



BNetzA-CAB-21/21-21

Test Report

Test report no.: 21065798-20830-0

Date of issue: 2021-08-31

Test result: The test item - **passed** - and complies with the listed standards.

Applicant

Mitsubishi Electric Corporation Sanda Works

Manufacturer

Mitsubishi Electric Corporation

Test Item

R1LOW-R

RF-Spectrum Testing according to:

FCC 47 CFR Part 15

Radio Frequency Devices (Subpart C)

RSS-247

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen

General Requirements for Compliance of Radio Apparatus

Tested by
(name, function, signature)

Karsten Gerald
Head of Laboratory RF

signature

Approved by
(name, function, signature)

Dr.-Ing. Harald Ansorge
Managing Director

signature

Applicant and Test item details	
Applicant	Mitsubishi Electric Corporation Sanda Works 2-3-33, Miwa, Sanda-City, Hyogo 669-1513 Japan DESIGN-A SECTION, CAR MULTIMEDIA DESIGN DEPT. Fon: +81 79 559 4813 E-Mail: Yoshinaga.Ryuji@db.MitsubishiElectric.co.jp
Manufacturer	Mitsubishi Electric Corporation 2-3-33, Miwa, Sanda-City, Hyogo 669-1513 Japan DESIGN-A SECTION, CAR MULTIMEDIA DESIGN DEPT. Fon: +81 79 559 4813 E-Mail: Yoshinaga.Ryuji@db.MitsubishiElectric.co.jp
Test item description	Automotive Display Audio
Model/Type reference	R1LOW-R
Standard specific information	
FCC ID	UJH-R1LOW-R
IC	662K-R1LOWR
PMN	R1LOW-R
HVIN	NR-0C-R-DV
FVIN	N/A
HMN	N/A
Frequency	2400 to 2483.5 MHz DTS band
Technology	Type of radio transmission: DSSS, OFDM Type of modulation: (D)BPSK, (D)QPSK, CCK, 16QAM, 64QAM
Number of channels	13 (20/22 MHz)
Antenna	Sheet metal antenna
Power supply	9 V – 16.5V, DC Battery
Temperature range	-40 °C to +75 °C

Disclaimer and Notes

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Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
If otherwise, a detailed note is added adjoined to its use.

IBL-Lab GmbH does not take test samples. The sample used for testing is provided by the applicant.

Decision rule: Binary Statement for Simple Acceptance Rule according ILAC-G8:09/2019

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2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	IBL-Lab GmbH Heinrich-Hertz-Allee 7 66386 Sankt Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: www.ib-lenhardt.de E-Mail: info@ib-lenhardt.de
Accreditation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkKS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: - Electronics D-PL-21375-01-01 - Electromagnetic Compatibility D-PL-21375-01-02 - Electromagnetic Compatibility and Telecommunication (FCC requirements) D-PL-21375-01-03 - Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards D-PL-21375-01-04 - ISED Company Number 27156 - Testing Laboratory CAB Identifier DE0020 - Telekommunikation (TK) D-PL-21375-01-05 Website DAkKS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkKS) is also a signatory to ILAC Mutual Recognition Arrangement
Testing location	IBL-Lab GmbH Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2021-07-07
Start – End of tests	2021-07-08 – 2021-08-25

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS)
Test sample does not meet the requirements	F (FAIL)
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

2.3 Observations

No additional observations other than the reported observations within this test report have been made.

2.4 Opinions and Interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017 clause 7.8.7 are within this test report.

2.5 Revision History

-0 Initial Version

2.6 Further documents

List of further applicable documents belonging to the present test report:
- no additional documents -

3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions

Temperature	20°C ± 5°C
Relative humidity	25-75 % r.H.
Barometric Pressure	860-1060 mbar
Power supply	230 V / 50 Hz

3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	-/-	+25 °C	-/-
Relative humidity	-/-	50 % r.h.	-/-
Power supply	-/-	12.6 V DC	-/-

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices (Subpart C)
RSS-247	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	General Requirements for Compliance of Radio Apparatus

Test standard (not accredited)	Description
none	---

Reference	Description
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 15.247 Meas Guide v05r02	Guidance for compliance measurements on digital transmission systems, frequency hopping spread spectrum systems and hybrid system devices operating under section 15.247 of the FCC rules

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product Description

Automotive Display Audio

*: as declared by applicant

5.2 Test Item Description

Model name*	R1LOW-R
Serial number*	radiated EUT: 60338 conducted EUT: 60337
PCB identifier*	NJ00193611
Hardware status*	NR-0C-R-DV
Software status*	Android 10

*: as declared by applicant; please see Annex A, B for EUT photographs.

5.3 Technical Data of Equipment

Operational frequency band*	2400 to 2483.5 MHz DTS band
Transmitter*	Chip QCA6574AU with 48 MHz TCXO (Module UGKZ5A3006A)
Technology*	802.11 b/g/n, DSSS, OFDM
Modulation type*	802.11 b: DBPSK, DQPSK, CCK 802.11 g: BPSK, QPSK, 16QAM, 64QAM 802.11 n: BPSK, QPSK, 16QAM, 64QAM
Data rate*	802.11 b: 1 Mbps – 11 Mbps 802.11 g: 6 Mbps – 54 Mbps 802.11 n: 6.5 Mbps – 144.4 Mbps
Number of channels*	13
Channel bandwidth*	22 MHz (b-mode) / 20 MHz (g-, n-mode)
Channel spacing*	5 MHz
Guard Interval*	802.11n: GI=800 ns, GI=400 ns
Antenna*	Sheet metal antenna,
Part name Antenna 0	2342059-2
Part name Antenna 1	2342059-1
Antenna gain*	Antenna 0: -3.55 dBi, Antenna 1: -3.42 dBi
Number of Spatial Streams*	NSS=1, NSS=2
Rated RF Output Power*	802.11 b: 14 dBm 802.11 g: 11 dBm 802.11 n: 11 dBm
Power supply, V_{nom}*	9 V – 16.5V, DC Battery, V_{nom} =12.6 V
Temperature range, T_{nom}*	-40 °C to +75 °C, T_{nom} =+25°C

*: as declared by applicant

Channels with **22 MHz (b-mode) / 20 MHz (g-, n-mode)** channel bandwidth:

2400 to 2483.5 DTS band channel number & center frequency													
channel	1	2	3	4	5	6	7	8	9	10	11	12	13
f _c / MHz	2412	2417	2422	2427	2432	2437	2442	2447	2452	2457	2462	2467	2472

5.4 Additional Information

Model differences	None
Ancillaries tested with	None
Additional equipment used for testing	Notebook with test tool

5.5 Test modes

Mode 1, b-mode	22 MHz bandwidth, Modulation type: DBPSK 1 Mbps*
	20 MHz bandwidth, Modulation type: BPSK 6 Mbps*
Mode 3, n-HT20 mode	20 MHz bandwidth, Modulation type: BPSK 6.5 Mbps, NSS=1*
Channel	Channels used for testing are marked in bold in 20 MHz channel list (see section 5.3)
Antennas and transmit operating mode	Equipment with 2 antennas/transmit chains (antenna 0, antenna 1); apart from conducted output power all other test cases can be performed with one antenna only (antenna 0)
Worst case configuration with respect to RF output power	Conducted RF output power has been measured for following modulation types, spatial streams and data rates at low, mid, and high channel frequencies marked in bold in 20 MHz channel list (see section 5.3): – 802.11b, DBPSK, 1 Mbps, antenna 0, antenna 1, antenna 0 + 1 – 802.11b, DBPSK, 1 Mbps, antenna 0 + 1 – 802.11b, DQPSK, 2 Mbps, antenna 0 + 1 – 802.11b, CCK, 5.5 Mbps, antenna 0 + 1 – 802.11b, CCK, 11 Mbps, antenna 0 + 1 – 802.11g, BPSK, 6 Mbps, antenna 0, antenna 1, antenna 0 + 1 – 802.11g, QPSK, 12 Mbps, antenna 0 + 1 – 802.11g, 16 QAM, 24 Mbps, antenna 0 + 1 – 802.11g, 64 QAM, 24 Mbps, antenna 0 + 1 – 802.11n, BPSK, 6.5 Mbps, antenna 0 – 802.11n, QPSK, 13 Mbps, antenna 0 – 802.11n, 16 QAM, 26 Mbps, antenna 0 – 802.11n, 64 QAM, 52 Mbps, antenna 0 * From conducted RF output measurements test mode 1, 2, 3 have been selected based on measured maximum conducted output power

6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 15 RSS-247 / RSS-Gen

Clause	Requirement / Test Case	Result - Remark	Verdict
§15.247(a)(2) RSS-247, 5.2 (a)	DTS bandwidth (6 dB)	KDB 558074, clause: 8.2	- PASS -
RSS Gen, 6.7	Occupied bandwidth (99%)	-/-	- PASS -
§15.247(b)(3) RSS-247, 5.4 (d)	RF output power (conducted peak power)	KDB 558074, clause: 8.3.1	- PASS -
§15.247(b)(4) RSS-247, 5.4 (d)	Antenna gain (calculated)	-/-	- PASS -
§15.247(e) RSS-247, 5.2 (b)	Peak power spectral density (PSD)	KDB 558074, clause: 8.4	- PASS -
§15.247(d) RSS-247, 5.5	Band edge compliance (BEC), conducted	KDB 558074, clause: 8.5	- PASS -
§15.247(d) RSS-247, 5.5	Band edge compliance (BEC), radiated	KDB 558074, clause: 8.7	- PASS -
§15.247(d) RSS-247, 5.5	Conducted spurious emissions (CSE)	KDB 558074 DTS clause: 8.5	- PASS -
15.247(d) / §15.209 RSS-247, 5.5 / RSS-Gen, 8.9	Radiated spurious emissions (RSE)	-/-	- PASS -
§15.207 RSS-Gen, 8.8	AC conducted emissions	EUT is battery powered	- N/A -

Comments and observations

Following pages show requirements and references of FCC Part 15.247, ANSI C63.10 and KDB 558074 only. Same tests are also applicable and valid for RSS-247, with clauses given in table above.

7 TEST RESULTS

7.1 DTS Bandwidth (6 dB)

Applicability

This requirement applies to all types of DTS equipment.

Description

The DTS Bandwidth is defined as the 6 dB bandwidth.

Limit

§15.247

(a)(2) The minimum 6 dB bandwidth shall be at least 500 kHz.

Test procedure

ANSI C63.10, 11.8

The steps are as follows:

- Set RBW = 100 kHz.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

The automatic bandwidth measurement capability of an instrument may be employed using the 6 dB bandwidth mode.

Test setup: 8.4 with conducted sample (see 5.2)

Test Results

EUT Mode	DTS Bandwidth (6 dB)			Limit [MHz]
	low channel [MHz]	mid channel [MHz]	high channel [MHz]	
Mode 1	8.150	8.150	7.750	≥ 0.500
Mode 2	15.850	15.400	15.750	≥ 0.500
Mode 3	15.250	15.450	15.250	≥ 0.500

Comment:

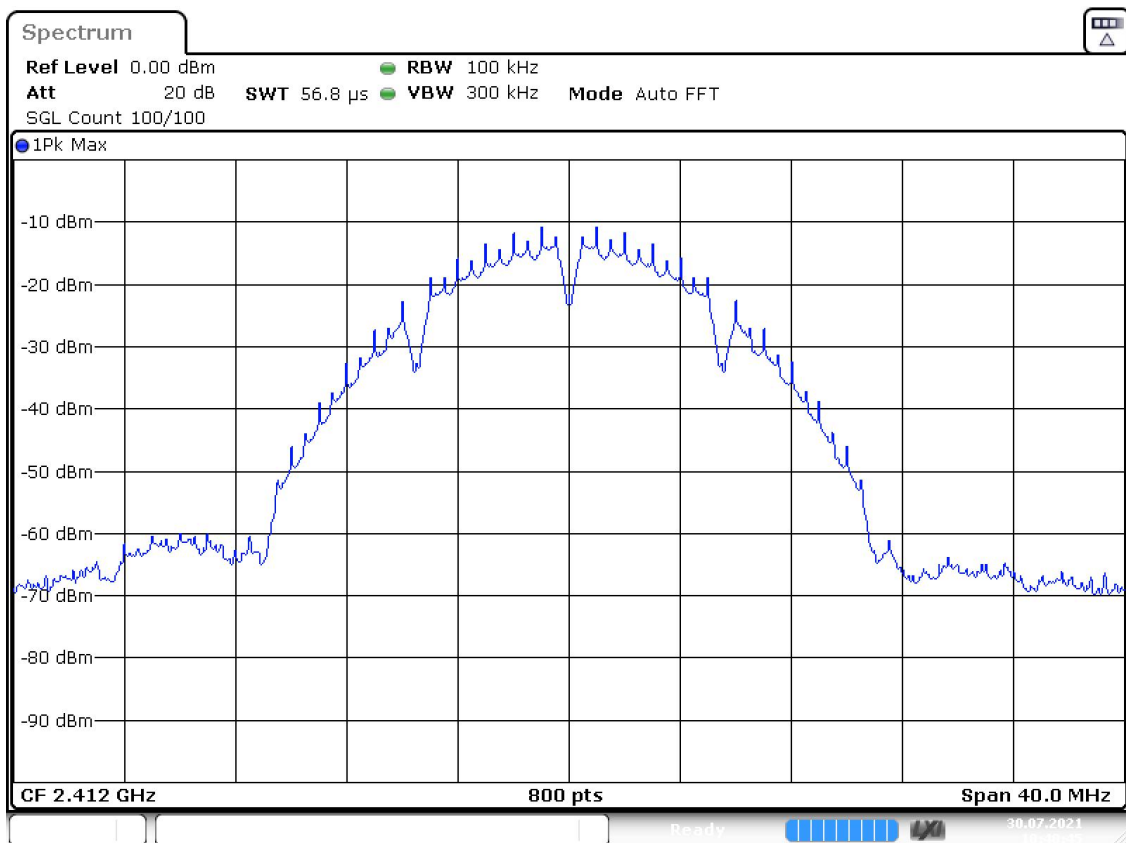
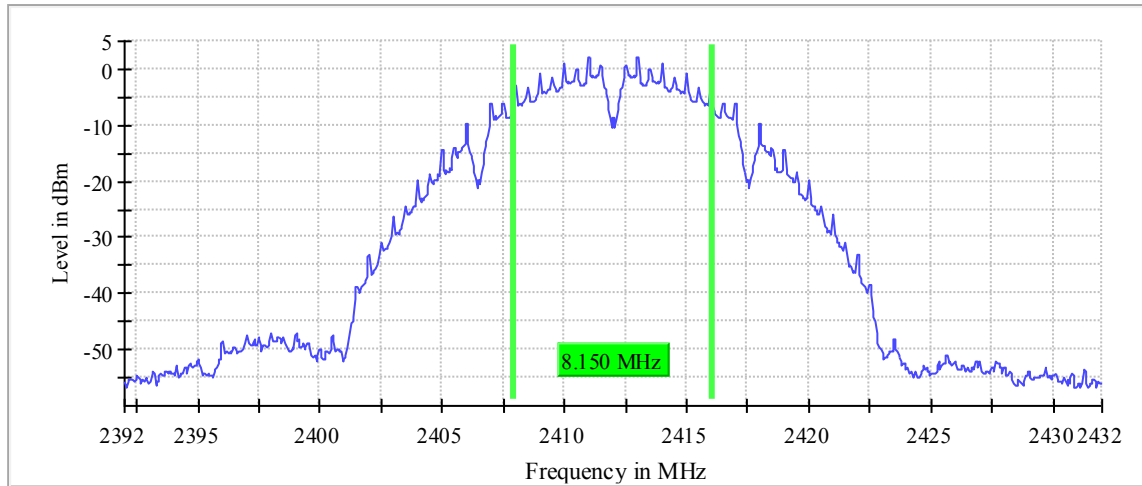
Verdict

- PASS -

see next plots

Plot 1: Mode 1, DTS Bandwidth, low channel

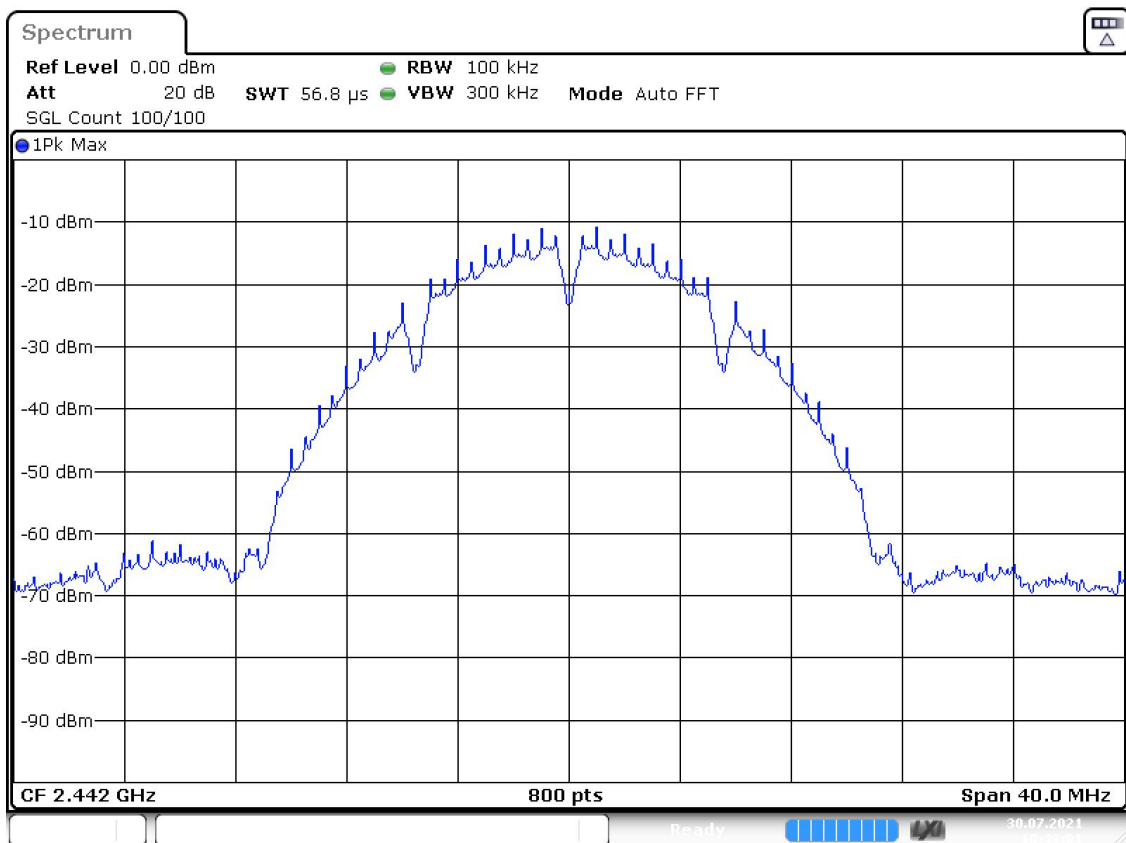
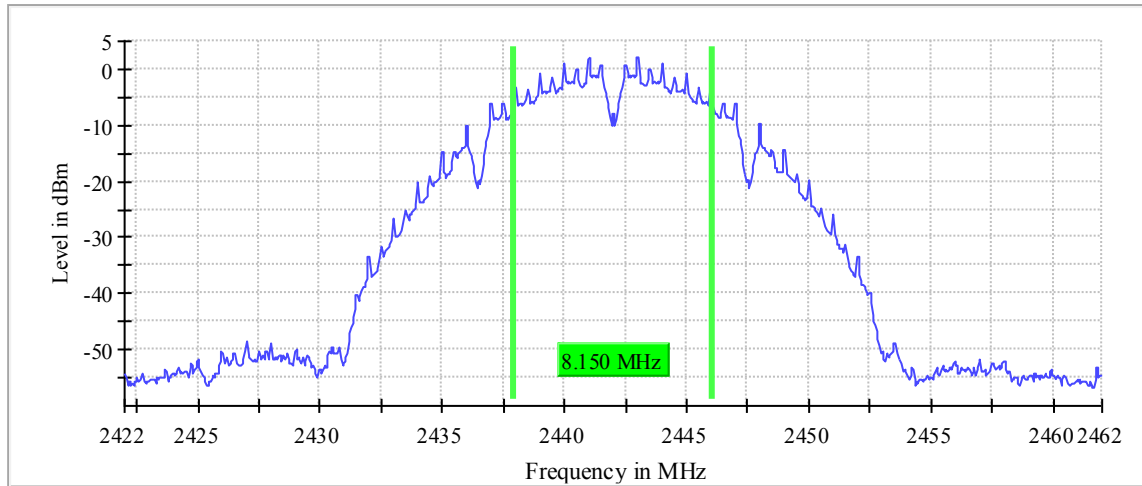
6 dB Bandwidth



Date: 30.JUL.2021 10:40:45

Plot 2: Mode 1, DTS Bandwidth, mid channel

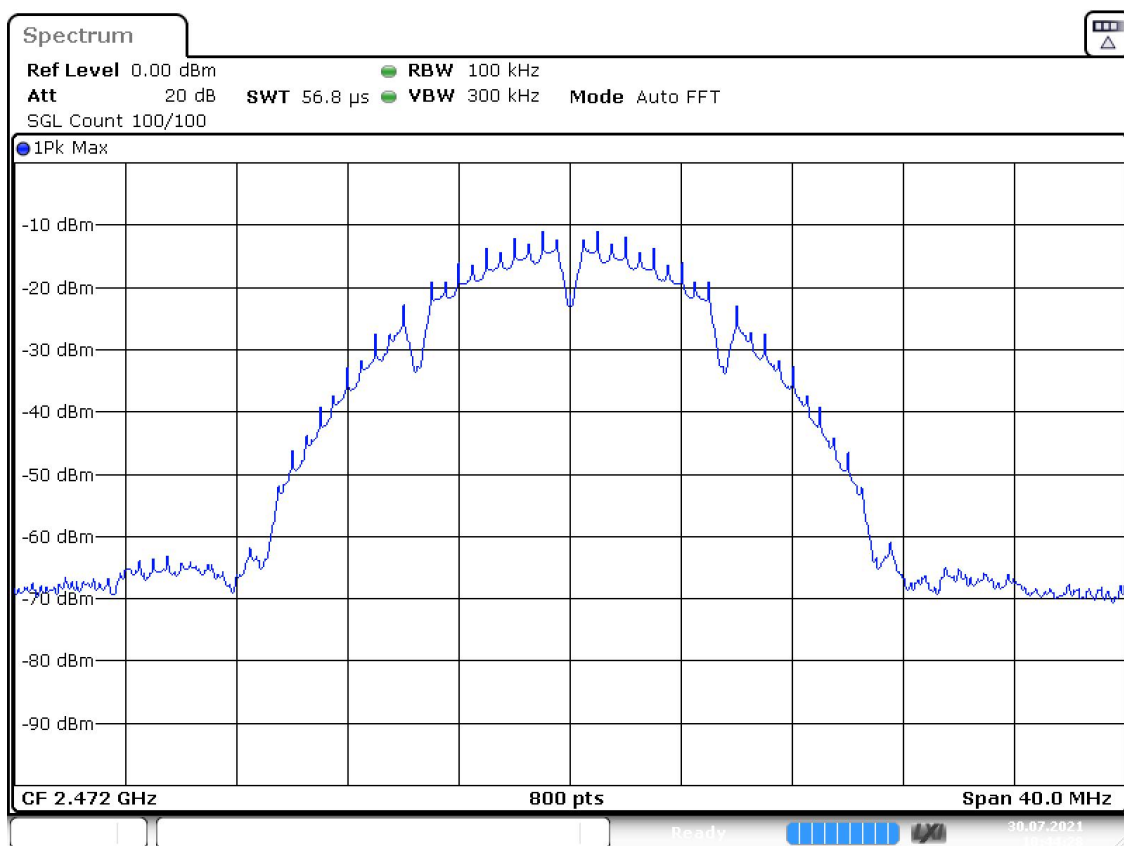
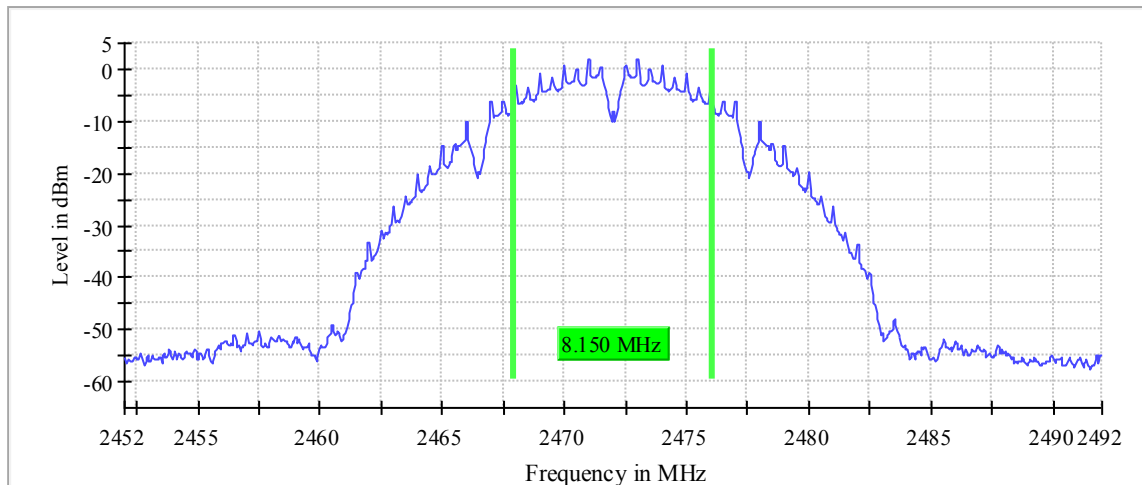
6 dB Bandwidth



Date: 30.JUL.2021 10:43:02

Plot 3: Mode 1, DTS Bandwidth, high channel

6 dB Bandwidth



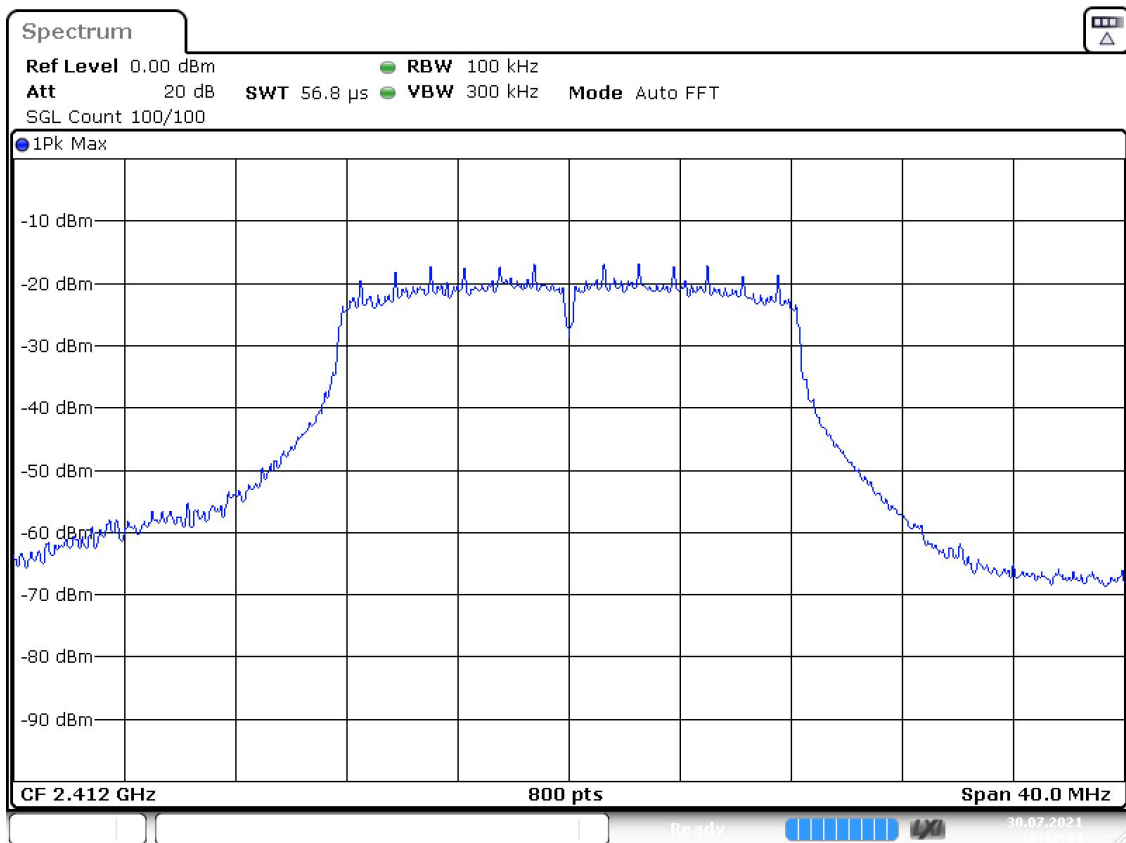
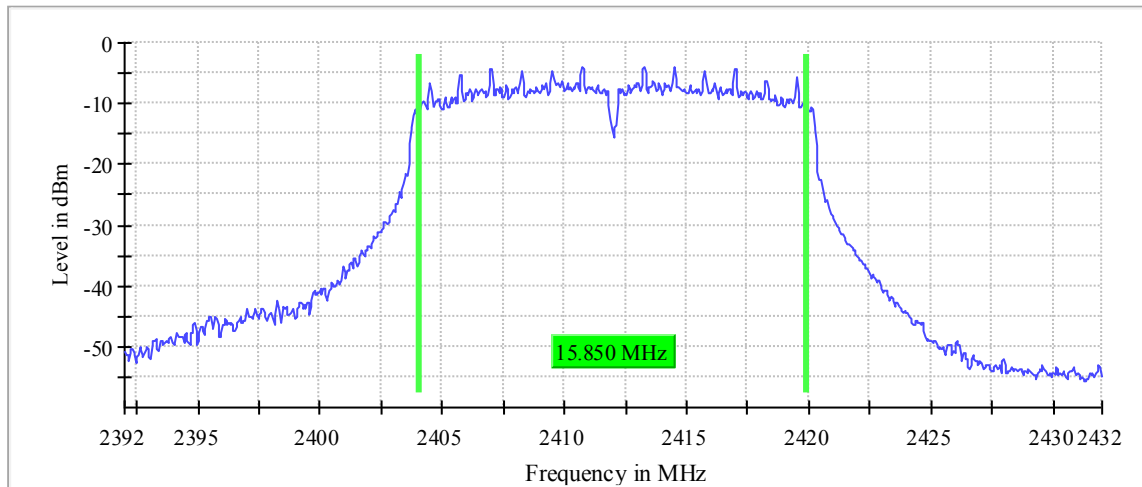
Date: 30.JUL.2021 10:44:29

TR no.: 21065798-20830-0

2021-08-31

Plot 4: Mode 2, DTS Bandwidth, low channel

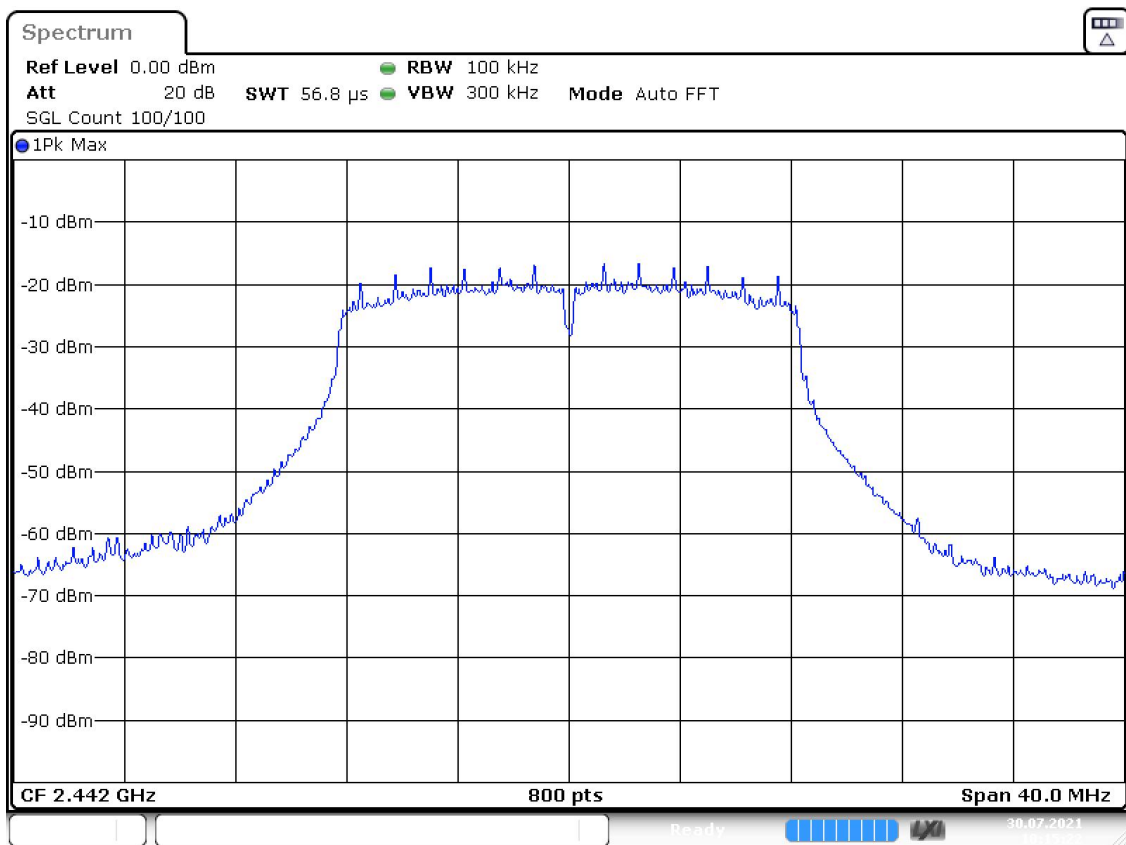
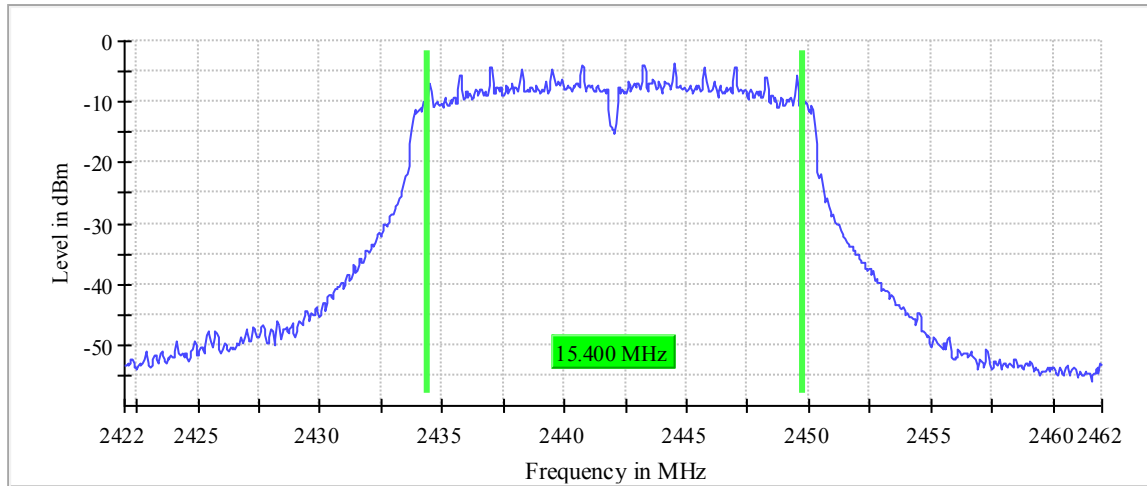
6 dB Bandwidth



Date: 30.JUL.2021 10:12:05

Plot 5: Mode 2, DTS Bandwidth, mid channel

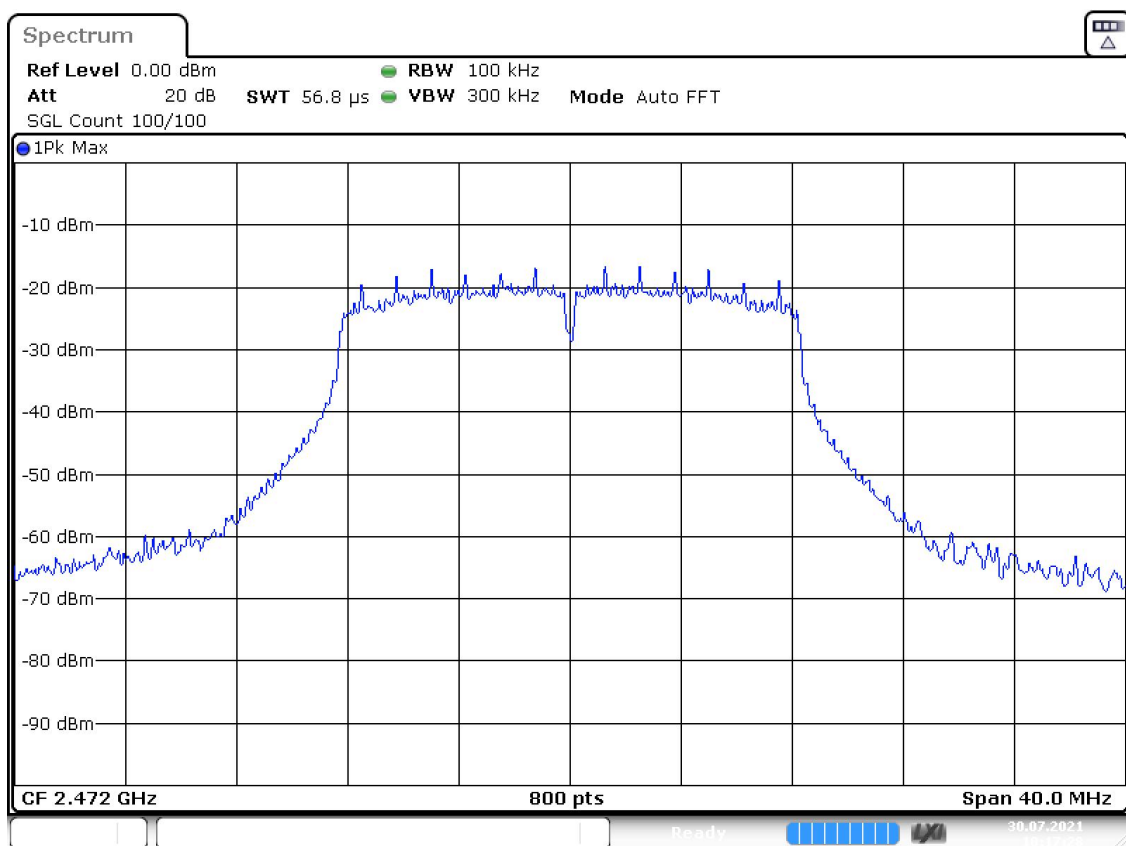
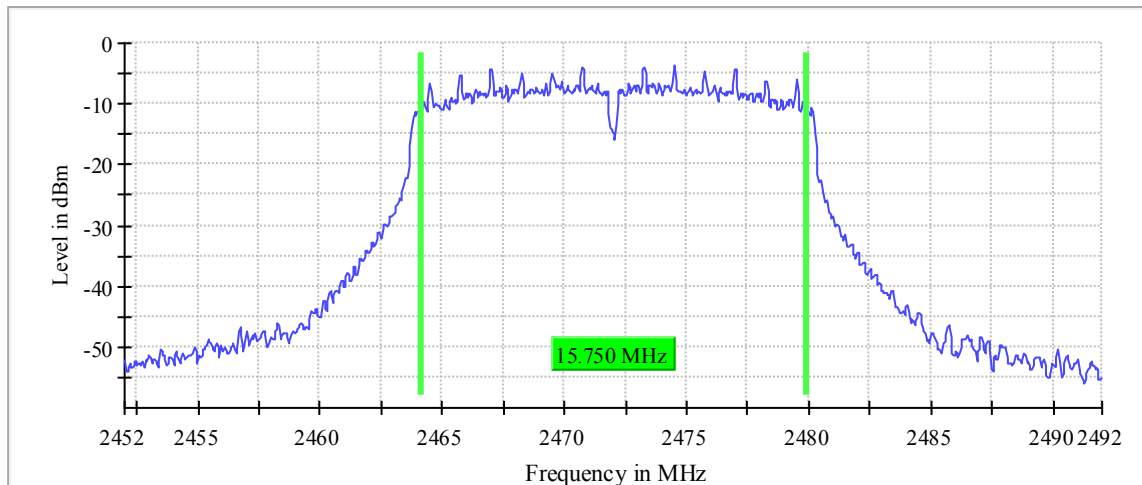
6 dB Bandwidth



Date: 30.JUL.2021 10:15:22

Plot 6: Mode 2, DTS Bandwidth, high channel

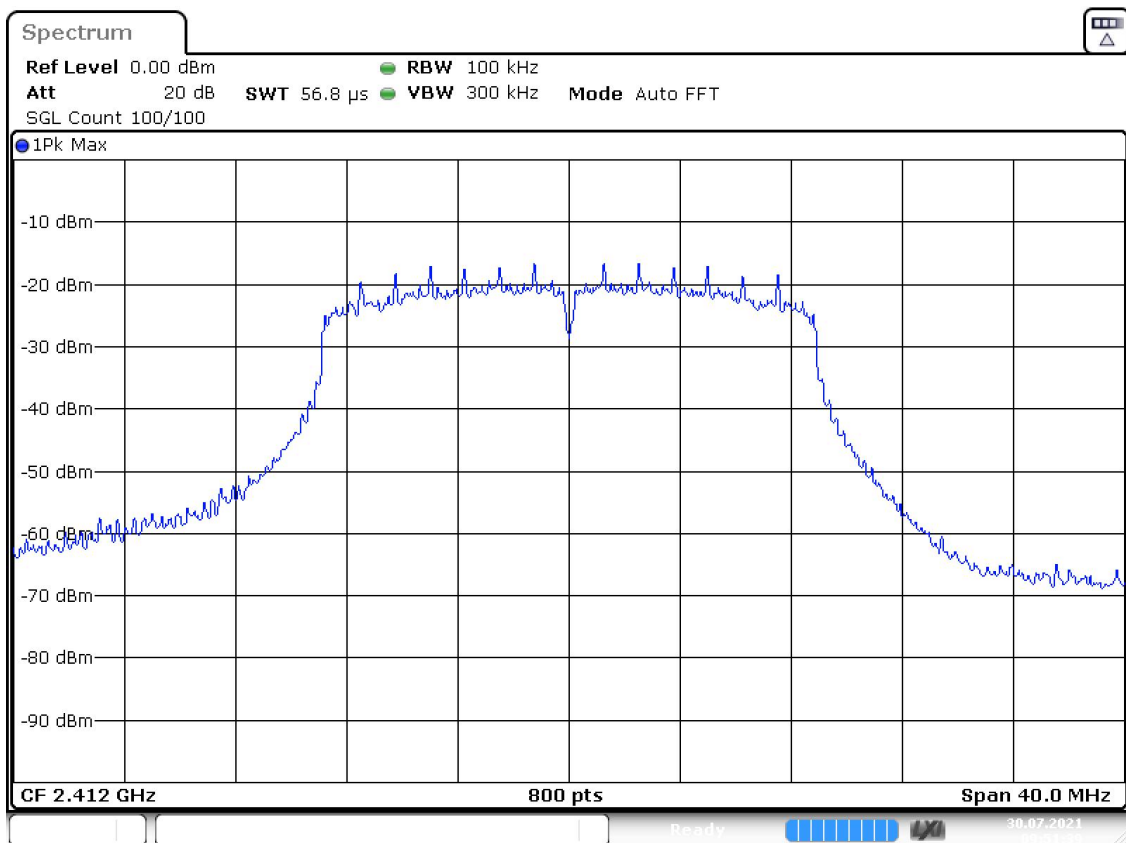
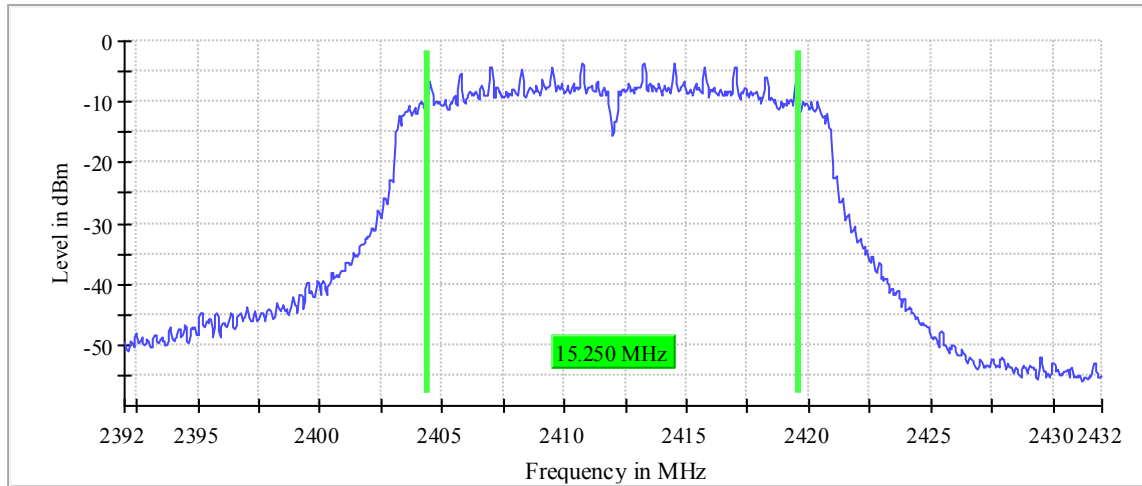
6 dB Bandwidth



Date: 30.JUL.2021 10:17:28

Plot 7: Mode 3, DTS Bandwidth, low channel

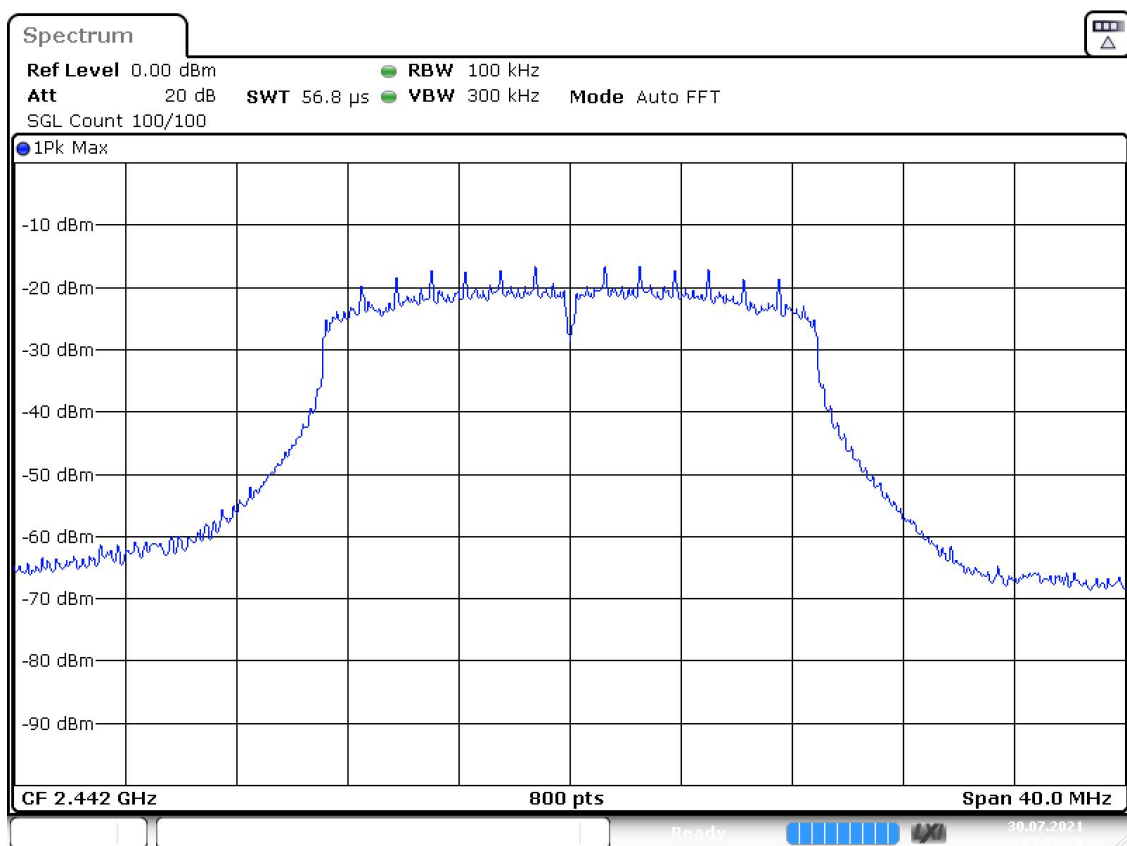
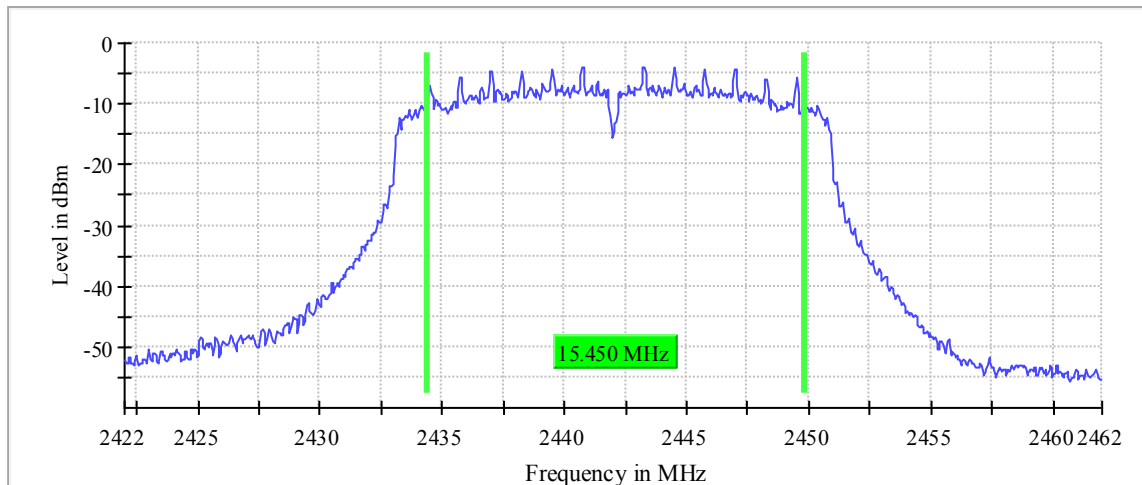
6 dB Bandwidth



Date: 30.JUL.2021 09:51:39

Plot 8: Mode 3, DTS Bandwidth, mid channel

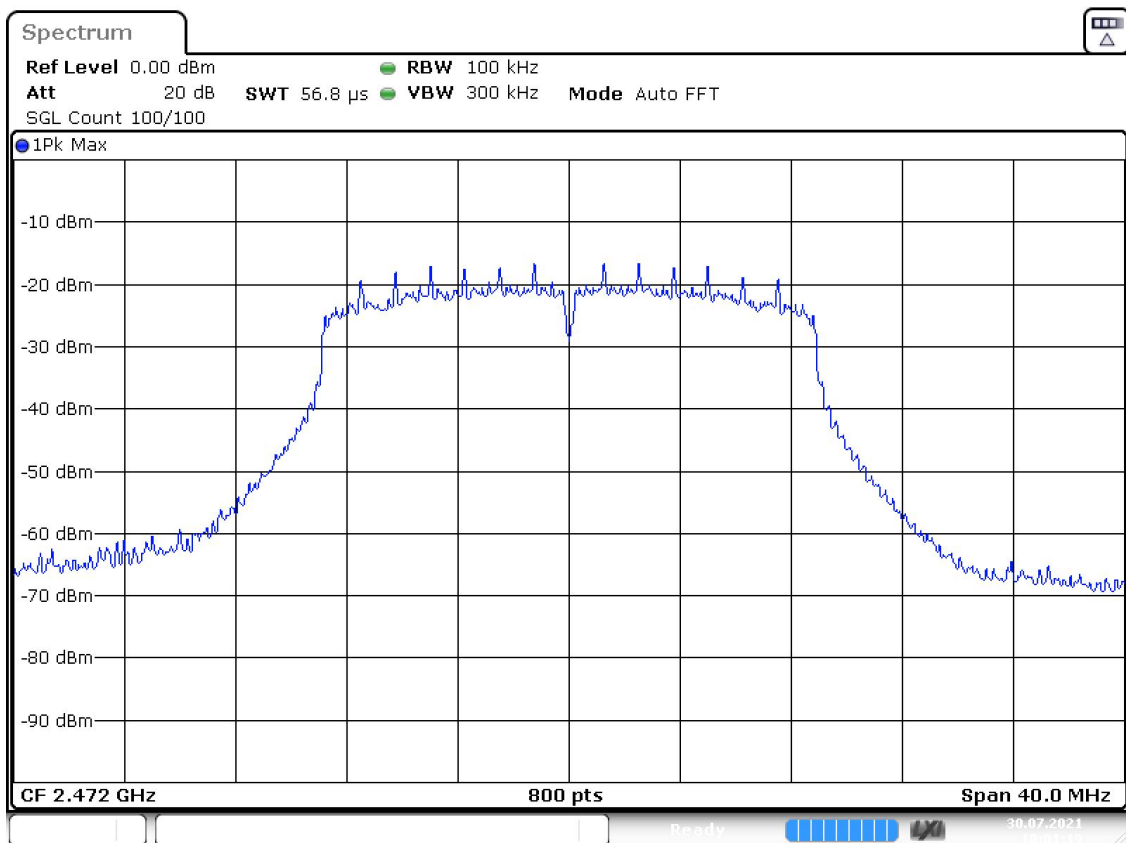
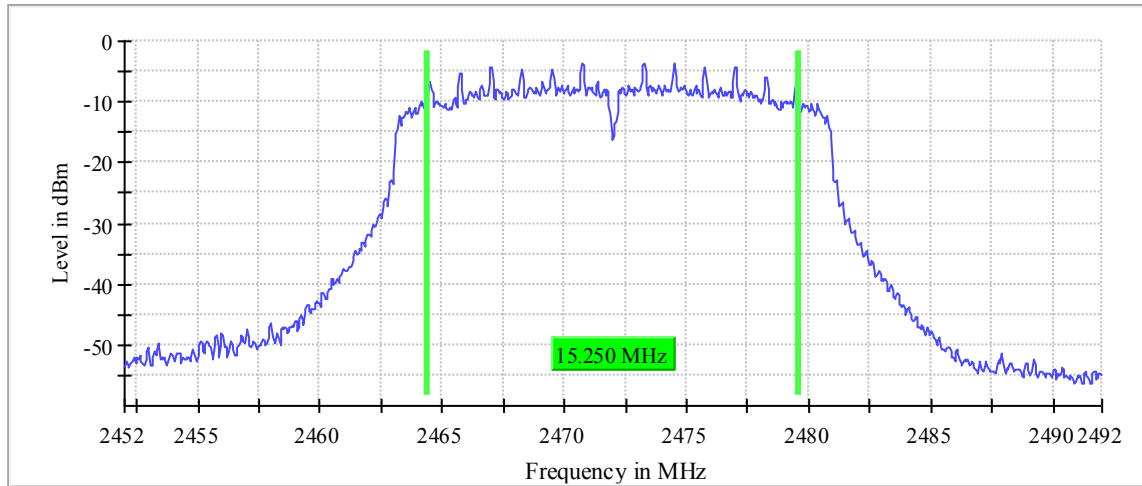
6 dB Bandwidth



Date: 30.JUL.2021 09:58:29

Plot 9: Mode 3, DTS Bandwidth, high channel

6 dB Bandwidth



Date: 30.JUL.2021 10:01:19

7.2 Occupied Bandwidth (99% OBW)

Applicability

This requirement applies to all types of DTS equipment.

Description

The Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal (RSS-Gen).

Limit

No limit defined.

Test procedure

ANSI C63.10, 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
- Step a) through step c) might require iteration to adjust within the specified range.
- Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Test setup: 8.4 with conducted sample (see 5.2)

Test Results

EUT Mode	Occupied Bandwidth (99%)		
	low channel [MHz]	mid channel [MHz]	high channel [MHz]
Mode 1	13.000	13.000	13.000
Mode 2	16.300	16.300	16.300
Mode 3	17.500	17.500	17.500

Comment:

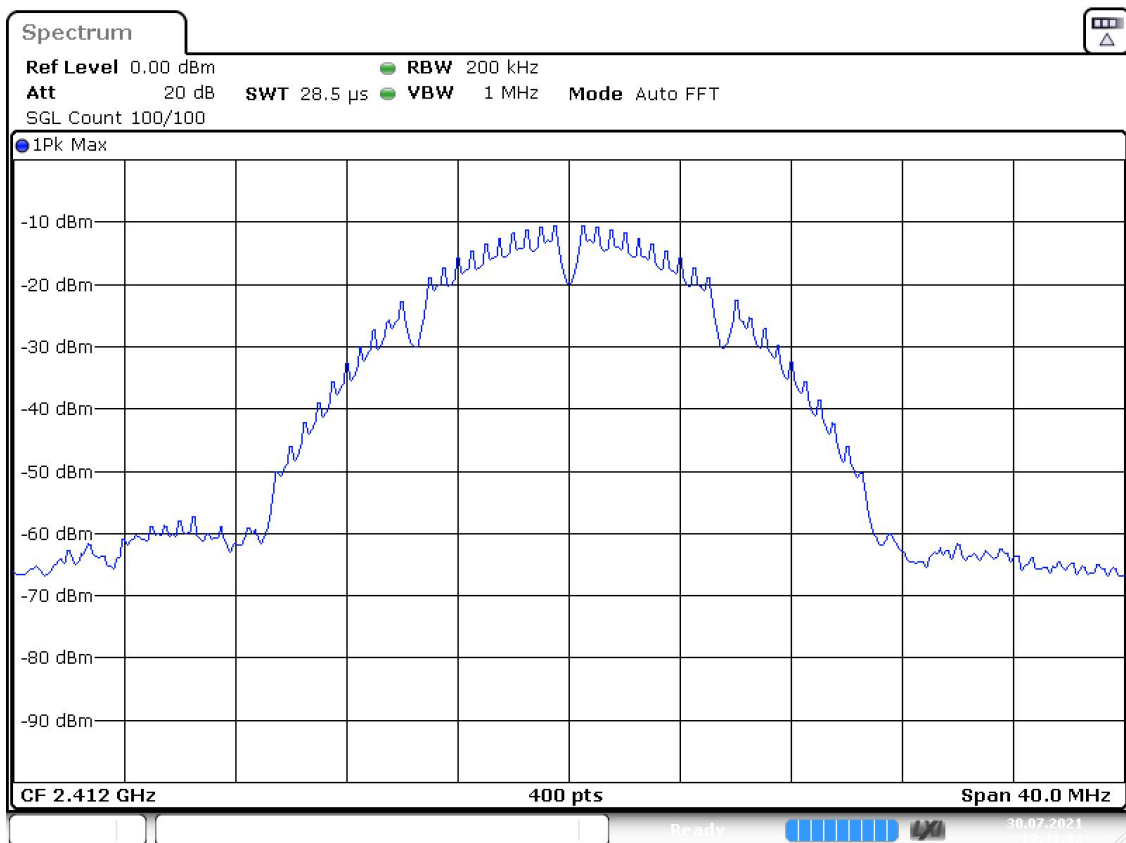
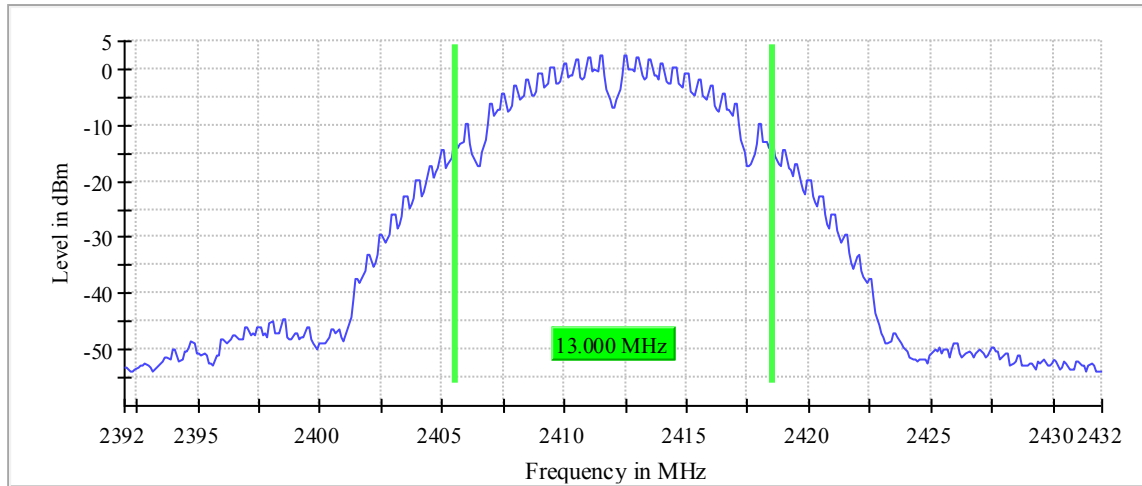
Verdict

- PASS -

see next plots

Plot 10: Mode 1, 99% Occupied Bandwidth, low channel

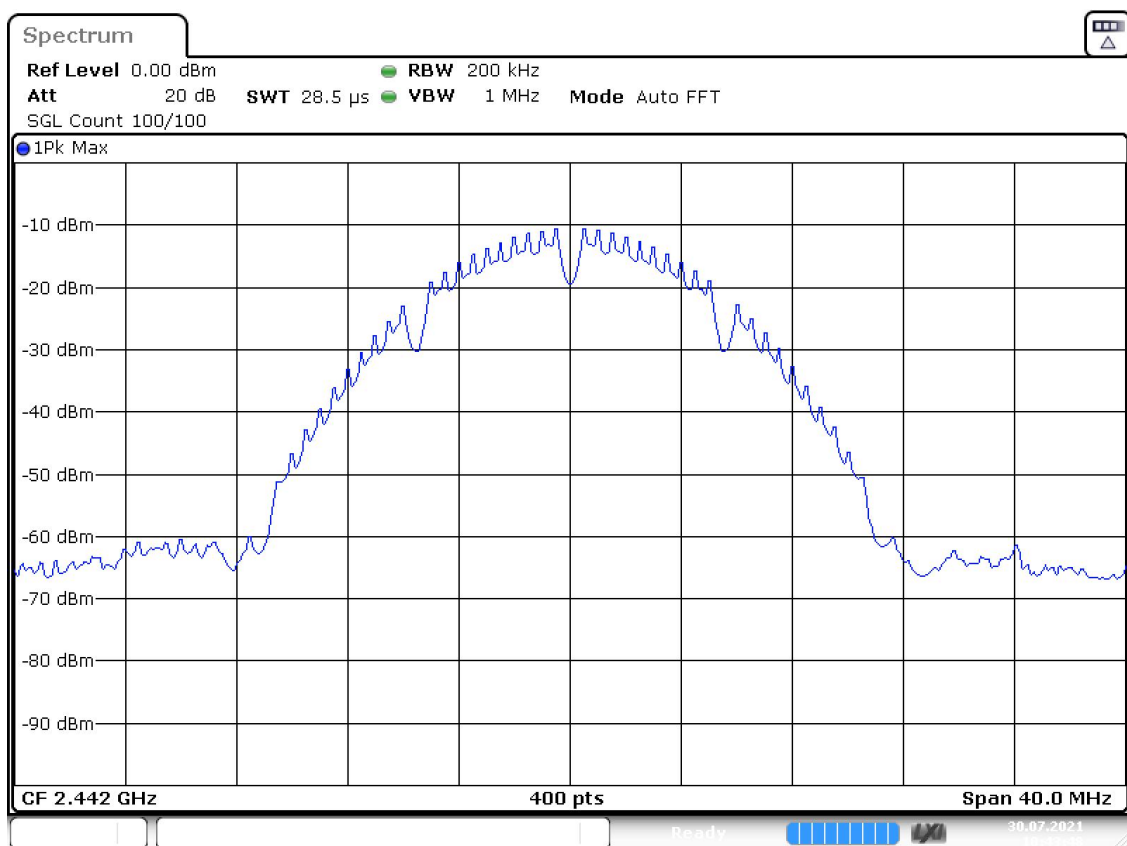
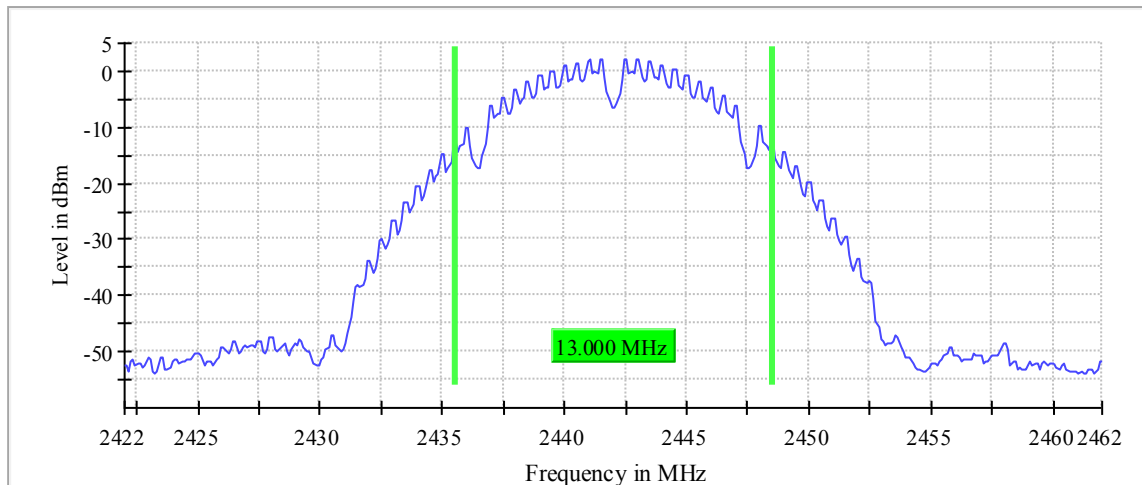
99 % Bandwidth



Date: 30.JUL.2021 10:41:32

Plot 11: Mode 1, 99% Occupied Bandwidth, mid channel

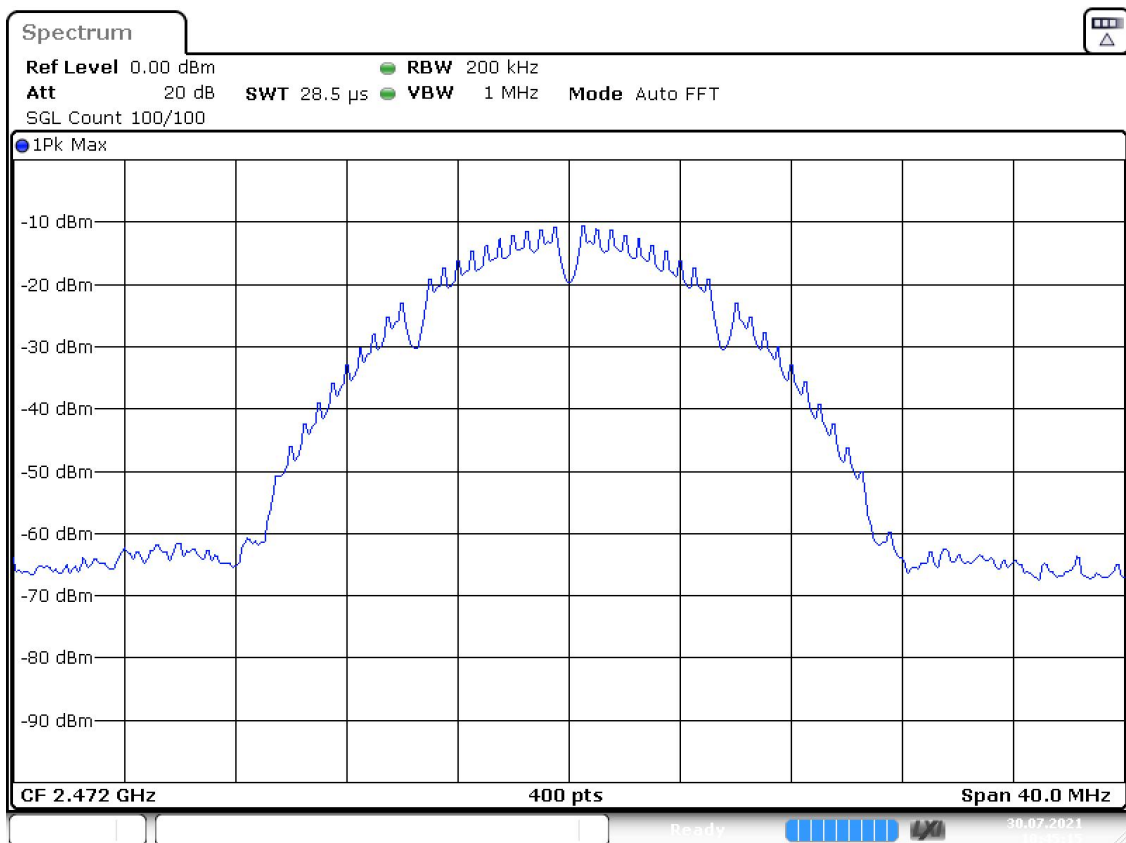
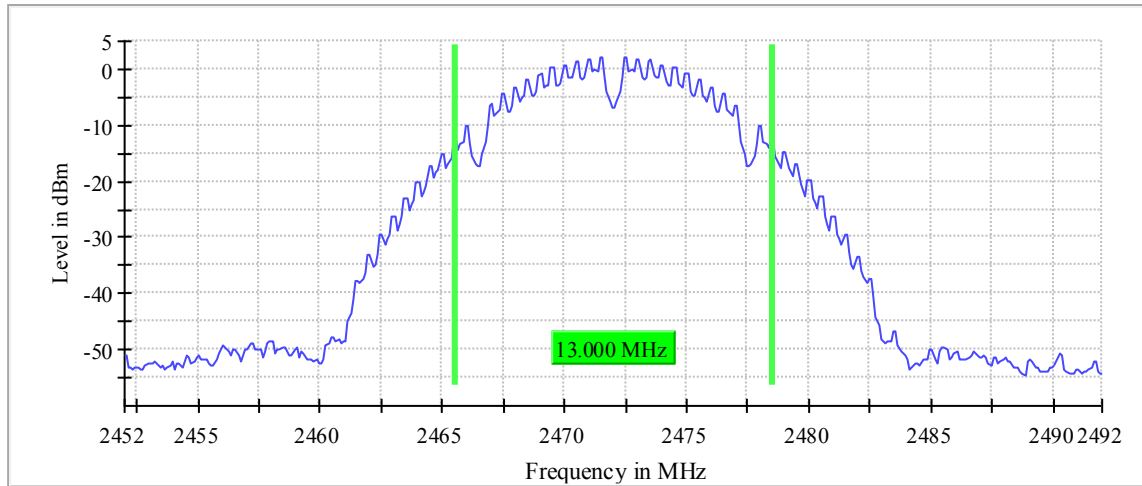
99 % Bandwidth



Date: 30.JUL.2021 10:43:48

Plot 12: Mode 1, 99% Occupied Bandwidth, high channel

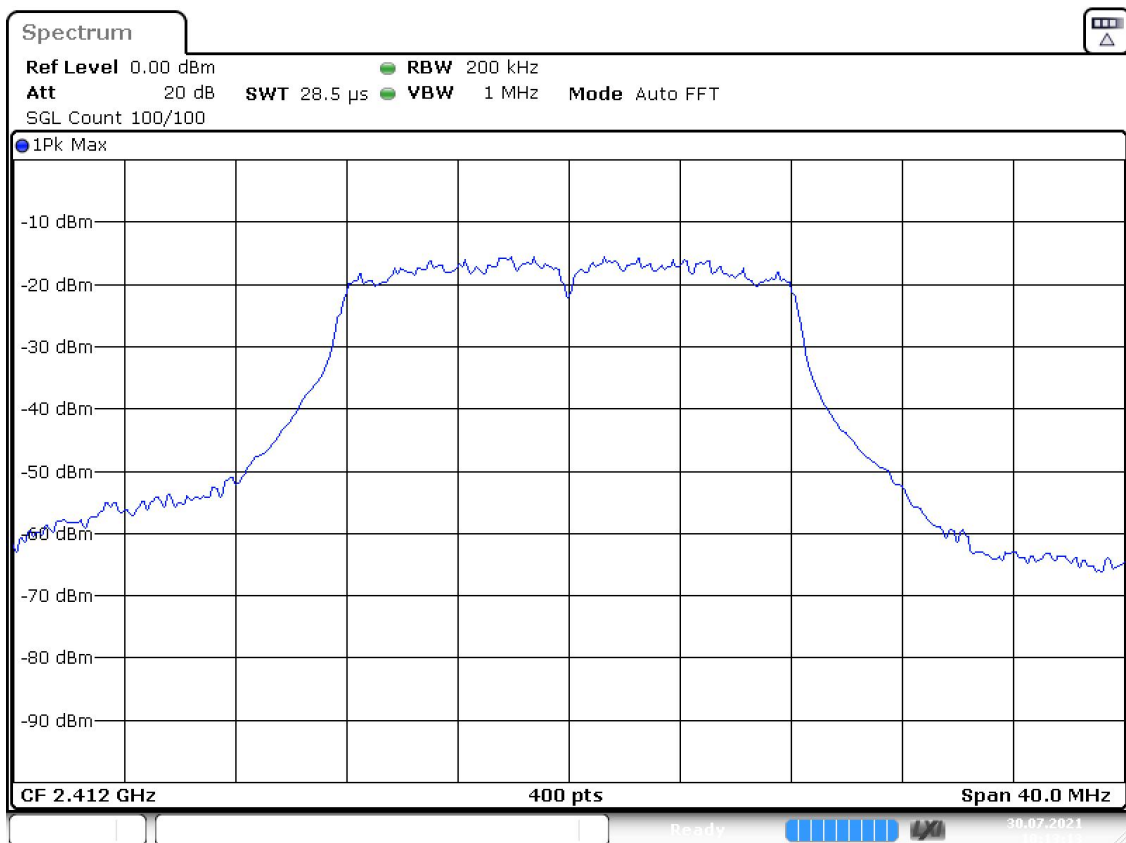
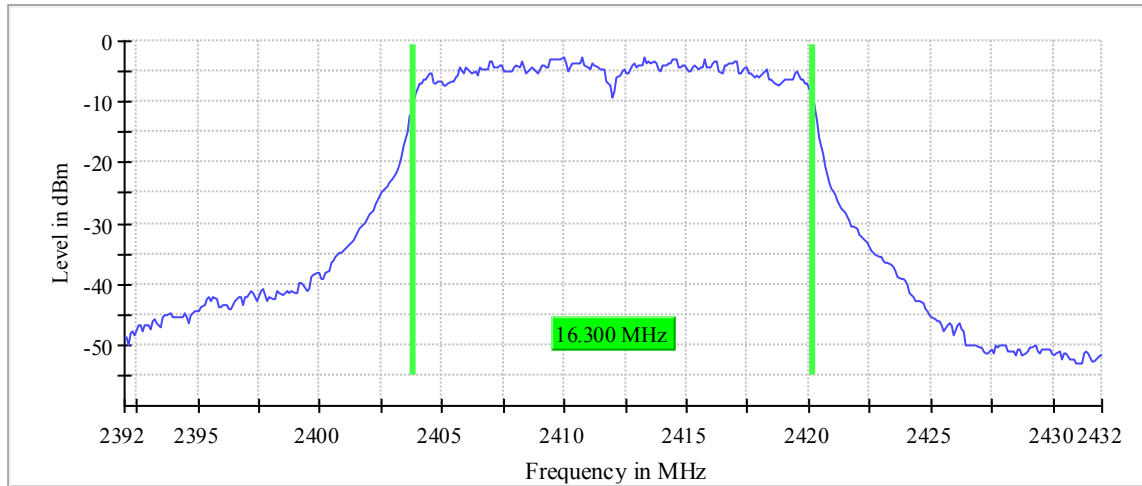
99 % Bandwidth



Date: 30.JUL.2021 10:45:15

Plot 13: Mode 2, 99% Occupied Bandwidth, low channel

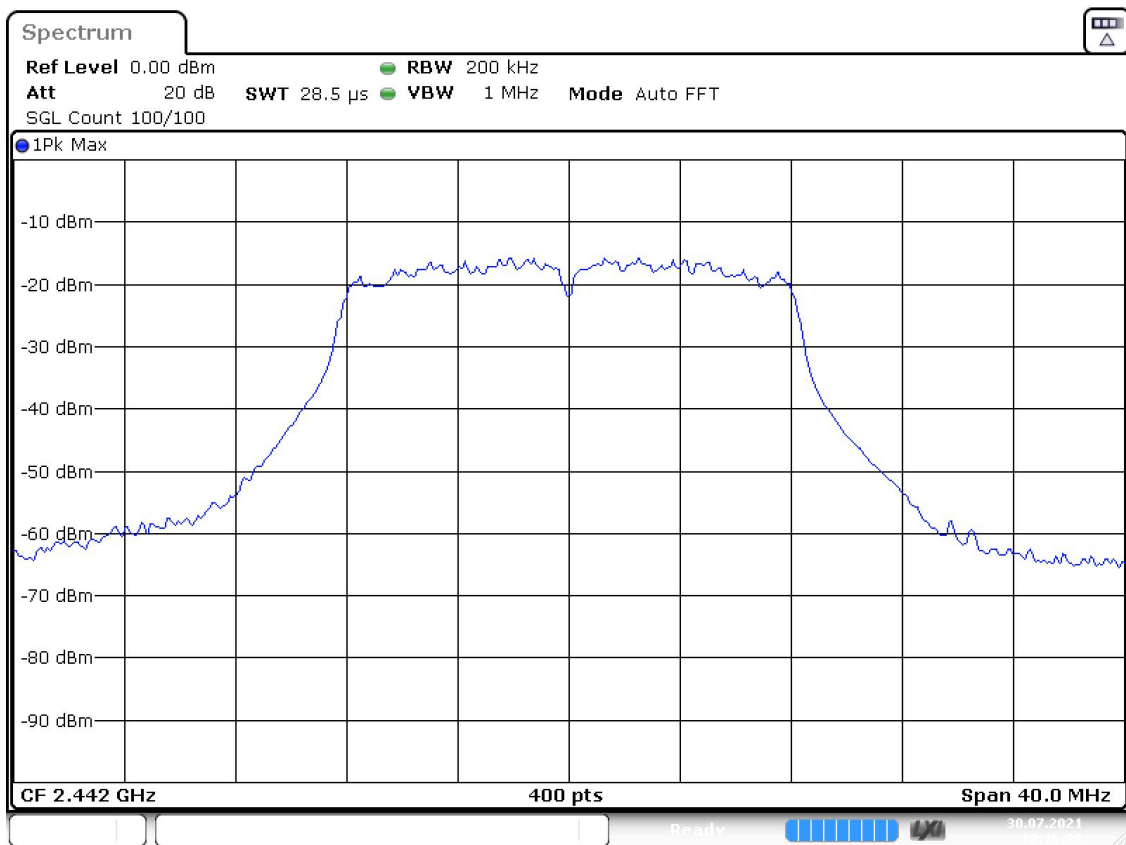
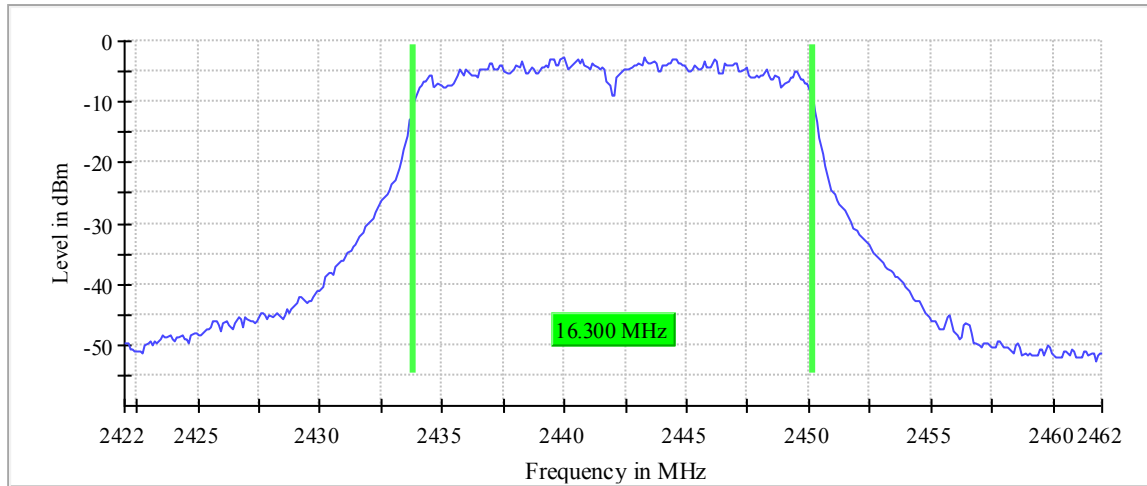
99 % Bandwidth



Date: 30.JUL.2021 10:13:13

Plot 14: Mode 2, 99% Occupied Bandwidth, mid channel

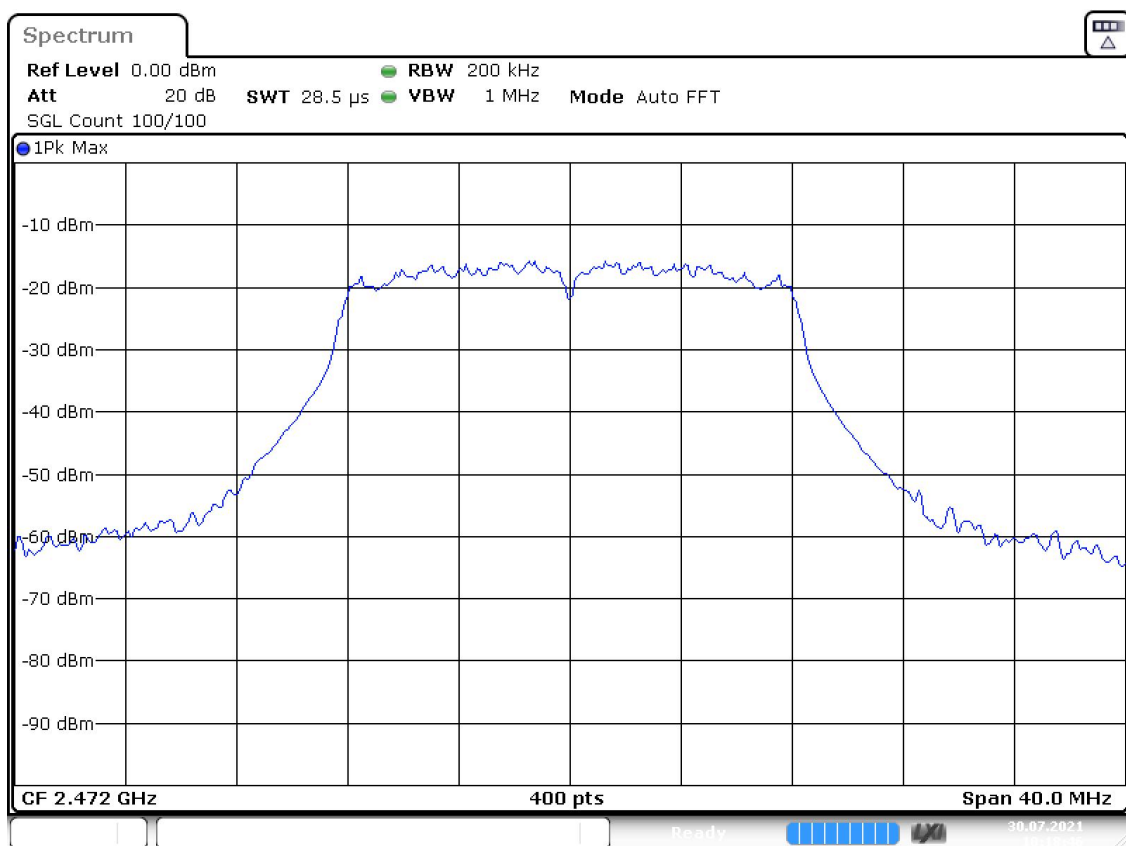
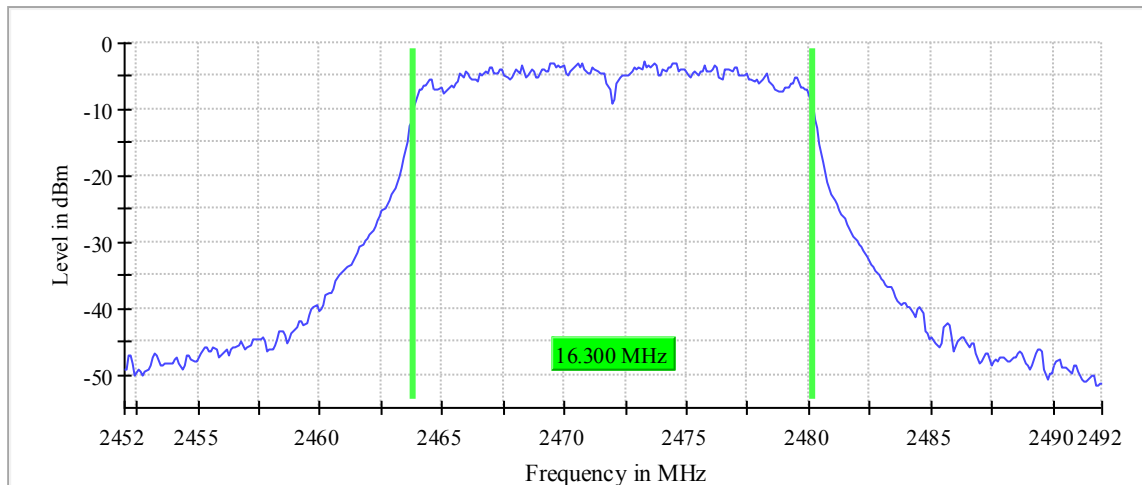
99 % Bandwidth



Date: 30.JUL.2021 10:16:38

Plot 15: Mode 2, 99% Occupied Bandwidth, high channel

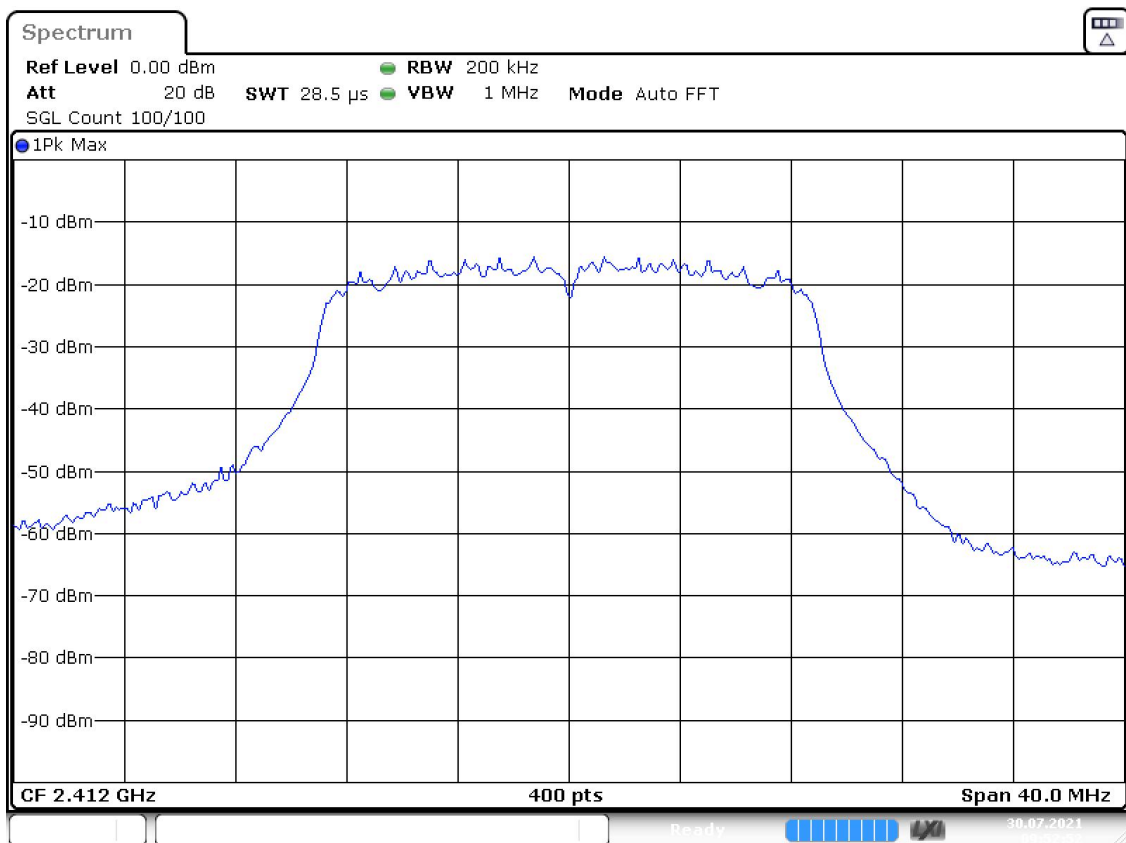
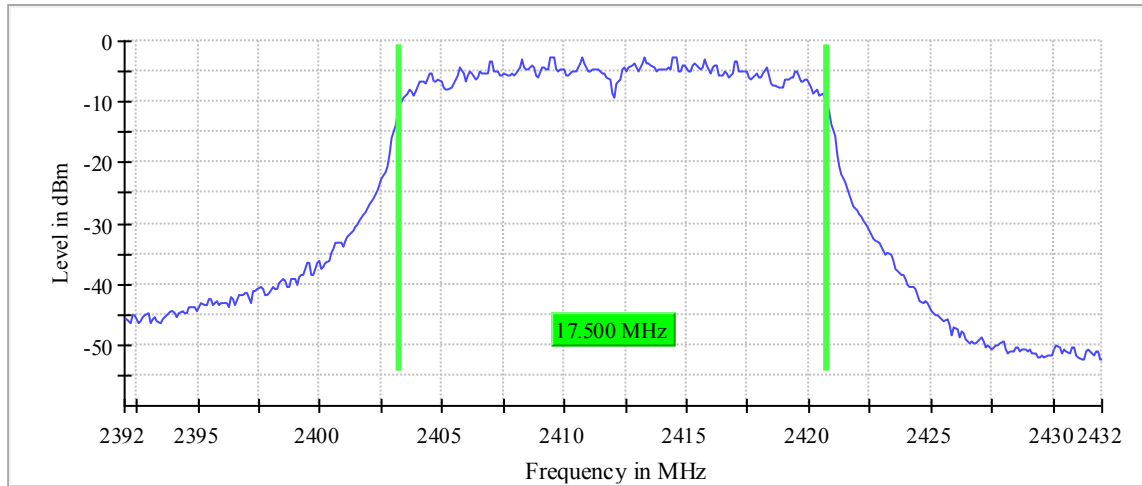
99 % Bandwidth



Date: 30.JUL.2021 10:18:46

Plot 16: Mode 3, 99% Occupied Bandwidth, low channel

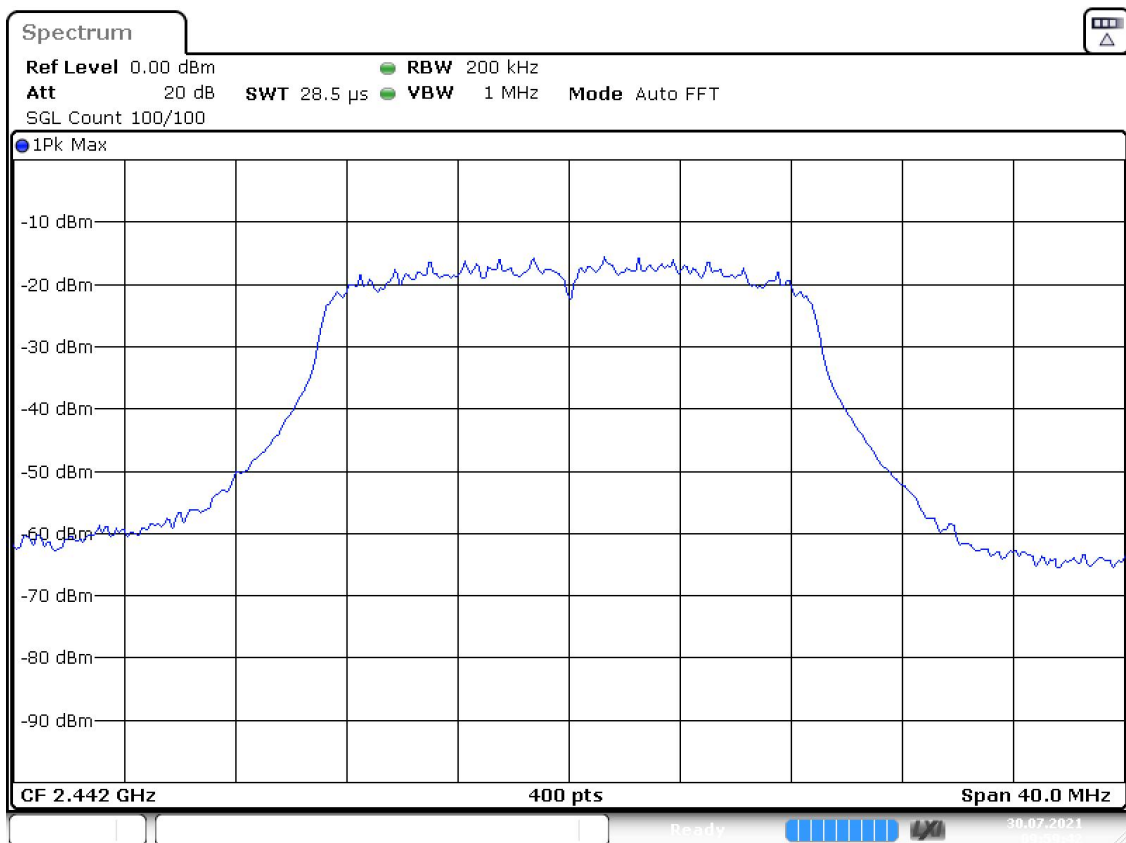
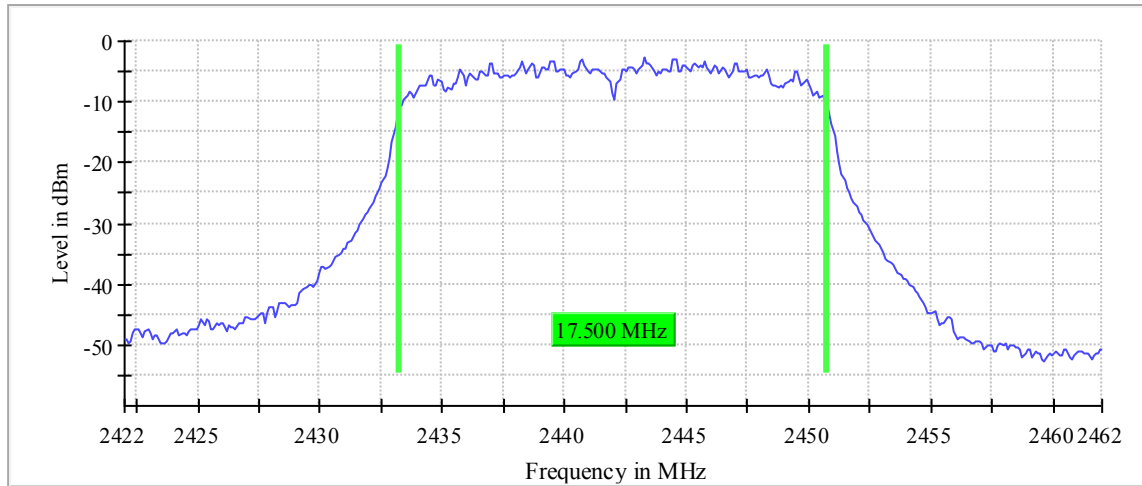
99 % Bandwidth



Date: 30.JUL.2021 09:52:52

Plot 17: Mode 3, 99% Occupied Bandwidth, mid channel

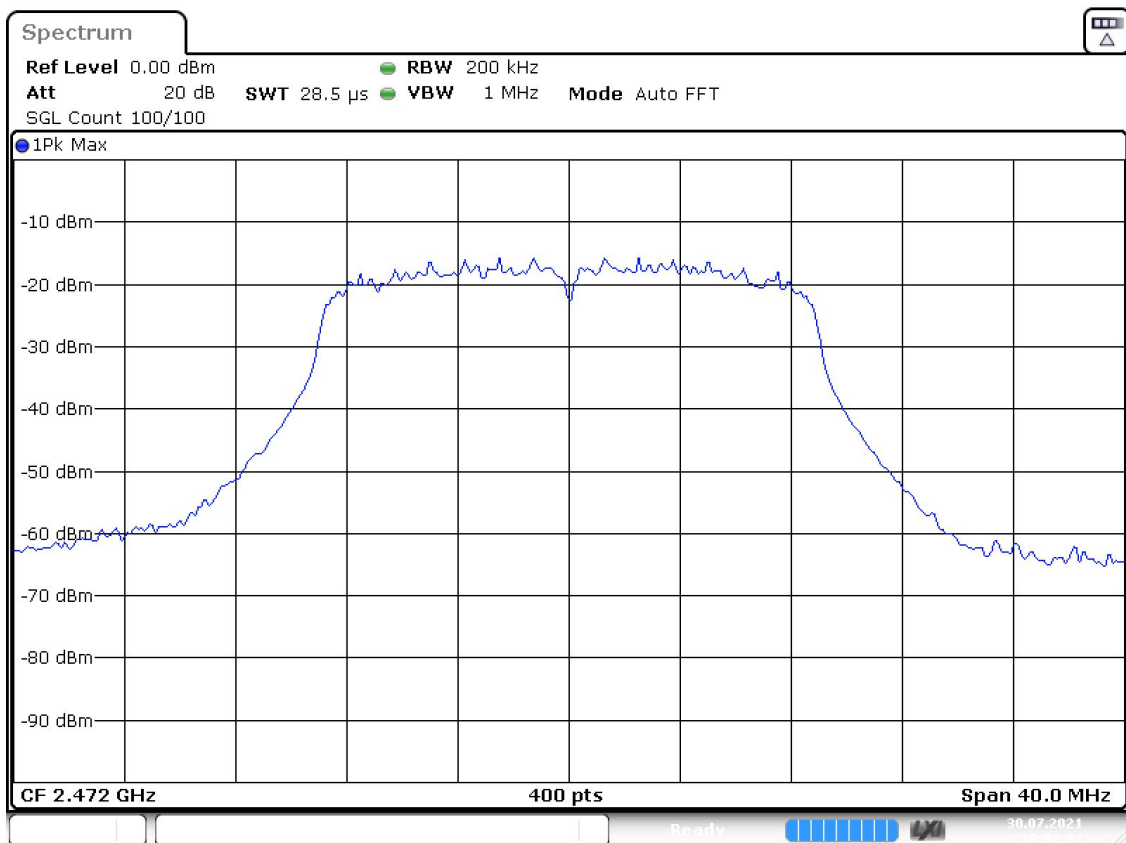
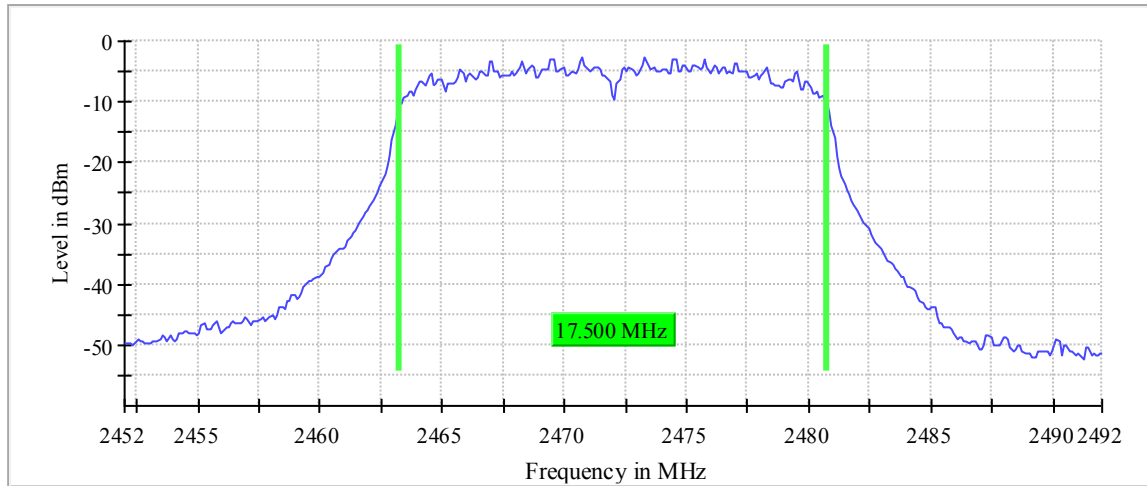
99 % Bandwidth



Date: 30.JUL.2021 09:59:42

Plot 18: Mode 3, 99% Occupied Bandwidth, high channel

99 % Bandwidth



Date: 30.JUL.2021 10:02:32

7.3 RF Output Power (Conducted Peak Power)

Applicability

This requirement applies to all types of DTS equipment.

Description

The RF Output Power is defined as the conducted peak output power.

Limit

§15.247

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test procedure

KDB 558074 D01.

ANSI C63.10, 11.9.2.3.2

Method AVGPM-G is a measurement using a gated RF average power meter.

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

Gate triggering can be implemented in such a way that the sweep of the instrument is only active during the burst period of the device. Any Gate triggering shall be performed on the full power portion of the pulses and care must be taken to ensure that static portions of the pulse are not included in the measurement (ensuring that the trace is averaged over the entire symbol range). All Gate triggered measurements shall be accompanied by a Gate setup plot in the test report.

Test setup: 8.4 with conducted sample (see 5.2)

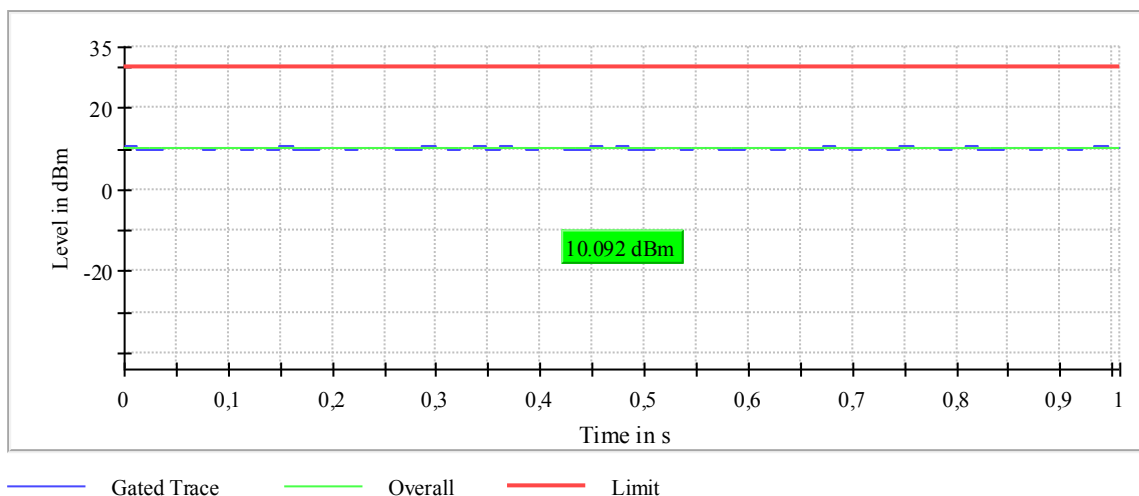
Test Results				
EUT Mode	RF Output Power			Limit Max [dBm]
	low channel [dBm]	mid channel [dBm]	high channel [dBm]	
Mode 1	10.1	9.9	9.9	30
Mode 2	7.6	7.4	7.4	30
Mode 3	7.4	7.2	7.2	30

Comment:	---
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Verdict	- PASS -	see next plots
---------	----------	----------------

Plot 19: Mode 1, AVGPM-G Gated Average Power Measurement, low channel

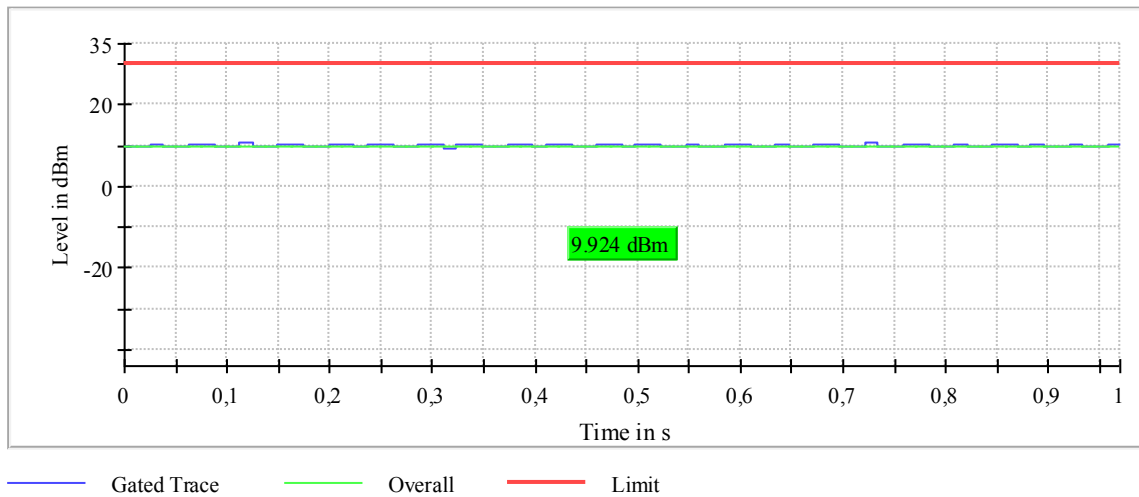
Gated Trace



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2412.000000	10.1	30.0	10.1	97.849	PASS

Plot 20: Mode 1, AVGPM-G Gated Average Power Measurement, mid channel

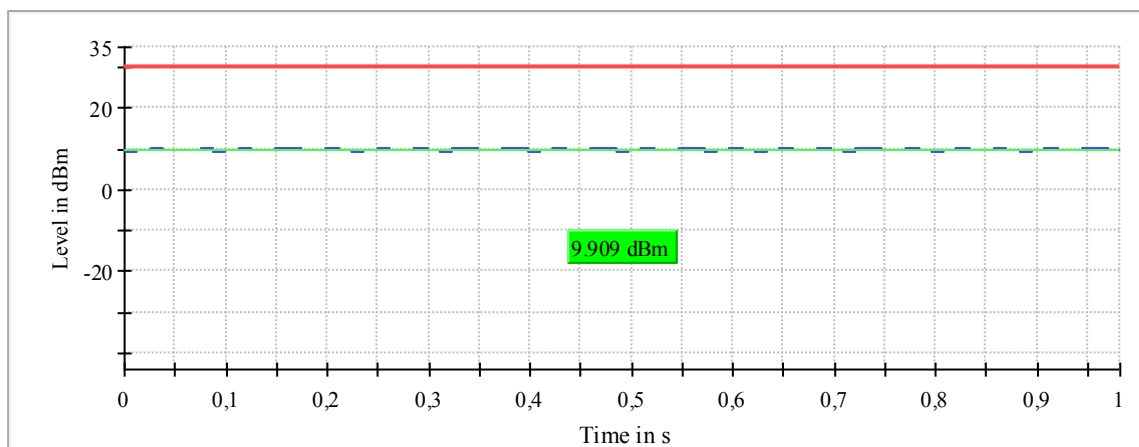
Gated Trace



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2442.000000	9.9	30.0	9.9	98.996	PASS

Plot 21: Mode 1, AVGP-M-G Gated Average Power Measurement, high channel

Gated Trace

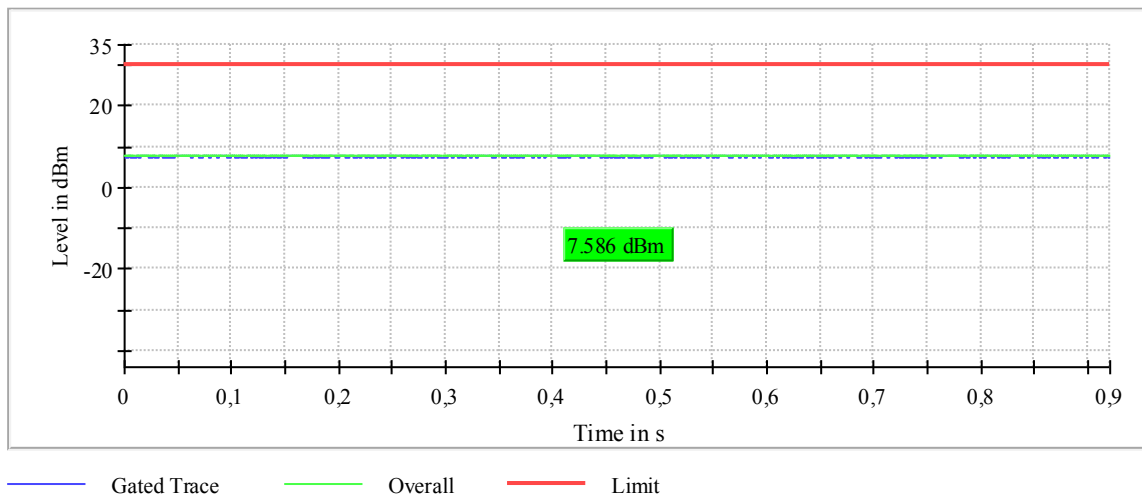


— Gated Trace — Overall — Limit

DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2472.000000	9.9	30.0	9.9	98.978	PASS

Plot 22: Mode 2, AVGPM-G Gated Average Power Measurement, low channel

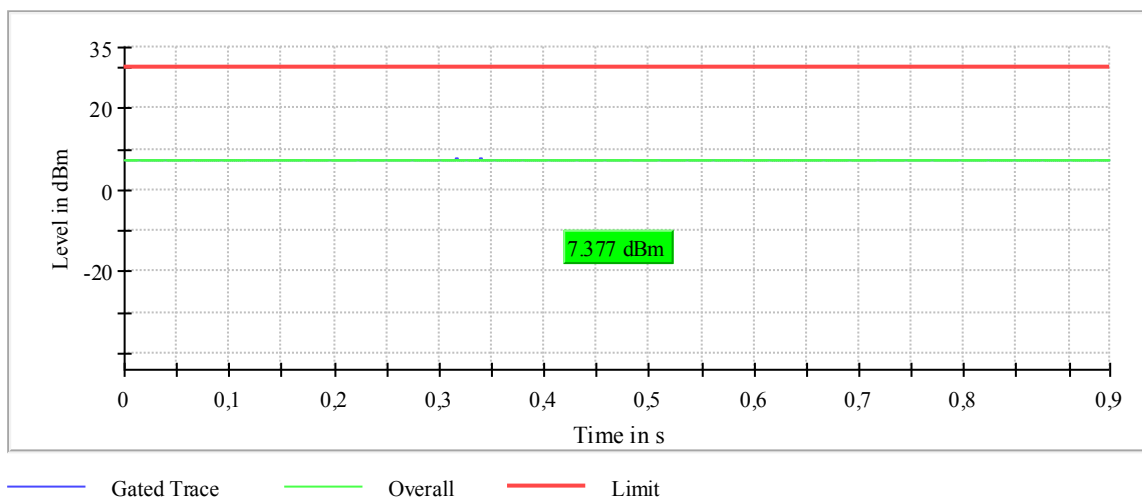
Gated Trace



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2412.000000	7.6	30.0	7.6	92.240	PASS

Plot 23: Mode 2, AVGPM-G Gated Average Power Measurement, mid channel

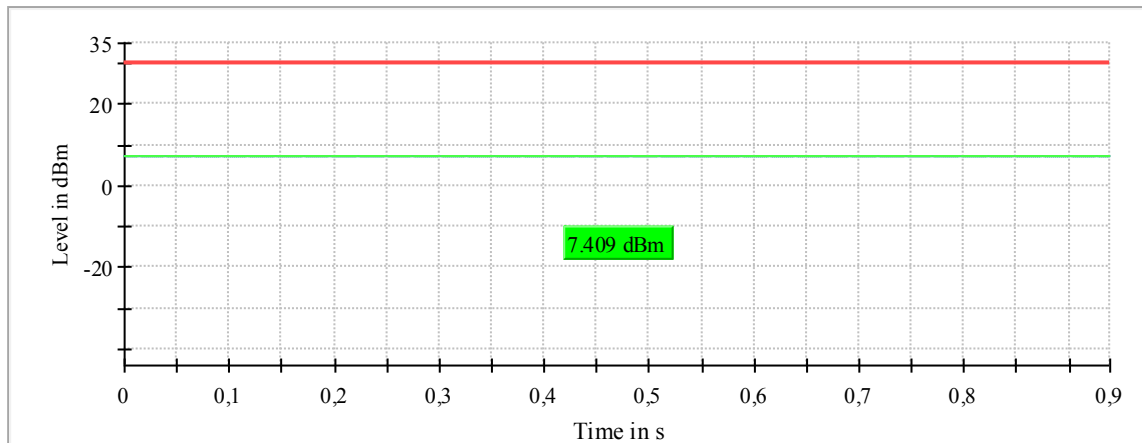
Gated Trace



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2442.000000	7.4	30.0	7.4	94.203	PASS

Plot 24: Mode 2, AVGPM-G Gated Average Power Measurement, high channel

Gated Trace

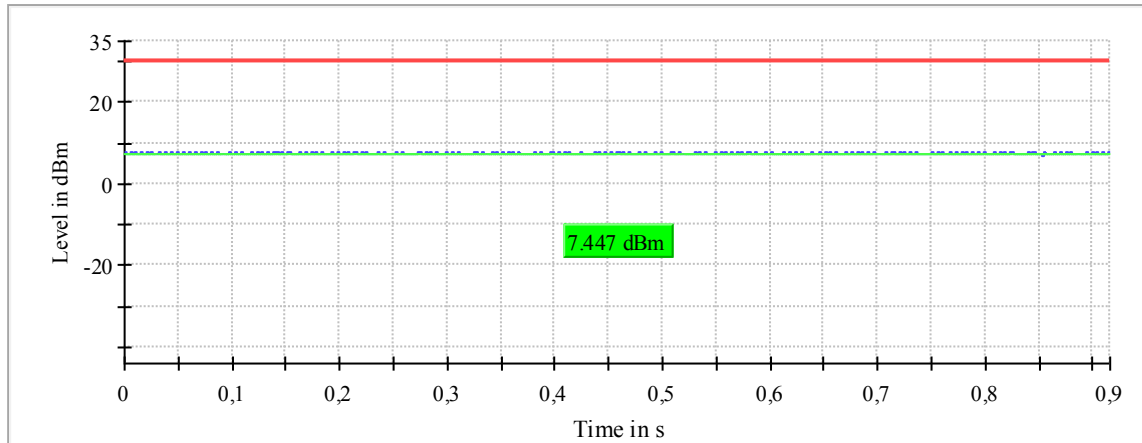


— Gated Trace — Overall — Limit

DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2472.000000	7.4	30.0	7.4	94.148	PASS

Plot 25: Mode 3, AVGPM-G Gated Average Power Measurement, low channel

Gated Trace

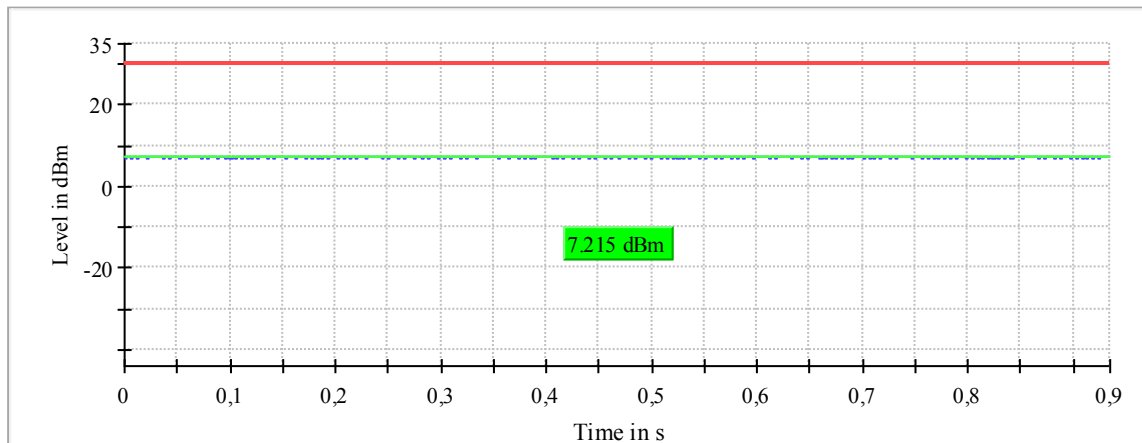


— Gated Trace — Overall — Limit

DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2412.000000	7.4	30.0	7.4	91.668	PASS

Plot 26: Mode 3, AVGPM-G Gated Average Power Measurement, mid channel

Gated Trace

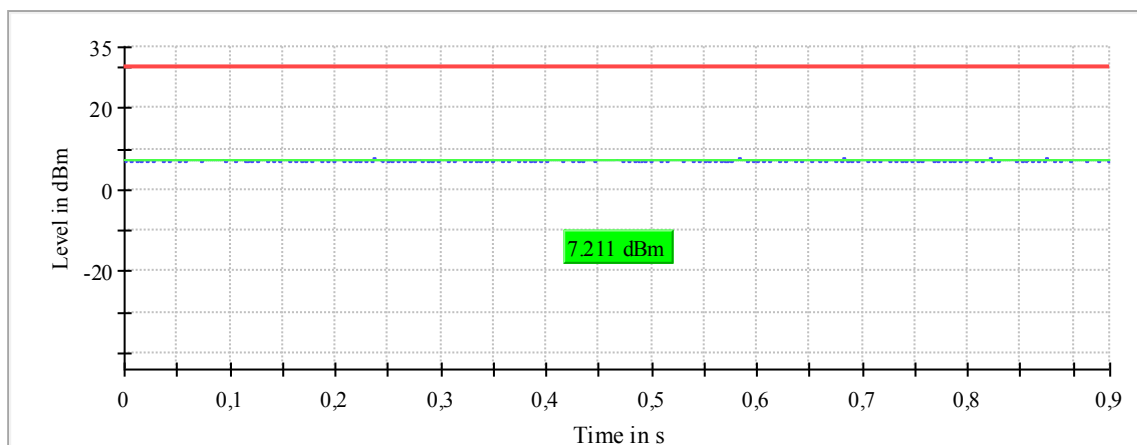


— Gated Trace — Overall — Limit

DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2442.000000	7.2	30.0	7.2	93.759	PASS

Plot 27: Mode 3, AVGPM-G Gated Average Power Measurement, high channel

Gated Trace



— Gated Trace — Overall — Limit

DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2472.000000	7.2	30.0	7.2	93.831	PASS

7.4 Antenna Gain (calculated)

Applicability

This requirement applies to all types of DTS equipment.

Description

The antenna gain is defined as the difference between radiated peak power (Peak EIRP) subtracted by the conducted peak power of the module, given in dBi.

Limit

§15.247

(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test setup: 8.2 with radiated sample (see 5.2), 8.4 with conducted sample (see 5.2)

Test Results

Mode 1	low channel	mid channel	high channel	Max Limit
Radiated peak power [dBm]	8.9	6.8	7.6	36
Conducted peak power [dBm]	10.1	9.9	9.9	30
Calculated antenna gain [dBi]	-1.2	-3.1	-2.3	6

Mode 2	low channel	mid channel	high channel	Max Limit
Radiated peak power [dBm]	8.3	7.1	7.6	36
Conducted peak power [dBm]	7.6	7.4	7.4	30
Calculated antenna gain [dBi]	0.7	-0.3	0.2	6

Mode 3	low channel	mid channel	high channel	Max Limit
Radiated peak power [dBm]	3.6	3.9	3.6	36
Conducted peak power [dBm]	7.4	7.2	7.2	30
Calculated antenna gain [dBi]	-3.8	-3.3	-3.6	6

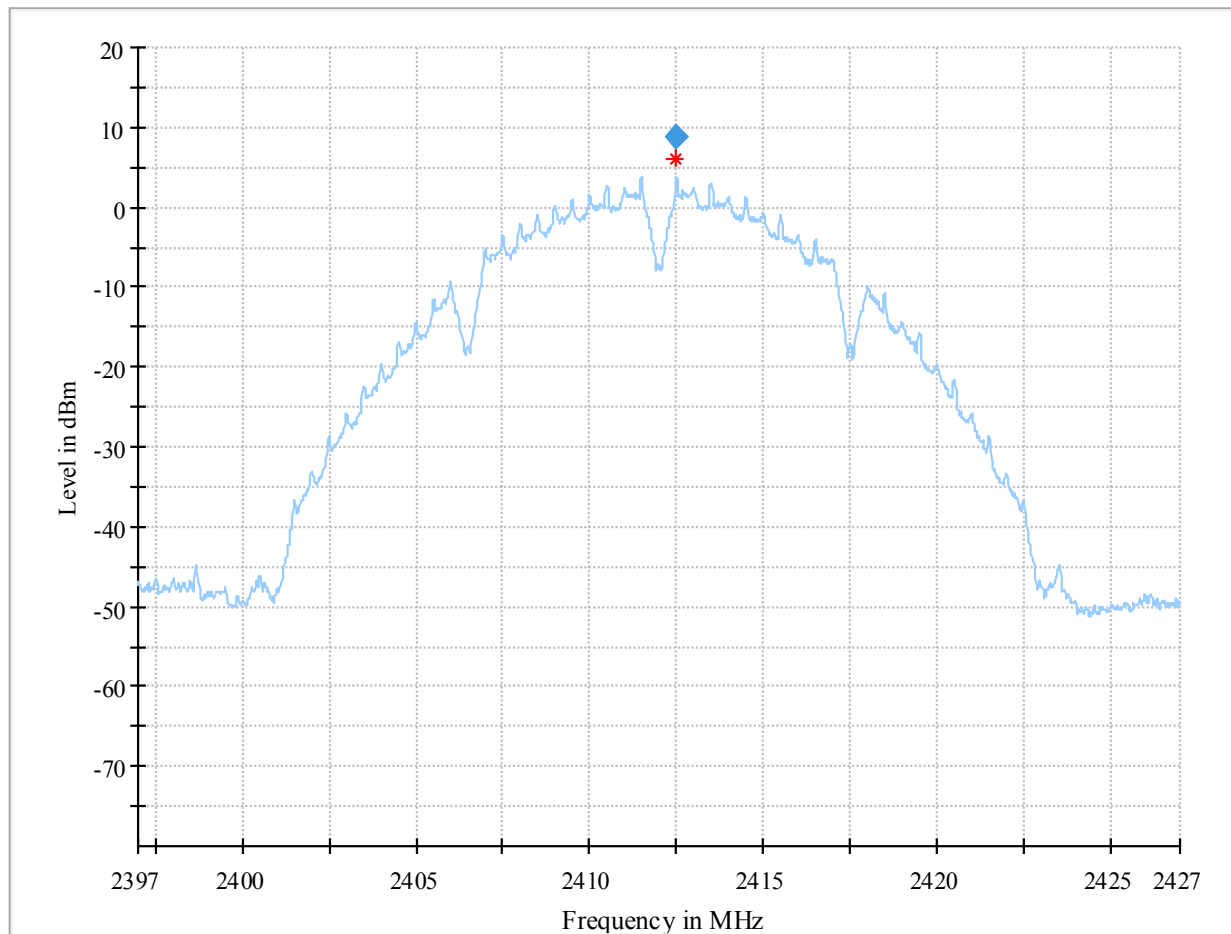
Comment:

Verdict	- PASS -	<i>see next plots*</i>
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*description of line and marker for all radiated Peak Power measurements:

-  positive Peak (Max Hold) trace during pre-scan
-  Max Peak value
-  final Quasi Peak value

Plot 28: Mode 1, Peak EIRP, low channel



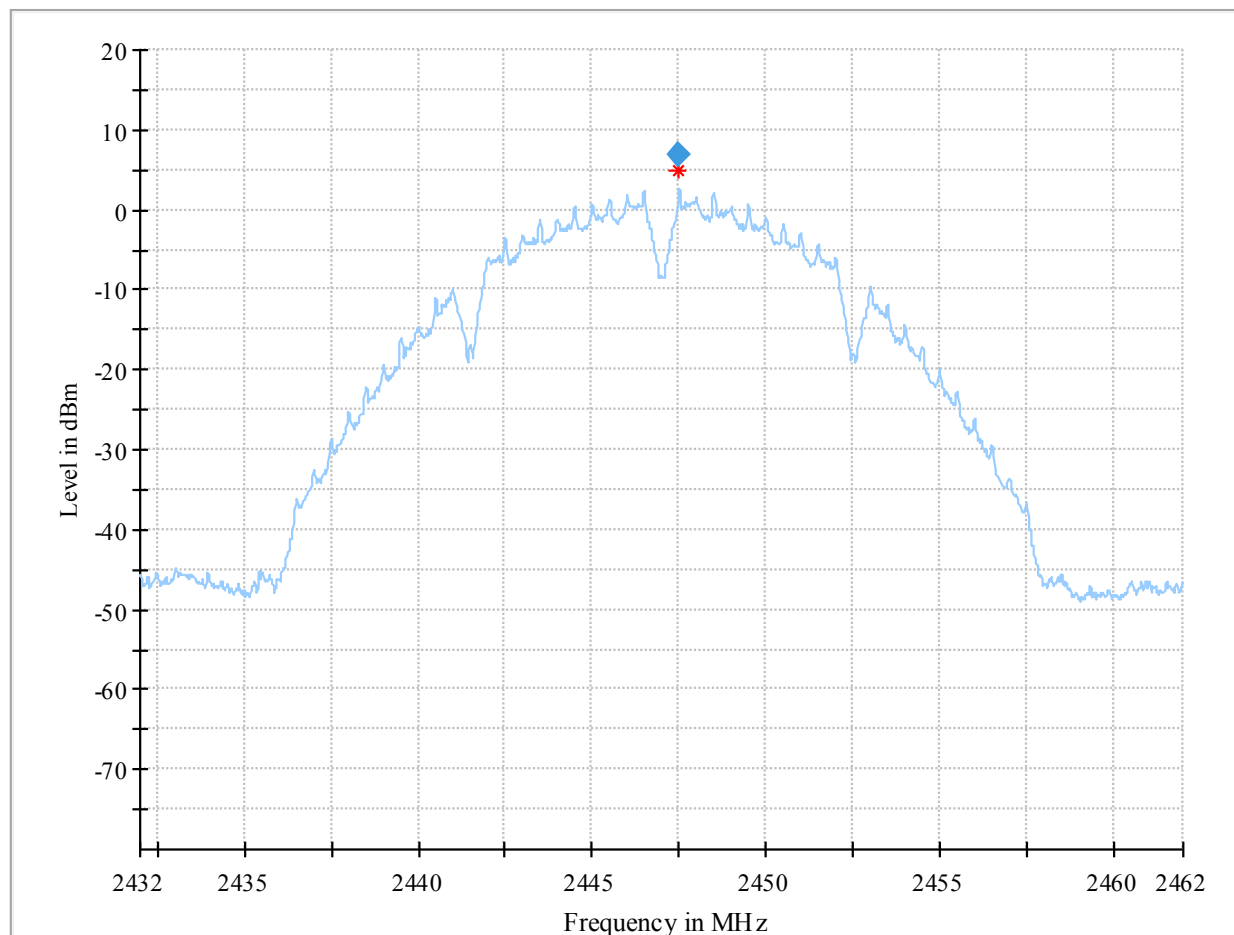
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2412.500000	8.91	---	---	100.0	1000.000	150.0	V	58.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2412.500000	90.0	-62.1	10:04:38 - 02.08.2021

Plot 29: Mode 1, Peak EIRP, mid channel



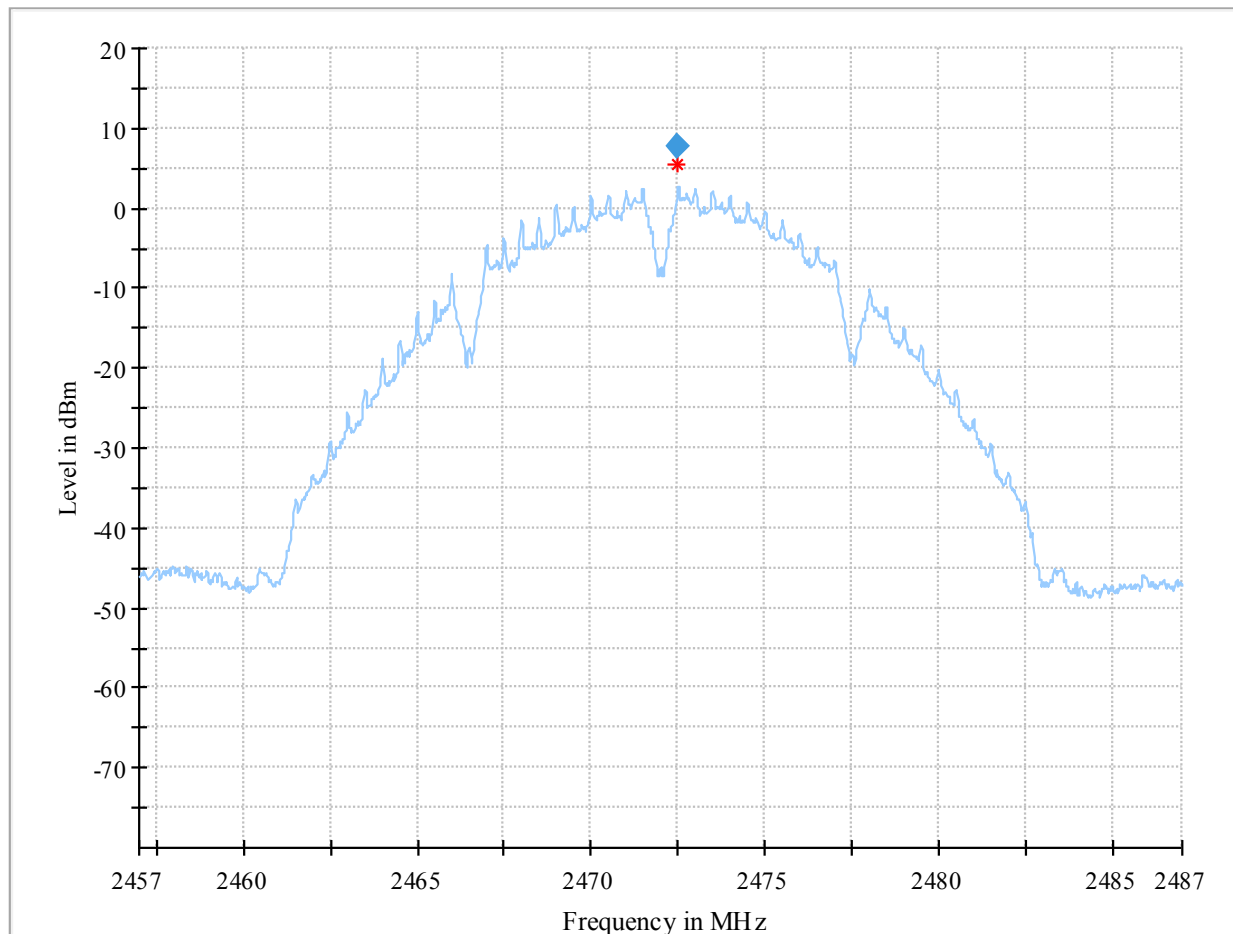
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2447.500000	6.79	---	---	100.0	1000.000	150.0	V	-1.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2447.500000	90.0	-61.9	10:21:41 - 02.08.2021

Plot 30: Mode 1, Peak EIRP, high channel



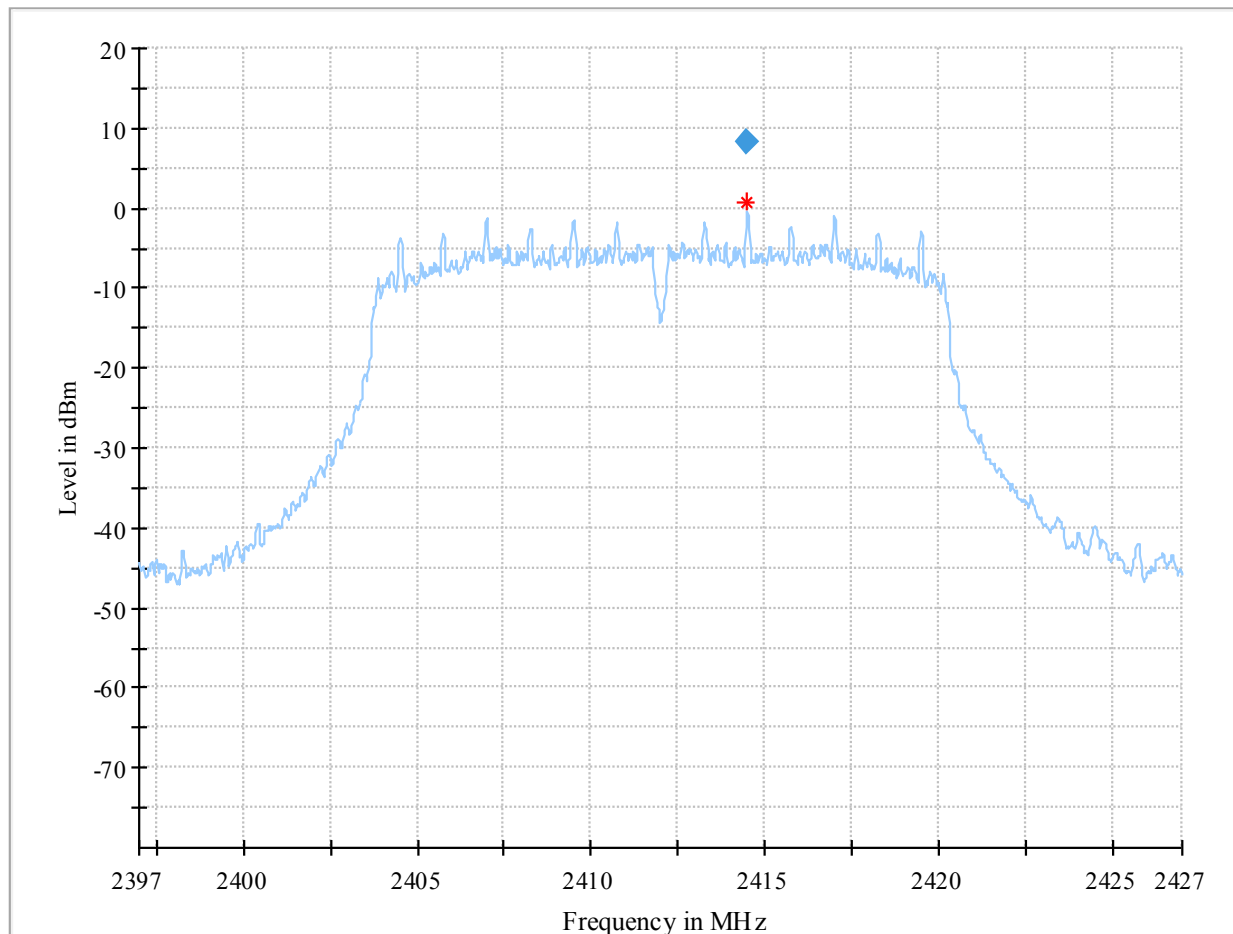
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2472.500000	7.63	---	---	100.0	1000.000	150.0	V	60.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2472.500000	90.0	-61.6	10:38:37 - 02.08.2021

Plot 31: Mode 2, Peak EIRP, low channel



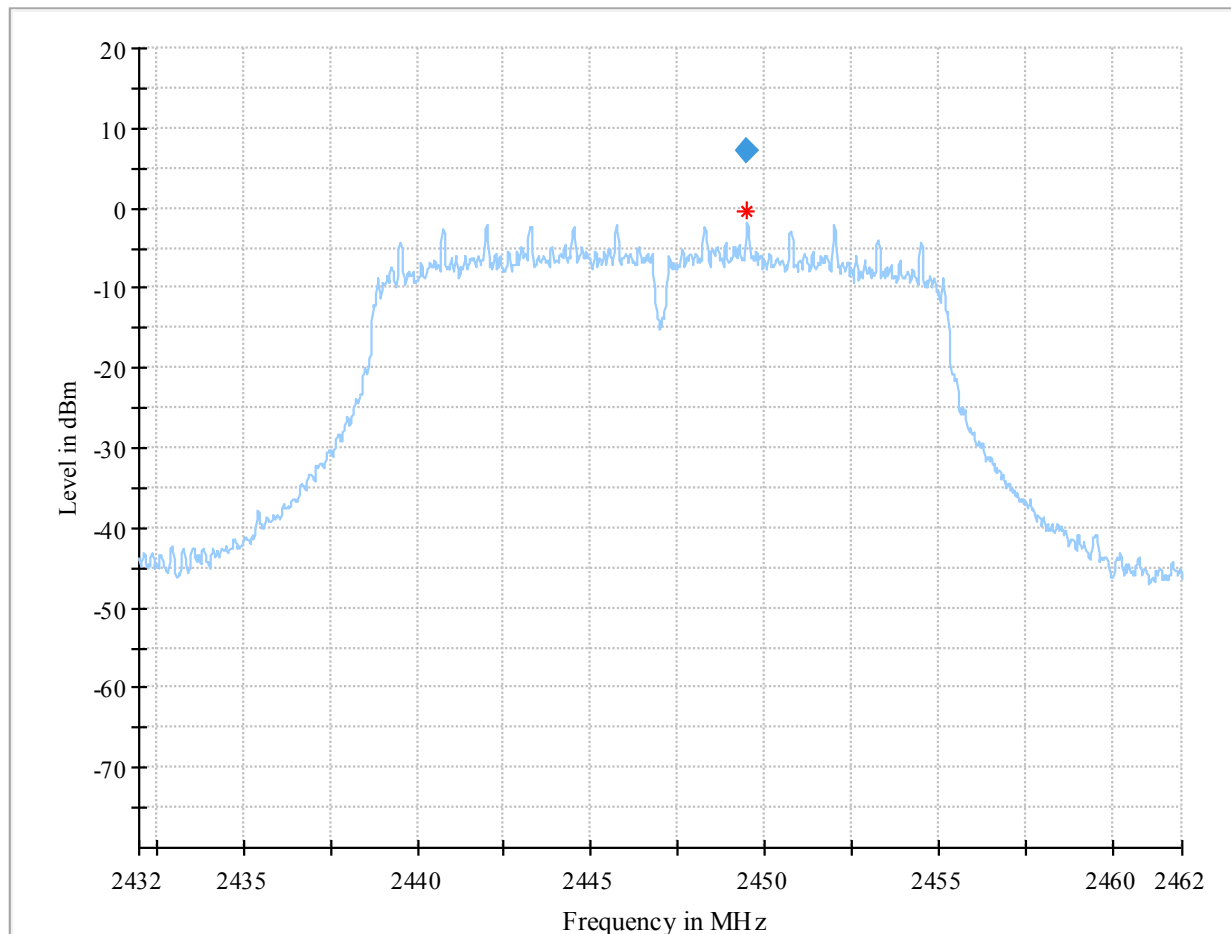
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2414.500000	8.28	---	---	100.0	1000.000	150.0	V	59.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2414.500000	90.0	-62.1	11:50:39 - 02.08.2021

Plot 32: Mode 2, Peak EIRP, mid channel



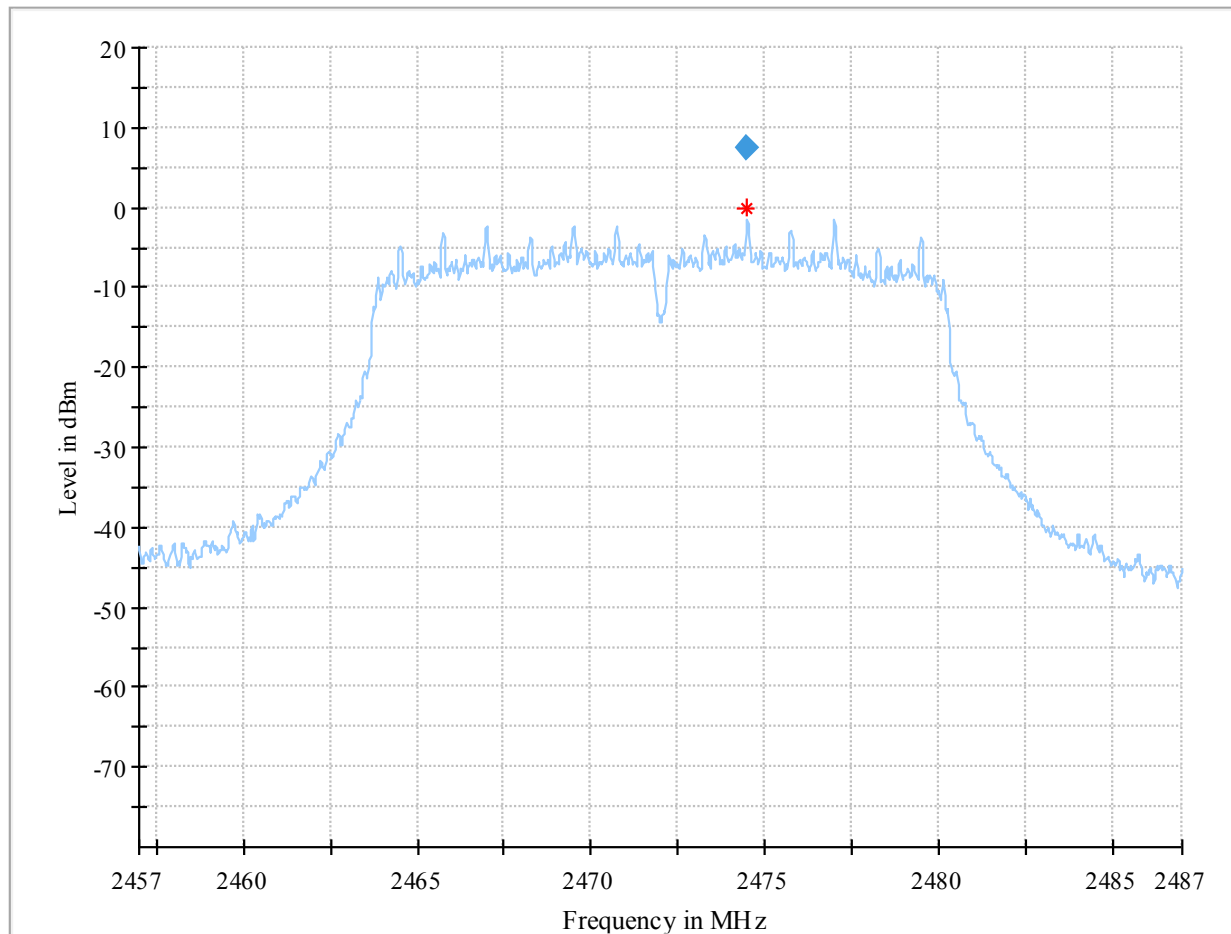
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2449.500000	7.11	---	---	100.0	1000.000	150.0	V	-7.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2449.500000	90.0	-61.8	12:06:05 - 02.08.2021

Plot 33: Mode 2, Peak EIRP, high channel



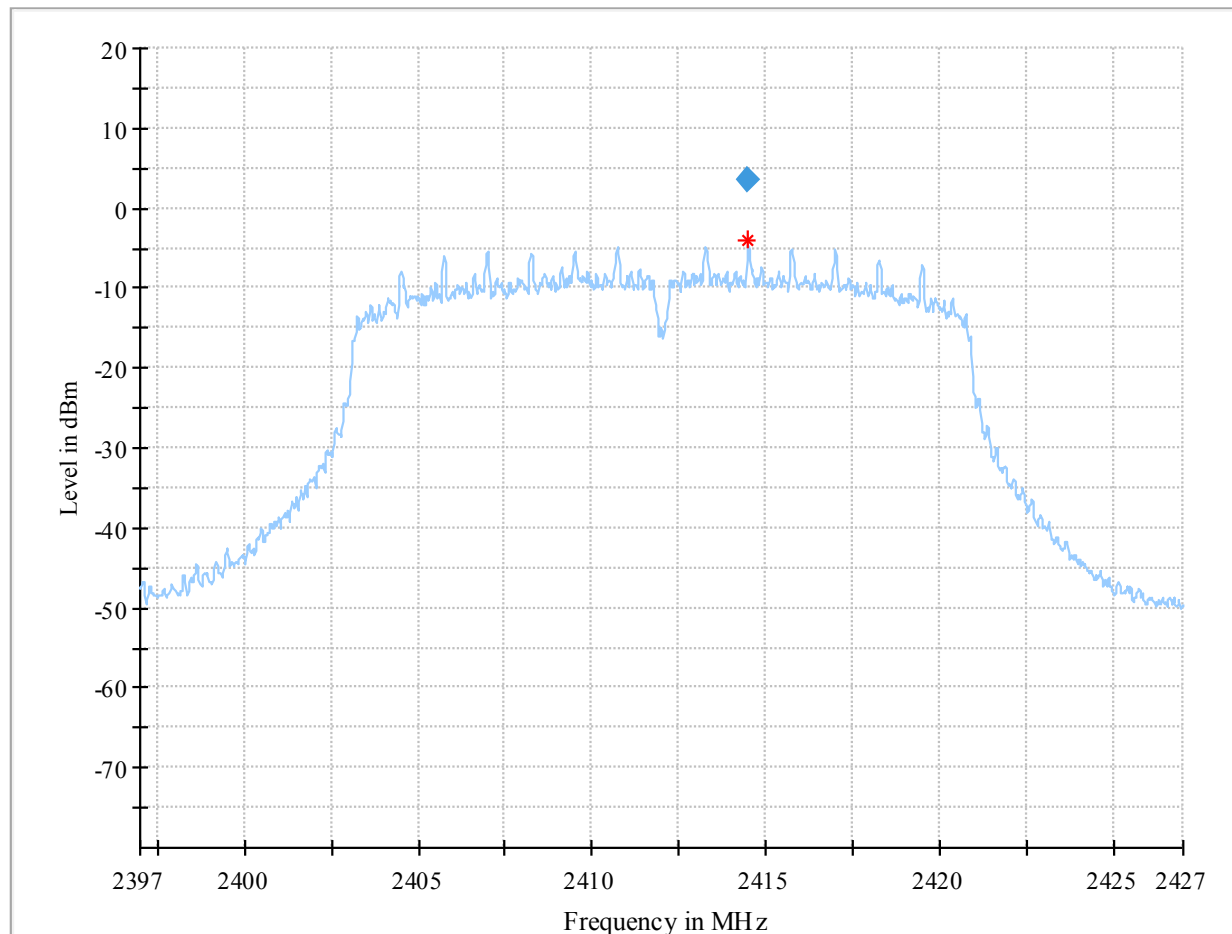
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2474.500000	7.55	---	---	100.0	1000.000	150.0	V	60.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2474.500000	90.0	-61.6	12:29:56 - 02.08.2021

Plot 34: Mode 3, Peak EIRP, low channel



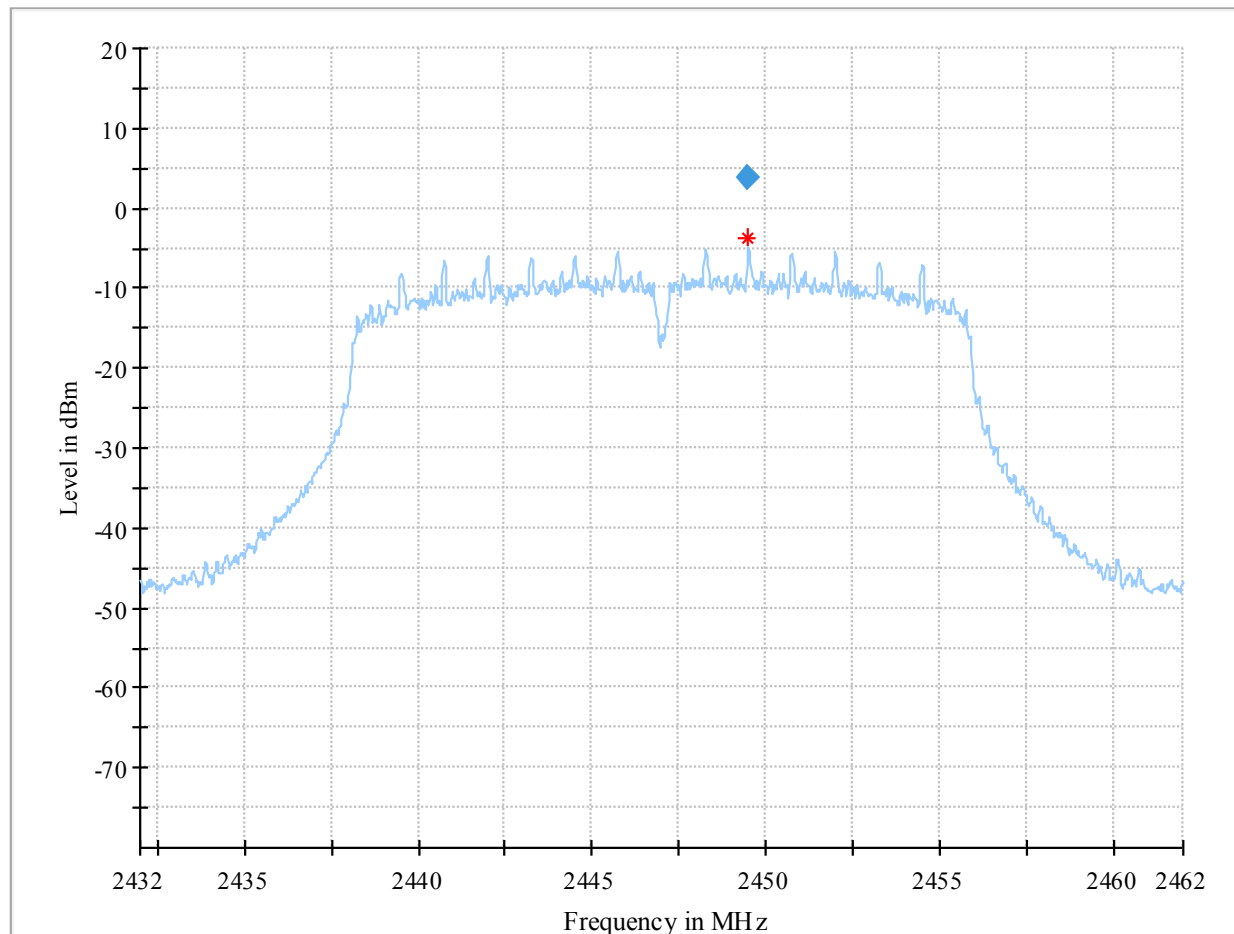
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2414.500000	3.61	---	---	100.0	1000.000	150.0	V	58.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2414.500000	90.0	-62.1	13:30:50 - 02.08.2021

Plot 35: Mode 3, Peak EIRP, mid channel



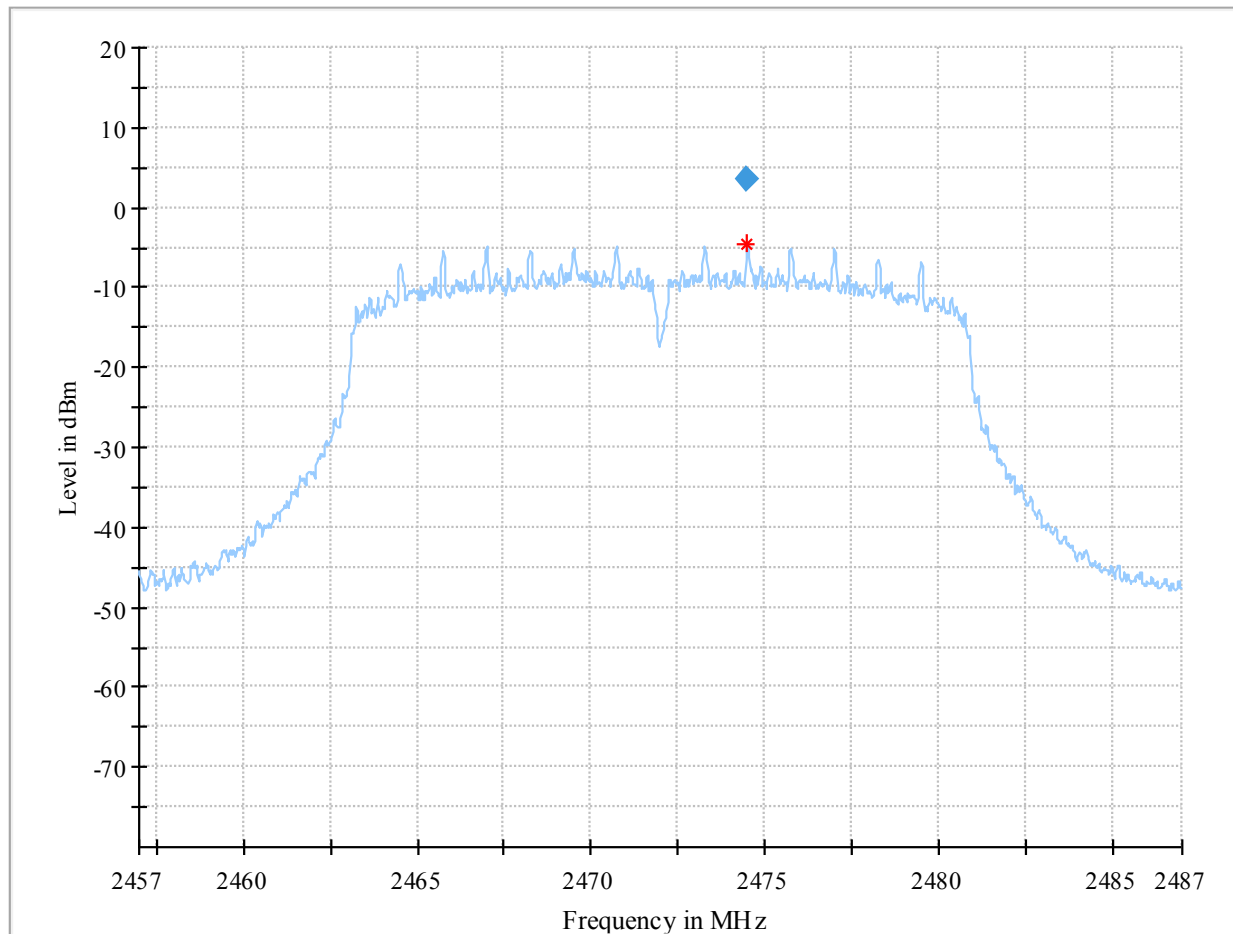
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2449.500000	3.89	---	---	100.0	1000.000	150.0	V	-8.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2449.500000	90.0	-61.8	13:46:29 - 02.08.2021

Plot 36: Mode 3, Peak EIRP, high channel



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2474.500000	3.59	---	---	100.0	1000.000	150.0	H	139.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Elevation (deg)	Corr. (dB)	Comment
2474.500000	90.0	-61.6	15:10:38 - 02.08.2021

7.5 Peak Power Spectral Density (PSD)

Applicability

This requirement applies to all types of DTS equipment.

Description

The Power Spectral Density (PSD) is defined as the conducted peak power spectral density in a 3 kHz bandwidth during any time of continuous transmission.

Limits

§15.247

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test procedure

ANSI C63.10, 11.10.2

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

Test setup: 8.4 with conducted sample (see 5.2)

Test Results

EUT Mode	Peak Power Spectral Density [dBm / 3 kHz]			Limit [dBm / 3 kHz]
	low channel	mid channel	high channel	
Mode 1	2.1	2.1	1.9	8

Comment:

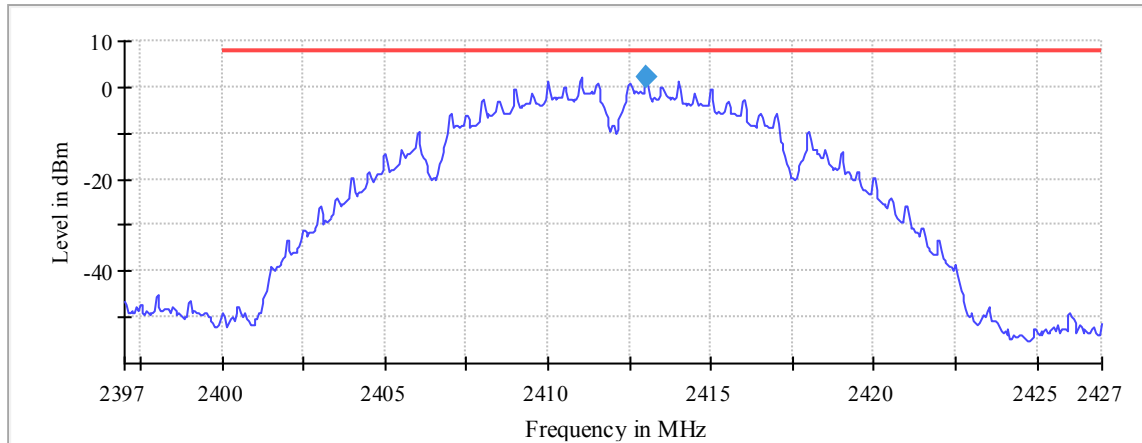
Verdict

- PASS -

see next plots

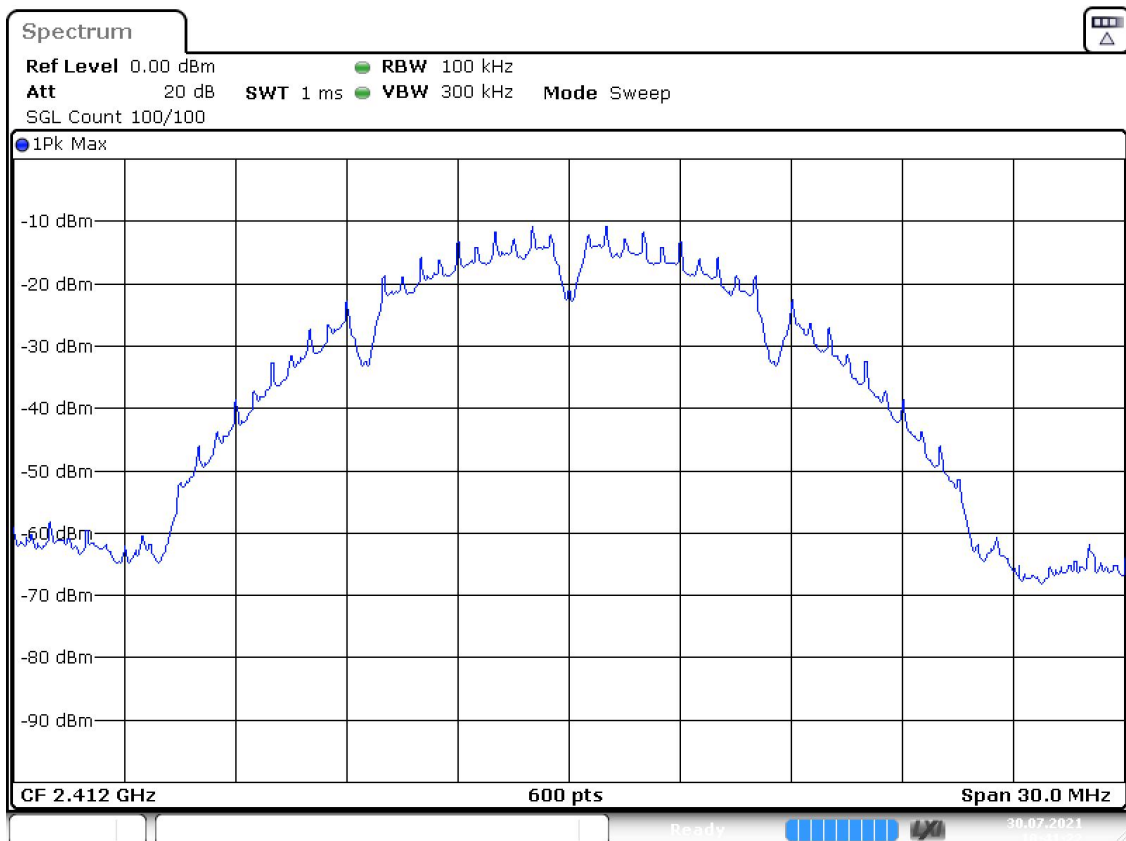
Plot 37: Mode 1, Peak PSD, low channel

Peak Power Spectral Density



— Limit — Sum Level ◆ PSD

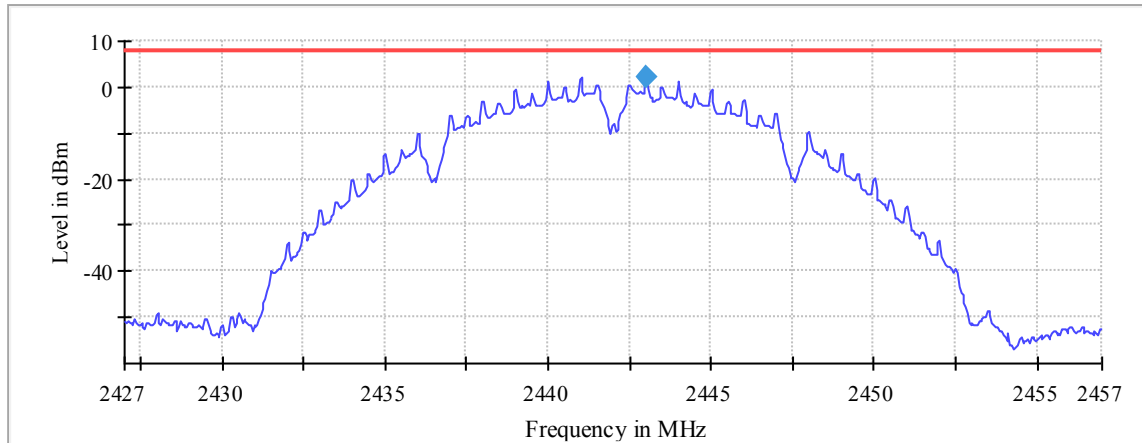
DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2412.000000	2413.025000	2.110	8.0	PASS



Date: 30.JUL.2021 10:41:22

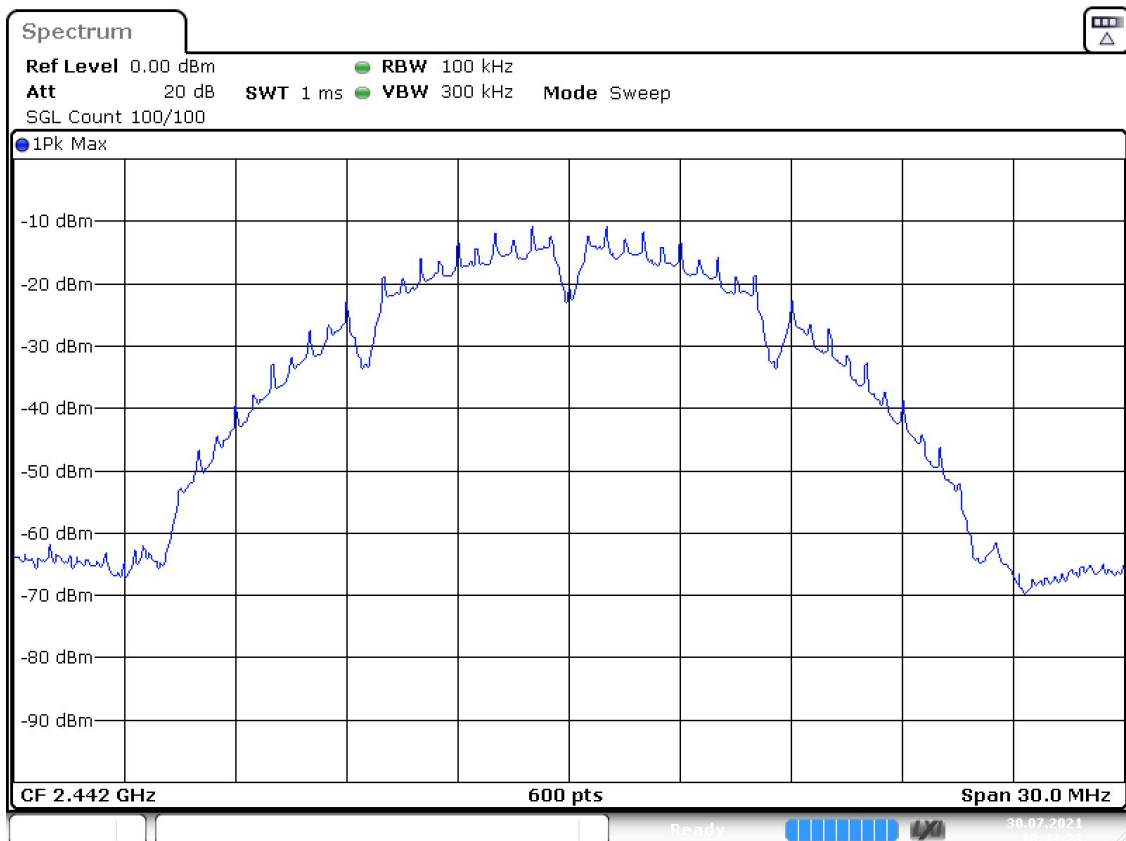
Plot 38: Mode 1, Peak PSD, mid channel

Peak Power Spectral Density



— Limit — Sum Level ◆ PSD

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2442.000000	2443.025000	2.052	8.0	PASS



Date: 30.JUL.2021 10:43:24