



RF MEASUREMENT REPORT

FCC ID: DD4ADX3K54
Applicant: Shure Incorporated
Product: Digital Plug-on Transmitter
Model No.: ADX3 K54
Brand Name: 
FCC Classification: Licensed LPAS Device (TLD)
FCC Rule Part(s): Part 74 Subpart H (Section 74.861)
Result: Complies
Received Date: 2022-12-26
Test Date: 2023-01-03 ~ 2023-02-07

Reviewed By:



Jame Yuan

Approved By:



Robin Wu



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standards through the calibration of the equipment and evaluated measurement uncertainty herein.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2211RSU077-U6	V01	Initial Report	2023-02-16	Valid

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1.4. Product Information

Product Name	Digital Plug-on Transmitter
Model No.	ADX3 K54
Serial No.	3BK03154131 (Radiated Testing) 95B52358 01 (Conducted Testing)
ZigBee Specification	802.15.4, 2405 ~ 2480 MHz
Frequency Range	UHF Band, 606 ~ 663 MHz
Power Type	Two AA batteries (3.0Vdc) or Li-ion battery
Operating Temperature	-10 ~ 50°C
Antenna Information	Refer to selection 1.5
Accessories	
Rechargeable Li-ion Battery	Model: SB900B Output: 3.7Vdc, 1240mAh, 4.59Wh

Note: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.

1.5. Radio Specification under Test

Frequency Range	606 ~ 608 MHz & 653 ~ 657 MHz
Working Mode	STD Mode and HD Mode (Note 2)
Declared Power Level	<u>606 ~ 608 MHz</u> STD: 2mW & 10mW & 35mW, HD: 2mW <u>653 ~ 657 MHz</u> STD: 2mW & 10mW, HD: 2mW
Type of Modulation	16QAM
Channel Spacing	25kHz
Antenna Type	Dipole
Antenna Gain	4.00 dBi

Note 1: Power level and transmit frequency can be selected using the front panel controls.

Note 2: STD means normal channel bandwidth mode, HD means high density channel bandwidth. End user can switch working modes through the digital wireless receiver.

1.6. Working Frequencies

Bottom Channel (MHz)	Top Channel (MHz)
606 ~ 608 MHz Band	
606.000	607.875
653 - 657 MHz Band	
653.125	656.875

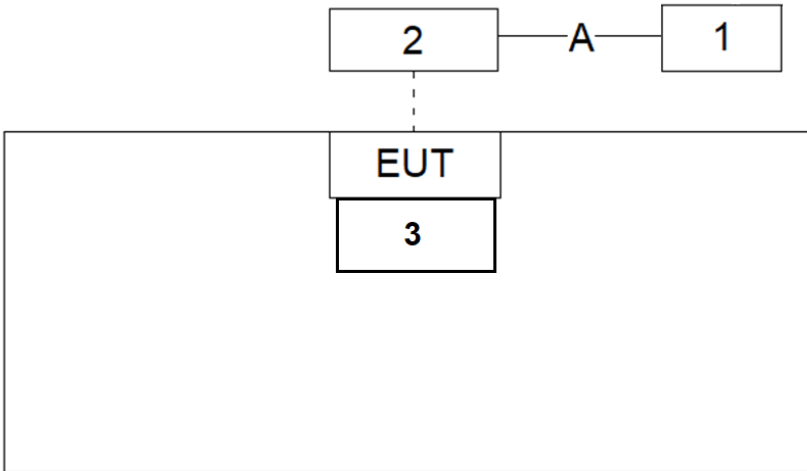
Note: Refer ANSI C63.26 clause 5.1.2 table 2, frequency range fall within 1 – 10 MHz, only two channels (Top and Bottom) shall be tested.

2. Test Configuration

2.1. Test Mode

Mode 1: Transmit by STD Mode
Mode 2: Transmit by HD Mode

2.2. Test System Connection Diagram

Connection Diagram			
 The diagram shows a test setup. At the top, a box labeled '2' is connected to a box labeled '1' by a line labeled 'A'. A dashed line connects box '2' to a box labeled 'EUT'. Below 'EUT' is a box labeled '3'. A large rectangle encloses the 'EUT' and '3' boxes.			
Product	Manufacturer		Model No.
1	Notebook (for RF Test)	Lenovo	E495
2	IR Dongle	Shure	PT21071
3	Premium Modular Shotgun Microphone	Shure	VP89M
Cable Type		Cable Description	
A	USB Cable	Shielded, 1.8m	

2.3. Test Software

The test utility software used during testing was “teraterm”, and the version was V4.85, all test commands were provided by the manufacturer.

2.4. Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 74.861
- KDB 206256 D01v02r01
- ANSI C63.26-2015
- ETSI EN 300 422 - 1 V 1.4.2

2.5. Test Environment Condition

Ambient Temperature	15 ~ 35°C
Relative Humidity	20 ~ 75%RH

3. Measuring Instrument

Instrument	Manufacturer	Model No.	Asset No.	Cali. Interval	Cali. Due Date	Test Site
TRILOG Antenna	Schwarzbeck	VULB 9162	MRTSUE06022	1 year	2023-05-20	WZ-AC2
EMI Test Receiver	Agilent	N9038A	MRTSUE06125	1 year	2023-06-04	WZ-AC2
Thermohygrometer	Mingle	ETH529	MRTSUE06170	1 year	2023-11-27	WZ-AC2
Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06171	1 year	2023-10-13	WZ-AC2
Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06176	1 year	2023-05-08	WZ-AC2
Anechoic Chamber	RIKEN	WZ-AC2	MRTSUE06213	1 year	2023-04-21	WZ-AC2
Thermohygrometer	testo	608-H1	MRTSUE11038	1 year	2023-11-01	WZ-AC2
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2023-09-29	WZ-AC2
USB Power Sensor	Keysight	U2021XA	MRTSUE06446	1 year	2023-06-04	WZ-SR5
Thermohygrometer	testo	608-H1	MRTSUE06402	1 year	2023-06-06	WZ-SR5
Shielding Room	HUAMING	WZ-SR5	MRTSUE06442	N/A	N/A	WZ-SR5
Signal Analyzer	Keysight	N9010B	MRTSUE06457	1 year	2023-06-04	WZ-SR5
Temperature Chamber	BAOYT	BYH-150CL	MRTSUE06051	1 year	2023-10-08	WZ-TR3
Thermohygrometer	testo	608-H1	MRTSUE06401	1 year	2023-06-06	WZ-TR3
Signal Analyzer	Keysight	N9010B	MRTSUE07027	1 year	2023-11-25	WZ-TR3
Attenuator	MVE	MVE2213	MRTSUE11071	1 year	2023-06-09	WZ
Attenuator	MVE	MVE2213	MRTSUE11072	1 year	2023-06-09	WZ

Software	Version	Function
EMI Software	V3.0.0	EMI Test Software
Controller_MF 7802	1.02	RE Antenna & Turntable
BenchVue Power Meter	2018.1	Power

4. Decision Rules and Measurement Uncertainty

4.1. Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2.

(Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.2. Measurement Uncertainty

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

AC Conducted Emission Measurement	
The maximum measurement uncertainty is evaluated as:	
9kHz~150kHz: 3.58dB	
150kHz~30MHz: 3.20dB	
Radiated Emission Measurement	
The maximum measurement uncertainty is evaluated as:	
Coaxial:	9kHz~30MHz: 2.59dB
Coplanar:	9kHz~30MHz: 2.60dB
Horizontal:	30MHz~200MHz: 3.85dB
	200MHz~1GHz: 4.36dB
	1GHz~40GHz: 4.98dB
Vertical:	30MHz~200MHz: 4.06dB
	200MHz~1GHz: 5.28dB
	1GHz~40GHz: 4.91dB
Spurious Emissions, Conducted	
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$):	
2.3dB	
Output Power	
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$):	
1.5dB	
Occupied Bandwidth	
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$):	
3.2%	

5. Test Result

5.1. Summary

FCC Part Section(s)	Test Description	Test Condition	Test Result
74.861(e)(1)(ii)	RF Output Power	Conducted	Pass
74.861(e)(4)	Frequency Stability		Pass
74.861(e)(5)	Occupied Bandwidth		Pass
74.861(e)(6)	Emission Mask		Pass
74.861(e)(7)	Necessary Bandwidth		Pass
74.861(e)(7)	Radiated Spurious Emission	Radiated	Pass

Notes:

- 1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 2) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst emissions.
- 3) For STD mode, besides test items of necessary bandwidth & emission mask were assessed three power levels, any others test items were only assessed max power level.

5.2. RF Output Power Measurement

5.2.1. Test Limit

The conducted power may not exceed 250mW in 470 ~ 608 and 614 ~ 698 MHz band.

In the 600 MHz duplex gap (653 ~ 667 MHz): 20mW EIRP.

5.2.2. Test Procedure

ANSI C63.26-2015 - Section 5.2.4.2

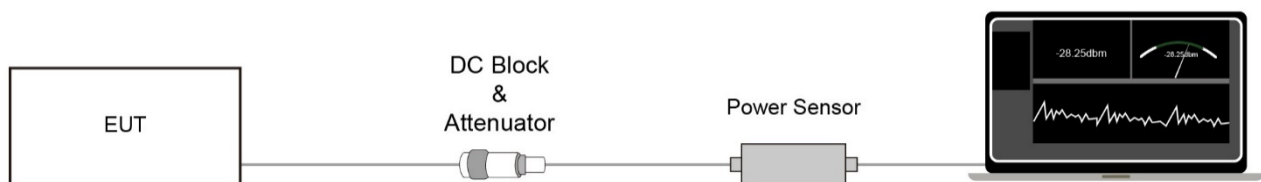
5.2.3. Test Setting

The output of the EUT was connected to an RF average power meter through fixed attenuation.

The EUT was set to transmit on the low, middle, and high frequencies in each power level.

Measure the average power of the transmitter. This EUT's duty cycle is 100%.

5.2.4. Test Setup



5.2.5. Test Result

Refer to Appendix A.1.

5.3. Frequency Tolerance Measurement

5.3.1. Test Limit

The frequency tolerance of the transmitter shall be 0.005 percent.

5.3.2. Test Procedure

ANSI C63.26-2015 - Section 5.6.3

5.3.3. Test Setting

Frequency Stability Under Temperature Variations:

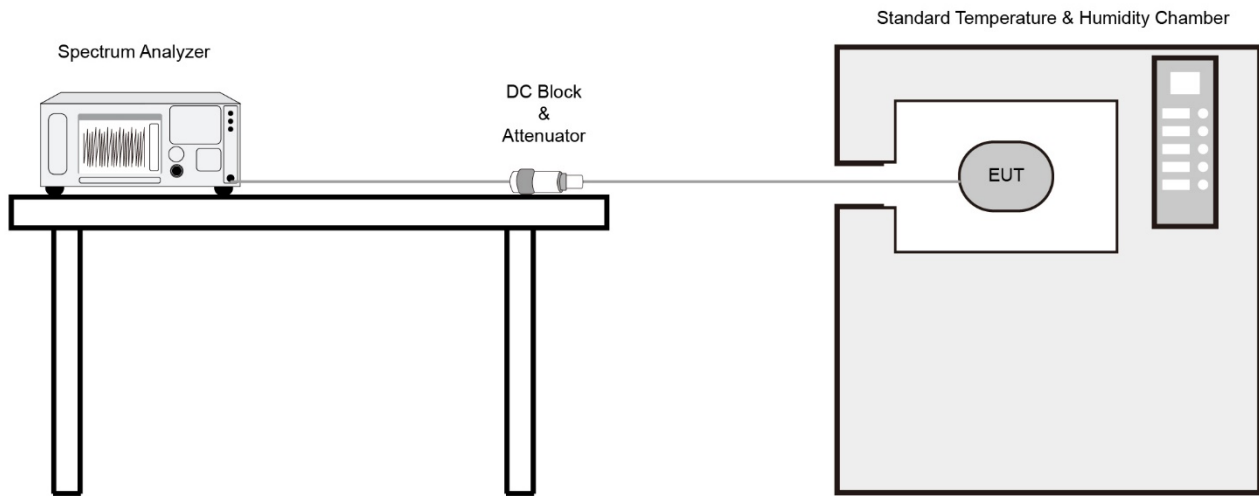
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C decreased per stage until the lowest temperature reached.

Frequency Stability Under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ($\pm 15\%$) and endpoint (If a product is specified to operate over a range of input voltage then the -15% variation is applied to the lowermost voltage and the $+15\%$ is applied to the uppermost voltage), record the maximum frequency change.

5.3.4. Test Setup



5.3.5. Test Result

Refer to Appendix A.2.

5.4. 99% Occupied Bandwidth Measurement

5.4.1. Test Limit

The operating bandwidth shall not exceed 200 kHz.

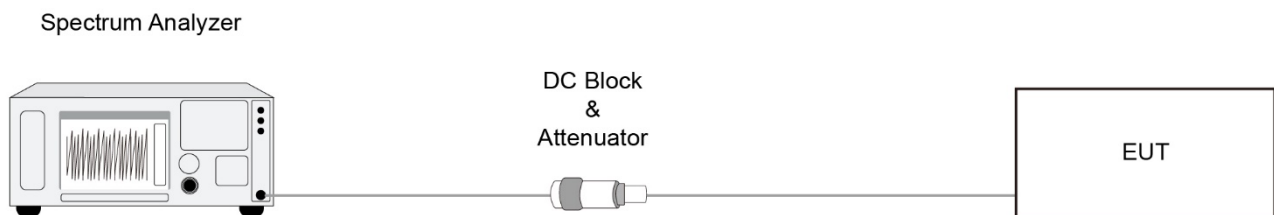
5.4.2. Test Procedure

ANSI C63.26-2015 - Section 5.4.4

5.4.3. Test Setting

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 - 5% of the expected OBW
3. VBW $\geq 3 \times$ RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. Reported the measured 99% occupied bandwidth

5.4.4. Test Setup



5.4.5. Test Result

Refer to Appendix A.3.

5.5. Out-of-band Emission Mask Measurement

5.5.1. Test Limit

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

- (i) On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB;
- (ii) On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB;
- (iii) On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least $43 + 10 \log_{10}$ (mean output power in watts) dB.

5.5.2. Test Procedure

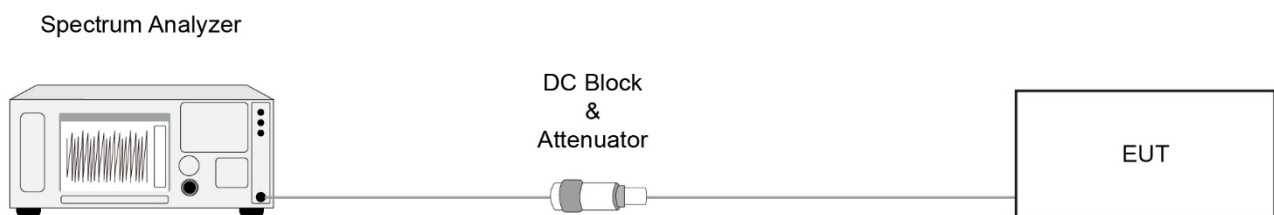
ANSI C63.26-2015 - Section 5.7

5.5.3. Test Setting

Emission Mask

- a) The EUT was connected to a spectrum analyzer. The un-modulated carrier signal level was measured and recorded.
- b) The EUT was modulated with typical digital modulation.
- c) The spectrum analyzer center frequency was set to the EUT operating frequency; span was set to 2 MHz; resolution bandwidth was set to 1 MHz; video bandwidth set to 3 MHz; sweep time set to 3 s; after clear/write, max-hold was set; Marker 1 was set to RMS, then Marker 1 was set to reference value.
- d) The RMS output power was recorded and used to set the reference level on the spectrum analyzer.
- e) The spectrum analyzer span was then set to 1.5 MHz; resolution bandwidth set to 2 kHz, video bandwidth set to 5 kHz, sweep time to Auto.

5.5.4. Test Setup



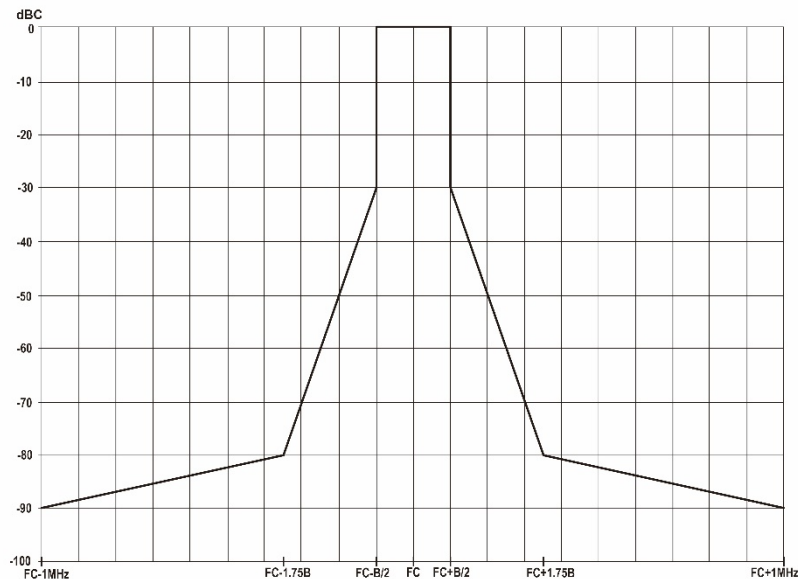
5.5.5. Test Result

Refer to Appendix A.4.

5.6. Necessary Bandwidth Measurement

5.6.1. Test Limit

Digital emissions within the band from one megahertz below to one megahertz above the carrier frequency shall comply with the emission mask in section 8.3.2.2 of the European Telecommunications Institute Standard ETSI EN 300 422-1 v1.4.2, the transmitter output spectrum shall be within the mask defined as below figure.



5.6.2. Test Procedure

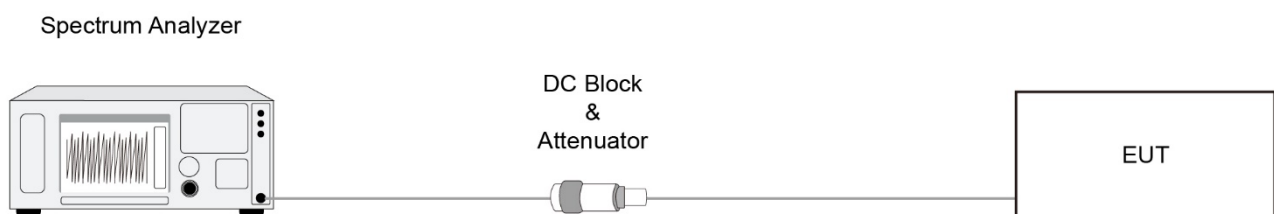
EN 300 422-1 V1.4.2 clause 8.3.2.1.

5.6.3. Test Setting

The EUT was powered up and the transmit frequency & power output of the EUT were selected.

The spectrum analyzer center frequency is set to the nominal EUT channel center frequency.

5.6.4. Test Setup



5.6.5. Test Result

Refer to Appendix A.5.

5.7. Radiated Spurious Emissions Measurement

5.7.1. Test Limit

According to FCC Part 74.861(e)(7), beyond one megahertz below and above the carrier frequency, emissions shall comply with the limits specified in section 8.4 of ETSI EN 300 422-1 v1.4.2.

State	Frequency Range		
	47MHz to 74MHz, 87.5MHz to 137MHz 174MHz to 230MHz, 470MHz to 862MHz	Other Frequencies below 1000MHz	Frequencies above 1000MHz
Operation	4nW	250nW	1uW
Standby	2nW	2nW	20nW

5.7.2. Test Procedure

ETSI EN 300 422-1 V1.4.2 clause 8.4.2.

5.7.3. Test Setting

Table 1 - RBW as a function of frequency

Frequency	RBW
25 ~ 30 MHz	9 kHz
30 ~ 1000 MHz	100 kHz
1000 ~ 6000 MHz	1 MHz

Emissions shall be investigated up to the 10th harmonic of the fundamental.

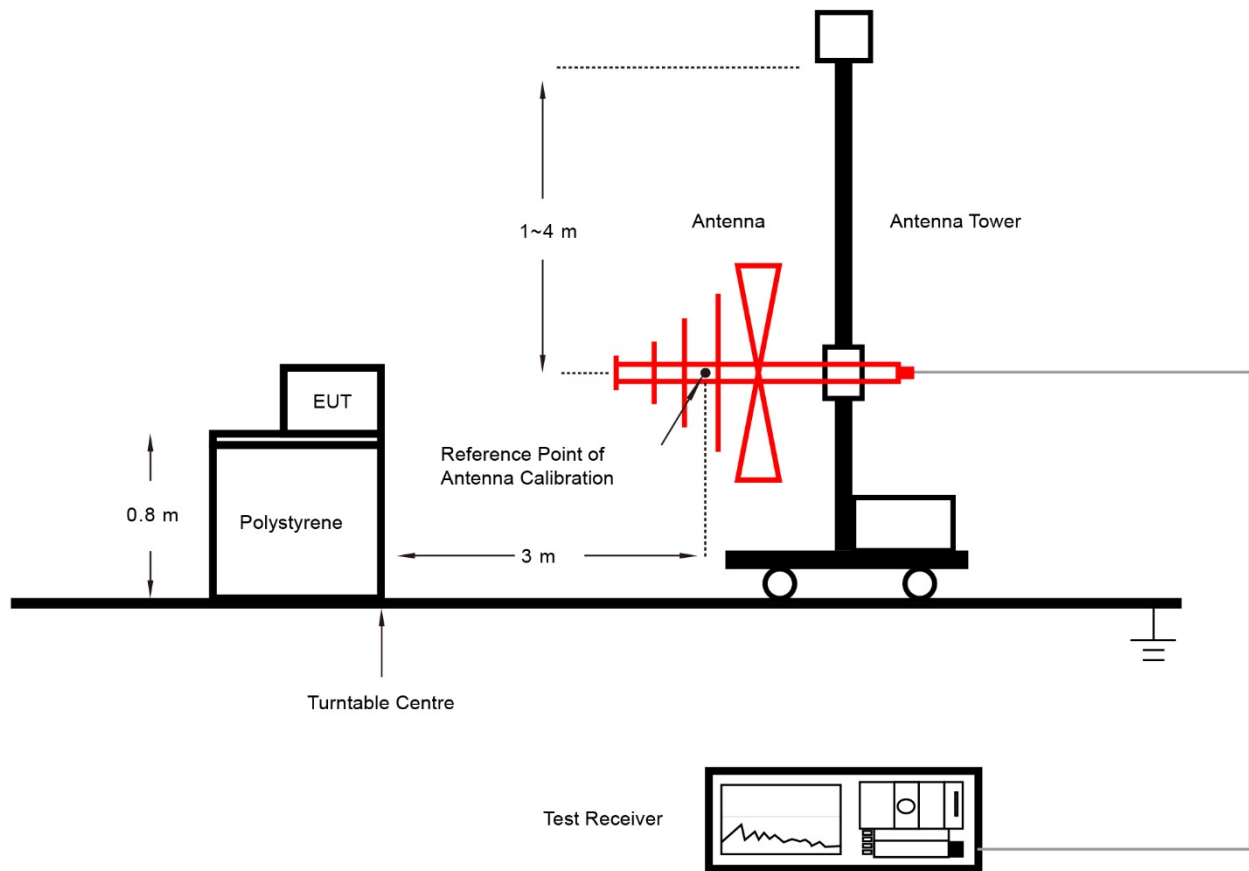
Compliance with the emission limits shall be demonstrated using an RMS Average detector.

All significant broadband and narrowband signals found in the preliminary sweeps were measured using a peak detector at a test distance of 3 meters.

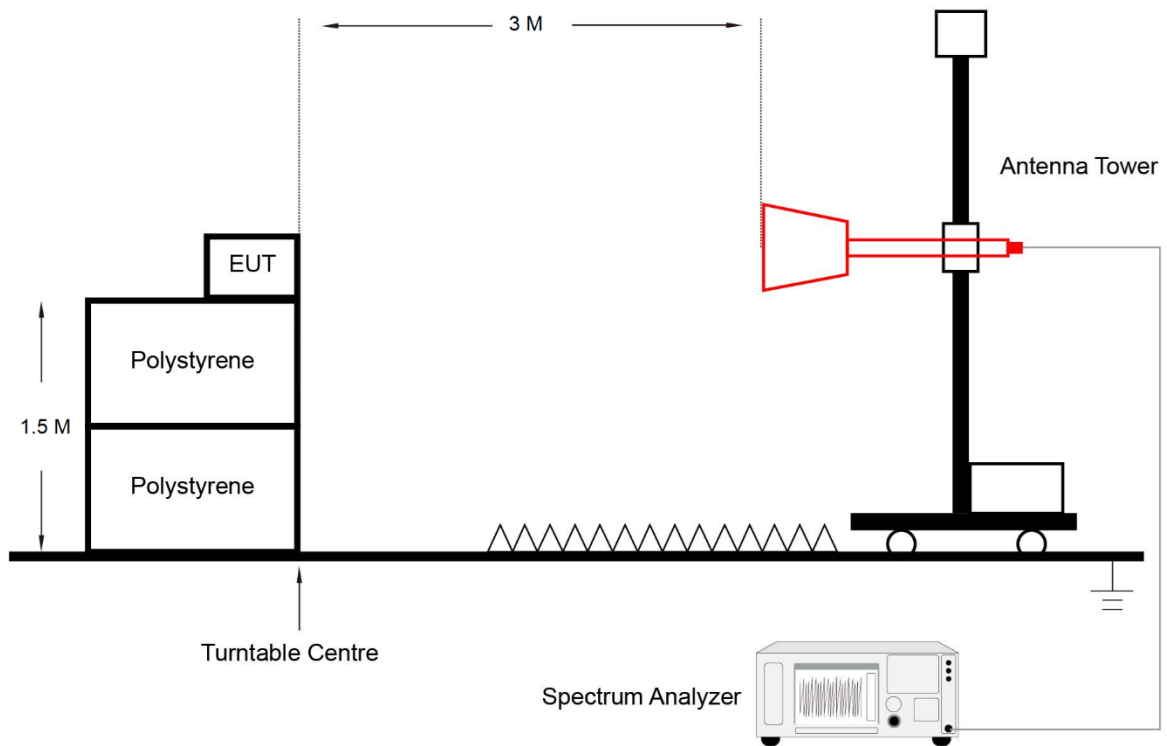
At each frequency at which a component is detected, the sample shall be rotated to obtain maximum response and the effective radiated power of that component determined by a substitution measurement.

5.7.4. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



5.7.5. Test Result

Refer to Appendix A.6.

Appendix A – Test Result

A.1 RF Output Power Test Result

Test Site	WZ-SR5	Test Engineer	Dandy Li
Test Date	2023-01-03		

Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Test Result
STD Mode - 10mW					
653.125	8.54	4.0	12.54	13.01	Pass
656.875	8.52	4.0	12.53	13.01	Pass
HD Mode - 2mW					
653.125	2.92	4.0	6.92	13.01	Pass
656.875	2.91	4.0	6.91	13.01	Pass

Note 1: Limit = $10 \cdot \log(20\text{mW}) = 13.01 \text{ dBm}$.

Note 2: EIRP (dBm) = Conducted Output Power (dBm) + Antenna Gain (dBi).

Test Site	WZ-SR5	Test Engineer	Dandy Li
Test Date	2023-01-03		

Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Test Result
STD Mode - 35mW			
606.000	12.70	≤ 23.98	Pass
607.875	12.71	≤ 23.98	Pass
HD Mode			
606.000	2.74	≤ 23.98	Pass
607.875	2.77	≤ 23.98	Pass

Note: Limit = $10 \cdot \log(250\text{mW}) = 23.98 \text{ dBm}$.

A.2 Frequency Tolerance Test Result

Test Site	WZ-TR3	Test Engineer	Dandy Li
Test Date	2023-02-06	Test Mode	606.000MHz

Voltage (%)	Power (VDC)	Temp (°C)	Frequency Tolerance (ppm)			
			0 minutes	2 minutes	5 minutes	10 minutes
100	3.7	- 10	-1.12	-1.20	-1.21	-1.22
		0	-0.75	-0.79	-0.79	-0.81
		+ 10	-0.33	-0.34	-0.34	-0.33
		+ 20	-0.26	-0.26	-0.25	-0.24
		+ 30	-0.40	-0.39	-0.38	-0.37
		+ 40	-0.40	-0.39	-0.37	-0.35
		+ 50	-0.41	-0.43	-0.44	-0.43
115	4.2	+ 20	-0.26	-0.25	-0.25	-0.49
85	3.1	+ 20	-0.26	-0.26	-0.25	-0.23

Note: Frequency Tolerance (ppm) = {[Measured Frequency (Hz) - Declared Frequency (Hz)] / Declared Frequency (Hz)} *10⁶.

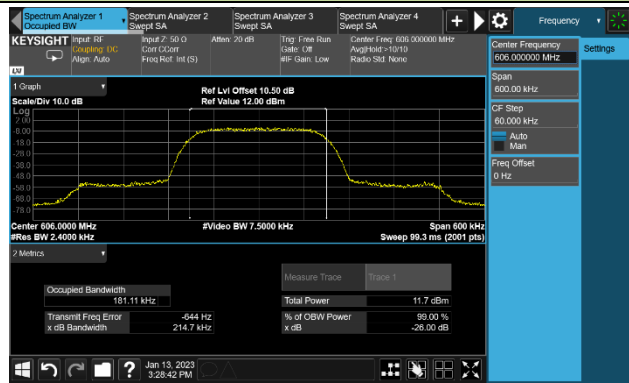
A.3 99% Occupied Bandwidth Test Result

Test Site	WZ-SR5	Test Engineer	Dandy Li
Test Date	2023-01-13 ~ 2023-01-15		

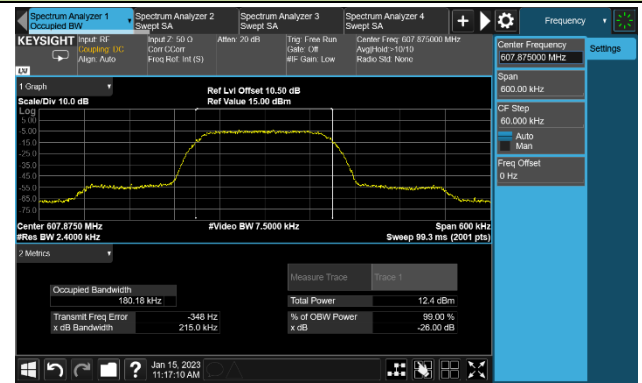
Test Mode	Frequency (MHz)	99% Bandwidth (kHz)	Limit (kHz)	Result
STD Mode (35mW)	606.000	181.11	< 200	Pass
	607.875	180.18	< 200	Pass
STD Mode (10mW)	653.125	180.85	< 200	Pass
	656.875	180.53	< 200	Pass
HD Mode (2mW)	606.000	97.451	< 200	Pass
	607.875	97.483	< 200	Pass
	653.125	96.916	< 200	Pass
	656.875	97.450	< 200	Pass

99% Occupied Bandwidth - STD Mode

606.000MHz

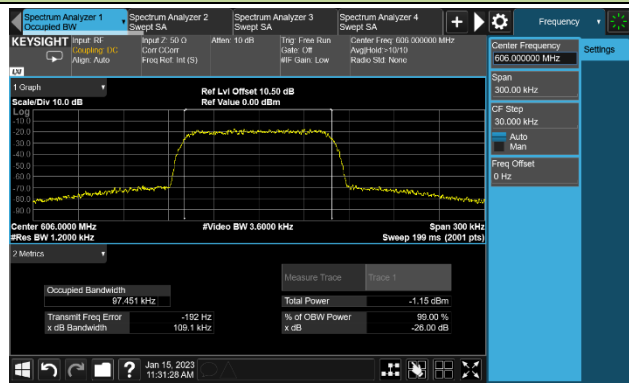


607.875MHz

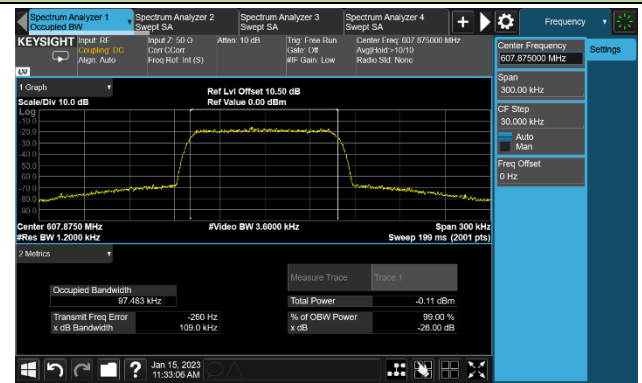


99% Occupied Bandwidth - HD Mode

606.000MHz

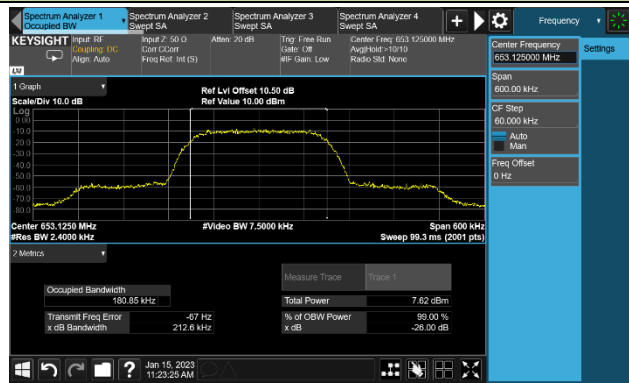


607.875MHz

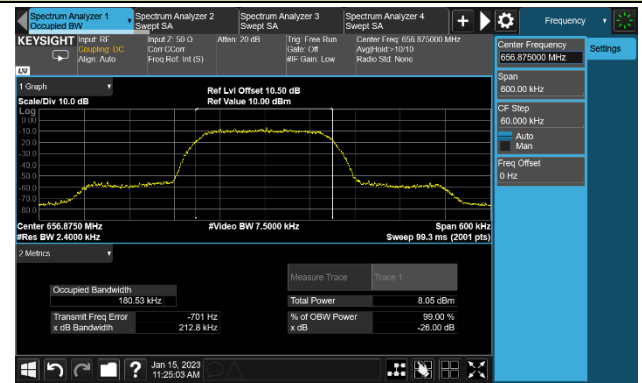


99% Occupied Bandwidth - STD Mode

653.125MHz

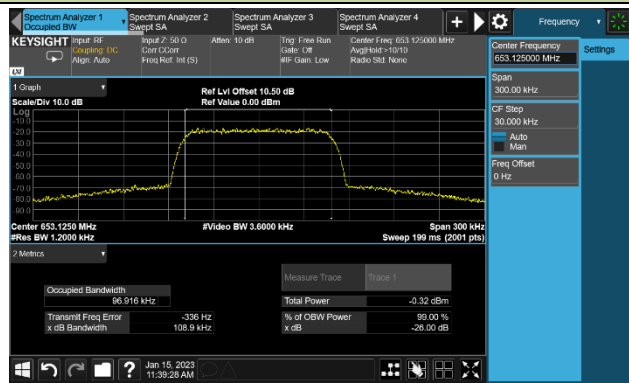


656.875MHz

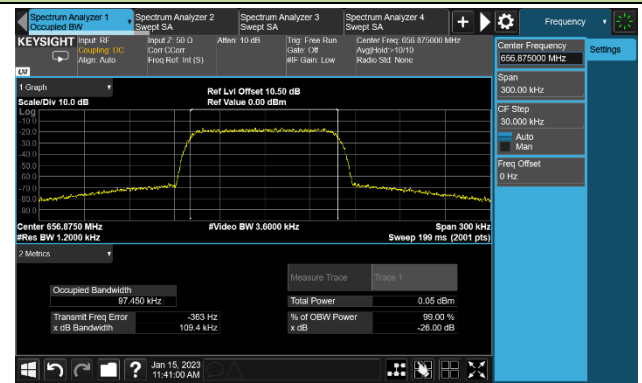


99% Occupied Bandwidth - HD Mode

653.125MHz

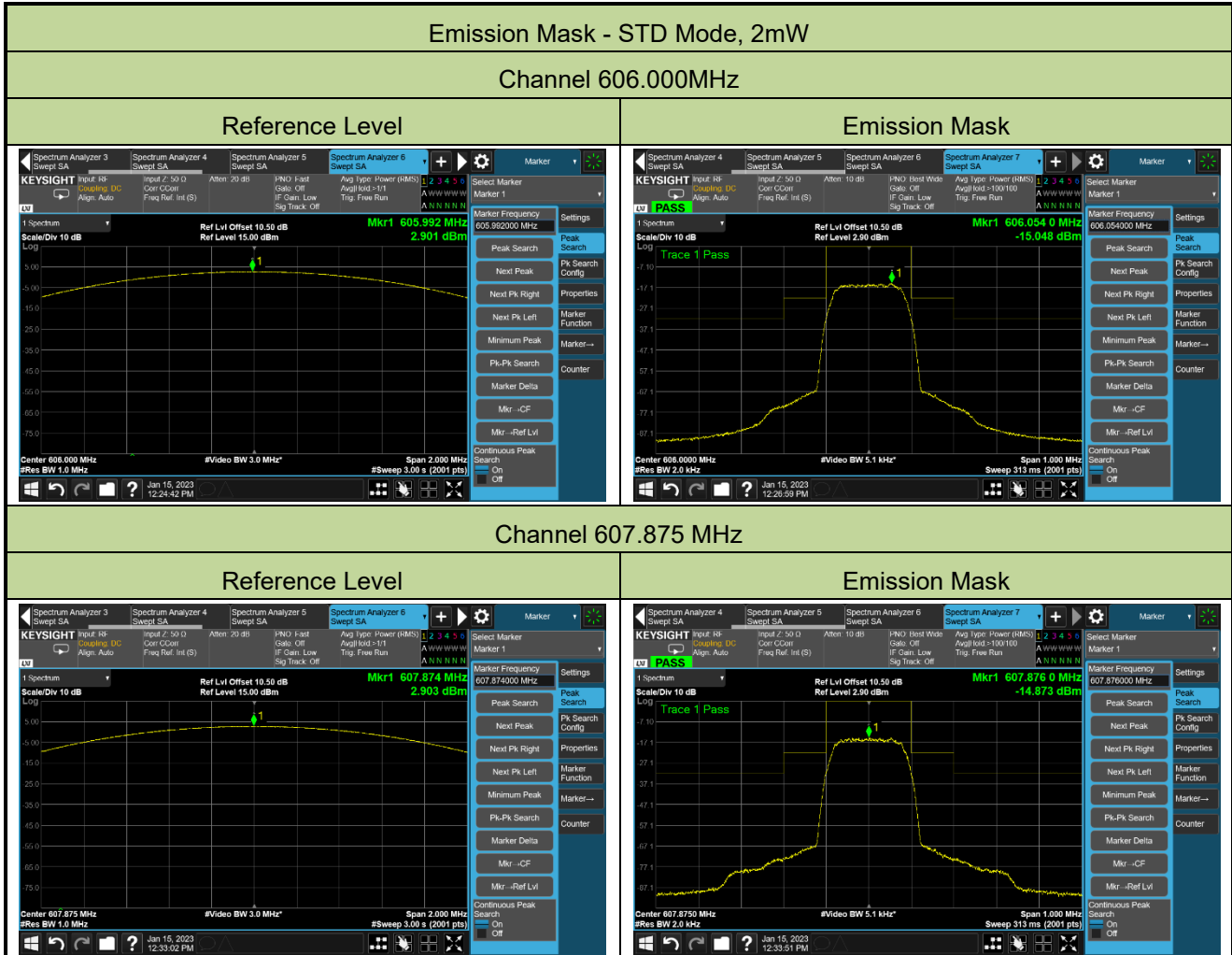


656.875MHz



A.4 Out-of-band Emission Mask Test Result

Test Site	WZ-SR5	Test Engineer	Dandy Li
Test Date	2023-01-15		



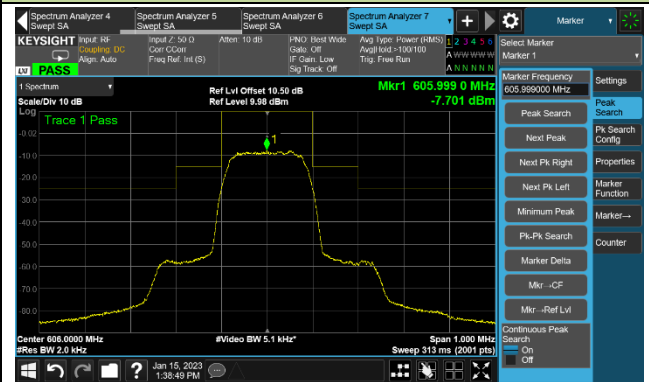
Emission Mask - STD Mode, 10mW

Channel 606.000MHz

Reference Level



Emission Mask

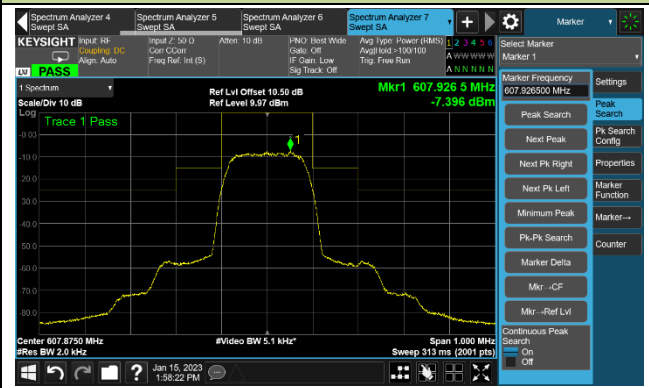


Channel 607.875 MHz

Reference Level



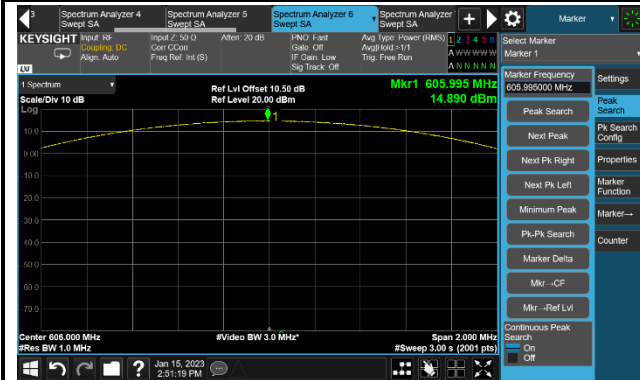
Emission Mask



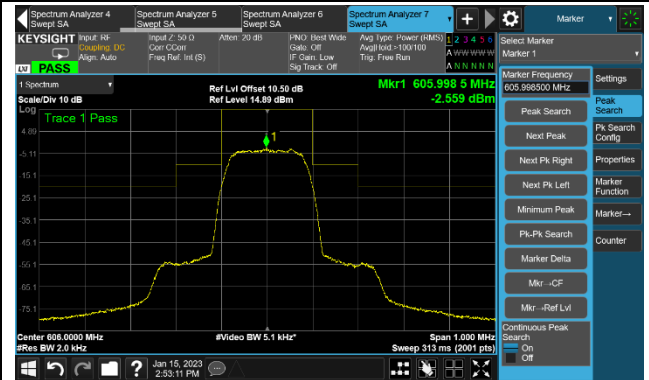
Emission Mask - STD Mode, 35mW

Channel 606.000MHz

Reference Level

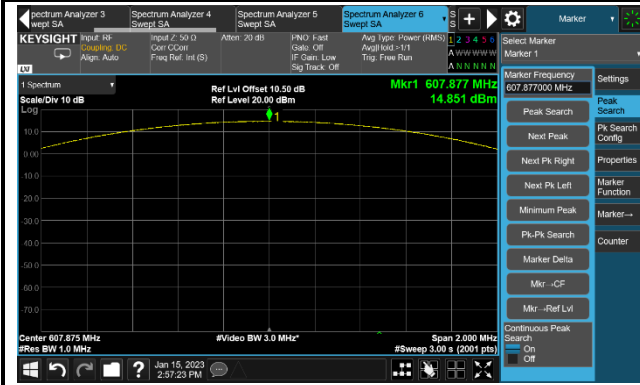


Emission Mask

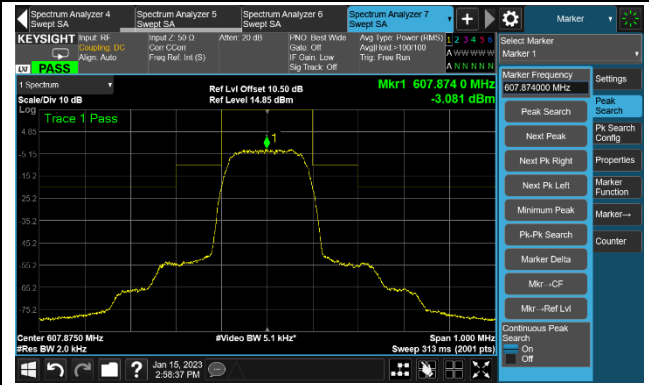


Channel 607.875 MHz

Reference Level



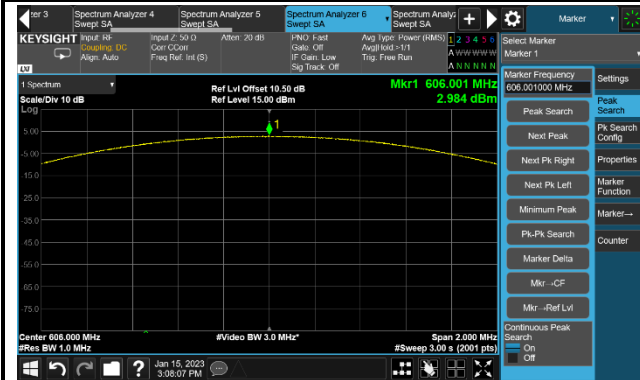
Emission Mask



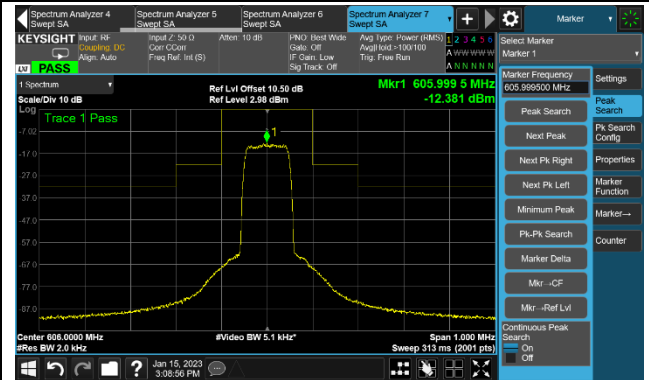
Emission Mask - HD Mode

Channel 606.000MHz

Reference Level

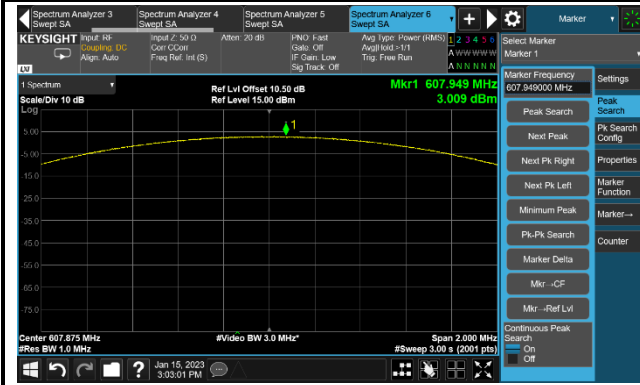


Emission Mask

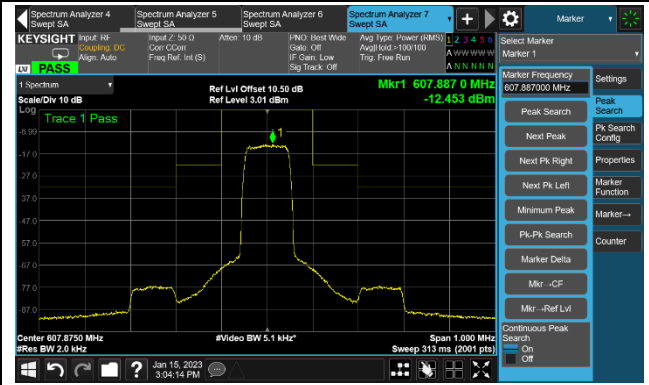


Channel 607.875 MHz

Reference Level



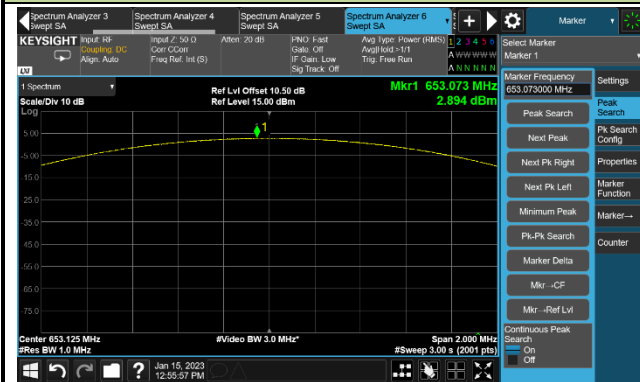
Emission Mask



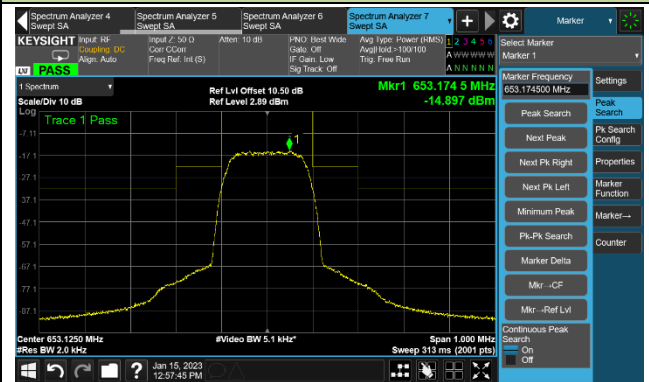
Emission Mask - STD Mode, 2mW

Channel 653.125MHz

Reference Level

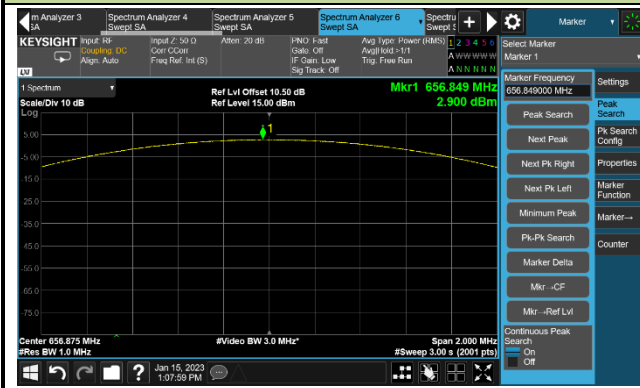


Emission Mask

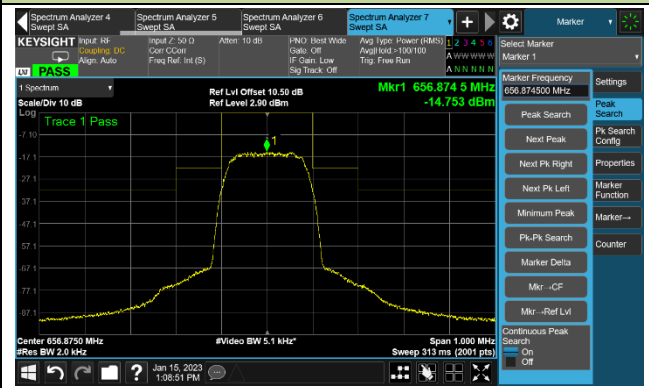


Channel 656.875 MHz

Reference Level



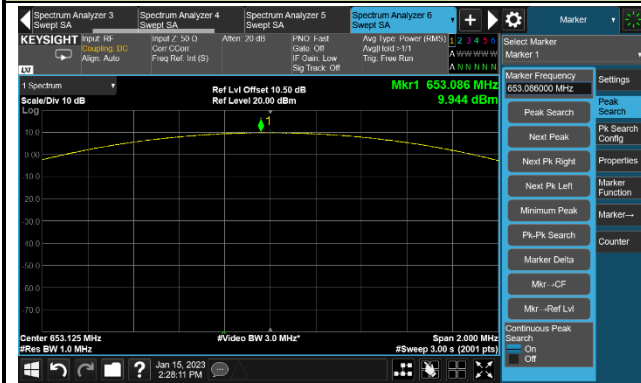
Emission Mask



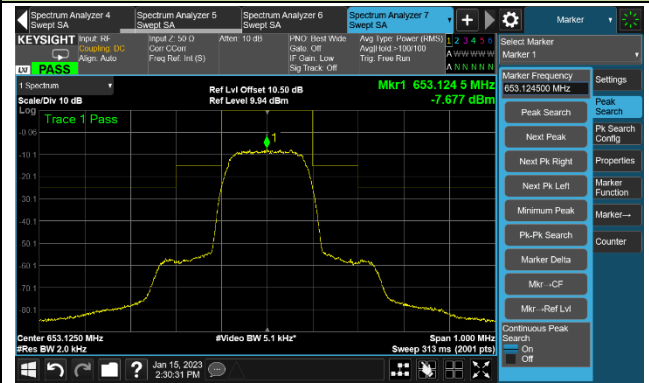
Emission Mask - STD Mode, 10mW

Channel 653.125MHz

Reference Level

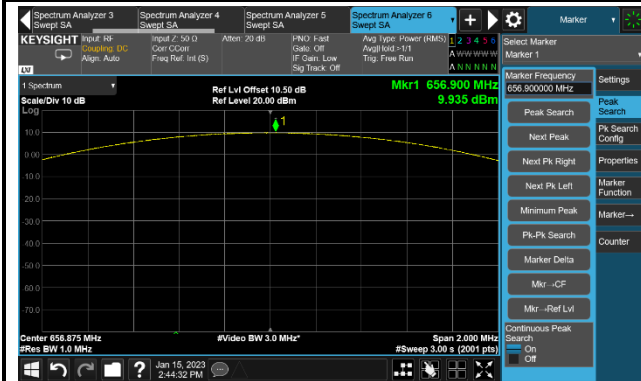


Emission Mask

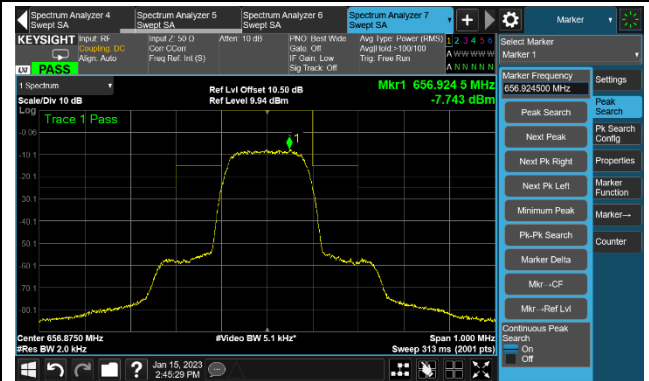


Channel 656.875 MHz

Reference Level



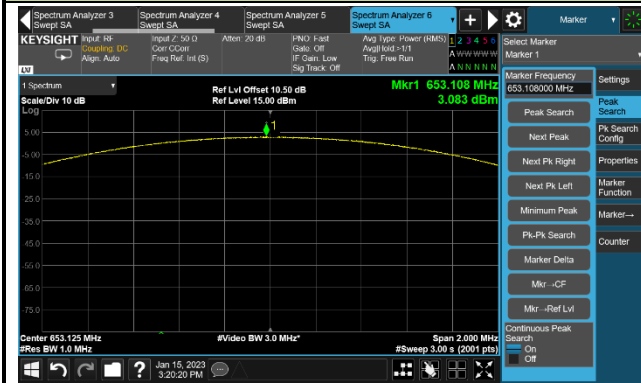
Emission Mask



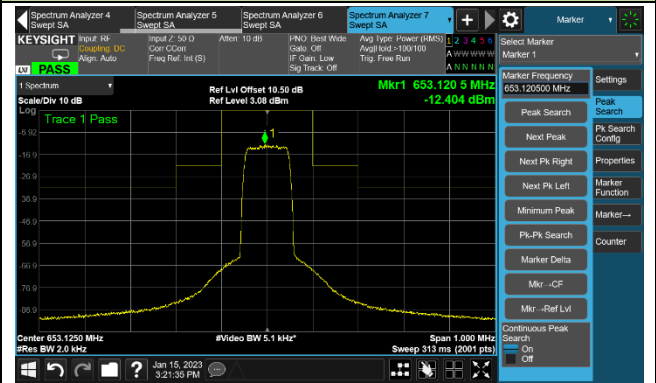
Emission Mask - HD Mode, 2mW

Channel 653.125MHz

Reference Level

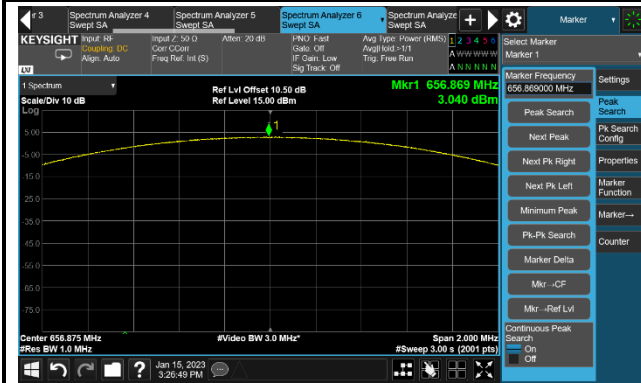


Emission Mask



Channel 656.875 MHz

Reference Level



Emission Mask

