PARTIAL TESTREPORT

No.: 18-1-0026601T05a

According to:

FCC Regulations
Part 20, Section 20.21

For

Kathrein Automotive GmbH

LTE Kompensator US
Compensator US

FCC-ID: 2ACC7LTECOMPB1

Laboratory Accreditation and Listings		
Deutsche Akkreditierungsstelle D-PL-12047-01-01 D-PL-12047-01-04 Accredited EMC-Test Laboratory	Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3	Voluntary Controls for Electromagnetic Emissions Reg. No.: R-4452, C-20009, T-20006, G-20013
AUTHORIZED RF LABORATORY	Authorized Test Lab Lab Code: 20011130-00	MRA US-EU 0003
accredited according to DIN EN ISO/IEC 17025		

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1. Summary of Test Results

☐ No deviations from the technical specifications were ascertained

☐ There were deviations from the technical specifications ascertained

☒ This test report is only a partial test report. The content and verdict of the performed test cases are listed below

Report Chapter	KDB Test Case	Reference to FCC part 20 for a consumer wideband booster, cradle type	Limit	Verdict
5.1	7.1 Authorized frequency band verification test	§ 20.21(e)(3) Frequency Bands	Pass	
5.2	7.2 Maximum power measurement test procedure	§ 20.21(e)(8)(i)(D) Power Limits § 20.21(e)(8)(i)(B) Bidirectional Capability § 20.21(e)(8)(ii)(B) Gain Control	17 < p < 30 dBm	Pass
5.3	7.3 Gain		< 23 dB	Pass
5.4	7.4 Intermodulation product test procedure	§ 20.21(e)(8)(i)(F) Intermodulation	-19 dBm	Pass
5.5	7.5 Out-of-band emissions test procedure	§ 20.21(e)(8)(i)(E) Out of Band Emission	-19 dBm	Pass
5.6	7.6 Conducted spurious emissions test procedure	§ 2.1051 Spurious emissions at antenna terminals	-19 dBm	Pass
5.7	7.7 Noise limits test	§ 20.21(e)(8)(i)(A) Noise Limits § 20.21(e)(8)(i)(H) Tr. Power Off	< -70 dBm/MHz	Pass
5.8	7.8 Uplink Inactivity	§ 20.21(e)(8)(i)(A) Noise Limits § 20.21(e)(8)(i)(H) Tr. Power Off	< 15 s	Pass
5.9	7.9 Variable booster gain test procedure	§ 20.21(e)(8)(i)(C)(1) Gain Limits § 20.21(e)(8)(ii)(B) Gain Control	6 …23 dB / 1 s	Pass
5.10	7.10 Occupied bandwidth test proc.	§ 2.1049 Occupied bandwidth	Pass	
5.11	7.11 Oscillation detection test procedure	§ 20.21(e)(8)(ii)(A) Anti-Oscillation	0.3 / 1 / 60 s	Pass
	7.12 Radiated spurious emissions test procedure	§ 2.1053 Field strength of spurious radiation	Separate test report	
	7.13 Spectrum block filtering test procedure	§ 20.21(e)(3) Frequency Bands	Not supported	
	7.14 Additional Requirements for dual-enclosure boosters	§ 20.21 (e)(8)(i) several parts	Not applicable	

Uplink Power and Gain Summary

Frequency Band	Supported signal types	Max Uplink Power [dBm]	Max Uplink Gain [dB]
Band 2: 1900 MHz (PCS)	GSM / CDMA / WCDMA / LTE	20.2	21.6
Band 4: 1.7 GHz	WCDMA / LTE	20.0	20.8
Band 5: 850 MHz (cell band)	GSM / CDMA / WCDMA / LTE	20.3	20.0
Band 12: 700 MHz	LTE	21.2	20.8
Band 13: 800 MHz	LTE	21.3	19.7

Digital unterschrieben von Piotr Sardyko
DN: cn=Piotr Sardyko, o=CETECOM GmbH, ou=Radio Communications & EMC, email=piotr.sardyko@cetecom.com, c=DE

....
Piotr Sardyko
Responsible for test report

....
Niels Jeß
Responsible for laboratory

2. Administrative Data

2.1. Identification of the Testing Laboratory and Test Location

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen Germany
Responsible for testing laboratory:	Niels Jeß

2.2. Organizational Items

Order No.:	20835062 / 15083280
Responsible for test report:	Piotr Sardyko
Receipt of EUT	27.09.2018
Date(s) of test:	01.10.2018 – 02.11.2018
Date of report:	07.11.2018
Attending persons during test:	
Version of template	V5-SB

2.3. Applicant´s Details

Applicant´s name:	Kathrein Automotive GmbH
Address:	Römerring 1 31137 Hildesheim Germany
Contact person: **Email:**	Herr T. Schuhbeck Thomas.Schuhbeck@kathreinautomotive.com

2.4. Manufacturer's Details

Applicant´s name:	Same as applicant
Address:	Same as applicant
Contact person: **Email:**	Same as applicant Same as applicant

2.5. Test Environment

Temperature:	T_{nom}: + 22 °C / air condition
Relative humidity:	55 % ± 25% rH
Barometric pressure:	not relevant for this kind of testing
Power supply:	V_{nom}: + 12.0 V, DC

3. Test Standard(s)

Test Standard	Version	Test Standard Description
FCC part 20.21	01.10.2014	Signal Boosters
KDB 935210 D03	v04r02, June 2018	Wideband Consumer Signal Booster Compliance Measurement Guidance

4. Equipment under Test

4.1. General information

Device classification:	Consumer wideband booster, cradle type
Type identification:	LTE Kompensator US
Type of radio transmission:	Bi-directional amplifier
Power supply:	12 V, DC
Supported Frequency Bands [MHz] and Modes:	Band 2: 1850 – 1910 / 1930 – 1990 MHz, GSM / CDMA / WCDMA / LTE Band 4: 1710 – 1755 / 2110 - 2155 MHz, WCDMA / LTE Band 5: 824 – 849 / 869 – 894 MHz, GSM / CDMA / WCDMA / LTE Band 12/17: 699 – 716 / 729 – 746 MHz, LTE Band 13: 777 – 787 / 746 – 756 MHz, LTE
Additional system description:	This booster requires a RF signal on its server port for enabling uplink operation. Additional there is on the donor side an antenna key sensor. Therefore, during conducted testing a special antenna key simulator must be used (50 Ω device, transparent to RF). According to a separate document, the MSCL (minimum coupling loss of the cradle) is 5.9 dB.

EUT short description*)	EUT	Type	Sample number	S/N serial number	HW hardware status	SW software status
EUT B	LTE Kompensator US	Compensator US	S32	18B234G K0010	13611825_B03V07	9408752_F01_RC14

4.2. Auxiliary Equipment

AE short description	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 7	Antenna key simulator	NAN	NAN	NAN	NAN

4.3. EUT Set Up

EUT set-up no.*)	Combination of EUT and AE	Remarks
Set 7	EUT B + AE 7	for conducted tests

*) EUT set-up no. is used to simplify the identification of the EUT set-up in CETECOM test reports.

5. Measurements / Detailed Test Results

The set up and test procedure has been according to FCC KDB 935210 D03: "Wideband Consumer Signal Booster Compliance Measurement Guidance". This booster requires an antenna key and a RF signal on its server port for enabling uplink operation. Therefor the needed RF cabling for testing and other details are provide in the appropriate chapters.

All conducted test have been carried out with EUT set number 1 with an antenna key simulator. An automated and calibrated test system has been used as described in chapter 6.

All power and gain related tests were carried out using a rms-detector. The appropriate wideband signal power levels (e.g. UMTS, LTE) where obtained using the spectrum analyzer channel power functionality. For GSM signal power tests a gated measurement was used.

5.1. Authorized Frequency Bands

The activated cable routing for this test in uplink is shown in Fig. 1 and for the downlink in Fig. 2, respectively. Below are summarized in the first table the measured results for the frequency f_0 with maximum gain in each band within the supported frequency band limits (but with 2.5 MHz distance to the band edges, CW mode). The input power level at AGC start for the center frequencies of the appropriate bands a summarized together with the other AGC data in chapter 5.2.

Band	Direction	Frequency range	Frequency f_0
2	up	1850 MHz – 1910 MHz	1881.87 MHz
4	up	1710 MHz – 1755 MHz	1743.73 MHz
5	up	824 MHz – 849 MHz	838.58 MHz
12	up	699 MHz – 716 MHz	707.24 MHz
13	up	777 MHz – 787 MHz	783.66 MHz
2	down	1930 MHz -1990 MHz	1963.36 MHz
4	down	2110 MHz – 2155 MHz	2116.62 MHz
5	down	869 MHz – 894 MHz	878.56 MHz
12	down	729 MHz -746 MHz	733.03 MHz
13	down	746 MHz -756 MHz	749.38 MHz

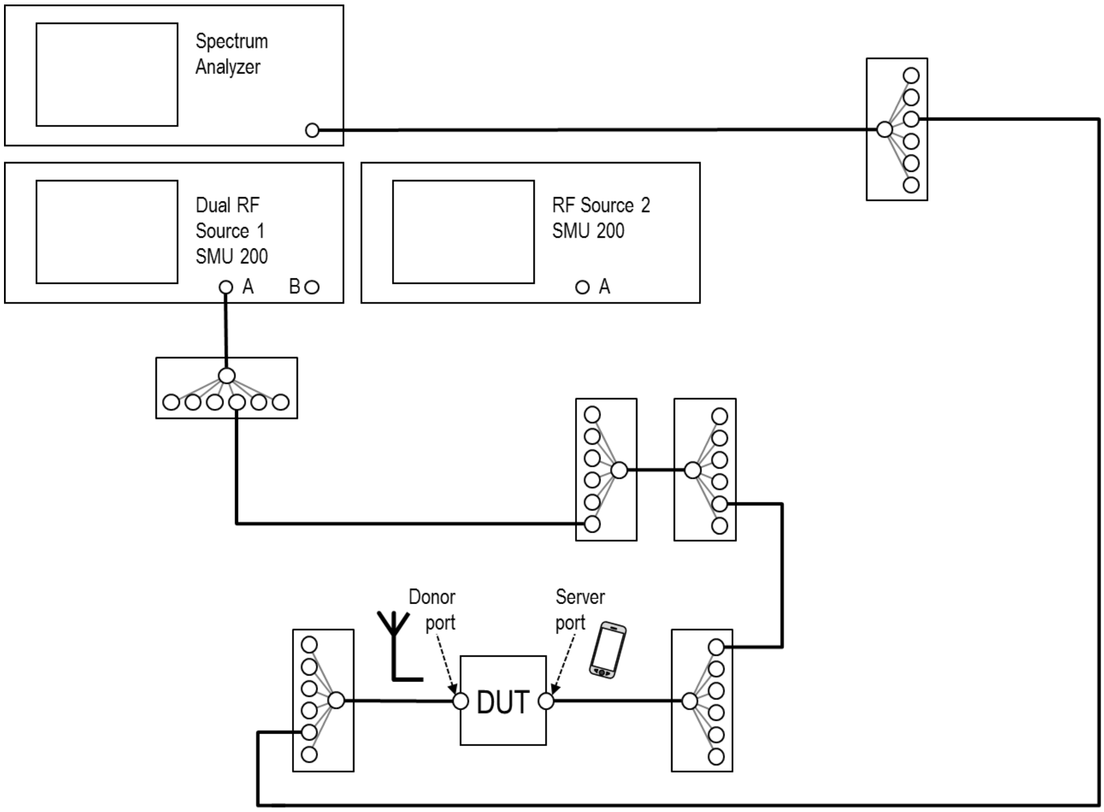

Fig. 1: Set up for frequency response test in uplink.

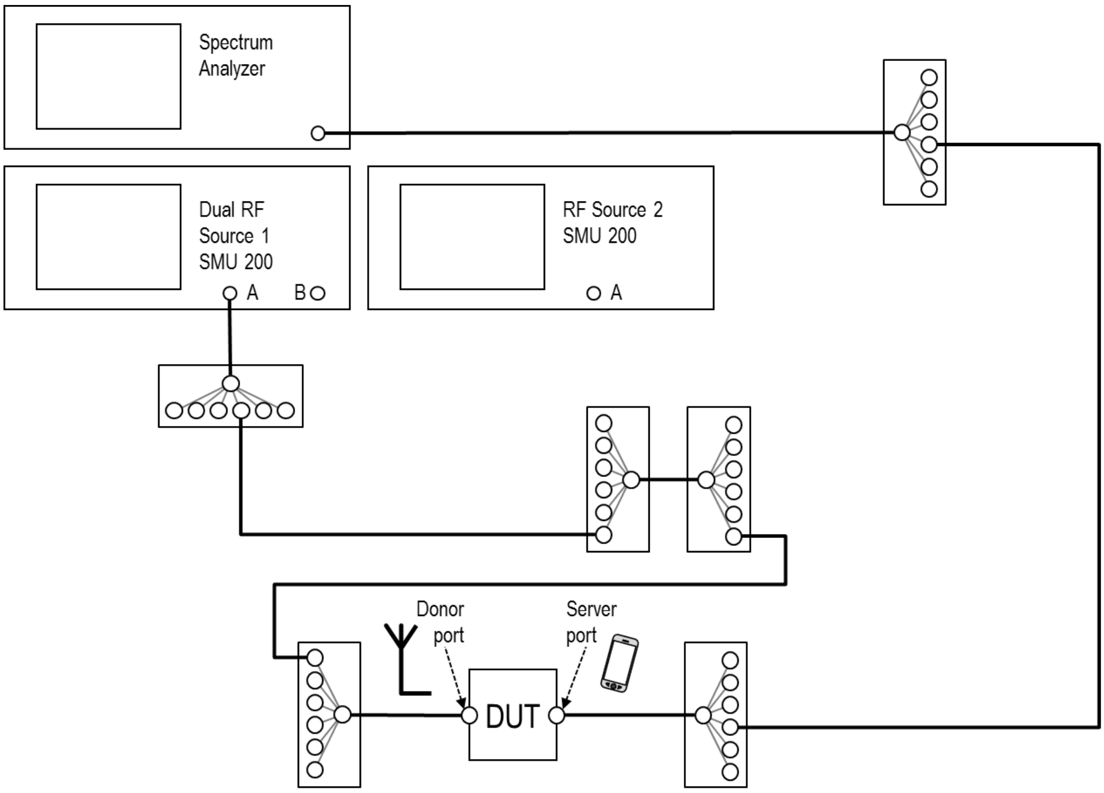

Fig. 2: Set up for frequency response test in downlink.

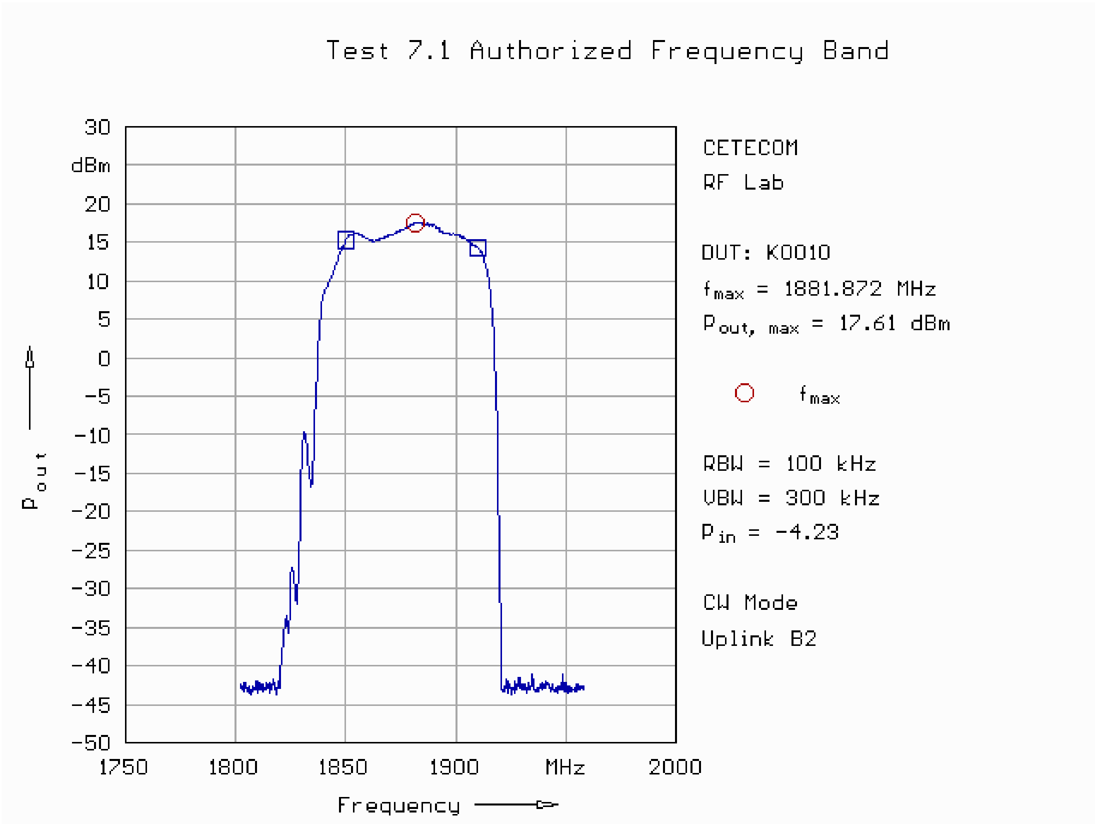

Fig. 3: Frequency response in uplink in band 2.

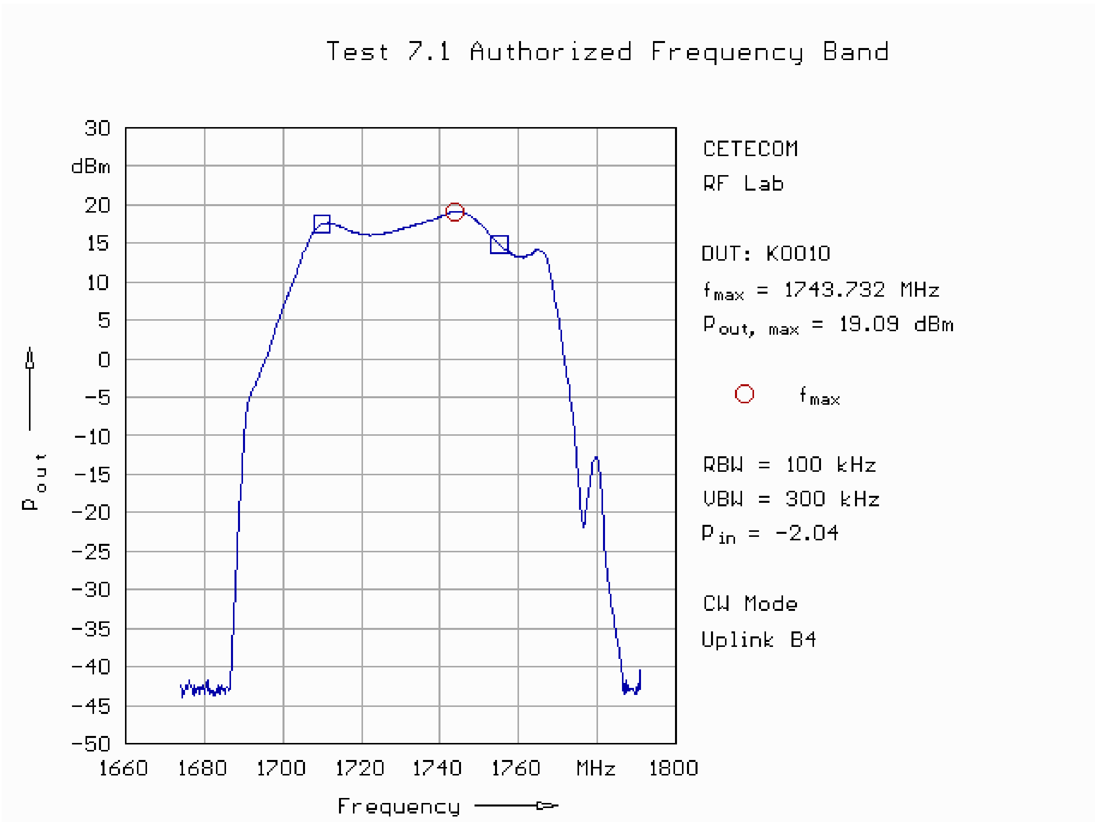

Fig. 4: Frequency response in uplink in band 4.

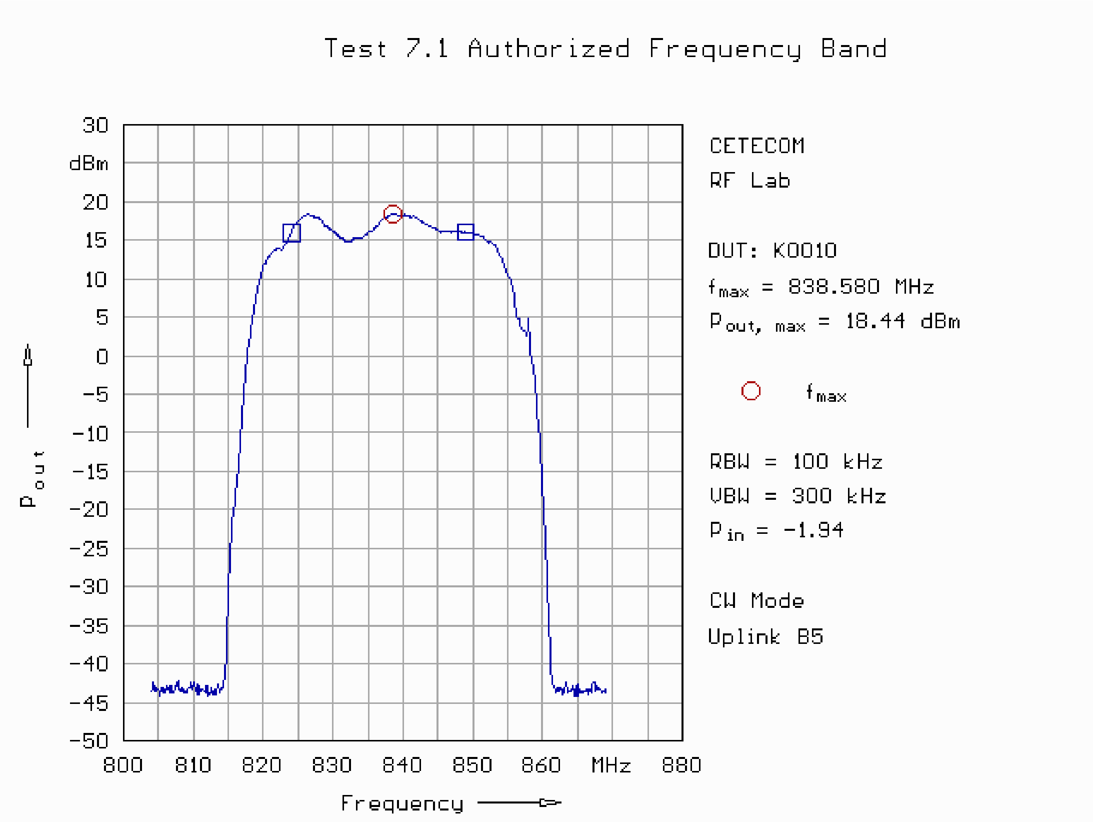

Fig. 5: Frequency response in uplink in band 5.

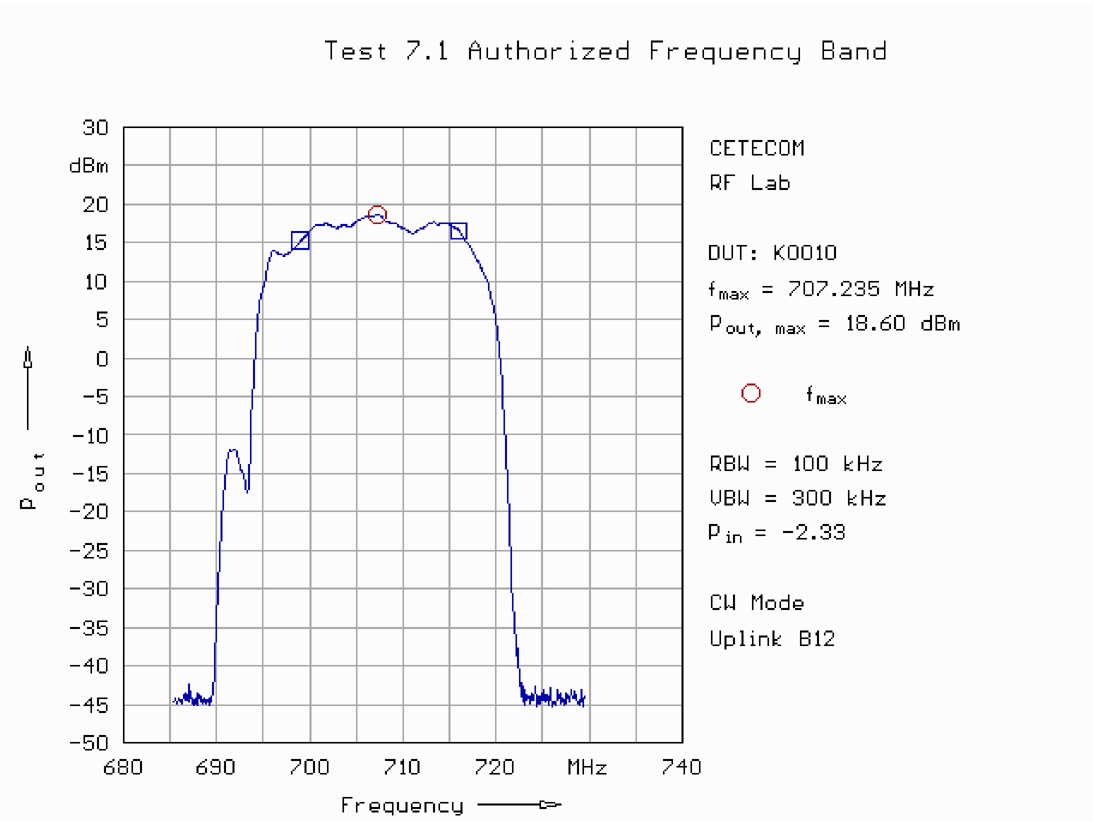

Fig. 6: Frequency response in uplink in band 12.

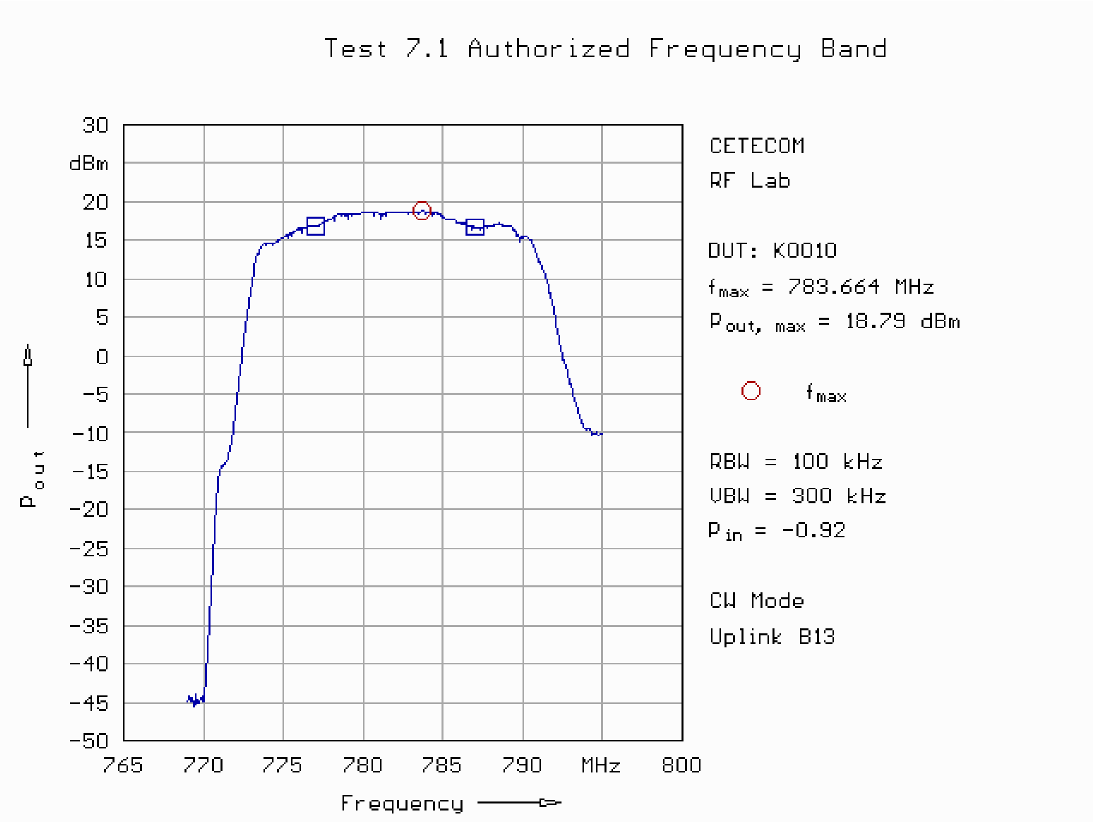

Fig. 7: Frequency response in uplink in band 13.

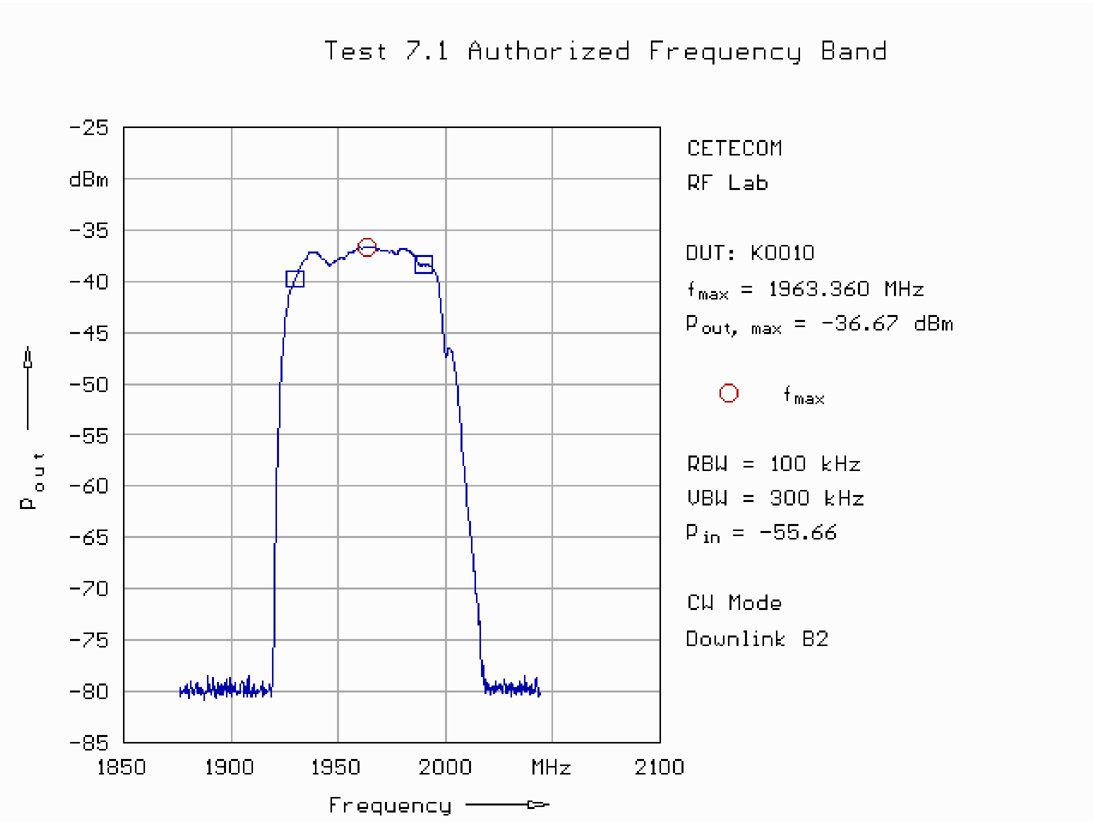

Fig. 8: Frequency response in downlink in band 2.

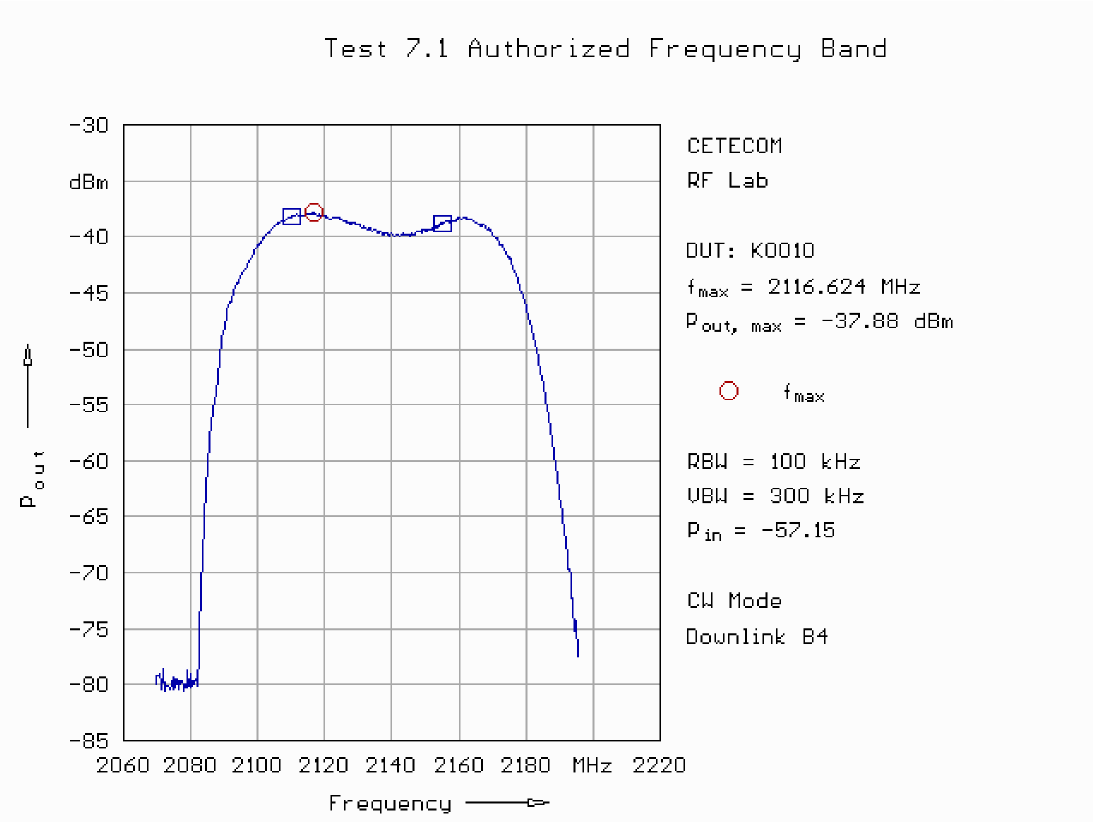

Fig. 9: Frequency response in downlink in band 4.

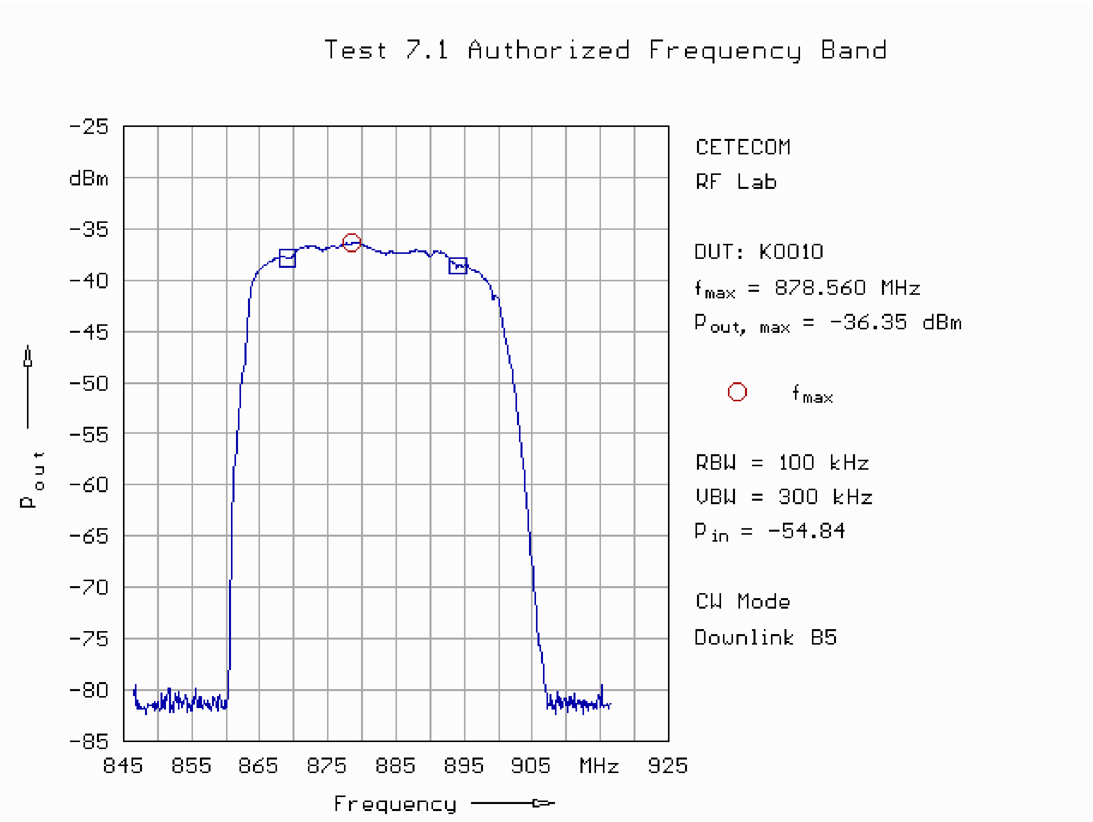

Fig. 10: Frequency response in downlink in band 5.

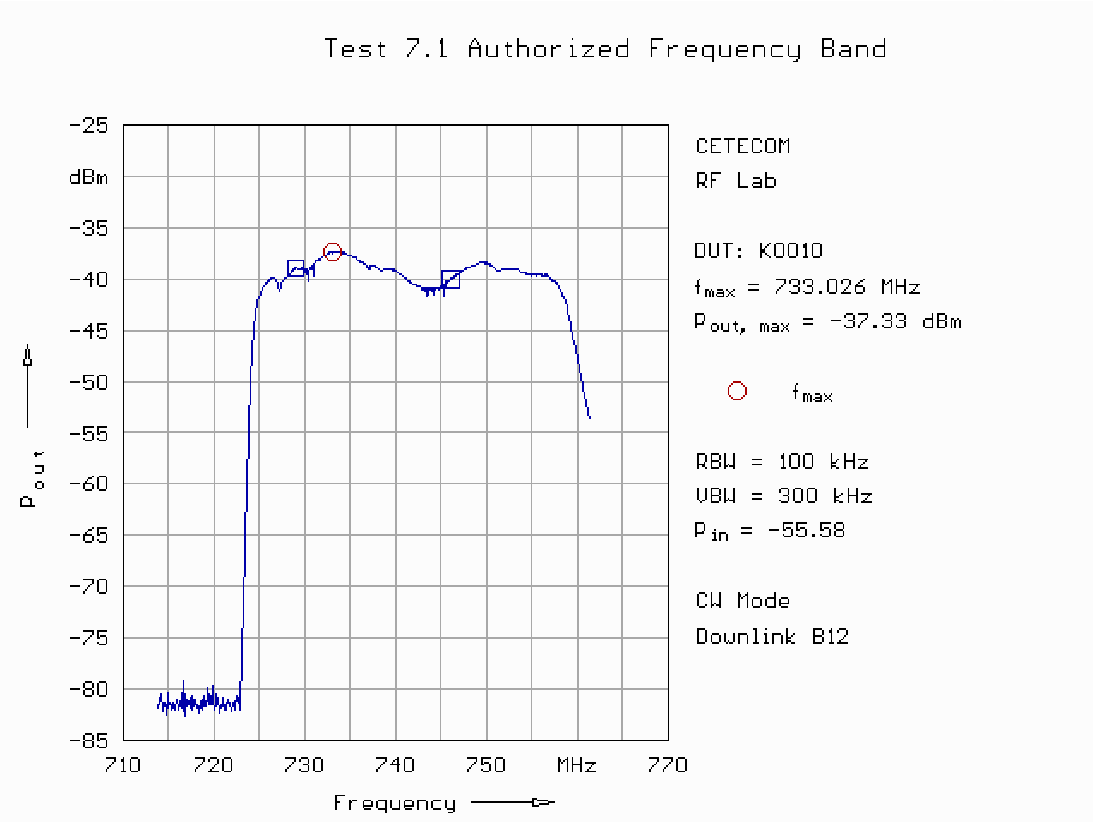

Fig. 11: Frequency response in downlink in band 12.

Note: In downlink band 12 and 13 are directly adjacent.

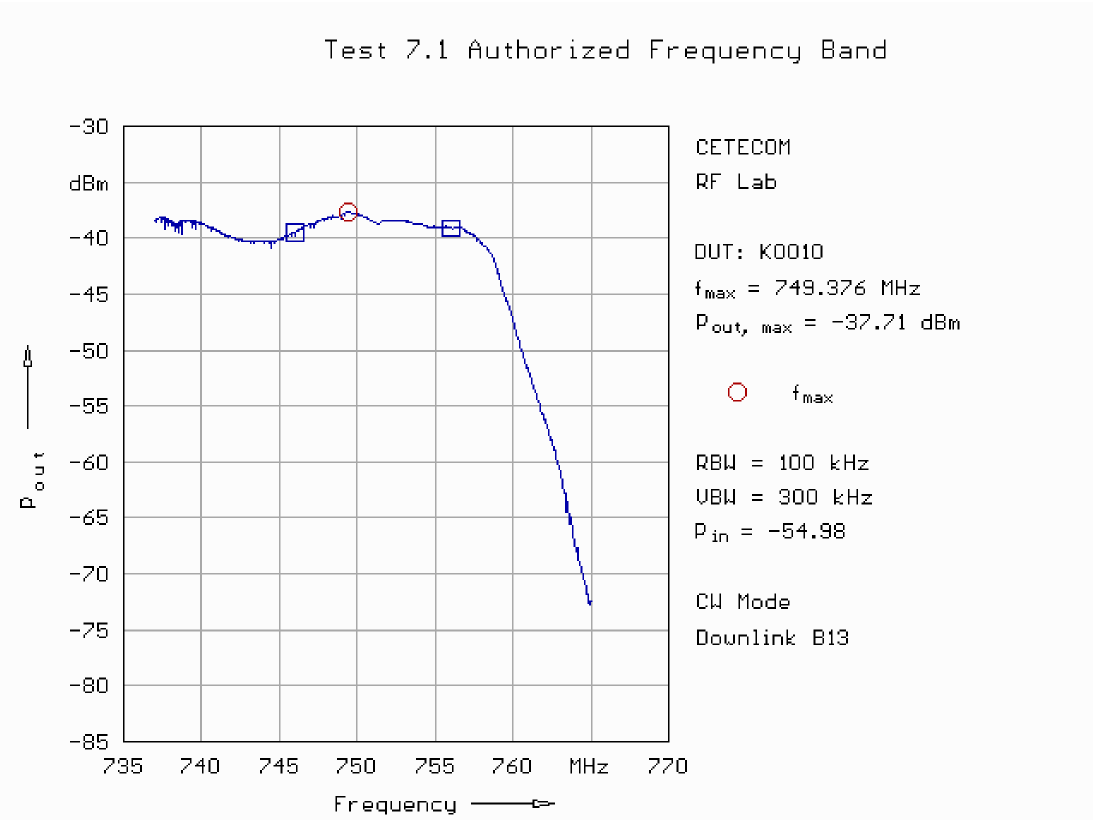

Fig. 12: Frequency response in downlink in band 13.

5.2. Maximum RF Power and Determination of AGC Start Level

The activated cable routing for this test in uplink is shown in Fig. 13 and for the downlink in Fig. 14, respectively. Below are summarized the measured results for the P_{in} and P_{out} found just bevor the AGC starts, plus the absolute overall maximum output power levels. For the dertimination of the maximum output power in downlink the maxiumum input power was set to -20 dBm as stated in chapter 5.5 “Maximum transmitter test input levels” in the KDB 935210 D03.

All measured conducted RF power levels for the uplink are found to be between +17 dBm and +30 dBm.

All measured conducted RF levels for the downlink are found to be well below +17 dBm.

Band	Direction	p_{in} in [dBm] at AGC start CW (center frequency)	p_{out} Max in [dBm] CW (center frequency)	p_{in} in [dBm] at AGC start GSM (at f_0)	p_{out} in [dBm] at AGC start GSM (at f_0)	p_{out} Max in [dBm] GSM (at f_0)	p_{in} in [dBm] at AGC start 4 MHz Signal (at f_0)	p_{out} in [dBm] at AGC start 4 MHz Signal (at f_0)	p_{out} Max in [dBm] 4 MHz Signal (at f_0)
2	up	-1.2	20.1	-2.1	19.6	20.2	-1.9	19.5	20.2
4	up	1.0	20.1	-1.3	19.5	20.0	-1.4	19.3	19.9
5	up	1.1	20.3	-0.4	19.6	20.2	-0.1	19.6	20.1
12	up	0.7	21.4	-0.1	20.7	21.3	0.5	20.6	21.2
13	up	2.1	21.6	1.0	20.8	21.6	1.5	20.7	21.3
2	down	-52.7	-23.6	-52.6	-34.3	-23.7	-51.9	-33.5	-23.6
4	down	-54.1	-24.0	-54.1	-35.4	-24.4	-53.6	-34.8	-24.2
5	down	-51.8	-22.2	-52.7	-34.8	-22.6	-51.9	-34.3	-22.1
12	down	-52.6	-21.8	-53.6	-35.8	-22.2	-51.5	-34.8	-22.1
13	down	-52.0	-21.9	-51.9	-35.4	-22.3	-51.3	-35.1	-22.3

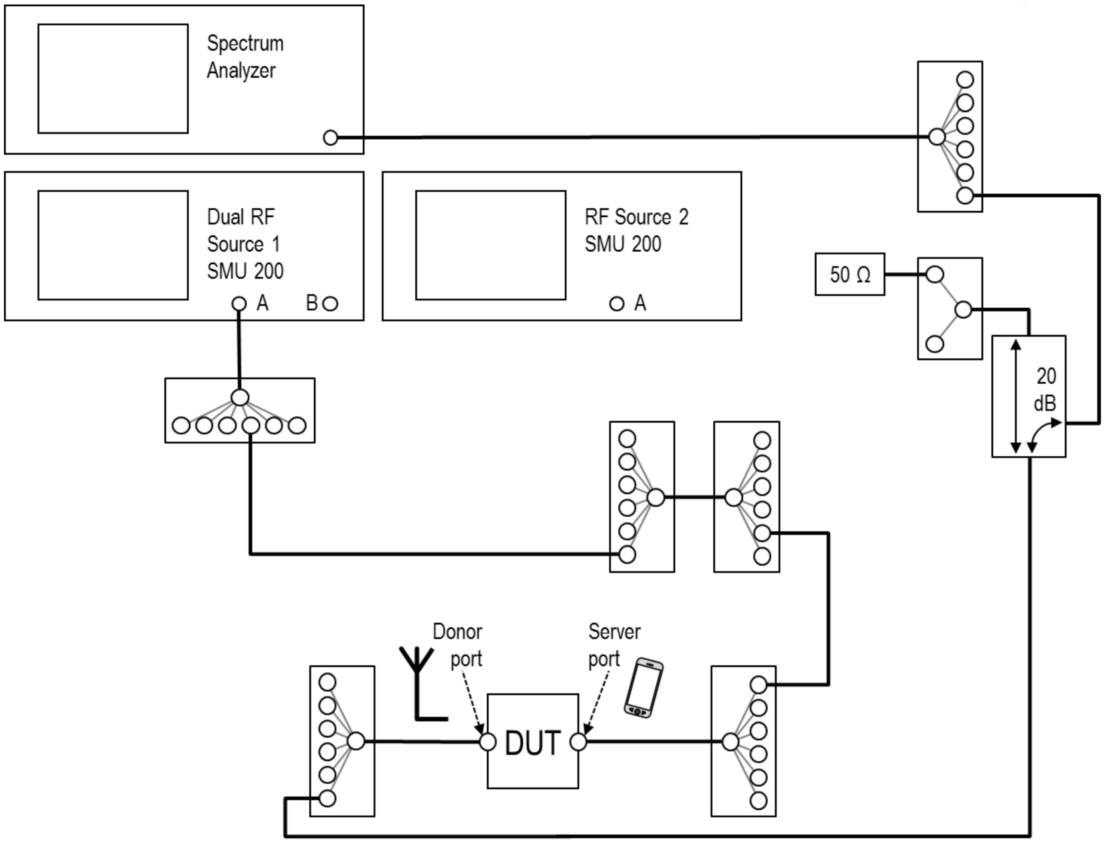

Fig. 13: Set up for maximum RF power test in uplink.

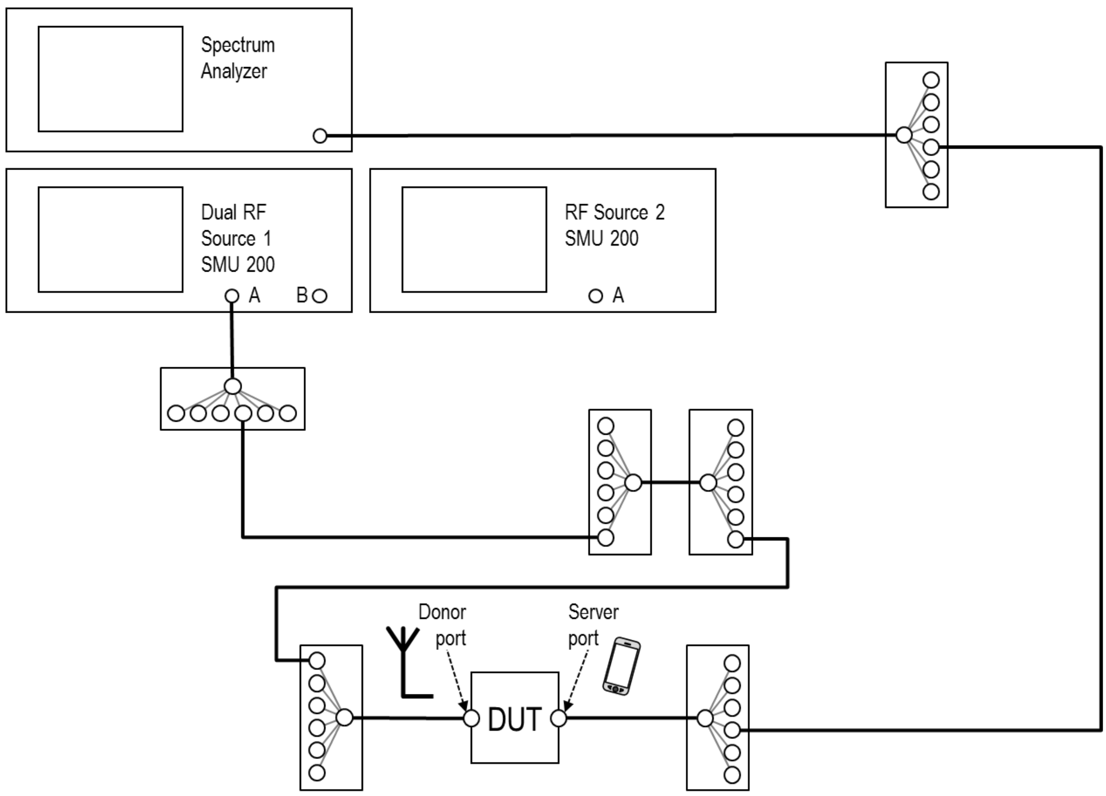

Fig. 14: Set up for maximum RF power test in downlink.

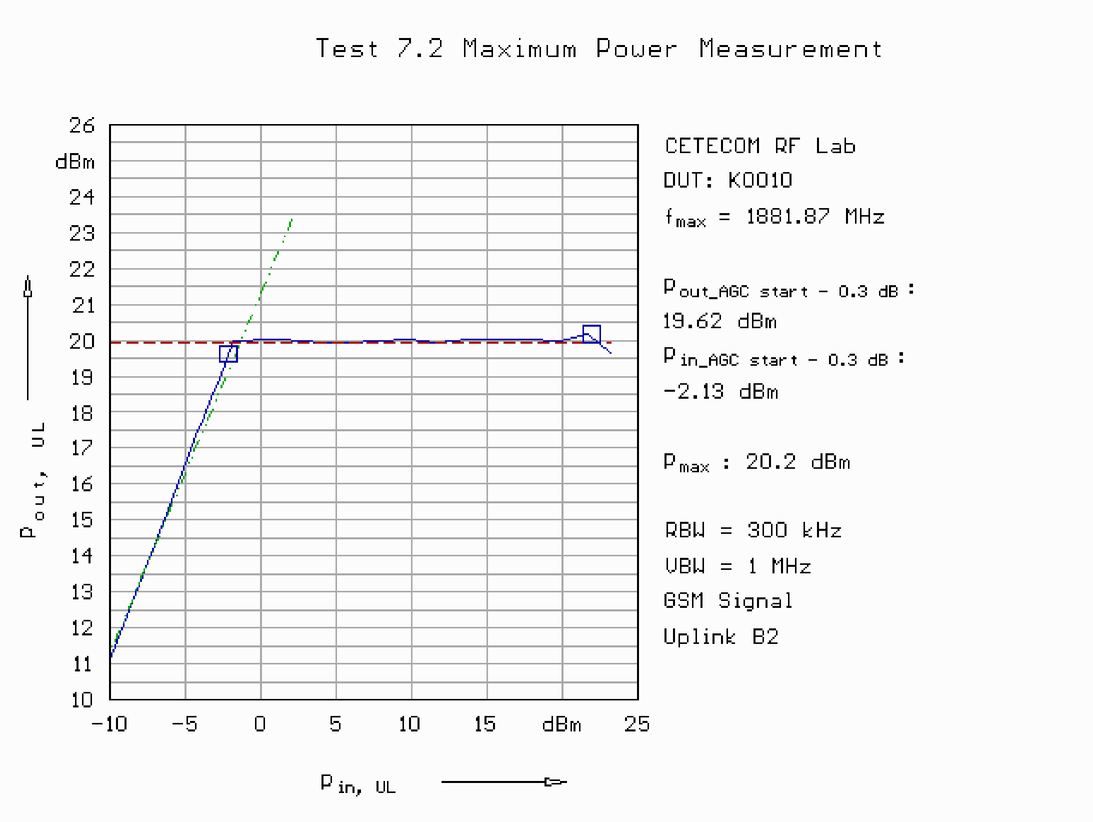

Fig. 15: Power measurement in uplink in band 2 applying a GSM signal.

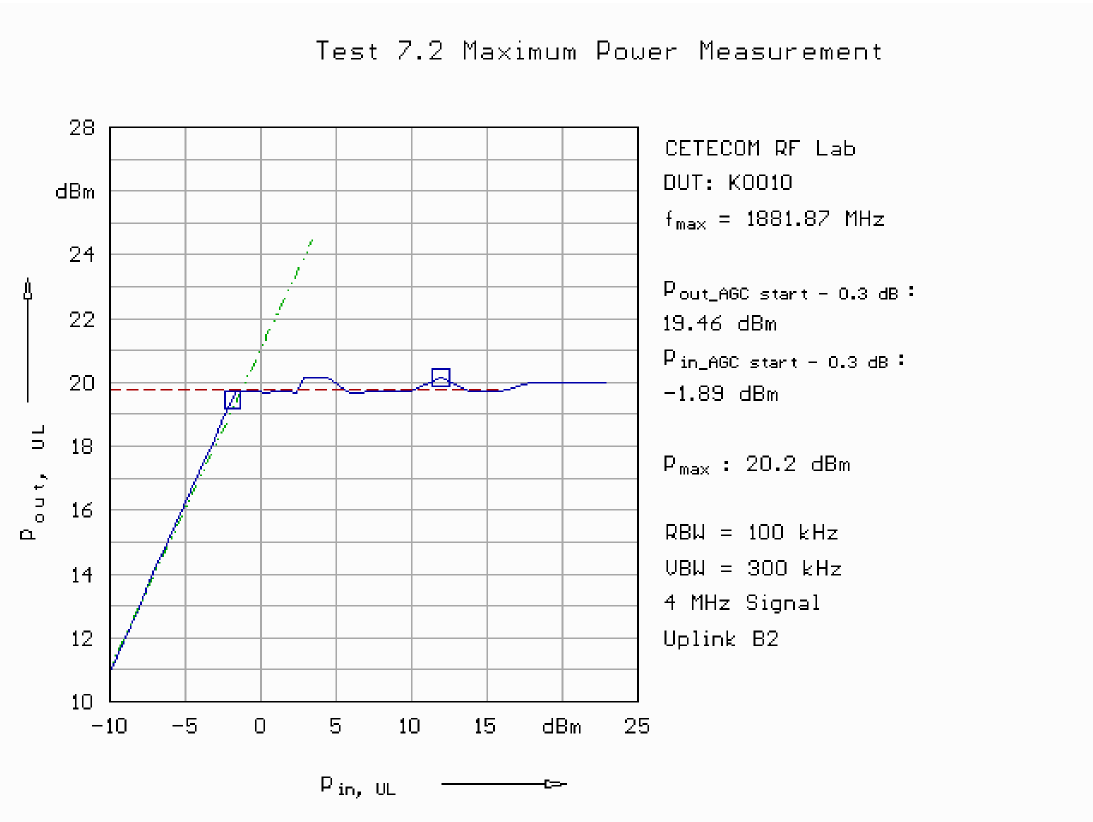

Fig. 16: Power measurement in uplink in band 2 applying a 4 MHz signal.

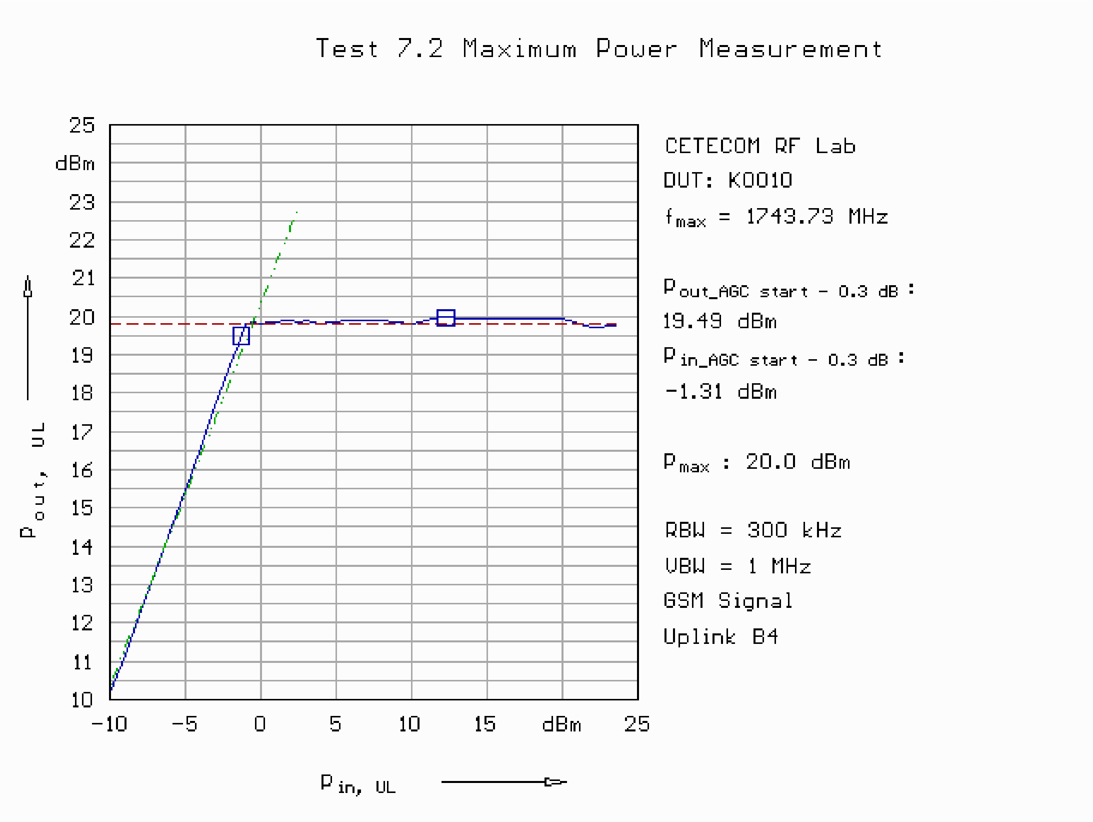

Fig. 17: Power measurement in uplink in band 4 applying a GSM signal.

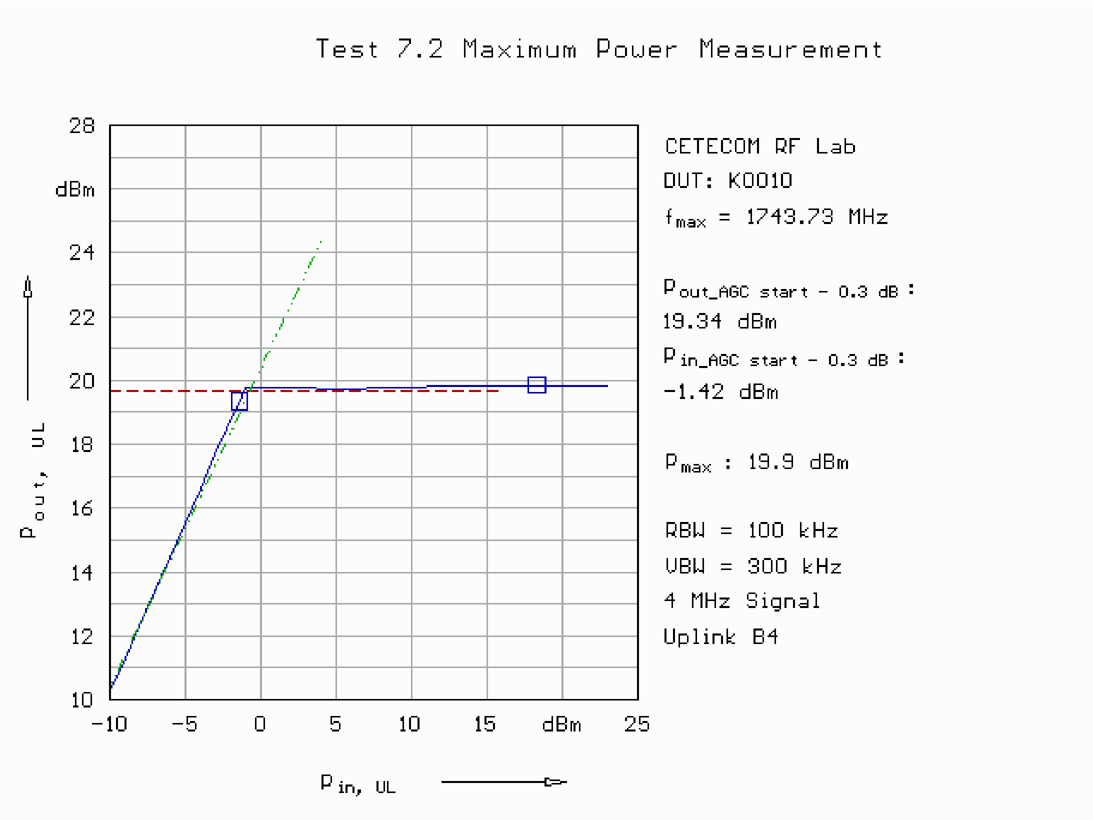

Fig. 18: Power measurement in uplink in band 4 applying a 4 MHz signal.

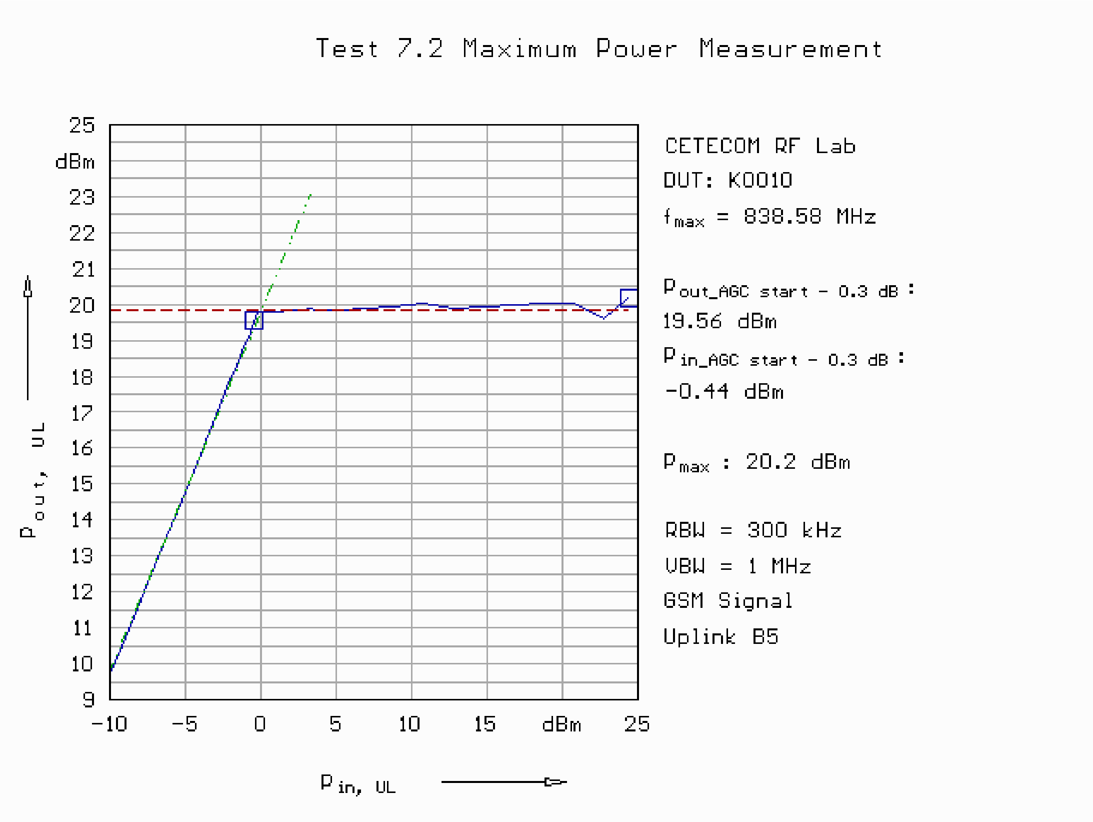

Fig. 19: Power measurement in uplink in band 5 applying a GSM signal.

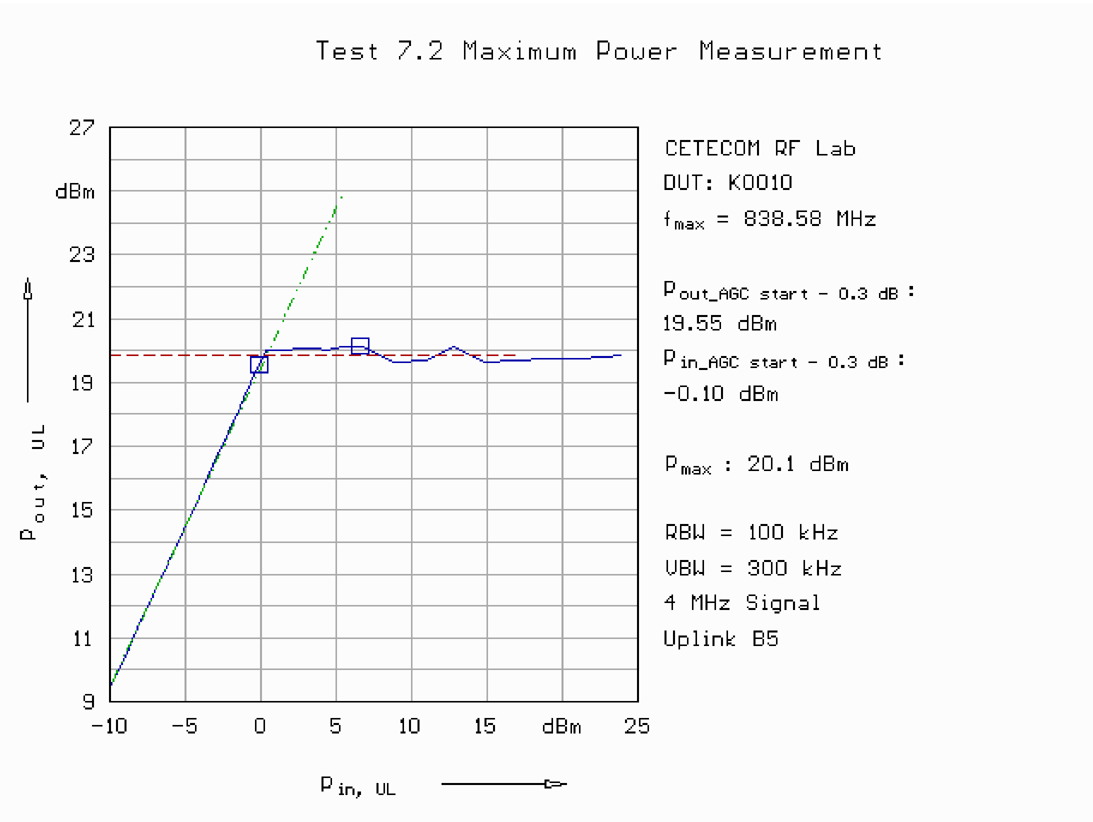

Fig. 20: Power measurement in uplink in band 5 applying a 4 MHz signal.

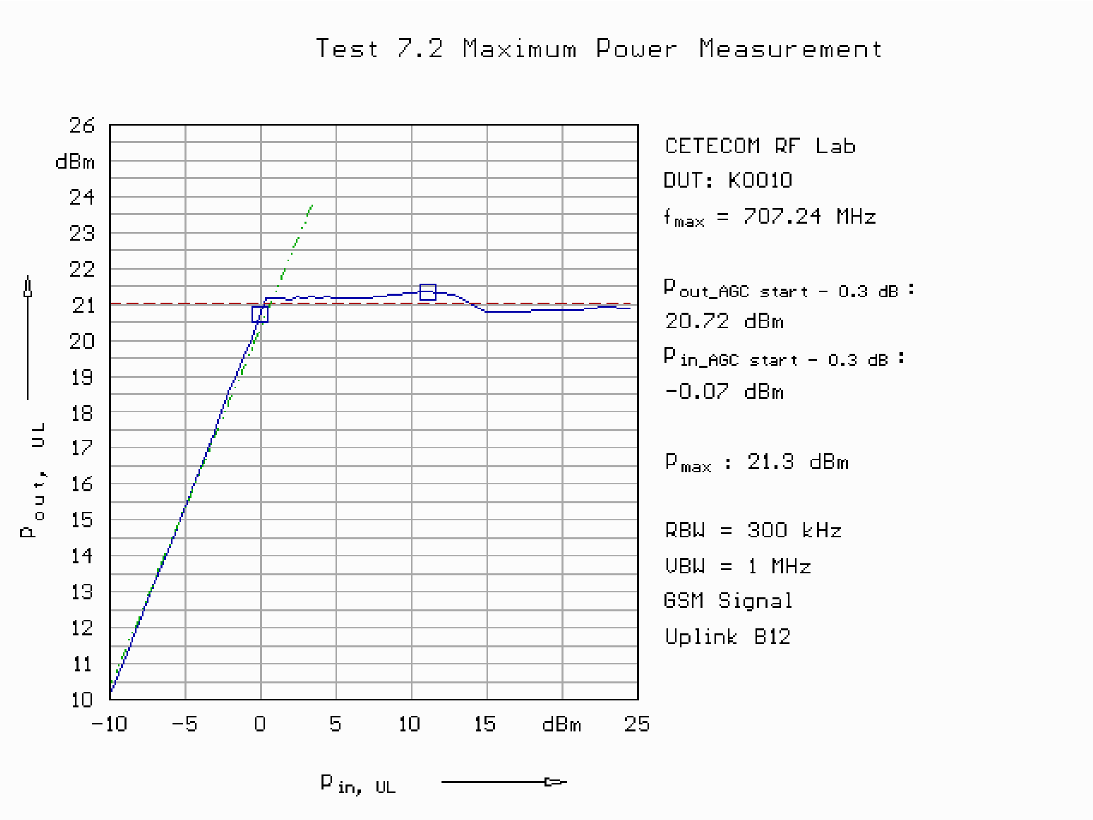

Fig. 21: Power measurement in uplink in band 12 applying a GSM signal.

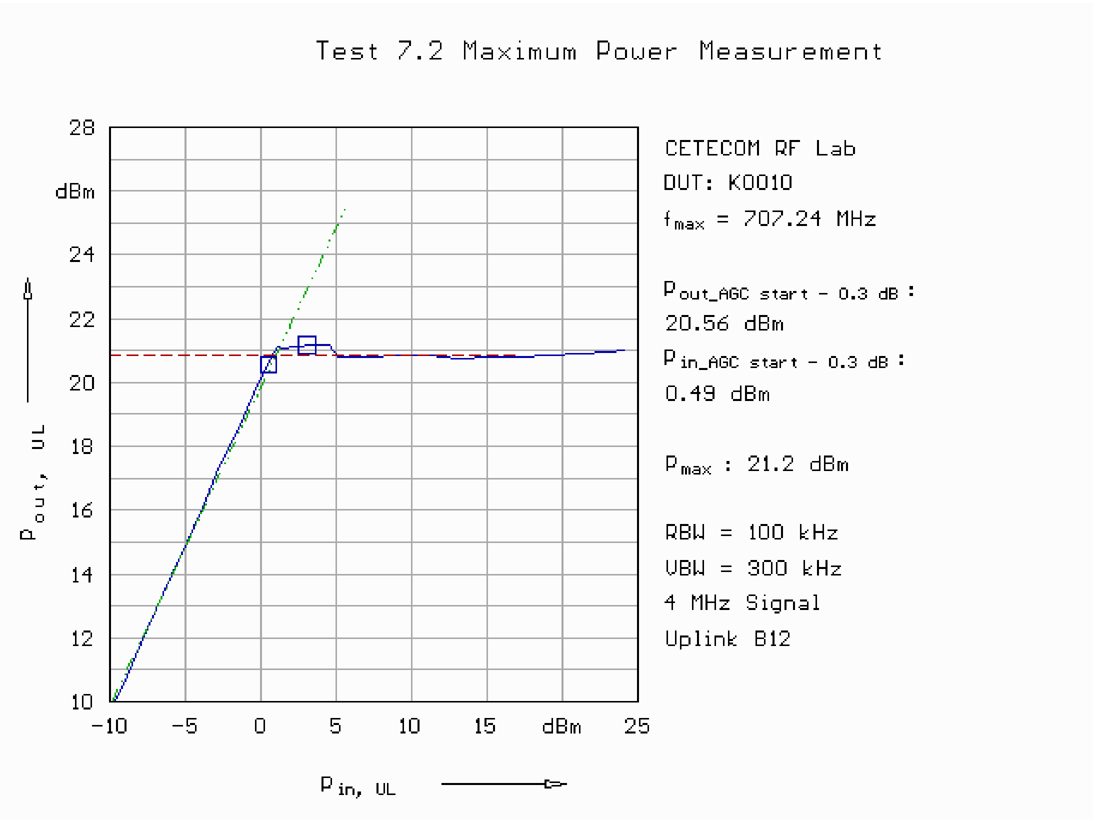

Fig. 22: Power measurement in uplink in band 12 applying a 4 MHz signal.

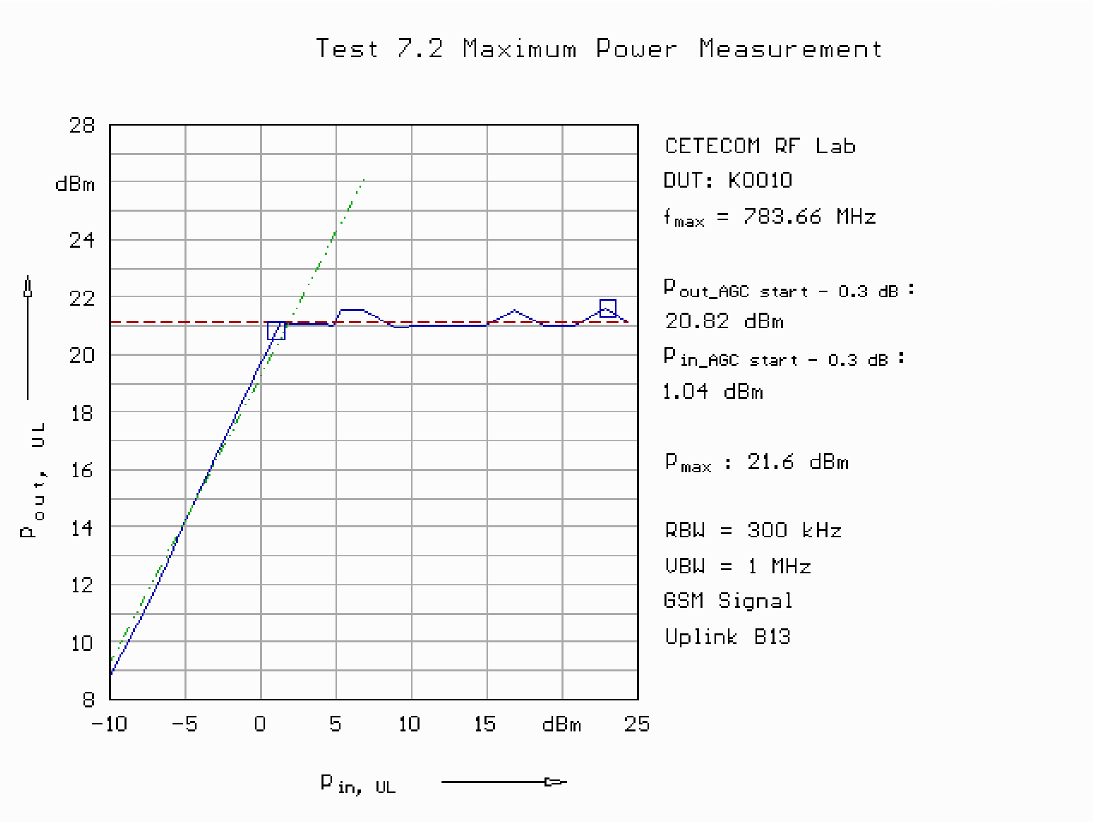

Fig. 23: Power measurement in uplink in band 13 applying a GSM signal.

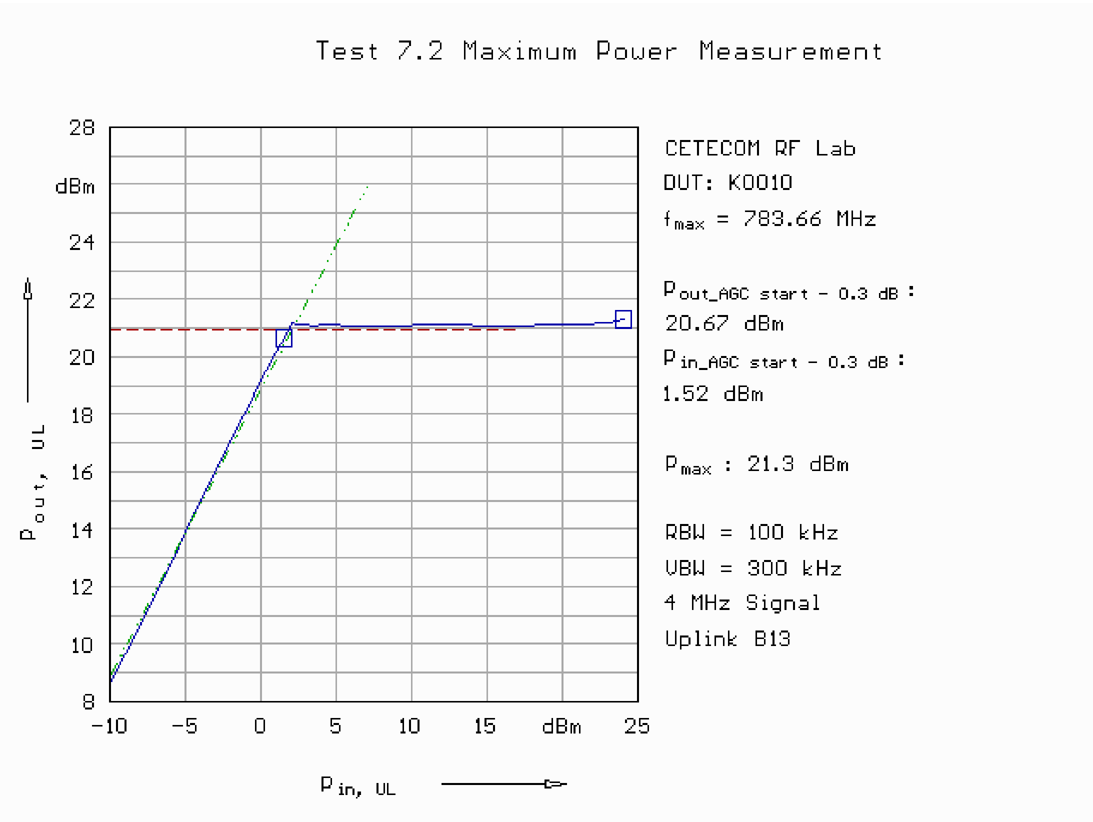

Fig. 24: Power measurement in uplink in band 13 applying a 4 MHz signal.

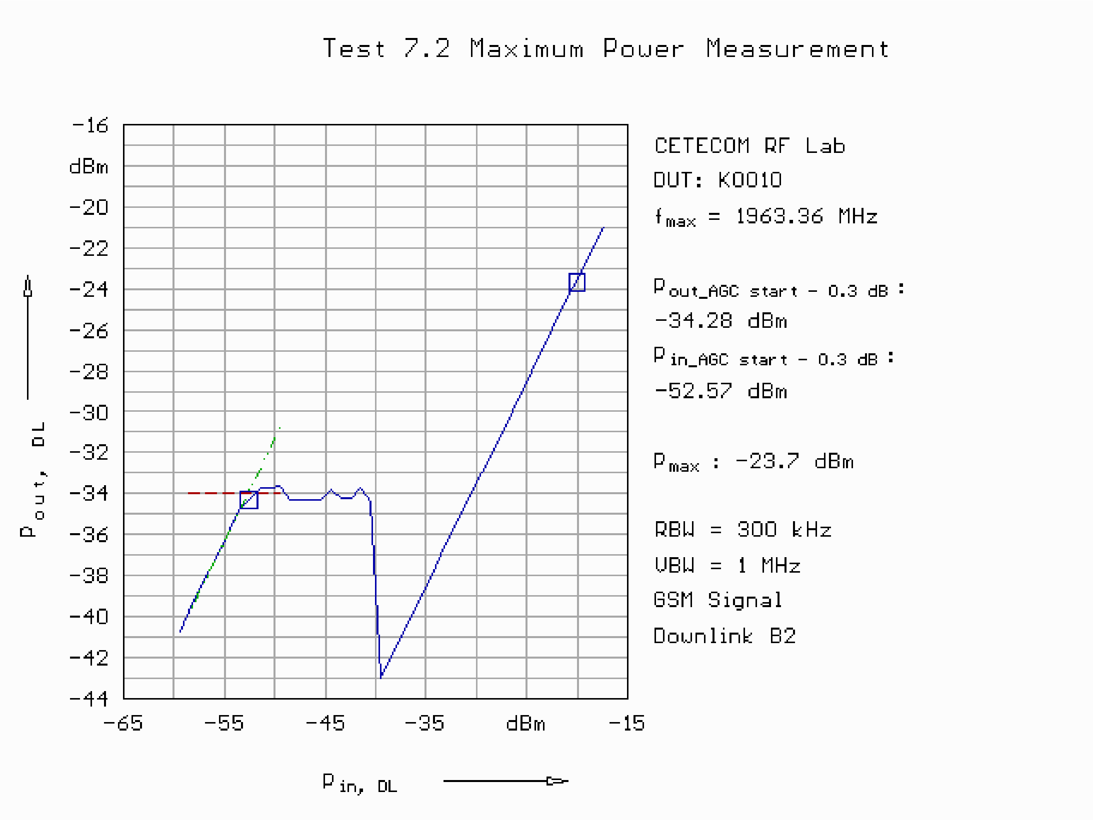

Fig. 25: Power measurement in downlink in band 2 applying a GSM signal.

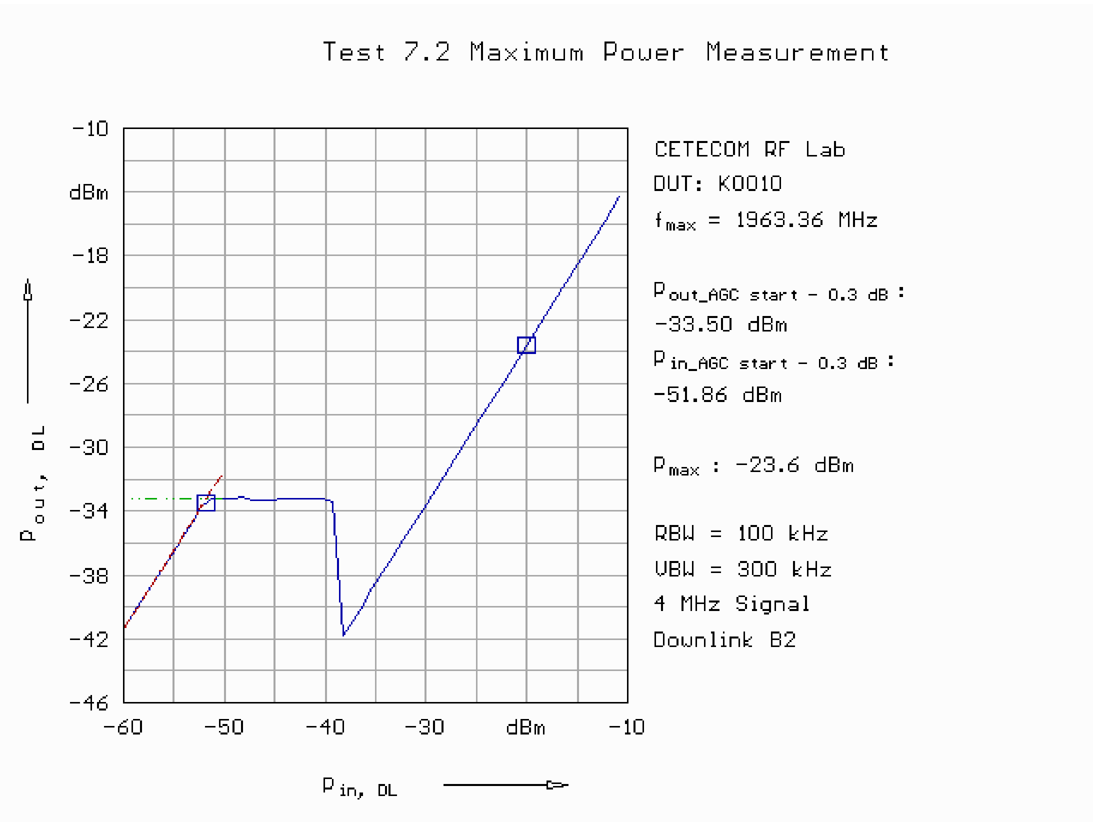

Fig. 26: Power measurement in downlink in band 2 applying a 4 MHz signal.

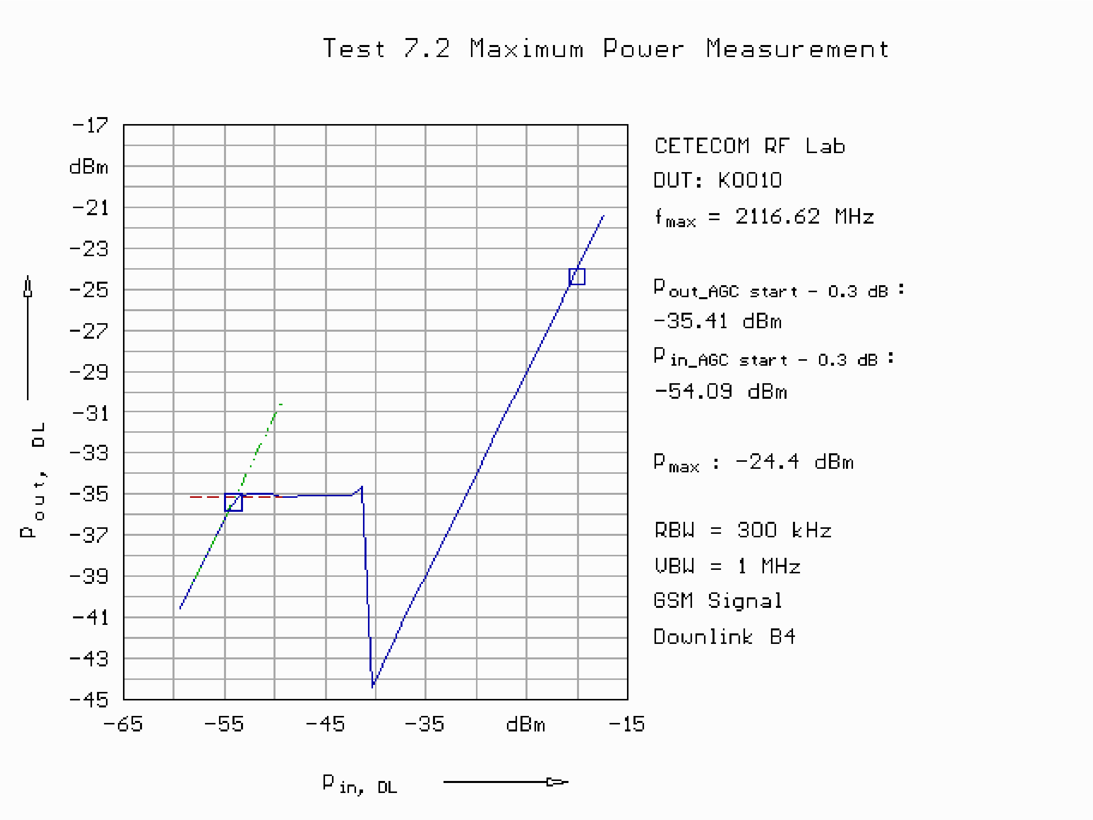

Fig. 27: Power measurement in downlink in band 4 applying a GSM signal.

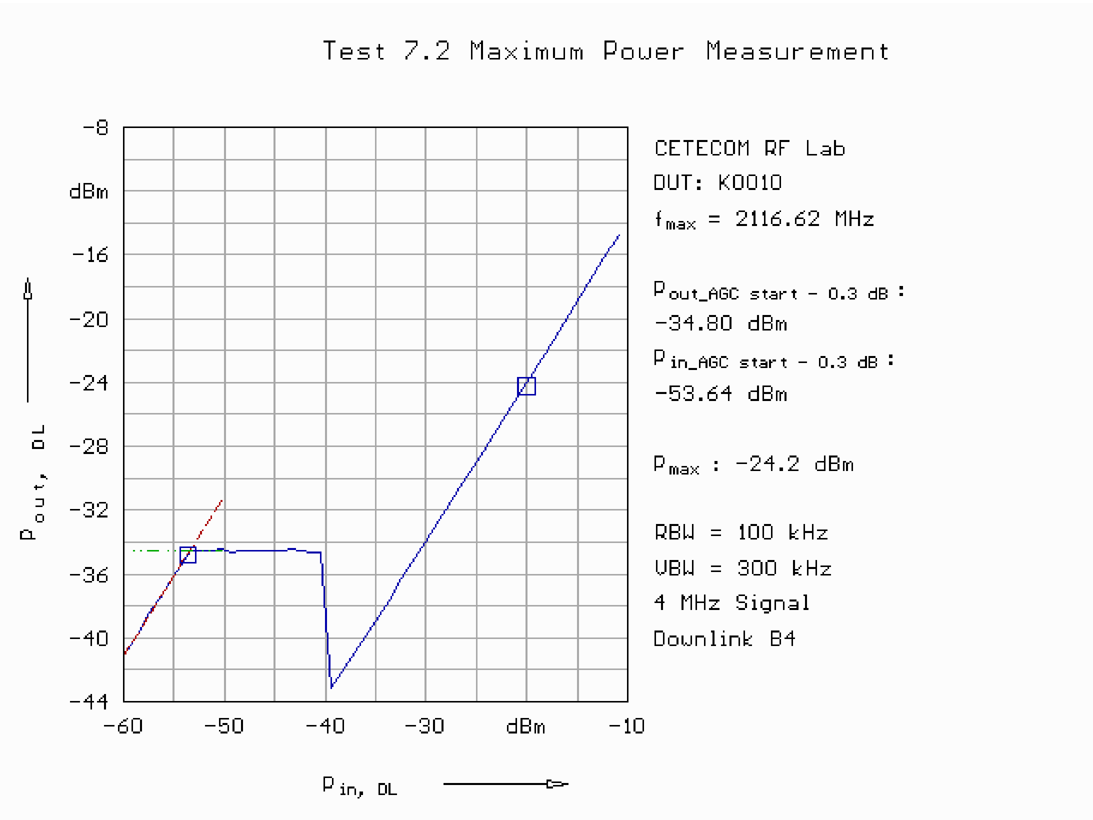

Fig. 28: Power measurement in downlink in band 4 applying a 4 MHz signal.

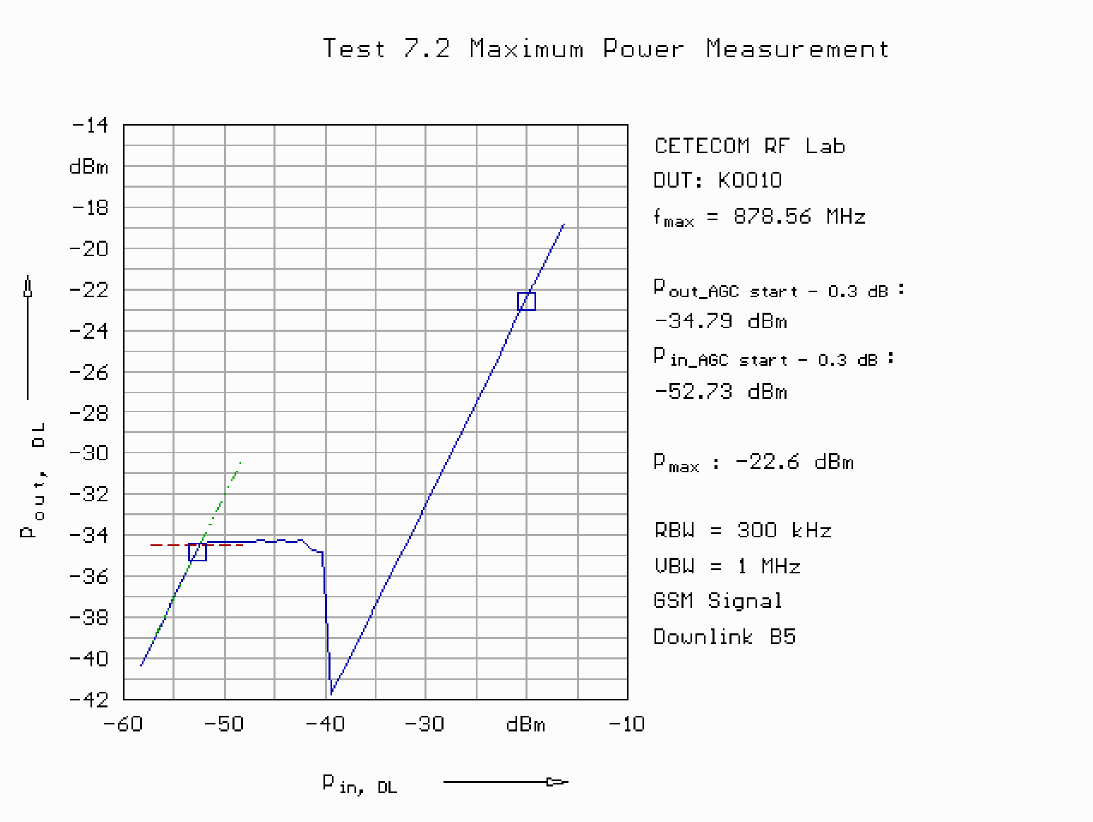

Fig. 29: Power measurement in downlink in band 5 applying a GSM signal.

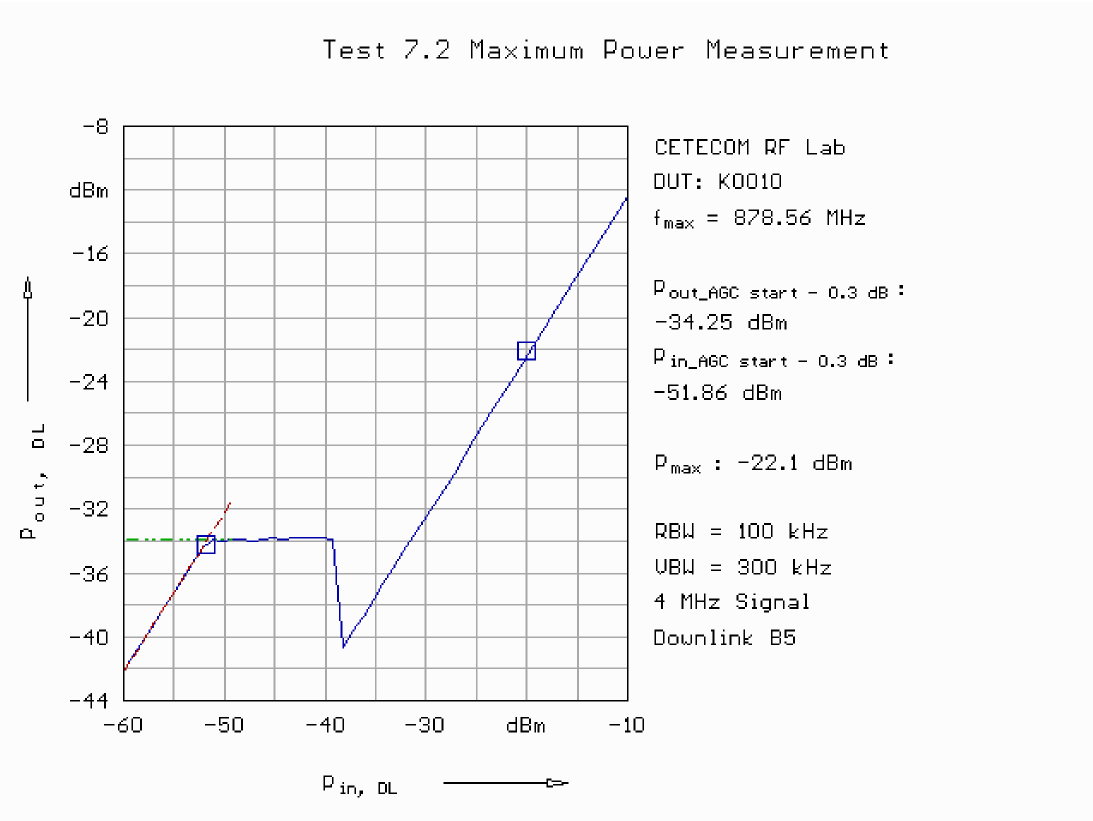

Fig. 30: Power measurement in downlink in band 5 applying a 4 MHz signal.

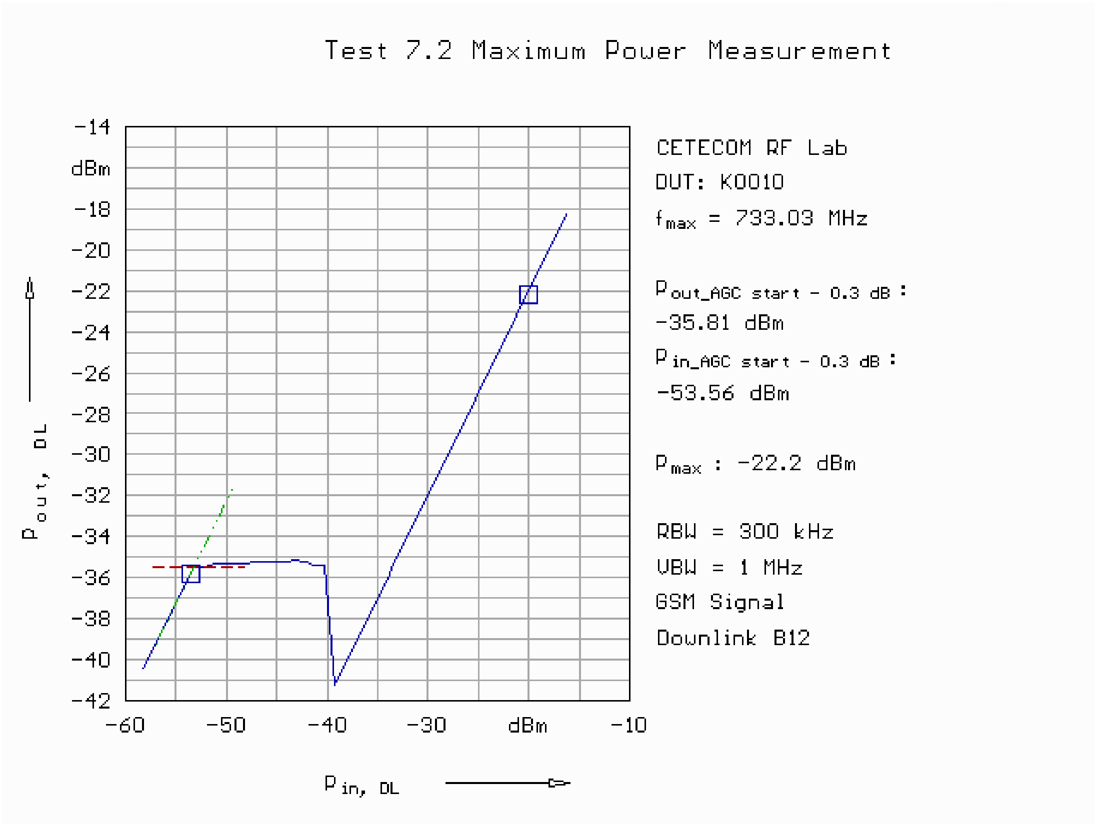

Fig. 31: Power measurement in downlink in band 12 applying a GSM signal.

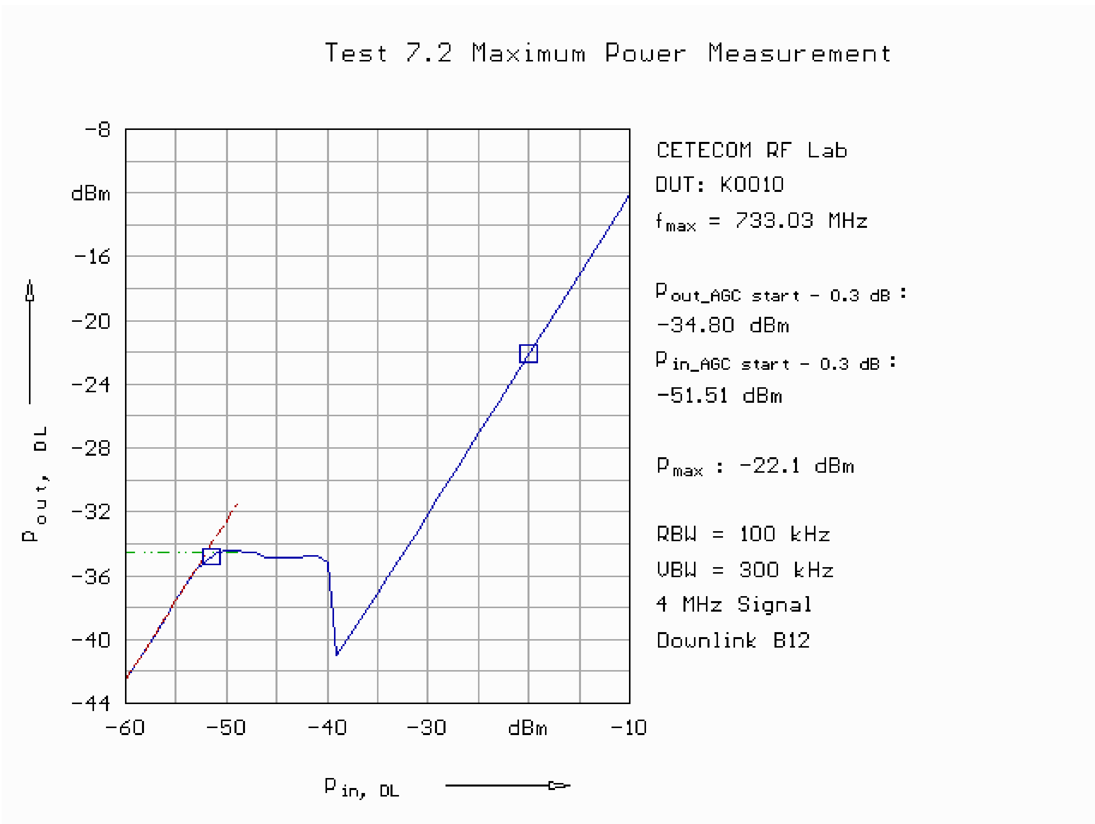

Fig. 32: Power measurement in downlink in band 12 applying a 4 MHz signal.

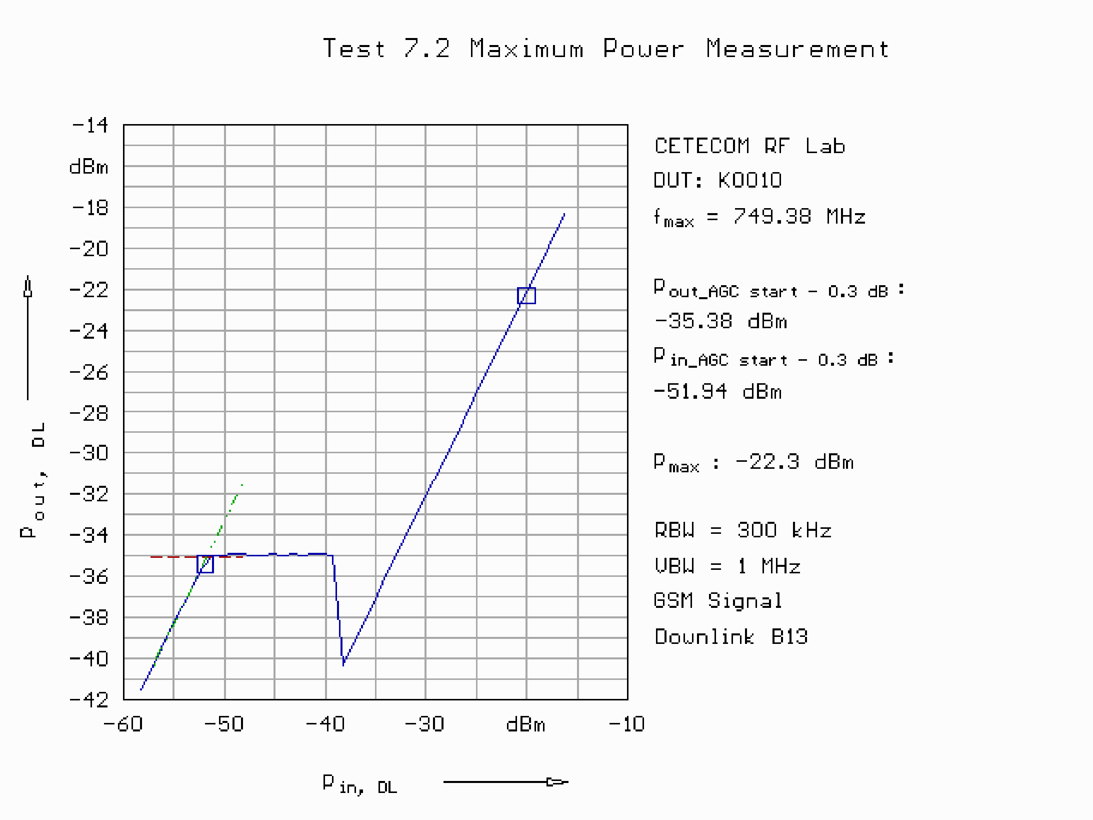

Fig. 33: Power measurement in downlink in band 13 applying a GSM signal.

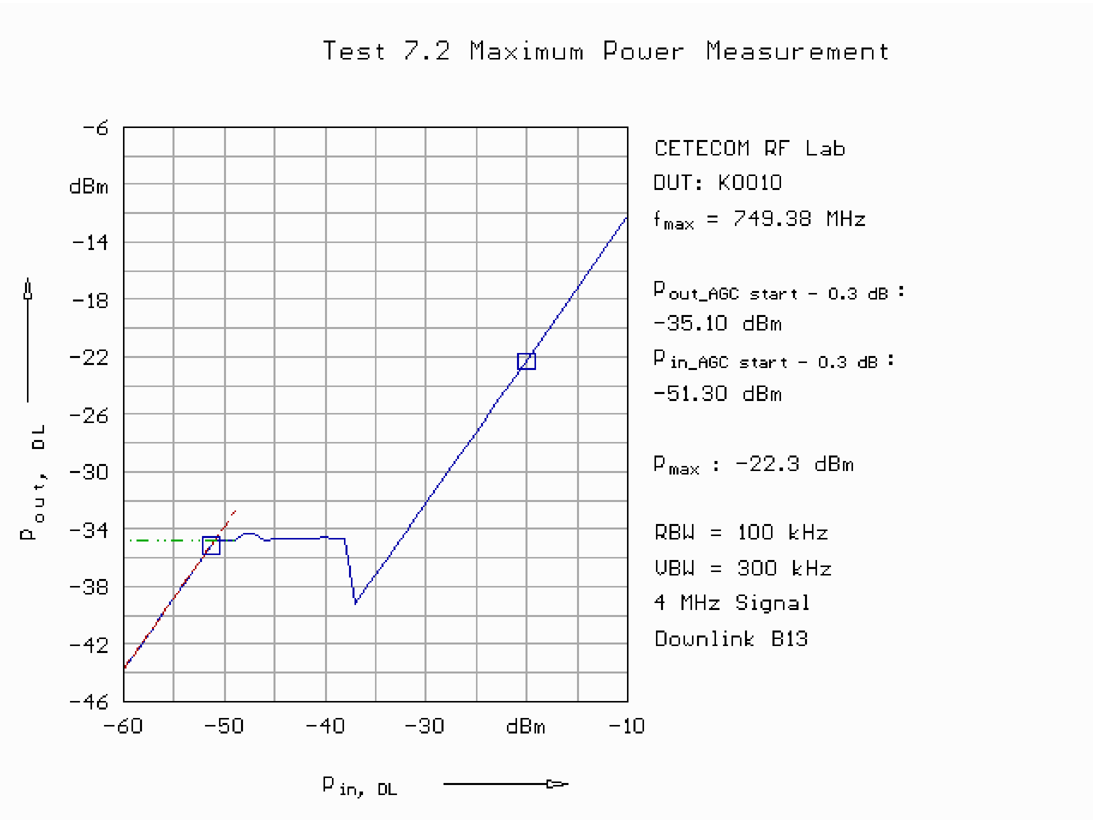

Fig. 34: Power measurement in downlink in band 13 applying a 4 MHz signal.

5.3. Gain

Measured data as shown in chapter 5.2 has been used to calculate maximum up- and downlink gain values. The results are summarized below.

Band	Gain uplink GSM mode in [dB]	Gain uplink 4 MHz Signal mode in [dB]	Gain downlink GSM mode in [dB]	Gain downlink 4 MHz Signal mode in [dB]
2	21.8	21.4	18.7	18.7
4	20.8	20.8	18.8	19.0
5	20.0	19.7	18.0	17.9
12	20.8	20.1	17.8	17.5
13	19.8	19.2	16.8	16.3

All gain data do meet the limit of 23 dB (for cradle type of booster) and the maximum difference between up- and downlink is actually 3.1 dB and hence well below the 9 dB limit.

5.4. Intermodulation

The activated cable routing for this test in uplink is shown in Fig. 35 and for the downlink in Fig. 36, respectively. As illustrated on the next pages the EUT meets the limit of -19 dBm in all required conditions for intermodulation. (Just before the EUT begins AGC and 10 dB above the AGC threshold).

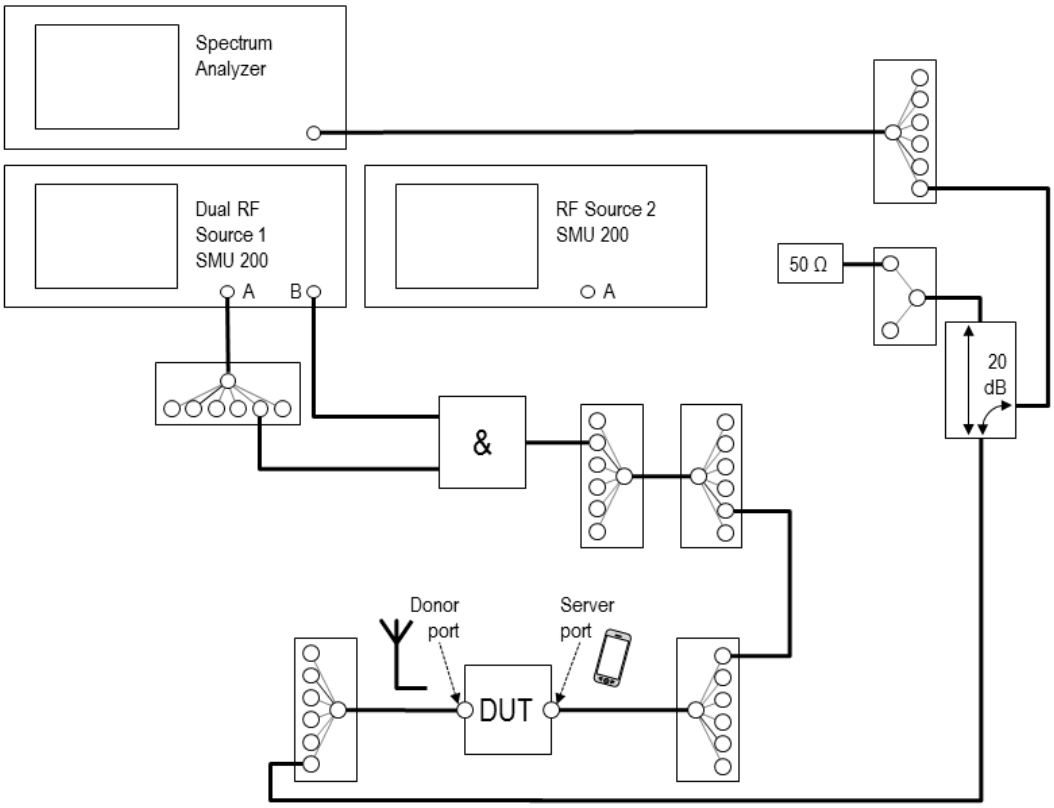

Fig. 35: Set up for intermodulation test in uplink.

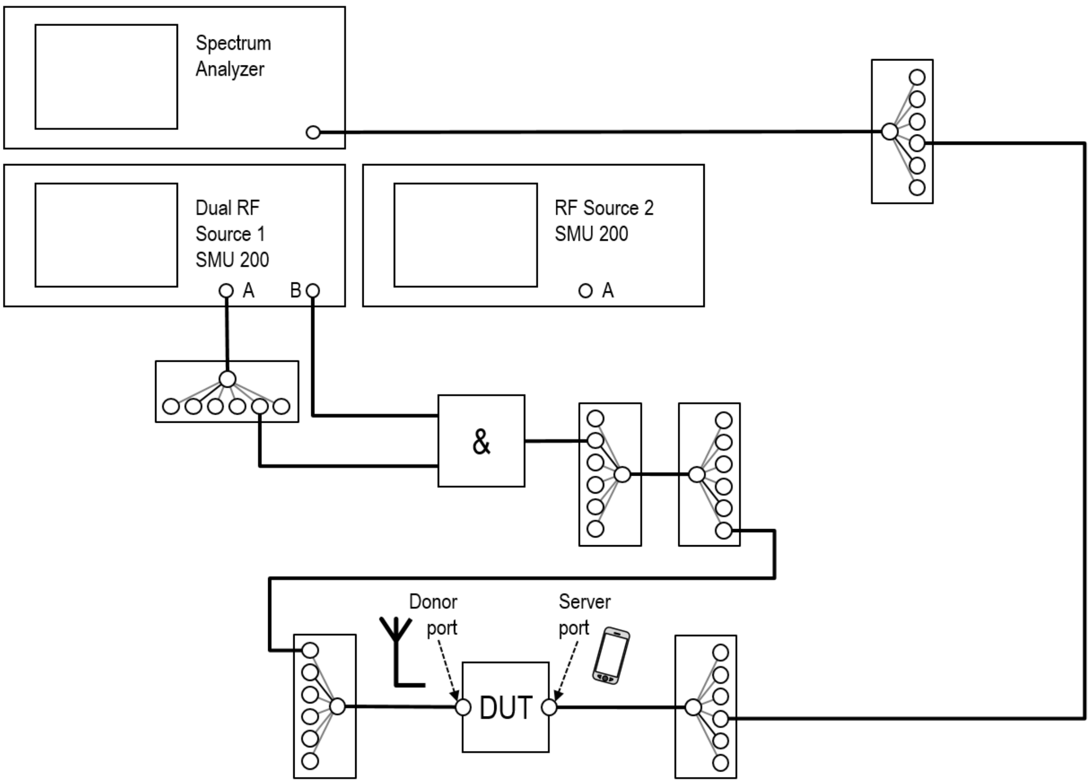

Fig. 36: Set up for intermodulation test in downlink.

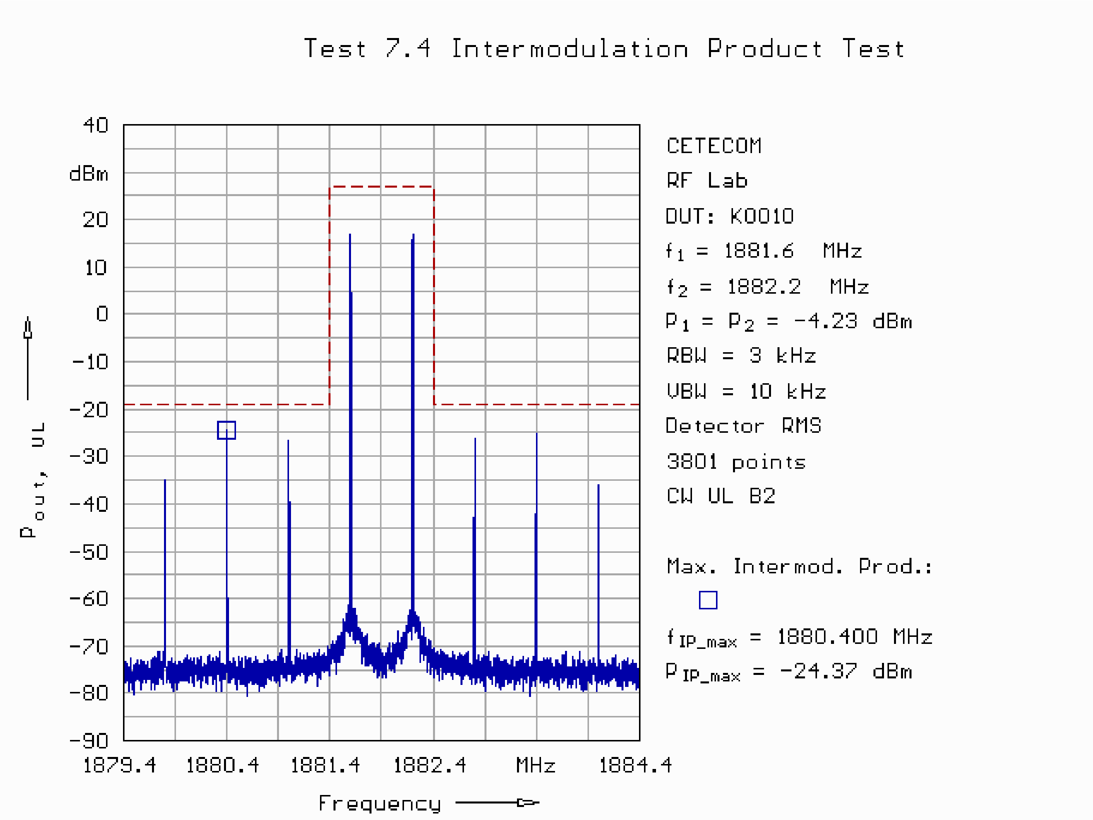

Fig. 37: Intermodulation test in uplink in band 2 at AGC.

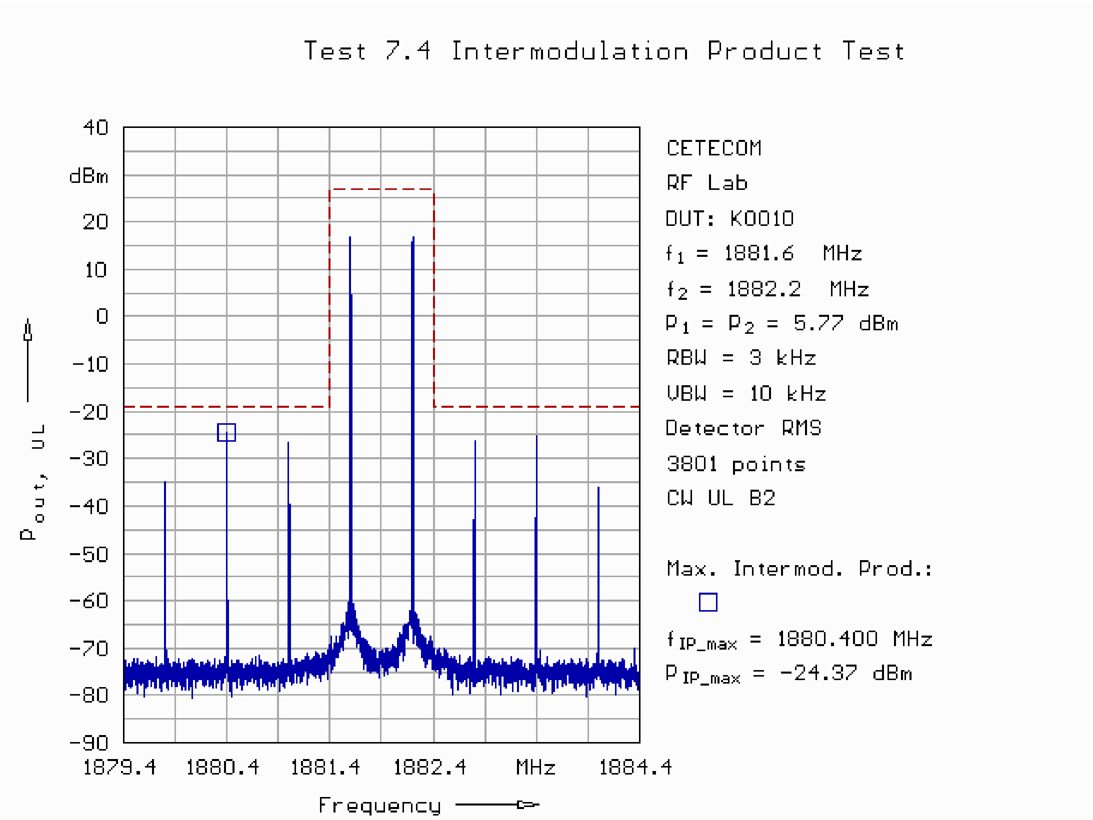

Fig. 38: Intermodulation test in uplink in band 2 at AGC plus 10 dB.

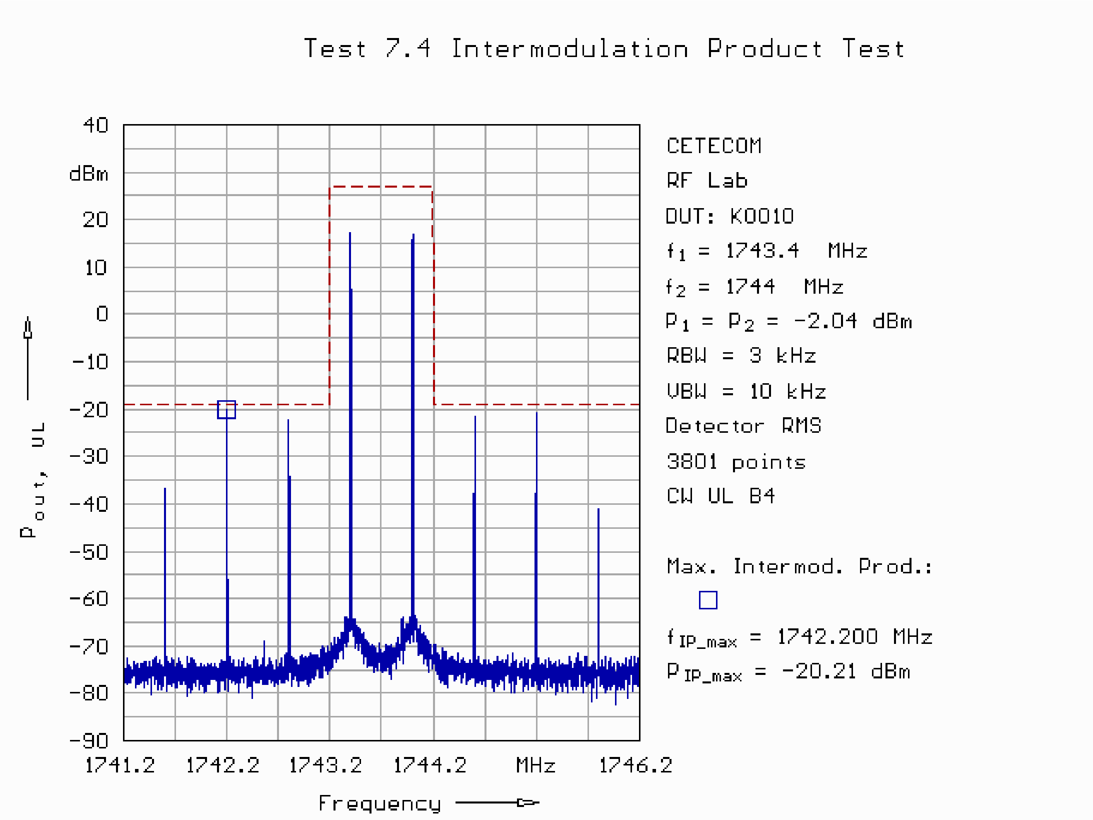

Fig. 39: Intermodulation test in uplink in band 4 at AGC.

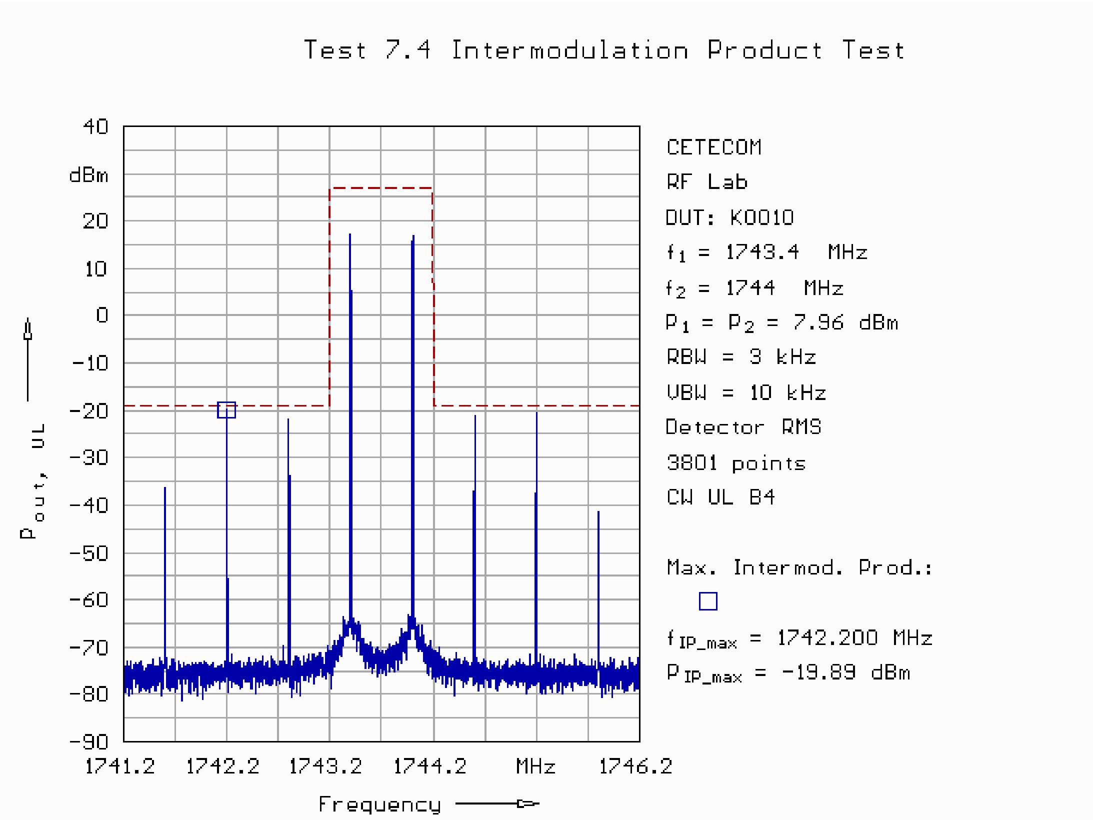

Fig. 40: Intermodulation test in uplink in band 4 at AGC plus 10 dB.

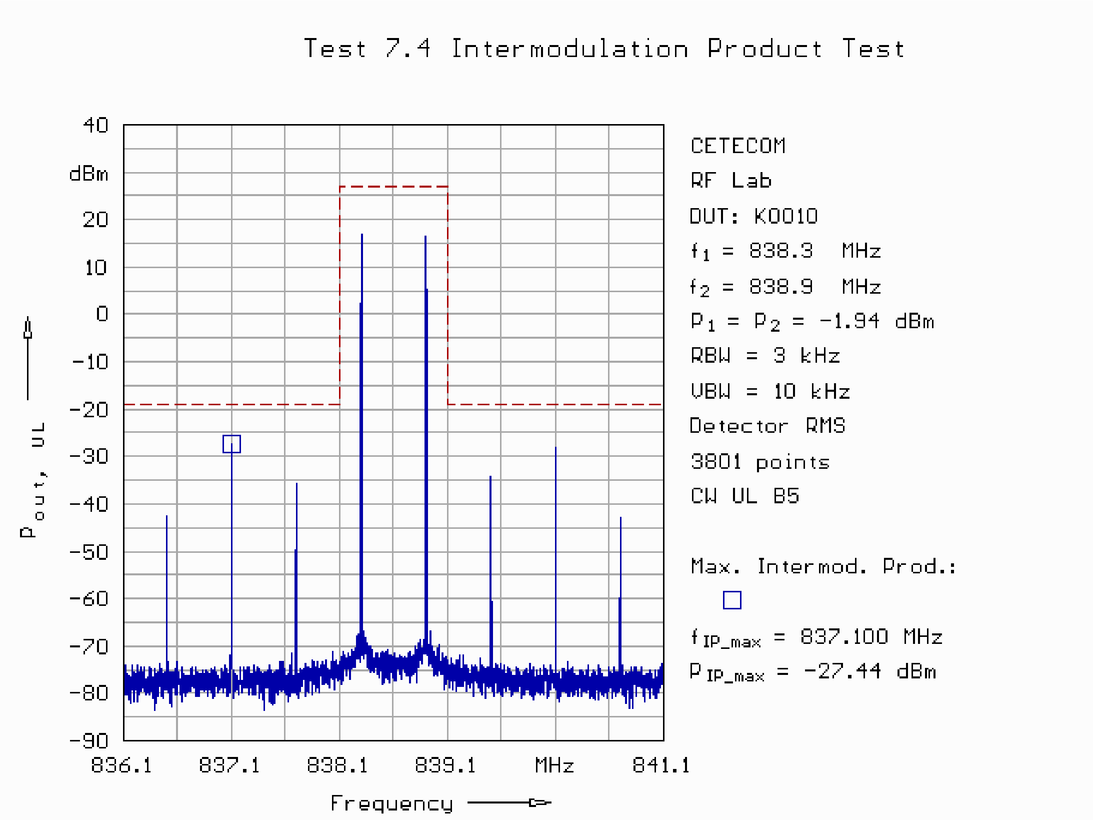

Fig. 41: Intermodulation test in uplink in band 5 at AGC.

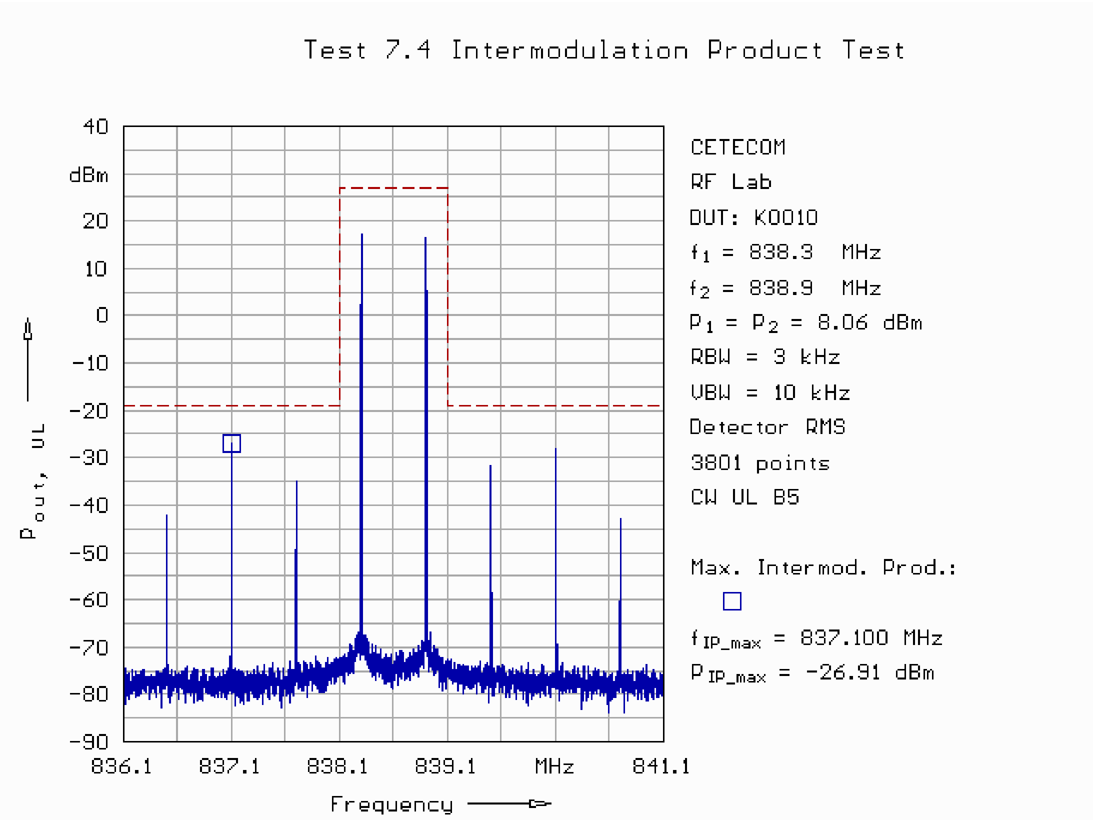

Fig. 42: Intermodulation test in uplink in band 5 at AGC plus 10 dB.

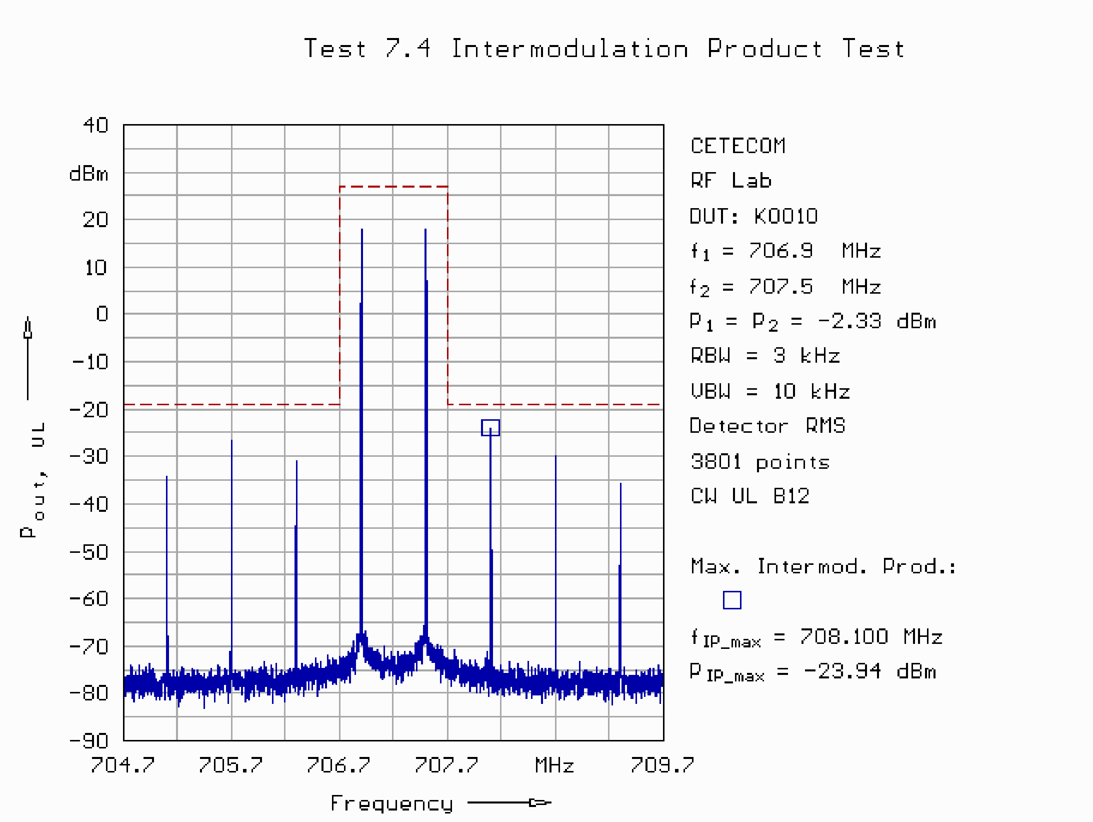

Fig. 43: Intermodulation test in uplink in band 12 at AGC.

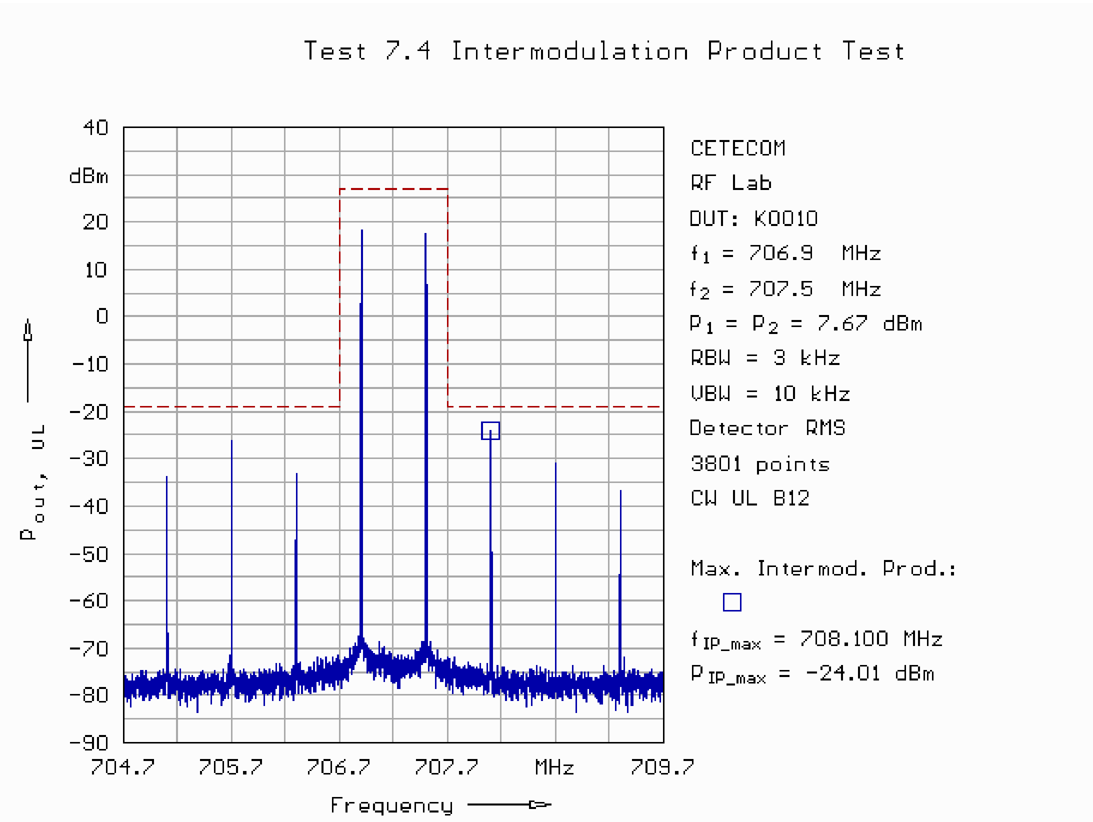

Fig. 44: Intermodulation test in uplink in band 12 at AGC plus 10 dB.

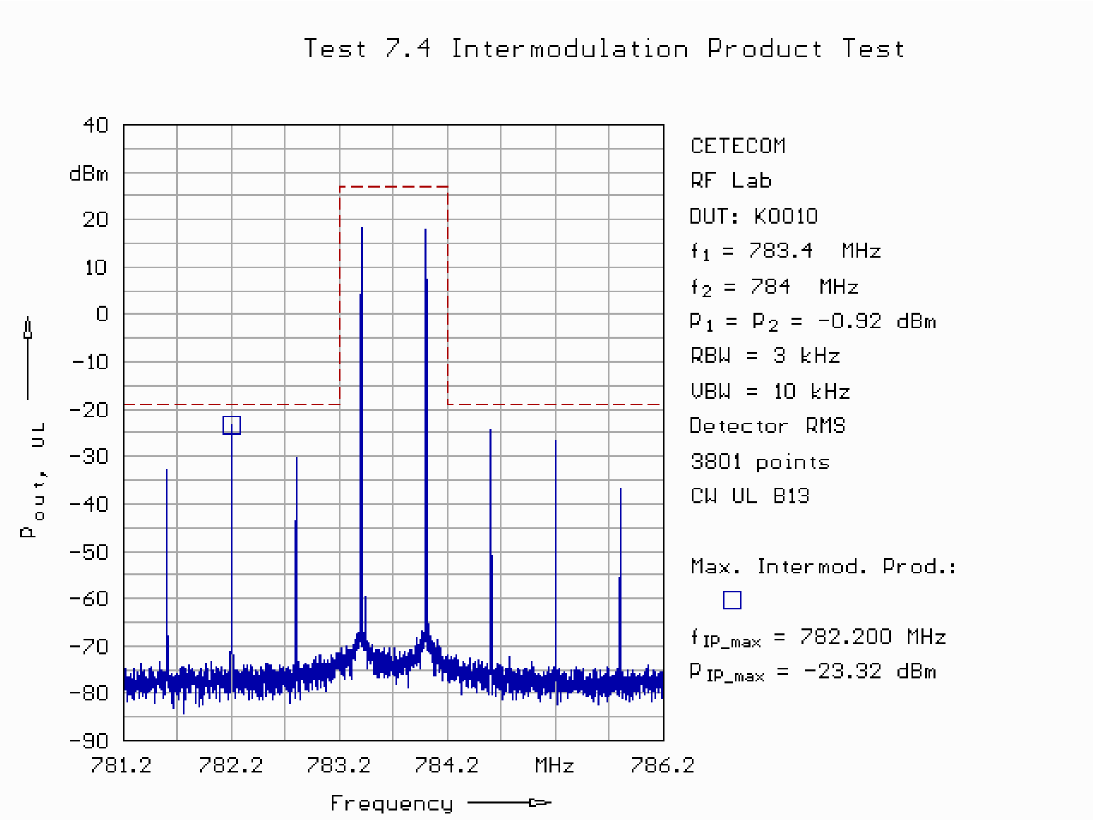

Fig. 45: Intermodulation test in uplink in band 13 at AGC.

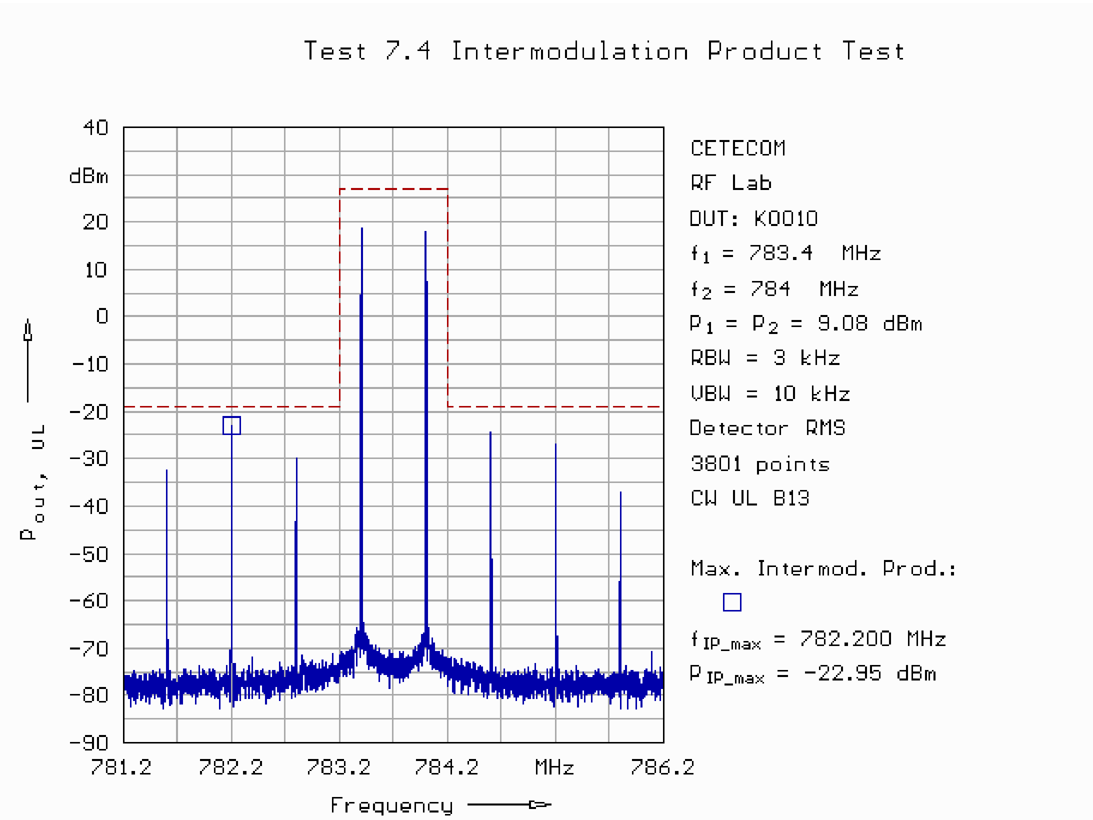

Fig. 46: Intermodulation test in uplink in band 13 at AGC plus 10 dB.

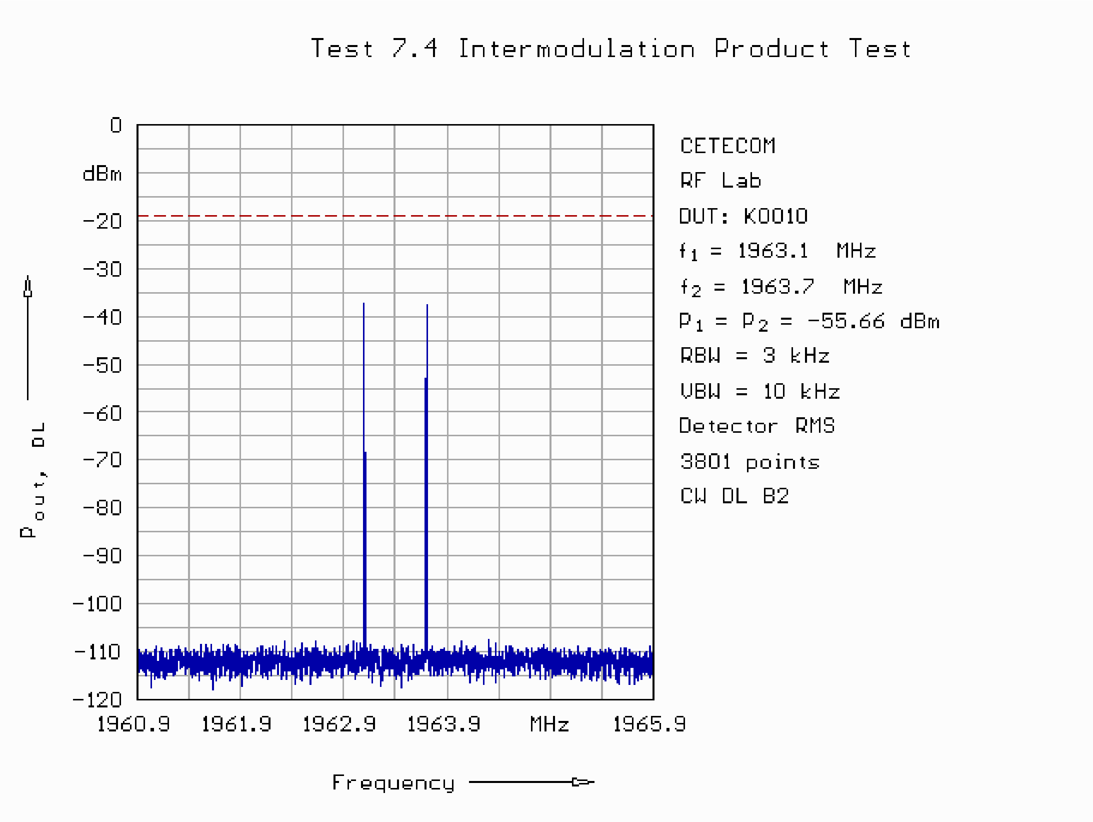

Fig. 47: Intermodulation test in downlink in band 2 at AGC.

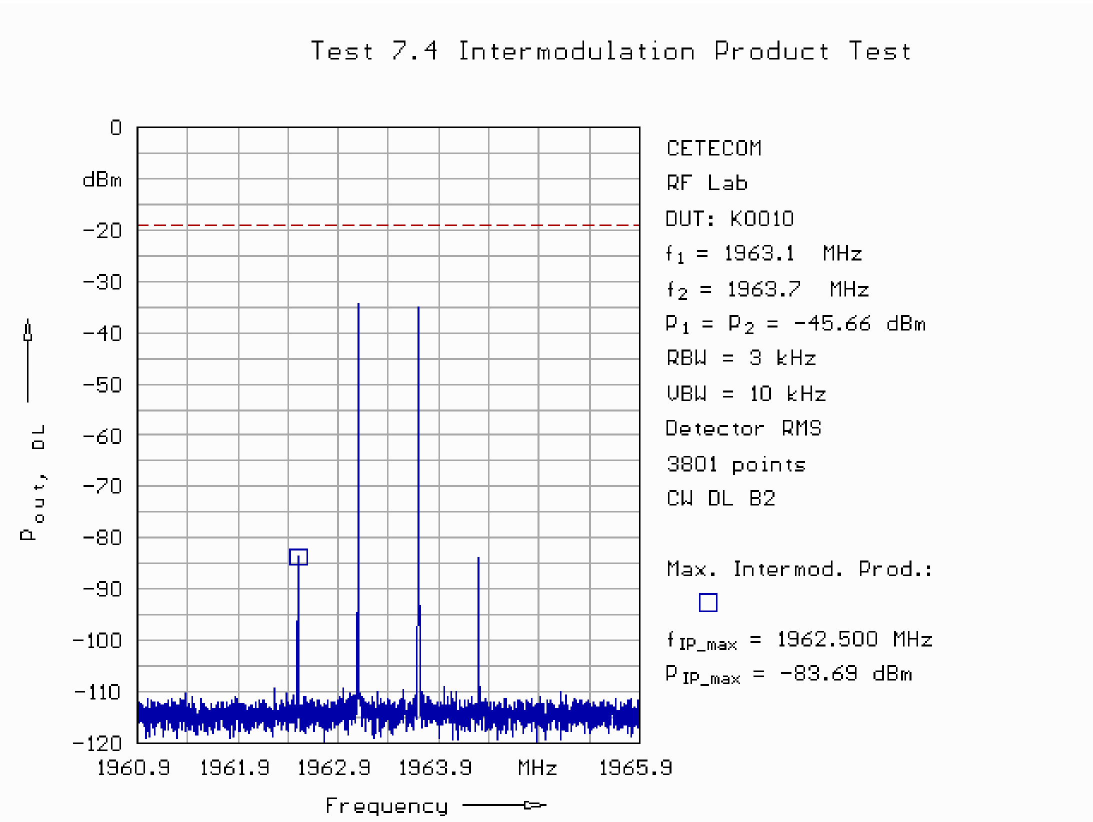

Fig. 48: Intermodulation test in downlink in band 2 at AGC plus 10 dB.

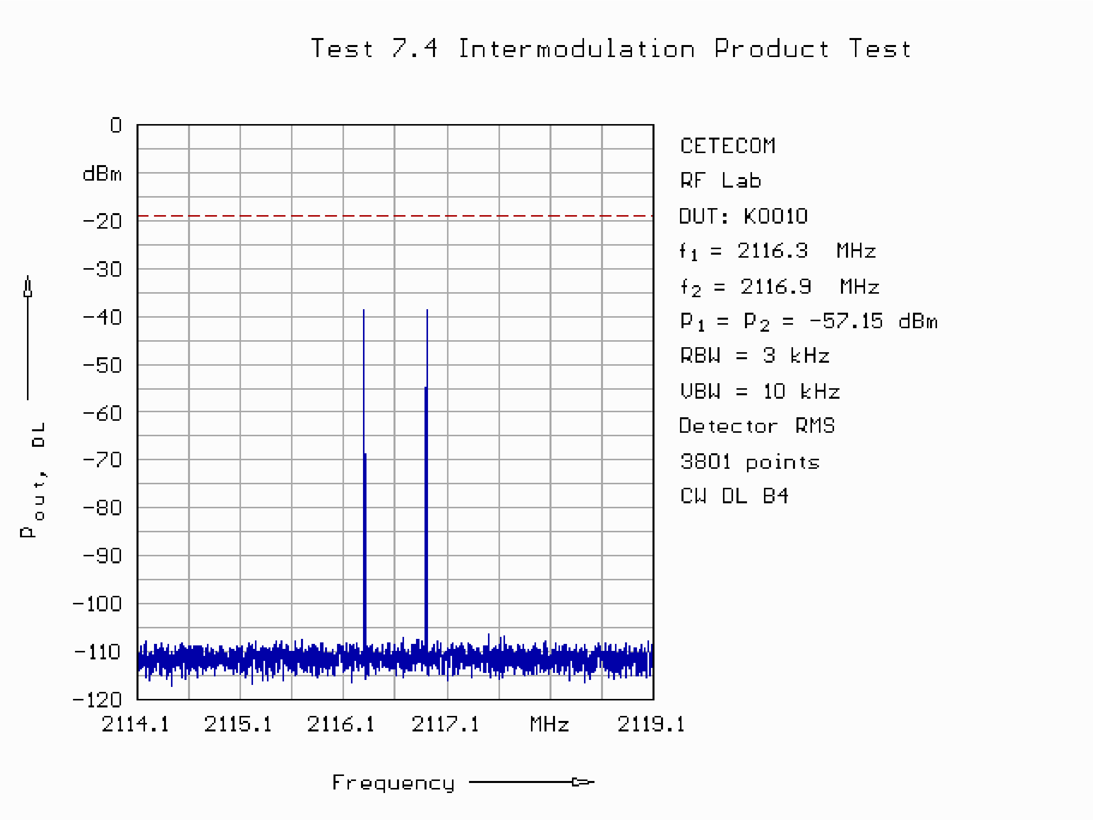

Fig. 49: Intermodulation test in downlink in band 4 at AGC.

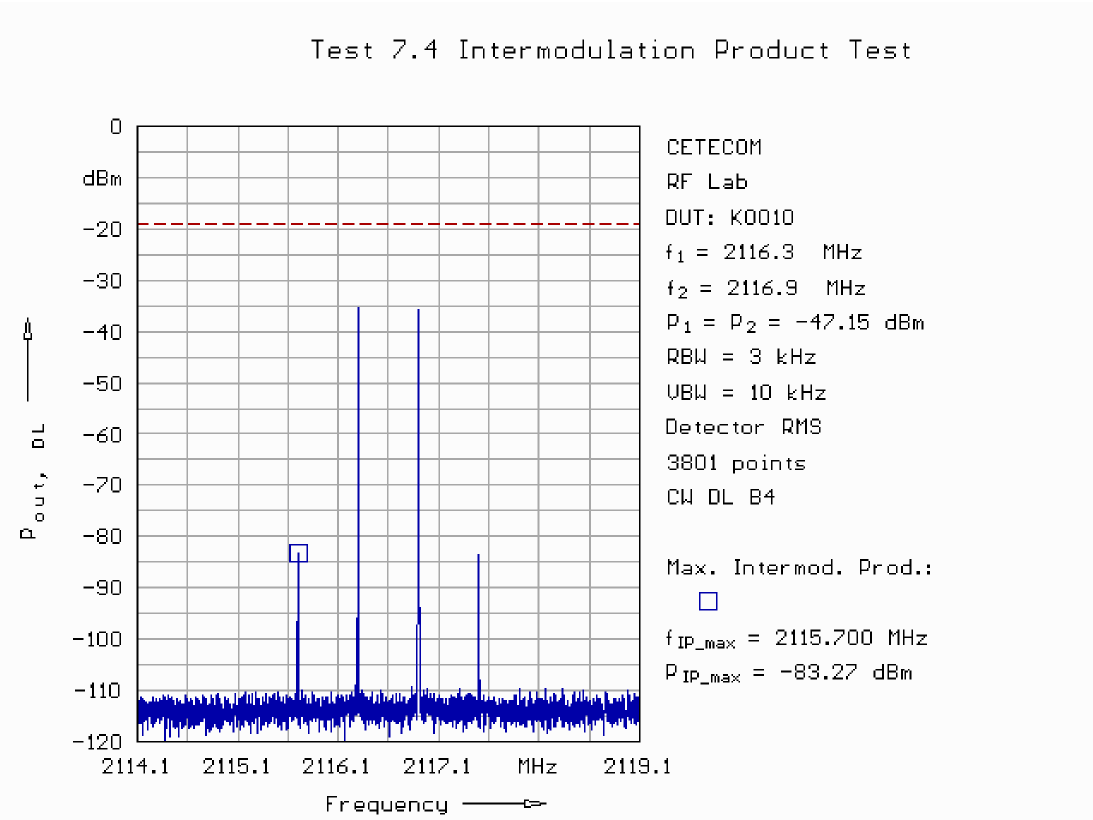

Fig. 50: Intermodulation test in downlink in band 4 at AGC plus 10 dB.

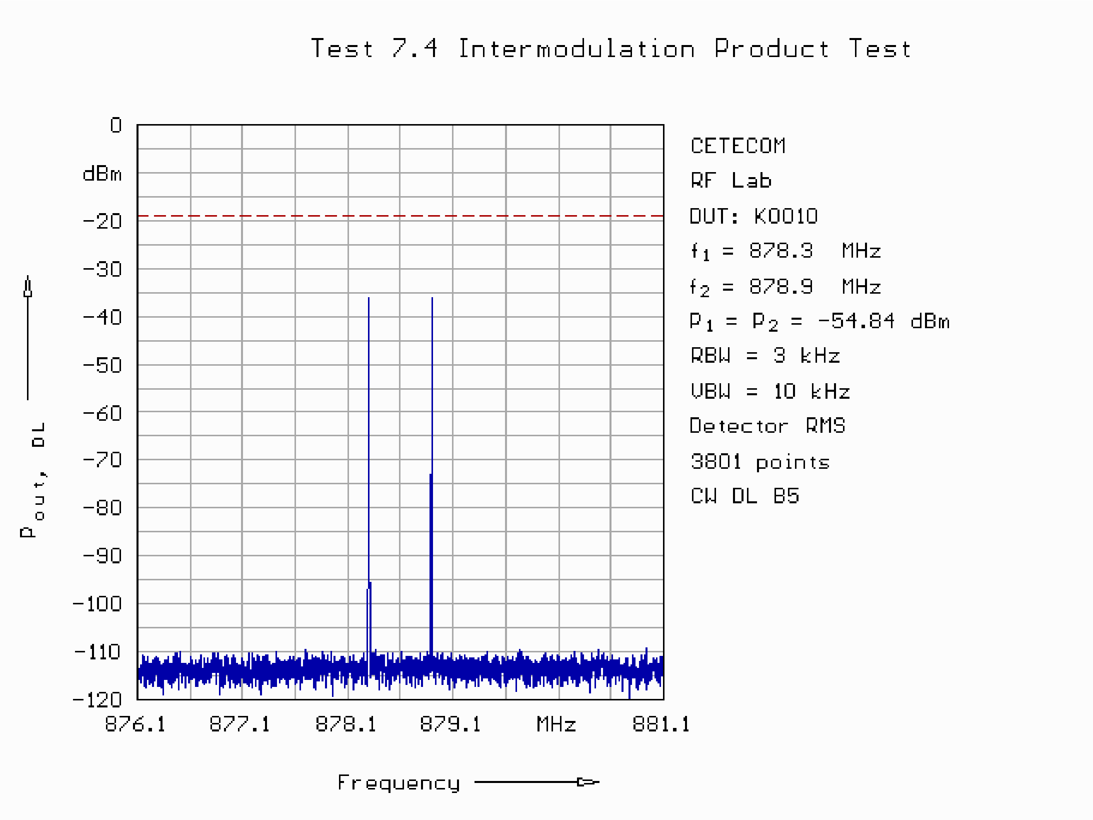

Fig. 51: Intermodulation test in downlink in band 5 at AGC.

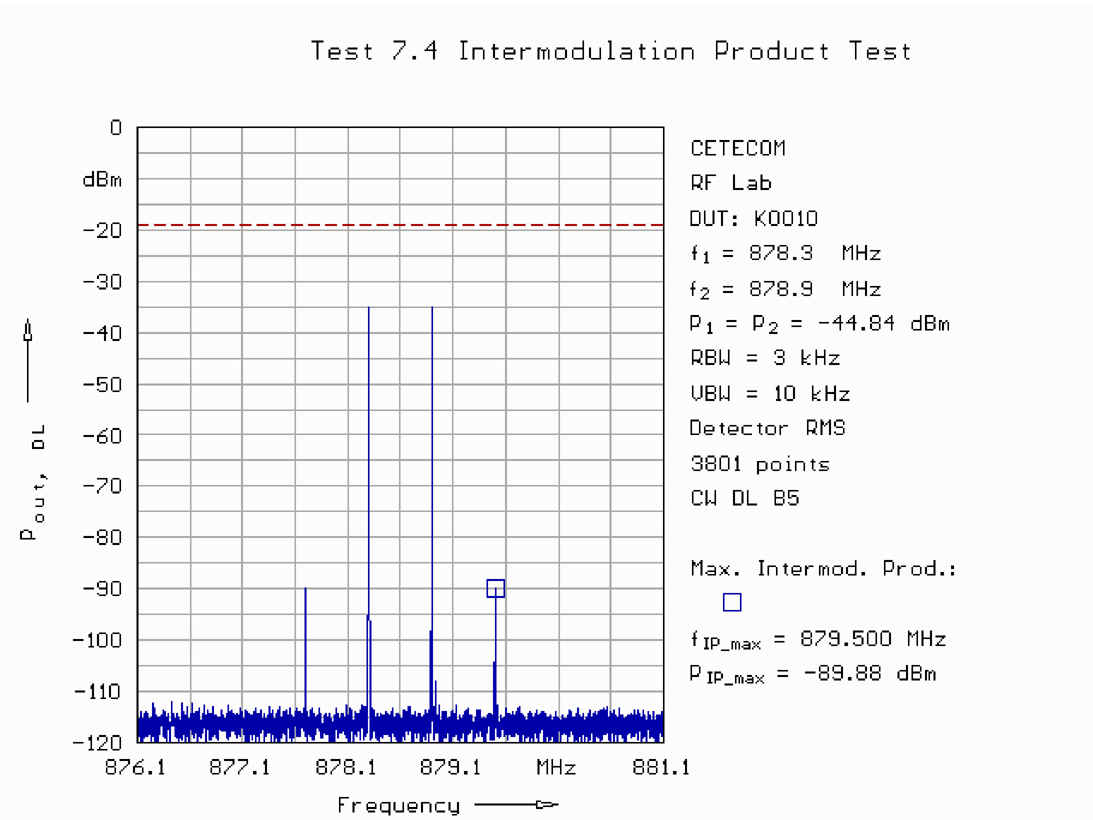

Fig. 52: Intermodulation test in downlink in band 5 at AGC plus 10 dB.

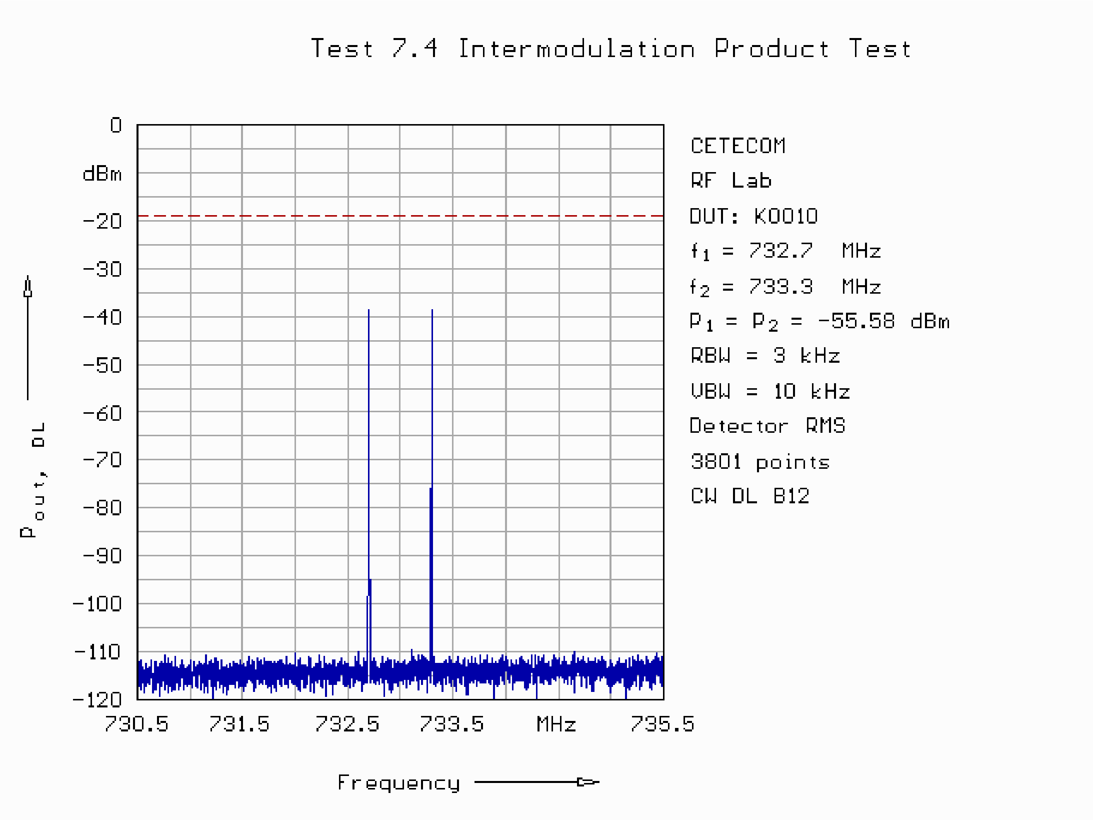

Fig. 53: Intermodulation test in downlink in band 12 at AGC.

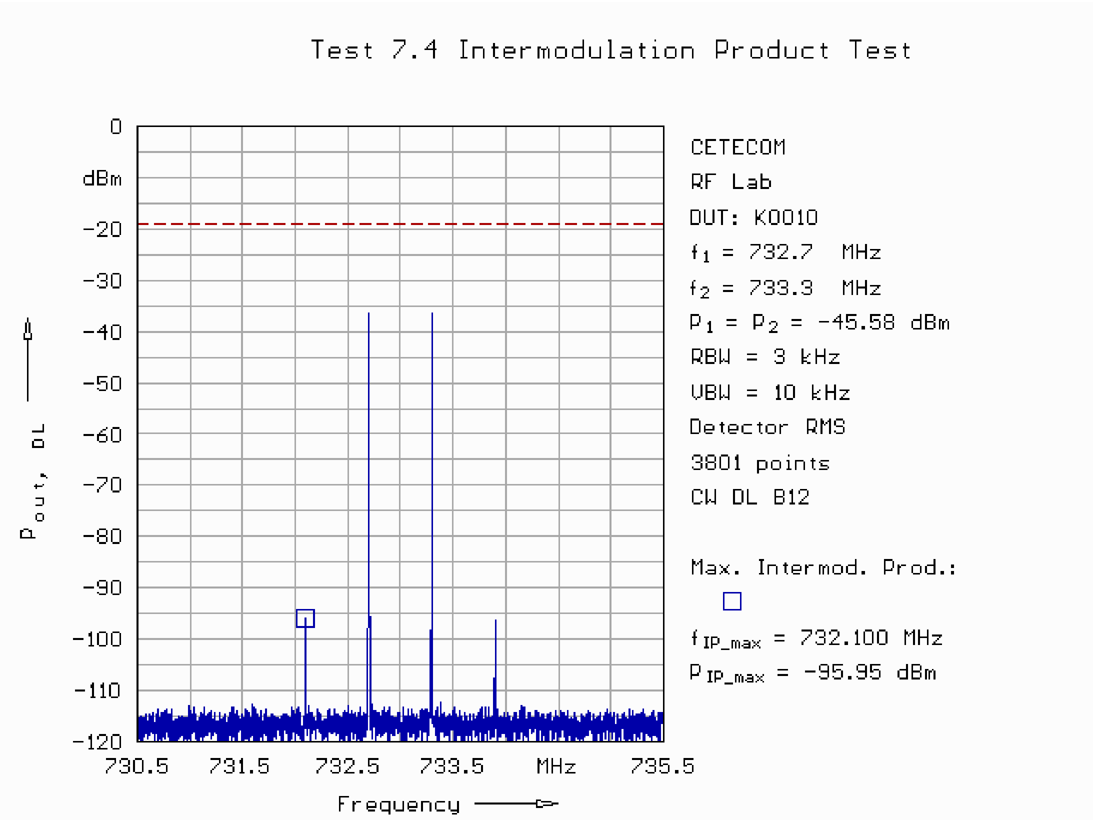

Fig. 54: Intermodulation test in downlink in band 12 at AGC plus 10 dB.

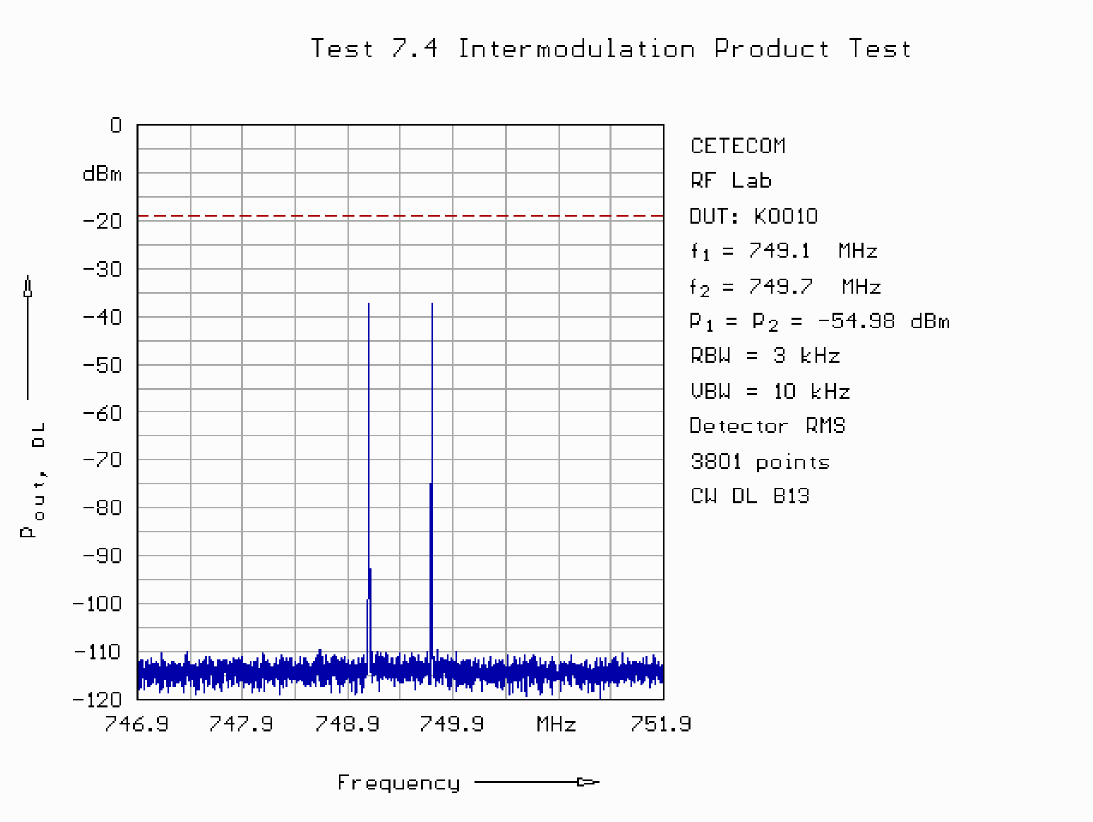

Fig. 55: Intermodulation test in downlink in band 13 at AGC.

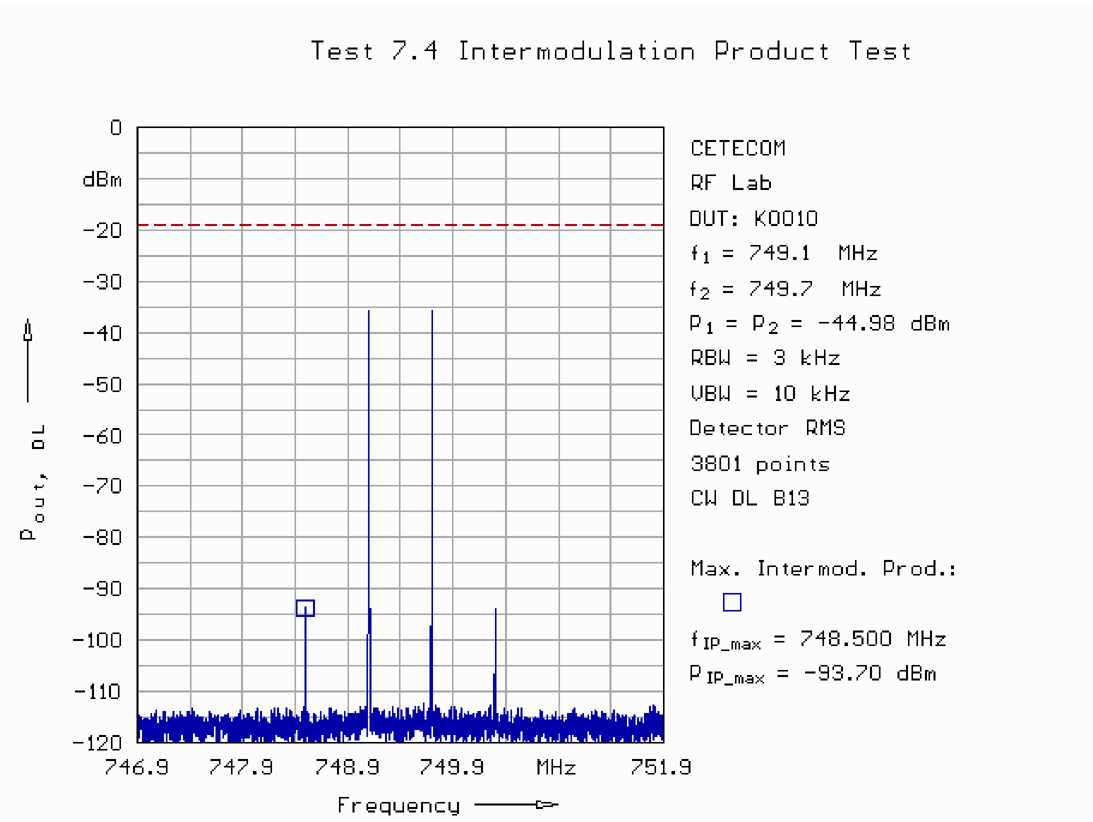

Fig. 56: Intermodulation test in downlink in band 13 at AGC plus 10 dB.

5.5. Out of Band Emission

The activated cable routing for this test is shown in Fig. 57 for GSM and CDMA in uplink and in Fig. 59 for LTE in uplink, in Fig. 58 and Fig. 60 for GSM and CDMA in downlink and for LTE in downlink, respectively.

As illustrated on the next pages the EUT meets the limit of -19 dBm in all required conditions for Out of Band Emissions.

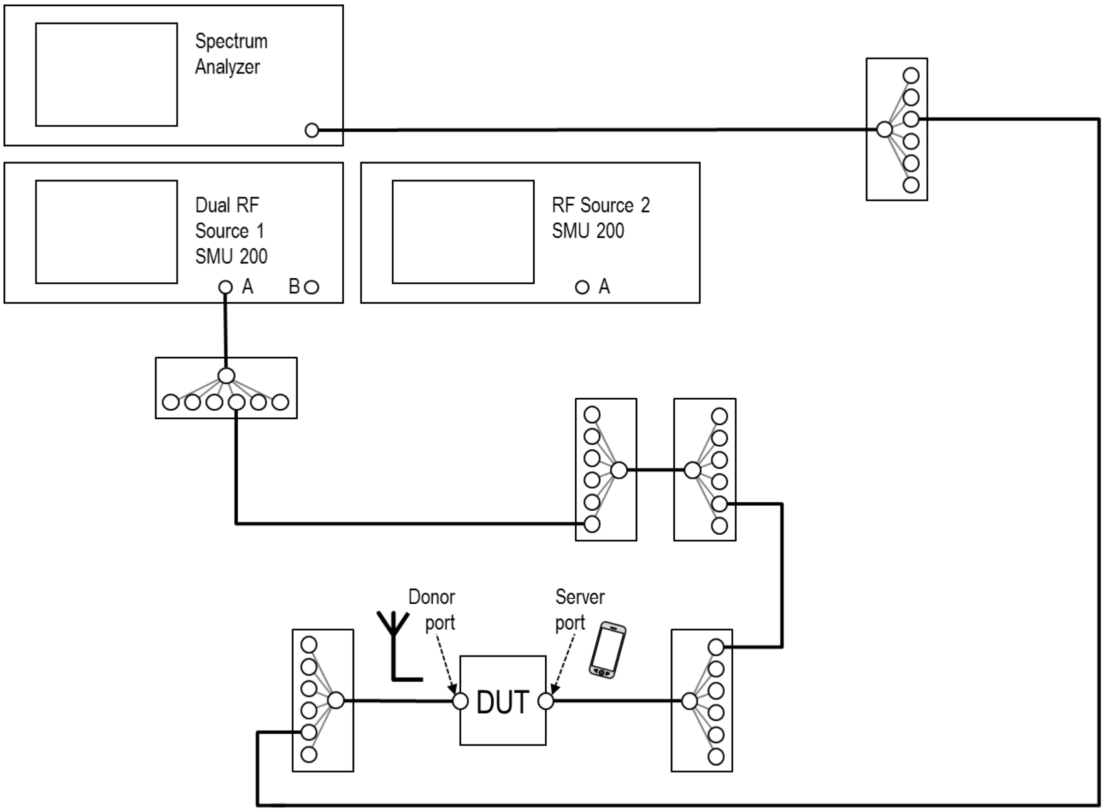

Fig. 57: Set up for out of band emission tests for GSM and CDMA in uplink.

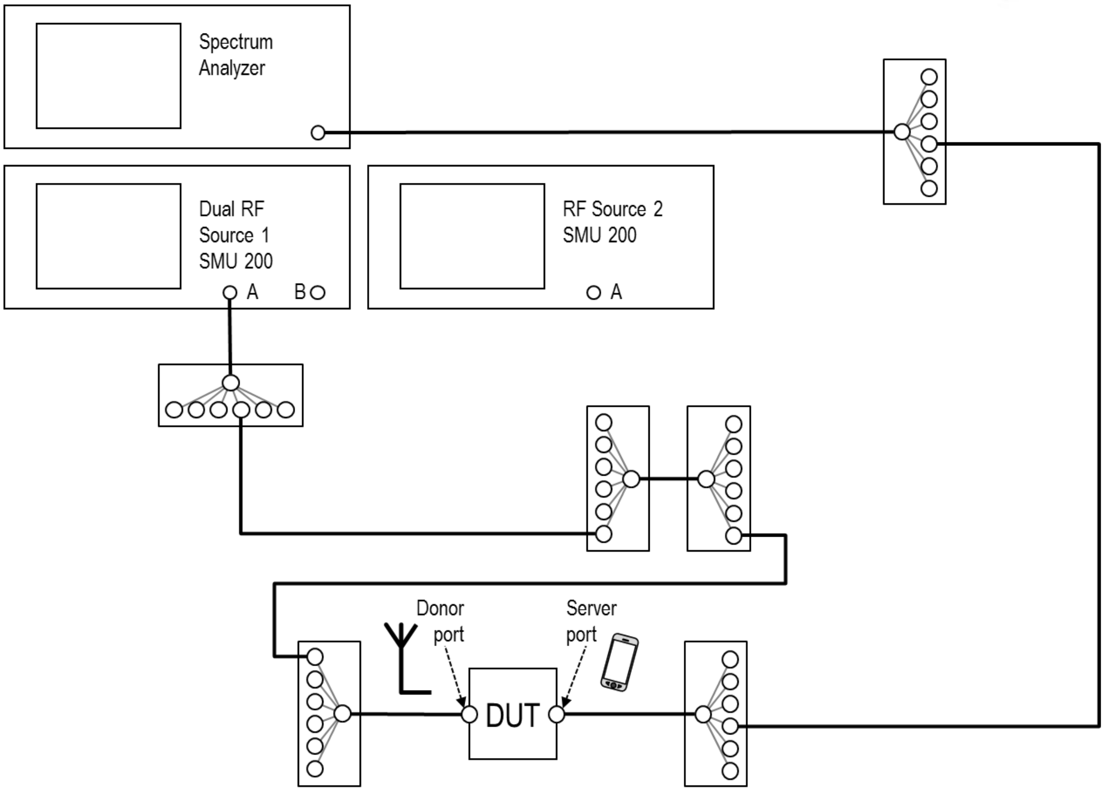

Fig. 58: Set up for out of band emission tests for GSM and CDMA in downlink.

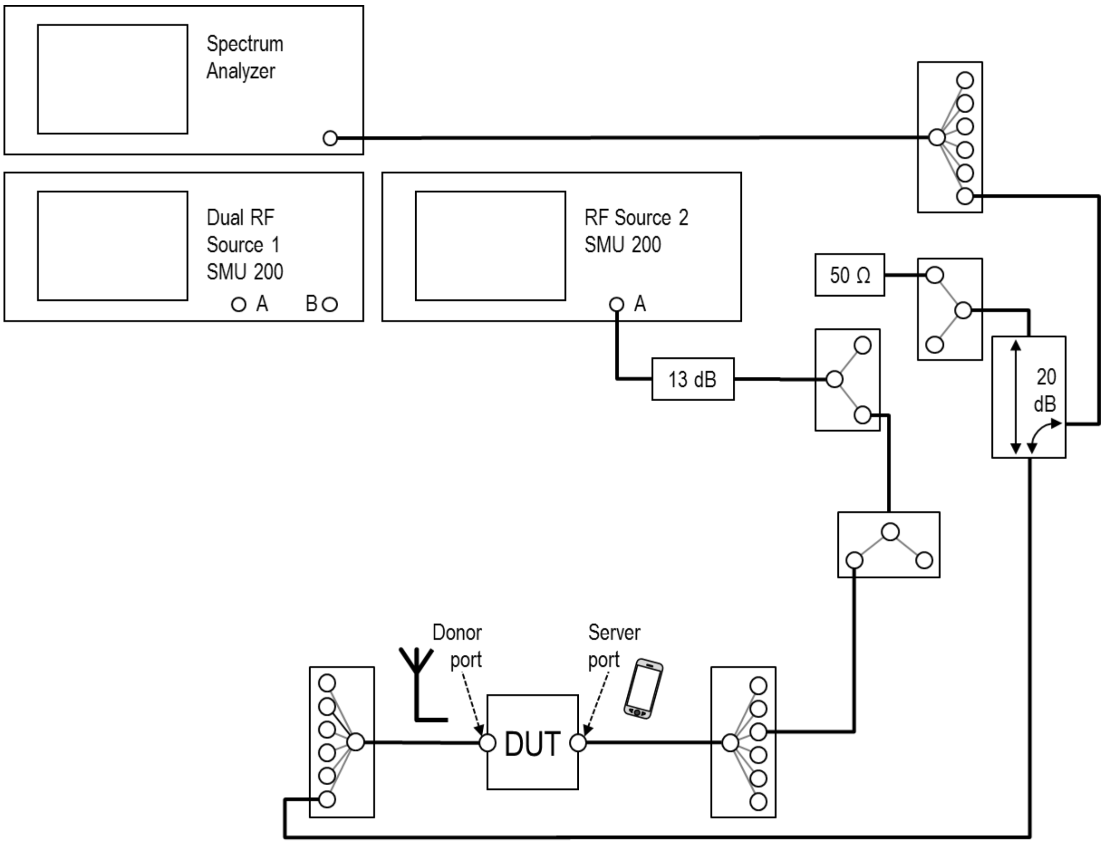

Fig. 59: Set up for out of band emission tests for LTE in uplink.

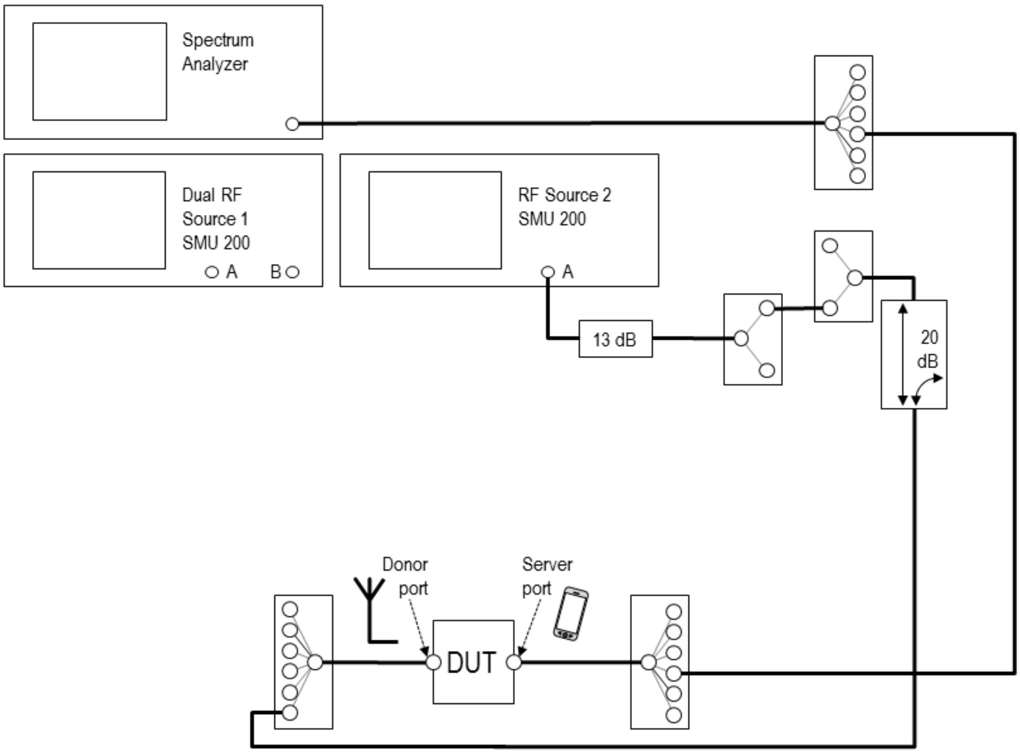

Fig. 60: Set up for out of band emission tests for LTE in downlink.

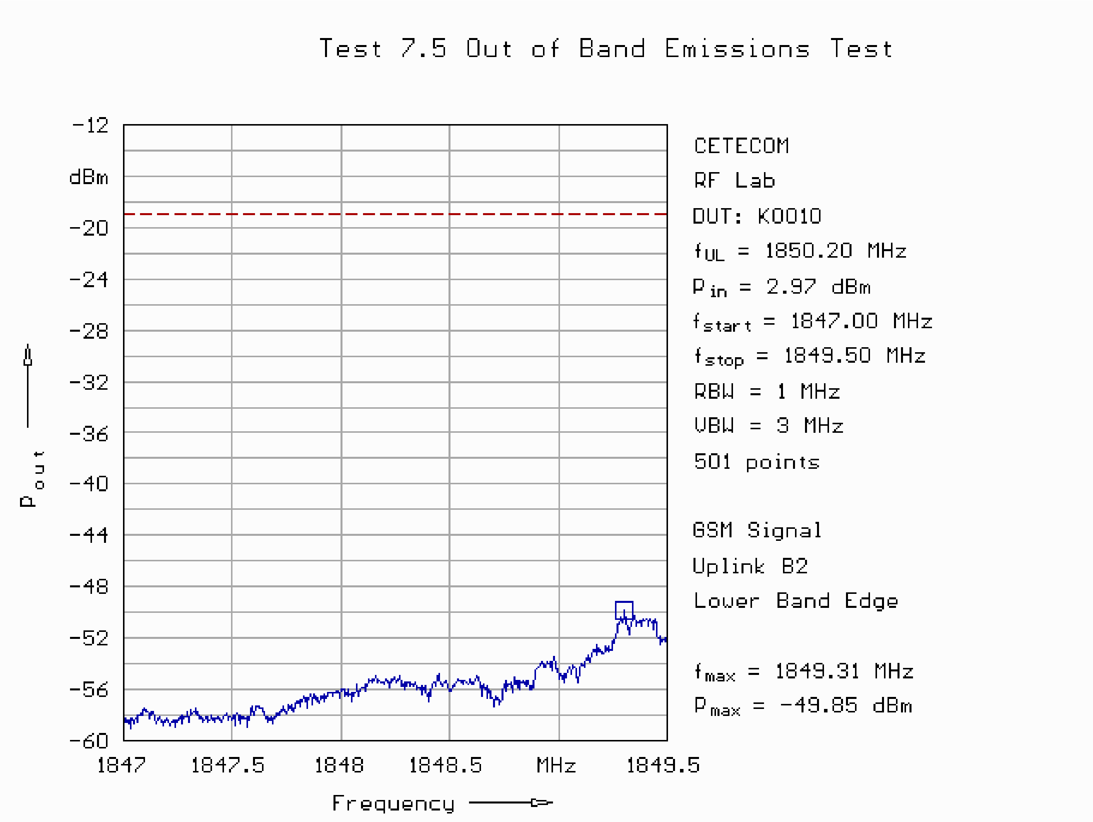

Fig. 61: Out-of-band emissions in uplink in band 2 applying a GSM signal for the lower band edge.

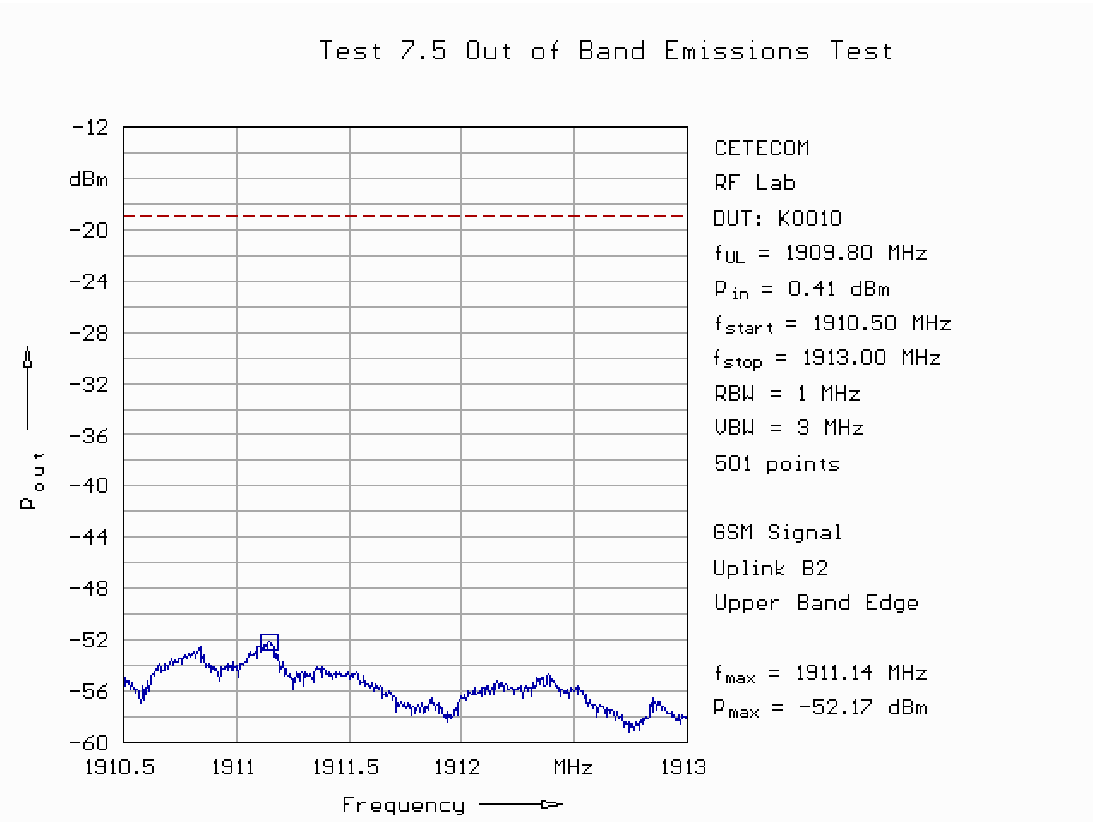

Fig. 62: Out-of-band emissions in uplink in band 2 applying a GSM signal for the upper band edge.

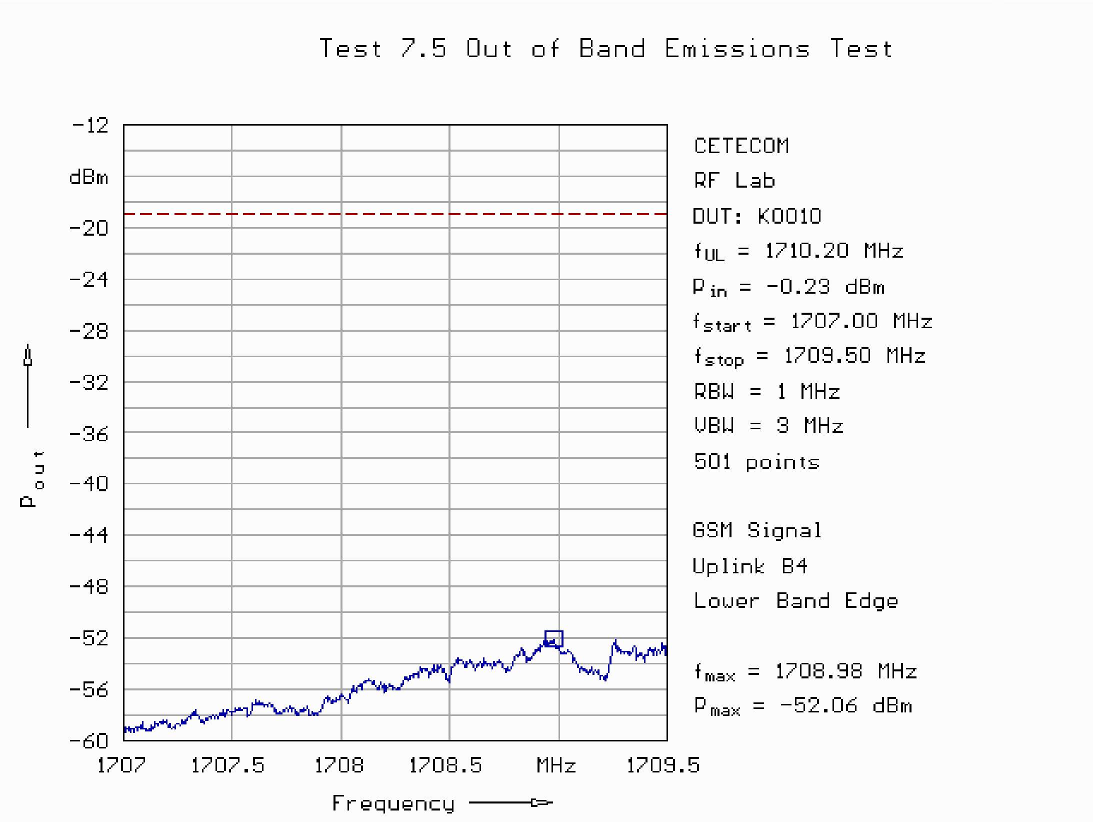

Fig. 63: Out-of-band emissions in uplink in band 4 applying a GSM signal for the lower band edge.

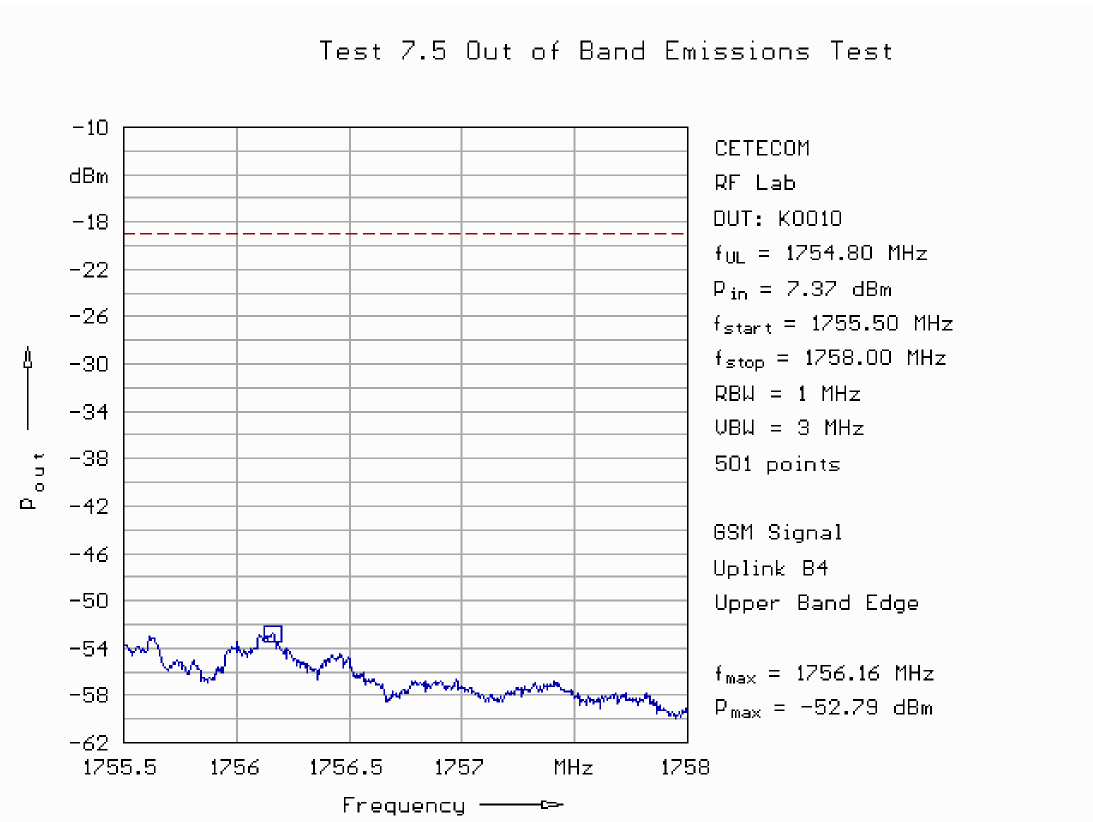

Fig. 64: Out-of-band emissions in uplink in band 4 applying a GSM signal for the upper band edge.

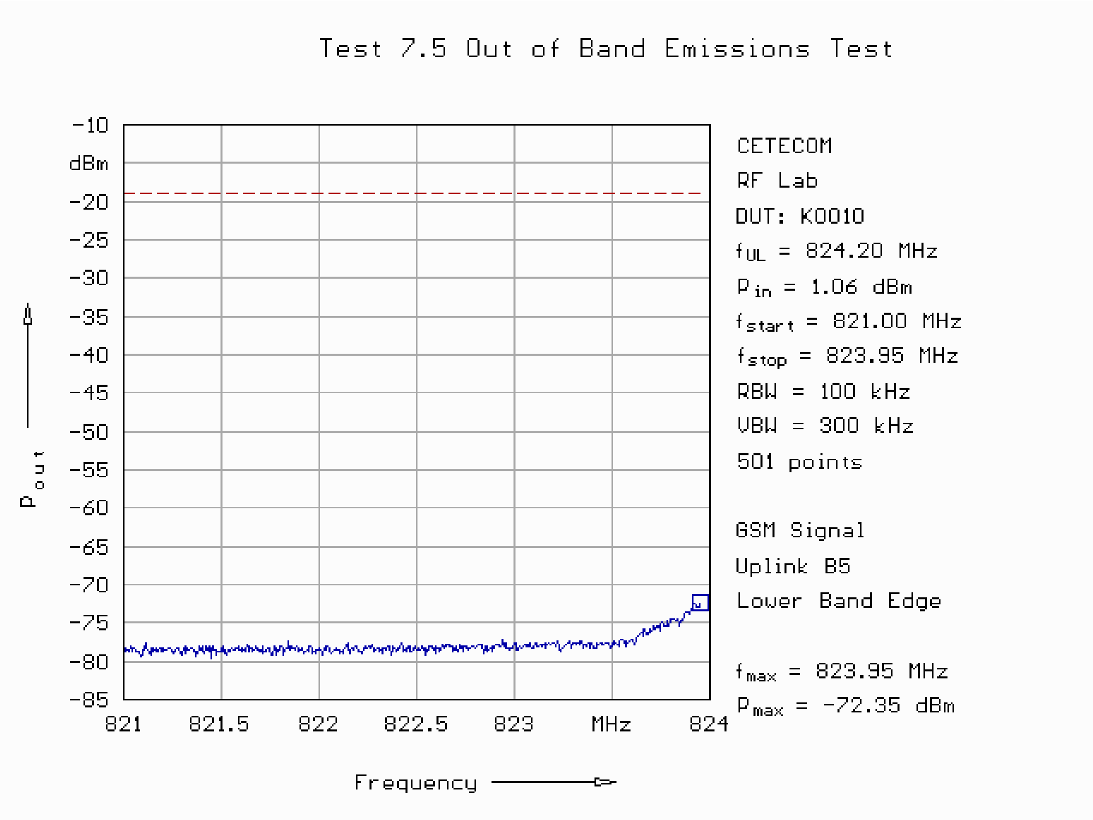

Fig. 65: Out-of-band emissions in uplink in band 5 applying a GSM signal for the lower band edge.

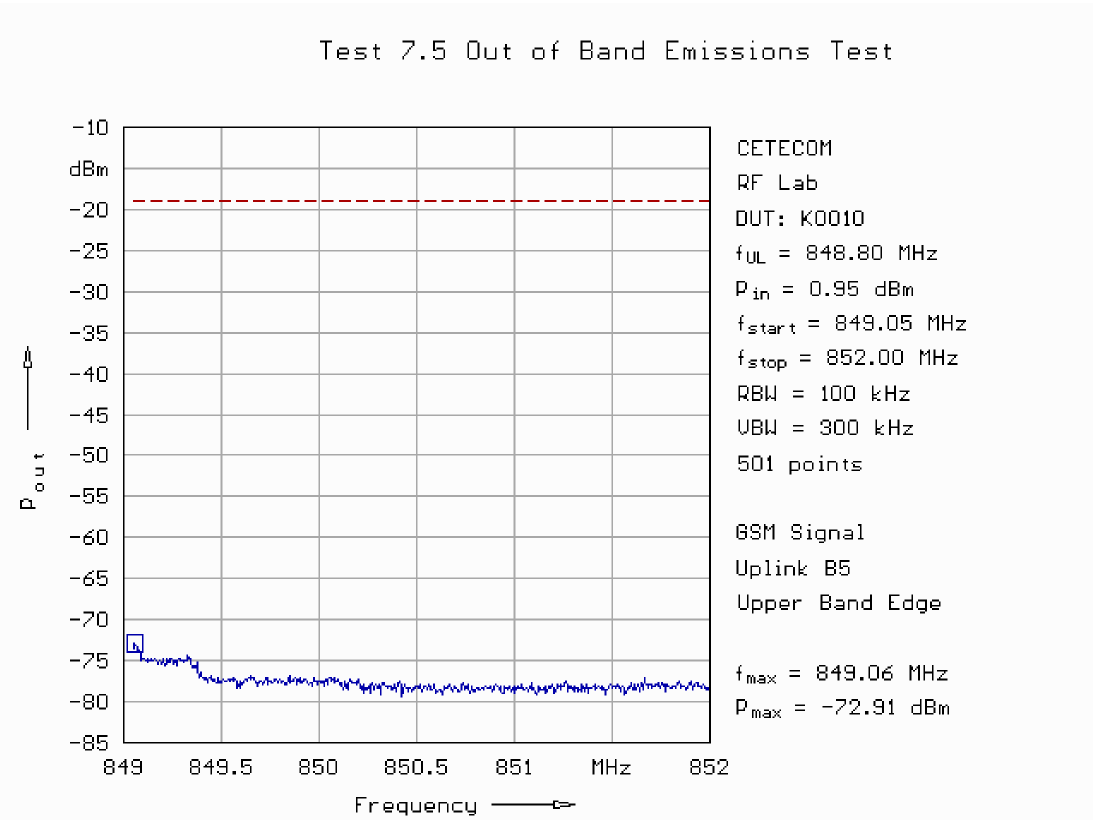

Fig. 66: Out-of-band emissions in uplink in band 5 applying a GSM signal for the upper band edge.

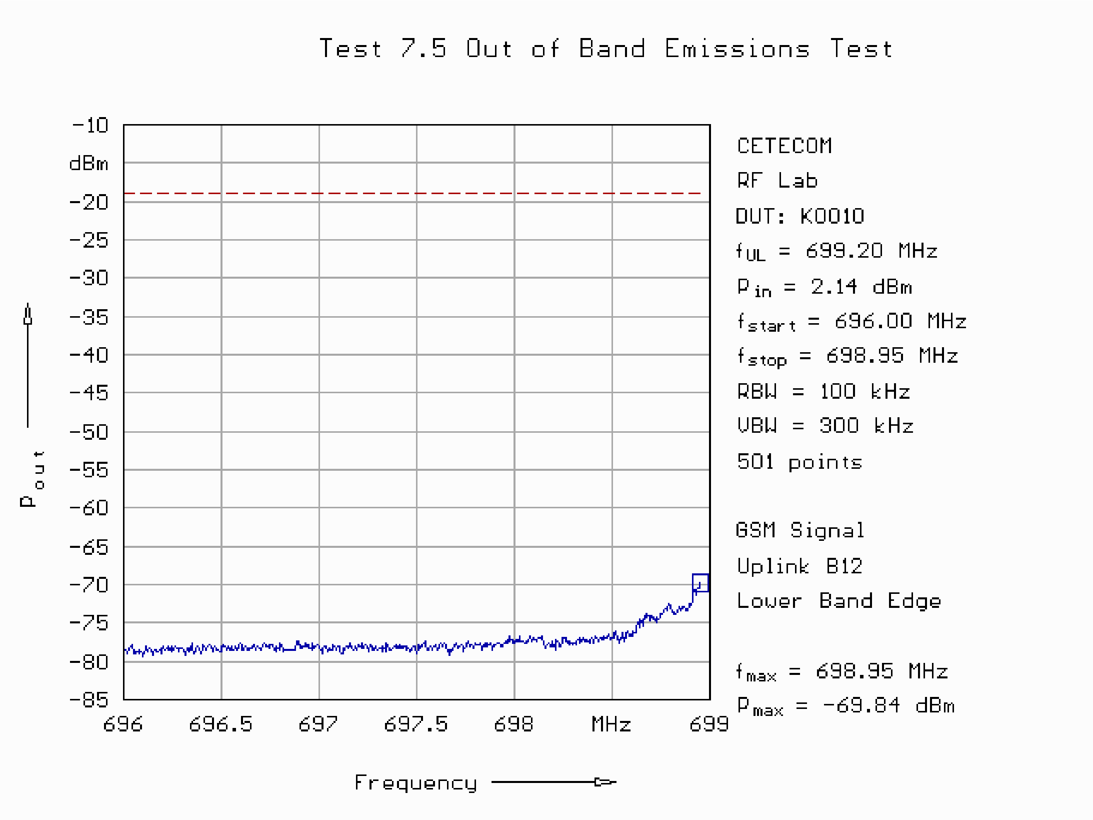

Fig. 67: Out-of-band emissions in uplink in band 12 applying a GSM signal for the lower band edge.

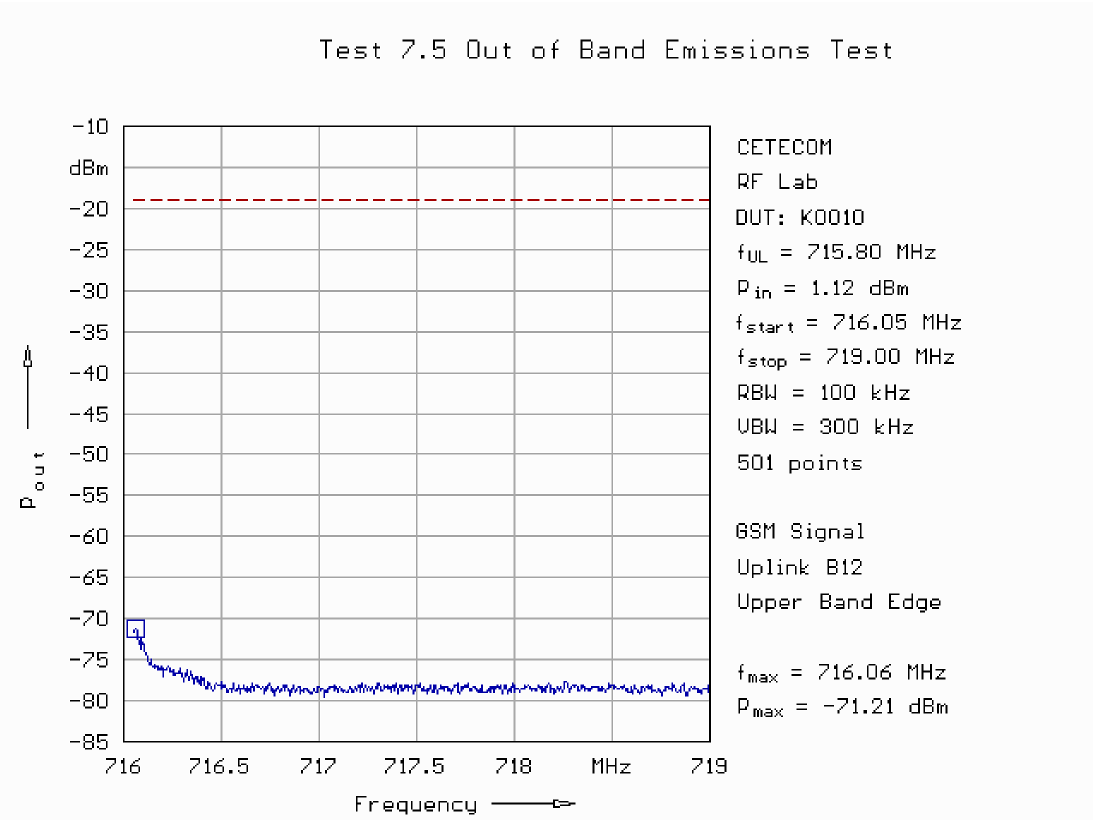

Fig. 68: Out-of-band emissions in uplink in band 12 applying a GSM signal for the upper band edge.

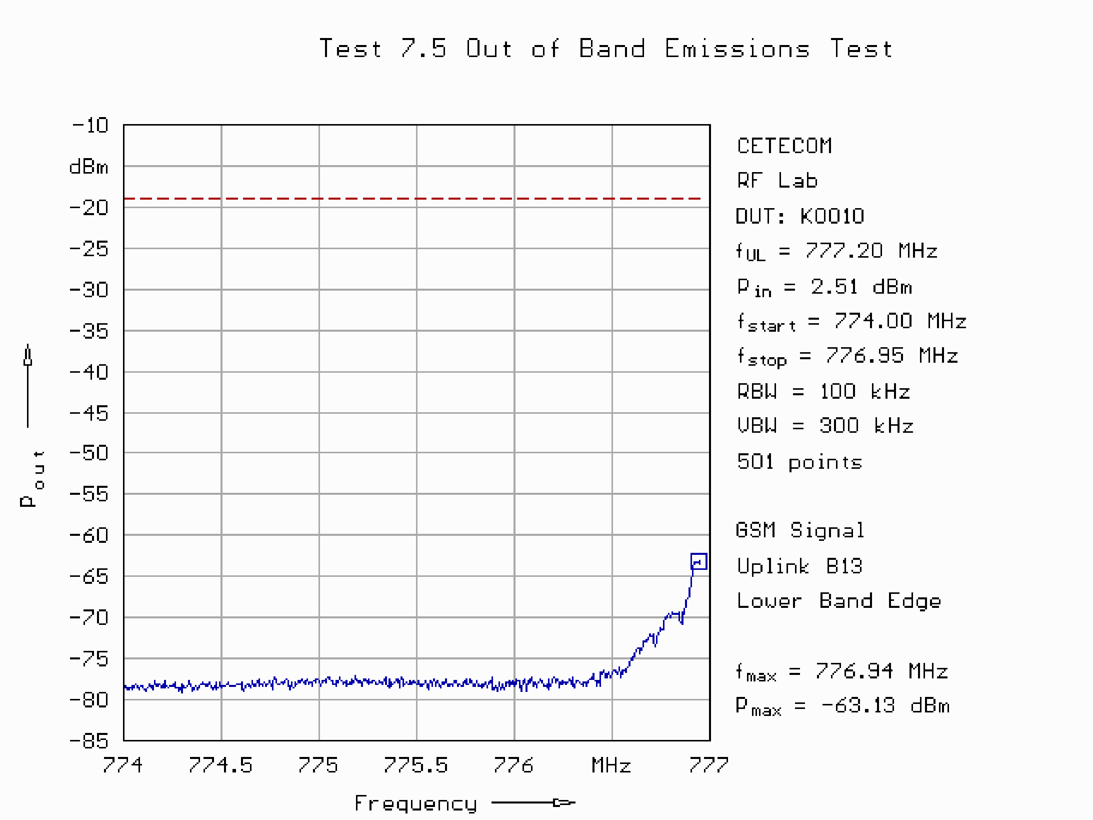

Fig. 69: Out-of-band emissions in uplink in band 13 applying a GSM signal for the lower band edge.

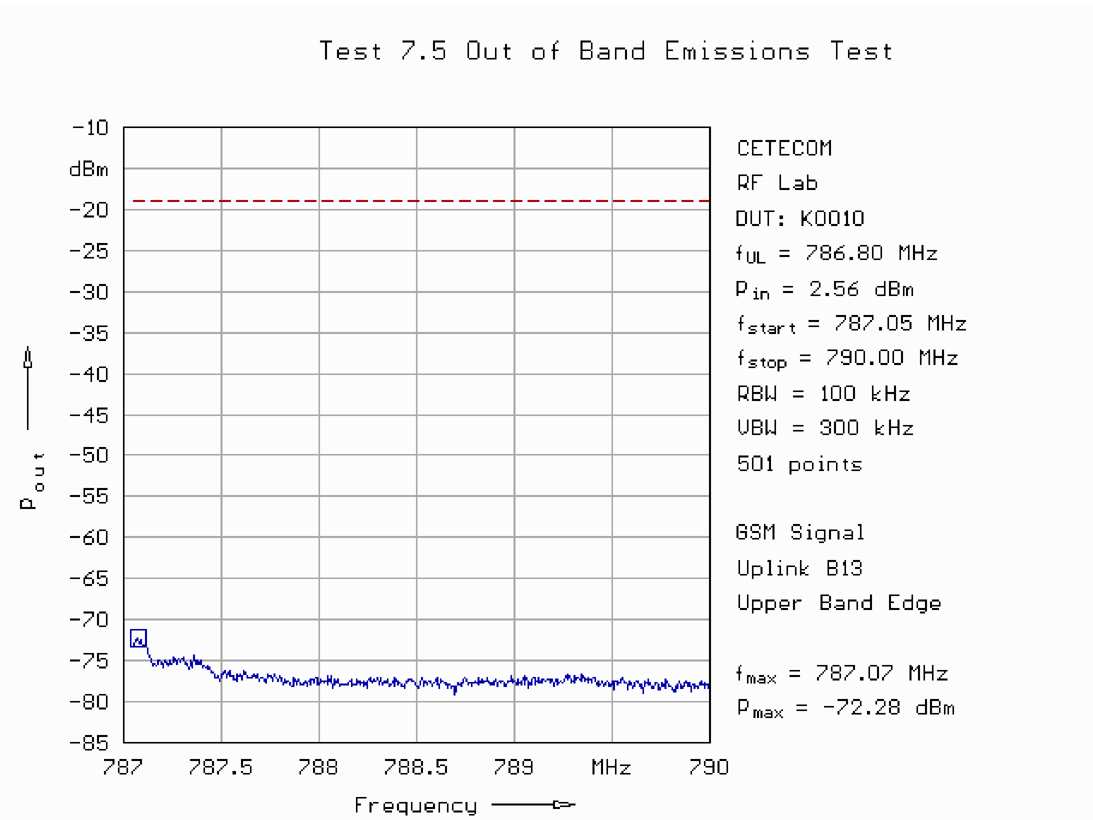

Fig. 70: Out-of-band emissions in uplink in band 13 applying a GSM signal for the upper band edge.

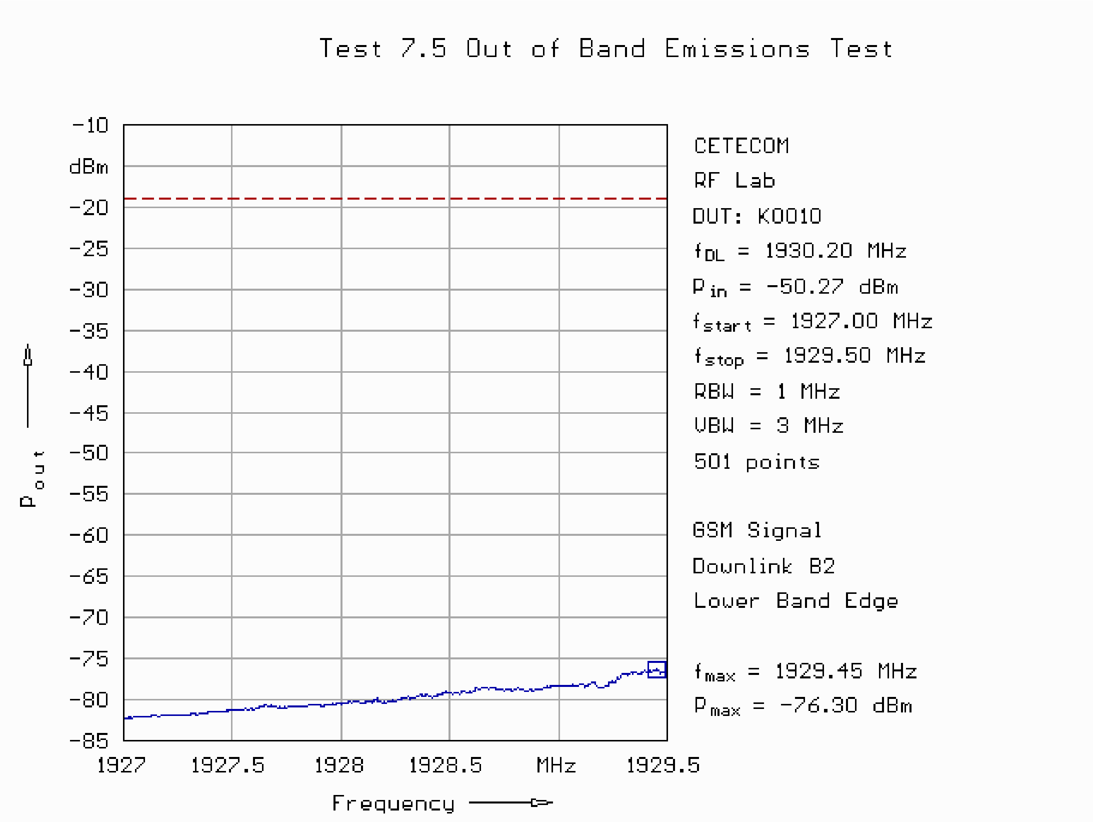

Fig. 71: Out-of-band emissions in downlink in band 2 applying a GSM signal for the lower band edge.

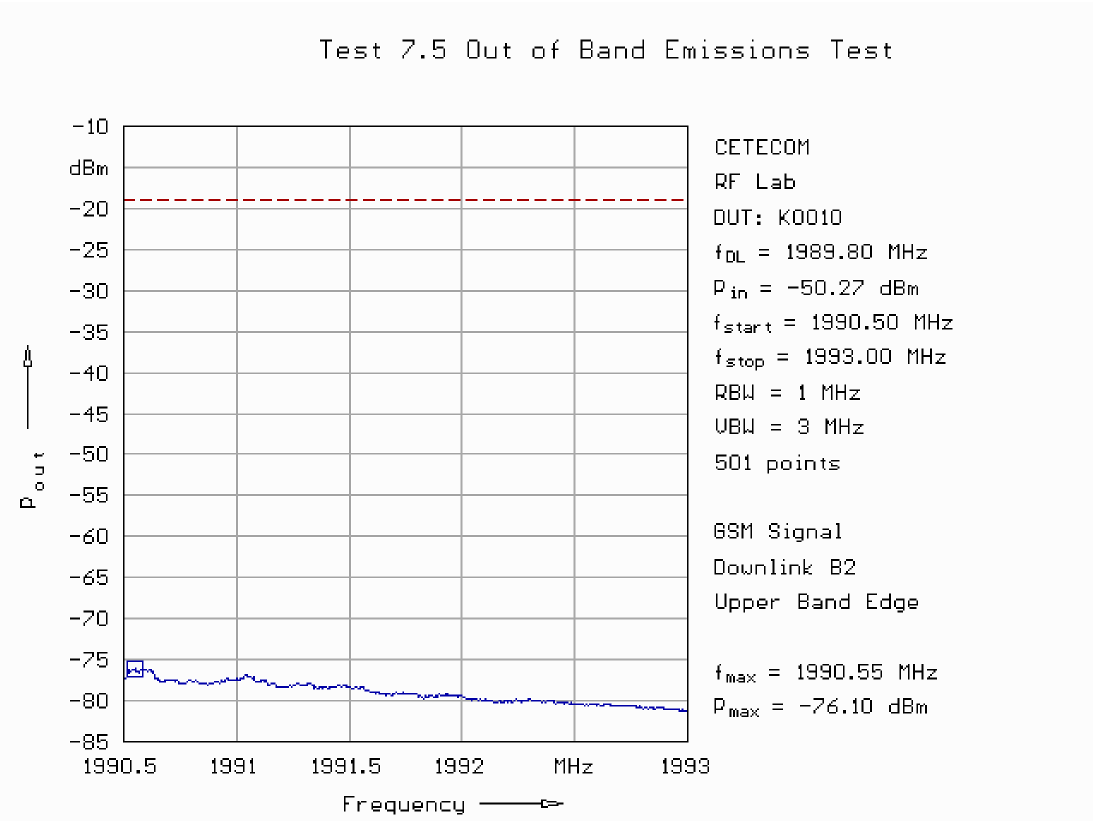

Fig. 72: Out-of-band emissions in downlink in band 2 applying a GSM signal for the upper band edge.

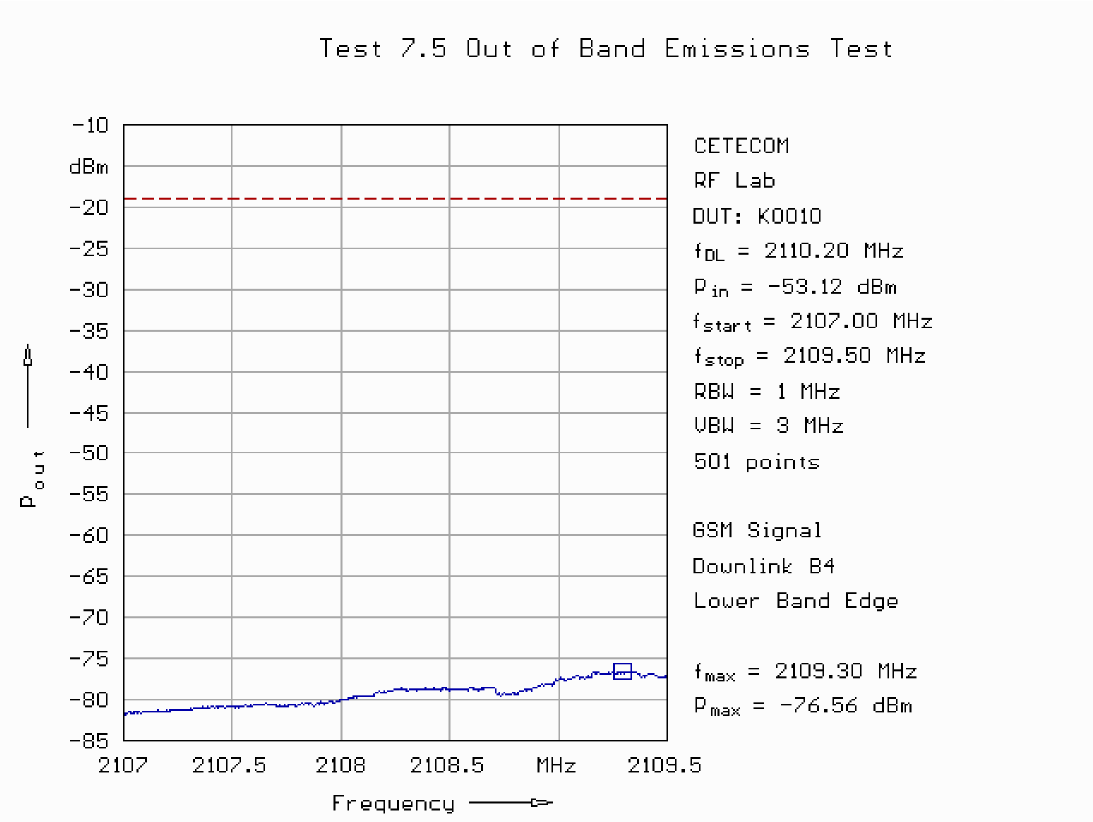

Fig. 73: Out-of-band emissions in downlink in band 4 applying a GSM signal for the lower band edge.

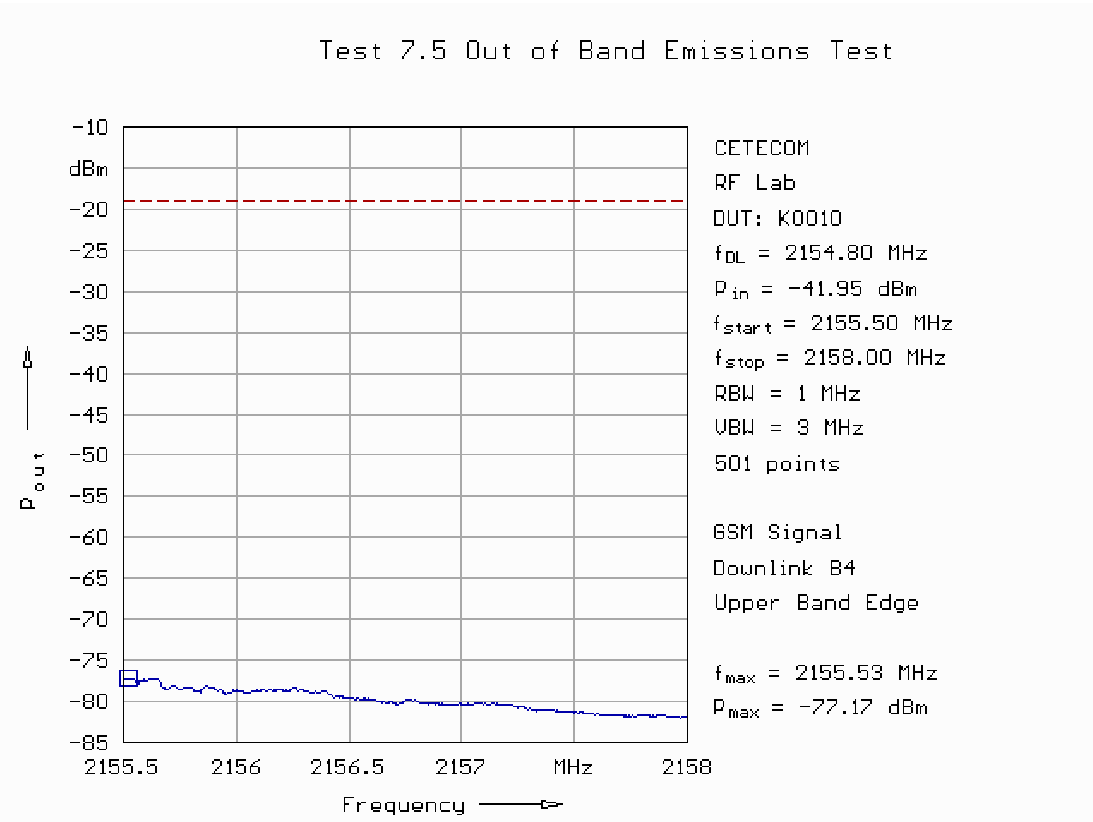

Fig. 74: Out-of-band emissions in downlink in band 4 applying a GSM signal for the upper band edge.

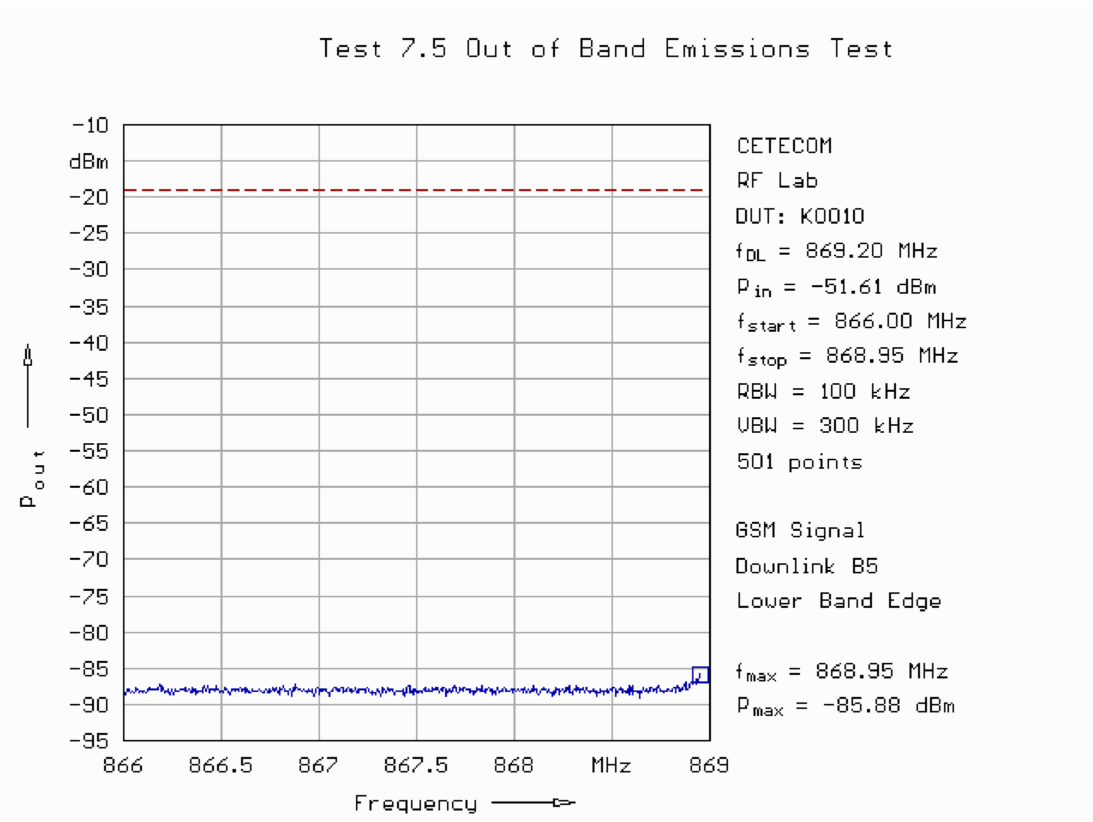

Fig. 75: Out-of-band emissions in downlink in band 5 applying a GSM signal for the lower band edge.

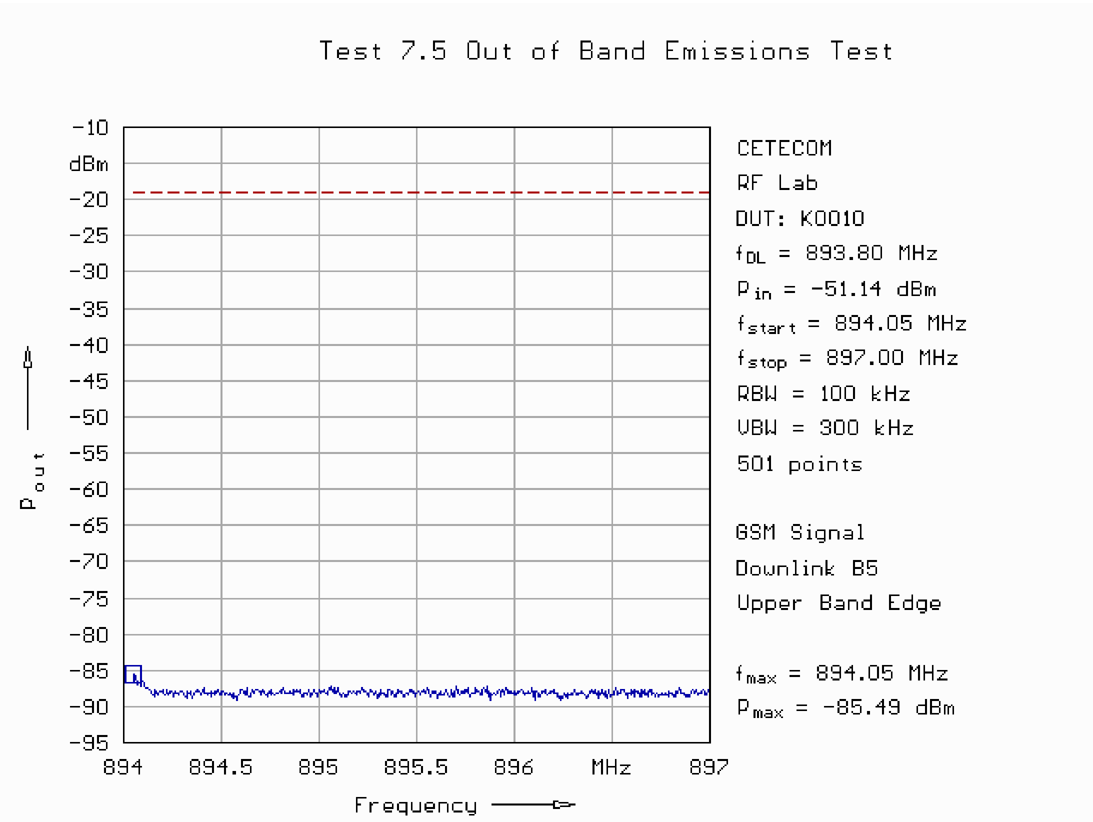

Fig. 76: Out-of-band emissions in downlink in band 5 applying a GSM signal for the upper band edge.

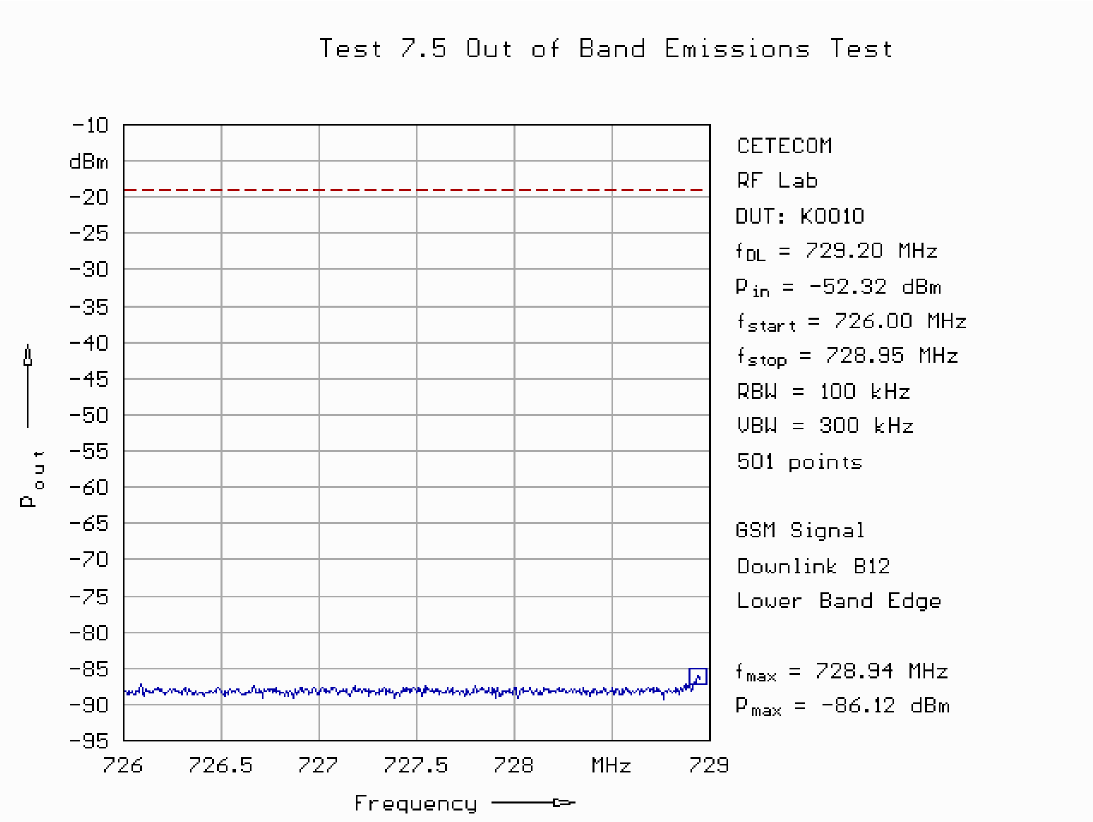

Fig. 77: Out-of-band emissions in downlink in band 12 applying a GSM signal for the lower band edge.

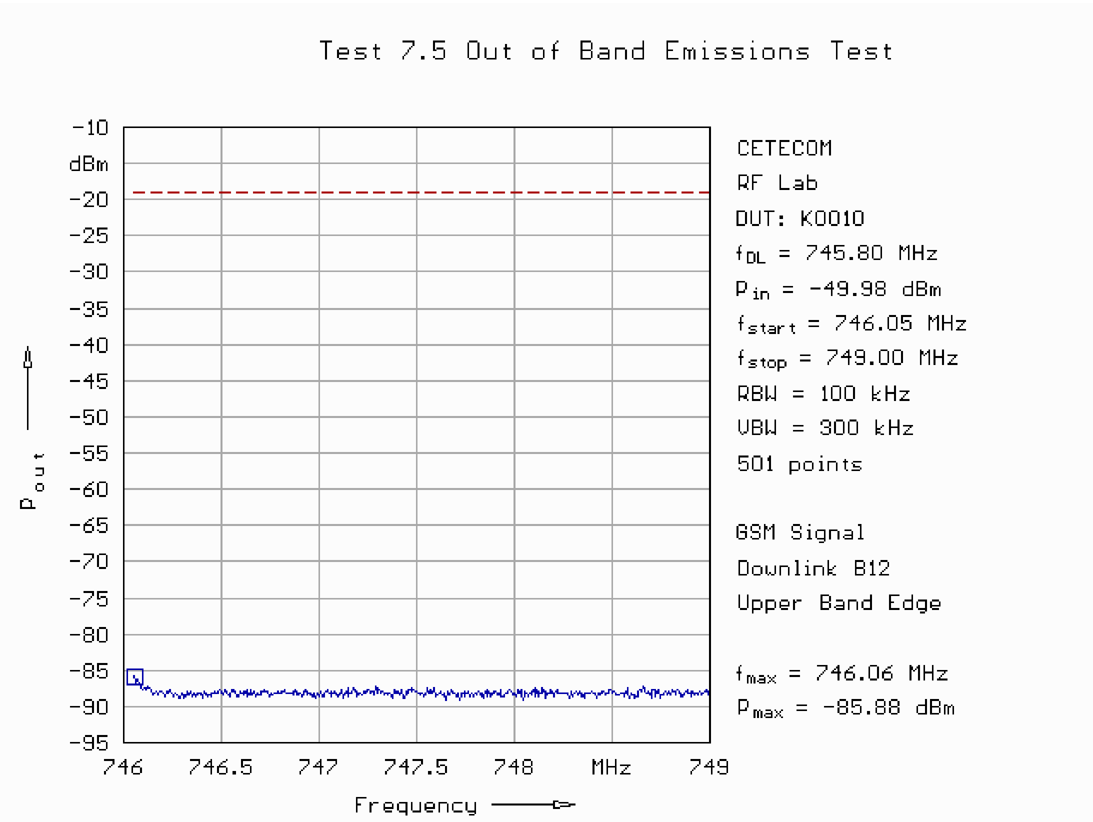

Fig. 78: Out-of-band emissions in downlink in band 12 applying a GSM signal for the upper band edge.

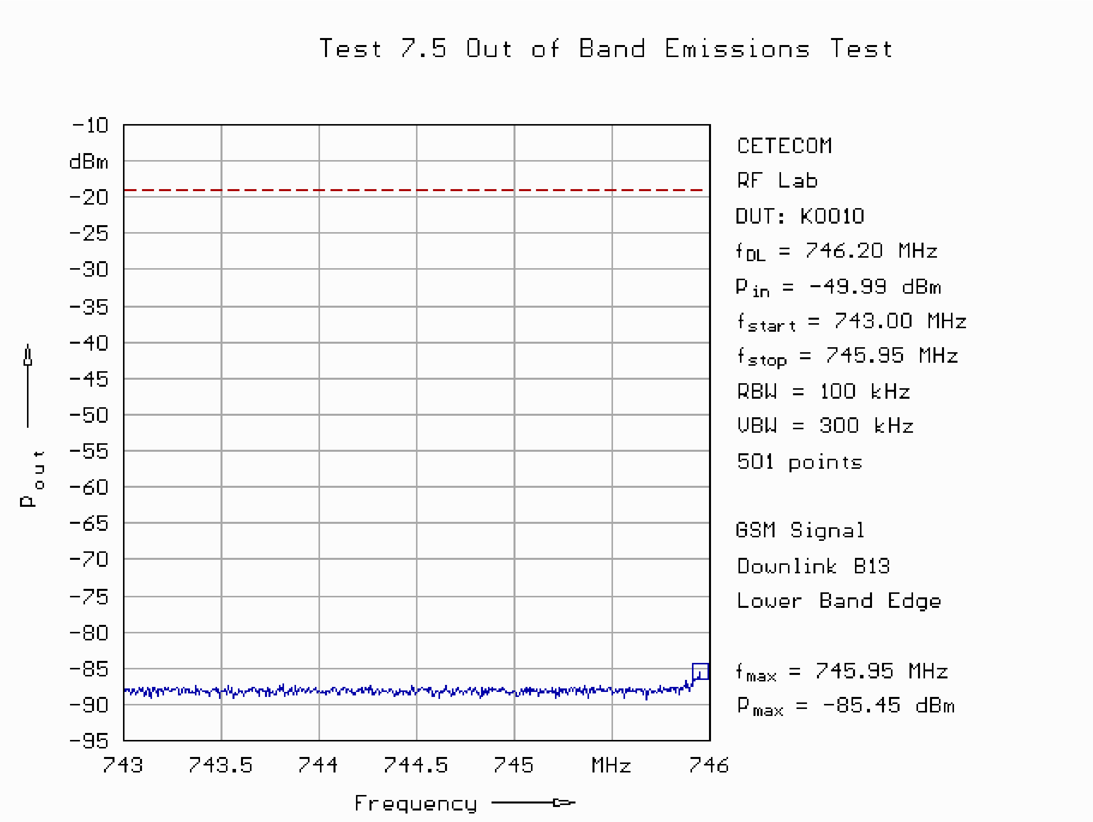

Fig. 79: Out-of-band emissions in downlink in band 13 applying a GSM signal for the lower band edge.

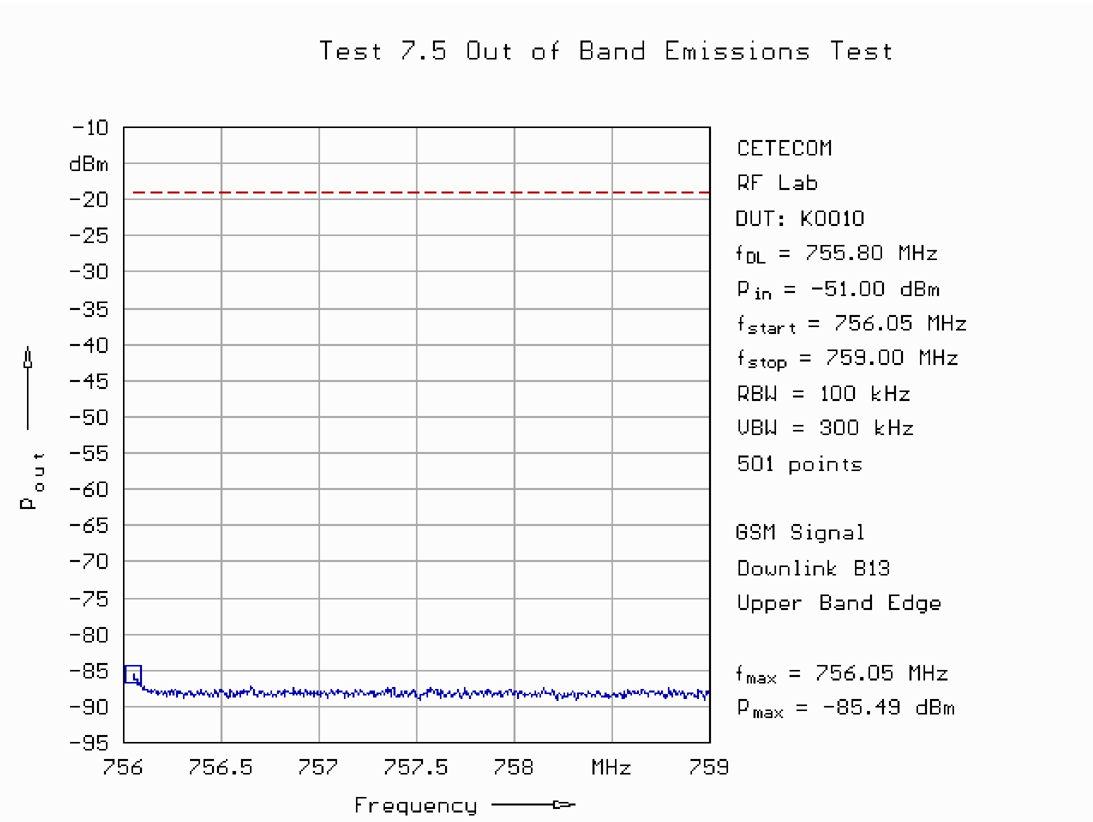

Fig. 80: Out-of-band emissions in downlink in band 13 applying a GSM signal for the upper band edge.

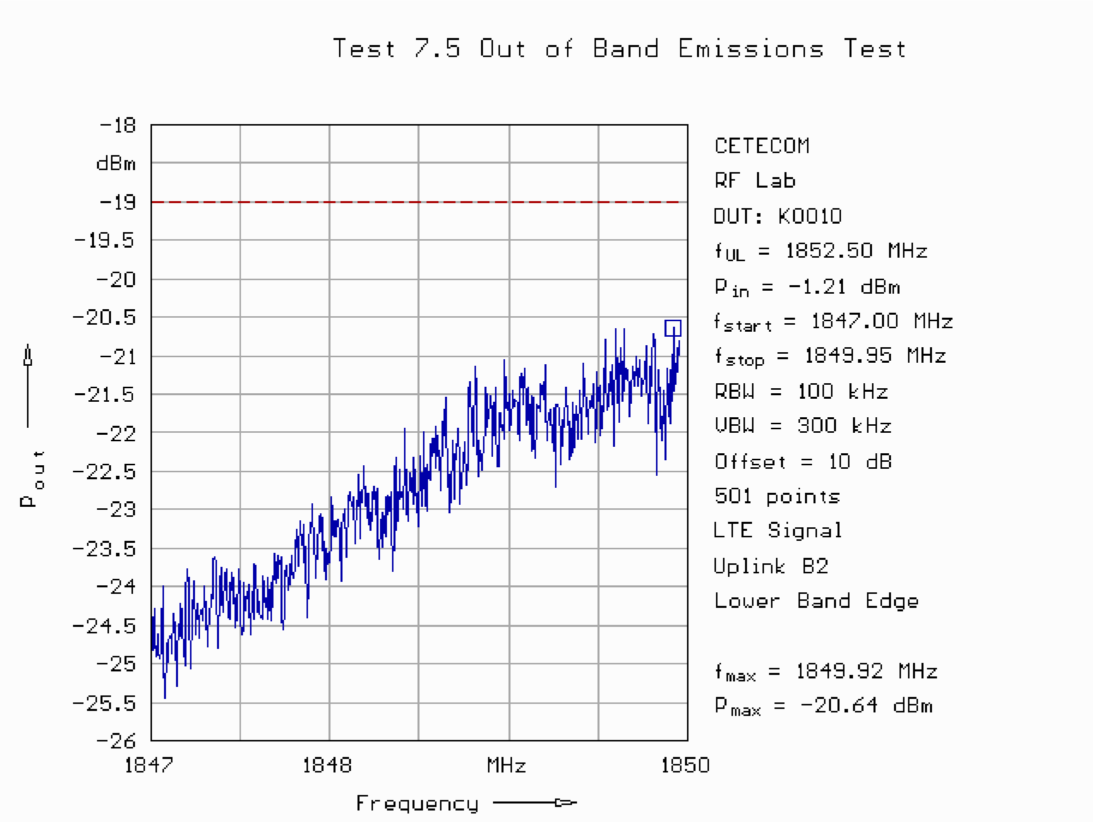

Fig. 81: Out-of-band emissions in uplink in band 2 applying a LTE signal for the lower band edge.

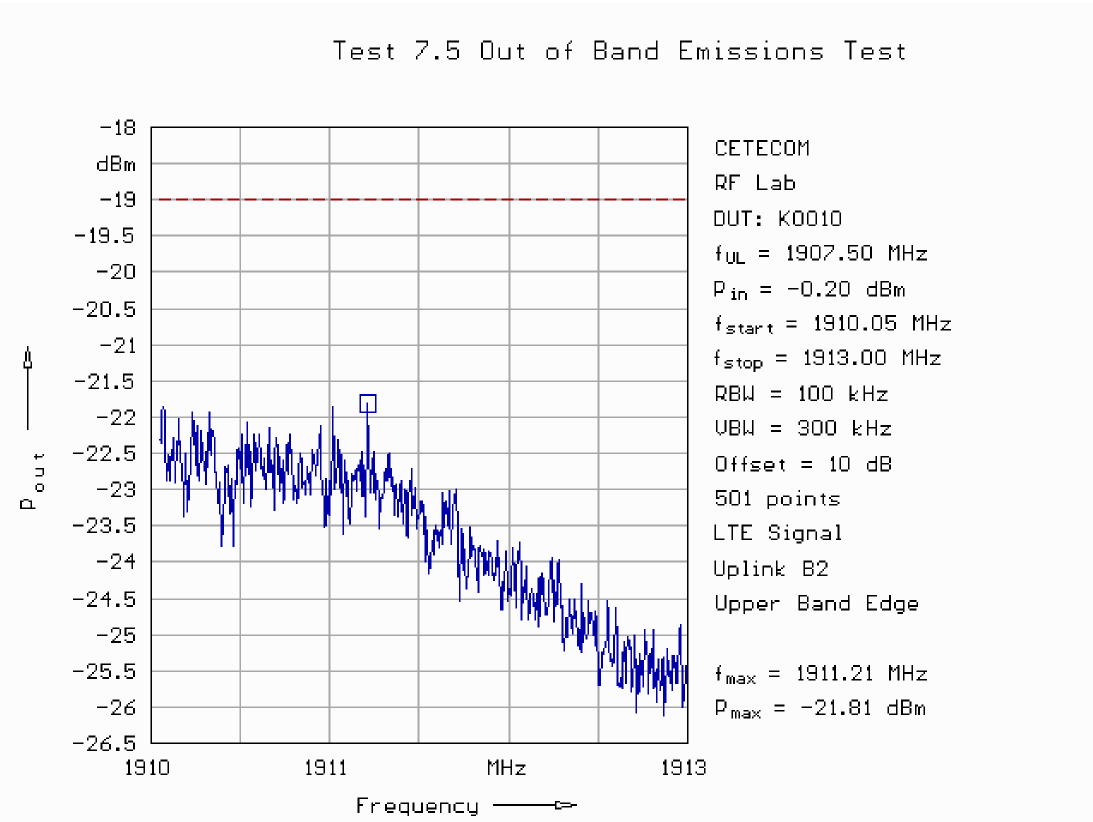

Fig. 82: Out-of-band emissions in uplink in band 2 applying a LTE signal for the upper band edge.

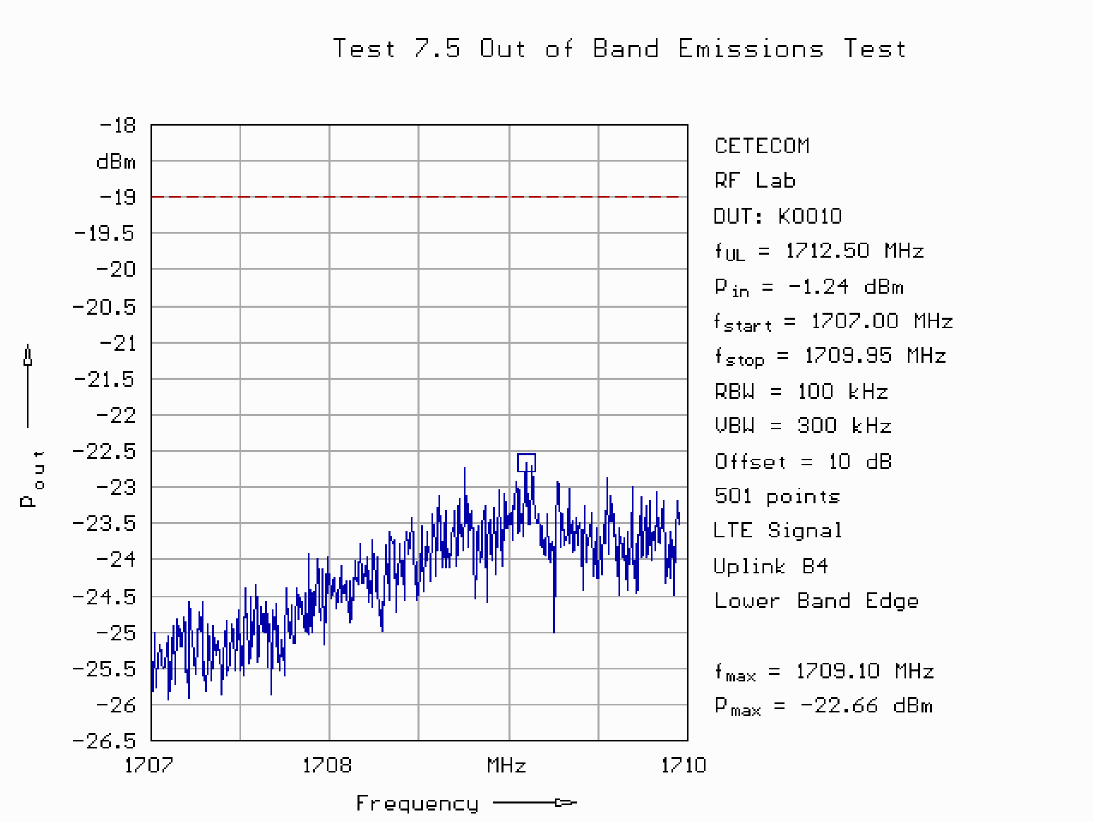

Fig. 83: Out-of-band emissions in uplink in band 4 applying a LTE signal for the lower band edge.

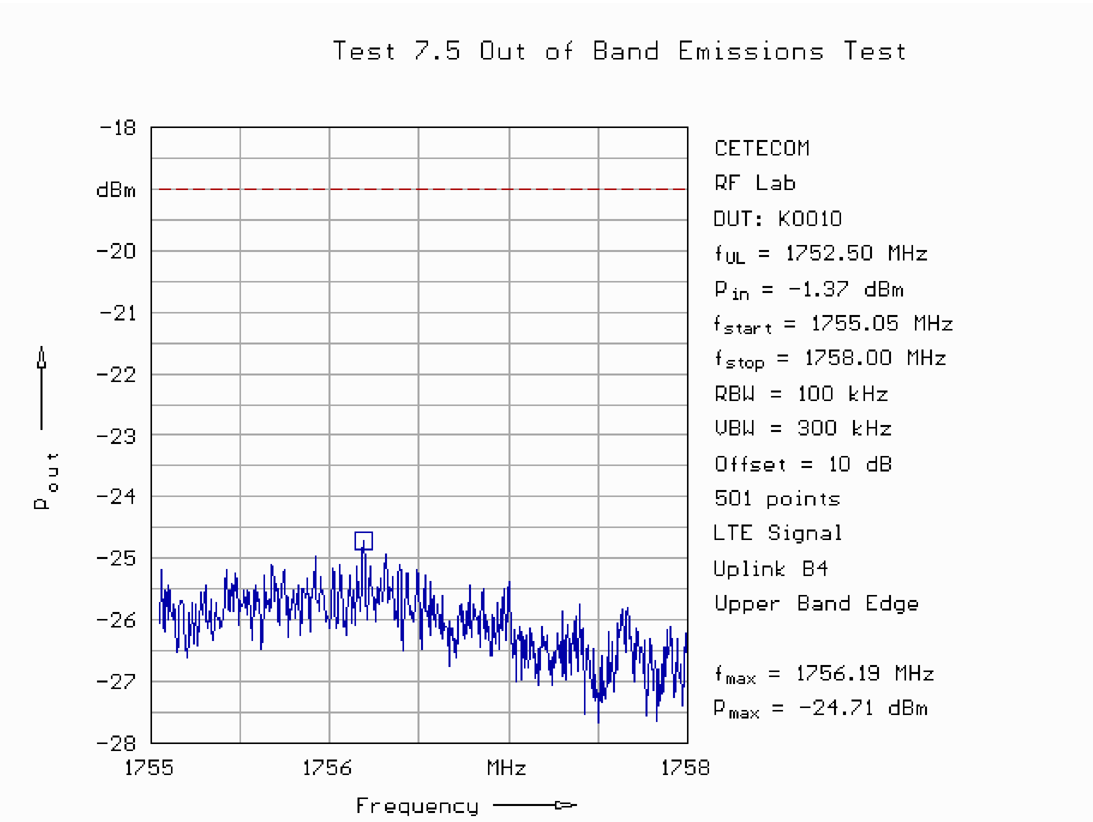

Fig. 84: Out-of-band emissions in uplink in band 4 applying a LTE signal for the upper band edge.

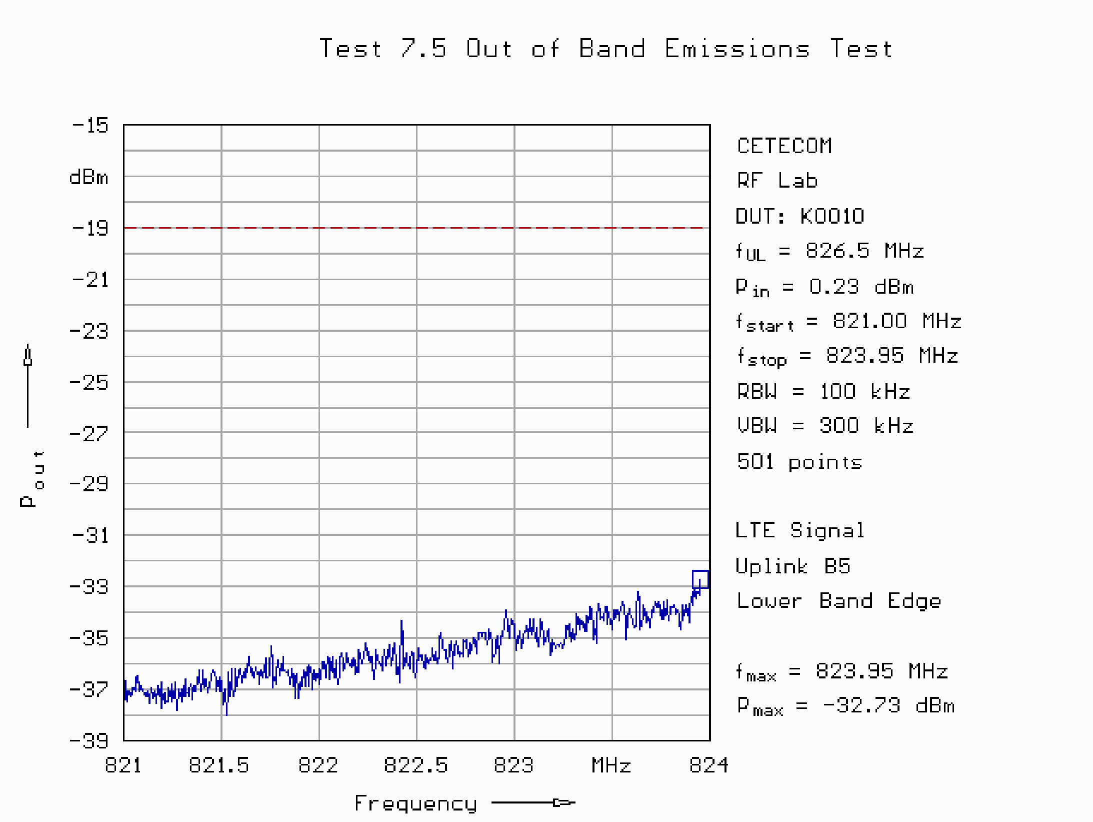

Fig. 85: Out-of-band emissions in uplink in band 5 applying a LTE signal for the lower band edge.

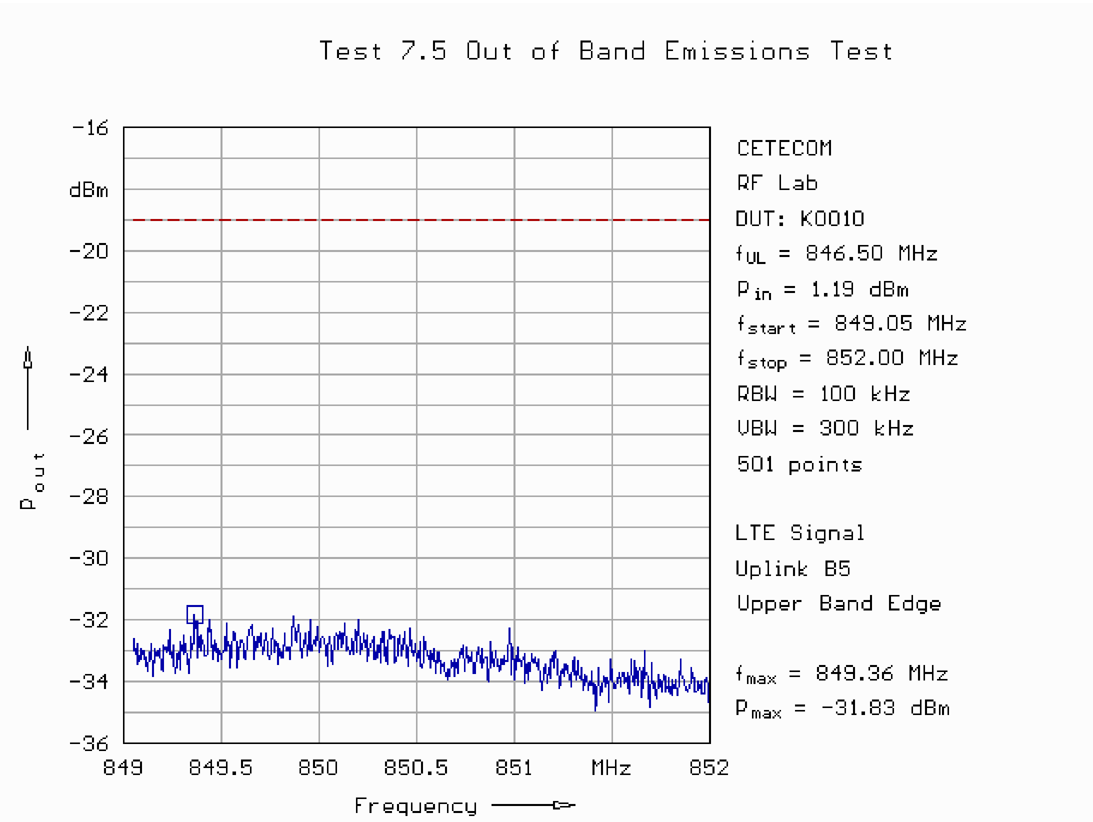

Fig. 86: Out-of-band emissions in uplink in band 5 applying a LTE signal for the upper band edge.

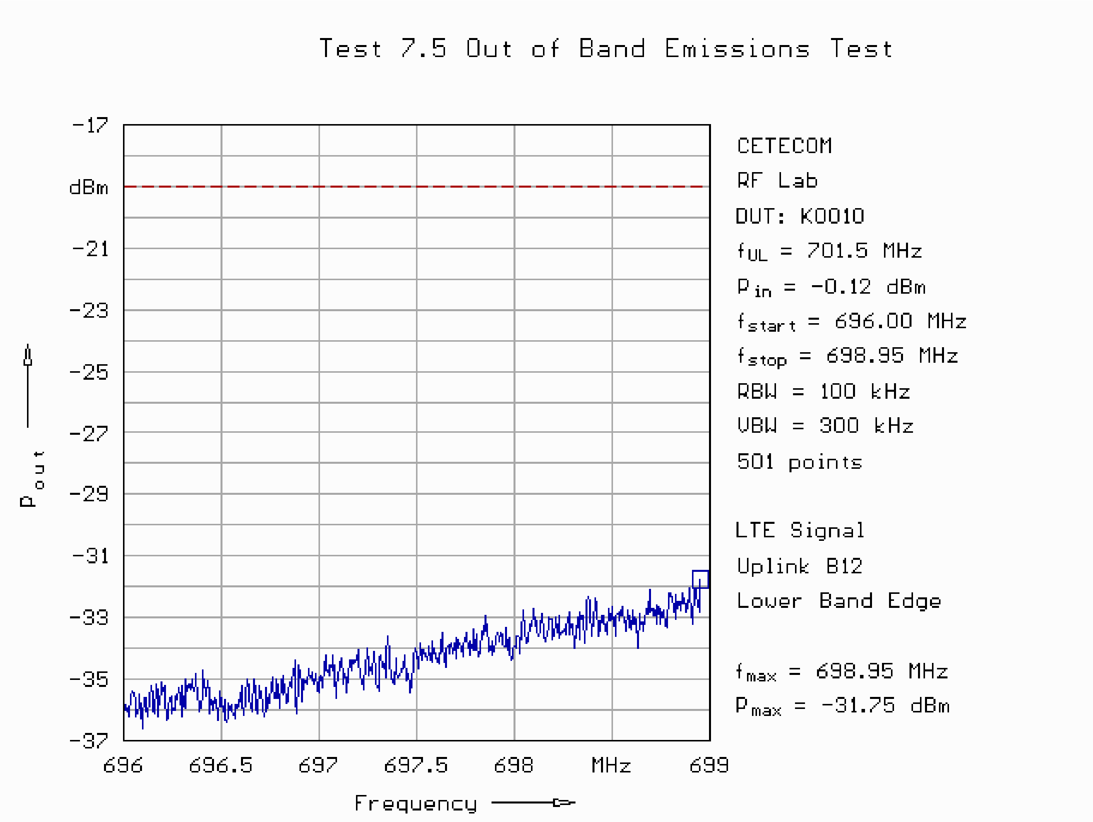

Fig. 87: Out-of-band emissions in uplink in band 12 applying a LTE signal for the lower band edge.

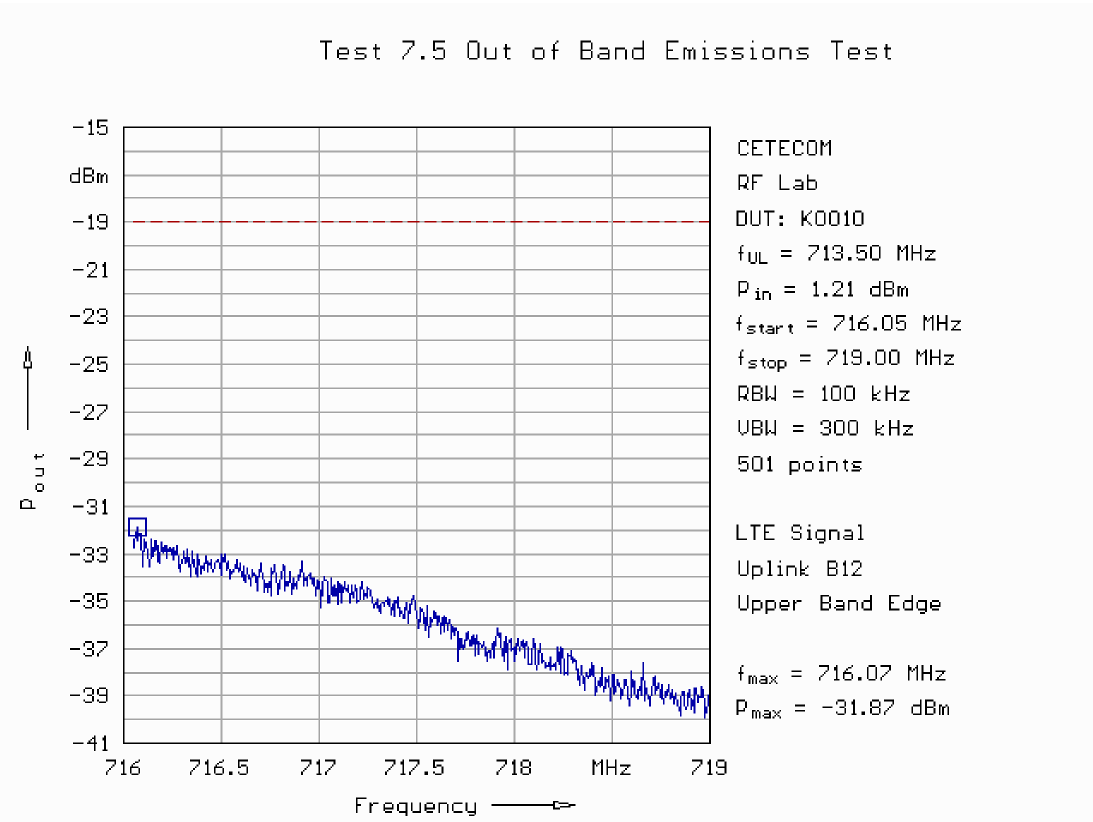

Fig. 88: Out-of-band emissions in uplink in band 12 applying a LTE signal for the upper band edge.

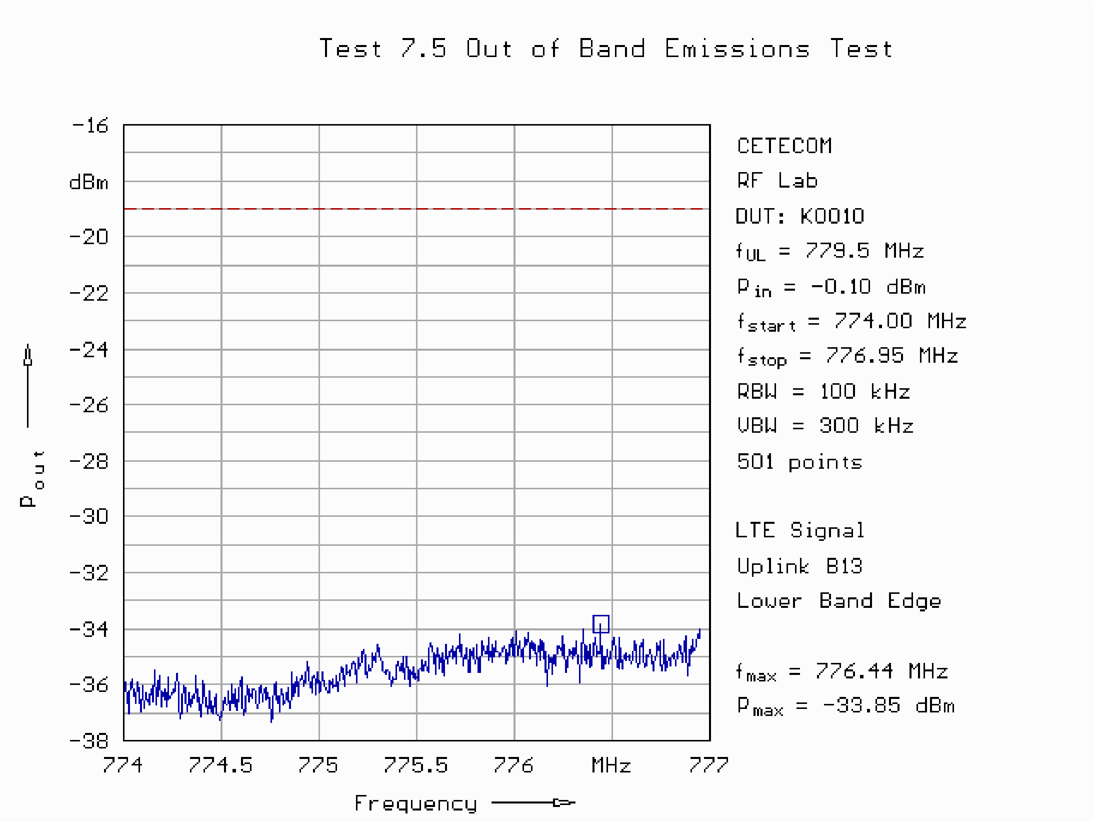

Fig. 89: Out-of-band emissions in uplink in band 13 applying a LTE signal for the lower band edge.

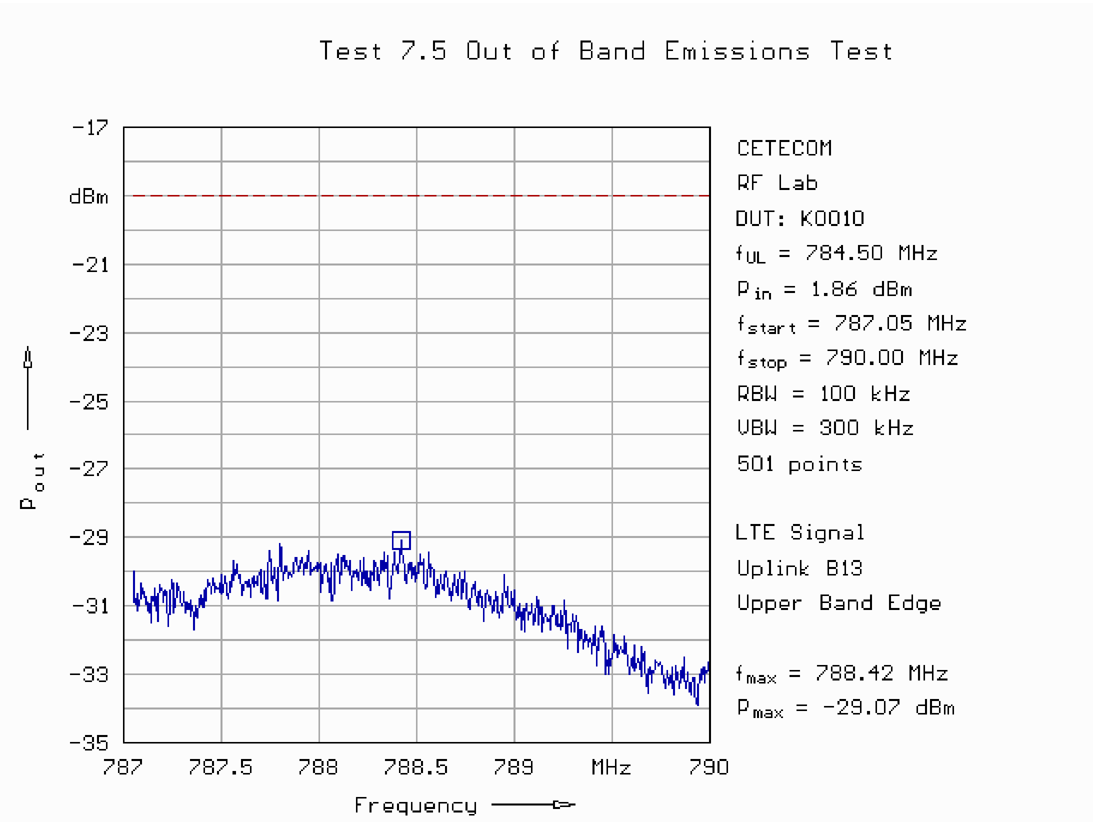

Fig. 90: Out-of-band emissions in uplink in band 13 applying a LTE signal for the upper band edge.

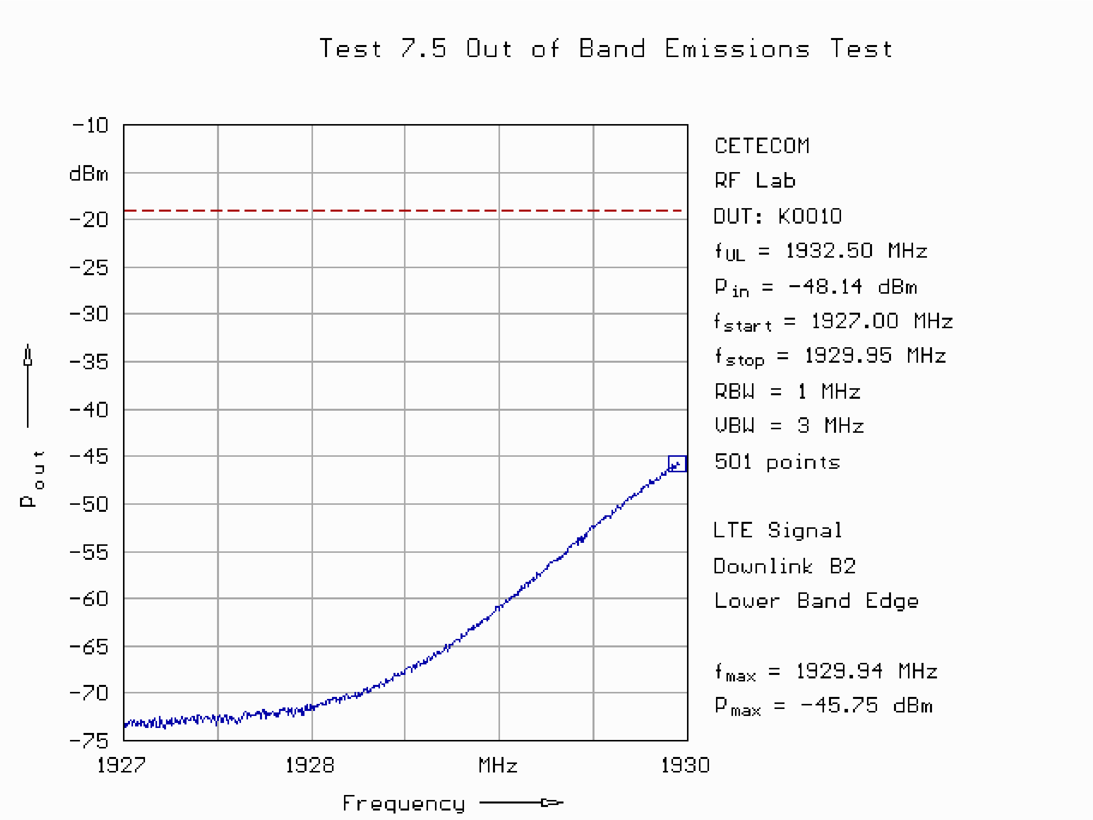

Fig. 91: Out-of-band emissions in downlink in band 2 applying a LTE signal for the lower band edge.

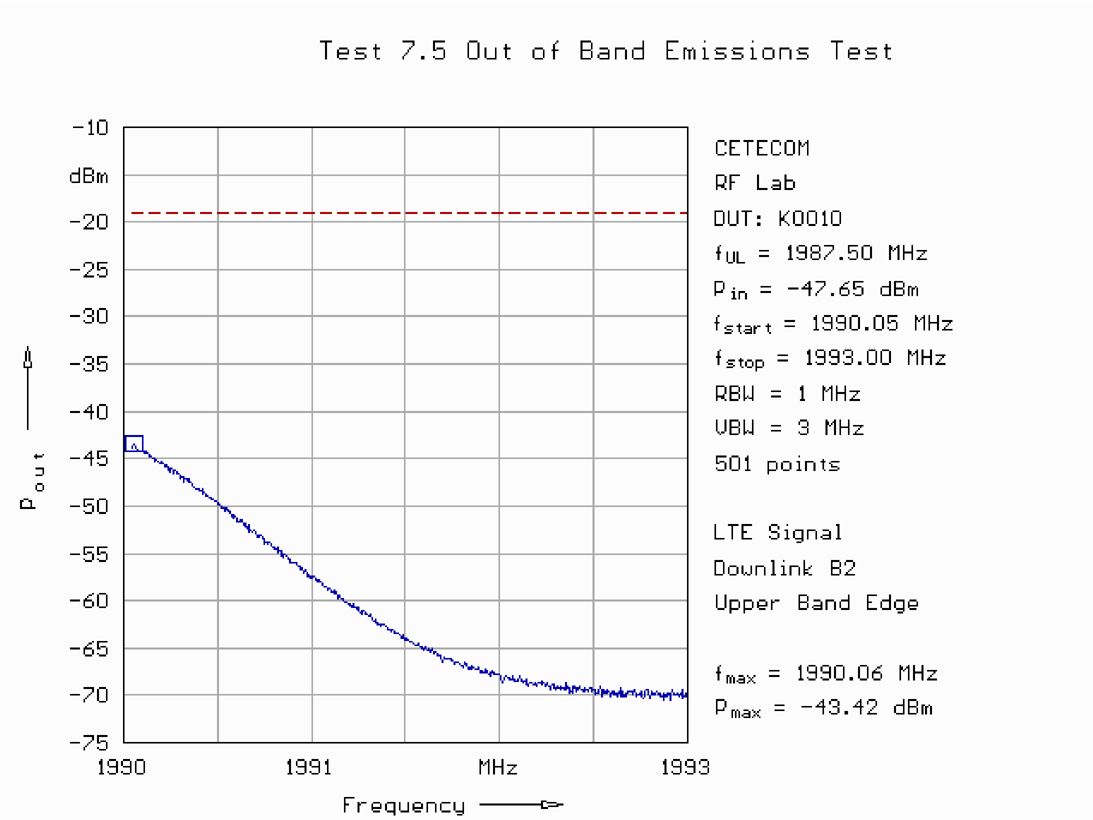

Fig. 92: Out-of-band emissions in downlink in band 2 applying a LTE signal for the upper band edge.

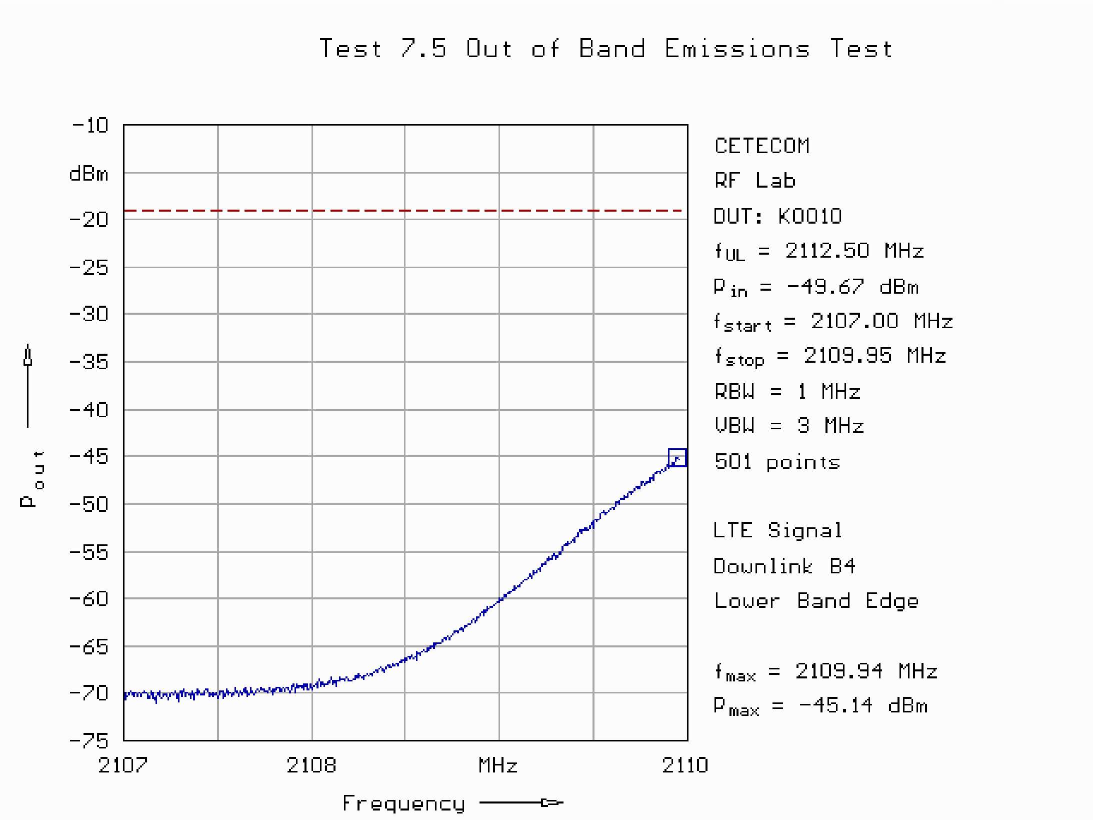

Fig. 93: Out-of-band emissions in downlink in band 4 applying a LTE signal for the lower band edge.

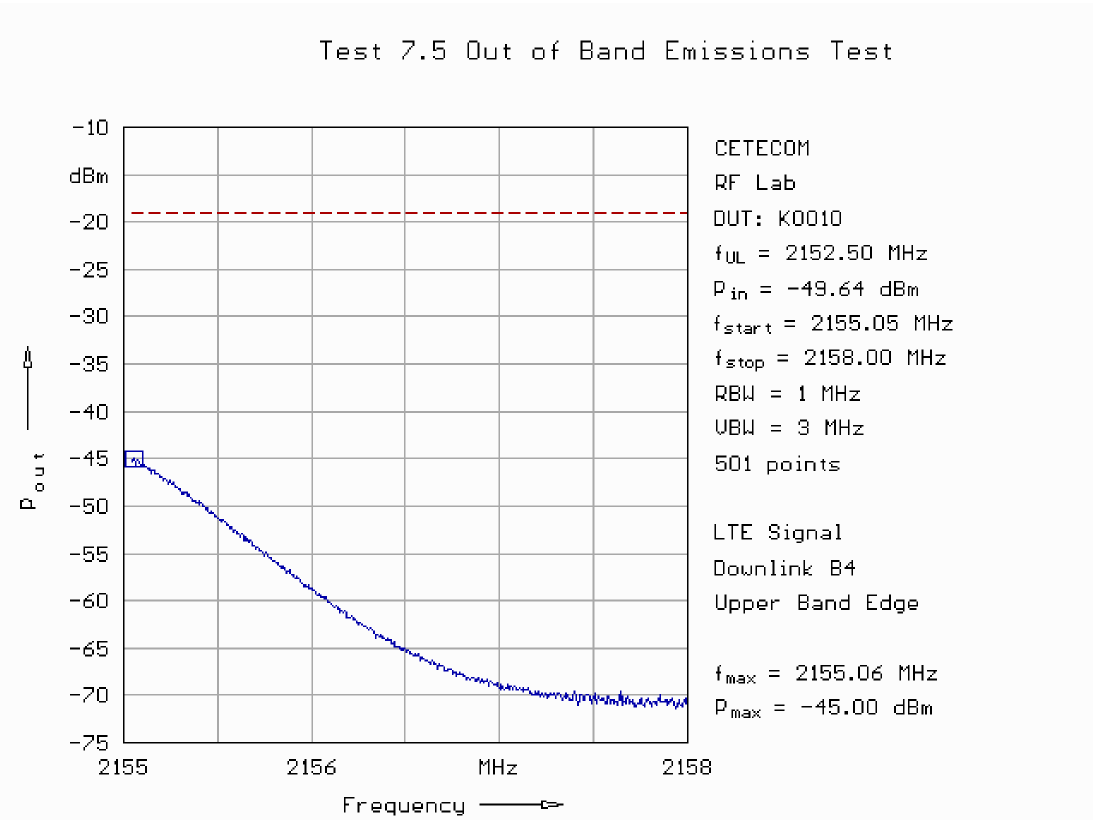

Fig. 94: Out-of-band emissions in downlink in band 4 applying a LTE signal for the upper band edge.

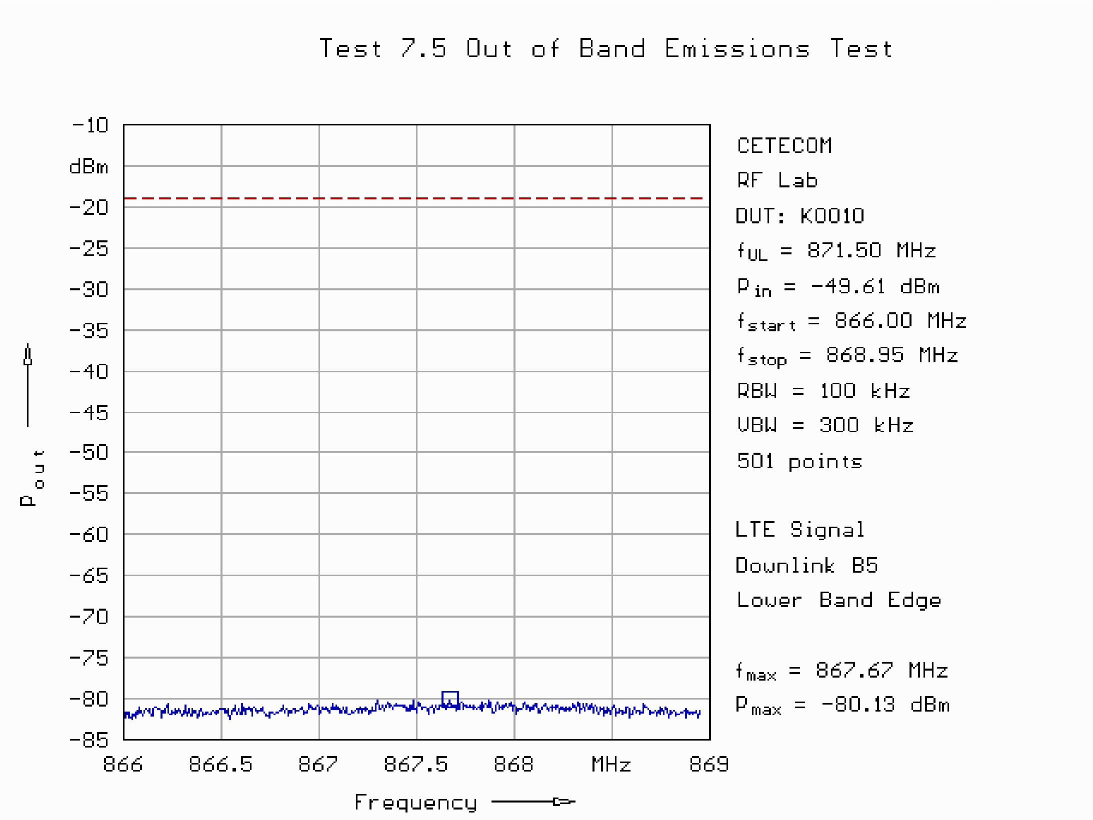

Fig. 95: Out-of-band emissions in downlink in band 5 applying a LTE signal for the lower band edge.

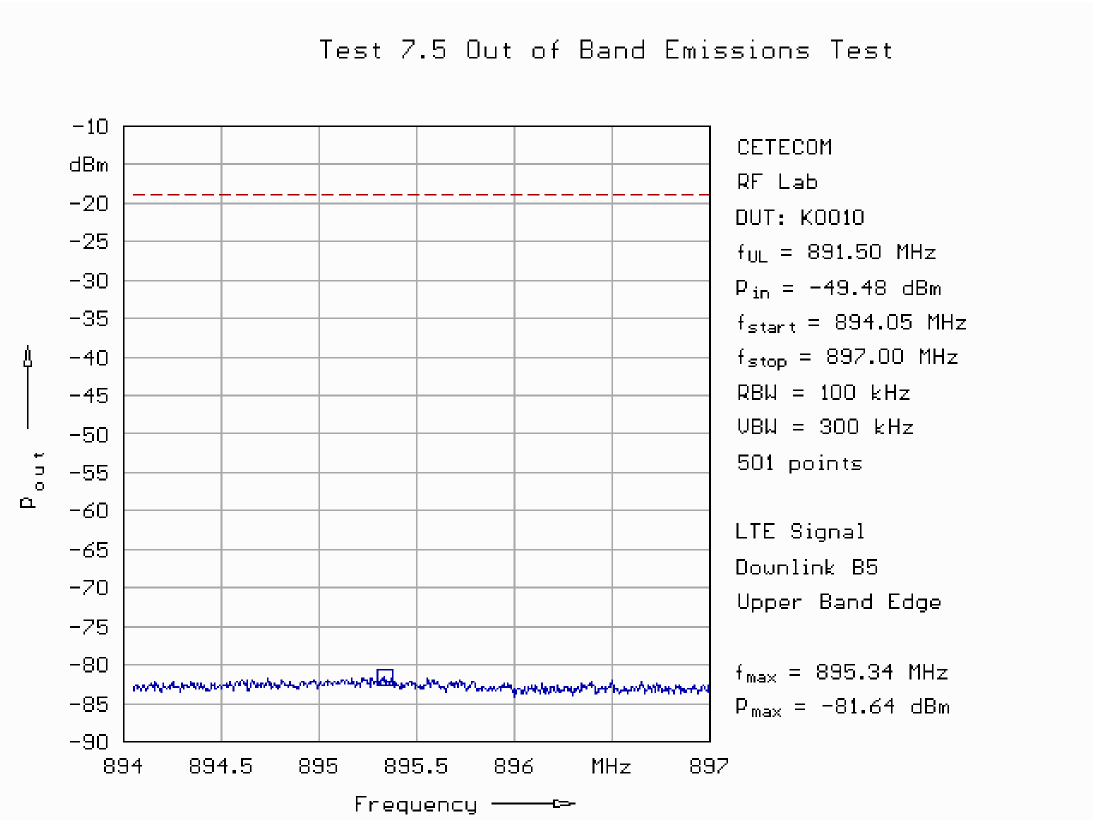

Fig. 96: Out-of-band emissions in downlink in band 5 applying a LTE signal for the upper band edge.

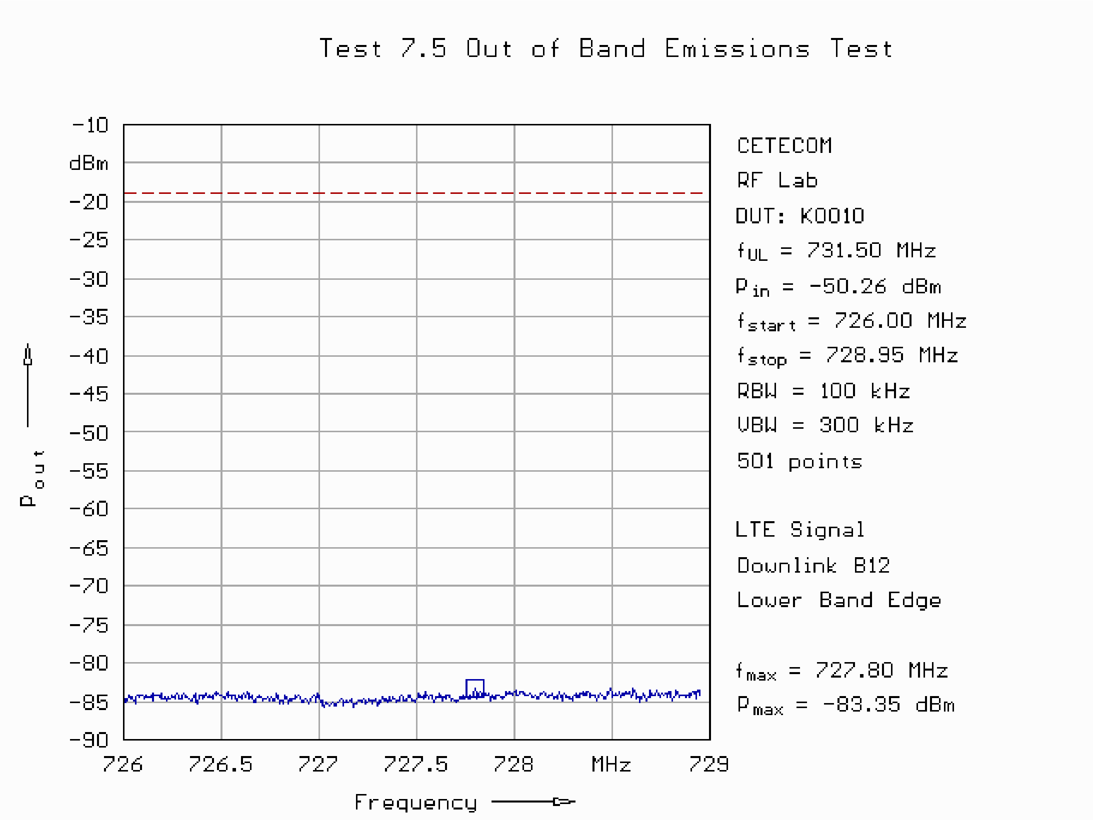

Fig. 97: Out-of-band emissions in downlink in band 12 applying a LTE signal for the lower band edge.

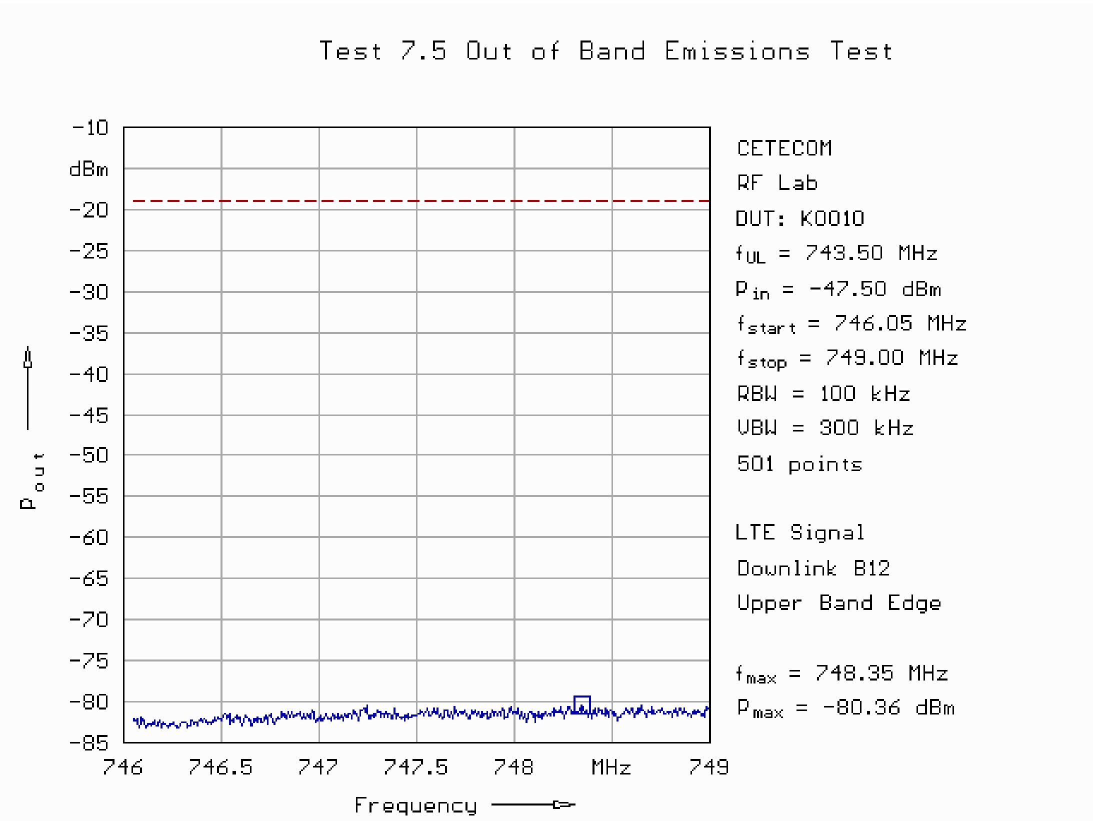

Fig. 98: Out-of-band emissions in downlink in band 12 applying a LTE signal for the upper band edge.

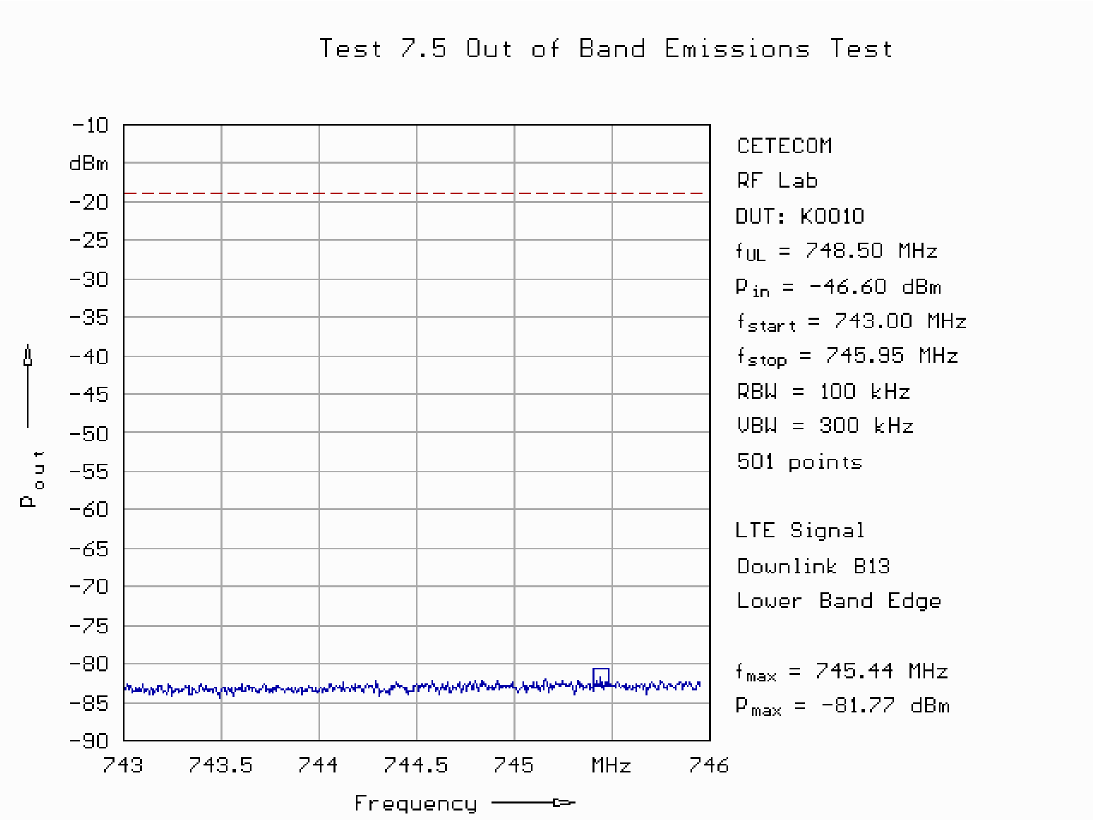

Fig. 99: Out-of-band emissions in downlink in band 13 applying a LTE signal for the lower band edge.

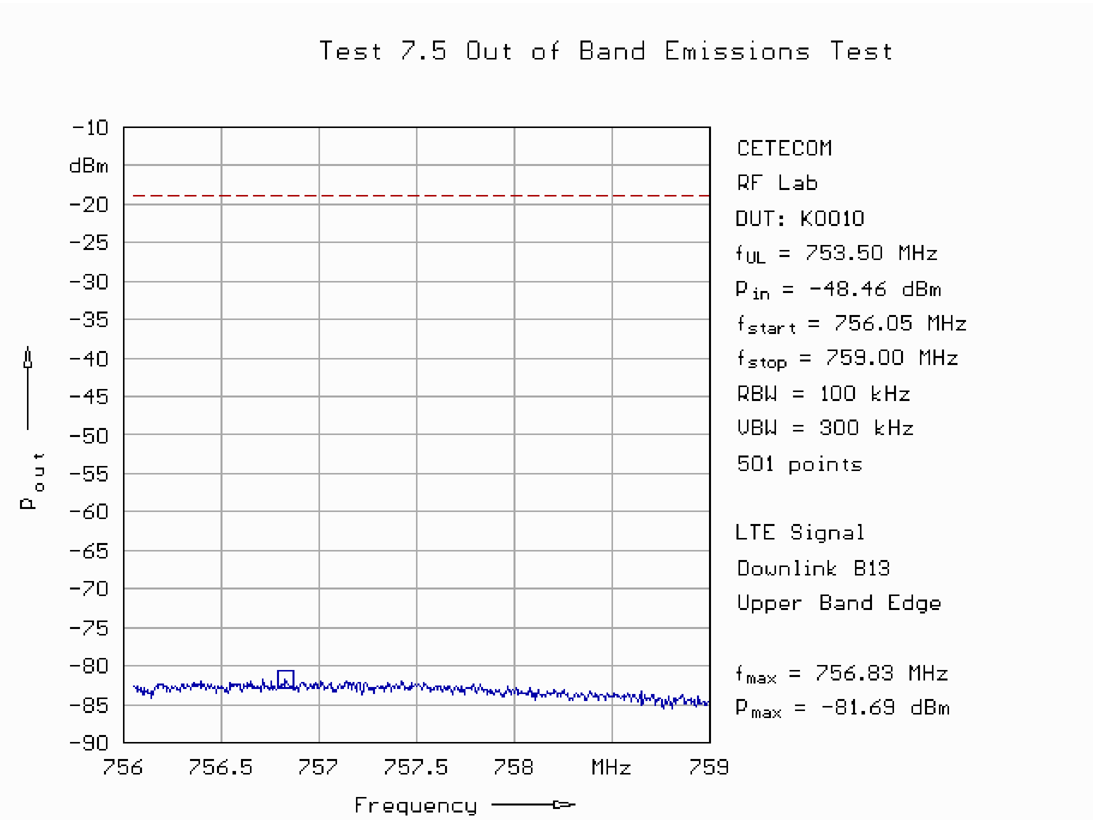

Fig. 100: Out-of-band emissions in downlink in band 13 applying a LTE signal for the upper band edge.

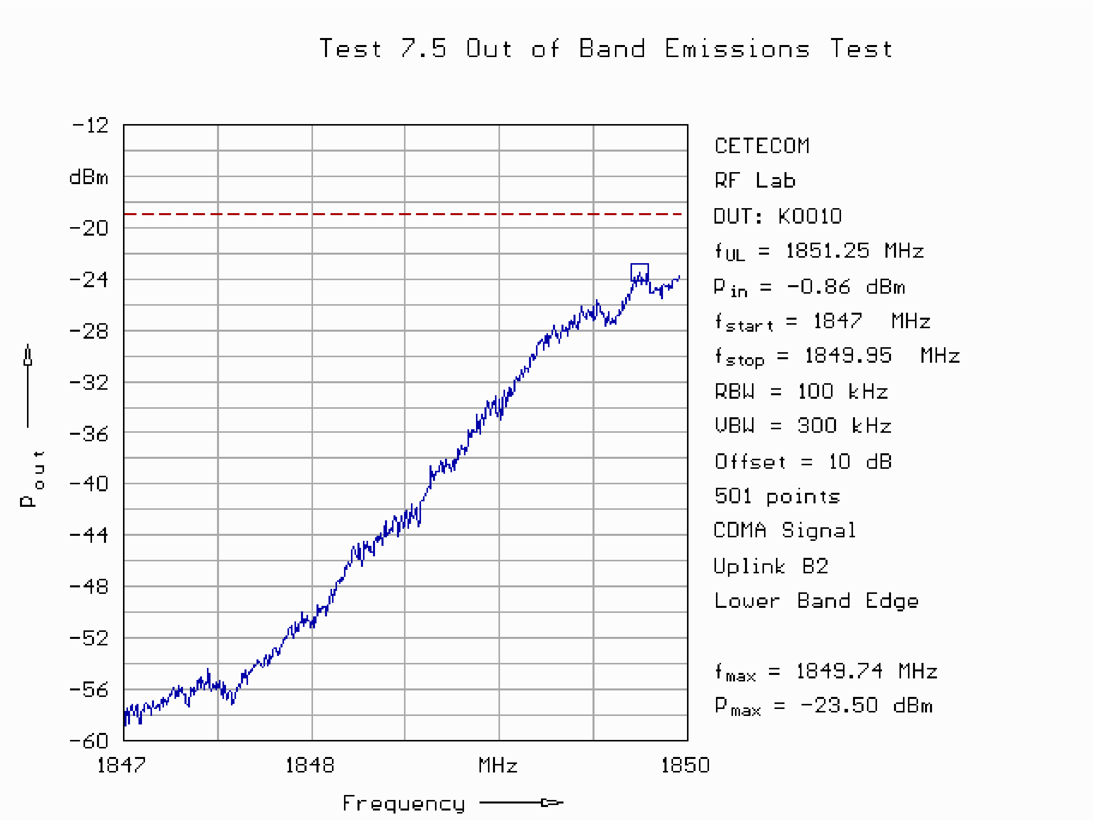

Fig. 101: Out-of-band emissions in uplink in band 2 applying a CDMA signal for the lower band edge.

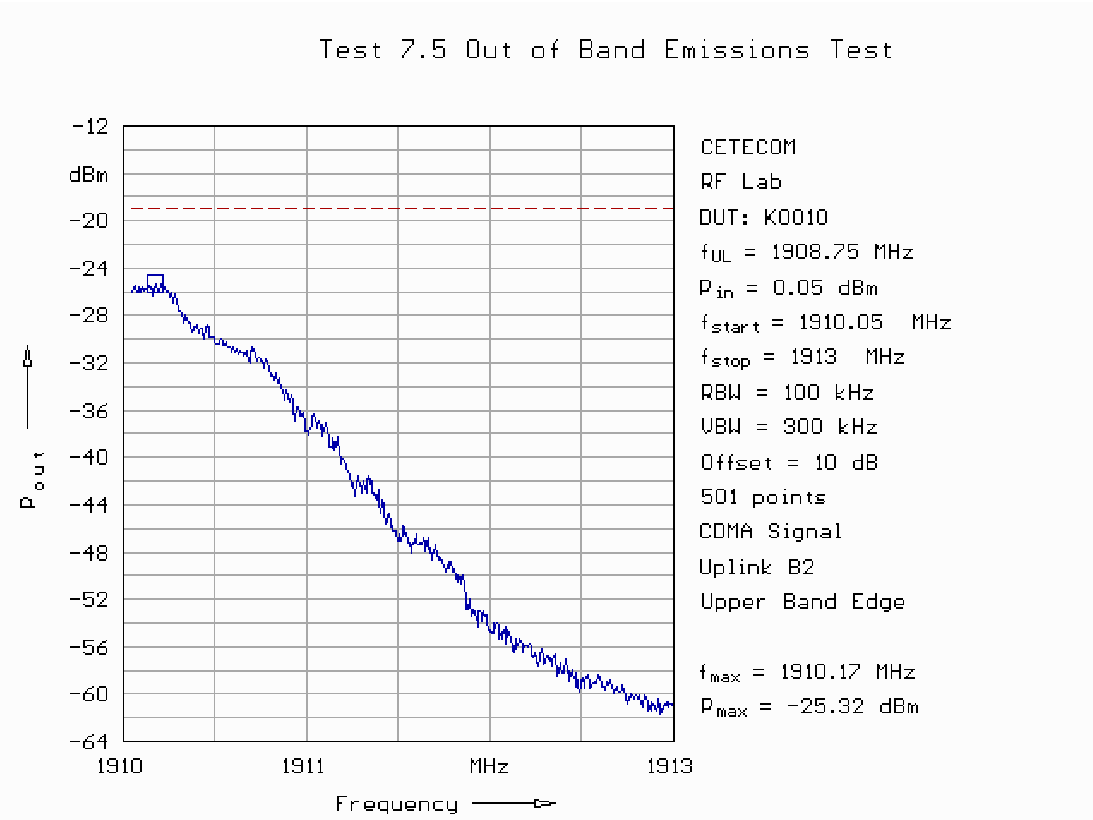

Fig. 102: Out-of-band emissions in uplink in band 2 applying a CDMA signal for the upper band edge.

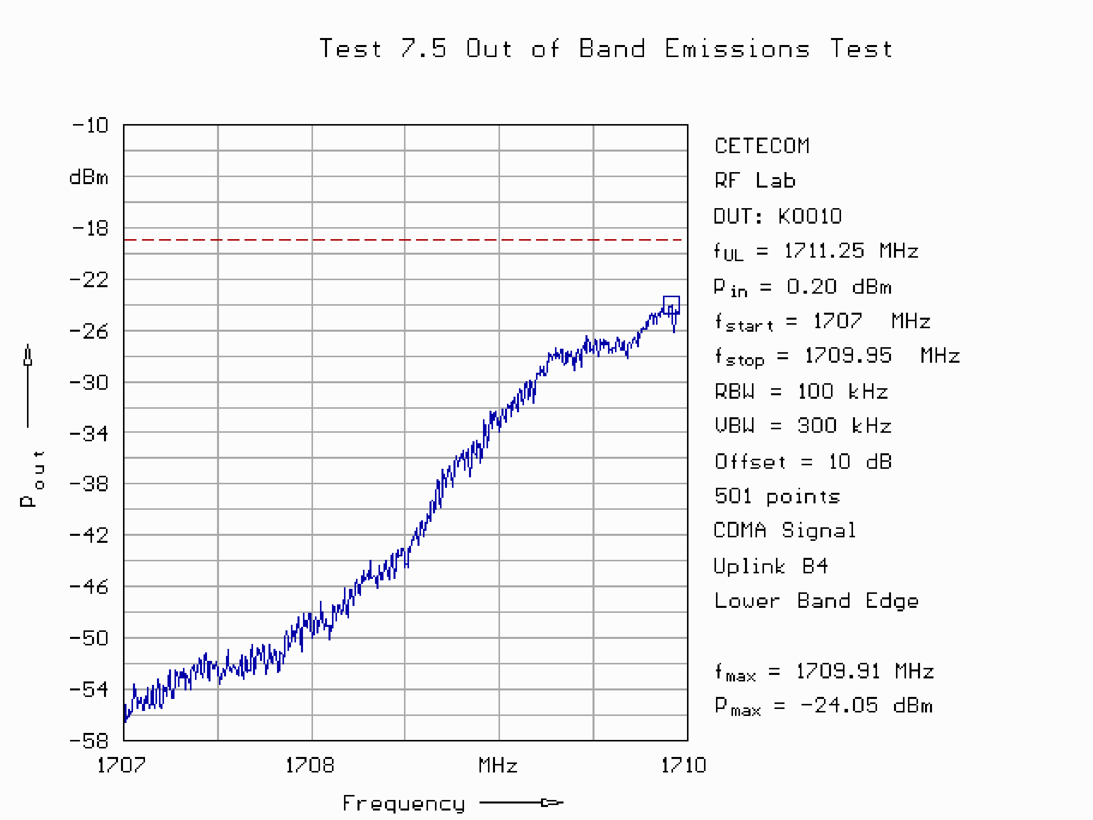

Fig. 103: Out-of-band emissions in uplink in band 4 applying a CDMA signal for the lower band edge.

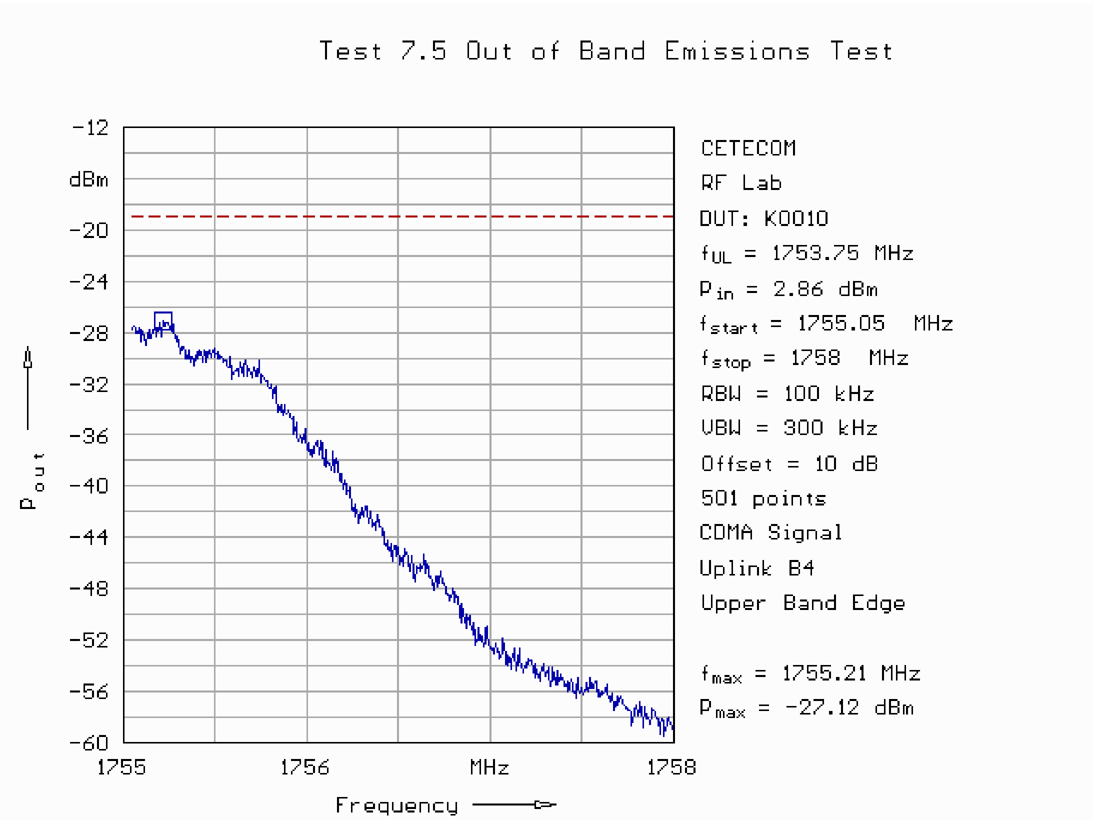

Fig. 104: Out-of-band emissions in uplink in band 4 applying a CDMA signal for the upper band edge.

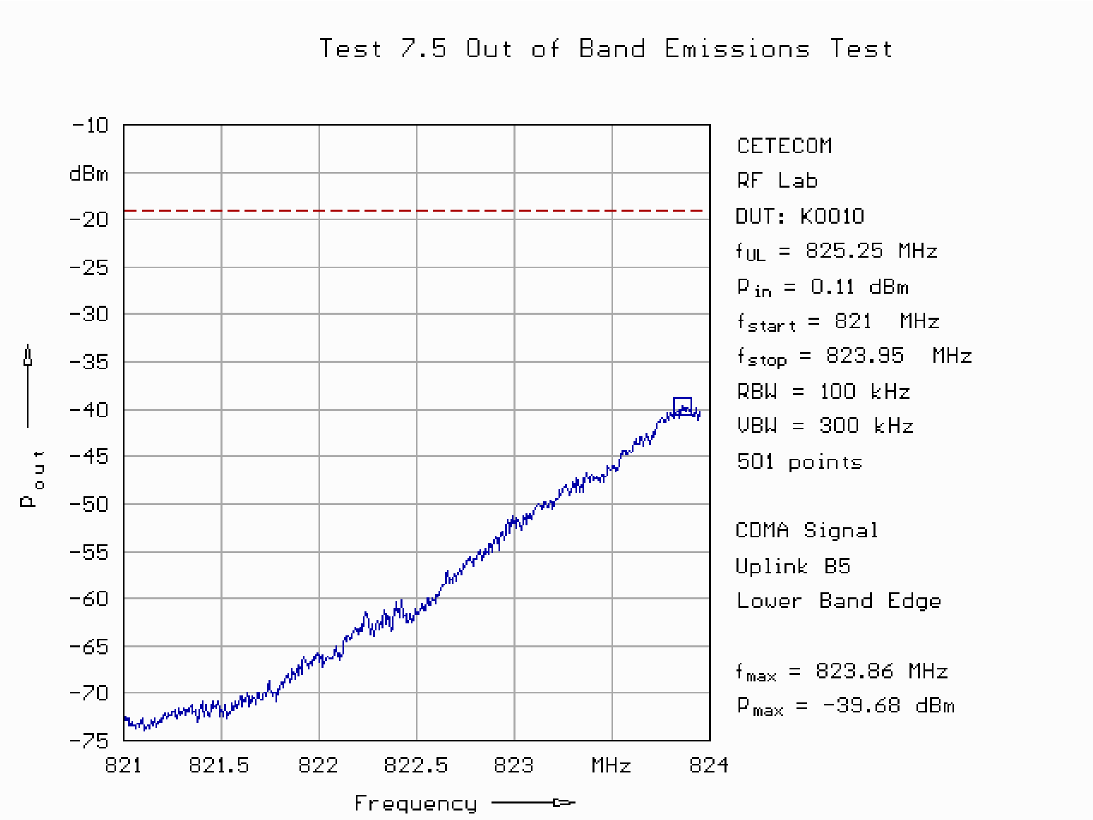

Fig. 105: Out-of-band emissions in uplink in band 5 applying a CDMA signal for the lower band edge.

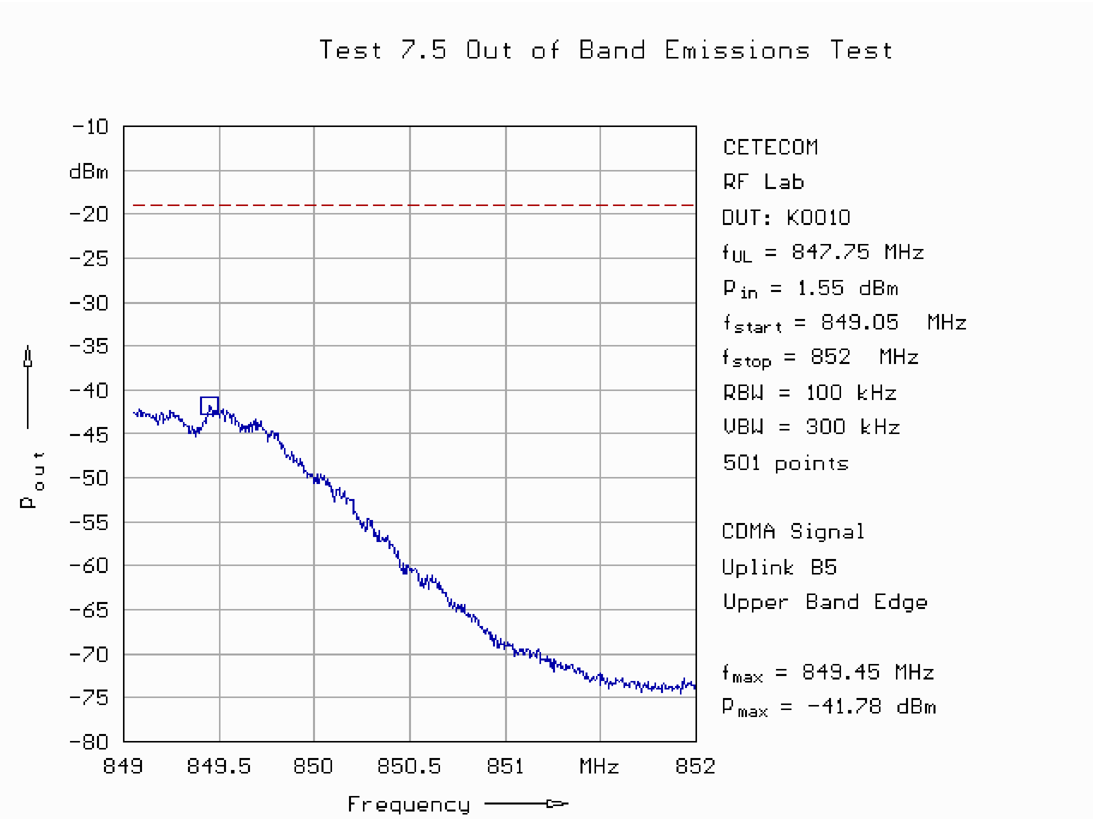

Fig. 106: Out-of-band emissions in uplink in band 5 applying a CDMA signal for the upper band edge.

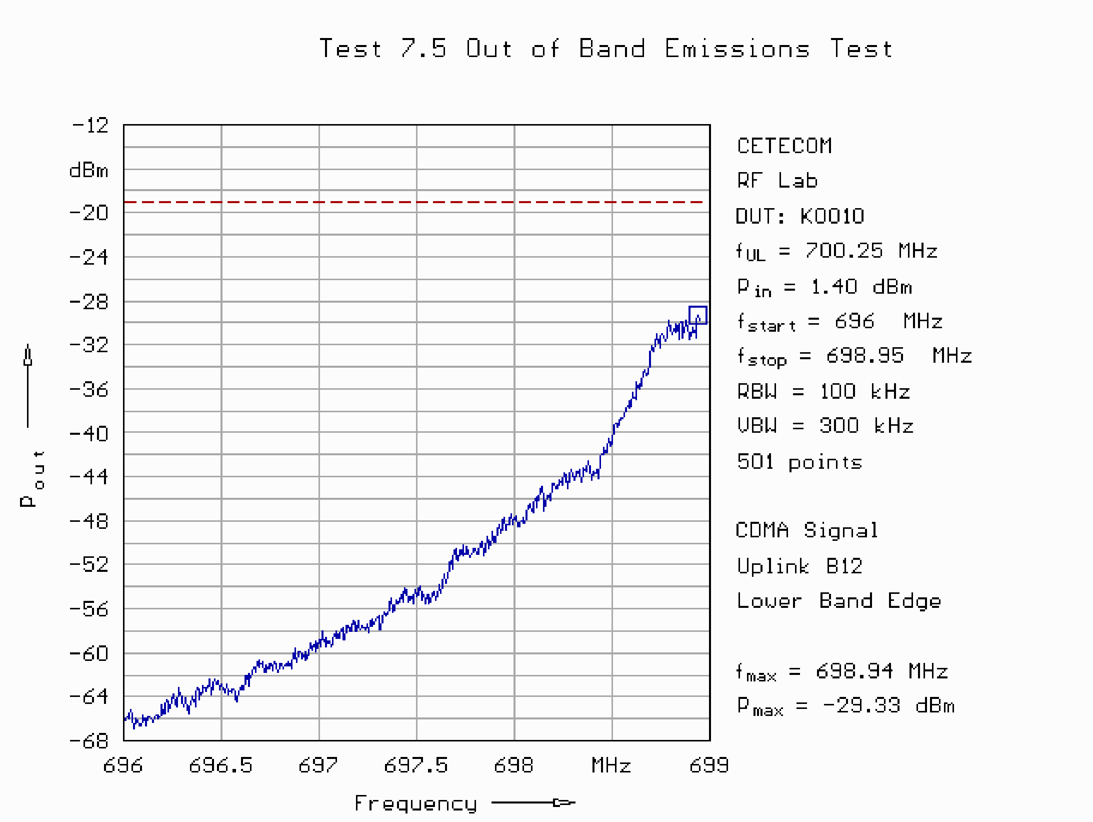

Fig. 107: Out-of-band emissions in uplink in band 12 applying a CDMA signal for the lower band edge.

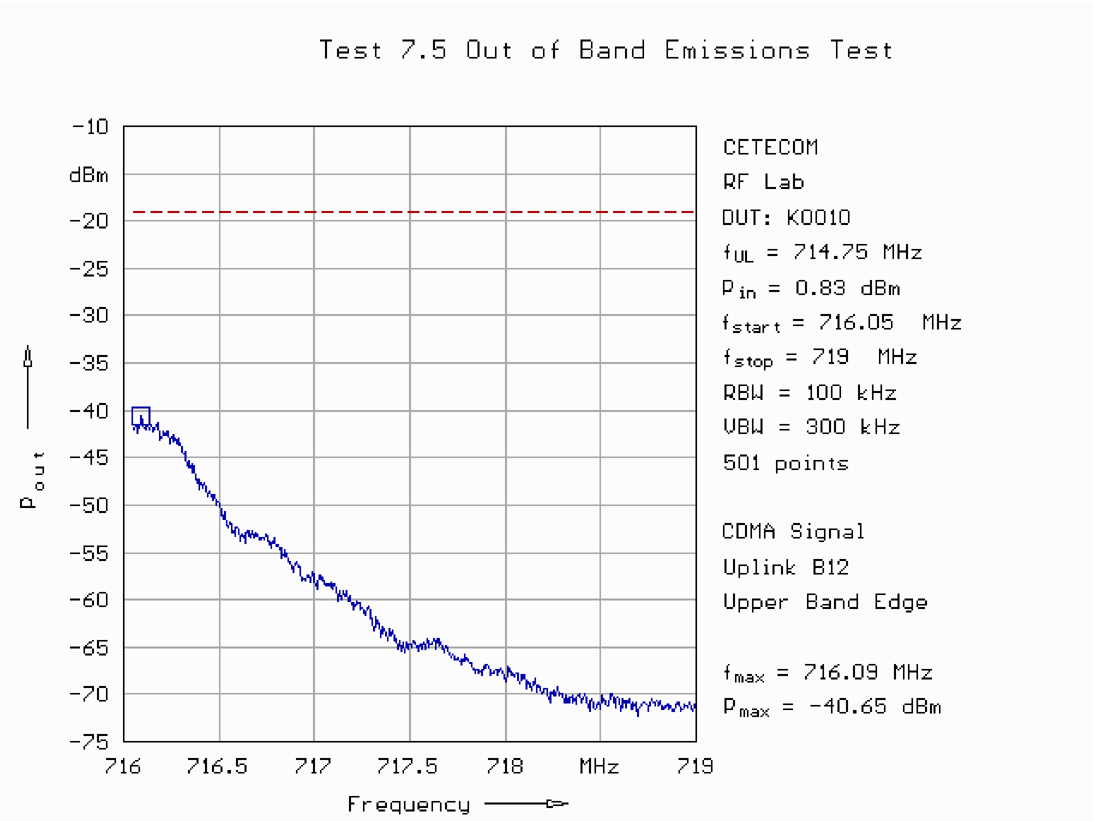

Fig. 108: Out-of-band emissions in uplink in band 12 applying a CDMA signal for the upper band edge.

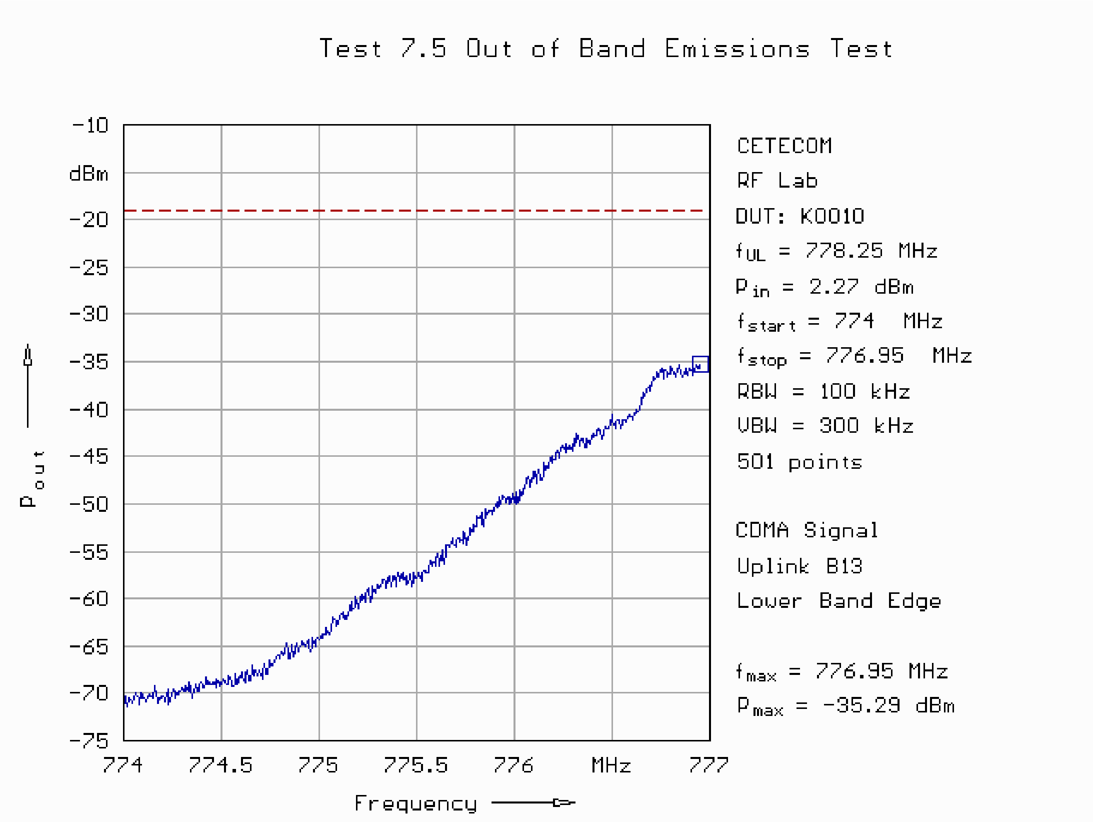

Fig. 109: Out-of-band emissions in uplink in band 13 applying a CDMA signal for the lower band edge.

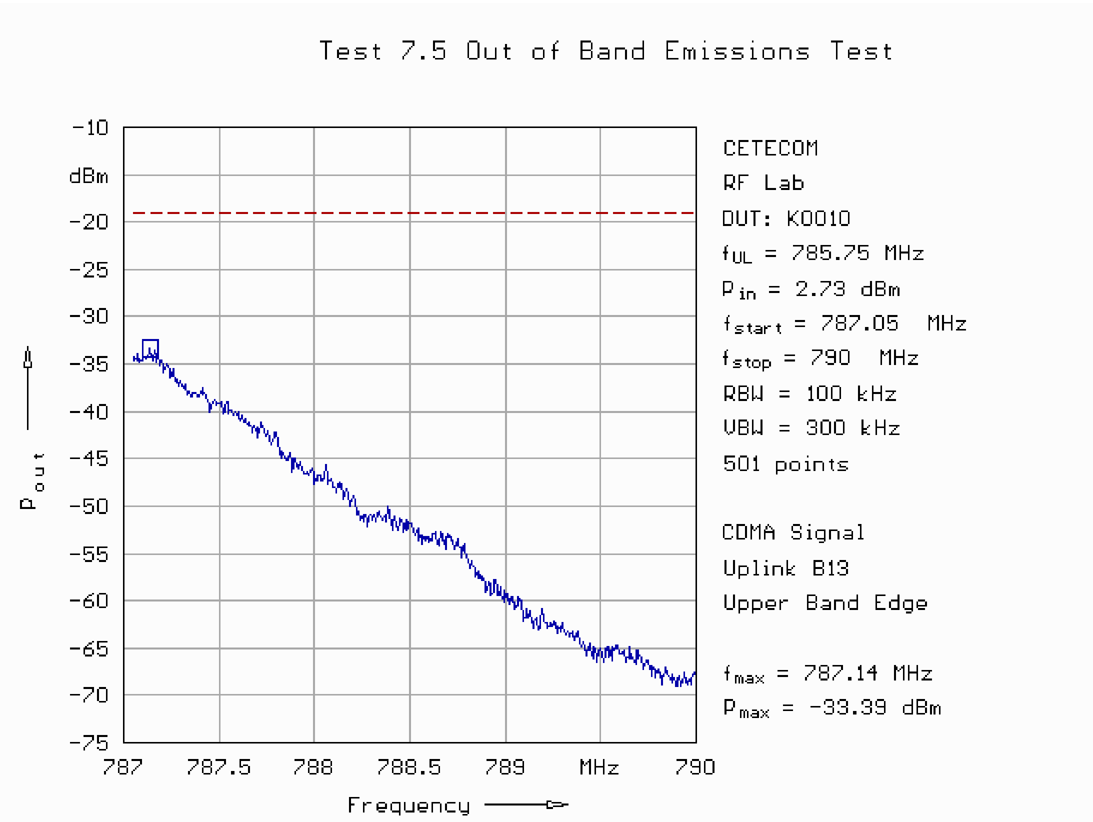

Fig. 110: Out-of-band emissions in uplink in band 13 applying a CDMA signal for the upper band edge.

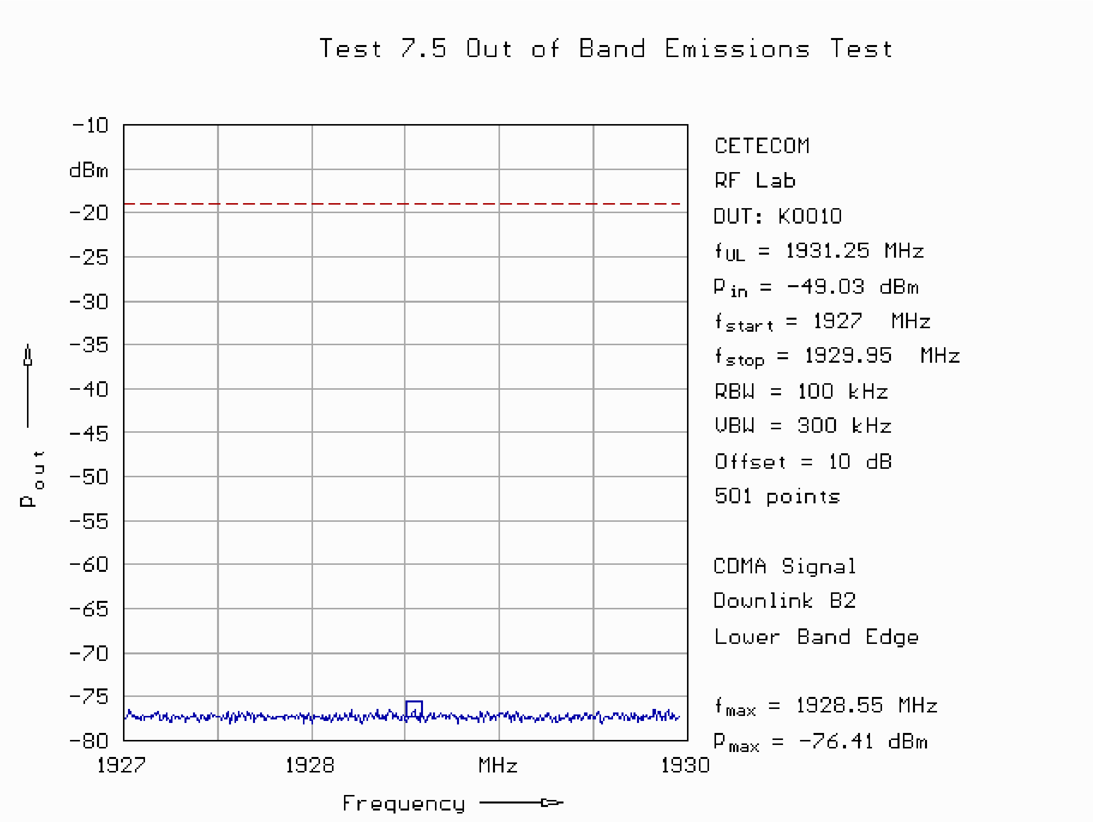

Fig. 111: Out-of-band emissions in downlink in band 2 applying a CDMA signal for the lower band edge.

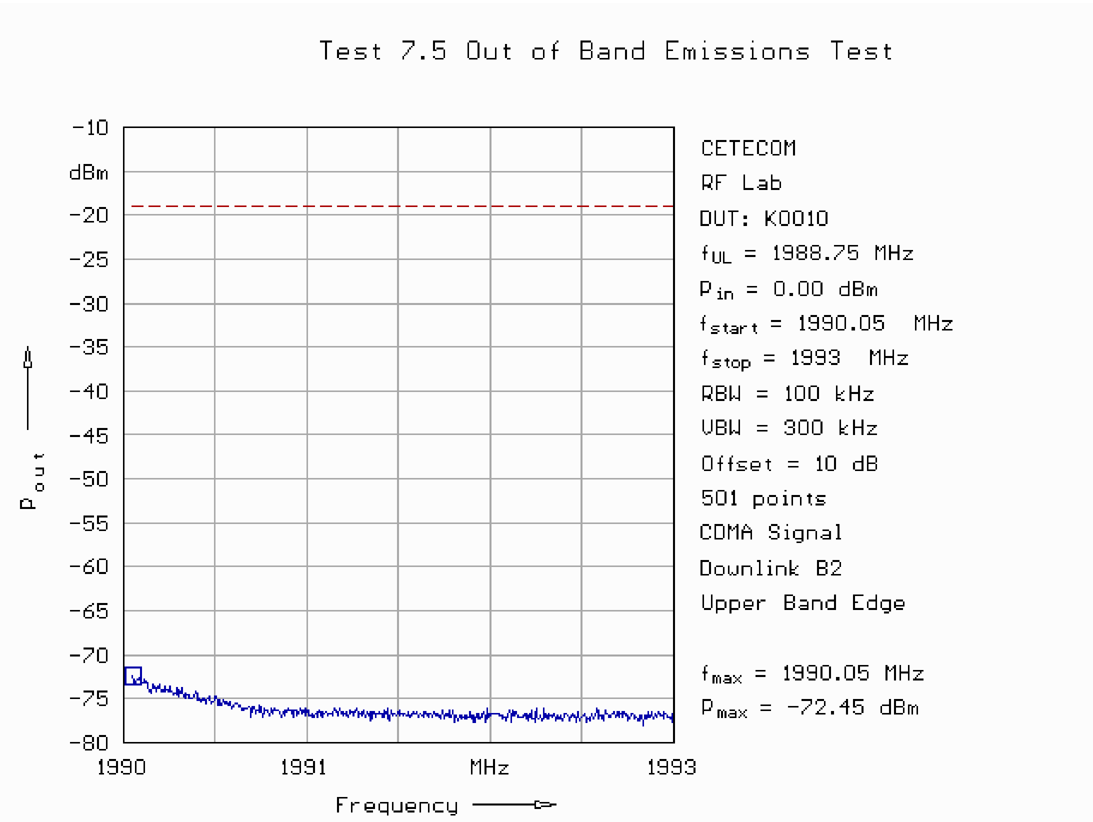

Fig. 112: Out-of-band emissions in downlink in band 2 applying a CDMA signal for the upper band edge.

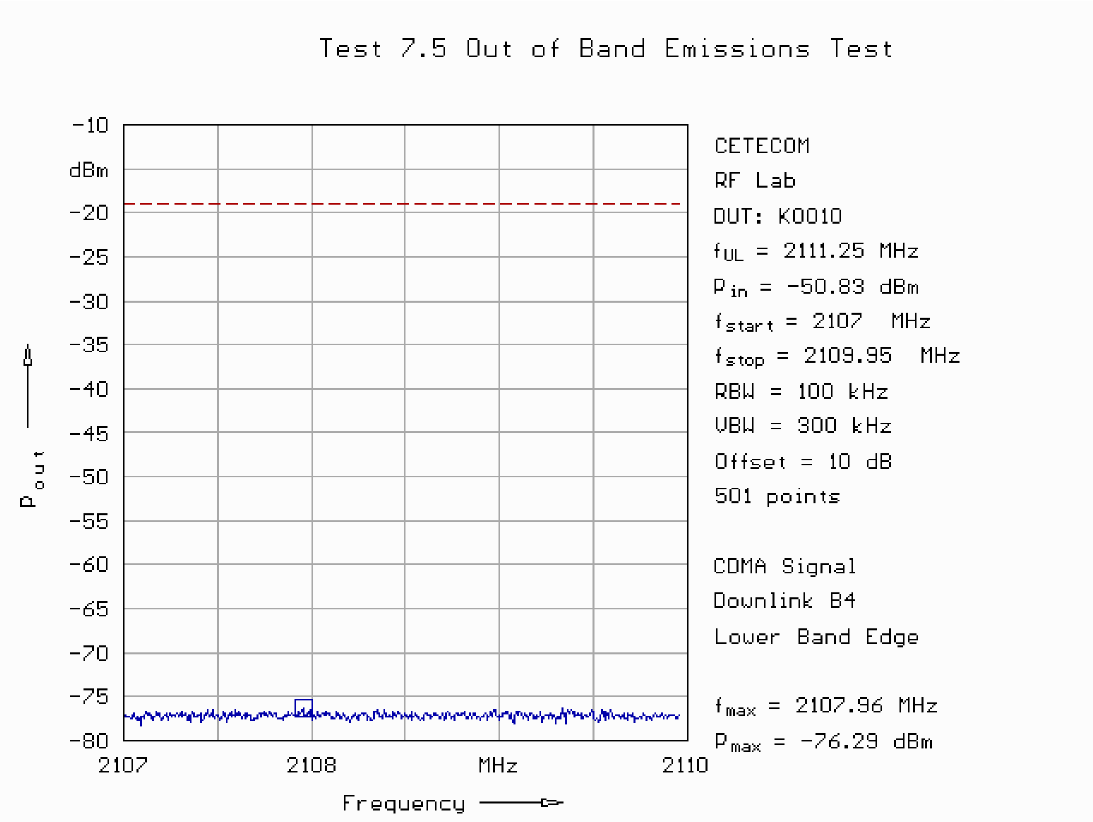

Fig. 113: Out-of-band emissions in downlink in band 4 applying a CDMA signal for the lower band edge.

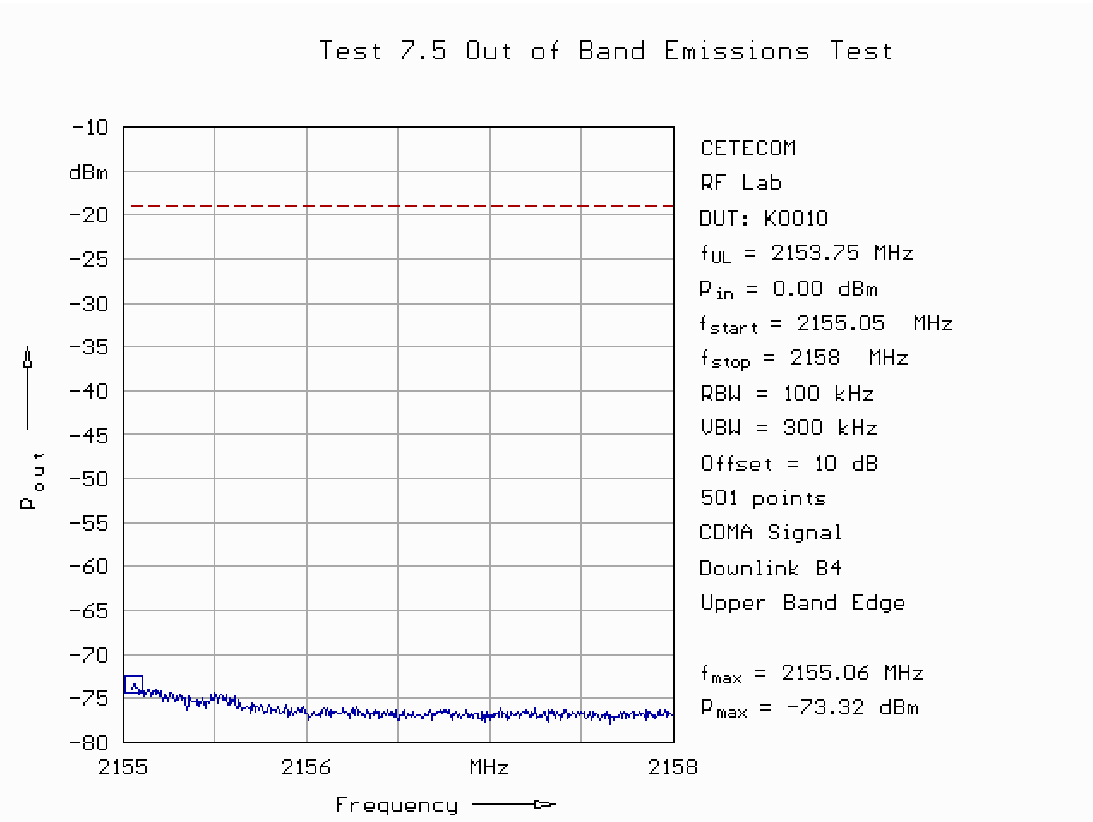

Fig. 114: Out-of-band emissions in downlink in band 4 applying a CDMA signal for the upper band edge.

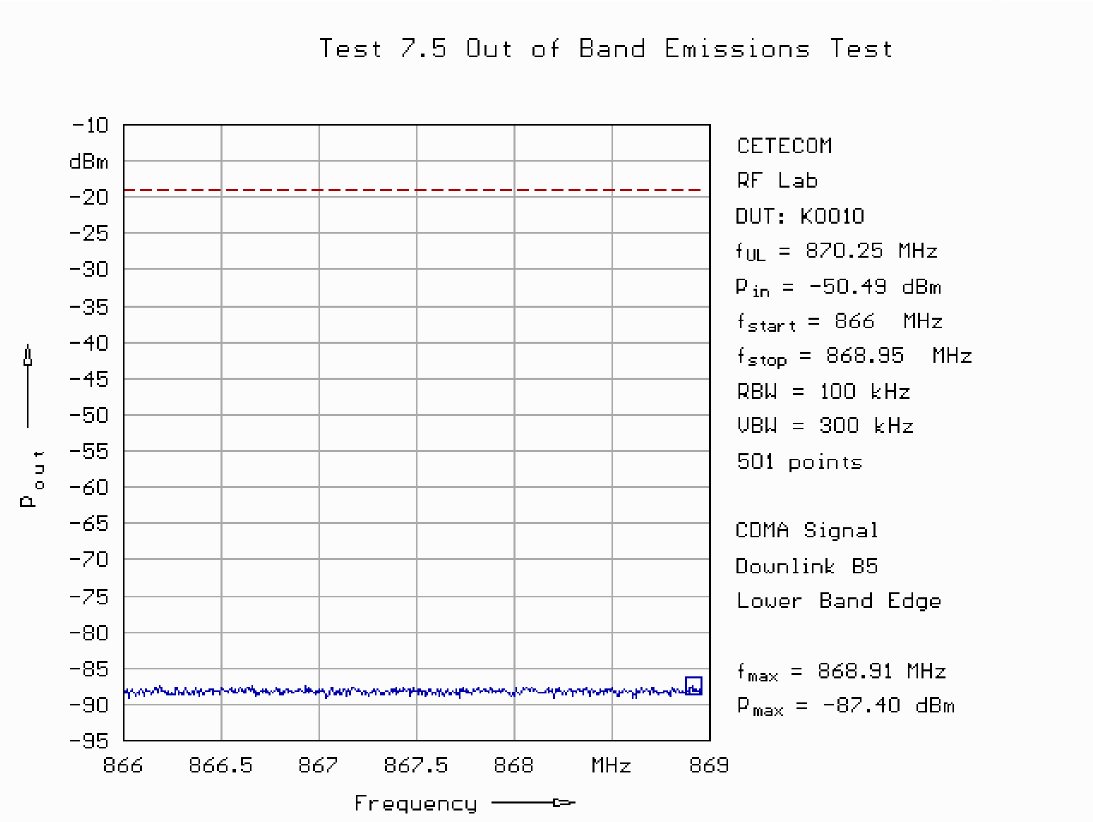

Fig. 115: Out-of-band emissions in downlink in band 5 applying a CDMA signal for the lower band edge.

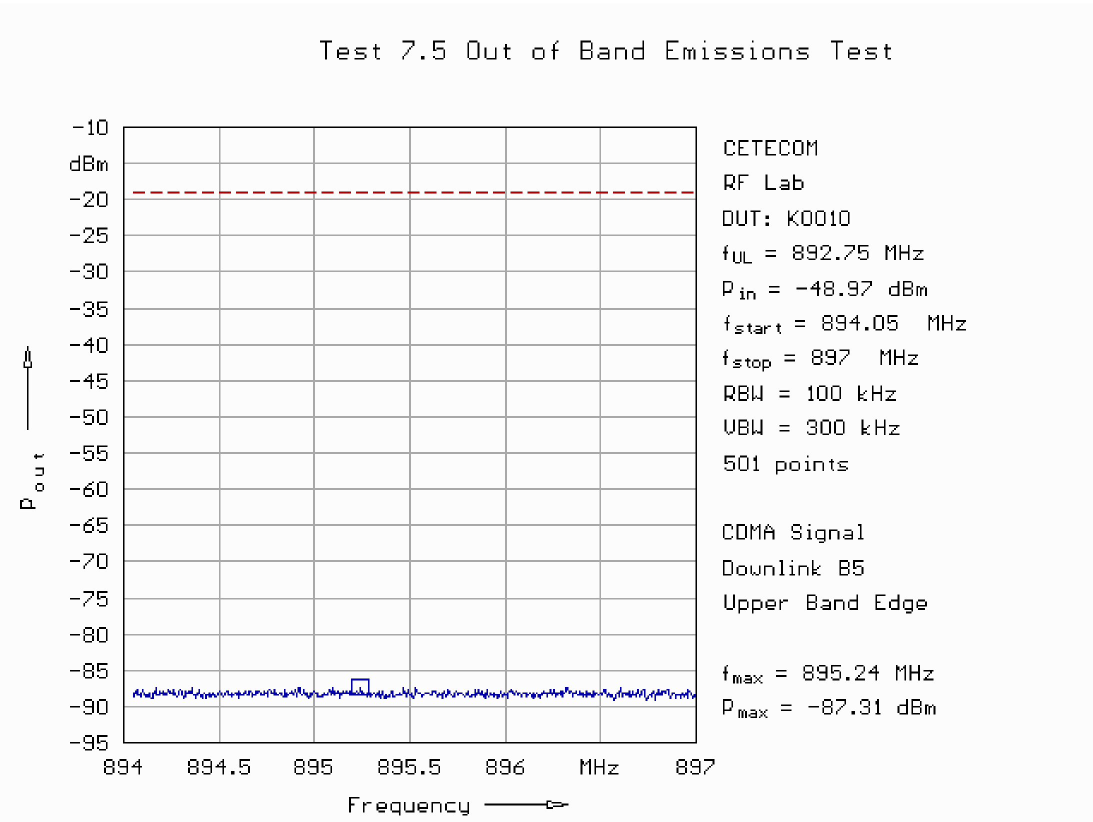

Fig. 116: Out-of-band emissions in downlink in band 5 applying a CDMA signal for the upper band edge.

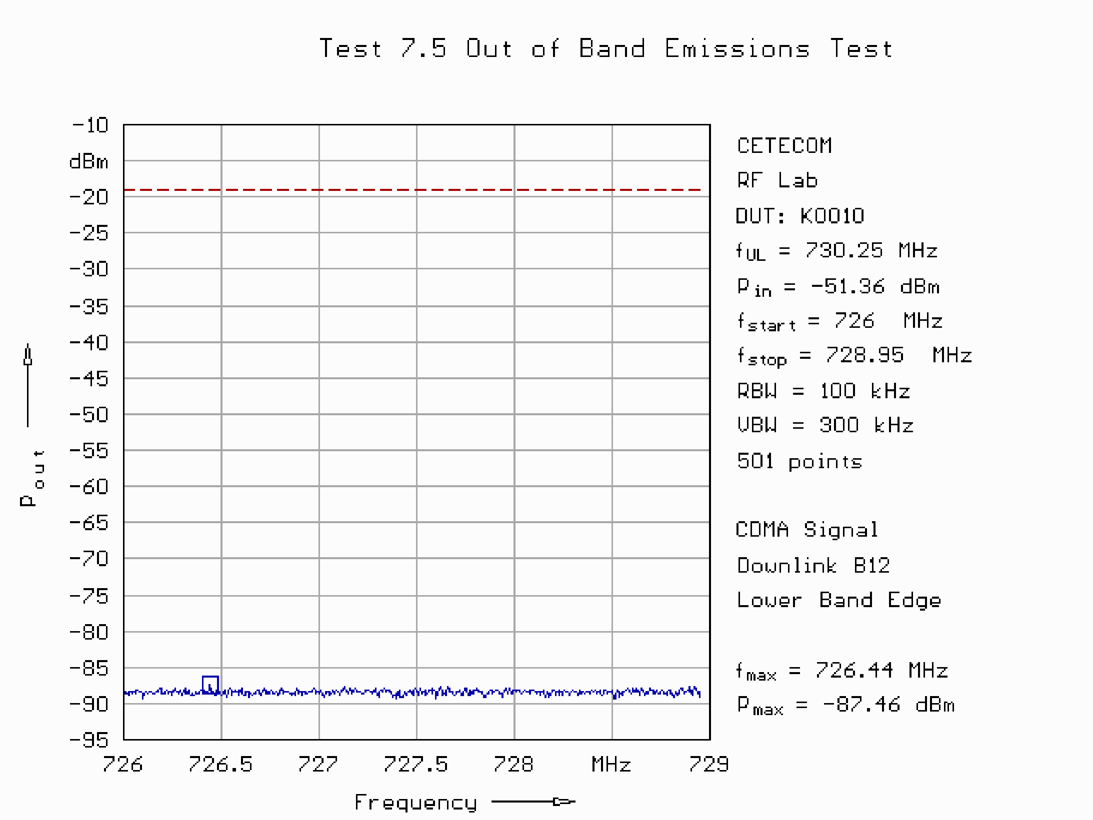

Fig. 117: Out-of-band emissions in downlink in band 12 applying a CDMA signal for the lower band edge.

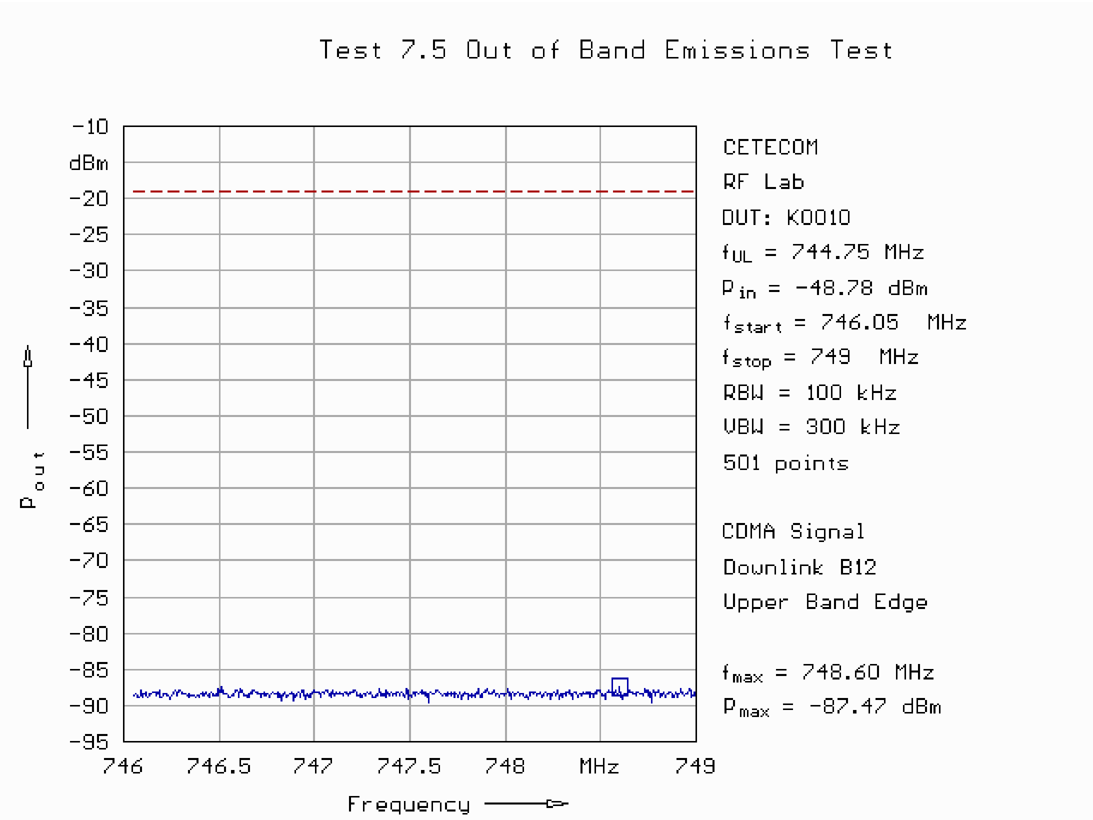

Fig. 118: Out-of-band emissions in downlink in band 12 applying a CDMA signal for the upper band edge.

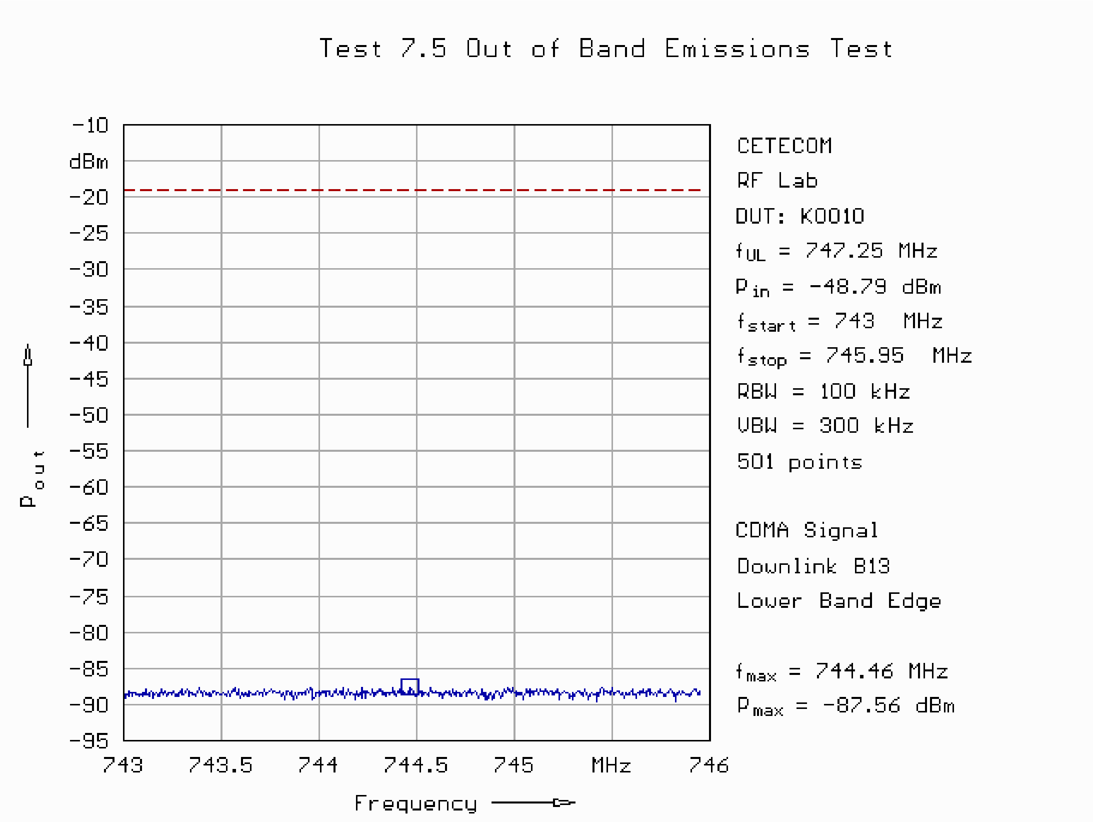

Fig. 119: Out-of-band emissions in downlink in band 13 applying a CDMA signal for the lower band edge.

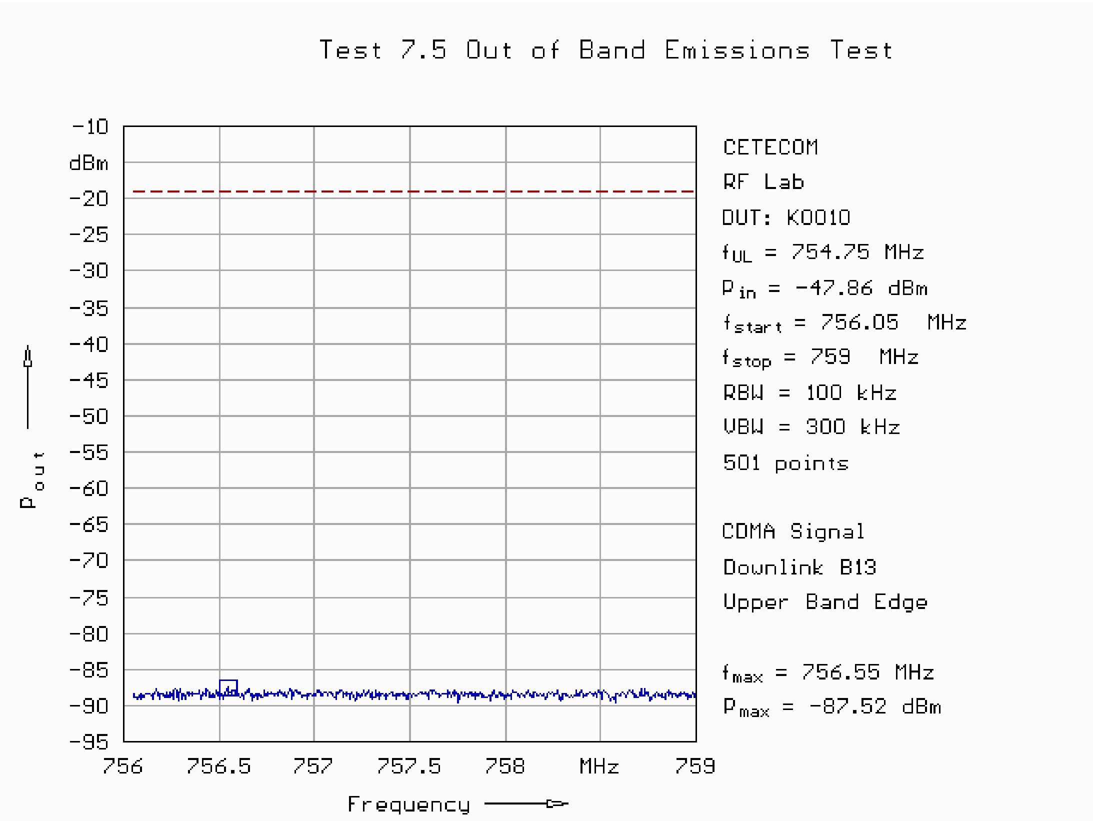

Fig. 120: Out-of-band emissions in downlink in band 13 applying a CDMA signal for the upper band edge.

5.6. Conducted Spurious Emissions

The activated cable routing for this test has been the same as used in chapter 5.1.

This test starts at 400 kHz since the minimal frequency created within the device is 410 kHz.

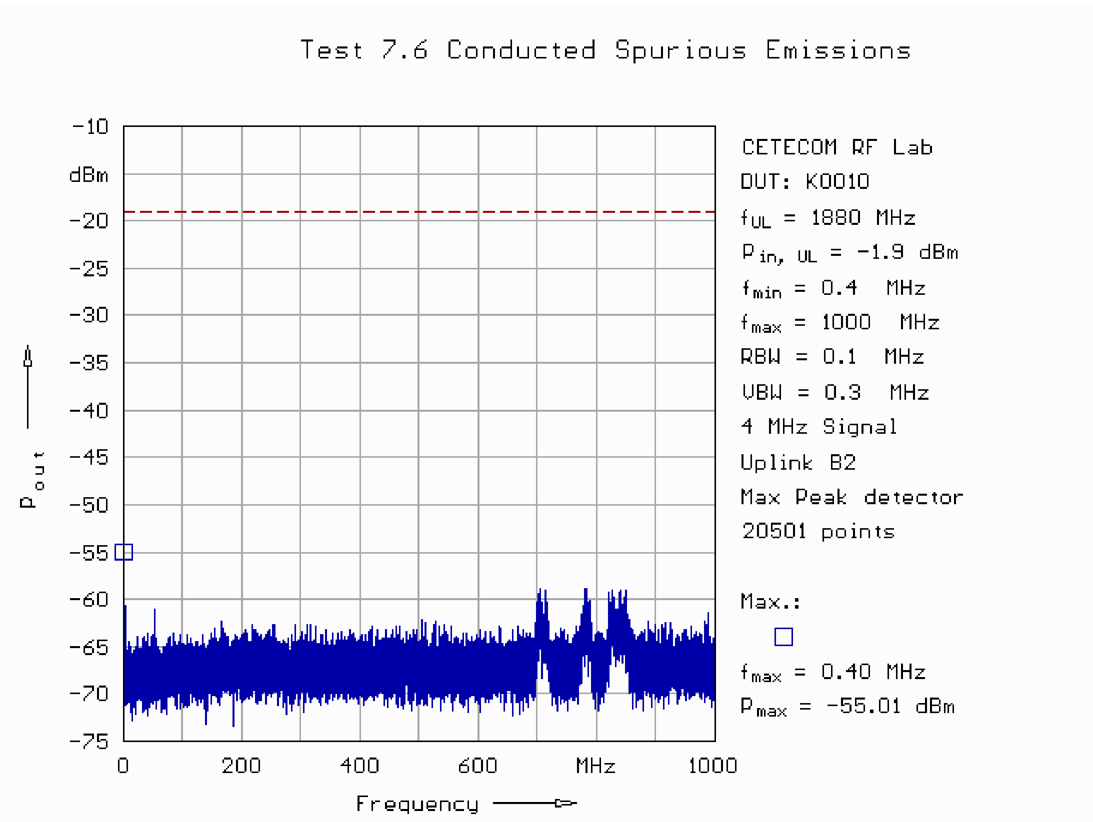

Fig. 121: Conducted spurious emissions in uplink in band 2 applying a 4 MHz signal (0.4 MHz – 1 GHz).

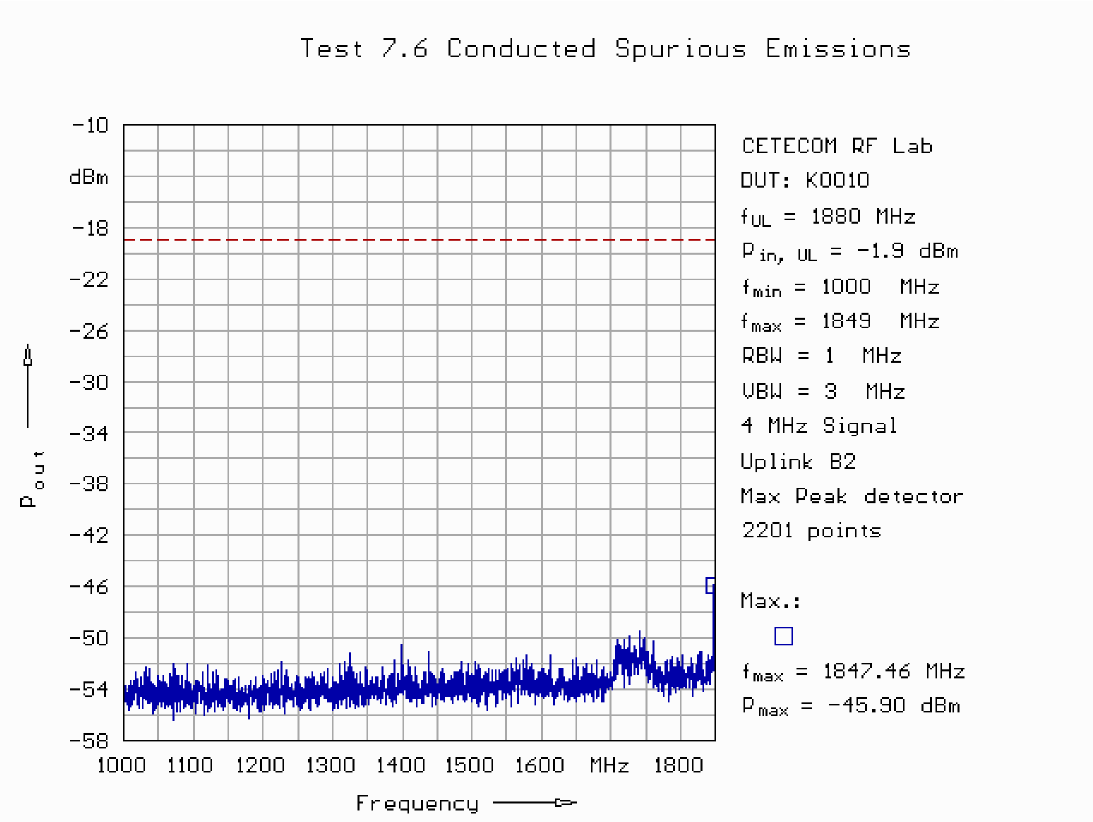

Fig. 122: Conducted spurious emissions in uplink in band 2 applying a 4 MHz signal (1 GHz – 1849 MHz).

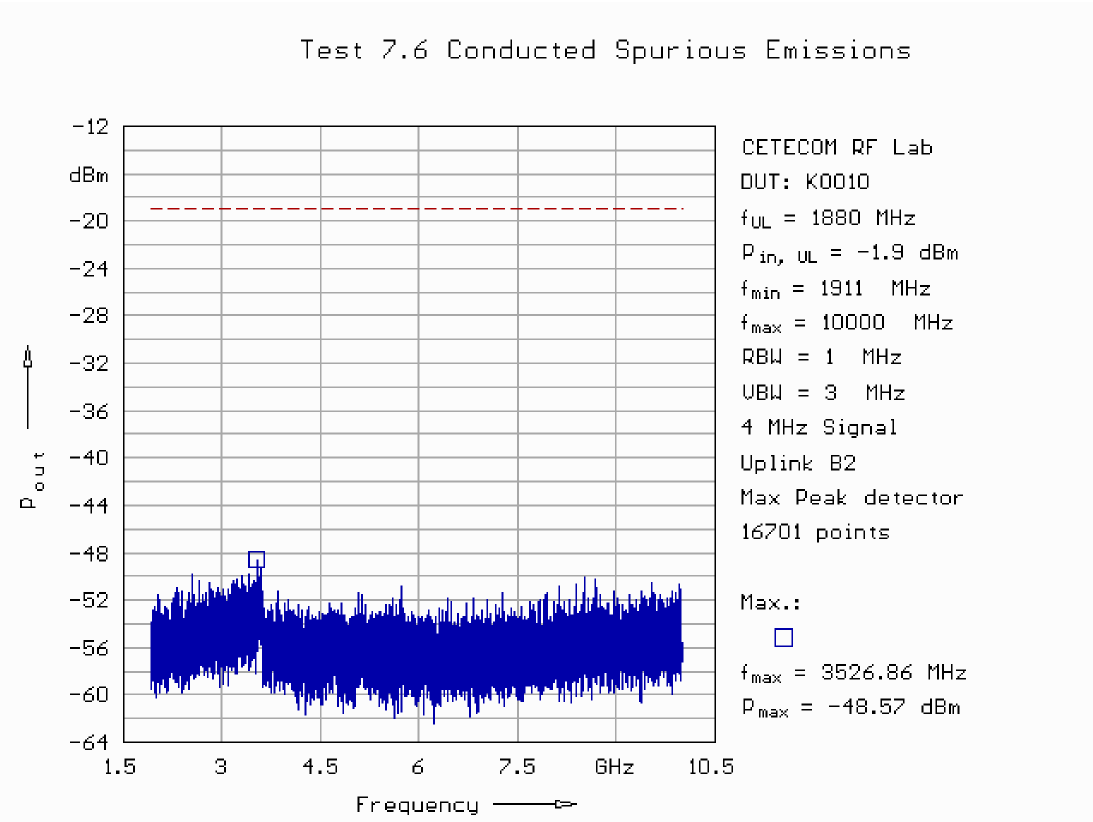

Fig. 123: Conducted spurious emissions in uplink in band 2 applying a 4 MHz signal (1911 MHz – 10 GHz).

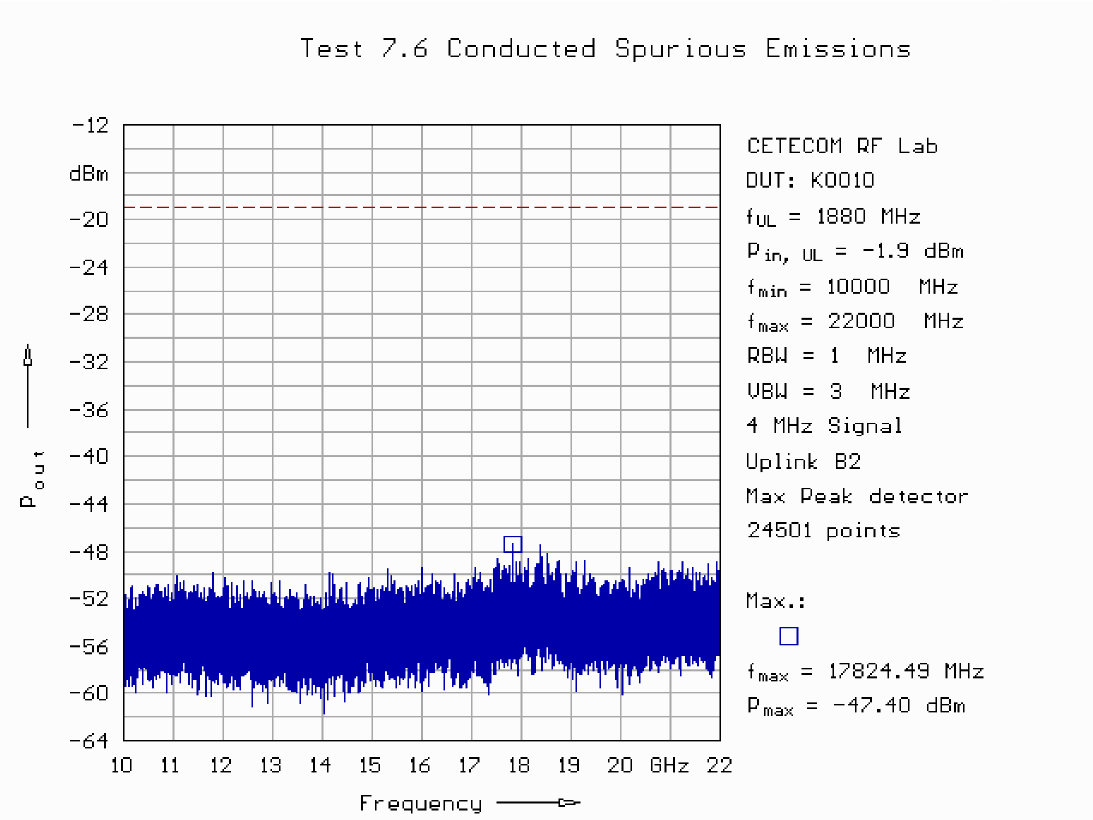

Fig. 124: Conducted spurious emissions in uplink in band 2 applying a 4 MHz signal (10 GHz – 22 GHz).

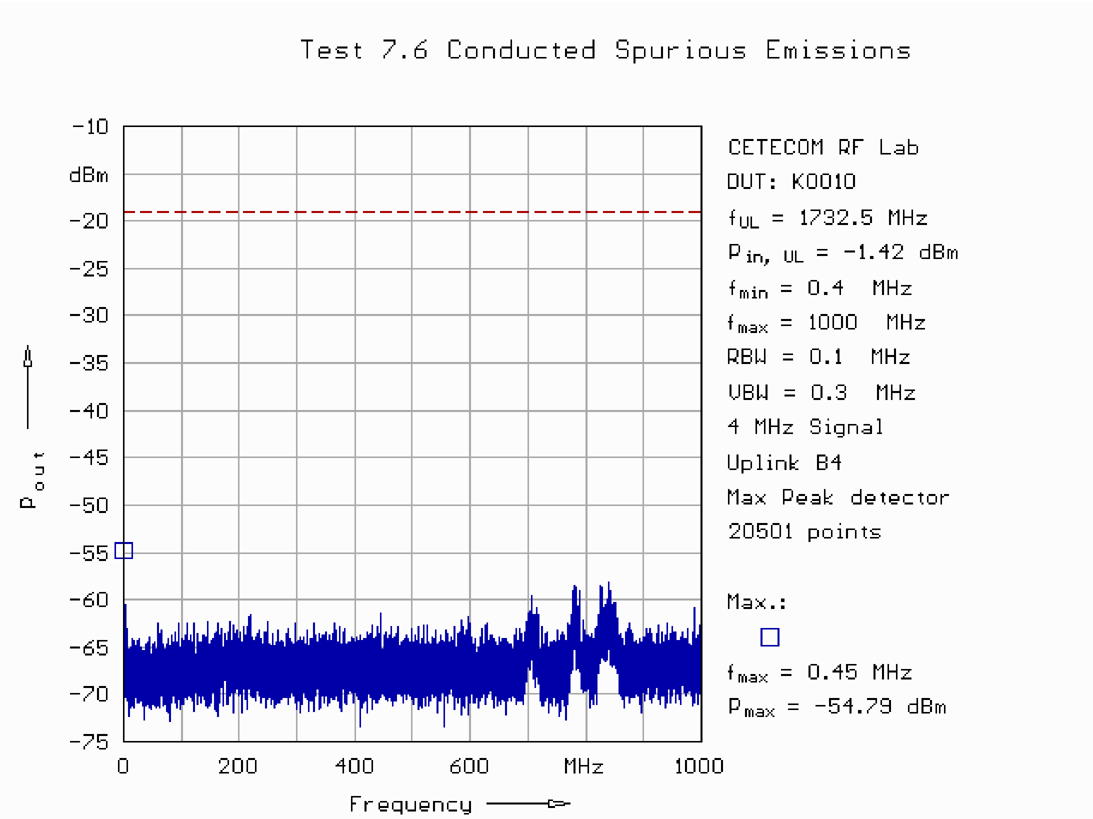

Fig. 125: Conducted spurious emissions in uplink in band 4 applying a 4 MHz signal (0.4 MHz – 1 GHz).

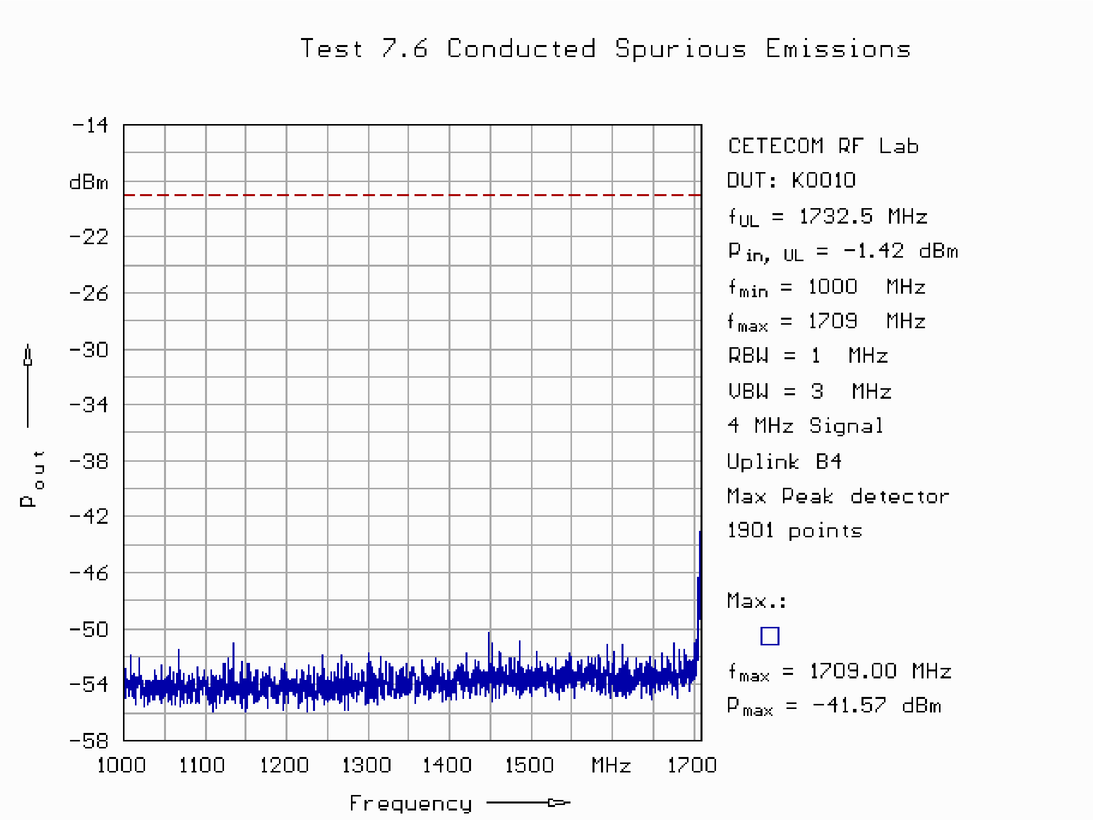

Fig. 126: Conducted spurious emissions in uplink in band 4 applying a 4 MHz signal (1 GHz – 1709 MHz).

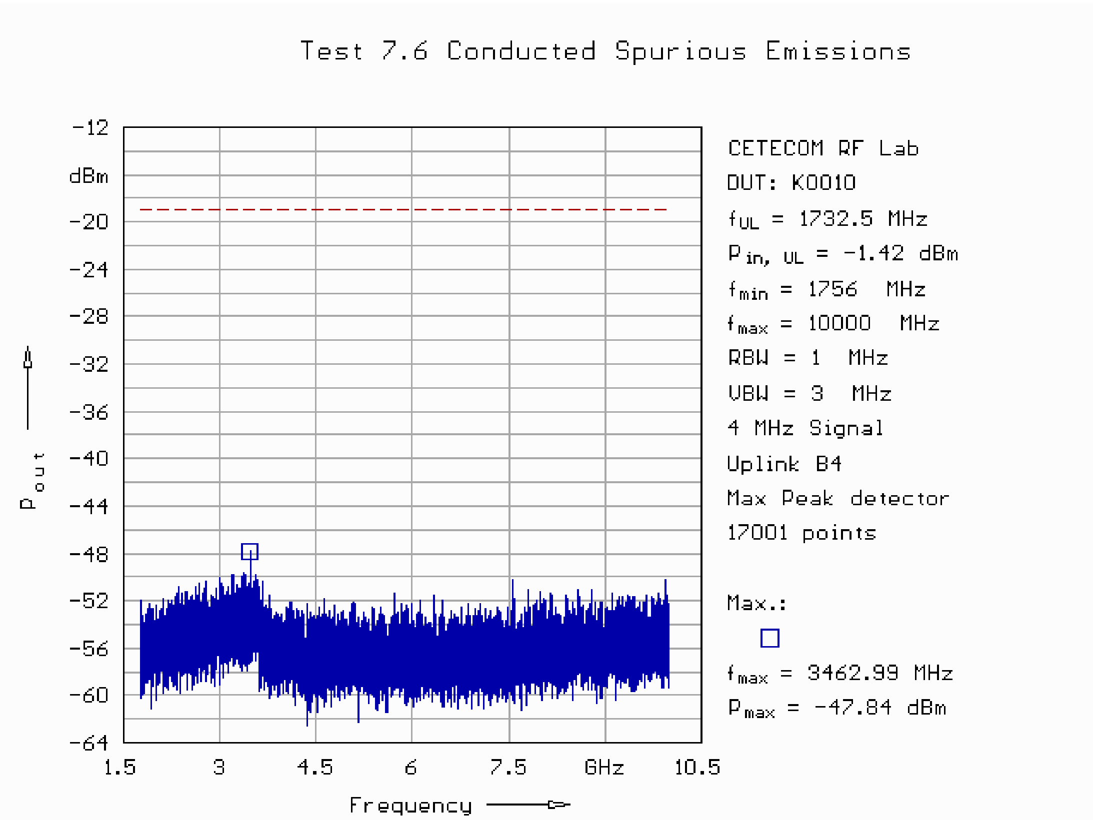

Fig. 127: Conducted spurious emissions in uplink in band 4 applying a 4 MHz signal (1756 MHz – 10 GHz).

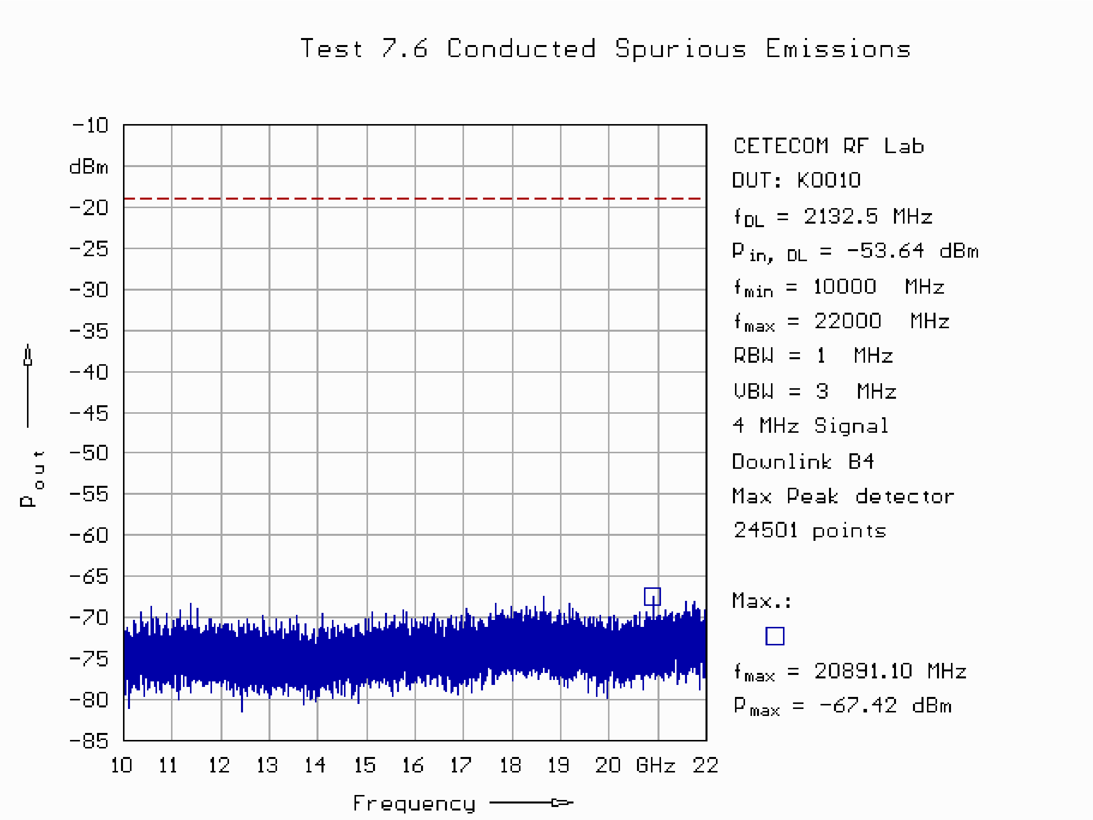

Fig. 128: Conducted spurious emissions in uplink in band 4 applying a 4 MHz signal (10 GHz – 22 GHz).

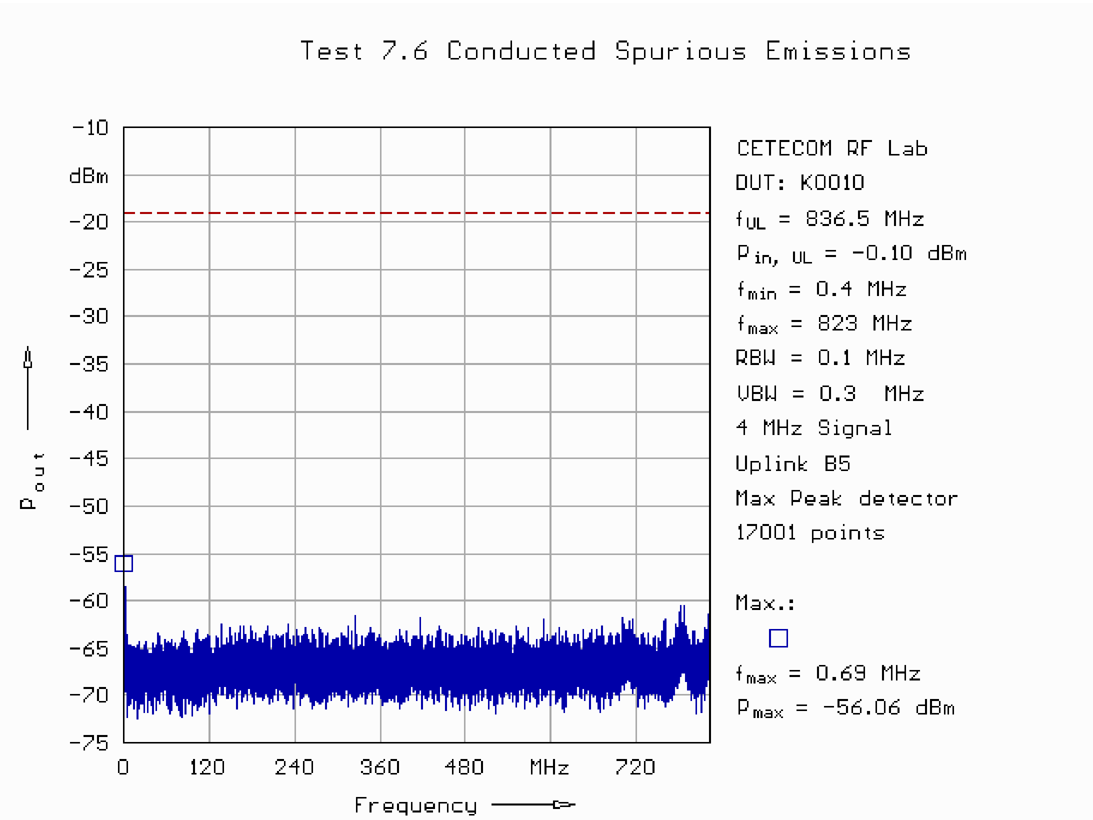

Fig. 129: Conducted spurious emissions in uplink in band 5 applying a 4 MHz signal (0.4 MHz – 823 MHz).

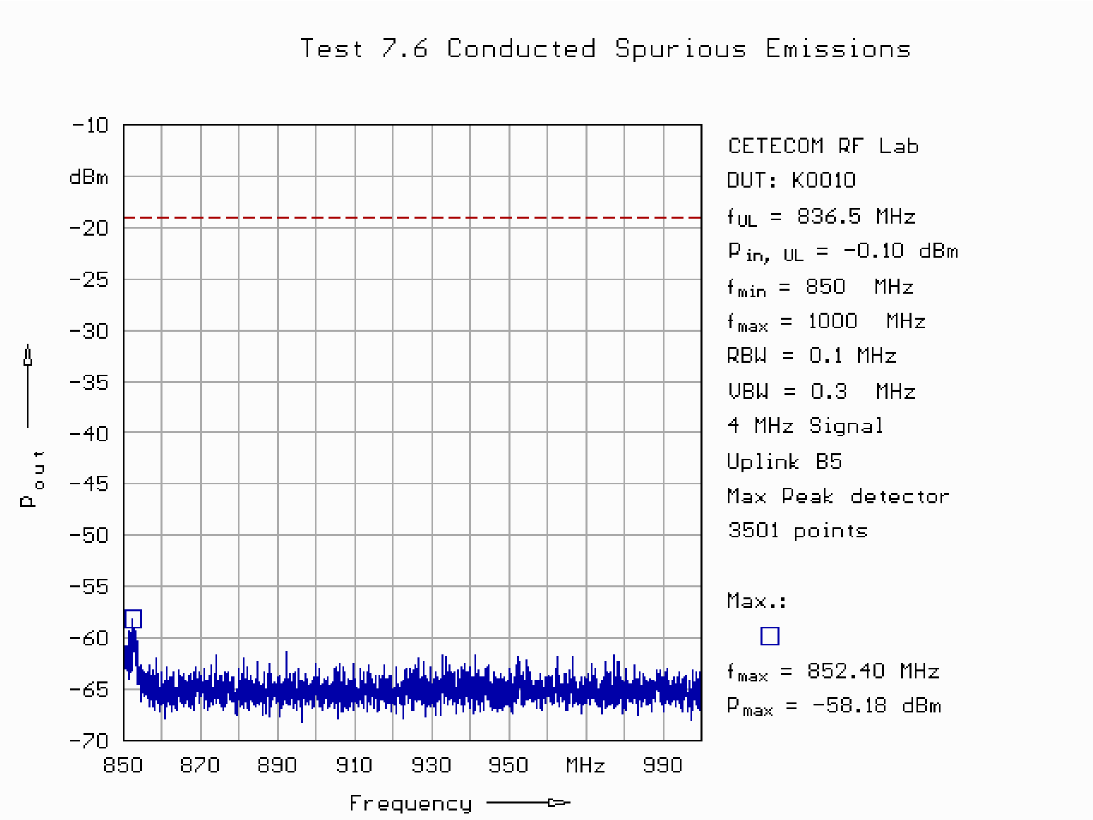

Fig. 130: Conducted spurious emissions in uplink in band 5 applying a 4 MHz signal (850 MHz – 1 GHz).

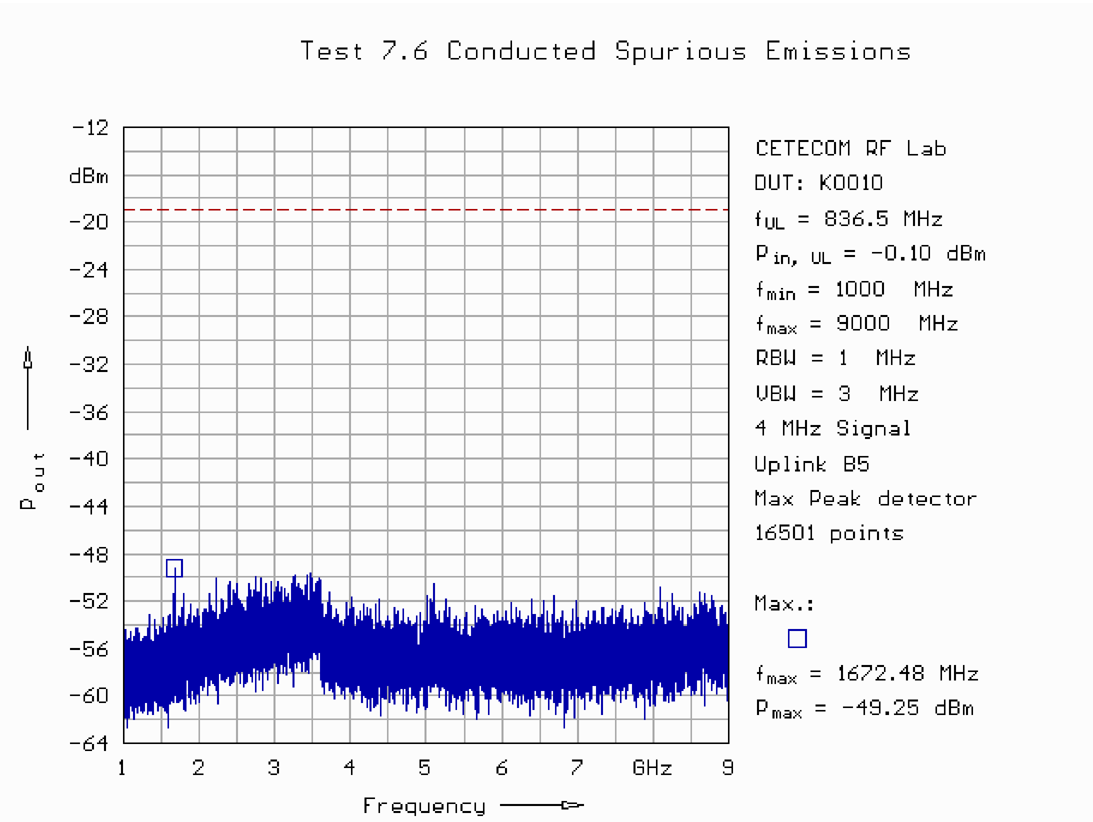

Fig. 131: Conducted spurious emissions in uplink in band 5 applying a 4 MHz signal (1 GHz – 9 GHz).

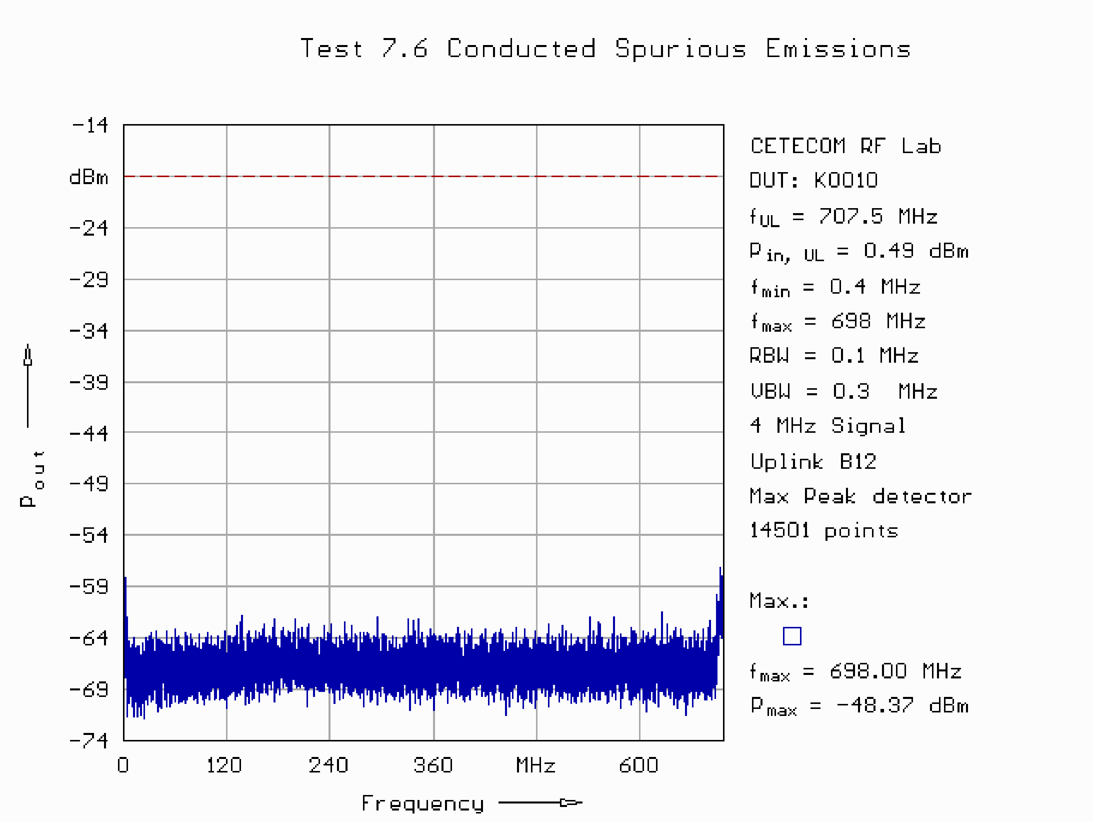

Fig. 132: Conducted spurious emissions in uplink in band 12 applying a 4 MHz signal (0.4 MHz – 698 MHz).

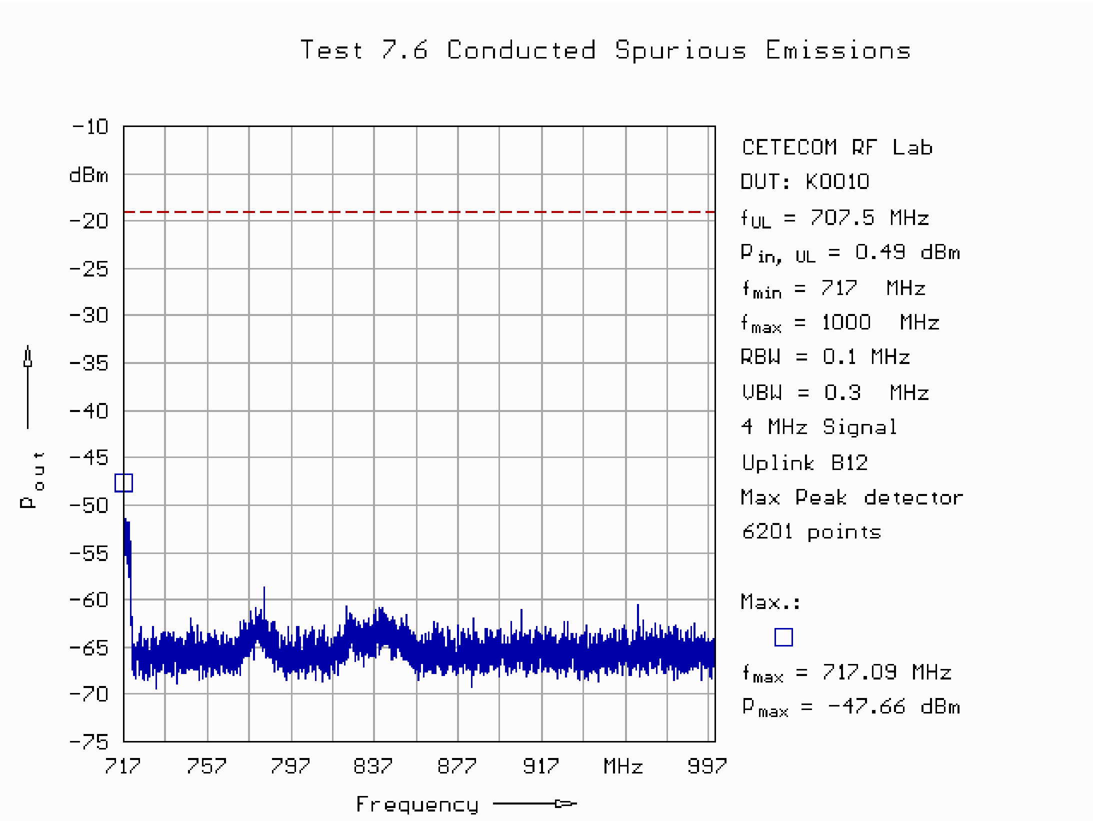

Fig. 133: Conducted spurious emissions in uplink in band 12 applying a 4 MHz signal (717 MHz – 1 GHz).

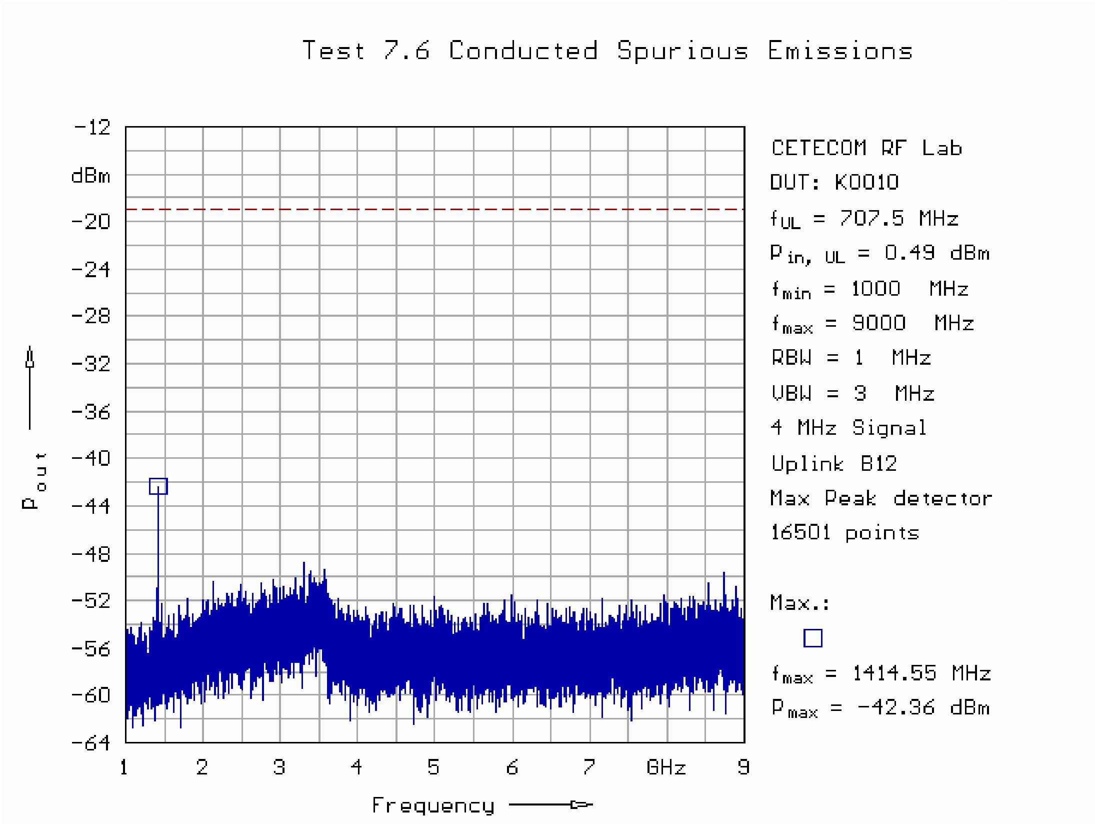

Fig. 134: Conducted spurious emissions in uplink in band 12 applying a 4 MHz signal (1 GHz – 9 GHz).

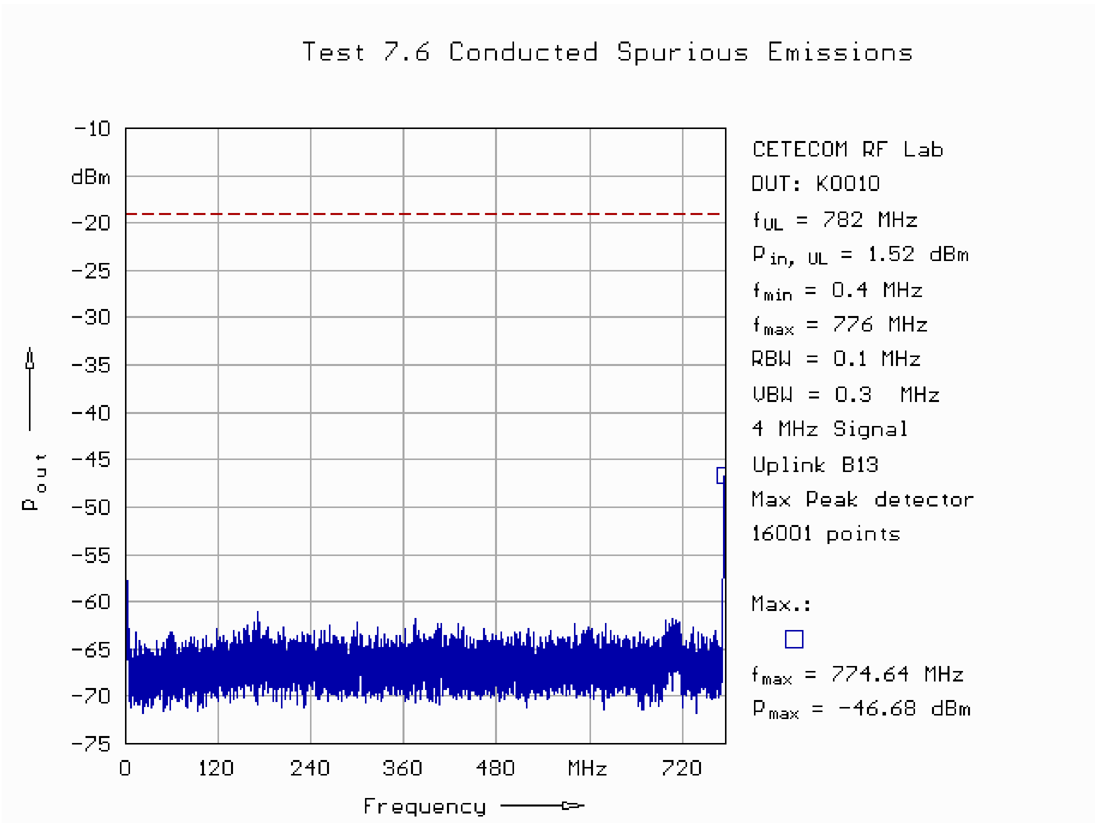

Fig. 135: Conducted spurious emissions in uplink in band 13 applying a 4 MHz signal (0.4 MHz – 776 MHz).

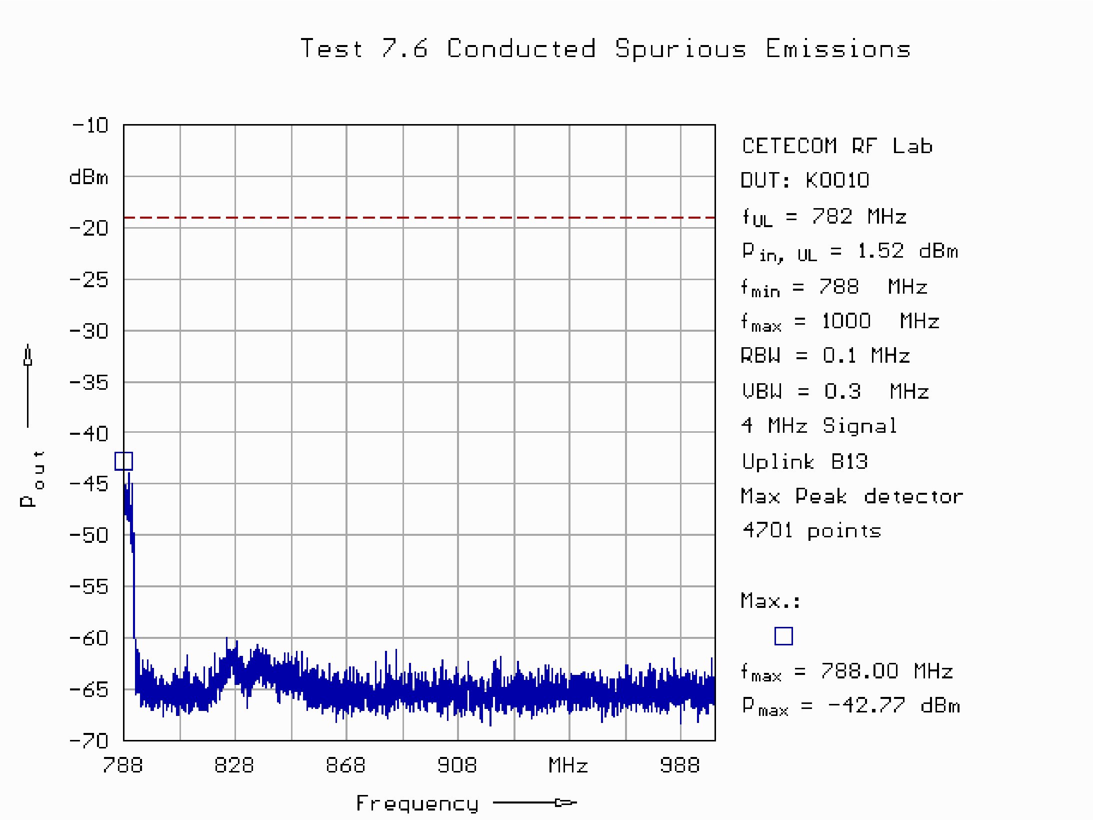

Fig. 136: Conducted spurious emissions in uplink in band 13 applying a 4 MHz signal (788 MHz – 1 GHz).

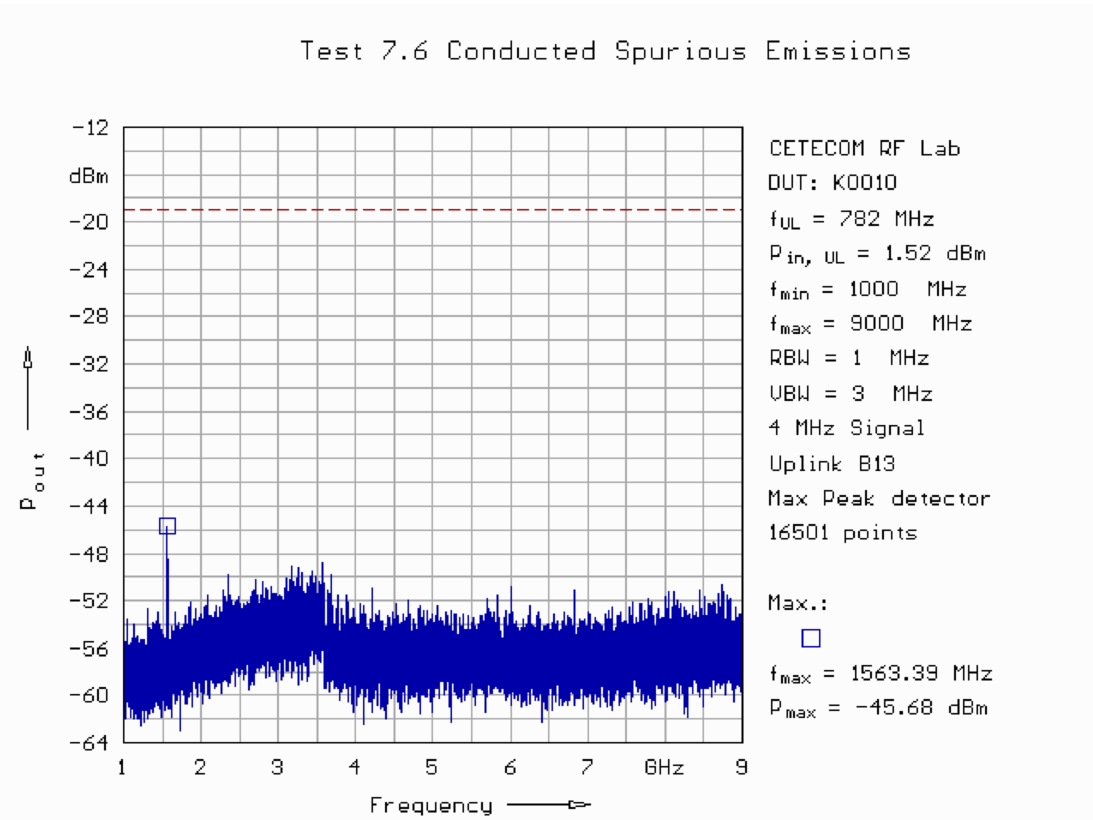

Fig. 137: Conducted spurious emissions in uplink in band 13 applying a 4 MHz signal (1 GHz – 9 GHz).

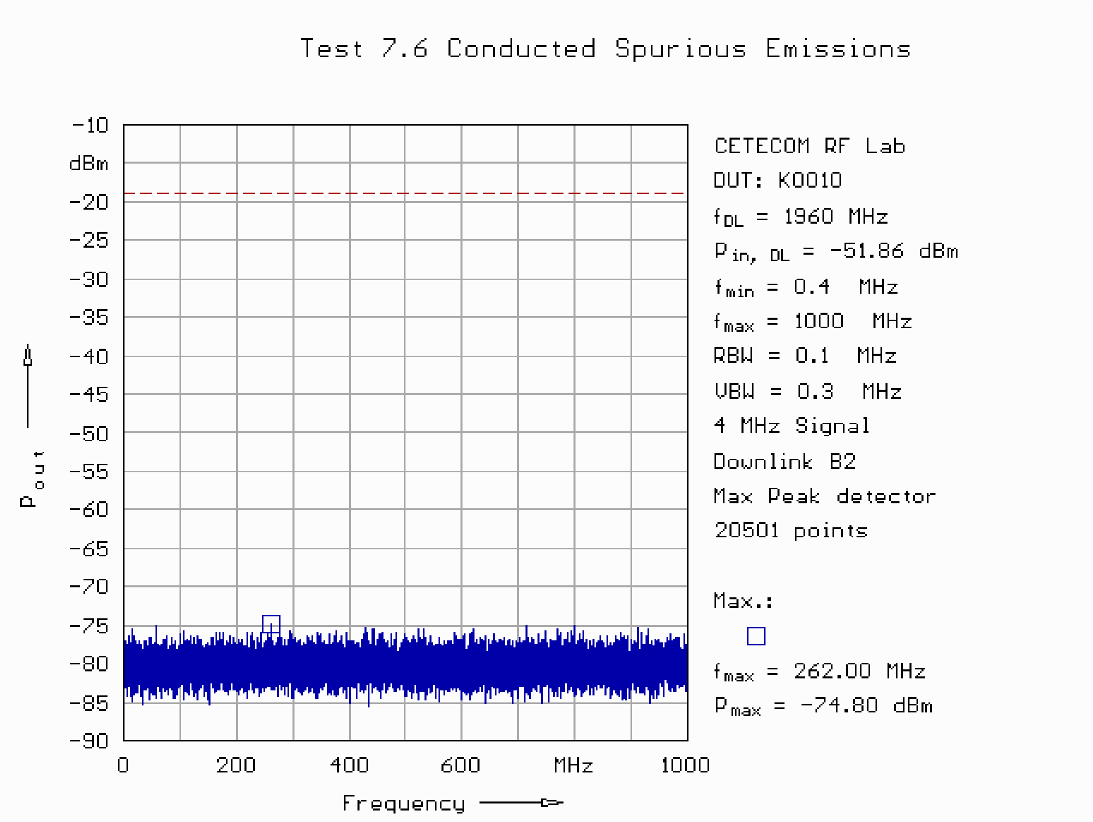

Fig. 138: Conducted spurious emissions in downlink in band 2 applying a 4 MHz signal (0.4 MHz – 1 GHz).

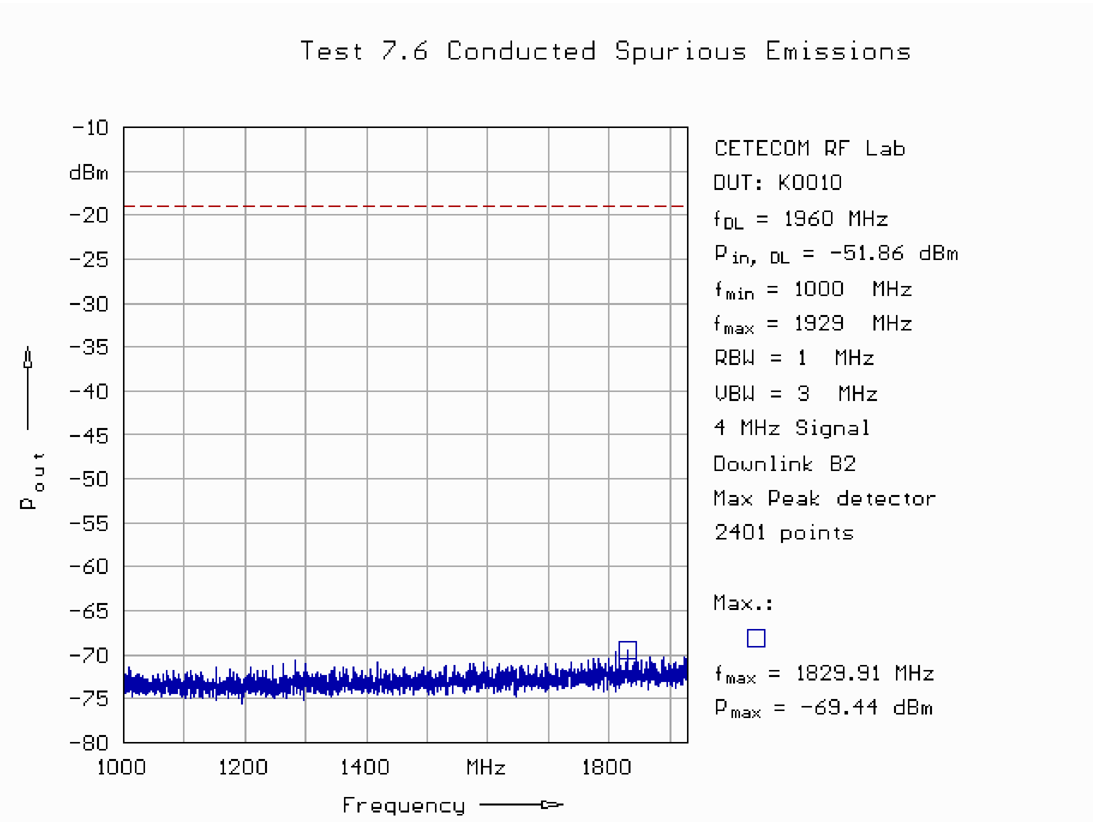

Fig. 139: Conducted spurious emissions in downlink in band 2 applying a 4 MHz signal (1 GHz – 1929 MHz).

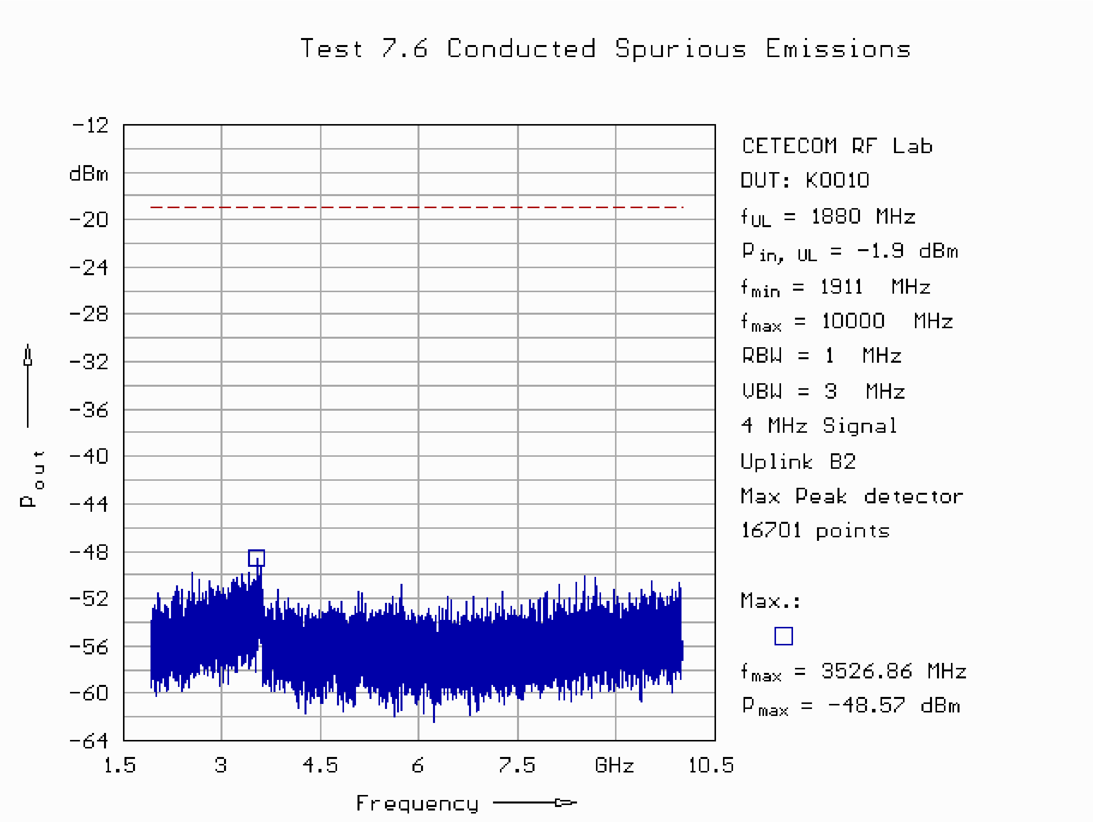

Fig. 140: Conducted spurious emissions in downlink in band 2 applying a 4 MHz signal (1911 MHz – 10 GHz).

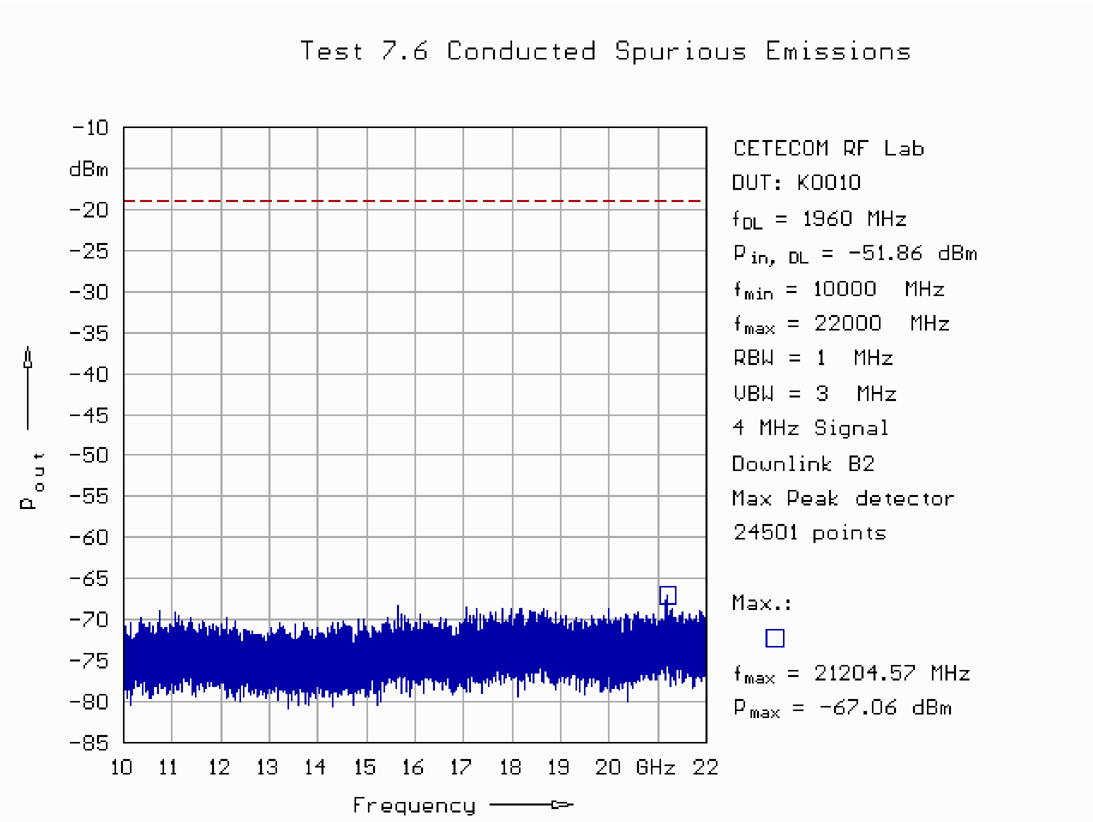

Fig. 141: Conducted spurious emissions in downlink in band 2 applying a 4 MHz signal (10 GHz – 22 GHz).

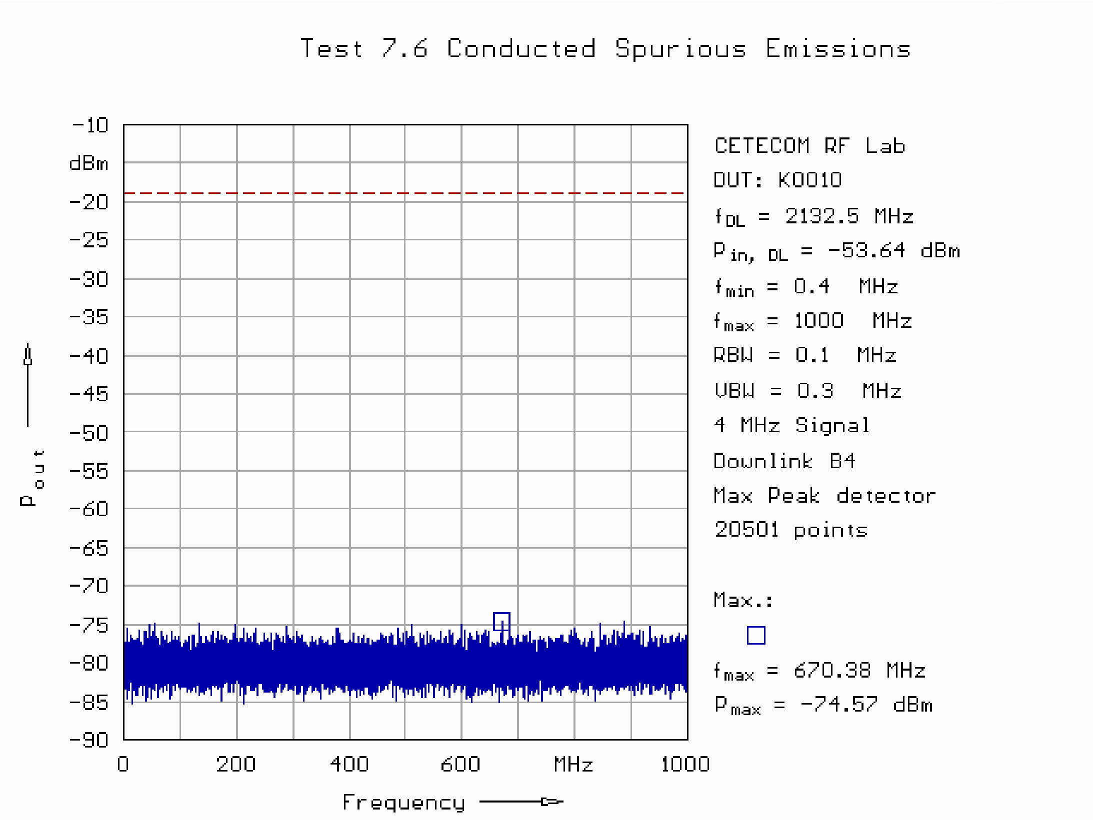

Fig. 142: Conducted spurious emissions in downlink in band 4 applying a 4 MHz signal (0.4 MHz – 1 GHz).

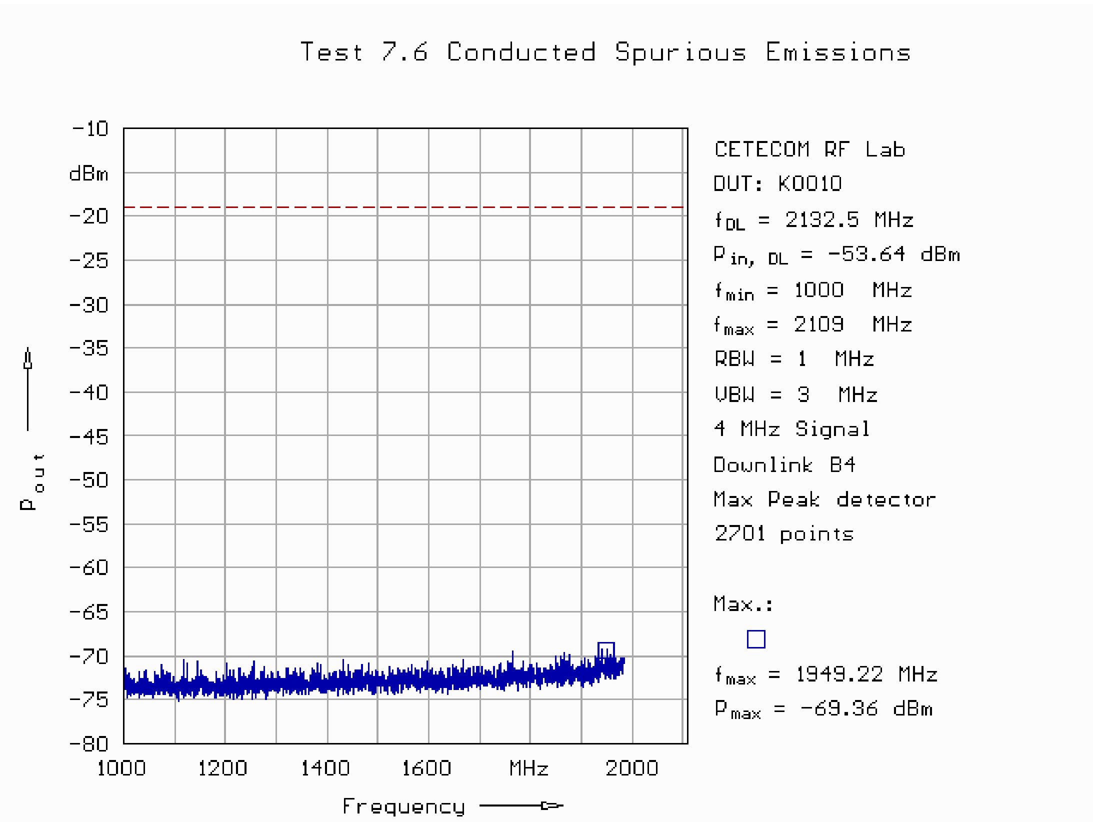

Fig. 143: Conducted spurious emissions in downlink in band 4 applying a 4 MHz signal (1 GHz – 2109 MHz).

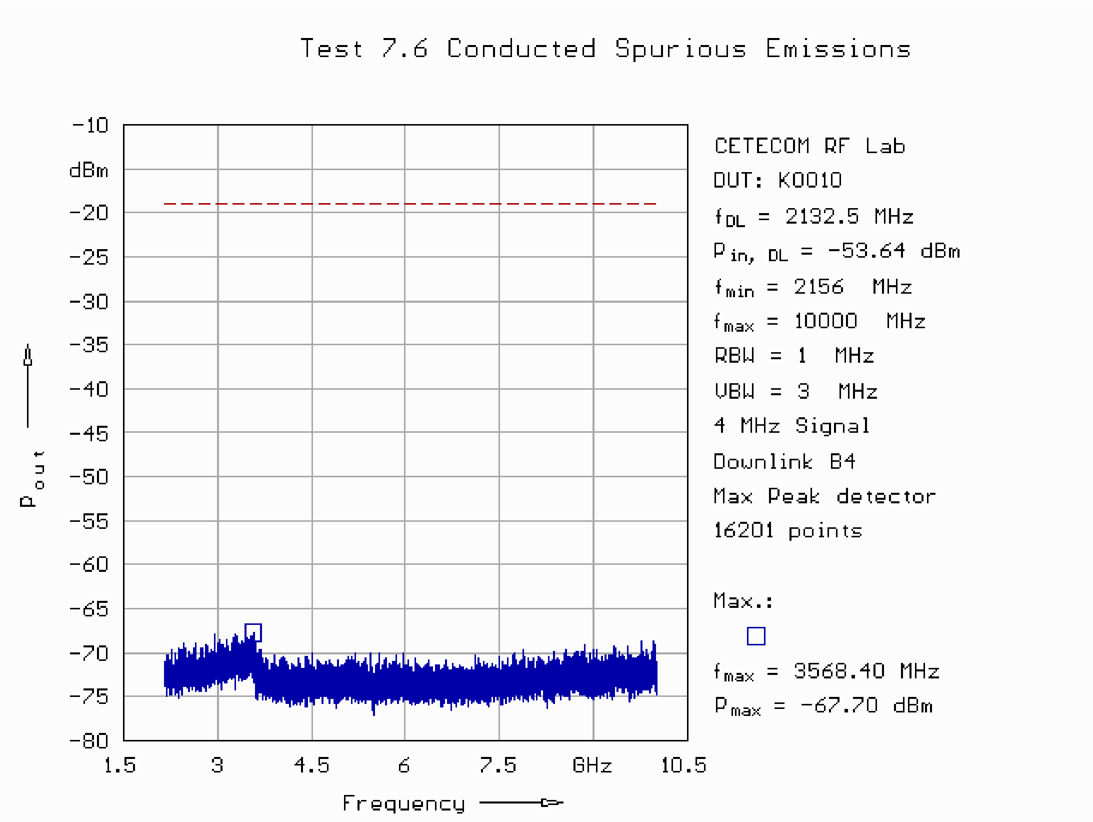

Fig. 144: Conducted spurious emissions in downlink in band 4 applying a 4 MHz signal (2156 MHz –10 GHz).

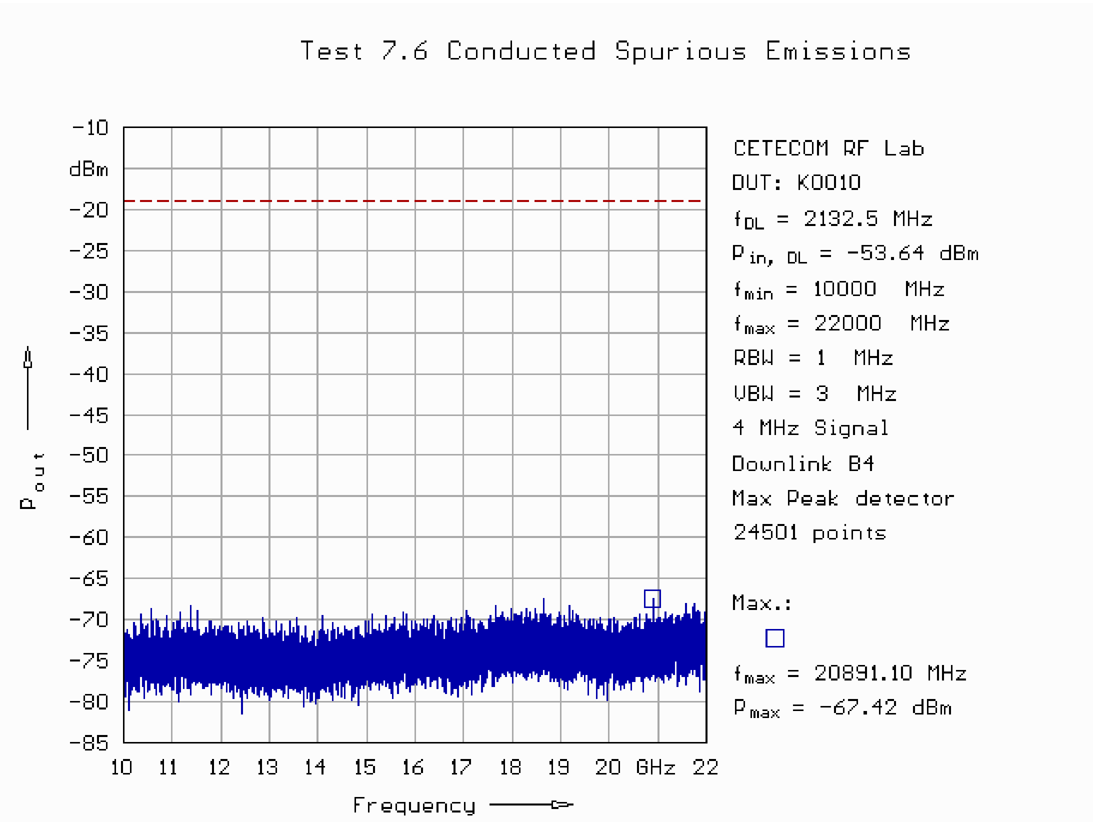

Fig. 145: Conducted spurious emissions in downlink in band 4 applying a 4 MHz signal (10 GHz – 22 GHz).

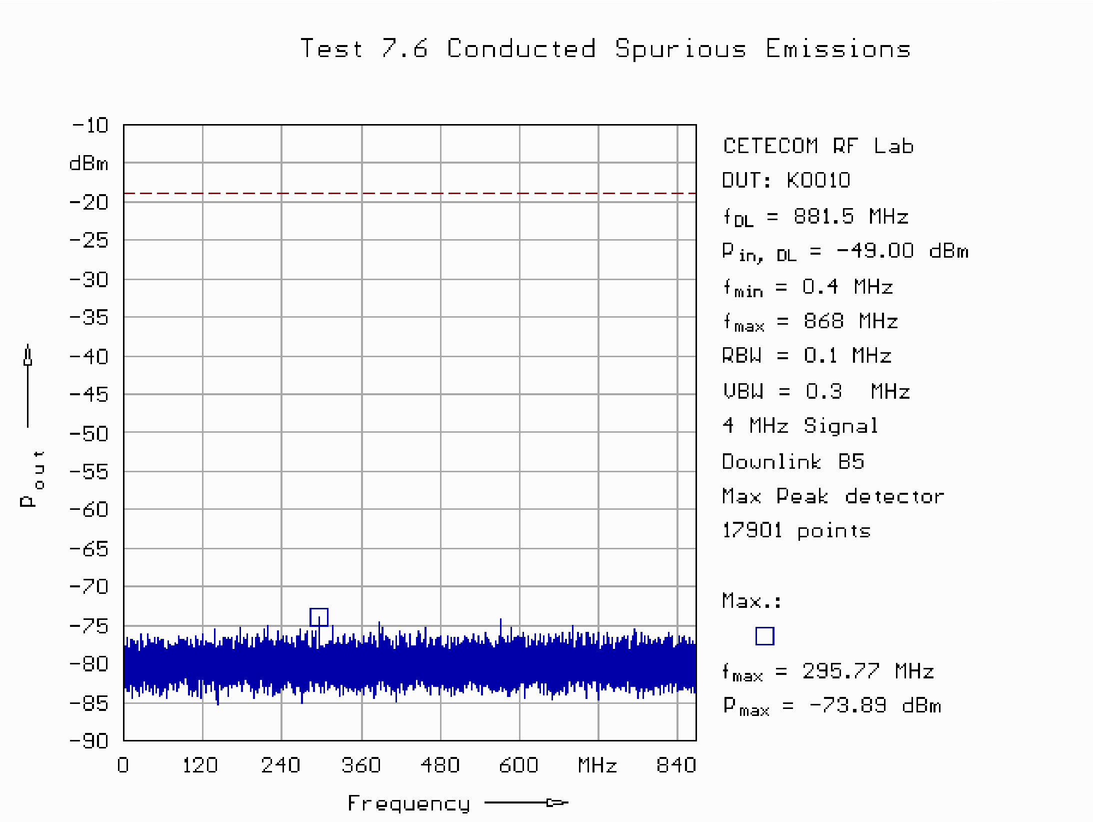

Fig. 146: Conducted spurious emissions in downlink in band 5 applying a 4 MHz signal (0.4 MHz – 868 MHz).

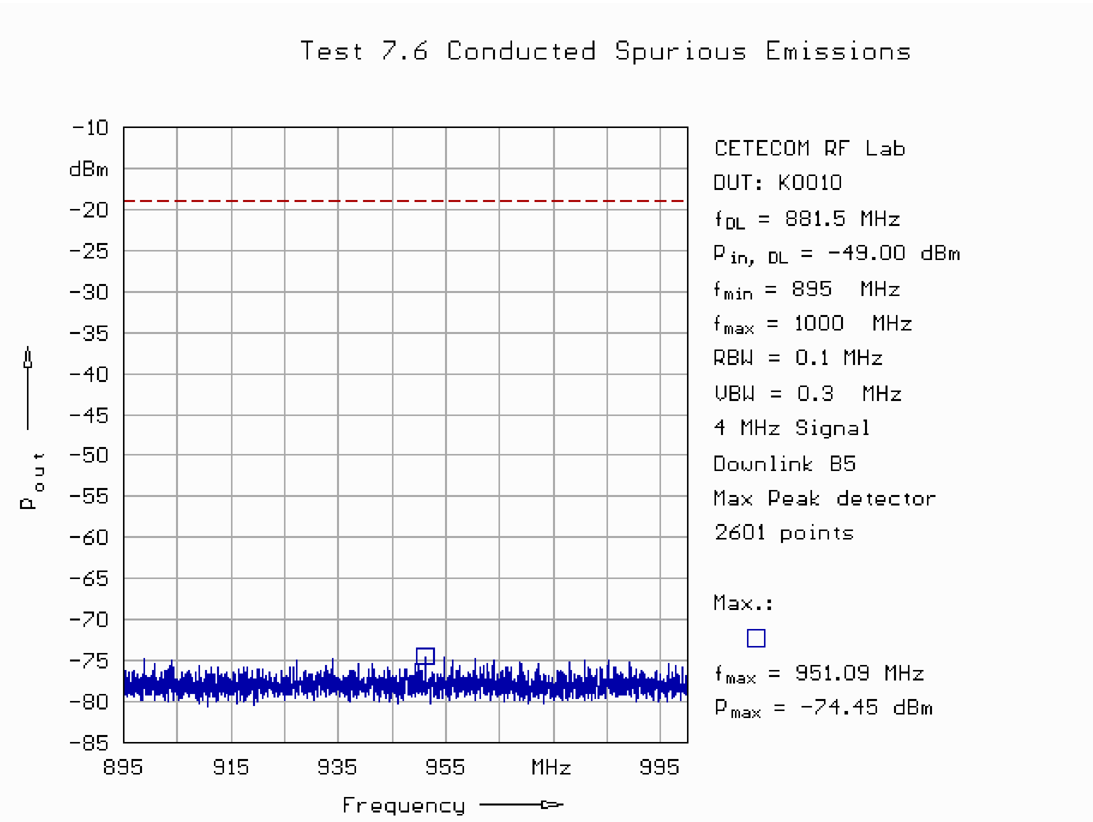

Fig. 147: Conducted spurious emissions in downlink in band 5 applying a 4 MHz signal (895 MHz – 1 GHz).

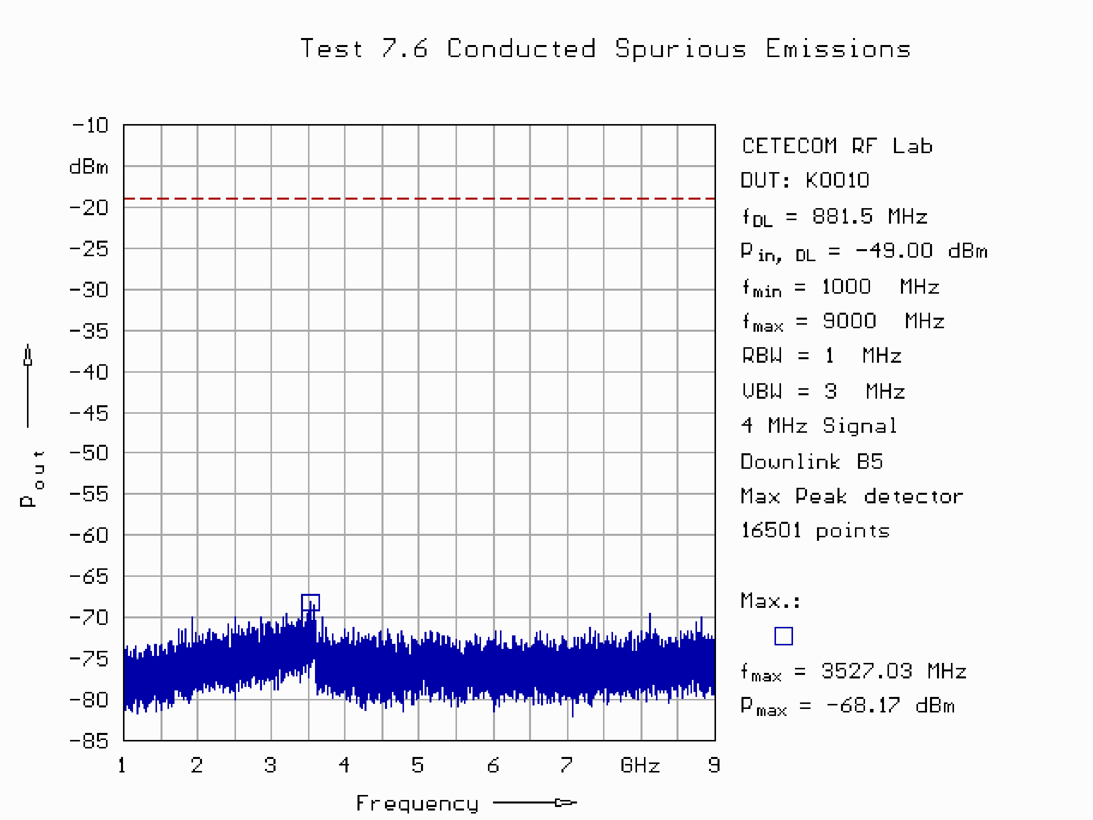

Fig. 148: Conducted spurious emissions in downlink in band 5 applying a 4 MHz signal (1 GHz – 9 GHz).

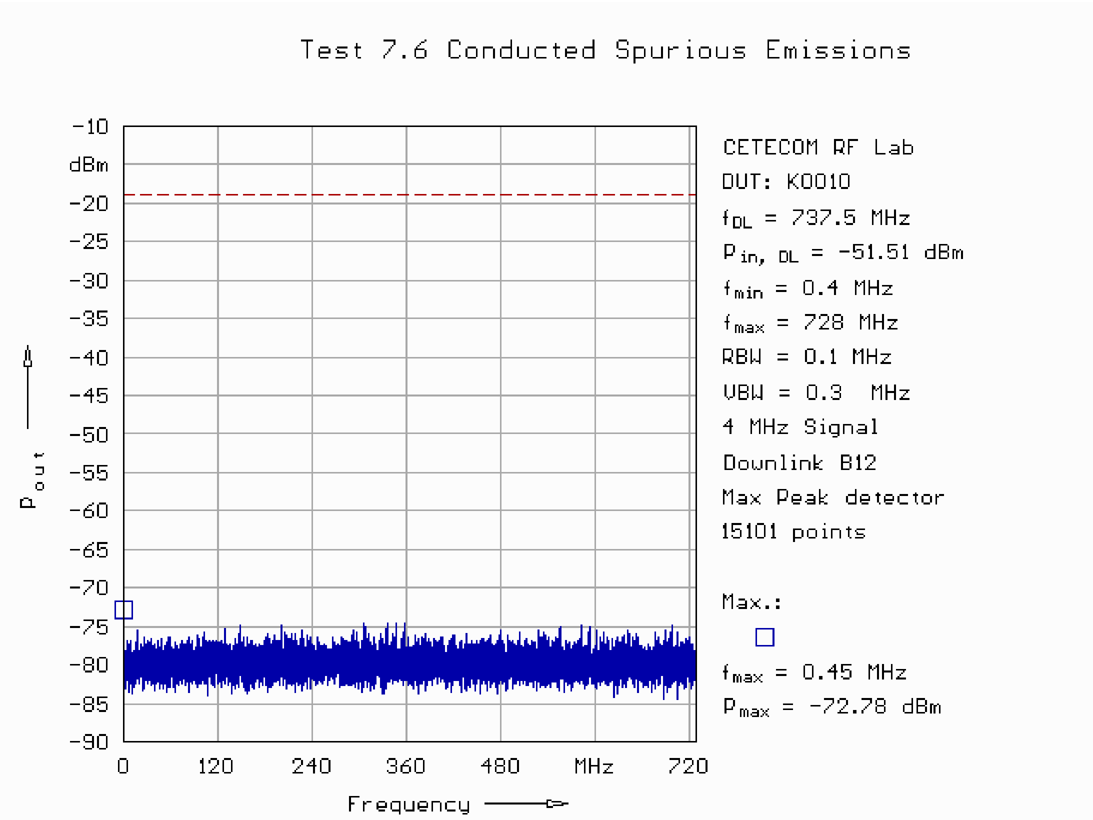

Fig. 149: Conducted spurious emissions in downlink in band 12 applying a 4 MHz signal (0.4 MHz – 728 MHz).

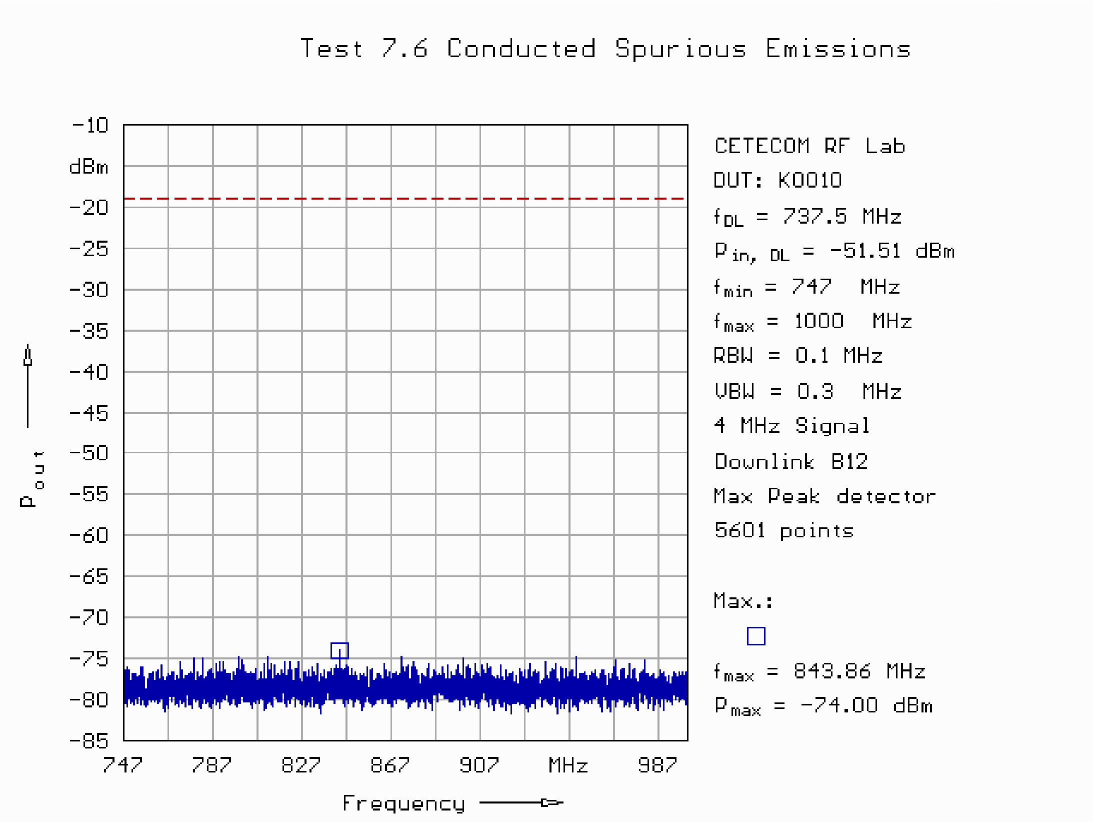

Fig. 150: Conducted spurious emissions in downlink in band 12 applying a 4 MHz signal (747 MHz – 1 GHz).

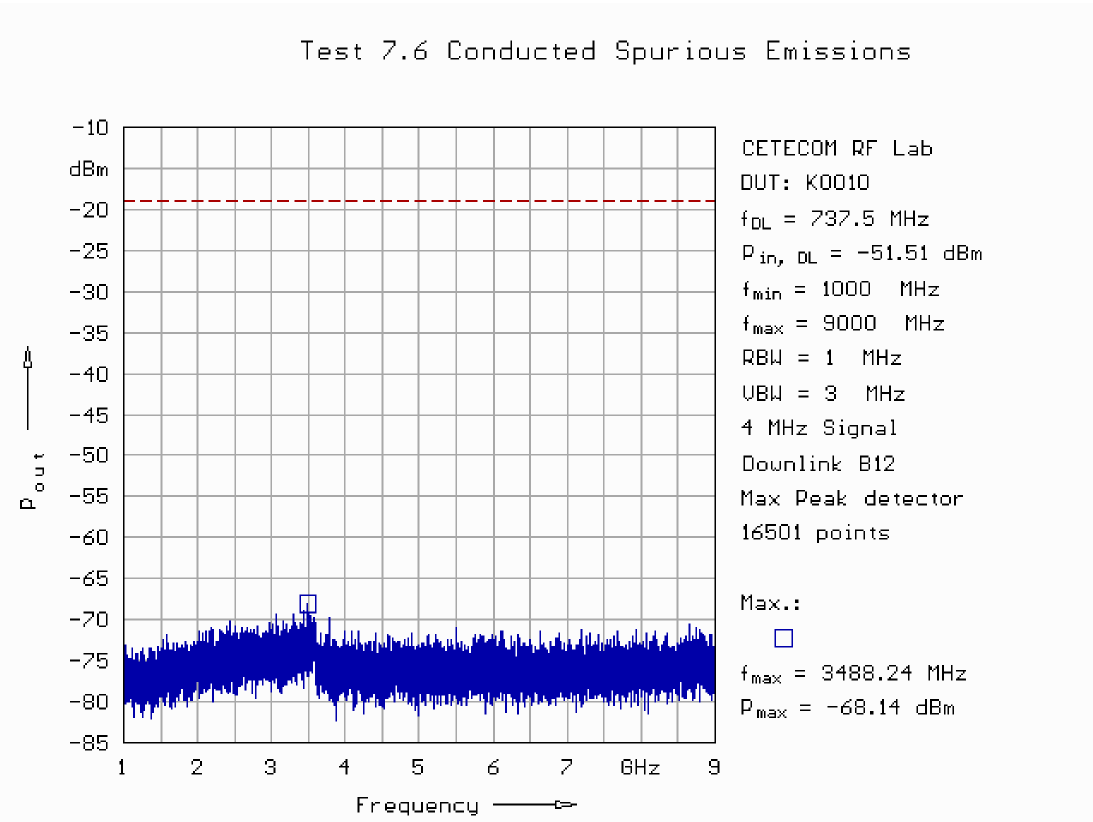

Fig. 151: Conducted spurious emissions in downlink in band 12 applying a 4 MHz signal (1 GHz – 9 GHz).

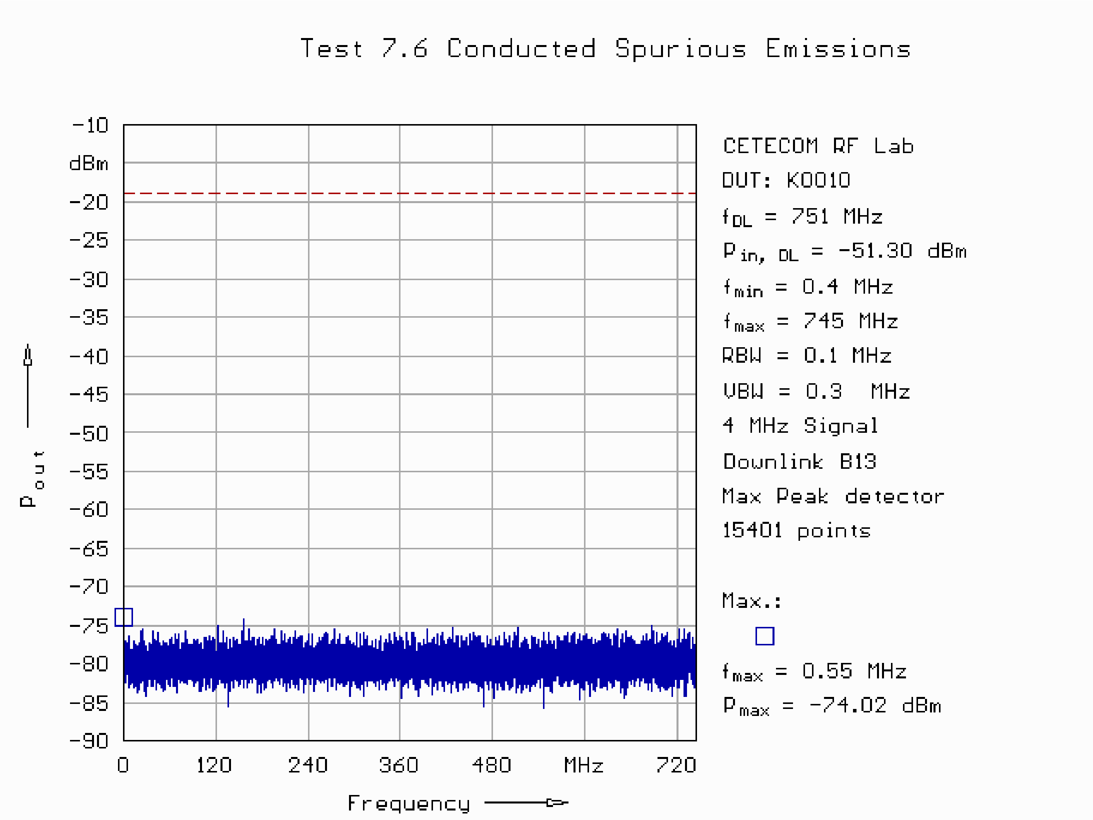

Fig. 152: Conducted spurious emissions in downlink in band 13 applying a 4 MHz signal (0.4 MHz – 745 MHz).

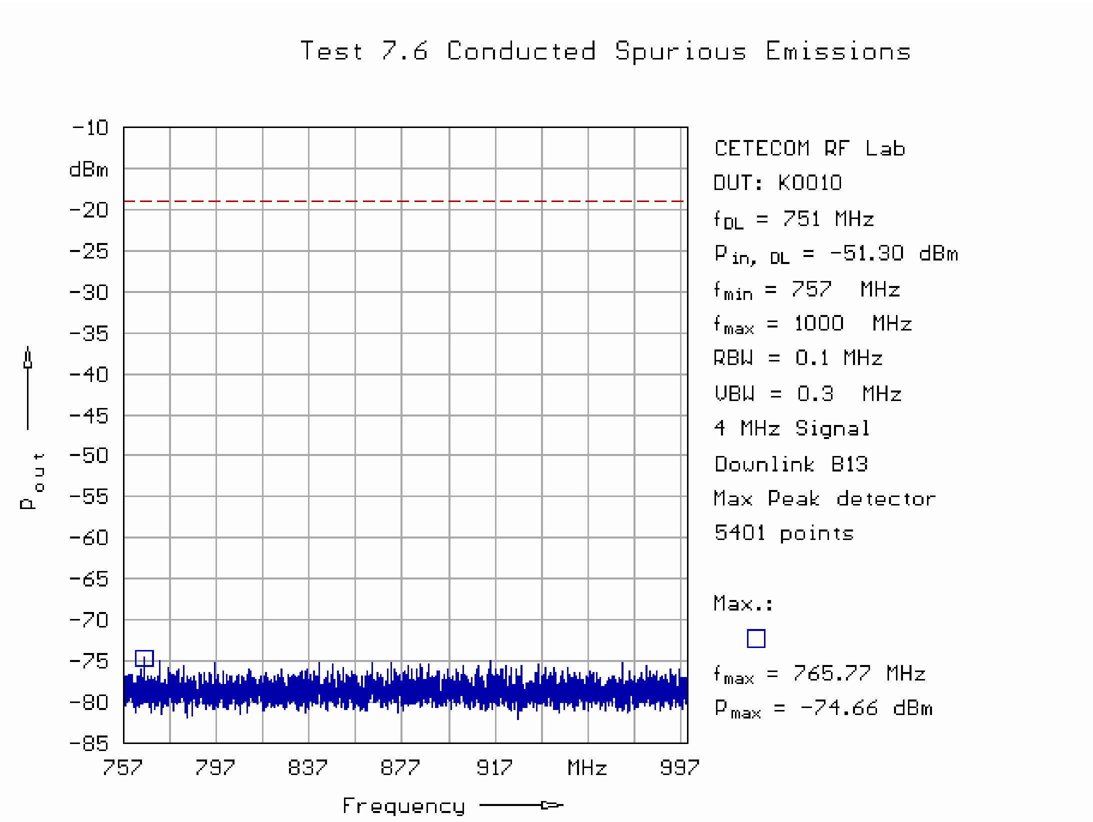

Fig. 153: Conducted spurious emissions in downlink in band 13 applying a 4 MHz signal (757 MHz – 1 GHz).

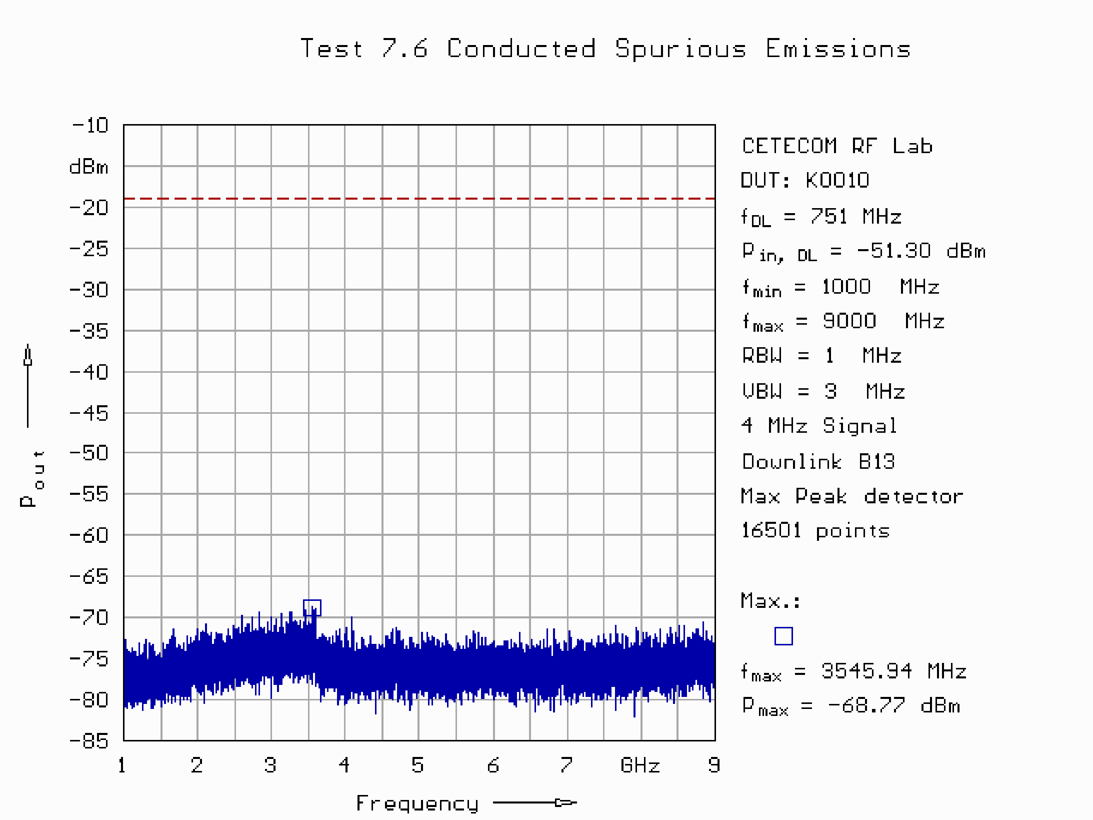

Fig. 154: Conducted spurious emissions in downlink in band 13 applying a 4 MHz signal (1 GHz – 9 GHz).

5.7. Noise

The activated cable routing for this tests are shown below. For the downlink see Fig. 157. For the uplink two scenarios are necessary as shown in Fig. 155 and Fig. 156, because for the special type of booster under test, a stimulating signal is required at the server port to switch ON the uplink amplifier in the right mode and frequency range. Additionally the stimulating signal was applied twice: At the lower frequency band edge plus in a second test at the higher edge in order to see the noise in the full frequency range.

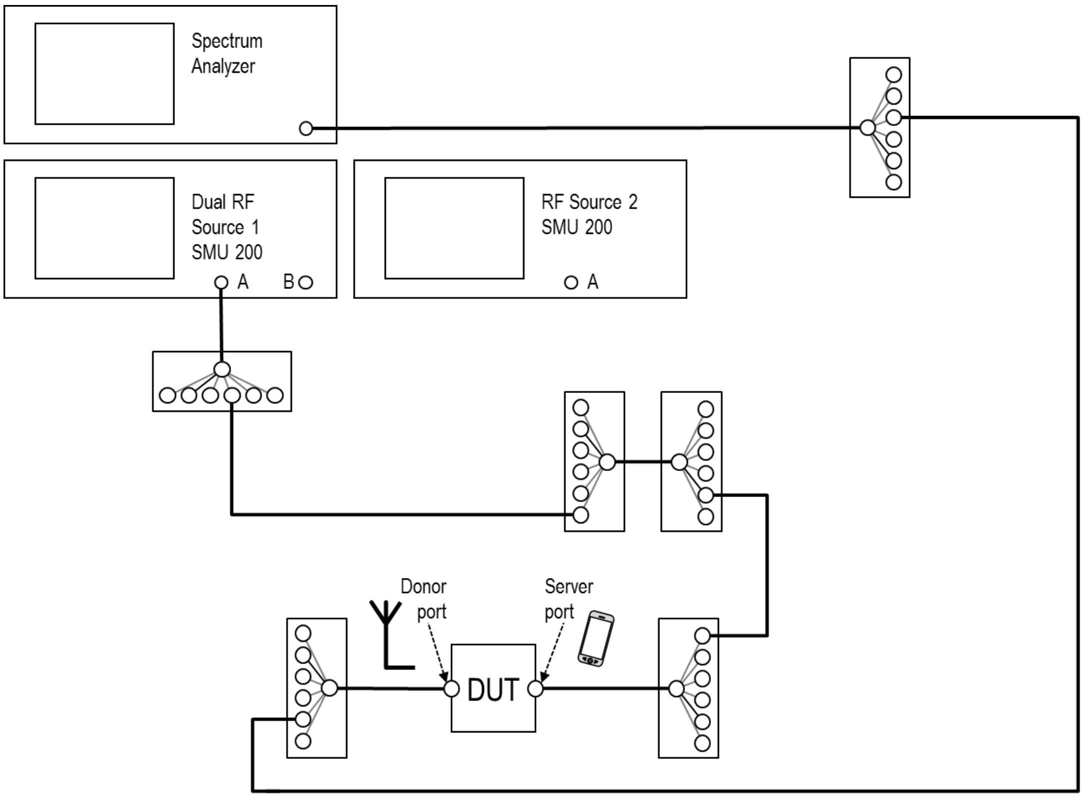

Fig. 155: Set up for the noise test in uplink with uplink activated (a uplink signal is present).

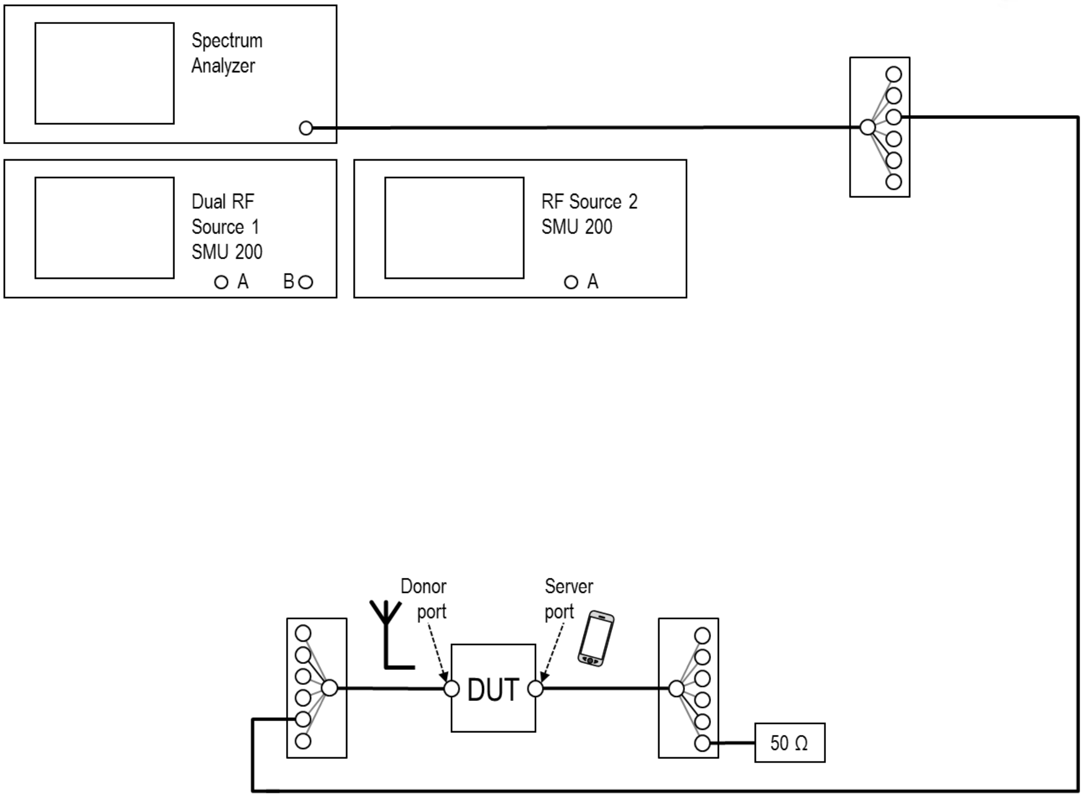

Fig. 156: Set up for the noise test in uplink when no uplink signal is present.

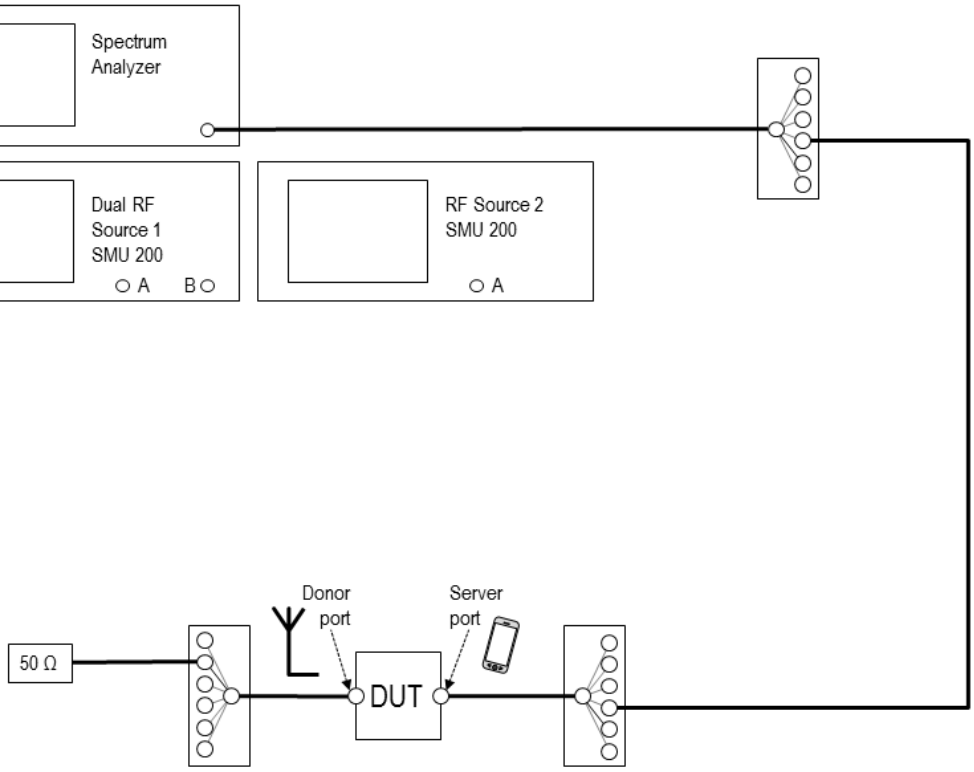

Fig. 157: Set up for the noise test in downlink.

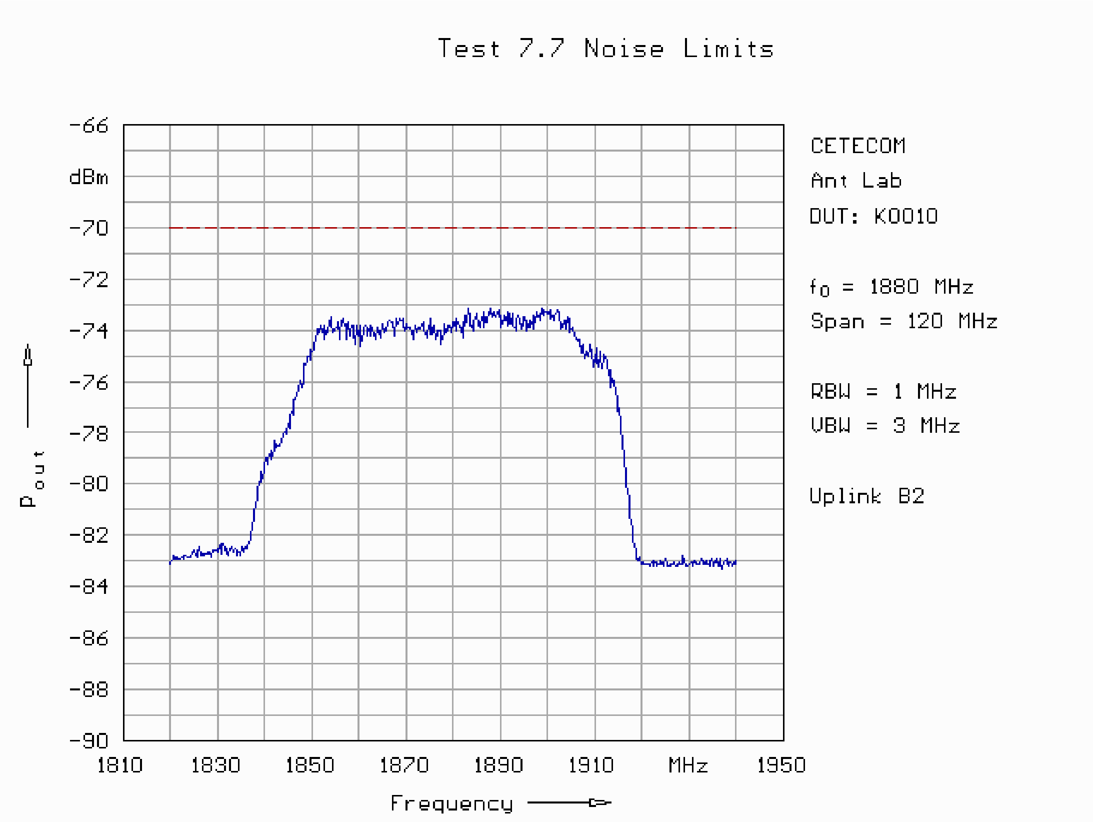

Fig. 158: Noise limits in uplink in band 2 (no uplink signal).

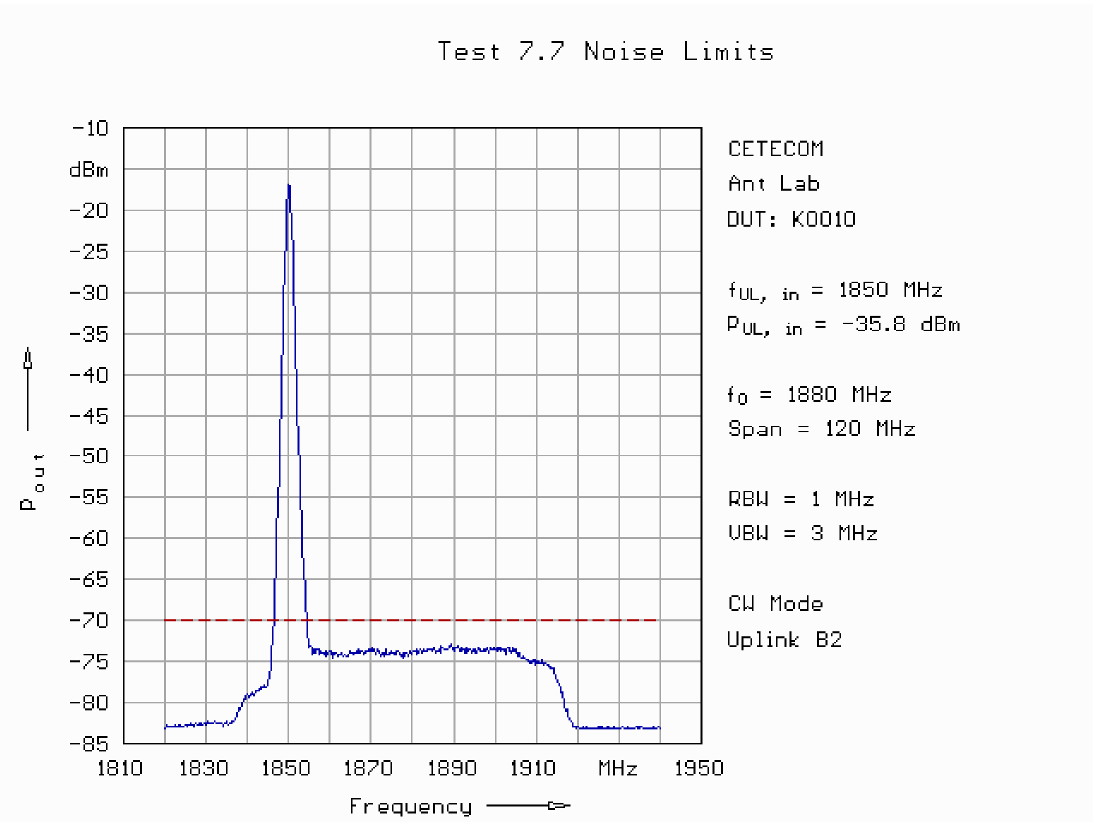

Fig. 159: Noise limits in uplink in band 2 (signal at lower band edge).

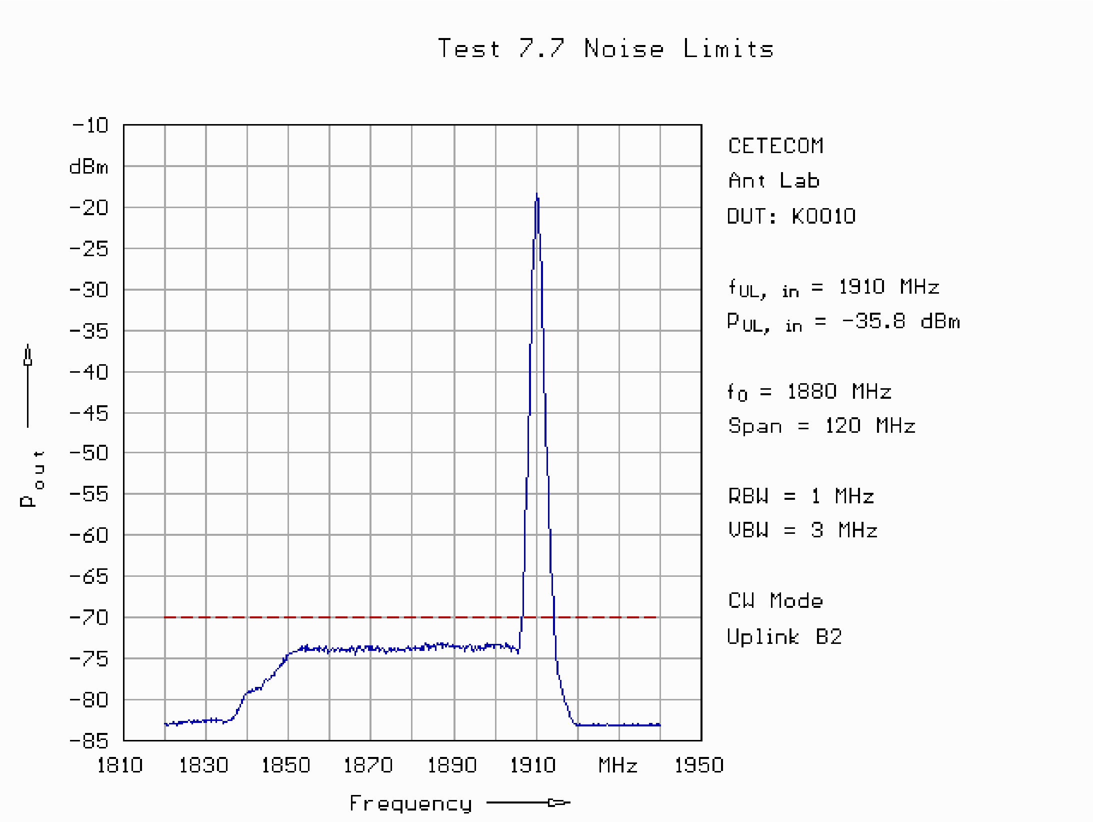

Fig. 160: Noise limits in uplink in band 2 (signal at upper band edge).

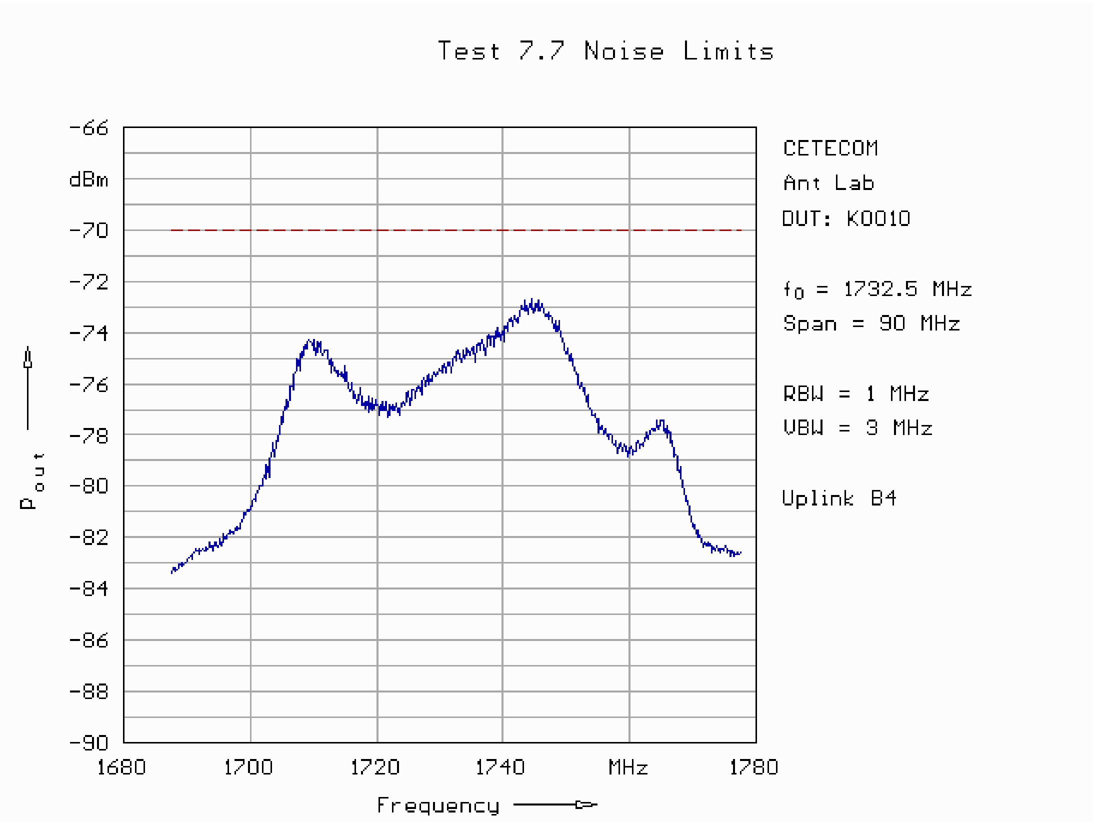

Fig. 161: Noise limits in uplink in band 4 (no uplink signal).

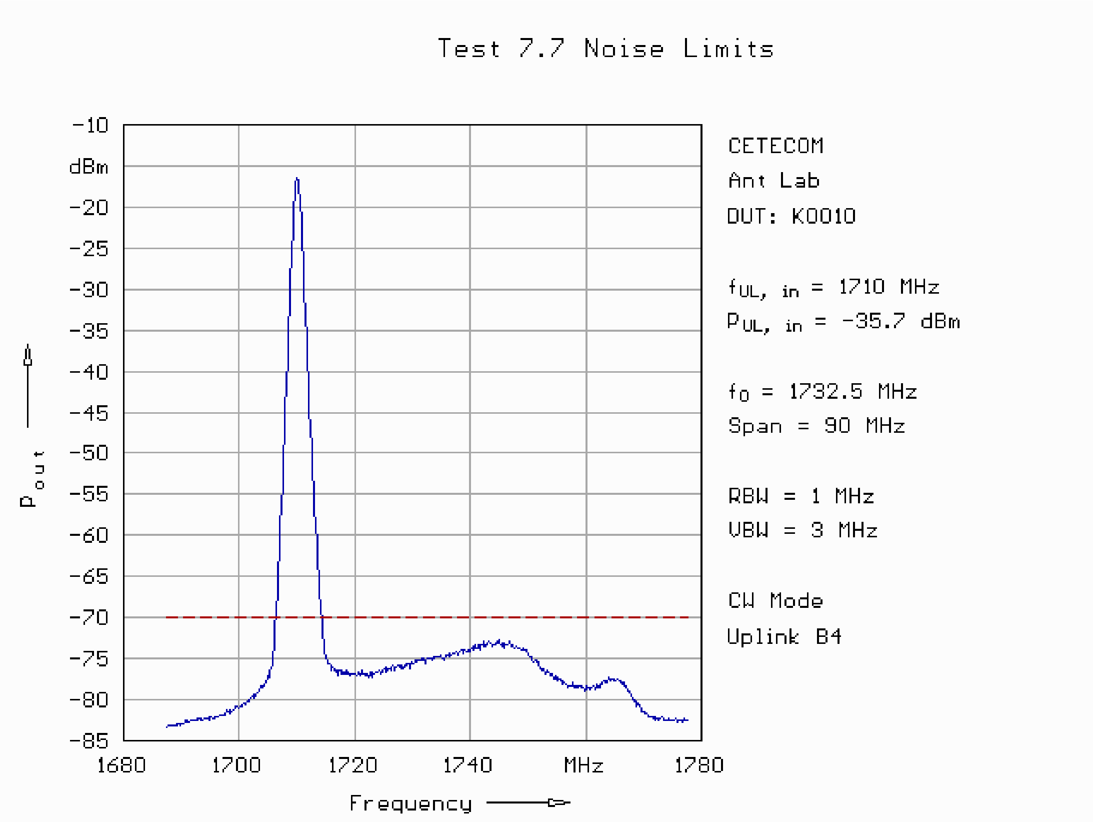

Fig. 162: Noise limits in uplink in band 4 (signal at lower band edge).

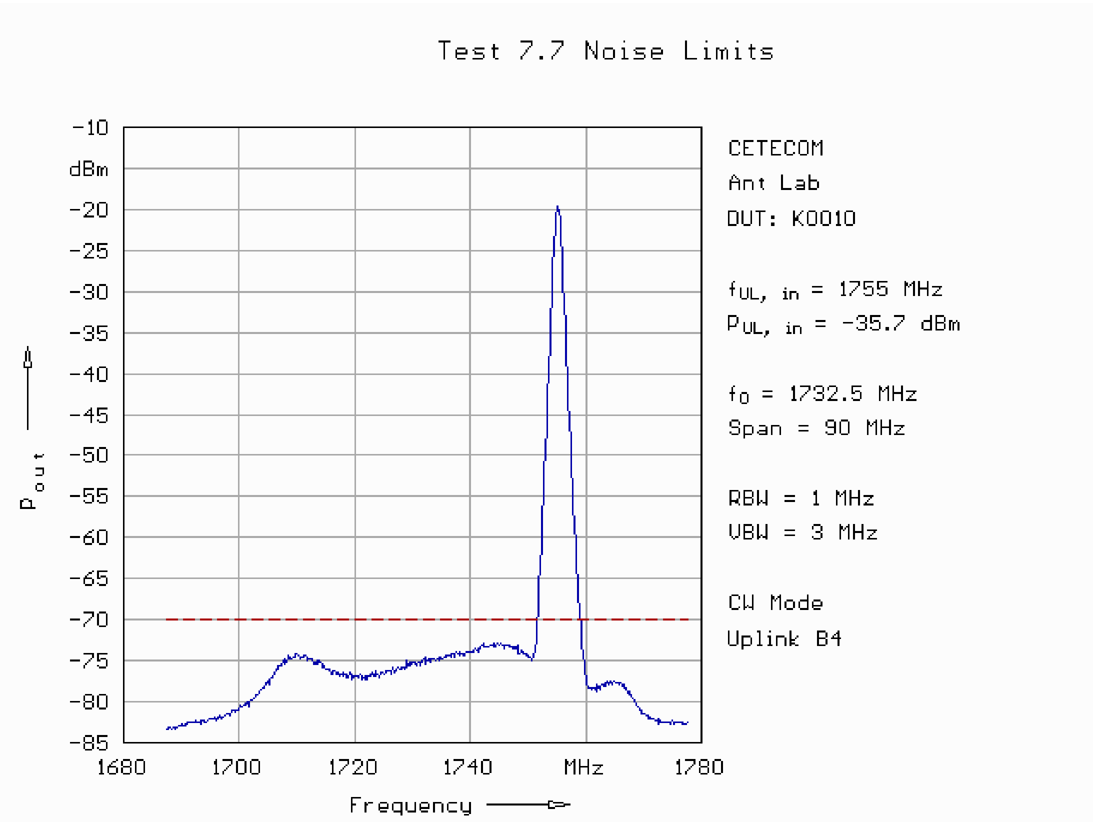

Fig. 163: Noise limits in uplink in band 4 (signal at upper band edge).

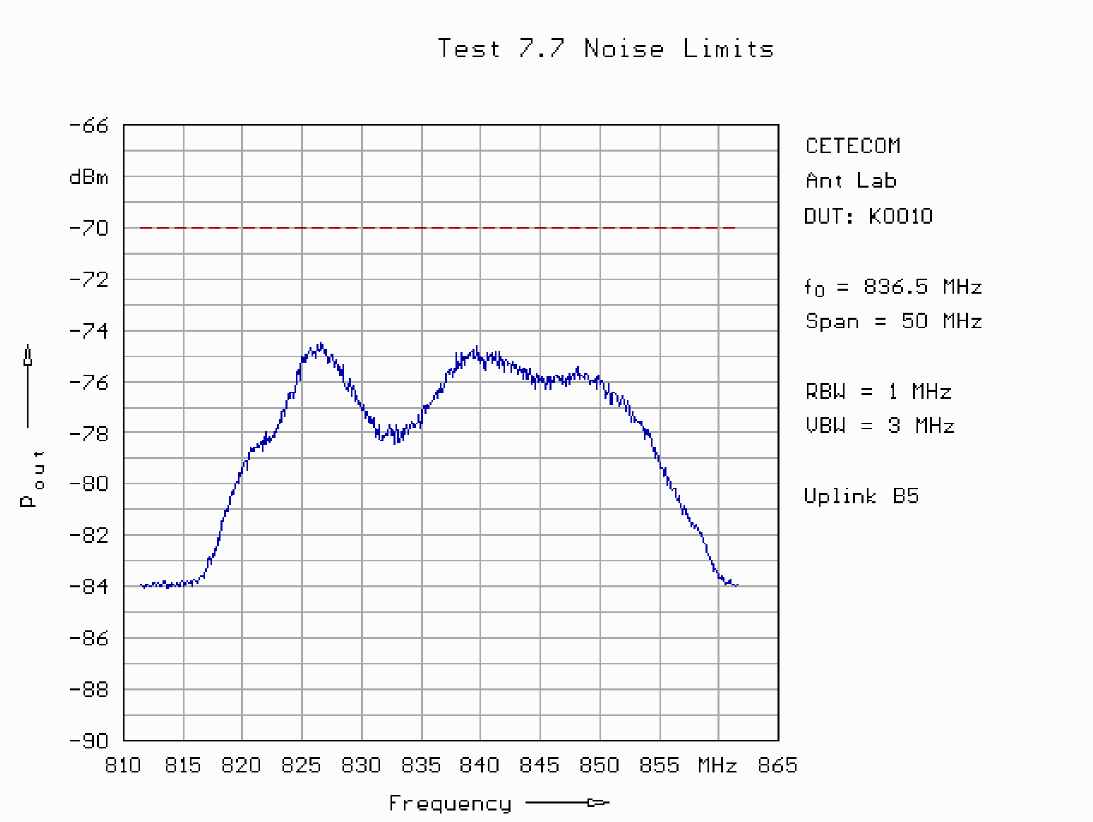

Fig. 164: Noise limits in uplink in band 5 (no uplink signal).

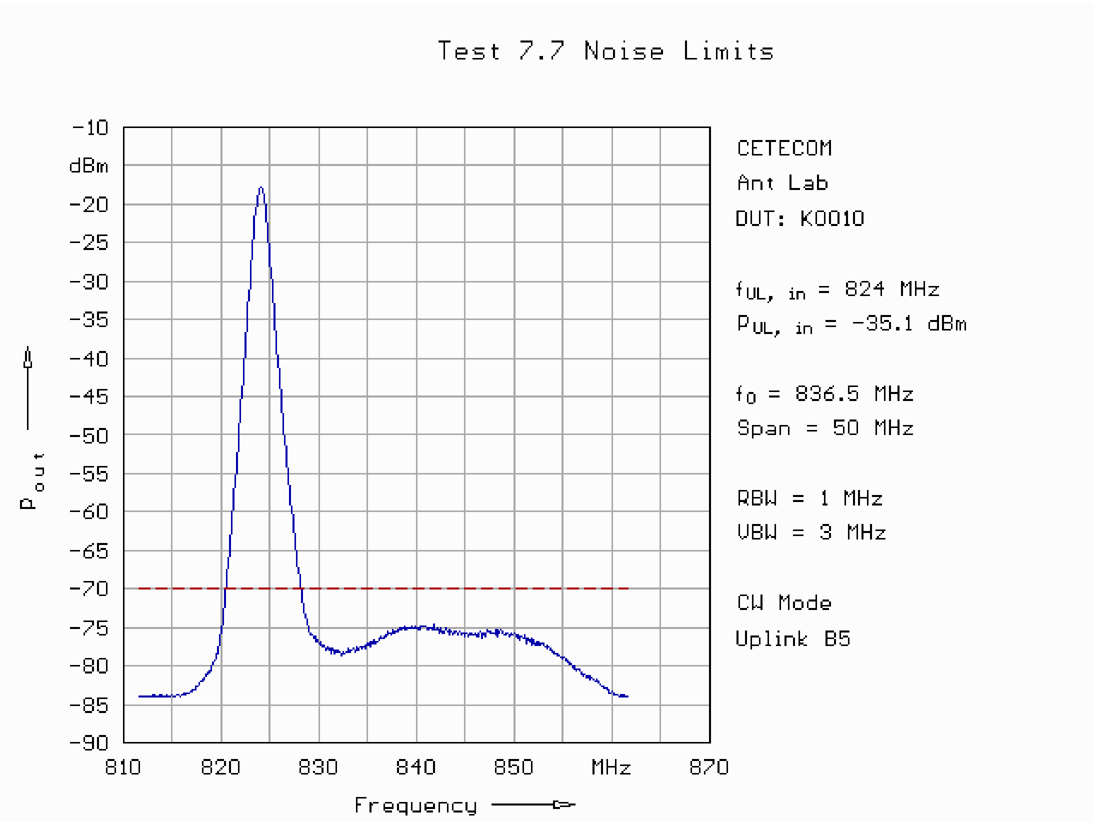

Fig. 165: Noise limits in uplink in band 5 (signal at lower band edge).

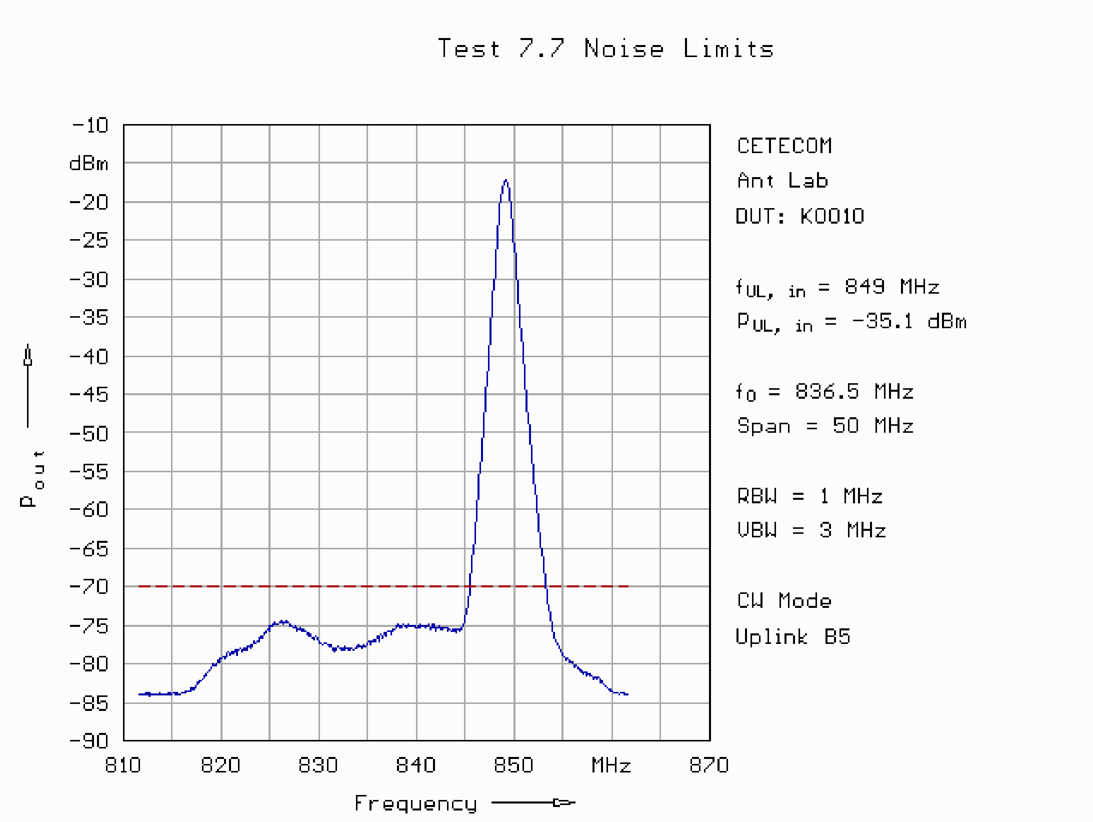

Fig. 166: Noise limits in uplink in band 5 (signal at upper band edge).

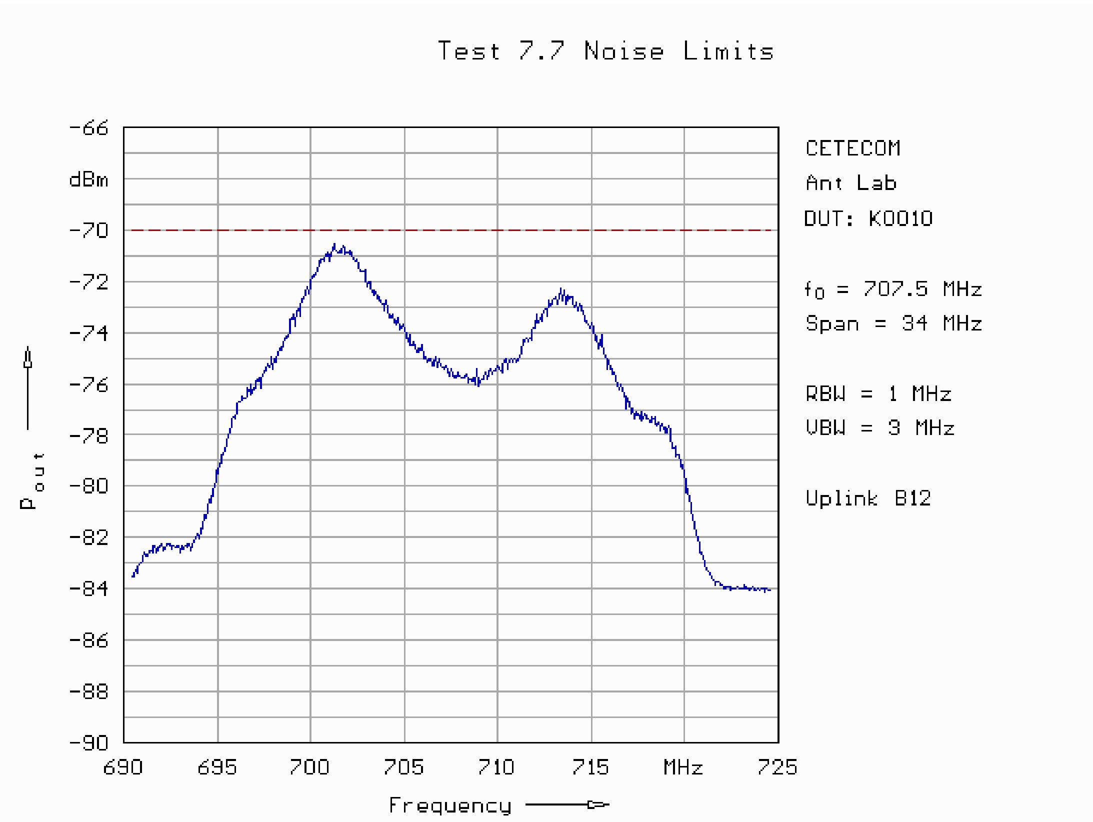

Fig. 167: Noise limits in uplink in band 12 (no uplink signal).

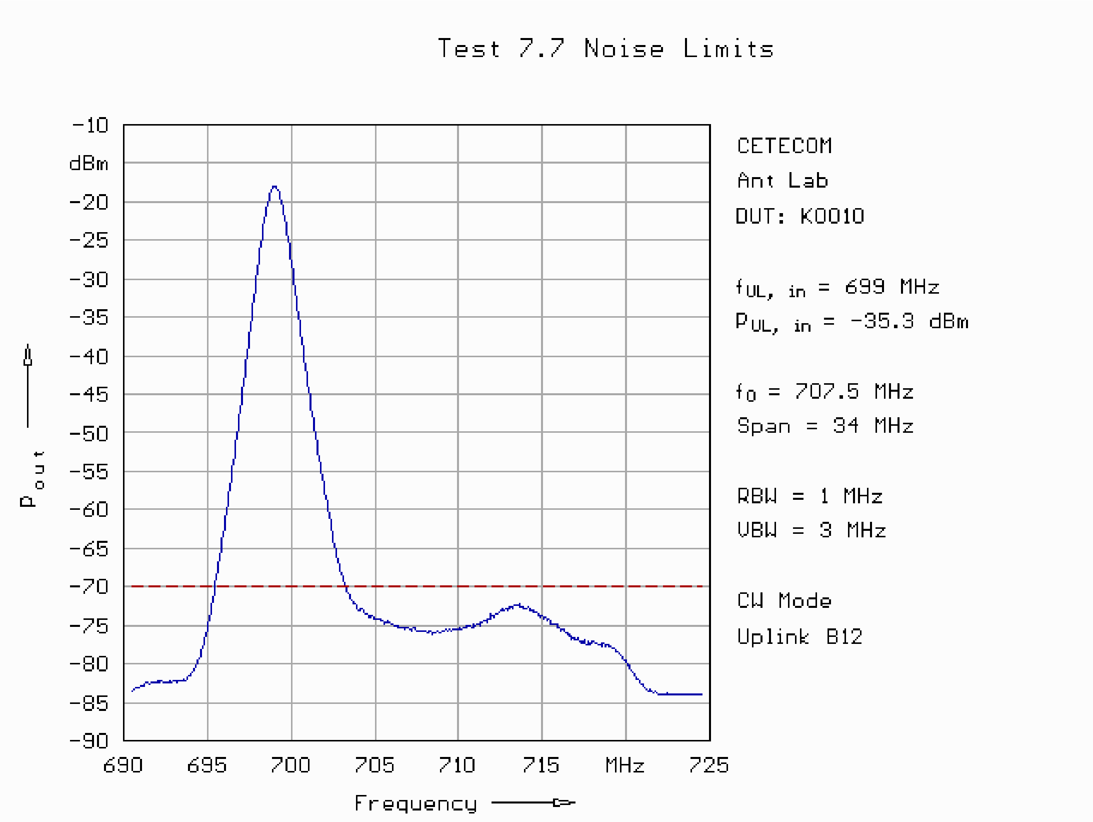

Fig. 168: Noise limits in uplink in band 12 (signal at lower band edge).

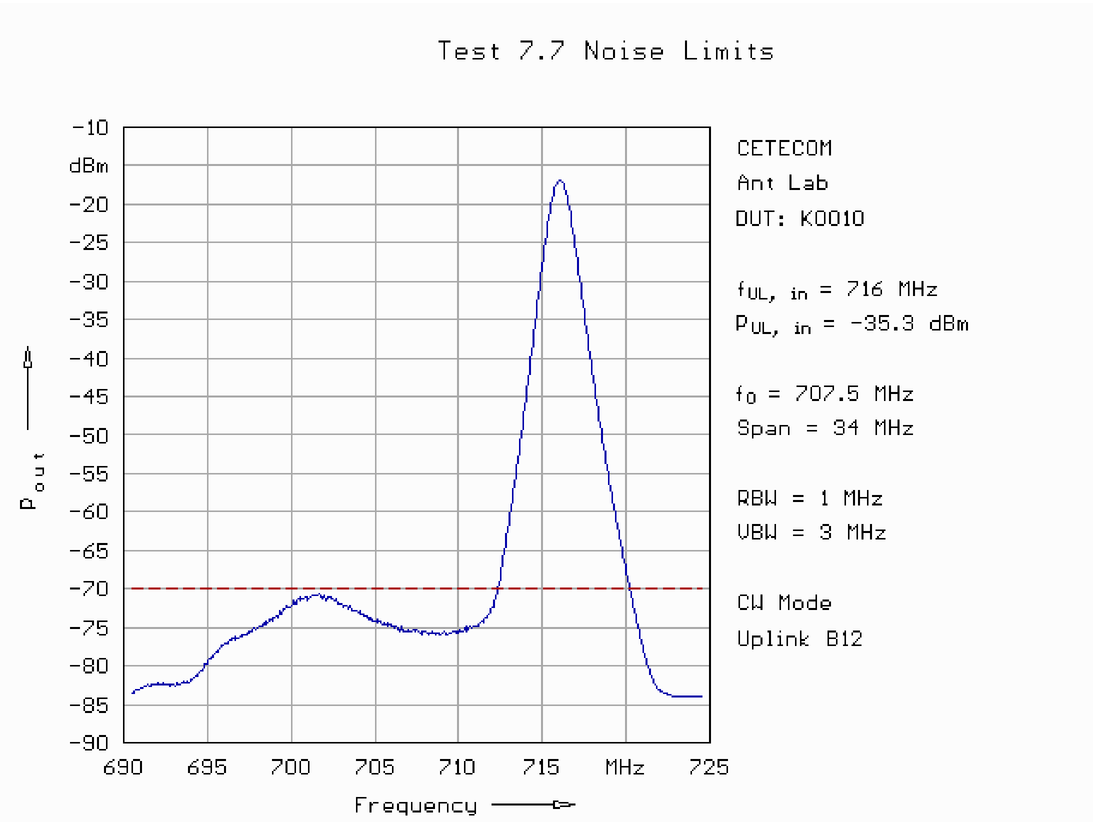

Fig. 169: Noise limits in uplink in band 12 (signal at upper band edge).

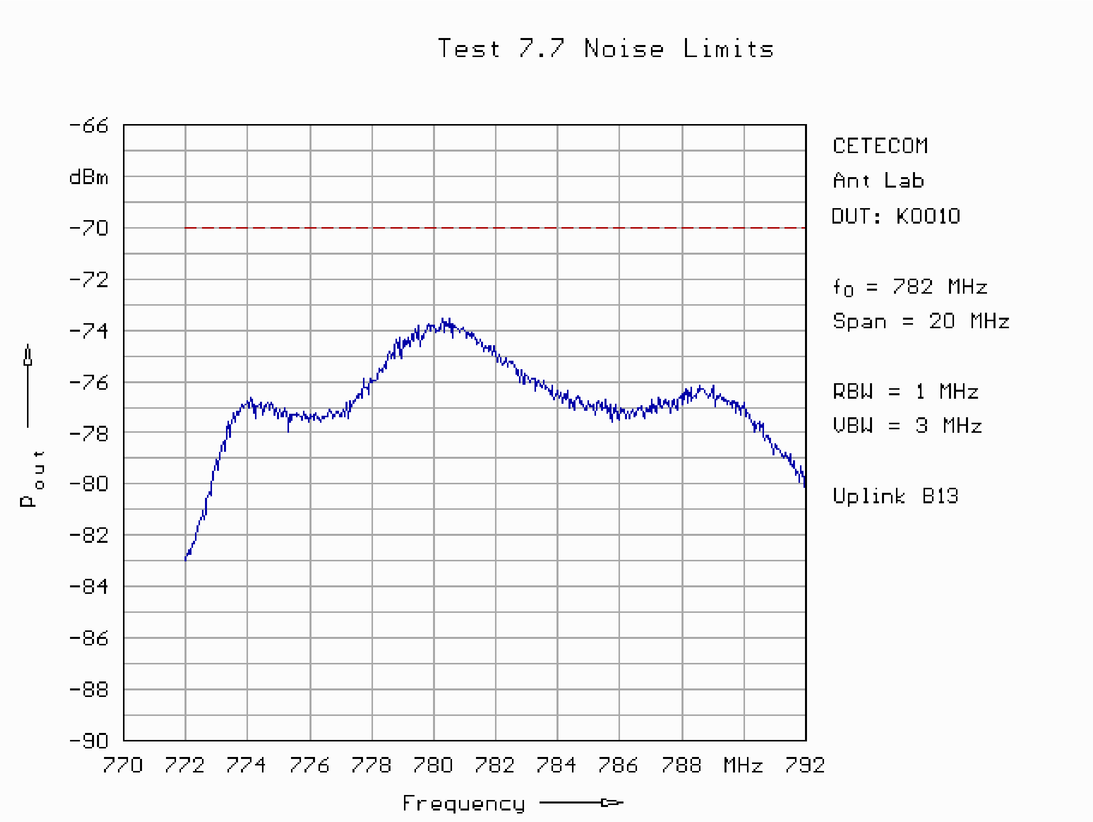

Fig. 170: Noise limits in uplink in band 13 (no uplink signal).

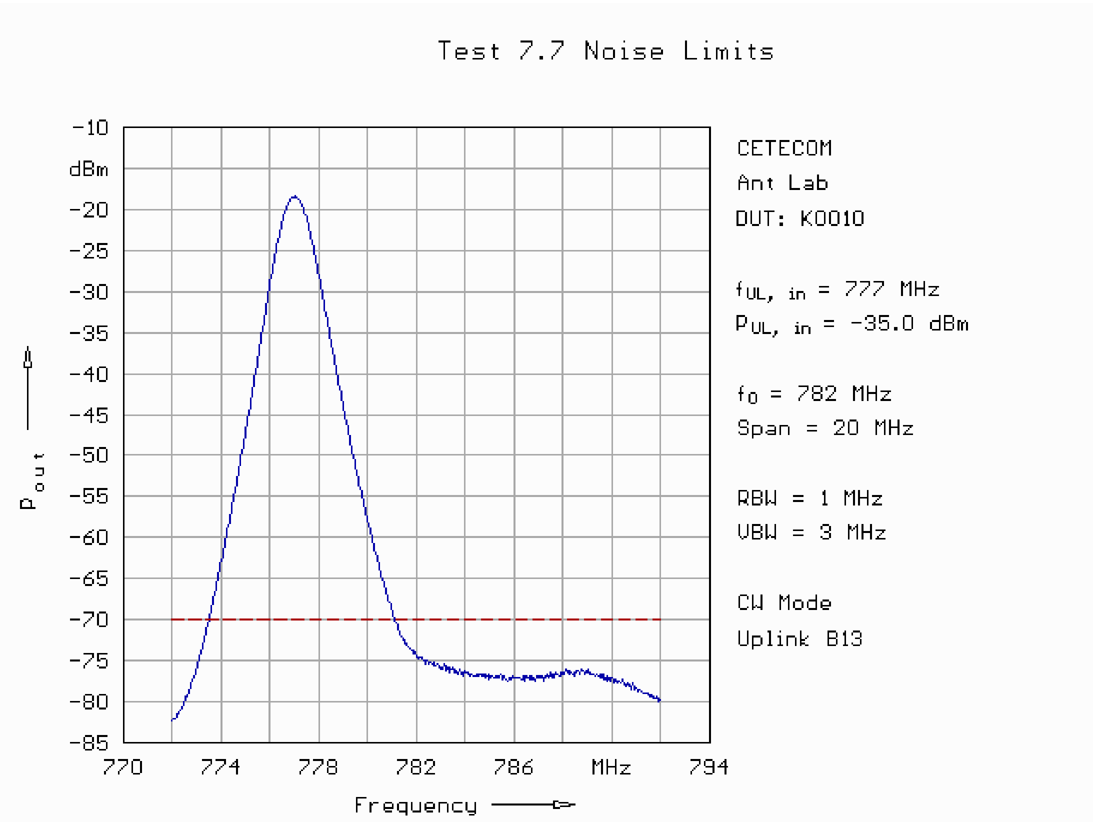

Fig. 171: Noise limits in uplink in band 13 (signal at lower band edge).

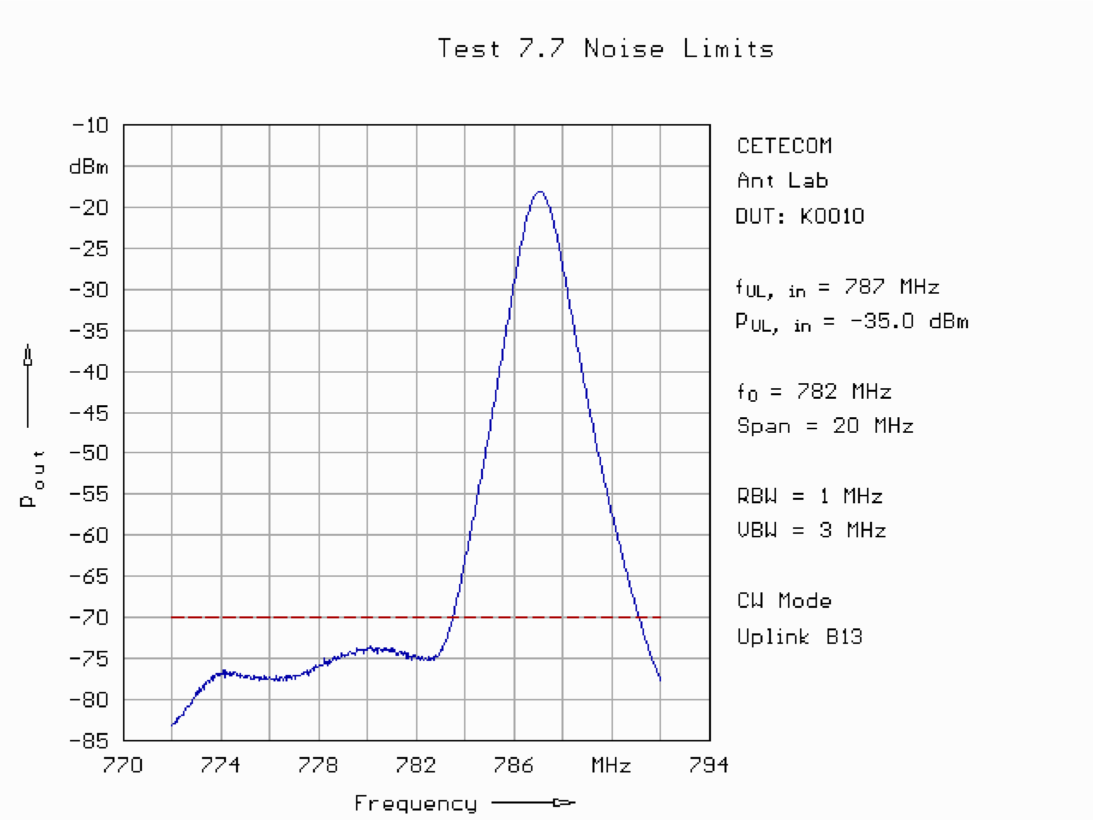

Fig. 172: Noise limits in uplink in band 13 (signal at upper band edge).

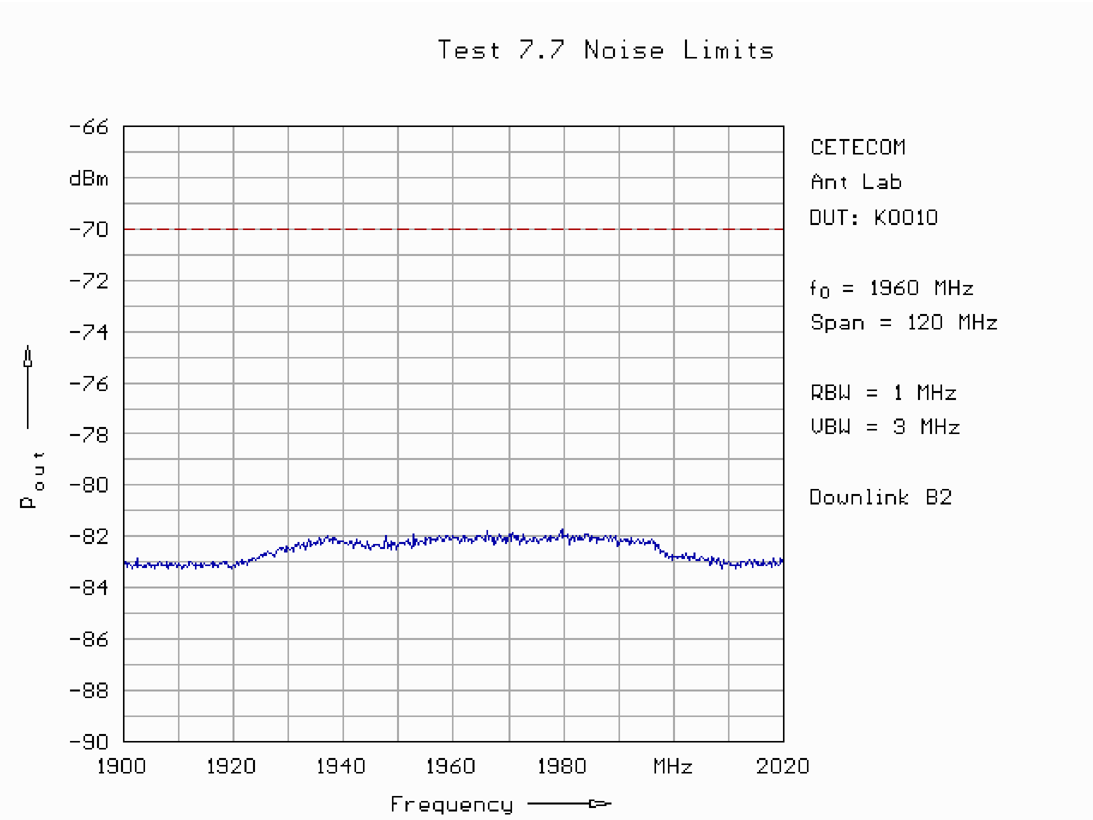

Fig. 173: Noise limits in downlink in band 2.

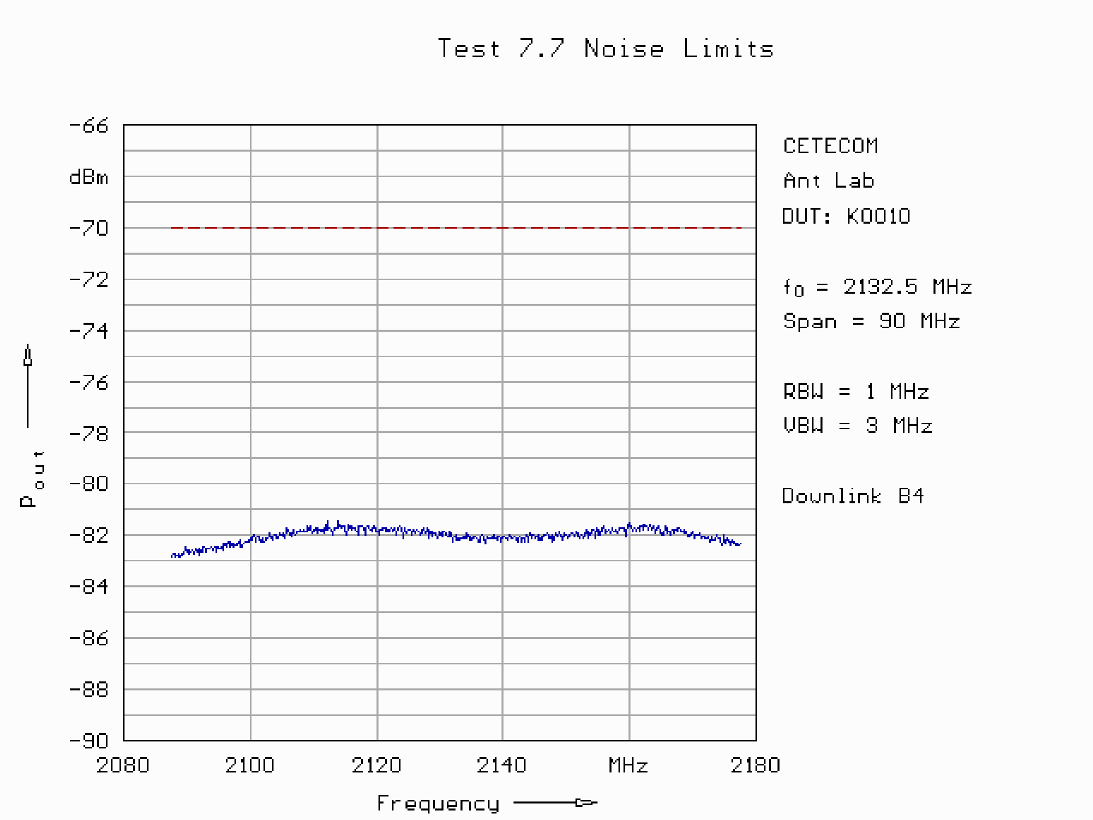

Fig. 174: Noise limits in downlink in band 4.

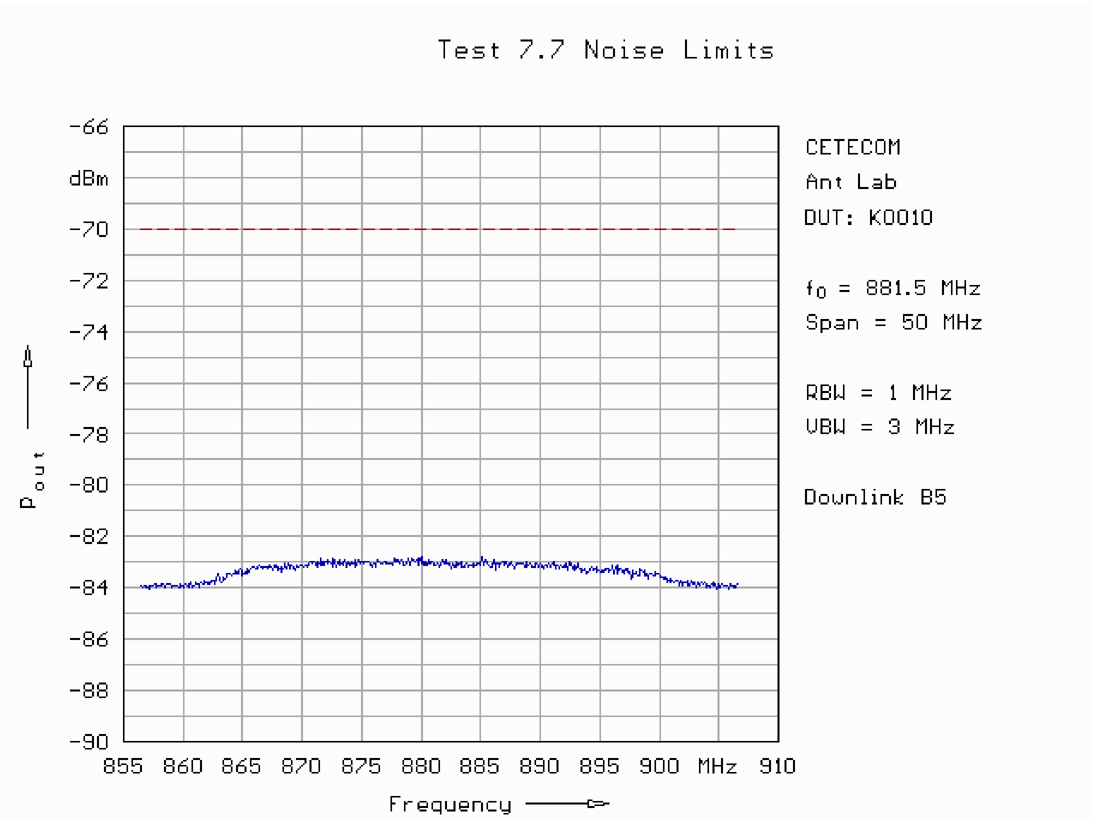

Fig. 175: Noise limits in downlink in band 5.

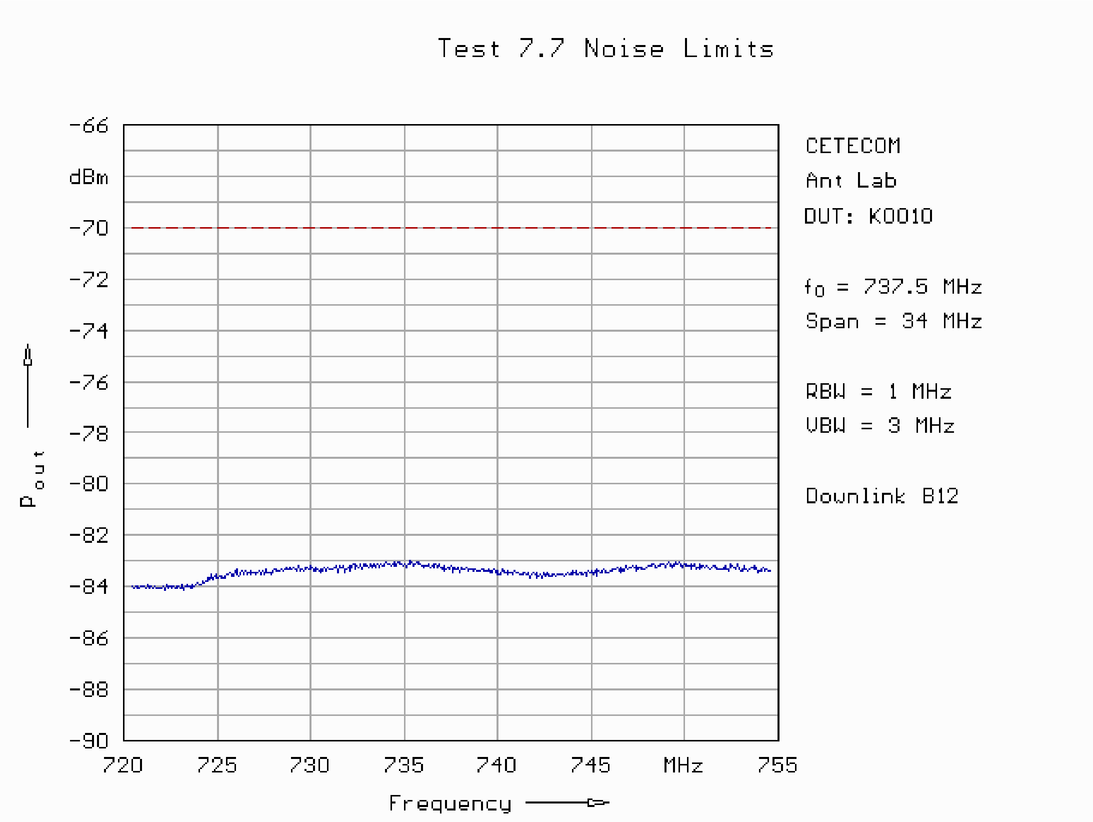

Fig. 176: Noise limits in downlink in band 12.

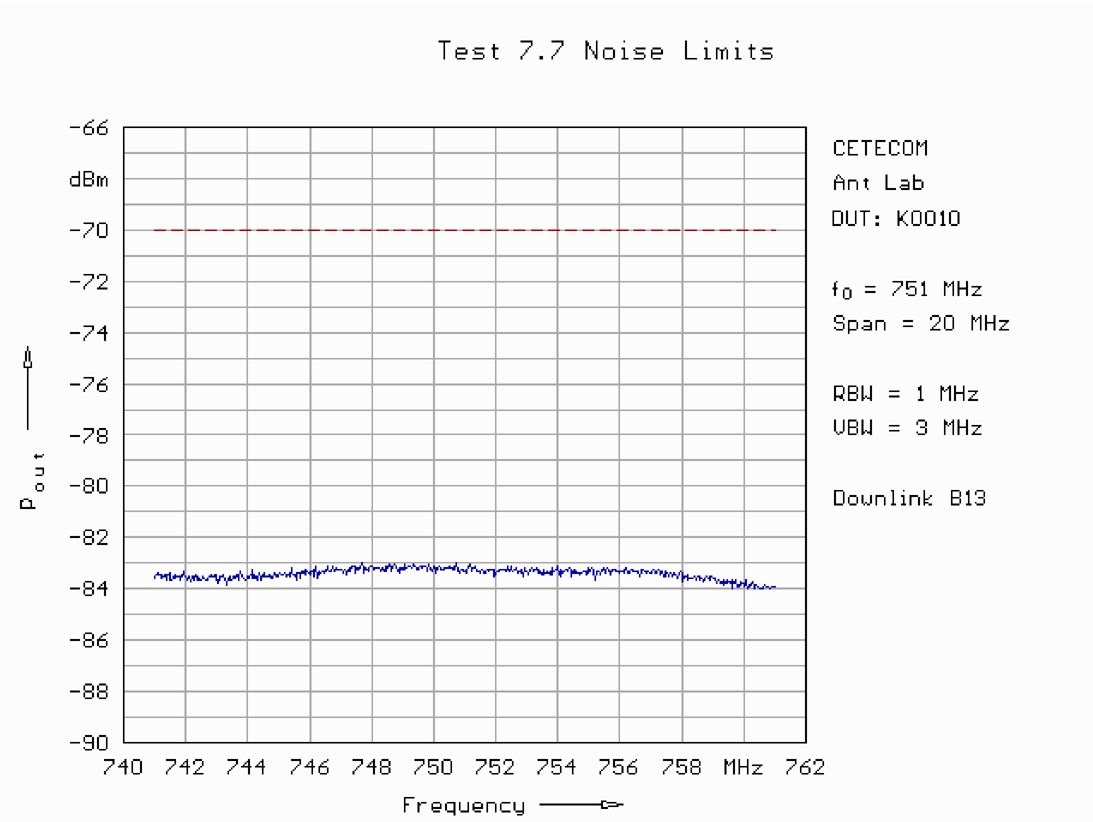

Fig. 177: Noise limits in downlink in band 13.

5.8. Uplink Inactivity

For testing the uplink inactivity, the set up as shown in Fig. 178 was used.

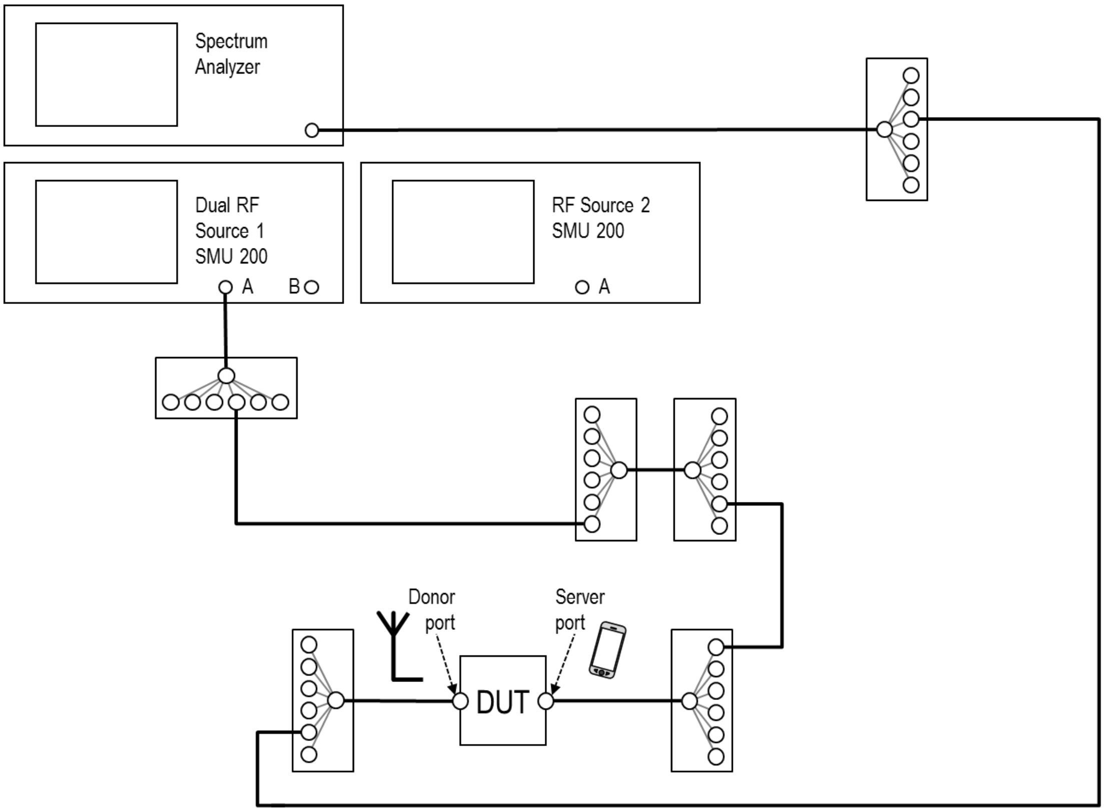

Fig. 178: Set up for the uplink inactivity tests.

In order to test automatically the time the system need to enter an uplink inactivity state we did the following:

1.) Switch OFF booster
2.) Apply a CW signal at the server port
3.) After 15 seconds we switched ON the booster
4.) Immediately after that we switched the signal OFF.

The pictures below shows the DUT basically switches into a bypass mode immediately when the signal is gone. Bypass mode means: No amplifier is active anymore, the whole device acts like a RF cable.

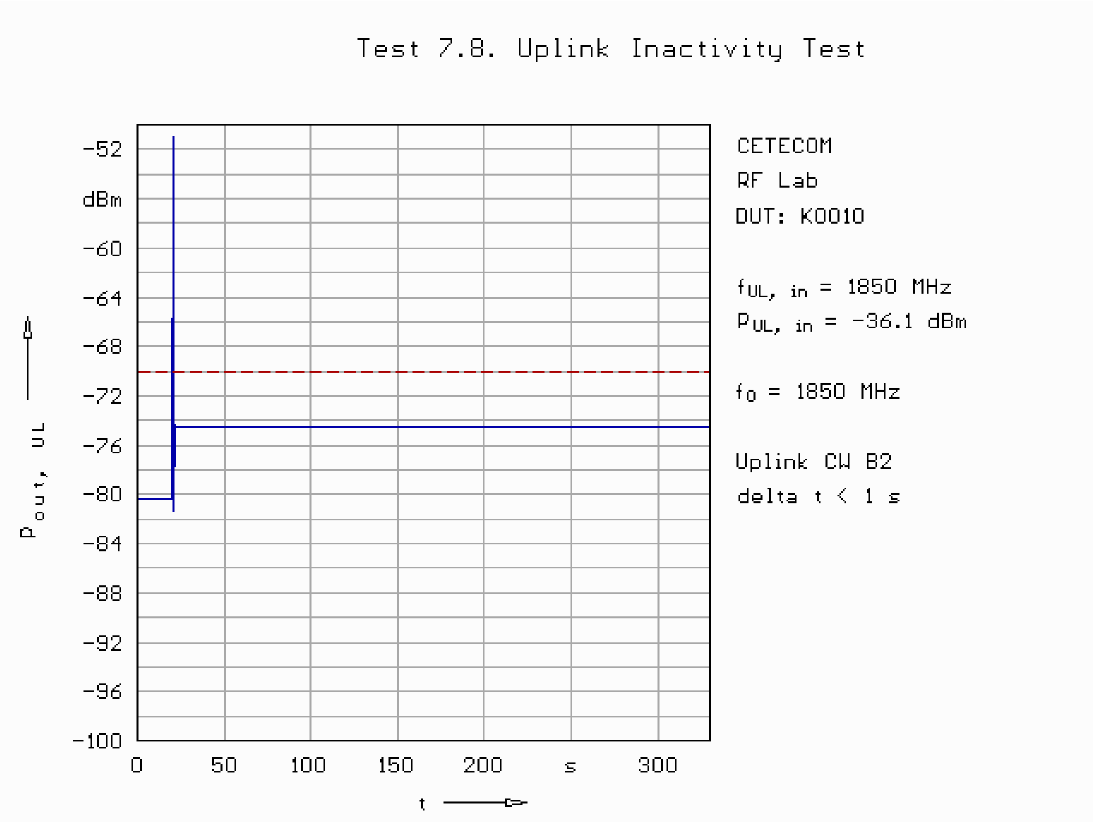

Fig. 179: Uplink inactivity test in band 2.

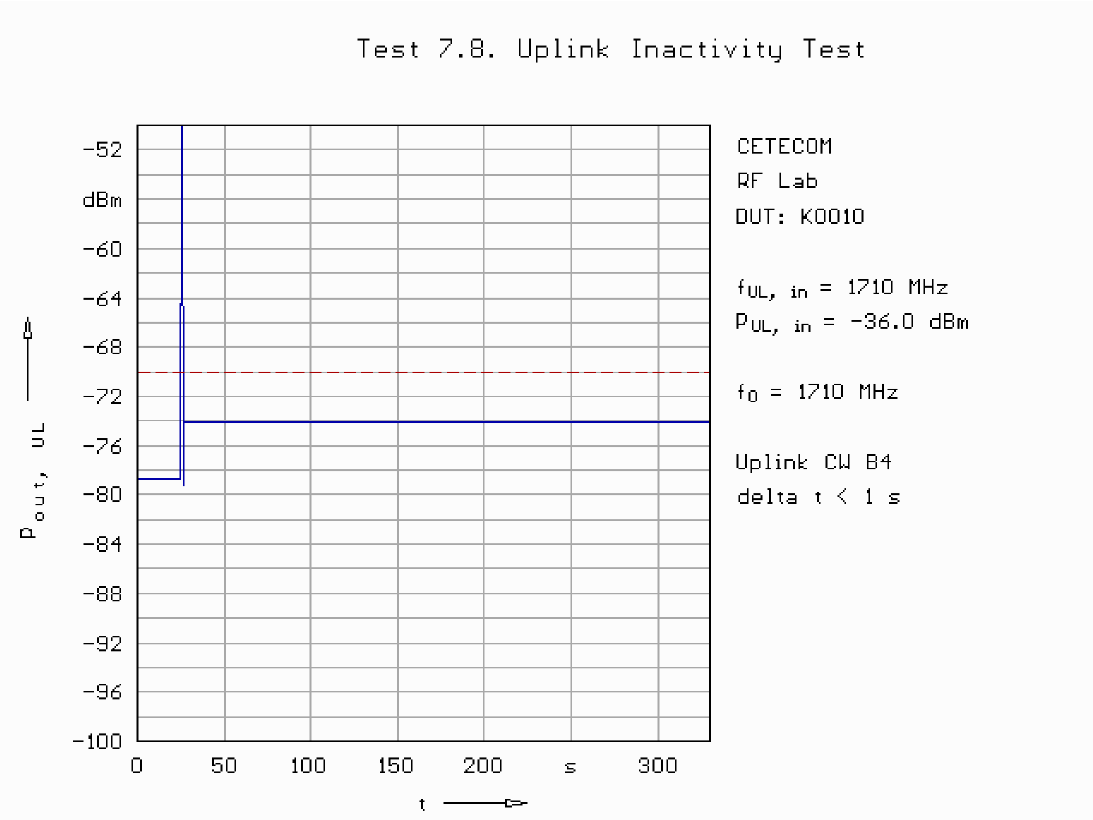

Fig. 180: Uplink inactivity test in band 4.

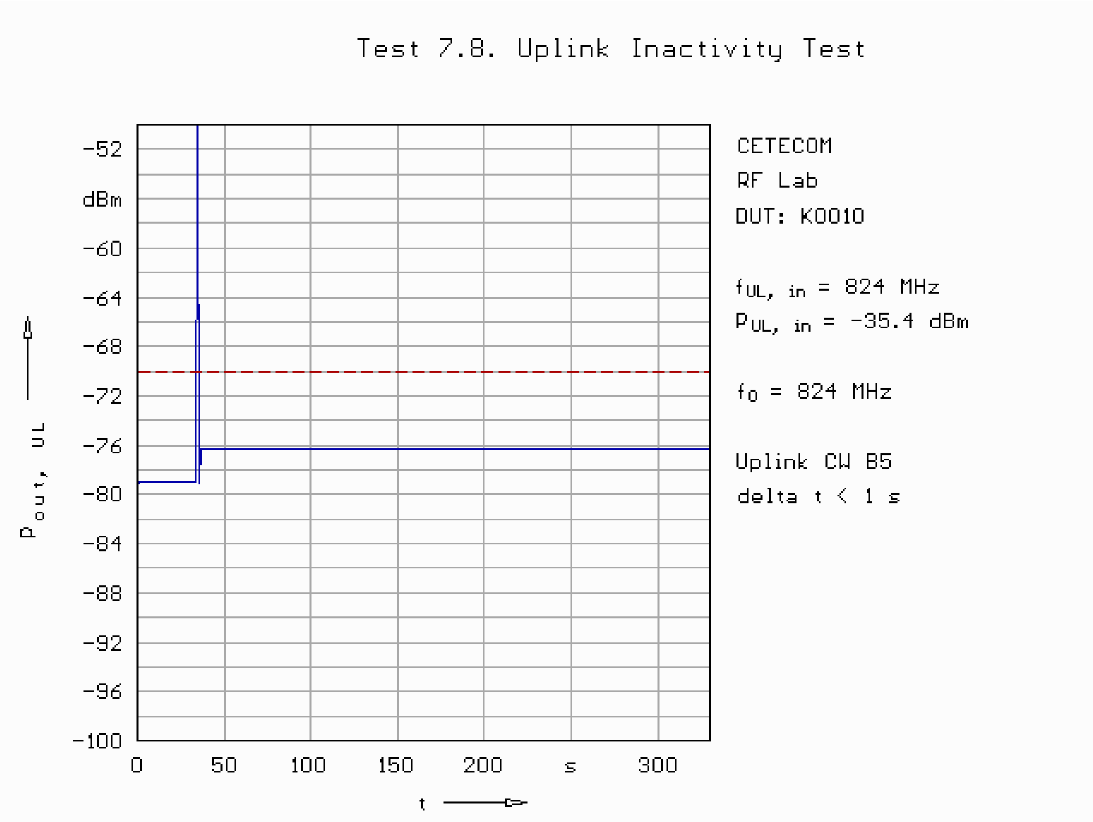

Fig. 181: Uplink inactivity test in band 5.

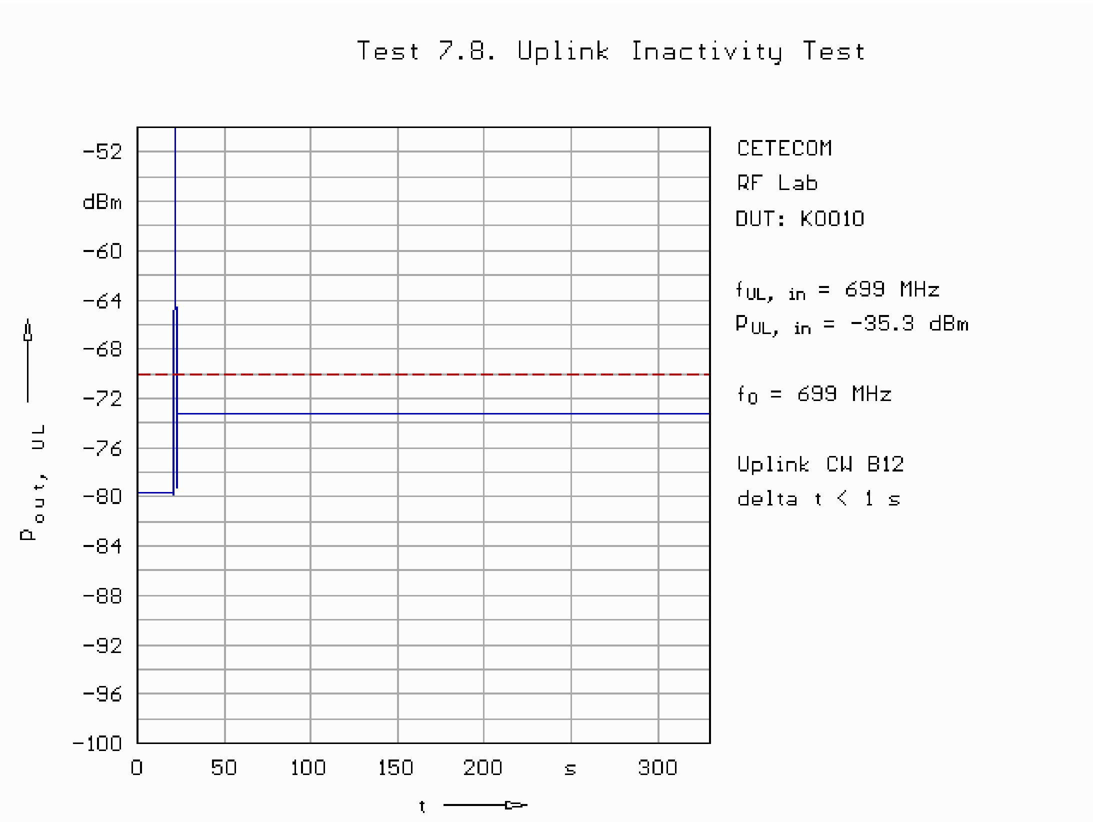

Fig. 182: Uplink inactivity test in band 12.

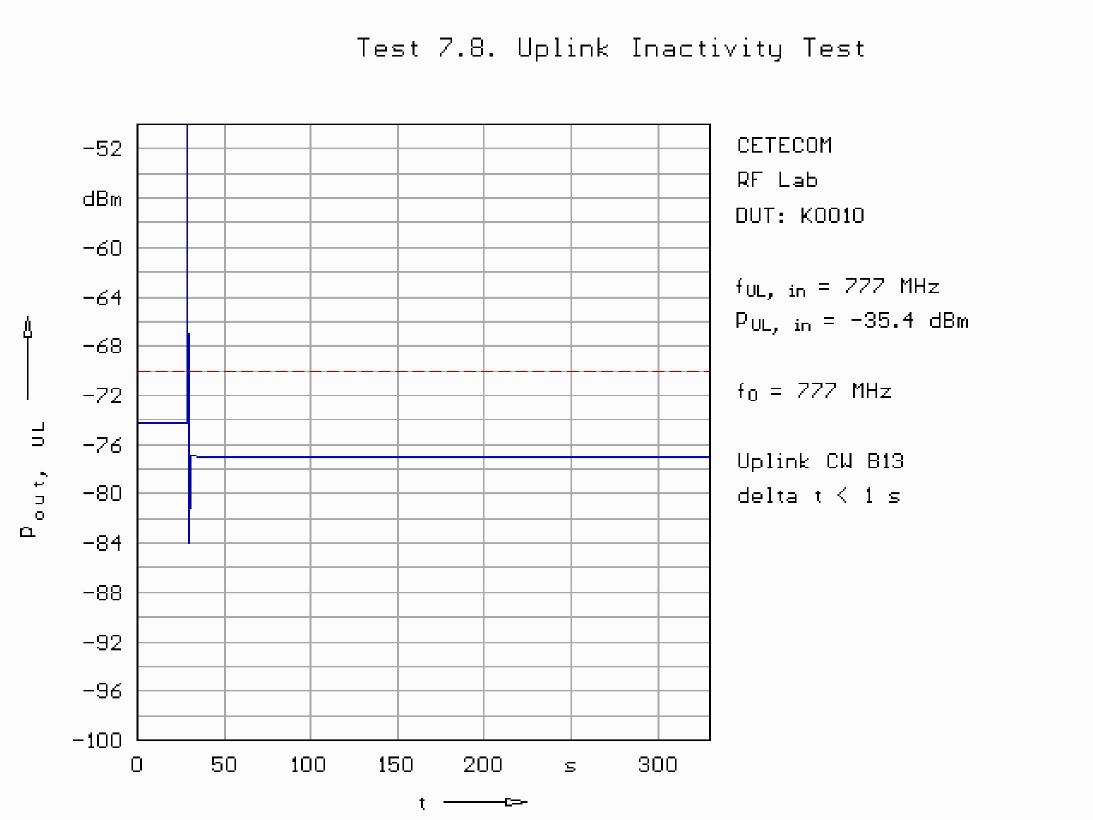

Fig. 183: Uplink inactivity test in band 13.

5.9. Variable Gain and Uplink Gain Timing

For measuring the variable gain and its dependency on RSSI signal level signal routings as shown in Fig. 184 and Fig. 185 are used. For the special booster under test always a signal at the server port is required to enable the uplink amplifier.

Within the variable gain data provided are measurement values for the gain values found with closest distance to the limit line. This distance is reported as “delta” in dB at the plots.

All data found met the limits for variable gain. All timing data found met the 1 s limit.

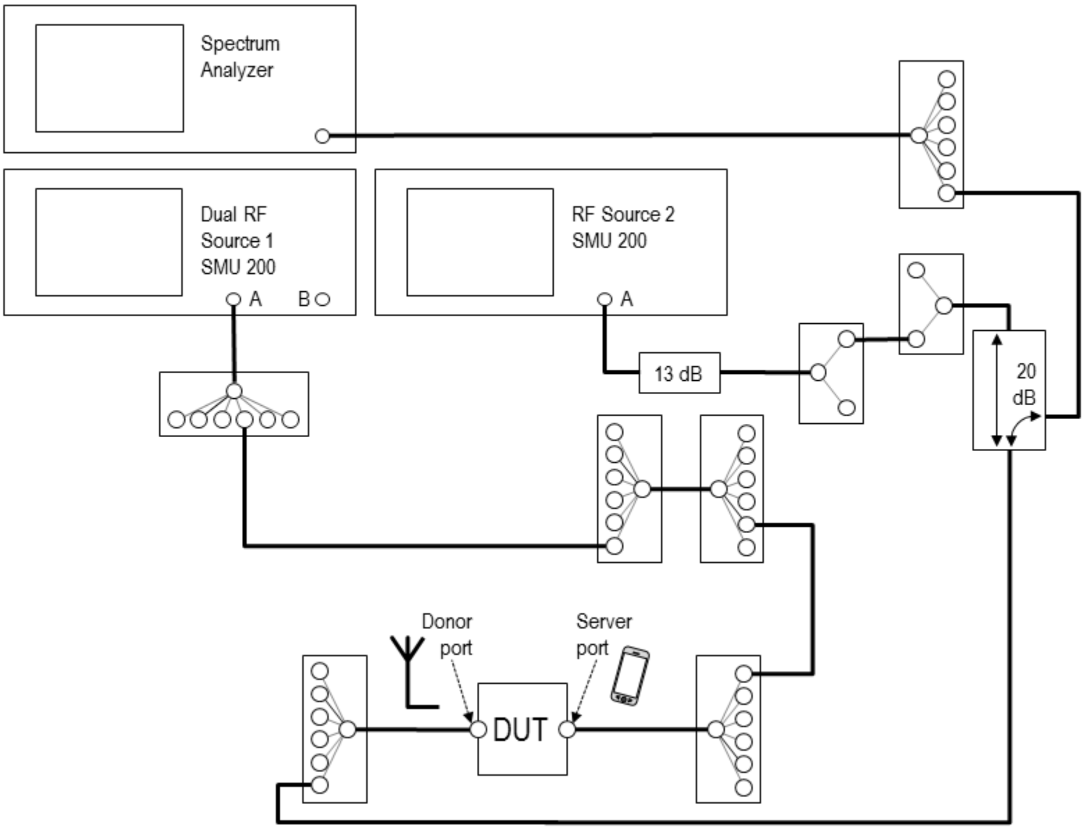

Fig. 184: Set up for the variable (RSSI dependent) gain measurements in uplink.

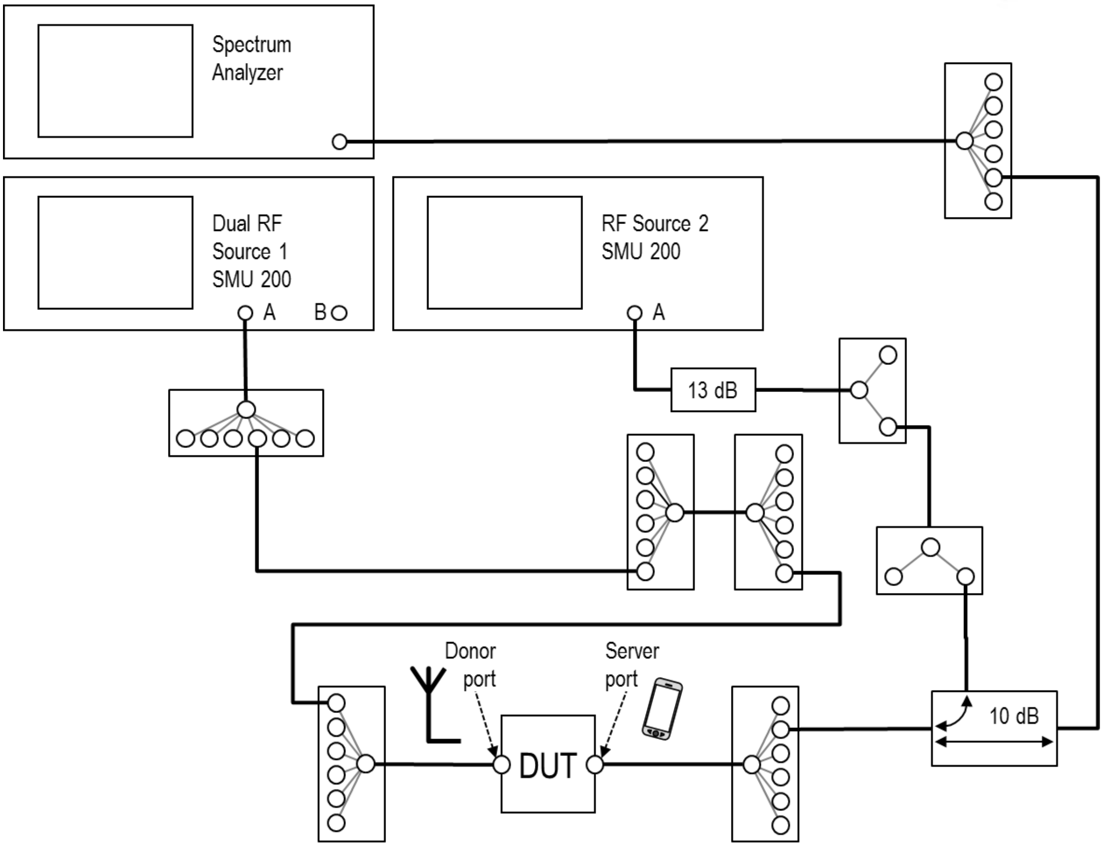

Fig. 185: Set up for the variable (RSSI dependent) gain measurements in downlink.

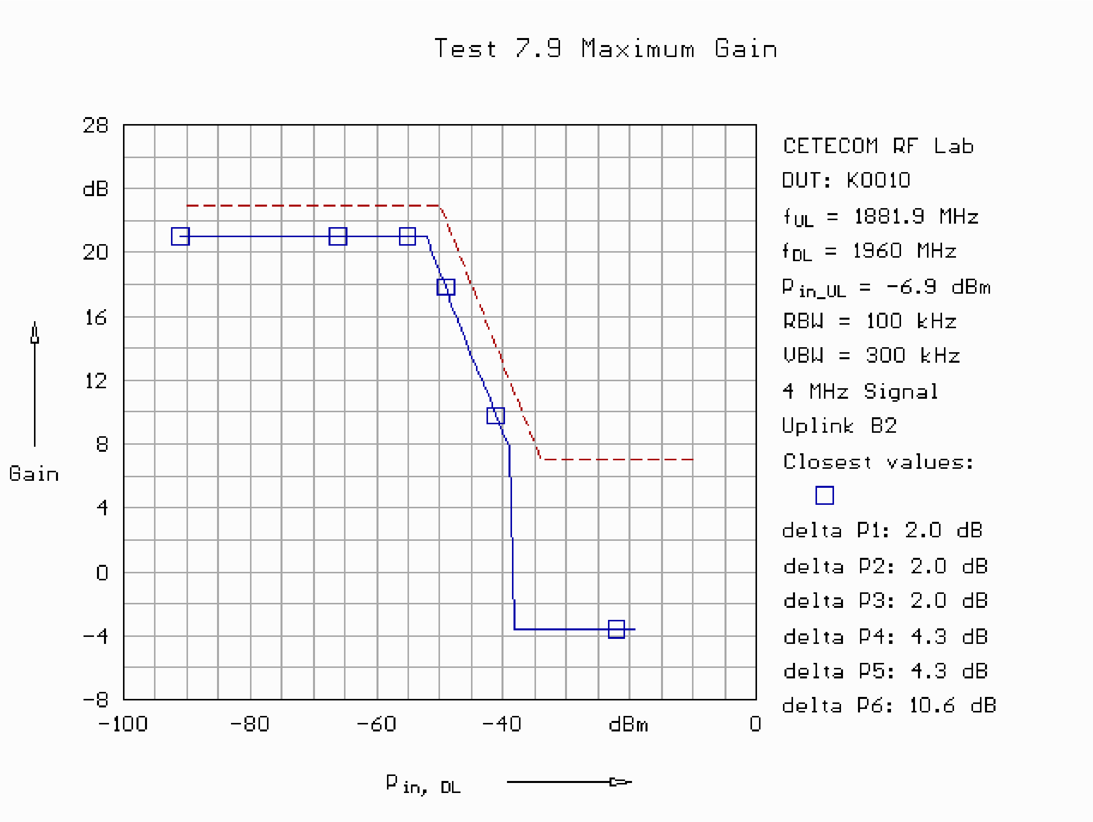

Fig. 186: Variable RSSI dependent uplink gain in band 2.

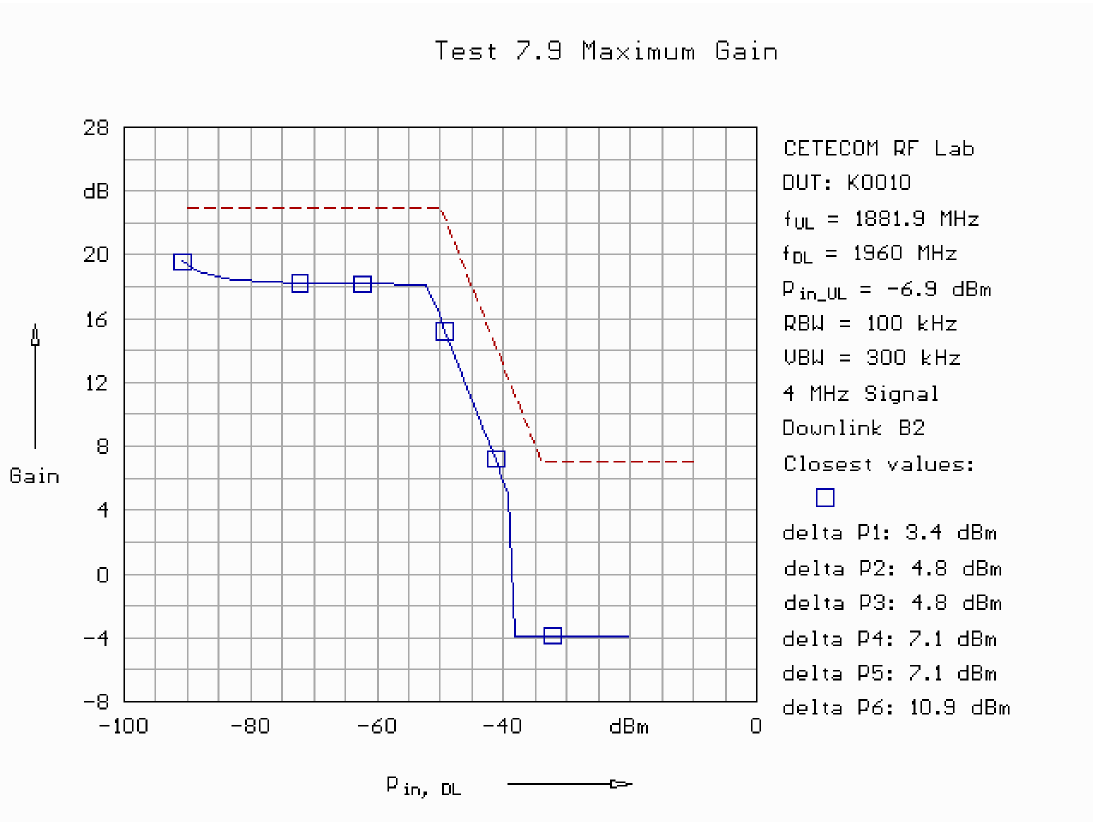

Fig. 187: Variable RSSI dependent downlink gain in band 2.

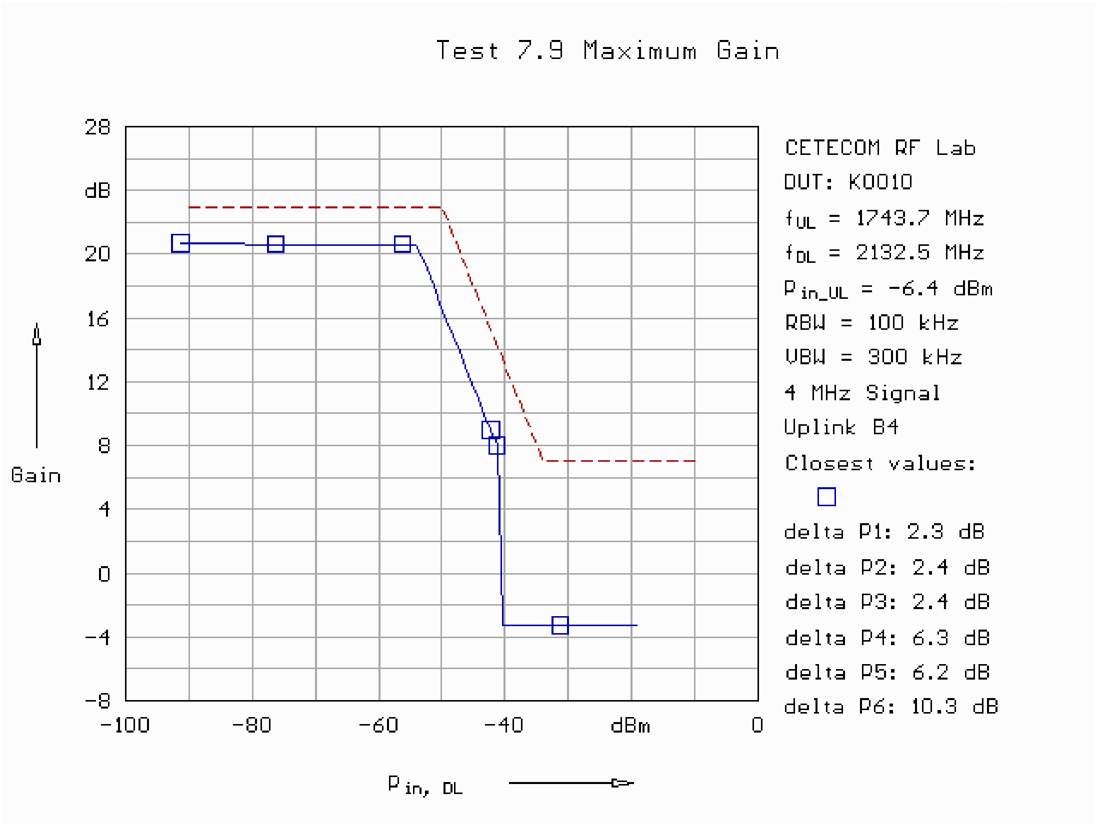

Fig. 188: Variable RSSI dependent uplink gain in band 4.

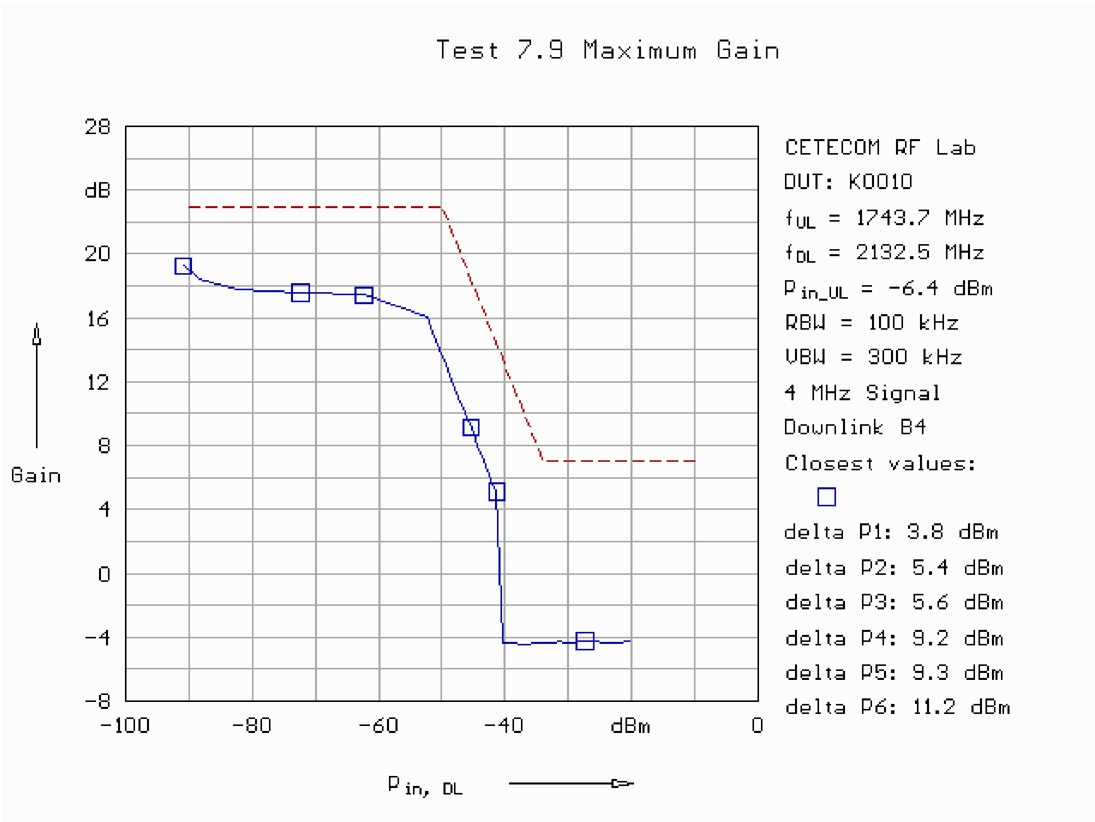

Fig. 189: Variable RSSI dependent downlink gain in band 4.

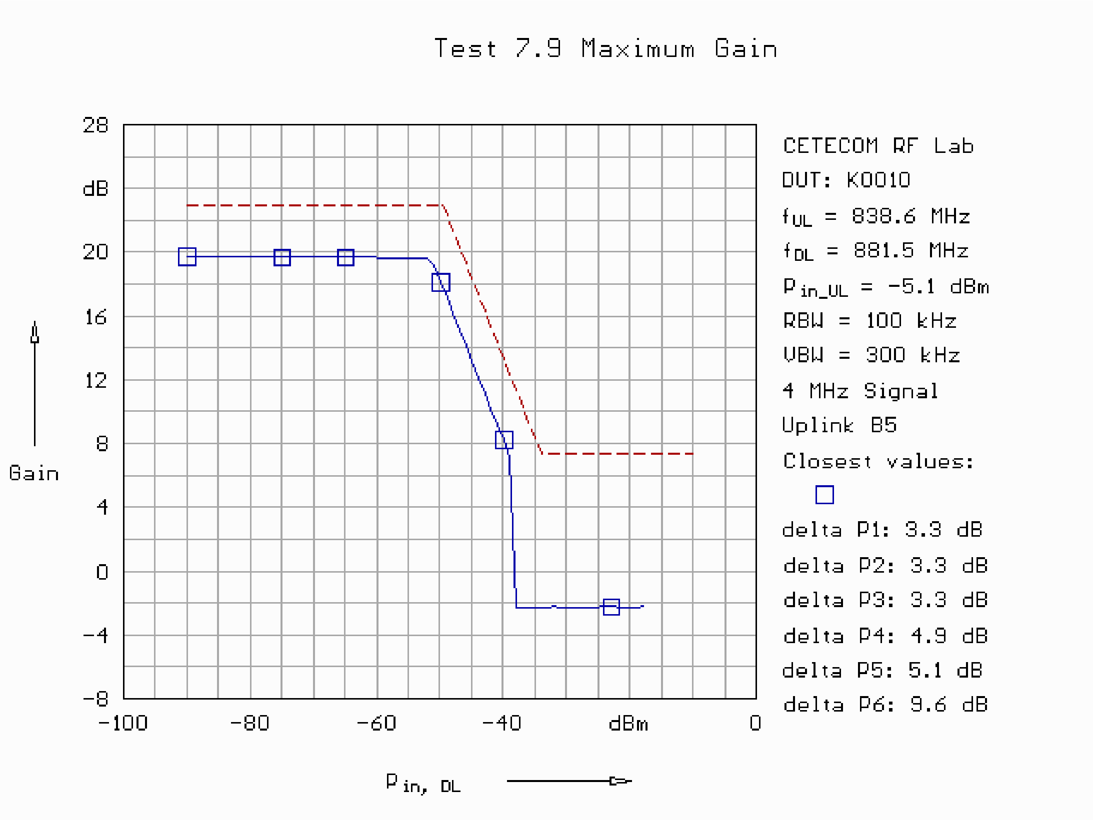

Fig. 190: Variable RSSI dependent uplink gain in band 5.

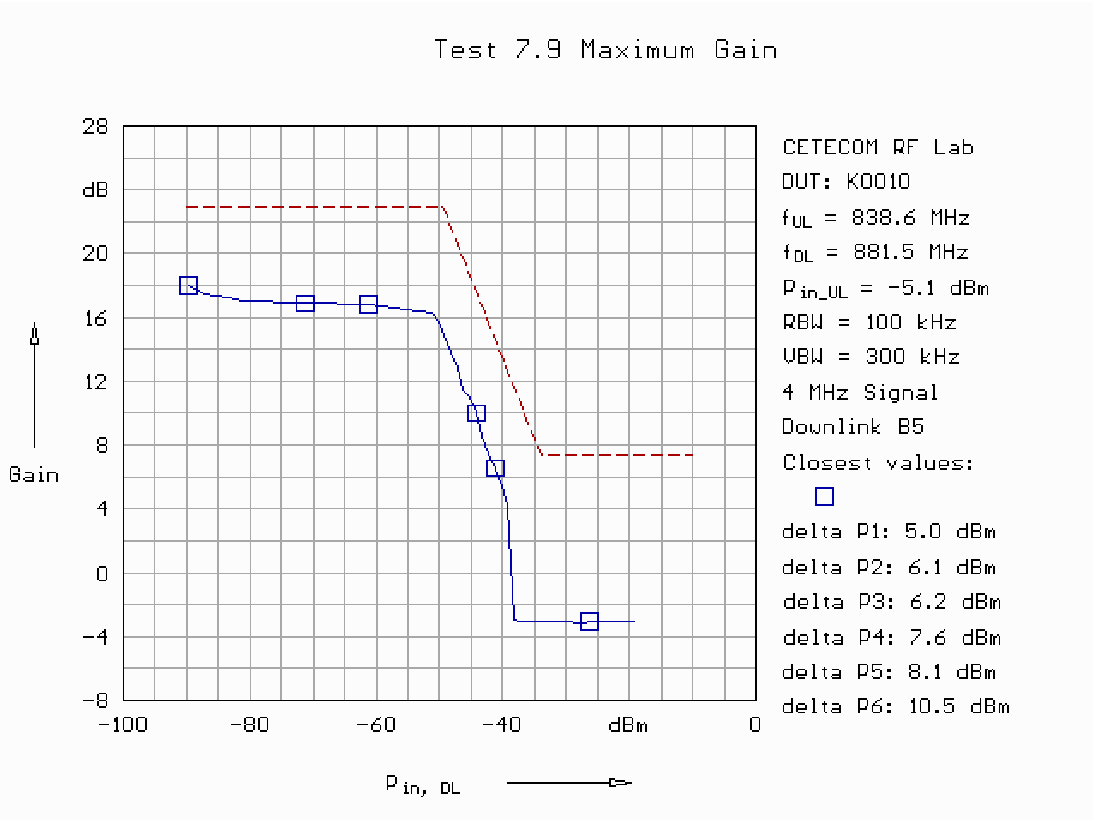

Fig. 191: Variable RSSI dependent downlink gain in band 5.

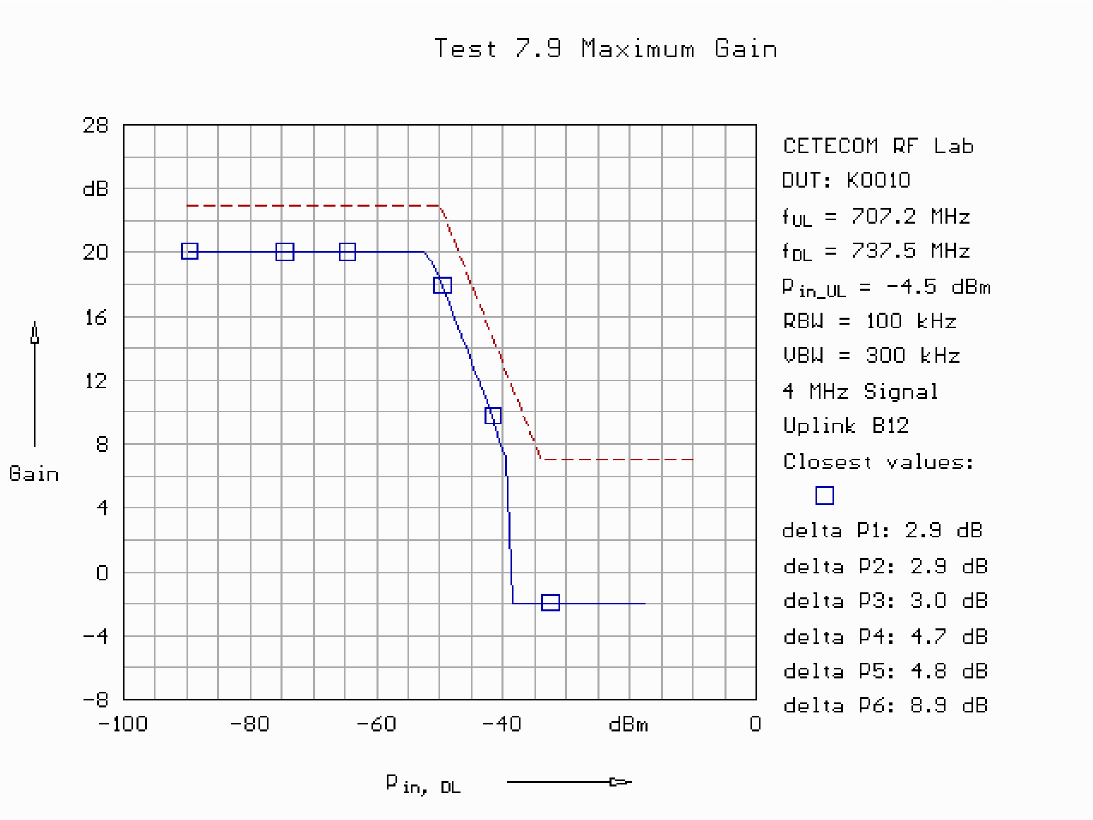

Fig. 192: Variable RSSI dependent uplink gain in band 12.

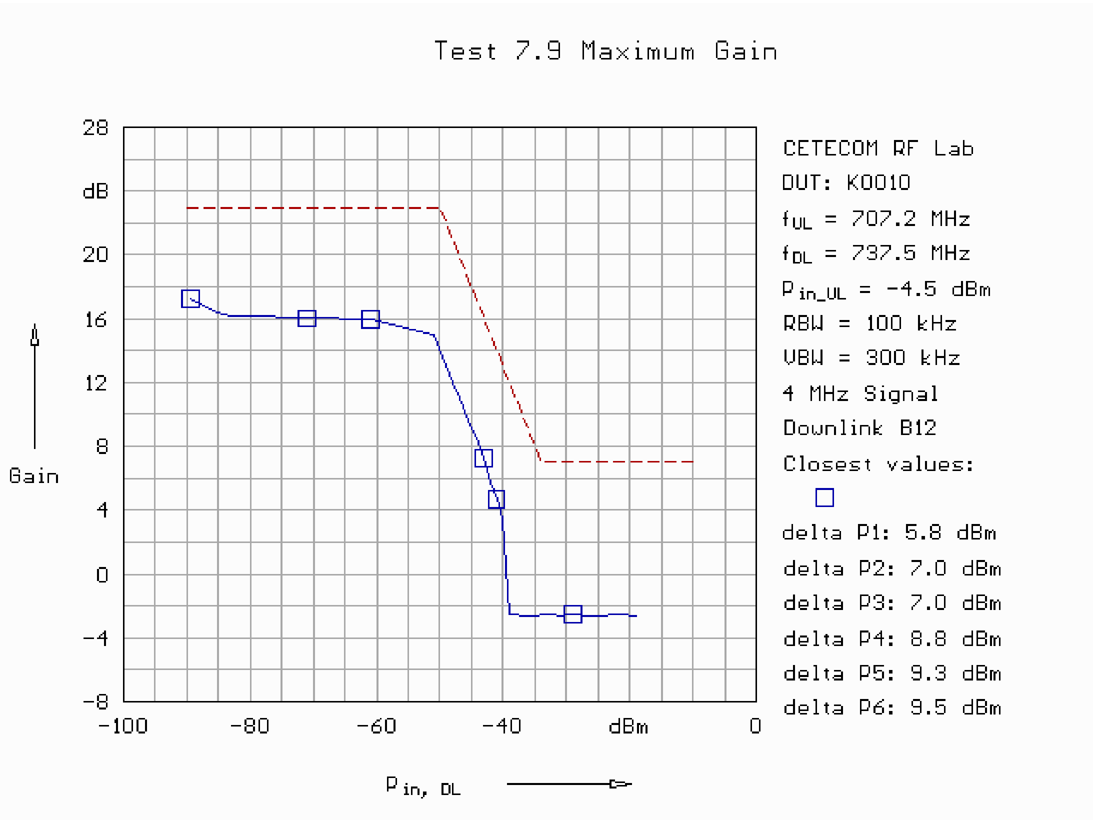

Fig. 193: Variable RSSI dependent downlink gain in band 12.

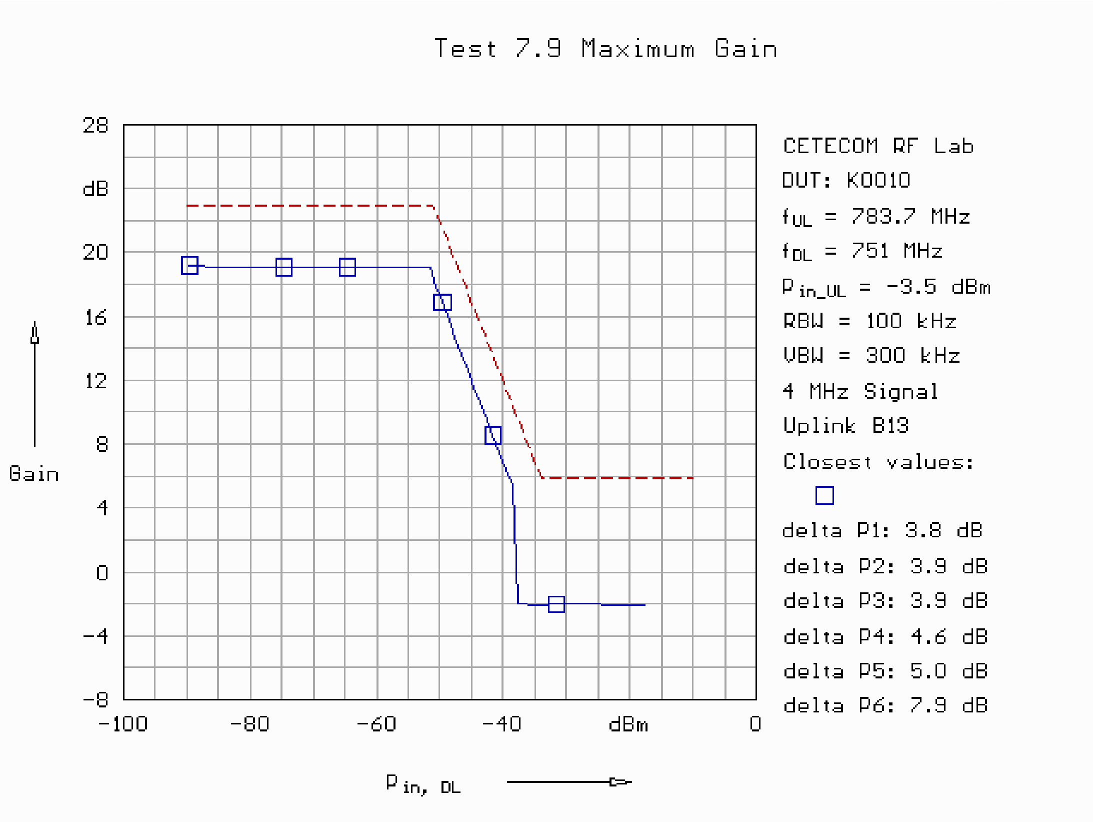

Fig. 194: Variable RSSI dependent uplink gain in band 13.

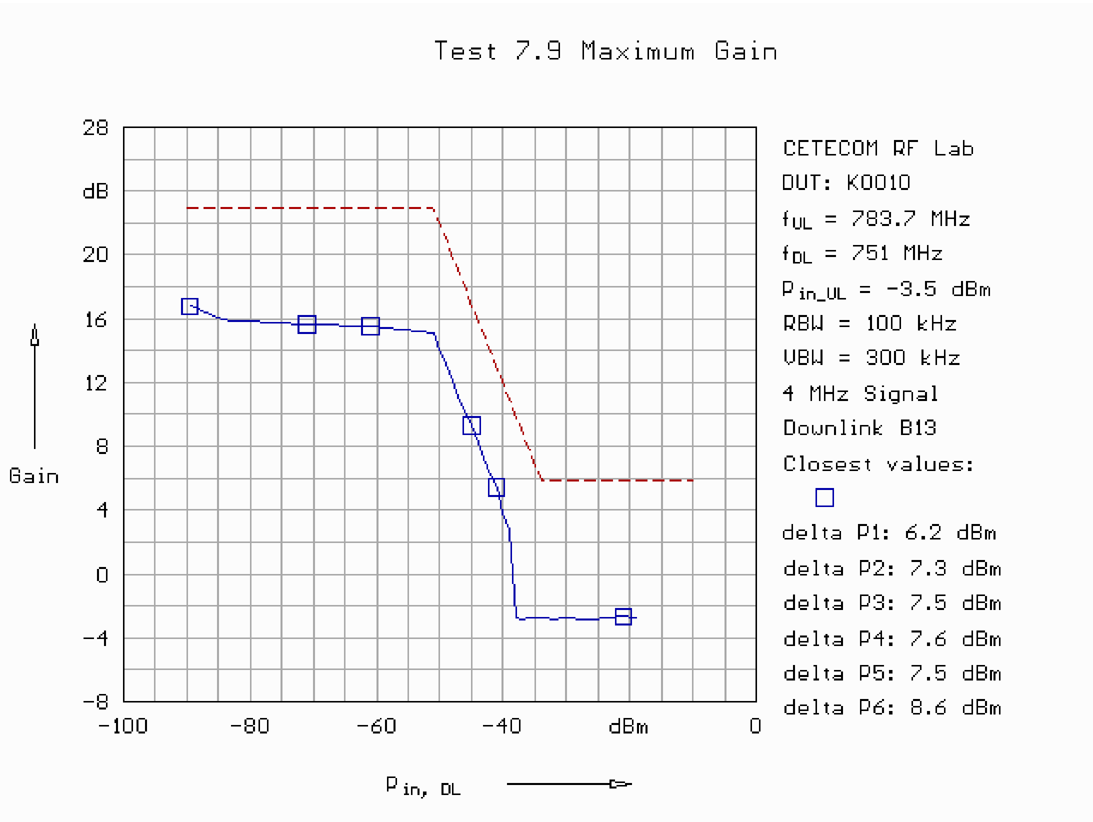

Fig. 195: Variable RSSI dependent downlink gain in band 13.

Below are summarized the measured results for uplink gain timing.

Band	Measured Time	Limit	Result
2	0.32 s	1 s	Pass
4	0.16 s	1 s	Pass
5	0.26 s	1 s	Pass
12	0.45 s	1 s	Pass
13	0.53 s	1 s	Pass

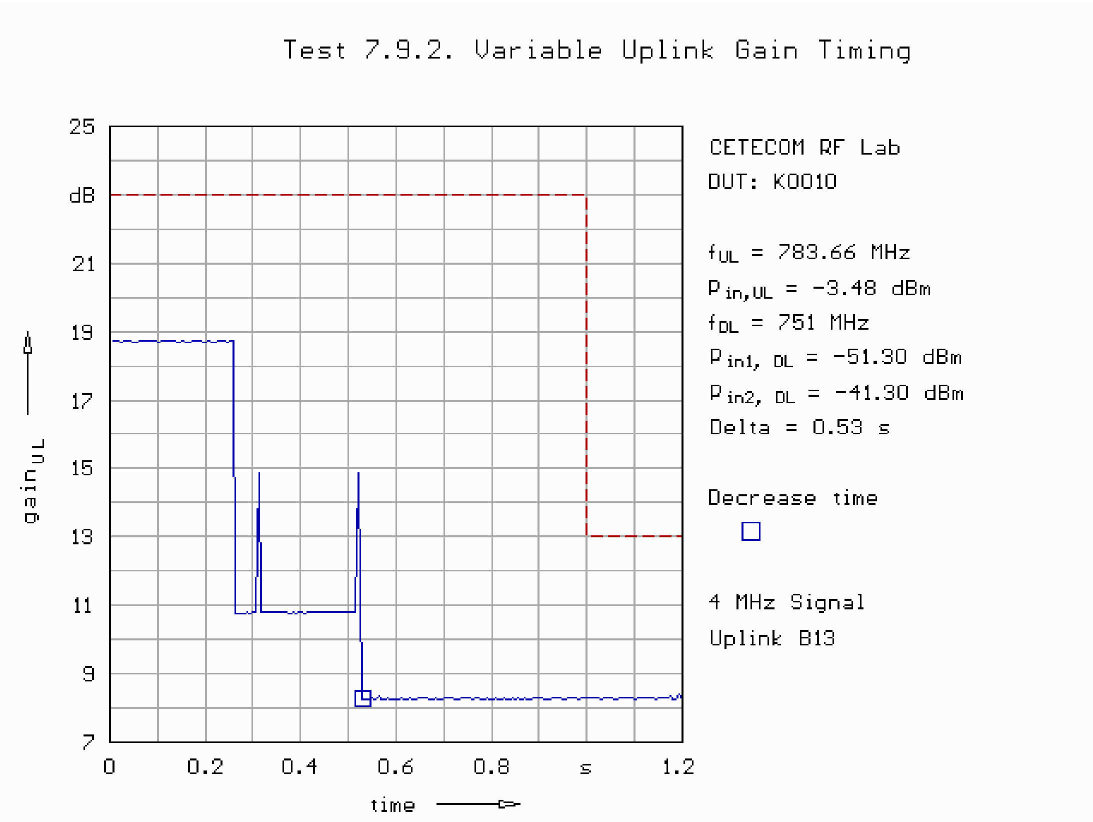

Fig. 196: Measured maximum uplink gain switch time (band 13).

5.10. Occupied Bandwidth

This measurement is required to compare the output signal relative to the input signal according to § 2.1049. In fact we found no substantial spectral growth.

The activated cable routing used is shown in Fig. 197 and Fig. 198 for up- and downlink, respectively. For showing the signal source signal the DUT was replaced by an RF through.

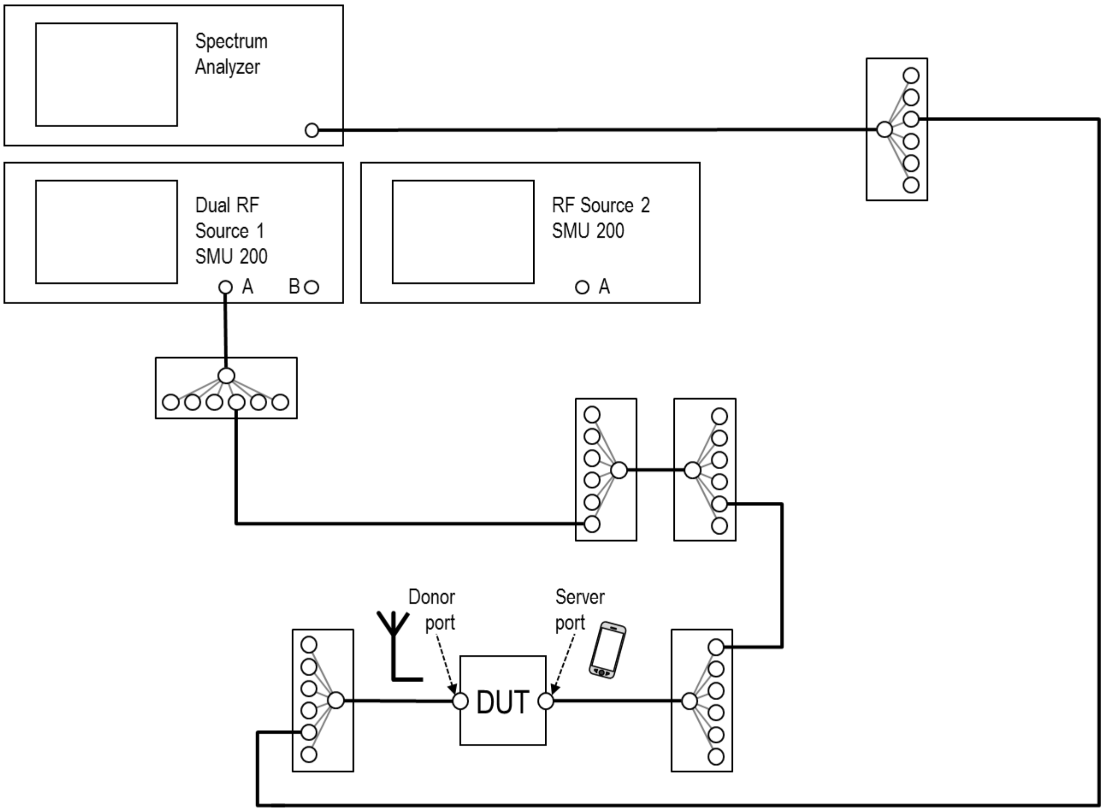

Fig. 197: Set up for the occupied bandwidth test in uplink.

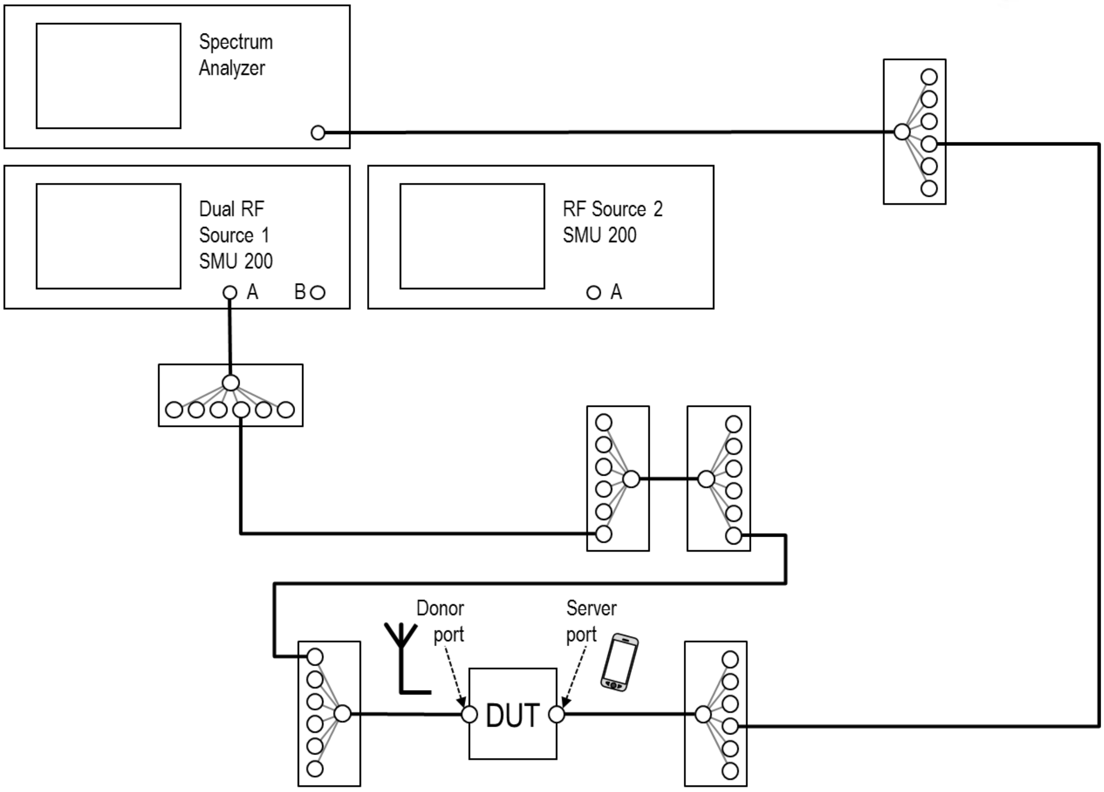

Fig. 198: Set up for occupied bandwidth test in downlink.

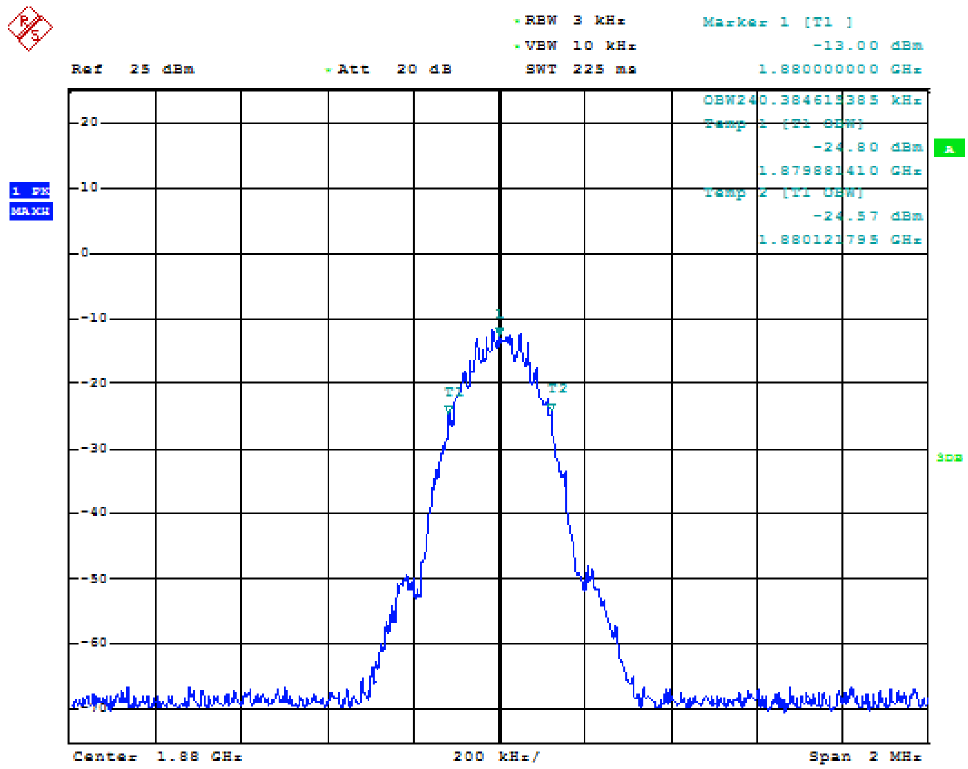

Fig. 199: Occupied bandwidth for GSM signal when using a through in band 2 uplink.

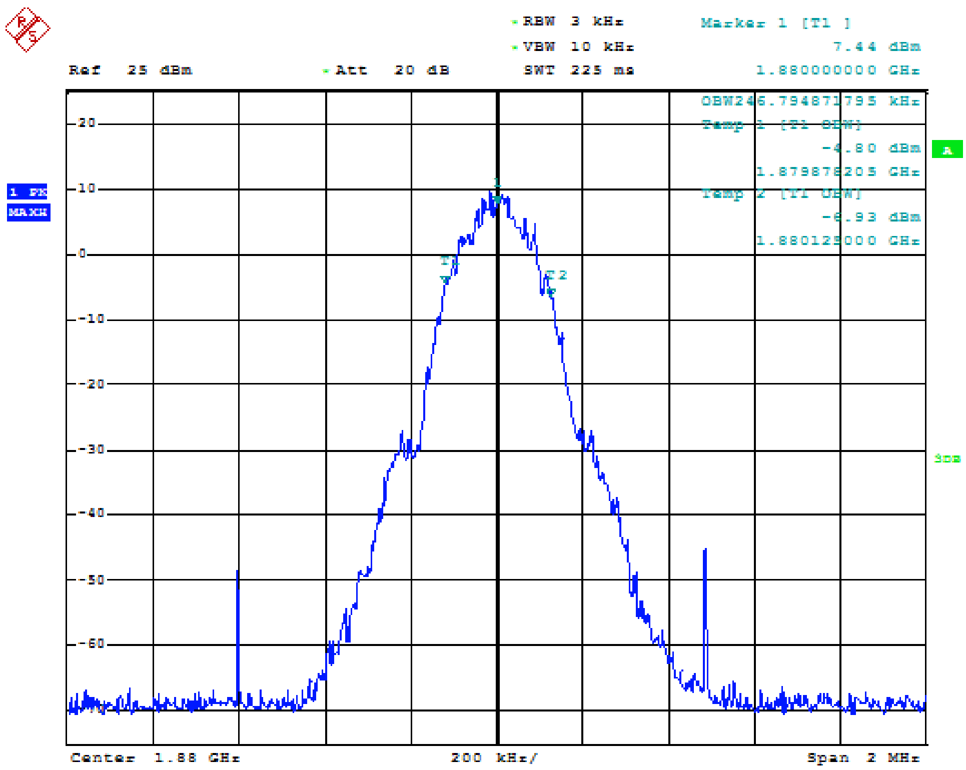

Fig. 200: Occupied bandwidth for GSM signal in band 2 uplink.

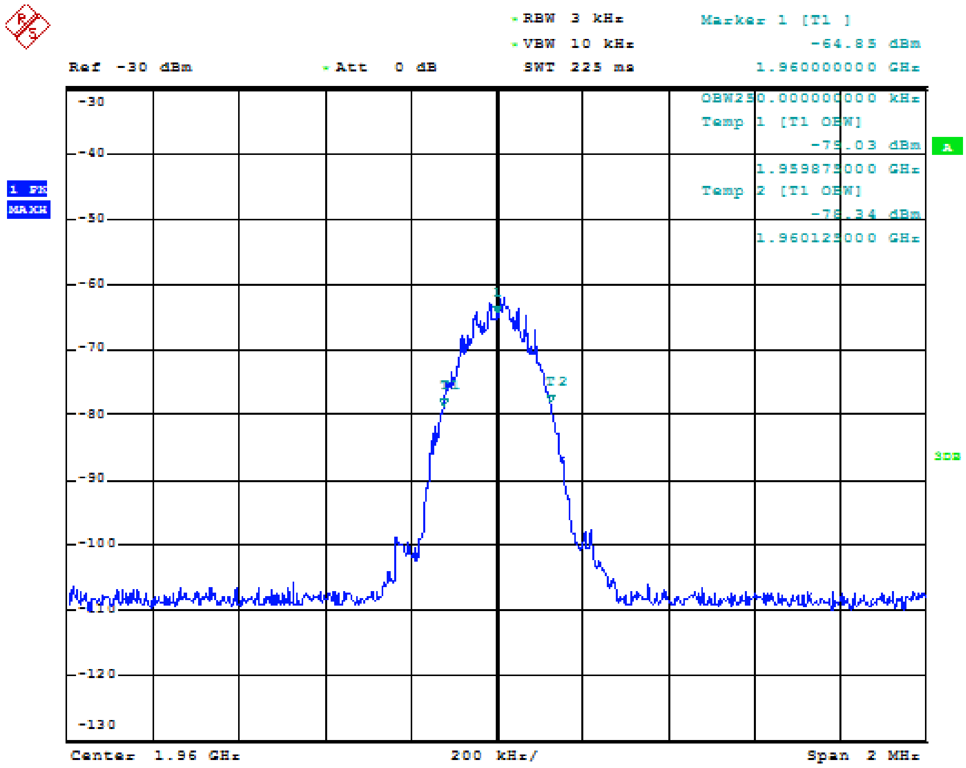

Fig. 201: Occupied bandwidth for GSM signal when using a through in band 2 downlink.

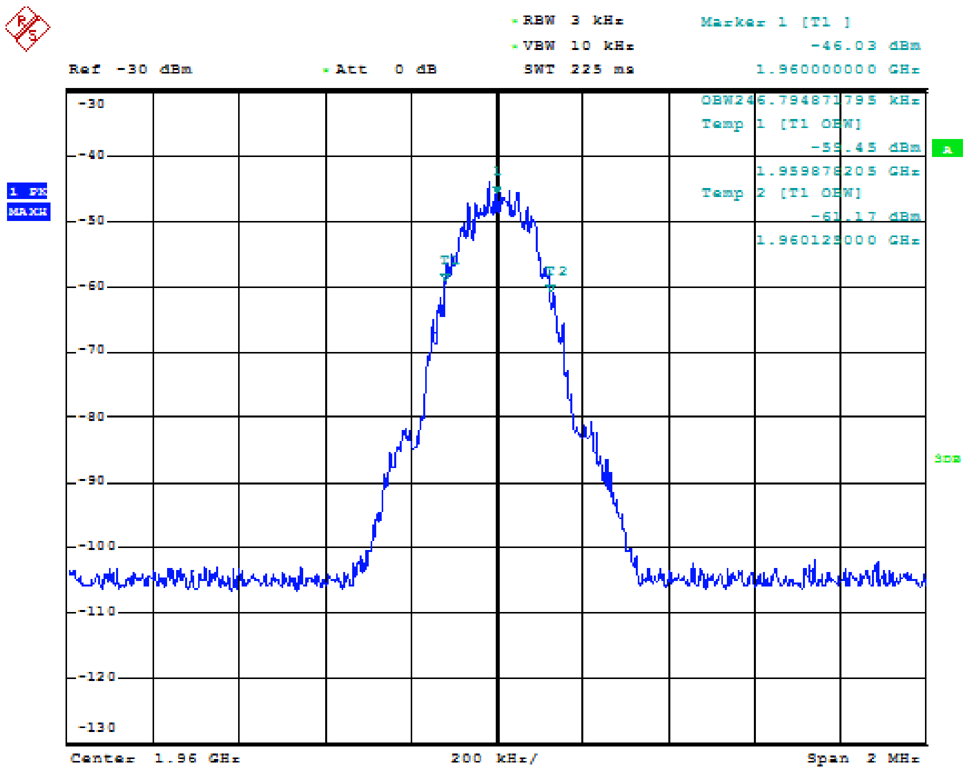

Fig. 202: Occupied bandwidth for GSM signal in band 2 downlink.

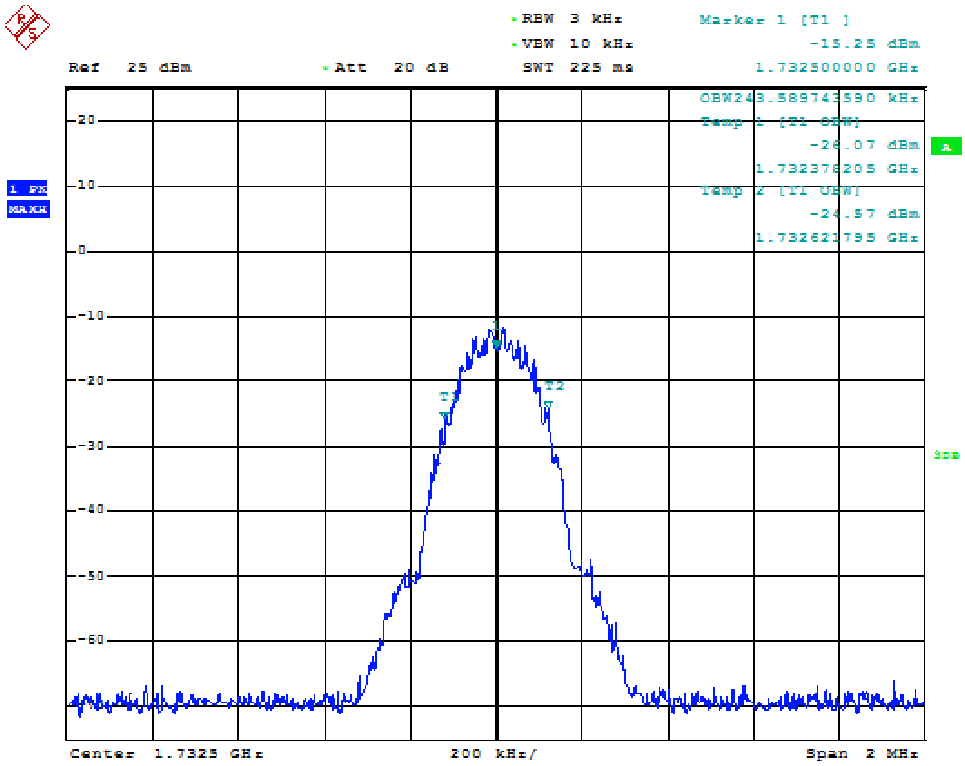

Fig. 203: Occupied bandwidth for GSM signal when using a through in band 4 uplink.

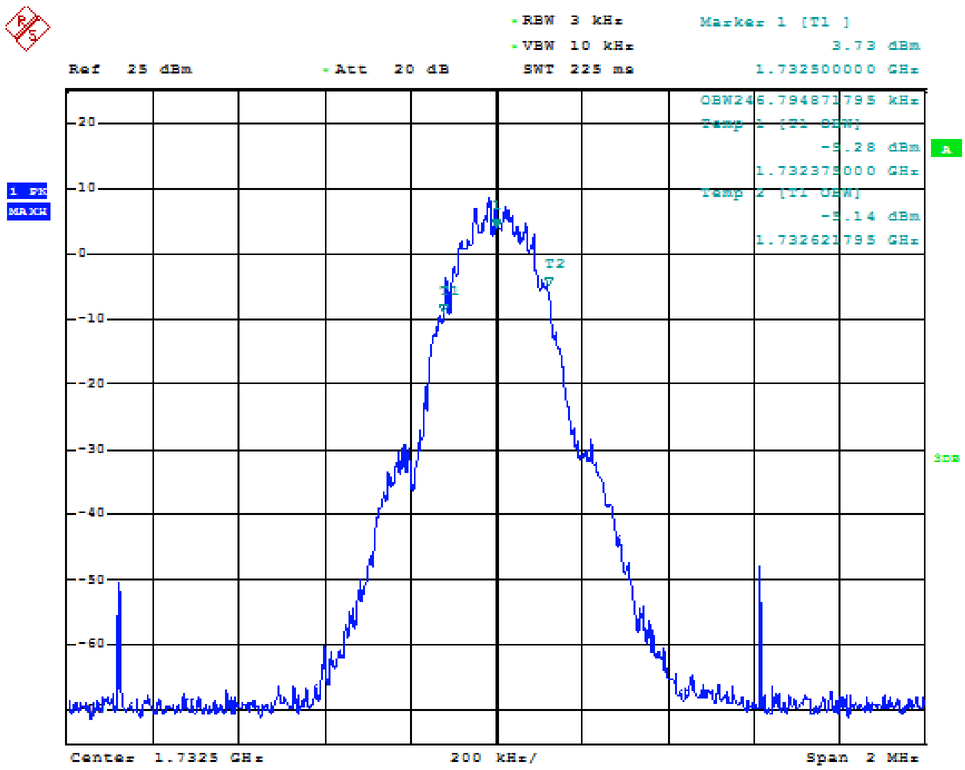

Fig. 204: Occupied bandwidth for GSM signal in band 4 uplink.

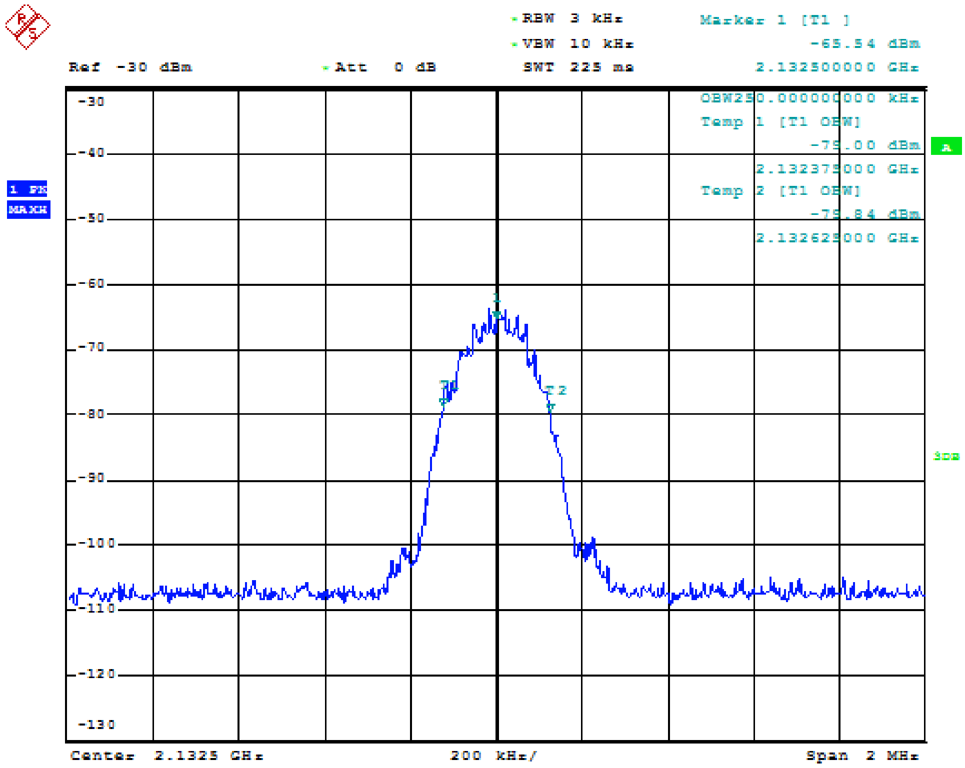

Fig. 205: Occupied bandwidth for GSM signal when using a through in band 4 downlink.

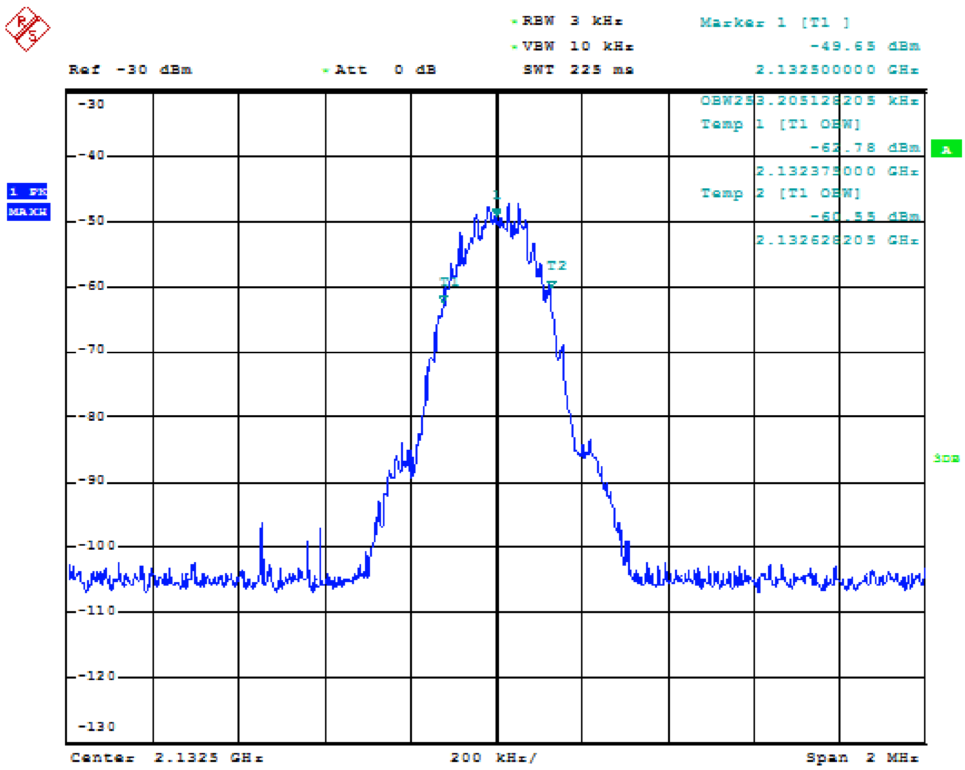

Fig. 206: Occupied bandwidth for GSM signal in band 4 downlink.

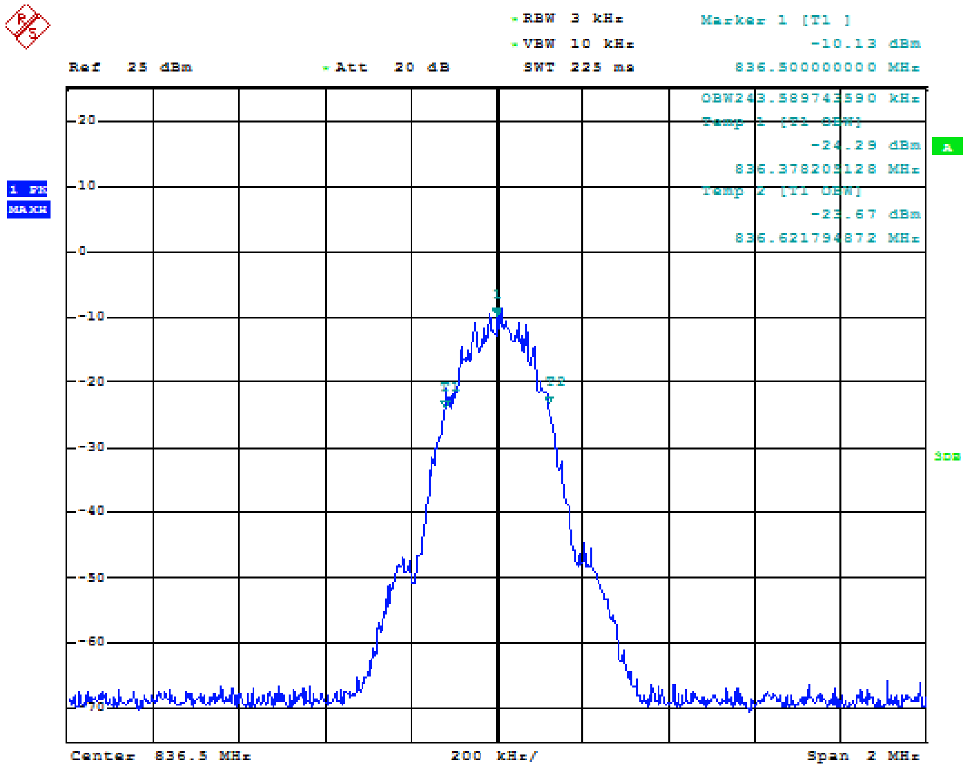

Fig. 207: Occupied bandwidth for GSM signal when using a through in band 5 uplink.

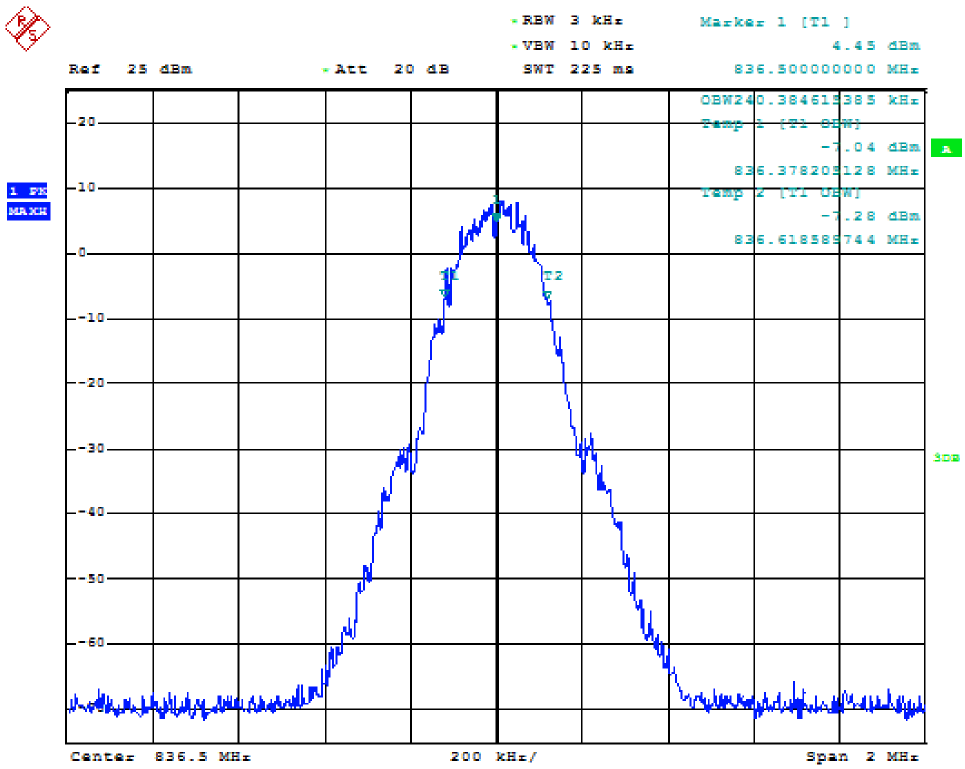

Fig. 208: Occupied bandwidth for GSM signal in band 5 uplink.

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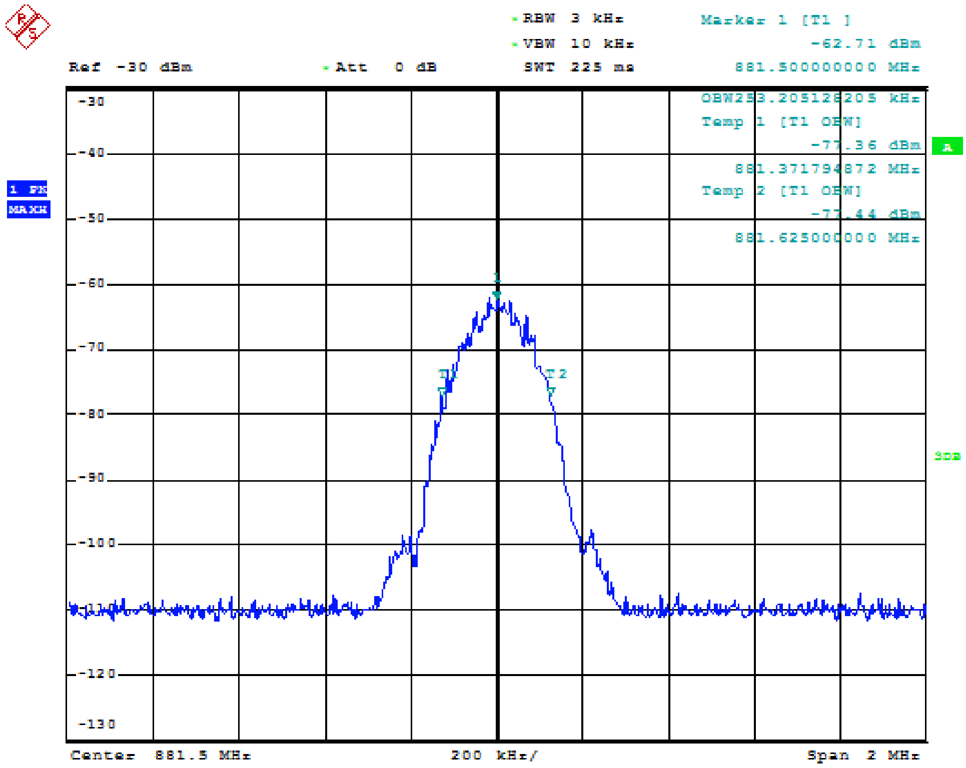

Fig. 209: Occupied bandwidth for GSM signal when using a through in band 5 downlink.

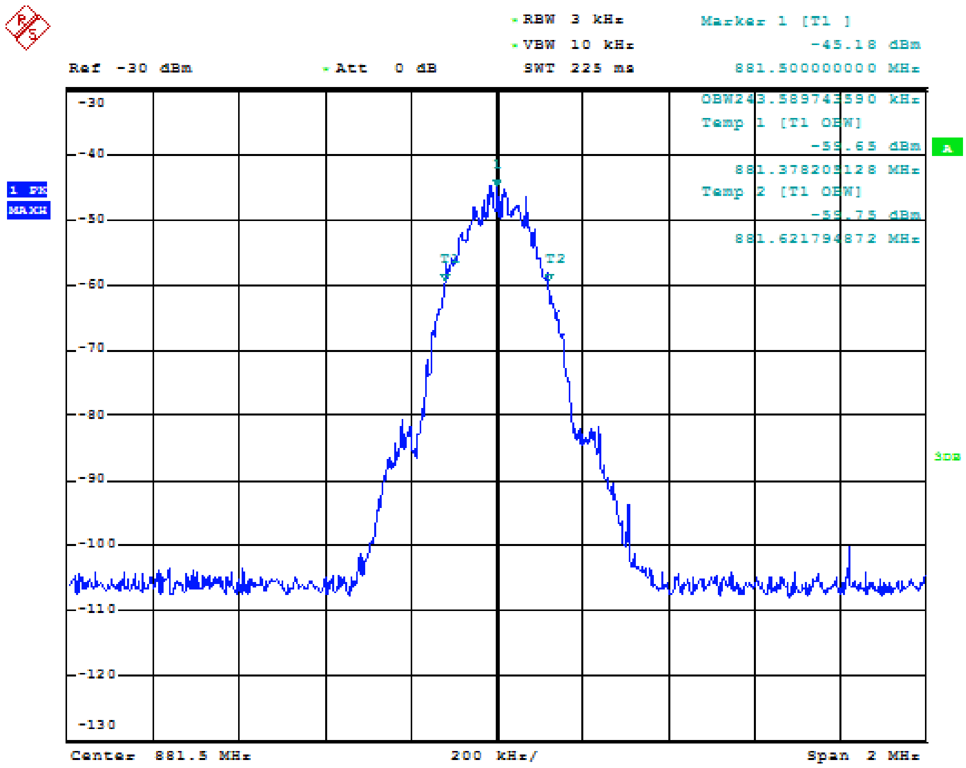

Fig. 210: Occupied bandwidth for GSM signal in band 5 downlink.

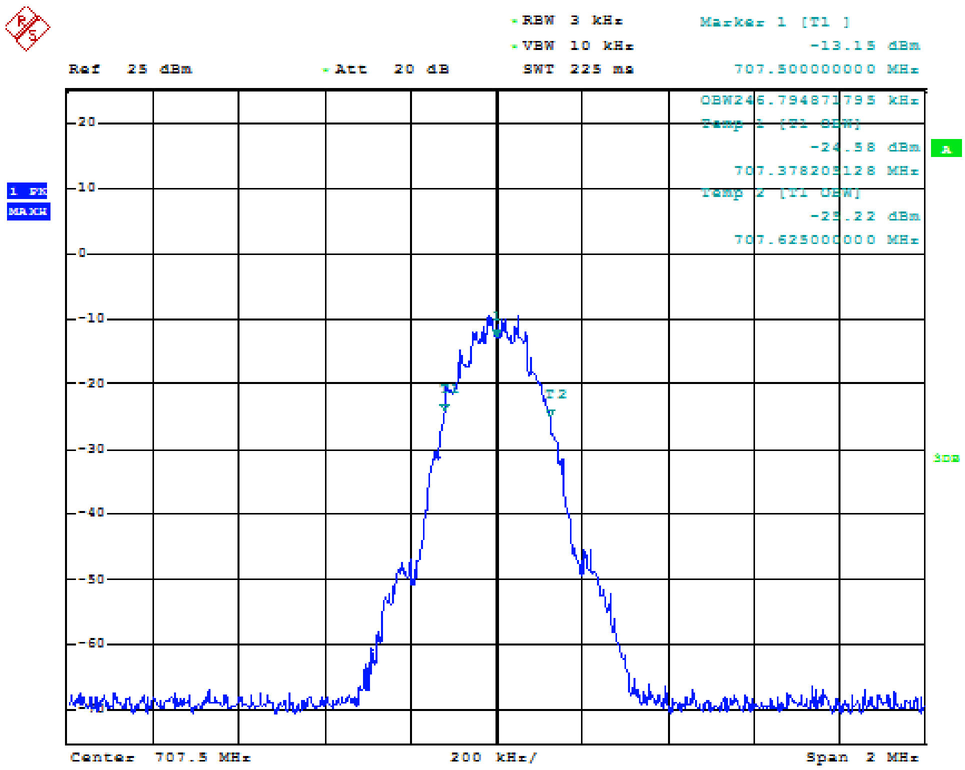

Fig. 211: Occupied bandwidth for GSM signal when using a through in band 12 uplink.

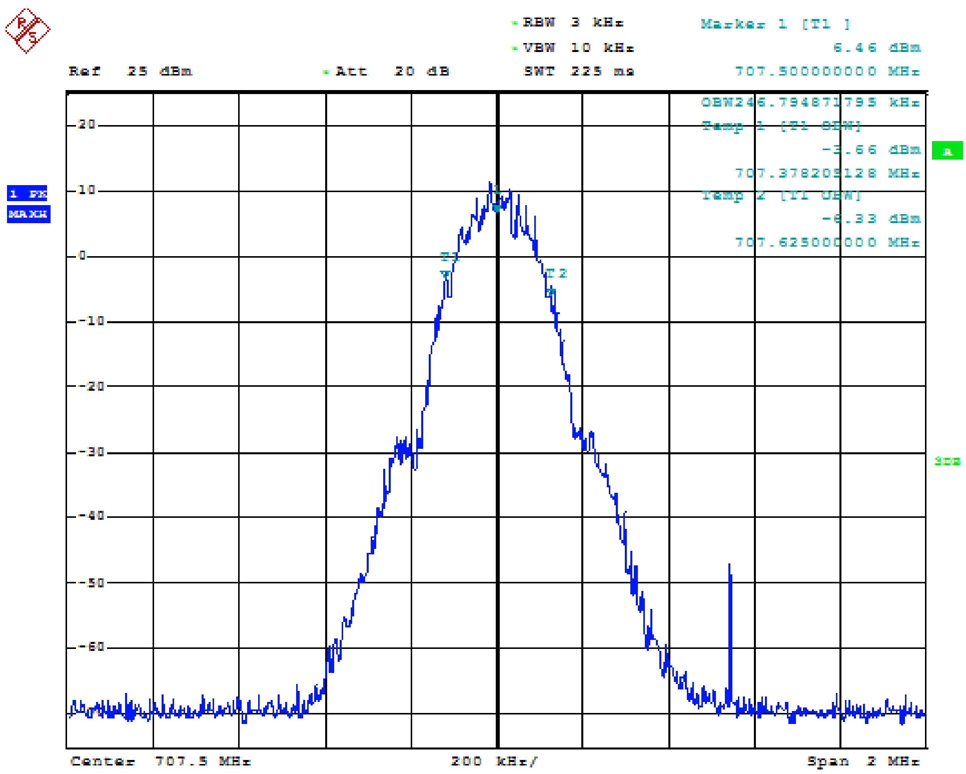

Fig. 212: Occupied bandwidth for GSM signal in band 12 uplink.

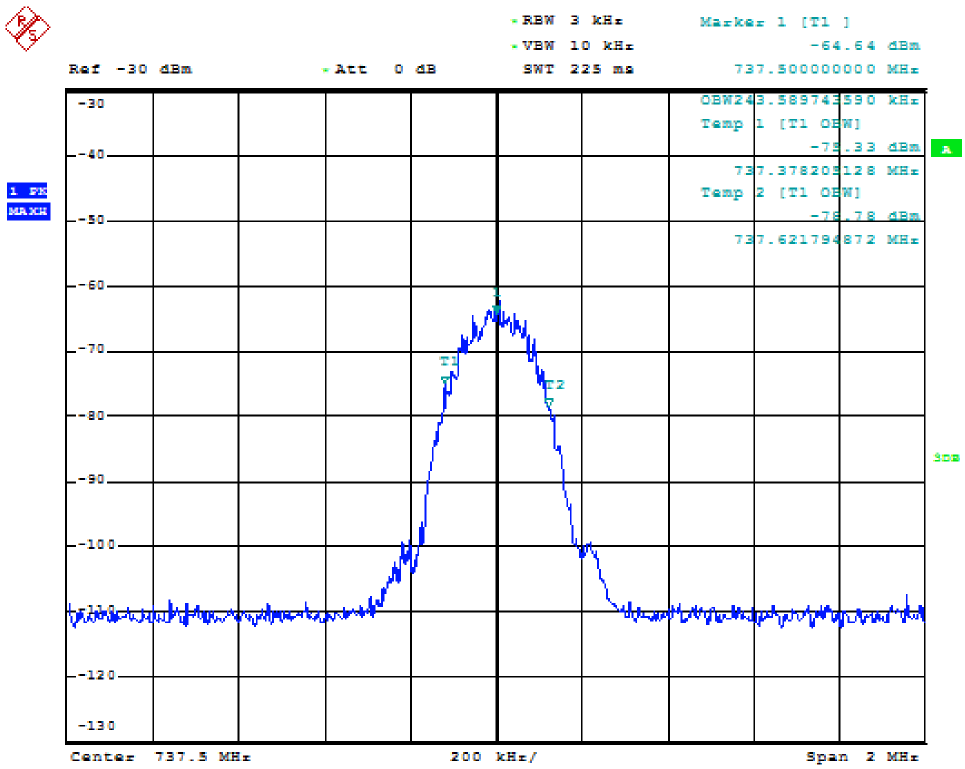

Fig. 213: Occupied bandwidth for GSM signal when using a through in band 12 downlink.

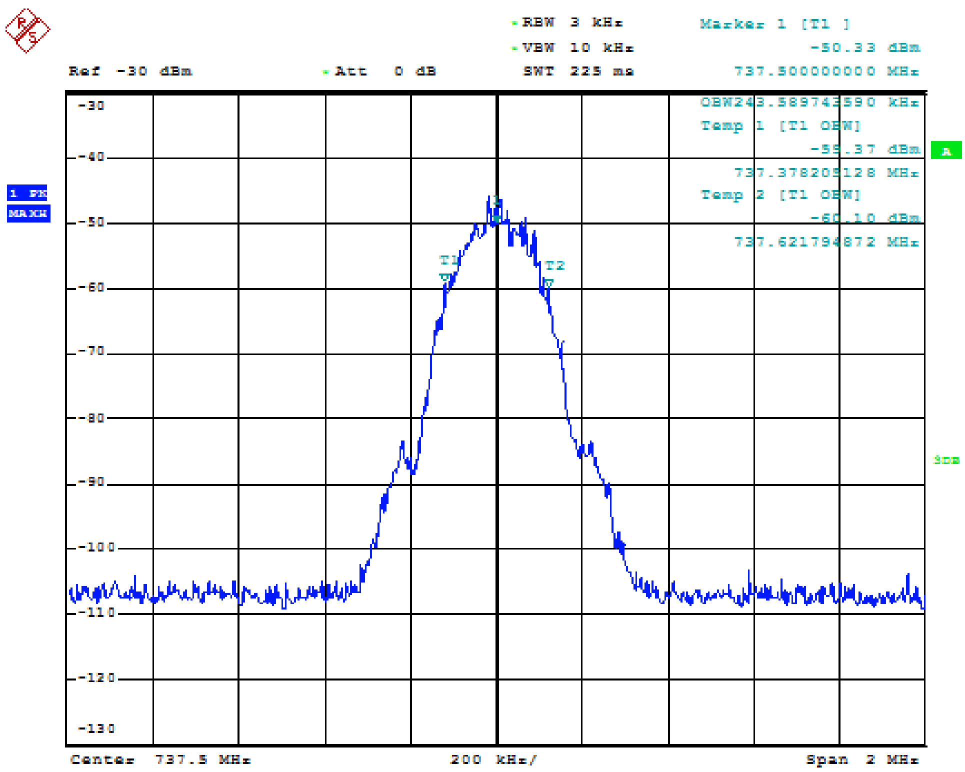

Fig. 214: Occupied bandwidth for GSM signal in band 12 downlink.

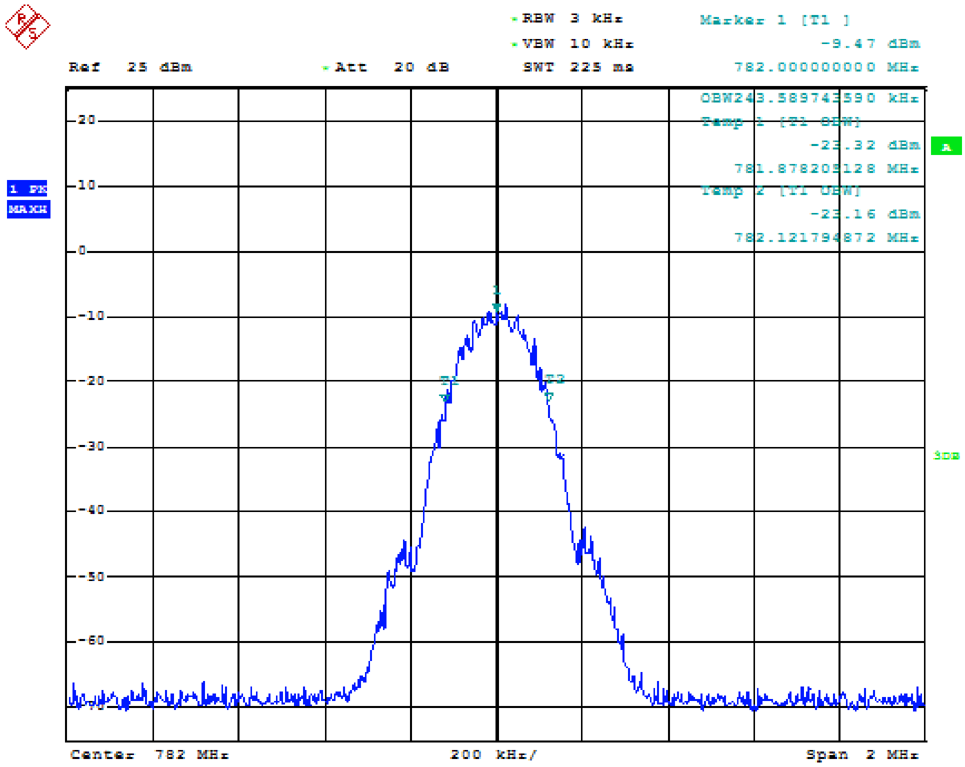

Fig. 215: Occupied bandwidth for GSM signal when using a through in band 13 uplink.

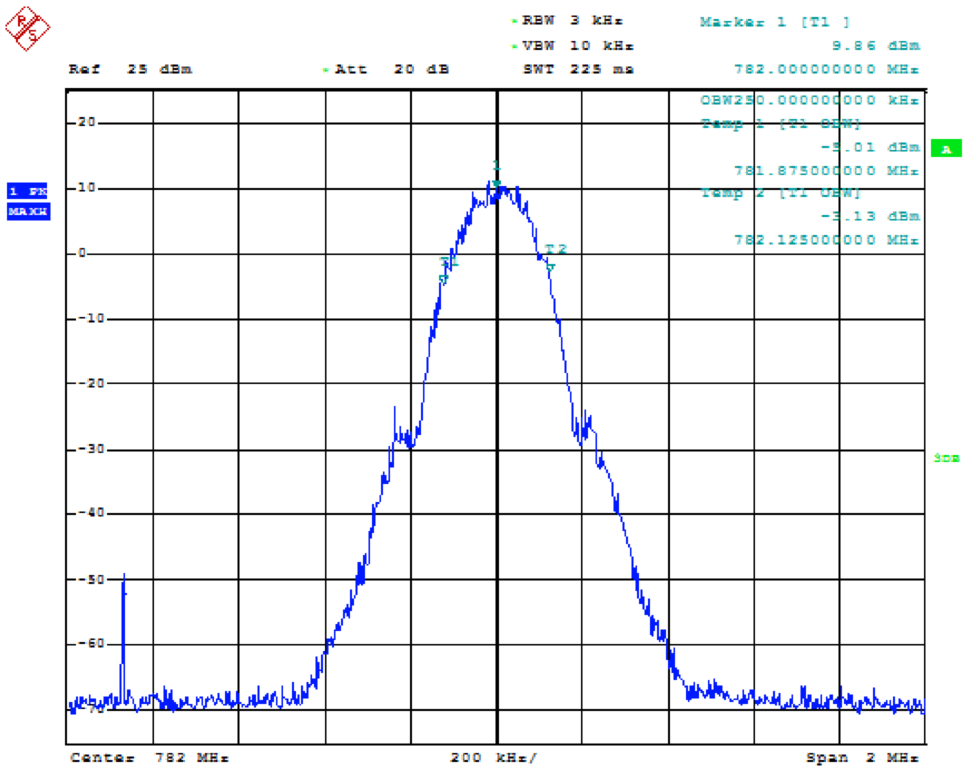

Fig. 216: Occupied bandwidth for GSM signal in band 13 uplink.

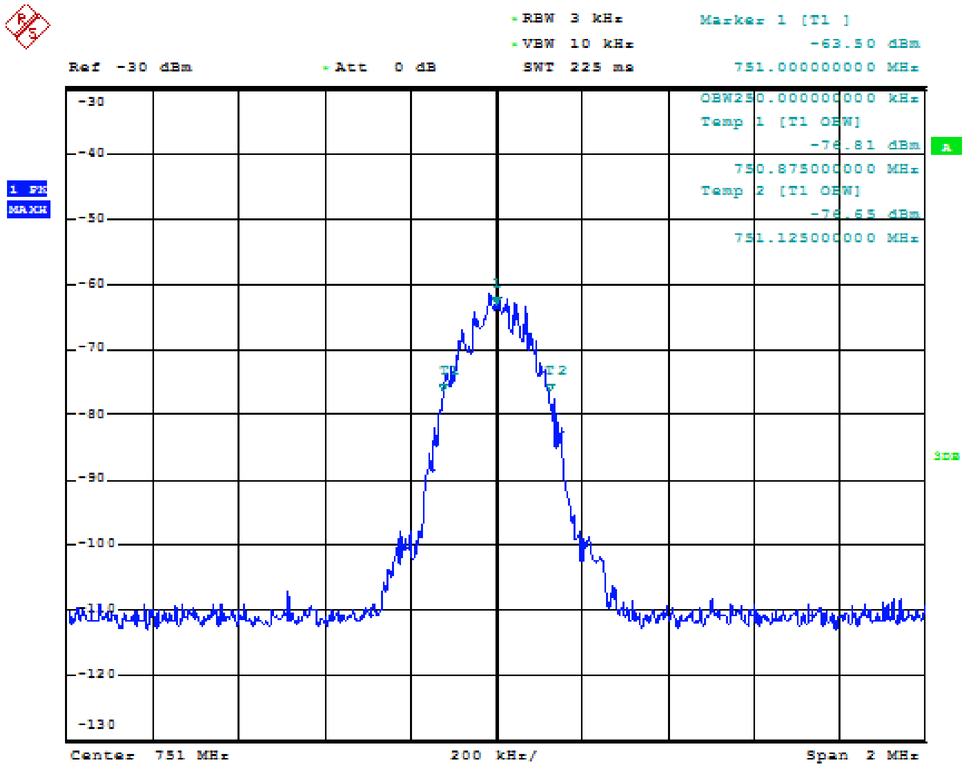

Fig. 217: Occupied bandwidth for GSM signal when using a through in band 13 downlink.

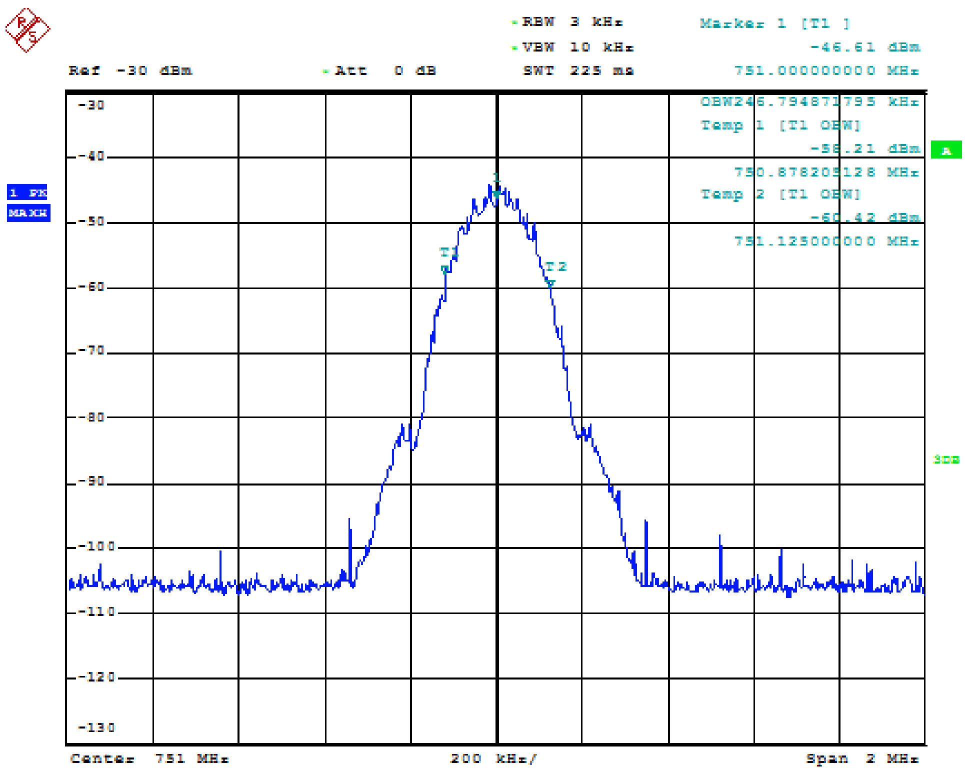

Fig. 218: Occupied bandwidth for GSM signal in band 13 downlink.

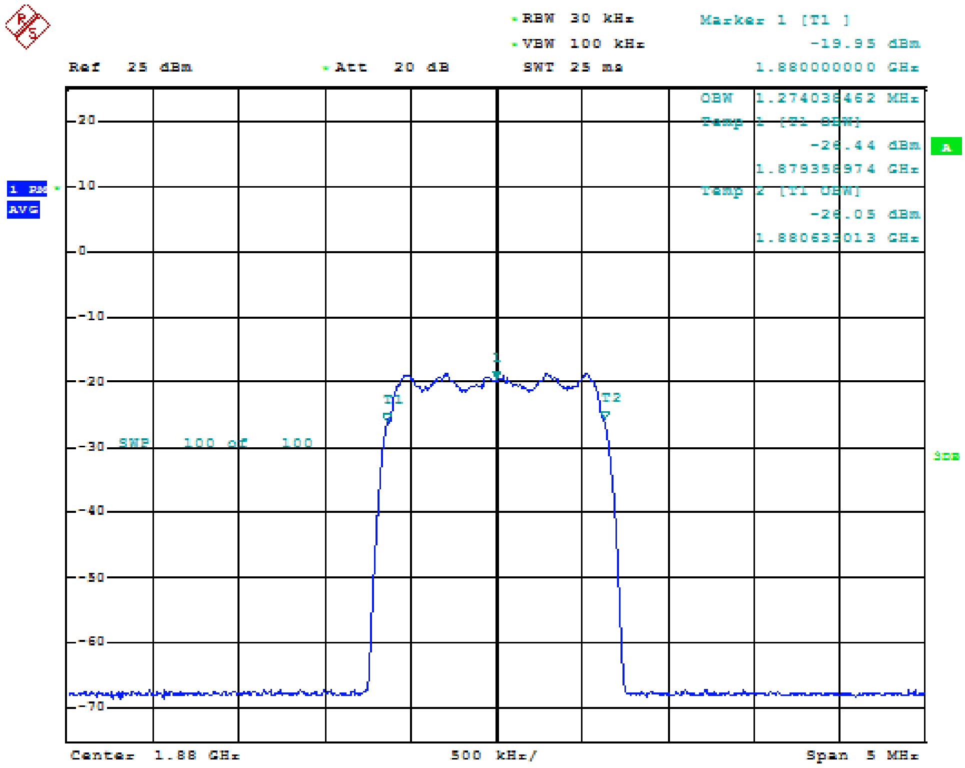

Fig. 219: Occupied bandwidth for CDMA signal when using a through in band 2 uplink.

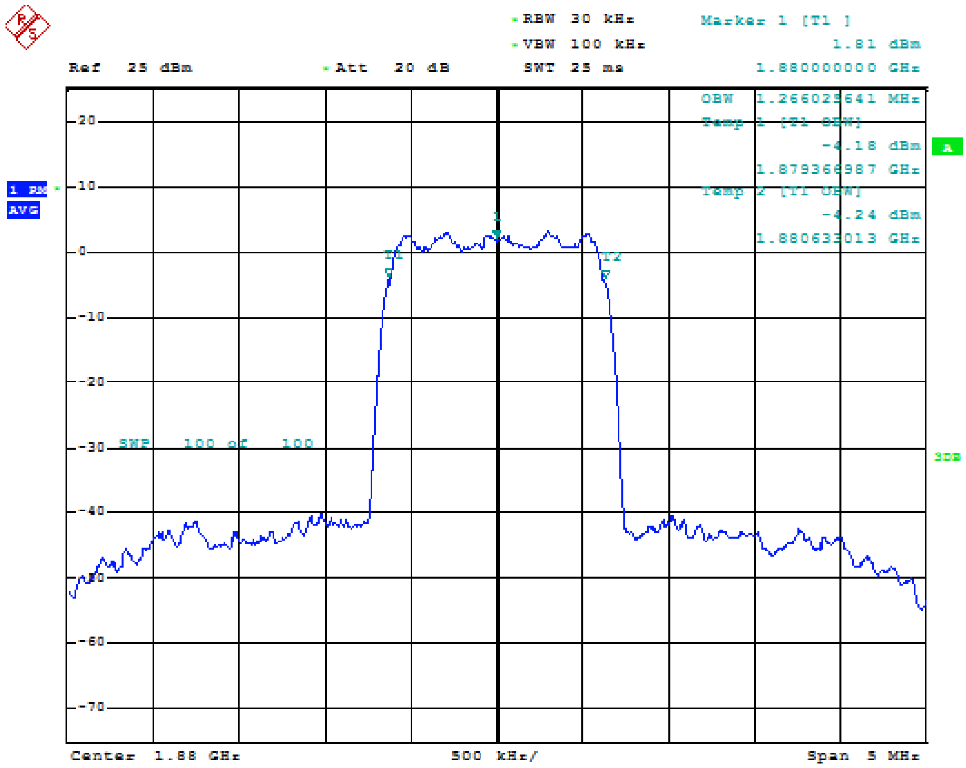

Fig. 220: Occupied bandwidth for CDMA signal in band 2 uplink.

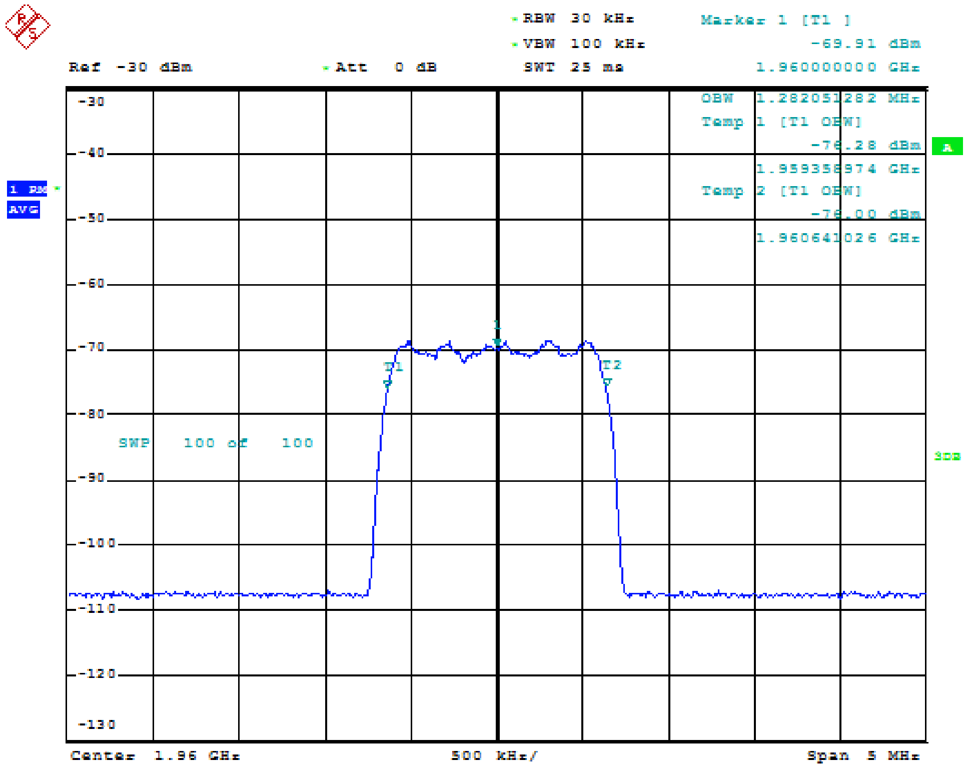

Fig. 221: Occupied bandwidth for CDMA signal when using a through in band 2 downlink.

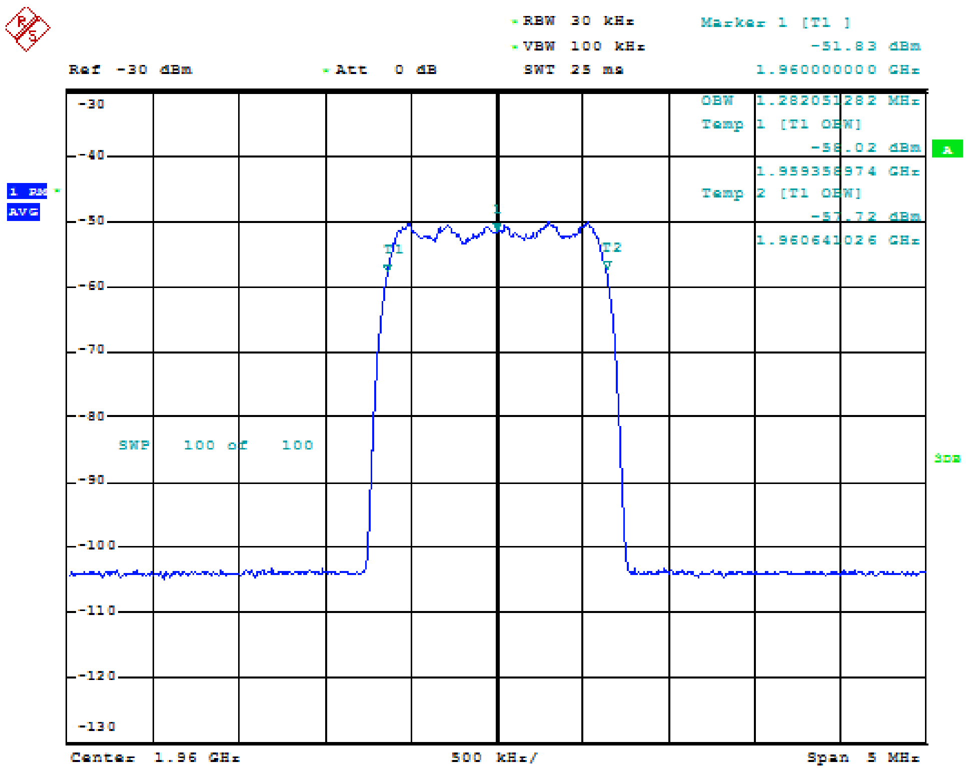

Fig. 222: Occupied bandwidth for CDMA signal in band 2 downlink.

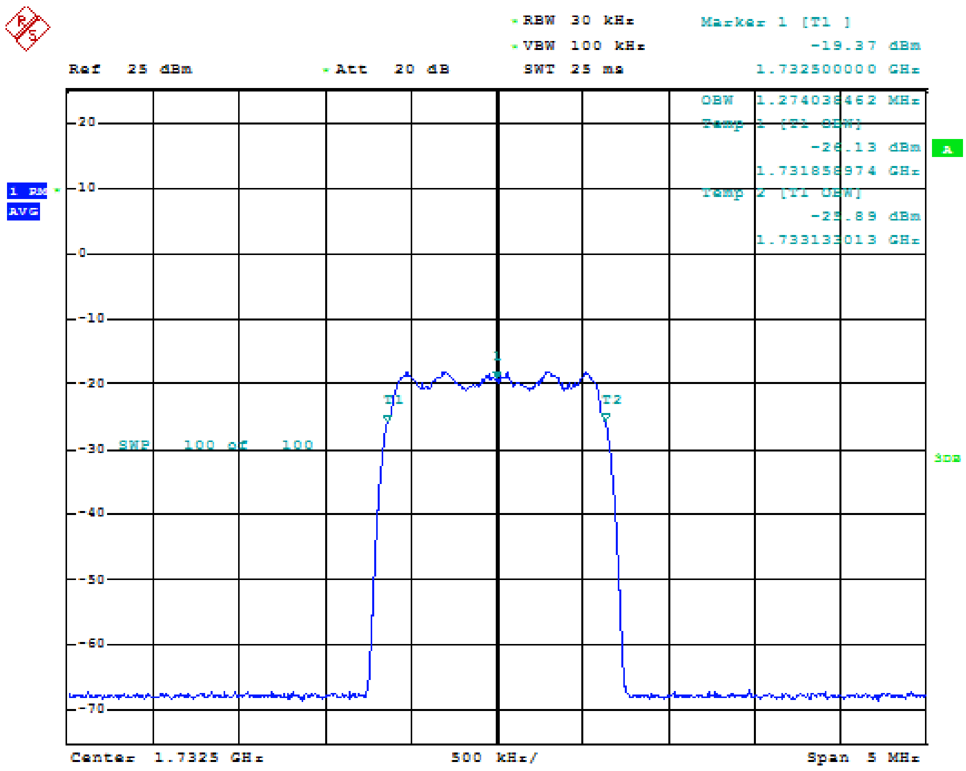

Fig. 223: Occupied bandwidth for CDMA signal when using a through in band 4 uplink.

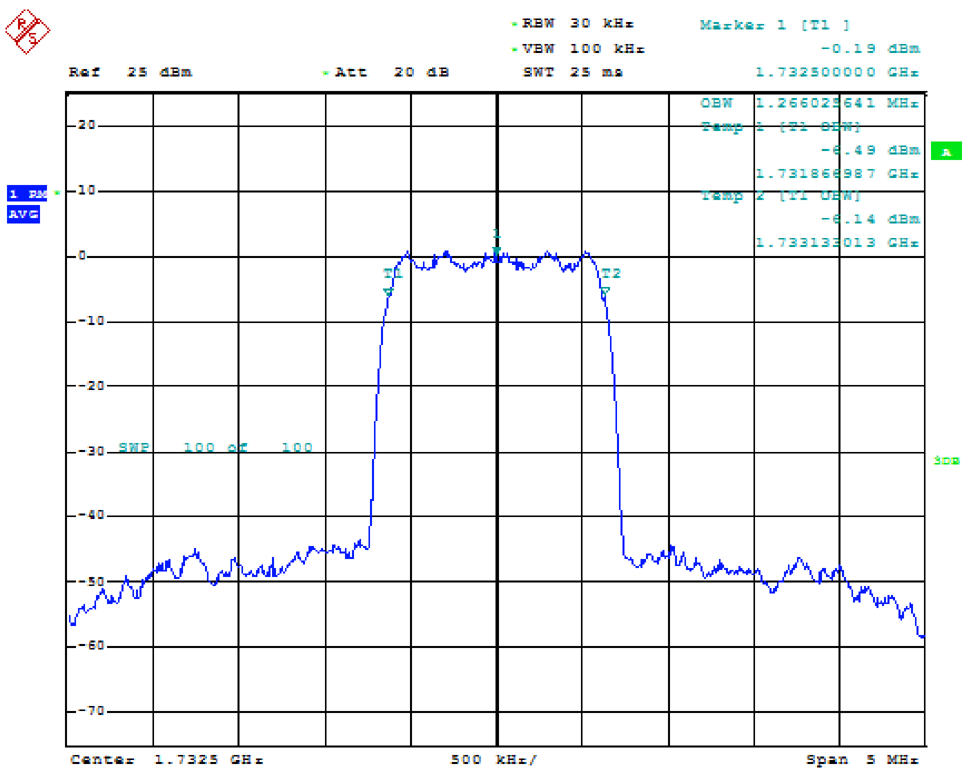

Fig. 224: Occupied bandwidth for CDMA signal in band 4 uplink.

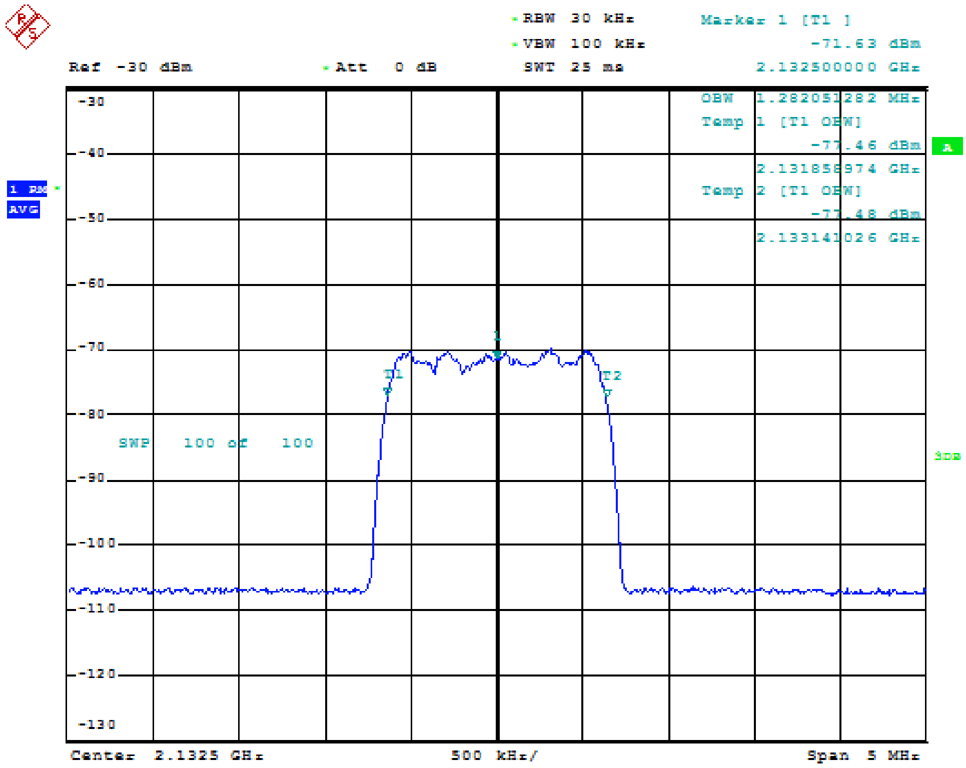

Fig. 225: Occupied bandwidth for CDMA signal when using a through in band 4 downlink.

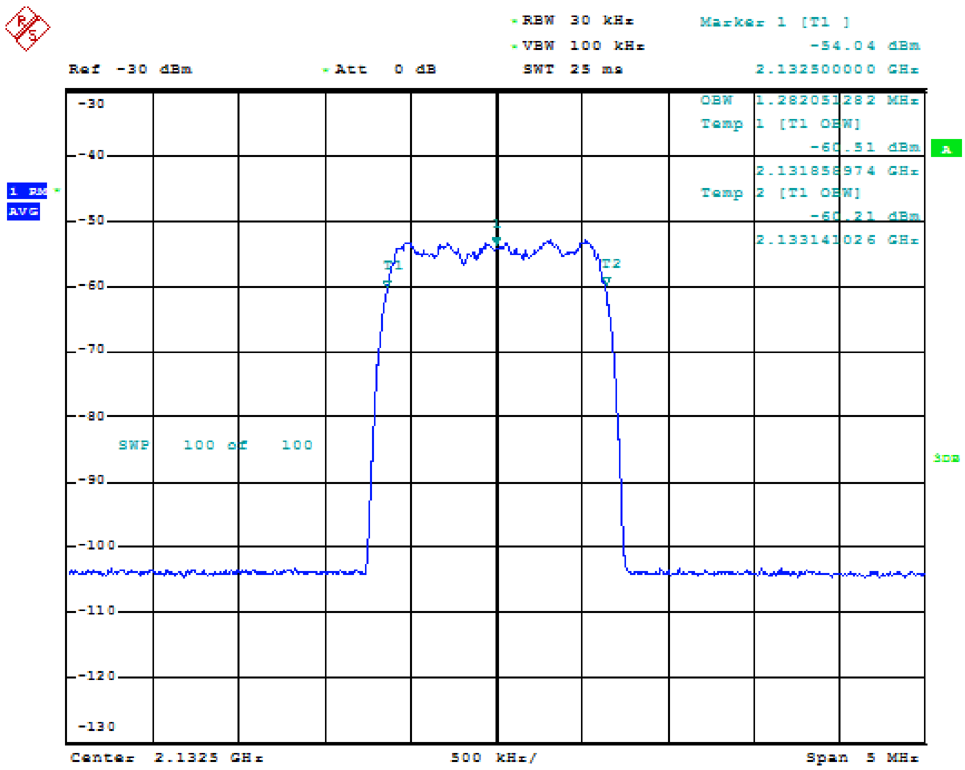

Fig. 226: Occupied bandwidth for CDMA signal in band 4 downlink.

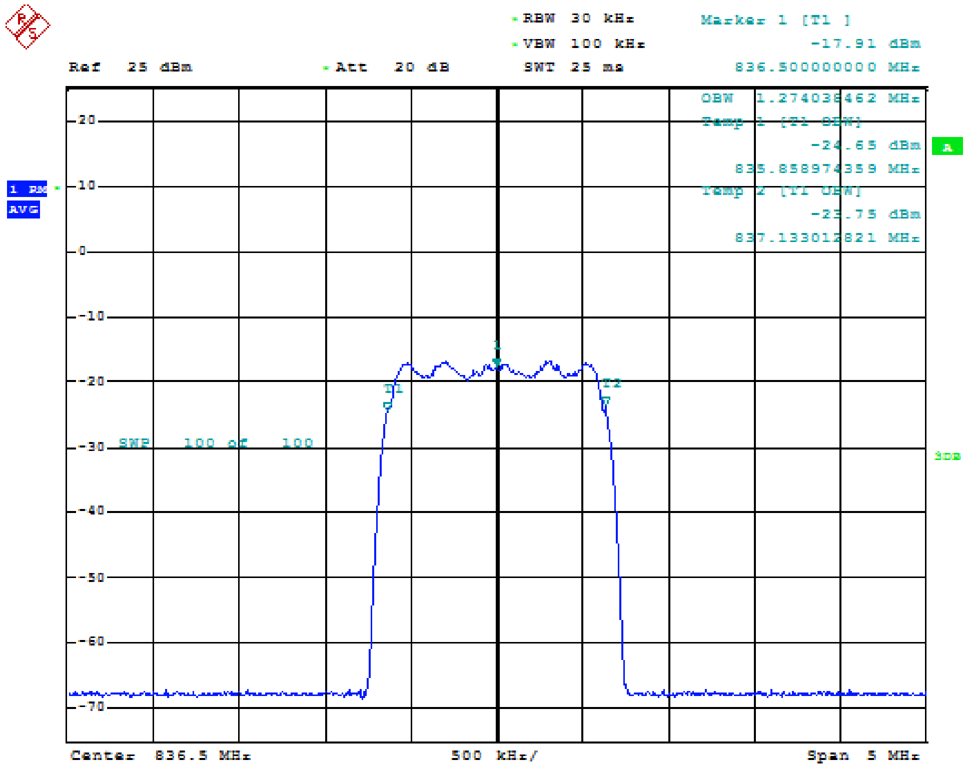

Fig. 227: Occupied bandwidth for CDMA signal when using a through in band 5 uplink.

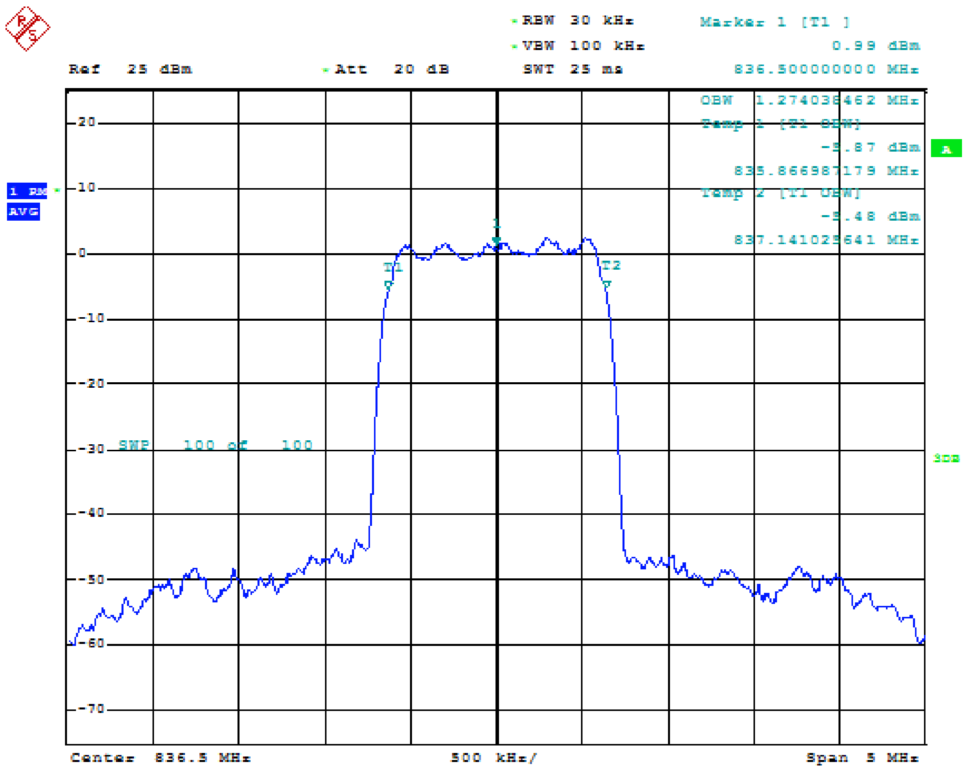

Fig. 228: Occupied bandwidth for CDMA signal in band 5 uplink.

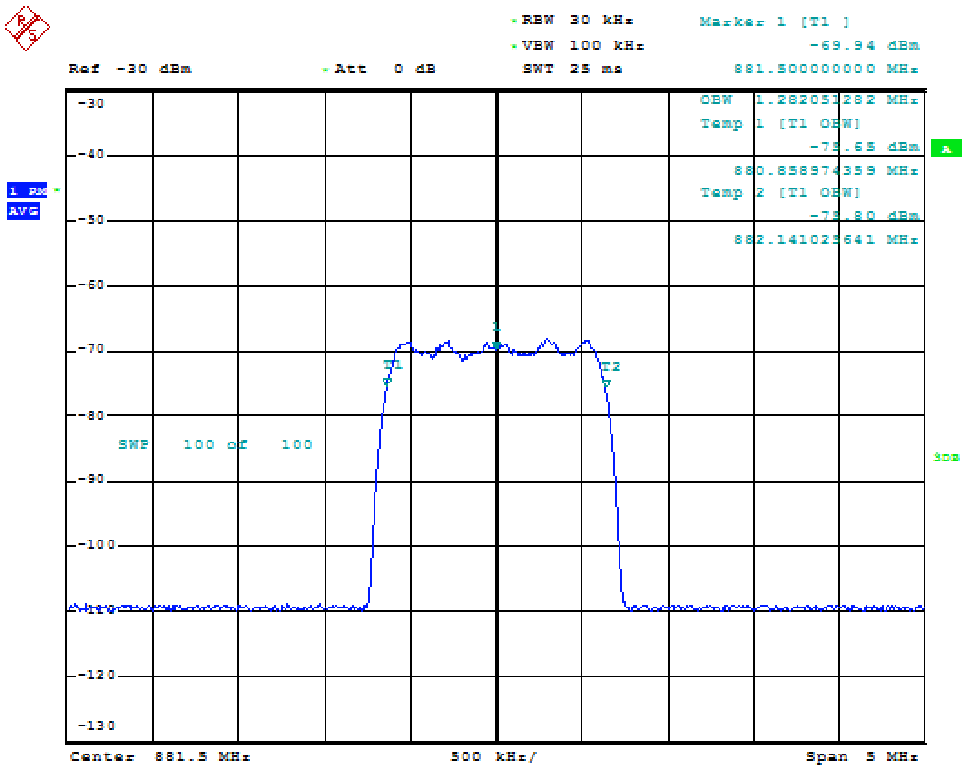

Fig. 229: Occupied bandwidth for CDMA signal when using a through in band 5 downlink.

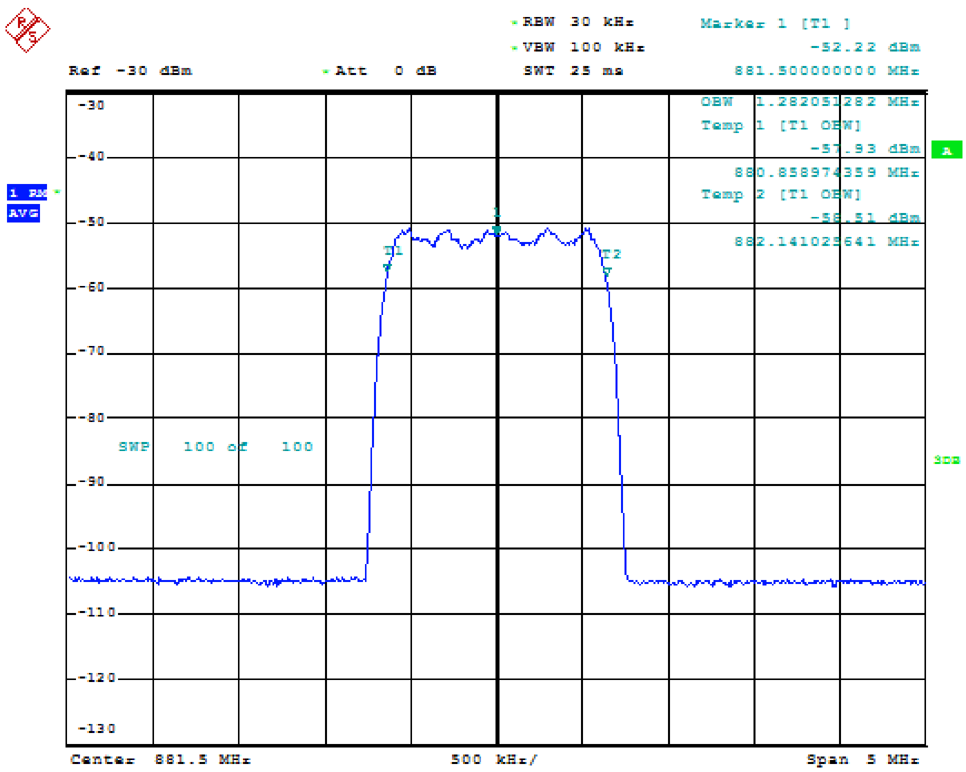

Fig. 230: Occupied bandwidth for CDMA signal in band 5 downlink.

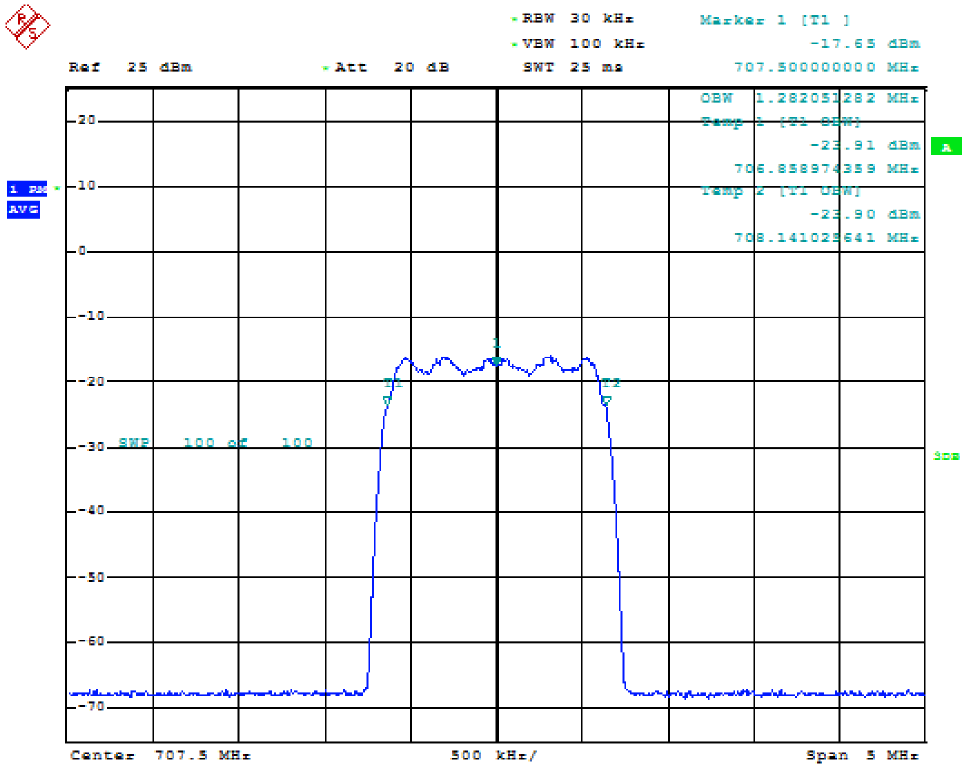

Fig. 231: Occupied bandwidth for CDMA signal when using a through in band 12 uplink.

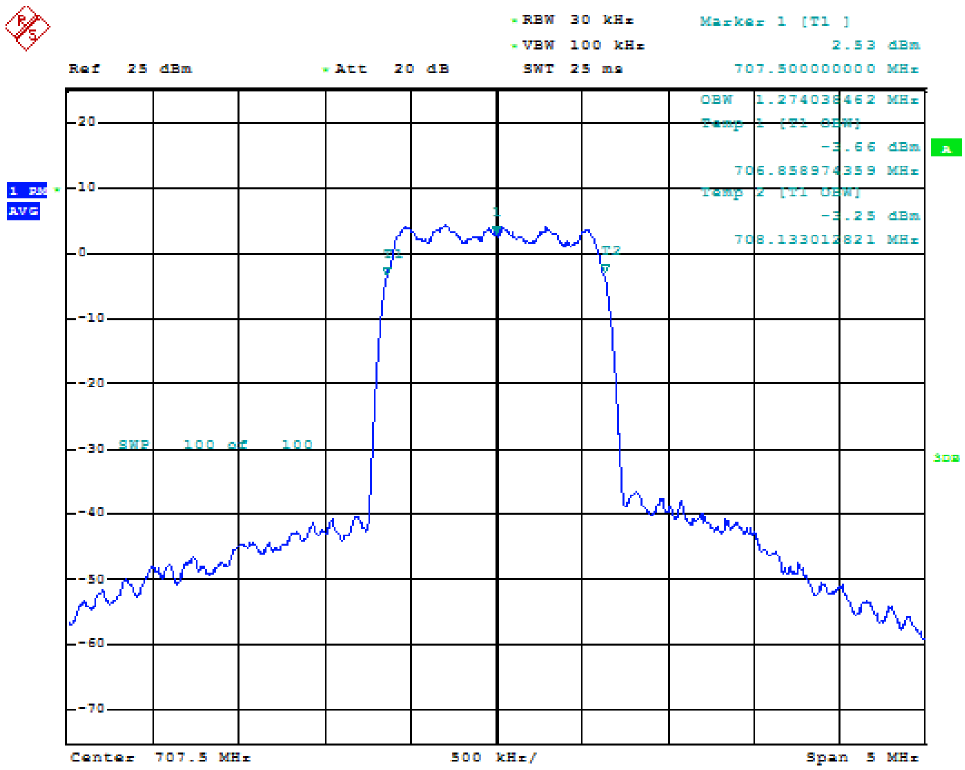

Fig. 232: Occupied bandwidth for CDMA signal in band 12 uplink.

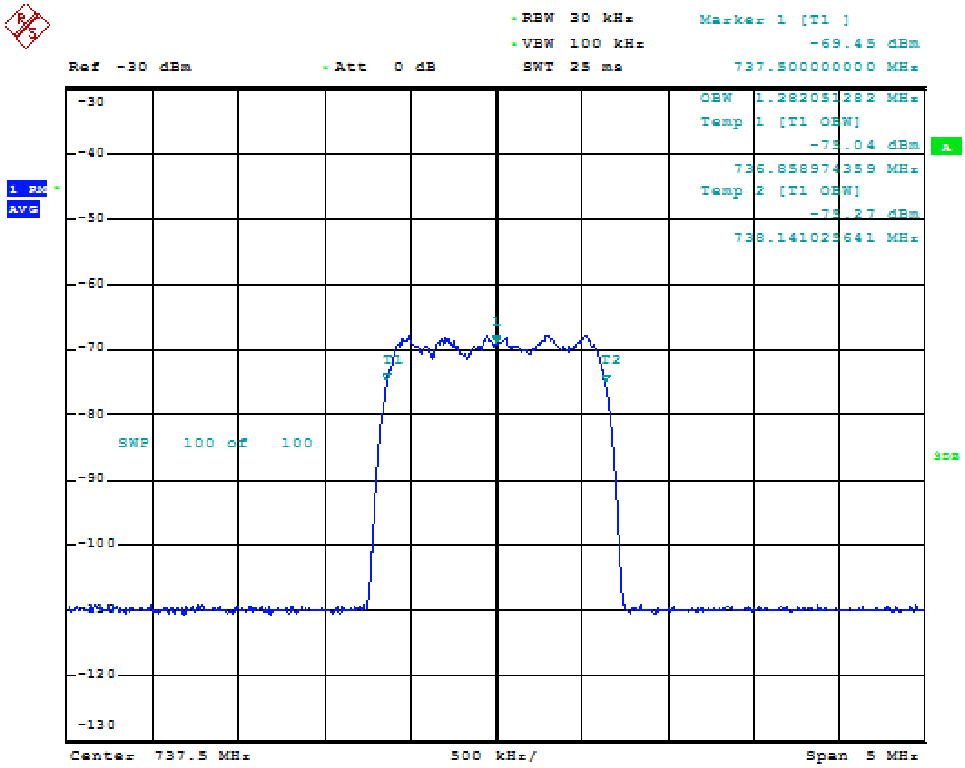

Fig. 233: Occupied bandwidth for CDMA signal when using a through in band 12 downlink.

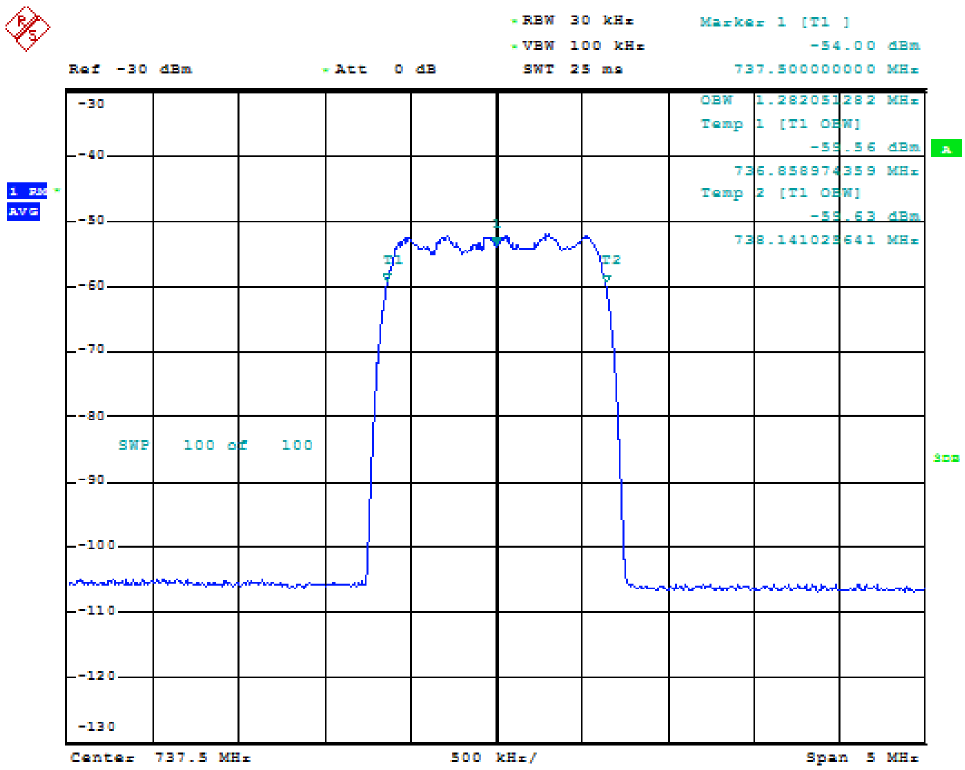

Fig. 234: Occupied bandwidth for CDMA signal in band 12 downlink.

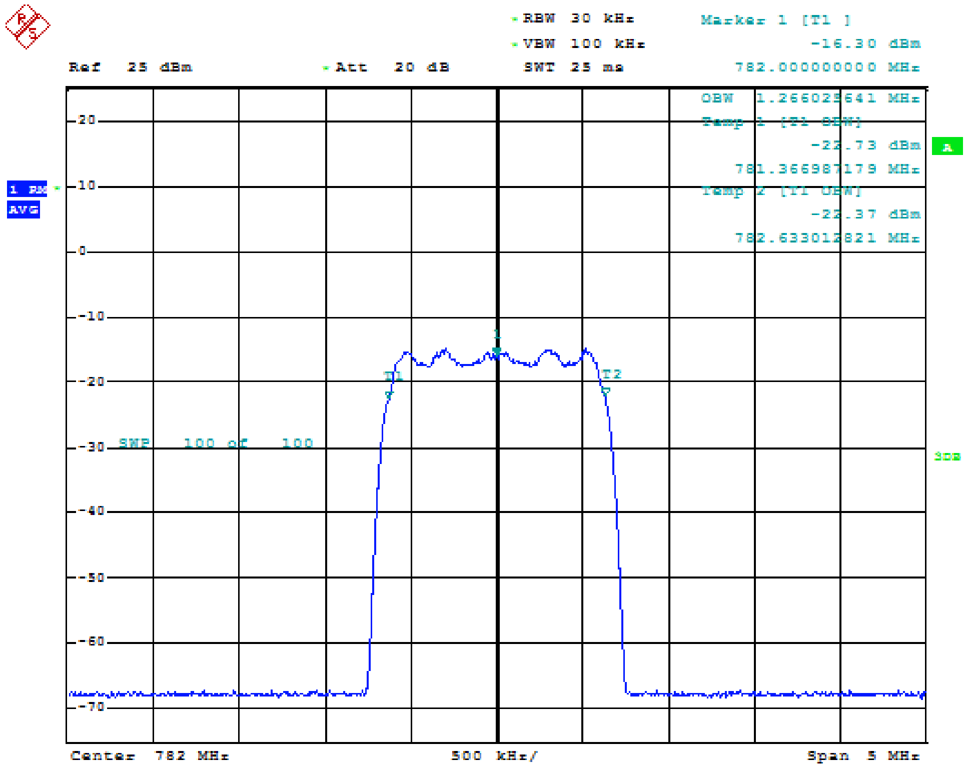

Fig. 235: Occupied bandwidth for CDMA signal when using a through in band 13 uplink.

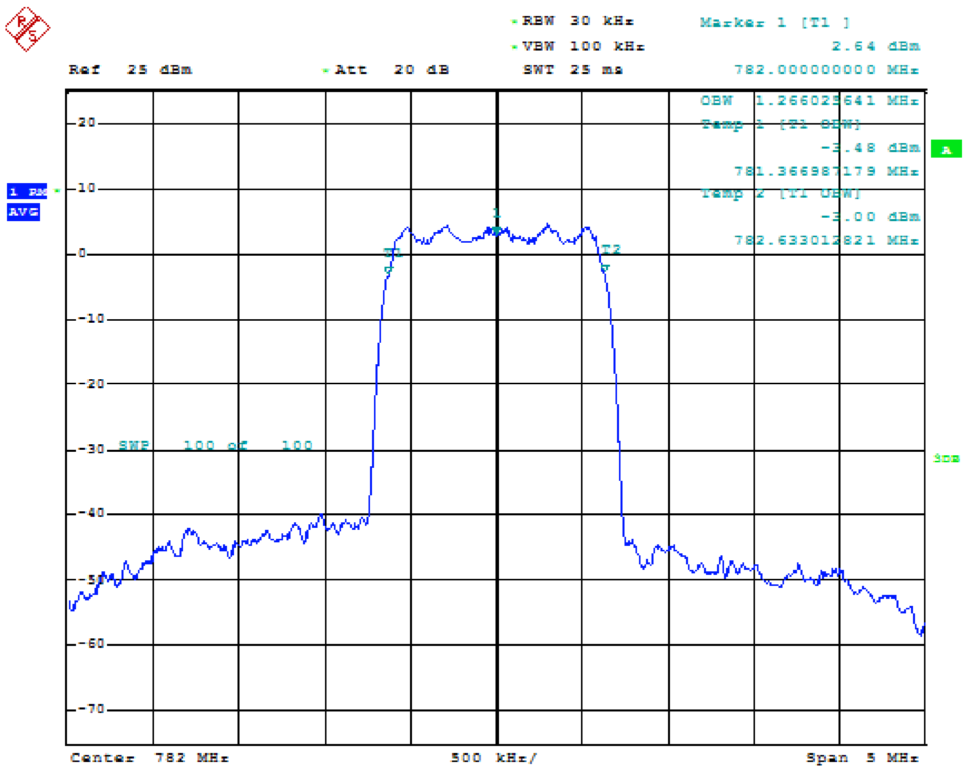

Fig. 236: Occupied bandwidth for CDMA signal in band 13 uplink.

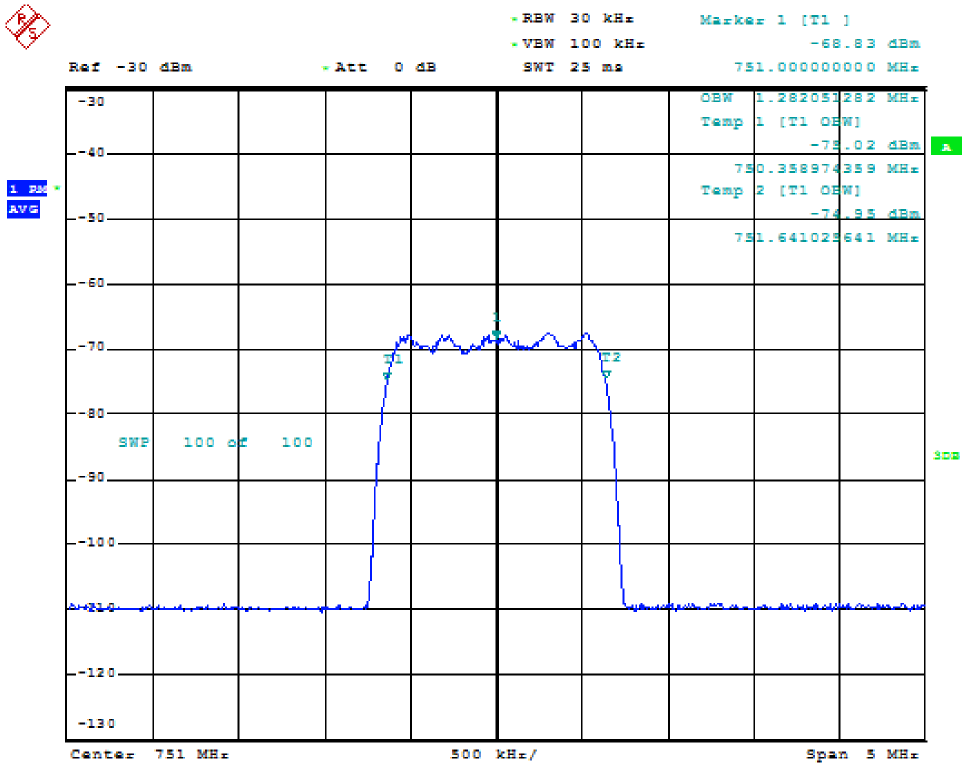

Fig. 237: Occupied bandwidth for CDMA signal when using a through in band 13 downlink.

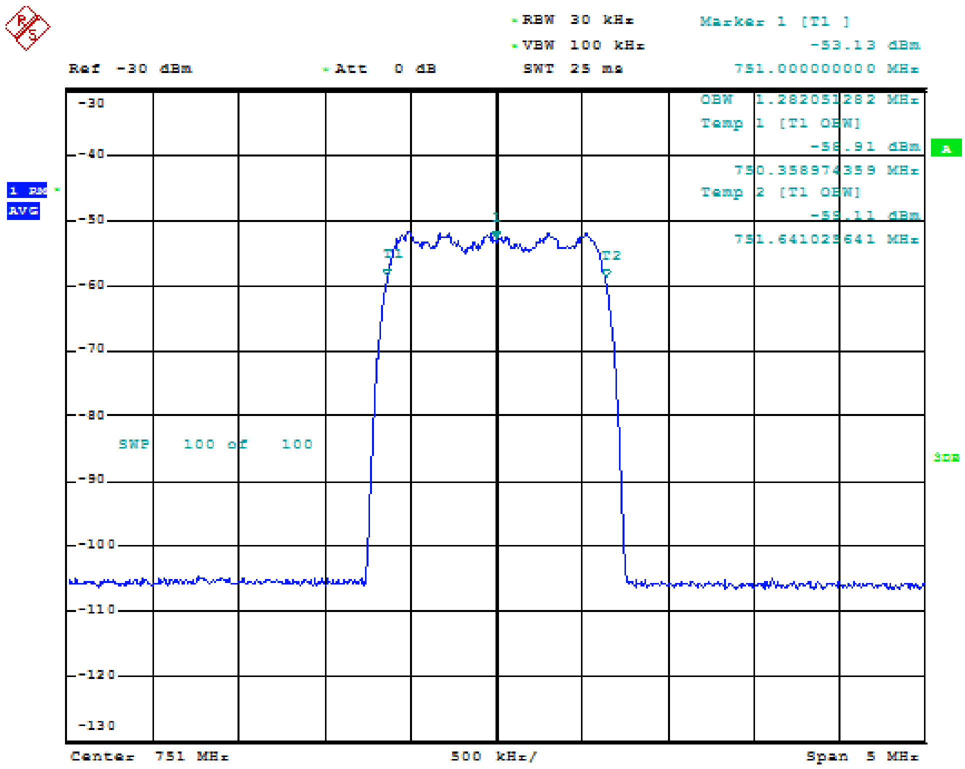

Fig. 238: Occupied bandwidth for CDMA signal in band 13 downlink.

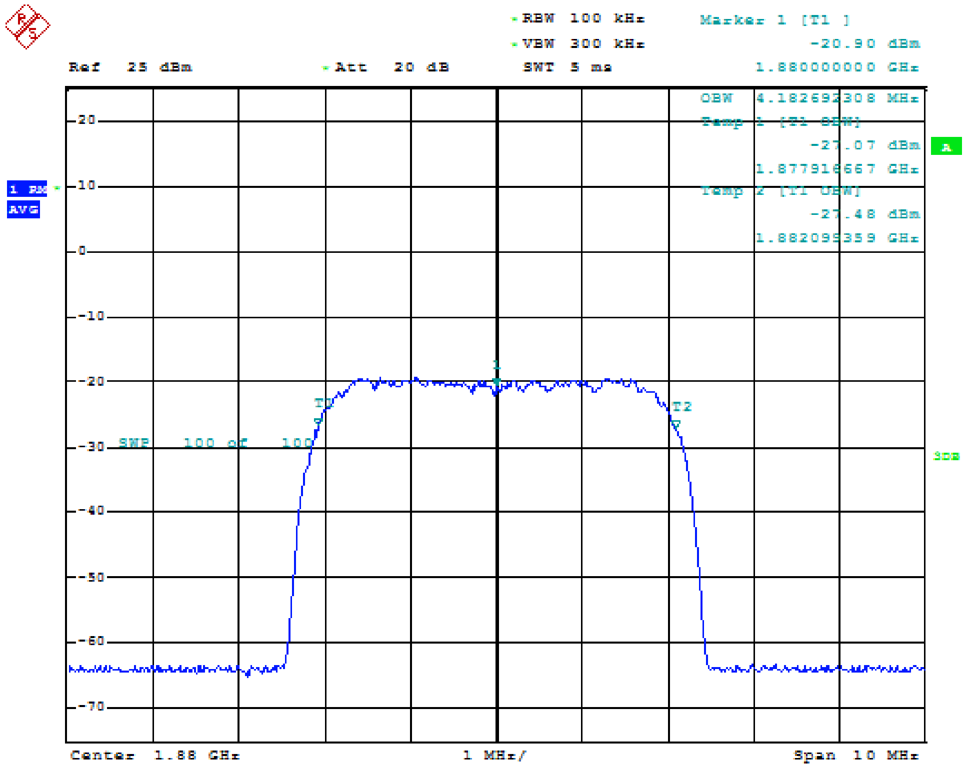

Fig. 239: Occupied bandwidth for WCDMA signal when using a through in band 2 uplink.

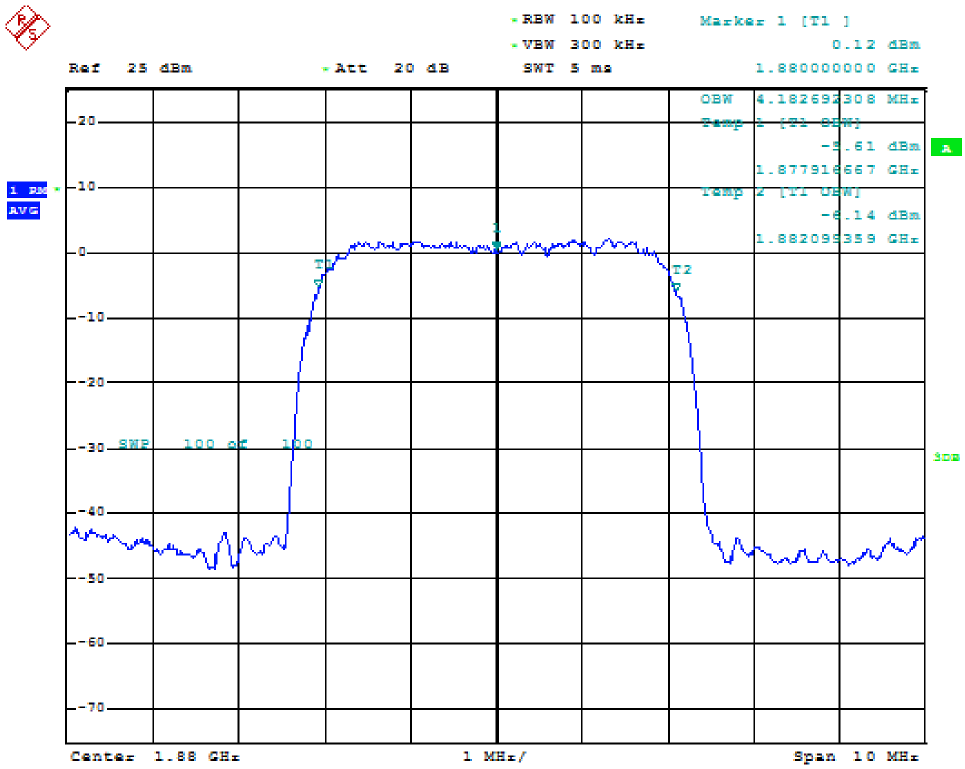

Fig. 240: Occupied bandwidth for WCDMA signal in band 2 uplink.

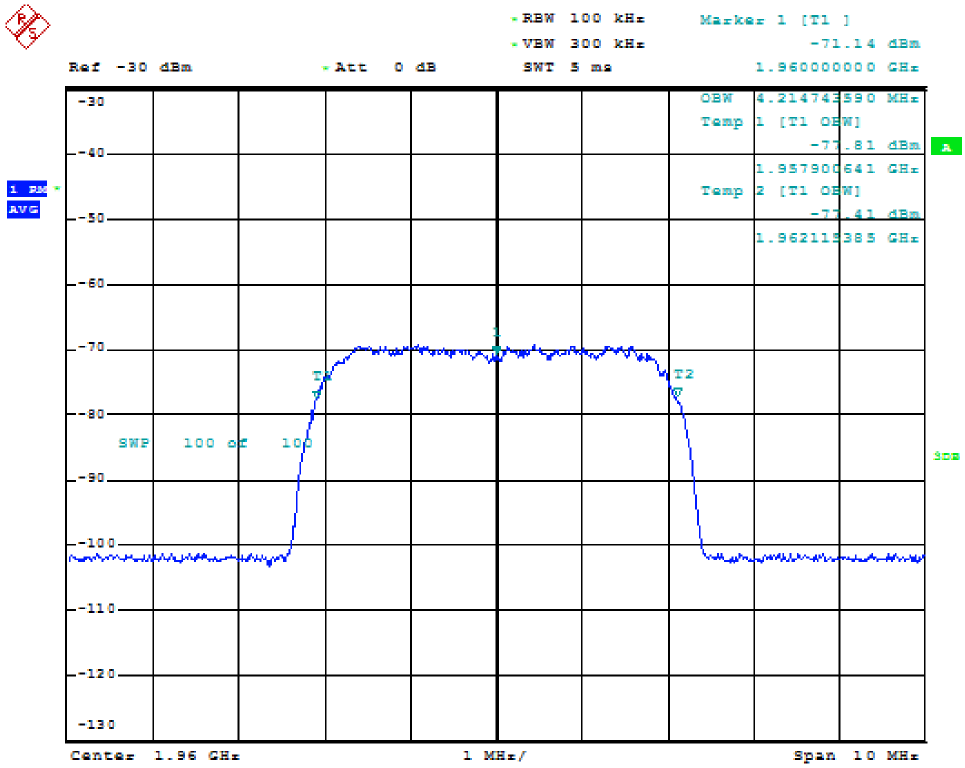

Fig. 241: Occupied bandwidth for WCDMA signal when using a through in band 2 downlink.

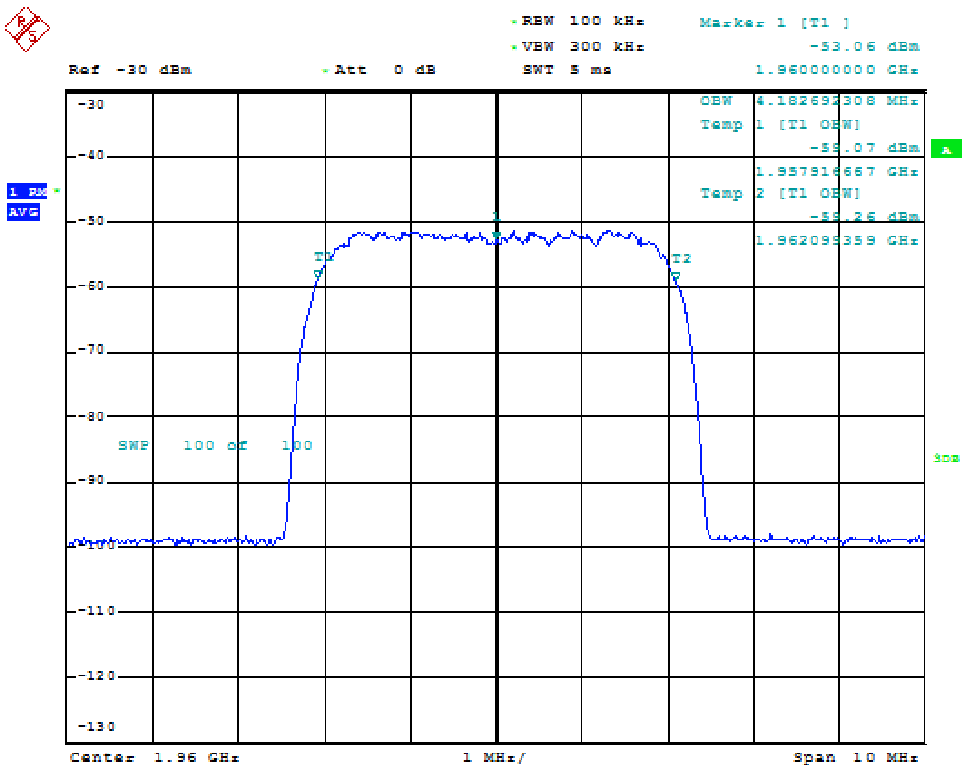

Fig. 242: Occupied bandwidth for WCDMA signal in band 2 downlink.

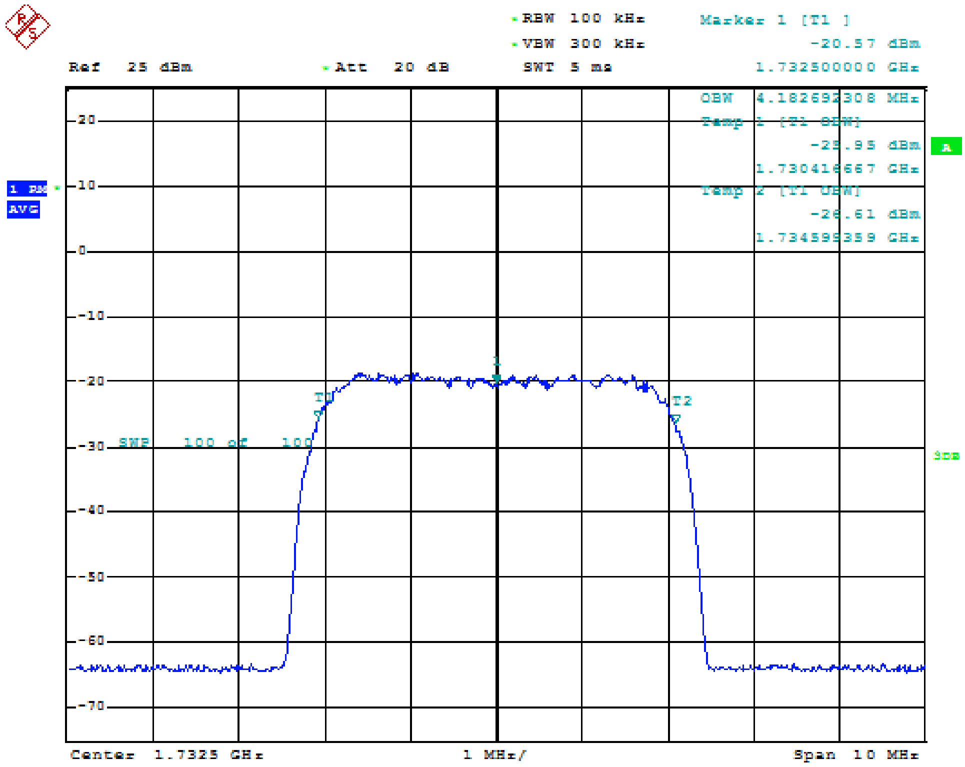

Fig. 243: Occupied bandwidth for WCDMA signal when using a through in band 4 uplink.

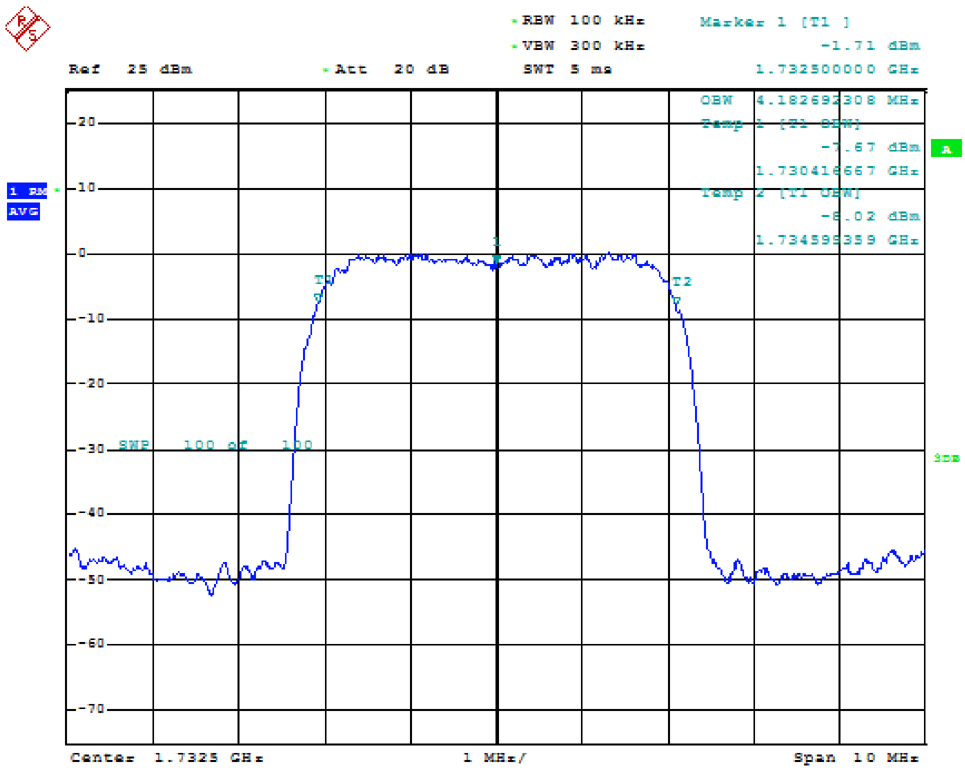

Fig. 244: Occupied bandwidth for WCDMA signal in band 4 uplink.

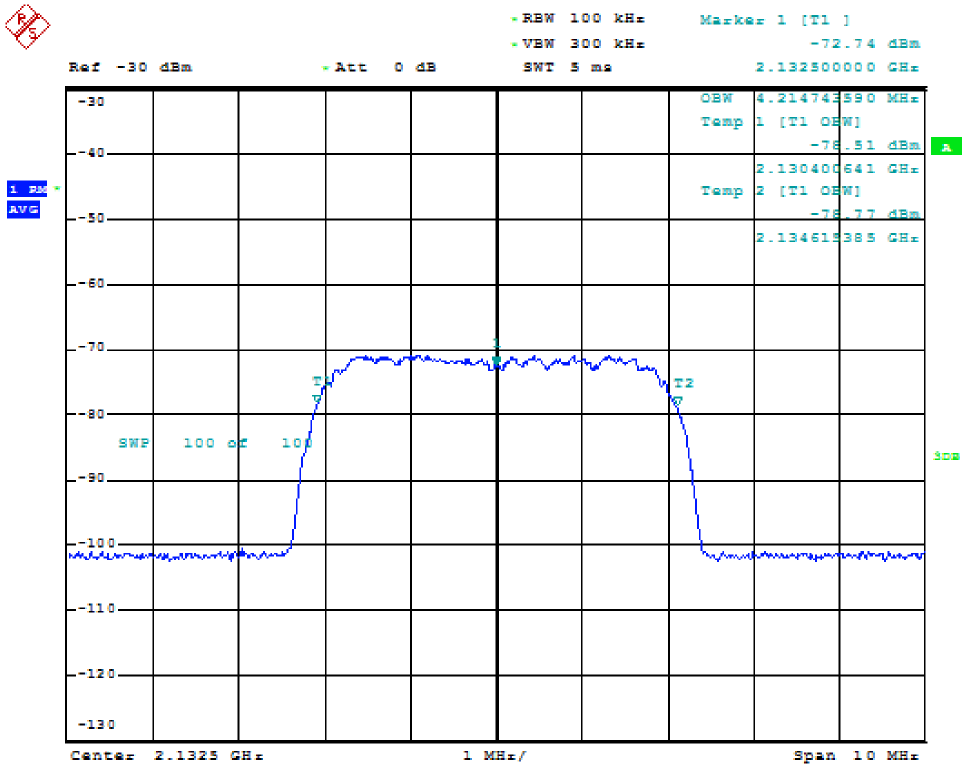

Fig. 245: Occupied bandwidth for WCDMA signal when using a through in band 4 downlink.

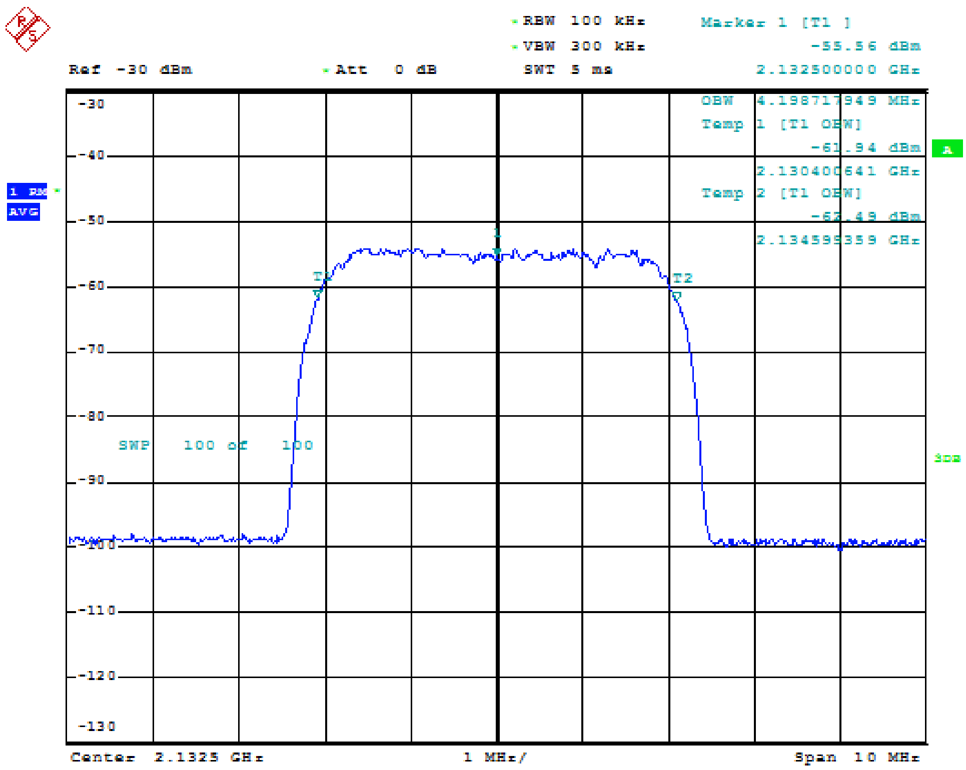

Fig. 246: Occupied bandwidth for WCDMA signal in band 4 downlink.

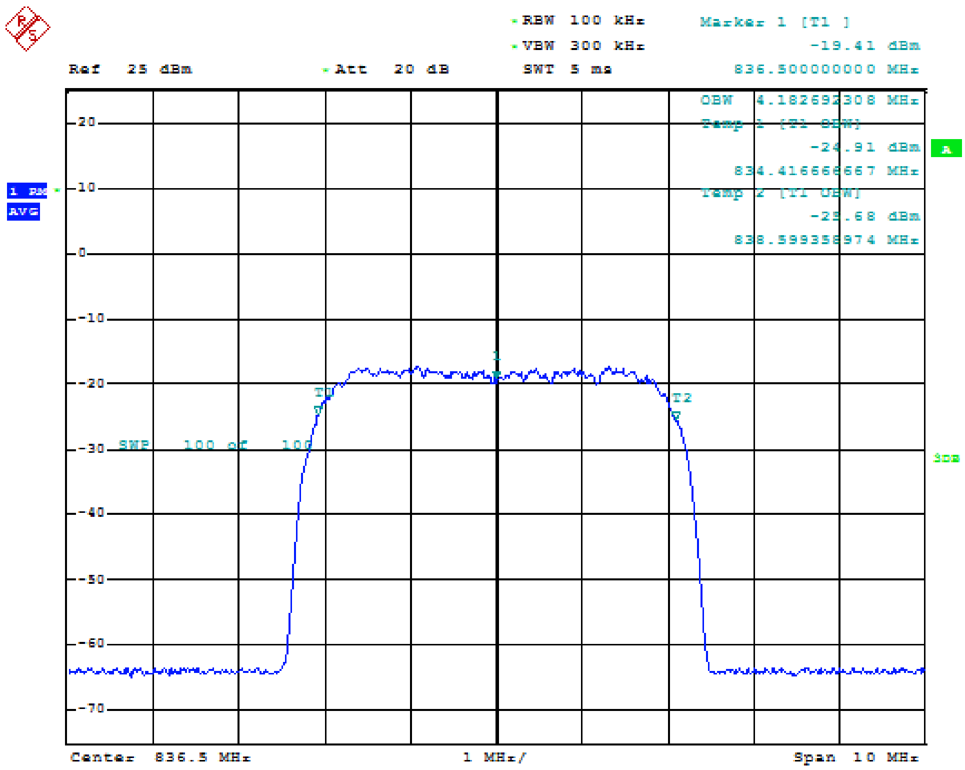

Fig. 247: Occupied bandwidth for WCDMA signal when using a through in band 5 uplink.

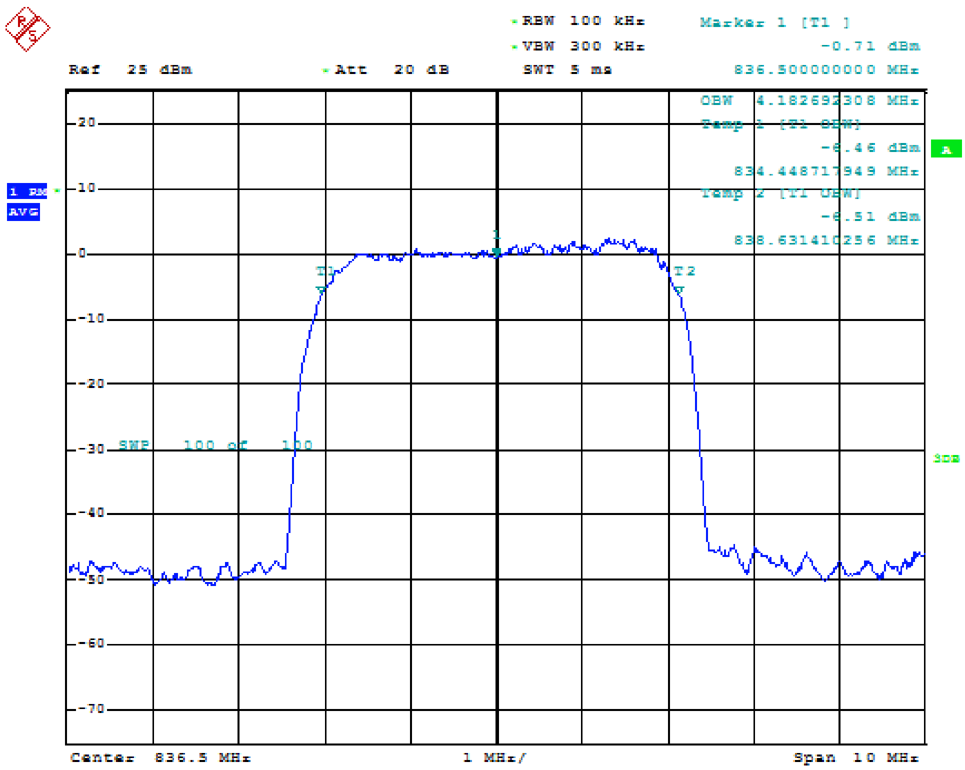

Fig. 248: Occupied bandwidth for WCDMA signal in band 5 uplink.

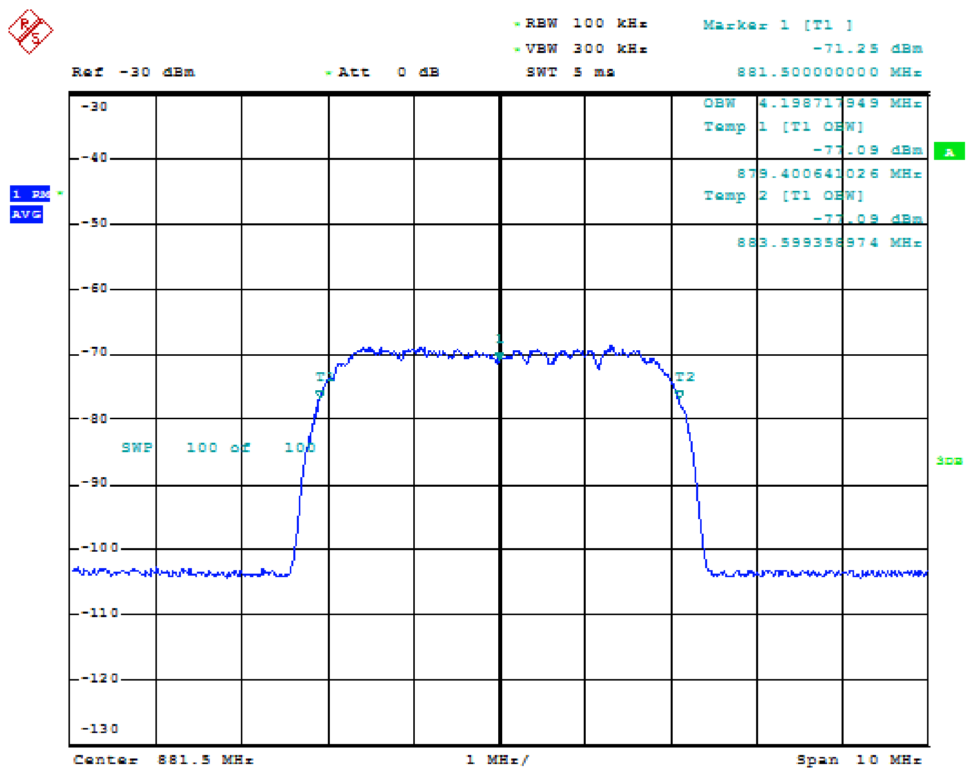

Fig. 249: Occupied bandwidth for WCDMA signal when using a through in band 5 downlink.

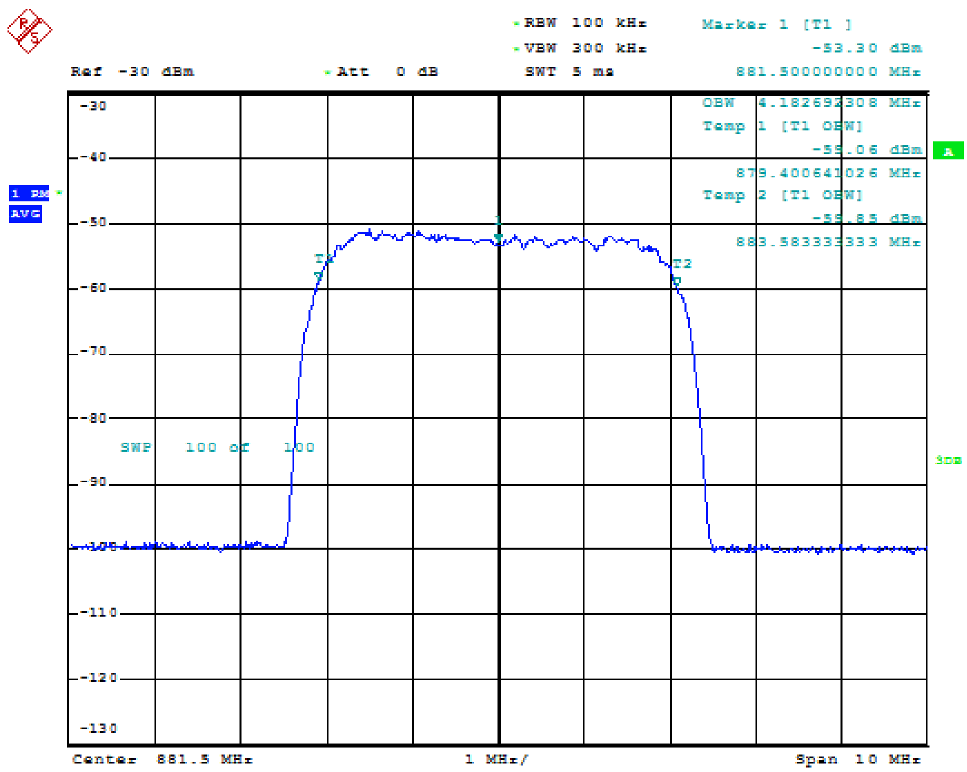

Fig. 250: Occupied bandwidth for WCDMA signal in band 5 downlink.

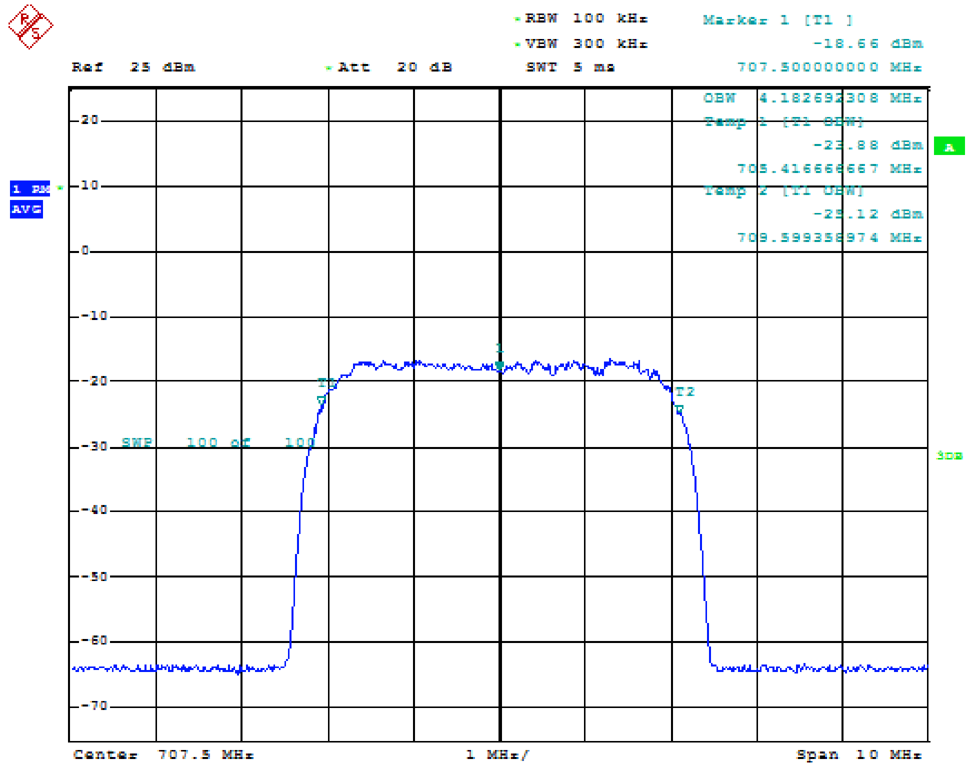

Fig. 251: Occupied bandwidth for WCDMA signal when using a through in band 12 uplink.

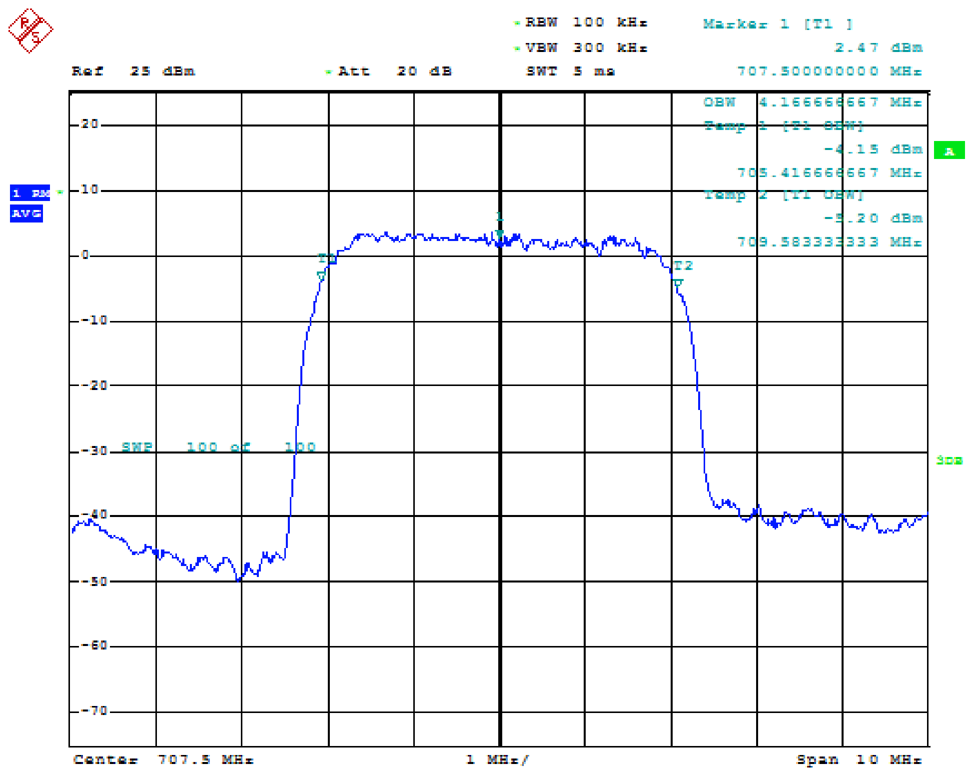

Fig. 252: Occupied bandwidth for WCDMA signal in band 12 uplink.

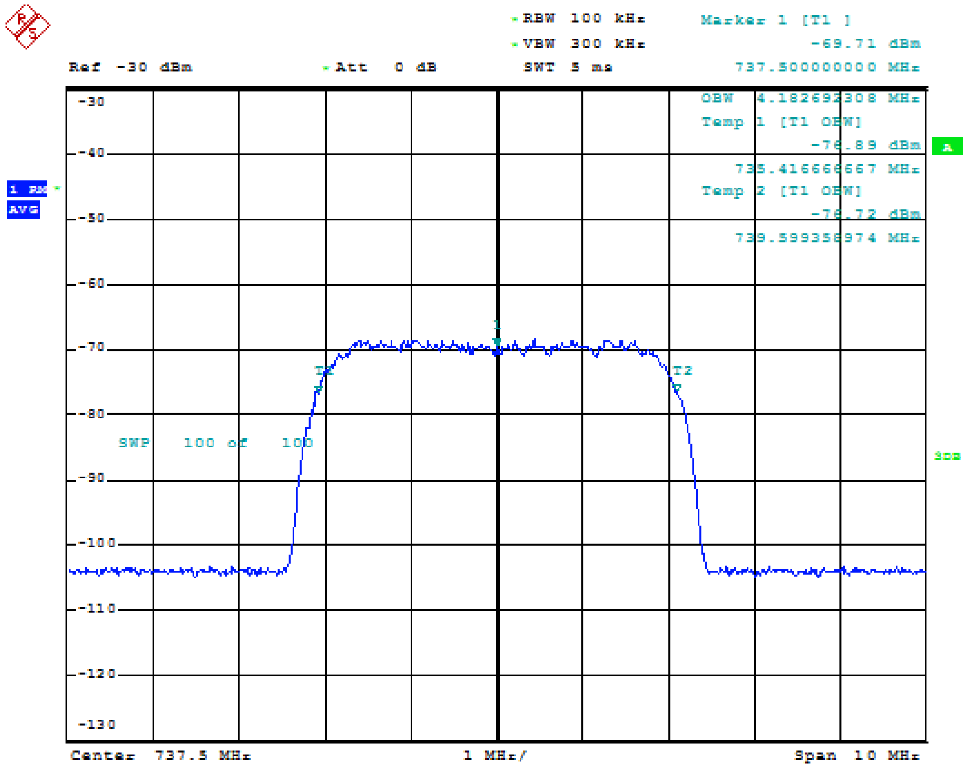

Fig. 253: Occupied bandwidth for WCDMA signal when using a through in band 12 downlink.

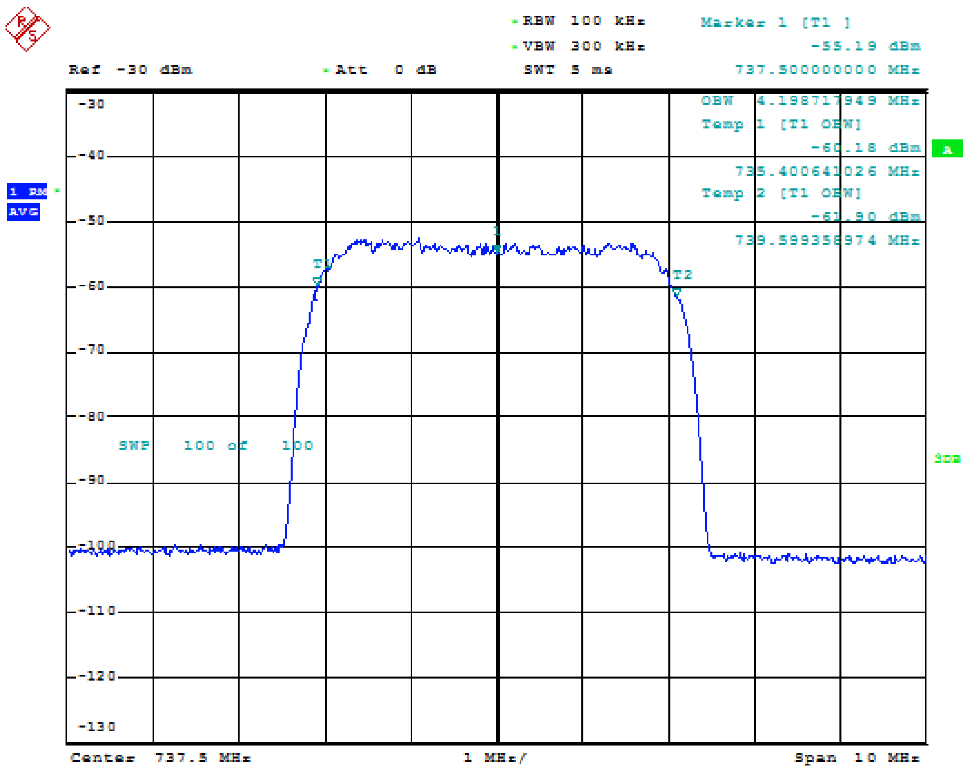

Fig. 254: Occupied bandwidth for WCDMA signal in band 12 downlink.

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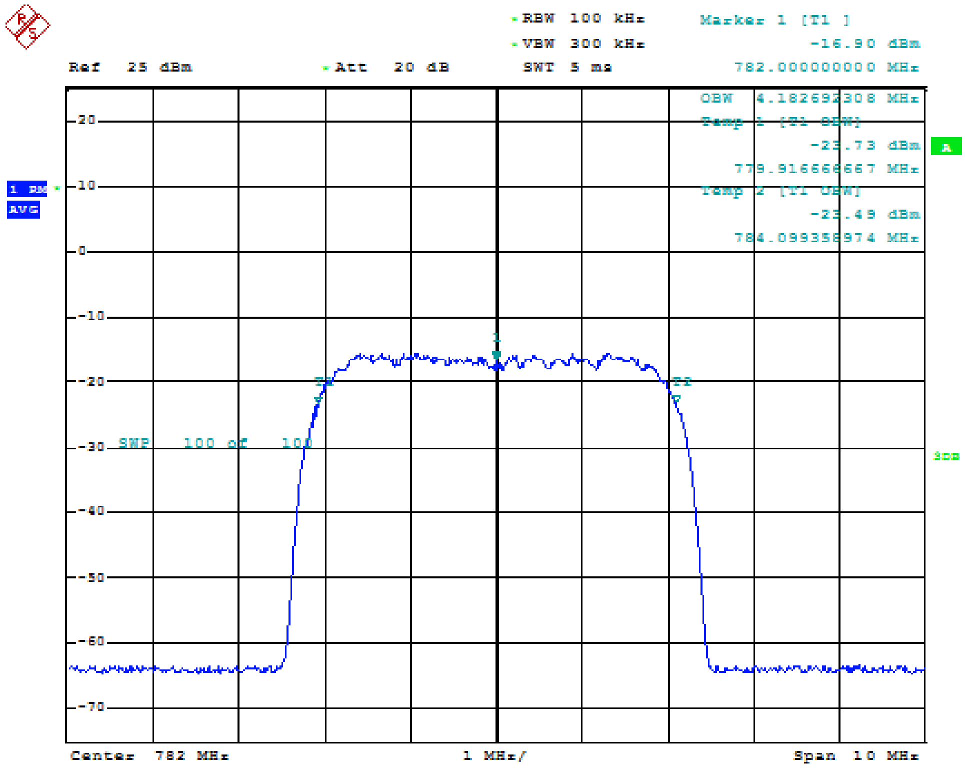


Fig. 255: Occupied bandwidth for WCDMA signal when using a through in band 13 uplink.

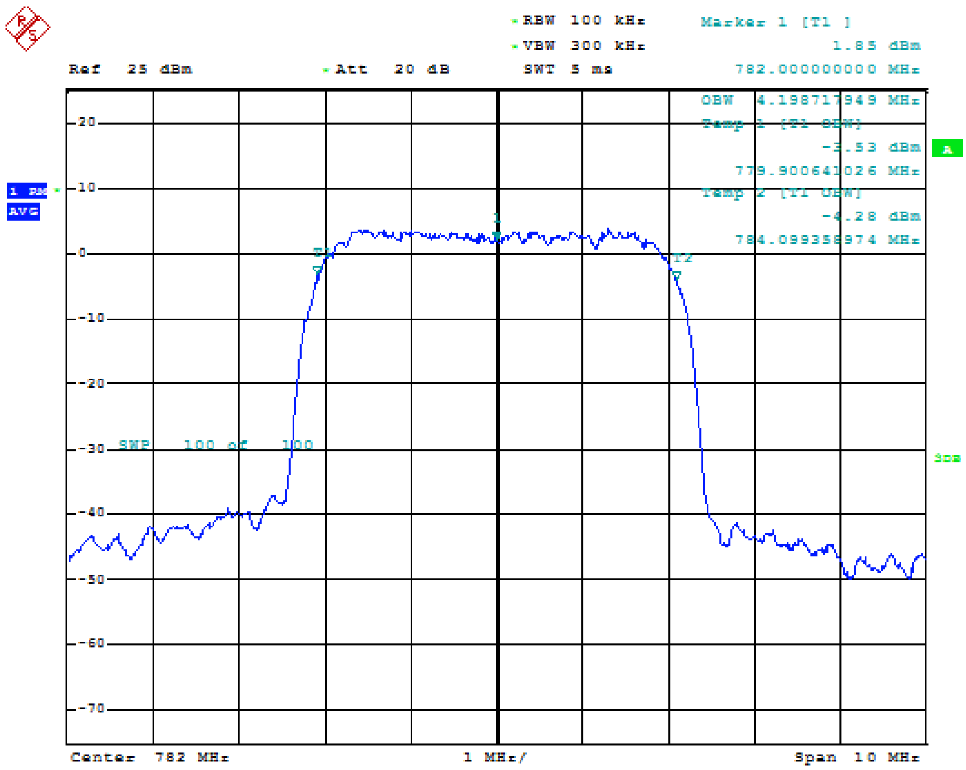


Fig. 256: Occupied bandwidth for WCDMA signal in band 13 uplink.

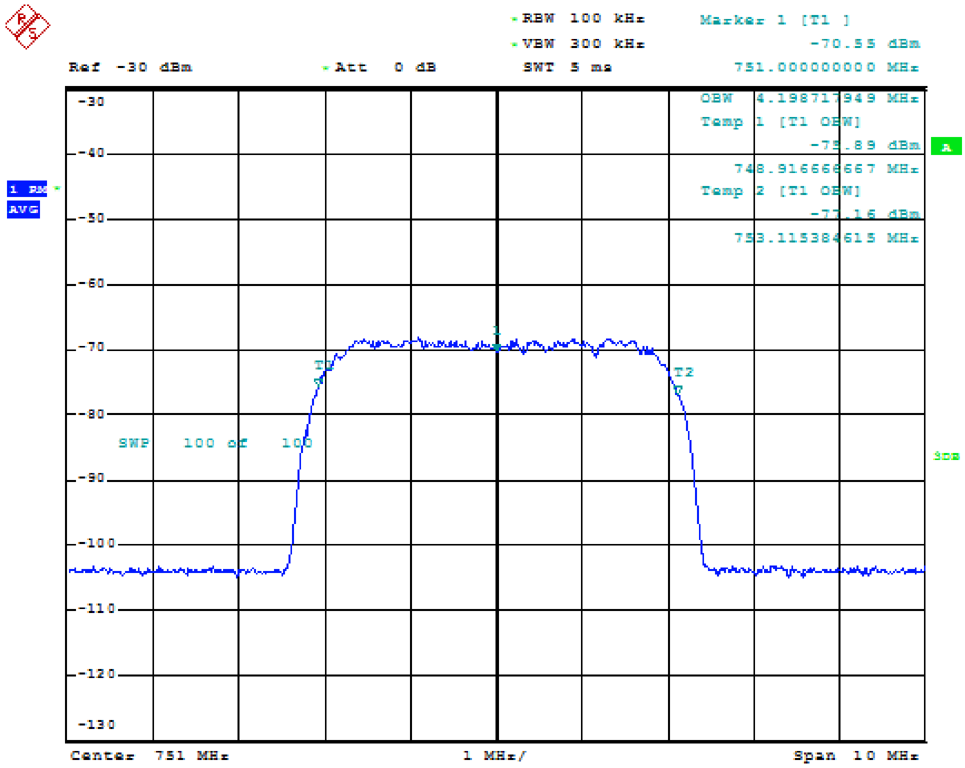


Fig. 257: Occupied bandwidth for WCDMA signal when using a through in band 13 downlink.

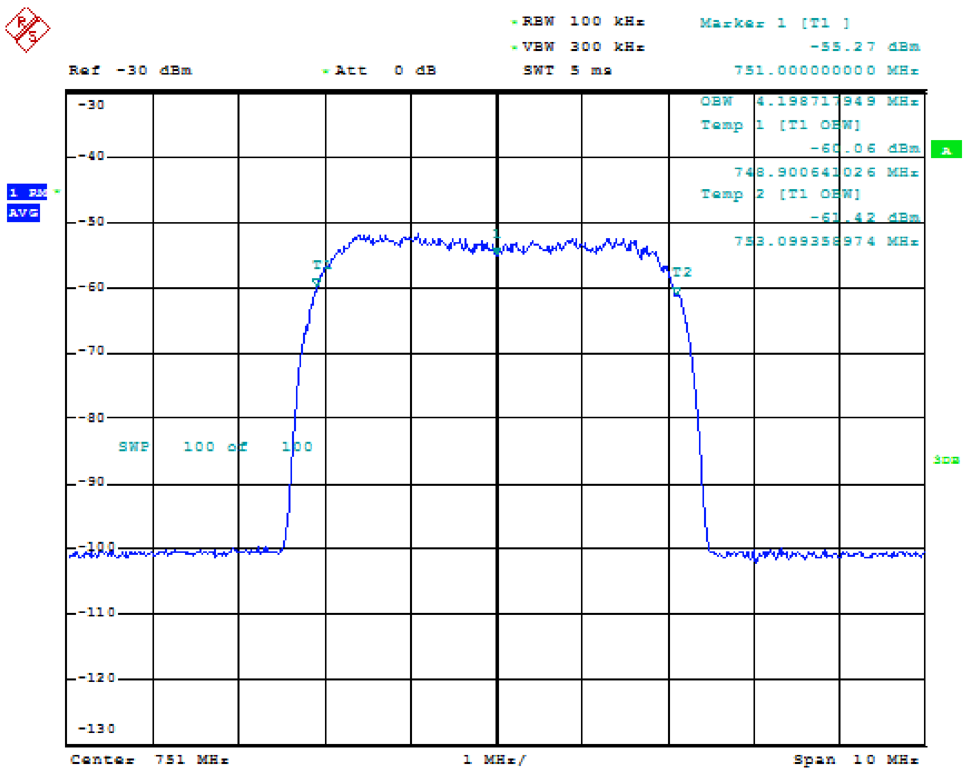


Fig. 258: Occupied bandwidth for WCDMA signal in band 13 downlink.

5.11. Oscillation Detection and Mitigation Test

5.11.1 Oscillation Restart Tests

For measuring the capability of the EUT to detect the presence of oscillation and to turn off then the output power within 300 ms for the uplink and 1000 ms for the downlink and remain off for one minute before restart the test setup as shown in Fig. 259 and for the downlink in Fig. 260 has been used.

Below are summarized the measured results for uplink and downlink oscillation detection time test limits

Band	direction	Frequency range	Measured Time	Limit	Result
2	up	1850 MHz – 1910 MHz	259 ms	300 ms	Pass
4	up	1710 MHz – 1755 MHz	238 ms	300 ms	Pass
5	up	824 MHz – 849 MHz	110 ms	300 ms	Pass
12	up	699 MHz – 716 MHz	184 ms	300 ms	Pass
13	up	777 MHz – 787 MHz	168 ms	300 ms	Pass
2	down	1930 MHz -1990 MHz	96 ms	1000 ms	Pass
4	down	2110 MHz – 2155 MHz	119 ms	1000 ms	Pass
5	down	868 MHz – 894 MHz	124 ms	1000 ms	Pass
12	down	729 MHz -746 MHz	179 ms	1000 ms	Pass
13	down	746 MHz -768 MHz	79 ms	1000 ms	Pass

Below are summarized the measured results for uplink and downlink restart time test limits

Band	direction	Frequency range	Measured Time	Limit	Result
2	up	1850 MHz – 1910 MHz	63.2 s	≥60 s	Pass
4	up	1710 MHz – 1755 MHz	63.2 s	≥60 s	Pass
5	up	824 MHz – 849 MHz	63.2 s	≥60 s	Pass
12	up	699 MHz – 716 MHz	63.2 s	≥60 s	Pass
13	up	777 MHz – 787 MHz	63.2 s	≥60 s	Pass
2	down	1930 MHz -1990 MHz	63.2 s	≥60 s	Pass
4	down	2110 MHz – 2155 MHz	63.2 s	≥60 s	Pass
5	down	868 MHz – 894 MHz	63.2 s	≥60 s	Pass
12	down	729 MHz -746 MHz	63.2 s	≥60 s	Pass
13	down	746 MHz -768 MHz	63.2 s	≥60 s	Pass

Below are summarized the measured results for uplink and downlink restart attempts

Band	direction	Frequency range	Restarts	Limit	Result
2	up	1850 MHz – 1910 MHz	4	≤ 5	Pass
4	up	1710 MHz – 1755 MHz	4	≤ 5	Pass
5	up	824 MHz – 849 MHz	4	≤ 5	Pass
12	up	699 MHz – 716 MHz	4	≤ 5	Pass
13	up	777 MHz – 787 MHz	4	≤ 5	Pass
2	down	1930 MHz -1990 MHz	4	≤ 5	Pass
4	down	2110 MHz – 2155 MHz	4	≤ 5	Pass
5	down	868 MHz – 894 MHz	4	≤ 5	Pass
12	down	729 MHz -746 MHz	4	≤ 5	Pass
13	down	746 MHz -768 MHz	4	≤ 5	Pass

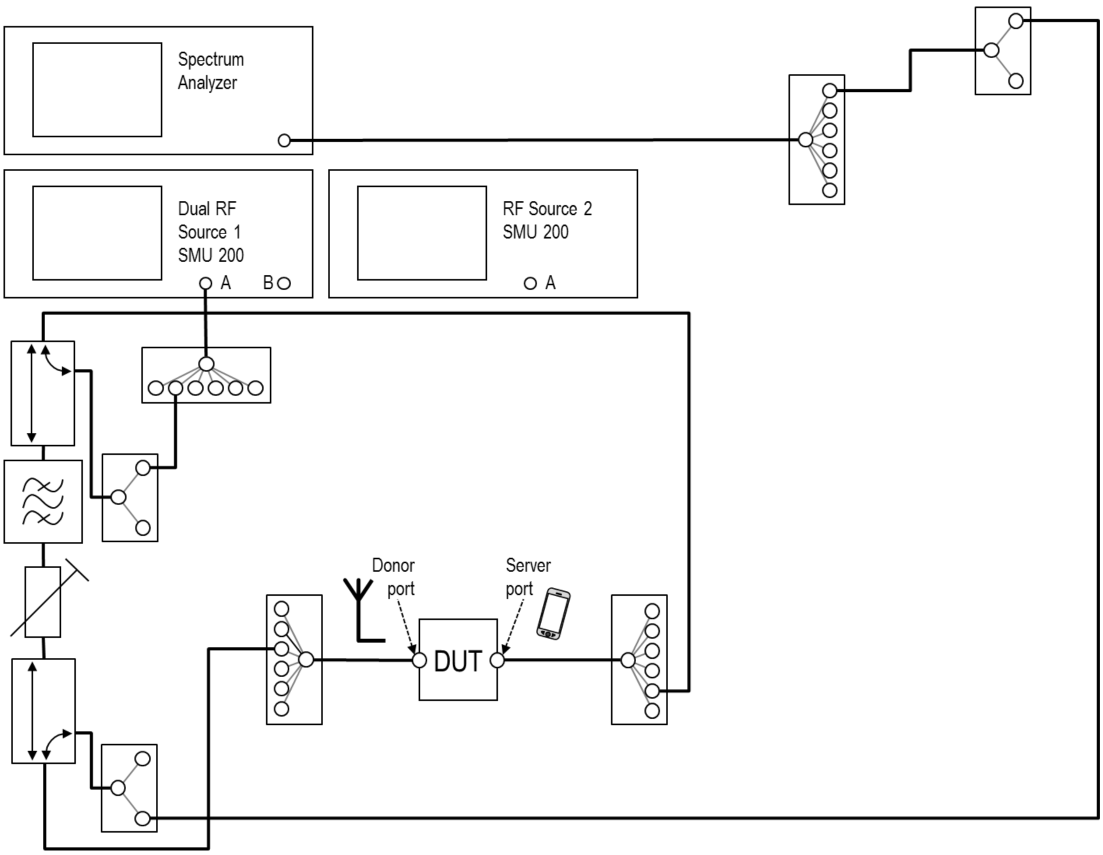


Fig. 259: Set up for oscillation detection and mitigation tests in uplink.

Note: For this special type of booster under test a stimulating signal is required at the server port to switch the uplink amplifier ON to be able to measure test 5.11.1 oscillation restart (KDB Test Case 7.11.2)

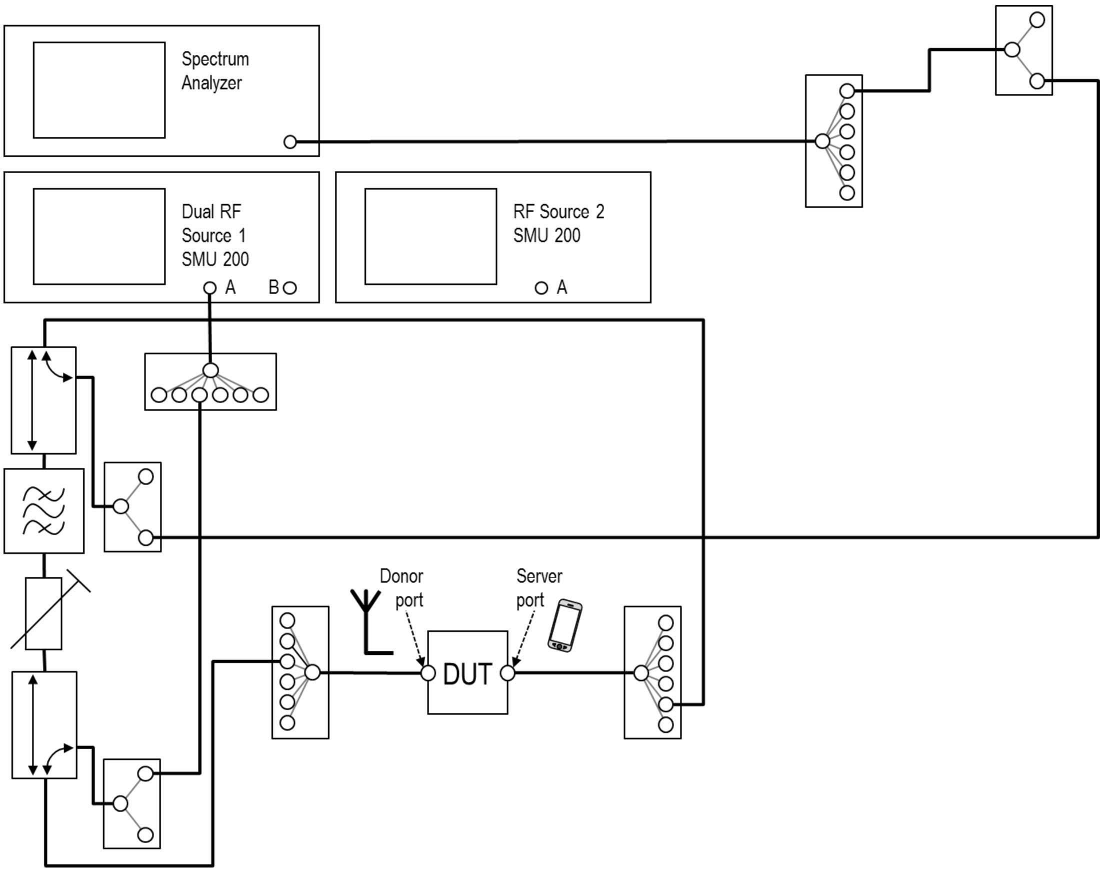


Fig. 260: Set up for oscillation detection and mitigation tests in downlink.

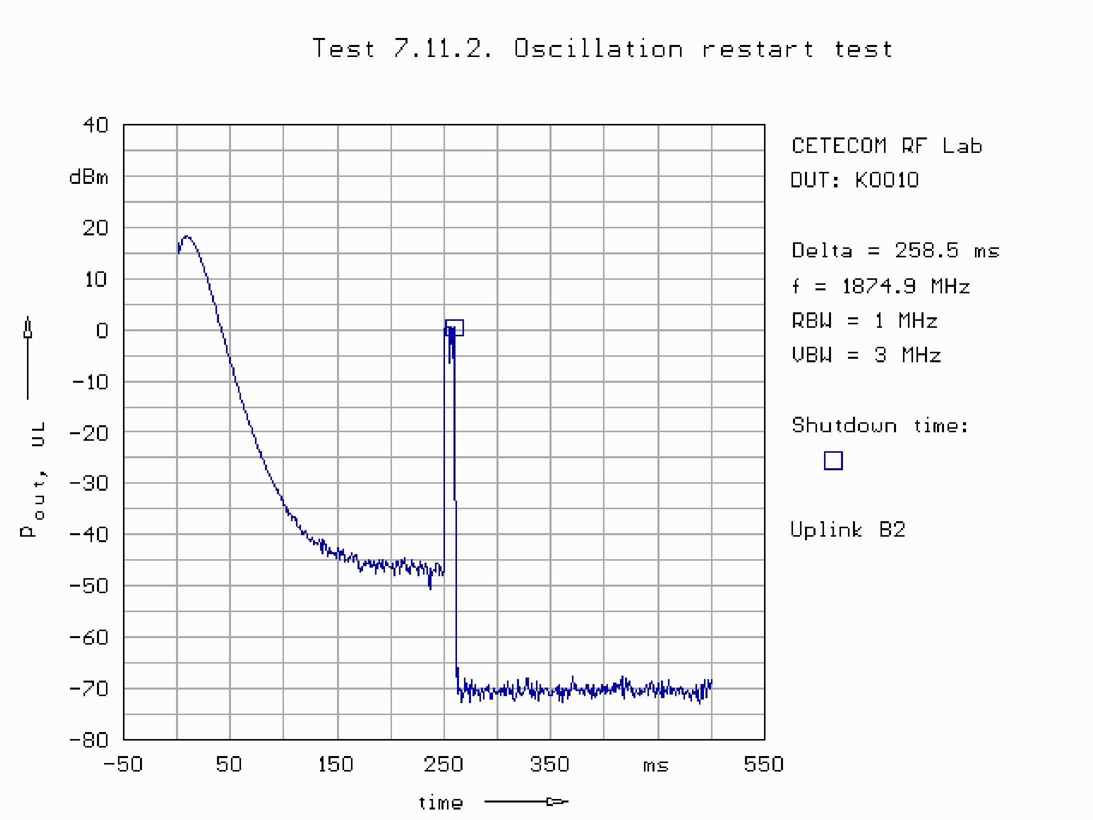


Fig. 261: Band 2 uplink oscillation detection time test result.

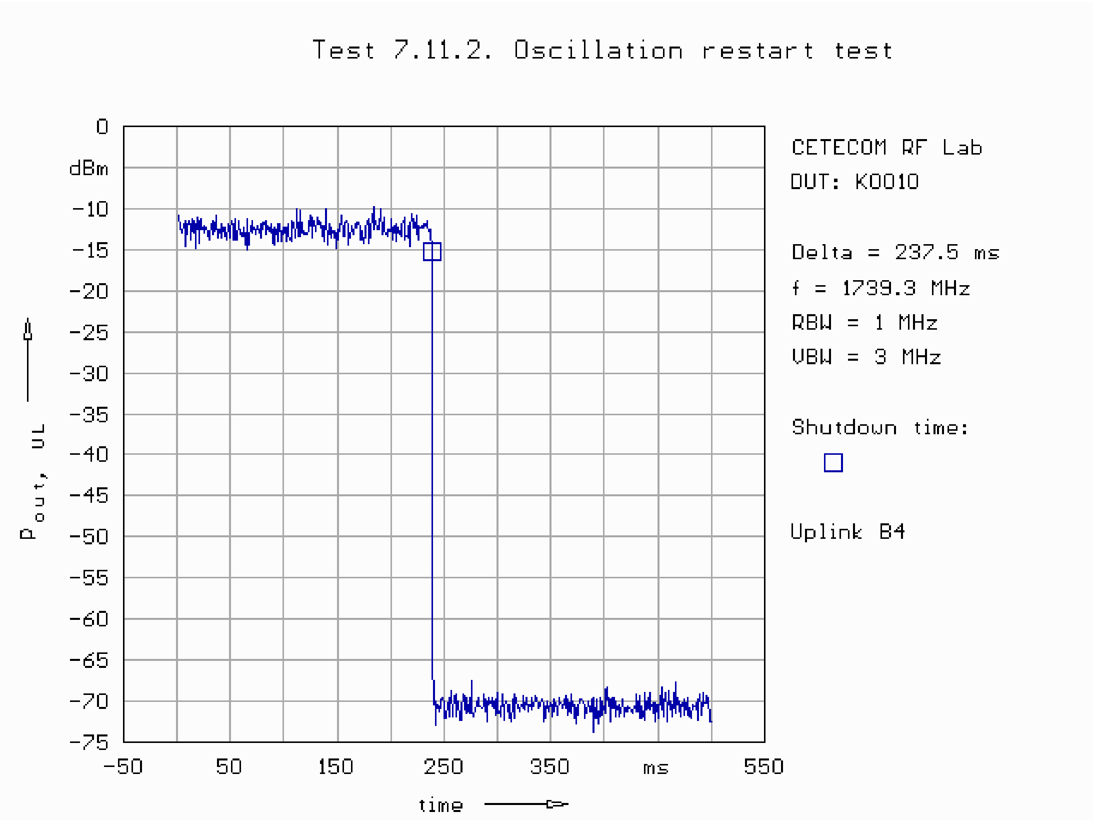


Fig. 262: Band 4 uplink oscillation detection time test result.

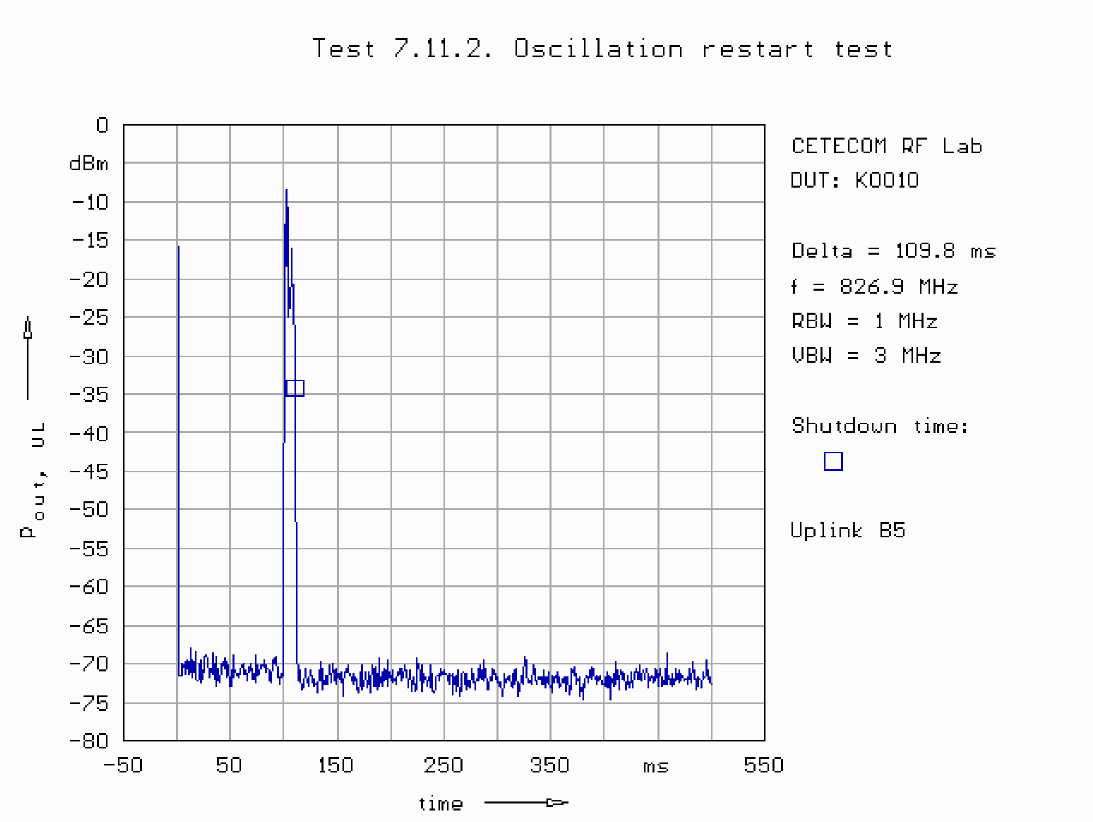


Fig. 263: Band 5 uplink oscillation detection time test result.

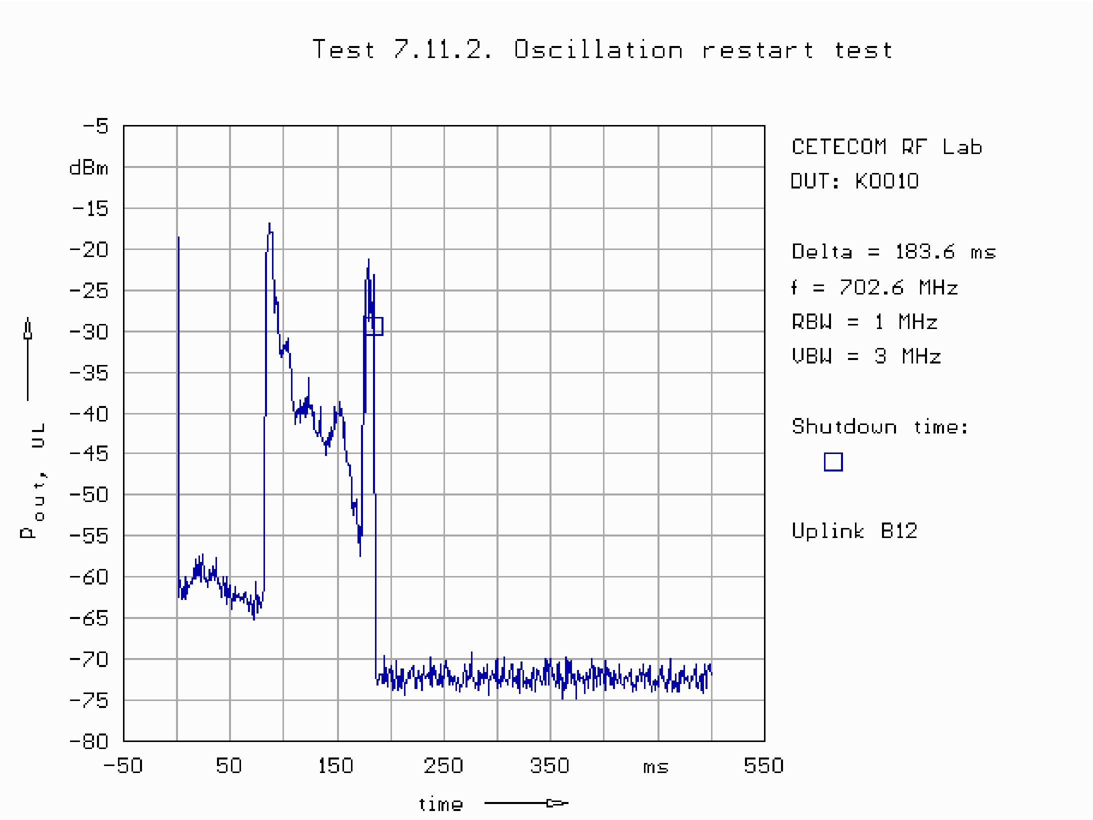


Fig. 264: Band 12 uplink oscillation detection time test result.

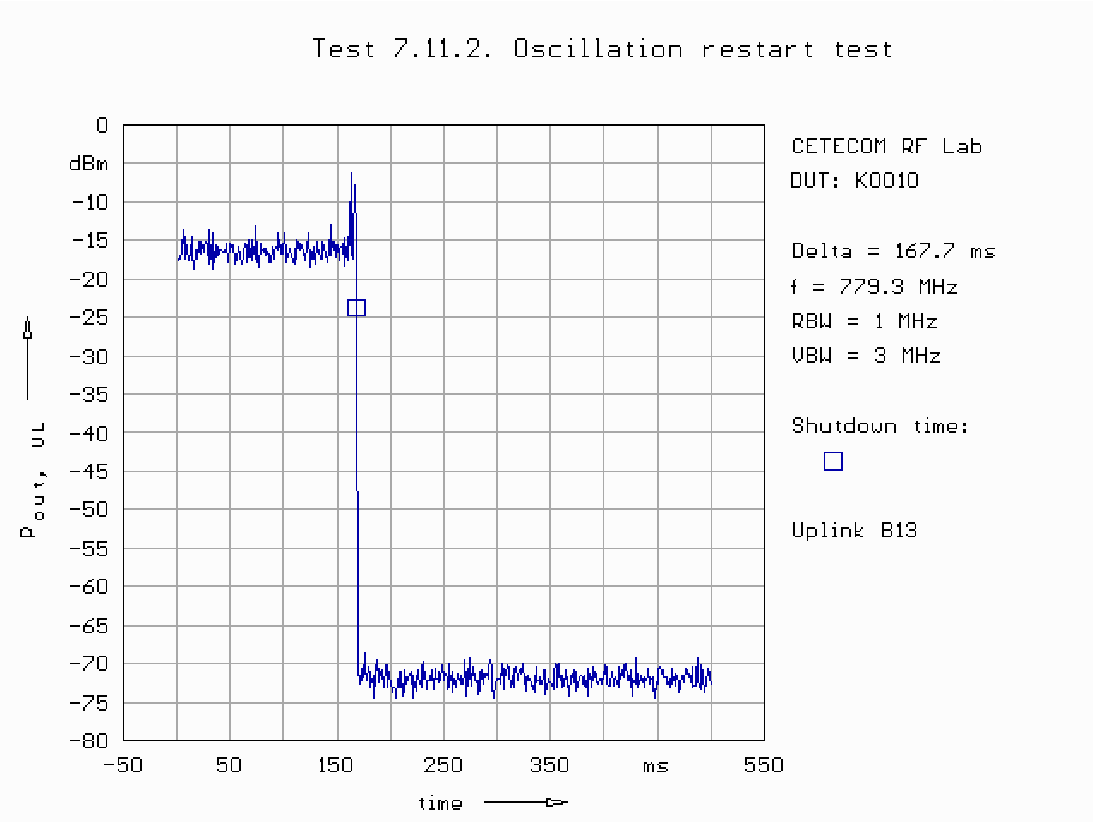


Fig. 265: Band 13 uplink oscillation detection time test result.

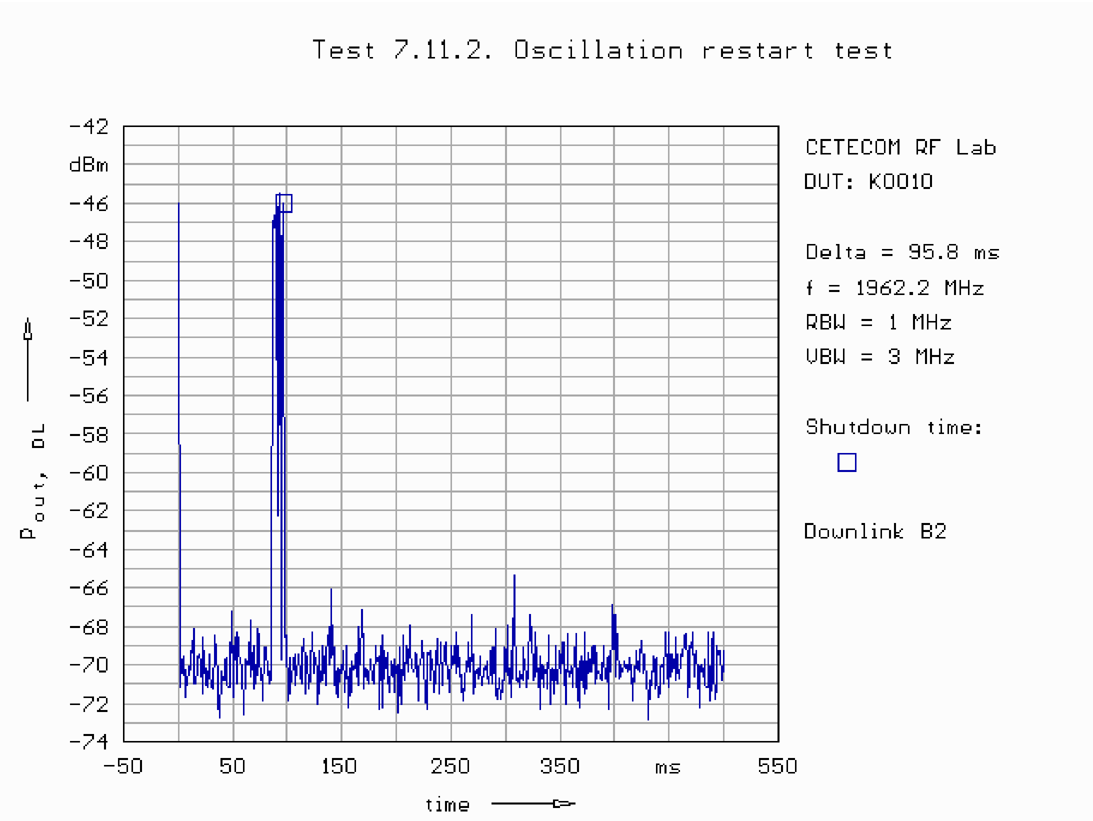


Fig. 266: Band 2 downlink oscillation detection time test result.

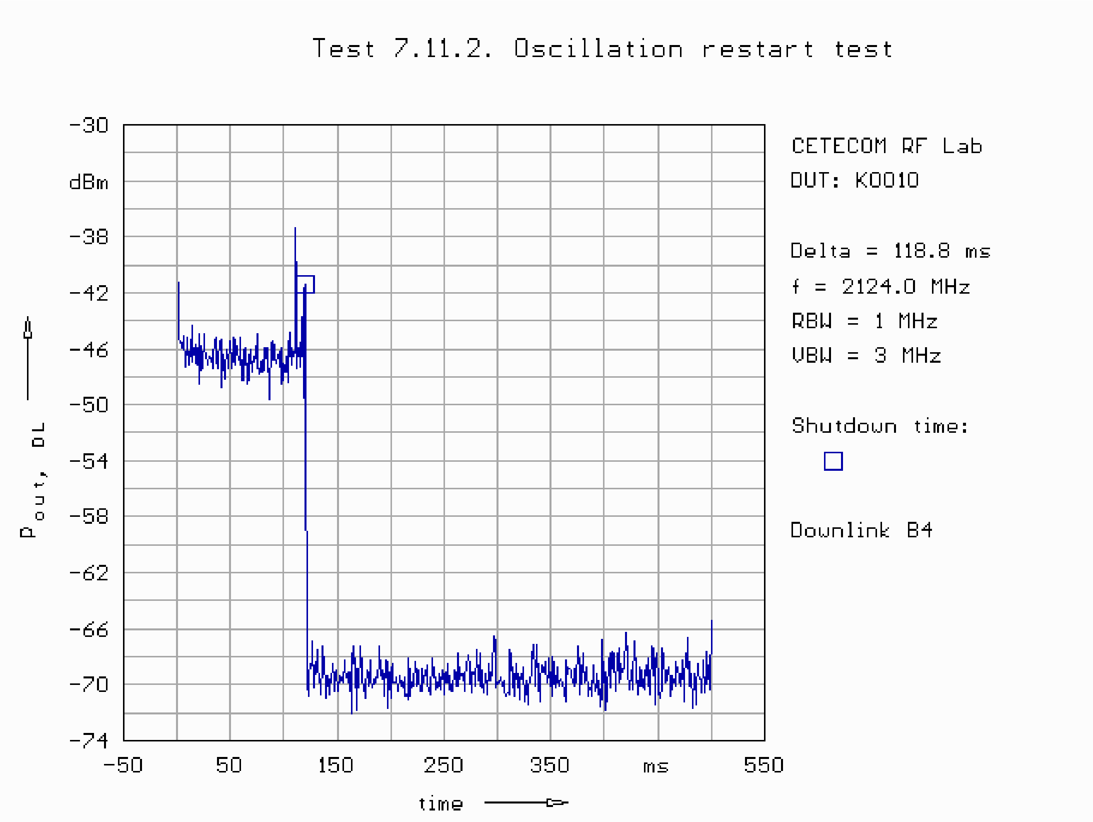


Fig. 267: Band 4 downlink oscillation detection time test result.

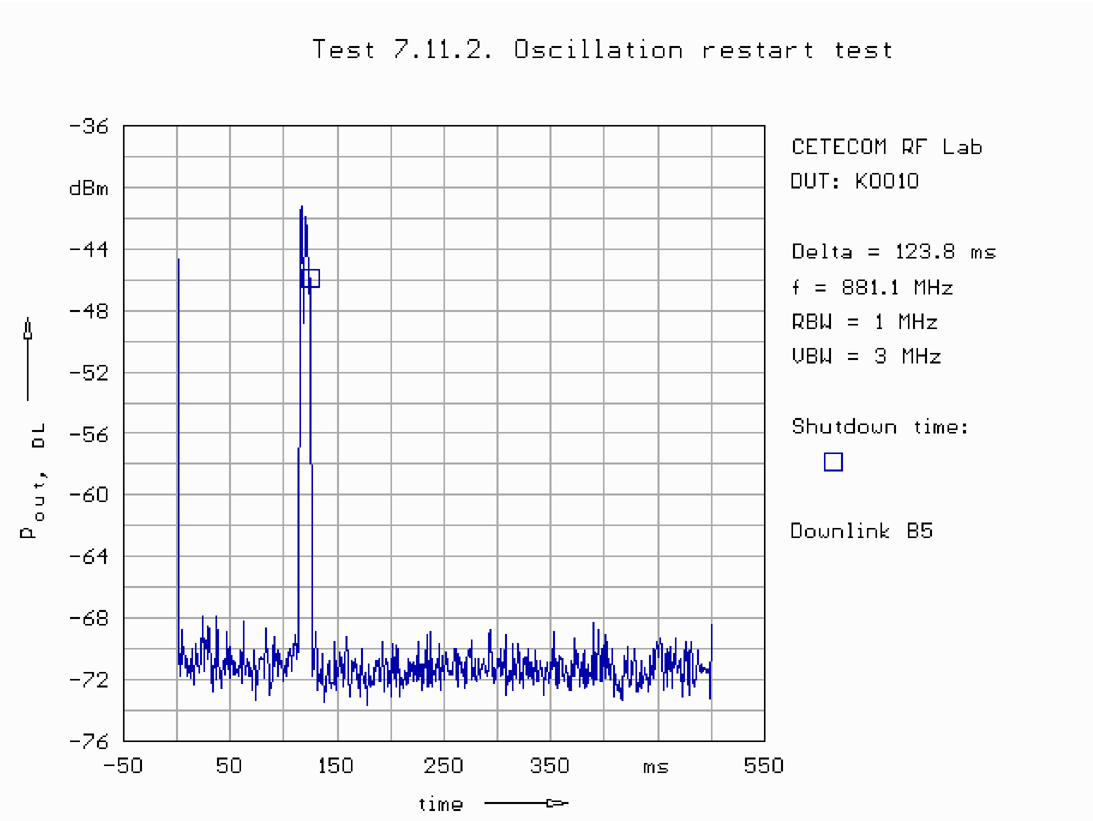


Fig. 268: Band 5 downlink oscillation detection time test result.

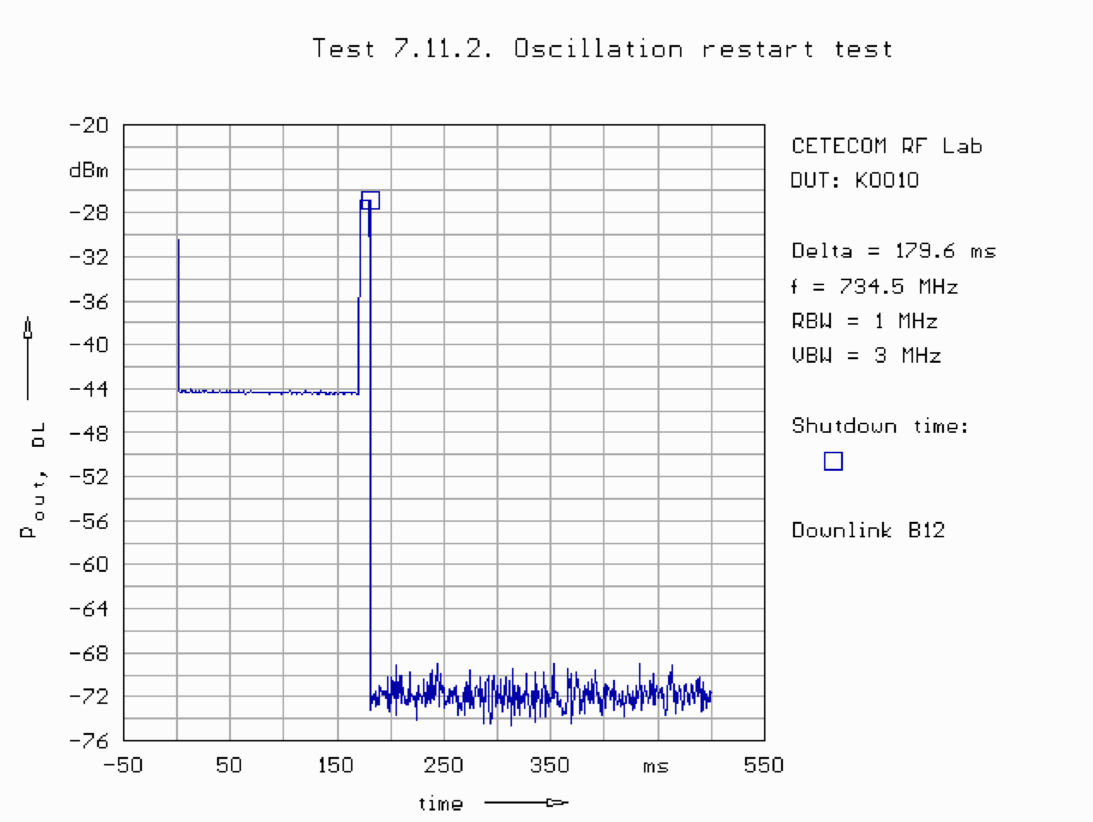


Fig. 269: Band 12 downlink oscillation detection time test result.

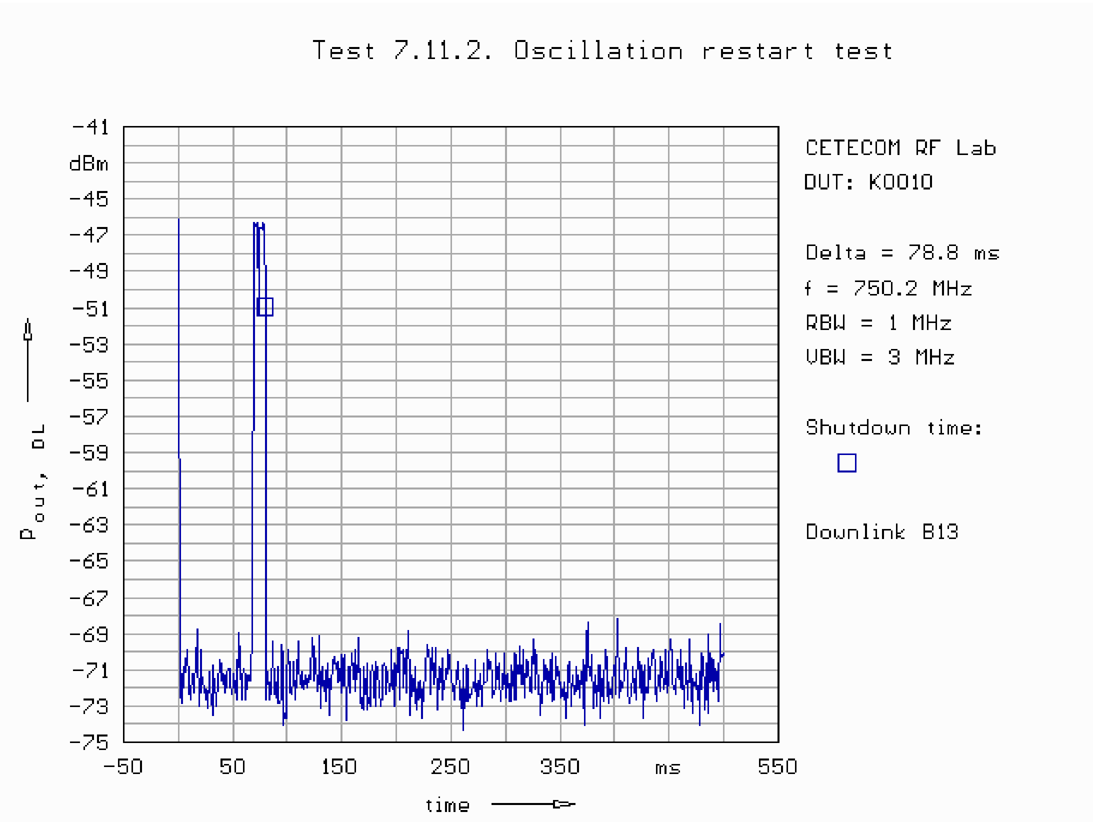


Fig. 270: Band 13 downlink oscillation detection time test result.

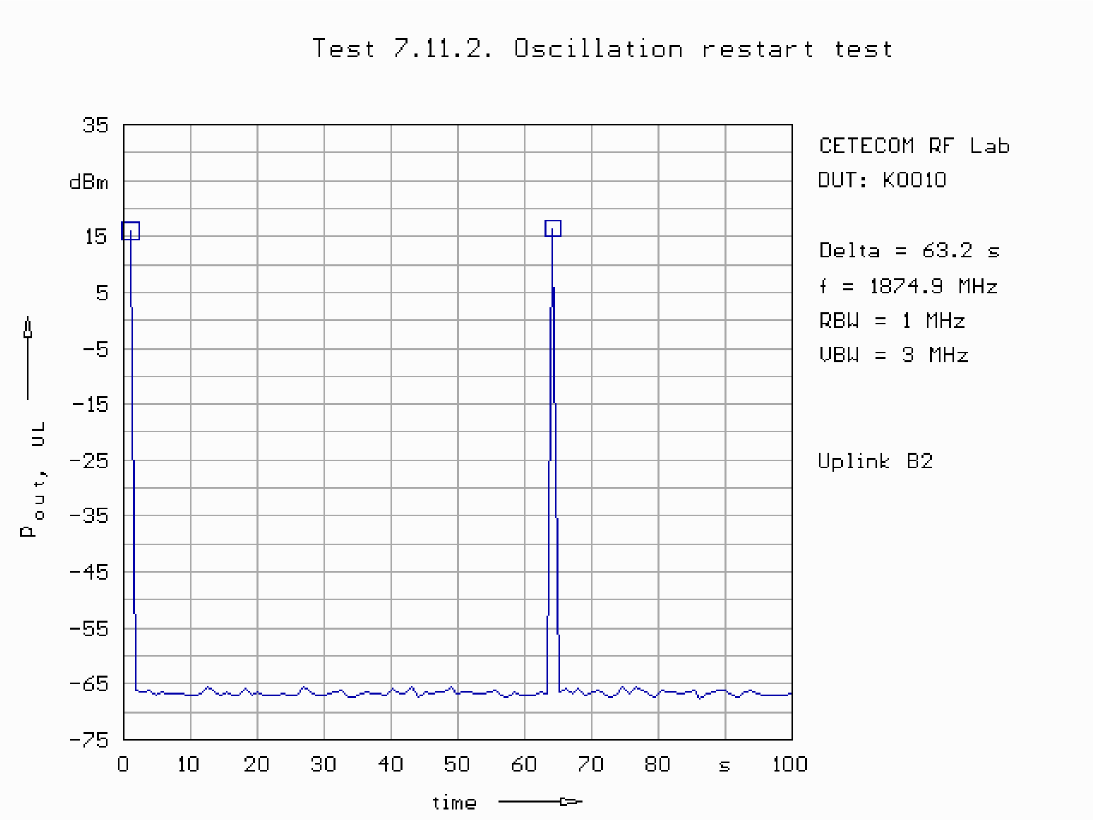


Fig. 271: Band 2 uplink restart time test result.

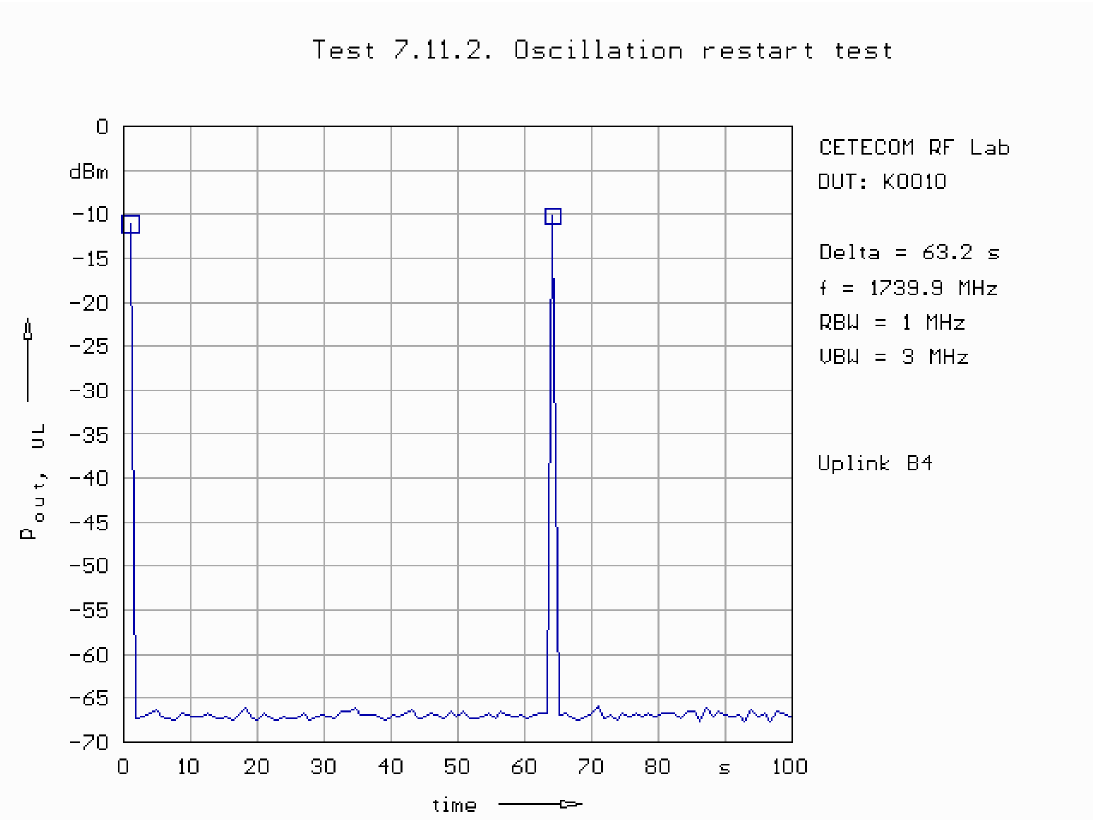


Fig. 272: Band 4 uplink restart time test result.

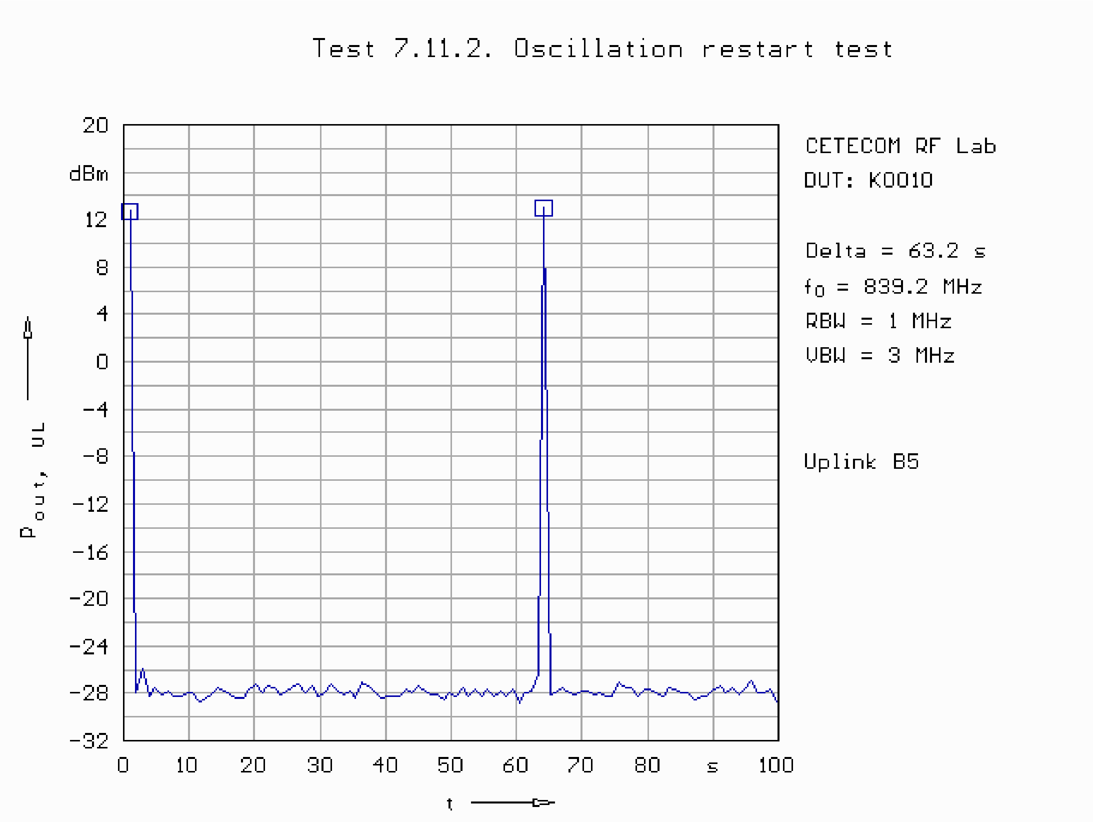


Fig. 273: Band 5 uplink restart time test result.

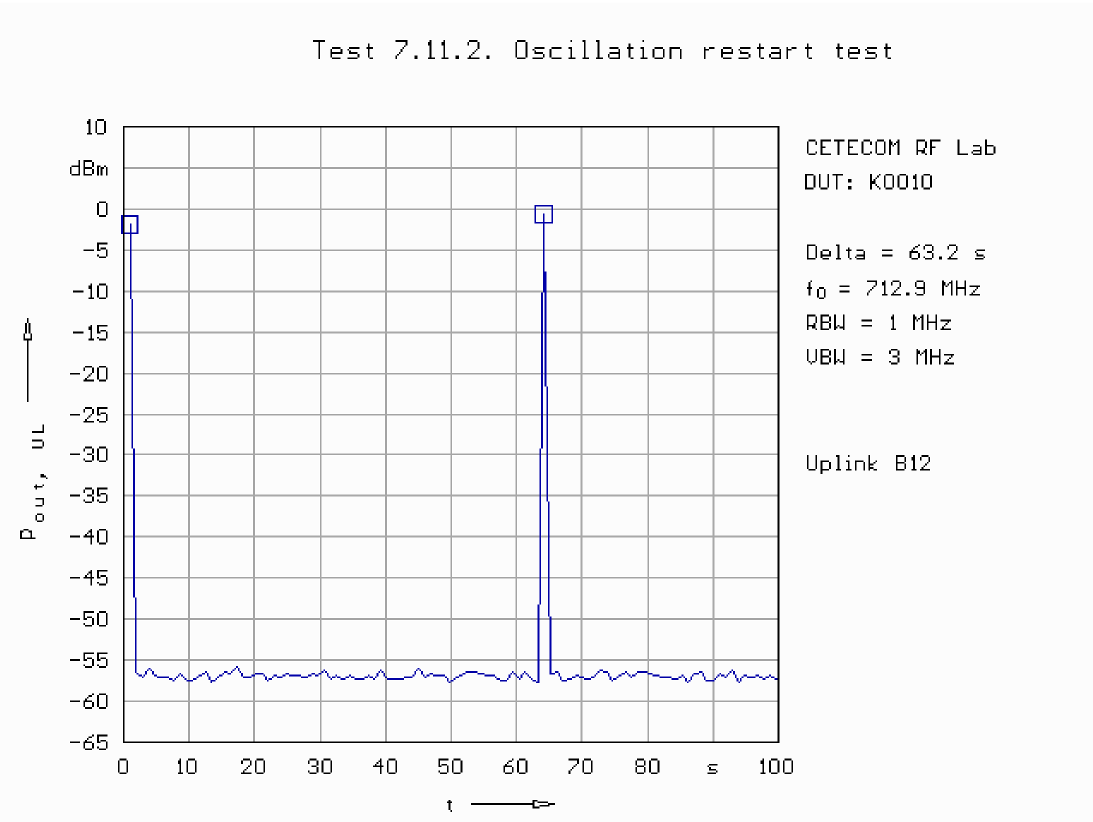


Fig. 274: Band 12 uplink restart time test result.

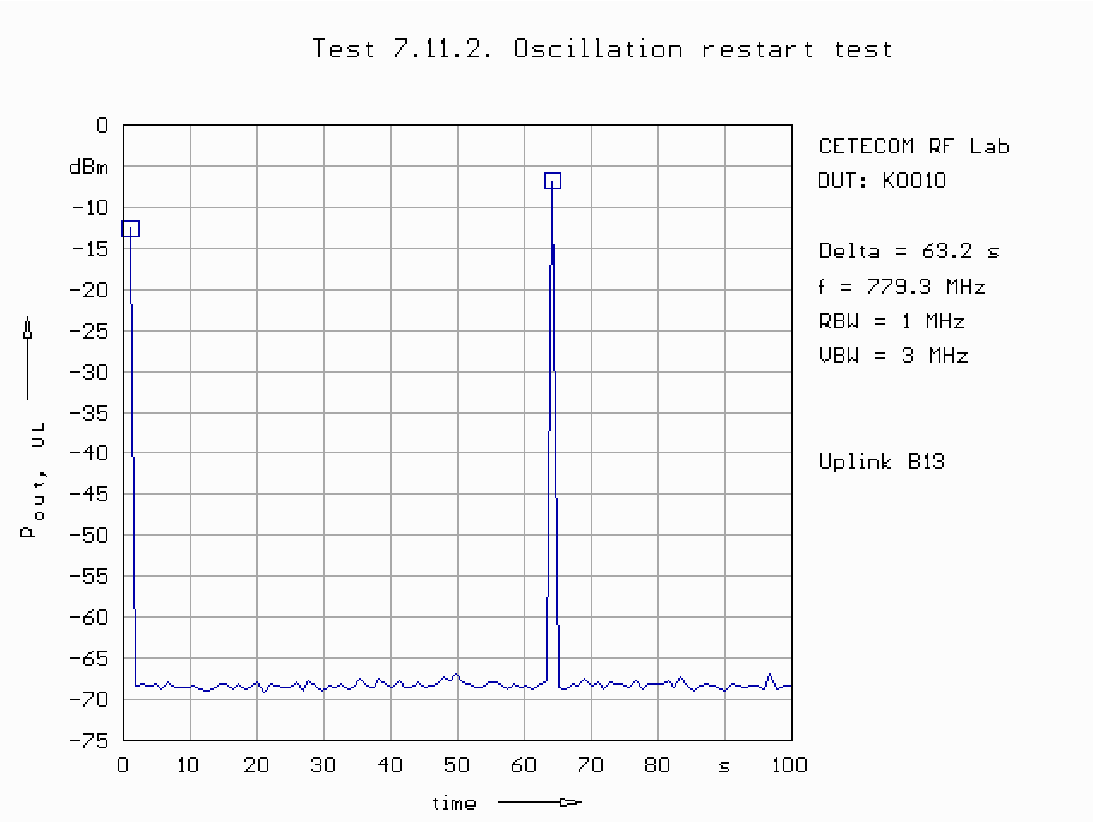


Fig. 275: Band 13 uplink restart time test result.

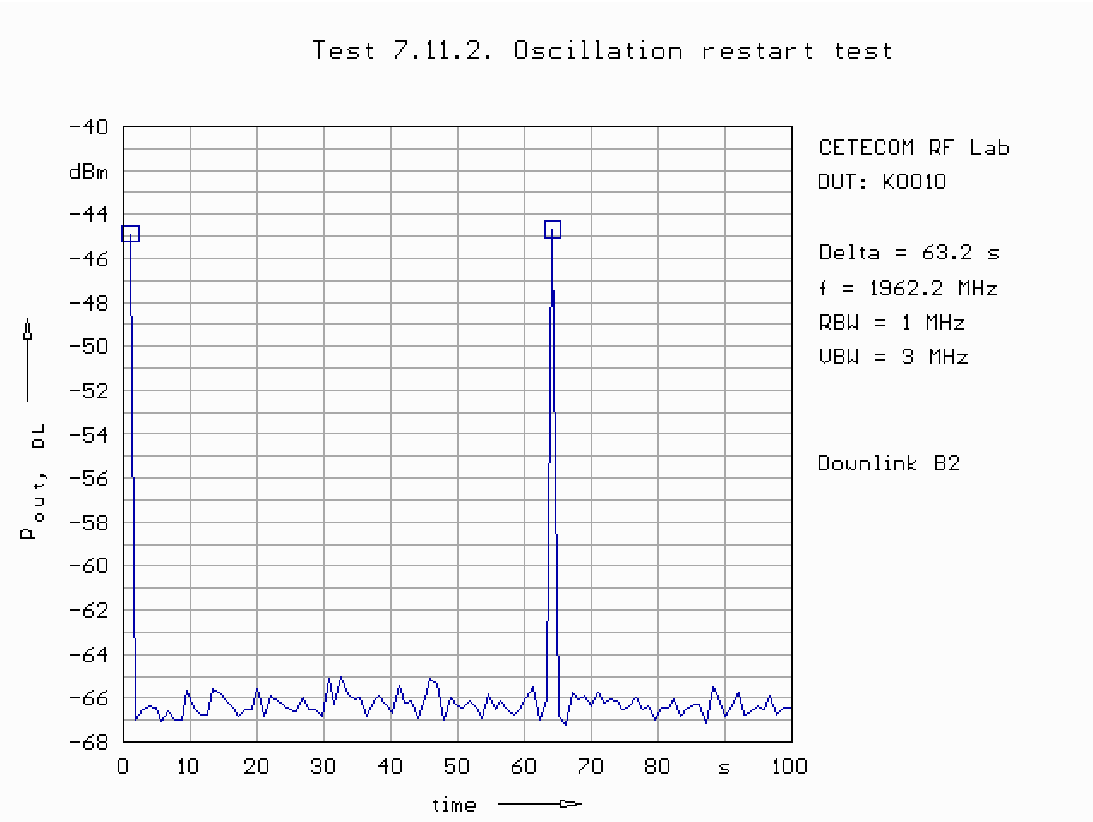


Fig. 276: Band 2 downlink restart time test result.

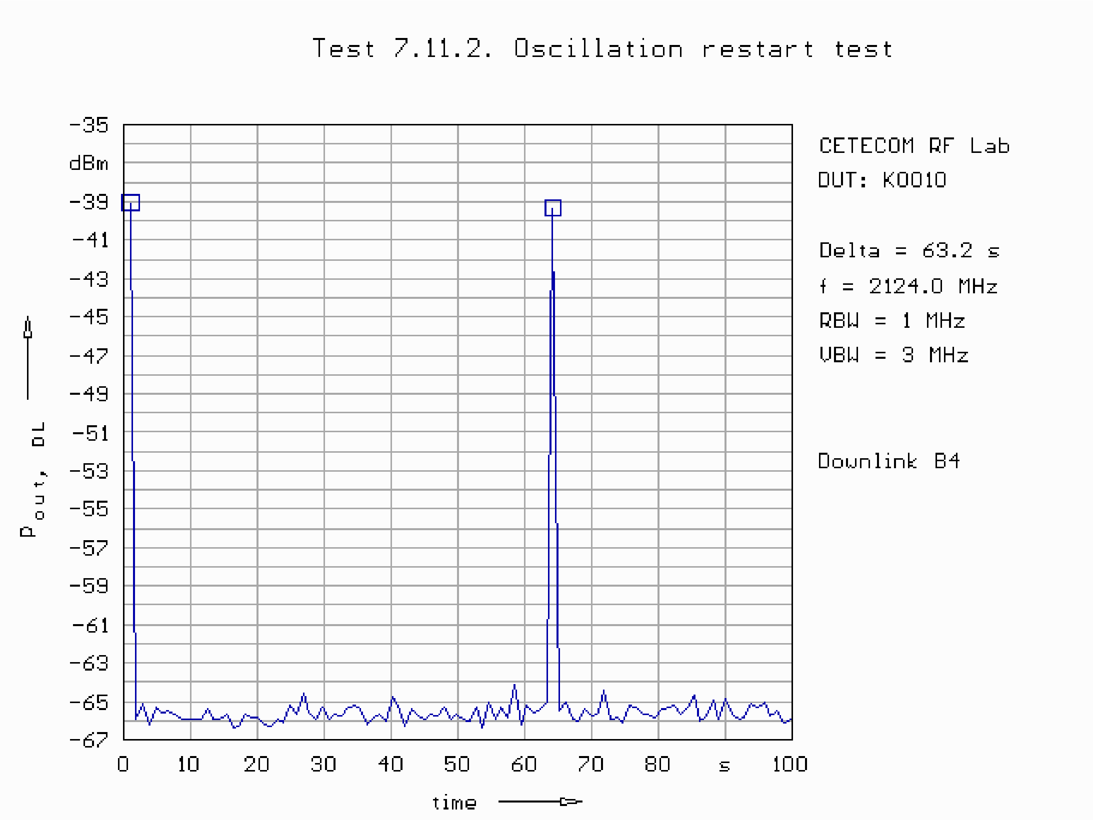


Fig. 277: Band 4 downlink restart time test result.

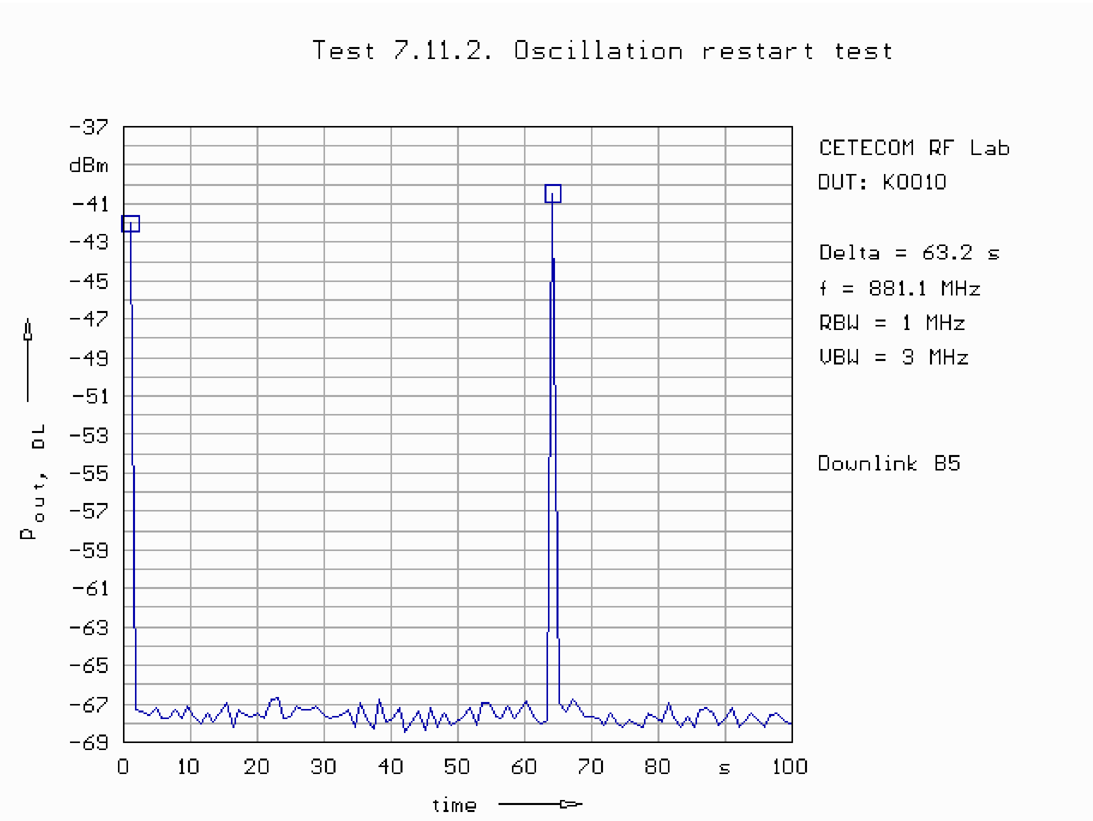


Fig. 278: Band 5 downlink restart time test result.

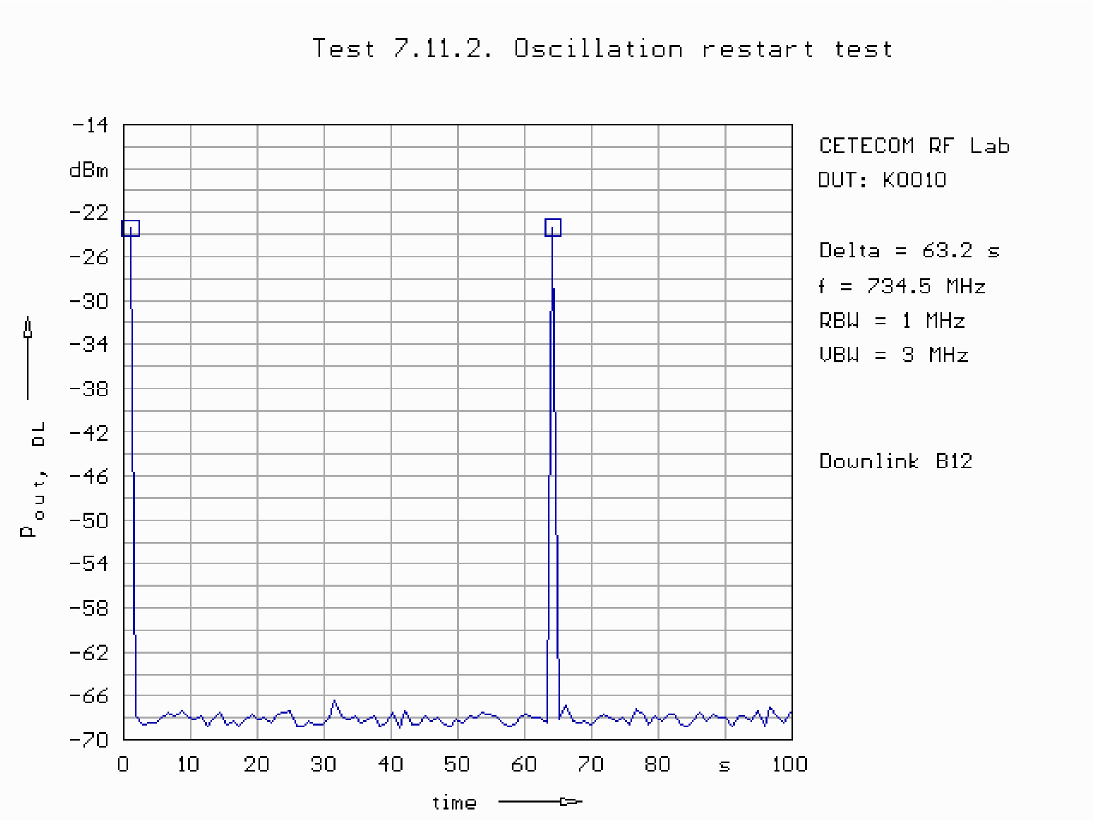


Fig. 279: Band 12 downlink restart time test result.

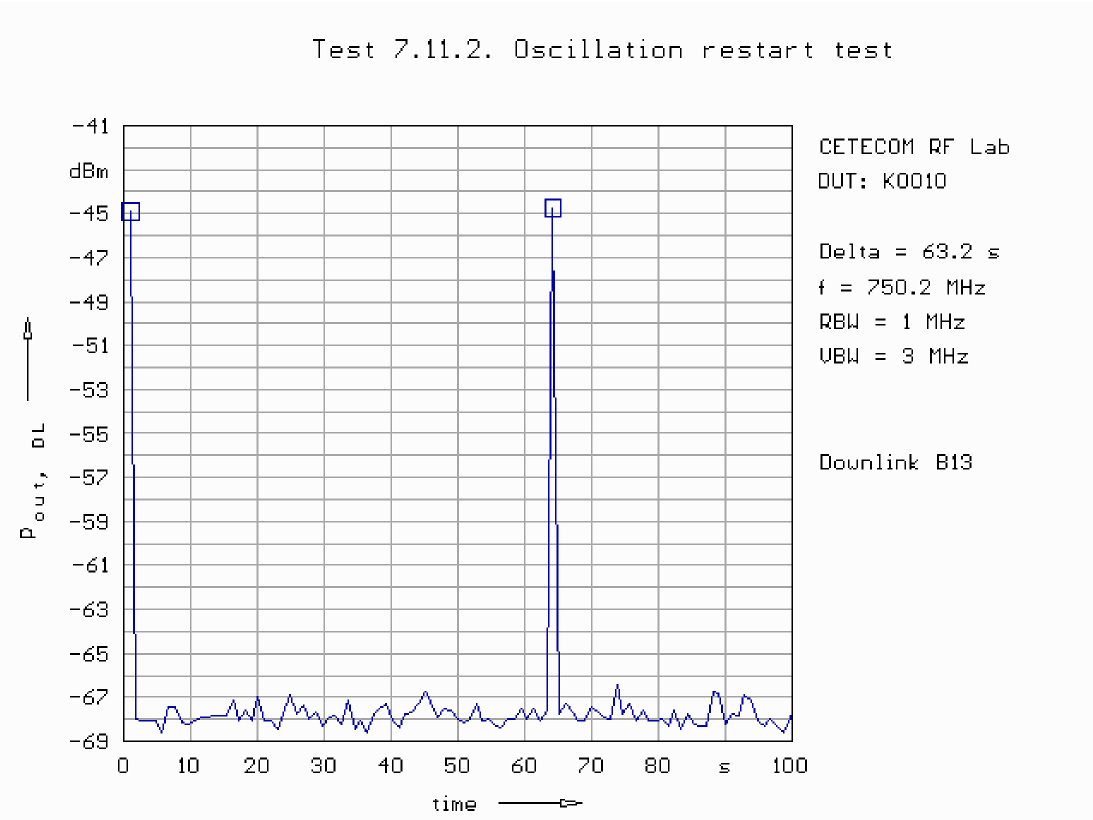


Fig. 280: Band 13 downlink restart time test result.

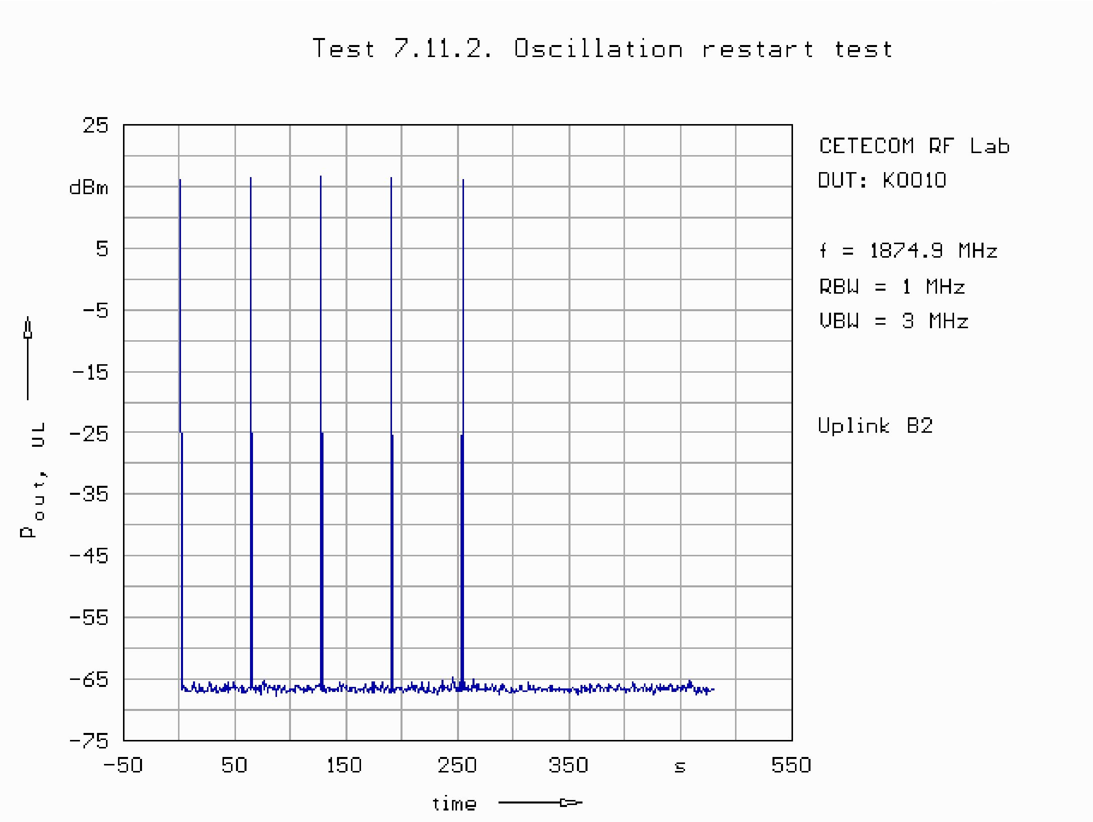


Fig. 281: Band 2 uplink restart attempt test result.

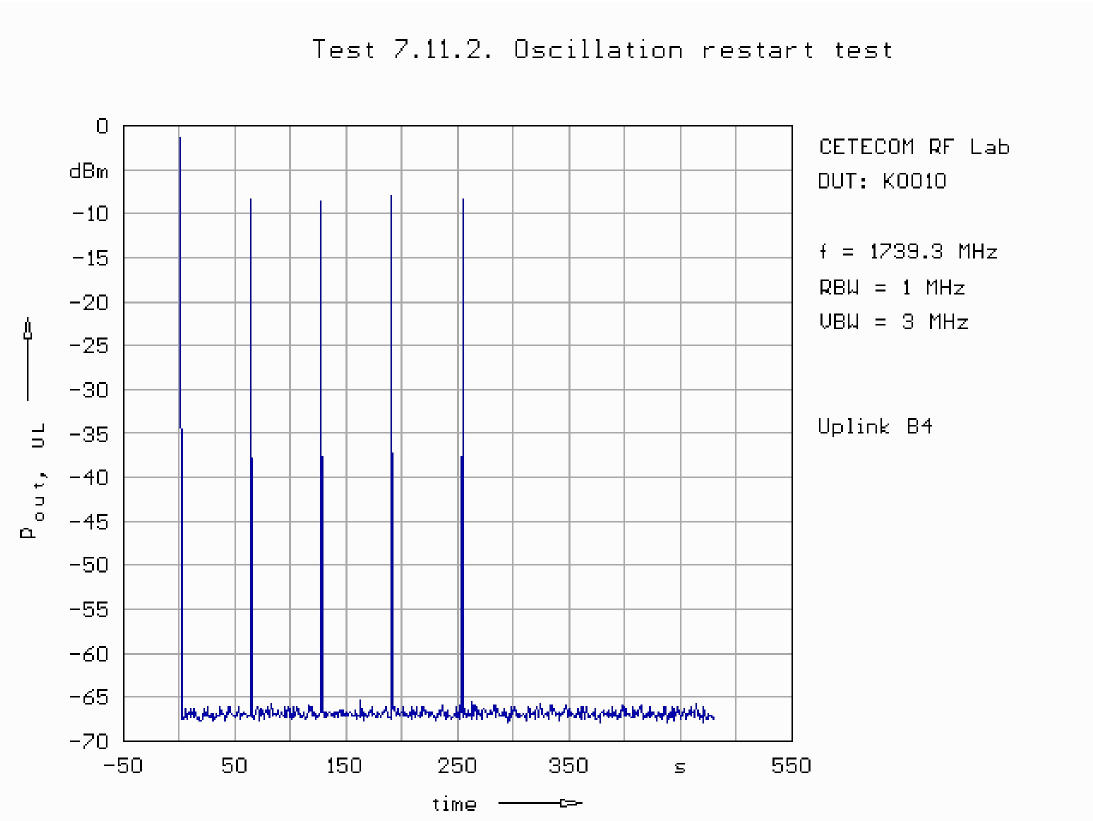


Fig. 282: Band 4 uplink restart attempt test result.

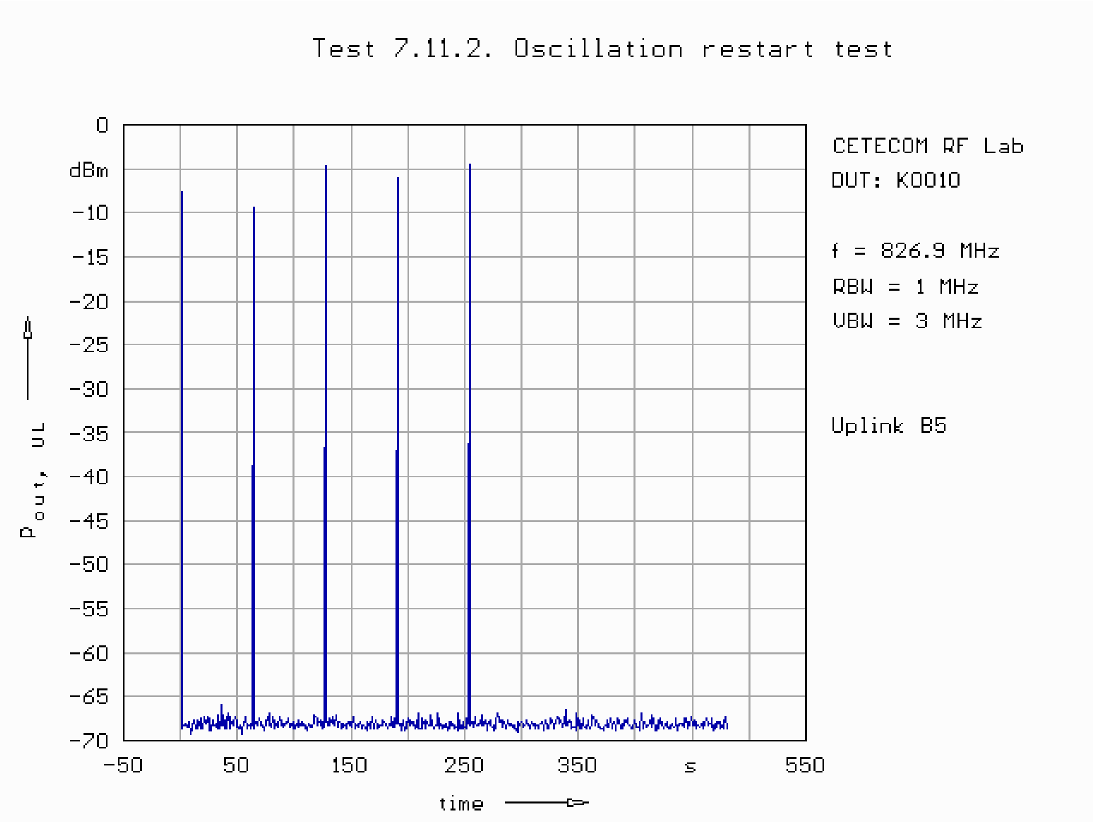


Fig. 283: Band 5 uplink restart attempt test result.

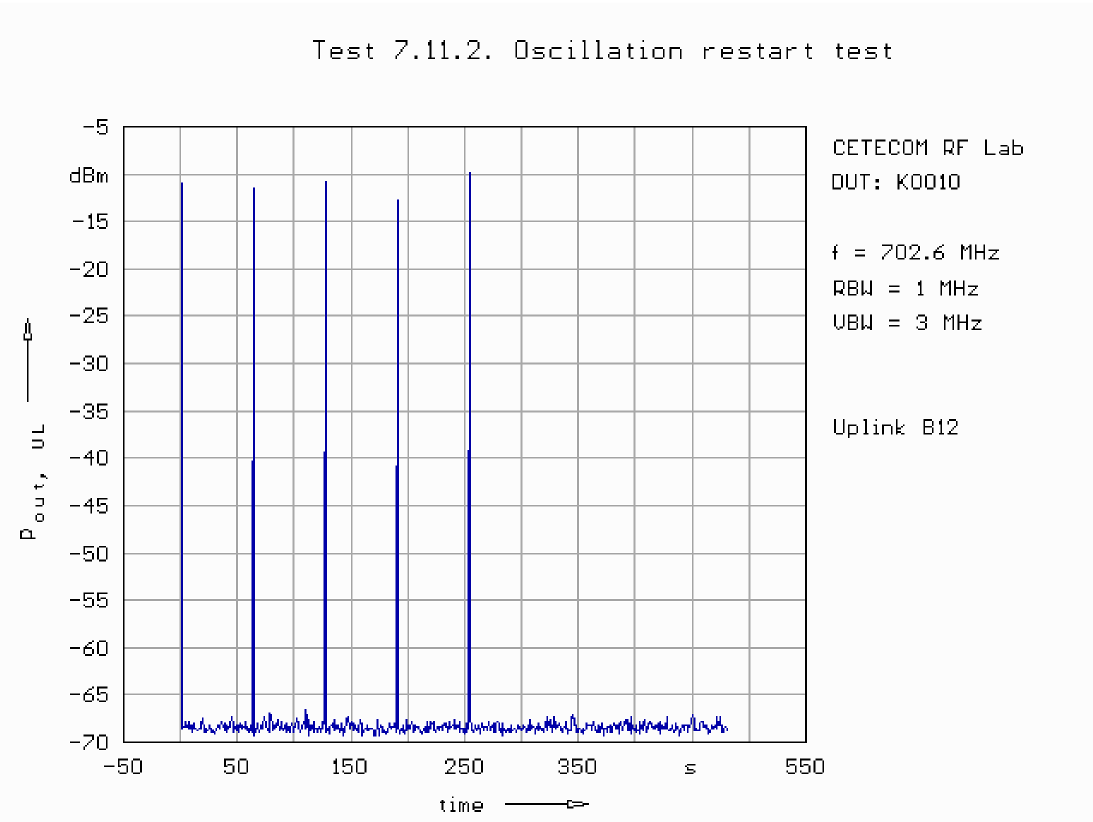


Fig. 284: Band 12 uplink restart attempt test result.

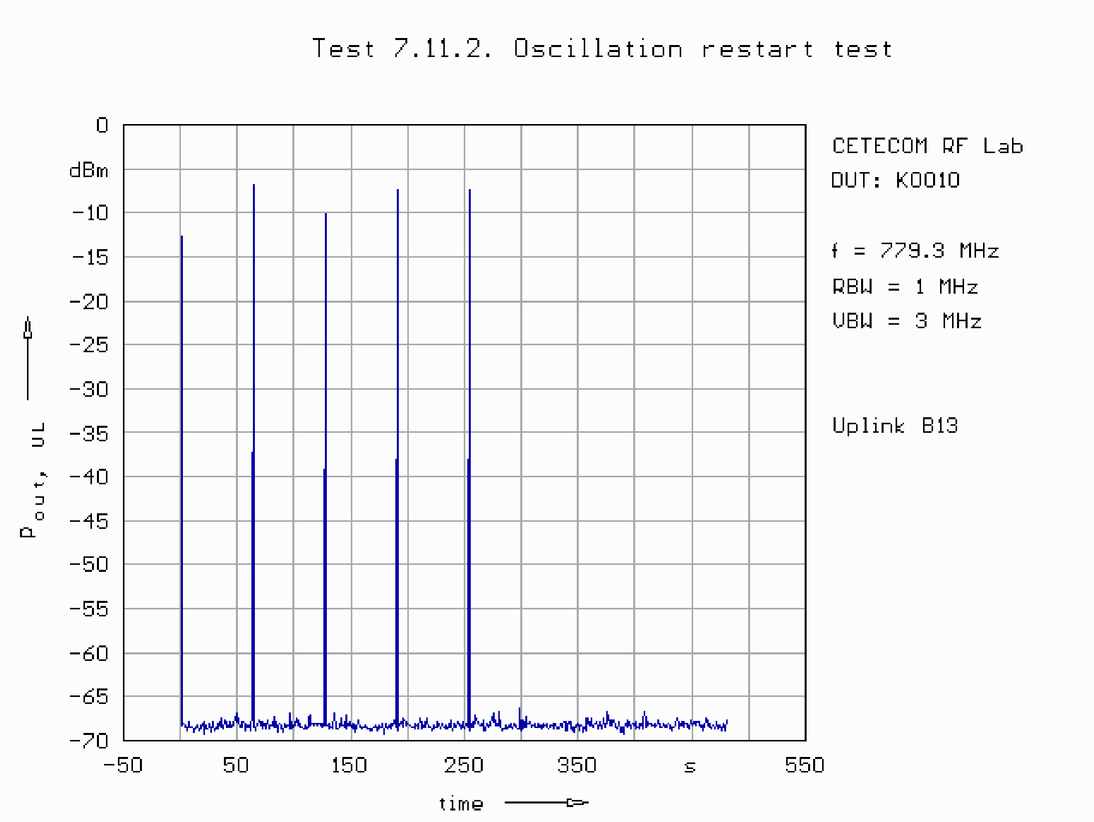


Fig. 285: Band 13 uplink restart attempt test result.

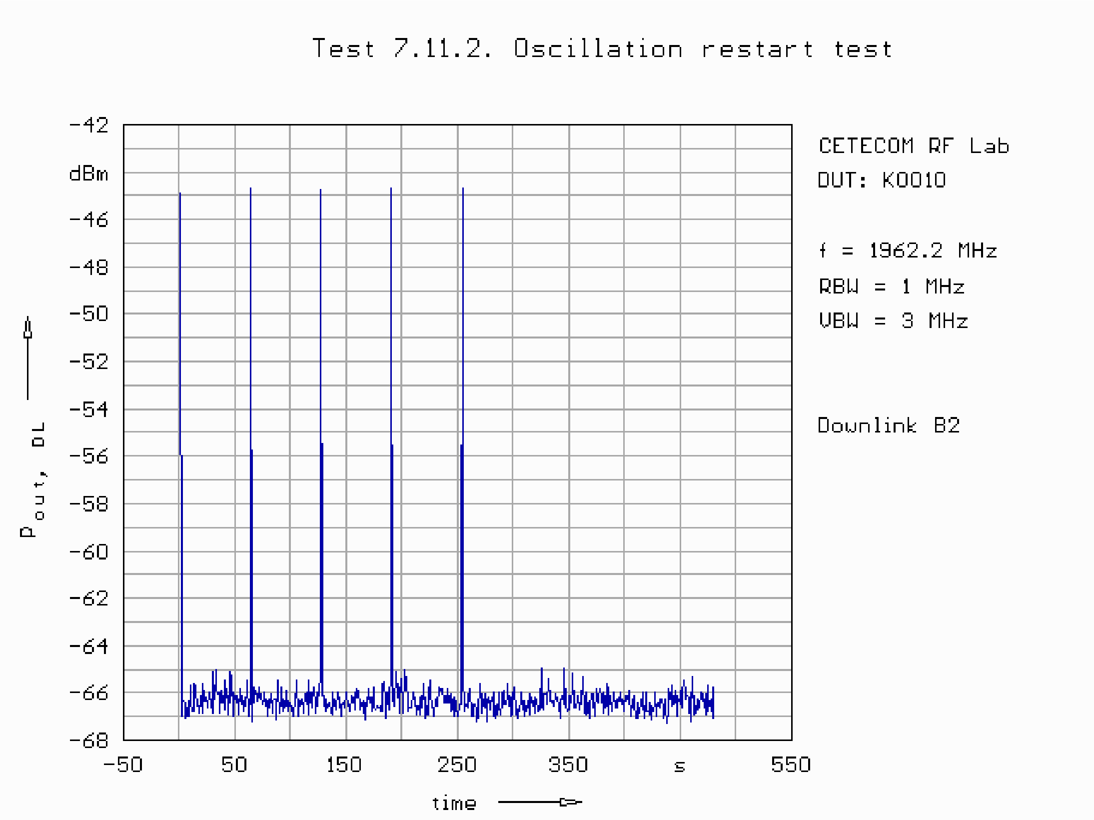


Fig. 286: Band 2 downlink restart attempt test result.

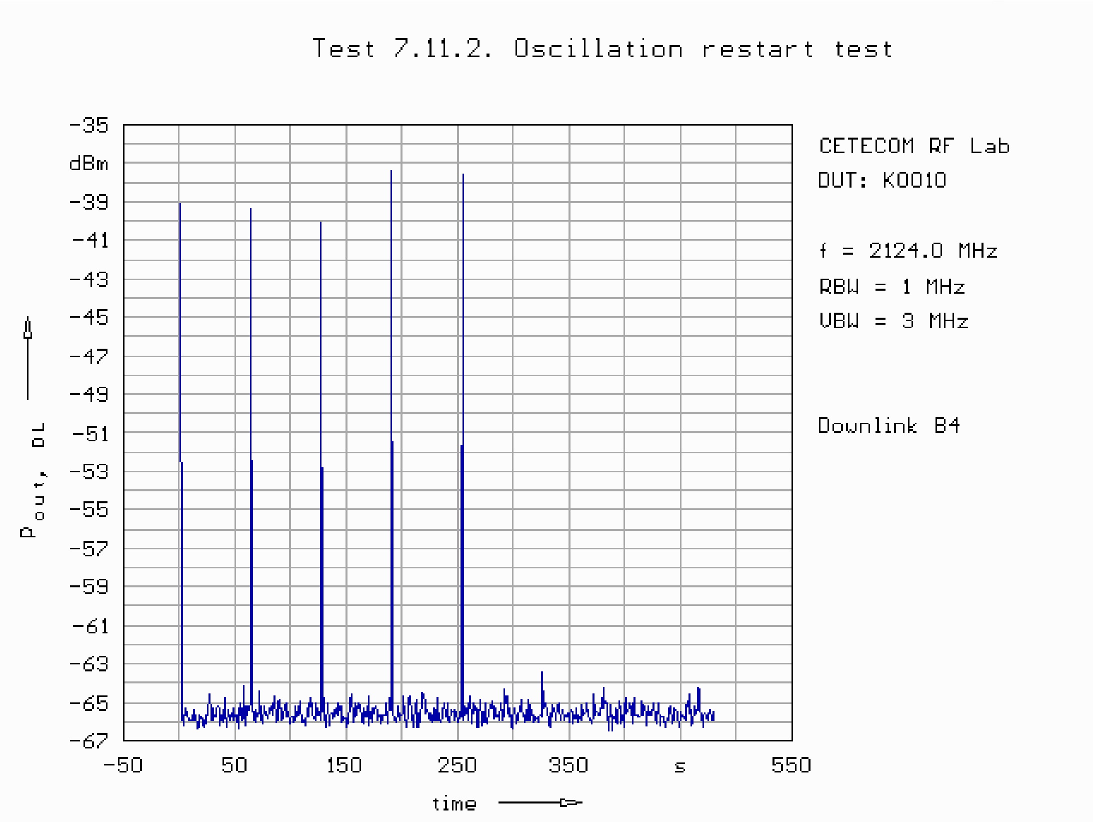


Fig. 287: Band 4 downlink restart attempt test result.

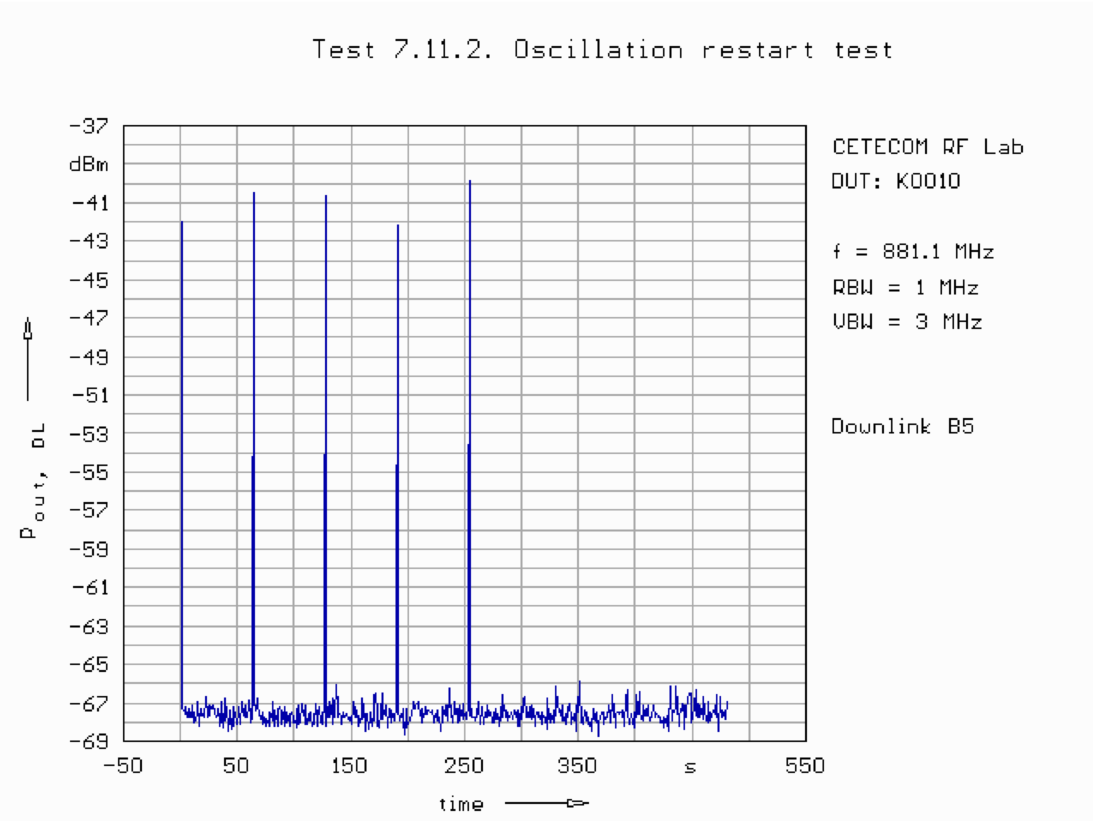


Fig. 288: Band 5 downlink restart attempt test result.

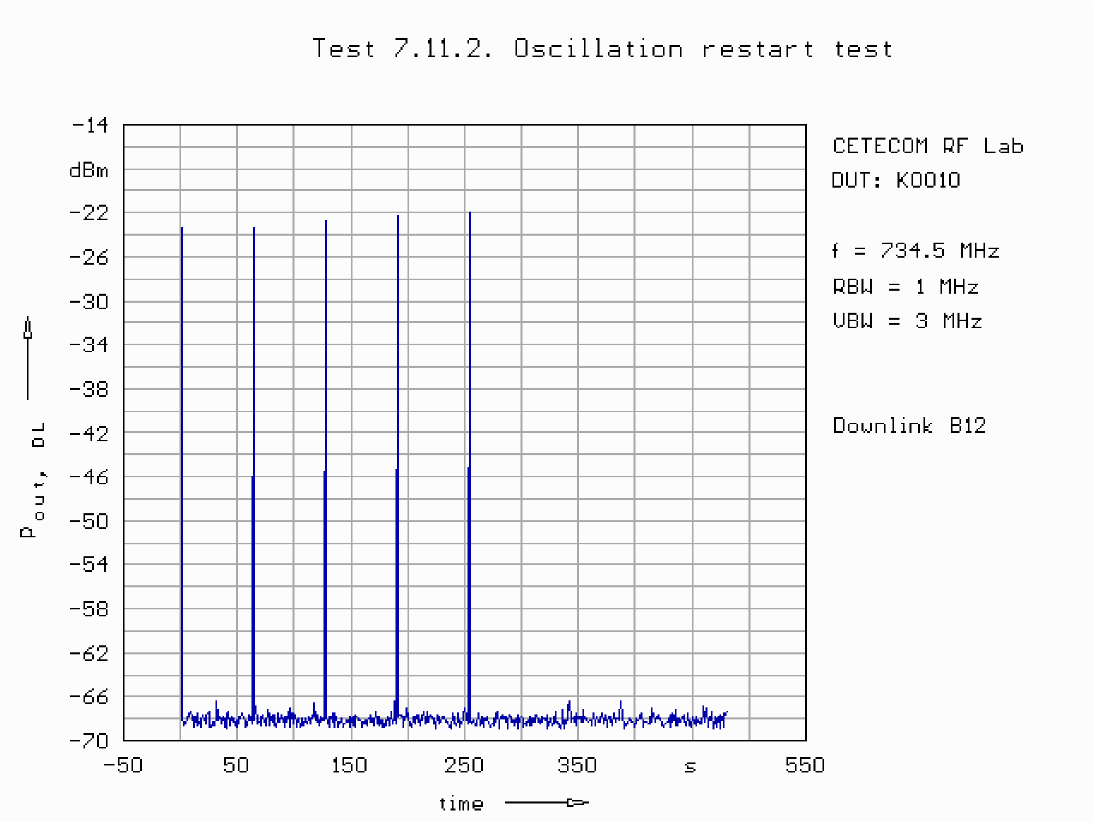


Fig. 289: Band 12 downlink restart attempt test result.

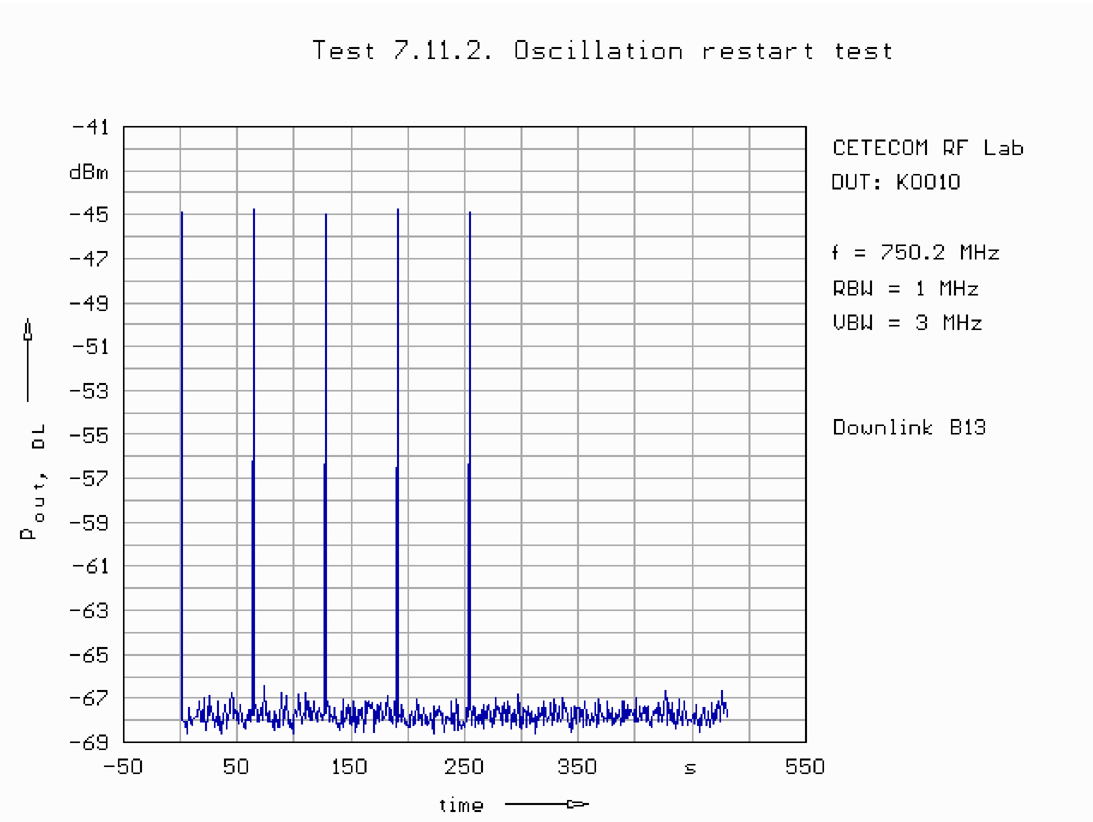


Fig. 290: Band 13 downlink restart attempt test result.

5.11.2 Test Procedure for Measuring Oscillation Mitigation or Shutdown

For measuring the capability of this special type of booster under test to shut down to mitigate the oscillations we have conducted measurements as described in the specification:
- That the booster shut down to mitigate the oscillation
  and
- also the maximum of oscillation as described in KDB 935210 D03 to ensure that the maximum output level of the oscillation does not exceed the minimal output level by 12 dB before the booster shut down.

The test setup as shown in Fig. 259 and Fig. 260 has been used. All test has been done in 1 dB steps as required. Below are summarized the measured results for uplink and downlink oscillation mitigation in terms of maximum oscillation levels found.

Band	direction	Max Oscillation Power and frequency	Min Power within the span and frequency	Δ level	Δ level limit
2	up	-76.2 dBm / 1897.9 MHz	-79.1 dBm / 1912.0 MHz	2.9 dB	12 dB
4	up	-77.1 dBm / 1727.0 MHz	-79.8 dBm / 1722.42 MHz	2.7 dB	12 dB
5	up	-78.9 dB / 846.3 MHz	-80.3 dBm / 843.7 MHz	1.4 dB	12 dB
12	up	-77.6 dBm/713.0 MHz	-80.9 dBm/708.0 MHz	3.3 dB	12 dB
13	up	-78.0 dBm/783.2 MHz	-80.4 dBm/786.4 MHz	2.4 dB	12 dB
2	down	-90.9 dBm/1959.6 MHz	-94.7 dBm/1954.8 MHz	3.8 dB	12 dB
4	down	-89.9 dBm/2121.8 MHz	-94.1 dBm/2118.4 MHz	4.2 dB	12 dB
5	down	-93.3 dB / 880.5 MHz	-97.1 dBm / 883.45 MHz	3.8 dB	12 dB
12	down	-94.5 dBm/734.2 MHz	-98.5 dBm/736.6 MHz	4.0 dB	12 dB
13	down	-94.1 dBm/749.8 MHz	-97.7 dBm/753.2 MHz	3.7 dB	12 dB

Since in band 4 in uplink the overall maximum was found, details of the determination is reported below for this particular band and direction, also serving as an example how those Δ level data have been measured.

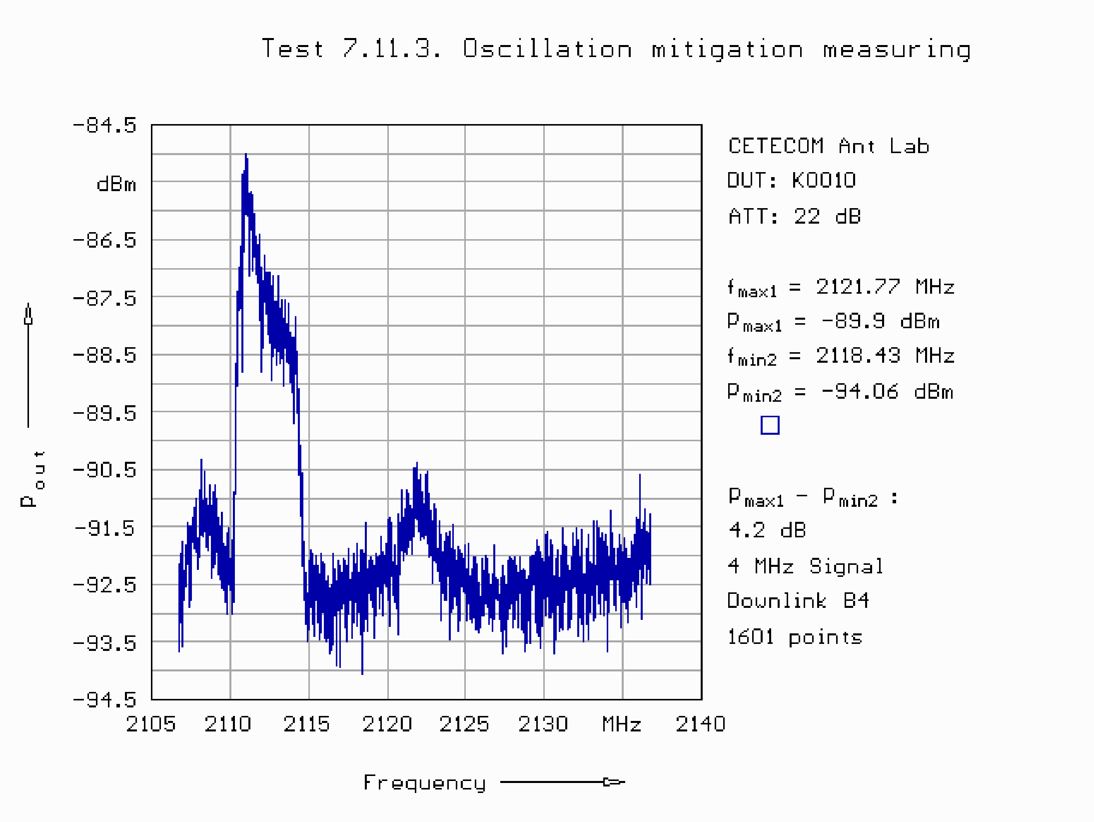


Fig. 291: Example (Band 4, downlink) determination for uplink oscillation recognition level.

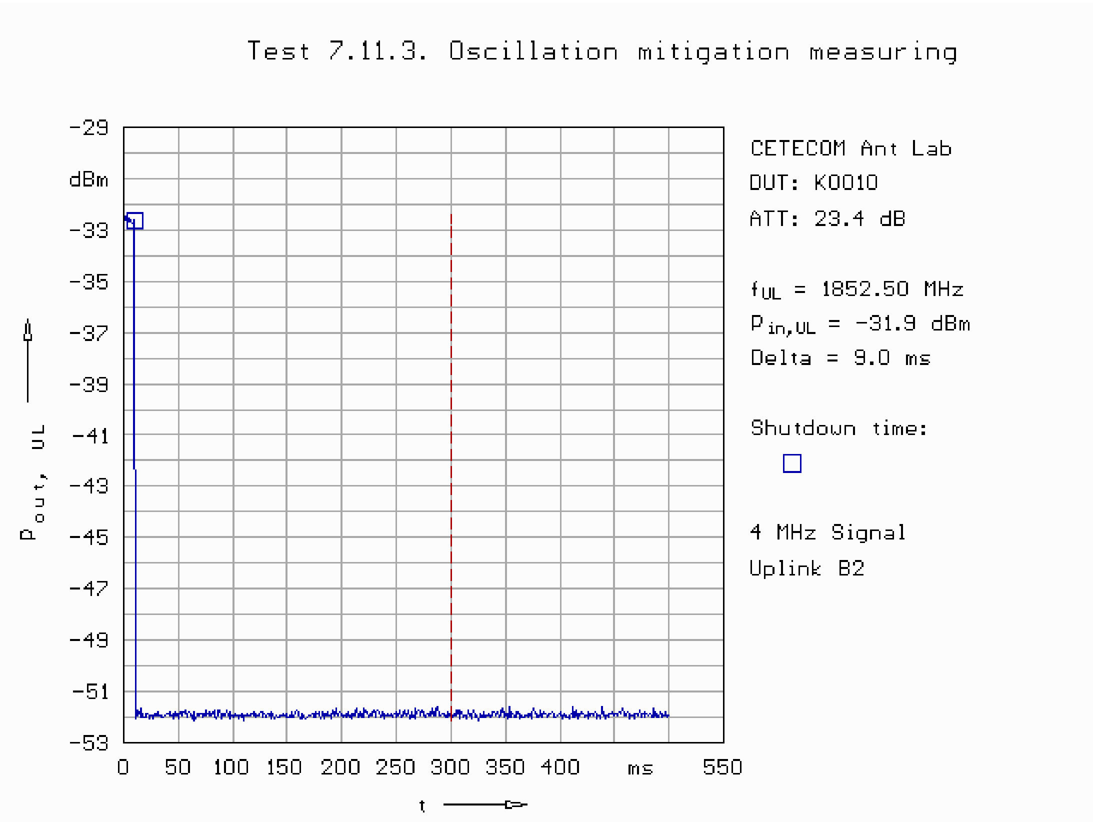


Fig. 292: Band 2 uplink shut down time.

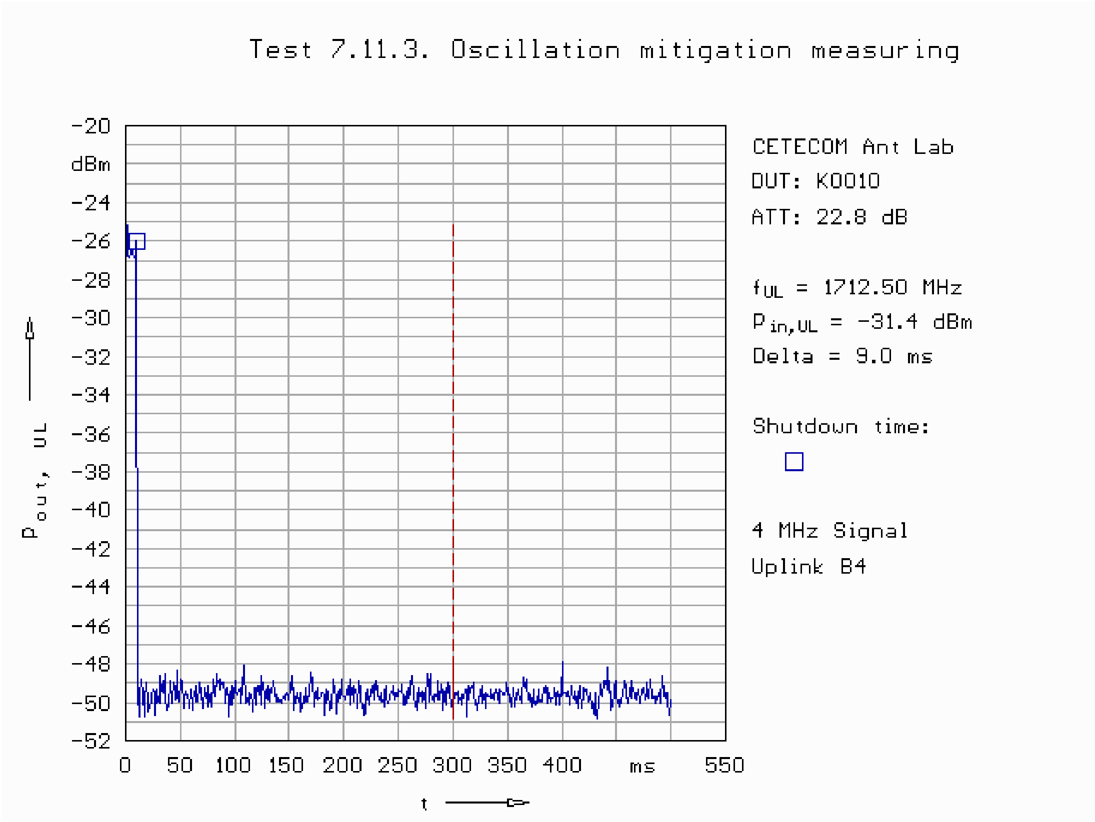


Fig. 293: Band 4 uplink shut down time.

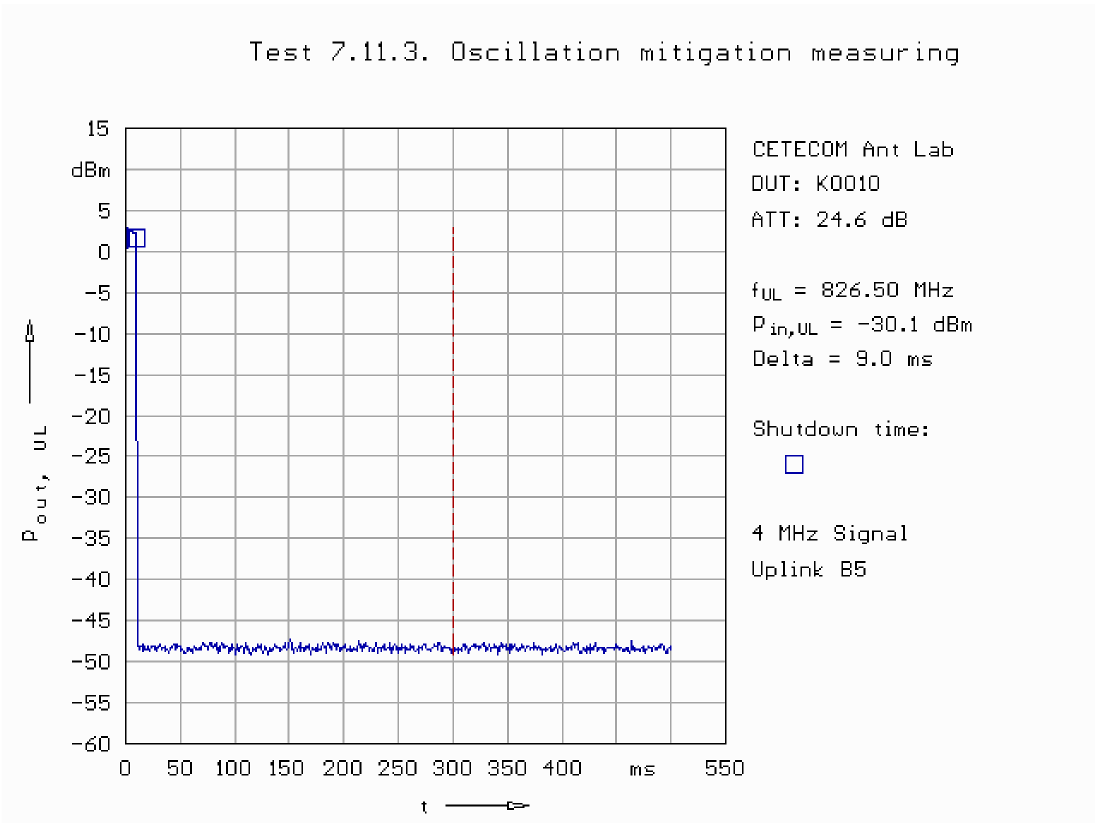


Fig. 294: Band 5 uplink shut down time.

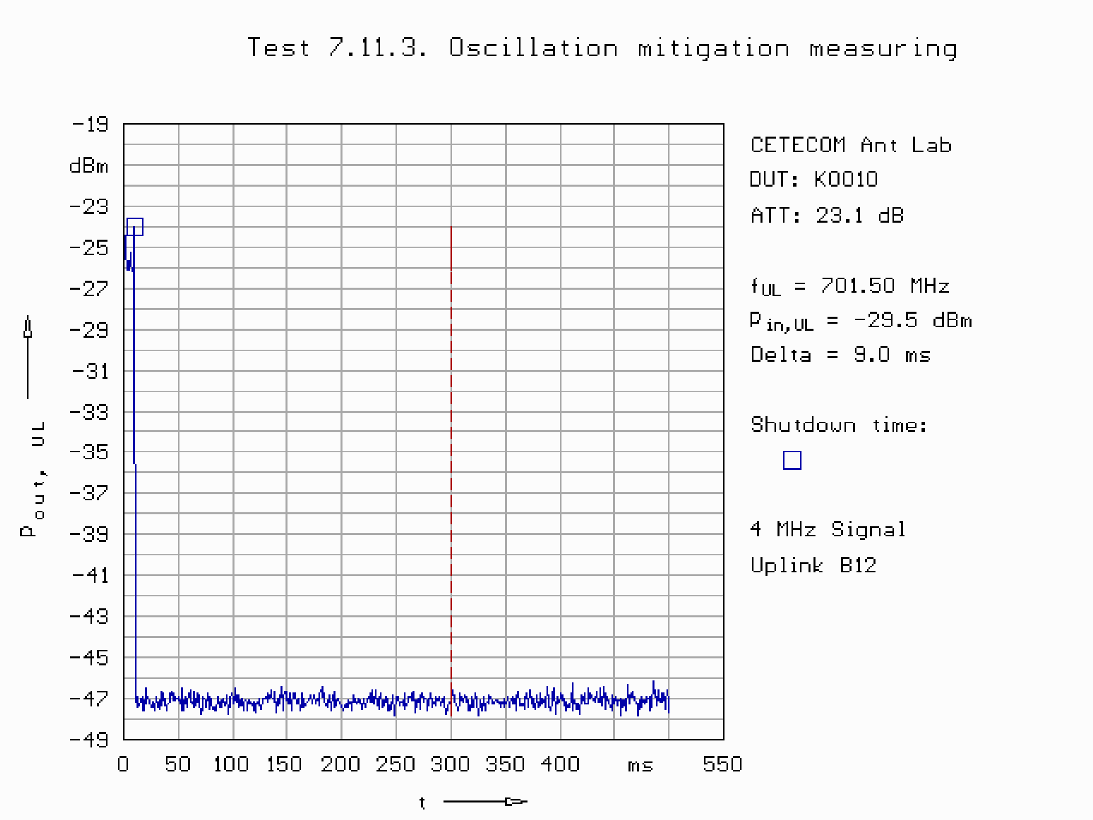


Fig. 295: Band 12 uplink shut down time.

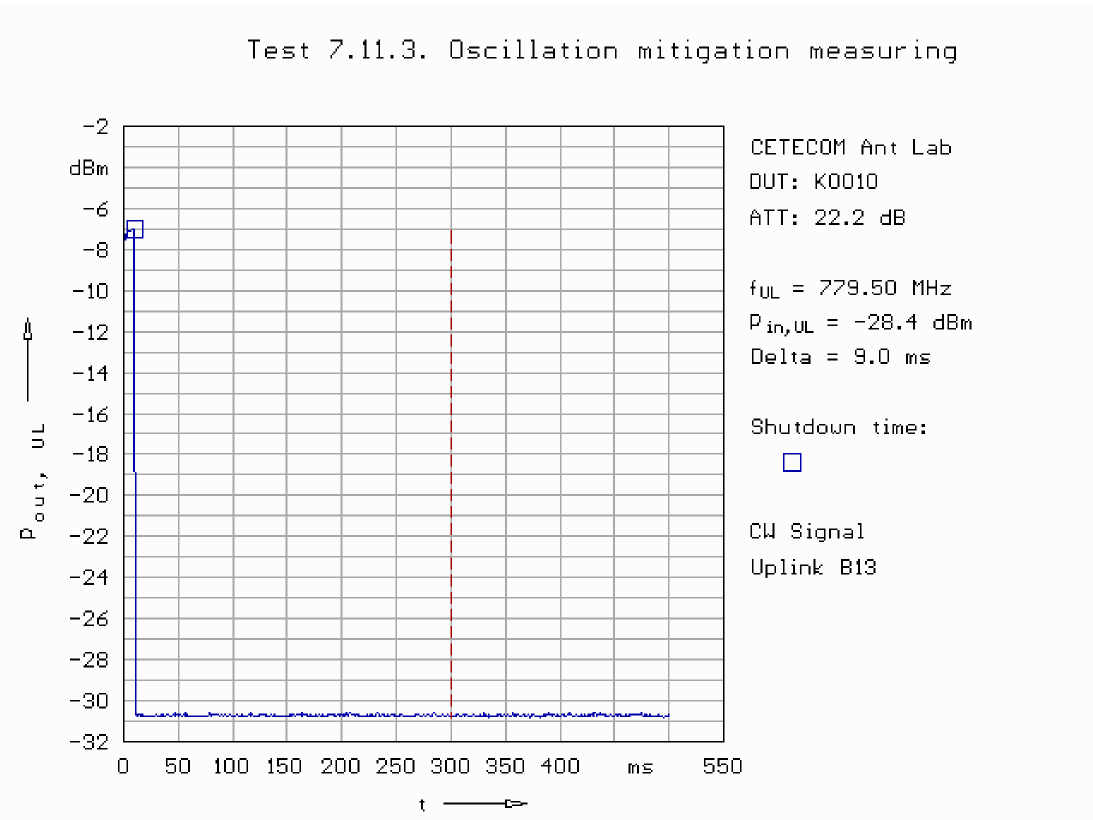


Fig. 296: Band 13 uplink shut down time.

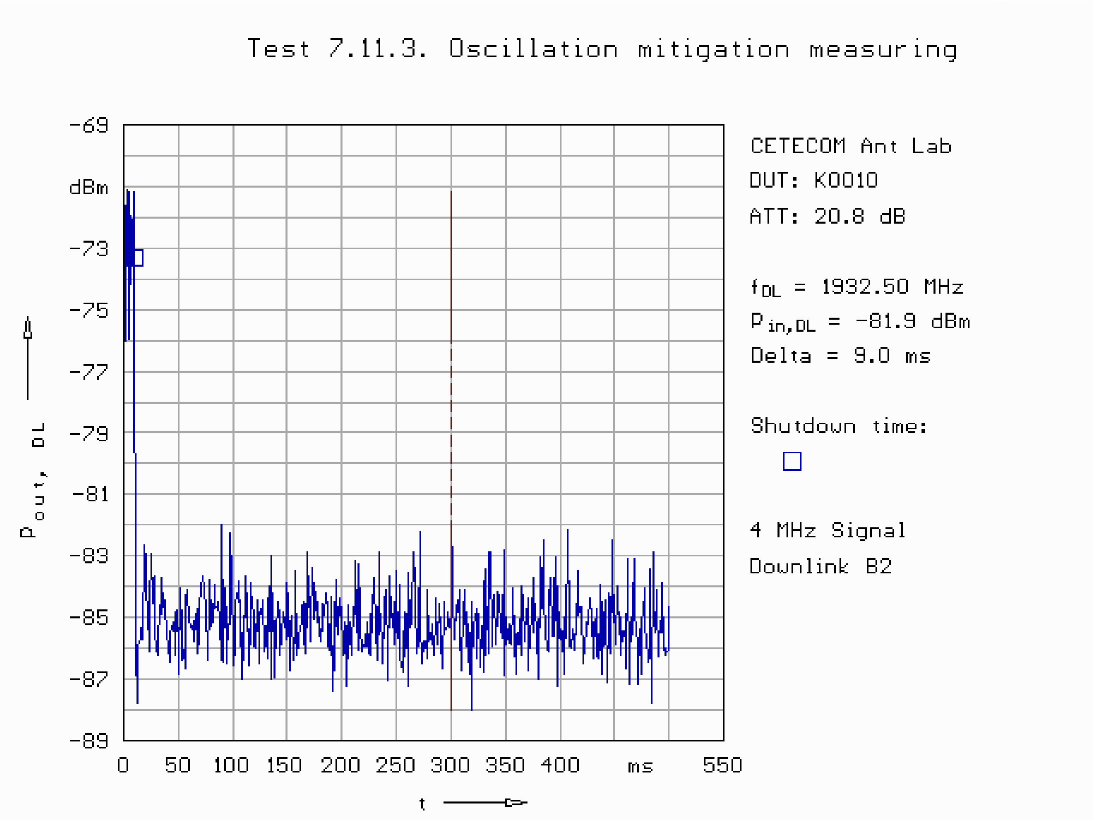


Fig. 297: Band 2 downlink shut down time.

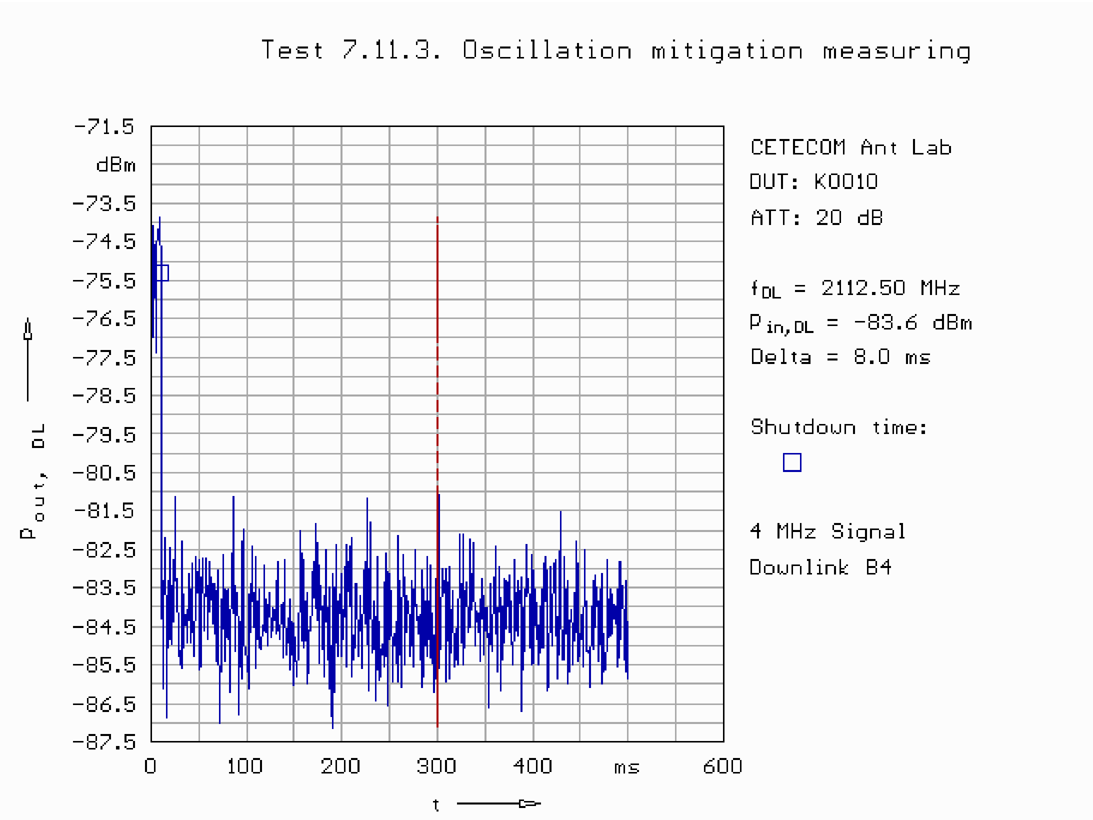


Fig. 298: Band 4 downlink shut down time.

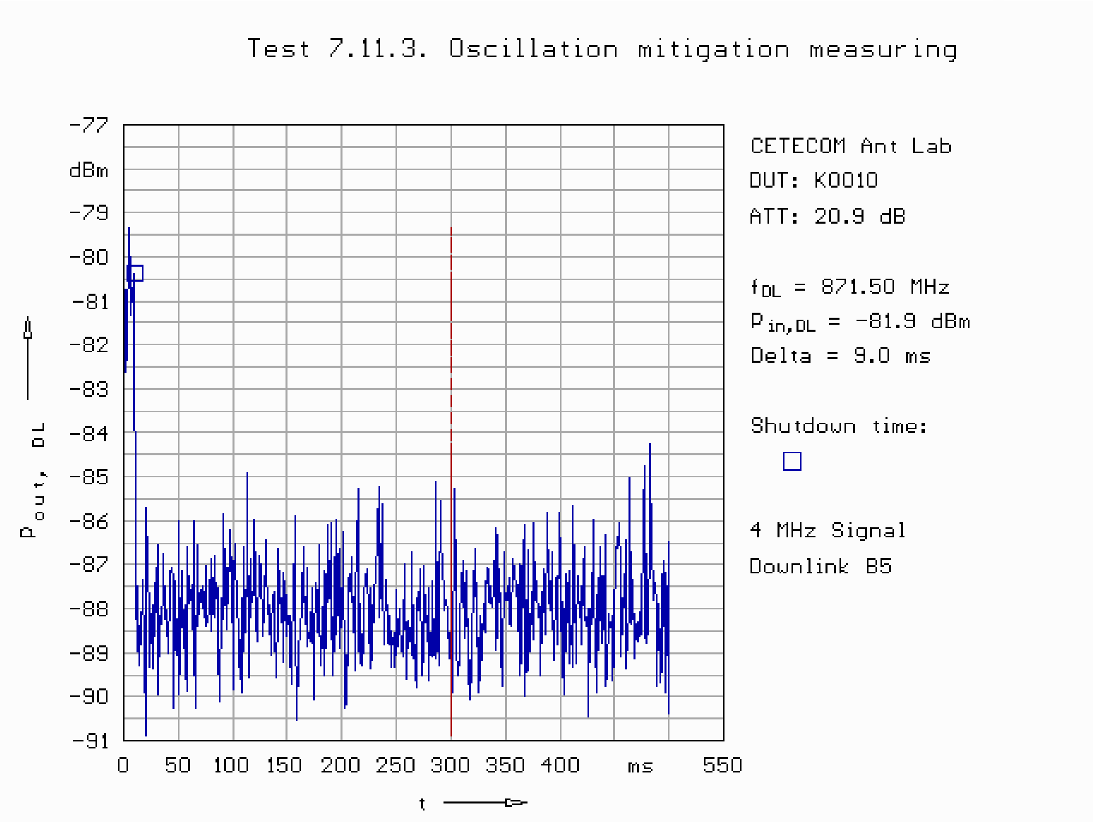


Fig. 299: Band 5 downlink shut down time.

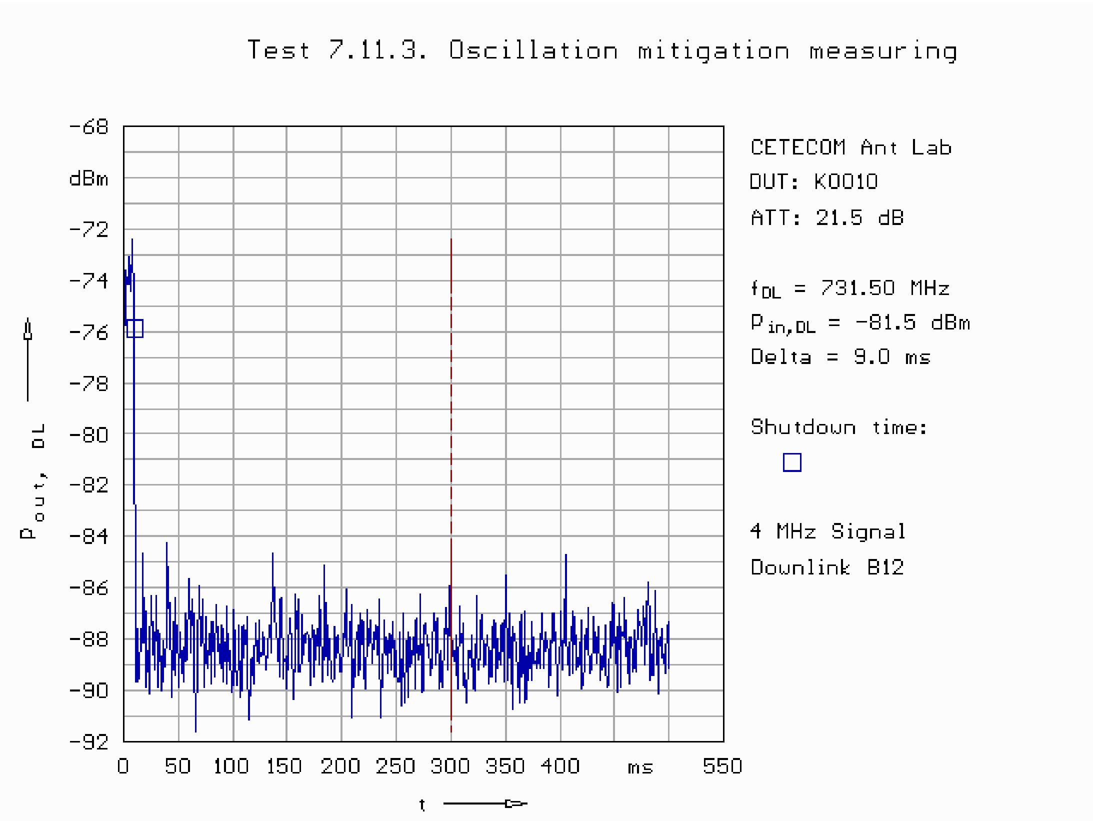


Fig. 300: Band 12 downlink shut down time.

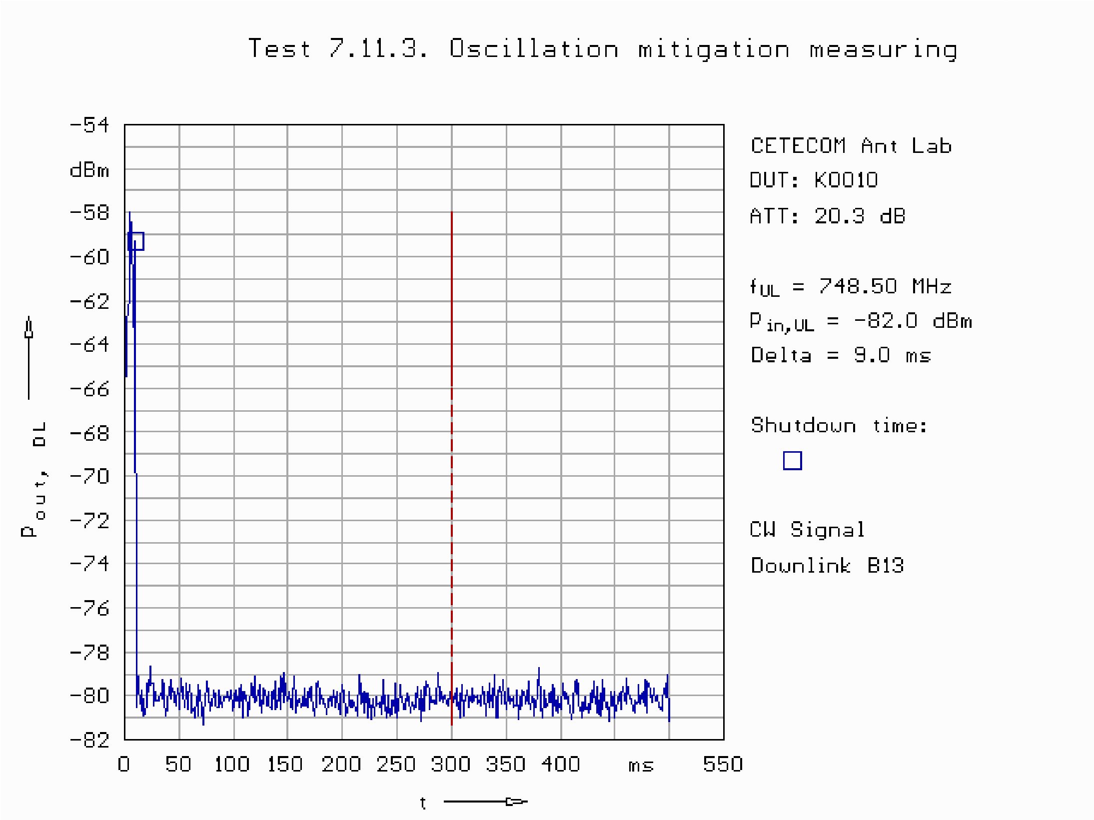


Fig. 301: Band 13 downlink shut down time.

6. Test System

6.1. System Set Up and Test Procedure

The test system used is a semi-automatic system made for testing booster and repeater. As shown in Fig. 302 it consist of a several RF switches, directional couplers, RF sources and a 26.5 GHz spectrum analyzer. All required test scenarios can be created without the need to re-route cable or other RF equipment. All RF paths have been calibrated in respect to the measurement ports (the booster server and donor port) by means of a vector network analyzer. The semi-automatic test procedures capture spectrum analyzer trace results numerically, does take into account the appropriate RF path loss (cable attenuation plus e.g. directional coupler data), and provides a graphical representations of the data at the RF measurements ports.

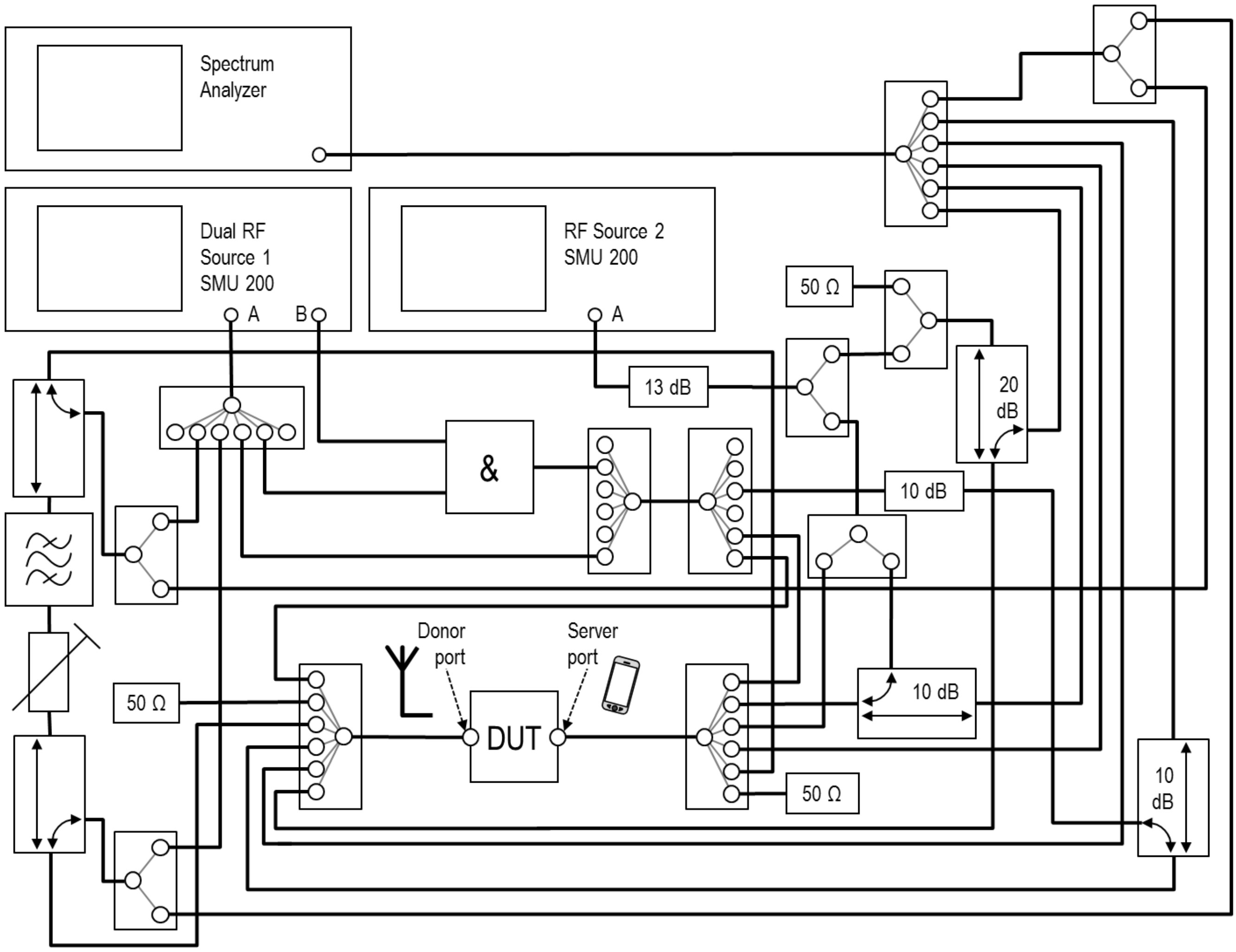


Fig. 302: Complete test system RF routing.

6.2. Measurement Equipment

Equipment	Type	SN	last cal	next cal
RF source	R&S SMU 200A	100754	Not required	Not required
RF source	R&S SMU 200A	100846	02.10.2017	01.10.2020
Spectrum analyzer	R&S FSU	100414/026	14.05.2018	13.05.2019
Network Analyzer	Agilent N5230A	US43500426	19.12.2016	18.12.2018
Temperature and Humidity measurement	Opus 10	DL010	21.08.2018	20.08.2019

6.3. Measurement Uncertainty

A number of measurements carried out with this test system are based on pure relative measurements: All tests considering a gain are tests, where the uncertainty depends on the repeatability of the RF connections and spectrum analyzer reading repeatability only. To assess this uncertainty contribution some gain measurements have been done by replacing the DUT in by a SMA RF through. The results shown in hence do effectively include the uncertainty of the cable attenuation measurements.

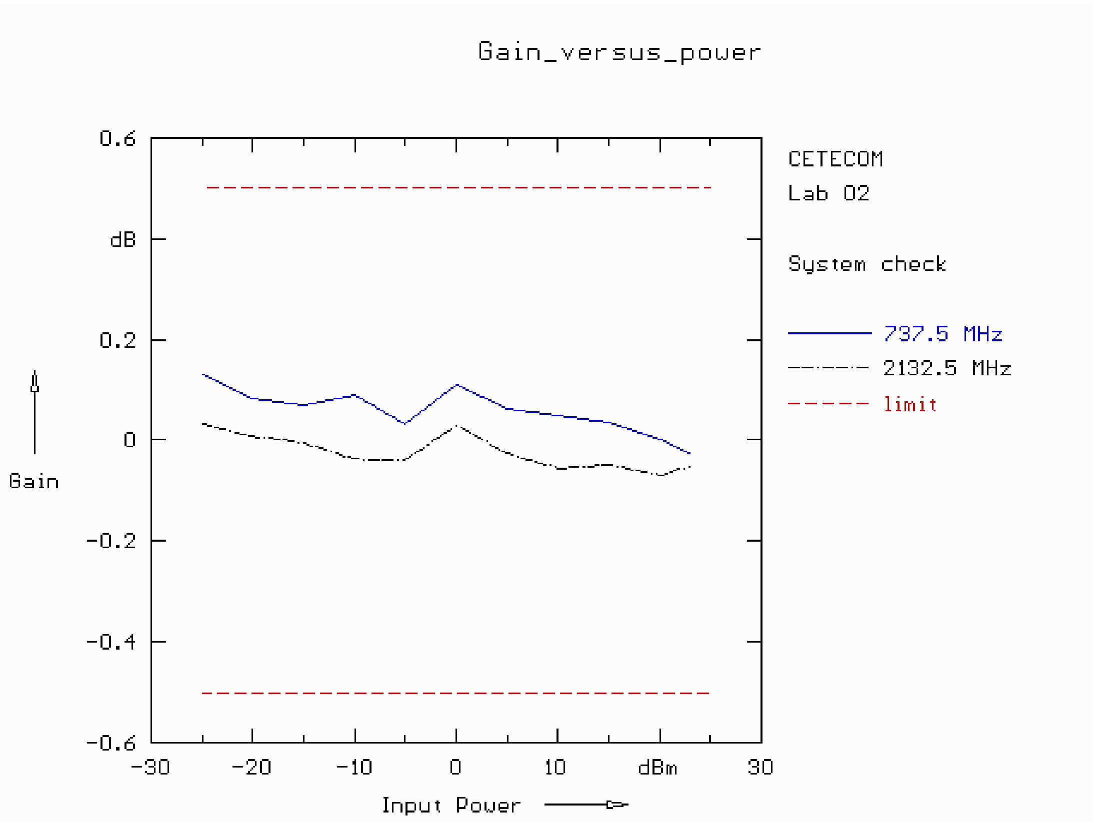


Fig. 303: Gain measurement of a RF through for two frequencies for different power levels.

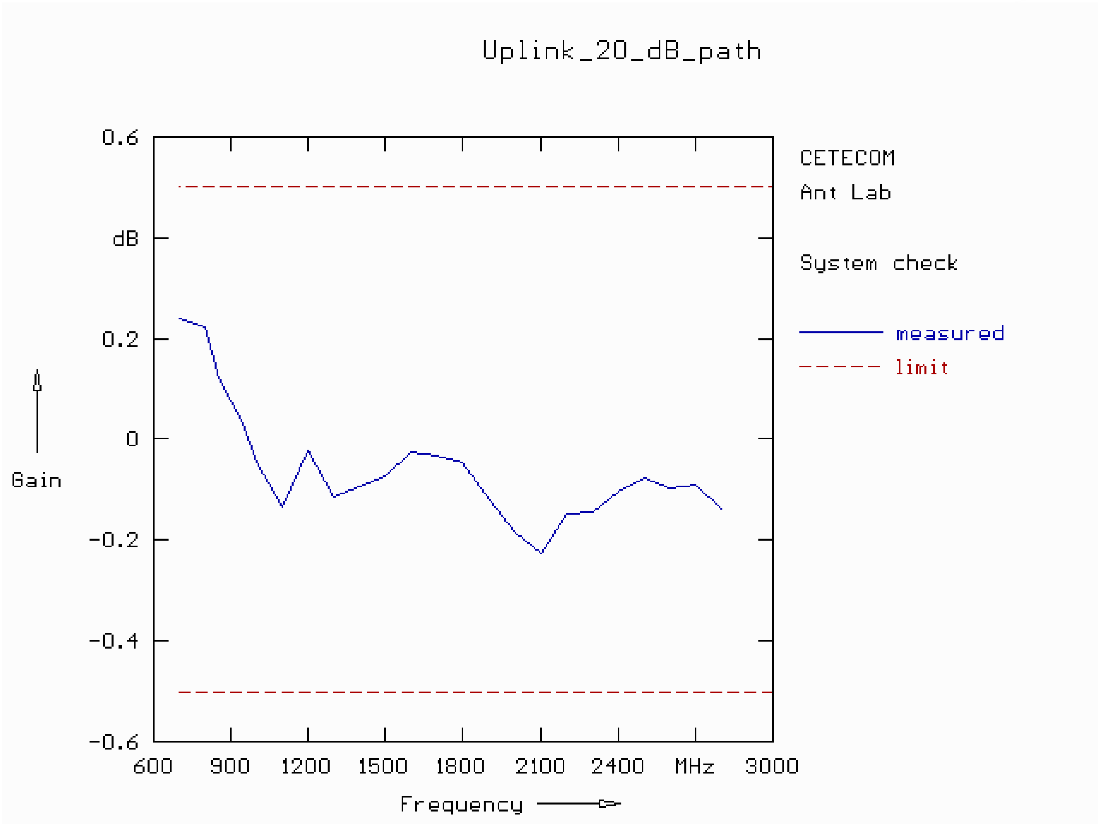


Fig. 304: Gain measurement of a RF through for the “20 dB path” over frequency.

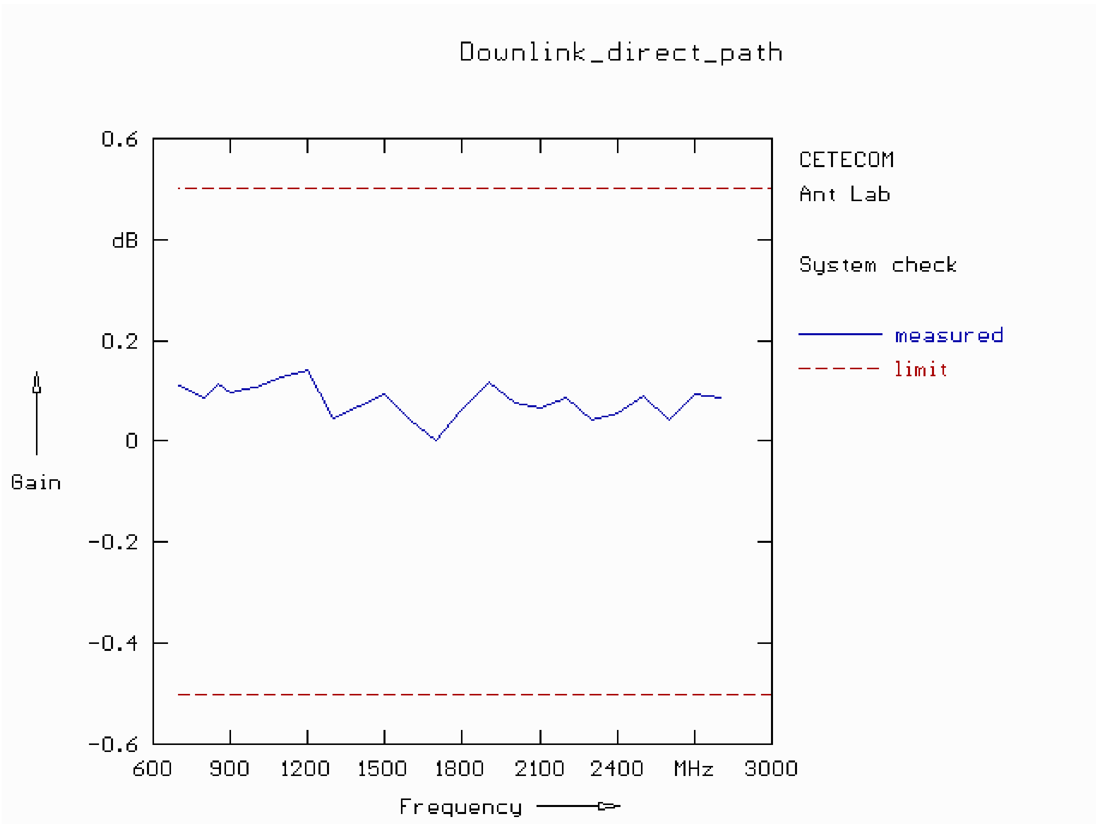


Fig. 305: Gain measurement of a RF through for the “direct path” over frequency

In conclusion we estimated the gain uncertainty of:

Δ gain < ±0.23 dB.

For absolute measurements the spectrum analyzer properties determine the uncertainty for frequency and RF power levels. According to the data sheet of the Rohde & Schwarz FSU the following data are applicable:

For Frequency it is:

Δ f / f < 0.05 pp m + 0.1 ppm / year.

For a power uncertainty estimation of the following contributions (in terms of standard deviations σ) are taken into account:

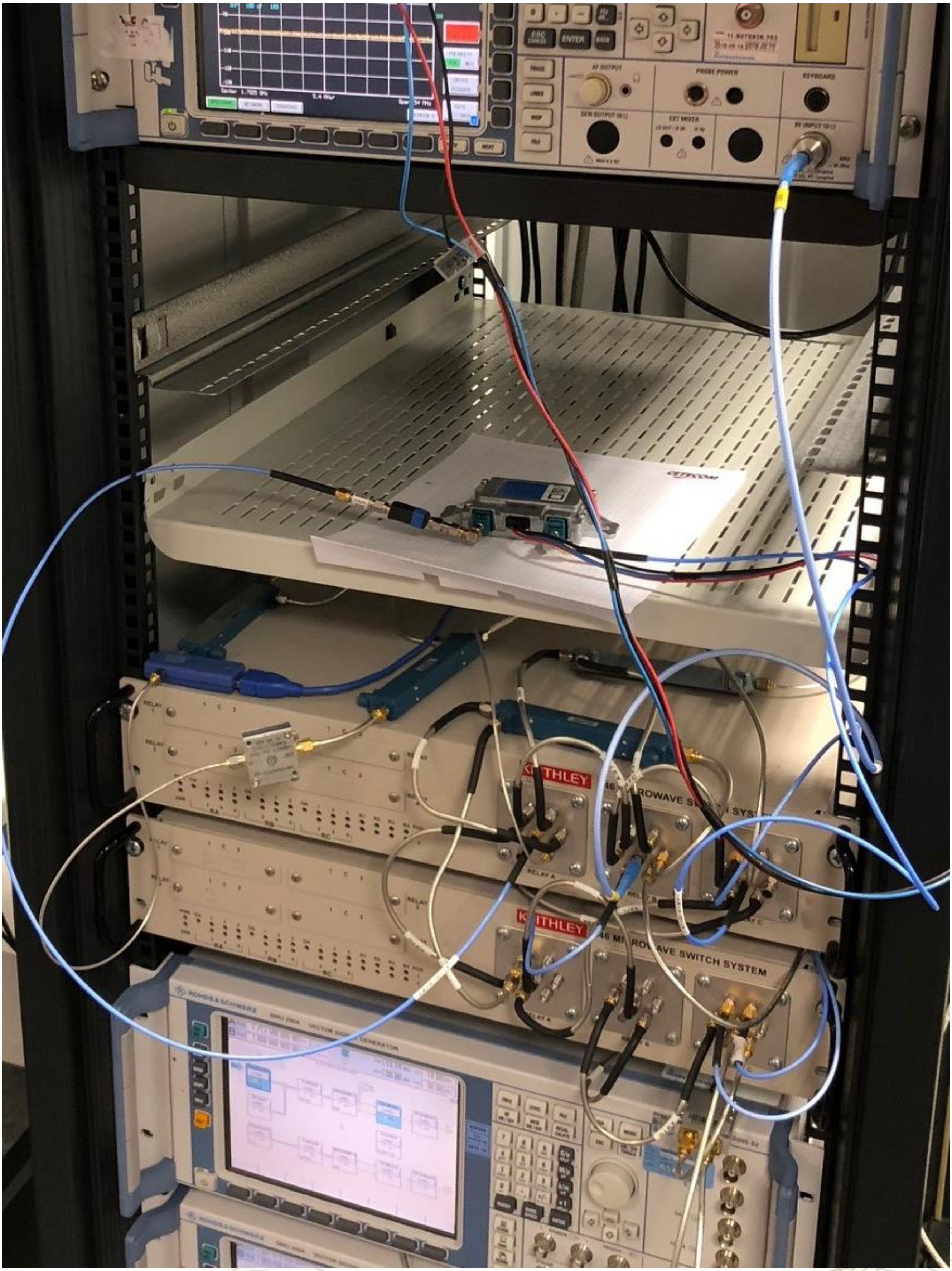
nonlinearity at levels > -70 dBm:	0.03 dB	
attenuator switching:	0.07 dB	
relative to reference level:	0.05 dB	
reference level:	0.07 dB	
frequency dependent contribution:	0.10 dB / 0.70 dB	for < 3.6 GHz / 22 GHz.
Additionally the relative (RF switching. cable loss uncertainty):	0.23 dB	

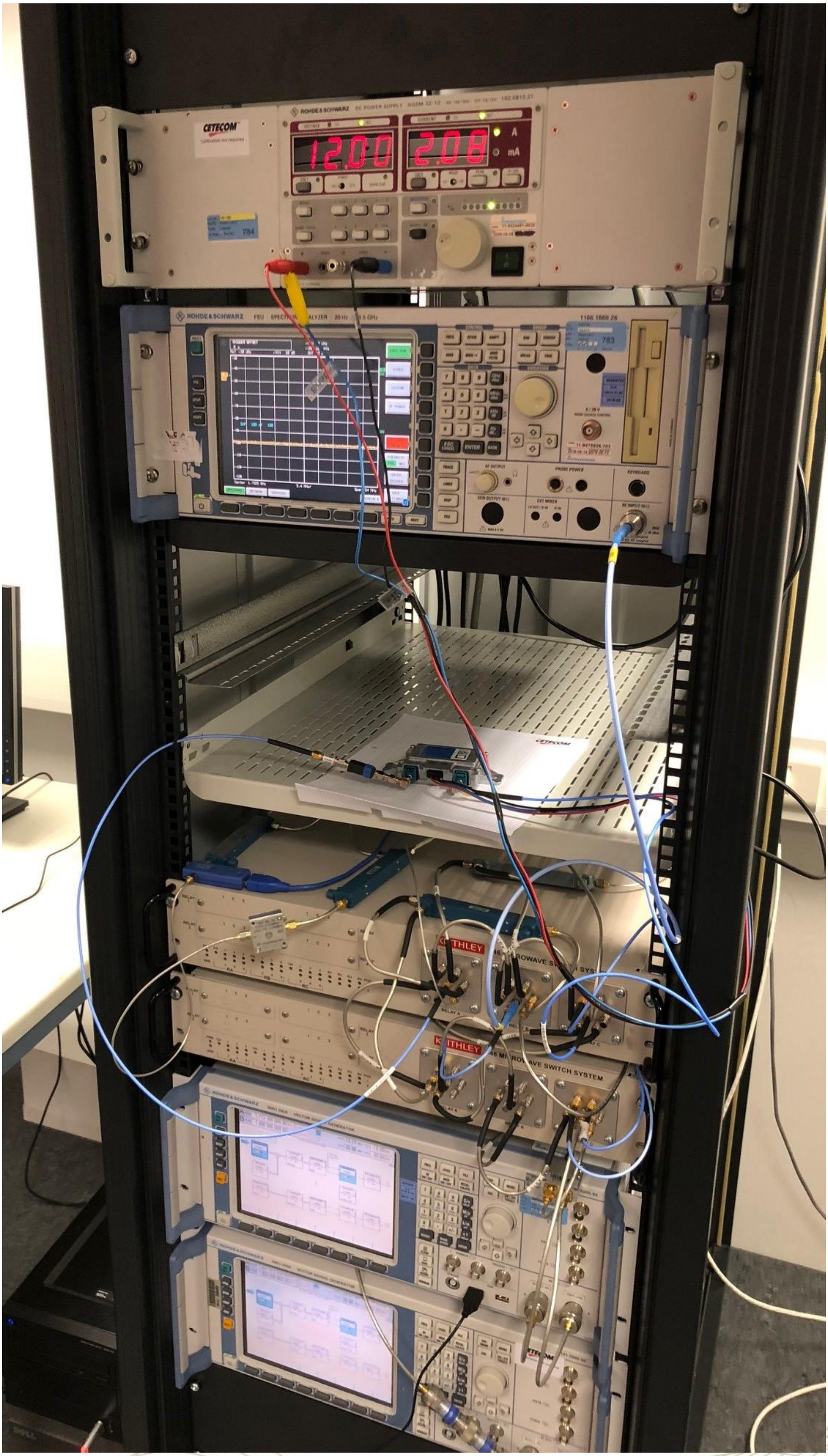
eventually add up to an overall RF power uncertainty of:

Δ power < ± 0.55 dB for frequencies below 3.6 GHz. and

Δ power < ± 1.2 dB for frequencies between 3.6 GHz up to 22 GHz.

Annex A: Photographs of Test set up(s)





Annex B: External Photographs of the EUT

Report History

Version	Remarks
18-1-0026601T05a	Report for conducted tests, first signed version (based on draft document V15)

—— End of test Report ——