



SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch

Report No.: SZCR210302000603

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TEST REPORT

Application No.:	SZCR2103020006AT
Applicant:	Sunwave Communications Co., Ltd.
Address of Applicant:	Sunwave Building 581 Huoju Avenue, Binjiang District, Hangzhou, P.R. China Zip: 310053
Manufacturer / Factory:	Sunwave Communications Co., Ltd.
Address of Manufacturer / Factory:	Sunwave Building 581 Huoju Avenue, Binjiang District, Hangzhou, P.R. China Zip: 310053
Product Name:	Remote unit
Product Description:	The RU conducts digital-analog conversion and power amplification of the input signals.
Model No.:	R222
Trade Mark:	CROSSFIRE, SUNWAVE
FCC ID:	2AEJ4R2220708
Standards:	47 CFR Part 2 47 CFR Part 20 47 CFR Part 90
Date of Receipt:	2020-09-21
Date of Test:	2020-09-21 to 2020-10-31
Date of Issue:	2021-04-25
Test Result :	Pass*

* In the configuration tested, the EUT detailed in this report complied with the standards specified above. Please refer to section 3 of this report for further details.

This report supersedes our previous report SZCR210302000601, issued on 2021-04-01, which is hereby deemed null and void.

Keny Xu

Keny Xu
EMC Laboratory Manager



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2 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2021-04-01		Original
02		2021-04-25		Update Model No.

Authorized for issue by:			
			
		Edison Li /Project Engineer	
			
		Eric Fu /Reviewer	



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3 Test Summary

758MHz to 775MHz			
Test Item	Test Requirement	Test Method	Result
Input/output power and amplifier/booster gain	47 CFR Part 90.219(e)(1)	KDB 935210 D05 v01r04	PASS
Conducted Spurious Emissions	47 CFR Part 90.219(e)(3) 47 CFR Part 90.543(c) 47 CFR Part 90.543(e)(2) 47 CFR Part 90.543(e)(3) 47 CFR Part 90.543(f)	KDB 935210 D05 v01r04	PASS
out-of-band/out-of-block (including intermodulation)	47 CFR Part 90.219(e)(3) 47 CFR Part 90.543(c) 47 CFR Part 90.543(e)(2) 47 CFR Part 90.543(e)(3) 47 CFR Part 90.543(f)	KDB 935210 D05 v01r04	PASS
Radiated Spurious Emissions	47 CFR Part 90.219(e)(3) 47 CFR Part 90.543(c) 47 CFR Part 90.543(e)(2) 47 CFR Part 90.543(e)(3) 47 CFR Part 90.543(f)	KDB 935210 D05 v01r04	PASS
Input-versus-output signal comparison	47 CFR Part 90.210 47 CFR Part 90.219(e)(4)	KDB 935210 D05 v01r04	PASS
Frequency Stability	47 CFR Part 90.539	KDB 935210 D05 v01r04	PASS
Out-of-band rejection	/	KDB 935210 D05 v01r04	PASS
Noise	47 CFR Part 2.1051 47 CFR Part 90.219(d)(6)	KDB 935210 D05 v01r04	PASS
Remark: EUT: In this whole report EUT means Equipment Under Test. Tx: In this whole report Tx (or tx) means Transmitter. Rx: In this whole report Rx (or rx) means Receiver. This is a DAS, no need to implement uplink test as it is cable connect to BTS (No air radiation), then the test about Uplink would be ignored.			





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Test method standard:

ANSI C63.26-2015

KDB 935210 D05 Indus Booster Basic Meas v01r04

851MHz to 869MHz			
Test Item	Test Requirement	Test Method	Result
Input/output power and amplifier/booster gain	47 CFR Part 90.635	KDB 935210 D05 v01r04	PASS
Conducted Spurious Emissions	47 CFR Part 90.691	KDB 935210 D05 v01r04	PASS
out-of-band/out-of-block (including intermodulation)	47 CFR Part 90.691	KDB 935210 D05 v01r04	PASS
Radiated Spurious Emissions	47 CFR Part 90.691	KDB 935210 D05 v01r04	PASS
Input-versus-output signal comparison	47 CFR Part 2.1049	KDB 935210 D05 v01r04	PASS
Frequency Stability	47 CFR Part 90.213	KDB 935210 D05 v01r04	PASS
Out-of-band rejection	/	KDB 935210 D05 v01r04	PASS
Remark: EUT: In this whole report EUT means Equipment Under Test. Tx: In this whole report Tx (or tx) means Transmitter. Rx: In this whole report Rx (or rx) means Receiver.			
This is a DAS, no need to implement uplink test as it is cable connect to BTS (No air radiation), then the test about Uplink would be ignored.			
Test method standard: ANSI C63.26-2015 KDB 935210 D05 Indus Booster Basic Meas v01r04			



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5 General Information

5.1 Client Information

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Manufacturer: Sunwave Communications Co., Ltd.
Address of Manufacturer: Sunwave Building 581 Huoju Avenue, Binjiang District, Hangzhou, P.R.China Zip: 310053
Factory: Sunwave Communications Co., Ltd.
Address of Factory: Sunwave Building 581 Huoju Avenue, Binjiang District, Hangzhou, P.R.China Zip: 310053

5.2 General Description of E.U.T.

Product Name: Remote unit
Model No.: R222
Trade Mark: CROSSFIRE, SUNWAVE
Sample Type: Fixed production
Class Type: B
Antenna Gain: 0dBi
Antenna No. 1(1T1R)
Power Supply: AC120V 60Hz
Optical Fiber: 200cm (unshielded)
AC Cable: 120cm (unshielded)
RF Cable: 200cm (shielded)

5.3 Details of E.U.T.

Type of Modulation CQPSK/12.5kHz FM/TETRA in 758MHz to 775MHz
CQPSK/12.5kHz FM/TETRA in 851MHz to 869MHz
Frequency Band: Downlink 758MHz to 775MHz
(The frequency bands 768MHz-775MHz for public safety services)
Downlink 851MHz to 869MHz
Normal Output Power: 37dBm (downlink)
System Gain: 47dB
Power Control Method: ALC

5.4 Standards Applicable for Testing

The standards used were 47 CFR Part 2, 47 CFR Part 20, 47 CFR Part 90.



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5.5 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.25 x 10 ⁻⁸
2	Occupied Bandwidth	3%
3	RF conducted power	0.75dB
4	Conducted Spurious emissions	0.75dB
5	RF Radiated power	4.5dB (below 1GHz)
		4.8dB (above 1GHz)
6	Radiated Spurious emission test	4.5dB (30MHz-1GHz)
		4.8dB (1GHz-18GHz)
7	Temperature test	1°C
8	Humidity test	3%
9	Supply voltages	1.5%
10	Time	3%





5.6 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China.
518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

5.7 Other Information Requested by the Customer

None.

5.8 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

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IC#: 4620C.



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6 Equipment Used during Test

RE in Chamber						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date	Cal. Due date
1	3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2020-05-10	2021-05-09
2	EXA Spectrum Analyzer	Agilent Technologies Inc	N9010A	SEM004-09	2020-07-19	2021-07-18
3	Log Antenna (26-3000MHz)	ETS-Lindgren	3142C	SEM003-02	2017-11-15	2020-11-14
4	Amplifier (0.1-1300MHz)	HP	8447D	SEM005-02	2019-10-09	2020-10-08
					2020-10-09	2021-10-08
5	Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018-06-14	2021-06-13
76	Horn Antenna (18-26GHz)	ETS-Lindgren	3160	SEM003-12	2017-11-24	2020-11-23
7	Horn Antenna (26GHz-40GHz)	A.H.Systems, inc.	SAS-573	SEM003-13	2018-02-12	2021-02-11
8	Low Noise Amplifier	Black Diamond Series	BDLNA-0118-352810	SEM005-05	2019-10-09	2020-10-08
					2020-10-09	2021-10-08
9	Band filter	Amindeon	Asi 3314	SEM023-01	N/A	N/A
10	Coaxial Cable	SGS	N/A	SEM026-01	2020-07-13	2021-07-12

RE in Chamber						
Item	Test Equipment	Manufacturer	Model No.	Inventory No	Cal. Date	Cal. Due date
1	10m Semi-Anechoic Chamber	SAEMC	FSAC1018	SEM001-03	2020-05-10	2021-05-09
2	EMI Test Receiver (9k-7GHz)	Rohde & Schwarz	ESR	SEM004-03	2020-04-25	2021-04-24
3	log-Broadband Antenna(30M-1GHz)	Schwarzbeck	VULB9168	SEM003-18	2019-06-29	2022-06-28
4	Pre-amplifier	Sonoma Instrument Co	310N	SEM005-03	2020-06-05	2021-06-04
5	Loop Antenna	ETS-Lindgren	6502	SEM003-08	2018-08-14	2021-08-13
6	Coaxial Cable	SGS	N/A	SEM029-01	2020-07-13	2021-07-12



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RF connected test						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date	Cal. Due date
1	EXG Analog Signal Generator	KEYSIGHT	N5171B	SEM006-04	2020-08-27	2021-08-26
2	ESG vector signal generator	Agilent Technologies	E4438C	SEM006-03	2020-07-19	2021-07-18
					2020-07-19	2021-07-18
3	Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2019-10-09	2020-10-08
					2020-10-09	2021-10-08
4	ESG Vector Signal Generator	KEYSIGHT	E4438C	MT-W520	2020-01-03	2022-01-02
5	PXA Signal Analyzer	KEYSIGHT	N9030A	MT-W521	2020-01-02	2022-01-01
6	Attenuator	HUAXIANG	10048953	MT-W504	2018-11-15	2020-11-14
7	Temperature chamber	ESPEC	EW1040	MT-X003	2019-11-03	2020-11-02
8	Noise Source	KEYSIGHT	N4001A	N/A	2019-05-08	2021-05-07



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7 Test Results

7.1 E.U.T. test conditions

Input voltage:	AC120V	
Test voltage	Normal	Test voltage
	Extreme	AC102V~AC138V
Operating Environment:		
Test Temperature:	Normal	22°C ~26°C
	Extreme	-40~50°C
Humidity:	46%~56% RH	
Atmospheric Pressure:	990~1005mbar	
Test Requirement:	The RF output power of the EUT was measured at the antenna port, by adjusting the input power of signal generator to drive the EUT to get to maximum output power point and keep the EUT at maximum gain setting for all tests. The device should be tested on downlink. For detail test Modulation and Frequency, please refer to 7.2.	

Remark:

The PS-R222030708 system working principle: the RF signal coupled from BTS is transferred into optical signal, and then transmitted via a fiber to remote unit. The remote re-transfers the optical signal back to RF signal, through the frequency translation and after power amplifiers, can extend the BTS coverage to another desired area; the PS-R222030708 system is compliant with the description about distributed antenna system in ISD rules, So **the Equipment belongs to the remote unit.**





7.2 Test Procedure & Measurement Data

7.2.1 Input/output power and amplifier/booster gain

Test Requirement:	47 CFR Part 90.219(e)(1), 47 CFR Part 90.635
Test Method:	KDB 935210 D05 Indus Booster Basic Meas v01r04
Limit:	1. The ERP limit is 5W for 768~775MHz 2. The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

EUT Operation:	
Status:	Drive the EUT to maximum output power.
Conditions:	Normal conditions
Application:	Cellular Band RF output ports
Test Configuration:	

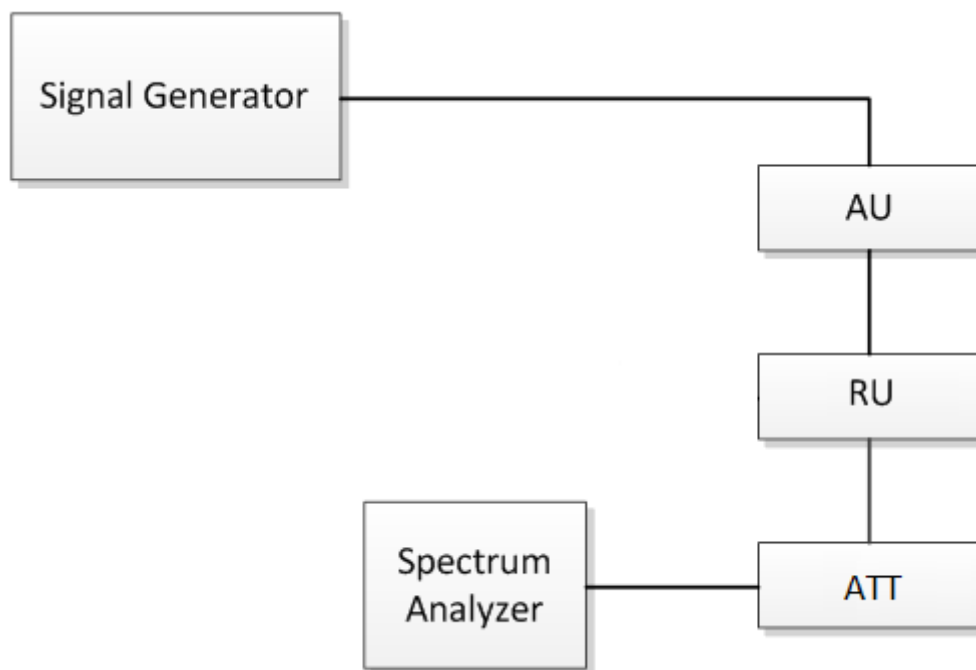


Fig.1 RF Output Power test configuration





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Test Procedure:

KDB 935210 D05 4.5

Apply the same guidance as in 3.5.2 to measure the maximum input and output power levels necessary for computing the mean EUT gain, but with the following modifications:

- a) Configure the signal generator for CW operation, instead of AWGN,
- b) Select the spectrum analyzer positive peak detector, instead of the power averaging (rms) detector,
- c) Activate the max hold function, instead of the trace averaging function,
- d) Use in conjunction with the guidance in 4.5.3.

4.5.3 Power measurement Method 1: using a spectrum or signal analyzer

- a) Set the frequency span to at least 1 MHz.
- b) Set RBW = 100 kHz.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Set the detector to PEAK, and trace mode to MAX HOLD.
- e) Place a marker on the peak of the signal, and record the value as the maximum power.
- f) Repeat step e) but with the EUT in place.
- g) EUT gain may be calculated as described in 4.5.5

4.5.5 Calculating amplifier, repeater, or industrial booster gain

NOTE—Sections 90.219 and 2.1033(c) do not require gain test data; inclusion of industrial booster gain test data in test reports submitted for FCC equipment authorization is optional.

After the input and output power levels have been measured as described in the preceding subclauses, the gain of the EUT can be determined from:

$$\text{Gain (dB)} = \text{output power (dBm)} - \text{input power (dBm)}.$$

Report the gain for each authorized operating frequency band, and each test signal stimulus.

Remark:

The system continuously monitors the input power.



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7.2.1.1 Measurement Record:

Mode	Operation Band	Frequency (MHz)	Signal Type	Signal Level (dBm)	Input Power (dBm)	Output Power (dBm)	ERP (W)	Gain (dB)
Downlink	758MHz to 775MHz	758.0125	CW	Pre-AGC	-10	36.91	2.99	46.91
				3dB Above AGC	-7	36.92	3.00	/
Downlink	758MHz to 775MHz	766.5000	CW	Pre-AGC	-10	36.95	3.02	46.95
				3dB Above AGC	-7	37.01	3.06	/
Downlink	758MHz to 775MHz	774.9875	CW	Pre-AGC	-10	36.83	2.94	46.83
				3dB Above AGC	-7	36.85	2.95	/

Note:

- 1) The nominal power is 37dBm and the measured output power which show in above table is within ± 1.0 dB tolerance
- 2) The ERP limit is 5W, the product satisfied with the limit.
- 3) ERP=Output power + Antenna Gain-2.15, Antenna Gain is 0

Mode	Operation Band	Frequency (MHz)	Signal Type	Signal Level (dBm)	Input Power (dBm)	Output Power (dBm)	ERP (W)	Gain (dB)
Downlink	851MHz to 869MHz	851.0125	CW	Pre-AGC	-10	36.98	3.04	46.98
				3dB Above AGC	-7	37.32	3.29	/
Downlink	851MHz to 869MHz	860.0000	CW	Pre-AGC	-10	36.94	3.01	46.94
				3dB Above AGC	-7	37.19	3.19	/
Downlink	851MHz to 869MHz	868.9875	CW	Pre-AGC	-10	37.22	3.21	47.22
				3dB Above AGC	-7	36.98	3.04	/

Note:

- 1) The nominal power is 37dBm and the measured output power which show in above table is within ± 1.0 dB tolerance
- 2) The ERP limit is 1000W, the product satisfied with the limit.
- 3) ERP=Output power + Antenna Gain-2.15, Antenna Gain is 0



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7.2.2 Conducted Spurious Emissions

Test Requirement: For 758-775MHz: 47 CFR Part 90.219(e)(3), 47 CFR Part 90.543(c), 47 CFR Part 90.543(e)(2), 47 CFR Part 90.543(e)(3), 47 CFR Part 90.543(f)

For 851-869MHz: 47 CFR Part 90.691

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04

Limit: For 758-775MHz:

The limit is -13 dBm in any 100 kHz measurement bandwidth

Note: Below 30MHz reduce the RBW, for 9 kHz ~ 150kHz the limit is -33dBm and 150 kHz ~ 30MHz the limit is -23dBm.

For 851-869MHz:

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

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

EUT Operation:

Status:

Drive the EUT to maximum output power.

Conditions:

Normal conditions

Application:

RF output ports

Test Configuration:



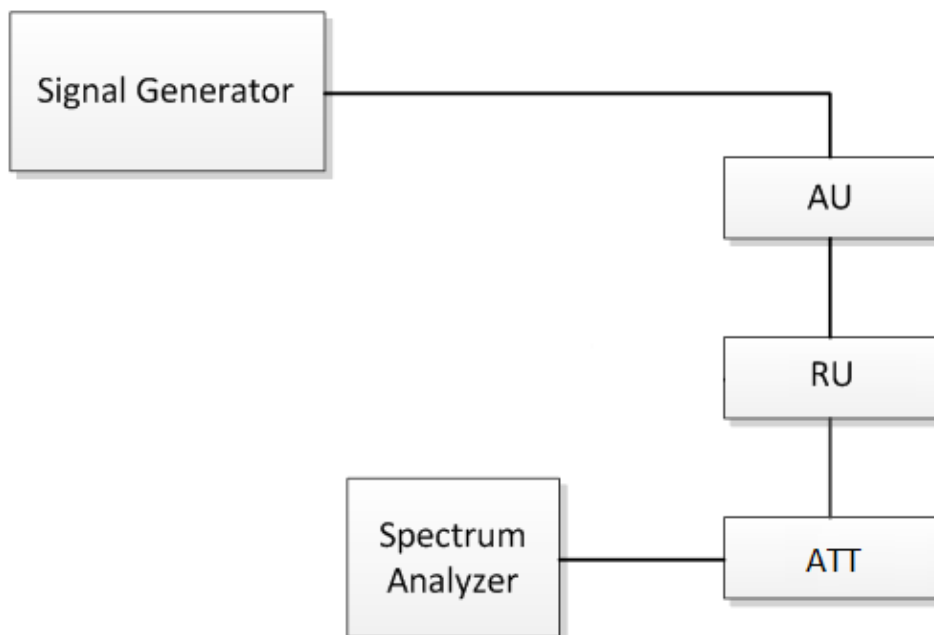


Fig.2. Conducted Spurious Emissions test configuration



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Test Procedure:

Conducted Emissions test procedure:

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle, and high channels or frequencies within each authorized frequency band of operation.

- a) Connect a signal generator to the input of the EUT.
- b) Configure the signal generator to produce a CW signal.
- c) Set the frequency of the CW signal to the center channel of the EUT passband.
- d) Set the output power level so that the resultant signal is just below the AGC threshold (see 4.2).
- e) Connect a spectrum analyzer to the output of the EUT, using appropriate attenuation as necessary.
- f) Set the RBW = 100 kHz. (i.e., for 30 MHz to 1 GHz PLMRS and/or PSRS booster devices)
- g) Set the VBW = $3 \times$ RBW.
- h) Set the Sweep time = auto-couple.
- i) Set the detector to PEAK.
- j) Set the spectrum analyzer start frequency to 30 MHz (or the lowest radio frequency signal generated in the EUT, without going below 9 kHz if the EUT has additional internal clock frequencies), and the stop frequency to $10 \times$ the highest allowable frequency of the EUT passband.
- k) Select MAX HOLD, and use the marker peak function to find the highest emission(s) outside the passband. (This could be either at a frequency lesser or greater than the passband frequencies.)
- l) Capture a plot for inclusion in the test report
- m) Repeat steps c) to l) for each authorized frequency band/block of operation



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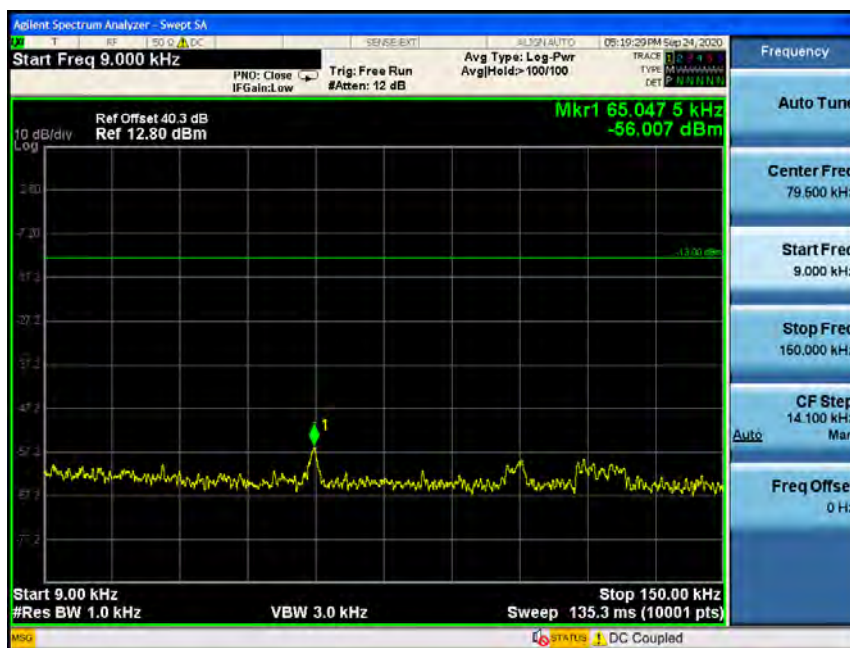
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7.2.2.1 Measurement Record:

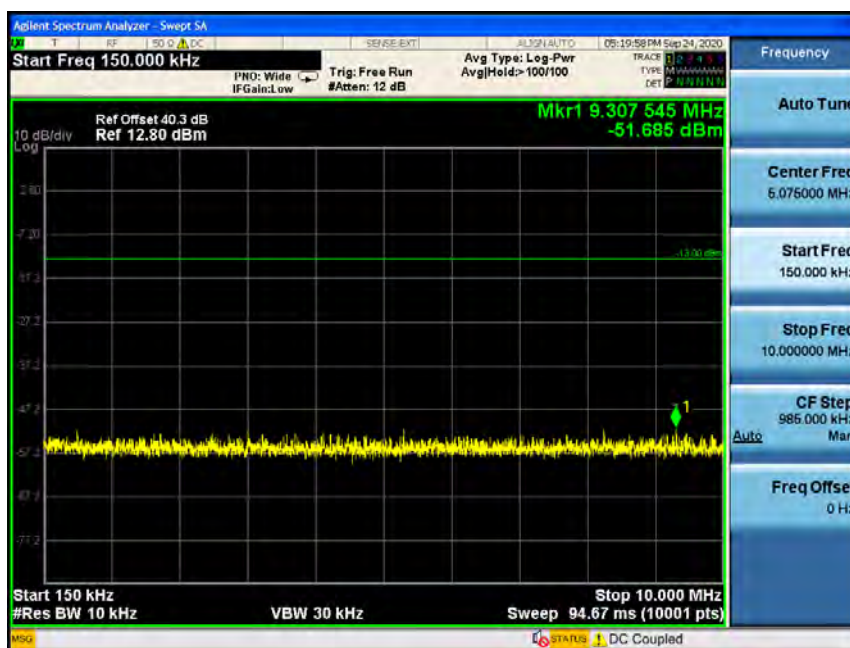
1.Downlink: 758MHz to 775MHz

1.1 lowest frequency:

9kHz to 150kHz



150kHz to 10MHz



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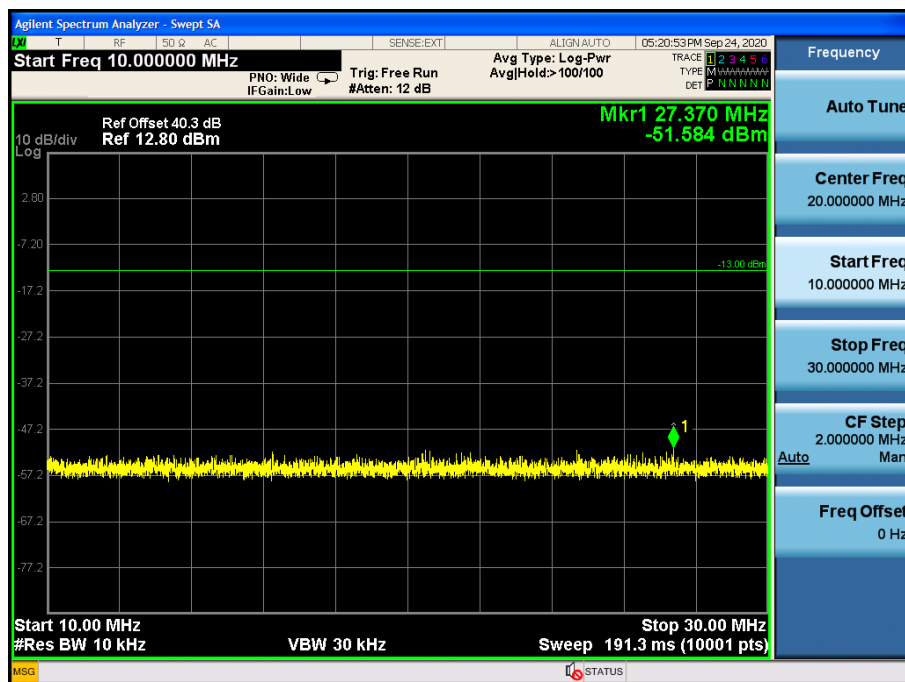
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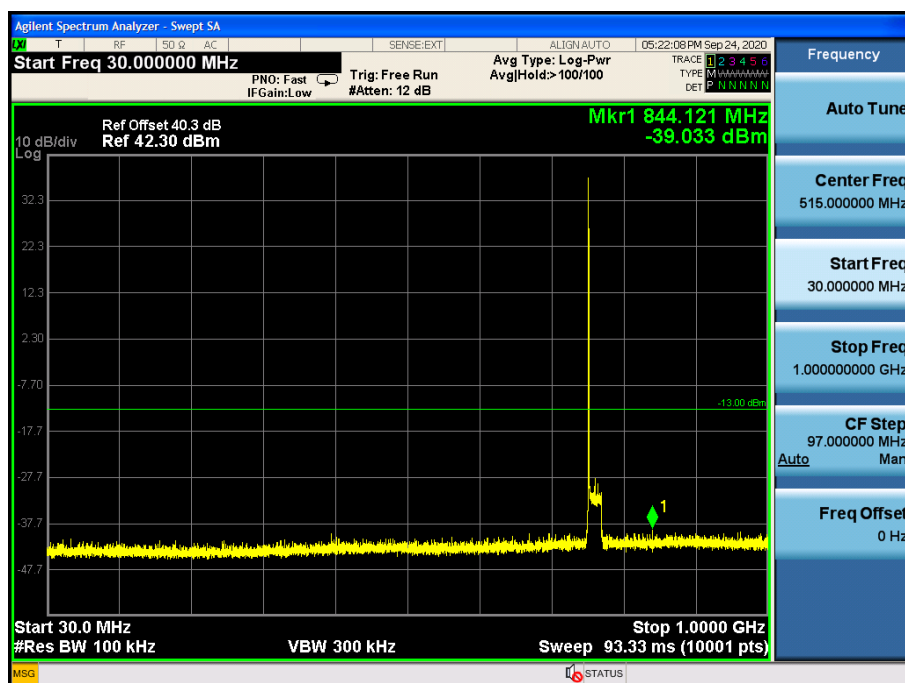
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10MHz to 30MHz



30MHz to 1GHz



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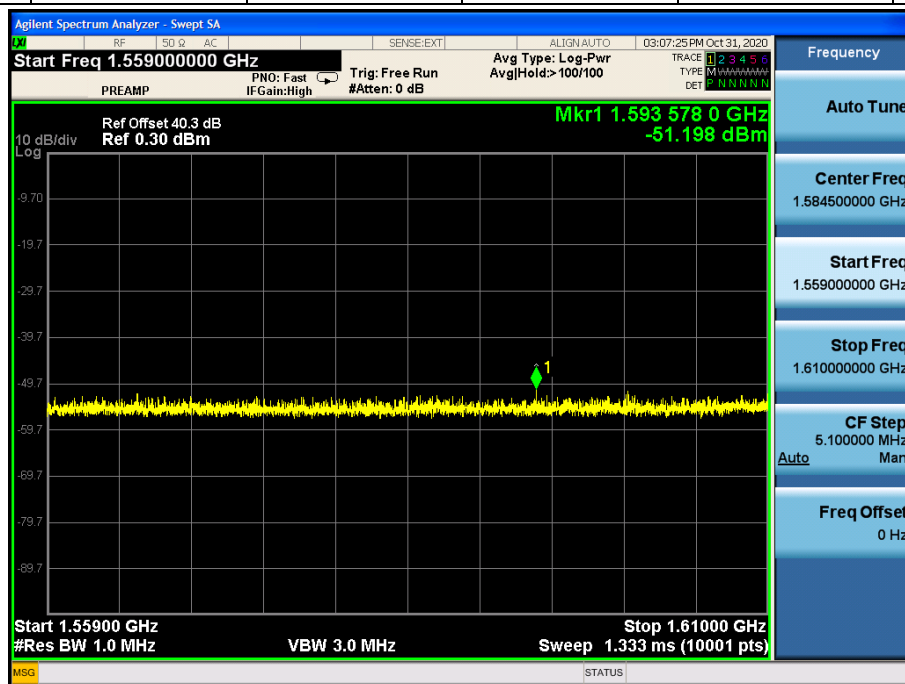
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1GHz to 9GHz



-70dBW/MHz EIRP for wideband emissions in the band 1559-1610 MHz

Frequency	Level	Antenna Gain	EIRP	Limit	Result
1559-1610	-51.2dBm	8dBi	-73.2dBW	-70dBw	Pass



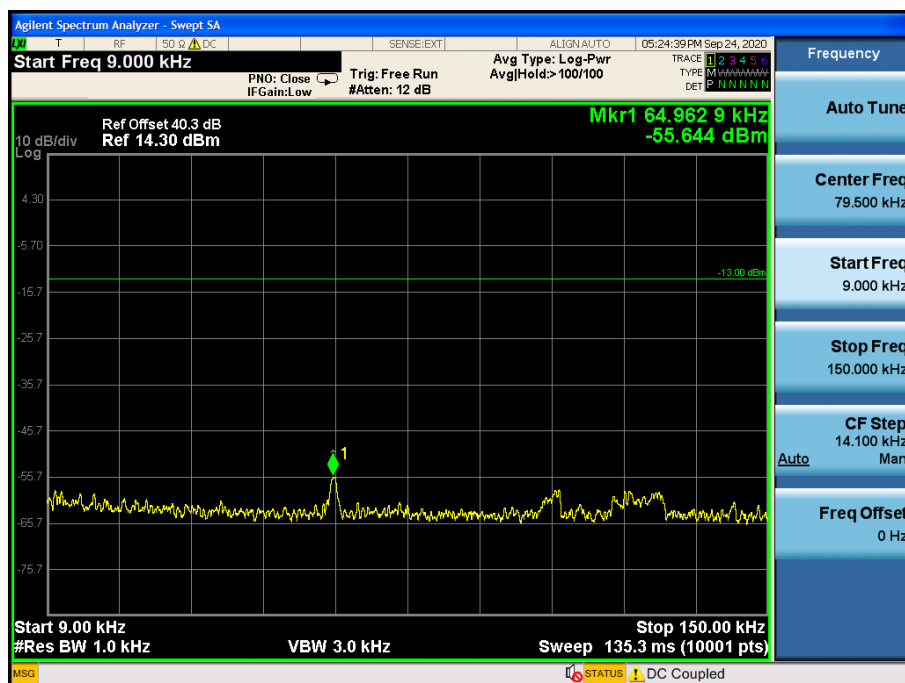
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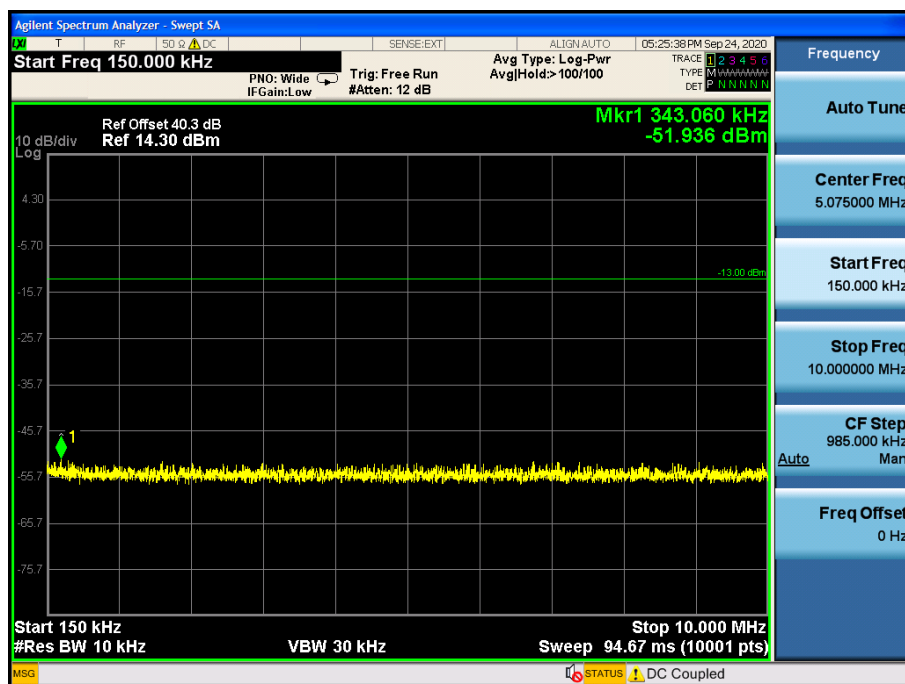
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1.2 Middle frequency 9kHz to 150kHz



150kHz to 10MHz



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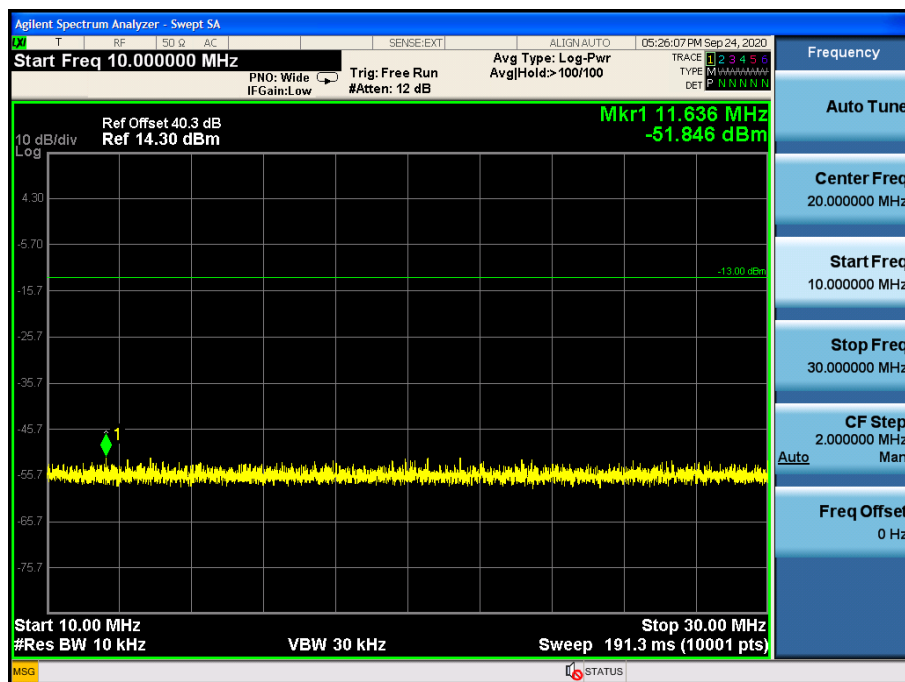
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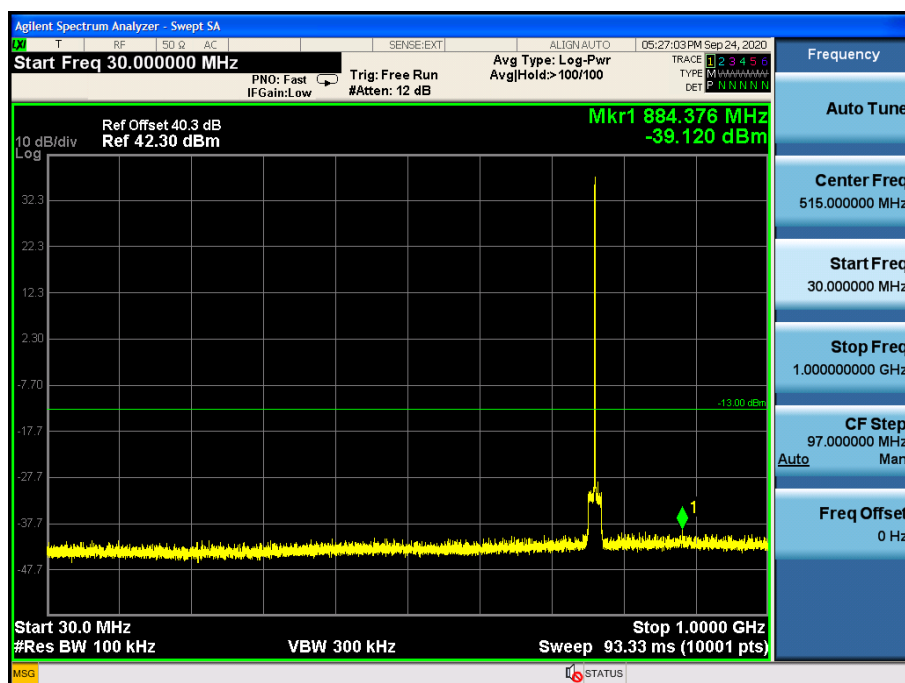
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10MHz to 30MHz



30MHz to 1GHz



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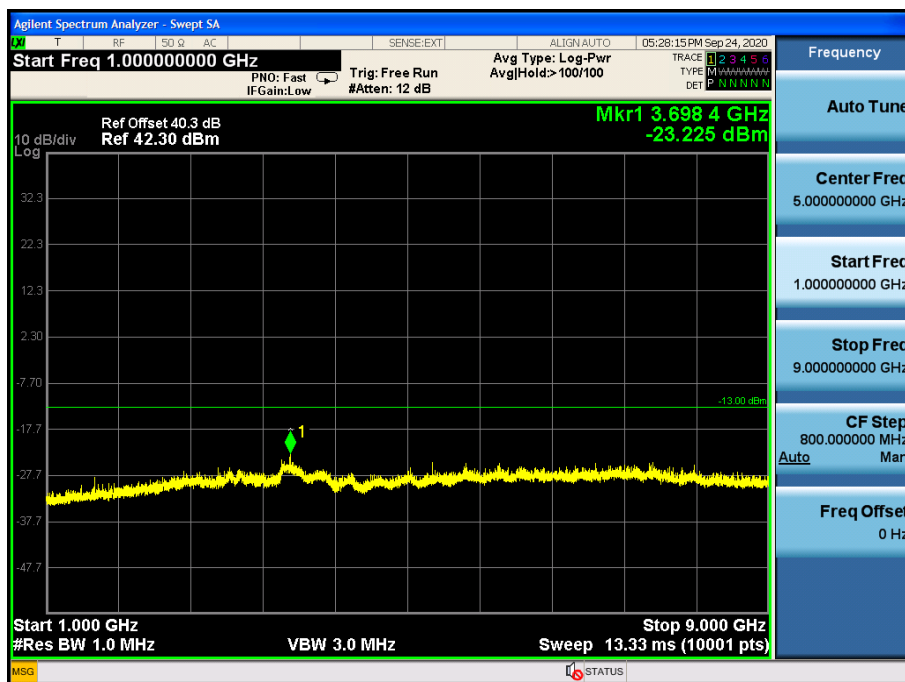
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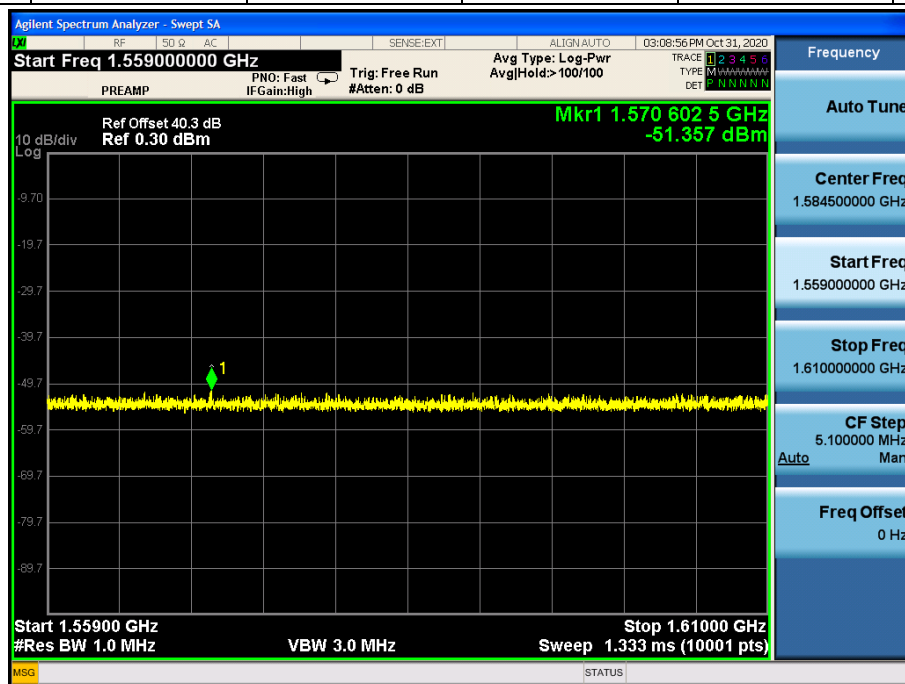
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1GHz to 9GHz



-70dBW/MHz EIRP for wideband emissions in the band 1559-1610 MHz

Frequency	Level	Antenna Gain	EIRP	Limit	Result
1559-1610	-51.4dBm	8dBi	-73.4dBW	-70dBw	Pass



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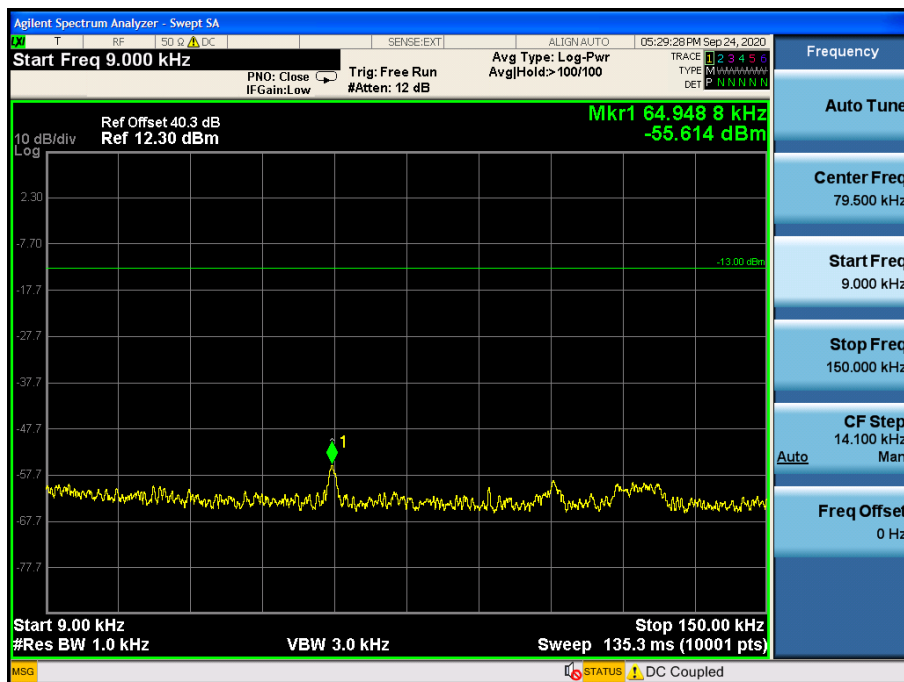
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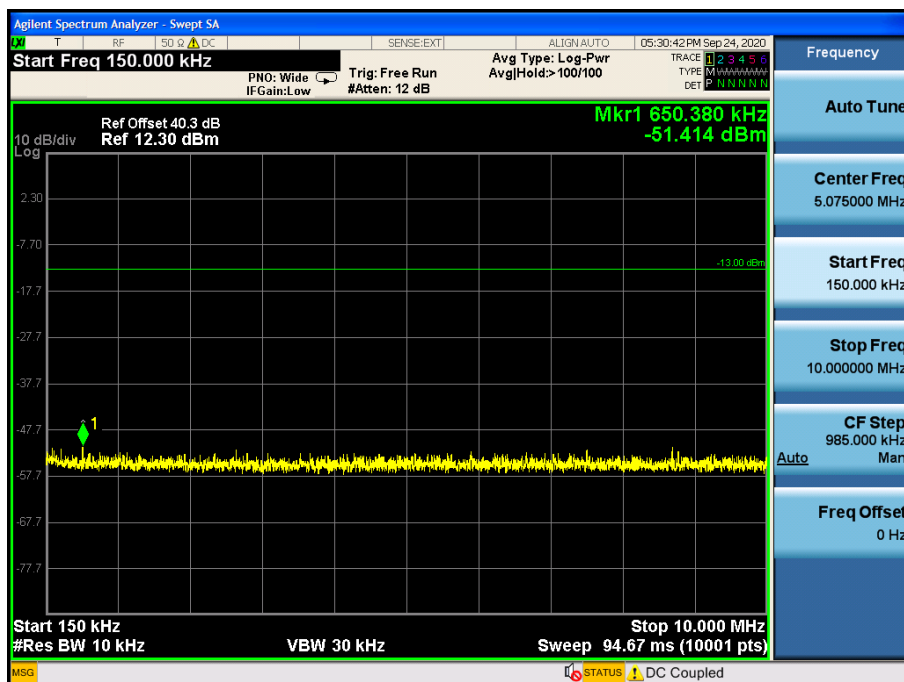
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1.3 highest frequency 9kHz to 150kHz



150kHz to 10MHz



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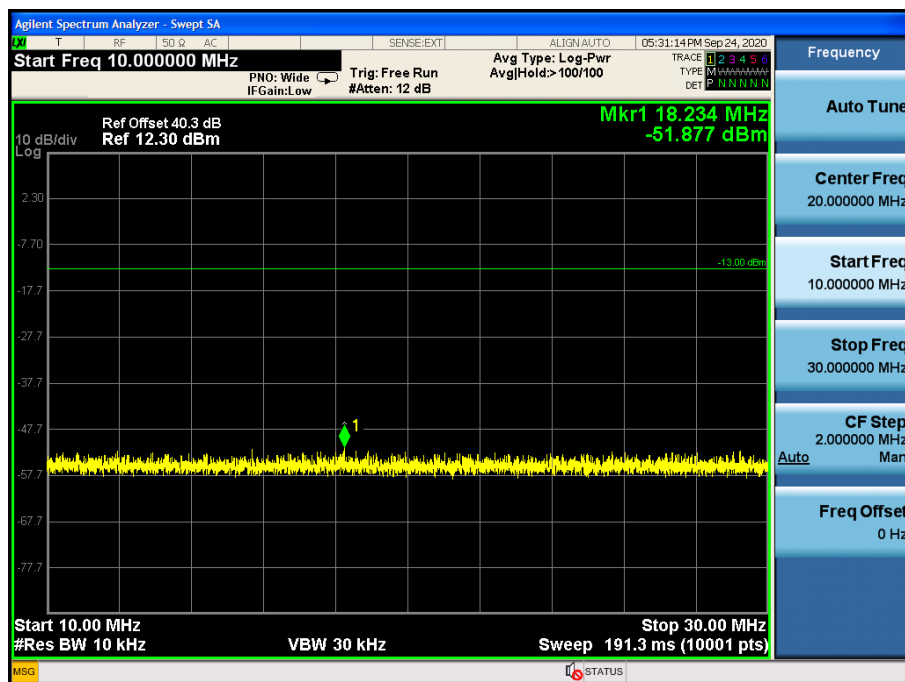
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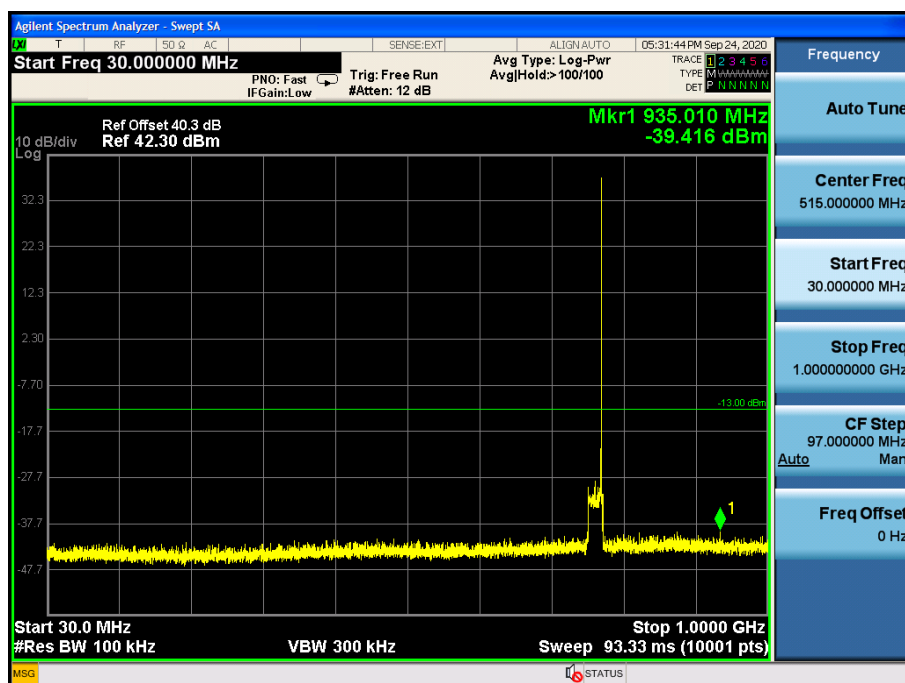
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10MHz to 30MHz



30MHz to 1GHz



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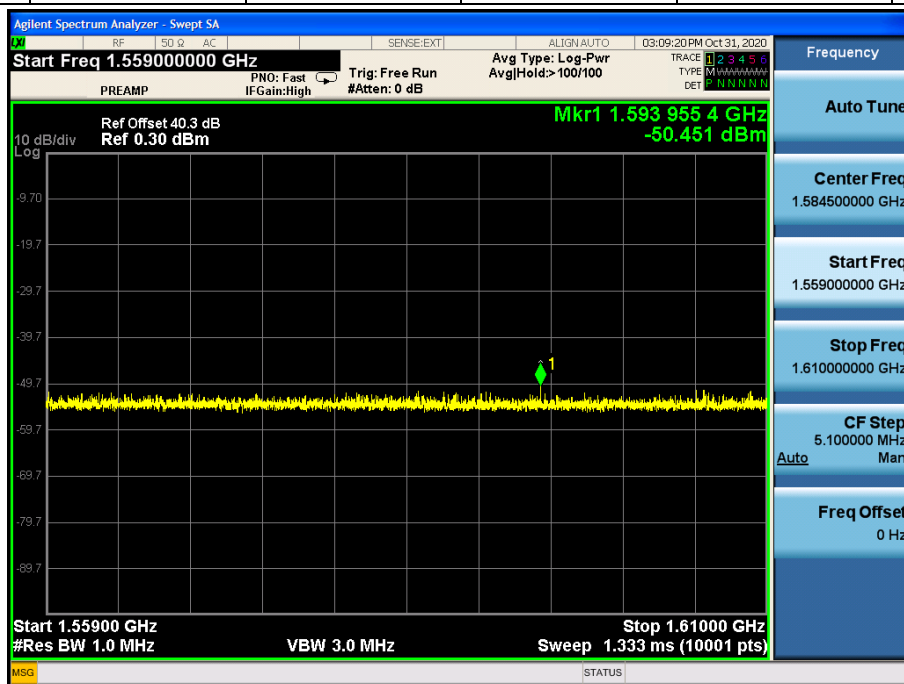
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1GHz to 9GHz



-70dBW/MHz EIRP for wideband emissions in the band 1559-1610 MHz

Frequency	Level	Antenna Gain	EIRP	Limit	Result
1559-1610	-50.5dBm	8dBi	-72.4dBW	-70dBw	Pass



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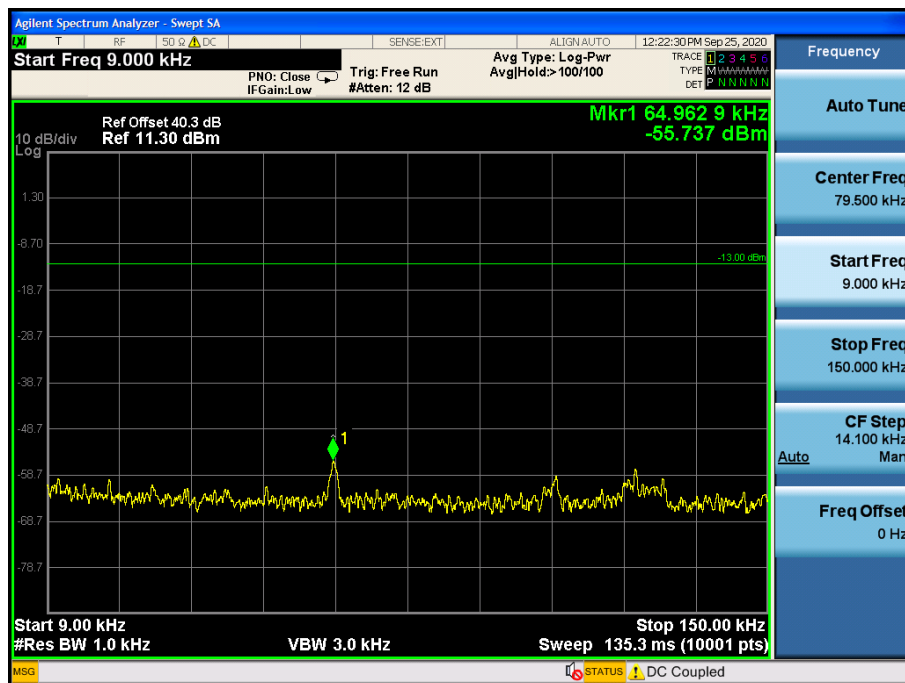
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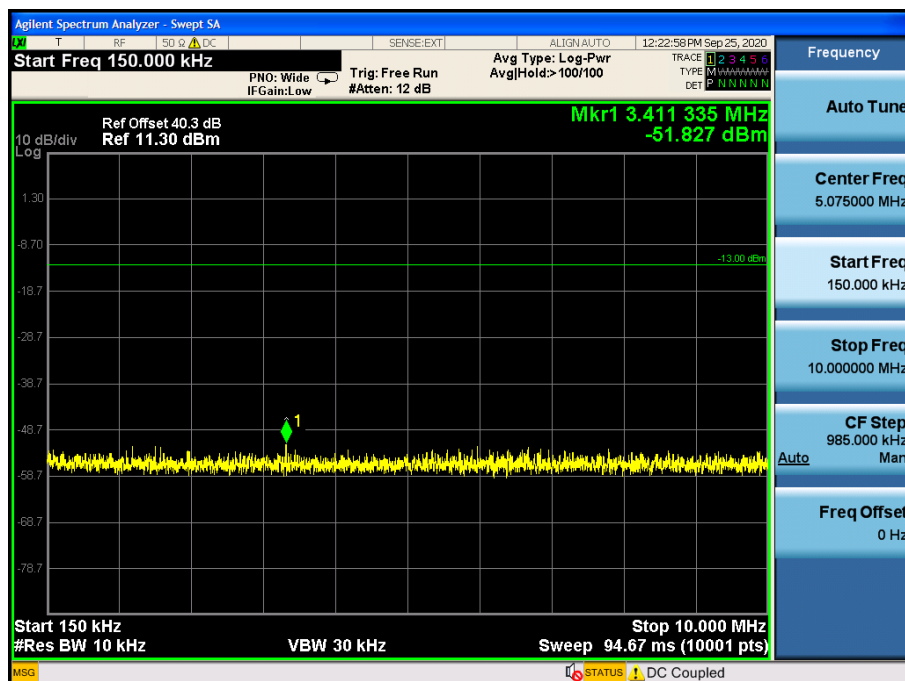
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2.Downlink: 851MHz to 869MHz
2.1 lowest frequency:
9kHz to 150kHz



150kHz to 10MHz



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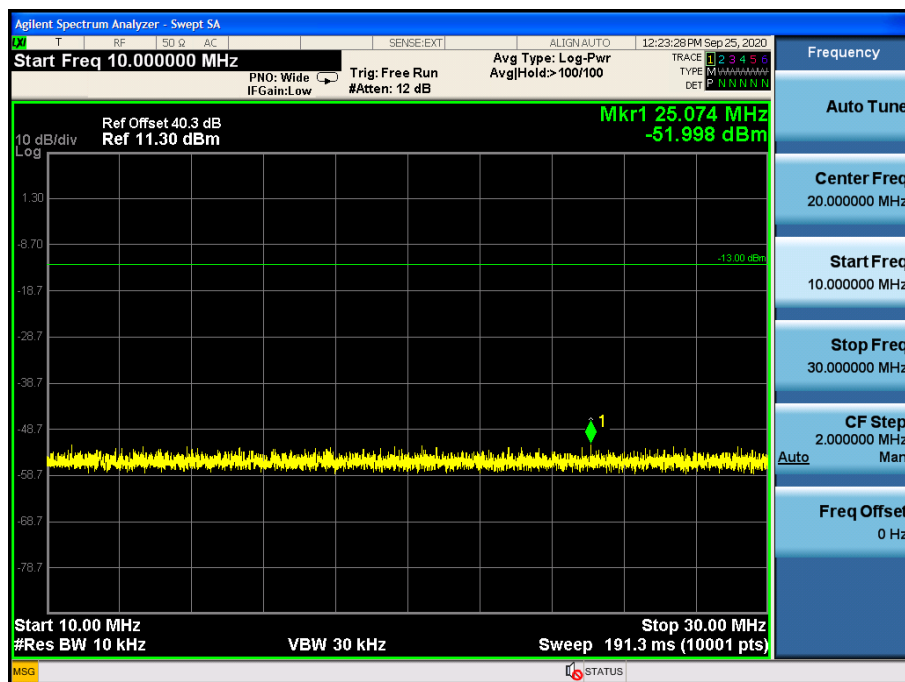
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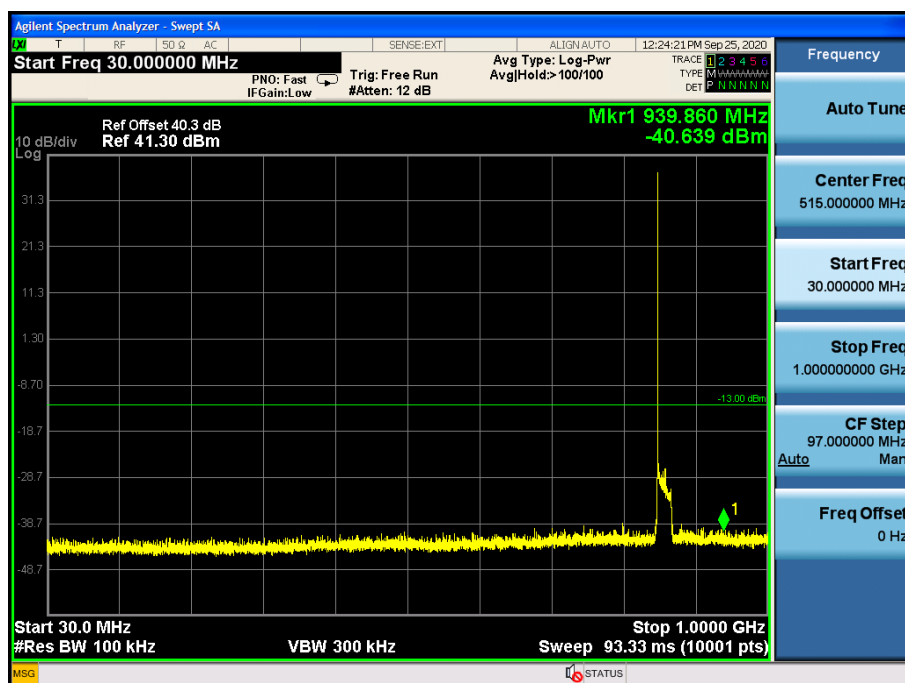
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10MHz to 30MHz



30MHz to 1GHz



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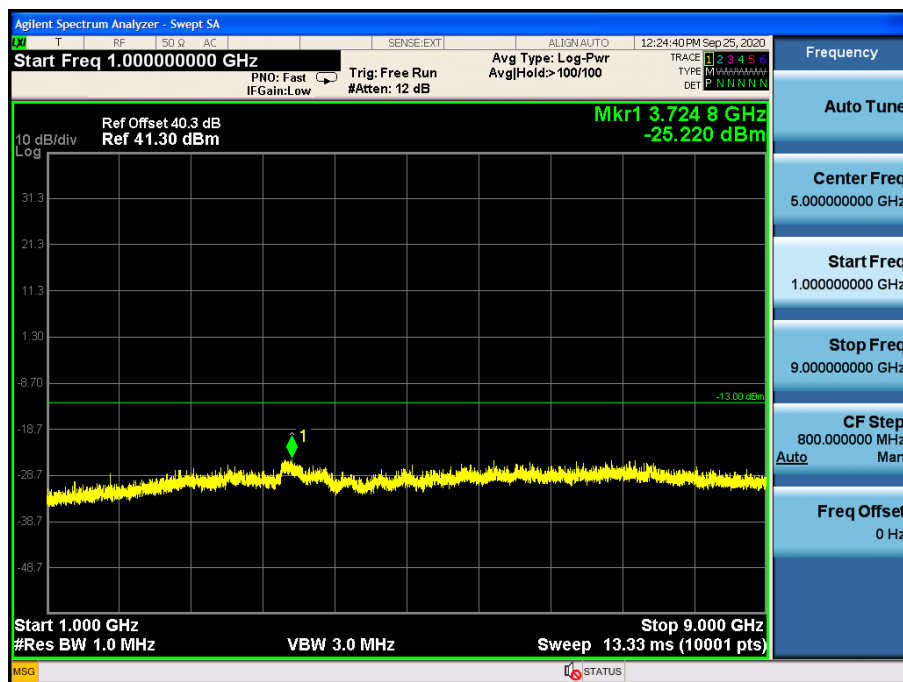
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1GHz to 9GHz



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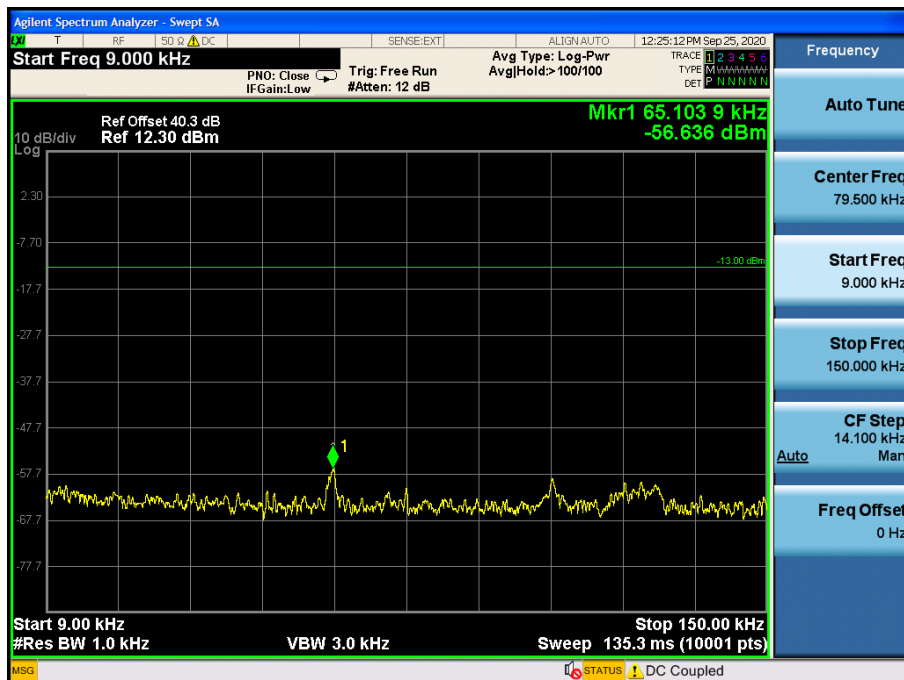
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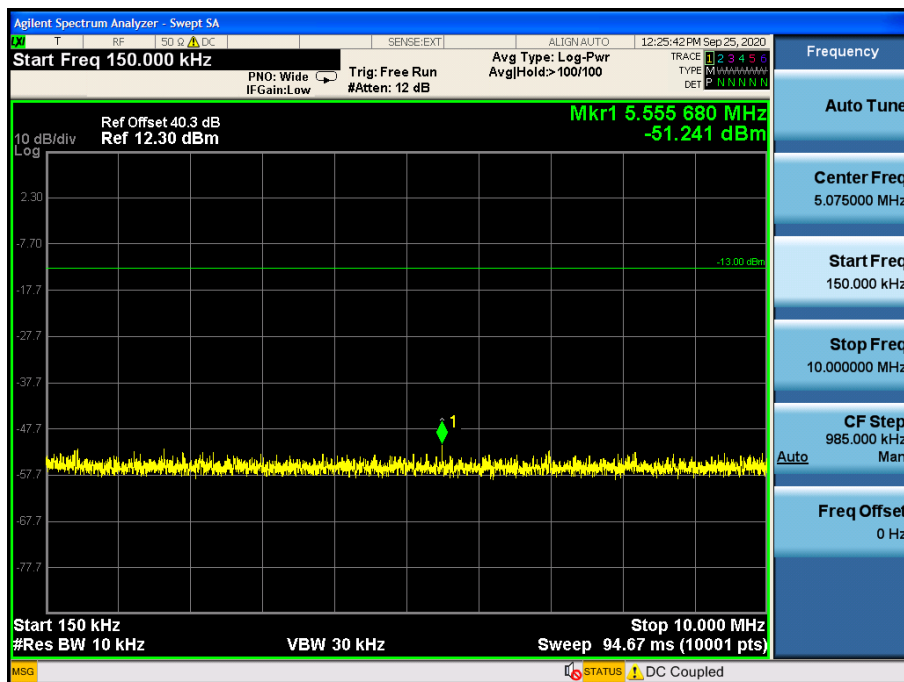
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2.2 Middle frequency 9kHz to 150kHz



150kHz to 10MHz



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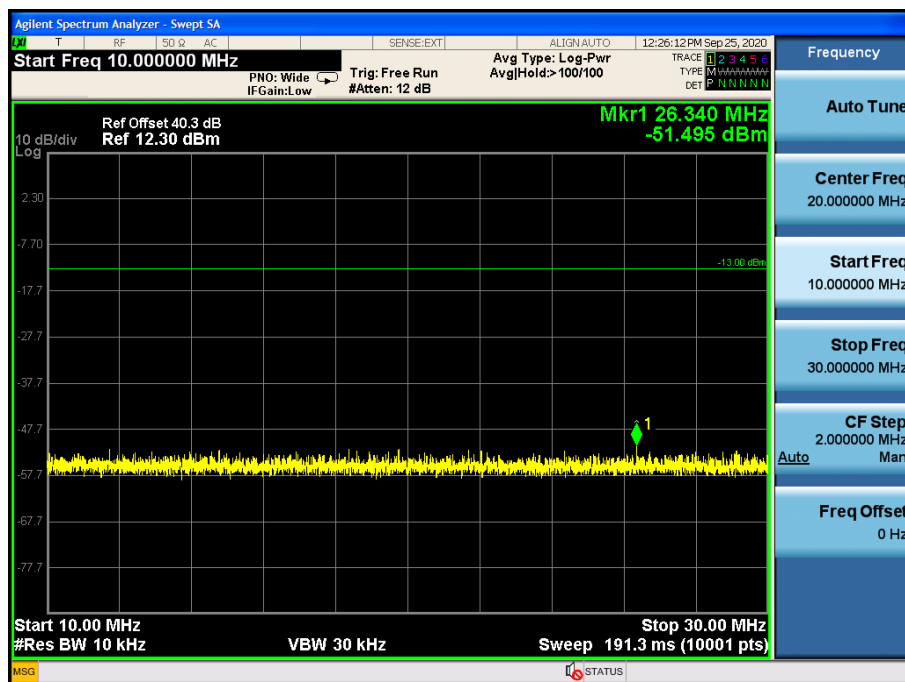
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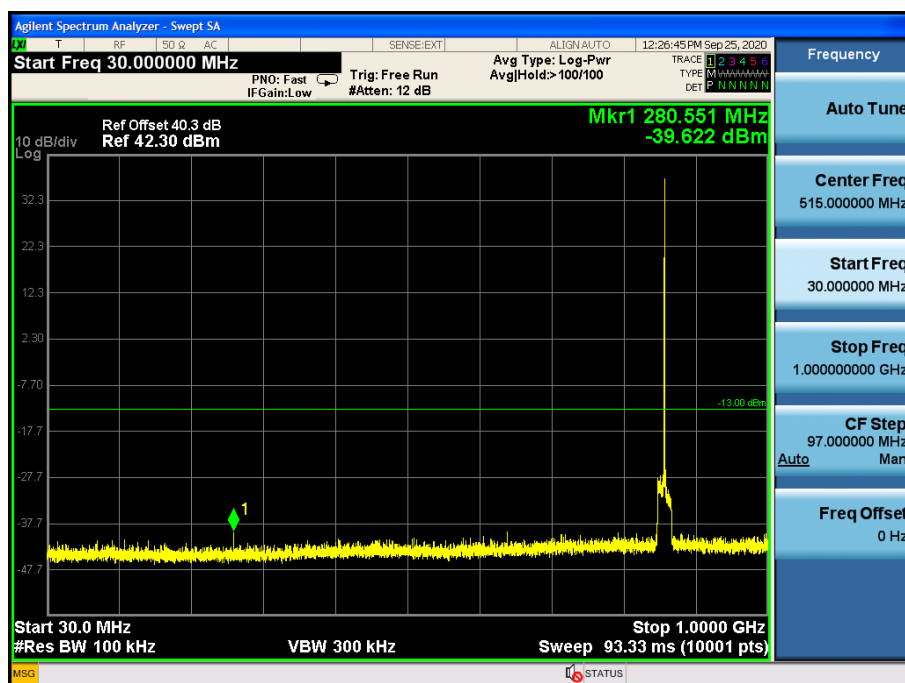
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10MHz to 30MHz



30MHz to 1GHz



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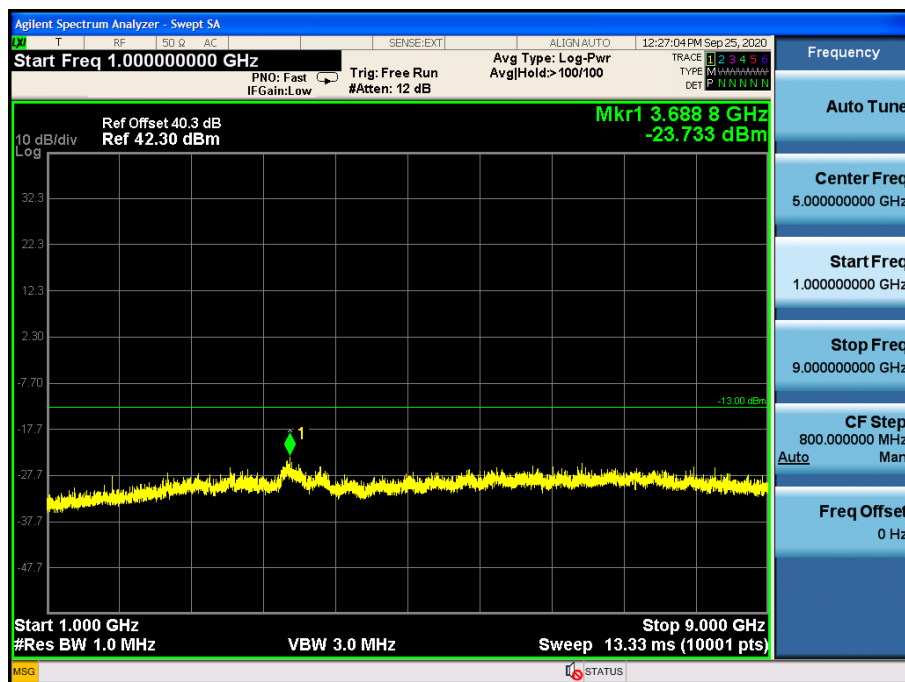
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1GHz to 9GHz



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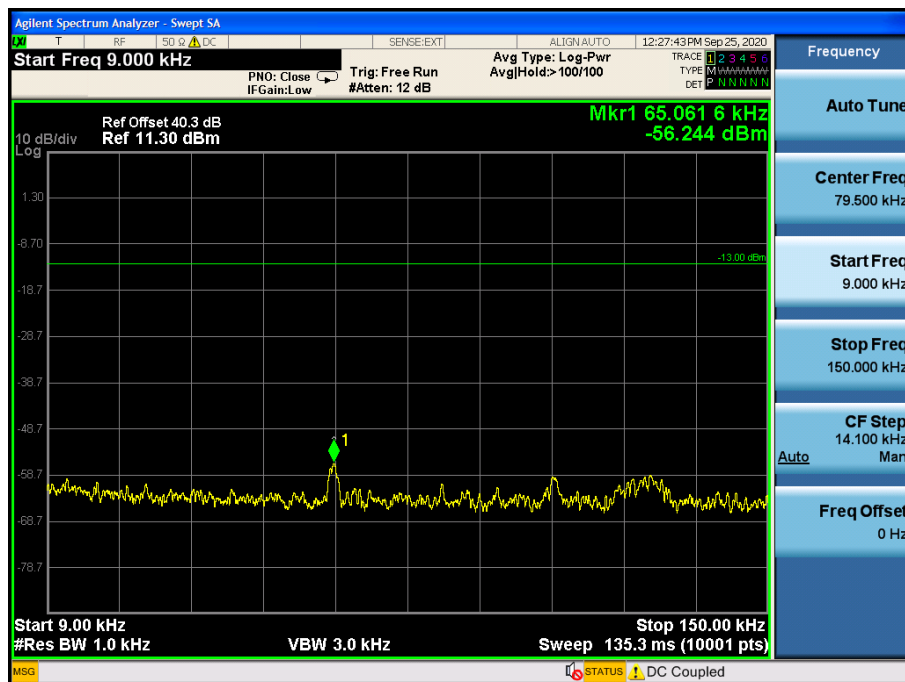
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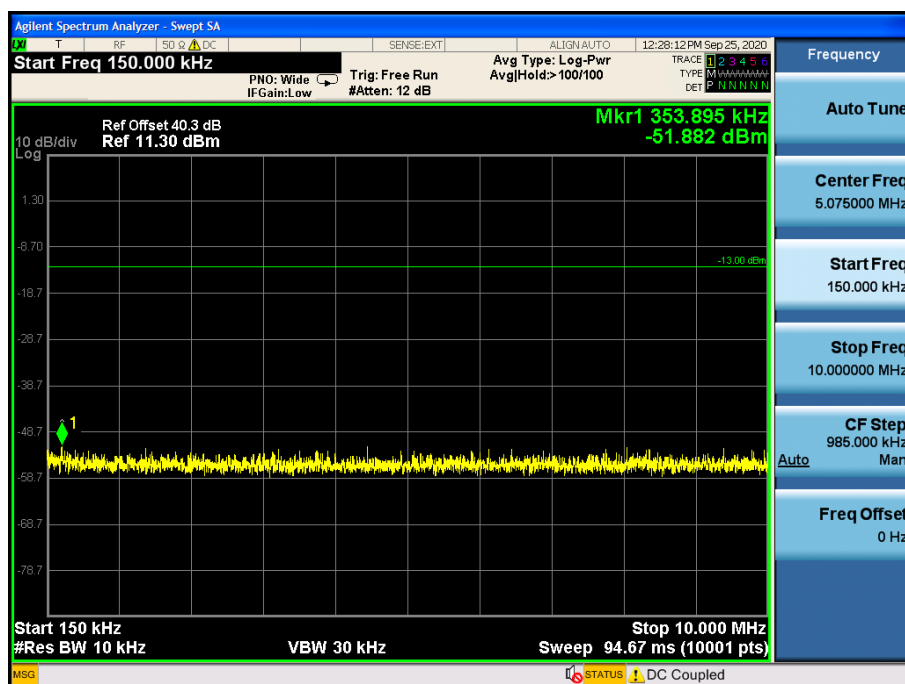
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2.3 highest frequency 9kHz to 150kHz



150kHz to 10MHz



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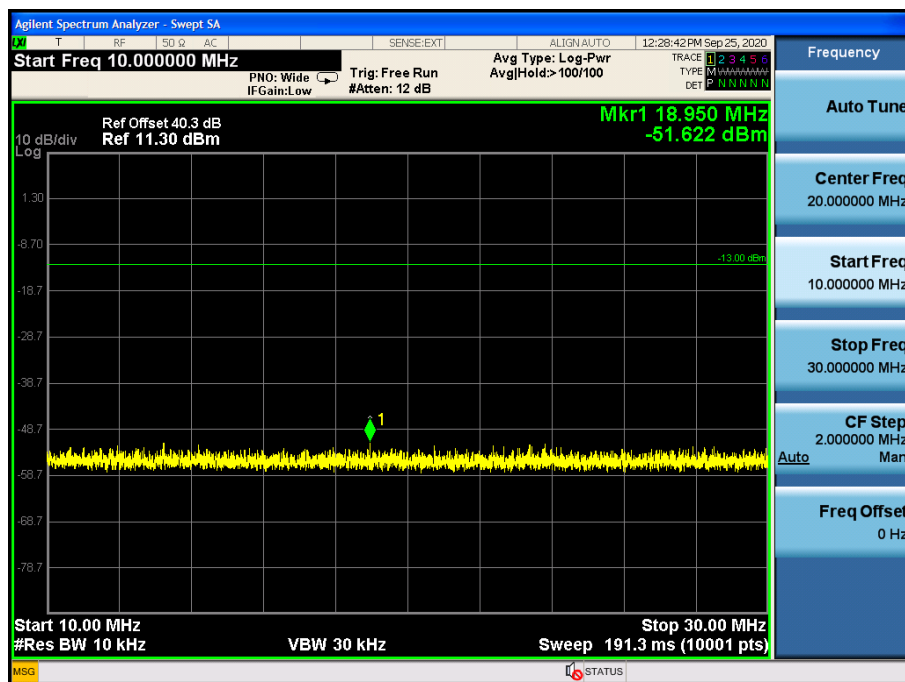
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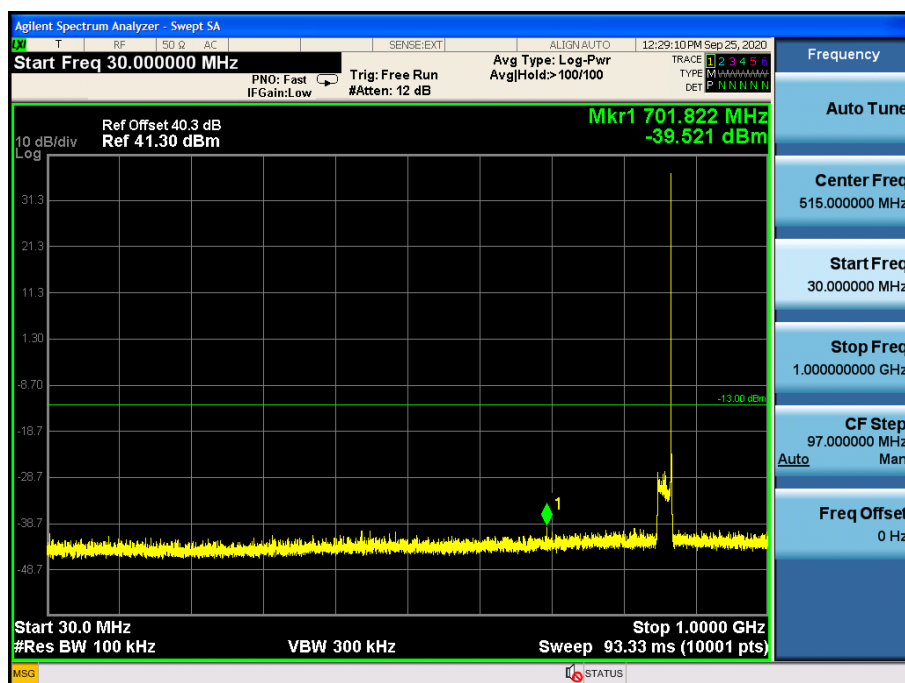
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10MHz to 30MHz



30MHz to 1GHz



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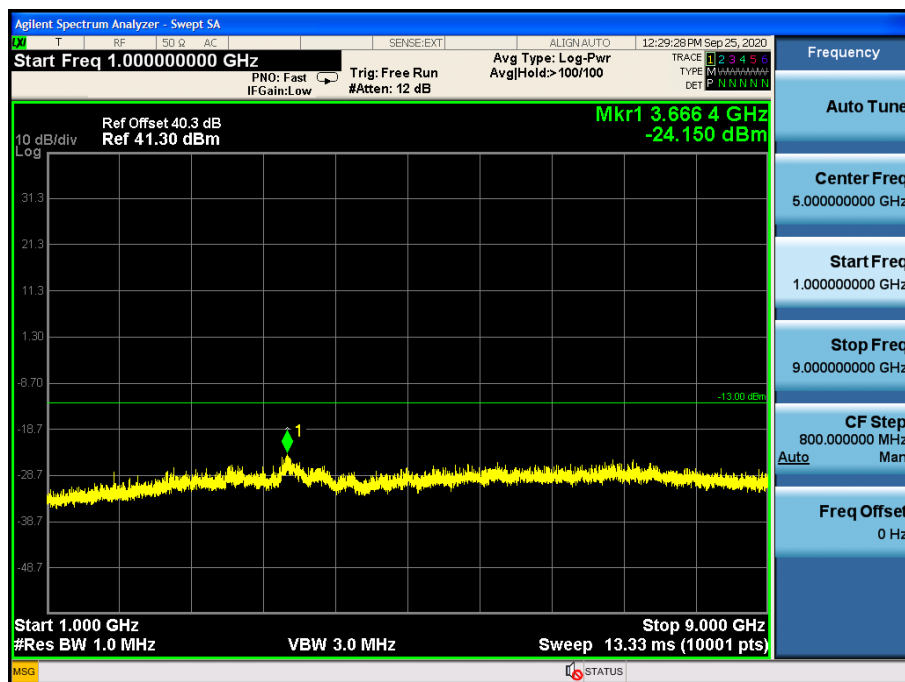
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1GHz to 9GHz



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7.2.3 out-of-band/out-of-block (including intermodulation)

Test Requirement: For 758-775MHz: 47 CFR Part 90.219(e)(3), 47 CFR Part 90.543(c), 47 CFR Part 90.543(e)(2), 47 CFR Part 90.543(e)(3), 47 CFR Part 90.543(f)
For 851-869MHz: 47 CFR Part 90.691

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04

Limit: For 758-775MHz:
The limit is -13 dBm in any 100 kHz measurement bandwidth

For 851-869MHz:

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

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

EUT Operation:

Status: Drive the EUT to maximum output power.

Conditions: Normal conditions

Application: Cellular Band RF output ports

Test Configuration:



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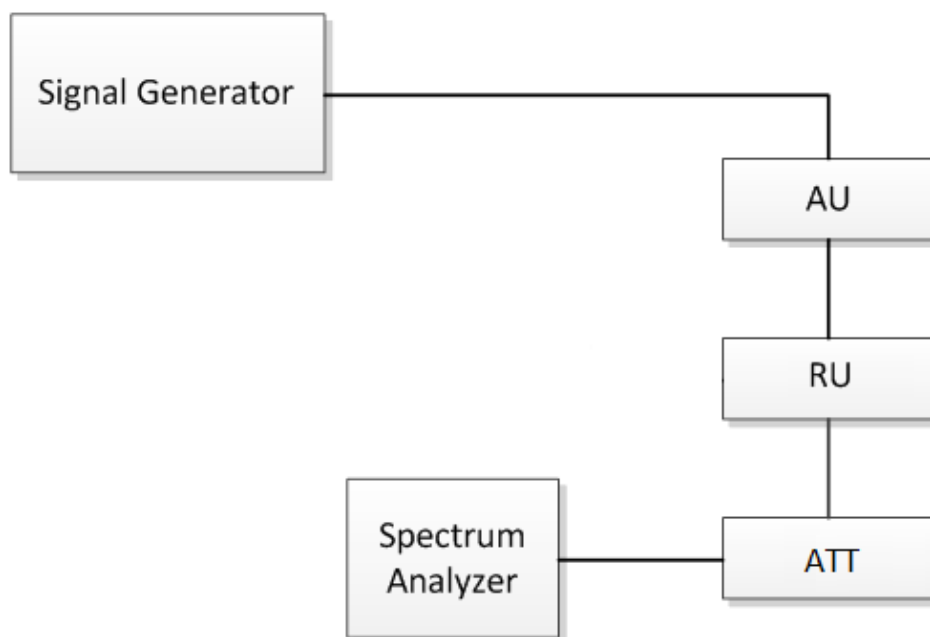


Fig.3. Band edge test configuration

Test Procedure:

Out-of-band/out-of-block emissions conducted test procedure:

Intermodulation products shall be measured using two CW signals with all available channel spacings (e.g., 12.5 kHz and 6.25 kHz) with the center between these channels being equal to the center frequency f_0 as determined from 4.3.

- Connect a signal generator to the input of the EUT. If the signal generator is not capable of producing two independent modulated carriers simultaneously, then two discrete signal generators can be connected, with an appropriate combining network to support the two-signal test.
- Configure the two signal generators to produce CW on frequencies spaced consistent with 4.7.1, with amplitude levels set to just below the AGC threshold (see 4.2). Set the signal generator amplitudes so that the power from each into the EUT is equivalent.
- Connect a spectrum analyzer to the EUT output.
- Set the span to 100 kHz.
- Set $RBW = 300 \text{ Hz}$ with $VBW \geq 3 \times RBW$.
- Set the detector to power averaging (rms).
- Place a marker on highest intermodulation product amplitude.
- Capture the plot for inclusion in the test report.
- Repeat steps c) to h) with the composite input power level set to 3 dB above the AGC threshold.
- Repeat steps b) to i) for all operational bands.

NOTE—Intermodulation-product spurious emission measurements are not required for single-channel boosters that cannot accommodate two simultaneous signals within the passband.





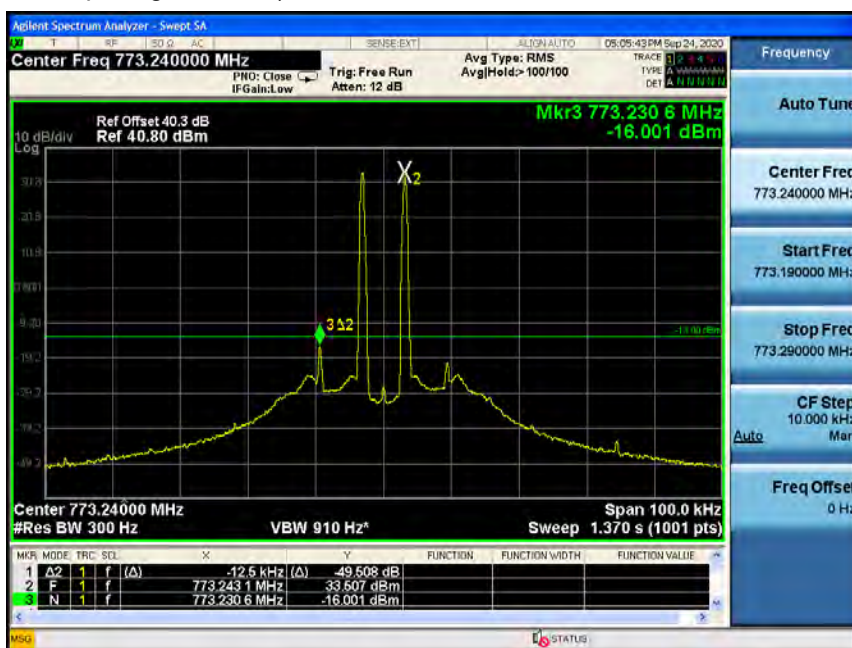
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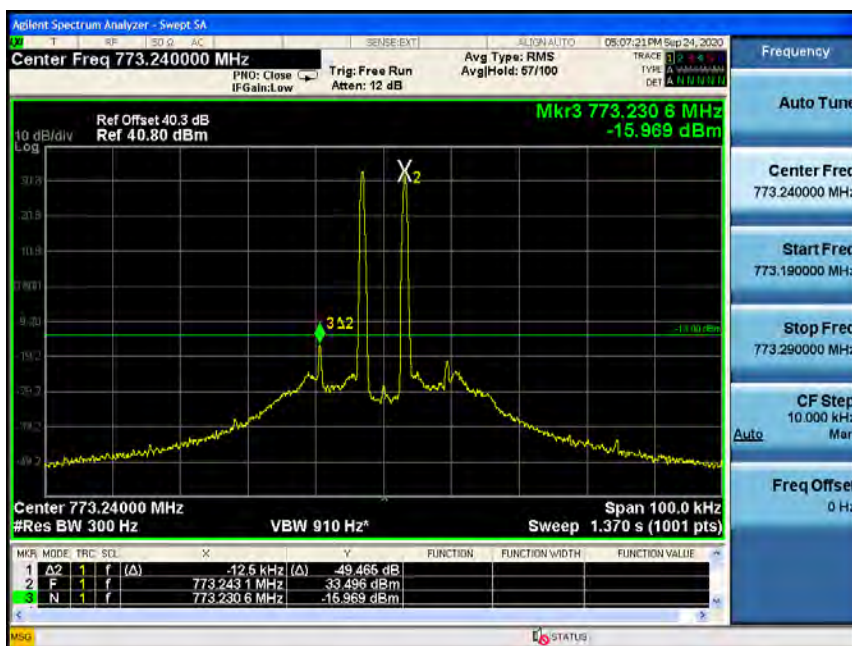
7.2.3.1 Measurement Record:

1.Downlink: 758MHz to 775MHz

1.1 Pre-AGC (channel spacing: 6.25kHz)



1.2 3dB above AGC (channel spacing: 6.25kHz)



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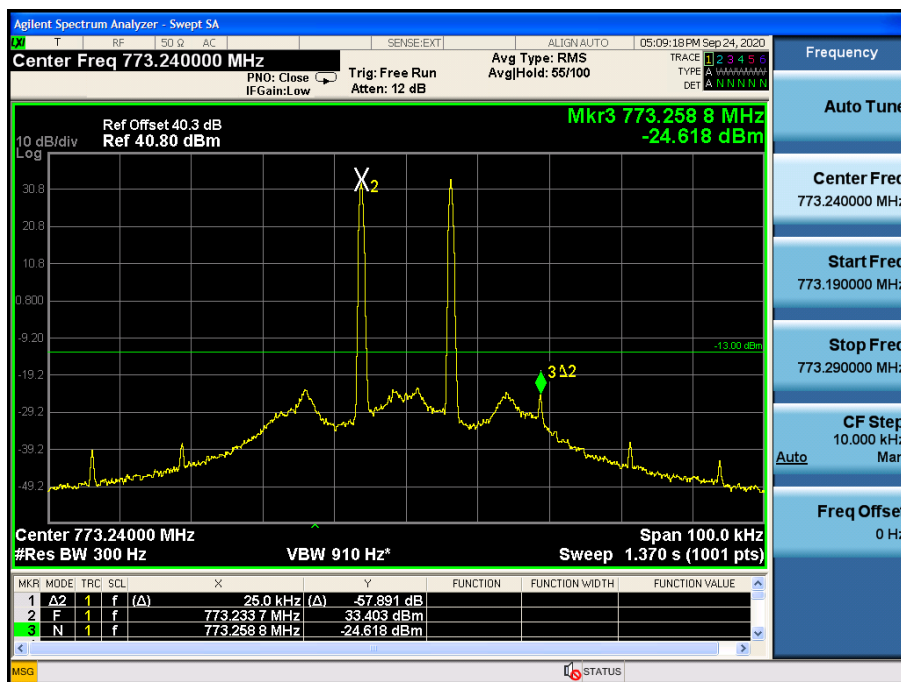
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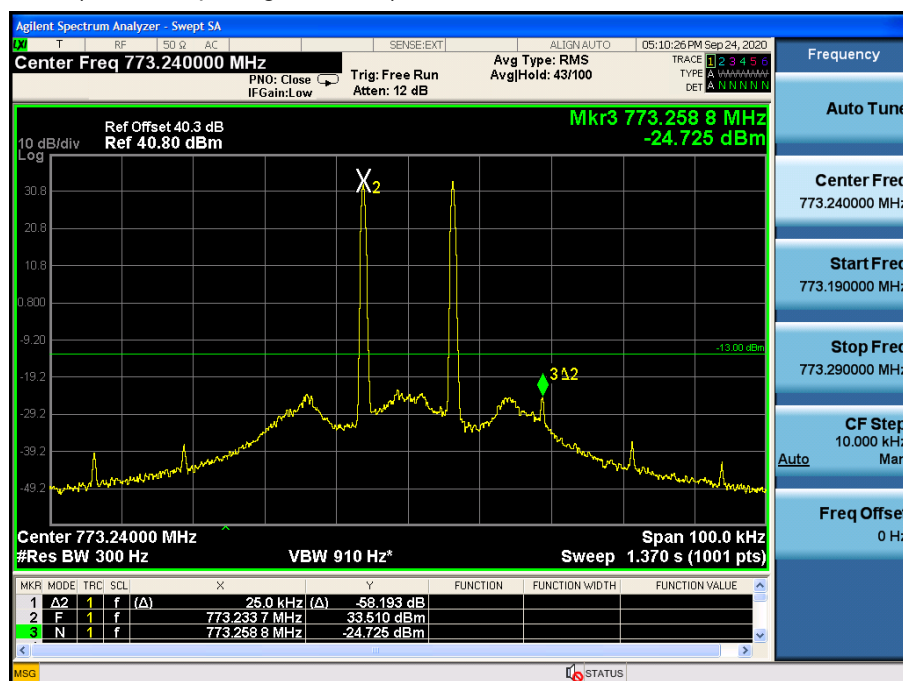
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1.3 Pre-AGC (channel spacing: 12.5kHz)



1.4 3dB above AGC (channel spacing: 12.5kHz)



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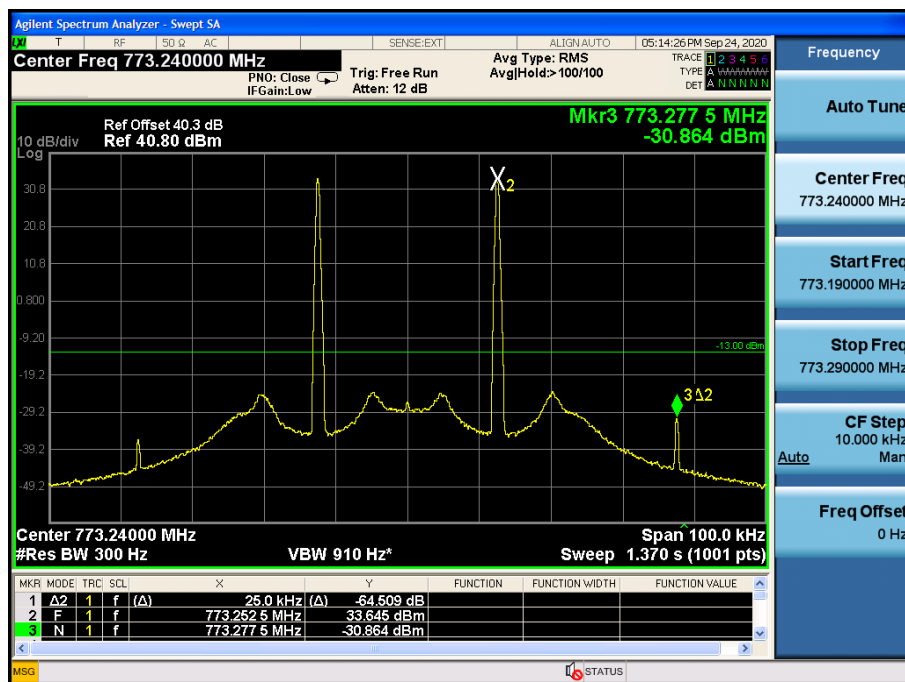
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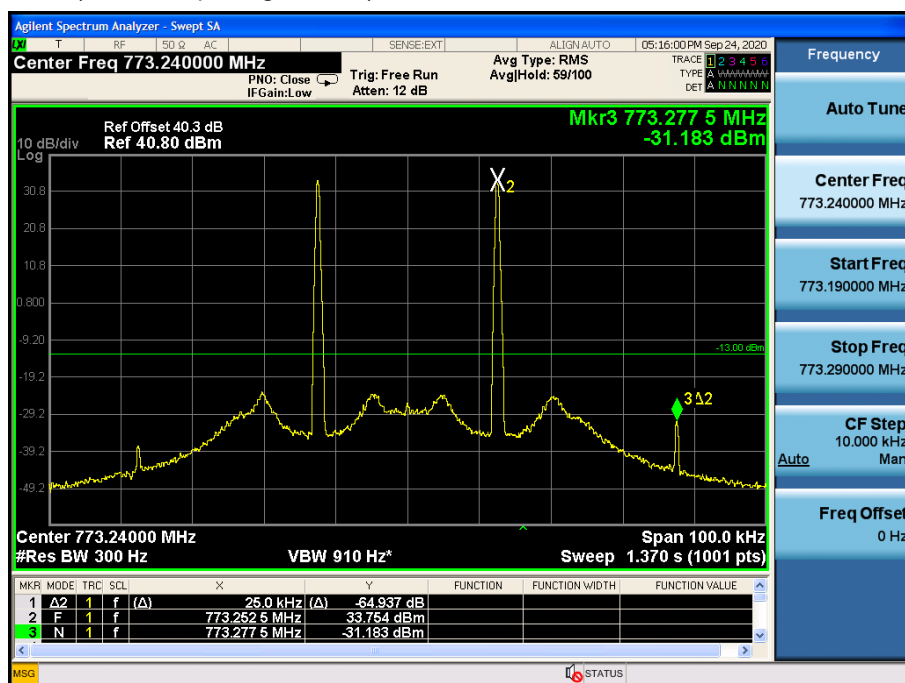
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1.5 Pre-AGC (channel spacing: 25kHz)



1.6 3dB above AGC (channel spacing: 25kHz)



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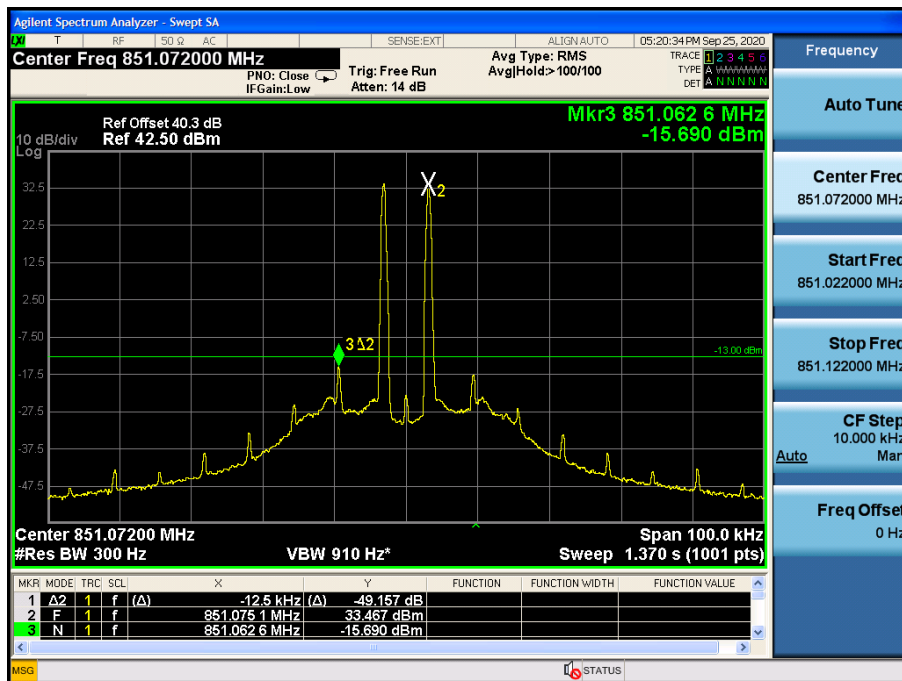


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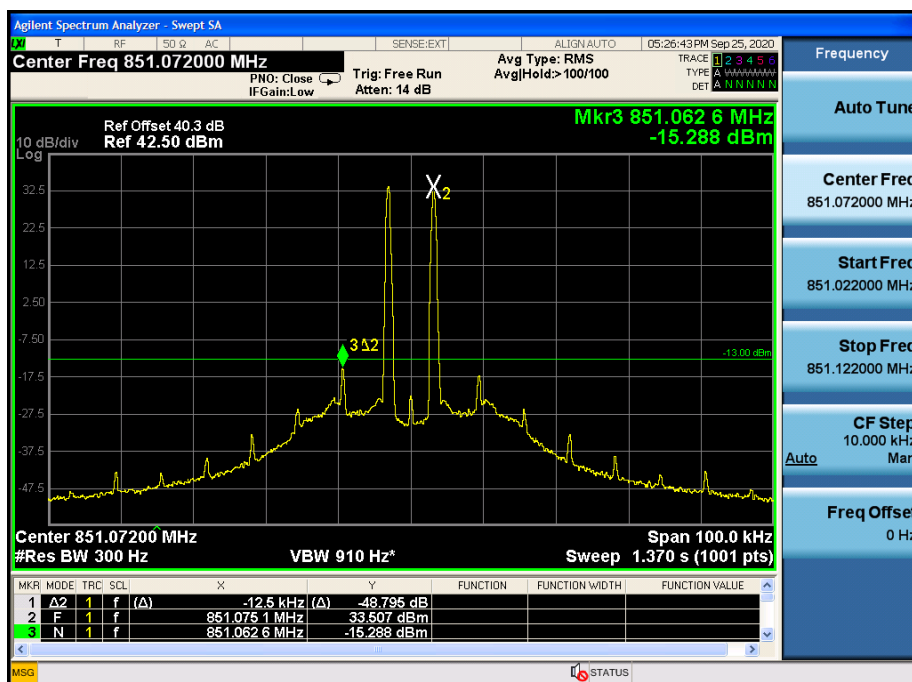
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2.Downlink: 851MHz to 869MHz

2.1 Pre-AGC (channel spacing: 6.25kHz)



2.2 3dB above AGC (channel spacing: 6.25kHz)



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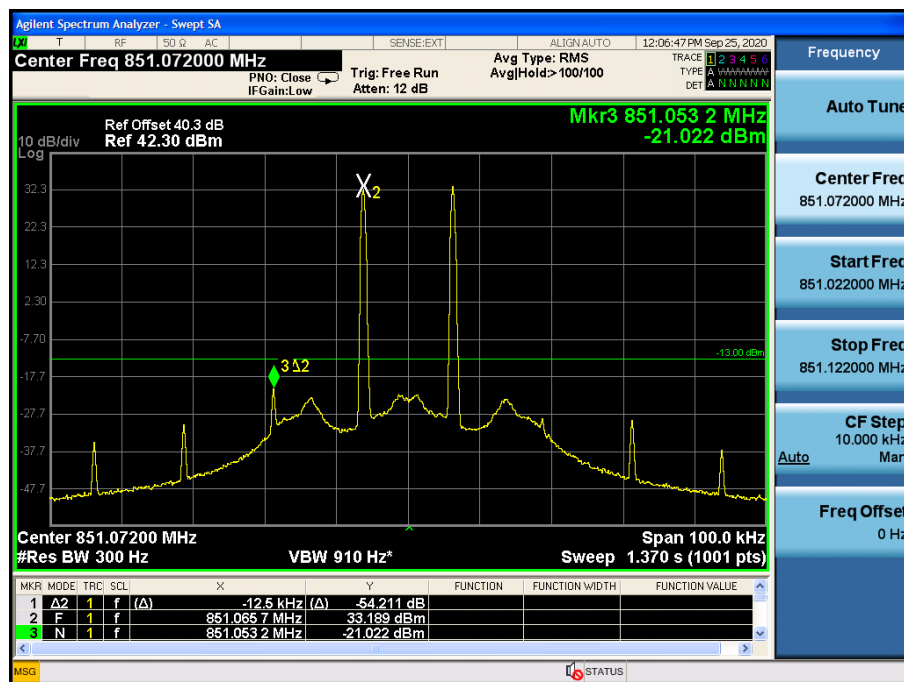
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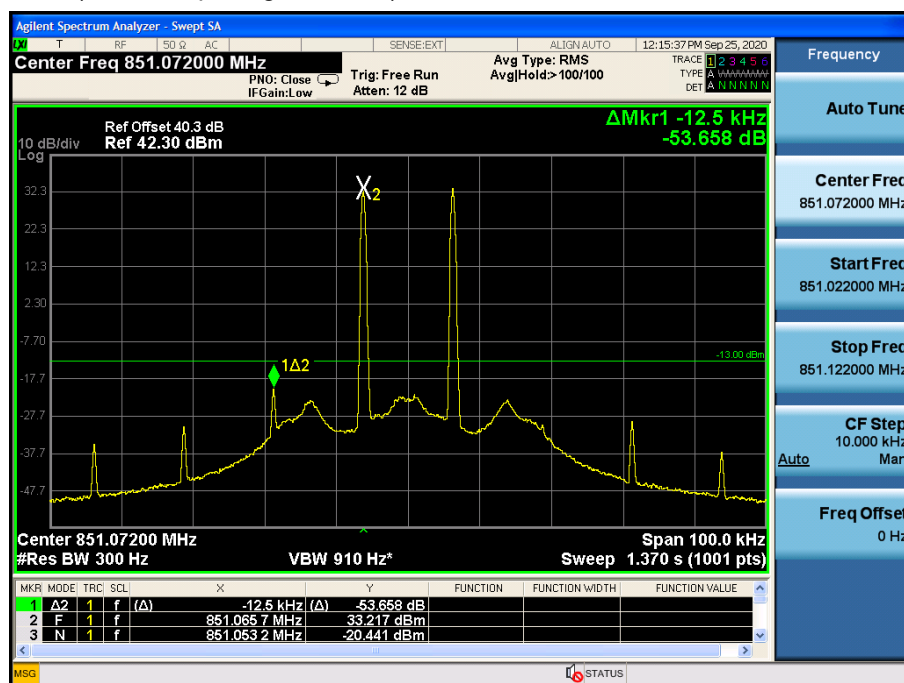
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2.3 Pre-AGC (channel spacing: 12.5kHz)



2.4 3dB above AGC (channel spacing: 12.5kHz)



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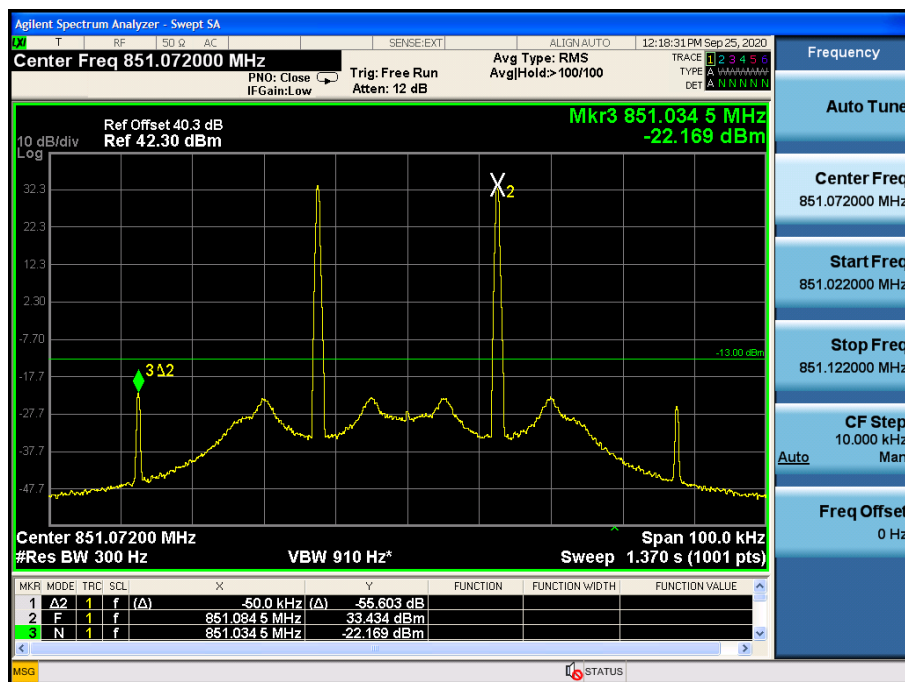
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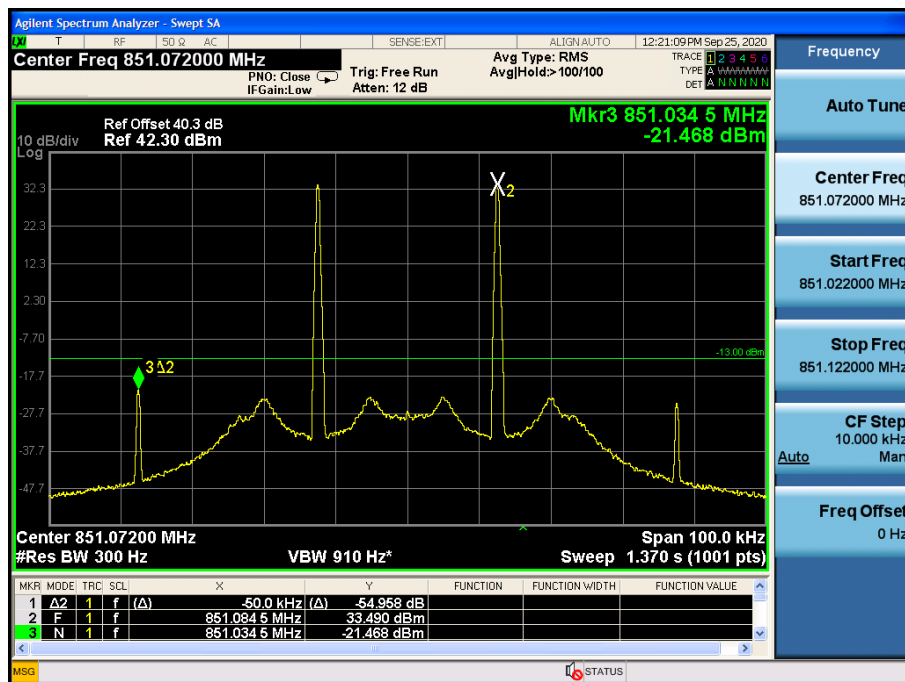
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2.5 Pre-AGC (channel spacing: 25kHz)



2.6 3dB above AGC (channel spacing: 25kHz)



Note: All test data for Band 851-869MHz is below -20dbm which satisfied with the limit.



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7.2.4 Radiated Spurious Emissions

Test Requirement: For 758-775MHz: 47 CFR Part 90.219(e)(3), 47 CFR Part 90.543(c), 47 CFR Part 90.543(e)(2), 47 CFR Part 90.543(e)(3), 47 CFR Part 90.543(f)

For 851-869MHz: 47 CFR Part 90.691

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04

Limit: For 758-775MHz:

The limit is -13 dBm in any 100 kHz measurement bandwidth

Note: Below 30MHz reduce the RBW, for 9 kHz ~ 150kHz the limit is -33dBm and 150 kHz ~ 30MHz the limit is -23dBm.

For 851-869MHz:

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

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

EUT Operation:

Status: Drive the EUT to maximum output power.

Conditions: Normal conditions

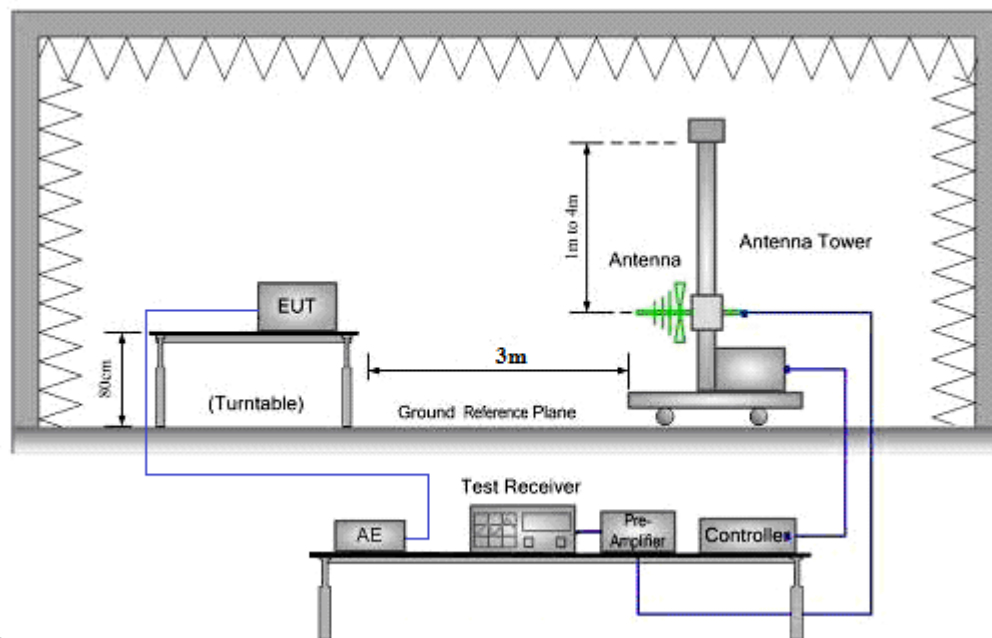
Application: Enclosure



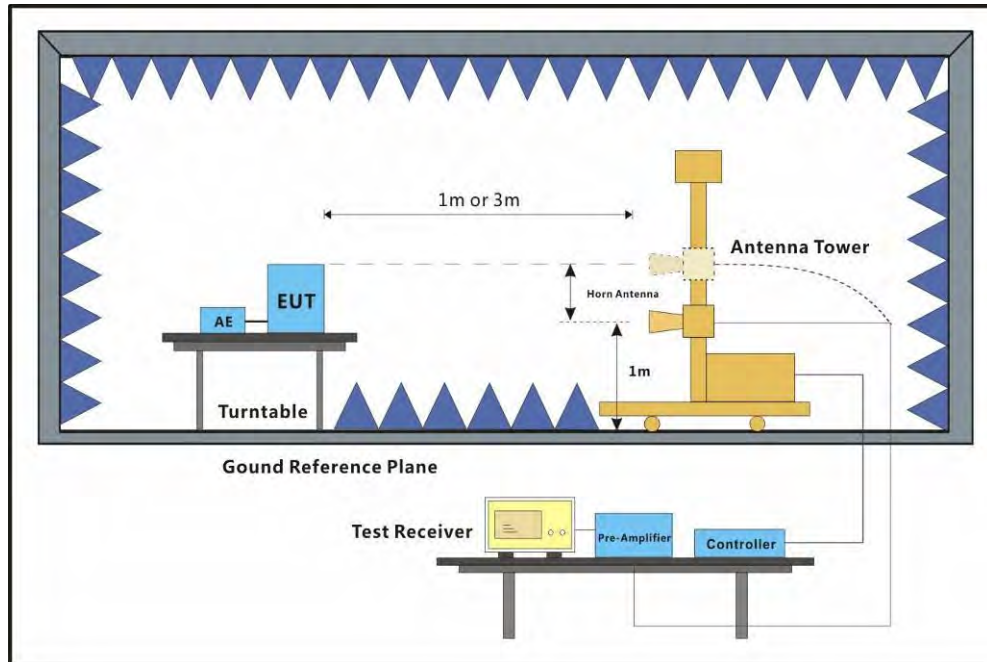


Test Configuration:

30MHz to 1GHz emissions:



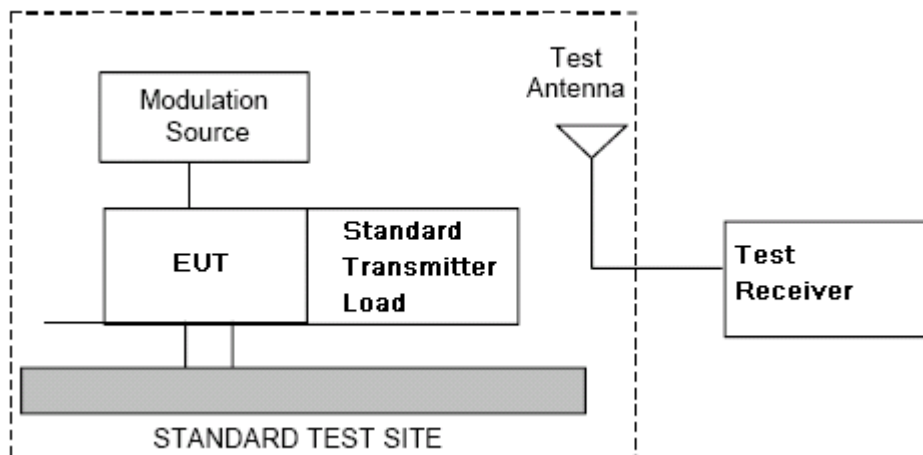
1GHz to 40GHz emissions:



Test Procedure:

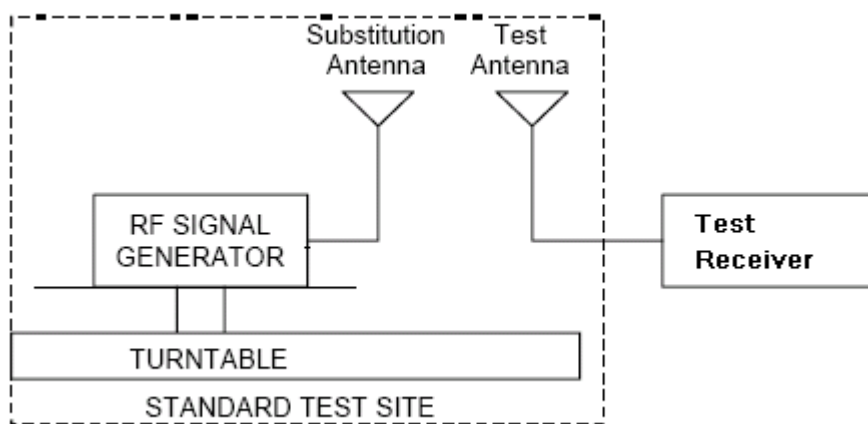
1. Test the background noise level with all the test facilities;
2. Keep one transmitting path, all other connectors shall be connected by normal power or RF leads;
3. Select the suitable RF notch filter to avoid the test receiver or spectrum analyzer produce unwanted spurious emissions;
4. Keep the EUT continuously transmitting in max power;
5. Read the radiated emissions of the EUT enclosure.

Radiated Emissions Test Procedure:





- a) Connect the equipment as illustrated.
- b) Adjust the spectrum analyzer for the following settings:
 - 1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1GHz.
 - 2) Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
 - 3) Sweep Speed slow enough to maintain measurement calibration.
 - 4) Detector Mode = Positive Peak.
- c) Place the transmitter to be tested on the turntable in the standard test site, The transmitter is transmitting into a no radiating load that is placed on the turntable. The RF cable to this load should be of minimum length.
- d) Measurements shall be made from 30MHz to 10 times of fundamental carrier, except for the region close to the carrier equal to $\pm$ the carrier bandwidth.
- e) Key the transmitter without modulation or normal modulation base the standard.
- f) For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Then the turntable should be rotated 360° to determine the maximum reading. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
- g) Repeat step f) for each spurious frequency with the test antenna polarized vertically.



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- h) Reconnect the equipment as illustrated.
- i) Keep the spectrum analyzer adjusted as in step b).
- j) Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.
- k) Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non radiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.
- l) Repeat step k) with both antennas vertically polarized for each spurious frequency.
- m) Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps k) and l) by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula:

$$Pd(\text{dBm}) = Pg(\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dB)}$$

where:

Pd is the dipole equivalent power and

Pg is the generator output power into the substitution antenna.

NOTE:

- 1) It is permissible to use other antennas provided they can be referenced to a dipole.
- 2) For below 1GHz signal, the *antenna gain* (dB) is dBd, and for above 1GHz signal, the *antenna gain* (dB) is dBi
- 3) Effective radiated power (e.r.p) refers to the radiation of a half wave tuned dipole instead of an isotropic antenna. There is a constant difference of 2.15 dB between e.i.r.p. and e.r.p.
 $\text{e.r.p (dBm)} = \text{e.i.r.p. (dBm)} - 2.15$
- 4) For this test, the AU and EU are put outside of the chamber; connect to the RU through the optical fiber



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7.2.4.1 Measurement Record:

No emissions were detected within 20dB below the limit for the Downlink direction.

Downlink 758MHz to 775MHz:

Lowest Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
188.993333	134.0	H	-55.70	-13.0	-42.70
349.993333	41.0	H	-56.53	-13.0	-43.53
450.000000	253.0	H	-62.56	-13.0	-49.56
549.962500	130.0	H	-64.73	-13.0	-51.73
825.191667	195.0	H	-49.48	-13.0	-36.48
3670.800000	346.0	H	-51.48	-13.0	-38.48
4177.150000	346.0	H	-45.72	-13.0	-32.72
5704.975000	334.0	H	-51.30	-13.0	-38.30
7884.750000	218.0	H	-48.87	-13.0	-35.87
9398.925000	346.0	H	-45.26	-13.0	-32.26

Lowest Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
149.980000	86.0	V	-65.02	-13.0	-52.02
188.666667	133.0	V	-55.66	-13.0	-42.66
249.986667	252.0	V	-66.86	-13.0	-53.86
349.993333	133.0	V	-58.21	-13.0	-45.21
549.962500	46.0	V	-63.07	-13.0	-50.07
3671.125000	323.0	V	-50.02	-13.0	-37.02
4177.150000	0.0	V	-43.63	-13.0	-30.63
6265.925000	359.0	V	-47.09	-13.0	-34.09
7884.750000	301.0	V	-47.05	-13.0	-34.05
8557.500000	335.0	V	-47.68	-13.0	-34.68



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Middle Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
191.373333	151.0	H	-56.54	-13.0	-43.54
249.986667	252.0	H	-65.30	-13.0	-52.30
349.993333	40.0	H	-56.48	-13.0	-43.48
450.000000	252.0	H	-62.18	-13.0	-49.18
549.962500	149.0	H	-64.48	-13.0	-51.48
3670.800000	345.0	H	-51.74	-13.0	-38.74
4176.825000	345.0	H	-45.72	-13.0	-32.72
5704.975000	334.0	H	-51.88	-13.0	-38.88
7885.075000	219.0	H	-49.51	-13.0	-36.51
9398.925000	345.0	H	-45.05	-13.0	-32.05

Middle Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
149.980000	78.0	V	-65.46	-13.0	-52.46
189.226667	134.0	V	-55.91	-13.0	-42.91
349.993333	134.0	V	-58.75	-13.0	-45.75
450.000000	84.0	V	-65.95	-13.0	-52.95
549.962500	56.0	V	-64.36	-13.0	-51.36
3670.800000	345.0	V	-49.13	-13.0	-36.13
4177.150000	0.0	V	-44.01	-13.0	-31.01
6265.925000	358.0	V	-47.24	-13.0	-34.24
7884.750000	309.0	V	-46.81	-13.0	-33.81
8557.500000	334.0	V	-49.64	-13.0	-36.64



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Highest Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
149.980000	271.0	H	-66.04	-13.0	-53.04
189.413333	161.0	H	-55.40	-13.0	-42.40
349.993333	41.0	H	-56.78	-13.0	-43.78
450.000000	114.0	H	-62.15	-13.0	-49.15
549.962500	142.0	H	-65.53	-13.0	-52.53
3670.800000	345.0	H	-51.74	-13.0	-38.74
4177.150000	345.0	H	-44.95	-13.0	-31.95
5704.650000	333.0	H	-52.33	-13.0	-39.33
7885.075000	218.0	H	-48.80	-13.0	-35.80
9398.925000	345.0	H	-45.25	-13.0	-32.25

Highest Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
149.980000	79.0	V	-66.31	-13.0	-53.31
189.553333	88.0	V	-54.76	-13.0	-41.76
349.993333	142.0	V	-59.04	-13.0	-46.04
450.000000	113.0	V	-66.36	-13.0	-53.36
550.008333	56.0	V	-63.95	-13.0	-50.95
3670.800000	348.0	V	-51.11	-13.0	-38.11
4177.150000	0.0	V	-43.93	-13.0	-30.93
6265.600000	359.0	V	-47.32	-13.0	-34.32
7884.750000	312.0	V	-47.23	-13.0	-34.23
8557.175000	335.0	V	-48.06	-13.0	-35.06



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Downlink 851MHz to 869MHz:

Lowest Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
188.806667	152.0	H	-54.70	-13.0	-41.70
349.993333	31.0	H	-56.91	-13.0	-43.91
450.000000	245.0	H	-62.29	-13.0	-49.29
549.962500	151.0	H	-65.02	-13.0	-52.02
1702.000000	309.0	H	-48.21	-13.0	-35.21
3670.800000	345.0	H	-51.99	-13.0	-38.99
4177.150000	345.0	H	-45.19	-13.0	-32.19
5704.975000	333.0	H	-52.28	-13.0	-39.28
7884.425000	252.0	H	-48.70	-13.0	-35.70
9398.925000	345.0	H	-45.07	-13.0	-32.07

Lowest Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
149.980000	105.0	V	-65.86	-13.0	-52.86
188.480000	114.0	V	-55.53	-13.0	-42.53
349.993333	143.0	V	-59.56	-13.0	-46.56
549.962500	63.0	V	-63.97	-13.0	-50.97
1702.000000	349.0	V	-48.24	-13.0	-35.24
3671.125000	334.0	V	-50.02	-13.0	-37.02
4177.150000	0.0	V	-44.30	-13.0	-31.30
6265.925000	0.0	V	-48.16	-13.0	-35.16
7884.750000	334.0	V	-47.19	-13.0	-34.19
8557.500000	334.0	V	-47.98	-13.0	-34.98



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Middle Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
190.206667	134.0	H	-54.22	-13.0	-41.22
250.033333	252.0	H	-65.33	-13.0	-52.33
349.993333	31.0	H	-57.14	-13.0	-44.14
450.000000	233.0	H	-62.90	-13.0	-49.90
1720.000000	325.0	H	-47.12	-13.0	-34.12
3671.125000	347.0	H	-51.87	-13.0	-38.87
4177.150000	347.0	H	-45.39	-13.0	-32.39
5704.650000	335.0	H	-52.17	-13.0	-39.17
7884.750000	243.0	H	-49.25	-13.0	-36.25
9398.925000	347.0	H	-47.18	-13.0	-34.18

Middle Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
149.980000	96.0	V	-65.23	-13.0	-52.23
188.946667	141.0	V	-54.58	-13.0	-41.58
349.993333	132.0	V	-59.63	-13.0	-46.63
550.008333	64.0	V	-65.13	-13.0	-52.13
1720.000000	343.0	V	-45.26	-13.0	-32.26
3670.800000	345.0	V	-50.57	-13.0	-37.57
4177.150000	0.0	V	-44.46	-13.0	-31.46
6265.600000	359.0	V	-48.37	-13.0	-35.37
7884.750000	310.0	V	-47.61	-13.0	-34.61
8557.500000	333.0	V	-49.59	-13.0	-36.59



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Highest Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
189.086667	139.0	H	-55.28	-13.0	-42.28
249.986667	260.0	H	-65.42	-13.0	-52.42
349.993333	29.0	H	-57.08	-13.0	-44.08
450.000000	242.0	H	-63.55	-13.0	-50.55
1738.000000	324.0	H	-44.46	-13.0	-31.46
3670.800000	345.0	H	-51.80	-13.0	-38.80
4177.150000	345.0	H	-45.71	-13.0	-32.71
5704.650000	334.0	H	-52.91	-13.0	-39.91
7884.425000	252.0	H	-49.17	-13.0	-36.17
9398.925000	345.0	H	-45.92	-13.0	-32.92

Highest Channel					
Frequency	Spurious Emission Level			Limit	Over limit
(MHz)	(Deg)	Polaxis	(dBm)	dBm	(dB)
189.180000	123.0	V	-56.29	-13.0	-43.29
249.986667	251.0	V	-66.70	-13.0	-53.70
349.993333	141.0	V	-59.47	-13.0	-46.47
549.962500	65.0	V	-65.04	-13.0	-52.04
1738.000000	0.0	V	-43.56	-13.0	-30.56
3671.125000	28.0	V	-50.73	-13.0	-37.73
4177.150000	359.0	V	-44.81	-13.0	-31.81
6265.925000	359.0	V	-47.57	-13.0	-34.57
7884.750000	311.0	V	-46.73	-13.0	-33.73
8557.175000	335.0	V	-48.74	-13.0	-35.74

Remark:

The cabinet radiation was measured with the equipment transmitting a CW signal into a non-radiating 50 Ohm load at maximum output power on a signal frequency.

Measured were performed in the lowest, middle and highest frequency for the Downlink.

The spectrum was searched from 30MHz to 12.75GHz (10th Harmonic) for downlink.



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7.2.5 Input-versus-output signal comparison

Test Requirement:	For 758-775MHz: 47 CFR Part 90.210, 47 CFR Part 90.219(e)(4) For 851-869MHz: 47 CFR Part 2.1049
Test Method:	KDB 935210 D05 Indus Booster Basic Meas v01r04
Limit:	Shall within the passband
EUT Operation:	
Status:	Drive the EUT to maximum output power. .
Conditions:	Normal conditions
Application:	RF output ports
Test Configuration:	

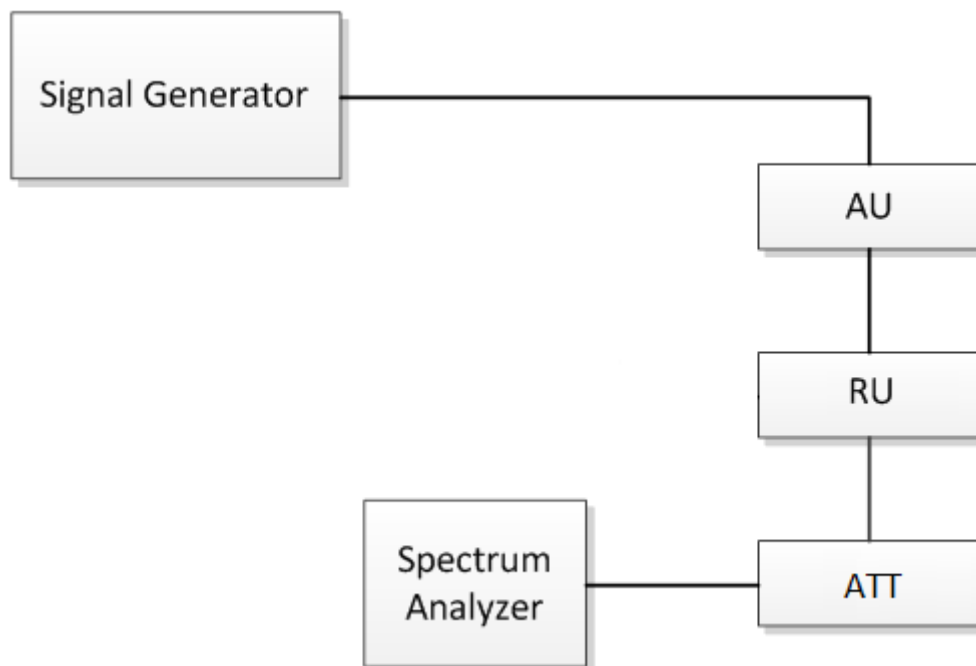


Fig.4. Input-versus-output signal comparison test configuration

Test Procedure:

- Connect a signal generator to the input of the EUT.
- Configure the signal generator to transmit the appropriate test signal associated with the public safety emission designation (see Table 1).
- Configure the signal level to be just below the AGC threshold (see results from 4.2).
- Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
- Set the spectrum analyzer center frequency to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between $2 \times$ to $5 \times$ the EBW (or OBW).



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- f) The nominal RBW shall be 300 Hz for 16K0F3E, and 100 Hz for all other emissions types.
- g) Set the reference level of the spectrum analyzer to accommodate the maximum input amplitude level, i.e., the level at f0 per 4.3.
- h) Set spectrum analyzer detection mode to peak, and trace mode to max hold.
- i) Allow the trace to fully stabilize.
- j) Confirm that the signal is contained within the appropriate emissions mask.
- k) Use the marker function to determine the maximum emission level and record the associated frequency.
- l) Capture the emissions mask plot for inclusion in the test report (output signal spectra).
- m) Measure the EUT input signal power (signal generator output signal) directly from the signal generator using power measurement guidance provided in KDB Publication 971168 [R8] (input signal spectra).
- n) Compare the spectral plot of the output signal (determined in step k), to the input signal (determined in step l) to affirm they are similar (in passband and rolloff characteristic features and relative spectral locations).
- o) Repeat steps d) to n) with the input signal amplitude set 3 dB above the AGC threshold.
- p) Repeat steps b) to o) for all authorized operational bands and emissions types (see applicable regulatory specifications, e.g., Section 90.210).
- q) Include all accumulated spectral plots depicting EUT input signal and EUT output signal in the test report, and note any observed dissimilarities.



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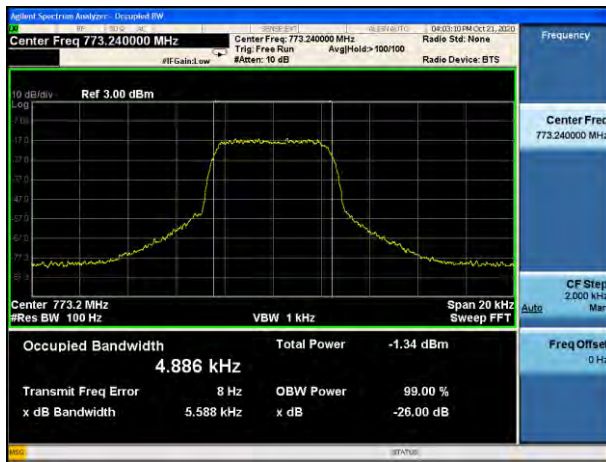
7.2.5.1 Measurement Record:

1.Downlink: 758MHz to 775MHz

1.1 Occupied Bandwidth

1.1.1 6.25kHz CQPSK Pre-AGC

Input

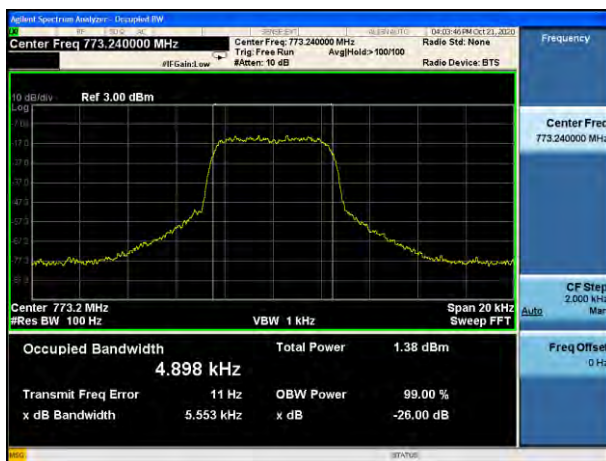


Output

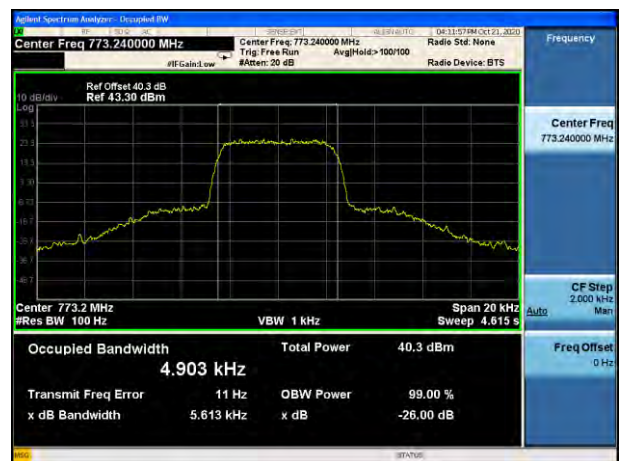


1.1.2 6.25kHz CQPSK 3dB above AGC

Input



Output



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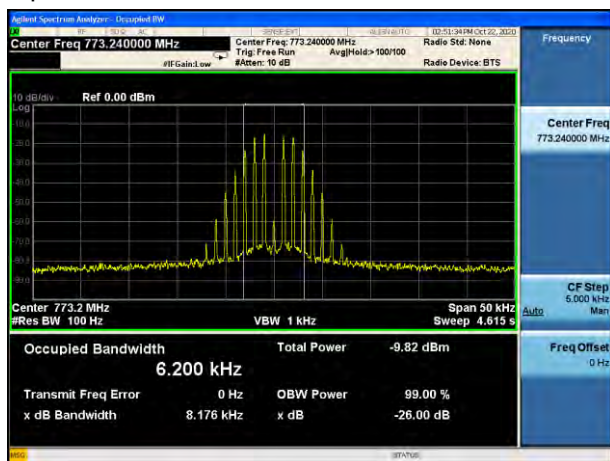
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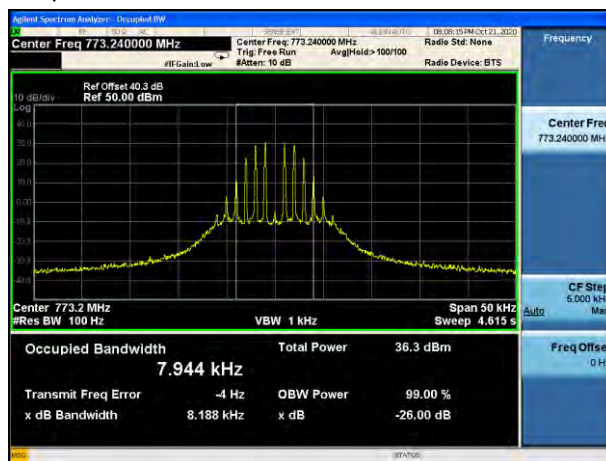
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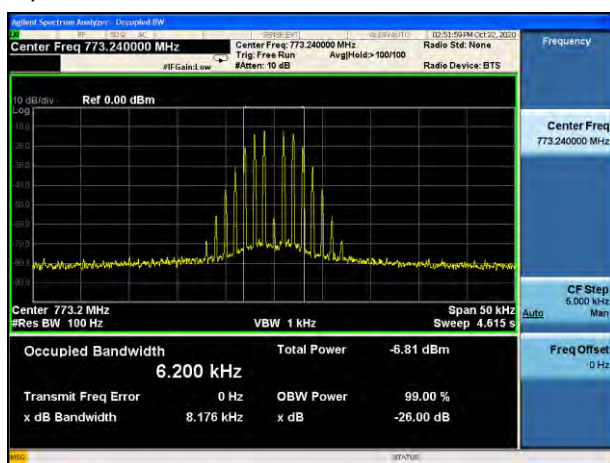
1.1.2 12.5kHz FM Pre-AGC Input



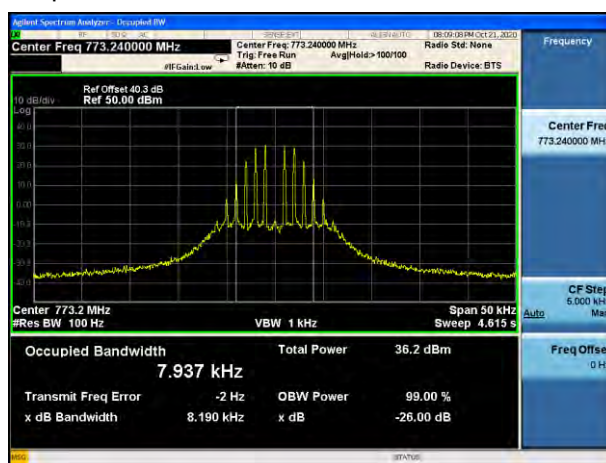
Output



1.1.2 12.5kHz FM 3dB above AGC Input



Output



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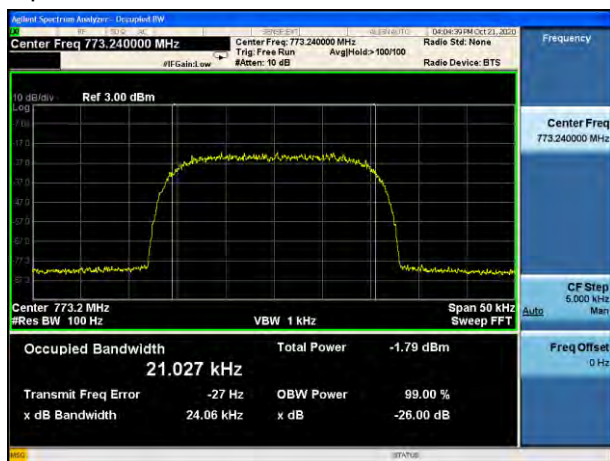
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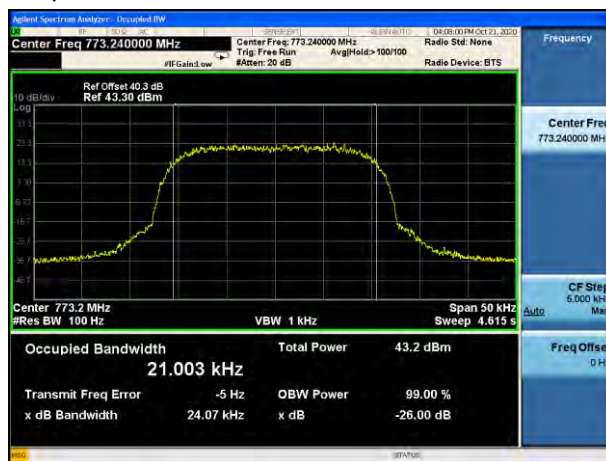
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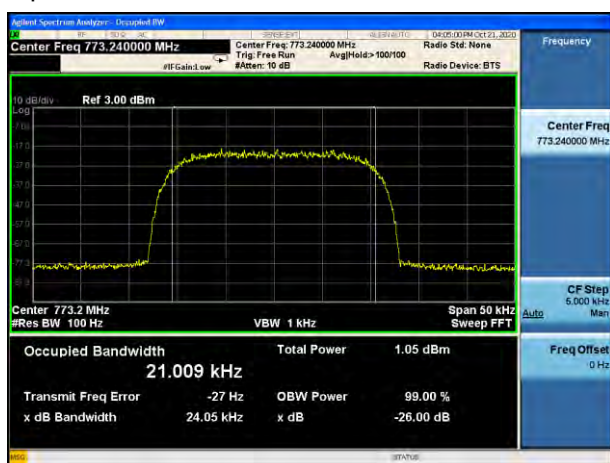
1.1.3 25kHz TETRA Pre-AGC Input



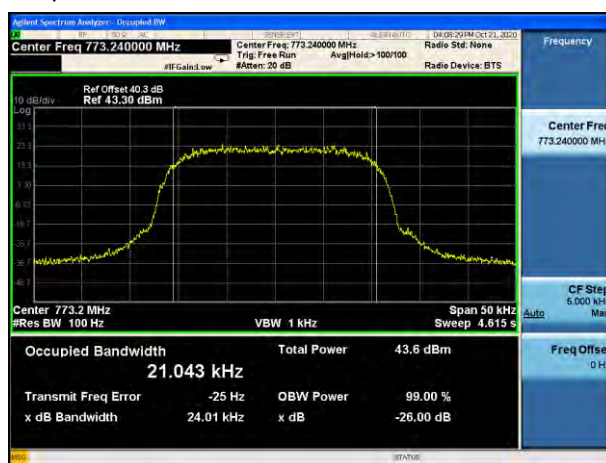
Output



1.1.3 25kHz TETRA 3dB above AGC Input



Output



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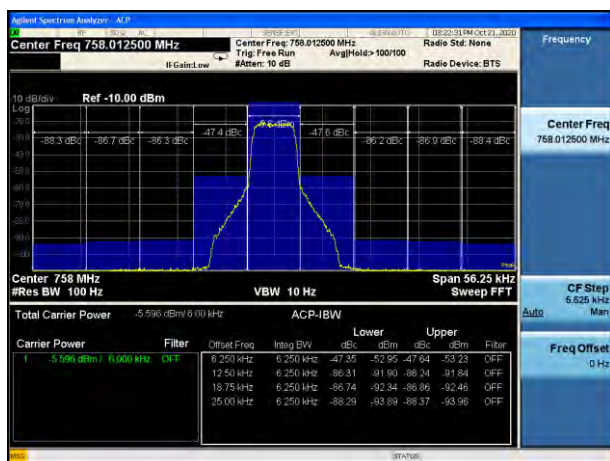
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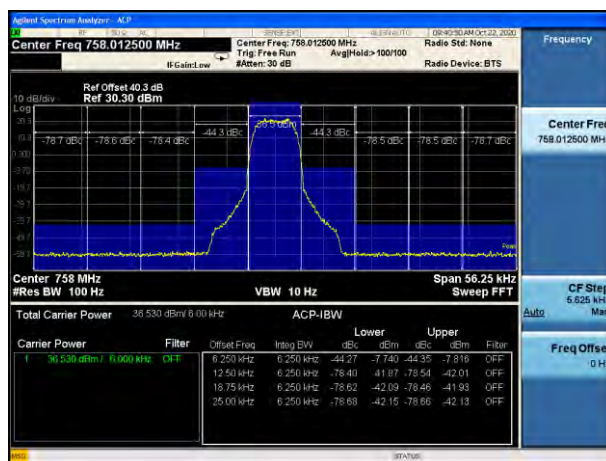
1.2 Adjacent Channel Power (6.25kHz CQPSK)

1.2.1 Pre-AGC_ Lowest frequency

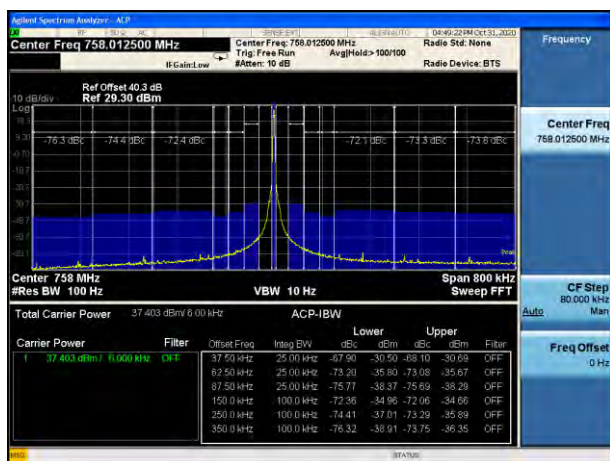
Input



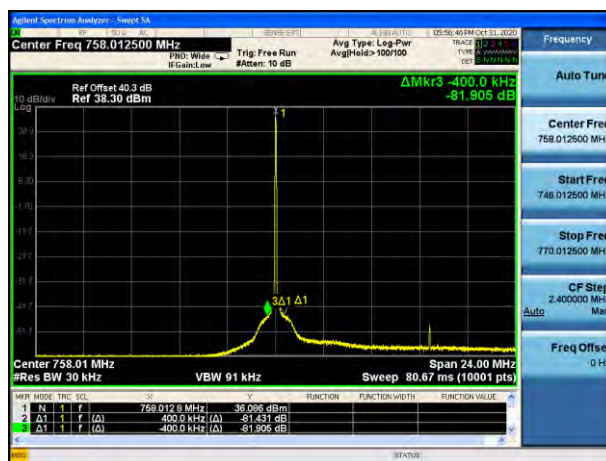
Output



Output



Output



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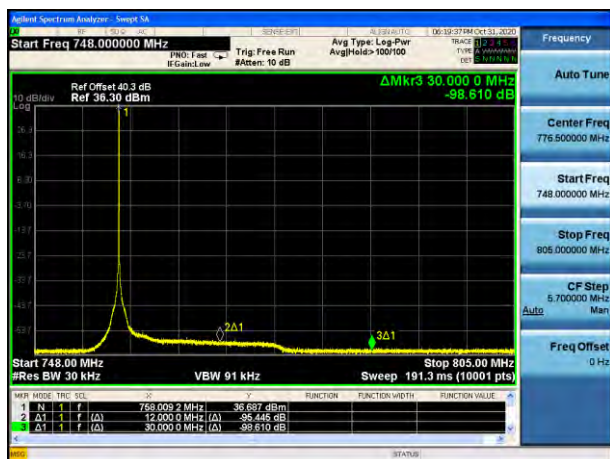
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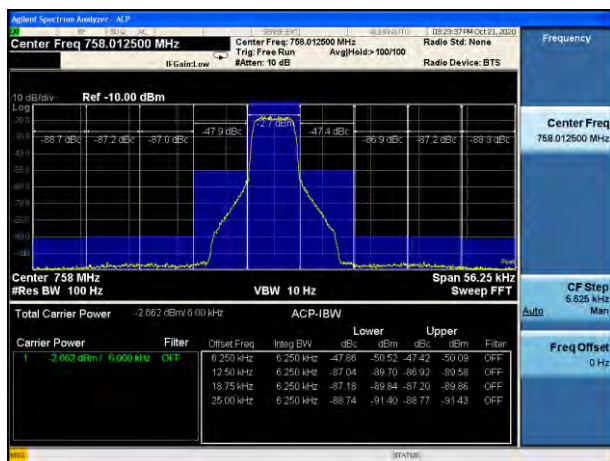
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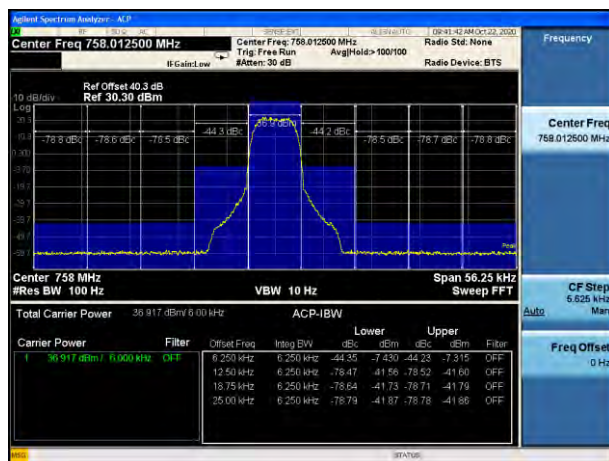
Output



1.2.2 3dB above AGC_ Lowest frequency Input



Output



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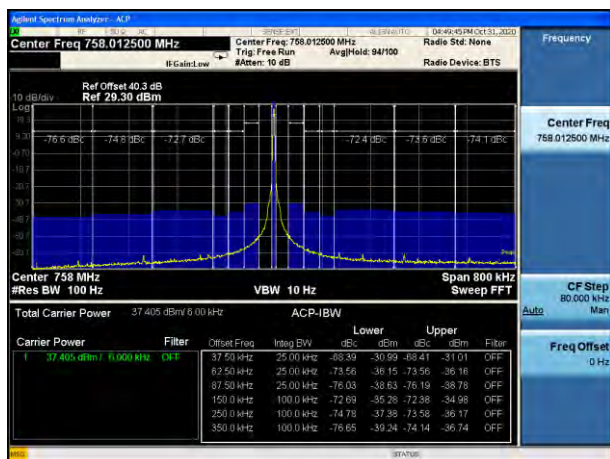
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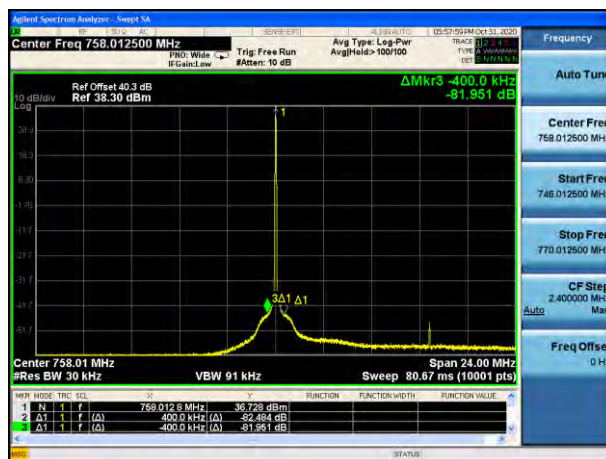
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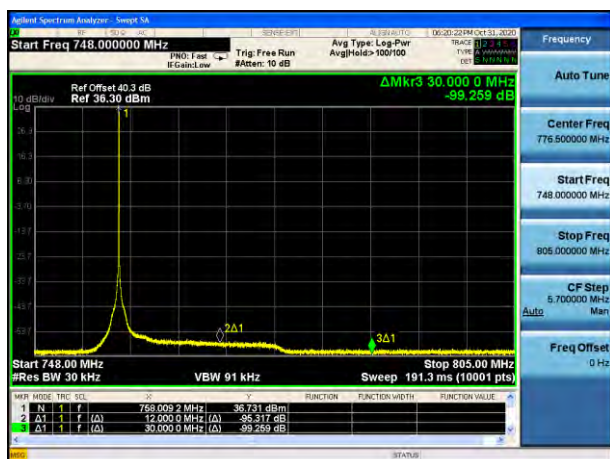
Output



Output



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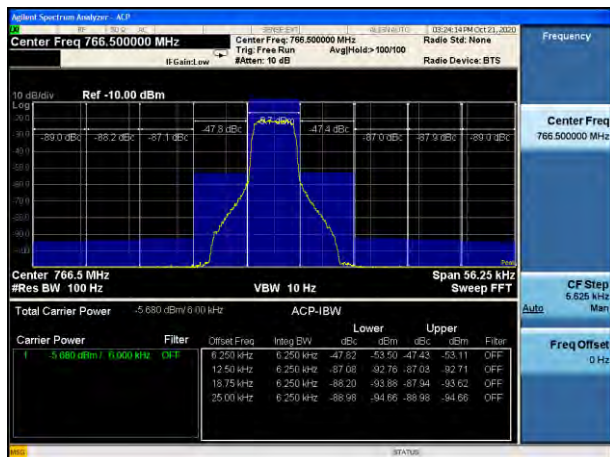
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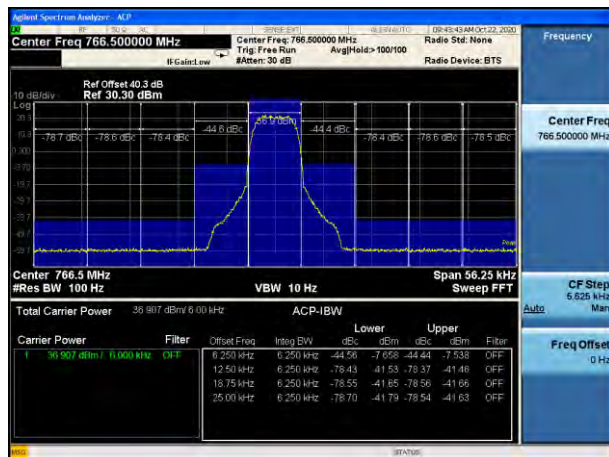
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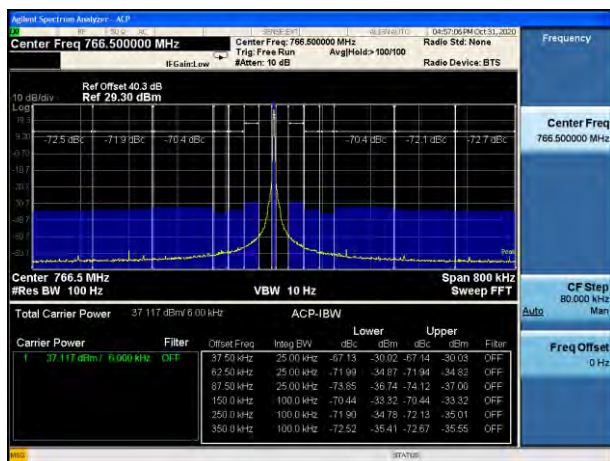
1.2.3 Pre-AGC_ Middle frequency Input



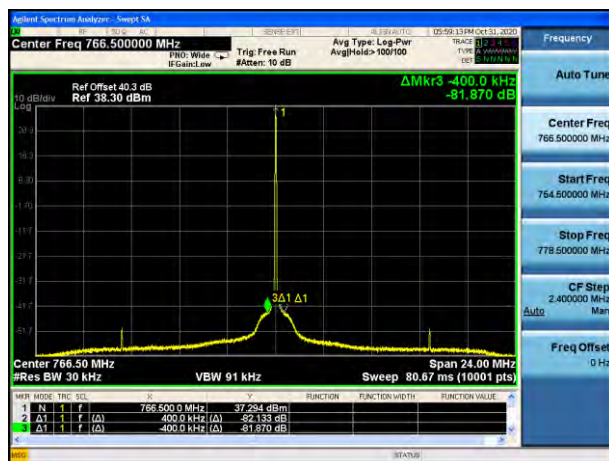
Output



Output



Output



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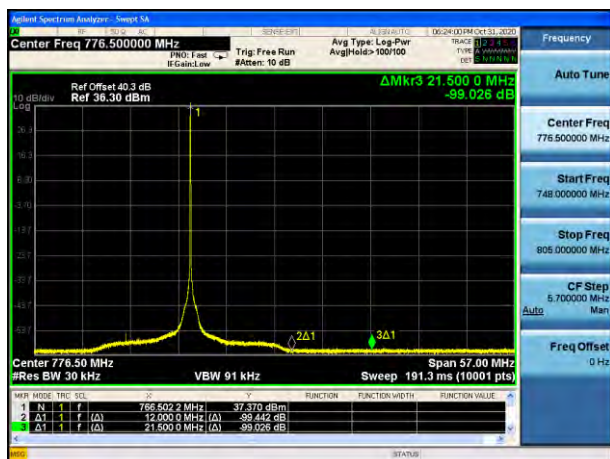
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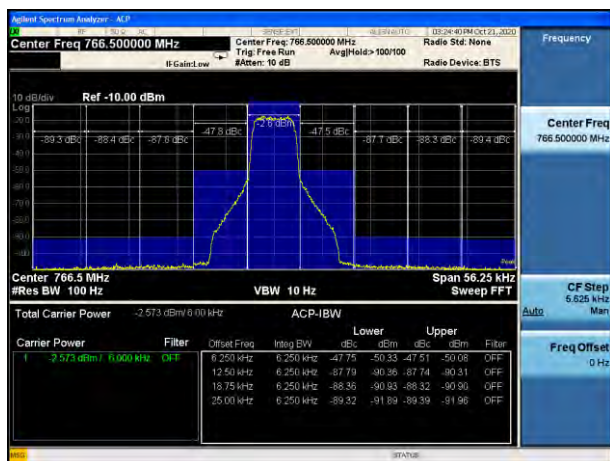
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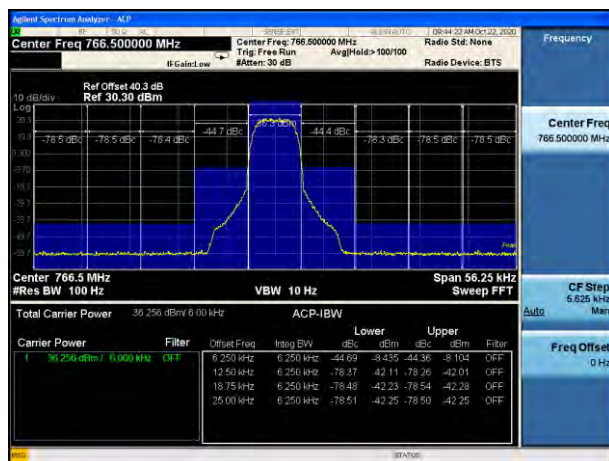
Output



1.2.4 3dB above AGC_ Middle frequency Input



Output



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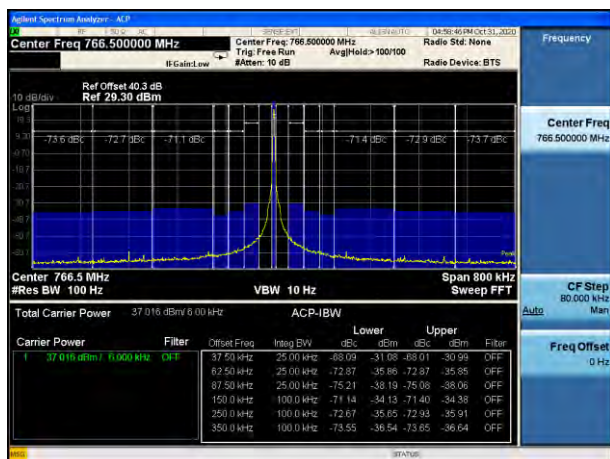
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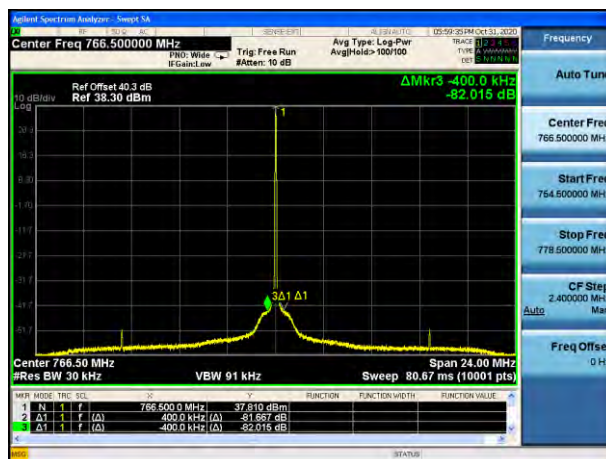
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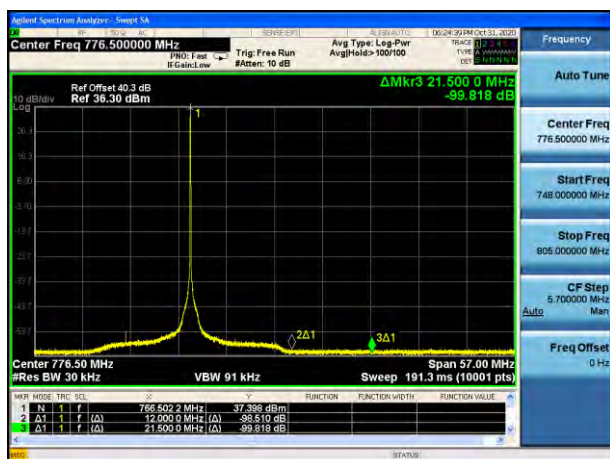
Output



Output



Output



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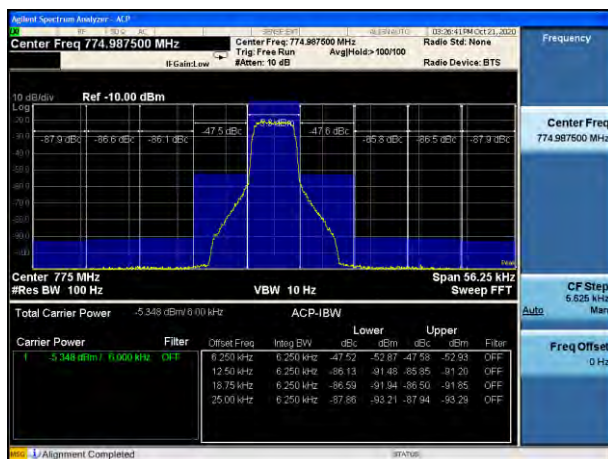
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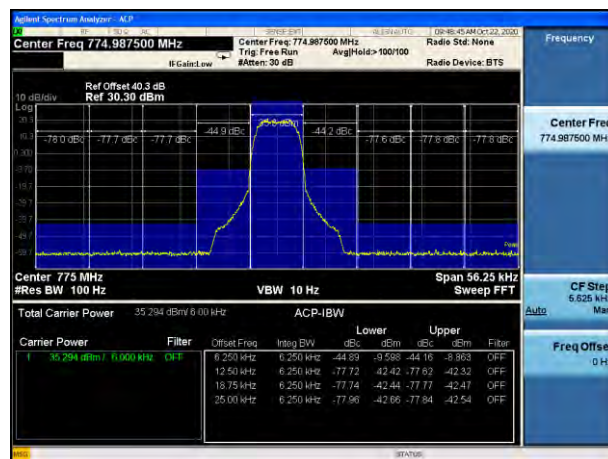
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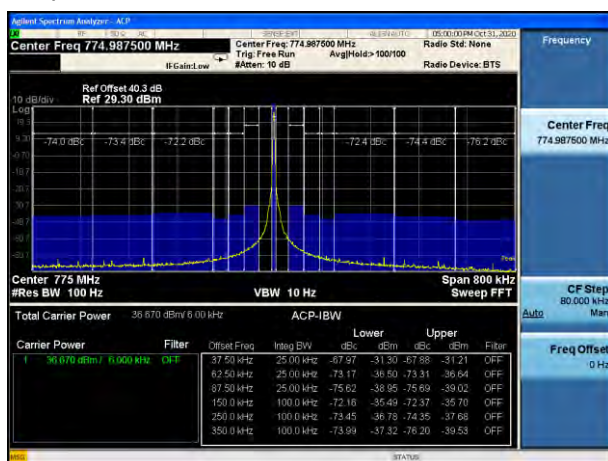
1.2.5 Pre-AGC_ Highest frequency Input



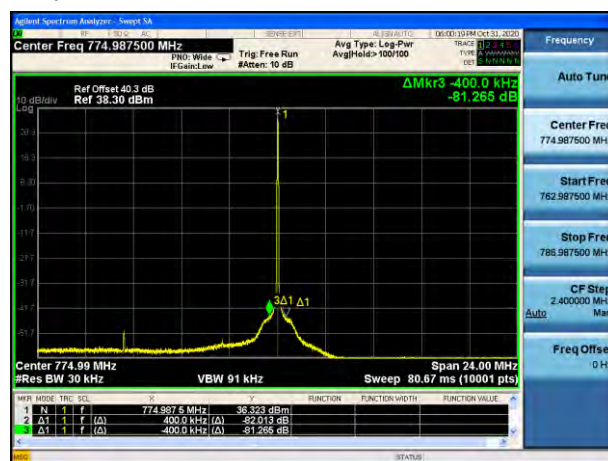
Output



Output



Output



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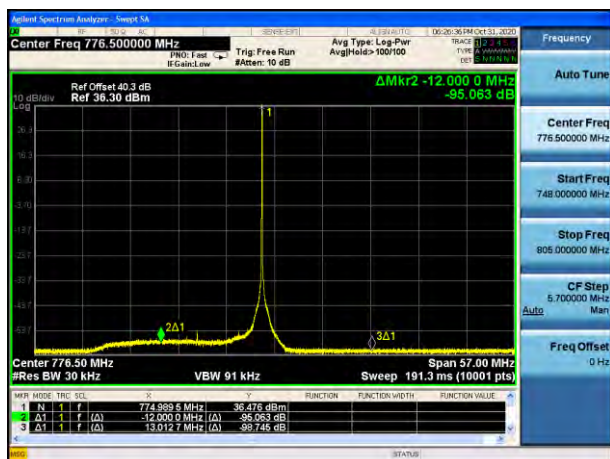
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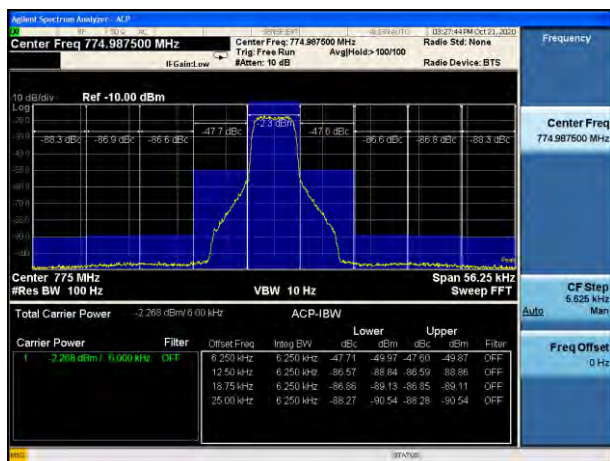
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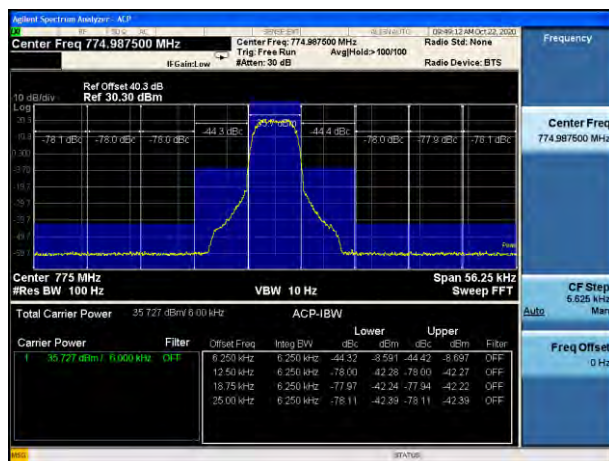
Output



1.2.6 3dB above AGC_ Highest frequency Input



Output



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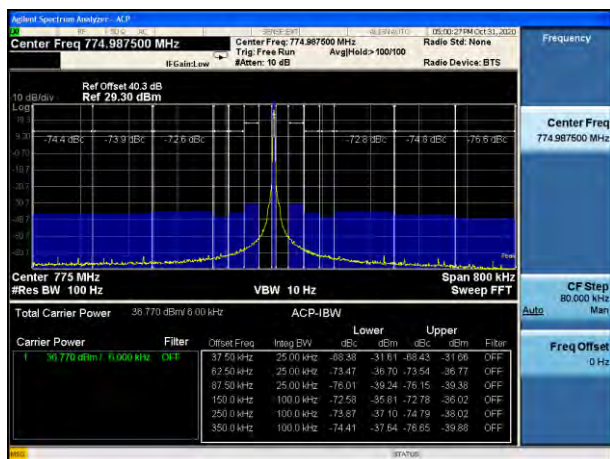
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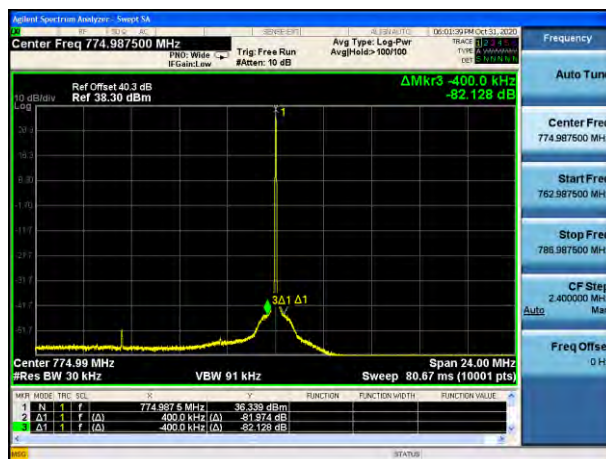
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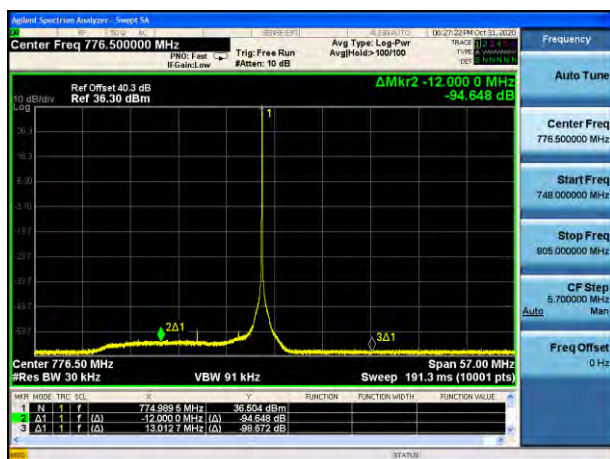
Output



Output



Output



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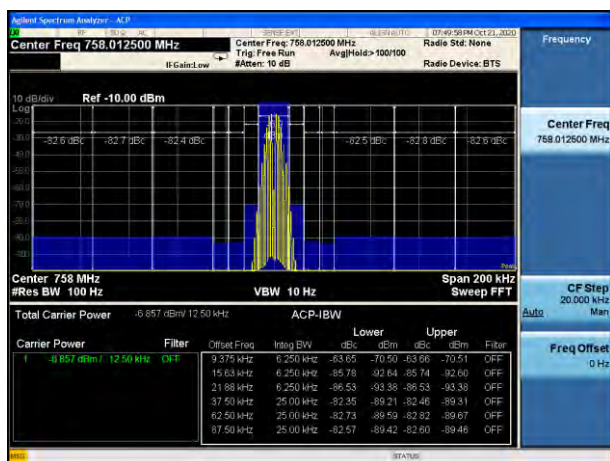
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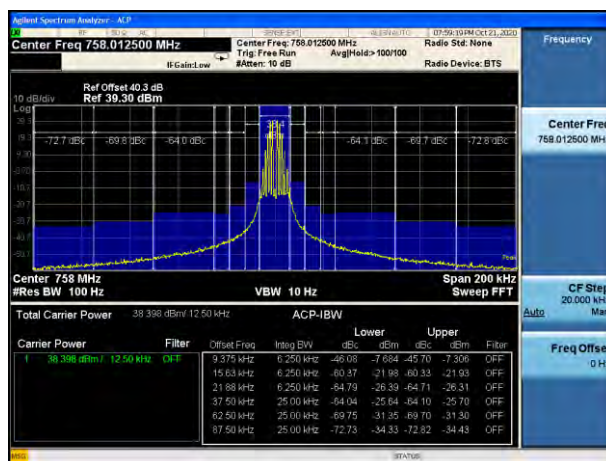
1.3 Adjacent Channel Power (12.5kHz FM)

1.3.1 Pre-AGC_ Lowest frequency

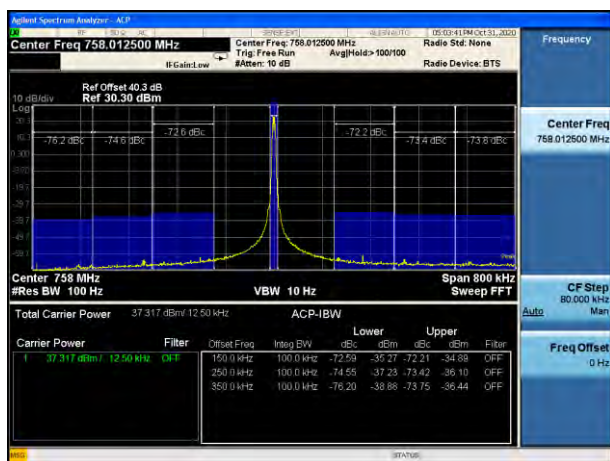
Input



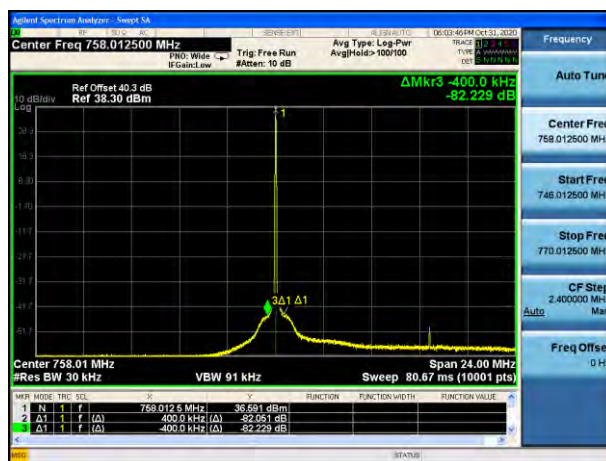
Output



Output



Output



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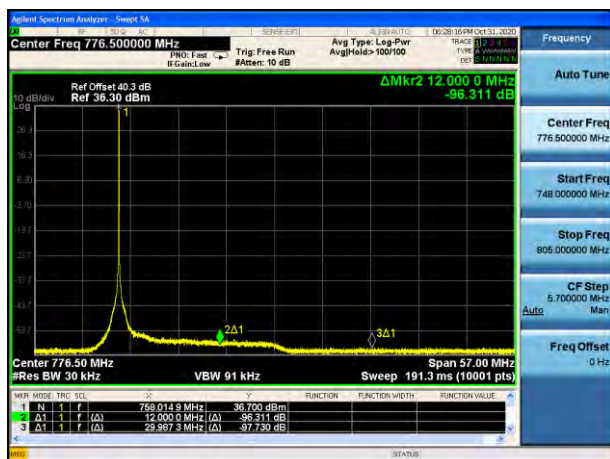
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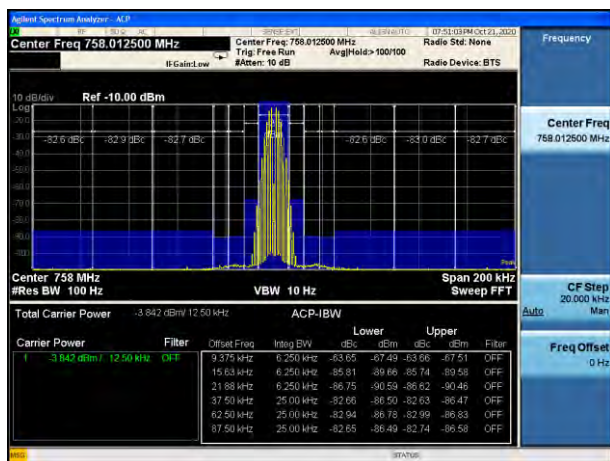
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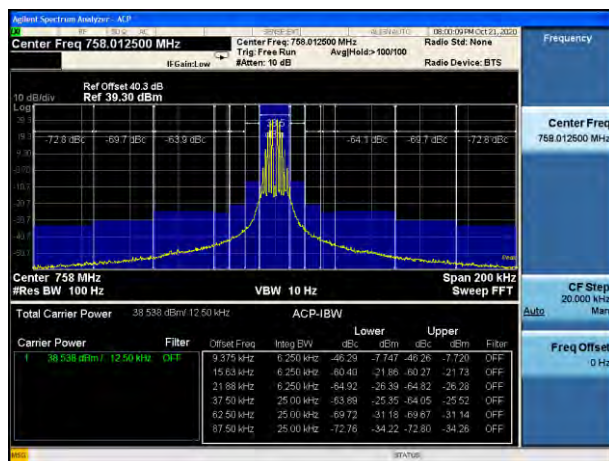
Output



1.3.2 3dB above AGC_ Lowest frequency Input



Output

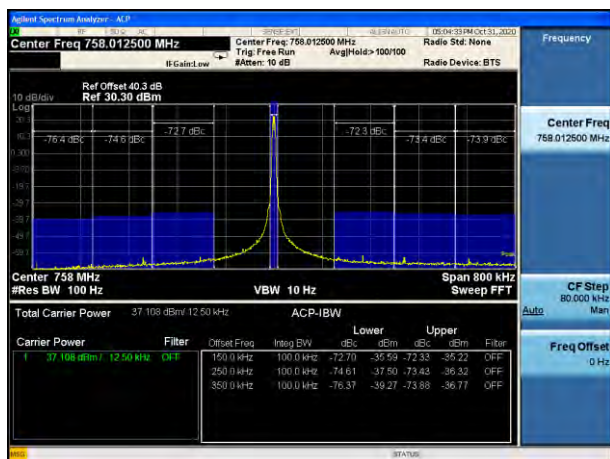


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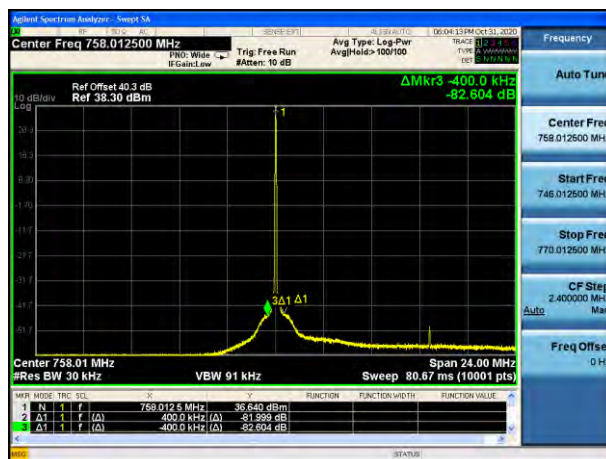
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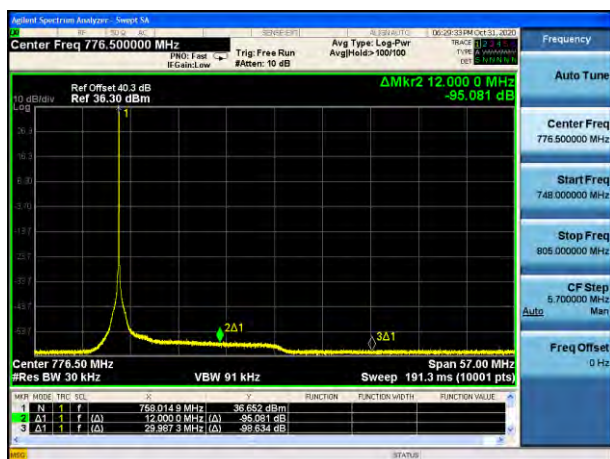
Output



Output



Output



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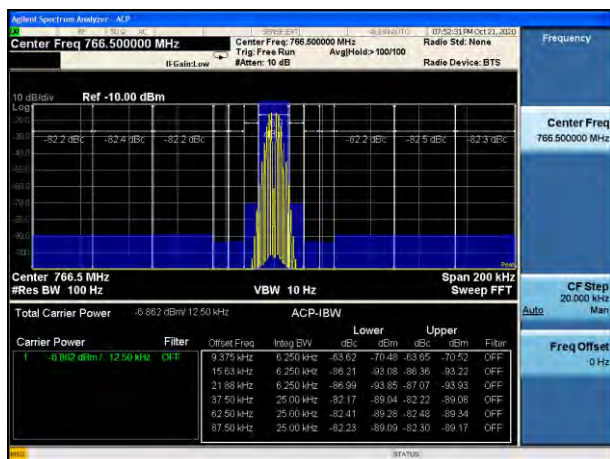
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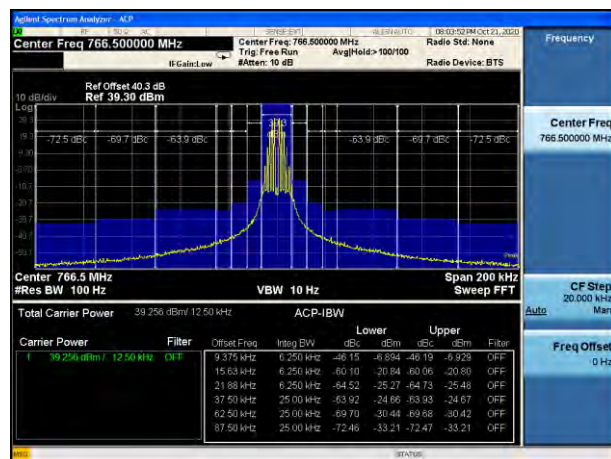
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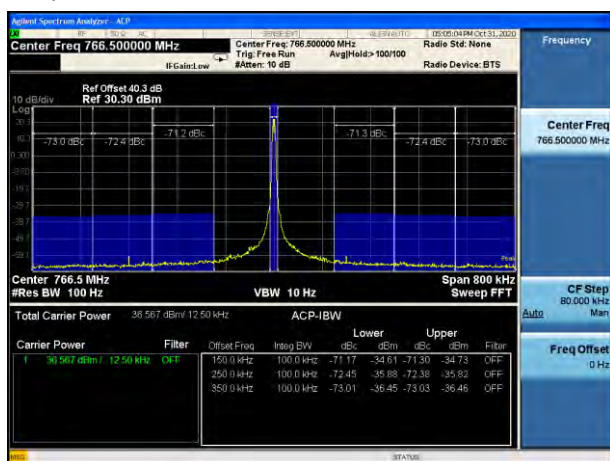
1.3.3 Pre-AGC_ Middle frequency Input



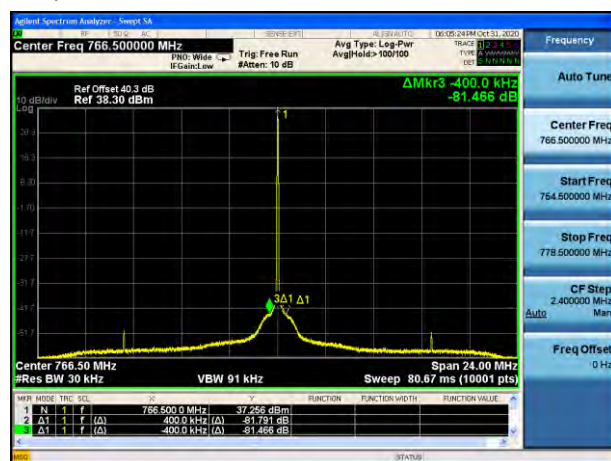
Output



Output



Output



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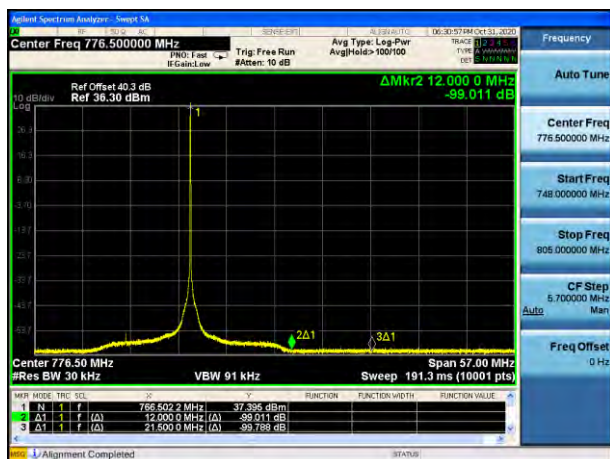
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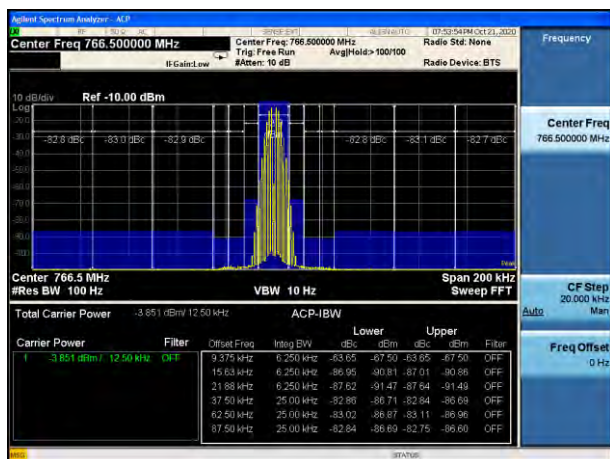
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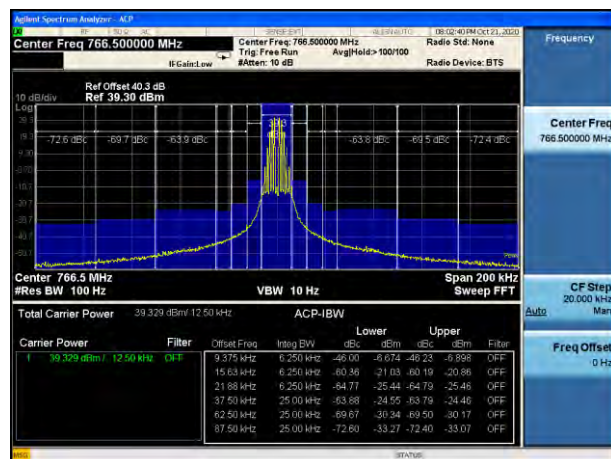
Output



1.3.4 3dB above AGC_ Middle frequency Input



Output

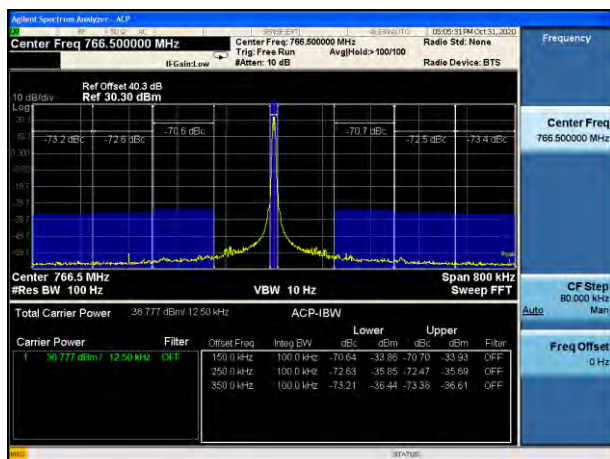


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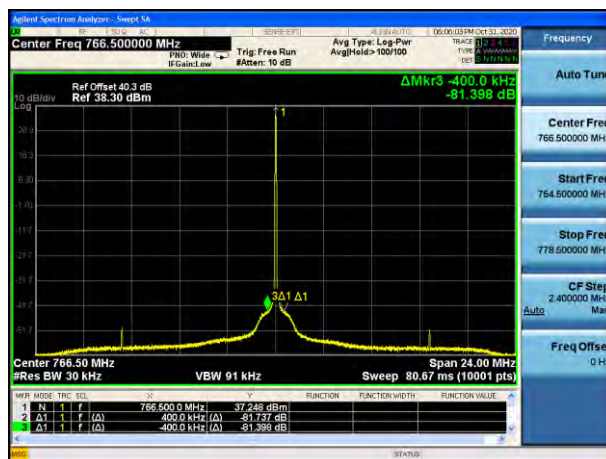
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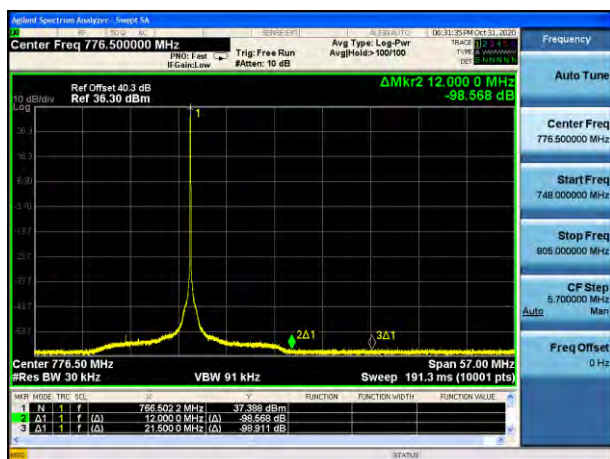
Output



Output



Output



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