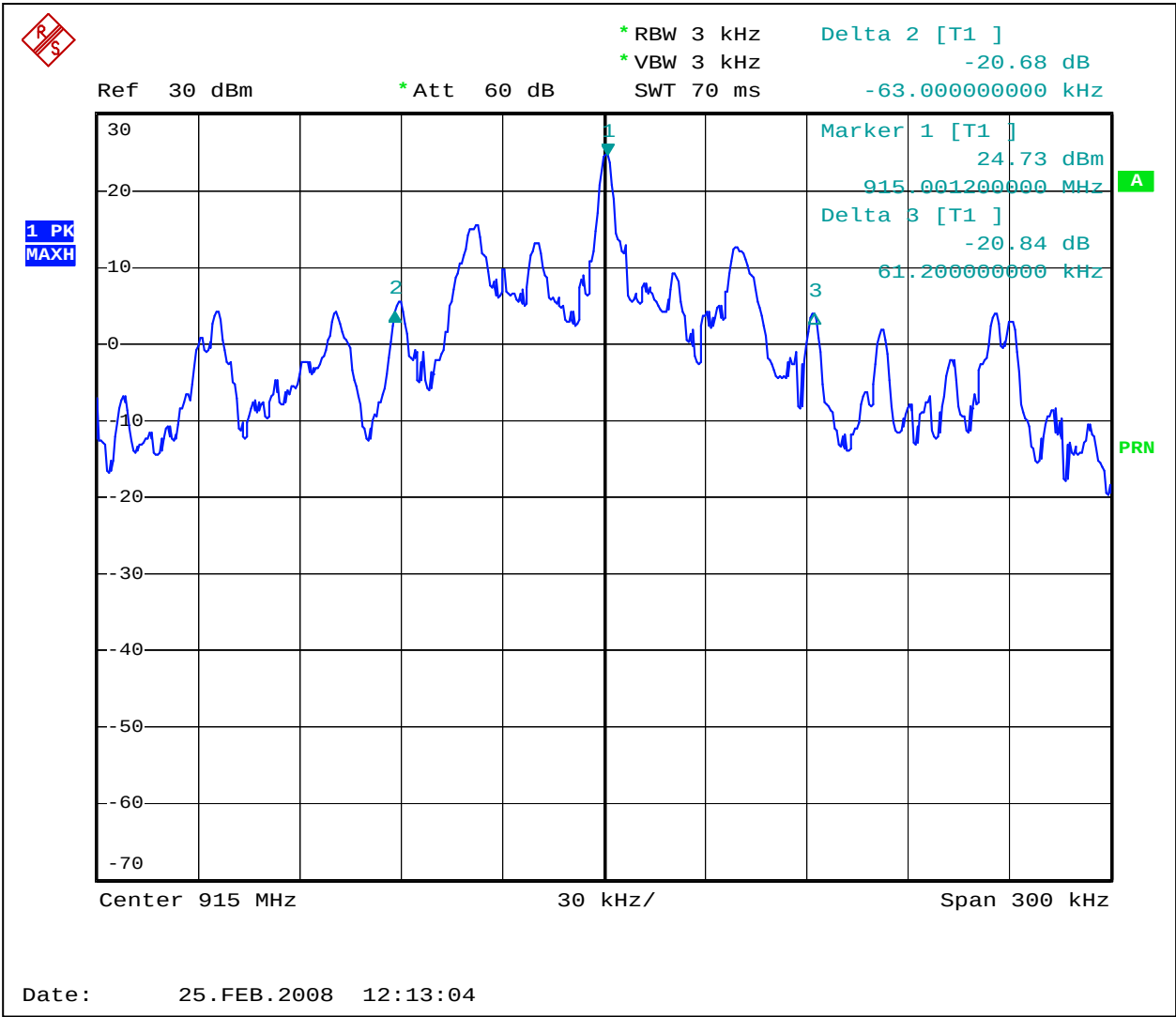
3.3 20dB bandwidth of the hopping channel

Frequency Range:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 5725-5850MHz			
Low Frequency Channel (kHz)	Middle Frequency Channel (kHz)	Upper Frequency Channel (kHz)	Limit (kHz)	Result
123.0	124.2	123.6	250.0	Pass
Span:	300kHz			
RBW:	☒ 3kHz ☐ 10kHz ☐ 100kHz ☐ other kHz			
VBW:	☒ 3kHz ☐ 10kHz ☐ 100kHz ☐ other kHz			

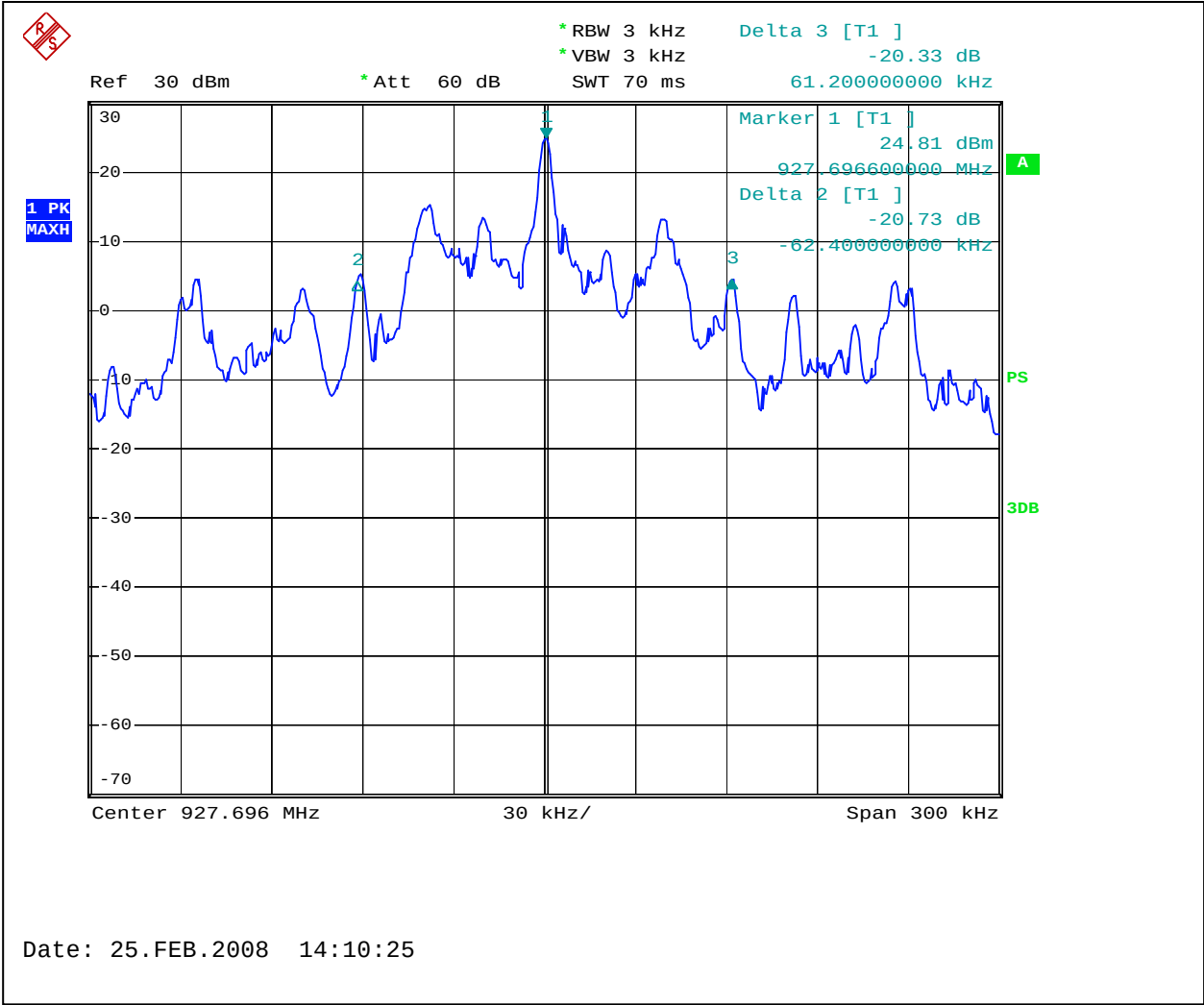
Notes: None



Graph 3.3.1



Graph 3.3.2

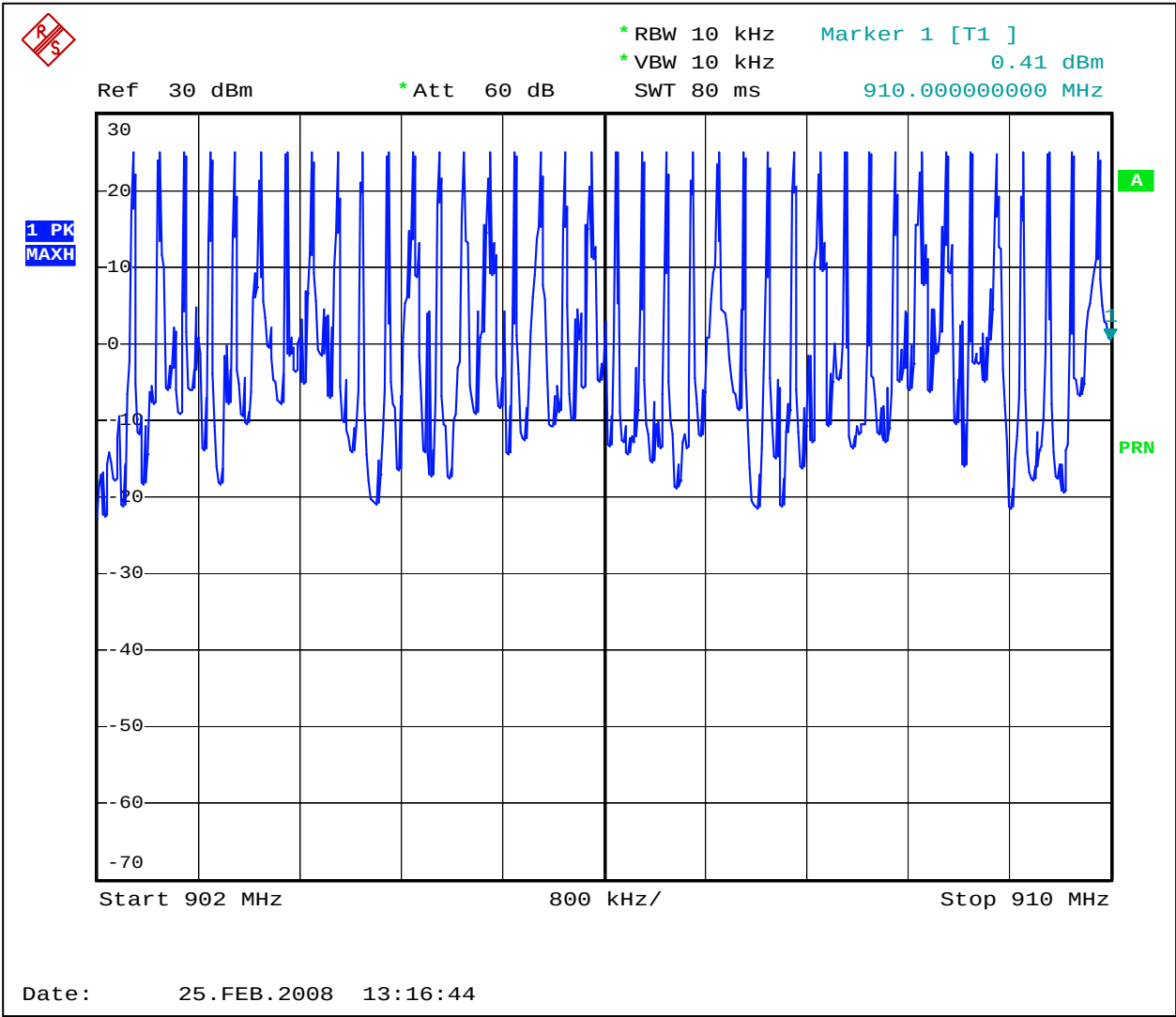


Graph 3.3.3

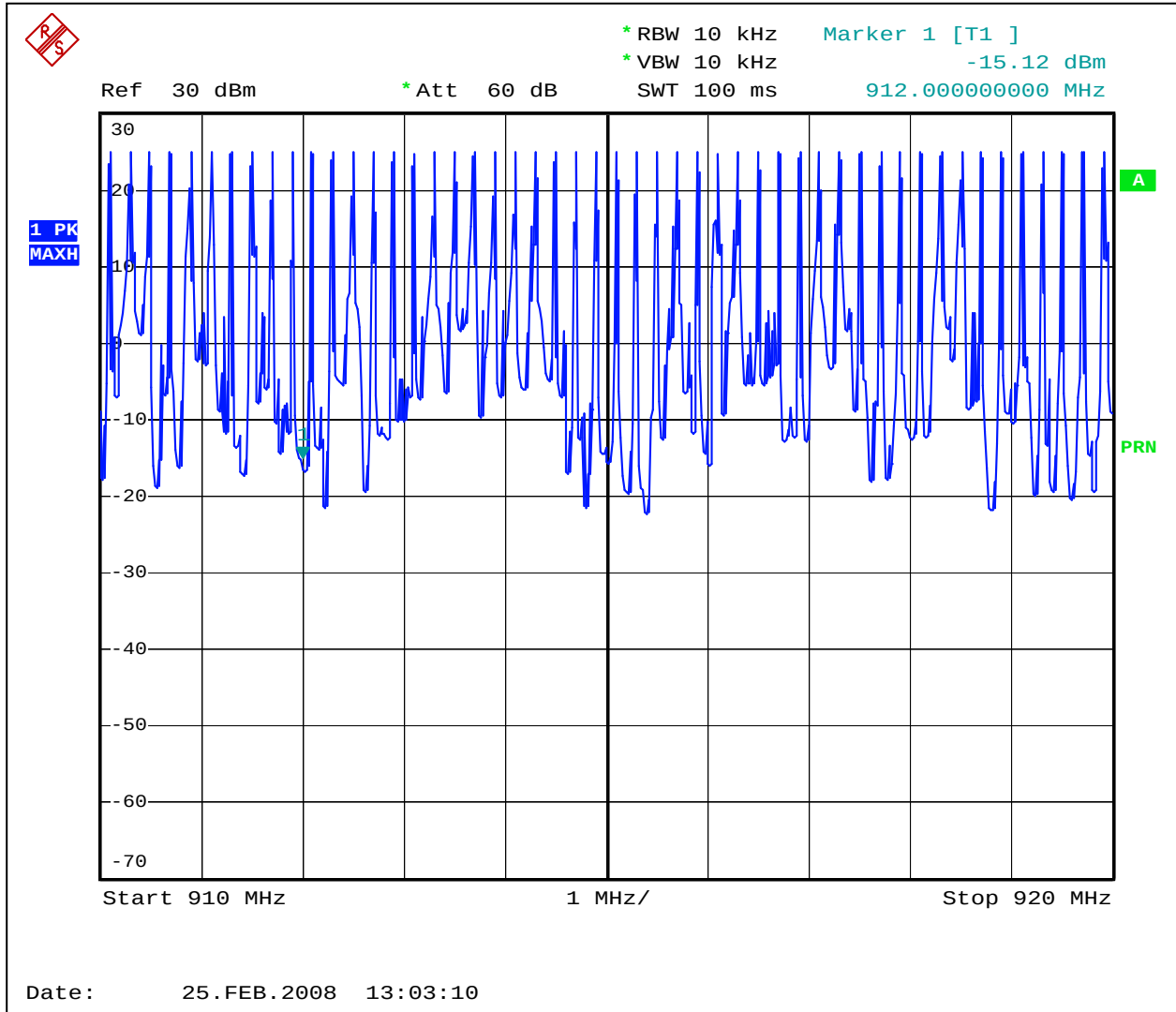
3.4 Number of hopping frequencies

Frequency Range:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 5725-5850MHz	
Measured Number	Requirements	Result
128	50	Pass
Channel 20dB Bandwidth:	☒ <250kHz ☐ ≥250kHz	

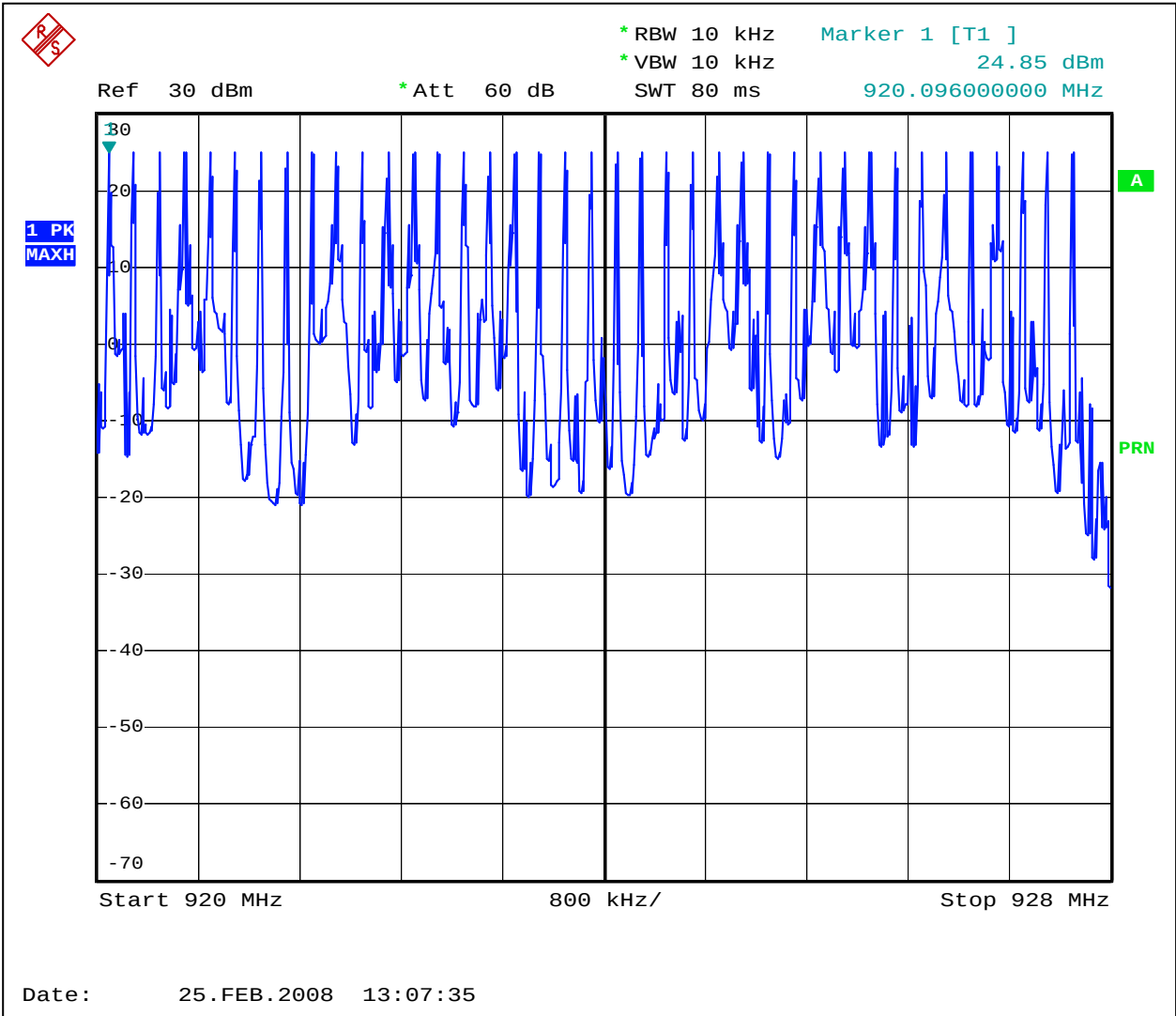
Notes: None



Graph 3.4.1



Graph 3.4.2



Graph 3.4.3

3.5 Average time of occupancy of hopping frequency

Frequency Range:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 5725-5850MHz		
Measured / Calculated Time sec	Period sec	Limit sec	Result
0.19	20	0.4	Pass
Period:	☐ 10s ☒ 20s ☐ 30s ☐ 0.4s multiplied by the channel number		
Channel 20dB Bandwidth:	☒ <250kHz ☐ ≥250kHz		

Time of occupancy calculation:

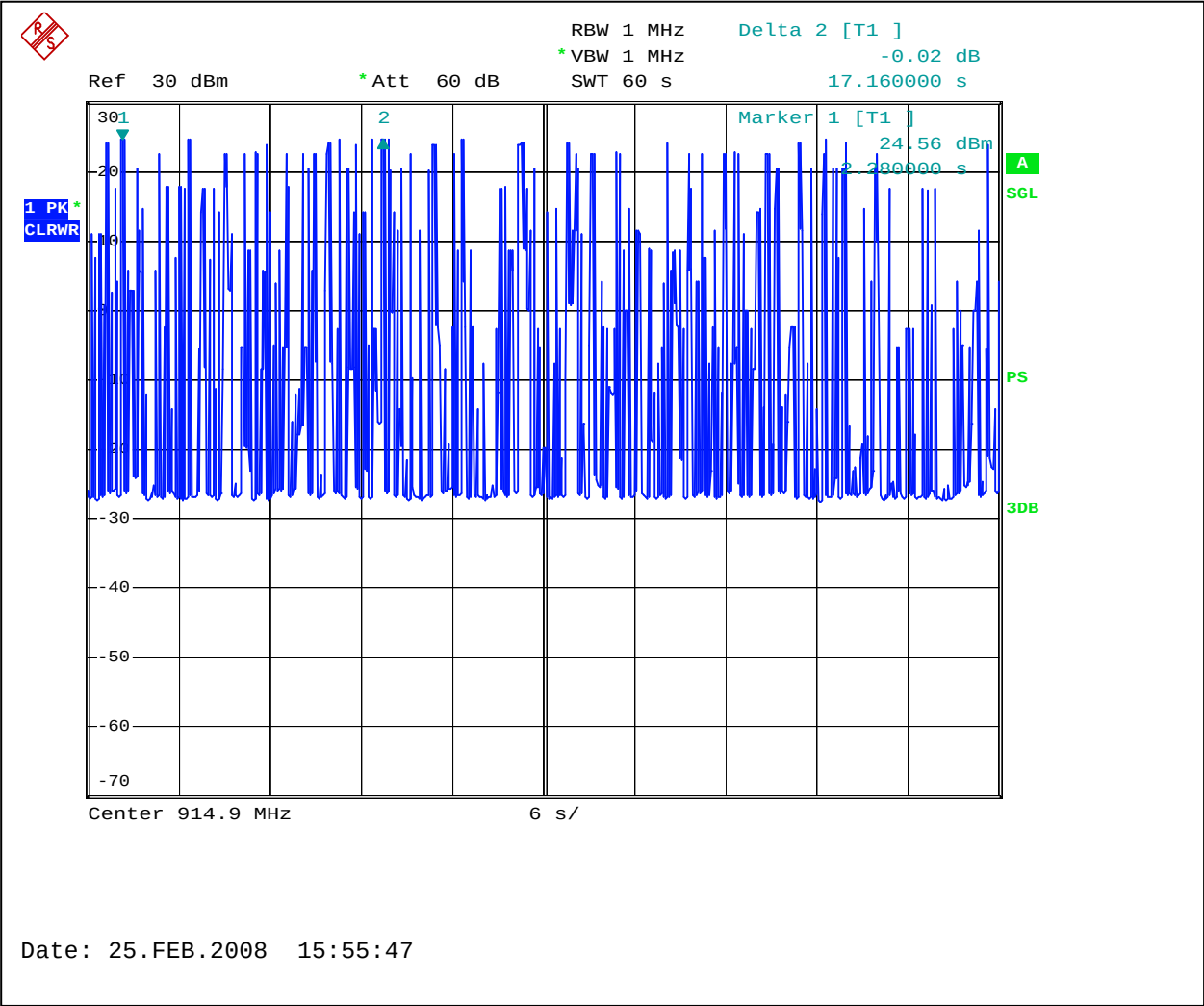
The minimum measured repetition of the channel occupancy (repetition) = 17.16 sec

Single occupancy duration (single duration) = 0.164 sec

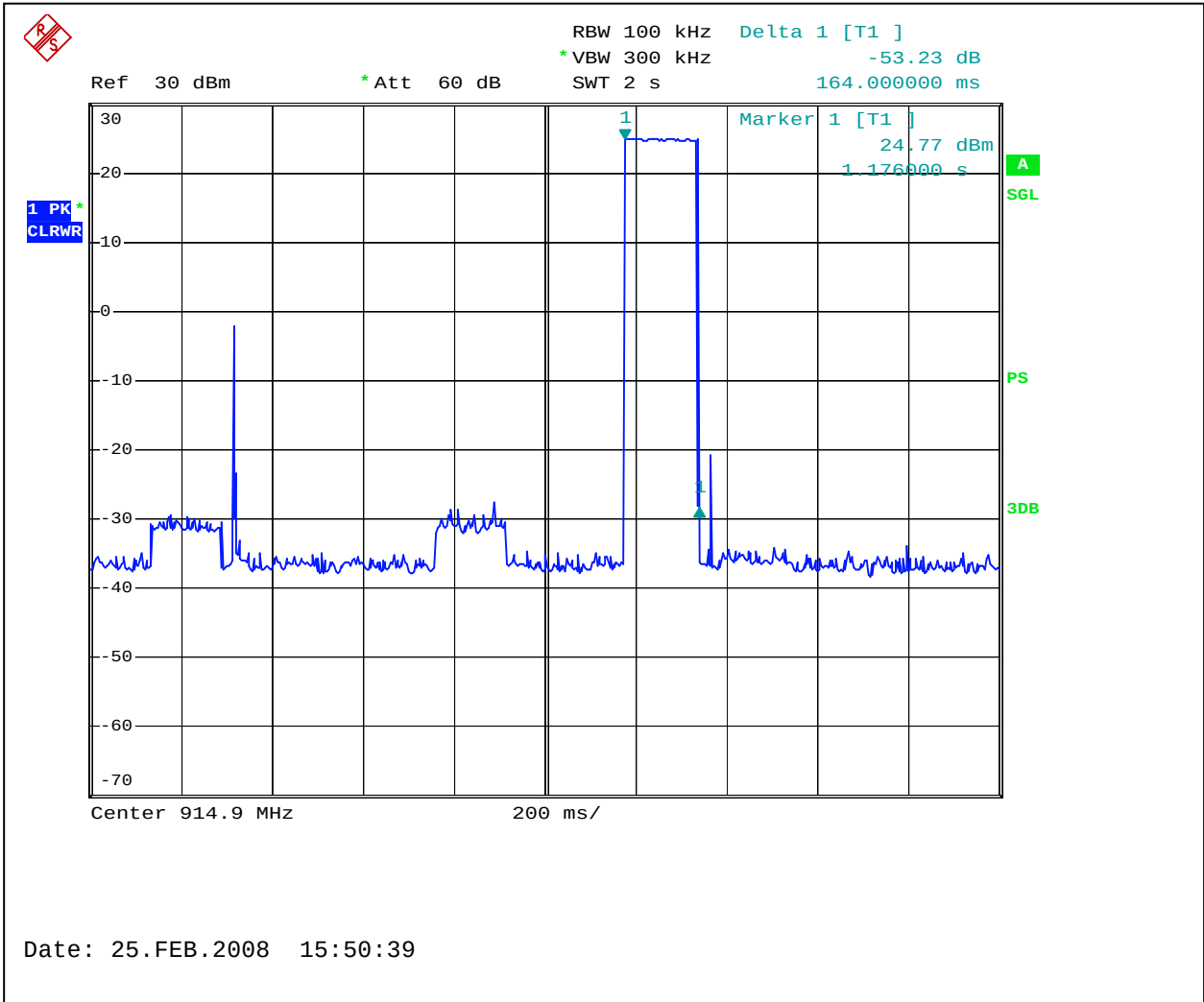
Period = 20 sec

Time of occupancy = (single duration) x (period) / (repetition) = 0.164 x 20 / 17.16 (sec) = 0.19 sec

Notes: None



Graph 3.5.1

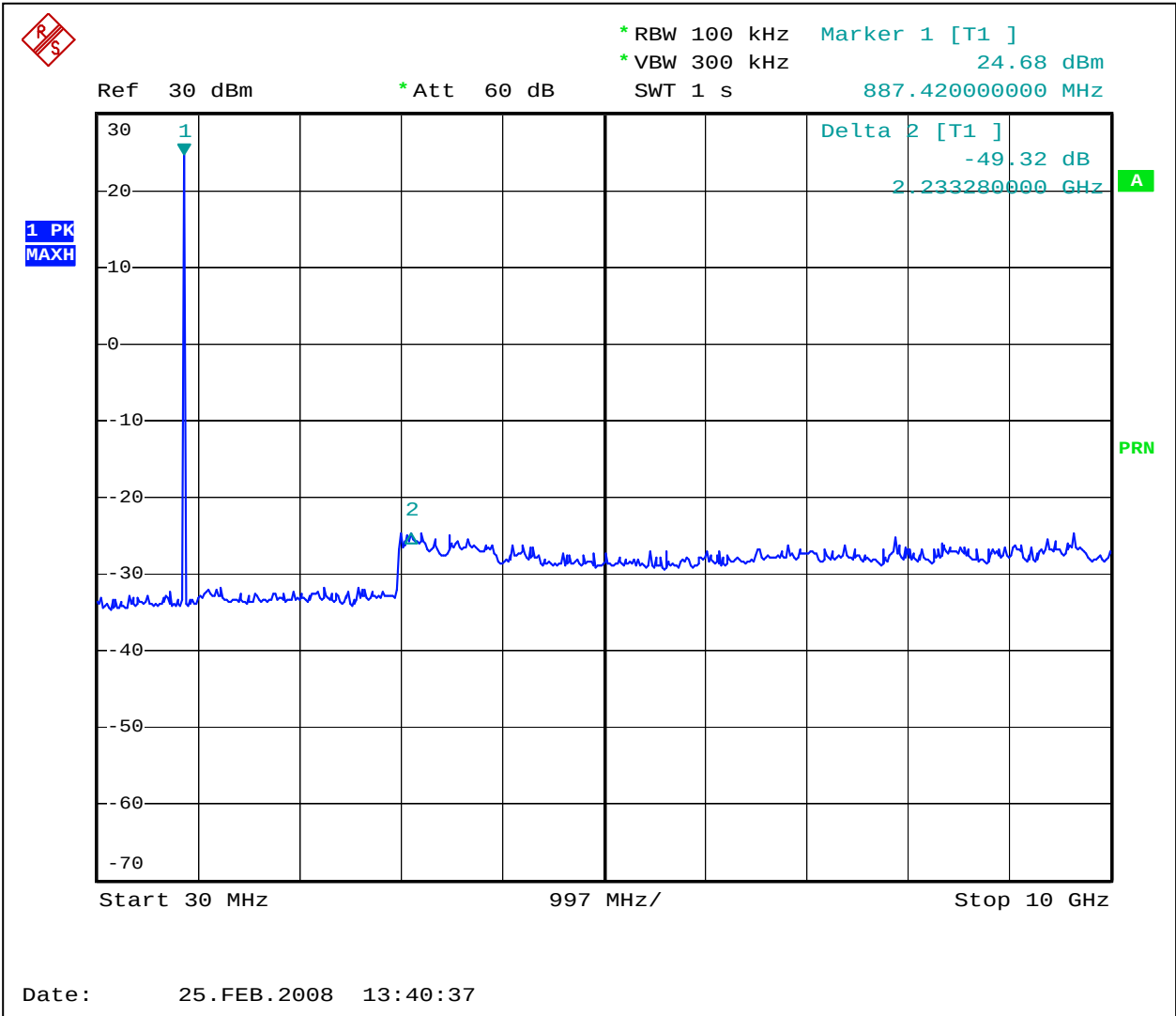


Graph 3.5.2

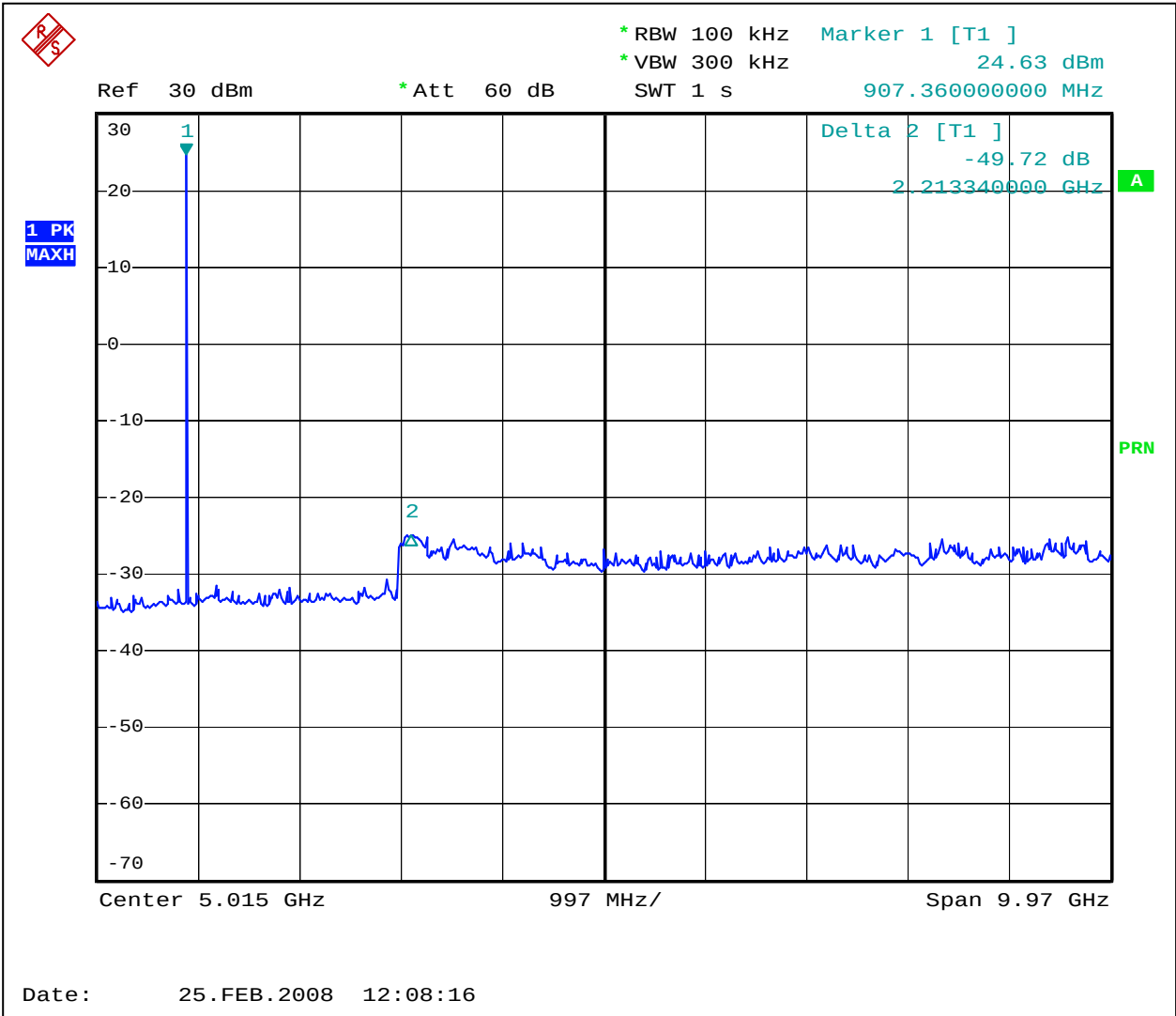
3.6 Antenna conducted spurious emissions

Frequency Range:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 5725-5850MHz		
	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	49.32	20	-29.3
Middle Frequency Channel	49.72	20	-29.7
Upper Frequency Channel	49.67	20	-29.7
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

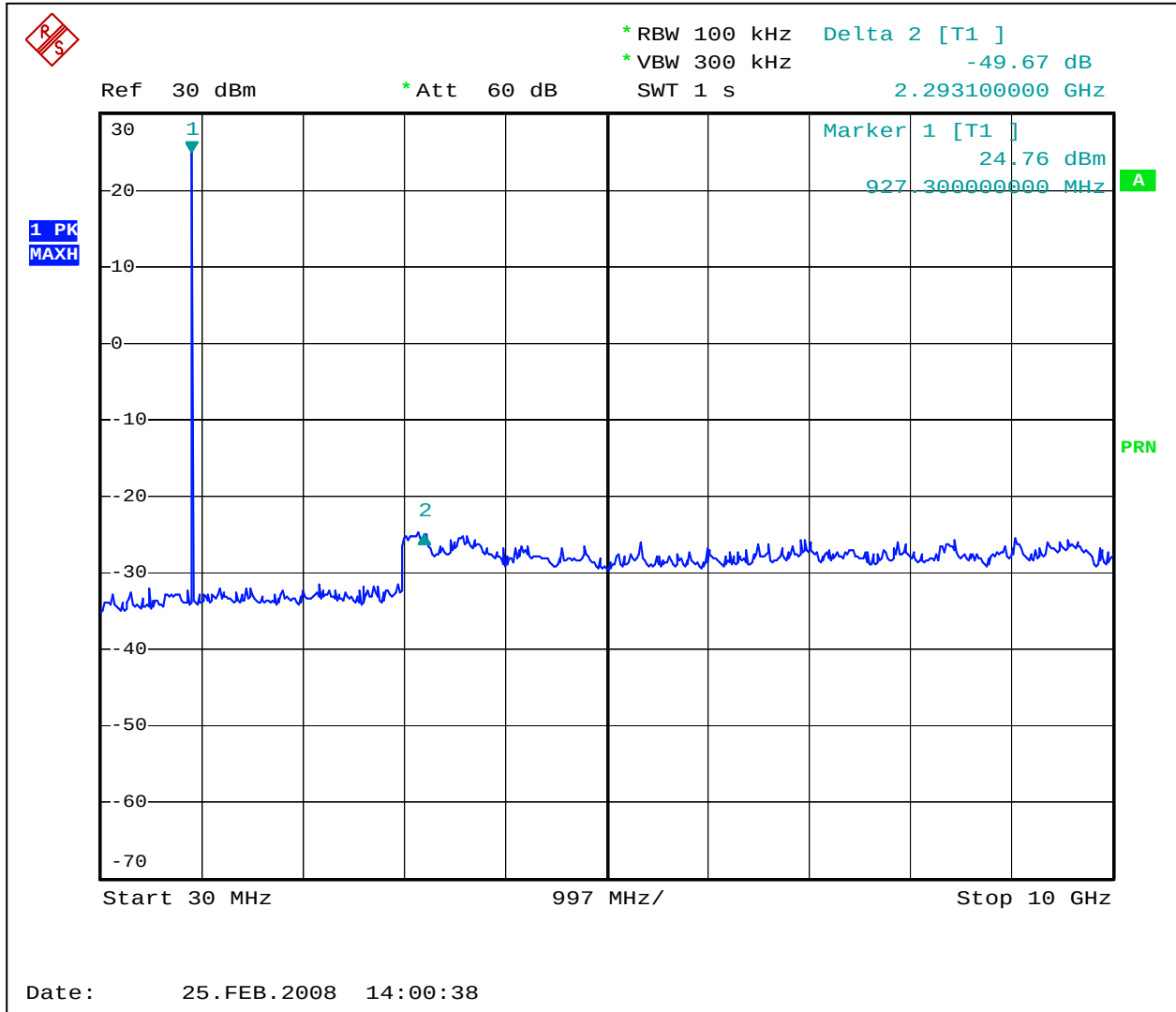
Notes: None



Graph 3.6.1



Graph 3.6.2



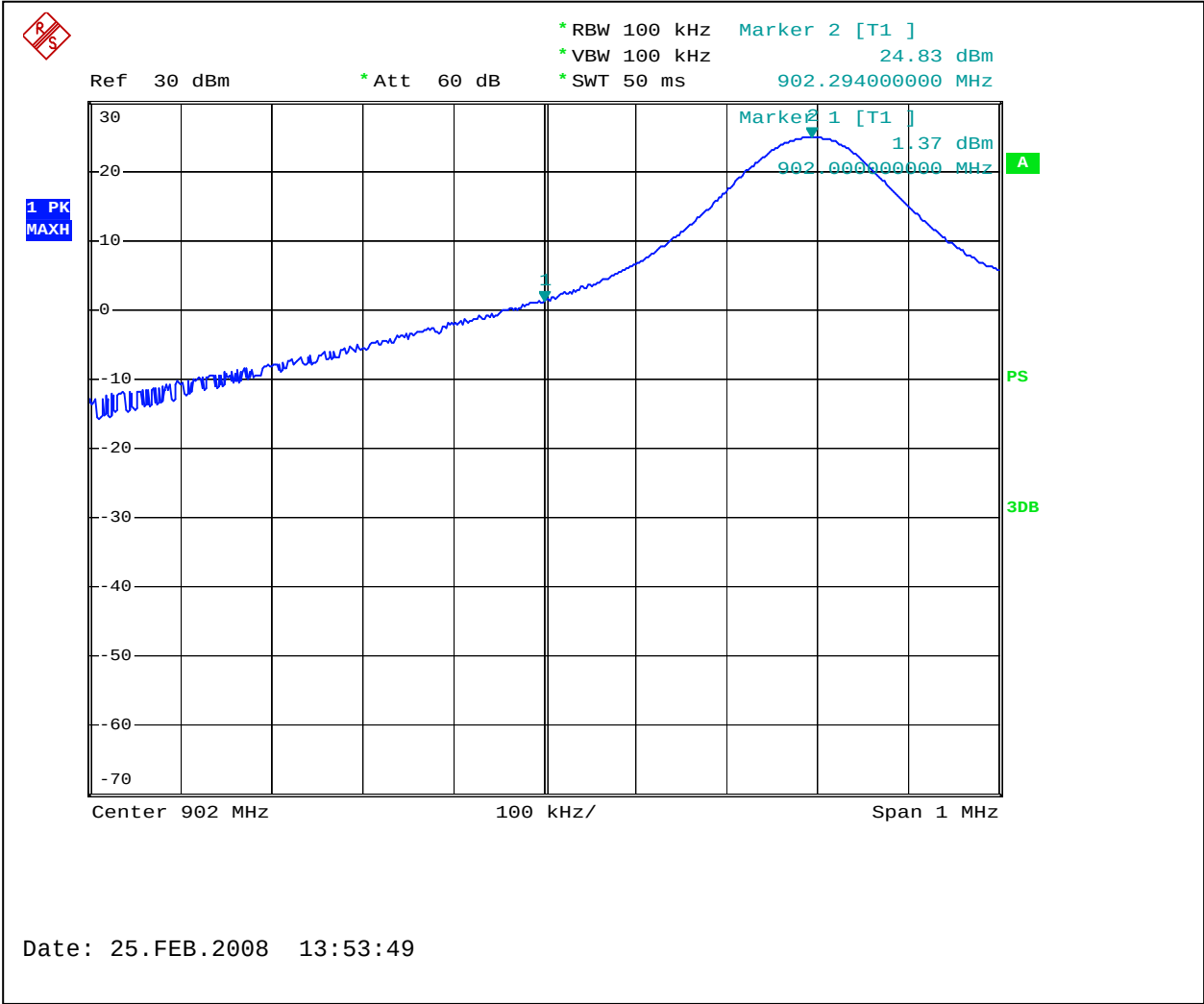
Graph 3.6.3



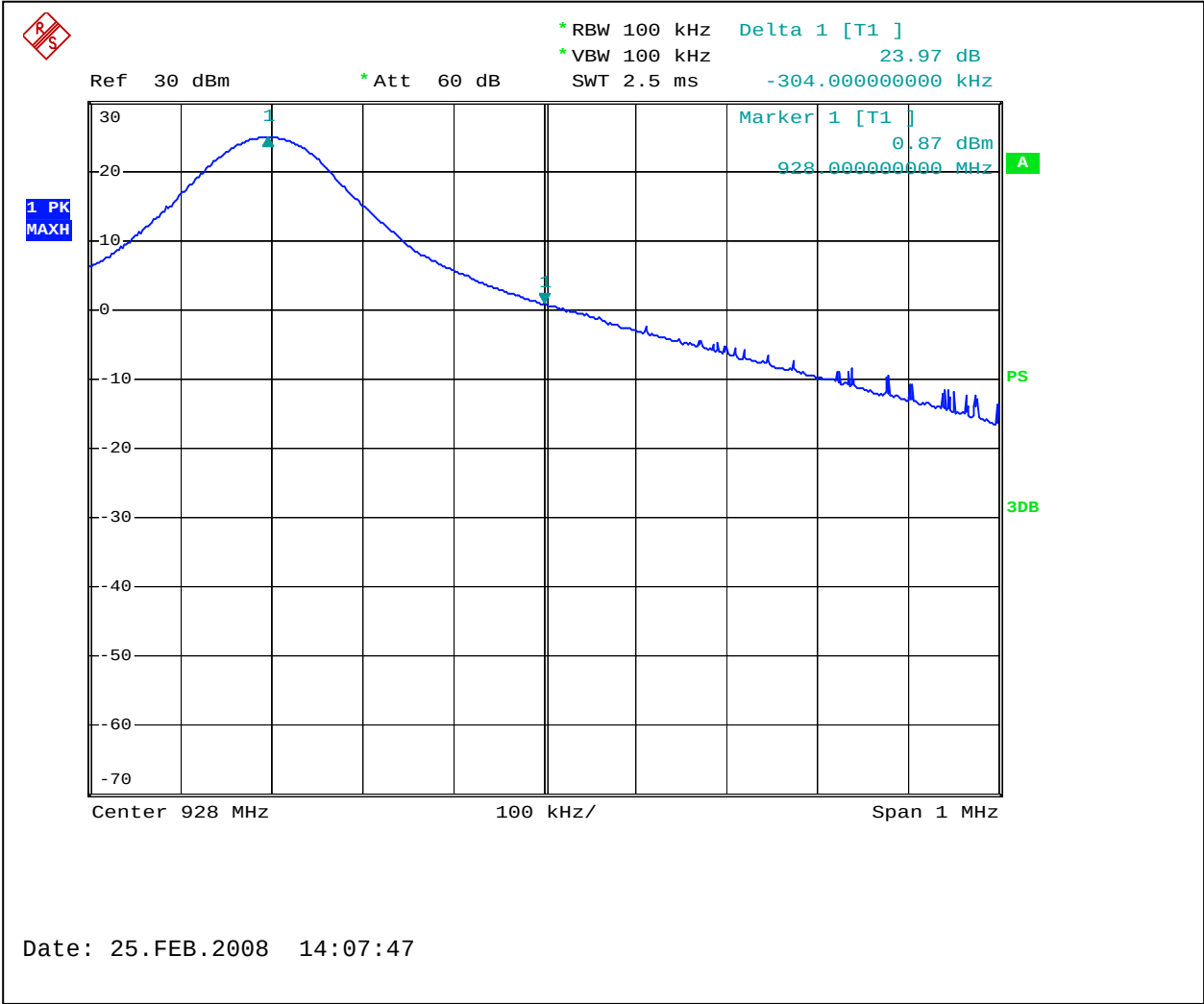
3.6.1 Antenna conducted band edge compliance

Frequency Range:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 5725-5850MHz		
	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	24.83	20	-4.8
Upper Frequency Channel	23.97	20	-4.0
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

Notes: None



Graph 3.6.4



Graph 3.6.5



3.7 Radiated spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Fail**

Max. Margin: 9.1 dB above the limits

Date:	February 26-27, 2008	Result: Fail
Standard:	FCC part 15.247(d)	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure	
Operation mode:	See Page 5	
Note:	Frequency range 30MHz to 10GHz	

Table 3.7.1

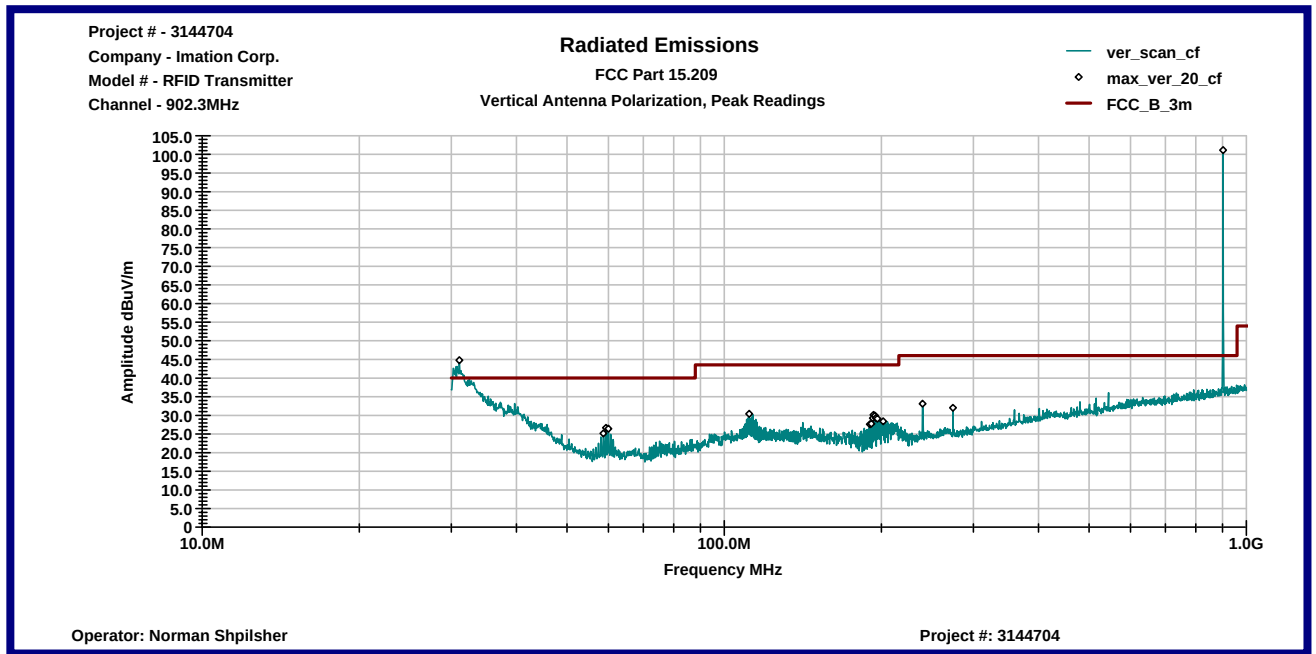
Table # 1

Frequency MHz	Antenna Polarity	Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBμV	Total @ 3m dBμV/m	Limit dBμV/m	Margin dB	Comments
			Channel 902.3MHz						
32.70	V	18.5	0.6	0.0	16.9	36.0	40.0	-4.0	
34.06	V	17.7	0.7	0.0	19.2	37.6	40.0	-2.4	
1804.60	V	27.0	5.7	0.0	29.5	62.2	not restricted band of operation		
1804.60	H	27.0	5.7	0.0	24.7	57.4	not restricted band of operation		
* 2706.9	V	29.3	4.0	38.1	50.5	45.7	54.0	-8.2	
* 2706.9	H	29.3	4.0	38.1	46.4	41.6	54.0	-12.4	
* 3609.2	V	31.6	4.4	38.3	41.7	39.4	54.0	-14.6	
* 3609.2	H	31.6	4.4	38.3	38.8	36.6	54.0	-17.4	
* 4511.5	V	32.6	6.1	38.2	42.7	43.1	54.0	-10.9	
* 4511.5	H	32.6	6.1	38.2	39.9	40.3	54.0	-13.7	
			Channel 915.0MHz						
32.78	V	18.4	0.6	0.0	15.8	34.9	40.0	-5.1	
34.01	V	17.8	0.7	0.0	18.4	36.8	40.0	-3.2	
1830.00	V	27.1	5.7	0.0	28.7	61.6	not restricted band of operation		
1830.00	H	27.1	5.7	0.0	28.1	61.0	not restricted band of operation		
* 2745	V	29.4	4.0	38.1	50.6	45.9	54.0	-8.1	
* 2745	H	29.4	4.0	38.1	47.7	43.1	54.0	-10.9	
* 3660	V	31.7	4.4	38.3	42.6	40.5	54.0	-13.5	
* 3660	H	31.7	4.4	38.3	39.1	37.0	54.0	-17.0	
* 4575	V	32.7	6.1	38.2	44.4	45.0	54.0	-9.0	
* 4575	H	32.7	6.1	38.2	38.2	38.7	54.0	-15.2	
* 5490	V	34.2	7.0	38.3	37.4	40.3	not restricted band of operation		
* 5490	H	34.2	7.0	38.3	36.1	39.0	not restricted band of operation		
			Channel 927.7MHz						
33.26	V	18.2	0.7	0.0	18.9	37.7	40.0	-2.3	
1004.49	H	22.1	3.9	0.0	1.7	27.7	54.0	-26.3	
1855.40	V	27.3	5.8	0.0	29.8	62.8	not restricted band of operation		
1855.40	H	27.3	5.8	0.0	30.5	63.5	not restricted band of operation		
2783.10	V	29.5	4.0	38.0	47.2	42.7	54.0	-11.3	
* 2783.1	H	29.5	4.0	38.0	44.1	39.6	54.0	-14.4	
* 3710.8	V	31.8	4.4	38.2	45.9	43.9	54.0	-10.0	
* 3710.8	H	31.8	4.4	38.2	39.8	37.9	54.0	-16.1	
* 4638.5	V	32.8	6.2	38.3	39.9	40.6	54.0	-13.4	
* 4638.5	H	32.8	6.2	38.3	37.2	37.9	54.0	-16.1	
* 5566.2	V	34.2	7.0	38.3	42.5	45.5	not restricted band of operation		
* 5566.2	H	34.2	7.0	38.3	38.7	41.6	not restricted band of operation		
* 6493.9	V	34.3	7.8	37.7	40.2	44.5	not restricted band of operation		
* 6493.9	H	34.3	7.8	37.7	39.5	43.8	not restricted band of operation		

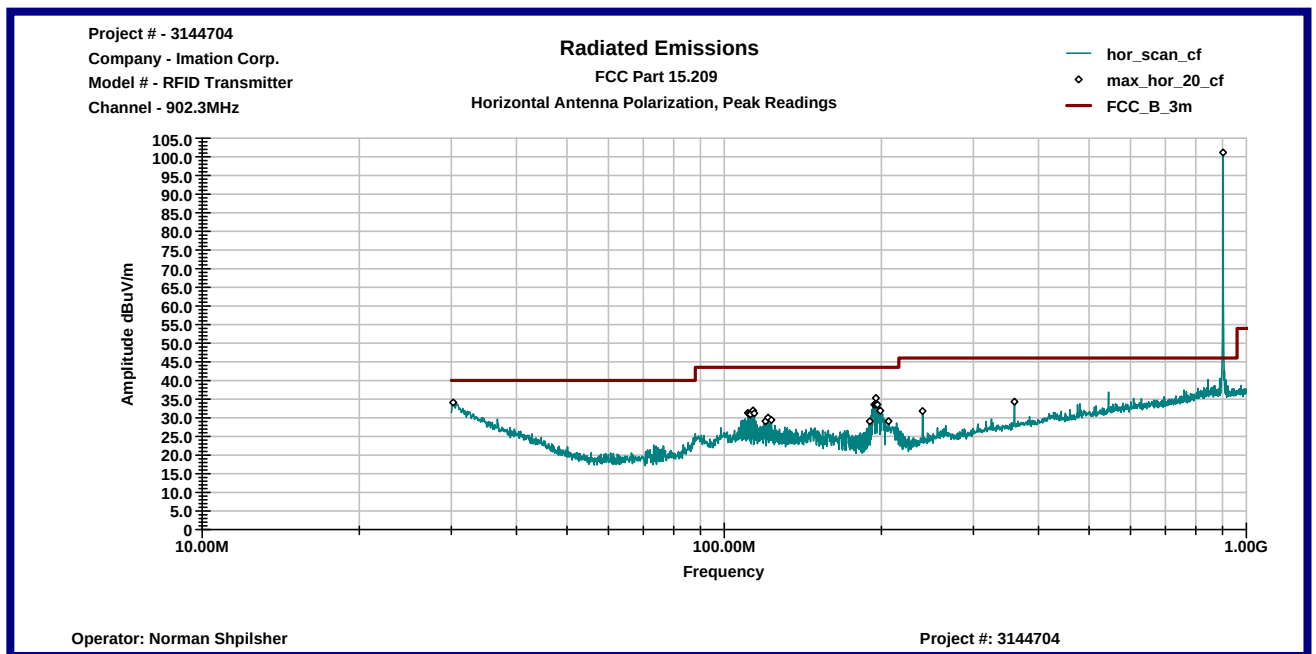
Measurements below 1GHz were taken using a CISPR Quasi-peak detector

Measurements above 1GHz were taken using an Average Value (RBW 1MHz, VBW 1Hz)

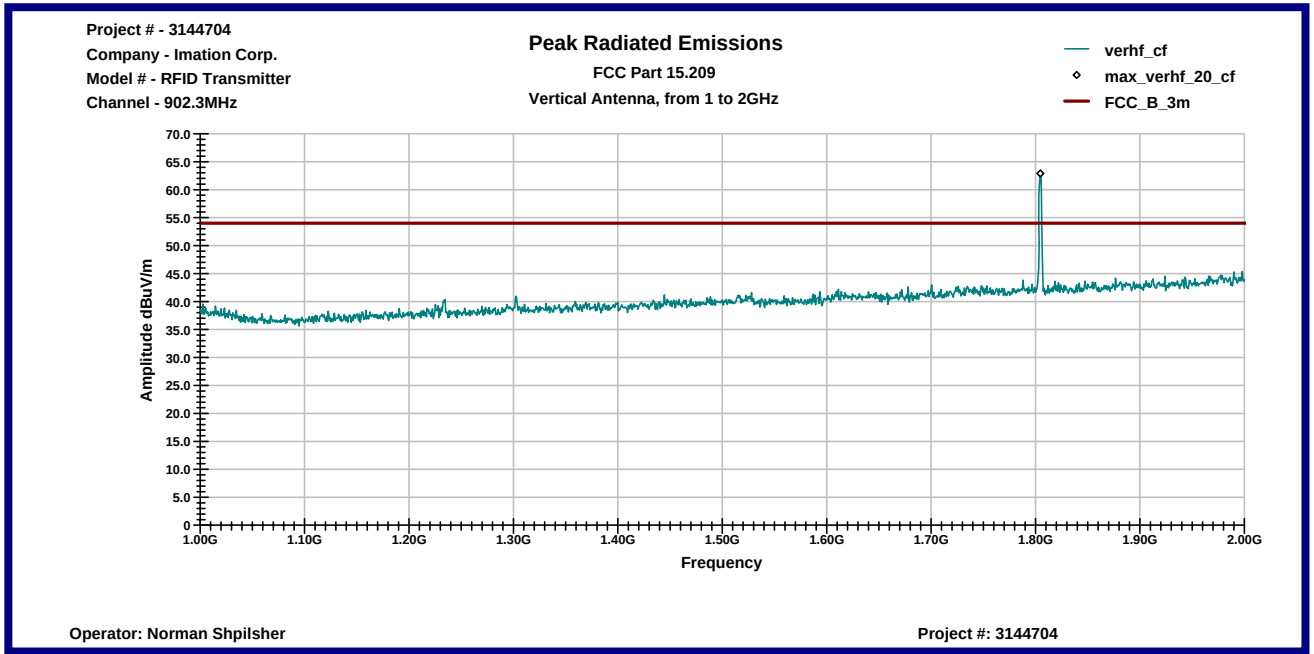
Measurements marked (*) were taken using a Peak detector



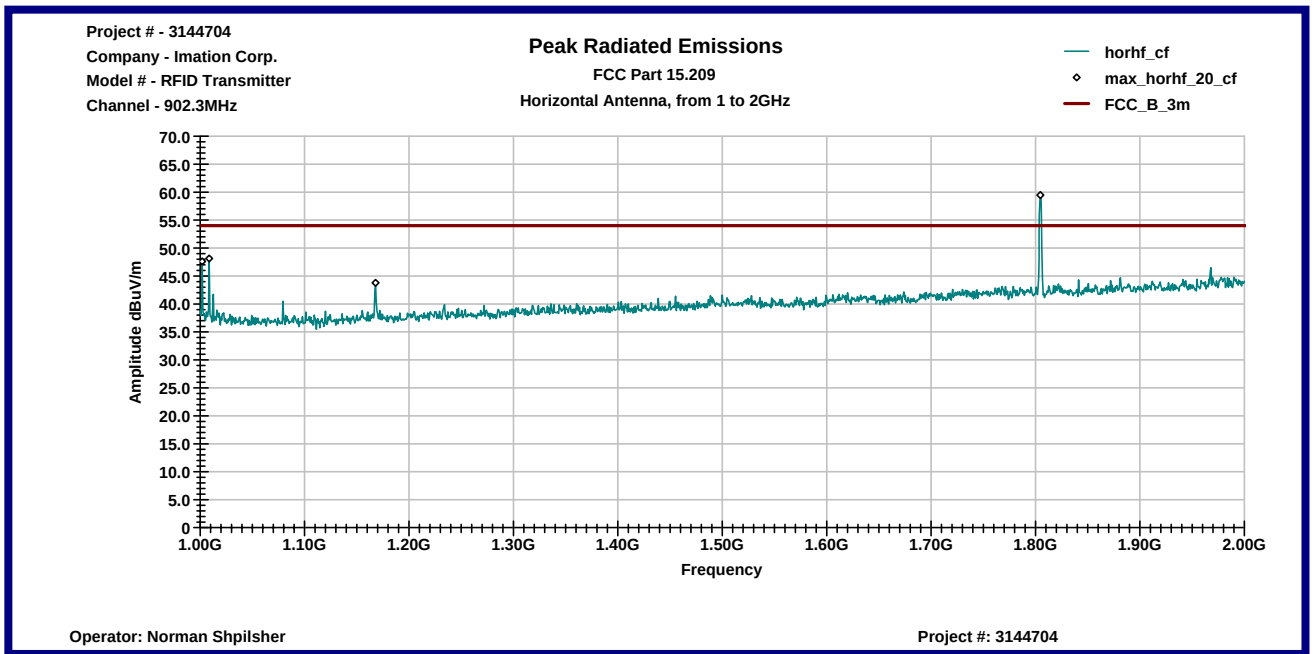
Graph 3.7.1



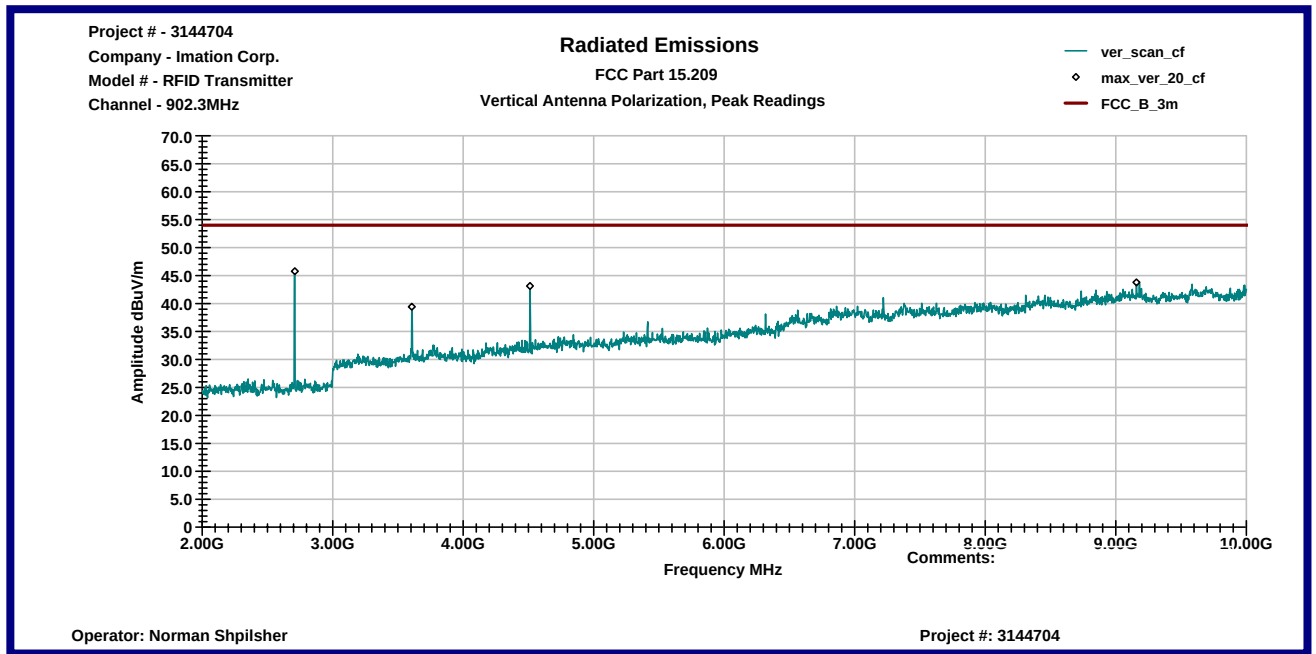
Graph 3.7.2



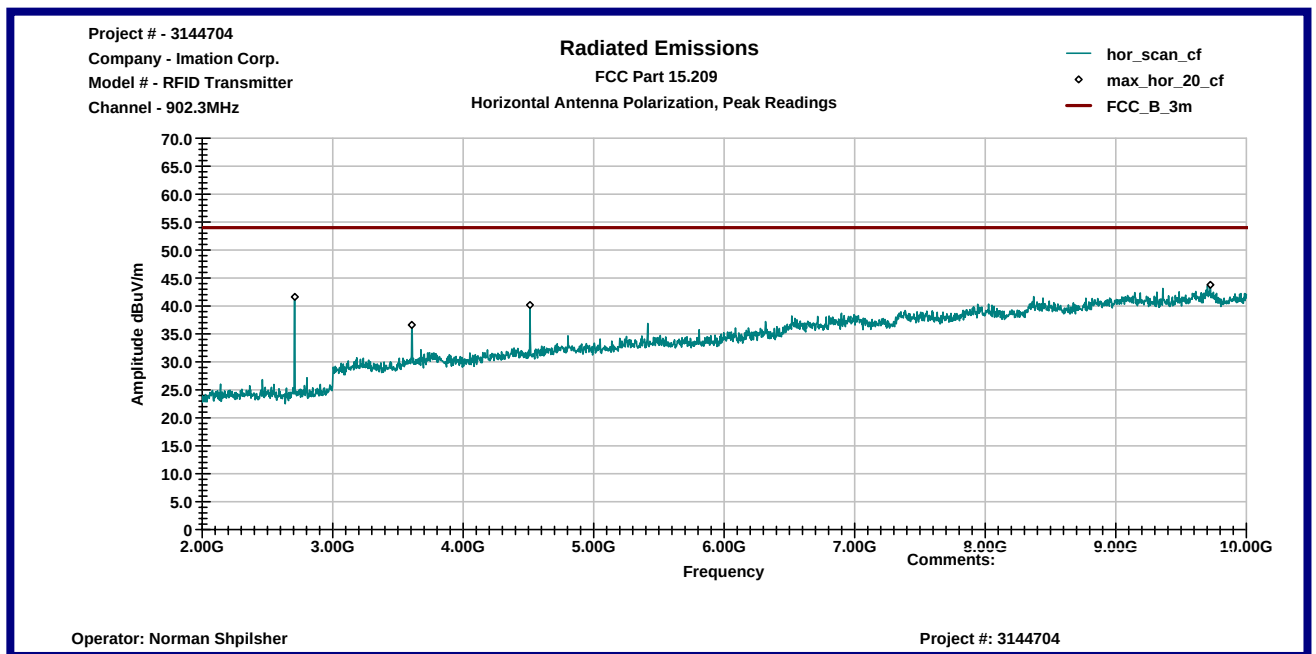
Graph 3.7.3



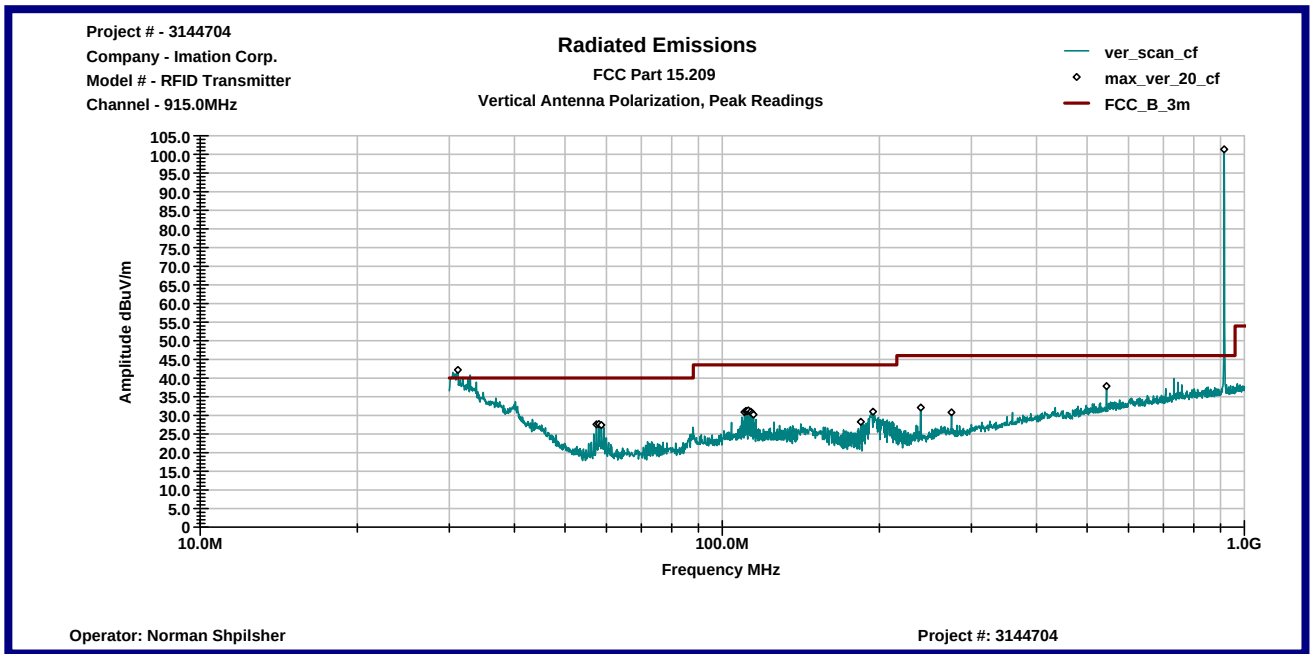
Graph 3.7.4



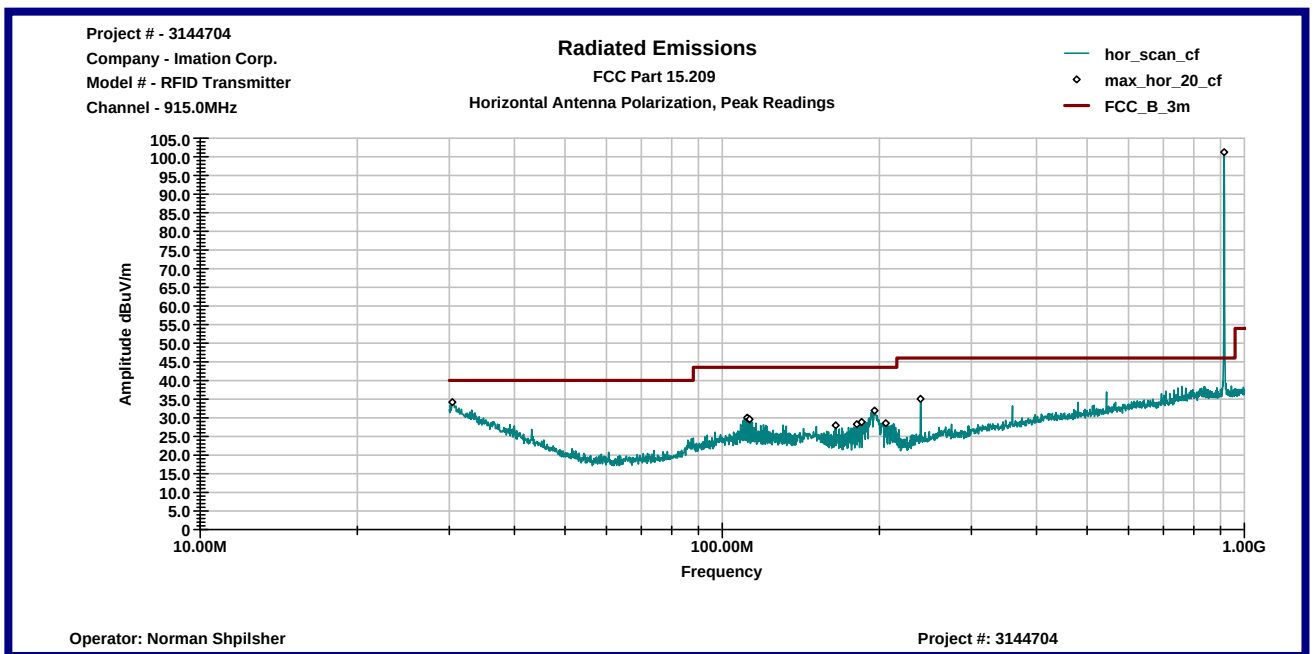
Graph 3.7.5



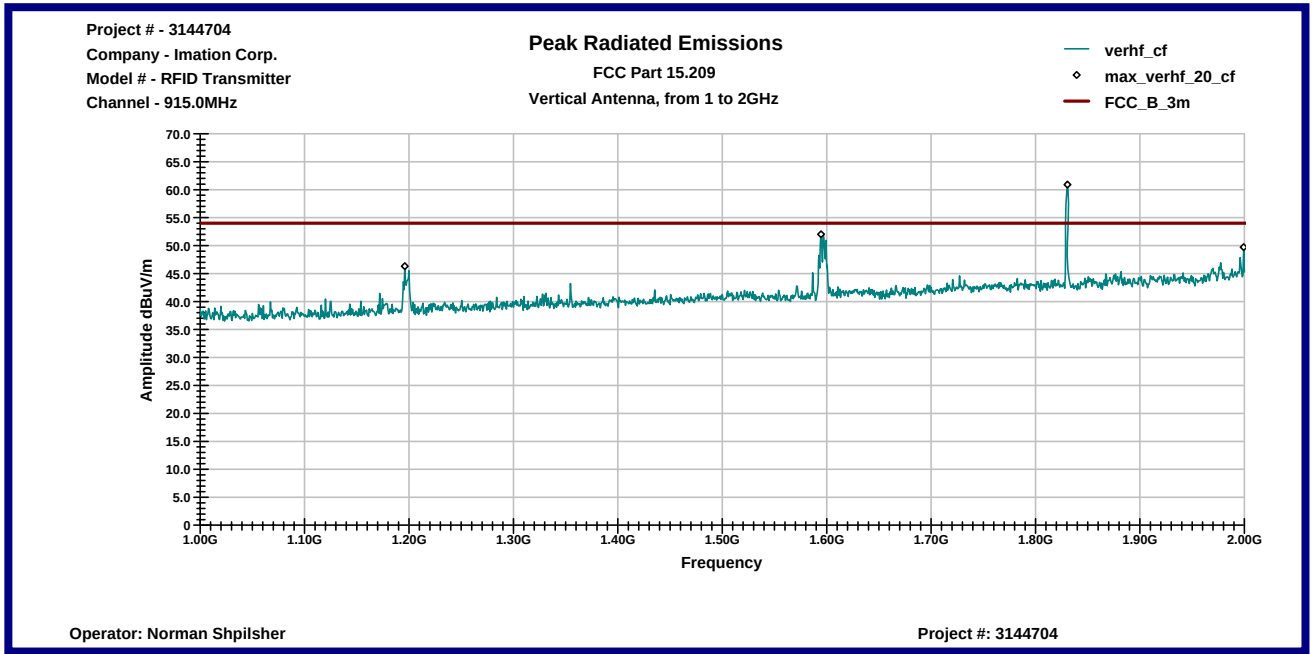
Graph 3.7.6



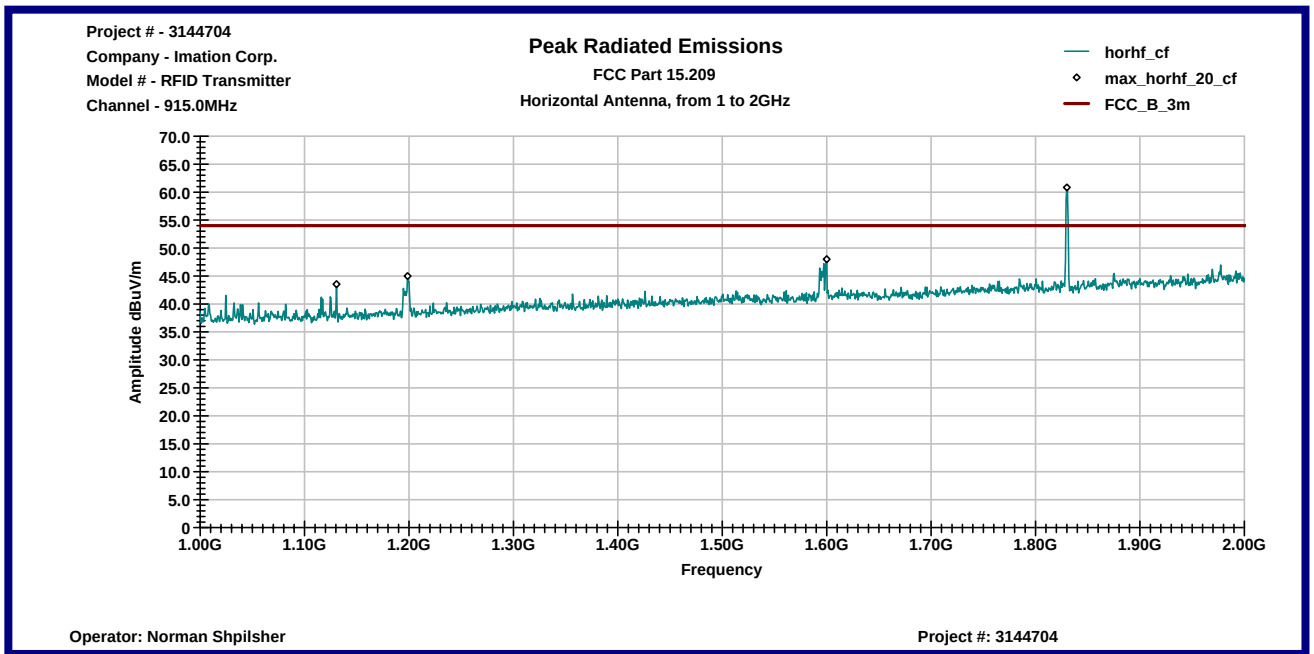
Graph 3.7.7



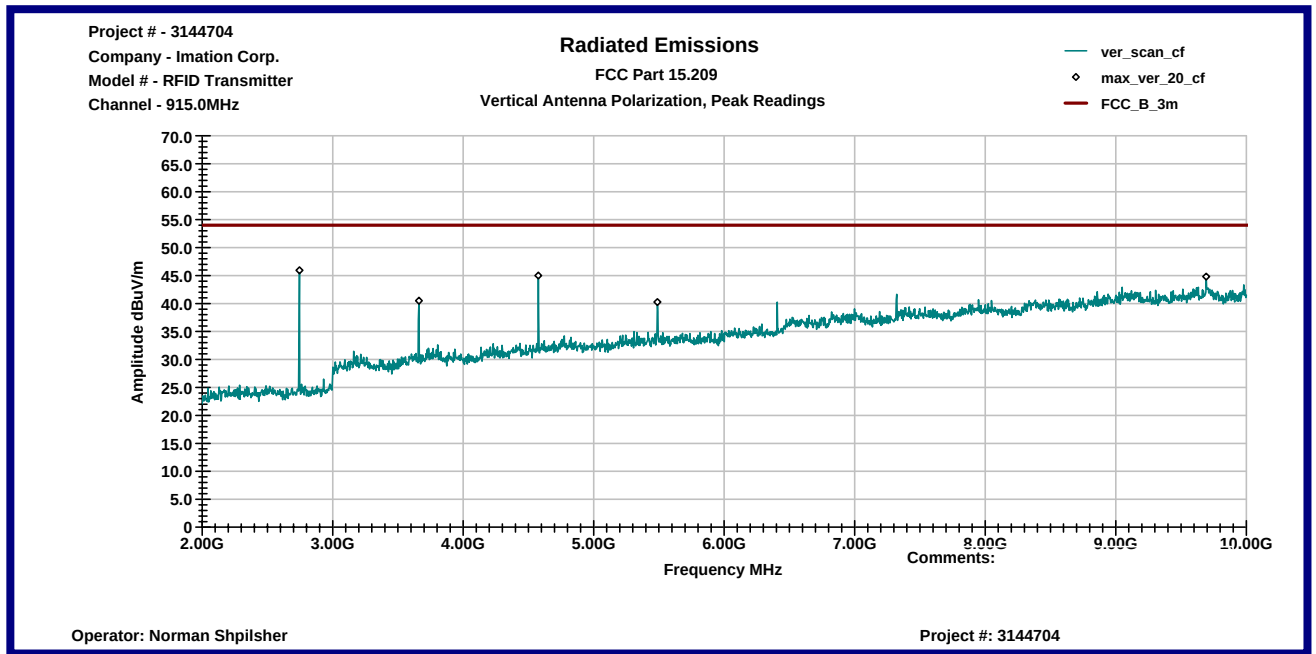
Graph 3.7.8



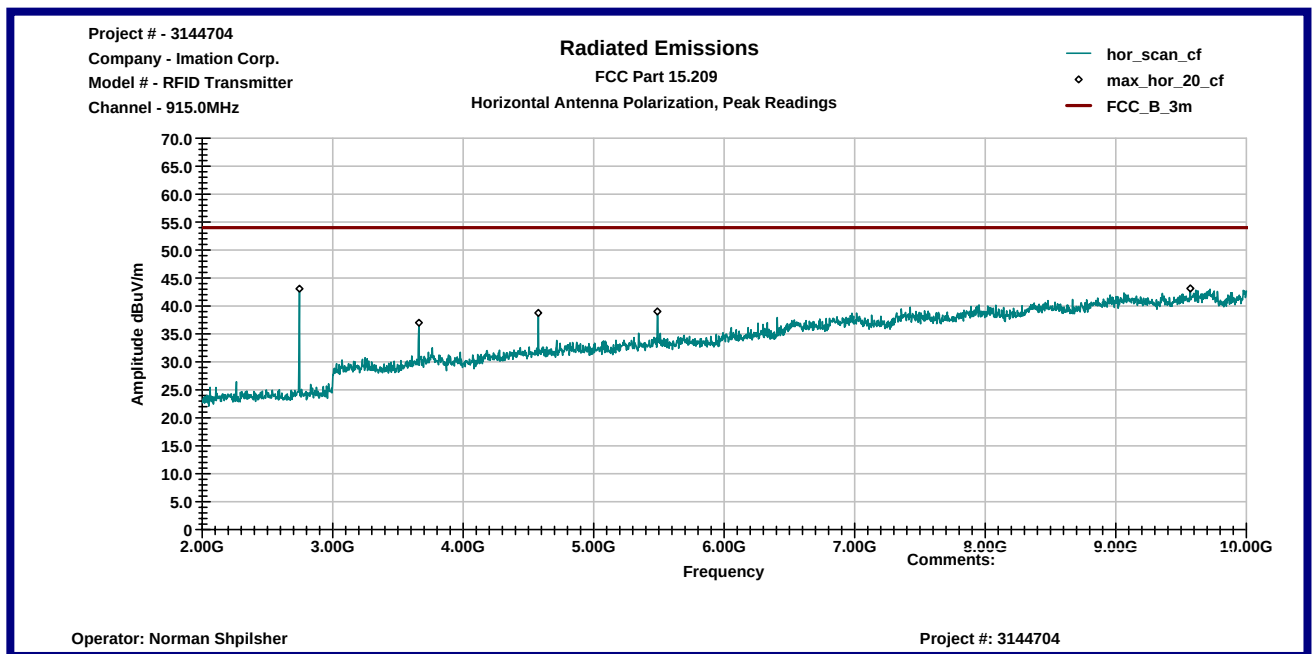
Graph 3.7.9



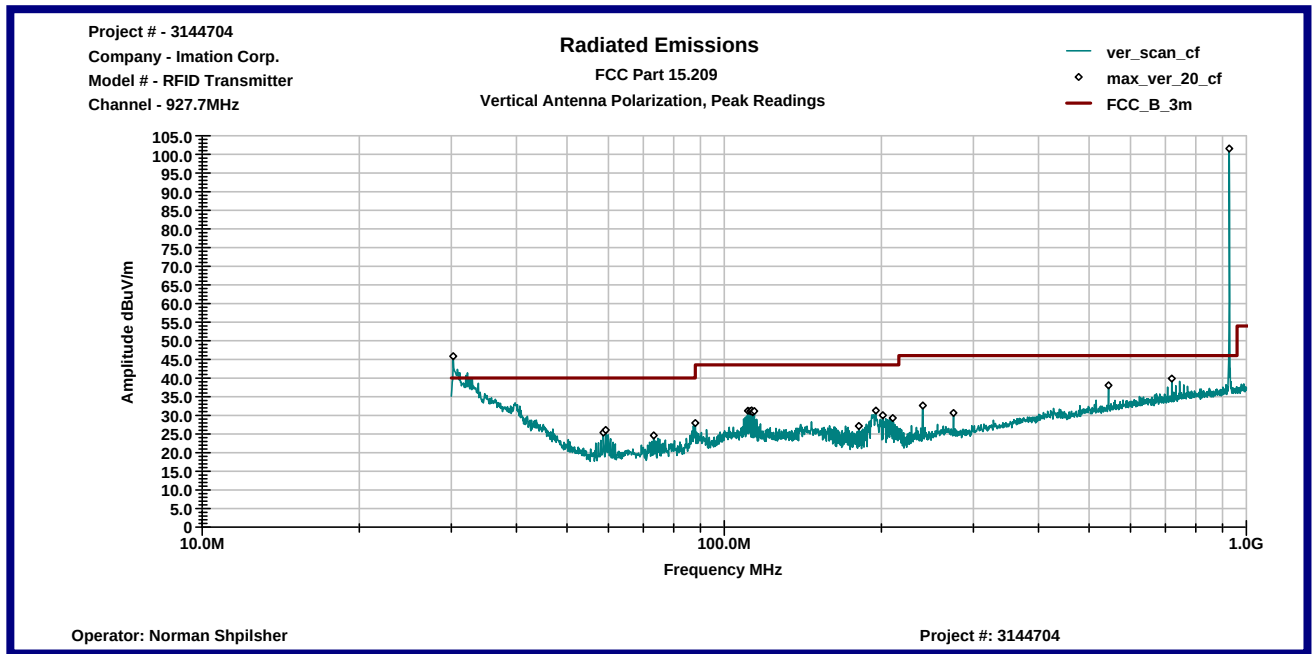
Graph 3.7.10



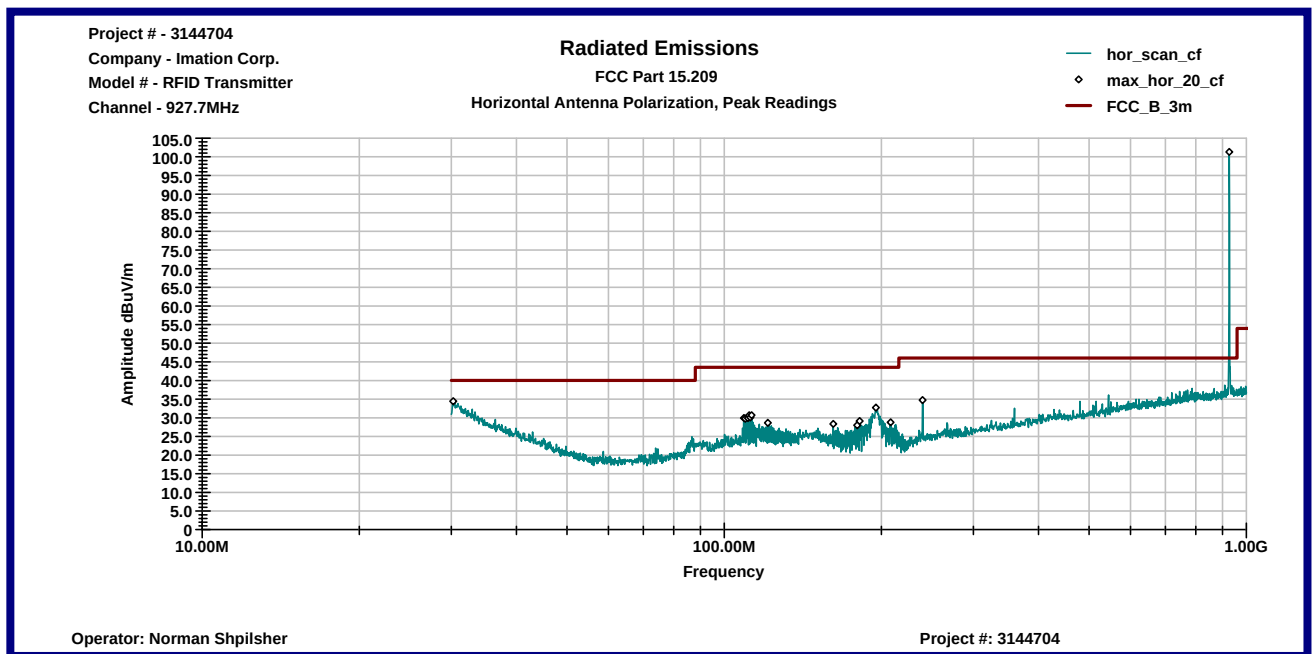
Graph 3.7.11



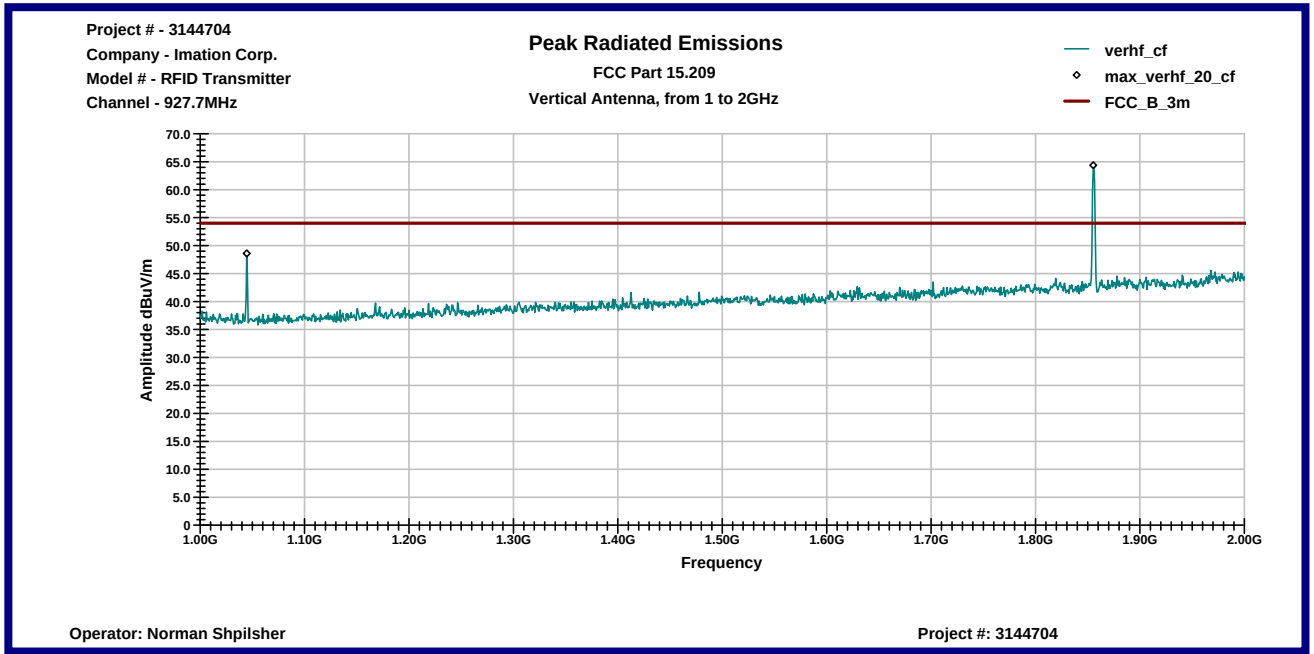
Graph 3.7.12



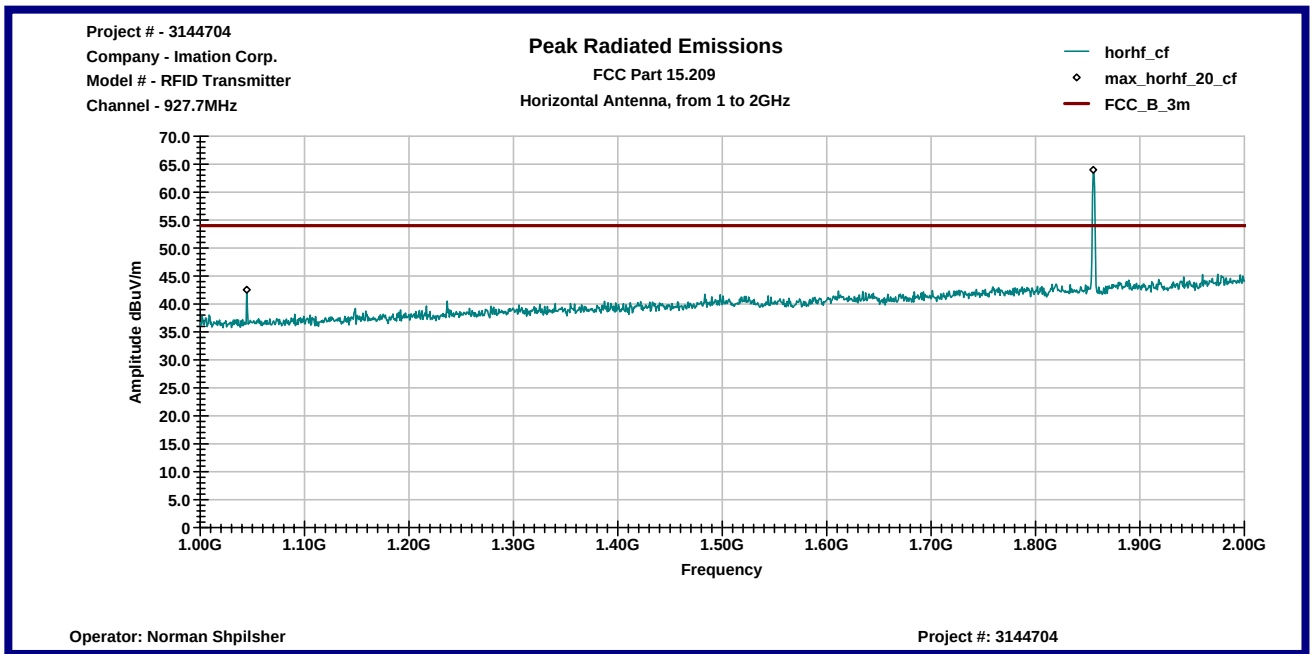
Graph 3.7.13



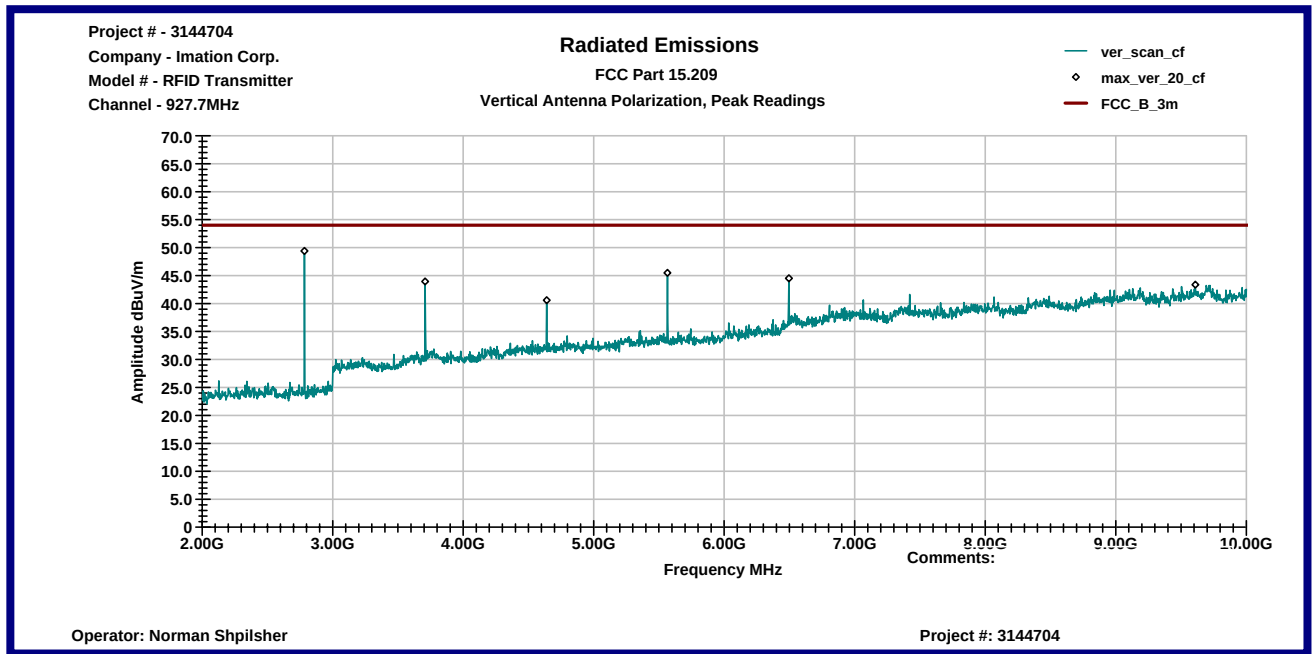
Graph 3.7.14



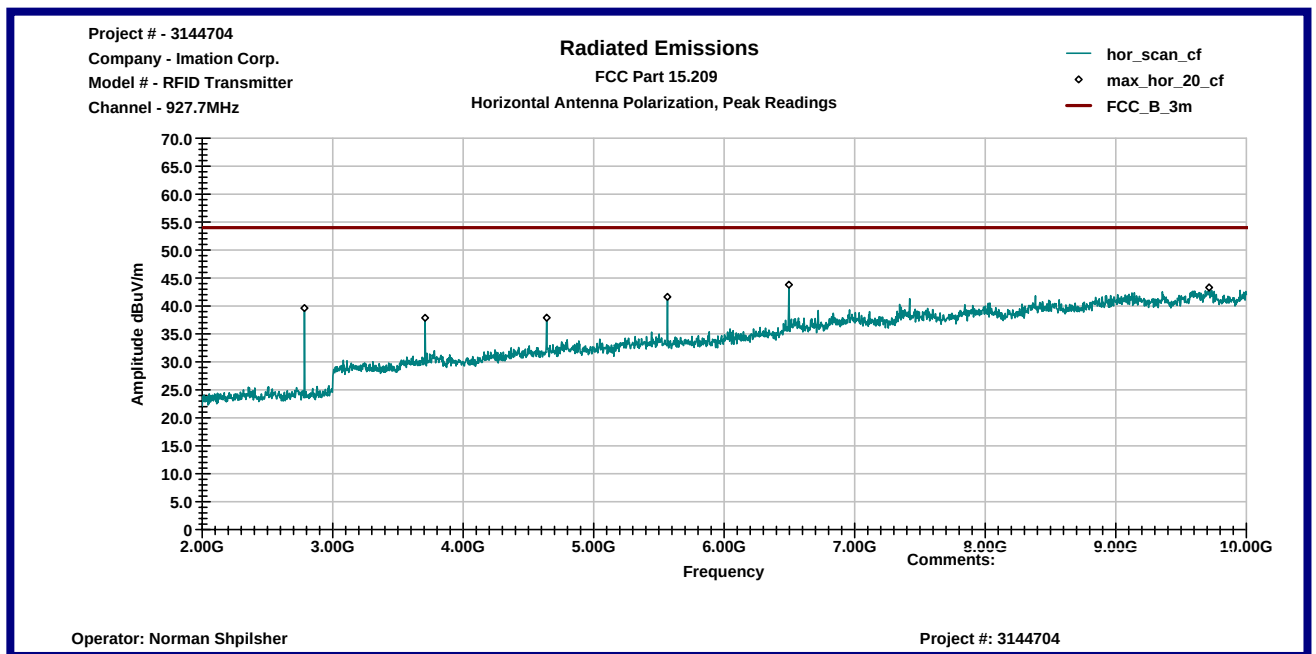
Graph 3.7.15



Graph 3.7.16



Graph 3.7.17



Graph 3.7.18

3.8 RF Exposure Compliance

The maximum measured antenna conducted power, P is 24.8dBm

The antenna gain, G is -8.8dBi

The maximum EIRP power is $24.8 - 8.8 = 16\text{dBm}$, or 0.04W

The limits for Maximum Permissible Exposure (MPE) for transmitter operating at 902-928MHz, MPE is $928/300 = 3.093\text{mW/cm}^2$, or 31W/m^2

The Power Density, S is related to EIRP with the equation:

$S = \text{EIRP} / 4\pi D^2$, where D is the safe separation distance and = 0.2m, or 20cm

$S = 0.04 / 4\pi 0.2^2$

$S = 0.08\text{mW/cm}^2$, or below the Maximum Permissible Exposure (MPE)



3.9 Transmitter power line conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin:  dB below the limits

Notes: None

Date:	February 26, 2008	Result: Pass
Standard:	FCC 15.207	
Tested by:	Norman Shpilsher	
Test Point:	Power Line	
Operation mode:	See Page 5	
Note:		

Table 3.9.1

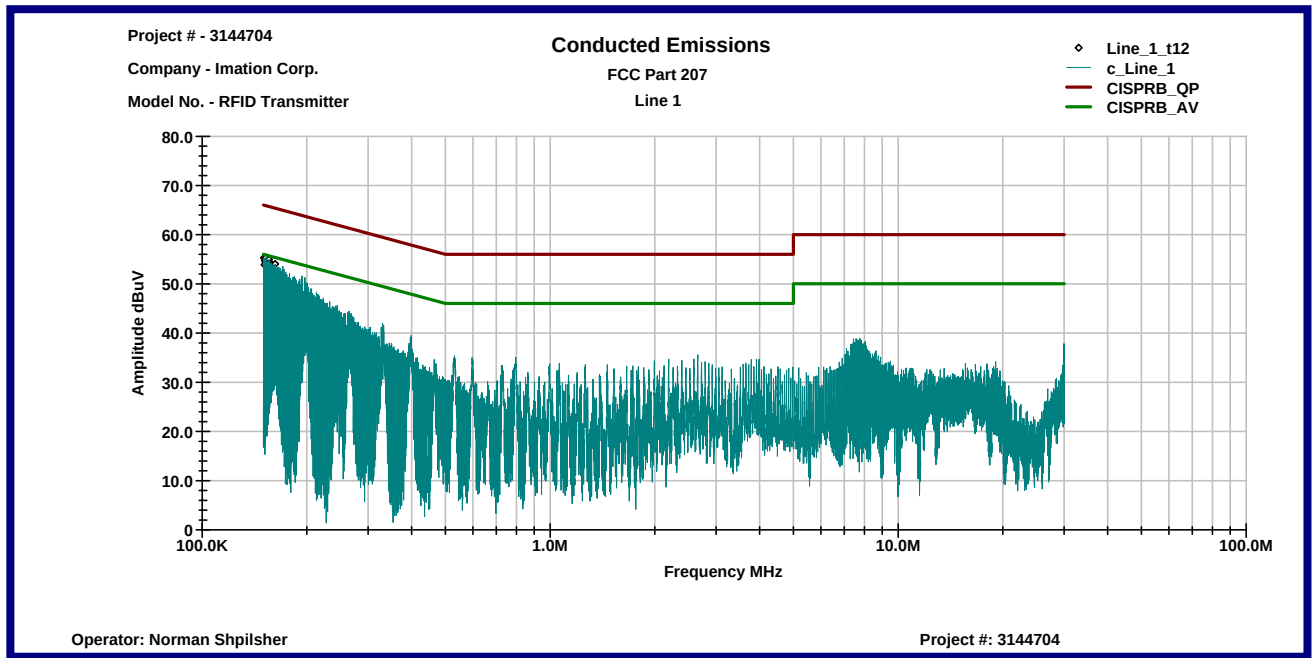
Line 1

Frequency MHz	Reading dBμV	Cable Loss dB	QP Lim dBμV	AVG Lim dBμV	QP Margin dB	AVG Margin dB
0.150	46.6	0.1	66.0	56.0	-19.3	-9.3
0.156	46.2	0.1	65.7	55.7	-19.4	-9.4
0.162	45.3	0.1	65.4	55.4	-20.0	-10.0
0.197	42.6	0.1	63.7	53.7	-21.1	-11.1
* 0.330	41.9	0.1	59.5	49.5	-17.5	-7.5
* 0.399	39.4	0.1	57.9	47.9	-18.4	-8.4
* 0.531	35.1	0.1	56.0	46.0	-20.8	-10.8
* 2.654	35.4	0.3	56.0	46.0	-20.3	-10.3
* 7.434	38.8	0.5	60.0	50.0	-20.7	-10.7
* 29.934	37.8	0.9	60.0	50.0	-21.3	-11.3

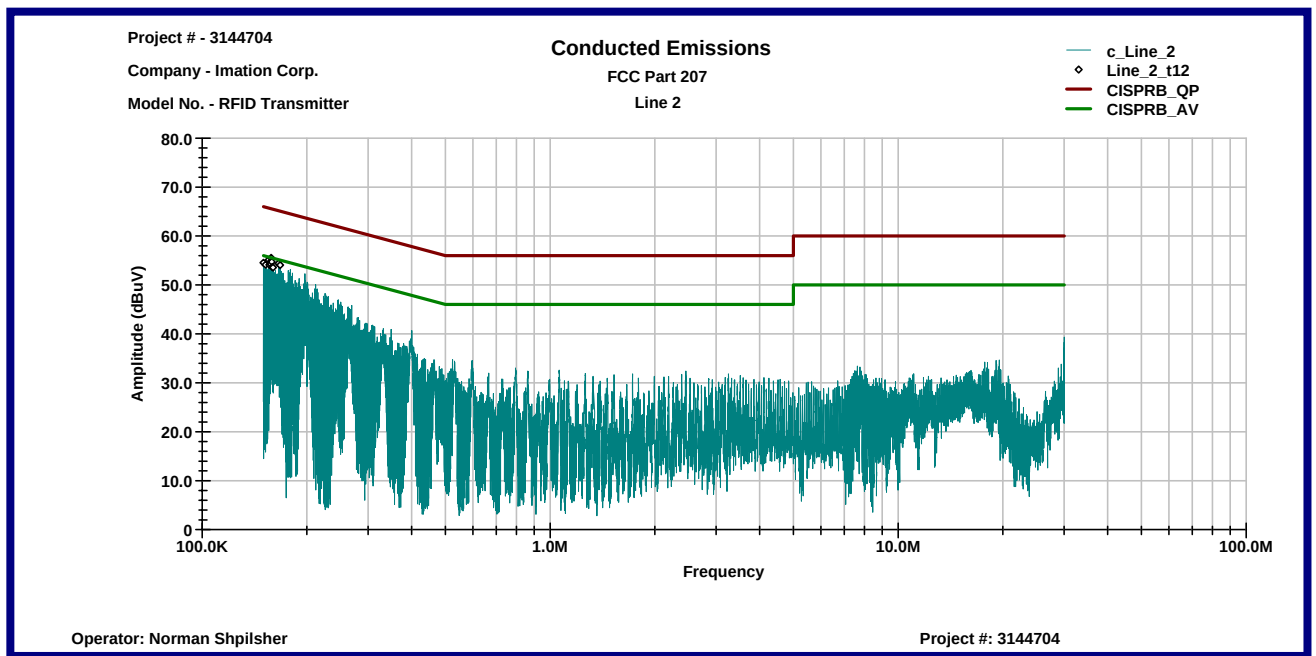
Line 2

Frequency MHz	Reading dBμV	Cable Loss dB	QP Lim dBμV	AVG Lim dBμV	QP Margin dB	AVG Margin dB
0.150	46.2	0.1	66.0	56.0	-19.7	-9.7
0.158	45.0	0.1	65.6	55.6	-20.5	-10.5
0.166	44.5	0.1	65.2	55.2	-20.6	-10.6
0.182	42.6	0.1	64.4	54.4	-21.7	-11.7
* 0.212	50.1	0.1	63.1	53.1	-12.9	-2.9
* 0.269	45.8	0.1	61.1	51.1	-15.3	-5.3
* 0.400	40.7	0.1	57.9	47.9	-17.1	-7.1
* 2.454	32.4	0.3	56.0	46.0	-23.3	-13.3
* 19.109	34.6	0.7	60.0	50.0	-24.7	-14.7
* 29.987	39.3	0.9	60.0	50.0	-19.8	-9.8

Note: Measurements were taken using a CISPR Quasi-peak detector or Peak detector (marked *)



Graph 3.9.1



Graph 3.9.2



3.10 Receiver/digital device radiated emissions

Test location: ☐ OATS ☒ Anechoic Chamber

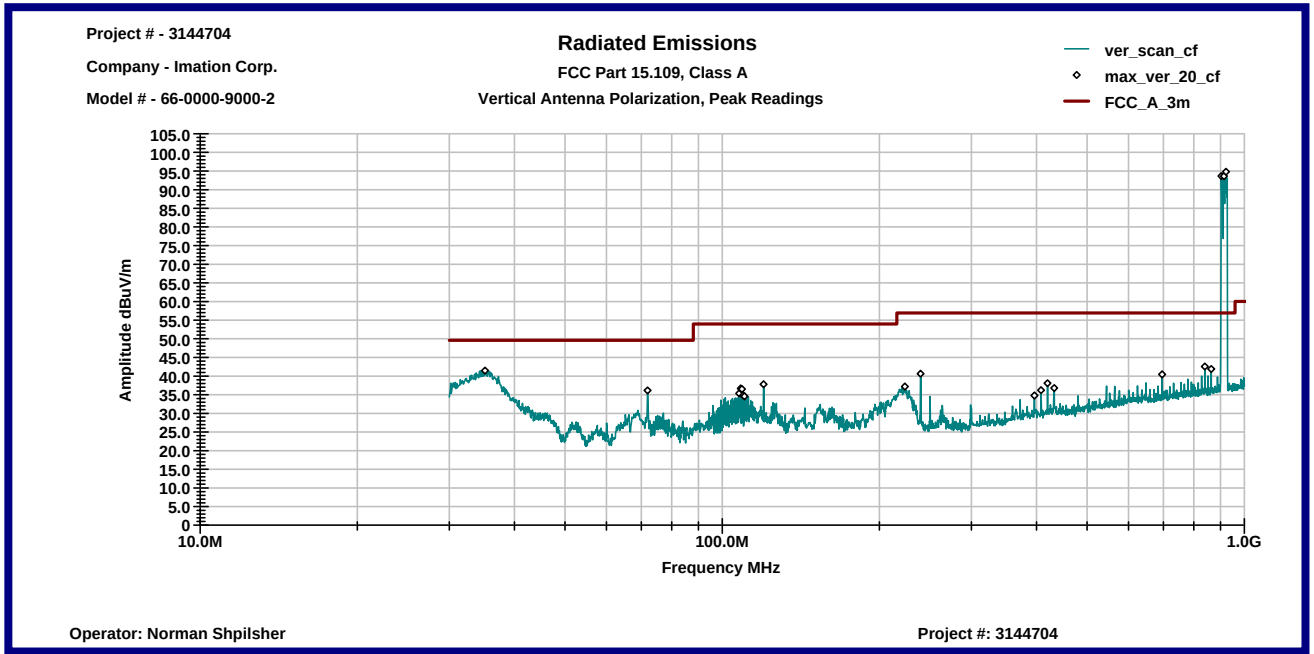
Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

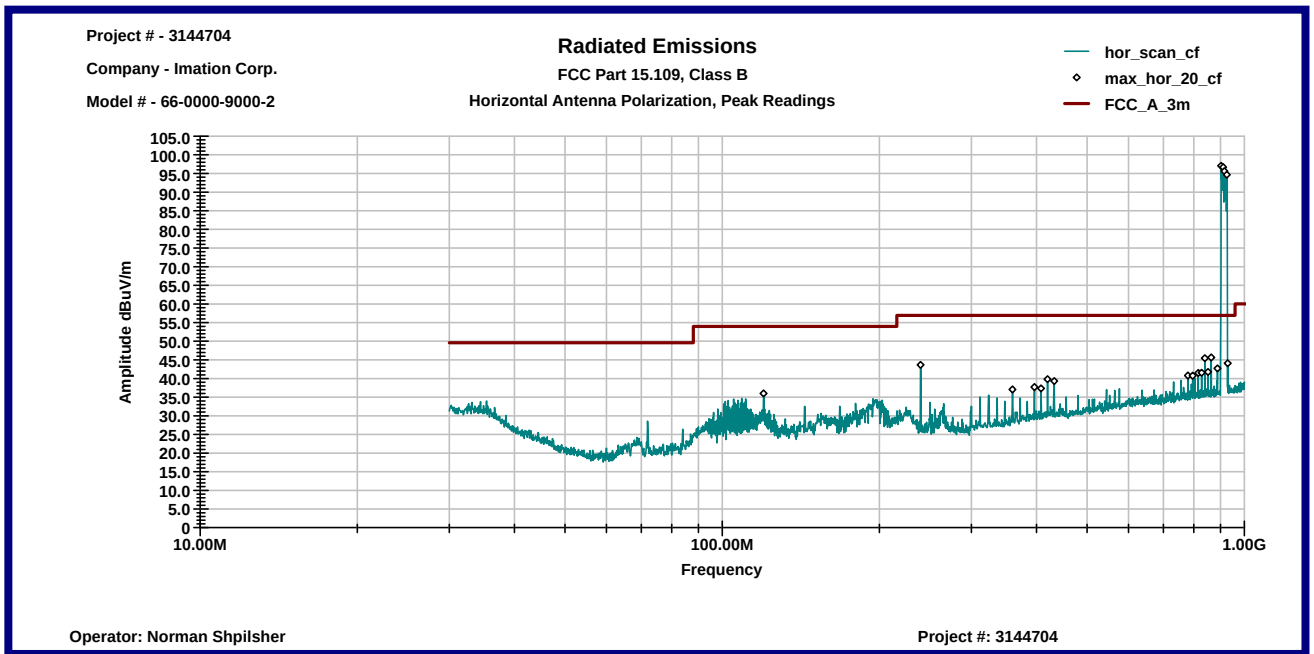
Frequency range: 30MHz-5.0GHz

Max. Emissions margin: 8.3 dB below the limits

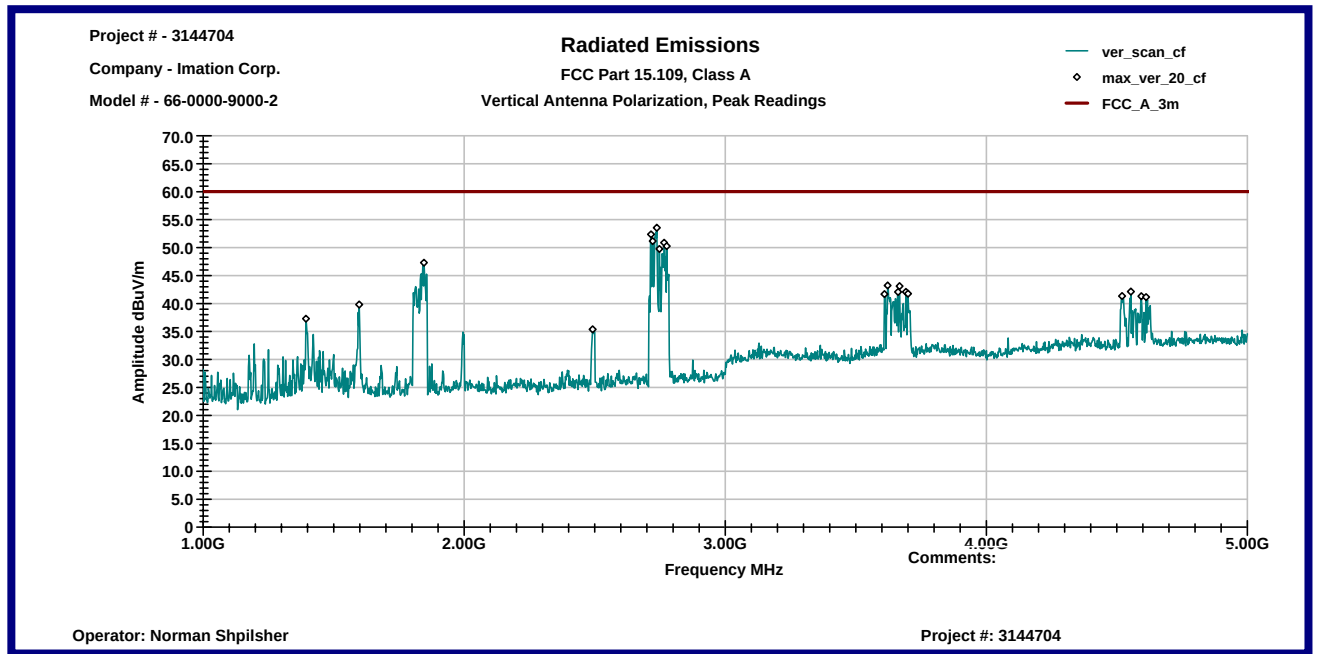
Date:	February 27, 2008	Result: Pass
Standard:	FCC Part 15.109, Class A	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure	
Operation mode:	See Page 5	
Note:		



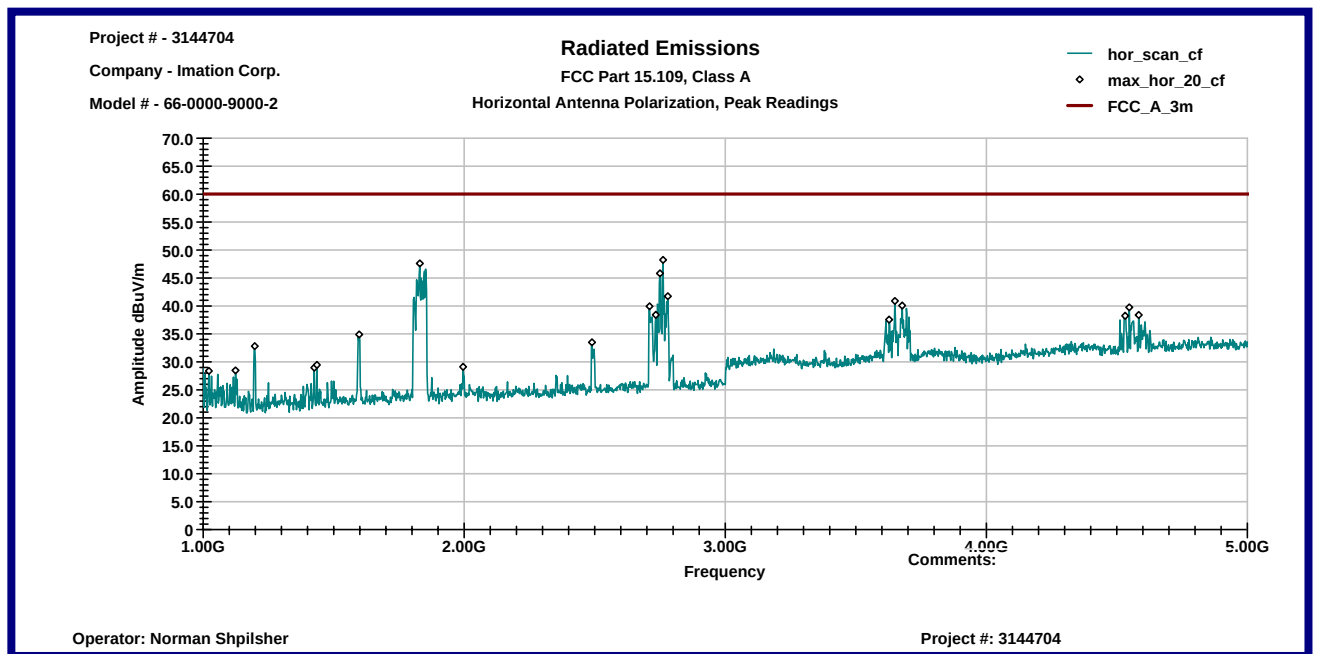
Graph 3.10.1



Graph 3.10.2



Graph 3.10.3



Graph 3.10.4



3.11 Digital device conducted emissions

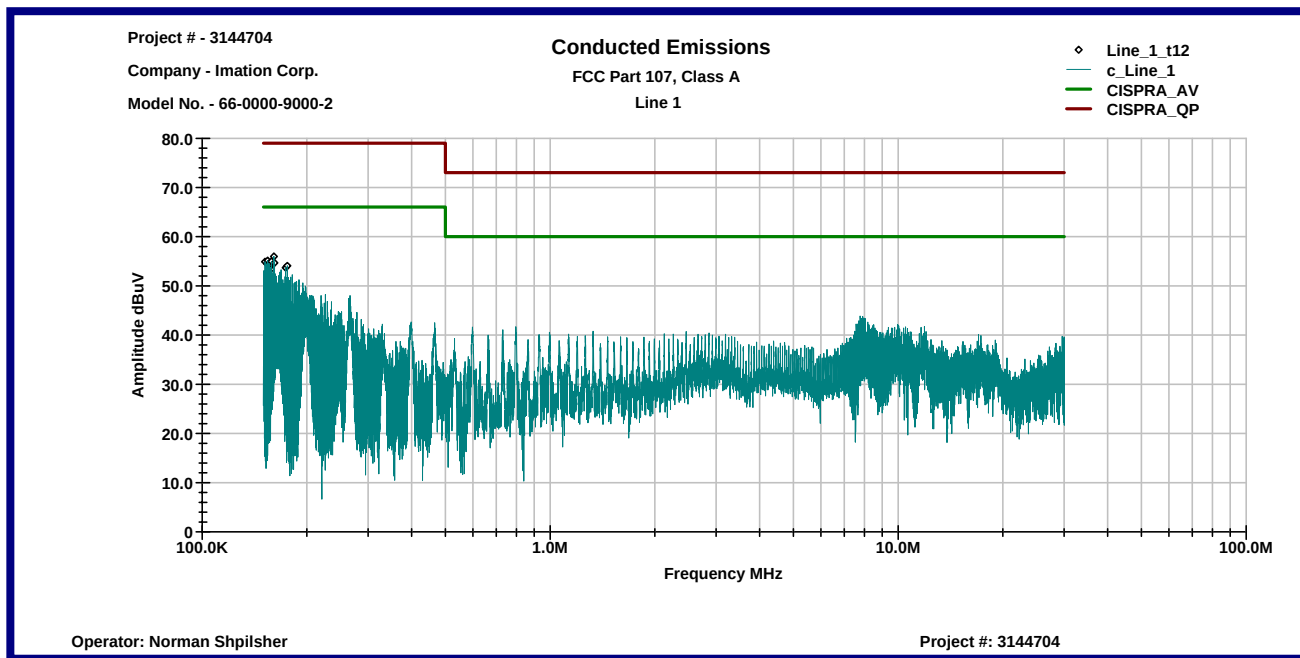
Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: Pass

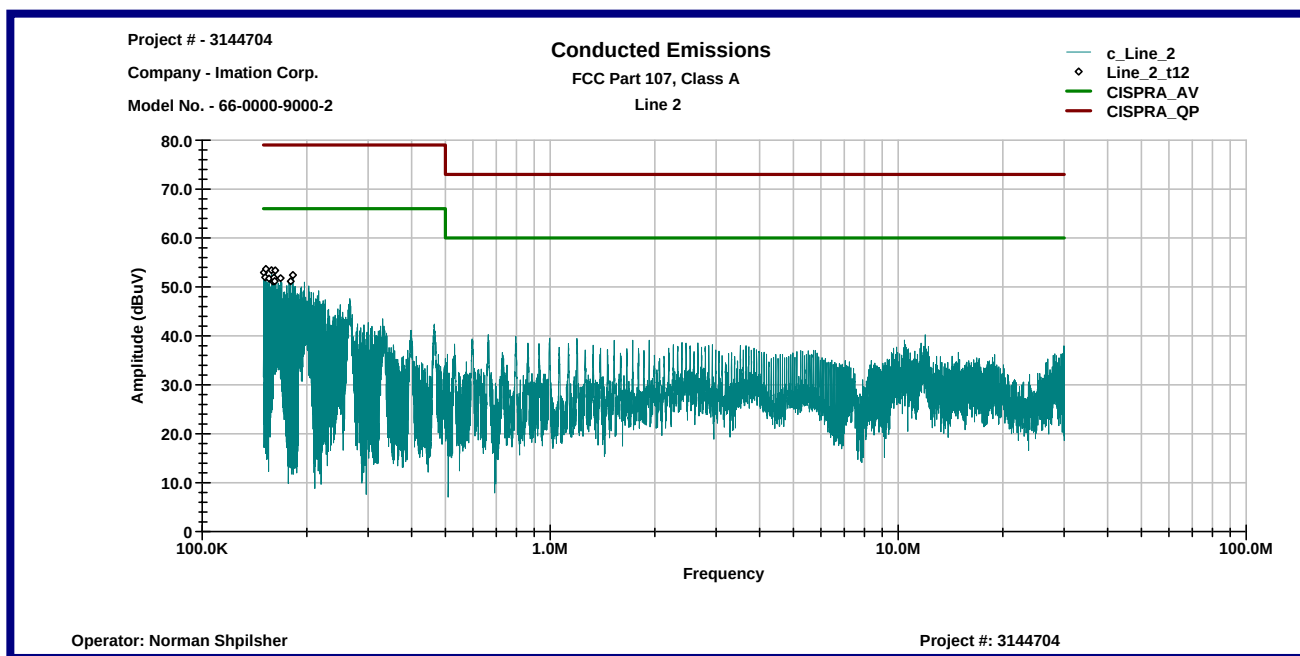
Frequency range: 0.15MHz-30MHz

Max. Emissions margin: dB below the limits

Date:	February 27, 2008	Result: Pass
Standard:	FCC Part 15.107, Class A	
Tested by:	Norman Shpilsher	
Test Point:	Power Line	
Operation mode:	See Page 5	
Note:		



Graph 3.11.1



Graph 3.11.2



4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	08/23/2008	☒
Spectrum Analyzer	R & S	ESCI	100358	04/27/2008	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	07/30/2008	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2630	09/07/2008	☐
Horn Antenna	EMCO	3115	9507-4513	02/13/2009	☒
Horn Antenna	EMCO	3115	6579	03/06/2008	☐
Waveguide Horn Antenna	EMCO	3116	9904-2423	07/20/2008	☐
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	04/24/2008	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	01/17/2009	☐
Pre-Amplifier	MITEQ	AMF-6F-26004000-40-8P	13224444	11/05/2008	☐
Pre-Amplifier	HP	8447F OPT H64	3113A04974	03/07/2008	☐
High Pass Filter	Reactel	7HS-1G-S12	0223	VBV	☒
System	TILE! Instrument Control		Ver. 3.4.K.29	VBV	☒



Test Setup Photos

