Appendix C: Test results FCC Part 27 / RSS-139, RSS-130

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TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 12 Vdc

Type of Power Supply: External power supply (Car Battery).

ANTENNA:

Type of Antennas: Internal.

Maximum Declared Gain for Bluetooth LE: +1.7 dBi

Maximum Declared Gain for WLAN 2.4 GHz: +5.9 dBi

Maximum Declared Gain for WLAN 5 GHz U-NII-1: +3.6 dBi

Maximum Declared Gain for WLAN 5 GHz U-NII-3: +5.2 dBi

Maximum Declared Gain for CELLULAR:

MIDDLE Band	GAIN	ANTENNA TYPE
3G Band IV (1700 MHz) WCMDA LTE Band 4 (1700 MHz)	+5.9 dBi	Internal (3D)

HIGH Band	GAIN	ANTENNA TYPE
LTE Band 7 (2600 MHz)	+5.9 dBi	Internal (3D)

LOW Band	GAIN	ANTENNA TYPE
LTE Band 12 (700 MHz) LTE Band 17 (700 MHz) LTE Band 13 (700MHz)	+5.9 dBi	Internal (3D)

TEST FREQUENCIES:

	CELLULAR 3G (Band IV) (worst case of antenna)	
Band:	3G Band IV	
Frequency Range:	1710 – 1755 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Low:	1712.4

	CELLULAR LTE (Bands 7, 12) (worst case of antenna)	
Band:	LTE 7	
Frequency Range:	2500 – 2570 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	High: 21400	2565
Band:	LTE 12	
Frequency Range:	699 – 716 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Middle: 23060	704

	WLAN (IEEE 802.11 anac) / U-NII (worst case of antenna)	
Mode:	802.11 a20: MCS0	
Frequency Range:	5150 MHz to 5250 MHz (U-NII-1)	
Channel Spacing:	20 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Low: 36	5180
Frequency Range:	5725 MHz to 5850 MHz (U-NII-3)	
Channel Spacing:	20 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Highest: 165	5825

	WLAN (IEEE 802.11 bgn2040) / Digital Transmission System (DTS) (worst case of antenna)	
Mode:	802.11 b: 1, 2, 5.5 & 11 Mbps (SISO)	
Channel Spacing:	20 MHz	
Frequency Range:	2412 MHz to 2472 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	1	2412
	11	2462

	Bluetooth LE	
Mode:	GFSK	
Channel Spacing:	1 MHz	
Frequency Range:	2400 MHz to 2483.5 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	39	2480
	37	2402

The test set-up was made in accordance to the general provisions of FCC DTS Measurement 558074 D01 DTS Meas Guidance v05r02 dated April 2, 2019 and FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The EUT was tested in the following operating mode:

- Continuous transmission with a modulated carrier at maximum power in all required channels selecting the supported data rates/modulations types.

During transmitter test the EUT was being controlled by the SW tool to operate in a continuous transmit mode on the test channel as required and in each of the different modulation modes.

The following configurations were selected based on preliminary testing that identified those corresponding to the worst cases:

Transmission modes selected with each radio:

* CELLULAR: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 3G band IV and LTE bands 7, 12 configuration as these channels were found to transmit higher EIRP than all the other LTE bands.

* 5 GHz WLAN: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 a20 / 6Mbps mode configuration as this mode was found to transmit higher EIRP than all the other 5 GHz WLAN modes.

* 2.4 GHz WLAN: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 b / 1Mbps mode configuration as this mode was found to transmit higher EIRP than all the other 2.4 GHz WLAN modes.

* BLUETOOTH: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in Bluetooth Low Energy (GFSK) mode configuration.

Simultaneous transmission modes selected:

1. CELLULAR 3G, WLAN 2.4 GHz, BLUETOOTH Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR 3G Band IV, WLAN 2.4 GHz in 802.11 b / 1 Mbps, Bluetooth Low Energy / GFSK.

2. CELLULAR 3G, WLAN 5 GHz, BLUETOOTH Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR 3G Band IV, WLAN 5 GHz (U-NII-1) in 802.11 a20 / 6 Mbps, Bluetooth Low Energy / GFSK.

3. CELLULAR 3G, WLAN 5 GHz, BLUETOOTH Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR 3G Band IV, WLAN 5 GHz (U-NII-3) in 802.11 a20 / 6 Mbps, Bluetooth Low Energy / GFSK.

4. CELLULAR LTE, WLAN 2.4 GHz, BLUETOOTH Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR LTE Band 7, WLAN 2.4 GHz in 802.11 b / 1 Mbps, Bluetooth Low Energy / GFSK.

5. CELLULAR LTE, WLAN 5 GHz, BLUETOOTH Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR LTE Band 7, WLAN 5 GHz (U-NII-1) in 802.11 a20 / 6 Mbps, Bluetooth Low Energy / GFSK.

6. CELLULAR LTE, WLAN 5 GHz, BLUETOOTH Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR LTE Band 7, WLAN 5 GHz (U-NII-3) in 802.11 a20 / 6 Mbps, Bluetooth Low Energy / GFSK.

7. CELLULAR LTE, WLAN 2.4 GHz Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR LTE Band 12, WLAN 2.4 GHz in 802.11 b / 1 Mbps, Bluetooth Low Energy / GFSK.

8. CELLULAR LTE, WLAN 5 GHz Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR LTE Band 12, WLAN 5 GHz (U-NII-1) in 802.11 a20 / 6 Mbps, Bluetooth Low Energy / GFSK.

9. CELLULAR LTE, WLAN 5 GHz Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, CELLULAR LTE Band 12, WLAN 5 GHz (U-NII-3) in 802.11 a20 / 6 Mbps, Bluetooth Low Energy / GFSK.

Radiated emissions

SPECIFICATION:

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c) / RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RSS-247. Attenuation below the general field strength limits specified in RSS-Gen is not required.

1. 3G Band IV. FCC §2.1053 & §27.53 (h) / RSS-139 Clause 6.6.

FCC §27.53 (h):

> (h) 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 log10 (P) dB.

RSS-139 Clause 6.6:

> i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment’s smallest operating frequency block, which can contain the equipment’s occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 p (watts) dB.
>
> ii. After the first 1.0 MHz outside the equipment’s smallest operating frequency block, which can contain the equipment’s occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 P (watts) dB.

2. LTE Band 7. FCC §2.1053 & §27.53 (m) (4) / RSS-199 Clause 4.5.

FCC §27.53 (m) (4)

> (m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

RSS-199 Clause 4.5.

4.5. In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

(b) for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least:

40 + 10 log10 p from the channel edges to 5 MHz away

43 + 10 log10 p between 5 MHz and X MHz from the channel edges, and

55 + 10 log10 p at X MHz and beyond from the channel edges

In addition, the attenuation shall not be less than 43 + 10 log10 p on all frequencies between 2490.5 MHz and 2496 MHz, and 55 + 10 log10 p at or below 2490.5 MHz.

In (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

3. LTE Band 12. FCC §2.1053 & §27.53 (g) / RSS-130 Clause 4.6.

FCC §27.53 (g):

(g) 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.

RSS-130 Issue 1 Clause 4.6.:

The power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside the frequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside the equipment’s operating frequency range, a resolution bandwidth of 30 kHz may be employed.

METHOD:

The measurement was performed with the EUT inside an anechoic chamber.

The spectrum was scanned from 9 kHz to at least the 10th harmonic of the highest frequency of the co-located radios till 40 GHz.

The EUT was placed on a non-conductive stand at a 3 meter distance from the measuring antenna.

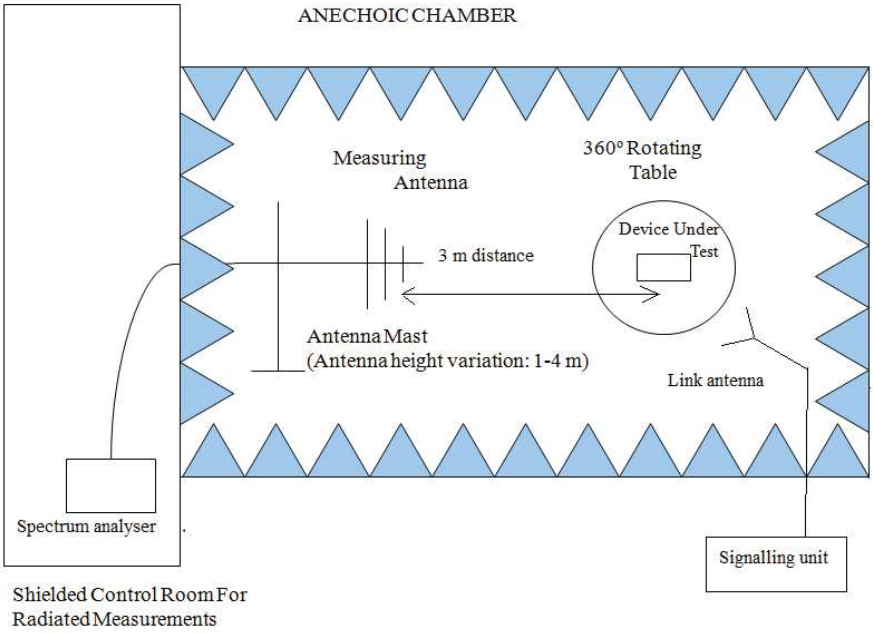
Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

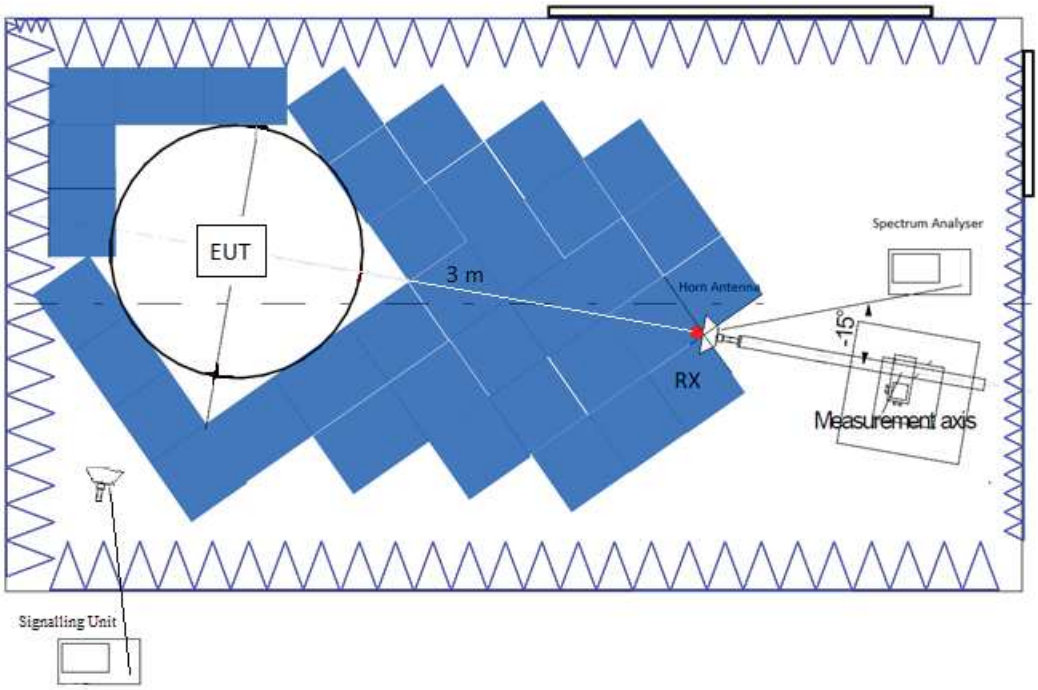
These measurements have been performed in order to check the impact of the Co-Location of all radio interfaces (licensed and unlicensed radios) that can be transmitting simultaneously. The results and plots below show the worst results obtained with the most restrictive limits.

TEST SETUP:

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS:

- **Mode 3G Band IV, 802.11 b, Bluetooth Low Energy.**

WCDMA and HSUPA:
A preliminary scan determined WCDMA modulation as the worst case.

3G Band IV:	Low Channel (1710 MHz).
WLAN 802.11 b:	High Channel (2462 MHz).
Bluetooth LE:	Low Channel (2402 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 17.55 GHz	PK	43 + 10 log (P) dB = -13 dBm -> 82.23 dBµV/m
17.55 to 26 GHz	PK	74 dBµV/m
17.55 to 26 GHz	AVG	54 dBµV/m (*)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).

(**) Radiated emissions which fall in the non-restricted bands.

Frequency range 30 MHz - 1 GHz

No spurious frequencies detected at less than 20 dB below the limit.

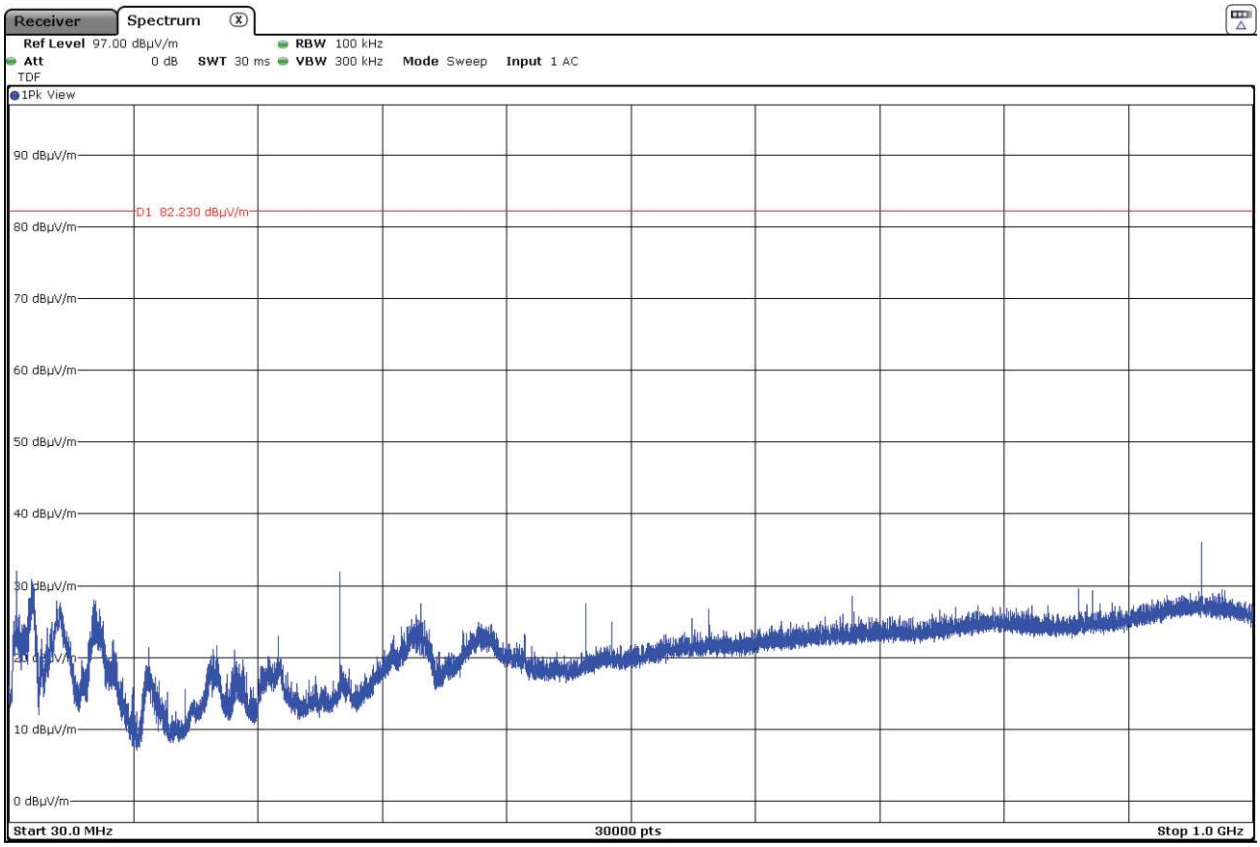
Frequency range 1 - 26 GHz

No spurious frequencies detected at less than 20 dB below the limit.

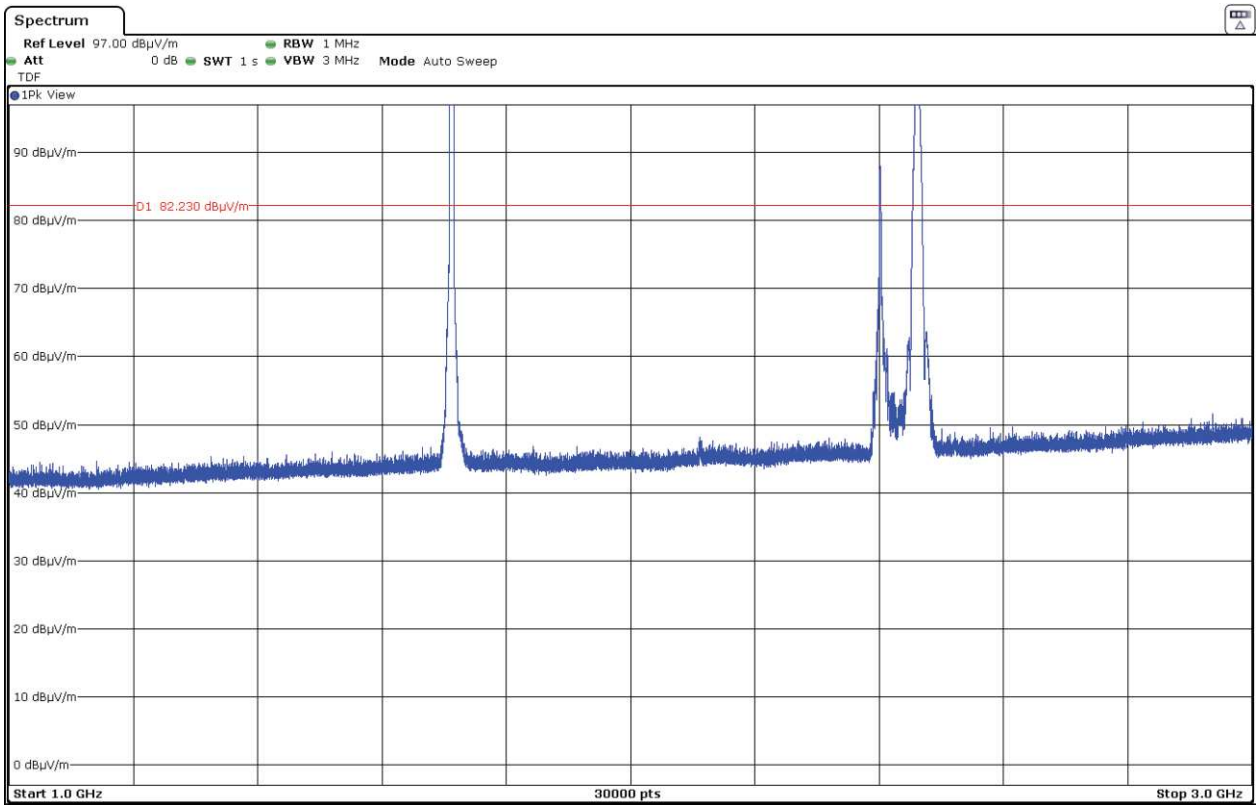
Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 26 GHz

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

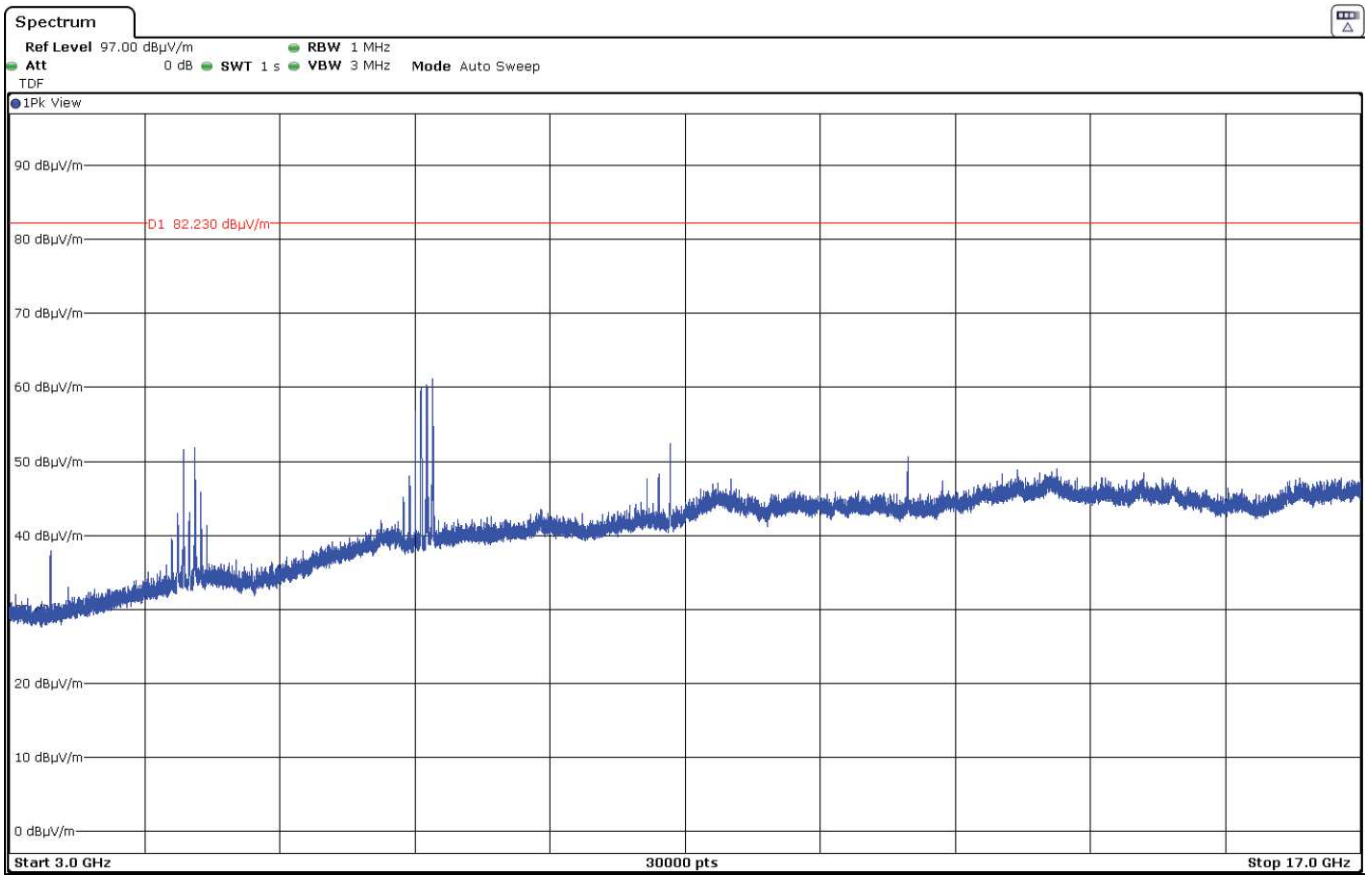


FREQUENCY RANGE 1 - 3 GHz

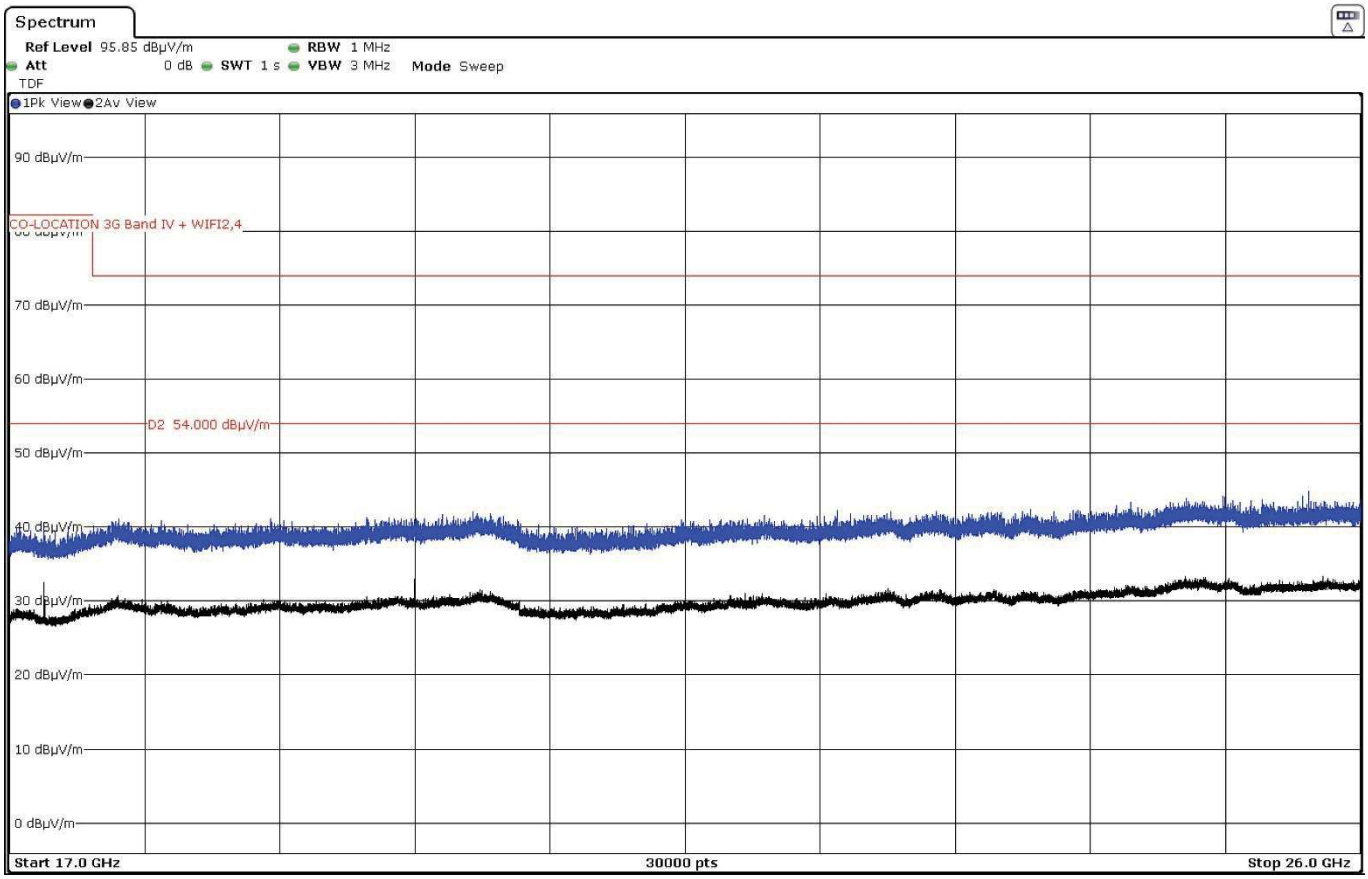


The peak above the limit on the left is the Carrier frequency 3G Band IV (1710 MHz)
The peak above the limit in the middle is the Carrier frequency Bluetooth Low Energy (2402 MHz).
The peak above the limit on the right is the Carrier frequency 802.11 b (2462 MHz).

FREQUENCY RANGE 3 - 17 GHz



FREQUENCY RANGE 17 - 26 GHz



- **Mode 3G Band IV, 802.11 a20 U-NII-1, Bluetooth Low Energy.**

WCDMA and HSUPA:
A preliminary scan determined WCDMA modulation as the worst case.

3G Band IV:	Low Channel (1712.4 MHz).
802.11 a U-NII-1:	BW=20 MHz, Low Channel (5180 MHz).
Bluetooth Low Energy:	High Channel (2480 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 17.55 GHz	PK	43 + 10 log (P) dB = -13 dBm -> 82.23 dBµV/m
17.55 to 26 GHz	PK	74 dBµV/m
26 to 40 GHz	PK	68.23 (**) OR 74 dBµV/m (*)
17.55 to 40 GHz	AVG	54 dBµV/m (*)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).
(**) Radiated emissions which fall in the non-restricted bands.

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 40 GHz

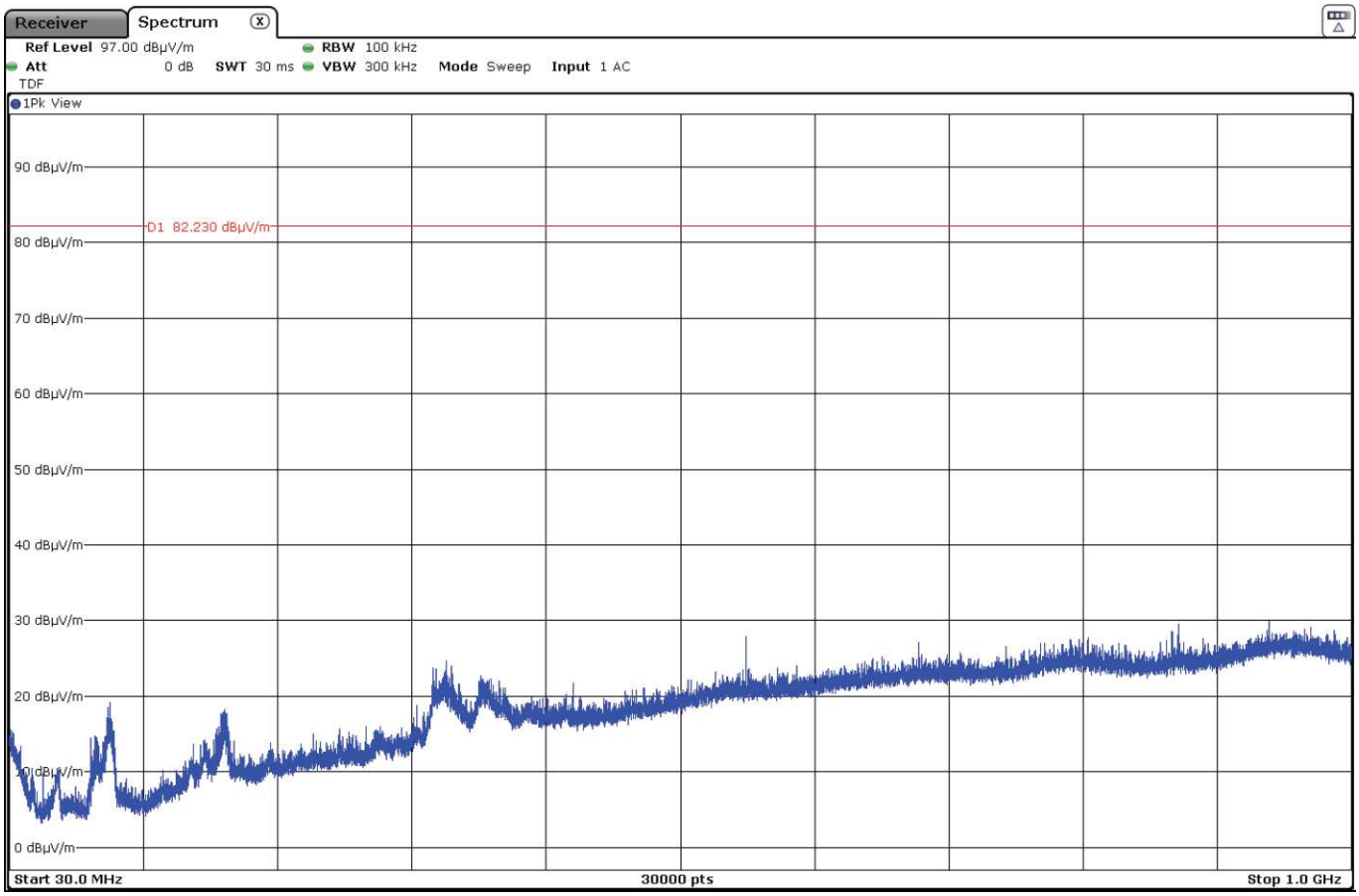
Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	E (dBµV/m)	Polarization
20.71955	Peak	42.84	V
39.54383	Peak	49.79	V
39.34783	Peak	49.71	H

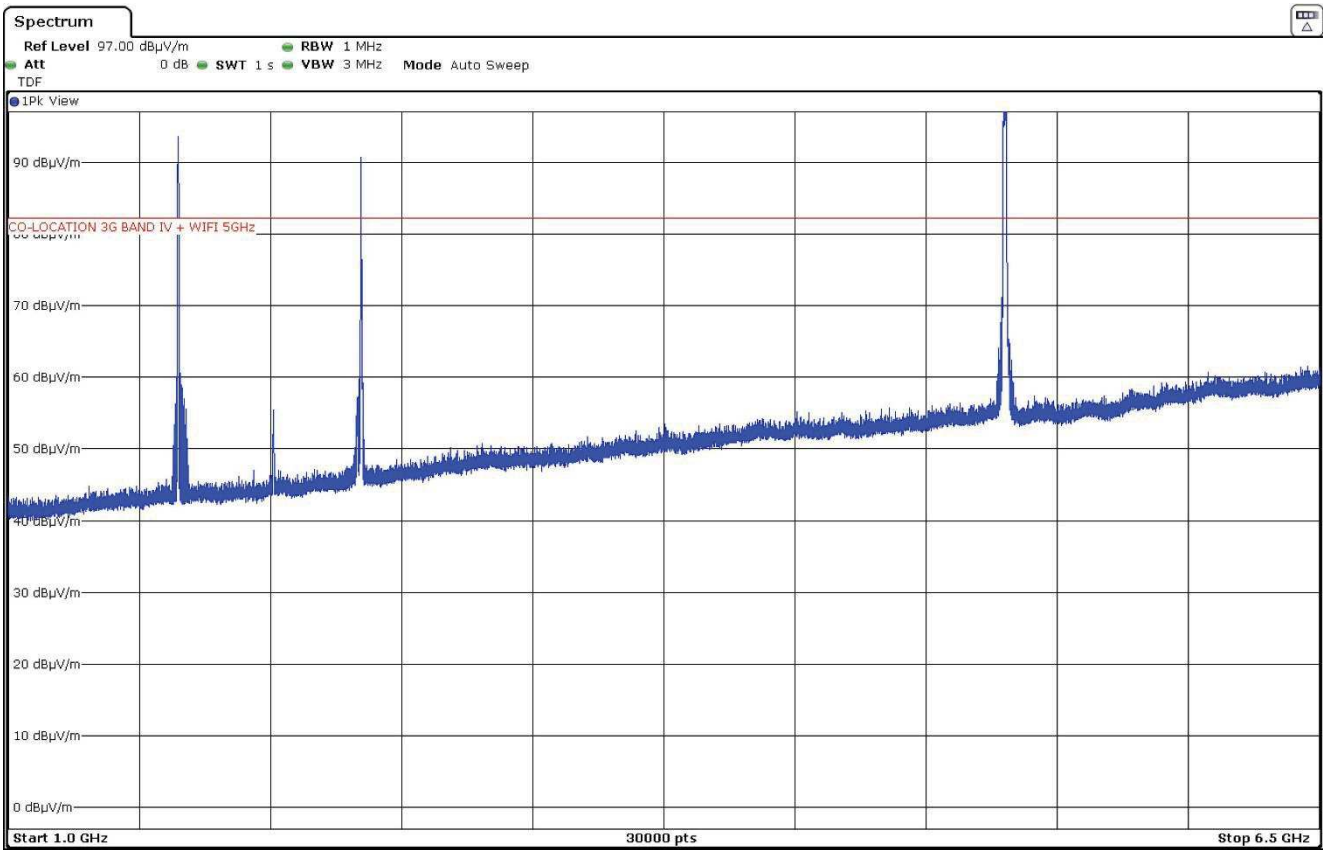
Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 40 GHz

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

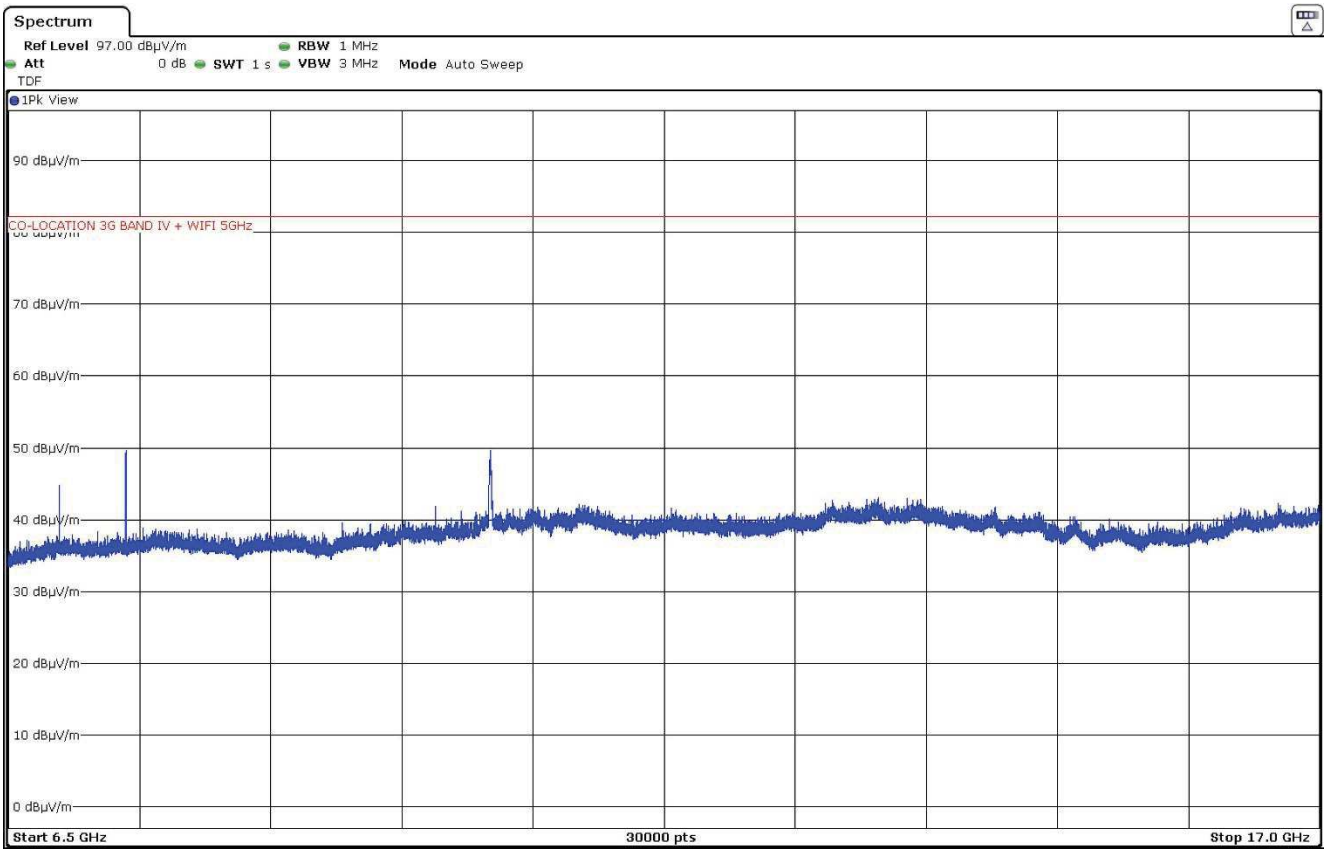


FREQUENCY RANGE 1 – 6.5 GHz

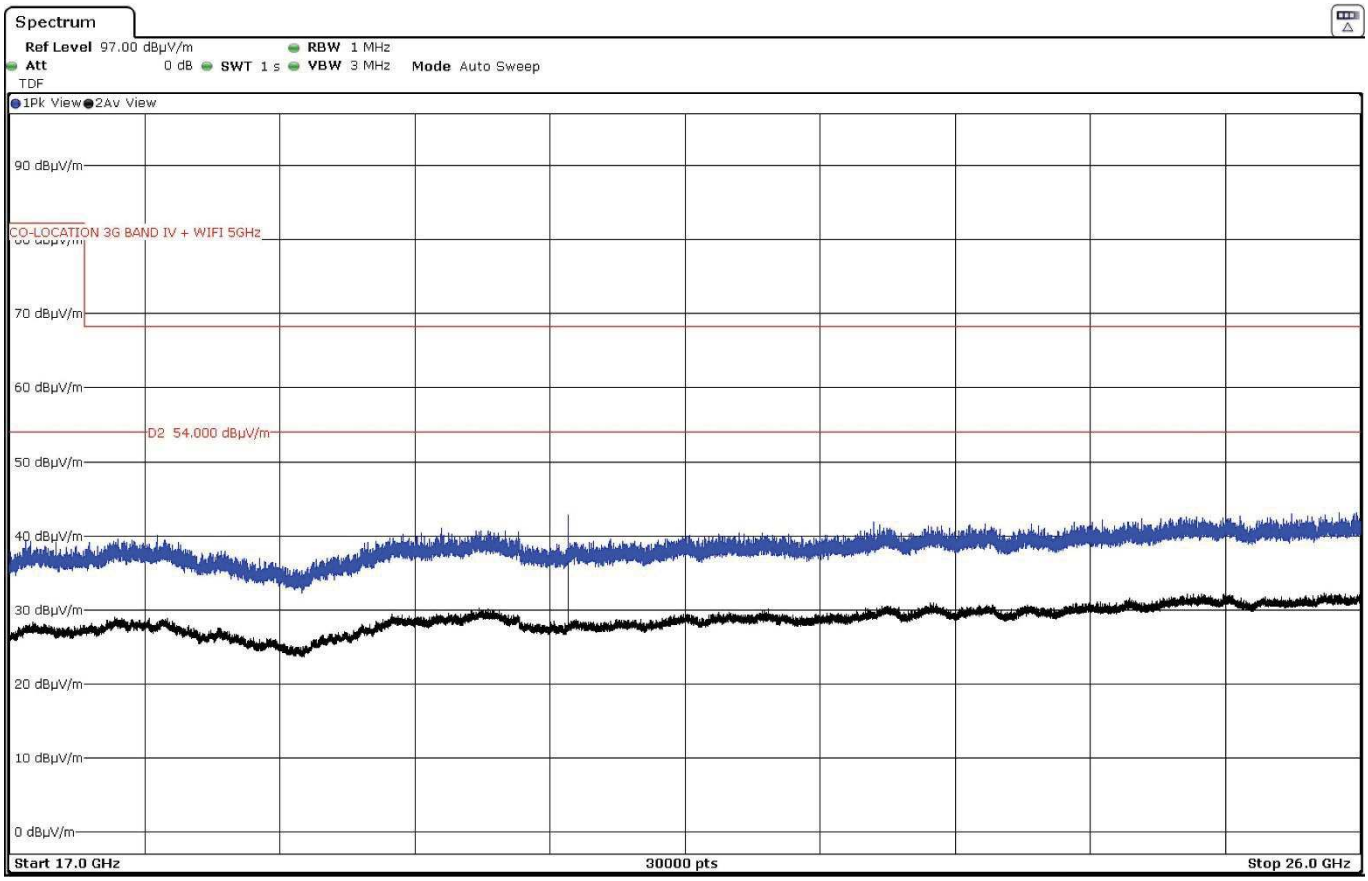


The peak above the limit on the left is the Carrier frequency 3G Band IV (1710 MHz)
The peak above the limit in the middle is the Carrier frequency Bluetooth Low Energy (2480 MHz).
The peak above the limit on the right is the Carrier frequency 802.11 a20 (5180 MHz).

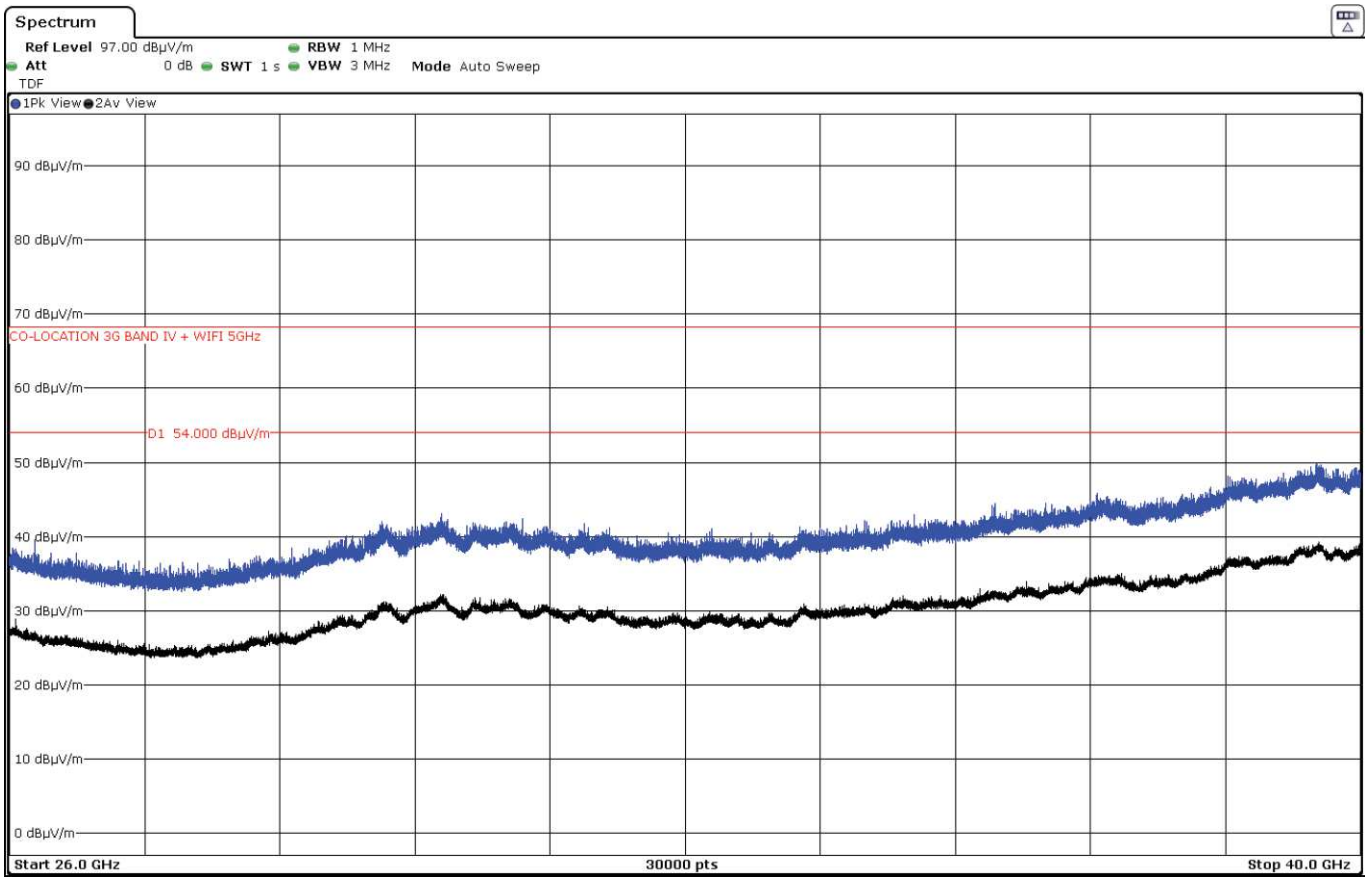
FREQUENCY RANGE 6.5 – 17 GHz



FREQUENCY RANGE 17 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz



- **Mode 3G Band IV, 802.11 a20 U-NII-3, Bluetooth Low Energy.**

WCDMA and HSUPA:
A preliminary scan determined WCDMA modulation as the worst case.

3G Band IV:	Low Channel (1710 MHz).
802.11 a U-NII-3:	BW=20 MHz, High Channel (5825 MHz).
Bluetooth Low Energy:	Low Channel (2402 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 17.55 GHz	PK	43 + 10 log (P) dB = -13 dBm -> 82.23 dBµV/m
17.55 to 26 GHz	PK	74 dBµV/m
26 to 40 GHz	PK	68.23 (**) OR 74 dBµV/m (*)
17.55 to 40 GHz	AVG	54 dBµV/m (*)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).
(**) Radiated emissions which fall in the non-restricted bands.

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 40 GHz

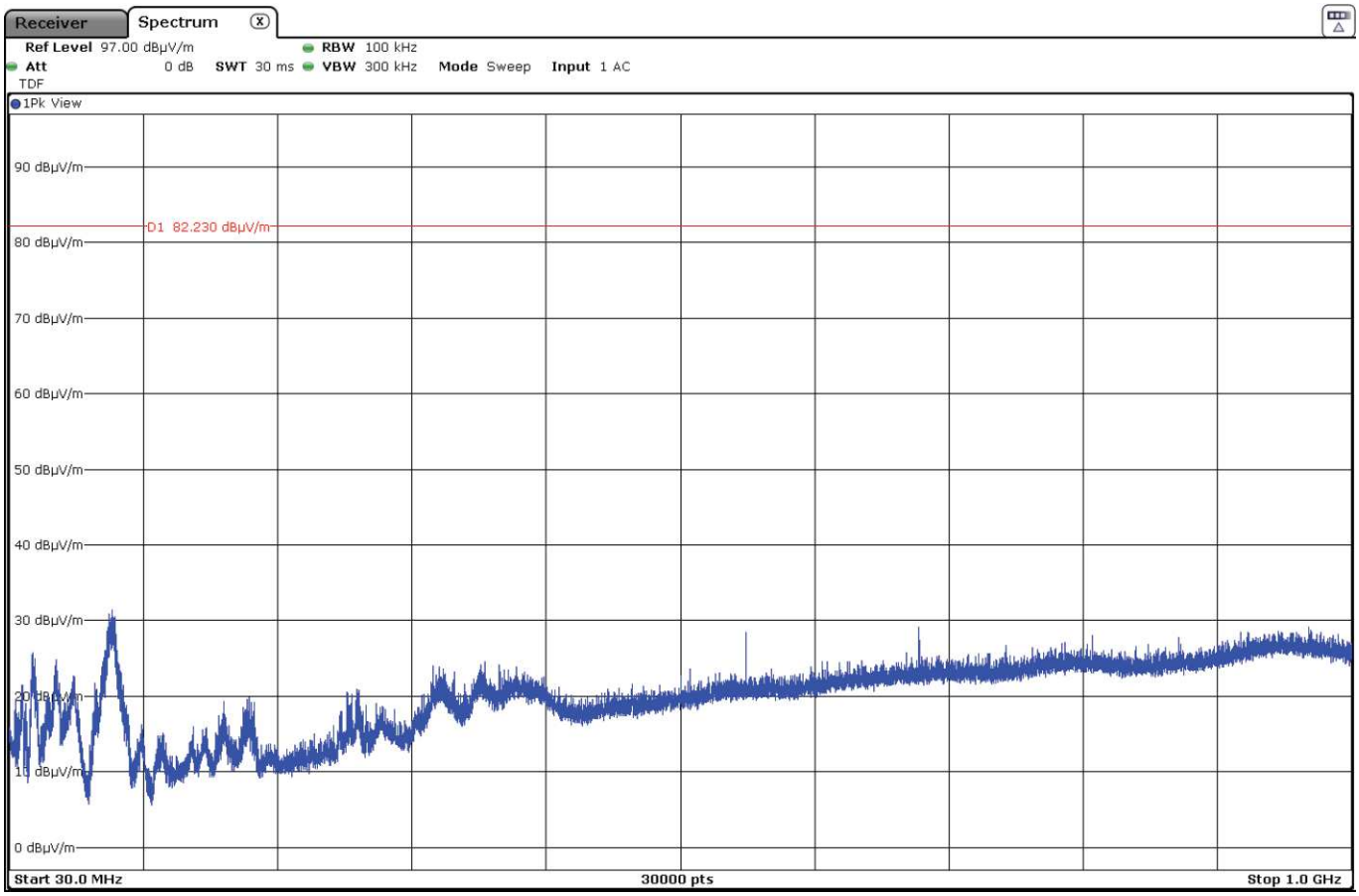
Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	E (dBµV/m)	Polarization
39.6213	Peak	49.80	V

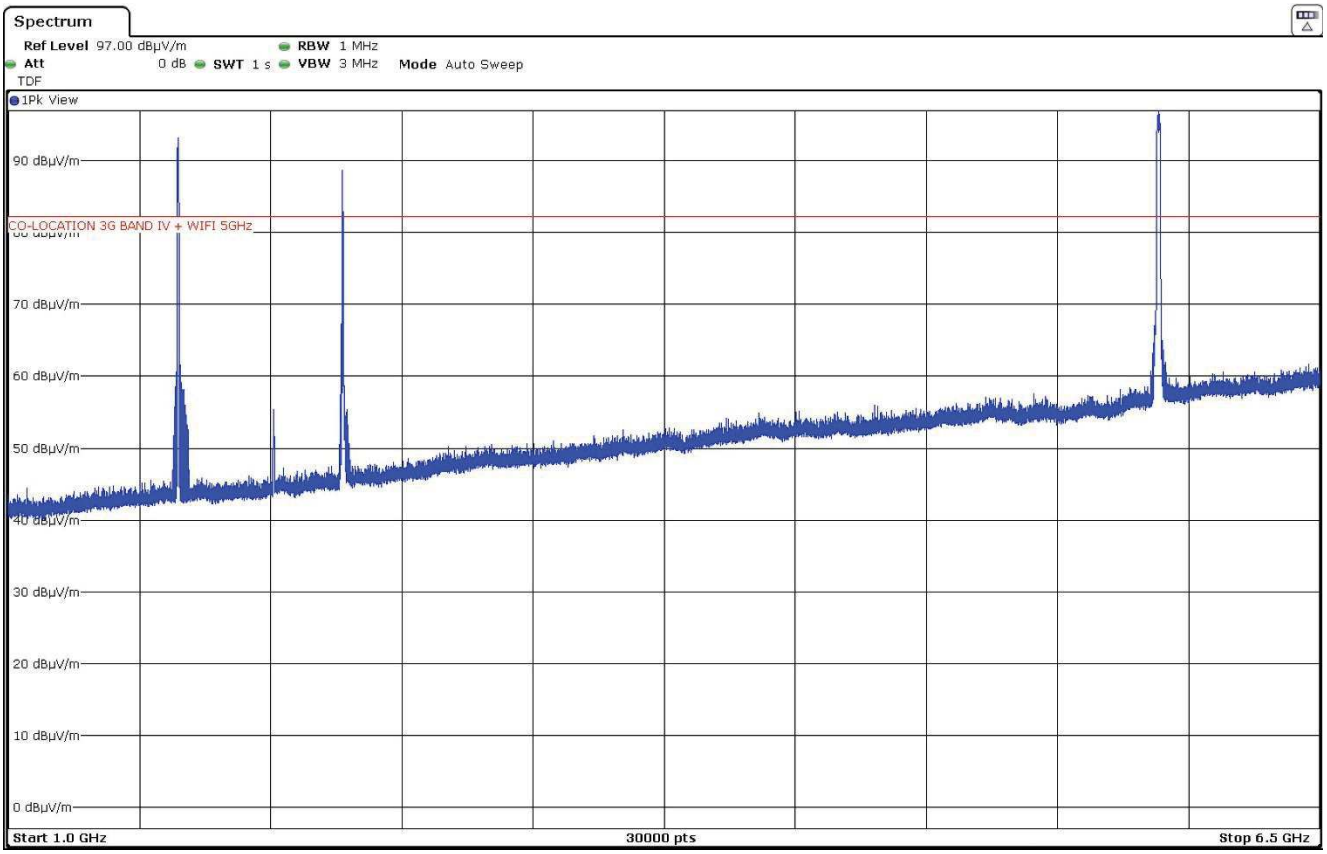
Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 40 GHz

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

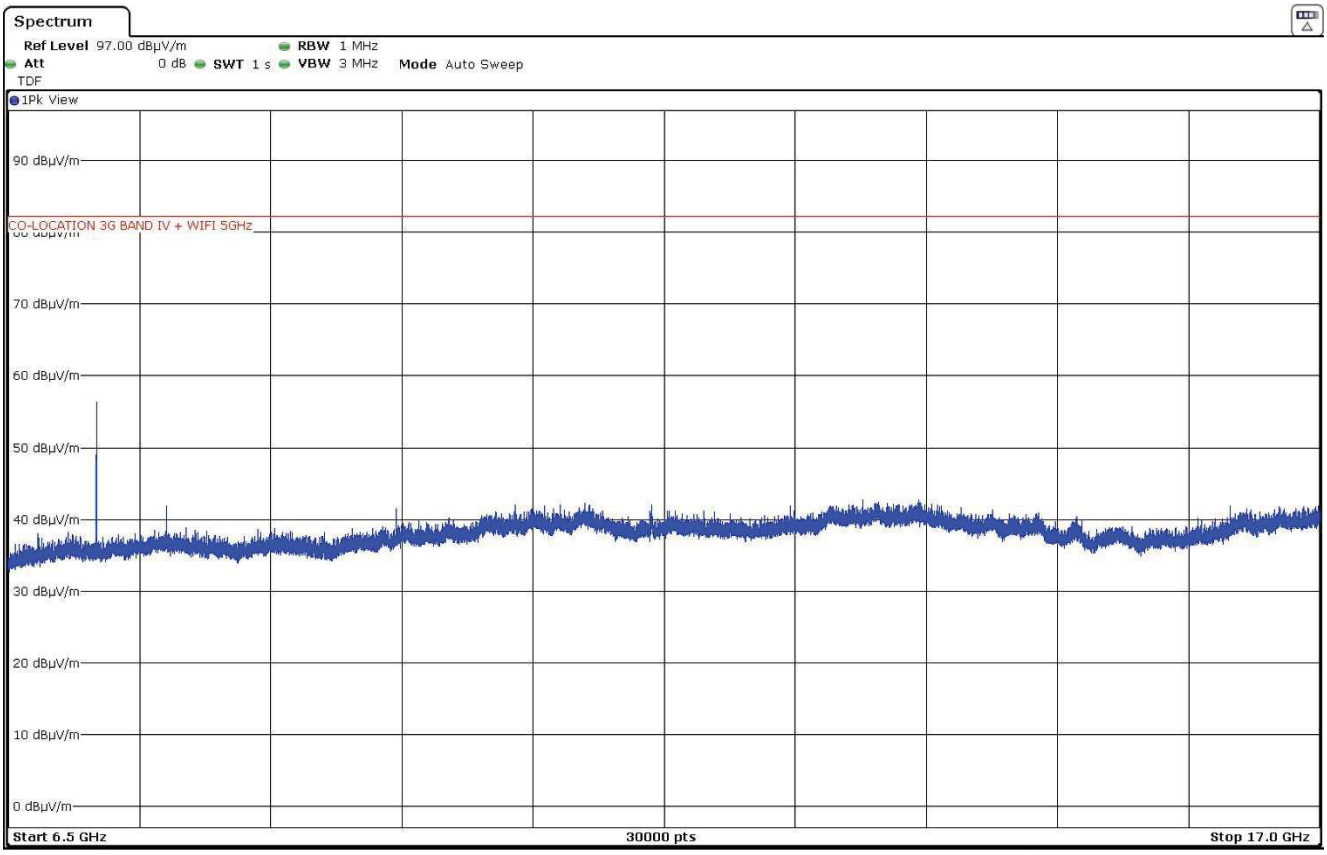


FREQUENCY RANGE 1 – 6.5 GHz

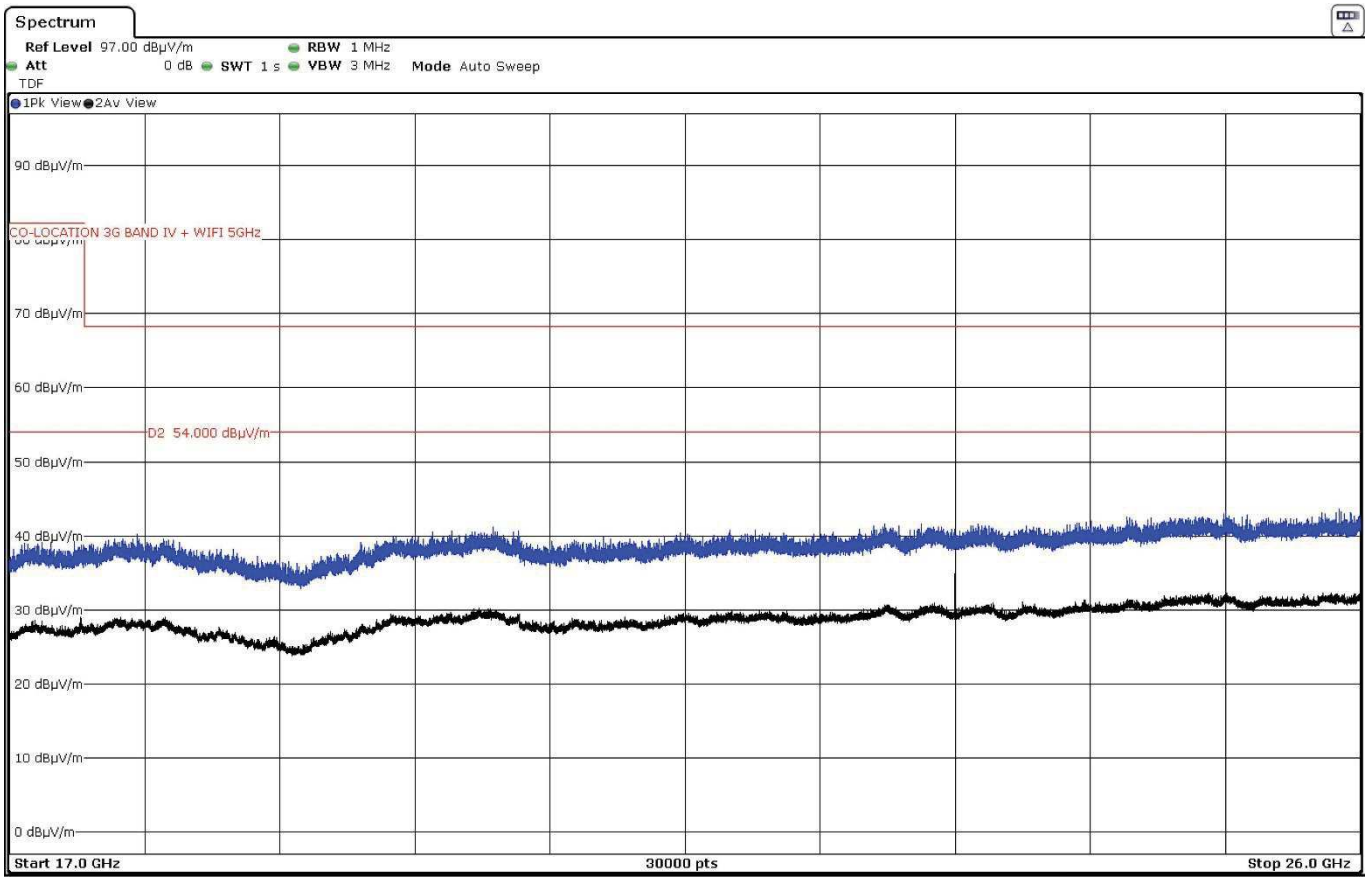


The peak above the limit on the left is the Carrier frequency 3G Band IV (1710 MHz)
The peak above the limit in the middle is the Carrier frequency Bluetooth Low Energy (2402 MHz).
The peak above the limit on the right is the Carrier frequency 802.11 a20 (5825 MHz).

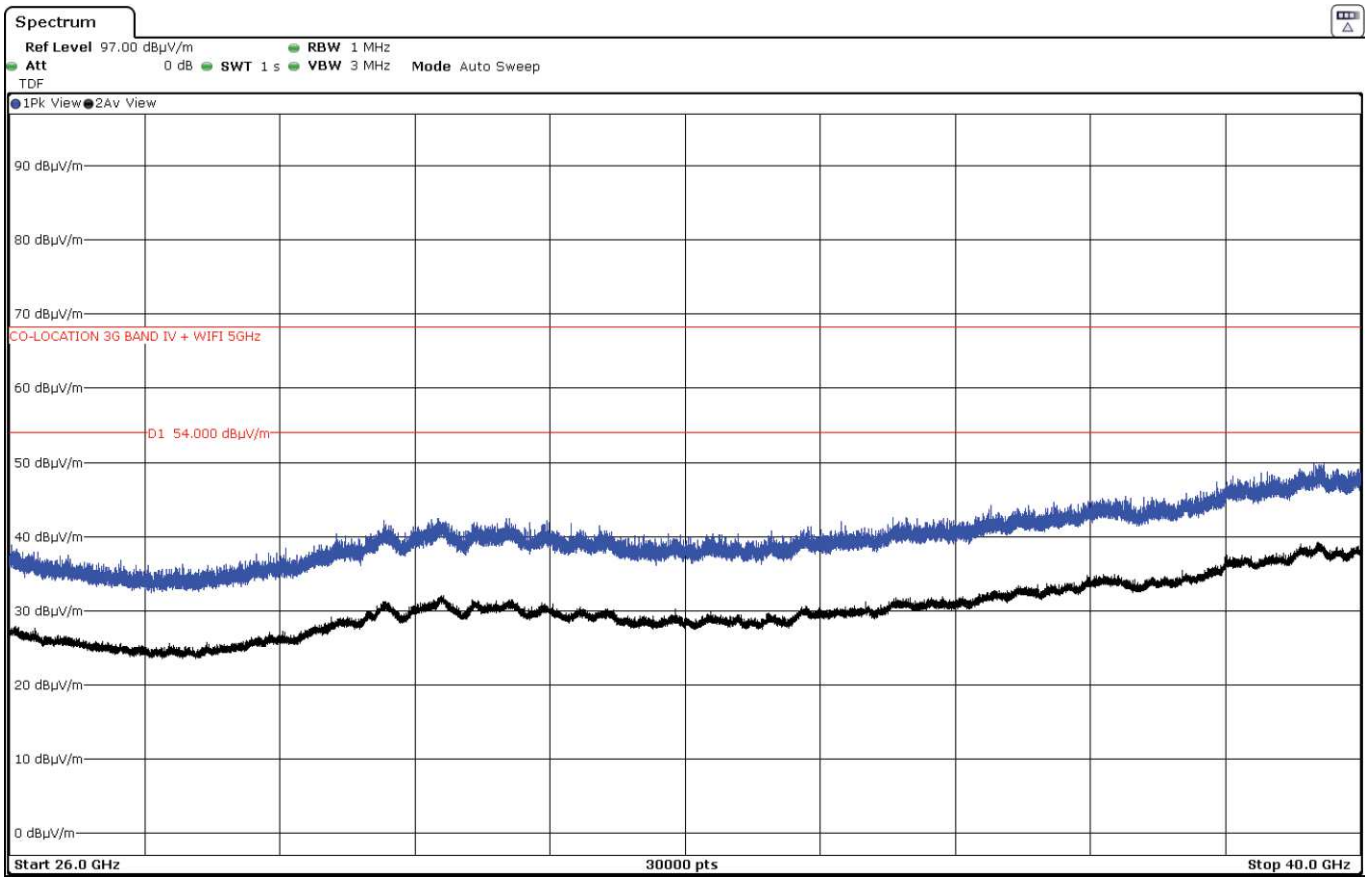
FREQUENCY RANGE 6.5 – 17 GHz



FREQUENCY RANGE 17 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz



- **Mode LTE Band 7, 802.11 b, Bluetooth Low Energy.**

QPSK & 16QAM:
A preliminary scan determined the QPSK modulation as the worst case.

LTE Band 7:	High Channel (2565 MHz). RB=1.Offset 0.
WLAN 802.11 b:	High Channel (2462 MHz).
Bluetooth Low Energy:	Low Channel (2402 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 1 GHz	PK	55 + 10 log (P) dB = -25 dBm -> 70.23 dBµV/m
30 MHz to 88 MHz	QP	40 dBµV/m (***)
88 MHz to 216 MHz	QP	43.5 dBµV/m (***)
216 MHz to 960 MHz	QP	46 dBµV/m (***)
960 MHz to 1GHz	QP	54 dBµV/m (***)
1 GHz to 26 GHz	PK	55 + 10 log (P) dB = -25 dBm -> 70.23 dBµV/m (**) OR -21.23 dBm -> 74 dBµV/m (*) (***)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).

(**) Radiated emissions which fall in the non-restricted bands.

(***) Radiated emission limits to comply with §15.209(a) (see §15.205(c) / RSS-Gen).

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 26 GHz

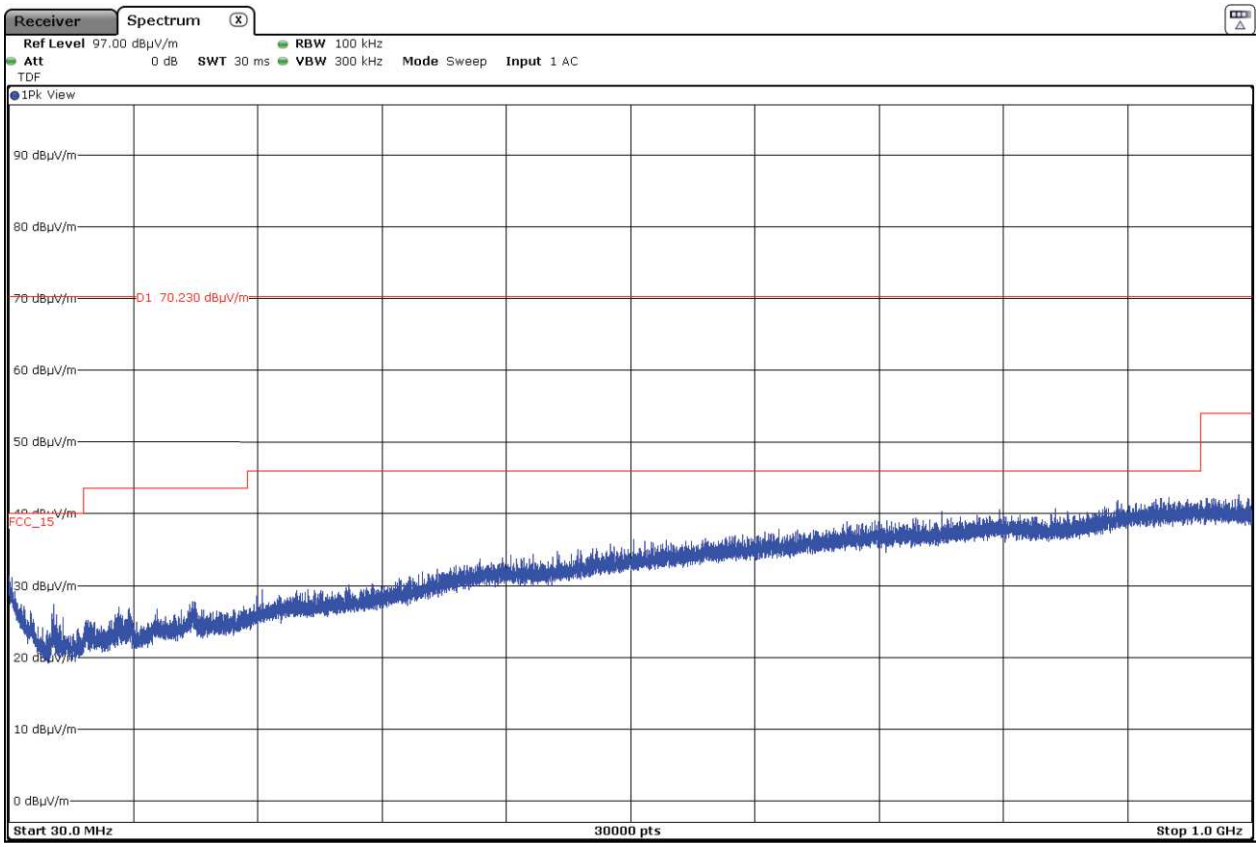
Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	E (dBµV/m)	Polarization
2.522167	Peak	63.27	V
5.12123	Peak	55.83	V
9.8481	Peak	54.93	V
7.2637	Peak	56.72	H
7.32577	Peak	62.01	H
7.38643	Peak	63.89	H

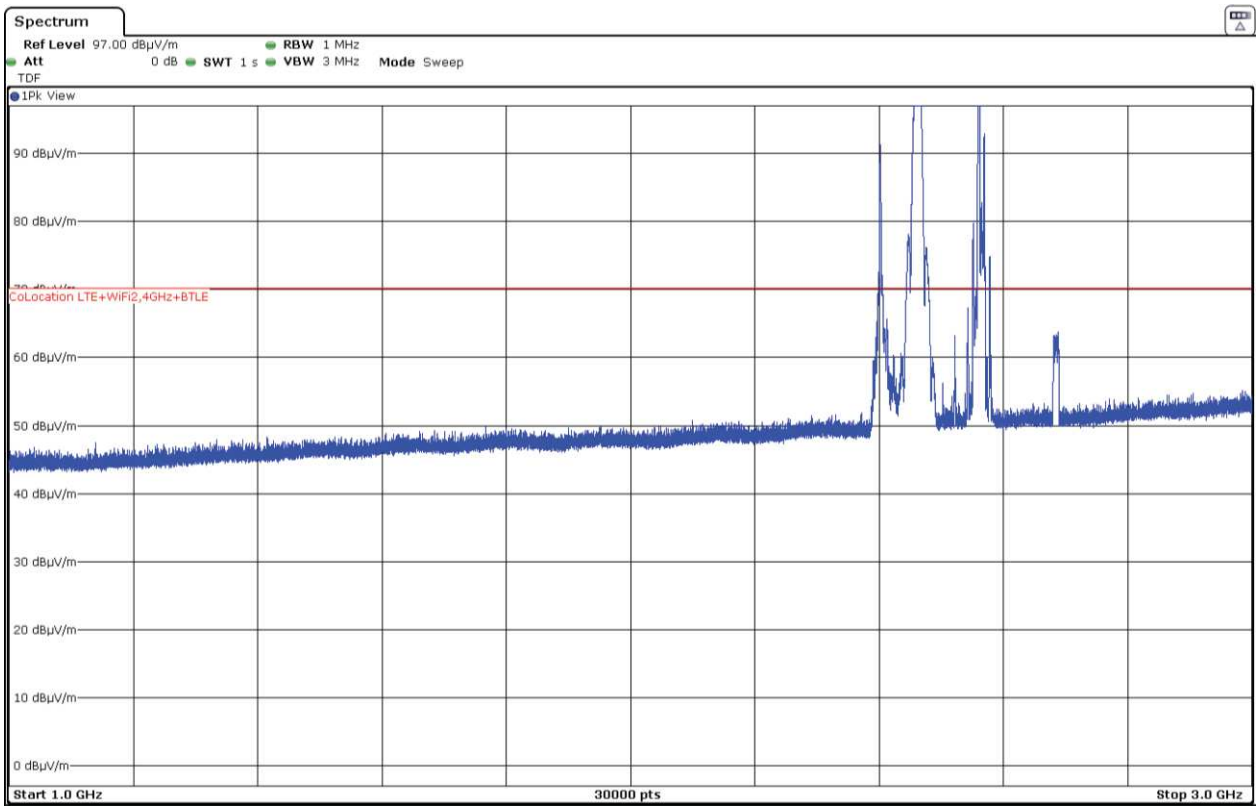
Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 26 GHz

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

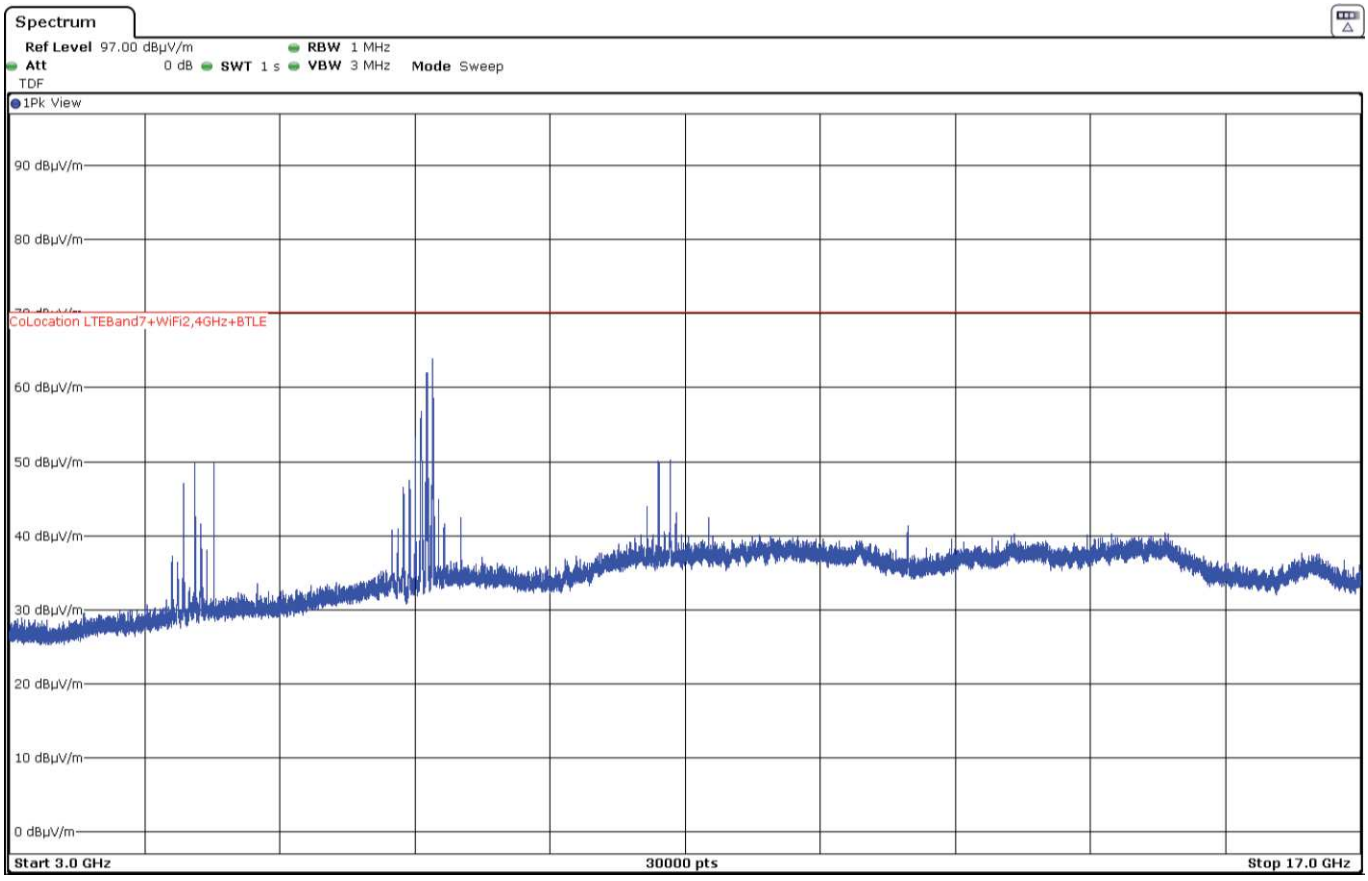


FREQUENCY RANGE 1 – 3 GHz

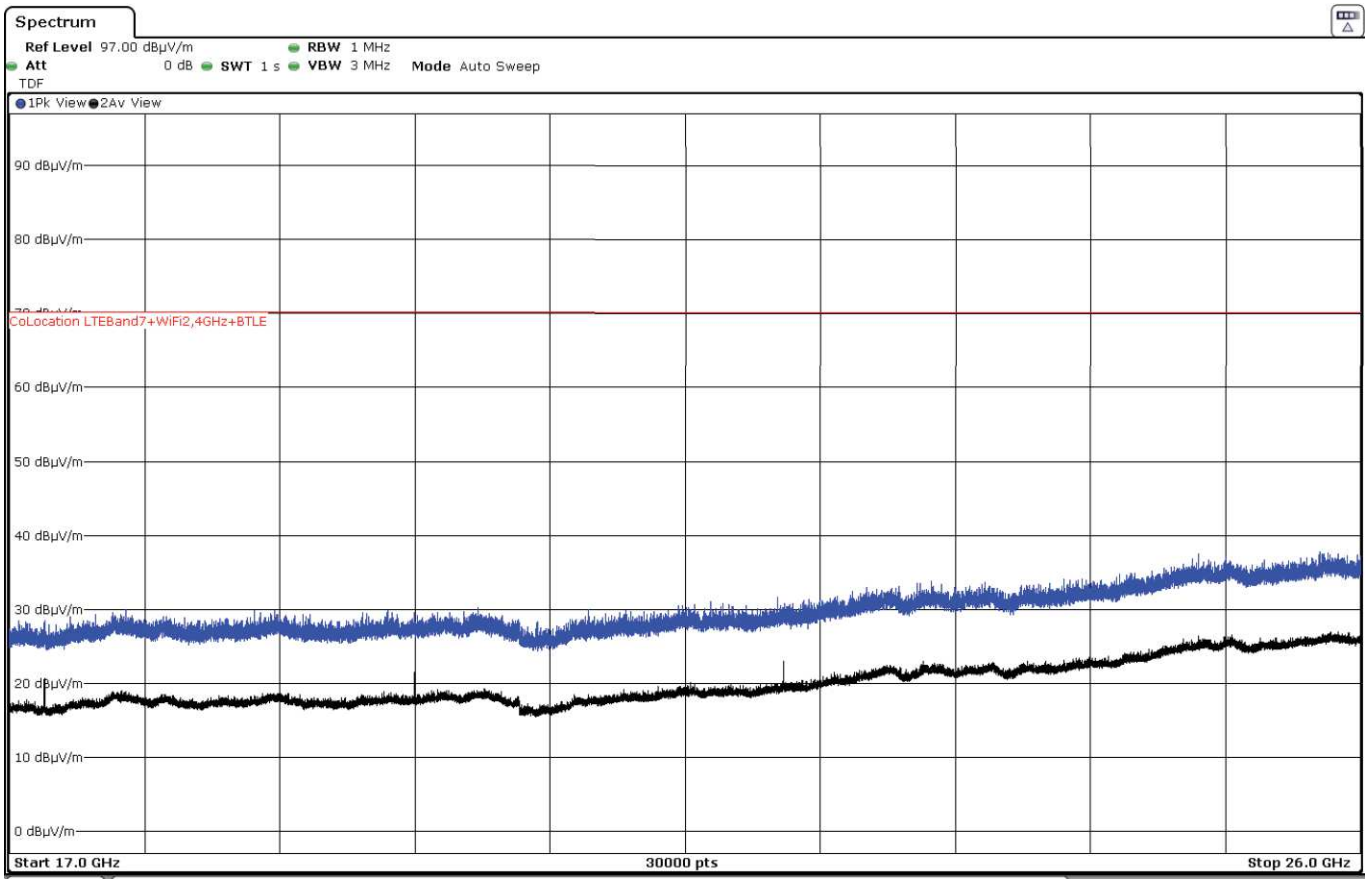


The peak above the limit on the left is the Carrier frequency Bluetooth Low Energy (2402 MHz).
The peak above the limit in the middle is the Carrier frequency 802.11 b (2462 MHz).
The peak above the limit on the left is the Carrier frequency LTE Band 7 (2565 MHz).
The peak at 2585 MHz corresponds to the downlink signal LTE Band 7.

FREQUENCY RANGE 3 – 17 GHz



FREQUENCY RANGE 17 - 26 GHz



- **Mode LTE Band 7, 802.11 a20 U-NII-1, Bluetooth Low Energy.**

QPSK & 16QAM
A preliminary scan determined the QPSK modulation as the worst case.

LTE Band 7:	High Channel (2565 MHz), RB=1.Offset 0.
802.11 a U-NII-1:	BW=20 MHz, Low Channel (5180 MHz).
Bluetooth Low Energy:	Low Channel (2402 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 1 GHz	PK	55 + 10 log (P) dB = -25 dBm -> 70.23 dBµV/m
30 MHz to 88 MHz	QP	40 dBµV/m (***)
88 MHz to 216 MHz	QP	43.5 dBµV/m (***)
216 MHz to 960 MHz	QP	46 dBµV/m (***)
960 MHz to 1GHz	QP	54 dBµV/m (***)
1 to 26 GHz	PK	55 + 10 log (P) dB = -25 dBm -> 70.23 dBµV/m (**) OR -21.23 dBm -> 74 dBµV/m (*)(***)
26 to 40 GHz	PK	68.23 (**) OR 74 dBµV/m (*)
26 to 40 GHz	AVG	54 dBµV/m (*)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).
(**) Radiated emissions which fall in the non-restricted bands.
(***) Radiated emission limits to comply with §15.209(a) (see §15.205(c) / RSS-Gen).

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit:

Frequency range 1 - 40 GHz

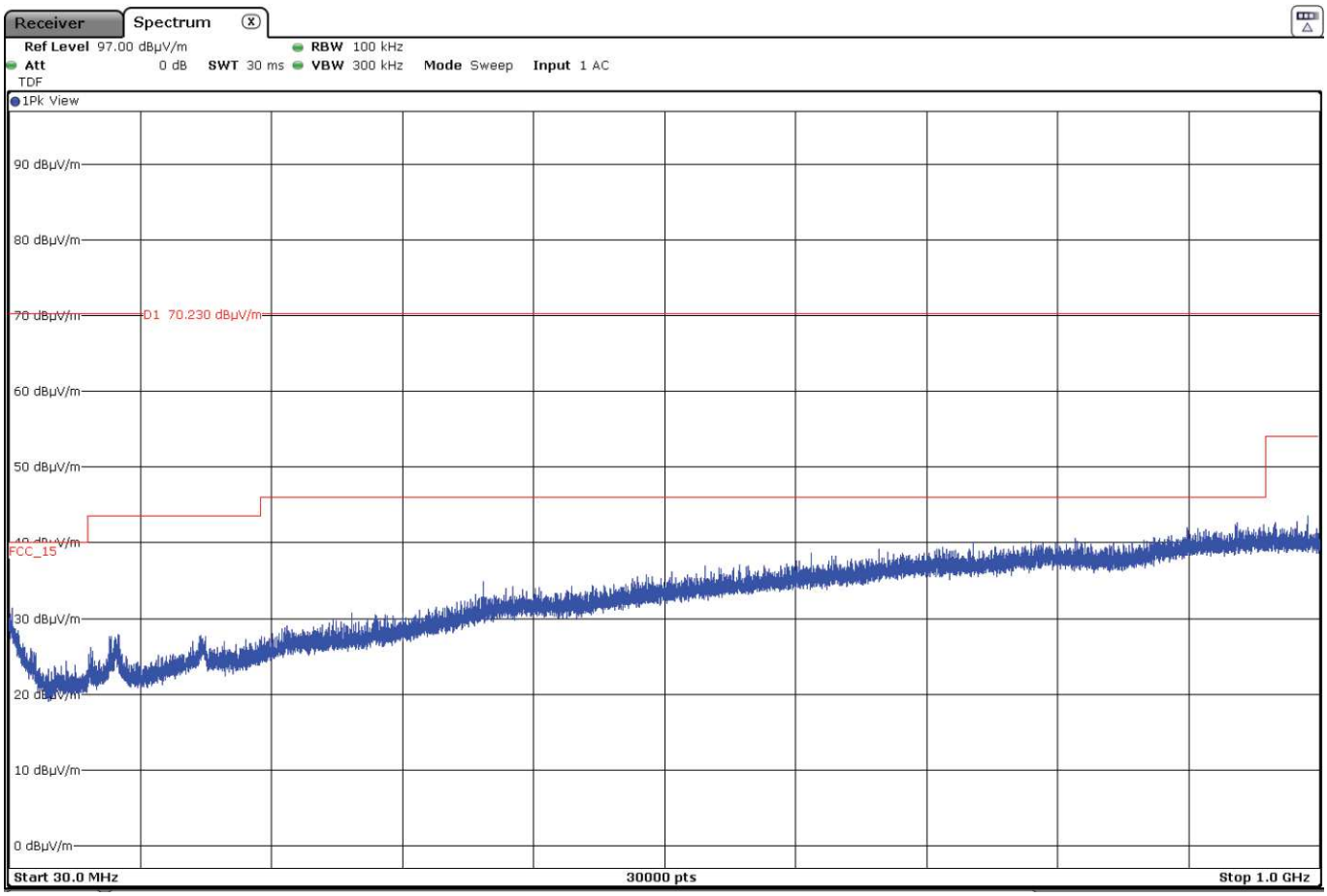
Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	E (dBµV/m)	Polarization
5.12103	Peak	58.79	V
7.20517	Peak	55.24	V

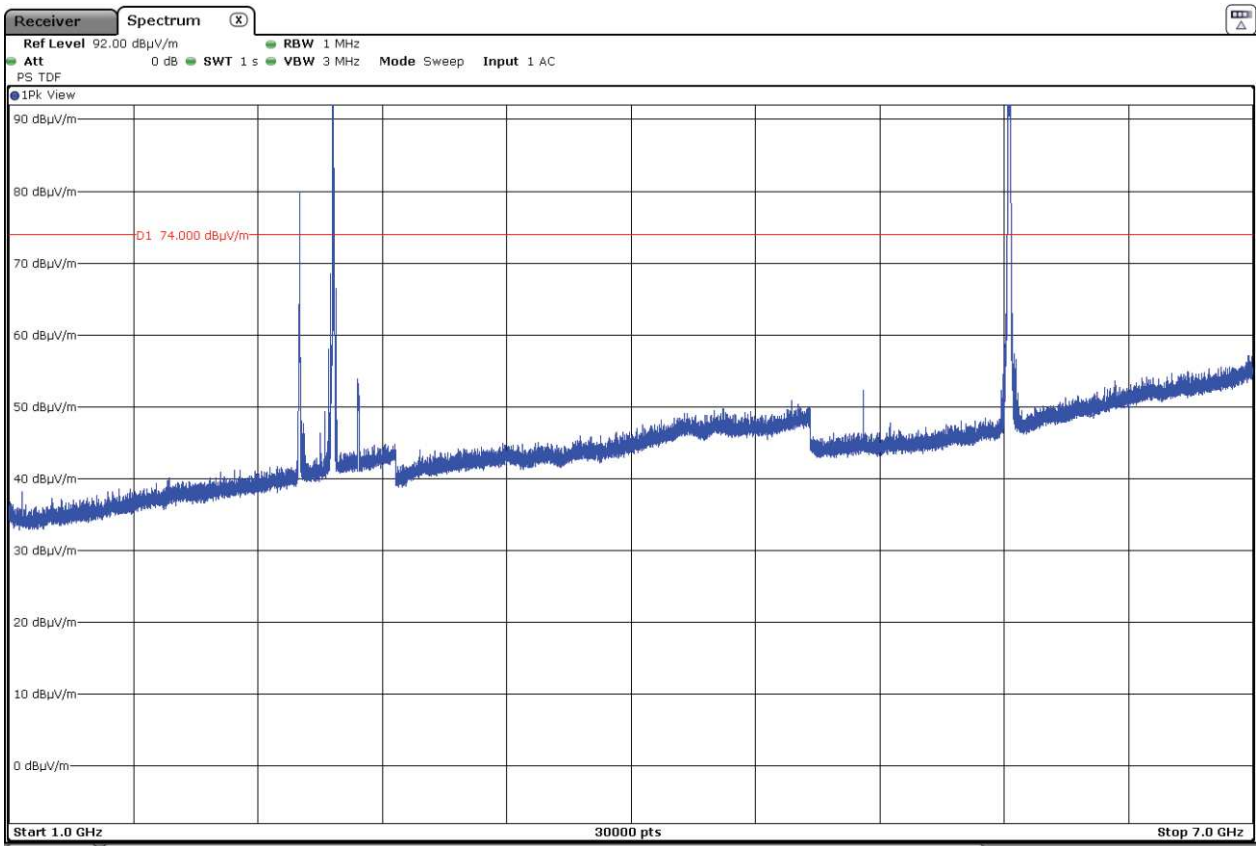
Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 40 GHz

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

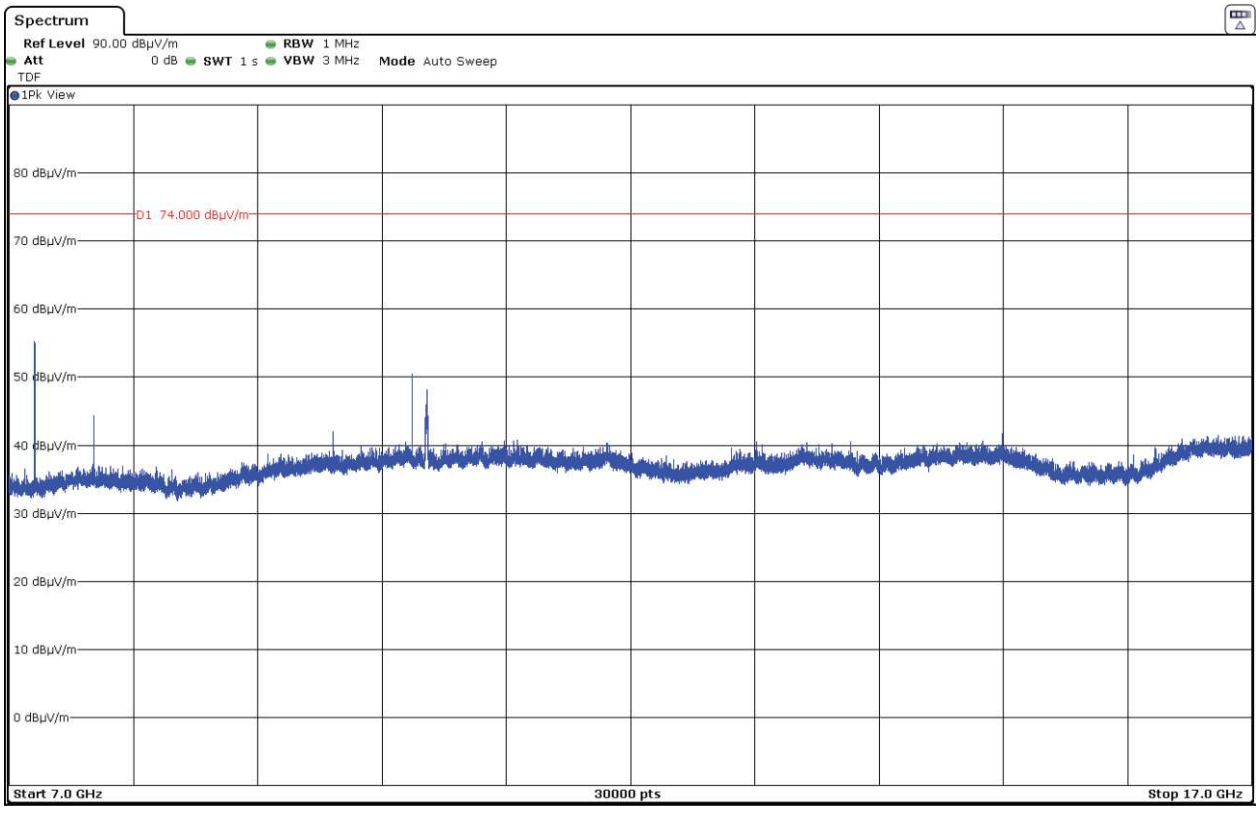


FREQUENCY RANGE 1 – 7 GHz

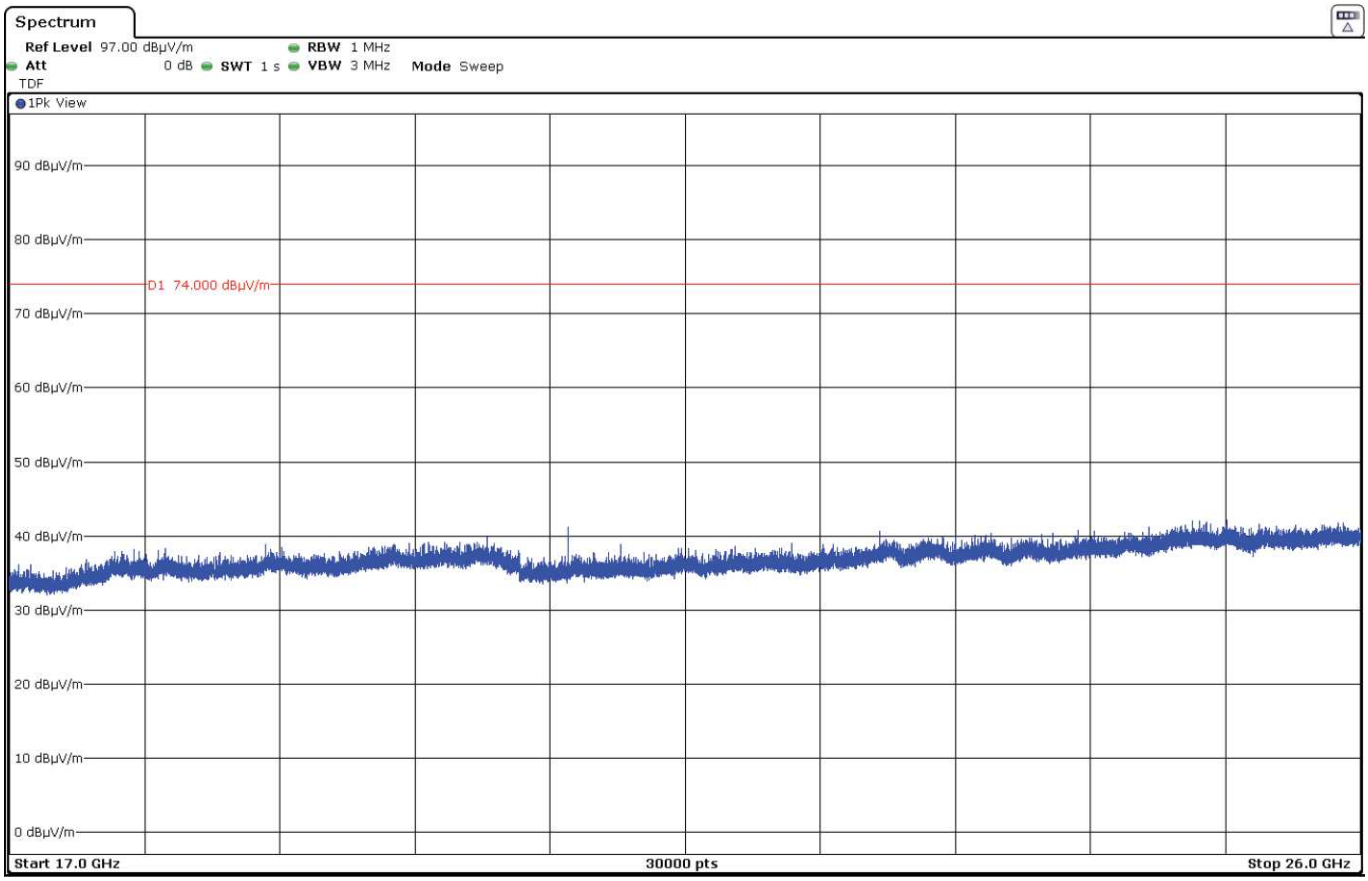


The peak above the limit on the left is the Carrier frequency Bluetooth Low Energy (2402 MHz).
The peak above the limit in the middle is the Carrier frequency LTE Band 7 (2565 MHz).
The peak at 2585 MHz corresponds to the downlink signal LTE Band 7.
The peak above the limit on the right is the Carrier frequency 802.11 a20 (5180 MHz).

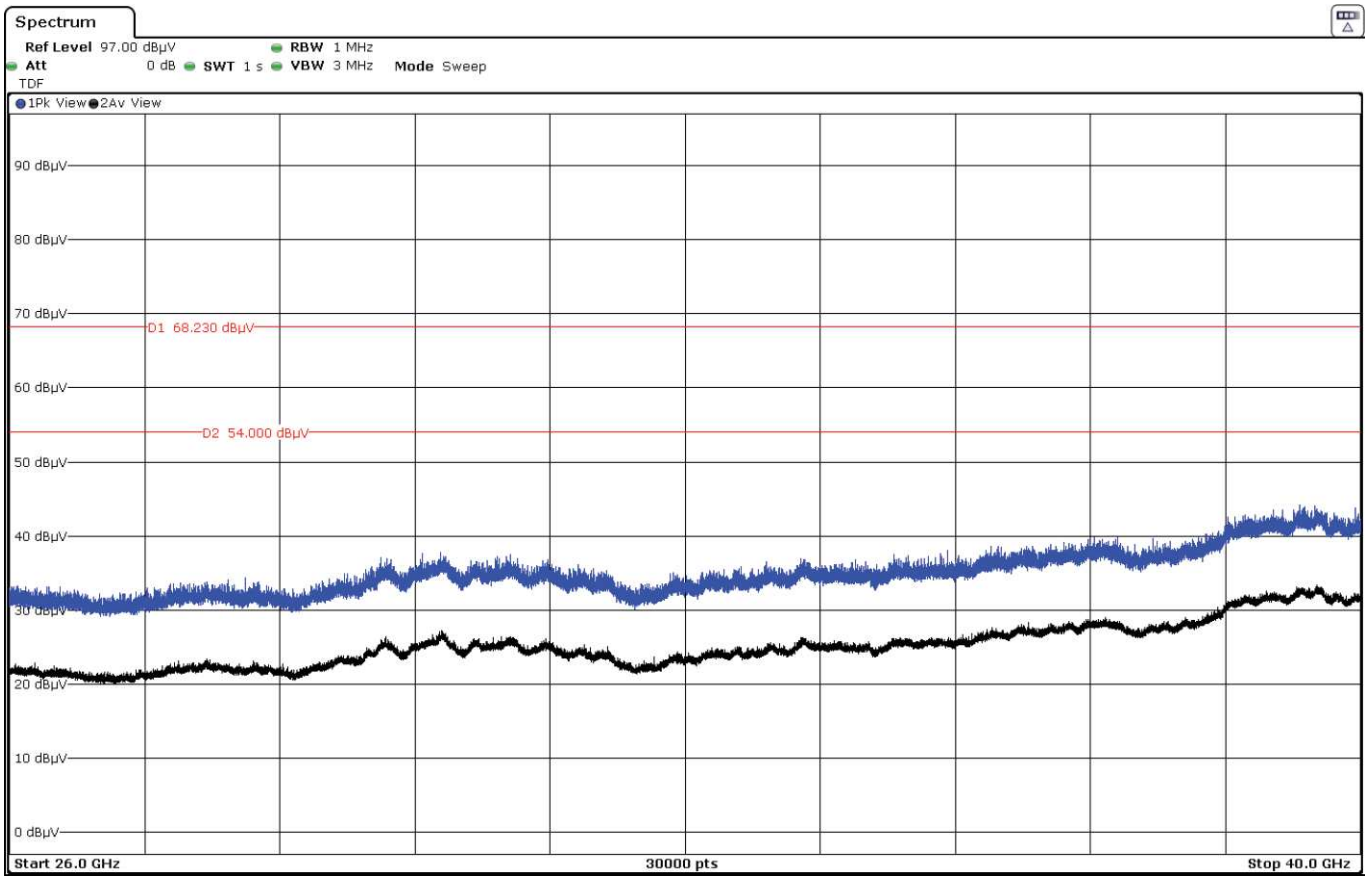
FREQUENCY RANGE 7 – 17 GHz



FREQUENCY RANGE 17 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz



- **Mode LTE Band 7, 802.11 a20 U-NII-3, Bluetooth Low Energy.**

QPSK & 16QAM
A preliminary scan determined the QPSK modulation as the worst case.

LTE Band 7:	High Channel (2565 MHz), RB=1.Offset 0.
802.11 a U-NII-3:	BW=20 MHz, High Channel (5825 MHz).
Bluetooth Low Energy:	Low Channel (2402 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 1 GHz	PK	55 + 10 log (P) dB = -25 dBm -> 70.23 dBµV/m
30 MHz to 88 MHz	QP	40 dBµV/m (***)
88 MHz to 216 MHz	QP	43.5 dBµV/m (***)
216 MHz to 960 MHz	QP	46 dBµV/m (***)
960 MHz to 1GHz	QP	54 dBµV/m (***)
1 to 26 GHz	PK	74 dBµV/m (***)
26 to 40 GHz	PK	68.23 (**) OR 74 dBµV/m (*)
26 to 40 GHz	AVG	54 dBµV/m (*)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).
(**) Radiated emissions which fall in the non-restricted bands.
(***) Radiated emission limits to comply with §15.209(a) (see §15.205(c) / RSS-Gen).

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit:

Frequency range 1 - 40 GHz

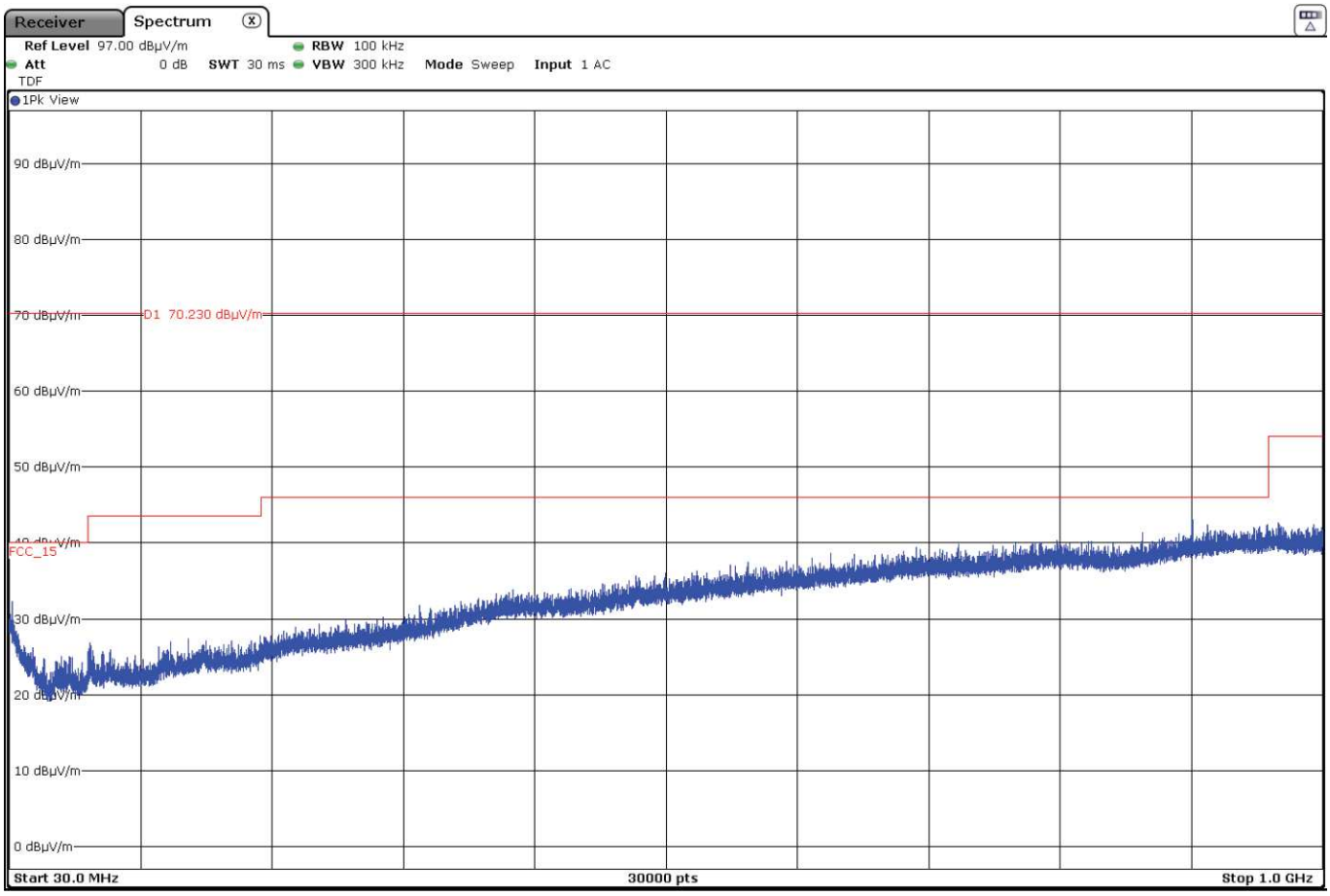
Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	E (dBµV/m)	Polarization	Limit (dBµV/m)
5.12094	Peak	59.46	V	74
7.20483	Peak	55.42	V	74

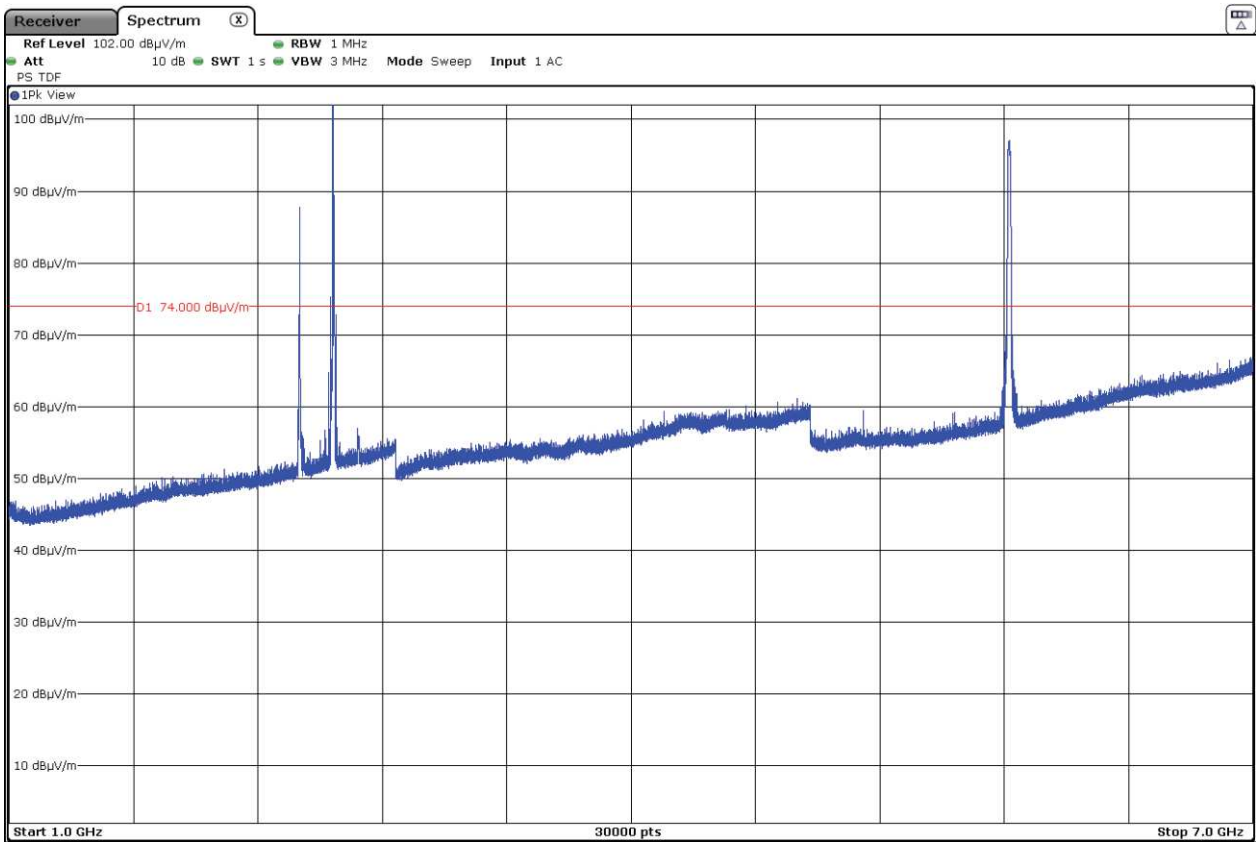
Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 40 GHz

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

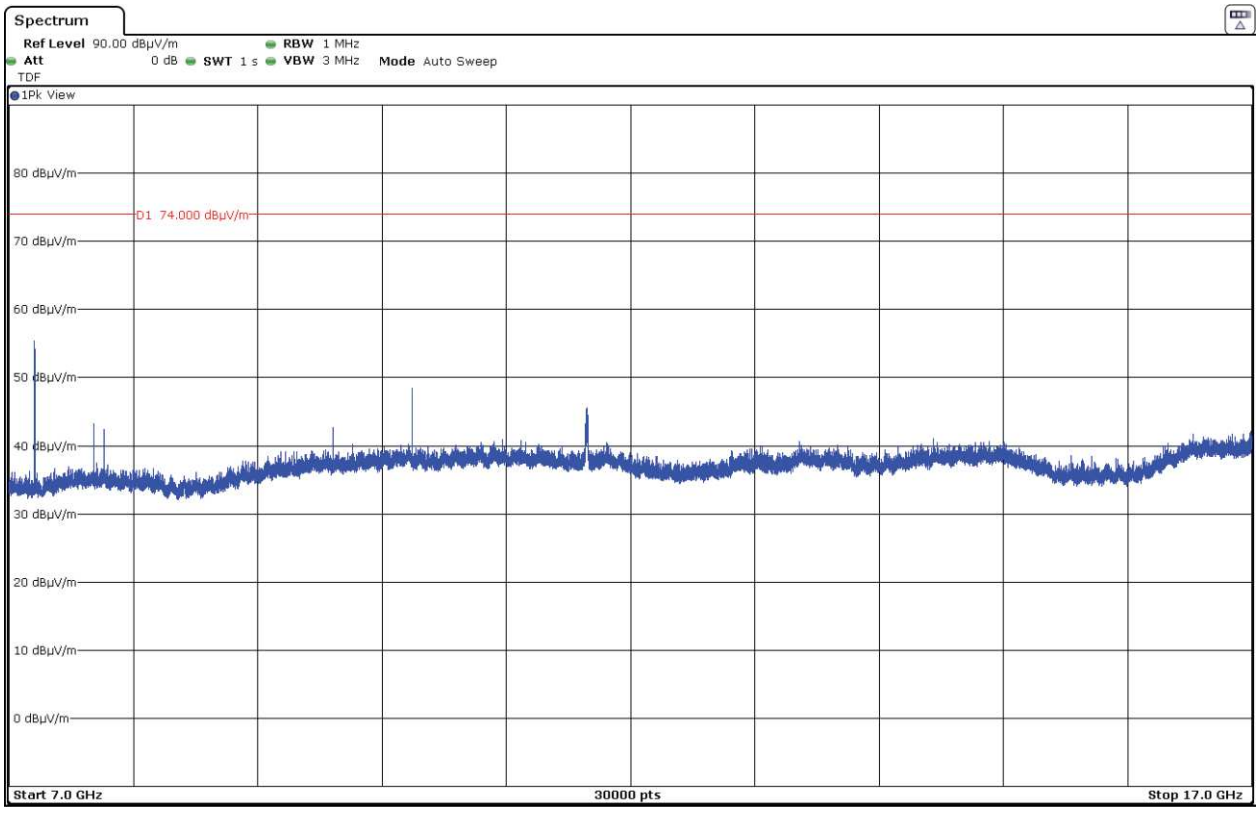


FREQUENCY RANGE 1 – 7 GHz

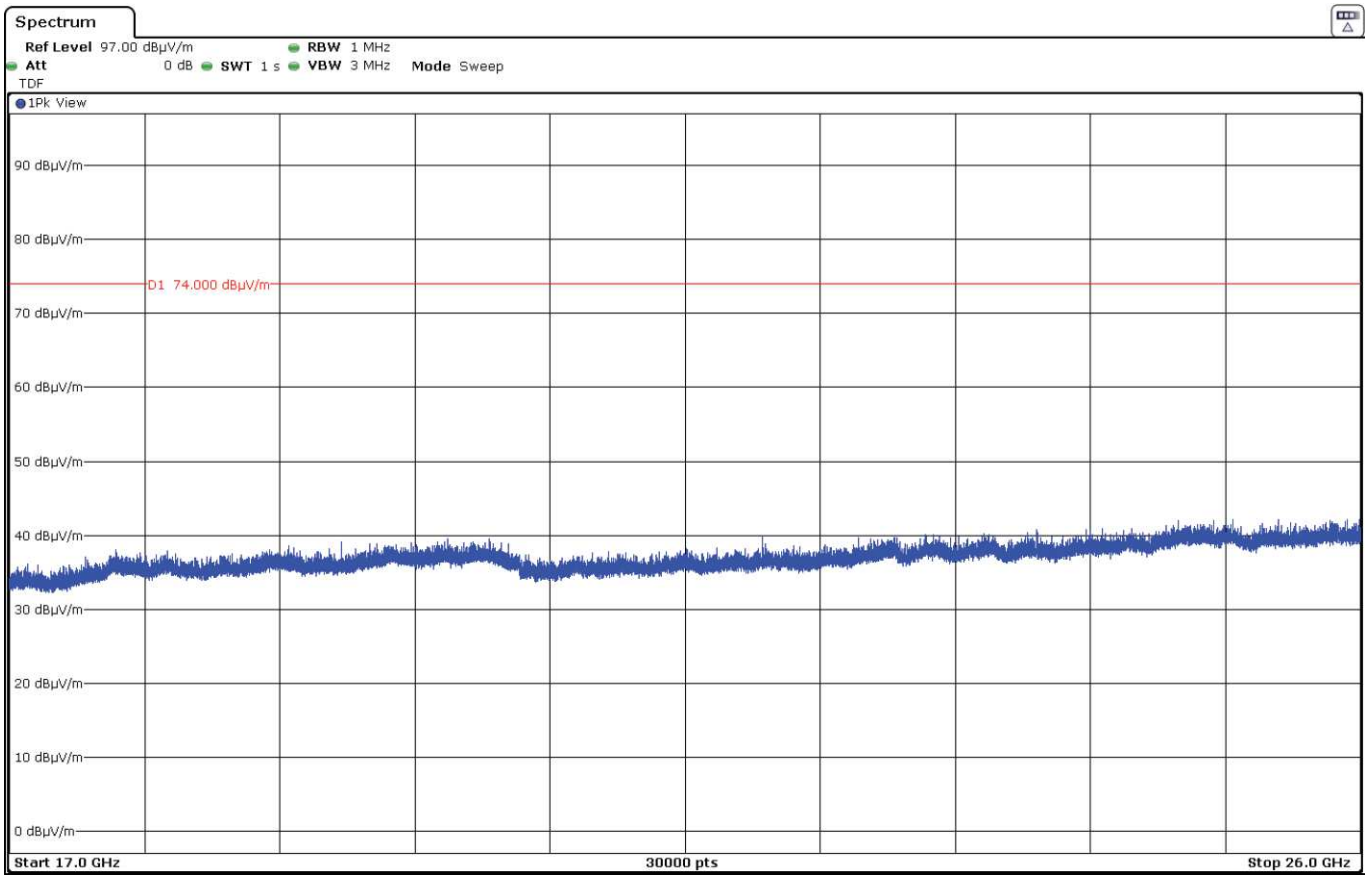


The peak above the limit on the left is the Carrier frequency Bluetooth Low Energy (2402 MHz).
The peak above the limit in the middle is the Carrier frequency LTE Band 7 (2565 MHz).
The peak at 2585 MHz corresponds to the downlink signal LTE Band 7.
The peak above the limit on the right is the Carrier frequency 802.11 a20 (5825 MHz).

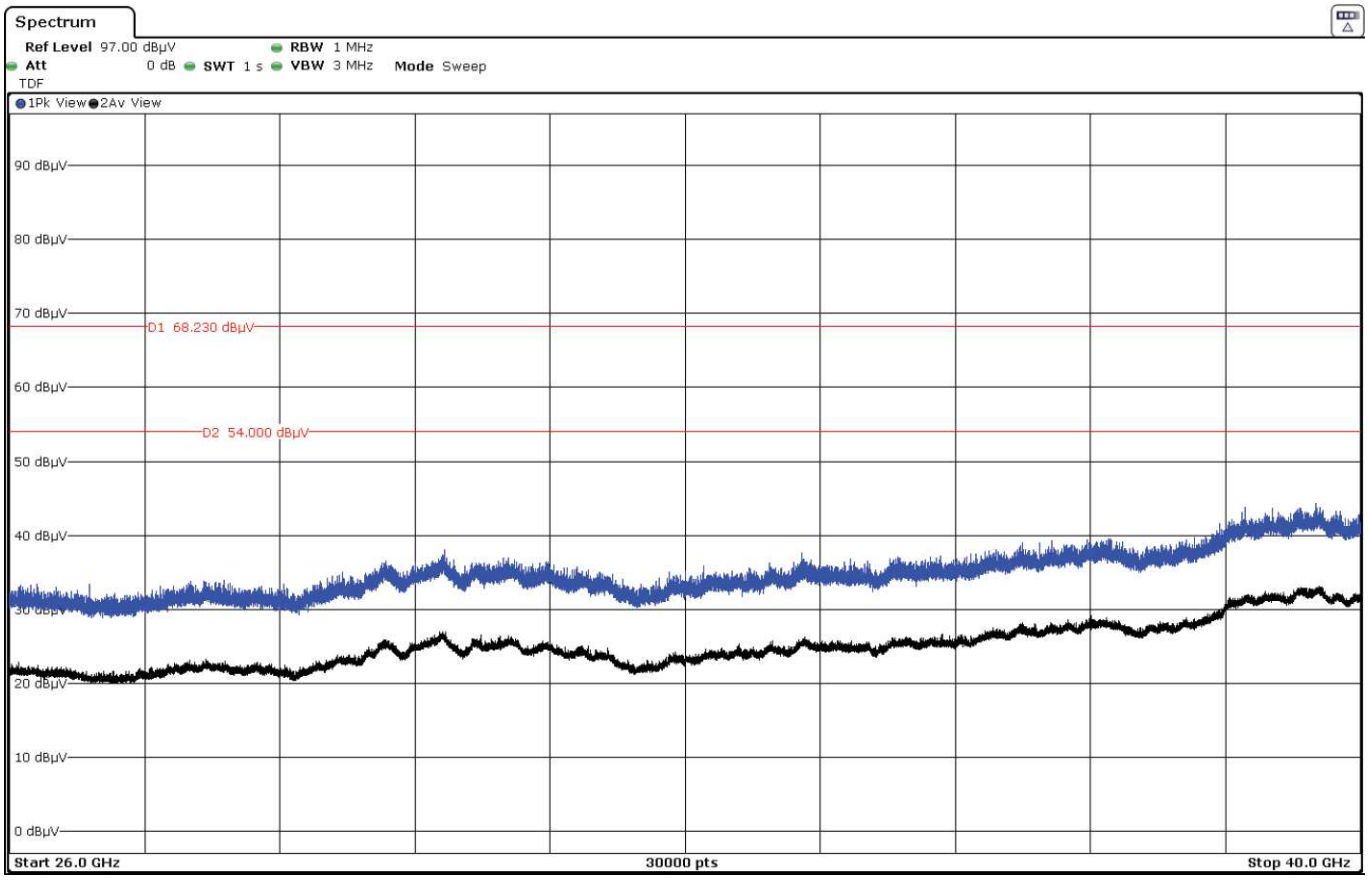
FREQUENCY RANGE 7 – 17 GHz



FREQUENCY RANGE 17 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz



- **Mode LTE Band 12, 802.11 b, Bluetooth Low Energy.**

QPSK & 16QAM
A preliminary scan determined the QPSK modulation as the worst case.

LTE Band 12:	Low Channel (704 MHz), RB=1. Offset=49.
WLAN 802.11 b:	High Channel (2462 MHz).
Bluetooth Low Energy:	Low Channel (2402 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 7.16 GHz	PK	43 + 10 log (P) dB = -13 dBm -> 82.23 dBµV/m
7.16 to 26 GHz	PK	74 dBµV/m (**)
7.16 to 26 GHz	AVG	54 dBµV/m (*) (**)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).
(**) Radiated emission limits to comply with §15.209(a) (see §15.205(c) / RSS-Gen).

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 26 GHz

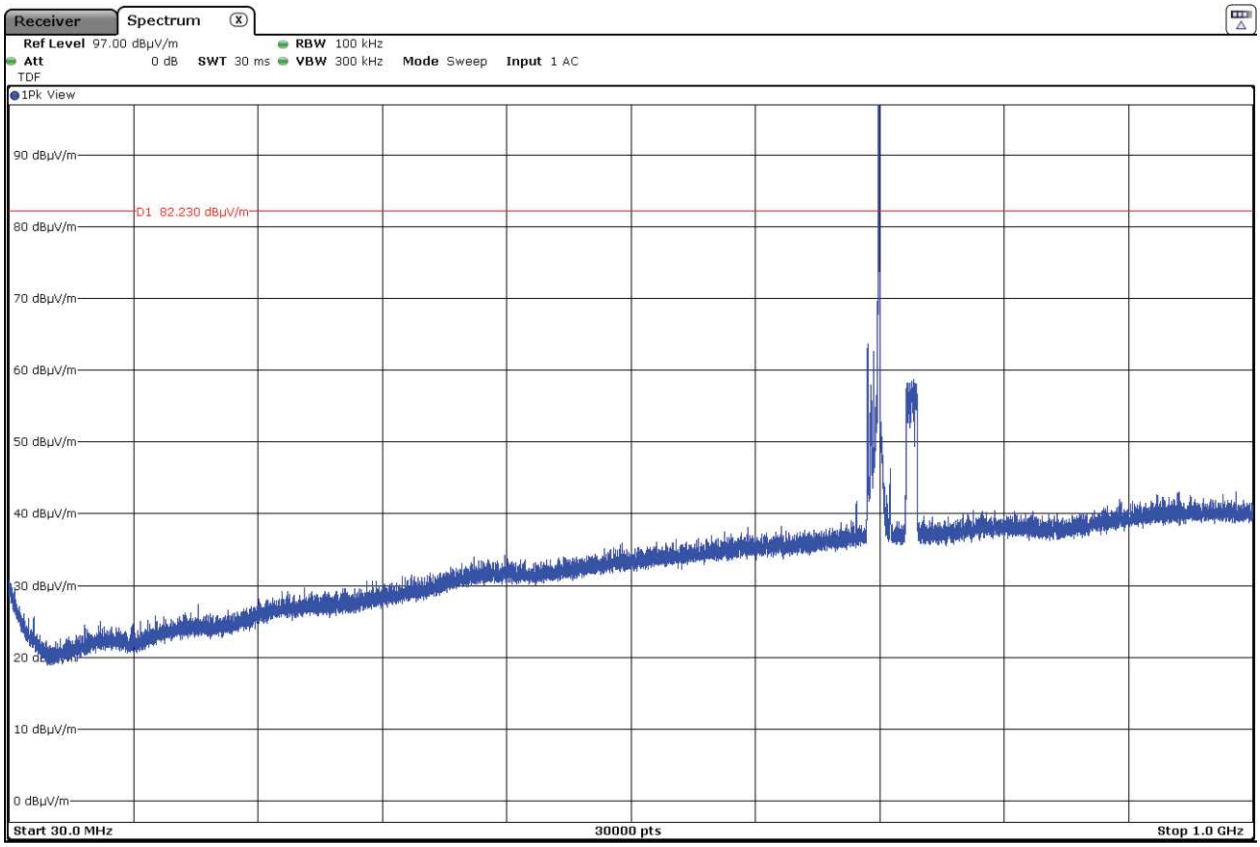
Spurious frequencies at less than 20 dB below the limits:

Spurious frequency (GHz)	Detector	E (dBµV/m)	Polarization
1.416833	Peak	51.9	H
4.80343	Peak	51.51	V
4.9243	Peak	49.54	V
7.26323	Peak	57.93	V
	Average	50.35	
7.32577	Peak	62.38	H
	Average	52.32	
7.3855	Peak	65.1	H
	Average	43.98	
9.84763	Peak	55.46	V

Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 26 GHz

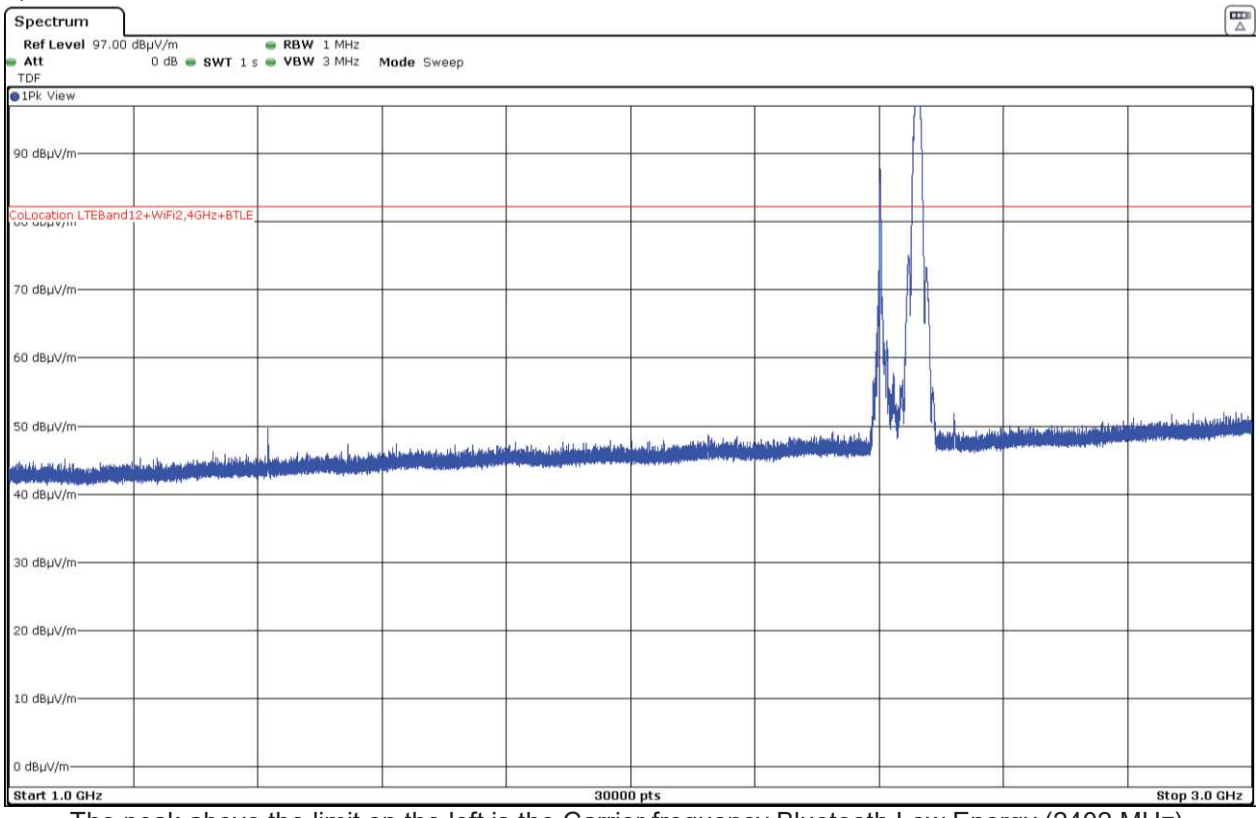
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz



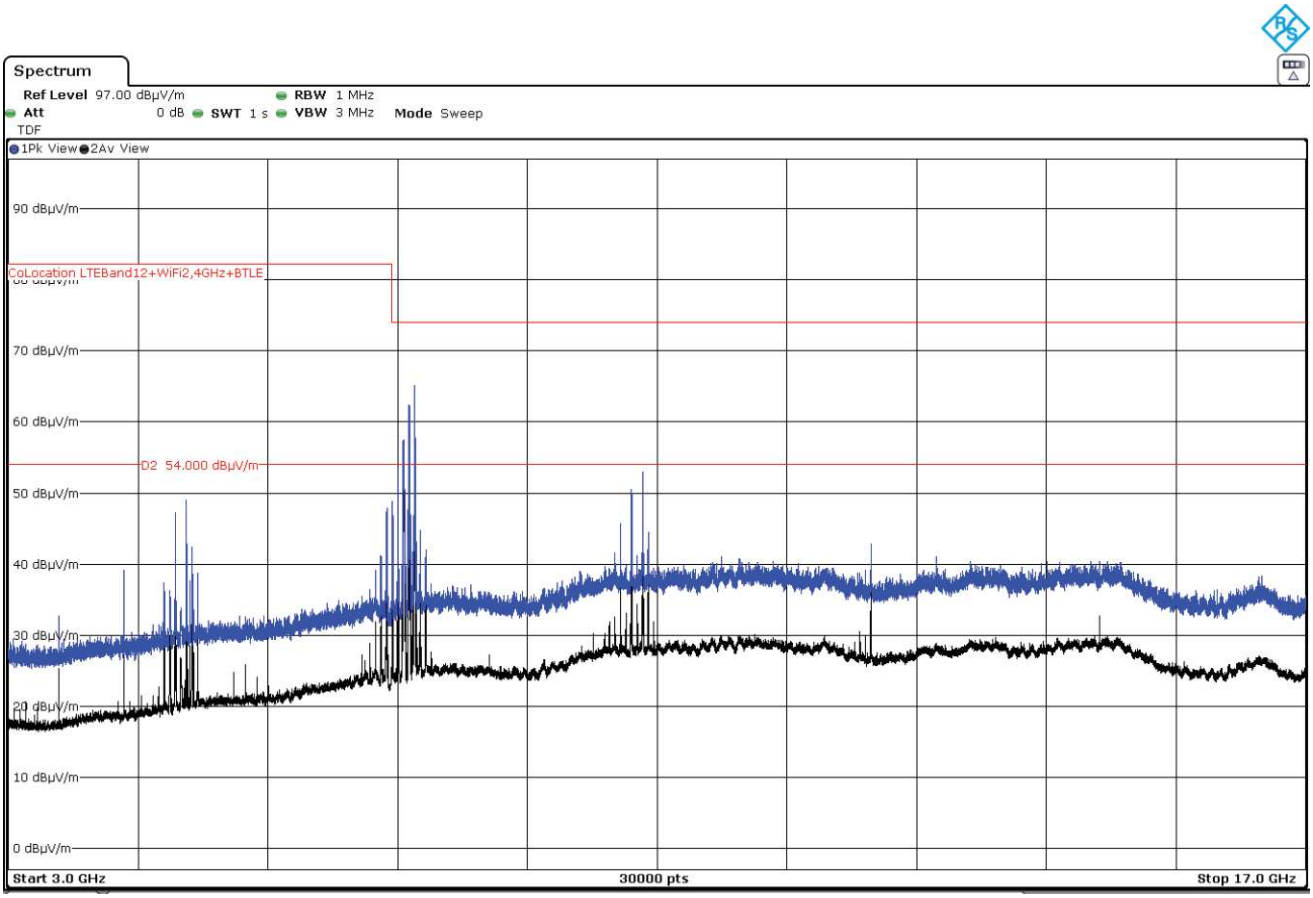
The peak above the limit is the Carrier frequency LTE Band 12 (704 MHz).
The peak at 734 MHz corresponds to the downlink signal LTE Band 12.

FREQUENCY RANGE 1 – 3 GHz

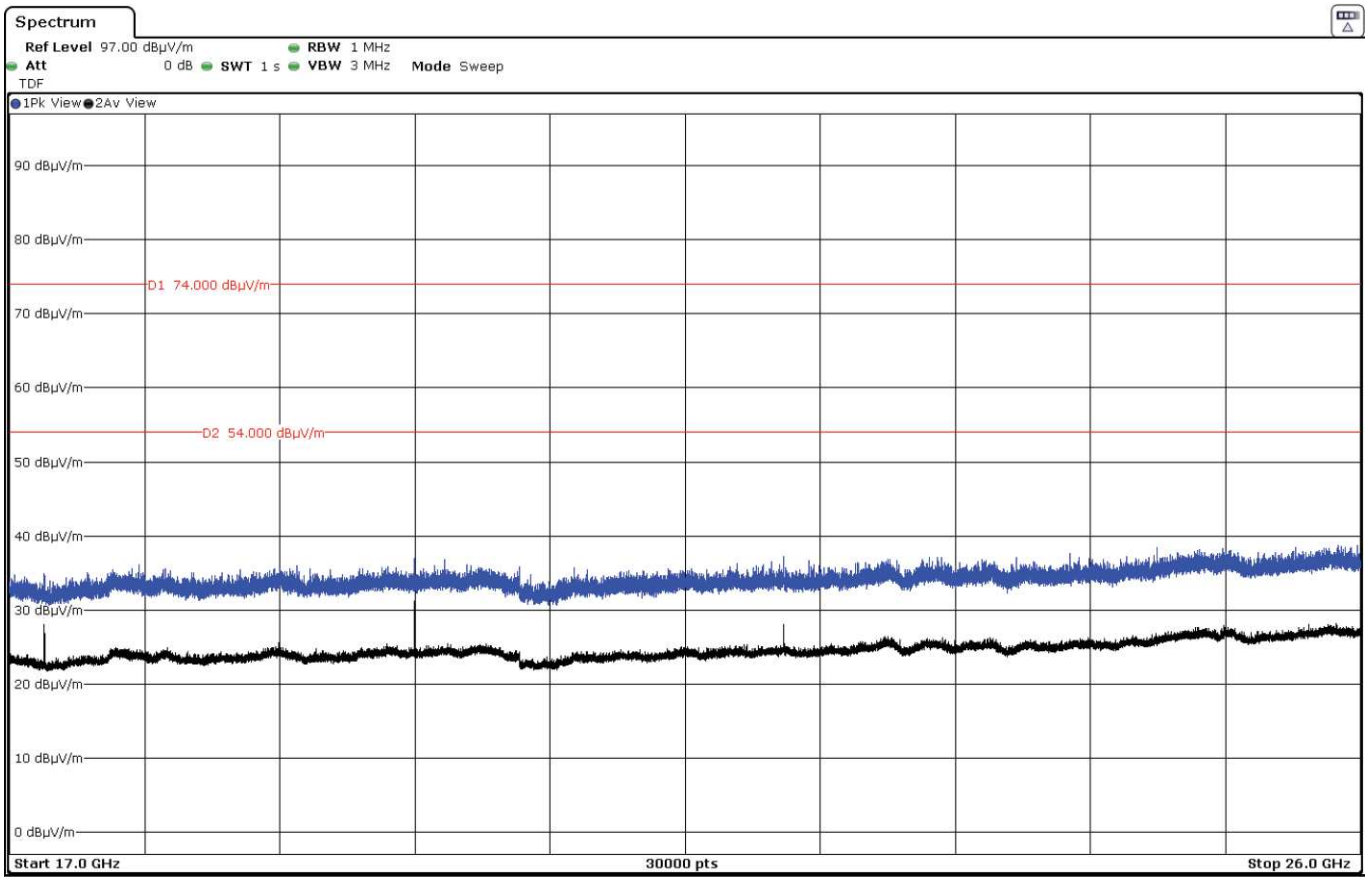


The peak above the limit on the left is the Carrier frequency Bluetooth Low Energy (2402 MHz).
The peak above the limit on the right is the Carrier frequency 802.11 b (2462 MHz).

FREQUENCY RANGE 3 – 17 GHz



FREQUENCY RANGE 17 - 26 GHz



- **Mode LTE Band 12, 802.11 a20 U-NII-1, Bluetooth Low Energy.**

QPSK & 16QAM
A preliminary scan determined the QPSK modulation as the worst case.

LTE Band 12:	Low Channel (704 MHz), RB=1. Offset=49.
802.11 a U-NII-1:	BW=20 MHz, Low Channel (5180 MHz).
Bluetooth Low Energy:	Low Channel (2402 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 7.16 GHz	PK	43 + 10 log (P) dB = -13 dBm -> 82.23 dBµV/m
7.16 to 26 GHz	PK	74 dBµV/m (***)
26 to 40 GHz	PK	68.23 dBµV/m (**) OR 74 dBµV/m (*)
7.16 to 40 GHz	AVG	54 dBµV/m (*)(***)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).
(**) Radiated emissions which fall in the non-restricted bands.
(***) Radiated emission limits to comply with §15.209(a) (see §15.205(c) / RSS-Gen).

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 40 GHz

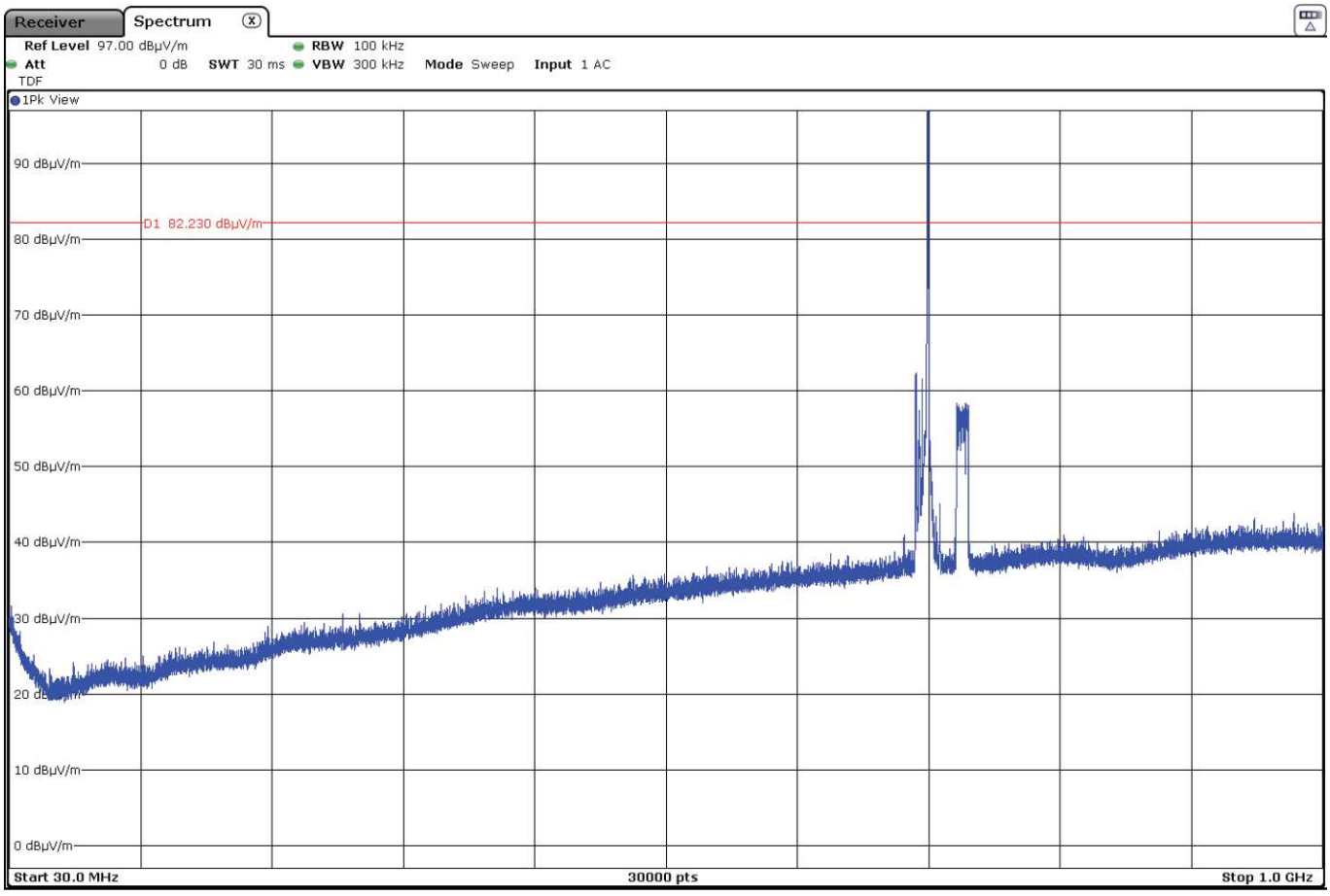
Spurious frequencies at less than 20 dB below the limits:

Spurious frequency (GHz)	Detector	E (dBµV/m)	Polarization
1.4169	Peak	50.55	H
2.1253	Peak	46.33	H
4.25008	Peak	51.03	V
4.95888	Peak	48.71	V
7.20517	Peak	53.41	V
9.60694	Peak	41.42	V
10.36217	Peak	36.87	V

Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 40 GHz

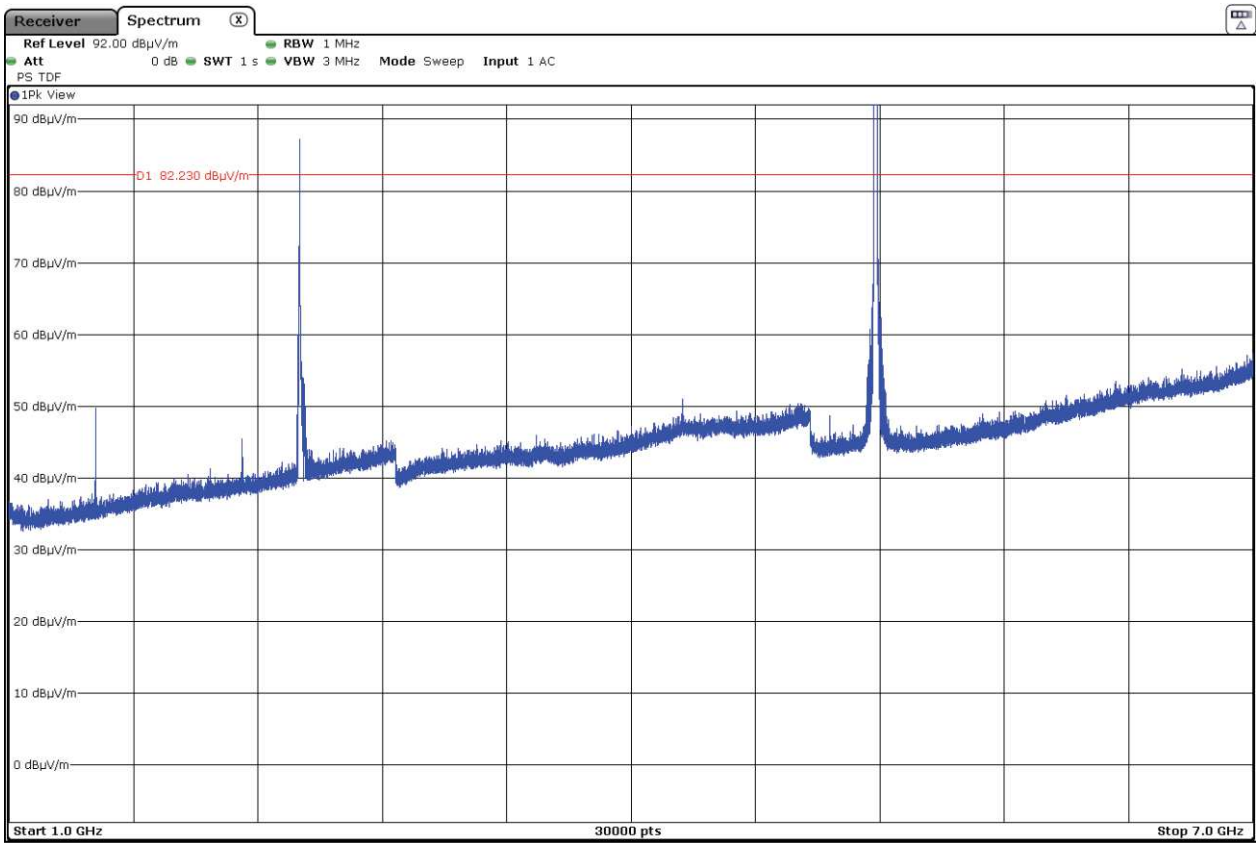
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz



The peak above the limit is the Carrier frequency LTE Band 12 (704 MHz).
The peak at 734 MHz corresponds to the downlink signal LTE Band 12.

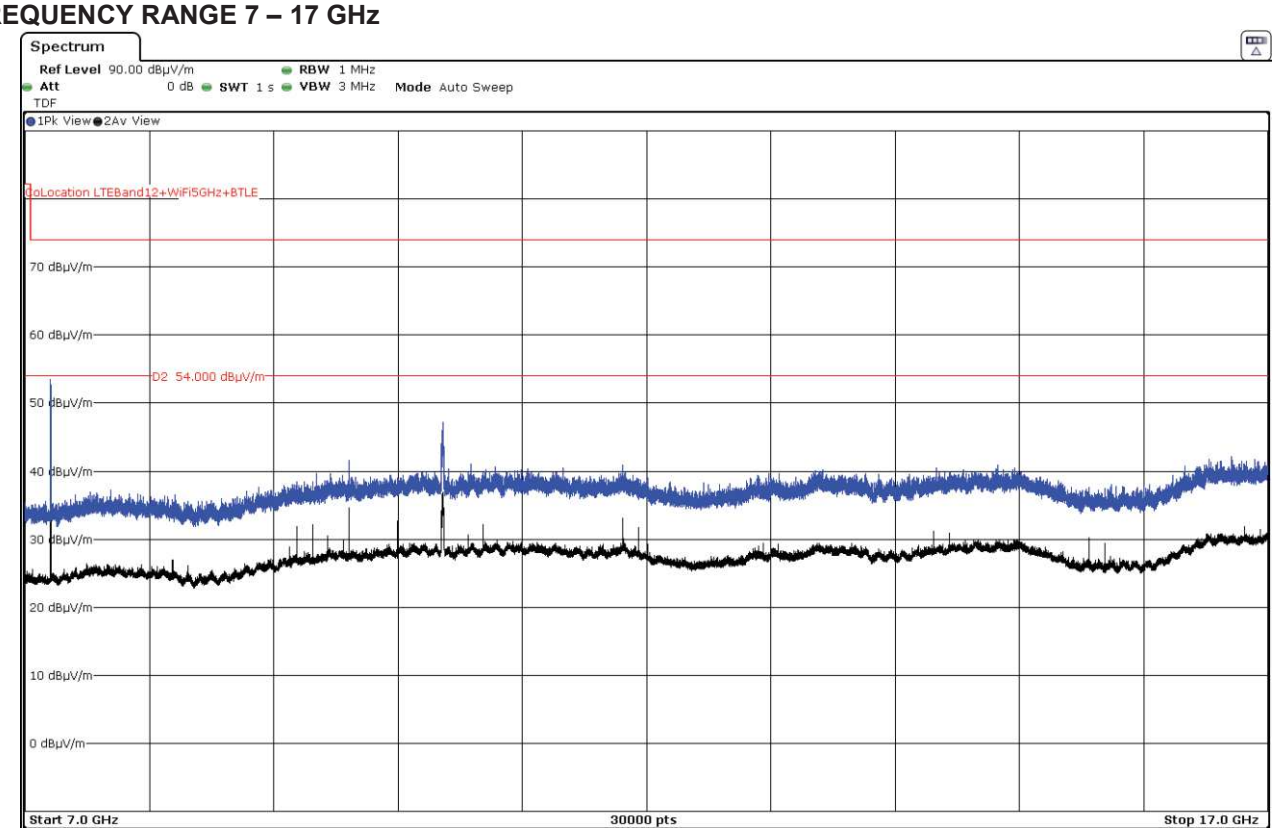
FREQUENCY RANGE 1 – 7 GHz



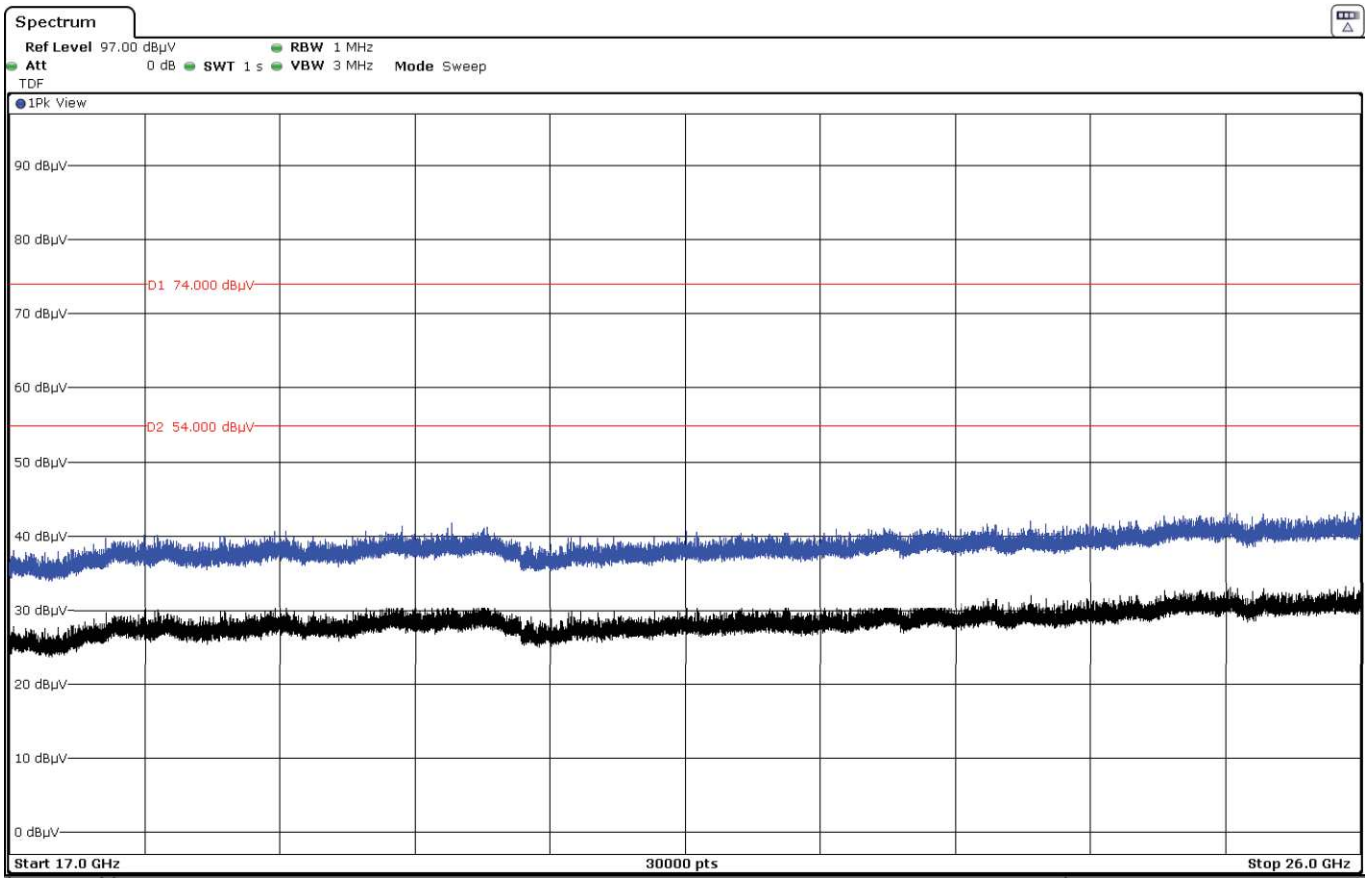
The peak above the limit on the left is the Carrier frequency Bluetooth Low Energy (2402 MHz).

The peak above the limit on the right is the Carrier frequency 802.11 a20 (5180 MHz).

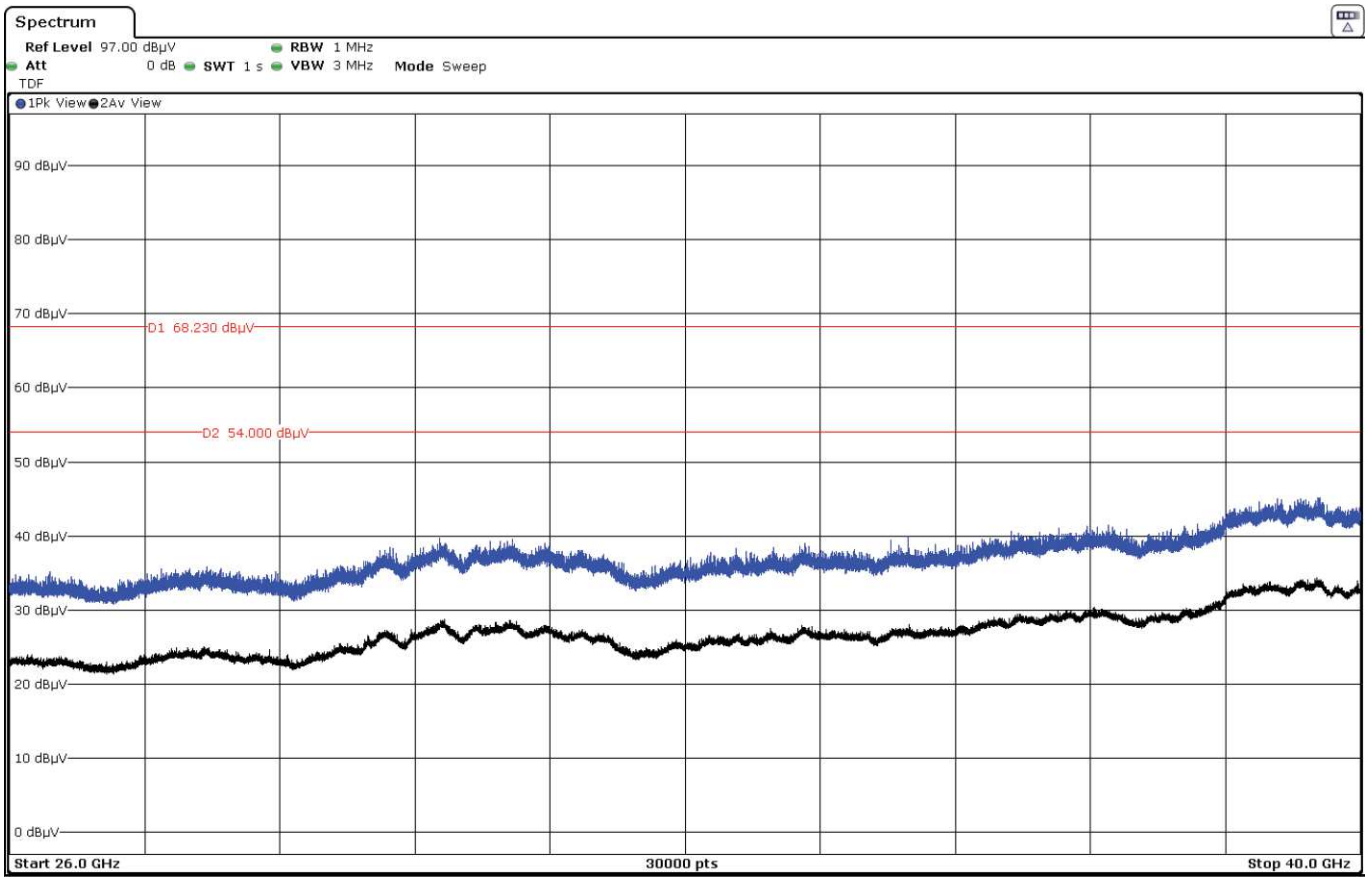
FREQUENCY RANGE 7 – 17 GHz



FREQUENCY RANGE 17 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz



- **Mode LTE Band 12, 802.11 a20 U-NII-3, Bluetooth Low Energy.**

QPSK & 16QAM
A preliminary scan determined the QPSK modulation as the worst case.

LTE Band 12:	Low Channel (704 MHz), RB=1. Offset=49.
802.11 a U-NII-3:	BW=20 MHz, High Channel (5825 MHz).
Bluetooth Low Energy:	Low Channel (2402 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 7.16 GHz	PK	43 + 10 log (P) dB = -13 dBm -> 82.23 dBµV/m
7.16 to 26 GHz	PK	74 dBµV/m (***)
26 to 40 GHz	PK	68.23 dBµV/m (**) OR 74 dBµV/m (*)
7.16 to 40 GHz	AVG	54 dBµV/m (*) (***)

(*) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).
(**) Radiated emissions which fall in the non-restricted bands.
(***) Radiated emission limits to comply with §15.209(a) (see §15.205(c) / RSS-Gen).

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 40 GHz

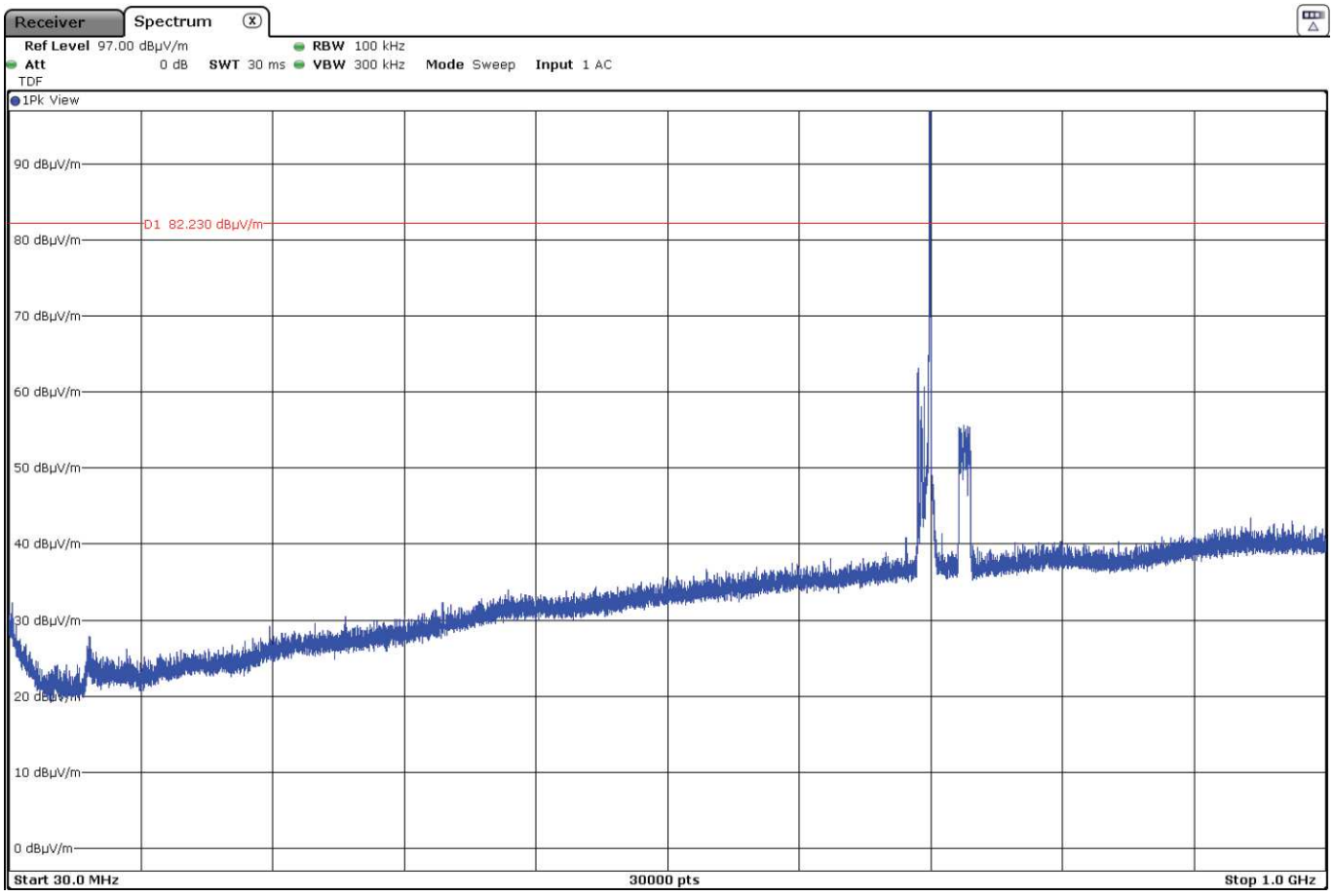
Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	E (dBµV/m)	Polarization
1.4167	Peak	69.21	H
2.1255	Peak	53.32	H
2.8339	Peak	51.66	H
4.25025	Peak	51.37	V
7.20483	Peak	54.26	V
7.7665	Peak	42.71	V
9.6067	Peak	41.41	V
11.64917	Peak	43.4	V

Measurement uncertainty (dB)	<±3.81 for f < 1GHz <±4.72 for f ≥ 1 GHz up to 18 GHz <±3.34 for f ≥ 18 GHz up to 40 GHz

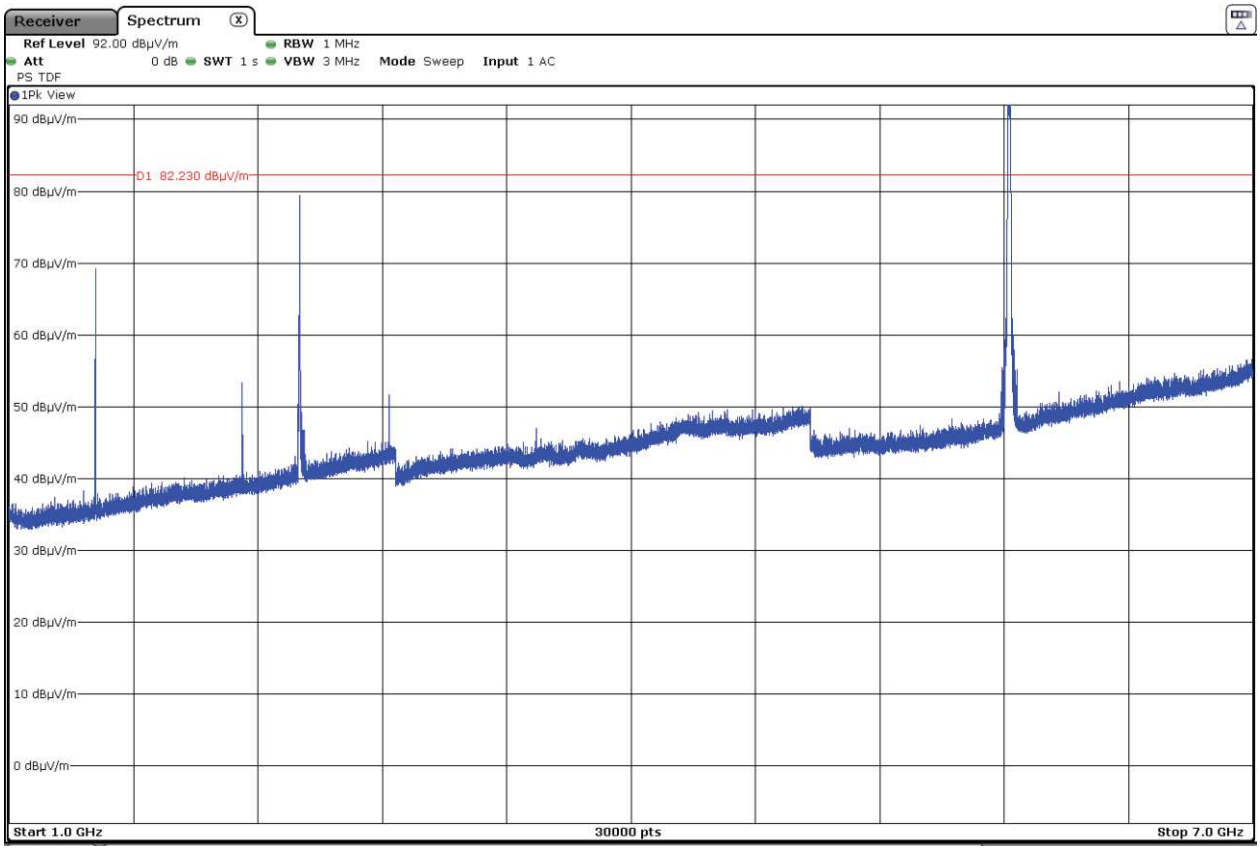
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz



The peak above the limit is the Carrier frequency LTE Band 12 (704 MHz).
The peak at 734 MHz corresponds to the downlink signal LTE Band 12.

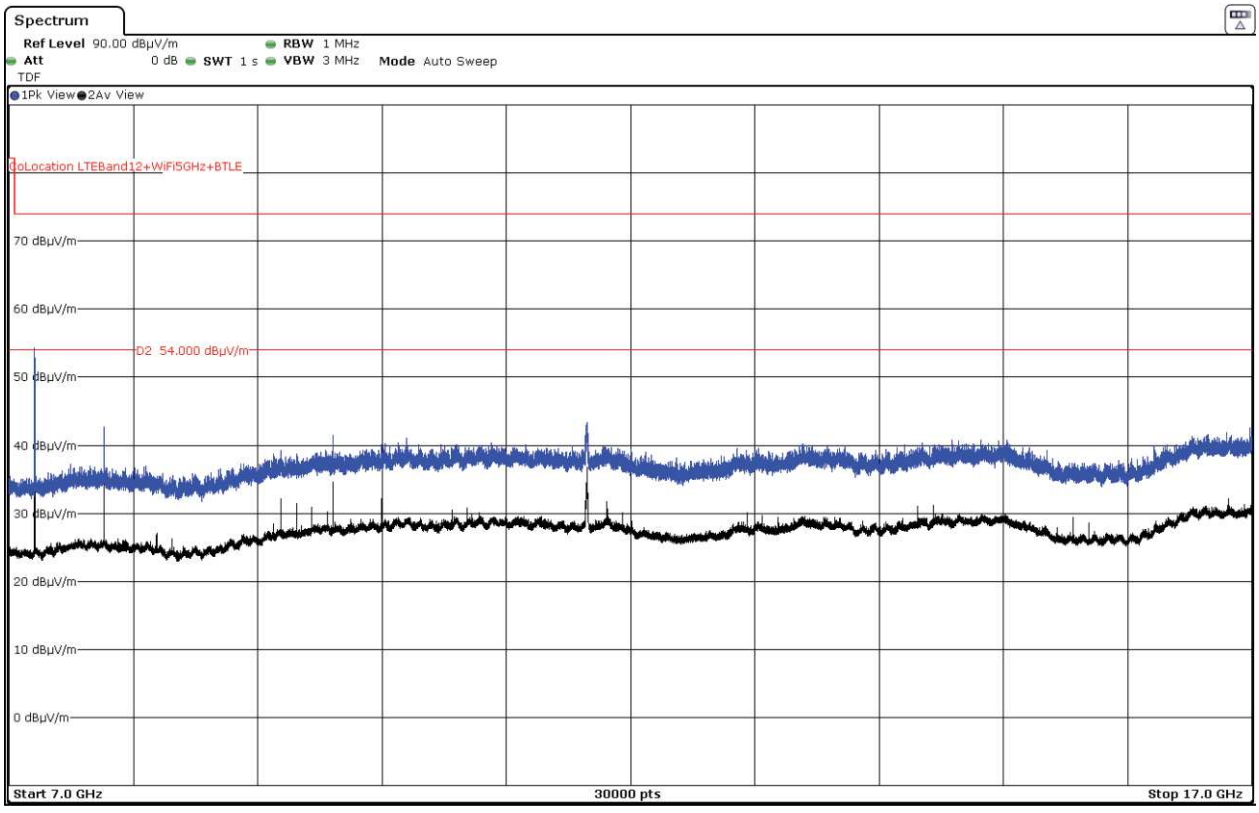
FREQUENCY RANGE 1 – 7 GHz



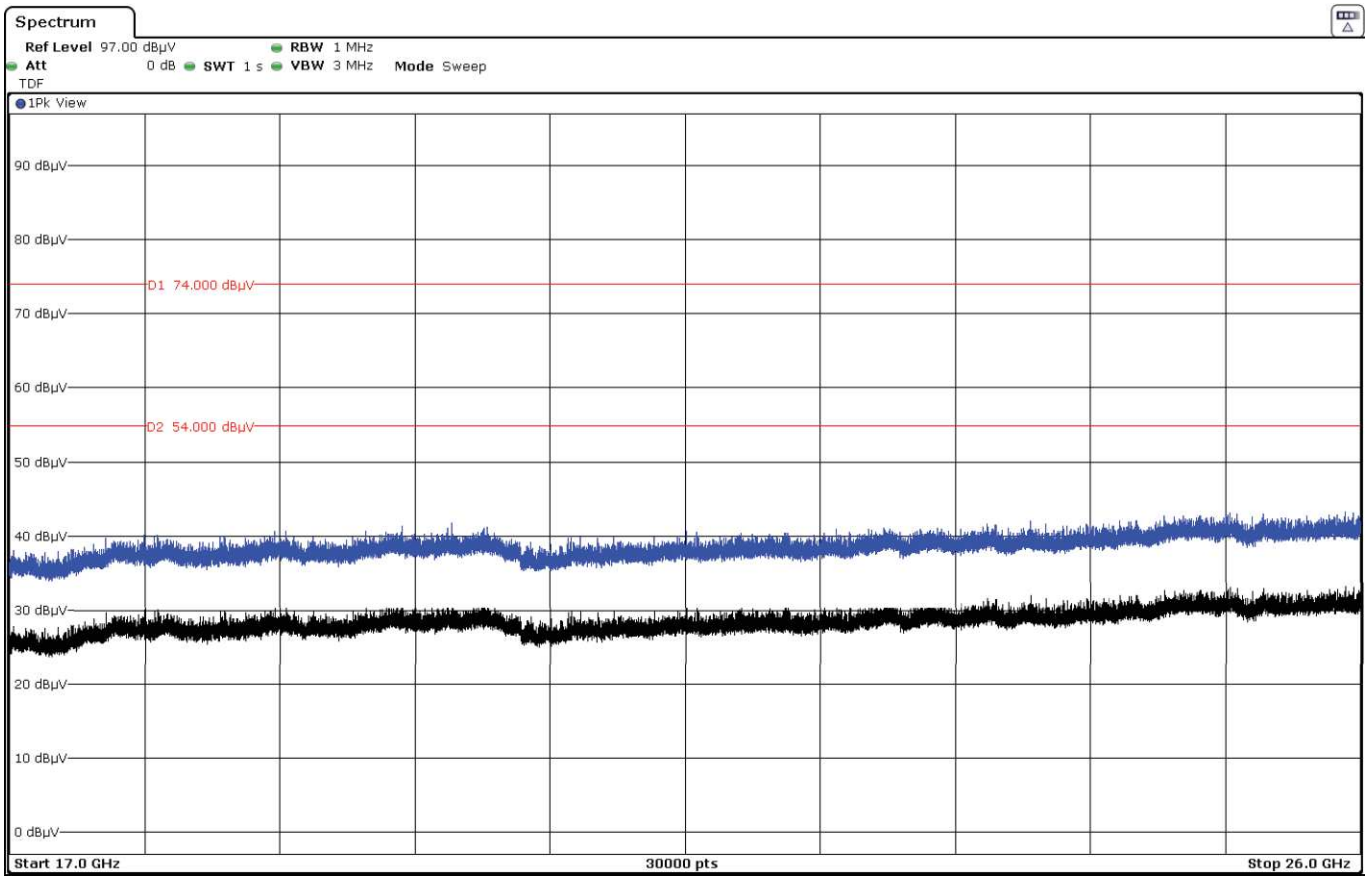
The peak close to the limit on the left is the Carrier frequency Bluetooth Low Energy (2402 MHz).

The peak above the limit on the right is the Carrier frequency 802.11 a20 (5825 MHz).

FREQUENCY RANGE 7 – 17 GHz



FREQUENCY RANGE 17 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz