FCC Measurement/Technical Report on

CAP H 7E/80-85/17E/19
Cellular Repeater

FCC ID: XS5-CAPH7E817E19
IC: 2237E-EH7E817E19

Test Report Reference: MDE_BVNBG_1806_FCCf

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche Akkreditierungsstelle D-PL-12140-01-00

Table of Contents

Applied Standards and Test Summary

1.1 APPLIED STANDARDS

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 20, 90, (10/1/18 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 20, Commercial Mobiles Services

§ 20.21 Signal Boosters

Part 90; Private Land Mobile Radio Services

Subpart R - Regulations Governing the Licensing and Use of Frequencies in the 763-775 and 793-805 MHz Bands

90.542 - Broadband transmitting power limits
90.543 - Emission limitations

Subpart S – Regulations Governing Licensing and Use of Frequencies in the 806-824, 851-869, 896-901, And 935-940 MHz Bands

§ 90.635 – Limitations on power and antenna height
§ 90.691 – Emission mask requirements for EA-based systems

Subpart I – General Technical Standards

§ 90.213 – Frequency Stability
§ 90.219 – Use of signal boosters

The tests were selected and performed with reference to:

- FCC Public Notice 935210 applying "Signal Boosters Basic Certification Requirements" 935210 D02 v04r01, 2018-06-19-27.
- FCC Public Notice 935210 applying "Measurement guidance for industrial and non-consumer signal booster, repeater and amplifier devices" 935210 D05 v01r02, 2017-10-27.
- FCC Public Notice 971168 applying "Measurement guidance for certification of licensed digital transmitters" 971168 D01 v03r01,2018-04-09
- ANSI C63.26: 2015

Summary Test Results:
The EUT complied with all performed tests as listed in chapter 1.3 Measurement Summary / Signatures.

1.2 FCC-ISED CORRELATION TABLE

Correlation of measurement requirements for Industrial Signal Booster from FCC and ISED Canada

Band 14 (758 MHz – 768 MHz)

Measurement	FCC reference	ISED reference
Effective radiated power, mean output power and zone enhancer gain	§2.1046 §90.542 KDB 935210 D05 v01r02: 3.5	RSS-GEN Issue 5, 6.12 RSS-140 Issue 1, 4.3 SRSP-540, Issue 7, 5.1.1
Peak to Average Ratio	-	RSS 140 Issue 1: 4.3
Occupied bandwidth Input-versus-output spectrum	§2.1049 KDB 935210 D05 v01r02: 3.4	RSS-GEN Issue 5, 6.7
Conducted spurious Emission at Antenna Terminal	§2.1051 §90.543	RSS-GEN Issue 5, 6.13 RSS-140 Issue 1, 4.4
Out-of-band emissions limits	§2.1051 §90.213 KDB 935210 D05 v01r02: 3.6	RSS-GEN Issue 5, 6.13 RSS-140 Issue 1, 4.4
Frequency stability	§2.1055	RSS-GEN Issue 5, 6.11 RSS-140 Issue 1, 4.2
Field strength of spurious radiation	§2.1053 §90.543	RSS-GEN Issue 5, 6.13 RSS-140 Issue 1, 4.4
Out-of-band rejection	KDB 935210 D05 v01r02: 3.3	-

1.3 MEASUREMENT SUMMARY / SIGNATURES

Band 26/27 (partly) (862 MHz – 869 MHz)

47 CFR CHAPTER I FCC PART 90 Subpart S/I [Base Stations/Repeater]	**§2.1046, §90.635 (a), KDB 935210 D02 II (p)(4)**
Effective Radiated Power, mean output power and zone enhancer gain The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r02: 3.5	**Final Result**

OP-Mode Frequency Band, Direction, Input Power, Signal Type	**Setup**	**FCC**	**IC**
Band 26/27, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Band 26/27, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Band 26/27, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Band 26/27, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S/I [Base Stations/Repeater]	
Peak to Average Ratio The measurement was performed according to ANSI C63.26	**Final Result**

OP-Mode Frequency Band, Direction, Input Power, Signal Type	**Setup**	**FCC**	**IC**
Band 26/27, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Band 26/27, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Band 26/27, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Band 26/27, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S/I [Base Stations/Repeater]	**§2.1049, KDB 935210 D02 II (p)(3)**
Occupied Bandwidth / Input-versus-output Spectrum The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r02: 3.4	**Final Result**

OP-Mode Frequency Band, Direction, Input Power, Signal Type	**Setup**	**FCC**	**IC**
Band 26/27, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Performed	Passed
Band 26/27, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Performed	Passed
Band 26/27, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Performed	Passed
Band 26/27, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Performed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater] **§2.1051, §90.691 (a)(2)**

Conducted spurious emissions at antenna terminals
The measurement was performed according to ANSI C63.26 **Final Result**

OP-Mode Frequency Band, Test Frequency, Direction, Signal Type	Setup	FCC	IC
Band 26/27, high, RF downlink, Narrowband	S01_AA01	Passed	Passed
Band 26/27, high, RF downlink, Wideband	S01_AA01	Passed	Passed
Band 26/27, low, RF downlink, Narrowband	S01_AA01	Passed	Passed
Band 26/27, low, RF downlink, Wideband	S01_AA01	Passed	Passed
Band 26/27, mid, RF downlink, Narrowband	S01_AA01	Passed	Passed
Band 26/27, mid, RF downlink, Wideband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater] **§2.1053, §90.691 (a)(2) KDB 935210 D02 II (p)(3)**

Out-of-band emission limits / Intermodulation
The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r02: 3.6 **Final Result**

OP-Mode Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal Type	Setup	FCC	IC
Lower, Band 26/27, 1, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Lower, Band 26/27, 1, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Lower, Band 26/27, 1, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Lower, Band 26/27, 1, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed
Lower, Band 26/27, 2, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Lower, Band 26/27, 2, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Upper, Band 26/27, 1, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Upper, Band 26/27, 1, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Upper, Band 26/27, 1, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Upper, Band 26/27, 1, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed
Upper, Band 26/27, 2, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Upper, Band 26/27, 2, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater] **KDB 935210 D02 II (p)(2)**

Out-of-band rejection
The measurement was performed according to ANSI C63.26 **Final Result**

OP-Mode Frequency Band, Direction	Setup	FCC	IC
Band 26/27, RF downlink	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater] **§2.1053, §90.691 (a)(2)**

Field strength of spurious radiation
The measurement was performed according to ANSI C63.26 **Final Result**

OP-Mode	**Setup**	**FCC**	**IC**
Frequency Band, Test Frequency, Direction			
Band 26/27, high, RF downlink	S01_AA01	Passed	Passed
Band 26/27, low, RF downlink	S01_AA01	Passed	Passed
Band 26/27, mid, RF downlink	S01_AA01	Passed	Passed

Band 14 (758 MHz – 768 MHz)

47 CFR CHAPTER I FCC PART 90 Subpart R / I [Base Stations / Repeater]	**§2.1046, §90.542 (a)(3) KDB 935210 D02 II (p)(4)**

Effective Radiated Power, mean output power and zone enhancer gain
The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r02: 3.5 — **Final Result**

OP-Mode	**Setup**	**FCC**	**IC**
Frequency Band, Direction, Input Power, Signal Type			
Band 14, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Band 14, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Band 14, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Band 14, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater]

Peak to Average Ratio
The measurement was performed according to ANSI C63.26 — **Final Result**

OP-Mode	**Setup**	**FCC**	**IC**
Frequency Band, Direction, Input Power, Signal Type			
Band 14, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Band 14, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Band 14, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Band 14, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater]	**§2.1049, §90.219(e)(4)(ii), KDB 935210 D02 II (p)(3)**

Occupied Bandwidth / Input-versus-output Spectrum
The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r02: 3.4 — **Final Result**

OP-Mode	**Setup**	**FCC**	**IC**
Frequency Band, Direction, Input Power, Signal Type			
Band 14, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Performed	Passed
Band 14, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Performed	Passed
Band 14, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Performed	Passed
Band 14, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Performed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater]	**§2.1051, §90.543(e)(1)(3), §90.543 (f)**

Conducted spurious emissions at antenna terminals
The measurement was performed according to ANSI C63.26 — **Final Result**

OP-Mode	**Setup**	**FCC**	**IC**
Frequency Band, Test Frequency, Direction, Signal Type			
Band 14, high, RF downlink, Narrowband	S01_AA01	Passed	Passed
Band 14, high, RF downlink, Wideband	S01_AA01	Passed	Passed
Band 14, low, RF downlink, Narrowband	S01_AA01	Passed	Passed
Band 14, low, RF downlink, Wideband	S01_AA01	Passed	Passed
Band 14, mid, RF downlink, Narrowband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater]	§2.1051, §90.543(e)(1)(3), §90.543 (f)

Conducted spurious emissions at antenna terminals
The measurement was performed according to ANSI C63.26 **Final Result**

OP-Mode Frequency Band, Test Frequency, Direction, Signal Type	Setup	FCC	IC
Band 14, mid, RF downlink, Wideband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater]	§2.1053, §90.213(e)(3), KDB 935210 D02 II (p)(3)

Out-of-band emission limits/Intermodulation
The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r02: 3.6 **Final Result**

OP-Mode Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal Type	Setup	FCC	IC
Lower, Band 14, 1, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Lower, Band 14, 1, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Lower, Band 14, 1, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Lower, Band 14, 1, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed
Lower, Band 14, 2, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Lower, Band 14, 2, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Lower, Band 14, 2, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Lower, Band 14, 2, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed
Upper, Band 14, 1, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Upper, Band 14, 1, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Upper, Band 14, 1, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Upper, Band 14, 1, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed
Upper, Band 14, 2, RF downlink, 0.3 dB < AGC, Narrowband	S01_AA01	Passed	Passed
Upper, Band 14, 2, RF downlink, 0.3 dB < AGC, Wideband	S01_AA01	Passed	Passed
Upper, Band 14, 2, RF downlink, 3 dB > AGC, Narrowband	S01_AA01	Passed	Passed
Upper, Band 14, 2, RF downlink, 3 dB > AGC, Wideband	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater]	KDB 935210 D02 II (p)(2)

Out-of-band rejection
The measurement was performed according to ANSI C63.26 **Final Result**

OP-Mode Frequency Band, Direction	Setup	FCC	IC
Band 14, RF downlink	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater] **§90.213(d)(6)(ii) / (iii), (e)(3)**

Noise

The measurement was performed according to ANSI C63.26 **Final Result**

OP-Mode Frequency Band, Direction, Test Step	Setup	FCC	IC
Band 14, RF downlink, passband	S01_AA01	Passed	Passed
Band 14, RF downlink, noise figure	S01_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S / I [Base Stations / Repeater] **§2.1053, §90.543(e)(1)(3)**

Field strength of spurious radiation

The measurement was performed according to ANSI C63.26 **Final Result**

OP-Mode Frequency Band, Test Frequency, Direction	Setup	FCC	IC
Band 14, high, RF downlink	S01_AA01	Passed	Passed
Band 14, low, RF downlink	S01_AA01	Passed	Passed
Band 14, mid, RF downlink	S01_AA01	Passed	Passed

N/A: Not applicable
N/P: Not performed

The test case frequency stability was not performed, since the EUT is not equipped with signal processing capabilities.

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2019-04-02	--	invalid
REV1	2019-04-10	• Page 4: wrong reference §22.917 change to § 90.543 in FCC-ISED correlation table. • Page 5-9: References to KDB document 935210 D02 added in test summary where applicable. • Page 6,9: "Intermodulation" added in name to test case "out-of-band emission limits". • Page 8: Paragraph §90.543(f) added as a requirement for the spurious emissions. • Page 18: Paragraph §90.219 added as a requirement and KDB 935210 D02 (j)(1)(i) & (ii) added as reference for output power > 5W • Page 42: Paragraph §90.543 (f) added as a requirement for the spurious emissions	valid

(responsible for accreditation scope)
Dipl.-Ing. Marco Kullik

(responsible for testing and report)
Dipl.-Ing. Daniel Gall

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

2 ADMINISTRATIVE DATA

2.1 TESTING LABORATORY

Company Name:	7layers GmbH
Address:	Borsigstr. 11 40880 Ratingen Germany

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-00
FCC Designation Number:	DE0015
FCC Test Firm Registration:	929146
ISED CAB Identifier	DE0007; ISED#:3699A
Responsible for accreditation scope:	Dipl.-Ing. Marco Kullik
Report Template Version:	2019-03-11

2.2 PROJECT DATA

Responsible for testing and report:	Dipl.-Ing. Daniel Gall
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2019-04-10
Testing Period:	2019-02-15 to 2019-02-21

2.3 APPLICANT DATA

Company Name:	Commscope Andrew Wireless Systems GmbH
Address:	Industriering 10 86675 Buchdorf Germany
Contact Person:	Mr. Frank Futter

2.4 MANUFACTURER DATA

Company Name:	please see applicant data
Address:	
Contact Person:	

3 TEST OBJECT DATA

3.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Cellular Repeater
Product name	Cellular Repeater
Type	CAP H 7E/80-85/17E/19
Declared EUT data by the supplier	
General Product Description	The EUT is an industrial signal booster supporting the followings: Band 2/ 1900 PCS Band 4/10/66 / AWS + Band 5 / 850 Band 12 / 700 a Band 13 / 700 c Band 14 / 700 PS Band 26/27 / 800 SMR (partly) A RF operation is only supported for the downlink.
Booster Type	Industrial Signal Booster
Voltage Type	AC
Voltage Level	100 – 240 V, 50 – 60 Hz
Maximum Output Donor Port [Uplink]	-
Maximum Output Server Port [Downlink]	Band 14: 43.0 dBm Band 26: 43.0 dBm
Maximum Gain [Uplink]	-
Maximum Gain [Downlink]	Band 14: 28.0 dB Band 27: 28.0 dB

The main components of the EUT are listed and described in chapter 3.2 EUT Main components.

3.2 EUT MAIN COMPONENTS

Sample Name	**Sample Code**	**Description**
EUT A	DE1277008aa01	FCC sample
Sample Parameter	**Value**	
Serial Number	BGCHDA1851001	
HW Version	7825719-0001 CAP H 7E/80-85/17E/19	
SW Version	7694174-12 SW V2.6.0.106	
Comment	-	

NOTE:The short description is used to simplify the identification of the EUT in this test report.

3.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Device	Details (Manufacturer, Type Model, OUT Code)	Description
-	-	-

3.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

Device	Details (Manufacturer, HW, SW, S/N)	Description
-	-	-

3.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup	Combination of EUTs	Description and Rationale
S01_AA01	EUT A	Setup for all tests

3.6 OPERATING MODES

This chapter describes the operating modes of the EUTs used for testing.

3.6.1 TEST CHANNELS

Band	Direction	Lower Frequency Band Edge [MHz]	Upper Frequency Band Edge [MHz]	Center Frequency [MHz]	Port
14	downlink	758.00	768.00	763.00	Donor
26/27 (partly)	downlink	862.00	869.00	865.50	Donor

3.6.2 AUTOMATIC GAIN CONTROL LEVELS

AGC Levels							
Band	Direction	Signal Type	AGC Start Pin [dBm]	AGC Start Pin -0.3 dB [dBm]	AGC Start Pin +3 dB [dBm]	Frequency [MHz]	Frequency
14	downlink	Narrowband	0.2	-0.1	3.2	763.0	Mid
14	downlink	Wideband	1.4	1.1	4.4	763.0	
14	downlink	Narrowband	1.0	0.7	4.0	758.2	Low
14	downlink	Wideband	0.4	0.1	3.4	760.5	
14	downlink	Narrowband	1.0	0.7	4.0	767.8	High
14	downlink	Wideband	1.0	0.7	4.0	765.5	
14	downlink	Narrowband	0.4	0.1	3.4	759.0	Max. Power
14	downlink	Wideband	0.4	0.1	3.4	759.0	

AGC Levels							
Band	Direction	Signal Type	AGC Start Pin [dBm]	AGC Start Pin -0.3 dB [dBm]	AGC Start Pin +3 dB [dBm]	Frequency [MHz]	Frequency
26/27	downlink	Narrowband	-0.2	-0.5	2.8	865.5	Mid
26/27	downlink	Wideband	0.2	-0.1	3.2	865.5	
26/27	downlink	Narrowband	-0.4	-0.7	2.6	862.2	Low
26/27	downlink	Wideband	0.0	-0.3	3.0	864.5	
26/27	downlink	Narrowband	0.8	0.5	3.8	868.8	High
26/27	downlink	Wideband	0.6	0.3	3.6	866.5	
26/27	downlink	Narrowband	-0.6	-0.9	2.4	868.1	Max. Power
26/27	downlink	Wideband	0.2	-0.1	3.2	868.1	

3.7 PRODUCT LABELLING

3.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

3.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

4 TEST RESULTS

4.1 EFFECTIVE RADIATED POWER, MEAN OUTPUT POWER AND ZONE ENHANCER GAIN

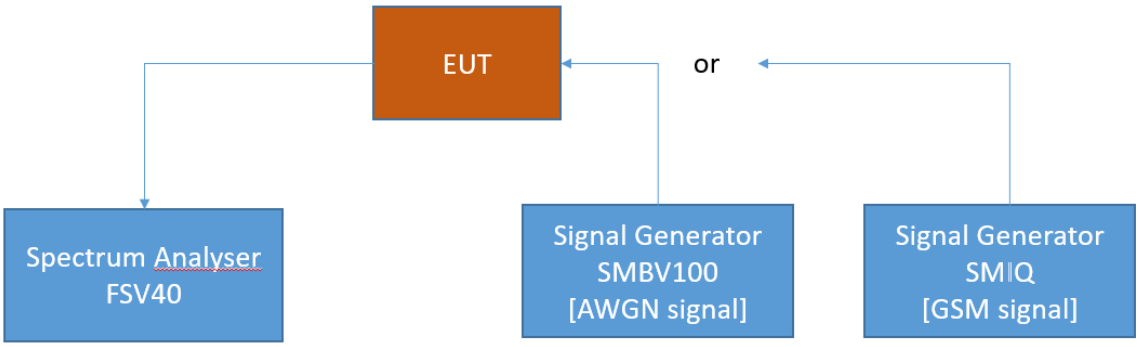
Standard FCC Part 90, §90.635, §90.542

The test was performed according to:
ANSI C63.26, KDB 935210 D05 v01r02: 3.5

4.1.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster power and gain limits and requirements for industrial signal boosters.

The EUT was connected to the test setup according to the following diagram:



FCC Part 22/24/27/90 Industrial signal booster – Test Setup; RF Output Power / Gain

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

4.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 90

§90.219 (d)(3)(i)

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

KDB 935210 D02

V. PART 90 SIGNAL BOOSTER SPECIFIC REQUIREMENTS

(j) Other provisions for part 90 boosters in specific bands and/or for specific conditions.

(1) Equipment authorizations to support both Section 90.219 and higher power operations. For devices that support output power higher than the 5 W ERP limit of Section 90.219, and are intended for marketing and subsequent US non-federal (FCC) station operations both within and outside the scope of the Section 90.219 authorization and deployment framework,8 for equipment authorization purposes the following provisions apply.

(i) For equipment to be certified as acceptable for Section 90.219(b) operations, B9A and B9B Form 731 applications must contain test data, install/operating instructions, etc., specifically for the Section 90.219(e) requirements, along with the usual Sections 2.911(c), 2.1033(c), 90.203, and associated contents requirements. In addition, the B9A or B9B application must contain test data, install/operating instructions, etc., for other intended and supported maximum output powers and maximum emissions end-use configurations.

(ii) Per the usual OET practice, the highest output powers for each emission mode are listed on Form 731 line entries. It is preferred, however not required, that the Section 90.219 associated emission modes (reflecting maximum 5 W ERP) are also separately listed on the Form 731 line entries. A grant comment should be applied that specific station authorizations are required for equipment operations exceeding Section 90.219 conditions.

Band 26 / 27 (862 MHz – 869 MHz)

§ 90.635

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

Band 14 (758 MHz – 768 MHz)

§90.542 (a)(3)

(a) The following power limits apply to the 758-768/788-798 MHz band:

(3) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.

4.1.3 TEST PROTOCOL

Band 14, downlink							
Signal Type	**Input Power**	**Frequency [MHz]**	**Input Power [dBm]**	**Maximum Average Output Power [dBm]**	**Limit Average Output Power [dBm]**	**Margin to Limit [dB]**	**Gain [dB]**
Wideband	0.3 dB < AGC	760.500	0.1	41.7	60.0	18.3	41.6
Wideband	3 dB > AGC	760.500	3.4	41.9	60.0	18.1	38.5
Narrowband	0.3 dB < AGC	759.000	0.1	41.8	60.0	18.2	41.7
Narrowband	3 dB > AGC	759.000	3.4	42.1	60.0	17.9	38.7

Band 26/27 (partly), downlink							
Signal Type	**Input Power**	**Frequency [MHz]**	**Input Power [dBm]**	**Maximum Average Output Power [dBm]**	**Limit Average Output Power [dBm]**	**Margin to Limit [dB]**	**Gain [dB]**
Wideband	0.3 dB < AGC	866.500	-0.1	42.6	60.0	17.4	42.7
Wideband	3 dB > AGC	866.500	3.2	42.8	60.0	17.2	39.6
Narrowband	0.3 dB < AGC	868.080	-0.9	42.6	60.0	17.4	43.6
Narrowband	3 dB > AGC	868.080	2.4	43.0	60.0	17.1	40.6

Remark: Please see next sub-clause for the measurement plot.

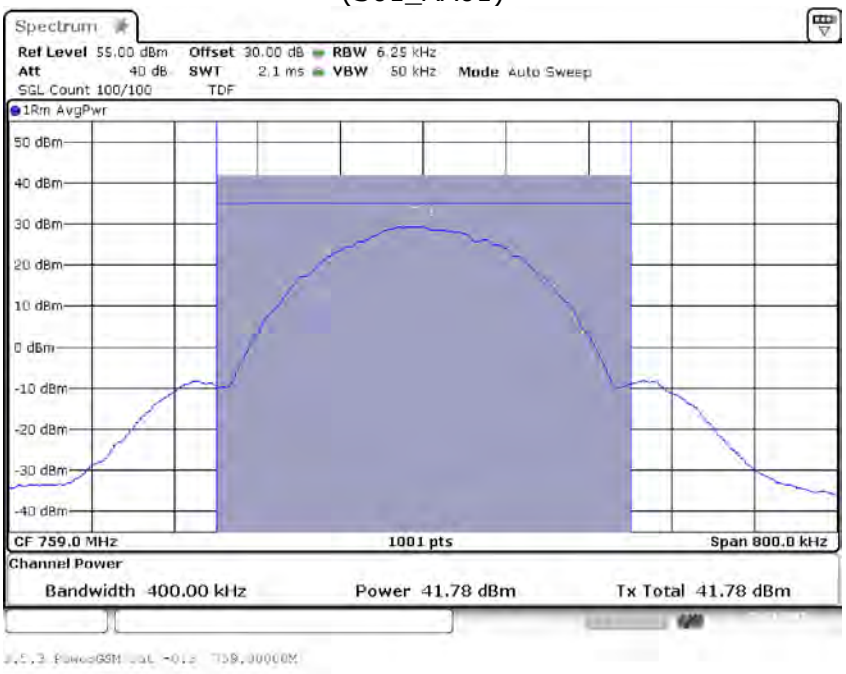
Sample calculation for output power 20 W

The conducted output power of the DUT can be 43 dBm (20 W) in the band 758 – 768 MHz.
This output power of 20 W (conducted) can be transformed to maximum 5 W per channel ERP by using appropriate antenna equipment.
for example:
feeder cable loss + antenna gain: - 10 dBd

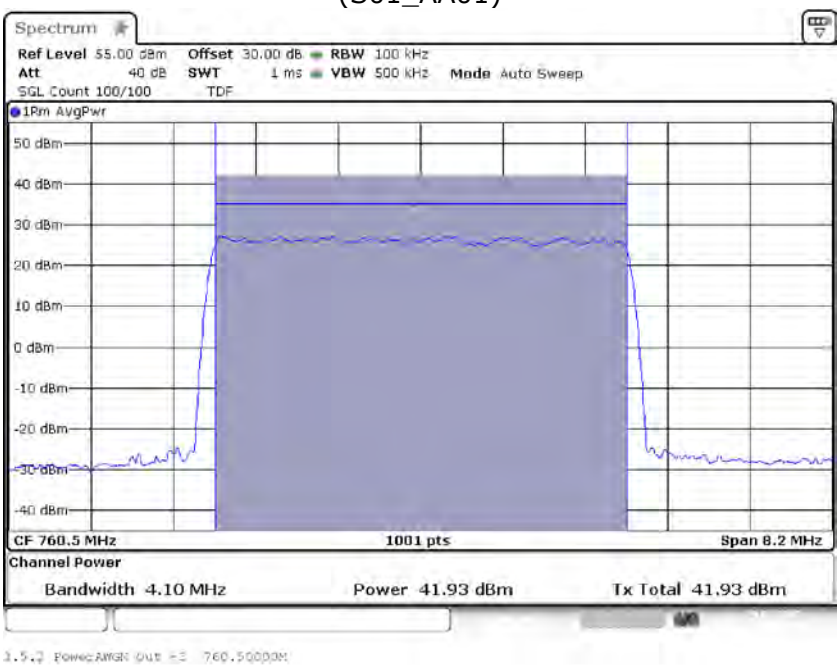
43 dBm (20 W) + (- 10 dBd) = 33 dBm (2 W) ERP

4.1.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

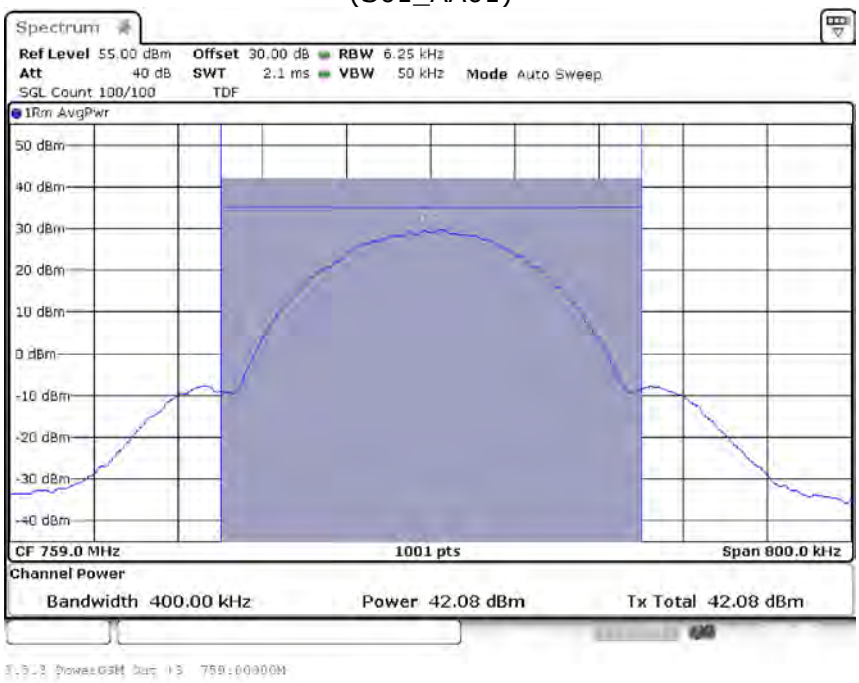
Frequency Band = Band 14, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Narrowband
(S01_AA01)



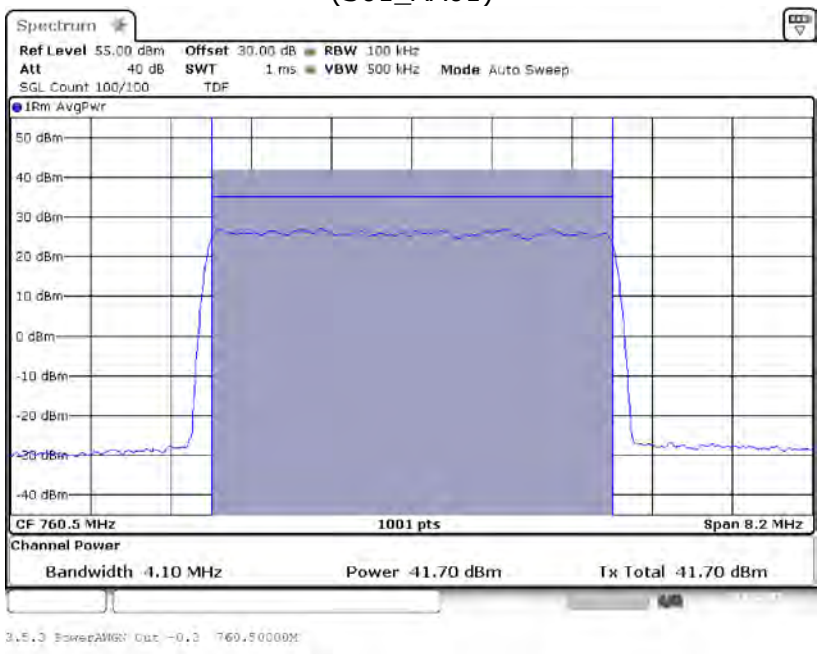
Frequency Band = Band 14, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Wideband
(S01_AA01)



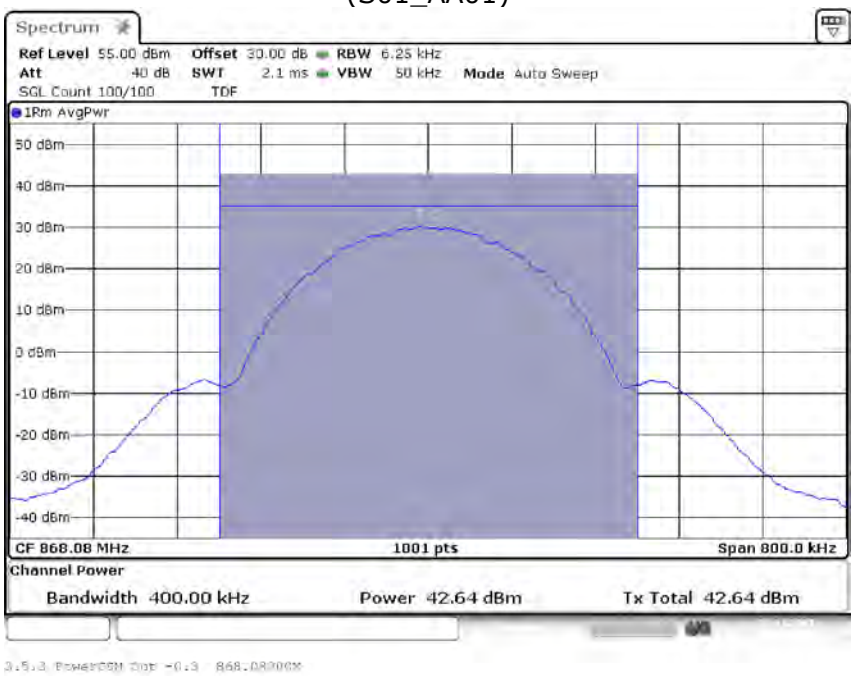
Frequency Band = Band 14, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Narrowband
(S01_AA01)



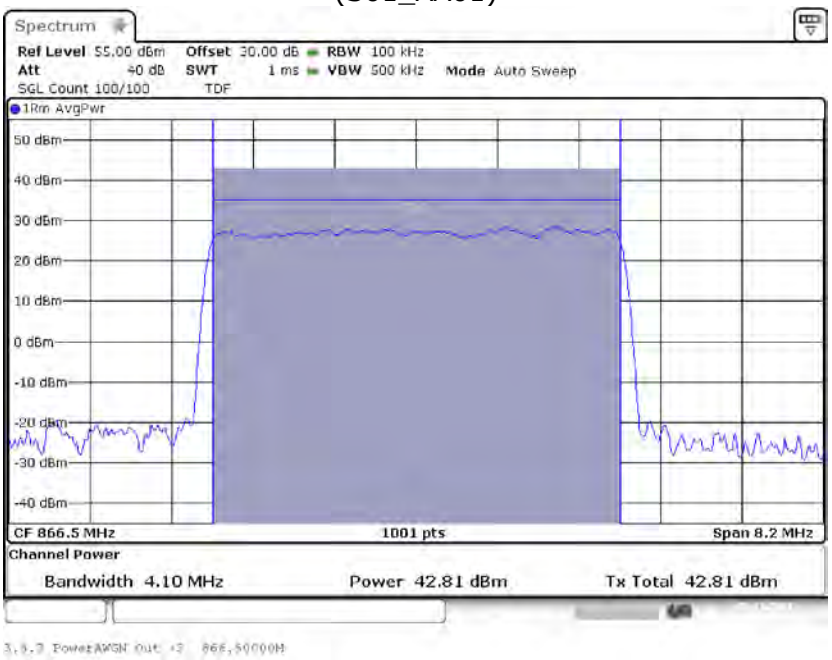
Frequency Band = Band 14, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Wideband
(S01_AA01)



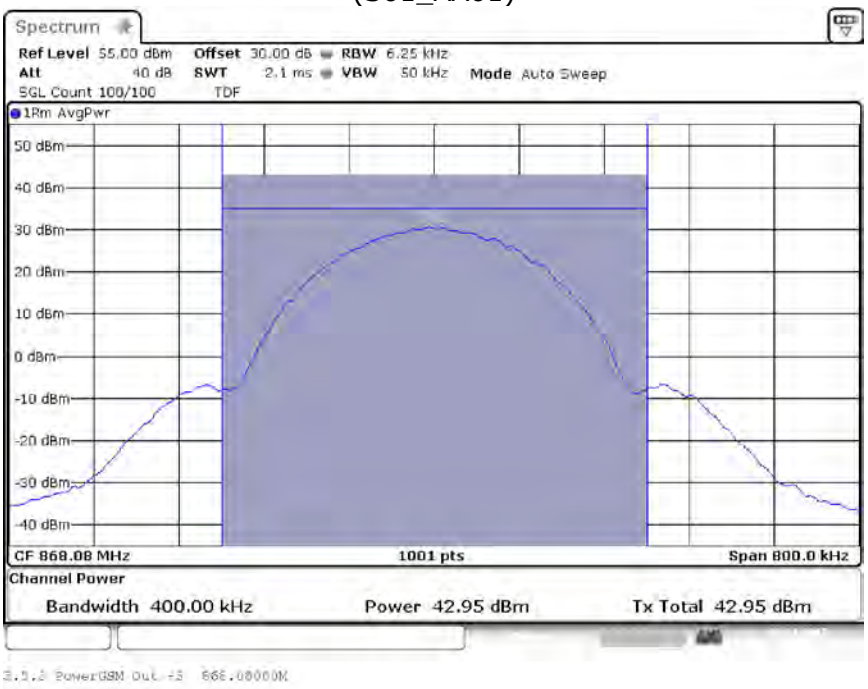
Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Narrowband
(S01_AA01)



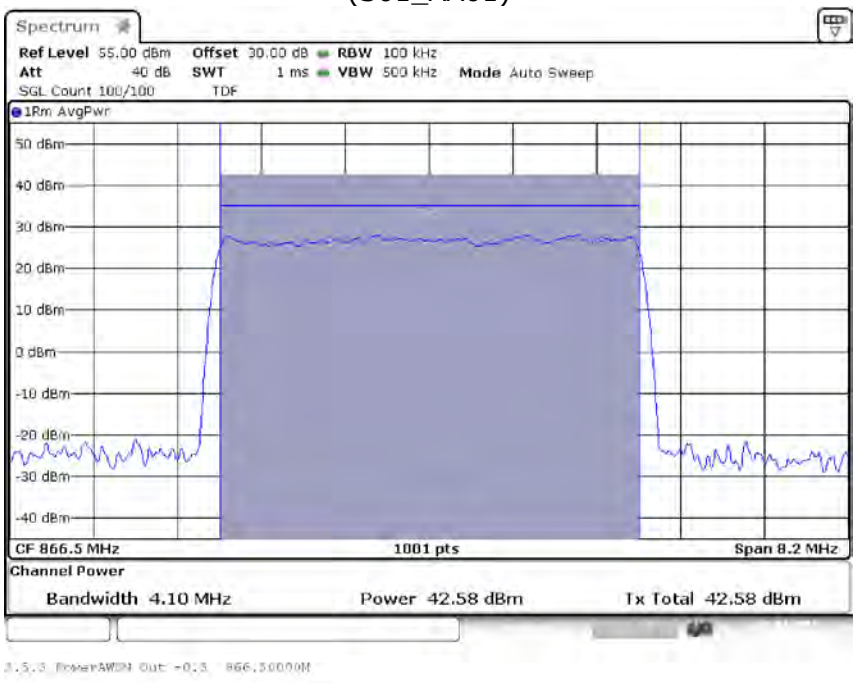
Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Wideband
(S01_AA01)



Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Narrowband
(S01_AA01)



Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Wideband
(S01_AA01)



4.1.5 TEST EQUIPMENT USED

- FCC Conducted Base Station / Repeater

4.2 PEAK TO AVERAGE RATIO

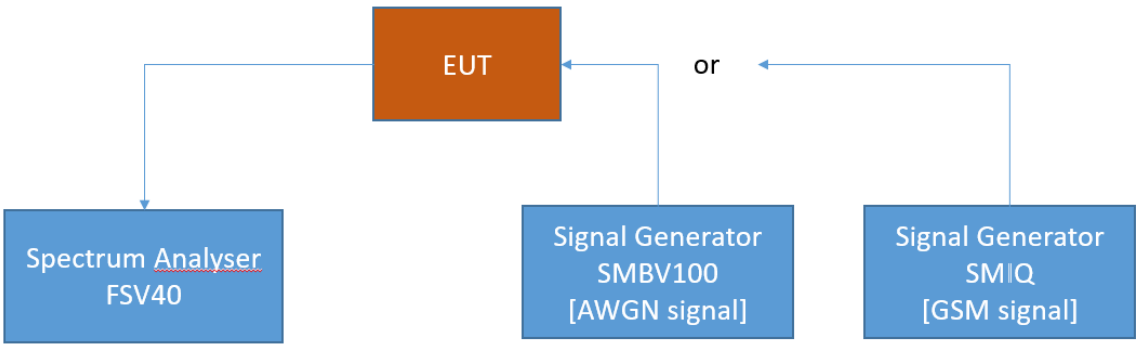
Standard -

The test was performed according to:
ANSI C63.26

4.2.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster power and gain limits and requirements for industrial signal boosters.

The EUT was connected to the test setup according to the following diagram:



FCC Part 22/24/27/90 Industrial signal booster – Test Setup; RF Output Power / Gain

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

4.2.2 TEST REQUIREMENTS / LIMITS

There is no requirement for the Peak-to-Average value in the applicable rule parts.

4.2.3 TEST PROTOCOL

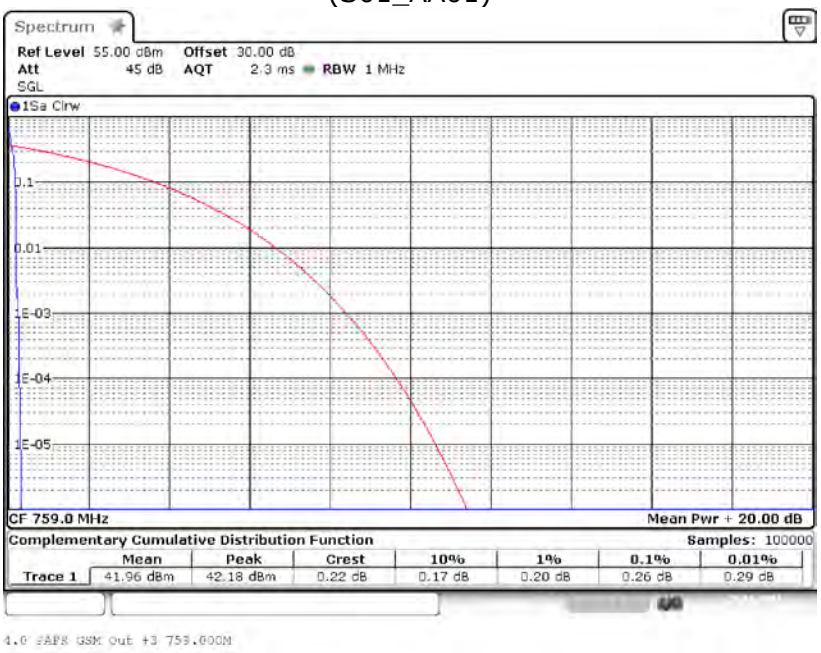
Band 14, downlink						
Signal Type	**Input Power**	**Frequency [MHz]**	**Input Power [dBm]**	**PAPR [dB]**	**Limit PAPR [dB] *)**	**Margin to Limit [dB]**
Wideband	0.3 dB < AGC	760.500	1.1	8.8	13.0	4.2
Wideband	3 dB > AGC	760.500	3.2	8.9	13.0	4.1
Narrowband	0.3 dB < AGC	759.000	0.1	0.2	13.0	12.8
Narrowband	3 dB > AGC	759.000	3.4	0.3	13.0	12.7

Band 26/27, downlink						
Signal Type	**Input Power**	**Frequency [MHz]**	**Input Power [dBm]**	**PAPR [dB]**	**Limit PAPR [dB] *)**	**Margin to Limit [dB]**
Wideband	0.3 dB < AGC	866.500	-	8.8	13.0	4.2
Wideband	3 dB > AGC	866.500	3.4	8.8	13.0	4.2
Narrowband	0.3 dB < AGC	868.080	-0.9	0.3	13.0	12.7
Narrowband	3 dB > AGC	868.080	2.4	0.2	13.0	12.8

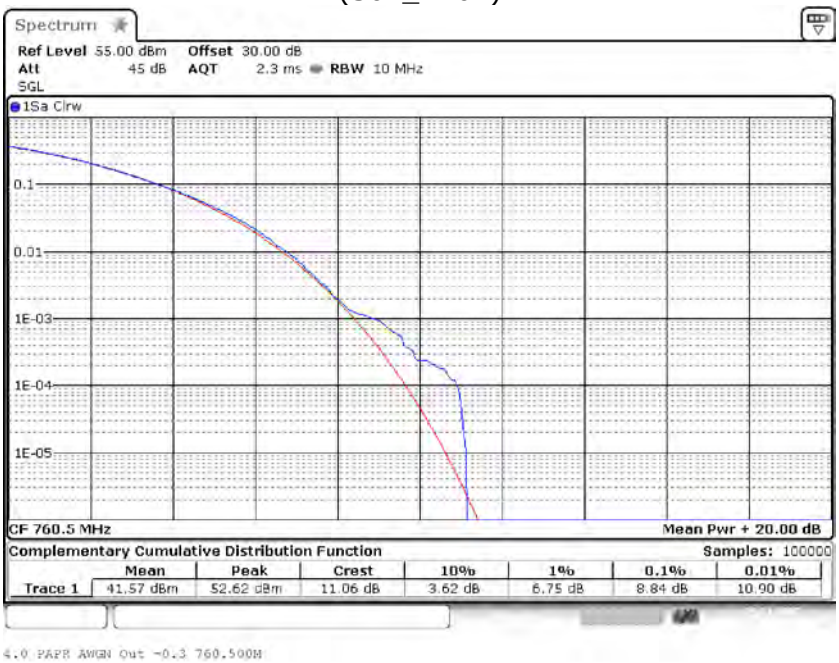
Remark: *) Limit only for comparison purposes, no Part 90 requirement
Please see next sub-clause for the measurement plot.

4.2.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

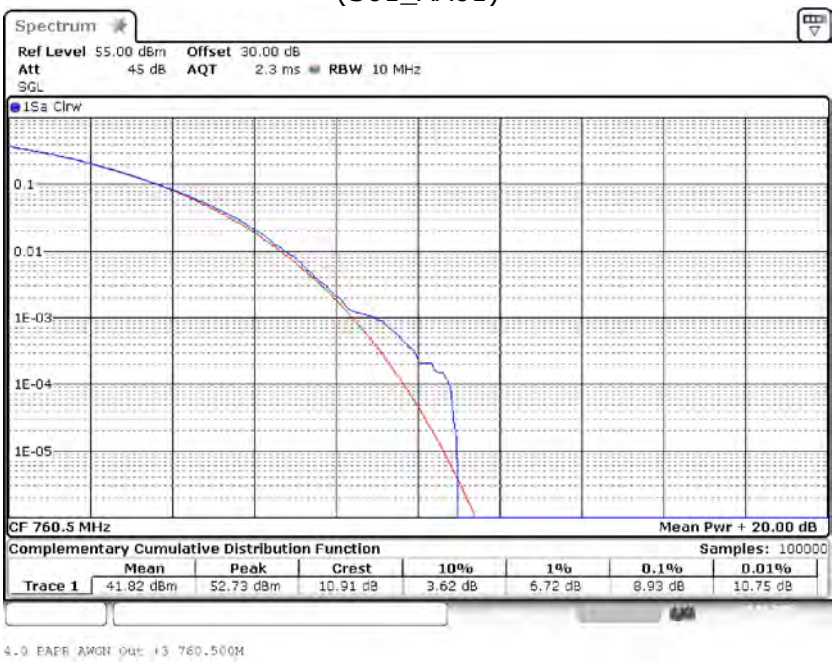
Frequency Band = Band 14, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Narrowband
(S01_AA01)



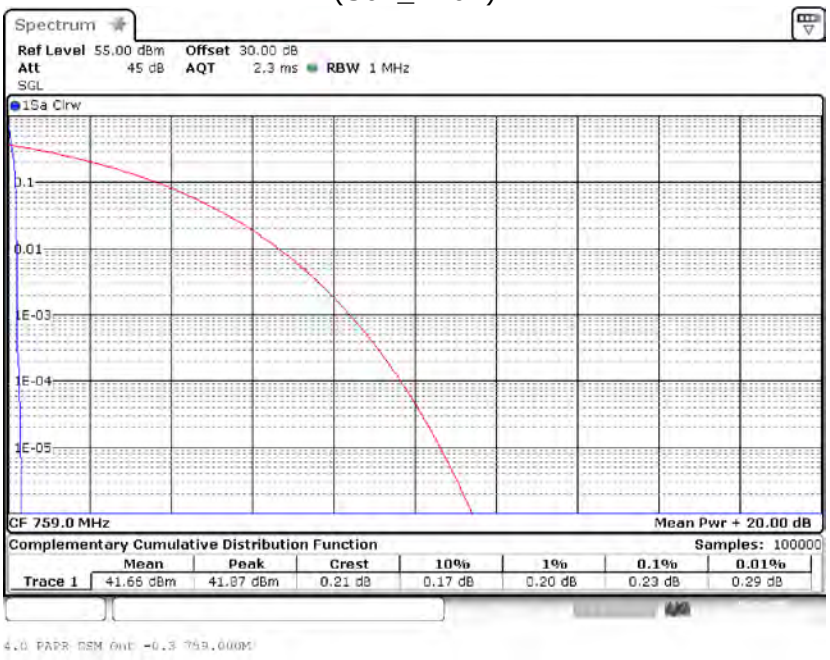
Frequency Band = Band 14, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Wideband
(S01_AA01)



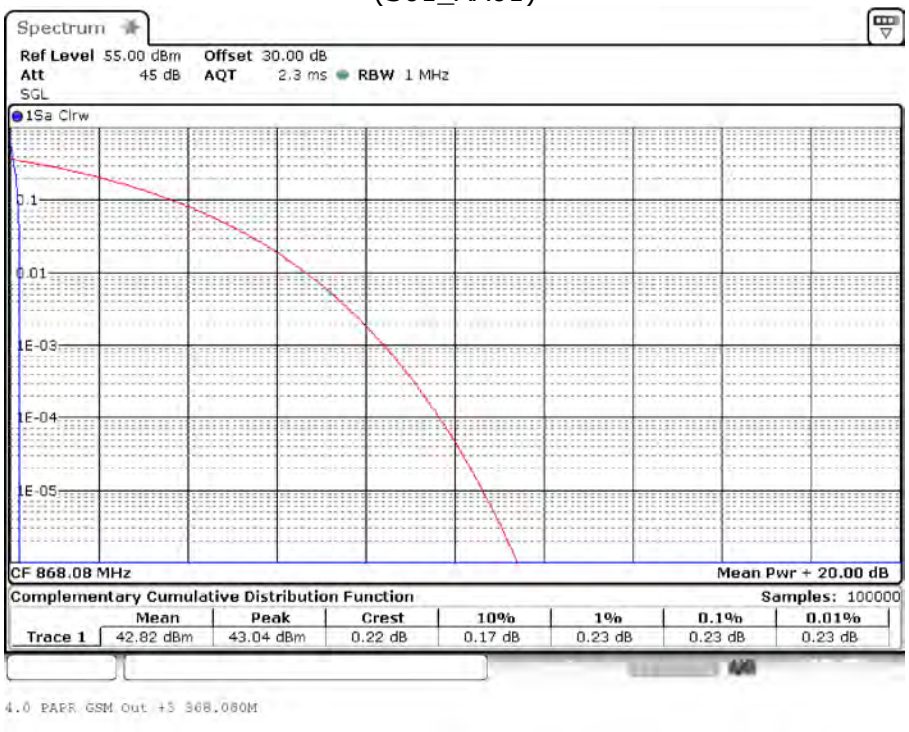
Frequency Band = Band 14, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Wideband
(S01_AA01)



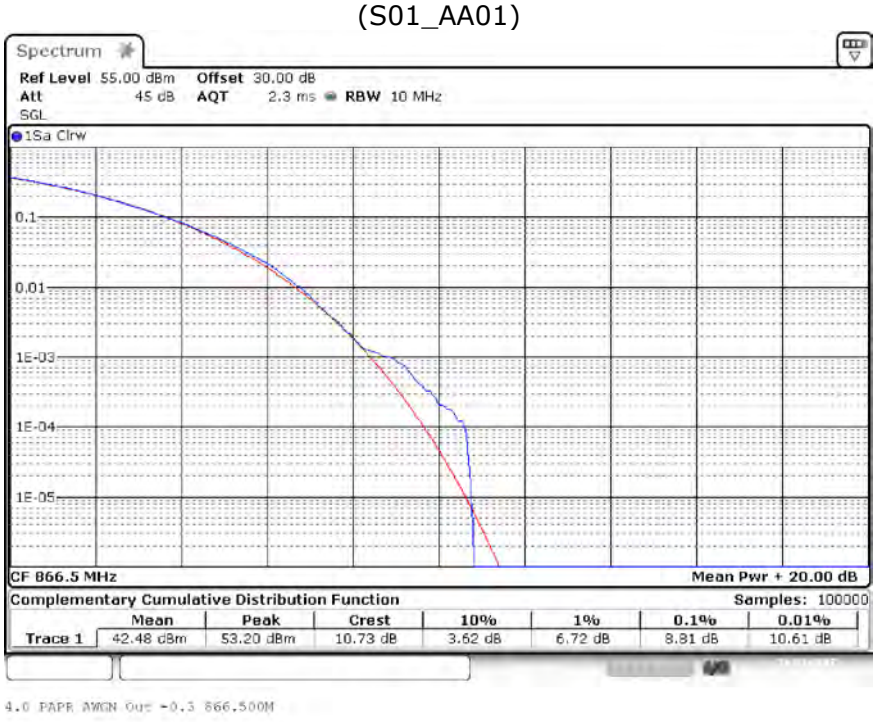
Frequency Band = Band 14, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Narrowband
(S01_AA01)



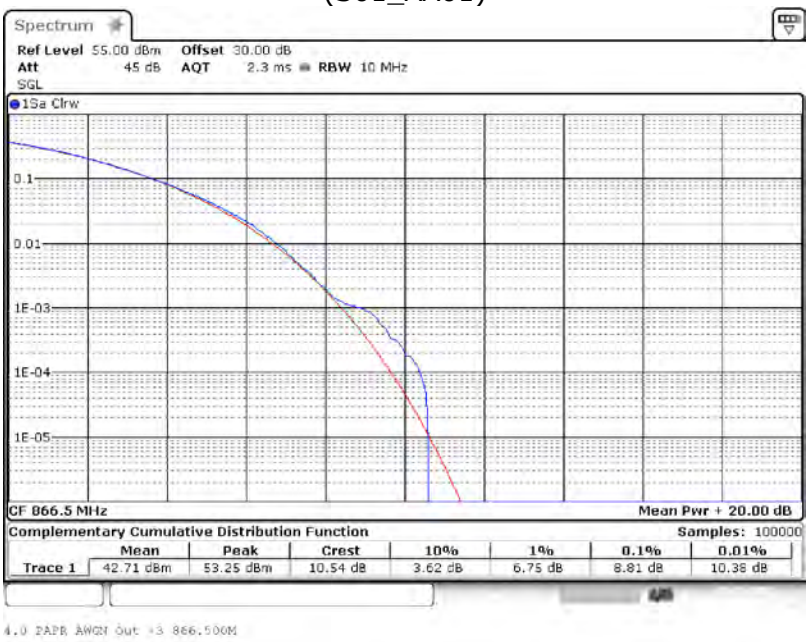
Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Narrowband
(S01_AA01)



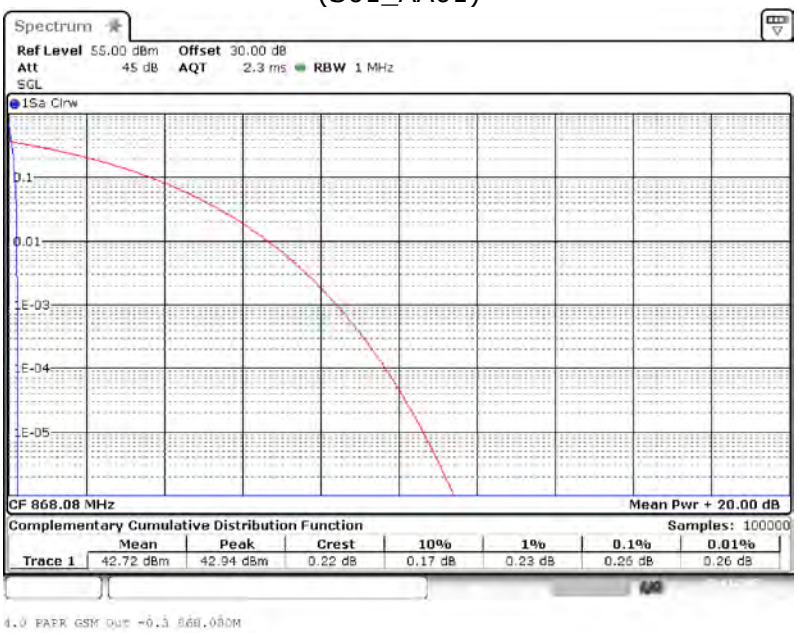
Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Wideband
(S01_AA01)



Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Wideband
(S01_AA01)



Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Narrowband
(S01_AA01)



4.2.5 TEST EQUIPMENT USED

- FCC Conducted Base Station / Repeater

4.3 OCCUPIED BANDWIDTH / INPUT-VERSUS-OUTPUT SPECTRUM

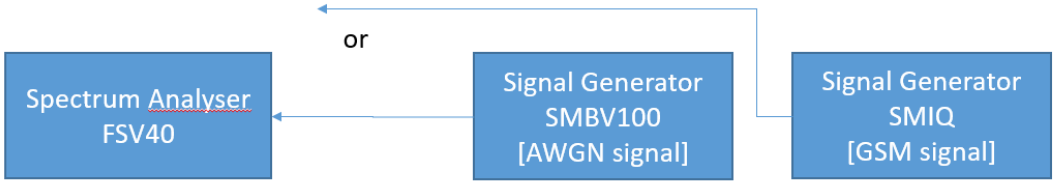
Standard FCC Part 2.1049; FCC Part 90; §90.219

The test was performed according to:
ANSI C63.26, KDB 935210 D05 v01r02: 3.4

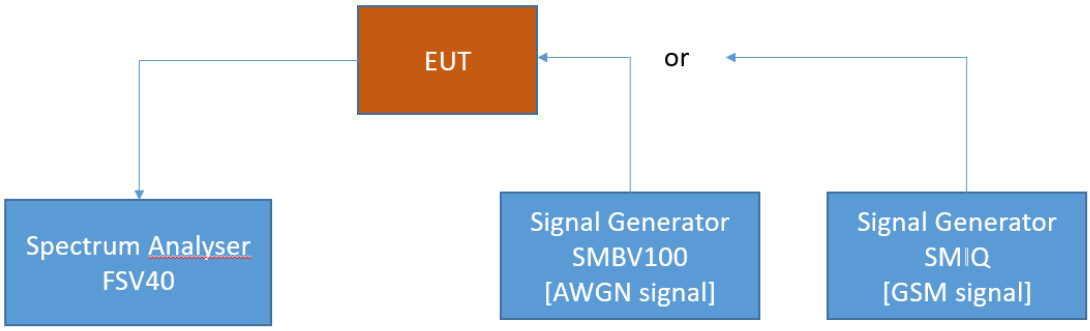
4.3.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission limits per FCC §2.1049, RSS-GEN 6.4 and RSS-131-5.2.2

The EUT was connected to the test setups according to the following diagram:



FCC Part 22/24/27/90; Industrial Signal Booster
Test Setup step 1: Measuring characteristics of test signals



FCC Part 22/24/27/90; Industrial Signal Booster
Test Setup step 2; Occupied Bandwidth/Input-versus-output spectrum

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

4.3.2 TEST REQUIREMENTS / LIMITS

FCC Part 2.1049; Occupied Bandwidth:

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

(i) Transmitters designed for other types of modulation—when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

Band 14 (758 MHz – 768 MHz)

FCC Part 90; §90.219(e)(ii)

There is no change in the occupied bandwidth of the signal.

4.3.3 TEST PROTOCOL

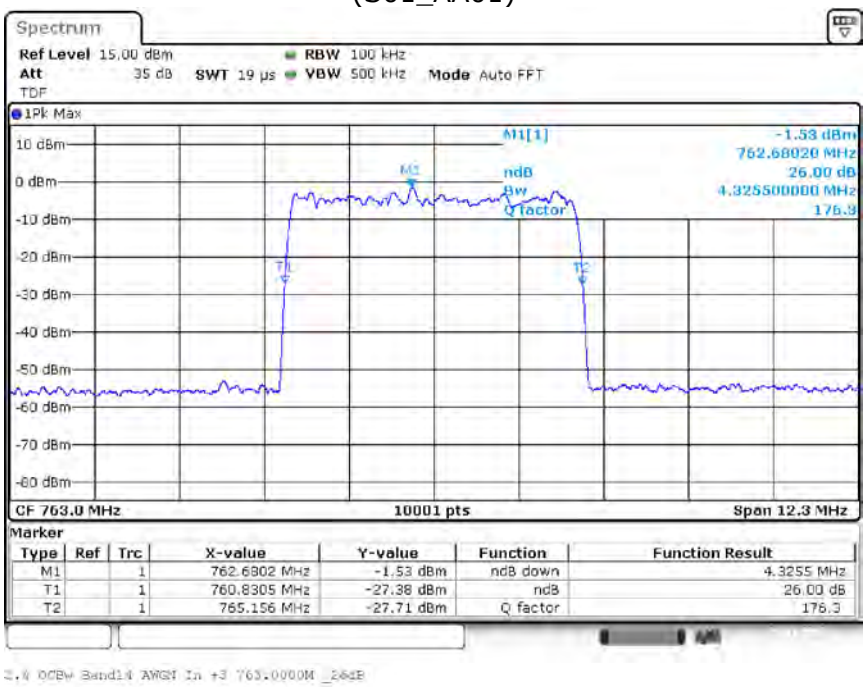
Band 14, downlink							
Signal Type	**Input Power**	**Signal Frequency [MHz]**	**Occupied Bandwidth SG [kHz]**	**Occupied Bandwidth Booster [kHz]**	**Delta Occupied Bandwidth [kHz]**	**Limit Delta Occupied Bandwidth [kHz]**	**Margin to Limit [kHz]**
Wideband	0.3 dB < AGC	763.00	4326.7	4325.5	1.2	205.0	203.8
Wideband	3 dB > AGC	763.00	4325.5	4326.7	1.2	205.0	203.8
Narrowband	0.3 dB < AGC	763.00	314.6	313.7	1.0	10.0	9.0
Narrowband	3 dB > AGC	763.00	311.3	313.8	2.5	10.0	7.5

Band 26 (partly), downlink							
Signal Type	**Input Power**	**Signal Frequency [MHz]**	**Occupied Bandwidth SG [kHz]**	**Occupied Bandwidth Booster [kHz]**	**Delta Occupied Bandwidth [kHz]**	**Limit Delta Occupied Bandwidth [kHz]**	**Margin to Limit [kHz]**
Wideband	0.3 dB < AGC	865.50	4326.7	4326.7	0.0	205.0	205.0
Wideband	3 dB > AGC	865.50	4325.5	4327.9	2.4	205.0	202.6
Narrowband	0.3 dB < AGC	865.50	312.8	314.9	2.0	10.0	8.0
Narrowband	3 dB > AGC	865.50	314.4	314.6	0.2	10.0	9.8

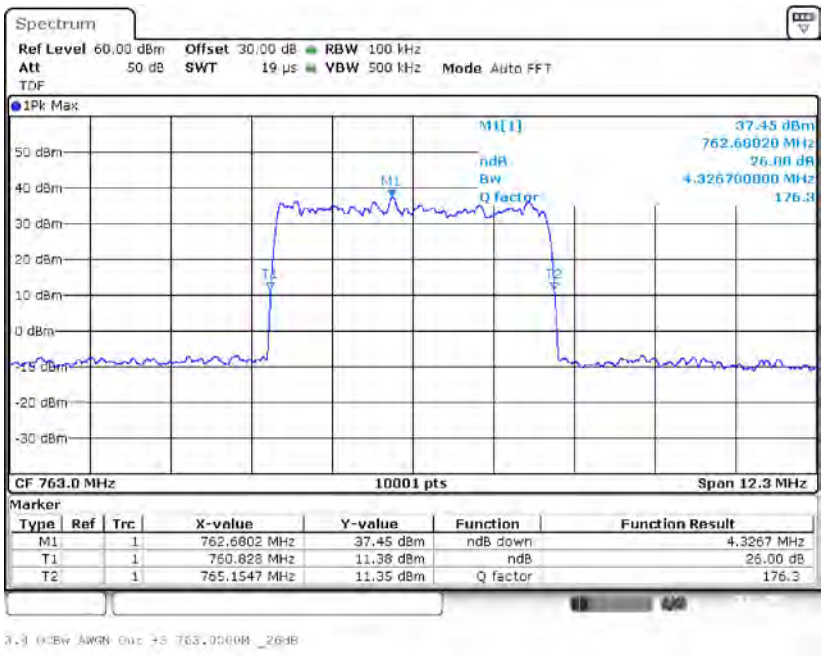
Remark: Please see next sub-clause for the measurement plot.

4.3.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Frequency Band = Band 14, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Wideband
(S01_AA01)

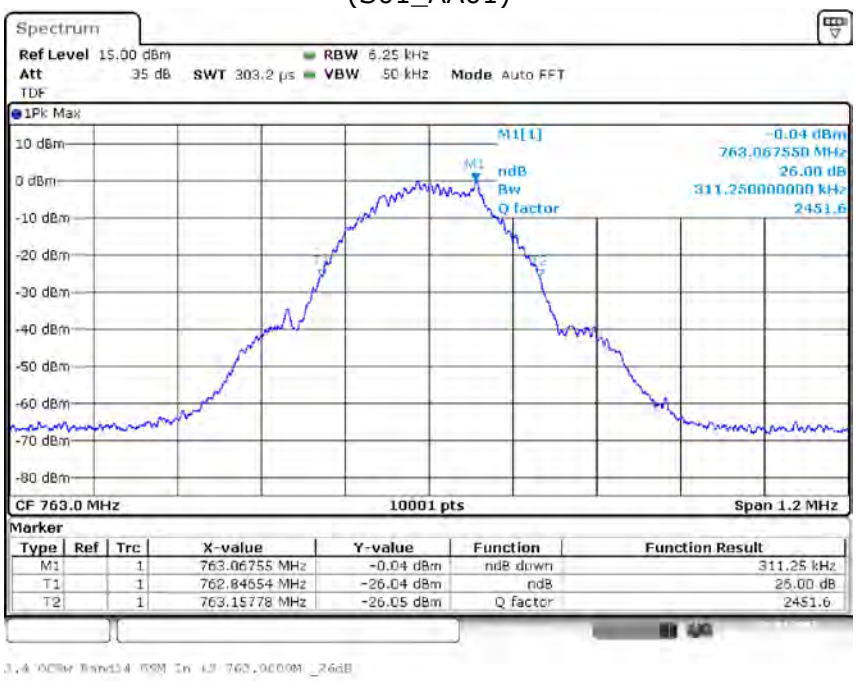


Input Signal

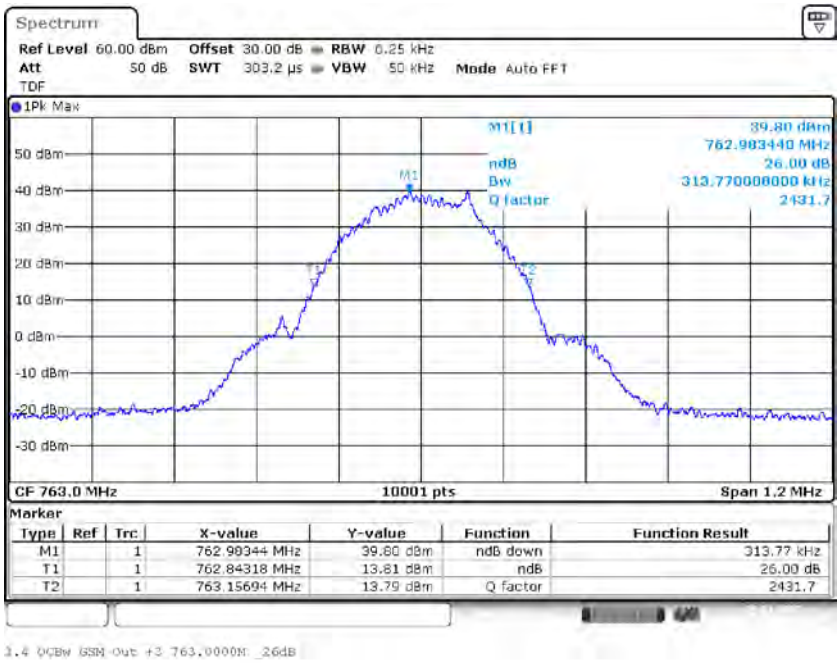


Output Signal

Frequency Band = Band 14, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Narrowband
(S01_AA01)

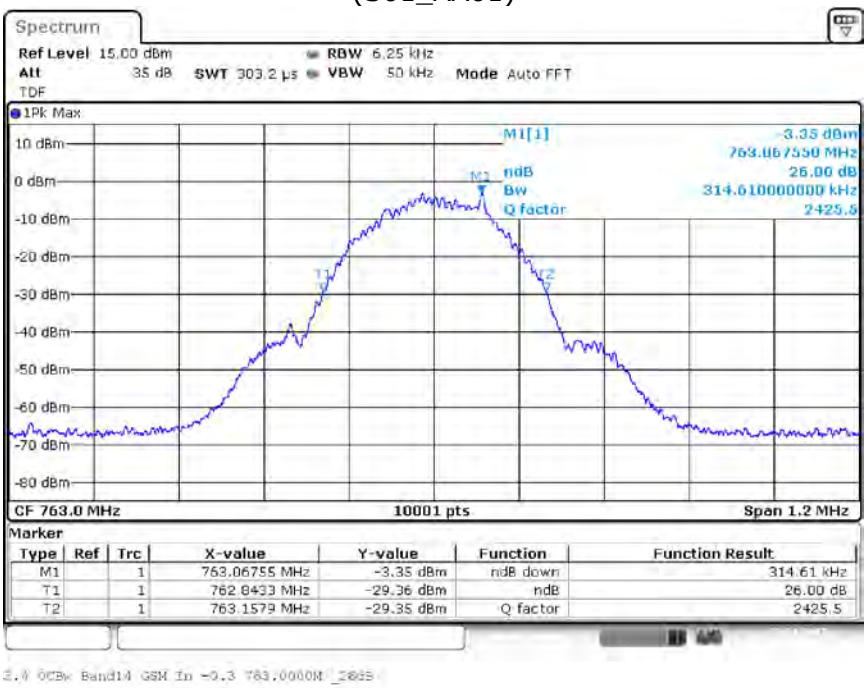


Input Signal

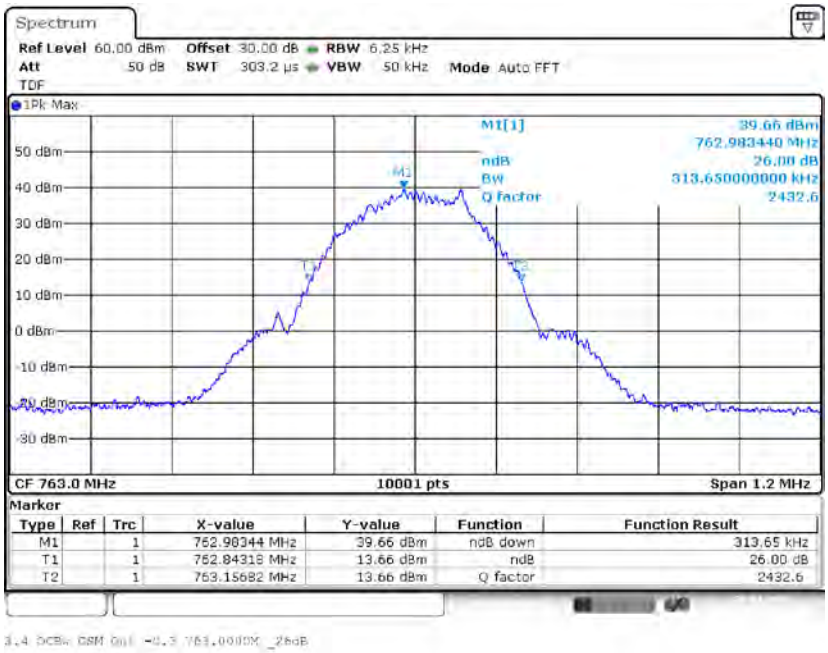


Output Signal

Frequency Band = Band 14, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Narrowband
(S01_AA01)

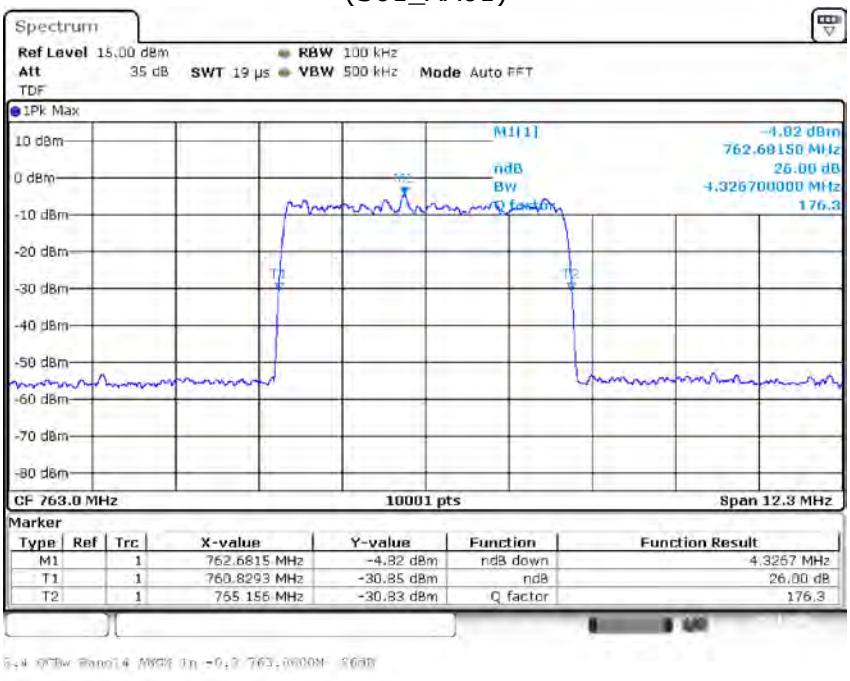


Input Signal

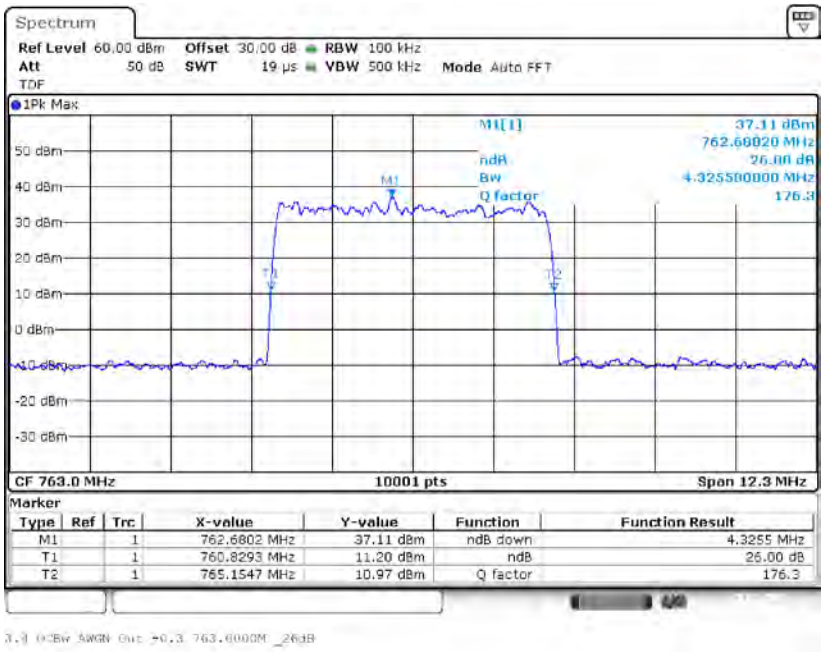


Output Signal

Frequency Band = Band 14, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Wideband
(S01_AA01)

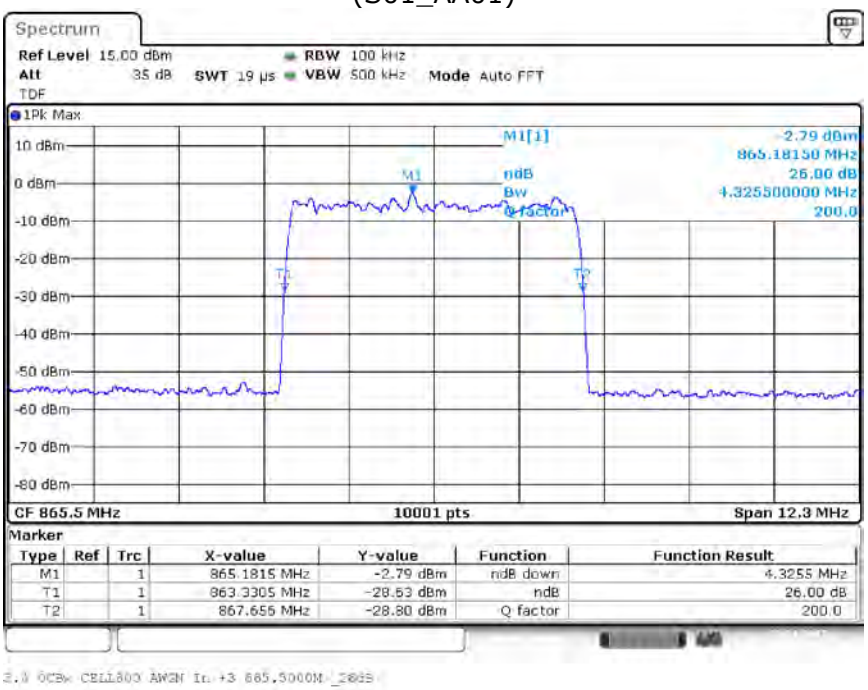


Input Signal

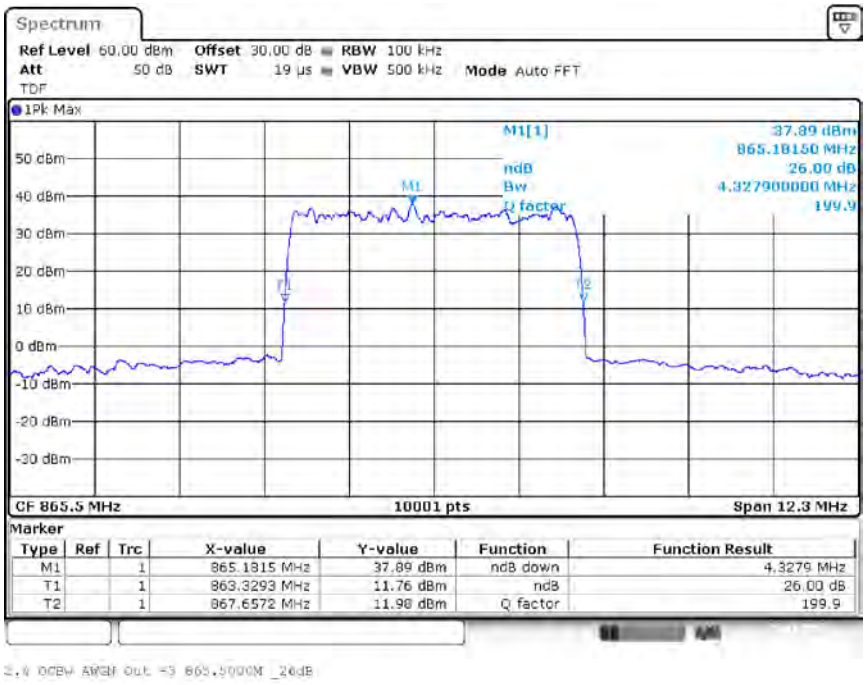


Output Signal

Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Wideband
(S01_AA01)

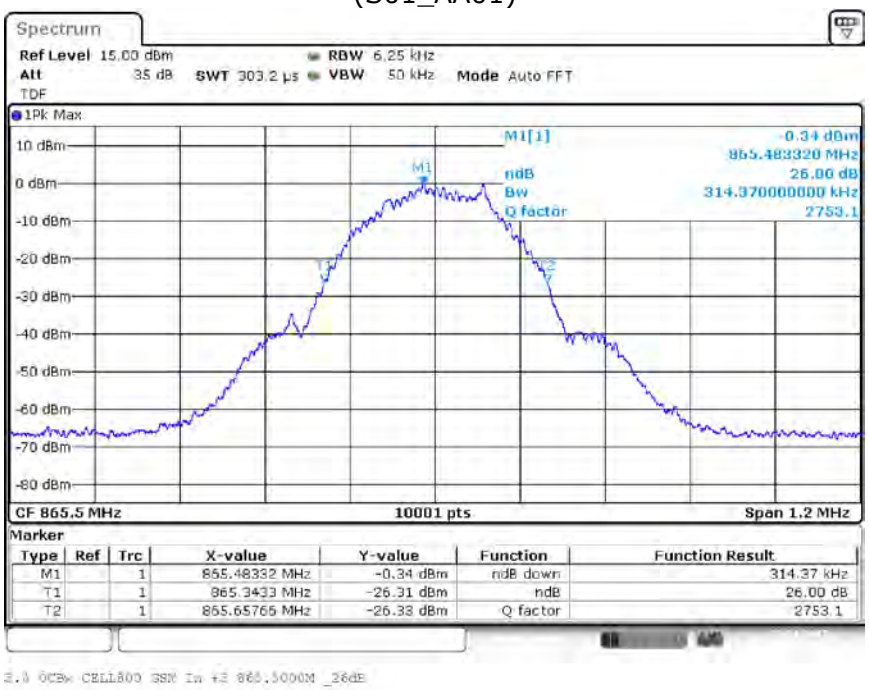


Input Signal

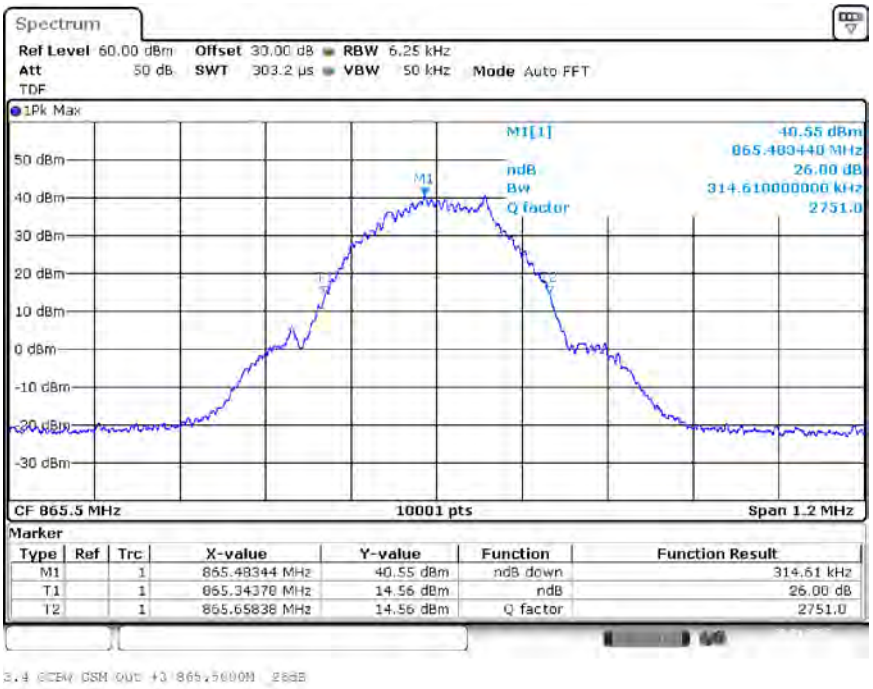


Output Signal

Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 3 dB > AGC, Signal Type = Narrowband
(S01_AA01)

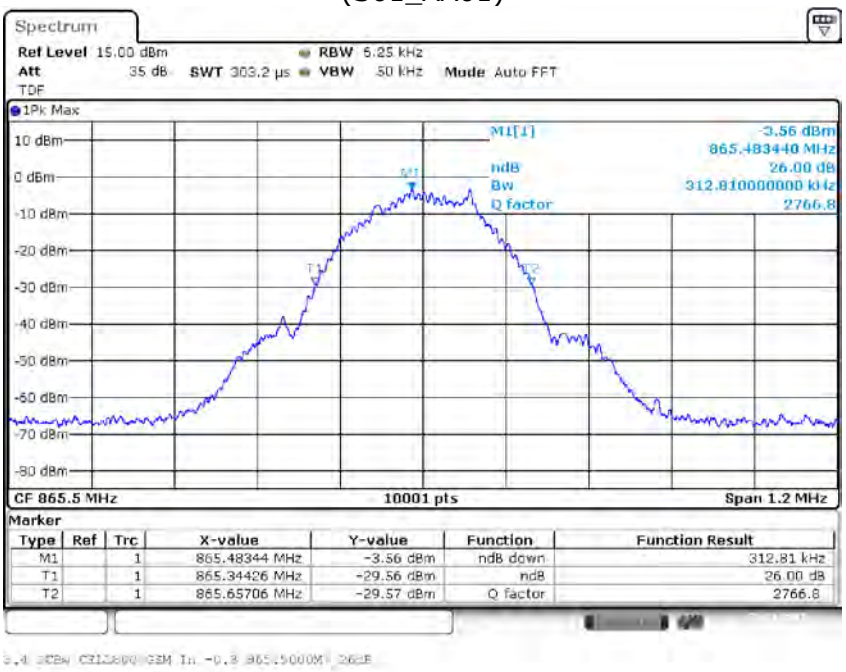


Input Signal

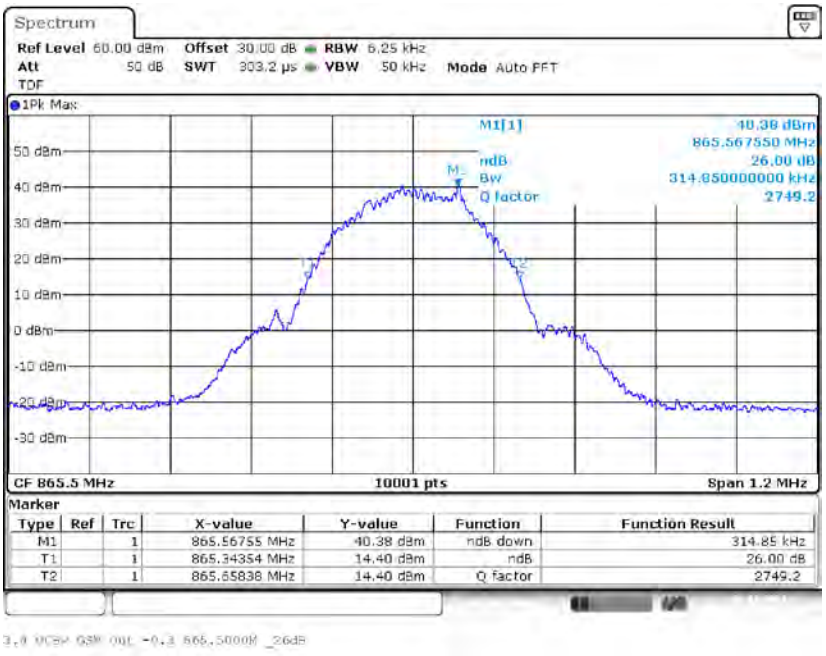


Output Signal

Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Narrowband
(S01_AA01)

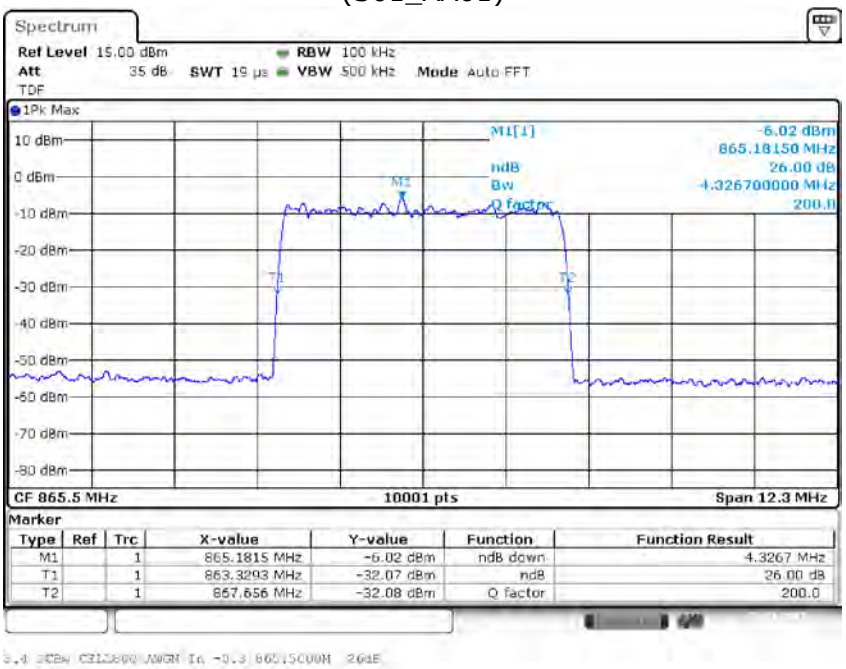


Input Signal

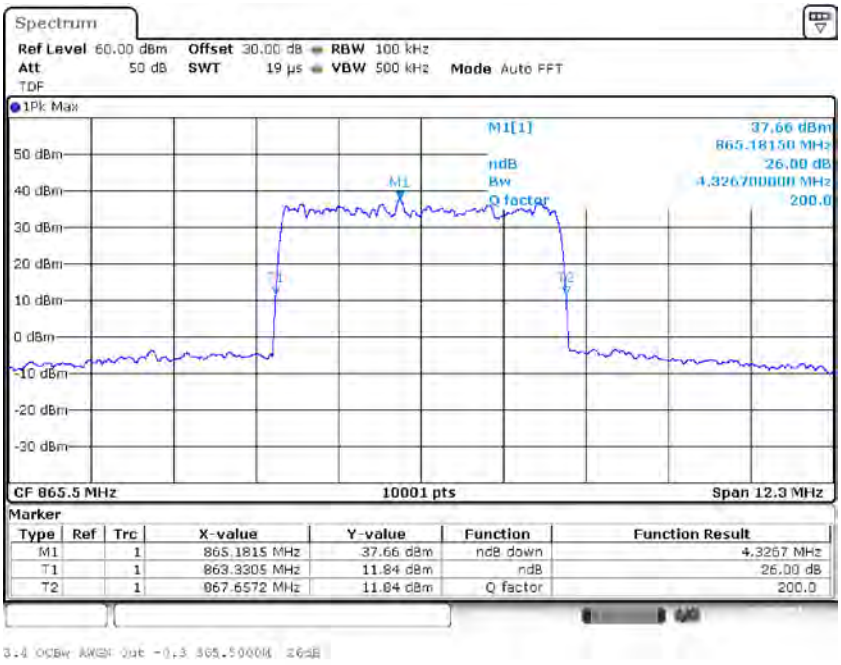


Output Signal

Frequency Band = Band 26/27, Direction = RF downlink, Input Power = 0.3 dB < AGC, Signal Type = Wideband
(S01_AA01)



Input Signal



Output Signal

4.3.5 TEST EQUIPMENT USED

FCC Conducted Base Station / Repeater

4.4 CONDUCTED SPURIOUS EMISSIONS AT ANTENNA TERMINALS

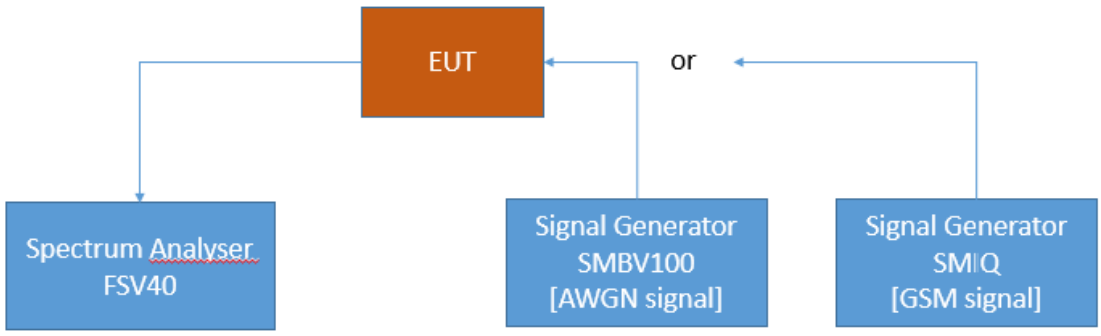
Standard FCC Part 2.1051, FCC Part 90: §90.543, §90.691

The test was performed according to:
ANSI C63.26

4.4.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission limits per § 2.1051. The limit comes from the applicable rule part for the operating band

The EUT was connected to the test setup according to the following diagram:



FCC Part 22/24/27/90 Industrial signal booster – Test Setup; Conducted Spurious Emissions

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

4.4.2 TEST REQUIREMENTS / LIMITS

FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:

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

Part 90, Subpart I/S

Band 14 (758 MHz – 768 MHz)

§90.543 – Emission limitations

(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.

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

(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.

Part 90, Subpart I/R

Band 26/27 (862 MHz – 869 MHz)

§90.691

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

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

4.4.3 TEST PROTOCOL

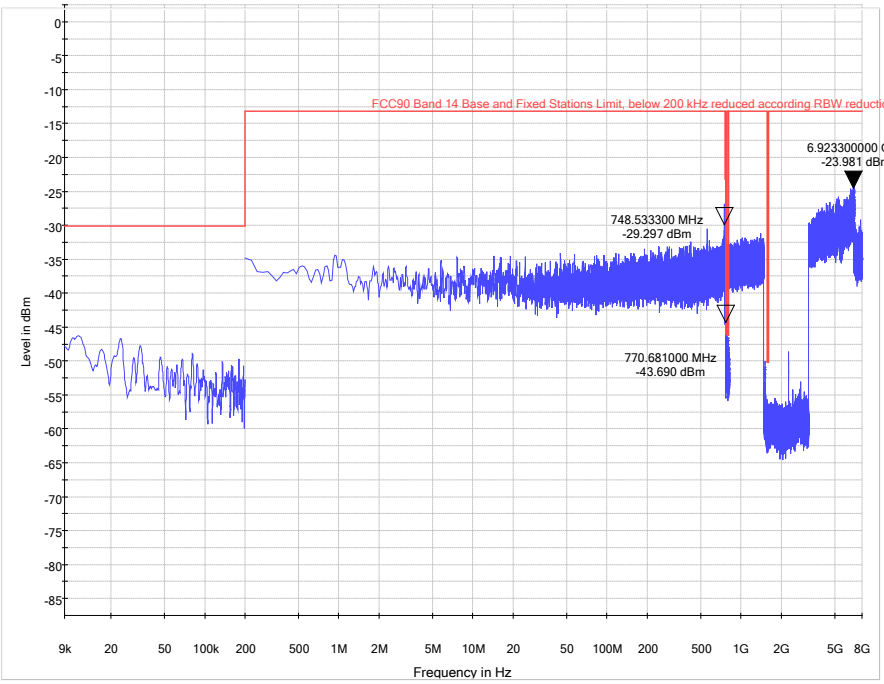
Band 14, downlink							
Test Frequency	**Signal Type**	**Spurious Freq. [MHz]**	**Spurious Level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
low	Wideband	755.510	-15.3	Peak	1000	-13.0	2.3
low	Wideband	768.474	-28.6	Peak	1000	-13.0	15.6
low	Wideband	769.143	-51.2	RMS	6.25	-46.0	5.2
low	Wideband	6929.600	-24.0	Peak	1000	-13.0	11.0
mid	Wideband	756.953	-25.0	Peak	1000	-13.0	12.0
mid	Wideband	768.559	-28.2	Peak	1000	-13.0	15.2
mid	Wideband	757.317	-30.2	Peak	1000	-13.0	17.2
mid	Wideband	769.191	-52.4	RMS	6.25	-46.0	6.4
mid	Wideband	6991.300	-23.8	Peak	1000	-13.0	10.8
high	Wideband	756.882	-18.5	RMS	1000	-13.0	5.5
high	Wideband	757.311	-26.8	RMS	1000	-13.0	13.8
high	Wideband	768.157	-29.0	Peak	1000	-13.0	16.0
high	Wideband	769.369	-47.1	RMS	6.25	-46.0	1.1
high	Wideband	6924.350	-23.3	Peak	1000	-13.0	10.3
low	Narrowband	748.533	-29.3	Peak	1000	-13.0	16.3
low	Narrowband	770.692	-53.6	RMS	6.25	-46.0	7.6
low	Narrowband	6923.300	-24.0	Peak	1000	-13.0	11.0
mid	Narrowband	756.787	-27.6	Peak	1000	-13.0	14.6
mid	Narrowband	769.215	-60.9	RMS	6.25	-46.0	14.9
mid	Narrowband	6992.300	-23.4	Peak	1000	-13.0	10.4
high	Narrowband	748.510	-29.3	Peak	1000	-13.0	16.3
high	Narrowband	755.392	-30.5	Peak	1000	-13.0	17.5
high	Narrowband	769.004	-55.3	RMS	6.25	-46.0	9.3
high	Narrowband	6983.300	-23.6	Peak	1000	-13.0	10.6

Band 26 / 27 (partly), downlink							
Test Frequency	**Signal Type**	**Spurious Freq. [MHz]**	**Spurious Level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
low	Wideband	861.856	-24.3	Peak	1000	-13.0	11.3
low	Wideband	1729.800	-24.4	Peak	1000	-13.0	11.4
low	Wideband	6897.688	-23.3	Peak	1000	-13.0	10.3
mid	Wideband	861.768	-25.6	Peak	1000	-13.0	12.6
mid	Wideband	1730.885	-25.3	Peak	1000	-13.0	12.3
mid	Wideband	6897.734	-24.4	Peak	1000	-13.0	11.4
high	Wideband	869.204	-24.2	Peak	1000	-13.0	11.2
high	Wideband	1732.390	-24.6	Peak	1000	-13.0	11.6
high	Wideband	6958.531	-24.0	Peak	1000	-13.0	11.0
low	Narrowband	877.981	-29.0	Peak	1000	-13.0	16.0
low	Narrowband	1724.280	-21.5	Peak	1000	-13.0	8.5
low	Narrowband	6904.250	-24.0	Peak	1000	-13.0	11.0
mid	Narrowband	878.003	-28.9	Peak	1000	-13.0	15.9
mid	Narrowband	1731.165	-21.2	Peak	1000	-13.0	8.2
mid	Narrowband	6918.828	-23.5	Peak	1000	-13.0	10.5
high	Narrowband	869.115	-30.0	Peak	1000	-13.0	17.0
high	Narrowband	1737.775	-21.7	Peak	1000	-13.0	8.7
high	Narrowband	6974.516	-24.3	Peak	1000	-13.0	11.3

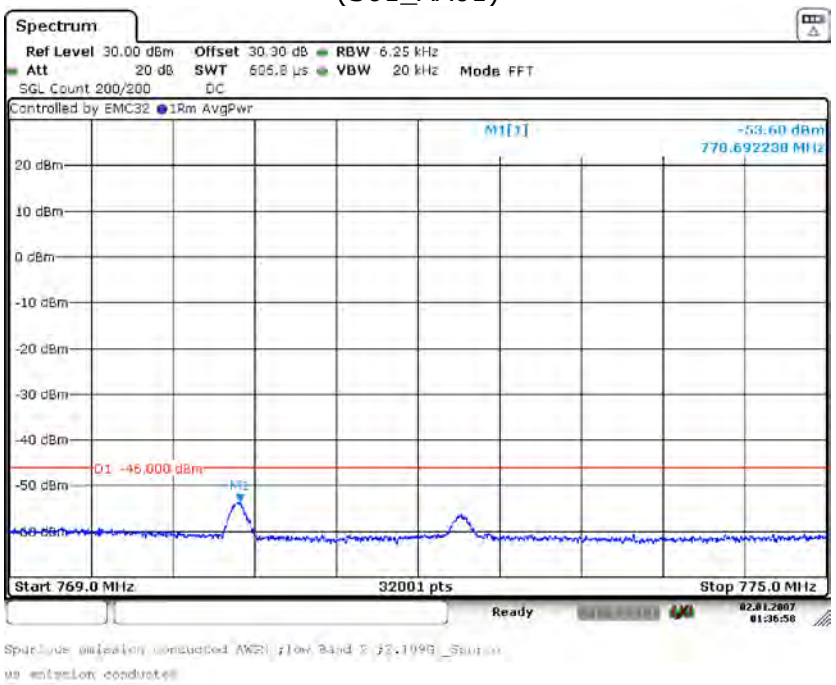
Remark: Please see next sub-clause for the measurement plot.
The peaks in the measurement plots are (input) wanted signal.

4.4.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

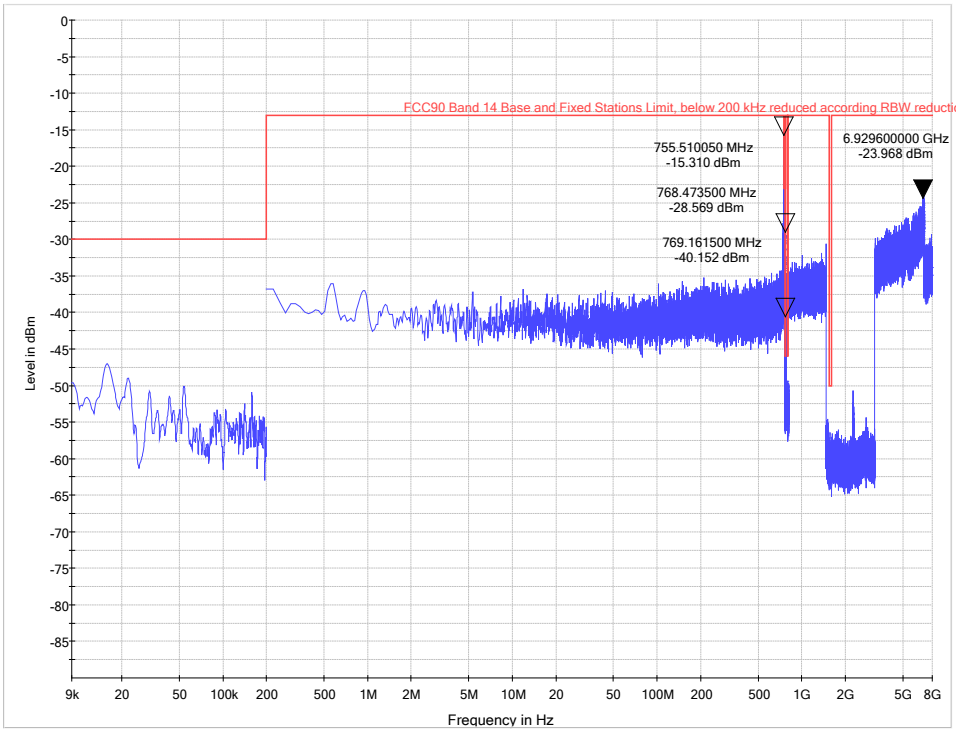
Frequency Band = Band 14, Test Frequency = low, Direction = RF downlink, Signal Type = Narrowband
(S01_AA01)



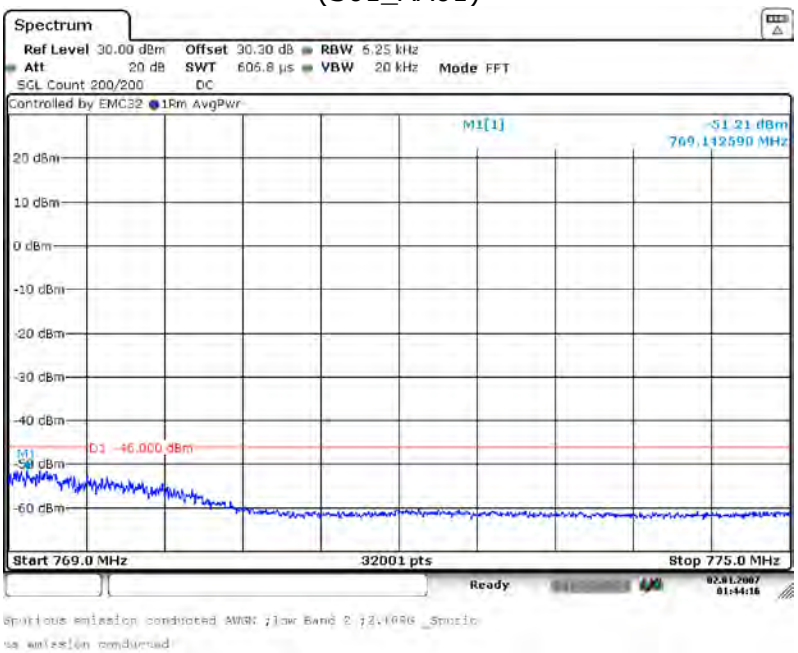
Frequency Band = Band 14, Test Frequency = low, Direction = RF downlink, Signal Type = Narrowband, final measurement
(S01_AA01)



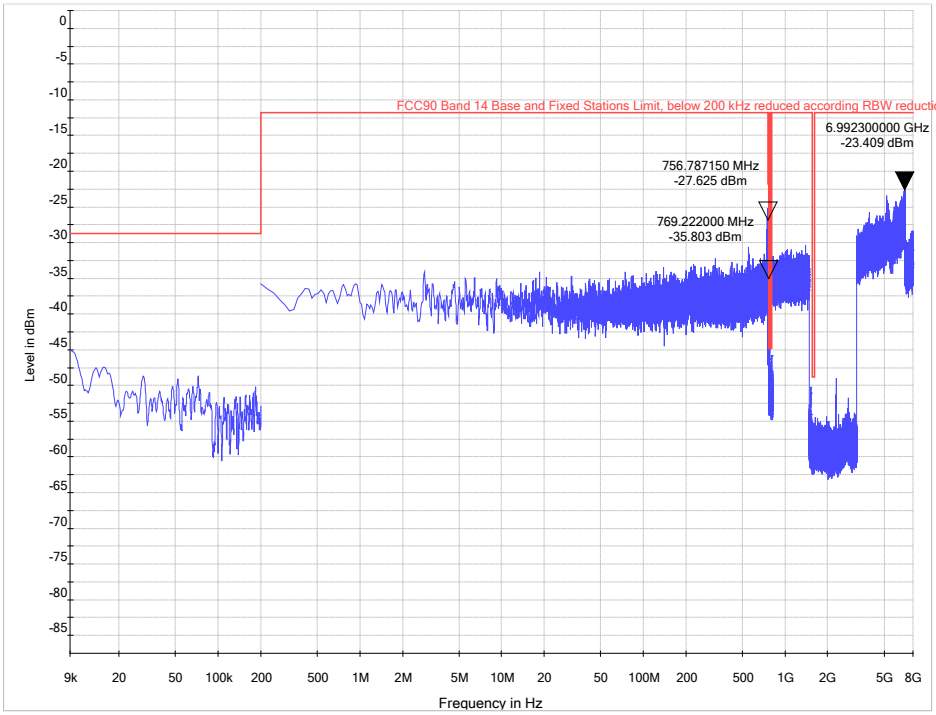
Frequency Band = Band 14, Test Frequency = low, Direction = RF downlink, Signal Type = Wideband
(S01_AA01)



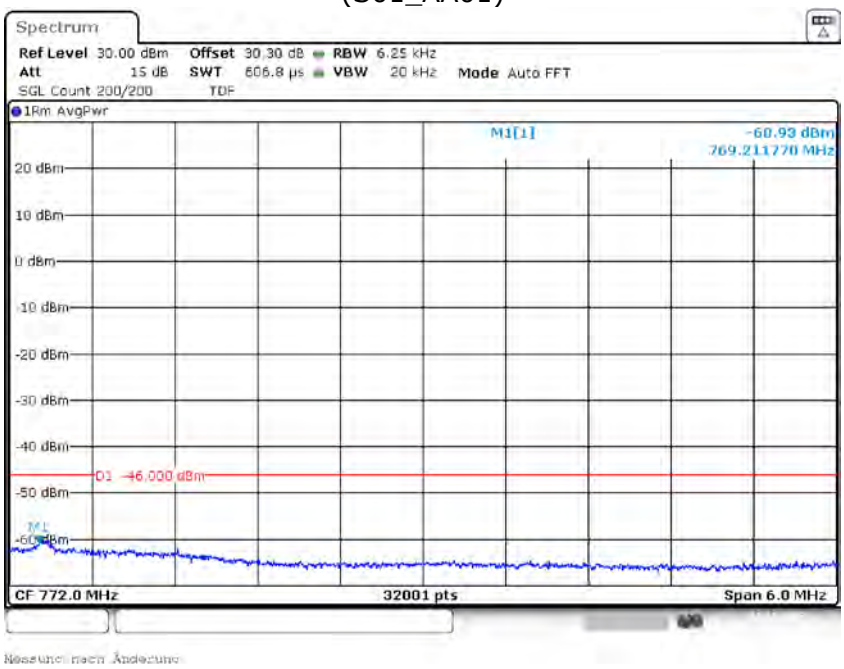
Frequency Band = Band 14, Test Frequency = low, Direction = RF downlink, Signal Type = Wideband, final measurement
(S01_AA01)



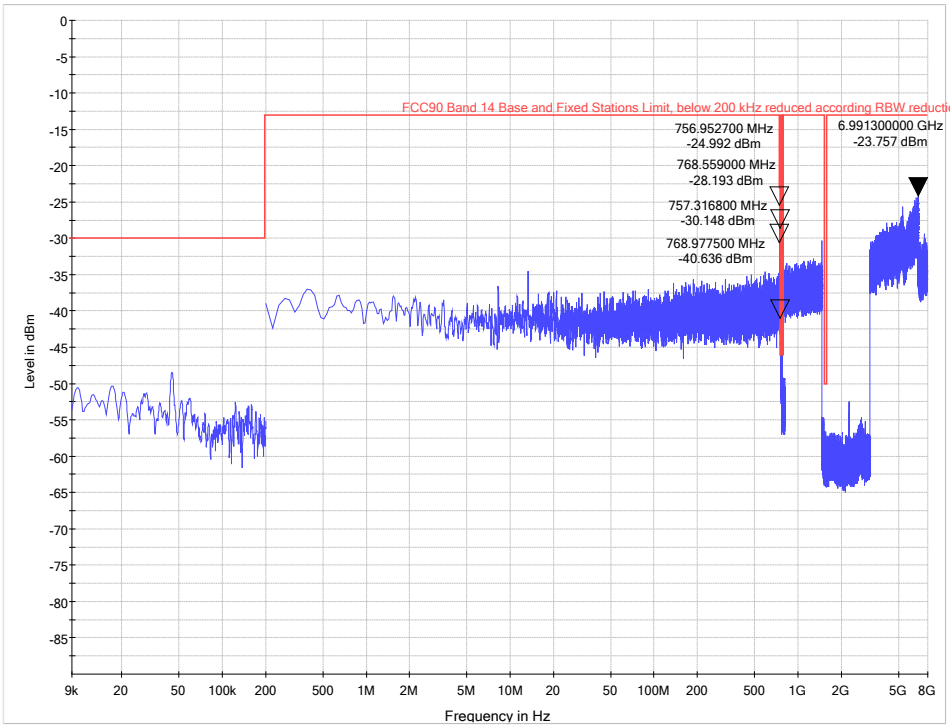
Frequency Band = Band 14, Test Frequency = mid, Direction = RF downlink, Signal Type = Narrowband
(S01_AA01)



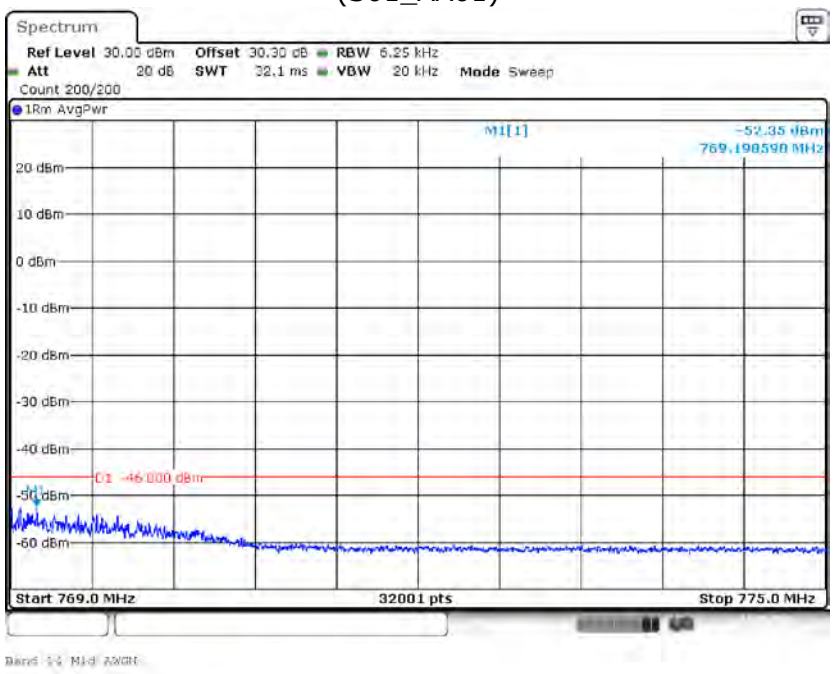
Frequency Band = Band 14, Test Frequency = mid, Direction = RF downlink, Signal Type = Narrowband, final measurement
(S01_AA01)



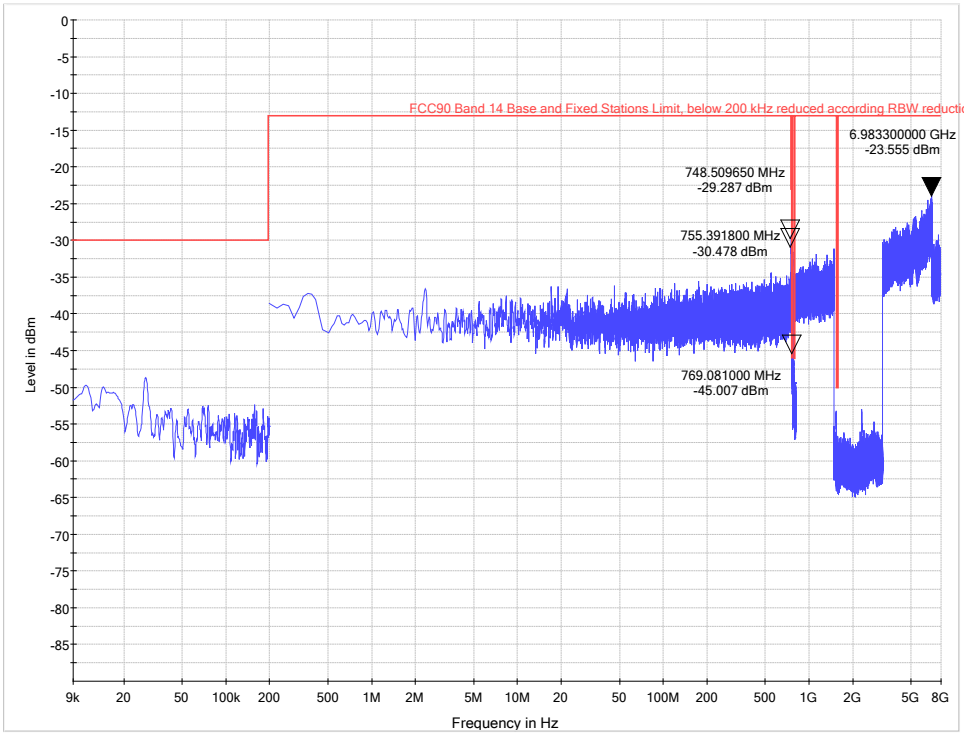
Frequency Band = Band 14, Test Frequency = mid, Direction = RF downlink, Signal Type = Wideband
(S01_AA01)



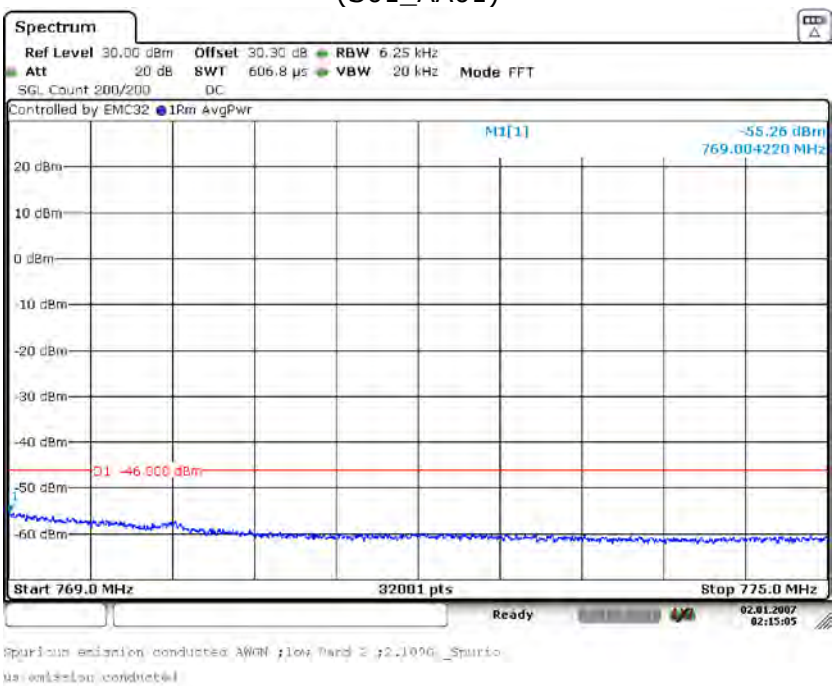
Frequency Band = Band 14, Test Frequency = mid, Direction = RF downlink, Signal Type = Wideband, final measurement
(S01_AA01)



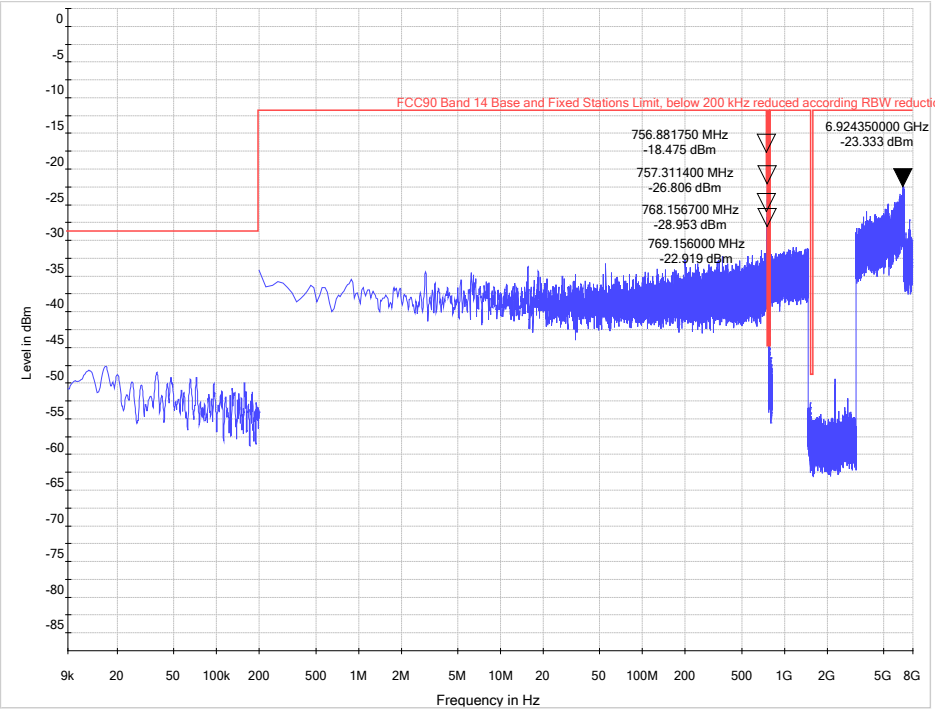
Frequency Band = Band 14, Test Frequency = high, Direction = RF downlink, Signal Type = Narrowband
(S01_AA01)



Frequency Band = Band 14, Test Frequency = high, Direction = RF downlink, Signal Type = Narrowband, final measurement
(S01_AA01)



Frequency Band = Band 14, Test Frequency = high, Direction = RF downlink, Signal Type = Wideband
(S01_AA01)



Frequency Band = Band 14, Test Frequency = high, Direction = RF downlink, Signal Type = Wideband, final measurement
(S01_AA01)