DAkkS Deutsche Akkreditierungsstelle D-PL-21375-01-00

INGENIEURBÜRO LENHARDT

Bundesnetzagentur

BNetzA-CAB-21/21-21

Test Report

Test report no.: 23018362-32583-0
Date of issue: 2023-11-15

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

Applicant
Robert Bosch GmbH

Manufacturer
Robert Bosch GmbH

Test Item
F5CP32

RF-Spectrum Testing according to:

FCC 47 CFR Part 95
Personal radio services,
Subpart M - The 76-81 GHz Band Radar Service

Tested by (name, function, signature)	*Sebastian Janoschka* *Head of Dept. RF*	signature
Approved by (name, function, signature)	*Karsten Geraldy* *Senior Lab Manager RF*	signature

Applicant and Test item details	
Applicant	Robert Bosch GmbH Diamlerstrasse 6 71229, Leonberg, Germany Phone: + 49 71140040990 Fax: + 49 71140040999
Manufacturer	Robert Bosch GmbH Diamlerstrasse 6 71229, Leonberg, Germany
Test item description	Radar Sensor
Model/Type reference	F5CP32
FCC ID	N/A
Frequency	76.0 GHz to 77.0 GHz
Antenna	integrated patch antenna
Power supply	7.0 to 16.0 V DC
Temperature range	-40 °C to +85 °C

Disclaimer and Notes

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

Decision rule:
Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2 according to 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 St. Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: https://ib-lenhardt.com/ E-Mail: info@ib-lenhardt.com
Accreditation / Designation	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: • Attachment to the accreditation certificate D-PL-21375-01-00 ○ Electronics ○ Electromagnetic Compatibility ○ Radio ○ Electromagnetic Compatibility and Telecommunication (FCC requirements) ○ Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ○ Automotive EMC Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement. • Designations ○ FCC Testing Laboratory Designation No. DE0024 ○ ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 Kraftfahrt-Bundesamt KBA-P 00120-23
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2023-07-20
Start – End of tests	2023-09-18 – 2023-11-14

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 AC ± 5%

3.2 Normal and extreme test conditions

	minimum	normal	maximum
Temperature	-40 °C	20 °C	+85 °C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	7.0 V DC	13.4 V DC	16.0 V DC

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	**Description**
FCC 47 CFR Part 95	Personal radio services, Subpart M - The 76-81 GHz Band Radar Service

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
ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
KDB 653005 D01, V01, R02	Equipment Authorization Guidance for 76-81 GHz Radar Devices

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product description

Radar Sensor

5.2 Description of test item

Model name*	F5CP32
Serial number*	5100010946600712560302010323135600602267
Hardware status*	02033BB457-80
Software status*	1037609188

*: as declared by applicant

5.3 Technical data of test item

Operational frequency band*	76.0 GHz to 77.0 GHz
Type of radio transmission*	modulated carrier
Modulation type*	FMCW
Number of channels*	1
Channel bandwidth*	< 1 GHz
Channel spacing*	N/A
Receiver category*	N/A
Receiver bandwidth*	N/A
Duty cycle*	~25.5%
Antenna*	integrated patch antenna
Rated RF output power*	< 50 dBm
Power supply*	7.0 to 16.0 V DC
Temperature range*	-40 °C to +85 °C

*: as declared by applicant

5.4 Additional information

Model differences	*w/CP23*
Ancillaries tested with	*-/-*
Additional equipment used for testing	*A notebook and a CANalyzer tool were used to change the running mode of the EUT*

5.5 Operating conditions

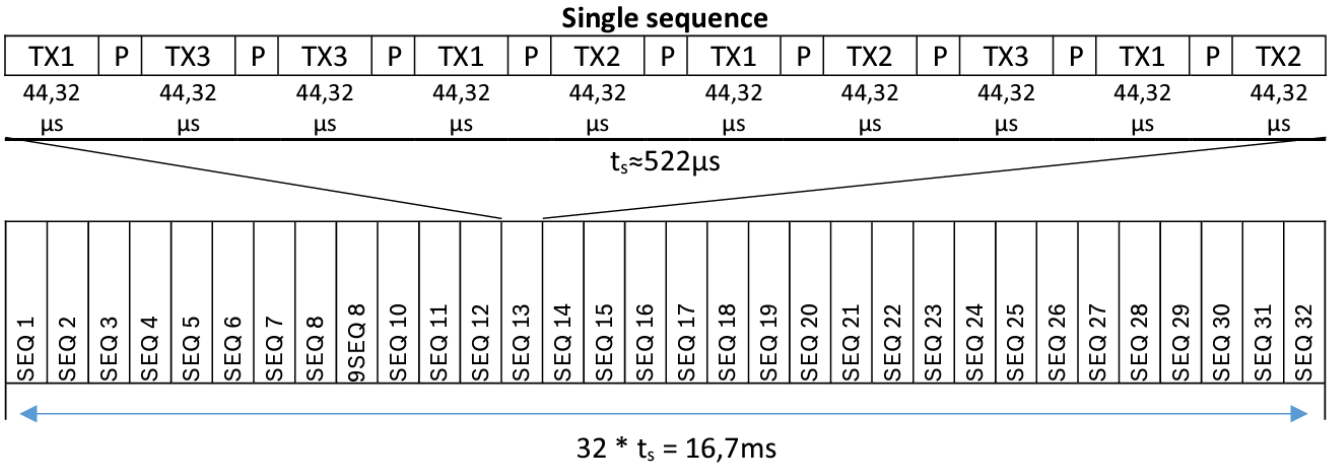
Following information is derived from document "*Technical Description.pdf*", provided by applicant.

4.3 Modulation description

The F5CP32 sensor modulation mode depends on vehicle speed.

Vehicle speed	Modulation mode	Active TX channels
up to 65km/h	DMP7	TX1, TX2, TX3
65km/h – 115 km/h	DMP8	TX1, TX2, TX3
above 115 km/h	DMP9	TX1, TX2, TX3

All modulations use the same basic principle:
The sensor emits a series of fast FMCW chirps. The chirps are grouped in sequence and sequences are grouped in bursts.
A single sequence takes 522µs and consists of 10 chirps around constant centre frequency. Each chirp is emitted on different TX channel and takes 44,32µs. In between chirps transmitter is turned off. In every sequence, 4 chirps are emitted on TX1 antenna, 3 chirps on TX2 and 3 chirps on TX3.
A burst takes 16,7ms and consists of 32 sequences (320 chirps). Centre frequency of each sequence is shifted slightly. Once burst emission is completed, transmitter is turned off until end of cycle.
A single cycle takes 66ms.



4.3.1 DMP07 modulation

Chirp frequency span: 228MHz
Burst frequency span: 618MHz
Occupied bandwidth: 846 MHz

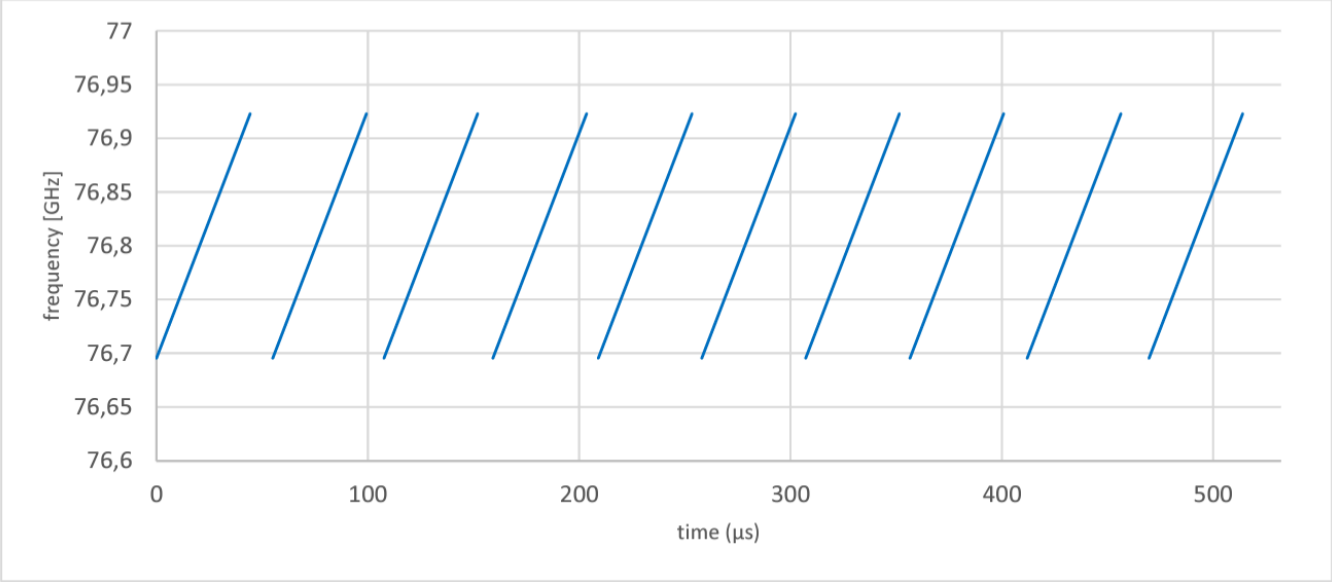


Figure 5: DMP07 single sequence

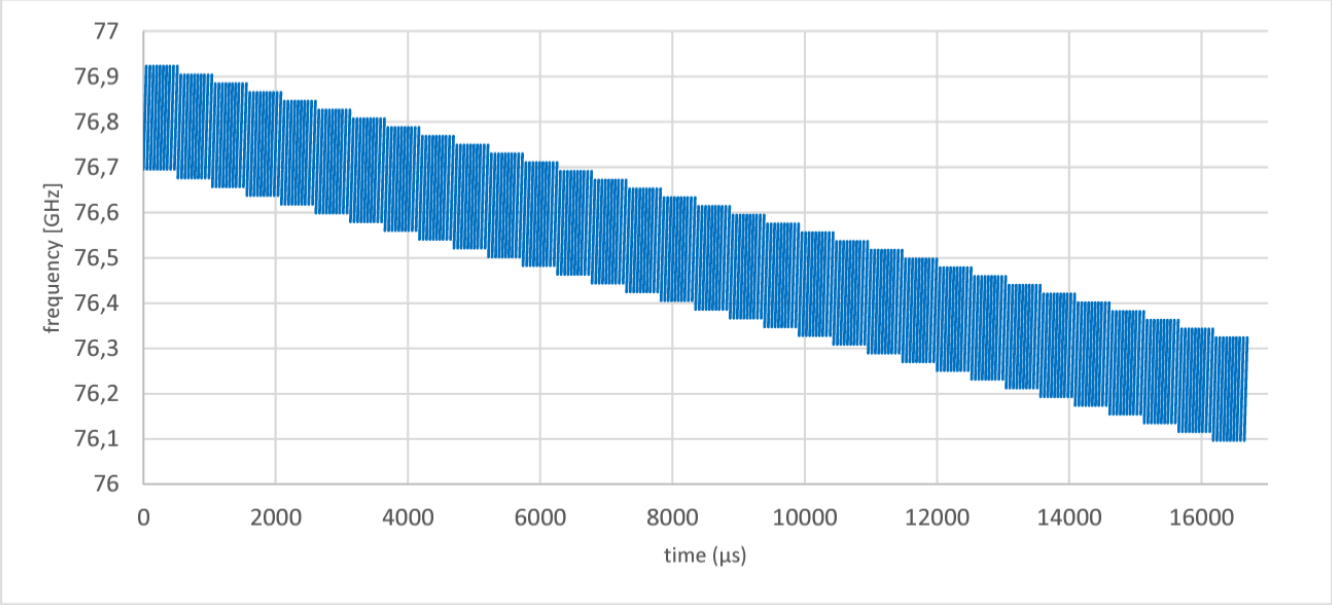


Figure 6: DMP07 single burst

4.3.2 DMP08 modulation

Chirp frequency span: 190 MHz
Burst frequency span: 570 MHz
Occupied bandwidth: 760 MHz

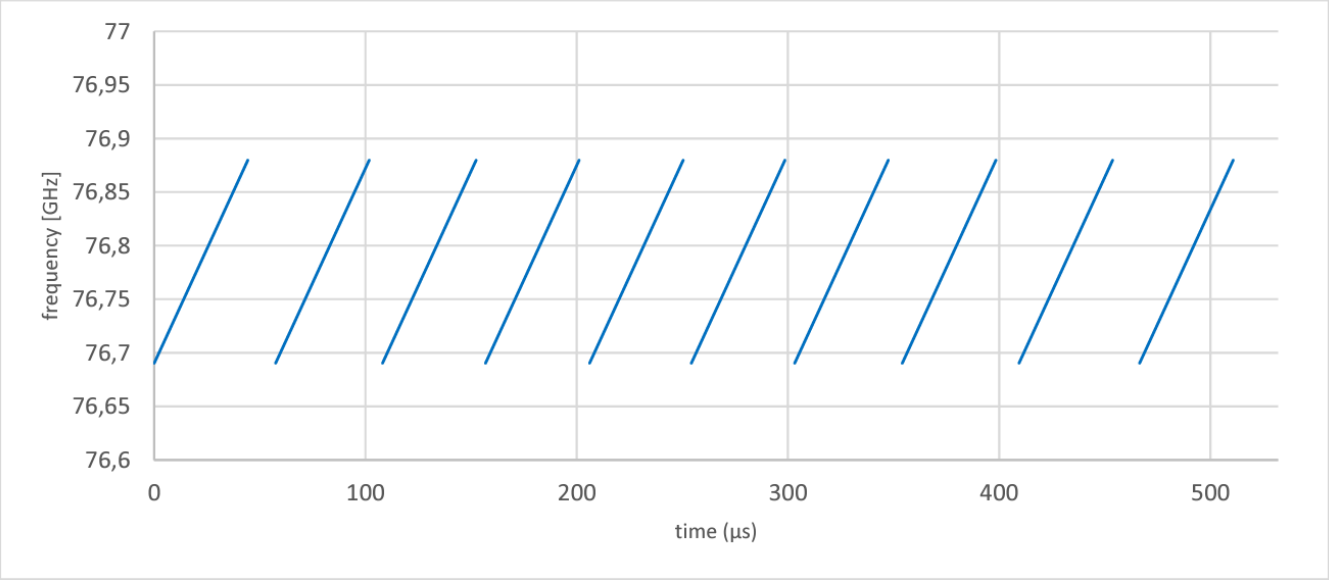


Figure 7: DMP08 single sequence

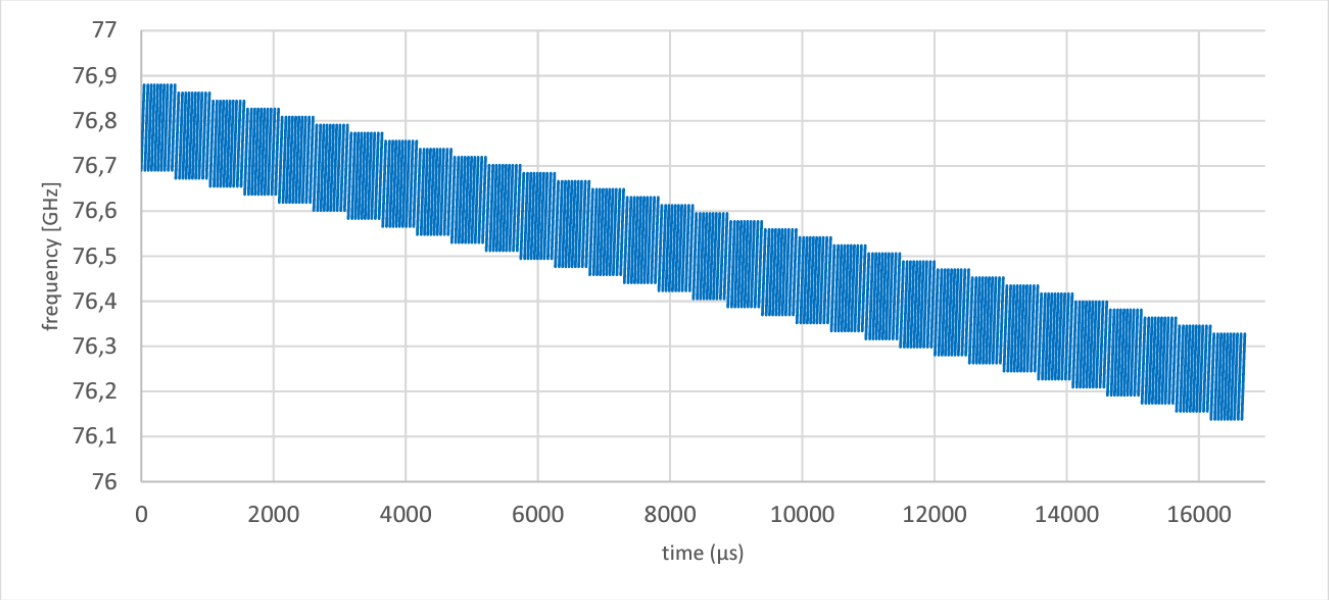


Figure 8: DMP08 single burst

4.3.3 DMP09 modulation

Chirp frequency span: 163 MHz
Burst frequency span: 489 MHz
Occupied bandwidth: 652 MHz

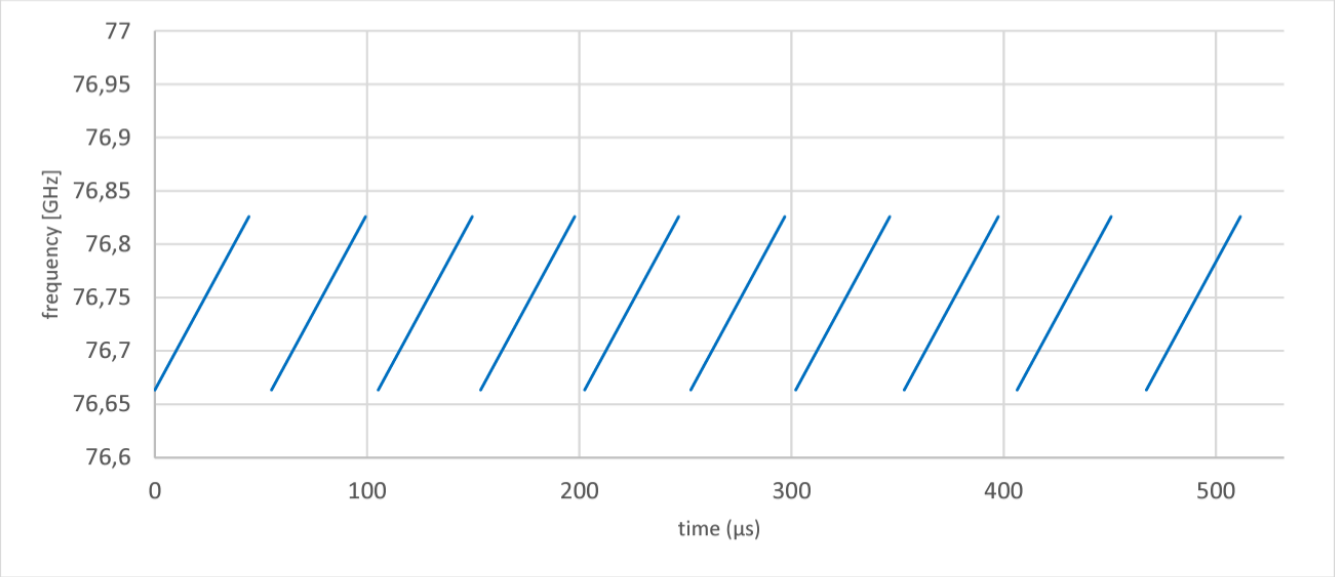


Figure 9: DMP09 single sequence

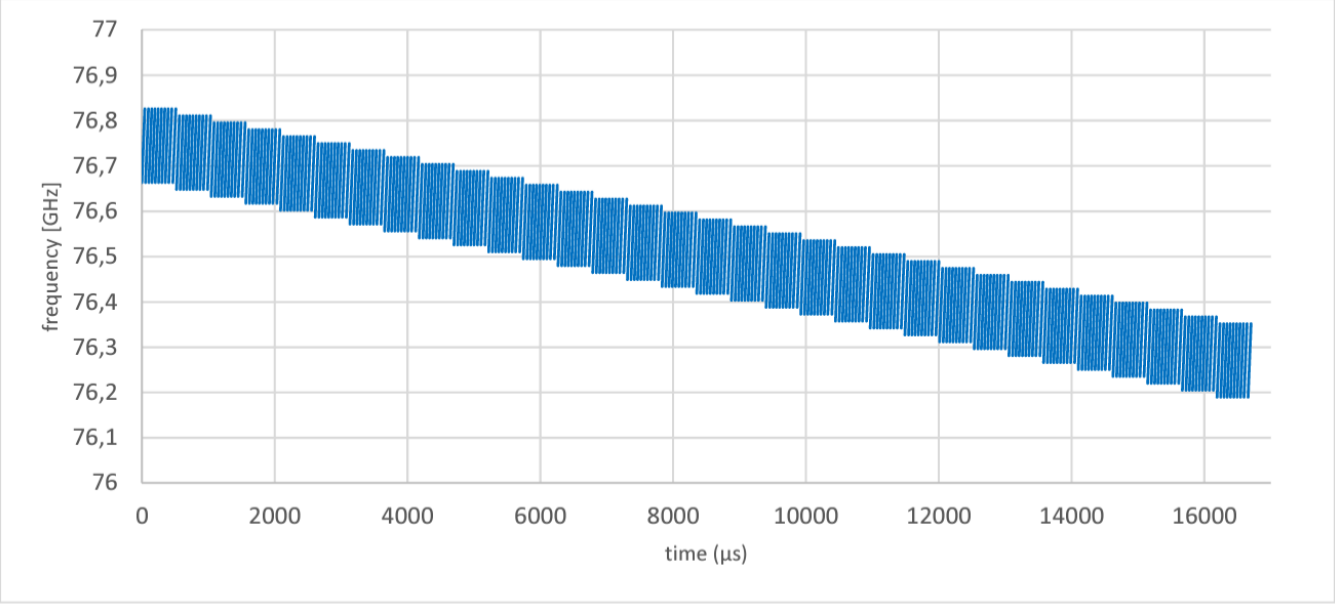


Figure 10: DMP09 single burst

4.4 Duty Cycle

Total duration of a single F5CP32 cycle is always 66ms. Within this time, the sensor transmits a single burst of 16,7ms. Additionally, every 2nd cycle, sensor emits a monitoring signal, which takes 0,29ms.
Therefore, sensor duty cycle:

$$Duty\_cycle = \frac{burst\_length + \frac{monitoring\_length}{2}}{cycle\_length} * 100$$

Modulation mode	**Burst length**	**Duty cycle**
DMP07; DMP08; DMP09	16,7ms	25,5%

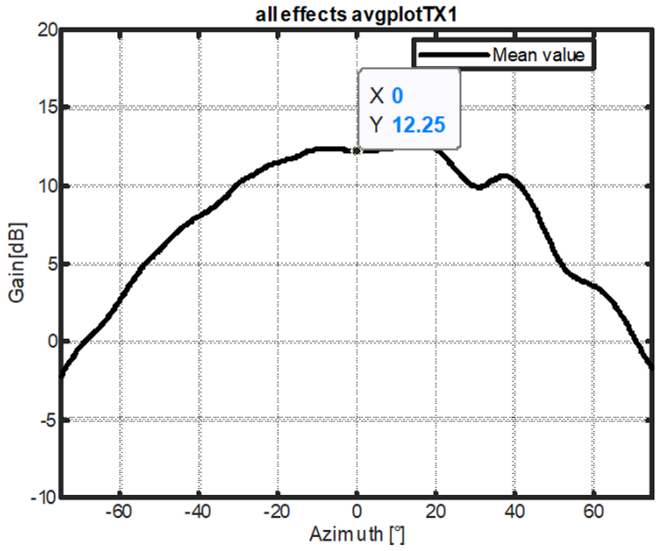
5.6 Antenna characteristics

Following information is derived from document "*Antenna specification.pdf*", provided by applicant.

4.2 Antenna characteristics

4.2.1 TX1 antenna characteristic

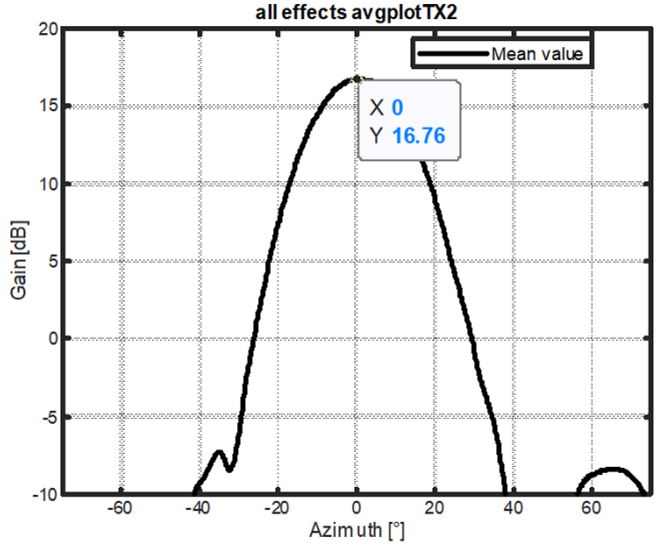
Simulation result of TX1 azimuth antenna characteristic is presented below:



Maximum gain is 12,25dBi

4.2.2 TX2 antenna characteristics

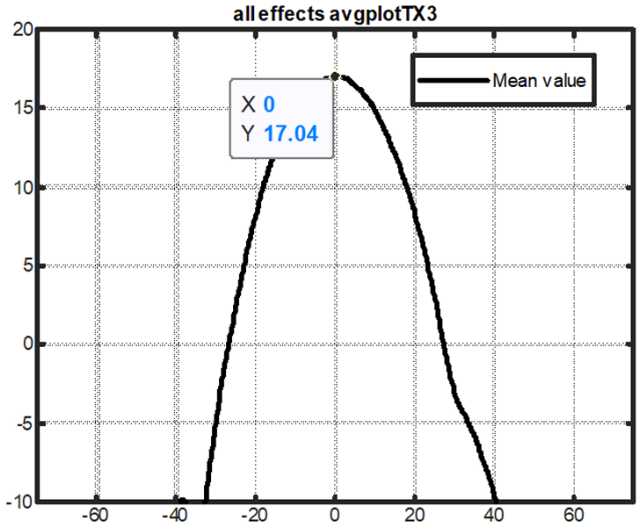
Simulation result of TX2 azimuth antenna characteristic is presented below:



Maximum gain is 16.76dBi.

4.2.3 TX3 antenna characteristics

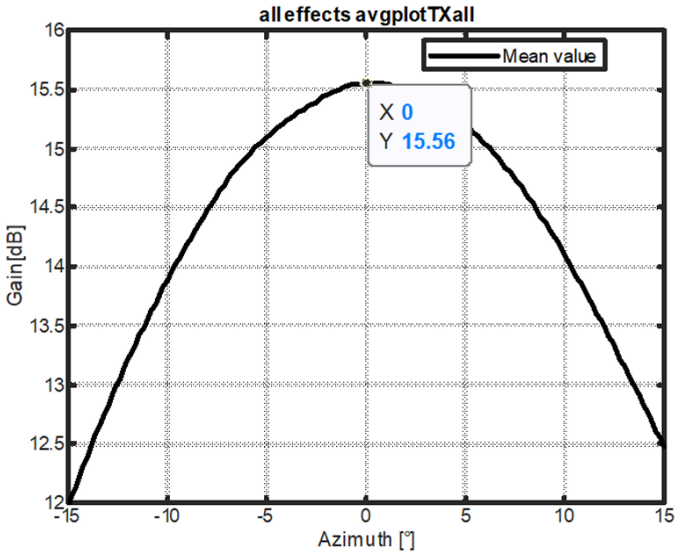
Simulation result of TX3 azimuth antenna characteristic is presented below:



Maximum gain is 17,04dBi.

4.2.4 TXall antenna characteristics

Simulation result of all channels (TX1, TX2, TX3) combined azimuth antenna characteristic is presented below:



Maximum gain is 15,56dBi at distance 1m.

6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 95 – Subpart M

Clause	Requirement / Test case	Test Conditions	Result / Remark	Verdict
§2.1046 §95.3367 (a) (b)	RF power output	Nominal	19.19 dBm mean 29.35 dBm peak	P
§2.1047	Modulation characteristics	Nominal		P
§2.1049 §95.3379 (b)	Occupied bandwidth	Nominal	888 MHz	P
§2.1051	Spurious emissions at antenna terminals	Nominal	see note	N/A
§2.1053 §95.3379 (a)(1) §95.3379 (a)(2) §95.3379 (a)(3)	Field strength of spurious radiation	Nominal	< limit	P
§2.1055 §95.3379 (b)	Frequency stability	Nominal Extreme	within band	P

Notes

FCC's Millimeter Wave Test Procedures:
I. A radiated method of measurements in order to demonstrate compliance with the various regulatory requirements has been chosen in consideration of test equipment availability and the limitations of many external harmonic mixers. A conducted method of measurement could be employed if EUT and mixer waveguides both are accessible and of the same type (WG number) and if waveguide sections and transitions can be found. Another potential problem is that the peak power output may exceed the +20 dBm input power limit of many commercially available mixers. For these reasons a radiated method is preferred.

Comments and observations

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7 TEST RESULTS

7.1 RF power output (§2.1046 & §95.3367)

Description

§2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

Limits

§95.3367 76-81 GHz Band Radar Service radiated power limits

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as follows:

(a) The maximum power (EIRP) within the 76-81 GHz band shall not exceed 50 dBm based on measurements employing a power averaging detector with a 1 MHz Resolution Bandwidth (RBW).

(b) The maximum peak power (EIRP) within the 76-81 GHz band shall not exceed 55 dBm based on measurements employing a peak detector with a 1 MHz RBW.

Test procedure

Mean Power

Method with spectrum analyser

A spectrum analyser with the following settings is used as measuring receiver in the test set-up:

- Start frequency: lower than the lower edge of the operating frequency range.
- Stop frequency: higher than the upper edge of the operating frequency range.
- Resolution bandwidth: 1 MHz.
- Video bandwidth: 3 MHz.
- Detector mode: RMS.
- Display mode: clear write.
- Averaging time: larger than one EUT cycle time.
- Sweep time: averaging time × number of sweep points.

Channel Power function needs to be used to calculate the average power. Boundaries for the calculation needs to be defined. This is typically the operating frequency range.

Method with power meter

The power meter shall be connected to the measurement antenna. The frequency correction factor shall be taken into account. The power meter shall be a true RMS power meter. The measurement time shall be equal or longer than the EUT cycle time.

KDB 653005 D01 76-81 GHz Radars v01r02, 4. b)

The maximum fundamental emission power (EIRP) shall be measured using a power averaging (rms) detector with a 1 MHz resolution bandwidth (RBW) and integrated over the full 99% occupied bandwidth (OBW) to obtain the data necessary to demonstrate compliance to the 50 dBm limit.

Test procedure

Peak Power

Method with a spectrum analyser

A spectrum analyser with the following settings is used as measuring receiver in the test set-up:
• Start frequency: lower than the lower edge of the operating frequency range.
• Stop frequency: higher than the upper edge of the operating frequency range.
• Resolution bandwidth: 1 MHz.
• Video bandwidth: 3 MHz.
• Detector mode: Peak detector.
• Display mode: Maxhold.
• Sweep time: EUT cycle time × number of sweep points.
• Measurement is done until trace is stabilised.
The peak power to be considered is the maximum value recorded.

KDB 653005 D01 76-81 GHz Radars v01r02, 4. c)

The maximum peak fundamental emission power (EIRP) measurement shall be performed by sweeping over the transmitted occupied bandwidth using a positive peak power detector with peak hold activated, and a 1 MHz RBW. Power integration is not to be used in performing this measurement. The resultant peak power spectral density (maximum in any 1 MHz) data shall be used to demonstrate compliance to the 55 dBm/MHz limit.

Peak power measurements of swept frequency radar implementations (e.g., high sweep rate FMCW) may require a desensitization correction factor to be applied to the measurement results. See relevant Application Note(s) from the measurement instrumentation vendor for details.

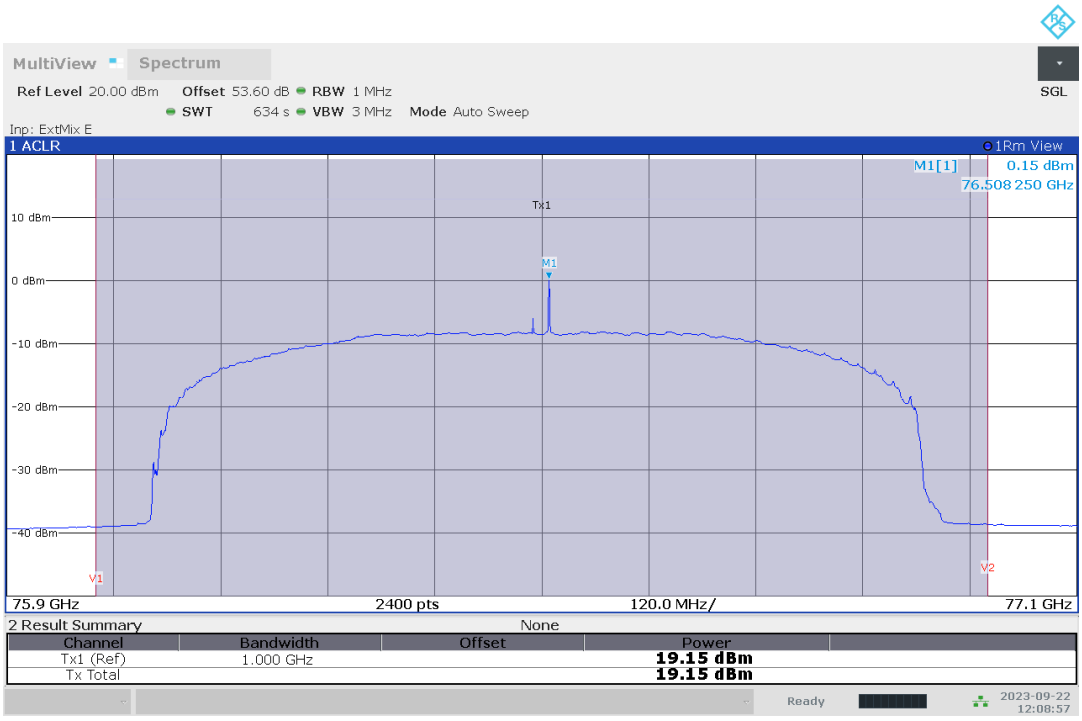
Test procedure used: Method with Spectrum Analyzer

Test setup: 8.3

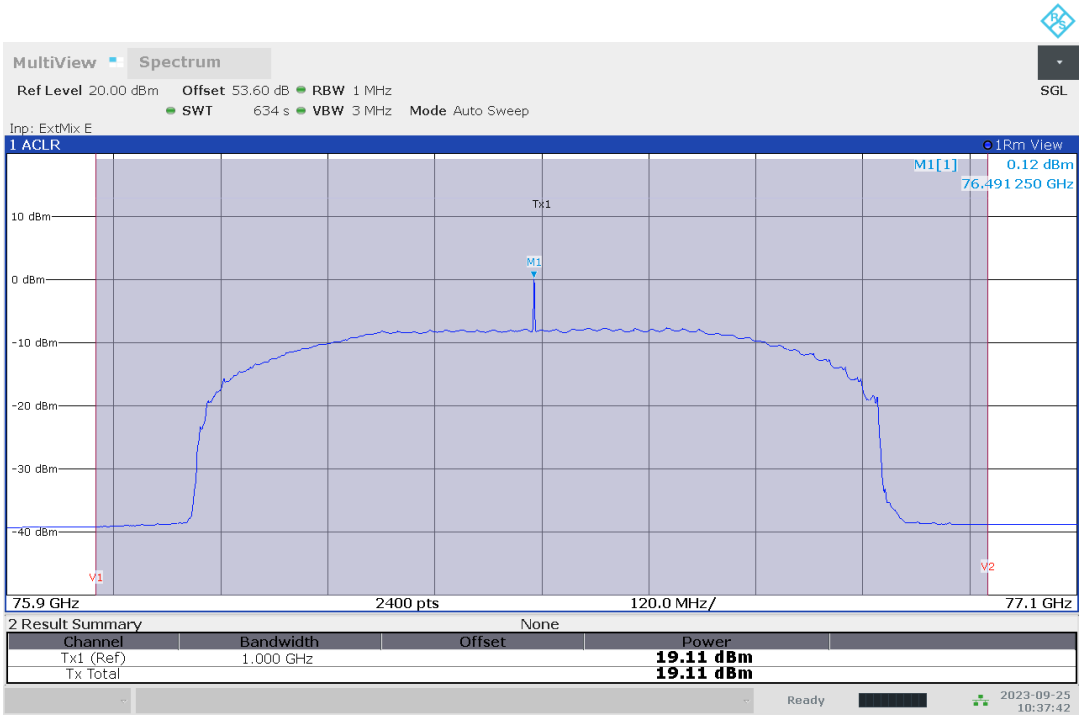
Test results

EUT mode	Test distance	Radiated Mean Power (EIRP) [dBm]	Radiated Peak Power (EIRP) [dBm]
7	1.5 m	19.15	29.34
8	1.5 m	19.11	29.35
9	1.5 m	19.19	29.22

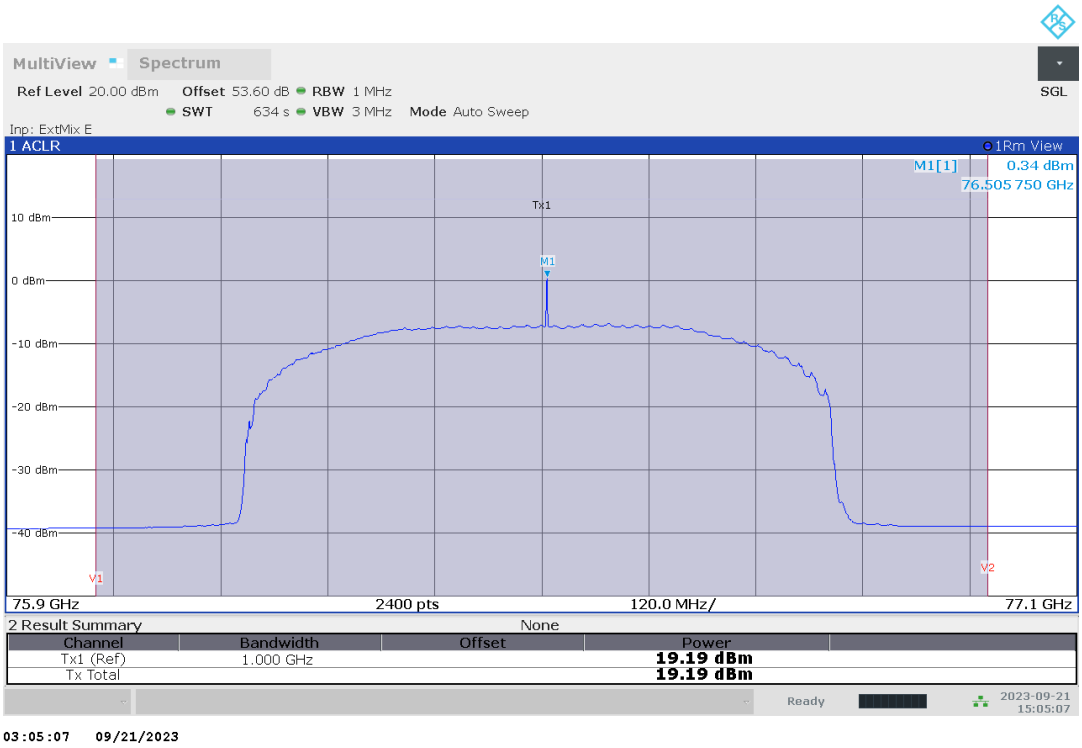
Plot no. 1: Mean Power EIRP, RMS detector / Channel Power, EUT Mode 7



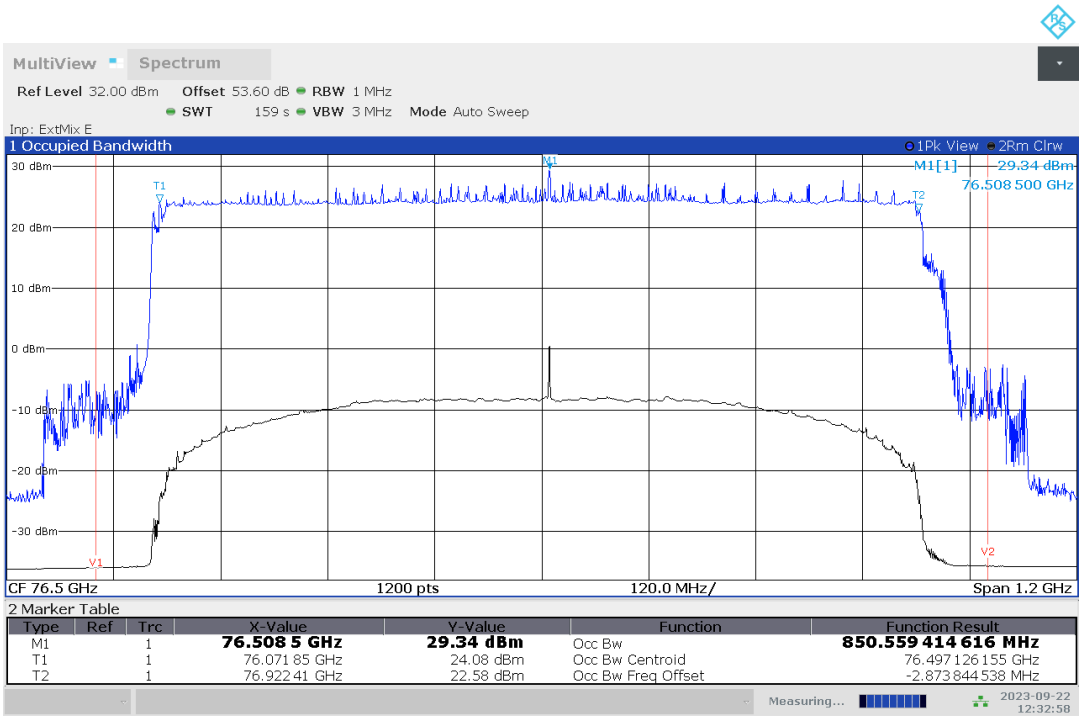
Plot no. 2: Mean Power EIRP, RMS detector / Channel Power, EUT Mode 8



Plot no. 3: Mean Power EIRP, RMS detector / Channel Power, EUT Mode 9



Plot no. 4: Peak Power EIRP, Peak detector, EUT Mode 7



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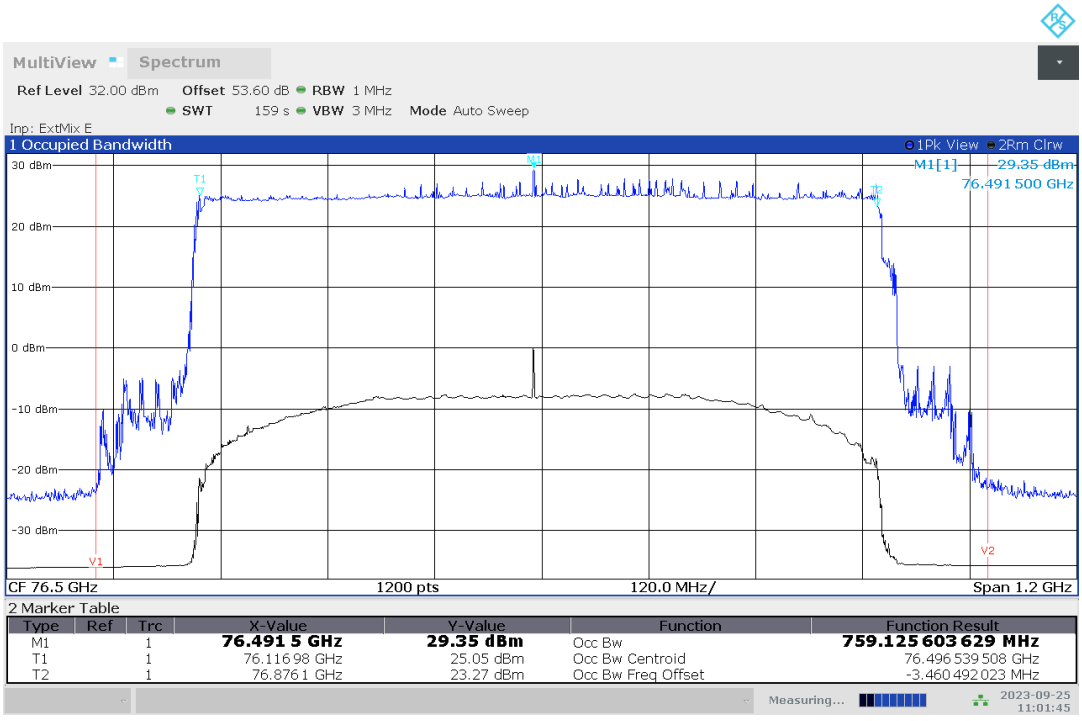
Plot no. 5: Peak Power EIRP, Peak detector, EUT Mode 8



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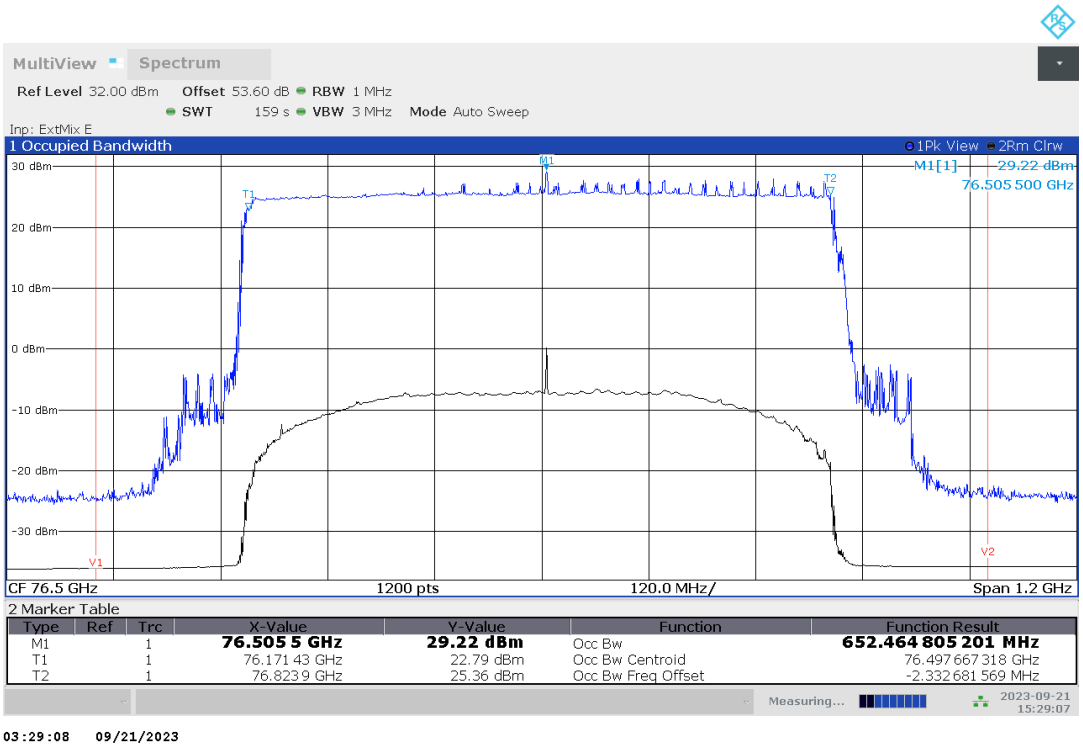
Plot no. 6: Peak Power EIRP, Peak detector, EUT Mode 9



7.2 Modulation characteristics (§2.1047 & KDB 653005 D01 76-81 GHz Radars)

Description

§2.1047 Modulation characteristics

(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

KDB 653005 D01 76-81 GHz Radars v01r02, 3. g)

Concerning the Section 2.1047 modulation characteristics requirement, the following information should be provided:

1) Pulsed radar: pulse width and pulse repetition frequency (if PRF is variable, then report maximum and minimum values).
2) Non-pulsed radar (*e.g.,* FMCW): modulation type (i.e., sawtooth, sinusoid, triangle, or square wave) and sweep characteristics (sweep bandwidth, sweep rate, sweep time).

Statement of applicant / manufacturer concerning modulation characteristics of EUT

Please refer to chapter 5

7.3 Occupied bandwidth (§2.1049 & §95.3379)

Description

§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.

Limits

§95.3379 (b)

Fundamental emissions (i.e. 99% emission bandwidth) must be contained within the frequency bands specified in this section during all conditions of operation.

Test procedure

ANSI C63.26, 5.4.4

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:

a) 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.

b) 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.

c) 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.
Note: Step a) through step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s)

KDB 653005 D01 76-81 GHz Radars v01r02, 4. d)

The occupied bandwidth of the radar device shall be measured, reported, and shown to be fully contained within the designated 76-81 GHz frequency band under normal operating conditions as well as under those extreme ambient temperature and input voltage conditions as described in Section 2.1057.

The OBW measurement of an FMCW radar shall be performed with the transmitter operating in normal mode (i.e., with frequency sweep or step active).

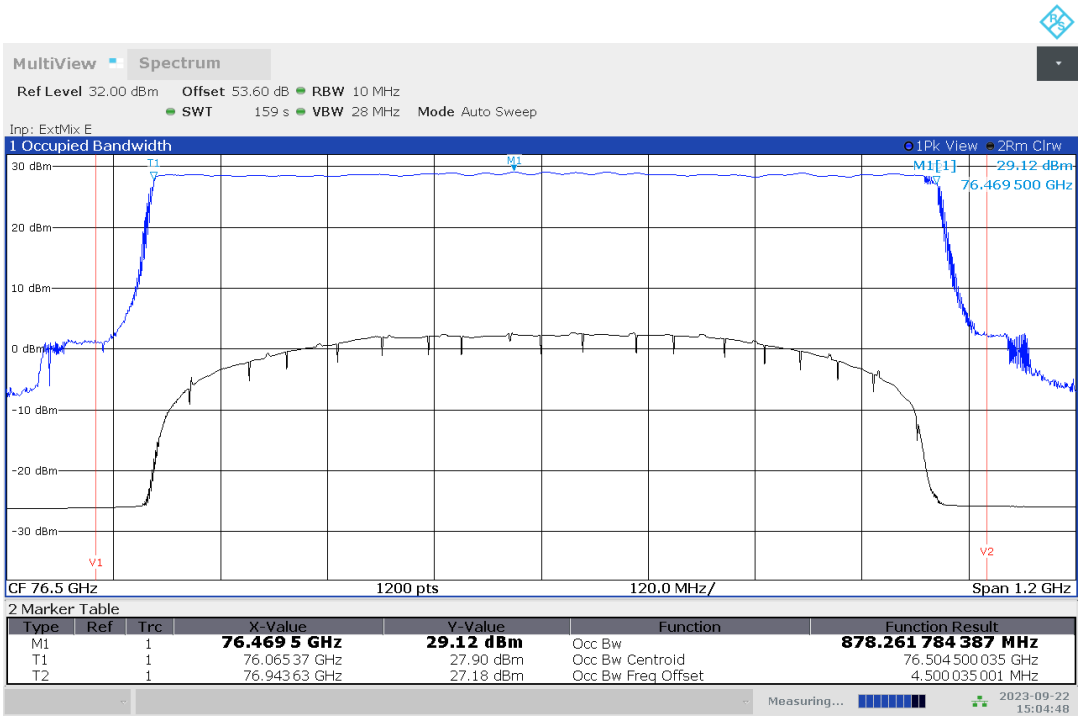
Note

Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.26, chapter D2: general considerations).

Test setup: 8.3, 8.4

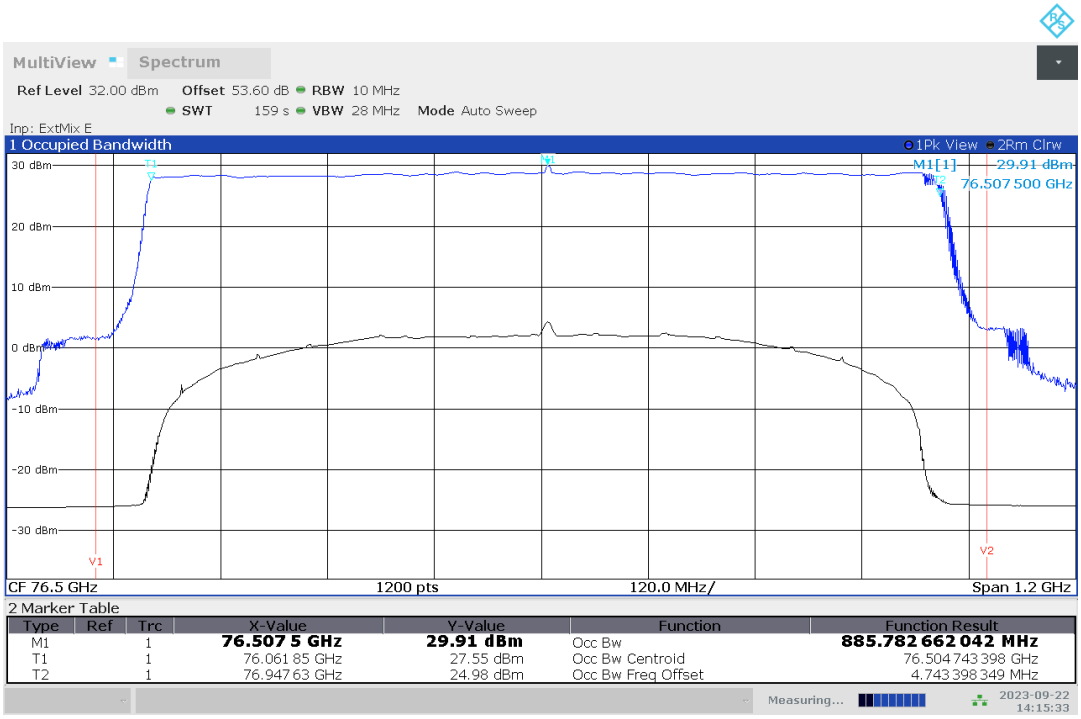
Test results under normal and extreme test conditions:				
EUT mode	**Test conditions**	**f_L [GHz]**	**f_H [GHz]**	**99% OBW [MHz]**
7	85 °C	76.065	76.944	878.262
7	50 °C	76.062	76.948	885.783
7	40 °C	76.064	76.948	883.888
7	30 °C	76.064	76.943	878.669
7	20 °C / V_{max}	76.063	76.943	880.063
7	20 °C / V_{nom}	76.065	76.943	878.536
7	20 °C / V_{min}	76.064	76.945	881.196
7	10 °C	76.063	76.952	**888.461**
7	0 °C	76.067	76.955	888.185
7	-10 °C	76.066	76.948	882.661
7	-20 °C	76.067	76.949	882.218
7	-30 °C	76.067	76.954	887.126
7	-40 °C	76.066	76.952	885.593
8	85 °C	76.112	76.905	793.043
8	50 °C	76.108	76.890	782.041
8	40 °C	76.108	76.895	787.367
8	30 °C	76.107	76.891	783.374
8	20 °C / V_{max}	76.108	76.897	788.904
8	20 °C / V_{nom}	76.108	76.896	788.110
8	20 °C / V_{min}	76.108	76.893	784.962
8	10 °C	76.109	76.888	779.293
8	0 °C	76.109	76.896	786.985
8	-10 °C	76.110	76.896	786.437
8	-20 °C	76.110	76.892	781.604
8	-30 °C	76.111	76.903	791.274
8	-40 °C	76.112	76.894	782.402
9	85 °C	76.165	76.843	677.686
9	50 °C	76.162	76.837	674.668
9	40 °C	76.161	76.837	675.553
9	30 °C	76.162	76.844	681.866
9	20 °C / V_{max}	76.162	76.842	680.098
9	20 °C / V_{nom}	76.162	76.842	679.955
9	20 °C / V_{min}	76.162	76.838	676.671
9	10 °C	76.163	76.835	672.384
9	0 °C	76.164	76.841	676.962
9	-10 °C	76.164	76.847	682.468
9	-20 °C	76.165	76.843	677.684
9	-30 °C	76.165	76.843	677.688
9	-40 °C	76.166	76.844	677.608
With voltage variation				
Input voltage variation does not affect the transmitted signal (see plots for ambient/normal temperature).				

Plot no. 7: 99% OBW, Peak detector, 85 °C, DMP07



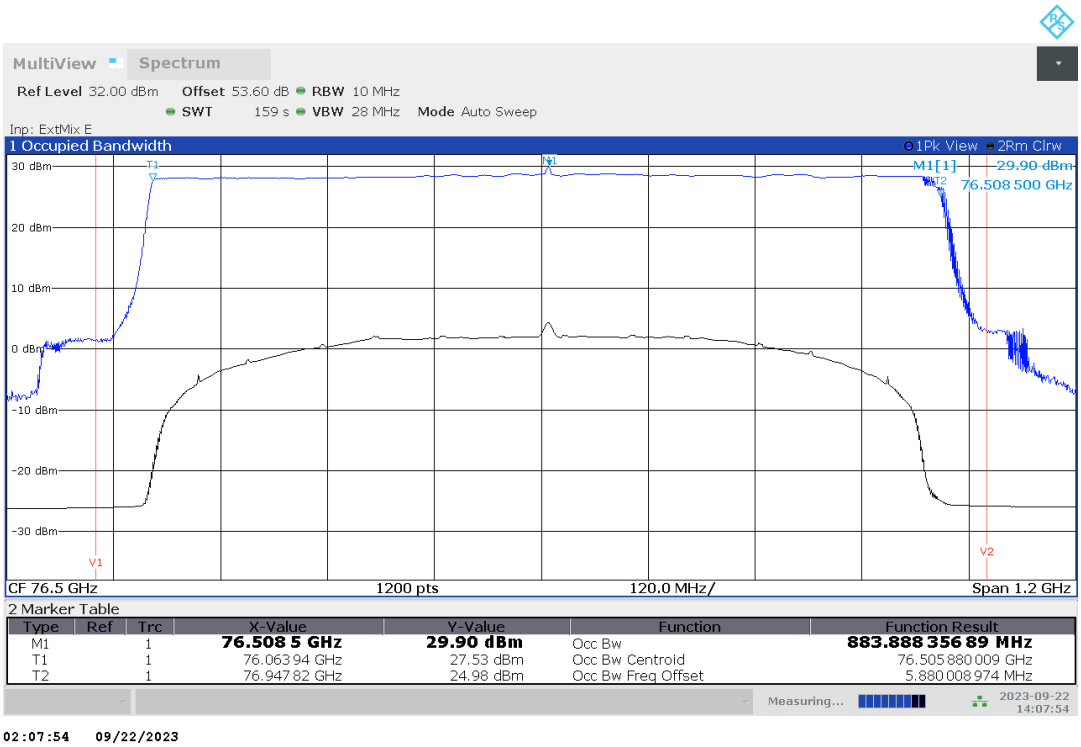
03:04:48 09/22/2023

Plot no. 8: 99% OBW, Peak detector, 50 °C, DMP07

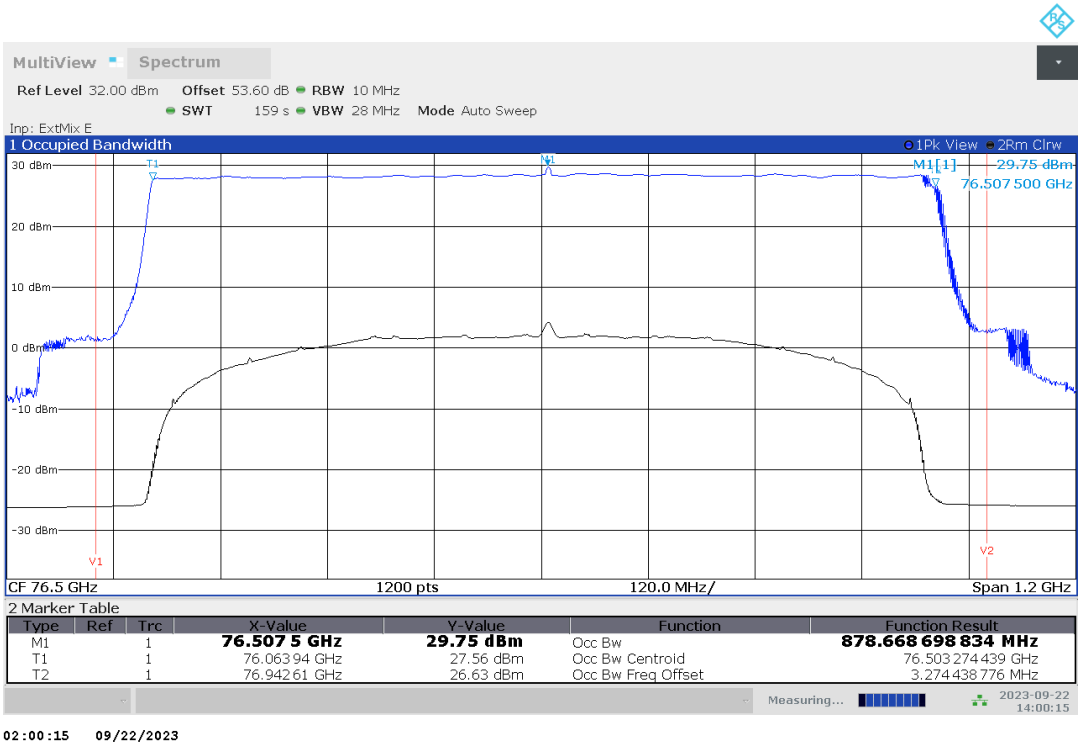


02:15:34 09/22/2023

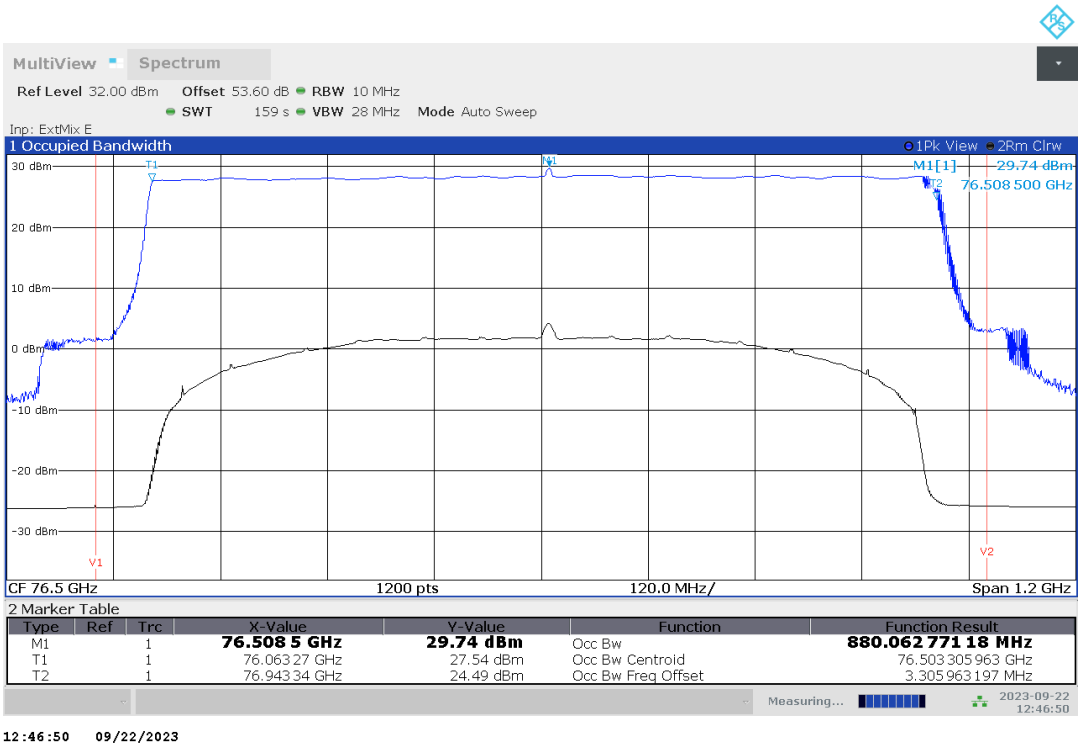
Plot no. 9: 99% OBW, Peak detector, 40 °C, DMP07



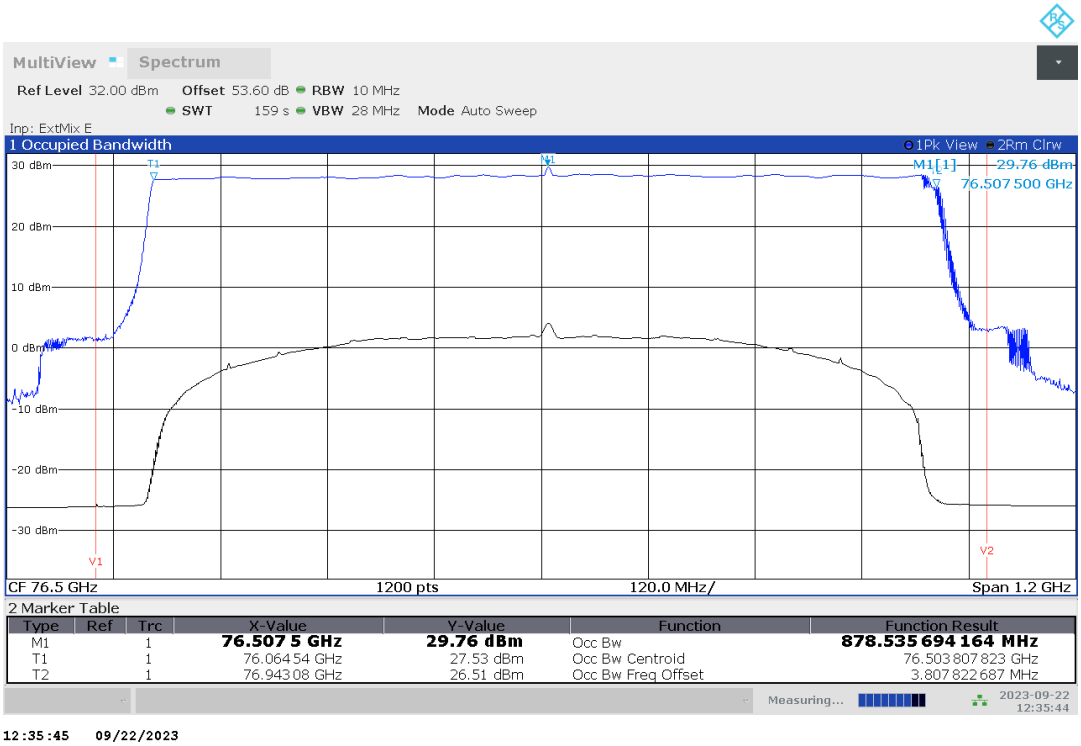
Plot no. 10: 99% OBW, Peak detector, 30 °C, DMP07



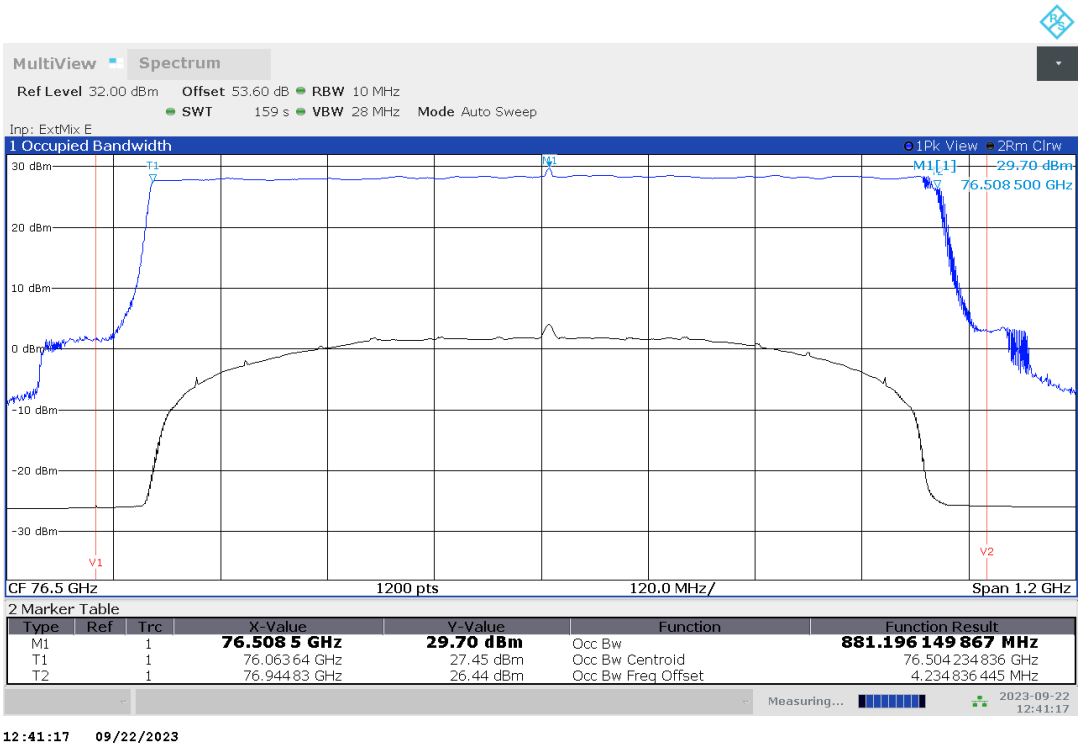
Plot no. 11: 99% OBW, Peak detector, 20 °C, V_{max}, DMP07



Plot no. 12: 99% OBW, Peak detector, 20 °C, V_{nom}, DMP07

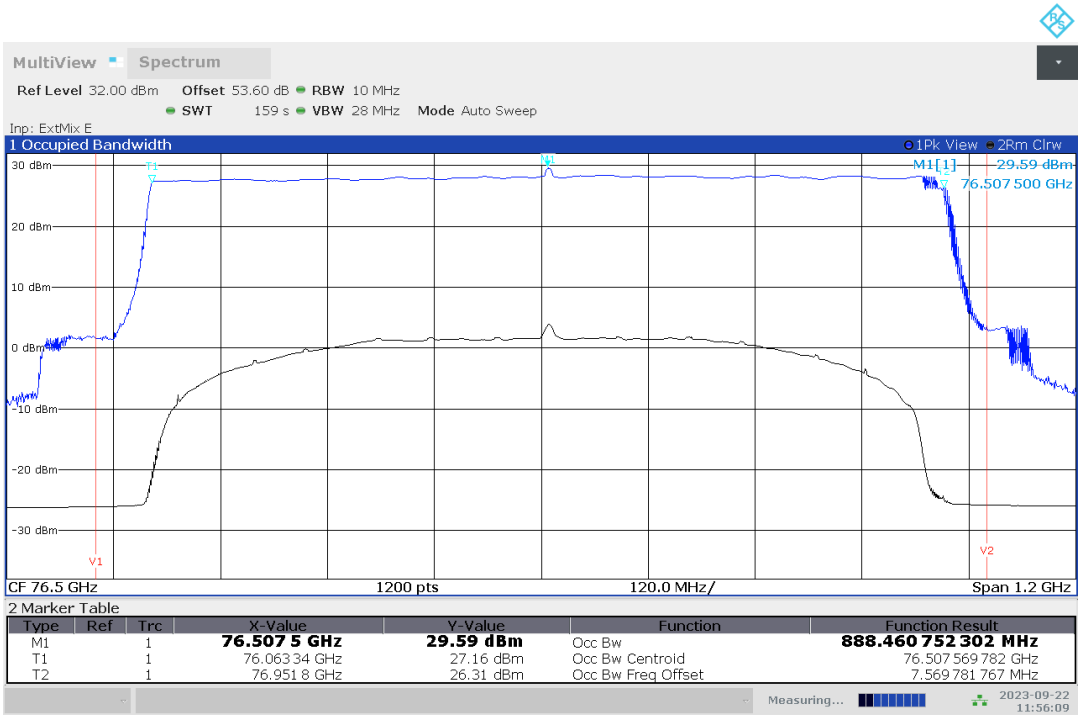


Plot no. 13: 99% OBW, Peak detector, 20 °C, V_{min}, DMP07



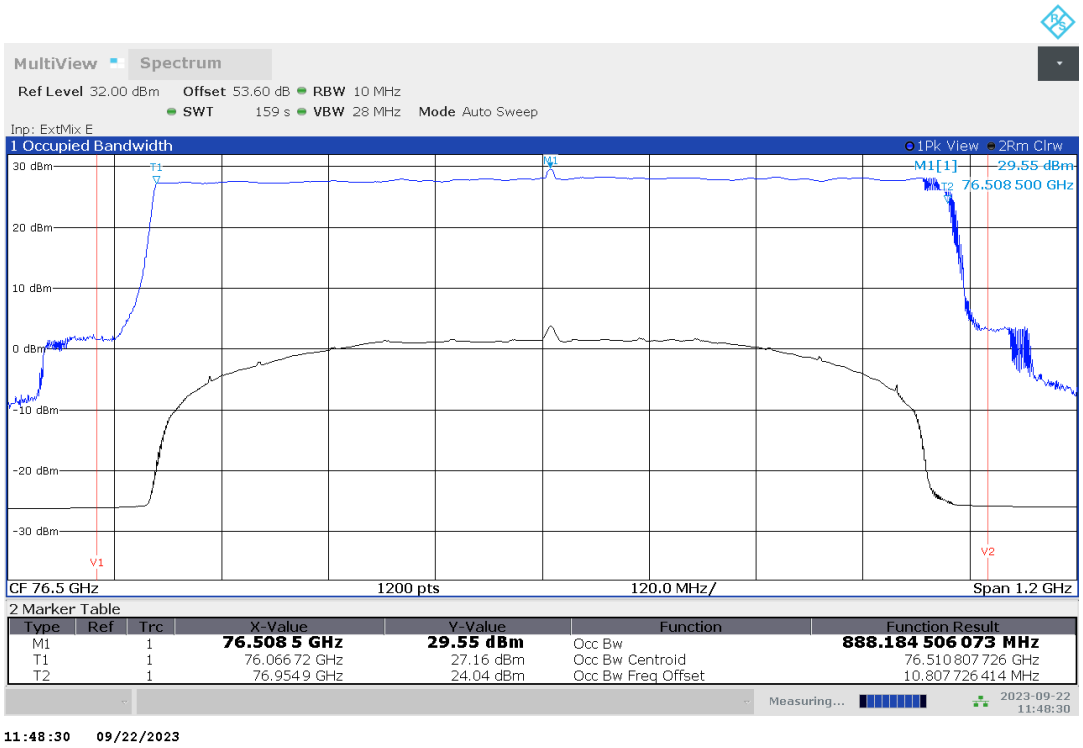
12:41:17 09/22/2023

Plot no. 14: 99% OBW, Peak detector, 10 °C, DMP07



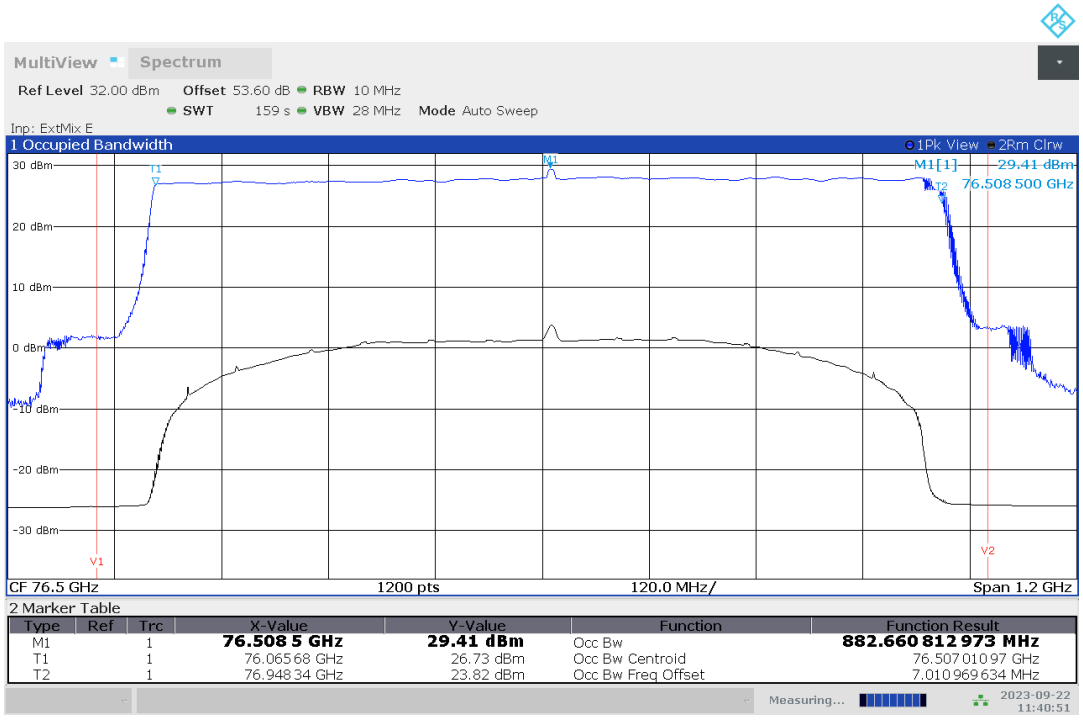
11:56:09 09/22/2023

Plot no. 15: 99% OBW, Peak detector, 0 °C, DMP07



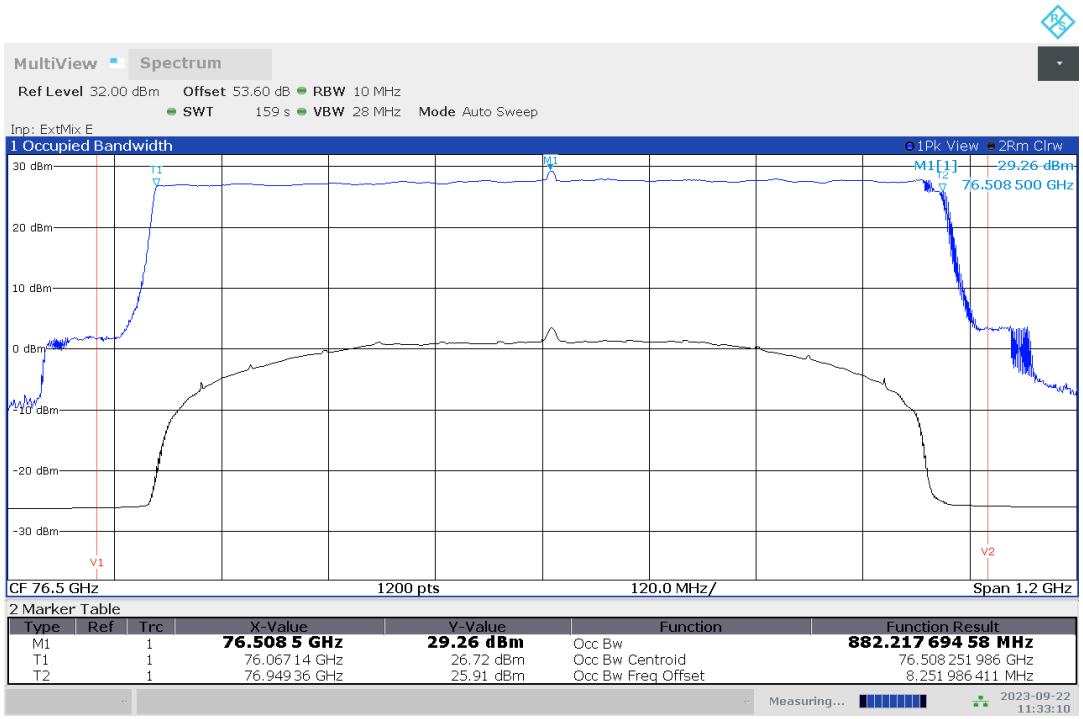
11:48:30 09/22/2023

Plot no. 16: 99% OBW, Peak detector, -10 °C, DMP07



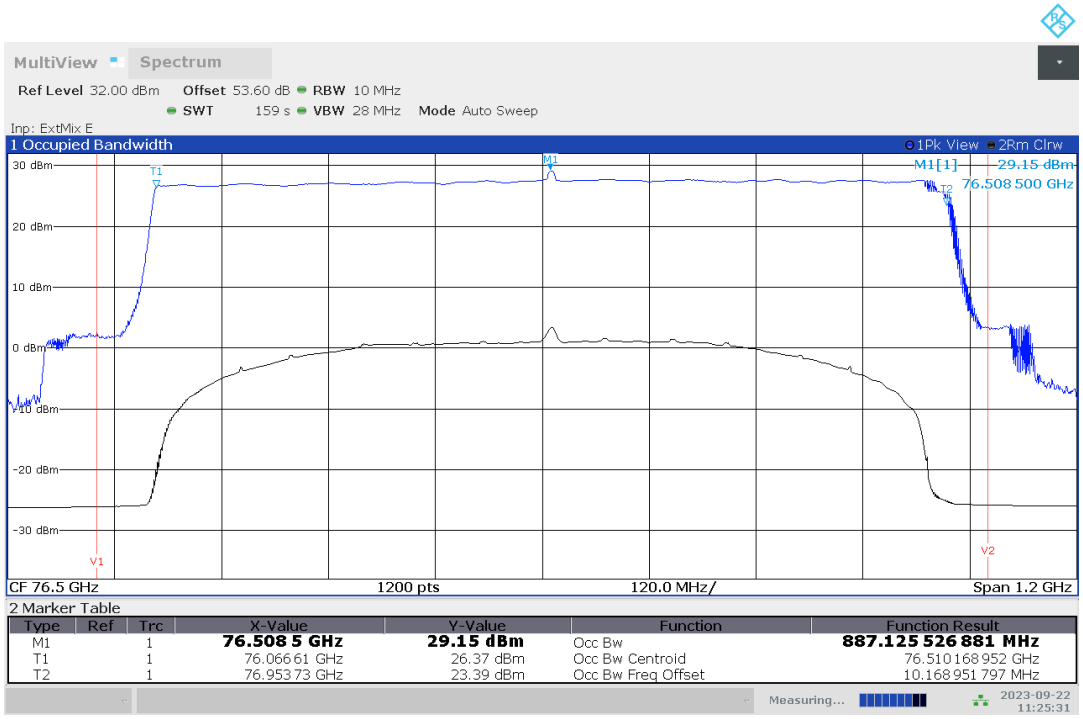
11:40:51 09/22/2023

Plot no. 17: 99% OBW, Peak detector, -20 °C, DMP07



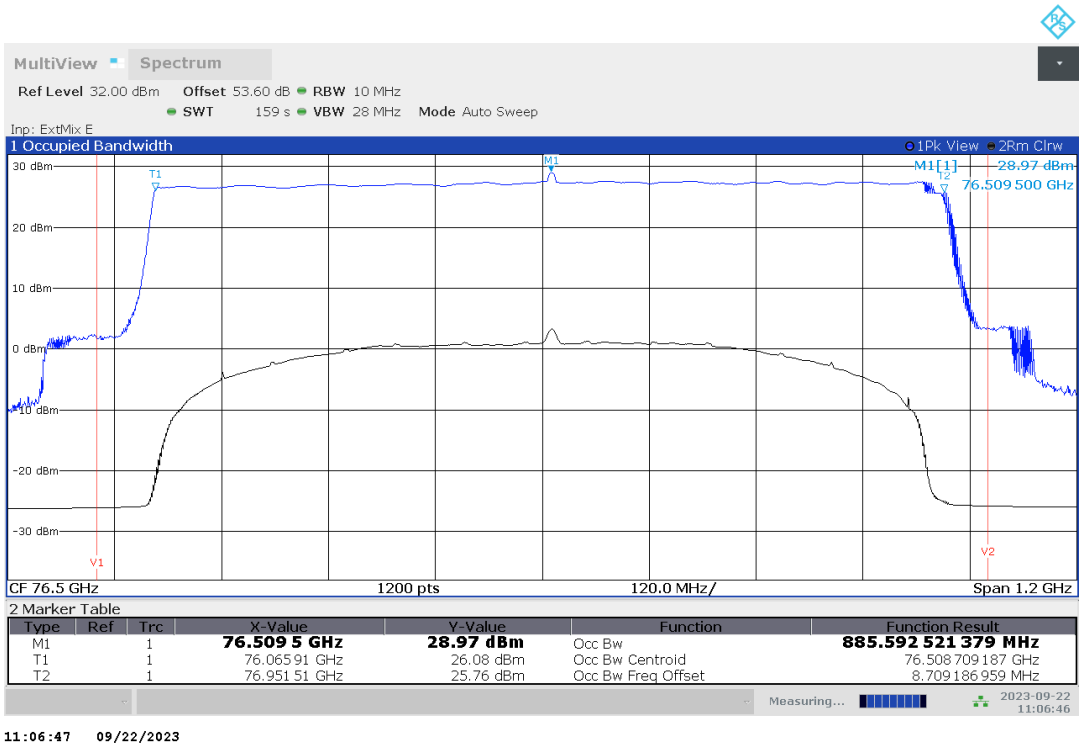
11:33:11 09/22/2023

Plot no. 18: 99% OBW, Peak detector, -30 °C, DMP07

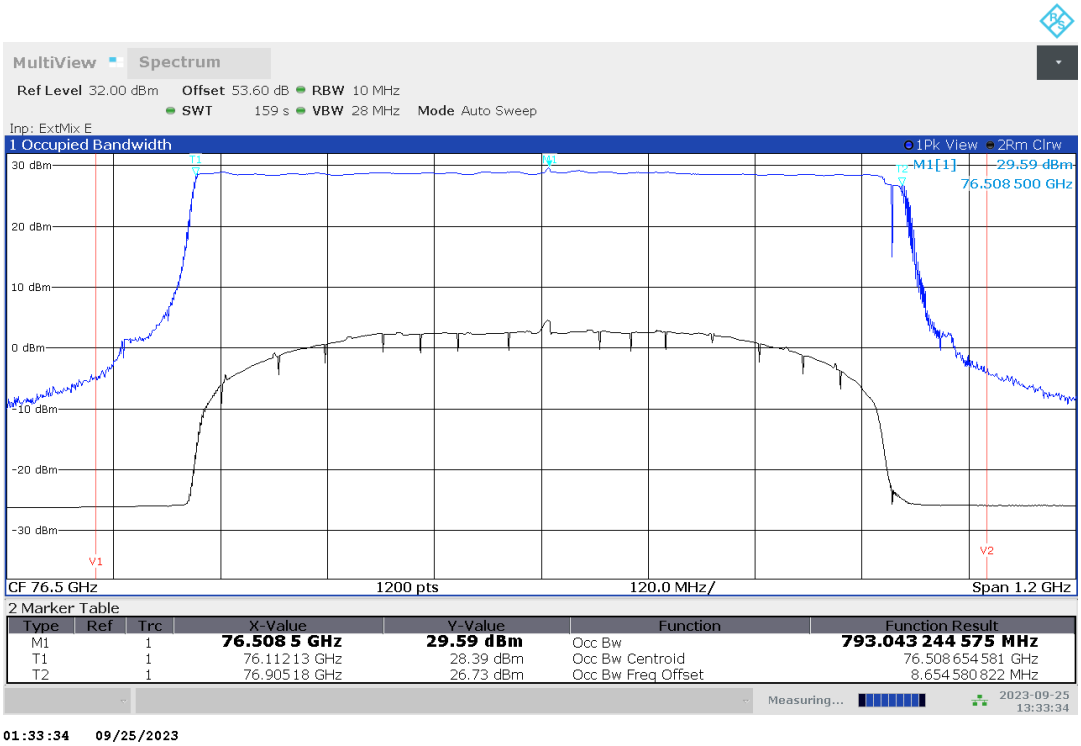


11:25:31 09/22/2023

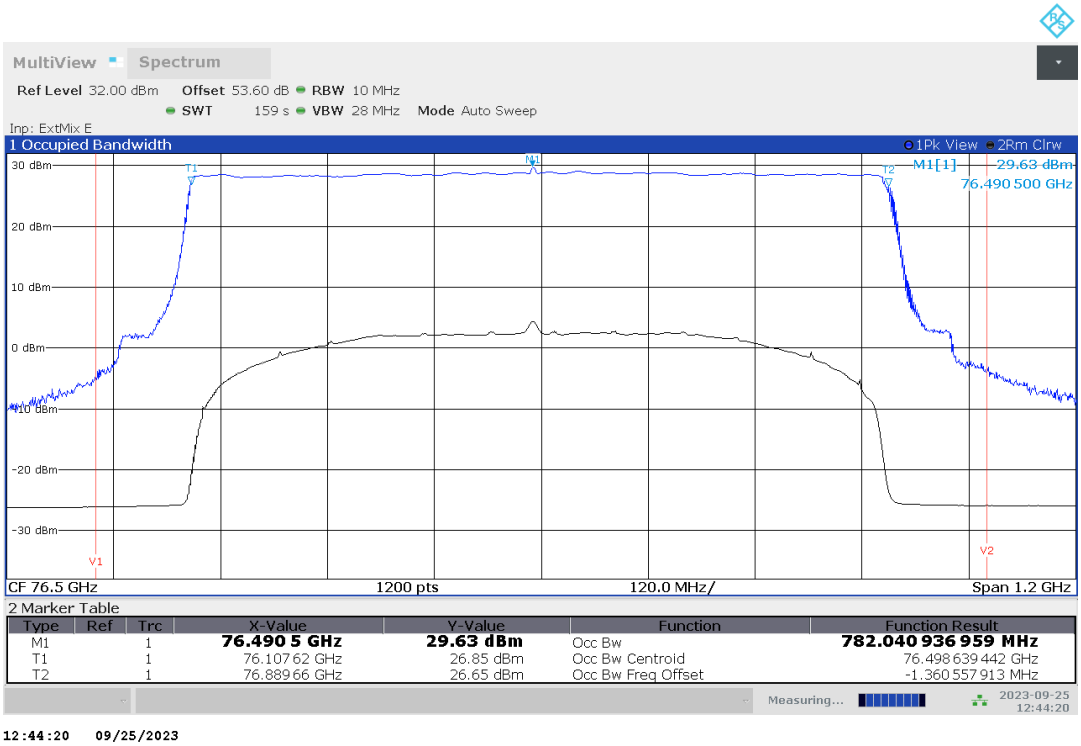
Plot no. 19: 99% OBW, Peak detector, -40 °C, DMP07



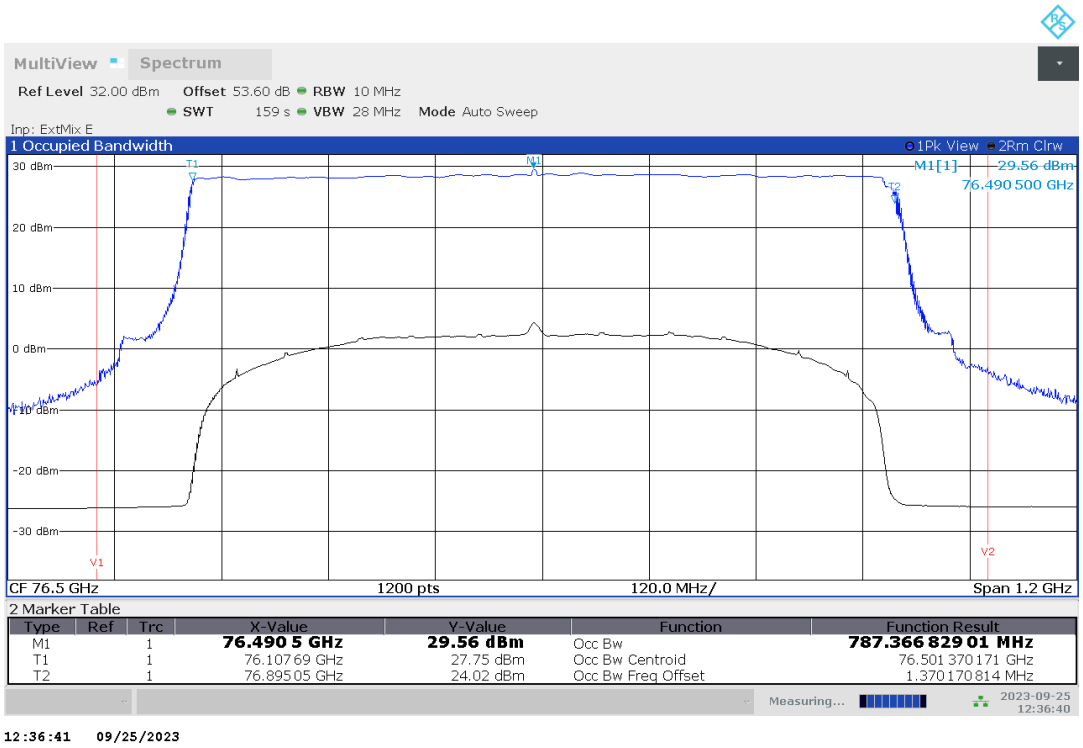
Plot no. 20: 99% OBW, Peak detector, 85 °C, DMP08



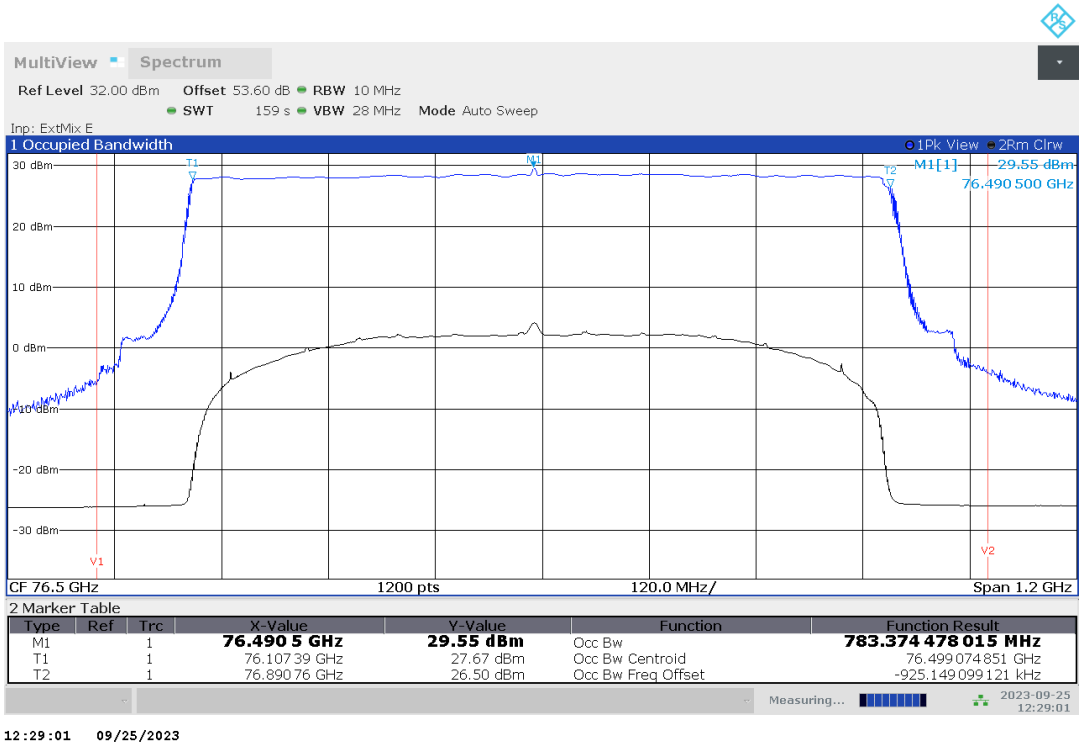
Plot no. 21: 99% OBW, Peak detector, 50 °C, DMP08



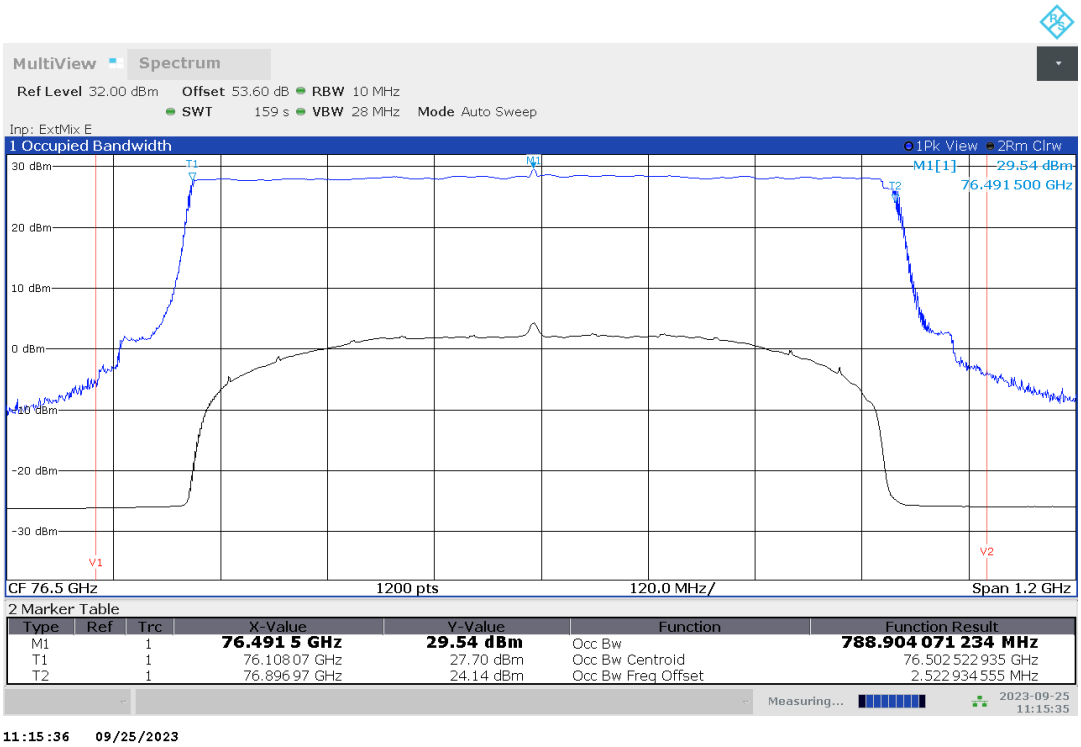
Plot no. 22: 99% OBW, Peak detector, 40 °C, DMP08



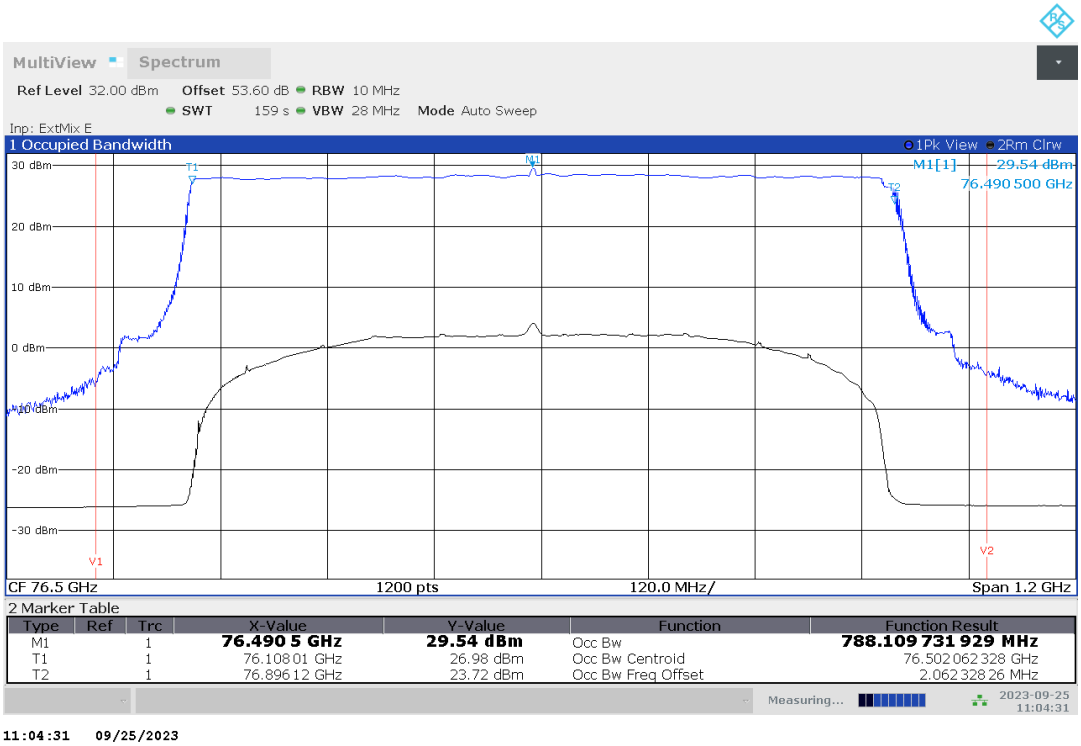
Plot no. 23: 99% OBW, Peak detector, 30 °C, DMP08



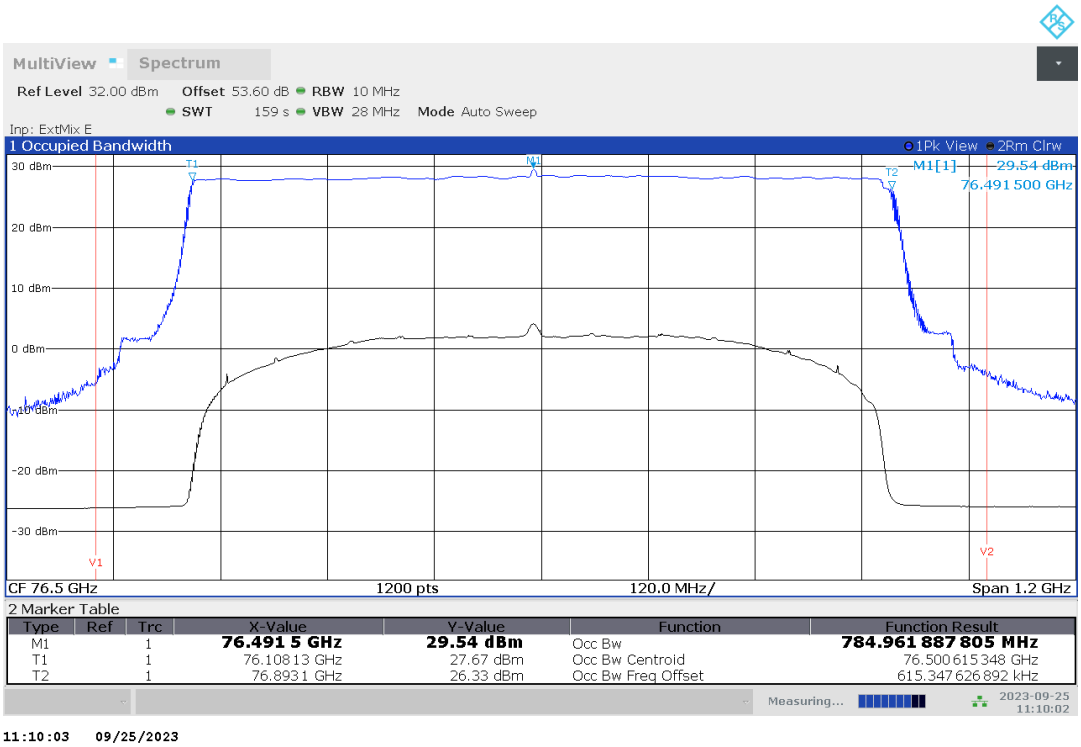
Plot no. 24: 99% OBW, Peak detector, 20 °C, V_{max}, DMP08



Plot no. 25: 99% OBW, Peak detector, 20 °C, V_{nom}, DMP08

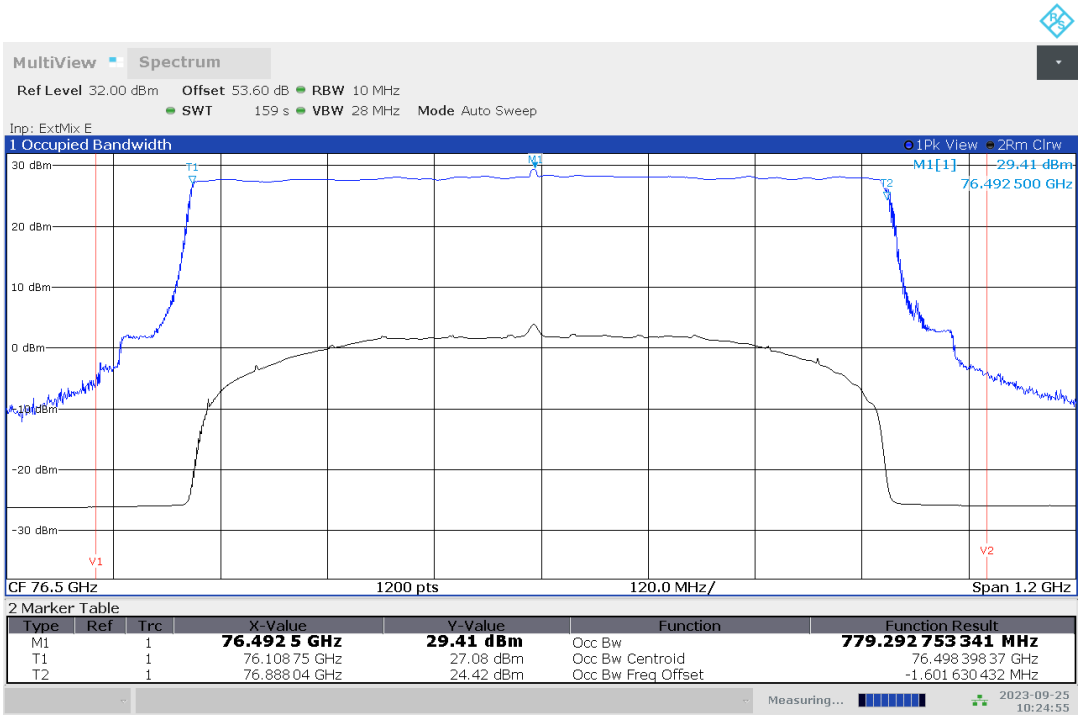


Plot no. 26: 99% OBW, Peak detector, 20 °C, V_{min}, DMP08



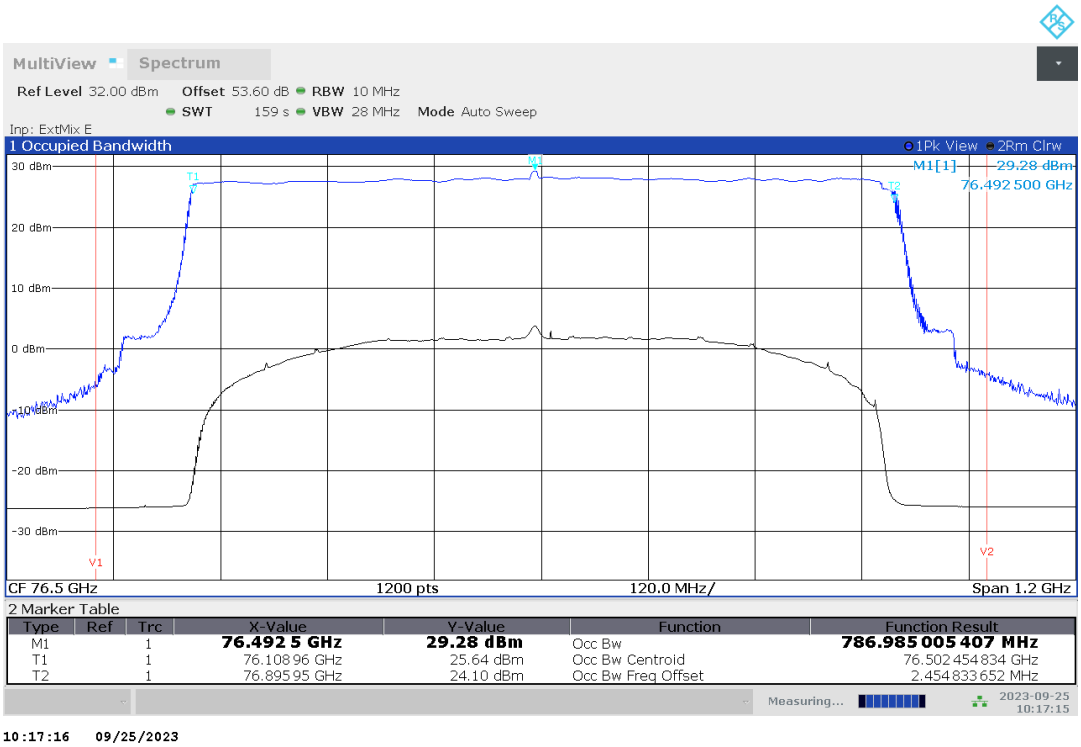
11:10:03 09/25/2023

Plot no. 27: 99% OBW, Peak detector, 10 °C, DMP08



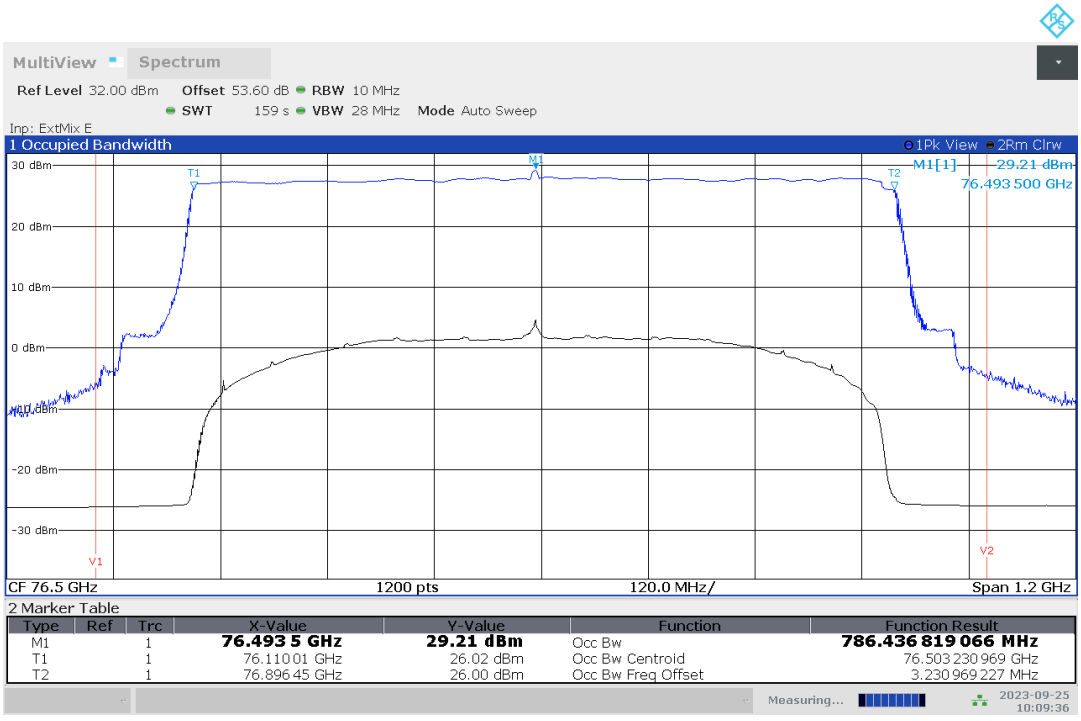
10:24:55 09/25/2023

Plot no. 28: 99% OBW, Peak detector, 0 °C, DMP08



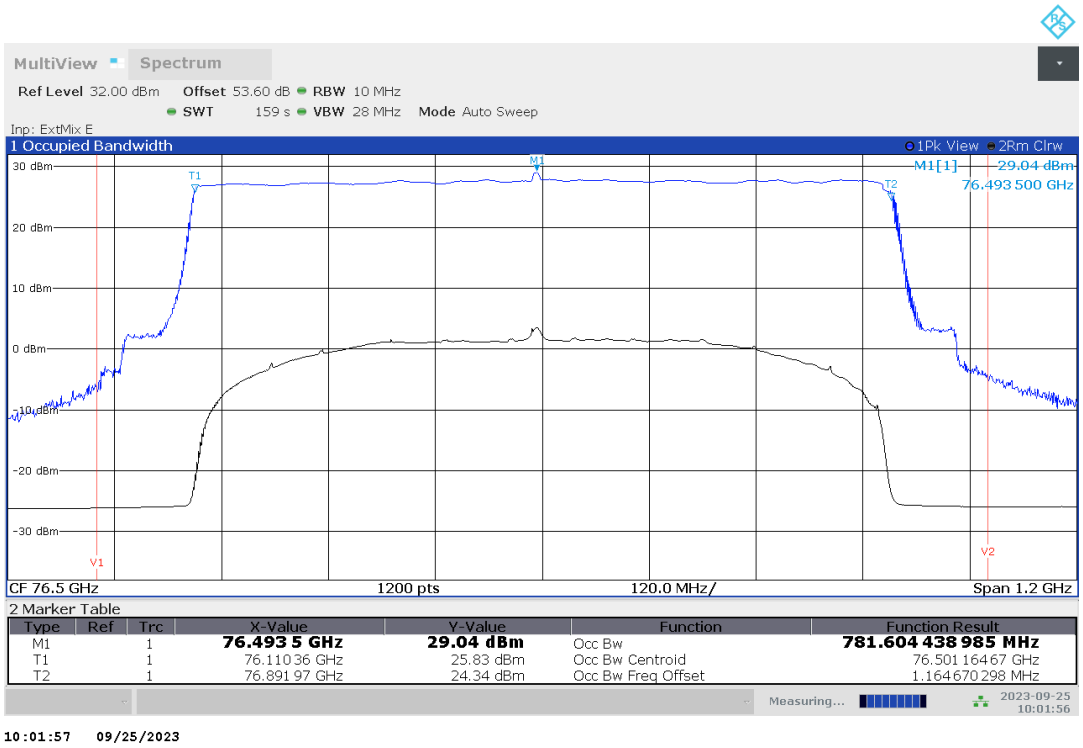
10:17:16 09/25/2023

Plot no. 29: 99% OBW, Peak detector, -10 °C, DMP08

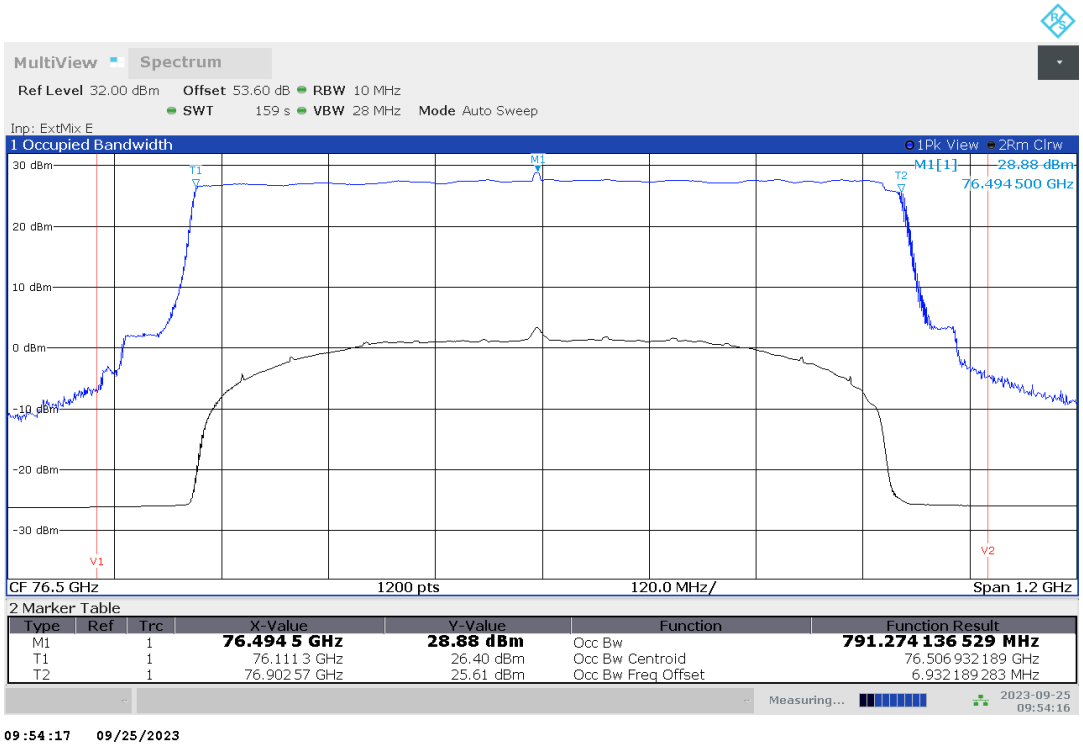


10:09:36 09/25/2023

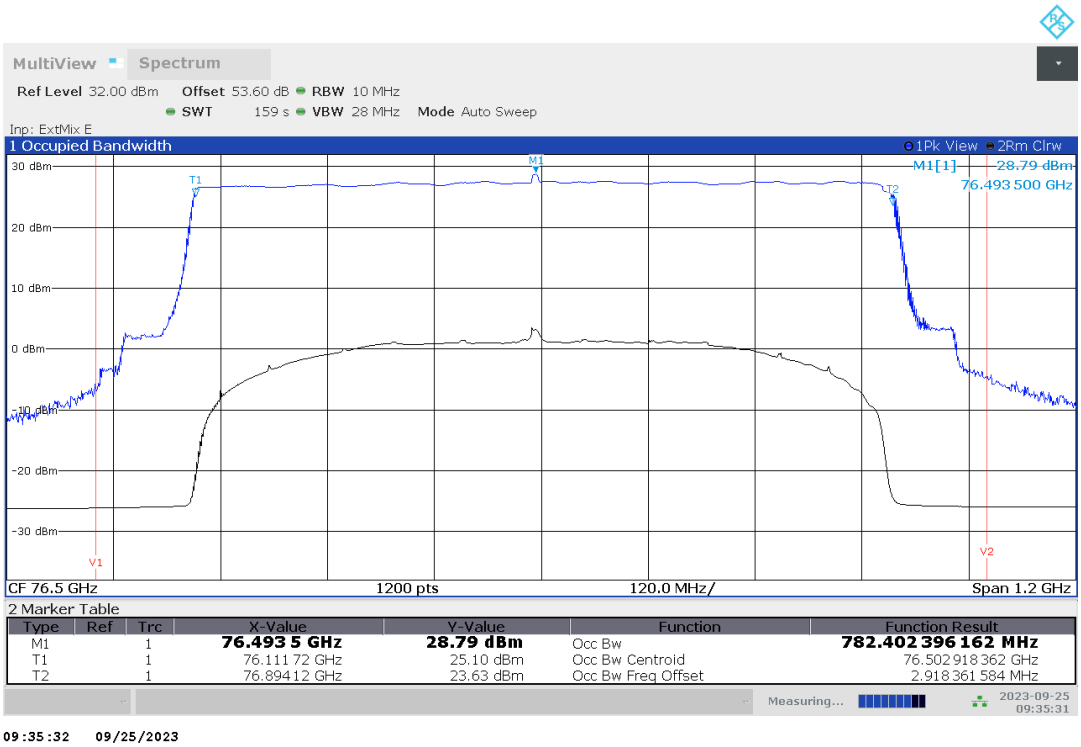
Plot no. 30: 99% OBW, Peak detector, -20 °C, DMP08



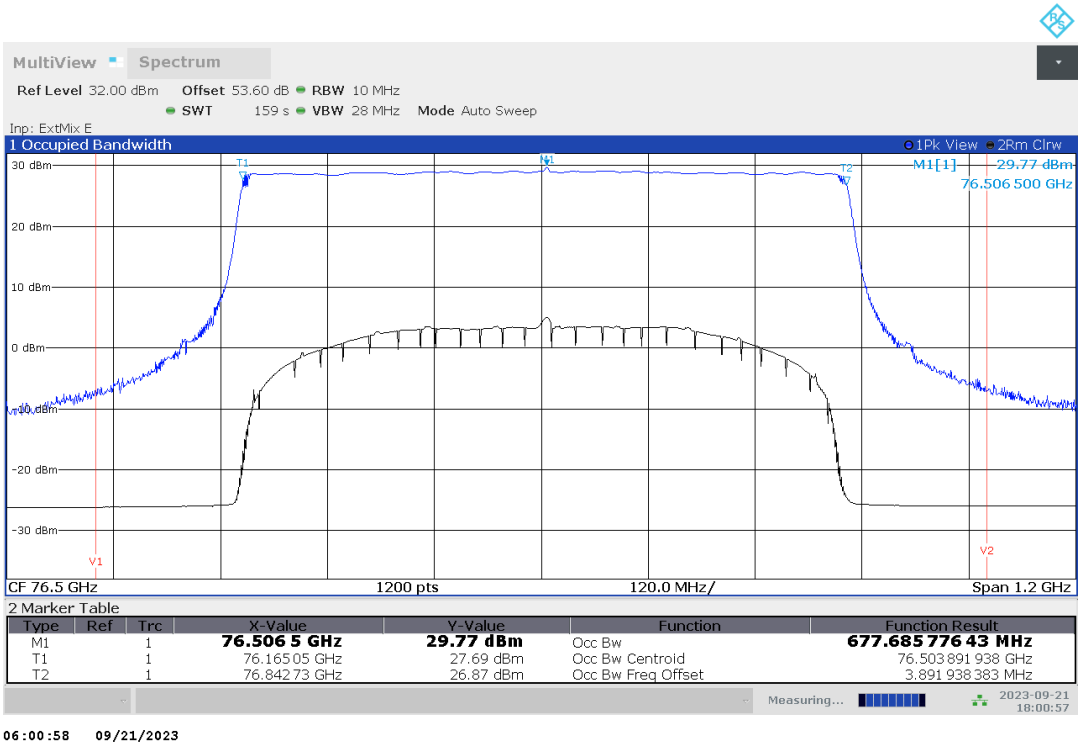
Plot no. 31: 99% OBW, Peak detector, -30 °C, DMP08



Plot no. 32: 99% OBW, Peak detector, -40 °C, DMP08

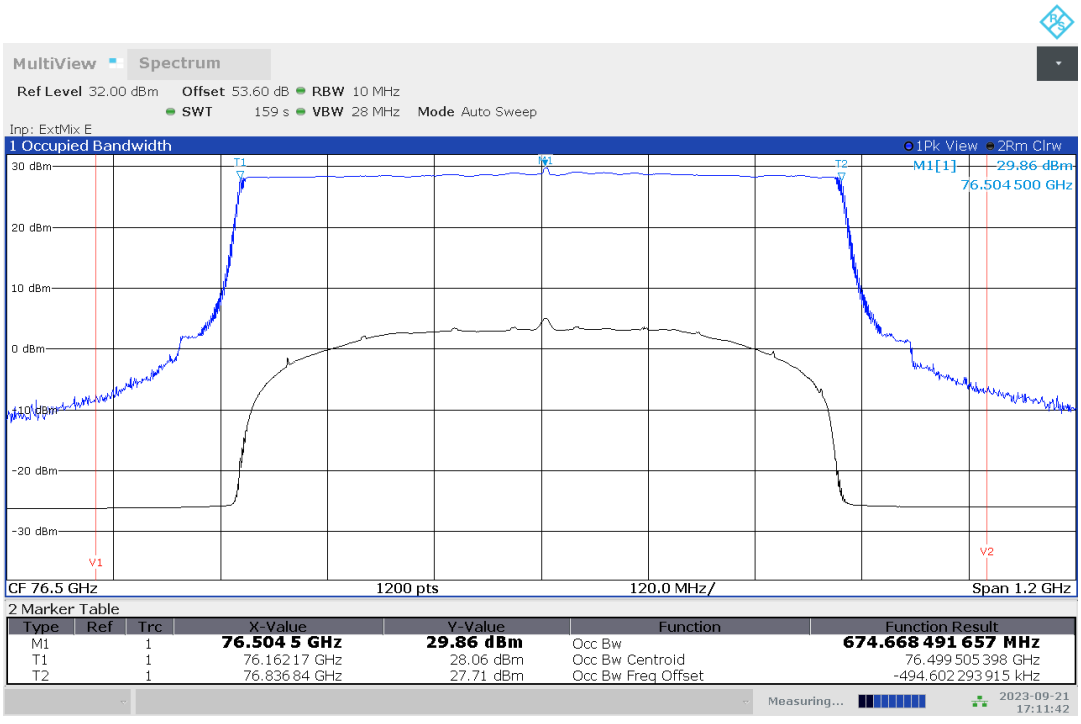


Plot no. 33: 99% OBW, Peak detector, 85 °C, DMP09



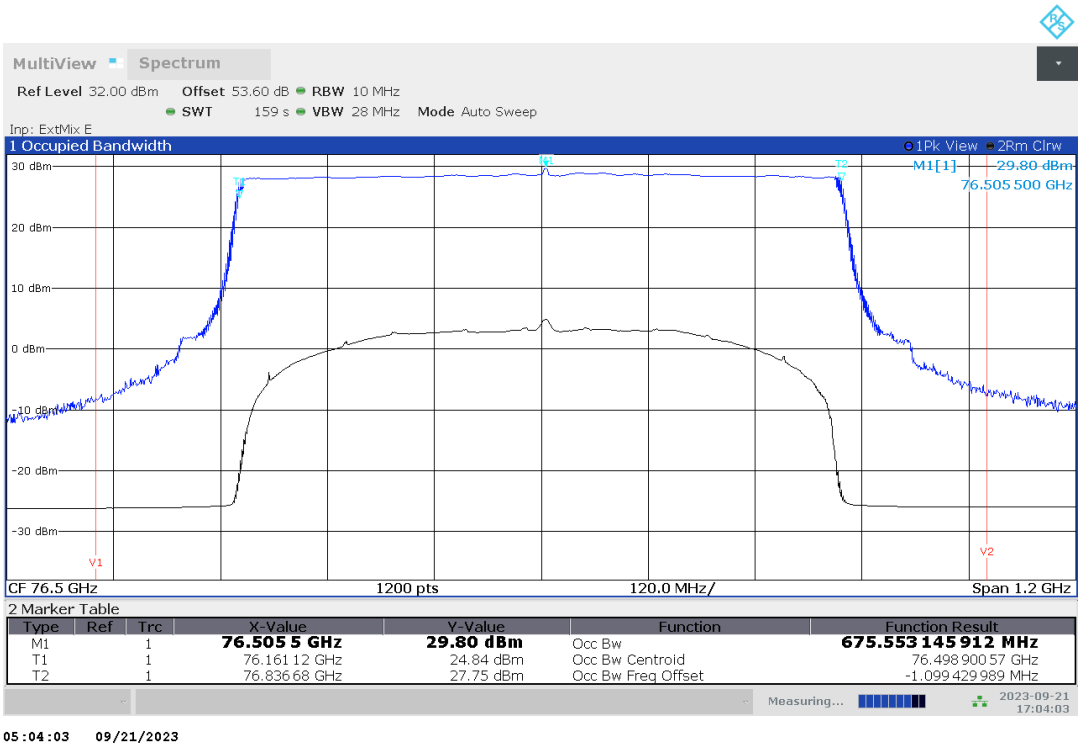
06:00:58 09/21/2023

Plot no. 34: 99% OBW, Peak detector, 50 °C, DMP09



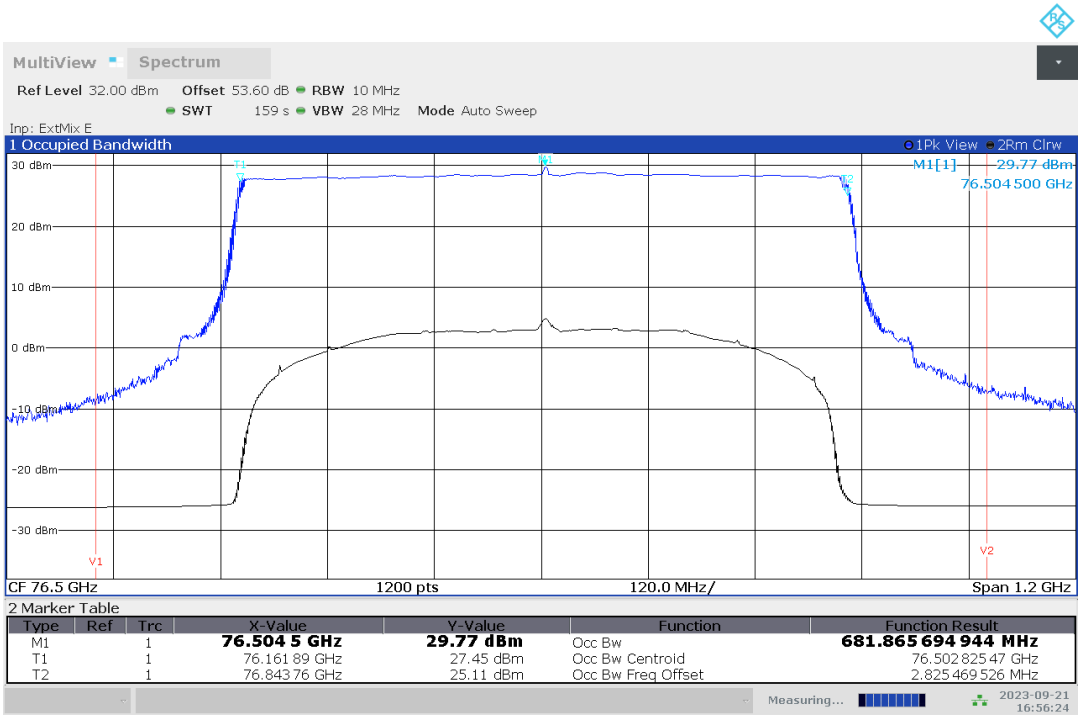
05:11:43 09/21/2023

Plot no. 35: 99% OBW, Peak detector, 40 °C, DMP09



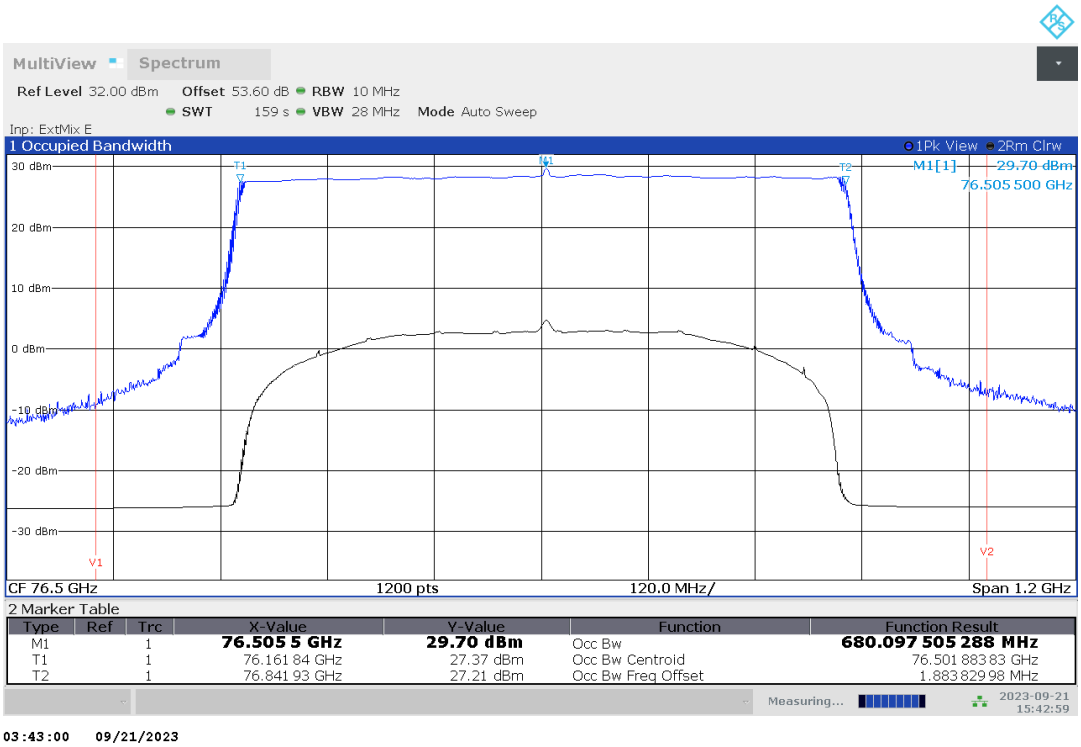
05:04:03 09/21/2023

Plot no. 36: 99% OBW, Peak detector, 30 °C, DMP09

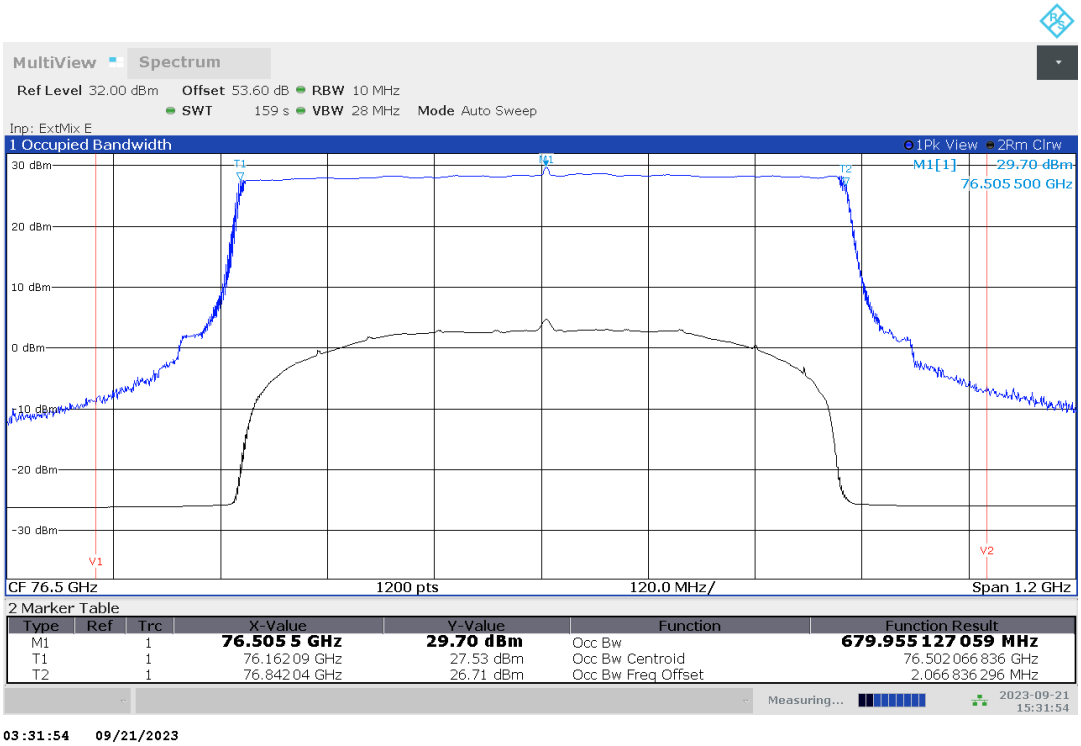


04:56:24 09/21/2023

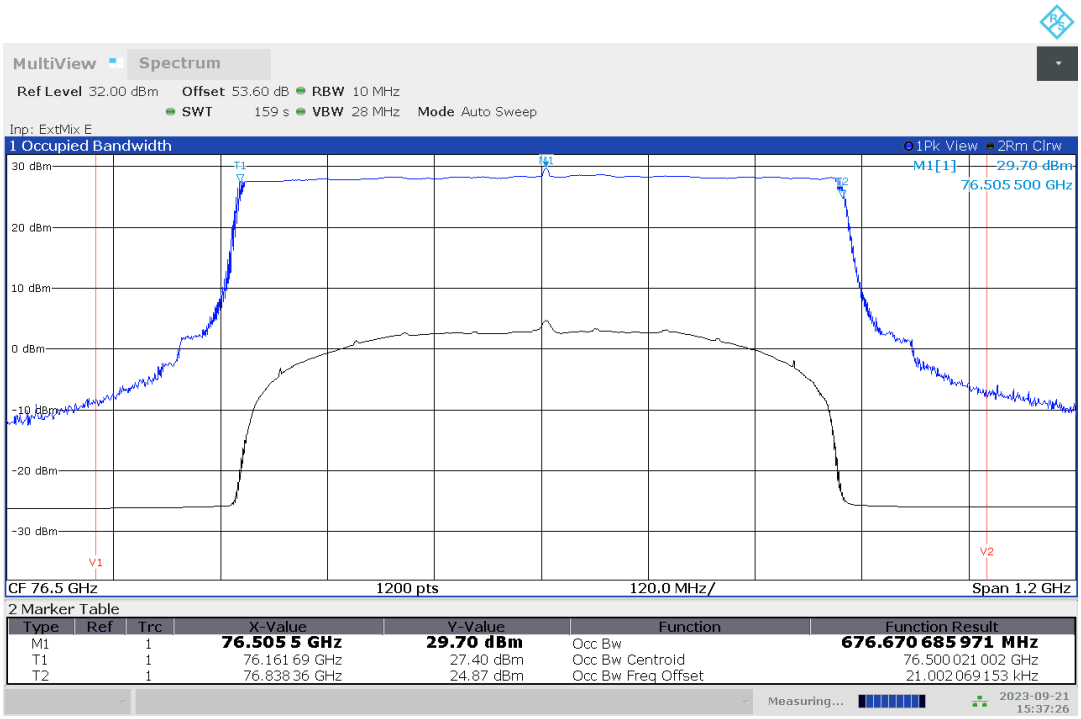
Plot no. 37: 99% OBW, Peak detector, 20 °C, V_{max}, DMP09



Plot no. 38: 99% OBW, Peak detector, 20 °C, V_{nom}, DMP09

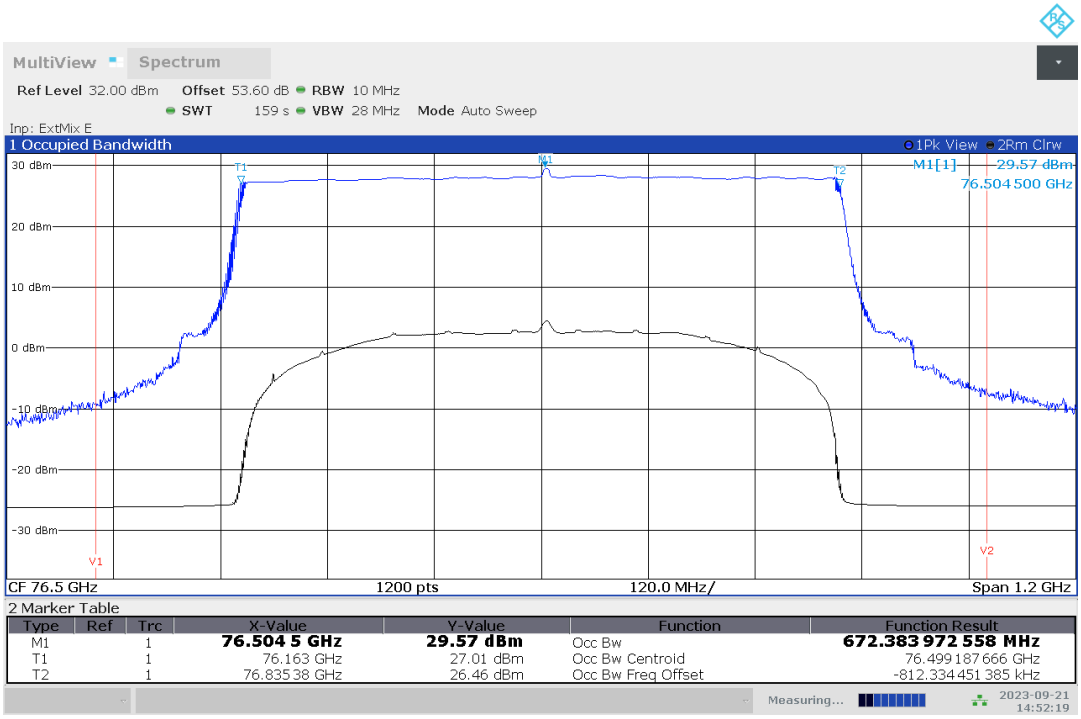


Plot no. 39: 99% OBW, Peak detector, 20 °C, V_{min}, DMP09



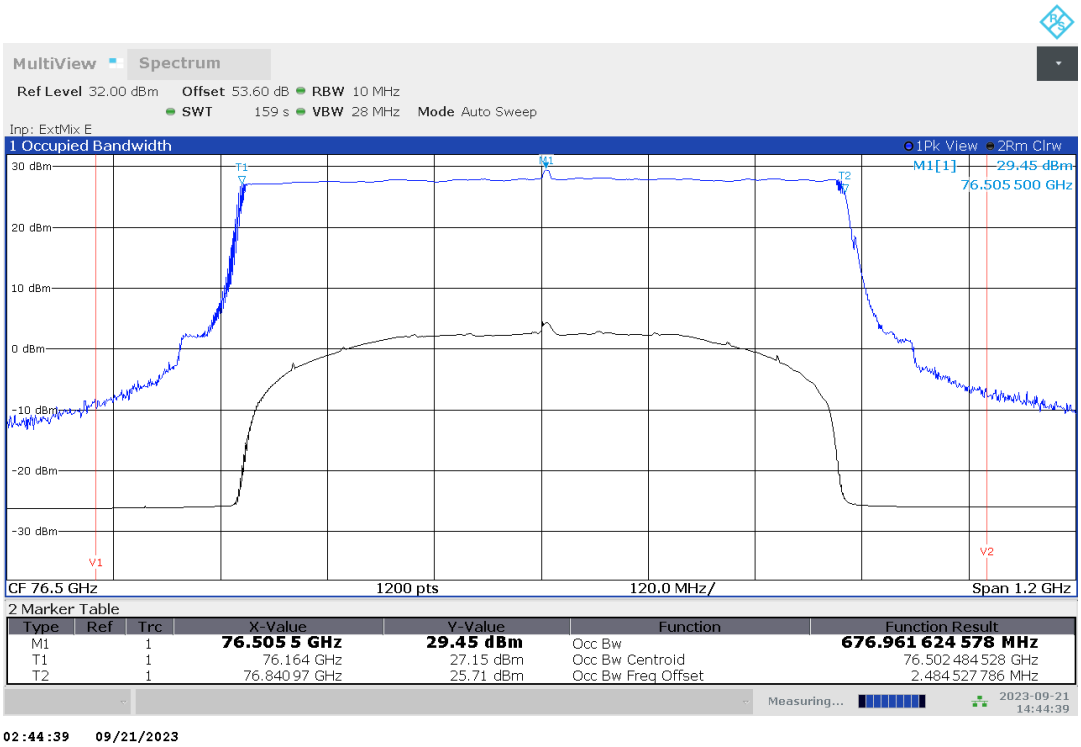
03:37:27 09/21/2023

Plot no. 40: 99% OBW, Peak detector, 10 °C, DMP09

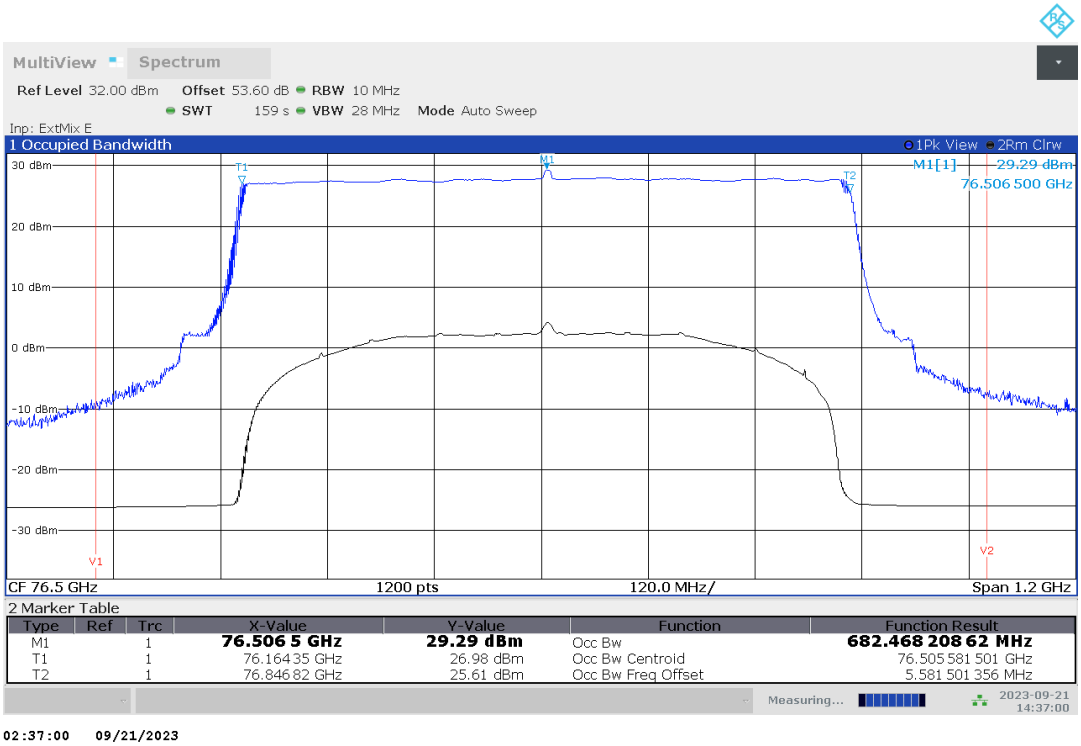


02:52:19 09/21/2023

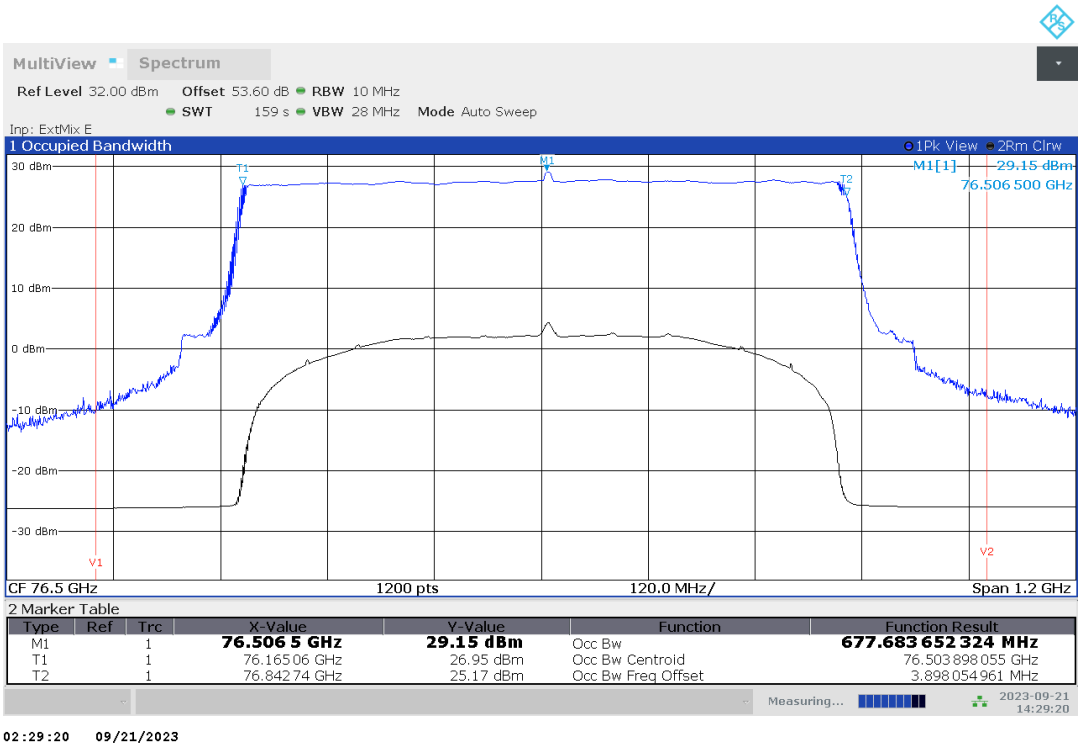
Plot no. 41: 99% OBW, Peak detector, 0 °C, DMP09



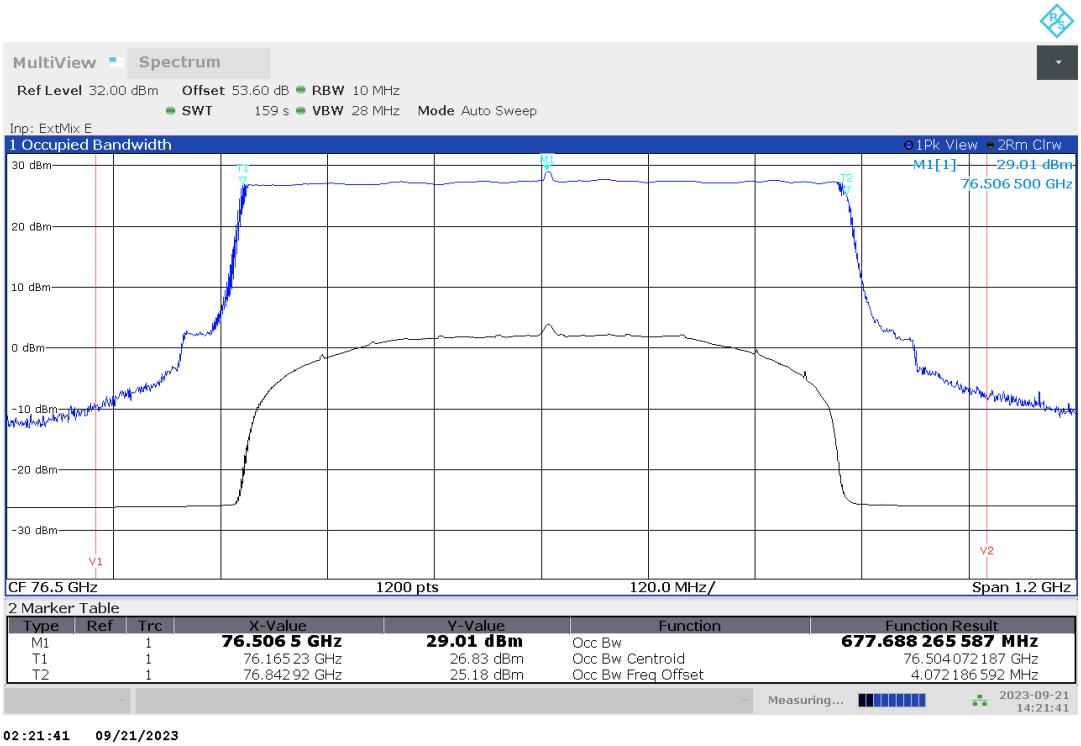
Plot no. 42: 99% OBW, Peak detector, -10 °C, DMP09



Plot no. 43: 99% OBW, Peak detector, -20 °C, DMP09



Plot no. 44: 99% OBW, Peak detector, -30 °C, DMP09



Plot no. 45: 99% OBW, Peak detector, -40 °C, DMP09