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TEST REPORT

FCC Test for PSR-78-8527
Class II Permissive Change

APPLICANT
ADRF KOREA, Inc.

REPORT NO.
HCT-RF-2111-FC058

DATE OF ISSUE
November 25, 2021

Tested by
Kyung Soo Kang

Technical Manager
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TEST REPORT

FCC Test for
PSR-78-8527

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Additional Model
-

Applicant	**ADRF KOREA, Inc.** 5-5, Mojeon-Ri, Backsa-Myun, Icheon-Citi, Kyunggi-Do, Korea
Eut Type Model Name	Repeater PSR-78-8527
FCC ID	N52-PSR-78-8527
Output Power	Downlink: 27 dBm / Uplink: 24 dBm
Date of Test	November 15, 2021 ~ November 24, 2021
FCC Rule Parts:	Part 2, Part 90

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	November 25, 2021	Initial Release

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

CONTENTS

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	ADRF KOREA, Inc.
Company Address	5-5, Mojeon-Ri, Backsa-Myun, Icheon-Citi, Kyunggi-Do, Korea

1.2. PRODUCT INFORMATION

EUT Type	Repeater		
EUT Serial Number	PSR788527211001		
Power Supply	Input: 110 Vac ~ 240 Vac / Output (DC): +27V, +6V, +3.8V		
Frequency Range	Band Name	Uplink (MHz)	Downlink (MHz)
	NPSPAC	806 ~ 809	851 ~ 854
Tx Output Power	DL: 27 dBm / UL: 24 dBm		
Antenna Peak Gain	Band Name	Uplink	Downlink
		Panel antenna	Omni antenna
	NPSPAC	16 dBi	3.9 dBi

1.3. TEST INFORMATION

FCC Rule Parts	Part 2, Part 90
Measurement Standards	KDB 935210 D05 v01r04, ANSI C63.26-2015
Test Location	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.

The site is constructed in conformance with the requirements of ANSI C63.4 (Version: 2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2 and Part 90.

Description	Reference
AGC threshold	KDB 935210 D05 v01r04 4.2
Out-of-band rejection	KDB 935210 D05 v01r04 4.3
Occupied Bandwidth	§ 2.1049 § 90.209, § 90.219(e)(4)(ii)
Input-versus-output signal comparison	§ 90.210, § 90.219(e)(4)(iii)
Input/output power and amplifier/booster gain	§ 2.1046, § 90.219(e)(1)
Noise figure	§ 90.219(e)(2)
Emission masks Out-of-band/out-of-block emissions and spurious emissions	§ 2.1051, § 90.219(e)(3)
Spurious emissions radiated	§ 2.1053

Note:

C2PC models are electrically identical to the Original models.

The Product Equality Declaration includes detailed information about the changes between the devices.

FCC ID : N52-PSR-78-8527 report. (Report No. HCT-RF-2012-FC042)

3.2. ADDITIONAL DESCRIPTIONS ABOUT TEST

Except for the following cases, EUT was tested under normal operating conditions.
: Out-of-band rejection test requires maximum gain condition without AGC.

This EUT is supported power supply both of AC and DC. Test results are only attached worst cases.

The test was generally based on the method of KDB 935210 D05 v01r04 and only followed ANSI C63.26-2015 if there was no test method in KDB standard.

EUT was tested with following modulated signals provide by applicant.

Band Name	Link	Frequency	Tested signals
NPSPAC	Uplink	(806 ~ 809) MHz	P25 Phase 1
	Downlink	(851 ~ 854) MHz	

Below channels are not tested because it could consist of a combination of P25 Phase 1 signals.

Channelizing	P25 Phase 1 combinations	Bandwidth
12.5 kHz x n	n = 6 ~ 26	75 kHz ~ 325 kHz

The frequency stability measurement has been omitted in accordance with section 3.7 of KDB 935210 D05 v01r04.
: It can be confirmed through input-versus-output signal comparison test that EUT does not alter the input signal.

The tests results included actual loss value for attenuator and cable combination as shown in the table below.

: Input Path

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
600	0.369	800	0.415
650	0.536	850	0.522
700	0.420	900	0.723
750	0.472	950	0.587

: Output Path

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
10	29.563	1 700	32.084
30	29.540	1 800	32.100
50	29.587	1 900	32.179
100	29.734	2 000	32.342
200	29.992	2 100	32.497
300	30.423	2 200	32.529
400	30.673	2 300	32.602
500	30.866	2 400	32.766
600	31.018	2 500	32.836
700	31.158	2 600	33.004
800	31.216	2 700	32.788
900	31.263	3 000	33.437
1 000	31.331	4 000	34.259
1 100	31.436	5 000	34.441
1 200	31.716	6 000	34.988
1 300	31.787	7 000	35.917
1 400	31.906	8 000	35.966
1 500	31.987	9 000	36.684
1 600	32.172	10 000	38.385

3.3. MEASUREMENTUNCERTAINTY

Description	Condition	Uncertainty
Radiated Disturbance	9 kHz ~ 30 MHz	± 3.40 dB
	30 MHz ~ 1 GHz	± 4.80 dB
	1 GHz ~ 18 GHz	± 5.70 dB
	18 GHz ~ 40 GHz	± 5.05 dB

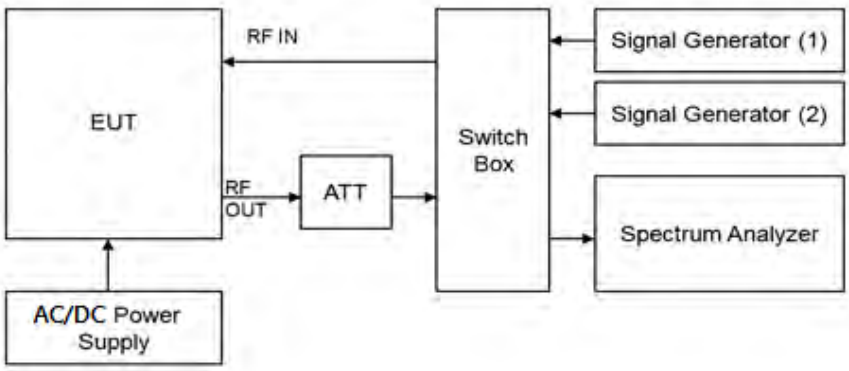
* Coverage factor k = 2, Confidence levels of 95 %

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature	+15 °C to +35 °C
Relative humidity	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

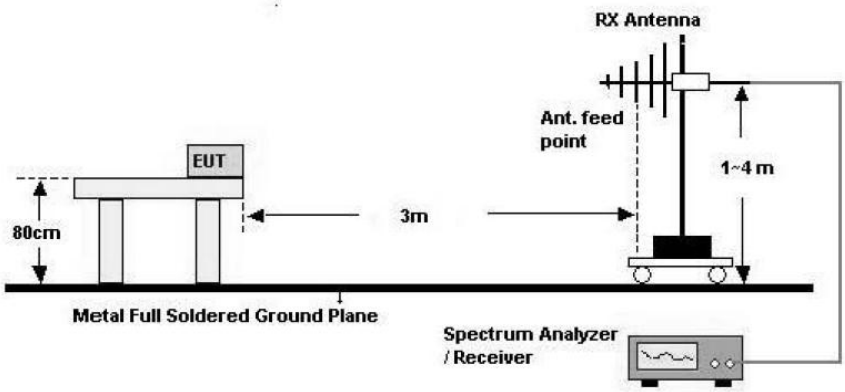
3.5. TEST DIAGRAMS

Conducted Test

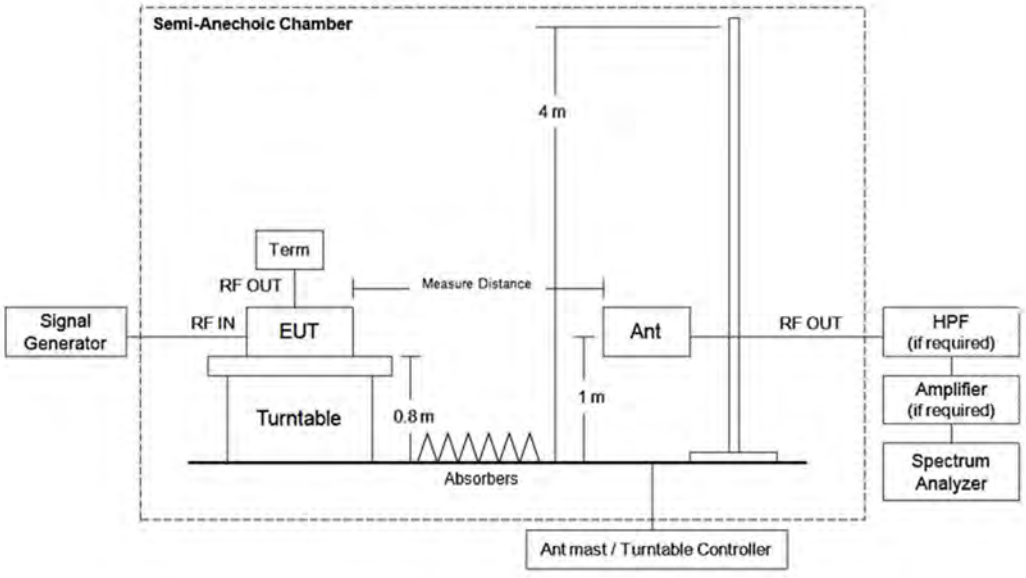


Radiated Test

30 MHz ~ 1 GHz



Above 1 GHz



4. TEST EQUIPMENTS

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
MXA Signal Analyzer	N9020A	Agilent	MY52440870	09/02/2022	Annual
MXG Vector Signal Generator	N5182A	Agilent	MY47070406	01/08/2022	Annual
MXG Vector Signal Generator	N5182A	Agilent	MY46240807	12/02/2021	Annual
30 dB Attenuator	WA93-30-33	Weinschel Associates	0202	03/30/2022	Annual
Switch	S46	KEITHLEY	1088024	N/A	N/A
AC, DC Power Supply	PCR4000M	KIKUSUI	VM002269	09/29/2022	Annual
Controller(Antenna mast & Turn Table)	CO3000	Innco system	CO3000/1251/48920320/P	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Controller	EM1000	Audix	060520	N/A	N/A
Turn Table	DS2000-S	Innco system	N/A	N/A	N/A
Amp & Filter Bank Switch Controller	FBSM-01B	TNM system	TM20090002	N/A	N/A
Loop Antenna	Loop Antenna	Rohde & Schwarz	1513-175	05/12/2022	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	01039	08/02/2022	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	02296	06/28/2022	Biennial
Spectrum Analyzer	FSP40	Rohde & Schwarz	100843	11/08/2022	Annual
Low Noise Amplifier	LLAU1183540Q	LTC Microwave	100	09/16/2022	Annual
High Pass Filter	WHKX10-900-1000-15000-40SS	Wainwright Instruments	16	08/05/2022	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

5. TEST RESULT

5.1. AGC THRESHOLD

Test Requirement:

KDB 935210 D05 v01r04

Testing at and above the AGC threshold is required.

Test Procedures:

Measurements were in accordance with the test methods section 4.2 of KDB 935210 D05 v01r04.

Testing at and above the AGC threshold will be required. The AGC threshold shall be determined by applying the procedure of 3.2, but with the signal generator configured to produce a test signal defined in Table 1, a CW input signal, or a digitally modulated signal, consistent with the discussion about signal types in 4.1.

Measurement were in accordance with the test methods in subclause 7.2.3.1 of ANSI C63.26.

a) Connect a signal generator to the input of the EUT.
b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation.
c) The signal generator must be set for CW operation.
d) While monitoring the output of the EUT, increase the input level until a 1 dB increase in the input signal no longer causes a 1 dB increase in the output signal.
e) This is the AGC threshold level of the EUT.

Test Results:

Test Band	Link	Signal	Center Frequency (MHz)	AGC Threshold Level (dBm)	Output Level (dBm)
NPSPAC	Uplink	P25 Phase 1	807.50	-61	23.86
	Downlink	P25 Phase 1	852.50	-58	26.73

5.2. OUT-OF-BAND REJECTION

Test Requirement:

KDB 935210 D05 v01r04

Out-of-band rejection required.

Test Procedures:

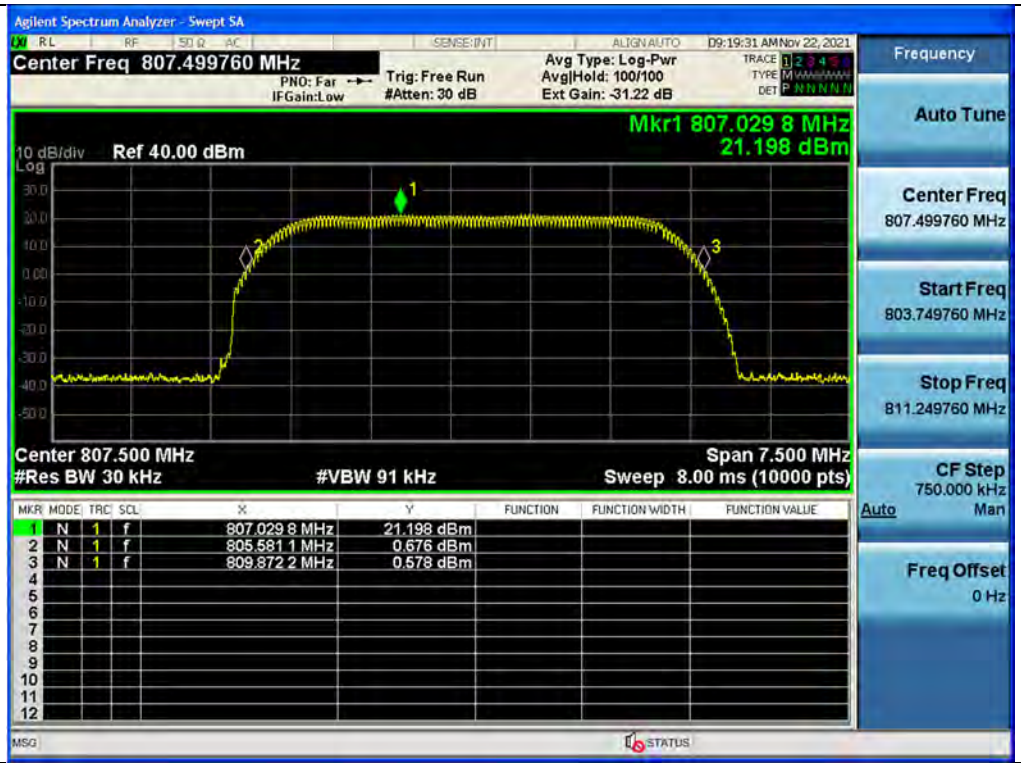
Measurements were in accordance with the test methods section 4.3 of KDB 935210 D05 v01r04.

A signal booster shall reject amplification of other signals outside of its passband. Adjust the internal gain control of the EUT to the maximum gain for which equipment certification is sought.

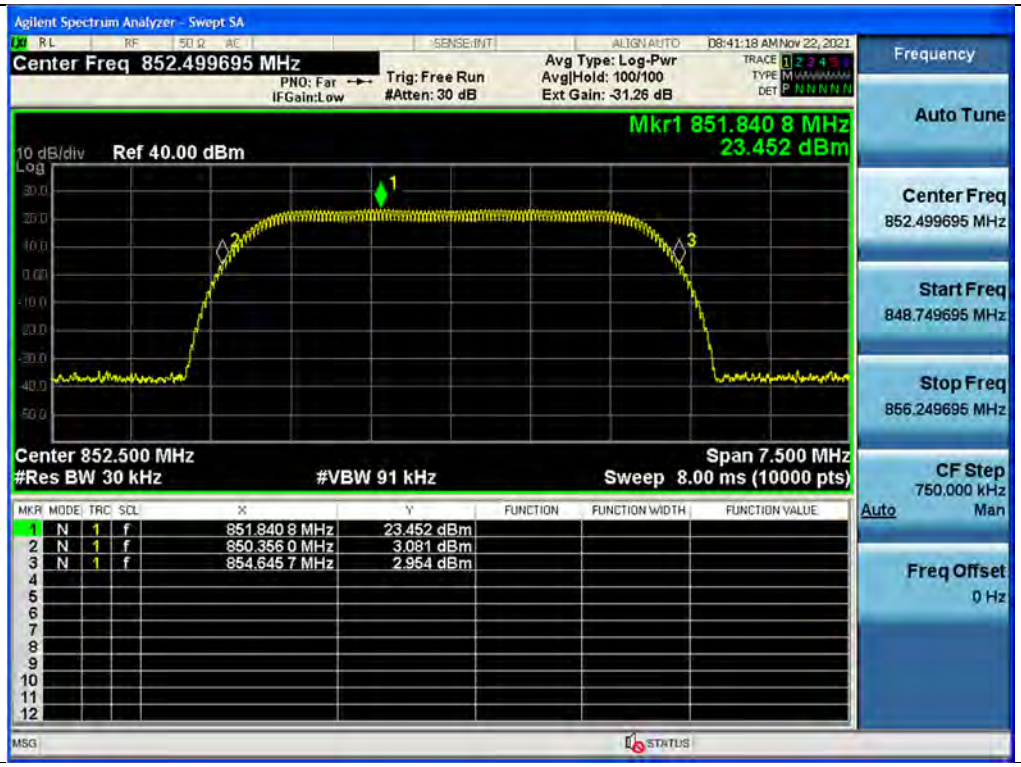
a) Connect a signal generator to the input of the EUT.
b) Configure a swept CW signal with the following parameters:
   1) Frequency range = ± 250 % of the manufacturer's specified pass band.
   2) The CW amplitude shall be 3 dB below the AGC threshold (see 4.2), and shall not activate the AGC threshold throughout the test.
   3) Dwell time = approximately 10 ms.
   4) Frequency step = 50 kHz.
c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
d) Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer's rated passband, and VBW = 3 × RBW.
e) Set the detector to Peak and the trace to Max-Hold.
f) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f_0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the level has fallen by 20 dB).
g) Capture the frequency response plot for inclusion in the test report.

Test Results:

NPSPAC / Uplink



NPSPAC / Downlink



5.3. OCCUPIED BANDWIDTH

Test Requirement:

§ 2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

§ 90.209 Bandwidth limitations.

Table 1 to § 90.209(b)(5) - Standard Channel Spacing/Bandwidth

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
Below 25		
25-50	20	20
72-76	20	20
150-174	7.5	[1]20/11.25/6
216-220	6.25	20/11.25/6
220-222	5	4
406-512	6.25	20/11.25/6
806-809/851-854*	12.5	20
809-817/854-862	12.5	20/11.25
817-824/862-869	25	20
896-901/935-940	12.5	13.6
902-928		
929-930	25	20
1427-1432	12.5	12.5
2450-2483.5		
Above 2500		

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(4) A signal booster must be designed such that all signals that it retransmits meet the following requirements:

(ii) There is no change in the occupied bandwidth of the retransmitted signals.

Test Procedures:

Measurements were in accordance with the test methods section 5.4.4 of ANSI C63.26-2015.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) Omit

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

Test Results:

Tabular data of Output Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)
NPSPAC	Uplink	P25 Phase 1	807.50	8.286
	Downlink	P25 Phase 1	852.50	8.249

Tabular data of Input Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)
NPSPAC	Uplink	P25 Phase 1	807.50	8.215
	Downlink	P25 Phase 1	852.50	8.306

Tabular data of 3 dB above the AGC threshold Output Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)
NPSPAC	Uplink	P25 Phase 1	807.50	8.378
	Downlink	P25 Phase 1	852.50	8.324

Tabular data of 3 dB above the AGC threshold Input Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)
NPSPAC	Uplink	P25 Phase 1	807.50	8.329
	Downlink	P25 Phase 1	852.50	8.167

Measured Occupied Bandwidth Comparison

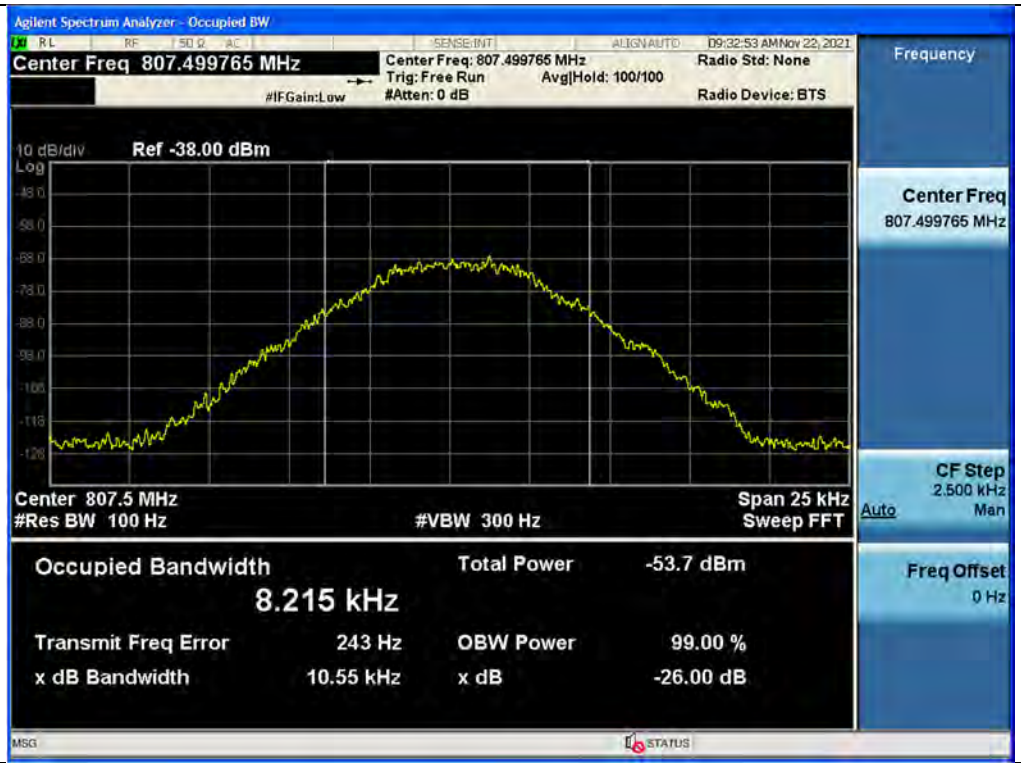
Test Band	Link	Signal	Variant of Input and output Occupied Bandwidth (%)	Variant of Input and 3 dB above the AGC threshold output Occupied Bandwidth (%)
NPSPAC	Uplink	P25 Phase 1	0.86	0.59
	Downlink	P25 Phase 1	-0.69	1.92

** Change in input-output OBW is less than ±5 %.*

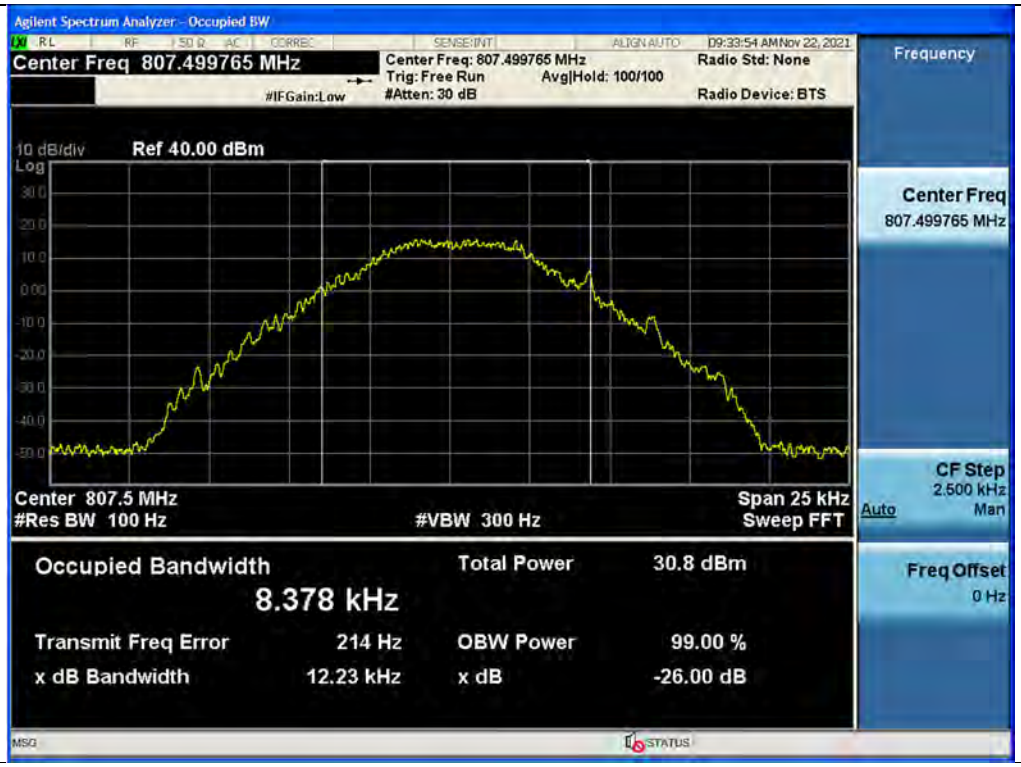
Plot data of Occupied Bandwidth

Output / NPSPAC / Uplink / P25 Phase 1

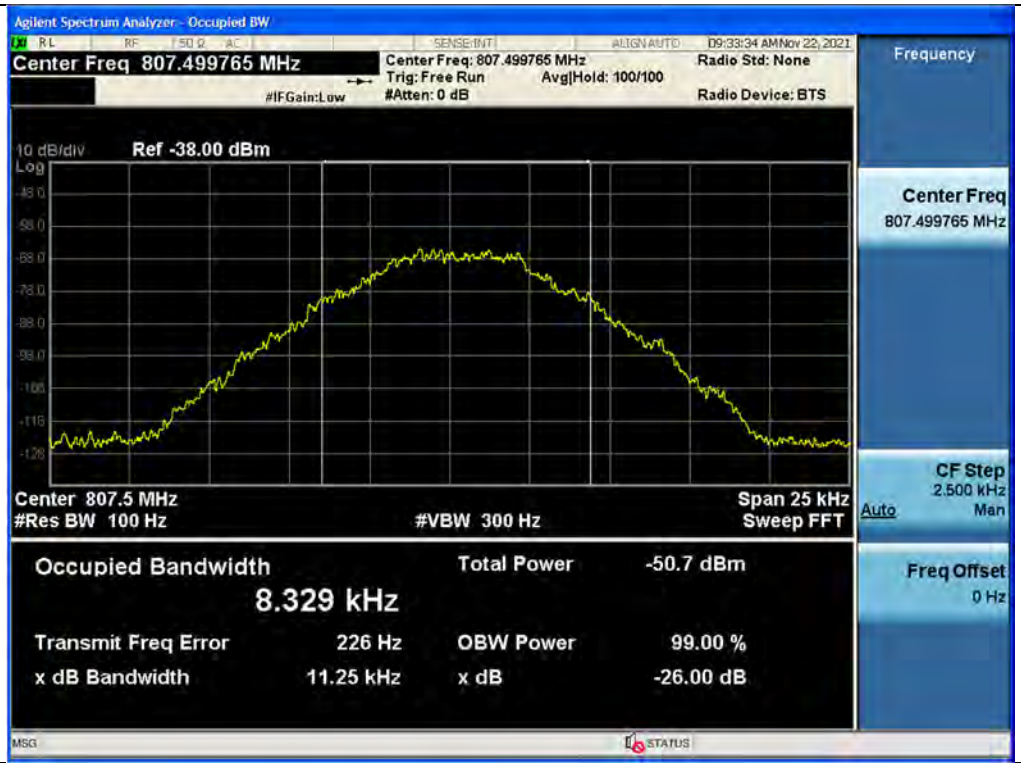
Input / NPSPAC / Uplink / P25 Phase 1



3 dB above the AGC threshold output / NPSPAC / Uplink / P25 Phase 1

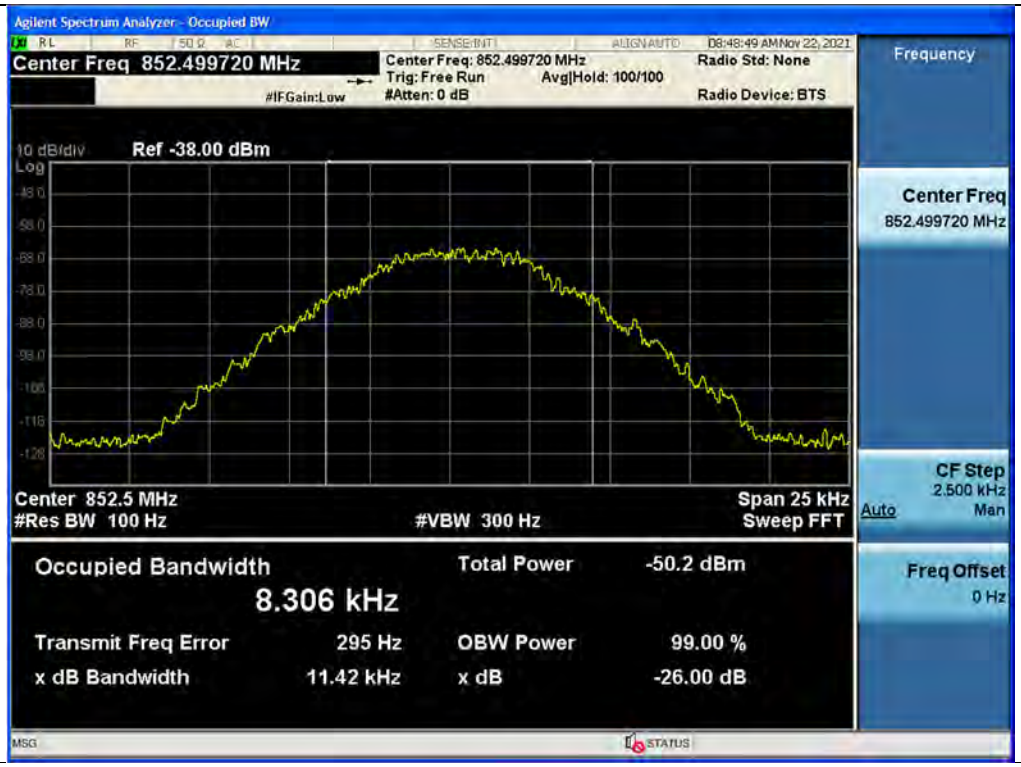


3 dB above the AGC threshold Input / NPSPAC / Uplink / P25 Phase 1



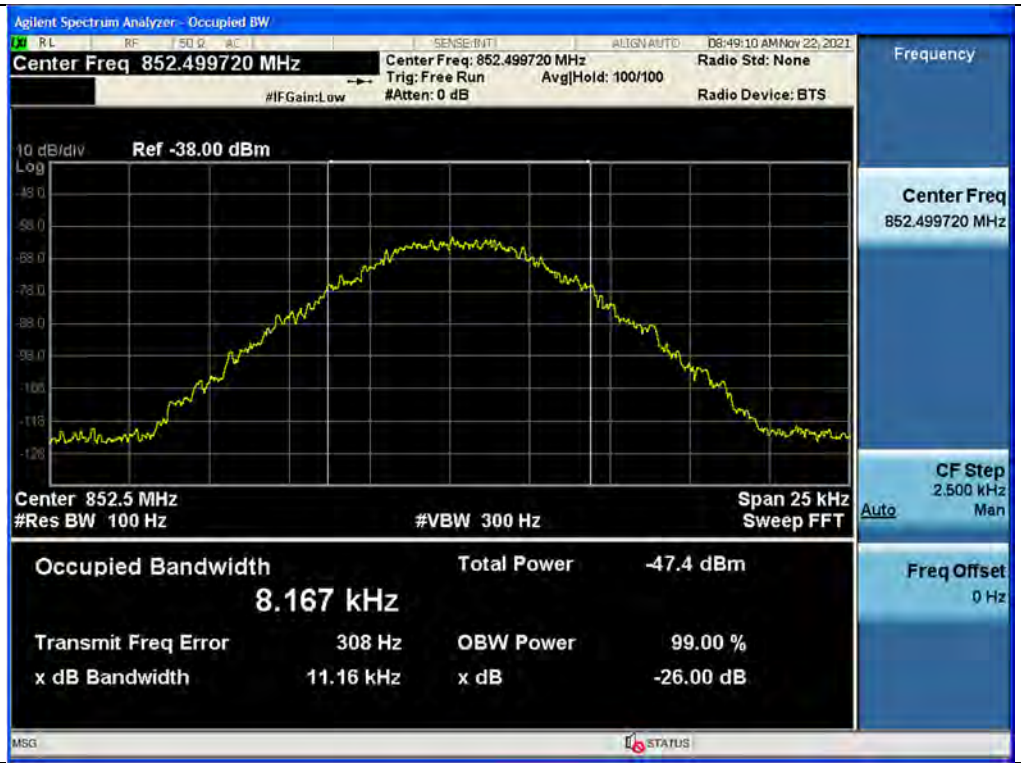
Output / NPSPAC / Downlink / P25 Phase 1

Input / NPSPAC / Downlink / P25 Phase 1



3 dB above the AGC threshold output / NPSPAC / Downlink / P25 Phase 1

3 dB above the AGC threshold Input / NPSPAC / Downlink / P25 Phase 1



5.4. INPUT-VERSUS-OUTPUT SIGNAL COMPARISON

Test Requirement:

§ 90.210 Emission masks.

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (o) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating under this part.

Applicable Emission Masks

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25	A or B	A or C
25-50	B	C
72-76	B	C
150-174	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854*	B	H
809-824/854-869	B, D	D, G.
896-901/935-940	I	J
902-928	K	K
929 ~ 930	B	G
4940-4990 MHz	L or M	L or M
5850-5925		
All other bands	B	C

* Transmitter utilizing analog emissions that are equipped with an audio low-pass filter must meet Emission Mask B. All transmitters utilizing digital emissions and those transmitters using analog emissions without an audio low-pass filter must meet Emission Mask H.

(h) Emission Mask H. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of 4 kHz or less: Zero dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 4 kHz, but not more than 8.5 kHz: At least 107 log (fd/4) dB;

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 8.5 kHz, but no more than 15 kHz: At least 40.5 log (fd/1.16) dB;

(4) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least 43 + 10 log(P) dB.

§ 90.219 Use of signal boosters.

(i) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(4) A signal booster must be designed such that all signals that it retransmits meet the following requirements:

(iii) The retransmitted signals continue to meet the unwanted emissions limits of § 90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).

Test Procedures:

Measurements were in accordance with the test methods section 4.4 of KDB 935210 D05 v01r04.

Compliance with the emission mask of the EUT output shall be measured for the public safety service signal types as specified in 4.1.

Refer to the applicable regulatory requirements (e.g., Section 90.210) for emission mask specifications.

a) Connect a signal generator to the input of the EUT.
b) Configure the signal generator to transmit the appropriate test signal associated with the public safety emission designation (see Table 1).
c) Configure the signal level to be just below the AGC threshold (see results from 4.2).
d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
e) Set the spectrum analyzer center frequency to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between 2 × to 5 × the EBW (or OBW).
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 f_0 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).

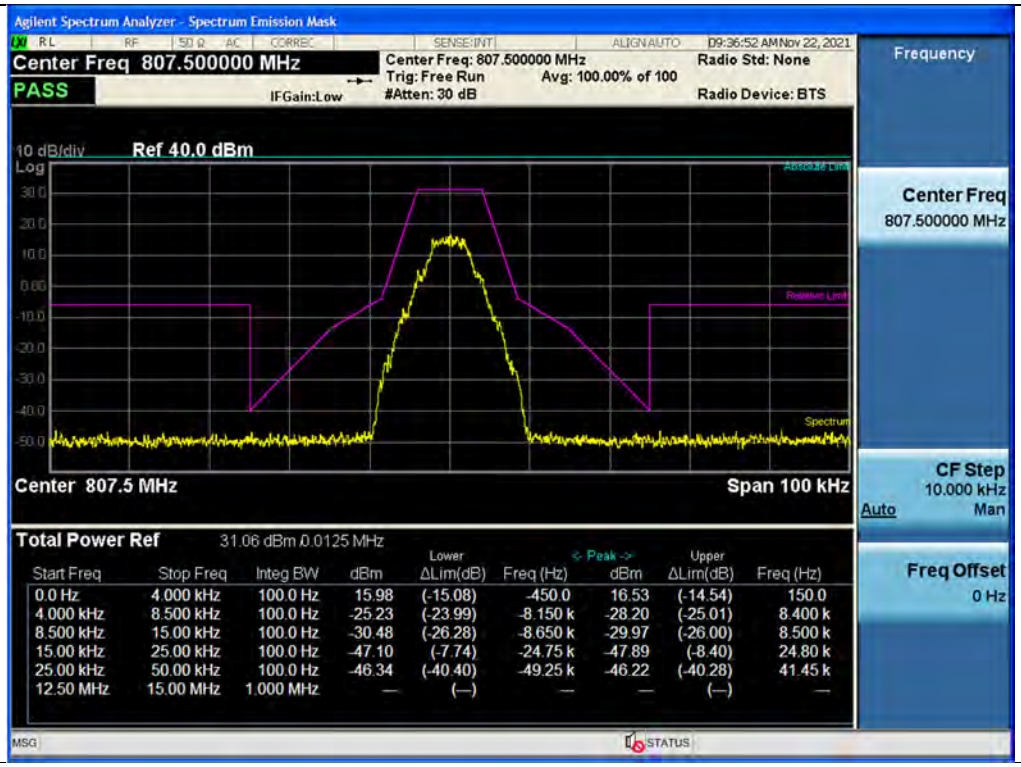
o) Repeat steps d) to n) with the input signal amplitude set 3 dB above the AGC threshold.

p) Repeat steps b) to o) for all authorized operational bands and emissions types (see applicable regulatory specifications, e.g., Section 90.210).

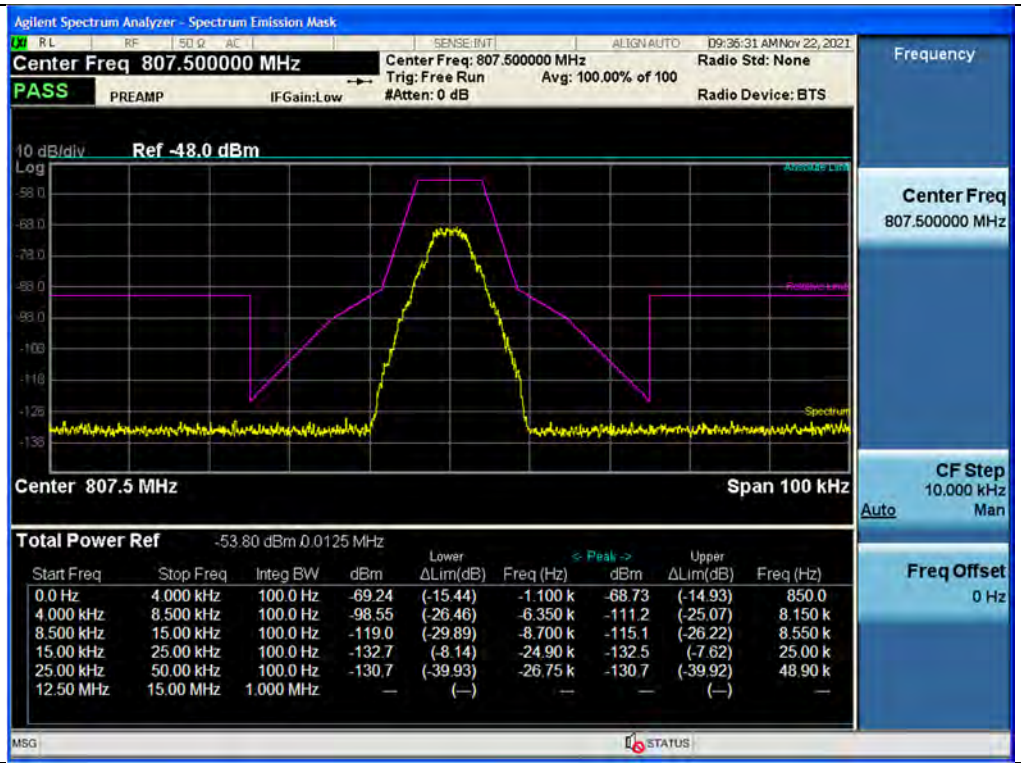
q) Include all accumulated spectral plots depicting EUT input signal and EUT output signal in the test report, and note any observed dissimilarities.

Plot data of Emission mask:

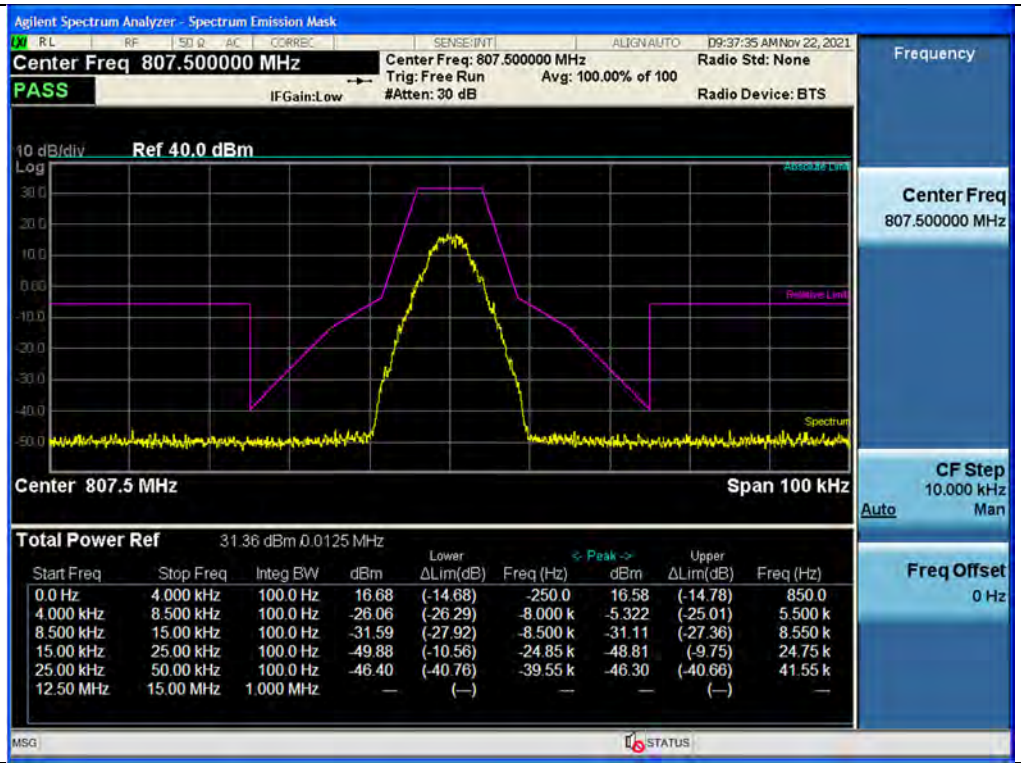
Output / NPSPAC / P25 Phase 1 / Uplink / Mask H



Input / NPSPAC / P25 Phase 1 / Uplink / Mask H

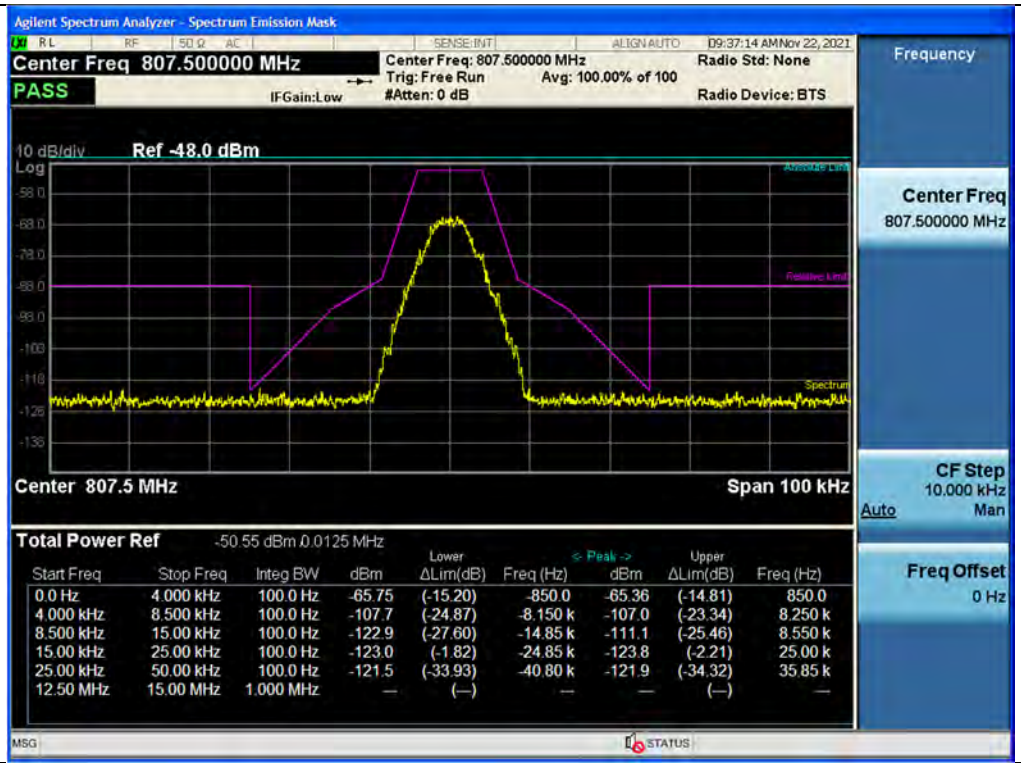


3 dB above the AGC threshold Output / NPSPAC / P25 Phase 1 / Uplink / Mask H



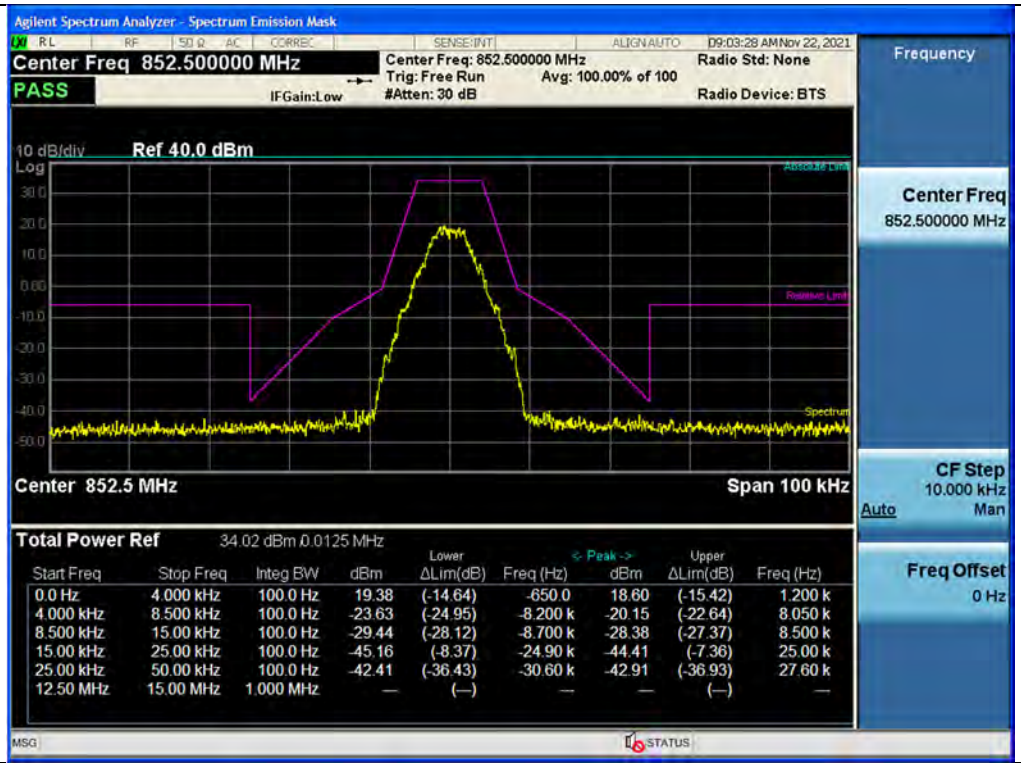
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	Peak dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	4.000 kHz	100.0 Hz	16.68	(-14.68)	-250.0	16.58	(-14.78)	850.0
4.000 kHz	8.500 kHz	100.0 Hz	-26.06	(-26.29)	-8.000 k	-5.322	(-25.01)	5.500 k
8.500 kHz	15.00 kHz	100.0 Hz	-31.59	(-27.92)	-8.500 k	-31.11	(-27.36)	8.550 k
15.00 kHz	25.00 kHz	100.0 Hz	-49.88	(-10.56)	-24.85 k	-48.81	(-9.75)	24.75 k
25.00 kHz	50.00 kHz	100.0 Hz	-46.40	(-40.76)	-39.55 k	-46.30	(-40.66)	41.55 k
12.50 MHz	15.00 MHz	1.000 MHz	—	(—)	—	—	(—)	—

3 dB above the AGC threshold Input / NPSPAC / P25 Phase 1 / Uplink / Mask H



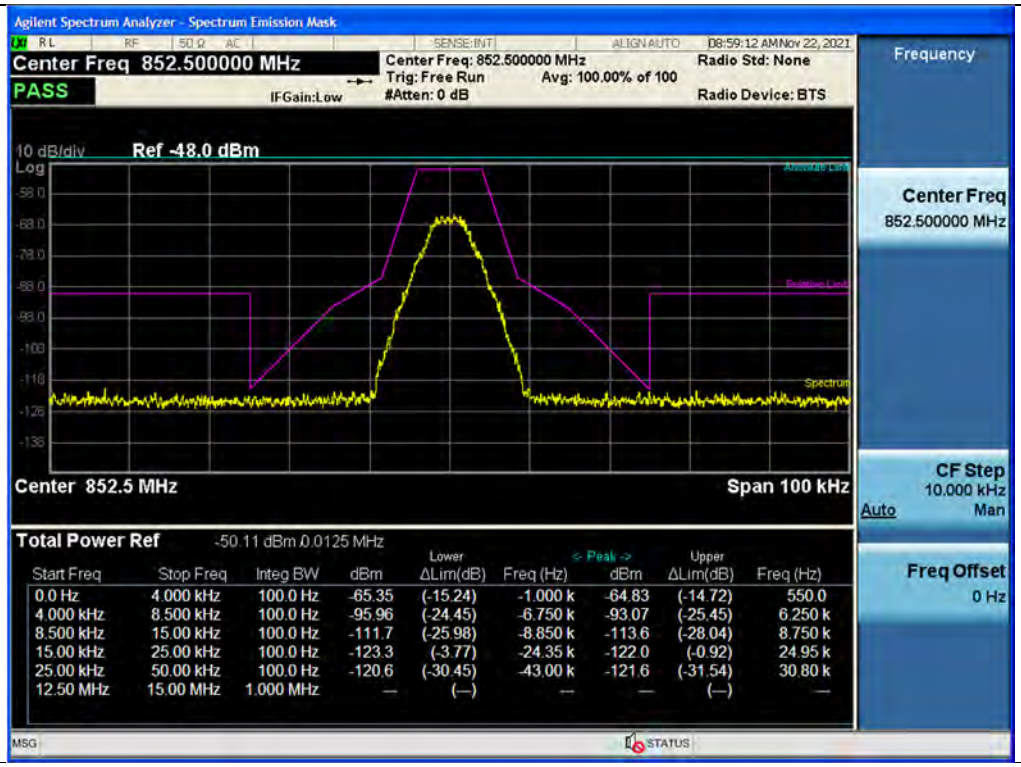
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	Peak dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	4.000 kHz	100.0 Hz	-65.75	(-15.20)	-850.0	-65.36	(-14.81)	850.0
4.000 kHz	8.500 kHz	100.0 Hz	-107.7	(-24.87)	-8.150 k	-107.0	(-23.34)	8.250 k
8.500 kHz	15.00 kHz	100.0 Hz	-122.9	(-27.60)	-14.85 k	-111.1	(-25.46)	8.550 k
15.00 kHz	25.00 kHz	100.0 Hz	-123.0	(-1.82)	-24.85 k	-123.8	(-2.21)	25.00 k
25.00 kHz	50.00 kHz	100.0 Hz	-121.5	(-33.93)	-40.80 k	-121.9	(-34.32)	35.85 k
12.50 MHz	15.00 MHz	1.000 MHz	—	(—)	—	—	(—)	—

Output / NPSPAC / P25 Phase 1 / Downlink / Mask H



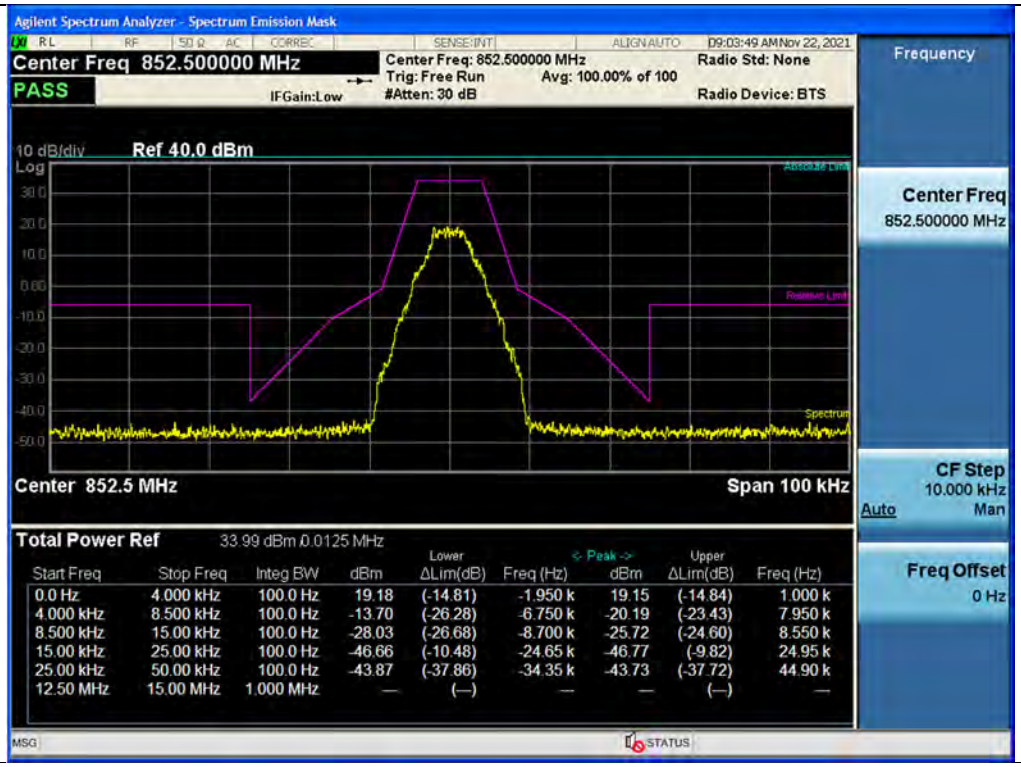
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	Peak dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	4.000 kHz	100.0 Hz	19.38	(-14.64)	-650.0	18.60	(-15.42)	1.200 k
4.000 kHz	8.500 kHz	100.0 Hz	-23.63	(-24.95)	-8.200 k	-20.15	(-22.64)	8.050 k
8.500 kHz	15.00 kHz	100.0 Hz	-29.44	(-28.12)	-8.700 k	-28.38	(-27.37)	8.500 k
15.00 kHz	25.00 kHz	100.0 Hz	-45.16	(-8.37)	-24.90 k	-44.41	(-7.36)	25.00 k
25.00 kHz	50.00 kHz	100.0 Hz	-42.41	(-36.43)	-30.60 k	-42.91	(-36.93)	27.60 k
12.50 MHz	15.00 MHz	1.000 MHz	—	(—)	—	—	(—)	—

Input / NPSPAC / P25 Phase 1 / Downlink / Mask H

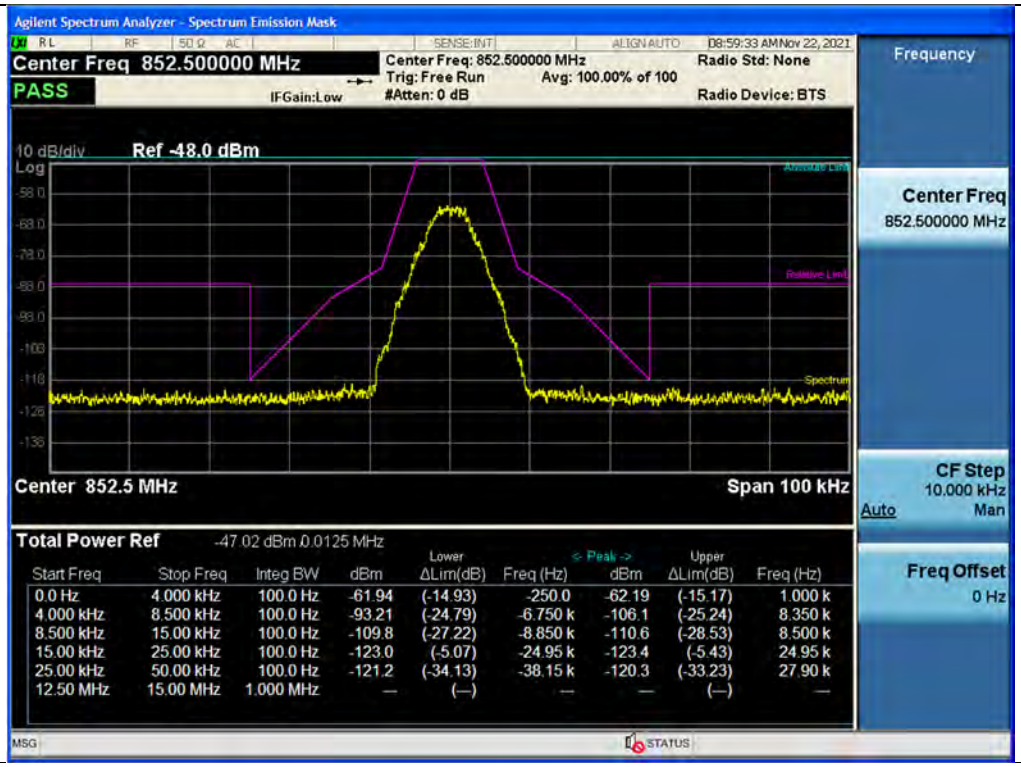


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	Peak dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	4.000 kHz	100.0 Hz	-65.35	(-15.24)	-1.000 k	-64.83	(-14.72)	550.0
4.000 kHz	8.500 kHz	100.0 Hz	-95.96	(-24.45)	-6.750 k	-93.07	(-25.45)	6.250 k
8.500 kHz	15.00 kHz	100.0 Hz	-111.7	(-25.98)	-8.850 k	-113.6	(-28.04)	8.750 k
15.00 kHz	25.00 kHz	100.0 Hz	-123.3	(-3.77)	-24.35 k	-122.0	(-0.92)	24.95 k
25.00 kHz	50.00 kHz	100.0 Hz	-120.6	(-30.45)	-43.00 k	-121.6	(-31.54)	30.80 k
12.50 MHz	15.00 MHz	1.000 MHz	—	(—)	—	—	(—)	—

3 dB above the AGC threshold Output / NPSPAC / P25 Phase 1 / Downlink / Mask H



3 dB above the AGC threshold Input / NPSPAC / P25 Phase 1 / Downlink / Mask H



5.5. INPUT/OUTPUT POWER AND AMPLIFIER/BOOSTER GAIN

Test Requirement:

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

Test Procedures:

Measurements were in accordance with the test methods section 4.5 of KDB 935210 D05 v01r04.

4.5.2 Measuring input and output power levels for determining amplifier/booster gain

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 span to at least 1 MHz.

b) Set the RBW 100 kHz.

c) Set the VBW to ≥ 3 × RBW.

d) Set the detector to PEAK with the trace 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

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:

Gain (dB) = output power (dBm) − input power (dBm).

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

Note:

1. If f_0 that determined from out-of-band rejection test is smaller or greater than difference of test signal's center frequency and operation band block, test is performed at the lowest or the highest frequency that test signals can be passed.
2. The uplink ERP is calculated including the cable loss value declared by the manufacturer.
   ex) ERP = Uplink Max Power + Ant. Peak Gain(dBi → dBd) – Cable Loss
   = 25 dBm + (16 dBi – 2.15 dB) – 2dB = 36.85 dBm

Test Results:

Tabular data of Input / Output Power and Gain

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
NPSPAC	Uplink	P25 Phase 1	807.03	-60.86	23.71	84.77
	Downlink	P25 Phase 1	851.84	-58.27	27.05	85.32

Note

: **§ 90.219(e)(1),** Max. ERP < 5 Watt (= 36.99 dBm).

- Uplink: 23.71 + (16dBi – 2.15 dB) - 2dB = 35.56 dBm
- Downlink: 27.05 + (3.9 dBi – 2.15 dB) = 28.85 dBm

5.6. NOISE FIGURE

Test Requirements:

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(2) The noise figure of a signal booster must not exceed 9 dB in either direction.

Test Procedures:

Measurements were in accordance with Agilent Application Note 57-1, 'The Direct Noise Measurement Method". The output power of the device is measured with an input termination at a temperature of approximately 290K. If the gain of the device and noise bandwidth of the measurement system is known, the noise factor can be determined.

$$F_{sys} = \frac{N_o}{kT_oBG}$$

F_{sys} = System Noise Factor

N_0 = Output Noise Power

k = Boltzmann's Constant

T_0 = Standard Noise Temperature (290K)

B = Noise Bandwidth

G = Gain

'kT_0B' calculation result for 1 MHz noise bandwidth is -114 dBm/MHz.

'Gain' value can be obtained from the test performed previously.

For measure the 'output noise power', perform the following procedure.

a) Remove a signal generator from the input port of EUT then terminate it.

b) Turn off the AGC function in EUT.

c) Connect a spectrum analyzer to output port of EUT.

d) Set the RBW 1 MHz. and set the VBW to ≥ 3 × RBW.

e) Measure the maximum output noise power for EUT pass band.

After the measurement, calculate the noise figure according to the following formular.

Noise Figure = Noise Output Power - kT0B - Gain

Test Results:

Test Band	Link	Input Power (dBm)	Output Power (dBm)	Gain (dB)	kT_0B (dBm/MHz)	Measured Value (dBm)	Noise Figure (dB)
NPSPAC	Uplink	-60.86	23.71	84.57	-114	-37.92	-8.49
	Downlink	-58.27	27.05	85.32	-114	-22.57	6.11

5.7. OUT-OF-BAND/OUT-OF-BLOCK EMISSIONS AND SPURIOUS EMISSIONS

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(3) Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.

Test Procedures:

Measurements were in accordance with the test methods section 4.7 of KDB 935210 D05 v01r04.

Spurious emissions shall be measured using a single test signal sequentially tuned to frequencies within each authorized frequency band of operation.

Intermodulation products shall be measured using two CW signals with all available channel spacing with the center between these channels being equal to the center frequency f_0 as determined from Out-of-band rejection test.

4.7.2 Out-of-band/out-of-block emissions conducted measurements

a) Connect a signal generator to the input of the EUT.
b) 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.
c) Configure the two signal generators to produce CW on frequencies spaced consistent with f_0, with amplitude levels set to just below the AGC threshold.
d) Connect a spectrum analyzer to the EUT output.
e) Set the span to 100 kHz.
f) Set RBW = 300 Hz with VBW ≥ 3 × RBW.
g) Set the detector to power averaging (rms).
h) Place a marker on highest intermodulation product amplitude.
i) Capture the plot for inclusion in the test report.
j) Repeat steps c) to h) with the composite input power level set to 3 dB above the AGC threshold.
k) Repeat steps b) to i) for all operational bands.

4.7.3 EUT spurious emissions conducted measurements

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.
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 × 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.

Note:

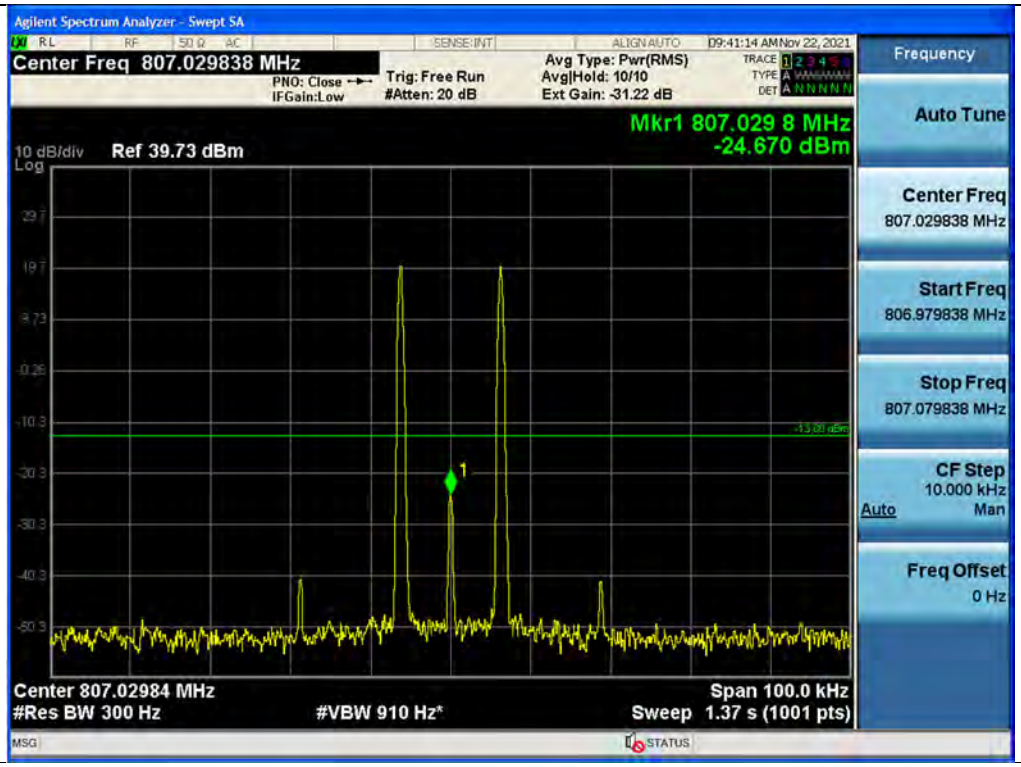
1. In some bands, RBW was reduced to 1 % and 10% of the reference bandwidth for measuring unwanted emission level (typically, 100 kHz if the authorized frequency band is below 1 GHz) and power was integrated according to section 5.7.2 of ANSI C63.26-2015.

Reduced RBW	0.1 %	1 %	10 %
Below 1 GHz (Ref.RBW: 100 kHz)	-	20 dB	10 dB

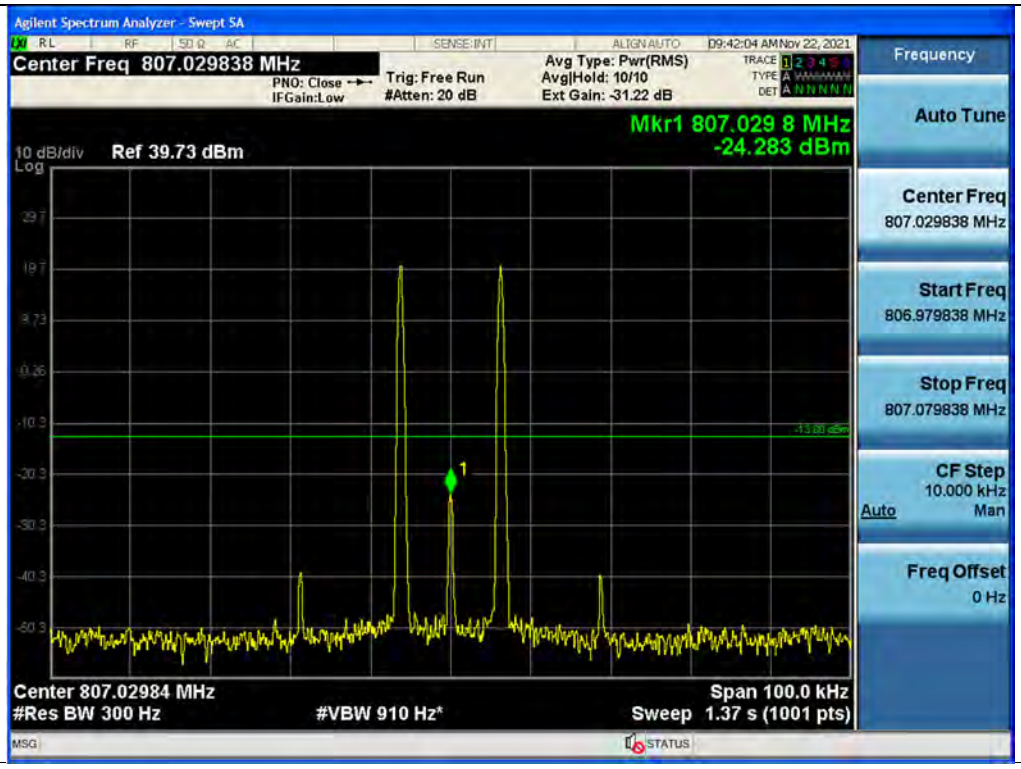
2. Among the data of simultaneous and single band emission conditions, the single emission condition is the worst.

Plot data of Out-of-band/out-of-block emissions

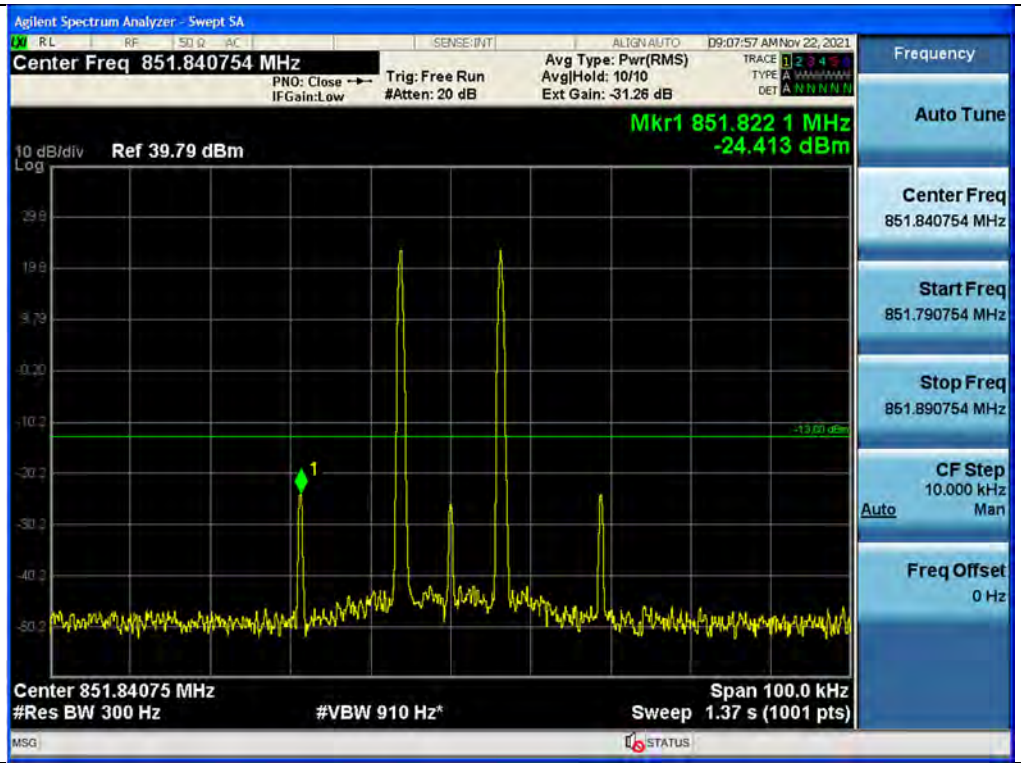
Out-of-band (two adjacent test signals) / NPSPAC / Uplink



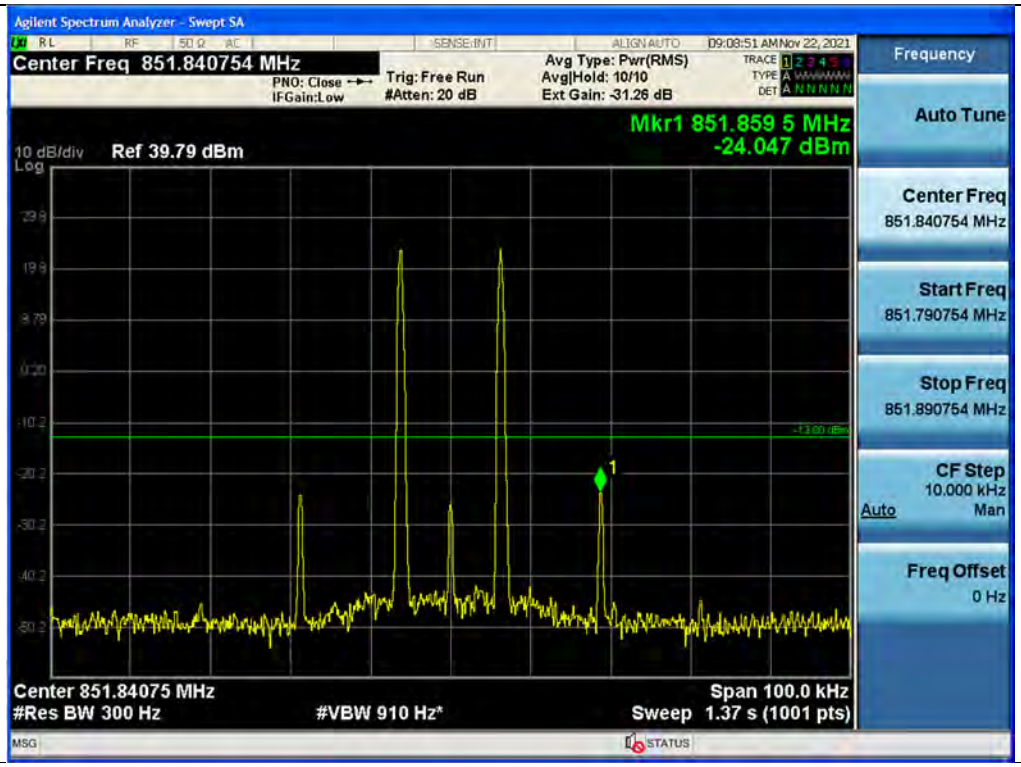
+3 dB above Out-of-band (two adjacent test signals) / NPSPAC / Uplink



Out-of-band (two adjacent test signals) / NPSPAC / Downlink

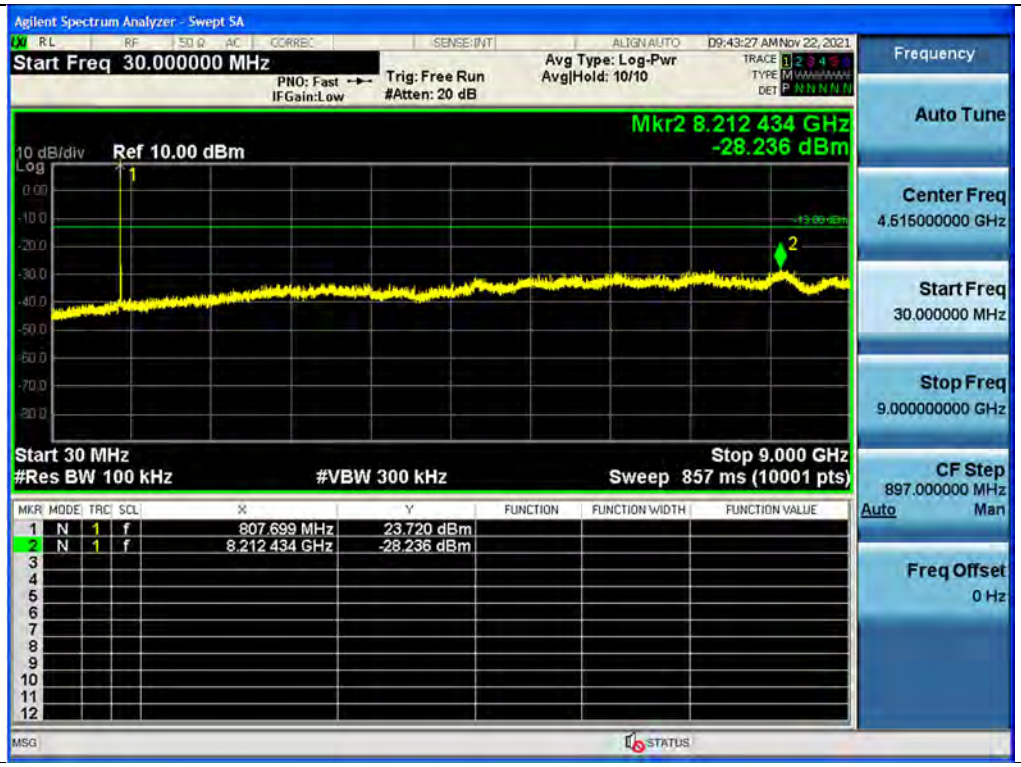


+3 dB above Out-of-band (two adjacent test signals) / NPSPAC / Downlink



Plot data of Spurious Emissions

Spurious / NPSPAC / Uplink



Spurious / NPSPAC / Downlink

5.8. RADIATED SPURIOUS EMISSIONS

Test Requirements:

§ 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

Test Procedures:

Because KDB 935210 D05 procedure does not provide this requirement, measurements were in accordance with the test methods section 5.5 of ANSI C63.26-2015

a) Place the EUT in the center of the turntable. The EUT shall be configured to transmit into the standard non-radiating load (for measuring radiated spurious emissions), connected with cables of minimal length unless specified otherwise. If the EUT uses an adjustable antenna, the antenna shall be positioned to the length that produces the worst case emission at the fundamental operating frequency.

b) Each emission under consideration shall be evaluated:

1) Raise and lower the measurement antenna in accordance 5.5.2, as necessary to enable detection of the maximum emission amplitude relative to measurement antenna height.

2) Rotate the EUT through 360° to determine the maximum emission level relative to the axial position.

3) Return the turntable to the azimuth where the highest emission amplitude level was observed.

4) Vary the measurement antenna height again through 1 m to 4 m again to find the height associated with the maximum emission amplitude.

5) Record the measured emission amplitude level and frequency using the appropriate RBW.

c) Repeat step b) for each emission frequency with the measurement antenna oriented in both the horizontal and vertical polarizations to determine the orientation that gives the maximum emissions amplitude.

Test Result:

NPSPAC_Uplink

Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	A.G. + C.L. +H.P.F. (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
1 199.79	70.70	25.10	37.69	V	-24.50	-37.09
1 600.17	65.10	25.10	36.29	V	-30.10	-41.29
2 000.15	53.38	26.00	34.94	V	-41.82	-50.76
2 400.13	61.61	27.40	33.60	V	-33.59	-39.79
4 000.05	49.21	29.60	29.10	V	-45.99	-45.49
5 199.99	45.45	31.50	26.50	V	-49.75	-44.75

* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

NPSPAC_Downlink

Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	A.G. + C.L. +H.P.F. (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
1 200.19	70.04	25.10	37.69	V	-25.16	-37.75
1 600.17	65.04	25.10	36.29	V	-30.16	-41.35
2 000.15	52.84	26.00	34.94	V	-42.36	-51.30
2 400.13	61.23	27.40	33.60	V	-33.97	-40.17
4 000.05	48.73	29.60	29.10	V	-46.47	-45.97
5 199.59	45.00	31.50	26.50	V	-50.20	-45.20

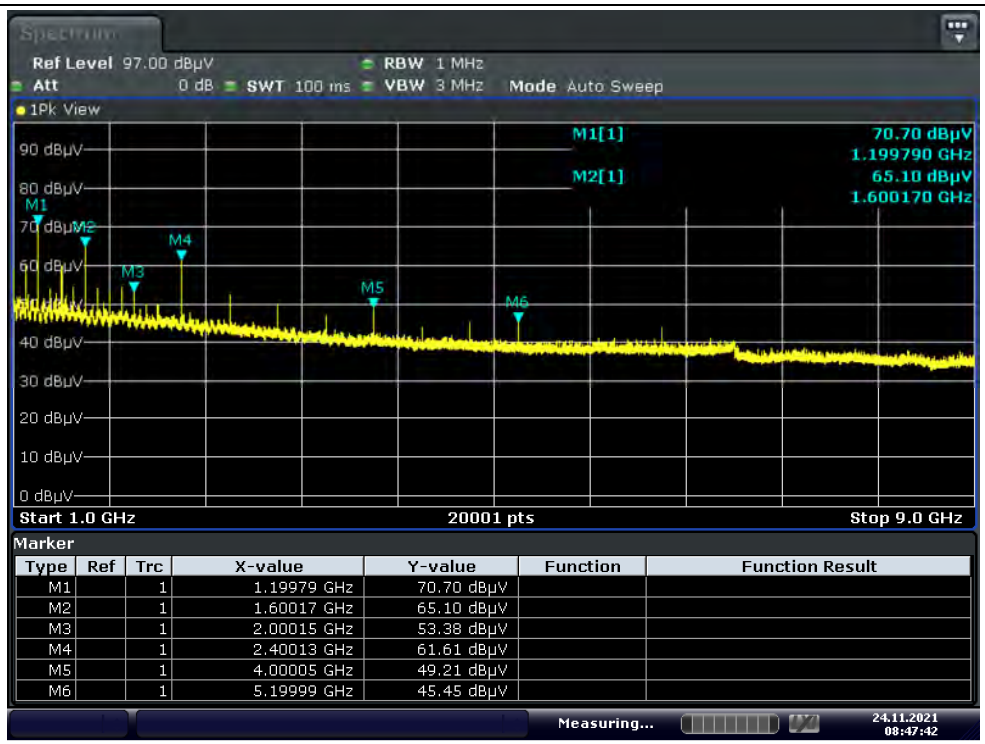
* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

Note:

1. We have done horizontal and vertical polarization in detecting antenna.
2. Measure distance = 3 m
3. The amplitude of the spurious domain emission attenuated by more than 20 dB over the permissible value was not recorded according to ANSI C63.26, clause 5.1.1., c).
4. Test data were only the worst case.
5. Among the data of simultaneous and single band emission conditions, the single emission condition is the worst.

Plot data of radiated spurious emissions

Uplink / NPSPAC



Note : Only the worst case plots for Radiated Spurious Emissions.

6. Annex A_EUT AND TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2111-FC058-P