TEST REPORT

Applicant Name:	SHENZHEN HUAPTEC CO., LTD
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Report Number:	SZ1231227-78770E-RF-00
FCC ID:	OWWF115705SR

Test Standard (s)

FCC PART 20.21

Sample Description

Product Type:	Signal Booster
Model No.:	F20G-5S-IOT
Multiple Model(s) No.:	F15G-5S-IOT,F15GB-5S-IOT,F20GB-5S-IOT
Trade Mark:	HiBoost
Date Received:	2023/12/27
Issue Date:	2024/04/25

Test Result:	Pass▲

▲ In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Mike Xiao
RF Engineer

Approved By:

Nancy Wang
RF Supervisor

Note: The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included.

This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "▼".

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	SZ1231227-78770E-RF-00	Original Report	2024/04/25

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Signal Booster
Tested Model	F20G-5S-IOT
Multiple Model(s) No.	F15G-5S-IOT,F15GB-5S-IOT,F20GB-5S-IOT
Voltage Range	DC 12.0V from adapter
Sample serial number	2FVB-1 (Assigned by BACL, Shenzhen)
Adapter Information	Model: J482-1203000DI Input: AC 100-240V 50/60Hz 1.5A Output: DC 12.0V 3.0A 36.0W
Sample/EUT Status	Good condition
Note: The Multiple models are electrically identical with the test model except for model name, gain and power. Please refer to the declaration letter# for more detail, which was provided by manufacturer.	

This device is a fixed wideband consumer and the Booster Operating frequency bands list below:

Electrical specification	Uplink	Downlink
Frequency Range	698 ～ 716MHz 776 ～ 787MHz 824 ～ 849 MHz 1850～1915MHz 1710 ～ 1755MHz	728 ～ 746MHz 746 ～ 757MHz 869 ～ 894 MHz 1930～1995MHz 2110 ～ 2155MHz

Objective

This test report is in accordance with Part 2, Part 20.21 and Part 22, Part 24, Part 27 of the Federal Communication Commissions rules.

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Applicable Standards: KDB 935210 D03 Signal Booster Measurements v04r04.
ANSI C63.26-2015: American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		213.55 Hz(k=2, 95% level of confidence)
RF output power, conducted		0.72 dB(k=2, 95% level of confidence)
Unwanted Emission, conducted		1.75 dB(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9kHz-150kHz	3.94dB(k=2, 95% level of confidence)
	150kHz-30MHz	3.84dB(k=2, 95% level of confidence)
Emissions, Radiated	9kHz - 30MHz	3.30dB(k=2, 95% level of confidence)
	30MHz~200MHz (Horizontal)	4.48dB(k=2, 95% level of confidence)
	30MHz~200MHz (Vertical)	4.55dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Horizontal)	4.85dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Vertical)	5.05dB(k=2, 95% level of confidence)
	1GHz - 6GHz	5.35dB(k=2, 95% level of confidence)
	6GHz - 18GHz	5.44dB(k=2, 95% level of confidence)
	18GHz - 40GHz	5.16dB(k=2, 95% level of confidence)
Temperature		±1℃
Humidity		±1%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 715558, the FCC Designation No. : CN5045.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode which has been done in the factory.

Antenna kitting requirement: EUT has some antennas kitting for marketing, the antenna gain and cable loss for varies band were listed below, fulfill the requirement of FCC Part 20.21(e)(8)(i)(G), more detail information please refer to the user manuals.

Outside antenna:

Frequency Range (MHz)	Outdoor antenna gain# (dBi)	Cable Loss# (dBi)
698-716	8	4.97
776-787	8	4.97
824-849	8	5.17
1850-1915	9	7.51
1710-1755	9	7.51

Inside antenna:

Frequency Range (MHz)	Indoor antenna gain# (dBi)	Cable Loss# (dBi)
728-746	6.5	4.97
746-757	6.5	4.97
869-894	6.5	5.17
1930-1995	8.5	7.51
2110-2155	8.5	7.51

Note:
The antenna gain and cable loss list above was provided by manufacturer.

EUT Exercise Software

No exercise software was used.

Special Accessories

No special accessory was used.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

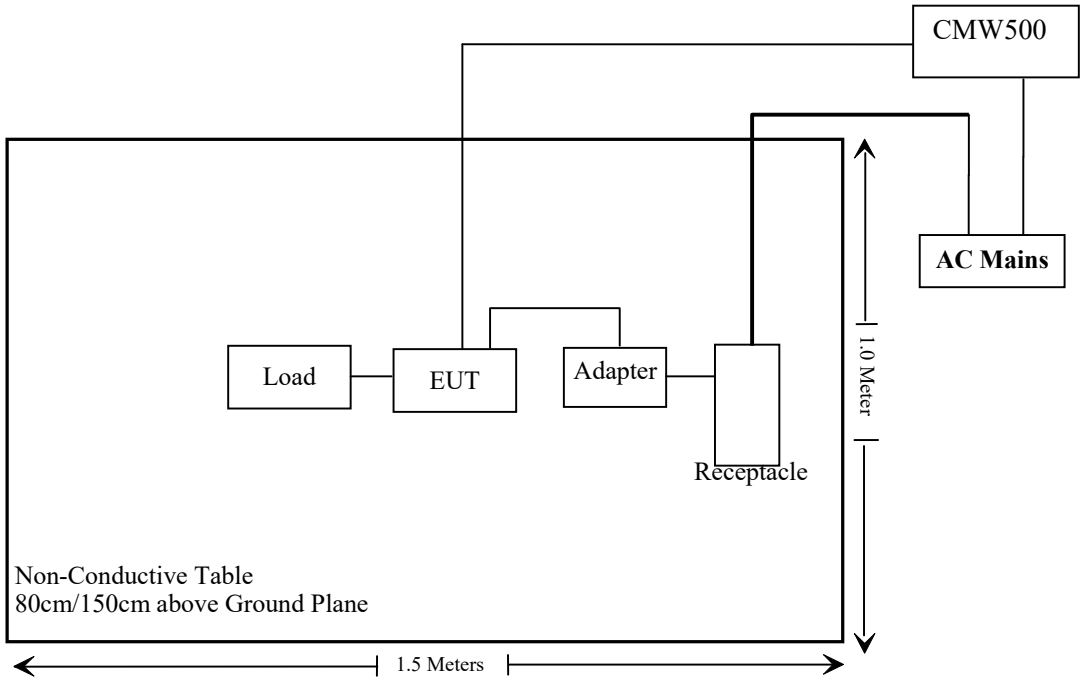
Manufacturer	Description	Model	Serial Number
Unknown	50ΩLoad	Unknown	BACLload002
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	141718

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-shielded Un-Detachable DC cable	1.2	Adapter	EUT
Shielded Detachable RF cable	5.0	CMW500	EUT
Shielded Detachable RF cable	1.0	50ΩLoad	EUT

Block Diagram of Test Setup

Radiated emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§20.21(e)(3)	7.1 Authorized Frequency Band Verification	Compliant
§ 20.21(e)(8)(i)(D) § 20.21(e)(8)(i)(B) & §20.21(e)(4)	7.2 Maximum Power Measurement	Compliant
§ 20.21(e)(8)(i)(C)(2) § 20.21(e)(8)(i)(B) & §20.21(e)(4)	7.3 Maximum Booster Gain Computation	Compliant
§ 20.21(e)(8)(i)(B) § 20.21(e)(3)	7.13 Spectrum block filtering test procedure	Not applicable
§ 20.21(e)(8)(i)(F)	7.4 Intermodulation Product	Compliant
§ 20.21(e)(8)(i)(E)	7.5 Out Of Band Emissions	Compliant
§ 20.21(e)(8)(i)(A) § 20.21(e)(8)(i)(H) &§20.21(e)(4)	7.7 Noise Limits	Compliant
§ 20.21(e)(8)(i)(I) &§20.21(e)(4)	7.8 Uplink Inactivity	Compliant
§ 20.21(e)(8)(i)(C)(1) & § 20.21(e)(8)(i)(H)	7.9 Variable Booster Gain	Compliant
§ 2.1049	7.10 Occupied Bandwidth	Compliant
§ 20.21(e)(8)(ii)(A) &§20.21(e)(4)	7.11 Oscillation Detection	Compliant
§2.1051	7.6 Spurious Emissions At Antenna Terminals	Compliant
§ 2.1053	7.12 Radiated Spurious Emissions	Compliant

Not applicable: This item only for wideband consumer boosters utilizing spectrum block filtering.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emissions Test					
R&S	EMI Test Receiver	ESR3	102455	2023/02/08	2024/02/07
Sonoma instrument	Pre-amplifier	310 N	186238	2023/06/08	2024/06/07
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2024/07/19
Unknown	Cable	Chamber Cable 1	F-03-EM236	2023/08/03	2024/08/02
Unknown	Cable	Chamber Cable 4	EC-007	2023/08/03	2024/08/02
Agilent	Signal Generator	N5183A	MY50140588	2023/12/18	2024/12/17
COM-POWER	Dipole Antenna	AD-100	721027	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40	101605	2023/04/18	2024/04/17
COM-POWER	Pre-amplifier	PA-122	181919	2023/06/29	2024/06/28
Schwarzbeck	Horn Antenna	BBHA9120D (1201)	1143	2023/07/26	2024/07/25
A.H.System	Horn Antenna	SAS-200/571	135	2021/07/14	2024/07/13
Unknown	RF Cable	KMSE	0735	2023/10/08	2024/10/07
Unknown	RF Cable	UFA147	219661	2023/10/08	2024/10/07
MICRO-TRONICS	2.8G Passband filter	HPM50111	F-03-EM217	2023/08/03	2024/08/02
A.H.System	Pre-amplifier	PAM-1840VH	190	2023/08/03	2024/08/02
Electro-Mechanics Co	Horn Antenna	3116	9510-2270	2023/09/18	2026/09/17
UTIFLEX	RF Cable	NO. 13	232308-001	2023/08/03	2024/08/02
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
RF Conducted Test					
R&S	spectrum analyzer	FSV40	101942	2023/12/18	2024/12/17
R&S	SPECTRUM ANALYZER	FSU26	200120	2024/01/08	2025/01/07
R&S	Wideband Radio Communication Tester	CMW500	141718	2023/09/06	2024/09/05
Keysight	MXG Vector Signal Generator	N5182B	MY53051503	2024/01/08	2025/01/07
MARCONI	10dB Attenuator	6534/3	2942	2023/07/04	2024/07/03
WEINSCHEL	Power Splitter	1515	RH397	2023/07/04	2024/07/03
Unknown	RF Cable	65475	01670515	2023/07/04	2024/07/03
Micro-Tronics	RF Cable	8082135	W1113	2023/07/04	2024/07/03
Micro-Tronics	RF Cable	8082176	W6102	2023/07/04	2024/07/03
Micro-Tronics	RF Cable	8082176	W6111	2023/07/04	2024/07/03
WEINSCHEL	adjustable attenuator	8496B/5494B	2827A12453	NCR	NCR

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

§ 20.21(E)(3) – AUTHORIZED FREQUENCY BAND VERIFICATION

Applicable Standard

According to§ 20.21(e)(3) Frequency Bands

This test is intended to confirm that the signal booster only operates on the CMRS frequency bands authorized for use by the NPS. In addition, this test will identify the frequency at which the maximum gain is realized within each CMRS operational band, which then serves as a basis for subsequent tests.

Test Procedure

a) Connect the EUT to the test equipment as shown in Figure 1. Begin with the uplink output connected to the spectrum analyzer.
b) Set the spectrum analyzer RBW for 100 kHz with the VBW ≥ 3 × the RBW using a PEAK detector with the MAX HOLD function.
c) Set the center frequency of the spectrum analyzer to the center of the operational band under test with a span of 1 MHz.
d) Set the signal generator for CW mode and tune to the center frequency of the operational band under test.
e) Set the initial signal generator power to a level that is at least 6 dB below the AGC level specified by the manufacturer.
f) Slowly increase the signal generator power level until the output signal reaches the AGC operational level.
g) Reduce the signal generator power to a level that is 3 dB below the level noted above and manually reset the EUT.
h) Reset the spectrum analyzer span to 2 × the CMRS band under test. Adjust the tuned frequency of the signal generator to sweep 2 × the CMRS band using the sweep function. The AGC must not be activated throughout the entire sweep.
i) Using three markers, identify the CMRS band edges and the frequency with the highest power. Affirm that the values of all markers are visible on the display of the spectrum analyzer (e.g., marker table set to on).
j) Capture the spectrum analyzer trace for inclusion in the test report.
k) Repeat 7.1c) to 7.1j) for all operational uplink and downlink bands.

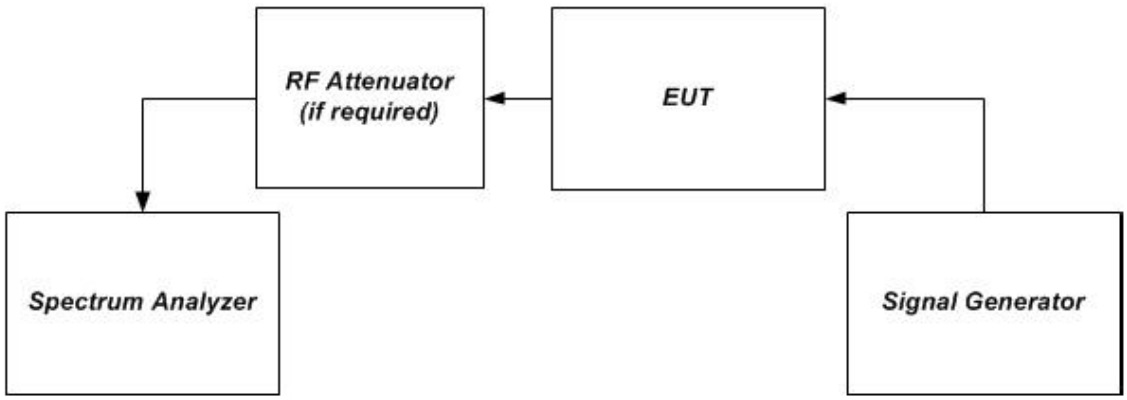


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	26.5℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

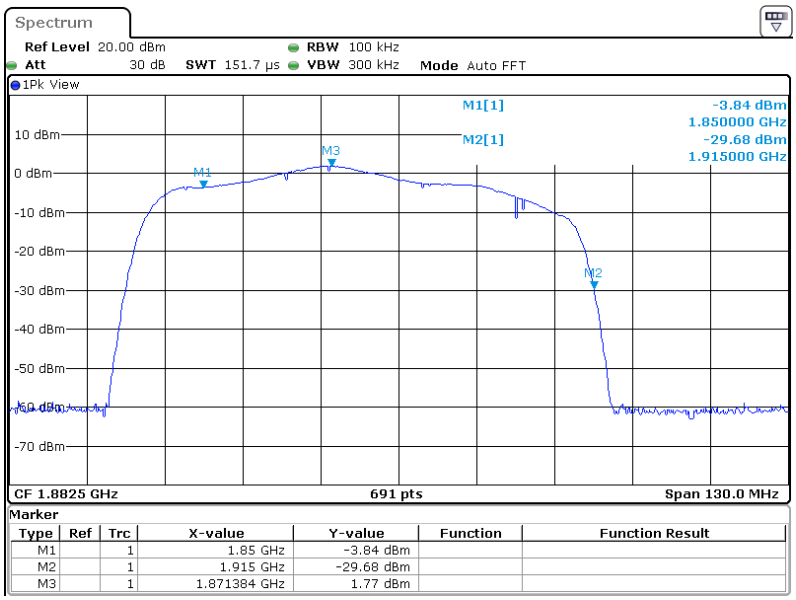
The testing was performed by Brace Lin on 2024-01-20.

Test Result: Pass

Please refer to following plots.

Uplink:

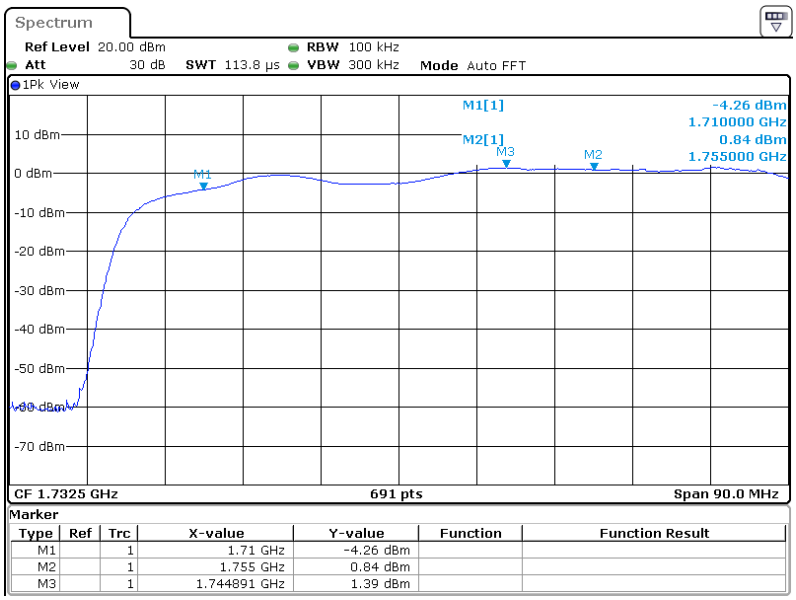
PCS Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:11:03

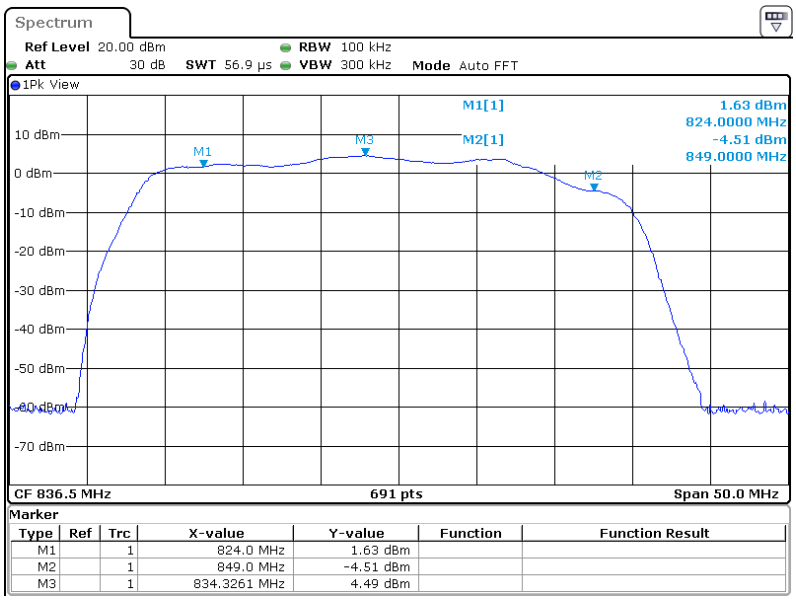
AWS Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:12:17

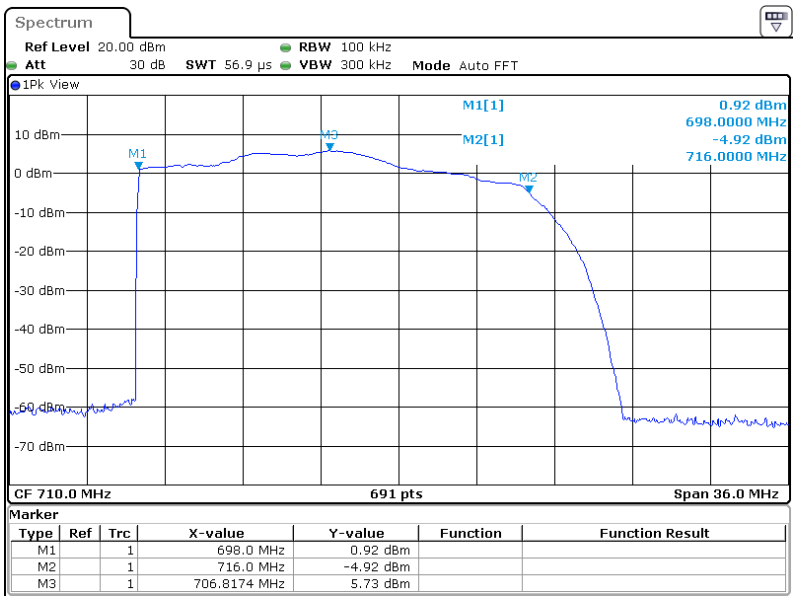
Cellular Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:10:10

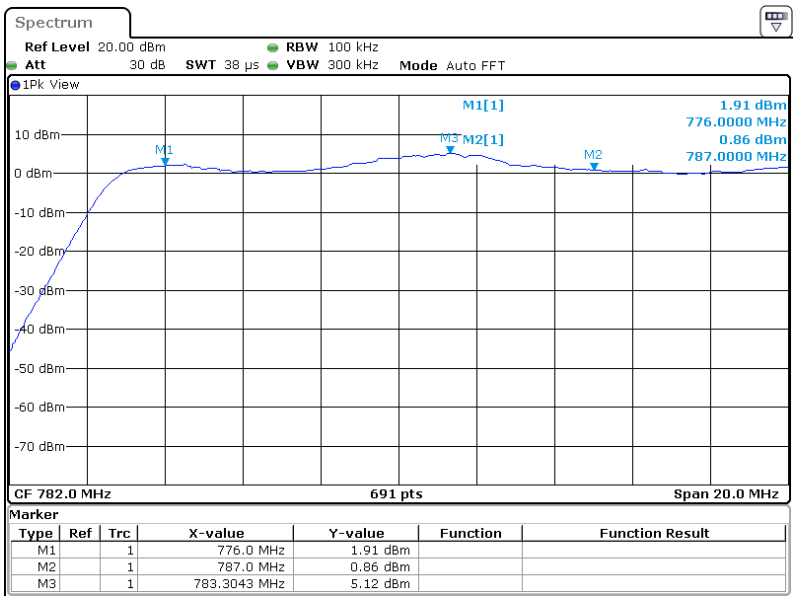
Lower 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:08:44

Upper 700MHz

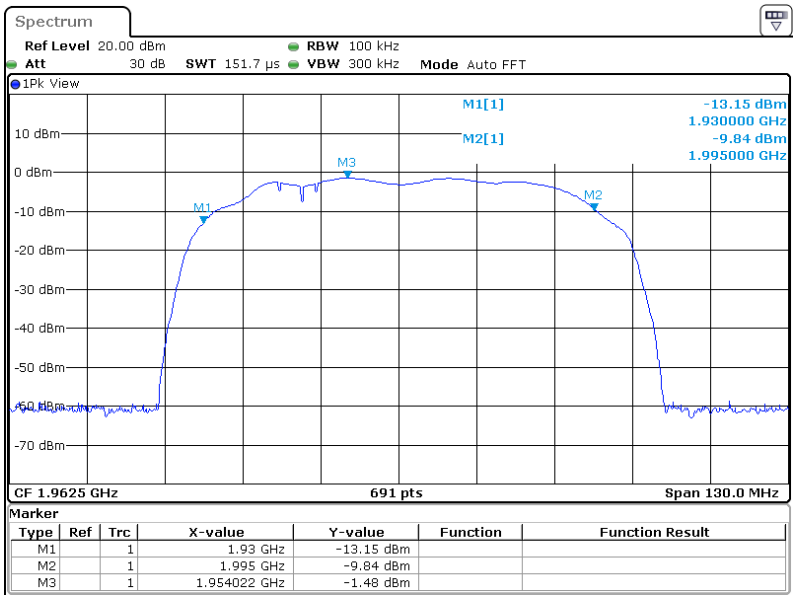


ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:09:37

Downlink:

PCS Band



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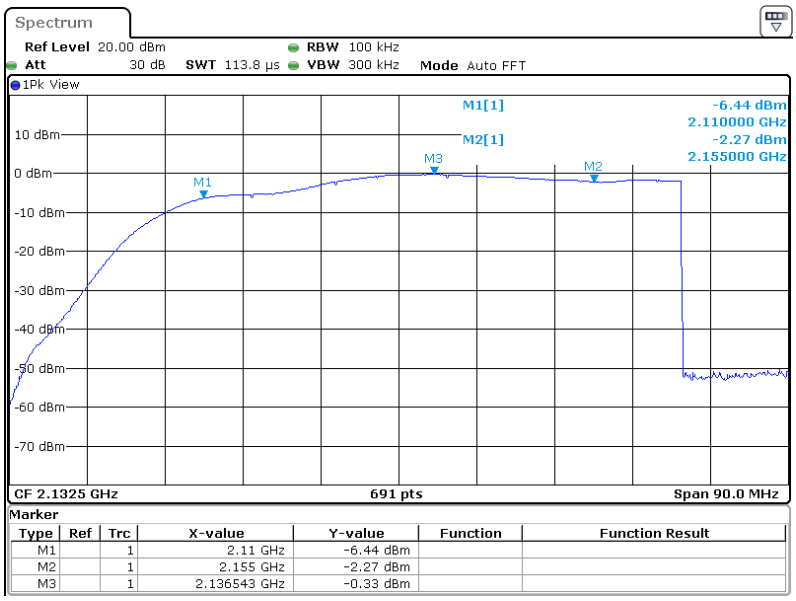
Date: 20.JAN.2024 01:03:52

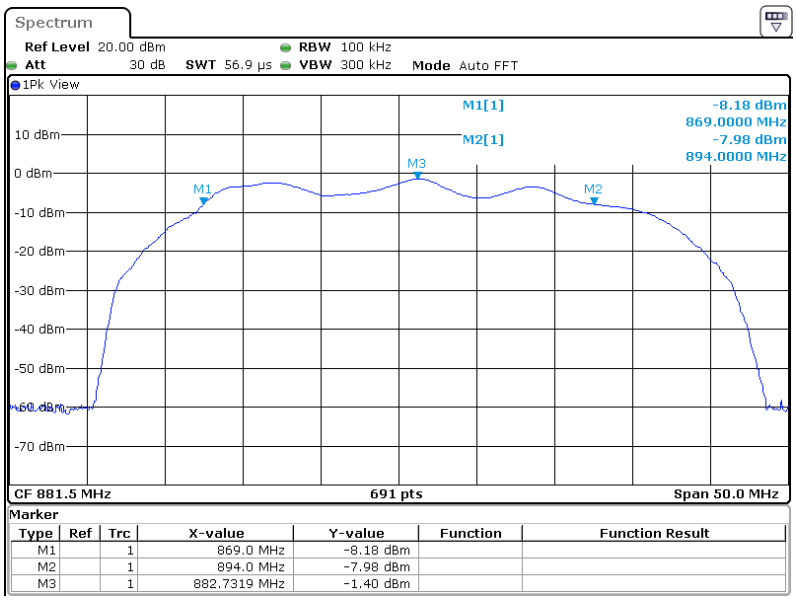
AWS Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:04:36

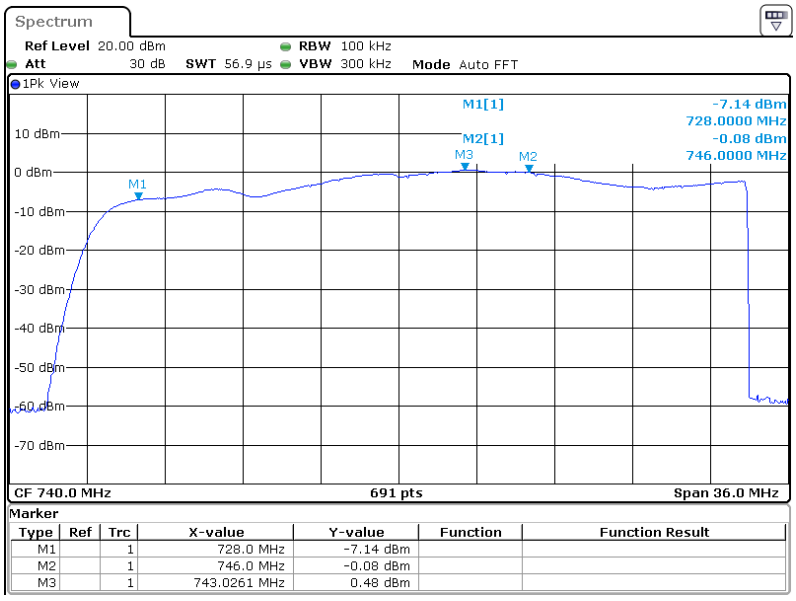
Cellular Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:02:50

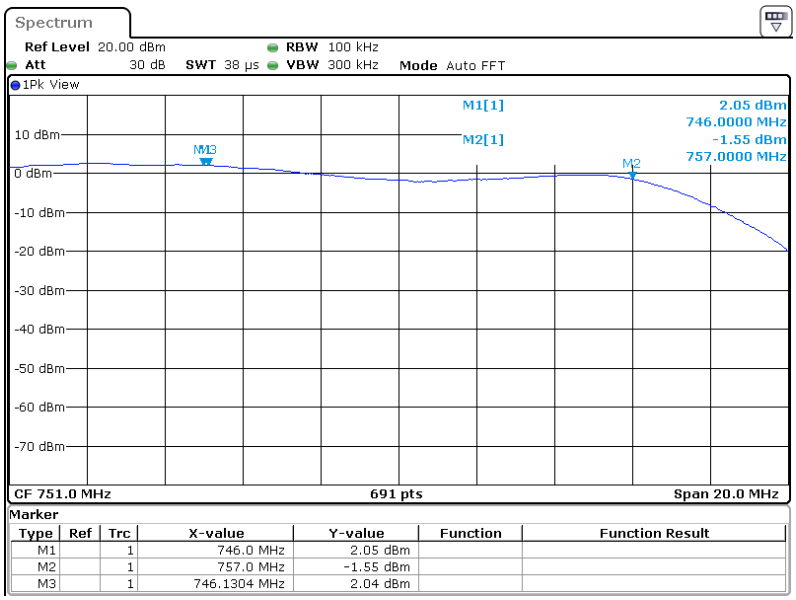
Lower 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:01:44

Upper 700MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	746.0 MHz	2.05 dBm		
M2		1	757.0 MHz	-1.55 dBm		
M3		1	746.1304 MHz	2.04 dBm		

ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 01:02:17

§ 20.21(e)(8)(i)(D) ,§ 20.21(e)(8)(i)(B)& §20.21(e)(4)– MAXIMUM POWER MEASUREMENT

Applicable Standard

According to§ 20.21(e)(8)(i)(D) Power Limits; § 20.21(e)(8)(i)(B) Bidirectional Capability (uplink minimum conducted power output); §20.21(e)(4) Self-monitoring.

This procedure shall be used to demonstrate compliance to the signal booster power limits and requirements as specified in §§ 20.21(e)(8)(i)(D) and 20.21(e)(8)(i)(B) for wideband consumer signal boosters.

a) Compliance to authorized EIRP limits must be shown using the highest gains from the list of antennas, cabling, and coupling devices declared by the manufacturer for use with the consumer booster.
b) In addition, the maximum power levels measured in this procedure will be utilized in calculating the maximum gain as described in the next subclause.
c) The frequency with the highest power level in each operational band as determined in 7.1 is to be measured discretely by applying the following procedure utilizing the stated emission and power detector types independently.
d) Use a signal generator to create a pulsed CW or GSM signal with a pulse width of 570 μs and a duty cycle of 12.5% (i.e., one GSM timeslot), then measure utilizing the burst power function of the measuring instrument.
e) Use a signal generator to create an AWGN signal with a 99% occupied bandwidth of 4.1 MHz, then measure utilizing the channel power or band power function of the measuring instrumentation.
f) All modes of operation must be verified to maintain operation within authorized limits at the maximum uplink and downlink test levels per device type as defined in 5.4, by increasing the power level in 2 dB steps from the AGC level to the maximum input level specified in 5.5.

Test Procedure

a) Connect the EUT to the test equipment as shown in Figure 1. Begin with the uplink output (donor port) connected to the spectrum analyzer.
b) Configure the signal generator and spectrum analyzer for operation on the frequency determined in 7.1 with the highest power level, but with the center frequency of the signal no closer than 2.5 MHz from the band edge. The spectrum analyzer span shall be set to at least 10 MHz.
c) Set the initial signal generator power to a level well below that which causes AGC control.
d) Slowly increase the signal generator power level until the output signal reaches the AGC operational limit (from observation of signal behavior on the spectrum analyzer; i.e., no further increase in output power as input power is increased).
e) Reduce power sufficiently on the signal generator to ensure that the AGC is not controlling the power output.
f) Slowly increase the signal generator power to a level just below (within 0.5 dB of) the AGC limit without triggering the AGC. Note the signal generator power level as Pin.
g) Measure the output power Pout with the spectrum analyzer as follows.

1) Set RBW = 100 kHz for AWGN signal type and 300 kHz for CW or GSM signal type.
2) Set VBW ≥ 3 × RBW.
3) Select either the BURST POWER or CHANNEL POWER measurement tool, as required for each signal type. The channel power integration bandwidth shall be 99% occupied bandwidth (4.1 MHz).
4) Select the RMS (power averaging) detector.
5) Ensure that the number Note: This requirement
6) Set sweep time = auto

7) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
h) Record the measured power level as P_{OUT} with one set of results for the GSM or CW input stimulus and another set of results for the AWGN input stimulus.
i) Repeat step h) while increasing the signal generator amplitude in 2 dB steps until the maximum input level indicated in 5.5 is reached. If the booster has shut down at any point during the input power steps it should be noted and step h) shall be repeated at an input level 1 dB less than that found to cause the shutdown.
j) Repeat the entire procedure for each operational uplink and downlink frequency band supported by the booster.
k) Provide tabulated results in the test report.

Test Data

Environmental Conditions

Temperature:	26.5℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin on 2024-01-20.

Test Result: Pass

Please refer to the following tables

AGC Level:

Mode	Operation Band	Signal type	AGC level dBm	Mode	Operation Band	Signal type	AGC level dBm
Uplink	Lower 700 MHz	AWGN	-41	Downlink	Lower 700 MHz	AWGN	-46.5
		GSM	-41			GSM	-46.5
	Upper 700 MHz	AWGN	-42		Upper 700 MHz	AWGN	-46.5
		GSM	-41.5			GSM	-46
	cellular	AWGN	-41.5		cellular	AWGN	-46.5
		GSM	-41.5			GSM	-47
	PCS	AWGN	-49.5		PCS	AWGN	-54
		GSM	-49.5			GSM	-54.5
	AWS	AWGN	-49		AWS	AWGN	-54
		GSM	-49.5			GSM	-54.5

Output Power:

Mode	Operation Band	Signal type	Pre AGC Input level	Conducted Output level	Limit	Antenna Gain	Cable loss	EIRP	EIRP Limit
			dBm	dBm	dBm	dB	dB	dBm	dBm
Uplink	Lower 700 MHz	AWGN	-41.5	19.23	17~30	8	4.97	22.26	≤30
		GSM	-41.5	19.12				22.15	
	Upper 700 MHz	AWGN	-42.5	19.16		8	4.97	22.19	
		GSM	-42	19.42				22.45	
	cellular	AWGN	-42	19.39		8	5.17	22.22	
		GSM	-42	19.49				22.32	
	PCS	AWGN	-50	19.13		9	7.51	20.62	
		GSM	-50	19.22				20.71	
	AWS	AWGN	-49.5	19.28		9	7.51	20.77	
		GSM	-50	19.19				20.68	
Downlink	Lower 700 MHz	AWGN	-47.0	15.25	≤17	6.5	4.97	16.78	≤17
		GSM	-47.0	15.36				16.89	
	Upper 700 MHz	AWGN	-47.0	15.13		6.5	4.97	16.66	
		GSM	-46.5	15.21				16.74	
	cellular	AWGN	-47.0	15.47		6.5	5.17	16.80	
		GSM	-47.5	15.42				16.75	
	PCS	AWGN	-54.5	15.53		8.5	7.51	16.52	
		GSM	-55.0	15.5				16.49	
	AWS	AWGN	-54.5	15.54		8.5	7.51	16.53	
		GSM	-55.0	15.35				16.34	

Maximum Input level:

Mode	Operation Band	Signal type	Maximum Input level	Maximum Input level Limits	Conducted Output level	Limit	EIRP	EIRP Limit
			dBm	dBm	dBm	dBm	dBm	dBm
Uplink	Lower 700 MHz	AWGN	-30.17	27.0	19.81	17~30	22.84	≤30
		GSM	-30.39		19.64		22.67	
	Upper 700 MHz	AWGN	-28.91		19.85		22.88	
		GSM	-29.16		20.03		23.06	
	cellular	AWGN	-28.78		19.96		22.79	
		GSM	-29.07		19.99		22.82	
	PCS	AWGN	-34.85		19.20		20.69	
		GSM	-34.81		19.23		20.72	
	AWS	AWGN	-37.24		19.42		20.91	
		GSM	-37.8		19.27		20.76	
Downlink	Lower 700 MHz	AWGN	-37.68	-20	15.01	≤17	16.54	≤17
		GSM	-36.68		15.17		16.70	
	Upper 700 MHz	AWGN	-37.67		15.00		16.53	
		GSM	-39.16		15.13		16.66	
	cellular	AWGN	-37.34		15.57		16.90	
		GSM	-37.6		15.58		16.91	
	PCS	AWGN	-43.3		15.37		16.36	
		GSM	-42.8		15.55		16.54	
	AWS	AWGN	-43.28		15.61		16.60	
		GSM	-42.98		15.46		16.45	

Note: The output power level was measured at input level 1dB less than the maximum input level.

§ 20.21(e)(8)(i)(C)(2), § 20.21(e)(8)(i)(B)&§20.21(e)(4) – MAXIMUM BOOSTER GAIN COMPUTATION

Applicable Standards

According to§ 20.21(e)(8)(i)(C)(2) (ii)Booster Gain Limits (maximum gain); § 20.21(e)(8)(i)(B) Bidirectional Capability (equivalent uplink and downlink gain); §20.21(e)(4) Self-monitoring.

This subclause provides guidance on the computation of the maximum gain based on the results obtained from previous measurements. The NPS limits on maximum gain for fixed and mobile wideband consumer signal boosters are provided in § 20.21(e)(8)(i)(C)(*2*). Additionally, § 20.21(e)(8)(i)(B) requires that wideband consumer signal boosters be able to provide equivalent uplink and downlink gain (within 9 dB)

Test Procedure

a) Calculate the maximum gain of the booster as follows to demonstrate compliance to the applicable gain limits as specified.
b) For both the uplink and downlink in each supported frequency band, use each of the P_{OUT} and P_{IN} result pairs for all signal types used in 7.2 in the following equation to determine the maximum gain (G) of the booster:
$G\ (dB) = P_{OUT}(dBm) - P_{IN}(dBm)$.
c) Record the maximum gain of the uplink and downlink paths for each supported frequency band, and verify that the each gain value complies with the applicable limit.
d) Provide tabulated results in the test report.

Test Data

Environmental Conditions

Temperature:	26.5℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin on 2024-01-20.

Test Result: Pass

Please refer to the following tables

Maximum gain:

Mode	Operation Band	Signal type	Pre AGC Input level	Conducted Output level	Gain	Limit
			dBm	dBm	dB	dB
Uplink	Lower 700 MHz	AWGN	-41.5	19.23	60.73	63.49
		GSM	-41.5	19.12	60.62	
	Upper 700 MHz	AWGN	-42.5	19.16	61.66	64.36
		GSM	-42.0	19.42	61.42	
	cellular	AWGN	-42.0	19.39	61.39	64.95
		GSM	-42.0	19.49	61.49	
	PCS	AWGN	-50.0	19.13	69.13	71.99
		GSM	-50.0	19.22	69.22	
	AWS	AWGN	-49.5	19.28	68.78	71.27
		GSM	-50.0	19.19	69.19	
Downlink	Lower 700 MHz	AWGN	-47.0	15.25	62.25	63.49
		GSM	-47.0	15.36	62.36	
	Upper 700 MHz	AWGN	-47.0	15.13	62.13	64.36
		GSM	-46.5	15.21	61.71	
	cellular	AWGN	-47.0	15.47	62.47	64.95
		GSM	-47.5	15.42	62.92	
	PCS	AWGN	-54.5	15.53	70.03	71.99
		GSM	-55.0	15.5	70.50	
	AWS	AWGN	-54.5	15.54	70.04	71.27
		GSM	-55.0	15.35	70.35	

Note: Fixed Booster maximum gain shall not exceed 6.5 dB + 20 Log10 (Frequency), Where, Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

Equivalent Uplink and downlink gain:

Operating Band	Signal type	Uplink Gain	Downlink Gain	Caculated Value	Limit
MHz		dB	dB	dB	dB
Lower 700 MHz	AWGN	60.73	62.25	1.52	9
	GSM	60.62	62.36	1.74	
Upper 700 MHz	AWGN	61.66	62.13	0.47	
	GSM	61.42	61.71	0.29	
cellular	AWGN	61.39	62.47	1.08	
	GSM	61.49	62.92	1.43	
PCS	AWGN	69.13	70.03	0.90	
	GSM	69.22	70.50	1.28	
AWS	AWGN	68.78	70.04	1.26	
	GSM	69.19	70.35	1.52	

§ 20.21(e)(8)(i)(F)- INTERMODULATION PRODUCT

Applicable Standards

According to§ 20.21(e)(8)(i)(F) Intermodulation Limits.

Test Procedure

The following procedures shall be used to demonstrate compliance to the intermodulation limit specified in § 20.21(e)(8)(i)(F) for wideband consumer signal boosters.

a) Connect the signal booster to the test equipment as shown in **Figure 2**. Begin with the uplink output connected to the spectrum analyzer.
b) Set the spectrum analyzer RBW = 3 kHz.
c) Set the VBW ≥ 3 × RBW.
d) Select the RMS detector
e) Set the spectrum analyzer center frequency to the center of the supported operational band under test.
f) Set the span to 5 MHz. Affirm that the number of measurement points per sweep ≥ (2 × span)/RBW.
g) Configure the two signal generators for CW operation with generator 1 tuned 300 kHz below the operational band center frequency and generator 2 tuned 300 kHz above the operational band center frequency.
h) Set the signal generator amplitudes so that the power from each into the RF combiner is equivalent, then turn on the RF output.
i) Increase the signal generators' amplitudes equally until just before the EUT begins AGC and affirm that all intermodulation products (if any exist) are below the specified limit of −19 dBm.
j) Utilize the trace averaging function of the spectrum analyzer and wait for the trace to stabilize. Place a marker at the highest amplitude intermodulation product.
k) Record the maximum intermodulation product amplitude level that is observed.
l) Capture the spectrum analyzer trace for inclusion in the test report.
m) Repeat 7.4e) to 7.4l) for all uplink and downlink operational bands.

Note: *If using a single signal generator with dual outputs, affirm that intermodulation products are not the result of the generator.*

n) Increase the signal generator amplitude in 2 dB steps to 10 dB above the AGC threshold determined in 7.4i), but to not to exceed the maximum input level in 5.5, to affirm that the EUT maintains compliance with the intermodulation limit

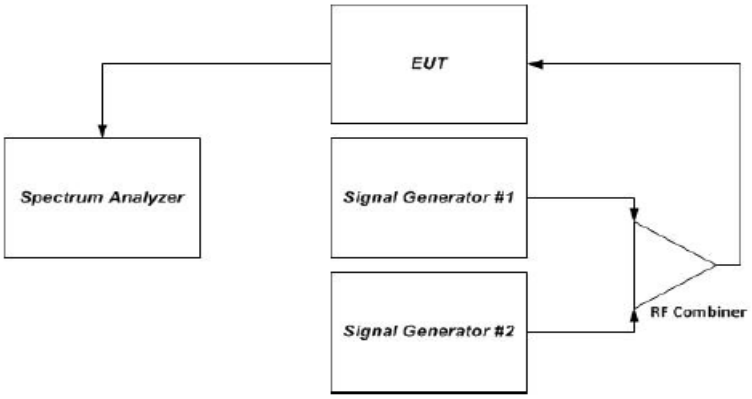


Figure 2 – Intermodulation product instrumentation test setup

Test Data

Environmental Conditions

Temperature:	26.5℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

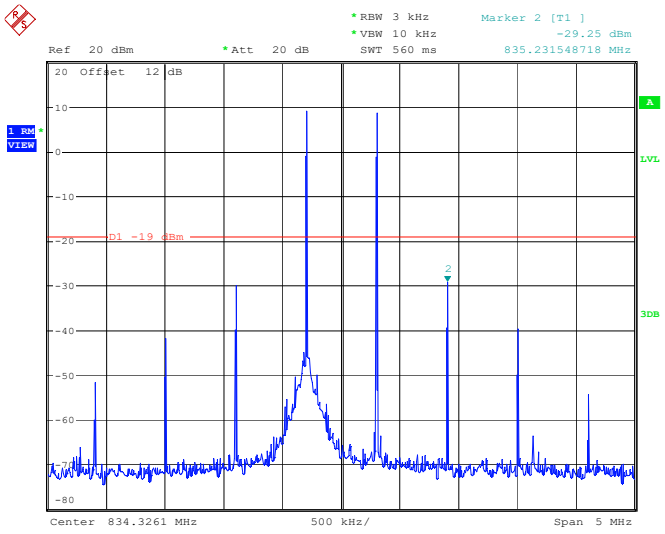
The testing was performed by Brace Lin on 2024-03-30.

Test Result: Pass

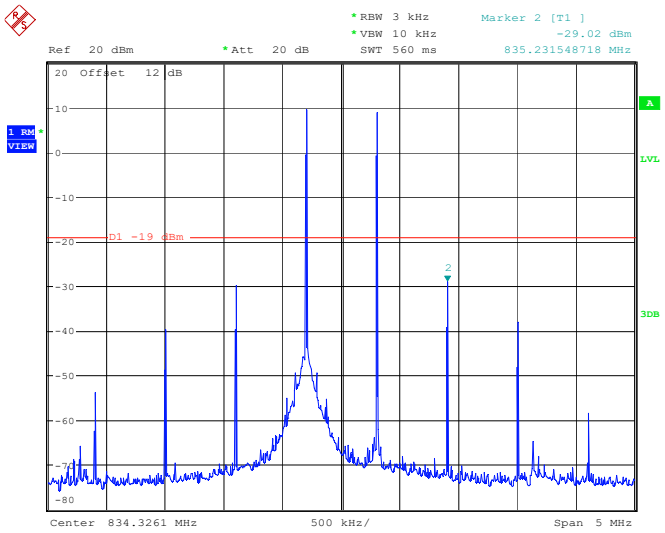
Please refer to the following plots

Uplink

Cellular Pre-AGC

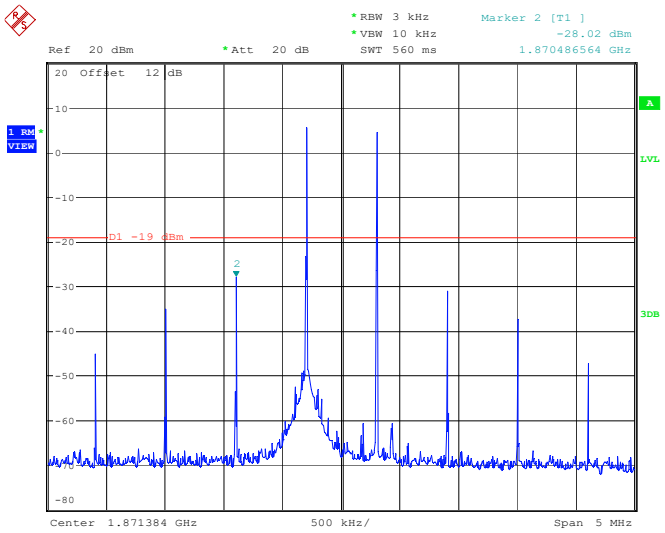


Cellular Above AGC



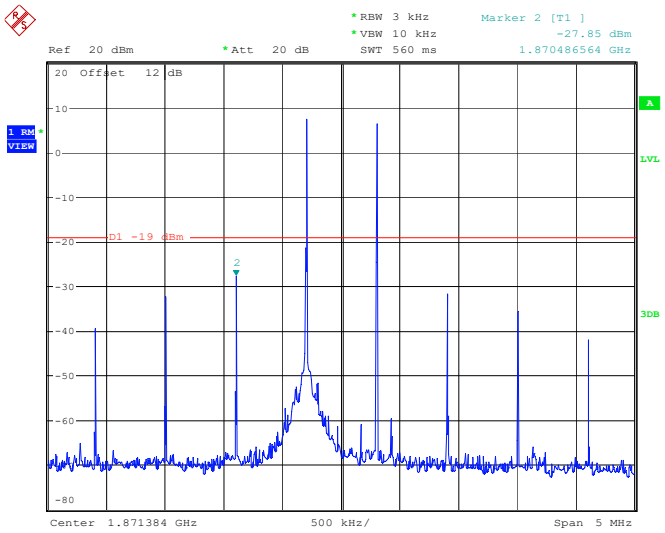
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:54:41

PCS Pre-AGC



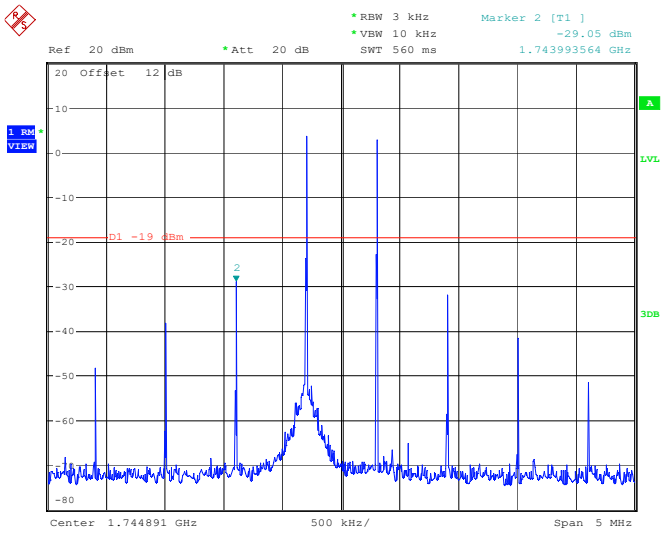
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 01:02:55

PCS Above AGC



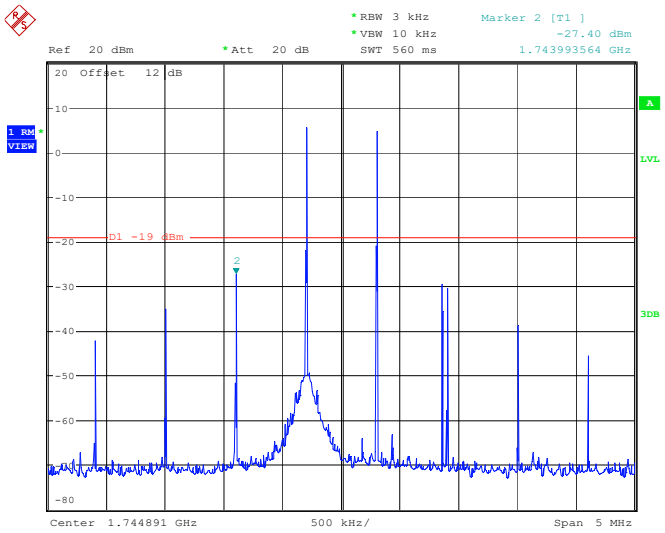
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 01:03:51

AWS Pre-AGC



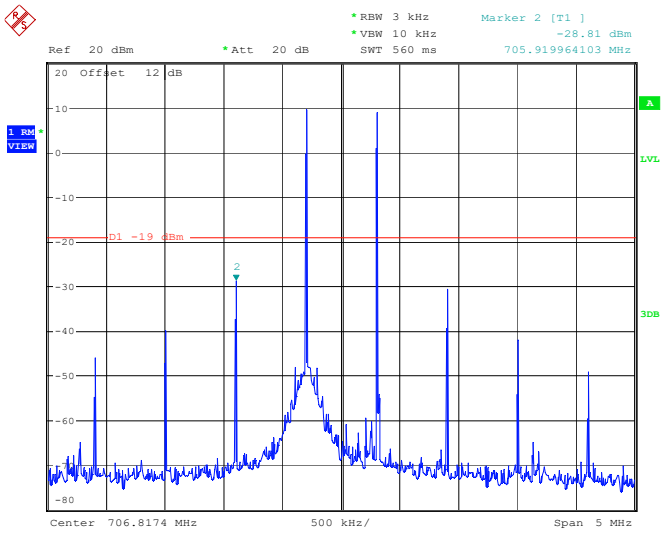
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 01:06:38

AWS Above AGC



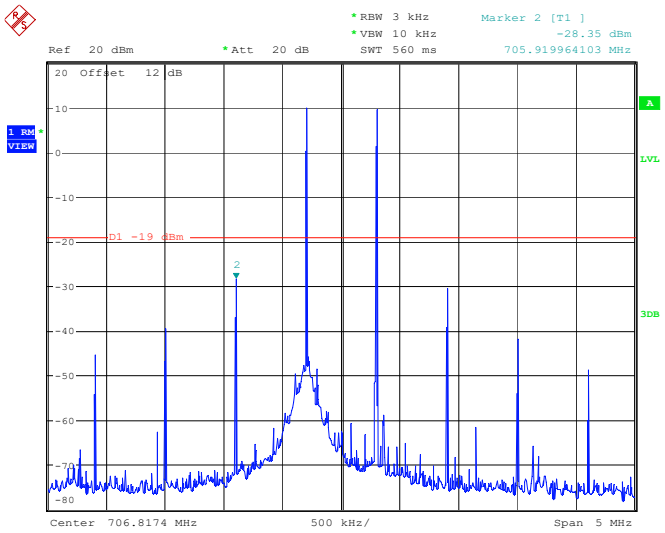
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 01:07:56

Lower 700MHz Pre-AGC



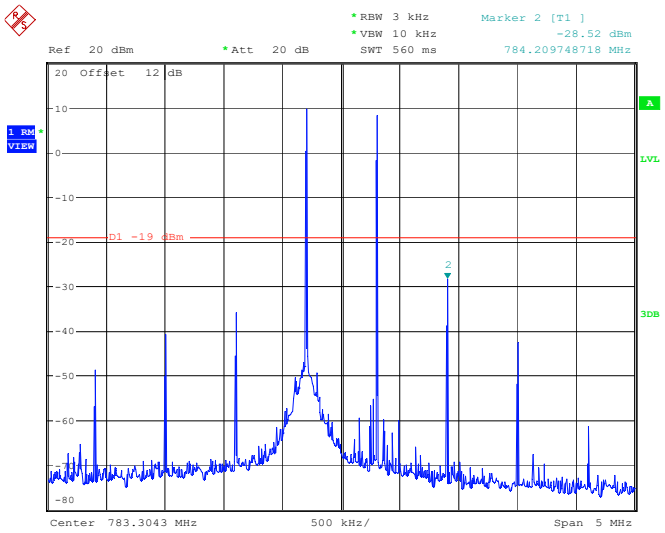
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:48:21

Lower 700MHz Above AGC



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:49:19

Upper 700MHz Pre-AGC



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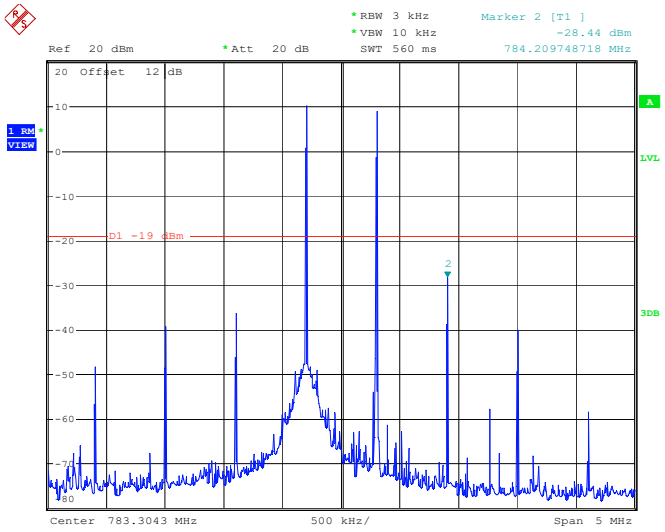
Date: 30.MAR.2024 00:51:12

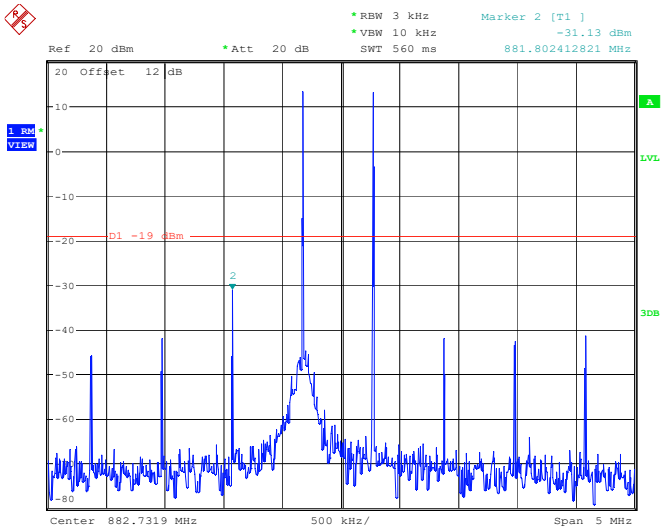
Upper 700MHz Above AGC



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:52:24

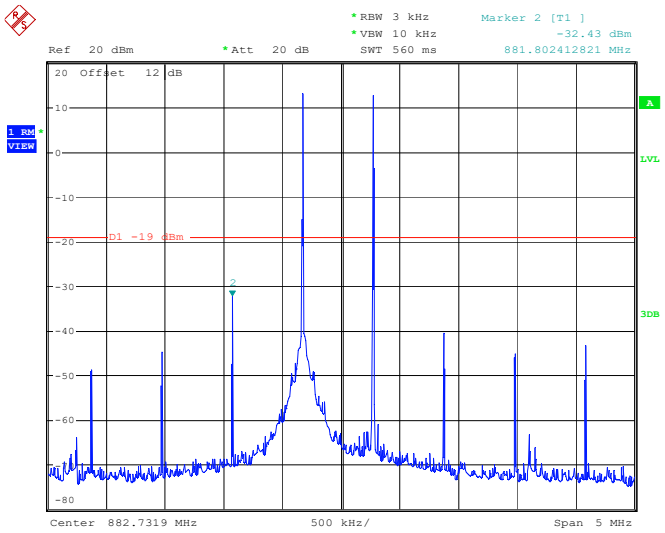
Downlink

Cellular Pre-AGC



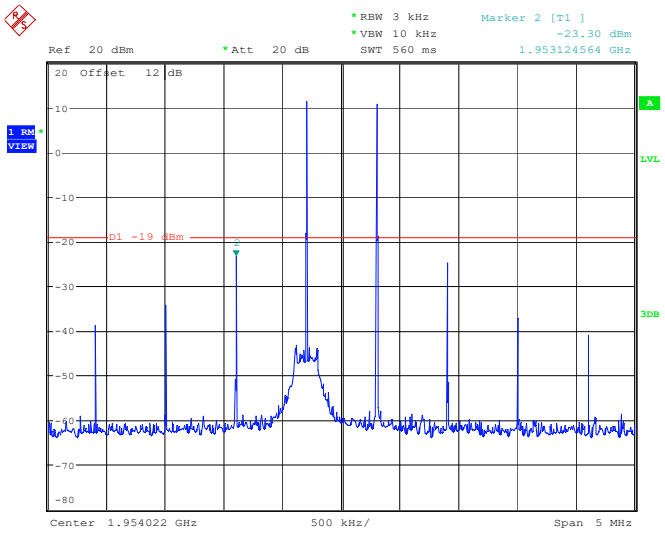
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:24:04

Cellular Above AGC



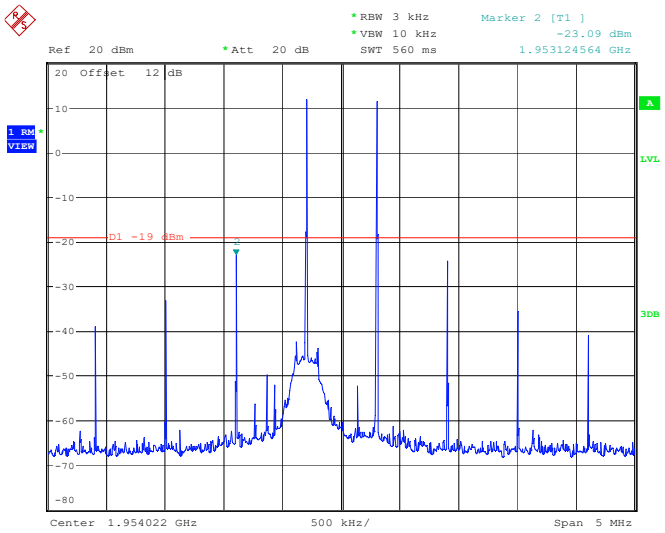
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:24:47

PCS Pre-AGC



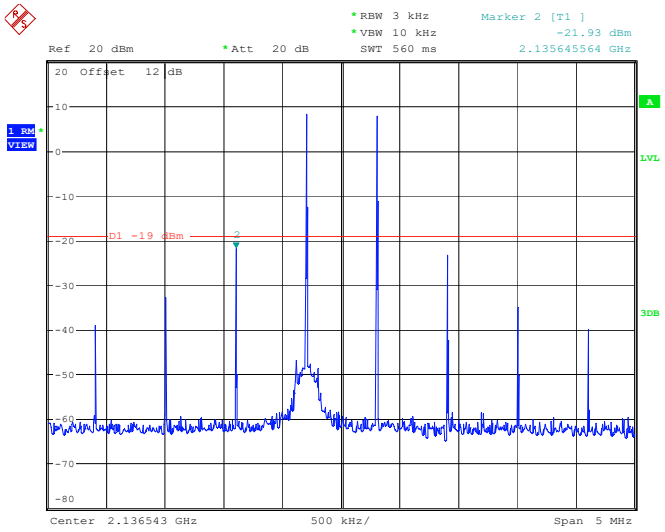
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:30:54

PCS Above AGC



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:31:56

AWS Pre-AGC



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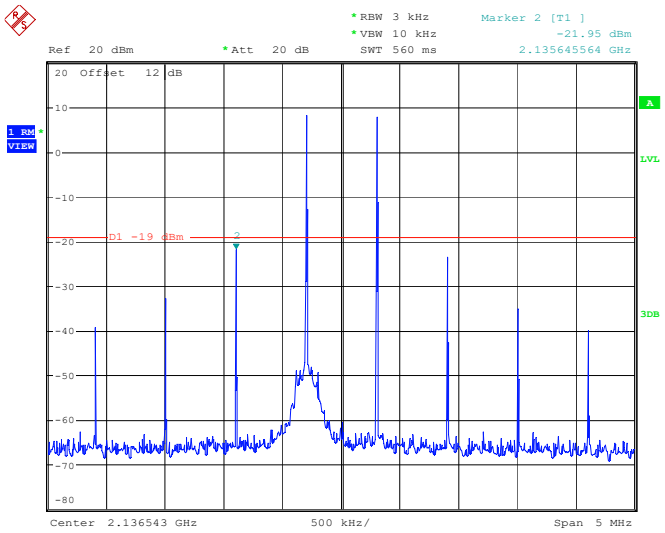
Date: 30.MAR.2024 00:41:45

AWS Above AGC



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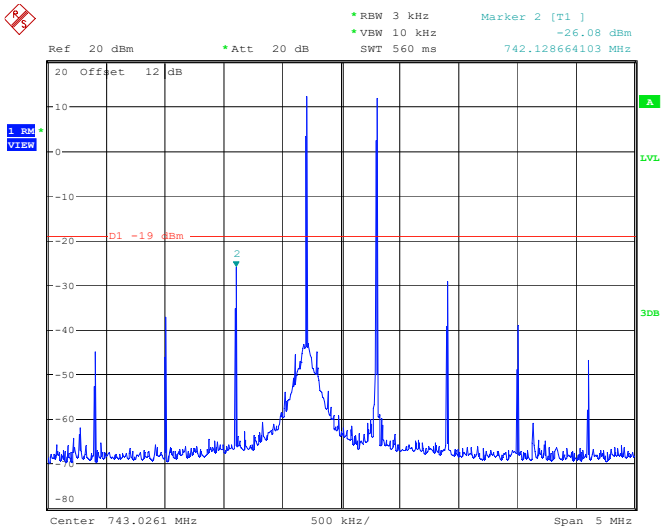
Date: 30.MAR.2024 00:42:27

Lower 700MHz Pre-AGC



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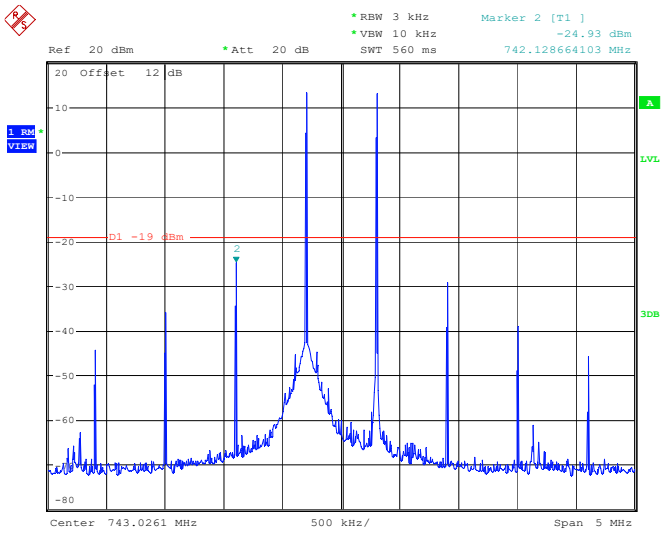
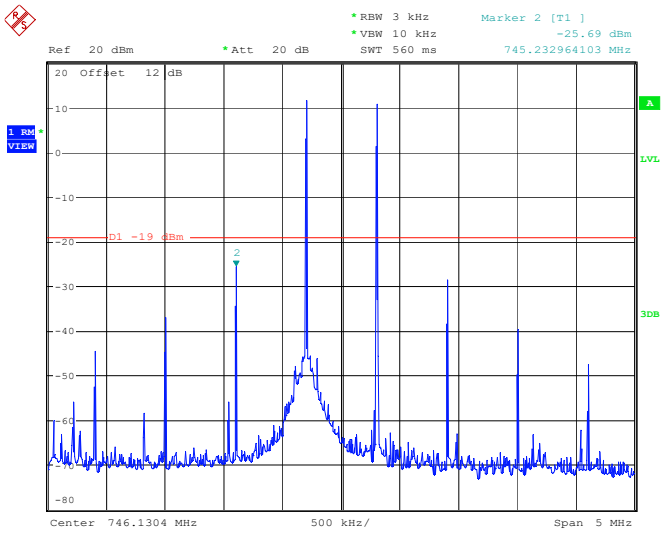
Date: 30.MAR.2024 00:08:24

Lower 700MHz Above AGC



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 30.MAR.2024 00:10:05

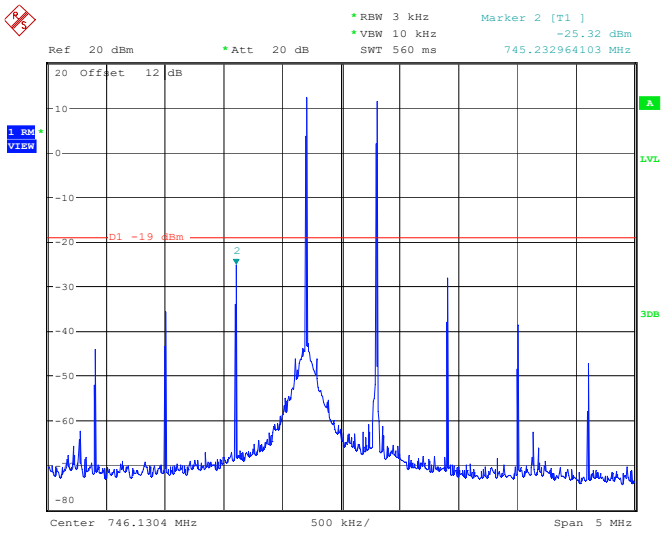
Upper 700MHz Pre-AGC



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 30.MAR.2024 00:18:20

Upper 700MHz Above AGC



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 30.MAR.2024 00:19:28

§ 20.21(e)(8)(i)(E)- OUT OF BAND EMISSIONS

Applicable Standards

According to§ 20.21(e)(8)(i)(E) Out of Band Emission Limits.

Test Procedure

This measurement is intended to demonstrate compliance to the limit specified in § 20.21(e)(8)(i)(E). The mobile emission limit applicable to the supported band of operation can be determined from the applicable rule part as listed in Annex A for each authorized operating band.

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 the appropriate operation for all uplink and downlink bands:
i) GSM: 0.2 MHz from upper and lower band edges.
ii) LTE (5 MHz): 2.5 MHz from upper and lower band edges.
iii) CDMA: 1.25 MHz from upper and lower band edges, except for cellular band as follows (only the upper and lower frequencies need to be tested):

824.88 MHz, 845.73 MHz, 836.52 MHz, 848.10 MHz, 869.88 MHz, 890.73 MHz, 881.52 MHz, 893.10 MHz.
Note 1: *Alternative test modulation types:*
• CDMA (alternative 1.25 MHz AWGN)
• LTE 5 MHz (alternative W-CDMA or 4.1 MHz AWGN)
Note 2: *For LTE, the signal generator should utilize the uplink and downlink signal types for these modulations in uplink and downlink tests, respectively. LTE shall use 5 MHz signal, 25 resource blocks transmitting.*
Note 3: *When using an AWGN test signal, the bandwidth shall be the measured 99% occupied bandwidth.*

c) Set the signal generator amplitude to the maximum power level prior to AGC similar to the procedures in 7.2.2e) to 7.2.2f) of power measurement procedure for appropriate modulations.
d) Set RBW = measurement bandwidth specified in the applicable rule section for the supported frequency band (*see Annex A for cross-reference to applicable rule section*).
e) Set VBW = 3 × RBW.
f) Select the RMS (power averaging) detector.
g) Sweep time = auto-couple.
h) Set the analyzer start frequency to the upper band/block edge frequency and the stop frequency to the upper band/block edge frequency plus 300 kHz (when operational frequency is < 1 GHz) or 3 MHz (when operational frequency is ≥ 1 GHz).
i) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
j) Use peak marker function to find the maximum power level.
k) Capture the spectrum analyzer trace of the power level for inclusion in the test report.
l) Increase the signal generator amplitude in 2 dB steps until the maximum input level indicated in 5.5 is reached. Affirm that the EUT maintains compliance with the OOBE limits.
m) Reset the analyzer start frequency to the lower band/block edge frequency minus 300 kHz (when operational frequency is < 1 GHz) or 3 MHz (when operational frequency is ≥ 1 GHz), and the stop frequency to the lower band/block edge frequency and repeat 7.5j) to 7.5l).
n) Repeat 7.5b) through 7.5m) for each uplink and downlink operational band.

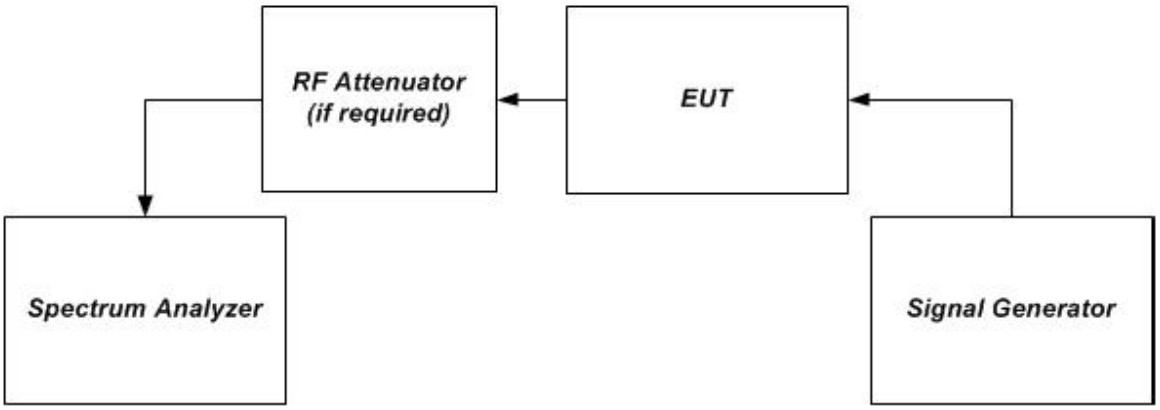


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	25.5-26.5℃
Relative Humidity:	52-55 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin from 2024-01-18to 2024-03-19.

Test Result: Pass the test plots please refer to the Appendix A.

§ 20.21(e)(8)(i)(A), § 20.21(e)(8)(i)(H) &§20.21(e)(4) - NOISE LIMITS

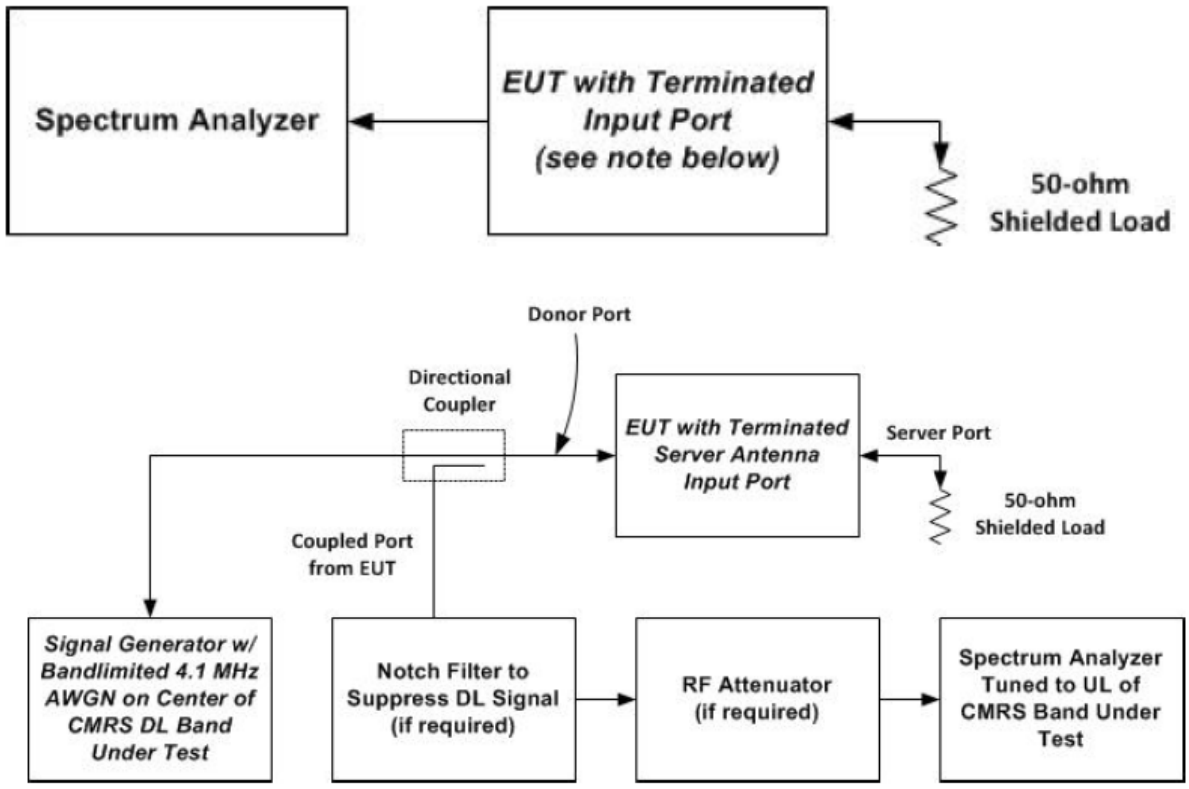
Applicable Standards

According to§ 20.21(e)(8)(i)(A) Noise Limits; § 20.21(e)(8)(i)(H) Transmit Power Off Mode (uplink and downlink noise power); §20.21(e)(4) Self-monitoring.

Test Procedure

Maximum transmitter noise power level
a) Connect the EUT to the test equipment as shown in **Figure 3**. Begin with the uplink output connected to the spectrum analyzer. When measuring downlink noise, connect the downlink output to the spectrum analyzer.
b) Set the spectrum analyzer RBW to 1 MHz with the VBW ≥ 3 × RBW.
c) Select the power averaging (RMS) detector and trace average over at least 100 traces.
d) Set the center frequency of the spectrum analyzer to the center of the CMRS band under test with the span ≥ 2 × the CMRS band.
e) Measure the maximum transmitter noise power level.
f) Save the spectrum analyzer plot as necessary for inclusion in the final test report.
g) Repeat 7.7b) to 7.7f) for all operational uplink and downlink bands.
h) Connect the EUT to the test equipment as shown in **Figure 4** for uplink. Affirm the coupled path of the RF coupler is connected to the spectrum analyzer.
i) Configure the signal generator for 4.1 MHz AWGN operation.
j) Set the spectrum analyzer RBW for 1 MHz with the VBW ≥ 3 × RBW with a power averaging (rms) detector with at least 100 trace averages.
k) Set the center frequency of the spectrum analyzer to the center of the CMRS band under test with the span ≥ 2 × the CMRS band. This shall include all spectrum blocks in the particular CMRS band under test (see Annex A).
l) For uplink noise measurements, set the spectrum analyzer center frequency for the uplink band under test and tune the signal generator to the center of the paired downlink band.
m) Measure the maximum transmitter noise power level when varying the downlink signal generator output level from −90 dBm to −20 dBm, as measured at the input port, in 1 dB steps inside the RSSI-dependent region and in 10 dB steps outside the RSSI-dependent region. Report the six values closest to the limit with at least two points within the RSSI-dependent region of the limit. See noise limit in Annex D.
n) Repeat 7.7.1h) through 7.7.1m) for all operational uplink.

Variable uplink noise timing
Variable uplink noise 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 noise.
d) Select MAX HOLD and increase the power level of signal generator 1 by 10 dB for mobile boosters and 20 dB for fixed boosters.
e) Confirm that the uplink noise decreases to the specified level within 1 second for mobile devices and 3 seconds for fixed devices
f) Repeat 7.7.2a) to 7.7.2e) for all operational uplink bands.
g) Include plots and summary table in test report.
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 second signal generator and cycle the RF output to simulate this function.*



Test Data

Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin on 2024-01-20.

Test Result: Pass

Please refer to following table.

Maximum Noise:

Mode	Operation Bands	Measured Value	Limit	Result
		dBm/MHz	dBm/MHz	
Uplink	Lower 700MHz	-49.10	-45.51	Compliance
	Upper 700MHz	-46.37	-44.64	Compliance
	cellular	-46.05	-44.05	Compliance
	PCS	-40.65	-37.01	Compliance
	AWS	-39.99	-37.73	Compliance
Downlink	Lower 700MHz	-47.16	-45.51	Compliance
	Upper 700MHz	-47.45	-44.64	Compliance
	cellular	-47.46	-44.05	Compliance
	PCS	-40.23	-37.01	Compliance
	AWS	-40.45	-37.73	Compliance

Note: Fixed booster maximum noise power shall not exceed −102.5 dBm/MHz + 20 Log10 (Frequency), where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

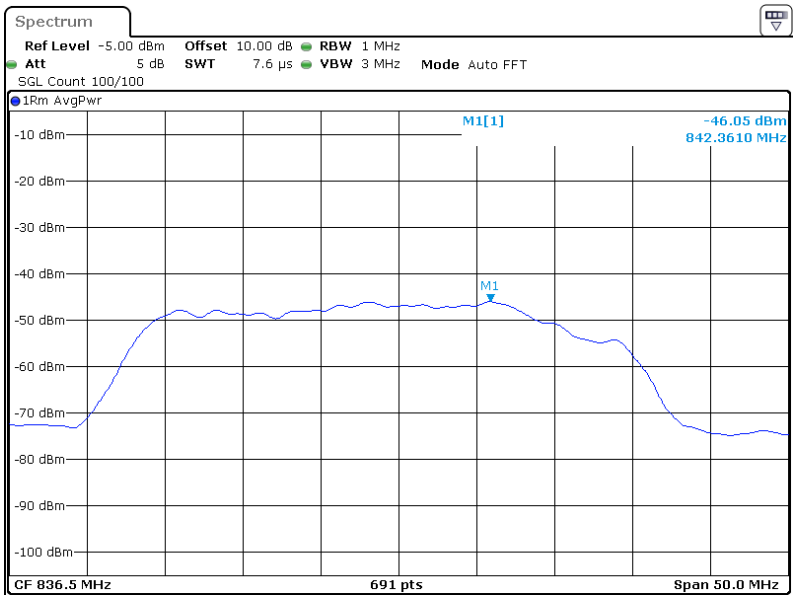
Variable Uplink Noise limit test result:

Operation Bands	RSSI	Measured Value	Limit	Results
	dBm	dBm/MHz	dBm/MHz	
Lower 700MHz	-61	-47.37	-45.51	Compliance
	-60	-48.06	-45.51	Compliance
	-59	-49.42	-45.51	Compliance
	-58	-49.60	-45.51	Compliance
	-57	-51.28	-46	Compliance
	-56	-51.74	-47	Compliance
Upper 700MHz	-61	-46.45	-44.64	Compliance
	-60	-47.69	-44.64	Compliance
	-59	-48.62	-44.64	Compliance
	-58	-49.67	-45	Compliance
	-57	-51.29	-46	Compliance
	-56	-52.32	-47	Compliance
Cellular	-60	-48.35	-44.05	Compliance
	-59	-49.26	-44.05	Compliance
	-58	-49.33	-45	Compliance
	-57	-50.81	-46	Compliance
	-56	-51.09	-47	Compliance
	-55	-51.61	-48	Compliance
PCS	-65	-41.72	-38	Compliance
	-64	-42.73	-39	Compliance
	-63	-42.96	-40	Compliance
	-62	-44.01	-41	Compliance
	-61	-44.71	-42	Compliance
	-60	-46.04	-43	Compliance
AWS	-66	-40.28	-37.73	Compliance
	-65	-42.04	-38	Compliance
	-64	-43.17	-39	Compliance
	-63	-43.48	-40	Compliance
	-62	-45.02	-41	Compliance
	-61	-45.45	-42	Compliance

Note: The Limit refers to KDB935210 D03 APPENDIX D Figure D1.

Maximum Noise:

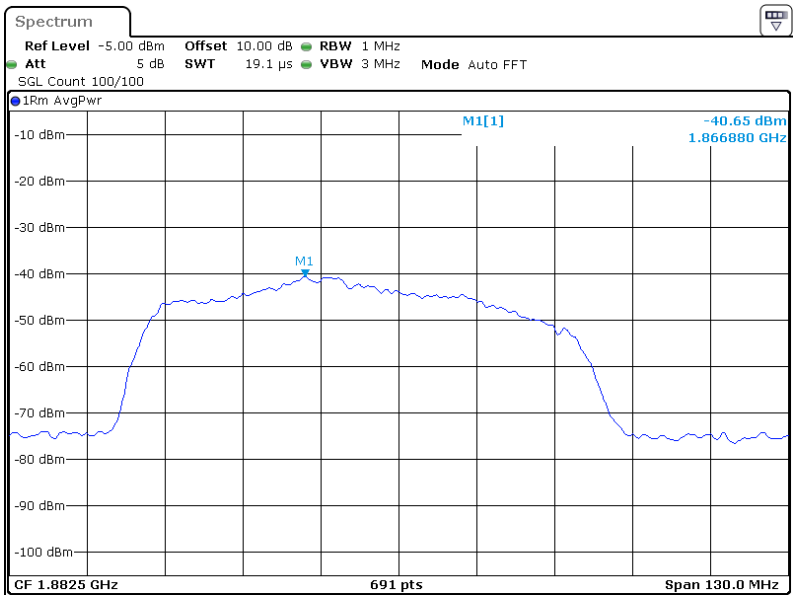
Uplink Cellular Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:56:03

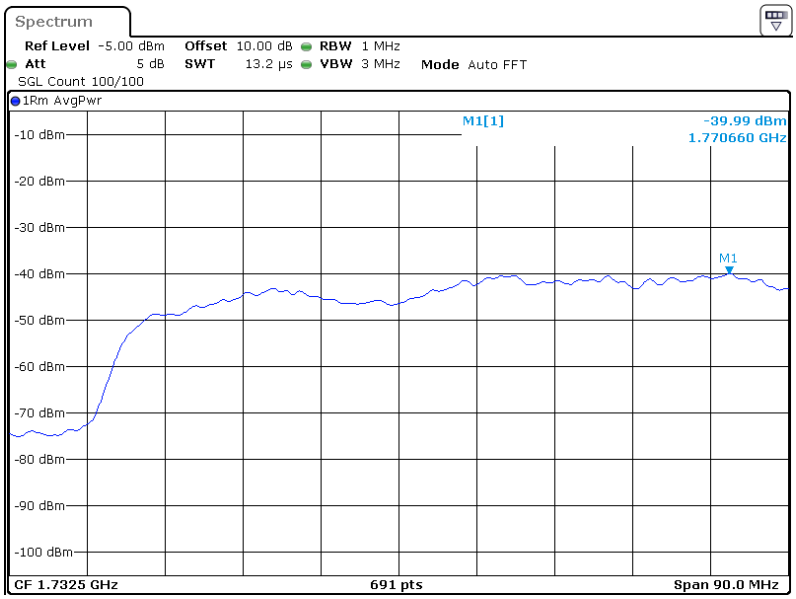
Uplink PCS Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

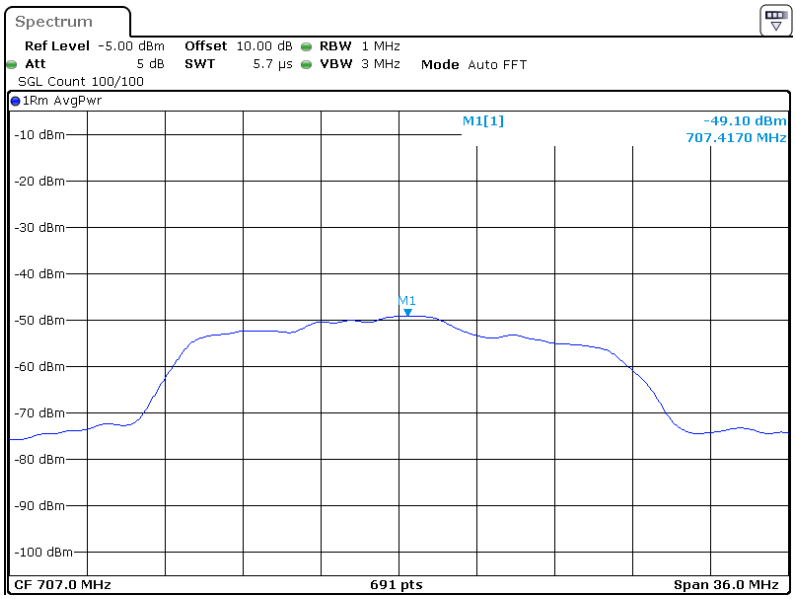
Date: 20.JAN.2024 02:56:15

Uplink AWS



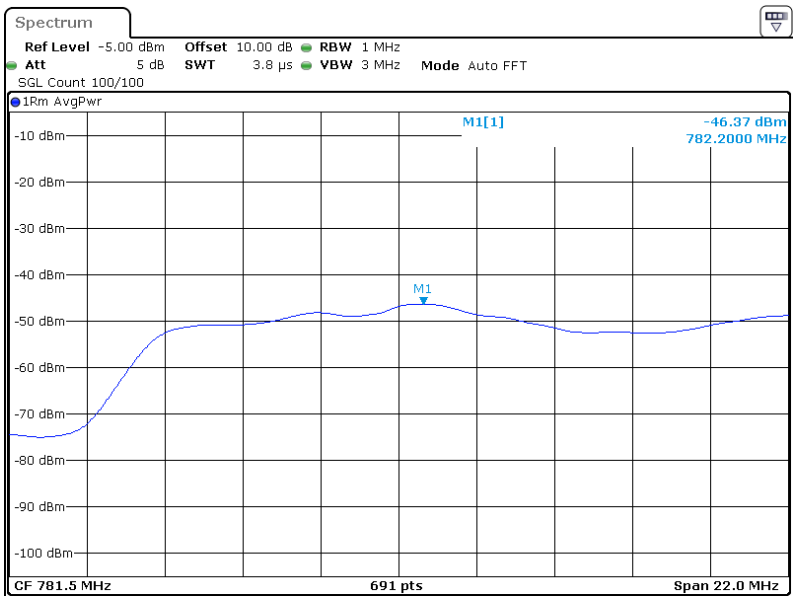
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 02:56:26

Uplink Lower 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 02:55:42

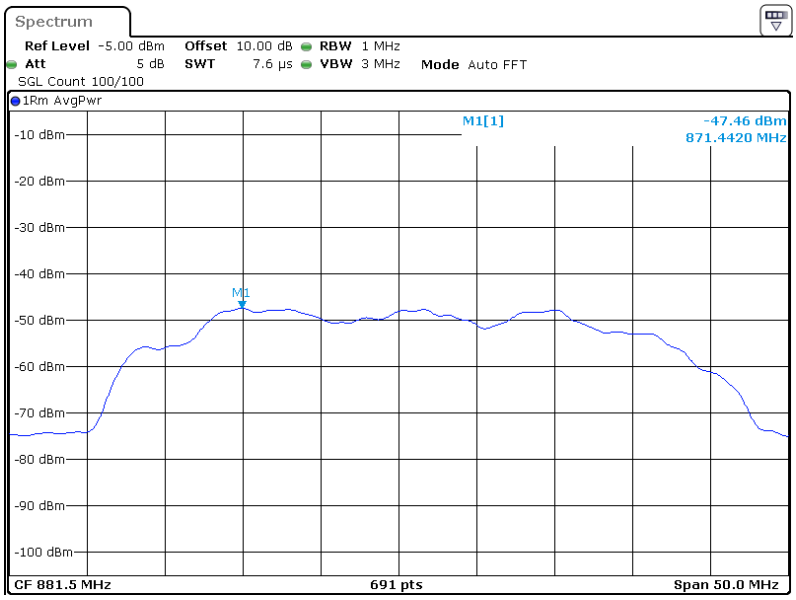
Uplink Upper 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:55:52

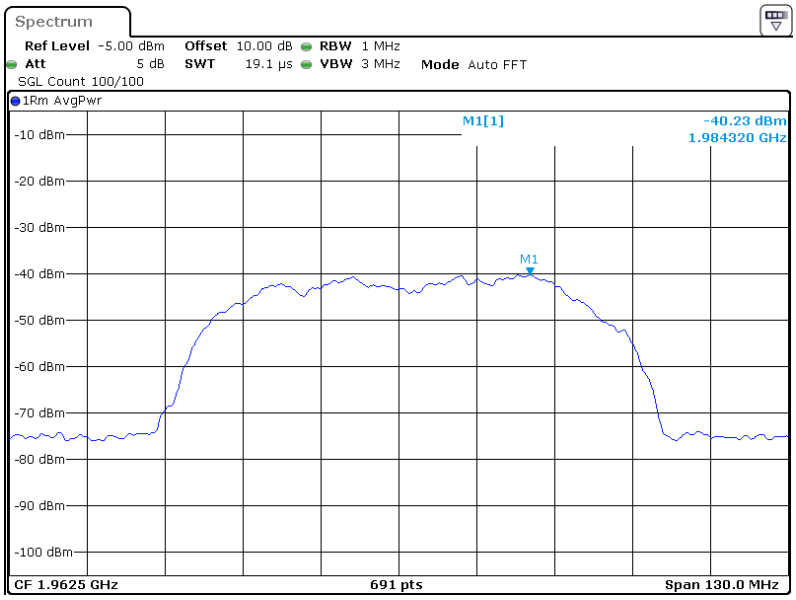
Downlink Cellular Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

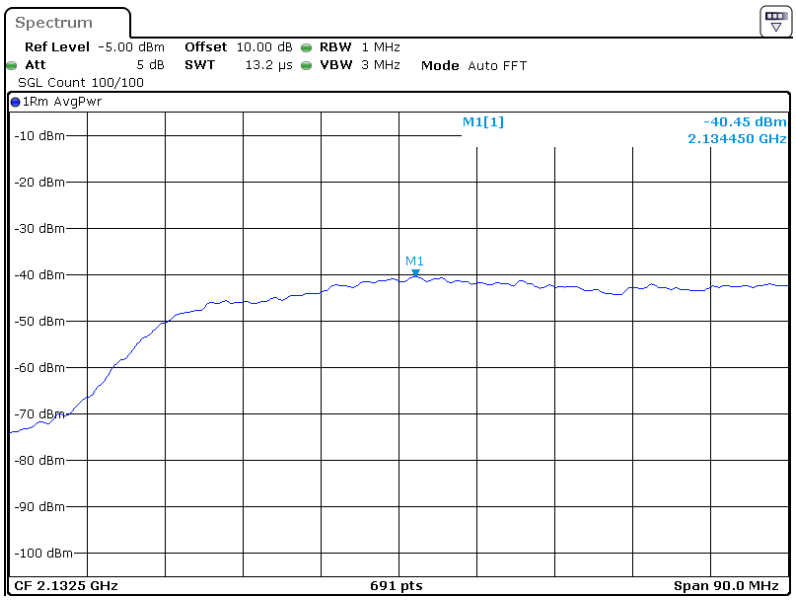
Date: 20.JAN.2024 02:54:21

Downlink PCS Band



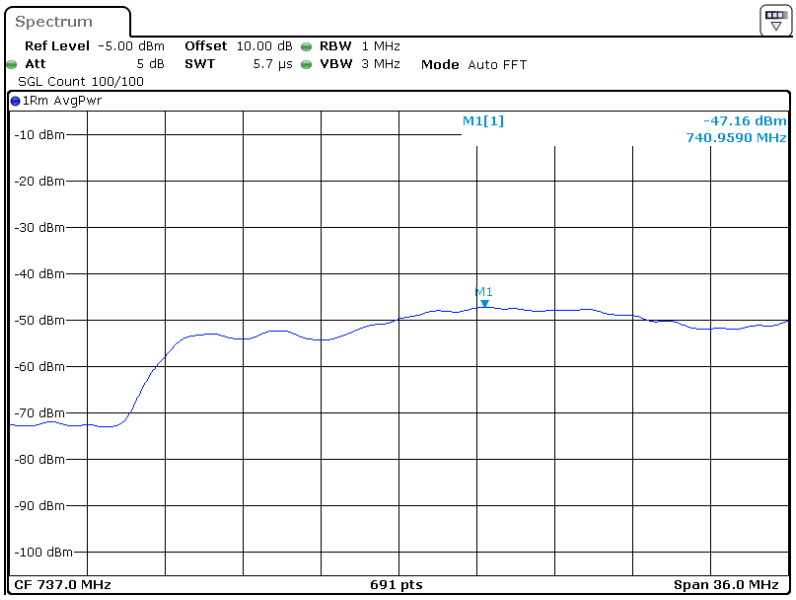
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 02:54:32

Downlink AWS Band



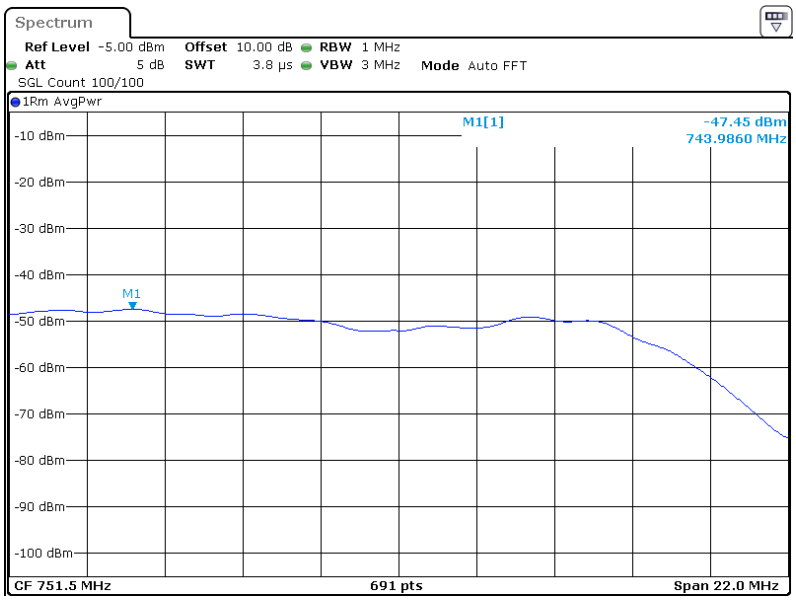
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 02:54:44

Downlink Lower 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 02:54:01

Downlink Upper 700MHz



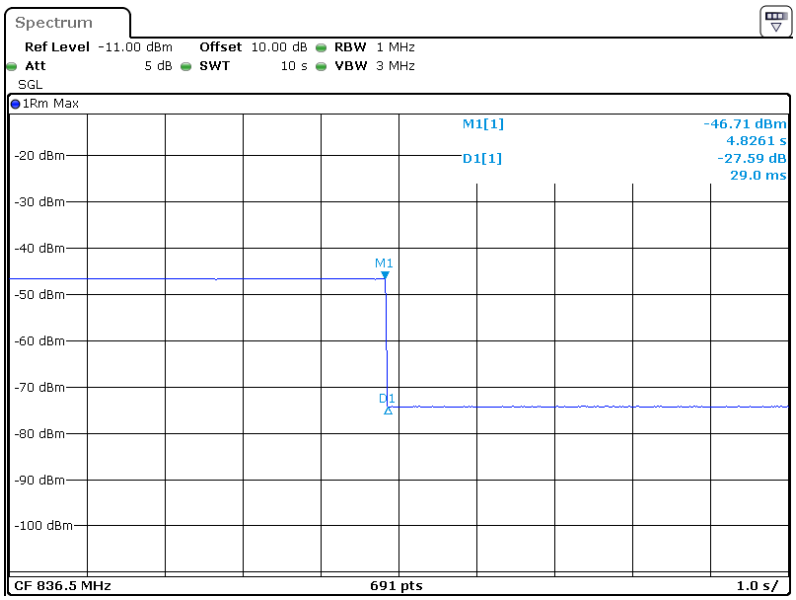
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 02:54:11

Variable Uplink Noise Timing:

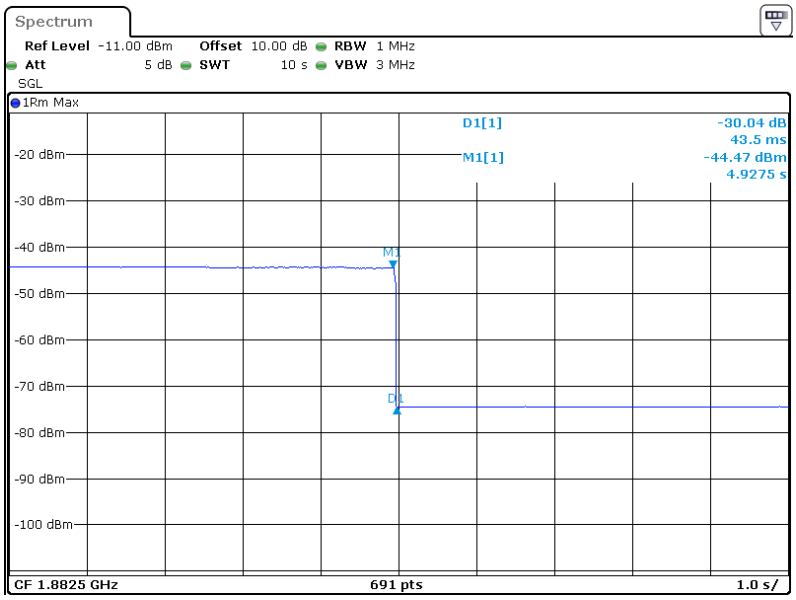
Operation Bands	Measured Value	Limit	Result
	s	s	
Lower 700MHz	0.029	3	Compliance
Upper 700MHz	0.029	3	Compliance
cellular	0.029	3	Compliance
PCS	0.044	3	Compliance
AWS	0.029	3	Compliance

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

Cellular Band

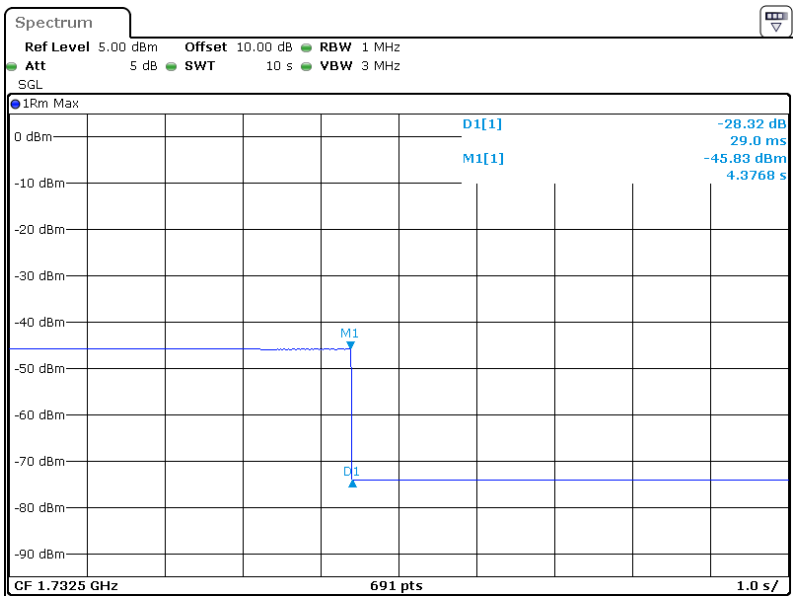


PCS Band



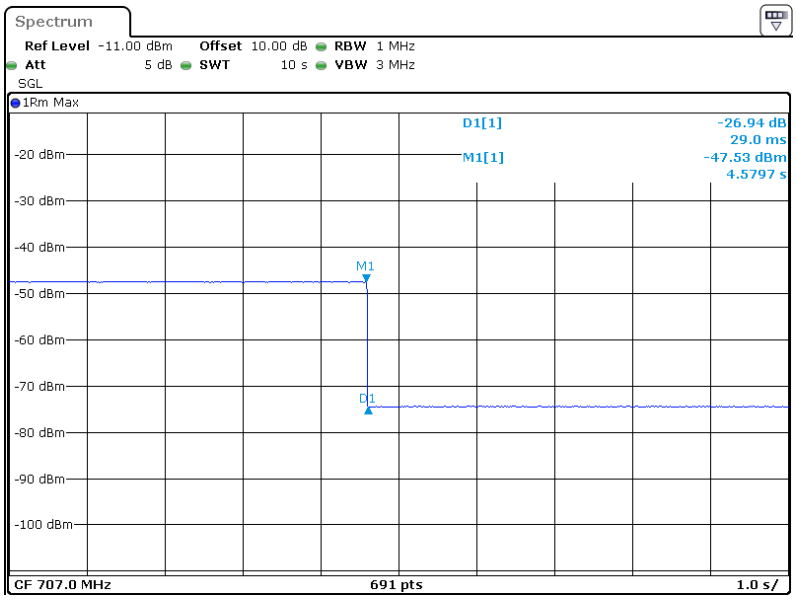
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:08:59

AWS Band



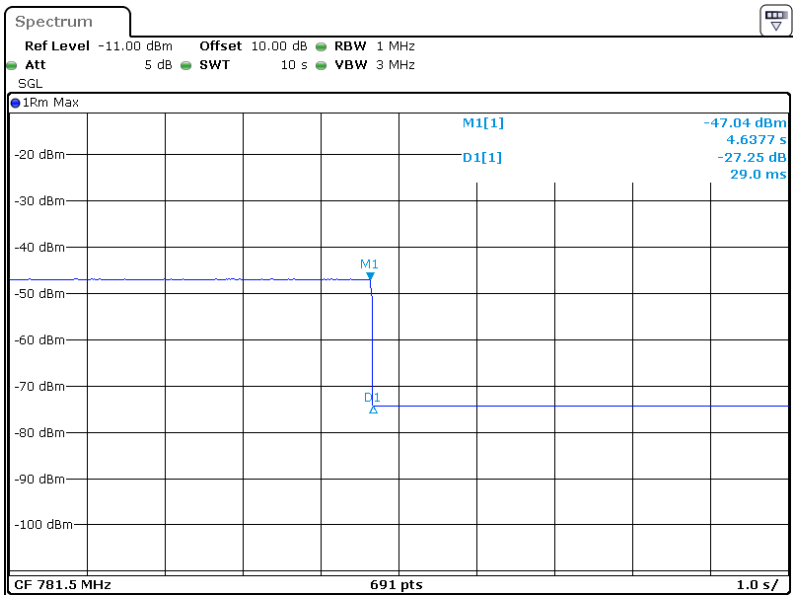
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:01:56

Lower 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:06:49

Upper 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:07:52

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

Applicable Standards

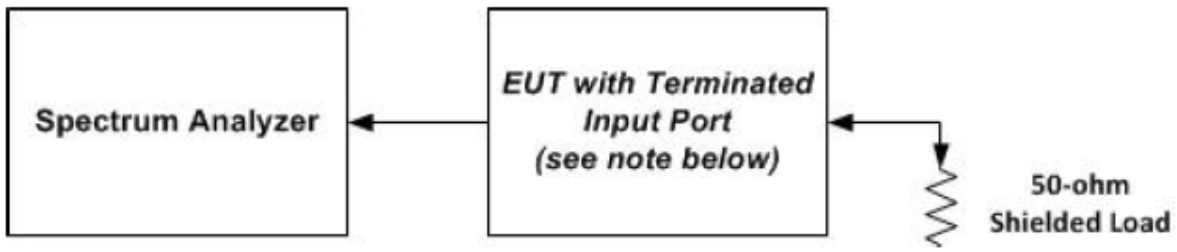
According to§ 20.21(e)(8)(i)(I) Uplink Inactivity&§20.21(e)(4); §20.21(e)(4) Self-monitoring.

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).

a) Connect the EUT to the test equipment as shown in **Figure 3** with the uplink output connected to the spectrum analyzer.
b) Select the RMS power averaging detector.
c) Set the spectrum analyzer RBW for 1 MHz with the VBW ≥ 3 × RBW.
d) Set the center frequency of the spectrum analyzer to the center of the uplink operational band.
e) Set the span for 0 Hz with a single sweep time for a minimum of 330 seconds.
f) Start to capture a new trace using MAX HOLD.
g) After approximately 15 seconds turn on the EUT power.
h) 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.
i) Affirm that the noise level for the squelched signal is below the uplink inactivity noise power limit, as specified by the rules.
j) Capture the plot for inclusion in the test report.
k) Measure noise using procedures in 7.7.1a) to 7.7.1f).
l) 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:	26 ℃
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin on 2024-01-25.

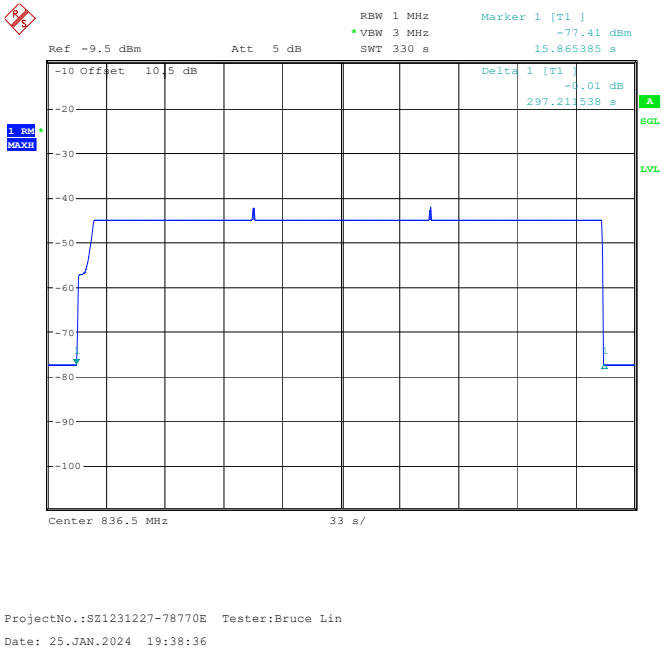
Test Result: Pass

Please refer to following table.

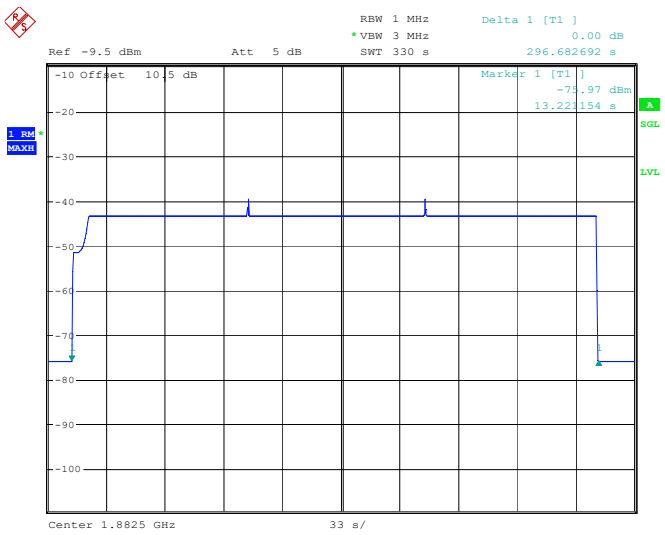
Operation Band	Measured value	Limit	Result
	s	s	
Lower 700 MHz	296.68	300	Compliance
Upper 700 MHz	296.15		Compliance
cellular	297.21		Compliance
PCS	296.68		Compliance
AWS	296.15		Compliance

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

Cellular Band

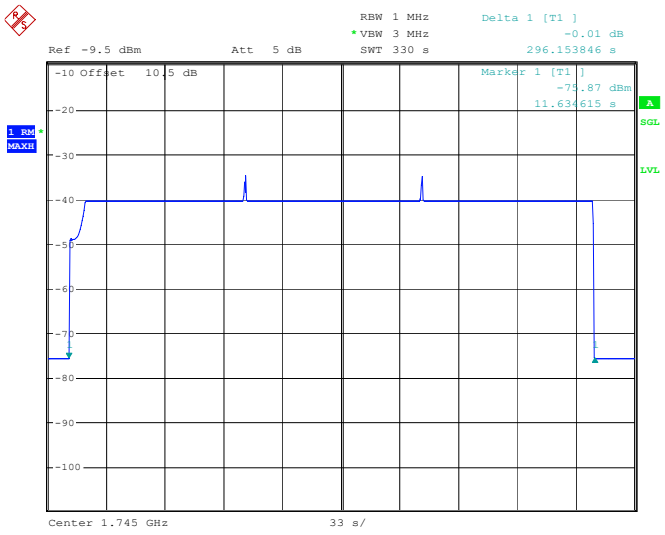


PCS Band



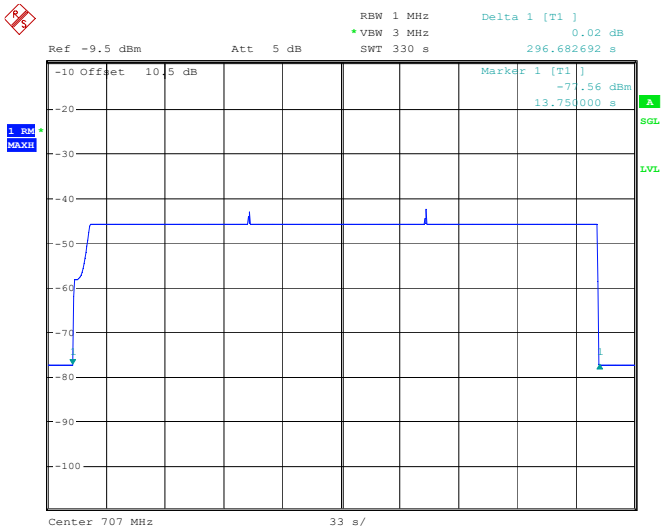
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 25.JAN.2024 20:19:57

AWS Band



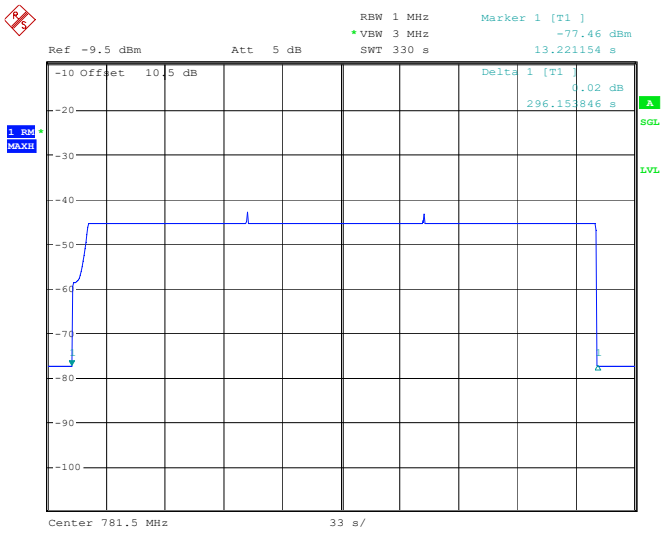
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 25.JAN.2024 19:31:56

Lower 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 25.JAN.2024 20:03:43

Upper 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 25.JAN.2024 20:12:16

§ 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 ≥ 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 ≥ (2 × span)/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.

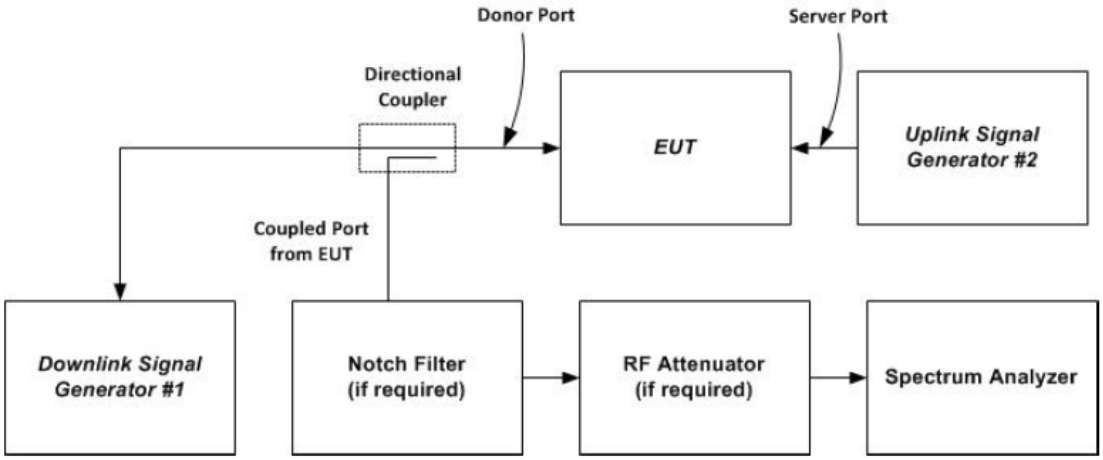


Figure 5 – Variable gain instrumentation test setup

Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin on 2024-01-18.

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	707.0	1	29.49	6.5	4.97	3.01	30.97
Upper700MHz	781.5	1	30.36	6.5	4.97	3.01	31.84
Cellular	836.5	1	30.95	6.5	5.17	3.01	32.63
PCS	1882.5	1	37.99	8.5	7.51	3.01	40.01
AWS	1732.5	1	37.27	8.5	7.51	3.01	39.29

Note:
Path loss=20logf+20logd-27.50
Polarity loss=20log(1/sin(45))=3.01
MSCL= Path loss + Indoor Cable Loss - Mobile Antenna Gain- Indoor Antenna Gain+ Polarity Loss

Mobile Antenna Gain=0

Variable booster gain:

Operation Bands	RSSI	P_{in}	P_{out}	MSCL	Measured Value	Limit	Result
	dBm	dBm	dBm	dB	dB	dB	
Lower 700MHz	-60	-46.0	3.24	30.97	49.24	56.97	Compliance
	-59	-46.0	2.12	30.97	48.12	55.97	Compliance
	-58	-46.0	0.97	30.97	46.97	54.97	Compliance
	-57	-46.0	0.03	30.97	46.03	53.97	Compliance
	-56	-46.0	-1.23	30.97	44.77	52.97	Compliance
	-55	-46.0	-2.73	30.97	43.27	51.97	Compliance
Upper 700MHz	-60	-47.0	0.23	31.84	47.23	57.84	Compliance
	-59	-47.0	-0.61	31.84	46.39	56.84	Compliance
	-58	-47.0	-1.87	31.84	45.13	55.84	Compliance
	-57	-47.0	-3.01	31.84	43.99	54.84	Compliance
	-56	-47.0	-4.48	31.84	42.52	53.84	Compliance
	-55	-47.0	-5.73	31.84	41.27	52.84	Compliance
Cellular	-60	-46.5	2.24	32.63	48.74	58.63	Compliance
	-59	-46.5	1.37	32.63	47.87	57.63	Compliance
	-58	-46.5	0.58	32.63	47.08	56.63	Compliance
	-57	-46.5	-0.23	32.63	46.27	55.63	Compliance
	-56	-46.5	-1.10	32.63	45.40	54.63	Compliance
	-55	-46.5	-2.16	32.63	44.34	53.63	Compliance
PCS	-64	-54.5	7.35	40.01	61.85	70.01	Compliance
	-63	-54.5	6.29	40.01	60.79	69.01	Compliance
	-62	-54.5	5.35	40.01	59.85	68.01	Compliance
	-61	-54.5	4.17	40.01	58.67	67.01	Compliance
	-60	-54.5	3.31	40.01	57.81	66.01	Compliance
	-59	-54.5	2.35	40.01	56.85	65.01	Compliance
AWS	-64	-54	6.19	39.29	60.19	69.29	Compliance
	-63	-54	4.91	39.29	58.91	68.29	Compliance
	-62	-54	3.96	39.29	57.96	67.29	Compliance
	-61	-54	2.79	39.29	56.79	66.29	Compliance
	-60	-54	1.93	39.29	55.93	65.29	Compliance
	-59	-54	0.88	39.29	54.88	64.29	Compliance

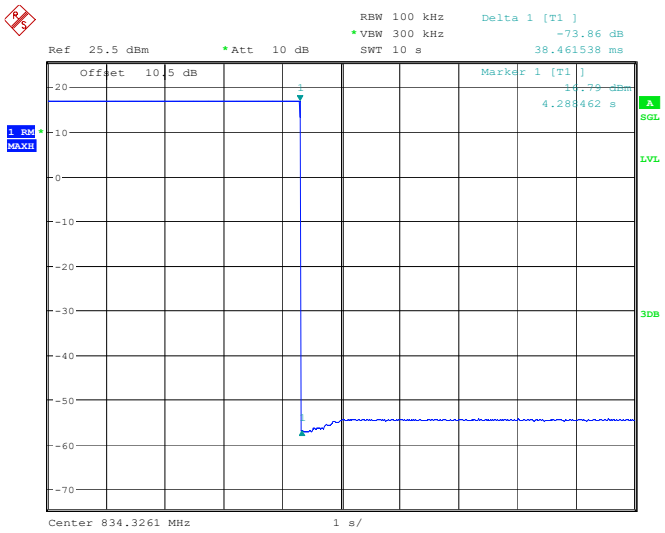
Note: Variable booster gain Limit: −34 dB-RSSI + MSCL.

Variable gain timing:

Operation Bands	Measured value	Limit	Results
MHz	s	s	
Lower 700MHz	0.029	3	Compliance
Upper 700MHz	0.061		Compliance
Cellular	0.038		Compliance
PCS	0.061		Compliance
AWS	0.038		Compliance

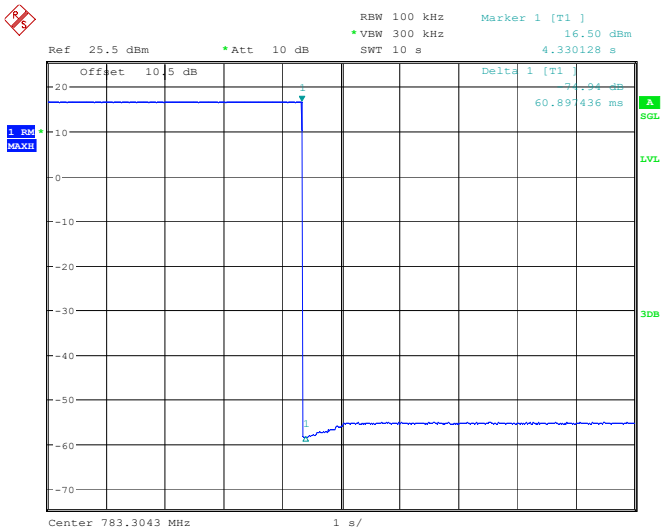
Variable gain timing:

Cellular Band



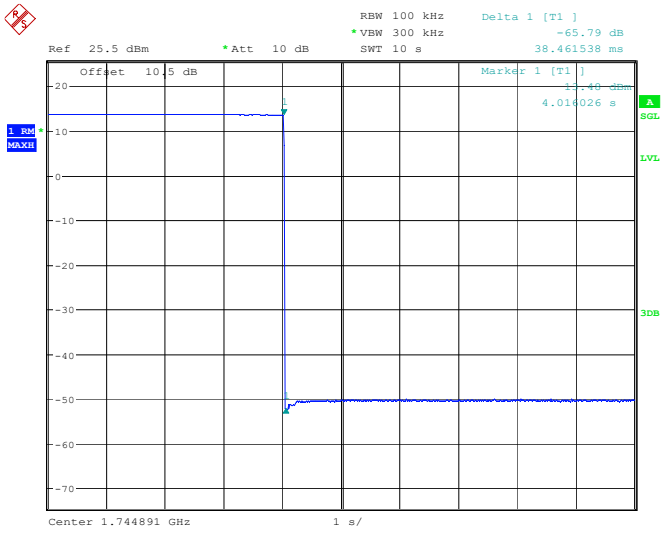
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 22:37:10

PCS Band



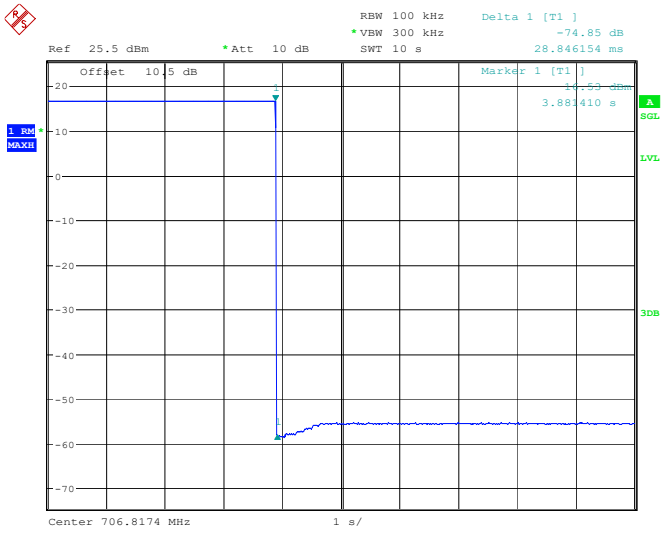
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 22:43:52

AWS Band



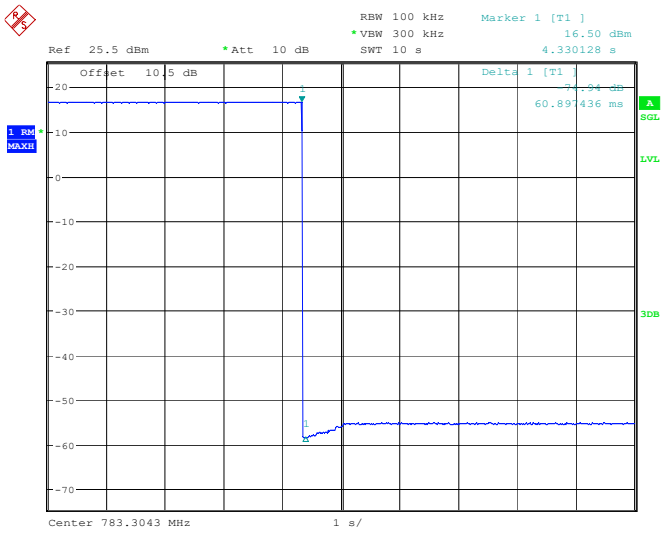
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 22:34:01

Lower 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 22:40:14

Upper 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 22:43:52

§ 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 ≥ 3 × 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.

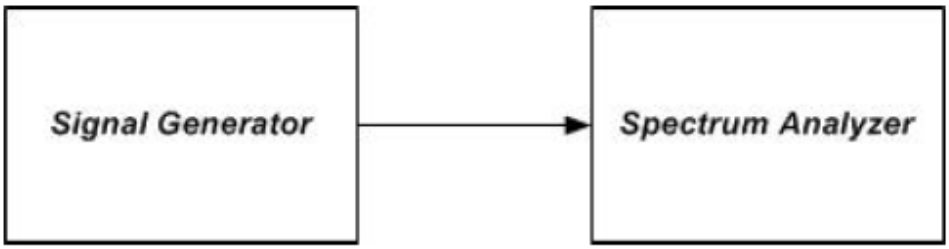


Figure 6 – Occupied bandwidth instrumentation test setup

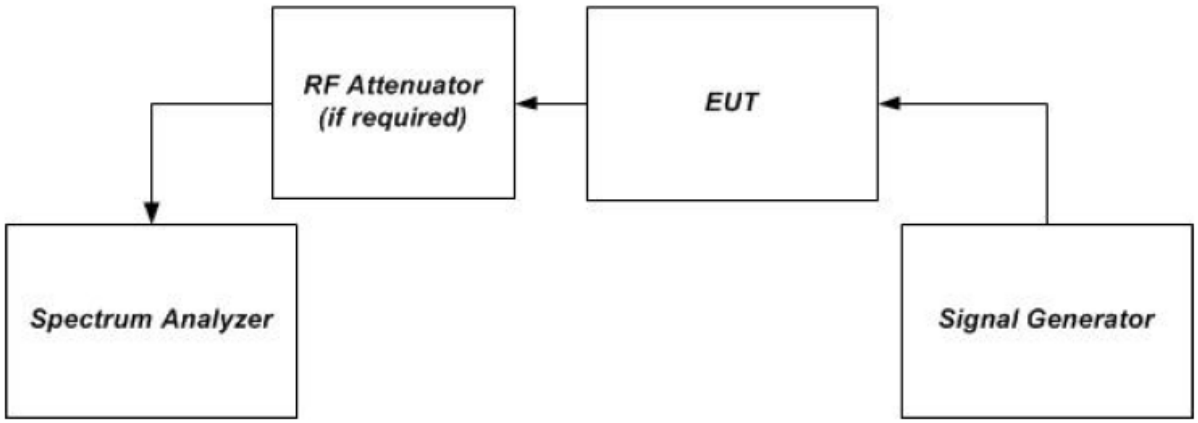


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	25.3~26.4℃
Relative Humidity:	52~54 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin on from 2024-01-18 to 2024-01-22.

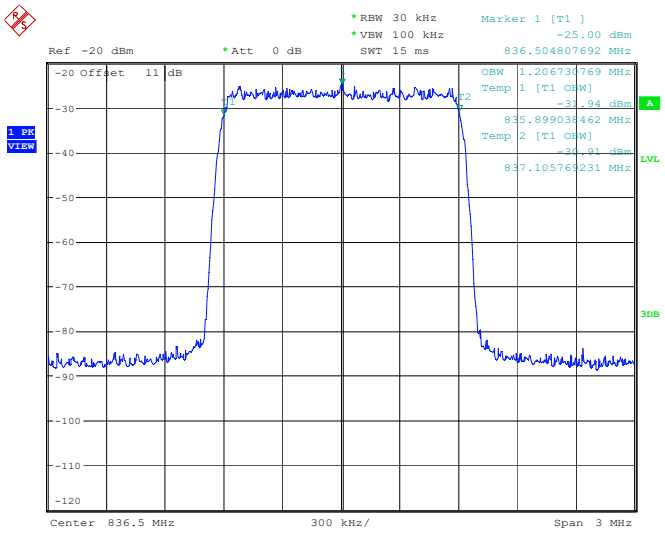
Test Result: Pass

Please refer to following table.

Mode	Operation Bands	Signal type	Occupied bandwidth(MHz)		Result
			In	Out	
Uplink	Lower 700MHz	GSM	0.244	0.245	Compliance
		CDMA	1.207	1.207	Compliance
		WCDMA	4.199	4.135	Compliance
	Upper 700MHz	GSM	0.244	0.244	Compliance
		CDMA	1.207	1.212	Compliance
		WCDMA	4.183	4.167	Compliance
	cellular	GSM	0.244	0.244	Compliance
		CDMA	1.207	1.207	Compliance
		WCDMA	4.183	4.183	Compliance
	PCS	GSM	0.244	0.245	Compliance
		CDMA	1.202	1.207	Compliance
		WCDMA	4.167	4.183	Compliance
	AWS	GSM	0.245	0.245	Compliance
		CDMA	1.207	1.202	Compliance
		WCDMA	4.167	4.199	Compliance
Downlink	Lower 700MHz	GSM	0.245	0.246	Compliance
		CDMA	1.207	1.203	Compliance
		WCDMA	4.167	4.153	Compliance
	Upper 700MHz	GSM	0.244	0.246	Compliance
		CDMA	1.207	1.203	Compliance
		WCDMA	4.167	4.197	Compliance
	cellular	GSM	0.244	0.246	Compliance
		CDMA	1.207	1.203	Compliance
		WCDMA	4.183	4.124	Compliance
	PCS	GSM	0.245	0.246	Compliance
		CDMA	1.207	1.207	Compliance
		WCDMA	4.167	4.182	Compliance
	AWS	GSM	0.245	0.245	Compliance
		CDMA	1.207	1.203	Compliance
		WCDMA	4.199	4.182	Compliance

Occupied Bandwidth:

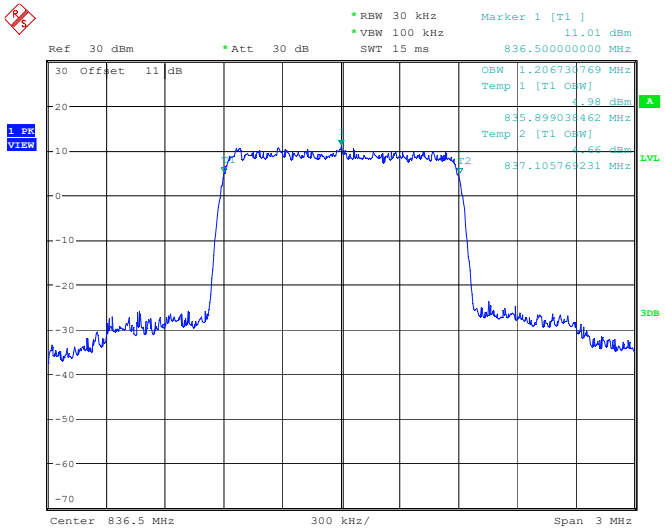
Uplink, 836.5MHz-CDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 22.JAN.2024 20:29:26

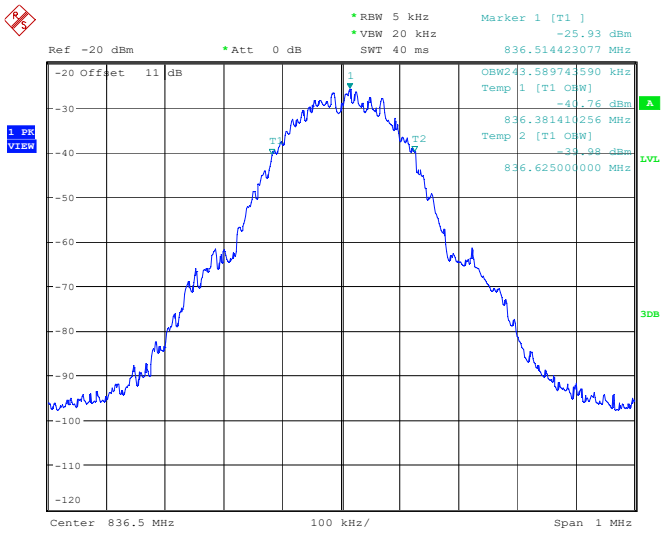
Uplink, 836.5MHz-CDMA (Output)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

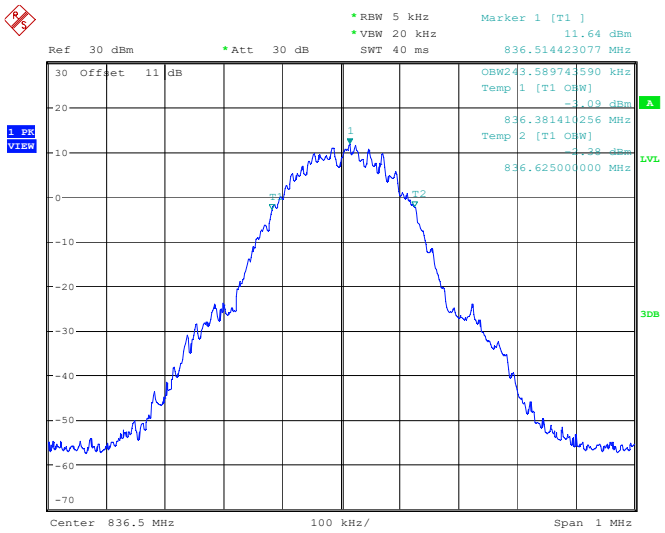
Date: 18.JAN.2024 19:15:12

Uplink, 836.5MHz–GSM (Input)



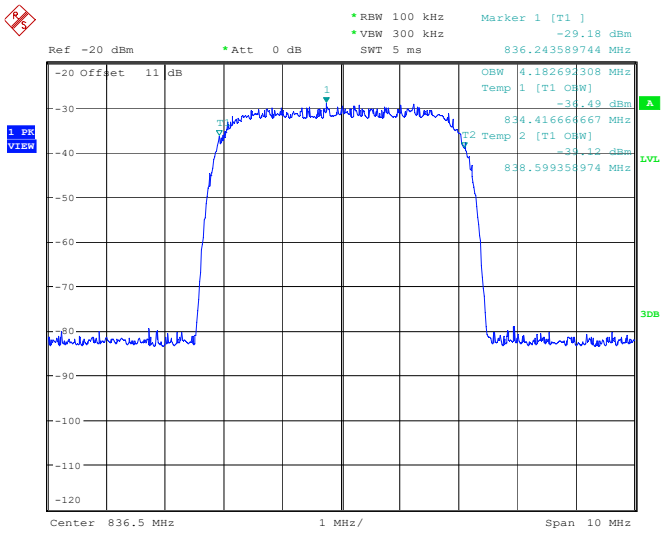
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:41:22

Uplink, 836.5MHz-GSM (Output)



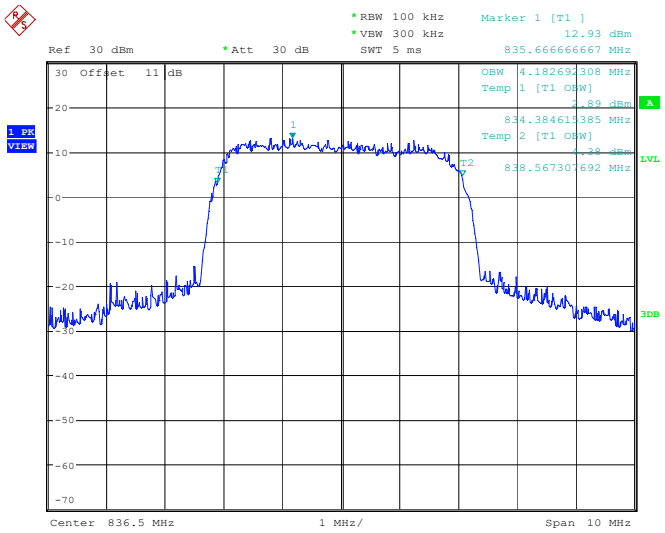
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:39:54

Uplink, 836.5MHz-WCDMA (Input)



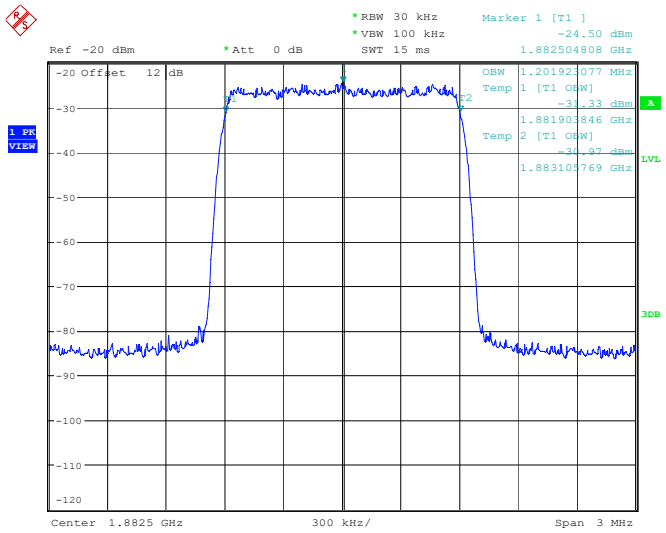
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:39:09

Uplink, 836.5MHz-WCDMA (Output)



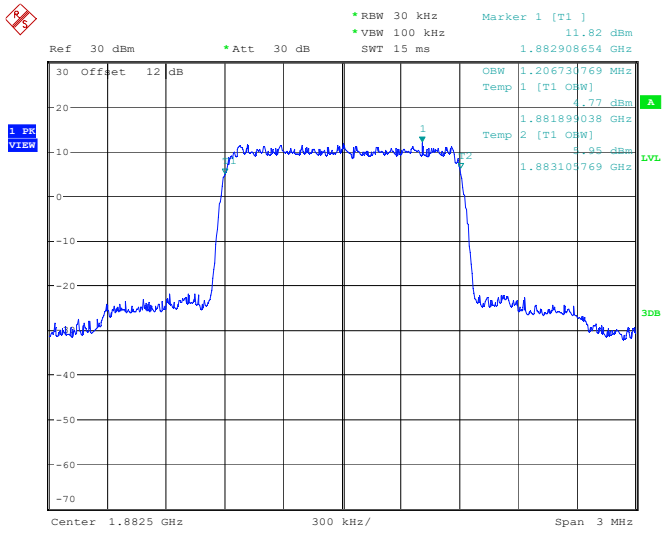
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 20:05:39

Uplink, 1882.5MHz-CDMA (Input)



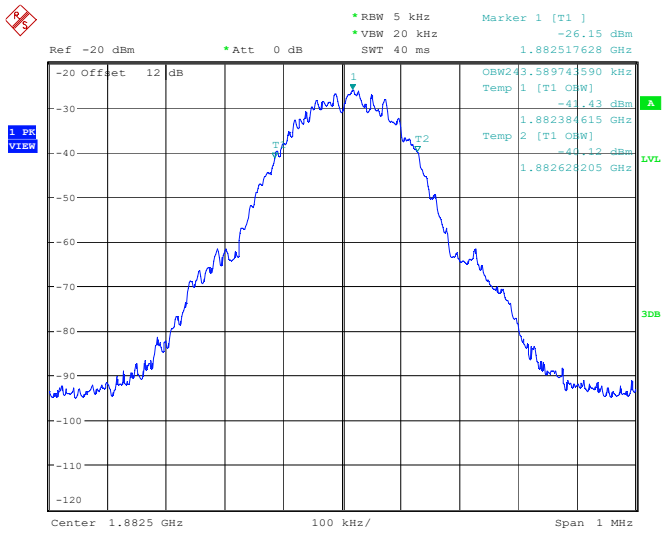
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:30:16

Uplink, 1882.5MHz-CDMA (Output)



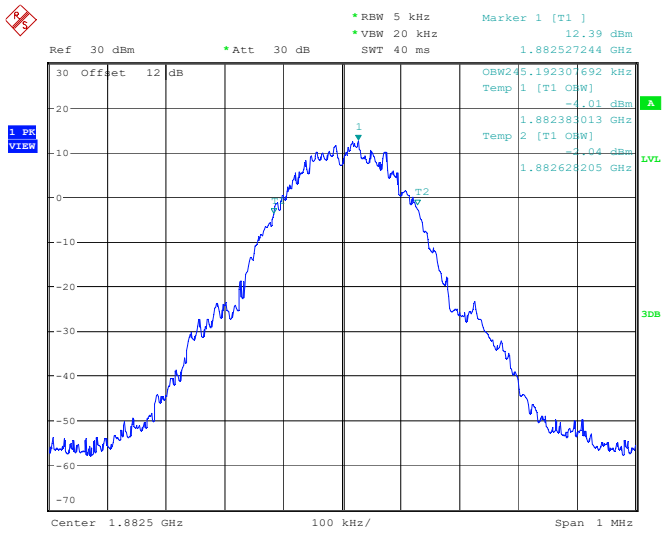
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:17:37

Uplink, 1882.5MHz-GSM (Input)



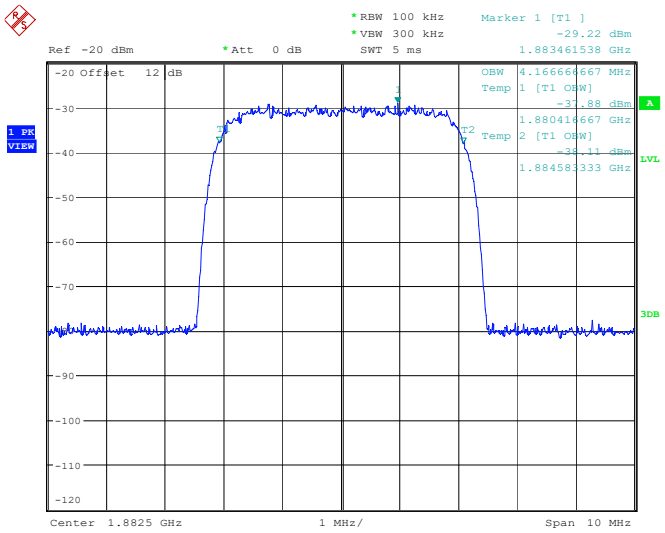
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:42:46

Uplink, 1882.5MHz-GSM (Output)



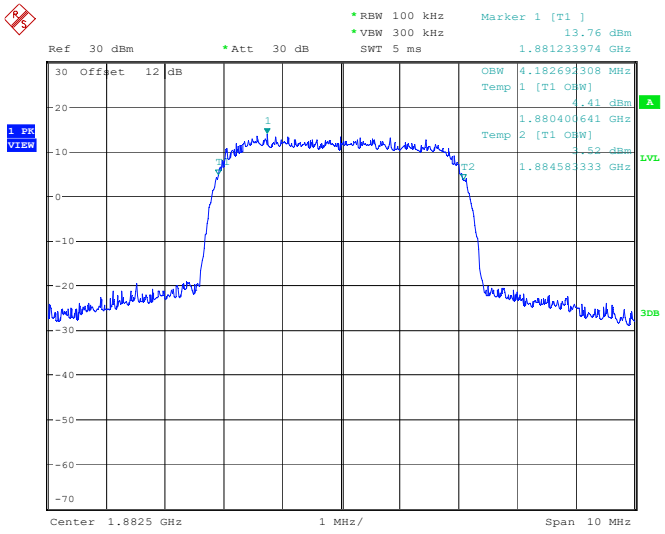
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:41:25

Uplink, 1882.5MHz-WCDMA (Input)



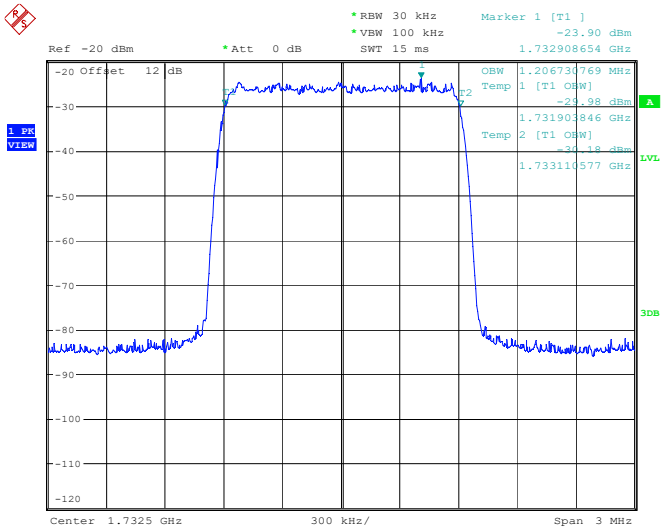
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:40:03

Uplink, 1882.5MHz-WCDMA (Output)



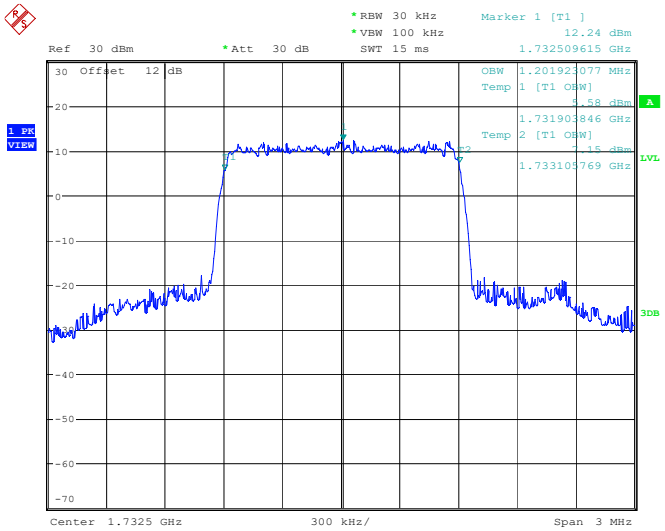
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 20:07:52

Uplink, 1732.5MHz-CDMA (Input)



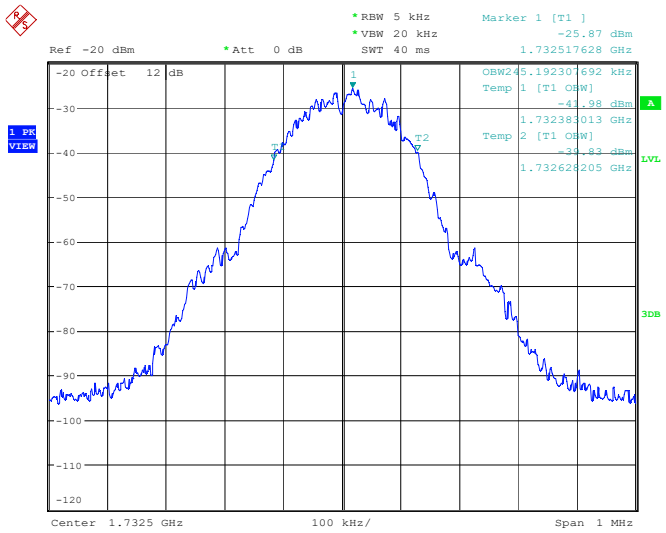
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:31:15

Uplink, 1732.5MHz-CDMA (Output)



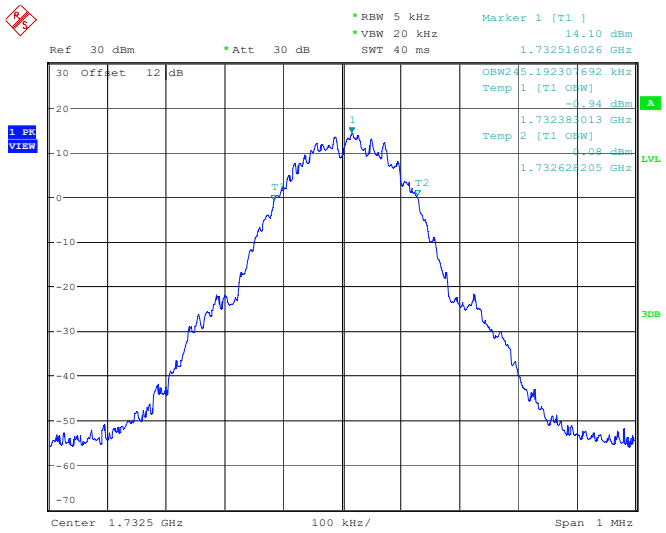
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:19:01

Uplink, 1732.5MHz-GSM (Input)



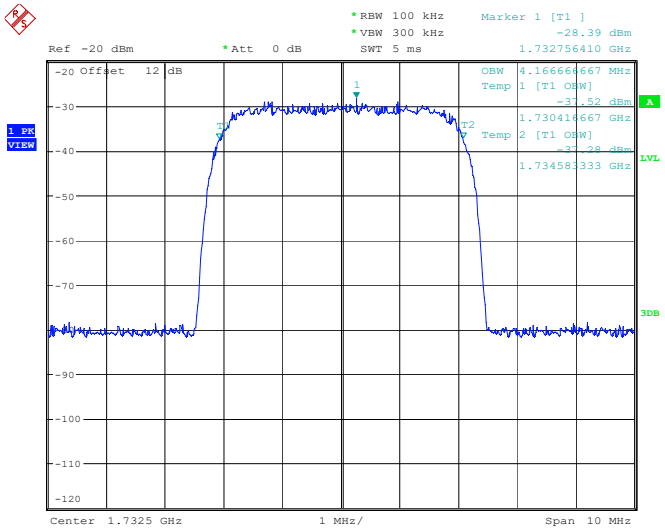
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:43:51

Uplink, 1732.5MHz-GSM (Output)



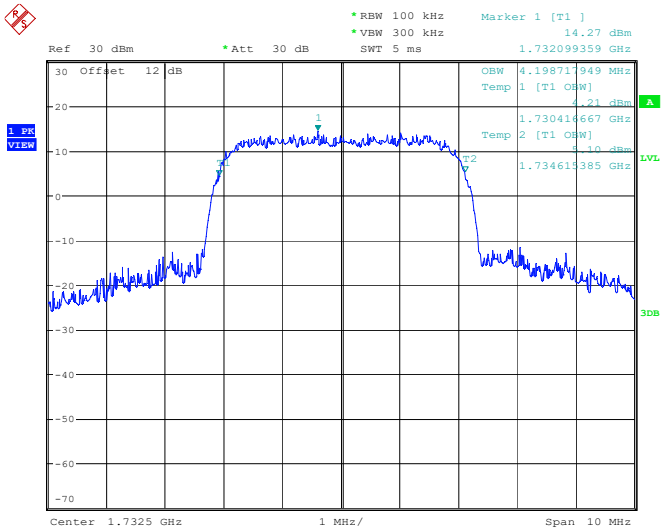
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:43:04

Uplink, 1732.5MHz-WCDMA (Input)



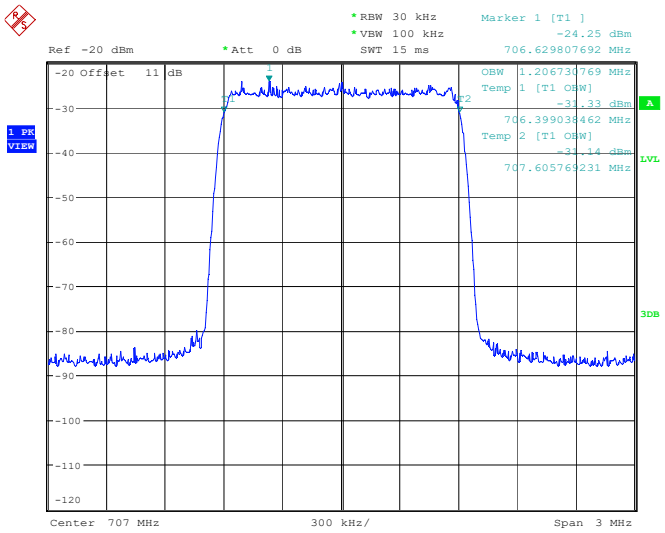
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:40:47

Uplink, 1732.5MHz-WCDMA (Output)



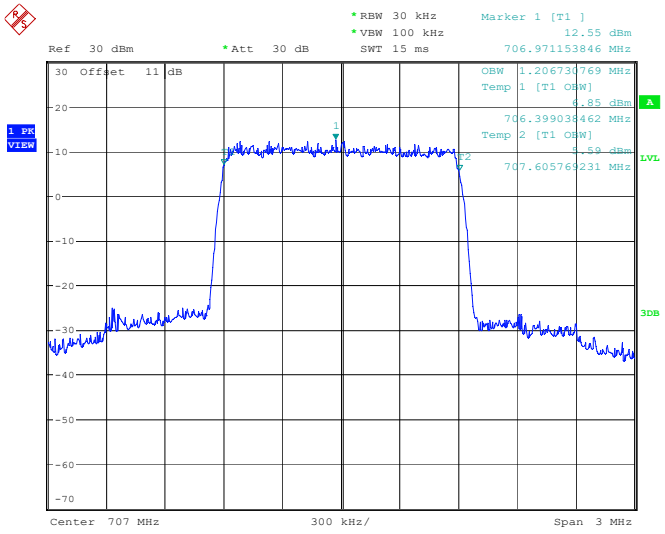
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 20:08:51

Uplink, 707MHz-CDMA (Input)



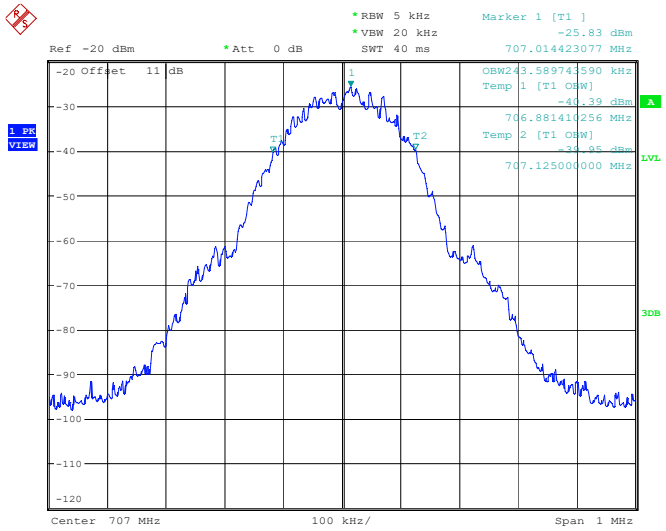
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:27:58

Uplink, 707MHz-CDMA (Output)



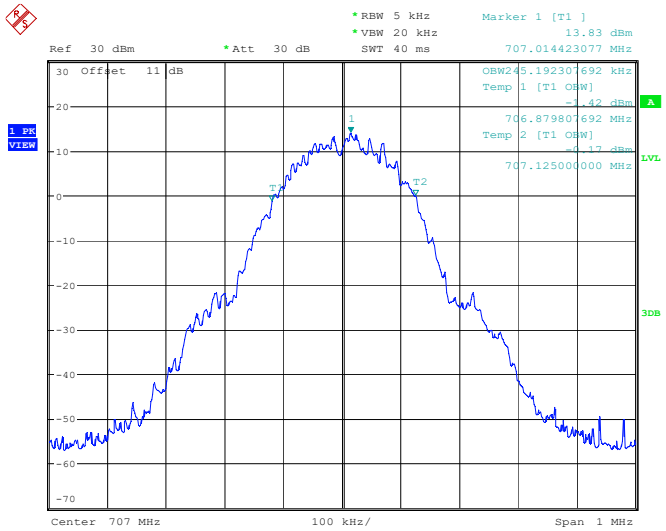
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:08:48

Uplink, 707MHz-GSM (Input)



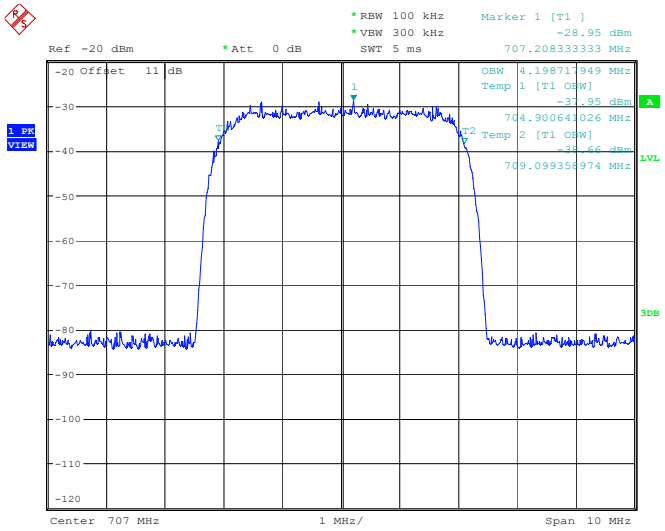
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:39:04

Uplink, 707MHz-GSM (Output)



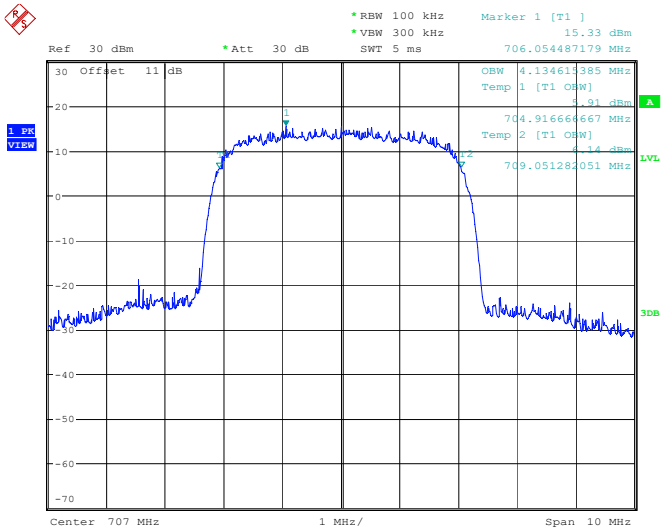
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:36:31

Uplink, 707MHz-WCDMA (Input)



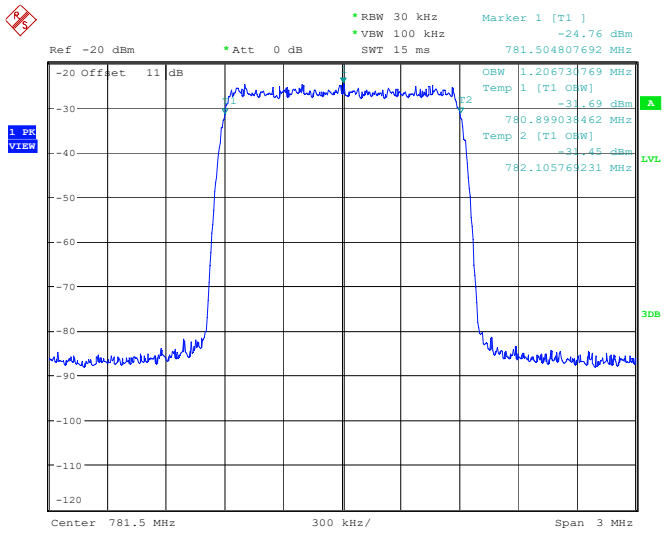
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:37:12

Uplink, 707MHz-WCDMA (Output)



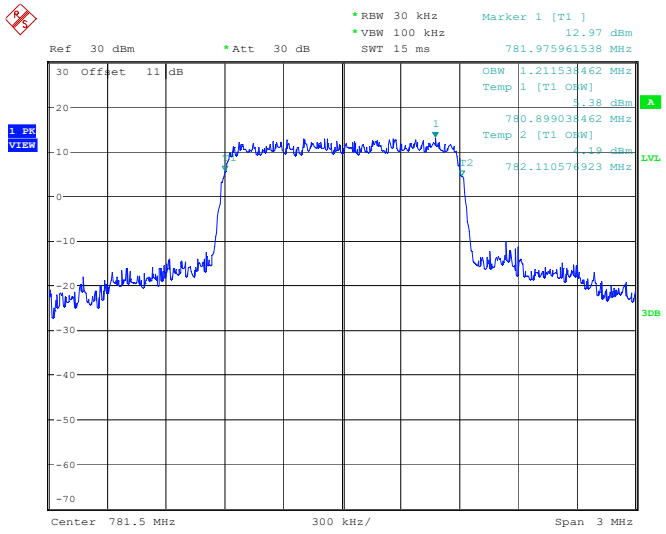
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:57:55

Uplink, 781.5MHz-CDMA (Input)



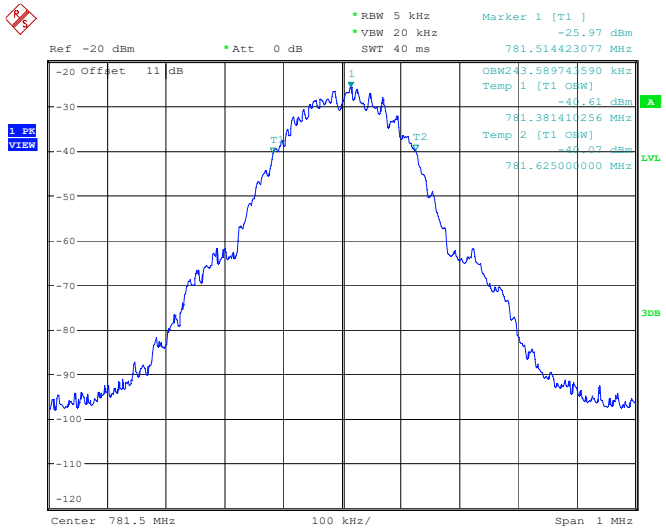
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:28:37

Uplink, 781.5MHz-CDMA (Output)



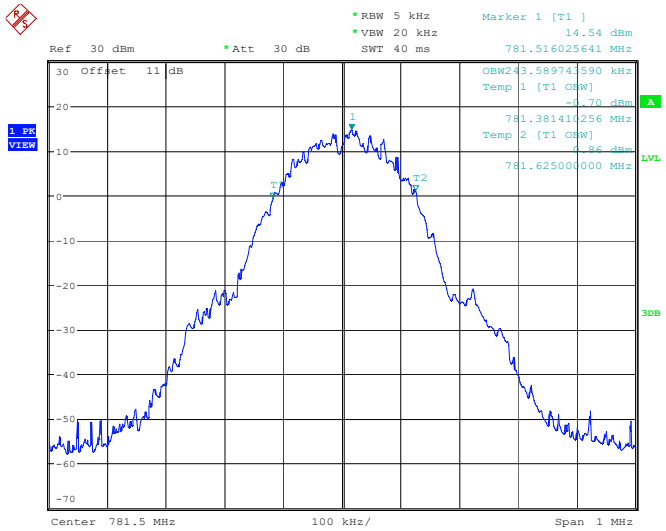
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:12:24

Uplink, 781.5MHz-GSM (Input)



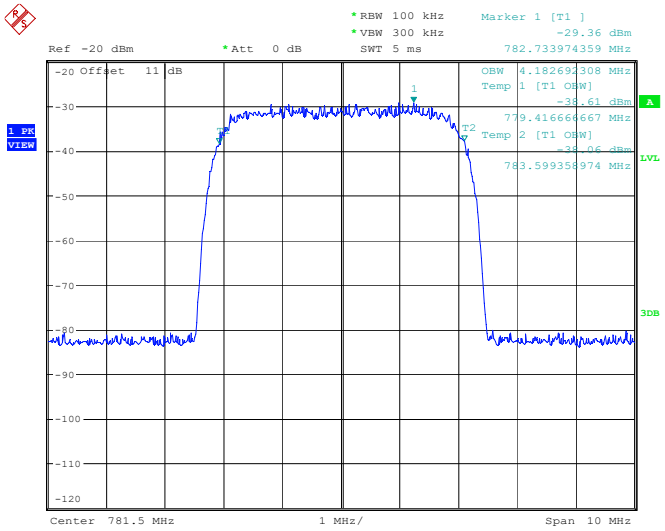
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:40:08

Uplink, 781.5MHz-GSM (Output)



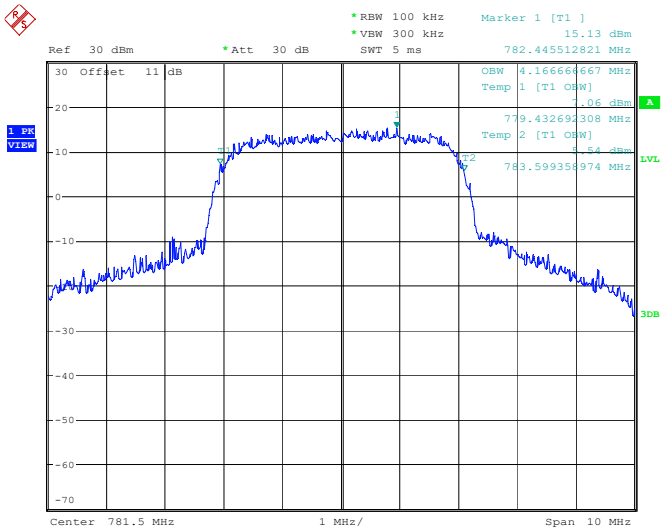
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 19:38:16

Uplink, 781.5MHz-WCDMA (Input)



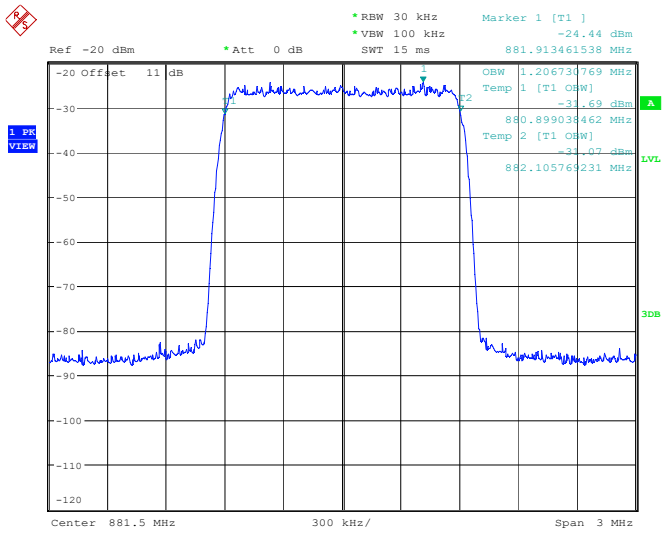
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:38:05

Uplink, 781.5MHz-WCDMA (Output)



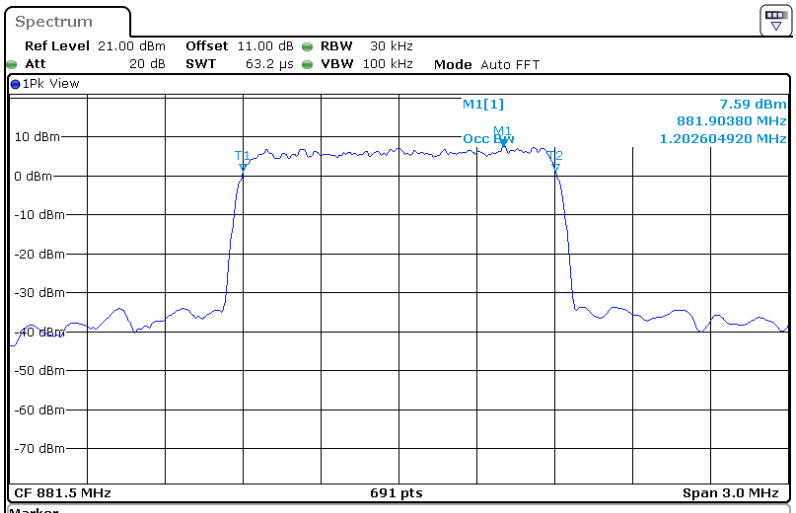
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 18.JAN.2024 20:03:58

Downlink, 881.5MHz-CDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:25:45

Downlink, 881.5MHz-CDMA (Output)

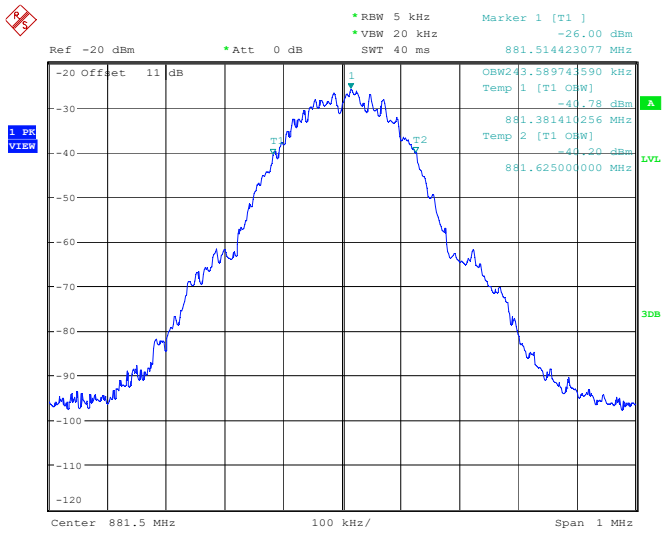


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	881.9038 MHz	7.59 dBm		
T1		1	880.90087 MHz	1.21 dBm	Occ Bw	1.20260492 MHz
T2		1	882.10347 MHz	1.26 dBm		

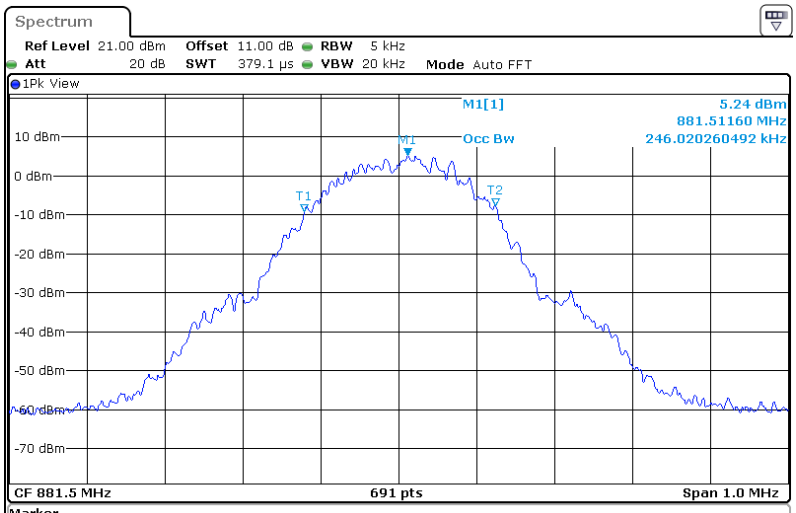
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:25:59

Downlink, 881.5MHz-GSM (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:35:11

Downlink, 881.5MHz-GSM (Output)

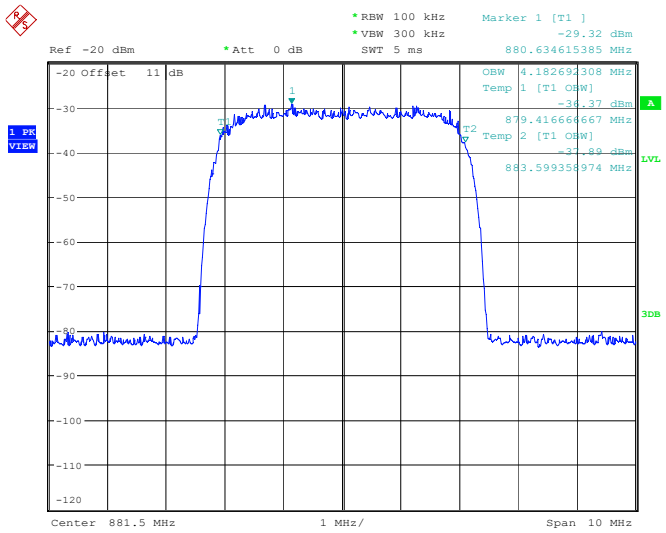


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	881.5116 MHz	5.24 dBm		
T1		1	881.37844 MHz	-9.10 dBm	Occ Bw	246.020260492 kHz
T2		1	881.62446 MHz	-7.72 dBm		

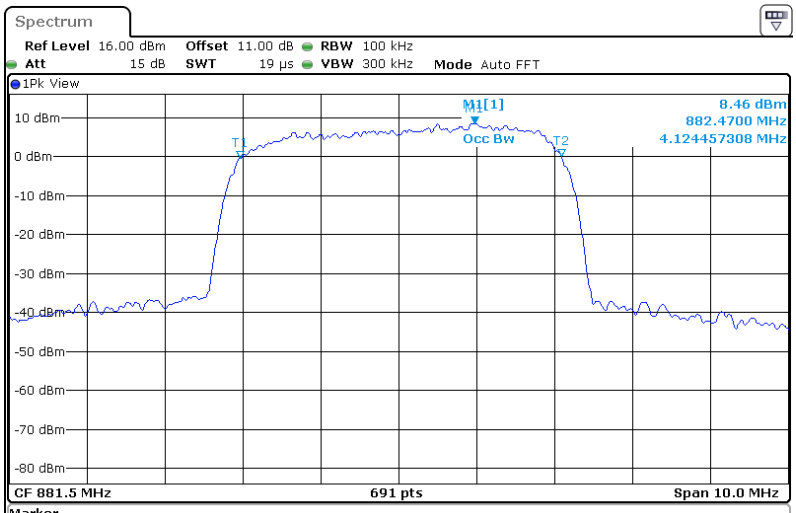
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:35:39

Downlink, 881.5MHz-WCDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:34:41

Downlink, 881.5MHz-WCDMA (Output)

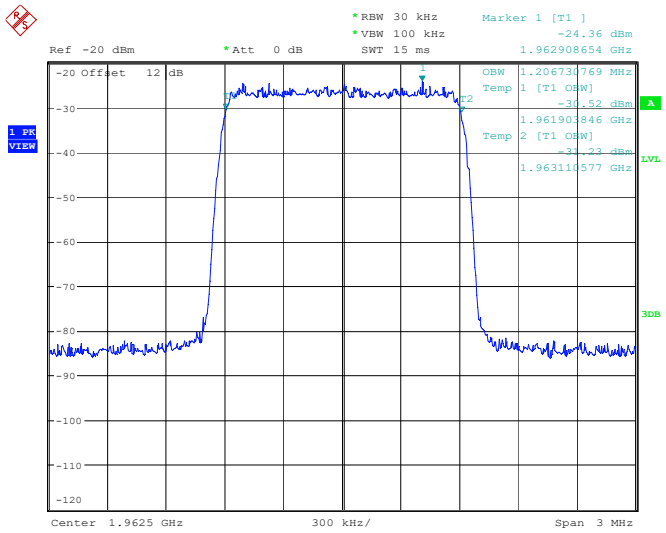


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	882.47 MHz	8.46 dBm		
T1		1	879.4595 MHz	-0.55 dBm	Occ Bw	4.124457308 MHz
T2		1	883.5839 MHz	0.01 dBm		

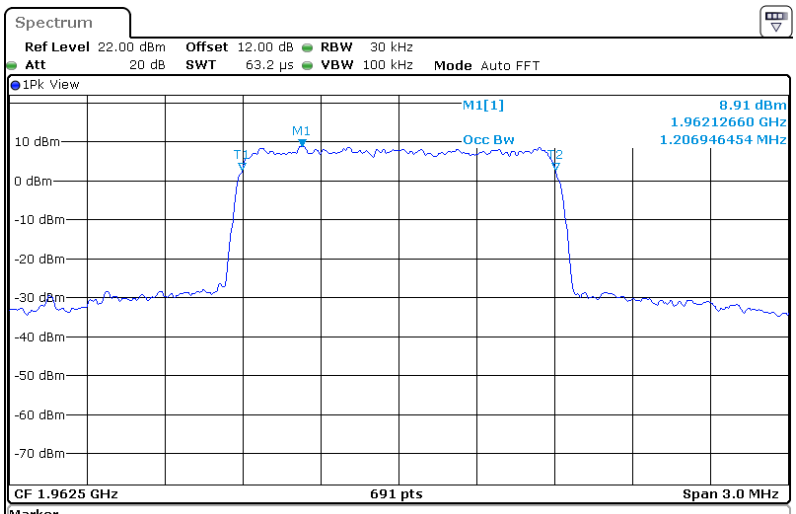
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:46:30

Downlink, 1962.5MHz-CDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:26:30

Downlink, 1962.5MHz-CDMA (Output)

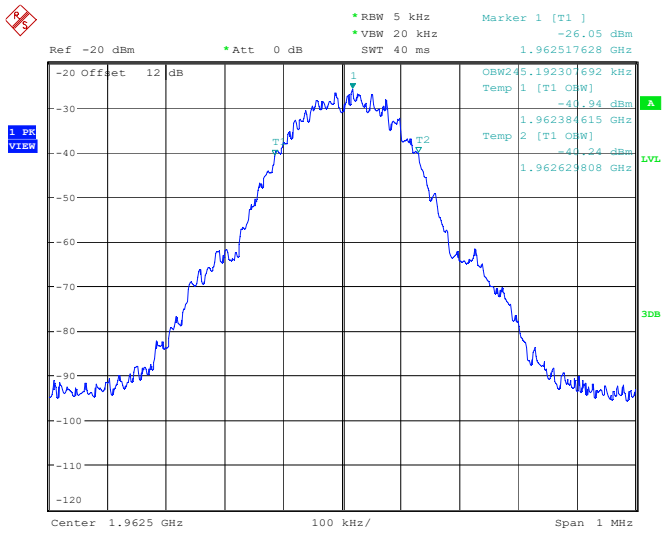


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.9621266 GHz	8.91 dBm		
T1		1	1.96189653 GHz	2.86 dBm	Occ Bw	1.206946454 MHz
T2		1	1.96310347 GHz	2.87 dBm		

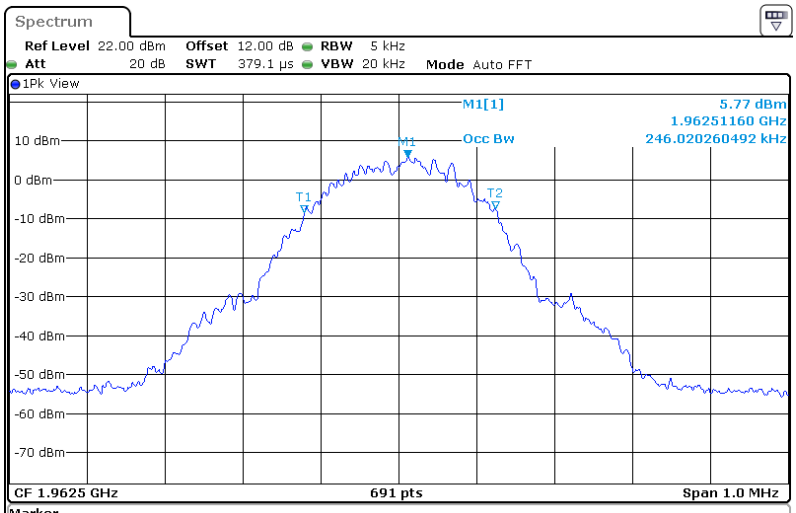
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:27:23

Downlink, 1962.5MHz-GSM (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:36:25

Downlink, 1962.5MHz-GSM (Output)

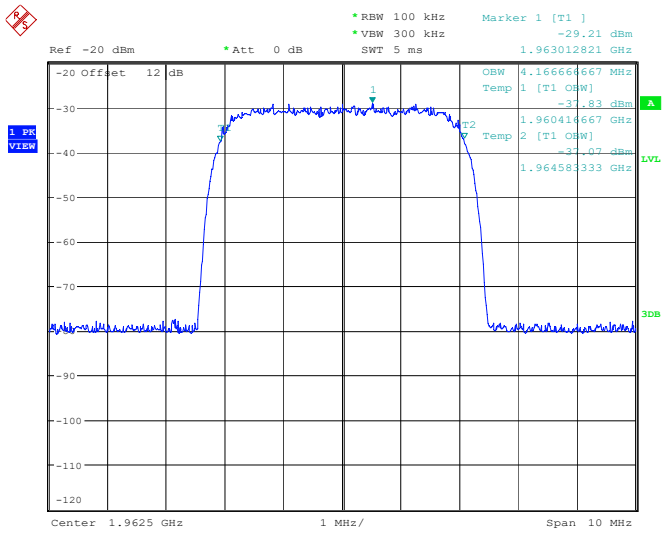


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.9625116 GHz	5.77 dBm		
T1		1	1.96237844 GHz	-8.37 dBm	Occ Bw	246.020260492 kHz
T2		1	1.96262446 GHz	-7.30 dBm		

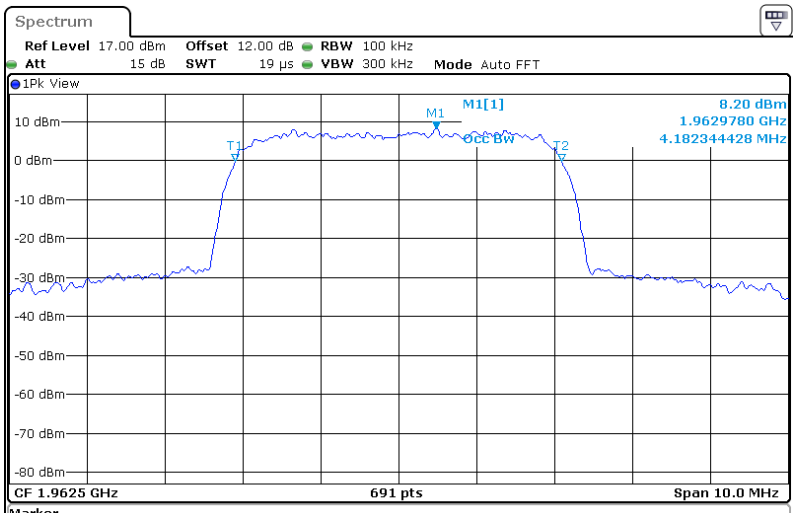
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:36:17

Downlink, 1962.5MHz-WCDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:35:35

Downlink, 1962.5MHz-WCDMA (Output)

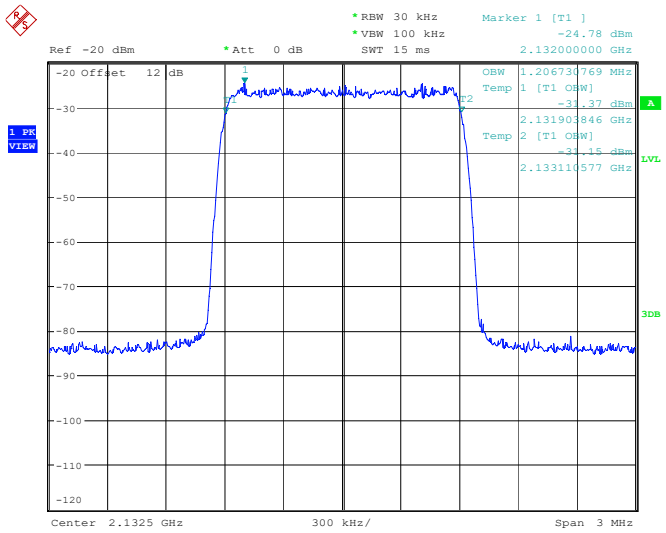


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.962978 GHz	8.20 dBm		
T1		1	1.9604016 GHz	-0.10 dBm	Occ Bw	4.182344428 MHz
T2		1	1.9645839 GHz	-0.23 dBm		

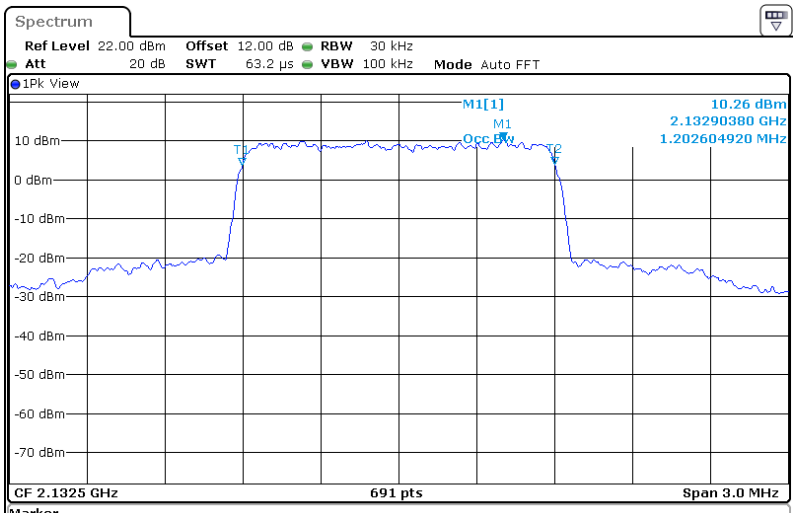
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:47:30

Downlink, 2132.5MHz-CDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:27:19

Downlink, 2132.5MHz-CDMA (Output)

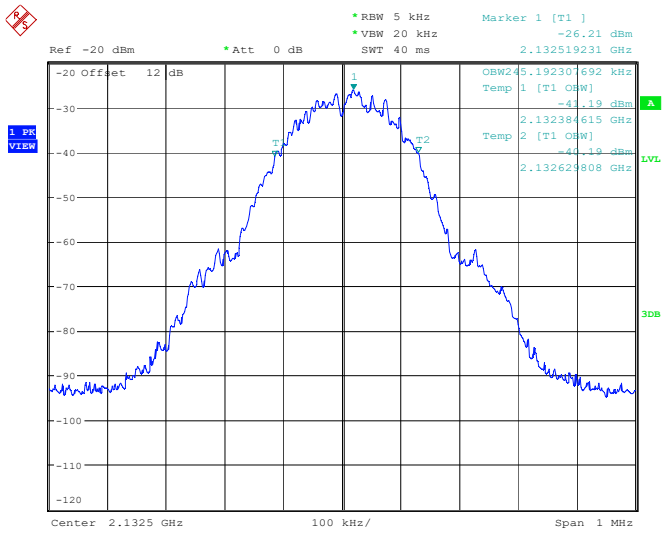


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.1329038 GHz	10.26 dBm		
T1		1	2.13189653 GHz	3.79 dBm	Occ Bw	1.20260492 MHz
T2		1	2.13309913 GHz	4.13 dBm		

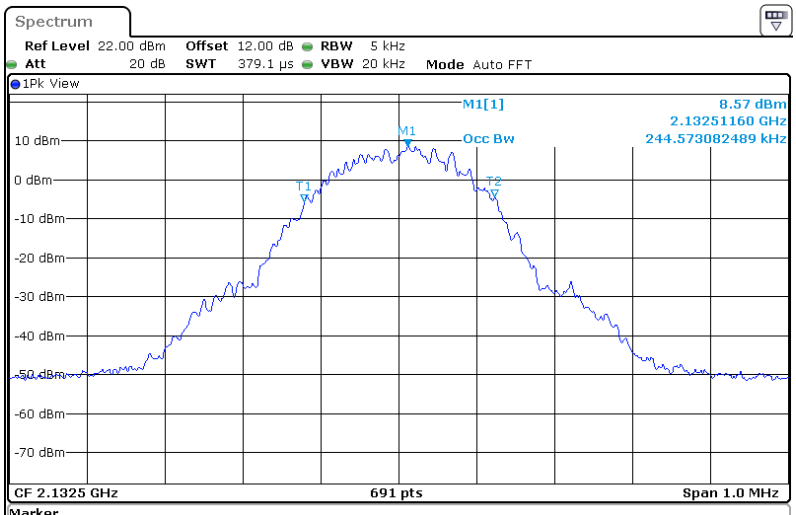
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:28:18

Downlink, 2132.5MHz-GSM (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:38:00

Downlink, 2132.5MHz-GSM (Output)

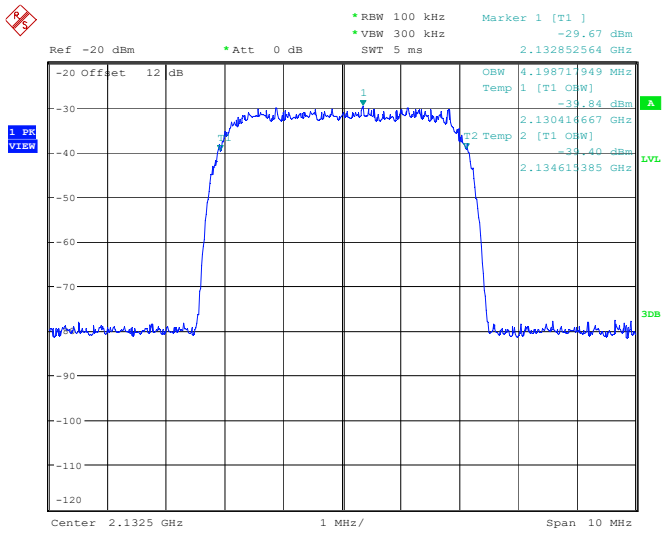


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.1325116 GHz	8.57 dBm		
T1		1	2.13237844 GHz	-5.51 dBm	Occ Bw	244.573082489 kHz
T2		1	2.13262301 GHz	-4.41 dBm		

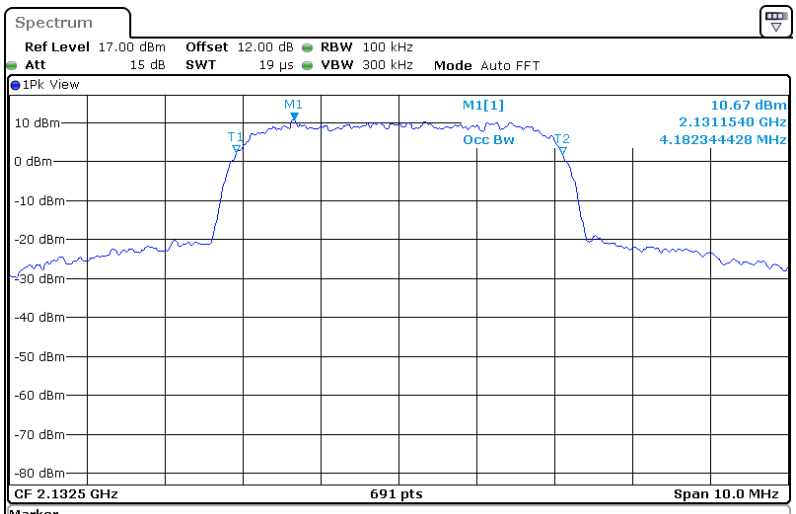
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:38:52

Downlink, 2132.5MHz-WCDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:36:18

Downlink, 2132.5MHz-WCDMA (Output)

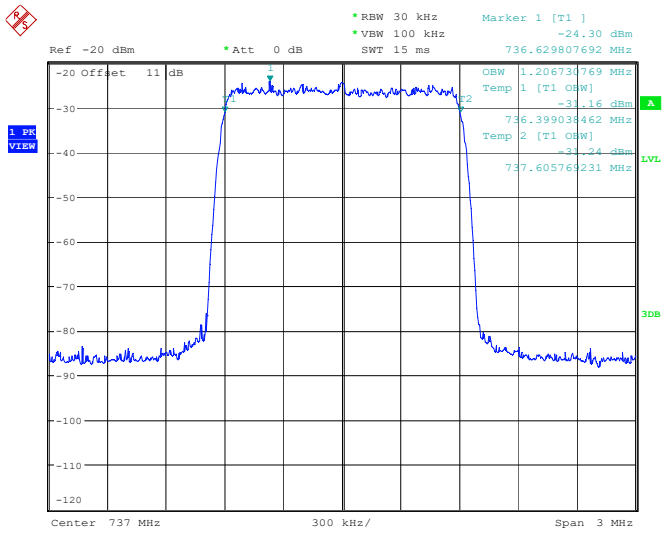


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.131154 GHz	10.67 dBm		
T1		1	2.1304161 GHz	2.19 dBm	Occ Bw	4.182344428 MHz
T2		1	2.1345984 GHz	1.84 dBm		

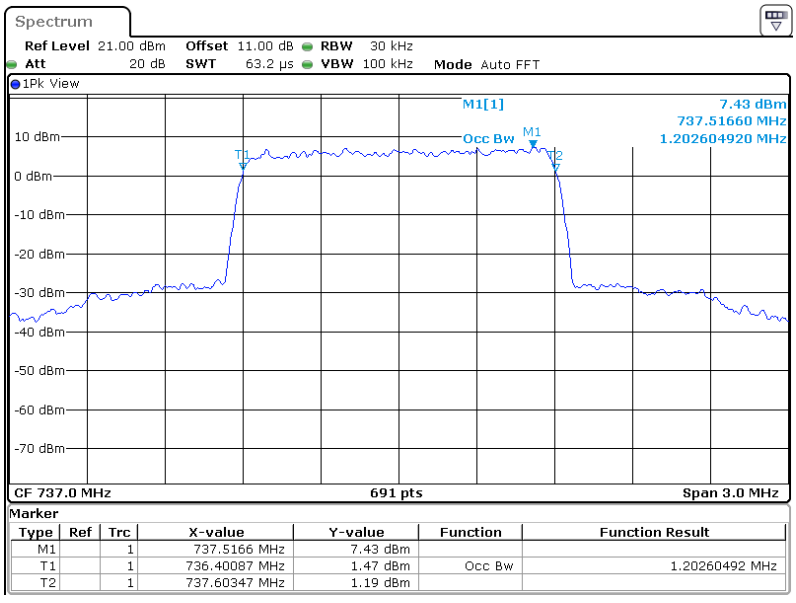
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:49:08

Downlink, 737MHz-CDMA (Input)



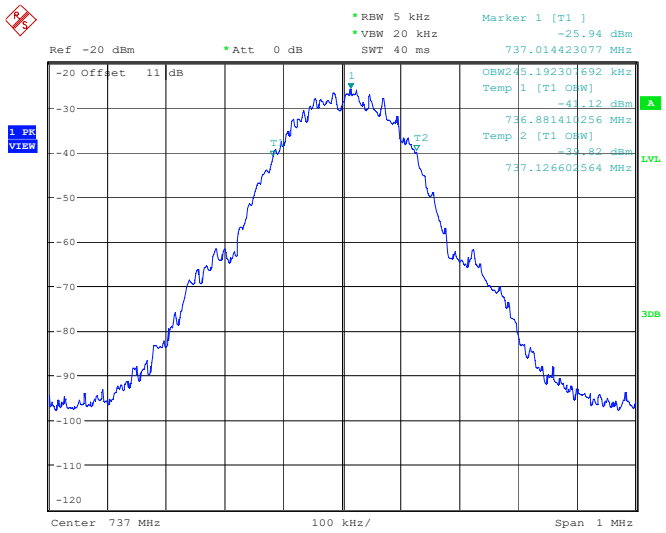
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:23:48

Downlink, 737MHz-CDMA (Output)



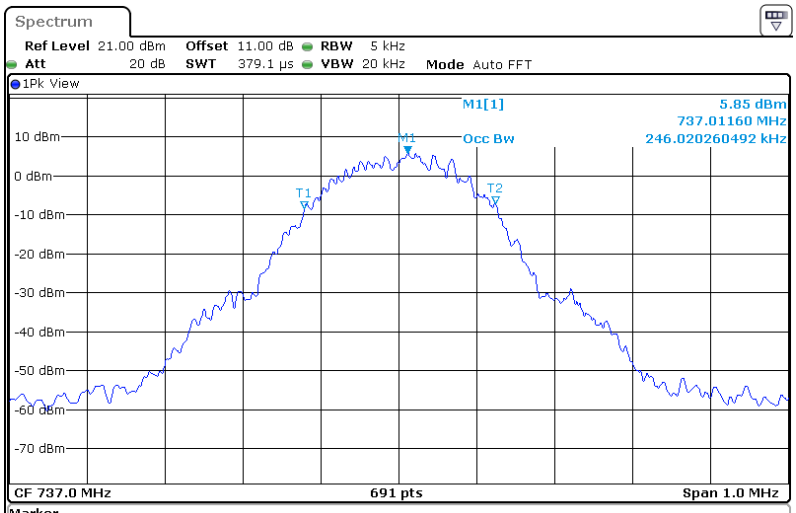
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:24:31

Downlink, 737MHz-GSM (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:32:33

Downlink, 737MHz-GSM (Output)

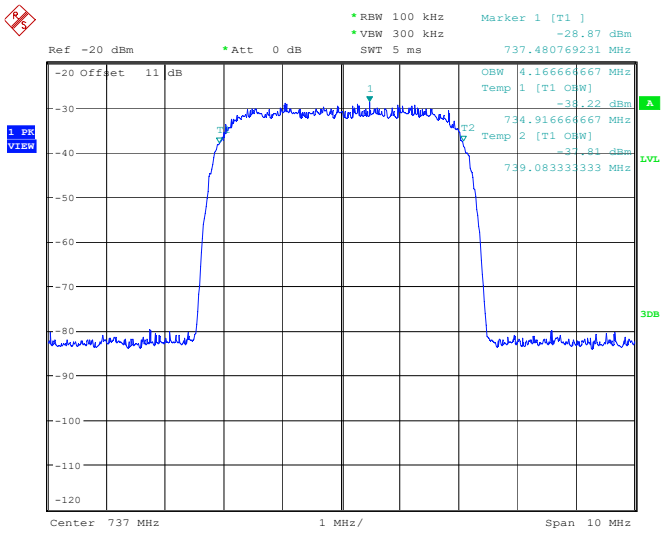


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	737.0116 MHz	5.85 dBm		
T1		1	736.87844 MHz	-8.46 dBm	Occ Bw	246.020260492 kHz
T2		1	737.12446 MHz	-7.20 dBm		

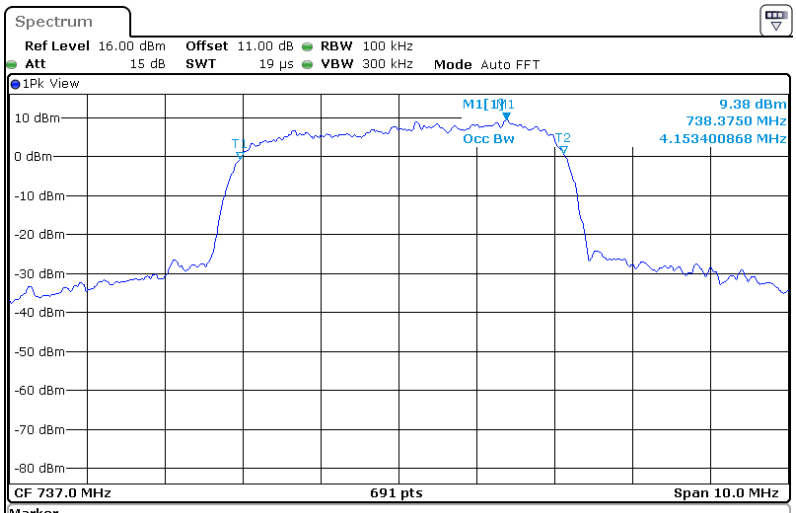
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:34:20

Downlink, 737MHz-WCDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:32:54

Downlink, 737MHz-WCDMA (Output)

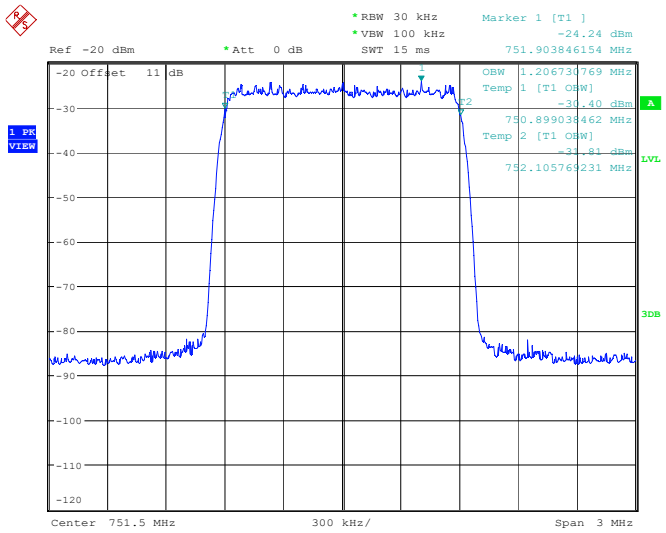


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	738.375 MHz	9.38 dBm		
T1		1	734.9595 MHz	-0.75 dBm	Occ Bw	4.153400868 MHz
T2		1	739.1129 MHz	0.70 dBm		

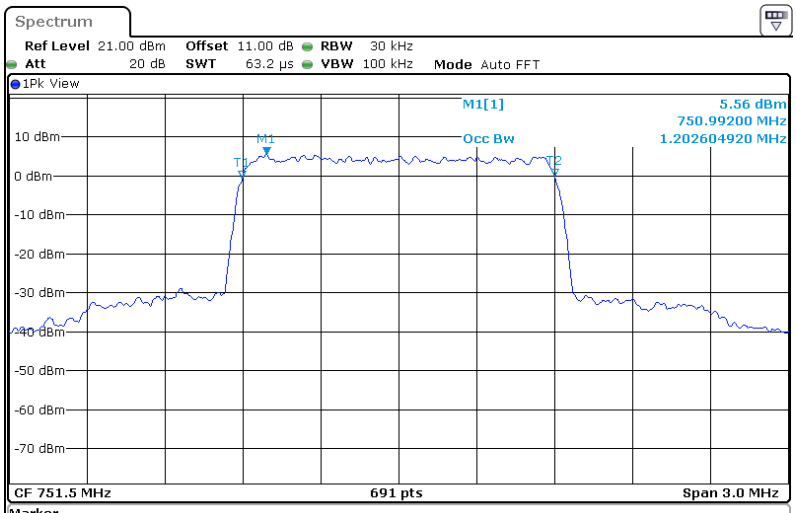
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:45:04

Downlink, 751.5MHz-CDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:24:52

Downlink, 751.5MHz-CDMA (Output)

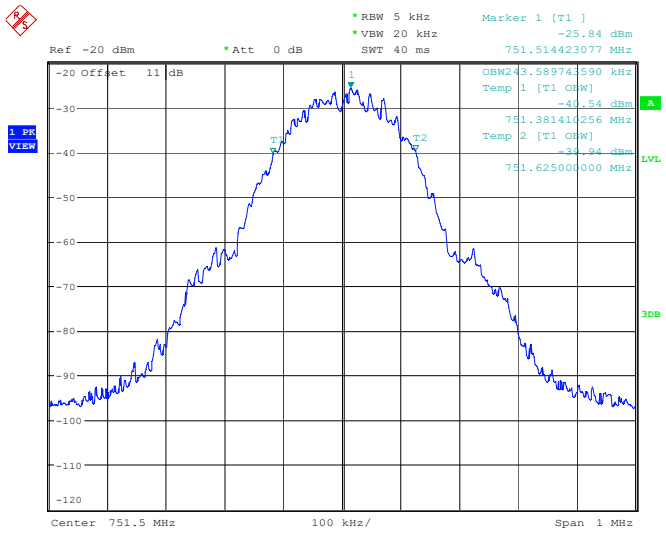


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	750.992 MHz	5.56 dBm		
T1		1	750.89653 MHz	-0.52 dBm	Occ Bw	1.20260492 MHz
T2		1	752.09913 MHz	-0.05 dBm		

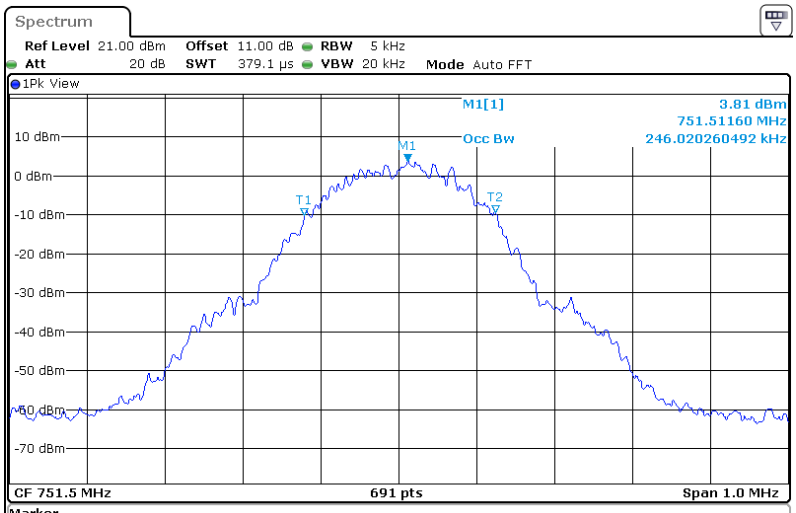
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:25:09

Downlink, 751.5MHz-GSM (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 20:33:47

Downlink, 751.5MHz-GSM (Output)

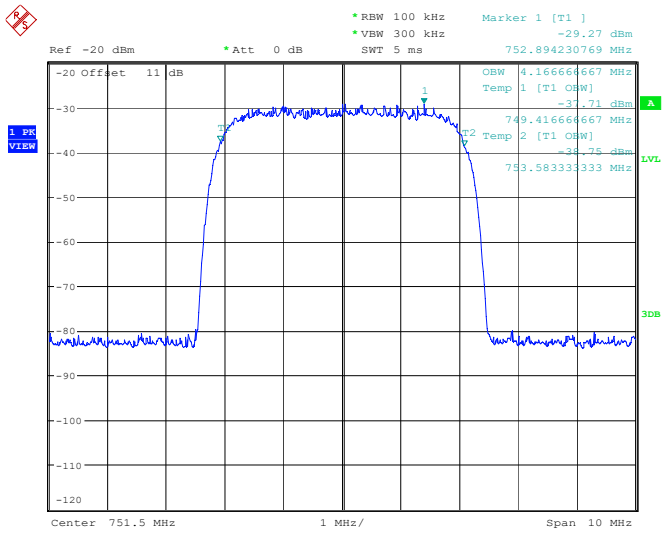


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	751.5116 MHz	3.81 dBm		
T1		1	751.37844 MHz	-10.24 dBm	Occ Bw	246.020260492 kHz
T2		1	751.62446 MHz	-9.29 dBm		

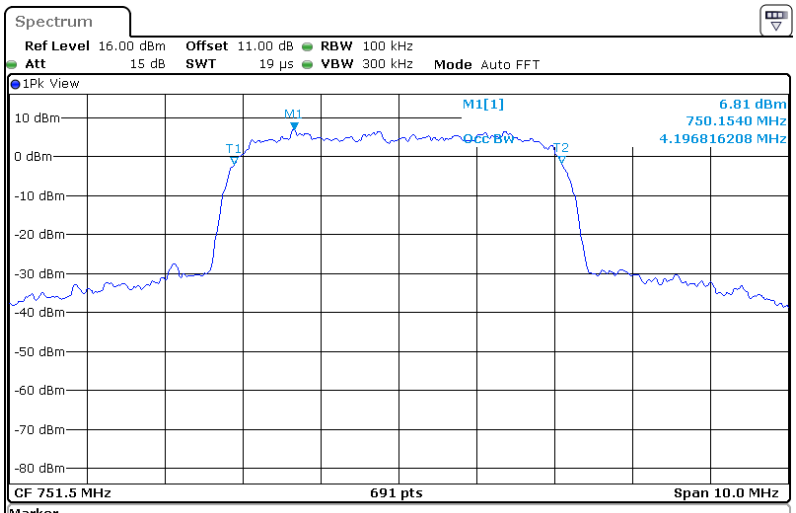
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:35:00

Downlink, 751.5MHz-WCDMA (Input)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 22.JAN.2024 21:33:48

Downlink, 751.5MHz-WCDMA (Output)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	750.154 MHz	6.81 dBm		
T1		1	749.3871 MHz	-1.93 dBm	Occ Bw	4.196816208 MHz
T2		1	753.5839 MHz	-1.66 dBm		

ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 03:45:41

§ 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 Signal Booster Measurements v04, §7.11.2 Oscillation restart tests and §7.11.3 Test procedure for measuring oscillation mitigation or shutdown

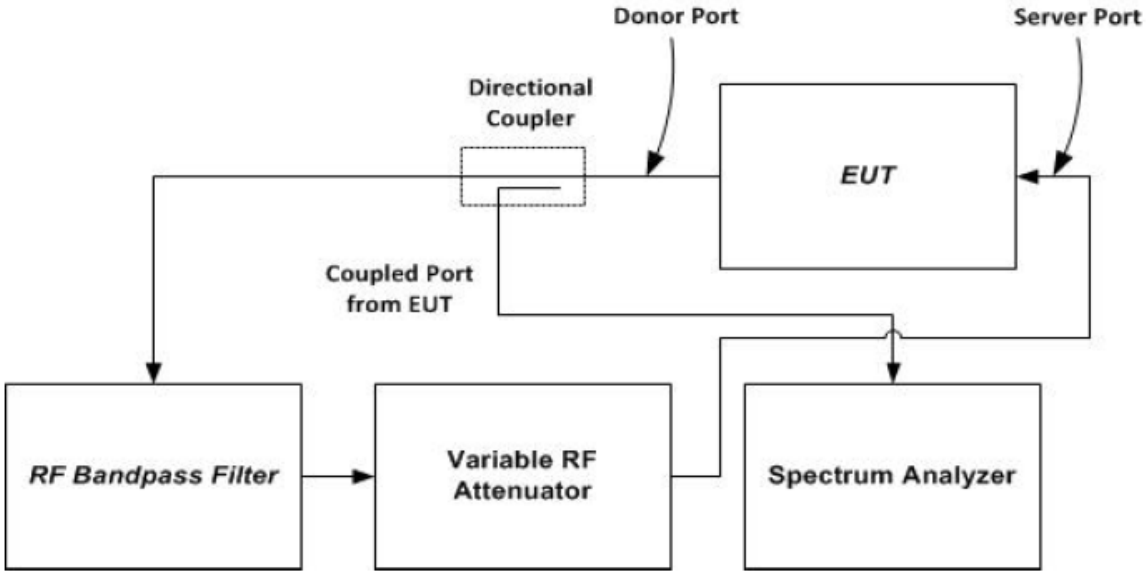


Figure 7 – Oscillation detection instrumentation test setup

Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin from 2024-01-24 to 2024-03-19.

Test Result: Pass

Please refer to following table.

Oscillation Restart Time:

Mode	Operation Bands	Detection Time (s)		Power level	Between restart time (s)		Number of restart		Result
		Reading	Limit	dBm	Reading	Limit	Reading	Limit	
Uplink	Lower 700	0.147	0.3	18.46	62.02	60	4	5	Compliance
	Upper 700	0.184		28.67	61.72		4		Compliance
	Cellular	0.238		28.2	61.87		4		Compliance
	PCS	0.160		15.69	62.60		4		Compliance
	AWS	0.073		14.1	62.12		4		Compliance
Downlink	Lower 700	0.188	1	18.64	62.21		4		Compliance
	Upper 700	0.144		18.53	62.02		4		Compliance
	Cellular	0.176		26.20	62.02		4		Compliance
	PCS	0.144		23.35	62.24		4		Compliance
	AWS	0.094		23.51	62.20		4		Compliance

Oscillation Mitigation or Shutdown:

Mode	Operation Band	Max gain dB	Isolation dB	Difference dB	Limit dB	Result
Uplink	Lower 700MHz	60.73	+5	-8.42	12.00	Compliance
			+4	-8.99	12.00	Compliance
			+3	-9.75	12.00	Compliance
			+2	-11.47	12.00	Compliance
			+1	-12.46	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	61.66	+5	-8.13	12.00	Compliance
			+4	-7.21	12.00	Compliance
			+3	-9.74	12.00	Compliance
			+2	-10.39	12.00	Compliance
			+1	-10.59	12.00	Compliance
			+0	-11.50	12.00	Compliance
			-1	-12.69	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	Cellular	61.49	+5	-11.24	12.00	Compliance
			+4	-11.44	12.00	Compliance
			+3	-13.67	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	69.22	+5	-18.42	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	69.19	+5	-15.33	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
Downlink	Lower 700MHz	62.36	+5	-18.77	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
	Upper 700MHz	62.13	+5	-10.70	12.00	Compliance
			+4	-17.31	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	62.92	+5	-7.59	12.00	Compliance
			+4	-8.62	12.00	Compliance
			+3	-10.60	12.00	Compliance
			+2	-10.79	12.00	Compliance
			+1	-12.58	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	70.50	+5	-11.88	12.00	Compliance
			+4	-13.01	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	70.35	+5	-13.95	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

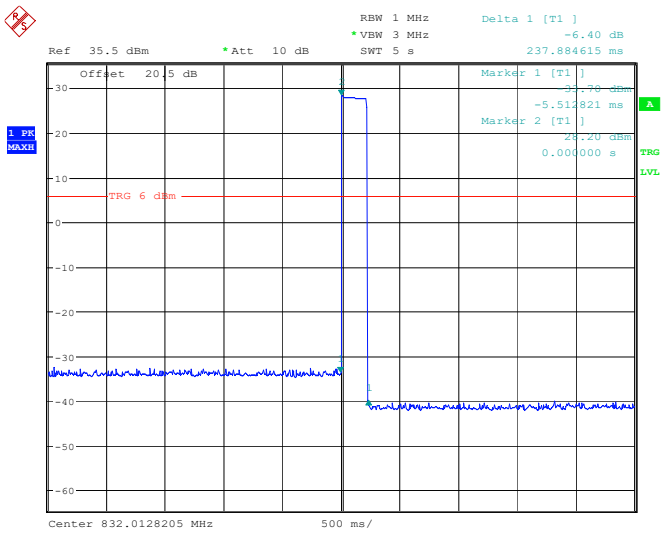
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance

Note: The mesured difference exceeds the limit for a period of less than 300 seconds before device mitigrate and shut down. The maximum recorded time prior to mitigate or shutdown was 98s.

Oscillation Restart tests:

Uplink

Cellular Band



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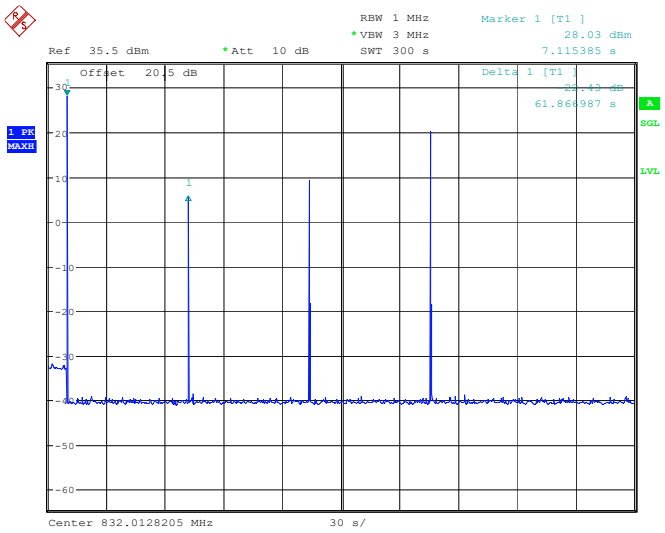
Date: 1.FEB.2024 20:21:18



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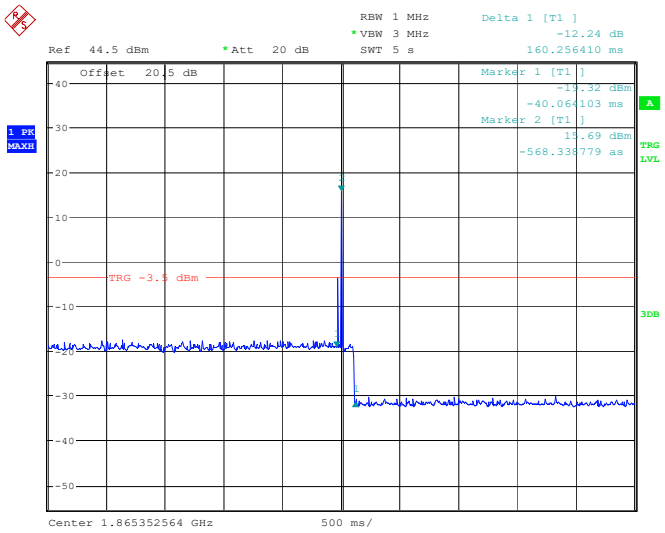
Date: 1.FEB.2024 20:27:13

PCS Band



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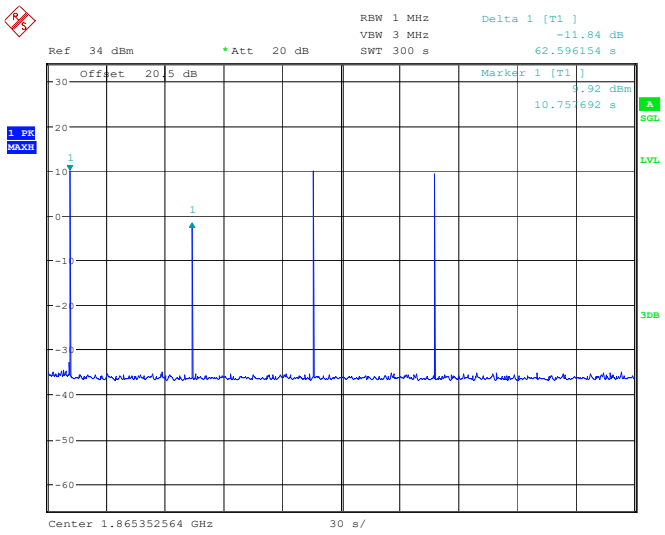
Date: 19.MAR.2024 23:47:01



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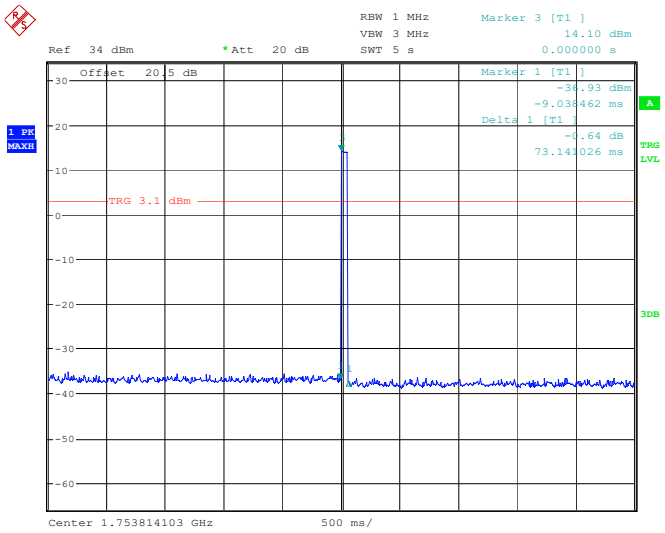
Date: 25.JAN.2024 00:47:58

AWS Band



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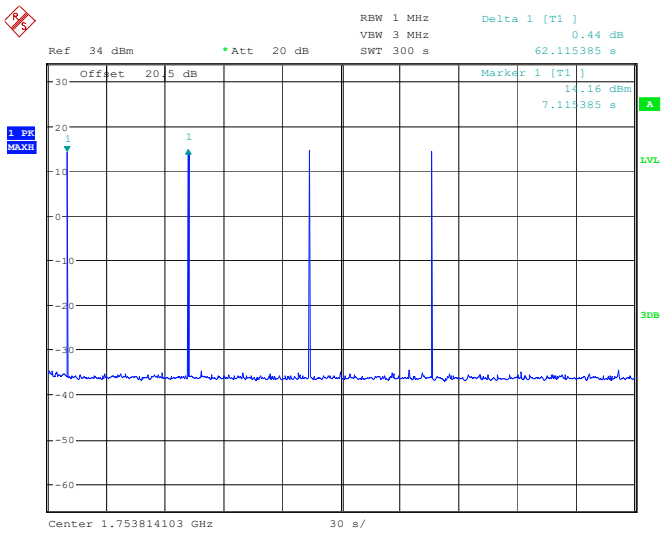

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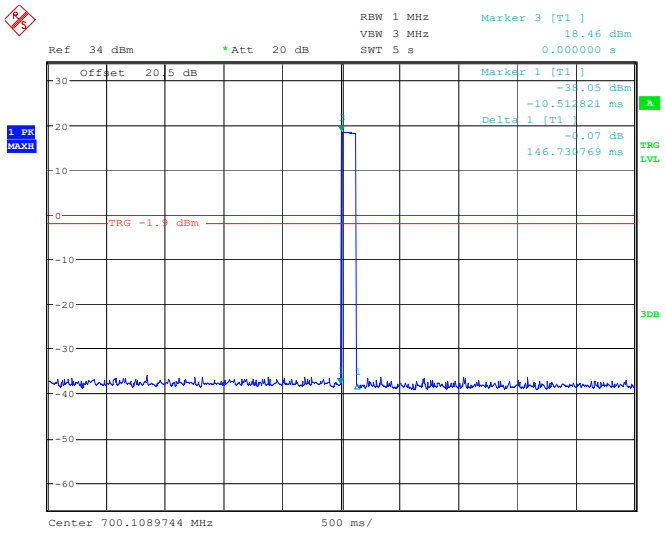
Lower 700MHz



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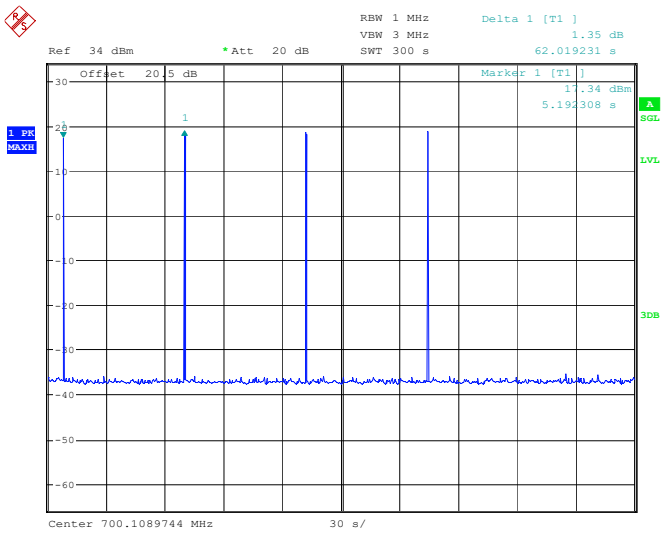

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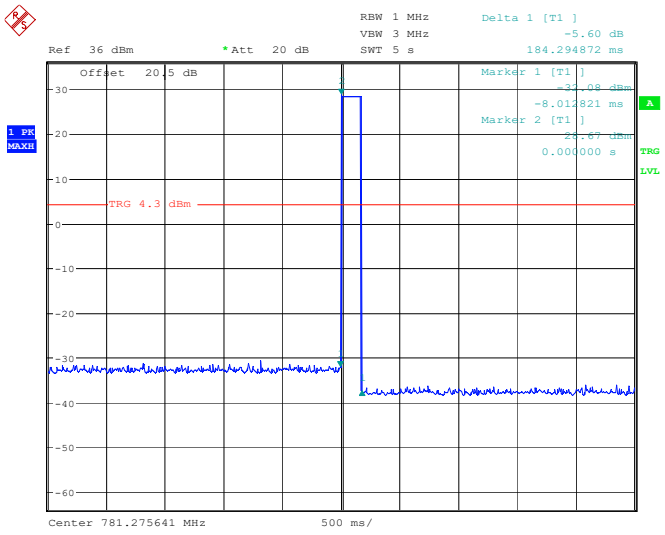
Upper 700MHz



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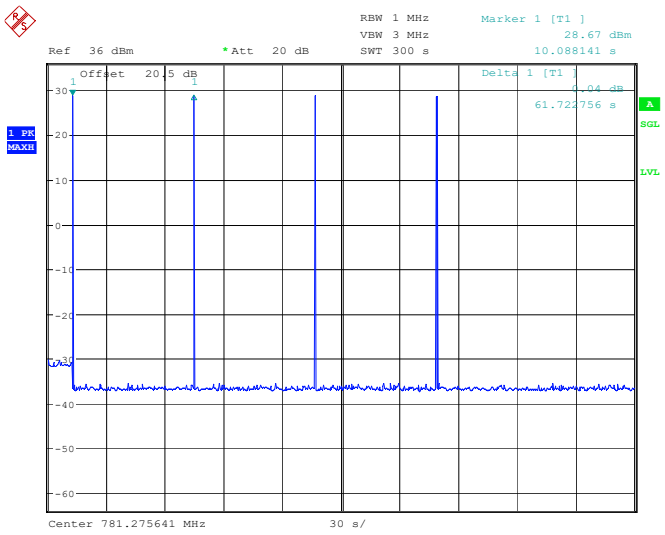
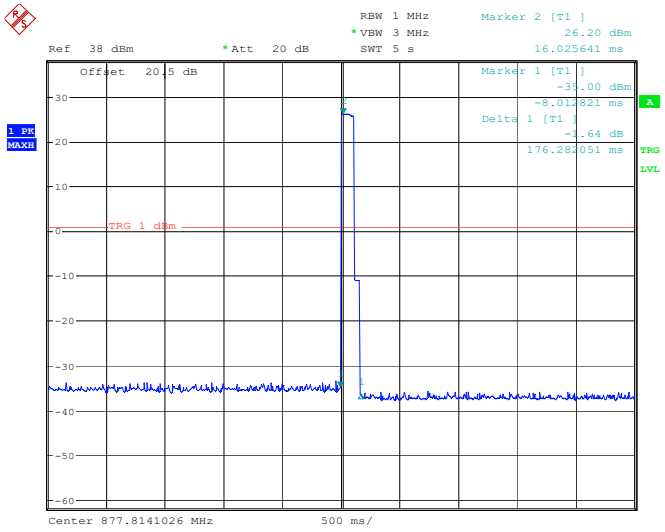


ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 25.JAN.2024 21:54:01

Downlink

Cellular Band



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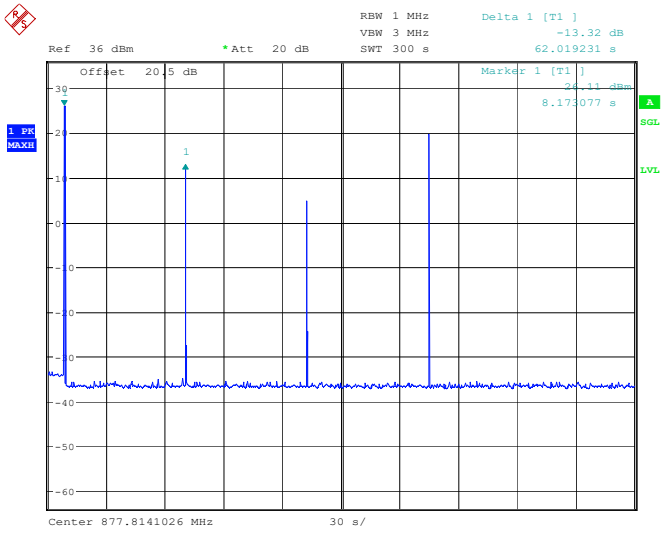

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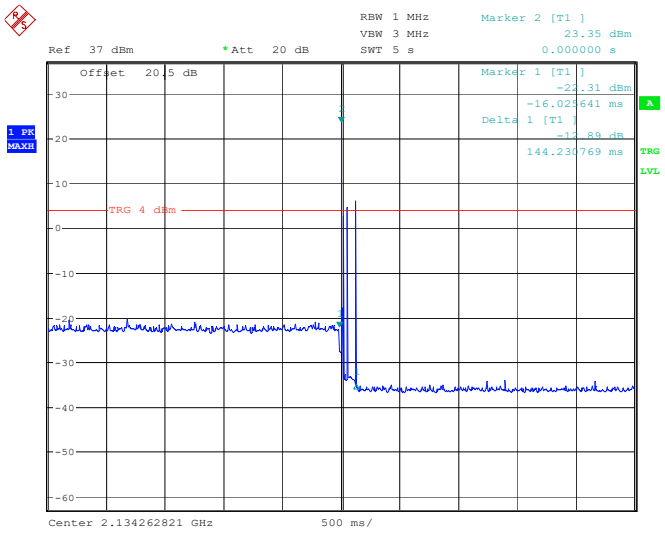
Date: 25.JAN.2024 21:05:46

PCS Band



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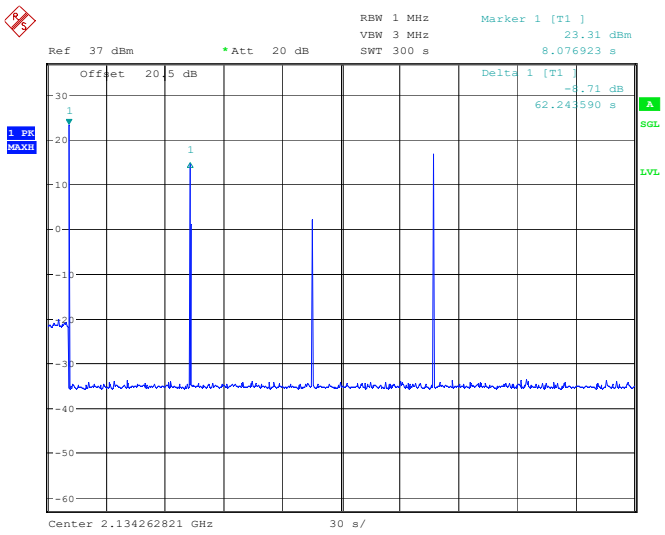
Date: 3.FEB.2024 23:12:17



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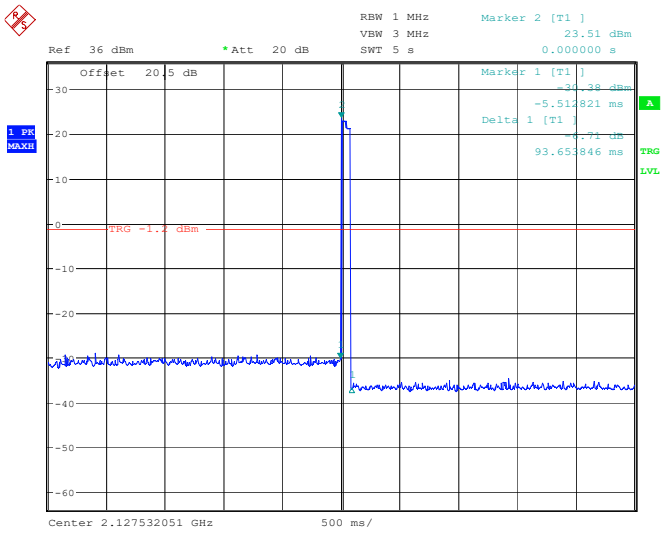
Date: 3.FEB.2024 23:18:01

AWS Band



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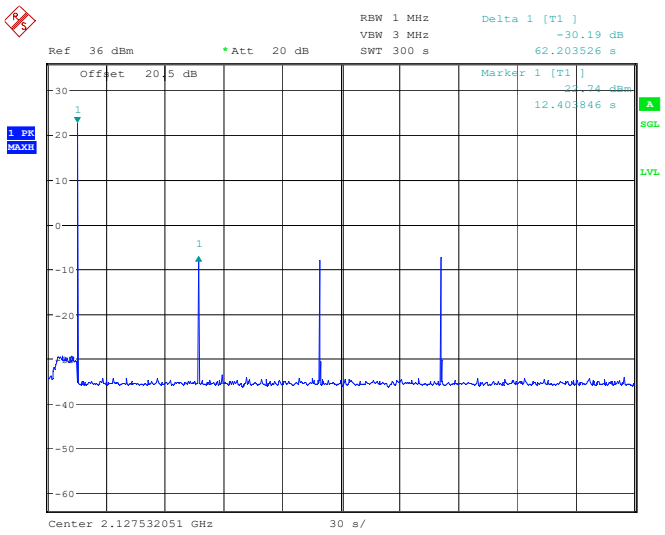

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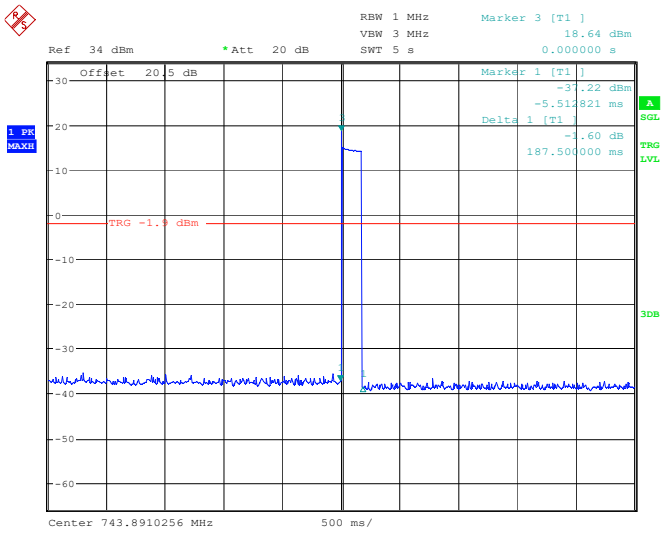
Date: 25.JAN.2024 21:32:12

Lower 700MHz



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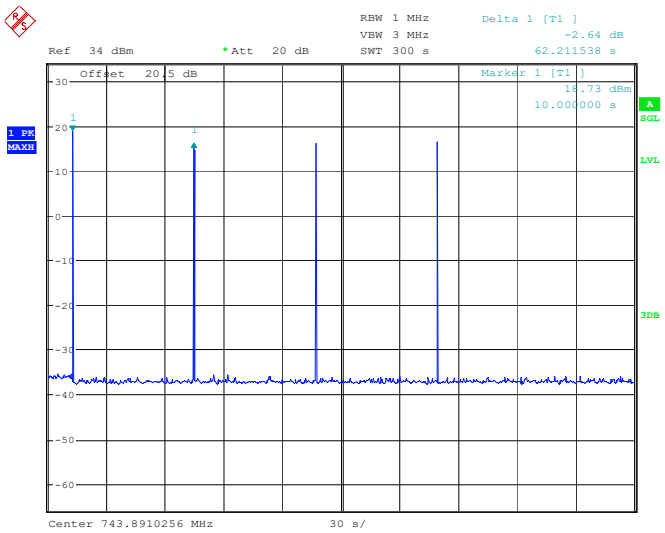

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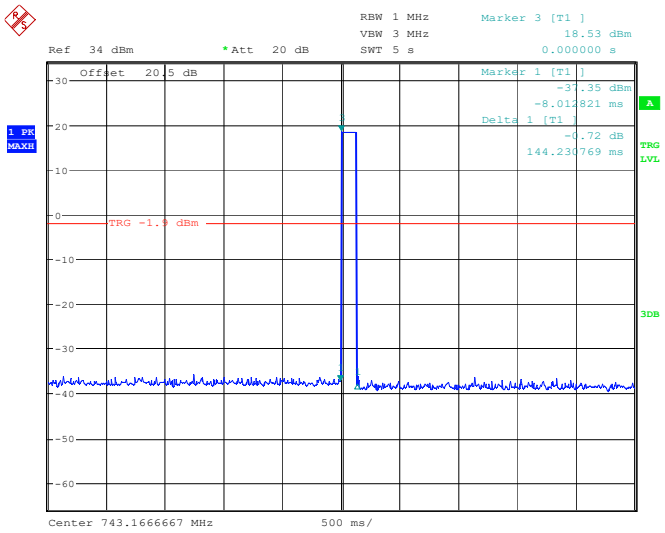
Upper 700MHz



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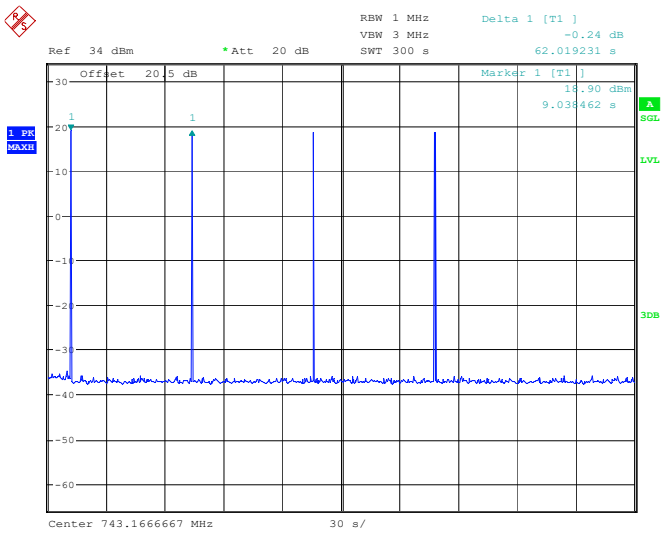


ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 24.JAN.2024 23:17:06

§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 ≥ 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 × 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 ≥ (2 × 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 × the highest frequency of the fundamental emission. Note that the number of measurement points in each sweep must be ≥ (2 × 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.

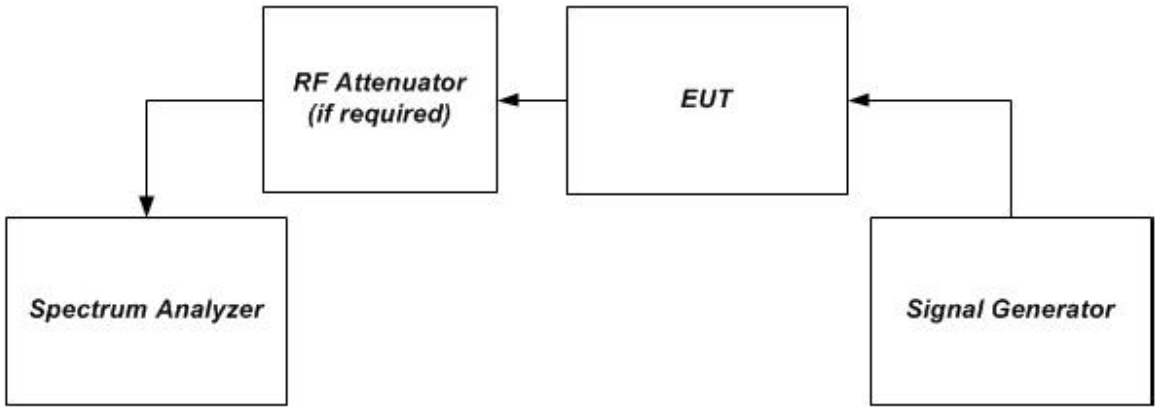


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Brace Lin from 2024-01-20 to 2024-04-08.

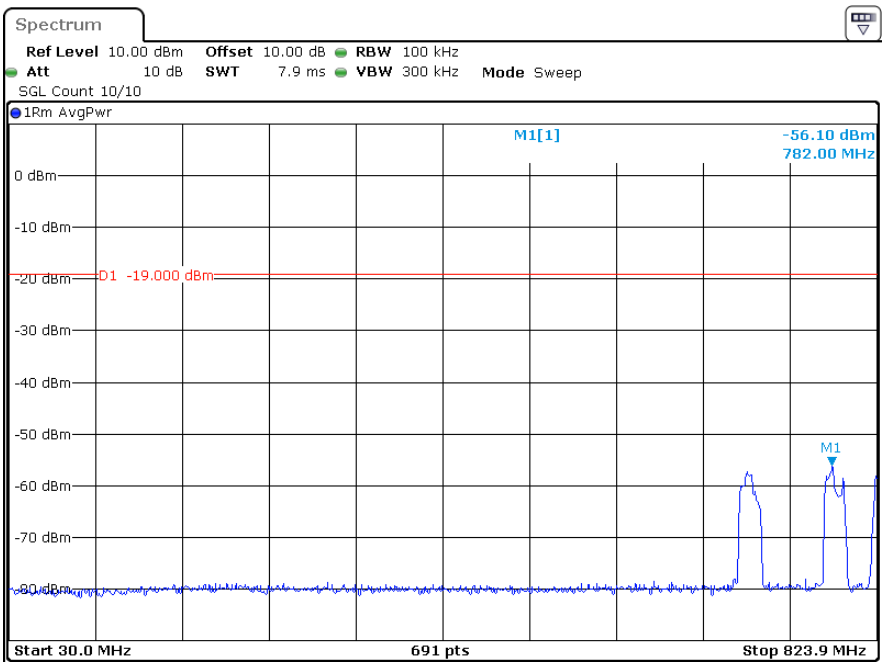
Test Mode: Transmitting

Test Result: Pass

Please refer to the following plots.

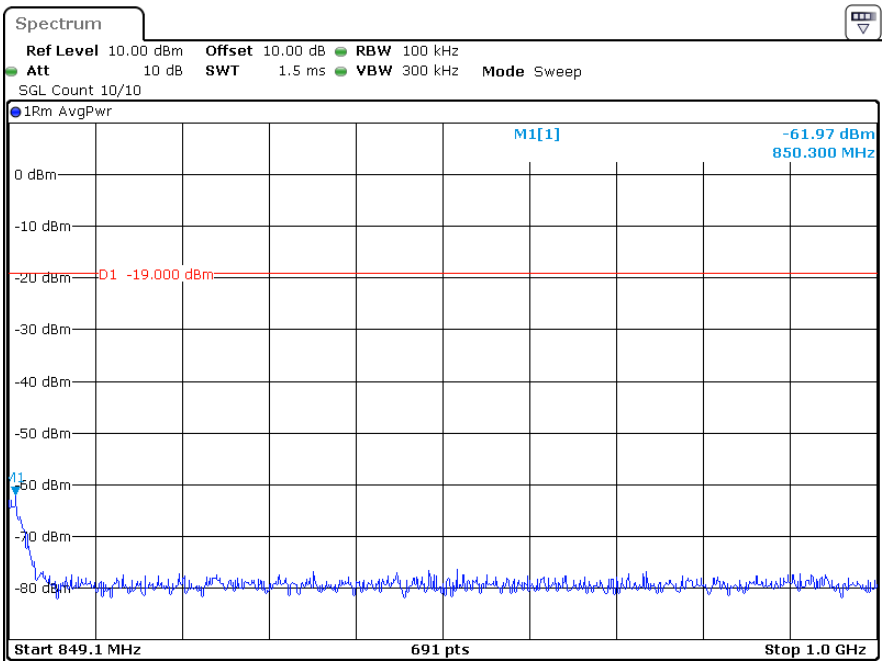
Uplink

Cellular Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:34:07



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

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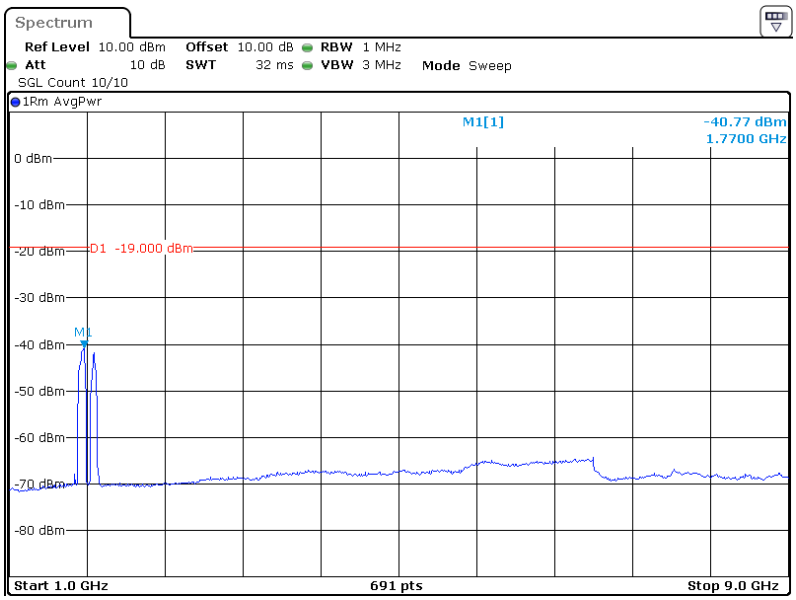

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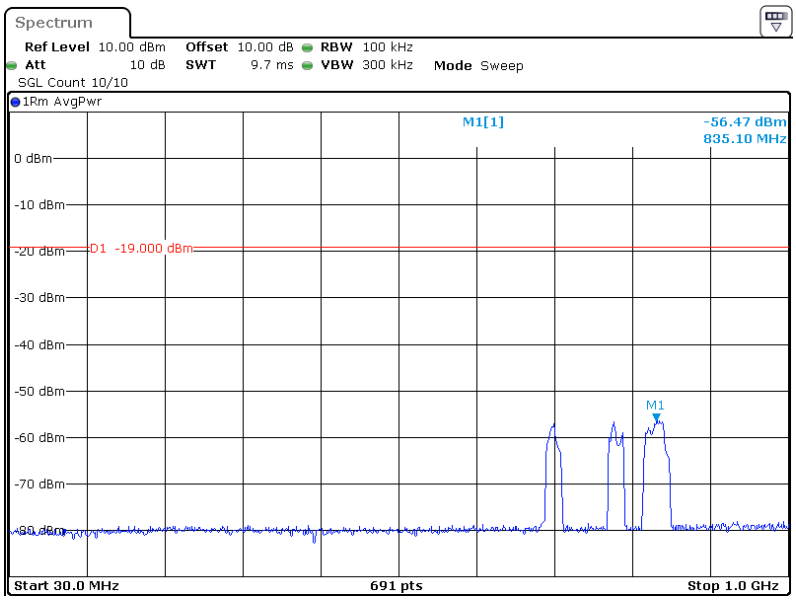
Date: 20.JAN.2024 02:33:56

PCS Band



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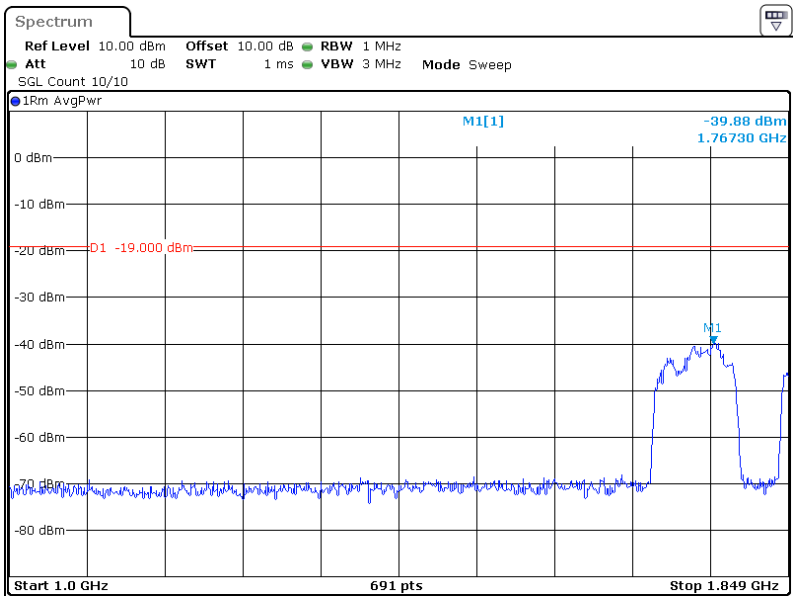

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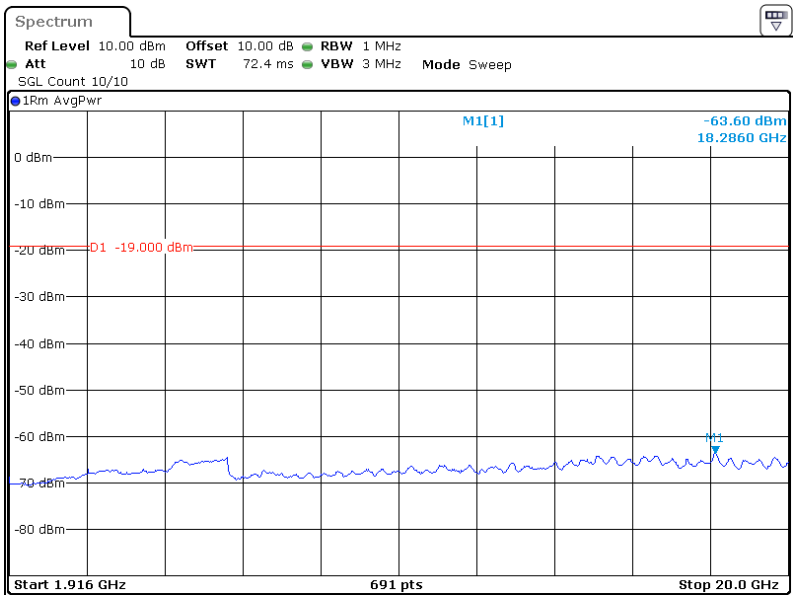

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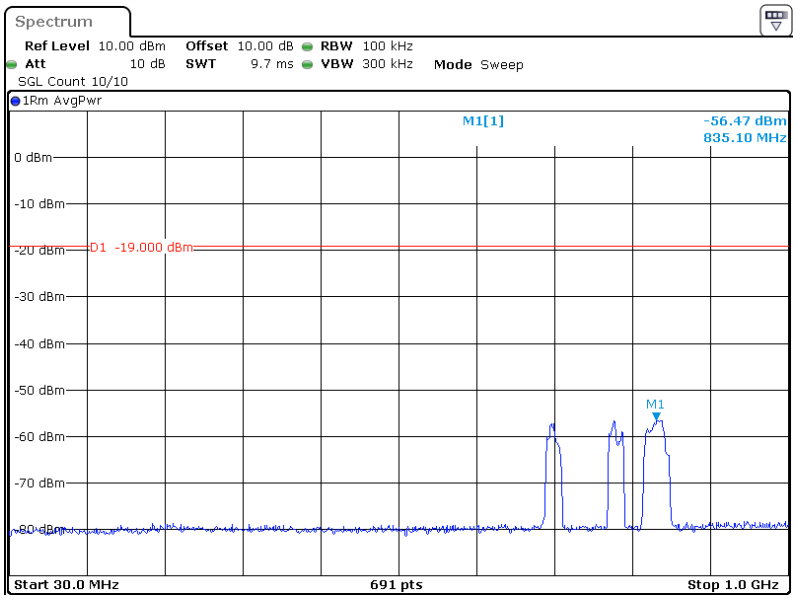
AWS Band



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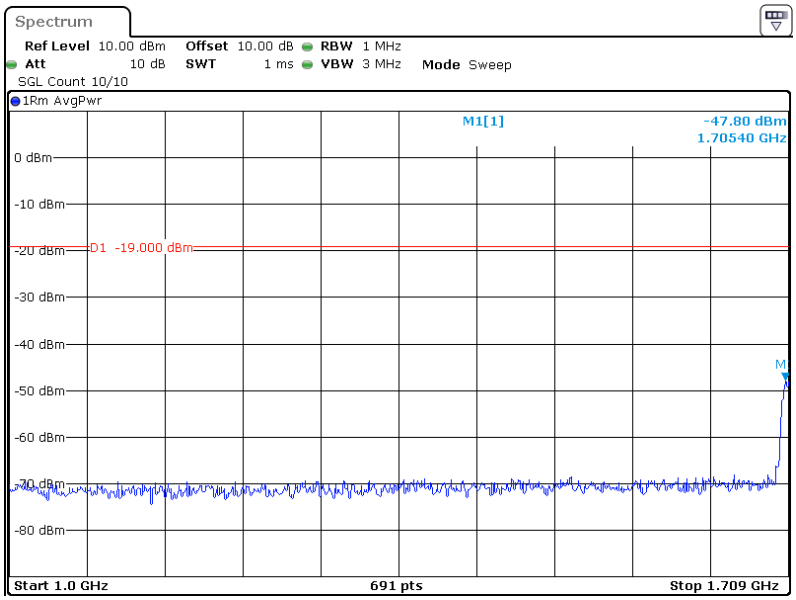

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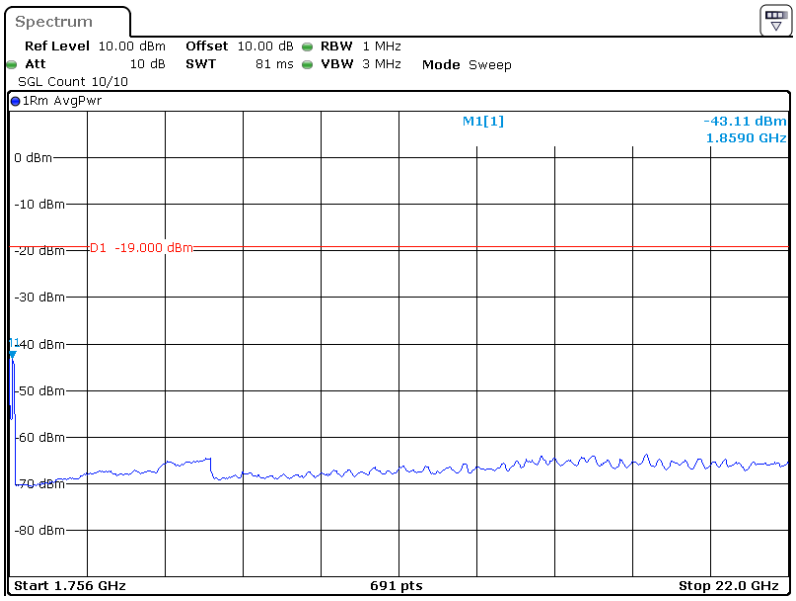

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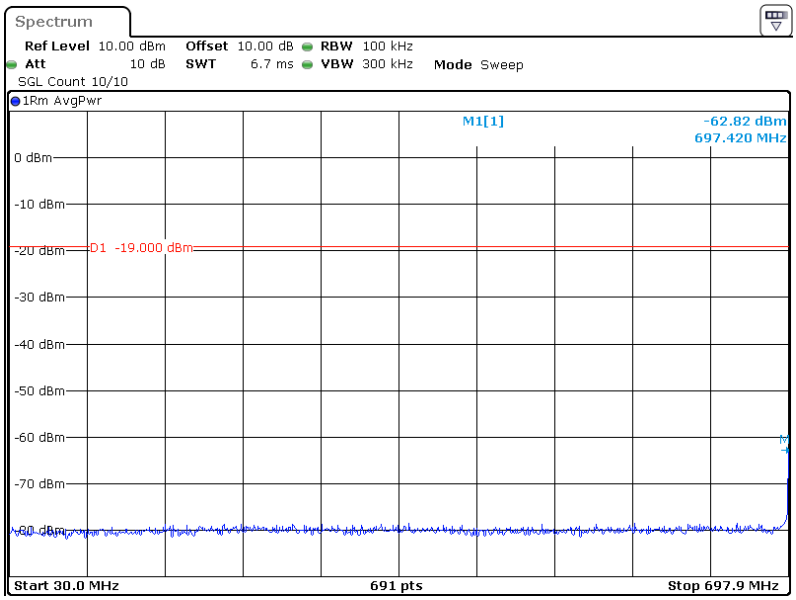
Lower 700MHz



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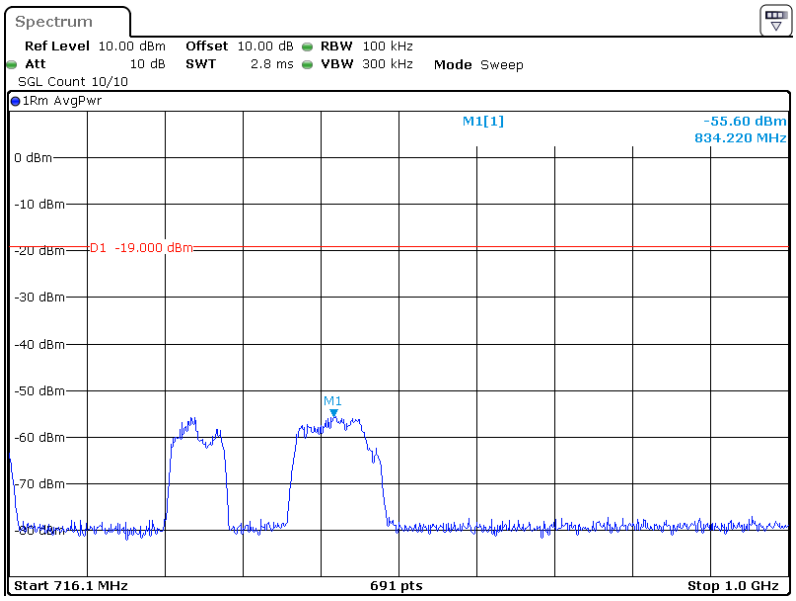

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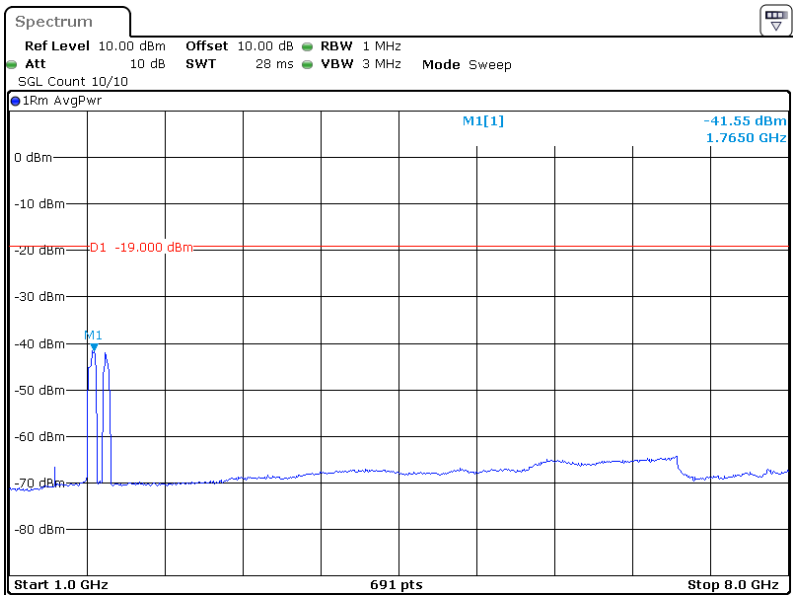

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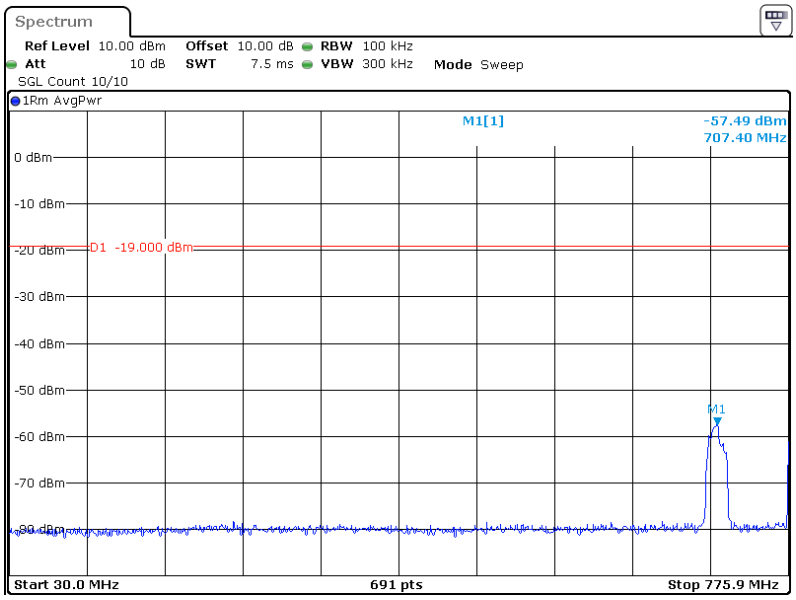
Date: 20.JAN.2024 02:32:49

Upper 700MHz



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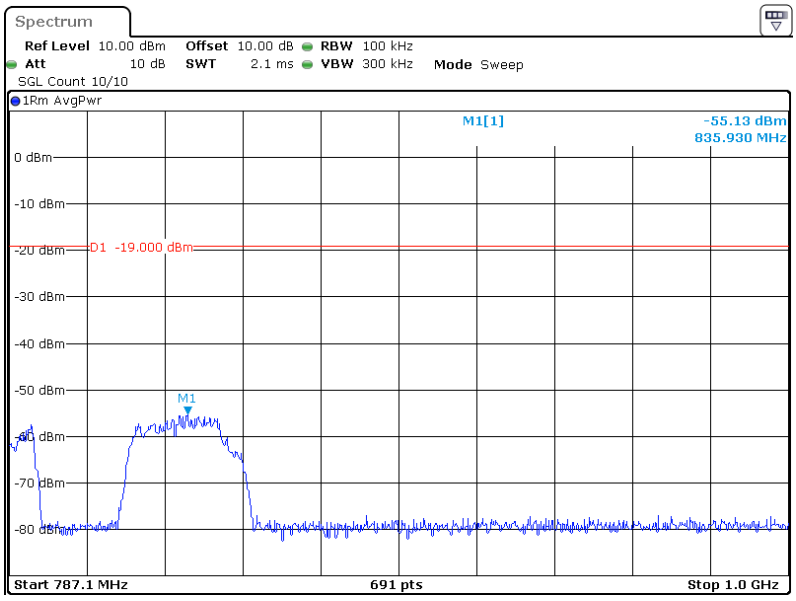

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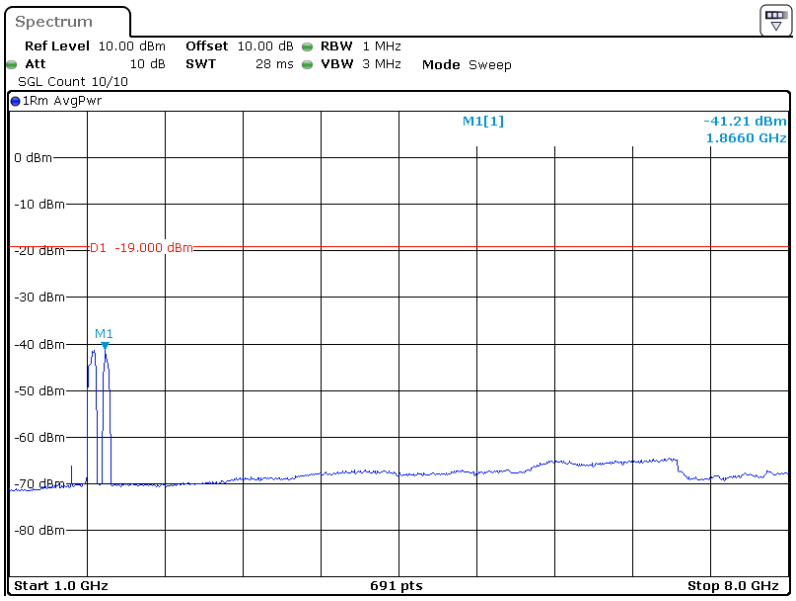
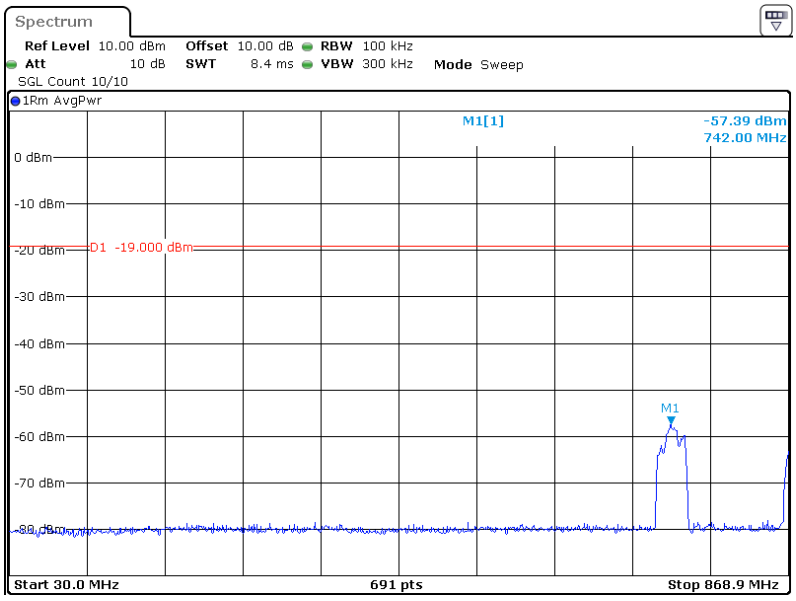


ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:33:23

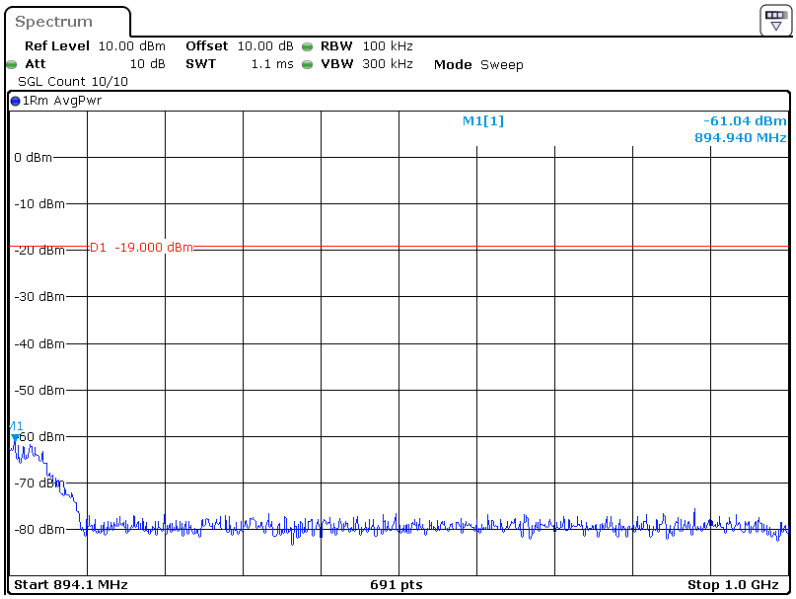
Downlink

Cellular Band



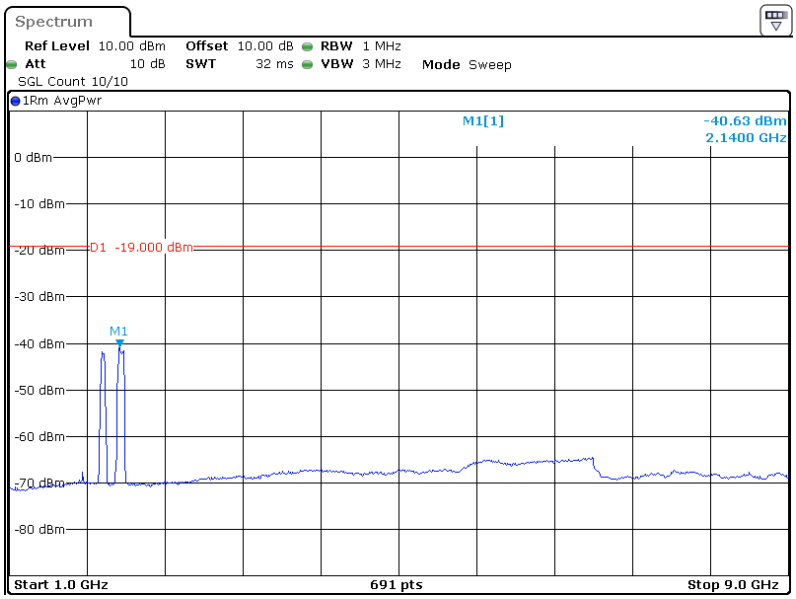
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:45:34



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

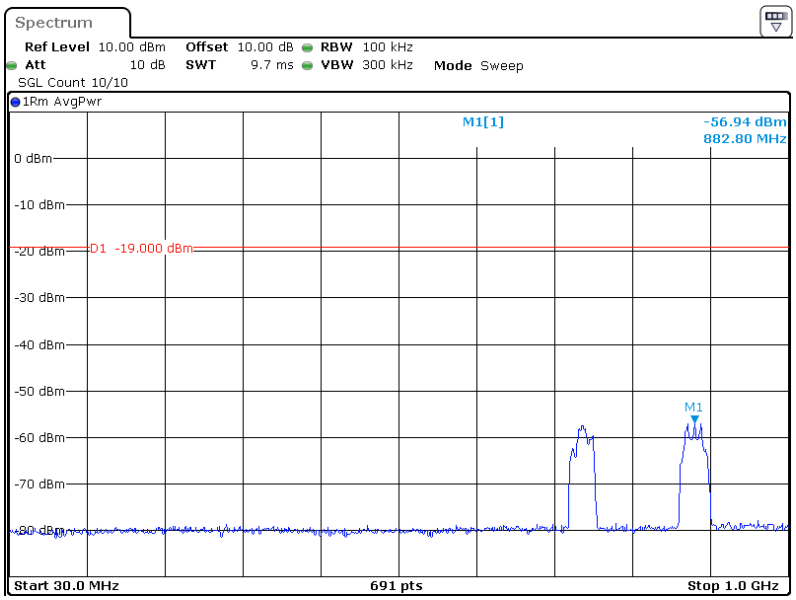
Date: 20.JAN.2024 02:45:45



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

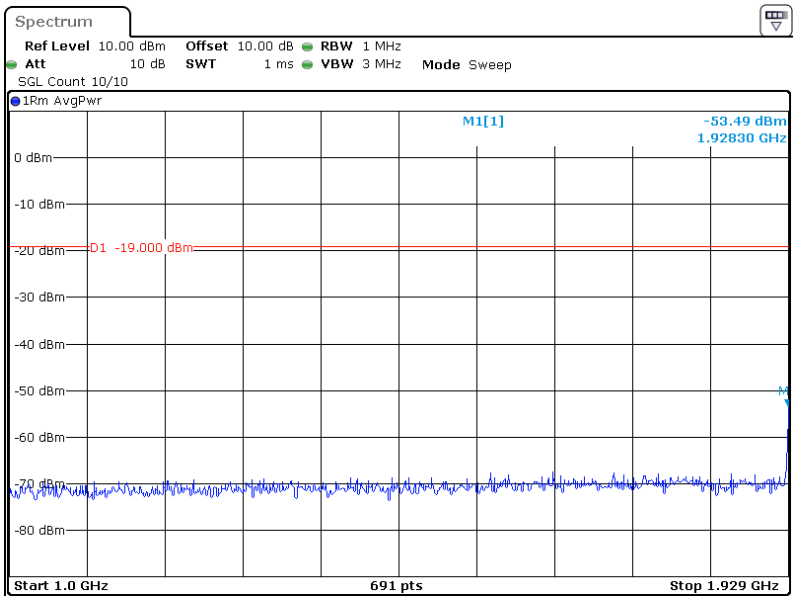
Date: 20.JAN.2024 02:45:23

PCS Band



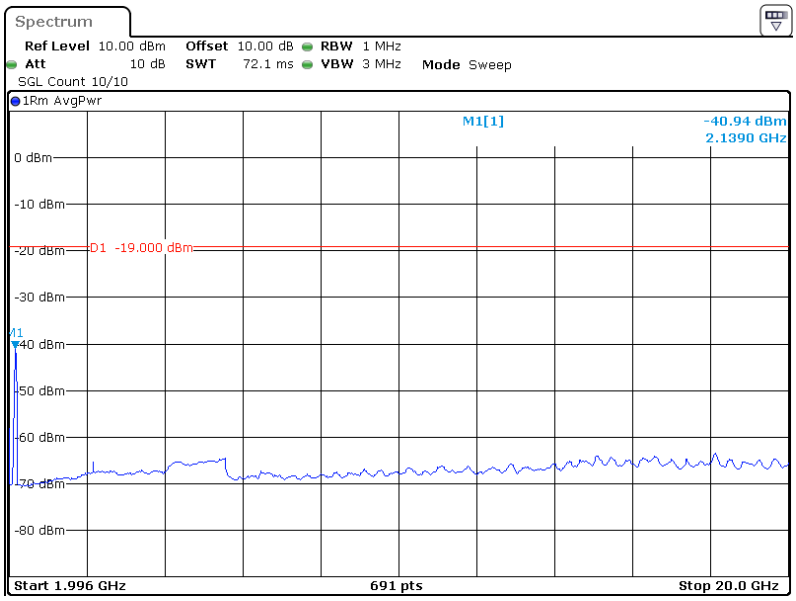
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:46:08



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

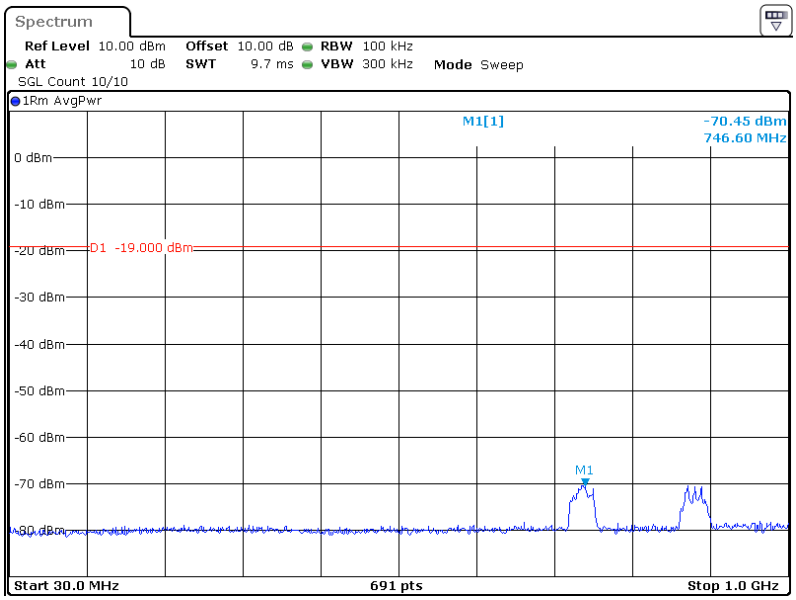
Date: 20.JAN.2024 02:45:57



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:46:21

AWS Band



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

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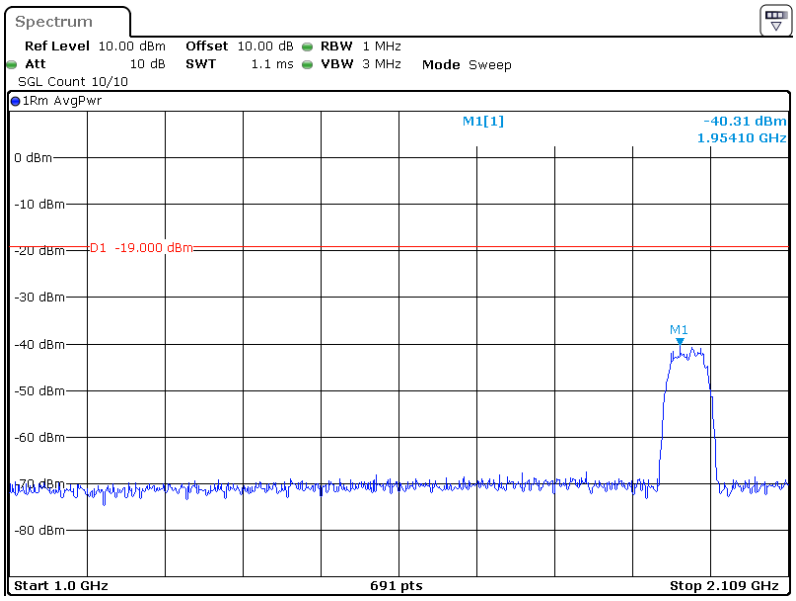

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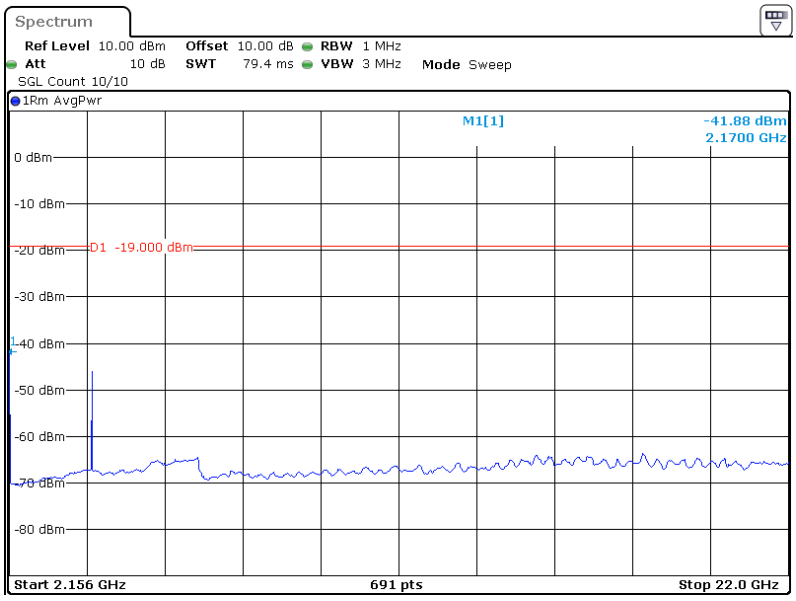

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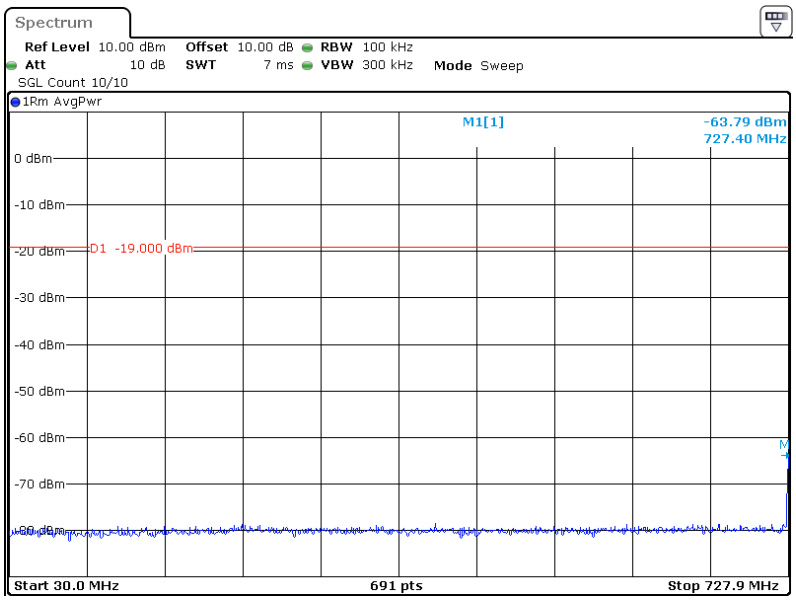
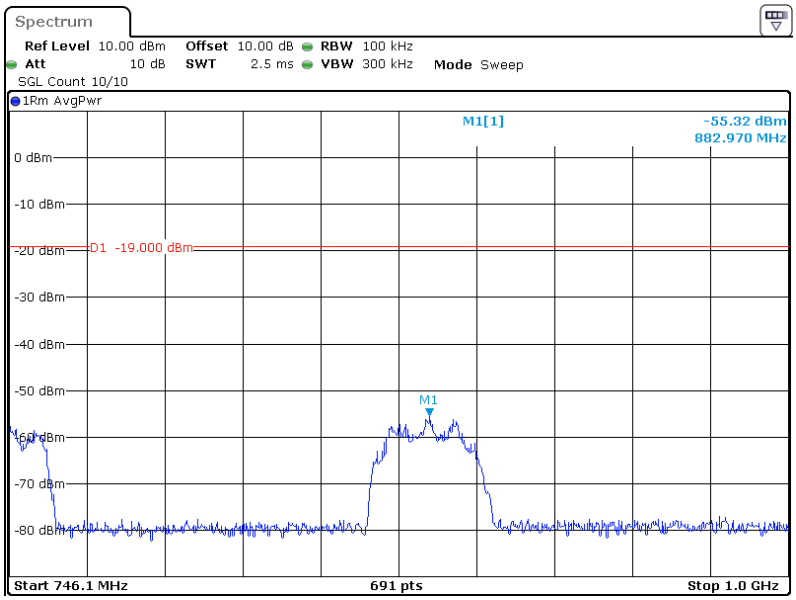
Date: 20.JAN.2024 02:46:56

Lower 700MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:44:26



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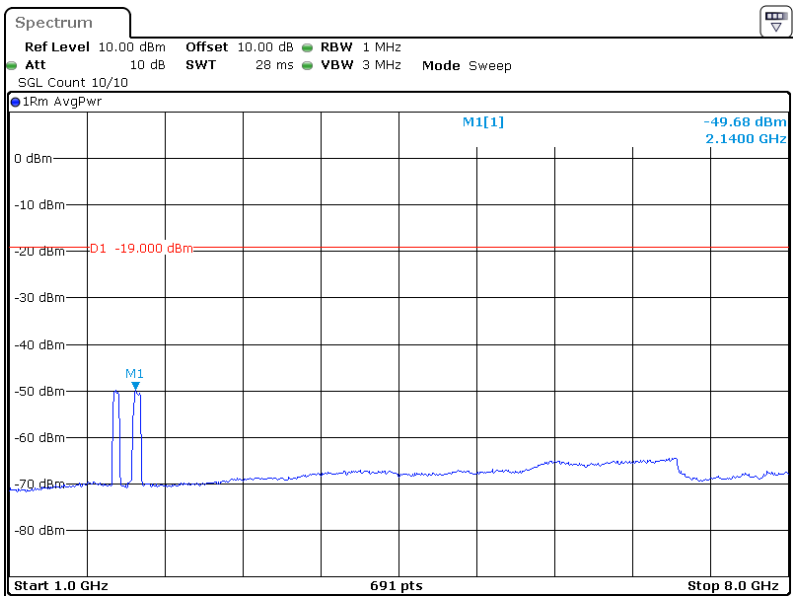
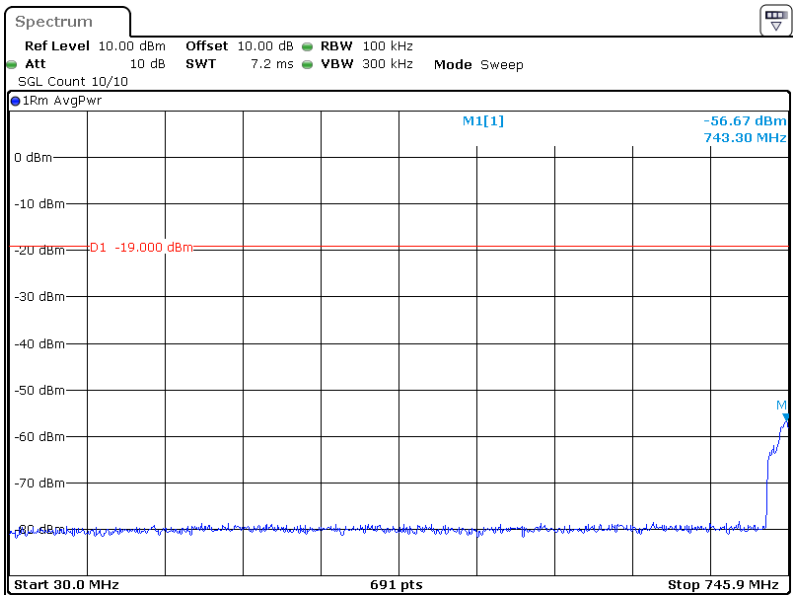


ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 02:44:15

Upper 700MHz



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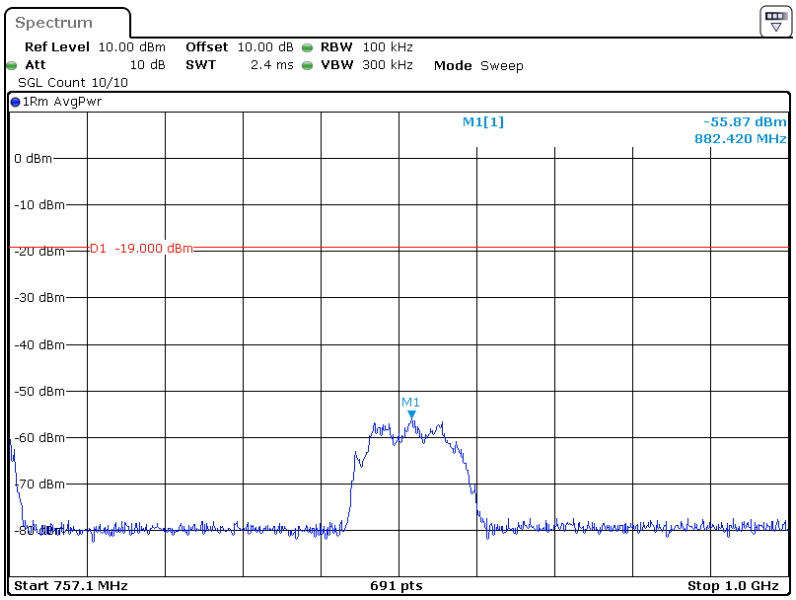
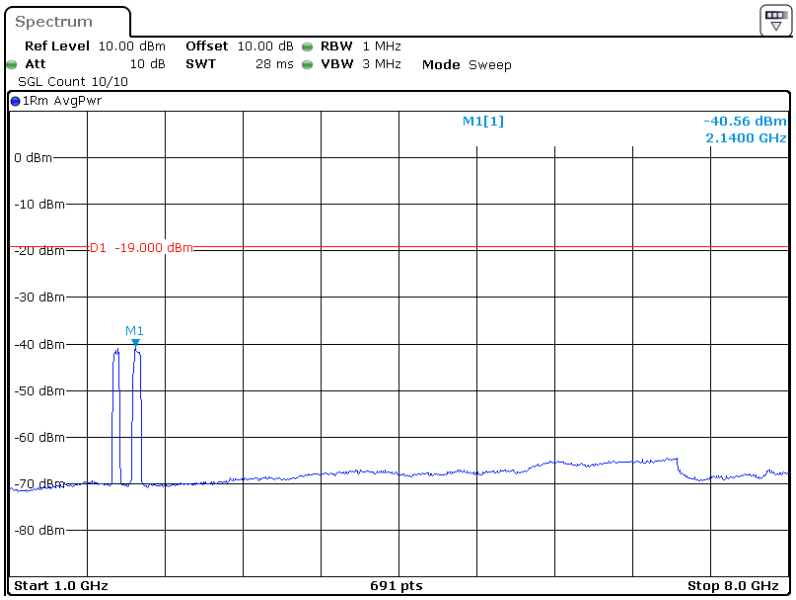


ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:45:10



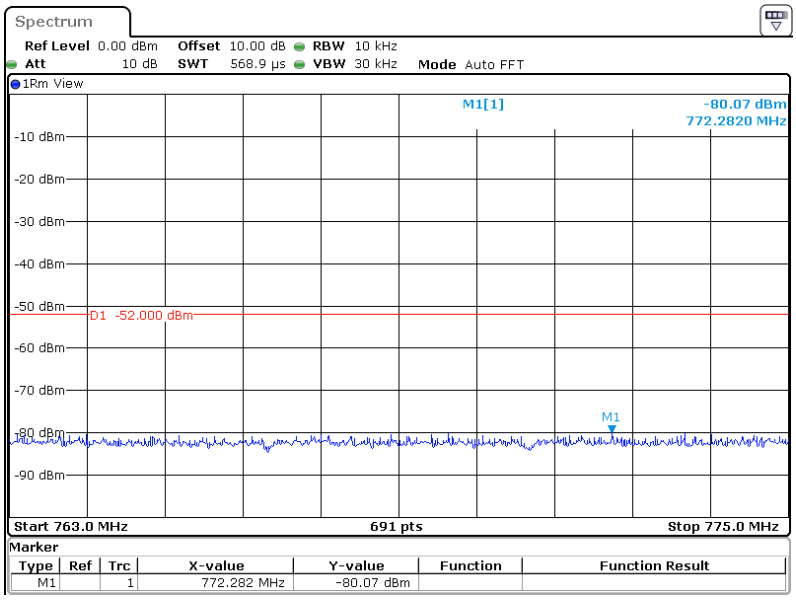
ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:44:49

Additional requirement for upper 700MHz band

Uplink

763 MHz~775 MHz



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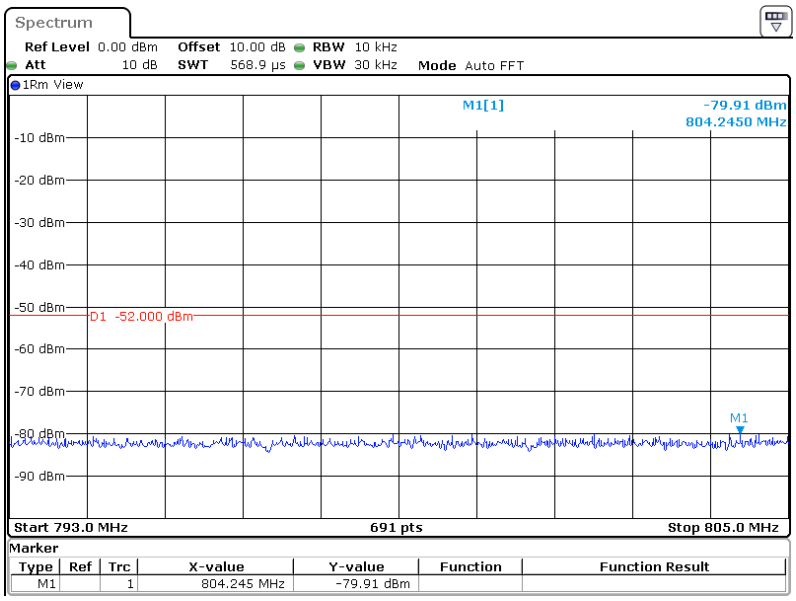
Date: 20.JAN.2024 02:50:33

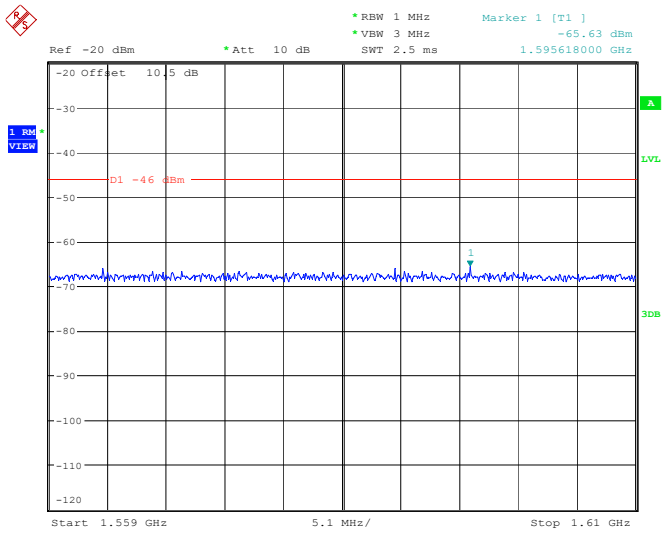
793 MHz~805 MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:50:54

1559 MHz~1610 MHz (wide band)



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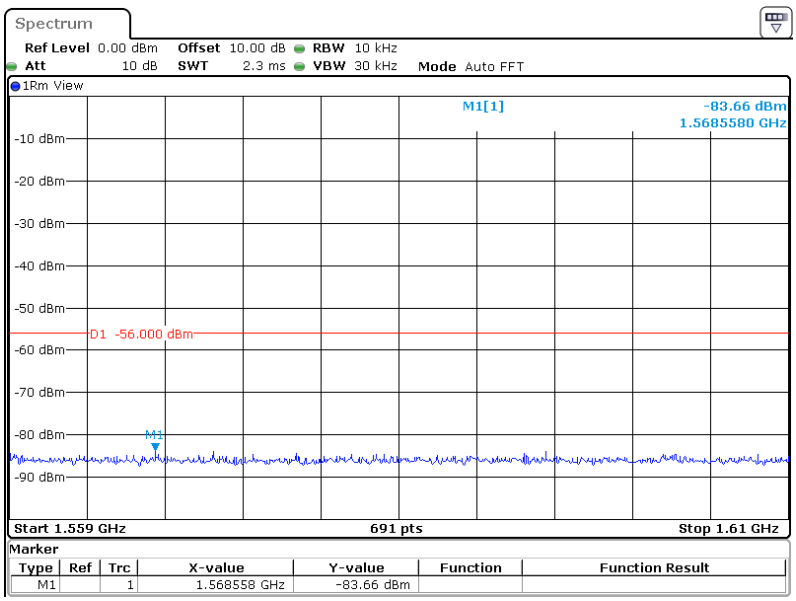
Date: 8.APR.2024 13:14:47

1559 MHz~1610 MHz (narrow band)



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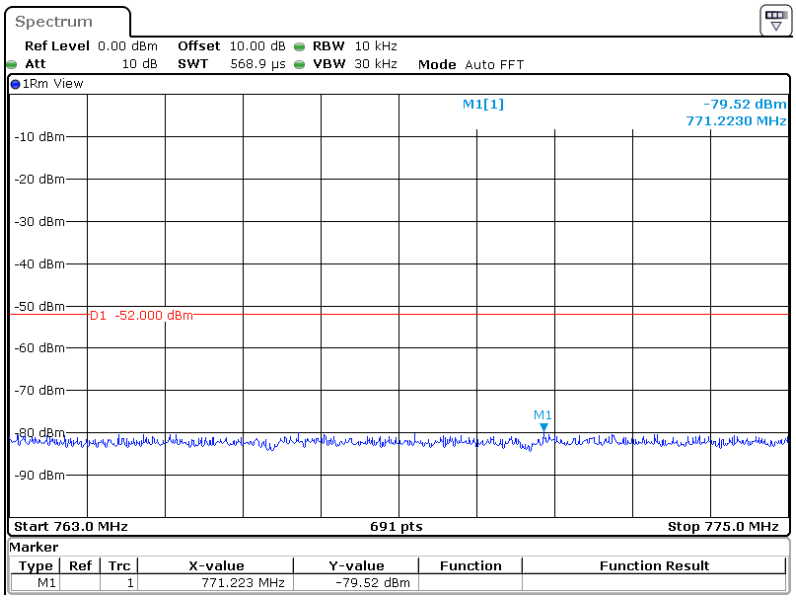
Date: 20.JAN.2024 02:51:15

Downlink

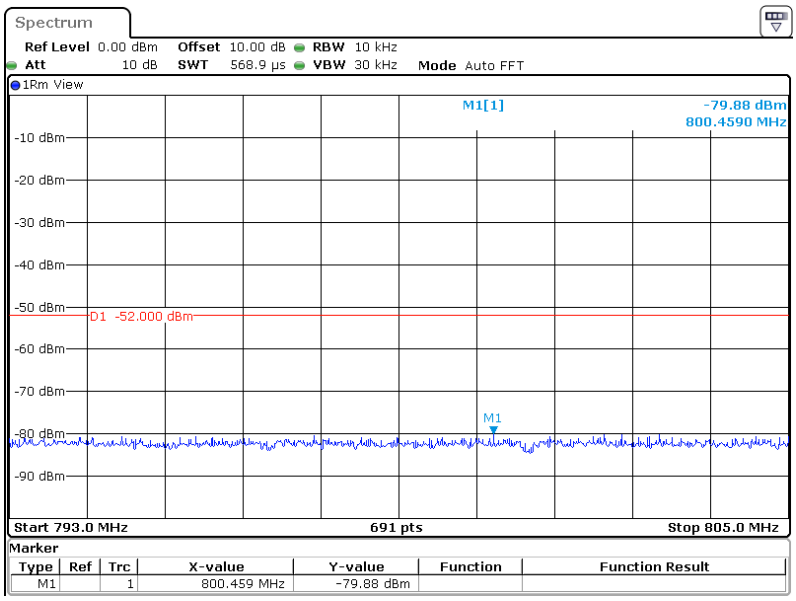
763 MHz~775 MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

Date: 20.JAN.2024 02:49:08

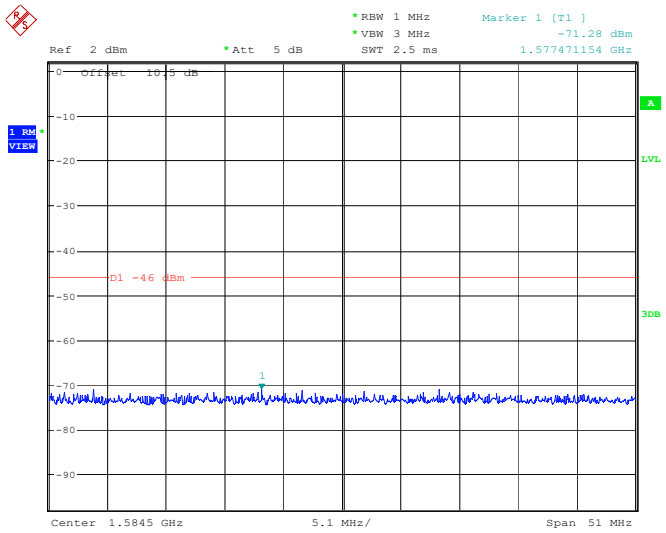
793 MHz~805 MHz



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin

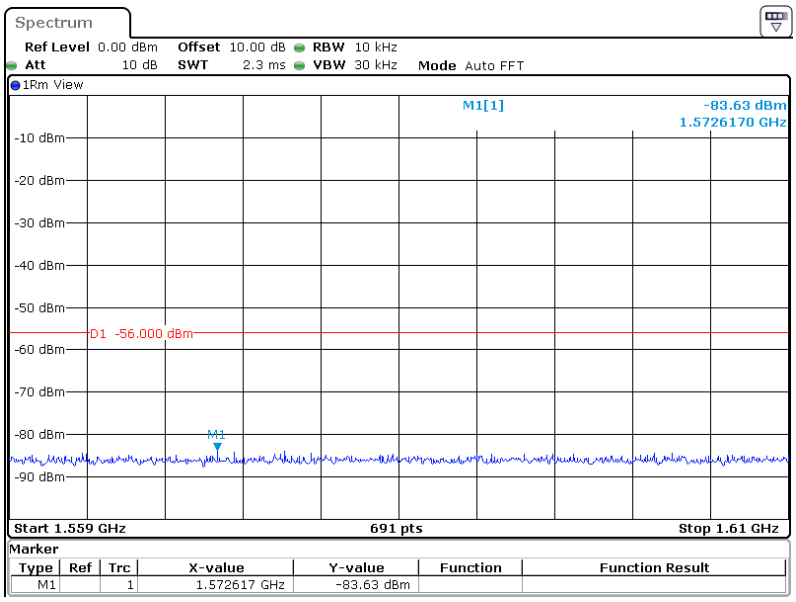
Date: 20.JAN.2024 02:49:29

1559 MHz~1610 MHz (wide band)



ProjectNo.: SZ1231227-78770E Tester:Bruce Lin
Date: 28.MAR.2024 23:02:14

1559 MHz~1610 MHz (narrow band)



ProjectNo.:SZ1231227-78770E Tester:Bruce Lin
Date: 20.JAN.2024 02:49:50

§ 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).

a) Place the EUT on an OATS or semi-anechoic chamber turntable 3 m from the receiving antenna. [12]
b) Connect the EUT to the test equipment as shown in **Figure 10** beginning with the uplink output.
c) 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.
d) 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.
e) 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.
f) Repeat 7.12c) through 7.12e) for all operational bands.

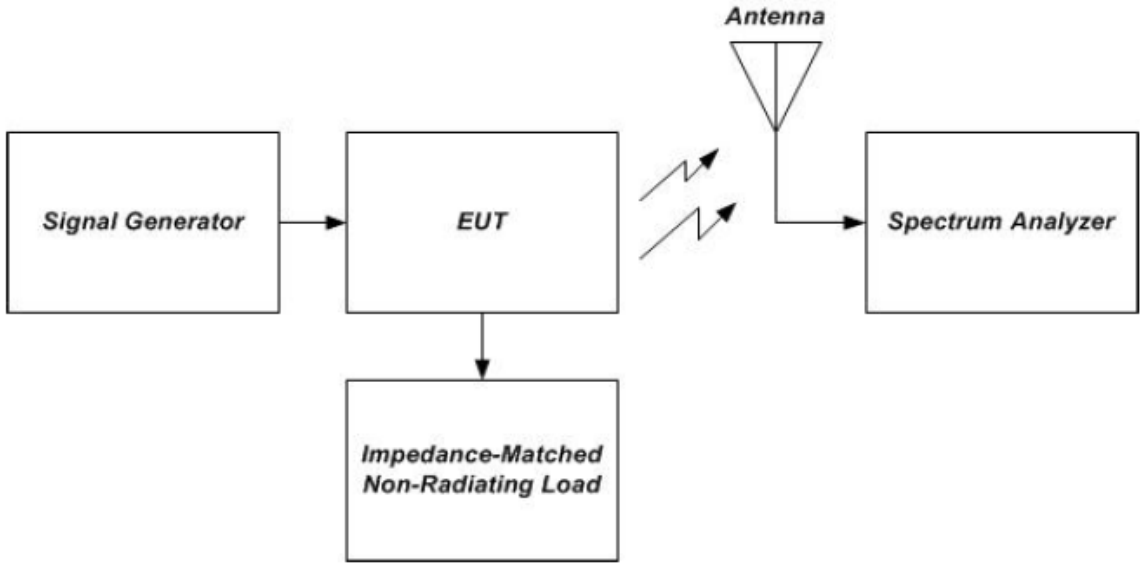


Figure 10 – Radiated spurious emissions test instrumentation setup

Test Data

Environmental Conditions

Temperature:	25.1~30 ℃
Relative Humidity:	51~52%
ATM Pressure:	101.0 kPa

The testing was performed by Anson Su on 2024-01-19 for below 1GHz and Tyler Wu 2024-01-21 for above 1GHz

Test Result: Pass

Please refer to following table.

Test Mode: Transmitting

Uplink

Frequency (MHz)	Receiver Reading (dBuV)	Polar (H/V)	Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			SG Level (dBm)	Cable loss(dB)	Antenna Gain(dB)			
Cellular Band, Test Frequency 836.5MHz								
953.4	36.06	H	-60.4	1.36	0.0	-61.76	-19	42.76
953.4	35.22	V	-58.8	1.36	0.0	-60.16	-19	41.16
1673.00	50.21	H	-57.4	0.90	8.60	-49.70	-19	30.70
1673.00	51.16	V	-57.0	0.90	8.60	-49.30	-19	30.30
PCS Band, Test Frequency 1882.5MHz								
958.0	36.37	H	-60.1	1.36	0.0	-61.46	-19	42.46
958.0	35.46	V	-58.6	1.36	0.0	-59.96	-19	40.96
3765.00	46.36	H	-58.8	1.30	10.70	-49.40	-19	30.40
3765.00	47.01	V	-58.1	1.30	10.70	-48.70	-19	29.70
AWS Band, Test Frequency 1732.5MHz								
954.7	37.15	H	-59.4	1.36	0.0	-60.76	-19	41.76
954.7	36.06	V	-58.0	1.36	0.0	-59.36	-19	40.36
3465.00	47.02	H	-58.9	1.30	10.50	-49.70	-19	30.70
3465.00	46.63	V	-59.0	1.30	10.50	-49.80	-19	30.80
Lower 700MHz, Test Frequency 707MHz								
954.1	36.87	H	-59.6	1.36	0.0	-60.96	-19	41.96
954.1	36.75	V	-57.3	1.36	0.0	-58.66	-19	39.66
1414.00	45.45	H	-62.3	0.80	7.90	-55.20	-19	36.20
1414.00	45.67	V	-62.7	0.80	7.90	-55.60	-19	36.60
Upper 700MHz, Test Frequency 781.5MHz								
955.2	36.47	H	-60.0	1.36	0.0	-61.36	-19	42.36
955.2	35.65	V	-58.4	1.36	0.0	-59.76	-19	40.76
1563.00	45.89	H	-61.8	0.90	8.60	-54.10	-46	8.10
1563.00	46.34	V	-61.9	0.90	8.60	-54.20	-46	8.20

Downlink

Frequency (MHz)	Receiver Reading (dBuV)	Polar (H/V)	Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			SG Level (dBm)	Cable loss(dB)	Antenna Gain(dB)			
Cellular Band, Test Frequency 836.5MHz								
956.8	37.31	H	-59.2	1.36	0.0	-60.56	-19	41.56
956.8	36.24	V	-57.8	1.36	0.0	-59.16	-19	40.16
1763.00	46.27	H	-61.2	0.90	8.40	-53.70	-19	34.70
1763.00	46.51	V	-61.6	0.90	8.40	-54.10	-19	35.10
PCS Band, Test Frequency 1882.5MHz								
953.7	36.61	H	-59.9	1.36	0.0	-61.26	-19	42.26
953.7	35.89	V	-58.2	1.36	0.0	-59.56	-19	40.56
3925.00	46.79	H	-58.1	1.40	10.30	-49.20	-19	30.20
3925.00	46.55	V	-58.3	1.40	10.30	-49.40	-19	30.40
AWS Band, Test Frequency 1732.5MHz								
956.1	37.65	H	-58.9	1.36	0.0	-60.26	-19	41.26
956.1	36.54	V	-57.5	1.36	0.0	-58.86	-19	39.86
4265.00	46.81	H	-57.5	1.40	10.90	-48.00	-19	29.00
4265.00	46.73	V	-57.4	1.40	10.90	-47.90	-19	28.90
Lower 700MHz, Test Frequency 707MHz								
956.0	37.04	H	-59.5	1.36	0.0	-60.86	-19	41.86
956.0	36.95	V	-57.1	1.36	0.0	-58.46	-19	39.46
1474.00	46.41	H	-61.3	0.90	8.50	-53.70	-19	34.70
1474.00	46.34	V	-61.9	0.90	8.50	-54.30	-19	35.30
Upper 700MHz, Test Frequency 781.5MHz								
955.1	36.25	H	-60.3	1.36	0.0	-61.66	-19	42.66
955.1	35.31	V	-58.7	1.36	0.0	-60.06	-19	41.06
1503.00	48.13	H	-59.6	0.90	8.50	-52.00	-19	33.00
1503.00	49.56	V	-58.7	0.90	8.50	-51.10	-19	32.10

Note:
Absolute Level = SG Level –Cable loss + Antenna Gain
Margin = Limit - Absolute Level
Other emission which was more than 20dB below limit was not recorded.

EUT PHOTOGRAPHS

Please refer to the attachment SZ1231227-78770E-RF External photo and SZ1231227-78770E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment SZ1231227-78770E-RF Test Setup photo.

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