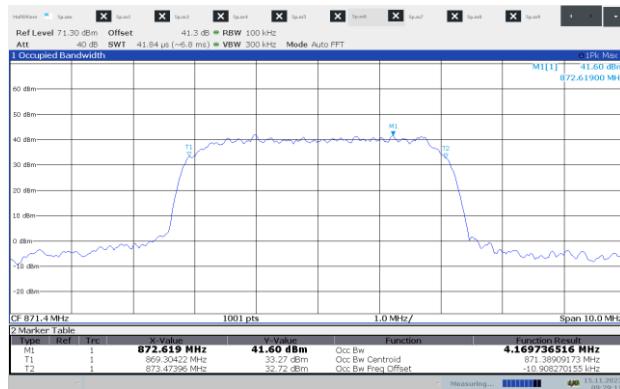
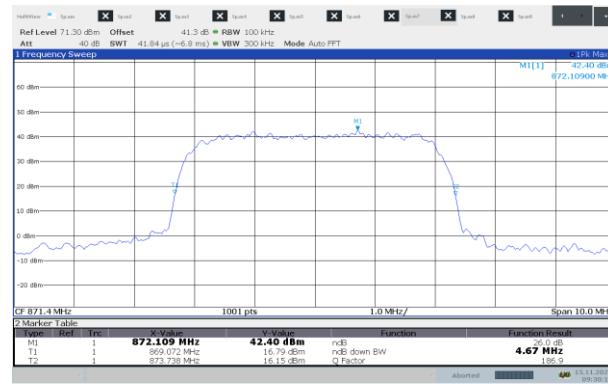
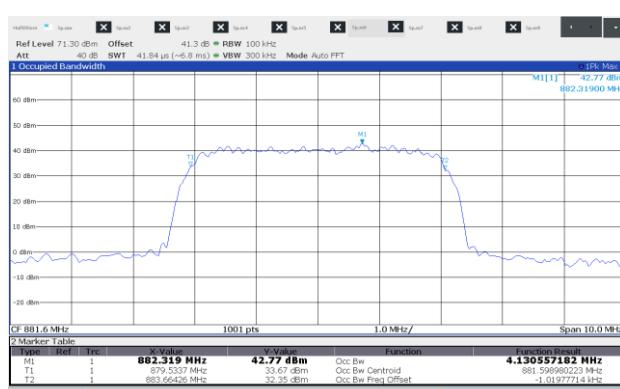
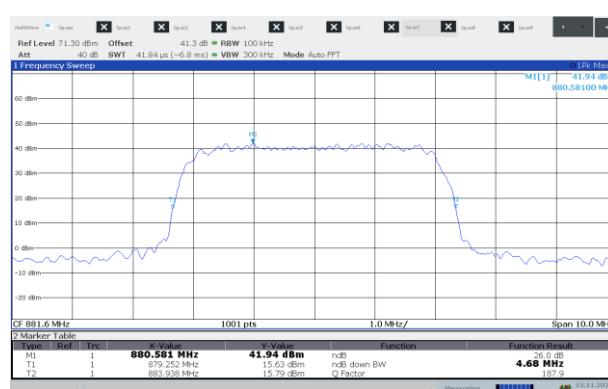


**Test data, Bandwidth, continued**

**Figure 7.1-246: OBW, WCDMA, B 05, CH 4357**

**Figure 7.1-247: EBW, WCDMA, B 05, CH 4357**

**Figure 7.1-248: OBW, WCDMA, B 05, CH 4408**

**Figure 7.1-249: EBW, WCDMA, B 05, CH 4408**

**Figure 7.1-250: OBW, WCDMA, B 05, CH 4458**

**Figure 7.1-251: EBW, WCDMA, B 05, CH 4458**

**Test data, Bandwidth, continued**


11:25:03 15.11.2023

**Figure 7.1-252: OBW, LTE, B 02, CH 630**

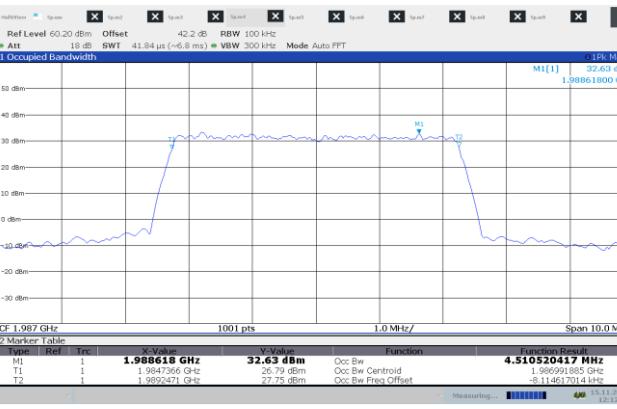

11:25:52 15.11.2023

**Figure 7.1-253: EBW, LTE, B 02, CH 630**

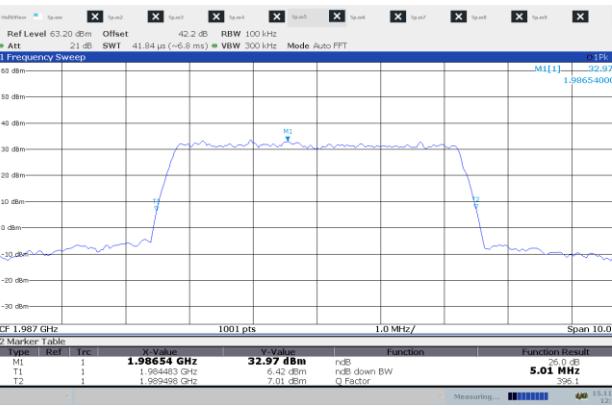

12:02:25 15.11.2023

**Figure 7.1-254: OBW, LTE, B 02, CH 900**


12:02:46 15.11.2023

**Figure 7.1-255: EBW, LTE, B 02, CH 900**


12:12:32 15.11.2023

**Figure 7.1-256: OBW, LTE, B 02, CH 1170**


12:12:55 15.11.2023

**Figure 7.1-257: EBW, LTE, B 02, CH 1170**

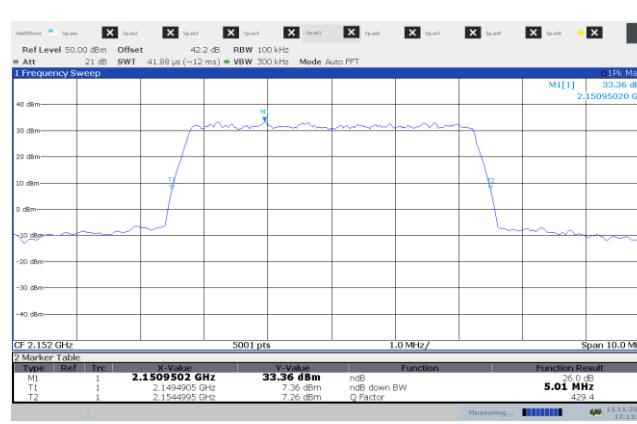
**Test data, Bandwidth, continued**

**Figure 7.1-258: OBW, LTE, B 04, CH 1980**

**Figure 7.1-259: EBW, LTE, B 04, CH 1980**

**Figure 7.1-260: OBW, LTE, B 04, CH 2175**

**Figure 7.1-261: EBW, LTE, B 04, CH 2175**

**Figure 7.1-262: OBW, LTE, B 04, CH 2370**

**Figure 7.1-263: EBW, LTE, B 04, CH 2370**

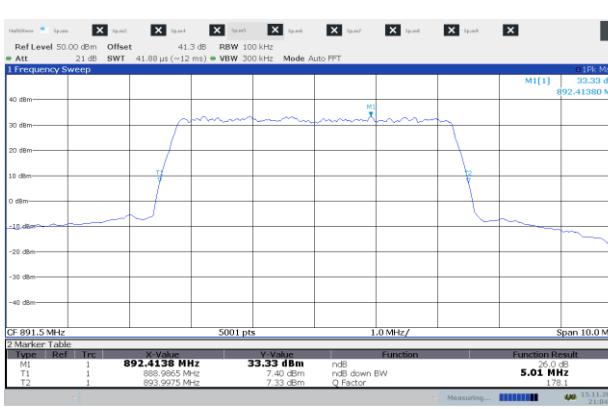
**Test data, Bandwidth, continued**

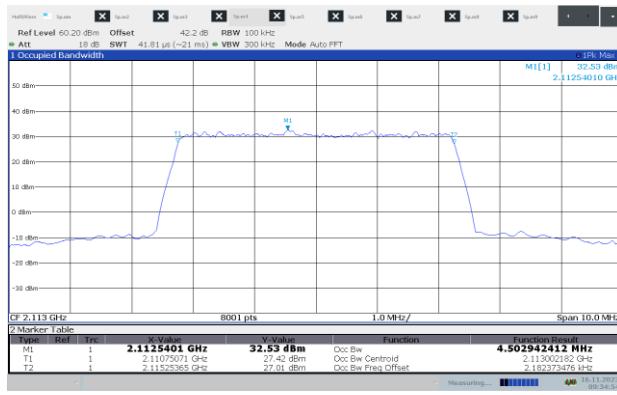
**Figure 7.1-264: OBW, LTE, B 05, CH 2425**

**Figure 7.1-265 : EBW, LTE, B 05, CH 2425**

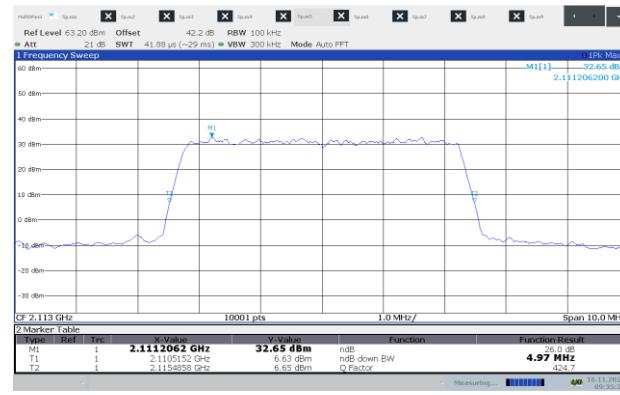
**Figure 7.1-266: OBW, LTE, B 05, CH 2525**

**Figure 7.1-267 : EBW, LTE, B 05, CH 2525**

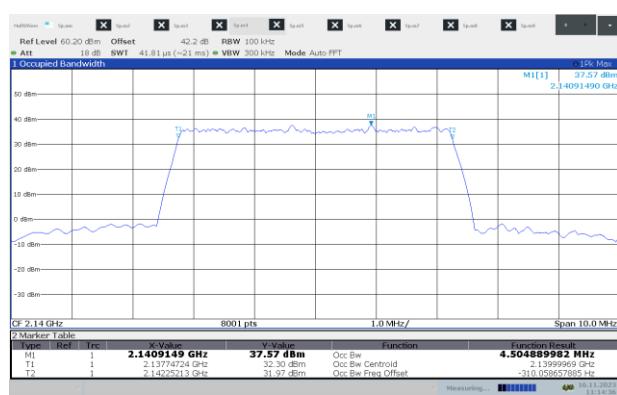
**Figure 7.1-268: OBW, LTE, B 05, CH 2625**

**Figure 7.1-269 : EBW, LTE, B 05, CH 2625**

**Test data, Bandwidth, continued**


09:34:54 16.11.2023

**Figure 7.1-270: OBW, LTE, B 10, CH 4180**


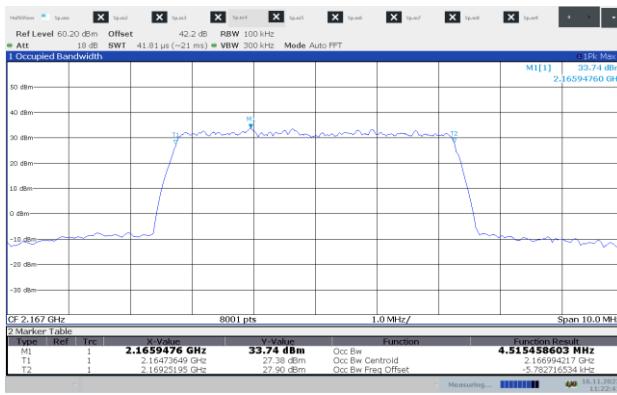
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**Figure 7.1-271 : EBW, LTE, B 10, CH 4180**


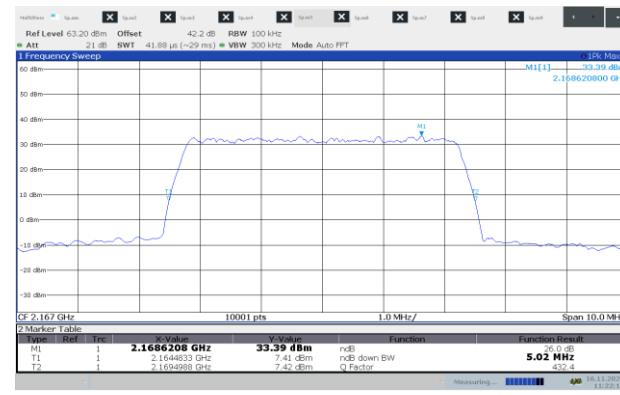
11:14:37 16.11.2023

**Figure 7.1-272: OBW, LTE, B 10, CH 4450**


11:15:06 16.11.2023

**Figure 7.1-273 : EBW, LTE, B 10, CH 4450**


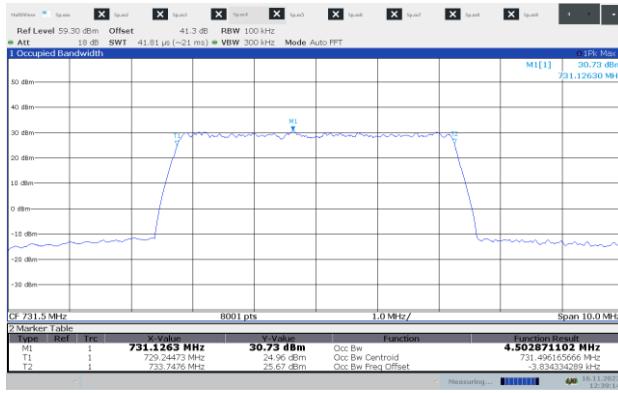
11:22:42 16.11.2023

**Figure 7.1-274: OBW, LTE, B 10, CH 4720**


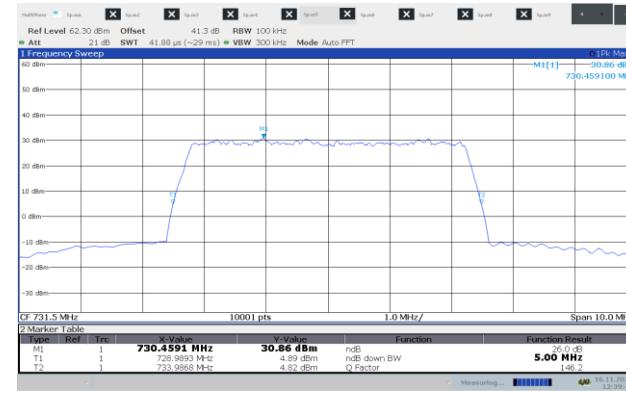
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**Figure 7.1-275 : EBW, LTE, B 10, CH 4720**

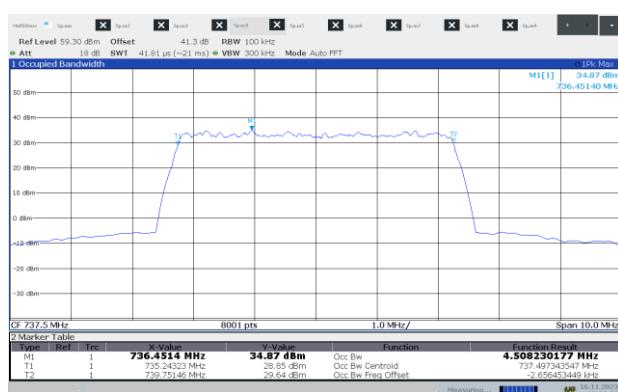
Test data, Bandwidth, continued



12:39:15 16.11.2023



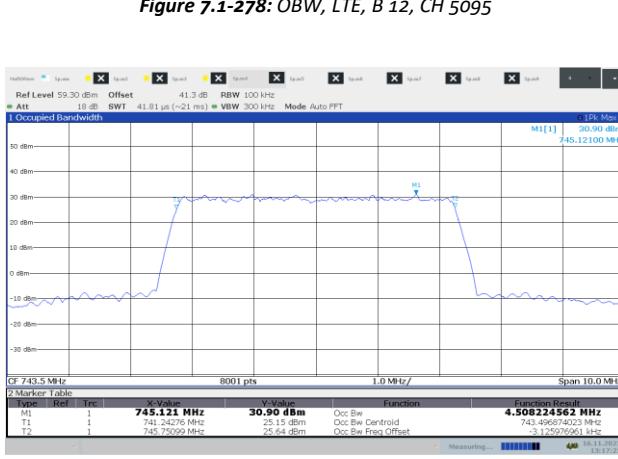
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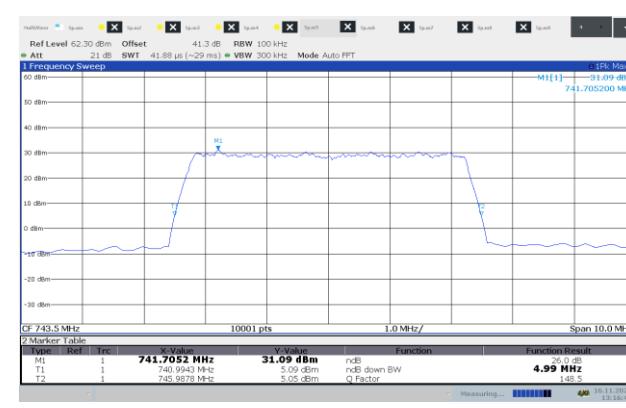
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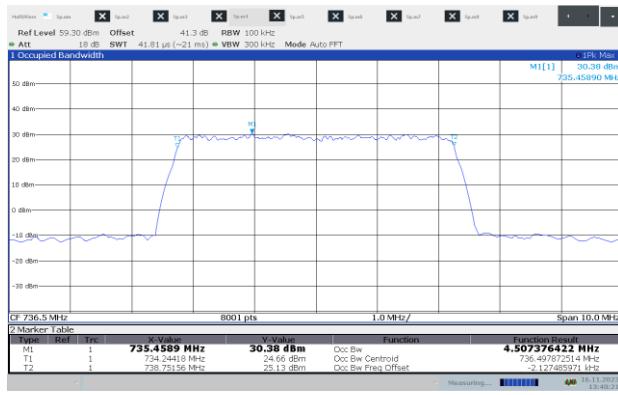
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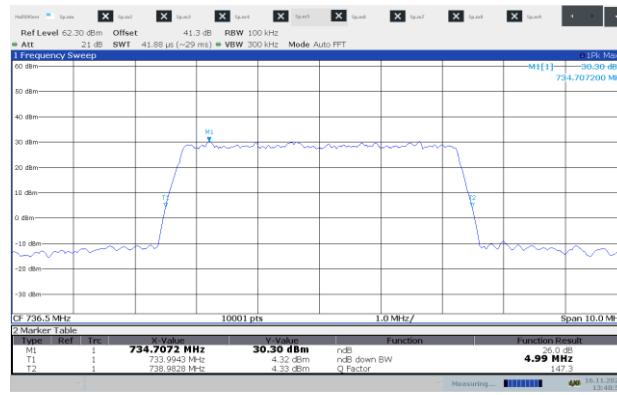
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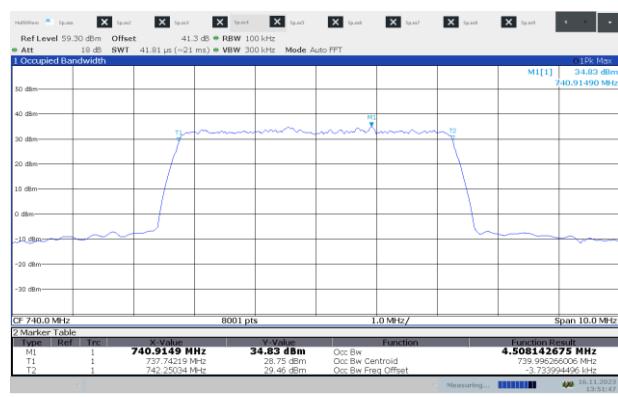
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**Test data, Bandwidth, continued**


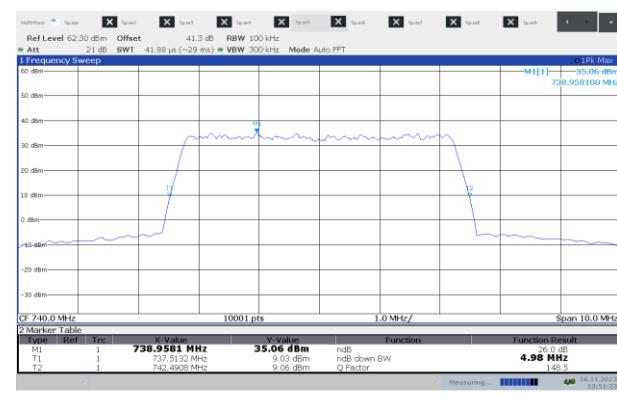
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**Figure 7.1-282: OBW, LTE, B 17, CH 5755**


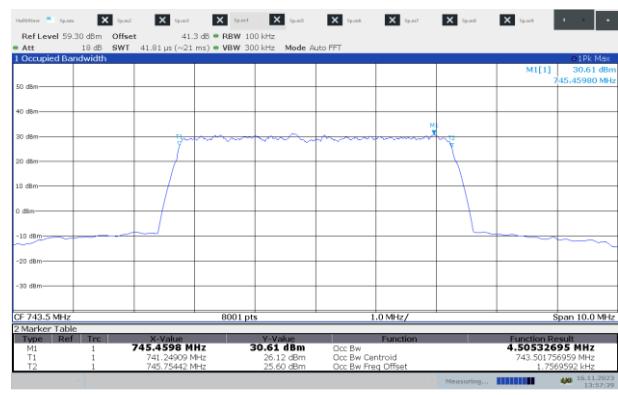
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**Figure 7.1-283 : EBW, LTE, B 17, CH 5755**


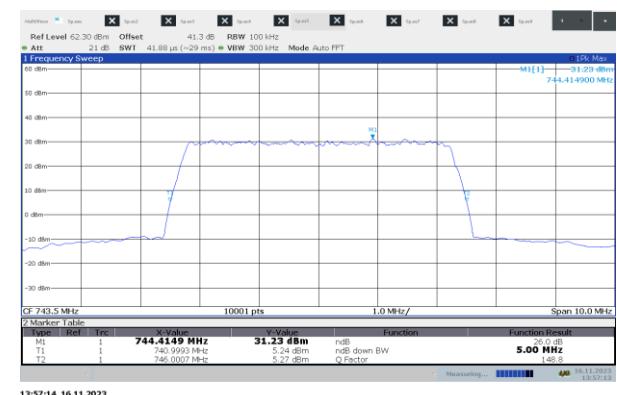
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**Figure 7.1-284: OBW, LTE, B 17, CH 5790**


13:51:24 16.11.2023

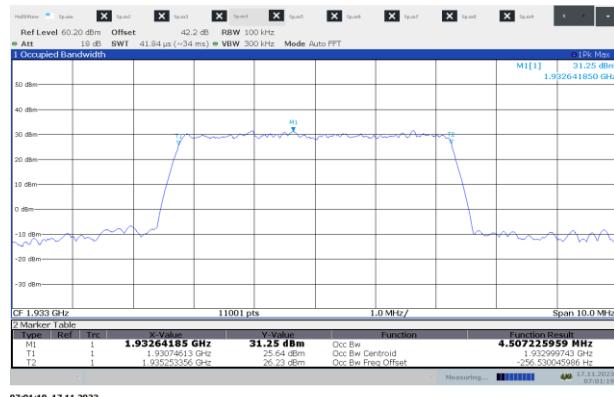
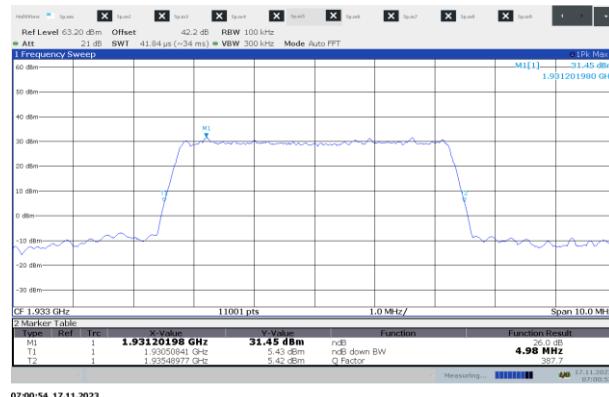
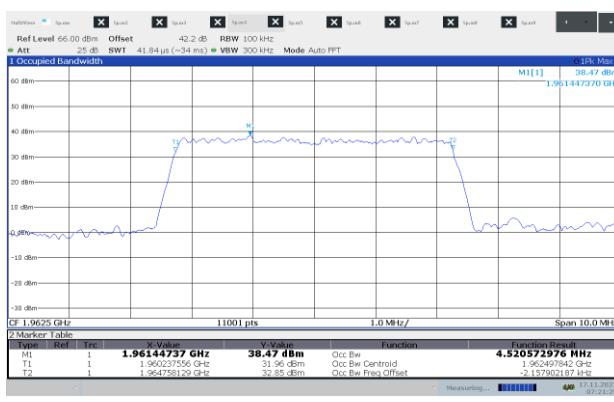
**Figure 7.1-285 : EBW, LTE, B 17, CH 5790**


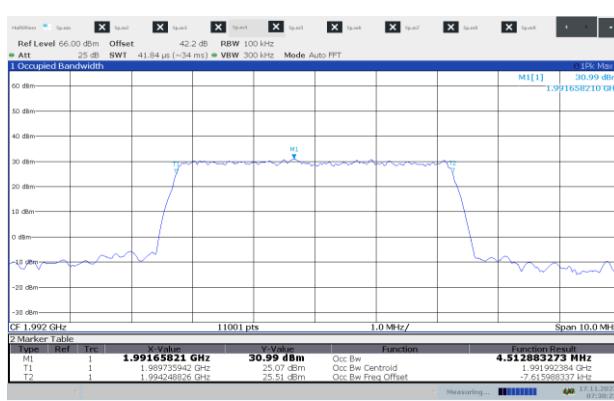
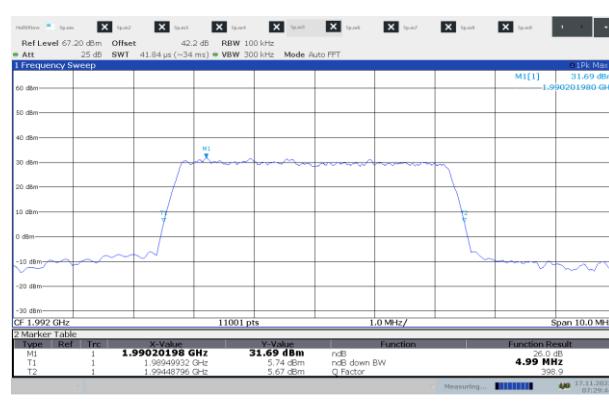
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**Figure 7.1-286: OBW, LTE, B 17, CH 5825**


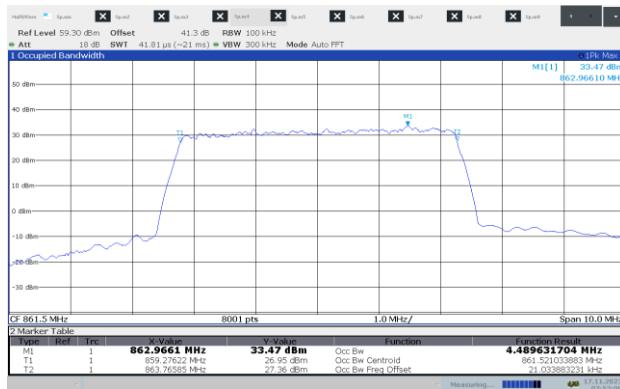
13:57:14 16.11.2023

**Figure 7.1-287 : EBW, LTE, B 17, CH 5825**

**Test data, Bandwidth, continued**

**Figure 7.1-288: OBW, LTE, B 25, CH 8070**

**Figure 7.1-289 : EBW, LTE, B 25, CH 8070**

**Figure 7.1-290: OBW, LTE, B 25, CH 8365**

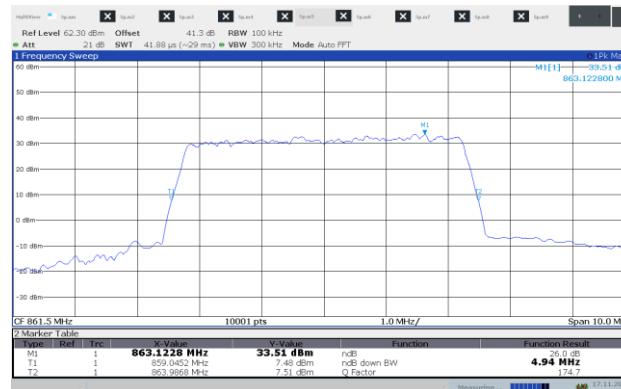
**Figure 7.1-291 : EBW, LTE, B 25, CH 8365**

**Figure 7.1-292: OBW, LTE, B 25, CH 8660**

**Figure 7.1-293 : EBW, LTE, B 25, CH 8660**

Test data, Bandwidth, continued



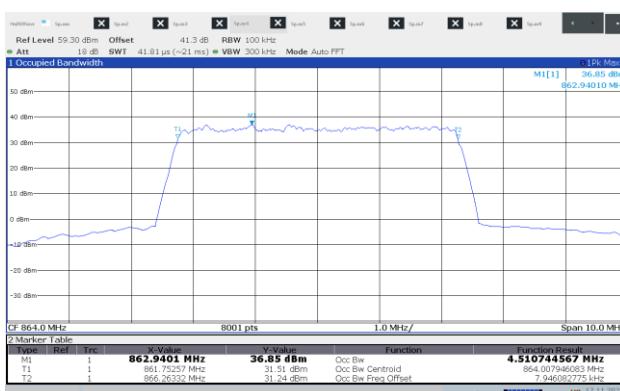
07:52:09 17.11.2023

Figure 7.1-294: OBW, LTE, B 26\_1, CH 8715



07:52:36 17.11.2023

Figure 7.1-295 : EBW, LTE, B 26\_1, CH 8715



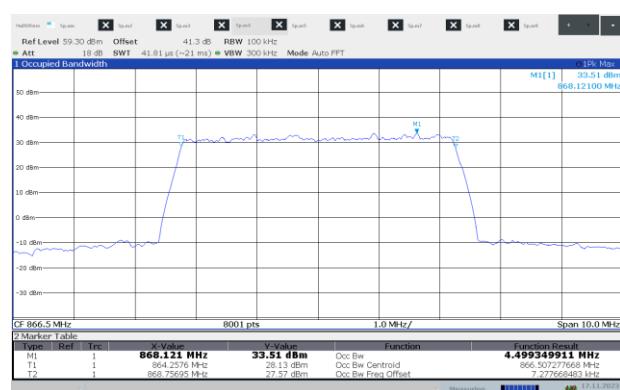
08:10:39 17.11.2023

Figure 7.1-296: OBW, LTE, B 26\_1, CH 8740



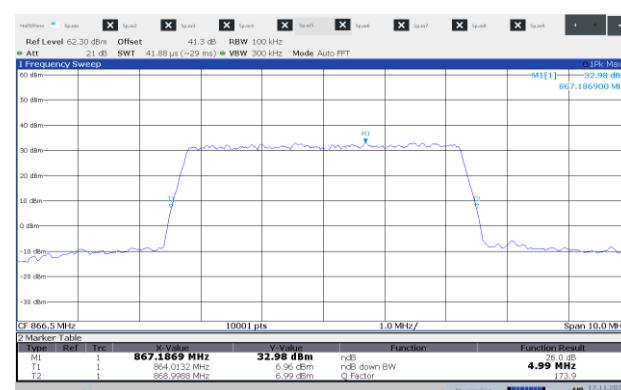
08:10:11 17.11.2023

Figure 7.1-297 : EBW, LTE, B 26\_1, CH 8740



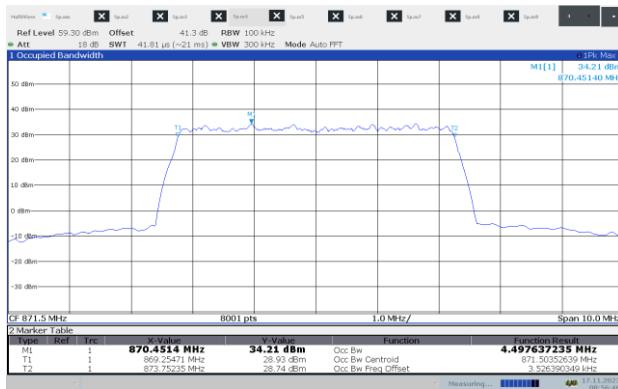
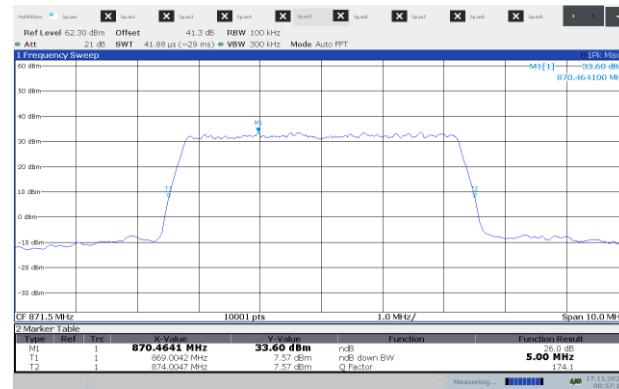
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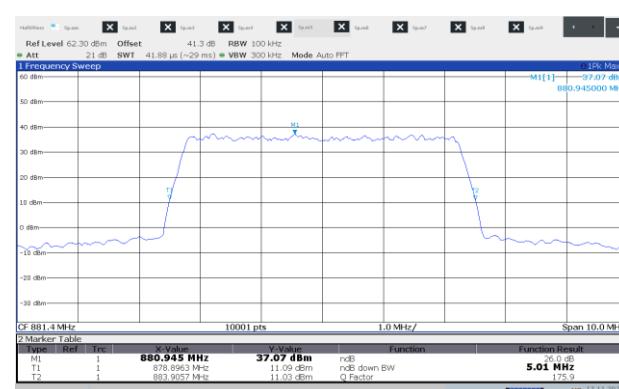
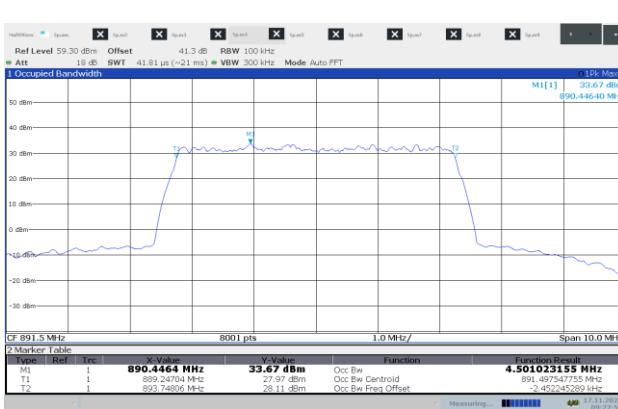
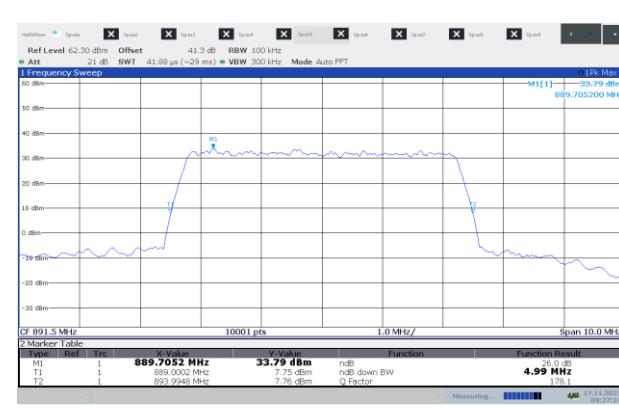
Figure 7.1-298: OBW, LTE, B 26\_1, CH 8765



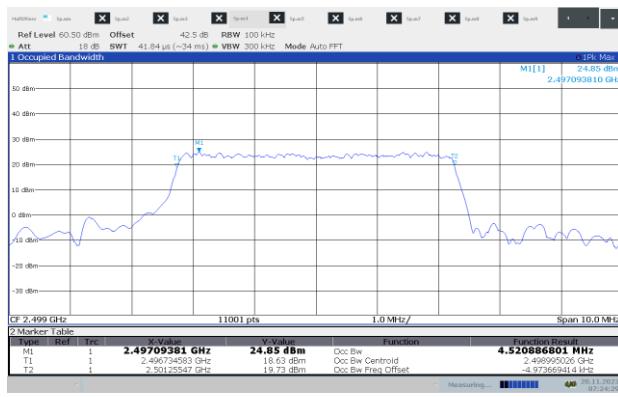
08:17:32 17.11.2023

Figure 7.1-299 : EBW, LTE, B 26\_1, CH 8765

**Test data, Bandwidth, continued**

**Figure 7.1-300: OBW, LTE, B 26\_2, CH 8815**

**Figure 7.1-301 : EBW, LTE, B 26\_2, CH 8815**

**Figure 7.1-302: OBW, LTE, B 26\_2, CH 8914**

**Figure 7.1-303 : EBW, LTE, B 26\_2, CH 8914**

**Figure 7.1-304: OBW, LTE, B 26\_2, CH 9015**

**Figure 7.1-305 : EBW, LTE, B 26\_2, CH 9015**

Test data, Bandwidth, continued



07:24:30 20.11.2023



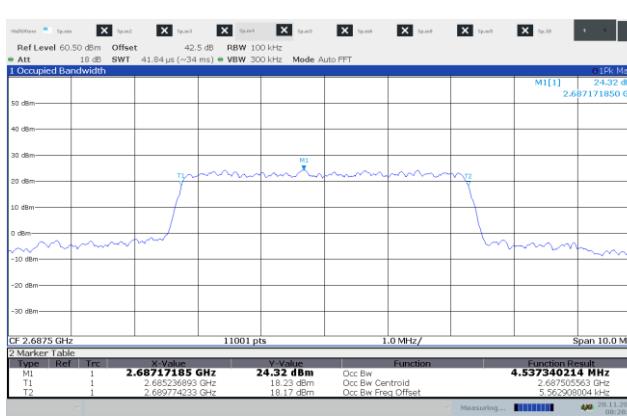
07:24:53 20.11.2023



08:04:25 20.11.2023



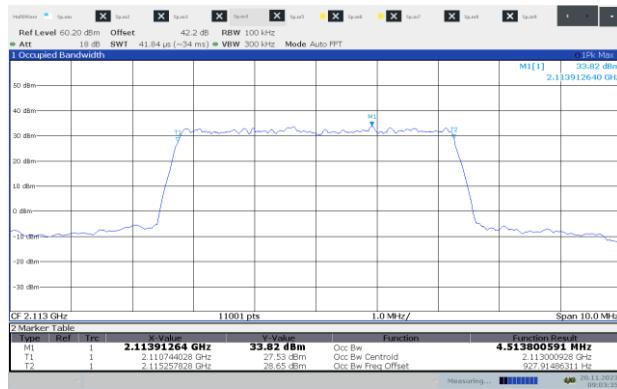
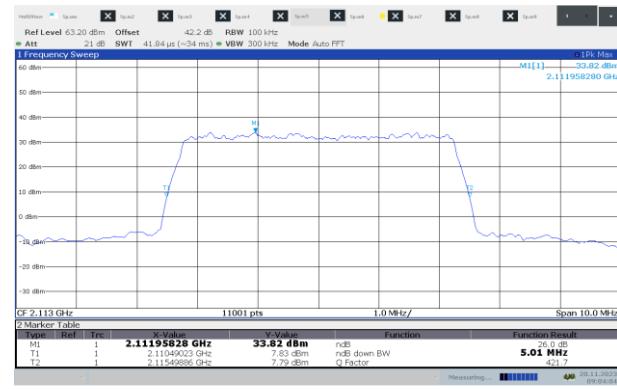
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08:28:30 20.11.2023



08:28:55 20.11.2023

**Test data, Bandwidth, continued**

**Figure 7.1-312: OBW, LTE, B 66, CH 66466**

**Figure 7.1-313 : EBW, LTE, B 66, CH 66466**

**Figure 7.1-314: OBW, LTE, B 66, CH 66886**

**Figure 7.1-315 : EBW, LTE, B 66, CH 66886**

**Figure 7.1-316: OBW, LTE, B 66, CH 67135**

**Figure 7.1-317 : EBW, LTE, B 66, CH 67135**



<b>Section 7</b>	<i>Testing data</i>
<b>Test name</b>	<i>Band edges and Spurious emissions</i>
<b>Specification</b>	<i>FCC 47 CFR Part 22, Subpart H, FCC 47 CFR Part 24, Subpart E, FCC 47 CFR Part 27, Subpart C, FCC 47 CFR Part 90, Subpart S, ISED RSS -119 Issue 12, ISED RSS -130 Issue 2, ISED RSS -132 Issue 4, ISED RSS -133 Issue 6, ISED RSS -139 Issue 4, ISED RSS -199 Issue 4</i>

## 7.2 Band edges and Spurious emissions

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### References, definitions and limits

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#### FCC §22.917:

(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.

#### FCC §24.238:

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(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.

#### FCC §27.53:

(h) AWS 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.

#### FCC §90.691:

(a) (2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10}(P)$  decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

#### RSS-119, Clause 5.8.9.2:

On any frequency outside of the ranges specified in the ACP tables 13 to 16, the power of any emission shall be attenuated below the mean output power P (dBW) by at least  $43 + 10 \log_{10}(p)$ , measured in a 100 kHz bandwidth for frequencies less than or equal to 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

#### RSS-130, Clause 4.7.1:

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  $43 + 10 \log_{10} p$  (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.

#### RSS-132, Clause 5.5:

Equipment shall meet the unwanted emission limits specified below:

- In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated below the transmitter output power P (dBW) by at least  $43 + 10 \log(p)$  dB.
- After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated below the transmitter output power P (dBW) by at least  $43 + 10 \log(p)$  dB. If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

#### RSS-133, Clause 6.5.1:

Equipment shall comply with the limits in (i) and (ii) below.

- In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least  $43 + 10 \log_{10} p$  (watts).
- After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least  $43 + 10 \log_{10} p$  (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

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References, definitions and limits, continued

**RSS-139, Clause 5.6:**

Unwanted emissions shall be measured in terms of average values.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors) of the unwanted emissions outside the frequency block or frequency block group shall not exceed the below limits.

Offset from the edge of the frequency block or frequency block group	Unwanted emission limits
1 MHz	-13 dBm/(1% of OBW)
>1 MHz	-13 dBm/MHz

**RSS-199, Clause 5.6:**

Unwanted emissions shall be measured in terms of average values when the transmitter is operating at the manufacturer's rated power and modulated as specified in RSS-Gen.

Equipment shall meet the unwanted emission limits, specified below, outside each frequency block group. For each channel bandwidth supported by the equipment under test, the unwanted emissions shall be measured and reported for two channel frequencies: one located as close as possible to the low end and one located as close as possible to the high end of the equipment's operating frequency range.

For the unwanted emission limits, in the 1 MHz band immediately outside and adjacent to the frequency block group, the power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for fixed stations, base stations, and fixed subscriber equipment, and 2% for subscriber equipment other than fixed subscriber equipment. Beyond this 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.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors), where applicable, of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in the tables below.

**Table 4: Unwanted emission limits for fixed station, base station and fixed subscriber equipment**

Offset from the edge of the frequency block or frequency block group (MHz)	Unwanted emission limits
≤ 1	-13 dBm/(1% of OBW)
> 1	-13 dBm/MHz



**Section 7**  
**Test name**  
**Specification**

*Testing data*  
**Band edges and Spurious emissions**  
FCC 47 CFR Part 22, Subpart H, FCC 47 CFR Part 24, Subpart E, FCC 47 CFR Part 27, Subpart C, FCC 47 CFR Part 90, Subpart S, ISED RSS -119 Issue 12, ISED RSS -130 Issue 2, ISED RSS -132 Issue 4, ISED RSS -133 Issue 6, ISED RSS -139 Issue 4, ISED RSS -199 Issue 4

Test summary

Verdict	Pass		
Test date	November 20, 2023	Temperature	21 °C
Tested by	Tarek Elkholly	Air pressure	974 mbar
Test location	Cambridge	Relative humidity	33 %

Observations, settings and special notes

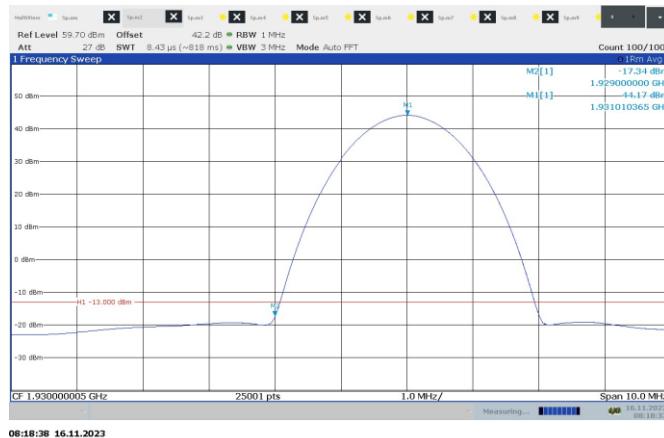
- The spectrum was searched from 30 MHz to the 10<sup>th</sup> harmonic.
- All measurements were performed using an average (RMS) detector per ANSI C63.26 Paragraph 5.7.3 method.
- Spurious emissions tests and band edges were performed at RF antenna connector and a radiated cabinet spurious emission was performed with the antenna ports terminated with 50Ω termination.

Spectrum analyser settings for out of band emissions:

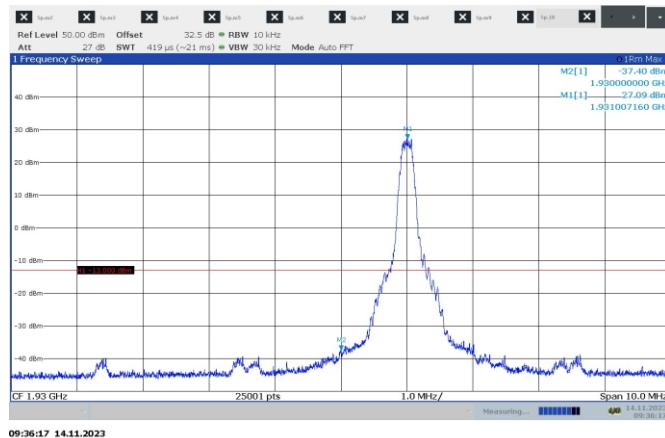
Resolution bandwidth:	1 MHz (Signals greater than 1 GHz) 100 kHz (Signals below 1 GHz)
Video bandwidth:	> RBW
Detector mode:	RMS
Trace mode:	Averaging

Spectrum analyser settings for spurious emissions in the 1 MHz bands immediately outside and adjacent to the licensee's frequency block:

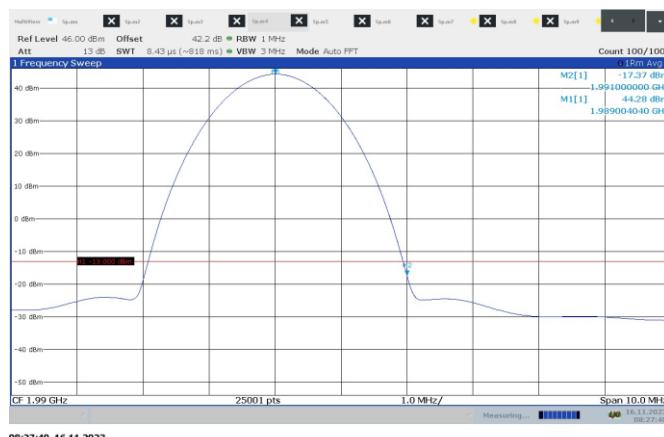
Resolution bandwidth:	At least 1% of EBW
Video bandwidth:	> RBW
Detector mode:	RMS
Trace mode:	Averaging

**Test data**


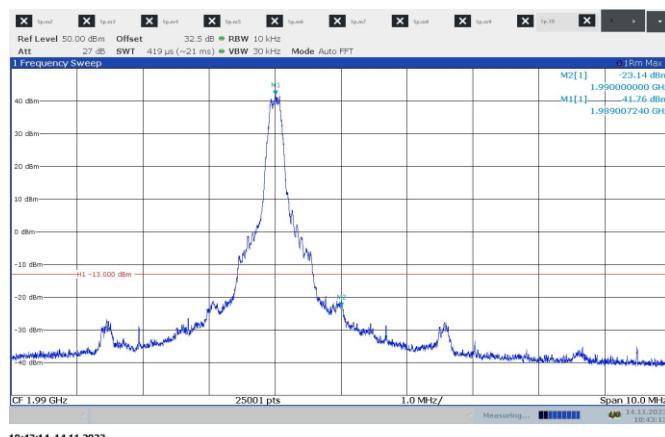
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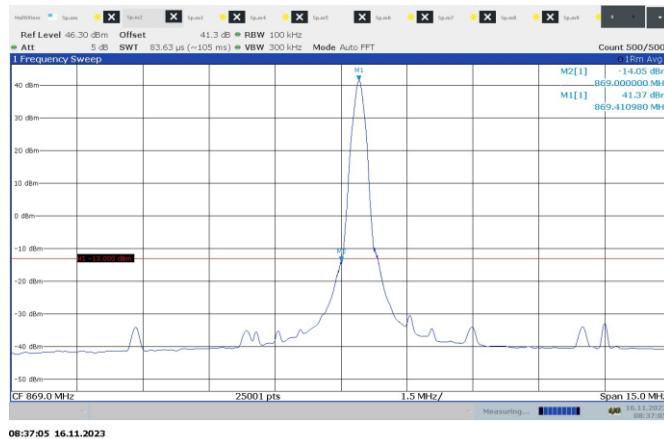
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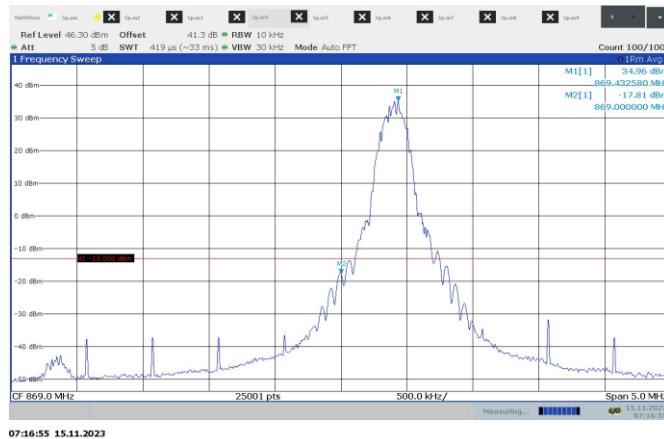
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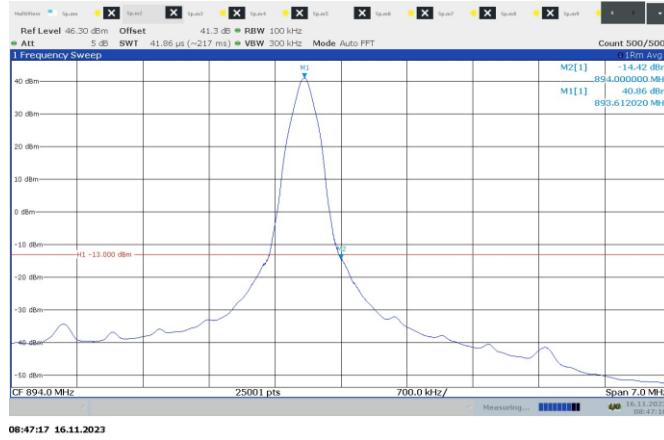
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**Test data, Band edges, continued**


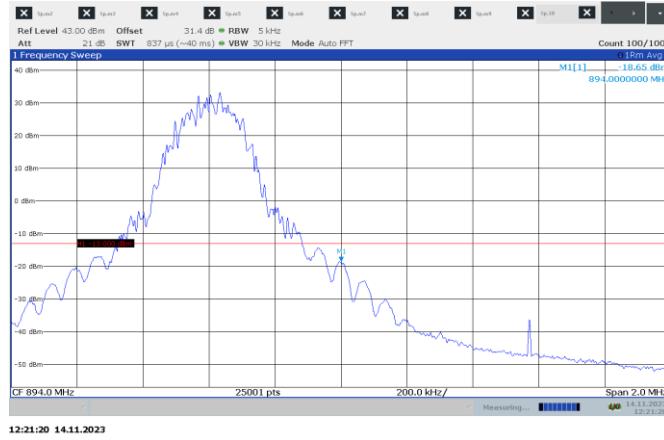
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**Figure 7.2-5: Conducted band edge, GSM, B 05, CH 129**


07:16:55 15.11.2023

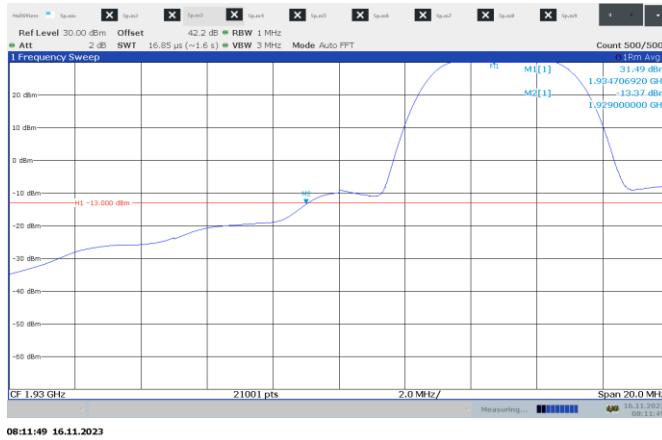
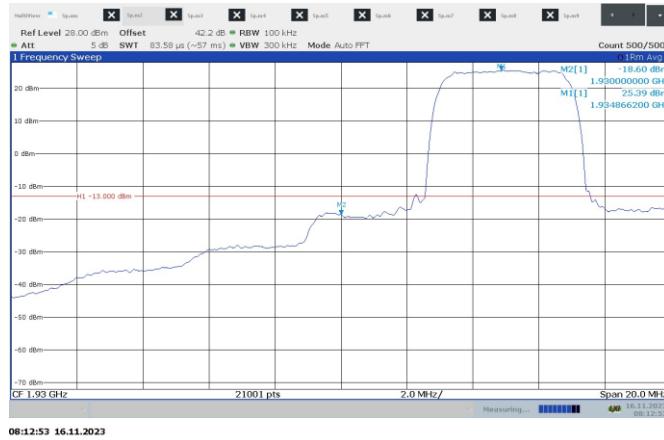
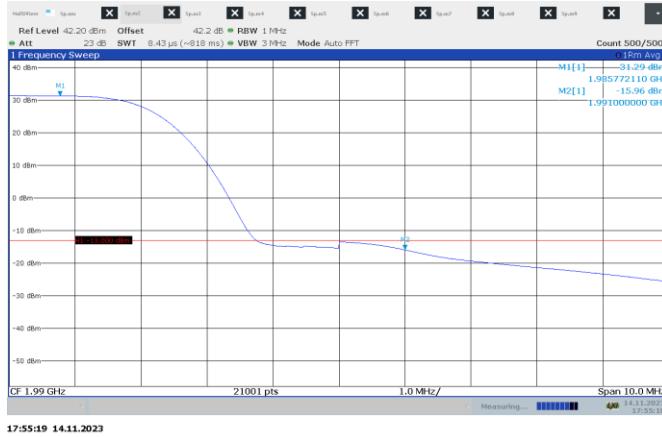
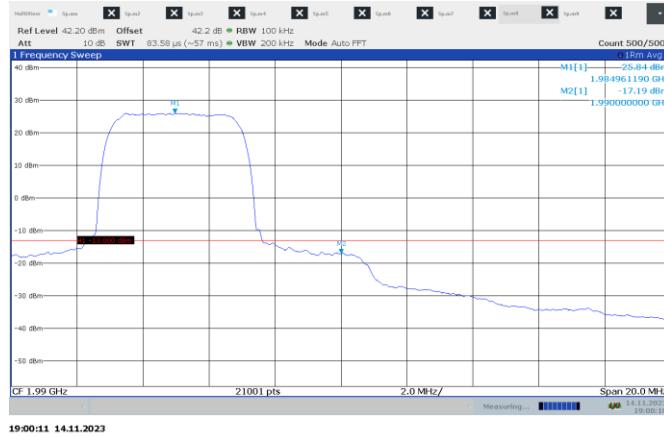
**Figure 7.2-6: Conducted band edge (RBW 1% of EBW), GSM, B 05, CH 129**


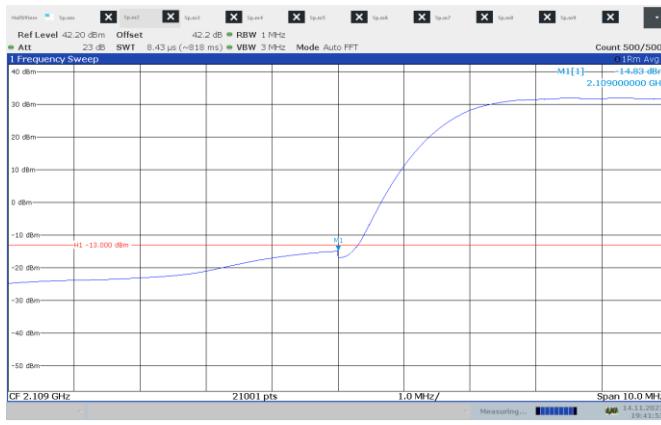
08:47:17 16.11.2023

**Figure 7.2-7: Conducted band edge, GSM, B 05, CH 250**


12:21:20 14.11.2023

**Figure 7.2-8: Conducted band edge (RBW 1% of EBW), GSM, B 05, CH 250**

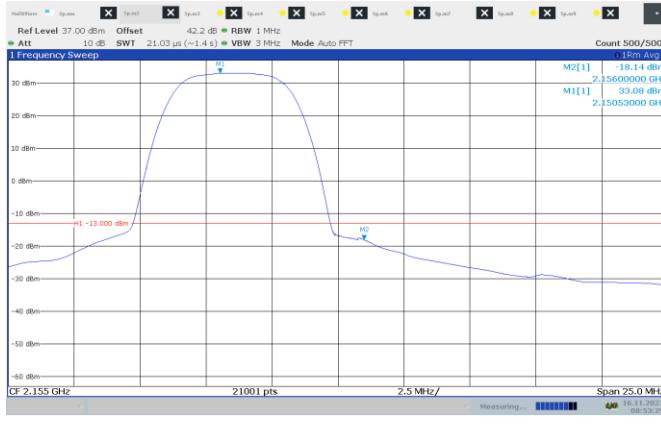
**Test data, Band edges, continued**

**Figure 7.2-9: Conducted band edge, WCDMA, B 02, CH 9675**

**Figure 7.2-10: Conducted band edge (RBW 1% of EBW), WCDMA, B 02, CH 9675**

**Figure 7.2-11: Conducted band edge, WCDMA, B 02, CH 9925**

**Figure 7.2-12: Conducted band edge (RBW 1% of EBW), WCDMA, B 02, CH 9925**

**Test data, Band edges, continued**


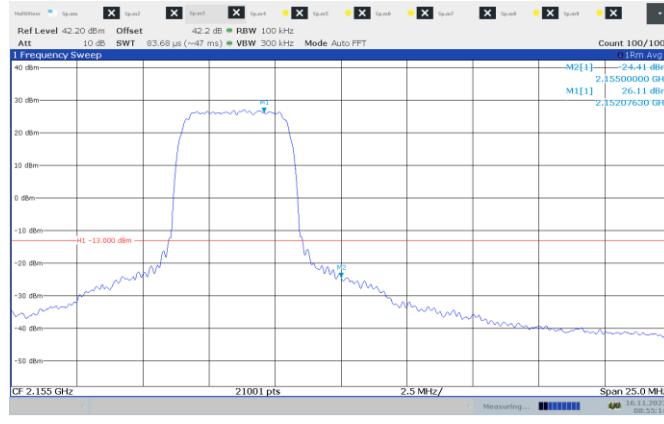
19:41:53 14.11.2023

**Figure 7.2-13: Conducted band edge, WCDMA, B 04, CH 1540**


19:43:42 14.11.2023

**Figure 7.2-14: Conducted band edge (RBW 1% of EBW), WCDMA, B 04, CH 1540**


08:53:30 16.11.2023

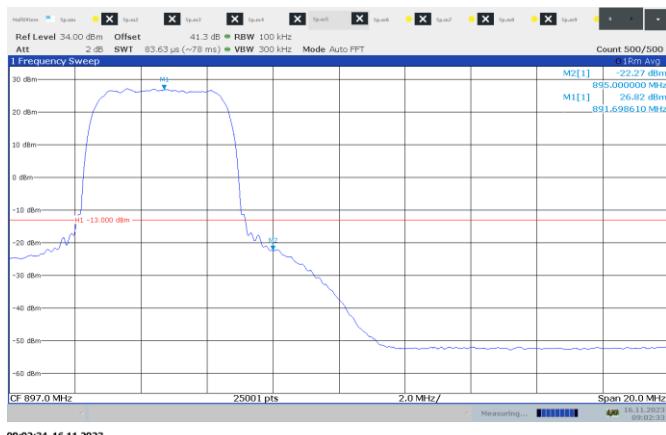
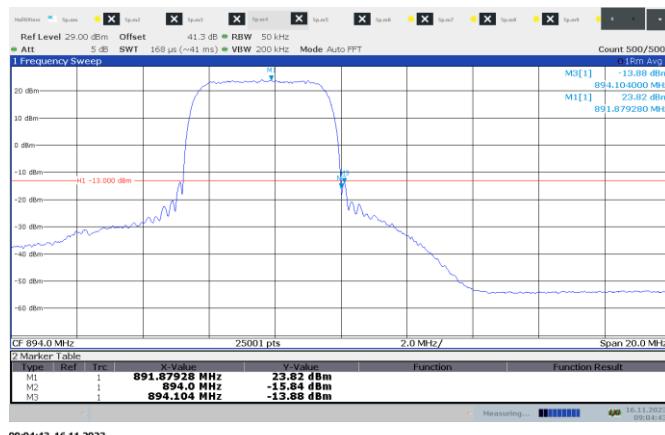
**Figure 7.2-15: Conducted band edge, WCDMA, B 04, CH 1730**


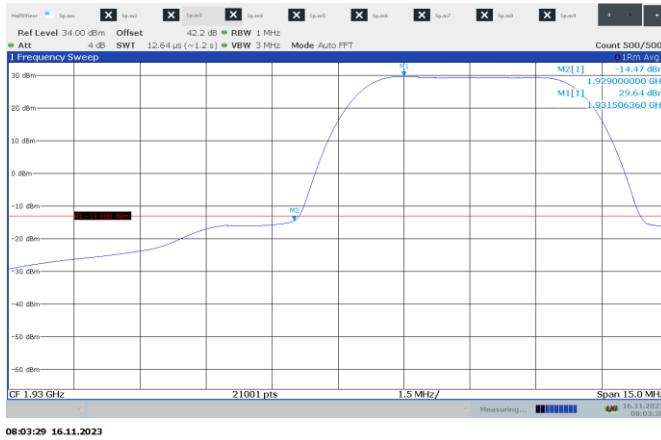
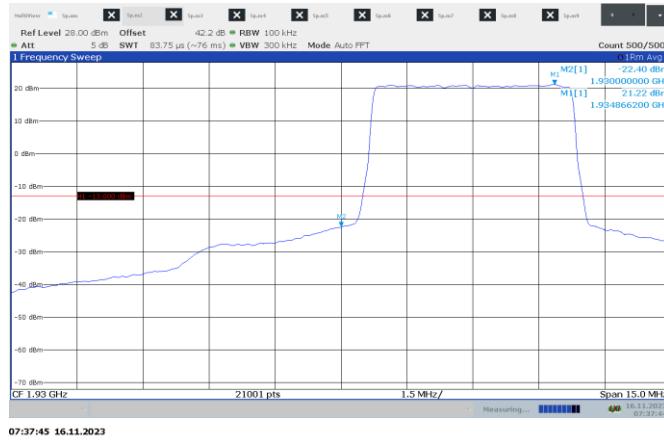
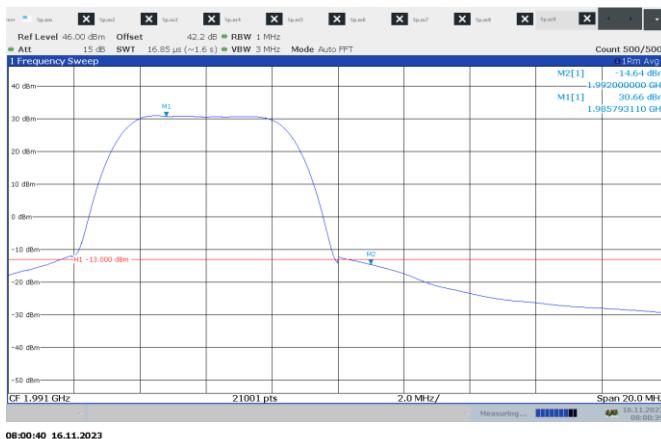
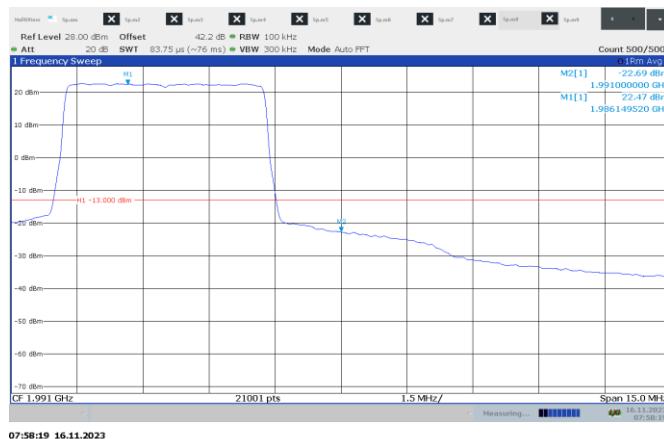
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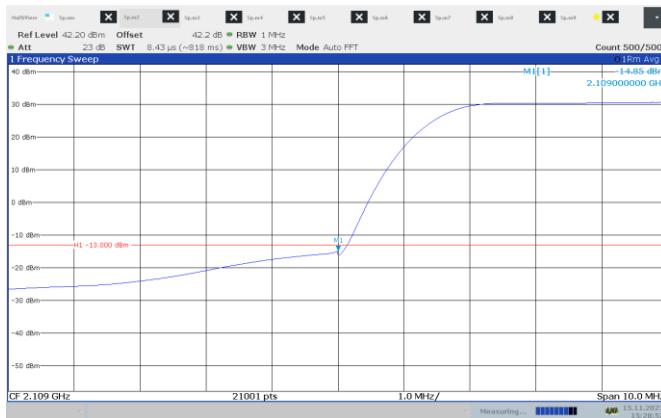
**Figure 7.2-16: Conducted band edge (RBW 1% of EBW), WCDMA, B 04, CH 1730**

**Test data, Band edges, continued**

**Figure 7.2-17: Conducted band edge, WCDMA, B 05, CH 4357**

**Figure 7.2-18: Conducted band edge (RBW 1% of EBW), WCDMA, B 05, CH 4357**

**Figure 7.2-19: Conducted band edge, WCDMA, B 05, CH 4458**

**Figure 7.2-20: Conducted band edge (RBW 1% of EBW), WCDMA, B 05, CH 4458**

**Test data, Band edges, continued**

**Figure 7.2-21: Conducted band edge, LTE, B 02, CH 630**

**Figure 7.2-22: Conducted band edge (RBW 1% of EBW), LTE, B 02, CH 630**

**Figure 7.2-23: Conducted band edge, LTE, B 02, CH 1170**

**Figure 7.2-24 : Conducted band edge (RBW 1% of EBW), LTE, B 02, CH 1170**

**Test data, Band edges, continued**


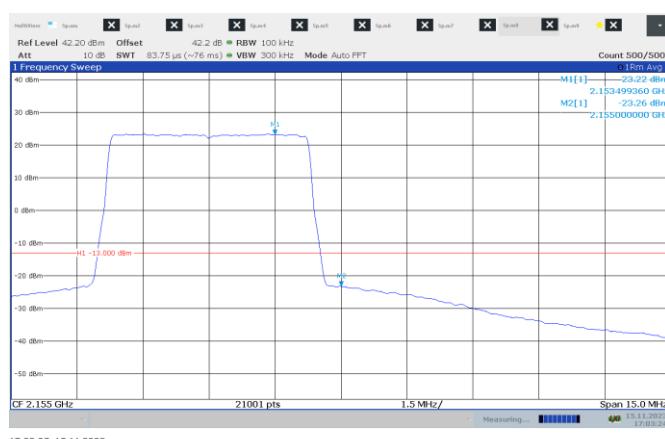
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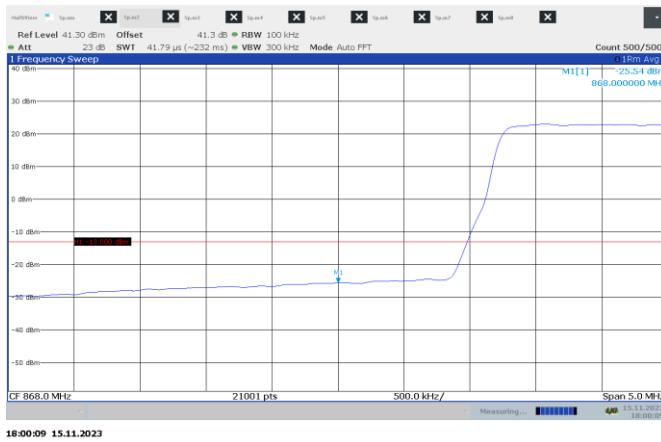
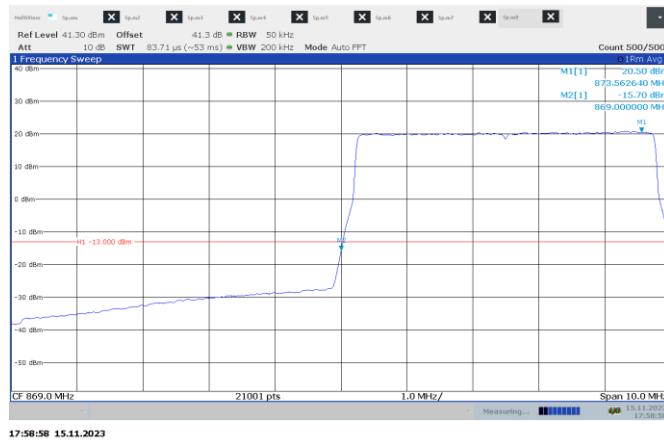
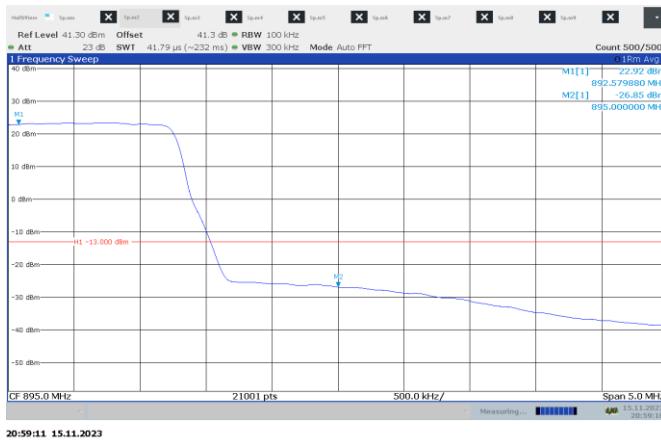
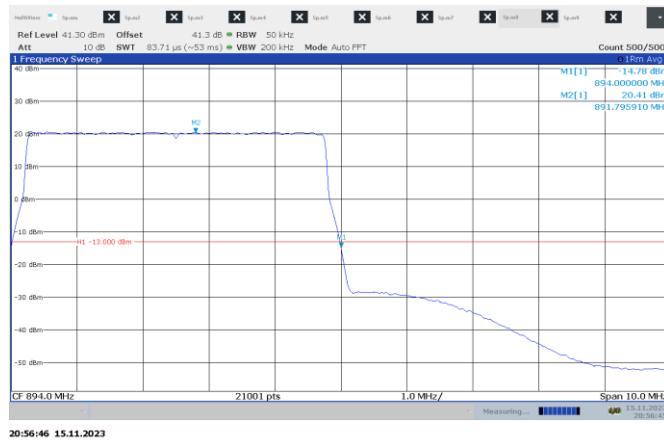
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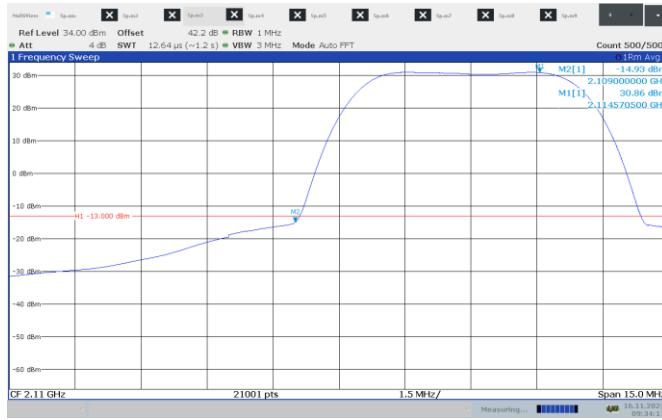


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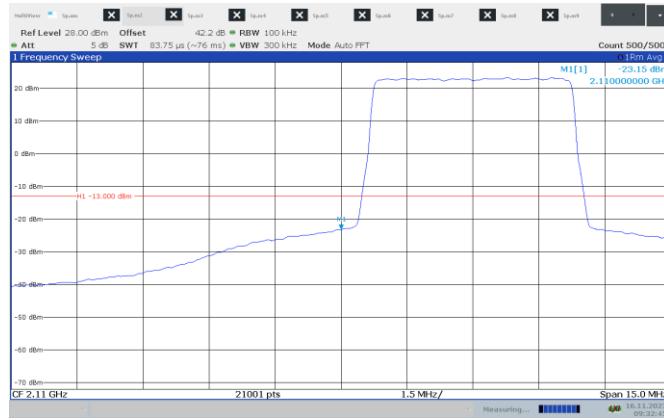


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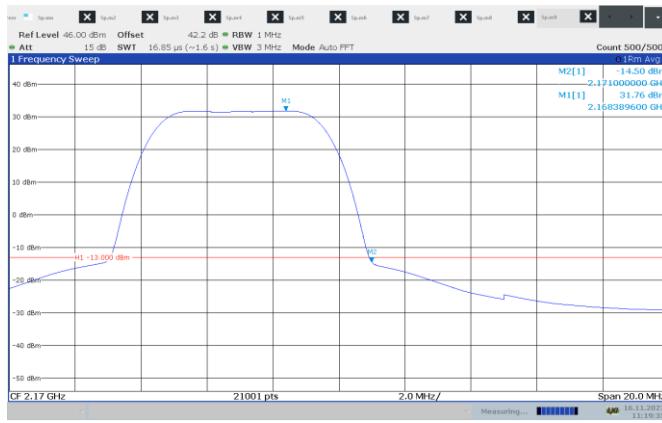
**Test data, Band edges, continued**

**Figure 7.2-29: Conducted band edge, LTE, B 05, CH 2425**

**Figure 7.2-30 : Conducted band edge (RBW 1% of EBW), LTE, B 05, CH 2425**

**Figure 7.2-31: Conducted band edge, LTE, B 05, CH 2625**

**Figure 7.2-32 : Conducted band edge (RBW 1% of EBW), LTE, B 05, CH 2625**

**Test data, Band edges, continued**


09:34:12 16.11.2023

**Figure 7.2-33: Conducted band edge, LTE, B 10, CH 4180**


09:32:45 16.11.2023

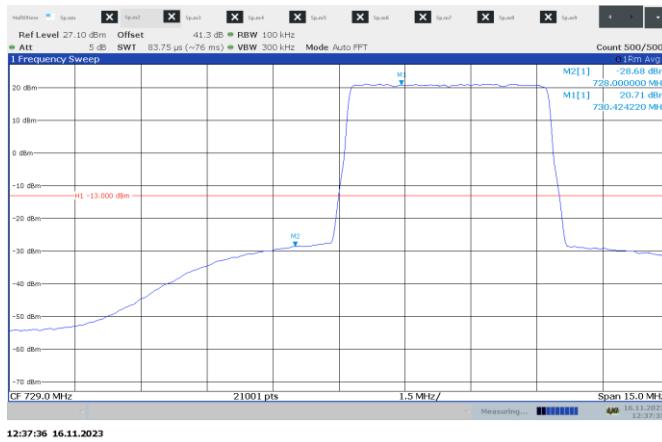
**Figure 7.2-34 : Conducted band edge (RBW 1% of EBW), LTE, B 10, CH 4180**


11:18:36 16.11.2023

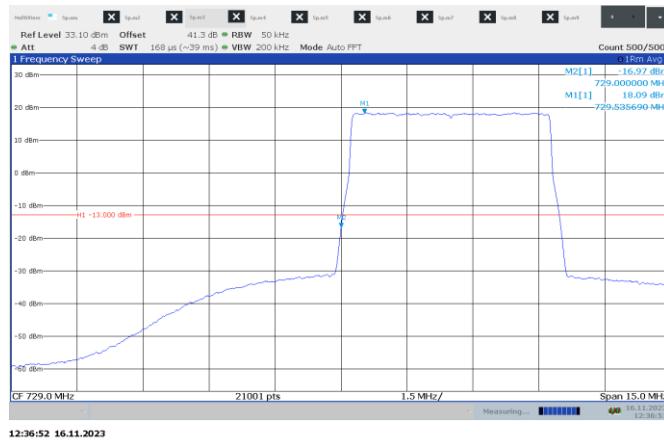
**Figure 7.2-35: Conducted band edge, LTE, B 10, CH 4720**


11:18:23 16.11.2023

**Figure 7.2-36 : Conducted band edge (RBW 1% of EBW), LTE, B 10, CH 4720**

**Test data, Band edges, continued**


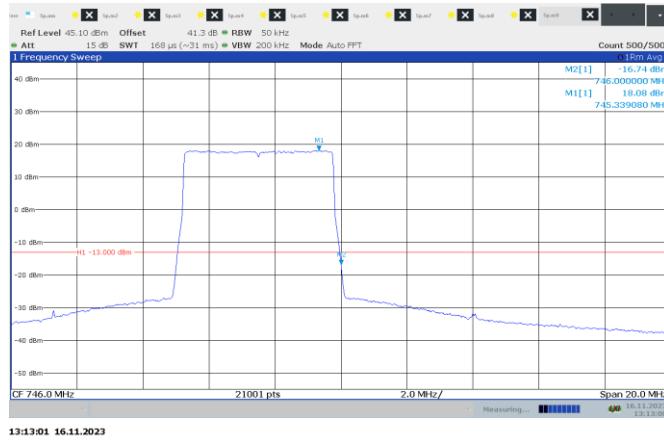
12:37:36 16.11.2023

**Figure 7.2-37: Conducted band edge, LTE, B 12, CH 5035**


12:36:52 16.11.2023

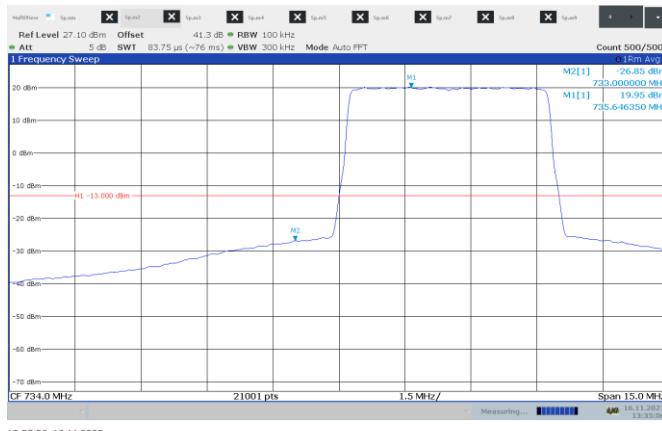
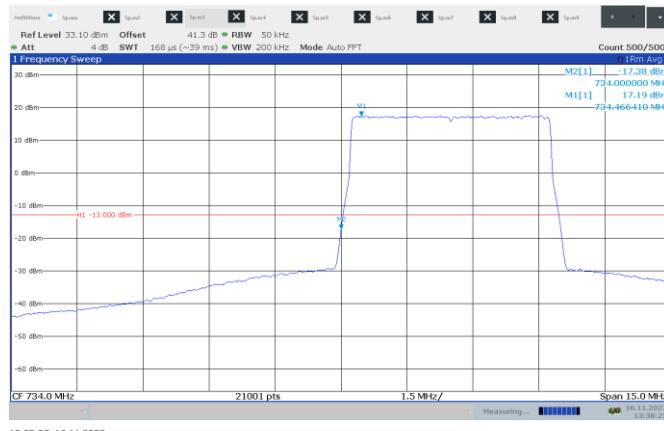
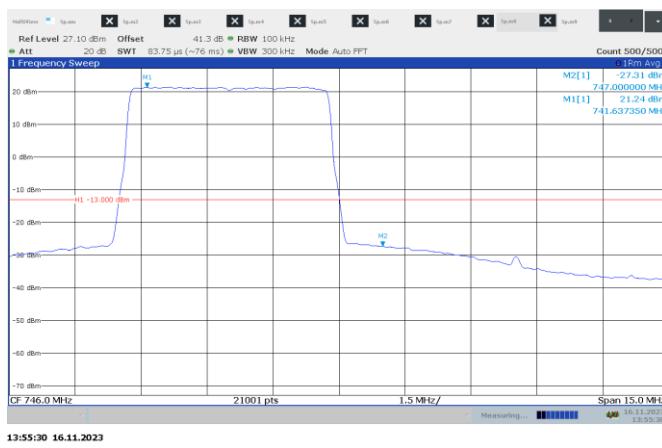
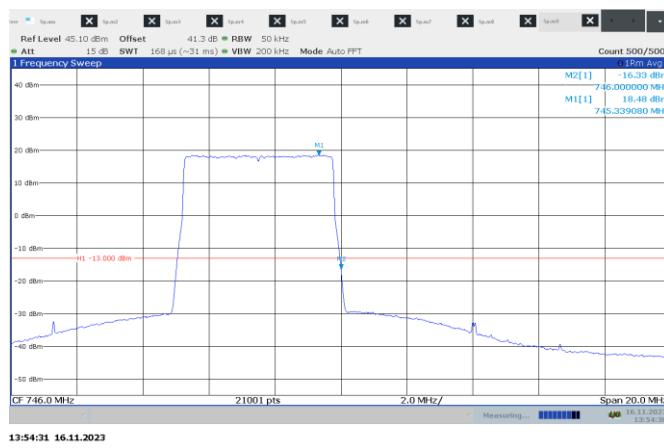
**Figure 7.2-38 : Conducted band edge (RBW 1% of EBW), LTE, B 12, CH 5035**


13:14:09 16.11.2023

**Figure 7.2-39: Conducted band edge, LTE, B 12, CH 5155**


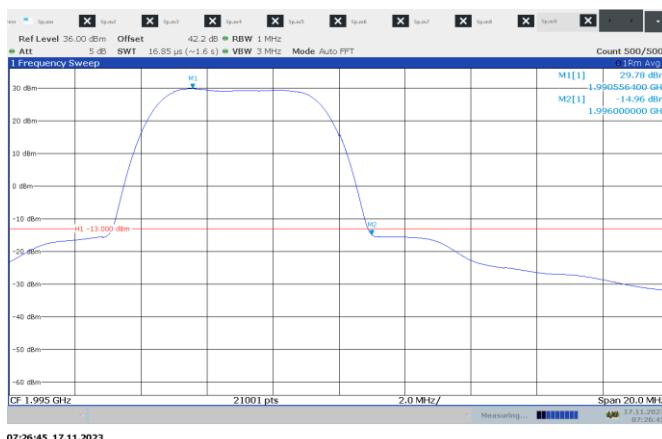
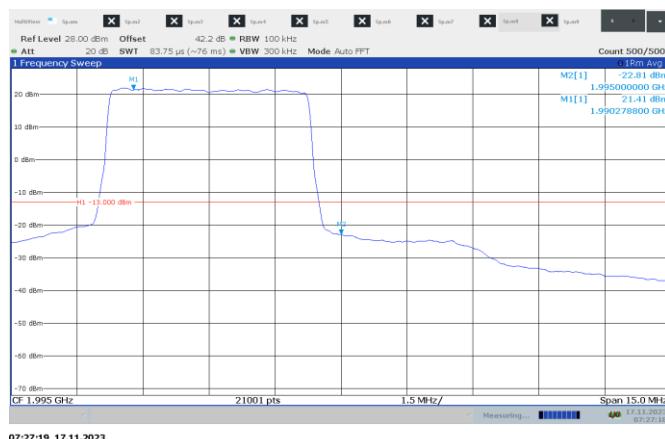
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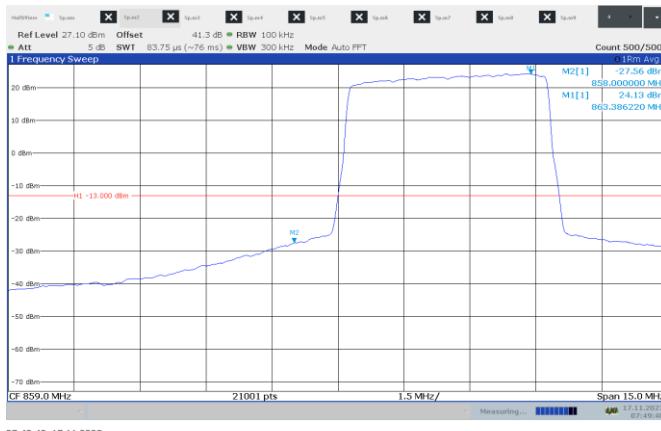
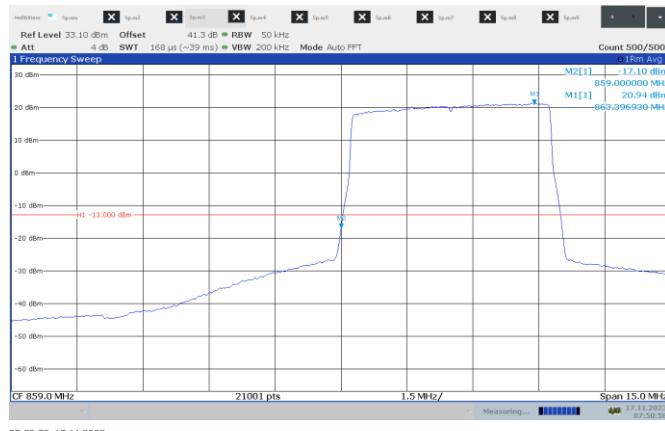
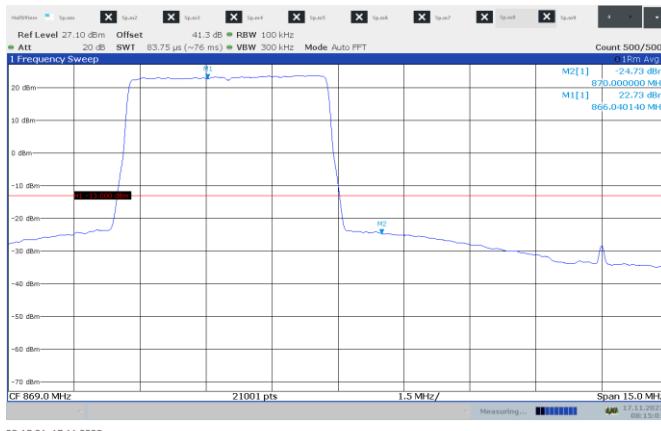
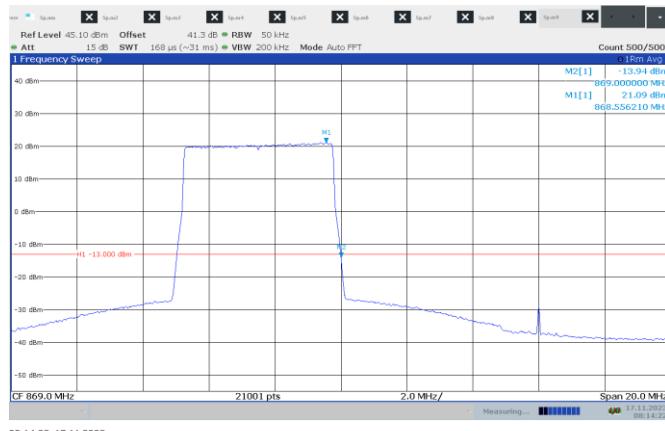
**Figure 7.2-40 : Conducted band edge (RBW 1% of EBW), LTE, B 12, CH 5155**

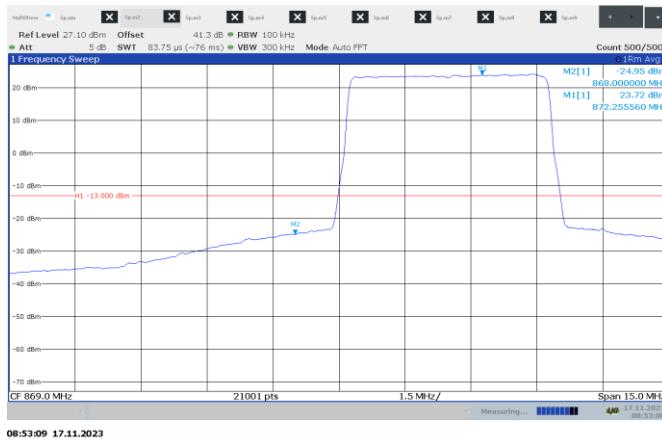
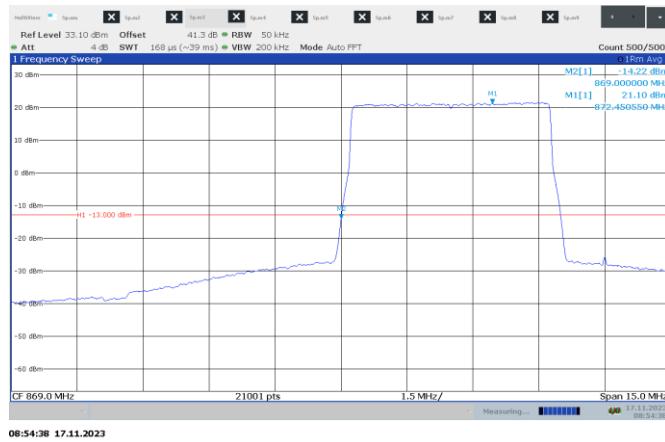
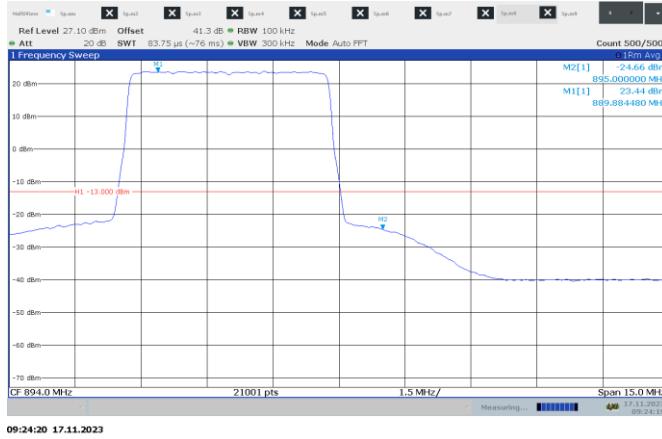
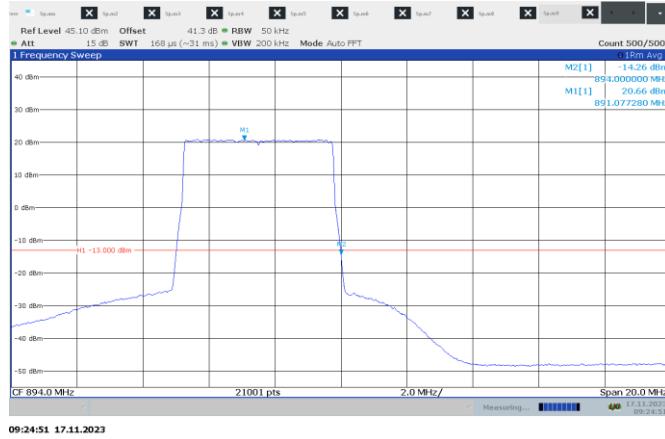
**Test data, Band edges, continued**

**Figure 7.2-41: Conducted band edge, LTE, B 17, CH 5755**

**Figure 7.2-42 : Conducted band edge (RBW 1% of EBW), LTE, B 17, CH 5755**

**Figure 7.2-43: Conducted band edge, LTE, B 17, CH 5825**

**Figure 7.2-44 : Conducted band edge (RBW 1% of EBW), LTE, B 17, CH 5825**

**Test data, Band edges, continued**

**Figure 7.2-45: Conducted band edge, LTE, B 25, CH 8070**

**Figure 7.2-46 : Conducted band edge (RBW 1% of EBW), LTE, B 25, CH 8070**

**Figure 7.2-47: Conducted band edge, LTE, B 25, CH 8660**

**Figure 7.2-48 : Conducted band edge (RBW 1% of EBW), LTE, B 25, CH 8660**

**Test data, Band edges, continued**

**Figure 7.2-49: Conducted band edge, LTE, B 26\_1, CH 8715**

**Figure 7.2-50 : Conducted band edge (RBW 1% of EBW), LTE, B 26\_1, CH 8715**

**Figure 7.2-51: Conducted band edge, LTE, B 26\_1, CH 8765**

**Figure 7.2-52 : Conducted band edge (RBW 1% of EBW), LTE, B 26\_1, CH 8765**

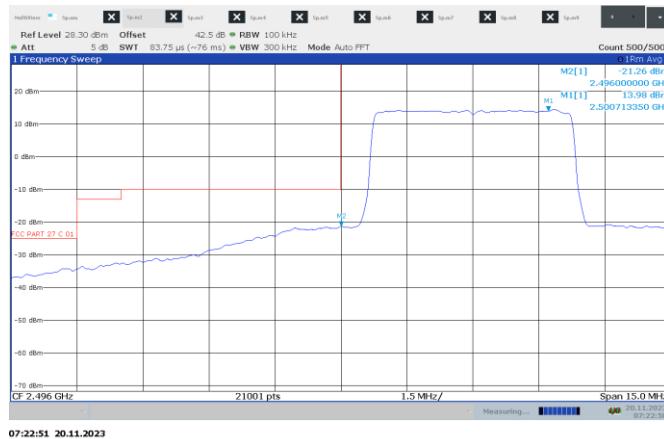
**Test data, Band edges, continued**

**Figure 7.2-53: Conducted band edge, LTE, B 26\_2, CH 8815**

**Figure 7.2-54 : Conducted band edge (RBW 1% of EBW), LTE, B 26\_2, CH 8815**

**Figure 7.2-55: Conducted band edge, LTE, B 26\_2, CH 9015**

**Figure 7.2-56 : Conducted band edge (RBW 1% of EBW), LTE, B 26\_2, CH 9015**

Test data, Band edges, continued

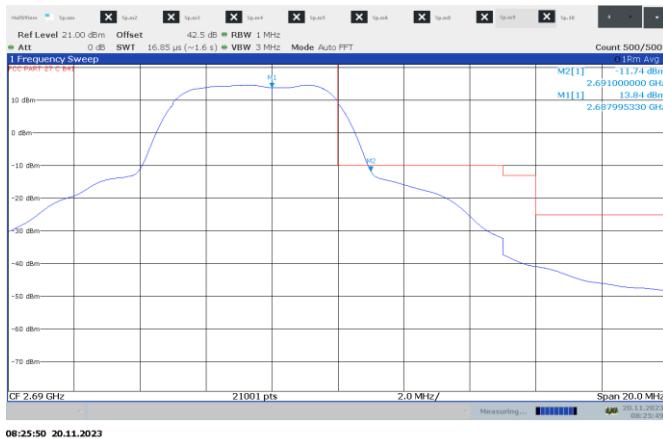


**Figure 7.2-57: Conducted band edge, LTE, B 41, CH 39680**

**Note:** plot in figure 7.2-57 is to show compliance 1 MHz away from the authorized bandwidth, the band edge at the authorized band edge is shown in plot in figure 7.2-58 utilizing a reduced RBW as per the standard

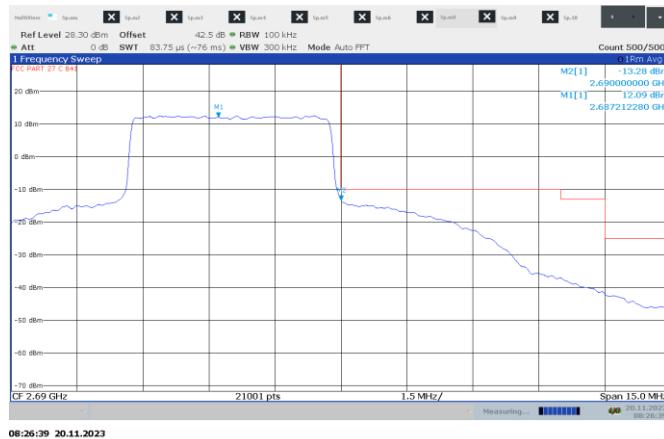


**Figure 7.2-58 : Conducted band edge (RBW 1% of EBW), LTE, B 41, CH 39680**



**Figure 7.2-59: Conducted band edge, LTE, B 41, CH 41565**

**Note:** plot in figure 7.2-59 is to show compliance 1 MHz away from the authorized bandwidth, the band edge at the authorized band edge is shown in plot in figure 7.2-60 utilizing a reduced RBW as per the standard



**Figure 7.2-60 : Conducted band edge (RBW 1% of EBW), LTE, B 41, CH 41565**