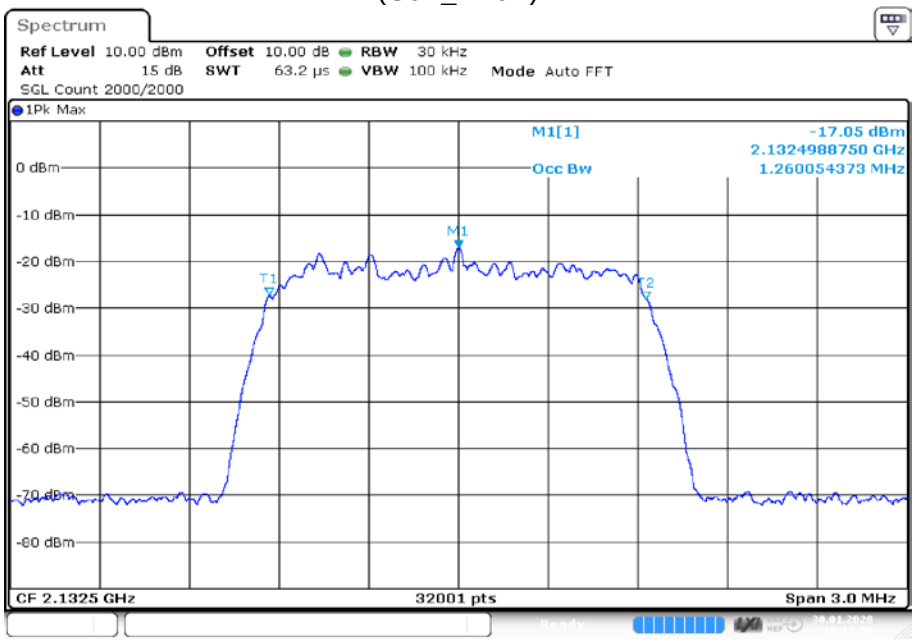
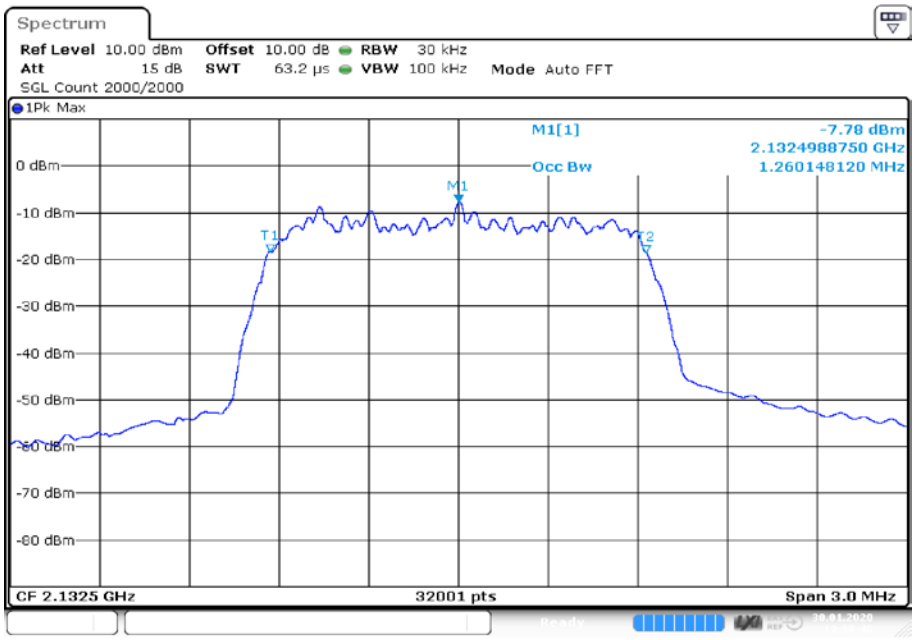
Frequency Band = Band 4, Direction = Downlink, Signal Type = CDMA (S01_AA01)

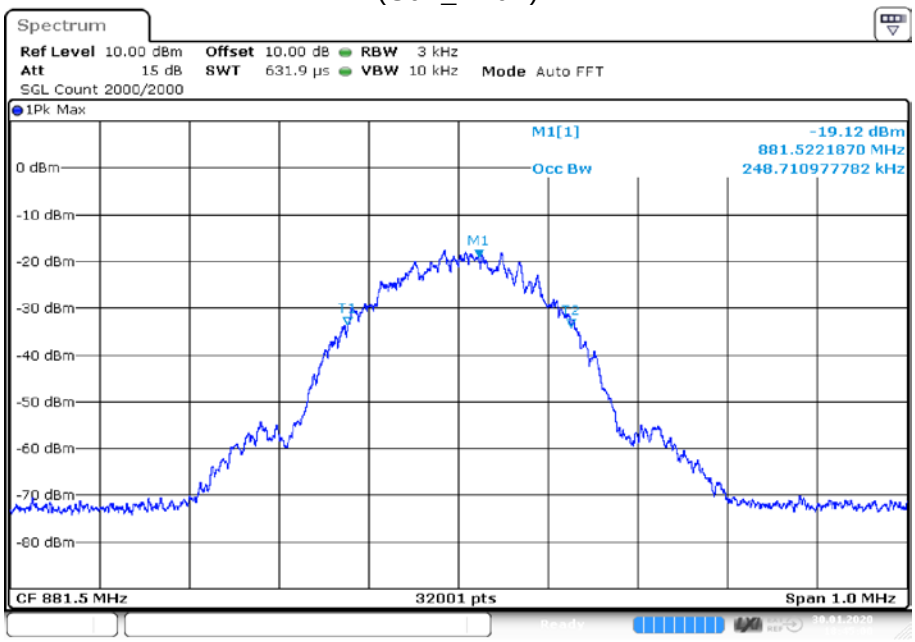


Date: 30.JAN.2020 19:17:57

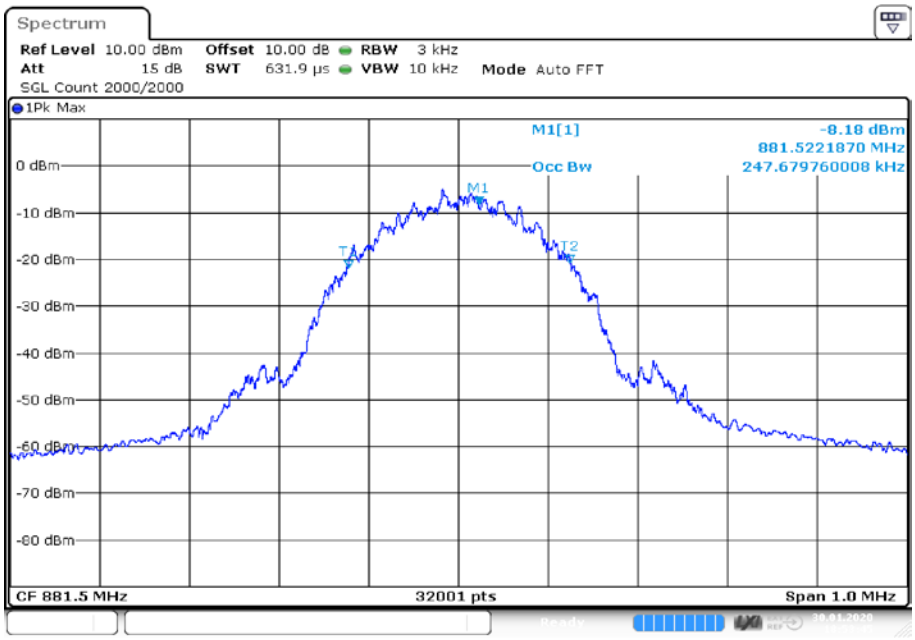


Date: 30.JAN.2020 19:30:47

Frequency Band = Band 5, Direction = Downlink, Signal Type = GSM (S01_AA01)

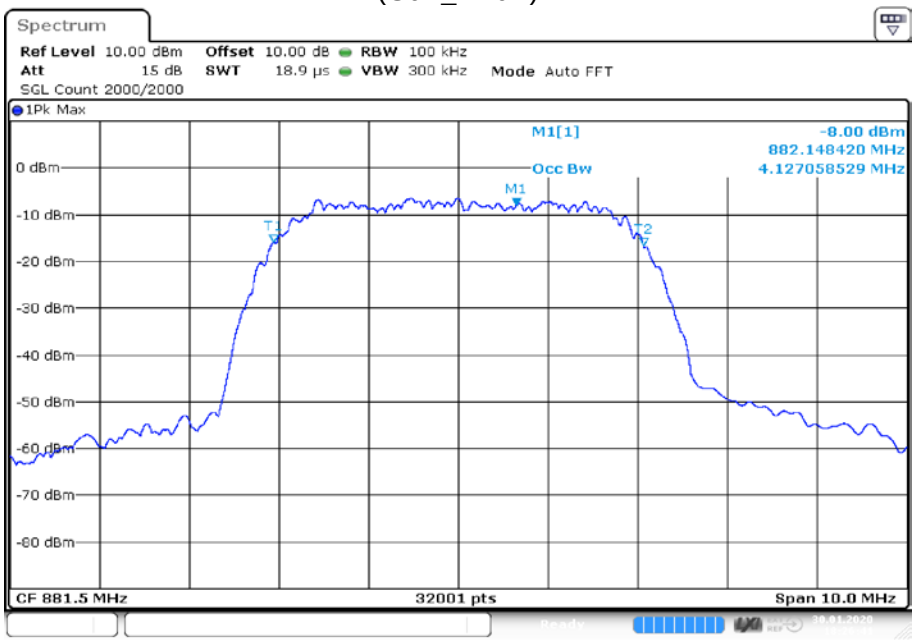


Date: 30.JAN.2020 18:45:00

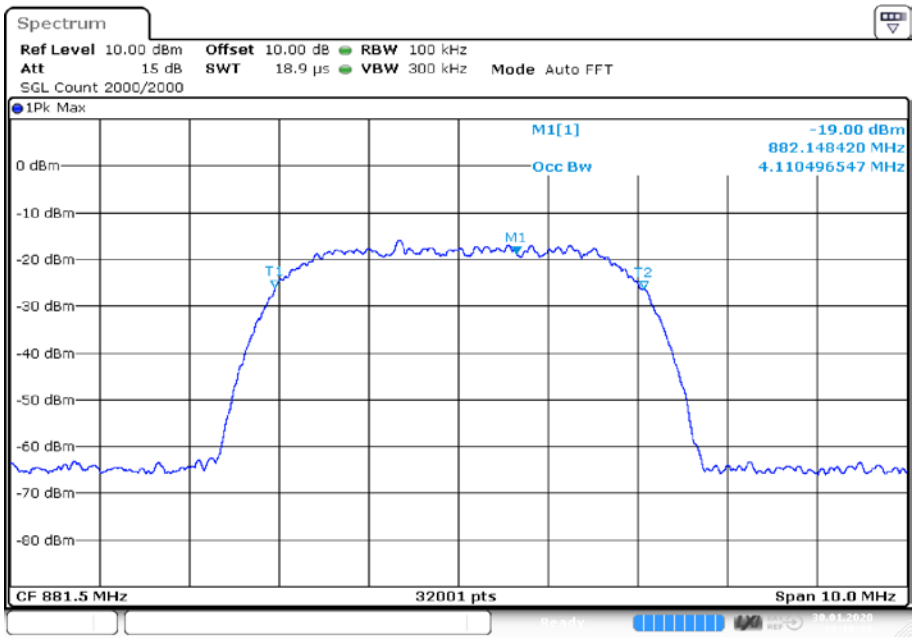


Date: 30.JAN.2020 18:53:45

Frequency Band = Band 5, Direction = Downlink, Signal Type = LTE (S01_AA01)

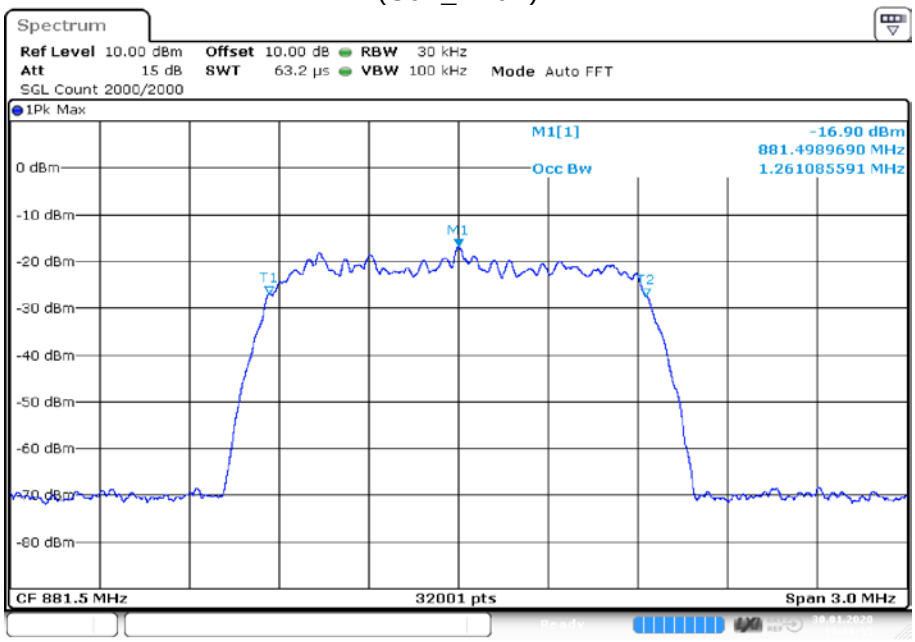


Date: 30.JAN.2020 18:26:41

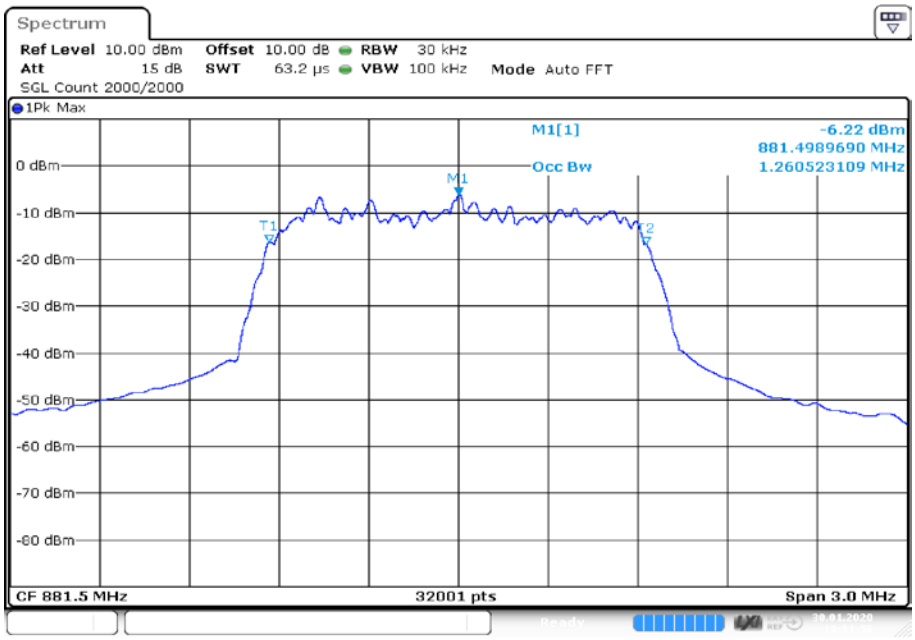


Date: 30.JAN.2020 18:10:37

Frequency Band = Band 5, Direction = Downlink, Signal Type = CDMA (S01_AA01)

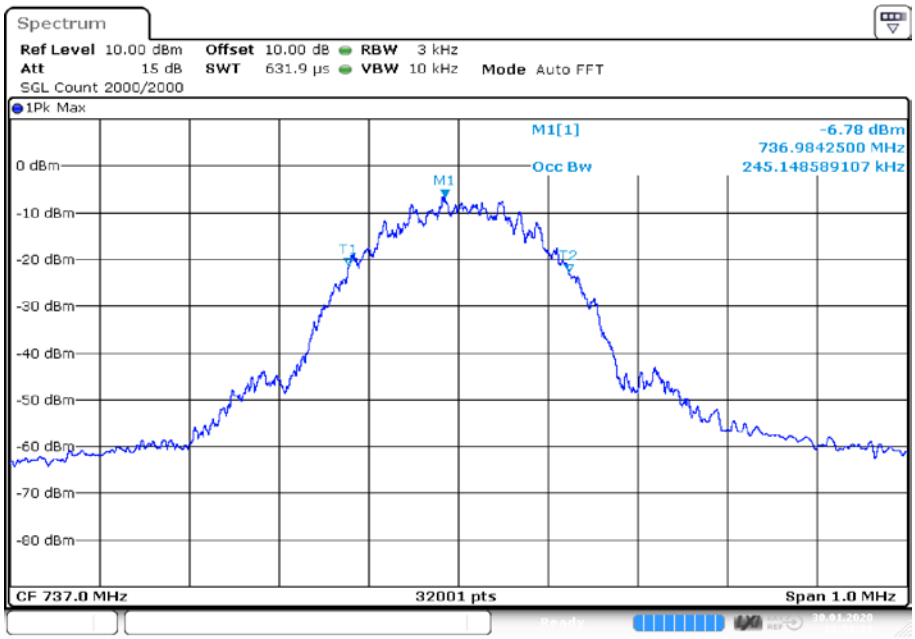


Date: 30.JAN.2020 19:19:15

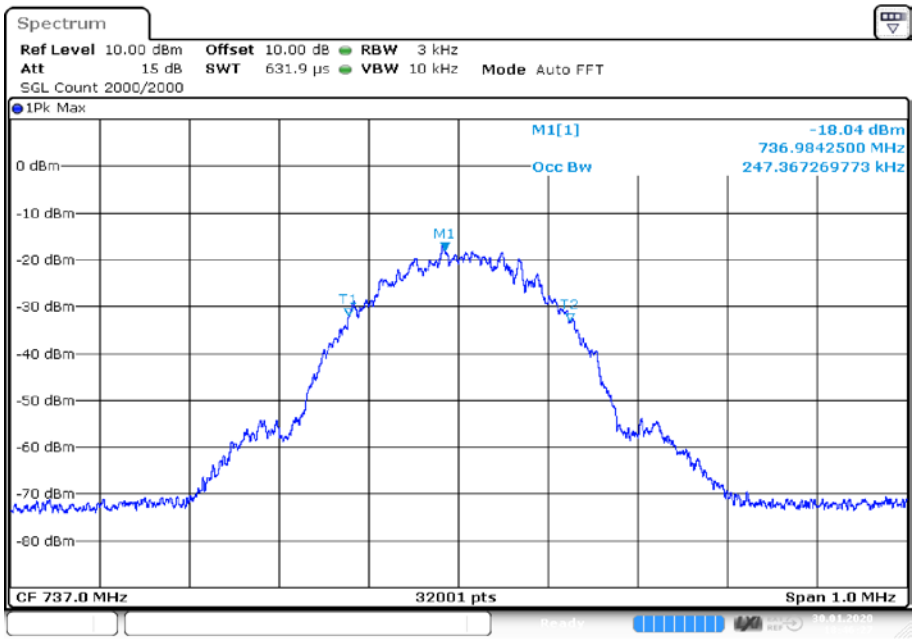


Date: 30.JAN.2020 19:31:57

Frequency Band = Band 12, Direction = Downlink, Signal Type = GSM (S01_AA01)

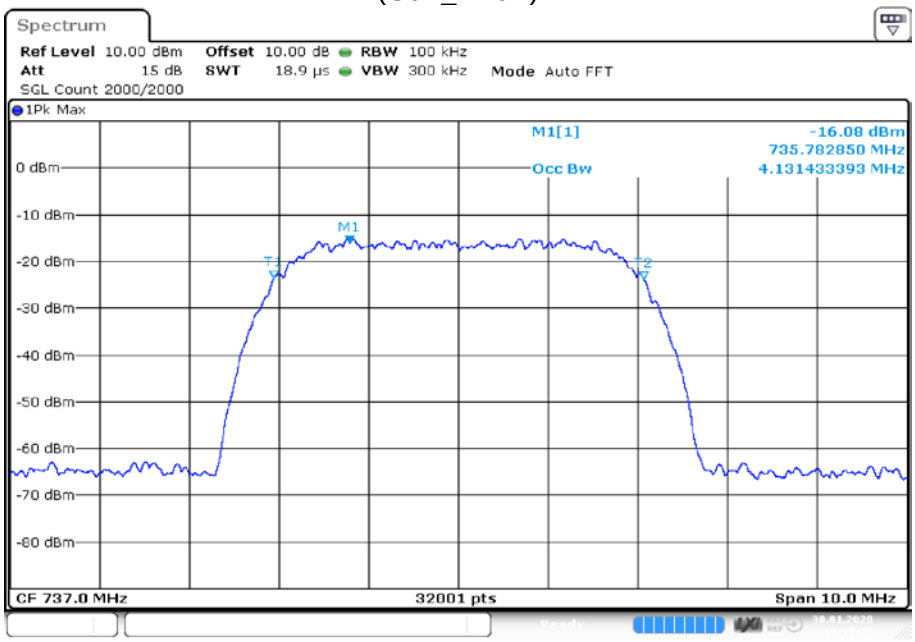


Date: 30.JAN.2020 18:52:22

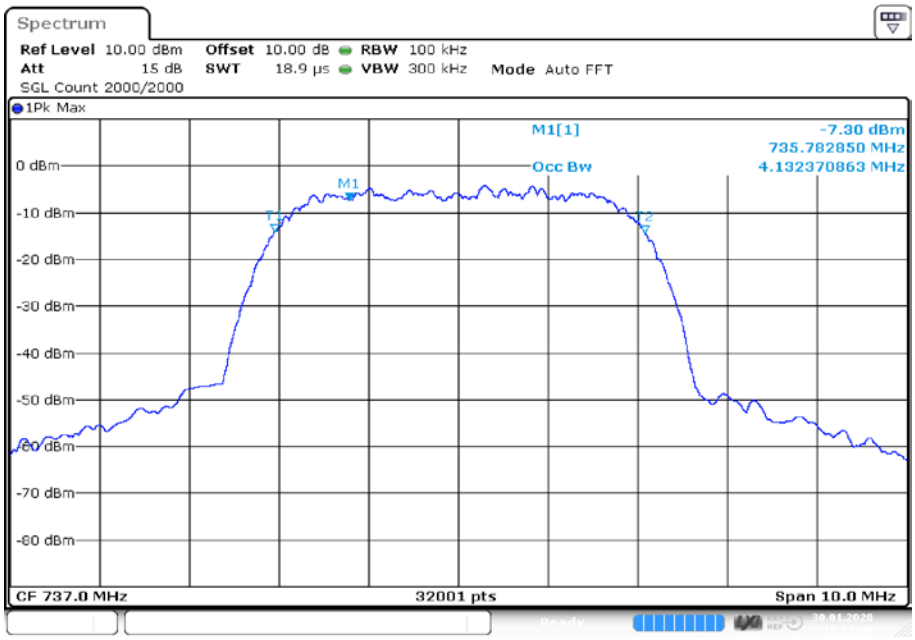


Date: 30.JAN.2020 18:46:27

Frequency Band = Band 12, Direction = Downlink, Signal Type = LTE (S01_AA01)

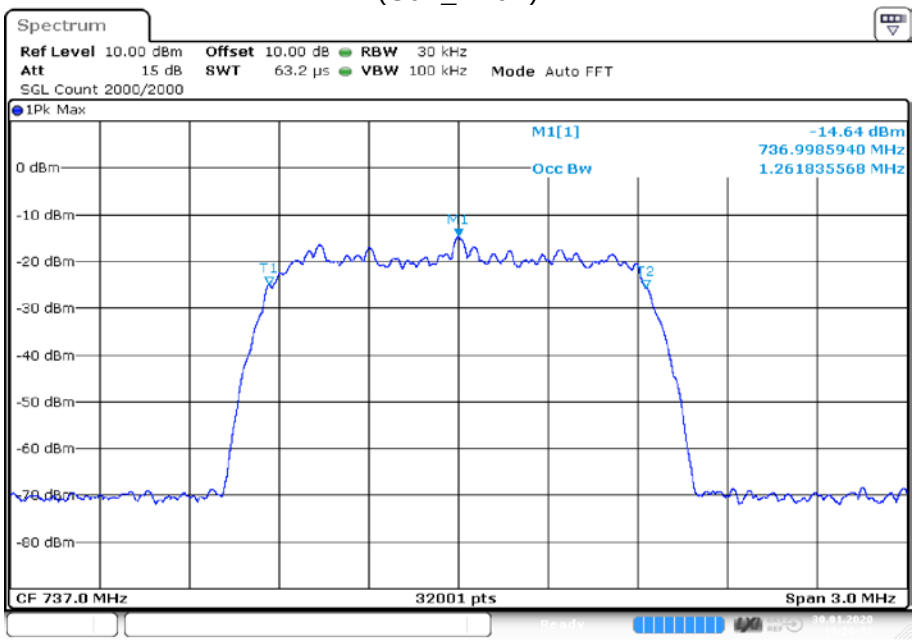


Date: 30.JAN.2020 18:12:17

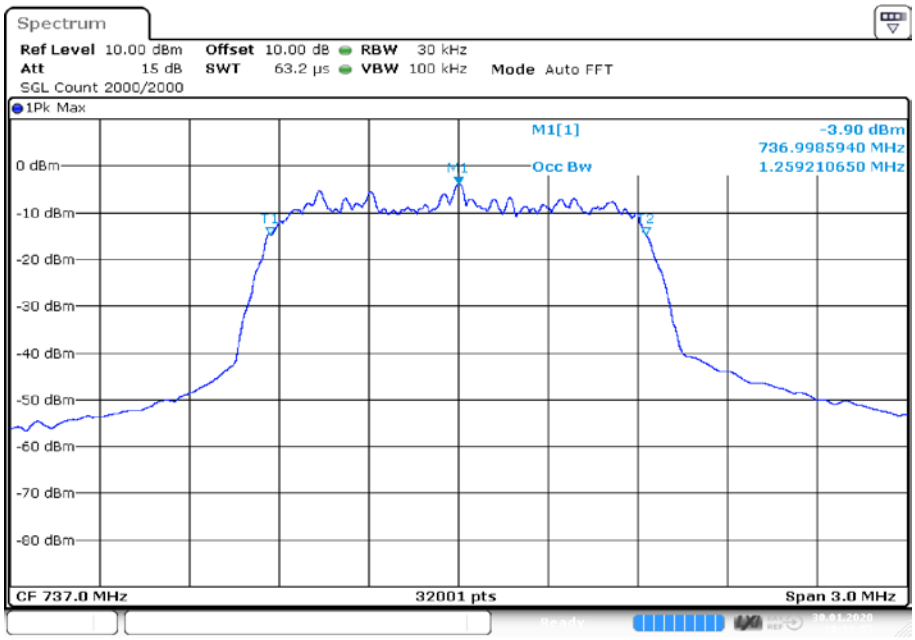


Date: 30.JAN.2020 18:27:46

Frequency Band = Band 12, Direction = Downlink, Signal Type = CDMA (S01_AA01)

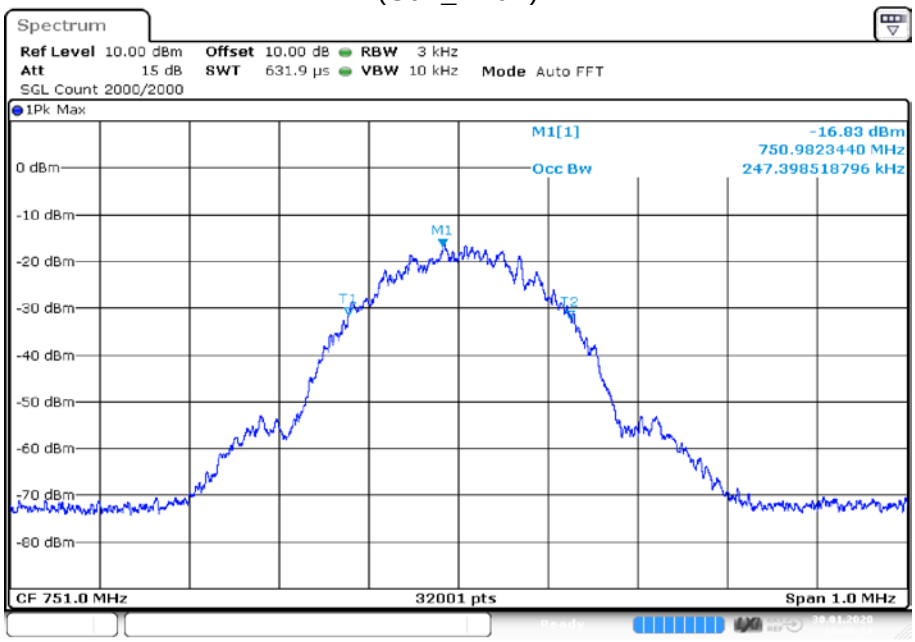


Date: 30.JAN.2020 19:20:32

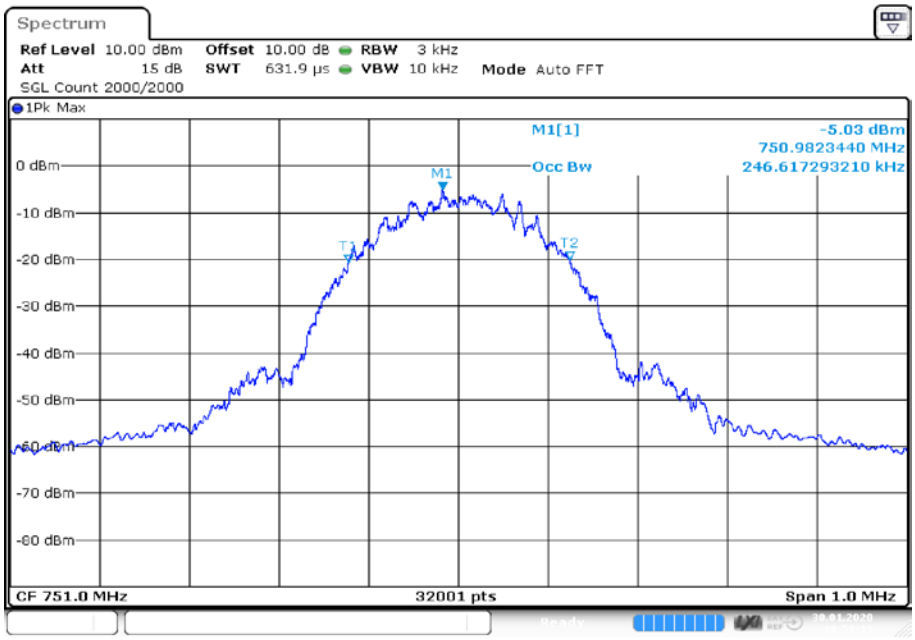


Date: 30.JAN.2020 19:32:55

Frequency Band = Band 13, Direction = Downlink, Signal Type = GSM (S01_AA01)

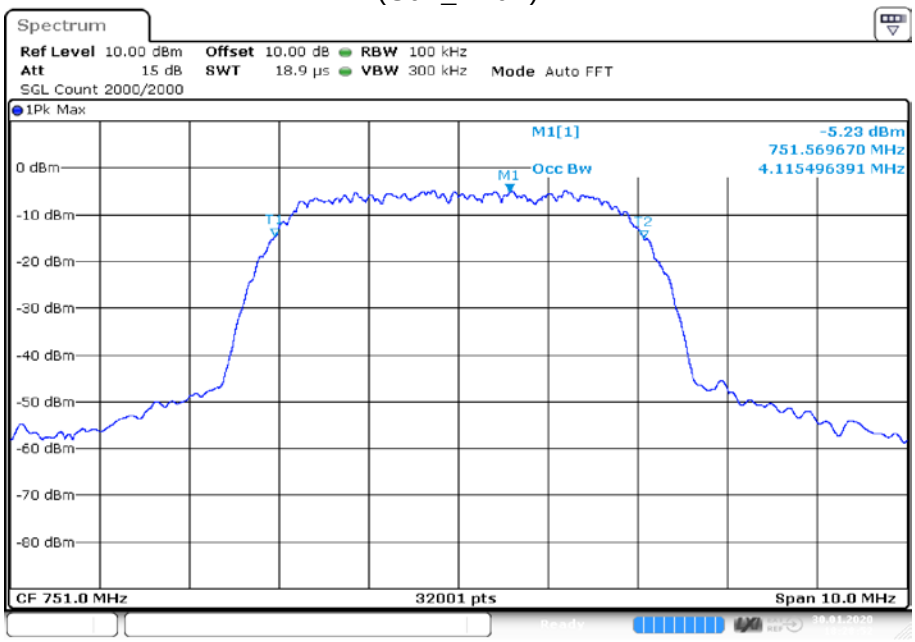


Date: 30.JAN.2020 18:48:11

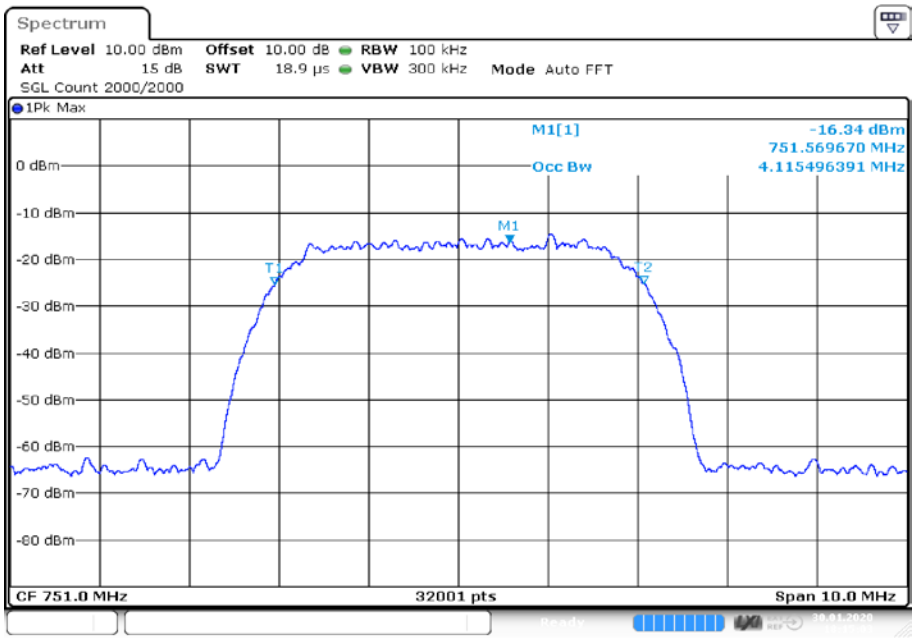


Date: 30.JAN.2020 18:51:14

Frequency Band = Band 13, Direction = Downlink, Signal Type = LTE (S01_AA01)

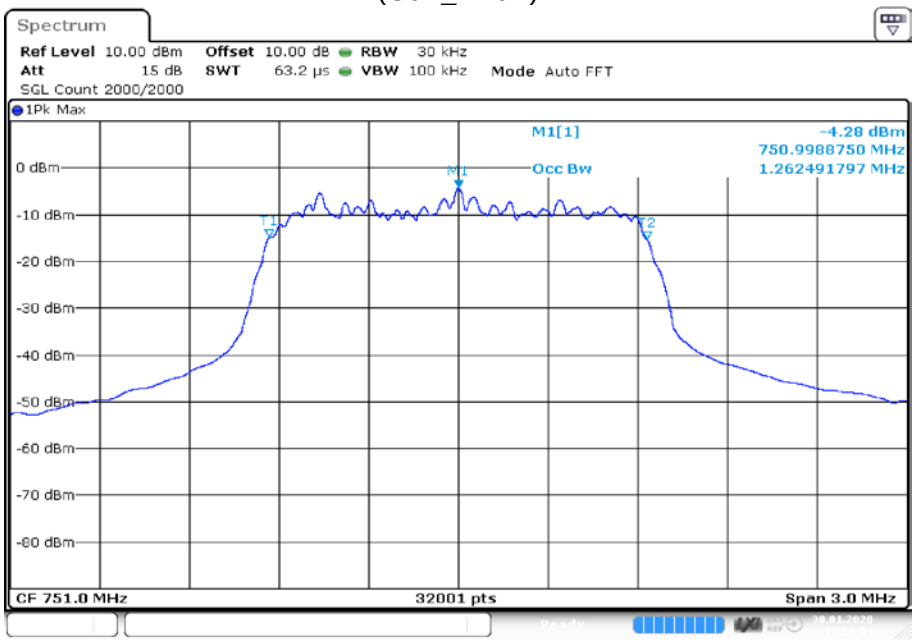


Date: 30.JAN.2020 18:28:52

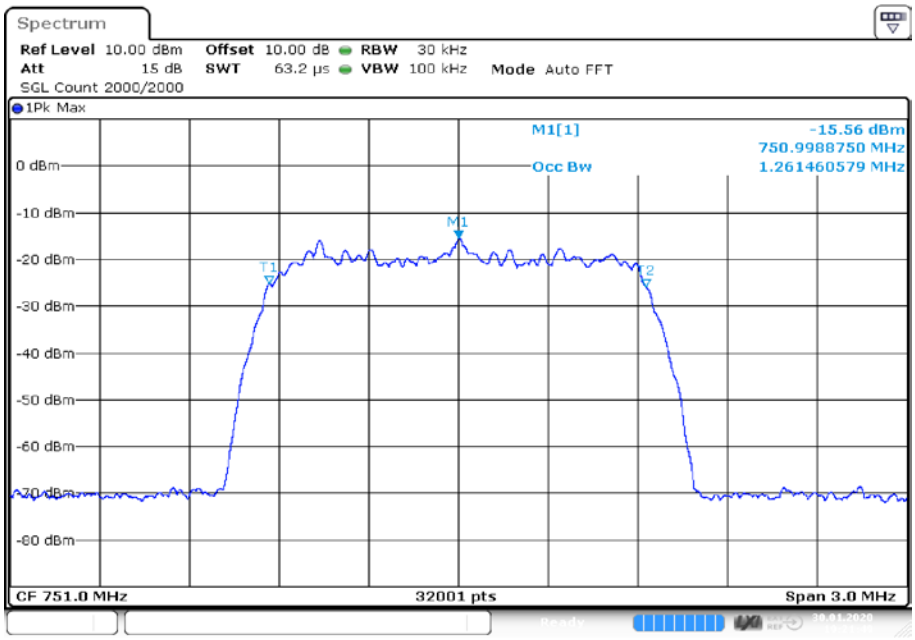


Date: 30.JAN.2020 18:15:04

Frequency Band = Band 13, Direction = Downlink, Signal Type = CDMA (S01_AA01)

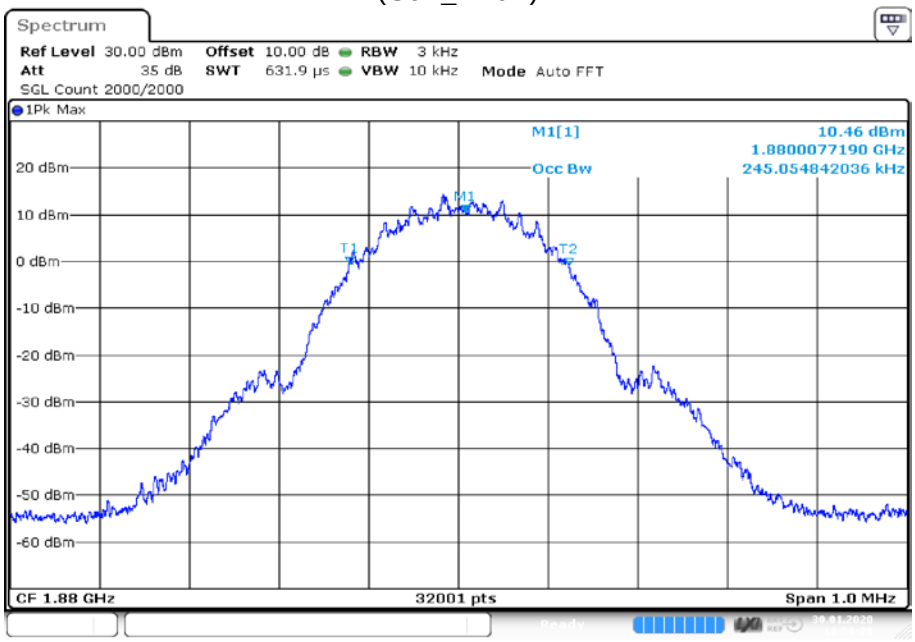


Date: 30.JAN.2020 19:34:04

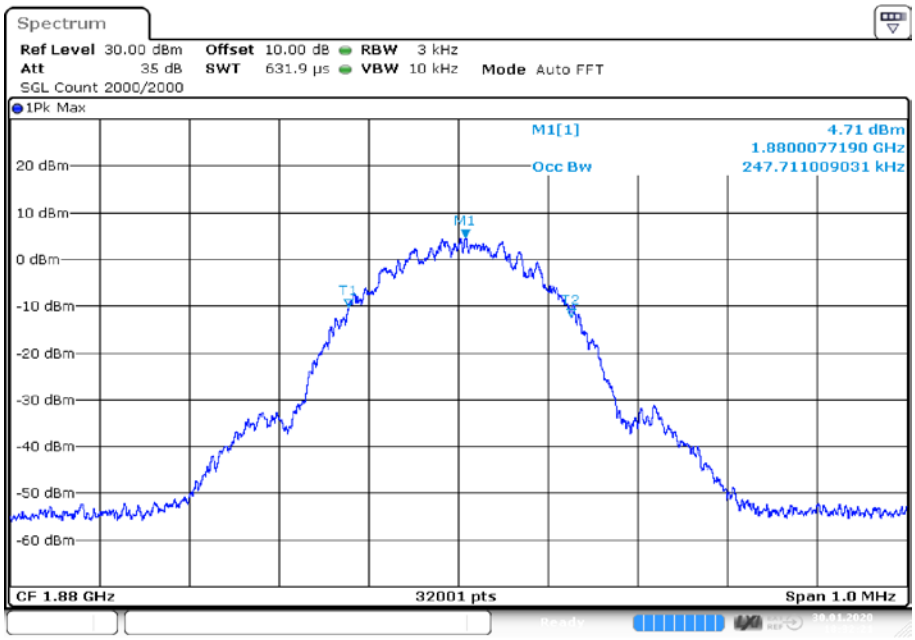


Date: 30.JAN.2020 19:21:49

Frequency Band = Band 2, Direction = Uplink, Signal Type = GSM (S01_AA01)

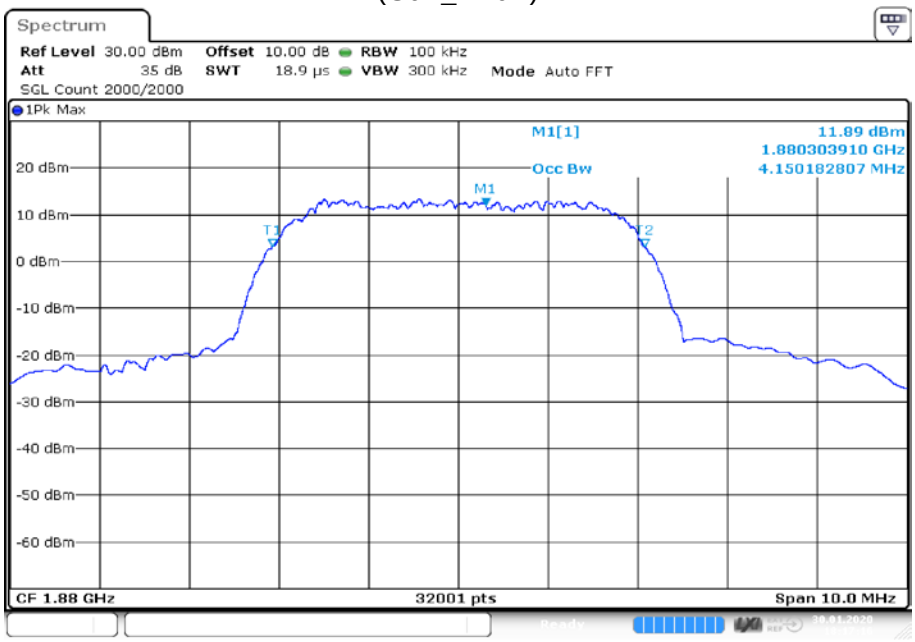


Date: 30.JAN.2020 18:59:20

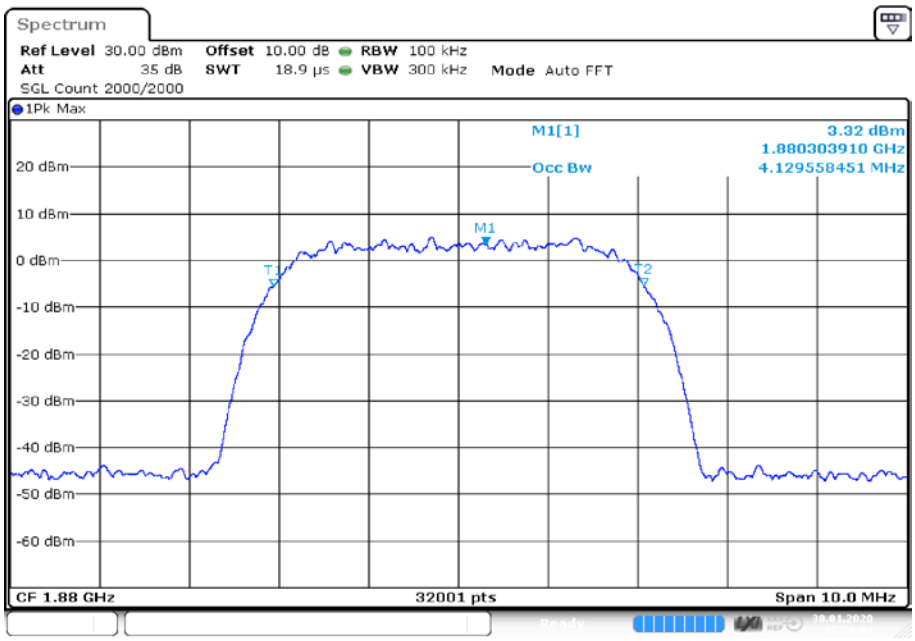


Date: 30.JAN.2020 18:32:21

Frequency Band = Band 2, Direction = Uplink, Signal Type = LTE (S01_AA01)

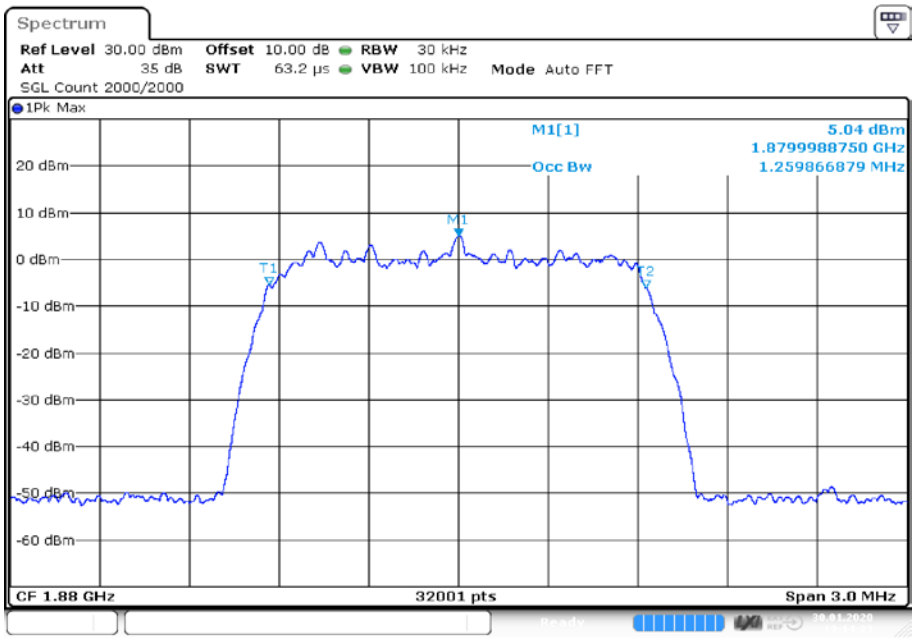


Date: 30.JAN.2020 18:17:16

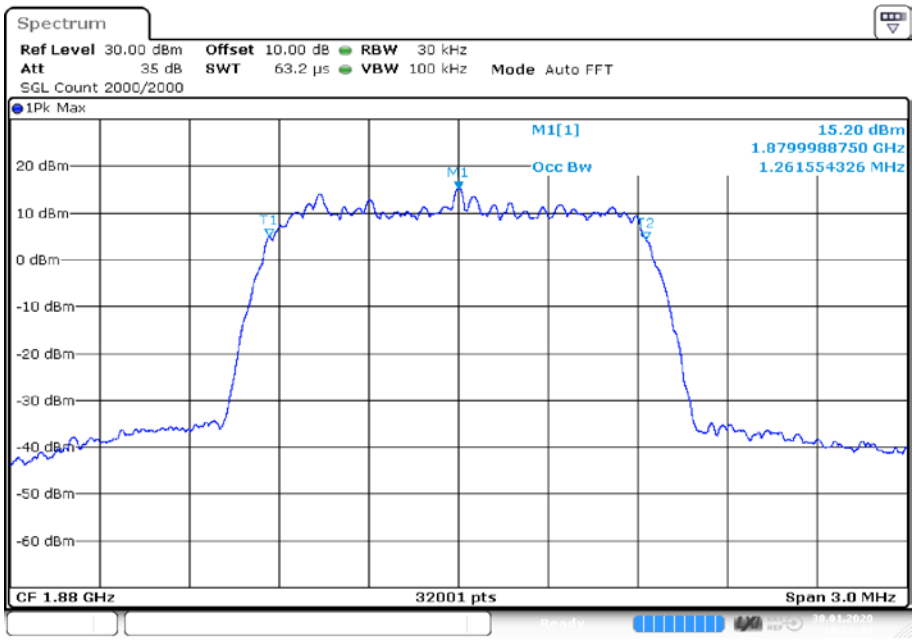


Date: 30.JAN.2020 17:50:02

Frequency Band = Band 2, Direction = Uplink, Signal Type = CDMA (S01_AA01)

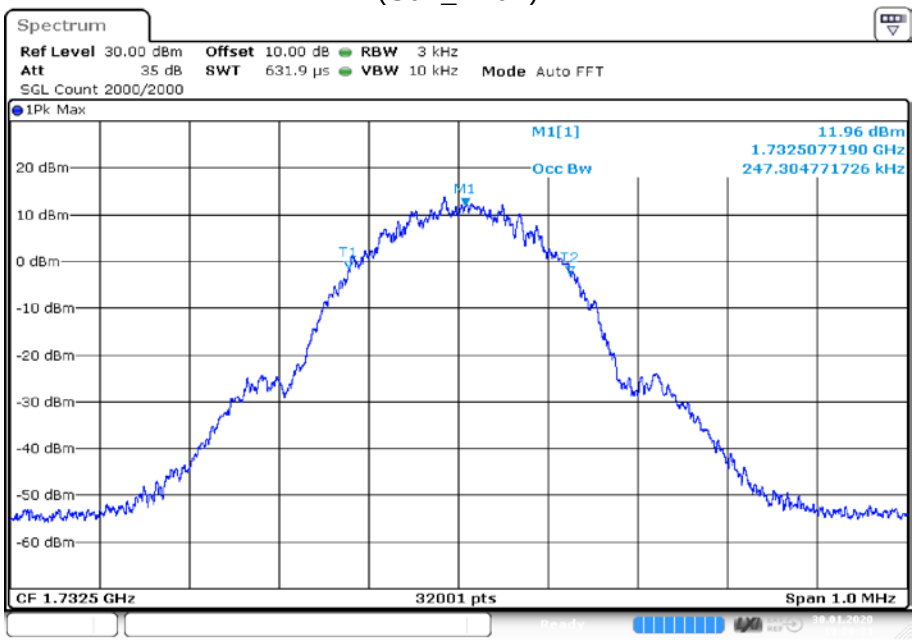


Date: 30.JAN.2020 19:14:24

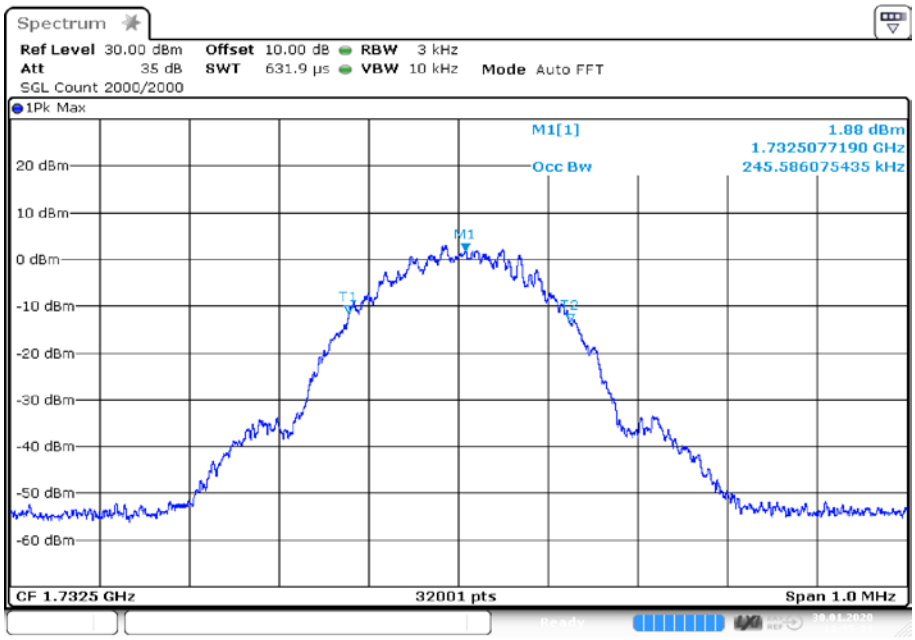


Date: 30.JAN.2020 19:23:34

Frequency Band = Band 4, Direction = Uplink, Signal Type = GSM (S01_AA01)

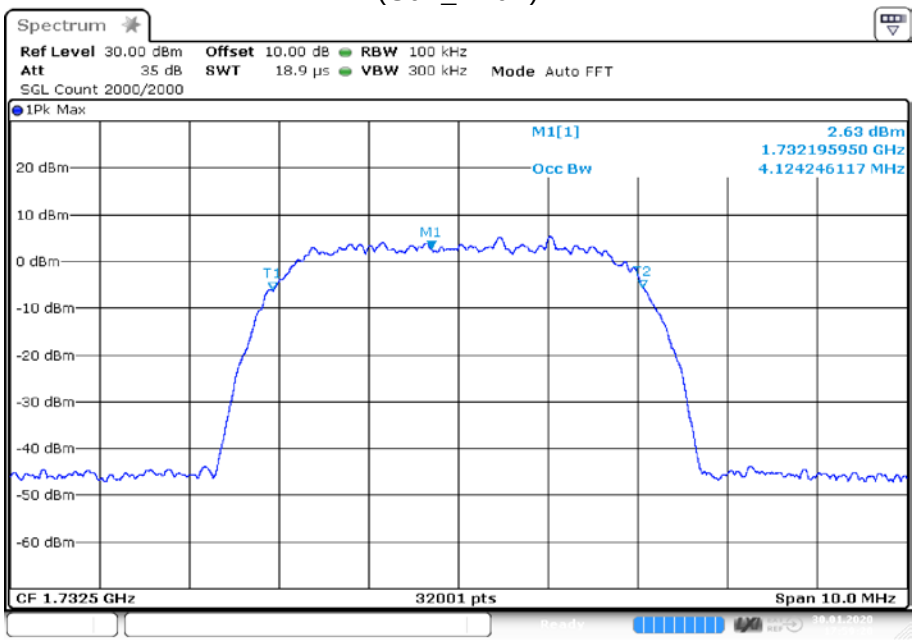


Date: 30.JAN.2020 19:00:31

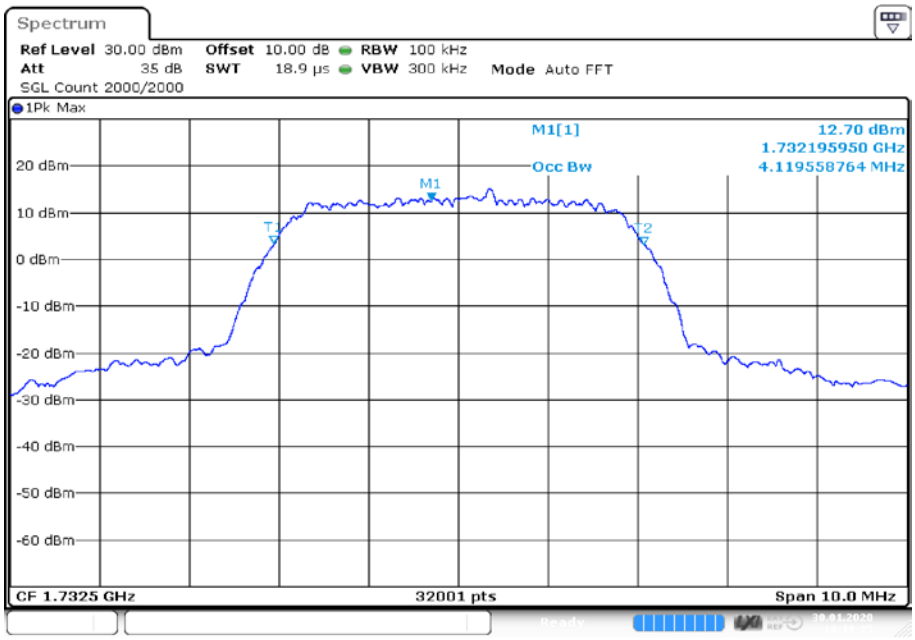


Date: 30.JAN.2020 18:35:24

Frequency Band = Band 4, Direction = Uplink, Signal Type = LTE (S01_AA01)

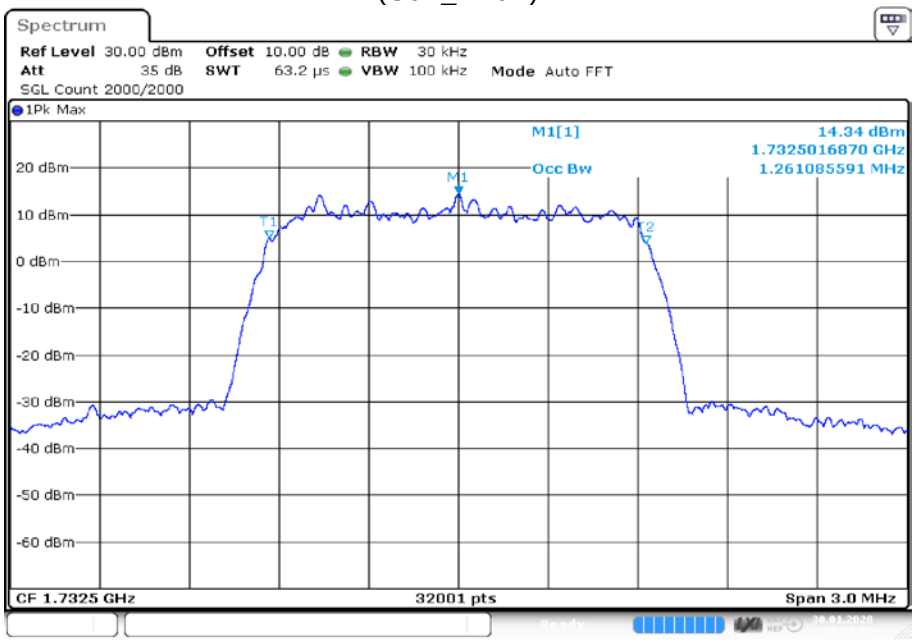


Date: 30.JAN.2020 17:59:21

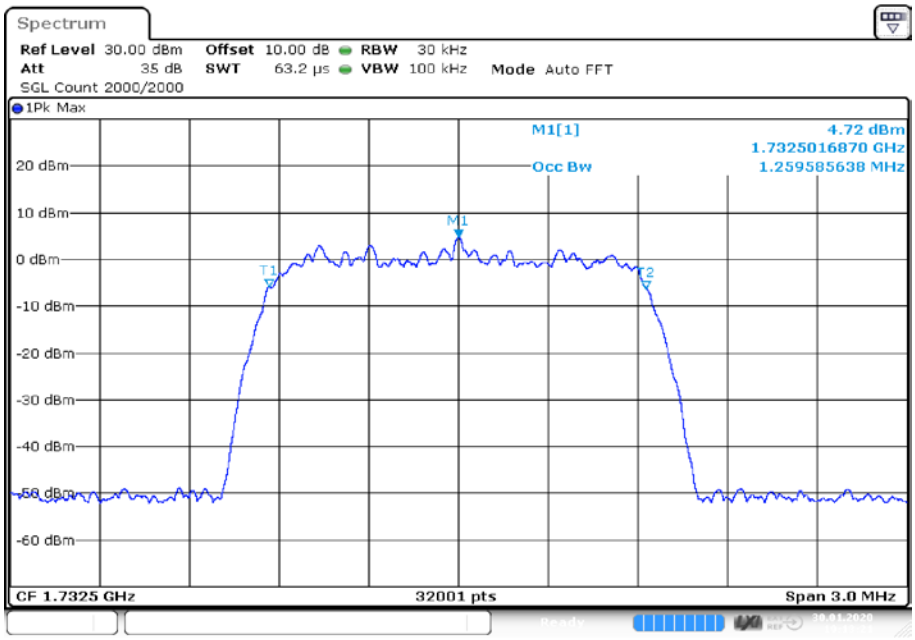


Date: 30.JAN.2020 18:19:25

Frequency Band = Band 4, Direction = Uplink, Signal Type = CDMA (S01_AA01)

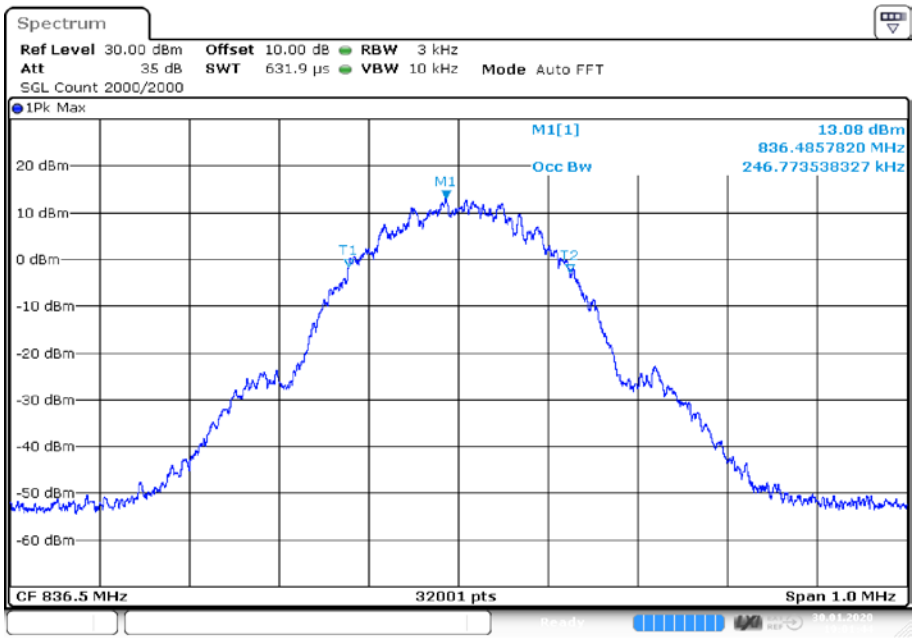


Date: 30.JAN.2020 19:24:33

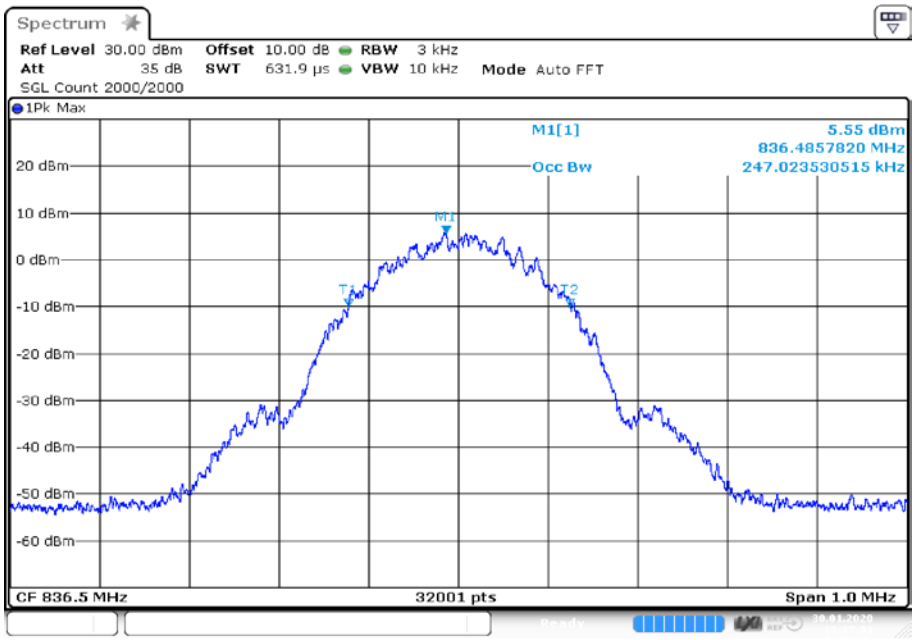


Date: 30.JAN.2020 19:13:21

Frequency Band = Band 5, Direction = Uplink, Signal Type = GSM (S01_AA01)

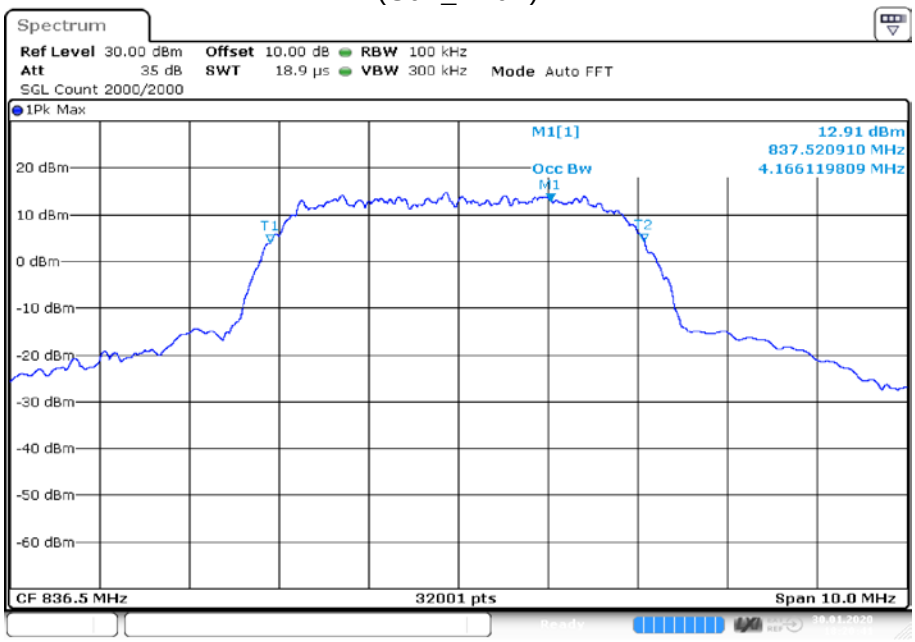


Date: 30.JAN.2020 19:01:44

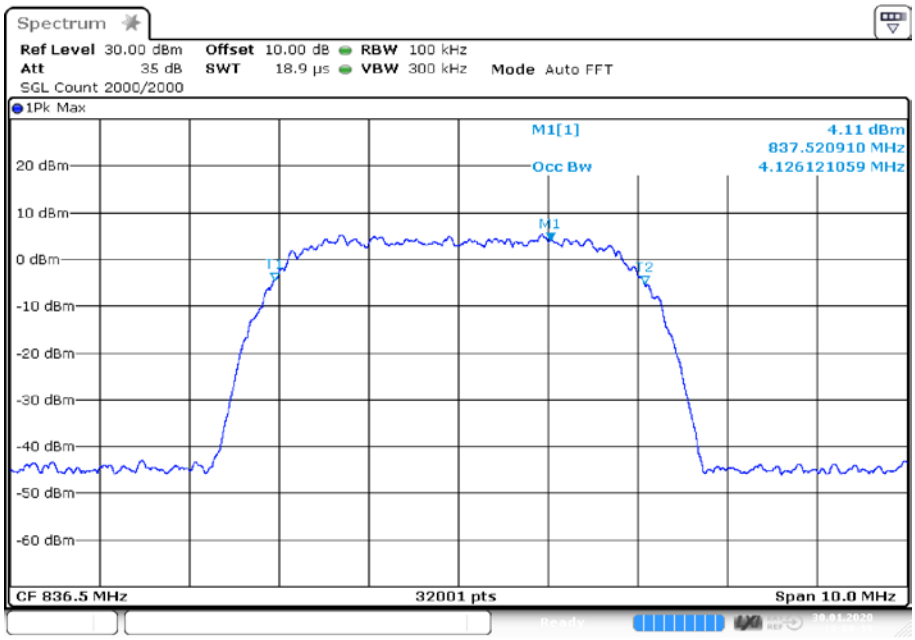


Date: 30.JAN.2020 18:37:01

Frequency Band = Band 5, Direction = Uplink, Signal Type = LTE (S01_AA01)

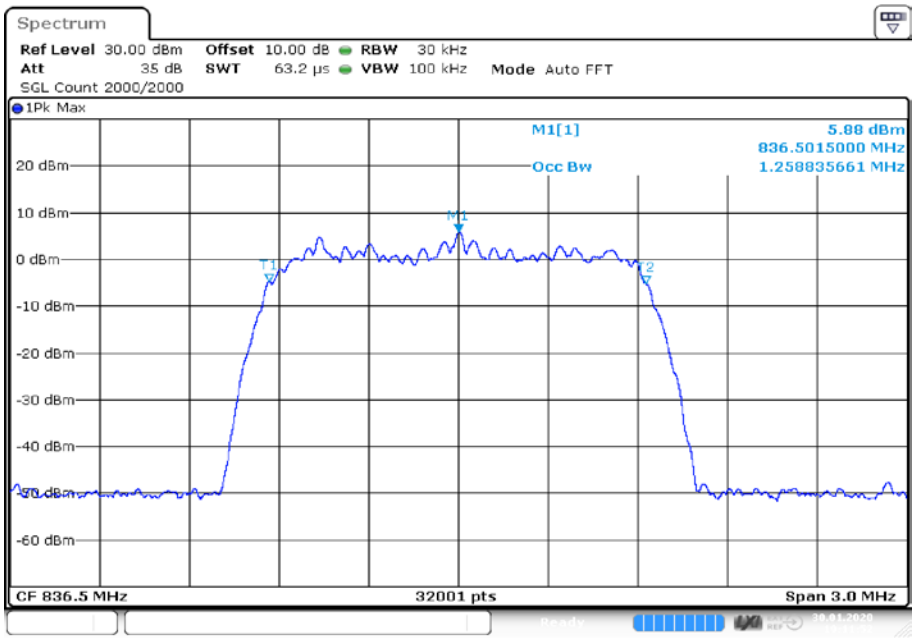


Date: 30.JAN.2020 18:20:41

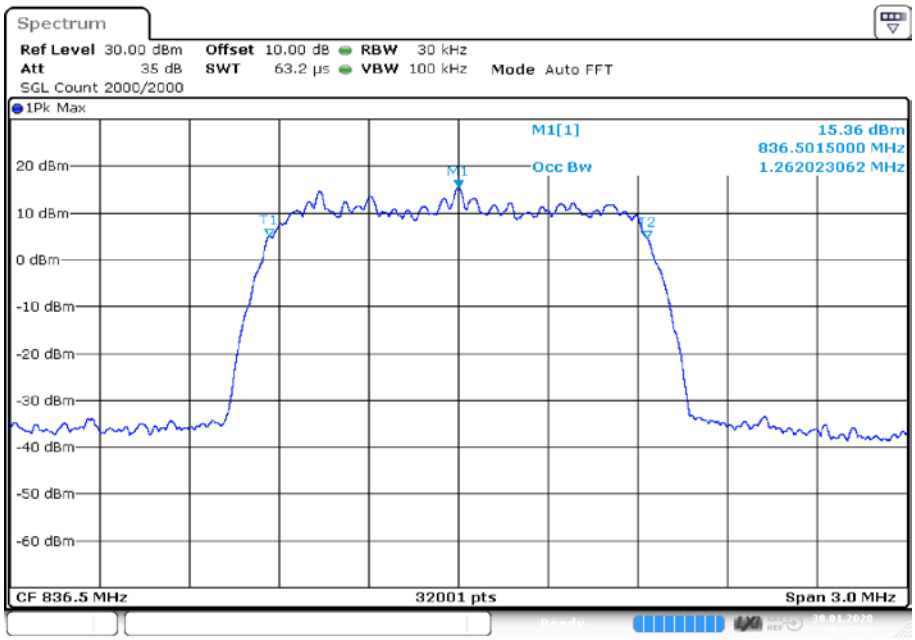


Date: 30.JAN.2020 18:00:40

Frequency Band = Band 5, Direction = Uplink, Signal Type = CDMA (S01_AA01)

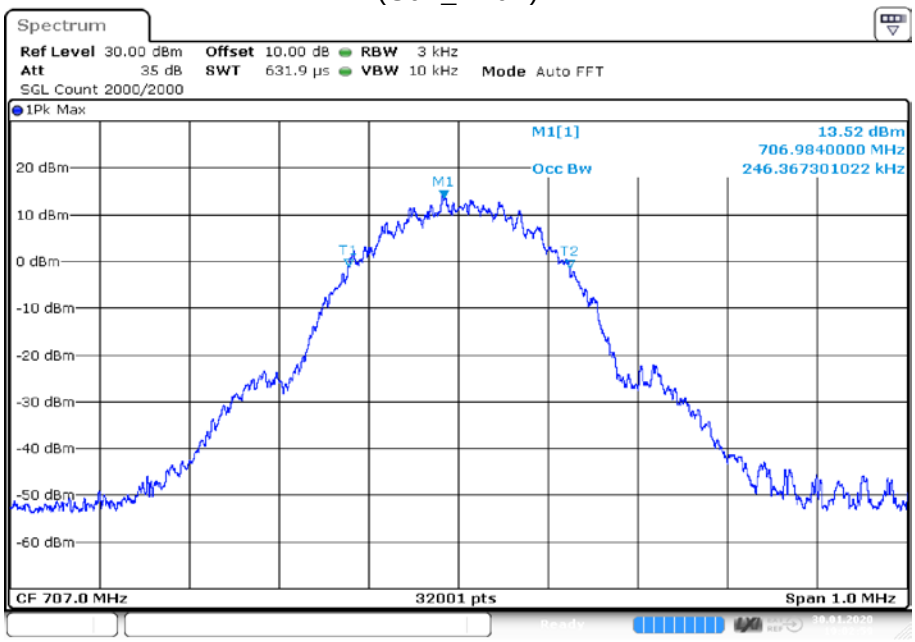


Date: 30.JAN.2020 19:11:53

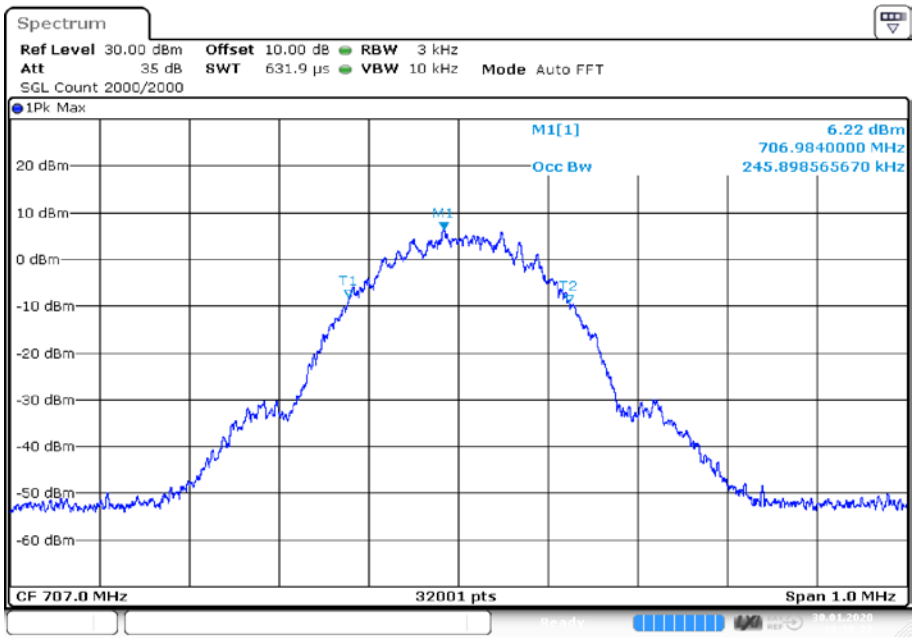


Date: 30.JAN.2020 19:25:38

Frequency Band = Band 12, Direction = Uplink, Signal Type = GSM (S01_AA01)

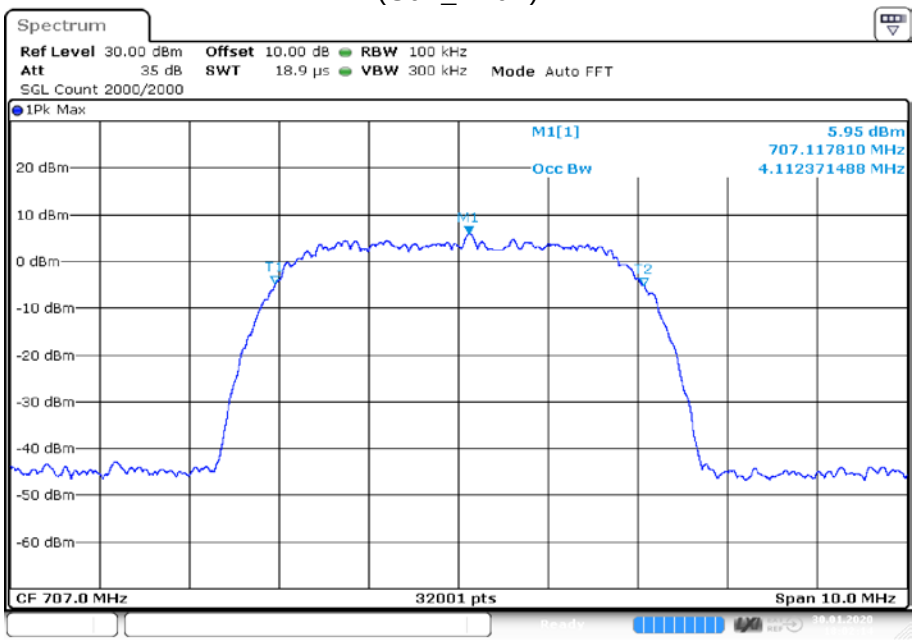


Date: 30.JAN.2020 19:03:00

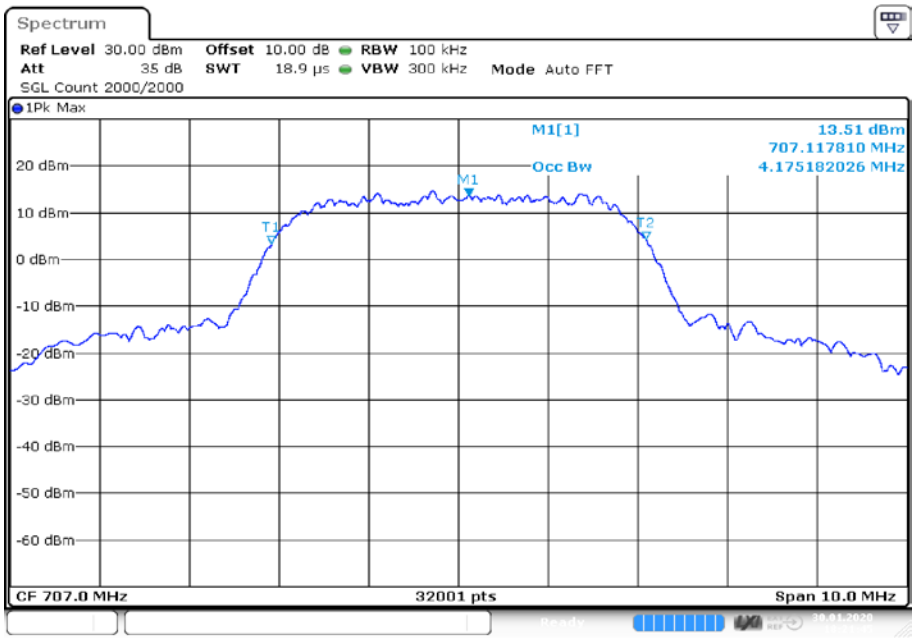


Date: 30.JAN.2020 18:38:22

Frequency Band = Band 12, Direction = Uplink, Signal Type = LTE (S01_AA01)

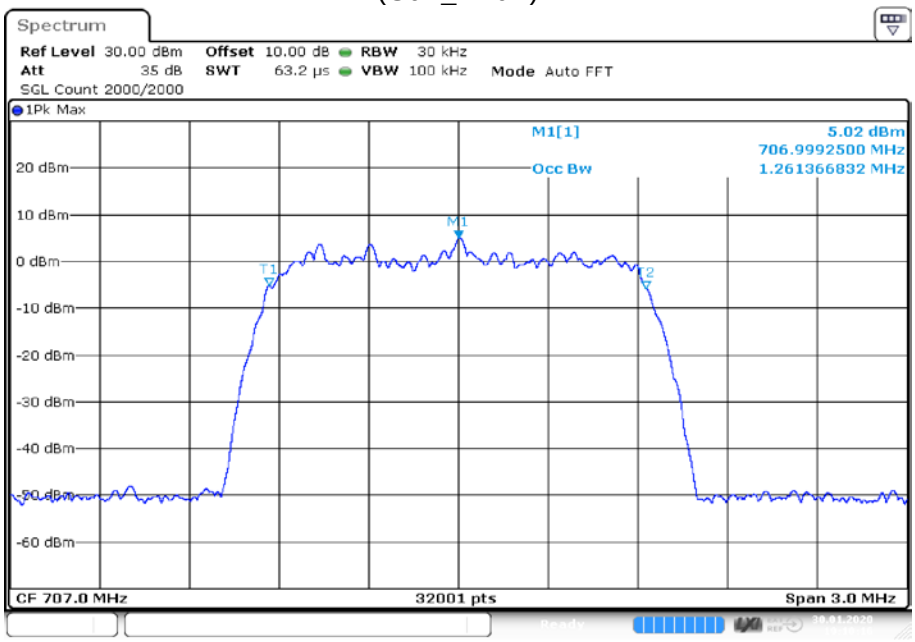


Date: 30.JAN.2020 18:02:14

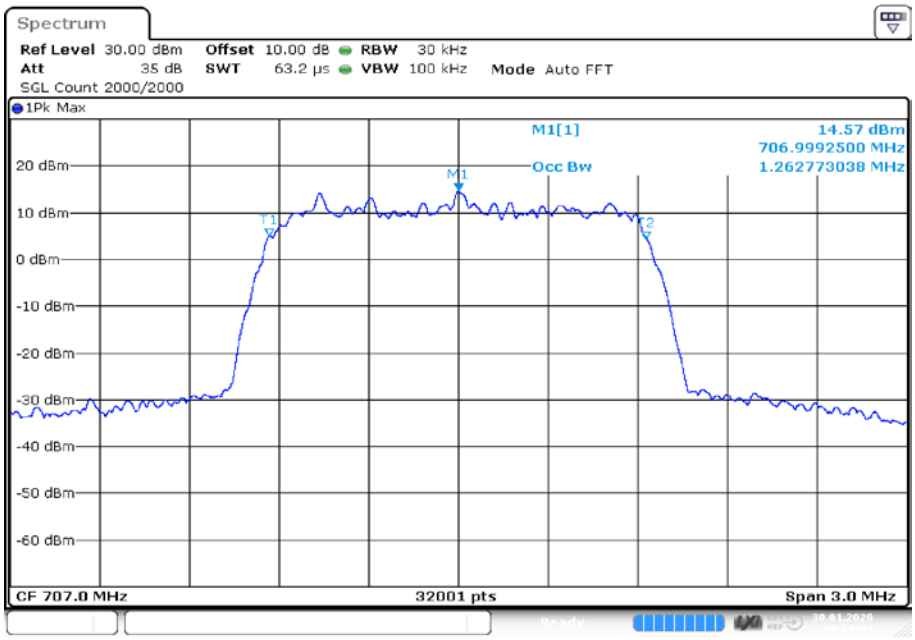


Date: 30.JAN.2020 18:21:45

Frequency Band = Band 12, Direction = Uplink, Signal Type = CDMA (S01_AA01)

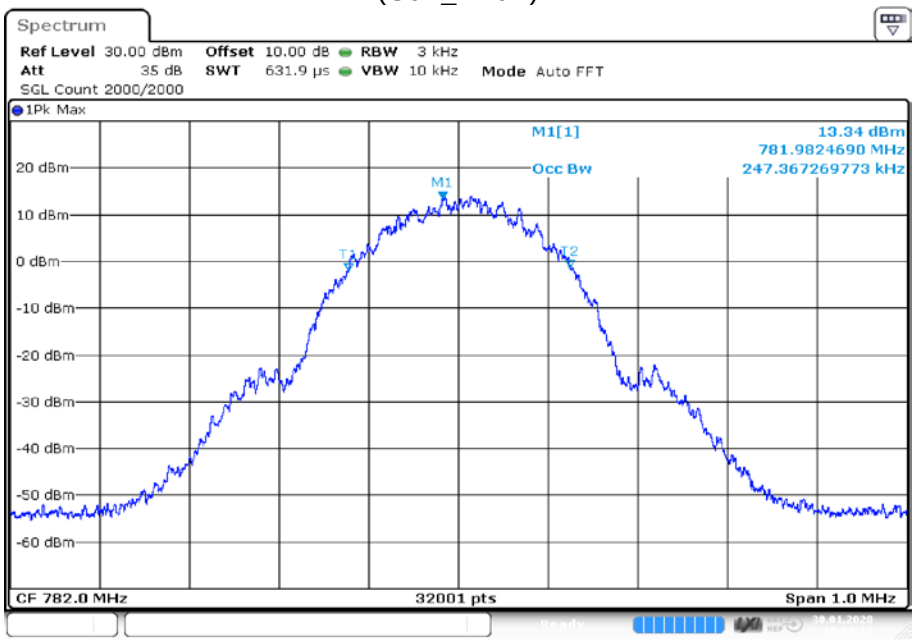


Date: 30.JAN.2020 19:10:17

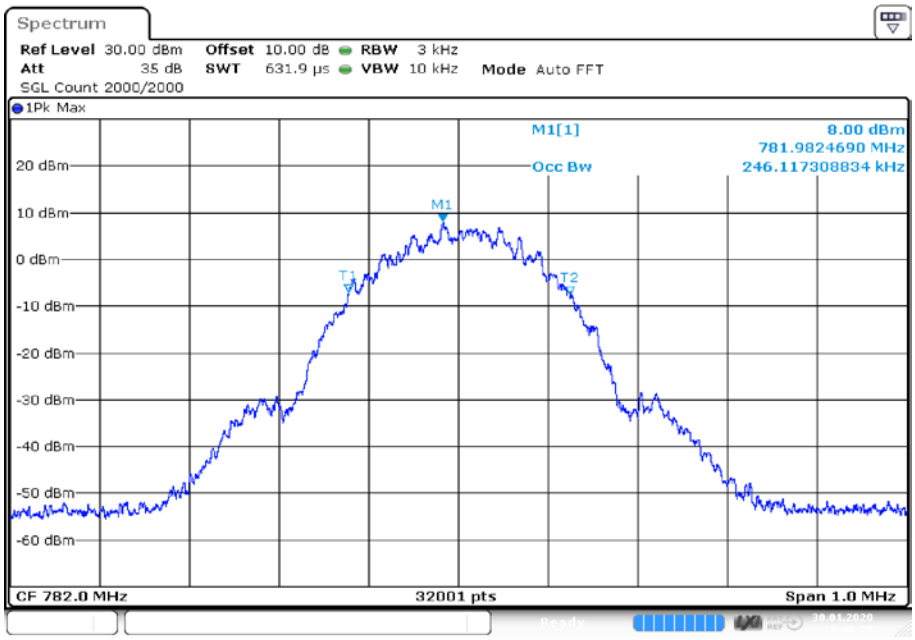


Date: 30.JAN.2020 19:26:43

Frequency Band = Band 13, Direction = Uplink, Signal Type = GSM (S01_AA01)

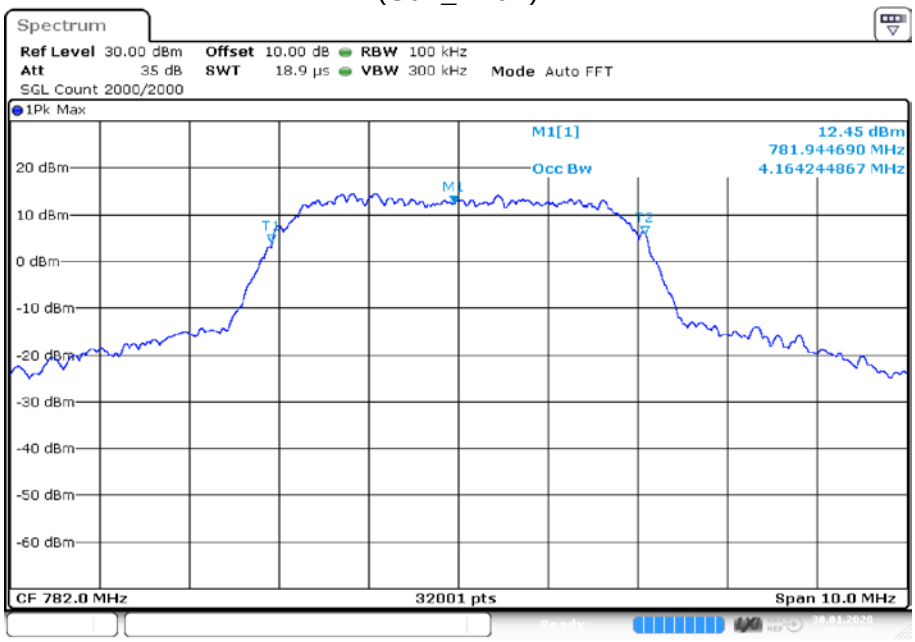


Date: 30.JAN.2020 19:04:12

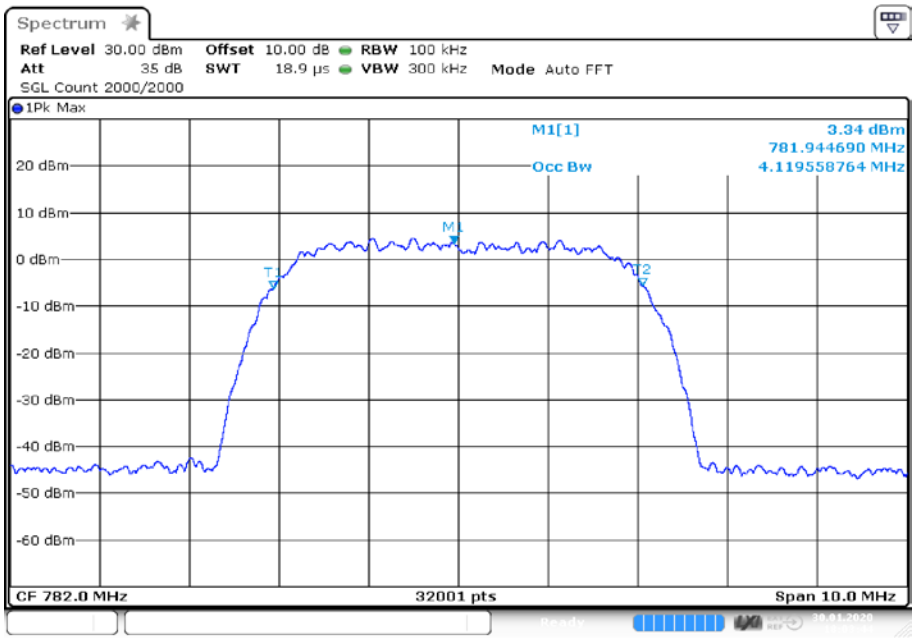


Date: 30.JAN.2020 18:40:20

Frequency Band = Band 13, Direction = Uplink, Signal Type = LTE (S01_AA01)

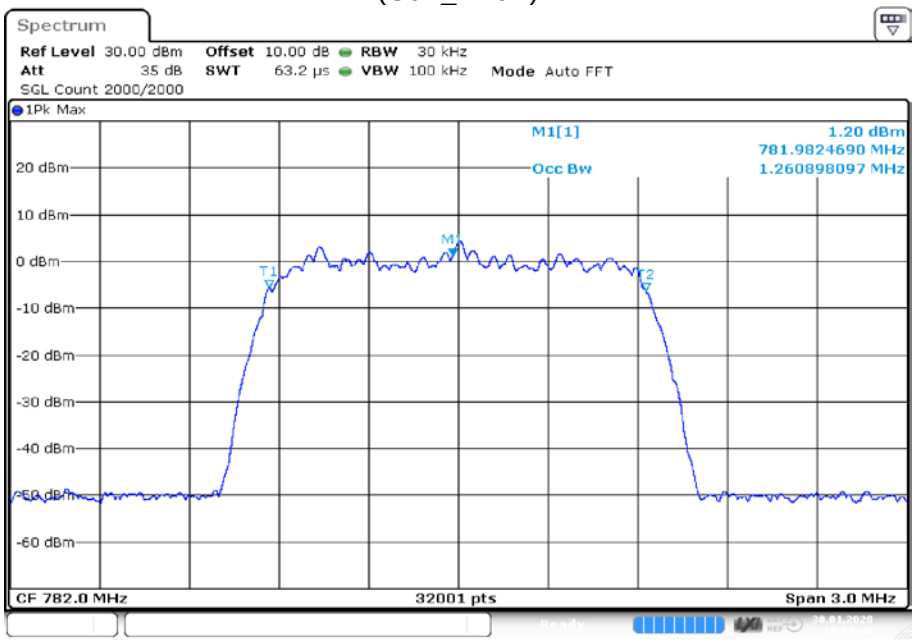


Date: 30.JAN.2020 18:22:50

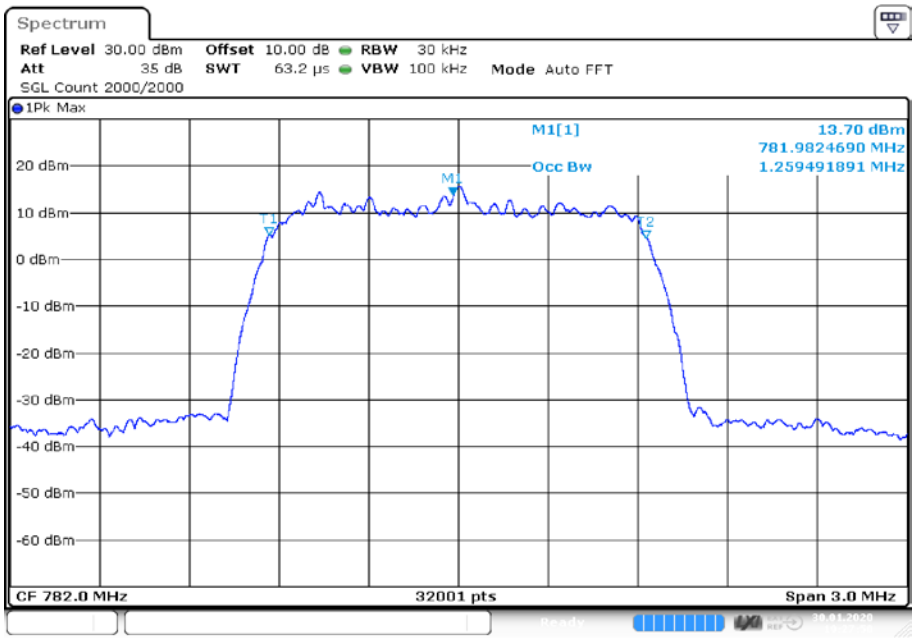


Date: 30.JAN.2020 18:03:44

Frequency Band = Band 13, Direction = Uplink, Signal Type = CDMA (S01_AA01)



Date: 30.JAN.2020 19:07:47



Date: 30.JAN.2020 19:27:50

5.12.5TEST EQUIPMENT USED

- R&S TS8997

5.13 OSCILLATION RESTART

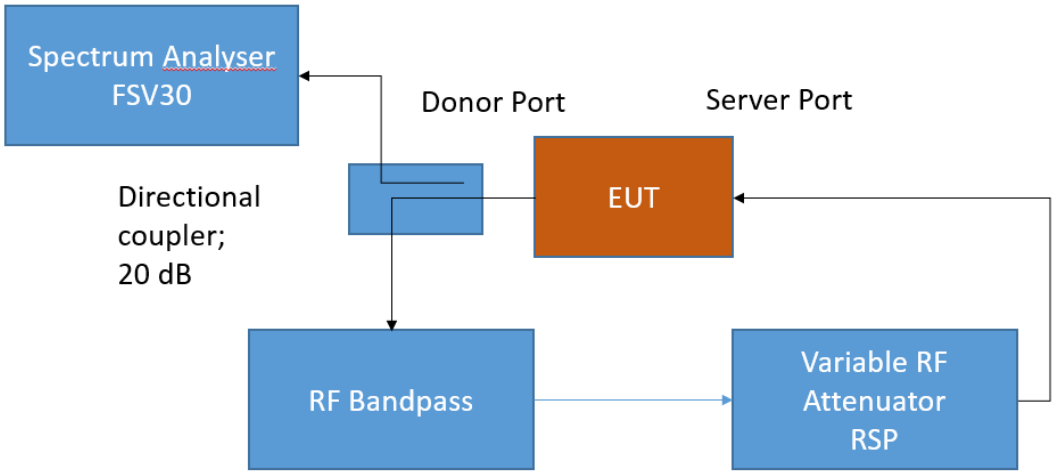
Standard

The test was performed according to:
KDB 935210 D03

5.13.1TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster Anti-Oscillation limits and requirements as specified in §§ 20.21(e)(8)(ii)(A for wideband consumer signal boosters.

The EUT was connected to the test setup according to the following diagram:



FCC Part 20.21; Consumer Signal Booster – Test Setup 7.11.2; Oscillation Restart

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.13.2TEST REQUIREMENTS / LIMITS

FCC Part 20, § 20.21 (e)(8)(ii)(A)

Anti-Oscillation. Consumer boosters must be able to detect and mitigate (*i.e.*, by automatic gain reduction or shut down), any oscillations in uplink and downlink bands. Oscillation detection and mitigation must occur automatically within 0.3 seconds in the uplink band and within 1 second in the downlink band. In cases where oscillation is detected, the booster must continue mitigation for at least one minute before restarting. After five such restarts, the booster must not resume operation until manually reset.

5.13.3TEST PROTOCOL

Ambient temperature: 24 °C
Air Pressure: 1036 hPa
Humidity: 36 %

Band 2, downlink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
1960.0	235.2	62.1	4	1000.0	60.0	5	764.8	2.1	1

Band 4, downlink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
2132.5	234.3	62.1	4	1000.0	60.0	5	765.7	2.1	1

Band 5, downlink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
881.5	236.8	62.1	4	1000.0	60.0	5	763.2	2.1	1

Band 12, downlink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
737.0	240.4	62.1	4	1000.0	60.0	5	759.6	2.1	1

Band 13, downlink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
751.0	237.9	62.1	4	1000.0	60.0	5	762.1	2.1	1

Band 2, uplink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
1880.0	112.1	62.1	4	300.0	60.0	5	187.9	2.1	1

Band 4, uplink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
1732.5	103.8	62.2	4	300.0	60.0	5	196.2	2.2	1

Band 5, uplink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
836.5	104.1	62.1	4	300.0	60.0	5	195.9	2.1	1

Band 12, uplink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
707.0	103.8	62.1	4	300.0	60.0	5	196.2	2.1	1

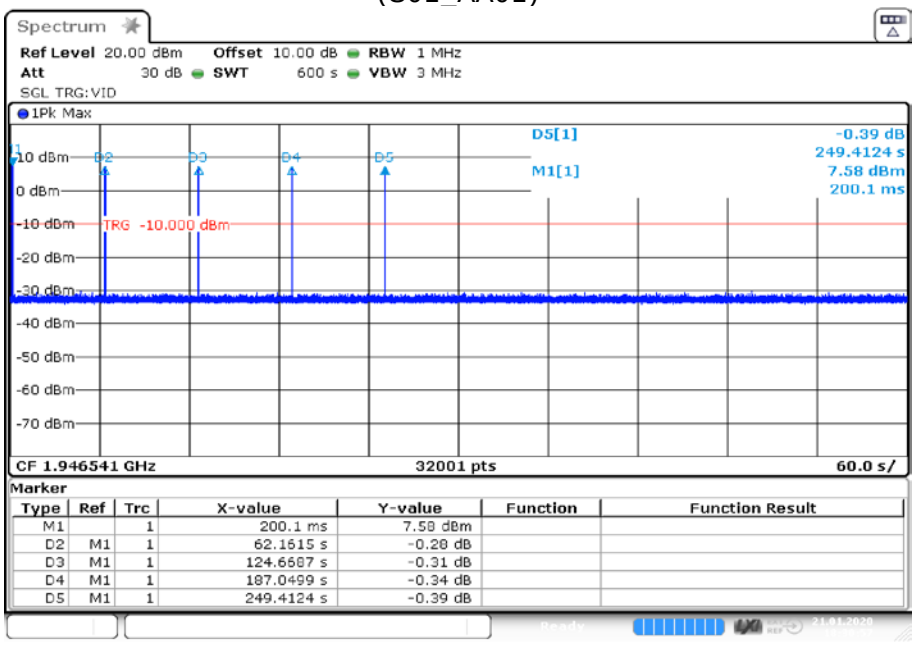
Band 13, uplink

Freq. [MHz]	Oscillation Detection Time [ms]	Oscillation Restart Time [s]	Oscil. Restarts	Oscillation Detection Time Limit [ms]	Oscillation Restart Time Limit [s]	Oscil. Restarts Limit	Margin Oscillation Detection Time [ms]	Margin Oscil. Restart Time [s]	Margin Oscillation Restarts
782.0	104.0	62.1	4	300.0	60.0	5	196.0	2.1	1

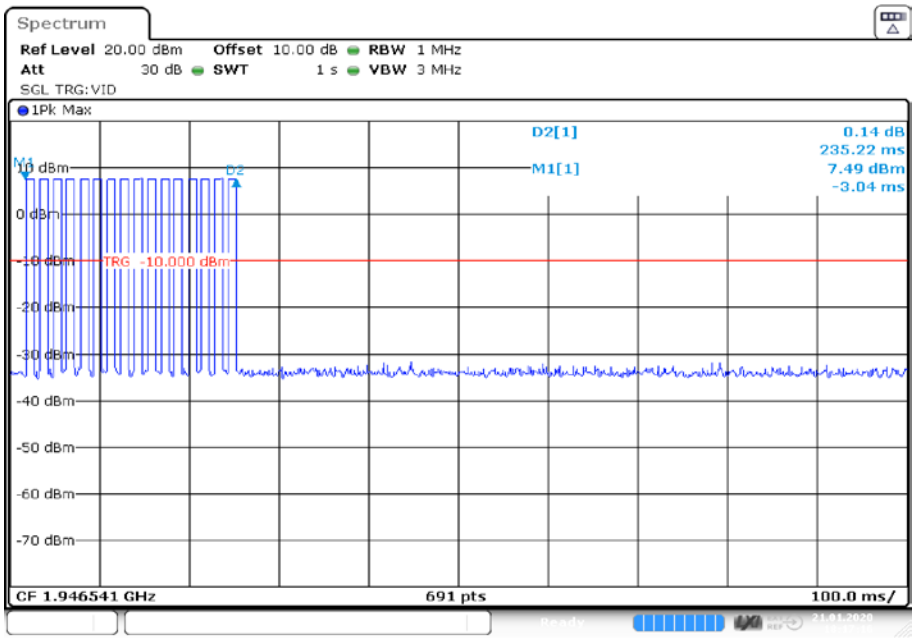
Remark: Please see next sub-clause for the measurement plot.
Plots for Oscillation Restart Time not shown since Oscillation Restart time can also be seen with little deviation in Oscillation Restart plots.

5.13.4MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, “WORST CASE”)

Frequency Band = Band 2, Direction = Downlink
(S01_AA01)

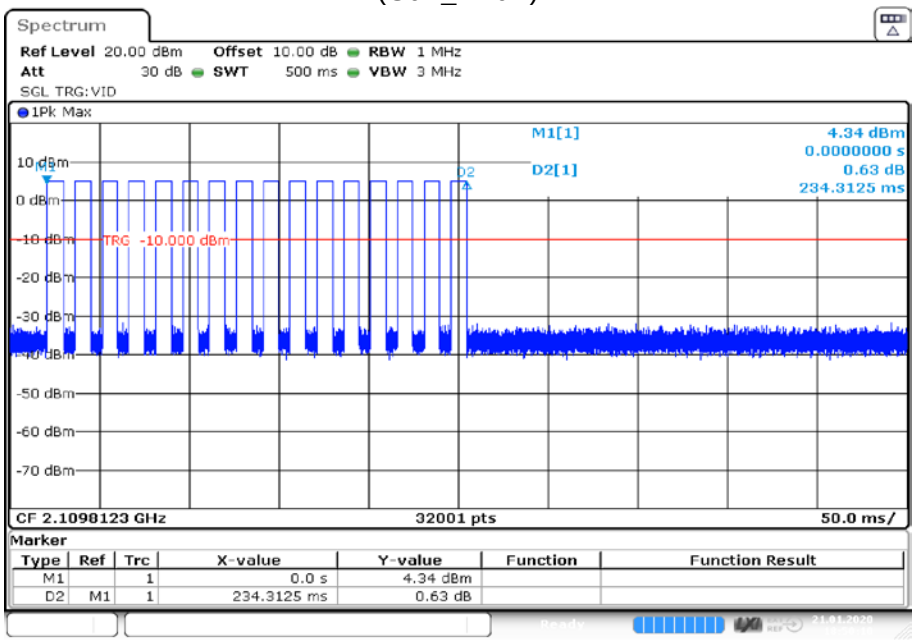


Date: 21.JAN.2020 18:30:57

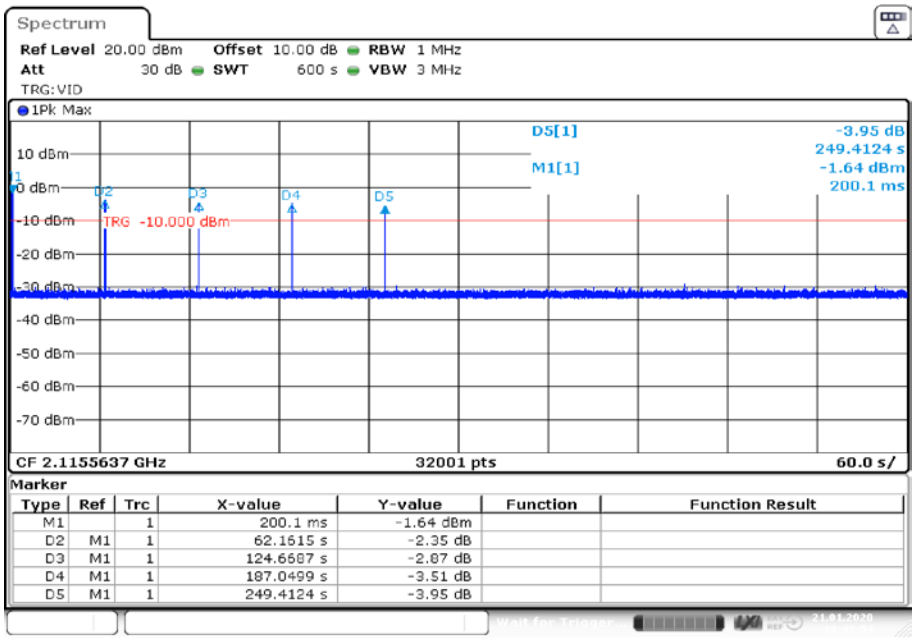


Date: 21.JAN.2020 18:17:16

Frequency Band = Band 4, Direction = Downlink
(S01_AA01)

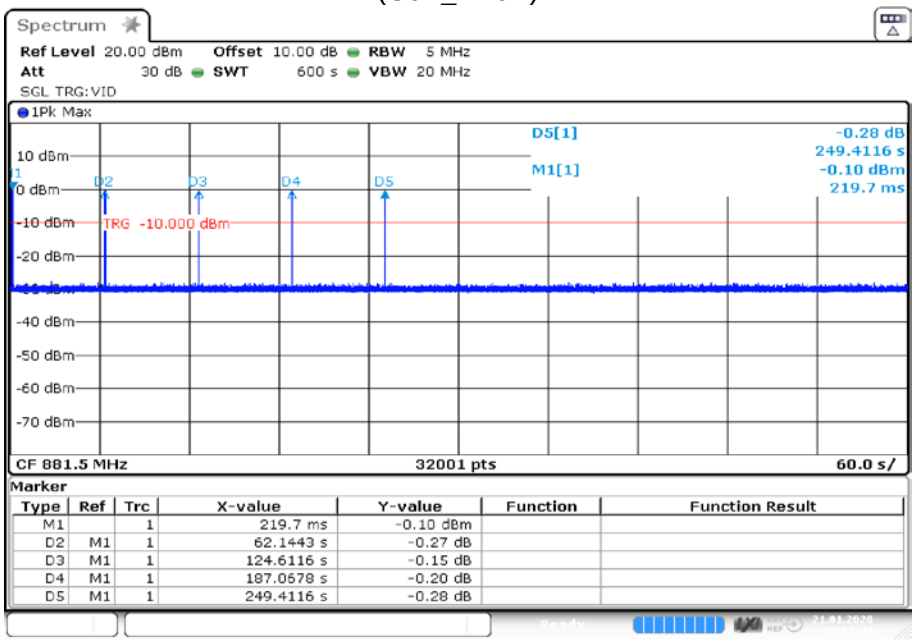


Date: 21.JAN.2020 18:50:11

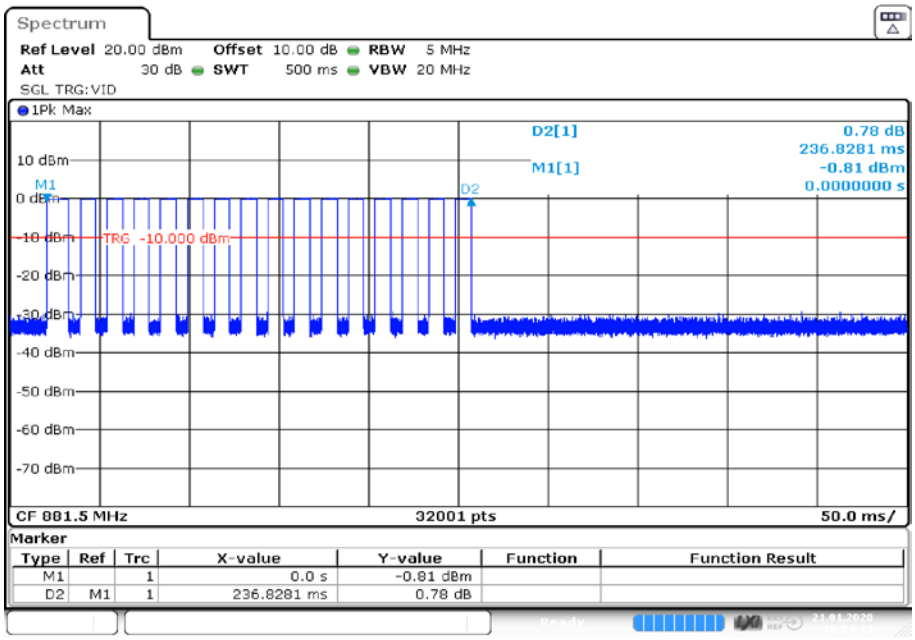


Date: 21.JAN.2020 18:43:54

Frequency Band = Band 5, Direction = Downlink
(S01_AA01)

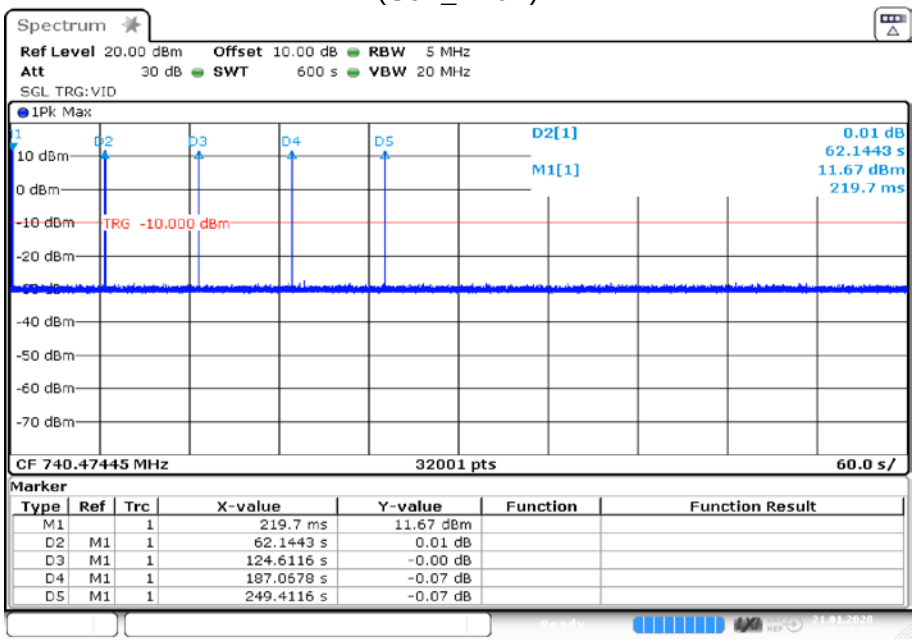


Date: 21.JAN.2020 19:07:43

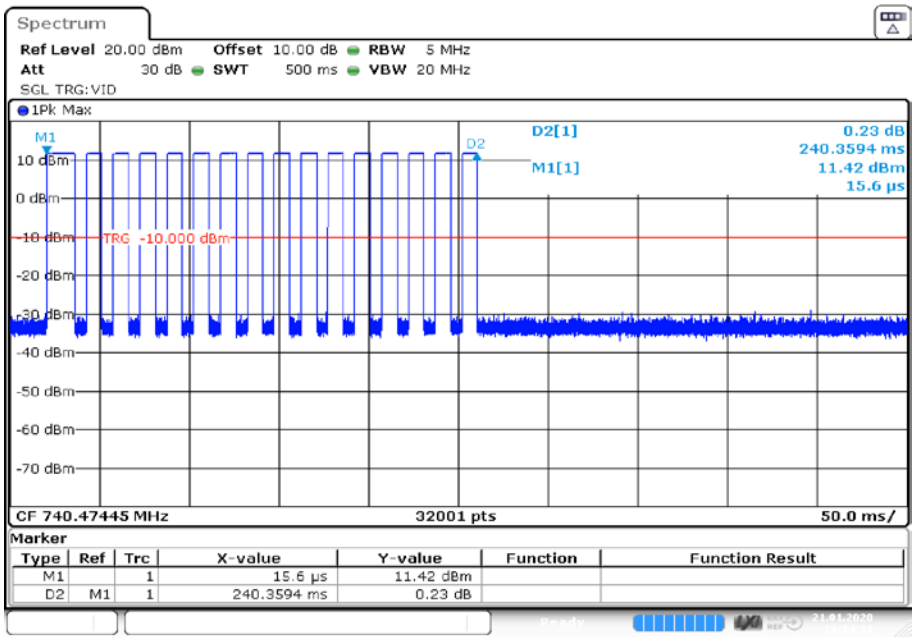


Date: 21.JAN.2020 18:54:31

Frequency Band = Band 12, Direction = Downlink
(S01_AA01)

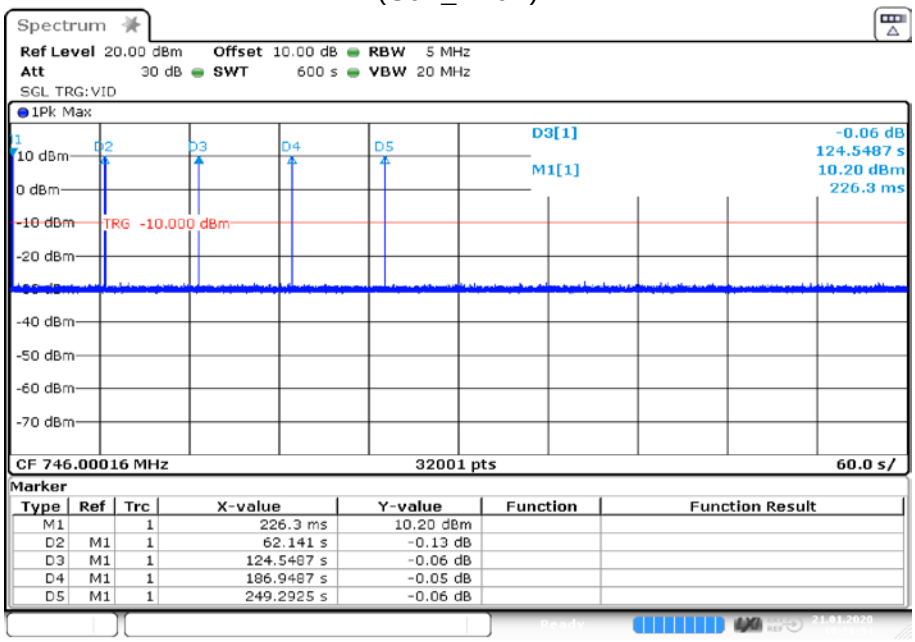


Date: 21.JAN.2020 19:21:27

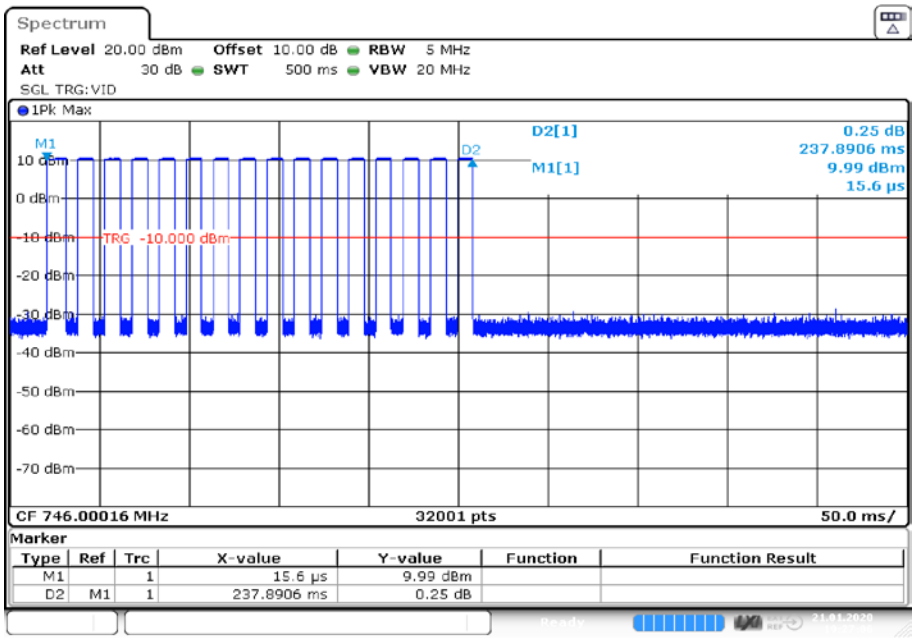


Date: 21.JAN.2020 19:24:32

Frequency Band = Band 13, Direction = Downlink
(S01_AA01)

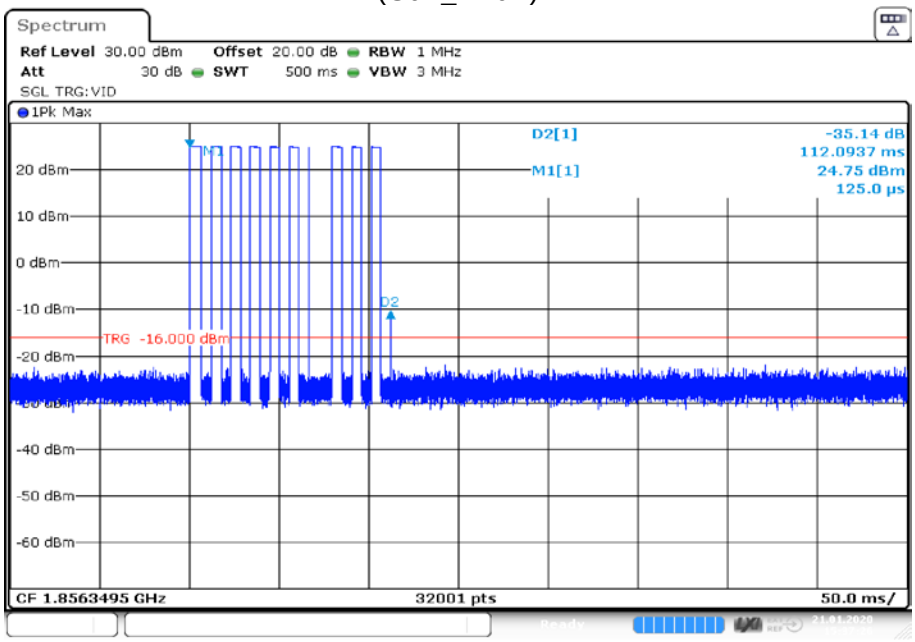


Date: 21.JAN.2020 19:39:34

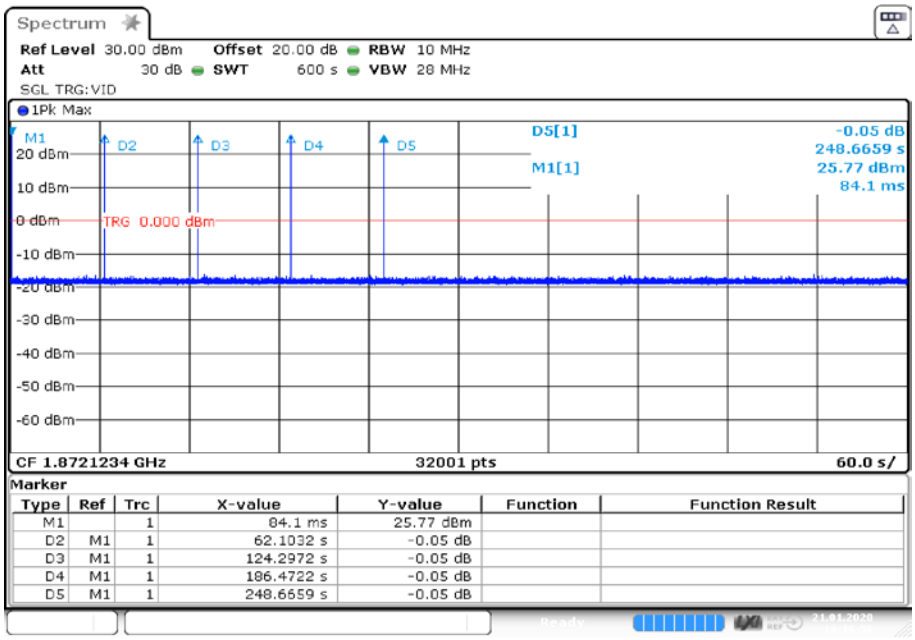


Date: 21.JAN.2020 19:27:06

Frequency Band = Band 2, Direction = Uplink
(S01_AA01)



Date: 21.JAN.2020 15:37:27

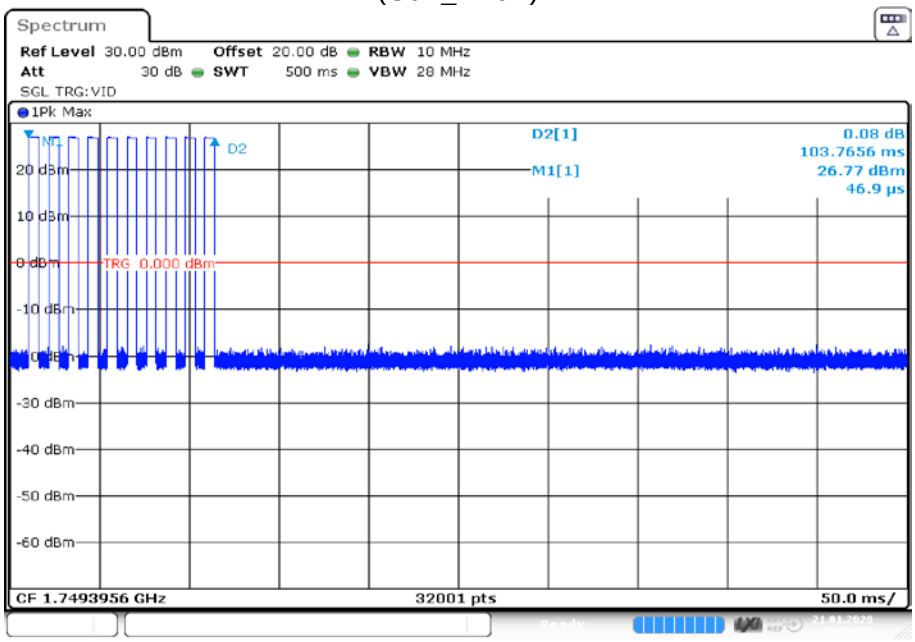


Marker

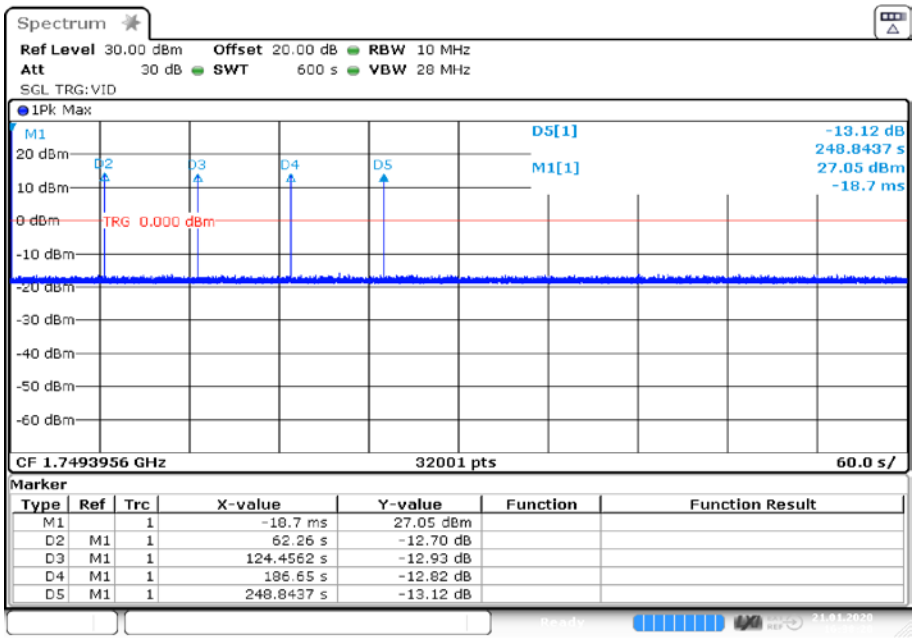
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	84.1 ms	25.77 dBm		
D2	M1	1	62.1032 s	-0.05 dB		
D3	M1	1	124.2972 s	-0.05 dB		
D4	M1	1	186.4722 s	-0.05 dB		
D5	M1	1	248.6659 s	-0.05 dB		

Date: 21.JAN.2020 16:16:56

Frequency Band = Band 4, Direction = Uplink
(S01_AA01)



Date: 21.JAN.2020 16:24:22

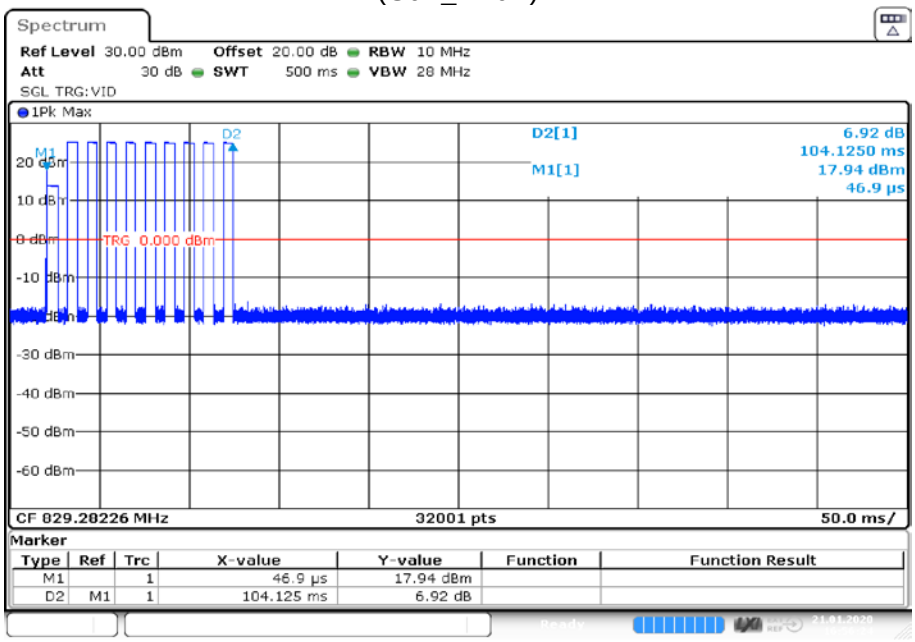


Marker

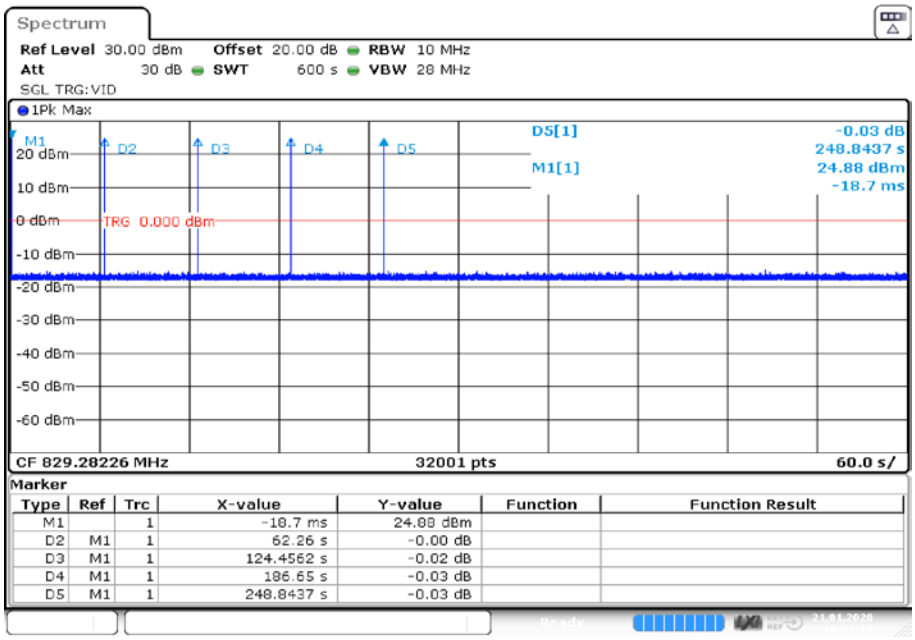
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	-18.7 ms	27.05 dBm		
D2	M1	1	62.26 s	-12.70 dB		
D3	M1	1	124.4562 s	-12.93 dB		
D4	M1	1	186.65 s	-12.82 dB		
D5	M1	1	248.8437 s	-13.12 dB		

Date: 21.JAN.2020 16:38:20

Frequency Band = Band 5, Direction = Uplink
(S01_AA01)

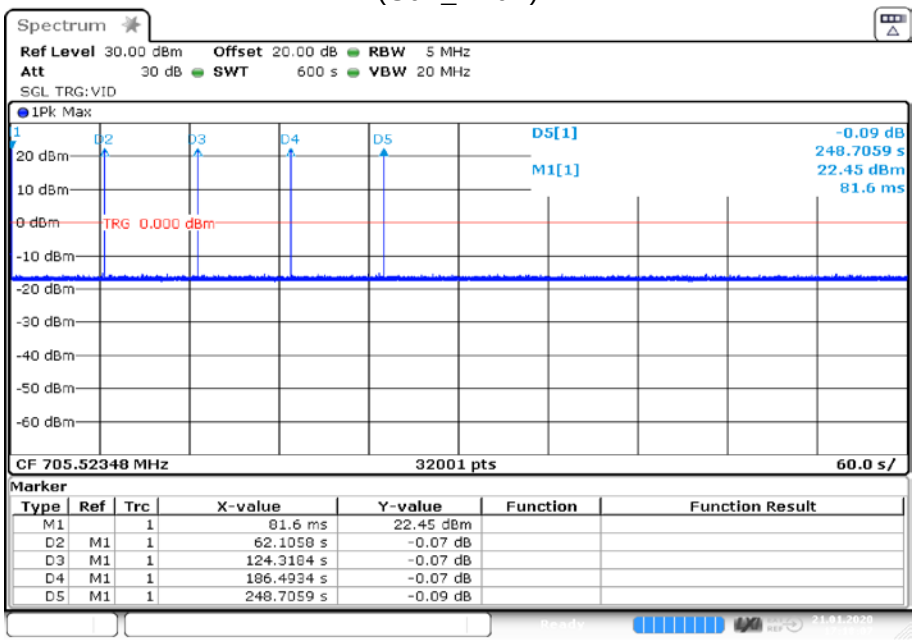


Date: 21.JAN.2020 16:56:24

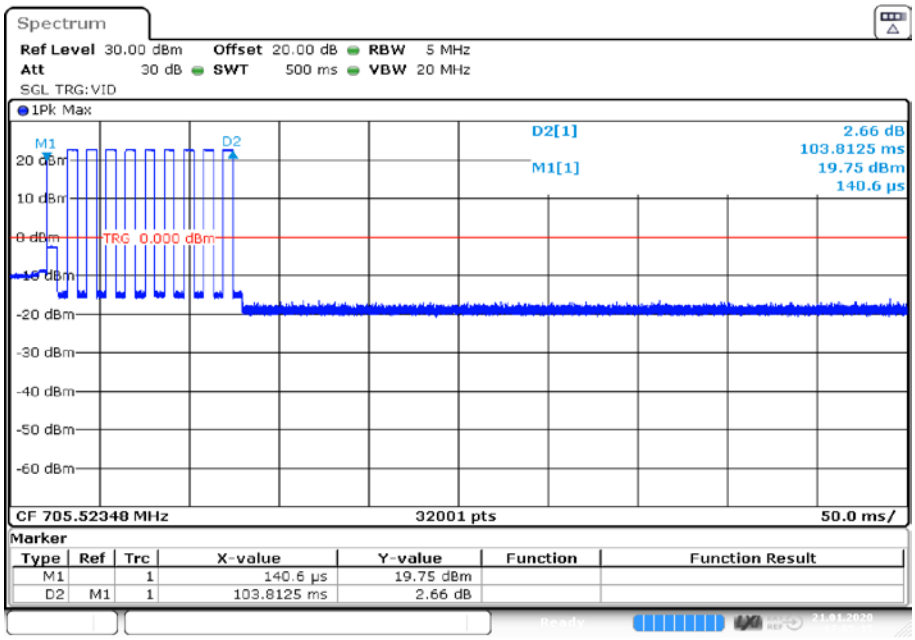


Date: 21.JAN.2020 16:53:18

Frequency Band = Band 12, Direction = Uplink
(S01_AA01)

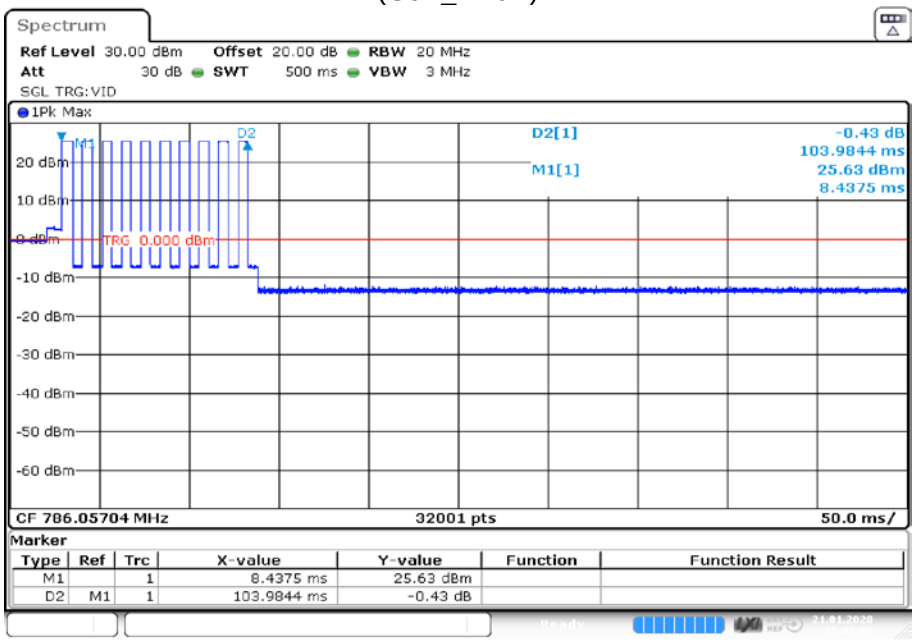


Date: 21.JAN.2020 17:18:07

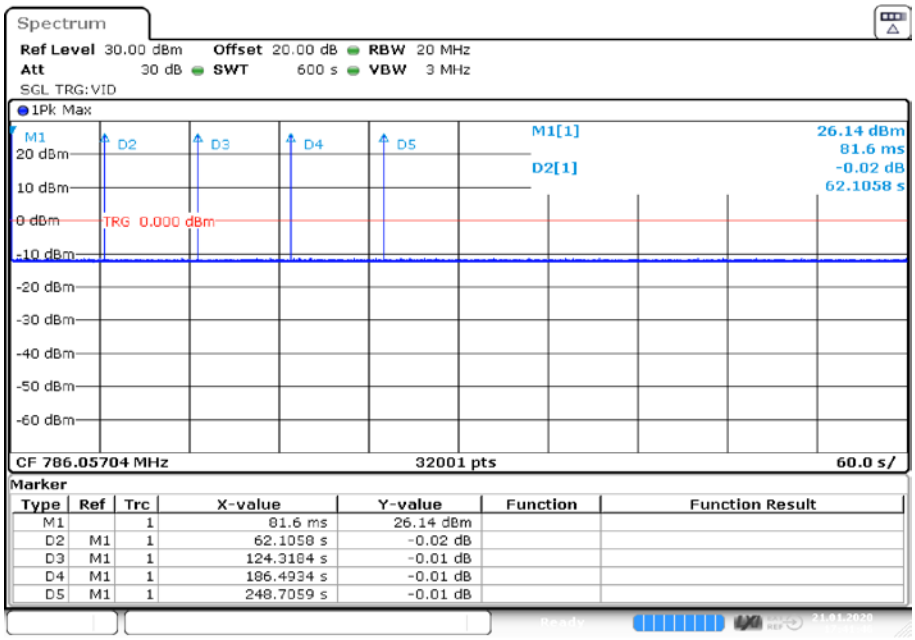


Date: 21.JAN.2020 17:05:36

Frequency Band = Band 13, Direction = Uplink
(S01_AA01)



Date: 21.JAN.2020 17:45:05



Date: 21.JAN.2020 17:41:46

5.13.5TEST EQUIPMENT USED

- R&S TS8997

5.14 OSCILLATION SHUTDOWN OR MITIGATION

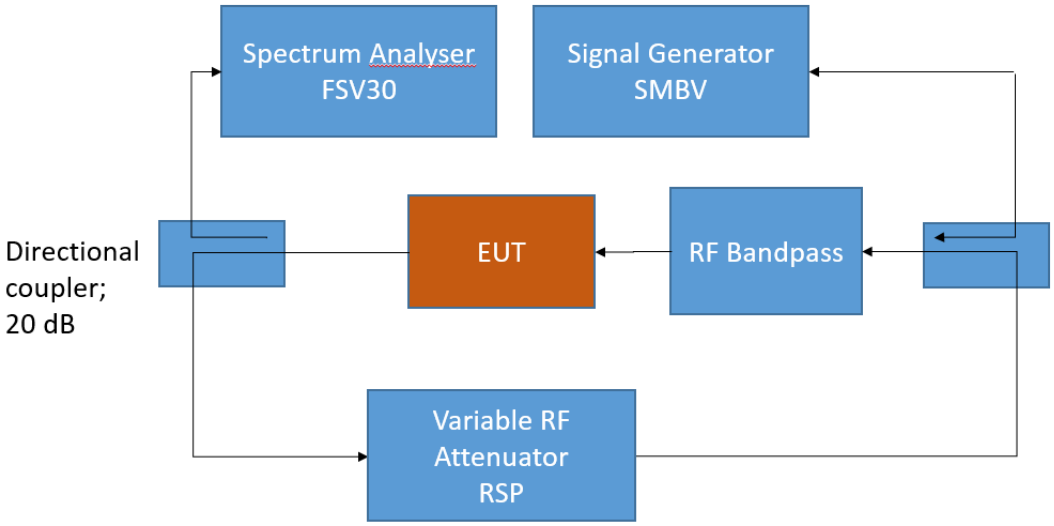
Standard

The test was performed according to:
KDB 935210 D03

5.14.1TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster Anti-Oscillation limits and requirements as specified in §§ 20.21(e)(8)(ii)(A for wideband consumer signal boosters.

The EUT was connected to the test setup according to the following diagram:



FCC Part 20.21; Consumer Signal Booster – Test Setup 7.11.3; Oscillation Mitigation/Shutdown

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.14.2TEST REQUIREMENTS / LIMITS

FCC Part 20, § 20.21 (e)(8)(ii)(A)

Anti-Oscillation. Consumer boosters must be able to detect and mitigate (*i.e.*, by automatic gain reduction or shut down), any oscillations in uplink and downlink bands. Oscillation detection and mitigation must occur automatically within 0.3 seconds in the uplink band and within 1 second in the downlink band. In cases where oscillation is detected, the booster must

continue mitigation for at least one minute before restarting. After five such restarts, the booster must not resume operation until manually reset.

KDB 935210 D03 7.11.3 f6)

The procedure of 7.11.3 f1) to 7.11.3 f5) allows the spectrum analyzer trace to stabilize, and verification of shutdown or oscillation level measurement must occur within 300 seconds.[1]

[1]The time response requirements are provisional and are as determined by the ANSI ASC C63® task group in collaboration and consultation with FCC OET Laboratory Division staff.

5.14.3TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1030 hPa
Humidity: 34 %

Band 2, downlink

Frequency [MHz]	Oscillator Frequency Max. Power [MHz]	Oscillator Max. Power [dBm]	Oscillator Frequency Min. Power [MHz]	Oscillator Min. Power [dBm]	Delta Max.-Min. Power [dB]	Limit Delta Max.-Min. Power [dB]	Margin Delta Max.-Min. Power [dB]
1932.5	1948.3	-83.5	1951.4	-87.6	4.1	12.0	7.9

Band 4, downlink

Frequency [MHz]	Oscillator Frequency Max. Power [MHz]	Oscillator Max. Power [dBm]	Oscillator Frequency Min. Power [MHz]	Oscillator Min. Power [dBm]	Delta Max.-Min. Power [dB]	Limit Delta Max.-Min. Power [dB]	Margin Delta Max.-Min. Power [dB]
2112.5	2117.4	-84.2	2131.5	-87.1	2.9	12.0	9.1

Band 5, downlink

Frequency [MHz]	Oscillator Frequency Max. Power [MHz]	Oscillator Max. Power [dBm]	Oscillator Frequency Min. Power [MHz]	Oscillator Min. Power [dBm]	Delta Max.-Min. Power [dB]	Limit Delta Max.-Min. Power [dB]	Margin Delta Max.-Min. Power [dB]
871.5	874.8	-79.7	878.3	-86.1	6.5	12.0	5.5

Band 12, downlink

Frequency [MHz]	Oscillator Frequency Max. Power [MHz]	Oscillator Max. Power [dBm]	Oscillator Frequency Min. Power [MHz]	Oscillator Min. Power [dBm]	Delta Max.-Min. Power [dB]	Limit Delta Max.-Min. Power [dB]	Margin Delta Max.-Min. Power [dB]
730.5	739.0	-83.7	744.3	-86.0	2.3	12.0	9.7

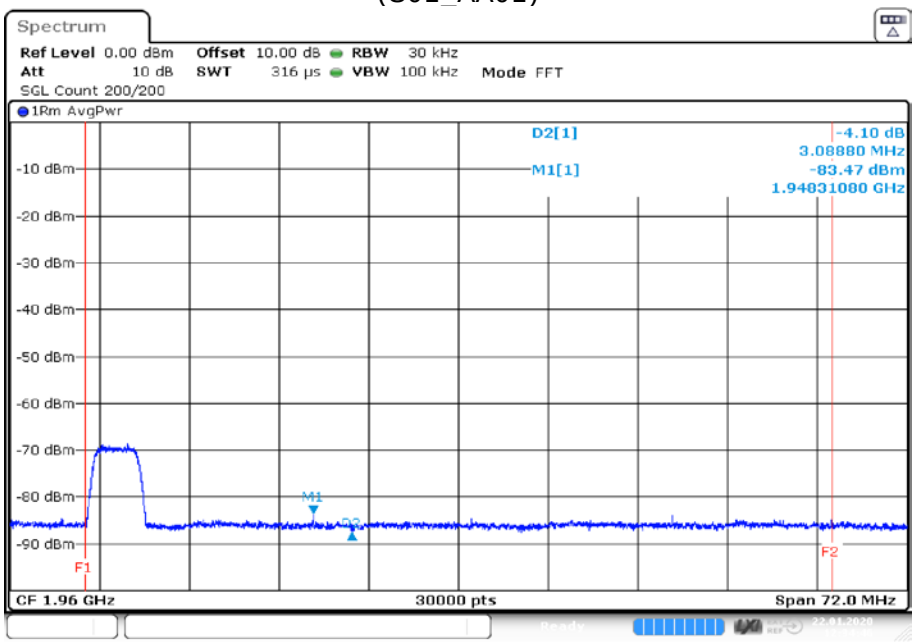
Band 13, downlink

Frequency [MHz]	Oscillator Frequency Max. Power [MHz]	Oscillator Max. Power [dBm]	Oscillator Frequency Max. Power [MHz]	Oscillator Min. Power [dBm]	Delta Max.-Min. Power [dB]	Limit Delta Max.-Min. Power [dB]	Margin Delta Max.-Min. Power [dB]
748.5	755.2	-82.5	751.3	-86.0	3.5	12.0	8.5

Remark: For the uplink, the EUT did not switch on at the KDB's specified value.
Please see next sub-clause for the measurement plot.

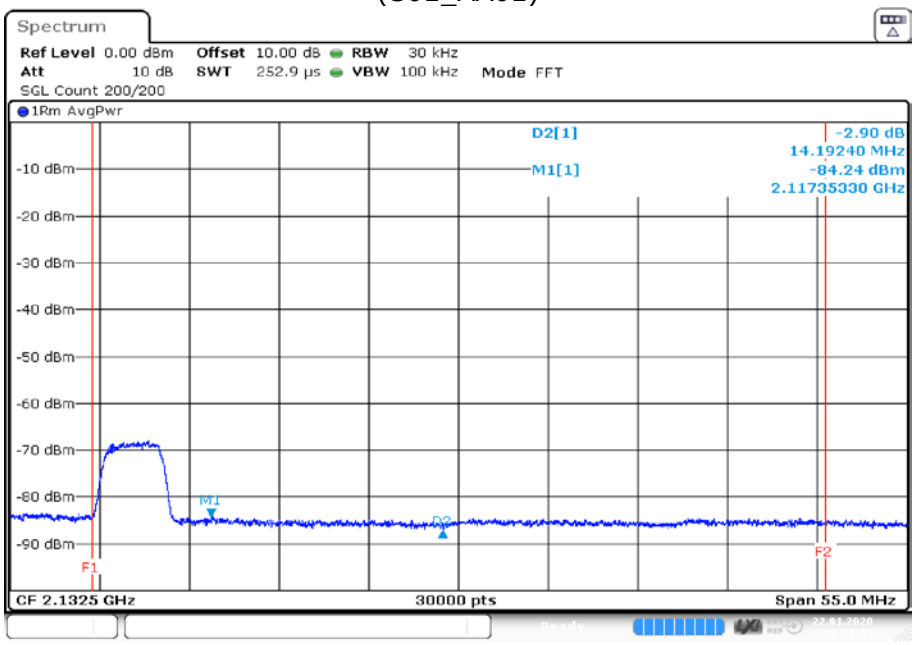
5.14.4MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, “WORST CASE”)

Frequency Band = Band 2, Direction = Downlink
(S01_AA01)



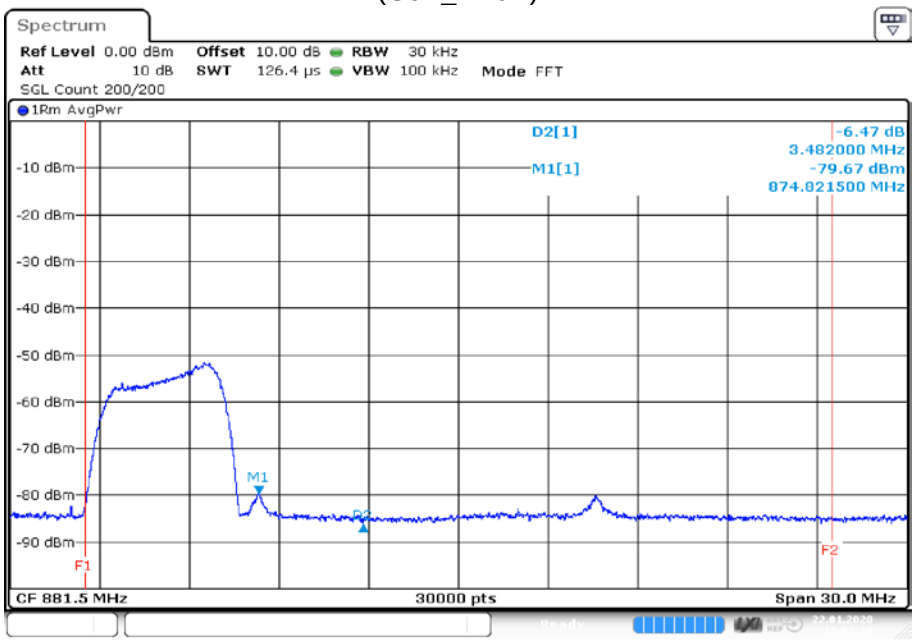
Date: 22.JAN.2020 12:34:46

Frequency Band = Band 4, Direction = Downlink
(S01_AA01)



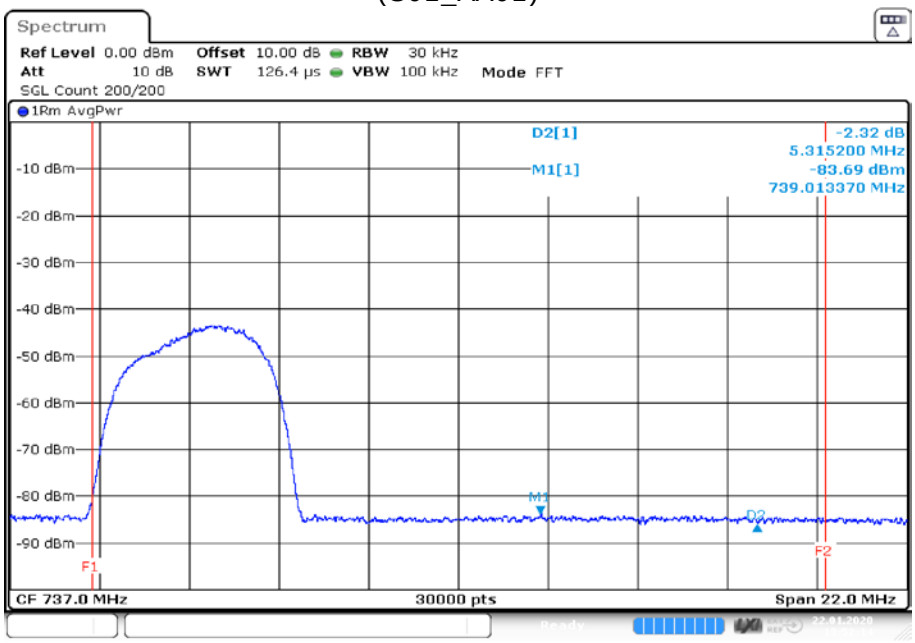
Date: 22.JAN.2020 12:20:36

Frequency Band = Band 5, Direction = Downlink
(S01_AA01)



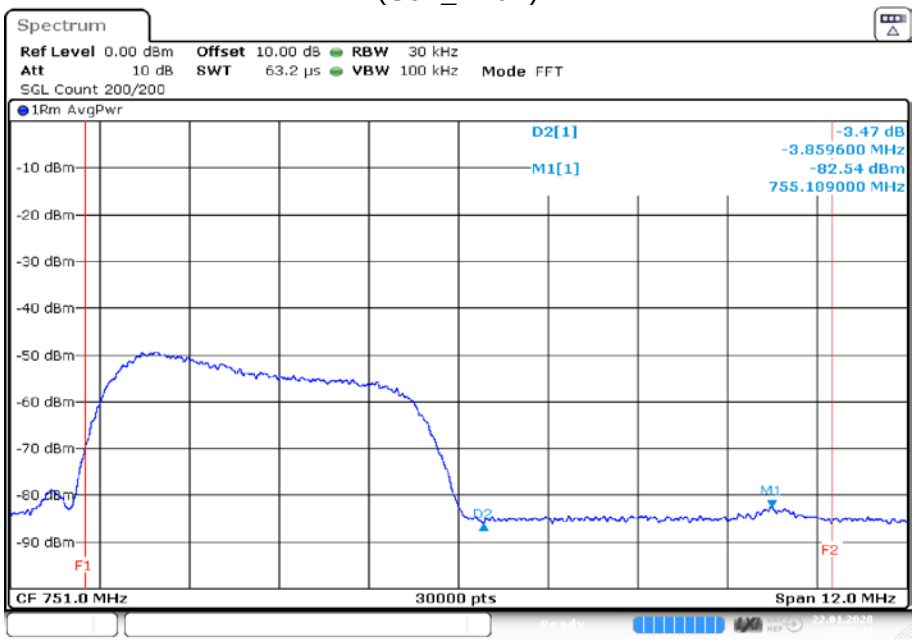
Date: 22.JAN.2020 12:02:10

Frequency Band = Band 12, Direction = Downlink
(S01_AA01)



Date: 22.JAN.2020 13:52:15

Frequency Band = Band 13, Direction = Downlink
(S01_AA01)



Date: 22.JAN.2020 14:14:42

5.14.5TEST EQUIPMENT USED

- R&S TS8997

5.15 RADIATED SPURIOUS EMISSIONS

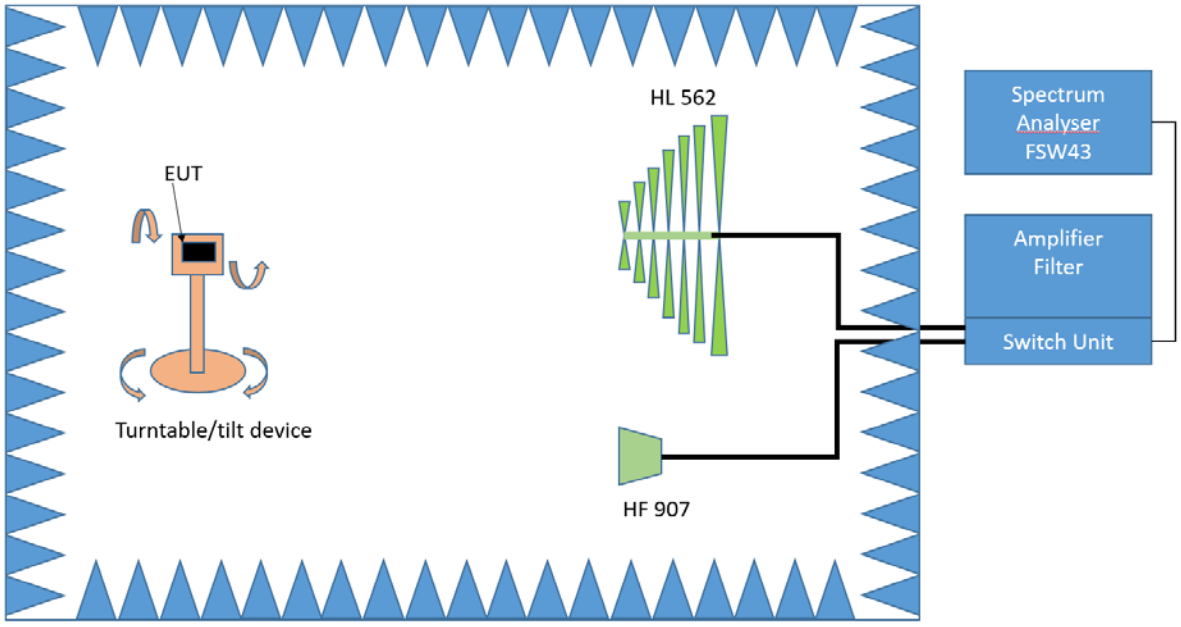
Standard

The test was performed according to:
KDB 935210 D03

5.15.1TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable radiated spurious emission measurements per § 2.1053

The EUT was connected to the test setup according to the following diagram:



FCC Part 20.21; Consumer Signal Booster – Test Setup 7.12; Radiated Spurious Emissions

The test set-up was made in accordance to the general provisions of ANSI C63.4 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

1. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz

- Frequency steps: 30 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: Adjustment measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

Step 1:

The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.

All steps were performed with one height (1.5 m) of the receiving antenna only.

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.

The turn table step size (azimuth angle) for the preliminary measurement is 45 °.

Step 2:

Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.

The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

Step 3:
Spectrum analyser settings for step 3:
- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

5.15.2TEST REQUIREMENTS / LIMITS

FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

FCC Part 20, § 20.21(e)(8)(i)(E)

Out of Band Emission Limits. Booster out of band emissions (OOBE) shall be at least 6 dB below the FCC's mobile emission limits for the supported bands of operation. Compliance to OOBE limits will utilize high peak-to-average CMRS signal types.

Part 22, Subpart H – Cellular Radiotelephone Service; Band 5 (Cellular)

§ 22 917 – Emission limitations for cellular equipment

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

Part 24 E – Personal Communication Services

§ 24.238 – Emission limitations for Broadband PCS equipment; Band 2 (Broadband PCS)

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

Part 27 – Miscellaneous Wireless Communication Services;

Band 4 (AWS-1)
§ 27.53 (h) – Emission limits

(1) *General protection levels.* Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) dB.
(2) *Additional protection levels.* Notwithstanding the foregoing paragraph (h)(1) of this section:
(i) Operations in the 2180-2200 MHz band are subject to the out-of-band emission requirements set forth in §27.1134 for the protection of federal government operations operating in the 2200-2290 MHz band.
(ii) For operations in the 2000-2020 MHz band, the power of any emissions below 2000 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 $\log_{10}$(P) dB.
(iii) For operations in the 1915-1920 MHz band, the power of any emission between 1930-1995 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 $\log_{10}$(P) dB.
(iv) For operations in the 1995-2000 MHz band, the power of any emission between 2005-2020 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 $\log_{10}$(P) dB.
Band 12 (Lower 700 MHz)
§ 27.53 (g) – Emission limits

For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed

Band 13 (Upper 700 MHz)
§ 27.53 (c), (f) – Emission limits

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the

frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

5.15.3TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1036 hPa
Humidity: 33 %

Band 2, downlink; Center frequency: 1960.00 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	-22.9	RMS	1000	-19.0	>6

Band 4, downlink; Center frequency: 2132.50 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	-23.9	RMS	1000	-19.0	>6

Band 5, downlink; Center frequency: 881.5.0 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	-21.2	RMS	100	-19.0	>6

Band 12, downlink; Center frequency: 737.00 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	-20.9	RMS	100	-19.0	>6

Band 13, downlink; Center frequency: 751.00 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	-21.8	RMS	100	-19.0	>6

Band 2, uplink; Center frequency: 1880.00 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	0.3	RMS	1000	-19.0	>6

Band 4, uplink; Center frequency: 1732.50 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	-0.1	RMS	1000	-19.0	>6

Band 5, uplink; Center frequency: 836.50 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	0.4	RMS	100	-19.0	>6

Band 12, uplink; Center frequency: 707.00 MHz

Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	0.7	RMS	100	-19.0	>6

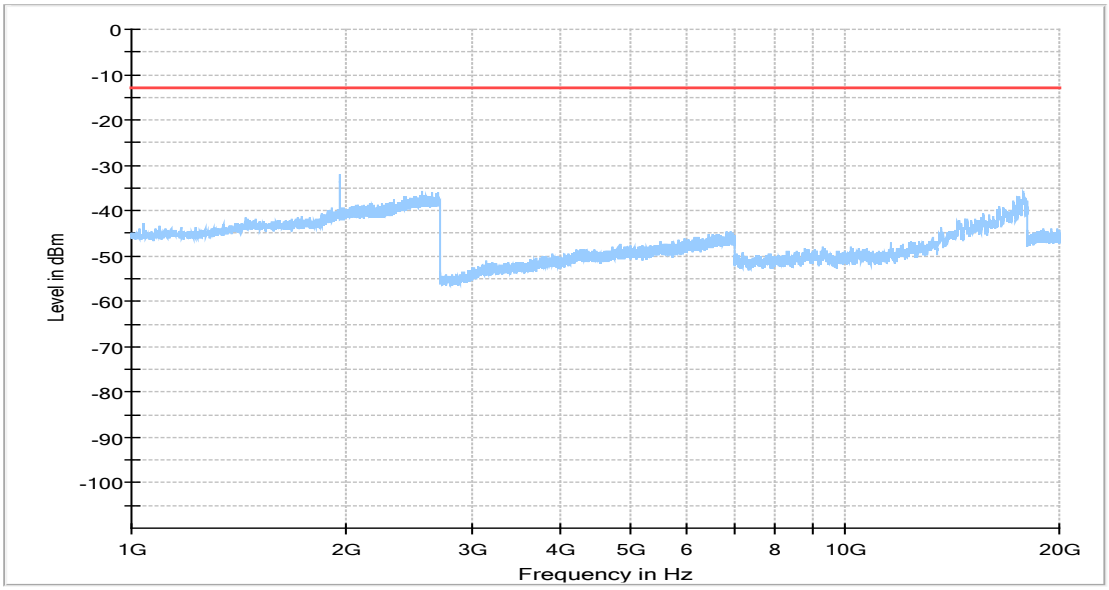
Band 13, uplink; Center frequency: 782.00 MHz

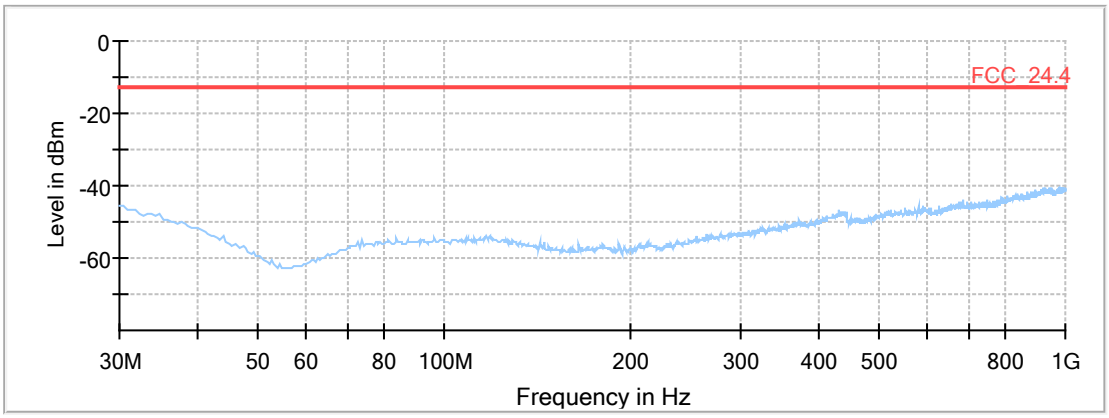
Spurious Freq. [MHz]	Spurious Level [dBm]	Pin [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
-	-	-0.1	RMS	100	-19.0	>6

Remark: Please see next sub-clause for the measurement plot.

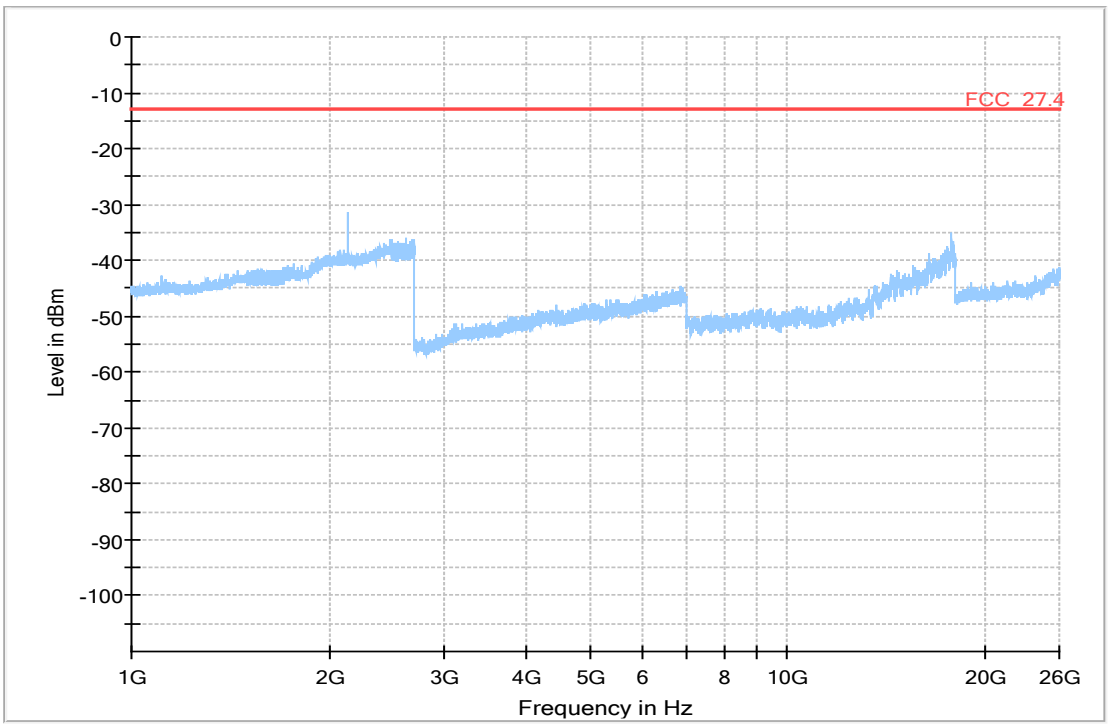
5.15.4MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, “WORST CASE”)

Frequency Band = Band 2, Direction = Downlink
(S01_AB01)

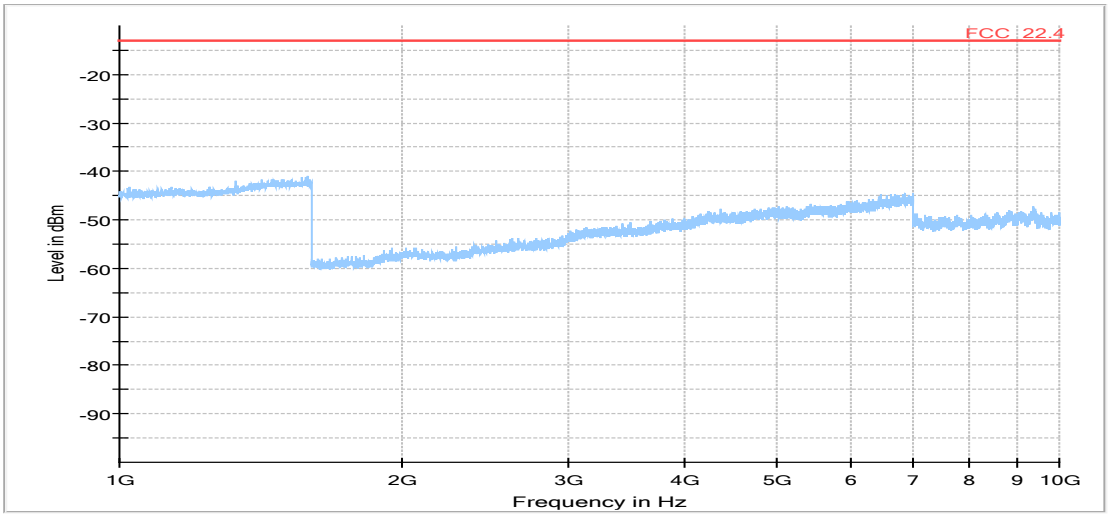


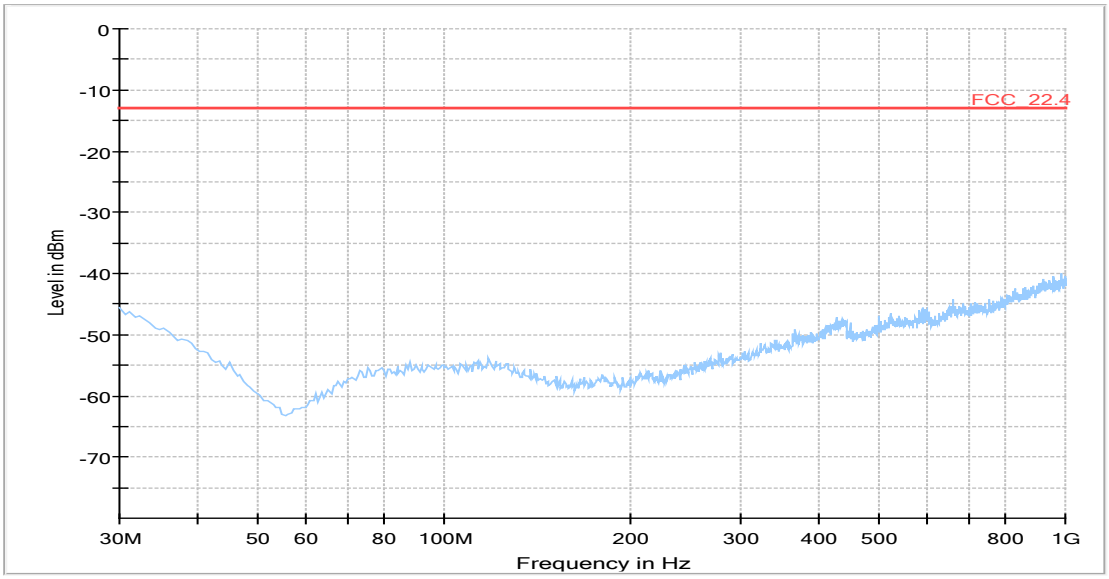


Frequency Band = Band 4, Direction = Downlink
(S01_AB01)

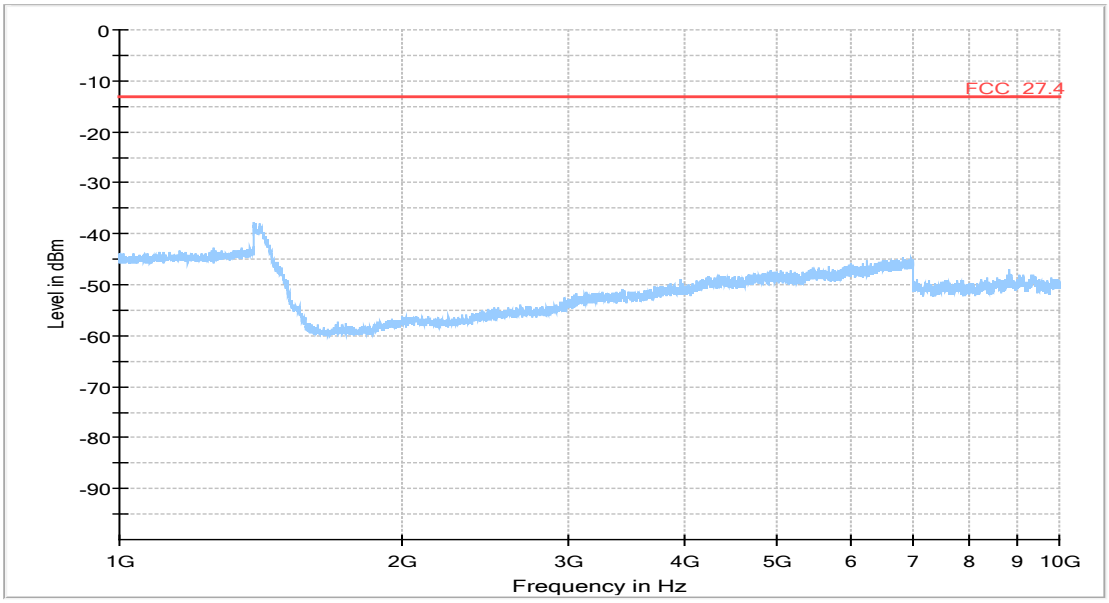


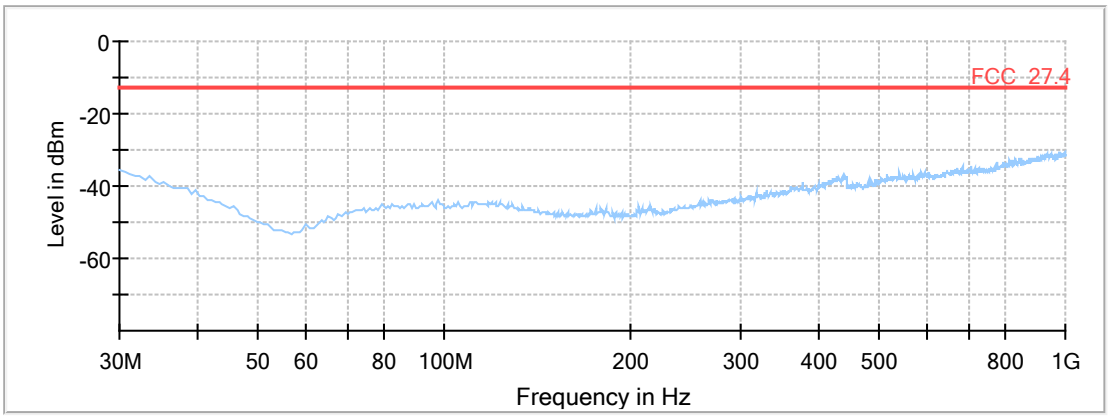
Frequency Band = Band 5, Direction = Downlink
(S01_AB01)



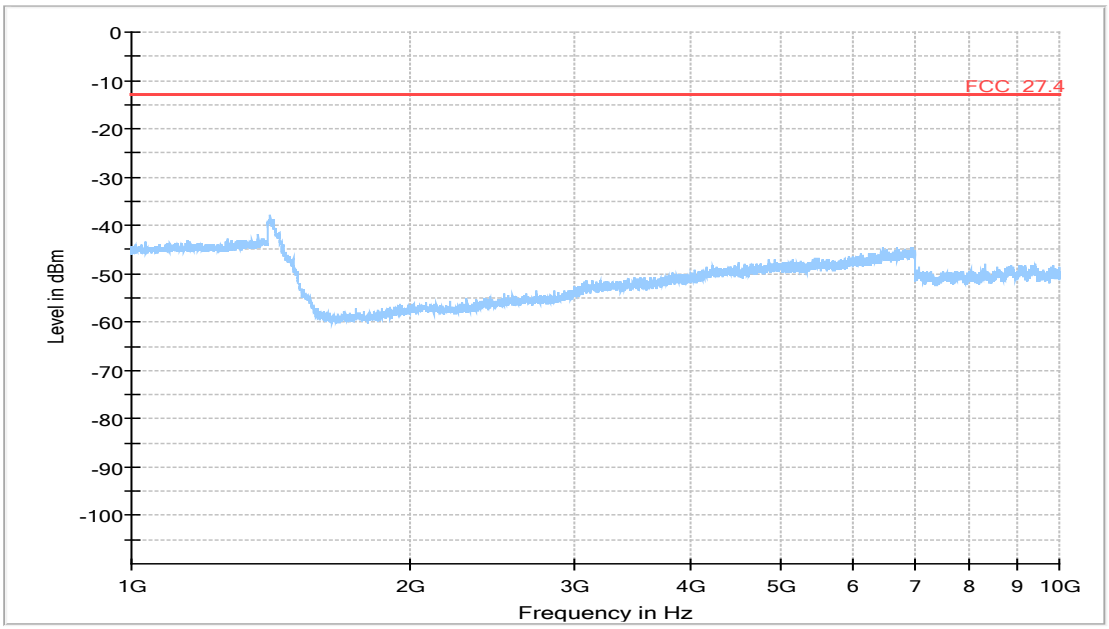


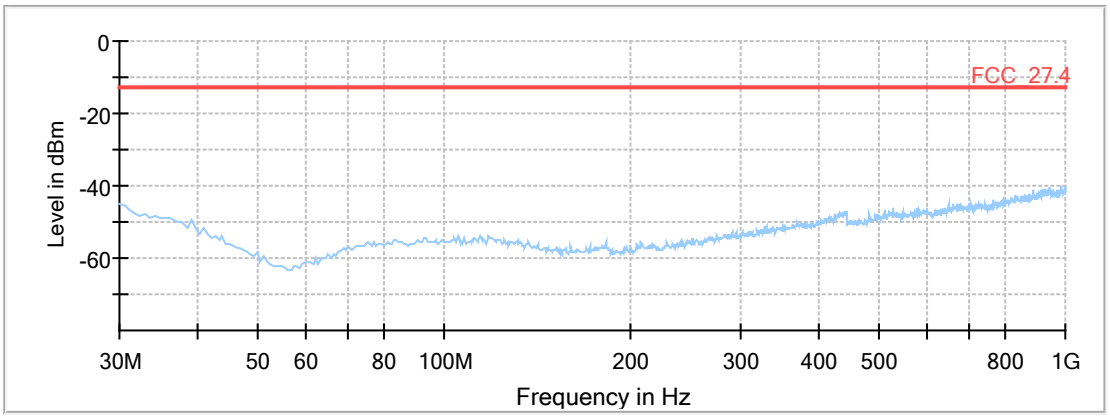
Frequency Band = Band 12, Direction = Downlink
(S01_AB01)



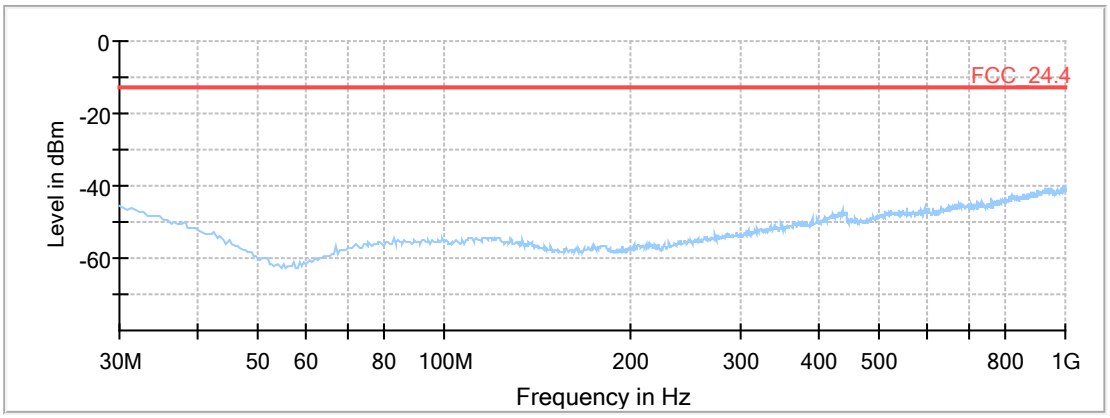


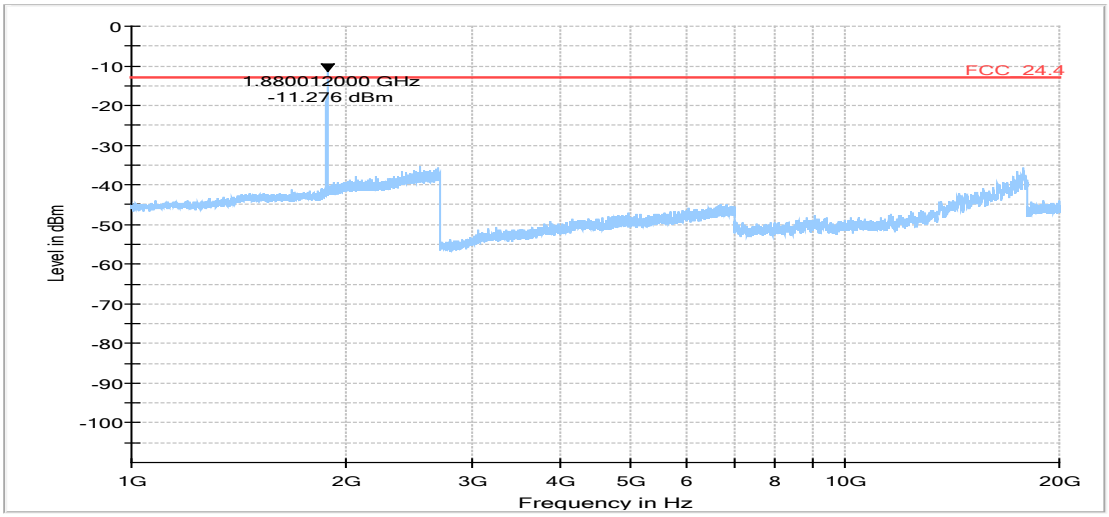
Frequency Band = Band 13, Direction = Downlink
(S01_AB01)





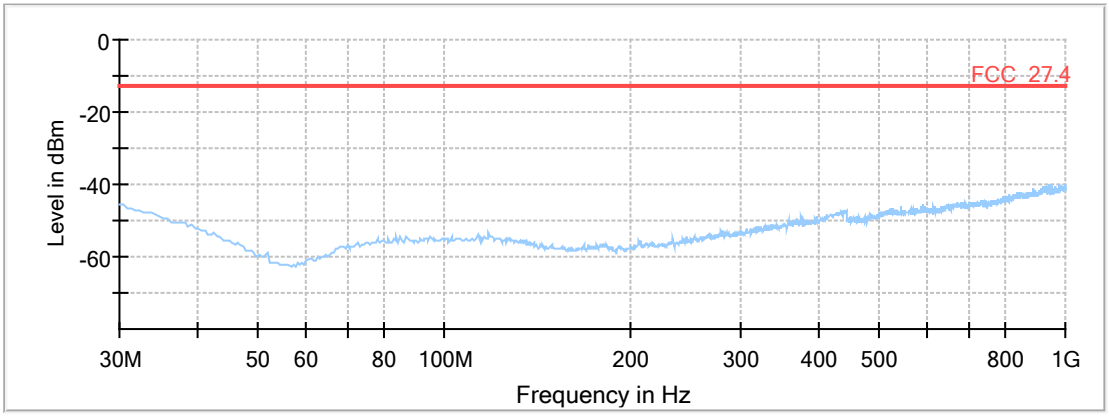
Frequency Band = Band 2, Direction = Uplink
(S01_AB01)

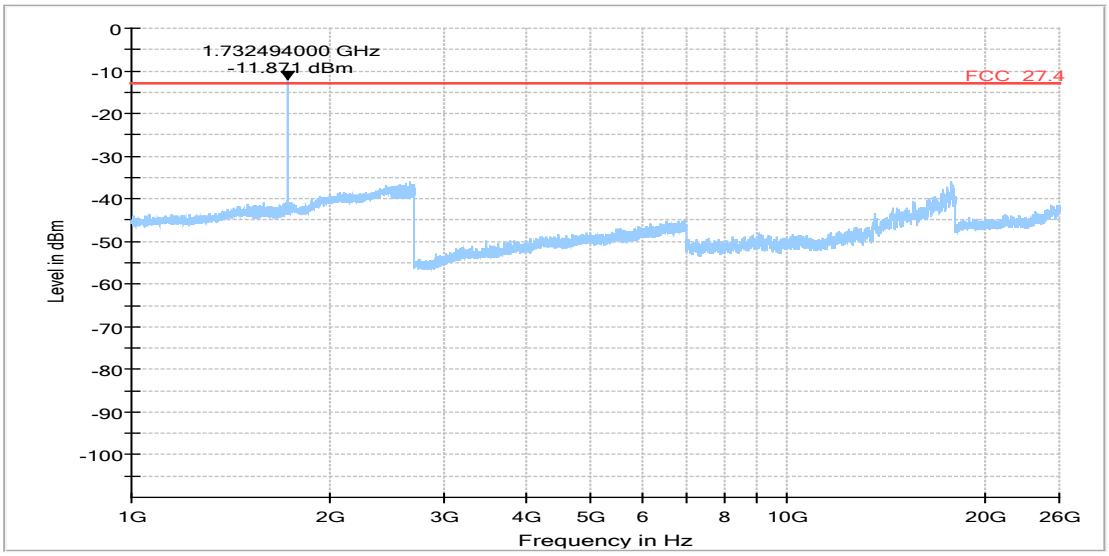




Note: The peak is the intentional radiator. It is not to be compared to the limit.

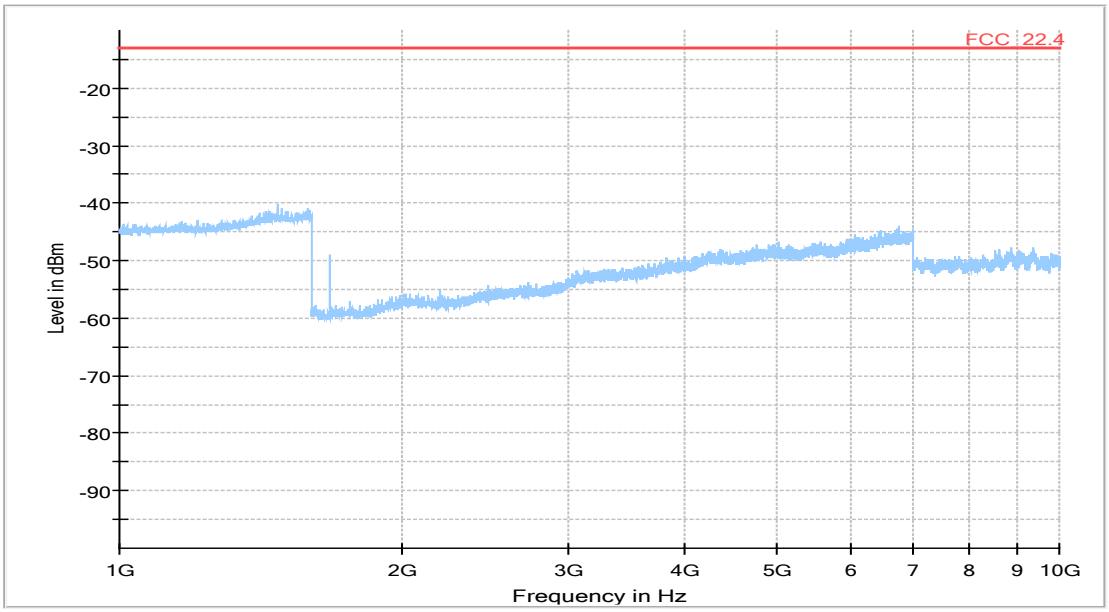
Frequency Band = Band 4, Direction = Uplink
(S01_AB01)

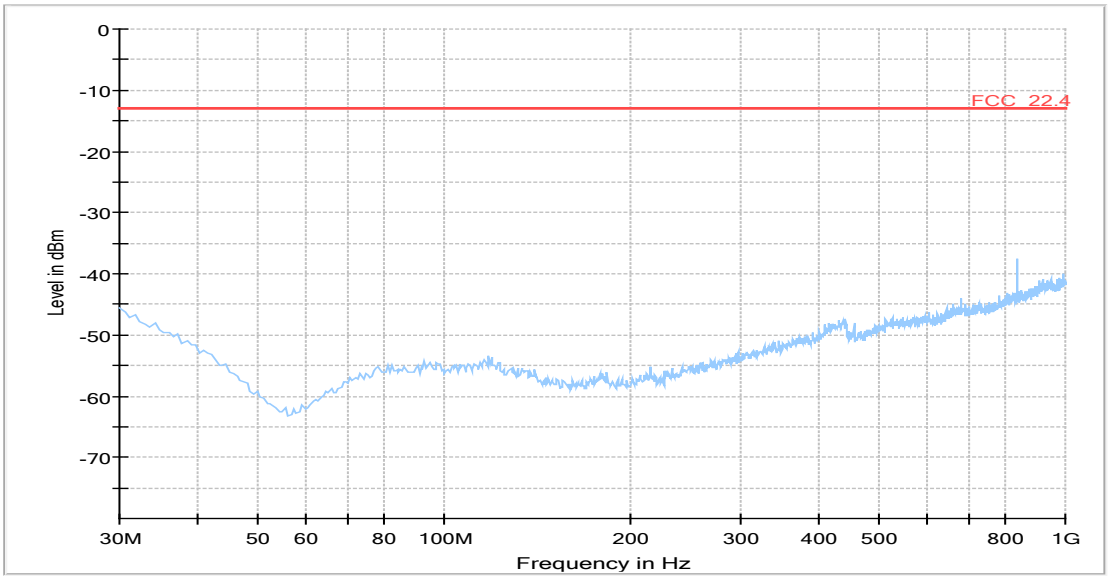




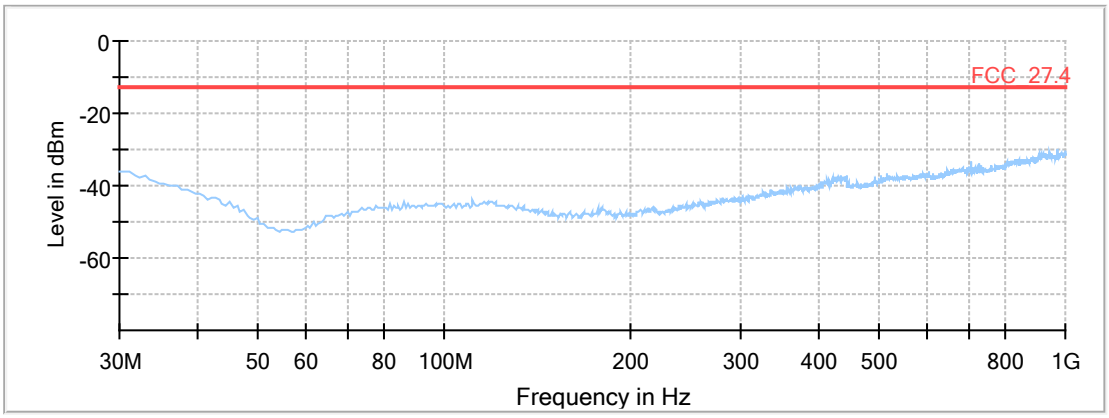
Note: The peak is the intentional radiator. It is not to be compared to the limit.

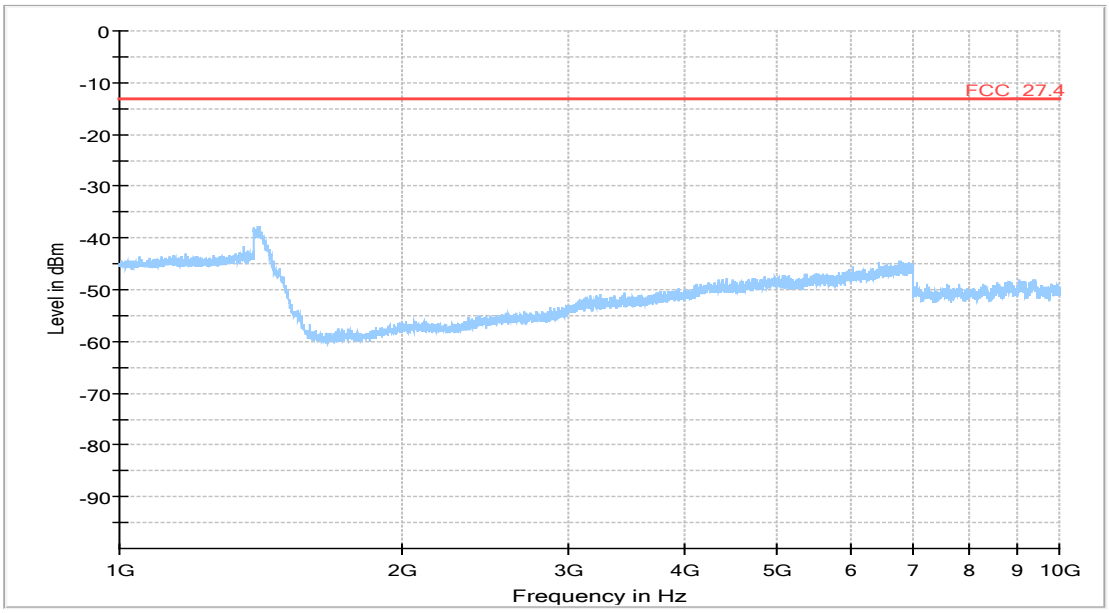
Frequency Band = Band 5, Direction = Uplink
(S01_AB01)



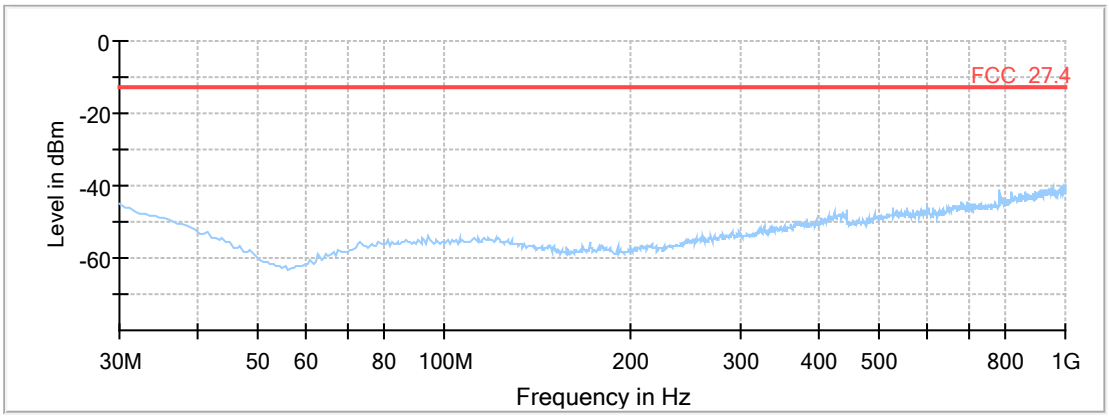


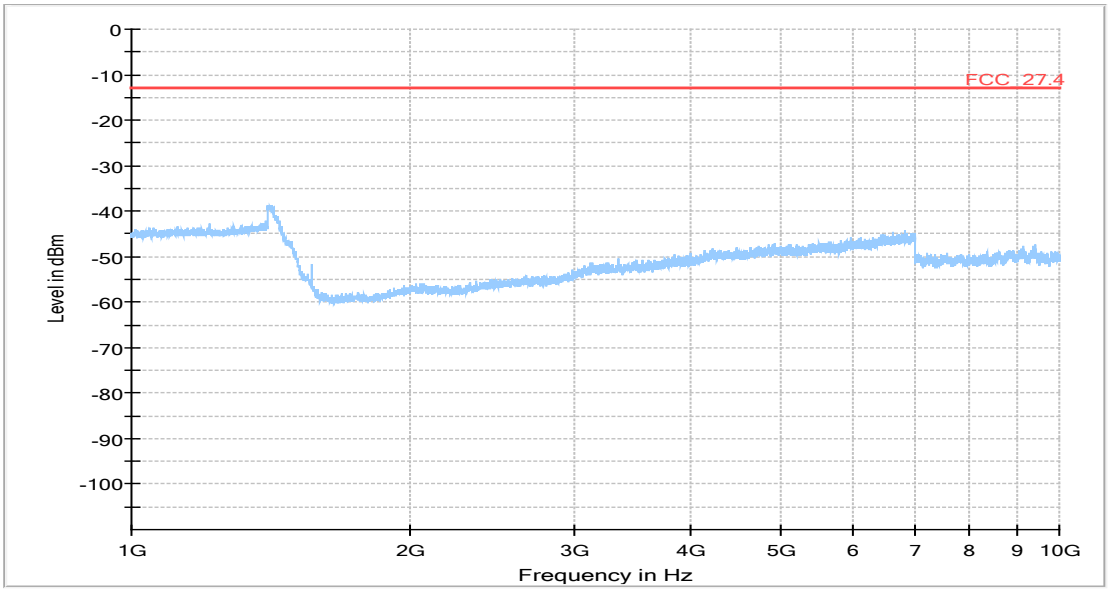
Frequency Band = Band 12, Direction = Uplink
(S01_AB01)





Frequency Band = Band 13, Direction = Uplink
(S01_AB01)





5.15.5TEST EQUIPMENT USED

- Radiated Emissions

6 TEST EQUIPMENT

1 R&S TS8997
EN300328/301893 Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	107695	2017-07	2020-07
1.2	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2018-04	2020-04
1.3	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2018-04	2020-04
1.4	Temperature Chamber VT 4002	Temperature Chamber Vötsch 03	Vötsch	58566002150010	2018-04	2020-04
1.5	A8455-4	4 Way Power Divider (SMA)		-		
1.6	Opus10 THI (8152.00)	T/H Logger 03	Lufft Mess- und Regeltechnik GmbH	7482	2019-06	2021-06
1.7	SMBV100A	Vector Signal Generator 9 kHz – 3.2 GHz	Rohde & Schwarz.	260001	2018-01	2021-01
1.8	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2019-11	2022-11
1.9	OSP120	Switching Unit with integrated power meter	Rohde & Schwarz	101158	2018-05	2021-05

2 Radiated Emissions
Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2019-10	2020-10
2.2	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515		
2.3	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2019-05	2021-05
2.4	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2019-12	2021-12
2.5	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia	none	2018-06	2020-06
2.6	HL 562 ULTRALOG	Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2018-07	2021-07

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.7	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq			
2.8	5HC2700/12750-1.5-KK	High Pass Filter	Trilithic	9942012		
2.9	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
2.10	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	2018-06	2020-06
2.11	SMBV100A	Vector Signal Generator 9 kHz - 3.2 GHz (GNSS / Broadcast Signalling Unit)	Rohde & Schwarz GmbH & Co. KG	260001	2018-01	2021-01
2.12	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2018-04	2020-04
2.13	WRD1920/1980-5/22-5EESD	Tunable Band Reject Filter	Wainwright Instruments GmbH	11		
2.14	PONTIS Con4101	PONTIS Camera Controller		6061510370		
2.15	NRVD	Power Meter	Rohde & Schwarz GmbH & Co. KG	828110/016	2019-08	2020-08
2.16	HF 906	Double-ridged horn	Rohde & Schwarz	357357/002	2018-09	2021-09
2.17	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
2.18	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2019-02	2021-02
2.19	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic GmbH	00083069		
2.20	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09		
2.21	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99		
2.22	4HC1600/12750-1.5-KK	High Pass Filter	Trilithic	9942011		
2.23	WRCD1879.8-0.2/40-10EE	Notch Filter Ultra Stable	Wainwright Instruments GmbH	16		
2.24	SMB100A	Signal Generator 100 kHz - 40 GHz	Rohde & Schwarz Vertriebs-GmbH	181486	2019-11	2021-11
2.25	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
2.26	TT 1.5 WI	Turn Table	Maturo GmbH	-		
2.27	HL 562 ULTRALOG	Biconical-log-per Antenna (30 MHz - 3 GHz)	Rohde & Schwarz GmbH & Co. KG	100609	2019-05	2022-05

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.28	HF 906	Double-ridged horn	Rohde & Schwarz	357357/001	2018-03	2021-03
2.29	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronic GmbH	00086675		
2.30	MA4985-XP-ET	Bore Sight Antenna Mast	innco systems GmbH	none		
2.31	A8455-4	4 Way Power Divider (SMA)		-		
2.32	JUN-AIR Mod. 6-15	Air Compressor	JUN-AIR Deutschland GmbH	612582		
2.33	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008		
2.34	HFH2-Z2	Loop Antenna	Rohde & Schwarz	829324/006	2018-01	2021-01
2.35	Opus10 THI (8152.00)	T/H Logger 12	Lufft Mess- und Regeltechnik GmbH	12482	2019-06	2021-06
2.36	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
2.37	AS 620 P	Antenna Mast (pneumatic polarisation)	HD GmbH	620/37		
2.38	6005D (30 V / 5 A)	Laboratory Power Supply 120 V 60 Hz	Peaktech	81062045		
2.39	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709		
2.40	Innco Systems CO3000	Controller for bore sight mast SAC	innco systems GmbH	CO3000/967/39371016/L		
2.41	NRV-Z1	Sensor Head B	Rohde & Schwarz GmbH & Co. KG	827753/006	2019-08	2020-08
2.42	HF 907-2	Double-ridged horn	Rohde & Schwarz	102817	2019-04	2022-04
2.43	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
2.44	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324		
2.45	WRCA800/960-0.2/40-6EEK	Tunable Notch Filter	Wainwright Instruments GmbH	20		
2.46	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/11920513		
2.47	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2018-07	2021-07

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

7 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

7.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB atten-uator)
MHz		dB	dB	dB
0.15		10.1	0.1	10.0
5		10.3	0.1	10.2
7		10.5	0.2	10.3
10		10.5	0.2	10.3
12		10.7	0.3	10.4
14		10.7	0.3	10.4
16		10.8	0.4	10.4
18		10.9	0.4	10.5
20		10.9	0.4	10.5
22		11.1	0.5	10.6
24		11.1	0.5	10.6
26		11.2	0.5	10.7
28		11.2	0.5	10.7
30		11.3	0.5	10.8

Sample calculation

U_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

7.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
0.009	20.50	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.01	20.45	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.015	20.37	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.02	20.36	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.025	20.38	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.03	20.32	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.05	20.35	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.08	20.30	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.1	20.20	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.2	20.17	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.3	20.14	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.49	20.12	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.490001	20.12	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.5	20.11	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.8	20.10	-39.6	0.1	0.1	0.1	0.1	-40	30	3
1	20.09	-39.6	0.1	0.1	0.1	0.1	-40	30	3
2	20.08	-39.6	0.1	0.1	0.1	0.1	-40	30	3
3	20.06	-39.6	0.1	0.1	0.1	0.1	-40	30	3
4	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
5	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
6	20.02	-39.5	0.2	0.1	0.1	0.1	-40	30	3
8	19.95	-39.5	0.2	0.1	0.1	0.1	-40	30	3
10	19.83	-39.4	0.2	0.1	0.2	0.1	-40	30	3
12	19.71	-39.4	0.2	0.1	0.2	0.1	-40	30	3
14	19.54	-39.4	0.2	0.1	0.2	0.1	-40	30	3
16	19.53	-39.3	0.3	0.1	0.2	0.1	-40	30	3
18	19.50	-39.3	0.3	0.1	0.2	0.1	-40	30	3
20	19.57	-39.3	0.3	0.1	0.2	0.1	-40	30	3
22	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
24	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
26	19.54	-39.3	0.3	0.1	0.2	0.1	-40	30	3
28	19.46	-39.2	0.3	0.1	0.3	0.1	-40	30	3
30	19.73	-39.1	0.4	0.1	0.3	0.1	-40	30	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

7.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18.6	0.6	0.29	0.04	0.23	0.02	0.0	3	3
50	6.0	0.9	0.39	0.09	0.32	0.08	0.0	3	3
100	9.7	1.2	0.56	0.14	0.47	0.08	0.0	3	3
150	7.9	1.6	0.73	0.20	0.59	0.12	0.0	3	3
200	7.6	1.9	0.84	0.21	0.70	0.11	0.0	3	3
250	9.5	2.1	0.98	0.24	0.80	0.13	0.0	3	3
300	11.0	2.3	1.04	0.26	0.89	0.15	0.0	3	3
350	12.4	2.6	1.18	0.31	0.96	0.13	0.0	3	3
400	13.6	2.9	1.28	0.35	1.03	0.19	0.0	3	3
450	14.7	3.1	1.39	0.38	1.11	0.22	0.0	3	3
500	15.6	3.2	1.44	0.39	1.20	0.19	0.0	3	3
550	16.3	3.5	1.55	0.46	1.24	0.23	0.0	3	3
600	17.2	3.5	1.59	0.43	1.29	0.23	0.0	3	3
650	18.1	3.6	1.67	0.34	1.35	0.22	0.0	3	3
700	18.5	3.6	1.67	0.42	1.41	0.15	0.0	3	3
750	19.1	4.1	1.87	0.54	1.46	0.25	0.0	3	3
800	19.6	4.1	1.90	0.46	1.51	0.25	0.0	3	3
850	20.1	4.4	1.99	0.60	1.56	0.27	0.0	3	3
900	20.8	4.7	2.14	0.60	1.63	0.29	0.0	3	3
950	21.1	4.8	2.22	0.60	1.66	0.33	0.0	3	3
1000	21.6	4.9	2.23	0.61	1.71	0.30	0.0	3	3

(d_{Limit} = 10 m)

30	18.6	-9.9	0.29	0.04	0.23	0.02	-10.5	10	3
50	6.0	-9.6	0.39	0.09	0.32	0.08	-10.5	10	3
100	9.7	-9.2	0.56	0.14	0.47	0.08	-10.5	10	3
150	7.9	-8.8	0.73	0.20	0.59	0.12	-10.5	10	3
200	7.6	-8.6	0.84	0.21	0.70	0.11	-10.5	10	3
250	9.5	-8.3	0.98	0.24	0.80	0.13	-10.5	10	3
300	11.0	-8.1	1.04	0.26	0.89	0.15	-10.5	10	3
350	12.4	-7.9	1.18	0.31	0.96	0.13	-10.5	10	3
400	13.6	-7.6	1.28	0.35	1.03	0.19	-10.5	10	3
450	14.7	-7.4	1.39	0.38	1.11	0.22	-10.5	10	3
500	15.6	-7.2	1.44	0.39	1.20	0.19	-10.5	10	3
550	16.3	-7.0	1.55	0.46	1.24	0.23	-10.5	10	3
600	17.2	-6.9	1.59	0.43	1.29	0.23	-10.5	10	3
650	18.1	-6.9	1.67	0.34	1.35	0.22	-10.5	10	3
700	18.5	-6.8	1.67	0.42	1.41	0.15	-10.5	10	3
750	19.1	-6.3	1.87	0.54	1.46	0.25	-10.5	10	3
800	19.6	-6.3	1.90	0.46	1.51	0.25	-10.5	10	3
850	20.1	-6.0	1.99	0.60	1.56	0.27	-10.5	10	3
900	20.8	-5.8	2.14	0.60	1.63	0.29	-10.5	10	3
950	21.1	-5.6	2.22	0.60	1.66	0.33	-10.5	10	3
1000	21.6	-5.6	2.23	0.61	1.71	0.30	-10.5	10	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit, atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24.4	-19.4	0.99	0.31	-21.51	0.79		
2000	28.5	-17.4	1.44	0.44	-20.63	1.38		
3000	31.0	-16.1	1.87	0.53	-19.85	1.33		
4000	33.1	-14.7	2.41	0.67	-19.13	1.31		
5000	34.4	-13.7	2.78	0.86	-18.71	1.40		
6000	34.7	-12.7	2.74	0.90	-17.83	1.47		
7000	35.6	-11.0	2.82	0.86	-16.19	1.46		

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit, atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31.0	-23.4	0.47	1.87	0.53	-27.58	1.33	
4000	33.1	-23.3	0.56	2.41	0.67	-28.23	1.31	
5000	34.4	-21.7	0.61	2.78	0.86	-27.35	1.40	
6000	34.7	-21.2	0.58	2.74	0.90	-26.89	1.47	
7000	35.6	-19.8	0.66	2.82	0.86	-25.58	1.46	

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35.6	-57.3	0.56	1.28	-62.72	2.66	0.94	1.46
8000	36.3	-56.3	0.69	0.71	-61.49	2.84	1.00	1.53
9000	37.1	-55.3	0.68	0.65	-60.80	3.06	1.09	1.60
10000	37.5	-56.2	0.70	0.54	-61.91	3.28	1.20	1.67
11000	37.5	-55.3	0.80	0.61	-61.40	3.43	1.27	1.70
12000	37.6	-53.7	0.84	0.42	-59.70	3.53	1.26	1.73
13000	38.2	-53.5	0.83	0.44	-59.81	3.75	1.32	1.83
14000	39.9	-56.3	0.91	0.53	-63.03	3.91	1.40	1.77
15000	40.9	-54.1	0.98	0.54	-61.05	4.02	1.44	1.83
16000	41.3	-54.1	1.23	0.49	-61.51	4.17	1.51	1.85
17000	42.8	-54.4	1.36	0.76	-62.36	4.34	1.53	2.00
18000	44.2	-54.7	1.70	0.53	-62.88	4.41	1.55	1.91

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

Frequency	AF EMCO 3160-09	Corr.	cable loss 1 (inside chamber)	cable loss 2 (pre-amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable loss 5 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB
18000	40.2	-23.5	0.72	-35.85	6.20	2.81	2.65
18500	40.2	-23.2	0.69	-35.71	6.46	2.76	2.59
19000	40.2	-22.0	0.76	-35.44	6.69	3.15	2.79
19500	40.3	-21.3	0.74	-35.07	7.04	3.11	2.91
20000	40.3	-20.3	0.72	-34.49	7.30	3.07	3.05
20500	40.3	-19.9	0.78	-34.46	7.48	3.12	3.15
21000	40.3	-19.1	0.87	-34.07	7.61	3.20	3.33
21500	40.3	-19.1	0.90	-33.96	7.47	3.28	3.19
22000	40.3	-18.7	0.89	-33.57	7.34	3.35	3.28
22500	40.4	-19.0	0.87	-33.66	7.06	3.75	2.94
23000	40.4	-19.5	0.88	-33.75	6.92	3.77	2.70
23500	40.4	-19.3	0.90	-33.35	6.99	3.52	2.66
24000	40.4	-19.8	0.88	-33.99	6.88	3.88	2.58
24500	40.4	-19.5	0.91	-33.89	7.01	3.93	2.51
25000	40.4	-19.3	0.88	-33.00	6.72	3.96	2.14
25500	40.5	-20.4	0.89	-34.07	6.90	3.66	2.22
26000	40.5	-21.3	0.86	-35.11	7.02	3.69	2.28
26500	40.5	-21.1	0.90	-35.20	7.15	3.91	2.36

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

7.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

Frequency	AF EMCO 3160-10	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

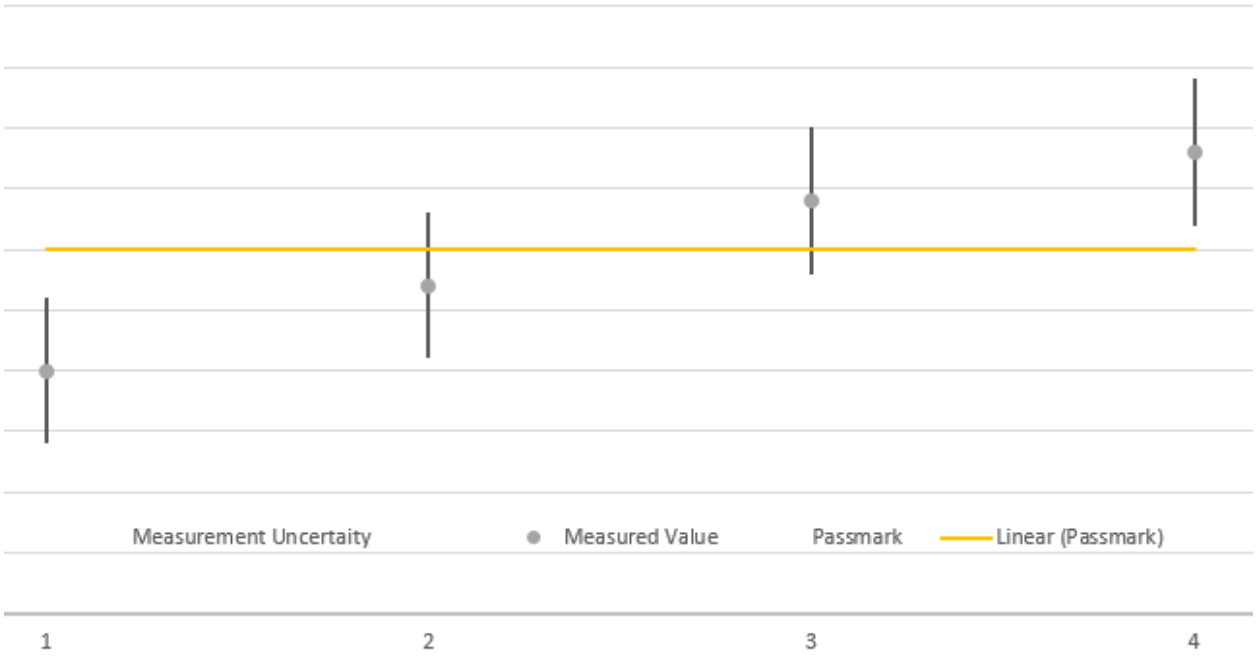
Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

8 MEASUREMENT UNCERTAINTIES

Test Case(s)	Parameter	Uncertainty
7.12 - Radiated Spurious Emissions	Power	± 5.5 dB
7.1 -Authorized Frequency Band 7.10 - Occupied Bandwidth (99%)	Power Frequency	± 2.9 dB ± 11.2 kHz
7.2 - Maximum Power 7.3 - Maximum Booster Gain 7.4 – Intermodulation 7.7.1 – Maximum TX Power Noise, 7.7.2 - Variable Uplink Noise 7.8 - Uplink Inactivity 7.9.1 - Variable Gain,	Power	± 2.2 dB
7.9.2 - Variable Uplink Gain Timing 7.11.2 - Oscillation Shutdown 7.11.3 - Oscillation Mitigation	Power Time	± 2.2 dB ± 1 x 10^{-4}s ± 120 x 10^{-3}s
7.5 - Out-of-band emissions 7.6 – Conducted Spurious Emissions	Power Frequency	± 2.2 dB ± 11.2 kHz

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) k = 1.96. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	above pass mark	within pass mark	Failed
4	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so called shared risk principle.

9 PHOTO REPORT

Please see separate photo report.