Test Report No. 7312306187

Applicant: Maytronics Ltd.

Equipment Under Test:

Remote Control for WAVE pool cleaners

Model: WAVE RCU

FCC ID: WCH9995412

From The Standards Institution
Of Israel
Industry Division
Electrical & Electronics Laboratory
EMC Branch

ilac-MRA

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TESTING LABORATORY
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42 Chaim Levanon St, Tel Aviv 6997701 Israel. www.sii.org.il

Applicant:	Maytronics Ltd.
Address:	Kibbutz Yizre'el , 19350, Israel
Sample for test selected by:	The customer
The date of tests:	Marth 2023

Description of Equipment Under Test (EUT):	Remote Control for WAVE pool cleaners.
Model:	WAVE RCU
Software version of radio unit:	01
Hardware version of radio unit:	01
Manufactured by:	Maytronics Ltd.

Reference Documents:

❖	CFR 47 FCC:	Rules and Regulations; Part 15. “Radio frequency devices”; Subpart C: “Intentional radiators” Section 15.205. “Restricted bands of operations”, Section 15.209. “Radiated emission limits, general requirements”. “Radiated Emission Limits, Additional Provisions”; Section 15.231. “Periodic operation in the bands 40.66 – 40.70 MHz, and above 70 MHz”.
❖	RSS – Gen	Radio Standard Specification, Issue 3, General Requirements and Information for the Certification of Radiocommunication Equipment
❖	IC RSS – 210 Annex D, 2019	Radio Standard Specification 2019, Issue 10, Licence-exempt Radio Apparatus: Category I Equipment.

Table of Contents

1. EUT Description and operation

1.1. General description:

* Note: the customer supplied all information in clause below.

Remote Control Unit for Robotic Pool Cleaner models WAVE300 XLR and WAVE200 XL.
Powered by 2 AAA batteries.

Operational frequency	433.92 MHz
Type of modulation:	FSK
Antenna type:	Internal integrated on PCB printed, without temporary RF connector,

The EUT external view is presented in photo # 1.

Photo 1. Transceiver front and rear view.

2. Test summary

Parameter	FCC Part 15 Reference paragraph	RSS-210 Reference paragraph	Verdict
Radiated emission from intentional radiators in restricted bands	Subpart C Section 15.205	A1.2 Field strengths	Comply
AC line conducted emission test	Subpart C Section 15.207	RSS GEN 8.8	N/A
Test of field strength emission from intentional radiators	"Radiated Emission Limits, Additional Provisions"; Section 15.231	A1.2 Field strengths	Comply
Occupied bandwidth	Subpart C section 15.231(c)	A1.3 Bandwidth of momentary signals	Comply

Electrical & Electronics Laboratory

06 June 2023

Name: Eng. Yuri Rozenberg
Position: Head of Branch

Name: Alexander Konkov
Position: Test engineer.

Normative References.

FCC 47 CFR Part 15, Subpart C	Radio Frequency Devices Subpart C – Intentional Radiators
ANSI C63.4: 2014	American National Standard for Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10: 2020	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

Measurement uncertainty.

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error.
The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.
In the following table the uncertainty calculation is given.

Type of disturbance Test description	Calculated uncertainty U_{LAB}
Radiated disturbance electric field strength in a SAR at 3 m distance 30 MHz – 1.0 GHz	±4.32 dB
electric field strength in a FAR at 3 m distance 1.0 – 18 GHz. 18 – 40 GHz.	±4.47 dB ±2.78 dB

2.1. Potential emission sources:

The potential emission sources are detailed in Table 1.

Table 1. Potential emission sources

Frequency	Location
32 MHz	Clock
433.92 MHz	RF signal

2.2. EUT setup and operation:

Test was performed in continuous transmission mode. Duty Cycle 100 %.

3. Measurements and derived results

3.1. Location of the Test Site:

Radiated test measurements were conducted in the Anechoic chamber at the EMC laboratory of the Standards Institution of Israel in Tel-Aviv.

3.2. Test condition:

Temperature: 23 °C. Humidity: 56 %. Atmospheric pressure: 1012 mbar.

3.3. Radiated emission test.

3.3.1. General:

Per FCC Part 15 Subpart C Sections 15.209, 15.231.

- Initial scans were made using a peak detector but still using the appropriate ANSI IF bandwidth.
- A tolerance limit was set 10 dB below the specification limit. Levels above the tolerance limit were retested using the Peak, QP or Average detectors.

3.3.2. Radiated emission measurements:

Preliminary investigation was performed from the lowest radio frequency signal generated in the equipment up to ten harmonic of a carrier frequency.
The final radiated emission measurements were performed in the semi Anechoic chamber at the 3 m test distances. Test was performed with a connected battery charger. The EUT was operated in continue transmition mode. The transmitter was installed on a turn - table. Biconilog and Double Ridged Guide antennas were used. The measurements were performed at frequencies at which the signal level was 10 dB below the limit or less. The levels were maximized by rotating turntable through 360° and changing antenna-to-EUT polarization from vertical to horizontal. The worse case result was noted in tables.

3.3.3. Radiated emission test results:

Final measurements result are presented in tables and plots ## 1 - 6 in section 3.5.

3.4. Common conditions for operation in the band above 70 MHz.

3.4.1. General:

Per FCC Part 15 Subpart C clause 15.231 (a).

3.4.2. Requirements:

15.231(a) – Transmitter is defined as a part of are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz.

15.231(a)(1) – A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

15.231(a)(2) - Transmission duration is limited by program and after activation is less than 5 second.

15.231(b)(1) – In addition to the provisions of § 15.205, the field strength of emissions from intentional radiators operated under this section.

15.231(c) - The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz.

3.4.3. Summary:

The verification tests according to 15.231(a) have been done and the EUT was found complies with the requirements of clause 15.231(a).

3.5. Test of field strength emission from intentional radiator.

3.5.1. General:

Per FCC Part 15 Subpart C clause 15.231(b).

3.5.2. Requirements:

The field strength emissions from intentional radiators operated on this frequency shall comply with the limit based on the average value.

Fundamental Frequency MHz	Calculated Field Strength limit of Fundamental dBμV/m	Calculated Field Strength limit of Harmonics dBμV/m
433.92	80.8	60.8

Note: Peak field strength shall not exceed the maximum permitted specified limit by more than 20 dB.
Field strength limits are specified at a distance of 3 meters.

3.5.3. Test procedure:

The test was conducted according to clause 15.231.

3.5.4. Test summary:

The tested unit meets the standard requirement.

3.5.5. Test results:

Radiated emission result at carrier frequencies.

Carrier frequency MHz	Peak Ampl. dBµV/m	Peak Limit dBµV/m	Margin dB	Avg Ampl.* dBµV/m	Specified Avg. @3m limit, dBµV/m	Margin dB
433.94	78.55	100.8	22.25	77.07	80.8	-3.73

*Without average factor - transmission Constance,
For transmitter see plot # 3.

For recorded Fundamental frequency result, see plot #1.
All received spurious emissions were found below the specified limit.
Founded spurious emissions results presented in tables below.

Unwanted emissions test result.

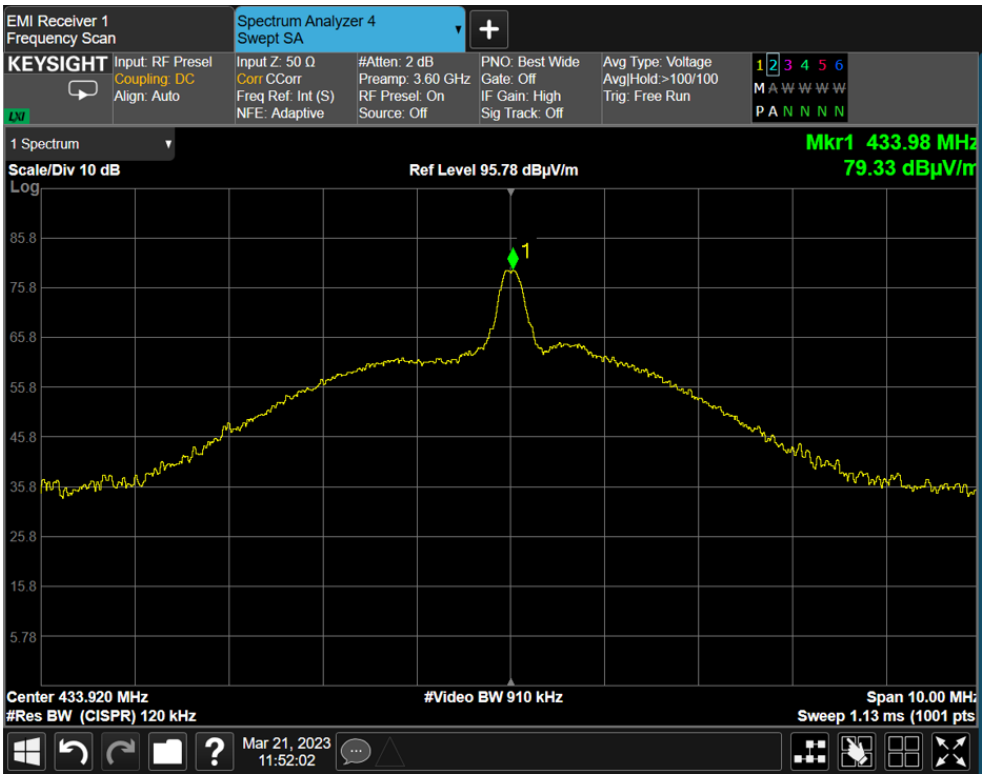
Freq. MHz	Antenna Polariz. V/H	Antenna Height (m)	Turn table Angle (°)	QP. Emission Level (dBµV/m)	Limit @ 3 m (dBµV/m)	Margin (dB)	Reference to plot #
41.940	H	1.0	105	21.99	40	-18.31	3
867.87	H	1.0	321	31.57	46.0	-12.4	3
903.82	H	1.0	46	33.50	46.0	-12.5	3

Spurious emission result.

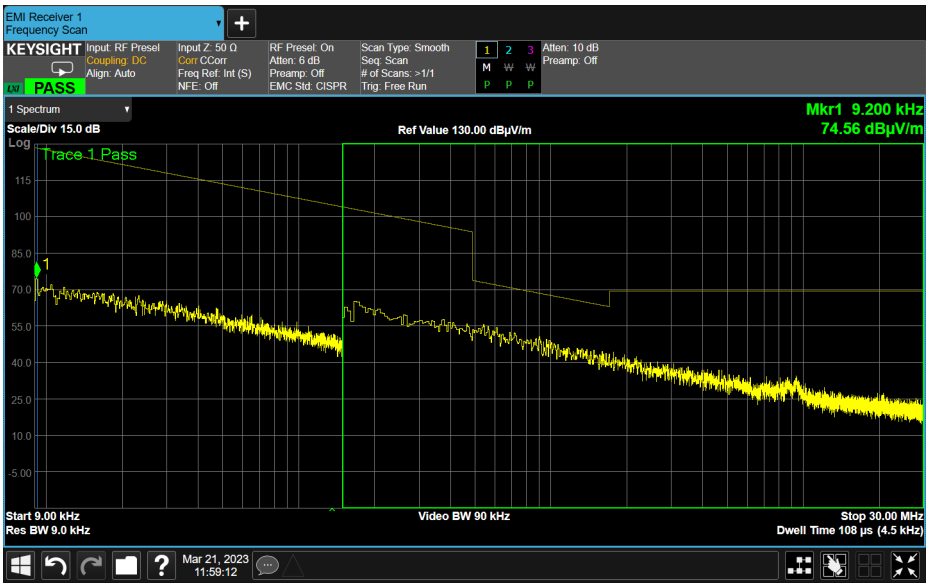
Freq. MHz	Antenna pol. V/H	Peak Ampl dBµV/m	Peak Ampl limit, dBµV/m	Margin dB	Avg Ampl. dBµV/m	Specified @3m limit, dBµV/m	Margin dB	Ref. to plot #
1.302	H	47.28	-	-	-	60.8	-13.52	6
1.7495	H	44.56	*74.0	>20	31.90	*54.0	-22.1	5
2.1705	H	47.06	*74.0	>20	34.48	*54.0	-19.52	5
3.1785	H	50.11	*74.0	>20	37.73	*54.0	-16.27	5

*Limit 15.205 restricted bands.

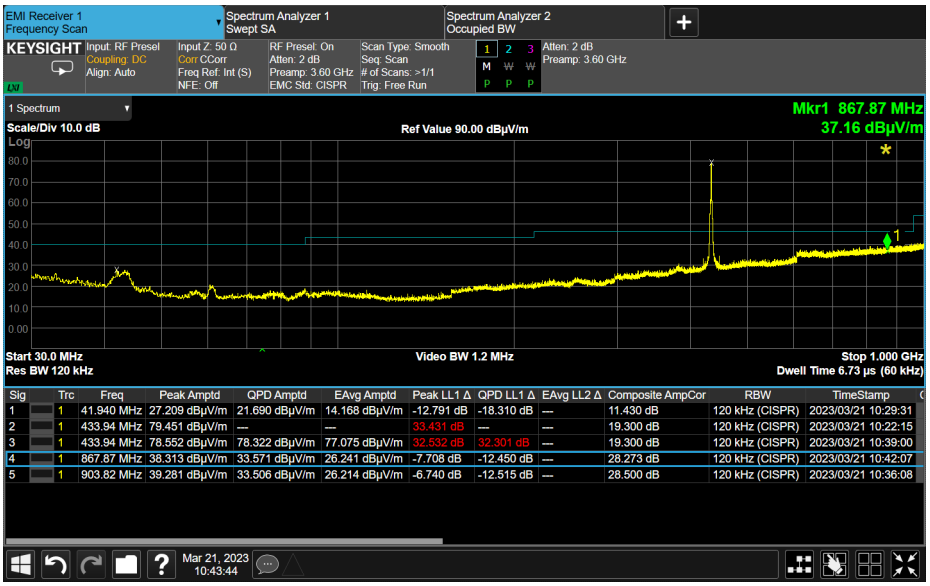
Fundamental frequency test.



Plot # 1. Carrier frequency 433.92 MHz.



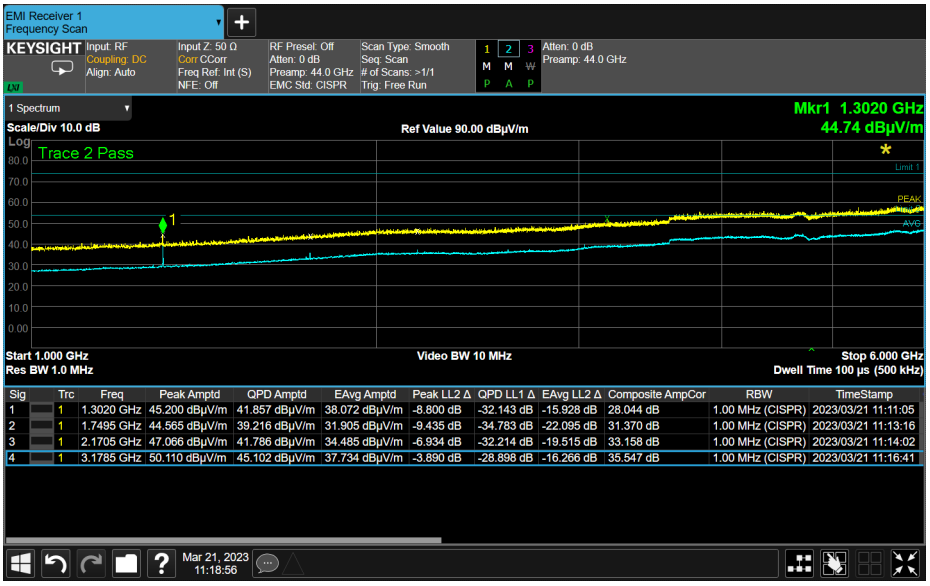
Plot # 2. Emissions scan 0.15 – 30 MHz.



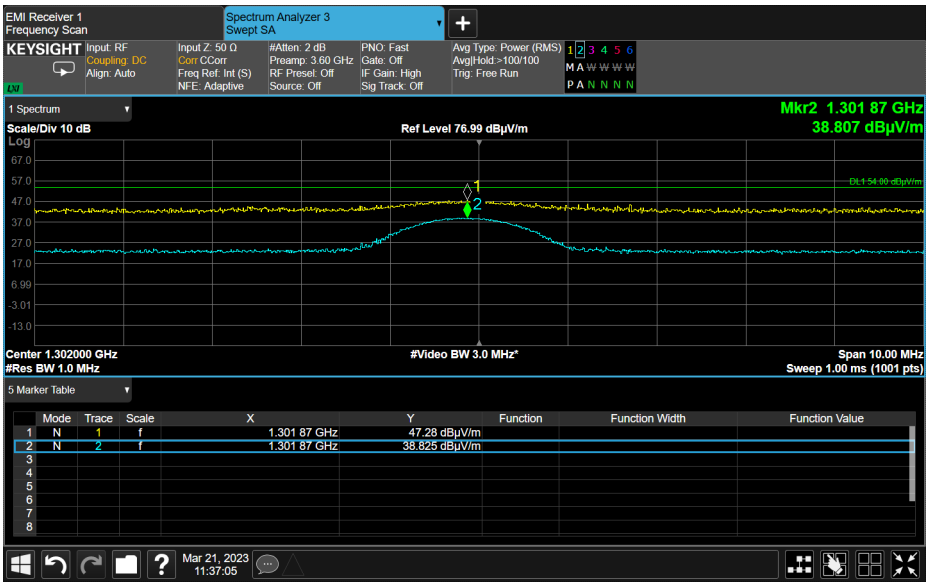
Sig	Trc	Freq	Peak Amptd	QPD Amptd	EAvg Amptd	Peak LL1 Δ	QPD LL1 Δ	EAvg LL2 Δ	Composite AmpCor	RBW	TimeStamp
1	1	41.940 MHz	27.209 dBµV/m	21.690 dBµV/m	14.168 dBµV/m	-12.791 dB	-18.310 dB	---	11.430 dB	120 kHz (CISPR)	2023/03/21 10:29:31
2	1	433.94 MHz	79.451 dBµV/m	---	---	33.431 dB	---	---	19.300 dB	120 kHz (CISPR)	2023/03/21 10:22:15
3	1	433.94 MHz	78.552 dBµV/m	78.322 dBµV/m	77.075 dBµV/m	32.532 dB	32.301 dB	---	19.300 dB	120 kHz (CISPR)	2023/03/21 10:39:00
4	1	867.87 MHz	38.313 dBµV/m	33.571 dBµV/m	26.241 dBµV/m	-7.708 dB	-12.450 dB	---	28.273 dB	120 kHz (CISPR)	2023/03/21 10:42:07
5	1	903.82 MHz	39.281 dBµV/m	33.506 dBµV/m	26.214 dBµV/m	-6.740 dB	-12.515 dB	---	28.500 dB	120 kHz (CISPR)	2023/03/21 10:36:08

Plot # 3. Emissions scan 30 – 1000 MHz.

Plot # 4. Harmonic emissions – 842.7 MHz.

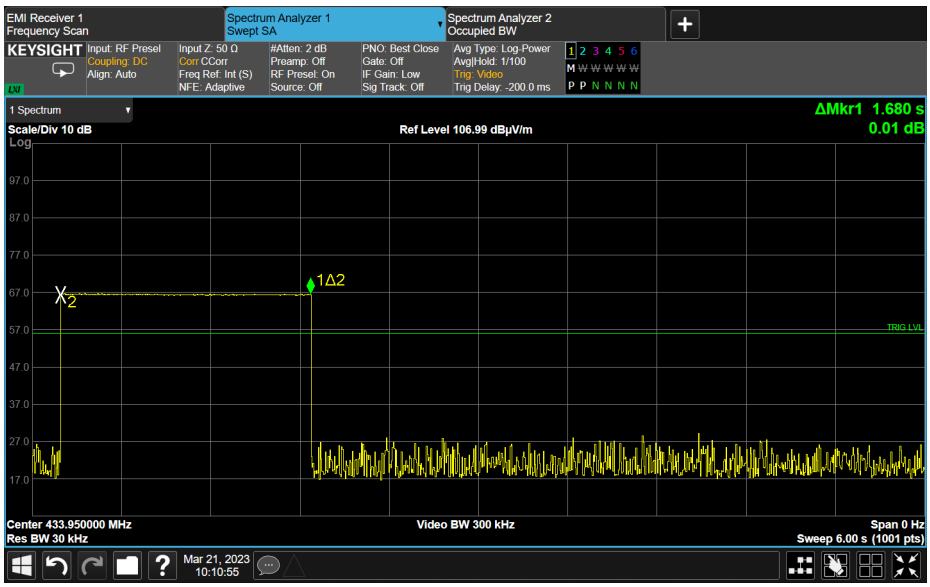


Plot # 5. Emissions scan 1.0 – 6 GHz.

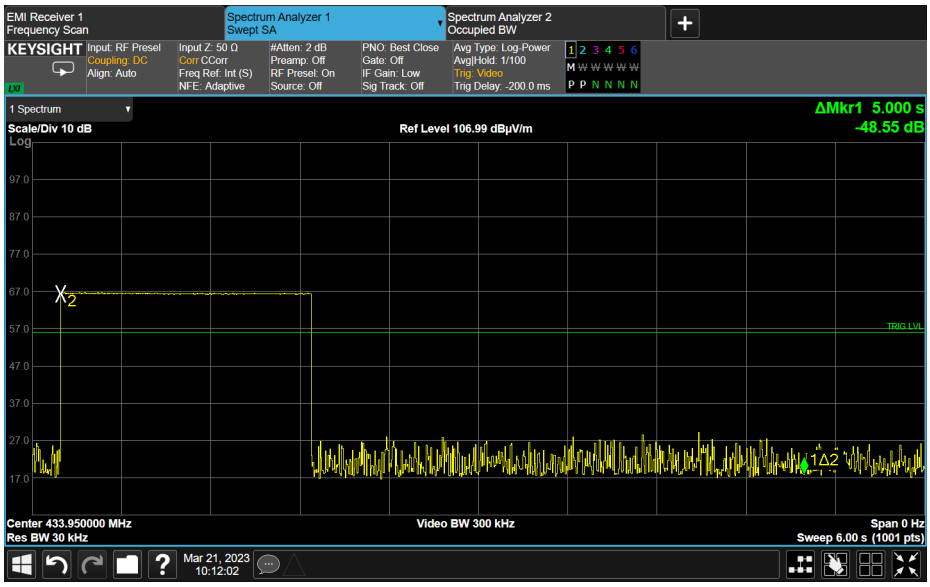


Plot # 6. Harmonic emissions - 1.302 GHz.

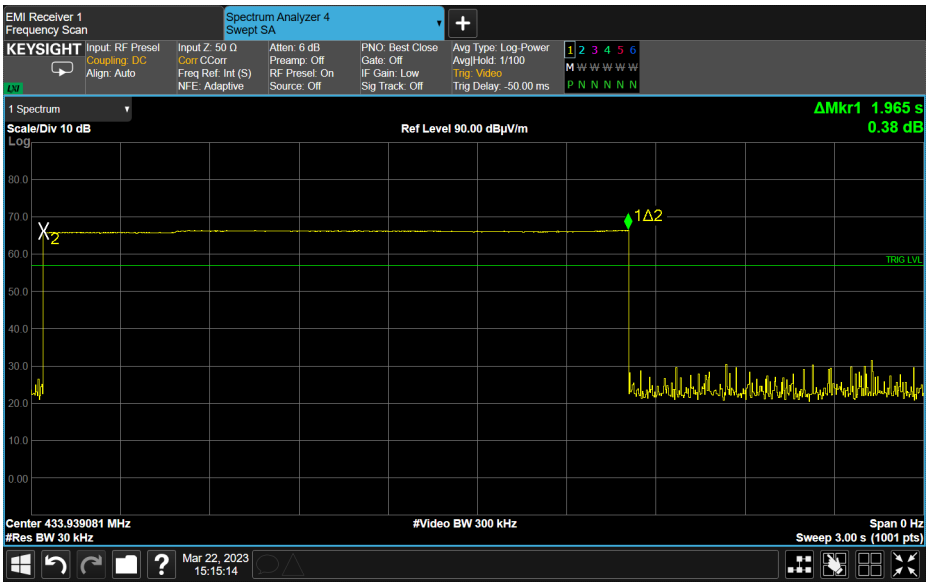
A remote-control transmitter has 2 options to transmit:
First - when turning on the remote control automatic transmission for 2 seconds (plots #9-10)
Second - pressing the buttons of the robot movement (plots #7-8).



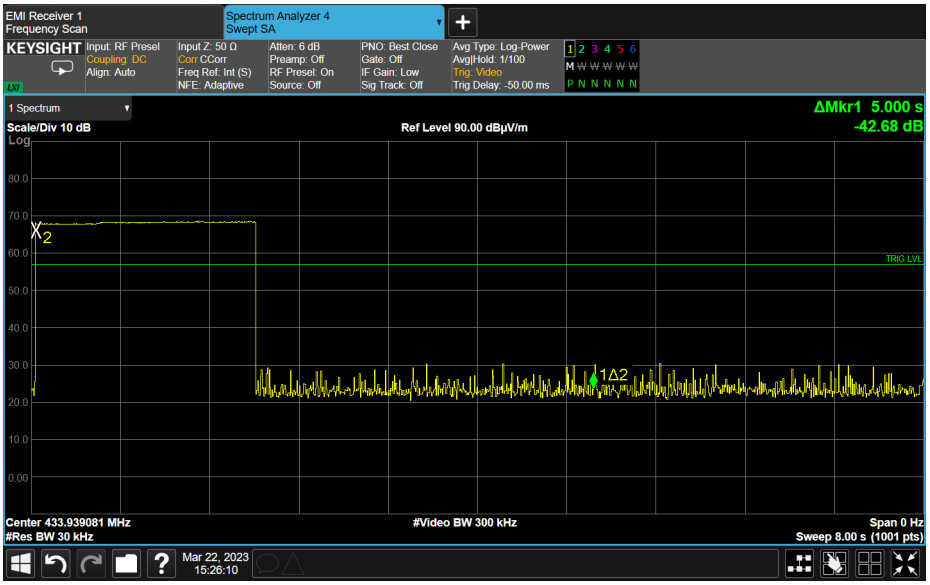
Plot # 7. Transmission time duration.



Plot # 8. Transmission within 5 seconds after activation



Plot # 9. Transmission time duration.



Plot # 10. Transmission within 5 seconds after activation

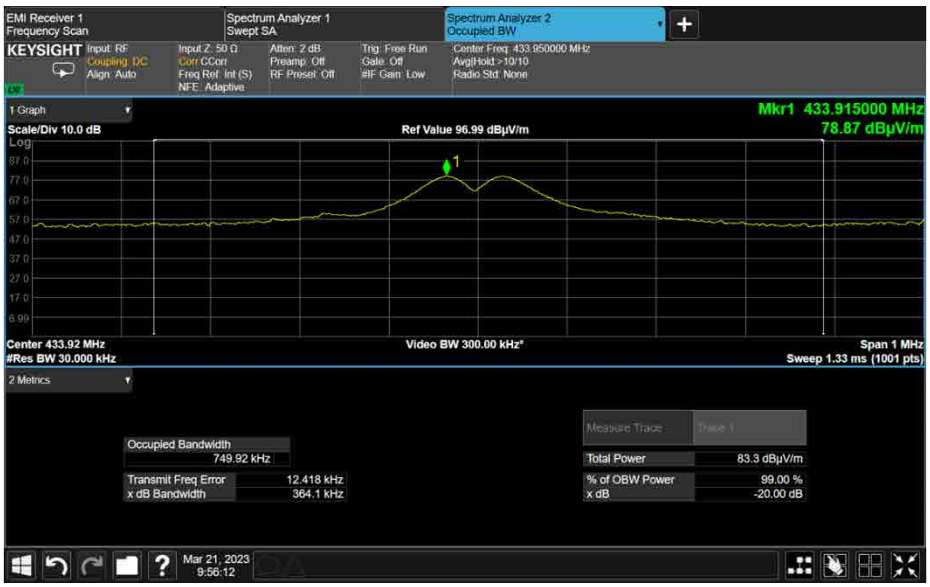
3.6. Test of occupied bandwidth per 15.231(c)

3.6.1. Requirements:

The bandwidth of the emissions shall be no wide than 0.25% of the centre frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.
For 433.92 MHz center frequency allowed emission bandwidth shell be less than (433.92/100) 0.25% = 1.085 MHz.

3.6.2. Test results:

Test result presented in plot below.



Plot # 11. Occupied bandwidth test result

3.6.3. Test summary:

20 dB occupied bandwidth is 364.1 kHz.
The tested unit meets the standard requirement.

1. Appendix 1: Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding one year.

Instrument	Manufacturer	Model	SII No.	Last calibration date	Next calibration date
EMI RECEIVER-MXE 3Hz-44GHz	Keysight	N9038B	6505208	09/22	09/23
Biconilog Antenna 30 – 6000 MHz	ETS Lindgren	3142D	00146488	10/21	10/23
Double Ridged Waveguide Antenna 1-18 GHz	ETS Lindgren	3115	0143138	07/21	07/23
Semi Anechoic Chamber	ETS-Lindgren	RFSD-F/A-100	5002	N/A	N/A
Multi-Device Positioning Controller	ETS-Lindgren	2090	5002	N/A	N/A
Antenna Tower	ETS-Lindgren	2175	5002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	5002	N/A	N/A
Turntable	ETS-Lindgren	2188	5002	N/A	N/A
MXG Analog Microwave Signal generator 100 KHz - 20 GHz	Agilent	N5183A	6501148	02/23	02/24
Cable Sets 9 kHz-18GHz (7mtr LLEF 142)	-	-	-	02/23	02/24
Cable Sets 9 kHz-6GHz RE Cbl Set (Horn Ant)	-	-	-	02/23	02/24
Cable Up to 18 GHz	SUCOFLEX	104PE	21323	02/23	02/24

2. Appendix 2: Antenna Factor

Antenna Factor

Biconilog Antenna, Model Number: 3142D S/N: 00146488 SII No. 6503046
Frequency range: 1.0 GHz – 2.0 GHz
3 m distance

No.	f / MHz	ACF / dB/m	f / MHz	AF / dB/m
1	30	22.7	200	16.7
2	35	20.4	250	18.0
3	40	17.8	300	19.8
4	45	15.7	400	22.7
5	50	14.2	500	25.8
6	60	13.0	600	27.4
7	70	13.0	700	28.4
8	80	12.4	800	30.0
9	90	13.3	900	31.3
10	100	14.2	1000	32.8
11	120	13.3	1250	35.8
12	140	13.3	1500	42.9
13	160	14.6	1750	36.1
14	180	16.3	2000	34.6

Double Ridged Waveguide Antenna Model Number: 3115 S/N 0143138
Frequency range: 1.0 GHz – 18.0 GHz
3m distance

No.	f / MHz	AF / dB/m	f / MHz	AF / dB/m	f / MHz	AF / dB/m
1	1000	23.6	7000	36.7	13000	39.7
2	1500	25.6	7500	37.3	13500	40.3
3	2000	28.2	8000	37.0	14000	41.0
4	2500	27.8	8500	37.6	14500	41.0
5	3000	29.3	9000	37.8	15000	39.6
6	3500	30.7	9500	38.0	15500	38.8
7	4000	31.8	10000	38.3	16000	39.1
8	4500	32.1	10500	38.6	16500	40.0
9	5000	32.9	11000	38.6	17000	40.9
10	5500	32.9	11500	38.9	17500	42.3
11	6000	34.0	12000	38.8	18000	42.5
12	6500	35.3	12500	38.9	--	--

3. Appendix 3: Test setups photo.

Photo 2.

Photo 3.

Photo 4.

Photo 5

End of the document.