Diagram 3.45a LTE: E-TM1.1, T_{5LTE}, 9 kHz – 1 GHz, Port B:

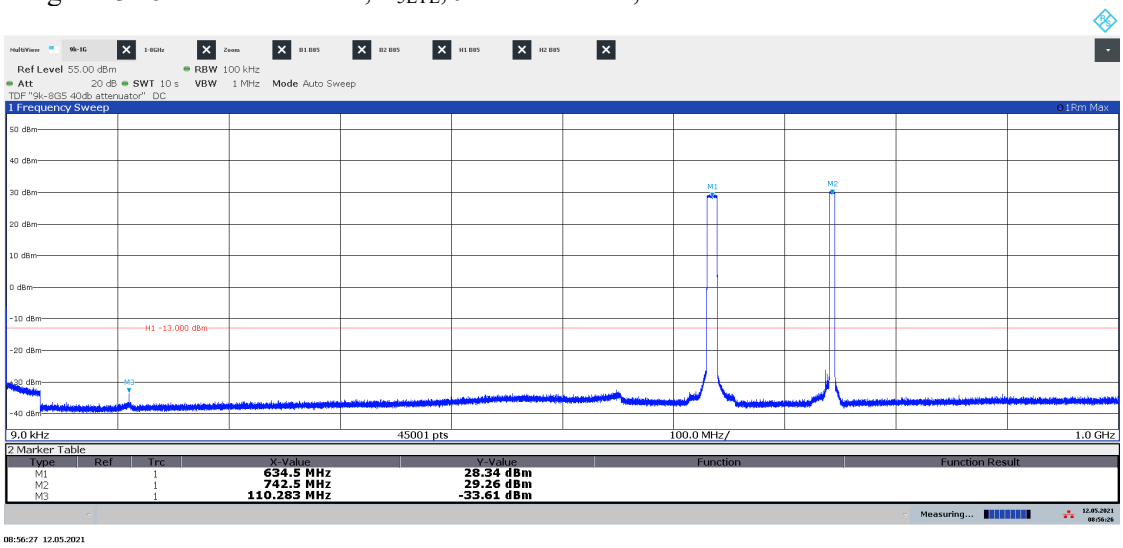


Diagram 3.45b LTE: E-TM1.1, T_{5LTE}, 1 – 8 GHz, Port B:

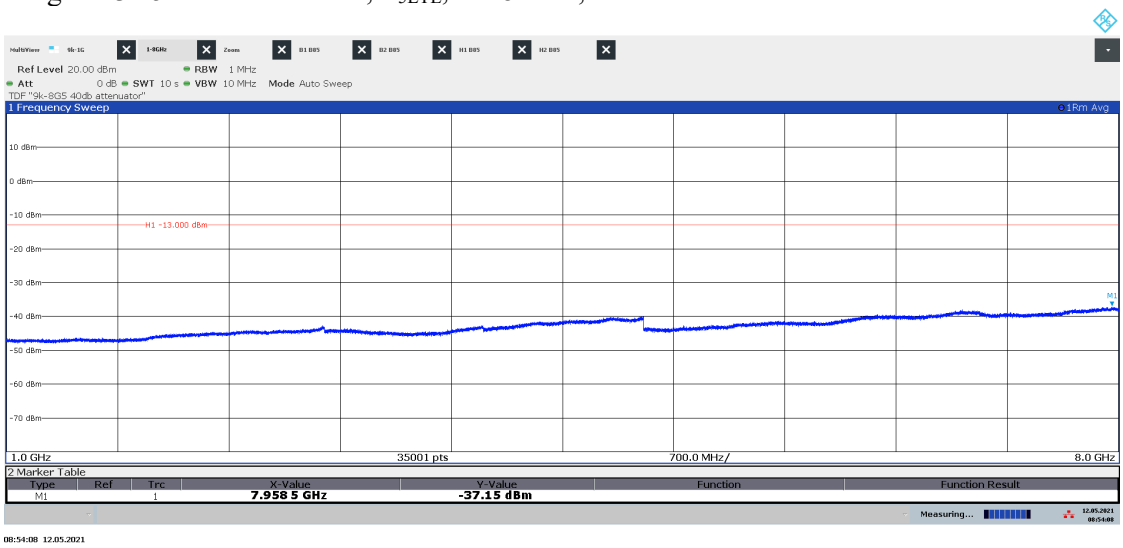


Diagram 3.46a LTE: E-TM1.1, Bim_{LTE}, 9 kHz – 1 GHz, Port B:

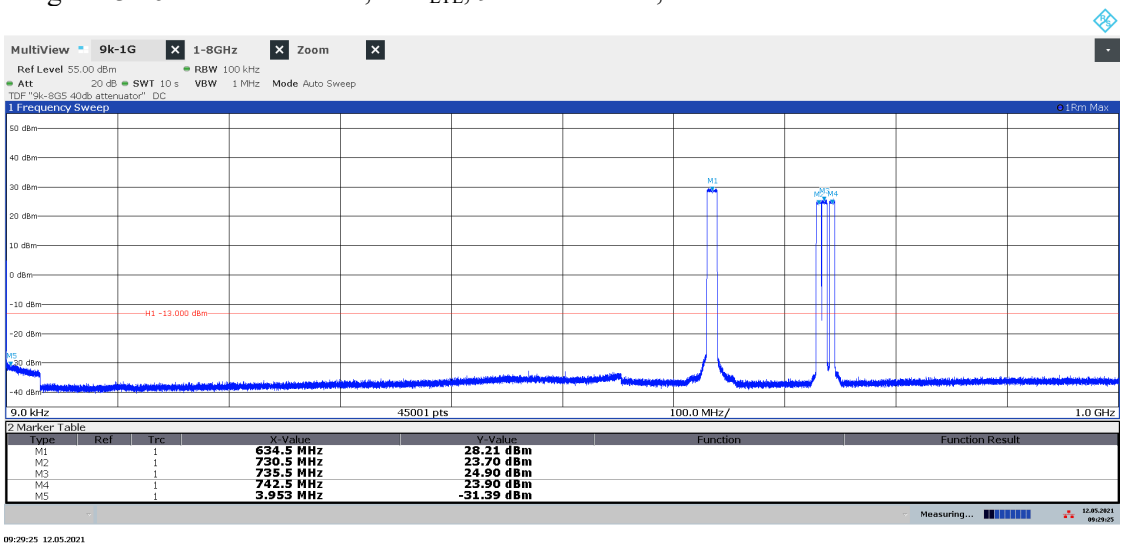
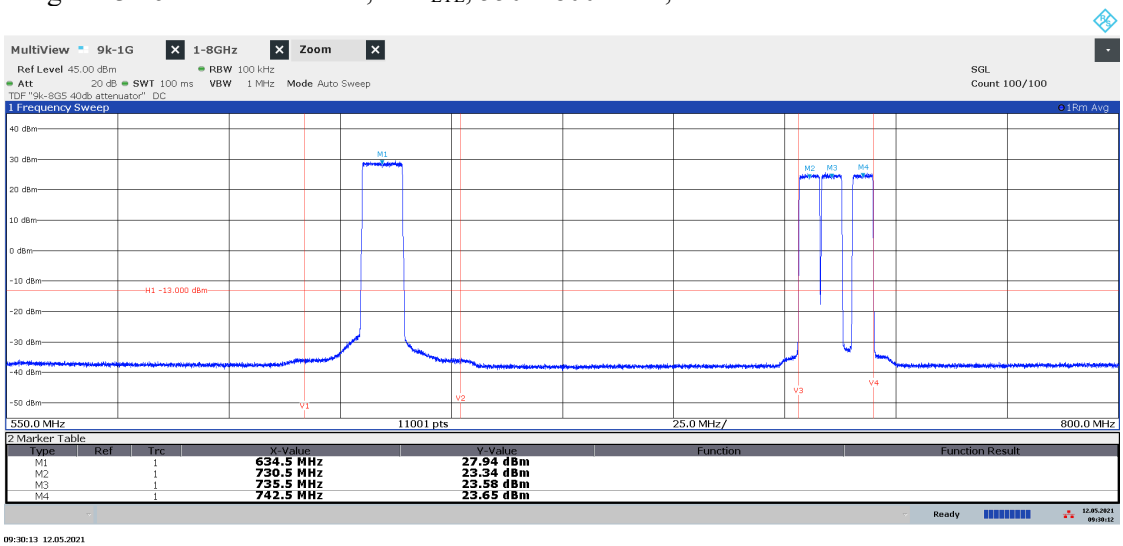


Diagram 3.46b LTE: E-TM1.1, Bim_{LTE}, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.46c LTE: E-TM1.1, Bim_{LTE}, 1 – 8 GHz, Port B:

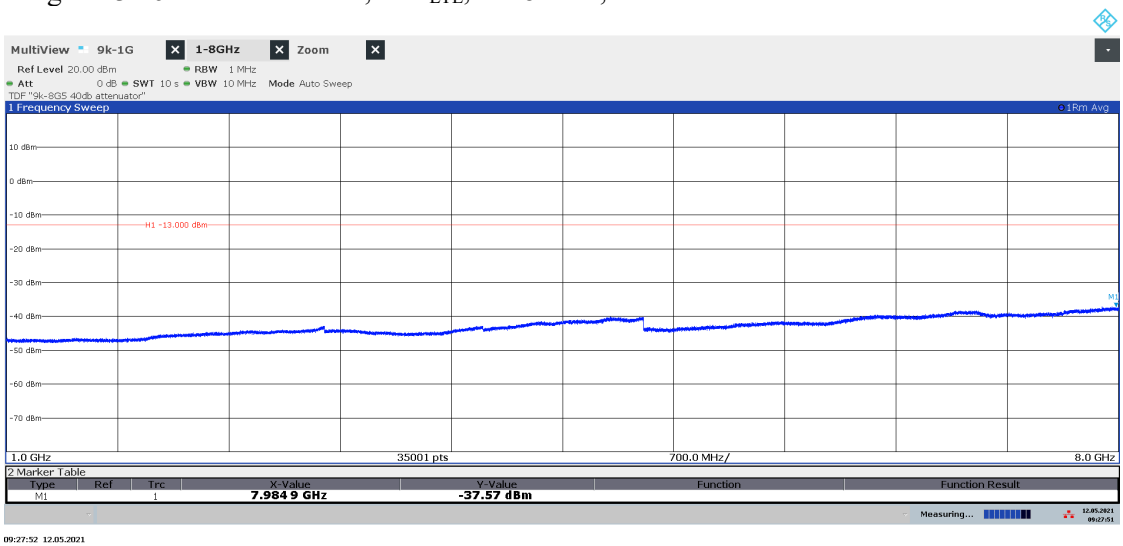


Diagram 3.47a LTE: E-TM1.1, Tim_{LTE}, 9 kHz – 1 GHz, Port B:

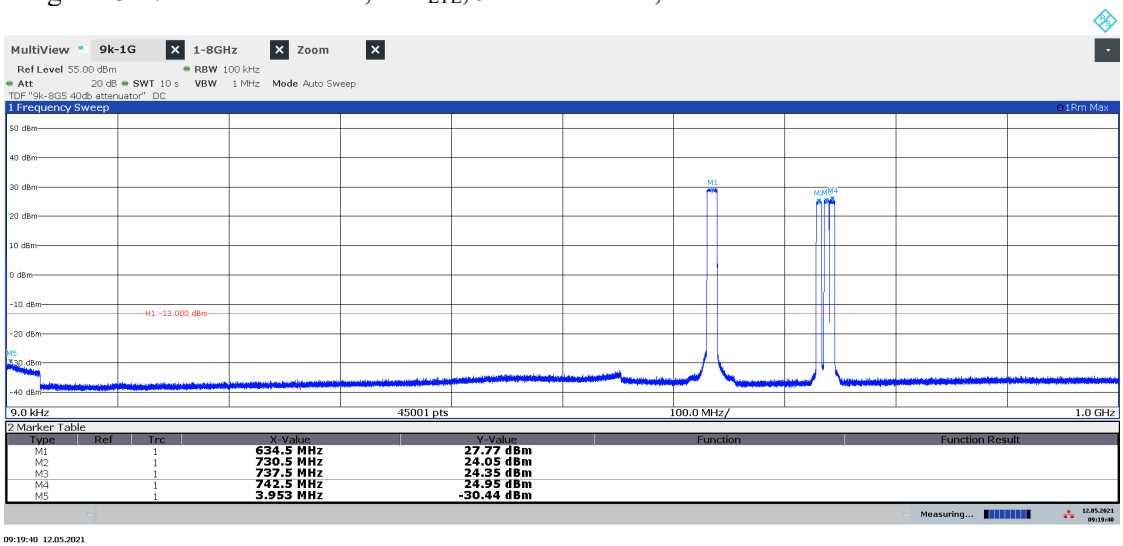
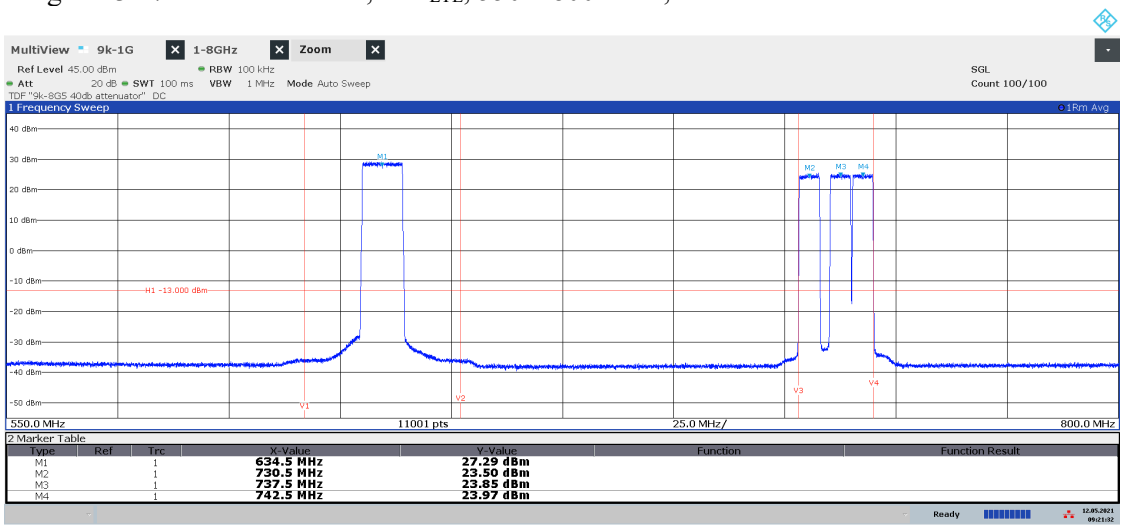


Diagram 3.47b LTE: E-TM1.1, Tim_{LTE}, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.47c LTE: E-TM1.1, Tim_{LTE}, 1 – 8 GHz, Port B:

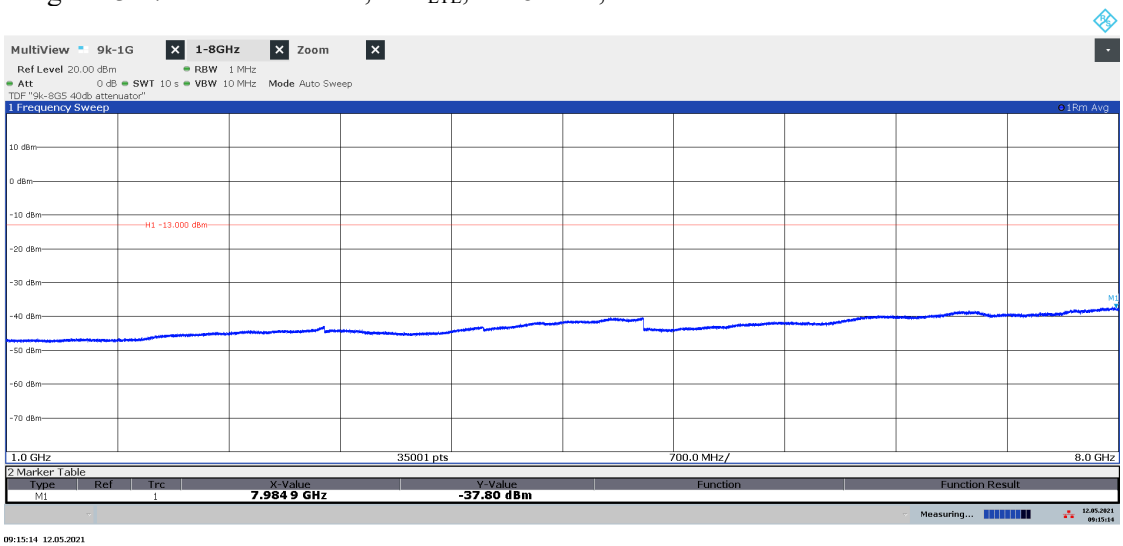


Diagram 3.48a NB IoT SA: N-TM, LTE: E-TM3.1, B_{IoT+L}, 9 kHz – 1 GHz, Port B:

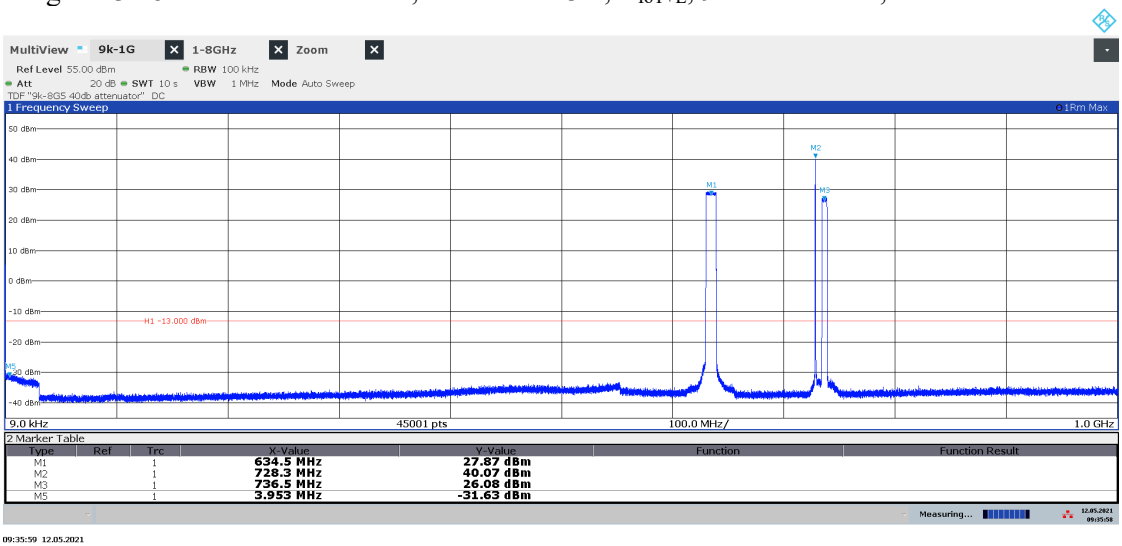
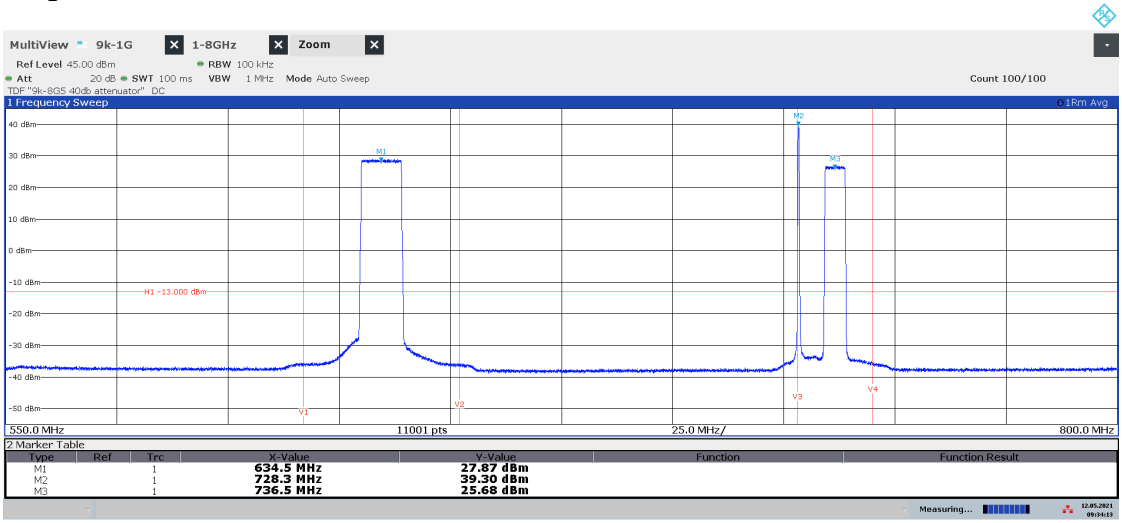


Diagram 3.48b NB IoT SA: N-TM, LTE: E-TM3.1, B_{IoT+L}, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.48c NB IoT SA: N-TM, LTE: E-TM3.1, B_{IoT+L}, 1 – 8 GHz, Port B:

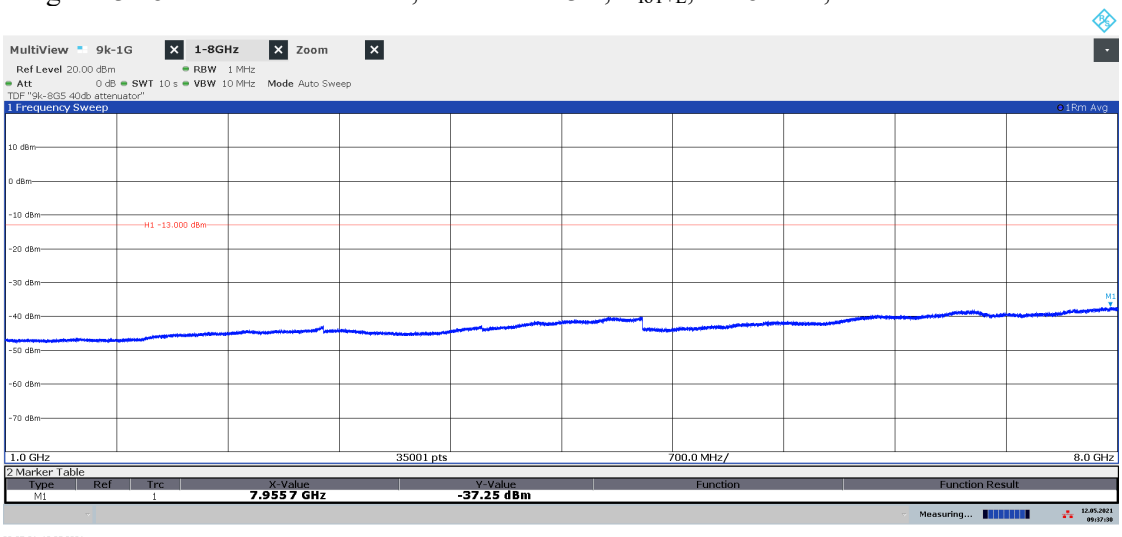


Diagram 3.49a NB IoT IB: N-TM, LTE: E-TM3.1, $B_{IBIoT+L}$, 9 kHz – 1 GHz, Port B:

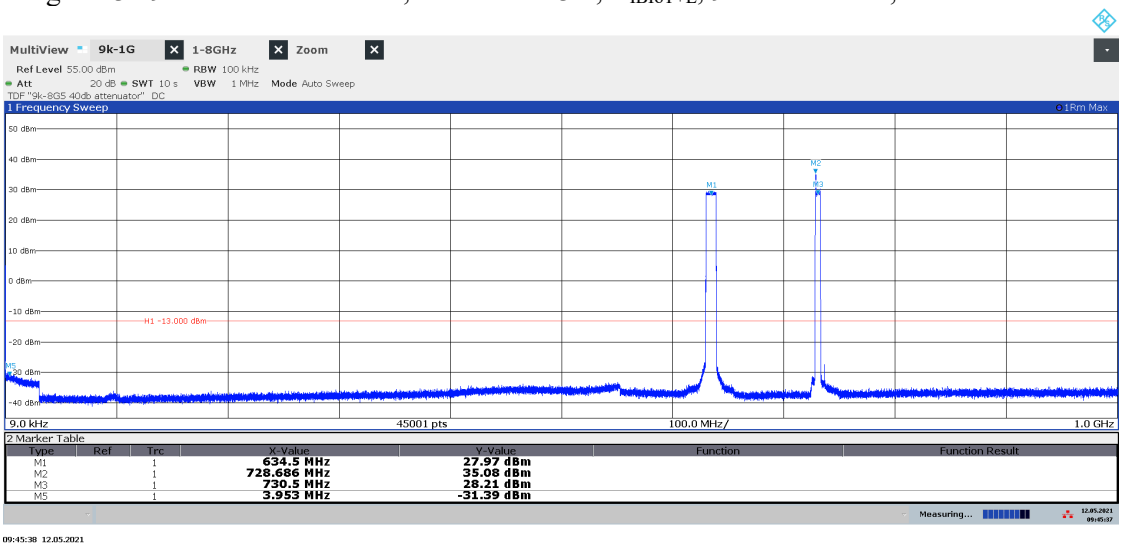
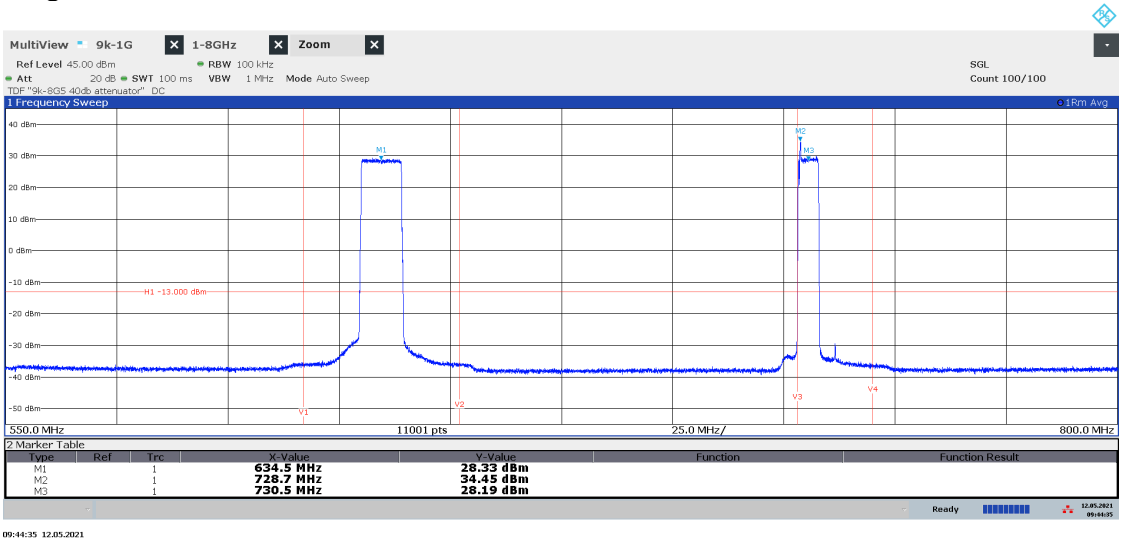


Diagram 3.49b NB IoT IB: N-TM, LTE: E-TM3.1, $B_{IBIoT+L}$, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.49c NB IoT SA: N-TM, LTE: E-TM3.1, $B_{IBIoT+L}$, 1 – 8 GHz, Port B:

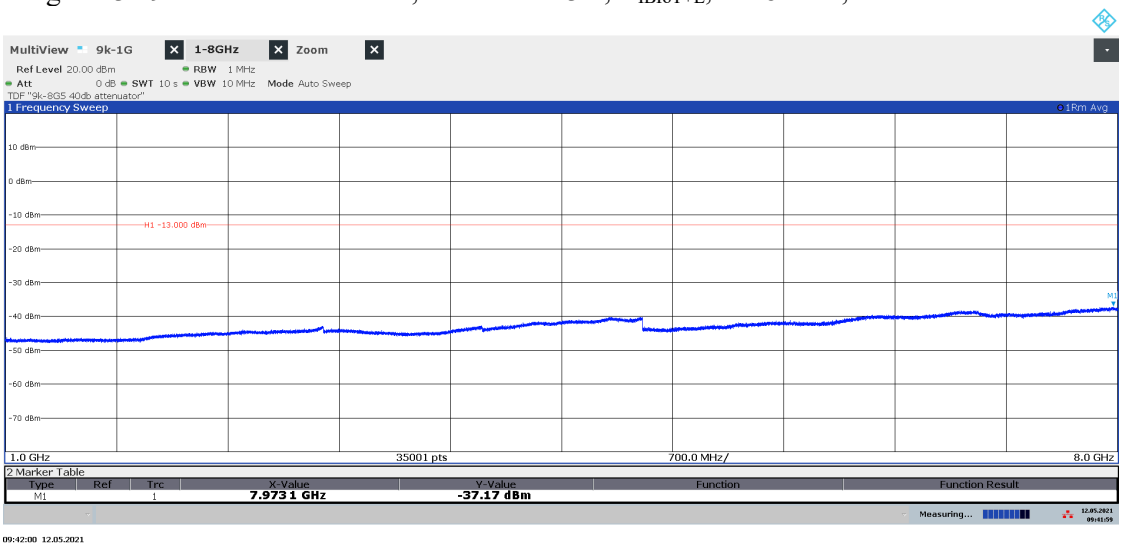


Diagram 3.50a NB IoT SA: N-TM, LTE: E-TM3.1, M_{IoT+L}, 9 kHz – 1 GHz, Port B:

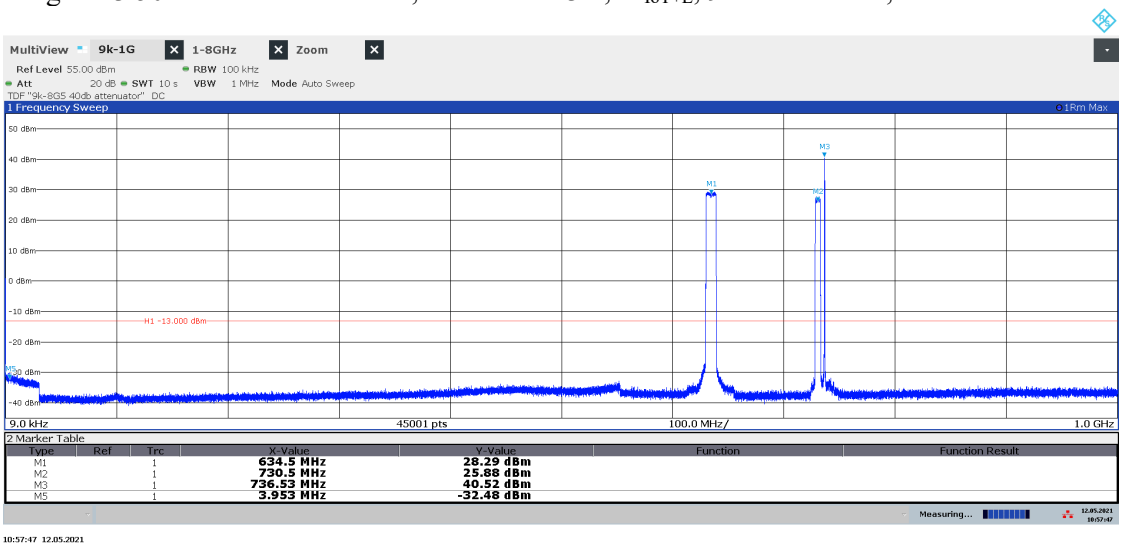
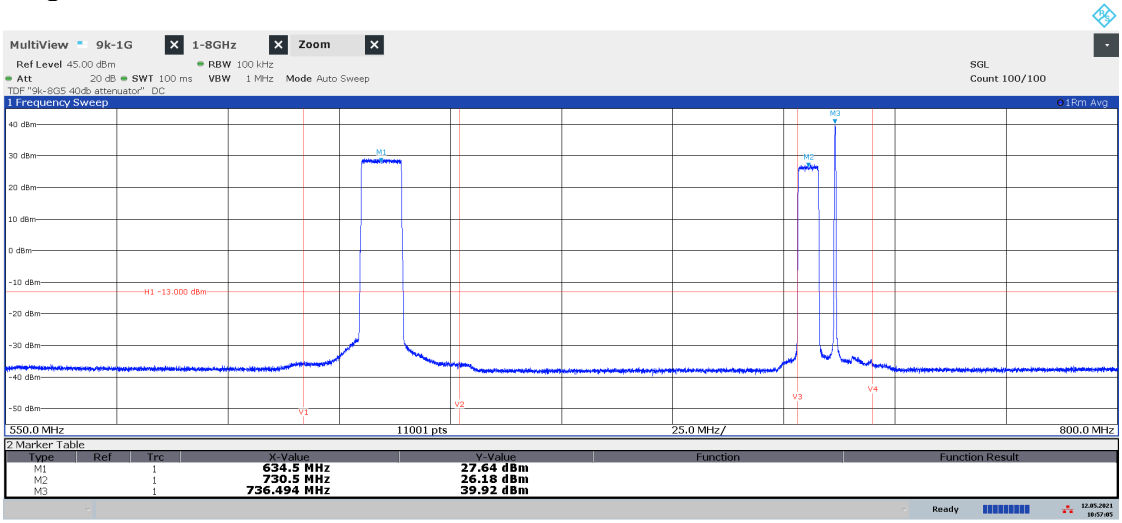


Diagram 3.50b NB IoT SA: N-TM, LTE: E-TM3.1, M_{IoT+L}, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.50c NB IoT SA: N-TM, LTE: E-TM3.1, M_{IoT+L}, 1 – 8 GHz, Port B:

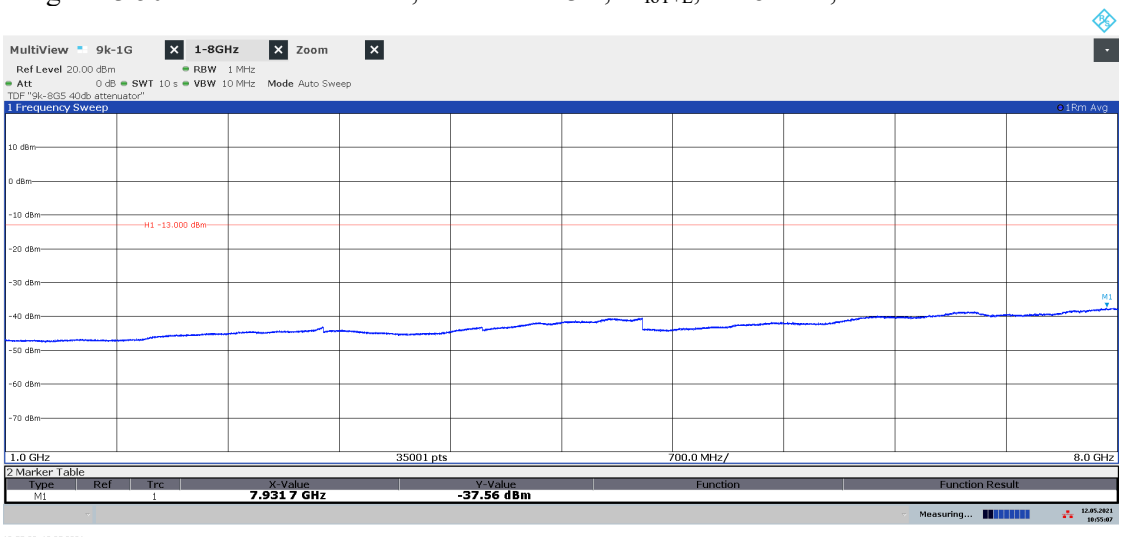


Diagram 3.51a NB IoT IB: N-TM, LTE: E-TM3.1, $M_{IBIoT+L}$, 9 kHz – 1 GHz, Port B:

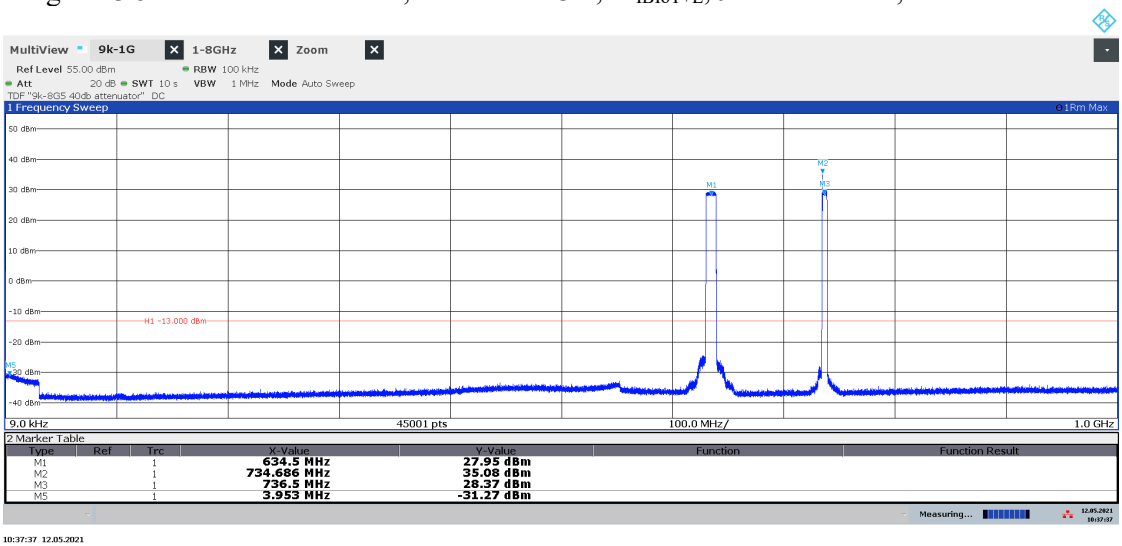
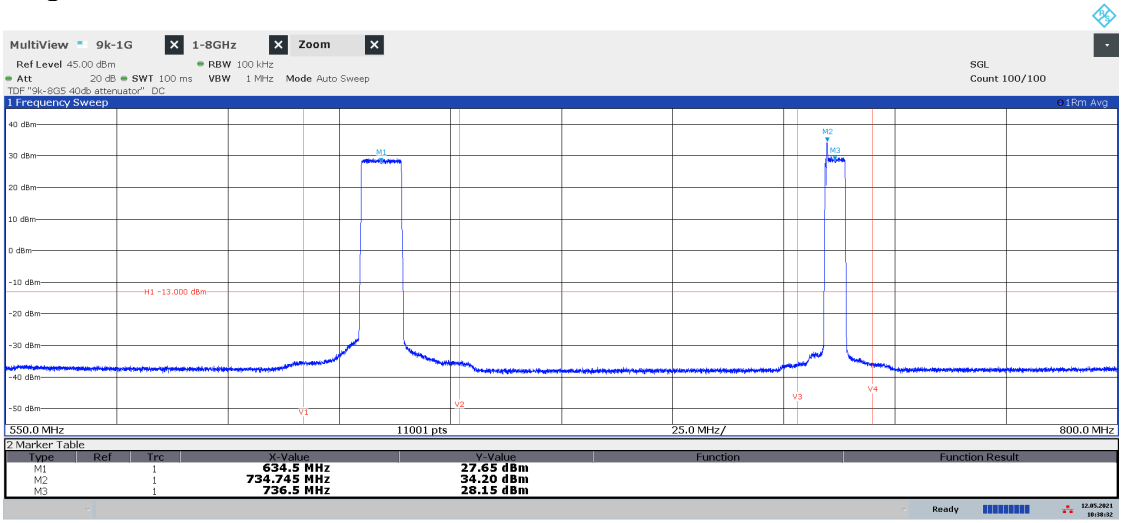


Diagram 3.51b NB IoT IB: N-TM, LTE: E-TM3.1, $M_{IBIoT+L}$, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.51c NB IoT IB: N-TM, LTE: E-TM3.1, $M_{IBIoT+L}$, 1 – 8 GHz, Port B:

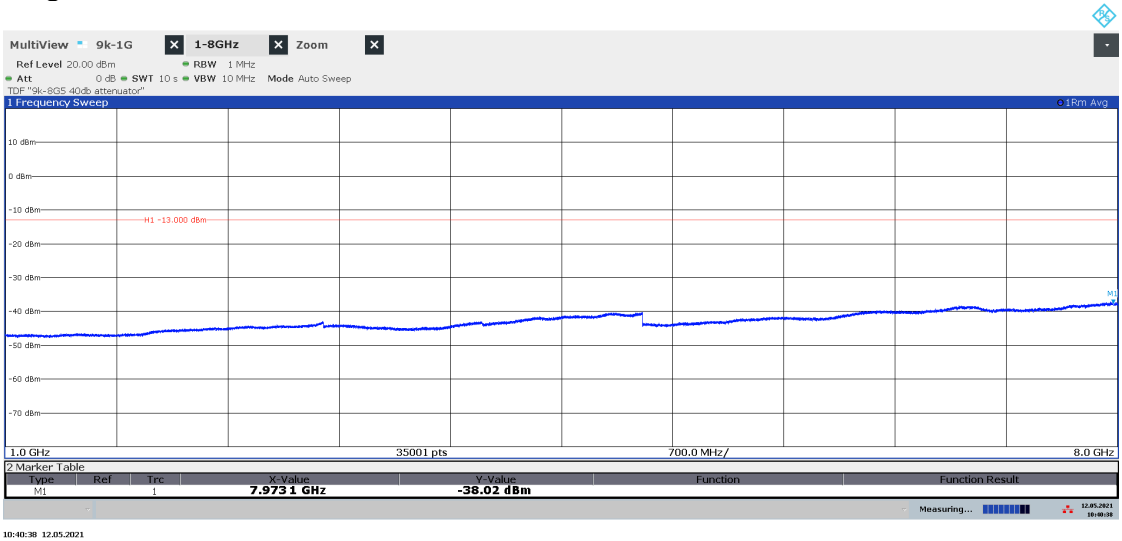


Diagram 3.52a NB IoT SA: N-TM, LTE: E-TM3.1, T_{IoT+L}, 9 kHz – 1 GHz, Port B:

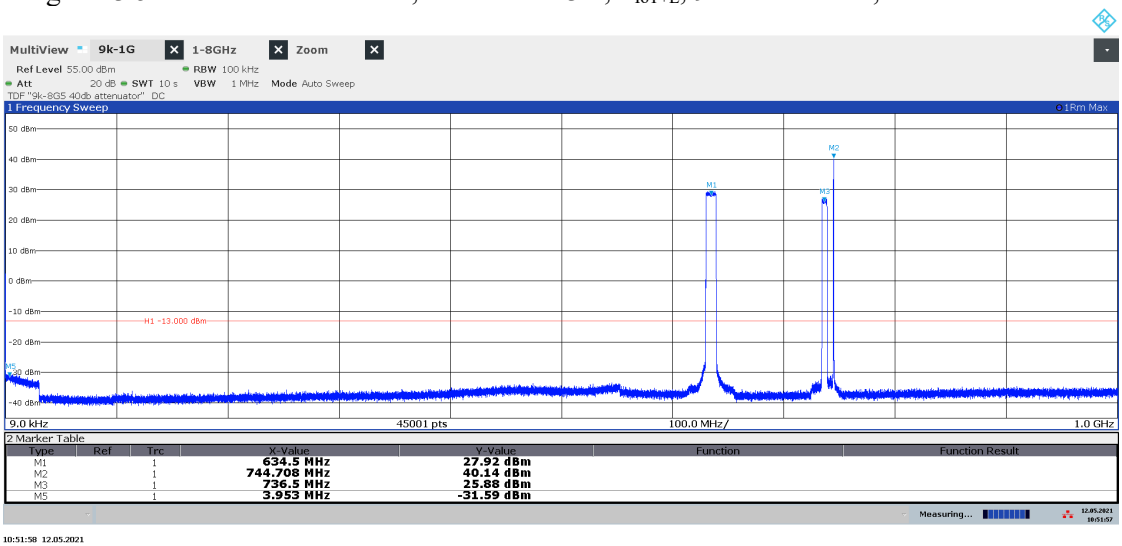
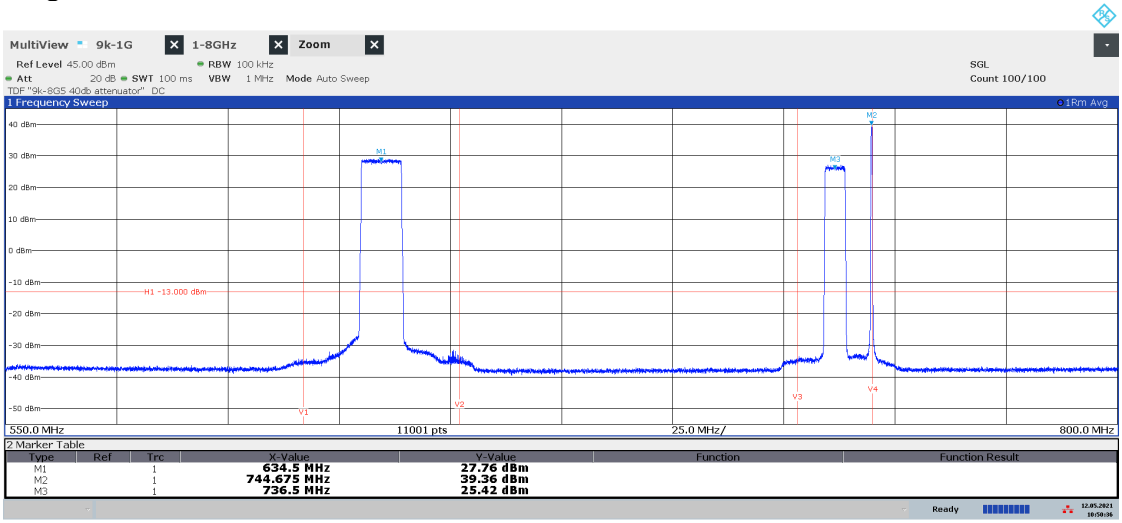


Diagram 3.52b NB IoT SA: N-TM, LTE: E-TM3.1, T_{IoT+L}, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.52c NB IoT SA: N-TM, LTE: E-TM3.1, T_{IoT+L}, 1 – 8 GHz, Port B:

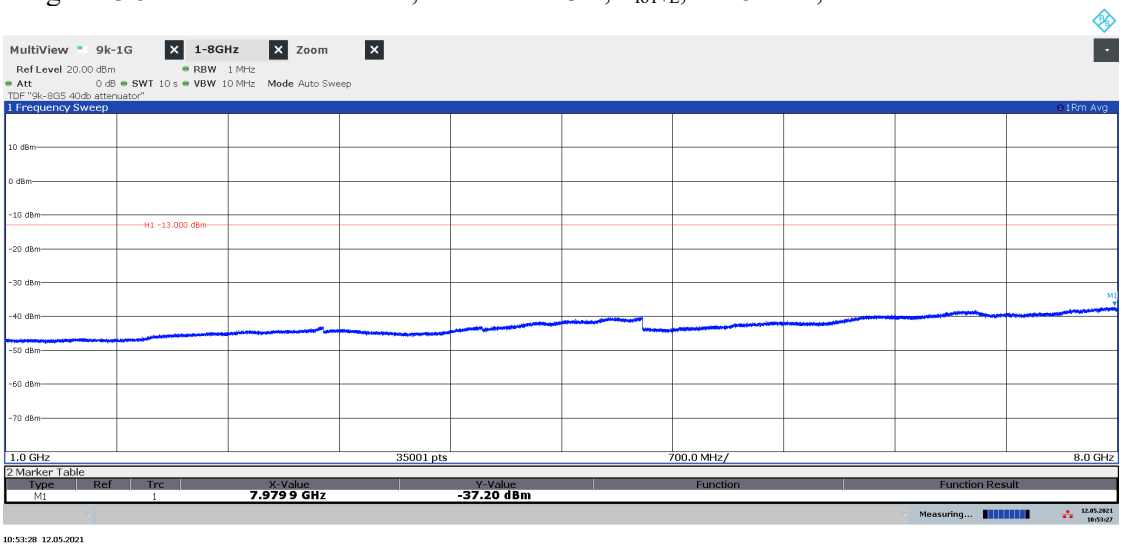


Diagram 3.53a NB IoT IB: N-TM, LTE: E-TM3.1, $T_{IBIoT+L}$, 9 kHz – 1 GHz, Port B:

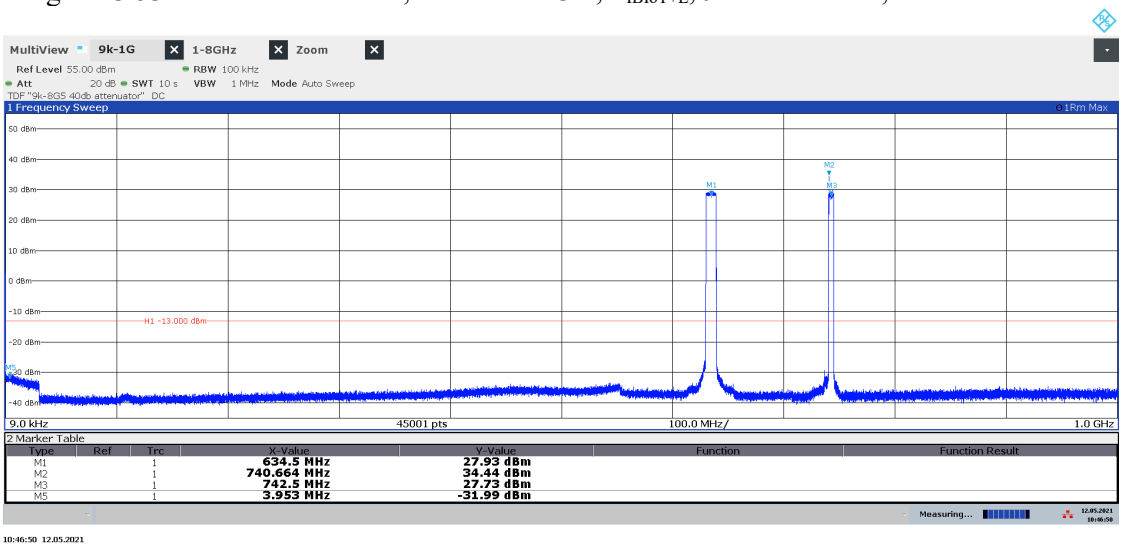
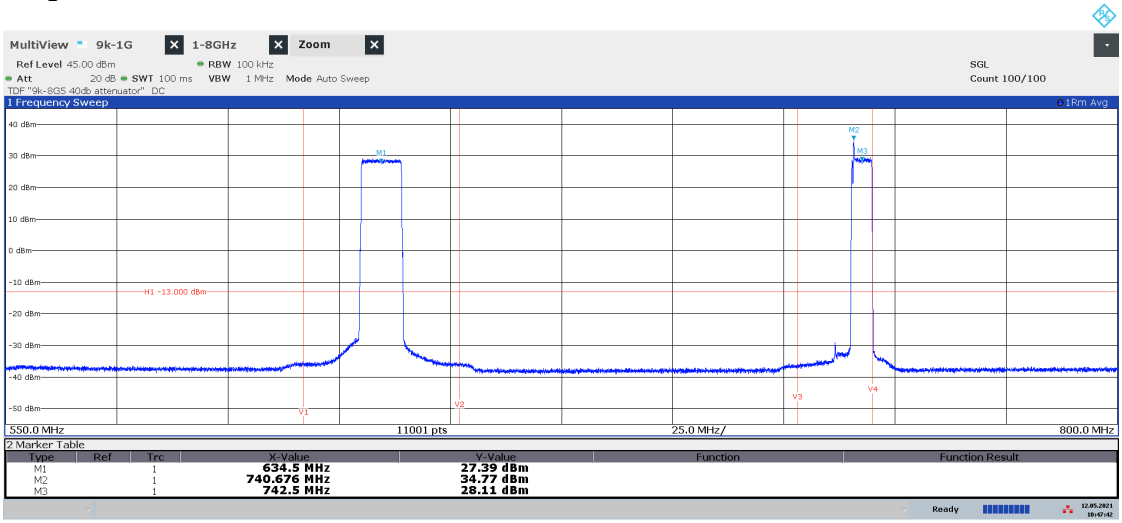


Diagram 3.53b NB IoT IB: N-TM, LTE: E-TM3.1, $T_{IBIoT+L}$, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.53c NB IoT IB: N-TM, LTE: E-TM3.1, $T_{IBIoT+L}$, 1 – 8 GHz, Port B:

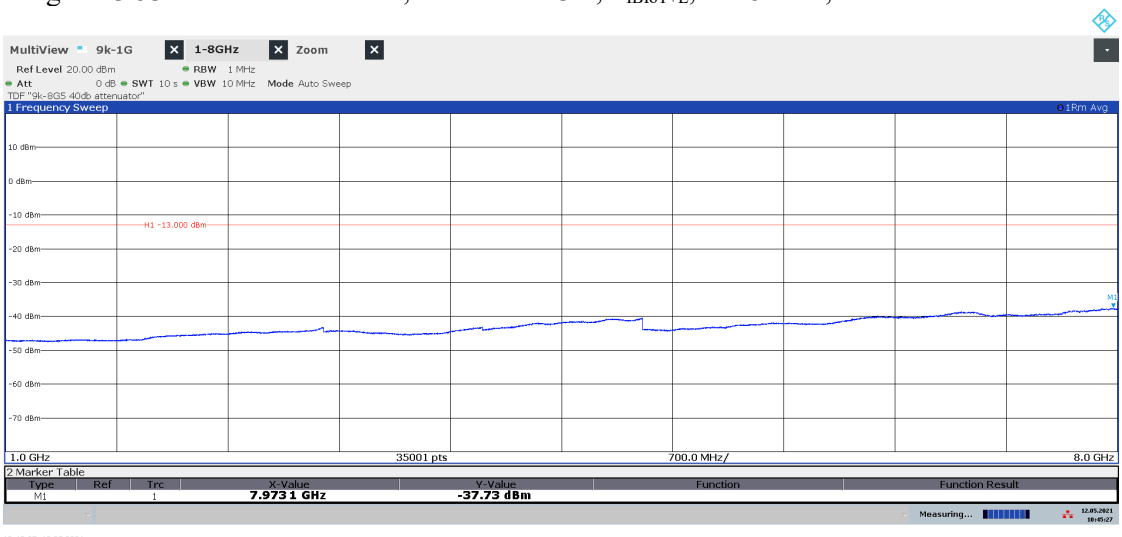


Diagram 3.54a NB IoT GB: N-TM, LTE: E-TM3.1, $T10_{Guard}$, 9 kHz – 1 GHz, Port B:

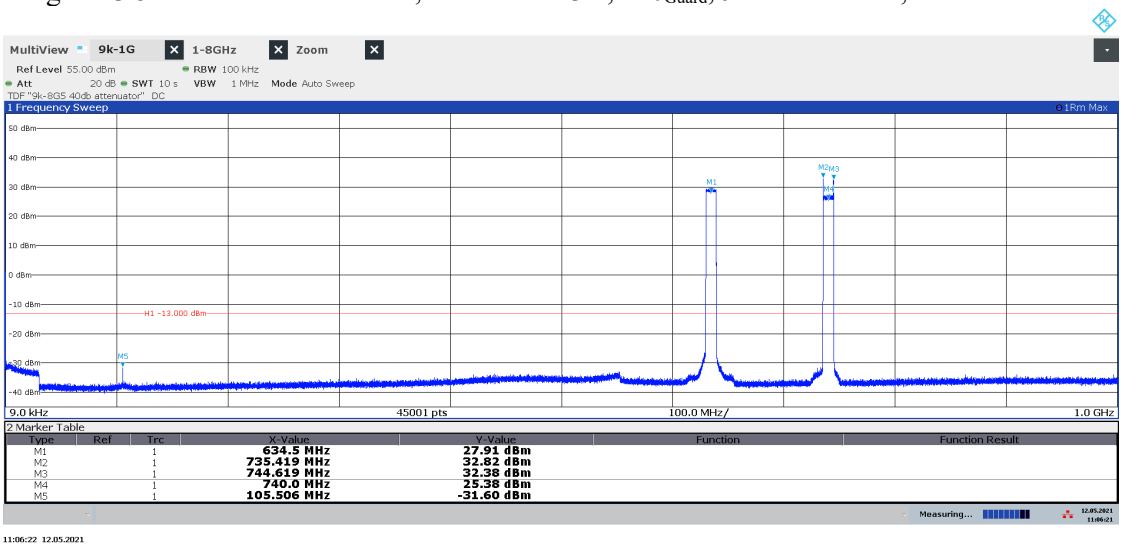
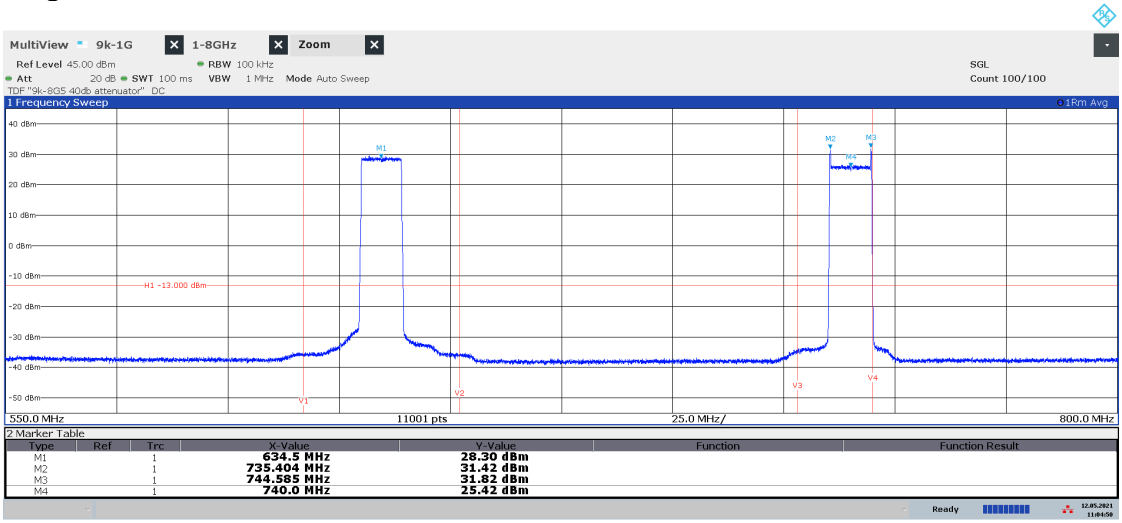


Diagram 3.54b NB IoT GB: N-TM, LTE: E-TM3.1, $T10_{Guard}$, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.54c NB IoT GB: N-TM, LTE: E-TM3.1, $T10_{Guard}$, 1 – 8 GHz, Port B:

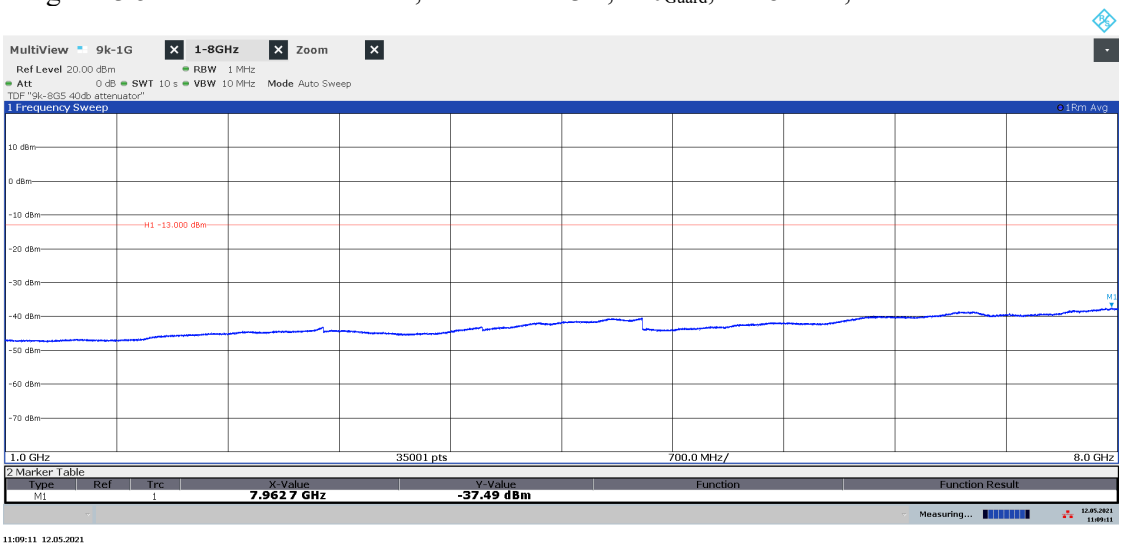


Diagram 3.55a NB IoT SA: N-TM, LTE: E-TM3.1, $Bim_{2IoT+LTE}$, 9 kHz – 1 GHz, Port B:

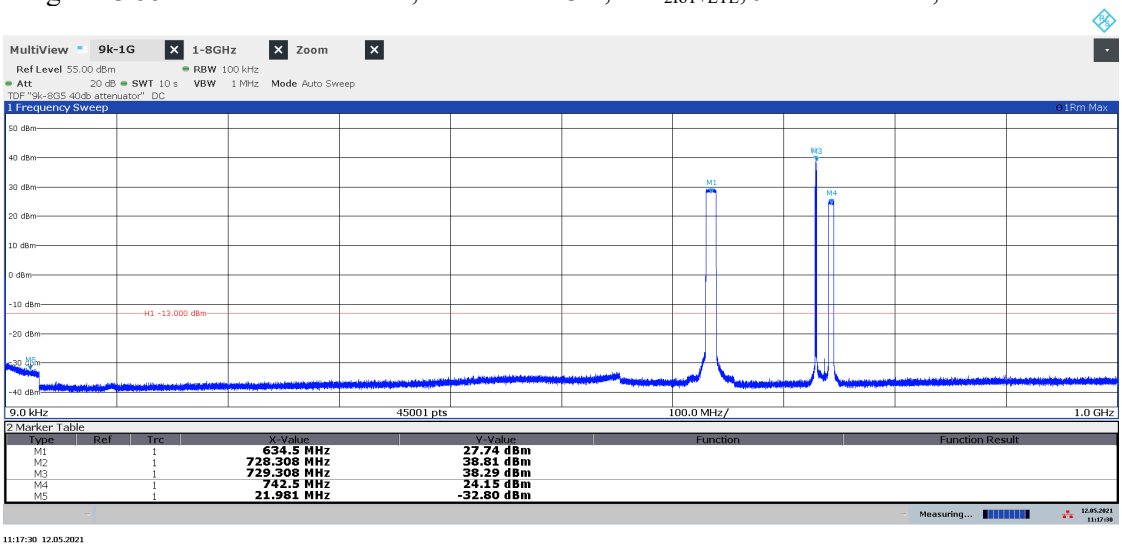
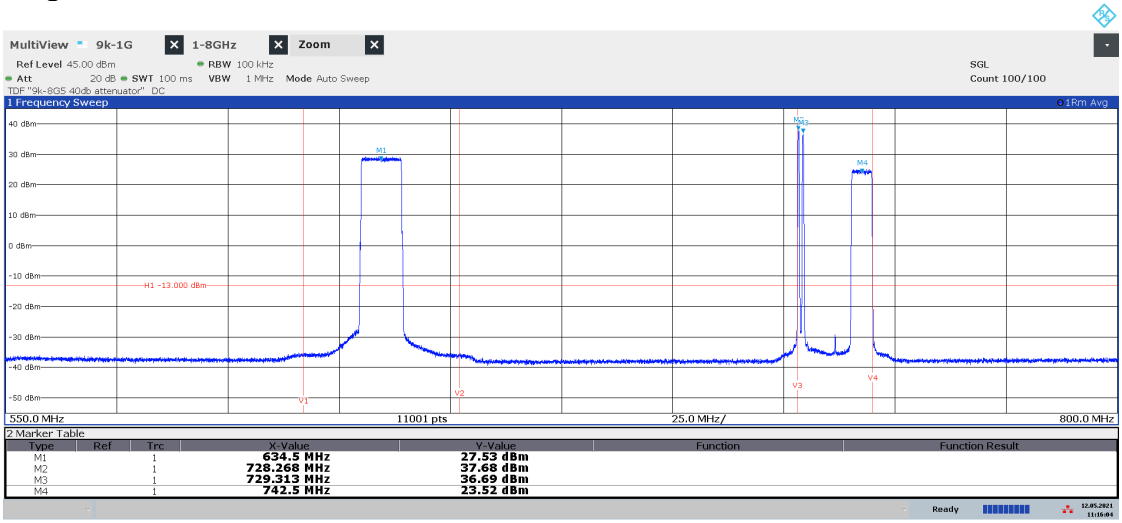


Diagram 3.55b NB IoT SA: N-TM, LTE: E-TM3.1, $Bim_{2IoT+LTE}$, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.55c NB IoT SA: N-TM, LTE: E-TM3.1, $Bim_{2IoT+LTE}$, 1 – 8 GHz, Port B:

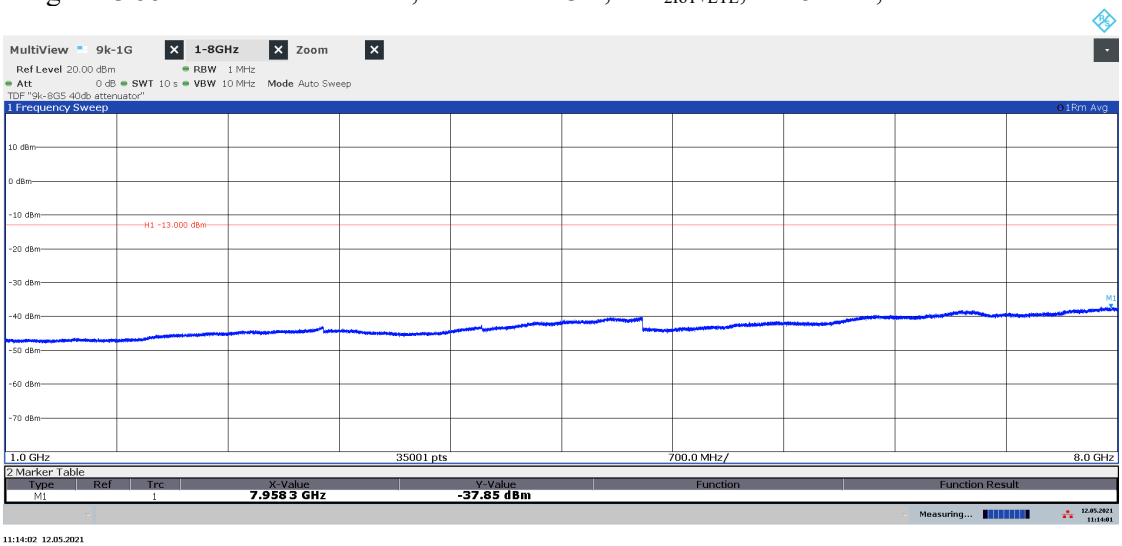


Diagram 3.56a NB IoT SA: N-TM, LTE: E-TM3.1, $Tim_{2IoT+LTE}$, 9 kHz – 1 GHz, Port B:

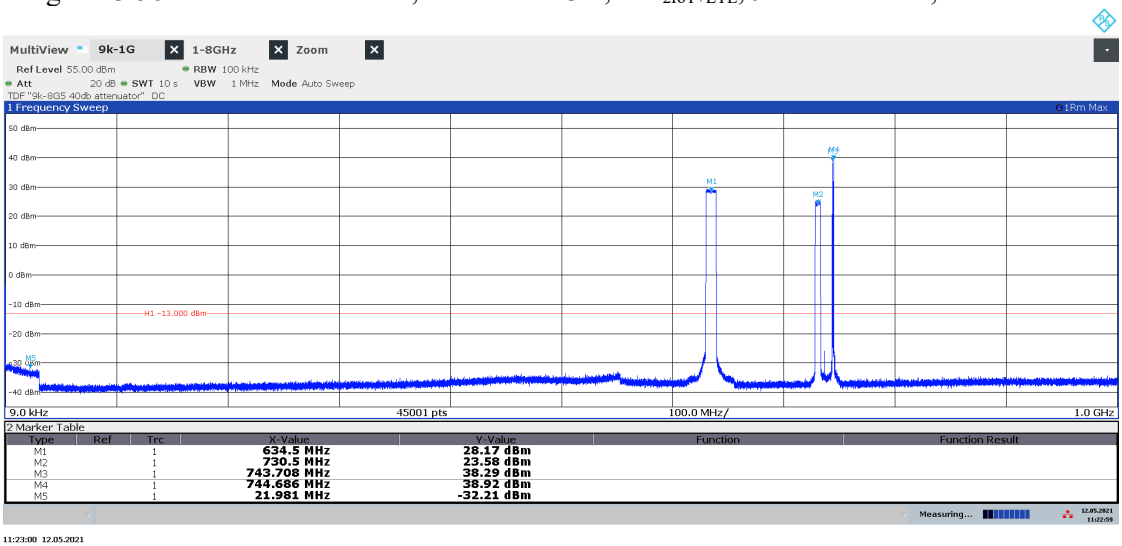
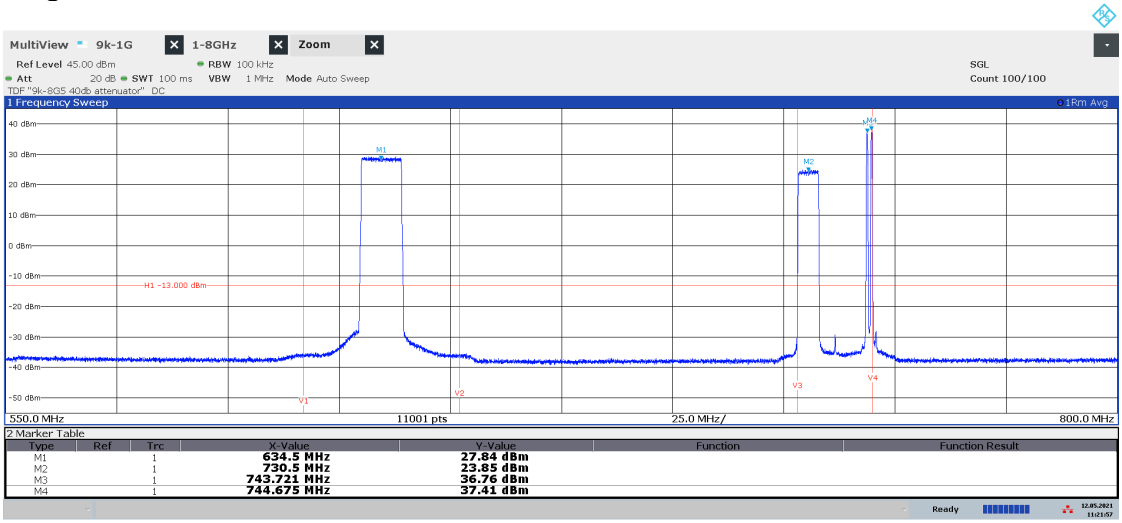


Diagram 3.56b NB IoT SA: N-TM, LTE: E-TM3.1, $Tim_{2IoT+LTE}$, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.56c NB IoT SA: N-TM, LTE: E-TM3.1, $Tim_{2IoT+LTE}$, 1 – 8 GHz, Port B:

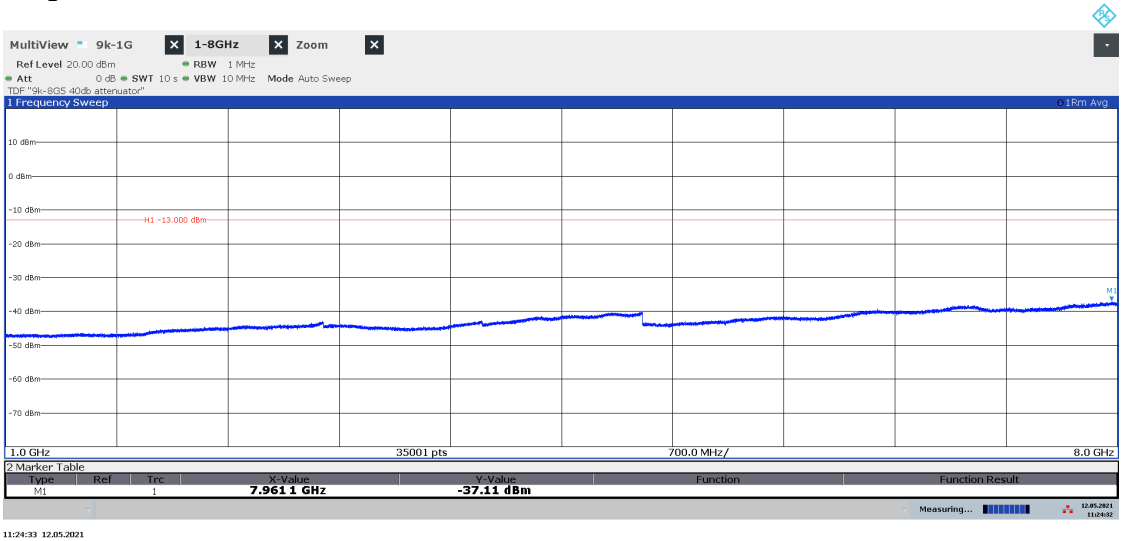


Diagram 3.57a NB IoT SA: N-TM, LTE: E-TM3.1, $M_{2IoT+3LTE}$, 9 kHz – 1 GHz, Port B:

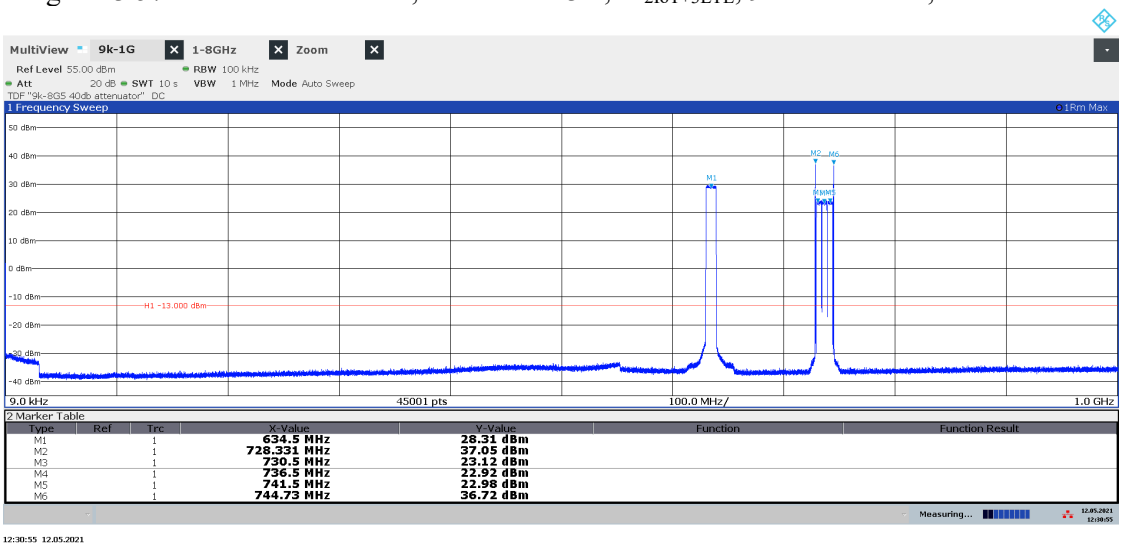
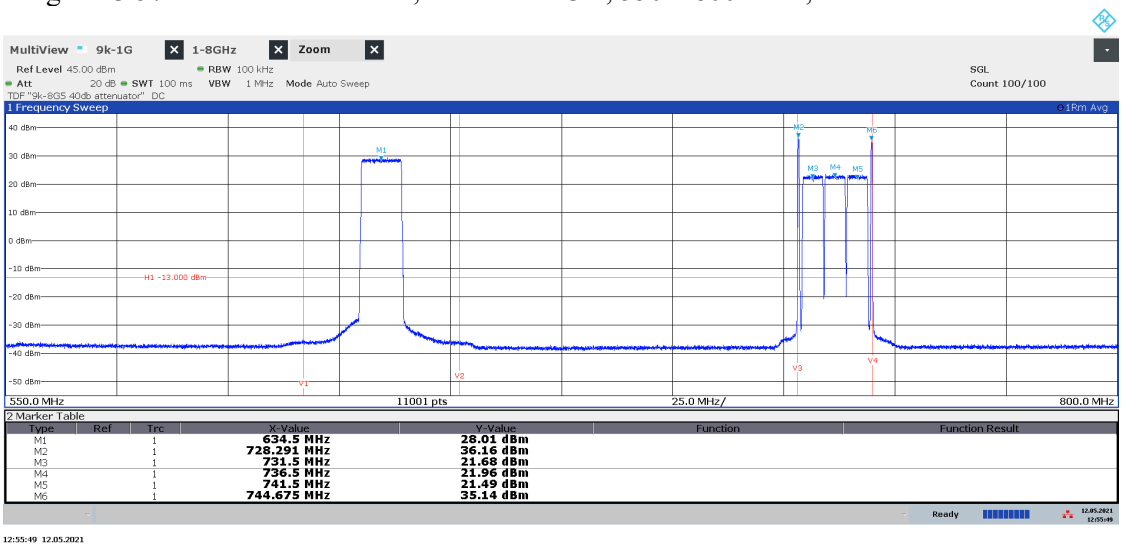
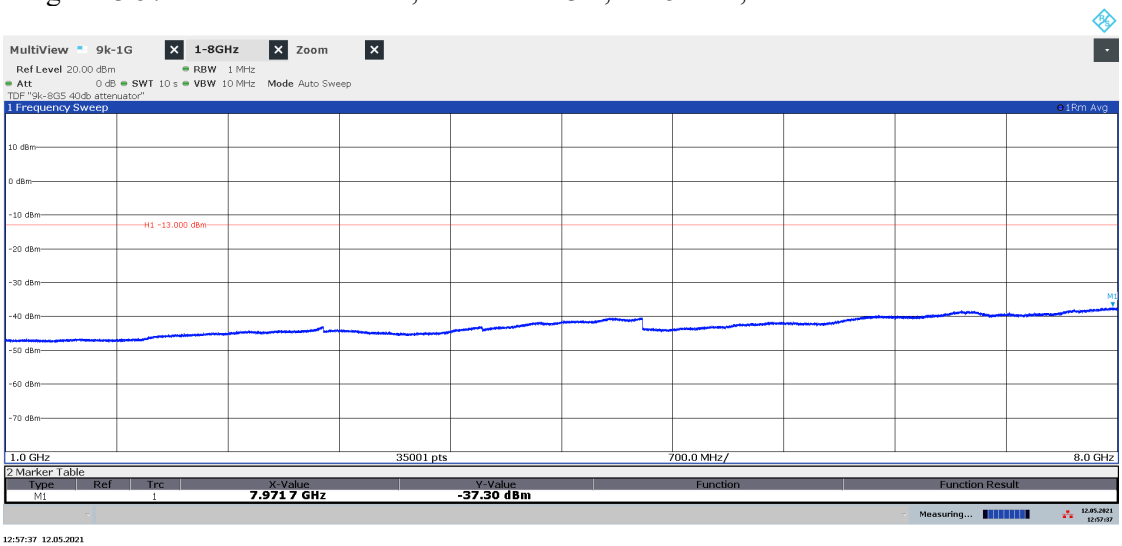


Diagram 3.57b NB IoT SA: N-TM, LTE: E-TM3.1, 550 – 800 MHz, Port B:



Note: The purpose of this measurement is to find IM products, not to verify compliance at the Band edges.

Diagram 3.57c NB IoT SA: N-TM, LTE: E-TM3.1, 1 – 8 GHz, Port B:



Field strength of spurious radiation measurements according to CFR 47 §27.53/ RSS-130 6.7.1

Date	Temperature	Humidity
2021-04-14	22 °C ± 3 °C	27 % ± 5 %
2021-04-15	22 °C ± 3 °C	26 % ± 5 %
2021-04-16	23 °C ± 3 °C	27 % ± 5 %

The test site conforms to the site validation criterion specified in ANSI C63.4.

The measurements were performed with both horizontal and vertical polarization of the antenna.

The antenna distance was 3 m in the frequency range 30 MHz – 8.2 GHz.

The EUT was placed 0.8 m above reference ground plane in frequency range 30 MHz – 1 GHz and 1.5 m above reference ground plane in frequency range 1 GHz – 8.2 GHz.

The measurement was performed with an RBW of 1 MHz.

A propagation loss in free space was calculated. The used formula was $\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

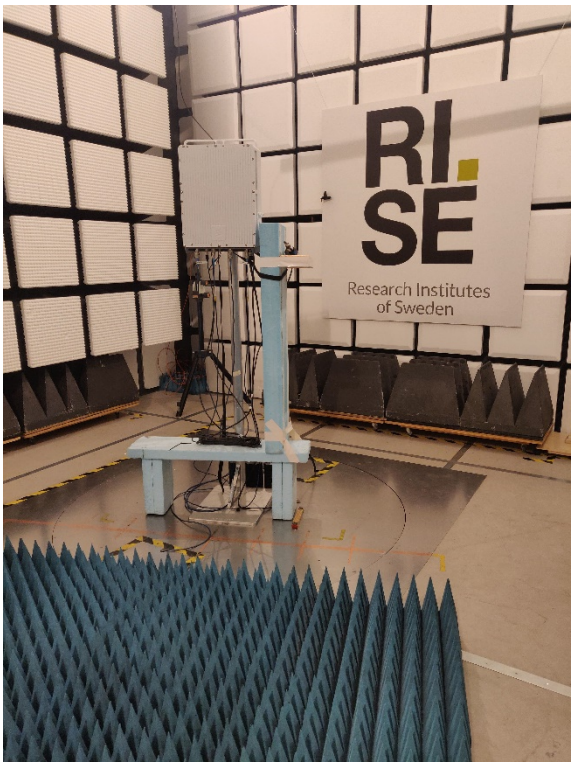
The measurement procedure was as the following:

1. A pre-measurement is performed with peak detector. For measurement < 1 GHz the test object was measured in eight directions with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m. For measurements > 1 GHz the test object was measured in seventeen directions with the antenna height 1.5 m, 2.0 m and 2.5 m with elevation angle.
2. Spurious radiation on frequencies closer than 20 dB to the limit in the pre-measurement is scanned 0-360 degrees and the antenna is scanned 1- 4 m for maximum response. The emission is then measured with the RMS detector and the RMS value is reported. Frequencies closer than 10 dB to the limit when measured with the RMS detector were measured with the substitution method according to ANSI 63.26.

The test set-up during the spurious radiation measurements is shown in the pictures below:

Test setup 30-1000 MHz:

Test setup 1-8.2 GHz:



Measurement equipment

Measurement equipment	RISE number
Test site Tesla	504 114
R&S ESU 26	902 210
Control computer with R&S software EMC32 version 10.60.15	503 889
High pass filter 1-20 GHz	901 501
Coaxial cable, Edison emission	BX91501
Coaxial cable	504 103
Coaxial cable	504 104
Teseq BiConiLog Antenna CBL6143A	504 079
ETS Lindgren Horn Antenna 3115	902 212
µComp Nordic, Low Noise Amplifier	504 160
Temperature and humidity meter, Testo 625	504 117

Test frequencies

Symbolic name:

B71	B85A
B_{5L}	B_{5L}
$M_{5\text{-}20L}$	$M_{5\text{-}10L}$
T_{5L}	T_{5L}
B_{IoT+L}	T_{IoT+L}
$BIM1_{IoT+L}$	TIM_{IoT+L}
$BIM2_{IoT+L}$	$2xSA_{IoT}$
$B10_{Guard}$	$T10_{Guard}$
M_{10NR}	
$M_{NR5+LTE5}$	
$MAX_{NR5+LTE5}$	

Results

Representing worst case:

Symbolic name $BIM2_{IoT+L} + 2xSA_{IoT}$, Diagram 4.1a-b

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-8200	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty: 3.1 dB

Limits

CFR 47 §27.53

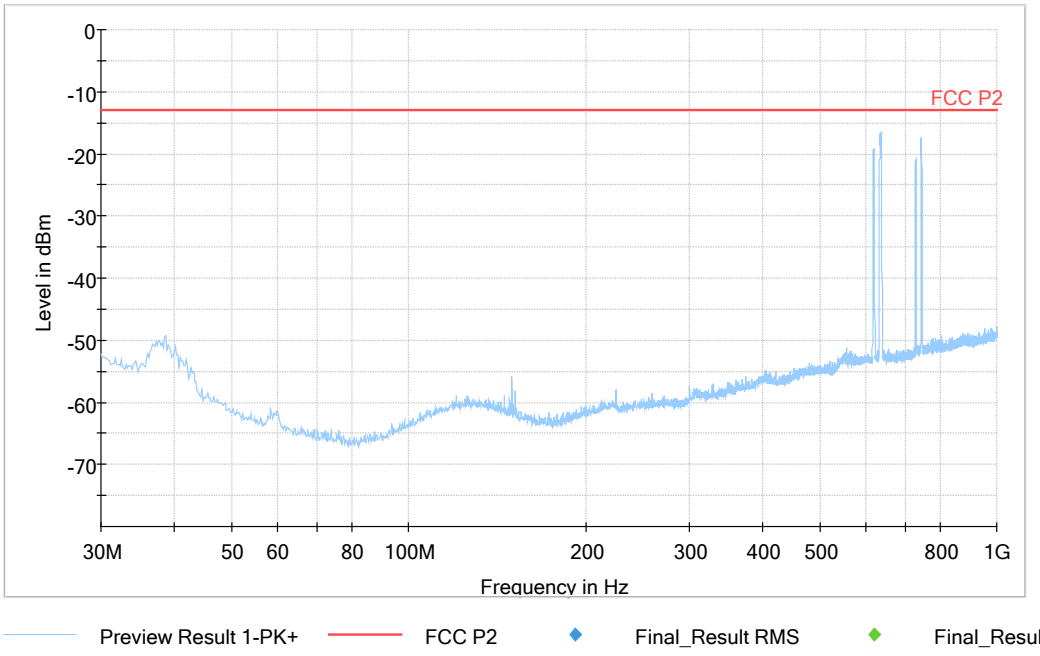
(g) Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, resulting in a limit of -13 dBm.

RSS-130 6.7.1

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), 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 of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

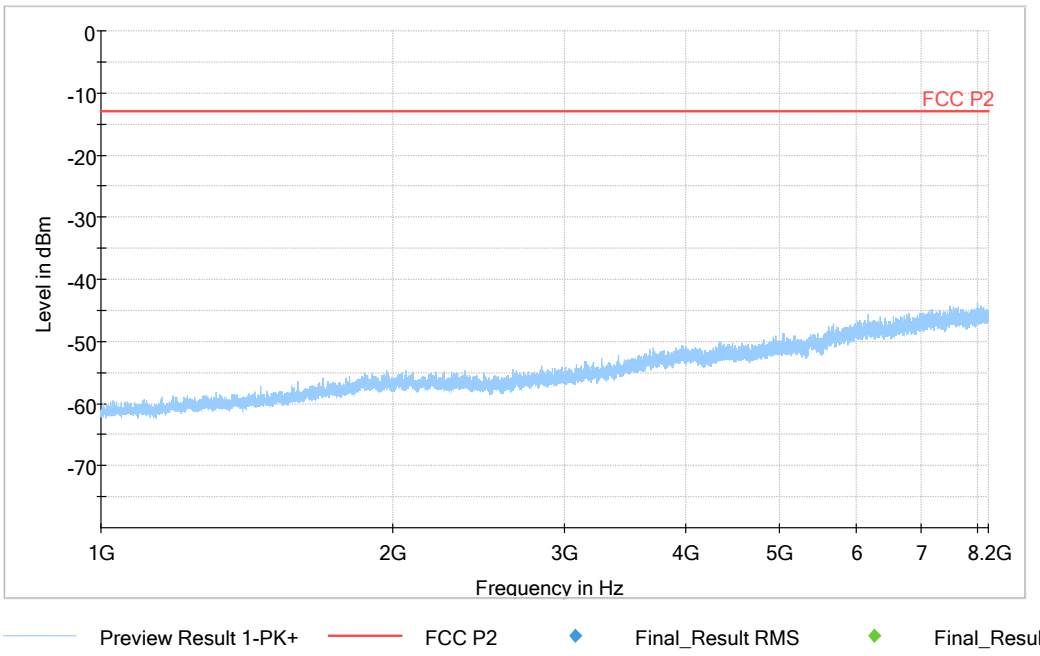
Complies?	Yes

Diagram 4.1a:



Note: The emissions in frequency range 617-652 MHz and 728-745 MHz are the carrier frequencies and shall be ignored in the context.

Diagram 4.1b:



Frequency stability measurements according to CFR 47 §27.54 / RSS-130 4.5

Date	Temperature (test equipment)	Humidity (test equipment)
2021-05-19	23 °C ± 3 °C	20 % ± 5 %
2021-05-20	23 °C ± 3 °C	25 % ± 5 %
2021-05-21	23 °C ± 3 °C	20 % ± 5 %
2021-06-23	24 °C ± 3 °C	39 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.7.3. The test object was connected to a spectrum analyzer with the RMS detector activated.

The transmitter unwanted emissions shall be measured with a resolution bandwidth of at least 100 kHz. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

(for 4x 4MIMO -19 dBm) at the band edge of the lowest and highest channel was selected, and the frequency at these points was recorded as fL and fH respectively.

Measurement equipment	RISE number
R&S FSQ40	504 143
RF attenuator	902 282
Coaxial cable Sucoflex 102EA	BX50236
Coaxial cable Sucoflex 102EA	BX50237
Temperature Chamber	503 360
Testo 635, temperature and humidity meter	504 203
Multimeter Fluke 87	502 190

Results NR B71

Rated output power level at connector RF B (maximum): 47.8 dBm

Test conditions			Frequency margin to band edge at -19 dBm	
			Symbolic name: B_{10NR}	Symbolic name: T_{10NR}
Supply voltage DC [V]	Temp [°C].	Carrier Bandwidth [MHz]	Margin for fL [kHz]	Margin for fH [kHz]
-40.8	+20	10	43	65
-55.2	+20	10	44	63
-48.0	+20	10	41	64
-48.0	+30	10	45	65
-48.0	+40	10	43	64
-48.0	+50	10	41	63
-48.0	+10	10	46	65
-48.0	0	10	45	65
-48.0	-10	10	46	65
-48.0	-20	10	45	62
-48.0	-30	10	45	65

Results LTE B71 and IoT GB

Nominal transmitter frequency was 634.5 MHz (M) with a bandwidth of 10 MHz. Rated output power level at connector RF B (maximum): 47.8 dBm.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
40.8	+20	3
55.2	+20	3
48	+20	3
48	+30	1
48	+40	1
48	+50	1
48	+10	2
48	0	1
48	-10	1
48	-20	1
48	-30	2
Maximum freq. error (Hz)		3
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Rated output power level at connector RF B (maximum): 46 dBm(5MHz) 47.8 dBm(20MHz)

Test conditions			Frequency margin to band edge at -19dBm			
Supply voltage DC [V]	Temp [°C].	Symbolic Name	Test frequency		Test frequency	
			fL [MHz]	Offset to lower band edge (617 MHz) [kHz]	fH [MHz]	Offset to upper band edge (652 MHz) [kHz]
-48.0	+20	B_{5LTE}, T_{5LTE}	617.027	27	651.966	34
-48.0	+20	B_{20LTE}, T_{20LTE}	617.219	219	651.773	227
-48.0	+20	$B_{10Guard}$, $T_{10Guard}$	617.018	18	651.974	26
-48.0	+20	$B_{20Guard}$, $T_{20Guard}$	617.154	154	651.831	169

The frequency error results clearly shows that the frequency stability is good enough to ensure that the transmitted carrier stay within the operating band.

Results LTE B85A and IoT GB

Nominal transmitter frequency was 736.5 MHz (M) with a bandwidth of 5 MHz. Rated output power level at connector RF B (maximum): 46 dBm.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
40.8	+20	2
55.2	+20	2
48	+20	2
48	+30	1
48	+40	1
48	+50	1
48	+10	1
48	0	1
48	-10	1
48	-20	1
48	-30	2
Maximum freq. error (Hz)		2
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

Rated output power level at connector RF B (maximum): 46 dBm

Test conditions			Frequency margin to band edge at -19dBm			
Supply voltage DC [V]	Temp [°C].	Symbolic Name]	Test frequency		Test frequency	
			fL [MHz]	Offset to lower band edge (728 MHz) [kHz]	fH [MHz]	Offset to upper band edge (745 MHz) [kHz]
-48.0	+20	B_{5LTE},T_{5LTE}	728.031	31	744.964	36
-48.0	+20	B_{10LTE}, T_{10LTE}	728.087	87	744.905	95
-48.0	+20	$B_{10Guard}$, $T_{10Guard}$	728.033	33	744.965	35

The frequency error results shows that the frequency stability is good enough to ensure that the transmitted carrier stay within the operating band.

Remark

It was deemed sufficient to test one combination of TX frequency, channel bandwidth configuration and test model (modulation), as all combinations share a common internal reference to derive the TX frequency from.

Remark

The measurements were performed with the bandwidth configuration 10 MHz representing worst case with regards to band edge compliance.

Limits

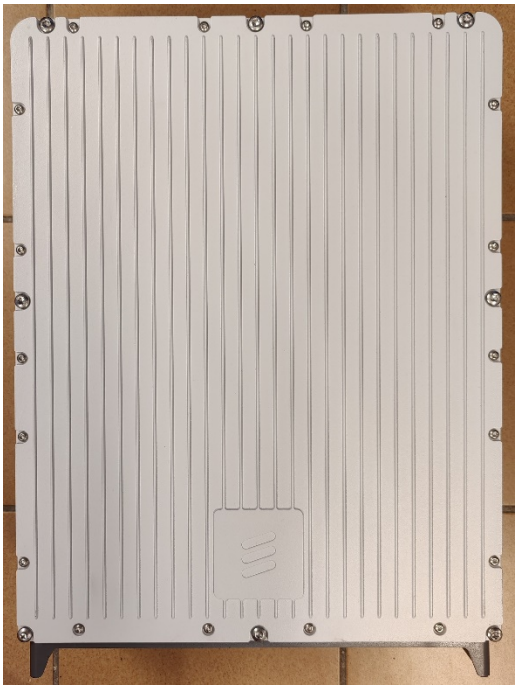
§27.54
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-130 4.5
The frequency stability shall be sufficient to ensure that the occupied bandwidth remains within each frequency block range when tested at the temperature and supply voltage variations specified in RSS-Gen.

Complies?	Yes

Photos of test object

Front side



Rear side

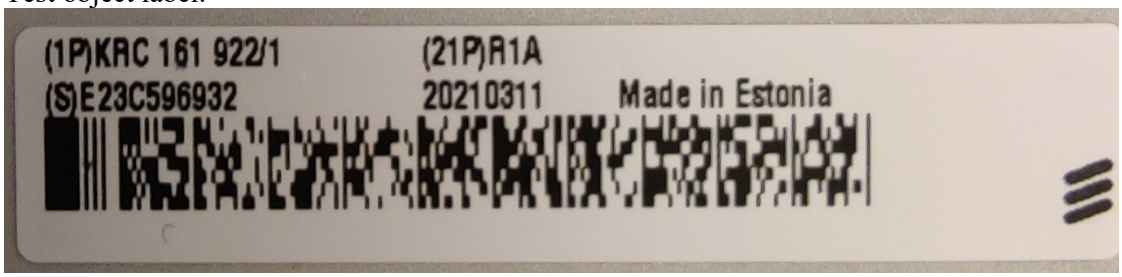
Left side

Right side

Bottom side

Top side

Test object label:



End of report.