

Maximum Noise:

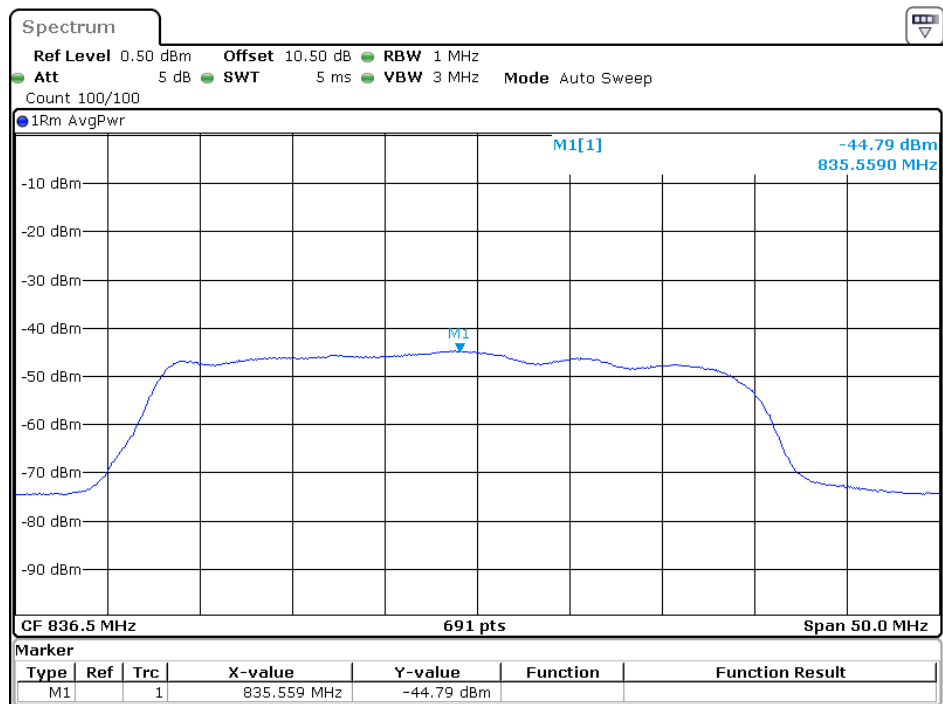
Mode	Operation Bands	Measured Value	Limit	Result
		dBm/MHz	dBm/MHz	
Uplink	Lower 700MHz	-46.35	-45.47	Pass
	Upper 700MHz	-47.91	-44.64	Pass
	Cellular	-44.79	-44.05	Pass
	PCS	-42.22	-37.02	Pass
	AWS	-41.38	-37.73	Pass
Downlink	Lower 700MHz	-45.94	-45.47	Pass
	Upper 700MHz	-44.90	-44.64	Pass
	Cellular	-44.28	-44.05	Pass
	PCS	-41.86	-37.02	Pass
	AWS	-41.57	-37.73	Pass

Note: Fixed booster maximum noise power shall not exceed $-102.5 \text{ dBm/MHz} + 20 \text{ Log}_{10}(\text{Frequency})$, where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

Variable uplink Noise limits test result:

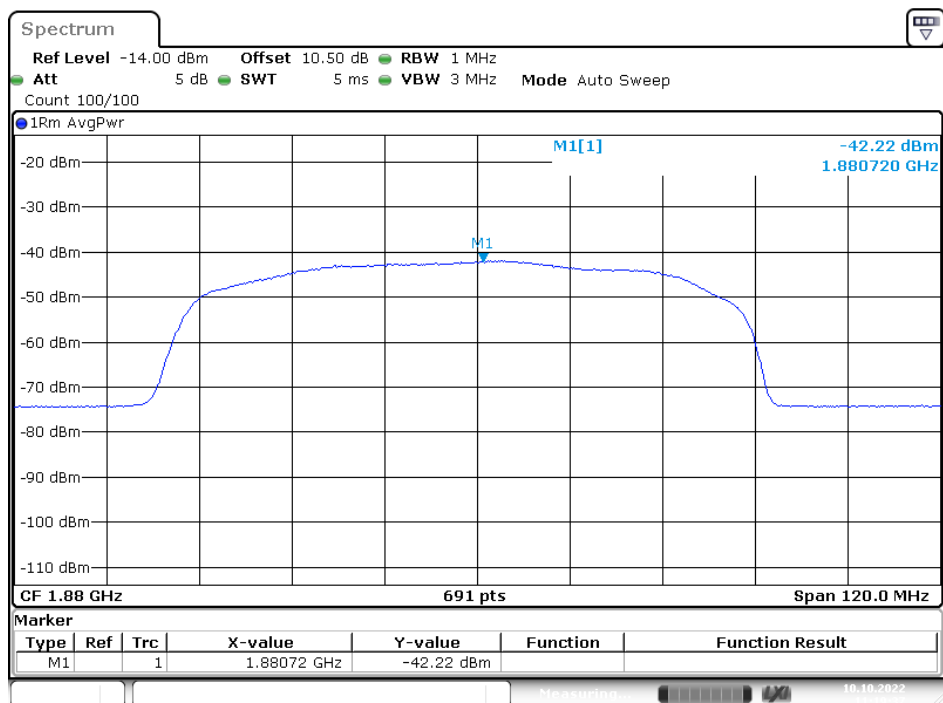
Operation Bands	RSSI	Measured Value	Limit	Results
	dBm	dBm/MHz	dBm/MHz	
Lower 700MHz	-60	-47.21	-45.47	Compliance
	-59	-48.32	-45.47	Compliance
	-58	-49.14	-45.47	Compliance
	-57	-50.28	-46.00	Compliance
	-56	-51.41	-47.00	Compliance
	-55	-52.35	-48.00	Compliance
Upper 700MHz	-60	-46.85	-44.64	Compliance
	-59	-47.94	-44.64	Compliance
	-58	-48.67	-45.00	Compliance
	-57	-49.72	-46.00	Compliance
	-56	-50.45	-47.00	Compliance
	-55	-51.36	-48.00	Compliance
Cellular	-62	-45.65	-44.05	Compliance
	-61	-46.47	-44.05	Compliance
	-60	-47.66	-44.05	Compliance
	-59	-48.48	-44.05	Compliance
	-58	-49.38	-45.00	Compliance
	-57	-50.41	-46.00	Compliance
PCS	-64	-42.98	-39.00	Compliance
	-63	-43.75	-40.00	Compliance
	-62	-44.86	-41.00	Compliance
	-61	-45.63	-42.00	Compliance
	-60	-46.74	-43.00	Compliance
	-59	-47.69	-44.00	Compliance
AWS	-63	-42.48	-40.00	Compliance
	-62	-43.62	-41.00	Compliance
	-61	-44.51	-42.00	Compliance
	-60	-45.69	-43.00	Compliance
	-59	-46.74	-44.00	Compliance
	-58	-47.54	-45.00	Compliance

Uplink Cellular Band



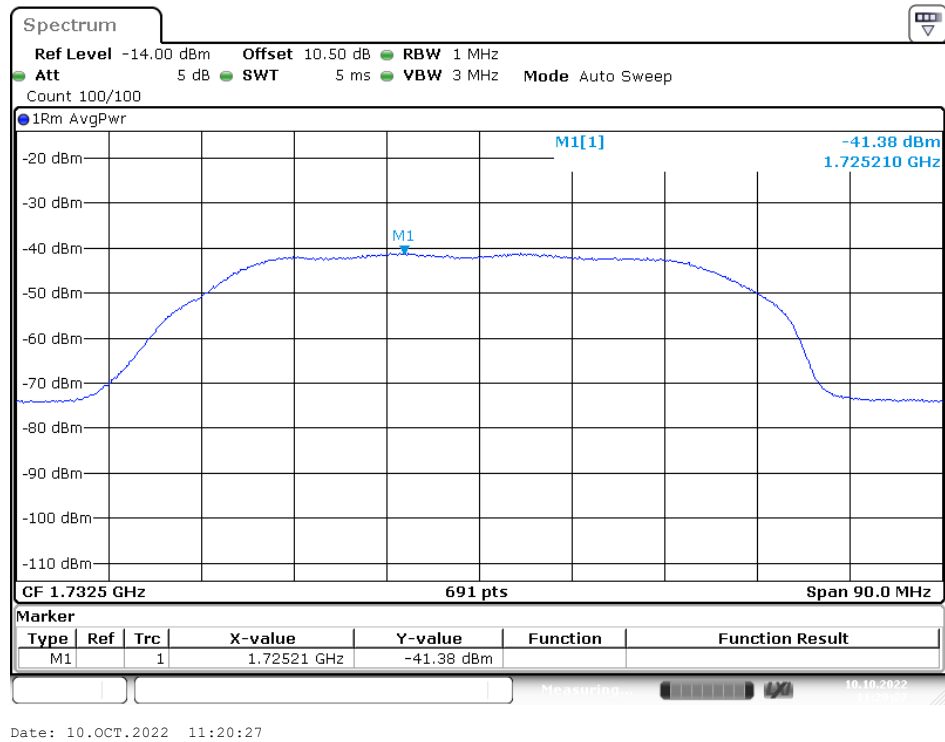
Date: 20.DEC.2022 16:40:30

Uplink PCS Band

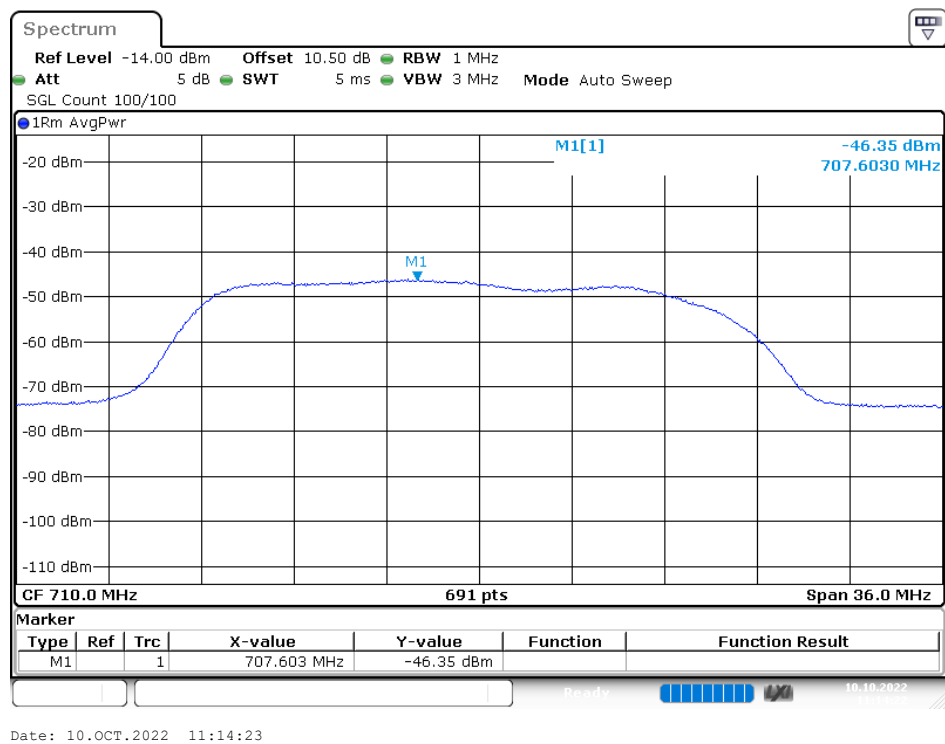


Date: 10.OCT.2022 11:19:37

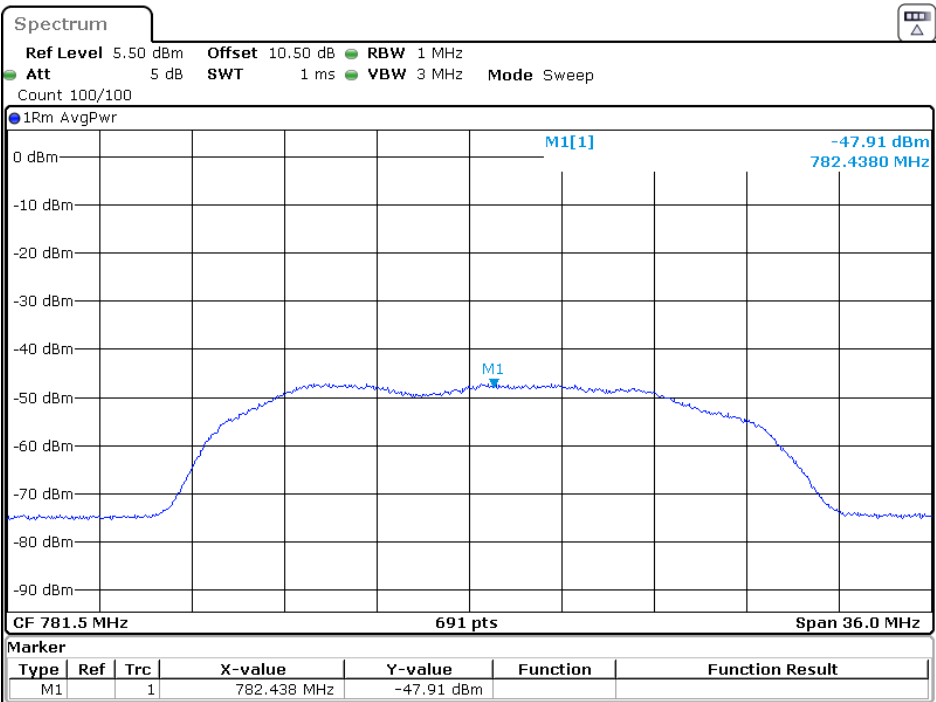
Uplink AWS



Uplink Lower 700MHz

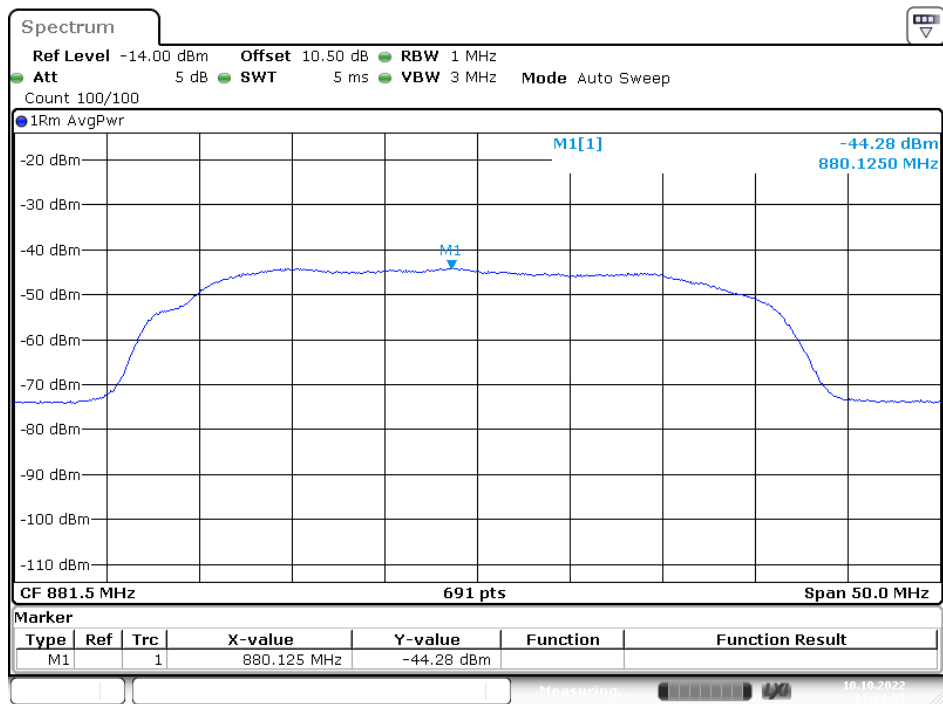


Uplink Upper 700MHz



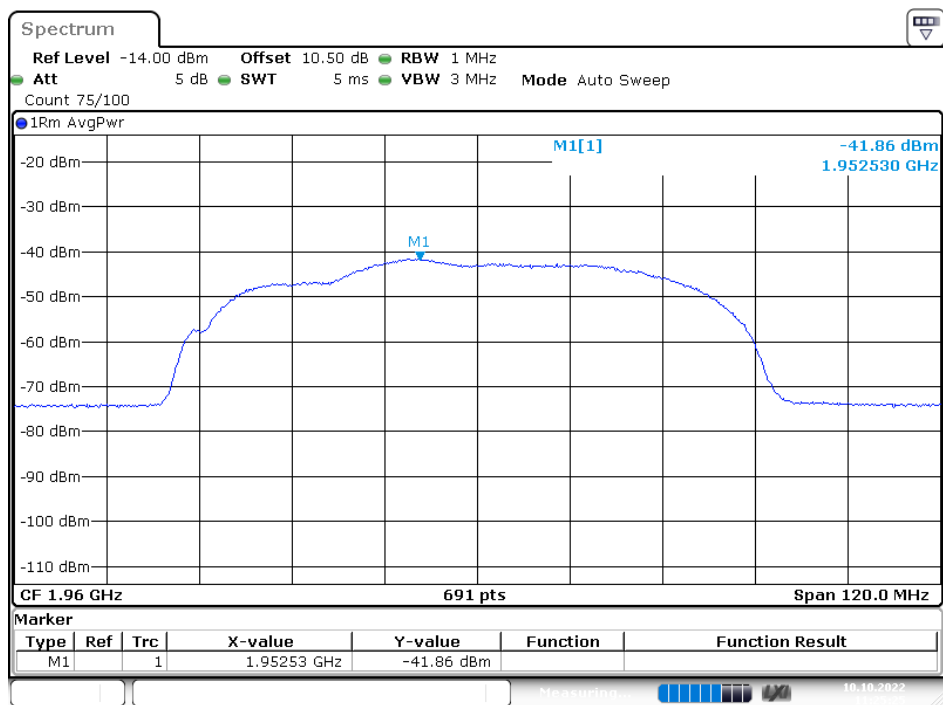
Date: 30.NOV.2022 06:53:24

Downlink Cellular Band



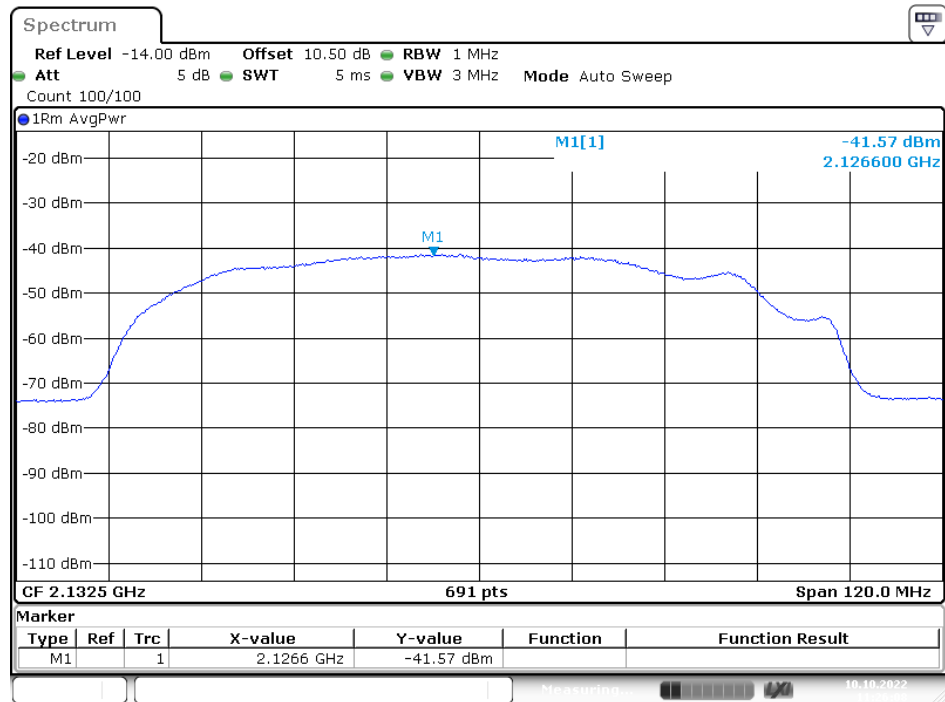
Date: 10.OCT.2022 11:24:51

Downlink PCS Band



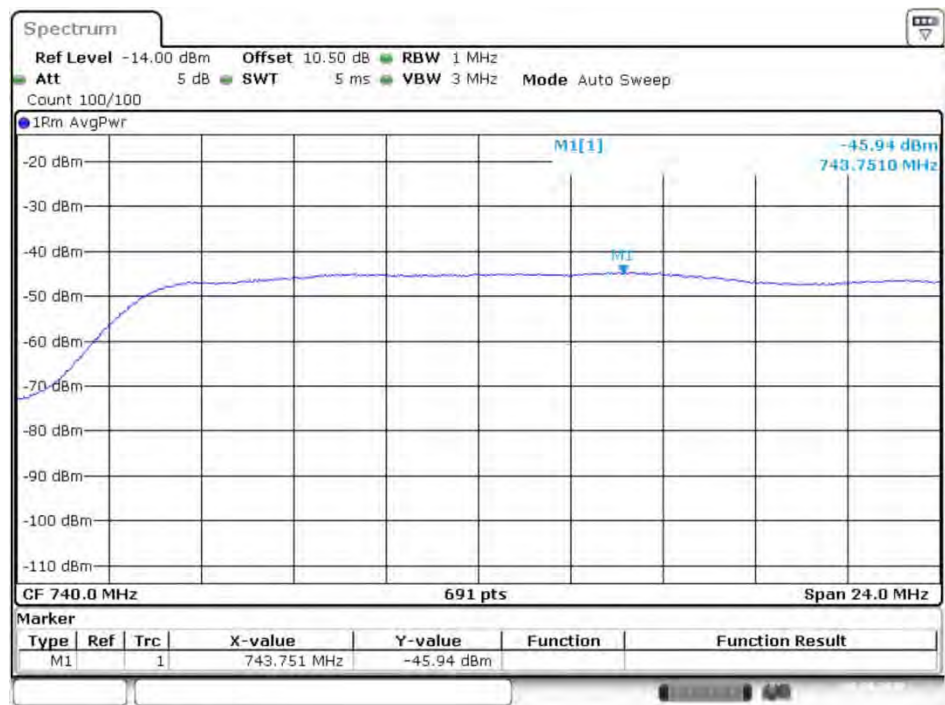
Date: 10.OCT.2022 11:25:25

Downlink AWS



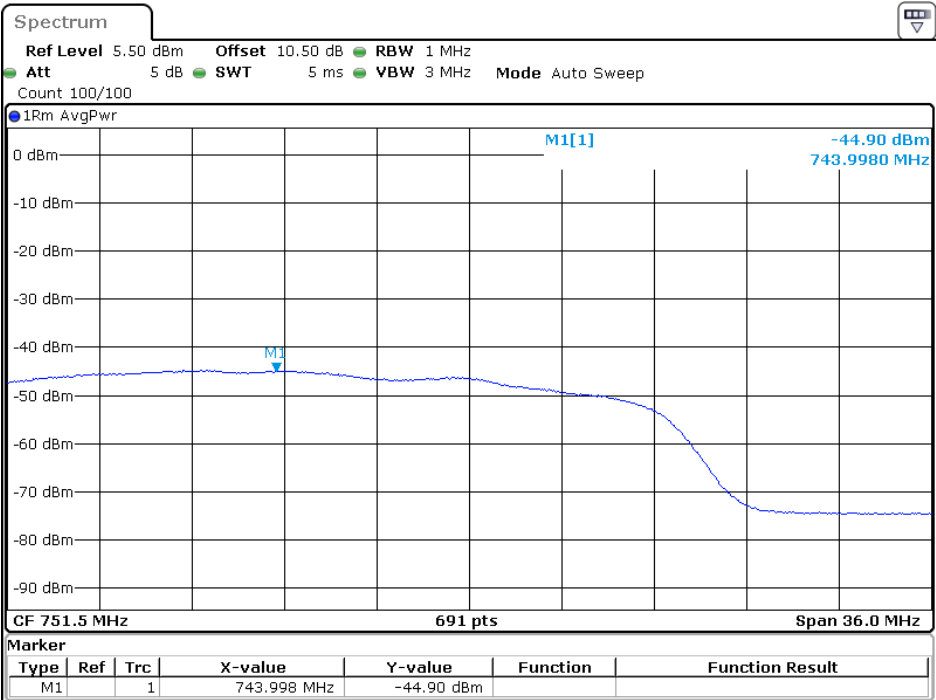
Date: 10.OCT.2022 11:26:08

Downlink Lower 700MHz



Date: 10.OCT.2022 11:24:20

Downlink Upper 700MHz

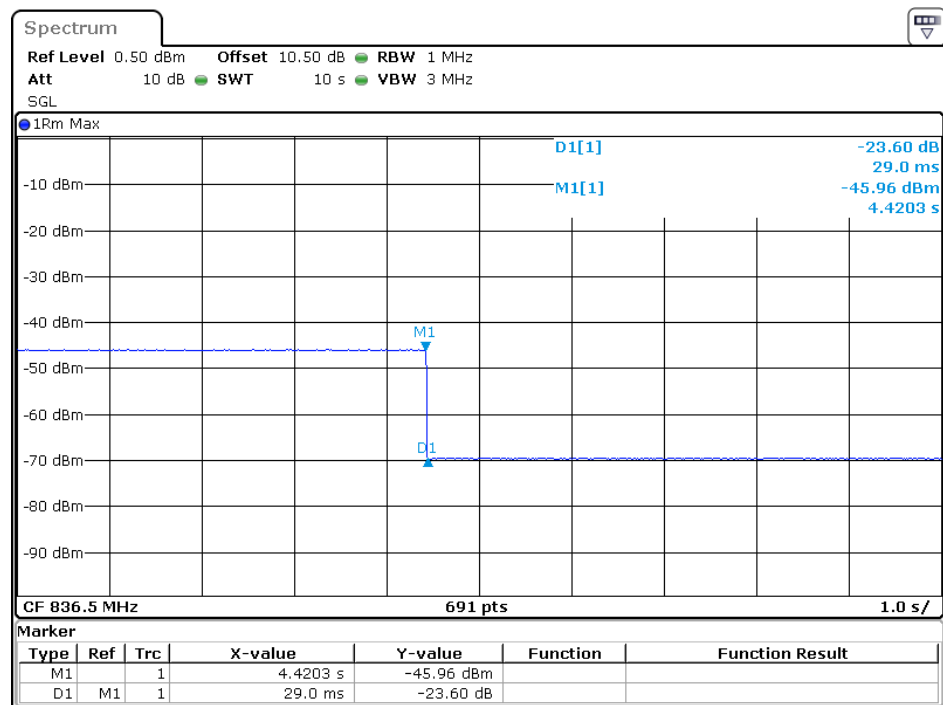


Date: 21.DEC.2022 11:02:20

Variable Uplink Noise Timing:

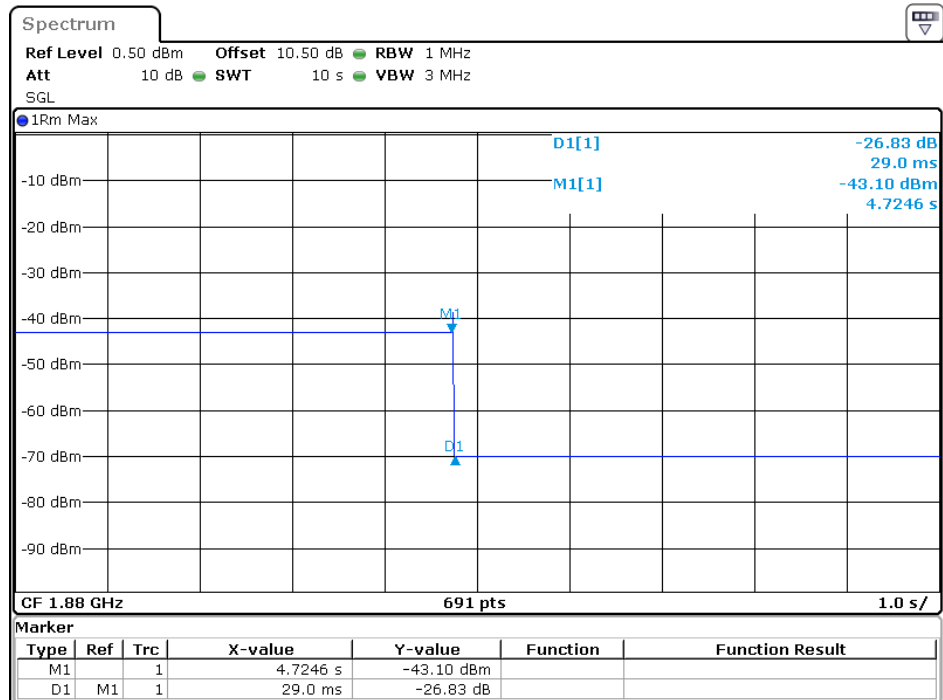
Operation Bands	Measured Value	Limit	Result
	s	s	
Lower 700MHz	0.029	3	Compliance
Upper 700MHz	0.029	3	Compliance
cellular	0.029	3	Compliance
PCS	0.029	3	Compliance
AWS	0.029	3	Compliance

Note: The uplink noise decreases to the specified level within 1 second for mobile devices and 3 seconds for fixed devices.

Cellular Band

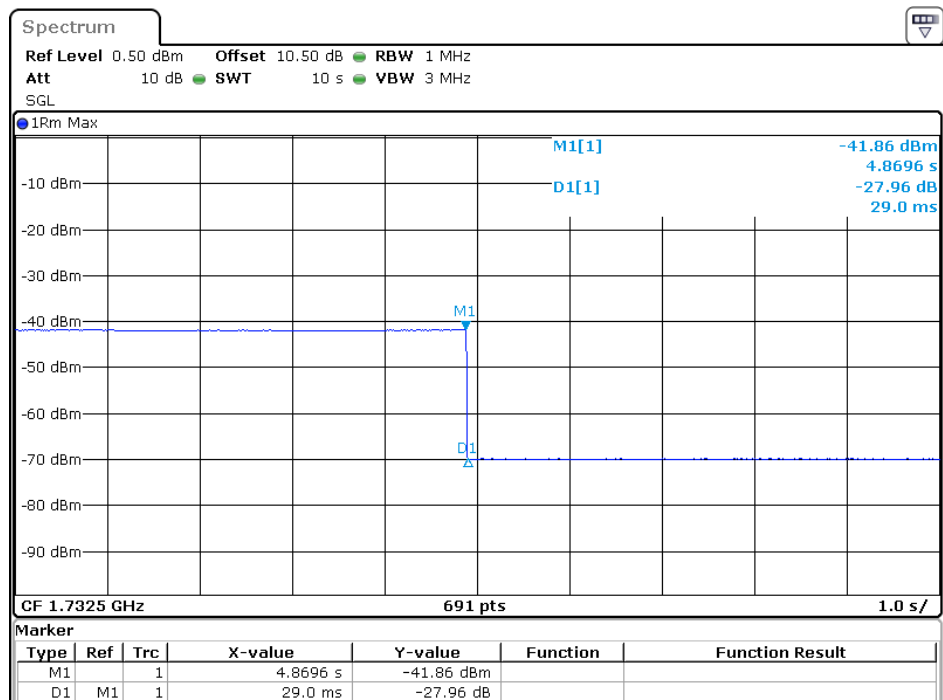
Date: 21.DEC.2022 13:48:27

PCS Band



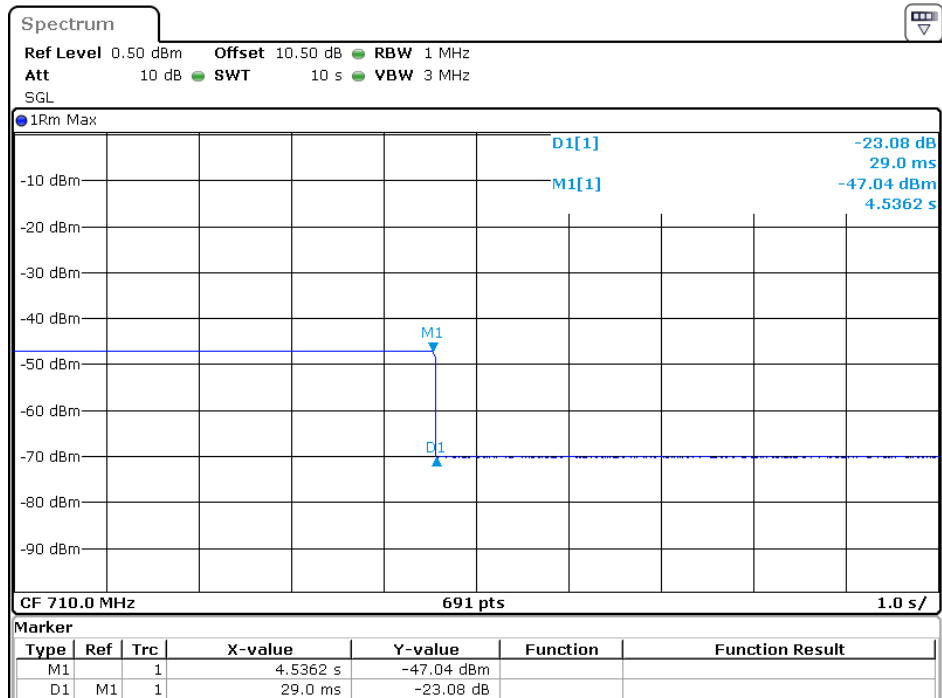
Date: 21.DEC.2022 13:41:43

AWS Band



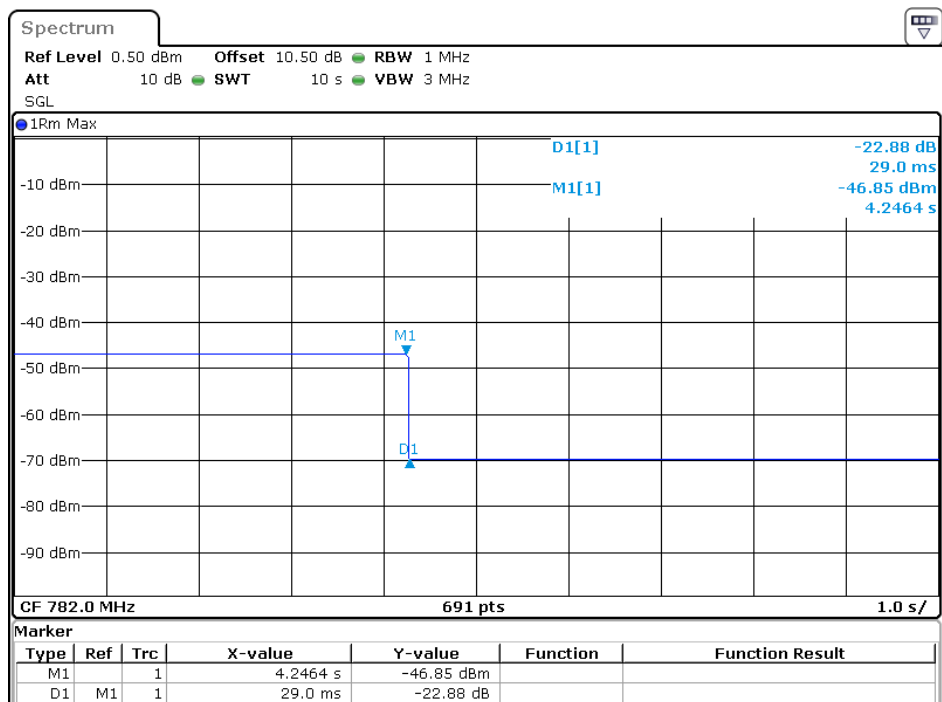
Date: 21.DEC.2022 13:42:30

Lower 700MHz



Date: 21.DEC.2022 13:34:29

Upper 700MHz



Date: 21.DEC.2022 13:36:19

§ 20.21(e)(8)(i)(I) & § 20.21(e)(4) - UPLINK INACTIVITY

Applicable Standards

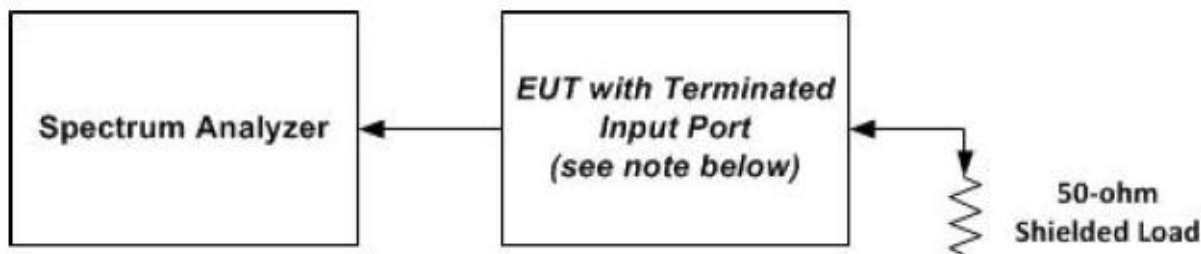
According to § 20.21(e)(8)(i)(I) Uplink Inactivity & § 20.21(e)(4); § 20.21(e)(4) Self-monitoring.

Test Procedure

This measurement procedure is intended to demonstrate compliance to the uplink inactivity requirements specified for wideband consumer signal boosters in § 20.21(e)(8)(i)(I).

- Connect the EUT to the test equipment as shown in **Figure 3** with the uplink output connected to the spectrum analyzer.
- Select the RMS power averaging detector.
- Set the spectrum analyzer RBW for 1 MHz with the $VBW \geq 3 \times RBW$.
- Set the center frequency of the spectrum analyzer to the center of the uplink operational band.
- Set the span for 0 Hz with a single sweep time for a minimum of 330 seconds.
- Start to capture a new trace using MAX HOLD.
- After approximately 15 seconds turn on the EUT power.
- Once the full spectrum analyzer trace is complete place a MARKER on the leading edge of the pulse and use the DELTA MARKER METHOD to measure the time until the uplink becomes inactive.
- Affirm that the noise level for the squelched signal is below the uplink inactivity noise power limit, as specified by the rules.
- Capture the plot for inclusion in the test report.
- Measure noise using procedures in 7.7.1a) to 7.7.1f).
- Repeat 7.8d) through 7.8k) for all operational uplink bands.

Note: Some signal boosters will require a signal generator input because they will not operate unless a signal is received at the input terminals. If this is the case, connect a signal generator and cycle the RF output to simulate this function.



Test Data

Environmental Conditions

Temperature:	25.1 °C
Relative Humidity:	58 %
ATM Pressure:	101.0 kPa

The testing was performed by Andy Yu on 2022-09-29.

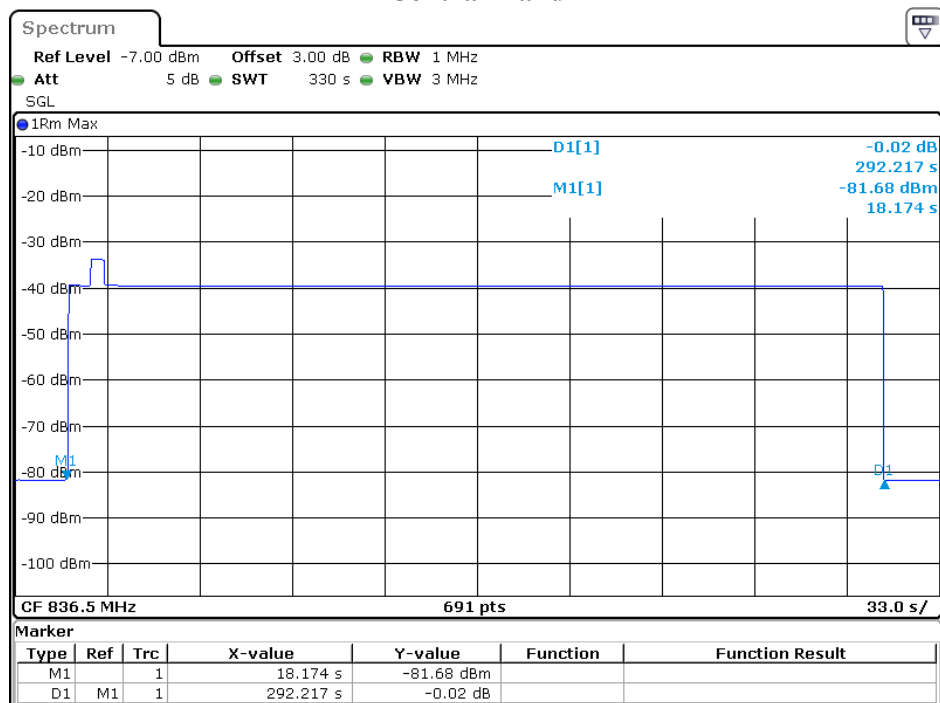
Test Result: Pass

Please refer to following table.

Operation Band	Measured value	Limit	Result
	s	s	
Lower 700 MHz	294.6	300	Compliance
Upper 700 MHz	293.2		Compliance
cellular	292.2		Compliance
PCS	288.9		Compliance
AWS	292.7		Compliance

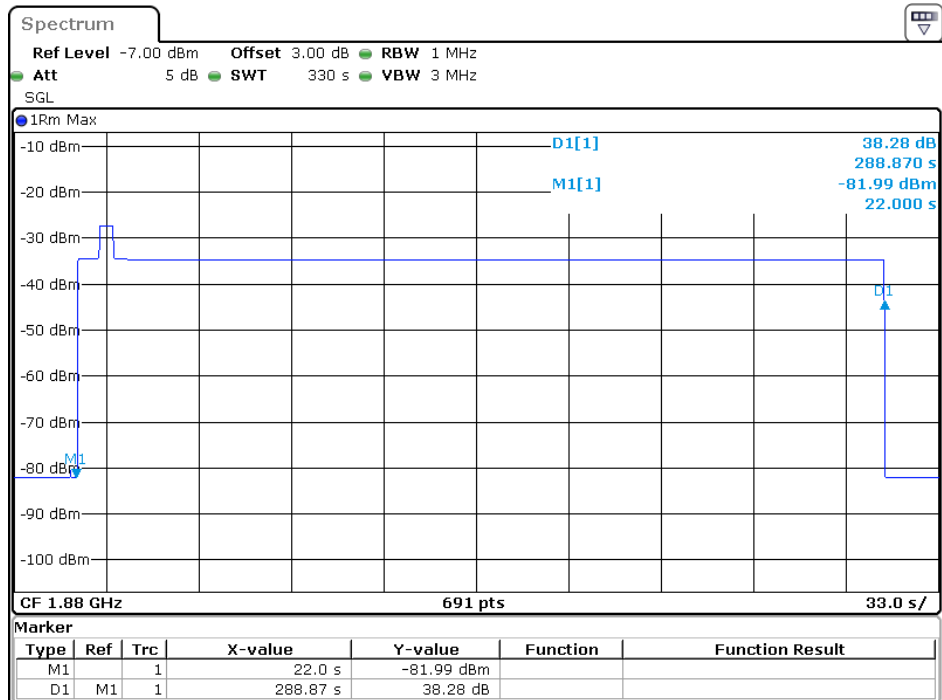
Note: When the consumer booster is not serving an active device connection after 5 minutes the uplink noise power not exceed -70dBm/MHz.

Cellular Band



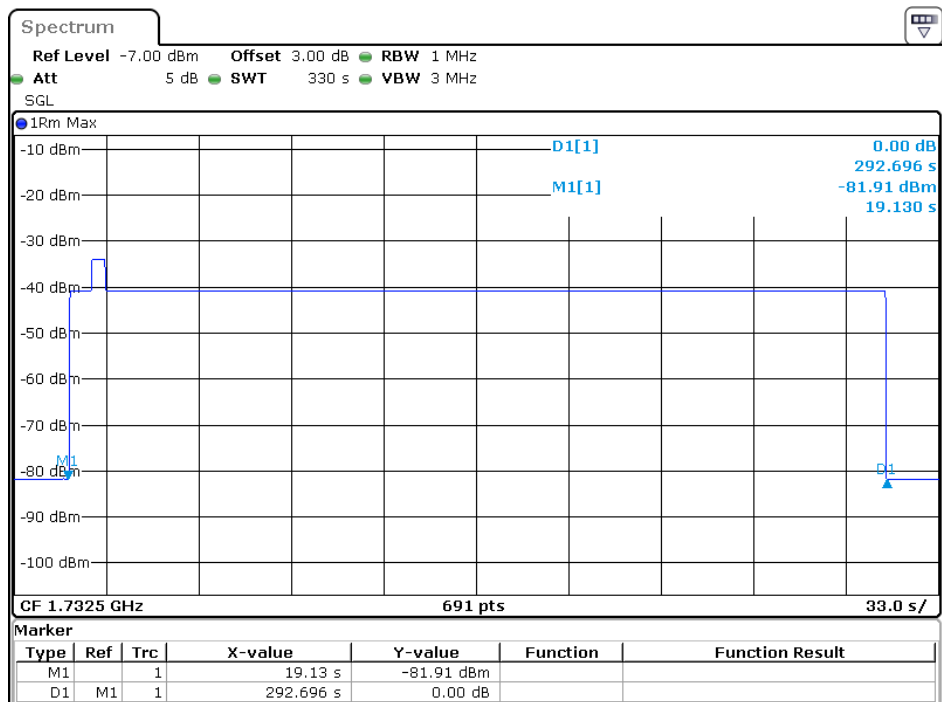
Date: 29.SEP.2022 08:14:04

PCS Band



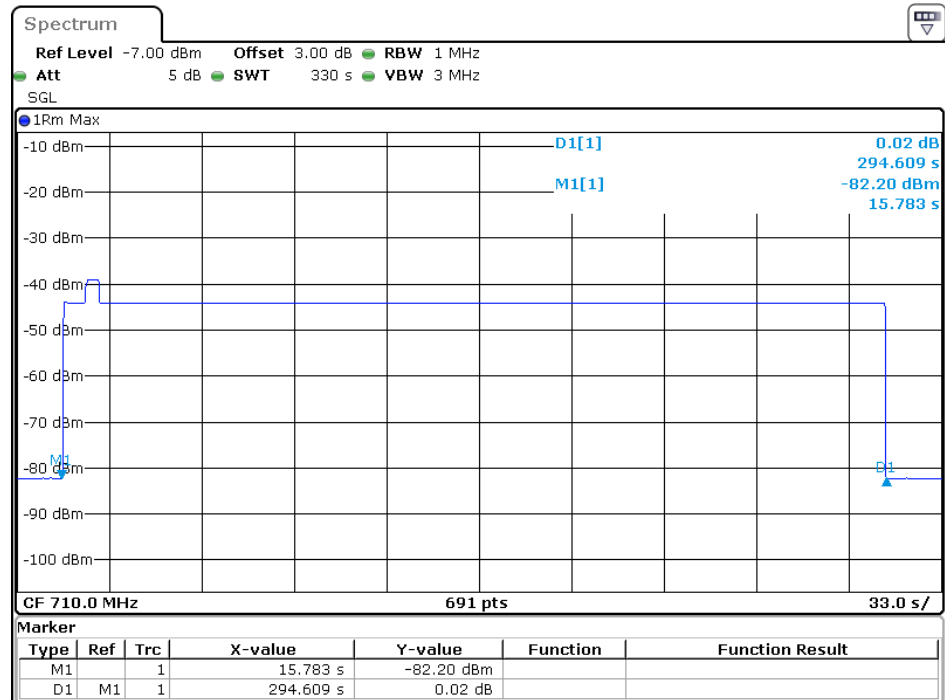
Date: 29.SEP.2022 08:24:28

AWS Band



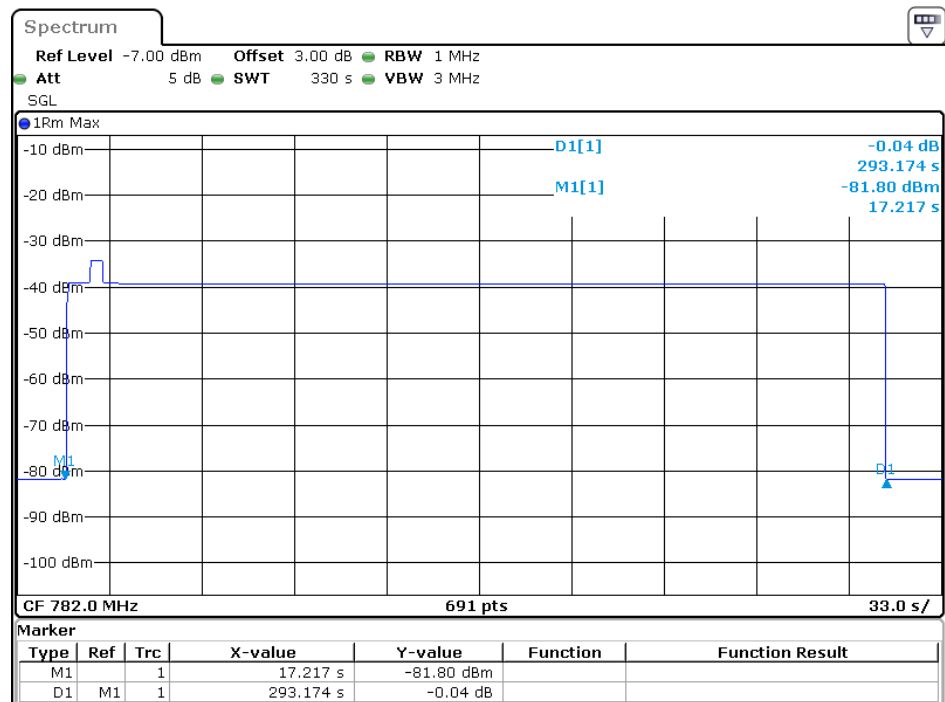
Date: 29.SEP.2022 08:31:59

Lower 700MHz



Date: 29.SEP.2022 07:53:17

Upper 700MHz



Date: 29.SEP.2022 08:06:12

§ 20.21(e)(8)(i)(C)(1) & § 20.21(e)(8)(i)(H) - VARIABLE BOOSTER GAIN

Applicable Standards

Rule paragraph(s): § 20.21(e)(8)(i)(C)(1) *Booster Gain Limits* (variable gain); § 20.21(e)(8)(i)(H) *Transmit Power Off Mode* (uplink gain).

Test Procedure

Maximum gain

This procedure shall be used to demonstrate compliance to the booster gain limits specified for wideband consumer signal boosters in § 20.21(e)(8)(i)(C) or § 20.21(e)(8)(i)(H). The variable booster gain limits are expressed as a function of RSSI and MSCL. The RSSI is varied over a range of values as specified within the procedure. Refer to Annex B of this document for guidance on determining the applicable MSCL value.

- a) Connect the EUT to the test equipment as shown in **Figure 5** with the uplink output connected to signal generator 1. Confirm that the coupled path of the RF coupler is connected to the spectrum analyzer.
- b) Configure downlink signal generator 1 for AWGN operation with a 99% occupied bandwidth of 4.1 MHz tuned to the center of the operational band.
- c) Set the power level and frequency of signal generator 2 to a value 5 dB below the AGC level determined from 7.2. The signal type is AWGN with a 99% OBW of 4.1 MHz.
- d) Set RBW = 100 kHz.
- e) Set VBW $\geq$ 300 kHz.
- f) Select the CHANNEL POWER measurement mode.
- g) Select the RMS (power averaging) detector.
- h) Ensure that the number of measurement points per sweep $\geq (2 \times \text{span})/\text{RBW}$.
- i) Sweep time = auto couple or as necessary (but no less than auto couple value).
- j) Trace average at least 10 traces in power averaging (i.e., RMS) mode.
- k) Measure the maximum channel power and compute maximum gain when varying the signal generator 1 output to a level from -90 dBm to -20 dBm as measured at the input port in 1 dB steps inside the RSSI-dependent region and 10 dB steps outside the RSSI-dependent region and report the six values closest to the limit, including at least two points from within the RSSI-dependent region of operation. See gain limit in charts in Annex D for uplink gain requirements. Additionally, document that the EUT provides equivalent uplink and downlink gain, and when operating in shutoff mode the uplink and downlink gain is within the transmit power off mode gain limits.
- l) Repeat 7.9.1b) to 7.9.1k) for all operational uplink bands.

Variable uplink gain timing

Variable uplink gain timing is to be measured as follows.

- a) Set the spectrum analyzer to the uplink frequency to be measured.
- b) Set the span to 0 Hz with a sweep time of 10 seconds.
- c) Set the power level of signal generator 1 to the lowest level of the RSSI-dependent gain.
- d) Select MAX HOLD and increase the power level of signal generator 1 by 10 dB for mobile boosters and 20 dB for fixed indoor boosters. Signal generator 2 remains same, as described in 7.9.1c).
- e) Confirm that the uplink gain decreases to the specified levels within 1 second for mobile devices and 3 seconds for fixed devices.
- f) Repeat 7.9.2a) to 7.9.2e) for all operational uplink bands.

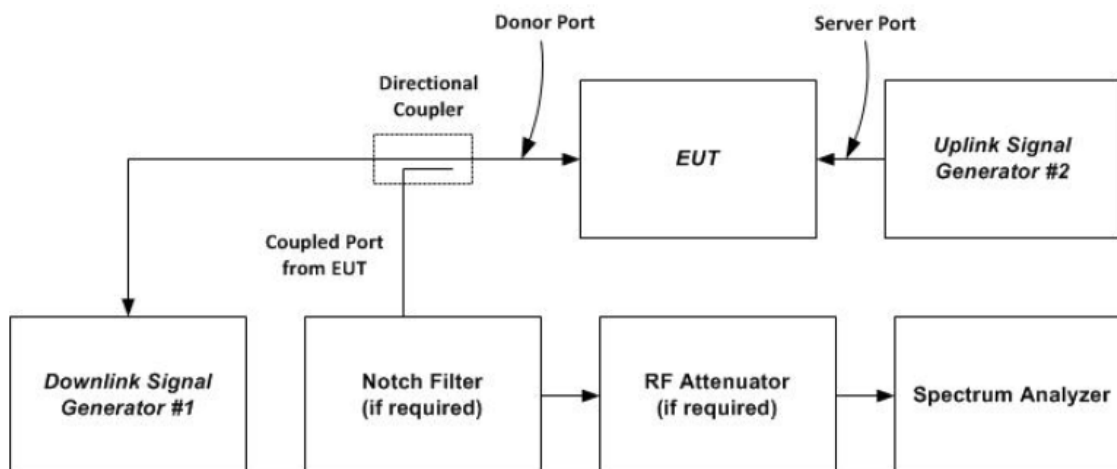


Figure 5 – Variable gain instrumentation test setup

Test Data

Environmental Conditions

Temperature:	25.3°C
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Andy Yu from 2022-11-16 to 2023-02-25.

Test Result: Pass

Please refer to following table.

MSCL calculation:

Operation Bands	Frequency	Distance	Path Loss	Indoor Antenna Gain	Indoor Cable Loss	Polarity Loss	MSCL
	MHz	m	dB	(dBi)	(dB)	(dB)	
Lower 700MHz	710	1	29.53	6.5	1.9	3.01	27.94
Upper 700MHz	781.5	1	30.36	6.5	2.0	3.01	28.87
Cellular	836.5	1	30.95	7	2.2	3.01	29.16
PCS	1880	1	37.98	6	0.5	3.01	35.49
AWS	1732.5	1	37.27	6	0.5	3.01	34.78

Note:

Path loss = $20\log f + 20\log d - 27.50$

Polarity loss = $20\log(1/\sin(45)) = 3.01$

MSCL = Path loss + Indoor Cable Loss - Mobile Antenna Gain - Indoor Antenna Gain + Polarity Loss

Mobile Antenna Gain = 0

The lowest MSCL was calculated and used according to the manufacturer's specification

Variable booster gain:

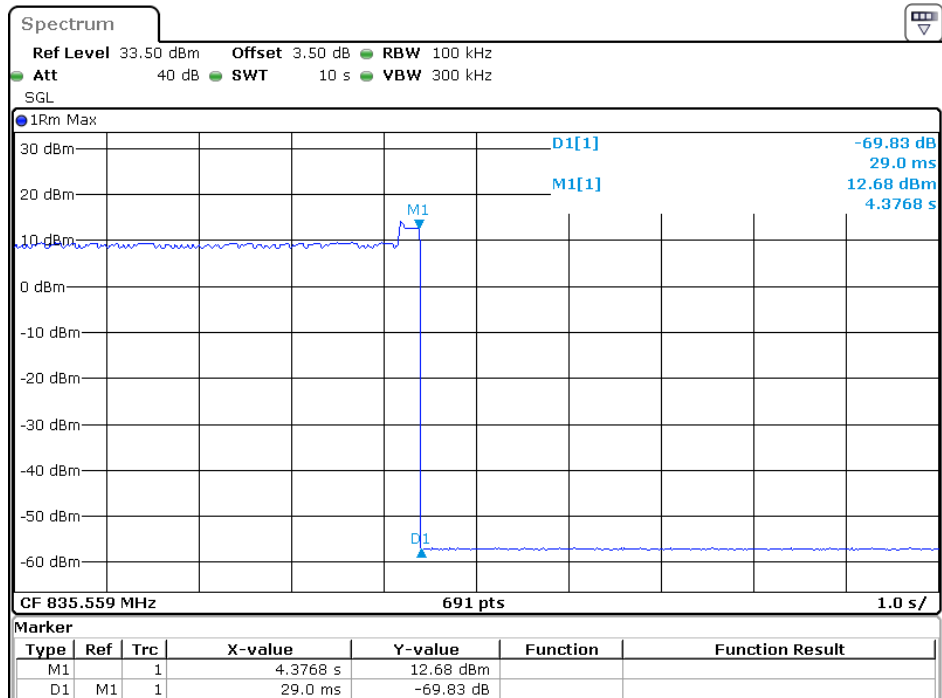
Operation Bands	RSSI	P _{in}	P _{out}	MSCL	Measured Value	Limit	Result
	dBm	dBm	dBm	dB	dB	dB	
Lower 700MHz	-59	-45.55	2.03	27.94	47.58	52.94	Compliance
	-58	-45.55	0.96	27.94	46.51	51.94	Compliance
	-57	-45.55	-0.23	27.94	45.32	50.94	Compliance
	-56	-45.55	-1.62	27.94	43.93	49.94	Compliance
	-55	-45.55	-2.54	27.94	43.01	48.94	Compliance
	-54	-45.55	-3.74	27.94	41.81	47.94	Compliance
Upper 700MHz	-60	-46.24	1.32	28.87	47.56	54.87	Compliance
	-59	-46.24	0.15	28.87	46.39	53.87	Compliance
	-58	-46.24	-1.16	28.87	45.08	52.87	Compliance
	-57	-46.24	-2.47	28.87	43.77	51.87	Compliance
	-56	-46.24	-3.69	28.87	42.55	50.87	Compliance
	-55	-46.24	-4.25	28.87	41.99	49.87	Compliance
Cellular	-61	-48.24	0.52	29.16	48.76	56.16	Compliance
	-60	-48.24	-0.69	29.16	47.55	55.16	Compliance
	-59	-48.24	-2.02	29.16	46.22	54.16	Compliance
	-58	-48.24	-3.14	29.16	45.10	53.16	Compliance
	-57	-48.24	-3.98	29.16	44.26	52.16	Compliance
	-56	-48.24	-4.57	29.16	43.67	51.16	Compliance
PCS	-64	-52.15	-1.32	35.49	50.83	65.49	Compliance
	-63	-52.15	-2.24	35.49	49.91	64.49	Compliance
	-62	-52.15	-3.45	35.49	48.70	63.49	Compliance
	-61	-52.15	-4.74	35.49	47.41	62.49	Compliance
	-60	-52.15	-5.39	35.49	46.76	61.49	Compliance
	-59	-52.15	-6.54	35.49	45.61	60.49	Compliance
AWS	-64	-54.35	-1.25	34.78	53.10	64.78	Compliance
	-63	-54.35	-2.41	34.78	51.94	63.78	Compliance
	-62	-54.35	-3.45	34.78	50.90	62.78	Compliance
	-61	-54.35	-4.62	34.78	49.73	61.78	Compliance
	-60	-54.35	-5.34	34.78	49.01	60.78	Compliance
	-59	-54.35	-6.47	34.78	47.88	59.78	Compliance

Note: Variable booster gain Limit: -34 dB-RSSI + MSCL.

Variable gain timing:

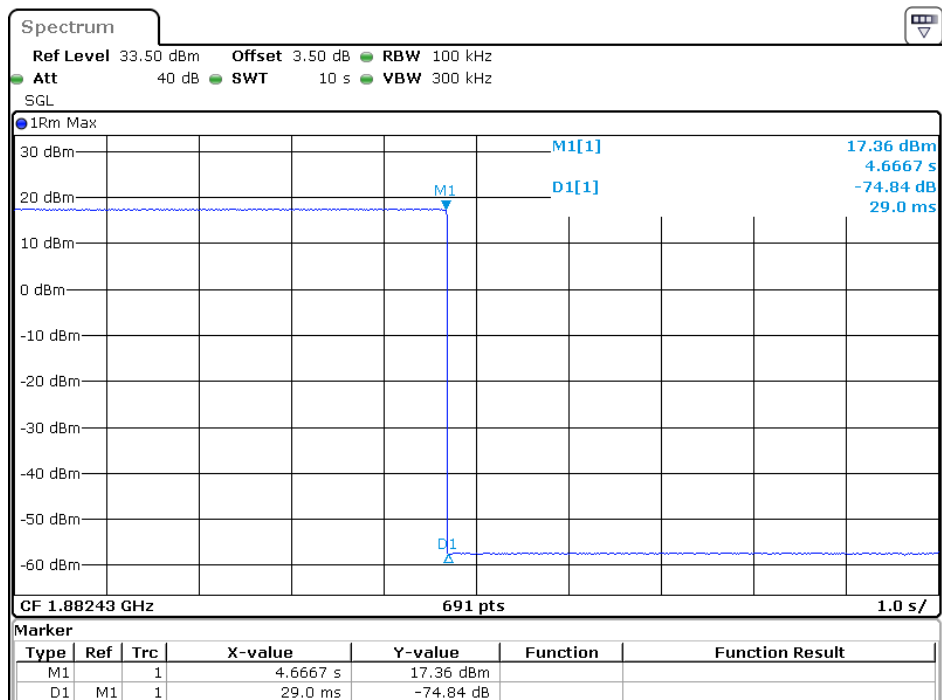
Operation Bands	Measured value	Limit	Results	
MHz	s	s		
Lower 700MHz	0.029	3	Compliance	
Upper 700MHz	0.032		Compliance	
Cellular	0.029		Compliance	
PCS	0.029		Compliance	
AWS	0.029		Compliance	

Cellular Band



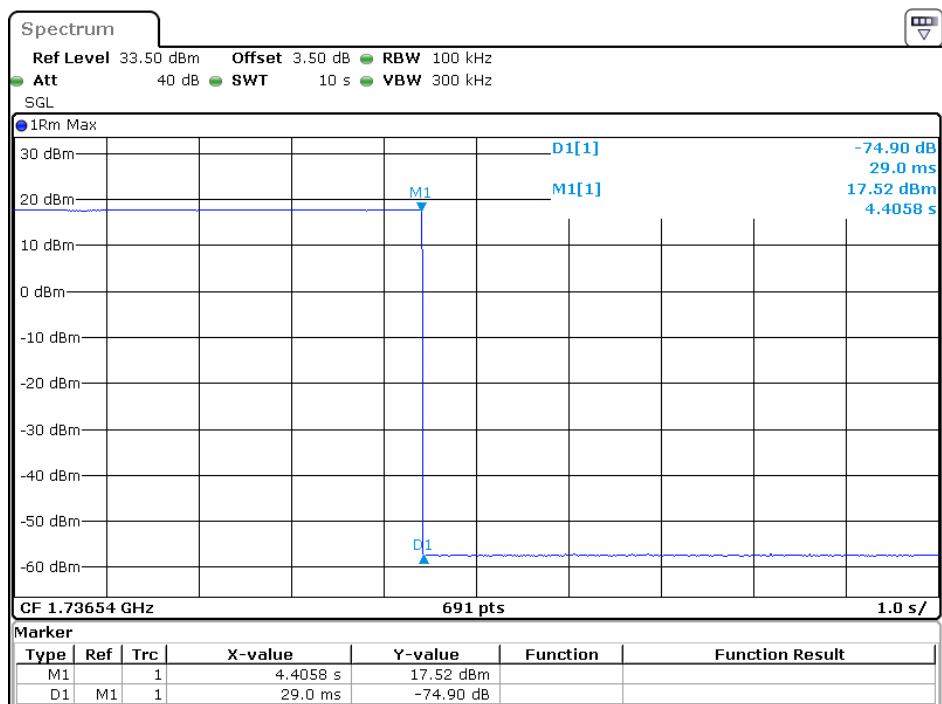
Date: 16.NOV.2022 08:52:18

PCS Band



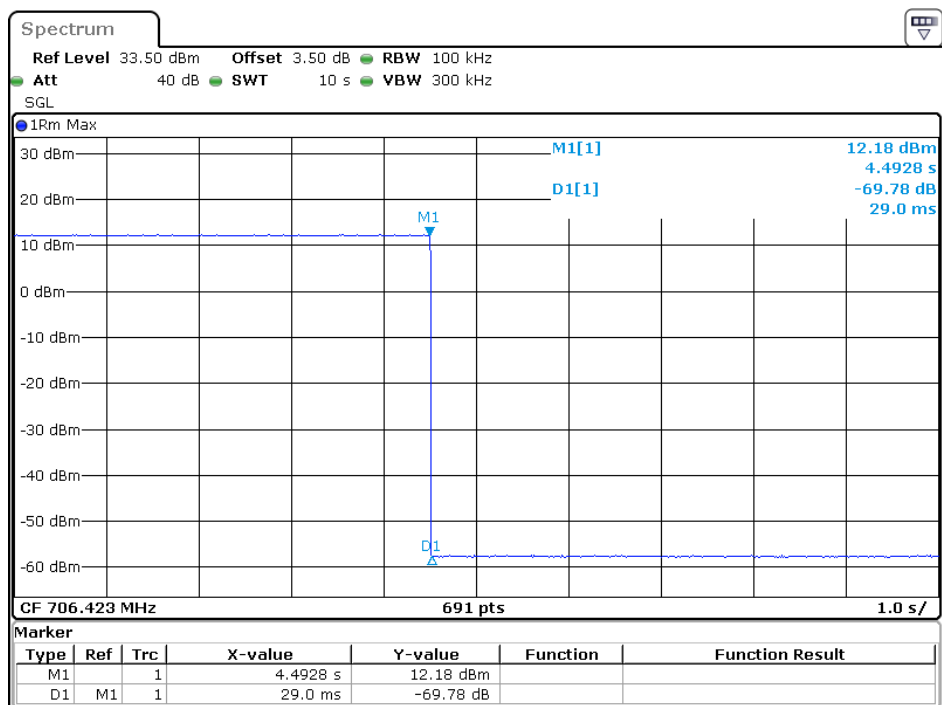
Date: 16.NOV.2022 08:57:35

AWS Band



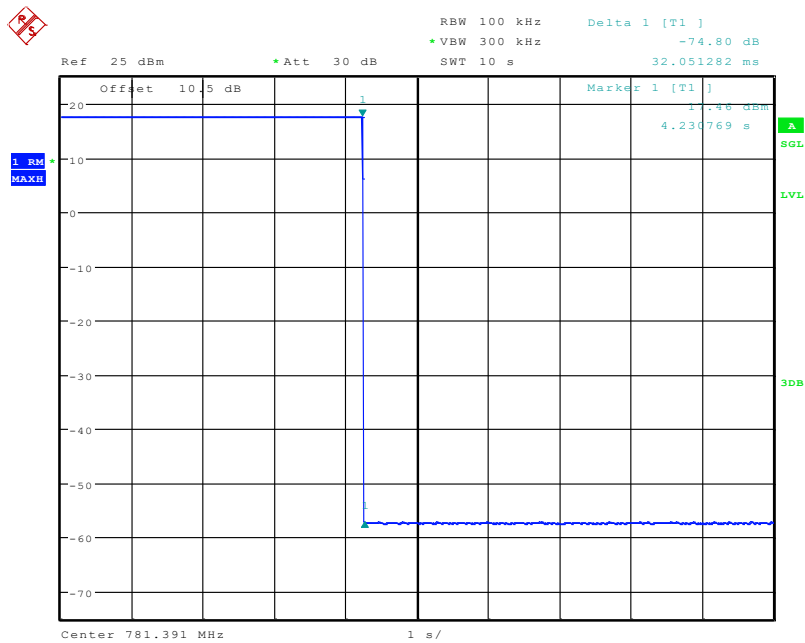
Date: 16.NOV.2022 08:46:51

Lower 700MHz



Date: 16.NOV.2022 08:54:14

Upper 700MHz



Date: 25.FEB.2023 18:23:38

§ 2.1049 - OCCUPIED BANDWIDTH

Applicable Standards

According to § 2.1049 Measurements required: Occupied bandwidth.

Test Procedure

This measurement is required to compare the uniformity of the output signal relative to the input signal and to satisfy the requirements of § 2.1049.

- a) Connect the test equipment as shown in **Figure 6** to measure the characteristics of the test signals produced by the signal generator.
- b) Set VBW to $\geq 3 \times \text{RBW}$.
- c) Set the center frequency of the spectrum analyzer to the center of the operational band. The span will be adjusted for each modulation type and occupied bandwidth as necessary for accurately viewing the signals.
- d) Set the signal generator for power level to match the values obtained in 7.2.
- e) Set the signal generator modulation type for GSM with a PRBS pattern and allow the trace on the signal generator to stabilize adjusting the span as necessary.
- f) Set the spectrum analyzer RBW for 1% to 5% of the emissions bandwidth.
- g) Capture the spectrum analyzer trace for inclusion in the test report.
- h) Repeat 7.10c) to 7.10g) for CDMA and W-CDMA modulation adjusting the span as necessary for all uplink and downlink operational bands. AWGN or LTE may be used in place of W-CDMA, as an option.
- i) Connect the test equipment as shown in **Figure 1**. Begin with the uplink output connected to the spectrum analyzer.
- j) Repeat 7.10c) to 7.10h) in this new configuration.

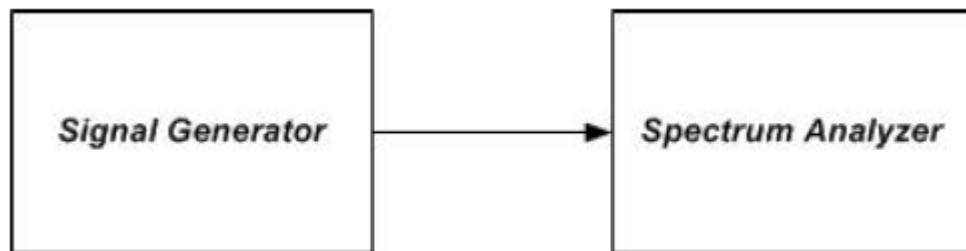


Figure 6 – Occupied bandwidth instrumentation test setup

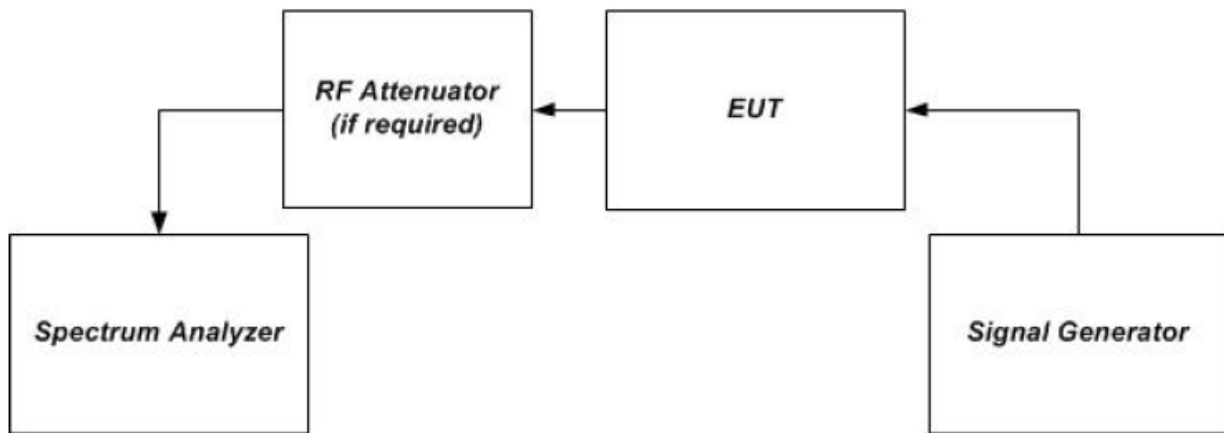


Figure 1 – Band verification test instrumentation setup

Test Data**Environmental Conditions**

Temperature:	25.2 °C
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

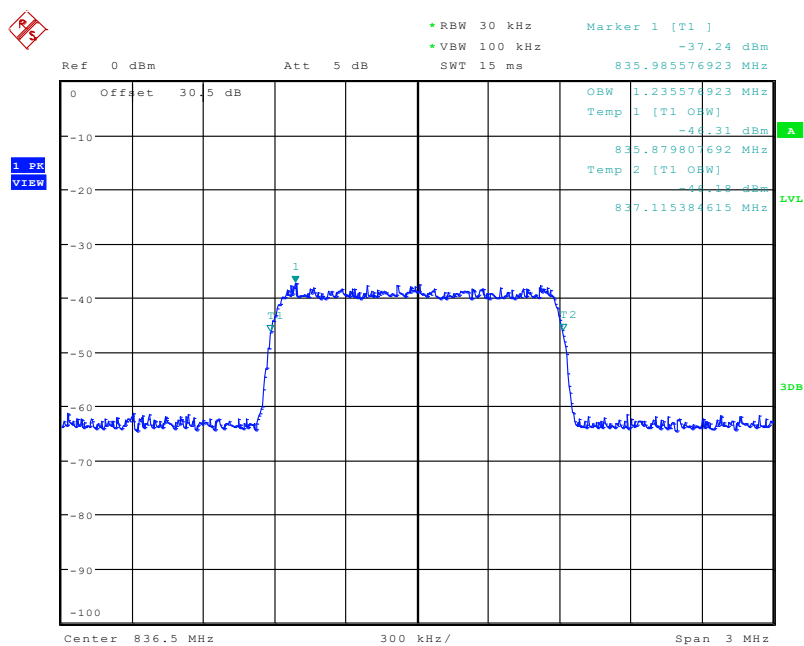
The testing was performed by Andy Yu on 2022-09-23.

Test Result: Pass

Please refer to following table.

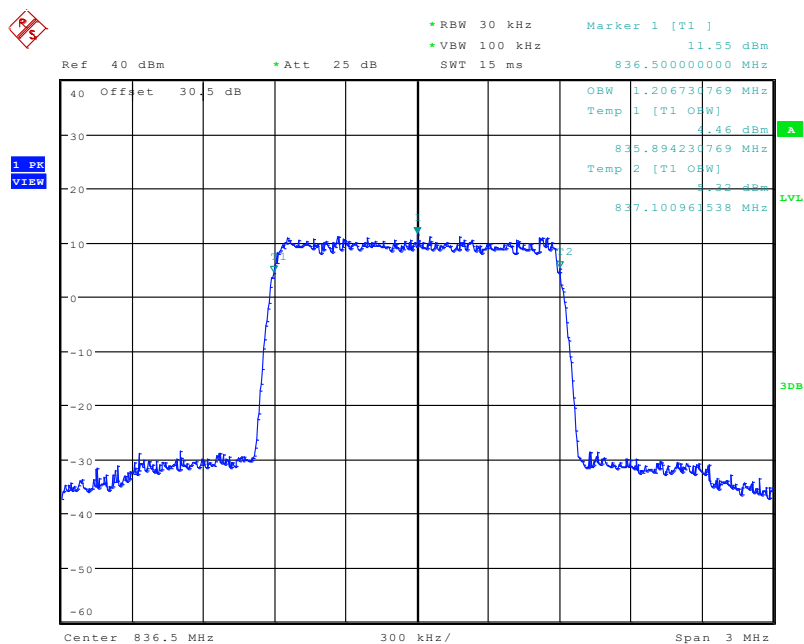
Mode	Operation Bands	Signal type	Occupied bandwidth(MHz)		Result
			In	Out	
Uplink	Lower 700MHz	GSM	0.247	0.244	Compliance
		CDMA	1.212	1.207	Compliance
		WCDMA	4.247	4.183	Compliance
	Upper 700MHz	GSM	0.247	0.244	Compliance
		CDMA	1.207	1.207	Compliance
		WCDMA	4.263	4.183	Compliance
	cellular	GSM	0.266	0.244	Compliance
		CDMA	1.236	1.207	Compliance
		WCDMA	4.183	4.151	Compliance
	PCS	GSM	0.245	0.244	Compliance
		CDMA	1.207	1.207	Compliance
		WCDMA	4.215	4.215	Compliance
	AWS	GSM	0.250	0.245	Compliance
		CDMA	1.212	1.202	Compliance
		WCDMA	4.423	4.199	Compliance
Downlink	Lower 700MHz	GSM	0.250	0.244	Compliance
		CDMA	1.216	1.212	Compliance
		WCDMA	4.519	4.199	Compliance
	Upper 700MHz	GSM	0.261	0.245	Compliance
		CDMA	1.226	1.207	Compliance
		WCDMA	4.231	4.167	Compliance
	cellular	GSM	0.248	0.244	Compliance
		CDMA	1.212	1.207	Compliance
		WCDMA	4.359	4.151	Compliance
	PCS	GSM	0.274	0.245	Compliance
		CDMA	1.255	1.212	Compliance
		WCDMA	4.279	4.183	Compliance
	AWS	GSM	0.247	0.245	Compliance
		CDMA	1.211	1.207	Compliance
		WCDMA	4.263	4.183	Compliance

Uplink, 836.5MHz-CDMA (Input)



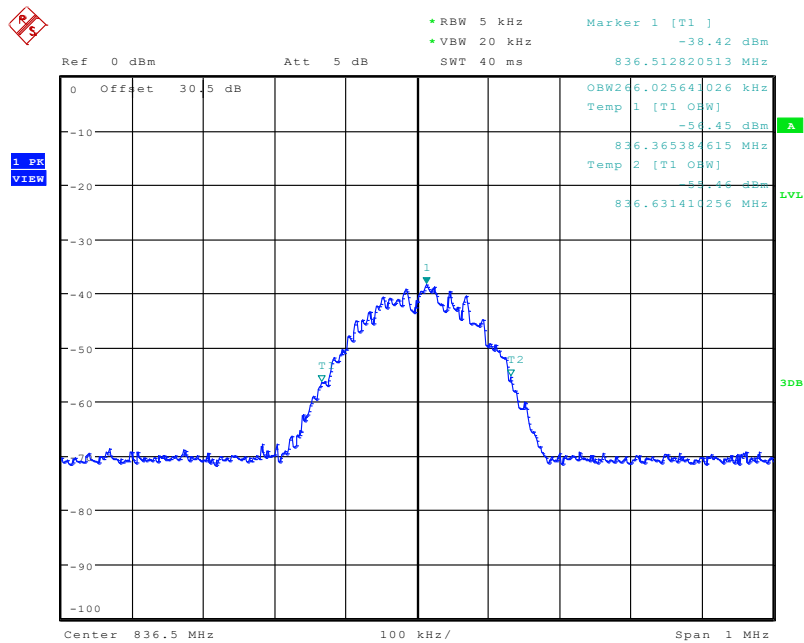
Date: 23.SEP.2022 11:28:29

Uplink, 836.5MHz-CDMA (Output)



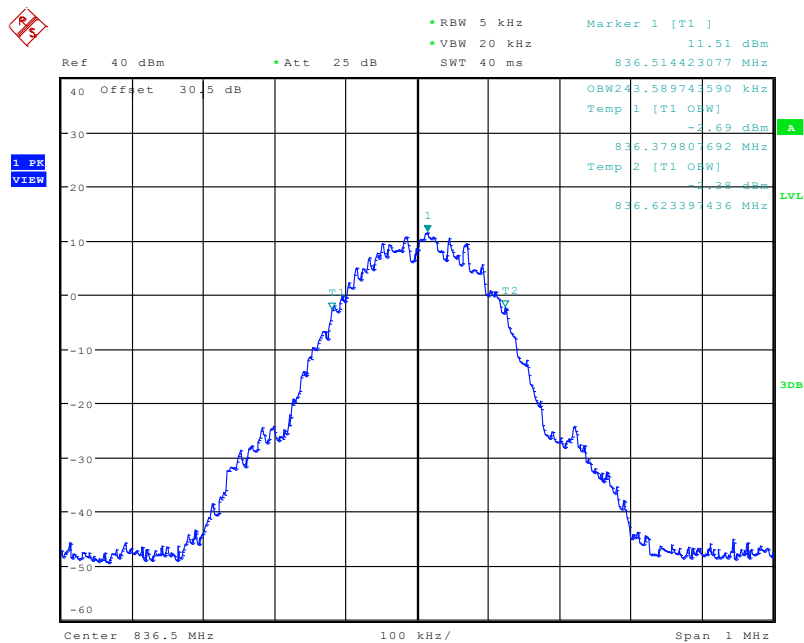
Date: 23.SEP.2022 14:38:02

Uplink, 836.5MHz-GSM (Input)



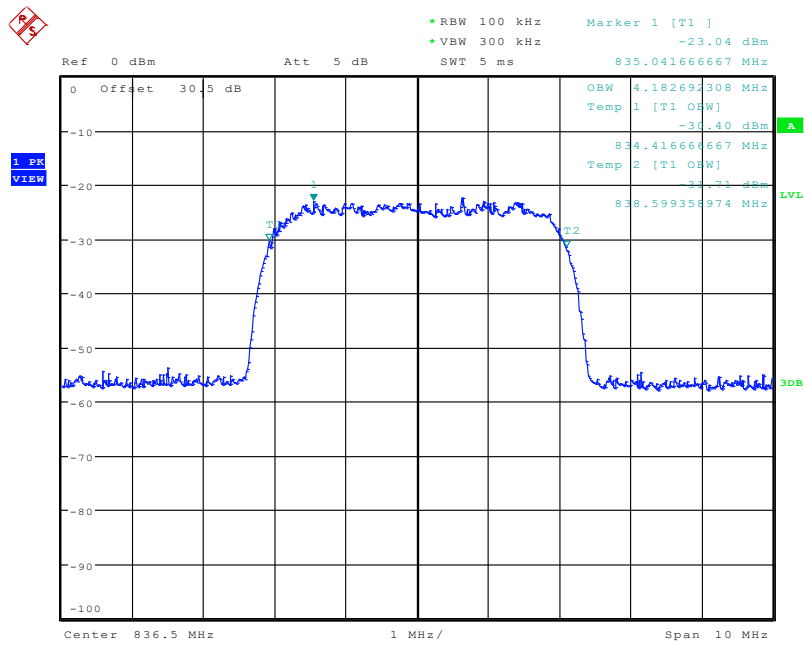
Date: 23.SEP.2022 11:26:21

Uplink, 836.5MHz-GSM (Output)



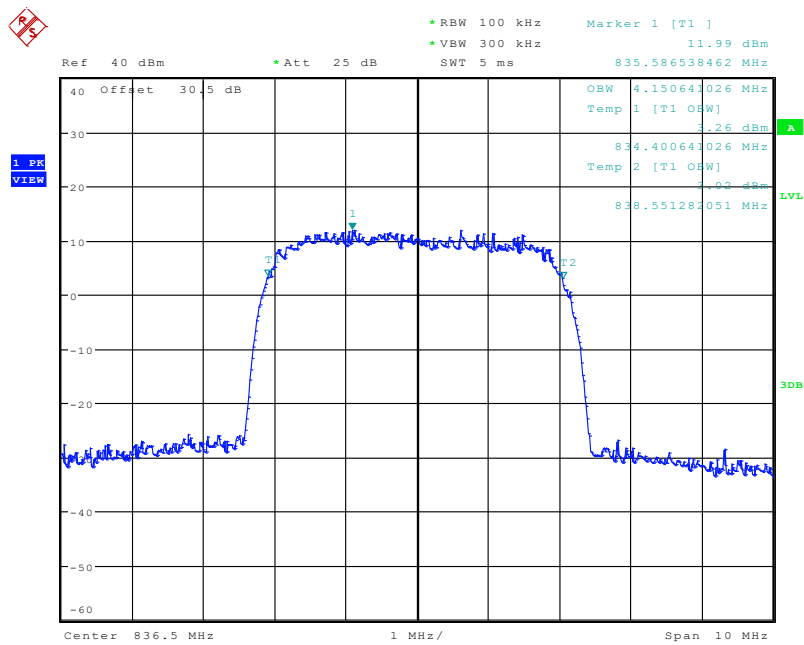
Date: 23.SEP.2022 14:36:53

Uplink, 836.5MHz-WCDMA (Input)



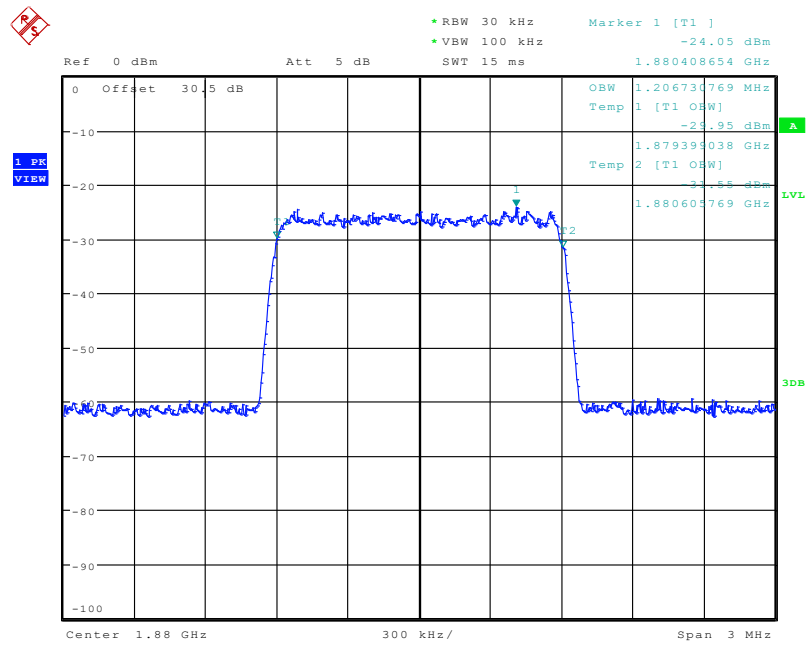
Date: 23.SEP.2022 11:34:00

Uplink, 836.5MHz-WCDMA (Output)



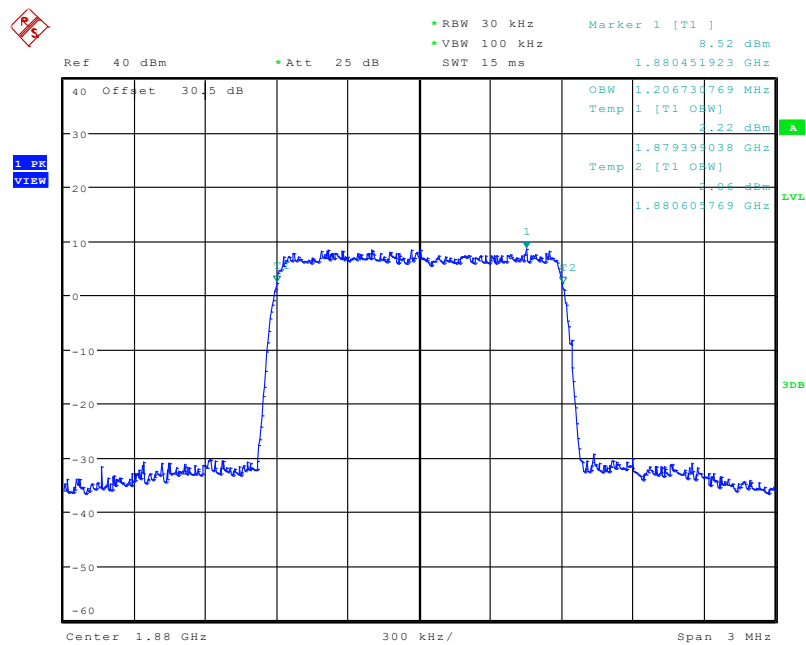
Date: 23.SEP.2022 14:39:13

Uplink, 1880MHz-CDMA (Input)



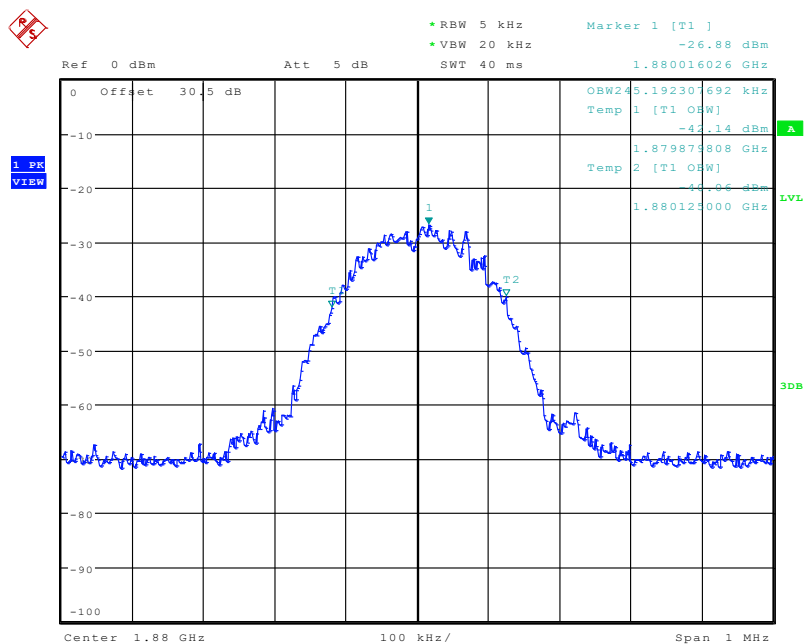
Date: 23.SEP.2022 11:38:57

Uplink, 1880MHz-CDMA (Output)



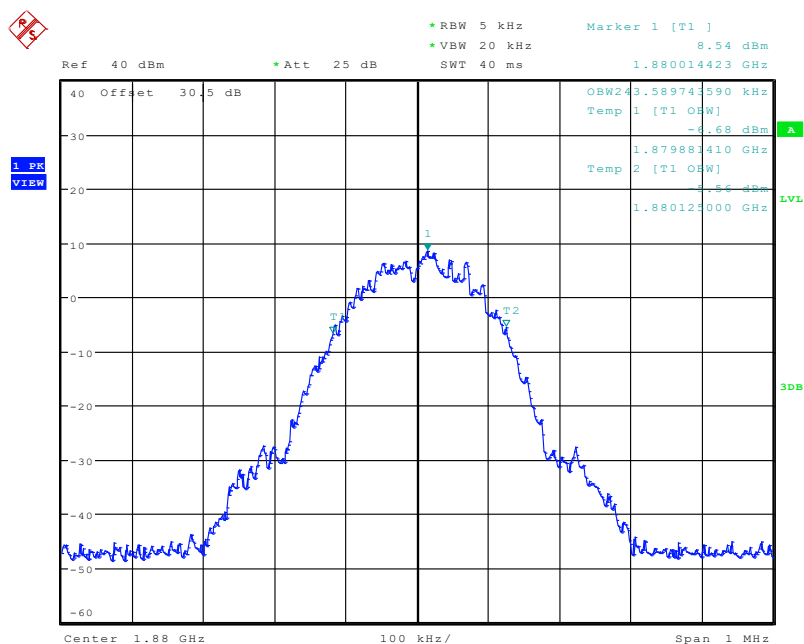
Date: 23.SEP.2022 14:42:03

Uplink, 1880MHz-GSM (Input)



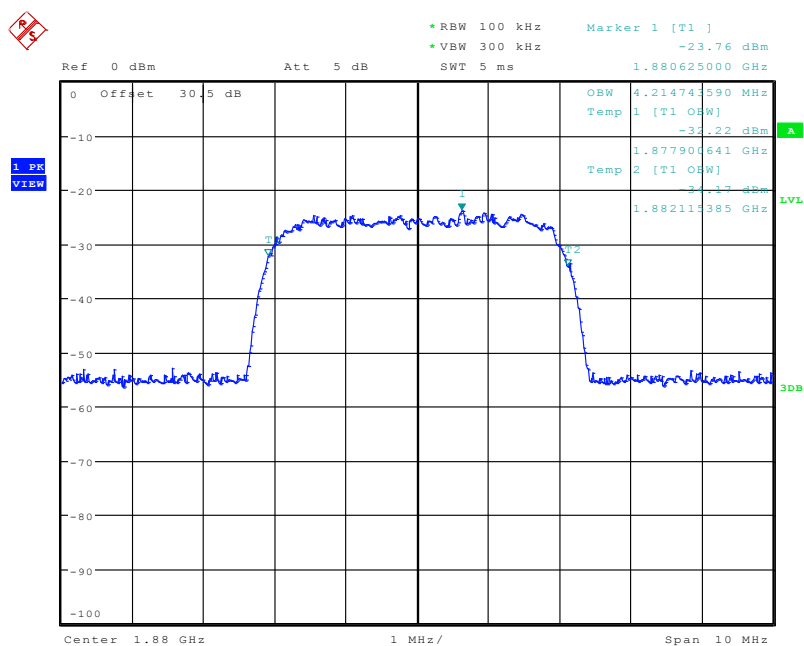
Date: 23.SEP.2022 11:40:18

Uplink, 1880MHz-GSM (Output)



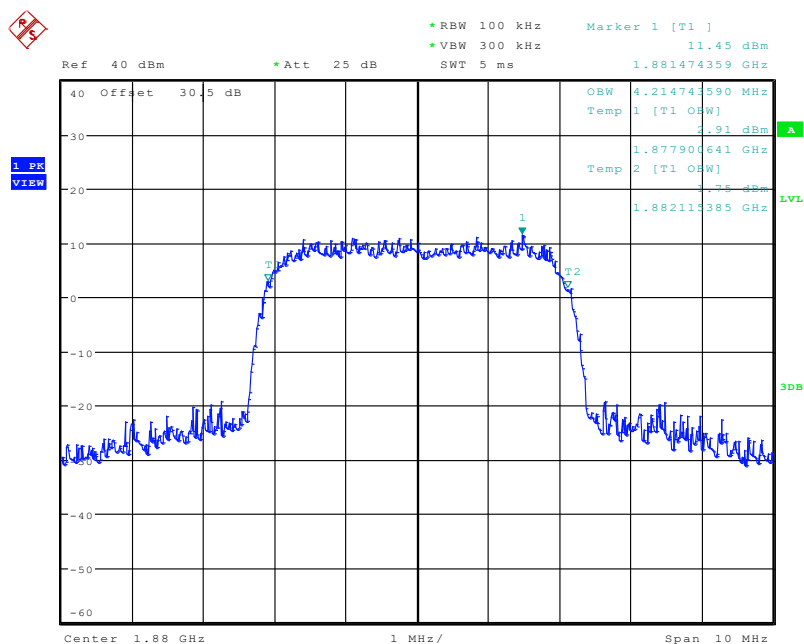
Date: 23.SEP.2022 14:43:12

Uplink, 1880MHz-WCDMA (Input)



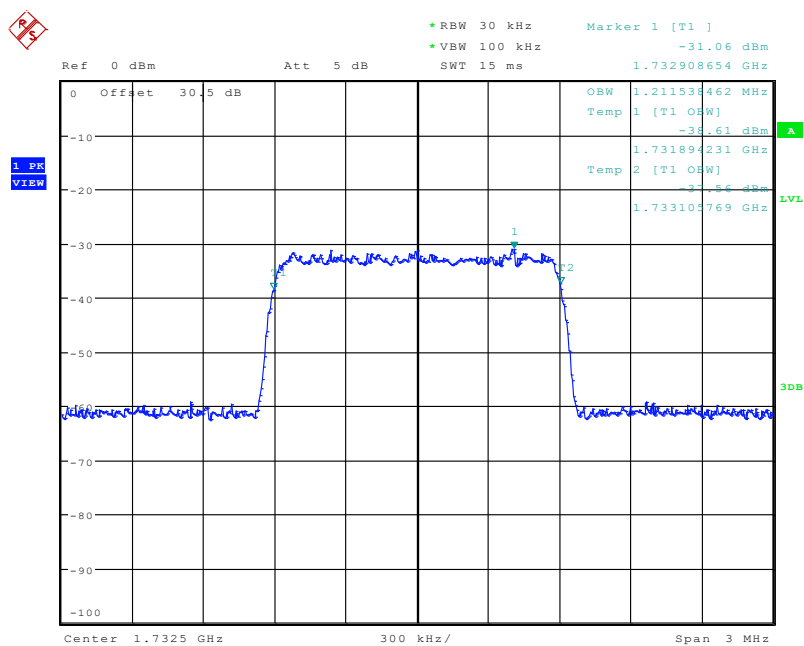
Date: 23.SEP.2022 11:37:41

Uplink, 1880MHz-WCDMA (Output)



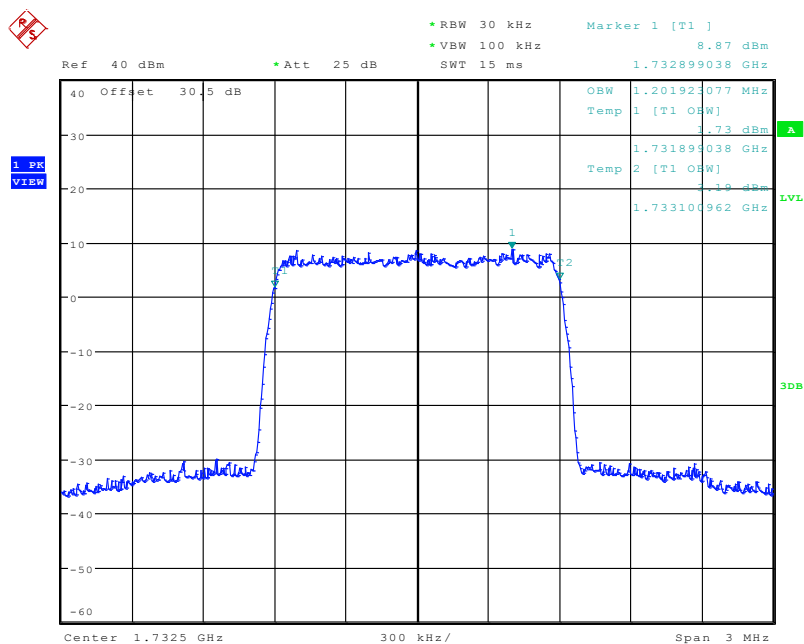
Date: 23.SEP.2022 14:40:59

Uplink, 1732.5MHz-CDMA (Input)



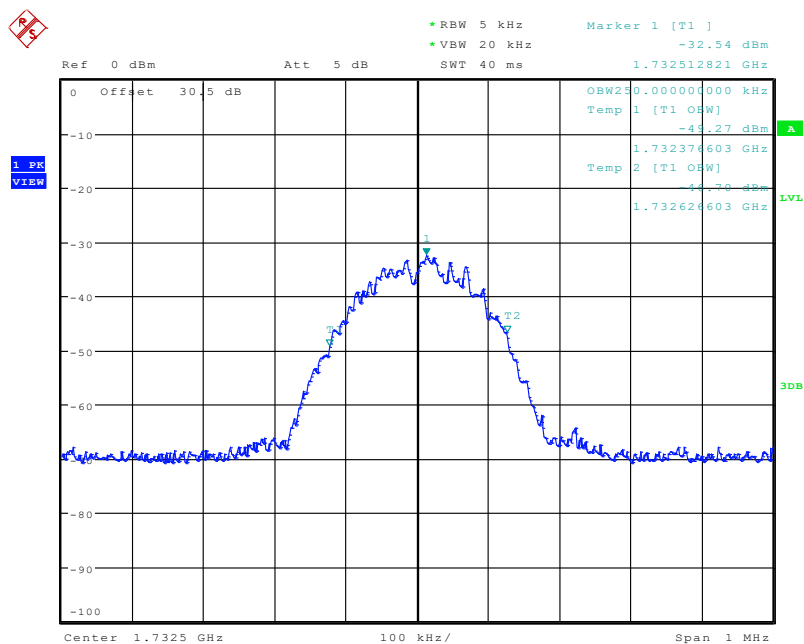
Date: 23.SEP.2022 13:20:01

Uplink, 1732.5MHz-CDMA (Output)



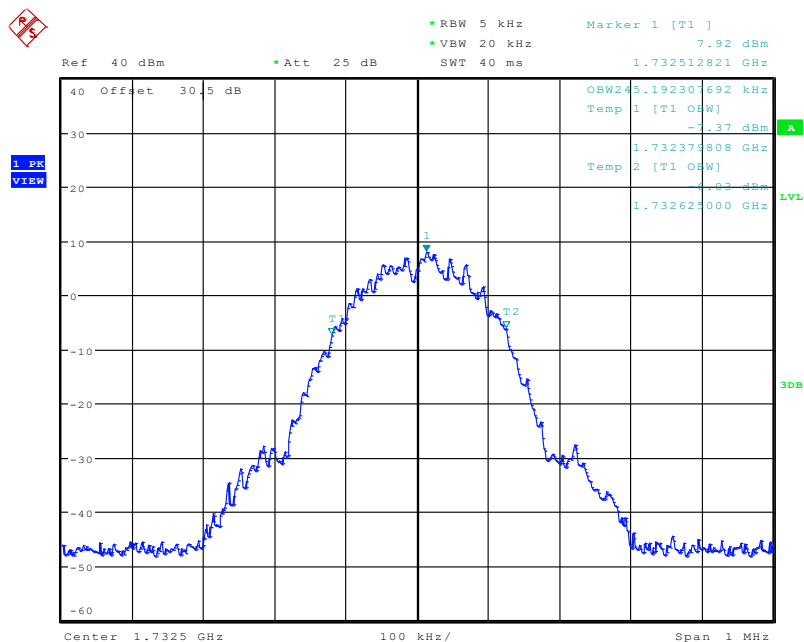
Date: 23.SEP.2022 14:48:52

Uplink, 1732.5MHz-GSM (Input)



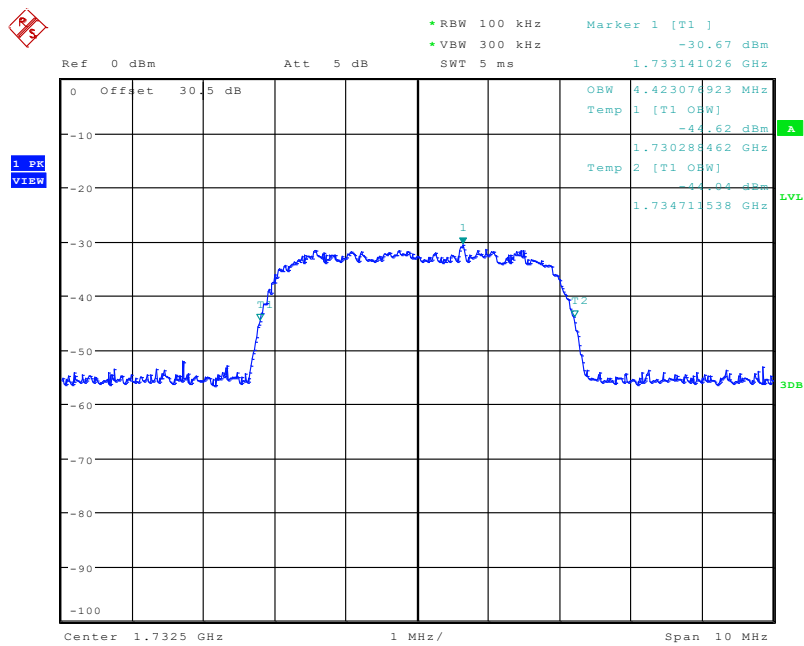
Date: 23.SEP.2022 13:17:11

Uplink, 1732.5MHz-GSM (Output)



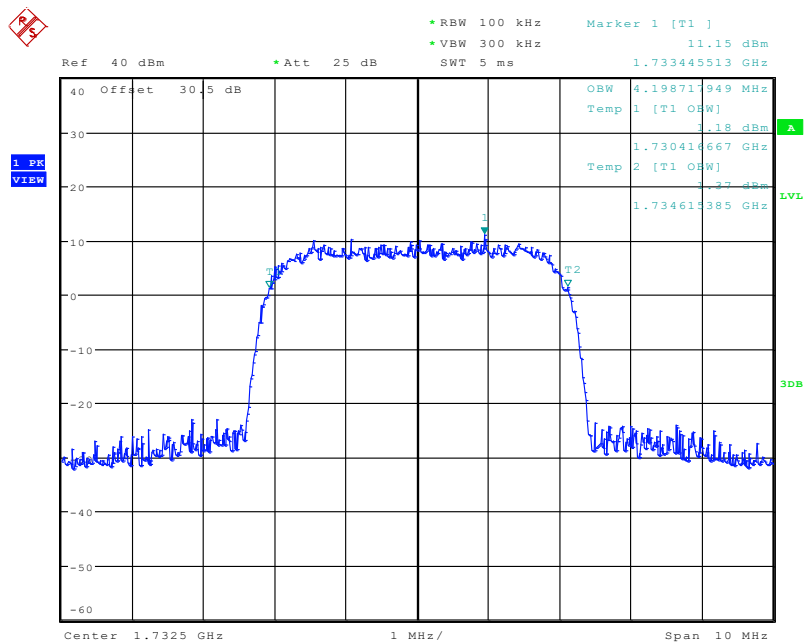
Date: 23.SEP.2022 14:47:39

Uplink, 1732.5MHz-WCDMA (Input)



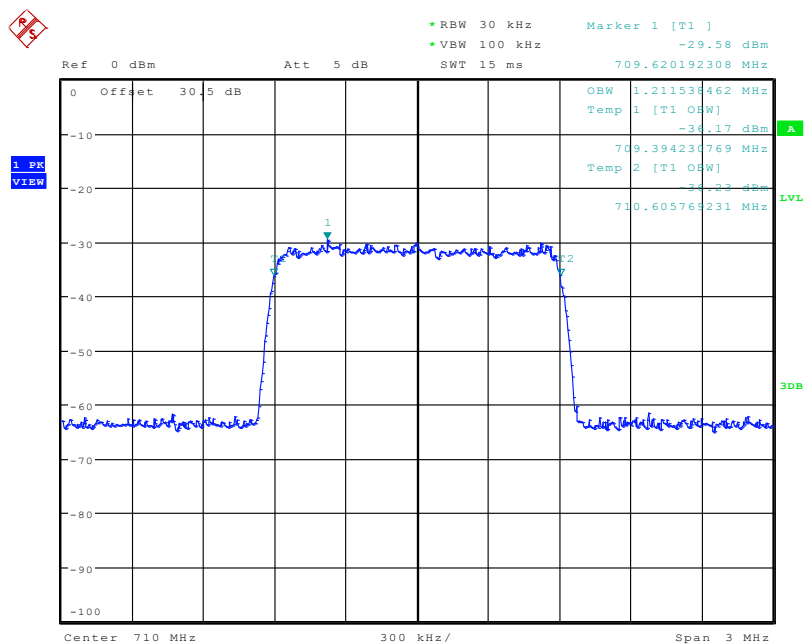
Date: 23.SEP.2022 13:21:44

Uplink, 1732.5MHz-WCDMA (Output)



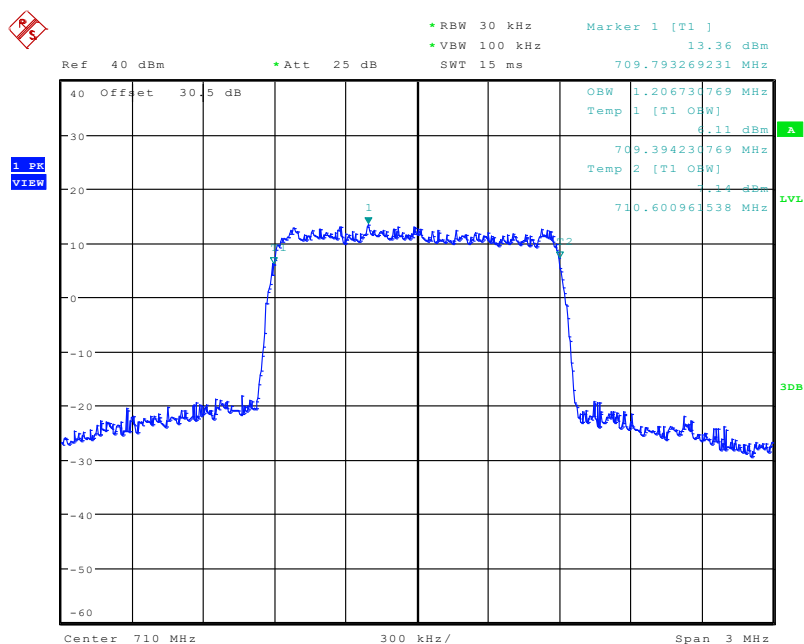
Date: 23.SEP.2022 14:49:52

Uplink, 710MHz-CDMA (Input)



Date: 23.SEP.2022 11:06:53

Uplink, 710MHz-CDMA (Output)



Date: 23.SEP.2022 14:29:18

Ref 0 dBm Att 5 dB

RBW 5 kHz VBW 20 kHz SWT 40 ms

Marker 1 [T1] 710.012500000 MHz

OBW246.794873795 kHz

Temp 1 [T1 OSW] -31.56 dBm

Temp 2 [T1 OSW] -47.30 dBm

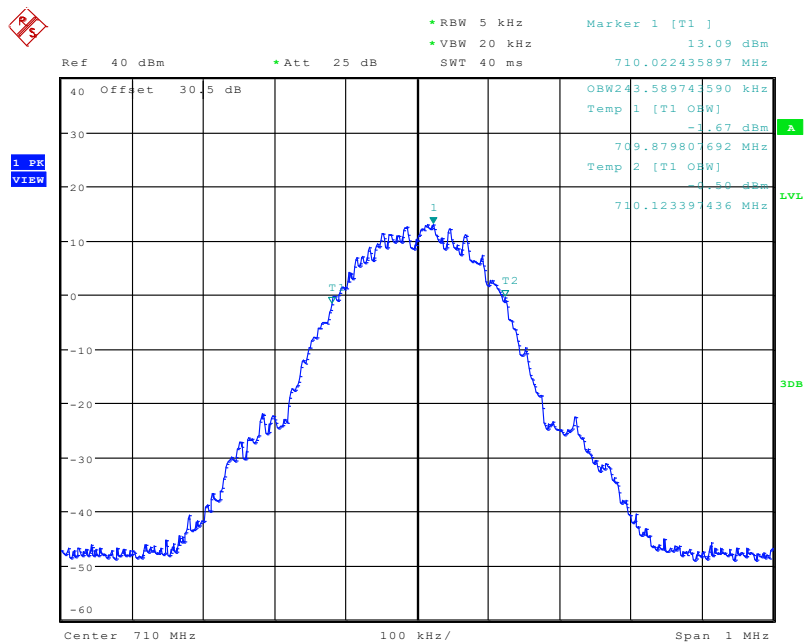
709.878205128 MHz

Temp 2 [T1 OSW] -47.42 dBm

710.125000000 MHz

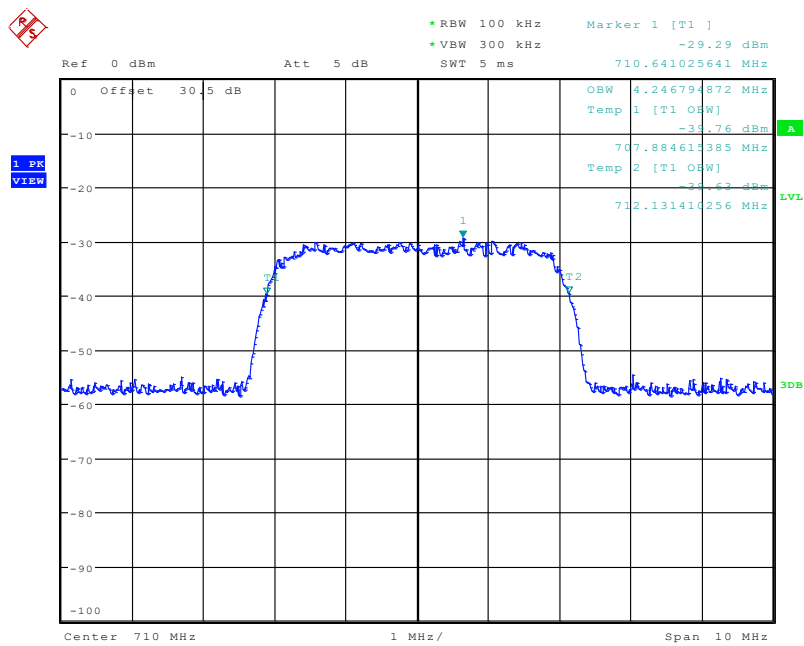
Center 710 MHz 100 kHz/ Span 1 MHz

Uplink, 710MHz-GSM (Output)



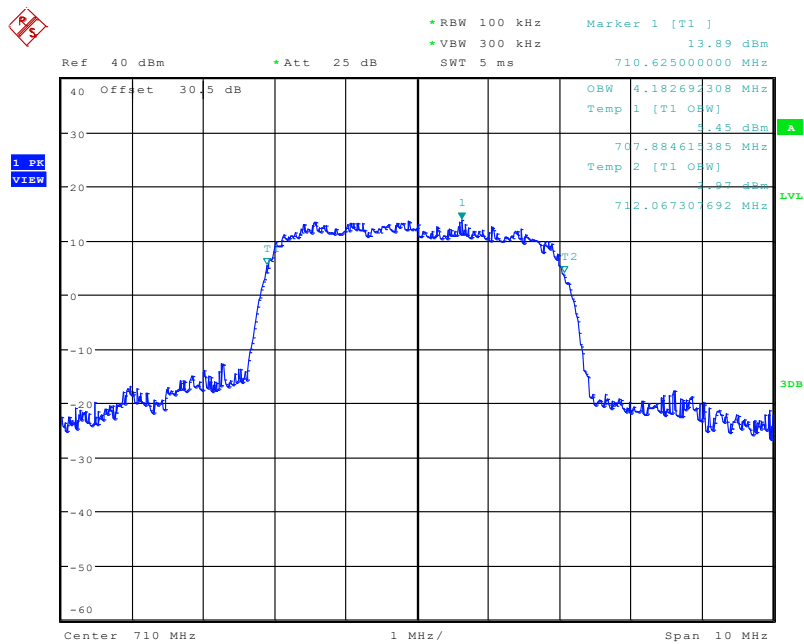
FCC Part 20.21

Uplink, 710MHz-WCDMA (Input)



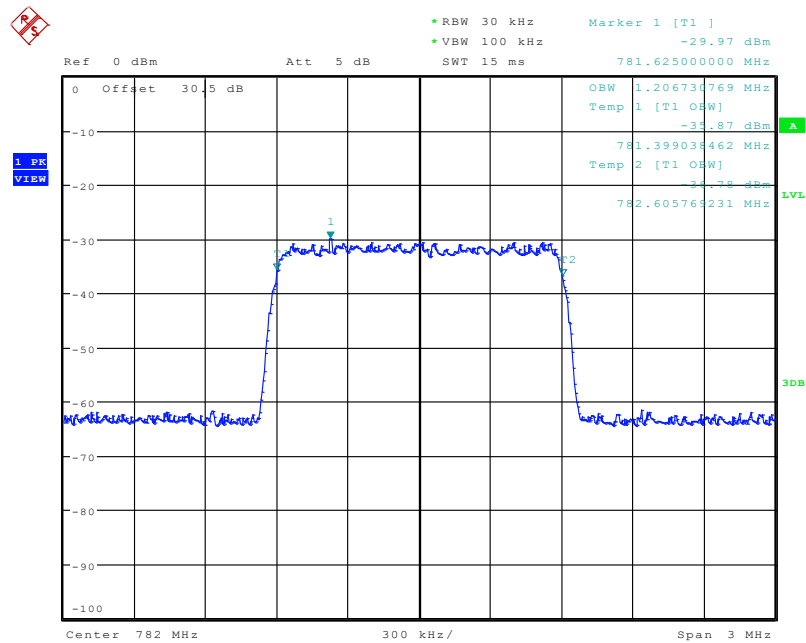
Date: 23.SEP.2022 11:09:27

Uplink, 710MHz-WCDMA (Output)



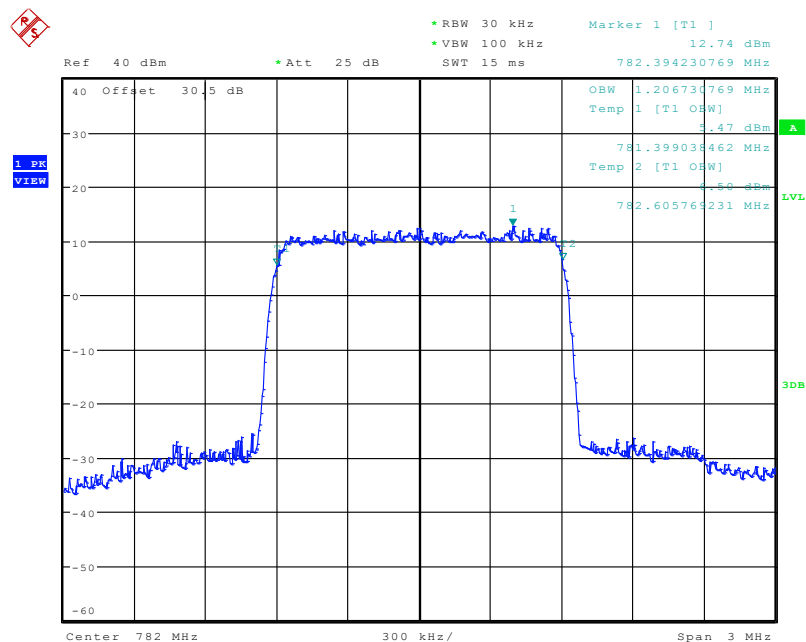
Date: 23.SEP.2022 14:30:11

Uplink, 782MHz-CDMA (Input)



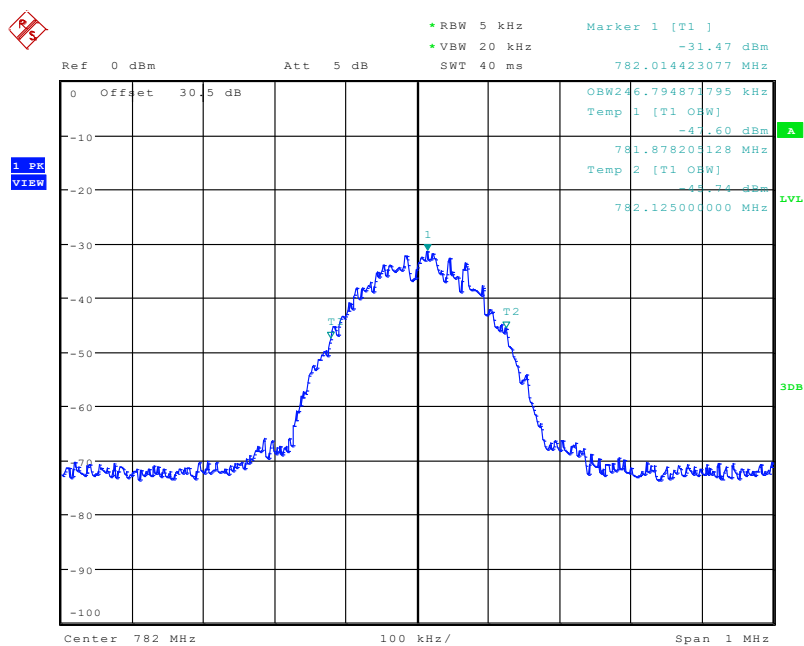
Date: 23.SEP.2022 11:15:41

Uplink, 782MHz-CDMA (Output)



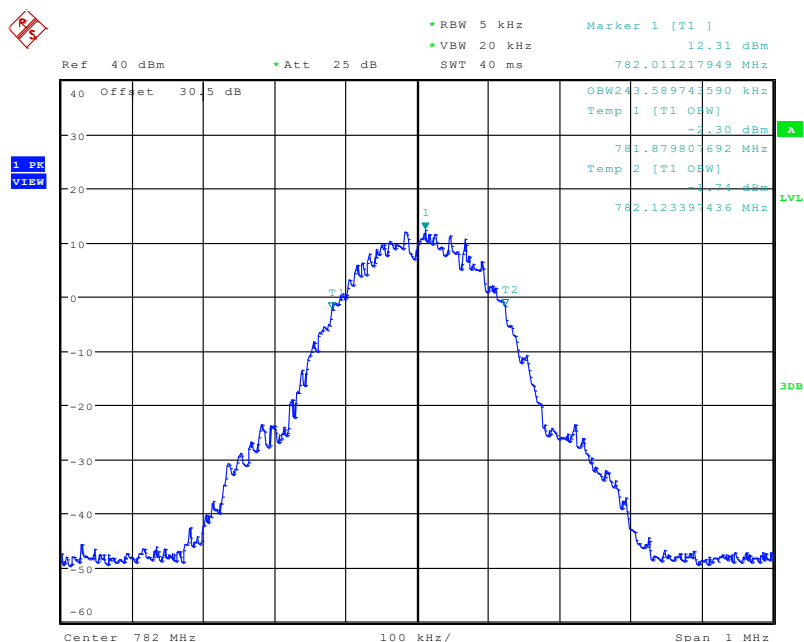
Date: 23.SEP.2022 14:34:00

Uplink, 782MHz-GSM (Input)



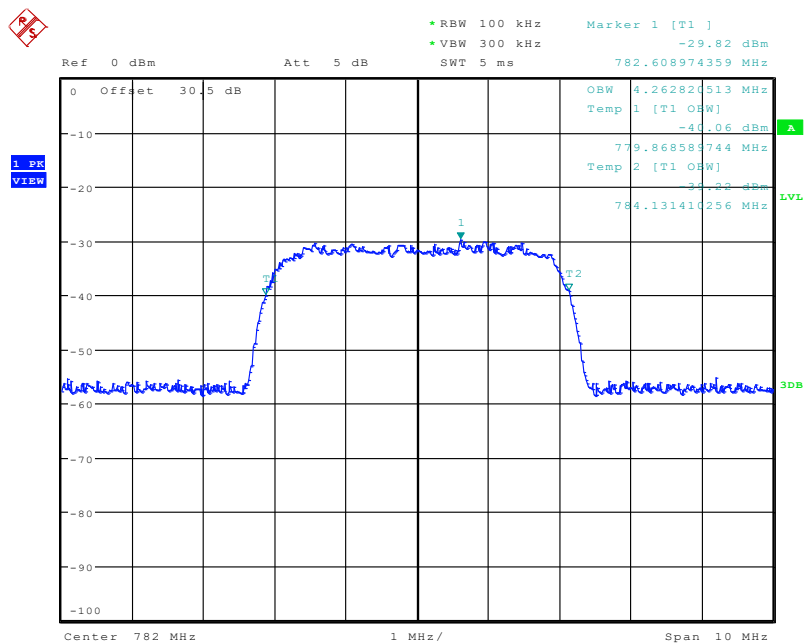
Date: 23.SEP.2022 11:18:10

Uplink, 782MHz-GSM (Output)



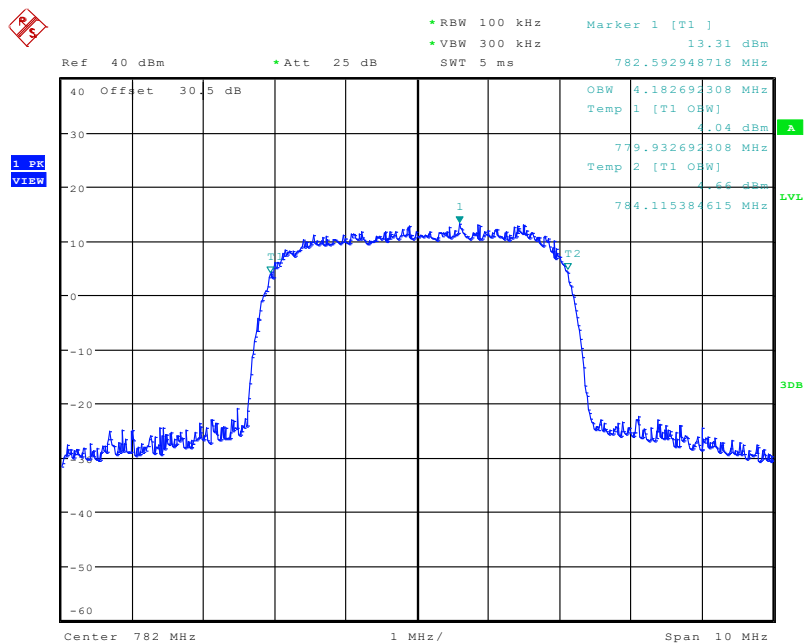
Date: 23.SEP.2022 14:35:08

Uplink, 782MHz-WCDMA (Input)

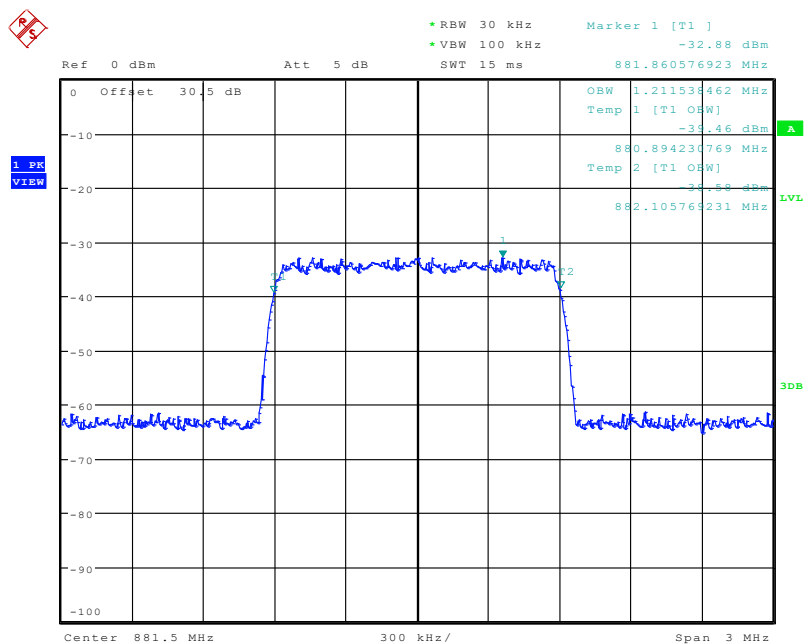


Date: 23.SEP.2022 11:11:27

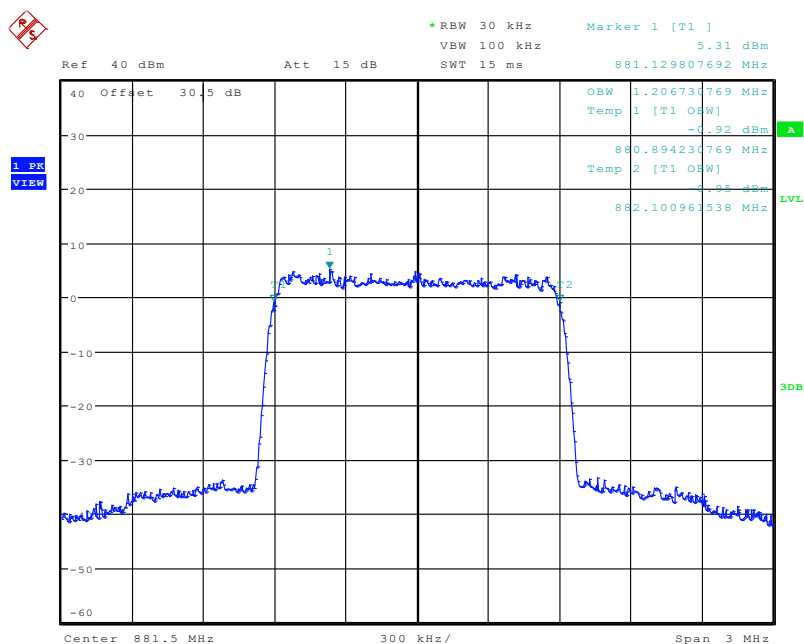
Uplink, 782MHz-WCDMA (Output)



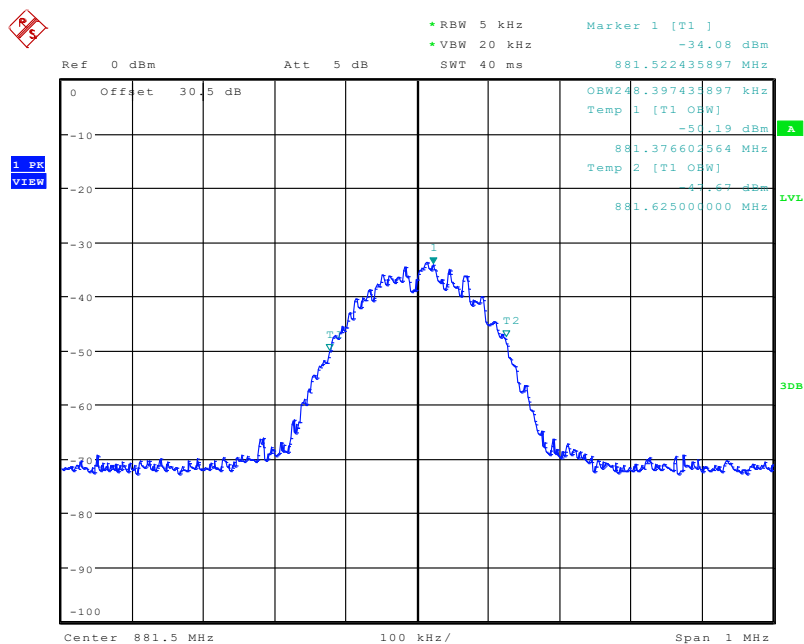
Date: 23.SEP.2022 14:32:50

Downlink, 881.5MHz-CDMA (Input)

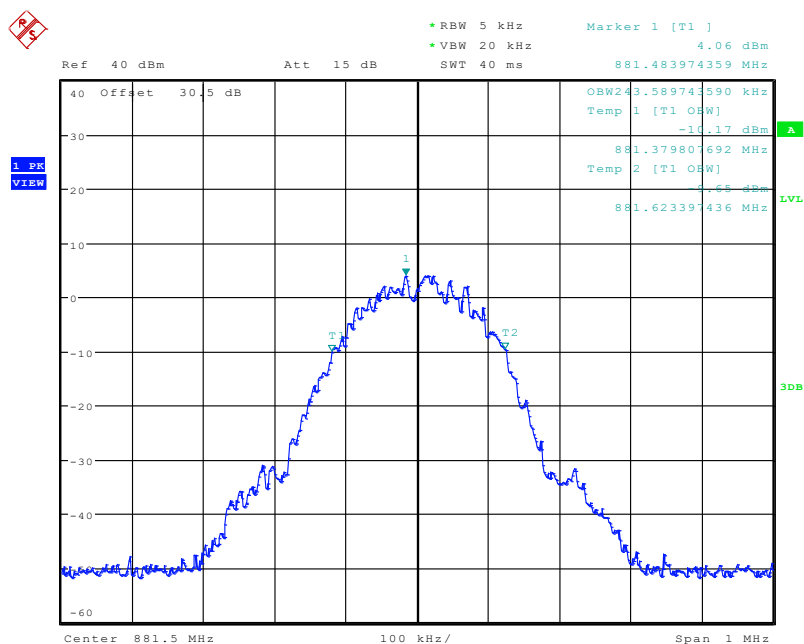
Date: 23.SEP.2022 14:10:24

Downlink, 881.5MHz-CDMA (Output)

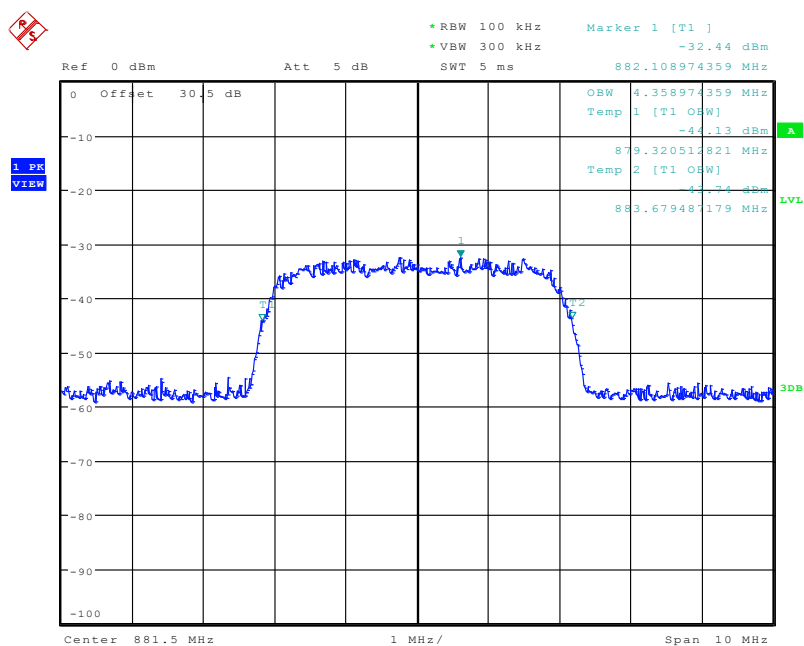
Date: 23.SEP.2022 15:10:13

Downlink, 881.5MHz-GSM (Input)

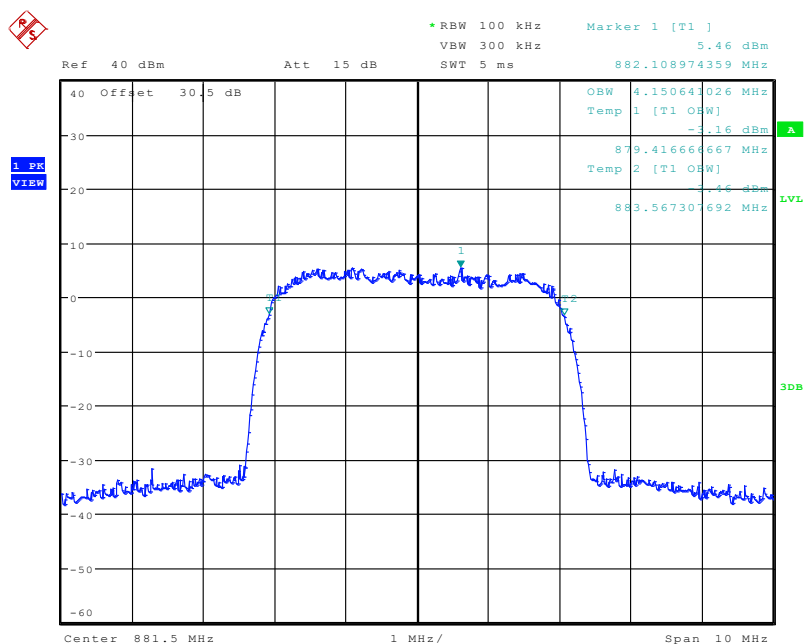
Date: 23.SEP.2022 14:08:29

Downlink, 881.5MHz-GSM (Output)

Date: 23.SEP.2022 15:11:44

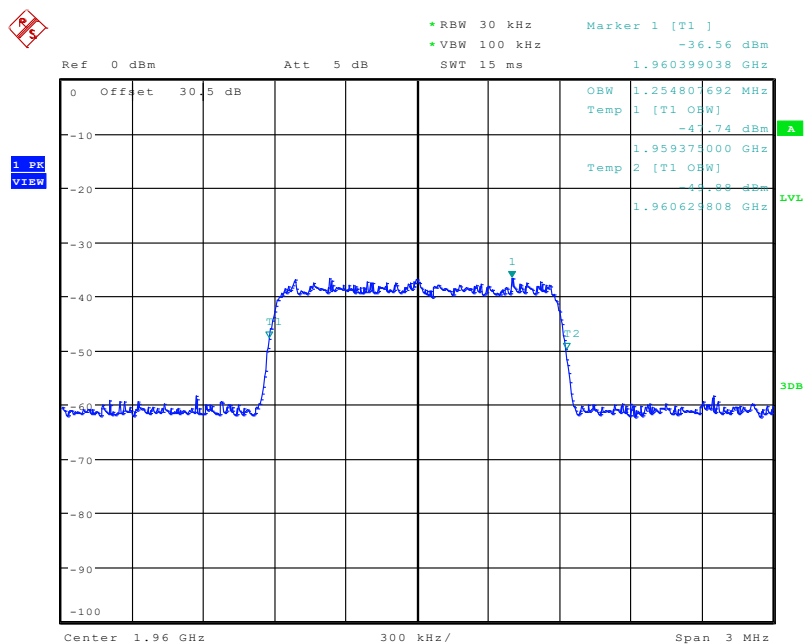
Downlink, 881.5MHz-WCDMA (Input)

Date: 23.SEP.2022 14:12:59

Downlink, 881.5MHz-WCDMA (Output)

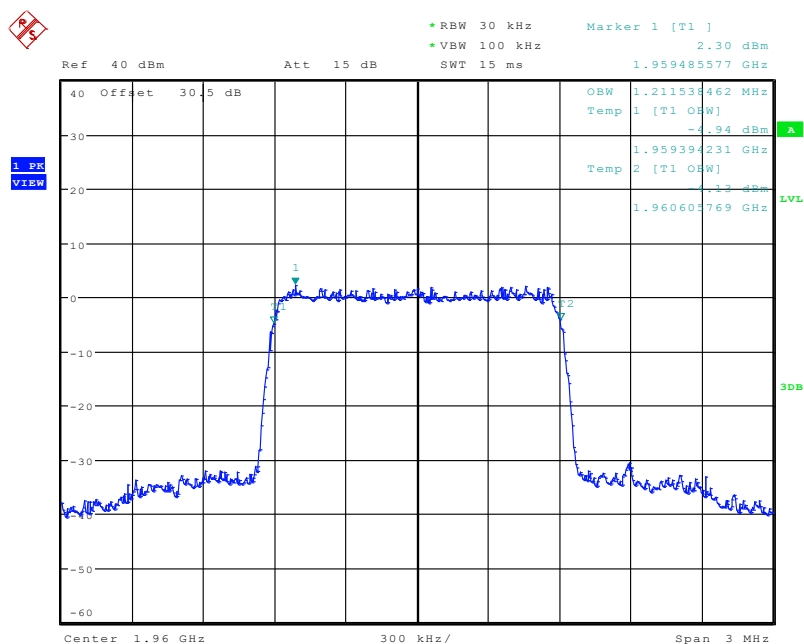
Date: 23.SEP.2022 15:09:03

Downlink, 1960MHz-CDMA (Input)

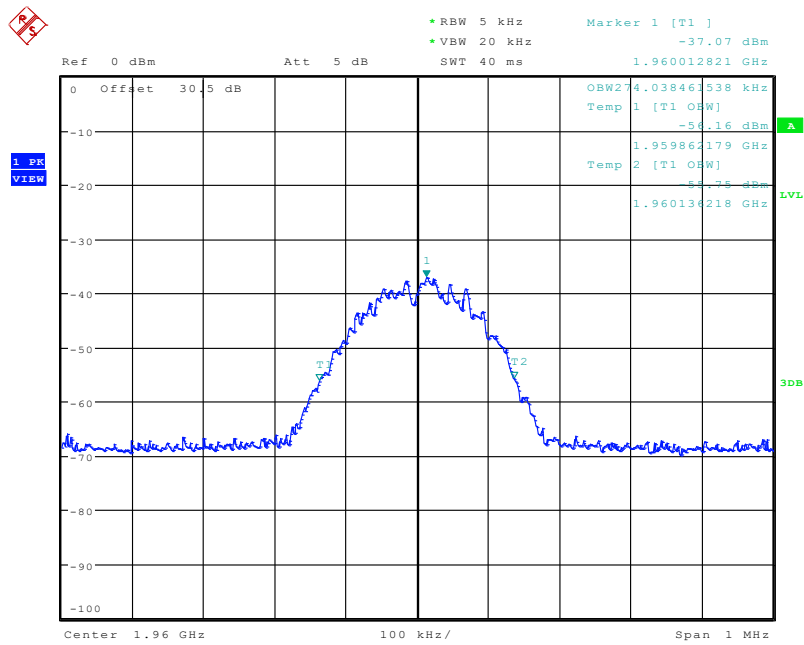


Date: 23.SEP.2022 13:56:14

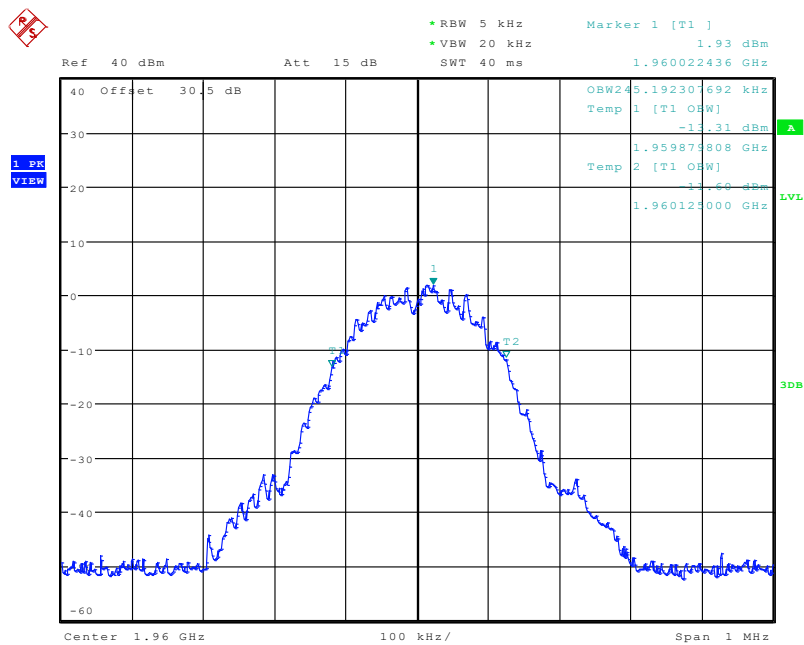
Downlink, 1960MHz-CDMA (Output)



Date: 23.SEP.2022 15:14:33

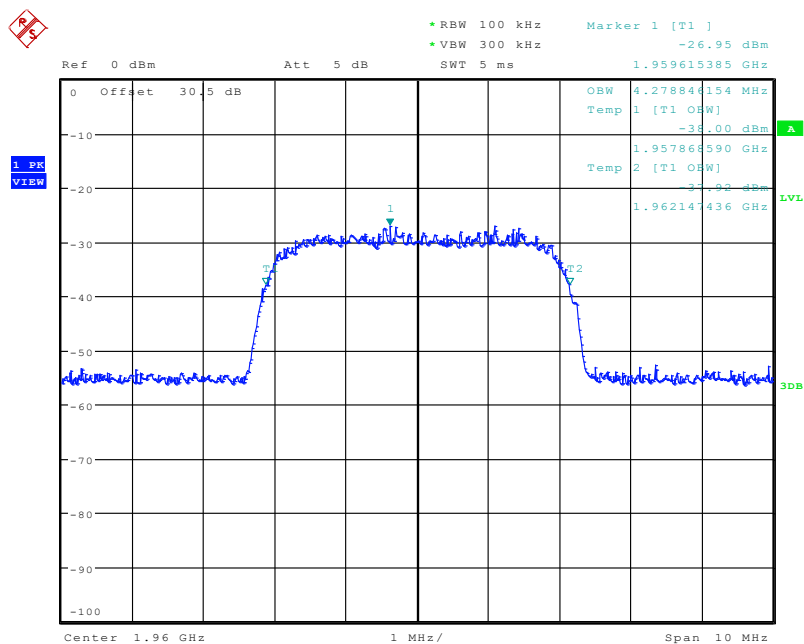
Downlink, 1960MHz-GSM (Input)

Date: 23.SEP.2022 13:54:09

Downlink, 1960MHz-GSM (Output)

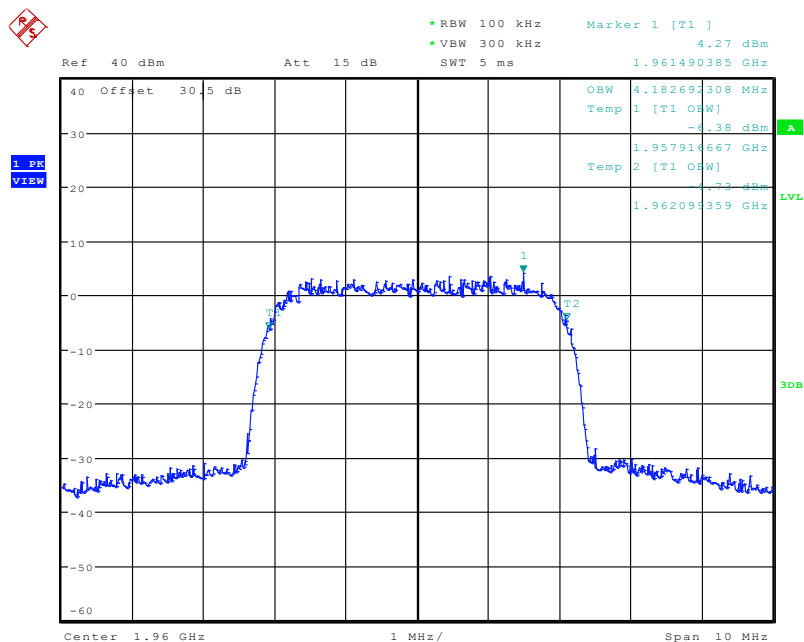
Date: 23.SEP.2022 15:13:19

Downlink, 1960MHz-WCDMA (Input)

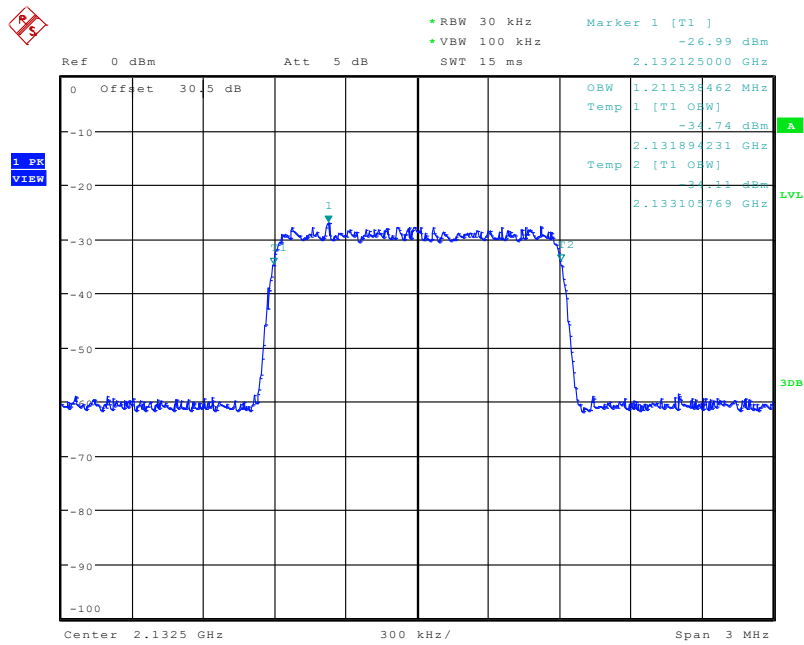


Date: 23.SEP.2022 13:57:39

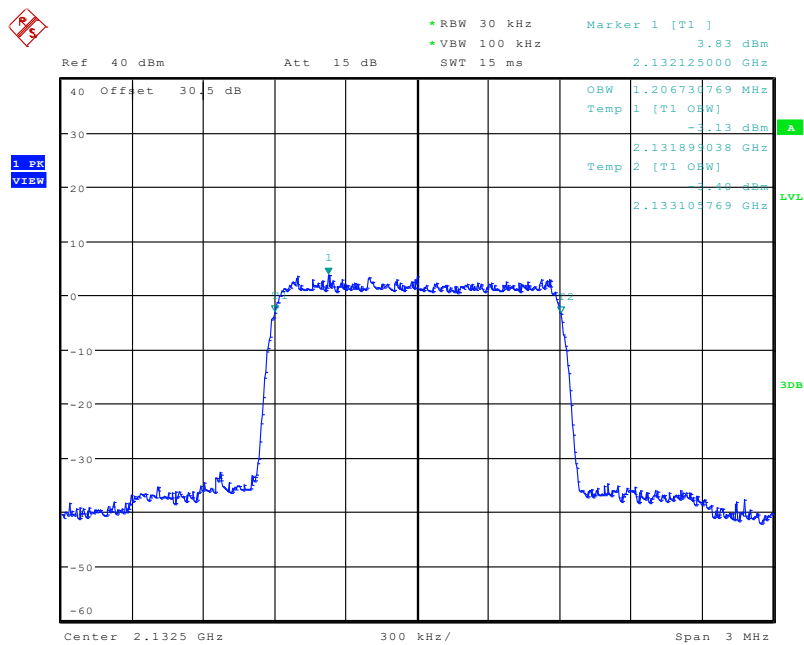
Downlink, 1960MHz-WCDMA (Output)



Date: 23.SEP.2022 15:15:34

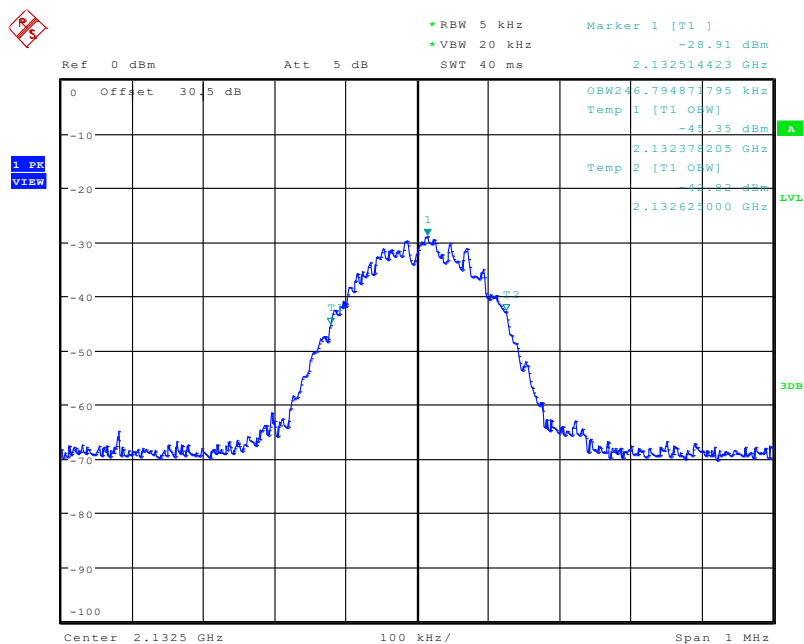
Downlink, 2132.5MHz-CDMA (Input)

Date: 23.SEP.2022 14:02:56

Downlink, 2132.5MHz-CDMA (Output)

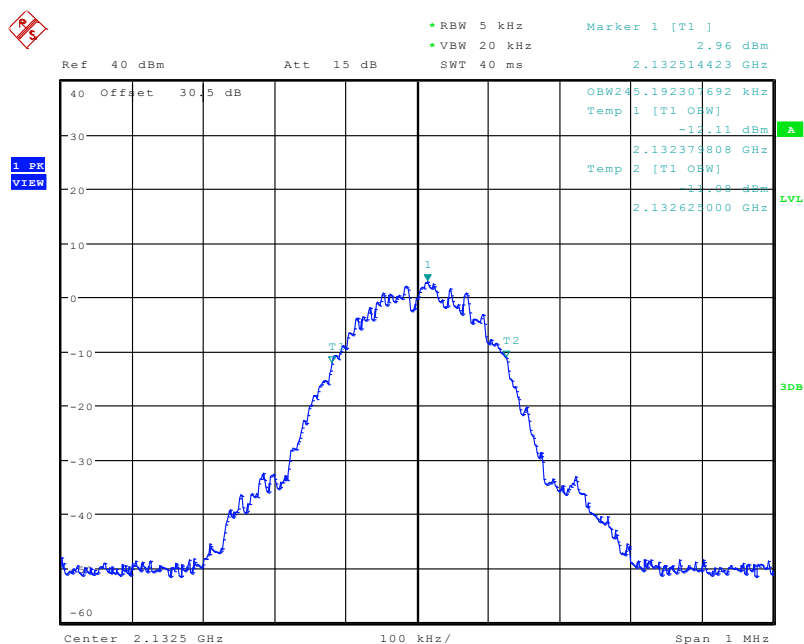
Date: 23.SEP.2022 15:19:58

Downlink, 2132.5MHz-GSM (Input)

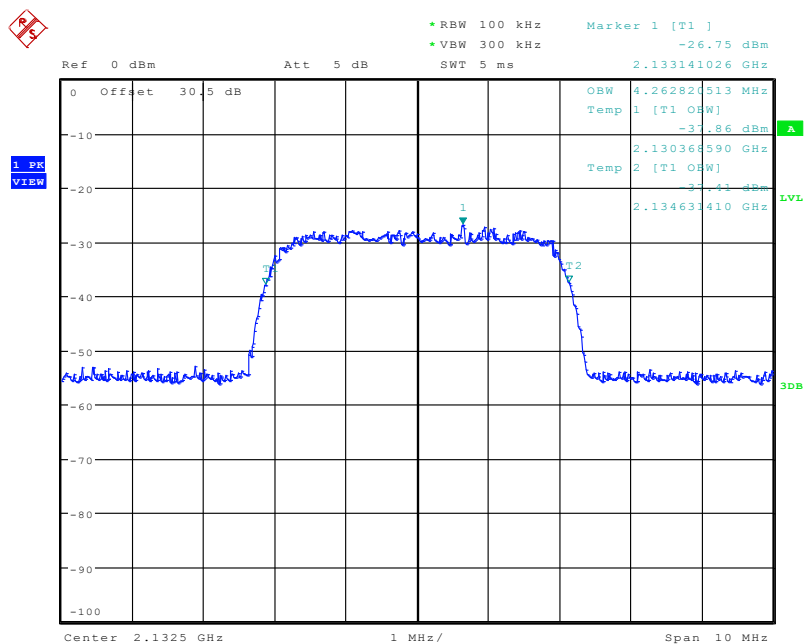


Date: 23.SEP.2022 14:04:21

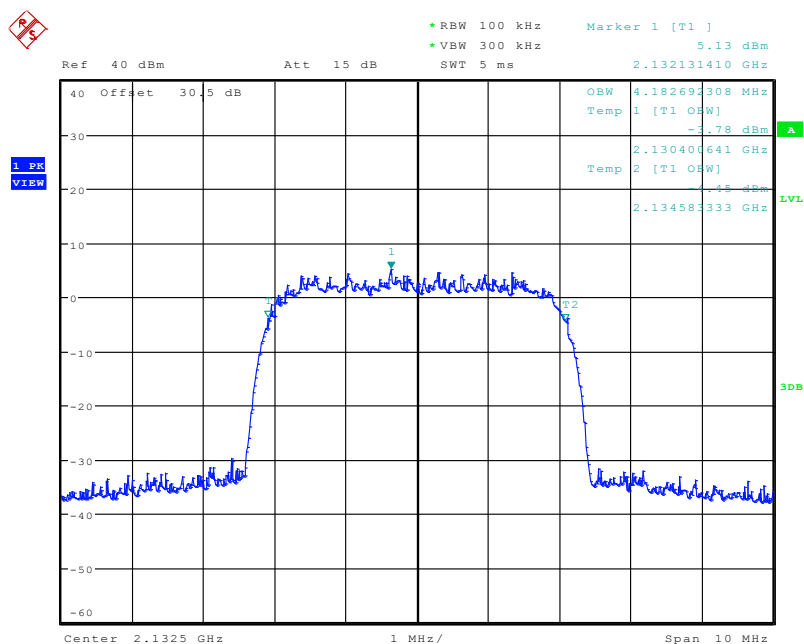
Downlink, 2132.5MHz-GSM (Output)



Date: 23.SEP.2022 15:21:18

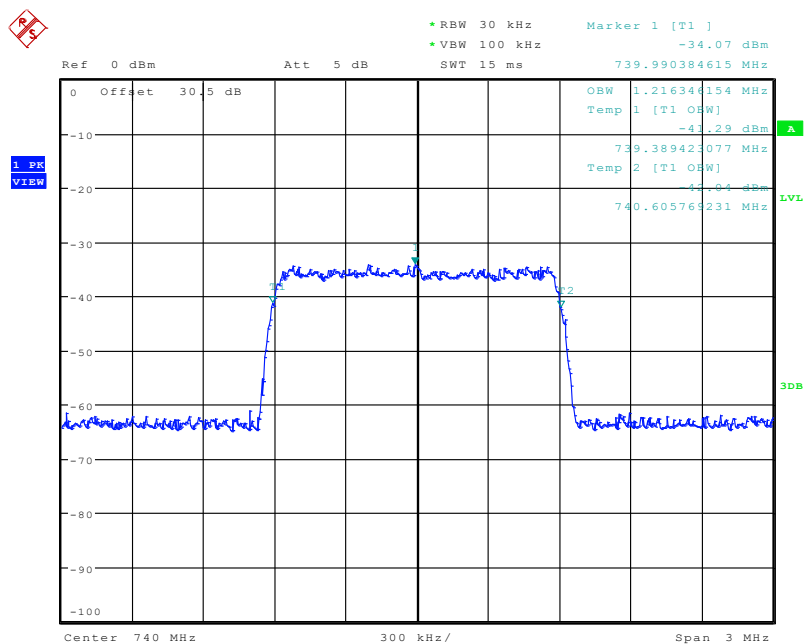
Downlink, 2132.5MHz-WCDMA (Input)

Date: 23.SEP.2022 14:00:13

Downlink, 2132.5MHz-WCDMA (Output)

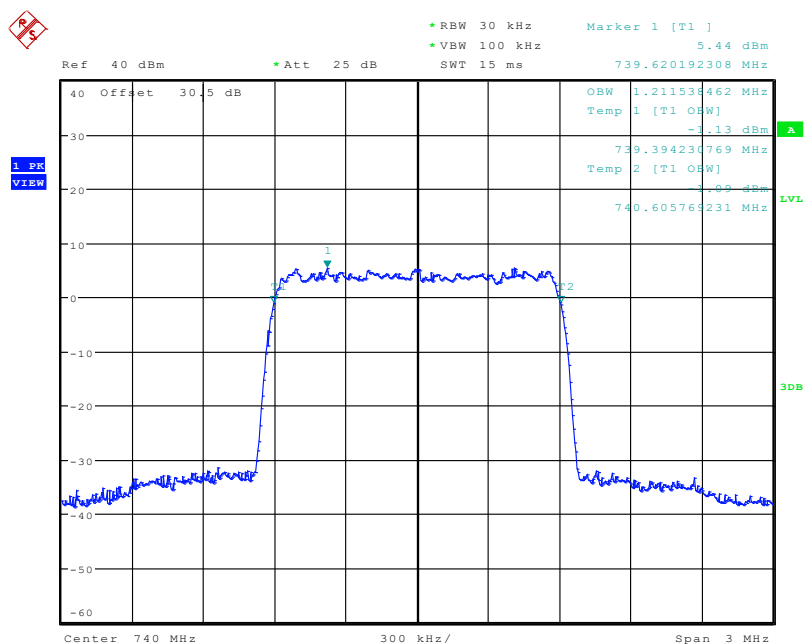
Date: 23.SEP.2022 15:16:48

Downlink, 740MHz-CDMA (Input)



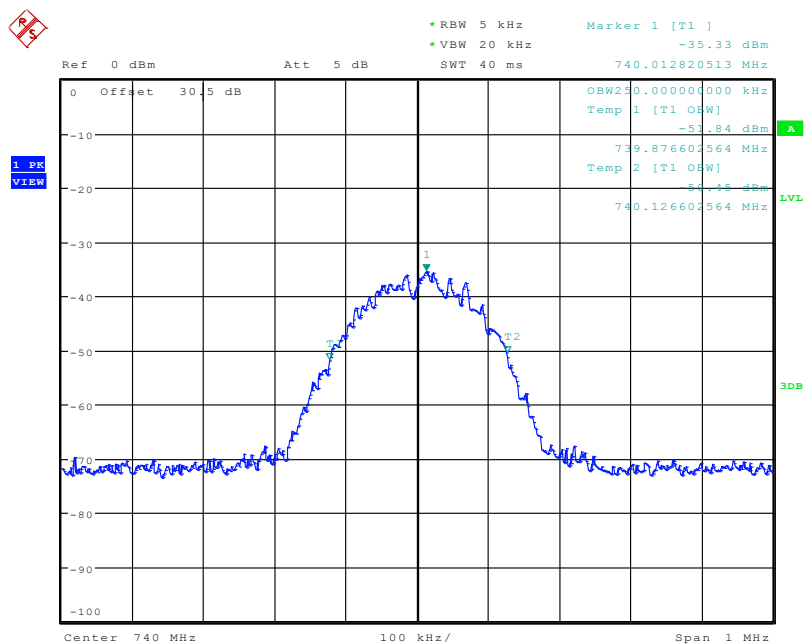
Date: 23.SEP.2022 13:27:10

Downlink, 740MHz-CDMA (Output)



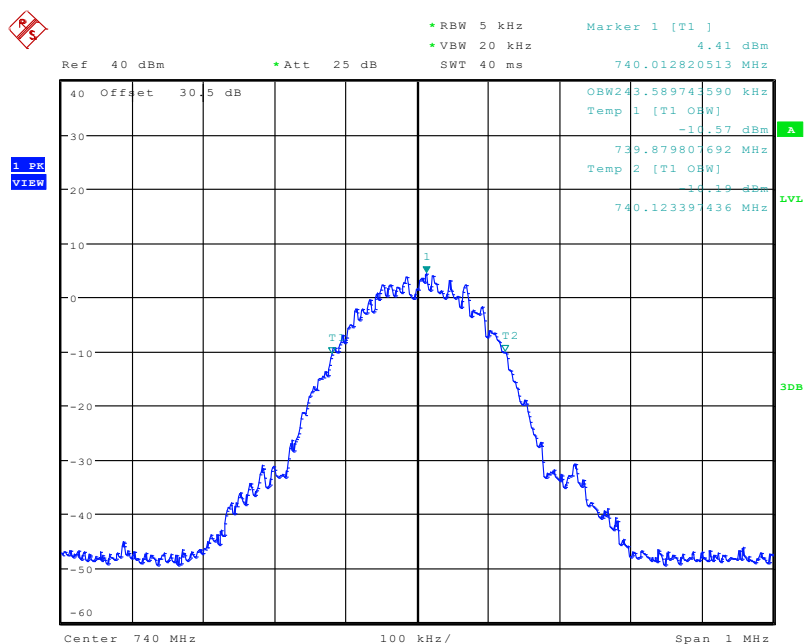
Date: 23.SEP.2022 15:00:12

Downlink, 740MHz-GSM (Input)



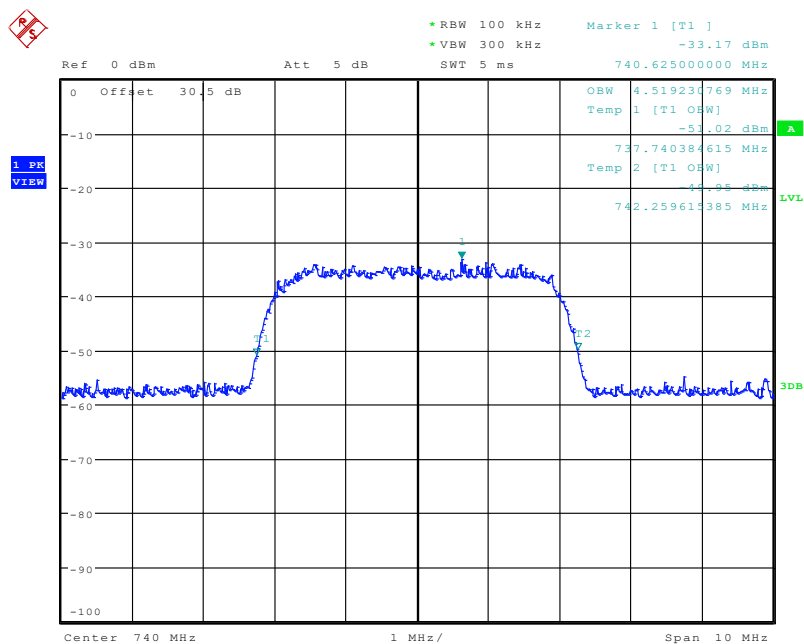
Date: 23.SEP.2022 13:28:53

Downlink, 740MHz-GSM (Output)



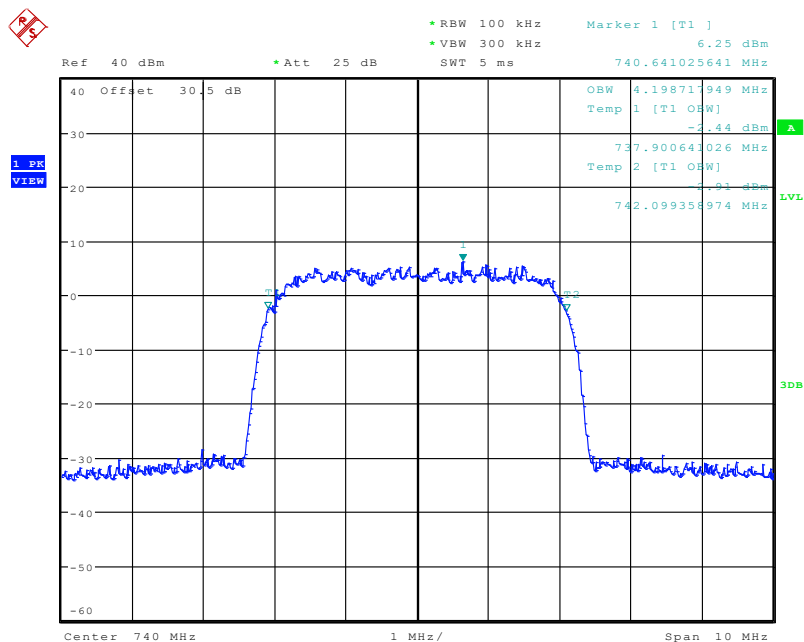
Date: 23.SEP.2022 15:02:01

Downlink, 740MHz-WCDMA (Input)

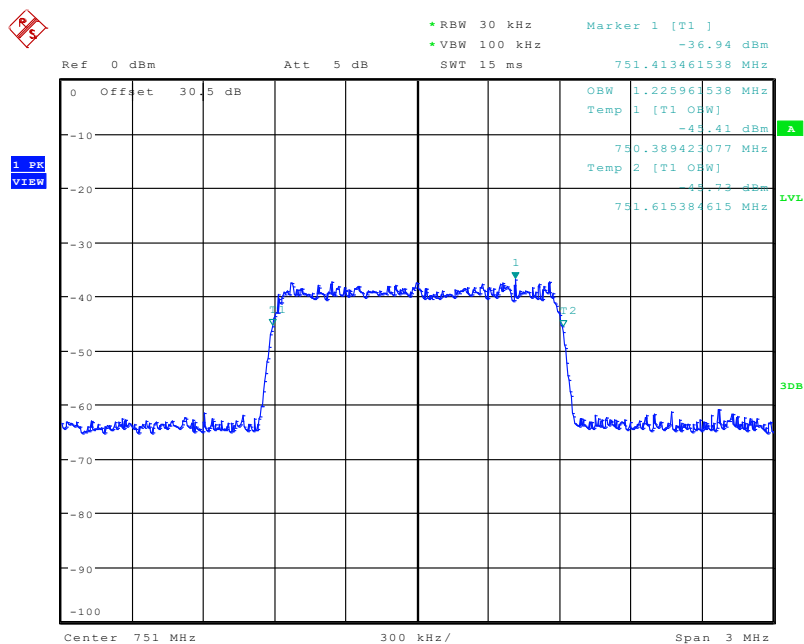


Date: 23.SEP.2022 13:25:39

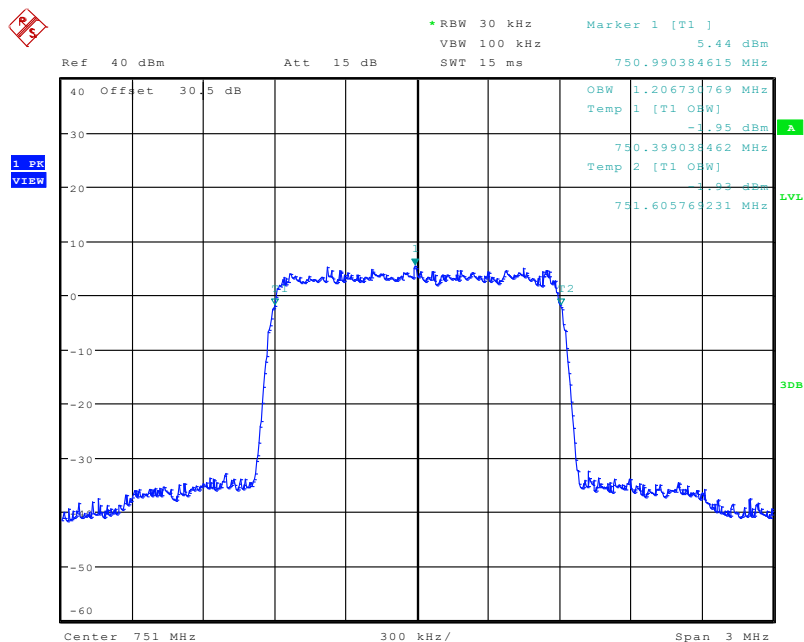
Downlink, 740MHz-WCDMA (Output)



Date: 23.SEP.2022 14:56:54

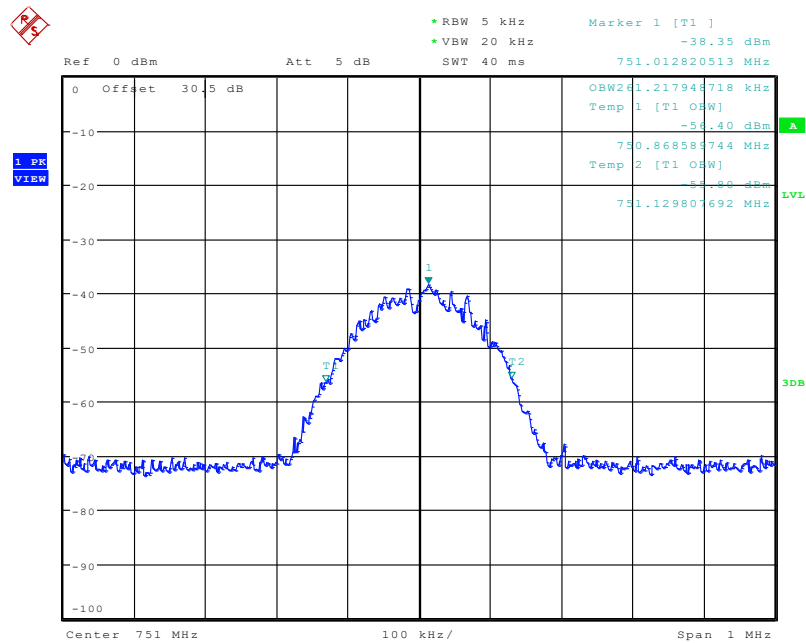
Downlink, 751MHz-CDMA (Input)

Date: 23.SEP.2022 13:37:03

Downlink, 751MHz-CDMA (Output)

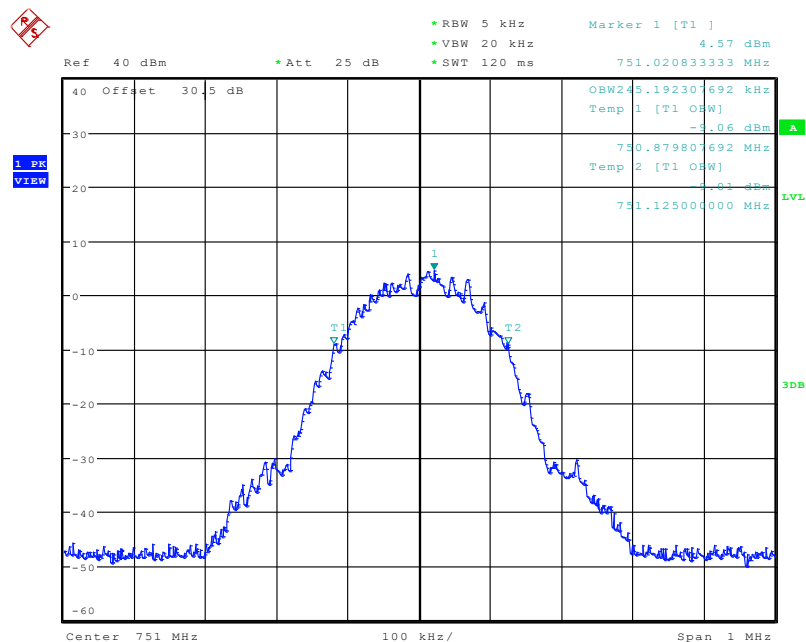
Date: 23.SEP.2022 15:06:51

Downlink, 751MHz-GSM (Input)

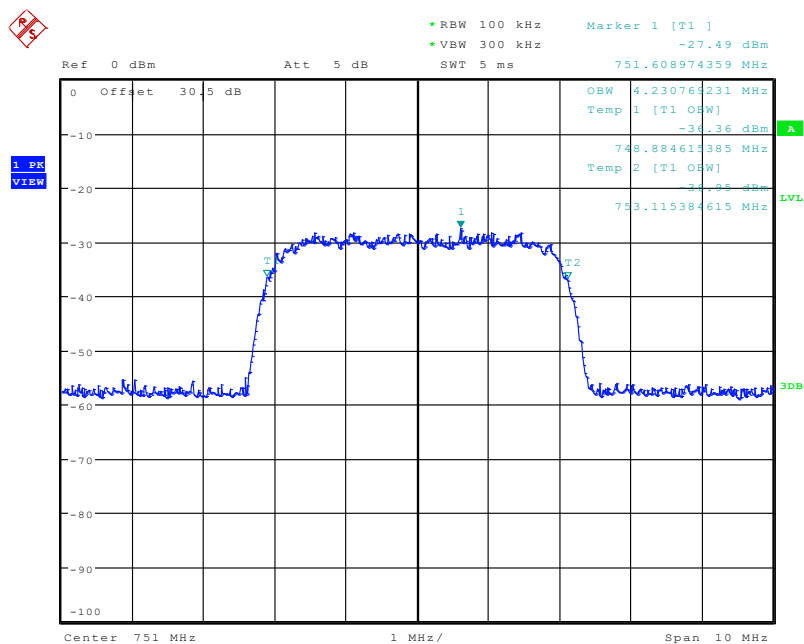


Date: 23.SEP.2022 13:34:33

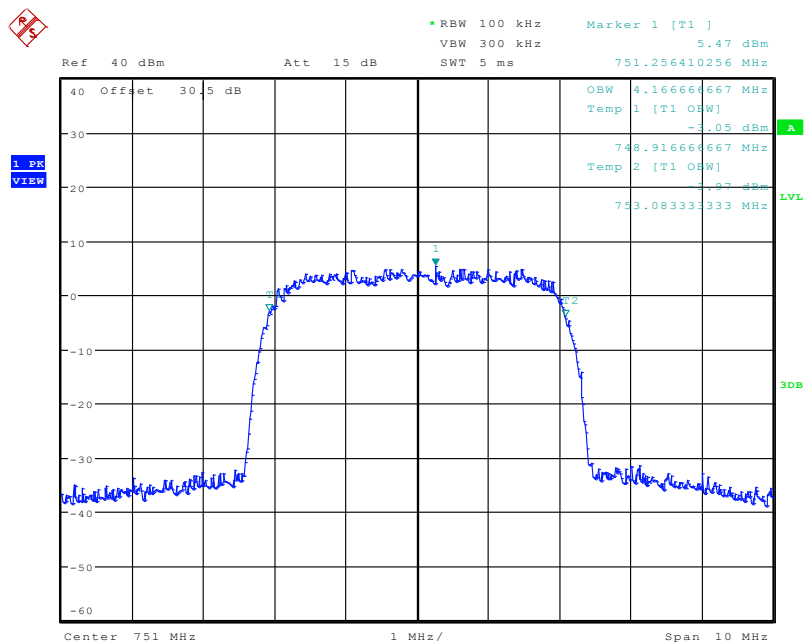
Downlink, 751MHz-GSM (Output)



Date: 23.SEP.2022 15:04:29

Downlink, 751MHz-WCDMA (Input)

Date: 23.SEP.2022 13:40:09

Downlink, 751MHz-WCDMA (Output)

Date: 23.SEP.2022 15:07:51

§ 20.21(e)(8)(ii)(A) & §20.21(e)(4) - OSCILLATION DETECTION

Applicable Standards

Rule paragraph(s): § 20.21(e)(8)(ii)(A) Anti-Oscillation, §20.21(e)(4) Self-monitoring

For this measurement two EUTs will be permitted, one operating in a normal mode and the second operating in a test mode that is capable of disabling the uplink inactivity squelching and or a reduction of the time between restarts to 5 seconds. This will greatly decrease the test time required.

NOTE — Consumer boosters certified as direct connection mobile boosters having gain of less than or equal to 15 dB are exempt from compliance to testing procedures in 7.11.3 and 7.11.4.

Test Procedure

According to KDB 935210 D03 Cellphone Signal Amplifier Measurements v04, §7.11.2 Oscillation restart tests and

§7.11.3 Test procedure for measuring oscillation mitigation or shutdown

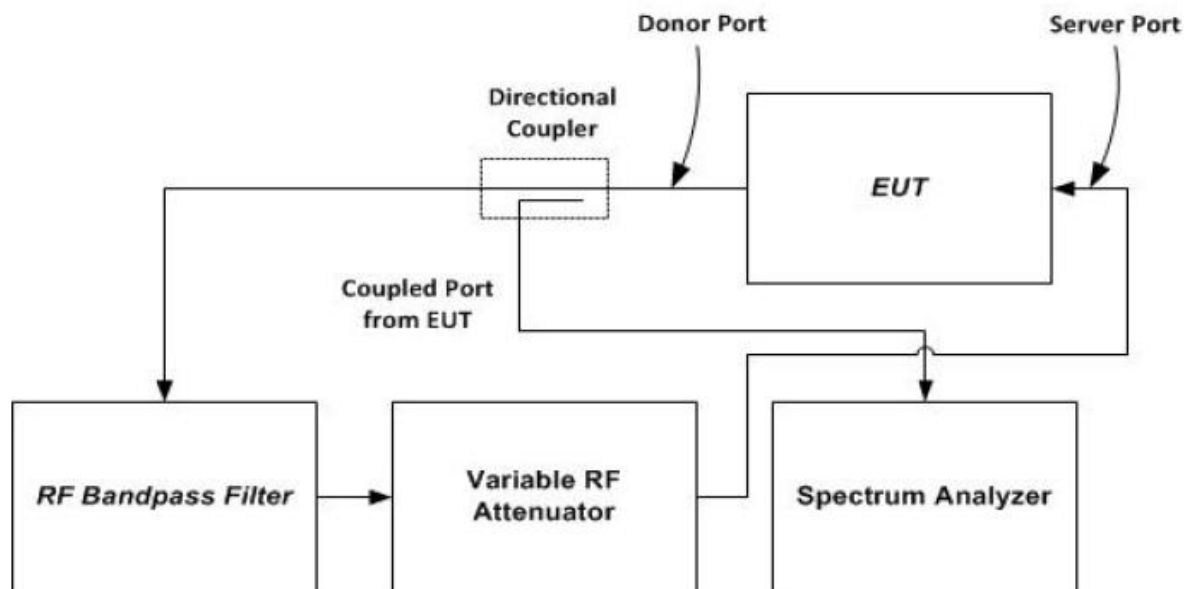


Figure 7 – Oscillation detection instrumentation test setup

Test Data

Environmental Conditions

Temperature:	24.6 °C
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Andy Yu from 2022-11-07 to 2023-02-25.

Test Result: Pass

Please refer to following table and plots.

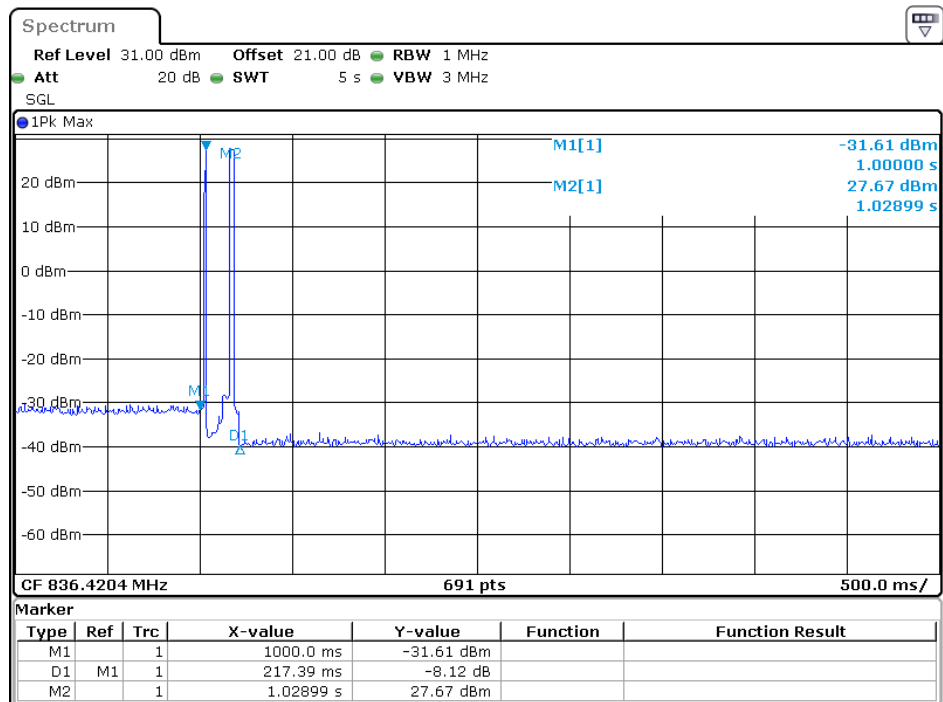
Mode	Operation Bands	Detection Time (s)		Power level dBm	Between restart time (s)		Number of restart		Result
		Reading	Limit		Reading	Limit	Reading	Limit	
Uplink	Lower 700	0.159	0.3	26.90	63.04	60	3	5	Compliance
	Upper 700	0.174		27.31	63.04		3		Compliance
	Cellular	0.217		27.67	63.04		3		Compliance
	PCS	0.152		23.81	63.04		3		Compliance
	AWS	0.196		26.92	63.48		3		Compliance
Downlink	700MHz Band	0.145	1	23.89	63.04	60	3	5	Compliance
	Cellular	0.217		21.53	63.48		3		Compliance
	PCS	0.101		25.38	63.04		3		Compliance
	AWS	0.101		22.57	63.48		3		Compliance

Oscillation Mitigation or Shutdown:

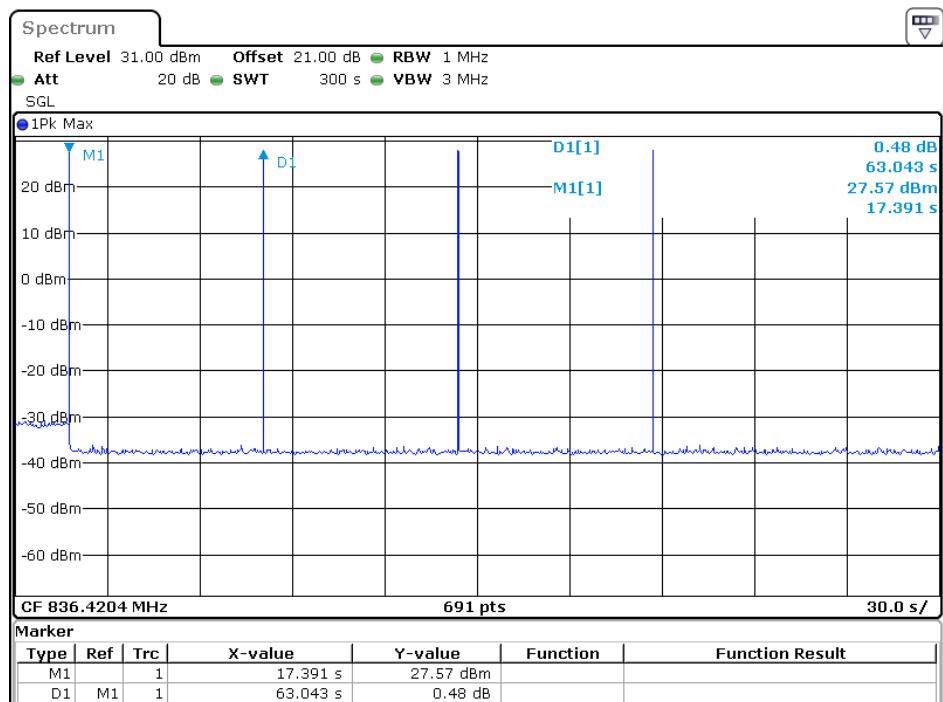
Mode	Operation Band	Max gain dB	Isolation dB	Difference dB	Limit dB	Result
Uplink	Lower 700MHz	63.08	+5	-10.78	12.00	Compliance
			+4	-12.23	12.00	Compliance
			+3	/	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	Upper 700MHz	62.63	+5	-10.52	12.00	Compliance
			+4	-12.37	12.00	Compliance
			+3	/	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	Cellular	63.33	+5	-11.43	12.00	Compliance
			+4	-14.73	12.00	Compliance
			+3	/	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	PCS	66.24	+5	-14.09	12.00	Compliance
			+4	/	12.00	Compliance
			+3	/	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	AWS	68.15	+5	-9.47	12.00	Compliance
			+4	-12.14	12.00	Compliance
			+3	/	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance

			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
Downlink	700MHz Band	63.37	+5	-8.91	12.00	Compliance
			+4	-10.70	12.00	Compliance
			+3	-13.43	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	Cellular	64.89	+5	-10.26	12.00	Compliance
			+4	-12.84	12.00	Compliance
			+3	/	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	PCS	68.72	+5	-11.83	12.00	Compliance
			+4	-13.80	12.00	Compliance
			+3	/	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	AWS	69.79	+5	-9.15	12.00	Compliance
			+4	-11.27	12.00	Compliance
			+3	-13.78	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance

Note: The measured difference exceeds the limit for a period of less than 300 seconds before device mitigate and shut down. The maximum recorded time prior to mitigate or shutdown was 95 s.

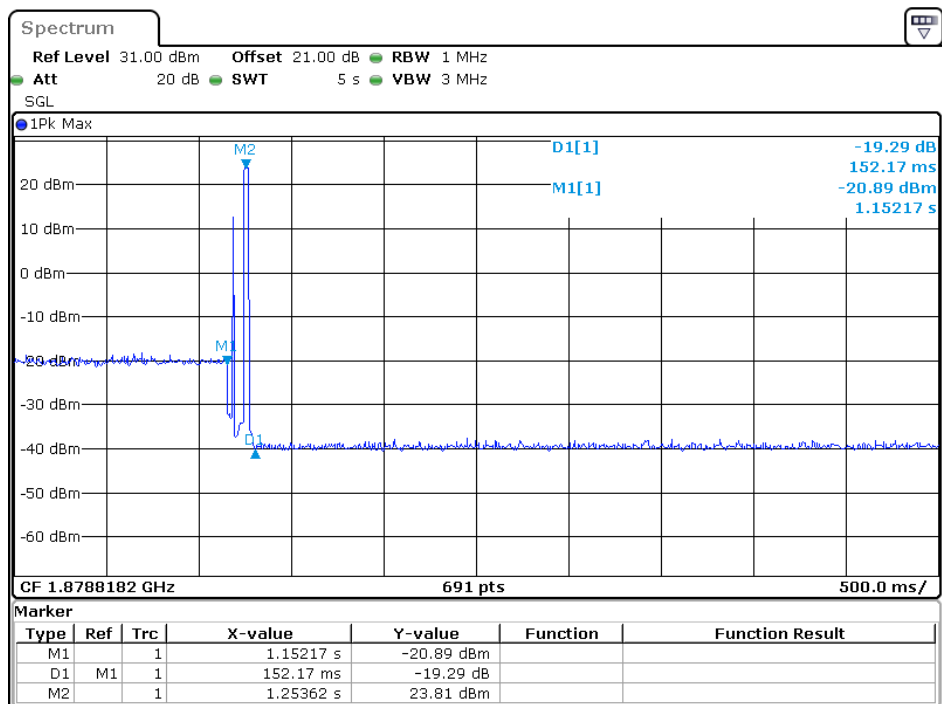
Oscillation Restart tests:**Uplink****Cellular Band**

Date: 7.NOV.2022 03:07:33

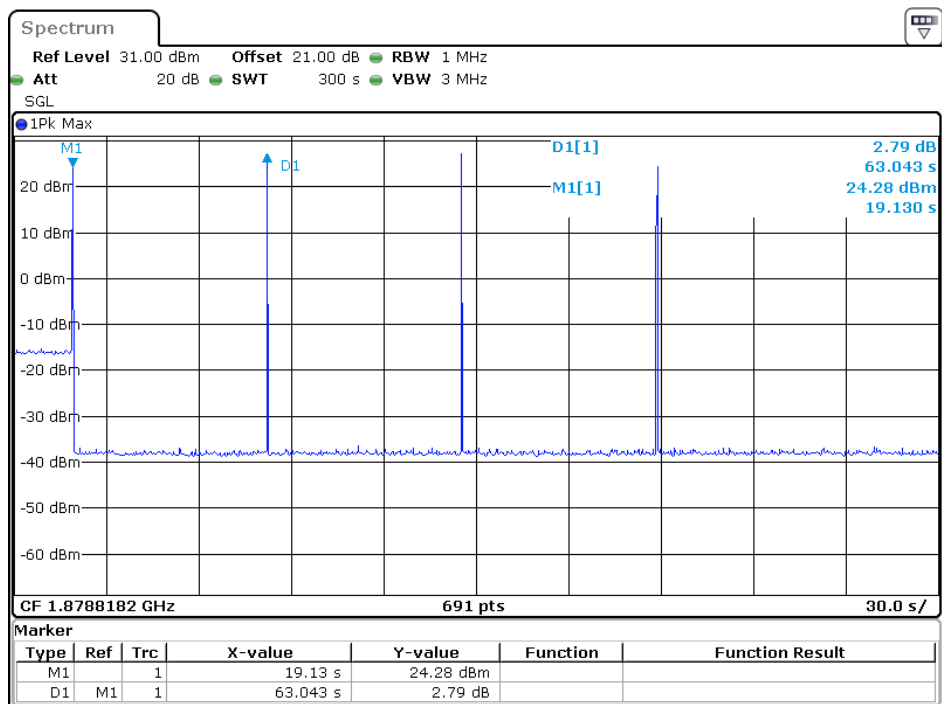


Date: 7.NOV.2022 03:14:02

PCS Band

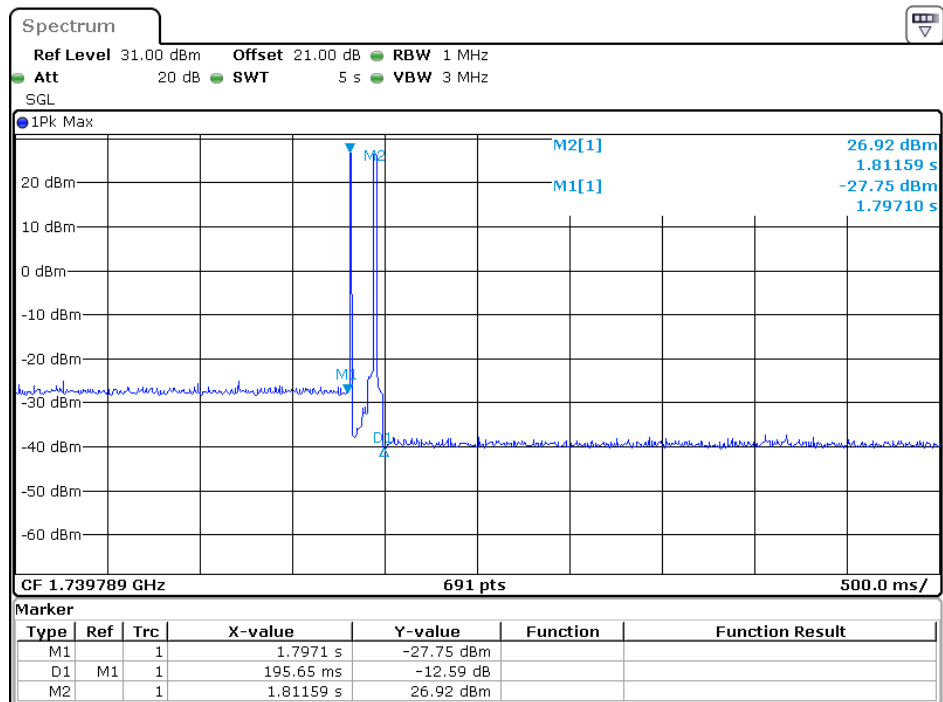


Date: 7.NOV.2022 02:18:59

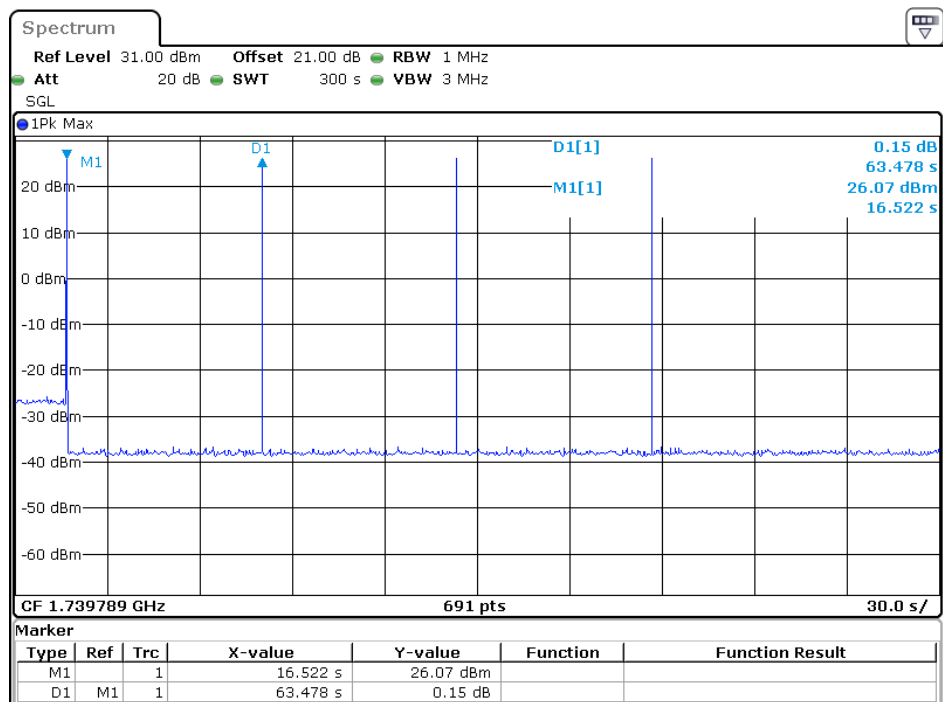


Date: 7.NOV.2022 02:32:15

AWS Band

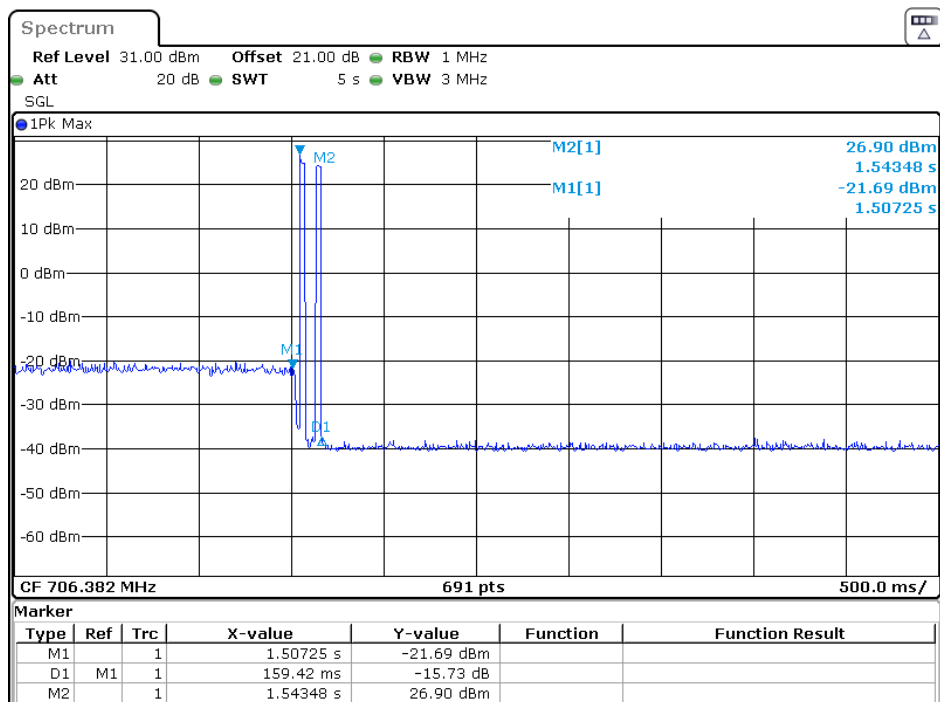


Date: 7.NOV.2022 04:03:17

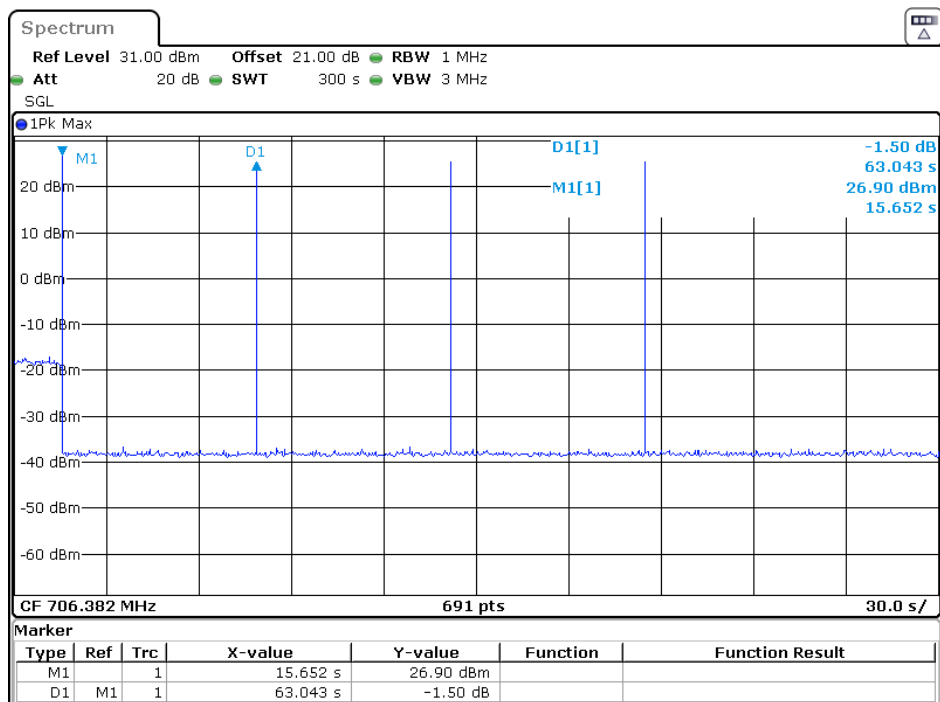


Date: 7.NOV.2022 04:09:23

Lower 700MHz

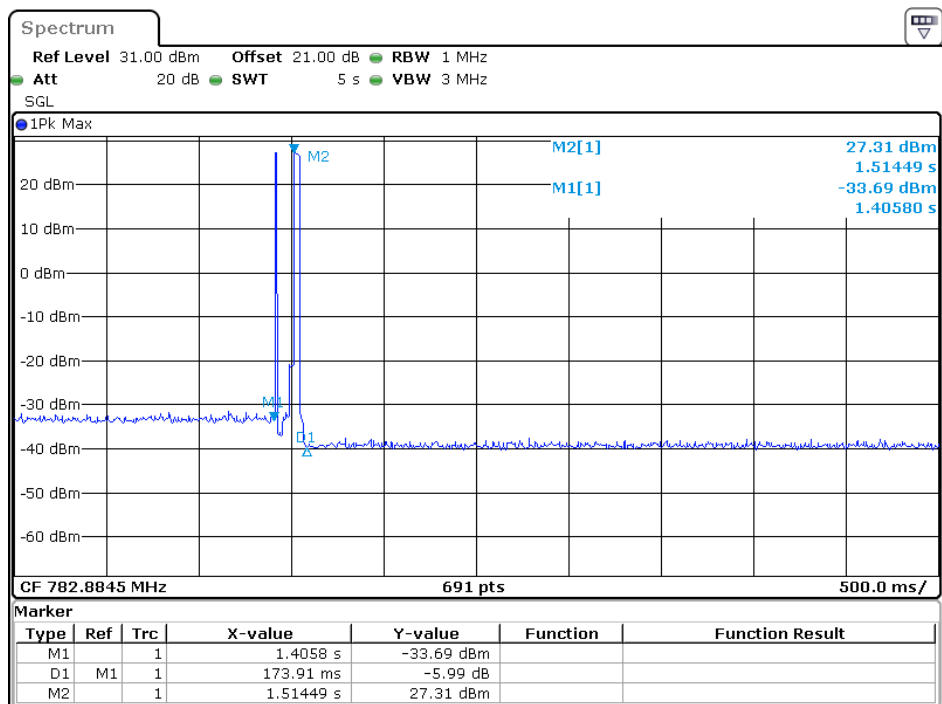


Date: 15.NOV.2022 13:20:04

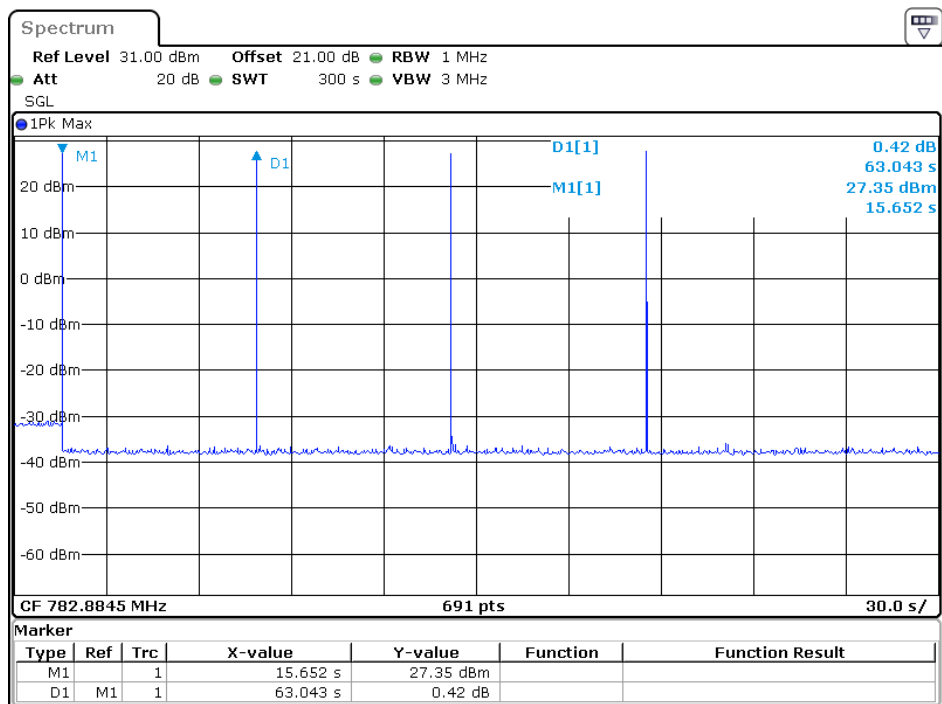


Date: 15.NOV.2022 13:26:46

Upper 700MHz



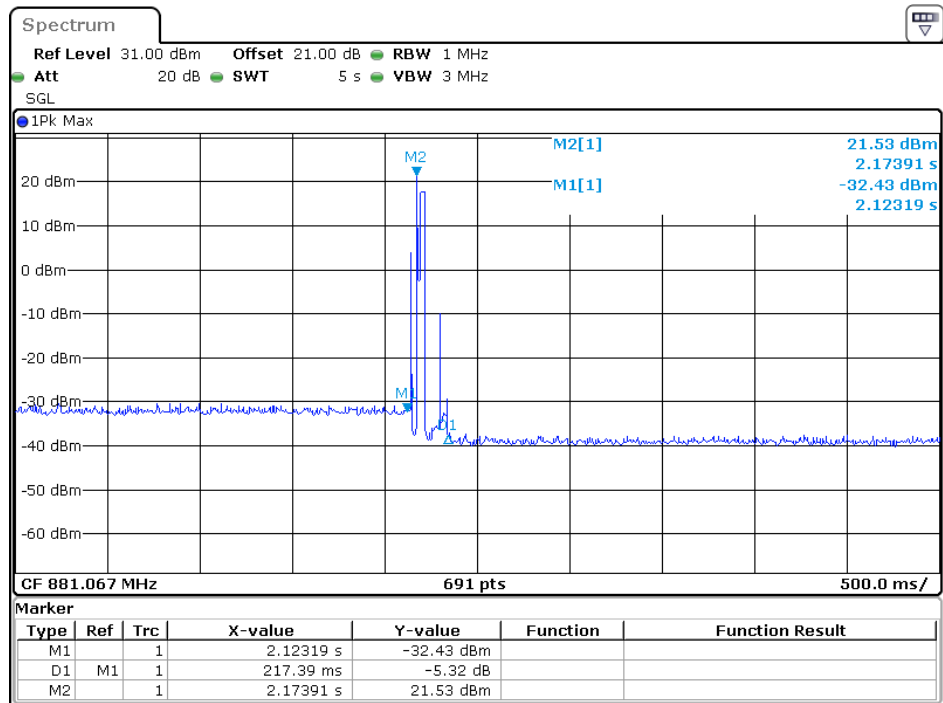
Date: 7.NOV.2022 03:20:14



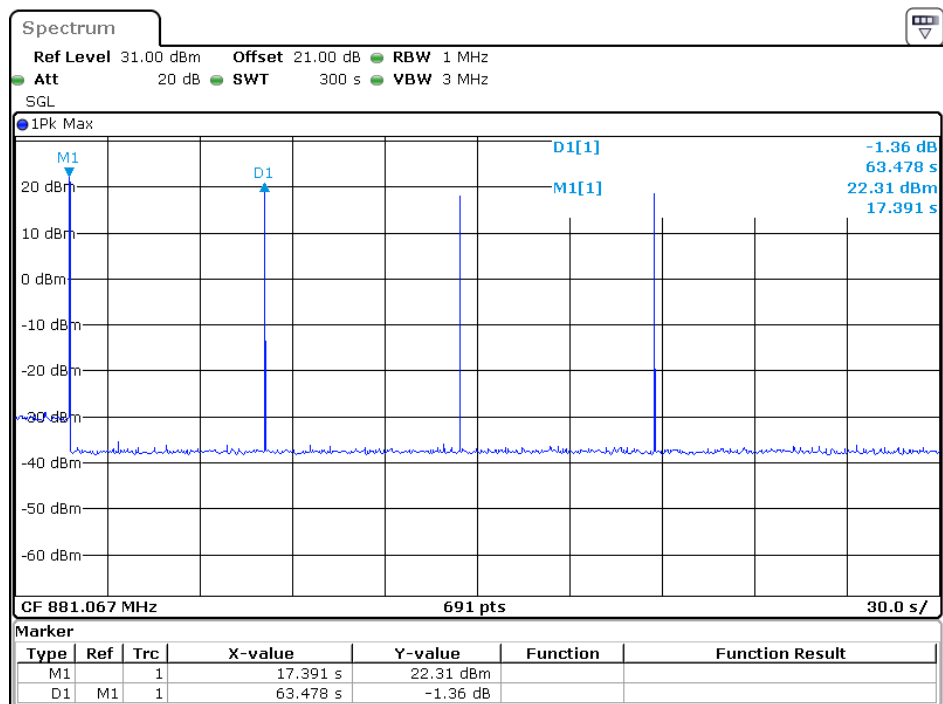
Date: 7.NOV.2022 03:26:21

Downlink

Cellular Band

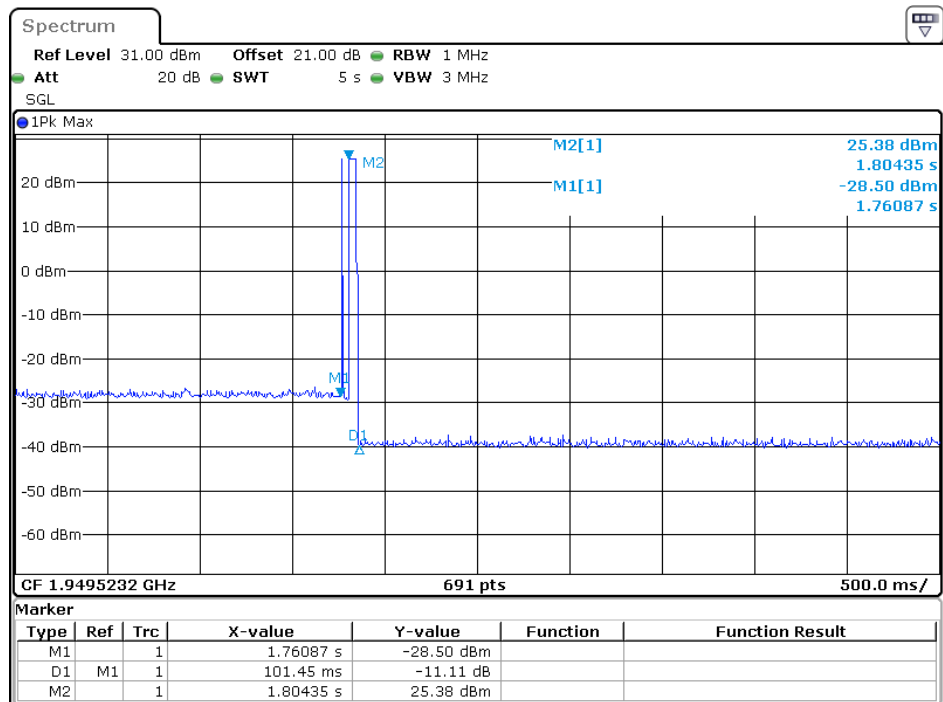


Date: 7.NOV.2022 04:50:05

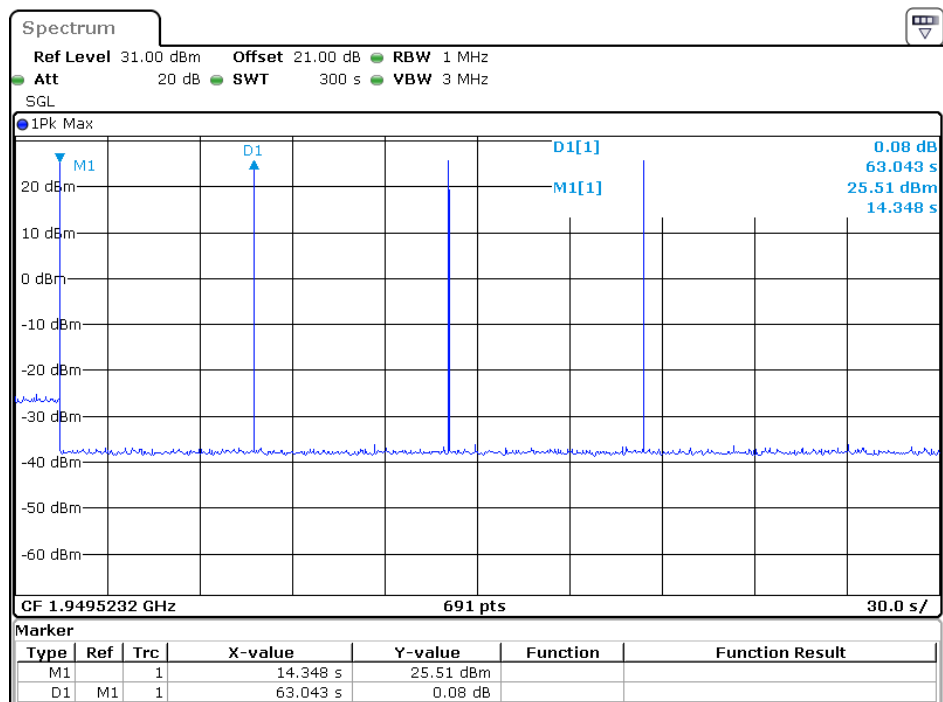


Date: 7.NOV.2022 04:55:56

PCS Band

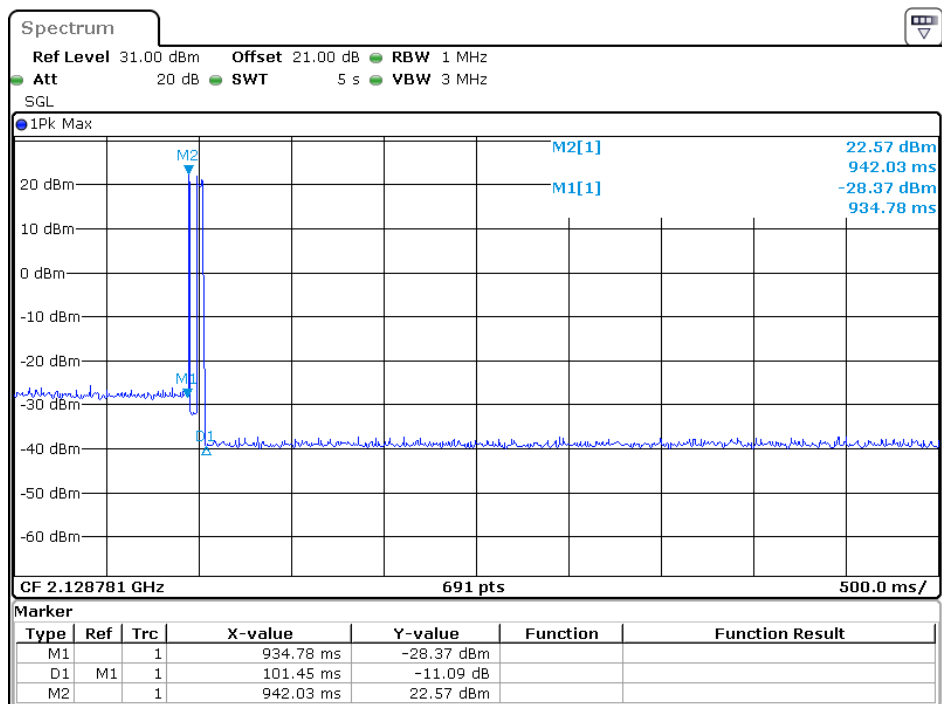


Date: 7.NOV.2022 04:18:42

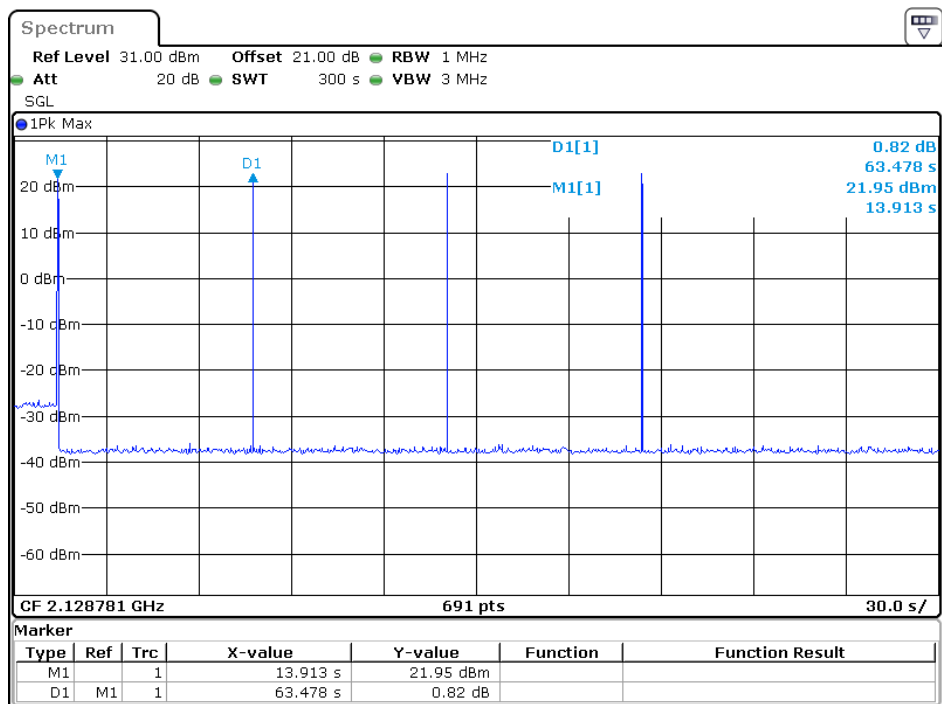


Date: 7.NOV.2022 04:25:30

AWS Band

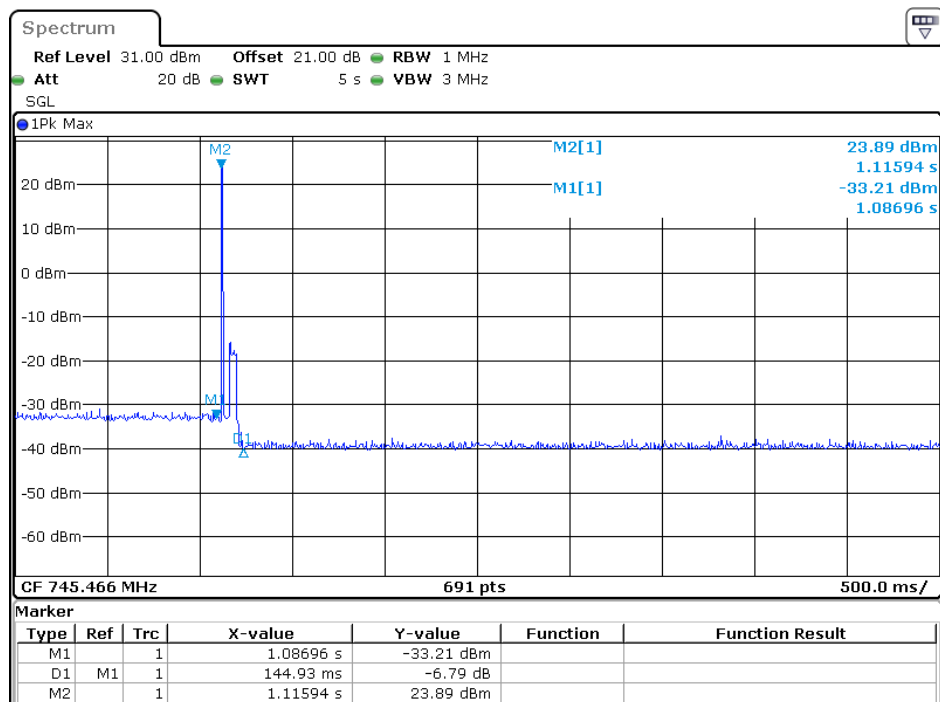


Date: 7.NOV.2022 04:30:28

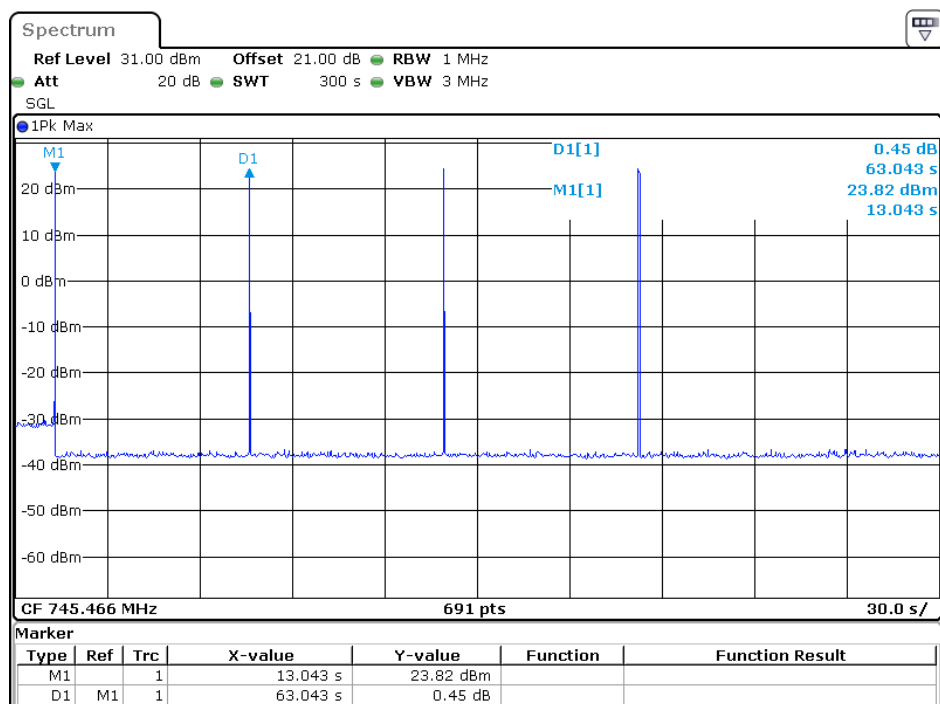


Date: 7.NOV.2022 04:44:21

700MHz Band



Date: 7.NOV.2022 04:58:52



Date: 7.NOV.2022 06:02:42

§2.1051- SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standards

FCC §2.1051 *Measurements required: Spurious emissions at antenna terminals.*

§20.21(e)(8)(i)(E): Booster out of band emissions (OOBE) shall be at least 6 dB below the FCC's mobile emission limits for the supported bands of operation. Compliance to OOBE limits will utilize high peak-to-average CMRS signal types.

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

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

§27.53: the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

Test Procedure

The following procedures shall be used to demonstrate compliance to the applicable conducted spurious emissions limits as per § 2.1051.

Note: *For frequencies below 1 GHz, an RBW of 1 MHz may be used in a preliminary measurement. If non-compliant emissions are detected, a final measurement shall be made with a 100 kHz RBW. Additionally, a peak detector may also be used for the preliminary measurement. If non-compliant emissions are detected then a final measurement of these emissions shall be made with the power averaging (RMS) detector.*

- a) Connect the EUT to the test equipment as shown in **Figure 1**. Begin with the uplink output connected to the spectrum analyzer.
- b) Configure the signal generator for AWGN with a 99% occupied bandwidth of 4.1 MHz with a center frequency corresponding to the center of the CMRS band under test.
- c) Set the signal generator amplitude to the level determined in the power measurement procedure in 7.2.
- d) Turn on the signal generator RF output and measure the spurious emission power levels with an appropriate measurement instrument as follows.
 - 1) Set RBW = measurement bandwidth specified in the applicable rule section for the operational frequency band under consideration (see Annex A for relevant cross-references). Note that many of the individual rule sections permit the use of a narrower RBW (typically $\geq 1\%$ of the emission bandwidth) to enhance measurement accuracy, but the result must then be integrated over the specified measurement bandwidth.
 - 2) Set VBW = $3 \times$ RBW.
 - 3) Select the power averaging (RMS) detector. (See above note regarding the use of a peak detector for preliminary measurements.)
 - 4) Sweep time = auto-couple.
 - 5) Set the analyzer start frequency to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part. Note that the number of measurement points in each sweep

must be $\geq (2 \times \text{span/RBW})$ which may require that the measurement range defined by the start and stop frequencies above be subdivided, depending on the available number of measurement points provided by the spectrum analyzer. Trace average at least 10 traces in power averaging (i.e., RMS) mode.

6) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.

7) Reset the analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the analyzer stop frequency to $10 \times$ the highest frequency of the fundamental emission. Note that the number of measurement points in each sweep must be $\geq (2 \times \text{span/RBW})$ which may require that the measurement range defined by the start and stop frequencies above be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

8) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report.

e) Repeat 7.6b) through 7.6d) for each supported frequency band of operation.

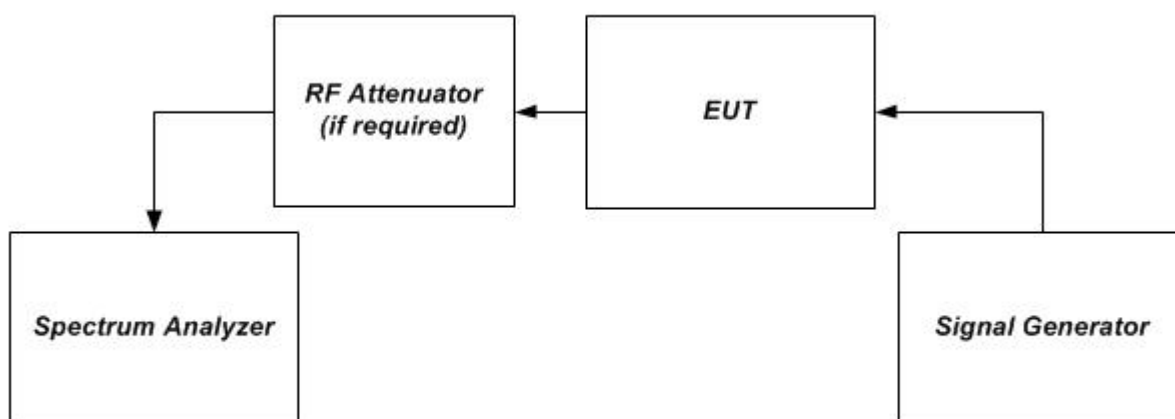


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	24.5~25.1 °C
Relative Humidity:	54~56 %
ATM Pressure:	101.0 kPa

The testing was performed by Andy Yu from 2022-09-26 to 2022-09-29.

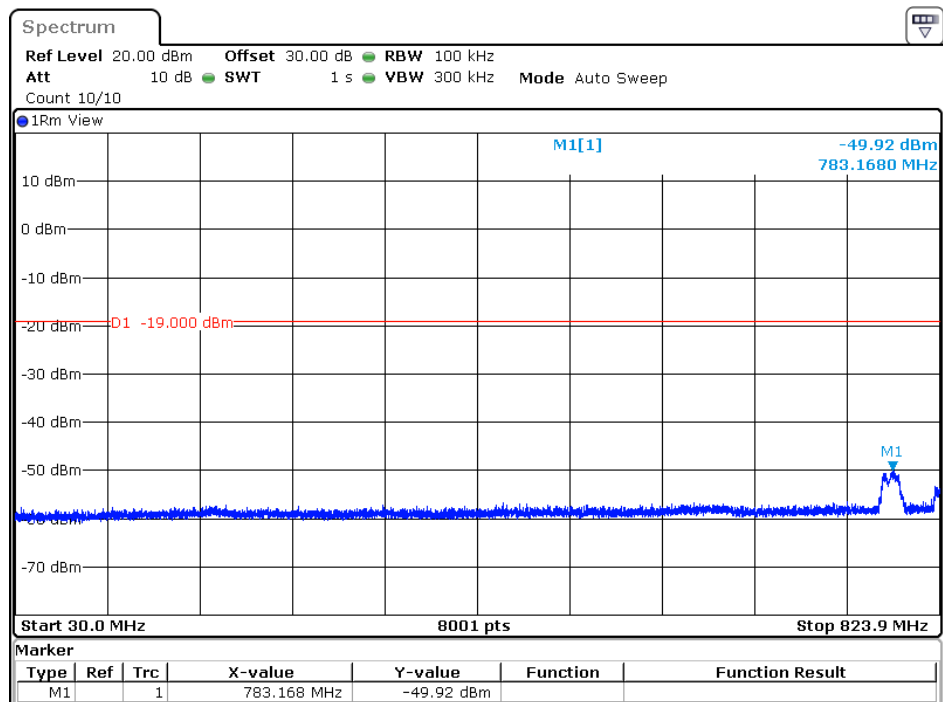
Test Mode: Transmitting

Test Result: Pass

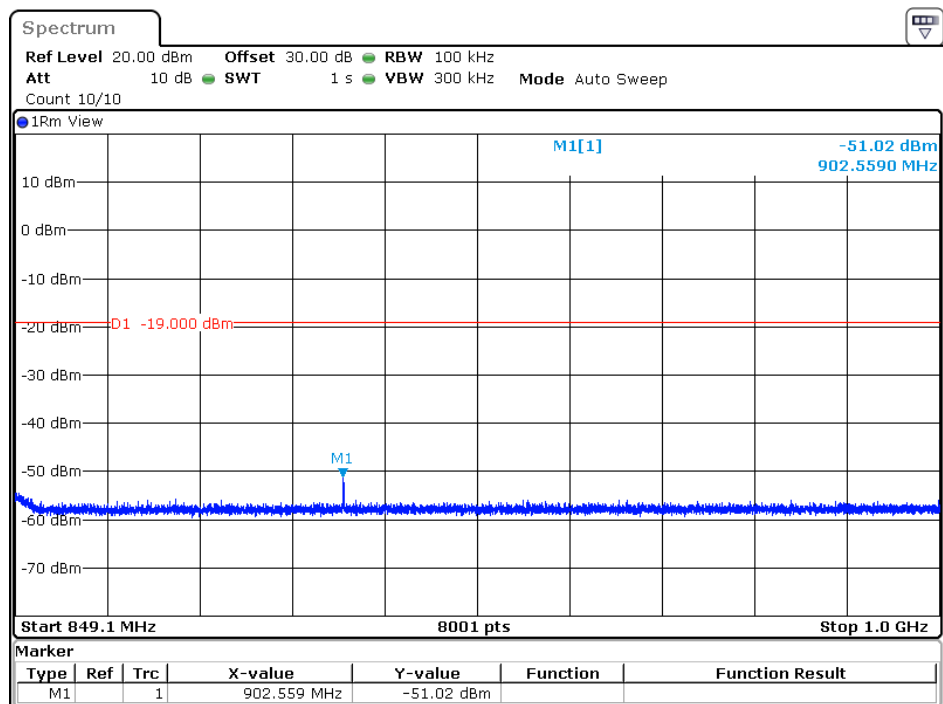
Please refer to the following plots.

Uplink

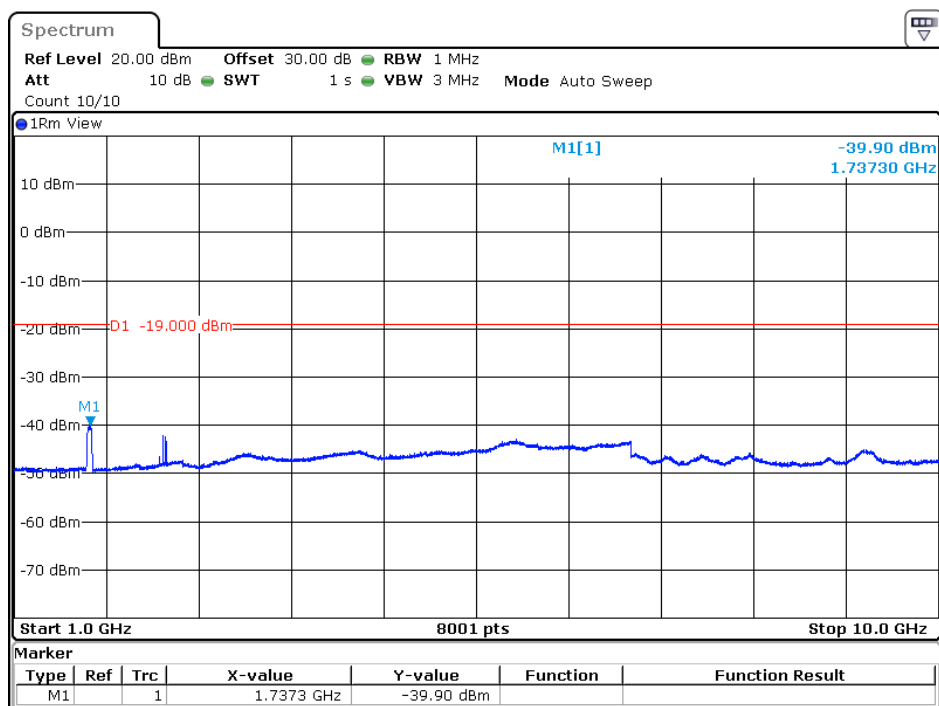
Cellular Band



Date: 27.SEP.2022 03:48:06

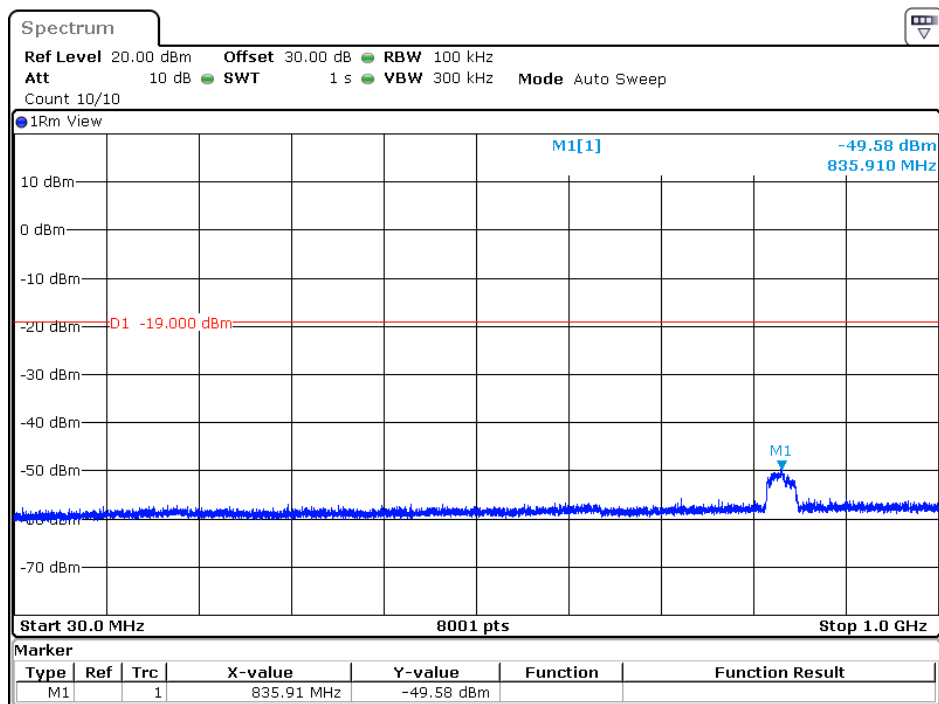


Date: 27.SEP.2022 03:49:31

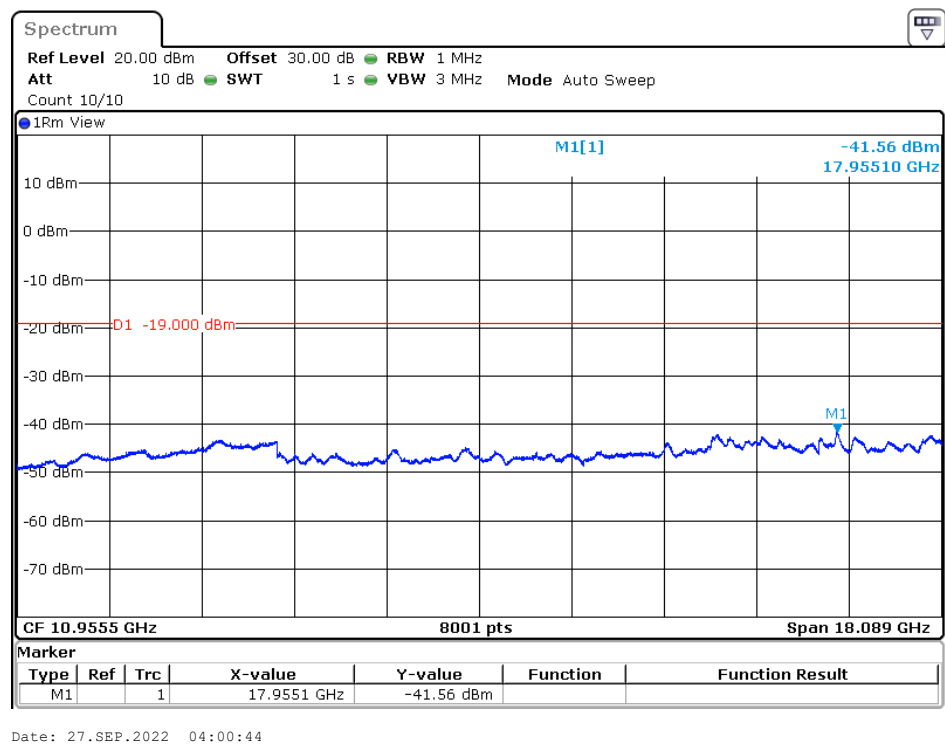
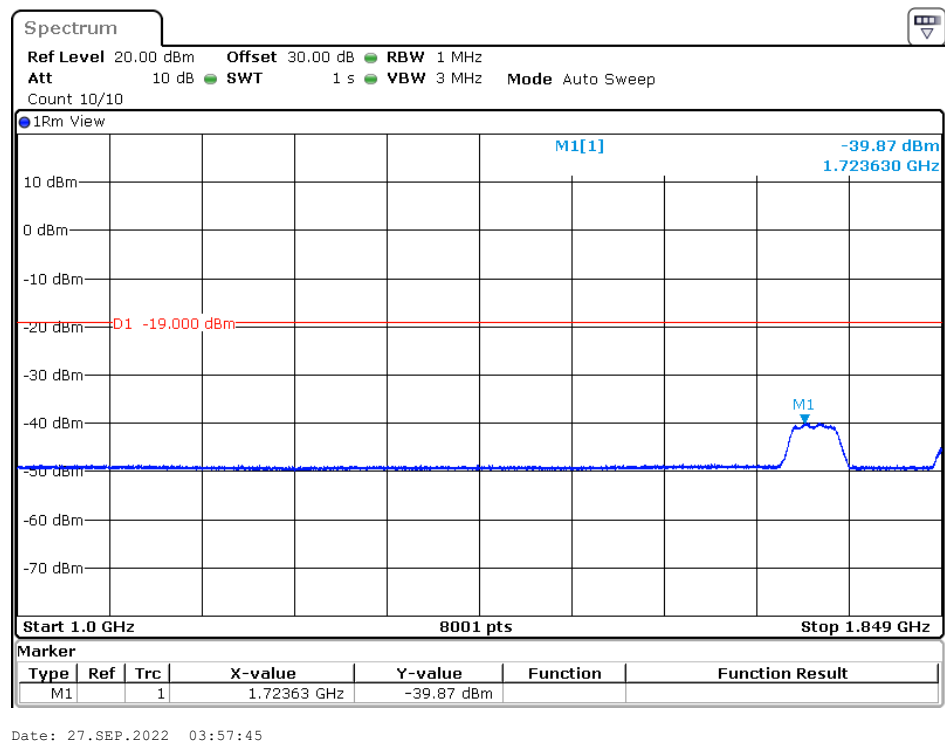


Date: 27.SEP.2022 03:51:26

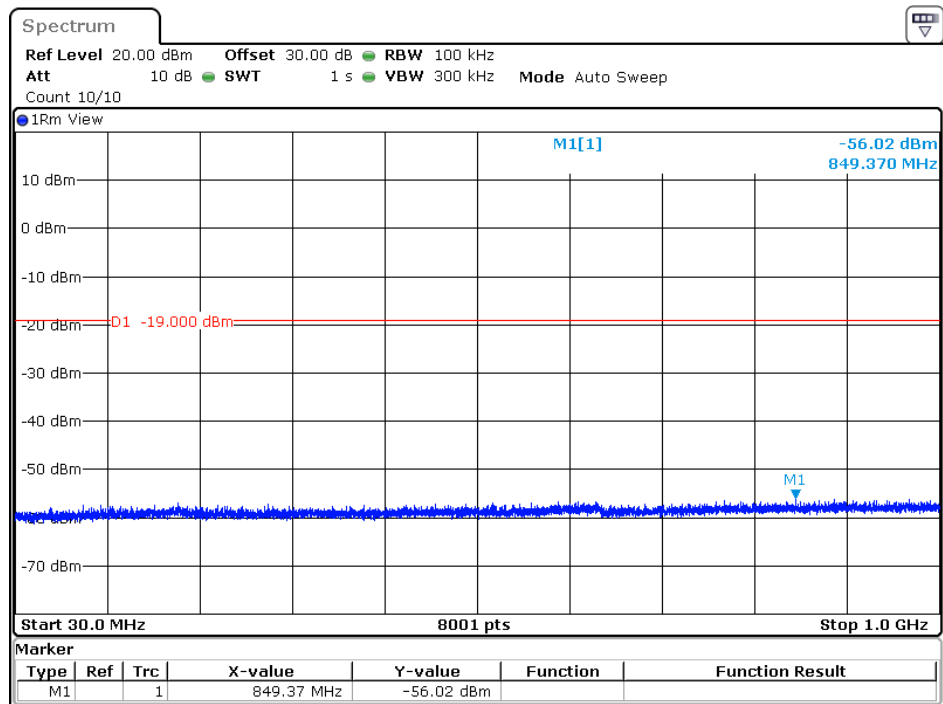
PCS Band



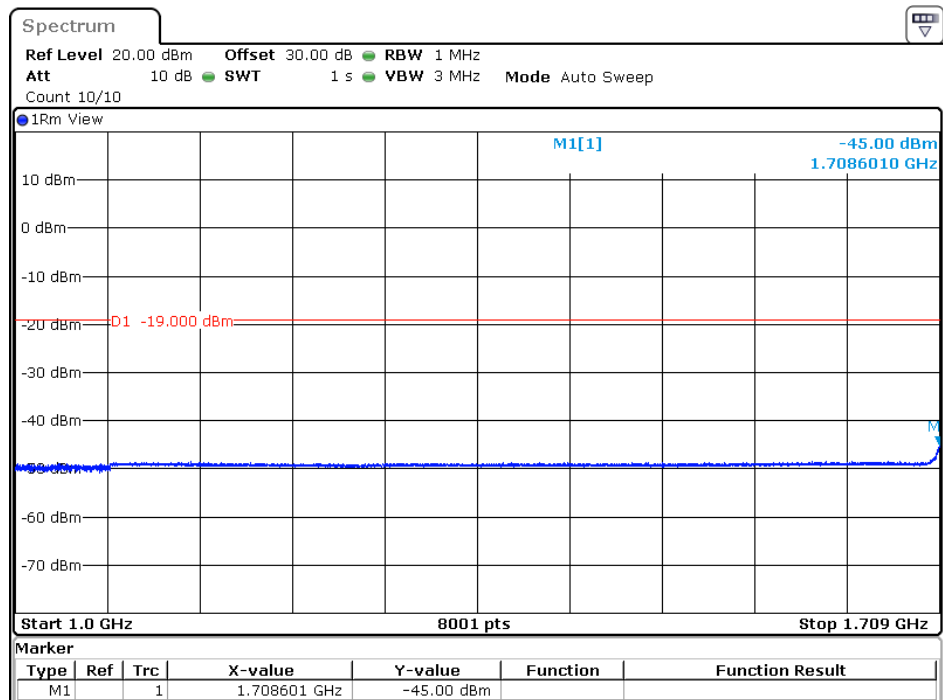
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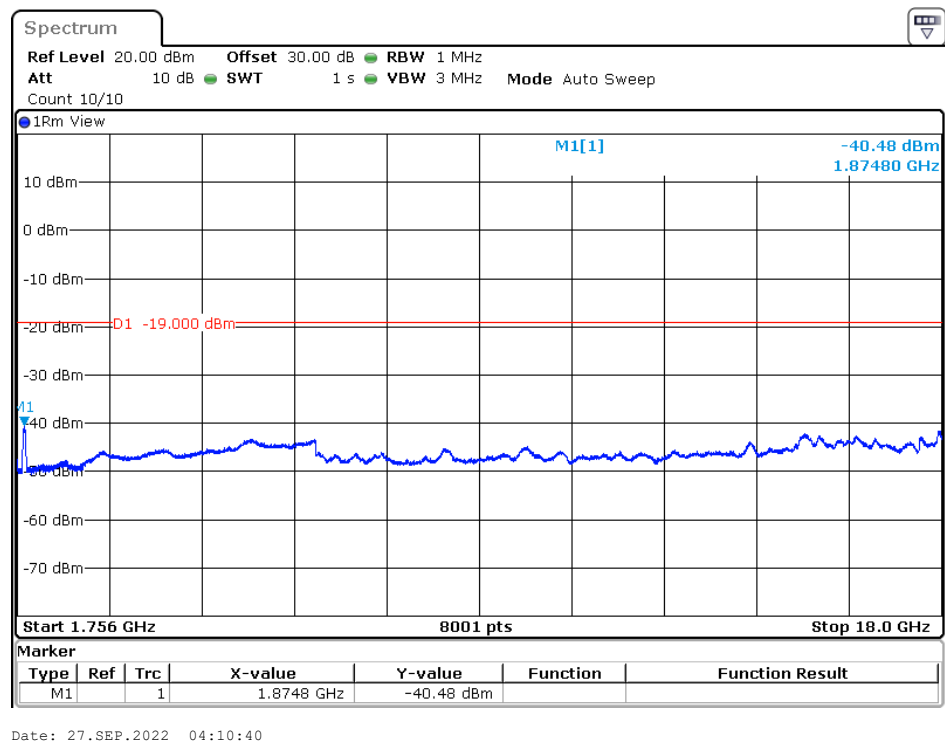
AWS Band



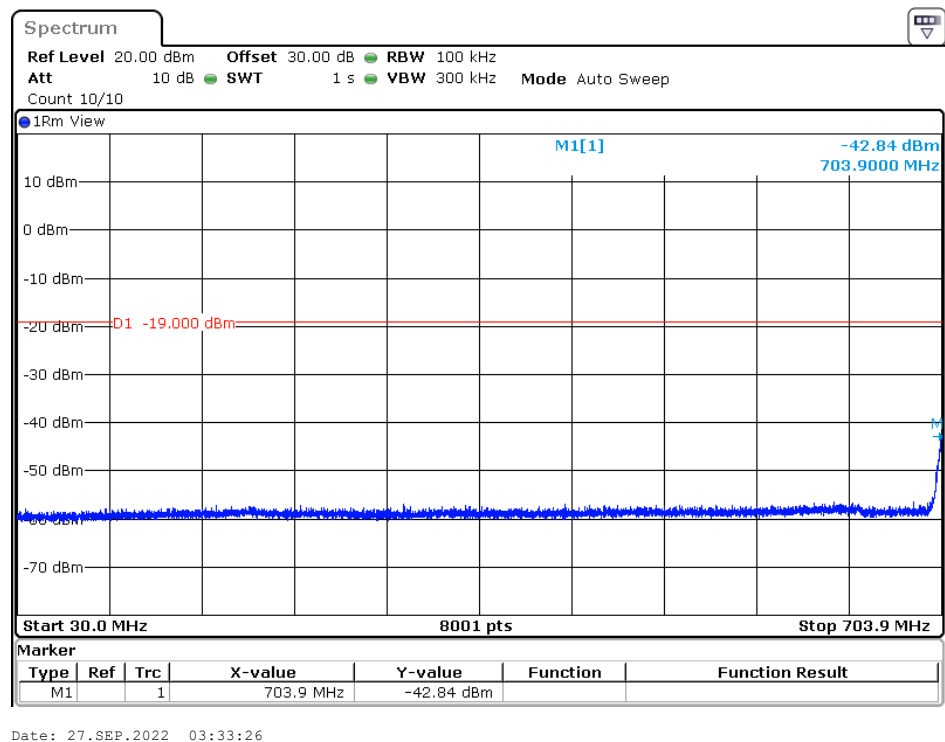
Date: 27.SEP.2022 04:03:47

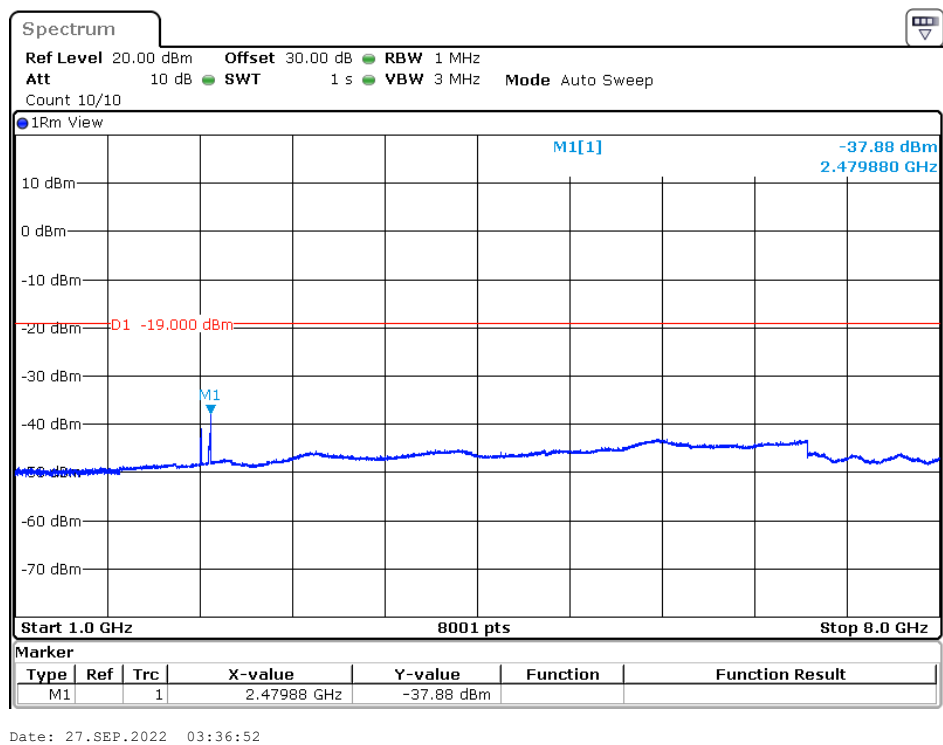
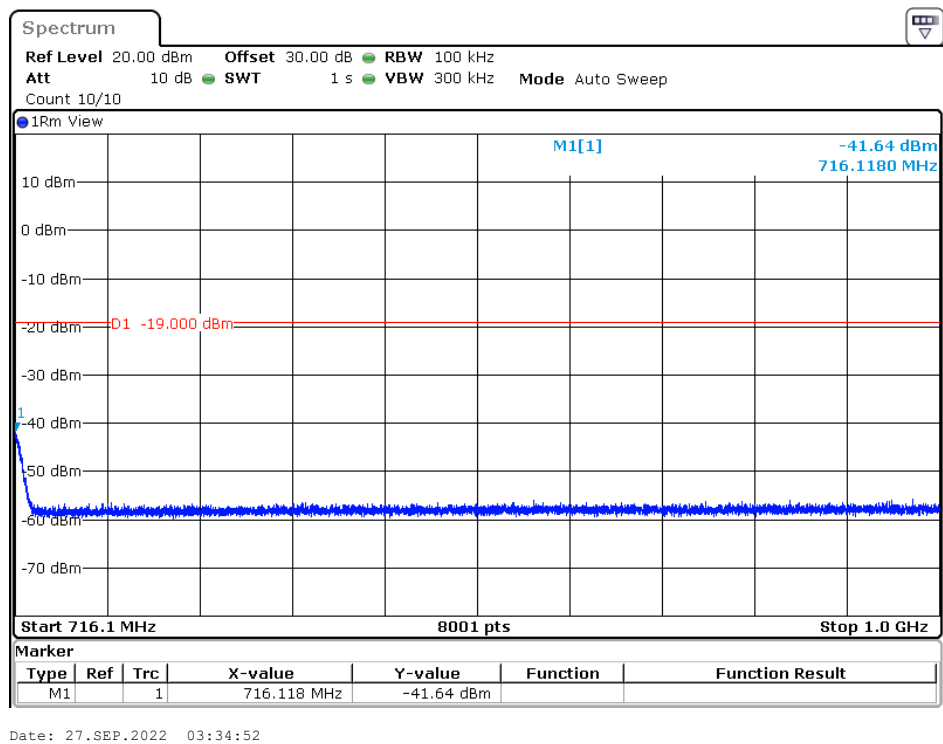


Date: 27.SEP.2022 04:05:44

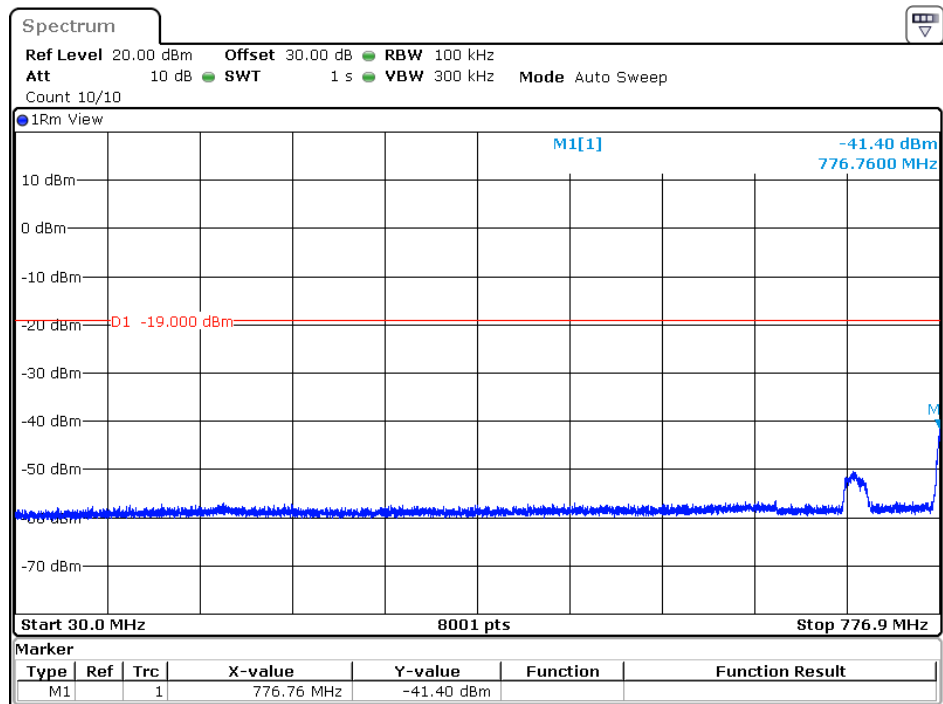


Lower 700MHz

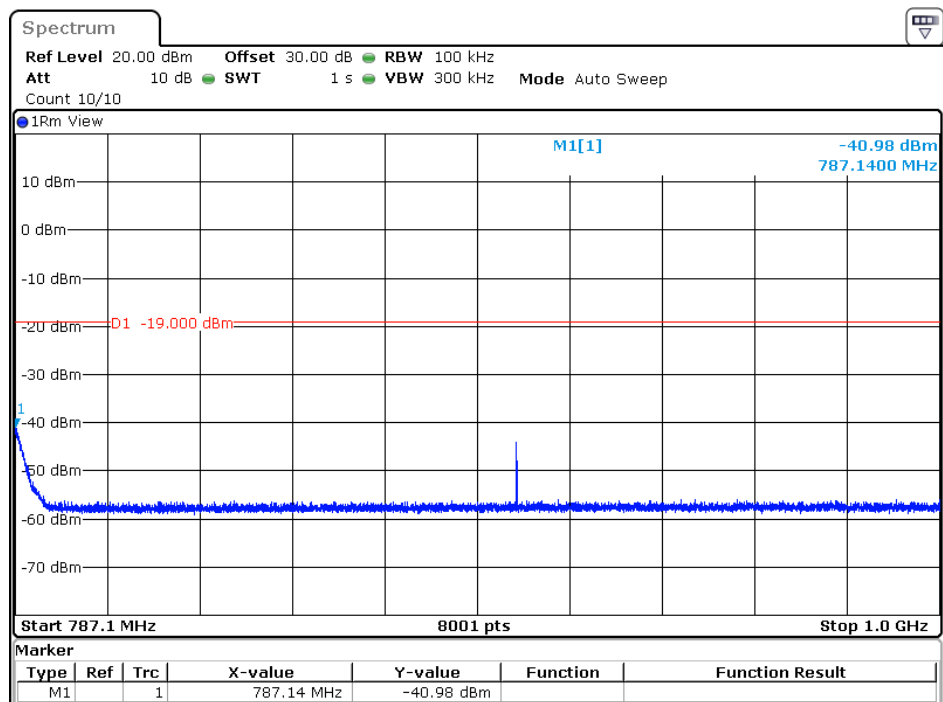




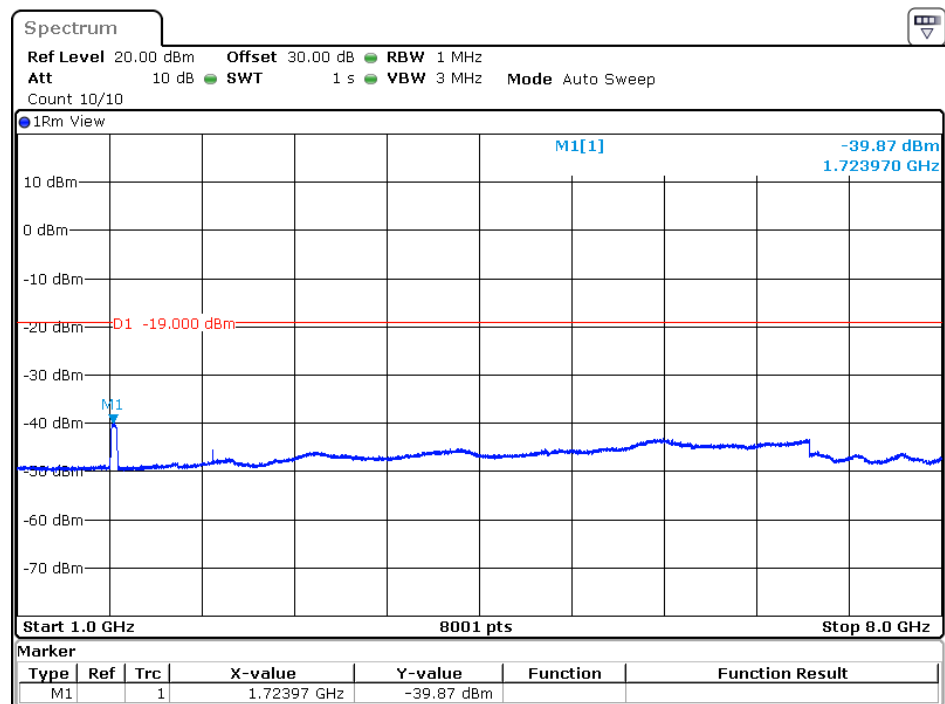
Upper 700MHz



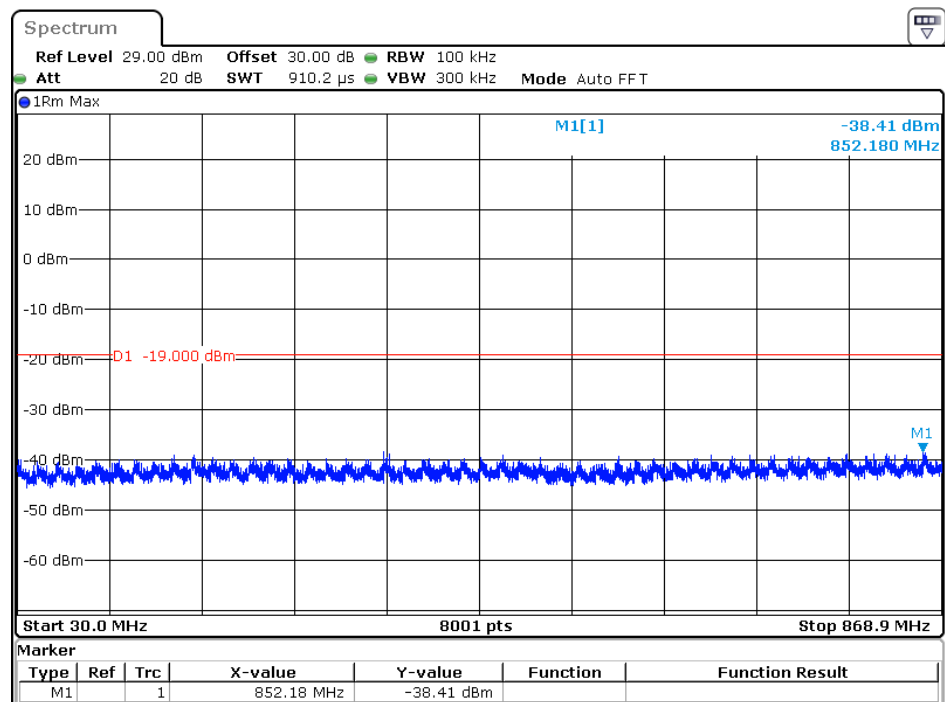
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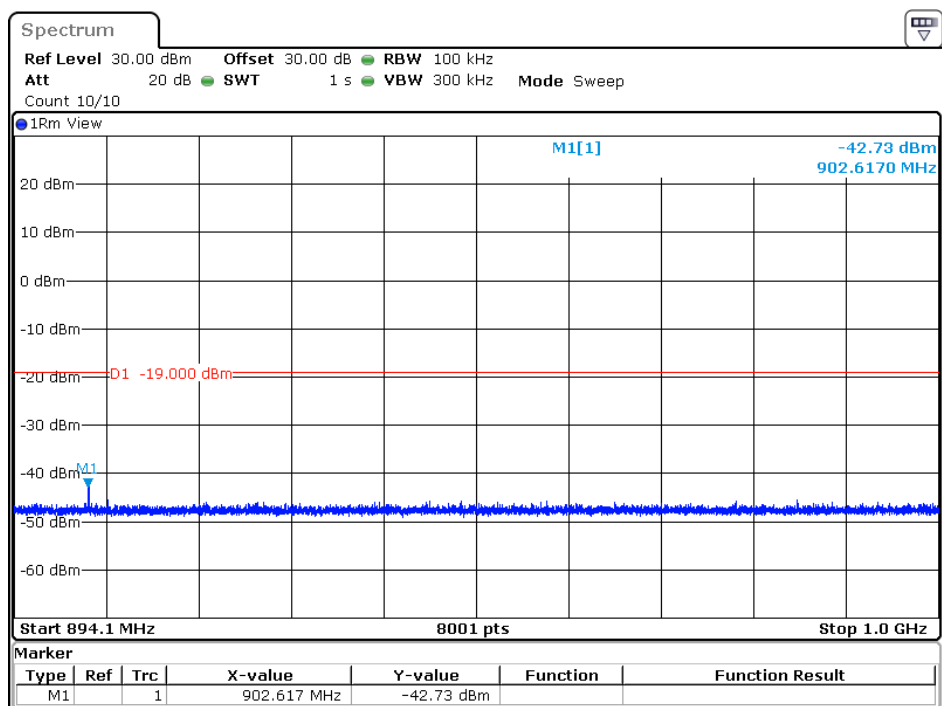
Date: 27.SEP.2022 03:41:38



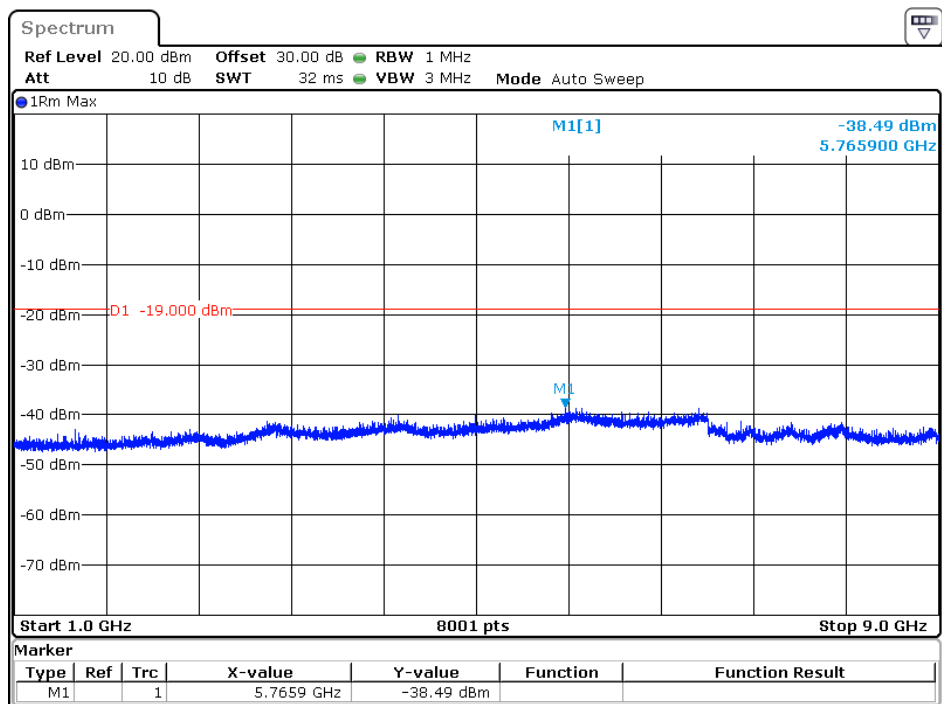
Date: 27.SEP.2022 03:42:57

Downlink**Cellular Band**

Date: 29.SEP.2022 05:07:08

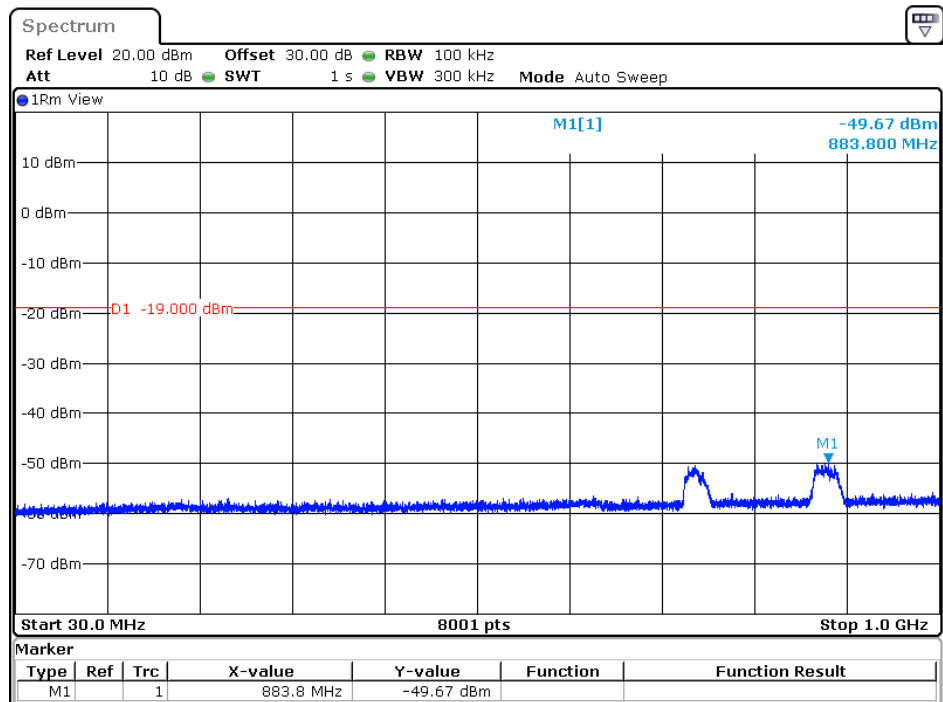


Date: 26.SEP.2022 11:15:04

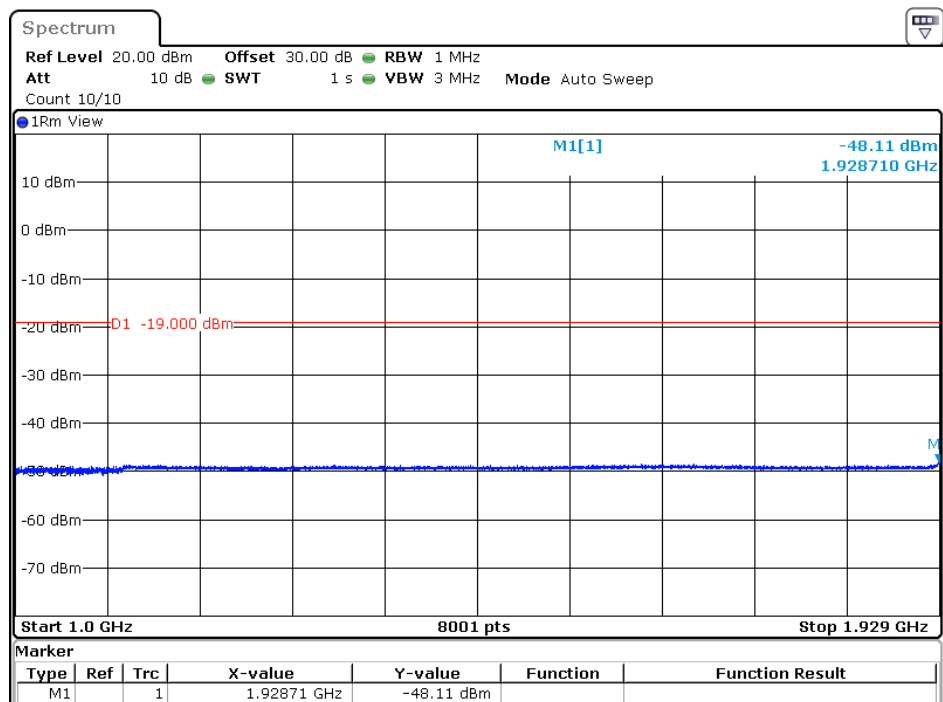


Date: 29.SEP.2022 04:59:52

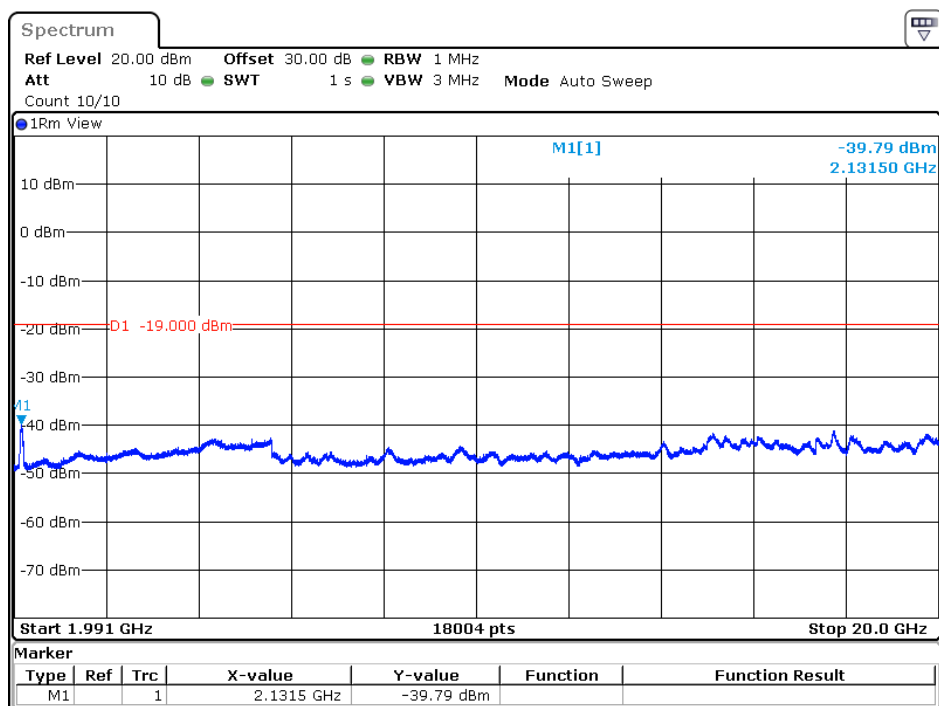
PCS Band



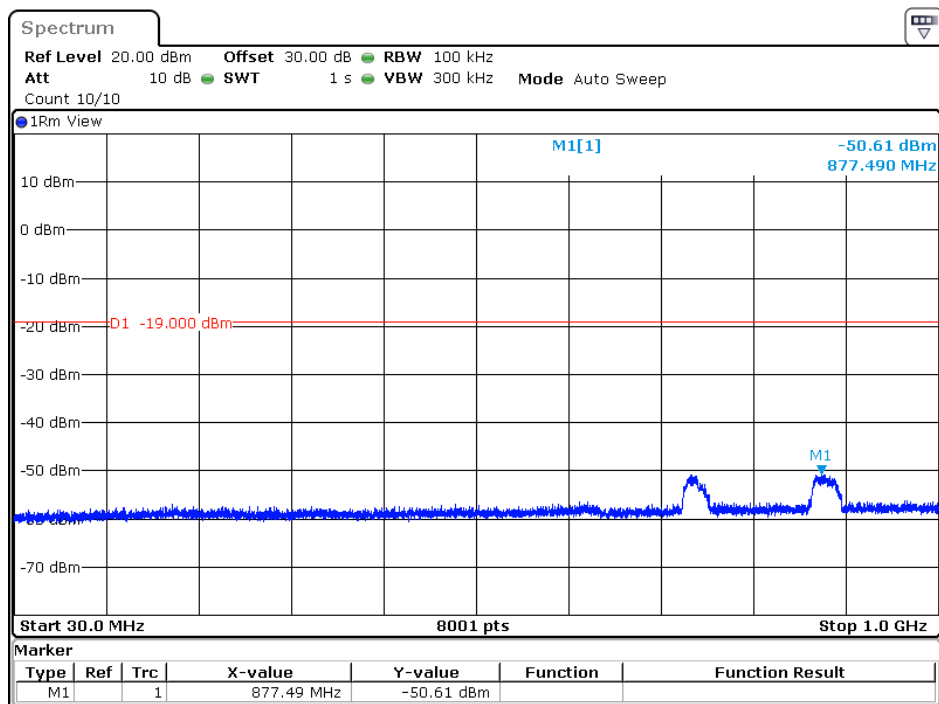
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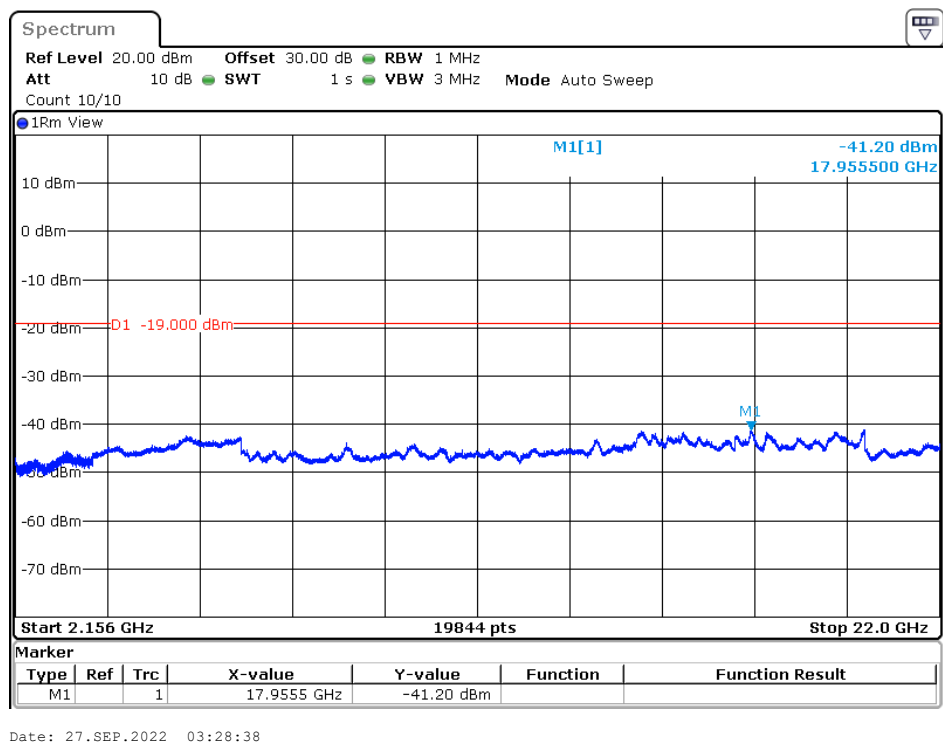
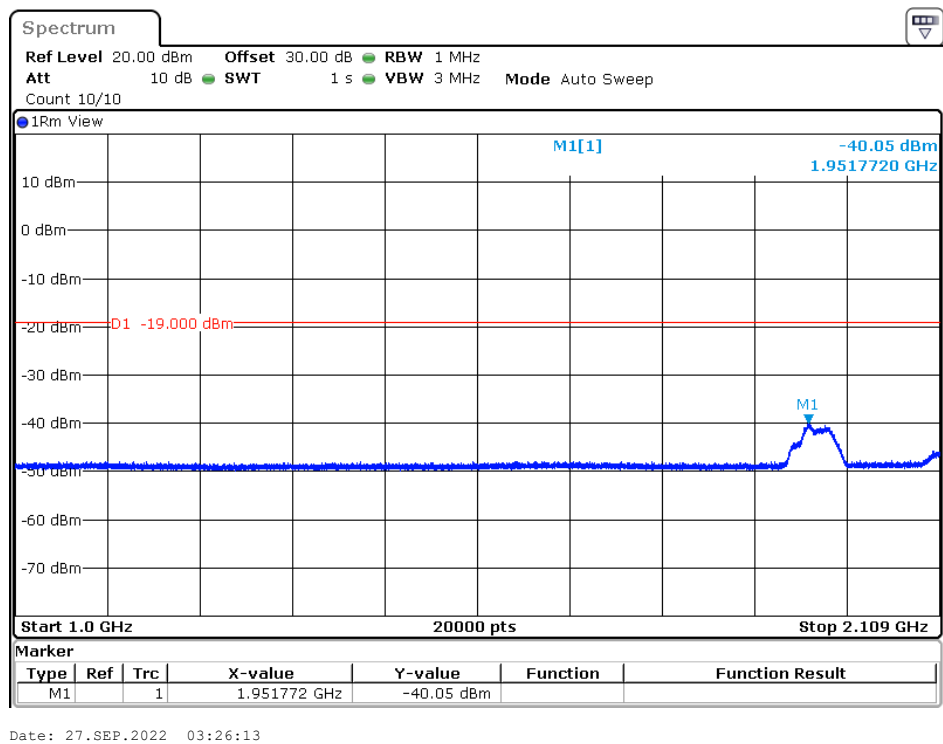
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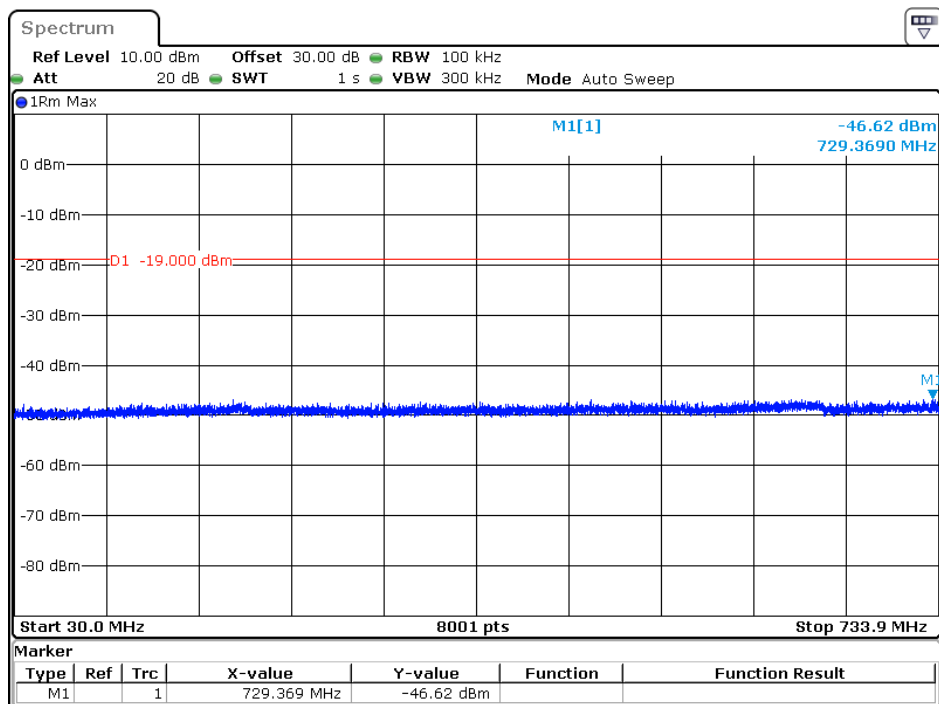
Date: 27.SEP.2022 03:18:45

AWS Band

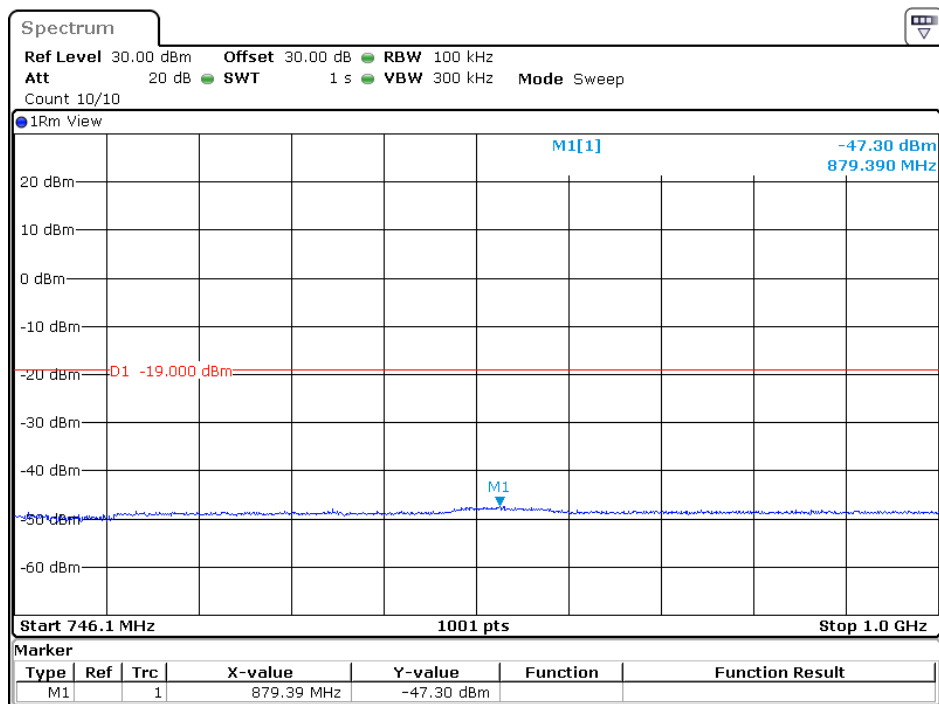
Date: 27.SEP.2022 03:21:48



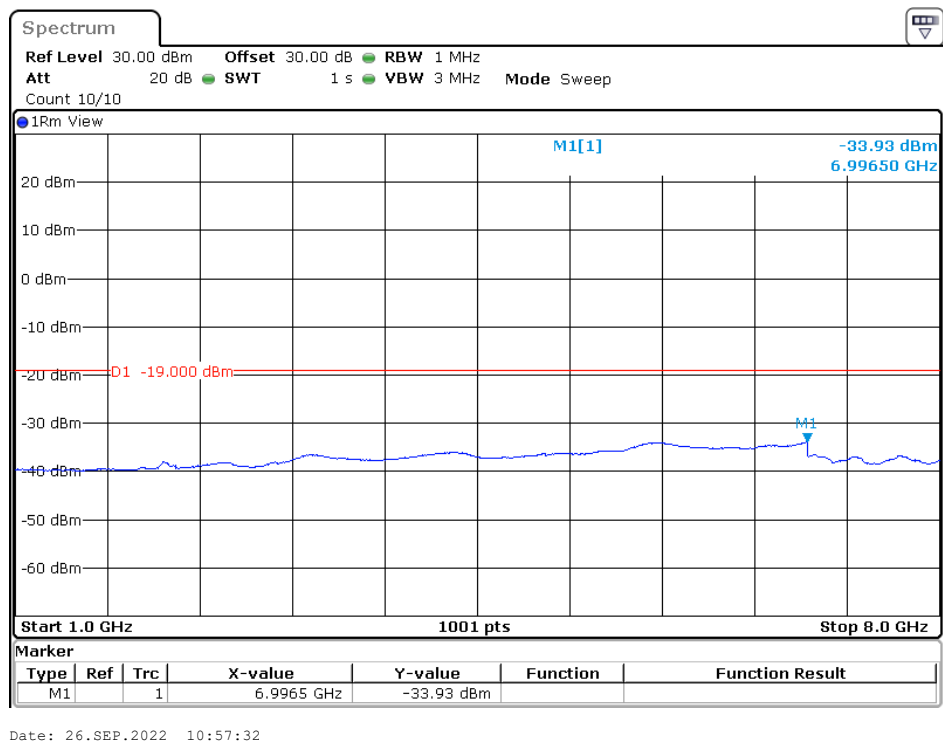
Lower 700MHz



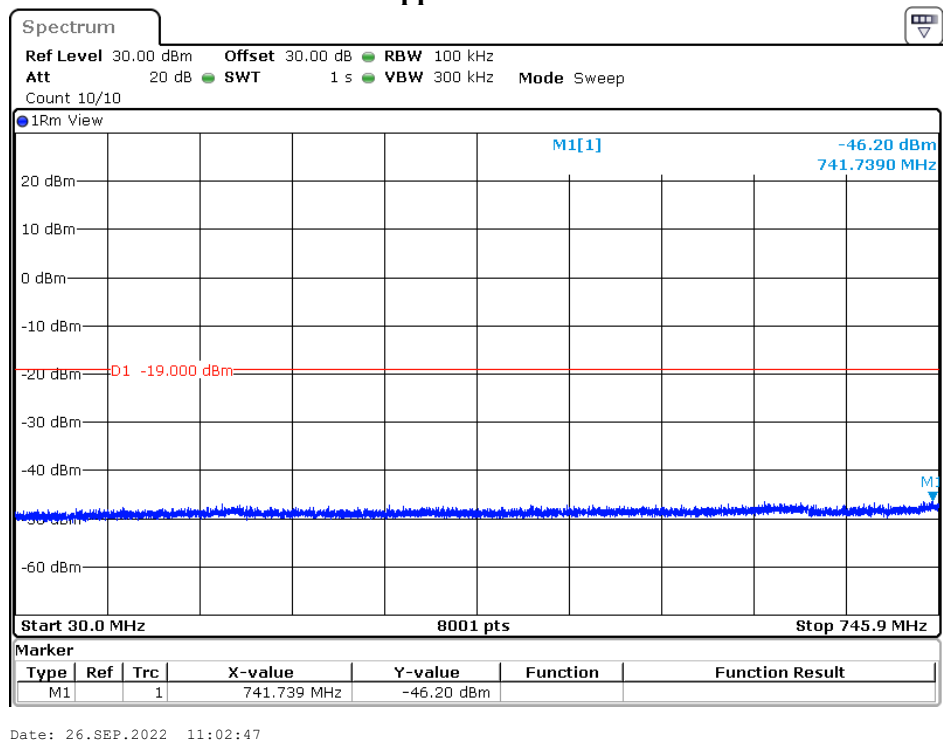
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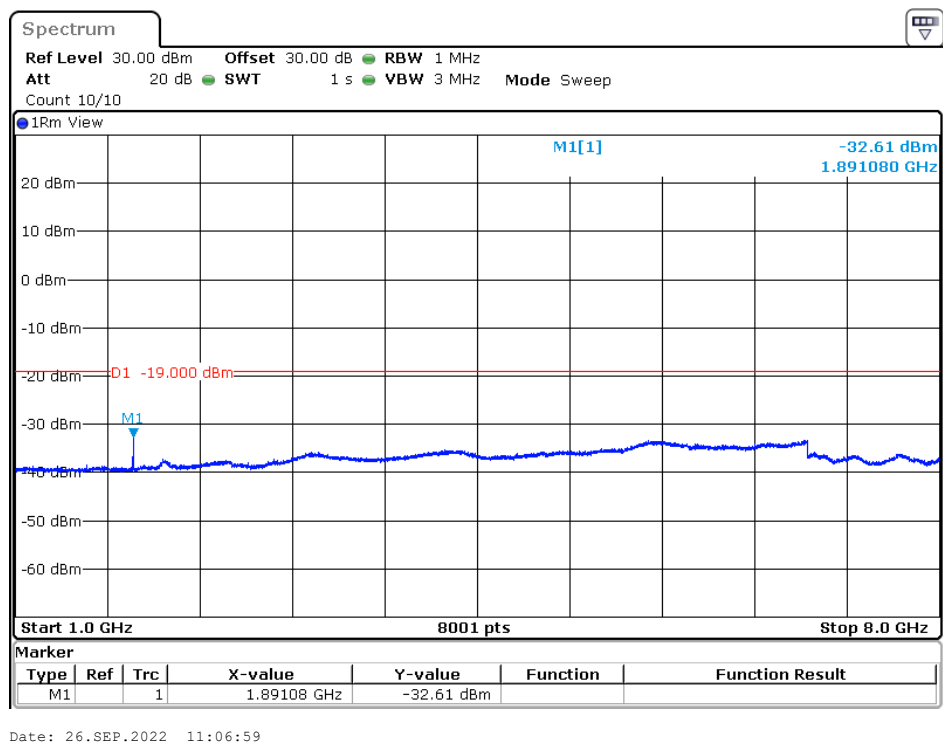
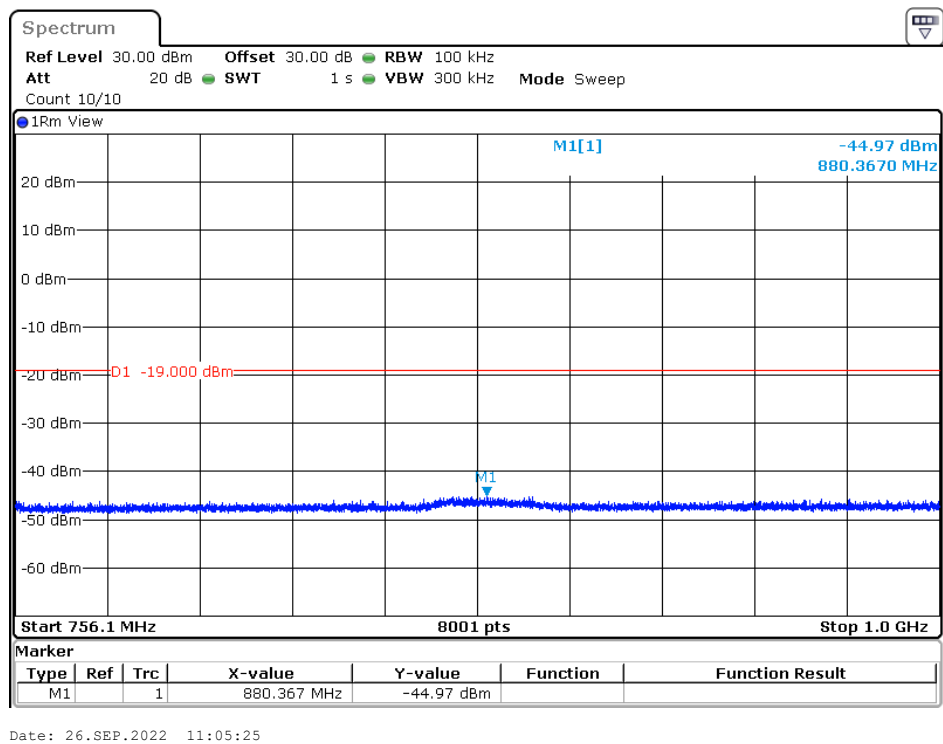


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Upper 700MHz

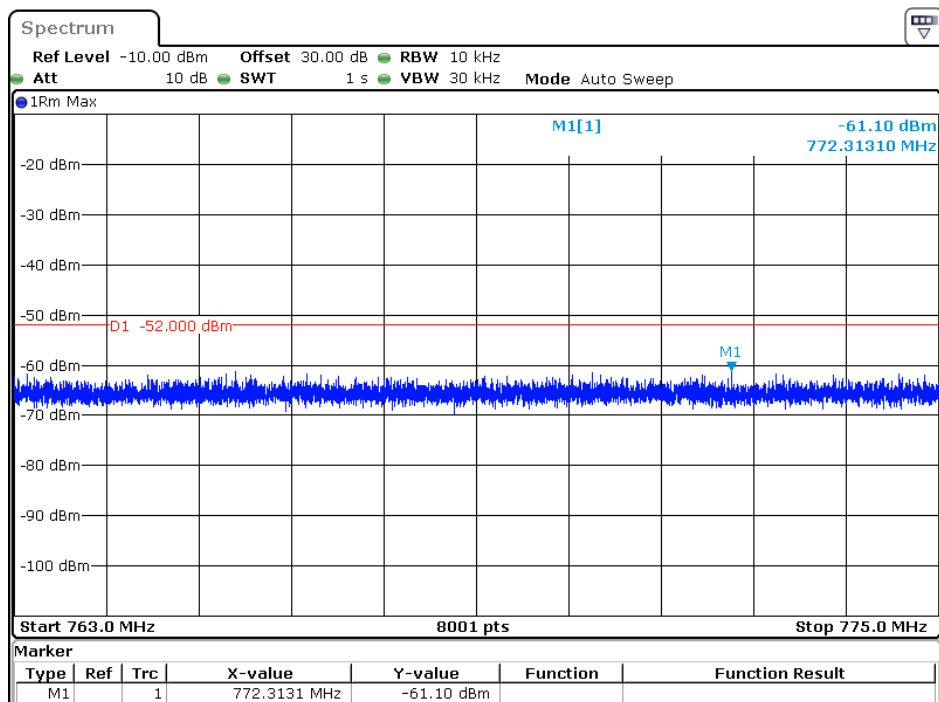




Uplink

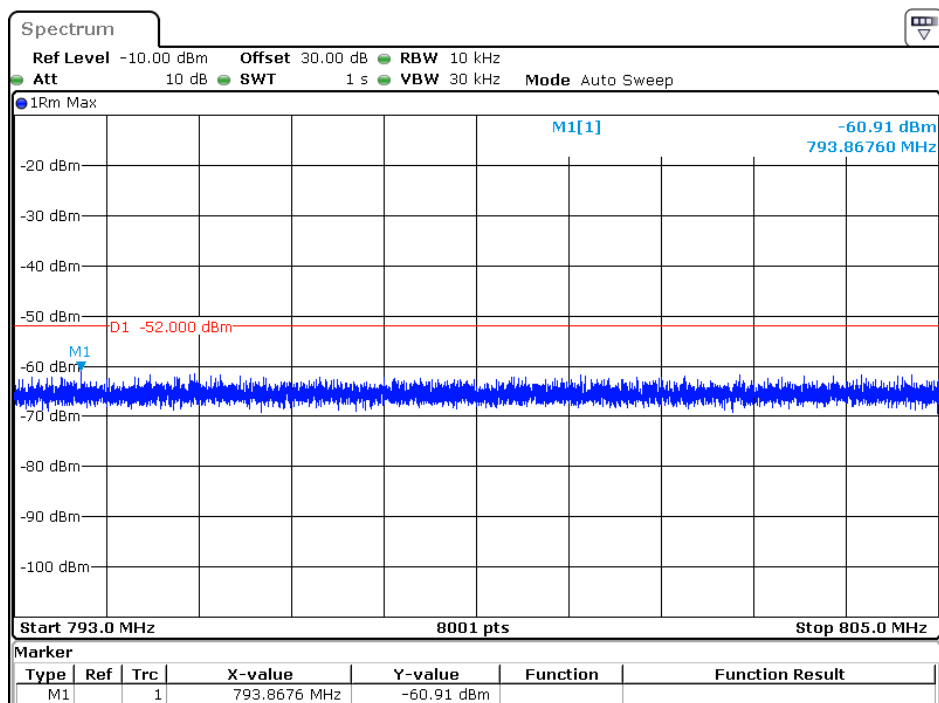
Additional requirement for upper 700MHz band

763 MHz~775 MHz



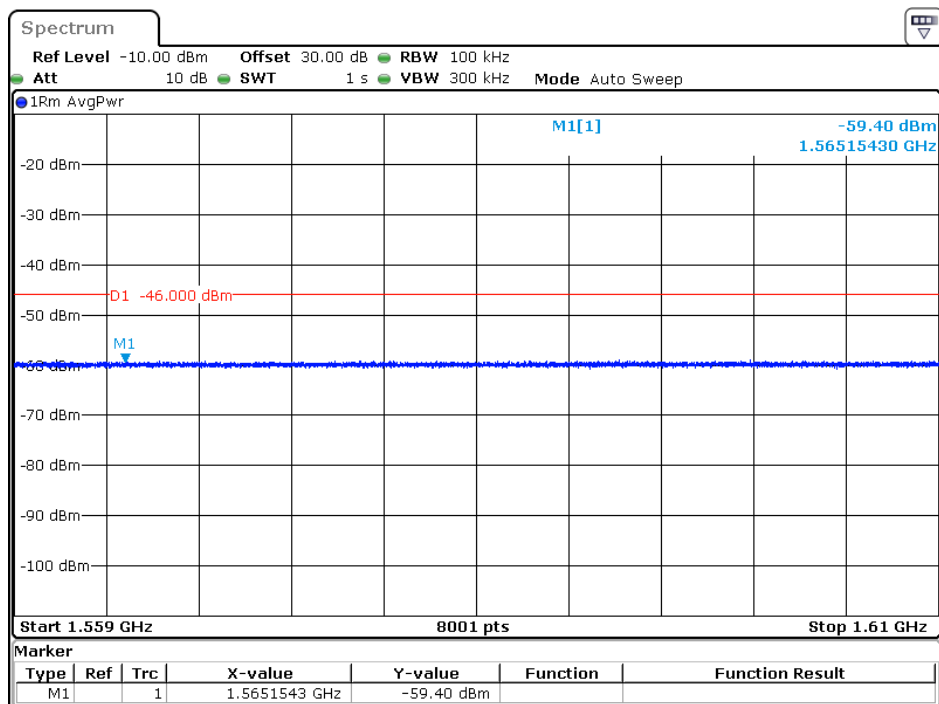
Date: 29.SEP.2022 05:52:35

793 MHz~805 MHz



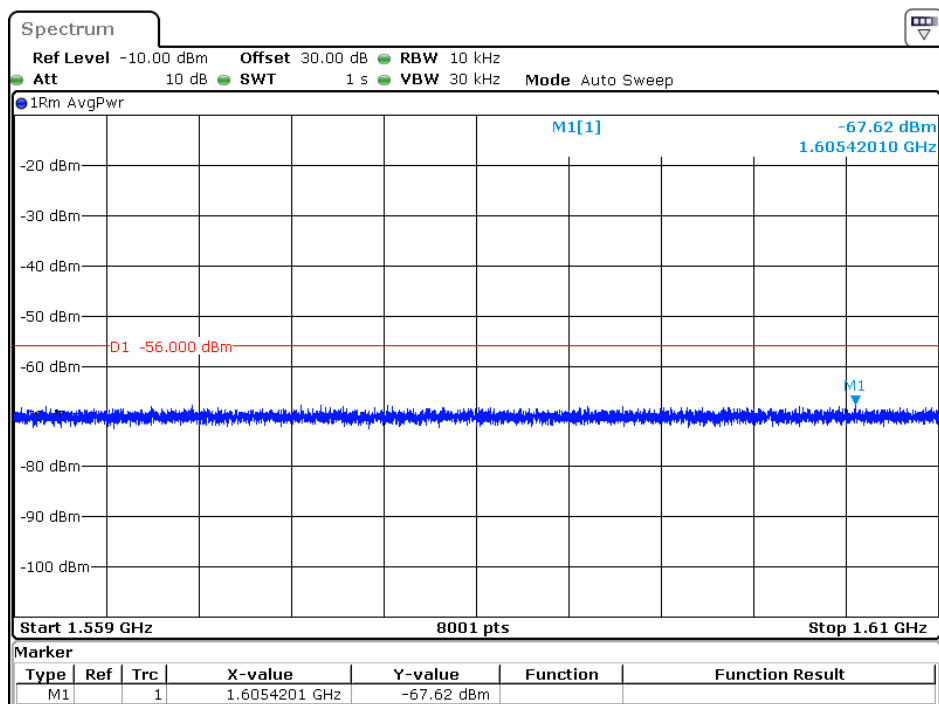
Date: 29.SEP.2022 05:53:48

1559 MHz~1610 MHz (wide band)



Date: 29.SEP.2022 06:06:54

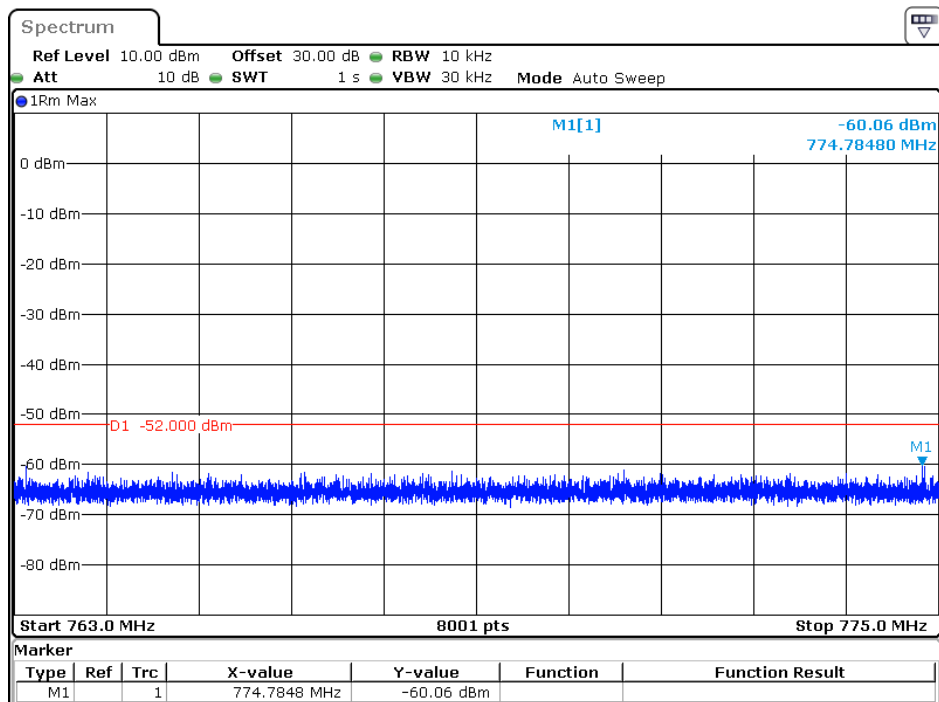
1559 MHz~1610 MHz (narrow band)



Date: 29.SEP.2022 06:06:07

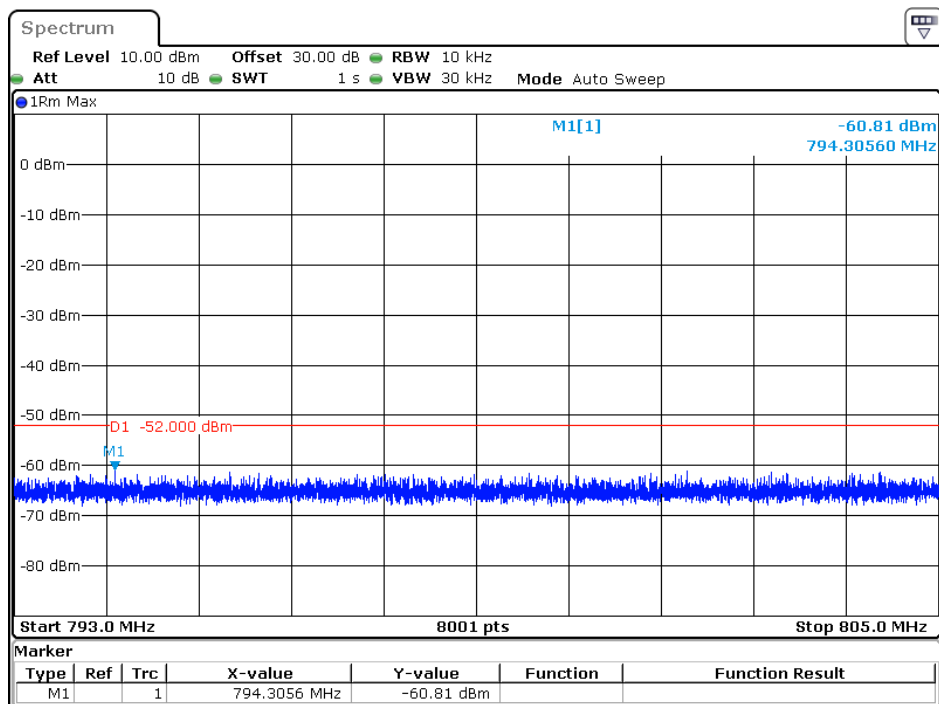
Downlink

763 MHz~775 MHz



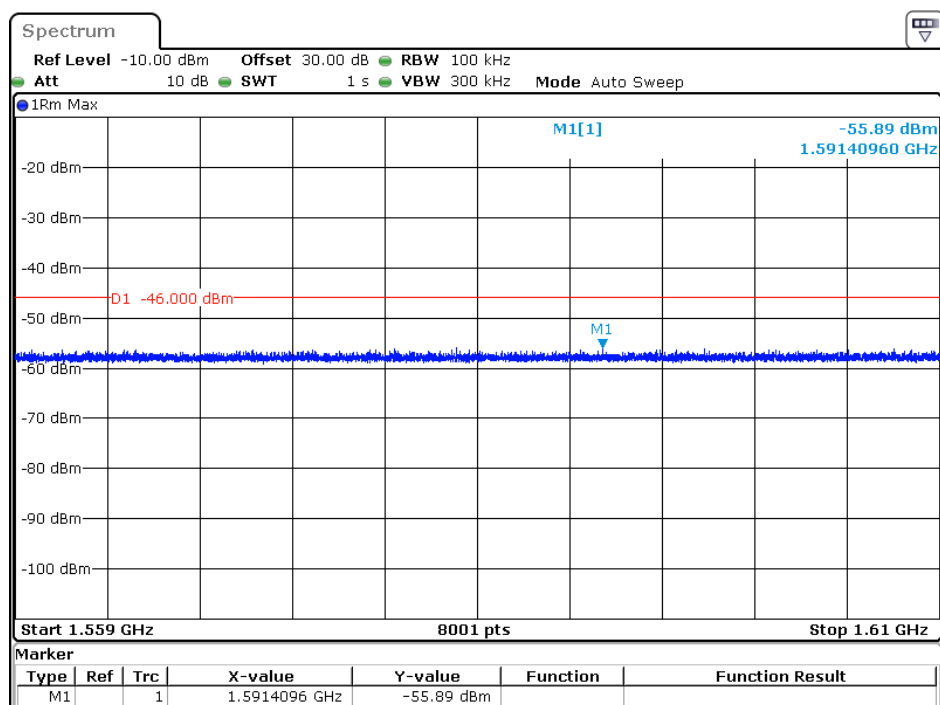
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793 MHz~805 MHz



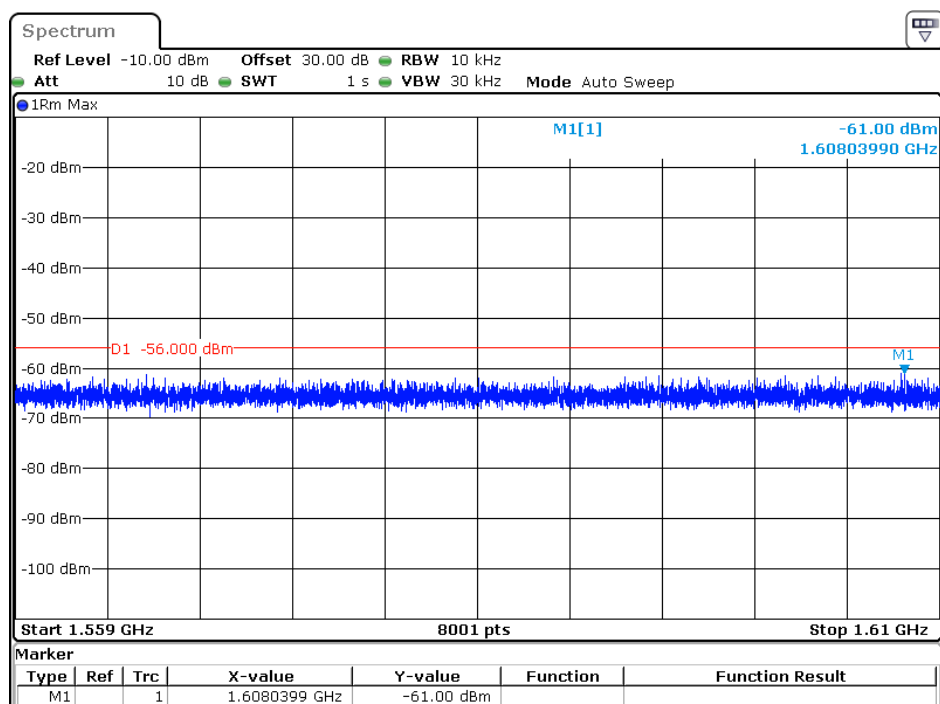
Date: 29.SEP.2022 05:23:25

1559 MHz~1610 MHz (wide band)



Date: 29.SEP.2022 05:27:00

1559 MHz~1610 MHz (narrow band)



Date: 29.SEP.2022 05:25:45

§ 2.1053 - RADIATED SPURIOUS EMISSIONS

Applicable Standards

§ 2.1053 *Measurements required: Field strength of spurious radiation.*

Test Procedure

This procedure is intended to satisfy the requirements specified in § 2.1053. The applicable limits are those specified for mobile emissions in the rule part appropriate to the band of operation (see Annex A).

- Place the EUT on an OATS or semi-anechoic chamber turntable 3 m from the receiving antenna. ¹²
- Connect the EUT to the test equipment as shown in **Figure 10** beginning with the uplink output.
- Set the signal generator to produce a CW signal with the frequency set to the center of the operational band under test and the power level set at P_{IN} as determined from 7.2.
- Measure the radiated spurious emissions from the EUT from lowest to the highest frequencies as specified in § 2.1057. Maximize the radiated emissions by utilizing the procedures described in Clause 8 of ANSI C63.4-2014.
- Capture the peak emissions plots using a peak detector with Max-Hold for inclusion in the test report. Tabular data is acceptable in lieu of spectrum analyzer plots.
- Repeat 7.12c) through 7.12e) for all operational bands.

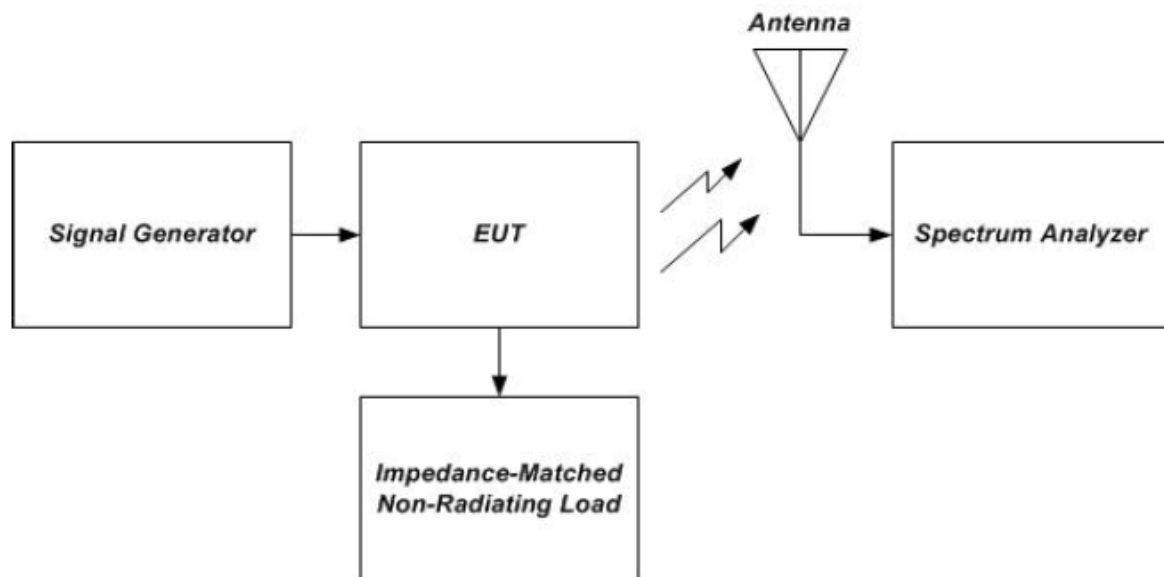


Figure 10 – Radiated spurious emissions test instrumentation setup

Test Data**Environmental Conditions**

Temperature:	25.2 °C
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by ZeKi Ma on 2022-11-14.

Test Result: Pass

Please refer to following table.

Test Mode: Transmitting (worst case)

Uplink

Frequency (MHz)	Receiver Reading (dBm)	Turntable Degree	Rx Antenna		Substituted Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)				
LTE (A+B),Test Frequency 710MHz								
950.09	-78.18	309	1.8	H	10.0	-68.18	-19	-49.18
950.09	-82.61	188	1.2	V	11.7	-70.91	-19	-51.91
1420	-62.1	158	1.2	H	5.6	-56.5	-19	-37.5
1420	-62.7	337	2.1	V	5.2	-57.5	-19	-38.5
2130	-56.8	324	1.7	H	6.8	-50.0	-19	-31.0
2130	-56.4	264	1.5	V	6.1	-50.3	-19	-31.3
LTE C,Test Frequency 782MHz								
952.39	-76.92	260	1.1	H	10.0	-66.92	-19	-47.92
952.39	-82.49	307	1.5	V	11.7	-70.79	-19	-51.79
1564	-62.8	244	2.3	H	4.2	-58.6	-40	-18.6
1564	-60.9	264	2.2	V	3.3	-57.6	-40	-17.6
2346	-60.2	148	2.1	H	7.3	-52.9	-19	-33.9
2346	-59.4	160	1.2	V	6.4	-53.0	-19	-34.0
Cellular,Test Frequency 836.5MHz								
953.33	-77.55	39	2.4	H	10.0	-67.55	-19	-48.55
953.33	-81.15	116	2.3	V	11.7	-69.45	-19	-50.45
1673	-60.9	132	1.4	H	3.8	-57.1	-19	-38.1
1673	-58.4	188	1.9	V	3.1	-55.3	-19	-36.3
2509.5	-58.1	273	2.4	H	6.2	-51.9	-19	-32.9
2509.5	-57.0	119	2.4	V	5.6	-51.4	-19	-32.4
PCS,Test Frequency 1880MHz								
955.99	-78.66	174	2.5	H	10.0	-68.66	-19	-49.66
955.99	-81.80	234	1.0	V	11.7	-70.10	-19	-51.10
3760	-56.3	235	1.7	H	8.9	-47.4	-19	-28.4
3760	-54.0	69	2.5	V	8	-46.0	-19	-27.0
5640	-55.3	179	2.2	H	10.2	-45.1	-19	-26.1
5640	-54.9	349	2.1	V	9.4	-45.5	-19	-26.5
AWS,Test Frequency 1732.5MHz								
954.71	-76.00	270	1.4	H	10.0	-66.00	-19	-47.00
954.71	-83.21	88	2.4	V	11.7	-71.51	-19	-52.51
3465	-53.7	173	1.0	H	7	-46.7	-19	-27.7
3465	-52.4	53	2.1	V	6.2	-46.2	-19	-27.2
5197.5	-56.2	65	1.2	H	10.4	-45.8	-19	-26.8
5197.5	-53.7	220	2.1	V	9.9	-43.8	-19	-24.8

Downlink

Frequency (MHz)	Receiver Reading (dBm)	Turntable Degree	Rx Antenna		Substituted Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)				
LTE (A+B),Test Frequency 740MHz								
955.26	-76.37	294	2.0	H	10.0	-66.37	-19	-47.37
955.26	-83.64	27	1.7	V	11.7	-71.94	-19	-52.94
1480	-64.1	160	2.5	H	5	-59.1	-19	-40.1
1480	-57.7	351	2.1	V	4.3	-53.4	-19	-34.4
2220	-60.3	269	2.0	H	8	-52.3	-19	-33.3
2220	-59.9	333	2.0	V	6.9	-53.0	-19	-34.0
LTE C,Test Frequency 751MHz								
950.15	-78.18	277	1.6	H	10.0	-68.18	-19	-49.18
950.15	-83.67	175	2.1	V	11.7	-71.97	-19	-52.97
1502	-64.1	206	1.7	H	5	-59.1	-19	-40.1
1502	-57.0	331	2.0	V	4.4	-52.6	-19	-33.6
2253	-61.9	264	2.0	H	8	-53.9	-19	-34.9
2253	-59.9	213	1.8	V	6.7	-53.2	-19	-34.2
Cellular,Test Frequency 881.5MHz								
951.33	-78.24	191	2.4	H	10.0	-68.24	-19	-49.24
951.33	-82.60	345	2.3	V	11.7	-70.90	-19	-51.90
1763	-60.3	83	1.4	H	4.4	-55.9	-19	-36.9
1763	-57.9	133	1.8	V	3.2	-54.7	-19	-35.7
2644.5	-58.8	4	2.2	H	6.4	-52.4	-19	-33.4
2644.5	-58.0	17	1.3	V	5.6	-52.4	-19	-33.4
PCS,Test Frequency 1960MHz								
956.20	-77.45	307	1.6	H	10.0	-67.45	-19	-48.45
956.20	-82.96	142	2.0	V	11.7	-71.26	-19	-52.26
3920	-56.5	133	1.9	H	9.1	-47.4	-19	-28.4
3920	-55.5	225	1.4	V	8.4	-47.1	-19	-28.1
5880	-57.1	117	1.5	H	11	-46.1	-19	-27.1
5880	-55.0	159	1.4	V	10.4	-44.6	-19	-25.6
AWS,Test Frequency 2132.5MHz								
954.50	-76.40	18	2.1	H	10.0	-66.40	-19	-47.40
954.50	-82.23	351	1.4	V	11.7	-70.53	-19	-51.53
4265	-54.7	31	1.6	H	9.7	-45.0	-19	-26.0
4265	-53.0	75	1.1	V	8.9	-44.1	-19	-25.1
6397.5	-58.5	174	2.2	H	12.7	-45.8	-19	-26.8
6397.5	-59.5	311	2.3	V	12.4	-47.1	-19	-28.1

Note:

Absolute Level = Reading Level + Substituted Factor

Substituted Factor contains: SG Level - Cable loss+ Antenna Gain

Margin = Absolute Level - Limit

***** END OF REPORT *****