TEST REPORT

Application No.:	KSEM2107001082CR
FCC ID:	OJFE62-N2-7F
Applicant:	Corning Optical Communications LLC
Address of Applicant:	6 Concord Road, Shrewsbury, MA 01545 United States
Manufacturer:	Corning Optical Communications LLC
Address of Manufacturer:	6 Concord Road, Shrewsbury, MA 01545 United States
Factory:	Sunwave Communications Co., Ltd
Address of Factory:	581 Houju Avenue, Binjiang District, Hangzhou, China
Equipment Under Test (EUT):	
EUT Name:	Remote Unit N2RU-I-8-DC
Model No.:	E62-N2
Trade mark:	CORNING
Standard(s) :	FCC Part 2; FCC Part 20; FCC Part 90
Date of Receipt:	2021-03-08
Date of Test:	2021-03-10 to 2021-10-18
Date of Issue:	2021-10-18
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Eric Lin
Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in writing.

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Revision Record			
Version	**Description**	**Date**	**Remark**
00	Original	2021-10-18	/

Authorized for issue by:				
		Damon zhou		
		Damon Zhou / Project Engineer		
		Eric Lin		
		Eric Lin / Reviewer		

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2 Test Summary

Test Item	Requirement	Method	Result
AGC Threshold Level	/	KDB 935210 D05 v01r04 Clause 4.2	PASS
Out of Band Rejection	/	KDB 935210 D05 v01r04 Clause 4.3	PASS
Input-versus-output Signal Comparison	47 CFR Part 90.210 47 CFR Part 90.219(e)(4)	KDB 935210 D05 v01r04 Clause 4.4	PASS
Input / Output and Amplifier / Booster Gain	47 CFR Part 90.541	KDB 935210 D05 v01r04 Clause 4.5	PASS
Noise Figure	47 CFR Part 90.219(e)(2)	KDB 935210 D05 v01r04 Clause 4.6	PASS
Out-of-band/out-of-block (including intermodulation) Emissions and Spurious Emission	47 CFR Part 90.219(e)(3) 47 CFR Part 90.543(c) 47 CFR Part 90.543(e)(1) 47 CFR Part 90.543(e)(3)	KDB 935210 D05 v01r04 Clause 4.7	PASS
Frequency Stability	47 CFR Part 90.539	47 CFR Part 2.1055 KDB 935210 D05 v01r04 Clause 4.8 ANSI C63.26-2015 Clause 5.6	PASS
Radiated Spurious Emissions	47 CFR Part 2.1053 47 CFR Part 90.219(e)(3) 47 CFR Part 90.543(f)	KDB935210 D05 v01r04 Clause 4.9 ANSI C63.26-2015 Clause 5.5	PASS
Noise/Emission at Antenna Terminal	47 CFR Part 2.1051 47 CFR Part 90.219(d)(6)	ANSI C63.26-2015 Clause 5.7	PASS
Occupied Bandwidth	47 CFR Part 2.1049 47 CFR Part 90.219(a)	ANSI C63.26-2015 Clause 5.4	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.

All modes have been tested and only record the worst test result.

The products are equipped with internal antenna and external antenna. The main difference is the appearance and antenna, but there is no difference in the circuit. Therefore, we only evaluated the internal and external antennas in the radiation test part, and the worst test result was the external antenna products with load test.

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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 KDB 935210 D02 Signal Booster Certification v04r02

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3 Contents

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4 General Information

4.1 Details of E.U.T.

Product Name:	Remote Unit N2RU-I-8-DC
Model No.:	E62-N2
Trade Mark:	CORNING
Antenna Type:	External / Internal Antenna
Antenna Gain:	Max Antenna Gain 3dBi
Power Supply:	DC 48V by Adapter Adapter: GST160A48 Input: 100-240V AC 50/60Hz 100W Output: DC 48V/3.34A 160W MAX
Test Voltage	AC 120V/60Hz
Max Power Consumption:	100W
Serial Number:	SWR7820938C
Firmware version:	iDAS_DRRU_E62-N2_V1.6_4300_20210308
Type of Modulation	LTE
Frequency Band:	Band 14: Downlink 758MHz to 768MHz
Normal Output Power:	17 ± 2dBm (downlink)
System Gain:	17 ± 3dB
Power Control Method:	ALC

4.2 Description of Support Units

The EUT has been tested as an independent unit.

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4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	± 7.25 x 10^{-8}
2	Duty cycle	± 0.37%
3	Occupied Bandwidth	± 3%
4	Conduction emission	± 3.0dB (150kHz to 30MHz)
5	RF conducted power	± 0.75dB
6	RF power density	± 2.84dB
7	Conducted Spurious emissions	± 0.75dB
8	RF Radiated power	± 4.5dB (Below 1GHz)
		± 4.8dB (Above 1GHz)
9	Radiated Spurious emission test	± 4.5dB (Below 1GHz)
		± 4.8dB (Above 1GHz)
10	Temperature test	± 1°C
11	Humidity test	± 3%
12	Supply voltages	± 1.5%
13	Time	± 3%

Remark:

The U_{lab} (lab Uncertainty) is less than U_{cispr} (CISPR Uncertainty), so the test results

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

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4.4 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

4.5 Test Facility

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

- **CNAS (No. CNAS L4354)**

CNAS has accredited Compliance Certification Services (Kunshan) Inc. to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **A2LA (Certificate No. 2541.01)**

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

- **FCC (Designation Number: CN1172)**

Compliance Certification Services Inc. has been recognized as an accredited testing laboratory.

Designation Number: CN1172.

- **ISED (CAB Identifier: CN0072)**

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development (ISED) Canada as an accredited testing laboratory.

CAB Identifier: CN0072.

- **VCCI (Member No.: 1938)**

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, C-11707, T-11499, G-10216 respectively.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

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5 Equipment List

RF Conducted Test						
1	Spectrum Analyzer	Agilent	E4446A	MY44020154	04/16/2021	04/15/2022
2	Spectrum Analyzer	Keysight	N9020A	MY55370209	12/02/2020	12/01/2021
3	Spectrum Analyzer	Keysight	N9010A	MY56480443	02/01/2021	01/31/2022
4	Signal Generator	Agilent	N5182A	MY50142015	09/25/2020	09/24/2021
					08/27/2021	08/26/2022
5	Radio Communication Test Station	Anritsu	MT8000A	6262012849	N/A	N/A
6	Radio Communication Analyzer	Anritsu	MT8821C	6201692222	N/A	N/A
7	Universal Radio Communication Tester	R&S	CMW500	159275	10/19/2020	10/18/2021
8	Universal Radio Communication Tester	R&S	CMW500	167239	04/16/2021	04/15/2022
9	Power Meter	Anritsu	ML2495A	1445010	04/15/2021	04/14/2022
10	Switcher	CCSRF	FY562	KUS2001M001-3	10/19/2020	10/18/2021
11	AC Power Source	EXTECH	6605	1570106	N.C.R	N.C.R
12	DC Power Supply	Aglient	E3632A	MY50340053	N.C.R	N.C.R
13	6dB Attenuator	Mini-Circuits	NAT-6-2W	15542-1	N.C.R	N.C.R
14	Power Divider	AISI	IOWOPE2068	PE2068	N.C.R	N.C.R
15	Filter	MICRO-TRONICS	BRM50701	5	N.C.R	N.C.R
16	Conducted test cable	/	RF01-RF04	/	04/15/2021	04/14/2022
17	Software	BST	TST-PASS	N/A	N/A	N/A
18	Temp. / Humidity Chamber	TERCHY	MHK-120AK	X30109	04/15/2021	04/14/2022
19	Thermometer	Anymetre	TH603	CCS007	10/16/2020	10/15/2021
					10/14/2021	10/13/2022
RF Radiated Test						
1	Spectrum Analyzer	R&S	FSV40	101493	10/19/2020	10/18/2021
2	Signal Generator	Agilent	E8257C	MY43321570	10/19/2020	10/18/2021
3	Loop Antenna	Schwarzbeck	HXYZ9170	9170-108	02/22/2021	02/21/2022
4	Bilog Antenna	TESEQ	CBL 6112D	35403	06/22/2019	06/21/2021
					06/21/2021	06/20/2023
5	Bilog Antenna	SCHWARZBECK	VULB9160	9160-3342	04/13/2021	04/12/2023
6	Horn-antenna(1-18GHz)	Schwarzbeck	BBHA9120D	267	10/26/2020	10/25/2022
7	Horn-antenna(1-18GHz)	ETS-LINDGREN	3117	00143290	02/22/2021	02/21/2023
8	Horn Antenna(18-40GHz)	Schwarzbeck	BBHA9170	BBHA9170171	02/22/2021	02/21/2022
9	Pre-Amplifier(30MHz~18GHz)	LNA	/	/	04/15/2021	04/14/2022
10	Amplifier(18~40GHz)	COM-POWER	PAM-840A	461332	10/23/2020	10/22/2021
11	Low Pass Filter	MICRO-TRONICS	VLFX-950	RV142900829	N.C.R	N.C.R
12	High Pass Filter	Mini-Circuits	VHF-1200	15542	N.C.R	N.C.R
13	RE test cable	/	RE01-RE04	/	04/15/2021	04/14/2022
14	Software	Farad	EZ-EMC	CCS-03A1	N/A	N/A

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6 Test Results

6.1 Test conditions

Input voltage:	AC 120V	
Test voltage	Normal	AC 120V
	Extreme	AC 108V~AC 132V
Operating Environment:		
Test Temperature:	Normal	22°C~26°C
	Extreme	-10~40°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:

FIBER-OPTIC AND OTHER SIMILAR RF DISTRIBUTION SYSTEMS

Fiber-optic distribution systems are a type of in-building radiation system that receives RF signals from an antenna, distributes the signal over fiber-optic cable, and then retransmits at another location for example within a building or tunnel. Most fiber-optic systems are signal boosters; however, some may be repeaters. These systems generally have two enclosures typically called host (or local or donor unit) and remote. Some systems may also have an optional expander box for fan-out to multiple remotes. The system transmits downlink signals from the remote unit to handsets, portables, or clients, and transmits uplink signals via from the host unit. Usually but not always the uplink goes through an intermediate amplifier to a “donor” antenna. Therefore both uplink and downlink must be tested, unless filing effectively documents how connection of uplink to donor antenna with or without an intermediate amplifier will be prevented, such as for always only a cabled connection to a base station. Fiber-optic systems are not amplifiers (AMP equipment class) – they are equipment class TNB or PCB. The same approval procedures also apply for multiple-enclosure systems connected by coax cable.

Synonyms and related terms: in-building radiation system, coverage enhancer, distributed antenna system, fiber-optic distribution system, converter, donor antenna

Typical in-building or distributed antenna systems can consist of five different components (enclosures), not counting antennas:

1) host unit

a) transmits uplink to base station via antenna thru coax, ***passive interface unit***, or ***active interface unit*** (amplifier)

b) sends base-station downlink via fiber-optic or coax to ***remote***

c) receives handset uplink via fiber-optic or coax from ***remote***

d) optional connection to ***expansion unit*** via fiber-optic

e) separate FCC ID from ***remote***, unless electrically identical

f) ***non-transmitting host unit***

i) connects directly to a base station via coax cable but does not connect to antenna or amplifier

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ii) Part 15 digital device subject to Verification, no FCC ID

2) remote unit

a) receives base-station downlink via fiber-optic or coax from ***host***, transmits via antenna to handsets

b) returns handset uplink via fiber-optic or coax to ***host***

c) separate FCC ID from ***remote***, unless electrically identical

3) fiber-optic expansion unit

a) fiber-optic or coax from ***host***

b) fiber-optic or coax fan-out to ***remote(s)***

c) Part 15 digital device subject to Verification, no FCC ID

4) RF expansion unit

a) internal or external device used to add band(s) and/or transmit mode(s) to a ***remote***
b) operates only when connected to a ***remote unit*** as part of a booster system
c) contains signal-processing functions to convert baseband signal into modulated RF signal
d) use equipment class PCB or TNB for an ***RF expansion unit*** (the associated ***remote*** uses an equipment class Bxx per **Table C.1** of this document, e.g., B2I)

5) ***passive interface unit***

a) contains attenuators, splitters, combiners

b) coax cable connection between ***host*** and base-station

c) passive device, no FCC ID

6) ***active interface unit***

a) amplifies uplink signal from ***host unit*** for transmit by donor antenna

b) attenuates downlink from donor antenna

c) coax cable connection between ***host*** and ***active interface unit***

d) usually has separate FCC ID; in some cases could be combined/included with ***host*** as one enclosure

GENERAL DEFINITIONS FOR CERTIFICATION PURPOSES:

The following three general definitions follow from those stated in the Part 22, 24, 27 and 90 rule sections as listed above. Two of the definitions replace previous EAB internal definitions given for booster, repeater and extender. The general term “extender” is the same as booster, but booster should be used rather than extender. The general term “translator” is the same as repeater, but repeater should be used rather than translator.

External radio frequency power amplifier (ERFPA) - any device which, (1) when used in conjunction with a radio transmitter signal source, is capable of amplification of that signal, and (2) is not an integral part of a radio transmitter as manufactured. The EAS equipment class AMP is used only for an ERFPA device inserted between a transmitter (TNB/PCB) and an antenna (has only one antenna port) ***Booster*** is a device that automatically reradiates signals from base transmitters without channel translation, for the purpose of improving the reliability of existing service by increasing the signal strength in dead spots. An “in-building radiation system” is a signal booster. These devices are not intended to extend the size of coverage from the originating base station. A booster can be either single or multiple channels***.***

Repeater is a device that retransmits the signals of other stations. Repeaters are different from boosters in that they can include frequency translation and can extend coverage beyond the design of the original base station. A repeater is typically single channel but can also be multiple channels.

ERFPA (AMP) and boosters/repeaters (TNB/PCB) can generally be authorized for all rule parts except 15 and 18.

Tests should be done with each typical signal. e.g., for F3E emissions use 2500 Hz with 2.5 or 5 kHz deviation. Use of CW signal for some tests is acceptable in lieu of actual emission, in some cases when

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CW signal gives worst case.

The E62-N2 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 E62-N2 system is compliant with the description about distributed antenna system in FCC rules, So **the Equipment belongs to the remote unit.**

6.2 Test Procedure & Measurement Data

6.2.1 AGC Threshold Level

Test Requirement: Not Specified

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04 Clause 4.2

EUT Operation:

Status: Drive the EUT to maximum output power.

Conditions: Normal conditions

Application: Cellular Band RF output ports

Test Configuration:

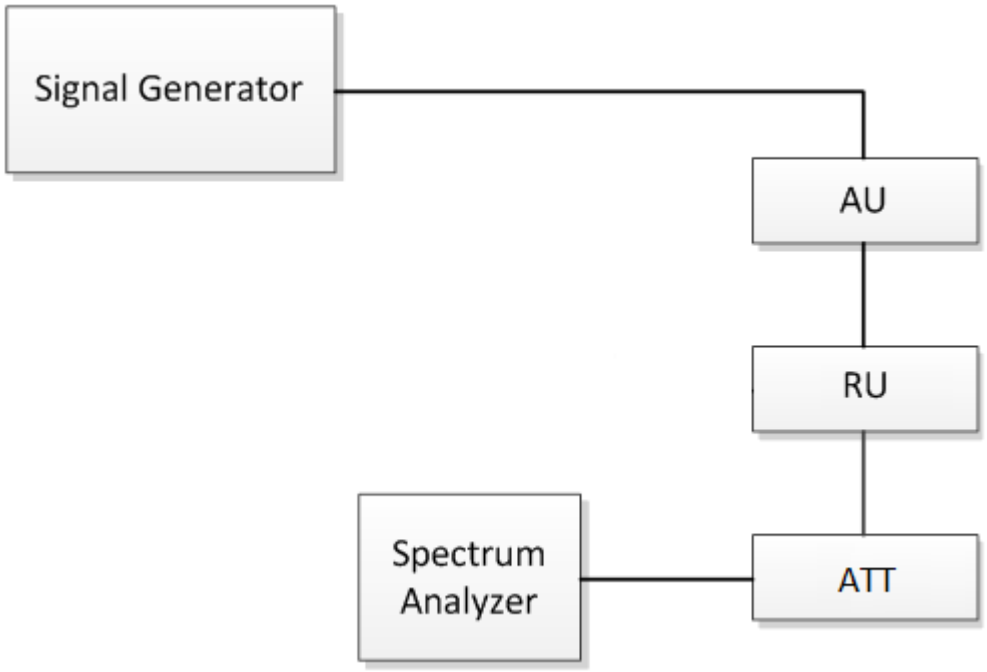

Fig.1. AGC Threshold Level test configuration

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Test Procedure: AGC Threshold Level test procedure:

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 as necessary.

c) The signal generator should initially be configured to produce either of the required test signals (i.e., broadband or narrowband).

d) Set the signal generator frequency to the center frequency of the EUT operating band.

e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.

f) Record this level as the AGC threshold level.

g) Repeat the procedure with the remaining test signal.

6.2.1.1 Measurement Record:

Test Conf.	RF Ch.	Test Freq. (MHz)	Test Signal	Remark	AGC Threshold Level (dBm)
DL_1S_M_AWGN	M	763	AWGN (99% OBW of 4.1MHz)	a single test signal	0.10

6.2.2 Out-of-band Rejection

Test Requirement: Not specified

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04 Clause 4.3

EUT Operation:

Status: Drive the EUT to maximum output power.

Conditions: Normal conditions

Application: Cellular Band RF output ports

Test Configuration:

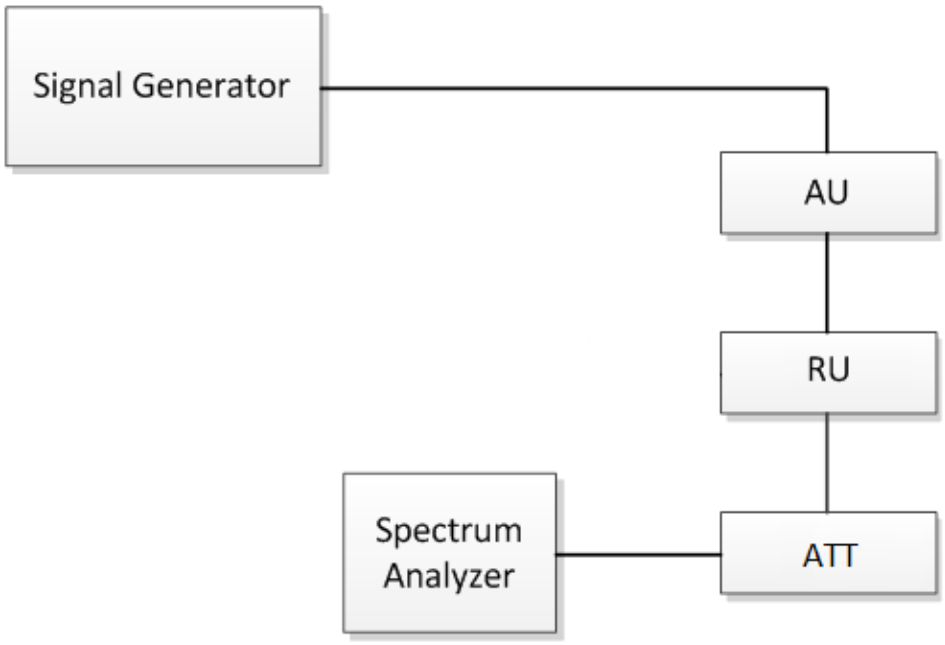


Fig.2. Out-of-band Rejection

Test Procedure:

Out-of-band Rejection test procedure:

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.

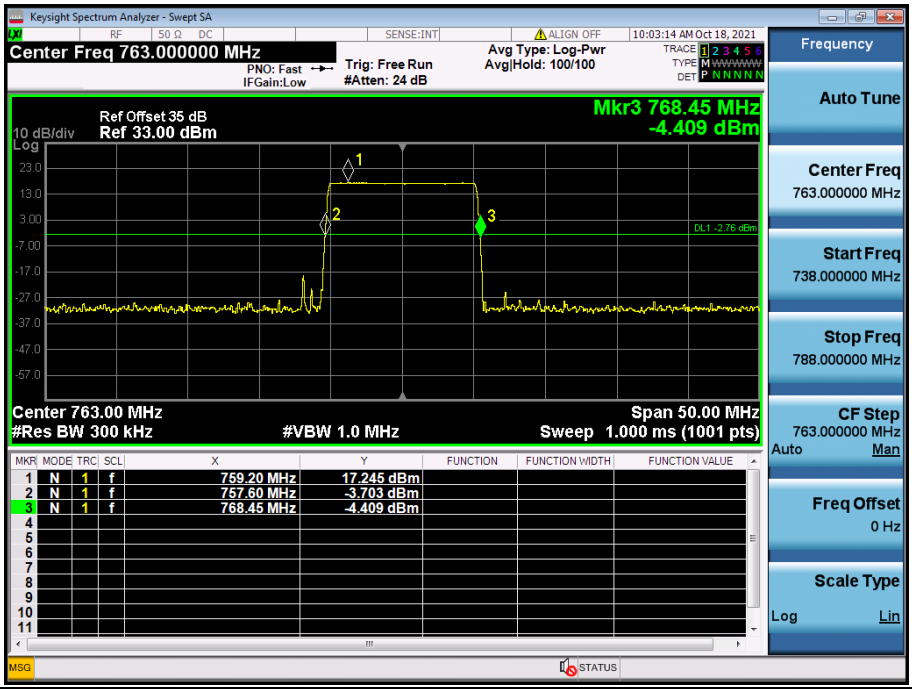
d) Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer's rated passband, and VBW = 3 × RBW.

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 f0, 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.

6.2.2.1 Measurement Record:

Downlink

The peak of the frequency response f_0 is 759.2MHz.

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6.2.3 Input-versus-output Signal Comparison

Test Requirement: 47 CFR Part 90.210, 90.219(e)(4)

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04 Clause 4.4

Limit: Compare the spectral plot of input signal to the output signal to affirm that they are similar.

90.210

Compliance with the emission mask stated in 90.210

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

The EUT is with audio low pass filter, which must comply with the emission mask B.

Emission Mask B. For transmitters that are 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 assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

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90.219(e)(4)

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

(i) The signals are retransmitted on the same channels as received. Minor departures from the exact provider or reference frequencies of the input signals are allowed, provided that the retransmitted signals meet the requirements of §90.213.

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

(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)

EUT Operation:

Status: Drive the EUT to maximum output power.

Conditions: Normal conditions

Application: Cellular Band RF output ports

Test Configuration:

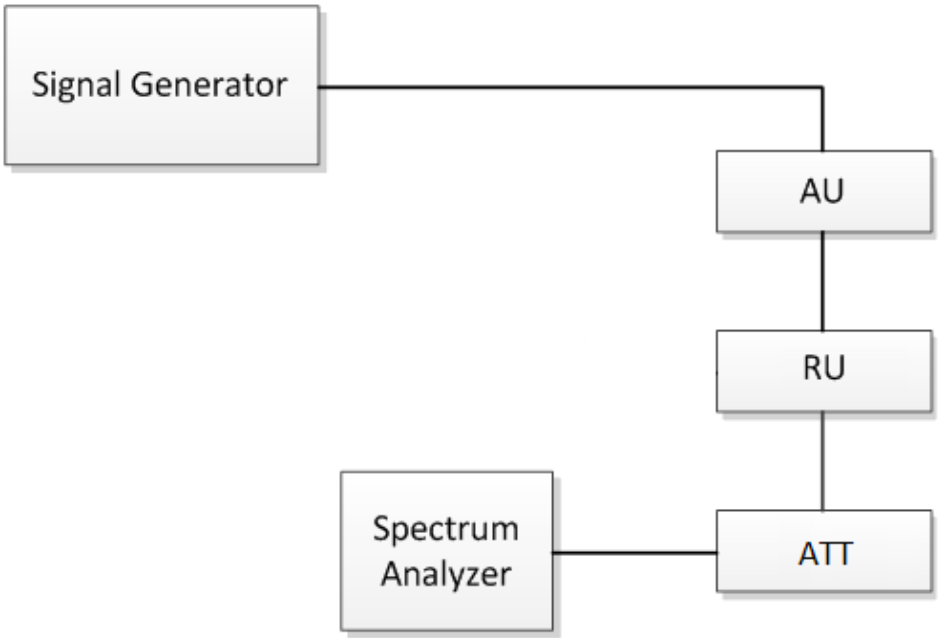

Fig.3. Input-versus-output Signal Comparison

Test Procedure:

Test procedure of emission mask:

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 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.

Test procedure of occupied bandwidth:

a) Connect a signal generator to the input of the EUT.

b) Configure the signal generator to transmit the AWGN signal.

c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.

d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between 2 × to 5 × the emission bandwidth (EBW) or alternatively, the OBW.

f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be ≥ 3 × RBW.

g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than [10 log (OBW / RBW)] below the reference level.
Steps f) and g) may require iteration to enable adjustments within the specified tolerances.

h) The noise floor of the spectrum analyzer at the selected RBW shall be at

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least 36 dB below the reference level.

i) Set spectrum analyzer detection function to positive peak.

j) Set the trace mode to max hold.

k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency.

l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the −26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the -26 dB down amplitude point.

m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).

n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.

o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.

p) Repeat steps e) to o) with the signal generator set to the narrowband signal.

q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

6.2.3.1 Measurement Record:

Please refer to Appendix A - Input-versus-output Signal Comparison.

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6.2.4 Input/Output Power and Amplifier/Booster Gain

Test Requirement: 47 CFR Part 90.541

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04 Clause 4.5

Limit: The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m

EUT Operation:

Status: Drive the EUT to maximum output power and maximum gain.

Conditions: Normal conditions

Application: Enclosure

Test Configuration:

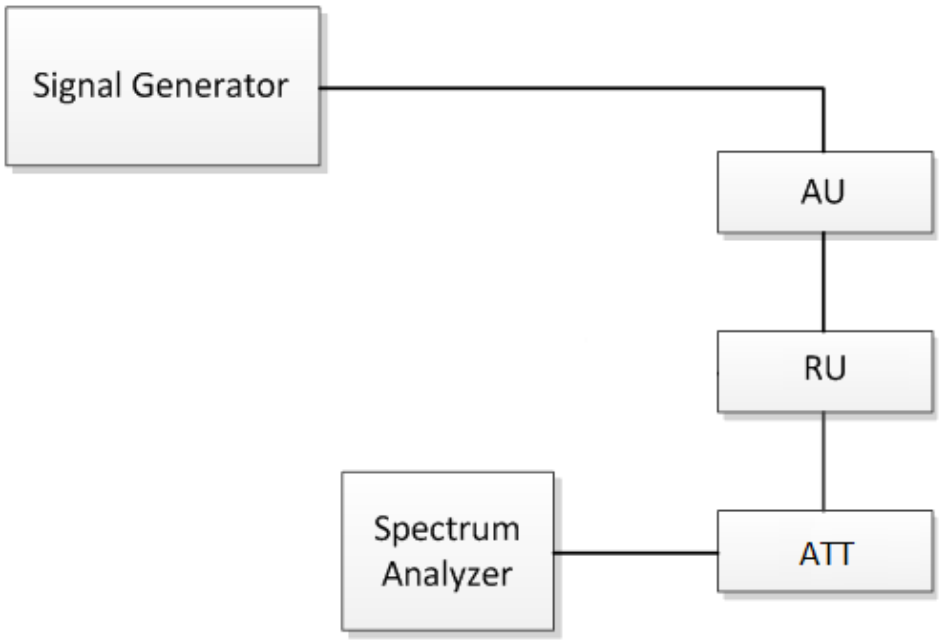

Fig.4. Input/Output Power and Amplifier/Booster Gain

Test Procedure:

Test procedure of output power:

a) Connect a signal generator to the input of the EUT.

b) Configure to generate the AWGN (broadband) test signal.

c) The frequency of the signal generator shall be set to the frequency f0 as determined from 3.3.

d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.

e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.

f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.

g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.

h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.

i) Repeat steps e) to h) with the narrowband test signal.

j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

1) Adjust the frequency of the input signals, either below or above the pass band, so that the lowest order intermodulation product is positioned in the centre of the pass band, according to clause 4.2.5.2.

2) Take the measurement of the rise of the output signal.

3) Repeat the measurement for the opposite path of the Repeater.
Calculating the mean gain:

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

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

6.2.4.1 Measurement Record:

Please refer to Appendix B - Input/Output Power and Amplifier/Booster Gain.

6.2.5 Noise Figure

Test Requirement: 47 CFR Part 90.219(e)(2)

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04 Clause 4.6

EUT Operation:

Status: Drive the EUT to maximum output power. .

Conditions: Normal conditions

Application: Cellular Band RF output ports

Test Configuration:

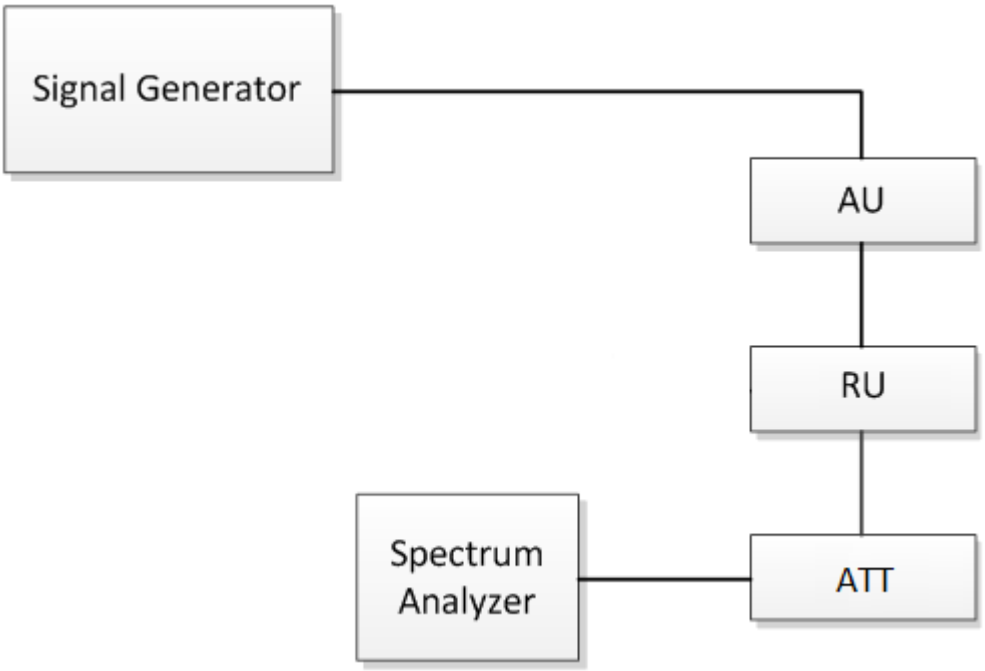

Fig.5. Noise Figure

Test Procedure: Several widely recognized methods for performing noise figure measurements are available. Some require the use of specialized equipment, such as a noise figure analyzer and/or an excess noise ratio (ENR) calibrated noise source, while others involve the use of conventional measurement instrumentation such as a spectrum analyzer. Methods that require use of a noise figure analyzer are generally accepted as producing the most accurate results and are considered to be the reference method within this document, while others are considered to be acceptable alternative methods.

Consult the relevant instrumentation application notes for detailed guidance regarding the selection and application of an appropriate methodology for performing noise figure measurements. Note also that noise figure measurements require that any AGC circuitry be disabled over the duration of the measurement.

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6.2.5.1 Measurement Record:

Test Conf.	RF Ch.	Test Freq. (MHz)	Test Signal	Remark	Noise Figure (dB)	Limit (dB)	Result
DL_1S_B_AWGN	B	760.5	AWGN (99% OBW of 4.1MHz)	a single test signal	8.23	9	Pass
DL_1S_M_AWGN	M	763			8.56	9	Pass
DL_1S_T_AWGN	T	765.5			8.64	9	Pass

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6.2.6 Out-of-band/out-of-block (including intermodulation) Emissions and Spurious

Test Requirement: 47 CFR Part 90.219(e)(3), 90.543(c), 90.543(e)

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04 Clause 4.7

Limit: 90.543(c)

Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

90.543(e)

For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

90.219 (e)(3)

Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

EUT Operation:

Status: Drive the EUT to maximum output power. .

Conditions: Normal conditions

Application: Cellular Band RF output ports

Test Configuration:

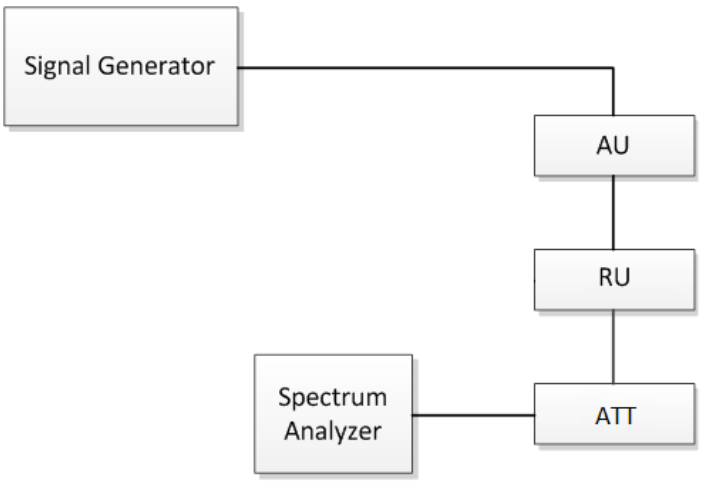

Fig.6. Out-of-band/out-of-block (including intermodulation) Emissions and Spurious

Test Procedure:

Test procedure of Out-of-band/out-of-block emissions:

a) 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.

b) 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.

c) Connect a spectrum analyzer to the EUT output.

d) Set the span to 100 kHz.

e) Set RBW = 300 Hz with VBW ≥ 3 × RBW.

f) Set the detector to power averaging (rms).

g) Place a marker on highest intermodulation product amplitude.

h) Capture the plot for inclusion in the test report.

i) Repeat steps c) to h) with the composite input power level set to 3 dB above the AGC threshold.

j) Repeat steps b) to i) for all operational bands.

Test procedure of Spurious emissions

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 × 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 × 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.

6.2.6.1 Measurement Record:

Please refer to Appendix C - Out-of-band/out-of-block (including intermodulation) Emissions and Spurious.

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6.2.7 Frequency Stability

Test Requirement: 47 CFR Part 90.539

Test Method: 47 CFR Part 2.1055

KDB 935210 D05 Indus Booster Basic Meas v01r04 clause 4.8

ANSI C63.26-2015 clause 5.6

Limit: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

EUT Operation:

Status: Drive the EUT to maximum output power.

Conditions: Temperature conditions, voltage conditions

Application: Cellular Band RF output ports

Test Configuration:

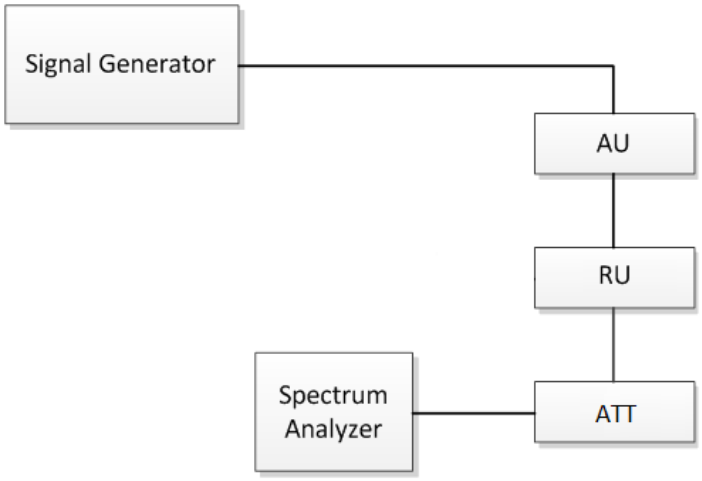

Fig.7. Frequency Stability

Test Procedure: Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

a) At 10 °C intervals of temperatures between −30 °C and +50 °C at the manufacturer's rated supply voltage, and

b) At +20 °C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage, then the -15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range.

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For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

When performing frequency stability measurements on booster, the instability associated with the EUT must be isolated from any frequency instability associated with the measurement instrumentation. One method for realizing this isolation is to connect the reference clock input of the signal generator to the reference output of the frequency counter to confirm that any frequency instability is associated with the EUT, but is not due to differences between the reference oscillators internal to the measurement instrumentation.

6.2.7.1 Measurement Record:

Please refer to Appendix D - Frequency Stability.

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6.2.8 Noise/Emission at Antenna Terminal

Test Requirement: 47 CFR Part 2.1051, 90.219(d)(6)

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r04 Clause 4.7

Limit: Good engineering practice must be used in regard to the radiation of intermodulation products and noise, such that interference to licensed communications systems is avoided. In the event of harmful interference caused by any given deployment, the FCC may require additional attenuation or filtering of the emissions and/or noise from signal boosters or signal booster systems, as necessary to eliminate the interference.

(i) In general, the ERP of intermodulation products should not exceed -30 dBm in 10 kHz measurement bandwidth.

(ii) In general, the ERP of noise within the passband should not exceed -43 dBm in 10 kHz measurement bandwidth.

(iii) In general, the ERP of noise on spectrum more than 1 MHz outside of the passband should not exceed -70 dBm in a 10 kHz measurement bandwidth.

EUT Operation:

Status: Drive the EUT to maximum output power. .

Conditions: Normal conditions

Application: Cellular Band RF output ports

Test Configuration:

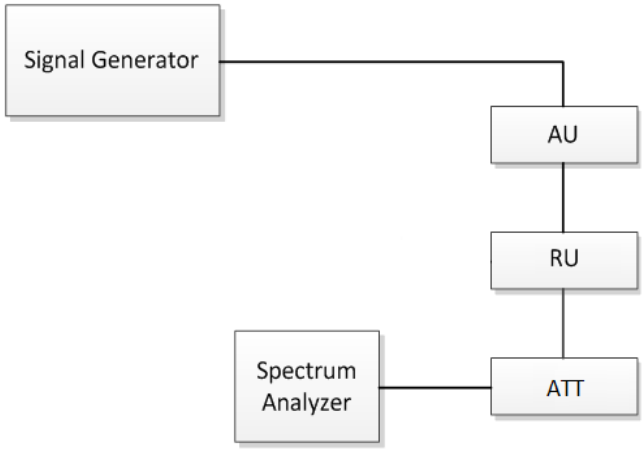

Fig.8. Noise/emission at Antenna Terminal

Test Procedure:

a) Connect a spectrum analyzer to the output of the EUT.

b) Set the RBW = 10 kHz

c) Set the VBW = 10 kHz.

d) Set the Sweep time = auto-couple.

e) Set the detector to PEAK.

f) Set the spectrum analyzer start frequency to 30 MHz and the stop frequency to 10 × the highest allowable frequency of the EUT passband.

g) 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.)

h) Capture a plot for inclusion in the test report.

6.2.8.1 Measurement Record:

Please refer to Appendix E - Noise/emission at Antenna Terminal

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6.2.9 Radiated Spurious Emission

Test Requirement: 47 CFR Part 90.219(e)(3), 90.543(f)

Test Method: 47 CFR Part 2.1055

KDB 935210 D05 Indus Booster Basic Meas v01r04 clause 3.7

ANSI C63.26-2015 clause 5.6

Limit: 47 CFR Part 90.219(e)(3)

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

47 CFR Part 90.543(f)

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

EUT Operation:

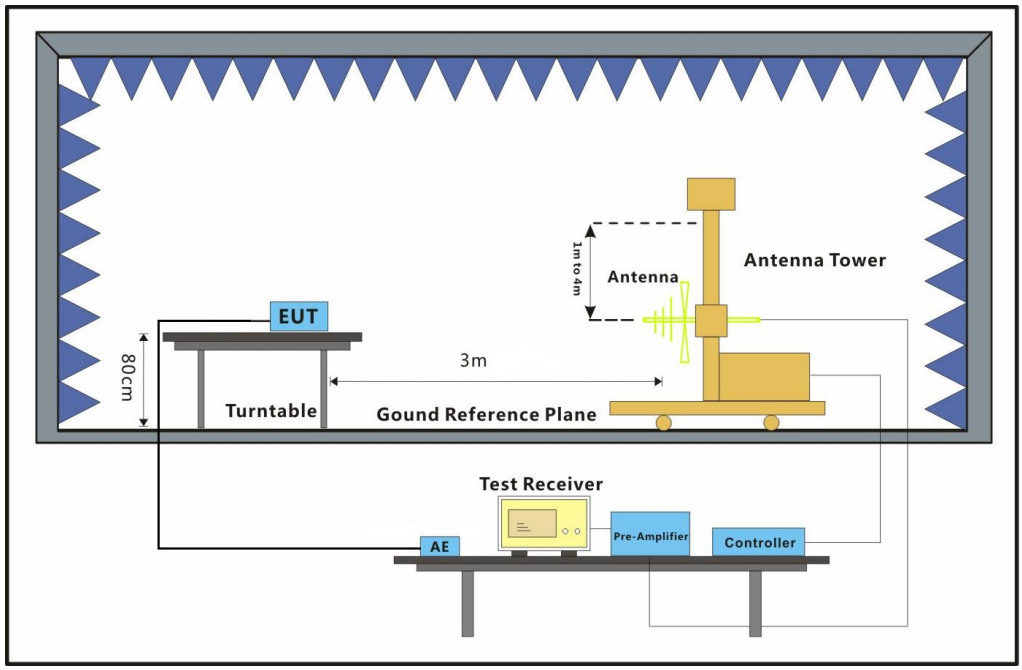
Status: Drive the EUT to maximum output power.

Conditions: Temperature conditions, voltage conditions

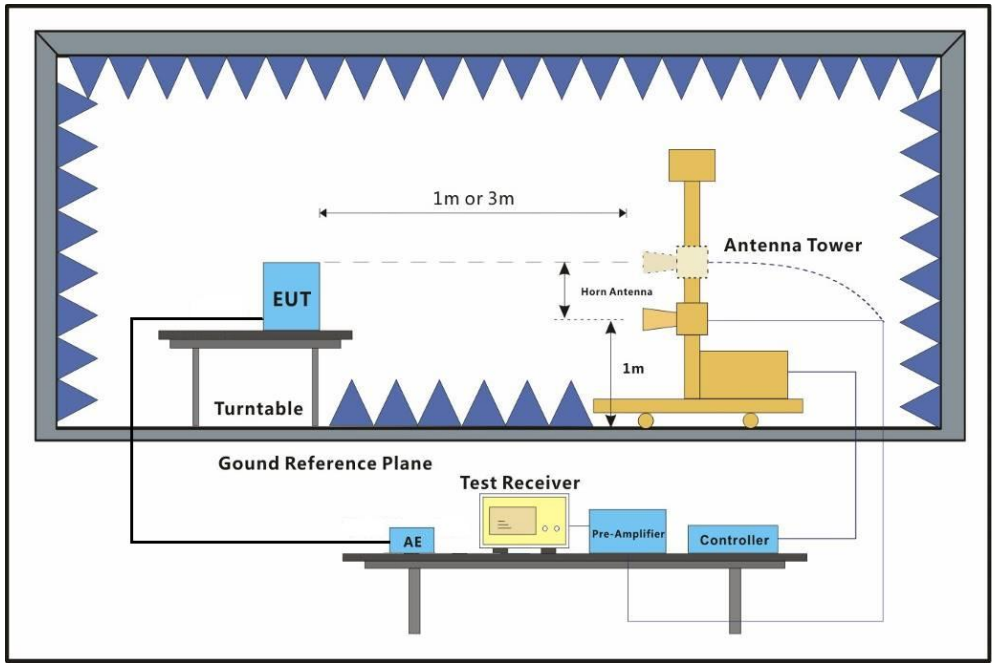
Application: Cellular Band RF output ports

Test Configuration:

30MHz to 1GHz emissions:



Above 1GHz emissions:



Test Procedure:

1. Scan from 30MHz to 12.75GHz, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.

Below 1GHz test procedure as below:

1) The EUT was powered on and placed on a table in the chamber. The antenna of the transmitter was extended to its maximum length. modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.

2) Rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.

3) Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.

4) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.

5) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 2) is obtained for this set of conditions.

6) The output power into the substitution antenna was then measured.

7) Steps 5) and 6)were repeated with both antennas vertically polarized.

8) Calculate power in dBm by the following formula:

Level (dBm) = Read Level (dBm) + Correction Factor (dB)

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6.2.9.1 Measurement Record:

Please refer to Appendix F - Radiated Spurious Emission.

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7 Photographs - Test Setup

Please refer to test setup photo

8 Photographs - EUT Constructional Details

Please refer to external and internal photo

--The End of Report--

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