TEST REPORT

Verified Code: 736316

Report No.:	E202109018709-1	**Application No.:**	E202109018709
Client:	TowerIQ,Inc.		
Address:	13723 Riverport Drive C/O Potter Electric Signal Company Saint Louis, Missouri 63043		
FCC ID:	2AXVJPSBG-2AUL		
Sample Description:	In-building 2-Way Emergency Radio Communication Enhancement booster		
Model:	TQ-GuardianA2A		
Test Specification:	FCC PART 2--- FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS FCC PART 90-- PRIVATE LAND MOBILE RADIO SERVICES		
Receipt Date:	2021-09-03		
Test Date:	2021-09-04 to 2021-09-11		
Issue Date:	2021-09-27		
Test Result:	Pass		

Prepared By:	**Reviewed By:**	**Approved By:**
Test Engineer	Technical Manager	Manager
Yu Shanshan.	Wu Haoting	GUANGZHOU GRG METROLOGY & TEST CO.,LTD. GRGTEST APPROVED(03)

Other Aspects:

Note: Note

Abbreviations: *ok / P = passed; fail / F = failed; n.a. / N = not applicable;*

DIRECTIONS OF TEST

1. **This station carries out test task according to the national regulation of verifications which can be traced to National Primary Standards and BIPM.**

2. **The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test result without the written permission of the test laboratory.**

3. **If there is any objection concerning the test, the client should inform the laboratory within 15 days from the date of receiving the test report.**

TABLE OF CONTENTS

1 Applicant information

1.1 Client information

Name:	TowerIQ,Inc.
Address:	13723 Riverport Drive C/O Potter Electric Signal Company Saint Louis, Missouri 63043

1.2 Manufacturer and Factory

Manufacture Name:	Potter Elmdene SZ Branch
Address:	Room 1483A,Hangdu Plaza, No. 1006 Huafu road, Huahang Community, Huaqiang North Street, Futian District, Shenzhen Bank Name:China Merchants Bank, Head Office, Shenzhen,P.R.China
Factory:	Potter Elmdene SZ Branch
Address:	Room 1483A,Hangdu Plaza, No. 1006 Huafu road, Huahang Community, Huaqiang North Street, Futian District, Shenzhen Bank Name:China Merchants Bank, Head Office, Shenzhen,P.R.China

2 General description of EUT

2.1 Basic description of EUT

Product Name:	In-building 2-Way Emergency Radio Communication Enhancement booster
Product Model:	TQ-GuardianA2A
Adding Model:	/
Trade Name:	TOWERIQ SIGNAL WHERE IT MATTERS
Power Supply:	AC 100~240V, 50/60Hz Typical working voltage: AC 110V, 50/60Hz
Power cord:	AC power cord
Frequency Band①:	700MHz Band: Downlink: 769MHz ~ 775MHz, Uplink: 799MHz ~805MHz 800MHz Band: Downlink: 851MHz ~861MHz, Uplink: 806MHz ~ 816MHz
Nominal Output Power:	Downlink: 33dBm Uplink: 27dBm
Nominal System Gain:	Downlink: 90dB Uplink: 90dB
EUT Operating Temperature:	-20°C to +50°C
Operating Humidity:	5% to 95%
Antenna Type:	N/A①

NOTE 1: This EUT is a narrowband device, which belongs to Class A signal booster.

NOTE 2: ① It's an indoor device, The EUT does not provide antenna by Manufacturer's statement, but it is required that The sum of antenna gain and cable loss shall not exceed 2 dBi for Downlink and 9 dBi for Uplink when the project is used by Manufacturer's statement.

NOTE 3: According to the manufacturer's statement, the minimum carrier spacing is 2 carrier bandwidths.

2.2 Test signal modulation description

According to FCC PART 2.202 (g), Table of necessary bandwidths follow:

2.2.1 Analog signals

Emission Designator	Description	Modulation type	M (modulaition Freq, kHz)	R (Rate, baud)	D (Deviation, kHz)	K (numeric constant)	S (Symbols)	Bandwidth Calculation	Necessary Bandwidth
11K2F3E	Narrowband Analog FM Voice	FM	3.0	--	2.5	1.0	--	Bn=2M+2DK	11.0
16K0F3E	Wideband Analog FM Voice	FM	3.0	--	5.0	1.0	--	Bn=2M+2DK	16.0

2.2.2 Digital signals

Emission Designator	Description	Modulation type	M (modulaition Freq, kHz)	R (Rate, baud)	D (Deviation, kHz)	K (numeric constant)	S (Symbols)	Bandwidth Calculation	Necessary Bandwidth
8K10F1E	P25 Phase I C4FM Voice	4FSK	--	9600	1.8	0.916	4	$Bn=(R/\log_2 S)+2DK$	8.1
8K10F1D	P25 Phase I C4FM Data	4FSK	--	9600	1.8	0.916	4	$Bn=(R/\log_2 S)+2DK$	8.1
8K10F1W	P25 Phase II H-CPM Voice/Data	4FSK	--	9600	1.8	0.916	4	$Bn=(R/\log_2 S)+2DK$	8.1
9K80F1E	P25 Phase II H-DQPSK Voice	QPSK	--	12000	--	0.817	4	$Bn=2RK/\log_2 S$	9.8
9K80F1D	P25 Phase II H-DQPSK Data	QPSK	--	12000	--	0.817	4	$Bn=2RK/\log_2 S$	9.8
21K0F1E	Tetra Voice	$\pi/4$DQPSK	--	9600	--	2.188	4	$Bn=2RK/\log_2 S$	21.0
21K0F1D	Tetra Data	$\pi/4$DQPSK	--	9600	--	2.188	4	$Bn=2RK/\log_2 S$	21.0

NOTE: In the above test signal modes, the typical signal and the worst mode signal are used as representatives in this test. The specific test signal types are as follows:

Emission Designator	Description	Modulation type	M (modulaition Freq, kHz)	R (Rate, baud)	D (Deviation, kHz)	K (numeric constant)	S (Symbols)	Bandwidth Calculation	Necessary Bandwidth
16K0F3E	Wideband Analog FM Voice	FM	3.0	--	5.0	1.0	--	Bn=2M+2DK	16.0
8K10F1D	P25 Phase I C4FM Data	4FSK	--	9600	1.8	0.916	4	$Bn=(R/\log_2 S)+2DK$	8.1
9K80F1D	P25 Phase II H-DQPSK Data	QPSK	--	12000	--	0.817	4	$Bn=2RK/\log_2 S$	9.8
21K0F1D	Tetra Data	$\pi/4$DQPSK	--	9600	--	2.188	4	$Bn=2RK/\log_2 S$	21.0

2.3 Signal Booster control process

2.3.1 System block

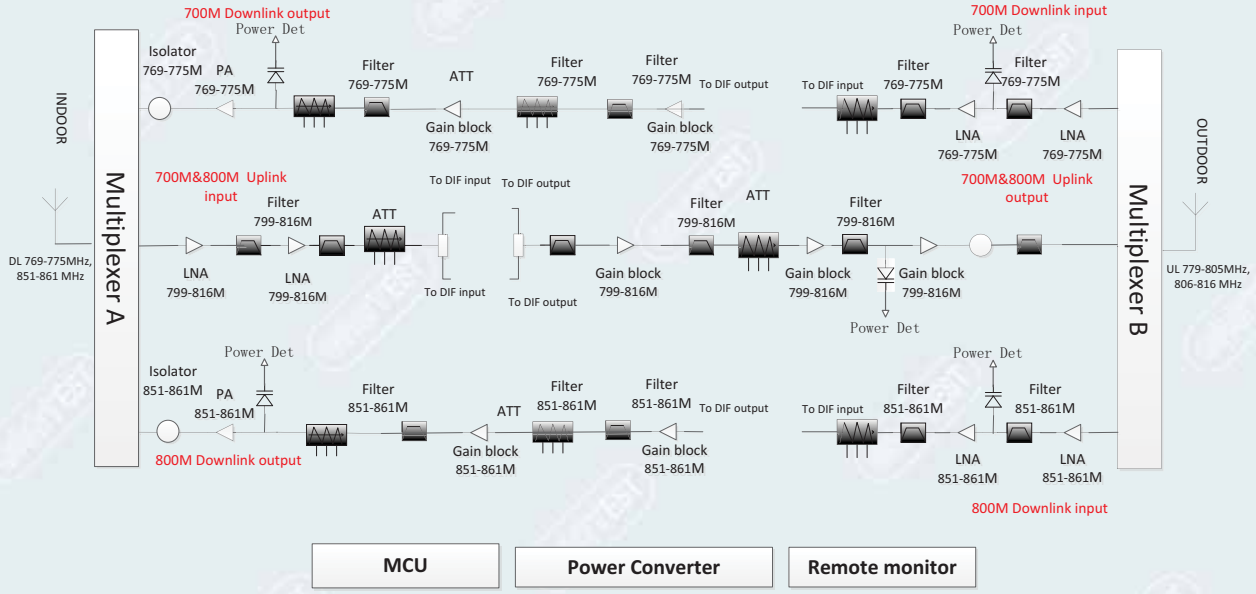


Figure 2-1 System block diagram

The block diagram is composed of the following units:

Uplink input Power detector;

Uplink output Power detector;

Uplink PA switch integrated in PA;

Downlink input Power detector;

Downlink PA switch integrated in PA, and so on

2.3.2 Signal control process

Above is the system block diagram, this system can enhance mobile communication signal. In the downlink, the BTS signals are received by donor antenna of the repeater. After the duplexer, the signals are sent to the LNA module for pre-amplification and digital RF integrated module for digitalfitering and frequency conversion.

Then the DL signals will be sent to downlink PA to amplify power and filter via duplexer. After amplification, the signals are transmitted via the MT port to the service antenna.

In the uplink, the mobile signals are received by the service antenna. After the MT port integrated duplexer, the signals are sent to the LNA, integrated module for digital filtering, then to PA for power amplification and to duplexer.

After that, the uplink signals are sent to the donor antenna for transmission back to the BTS

3 Related documents

FCC PART 2 (2020)
FCC PART 90 (2020)
KDB 935210 D05 Indus Booster Basic Meas v01r04
KDB 935210 D02 Signal Boosters Certification v04r02
KDB 971168 D01 Power Meas License Digital Systems v03r01
ANSI/TIA 603-E-2016
ANSI/TIA-102.CAAA-E-2016
ANSI C63.26-2015

4 Test result summary

Test Item	Test Requirements	Test Method	Reported	N/A
Test Frequency	KDB 935210 D02 APPENDIX D/Table D.3, FCC PART 2.1057, ANSI C63.26-2015 Clause 5.1.2	/	Reported only	
Input Signals	KDB 935210 D05 clause 4.1	/	Reported only	
AGC Threshold	KDB 935210 D05 clause 4.2	/	Reported only	
Out of Band Rejection	KDB 935210 D05 clause 4.3 FCC PART 90.219 (a) FCC PART 90.219 (d)((7)	KDB 935210 D05 clause 4.3	☒	
Input VS output Comparison	KDB 935210 D05 clause 4.4 FCC PART 2.1049(c) FCC PART 90.219 (e)(4)(ii)	KDB 935210 D05 clause 4.4	☒	
Mean power and amplifier/booster gain	KDB 935210 D05 clause 4.5 FCC PART 90.219 (e)(1)	KDB 935210 D05 clause 4.5	☒	
Noise Figure	KDB 935210 D05 clause 4.6 FCC PART 90.219 (e)(2)	KDB 935210 D05 clause 4.6	☒	
Out-of-band/out-of-block emissions	KDB 935210 D05 clause 4.7.2 FCC PART 2.1051 FCC PART 90.219 (d)(6)(i) FCC PART 90.219 (e)(3)	KDB 935210 D05 clause 4.7.2	☒	
Conducted spurious emissions	KDB 935210 D05 clause 4.7.3 FCC PART 2.1051 FCC PART 90.219 (e)(3)	KDB 935210 D05 clause 4.7.3	☒	
Frequency stability	KDB 935210 D05 clause 4.8 FCC PART 2 1055(a)(2) FCC PART 90.213 and 90.539 FCC PART 90.219 (e)(4)(i)	KDB 935210 D05/4.8 FCC PART 2 1055(b)	☒	
Radiated spurious emissions	KDB 935210 D05 clause 4.9 FCC PART 2.1053 FCC PART 90.219 (e)(3)	KDB 935210 D05 clause 4.9 ANSIC63.26-2015/5.5 ANSI/TIA 603-E-2016 ANSI/TIA-102.CAAA-E-2016	☒	

NOTE: ☒ mean that test needs to be performed.

5 About Signal Booster

According to the basic information of EUT and FCC part 90.219 (a) and KDB 935210 D02 APPENDIX A3.1 rules, this EUT belongs to PART 90 class B Industrial signal booster and it is a non SMR.

5.1 KDB 935210 D02 APPENDIX A3.1

A.3.1 Signal Booster (Section 90.219)

A **Signal Booster (Section 90.219)** is a device or system that automatically receives, amplifies, and retransmits signals from wireless stations into and out of building interiors, tunnels, shielded outdoor areas and other locations where these signals would otherwise be too weak for reliable communications. Signal booster systems may contain both Class A and Class B signal boosters as components. [Section 90.219(a)]

All **Section 90.219 boosters** are a type of Industrial Signal Booster, and are classified as either **Class A boosters** (narrowband) or **Class B boosters** (wideband).[R11] [*Order*, ¶ 15]

Note also that Consumer Signal Boosters are not defined for PLMRS or PSRS because licensees are considered to operate private services. Part 90 PLMR licensees typically obtain authorizations for individual narrowband channels or groups of channels to satisfy their own communication needs. Moreover, many Part 90 channels are interleaved and a licensee's channels may not be adjacent to one another, which presents unique considerations for signal boosters used with Part 90 PLMR services. [*Order*, ¶ 144]

a) Class A signal booster: A signal booster designed to retransmit signals on one or more specific channels. A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75 kHz. [Section 90.219(a)]

b) Class B signal booster: A signal booster designed to retransmit any signals within a wide frequency band. A signal booster is deemed to be a Class B signal booster if it has a passband that exceeds 75 kHz. [Section 90.219(a)]

Class B signal boosters may be deployed only at fixed locations; mobile operation of Class B signal boosters is prohibited (after November 1, 2014). [Section 90.219(d)(4)]

Except for signal boosters incorporating distributed antenna systems (DAS) and installed in buildings, the passband of a Class B booster shall not encompass both commercial services (such as ESMR and Cellular Radiotelephone) and Part 90 Land Mobile and Public Safety Services. [Section 90.219(d)(7)]

5.2 FCC part 90.219 (a) Definitions

§90.219 Use of signal boosters.

This section contains technical and operational rules allowing the use of signal boosters in the Private Land Mobile Radio Services (PLMRS). Rules for signal booster operation in the Commercial Mobile Radio Services under part 90 are found in §20.21 of this chapter.

https://www.ecfr.gov/cgi-bin/text-idx?SID=2097cbedce8abb94d012e95530a44e05&mc=true&node=pt47.5.90&rgn=div5

2020/6/15 Electronic Code of Federal Regulations (eCFR)

(a) *Definitions.* The definitions in this paragraph apply only to the rules in this section.

Class A signal booster. A signal booster designed to retransmit signals on one or more specific channels. A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75 kHz.

Class B signal booster. A signal booster designed to retransmit any signals within a wide frequency band. A signal booster is deemed to be a Class B signal booster if it has a passband that exceeds 75 kHz.

6 Test modes

Test modes	Downlink mode: “OUTSIDE” port of the EUT is connected to the signal generator, “INSIDE” port is connected to the spectrum analyzer through attenuator, and the power of the EUT is turned on and signal is sent. Uplink mode: “INSIDE” port of the EUT is connected to the signal generator, “OUTSIDE” port is connected to the spectrum analyzer through attenuator, and the power of the EUT is turned on and signal is sent.

7 Laboratory

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of Guangzhou GRG Metrology & Test Co,. Ltd.

Add. : No.1301 Guanguang Road Xinlan Community, Guanlan Street, Longhua District Shenzhen, 518110, People's Republic of China.

P.C. : 518110

Tel : 0755-61180008

Fax : 0755-61180008

8 Measurements uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Emission	Horizontal	30MHz～1000MHz	4.3dB
	Horizontal	1GHz～18GHz	5.6dB
	Vertical	30MHz～1000MHz	4.3dB
	Vertical	1GHz～18GHz	5.6dB

Measurement	Uncertainty
RF frequency	6×10^{-6}
RF power conducted	0.78dB
Occupied channel bandwidth	0.4%
Unwanted emission, conducted	0.68dB
Humidity	6%
Temperature	2℃

Note: This uncertainty represents an expanded uncertainty factor of k=2.

9 Equipments used during test

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Vector Signal Generator	Agilent	N5182A	MY50142870	2021-10-08
Signal Generator	Agilent	E4438C	MY49072994	2022-05-15
Vector Signal Generator	R&S	SMBV 100A	260996	2022-01-21
Signal Generator	R&S	SMB 100A	109290	2022-01-11
Spectrum analyzer	R&S	FSV30	104381	2022-02-21
Spectrum analyzer	R&S	FSV30	103264	2021-11-23
Spectrum analyzer	Agilent	N9020B	MY59050667	2022-02-21
Spectrum analyzer	Agilent	N9020A	MY51285942	2022-05-15
Power splitter	WEINSCHEL	1580	SL767	2022-03-02
SNS Series Noise Source	Agilent	346B	MY44422241	2022-05-15
Frequency meter	Suin	SS7300	6E5042026	2022-04-23
Voltage regulator	Qingdaoqingzhi	TDGC2J-5	GRGTAG2013026	/
Digital multimeter	Fluke	F15B+	44750292WS	2022-01-13
Isolator	China guangshun	TG101A 700~800	121003889	/
Attenuation	Shanghaihua xiang	TS5-30dB-4G	54451395	/
Temp & Humidity chamber	HOSON	HS01060SDF	191008401	2021-10-15
Radiated emissions				
Receiver	R&S	ESU26	100526	2022-08-20
Receiver	R&S	ESU40	100106	2022-04-05
Bi-log Antenna	Schwarzbeck	VULB 9160	9160-3402	2021-10-08
Bi-Log Antenna	ETS-lindgren	3142C	75971	2021-12-18
Horn Antenna	Schwarzbeck	BBHA9120	D286	2021-10-08
Horn Antenna	ETS	3117 C	00075824	2022-01-21
Broadband Amplifiers	Schwarzbeck	BBV9718	00246	2022-08-16
Semi-anechoic chamber	ETS-lindgren	966(RFD-F/A-100)	3730	2021-10-01

10 Radio technical requirement specification

10.1 Test Frequencies

Test requirement: KDB 935210 D02 APPENDIX D/Table D.3
FCC PART 2.1057
ANSI C63.26-2015 Clause 5.1.2

10.1.1 Requirements

According to FCC regulations, FCC part 2.1057, ANSI c63.26-2015 clause 5.1.2 and KDB 935210 D02 Appendix D / table D.3 have relevant frequency band requirements.

(1) FCC PART 2.1057

§2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in §§2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower.

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

(2) ANSI C63.26-2015 Clause 5.1.2

5.1.2 Number of fundamental frequencies to be tested in EUT transmit band

5.1.2.1 General requirement

Measurements of transmitters shall be performed and, if required, reported for each frequency band in which the EUT can be operated with the device transmitting at the number of frequencies in each band specified in Table 2.

[24] See 47 CFR 2.1057.

Table 2—Number of frequencies to be tested

Frequency range over which EUT operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

(3) KDB 935210 D02 APPENDIX D/Table D.3

Section 90.219 purposes (for info only – see rules for details, also KDB Publication 634817 [R14])

Fr. (MHz)	–	Fr. (MHz)	Rule(s)	Misc. Notes
150	–	150.05	Federal (non-FCC)	
150.05	–	150.8	90.265	
150.8	–	162.0125	90	
162.0125	–	173.2	90.265	
173.2	–	173.4	90	
173.4	–	174	Federal (non-FCC)	
406.1	–	420	90.265	
420	–	421	ULS presently shows no licensees for 420-420.9 MHz	
421	–	430	90	
430	–	450	Not available under 90 Subparts B, C land mobile service	
450	–	470	90 (selected bands)	
470	–	512	90	
746	–	757	27.5(b)(3) Block C; 90 not available	
757	–	758	27.5(b)(1) Block A; 90 not available	
758	–	768	90-R, Public Safety (PS) Broadband (FirstNet)	B9B (LTE)
768	–	769	PS Guardband	
769	–	775	PS Narrowband	
775	–	776	27.5(b)(2) Block B; 90 not available	
776	–	787	27.5(b)(3) Block C; 90 not available	
787	–	788	27.5(b)(1) Block A; 90 not available	
788	–	798	90-R, Public Safety (PS) Broadband (FirstNet)	B9B (LTE)
798	–	799	PS Guardband	
799	–	805	PS Narrowband	
805	–	806	27.5(b)(2) Block B; 90 not available	
806	–	809	90 NPSPAC (PS) [90.617(a)(1)]	B9B/B9A
809	–	815	90 Interleaved PS; B/ILT; SMR [90.614(a); 90.613 ch. nos. 1-470][a]	B9B/B9A
815	–	816	90 Expansion B/ILT; SMR [90.614(a); 90.613 ch. nos. 470-550][a]	B9B/B9A
816	–	817	90 Guardband	B9B/B9A
817	–	824	CMRS 90 ESMR [90.614(b); 90.613 ch. nos. 551-830]	B2I 90-S
824	–	849	22 H; 90 not available	B2I
849	–	851	22 G; 90 not available	BOS
851	–	854	90 NPSPAC (PS) [90.617(a)(1)]	B9B/B9A
854	–	860	90 Interleaved PS; B/ILT; SMR [90.614(a); 90.613 ch. nos. 1-470][a]	B9B/B9A
860	–	861	90 Expansion B/ILT; SMR [90.614(a); 90.613 ch. nos. 470-550][a]	B9B/B9A
861	–	862	90 Guardband	B9B/B9A
862	–	869	CMRS 90 ESMR [90.614(b); 90.613 ch. nos. 551-830]	B2I 90-S
869	–	894	22-H; 90 not available	B2I
894	–	896	22-G; 90 not available	BOS
896	–	901	90 Interleaved B/ILT [90.617(c)] and SMR [90.617(f)]; UL (donor)	B2I 90-S& B9B/B9A 90-S
901	–	902	24-D; 90 not available	B2I
928	–	929	101; 90 not available[b,c]	BOS
929	–	930	90[d, e]	B9B/B9A
930	–	931	24-D; 90 not available	B2I
931	–	932	22-E; 90 not available	B2I
932	–	935	101; 90 not available	BOS
935	–	940	90 Interleaved B/ILT [90.617(c)] and SMR [90.617(f)]; DL (server)	B2I 90-S& B9B/B9A 90-S

The EUT will utilize bands:

700MHz Band: Downlink: 769MHz ~ 775MHz, Uplink: 799MHz ~805MHz
800MHz Band: Downlink: 851MHz ~861MHz, Uplink: 806MHz ~ 816MHz

10.1.2 Result

This project is only reported and checked, the frequency range of this EUT meets the above regulatory requirements.

10.2 Input Signals

Test requirement: KDB 935210 D05 clause 4.1

10.2.1 Requirements

KDB 935210 D05 clause 4.1

The procedures in this clause are specific to EUTs intended for operating in the Private Land Mobile Radio Services (PLMRS) and Public Safety Radio Services (PSRS)[5], which are governed under the provisions and requirements of the Part 90 rules (i.e., Section 90.219 applies).

Table 1 depicts signal types associated with PLMRS operations, which are to be considered as test signals to be used in performing compliance testing on PLMRS amplifiers, repeaters, and industrial boosters. Not all of the procedures in this clause will require using each of the signals listed in Table 1, because for

[5] As explained in § 90.16, Public Safety Radio Services is part of the Public Safety Radio Pool, also known as the Public Safety Pool.

many EUTs a CW tone can adequately model the narrowband signals typically encountered within these services. For EUTs supporting digitally modulated signals, the intended operating signal types should be tested (e.g., P25 Phase 1, P25 Phase 2, TETRA, etc.), especially for PSRS devices. Devices intended for use in 700 MHz Public Safety Broadband spectrum shall be tested using a representative band-limited AWGN signal (99 % OBW of 4.1 MHz) or the applicable signal type (e.g., LTE).

Table 1—Test signals for PLMRS devices

Emission Designator	Modulation	Occupied Bandwidth	Channel Bandwidth	Audio Frequency
16K0F3E	FM	16 kHz	25 kHz	1 kHz
11K3F3E	FM	11.3 kHz	12.5 kHz	1 kHz
4K00F1E	FM	4 kHz	6.25 kHz	1 kHz
N/A	CW	N/A	N/A	N/A

10.2.2 Result:

Test Date (yy-mm-dd): 2021-09-05

Normal condition: Temp: 25.3℃, Humid:52%, Atmospheric Pressure:101kpa

Supply Voltage: AC 110V, 50Hz

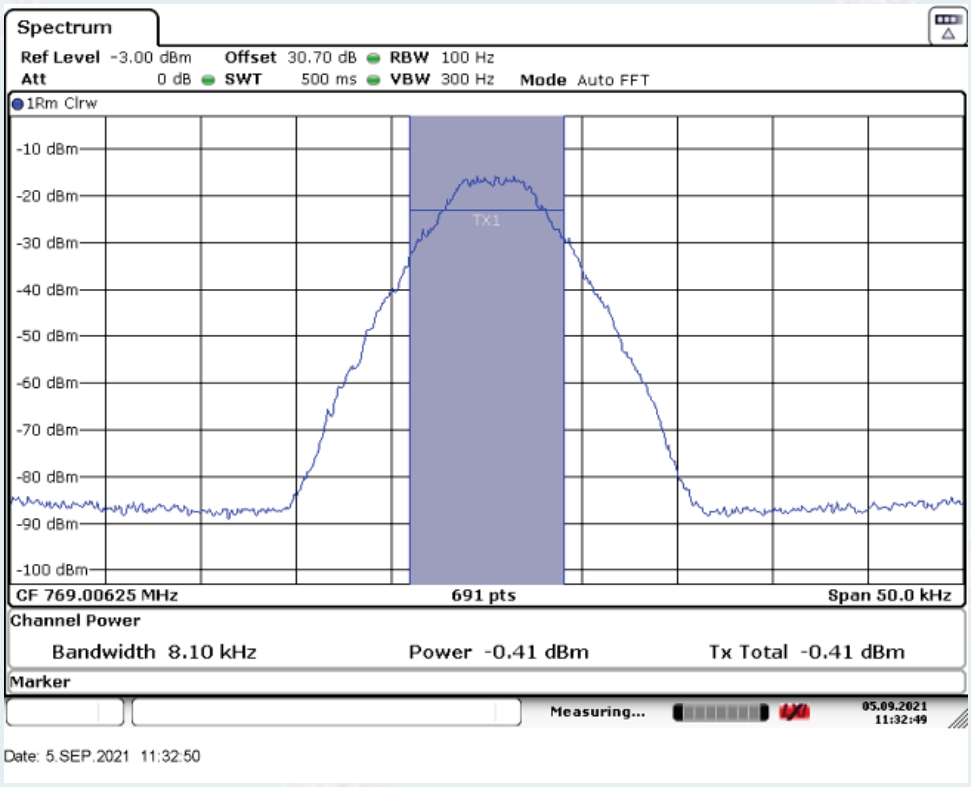
This project is only reported and checked.

10.2.3 Input Signals screenshot

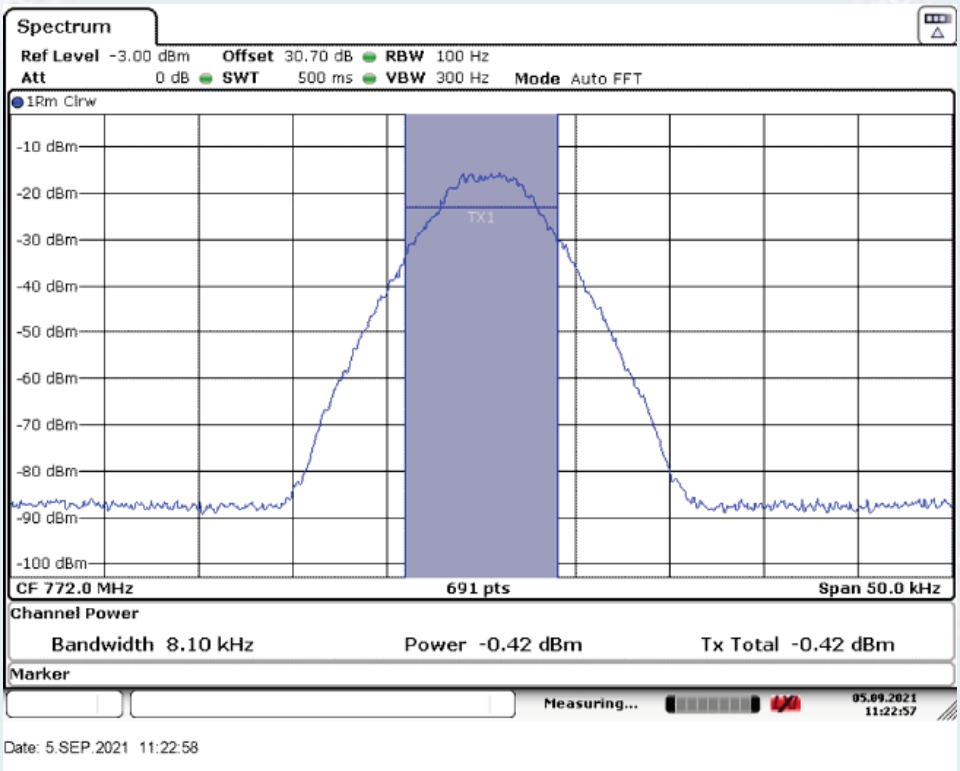
10.2.3.1 700MHz Band

10.2.3.1.1 P25 Phase I(C4FM) mode

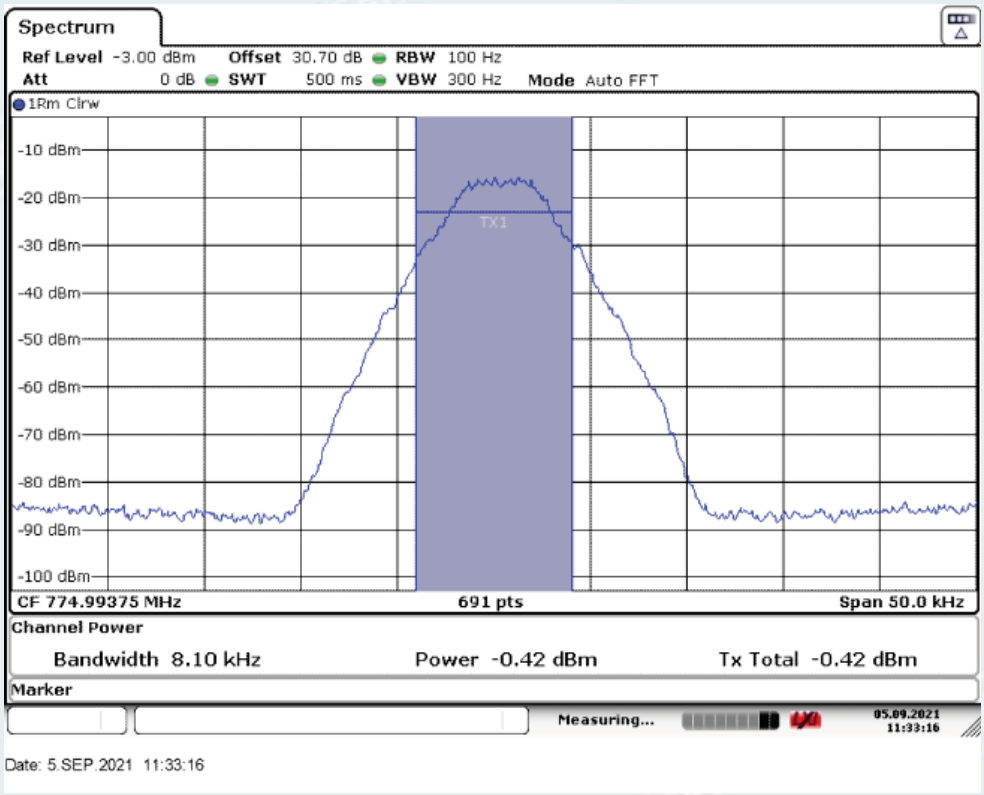
10.2.3.1.1.1 Downlink



Low Frequency: 769.00625MHz

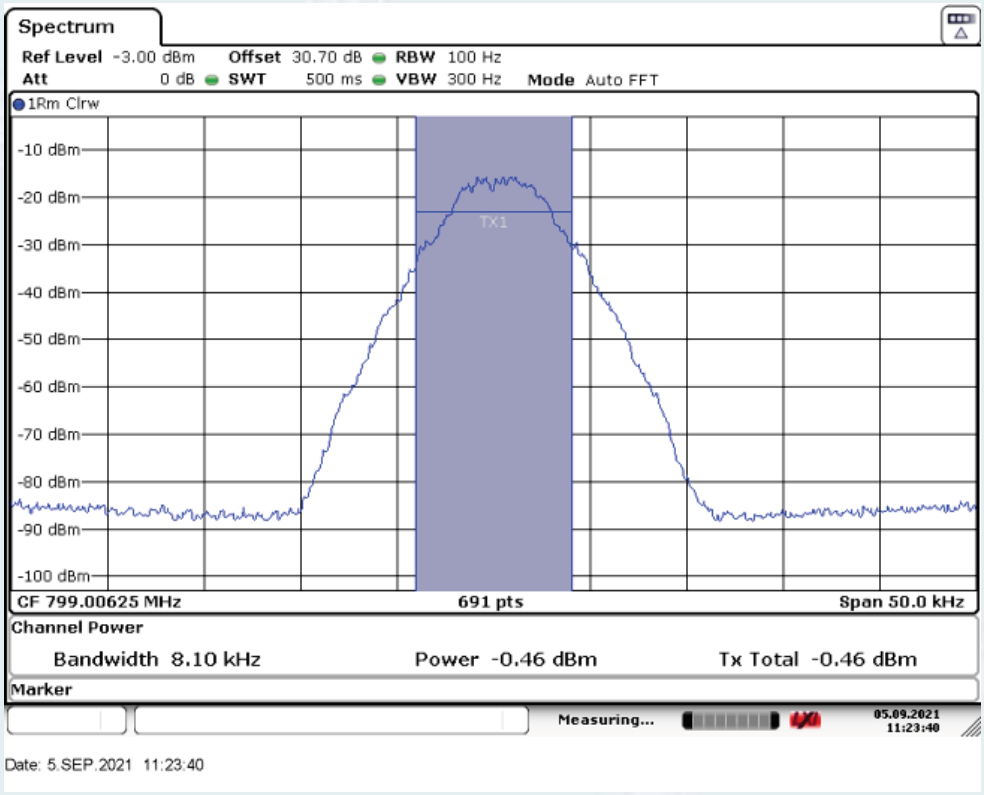


Middle Frequency: 772MHz

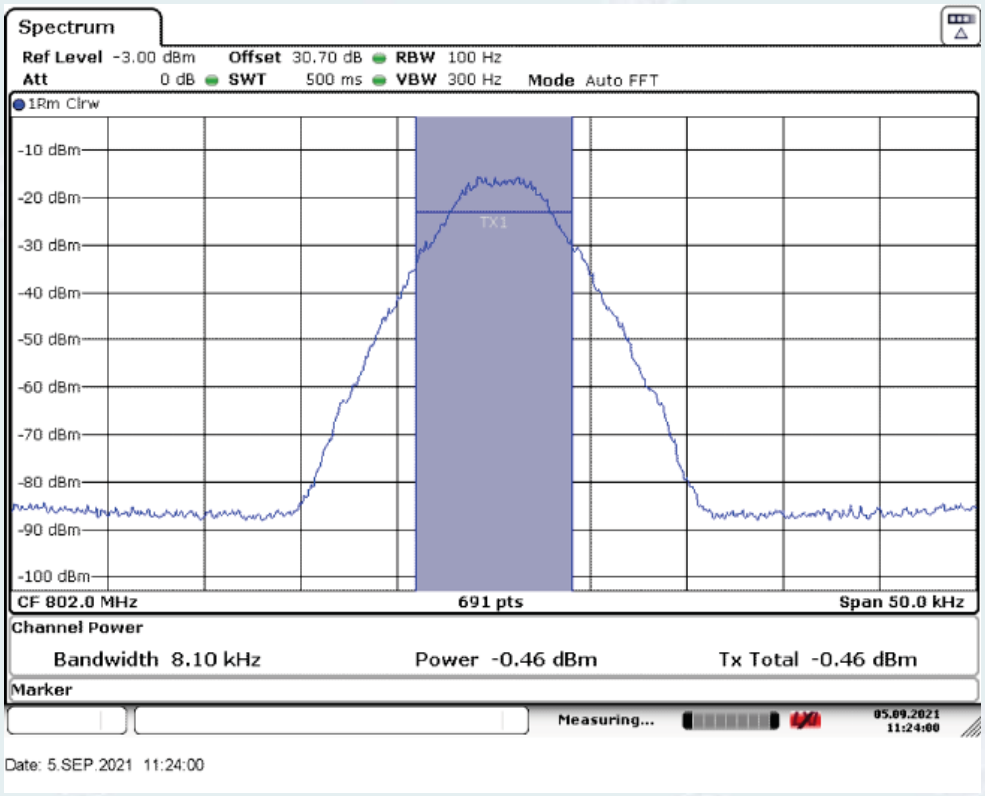


High Frequency: 774.99375MHz

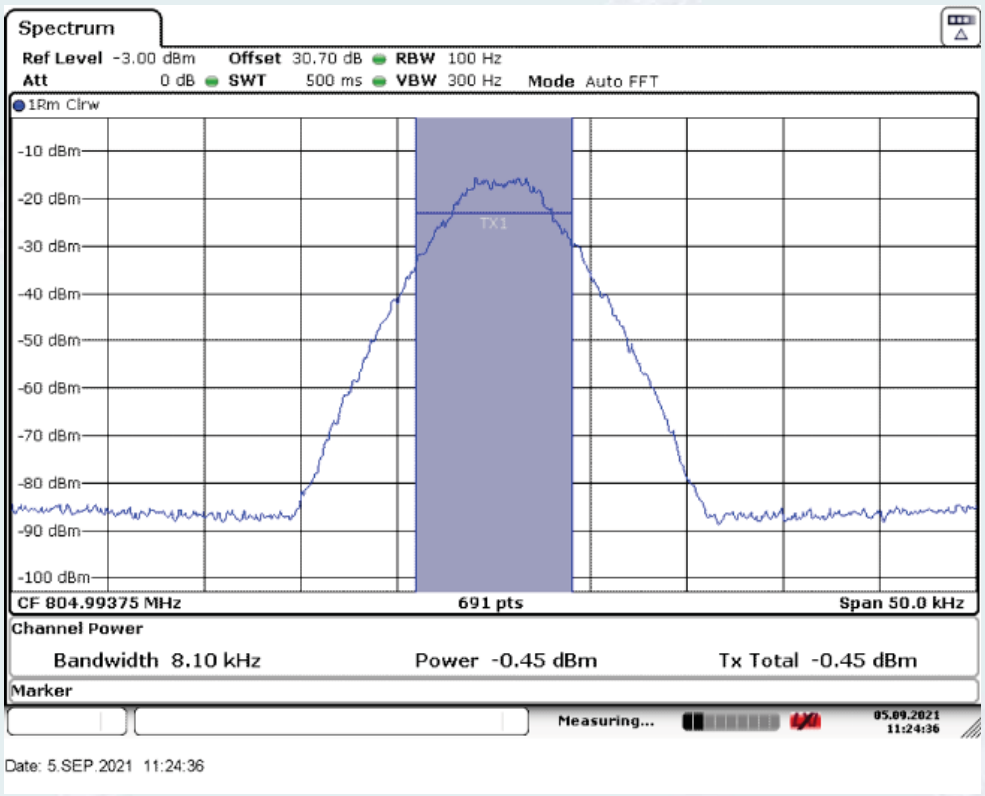
10.2.3.1.1.2 Uplink



Low Frequency: 799.00625MHz



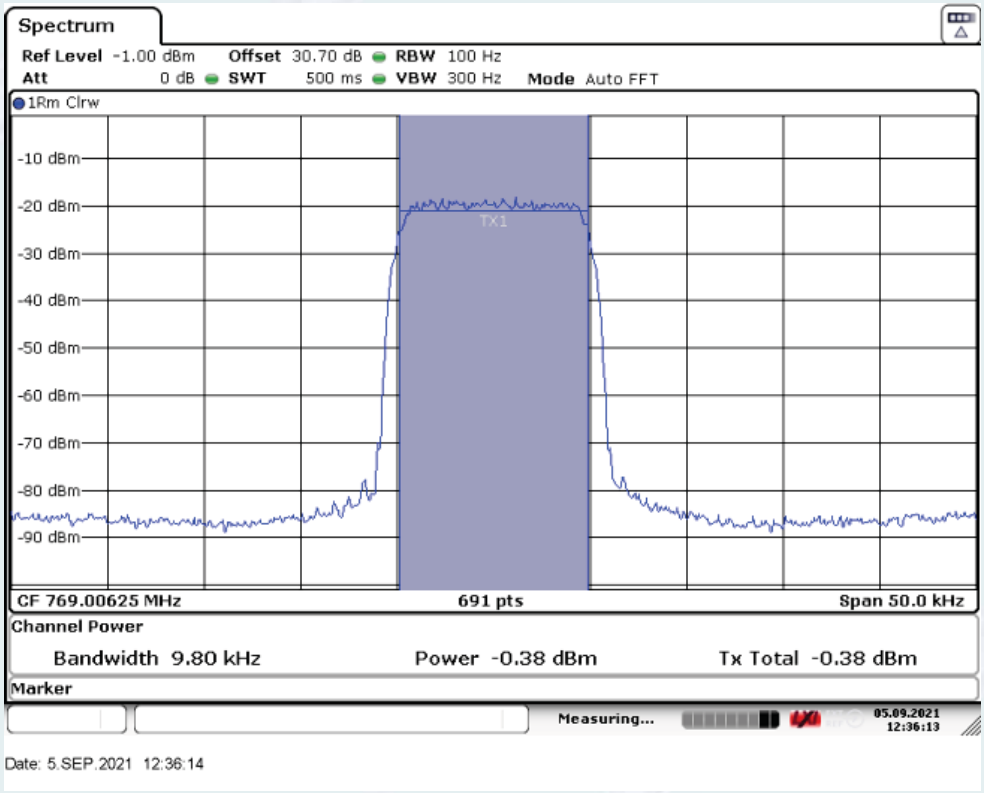
Middle Frequency: 802MHz



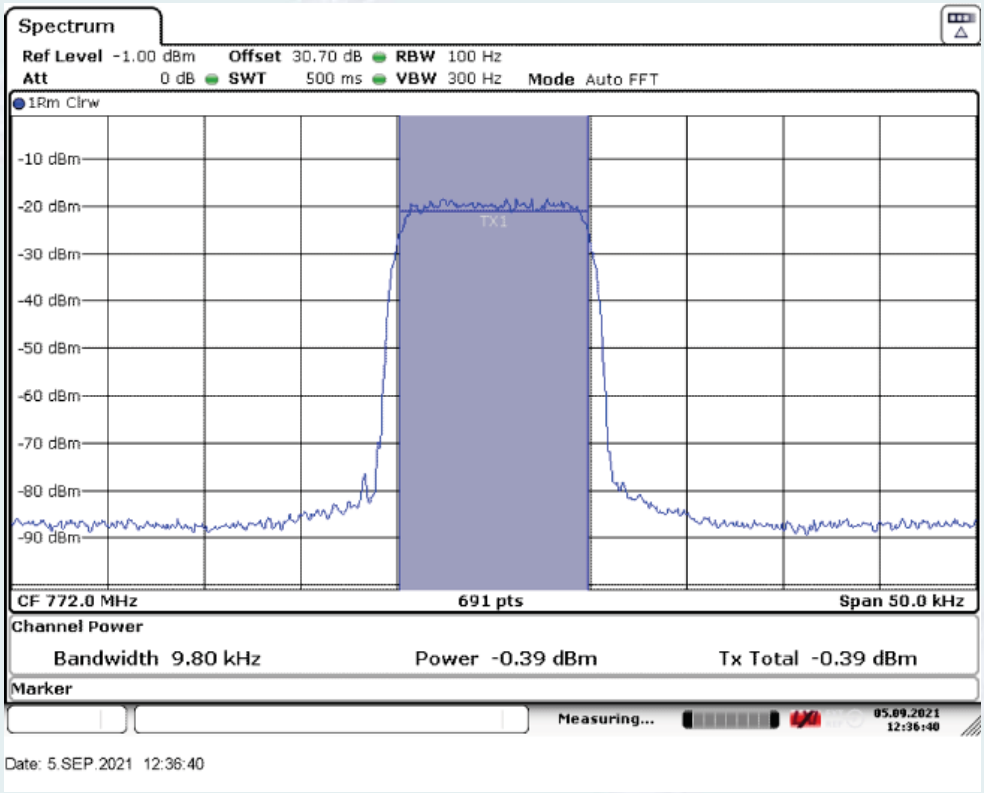
High Frequency: 804.99375MHz

10.2.3.1.2 P25 Phase II(H-DQPSK) mode

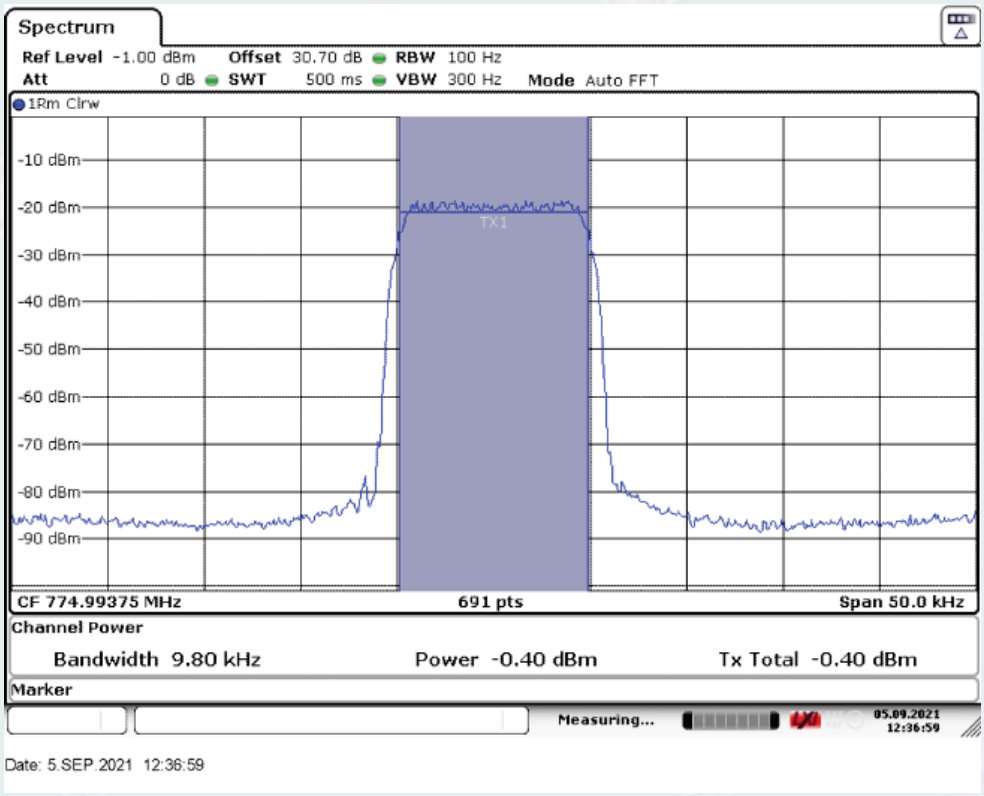
10.2.3.1.2.1 Downlink



Low Frequency: 769.00625MHz

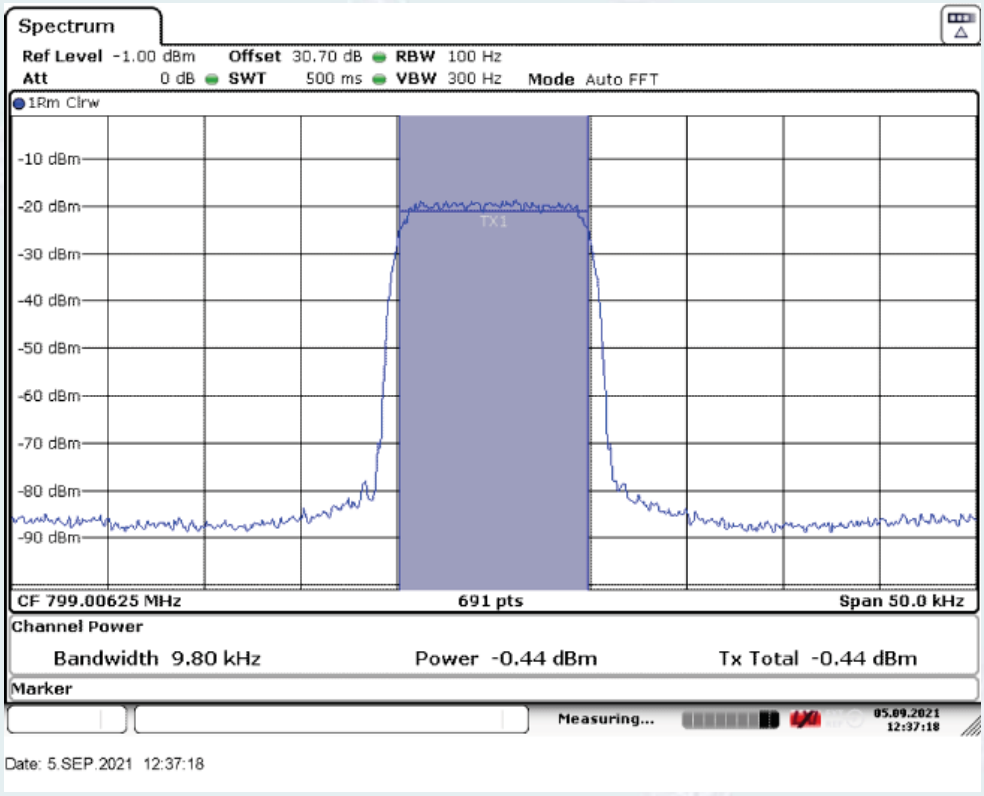


Middle Frequency: 772MHz

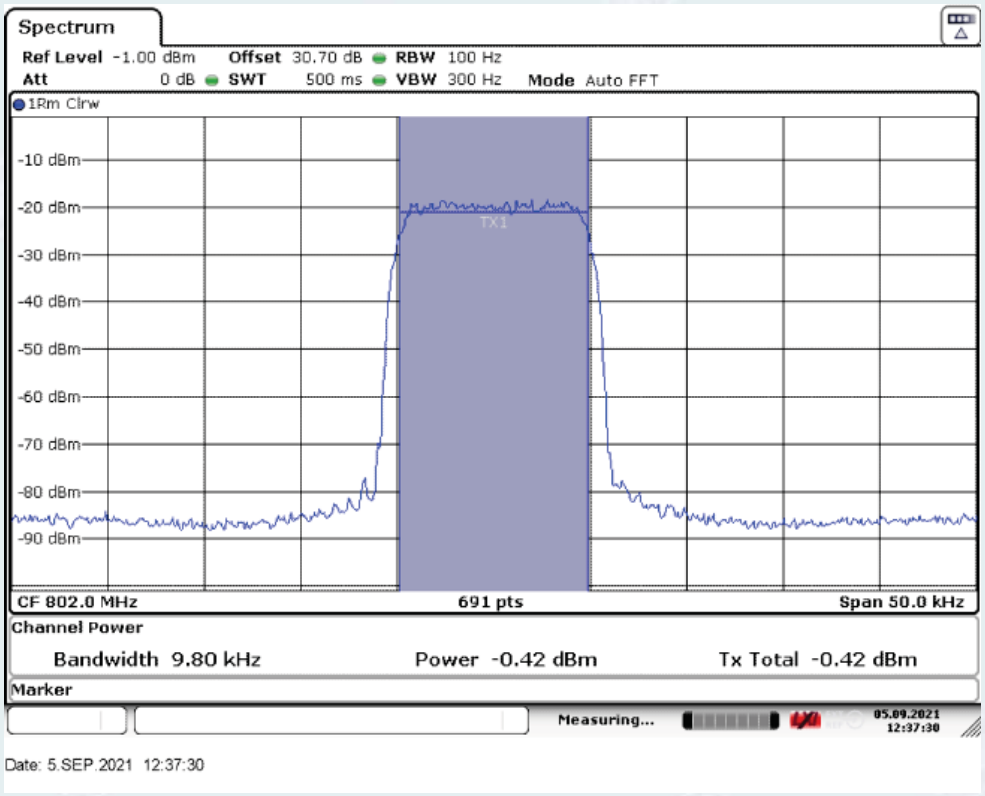


High Frequency: 774.99375MHz

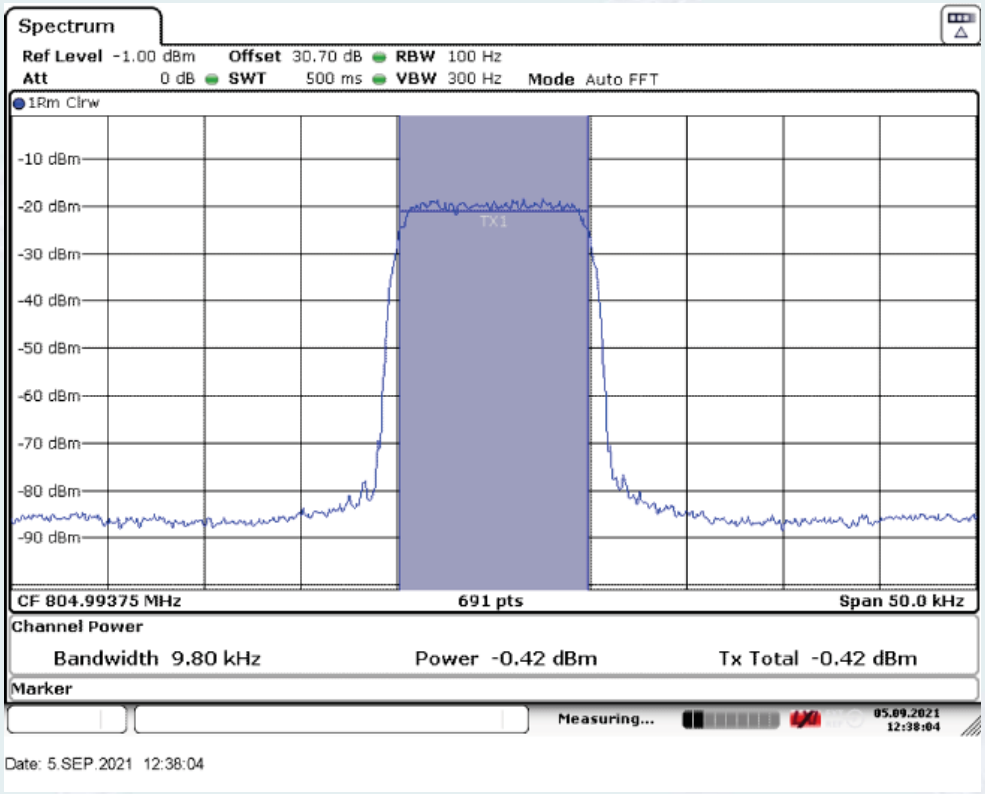
10.2.3.1.2.2 Uplink



Low Frequency: 799.00625MHz



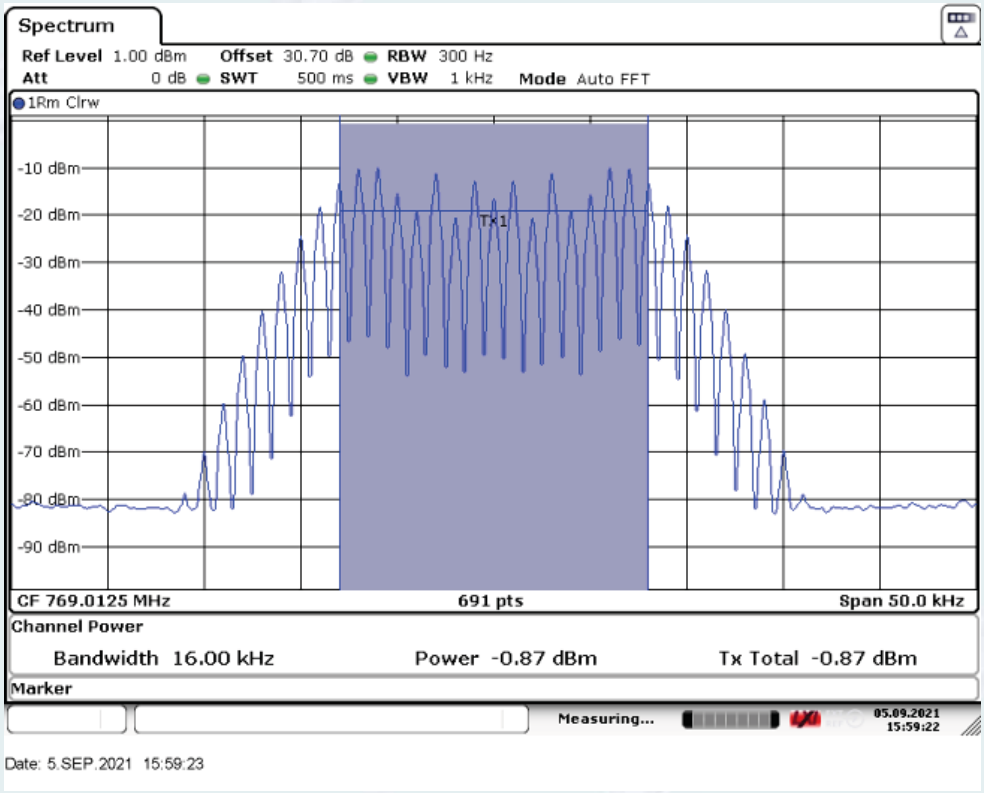
Middle Frequency: 802MHz



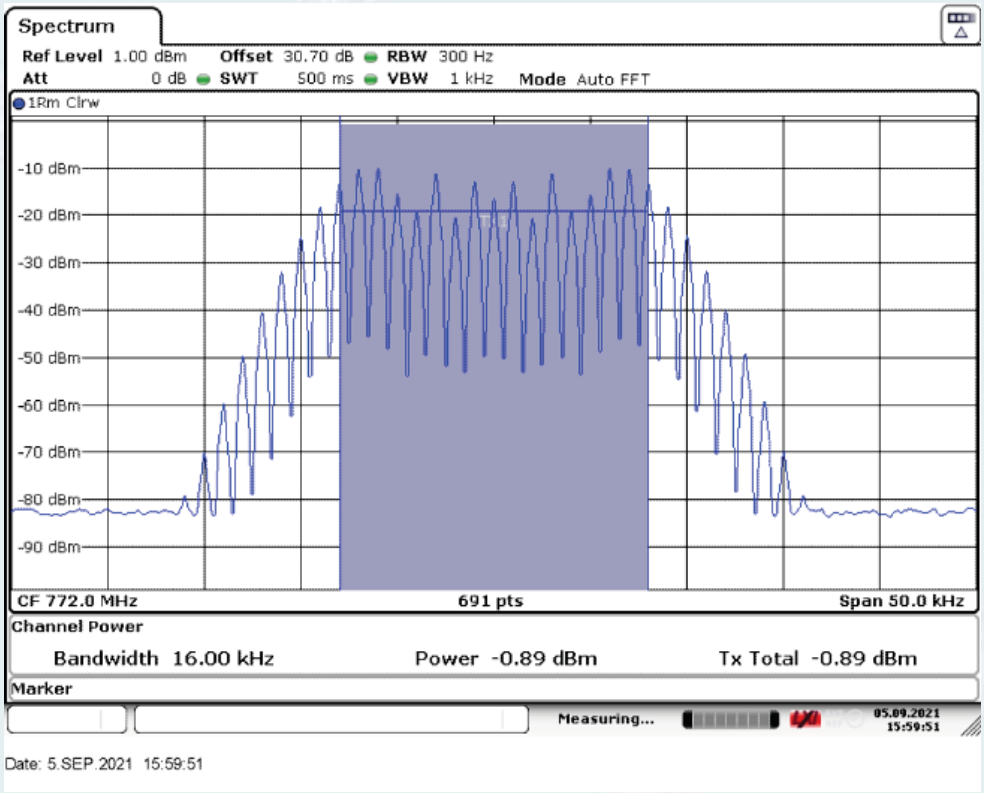
High Frequency: 804.99375MHz

10.2.3.1.3 Analog FM mode

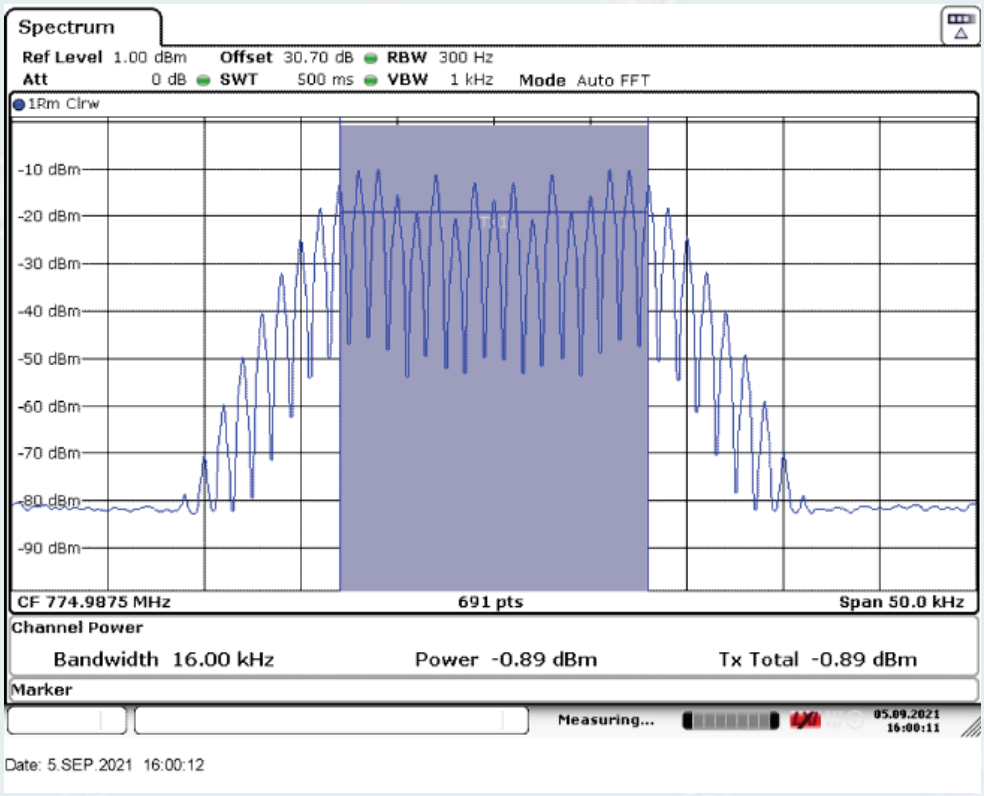
10.2.3.1.3.1 Downlink



Low Frequency: 769.0125MHz

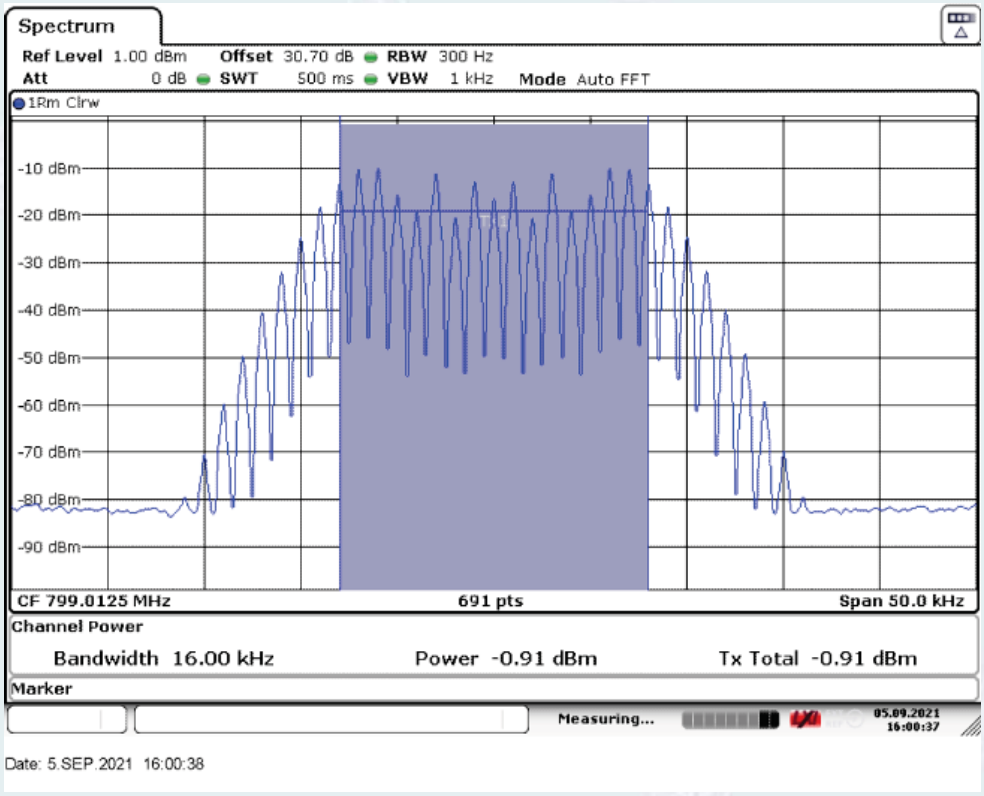


Middle Frequency: 772MHz

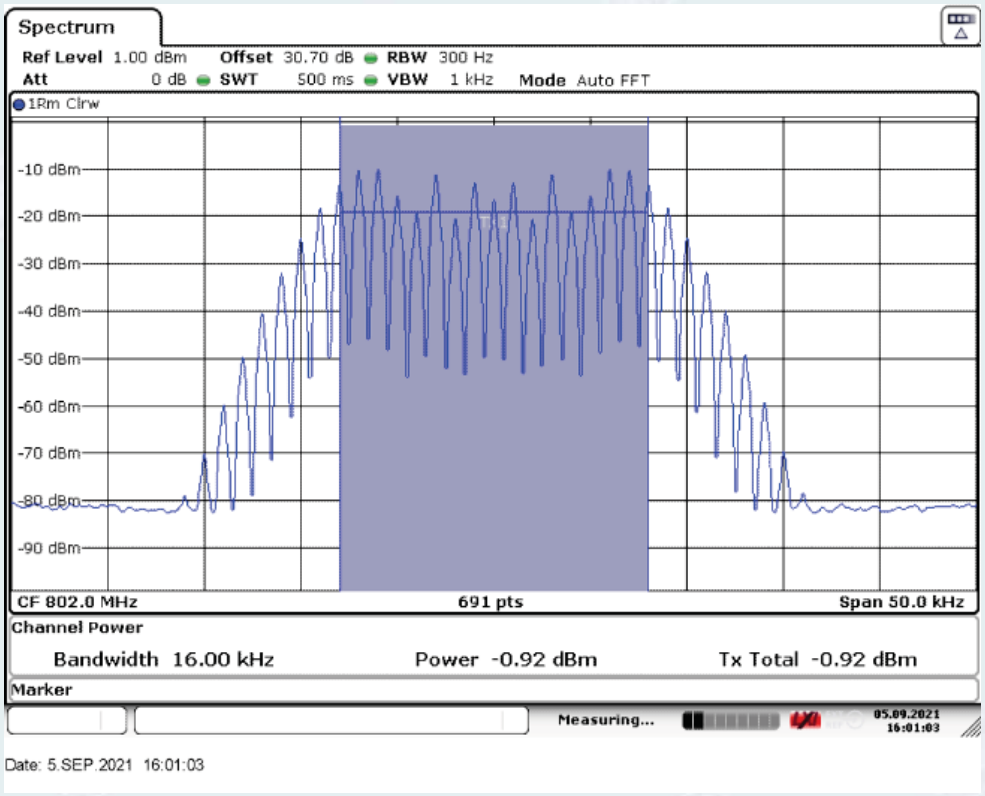


High Frequency: 774.9875MHz

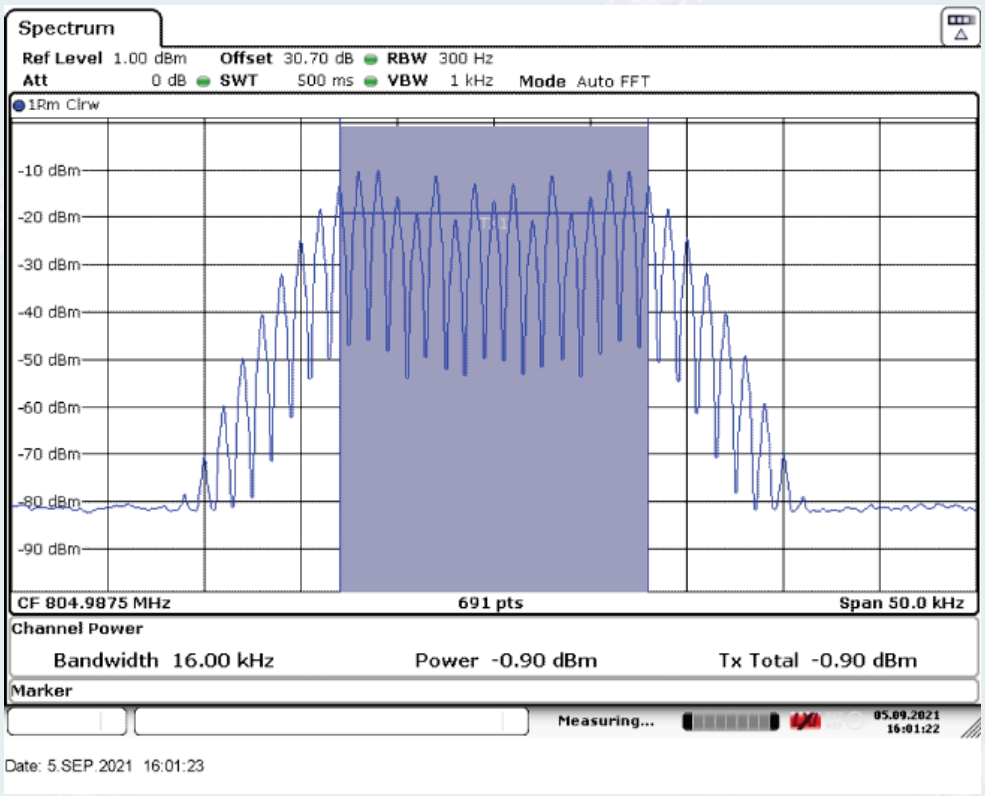
10.2.3.1.3.2 Uplink



Low Frequency: 799.0125MHz



Middle Frequency: 802MHz

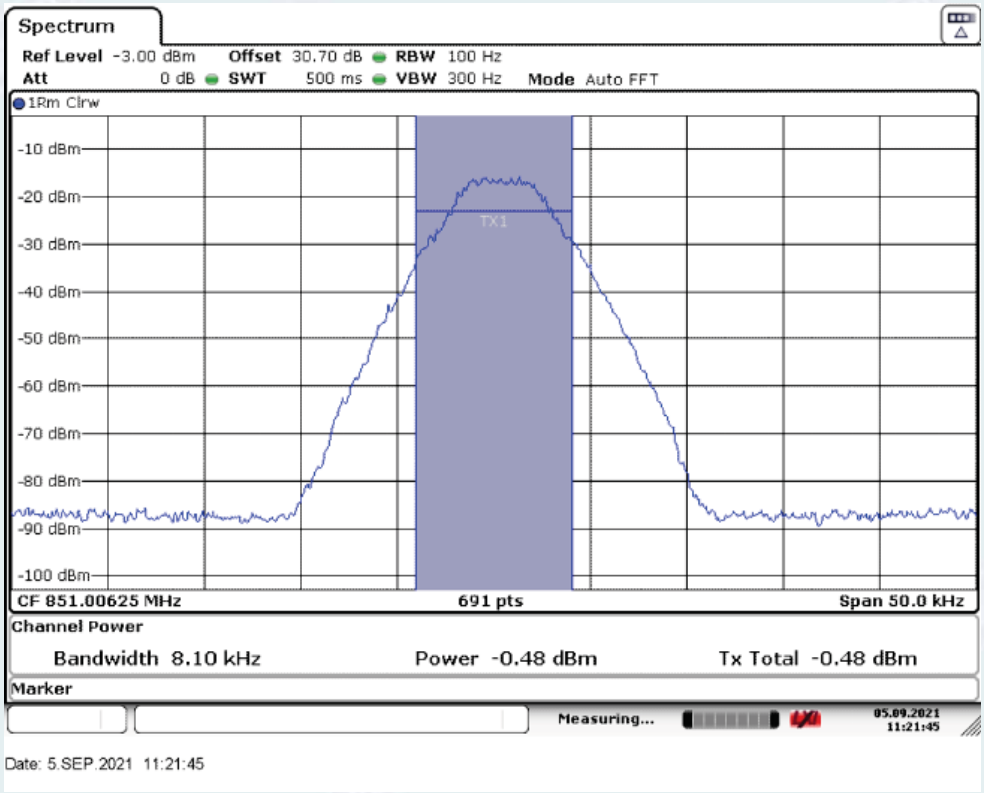


High Frequency: 804.9875MHz

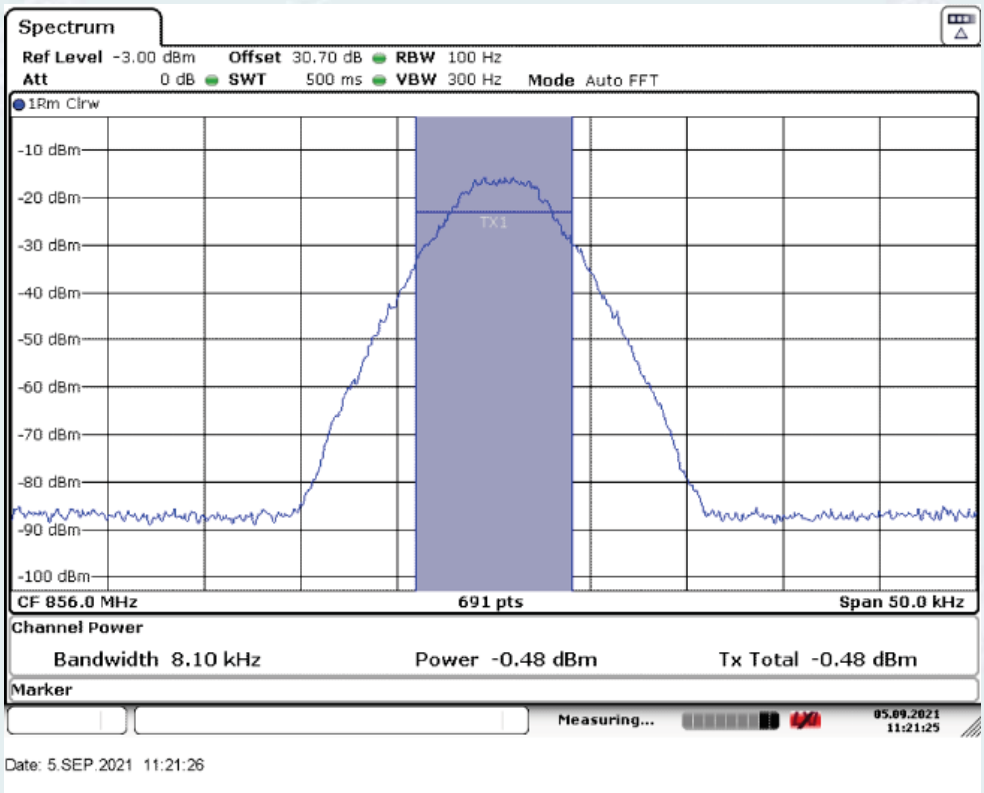
10.2.3.2 800MHz Band

10.2.3.2.1 P25 phase I mode

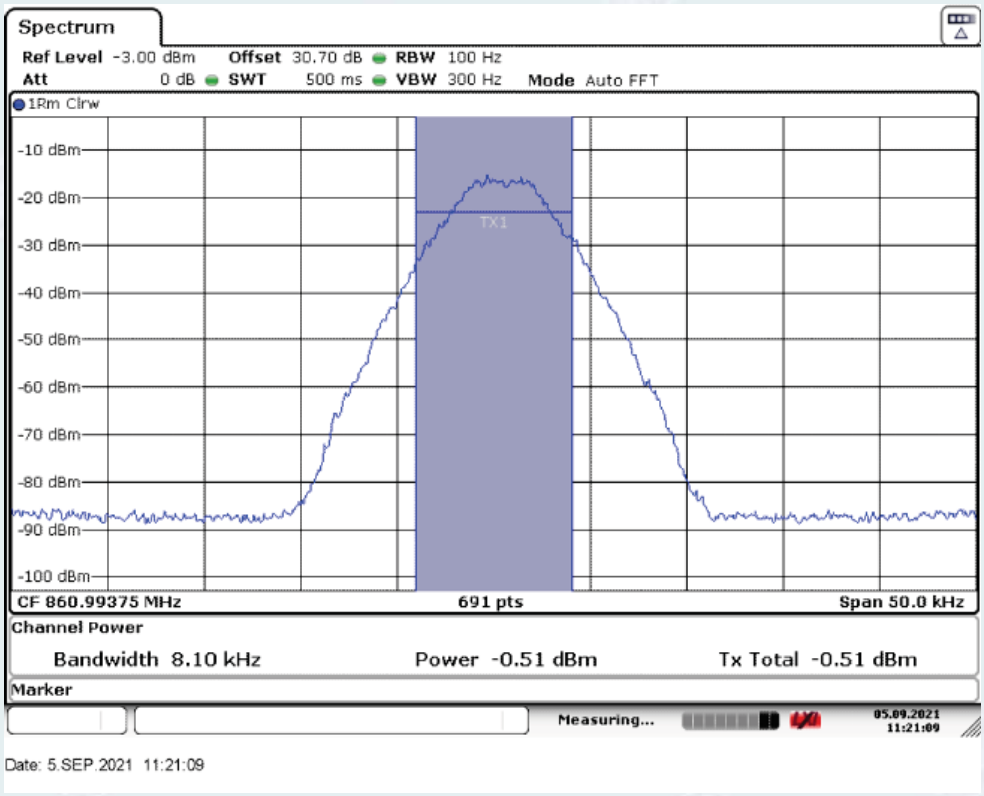
10.2.3.2.1.1 Downlink



Low Frequency: 851.00625MHz

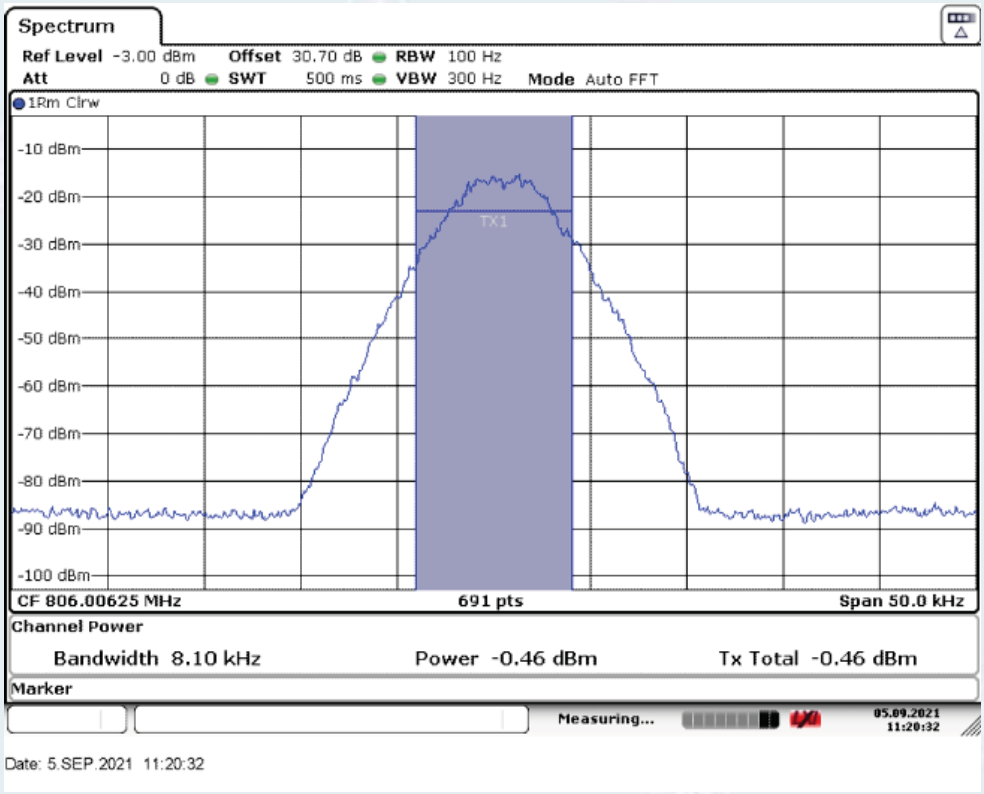


Middle Frequency: 856.0MHz

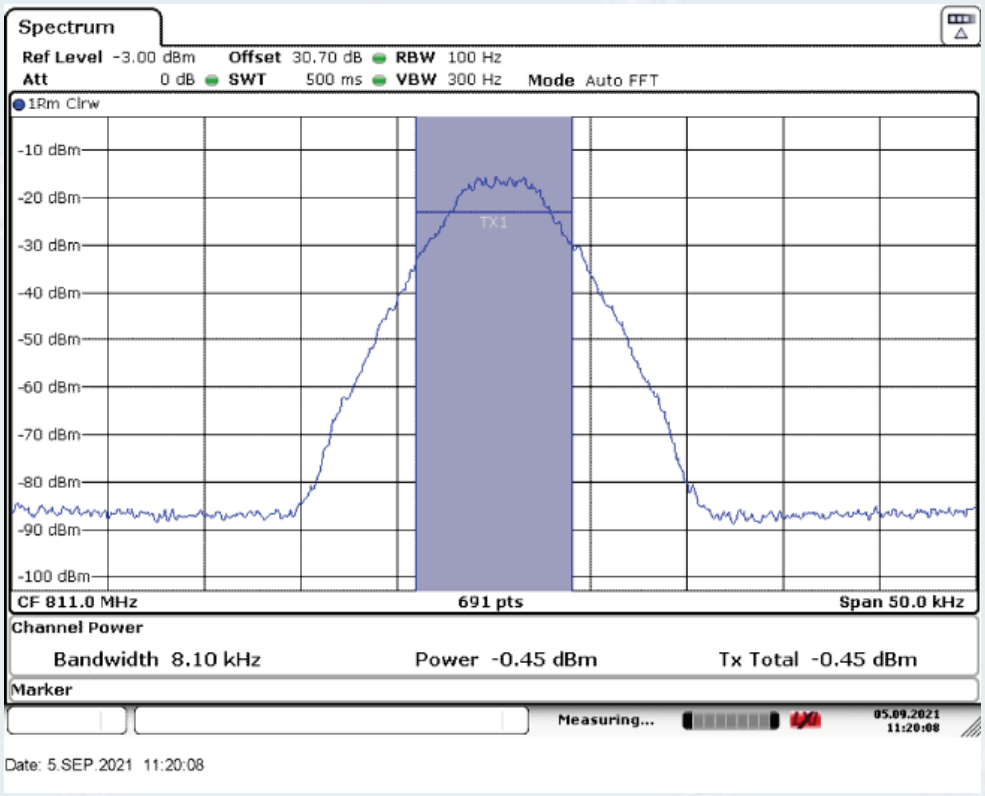


High Frequency: 860.99375MHz

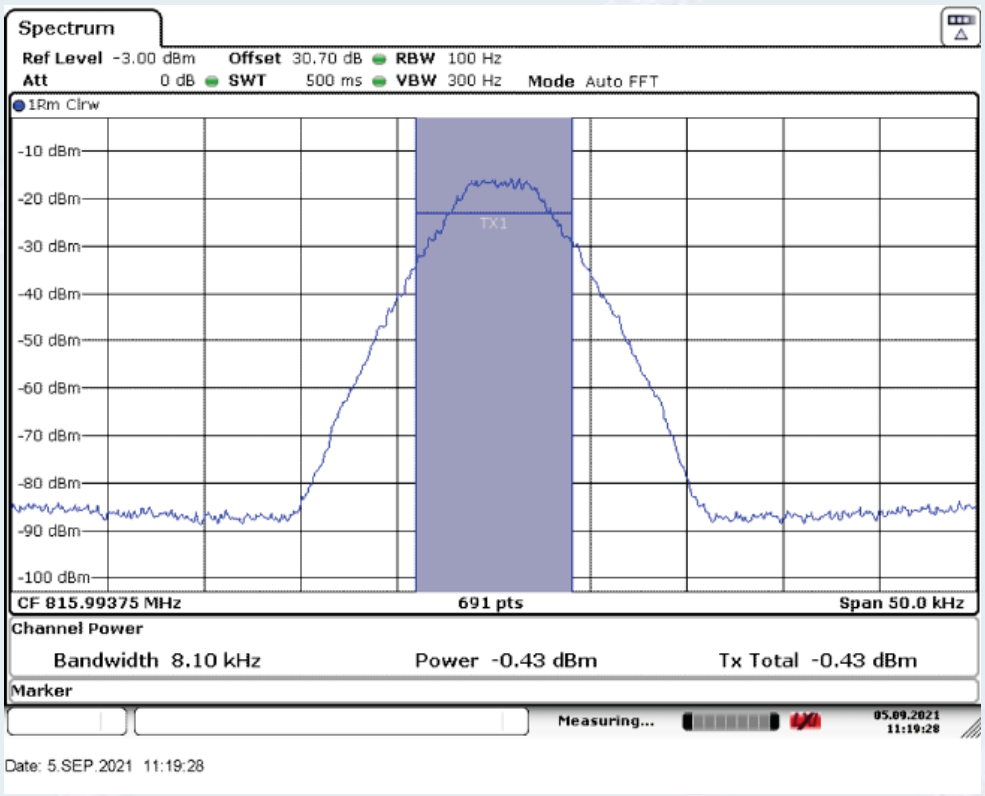
10.2.3.2.1.2 Uplink



Low Frequency: 806.00625MHz



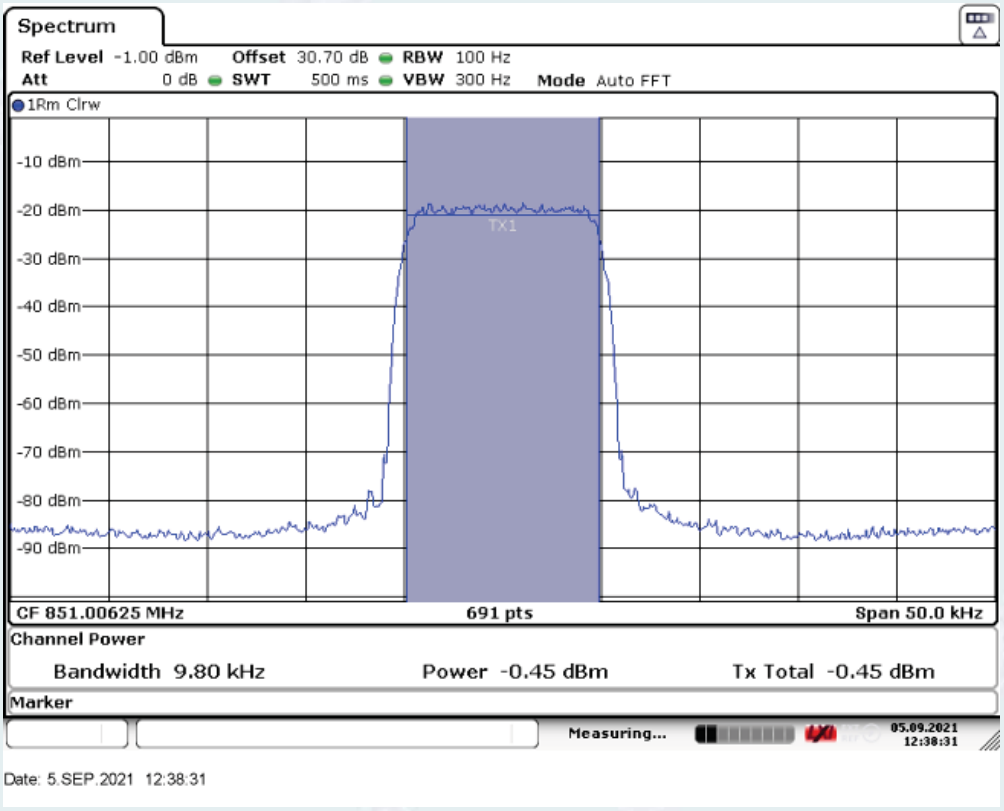
Middle Frequency: 811.0MHz



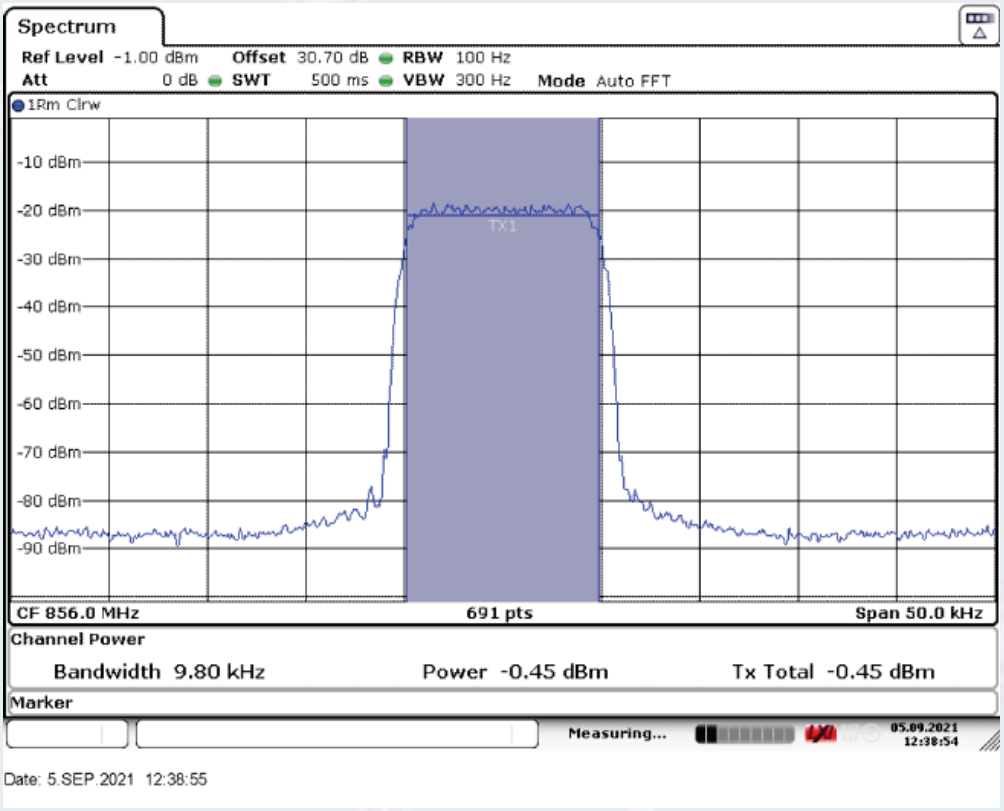
High Frequency: 815.99375MHz

10.2.3.2.2 P25 phase II mode

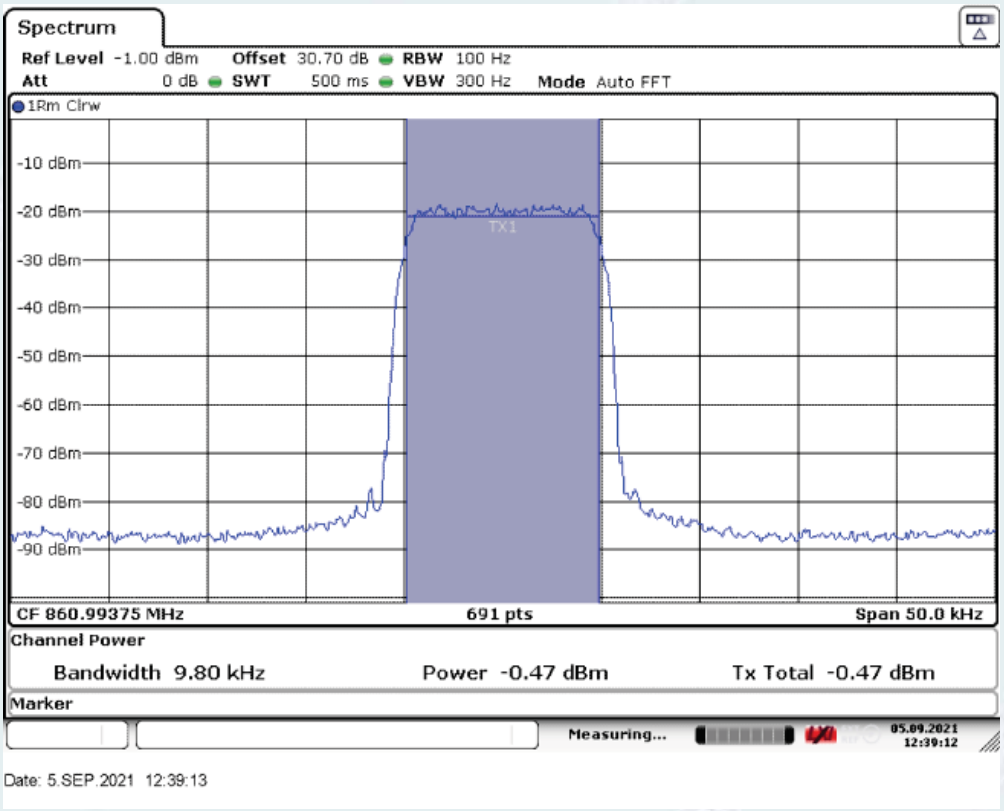
10.2.3.2.2.1 Downlink



Low Frequency: 851.00625MHz

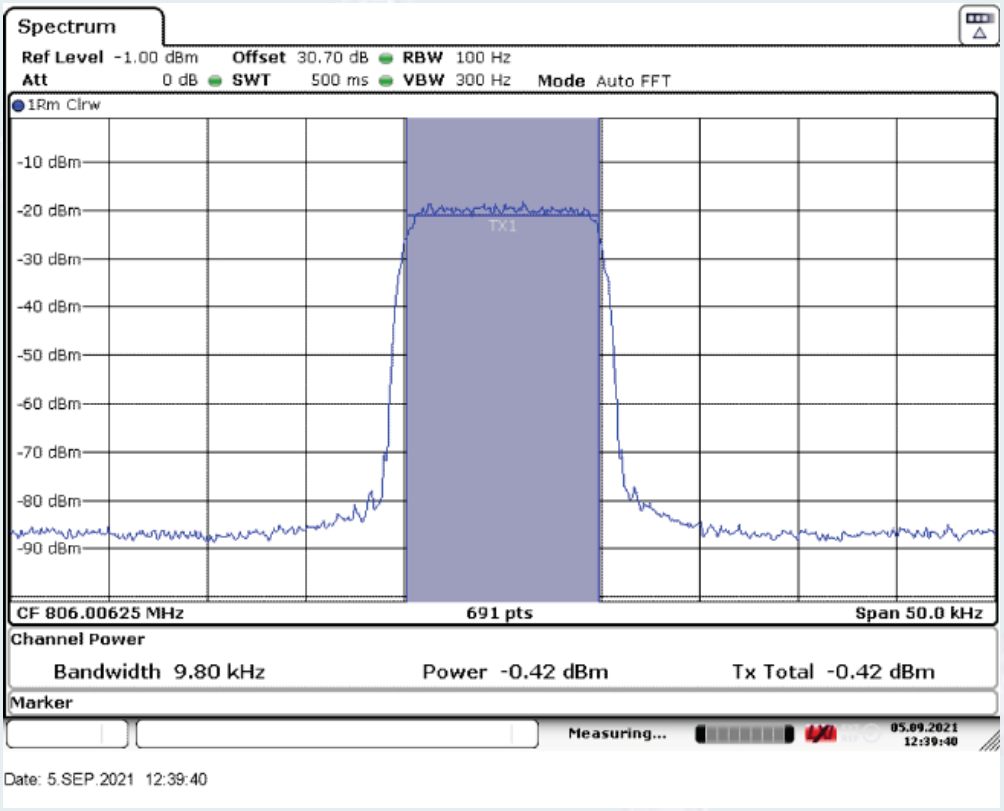


Middle Frequency: 856.0MHz

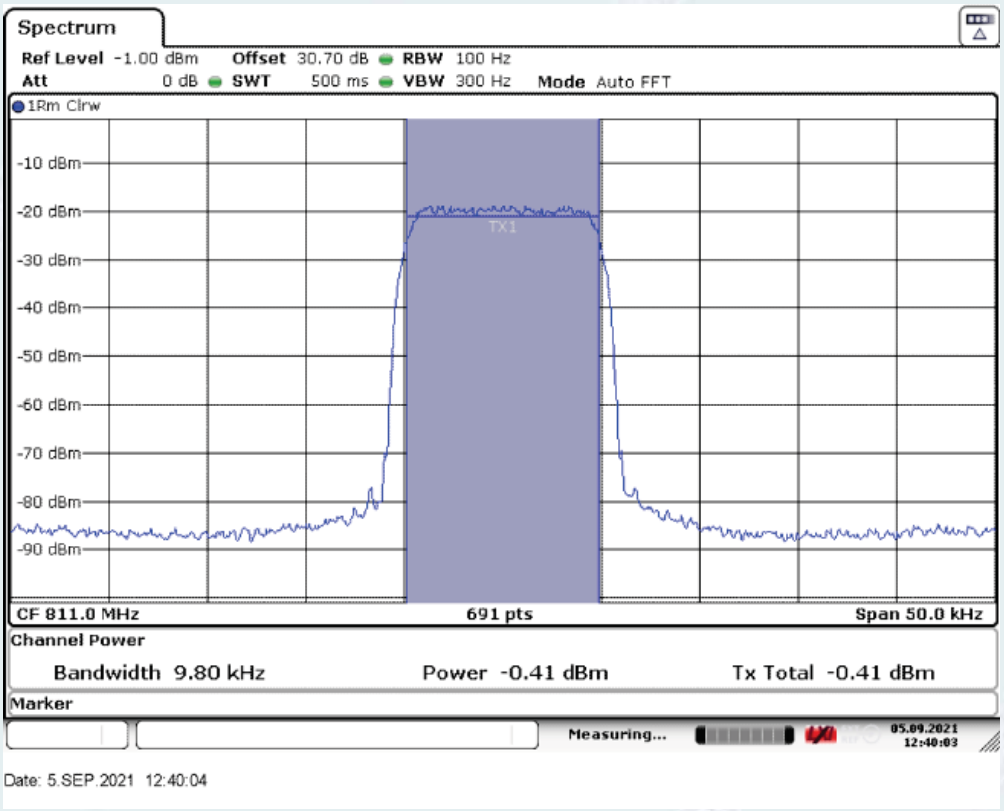


High Frequency: 860.99375MHz

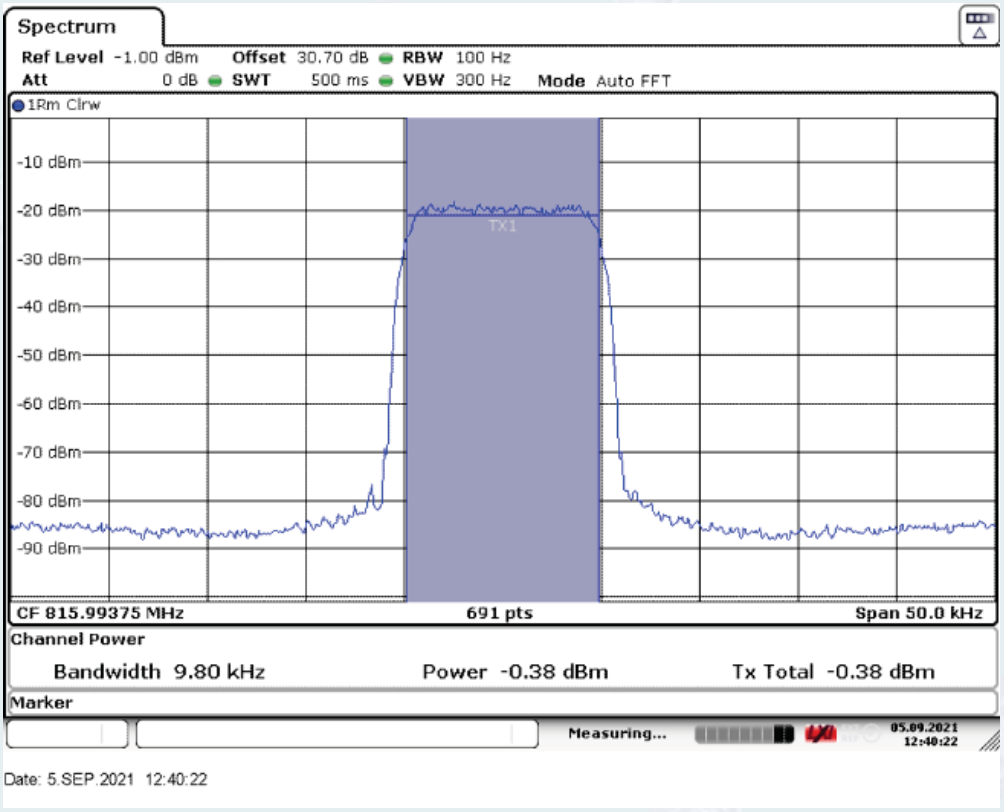
10.2.3.2.2.2 Uplink



Low Frequency: 806.00625MHz



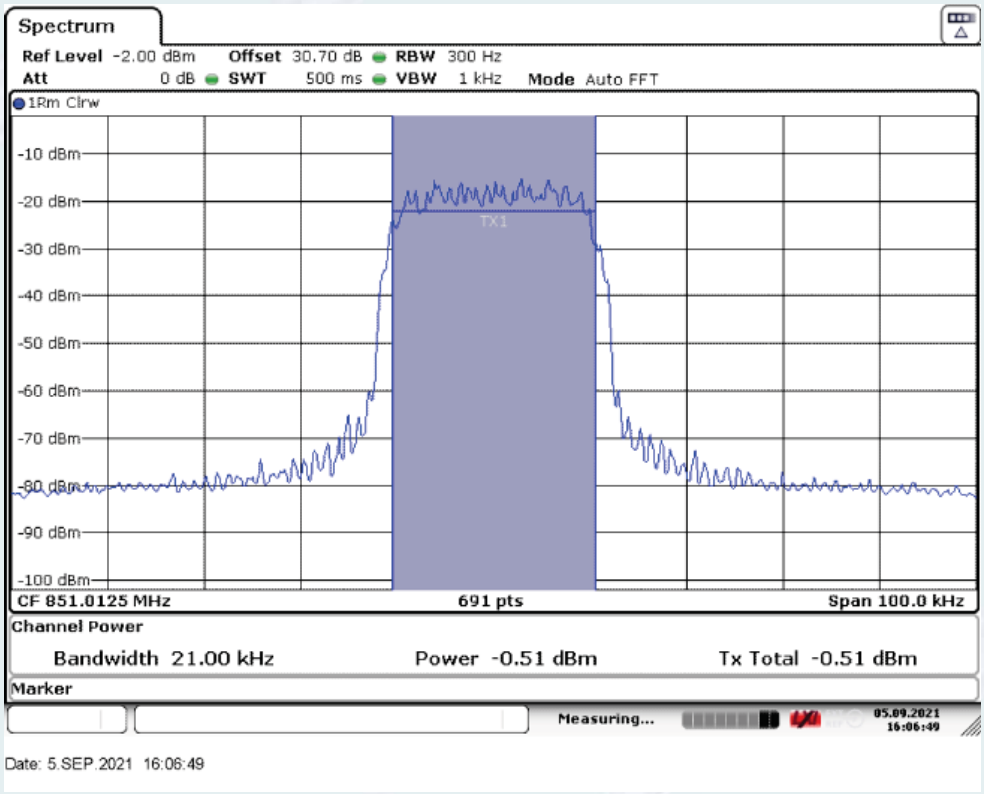
Middle Frequency: 811.0MHz



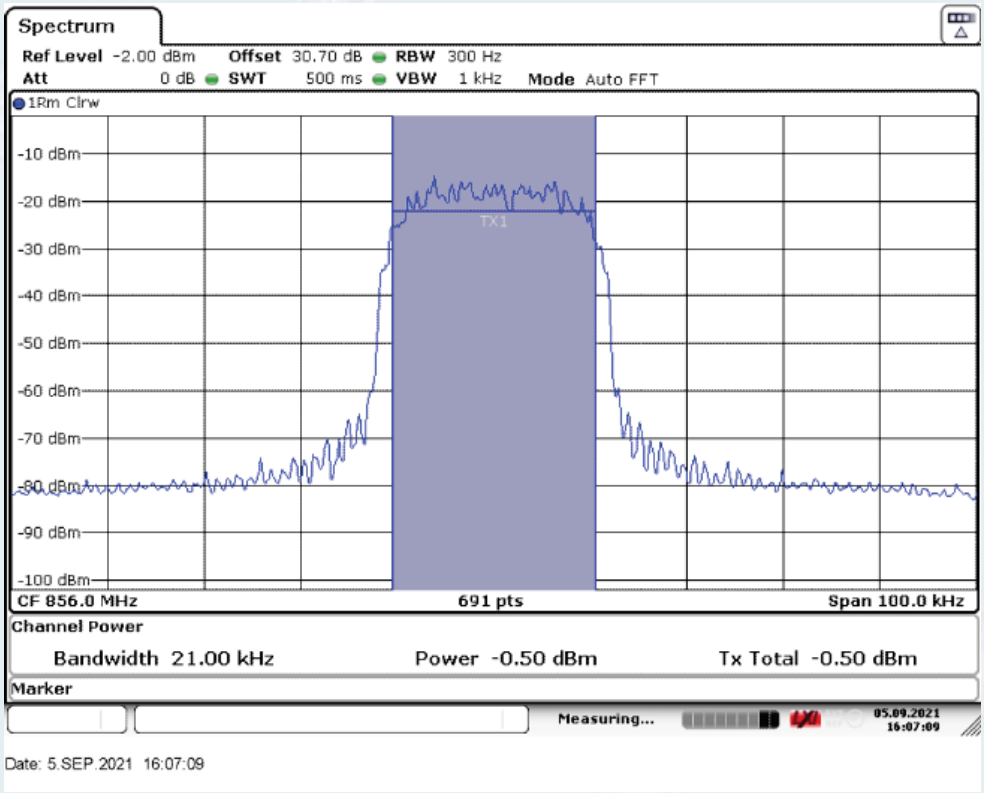
High Frequency: 815.99375MHz

10.2.3.2.3 Tetra mode

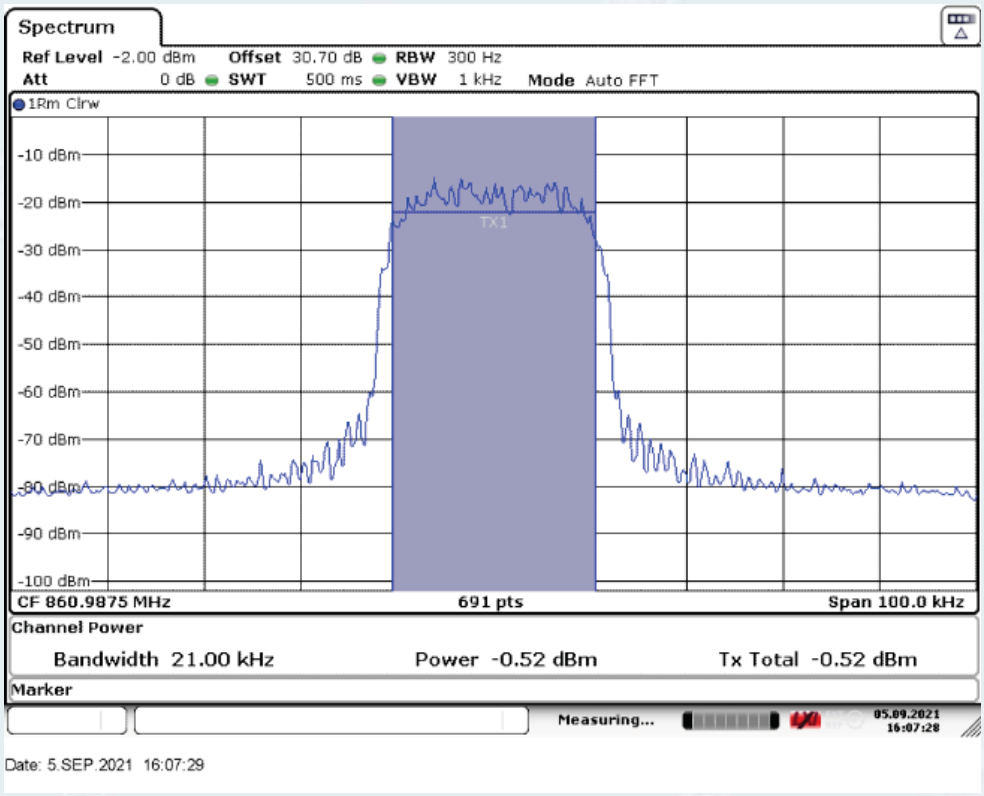
10.2.3.2.3.1 Downlink



Low Frequency: 851.0125MHz

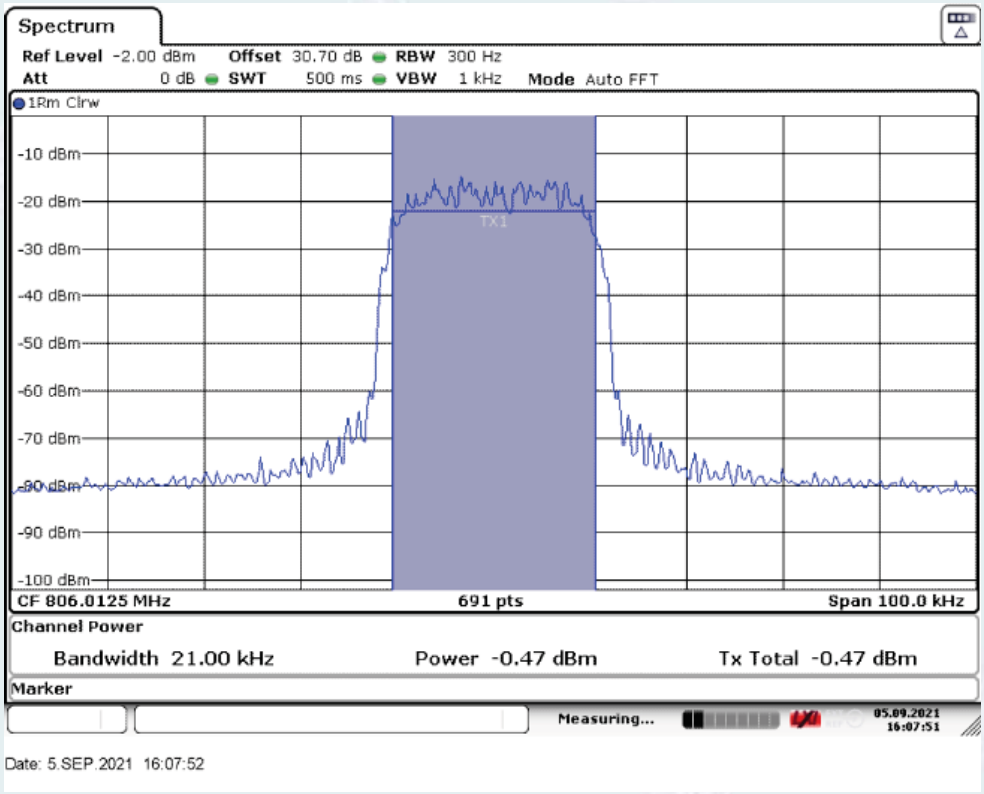


Middle Frequency: 856.0MHz

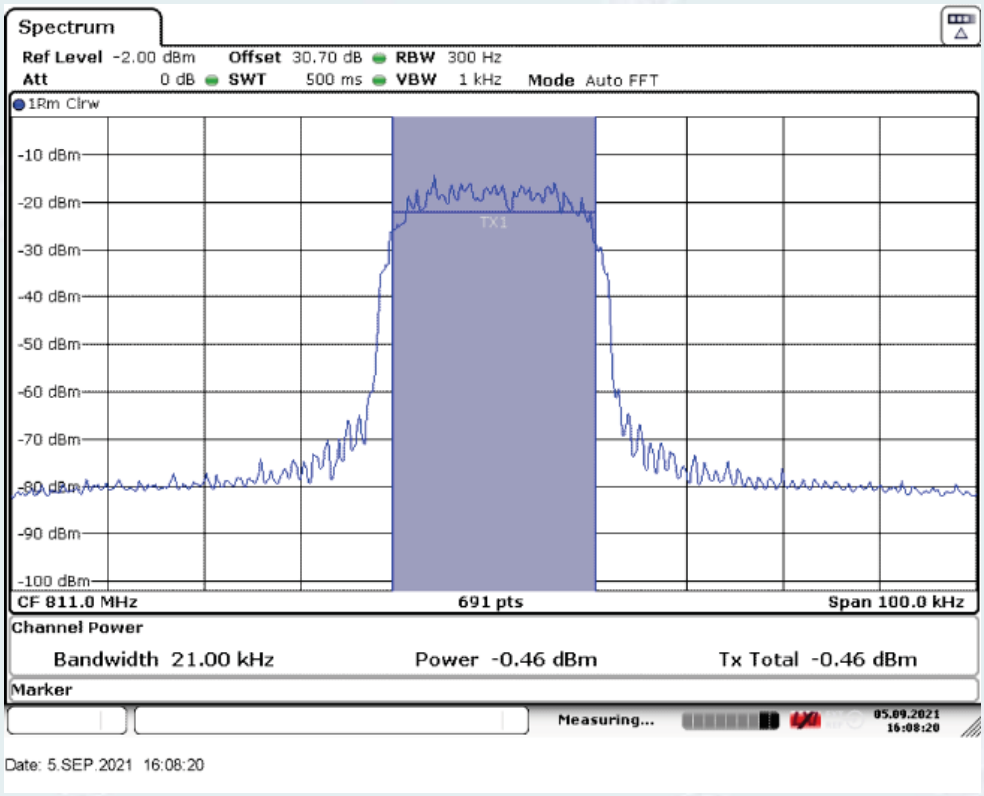


High Frequency: 860.9875MHz

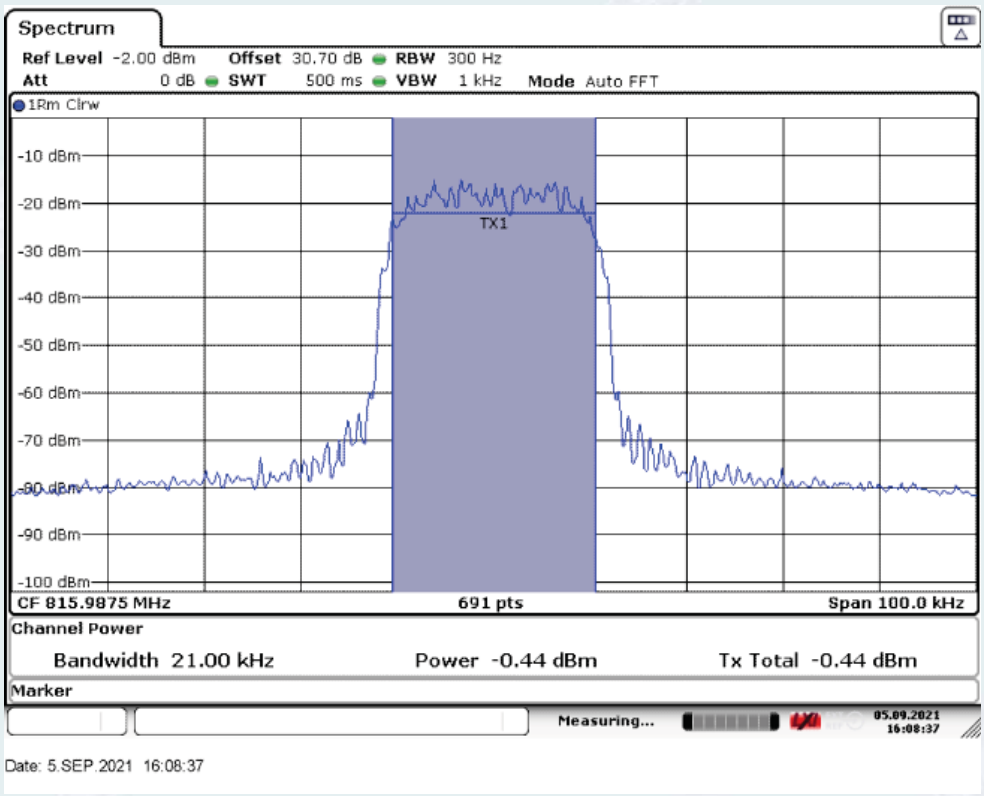
10.2.3.2.3.2 Uplink



Low Frequency: 806.0125MHz



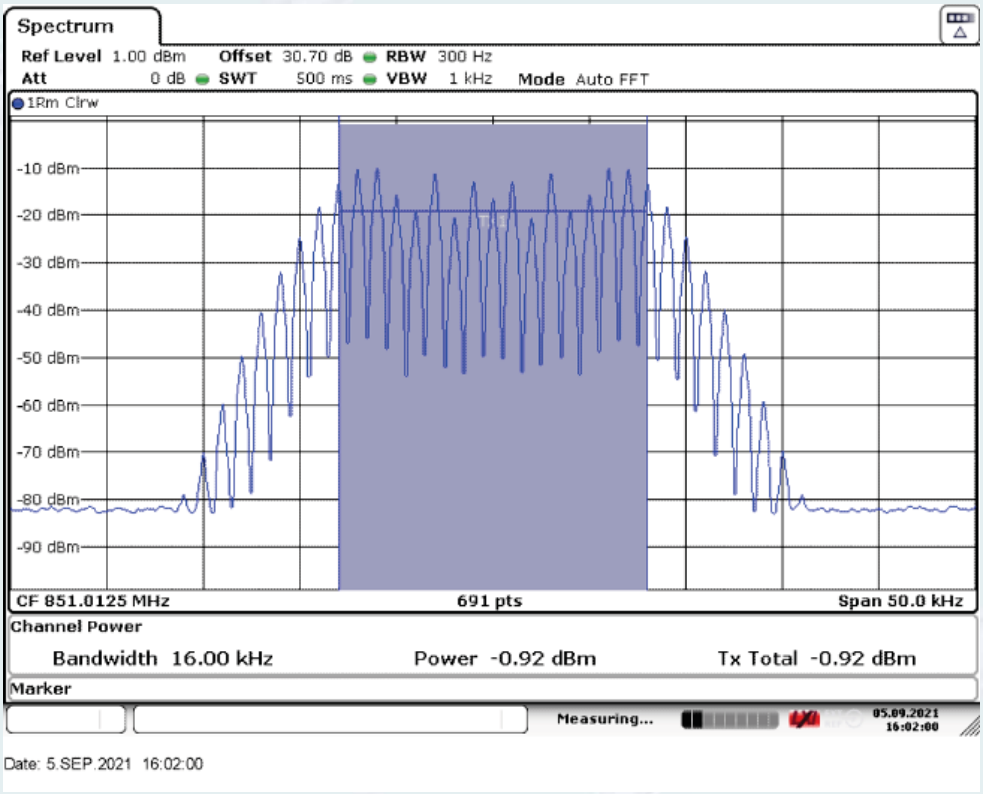
Middle Frequency: 811.0MHz



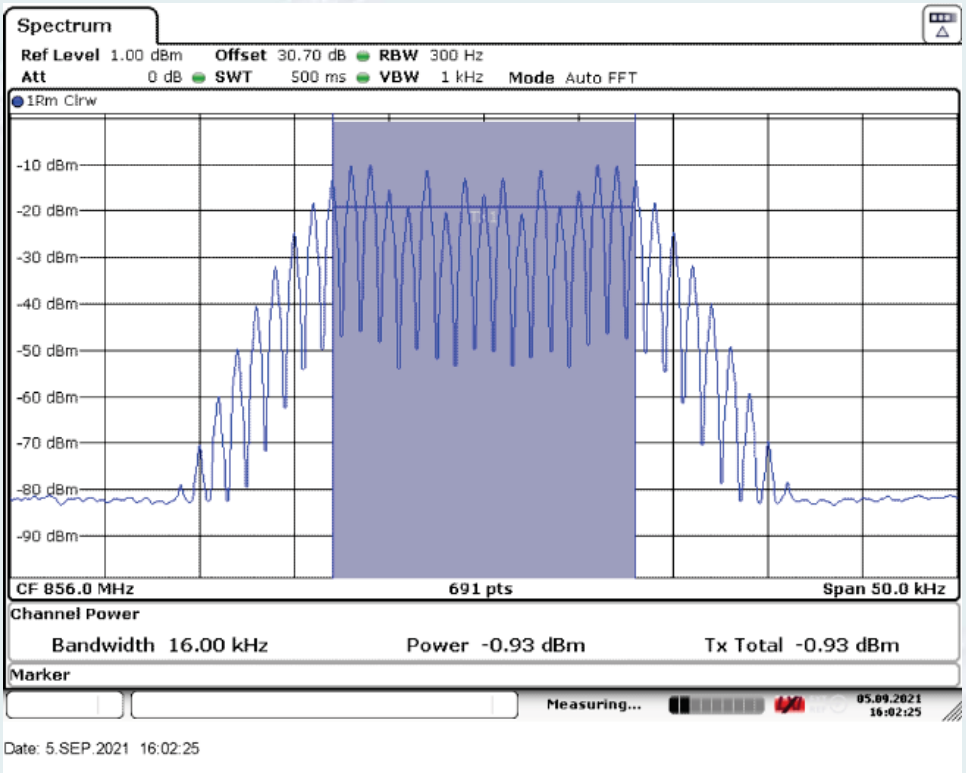
High Frequency: 815.9875MHz

10.2.3.2.4 Analog FM mode

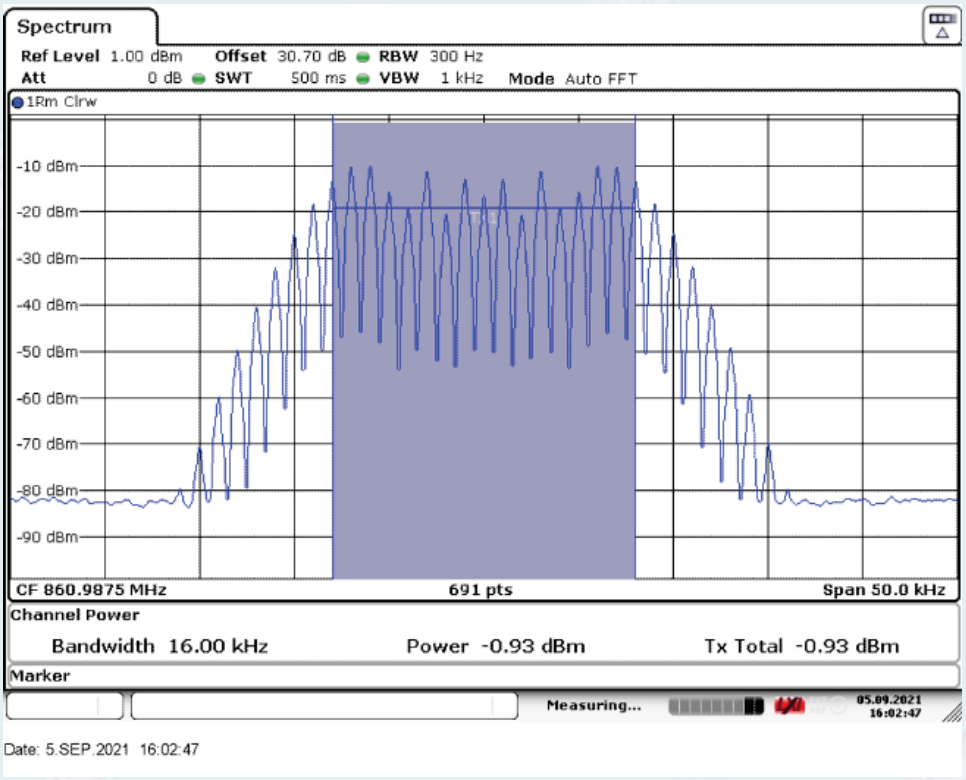
10.2.3.2.4.1 Downlink



Low Frequency: 851.0125MHz

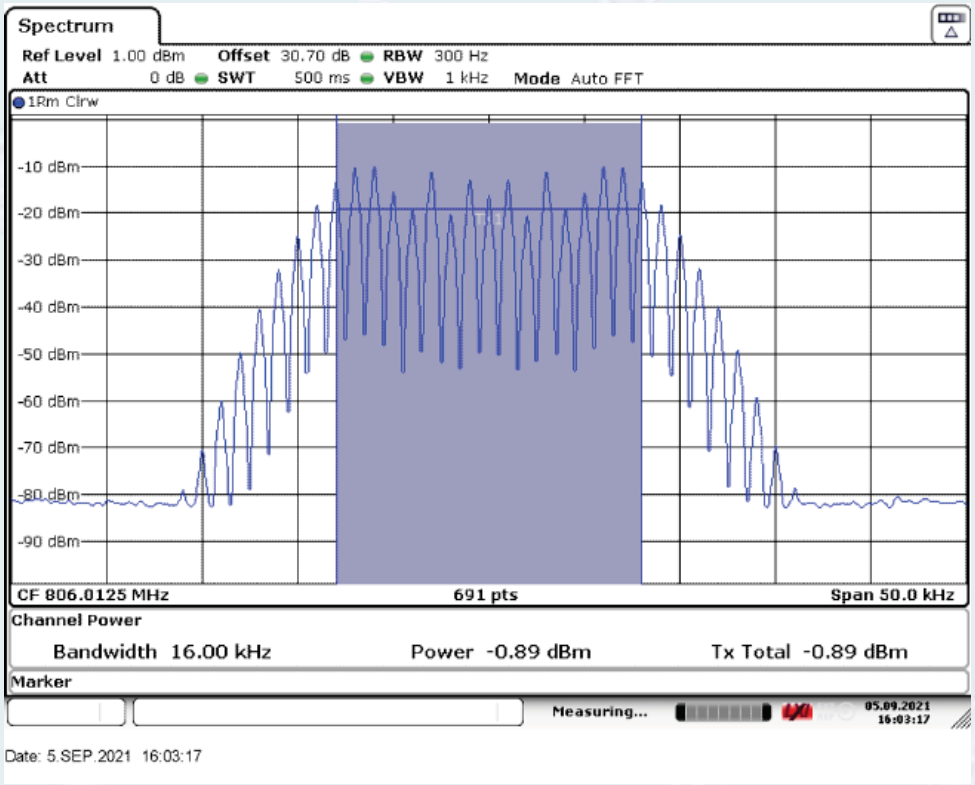


Middle Frequency: 856.0MHz

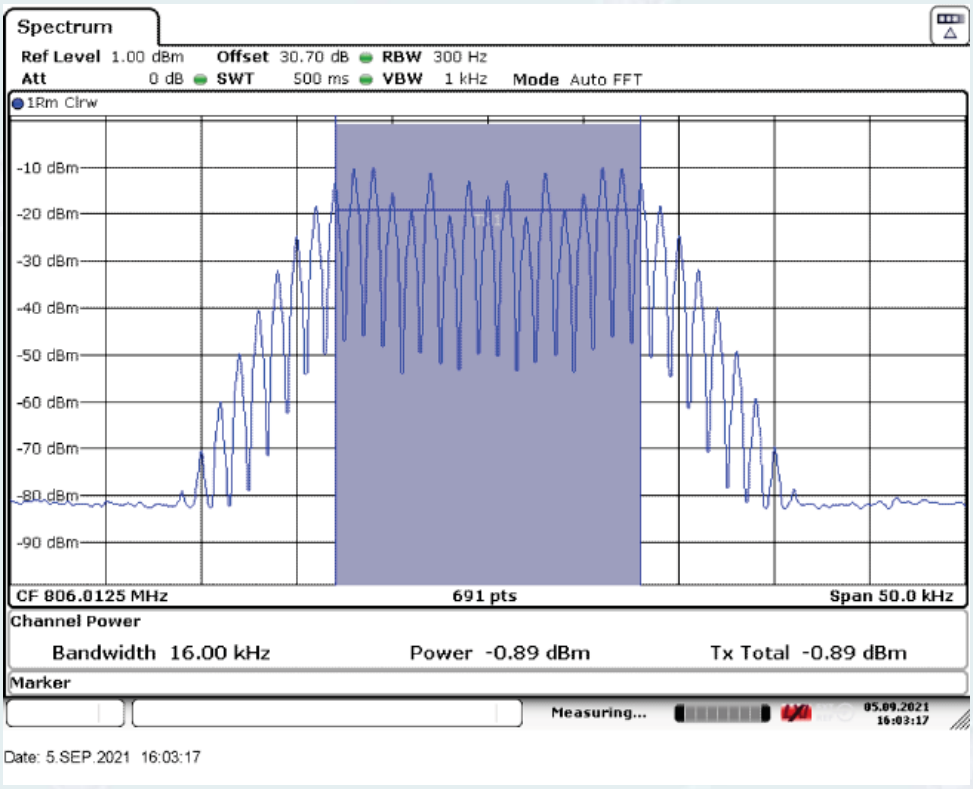


High Frequency: 860.9875MHz

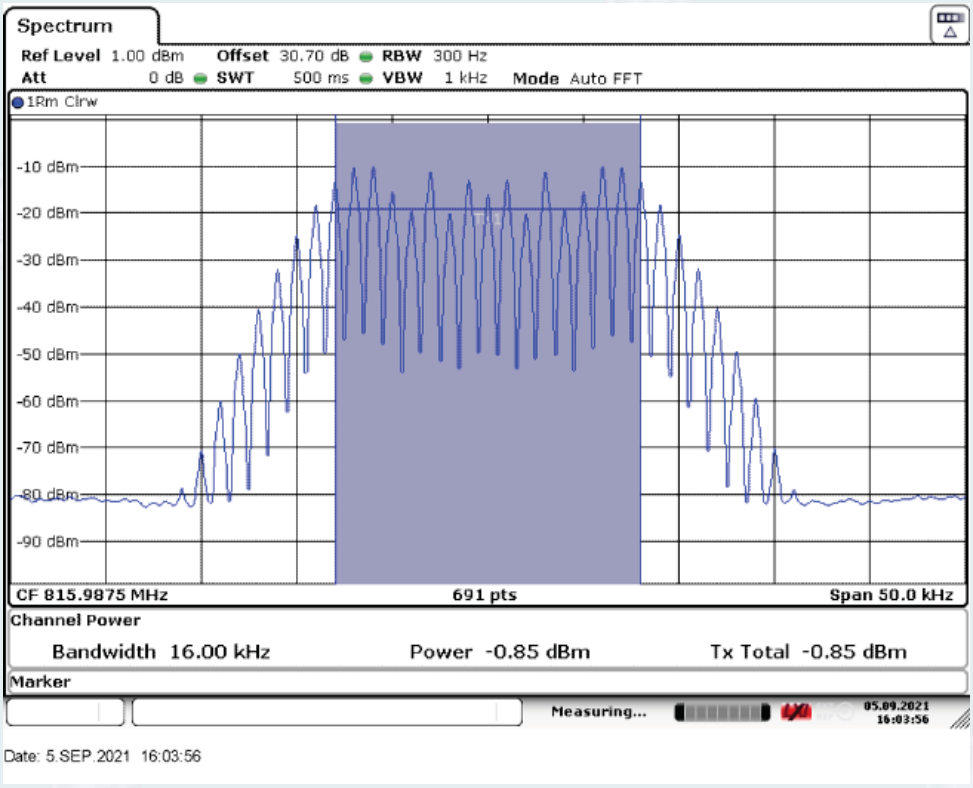
10.2.3.2.4.2 Uplink



Low Frequency: 806.0125MHz



Middle Frequency: 811.0MHz



High Frequency: 815.9875MHz

10.3 AGC Threshold

Requirements: KDB 935210 D05 clause 4.2

Test Method: KDB 935210 D05 clause 3.2

10.3.1 Requirements

Testing at and above the AGC threshold will be required.[6] The AGC threshold shall be determined by applying the procedure of 3.2, but with the signal generator configured to produce a test signal defined in Table 1, a CW input signal, or a digitally modulated signal, consistent with the discussion about signal types in 4.1.

10.3.2 Test configuration

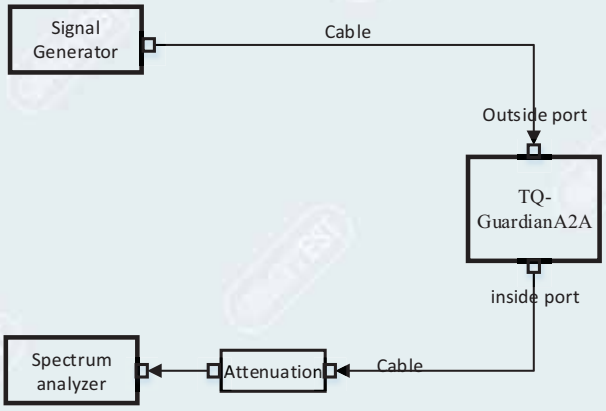


Figure 10.3-1 Downlink connection diagram

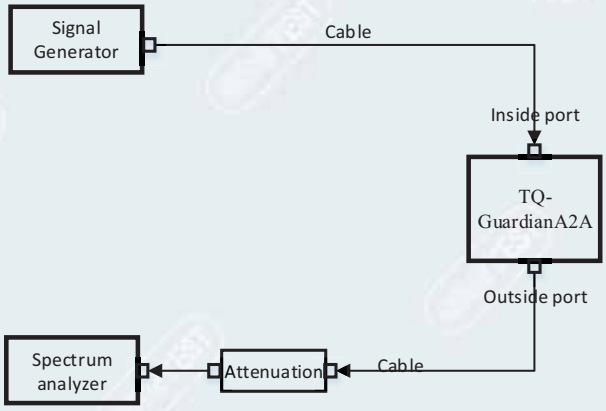


Figure 10.3-2 Uplink connection diagram

10.3.3 Test procedures

3.2 Measuring AGC threshold level

The AGC threshold is to be determined as follows.[3]

In the case of fiber-optic distribution systems, the RF input port of the equipment under test (EUT) refers to the RF input of the supporting equipment RF to optical convertor; see also descriptions and diagrams for typical DAS booster systems in KDB Publication 935210 D02 [R7].

Devices intended to be directly connected to an RF source (donor port) only need to be evaluated for any over-the-air transmit paths.

a) Connect a signal generator to the input of the EUT.
b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
c) The signal generator should initially be configured to produce either of the required test signals (i.e., broadband or narrowband).
d) Set the signal generator frequency to the center frequency of the EUT operating band.
e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
f) Record this level as the AGC threshold level.
g) Repeat the procedure with the remaining test signal.

10.3.4 Test results

Test Date (yy-mm-dd): 2021-09-04

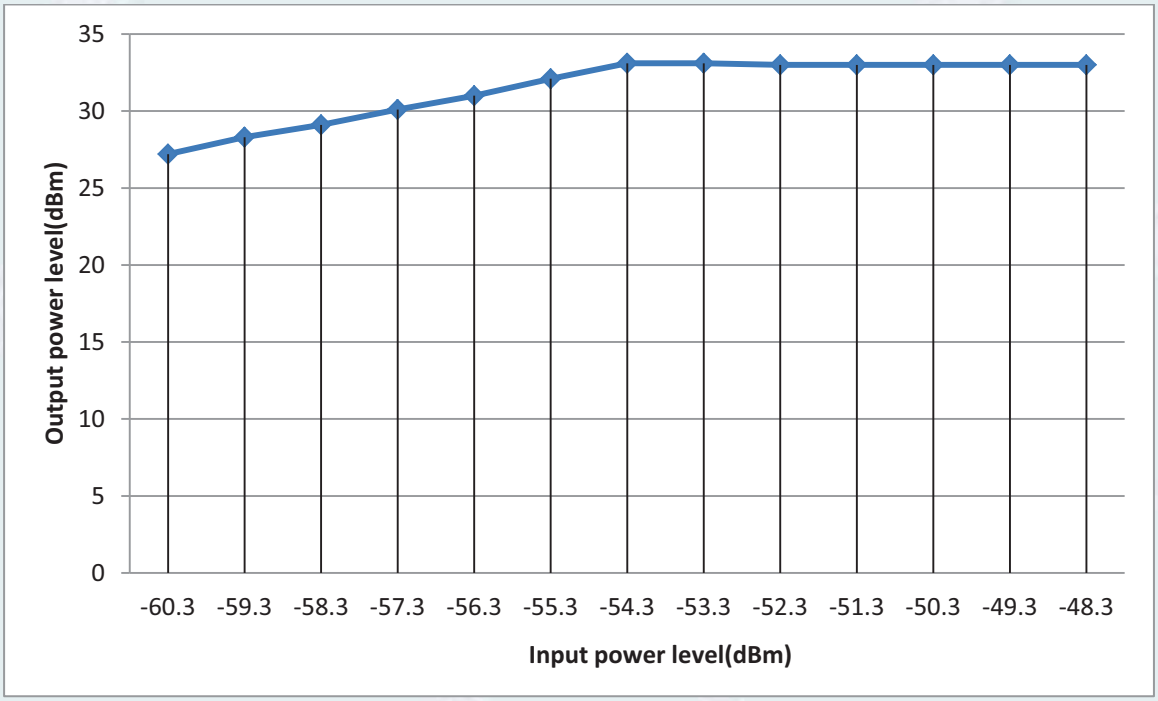
Normal condition: Temp: 25.2℃, Humid:51%, Atmospheric Pressure:101kpa

Supply Voltage: AC 110V, 50Hz

10.3.4.1 700MHz Band

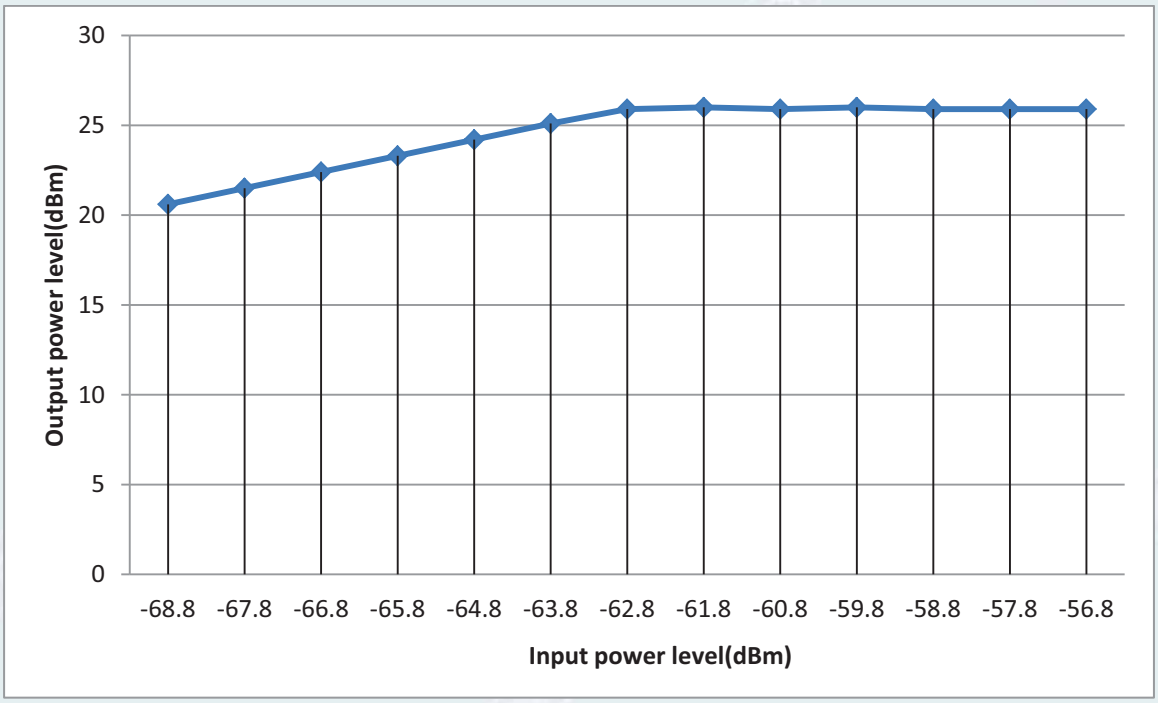
10.3.4.1.1 Frequency range: Downlink: 769MHz~775MHz

Test frequency	Signal output power (dBm)	EUT Input cable loss (dB)	EUT Corrected Input power (dBm)	EUT Corrected Output power (dBm)
Downlink 772MHz	-60.3	1.0	-61.3	27.2
	-59.3	1.0	-60.3	28.3
	-58.3	1.0	-59.3	29.1
	-57.3	1.0	-58.3	30.1
	-56.3	1.0	-57.3	31.0
	-55.3	1.0	-56.3	32.1
	-54.3	1.0	-55.3	33.1
	-53.3	1.0	-54.3	33.1
	-52.3	1.0	-53.3	33.0
	-51.3	1.0	-52.3	33.0
	-50.3	1.0	-51.3	33.0
	-49.3	1.0	-50.3	33.0
	-48.3	1.0	-49.3	33.0



10.3.4.1.2 Frequency range: Uplink: 799MHz~805MHz

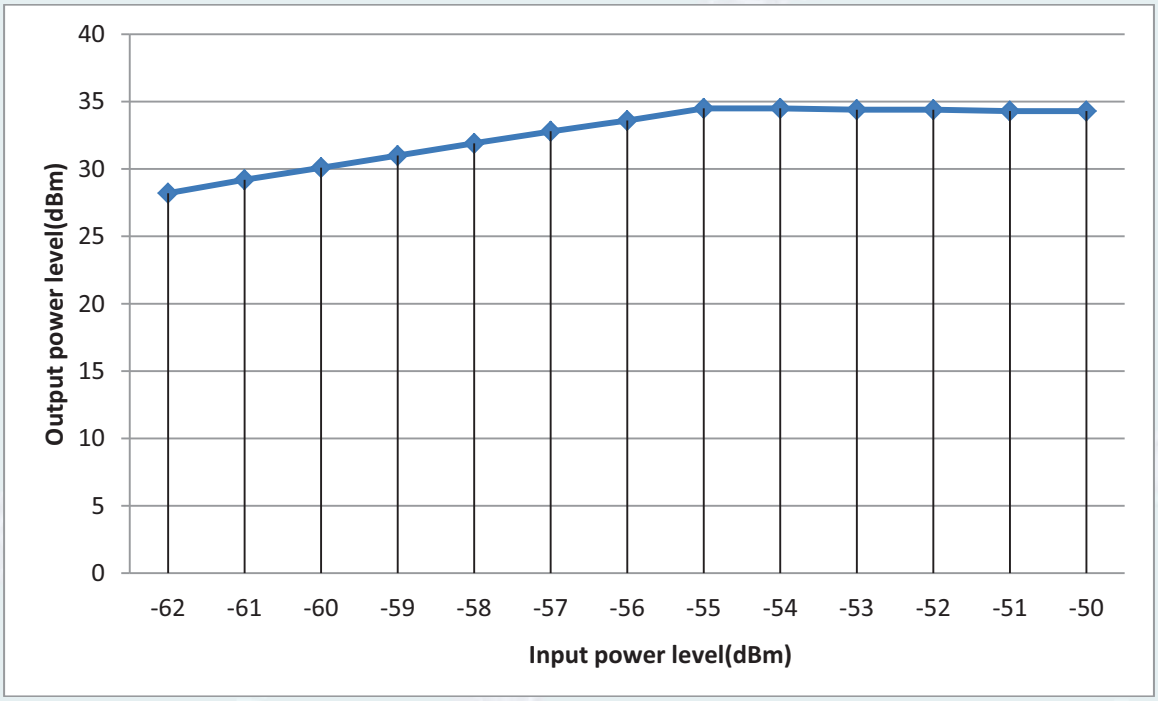
Test frequency	Signal output power (dBm)	EUT Input cable loss (dB)	EUT Corrected Input power (dBm)	EUT Corrected Output power (dBm)
Uplink 802MHz	-67.8	1.0	-68.8	20.6
	-66.8	1.0	-67.8	21.5
	-65.8	1.0	-66.8	22.4
	-64.8	1.0	-65.8	23.3
	-63.8	1.0	-64.8	24.2
	-62.8	1.0	-63.8	25.1
	-61.8	1.0	-62.8	25.9
	-60.8	1.0	-61.8	26.0
	-59.8	1.0	-60.8	26.0
	-58.8	1.0	-59.8	26.0
	-57.8	1.0	-58.8	26.0
	-56.8	1.0	-57.8	26.0
	-55.8	1.0	-56.8	26.0



10.3.4.2 800MHz Band

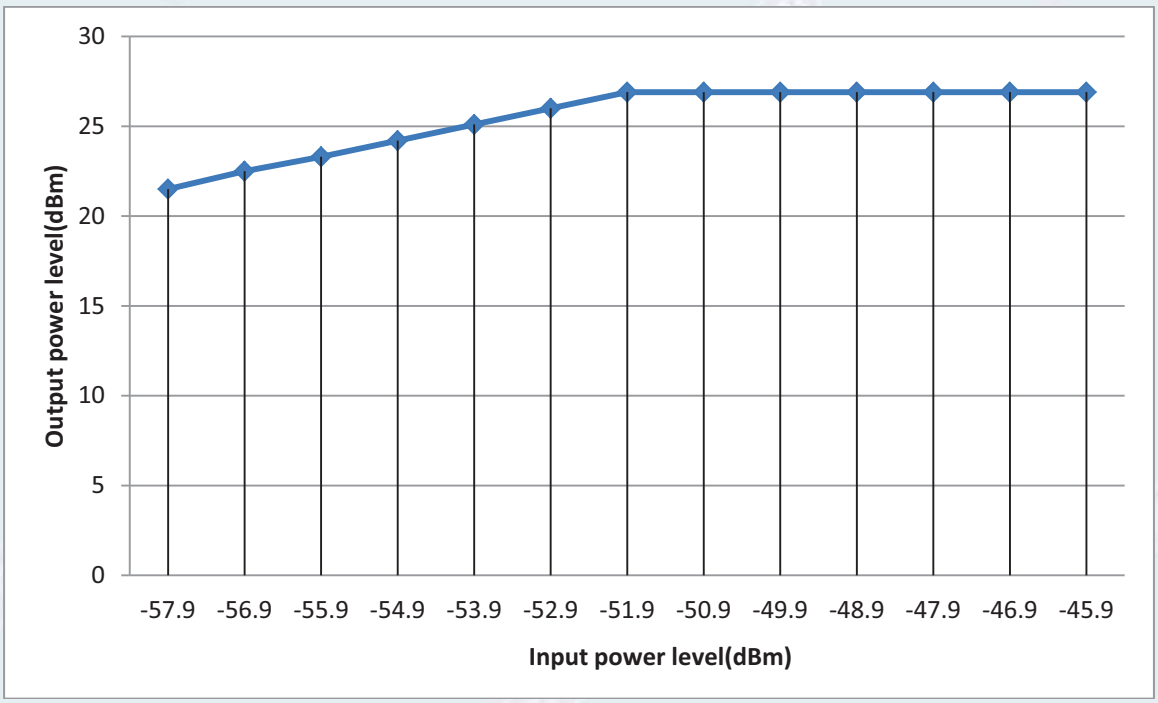
10.3.4.2.1 Frequency range: Downlink: 851MHz~861MHz

Test frequency	Signal output power (dBm)	EUT Input cable loss (dB)	EUT Corrected Input power (dBm)	EUT Corrected Output power (dBm)
Downlink 856MHz	-61.0	1.0	-62.0	28.2
	-60.0	1.0	-61.0	29.2
	-59.0	1.0	-60.0	30.1
	-58.0	1.0	-59.0	31.0
	-57.0	1.0	-58.0	31.9
	-56.0	1.0	-57.0	32.8
	-55.0	1.0	-56.0	33.6
	-54.0	1.0	-55.0	34.5
	-53.0	1.0	-54.0	34.5
	-52.0	1.0	-53.0	34.4
	-51.0	1.0	-52.0	34.4
	-50.0	1.0	-51.0	34.3
	-49.0	1.0	-50.0	34.3



10.3.4.2.2 Frequency range: Uplink: 806MHz~816MHz

Test frequency	Signal output power (dBm)	EUT Input cable loss (dB)	EUT Corrected Input power (dBm)	EUT Corrected Output power (dBm)
Uplink 811MHz	-56.9	1.0	-57.9	21.5
	-55.9	1.0	-56.9	22.5
	-54.9	1.0	-55.9	23.3
	-53.9	1.0	-54.9	24.2
	-52.9	1.0	-53.9	25.1
	-51.9	1.0	-52.9	26.0
	-50.9	1.0	-51.9	26.9
	-49.9	1.0	-50.9	26.9
	-48.9	1.0	-49.9	26.9
	-47.9	1.0	-48.9	26.9
	-46.9	1.0	-47.9	26.9
	-45.9	1.0	-46.9	26.9
	-44.9	1.0	-45.9	26.9



10.4 Out-of-band rejection

Test requirement:	KDB 935210 D05 clause 4.3 FCC PART 90.219 (a) FCC PART 90.219 (d)((7)
Test Method:	KDB 935210 D05 clause 4.3

10.4.1 Requirements

According to KDB 935210 D05 clause 4.3 requirement, A signal booster shall reject amplification of other signals outside of its passband. Adjust the internal gain control of the EUT to the maximum gain for which equipment certification is sought.

10.4.2 Test configuration

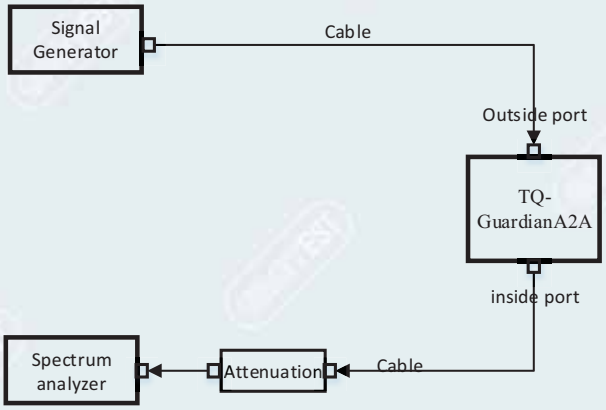


Figure 10.4-1 Downlink connection diagram

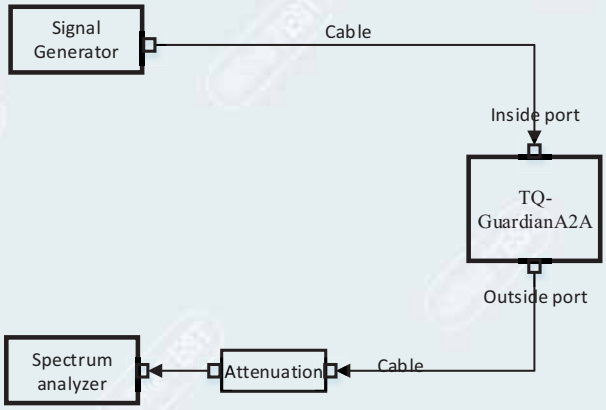


Figure 10.4-2 Uplink connection diagram

10.4.3 Test procedures

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

10.4.4 Test results

Test Date (yy-mm-dd): 2021-09-04

Normal condition: Temp: 25.2℃, Humid:51%, Atmospheric Pressure:101kpa

Supply Voltage: AC 110V, 50Hz

10.4.4.1 700MHz Band

RBW (kHz)	VBW (kHz)	20dB down		20dB BW (MHz)
		Below frequency (MHz)	Up frequency (MHz)	
(1) Downlink: 769MHz~775MHz				
100	300	769.178	774.909	6.056
(2) Uplink: 799MHz~816MHz				
100	300	798.817	805.156	6.339

NOTE: 700MHz uplink and 800MHz uplink use the same power amplifier module, and it is broadband power amplifier.

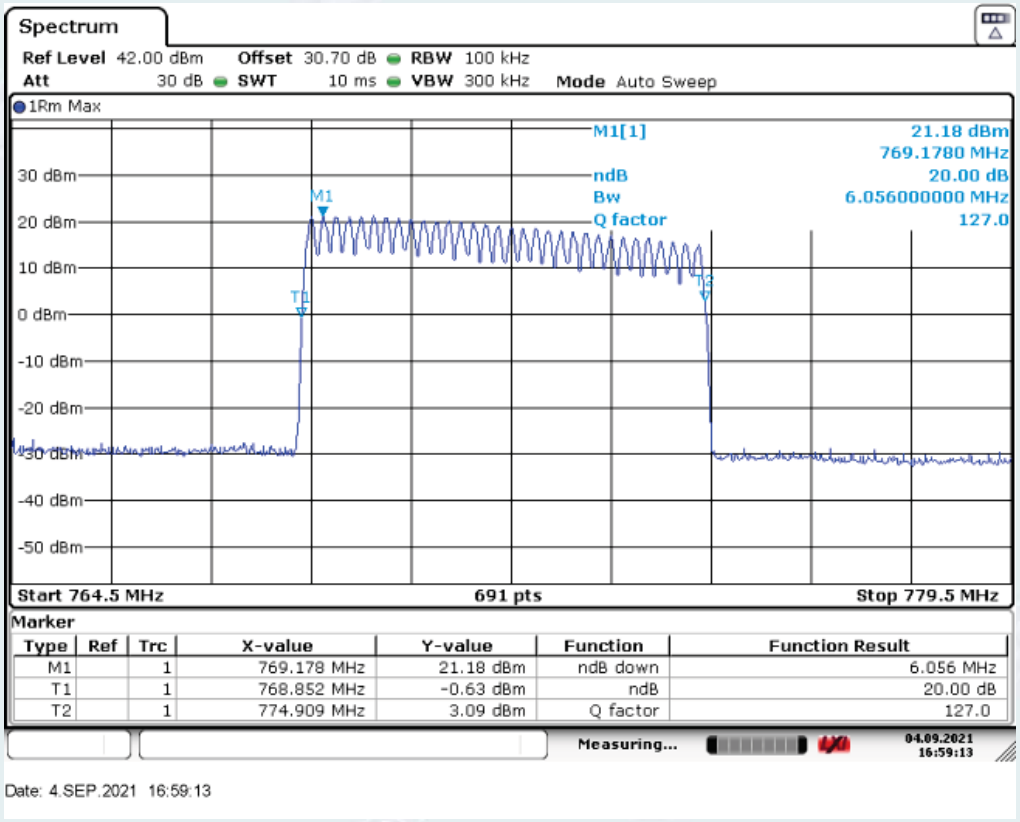
10.4.4.2 800MHz Band

RBW (kHz)	VBW (kHz)	20dB down		20dB BW (MHz)
		Below frequency (MHz)	Up frequency (MHz)	
(3) Downlink: 851MHz~861MHz				
100	300	850.826	861.137	10.311
(4) Uplink: 806MHz~816MHz				
100	300	806.043	816.096	10.289

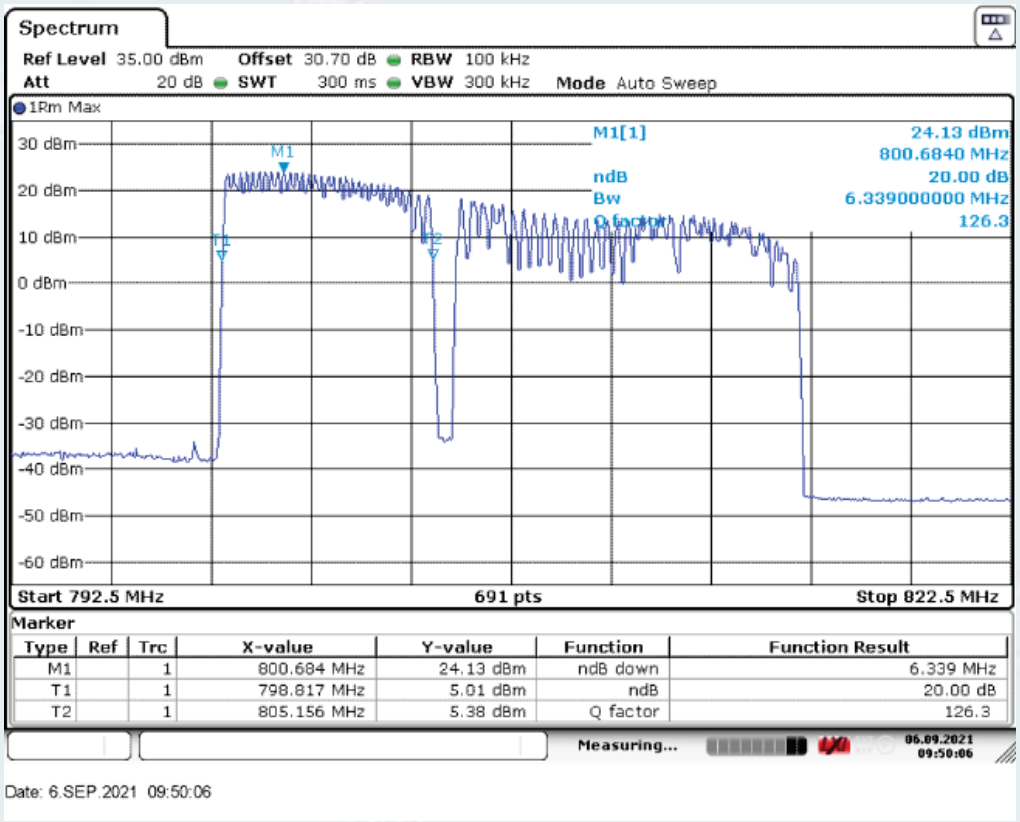
NOTE: 700MHz uplink and 800MHz uplink use the same power amplifier module, and it is broadband power amplifier.

10.4.5 Test screenshot

10.4.5.1 700MHz Band

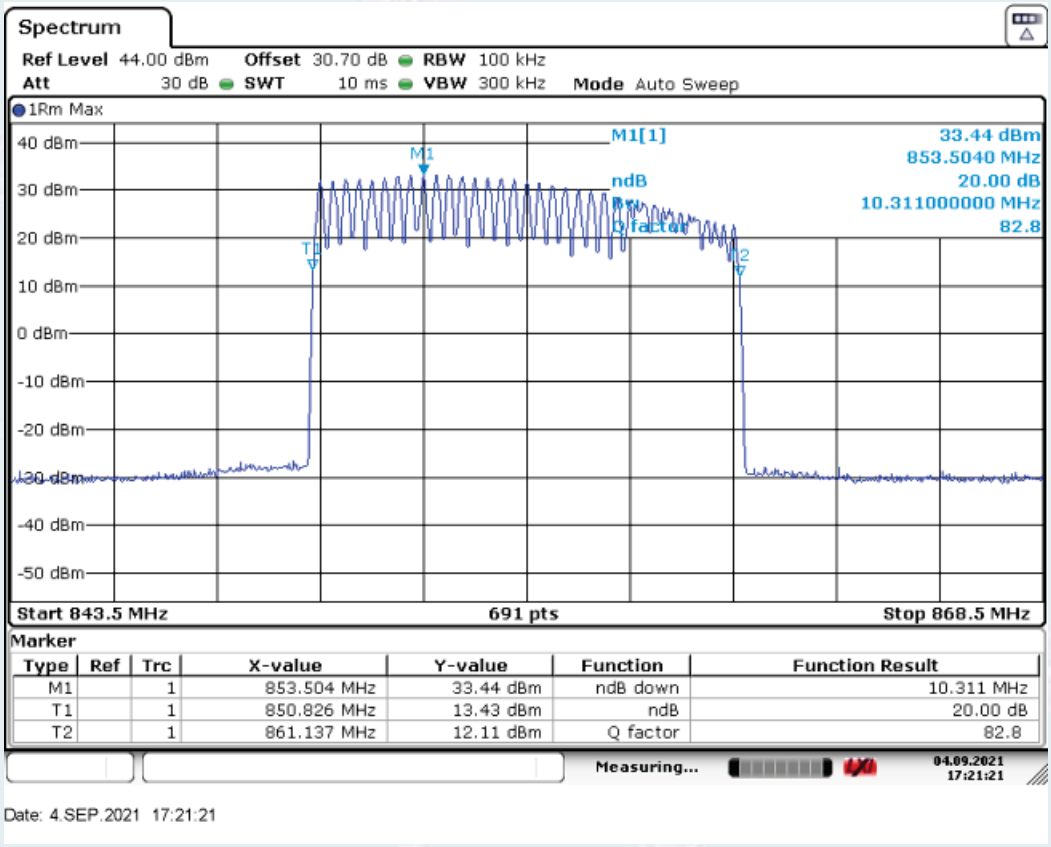


Downlink: 769MHz~775MHz

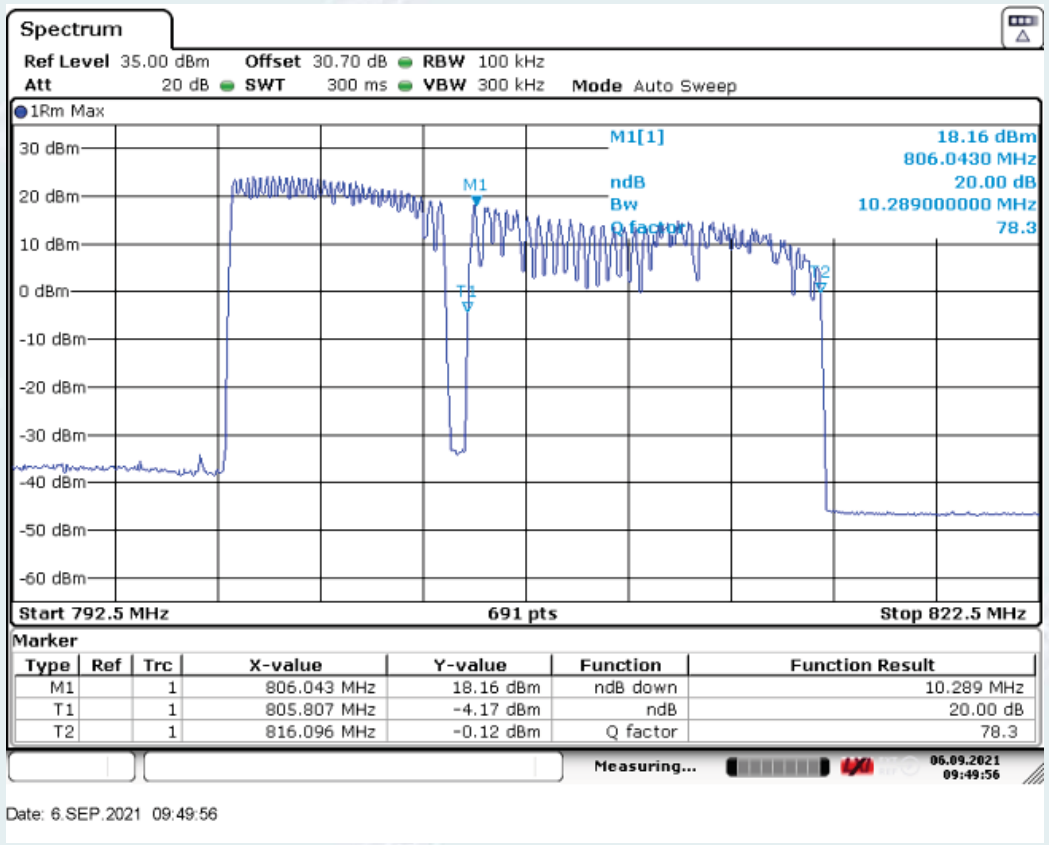


Uplink: 799MHz~805MHz

10.4.5.2 800MHz Band



Downlink: 851MHz~861MHz



Uplink: 806MHz~816MHz

10.5 Input VS output Comparison

Test requirement:	KDB 935210 D05 clause 4.4 FCC PART 2.1049(c) FCC PART 90.219 (e)(4)(ii) FCC PART 90.219 (e)(4)(iii)
Test Method:	KDB 935210 D05 clause 4.4

10.5.1 Requirements

10.5.1.1 KDB 935210 D05 clause 4.4

4.4 Input-versus-output signal comparison

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

According to the characteristics of the product and FCC PART 90.210 requirement, Clause (b) and Clause (d) are used, Except as indicated else where in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for device operating under this part.

§90.210 Emission masks.

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

APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25[1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174[2]	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512[2 5]	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854[6]	B	H
809-824/854-869[35]	B, D	D, G.
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925[4]		
All other bands	B	C

10.5.1.2 FCC PART 90.210 (b) and (d)

(b) *Emission Mask B.* For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

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

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

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

(d) *Emission Mask D—12.5 kHz channel bandwidth equipment.* For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88$ kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

10.5.1.3 FCC PART 2.1049(c)

§2.1049 Measurements required: Occupied bandwidth.

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

(a) Radiotelegraph transmitters for manual operation when keyed at 16 dots per second.

(b) Other keyed transmitters—when keyed at the maximum machine speed.

(c) Radiotelephone transmitters equipped with a device to limit modulation or peak envelope power shall be modulated as follows. For single sideband and independent sideband transmitters, the input level of the modulating signal shall be 10 dB greater than that necessary to produce rated peak envelope power.

(1) Other than single sideband or independent sideband transmitters—when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

(2) Single sideband transmitters in A3A or A3J emission modes—when modulated by two tones at frequencies of 400 Hz and 1800 Hz (for 3.0 kHz authorized bandwidth), or 500 Hz and 2100 Hz (for 3.5 kHz authorized bandwidth), or 500 Hz and 2400 Hz (for 4.0 kHz authorized bandwidth), applied simultaneously. The input levels of the tones shall be so adjusted that the two principal frequency components of the radio frequency signal produced are equal in magnitude.

10.5.1.4 FCC PART 90.219 (e)(4)(ii)

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

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

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020/6/15 Electronic Code of Federal Regulations (eCFR)

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

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

According to FCC PART 2.1049(c), FCC PART 90.219 (e)(4)(ii) and (iii) requirement, 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.