Test Report

INTENTIONAL RADIATOR TESTS ACCORDING TO JAPANESE RADIO LAW REQUIREMENTS

Equipment Under Test:	Bluetooth Low Energy Module
Model:	BGM13P22A
Brand:	Silicon Laboratories
Manufacturer:	Silicon Laboratories Finland Oy Bertel Jungin aukio 2 FI-02600 Espoo FINLAND
Customer:	Silicon Laboratories Finland Oy Bertel Jungin aukio 2 FI-02600 Espoo FINLAND

Date: 7 August 2018

Issued by:

Jani Tuomela
Test Engineer

Date: 7 August 2018

Checked by:

Rauno Repo
Test Engineer

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Equipment Under Test (EUT)

Brand:	Silicon Laboratories
Model:	BGM13P22A
Type:	-
Serial no:	-
HW version:	-
SW version:	-

Description of the EUT

BGM13P22A is a Bluetooth V5.0 compliant Bluetooth SiP module. Max power for BGM13P22A variant is 8.33 mW.

Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

Ratings and declarations

Operating Frequency Range (OFR):	2402 – 2480 MHz
Channels:	40
Channel separation:	2 MHz
Conducted power:	8.33 mW
Modulation:	GFSK
Antenna gain:	A-variant: 1 dBi

Power Supply

BGM13P22A is powered by a single, nominally 3.3 V supply. The module is designed to operate with supply voltages between 2.4 and 3.8 V.

Internal supply voltages of the EUT are regulated. Variation of the internal supply voltage after regulator was verified with supply voltage range 2.4-3.8 V ±10%. Therefore tests were performed using only the nominal input voltage level.

Table 1: EUT internal supply voltage measurements

Supply voltage [Vdc]	Internal supply voltage [Vdc]	Voltage variation [%]	Limit [%]	Result
3.30	1.794	-	-	-
2.16	1.793	0.06	1	PASS
4.18	1.798	0.22	1	PASS

MAC address

Existence of interference protection function is verified and EUT MAC address contains 48 bits. Tested sample MAC address is 00:0B:57:8C:84:02.

Disclaimer

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SUMMARY OF TESTING

Description of Test	Result
Antenna power, tolerances for antenna power	PASS
Frequency tolerance	PASS
Occupied Bandwidth (99%)	PASS
Transmission spurious emissions	PASS
Receiver spurious emissions	PASS

EUT Test Conditions during Testing

The EUT was in continuous transmit or receiving mode during all the tests.

The hopping was stopped and the EUT was configured into the wanted channel. Normal modulation and duty cycle was applied in all tests except for frequency tolerance measurement that was performed with unmodulated signal.

Internal supply voltages of the EUT are regulated. Therefore tests were performed using only the nominal input voltage level.

Power setting 95 was used during the tests.

Following channels were used during the tests when the hopping was stopped:

Channel 0 LOW = 2402 MHz

Channel 20 MID = 2442 MHz

Channel 39 HIGH = 2480 MHz

The EUT was controlled by using software supplied by the customer.

Test Facility

☐	Testing Location / address: FCC registration number: **90598**	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
☒	Testing Location / address: FCC registration number: **178986** Industry Canada registration number: **8708A-2**	SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND

Antenna Power and Tolerances

Limit:	Article 14. and 49.20 1) e	
Tested by:	JAT	
Date:	7 November 2017	
Temperature:	23 °C	
Humidity:	22 % RH	
Measurement uncertainty	± 0.49 dB	Level of confidence 95 % (k = 2)
Limits:	10 mW or less; 2 400 - 2483.5 MHz Antenna power tolerance: -80% to +20%	

Test procedure

Antenna power was measured using spectrum analyzer. First the maximum peak power frequency was searched for channel under measurement. This frequency was used as a center frequency for zero span measurements to measure the Average Burst Power (True RMS) (= Antenna Power (W)).

The Average Burst Power level was measured in continuous modulated mode.

Test Results

Table 2. Measured antenna power

Channel	Reading (dBm)	Result (mW)	Limit (mW)	Margin (mW)	Result
Low	9.28	8.47	10	1.53	PASS
Mid	8.96	7.87	10	2.13	PASS
High	8.85	7.67	10	2.33	PASS

Table 3. Tolerances of antenna power

Channel	Declared antenna power (mW)	-80% limit	+20% limit	Maximum measured power (mW)	Deviation (%)	Result
Low	8.33	1.67	10	8.47	1.708	PASS
Mid	8.33	1.67	10	7.87	-5.517	PASS
High	8.33	1.67	10	7.67	-7.880	PASS

Power tolerance is calculated by using the following formula:

Power tolerance = {[(Measured power)-(Rated Cond. P)] / (Rated Cond. P)} × 100

Table 4. EIRP evaluation

Antenna Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP = Antenna Power (dBm) + Antenna Gain (dBi)
9.29	1	10.29	

Antenna gain and beamwidth measurements are not required because the EIRP power is less than 12.14 dBm.

Frequency Tolerance

Limit:	Article 5.	
Tested by:	JAT	
Date:	3 November 2017	
Temperature:	22 °C	
Humidity:	18 % RH	
Measurement uncertainty:	± $4.758x10^{-8}$	Level of confidence 95 % (k = 2)
Limit:	± 50 ppm	

Test procedure

Frequency tolerance was measured by using frequency counter function of the spectrum analyzer.

Test Results

Table 5. Test Results for Frequency Tolerance

Channel	Low	Mid	High
Channel Frequency [MHz]	2402	2442	2480
Reading Frequency [MHz]	2401.954001	2441.952220	2479.950564
Frequency error [kHz]	-45.999	-47.780	-49.436
Frequency error [ppm]	-19.150	-19.566	-19.934
Margin [ppm]	30.850	30.434	30.066
Result	PASS	PASS	PASS

99% Occupied Bandwidth

Limit:	Article 6.	
Tested by:	JAT	
Date:	3 November 2017	
Temperature:	22 °C	
Humidity:	18 % RH	
Measurement uncertainty:	± 1.78 dB	Level of confidence 95 % (k = 2)

Test procedure

99% Occupied Bandwidth was measured with the occupied bandwidth function of the test receiver.
The limit for 99% occupied bandwidth is ≤ 26 MHz.

Test Results

Table 6. Test results for 99% Occupied Bandwidth

Channel	Limit [MHz]	99% BW [MHz]	Result
Low	≤26	1.210587169	PASS
Mid	≤26	1.204337364	PASS
High	≤26	1.207462267	PASS

Transmission Spurious Emissions

Limit:	Article 7.
Tested by:	JAT
Date:	3 November 2017
Temperature:	22 °C
Humidity:	18 % RH
Measurement uncertainty:	± 2.96 dB Level of confidence 95 % (k = 2)
Limits:	-26.02 dBm/MHz (< 2387 MHz) -16.02 dBm/MHz (2387 MHz – 2400 MHz) -16.02 dBm/MHz (2483.5 MHz – 2496.5 MHz) -26.02 dBm/MHz (> 2496.5 MHz)

Test procedure

Unwanted spurious emissions are measured in the frequency range of 30 MHz – 12.5 GHz. The resolution bandwidth is 1 MHz for all measurements.

Test Result

Table 7. Channel low

Frequency [MHz]	Detector	Level [dBm/MHz]	Limit [dBm/MHz]	Margin [dBm/MHz]	Result
2399.96	Peak	-23.66	-16.02	7.64	PASS
4803.34	Peak	-47.67	-26.02	21.65	PASS

Table 8. Channel mid

Frequency [MHz]	Detector	Level [dBm/MHz]	Limit [dBm/MHz]	Margin [dBm/MHz]	Result
4884.41	Peak	-47.90	-26.02	21.88	PASS

Table 9. Channel high

Frequency [MHz]	Detector	Level [dBm/MHz]	Limit [dBm/MHz]	Margin [dBm/MHz]	Result
2483.50	Peak	-38.84	-16.02	22.82	PASS
4960.47	Peak	-48.22	-26.02	22.20	PASS

Limitation of Collateral Emission of Receiver

Limit:	Article 24.2	
Tested by:	JAT	
Date:	3 November 2017	
Temperature:	22 °C	
Humidity:	18 % RH	
Measurement uncertainty:	± 2.96 dB	Level of confidence 95 % (k = 2)
Limits:	-53.98 dBm (<1 GHz) -46.99 dBm (>1 GHz)	

Test procedure

Unwanted spurious emissions are measured in the frequency range of 30 MHz – 12.5 GHz. The resolution bandwidth for measurements is 1 MHz.

Test Results

With low, mid and high channels activated peak margins are more than 10 dB below the limit.

LIST OF TEST EQUIPMENT

Type	Manufacturer	Model	Serial No.	Calibrated	Next calibration
Attenuator 10dB	Palsternack	10dB, DC-40GHz	-	2017-07-31	2018-07-31
Spectrum analyzer	Rohde&Schwarz	FSV40	101068	2017-07-07	2018-07-07
Frequency standard	Pendulum	GPS-88	SM 968615	2009-03-18	(2
Cable	Megaphase	EM40-3131-59	11153203	(1	(1
Multimeter	Fluke	23	42630524	2017-11-10	2018-11-10
Multimeter	Fluke	21	40790690	2017-12-19	2018-12-19

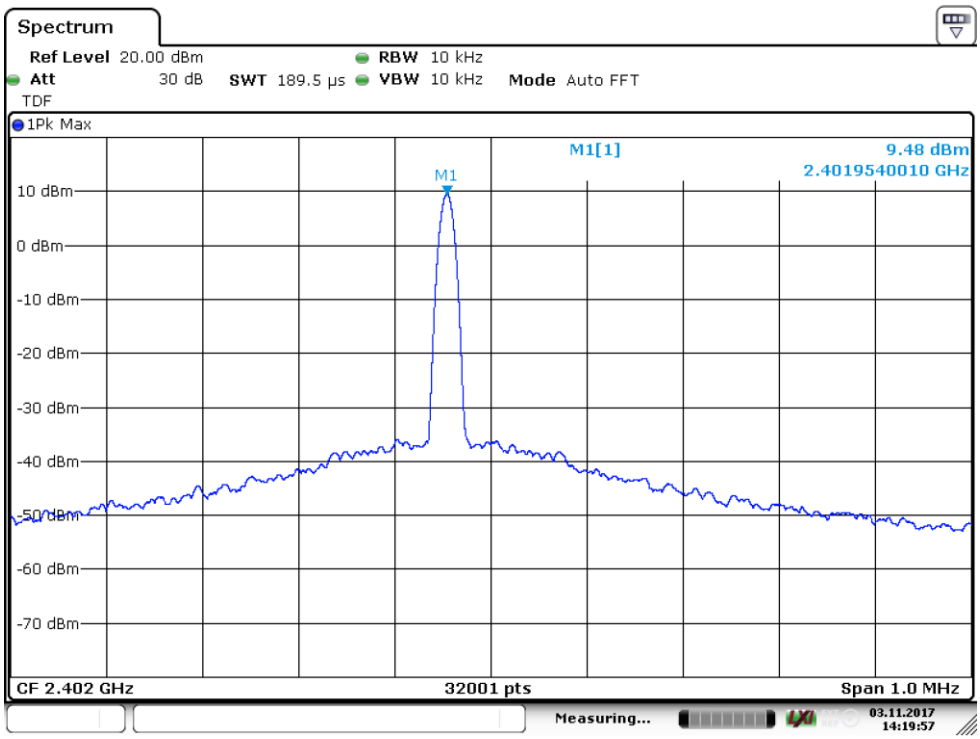
1) The equipment was calibrated for this test case

2) Unit has auto calibration feature

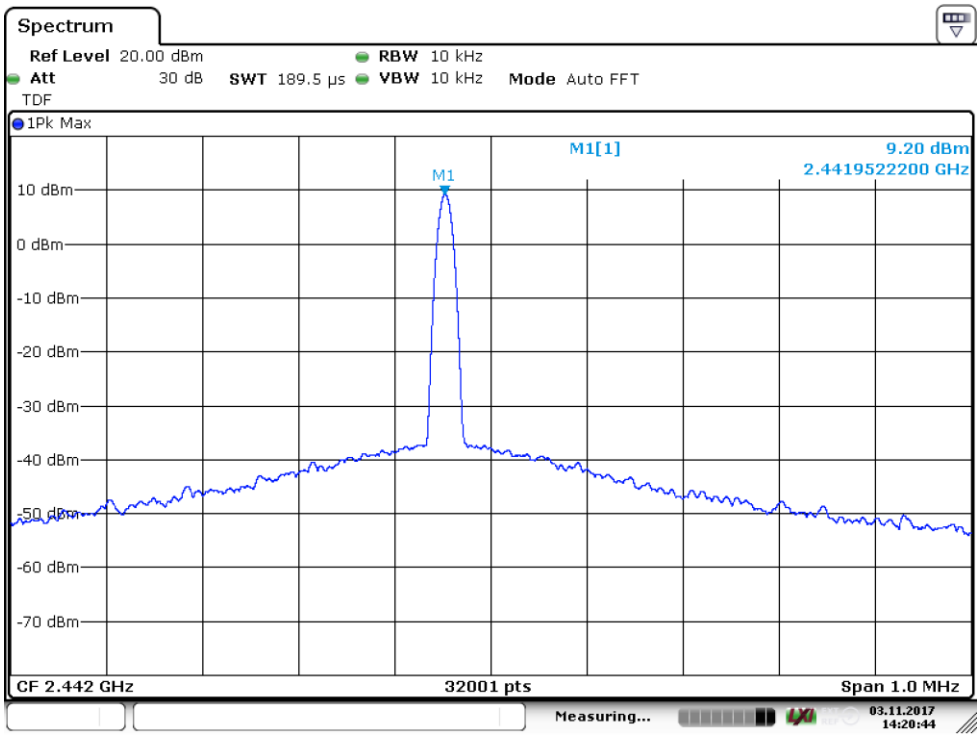
ANNEX A

Graphical data

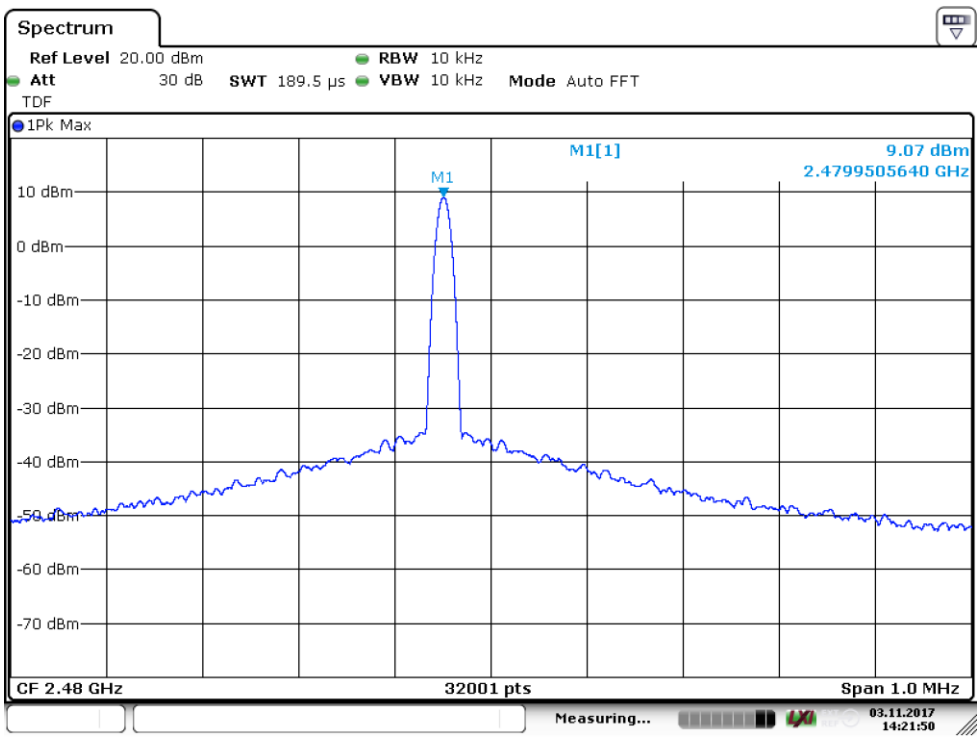
This annex contains the graphical data recorded during the tests.



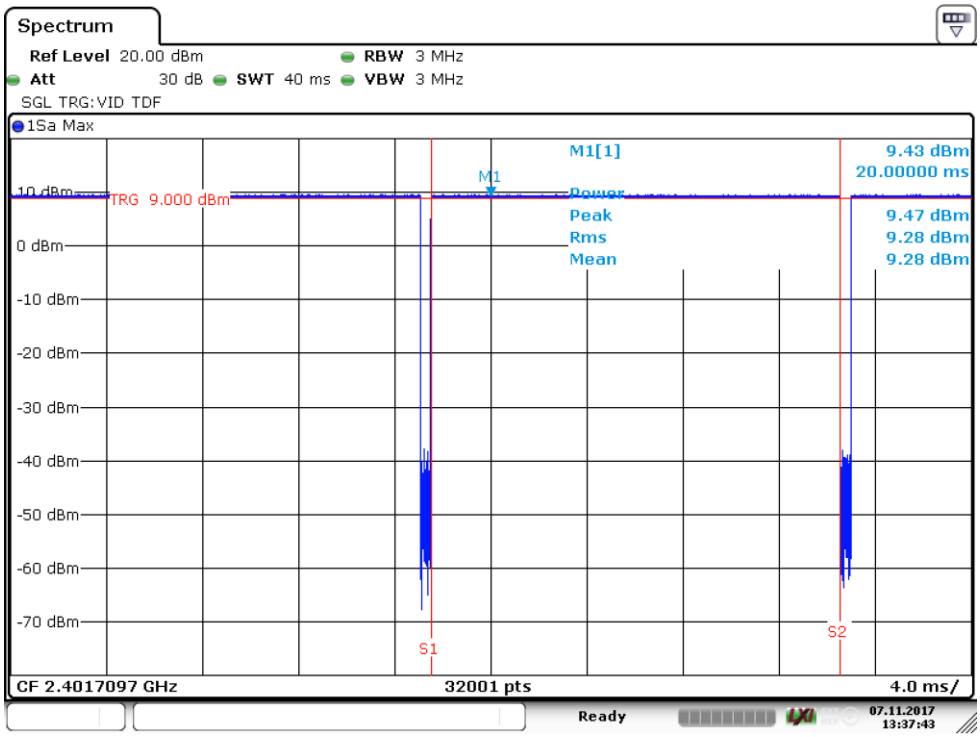
Graph 1. Frequency Tolerance Channel Low.



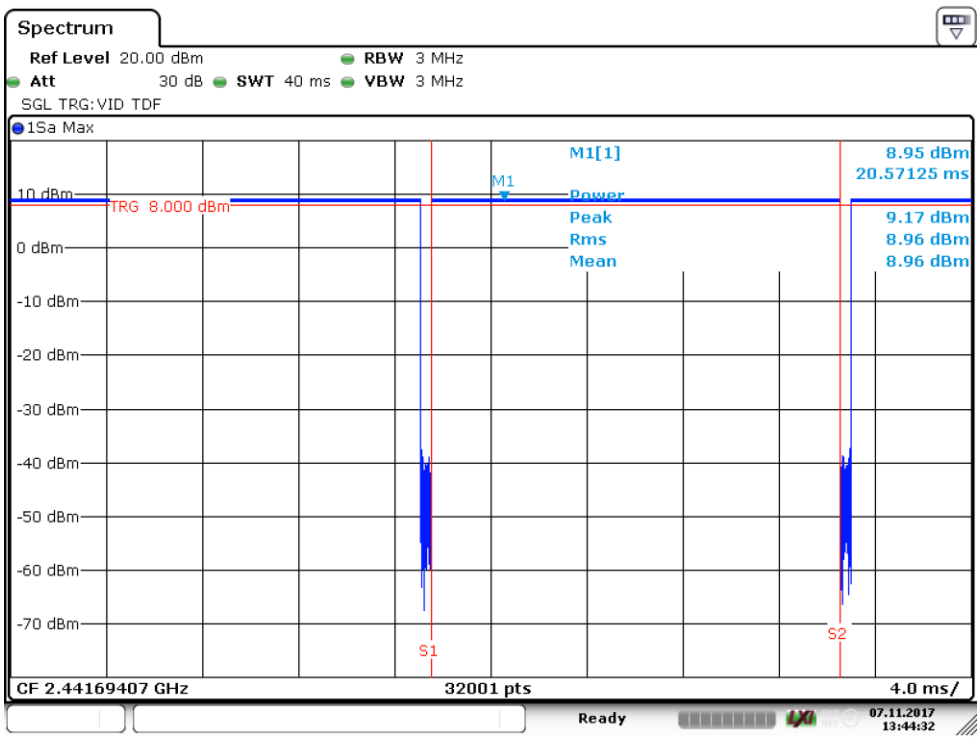
Graph 2. Frequency Tolerance Channel Mid.



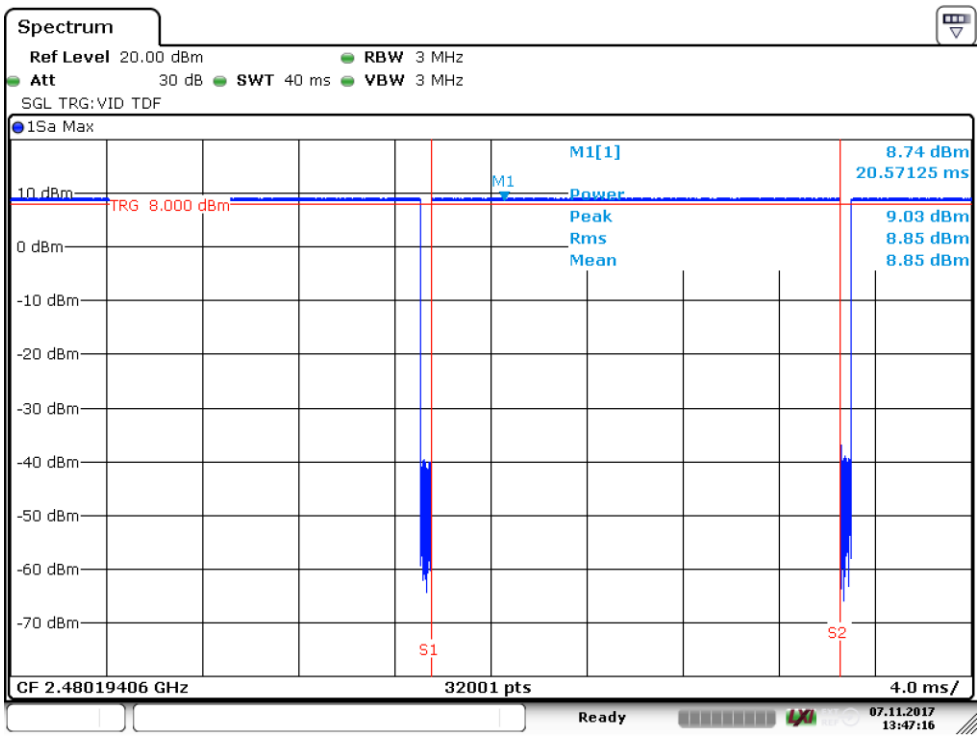
Graph 3. Frequency Tolerance Channel High.



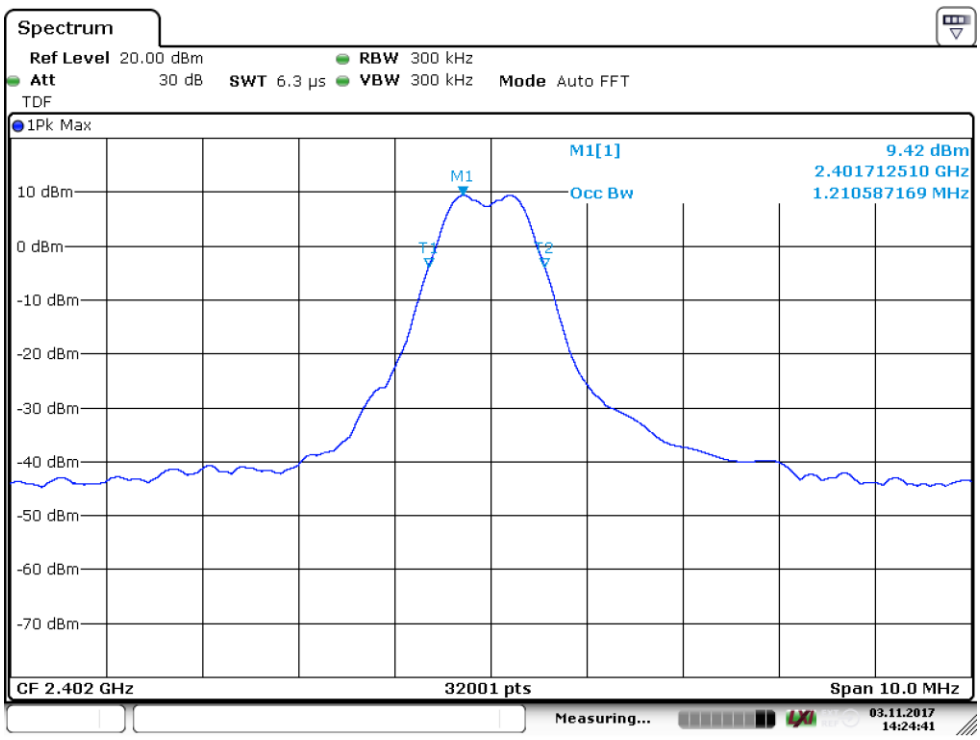
Graph 4. Antenna Power Channel Low.



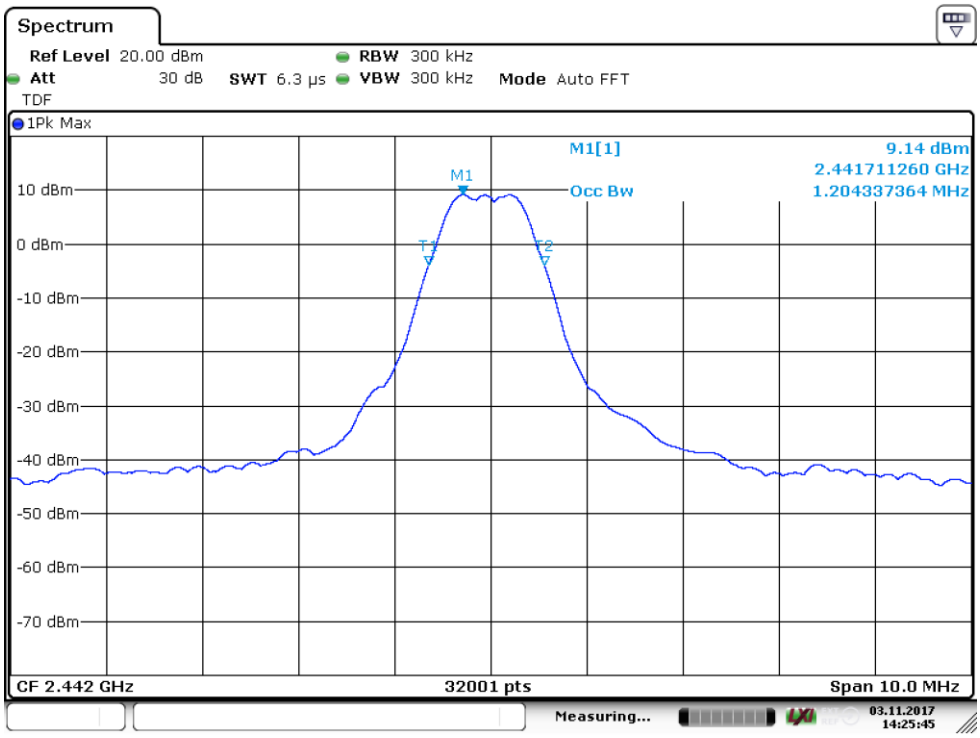
Graph 5. Antenna Power Channel Mid.



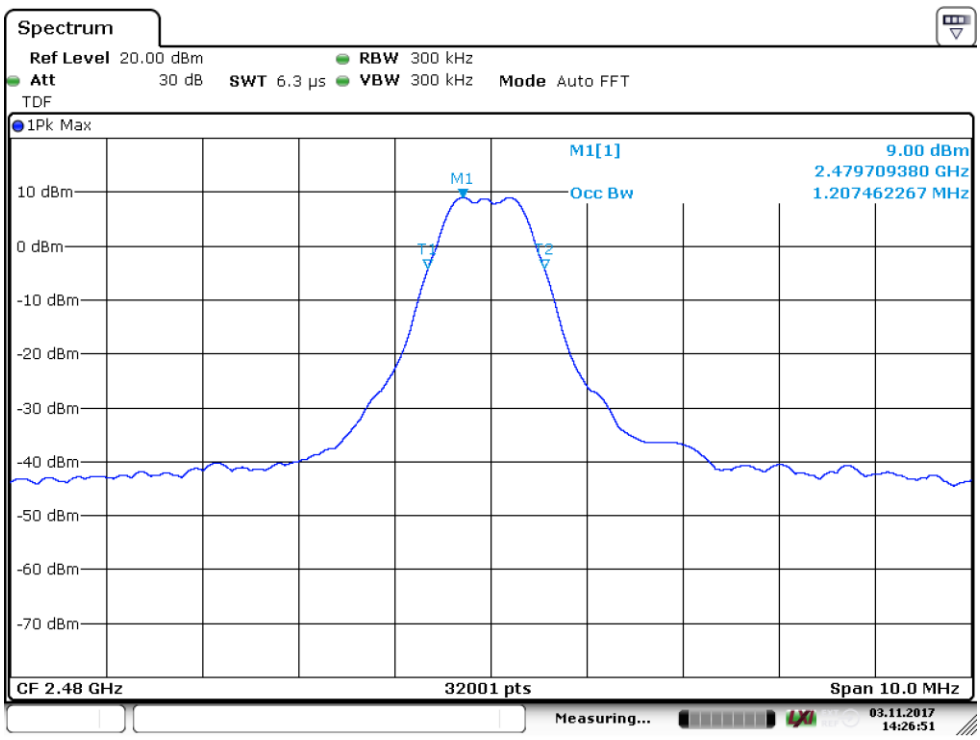
Graph 6. Antenna Power Channel High.



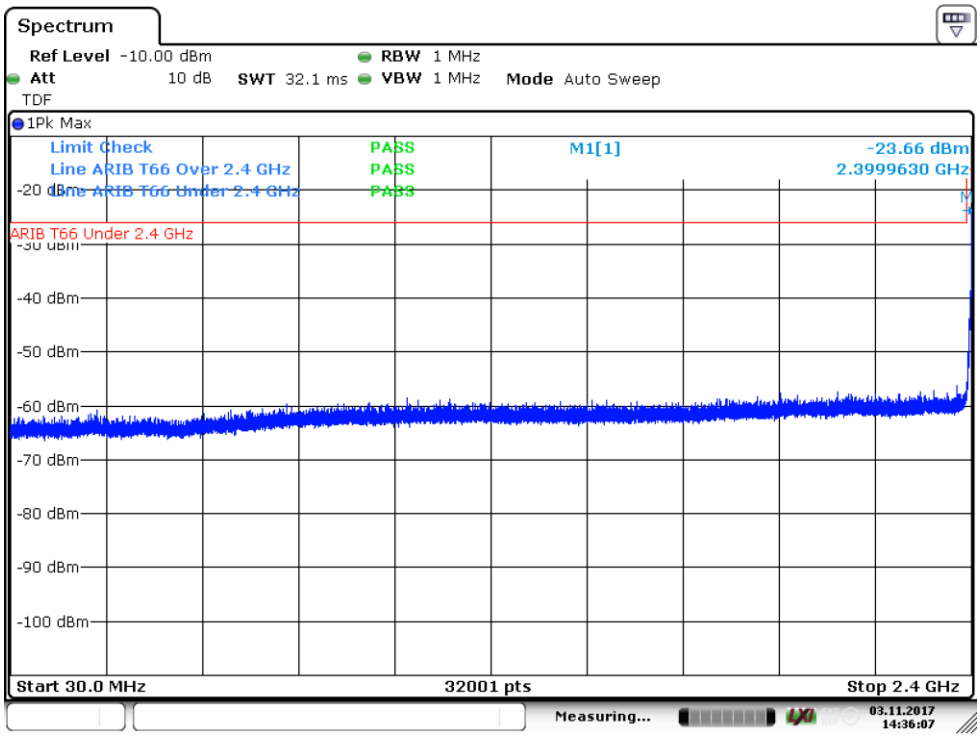
Graph 7. 99% Occupied Bandwidth Channel Low.



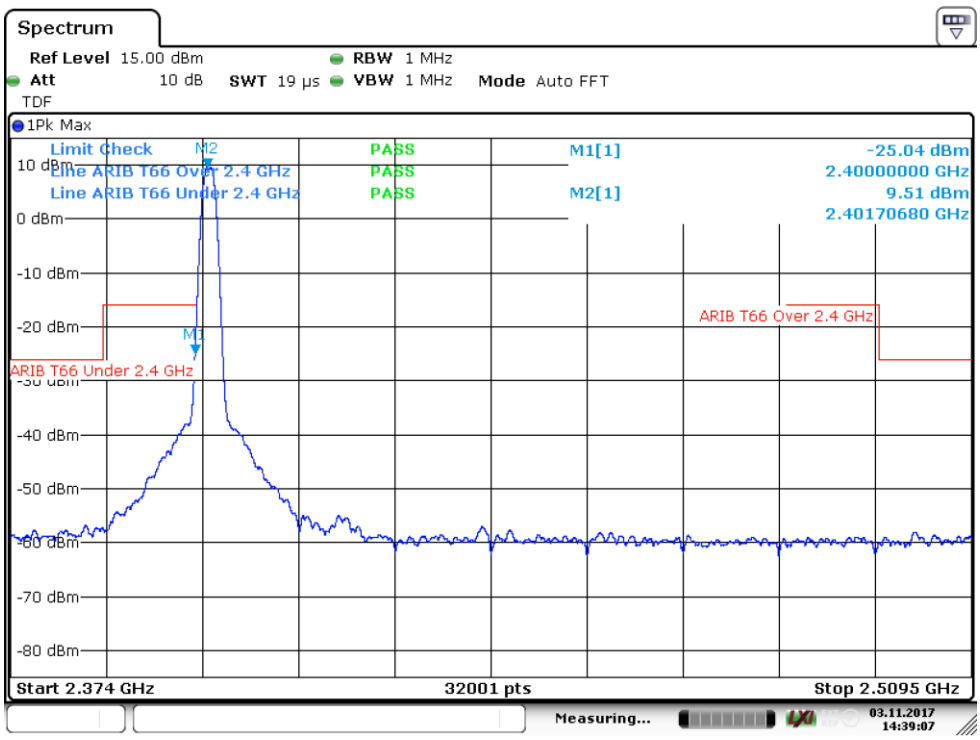
Graph 8. 99% Occupied Bandwidth Channel Mid.



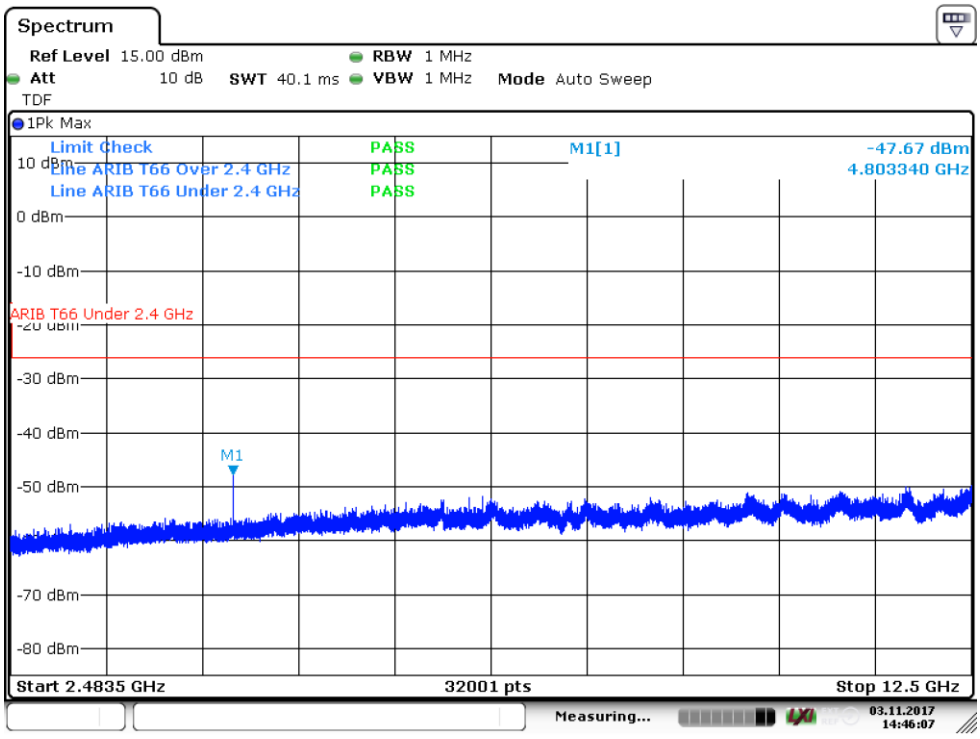
Graph 9. 99% Occupied Bandwidth Channel High.



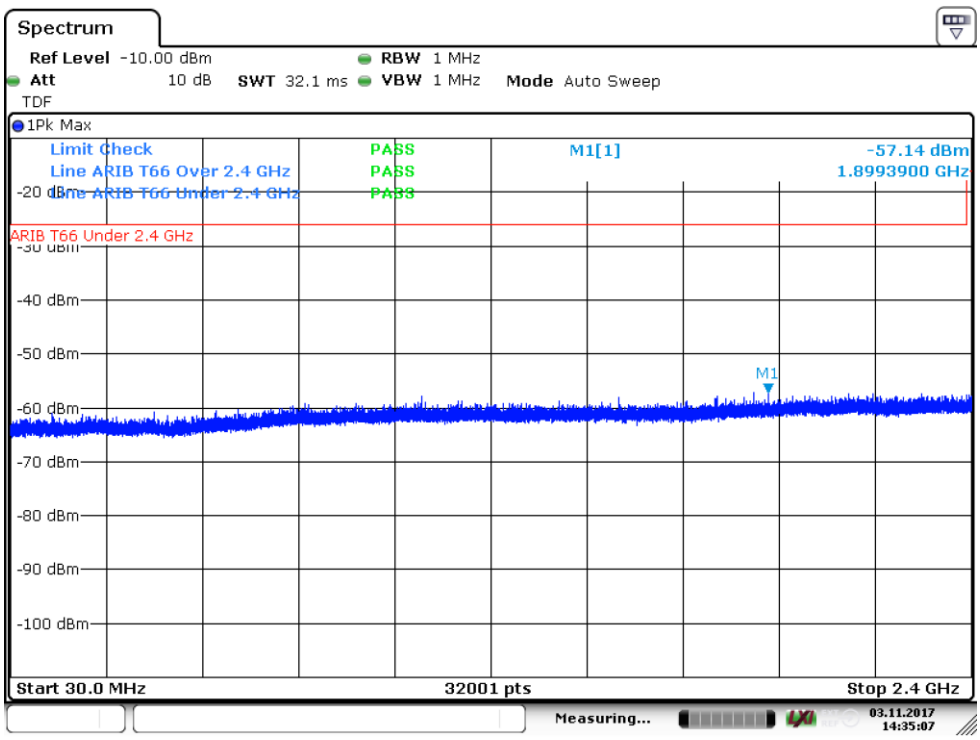
Graph 10. Tx Spurious Emissions Channel Low 30 - 2400 MHz.



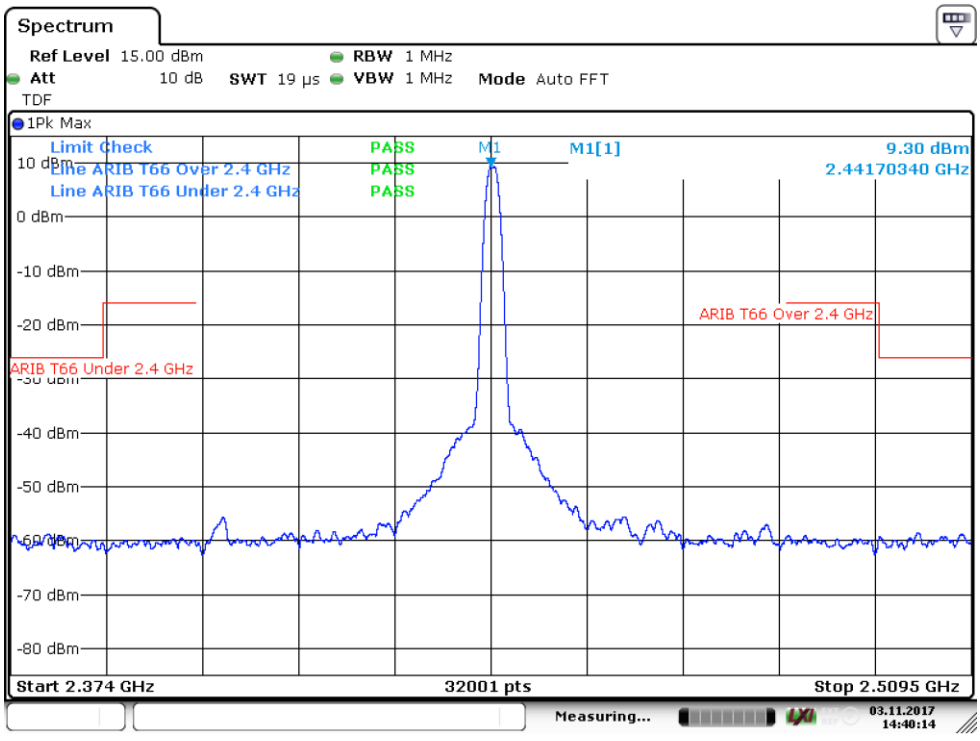
Graph 11. Tx spurious Emissions Channel Low 2.4 GHz.



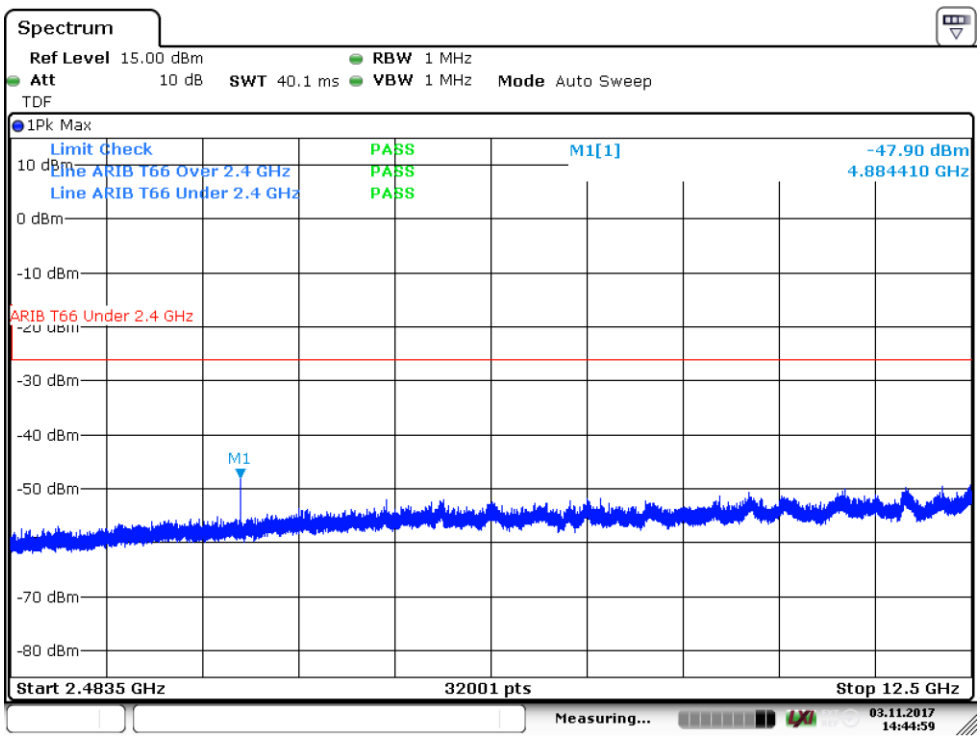
Graph 12. Tx Spurious Emissions Channel Low 2.4835 - 12.5 GHz.



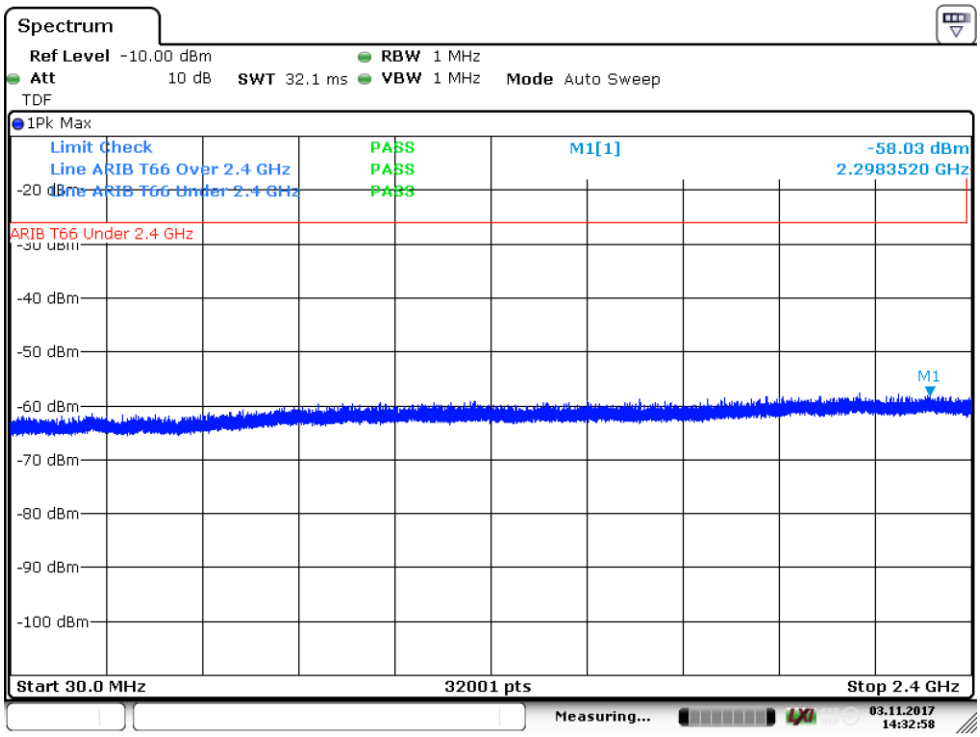
Graph 13. Tx Spurious Emissions Channel Mid 30 - 2400 MHz.



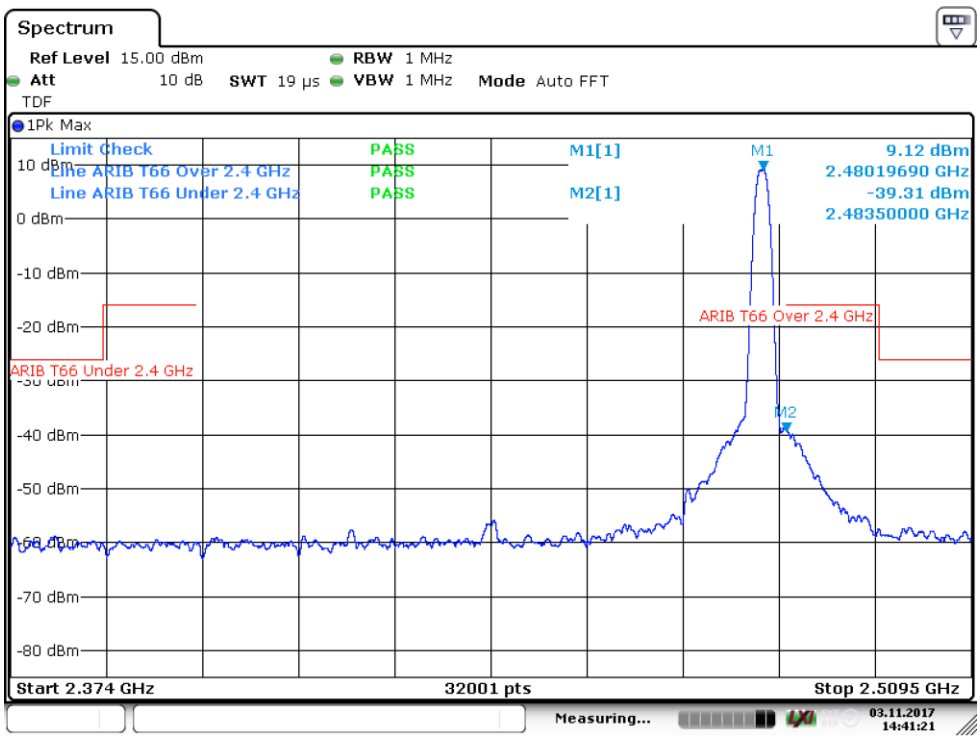
Graph 14. Tx spurious Emissions Channel Mid 2.4 GHz.



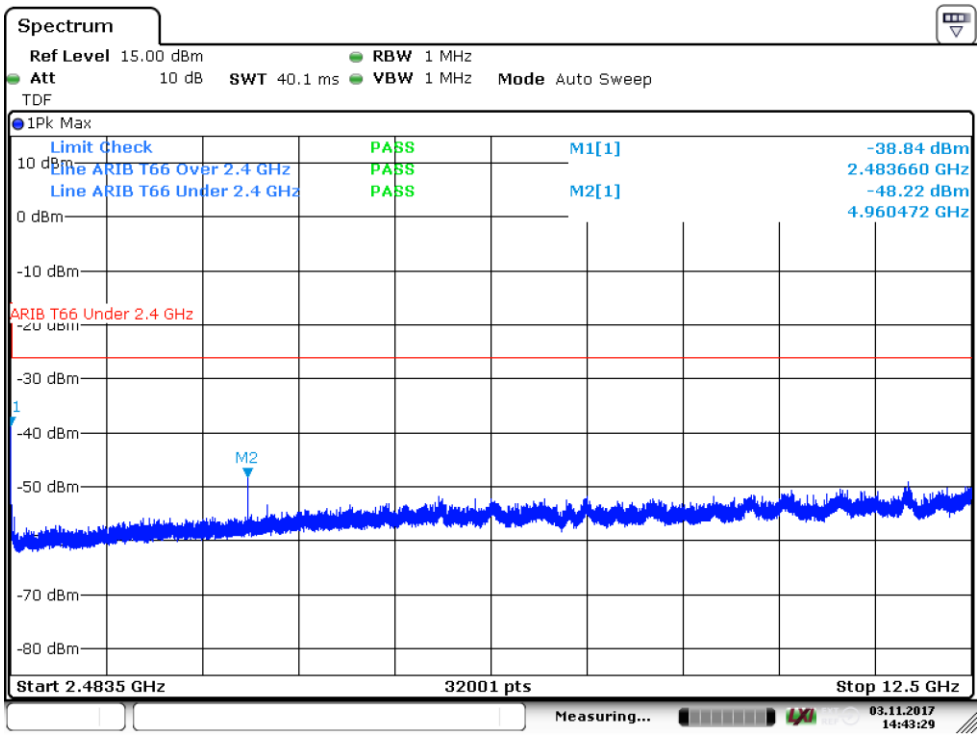
Graph 15. Tx Spurious Emissions Channel Mid 2.4835 - 12.5 GHz



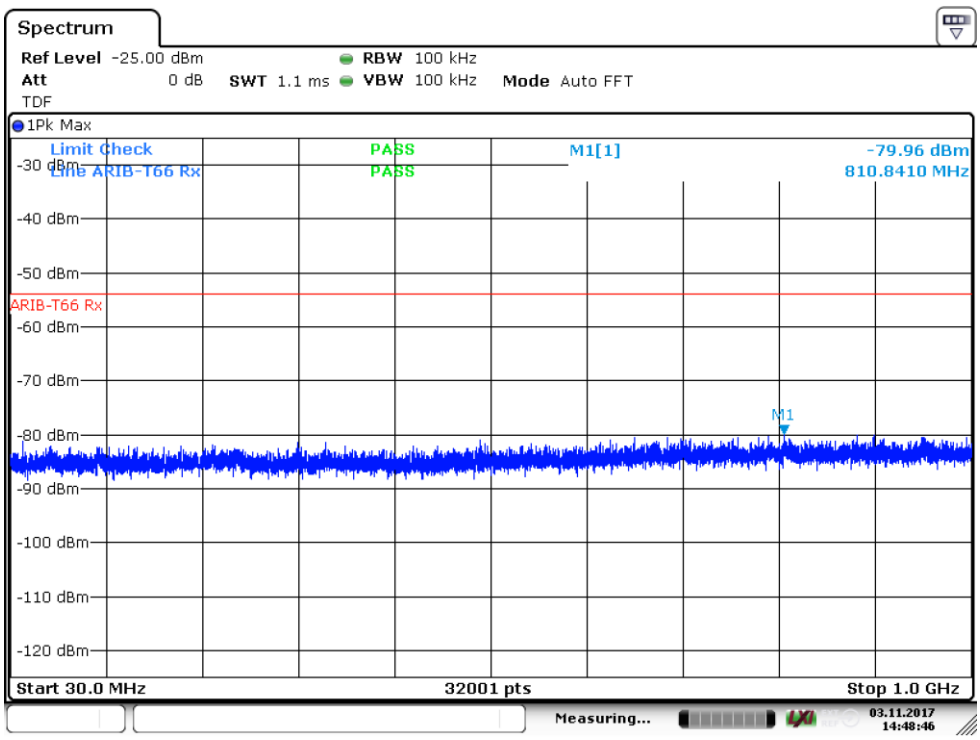
Graph 16. Tx Spurious Emissions Channel High 30 MHz - 2400 MHz.



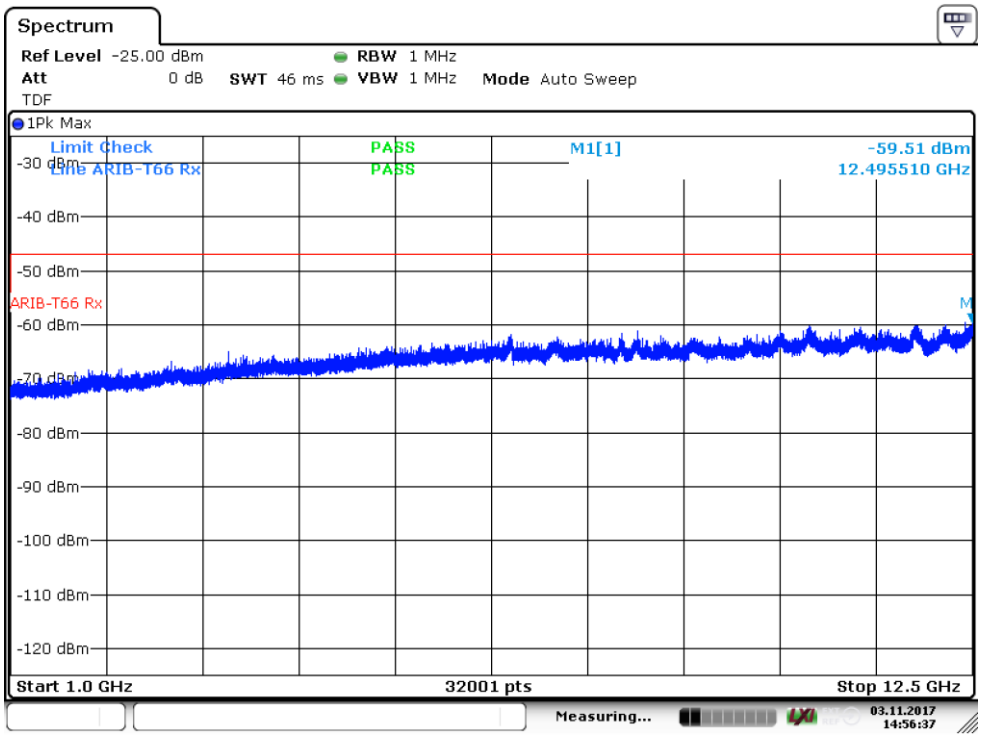
Graph 17. Tx Spurious Emissions Channel High 2.4 GHz.



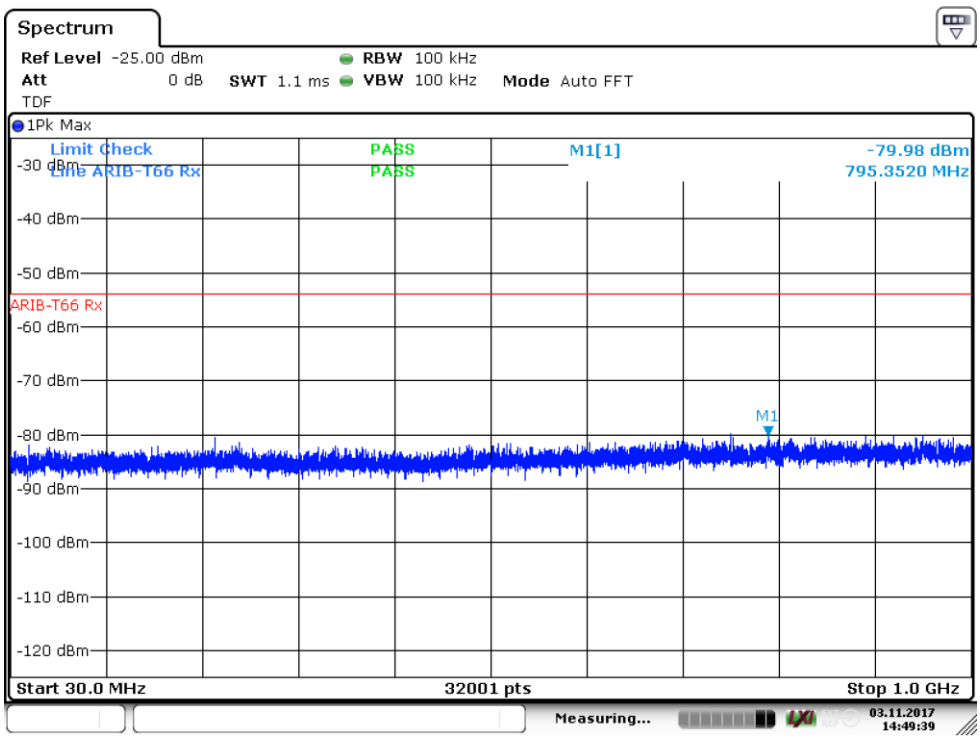
Graph 18. Tx Spurious Emissions Channel High 2.4835 - 12.5 GHz.



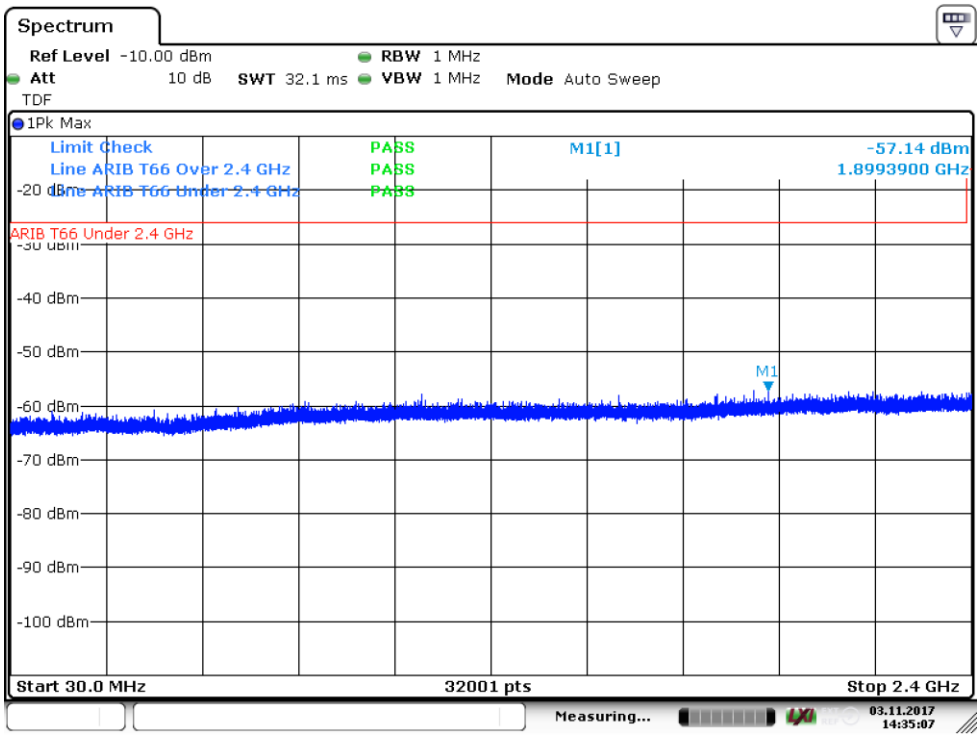
Graph 19. Rx Spurious Emissions Channel Low 30 MHz – 1.0 GHz.



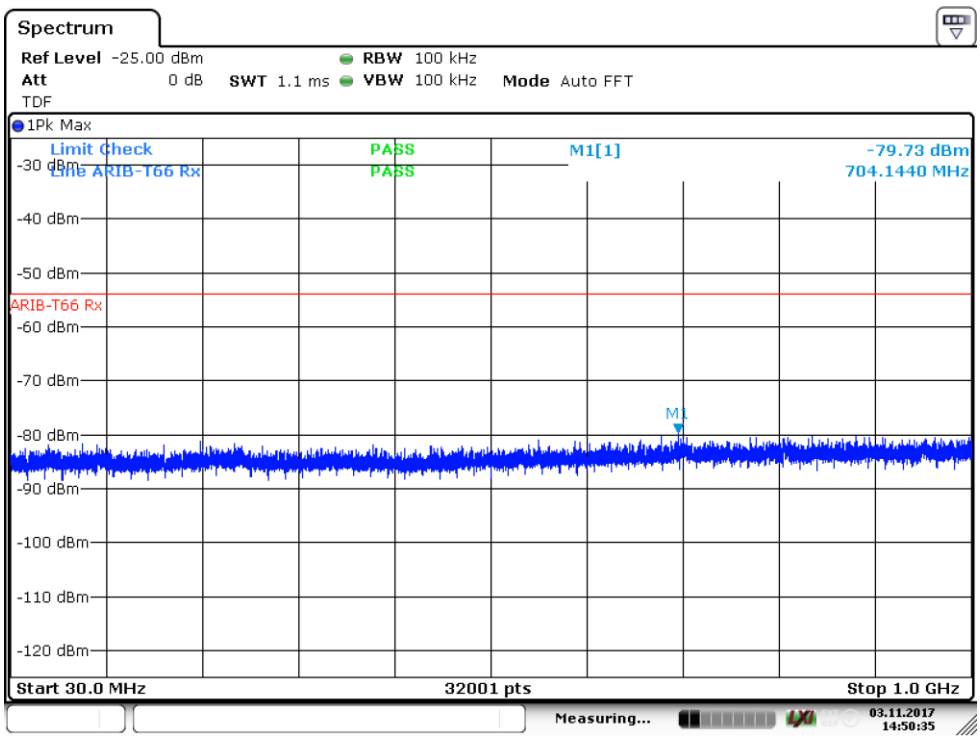
Graph 20. Rx Spurious Emissions Channel Low 1.0 GHz – 12.75 GHz.



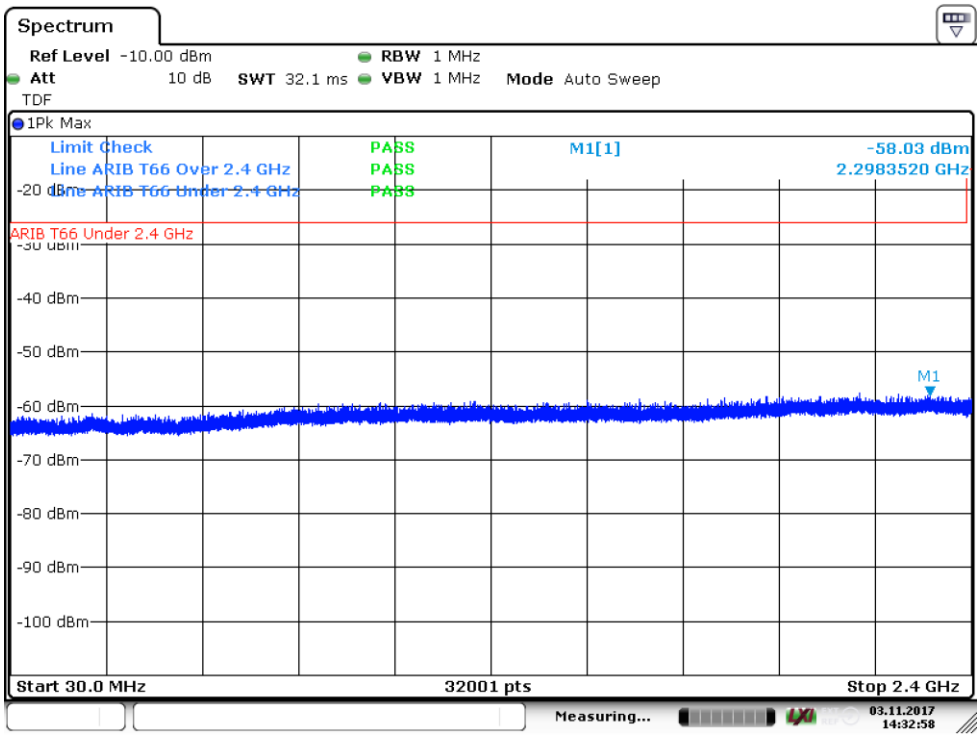
Graph 21. Rx Spurious Emissions Channel Mid 30 MHz – 1.0 GHz.



Graph 22. Rx Spurious Emissions Channel Mid 1.0 GHz – 12.75 GHz.



Graph 23. Rx Spurious Emissions Channel High 30 MHz – 1.0 GHz.

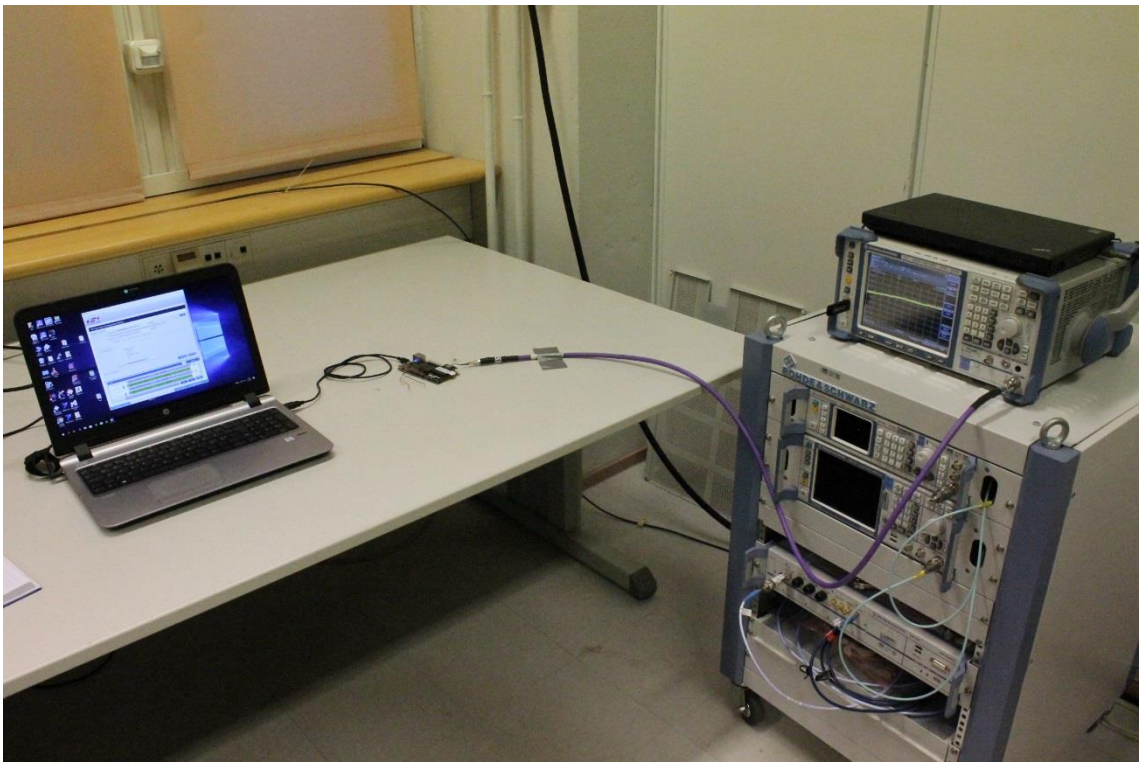


Graph 24. Rx Spurious Emissions Channel High 1 GHz – 12.75 GHz.

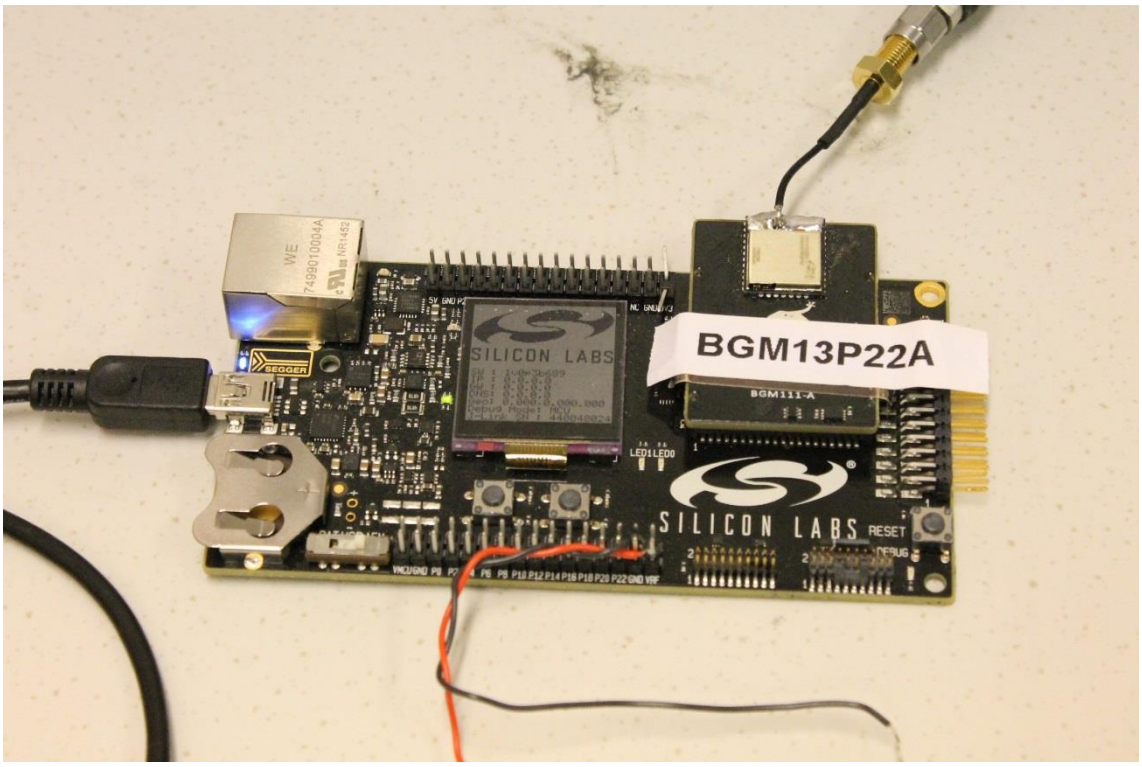
ANNEX B

Photographs

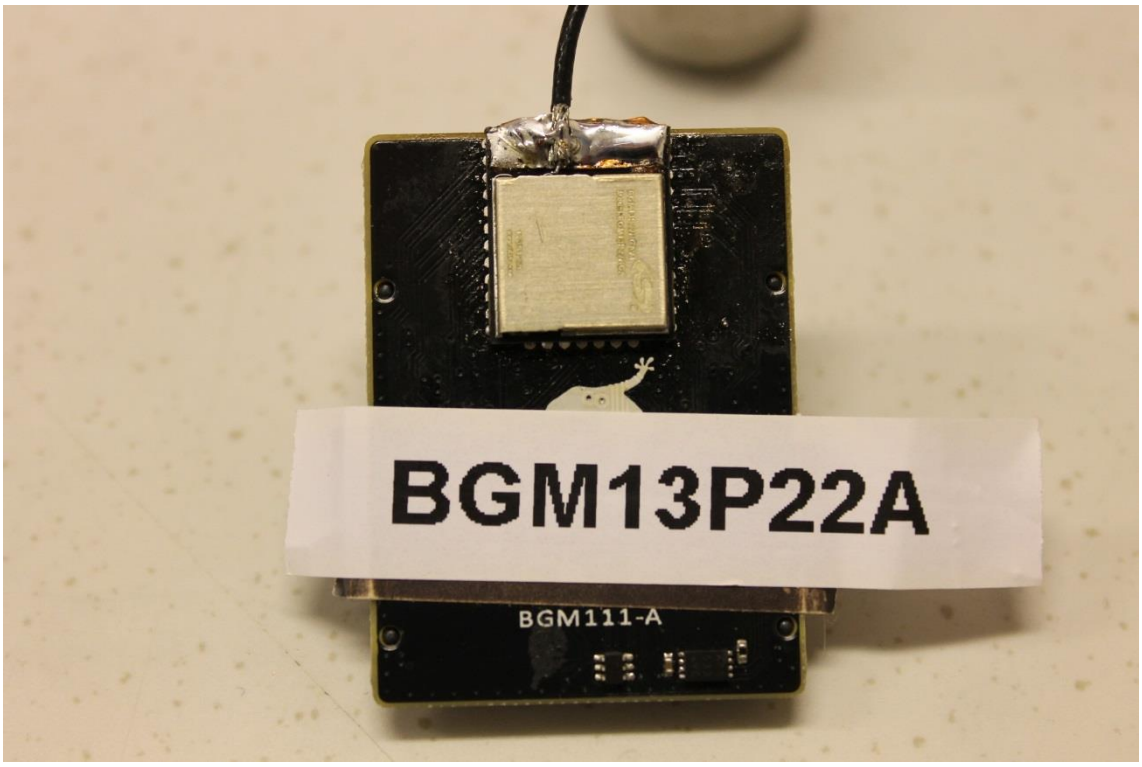
This annex contains the photographs of the EUT and test setup.



Photograph 1. Test setup



Photograph 2. The EUT attached to the evaluation board



Photograph 3. The EUT