

TEST REPORT

Application No.: GZCR2303000220AT
Applicant: Comba Telecom Network Systems Limited
Address of Applicant: Flat/Rm 10, 3/F, Bio-Informatics Ctr, 2 Science Park West Avenue, HK Science Park, Pak Shek Kok, N.T. Hong Kong
Manufacturer: Comba Network Systems Company Limited
Address of Manufacturer: No. 10 Shenzhou Road, Guangzhou Science City, Guangzhou 510663, Guangdong, P.R.China
Factory: Comba Telecom Technology (Guangzhou) Ltd.
Address of Factory: No. 6 Jinbi Road, Economics and Technology Development District, Guangzhou, Guangdong, China

Equipment Under Test (EUT):

EUT Name: Comflex NGc
Model No.: ARU-6B-Internal (ARU)
Comflex NGc MU (MU)

Trade Mark: Comba

Standard(s) :
47 CFR Part 2
47 CFR Part 20
47 CFR Part 22
47 CFR Part 24
47 CFR Part 27

Date of Receipt: 2023-03-01

Date of Test: 2023-05-08 to 2023-07-21

Date of Issue: 2023-08-08

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.



Ricky Liu
Manager



Revision Record			
Version	Chapter	Date	Remark
01	GZCR230300022002	2023-08-08	Original

Authorized for issue by:			
		<i>Kevin Zhang</i>	
		Kevin Zhang /Project Engineer	
		<i>Jerry Chan</i>	
		Jerry Chan /Reviewer	



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2 Test Summary

Item (FCC Rule 47 CFR)	Item & Method (KDB 935210 D04 v02r02 Subclause)	Result
20.21(e)(3) Frequency Bands	7.1.1 Authorized frequency band verification	PASS
	7.1.2 Authorized CMRS provider test	PASS
20.21(e)(9)(i)(D) Power Limits 20.21(e)(9)(i)(B) Bidirectional Capability	7.2 Maximum power	PASS
20.21(e)(9)(i)(C)(2) Booster Gain Limits 20.21(e)(9)(i)(B) Bidirectional Capability	7.3 Maximum booster gain computation	PASS
20.21(e)(9)(i)(G) Intermodulation Limits	7.4 Intermodulation product	PASS
20.21(e)(9)(i)(F) Out of Band Emission Limits	7.5 Out-of-band emissions	PASS
2.1051 Spurious emissions at antenna terminals	7.6 Conducted spurious emissions	PASS
20.21(e)(9)(i)(A) Noise Limits 20.21(e)(9)(i)(I) Transmit Power Off Mode	7.7 Noise	PASS
20.21(e)(9)(i)(J) Uplink Inactivity	7.8 Uplink inactivity	PASS
20.21(e)(9)(i)(C)(1) Booster Gain Limits 20.21(e)(9)(i)(I) Transmit Power Off Mode	7.9 Variable booster gain	PASS
2.1049 Occupied bandwidth	7.10 Occupied bandwidth	PASS
20.21(e)(9)(ii)(A) Anti-Oscillation 20.21(e)(5) Anti-Oscillation	7.11 Oscillation detection	PASS
2.1053 Field strength of spurious radiation	7.12 Radiated spurious emissions	PASS
20.21(e)(9)(i)(B) Bidirectional Capability 20.21(e)(3) Frequency Band	7.13 Spectrum block filtering	PASS
20.21(e)(9)(i)(E) Out of Band Gain Limits	7.14 Out of band gain	PASS



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Item (FCC Rule 47 CFR)	Item & Method (KDB 935210 D04 v02r02 Subclause)	Result
2.1055 Frequency stability	7.15 Frequency stability	PASS
20.21(e)(4) Self-monitoring	1	PASS
20.21(e)(9)(i)(H) Booster Antenna Kitting	2	PASS
20.21(e)(9)(i)(I) Transmit Power Off Mode	3	PASS
20.21(e)(9)(ii)(B) Gain Control	4	PASS
20.21(e)(9)(ii)(C) Interference Avoidance for Wireless Subsystems	5	PASS

Note:

E.U.T./ EUT means Equipment Under Test

Pass means the test result passed the test standard requirement, please find the detailed decision rule in the report relative section.

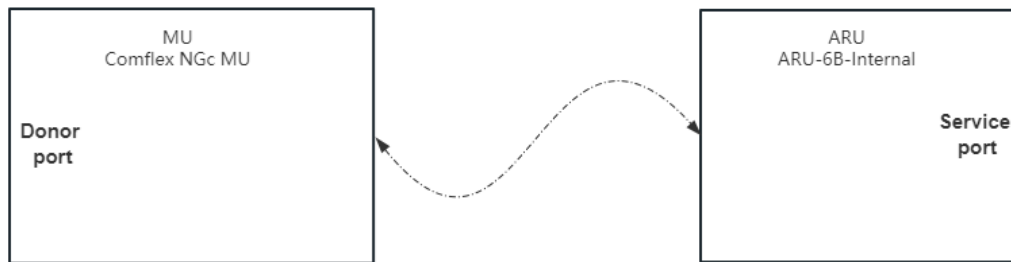
- ¹ There is no specific test for this functionality but it is instead indirectly addressed by the noise and gain limits tests.
- ² Generic testing requirements are not established; rather technical documentation is used describing all antennas, cables, and/or coupling devices that may be used with a consumer booster and how those meet the requirements.
- ³ There is no specific test for this functionality but it is instead addressed through a combination of the variable noise, variable gain, and oscillation detection tests.
- ⁴ Conformance to the requirement to include AGC circuitry is verified in 7.1 and 7.2.
- ⁵ 20.21(e)(9)(ii)(C) Consumer boosters using unlicensed (part 15) or other frequency bands for wireless transmissions between donor and server subsystems for its internal operations must employ interference avoidance methods to prevent interference transmitted into authorized CMRS spectrum bands. Before testing please submit a proposed test plan in a KDB inquiry for FCC review and acceptance. This device without any unlicensed (part 15) or other frequency bands for wireless transmissions function, PAG is not required.



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The EUT is an in-building distributed antenna solution for provider-specific consumer application (Comflex NGc). The EUT consists of two separate units: the Master Unit (MU, model No.: Comflex NGc MU), and the Active Remote Unit (ARU, model No.: ARU-6B-Internal). The MU receives handset uplink via fiber-optic or coaxial cable from ARU, transmits via donor antenna to base station, and returns base station downlink via fiber-optic or coaxial cable to ARU. The ARU receives base-station downlink via fiber-optic or coaxial cable from host unit, transmits via service antenna to handset, and returns handset uplink via fiber-optic or coaxial cable to host unit. The MU has one antenna port which is used to connect donor antenna. The donor antenna is an external dedicated antenna and the permission gain is 10dBi or less declared from the manufacturer. The ARU has 3 integral antennas and each integral antenna is assigned to support separated authorized frequency band(s). The antenna gain is 4dBi declared from the manufacturer.



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4 General Information

4.1 Details of EUT

Power Supply:	MU: AC 100-240V, 50/60Hz	
	ARU: DC 48V	
Test Voltage:	MU: AC 110V	
	ARU: DC 48V	
Operating Temperature:	MU: 0 to +45 °C	
	ARU: -20 to +55 °C	
Operating Humidity:	≤85%	
Frequency Range:	Lower 700MHz:	Uplink: 698-716MHz Downlink: 728-746MHz
	Upper 700MHz:	Uplink: 777-787MHz Downlink: 746-756MHz
	Cellular:	Uplink: 824-849MHz Downlink: 869-894MHz
	AWS-1:	Uplink: 1710-1755MHz Downlink: 2110-2155MHz
	Broadband PCS:	Uplink: 1850-1915MHz Downlink: 1930-1995MHz
Interface:	MU	Input Port 1 (4.3-10-Female) Debug Port 1 (RJ45)
	ARU	Input Port 2 (N-Female ,1 port for Rx only, 1 port for Tx only) Debug Port 1 (Type-c)
Radio System Type:	MU	WCDMA, LTE
	ARU	WCDMA, LTE
Minimum Bandwidth:	5MHz	
Normal Output Power:	Uplink	19dBm (conducted)
	Downlink	10dBm/5MHz (EIRP)
Normal System Gain:	Uplink	80dB
	Downlink	80dB
Antenna Type:	MU	External dedicated antenna
	ARU	Integral antenna
Permission Antenna Gain:	MU	10dBi or less declared from the manufacturer
Antenna Gain:	ARU	4dBi declared from the manufacturer



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Antenna Frequency:	ARU	Ant 1: 728-756MHz, 1930-1995MHz Ant 2: 824-894MHz, 1850-1915MHz Ant 3: 698-716MHz, 777-787MHz, 1710-1755MHz, 2110-2155MHz
Software Version:	MU	ChassisOAMV0100.01c
	ARU	ARUFGAV0100.01c



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4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Notebook	LENOVO	Lenovo Xiaoxinchao 5000	PF0TNMG8
Comflex NG	Comba Network System Company Limited	ARU-HUB-AC	/
Mathced load and attenuator supplied by the client.	/	/	/

4.3 Test Environment

Environment Parameter	Selected Values During Test		
Ralative Humidity	Ambient		
Value	Temperature (°C)	Voltage (V)	
		MU	ARU
TNVN	Asmbient	AC 110	DC 48
TLVL	-30	AC 93.5	DC 40.8
TLVH	-30	AC 126.5	DC 55.2
THVL	+50	AC 93.5	DC 40.8
THVH	+50	AC 126.5	DC 55.2

VN: Normal Voltage, TN: Normal Teperature

VL: Lower Extreme Voltege, VH: Higher Extreme Voltage

TL: Lower Extreme Temperature, TH: Higher Extreme Teperature

4.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	RF Output Power	±0.75dB
2	Transmitter unwanted emissions	±0.75dB
3	Radiated Spurious Emission	±5.06dB (30MHz-1GHz; 3m); ±4.46dB (30MHz-1GHz; 10m); ±5.08dB (1GHz-6GHz); ±5.14dB (6GHz-18GHz)
4	Occupied Channel Bandwidth	± 3%



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4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou Branch EMC Laboratory,
198 Kezhu Road, Sciencetech Park, Guangzhou Economic & Technology Development District,
Guangzhou, China 510663

Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.

4.6 Test Facility

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

- **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian/New Zealand Regulatory Compliance Mark (RCM).

- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818.

- **ISED (Registration No.: 4620B, CAB identifier: CN0052)**

SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Innovation Science and Economic Development Canada for Wireless Device Testing laboratories to test to Canadian radio equipment requirements. Registration No. 4620B, CAB identifier: CN0052.

- **VCCI (Registration No.: R-12460, C-12584, G-20107 and T-11179)**

The 10m Semi-anechoic chamber, 966 Anechoic Chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-12460, C-12584, G-20107 and T-11179 respectively.

- **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2017, the Basic Rules, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.

4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None



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5 Equipment List

Conducted test equipment					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Temperature Chamber	GZ GongWen Co.Ltd.	GDJW-100	EMC0039	2023-06-29	2024-06-28
MI CABLE	SGS-EMC	0.8M	EMC2137	2021-11-02	2023-11-01
MI CABLE	SGS-EMC	0.8M	EMC2136	2021-11-02	2023-11-01
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2022-09-08	2023-09-07
MXA Signal Analyzer (10Hz-50GHz)	KEYSIGHT	N9020B	SEM004-24	2023-03-20	2024-03-19
Wideband Radio Communication Teste	R&S	CMW 500	EMC2215	2022-12-16	2023-12-15
Test Software	TST	V2.0	GZE100-78	N/A	N/A
ESG vector signal generator (250kHz-6GHz)	Agilent Technologies	E4438C	SEM006-03	2023-02-20	2024-02-19

Radiated test equipment (30MHz to 1GHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver (1Hz-8GHz)	Rohde & Schwarz	ESW8	EMC2229	2023-02-20	2024-02-19
966 Anechoic Chamber	Shenzhen C.R.T Technology Co., LTD	9mX6mX6m	EMC2230	2022-04-12	2025-04-11
Network Analyzer (100k-8.5GHz)	KEYSIGHT	ENA Series E5071C	EMC2191	2023-05-25	2024-05-24
Amplifier (9k-1000MHz)	SONOMA	310	EMC2237	2023-04-13	2024-04-11
TRILOG Broadband Antenna (25M-2GHz)	SCHWARZBECK	VULB 9168	EMC2238	2022-04-20	2025-04-19
Trilog Broadband Antenna (25MHz-1GHz)	SCHWARZBECK MESS-ELEKTRONIK	VULB 9168	EMC2174	2022-06-19	2025-06-18
Coaxial Cable	Times Microwave	TMC-AMI19394A	EMC239	2022-05-18	2024-05-17



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Radiated test equipment (above 1GHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2022-12-16	2023-12-15
Microwave Broadband Preamplifier (18-40GHz)	SCHWARZBECK	BBV 9721	EMC2172	2022-08-24	2023-08-23
EMI Test Receiver (10Hz-26.5GHz)	Rohde & Schwarz	ESIB26	EMC0522	2022-12-16	2023-12-15
EXA Signal Analyzer (10Hz-44GHz)	Keysight	N9010A	EMC2138	2022-09-08	2023-09-07
Chamber cable (Above 1GHz)	Scoflex	KMKM-8.0m	EMC0545	2022-08-24	2024-08-23
Chamber Cable (Below 1GHz)	Scoflex	KMKM-8.0m	EMC0546	2022-08-24	2024-08-23
Trilog Broadband Antenna (25MHz-1GHz)	SCHWARZBECK	VULB 9160	EMC2025	2022-09-07	2023-09-06
Horn Antenna (1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2022-09-21	2025-09-20
Horn Antenna 1-18GHz	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2251	2022-02-02	2025-08-01
Horn Antenna (14-40GHz)	SCHWARZBECK	BBHA 9170	EMC2041	2020-06-28	2023-06-27
Broad-Band Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2021-7-11	2024-07-10
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A



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6 Radio Spectrum Matter Test Results

6.1 Authorized frequency band verification

Test Requirement: 47 CFR Part 20.21(e)(3), KDB 935210 D04 clause 7.1.1

Test Method: KDB 935210 D04 clause 7.1.1

Limit: *20.21(e)(3) Frequency Bands:*
Consumer Signal Boosters must be designed and manufactured such that they only operate on the frequencies used for the provision of subscriber-based services under parts 22 (Cellular), 24 (Broadband PCS), 27 (AWS-1, 700 MHz Lower A-E Blocks, and 700 MHz Upper C Block), and 90 (Specialized Mobile Radio).

KDB 935210 D04 clause 7.1.1:

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

6.1.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.1.2 Test Setup

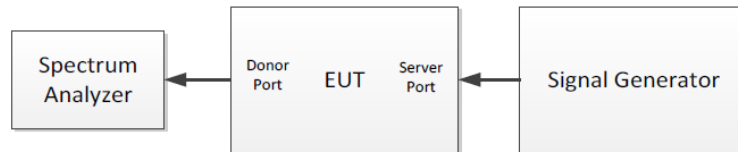


Figure 2 – Uplink test configuration in EUT test mode

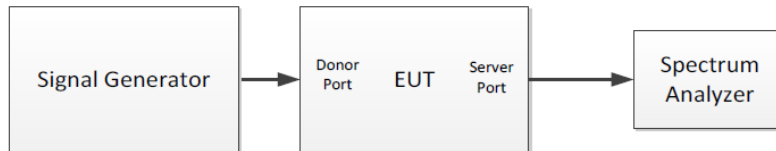


Figure 3 – Downlink test configuration in EUT test mode

6.1.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.2 Authorized CMRS provider test

Test Requirement: 47 CFR Part 20.21(e)(3), KDB 935210 D04 clause 7.1.2

Test Method: KDB 935210 D04 clause 7.1.2

Limit: **20.21(e)(3) Frequency Bands:**
Consumer Signal Boosters must be designed and manufactured such that they only operate on the frequencies used for the provision of subscriber-based services under parts 22 (Cellular), 24 (Broadband PCS), 27 (AWS-1, 700 MHz Lower A-E Blocks, and 700 MHz Upper C Block), and 90 (Specialized Mobile Radio).

KDB 935210 D04 clause 7.1.2:

This test shall be used to ensure the booster restricts its operation only to the spectrum assigned to the CMRS provider supporting the equipment certification request.

6.2.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.2.2 Test Setup

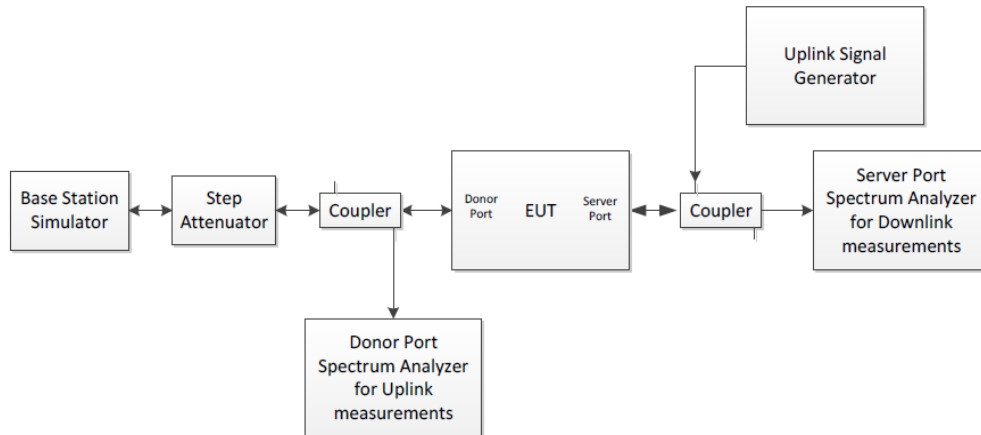


Figure 1 – Test configuration in EUT normal operational mode

6.2.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.3 Maximum power

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(D), 20.21(e)(9)(i)(B)

Test Method: KDB 935210 D04 clause 7.2

Limit: **20.21(e)(9)(i)(D) Power Limits:**
 A booster's uplink power must not exceed 1 watt composite conducted power and equivalent isotropic radiated power (EIRP) for each band of operation. Downlink power shall not exceed 0.05 watt (17 dBm) composite and 10 dBm per channel conducted and EIRP for each band of operation. Compliance with power limits will use instrumentation calibrated in terms of RMS equivalent voltage.

20.21(e)(9)(i)(B) Bidirectional Capability:
 Consumer Boosters must be able to provide equivalent uplink and downlink gain and conducted uplink power output that is at least 0.05 watts.

6.3.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.3.2 Test Setup

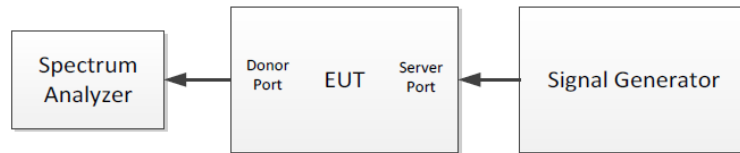


Figure 2 – Uplink test configuration in EUT test mode

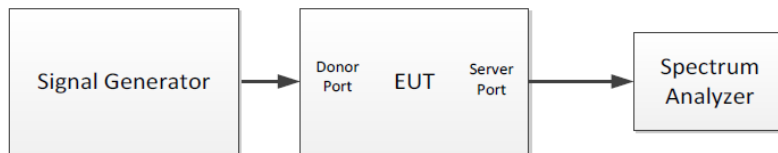


Figure 3 – Downlink test configuration in EUT test mode

6.3.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.4 Maximum booster gain computation

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(C)(2), 20.21(e)(9)(i)(B)

Test Method: KDB 935210 D04 clause 7.3

Limit: **20.21(e)(9)(i)(C)(2) Booster Gain Limits:**
 The uplink and downlink maximum gain of a Consumer Booster referenced to its input and output ports shall not exceed the following limits:
 (i) Fixed Booster maximum gain shall not exceed 19.5 dB + 20 Log₁₀ (Frequency), or 100 dB for systems having automatic gain adjustment based on isolation measurements between booster donor and server antennas.
 (ii) Where, Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

20.21(e)(9)(i)(B) Bidirectional Capability:
 Consumer Boosters must be able to provide equivalent uplink and downlink gain and conducted uplink power output that is at least 0.05 watts.

6.4.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.4.2 Test Setup

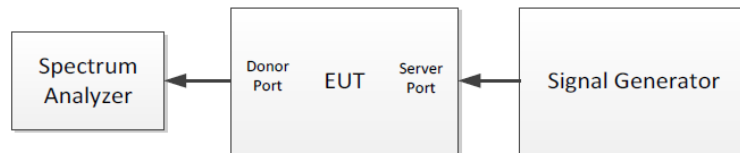


Figure 2 – Uplink test configuration in EUT test mode

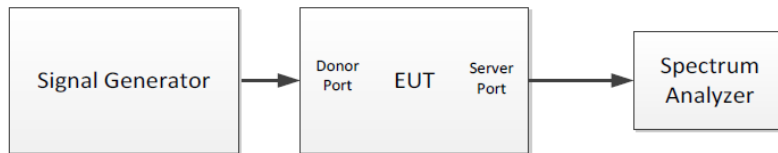


Figure 3 – Downlink test configuration in EUT test mode

6.4.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.5 Intermodulation product

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(G)

Test Method: KDB 935210 D04 clause 7.4

Limit: **20.21(e)(9)(i)(G) Intermodulation Limits:**
 The transmitted intermodulation products of a consumer booster at its uplink and downlink ports shall not exceed the power level of -19 dBm for the supported bands of operation. Compliance with intermodulation limits will use boosters operating at maximum gain and maximum rated output power, with two continuous wave (CW) input signals spaced 600 kHz apart and centered in the pass band of the booster, and with a 3 kHz measurement bandwidth.

6.5.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.5.2 Test Setup

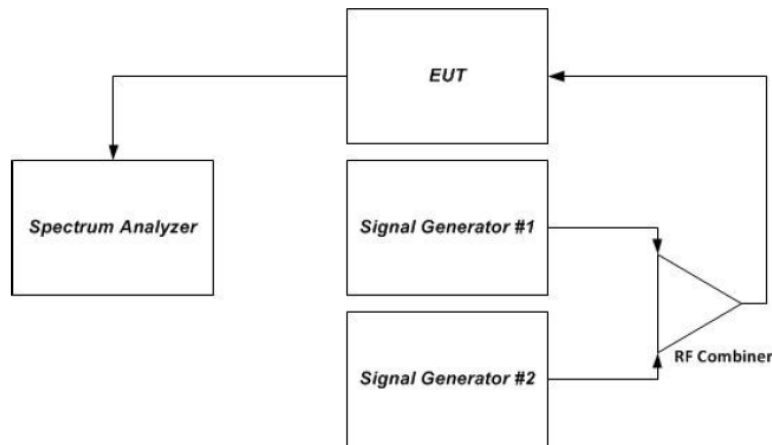


Figure 5 – Intermodulation product instrumentation test setup

6.5.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.6 Out-of-band emissions

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(F)

Test Method: KDB 935210 D04 clause 7.5

Limit:

20.21(e)(9)(i)(F) Out of Band Emission Limits:

Booster out of band emissions (OOBE) shall meet the FCC's mobile emission limits for the supported bands of operation. Compliance to OOBE limits will utilize high peak-to-average CMRS signal types.

22.917

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

24.238

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

27.53(c)

For operations in the 746-758 MHz band and the 776-788 MHz band, 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 any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

27.53(g)

For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a 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, by at least $43 + 10 \log(P)$ dB.

27.53(h)

the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.



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6.6.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.6.2 Test Setup

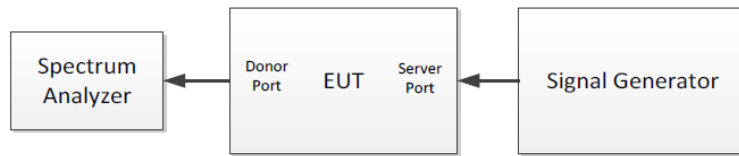


Figure 2 – Uplink test configuration in EUT test mode

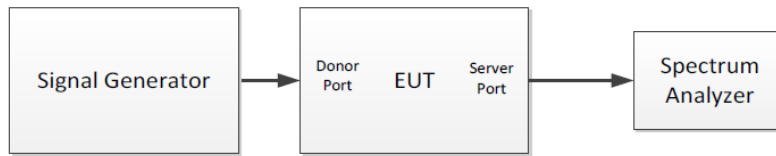


Figure 3 – Downlink test configuration in EUT test mode

6.6.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.7 Conducted spurious emissions

Test Requirement: 47 CFR Part 2.1051, 20.21(e)(9)(i)(F)

Test Method: KDB 935210 D04 clause 7.6

Limit:

20.21(e)(9)(i)(F) Out of Band Emission Limits:

Booster out of band emissions (OOBE) shall meet the FCC's mobile emission limits for the supported bands of operation. Compliance to OOBE limits will utilize high peak-to-average CMRS signal types.

22.917

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

24.238

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

27.53(c)

For operations in the 746-758 MHz band and the 776-788 MHz band, 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 any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- (2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- (3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations;
- (4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;

27.53(g)

For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a 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, by at least $43 + 10 \log(P)$ dB.

27.53(h)

the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.



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6.7.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.7.2 Test Setup

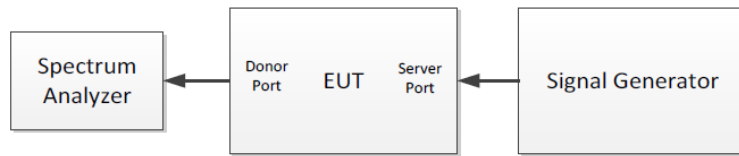


Figure 2 – Uplink test configuration in EUT test mode

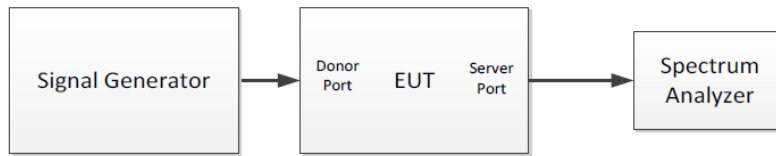


Figure 3 – Downlink test configuration in EUT test mode

6.7.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.8 Noise

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(A), 20.21(e)(9)(i)(I)

Test Method: KDB 935210 D04 clause 7.3

Limit:

20.21(e)(9)(i)(A) Noise Limits:

The transmitted noise power in dBm/MHz of frequency selective consumer boosters outside the licensee's spectrum blocks at their uplink and downlink ports shall not exceed the following limits:

(1) -103 dBm/MHz-RSSI

(i) Where RSSI is the downlink composite signal power received in dBm for frequencies in the band of operation outside the licensee's spectrum block as measured after spectrum block filtering is applied and is referenced to the booster's donor port for each band of operation. RSSI is expressed in negative dB units relative to 1 mW.

(ii) Boosters with MSCL less than 40 dB, shall reduce the Noise output in (A) by 40dB-MSCL, where MSCL is the minimum coupling loss in dB between the wireless device and booster's server port. MSCL must be calculated or measured for each band of operation and provided in compliance test reports.

(2)

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

(iii) Compliance with Noise limits will use instrumentation calibrated in terms of RMS equivalent voltage, and with booster input ports terminated or without input signals applied within the band of measurement.

20.21(e)(9)(i)(I) Transmit Power Off Mode:

When the consumer booster cannot otherwise meet the noise and gain limits defined herein it must operate in "Transmit Power OFF Mode." In this mode of operation, the uplink and downlink noise power shall not exceed -70 dBm/MHz and uplink gain shall not exceed the lesser of 23 dB or MSCL.

6.8.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain.



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6.8.2 Test Setup

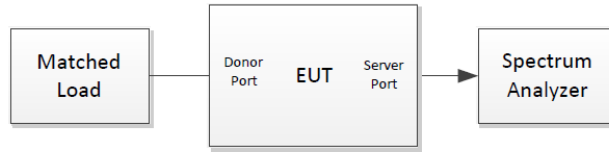


Figure 6 – Maximum downlink noise limit test configuration

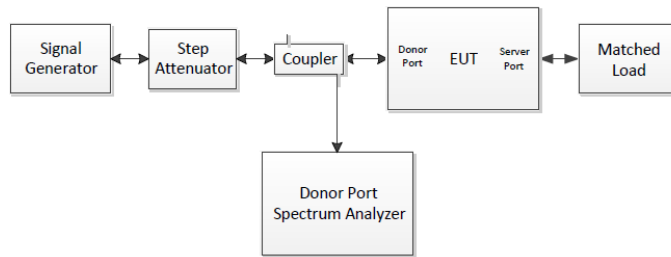


Figure 7 – Uplink RSSI-dependent noise limit test configuration

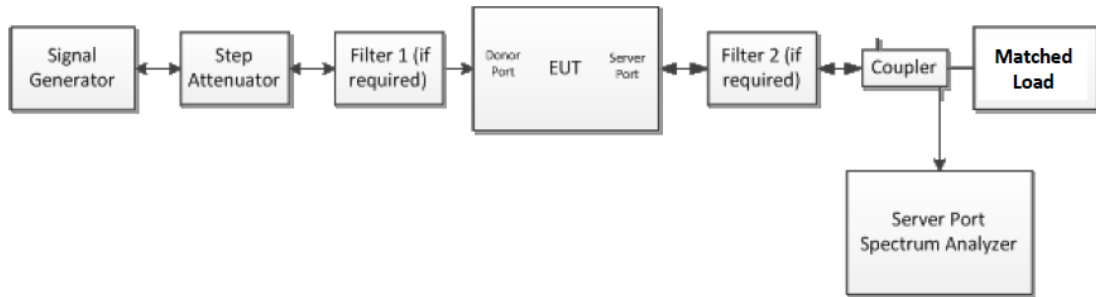


Figure 8 – Downlink RSSI-dependent noise limit test configuration

6.8.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.9 Uplink inactivity

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(J)
 Test Method: KDB 935210 D04 clause 7.8
 Limit: **20.21(e)(9)(i)(C)(2) Uplink inactivity:**
 When a consumer booster is not serving an active device connection after 5 seconds the uplink noise power shall not exceed -70 dBm/MHz.

6.9.1 E.U.T. Operation

Operating Environment:
 Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar
 EUT Operation: Set the EUT to maximum gain.

6.9.2 Test Setup

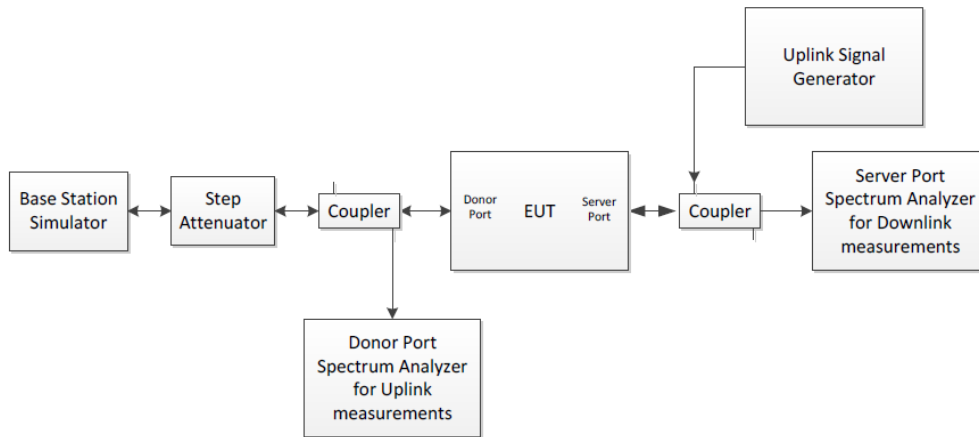


Figure 1 – Test configuration in EUT normal operational mode

6.9.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.10 Variable booster gain

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(C)(1), 20.21(e)(9)(i)(I)

Test Method: KDB 935210 D04 clause 7.9

Limit: **20.21(e)(9)(i)(C)(1) Booster Gain Limits:**
 The uplink and downlink gain in dB of a frequency selective consumer booster referenced to its input and output ports shall not exceed BSCL-28 dB-(40 dB-MSCL).

20.21(e)(9)(i)(I) Transmit Power Off Mode:
 When the consumer booster cannot otherwise meet the noise and gain limits defined herein it must operate in "Transmit Power OFF Mode." In this mode of operation, the uplink and downlink noise power shall not exceed -70 dBm/MHz and uplink gain shall not exceed the lesser of 23 dB or MSCL.

6.10.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.10.2 Test Setup

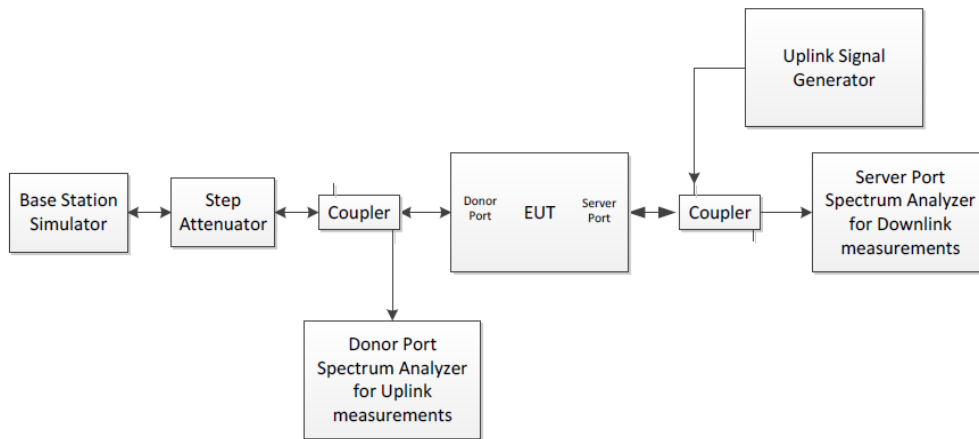


Figure 1 – Test configuration in EUT normal operational mode

6.10.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



6.11 Occupied bandwidth

Test Requirement: 47 CFR Part 2.1049
 Test Method: KDB 935210 D04 clause 7.10
 Limit: Compare the consistency of the output signal relative to the input signal, and to satisfy the requirements of Section 2.1049.

6.11.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.11.2 Test Setup

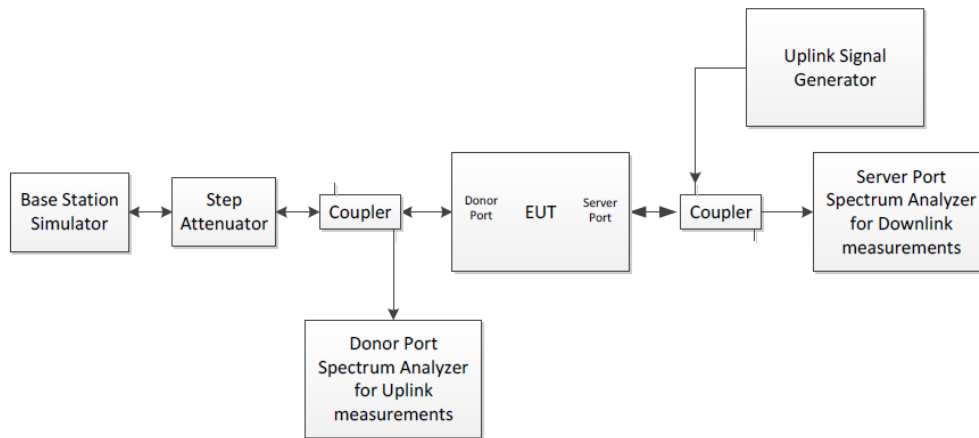


Figure 1 – Test configuration in EUT normal operational mode

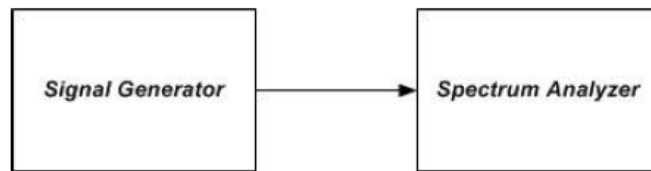


Figure 9 – Test setup for measuring characteristics of test signals used for subsequent EUT occupied bandwidth testing

6.11.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.12 Oscillation detection

Test Requirement: 47 CFR Part 20.21(e)(9)(ii)(A), 20.21(e)(5)

Test Method: KDB 935210 D04 clause 7.11

Limit: **20.21(e)(9)(ii)(A) Anti-Oscillation:**
 Consumer boosters must be able to detect and mitigate (i.e., by automatic gain reduction or shut down), any oscillations in uplink and downlink bands. Oscillation detection and mitigation must occur automatically within 0.3 seconds in the uplink band and within 1 second in the downlink band. In cases where oscillation is detected, the booster must continue mitigation for at least one minute before restarting. After five such restarts, the booster must not resume operation until manually reset.

20.21(e)(5) Anti-Oscillation:
 Consumer Signal Boosters must be able to detect and mitigate any unintended oscillations in uplink and downlink bands (such as may result from insufficient isolation between the antennas).

6.12.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.12.2 Test Setup

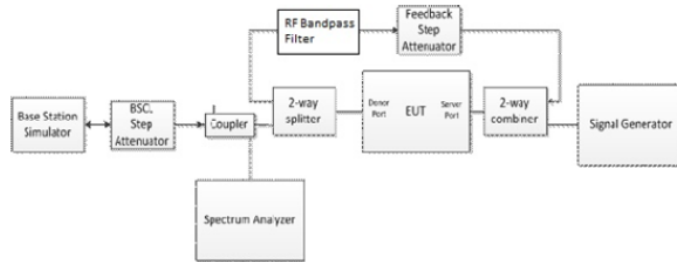


Figure 10 – Uplink oscillation detection test setup

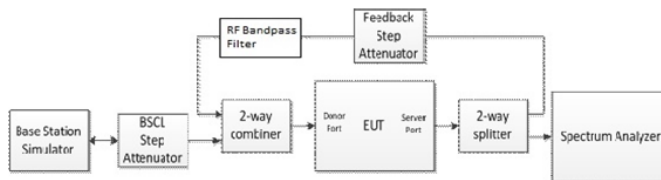


Figure 11 – Downlink oscillation detection test setup



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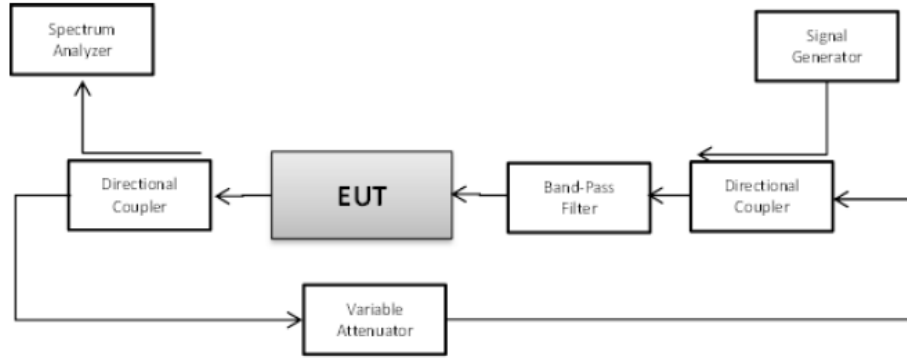


Figure 12 – Downlink oscillation mitigation test setup

6.12.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.13 Radiated Spurious emission

Test Requirement: 47 CFR Part 2.1053, 20.21(e)(9)(i)(F)

Test Method: KDB 935210 D04 clause 7.12

Limit:

20.21(e)(9)(i)(F) Out of Band Emission Limits:

Booster out of band emissions (OOBE) shall meet the FCC's mobile emission limits for the supported bands of operation. Compliance to OOBE limits will utilize high peak-to-average CMRS signal types.

22.917

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

24.238

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

27.53(c)

For operations in the 746-758 MHz band and the 776-788 MHz band, 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 any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

27.53(f)

For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions 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.

27.53(g)

For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a 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, by at least $43 + 10 \log(P)$ dB.

27.53(h)

the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.



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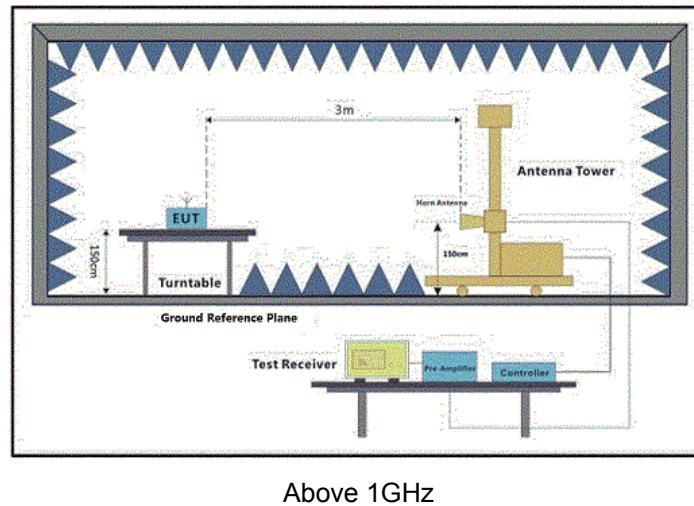
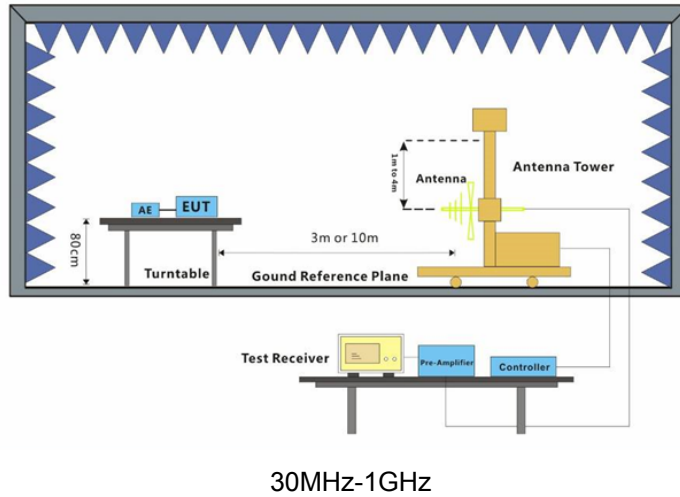
6.13.1 E.U.T. Operation

Operating Environment:

Temperature: 25.3 °C Humidity: 56 % RH Atmospheric Pressure: 1010 mbar

EUT Operation: Set the EUT to maximum gain and drive to maximum output power.

6.13.2 Test Setup



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6.13.3 Test procedure

1. Scan from 30MHz to 40GHz, 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)

Above 1GHz test procedure as below:

- 1) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber.
- 2) Calculate power in dBm by the following formula:
Level (dBm) = Read Level (dBm) + Correction Factor (dB)

6.13.4 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.14 Spectrum block filtering

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(C)(2), 20.21(e)(9)(i)(B)

Test Method: KDB 935210 D04 clause 7.13

Limit: *20.21(e)(9)(i)(B) Bidirectional Capability:*
Consumer Boosters must be able to provide equivalent uplink and downlink gain and conducted uplink power output that is at least 0.05 watts.

20.21(e)(3) Frequency Bands:
Consumer Signal Boosters must be designed and manufactured such that they only operate on the frequencies used for the provision of subscriber-based services under parts 22 (Cellular), 24 (Broadband PCS), 27 (AWS-1, 700 MHz Lower A-E Blocks, and 700 MHz Upper C Block), and 90 (Specialized Mobile Radio).

6.14.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum output power and maximum gain.

6.14.2 Test Setup

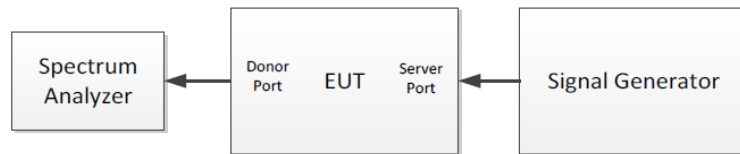


Figure 2 – Uplink test configuration in EUT test mode

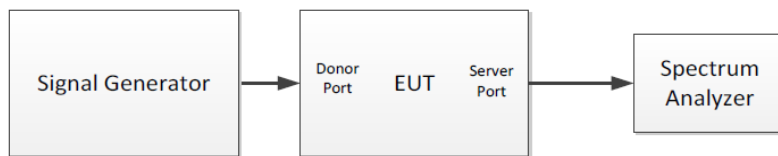


Figure 3 – Downlink test configuration in EUT test mode

6.14.3 Measurement Record

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6.15 Out of band gain

Test Requirement: 47 CFR Part 20.21(e)(9)(i)(E)

Test Method: KDB 935210 D04 clause 7.14

Limit: *20.21(e)(9)(i)(E) Out of Band Gain Limits:*

(1) A frequency selective booster shall have the following minimum attenuation referenced to the gain in the center of the pass band of the booster:

- (i) -20 dB at the band edge, where band edge is the end of the licensee's allocated spectrum,
- (ii) -30 dB at 1 MHz offset from band edge,
- (iii) -40 dB at 5 MHz offset from band edge.

(2) A frequency selective booster having maximum gain greater than 80 dB (referenced to the center of the pass band) shall limit the out of band gain to 60 dB at 0.2 MHz offset from the band edge, and 45 dB at 1 MHz offset from the band edge, where band edge is the end of the licensee's allocated spectrum.

6.15.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum output power and maximum gain.

6.15.2 Test Setup

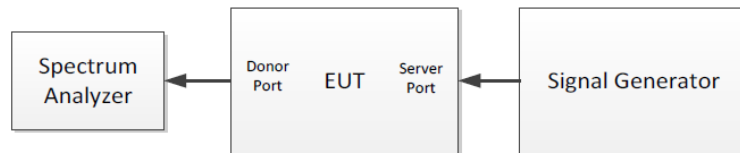


Figure 2 – Uplink test configuration in EUT test mode

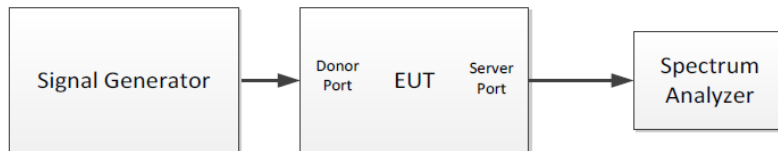


Figure 3 – Downlink test configuration in EUT test mode

6.15.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022002.



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6.16 Frequency Stability

Test Requirement: 47 CFR Part 2.1055
 Test Method: 47 CFR Part 2.1055
 KDB 935210 D04 clause 3.7

Limit: **24.335 Frequency tolerance:**
 The carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in below table:

Frequency range (MHz)	Base, fixed (ppm)
25 to 50	20.0
50 to 450	5.0
450 to 512	2.5
821 to 896	1.5
928 to 929	5.0
929 to 960	1.5
2110 to 2220	10.0

24.235 & 27.54 Frequency stability:

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

6.16.1 E.U.T. Operation

Operating Environment:

Temperature: 23.1 °C Humidity: 59 % RH Atmospheric Pressure: 1015 mbar

EUT Operation: Set the EUT to maximum output power and maximum gain.

6.16.2 Test Setup

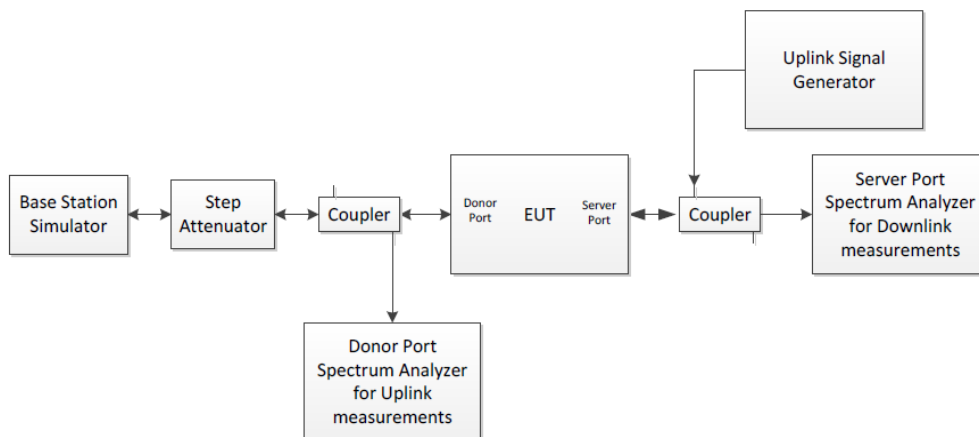


Figure 1 – Test configuration in EUT normal operational mode

6.16.3 Measurement Record

Please refer to Appendix - Test Data and Result for report GZCR230300022302.



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7 Test Setup Photographs

Refer to Appendix - Test Setup Photos for GZCR2303000220AT.

8 EUT Constructional Details (EUT Photos)

Refer to Appendix - External and Internal Photos for GZCR2303000220AT.

- End of the Report -



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