Test Report

Test Report No.: CQC-IVTS-2023-00334

Product Name	On board (Transceiver) unit for Automotive
Model Number	MK6 OBU
Applicant	Cohda Wireless Pty Ltd.
Approval Types	FCC ID: 2AEGPMK6OBU

CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.

National Quality Inspection and Testing Center for Internet of Vehicles Products

TEST REPORT DECLARATION

Equipment under Test	:	**On board (Transceiver) unit for Automotive**
Model /Type	:	MK6 OBU
Listed Models	:	N/A
Applicant	:	**Cohda Wireless Pty Ltd.**
Address	:	27 Greenhill Road Wayville SA 5034 Australia
Manufacturer	:	**Cohda Wireless Pty Ltd.**
Address	:	27 Greenhill Road Wayville SA 5034 Australia

The EUT described above is tested by CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd. to determine the maximum emissions from the EUT. CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd. is assumed full responsibility for the accuracy of the test results.

Project Engineer:	Yankun Wang (Yankun Wang 王炎坤)	Date: 2023-9-12
Checked by:	Haohao Li (Haohao Li 李昊昊)	Date: 2023-9-12
Approved by:	Wenliang Li (Wenliang Li 李文亮)	Date: 2023-9-12

Contents

1. TEST STANDARDS

The tests were performed according to following standards: The equipment under test (EUT) has been tested at CQC-IVTS's (own or subcontracted) laboratories according to the leading reference documents giving table below:

No	Identify	Document Title	Version/Date
1	FCC Part 95L	DSRCS On-Board Units	07/20/2023
2	ANSI C63.4	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	2014
3	ANSI C63.26	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services	2015
4	ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	March 2016
5	ASTM E2213-03	Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems—5GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications	2010
6	RSS-252	Intelligent Transportation Systems — Dedicated Short Range Communications (DSRC) — On-Board Unit (OBU)	Issue 1 / September 2017
7	RSS-Gen	General Requirements for Compliance of Radio Apparatus	Issue 5 Amendment 2 / February 2021

2 . SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	June 30, 2023
Testing commenced on	:	July 17, 2023
Testing concluded on	:	July 25, 2023

2.2. Product Description*

Product Name:	On board (Transceiver) unit for Automotive
Trade Mark	Cohda Wireless
Model/Type reference:	MK6 OBU
FCC ID:	2AEGPMK6OBU
IC:	24048–MK6OBU
PMN:	-/-
HVIN:	MK6 OBU
FVIN:	-/-
HMN:	-/-
Hardware Version:	Rev 1.0
Software Version:	19.Release.134186
Frequency Range:	5900.00 – 5920.00 MHz
Technology:	DSRC / IEEE 802.11p
Modulation Type:	OFDM (BPSK / QPSK / 16QAM / 64QAM)
Emission Type:	D1D
Device Class:	C
Channel Number:	3
Usage:	On-Board Unit (OBU)
Antenna:	Magnet Surface Mount Multi-Band Antenna
Antenna Gain:	5.00 dBi
Maximum Conducted Output Power:	19.90 dBm
Power Supply:	DC 12.00V from Vehicle Battery
Temperature Range:	-20℃ to +75℃
Difference Declaration	n/a
Note 1: The EUT Under Test (EUT) use for Dedicated Short Range Communications Service. DSRCS system is transmit is transmit status and instrunctional messages related to the units involved. This unit is On-Board Unit (OBU).	

*: declared by the applicant. CQC-IVTS not responsible for accuary.

2.3. EUT Operation Mode*

EUT operating mode no	Description of operating modes	Additional information
op. 1	Continuously transmitting and receiving mode at BPSK modulation	Lowest Channel (5900 MHz), a continuous wave with 100% duty cycle
op. 2	Continuously transmitting and receiving mode at BPSK modulation	Middle Channel (5910 MHz), a continuous wave with 100% duty cycle
op. 3	Continuously transmitting and receiving mode at BPSK modulation	Highest Channel (5920 MHz), a continuous wave with 100% duty cycle
op. 4	Continuously transmitting and receiving mode at QPSK modulation	Lowest Channel (5900 MHz), a continuous wave with 100% duty cycle
op. 5	Continuously transmitting and receiving mode at QPSK modulation	Middle Channel (5910 MHz), a continuous wave with 100% duty cycle
op. 6	Continuously transmitting and receiving mode at QPSK modulation	Highest Channel (5920 MHz), a continuous wave with 100% duty cycle
op. 7	Continuously transmitting and receiving mode at 16QAM modulation	Lowest Channel (5900 MHz), a continuous wave with 100% duty cycle
op. 8	Continuously transmitting and receiving mode at 16QAM modulation	Middle Channel (5910 MHz), a continuous wave with 100% duty cycle

op. 9	Continuously transmitting and receiving mode at 16QAM modulation	Highest Channel (5920 MHz), a continuous wave with 100% duty cycle
op. 10	Continuously transmitting and receiving mode at 64QAM modulation	Lowest Channel (5900 MHz), a continuous wave with 100% duty cycle
op. 11	Continuously transmitting and receiving mode at 64QAM modulation	Middle Channel (5910 MHz), a continuous wave with 100% duty cycle
op. 12	Continuously transmitting and receiving mode at 64QAM modulation	Highest Channel (5920 MHz), a continuous wave with 100% duty cycle

*: declared by the applicant

2.4. Modifications

No modifications were implemented to meet testing criteria

2.5. Test Item (Equipment Under Test) Description*

Short designation	EUT Name	EUT Description	Serial number	Hardware status	Software status
EUT A	MK6 OBU	On board (Transceiver) unit for Automotive	04E548500910	Rev 1.0	19.Release.134186

*: declared by the applicant.

2.6. Auxiliary Equipment (AE) Description*

AE short designation	EUT Name (if available)	EUT Description	Serial number (if available)	Software (if used)
AE 1	**-/-**	DC 12.00 Vehicle Battery	-/-	-/-
AE 2	Power Cable	Length: 50cm	-/-	-/-
			-/-	-/-

*: declared by the applicant.

2.7. Test Item Set-ups Description

set. 1	EUT A + AE 1 + AE2	EUT operating mode 1
set. 2	EUT A + AE 1 + AE2	EUT operating mode 2
set. 3	EUT A + AE 1 + AE2	EUT operating mode 3
set. 4	EUT A + AE 1 + AE2	EUT operating mode 4
set. 5	EUT A + AE 1 + AE2	EUT operating mode 5
set. 6	EUT A + AE 1 + AE2	EUT operating mode 6
set. 7	EUT A + AE 1 + AE2	EUT operating mode 7
set. 8	EUT A + AE 1 + AE2	EUT operating mode 8
set. 9	EUT A + AE 1 + AE2	EUT operating mode 9
set. 10	EUT A + AE 1 + AE2	EUT operating mode 10
set. 11	EUT A + AE 1 + AE2	EUT operating mode 11
set. 12	EUT A + AE 1 + AE2	EUT operating mode 12

2.8. Test Conditions*

Temperature, [°C]		Voltage, [V]	
T_{nom}	+25.0	V_{nom}	DC 12.0 V
T_{min}	-20.0	V_{min}	DC 10.2 V
T_{max}	+75.0	V_{max}	DC 13.8 V

*: declared by the applicant

2.9. Additional Information

Test items differences	None
Additional application considerations to test a component or sub-assembly	Laptop with test software

2.10. Test Location

Location 1

Company:	CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.
Address:	Building G5, TCL International E City, Xili Street, Nanshan District, Shenzhen, China
Post code:	518112
Contact Person:	Wenliang Li
Telephone:	+86-755-8618 9654
e-Mail:	liwenliang@cqc.com.cn

2.11. Abnormalities from Standard Conditions

None

2.12. Possible verdicts of the results

Test sample meets the requirements	P (PASS) ± the measured value is below the acceptance limit, AL = TL
Test sample does not meet the requirements	F (FAIL) ± the measured value is above the acceptance limit, AL = TL
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

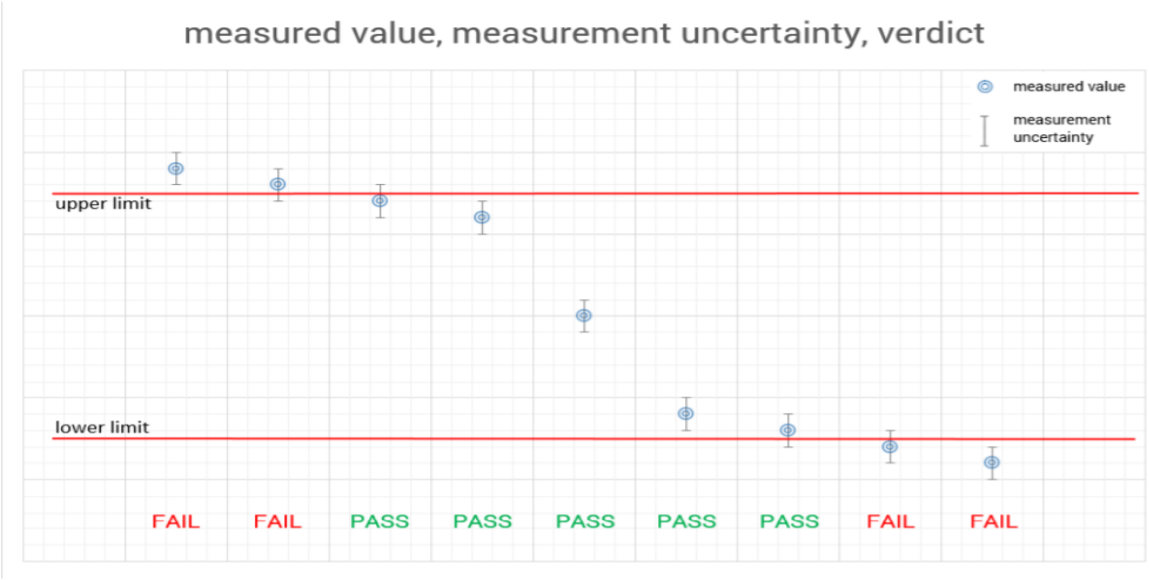
2.13. Formula for Determination of Correction Values (E_C)

$E_C = E_R + AF + C_L + D_F - G_A$ (1)
$M = L_T - E_C$ (2)

E_C = Electrical field ± corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)
All units are dB-units, positive margin means value is below limit.

2.14. Reporting Statements of Conformity – Decision Rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed. The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



2.15. Parameter of Test Software Setting

During testing, Channel & Power Controlling Software provided by customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Test Software Version	Type commands using terminal program					
Modulation: IEEE 802.11p [10MHz]	Test Frequency [MHz]					
	5900		5910		5920	
	Port 1	Port 2	Port 1	Port 2	Port 1	Port 2
BPSK	40	40	40	40	41	41
QPSK	40	40	40	40	39	39
16QAM	40	40	40	40	39	39
64QAM	42	42	42	42	40	40

2.16. Test Data Rate & Modulation*

Rate-Dependent Parameters

Data Rate, Mbits/s	Modulation	Coding Rate, R	Coded Bits per Subcarrier, N_{BPSC}	Coded Bits Per OFDM Symbol, N_{CBPS}	Data Bits Per OFDM Symbol, N_{DBPS}
3	**BPSK**	**1/2**	1	48	24
4.5	BPSK	3/4	1	48	36
6	**QPSK**	**1/2**	2	96	48
9	QPSK	3/4	2	96	72
12	**16QAM**	**1/2**	4	192	96
18	16QAM	3/4	4	192	144
24	**64QAM**	**2/3**	6	288	192
27	64QAM	3/4	6	288	216

Note 1: The data rates used when evaluating the EUT was the lowest data rates, The device was operating at its maximum output power at the lowest data rate for all measurements.

2.17. Table For Carrier Frequencies*

Frequency Range: 5895 – 5925 MHz		
Frequency Range	Channel	BW: 5 / 10 MHz
5895 – 5905 MHz	180	5900 MHz
5905 – 5915 MHz	182	5910 MHz
5915 – 5925 MHz	184	5920 MHz

Note 1: Regarding the operating frequency, the lowest, middle, and highest frequency are selected to perform the test.

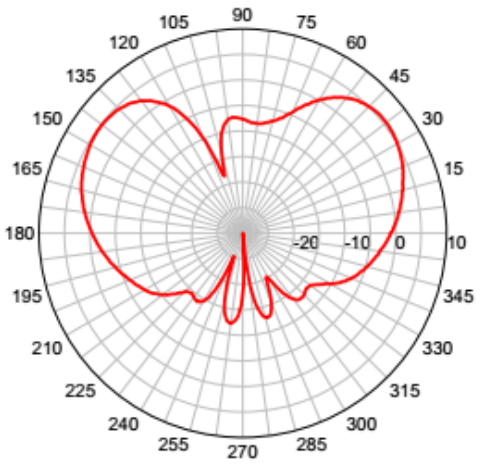
2.18. Antenna Characteristics

Following information is derived from documents “MGW-303” provided by applicant.

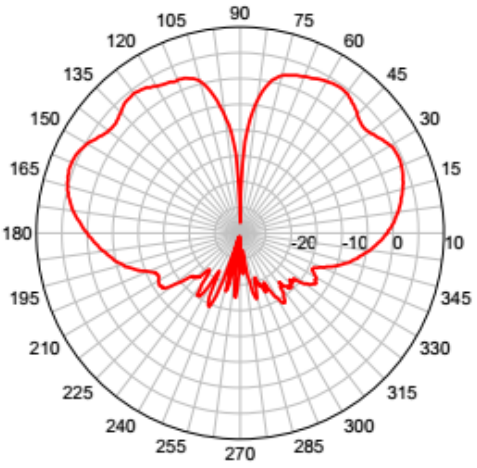
MGW-303 Series Antennas

Magnet Surface Mount Multi-Band Antenna with
5 dBi Gain, Frequency (2.4 & 4.9-6.0 GHz) Cable #1
5 dBi Gain, Frequency (2.4/5.5 GHz) Cable #2
GPS (1575 MHz) Cable #3

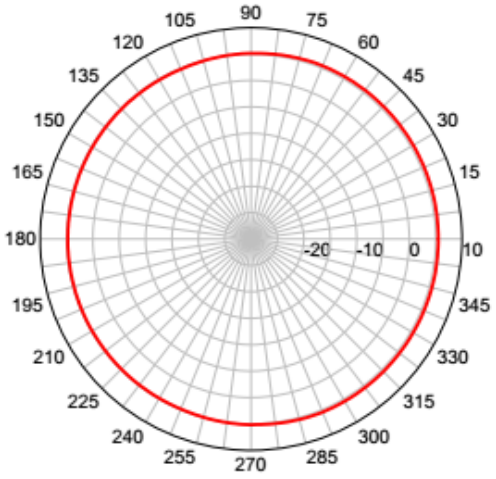
Cable #1 & #2
MGW 2400 MHz Band – Elevation Plot



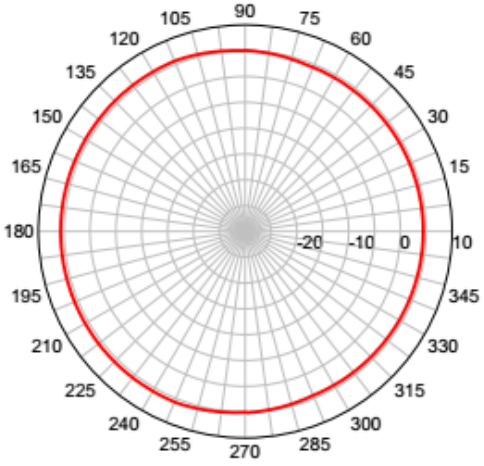
Cable #1 & #2
MGW 5500 MHz – Elevation Plot



Cable #1 & #2
MGW 2400 MHz Band – Azimuth Plot



Cable #1 & #2
MGW 5500 MHz – Azimuth Plot



3. TEST ENVIRONMENT

3.1. Address of the test laboratory

CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.
Building G5, TCL International E City, Xili Street, Nanshan District, Shenzhen, China
CQC-IVTS A2LA Certification Number: 6645.01;

3.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Lative Humidity	55 %
Air Pressure	989 hPa

3.3. Test Description

Test Specification Clause	Test Case	Temperature Condition	Power Supply	PASS	FAIL	NA	NP	Results
§ 2.1049 § 95.3189 RSS-252 Clause 5.1 RSS-Gen Clause 6.7	Emission Bandwidth	Nominal	Nominal	☒	☐	☐	☐	
§ 90.379 ASTM E2213-03 8.10.1 RSS-252 Clause 5.3	Maximum Transmitter Power (Effective Isotropic Radiated Power (EIRP))	Nominal	Nominal	☒	☐	☐	☐	
§ 90.379 ASTM E2213-03 8.10.2 RSS-252 Clause 5.4	Transmit Spectrum Mask	Nominal	Nominal	☒	☐	☐	☐	
§ 2.1051 § 90.379 ASTM E2213-03 8.10.2 & 8.10.3 RSS-252 Clause 5.4	Transmitter Conducted Unwanted Emissions	Nominal	Nominal	☒	☐	☐	☐	
§ 2.1053 § 90.379 ASTM E2213-03 8.10.2 & 8.10.3 RSS-252 Clause 5.4	Transmitter Radiated Unwanted Emissions	Nominal	Nominal	☐	☐	☐	☒	
§ 90.213 ASTM E2213-03 8.10.4 RSS-252 Clause 5.5	Frequency Stability	Nominal Extreme	Nominal Extreme	☒	☐	☐	☐	
ASTM E2213-03	Emission Types	-/-	-/-	☒	☐	☐	☐	
ASTM E2213-03	Modulation Standard	-/-	-/-	☒	☐	☐	☐	

Note 1: NA means “not applicable”; NP means Not Performed;
Note 2: The measurement uncertainty is not included in the test result.
Note 3: The radiation measurements are performed in X, Y, Z axis positioning, only the worst case is shown in the report.
Note 4: Transmitter Radiated Unwanted Emissions **Not Including** this report.

3.4. Statement of The Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd..quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.:

Test	Range	Measurement Uncertainty	Notes
RF Output Power	9 KHz – 40 GHz	0.35 dB	(1)
Power Spectral Density	9 KHz – 40 GHz	0.35 dB	(1)
Occupied Bandwidth	9 KHz – 40 GHz	0.25 MHz	(1)
Conducted Spurious Emission	9 KHz – 40 GHz	1.39 dB	(1)
Radio frequency	9 KHz – 40 GHz	1×10^{-7}	(1)
DC and low frequency voltages	-/-	±3 %	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.5. Equipments Used during the Test

Radiated Emission						
Item	Test Equipment	Manufacturer	Model No.	Equipment No.	Last Cal.	Cal.Due
1	Spectrum Analyzer	R&S	FSW43	10182	2022/08/25	2023/08/24
2	Thermal chamber	ESPEC	GFS-800-15	0050-001161	2022/07/26	2023/07/25
3	Wideband Communication Tester	R&S	CMW500	170436	2022/08/25	2023/08/24

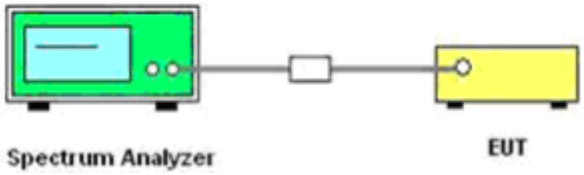
4. TEST CONDITIONS AND RESULTS

4.1. Emission Bandwidth [§2.1049 & 95.3189 & RSS-252 Clause 5.1]

4.1.1. LIMITS

According to § 95.3189: DSRCS On-Board Unit (OBU) transmitter types operating in the 5895–5925 MHz band must be designed to comply with the technical standard Institute of Electrical and Electronics Engineers (IEEE) 802.11p–2010.
According to RSS-252 Clause 5.1: OBU devices shall comply with the requirements of the ASTM E 2213-03 (2010) standard, as referenced in section 2.6.2. In case of any discrepancy between the ASTM standard and this RSS (i.e. RSS-252), the RSS shall take precedence.
A statement declaring testing and compliance to the ASTM E 2213-03 (2010) standard shall be included in the test report.

4.1.2. TEST CONFIGURATION



4.1.3. TEST PROCEDURE

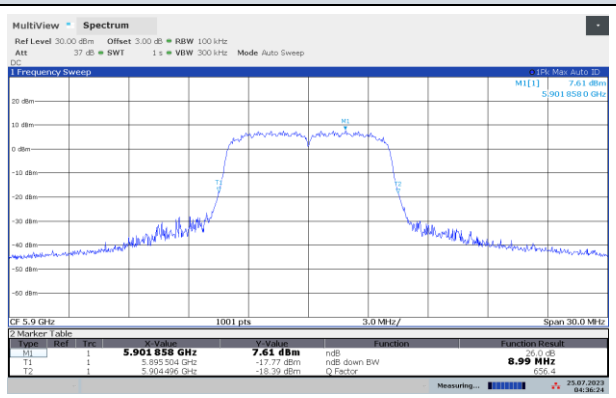
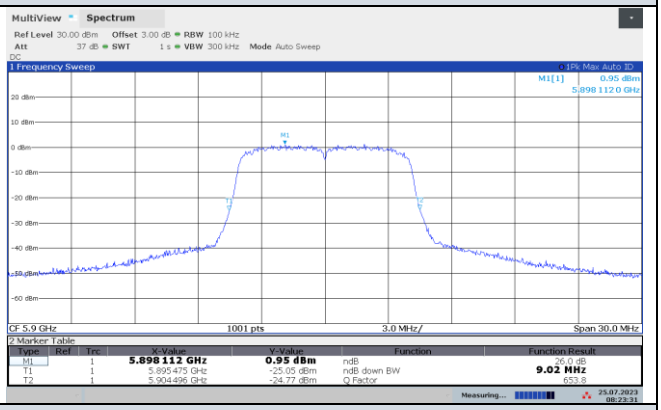
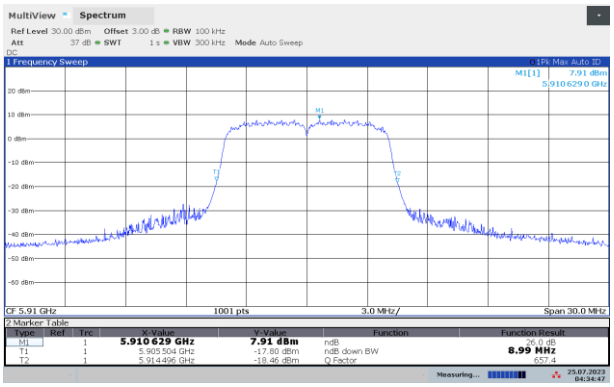
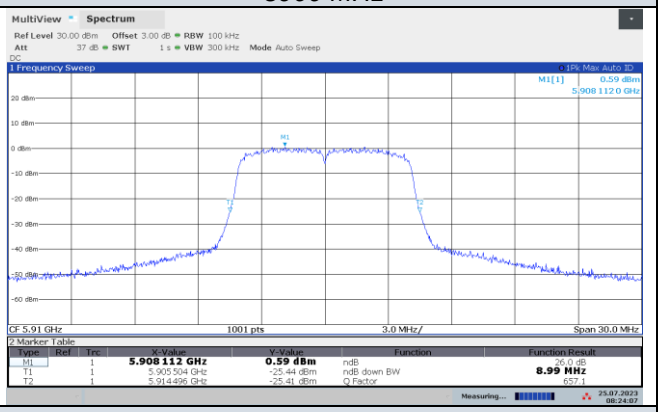
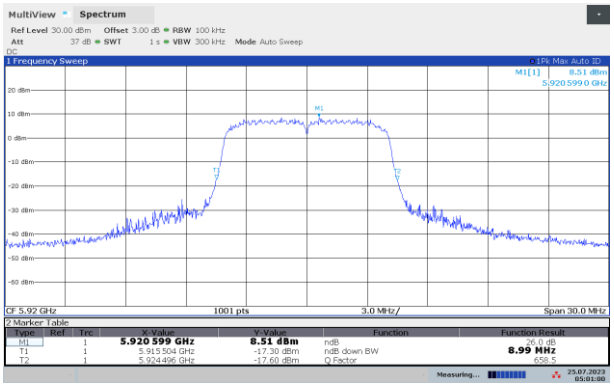
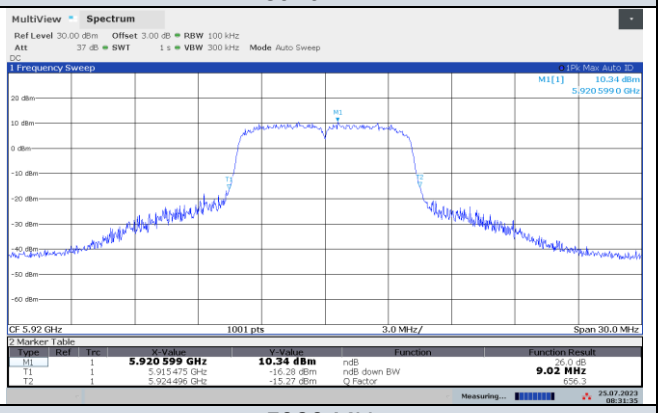
According to ANSI C63.26:2015 section 5.4.4 and ANSI C63.10: 2020 section 6.9: The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are equal to 0.5% of the total mean power of the given emission.
The following procedure shall be used for measuring 99% power bandwdith and 26dB bandwidth emission bandwidth:

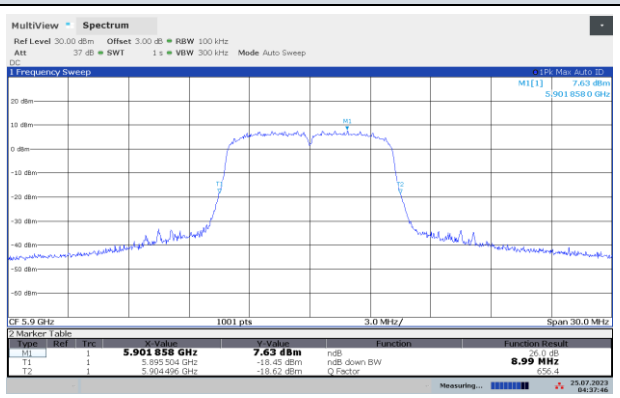
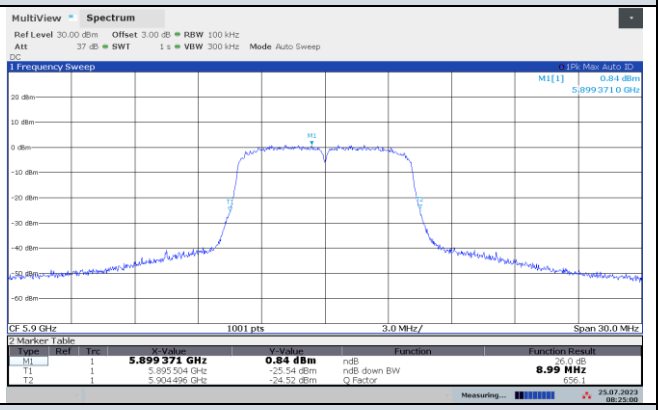
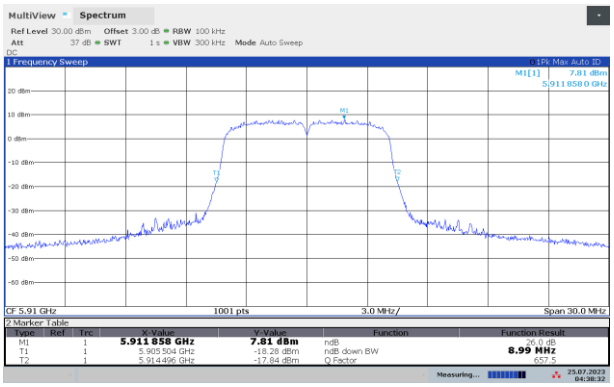
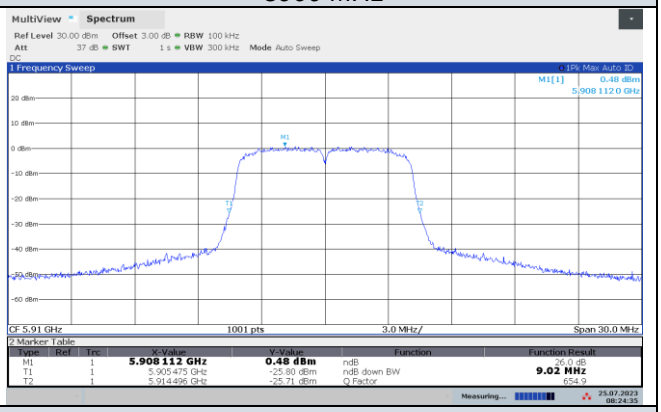
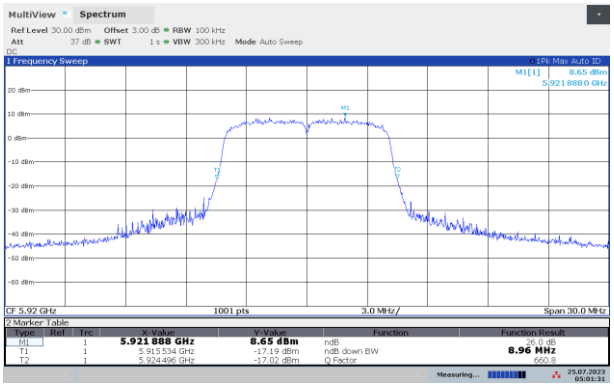
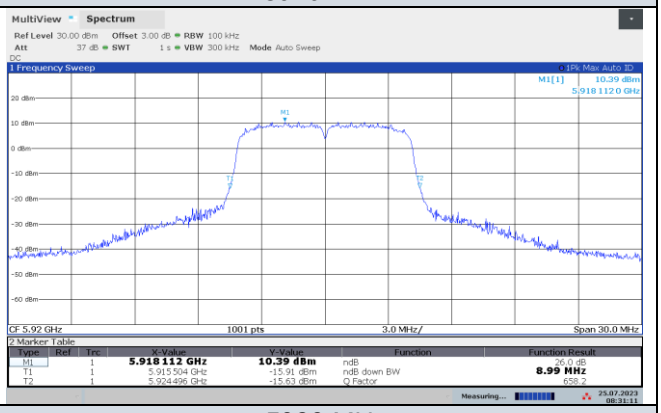
a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
b) The nominal IF filter bandwidth (3dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately 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 [$10\log_{10}$(OBW/RBW] below the reference level. Specific guidance is given in 4.1.5.2.
d) Set the detection mode to peak, and the trace mode to maxhold.
e) If the instrument does not have 99% OBW function, recover the trace data points and sum directly in linear power terms. Placce the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Recorded 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 plots of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labelled. Tabular data can be reported in addition to the plots.

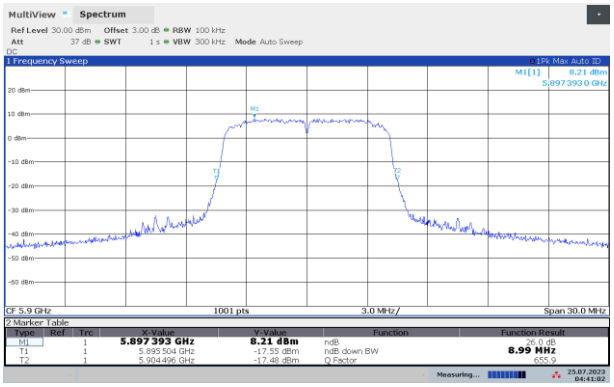
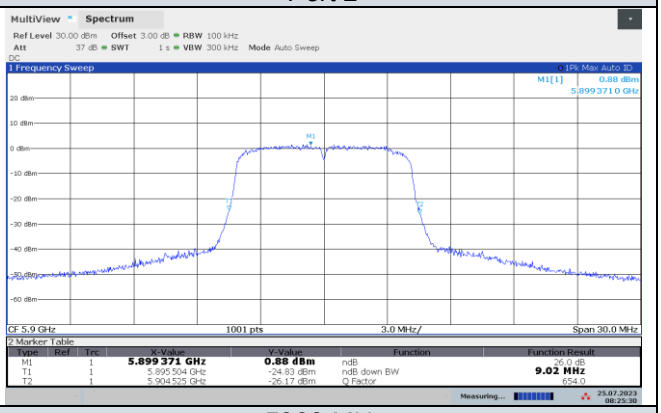
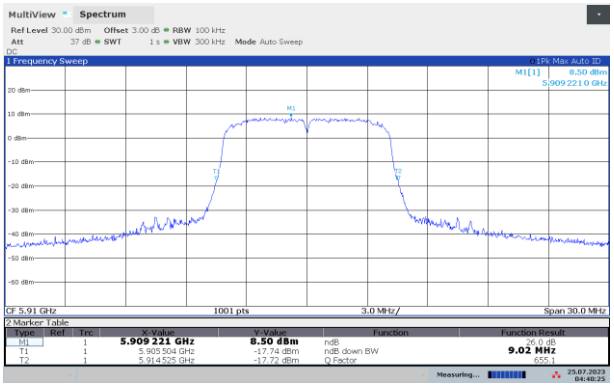
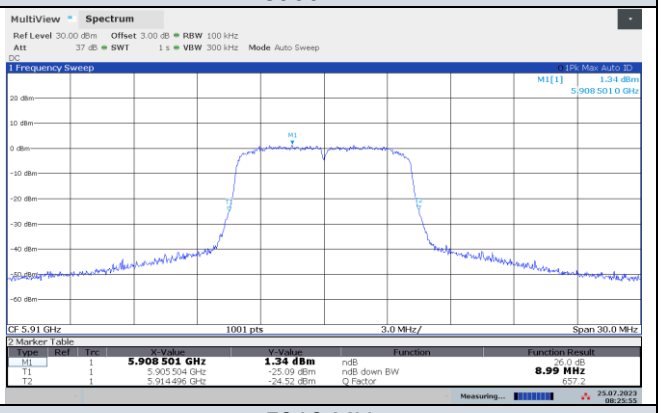
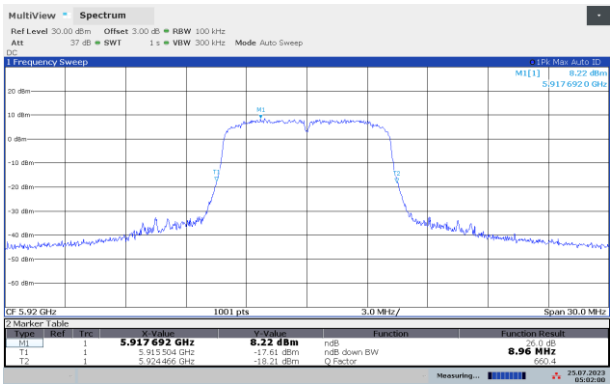
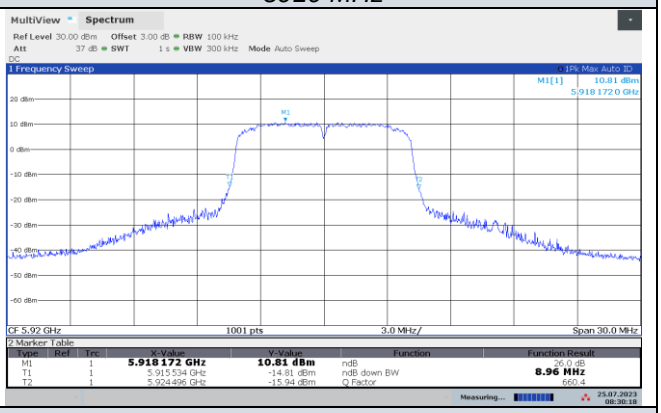
4.1.4. TEST RESULTS

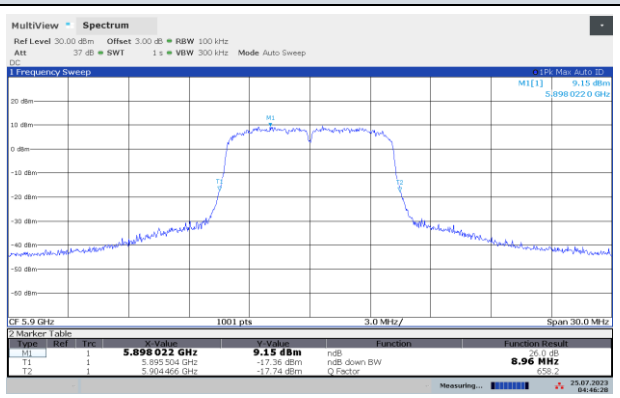
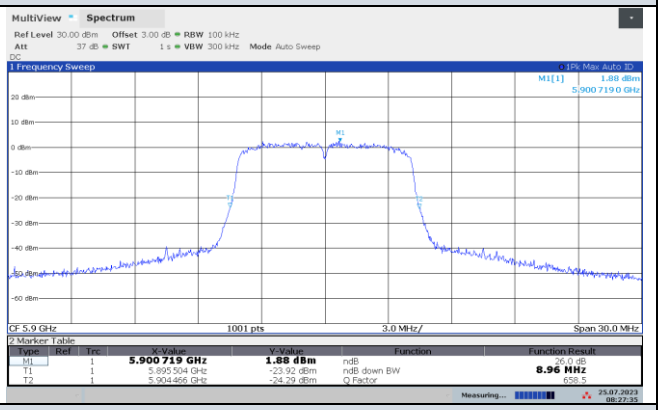
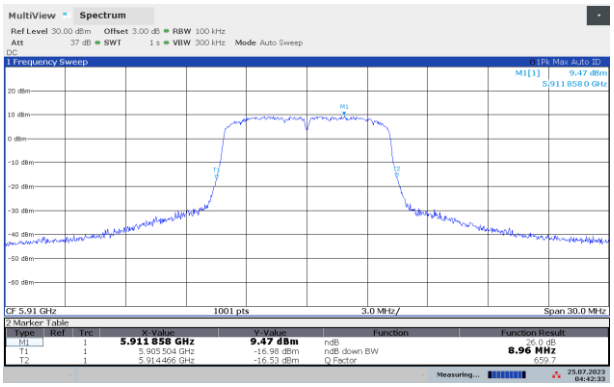
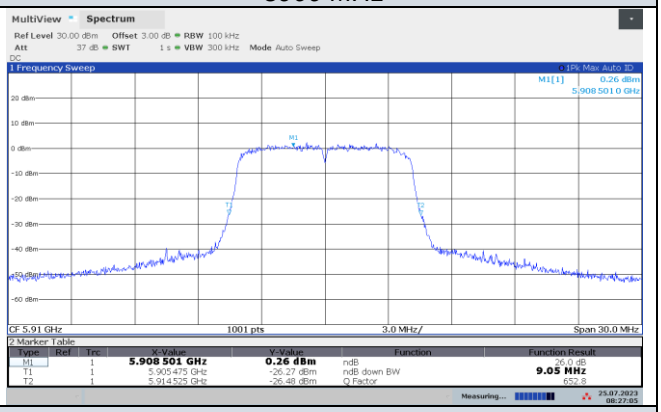
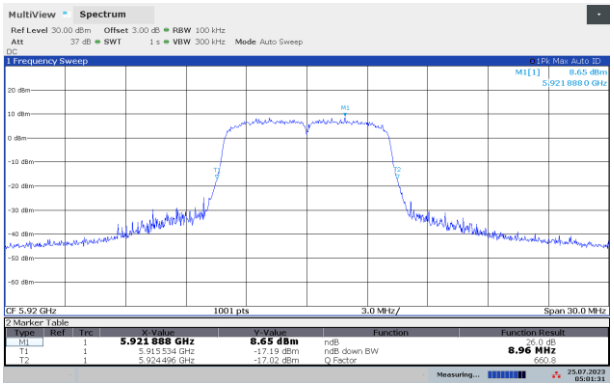
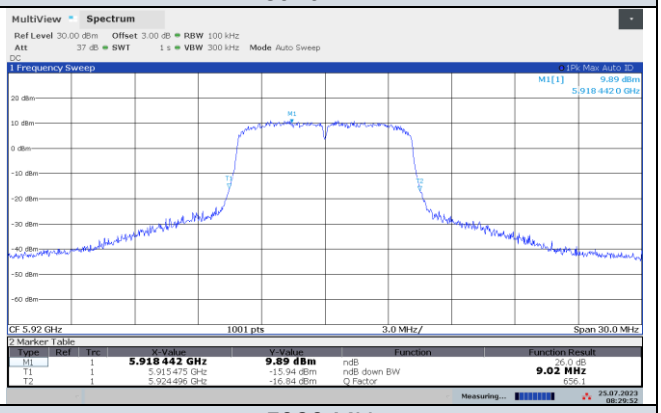
Channel	Frequency [MHz]	Modulation	Measurement Results [MHz]				Limits [MHz]	Results
			26 dB Bandwidth		99% Bandwidth			
			Port 1	Port 2	Port 1	Port 2		
180	5900	BPSK	8.99	9.02	8.013	8.030	-/-	PASS
182	5910	BPSK	8.99	8.99	8.012	8.026	-/-	PASS
184	5920	BPSK	8.99	9.02	8.017	8.036	-/-	PASS
180	5900	QPSK	8.99	8.96	8.053	8.059	-/-	PASS
182	5910	QPSK	8.99	8.96	8.048	8.066	-/-	PASS
184	5920	QPSK	8.96	8.96	8.056	8.059	-/-	PASS
180	5900	16QAM	8.99	8.99	8.070	8.071	-/-	PASS
182	5910	16QAM	9.02	9.02	8.067	8.079	-/-	PASS
184	5920	16QAM	8.96	8.96	8.071	8.073	-/-	PASS
180	5900	64QAM	8.96	8.99	8.081	8.083	-/-	PASS
182	5910	64QAM	8.96	9.05	8.082	8.085	-/-	PASS
184	5920	64QAM	8.99	8.99	8.070	8.078	-/-	PASS

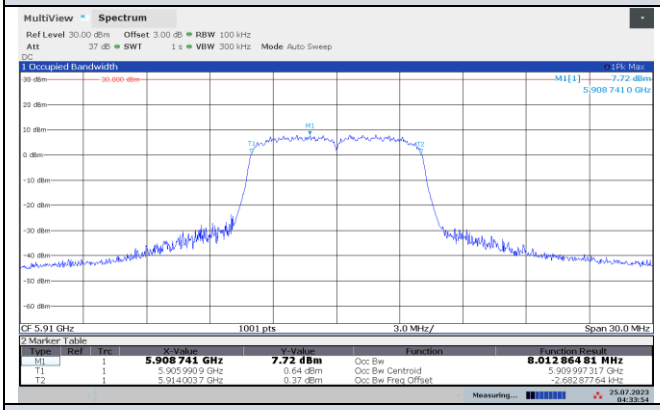
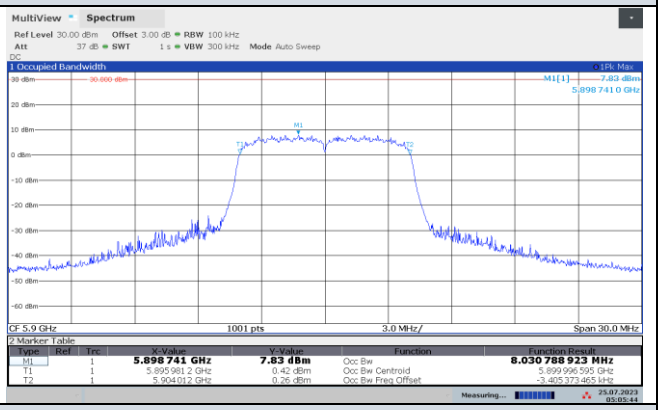
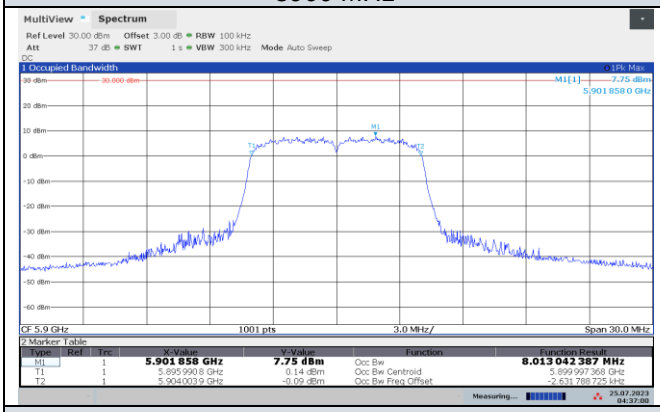
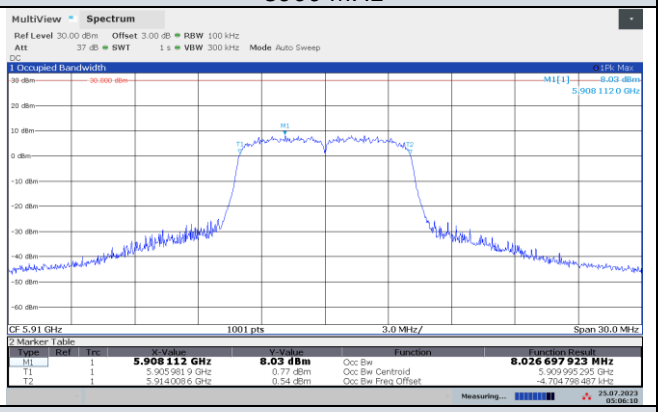
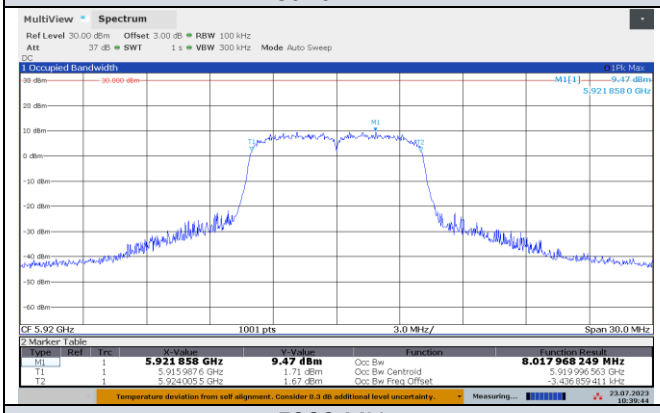
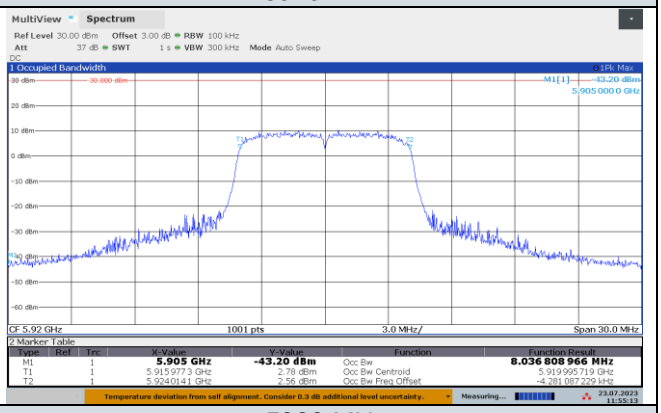
Note 1: Refer to following test plots.

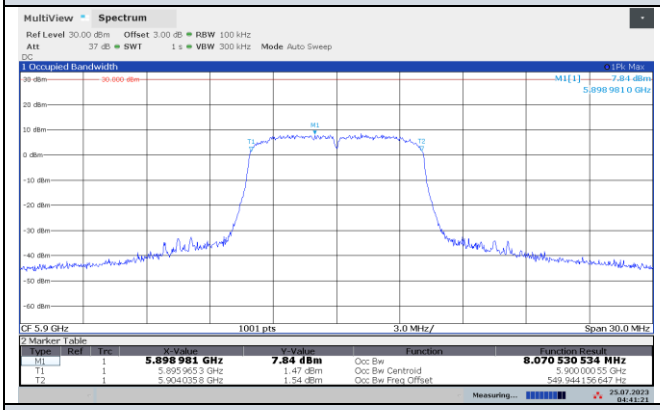
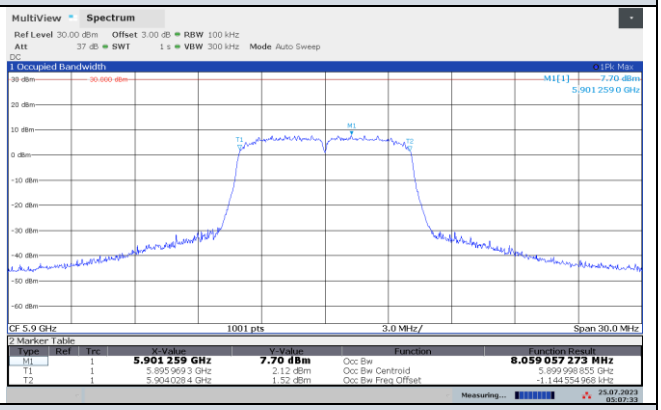
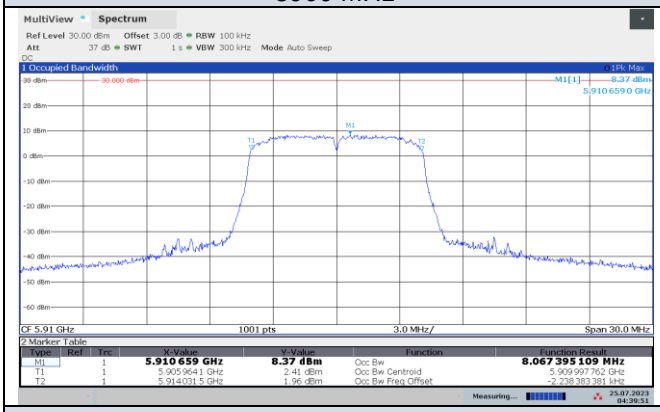
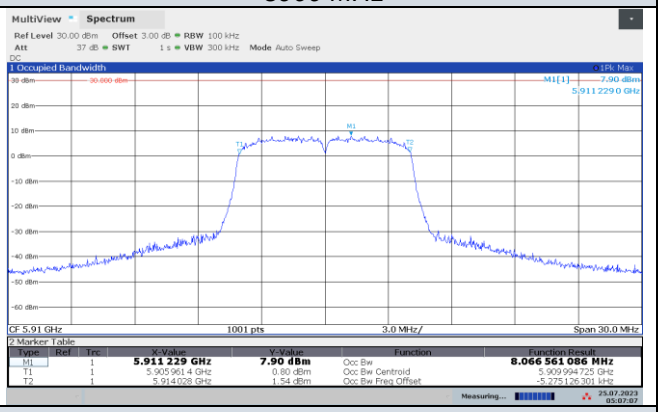
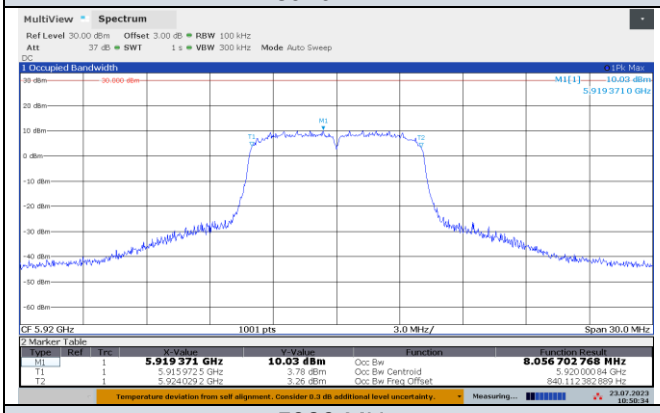
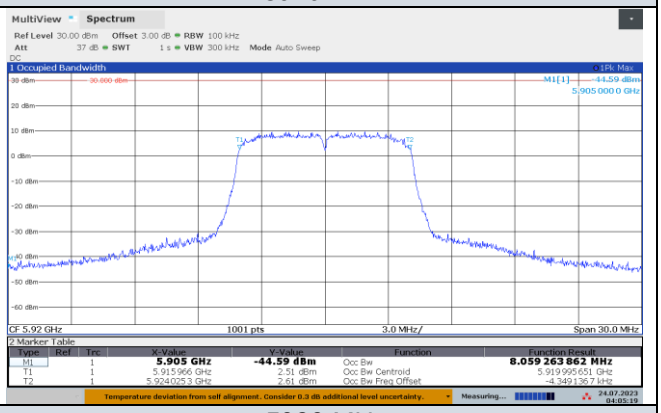
Plots of Emission Bandwidth [26 dB Bandwidth]	
Modulation: BPSK	*Modulation: BPSK*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

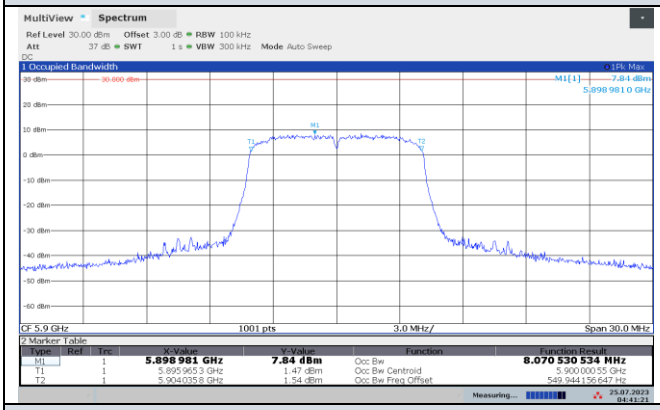
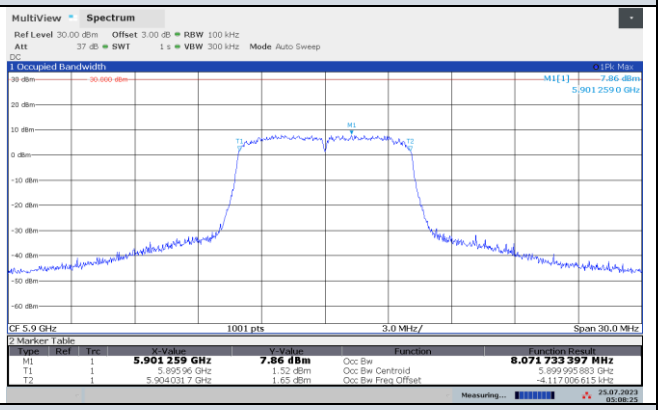
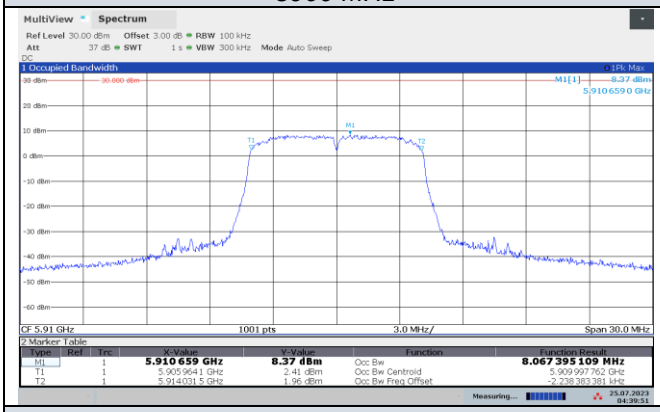
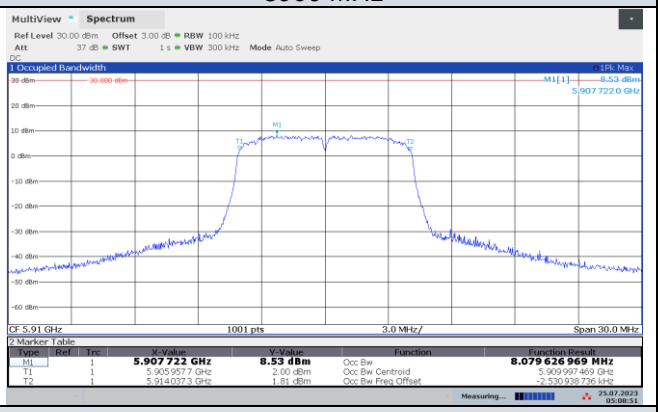
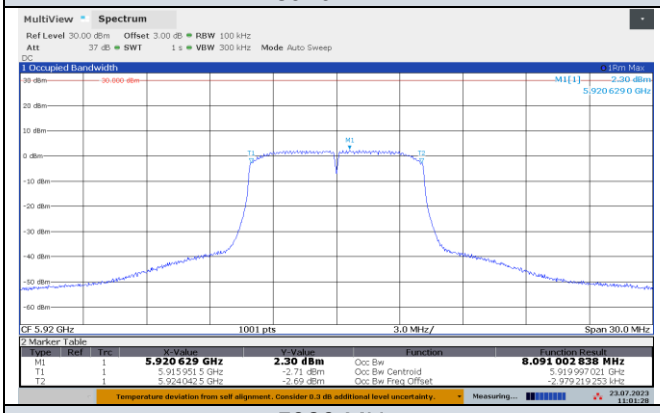
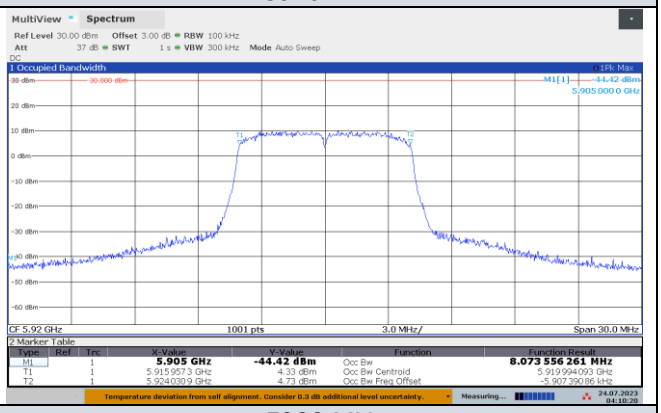
Plots of Emission Bandwidth [26 dB Bandwidth]	
Modulation: QPSK	*Modulation: QPSK*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

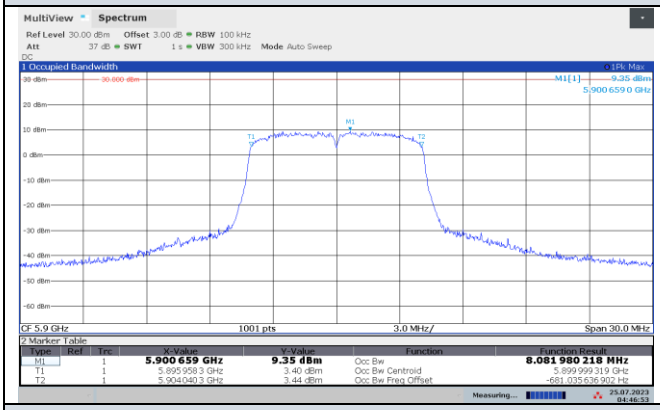
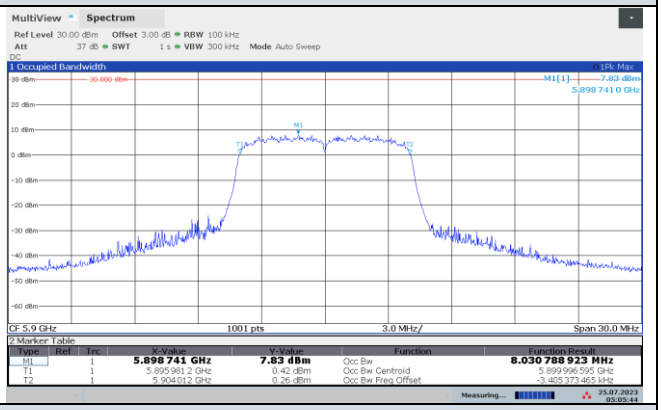
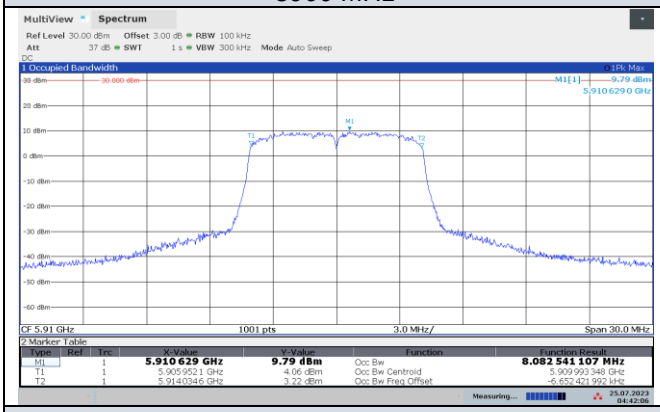
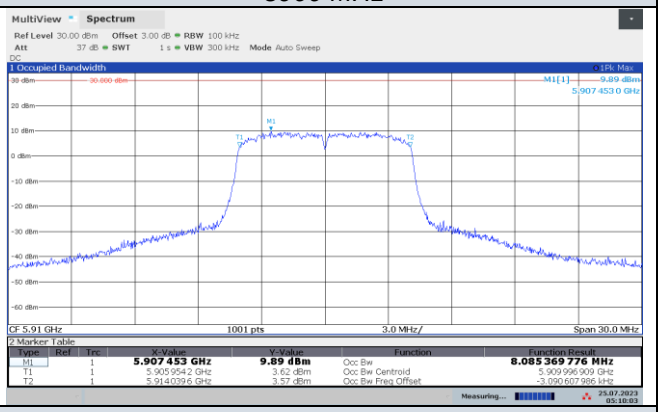
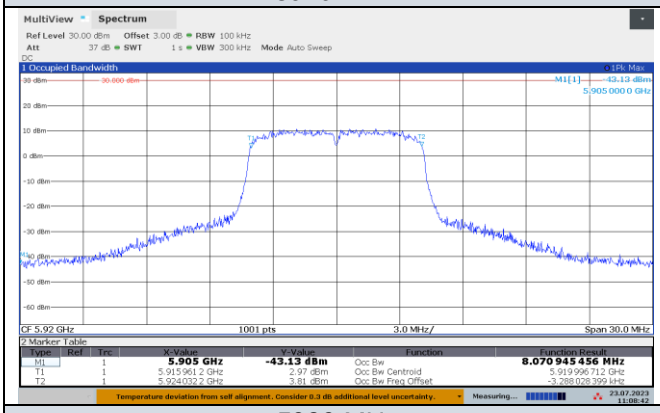
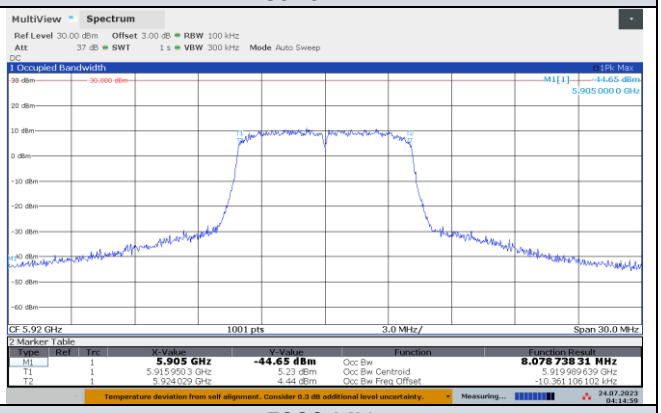
Plots of Emission Bandwidth [26 dB Bandwidth]	
Modulation: 16QAM	*Modulation: 16QAM*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

Plots of Emission Bandwidth [26 dB Bandwidth]	
Modulation: 64QAM	*Modulation: 64QAM*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

Plots of Emission Bandwidth [99% Bandwidth]	
Modulation: BPSK	*Modulation: BPSK*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

Plots of Emission Bandwidth [99% Bandwidth]	
Modulation: QPSK	*Modulation: QPSK*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

Plots of Emission Bandwidth [99% Bandwidth]	
Modulation: 16QAM	*Modulation: 16QAM*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

Plots of Emission Bandwidth [99% Bandwidth]	
Modulation: 64QAM	*Modulation: 64QAM*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

4.2. Maximum Transmitter Power [§95.3189 & ASTM E2213-03 8.10.1 & RSS-252 Clause 5.3]

4.2.1. LIMITS

According to §95.3101 - This subpart contains rules that apply only to On-Board Units (OBUs) transmitting in the 5895–5925 MHz frequency band in the Dedicated Short-Range Communications Services (DSRCS) (see § 90.371 of this chapter).
According to RSS-252 Clause 5.3 - OBU devices shall comply with the transmitter power levels described in the ASTM E 2213-03 (2010) standard.
According to ASTM E2213-03 8.10.1 – For the 5850 – 5925 MHz band, the maxmum conducted output power shall not exceed the below table.
OBU portable devices shall limit their maximum output power to 1 mW. Others as following as;

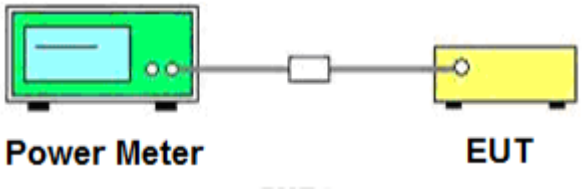
Frequency Range [MHz]	Channel	BW: 5 / 10 MHz	Conducted Power [dBm]	EIRP Power [dBm]
5855 – 5865	172	5860	28.8	33
5865 – 5875	174	5870	28.8	33
5875 – 5885	176	5880	28.8	33
5885 – 5895	178	5890	28.8	33 or 44.8
5895 – 5905	180	5900	20	23
5905 – 5915	182	5910	20	23
5915 – 5925	184	5920	28.8	33 or 40
5855 – 5865	175	5875	20	23
5865 – 5875	181	5905	20	23
Note 1: Conducted power could overcome limit but EIRP power shall under limit Note 2: Refer to ASTM E2213-03 Clause 8.10.1				

According to ASTM E2213-03 8.10.1.10 - Four classes of operation are specified for DSRC devices in the 5.850 to 5.925 GHz band and are shown in following table:

DSRC Device Classes and Transmit Power Levels

Device Class	Maximum Device Output Power [dBm]
A	0
B	10
C	**20**
D	28.8 or more

4.2.2. TEST CONFIGURATION



4.2.3. TEST PROCEDURE

According to ANSI C63.26:2015 section 5.2.4 and ANSI C63.10:2020 section 11.9.2.3: General procedure for measuring average power with an average power meter.
When an average power meter is used to perform RF output power measurements, the fundamental condition that measurements be performed only over durations of active transmissions at maximum output power level applies. Thus, an average power meter can always be used to perform the measurement when the EUT can be configured to transmit continuously.
If the EUT cannot be configured to transmit continuously (i.e., burst duty cycle < 98%), then the following options can be implemented to facilitate measurement of the average power with an average power meter:

a) A gated average power meter can be used to perform the measurement if the gating parameters can be adjusted such that the power is measured only during active transmission bursts at maximum output power levels.
b) A conventional average power meter with no signal gating capability can also be used if the measured burst duty cycle is constant (i.e. duty cycle variations are less than or equal to ±2%) by performing the measurement over the on/off burst cycles and then correcting (increasing) the measured level by a factor equal to [10 log (1/duty cycle)]. See 5.2.4.3.4 for guidance with respect to measuring the transmitter duty cycle.

4.2.4. TEST RESULTS

Channel	Frequency [MHz]	Rate [Mbps]	Conducted Power [dBm]		Conducted EIRP Power* [dBm]		Limit [dBm]		Results
			Port 1	Port 2	Port 1	Port 2	Conduted Power	Conducted EIRP Power	
180	5900	3	17.80	17.95	22.80	22.95	20	23	PASS
		4.5	17.73	17.62	22.73	22.62	20	23	
		6	17.80	17.84	22.80	22.84	20	23	
		9	17.75	17.48	22.75	22.48	20	23	
		12	17.74	17.56	22.74	22.56	20	23	
		18	17.47	17.52	22.47	22.52	20	23	
		24	17.81	17.64	22.81	22.64	20	23	
		27	17.45	17.16	22.45	22.16	20	23	
182	5910	3	17.97	17.88	22.97	22.88	20	23	PASS
		4.5	17.88	17.82	22.88	22.82	20	23	
		6	17.93	17.85	22.93	22.85	20	23	
		9	17.85	17.78	22.85	22.78	20	23	
		12	17.92	17.79	22.92	22.79	20	23	
		18	17.64	17.72	22.64	22.72	20	23	
		24	17.98	17.43	22.98	22.43	20	23	
		27	17.54	17.35	22.54	22.35	20	23	
184	5920	3	19.51	19.90	24.51	24.90	20	33	PASS
		4.5	19.47	19.36	24.47	24.36	20	33	
		6	19.85	19.89	24.85	24.89	20	33	
		9	19.42	19.32	24.42	24.32	20	33	
		12	19.85	19.84	24.85	24.84	20	33	
		18	19.44	19.57	24.44	24.57	20	33	
		24	19.47	19.67	24.47	24.67	20	33	
		27	19.19	19.27	24.19	24.27	20	33	

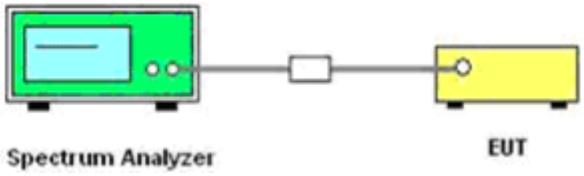
Note 1: Conducted EIRP Power* = Conducted Output Power + Antenna Gain (5.00 dBi)

4.3. Transmit Spectrum Mask [§95.3189 & ASTM E2213-03 8.10.2 & RSS-252 Clause 5.4]

4.3.1. LIMITS

According to ASTM E2213-03 8.10.2 – Transmit Spectrum Mask: The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and bandedges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and bandedges by 55 + 10log (P) dB, where P is the total transmitted power in watts.
According to RSS-252 Clause 5.4 - OBU devices shall comply with the transmitter emission masks described in the ASTM E 2213-03 (2010) standard.
Emissions in frequencies beyond the DSRC emission masks described in the ASTM E2213-03 (2010) standard, shall comply with the same emission limit as the limit that is applicable to the highest frequency offset described in the emission mask.
According to § 95.3189: DSRCS On-Board Unit (OBU) transmitter types operating in the 5895–5925 MHz band must be designed to comply with the technical standard Institute of Electrical and Electronics Engineers (IEEE) 802.11p–2010.

4.3.2. TEST CONFIGURATION



4.3.3. TEST PROCEDURE

According to ASTM E2213-03 8.10.2 – Transmit Spectrum Mask: The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and bandedges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and bandedges by 55 + 10log (P) dB, where P is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask,as detailed in following table. The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

DSRC Device Classes and Transmit Power Levels

Device Class	Maximum Device Output Power [dBm]
A	0
B	10
C	**20**
D	28.8 or more

The transmitted spectral mask for class A, B, C, and D devices are shown in following table. In addition, all DSRC site installations shall limit the EIRP in the transmitted spec-trum to −25dB mor less in the 100 kHz at the channel edges and the band edges. Additional filtering that supplements the filtering provided by the transmitter may be needed for some antenna / transmitter combinations.

DSRC Spectrum Mask
Note 1—Reduction in Power Spectral Density, dBr.

Class	±4.5 MHz Offset	±5.0 MHz Offset	±5.5 MHz Offset	±10 MHz Offset	±15 MHz Offset
Class A	0	-10	-20	-28	-40
Class B	0	-16	-20	-28	-40
Class C	**0**	**-26**	**-32**	**-40**	**-50**
Class D	0	-35	-45	-55	-65

Measurement with the RMS 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.
The spectrum analyzer is set to as follows;

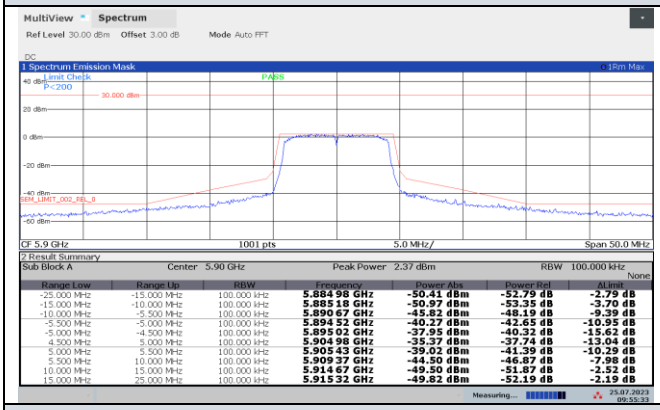
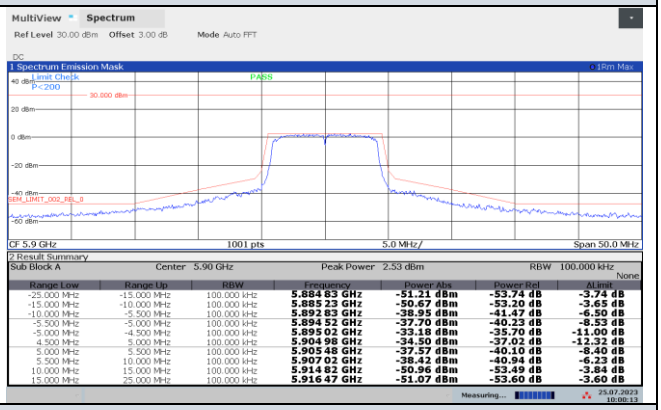
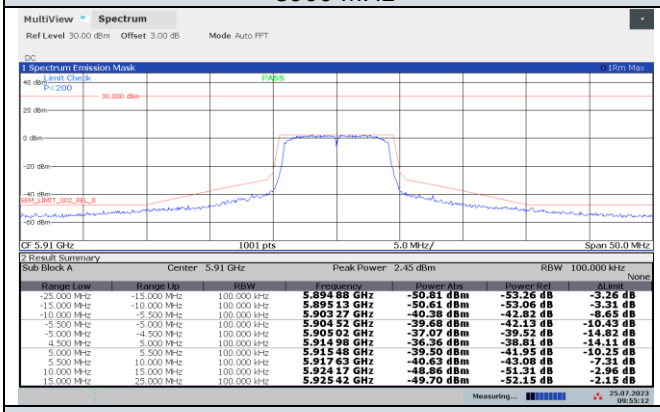
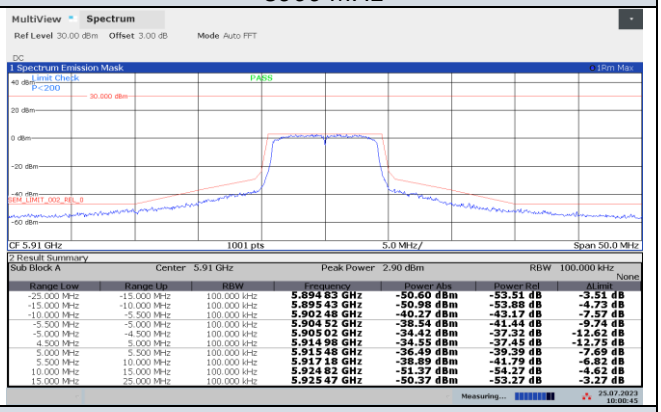
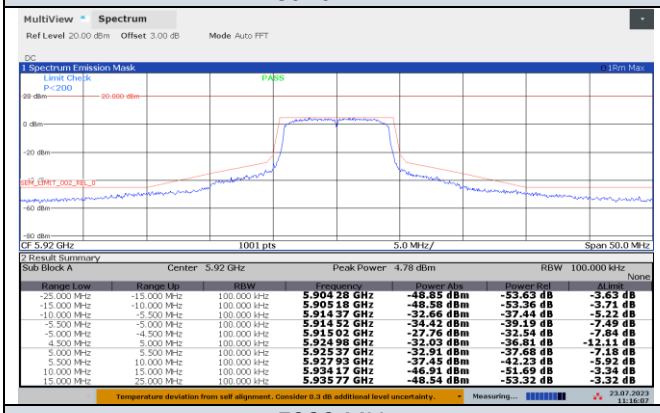
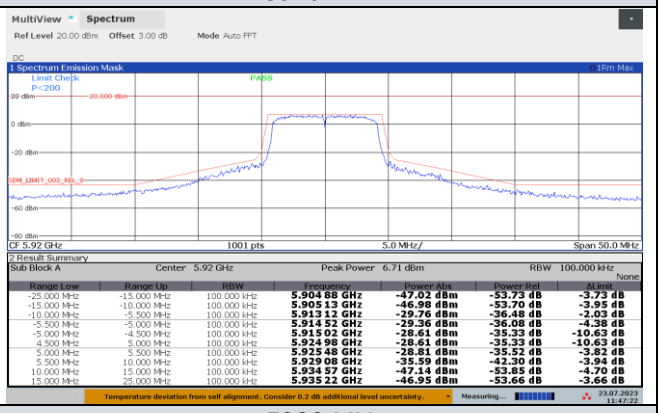
- RBW: 100 KHz
- VBW: 30 KHz
- Sweep: Auto
- Detector: RMS
- Trace: Maxhold

4.3.4. TEST RESULTS

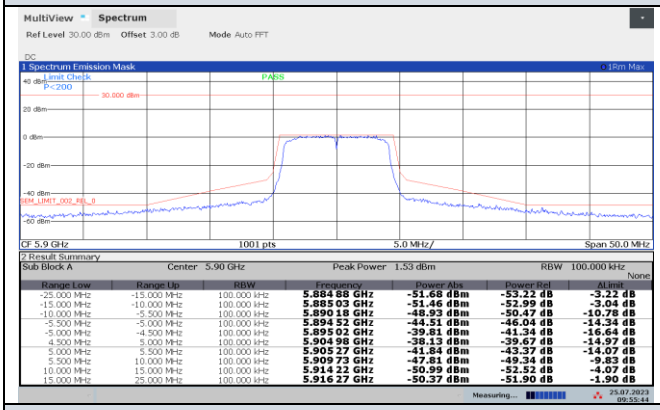
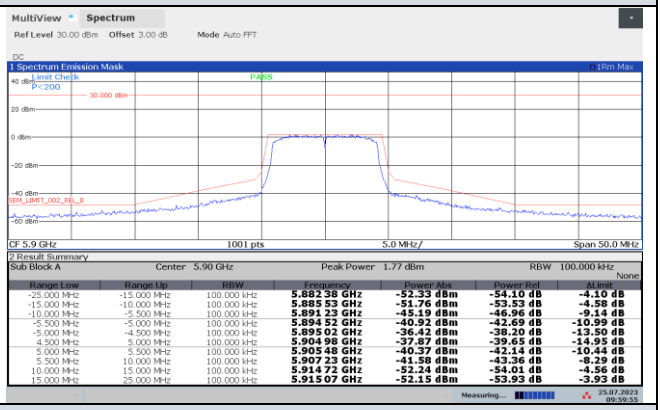
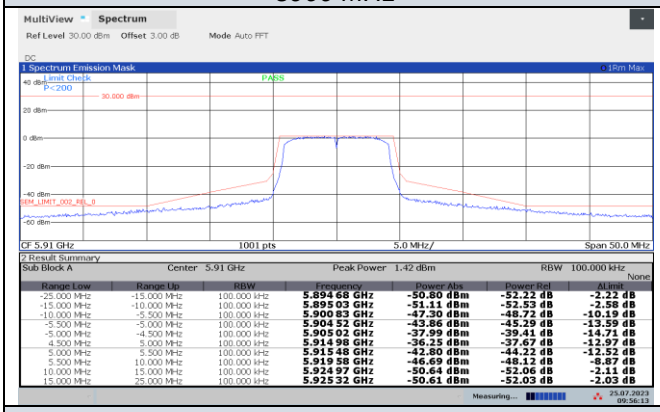
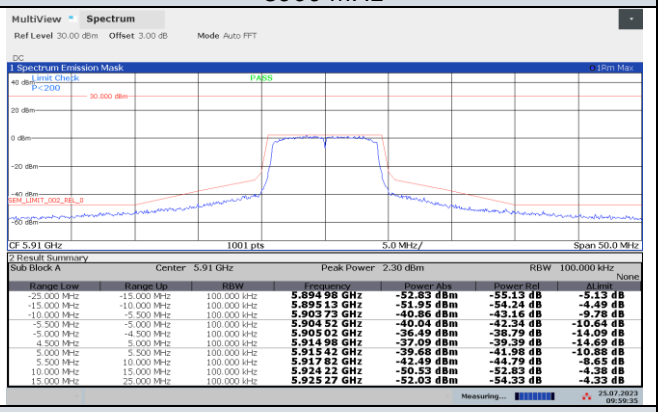
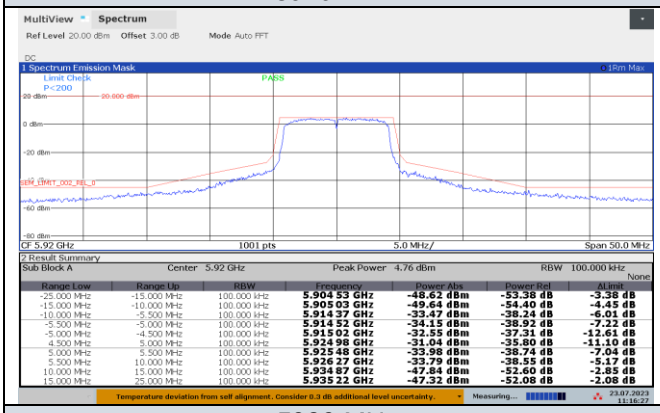
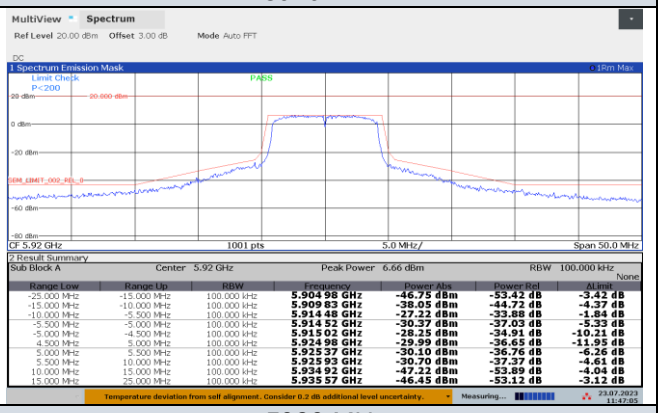
Channel	Frequency [MHz]	Modulation	Measurement Results [dBc]		Limits [dBc]	Results
			Port 1	Port 2		
180	5900	BPSK	Note 1	Note 1	Note 2	PASS
182	5910	BPSK	Note 1	Note 1	Note 2	PASS
184	5920	BPSK	Note 1	Note 1	Note 2	PASS
180	5900	QPSK	Note 1	Note 1	Note 2	PASS
182	5910	QPSK	Note 1	Note 1	Note 2	PASS
184	5920	QPSK	Note 1	Note 1	Note 2	PASS
180	5900	16QAM	Note 1	Note 1	Note 2	PASS
182	5910	16QAM	Note 1	Note 1	Note 2	PASS
184	5920	16QAM	Note 1	Note 1	Note 2	PASS
180	5900	64QAM	Note 1	Note 1	Note 2	PASS
182	5910	64QAM	Note 1	Note 1	Note 2	PASS
184	5920	64QAM	Note 1	Note 1	Note 2	PASS

Note 1: Refer to following test plots;

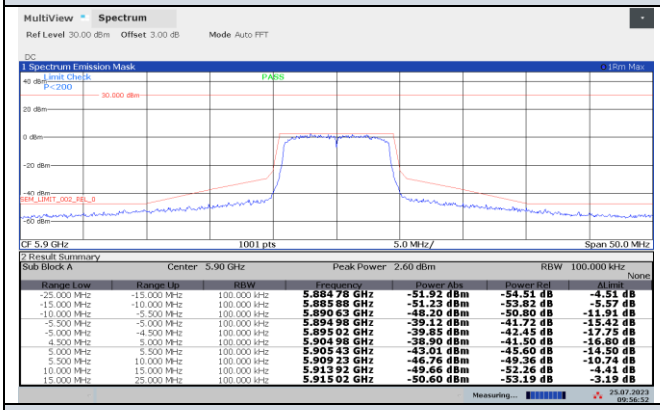
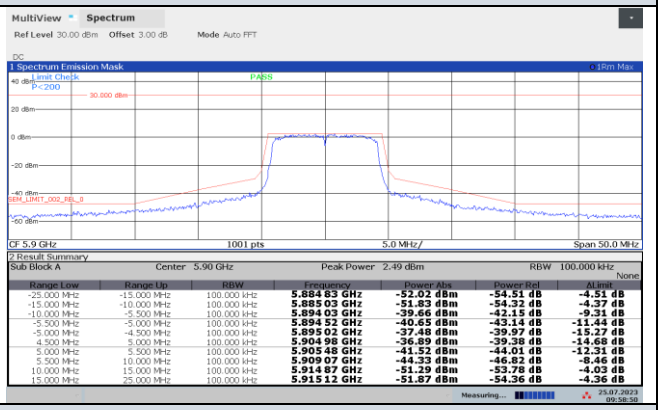
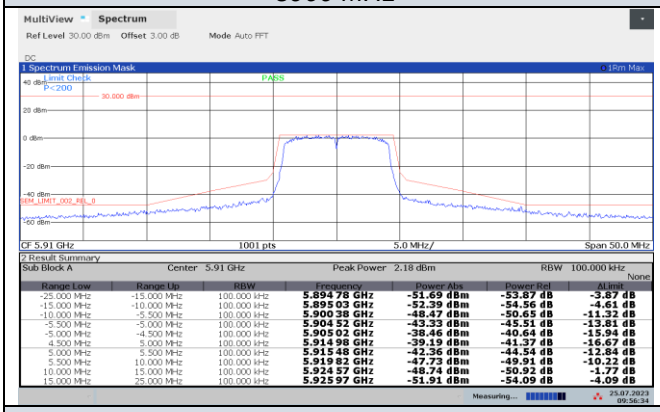
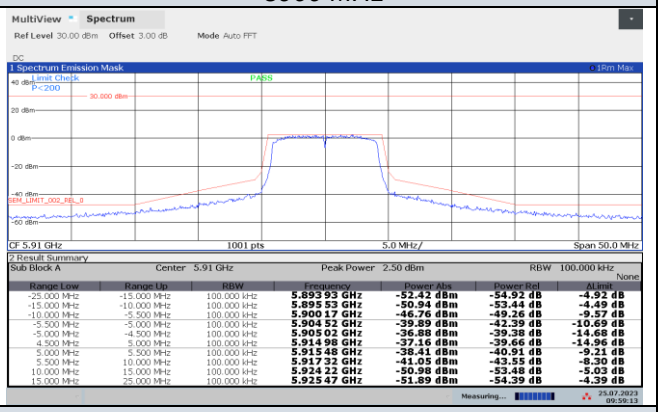
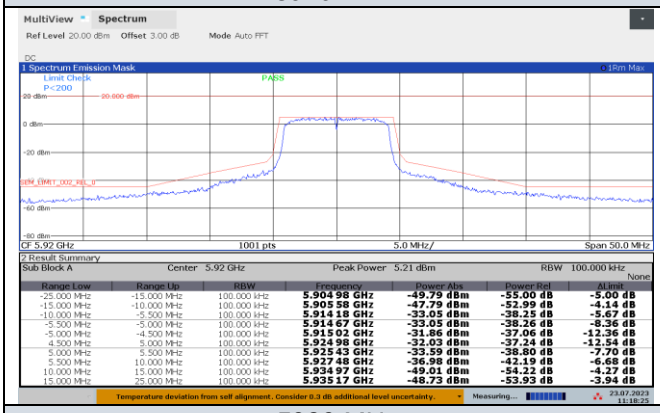
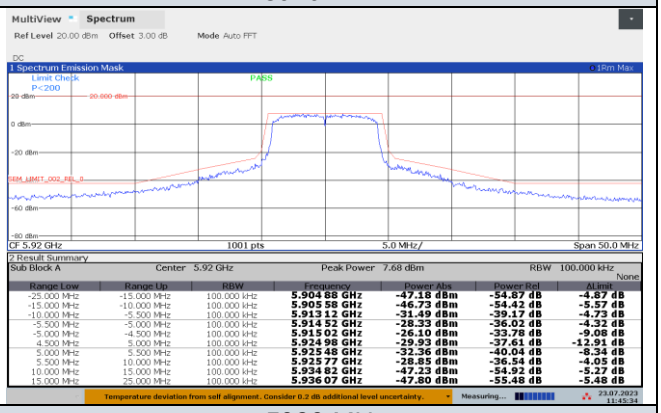
Plots of Transmit Spectrum Mask

Modulation: BPSK	*Modulation: BPSK*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

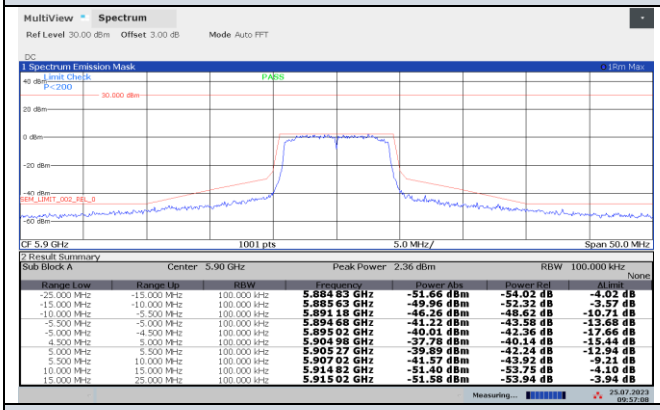
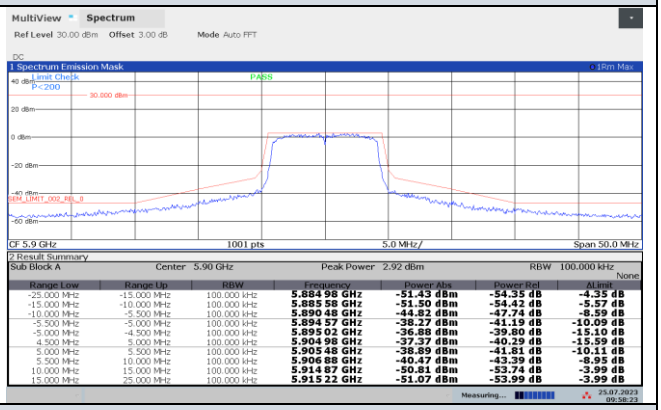
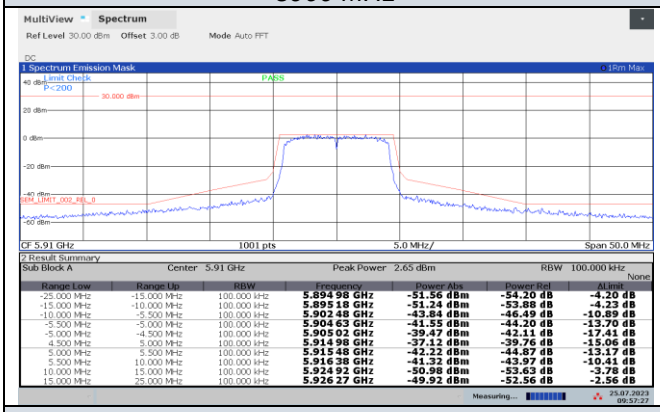
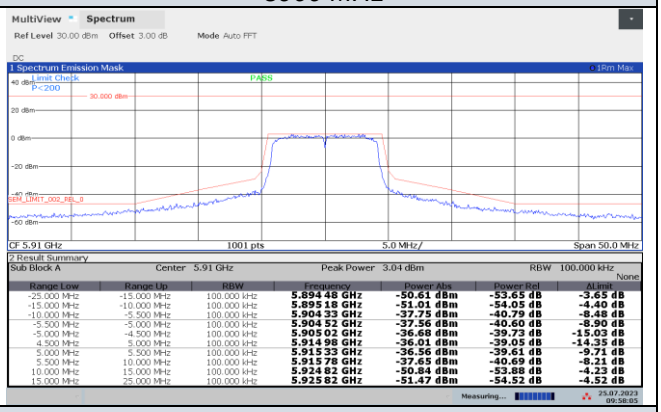
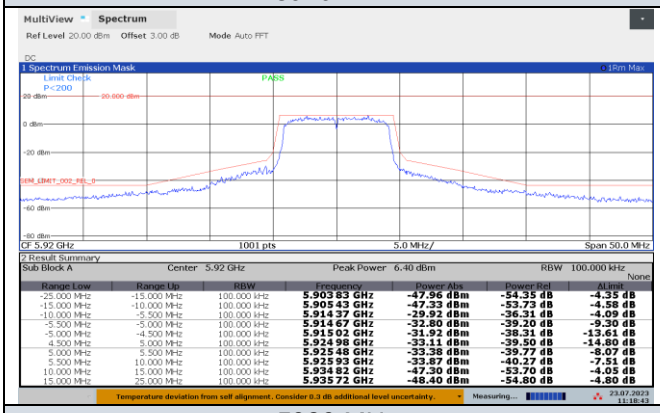
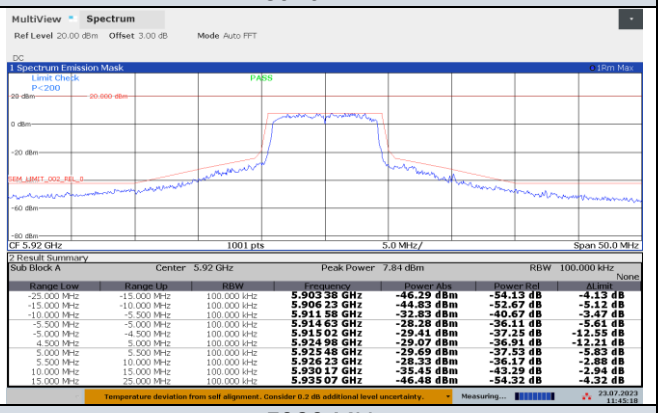
Plots of Transmit Spectrum Mask

Modulation: QPSK	*Modulation: QPSK*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

Plots of Transmit Spectrum Mask

Modulation: 16QAM	*Modulation: 16QAM*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

Plots of Transmit Spectrum Mask

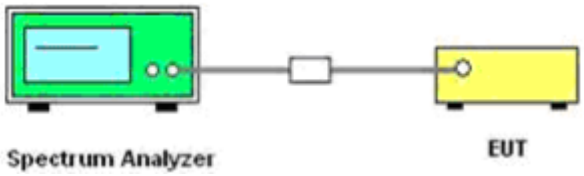
Modulation: 64QAM	*Modulation: 64QAM*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*

4.4. Transmitter Conducted Unwanted Emissions [§95.3189 & ASTM E2213-03 8.10.2 & RSS-252 Clause 5.4]

4.4.1. LIMITS

According to ASTM E2213-03 8.10.2 – Transmit Spectrum Mask: The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and bandedges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and bandedges by 55 + 10log (P) dB, where P is the total transmitted power in watts.
According to RSS-252 Clause 5.4 - OBU devices shall comply with the transmitter emission masks described in the ASTM E 2213-03 (2010) standard.
Emissions in frequencies beyond the DSRC emission masks described in the ASTM E2213-03 (2010) standard, shall comply with the same emission limit as the limit that is applicable to the highest frequency offset described in the emission mask.
According to § 95.3189: DSRCS On-Board Unit (OBU) transmitter types operating in the 5895–5925 MHz band must be designed to comply with the technical standard Institute of Electrical and Electronics Engineers (IEEE) 802.11p–2010.

4.4.2. TEST RESULTS



4.4.3. TEST PROCEDURE

According to ASTM E2213-03 8.10.2 – Transmit Spectrum Mask: The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and bandedges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and bandedges by 55 + 10log (P) dB, where P is the total transmitted power in watts. The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

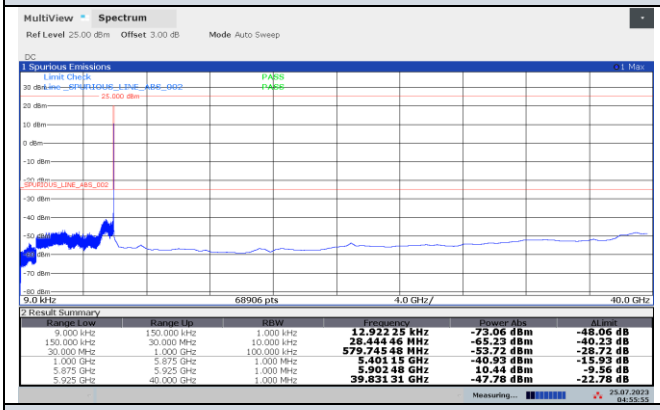
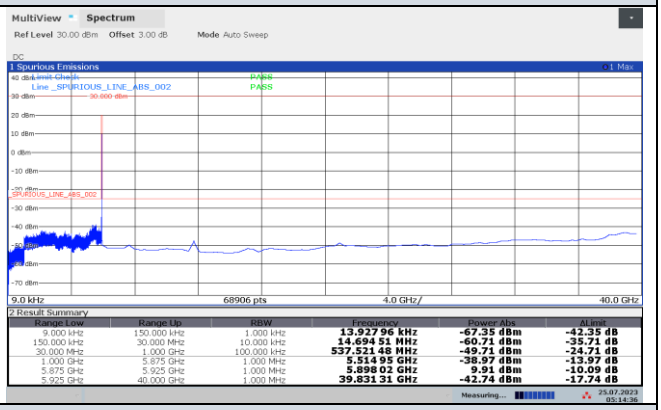
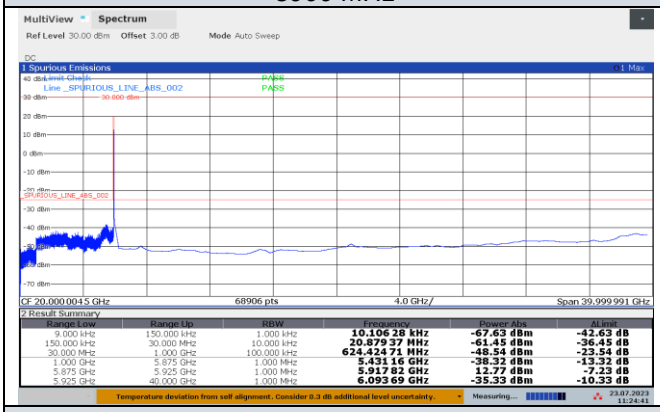
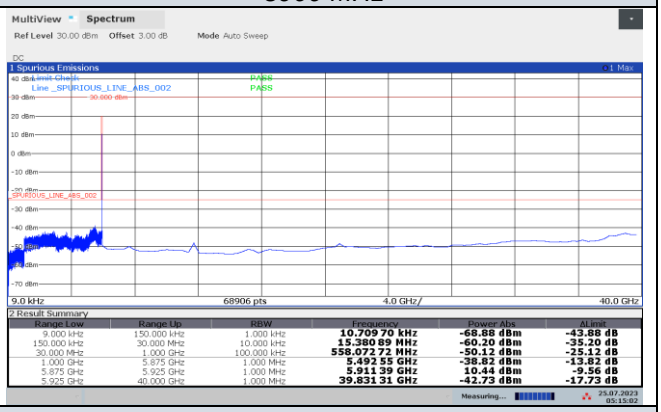
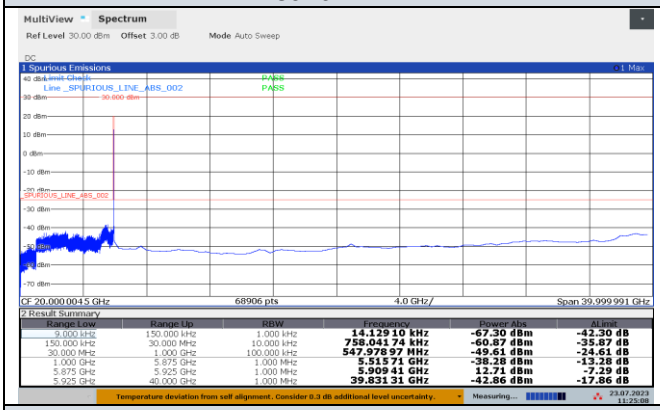
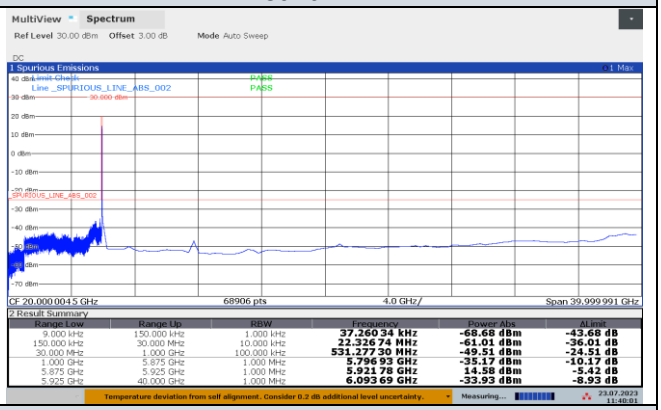
4.4.4. TEST RESULTS

Channel	Frequency [MHz]	Modulation	Measurement Results [dBm]		Limits [dBc]	Results
			Port 1	Port 2		
180	5900	BPSK	< -25	< -25	-25	PASS
182	5910	BPSK	< -25	< -25	-25	PASS
184	5920	BPSK	< -25	< -25	-25	PASS
180	5900	QPSK	< -25	< -25	-25	PASS
182	5910	QPSK	< -25	< -25	-25	PASS
184	5920	QPSK	< -25	< -25	-25	PASS
180	5900	16QAM	< -25	< -25	-25	PASS
182	5910	16QAM	< -25	< -25	-25	PASS
184	5920	16QAM	< -25	< -25	-25	PASS
180	5900	64QAM	< -25	< -25	-25	PASS
182	5910	64QAM	< -25	< -25	-25	PASS
184	5920	64QAM	< -25	< -25	-25	PASS

Note 1: Refer to following test plots;
Note 2: Conducted spurious emission from 9 KHz – 40 GHz.
Note 3: The higher level over limit is fundantal frequency.
Note 4: Measure RBW and VBW as follwing table, which more than standards requirement, if results over limit, will require reduce RBW = 100 KHz / VBW = 30 KHz remeasurement again.

Frequency Range	RBW / VBW
9 KHz – 150 KHz	1 KHz / 3 KHz
150 KHz – 30 MHz	10 KHz / 30 KHz
30 MHz – 1000 MHz	100 KHz / 300 KHz
1 GHz – 40 GHz	1 MHz / 3 MHz

Plots of Transmit Transmitter Conducted Unwanted Emissions

Modulation: BPSK	*Modulation: BPSK*
Port 1	*Port 2*
	
5900 MHz	*5900 MHz*
	
5910 MHz	*5910 MHz*
	
5920 MHz	*5920 MHz*