FCC / ISED Test Report

For:

Mobilogix, Inc.

Model Name:

ATD700S

Product Description:

Radar sensor for water level measurement in tanks

FCC ID: 2AH4HATD700S
IC ID: 21385-ATD700S

Applied Rules and Standards:
47 CFR Part 15.255
RSS-210 Issue 10 & RSS-Gen Issue 5

REPORT #: EMC_METLA-001-21001

DATE: 2021-07-19

A2LA Accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecom.com ◆ http://www.cetecom.com
CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

TABLE OF CONTENTS

1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.255 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-210.

No deviations were ascertained.

Company	Description	Model #
Mobilogix, Inc.	Radar sensor for water level measurement in tanks	ATD700S

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2021-07-19	Compliance	Kevin Wang (EMC Lab Manager)	kevin. wang@cetecom. com Digitally signed by: kevin. wang@cetecom.com DN: CN = kevin.wang@cetecom. com Date: 2021.07.20 15:41:43 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2021-07-19	Compliance	Kris Lazarov (EMC Engineer)	Kris Lazarov Digitally signed by Kris Lazarov Date: 2021.07.20 15:28:34 -07'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Kevin Wang

2.2 Identification of the Client

Client's Name:	Mobilogix, Inc.
Street Address:	5500 Trabuco Rd, Suite 150
City/Zip Code	Irvine, California 92620
Country	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	ATD700S
HW Version :	Rev 1
SW Version :	Rev 1
FCC-ID :	2AH4HATD700S
ISED-ID:	21385-ATD700S
FWIN:	NA
HVIN:	NA
PMN:	NA
Product Description:	Radar sensor for water level measurement in tanks
Frequency Range:	Nominal band: 57 GHz – 71 GHz
Antenna Information:	Two embedded dipole antennas
Operating Voltage Range:	Vmin: 1.71 V / Vmax: 1.89 V DC
Operating Temperature Range:	-40 C to + 85 C
Other Radios:	LTE CAT-M1 Bands: 2; 4; 5; 13
Sample Revision	☐Prototype Unit; ☐Production Unit; ■Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Comments
1	Engineering Sample	Rev 1	Rev 1	

3.3 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT # 1	

3.4 EUT Mode of operation

Operation Mode	Comments
Constant Transmission	Continuous transmission

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets to highest possible duty cycle. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

This test report is to support a request for new equipment authorization under the FCC ID: 2AH4HATD700S and ISED ID: 21385-ATD700S The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules 15.255 of CFR 47 and Radio Standard Specification RSS-210 of ISED.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Pass	NA	NP	Result
§15.215 RSS-Gen	Occupied Bandwidth	Nominal	☐	☐	■	See note 2
§15.255 (f) RSS-210 J.6	Frequency Stability	Extreme Temperature and Voltage	☐	☐	■	See note 2
§15.255 (c) RSS-210 J.2	Equivalent Isotropically Radiated Power	Nominal	■	☐	☐	Complies
§15.255 (d) RSS-210 J.3; RSS-Gen	Spurious Emissions	Nominal	■	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: Leveraged from module certification FCC ID: 2AQ6KA1001

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30 MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

6.1 Environmental Conditions:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

2021-07-16 to 2021-07-19

7 Measurement Procedures

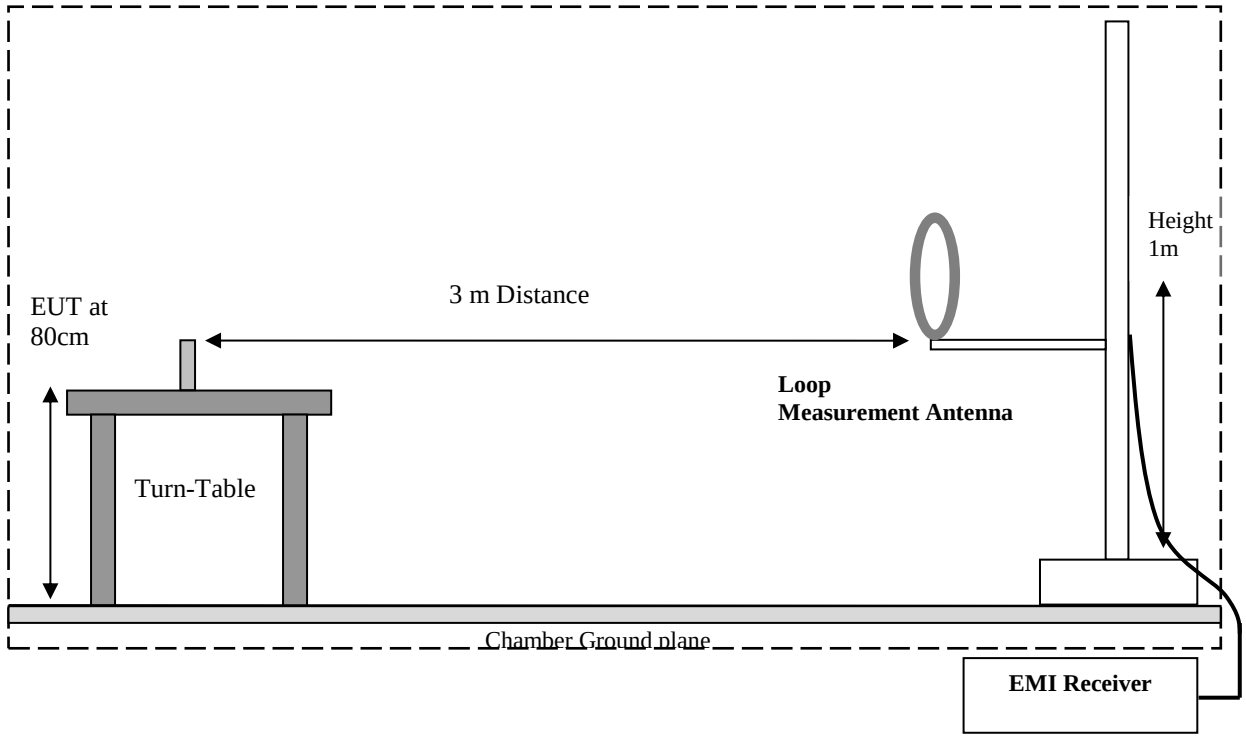
The radiated measurement is performed according to ANSI C63.10 (2013)

- Measurements below 40 GHz are split to 5 frequency ranges using appropriate antennas and EUT configuration. Magnetic loop is used from 9 kHz to 30 MHz; Biconilog antenna is used from 30 MHz to 1 GHz; and three different horn antennas are used to cover frequencies up to 40 GHz.
- Exploratory measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.
- Using the orientation and equipment arrangement of the EUT, based on the measurement results found during the exploratory measurement, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit are selected for the final measurement.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- Radiated field strength levels are calculated from the measurement instrument readings, using the following equation:

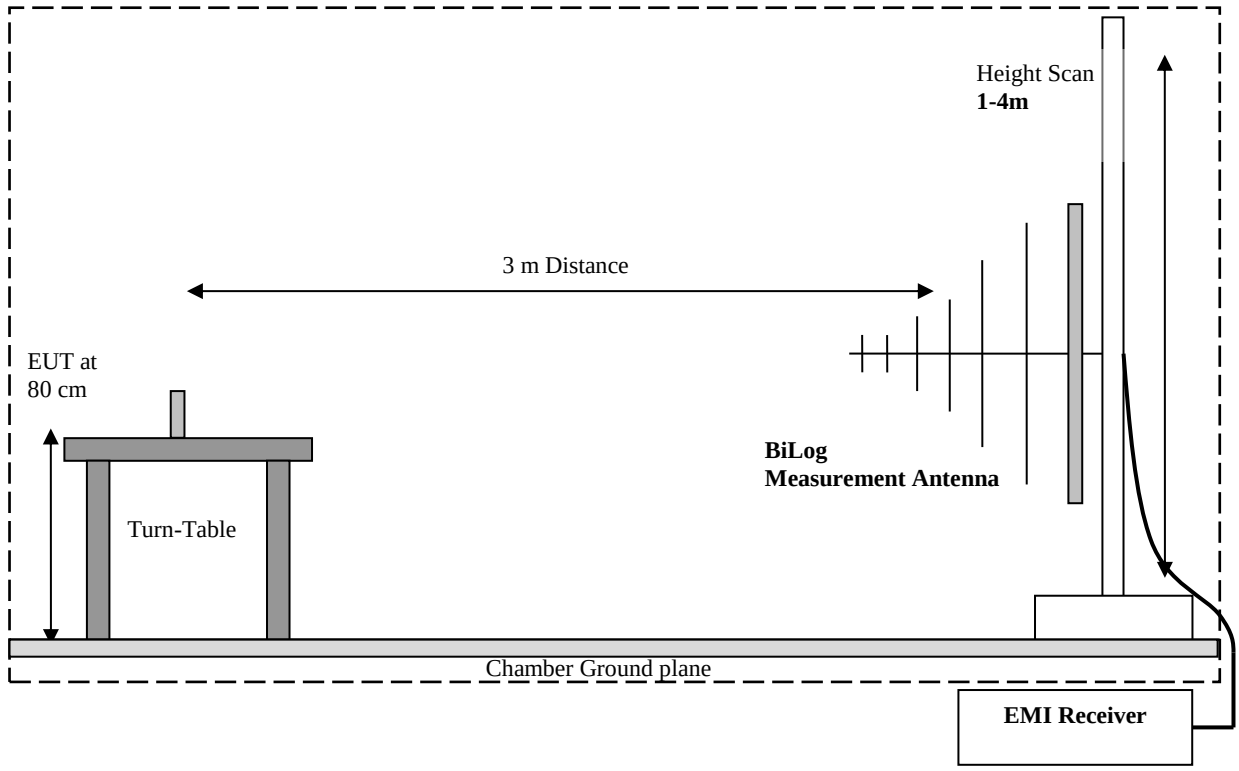
  FS (dBµV/m) = Measured Value on SA + Cable Loss + Antenna Factor

  Where:
  - Measured Value on SA in dBµV
  - Cable Loss between the receiving antenna and SA in dB
  - Antenna Factor in dB/m

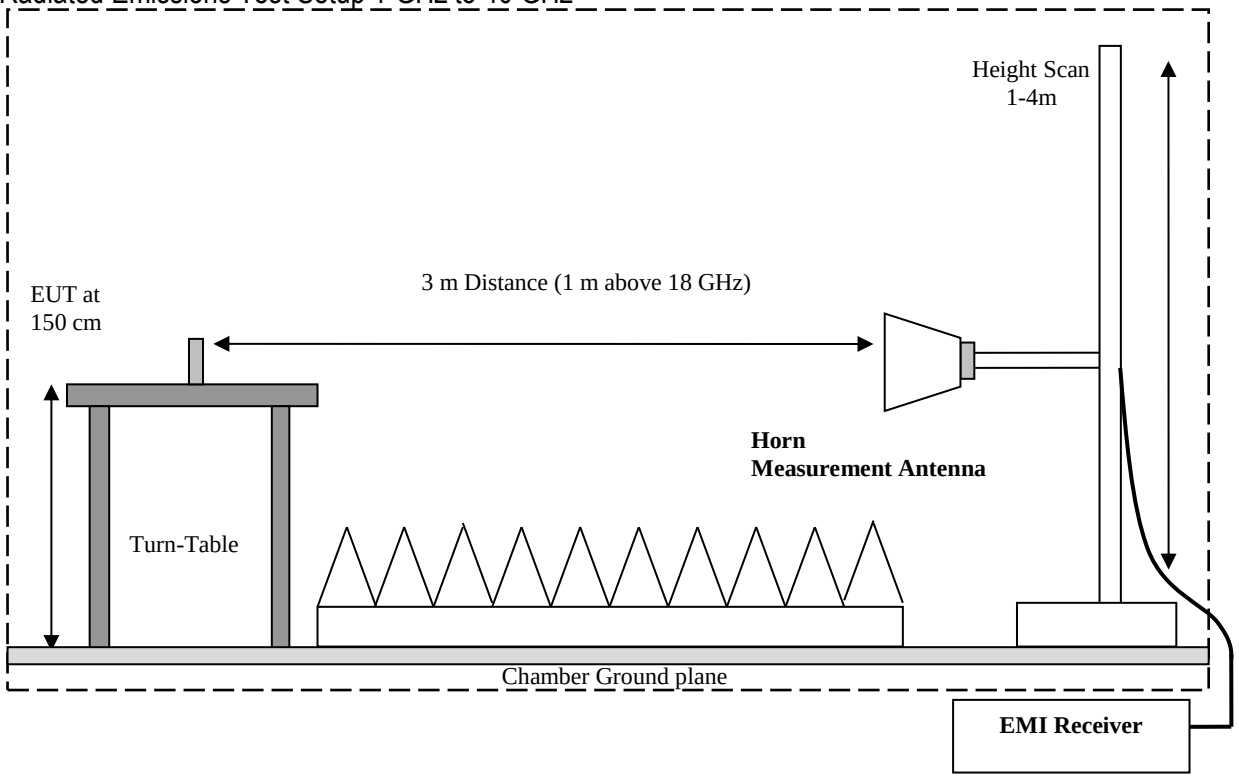
Radiated Emissions Test Setup 9 kHz to 30 MHz



Radiated Emissions Test Setup 30 MHz to 1 GHz



Radiated Emissions Test Setup 1 GHz to 40 GHz



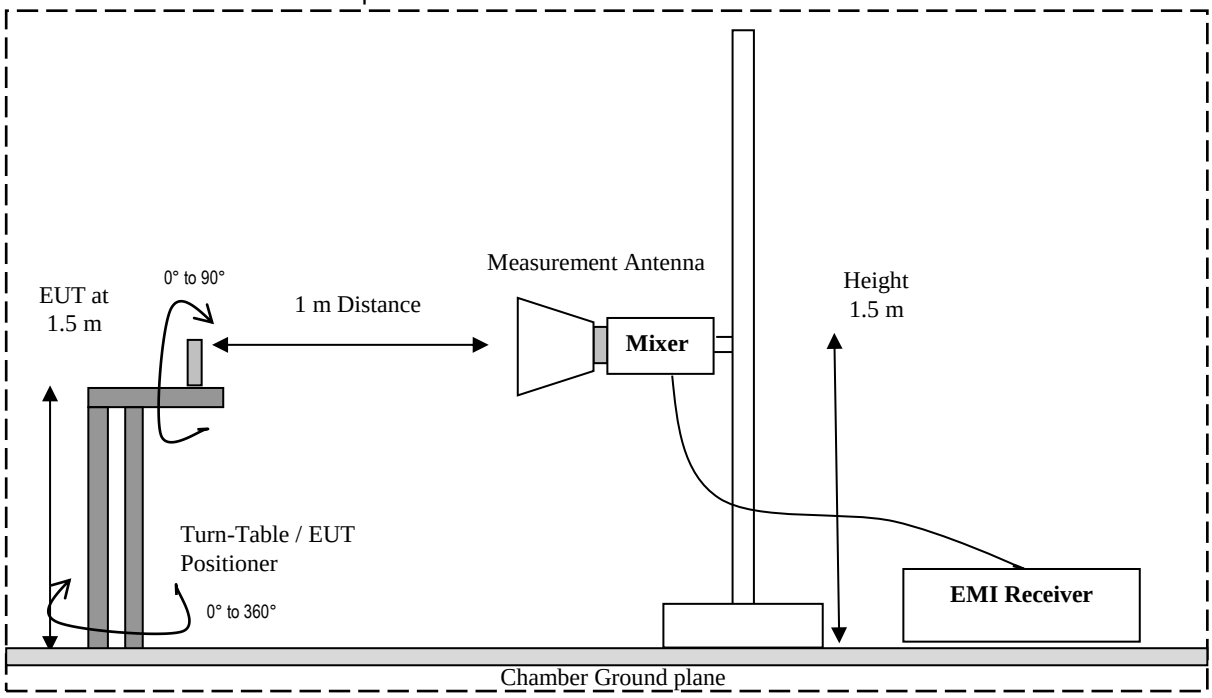
- Measurements above 40 GHz are split to 5 frequency ranges using E&S external mixers and appropriate antennas as follow:
  - 40-60 GHz FS-Z60 + 261U-25
  - 60-90 GHz FS-Z90 + 261E-23
  - 90-140 GHz FS-Z140 + 261F-25
  - 140-220 GHz FS-Z220 + 261G-25
- Exploratory measurements are performed with the EUT rotated horizontally from 0° to 360°, and vertically from 0° to 90°, and the antenna rotated to repeat the measurements for horizontal and vertical antenna polarizations.
- Using the orientation and equipment arrangement of the EUT, found during the exploratory measurement, at the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit are selected for the final measurement.
- The field strength is calculate from the radiated measurement using equation (19) from ANSI C63.10 (2013):

$$E = 126.8 - 20\log(\lambda) + P - G$$

Where:

- E is the field strength of the emission at the measurement distance, in dBµV/m
- P is the power measured at the output of the test antenna, in dBm
- λ is the wavelength of the emission under investigation [300/fMHz], in m
- G is the gain of the test antenna, in dBi

Radiated Emissions Test Setup above 40 GHz



7.1 E.I.R.P.

7.1.1 Measurement according to ANSI C63.10 (2013) Section 9.10

Spectrum Analyzer settings:

- Center Frequency = Fundamental
- RBW = 1 MHz
- VBW = 3 MHz
- Span ≥ 2 x Occupied Bandwidth
- Sweep = Auto couple
- Detector function = Peak, repeat with RMS
- Compute power by integrating the spectrum across the occupied bandwidth of the signal using the spectrum analyzer's band power measurement function.

7.1.2 Limits:

FCC § 15.255 (c), and RSS-210 J2

- Within the band 57-71 GHz, the power of any emissions, measured during the transmit interval, shall comply with the e.i.r.p. limits in this section.
    - For fixed field disturbance sensors that occupy a bandwidth of 500 MHz or less and for which the bandwidth is contained wholly within the frequency band 61.0-61.5 GHz, the equipment's average and peak e.i.r.p. in the channel bandwidth shall not exceed 40 dBm and 43 dBm respectively. In addition, the average and peak e.i.r.p. of any emission outside of the band 61.0-61.5 GHz, but still within the band 57-71 GHz, shall not exceed 10 dBm and 13 dBm respectively.

7.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Antenna Gain
22° C	1	Constant Transmission	25 dBi

7.1.4 Measurement result:

Plot #	Frequency (GHz)	Instrument Reading (dBm)	EIRP (dBm)	Limit (dBm)	Result
1	61.25	-52.59 RMS Detector	-9.29	40	Pass
2	61.25	-47.03 Peak Detector	-3.73	43	Pass

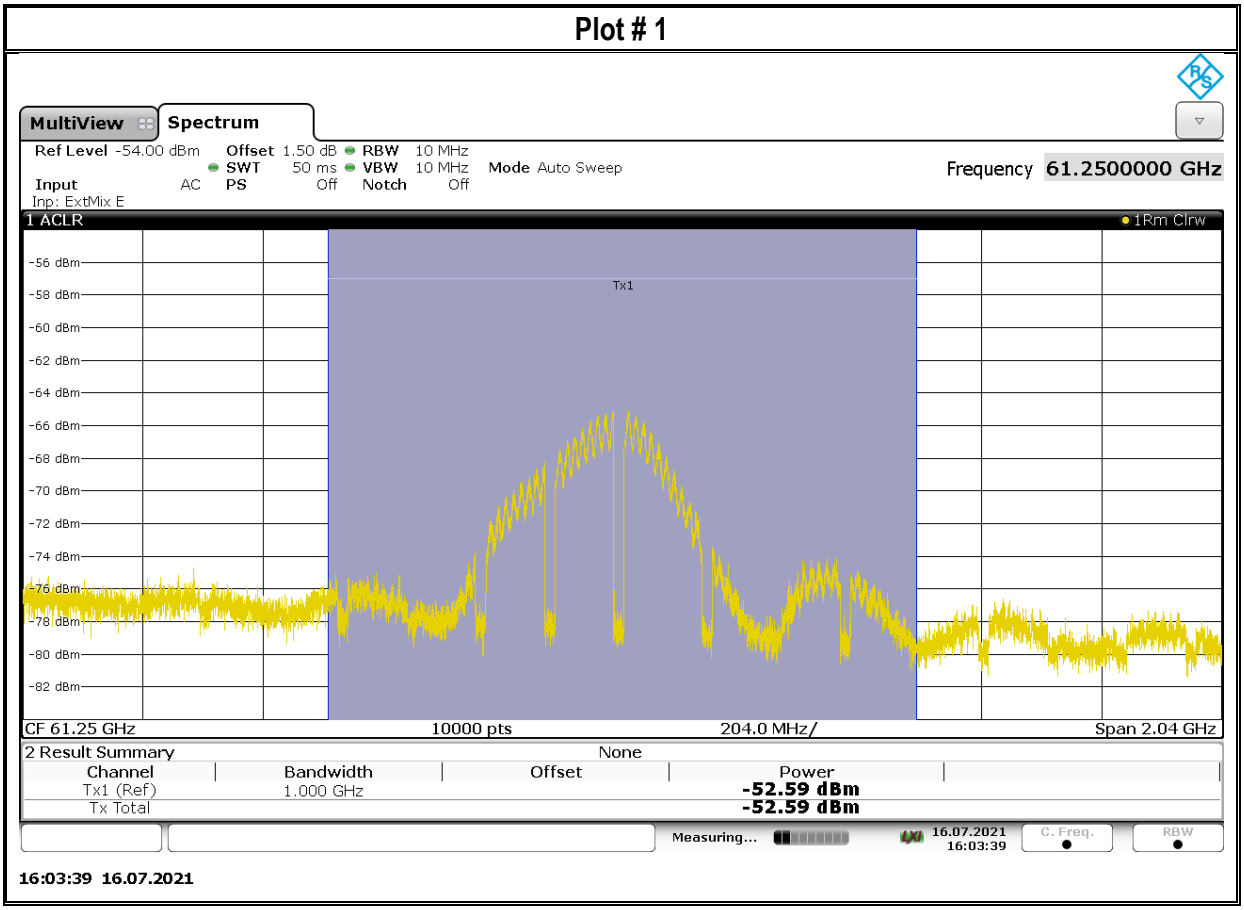
Note: The EIRP is calculate from the radiated measurement using equation (22) from ANSI C63.10 (2013):

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

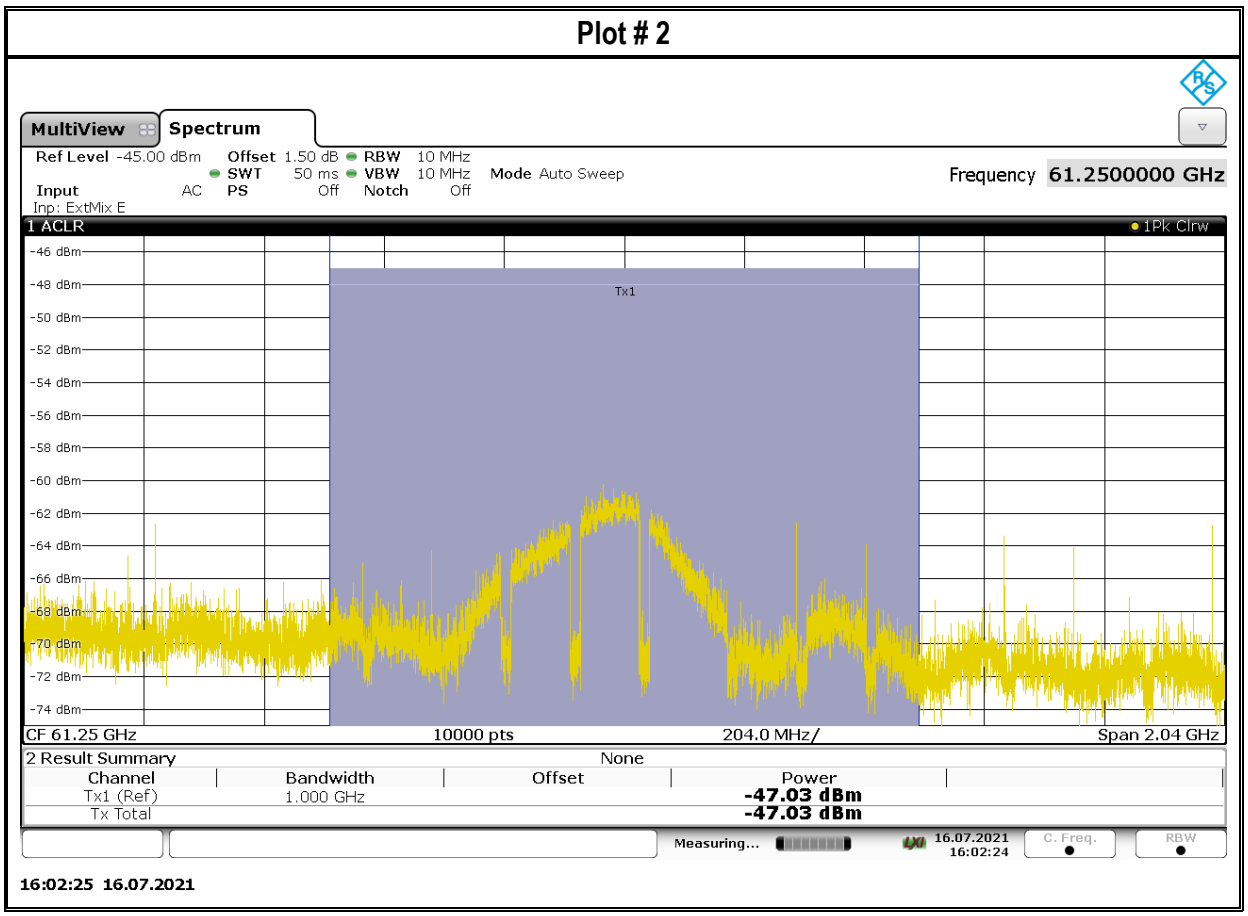
Where:
EIRP is the equivalent isotropically radiated power, in dBm
E_{Meas} is the field strength of the emission at the measurement distance, in dBµV/m
d_{Meas} is the measurement distance, in m

7.1.5 Measurement Plots:

Plot # 1



Plot # 2


MultiView
Spectrum
Ref Level -45.00 dBm
Offset 1.50 dB
RBW 10 MHz
SWT 50 ms
VBW 10 MHz
Mode Auto Sweep
Input AC
PS Off
Notch Off
Inp: ExtMix E
Frequency 61.2500000 GHz
1 ACLR
1Pk Clrw
-46 dBm
-48 dBm
-50 dBm
-52 dBm
-54 dBm
-56 dBm
-58 dBm
-60 dBm
-62 dBm
-64 dBm
-66 dBm
-68 dBm
-70 dBm
-72 dBm
-74 dBm
Tx1
CF 61.25 GHz
10000 pts
204.0 MHz/
Span 2.04 GHz
2 Result Summary
None
Channel
Bandwidth
Offset
Power
Tx1 (Ref)
1.000 GHz
-47.03 dBm
Tx Total
-47.03 dBm
Measuring...
16.07.2021
16:02:24
C. Freq.
RBW
16:02:25 16.07.2021

7.2 Spurious Emissions

7.2.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Quasi-Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Quasi-Peak
- RBW= 120 KHz

- Frequency 1 - 231 GHz
- Detector = Peak / Average
- RBW = 1 MHz

- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing frequencies below 30 MHz at distance other than the specified in the standard, the limit conversion is calculated by using the FCC materials for the ANSI 63 committee issued on January, 27 1991.

7.2.2 Limits:

FCC §15.255 (d)

- The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.
- Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.
- Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm2 at distance of 3 m
- The levels of the spurious emissions shall not exceed the level of the fundamental emission.

RSS-210 J.3

The power of any emissions outside the band 57-71 GHz shall consist solely of spurious emissions and shall not exceed:

- the fundamental emission levels
- the general field strength limits specified in RSS-Gen for emissions below 40 GHz
- 90 pW/cm^2 at a distance of 3 m for emissions between 40 GHz and 200 GHz

7.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode
22° C	1	Constant Transmission

7.2.4 Measurement result:

Plot #	Frequency Range	Measurement Distance	Limit	Result
1 - 4	9 kHz – 18 GHz	3 m	See section 7.2.2	Pass
5 - 10	18 GHz – 140 GHz	1 m	See section 7.2.2	Pass
11	140 GHz – 200 GHz	0.3 m	See section 7.2.2	Pass

7.2.5 Testing notes:

- Measurement antenna far-field boundary was evaluated according to ANSI C63.10-2013

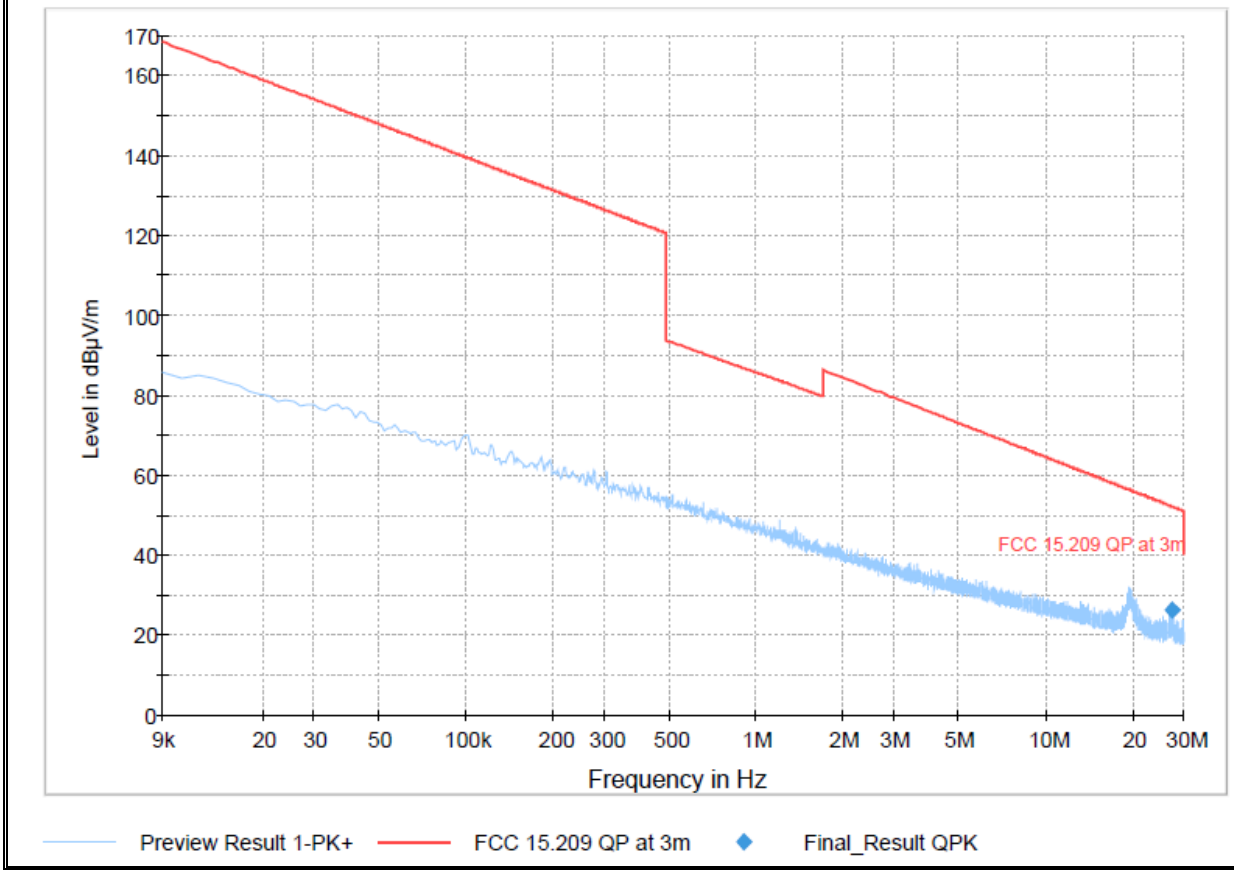
Measurement Antenna	F range GHz	Largest Antenna Dimention (m)	Far-field Boundry (m)
261U-25	40 - 60	0.0500	0.67 – 1.00
261E-25	60 - 90	0.0350	0.49 - 0.74
261W-25	75 - 110	0.0280	0.39 - 0.57
261F-25	90 - 140	0.0190	0.22 - 0.34
261G-25	140 - 220	0.0120	0.13 - 0.21

- The measurements from 18 – 140 GHz were conducted at 1 m, and from 140 – 200 at 0.3 m distance.
- The measurement plots above 18 GHz include a reference line corresponding to the limit level at the measurement distance specified by the requirements, and accounting for the measurement system configuration, the external mixers conversion loss, IF cable path loss, and antenna gain. The reference line is derived from reverse calculation from the 3 m limit using the equations (19), (22), (24), and (25) from ANSI C63.10 (2013)
- For all measurements above 40 GHz the measurement system noise floor was more than 6 dB below the limit levels ate the measurement distance.
- All significant emissions above the noise floor above 40 GHz were evaluated with the ESW 44 Signal ID function to eliminate the mixing products resulting from the use of external mixers in the measurement.
- For all measurements above 40 GHz the plots are providing a max peak pre-scan for each measurement antenna and the EUT orientation. If no emissions above the measurement system noise floor were detected during the pre-scan, no final (RMS detector) measurements were conducted.

7.2.6 Measurement Plots:

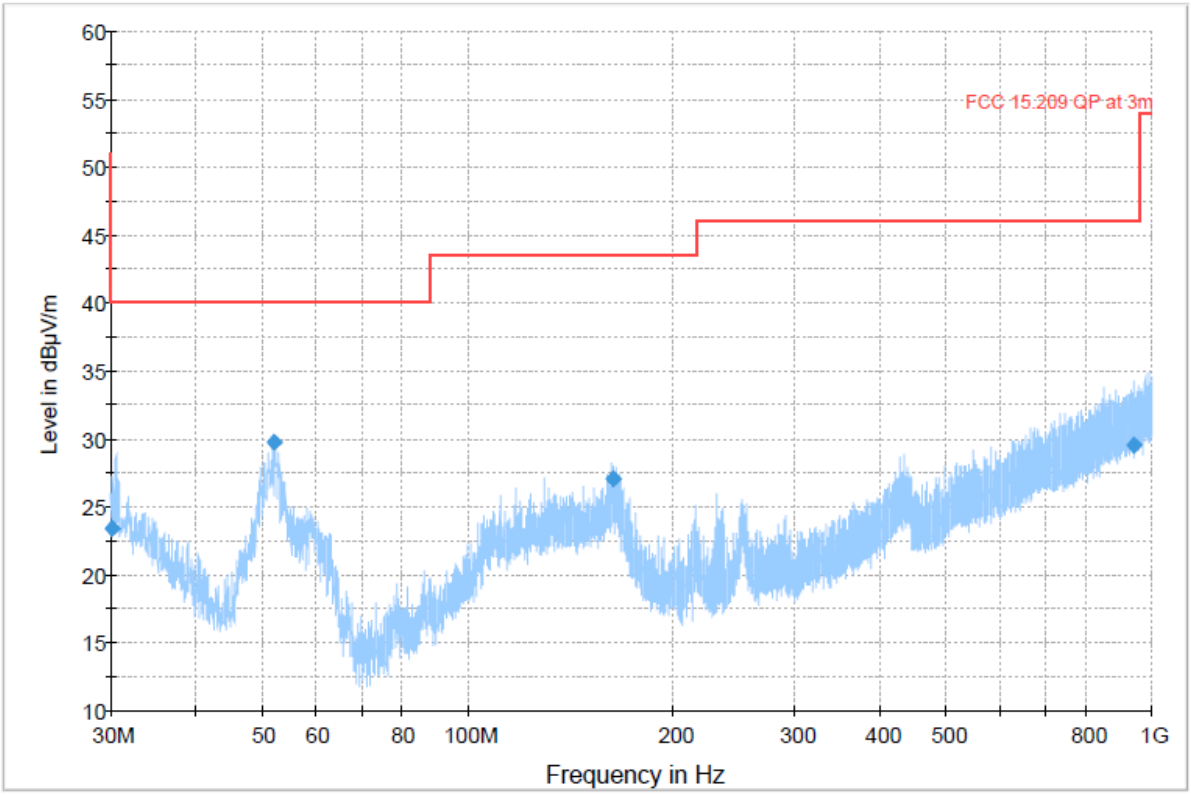
Plot # 1 Spurious Emissions: 9 kHz - 30 MHz

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
27.161	26.13	52.26	26.13	500.0	9.000	107.0	H	163.0	16.4



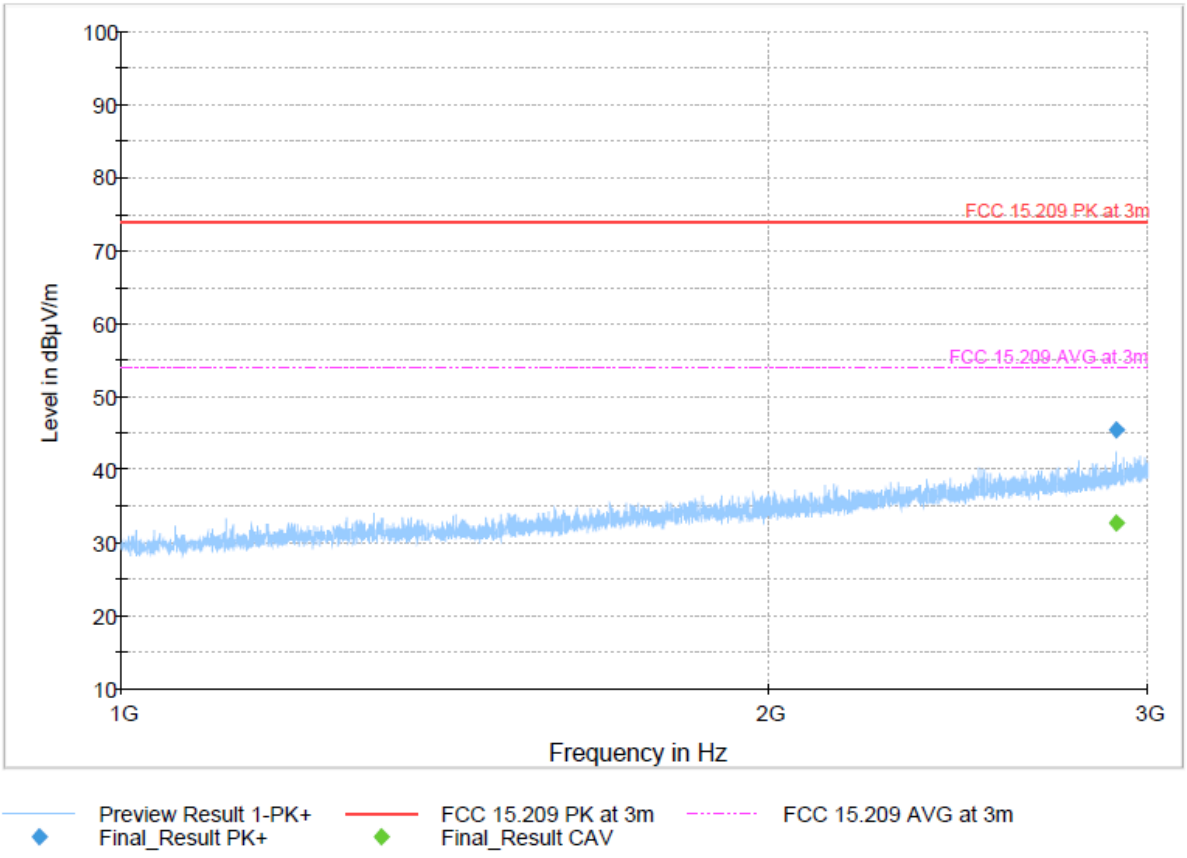
Plot # 2 Spurious Emissions: 30 MHz – 1GHz

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.098	23.37	40.00	16.63	500.0	120.000	202.0	H	162.0	19.1
52.124	29.75	40.00	10.25	500.0	120.000	117.0	V	159.0	8.6
162.995	27.11	43.50	16.39	500.0	120.000	237.0	V	190.0	19.6
940.588	29.51	46.02	16.51	500.0	120.000	117.0	H	340.0	25.9



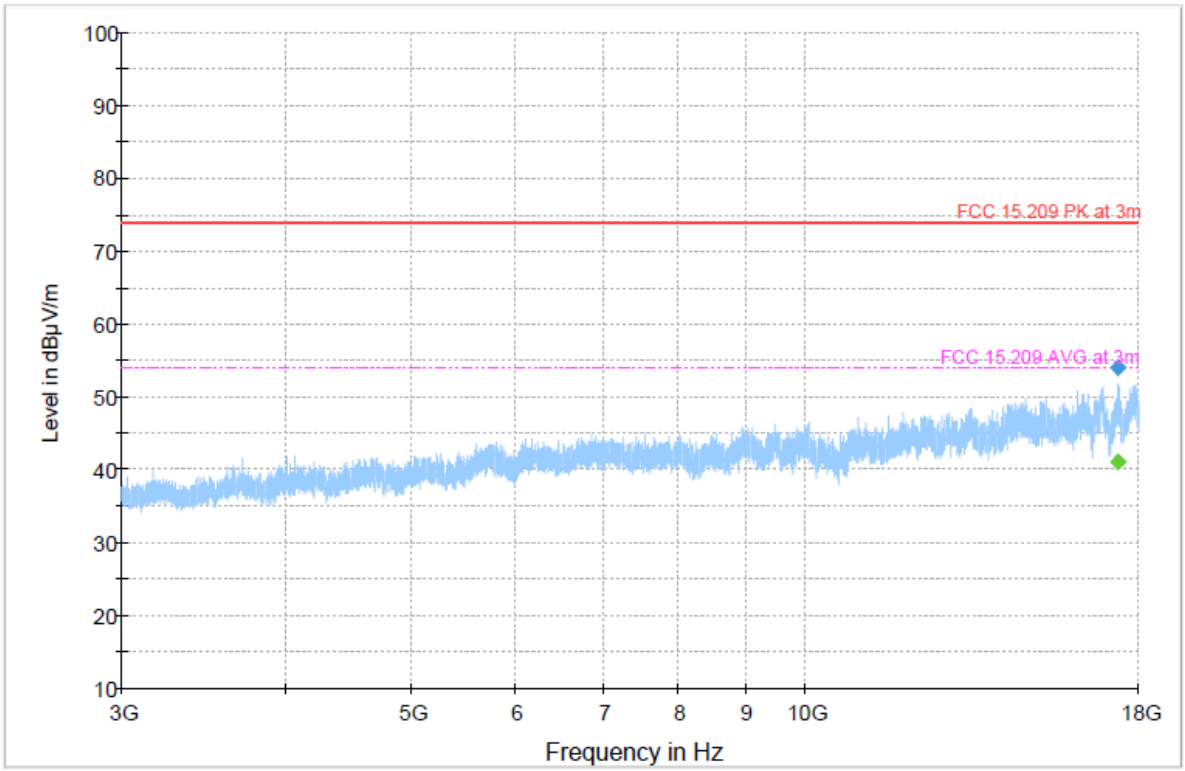
Plot # 3 Spurious Emissions: 1-3 GHz

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2902.250	---	32.76	53.98	21.21	500.0	1000.000	177.0	H	236.0	34.9
2902.250	45.48	---	73.98	28.50	500.0	1000.000	177.0	H	236.0	34.9



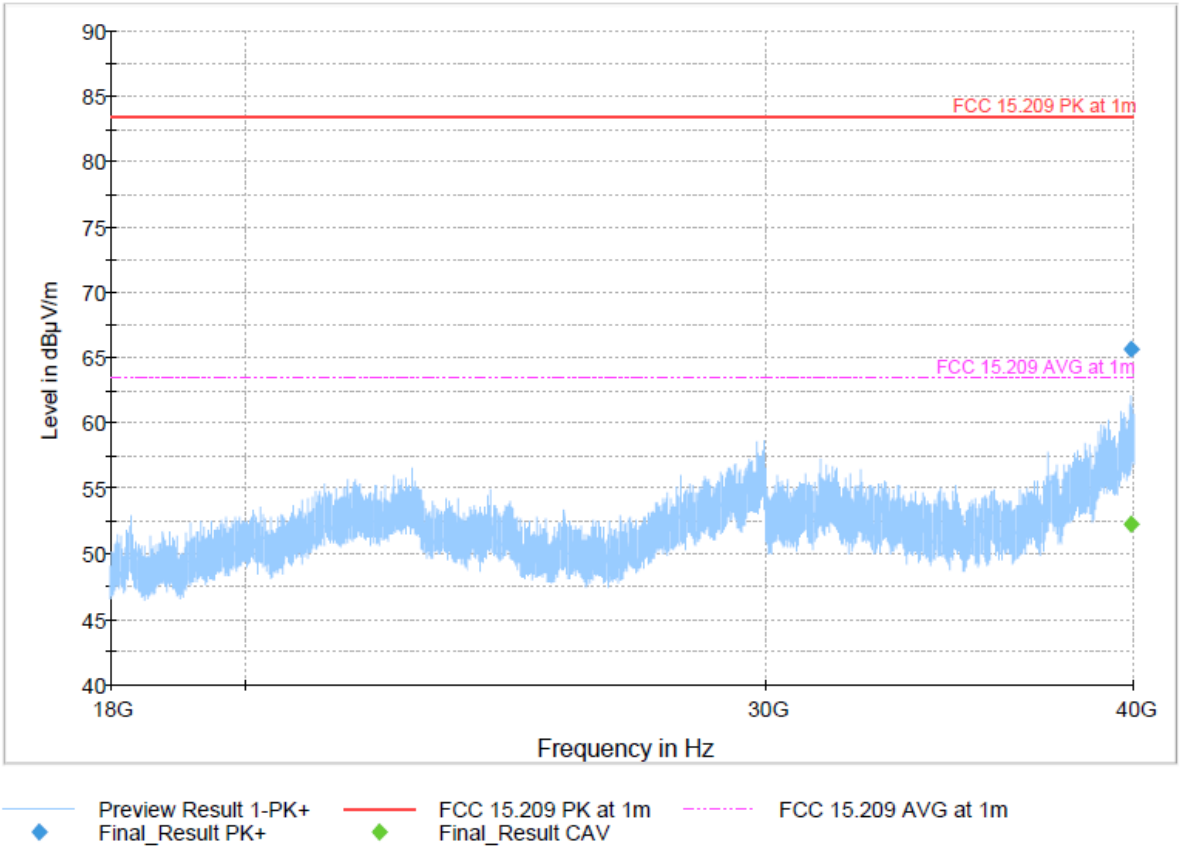
Plot # 4 Spurious Emissions: 3 - 18 GHz

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
17347.550	---	40.98	53.98	13.00	500.0	1000.000	161.0	V	241.0	15.8
17347.550	53.92	---	73.98	20.05	500.0	1000.000	161.0	V	241.0	15.8



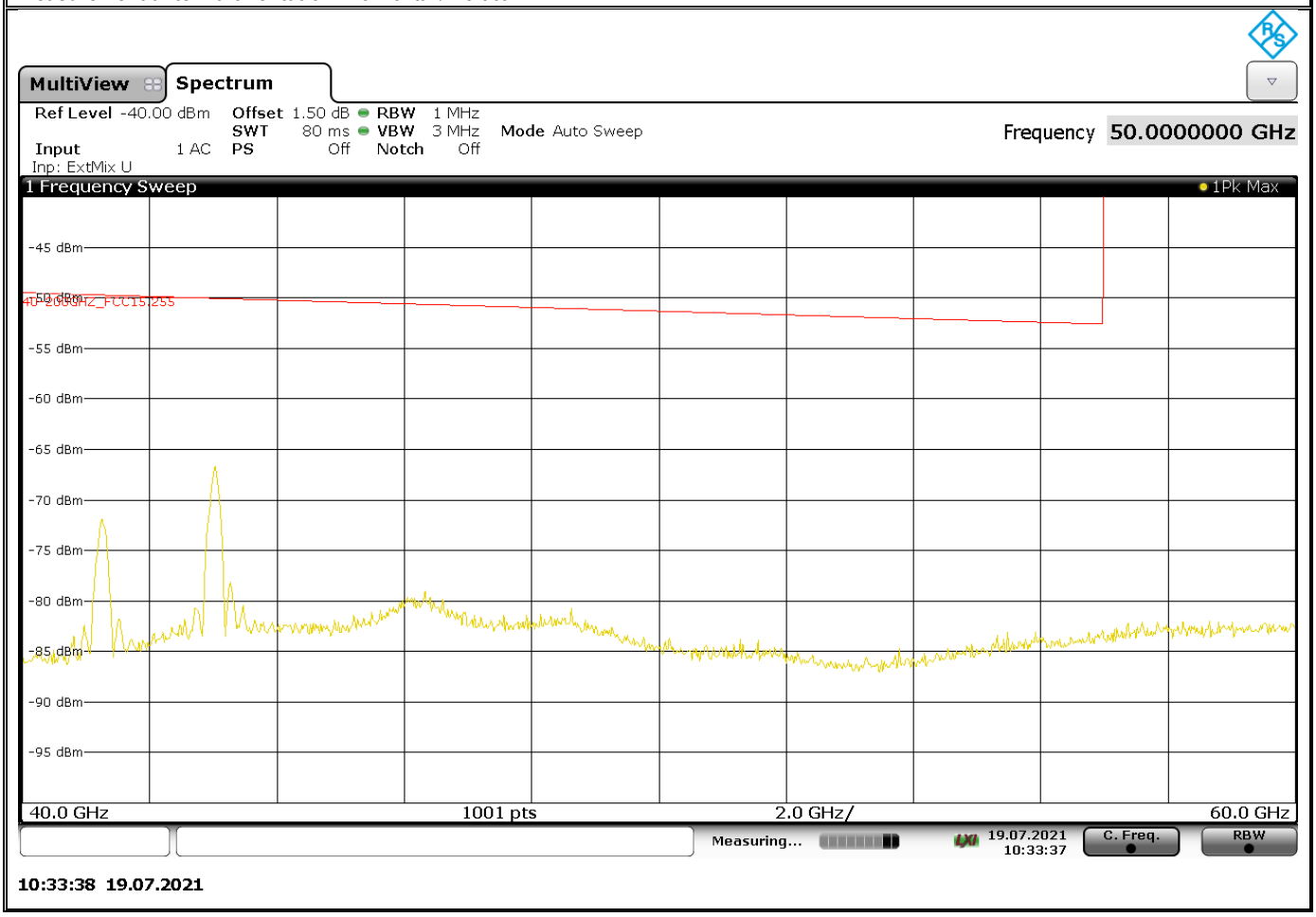
Plot # 5 Spurious Emissions: 18-40 GHz

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39897.500	---	52.30	63.50	11.20	500.0	1000.000	150.0	H	296.0	24.6
39897.500	65.65	---	83.50	17.85	500.0	1000.000	150.0	H	296.0	24.6



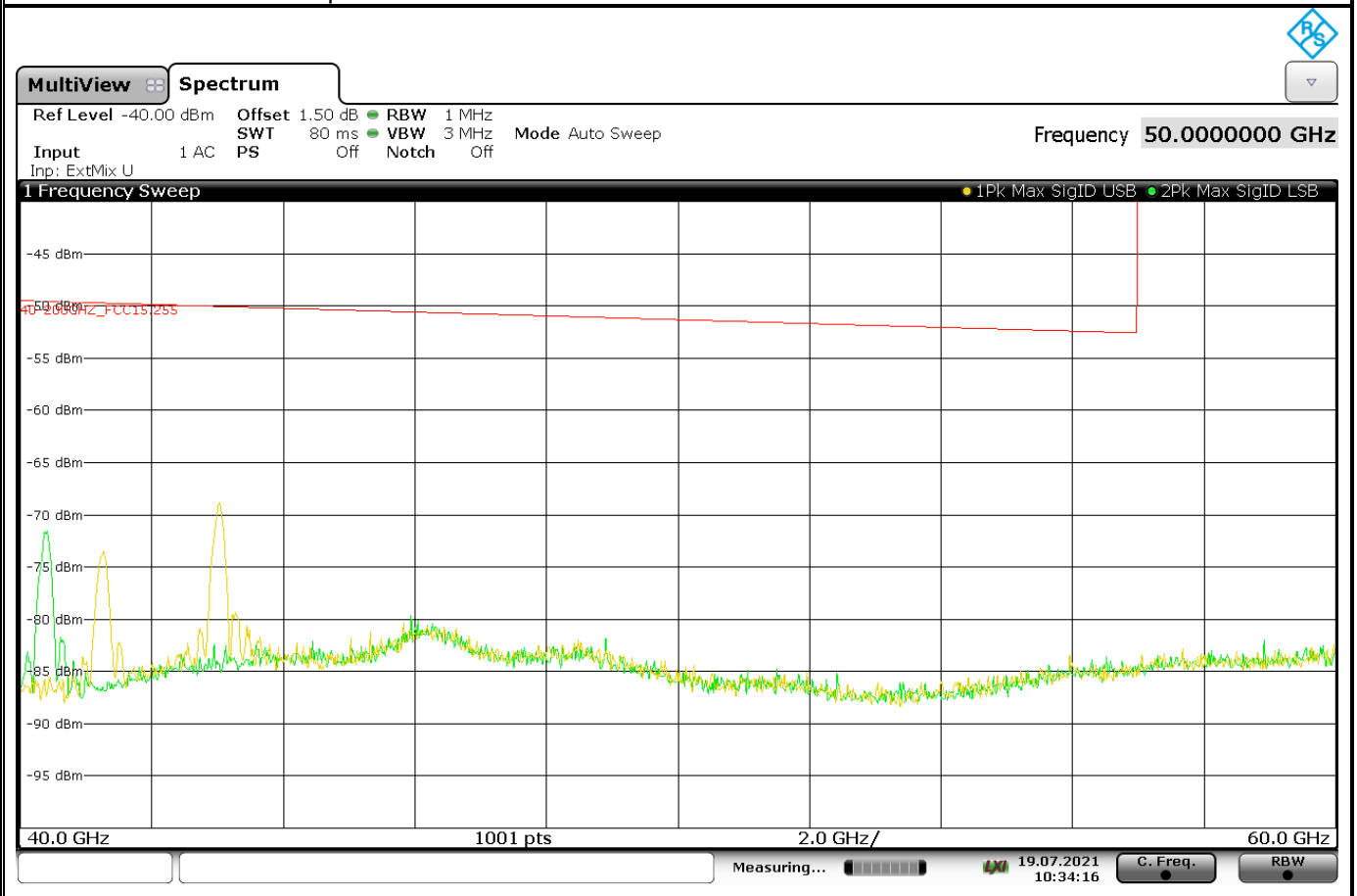
Plot # 6 Spurious Emissions: 40 - 60 GHz

Measurement antenna orientation: Horizontal / Vertical



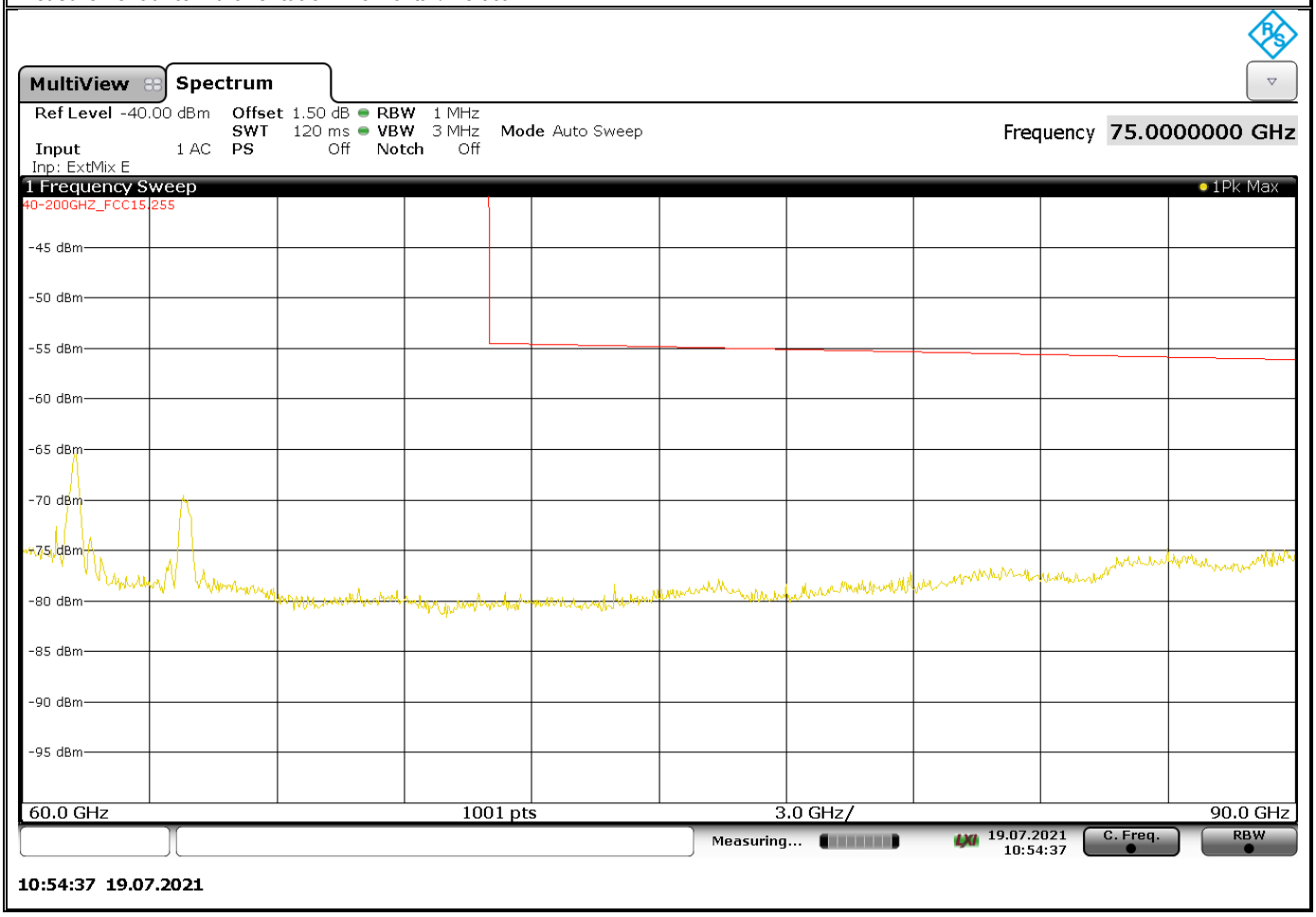
Plot # 7 Signal ID: 40 - 60 GHz

The Signal ID function of the ESW44 was used to evaluate the spectrum from 40 – 60 GHz. The conclusion is that all observed emissions are products of the external mixer.



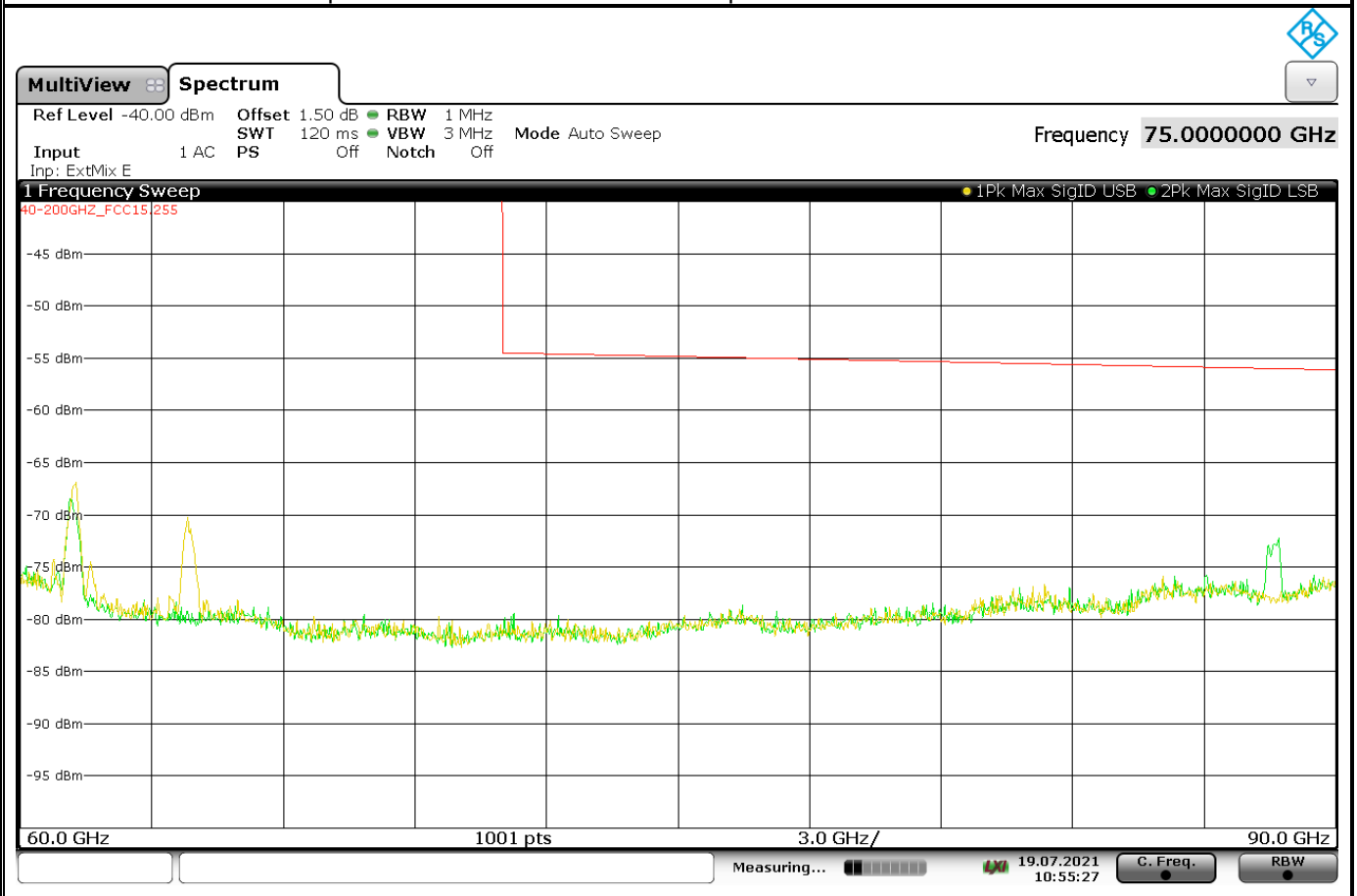
Plot # 8 Spurious Emissions: 60 - 90 GHz

Measurement antenna orientation: Horizontal / Vertical



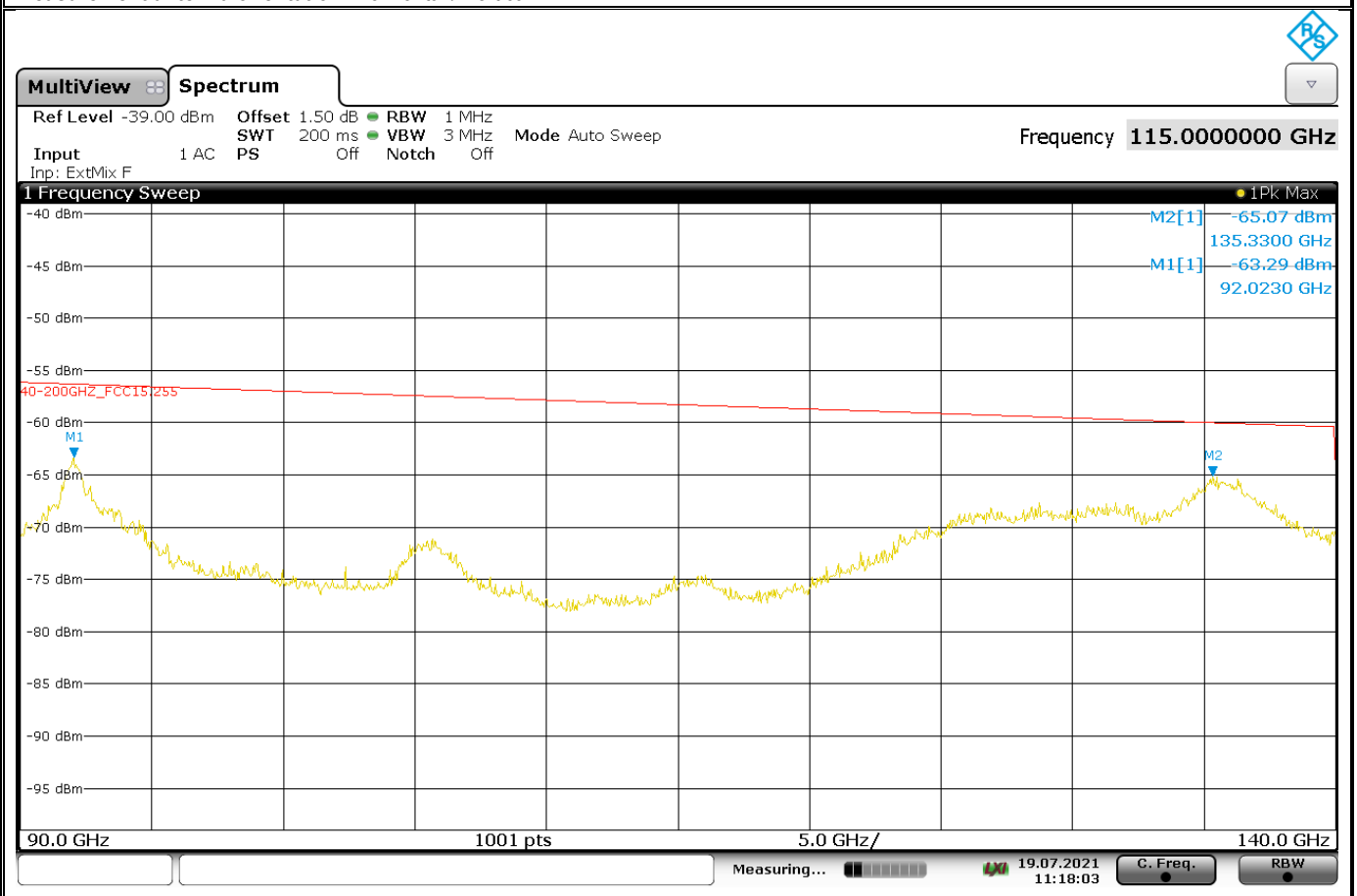
Plot # 9 Signal ID: 60 - 90 GHz

The Signal ID function of the ESW44 was used to evaluate the spectrum from 60 – 90 GHz. The conclusion is that all observed emissions are products of the external mixer except the fundamental at 60.25GHz.



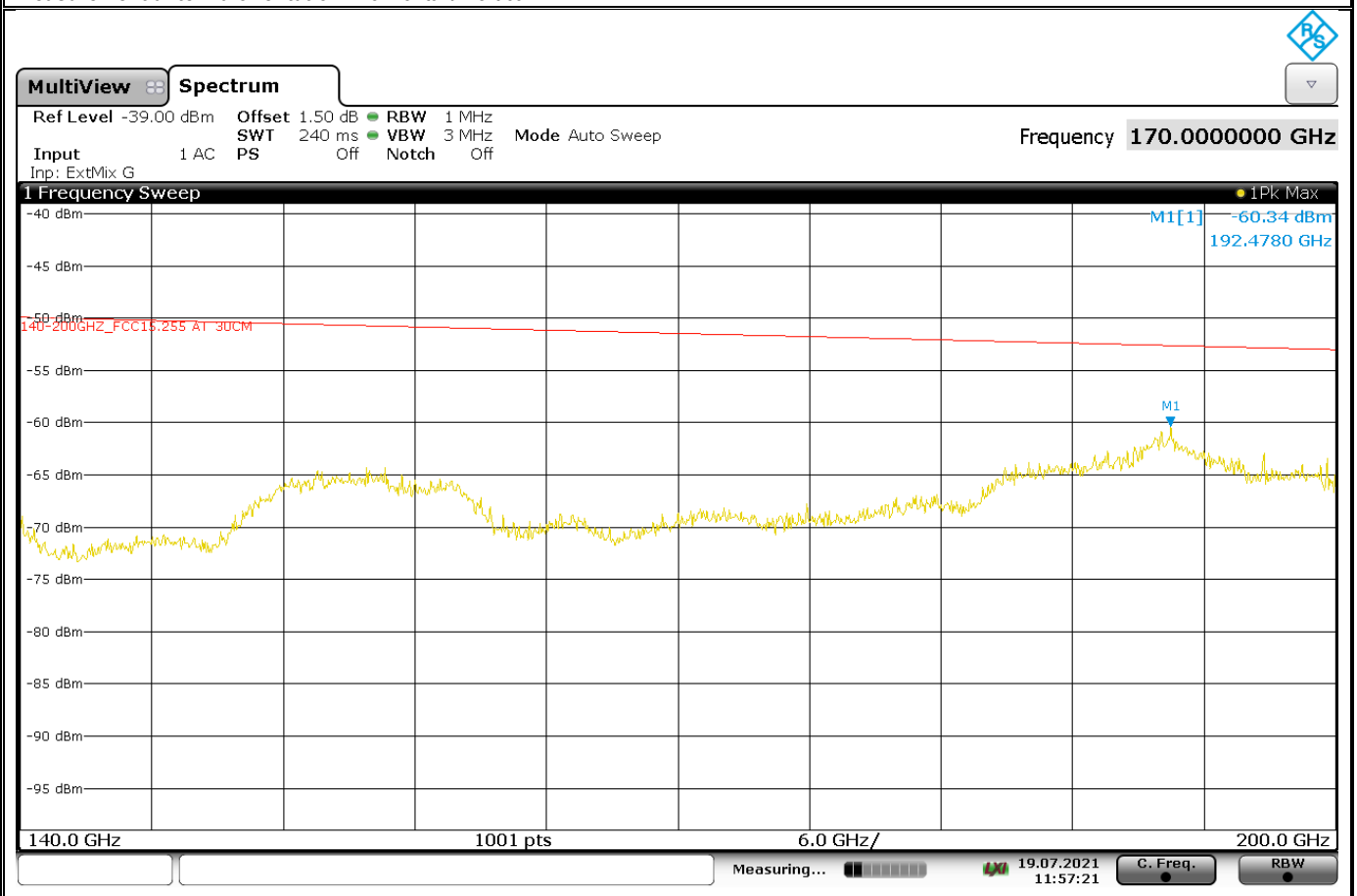
Plot # 10 Spurious Emissions: 90 - 140 GHz

Measurement antenna orientation: Horizontal / Vertical



Plot # 11 Spurious Emissions: 140 - 200 GHz

Measurement antenna orientation: Horizontal / Vertical



8 Test setup photos

Setup photos are included in supporting file name: "EMC_METLA-001-21001_Setup_Photos.pdf"

9 Test Equipment And Ancillaries Used For Testing

Equipment Name/Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
EMI Receiver/Analyzer	Rohde&Schwarz	ESW44	101715	3 years	01/07/2020
Loop antenna	ETS Lindgren	6507	161344	3 Years	10/30/2020
Biconlog Antenna	A.H. Systems; JFW	BiLA2G	569	3 years	12/01/2020
Horn Antenna	EMCO	3115	35111	3 years	04/17/2019
Horn Antenna	ETS Lindgren	3117-PA	49634	3 years	09/01/2020
Horn Antenna	ETS Lindgren	3116C-PA	169535	3 years	09/23/2020
Horn Antenna 25 dBi Gain	Mi-Wave	261U-25	N/A	3 years	06/03/2020
Horn Antenna 25 dBi Gain	Mi-Wave	261E-25	N/A	3 years	06/03/2020
Horn Antenna 25 dBi Gain	Mi-Wave	261W-25	N/A	3 years	06/03/2020
Horn Antenna 25 dBi Gain	Mi-Wave	261F-25	N/A	3 years	06/03/2020
Horn Antenna 25 dBi Gain	Mi-Wave	261G-25	N/A	3 years	06/03/2020
Harmonic Mixer	Rohde&Schwarz	FS-Z60	101025	3 years	01/22/2020
Harmonic Mixer	Rohde&Schwarz	FS-Z90	102088	3 years	02/19/2020
Harmonic Mixer	Rohde&Schwarz	FS-Z140	101145	3 years	02/24/2020
Harmonic Mixer	Rohde&Schwarz	FS-Z220	101037	3 years	03/23/2020
Compact Digital Barometer	Control Company	D4540001	130070752	3 Years	04/13/2020

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.
Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

10 History

Date	Template Revision	Changes to report	Prepared by
2021-07-19	EMC_METLA-001-21001	Initial Version	Kris Lazarov

<<< The End >>>