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Certificate # 2861.01

GRGTEST®

TEST REPORT

Verified Code: 920759

Report No.:	E202106032722-1	Application No.:	E202106032722
Client:	Autel Intelligent Tech. Corp., Ltd.		
Address:	7th-8th, 10th Floor, Bldg. B1, Zhiyuan, Xueyuan Rd., Xili, Nanshan Shenzhen China		
Sample Description:	MX-Sensor		
Model:	1 Sensor(Screw In)		
Test Specification:	CFR 47 FCC Part 15 Subpart C ANSI C63.10:2013		
Receipt Date:	2021-06-09		
Test Date:	2021-06-10 to 2021-07-28		
Issue Date:	2021-10-12		
Test Result:	Pass		
Prepared By: Test Engineer 	Reviewed By: Technical Manager 	Approved By: Manager  	
Other Aspects:			
/			
Abbreviations: ok / P = passed; fail / F = failed; n.a. / N = not applicable;			
The test result in this test report refers exclusively to the presented test sample. This report shall not be reproduced except in full, without the written approval of GRGT.			



DIRECTIONS OF TEST

- 1. This station carries out test task according to the national regulation of verifications which can be traced to National Primary Standards and BIPM.**
- 2. The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test result without the written permission of the test laboratory.**
- 3. If there is any objection concerning the test, the client should inform the laboratory within 15 days from the date of receiving the test report.**

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1. TEST RESULT SUMMARY

Standard	Item	Limit / Severity	Result
Part 15, Subpart C (15.231)	Conducted Emissions	§15.207	N/A ¹⁾
	Antenna Requirement	§15.203	PASS
	Transmission Time	§15.231 §15.231(a) (2)	PASS
	20DB Bandwidth	§15.231 (c)	PASS
	Radiated Spurious Emission	§15.231(b)	PASS

N/A¹⁾ : EUT is powered by battery

The EUT antenna is internal antenna. Max antenna gain is -3.27dBi .which accordance 15.203.is considered sufficient to comply with the provisions of this section.

2. GENERAL DESCRIPTION OF EUT

2.1. APPLICANT

Name: Autel Intelligent Tech. Corp., Ltd.
Address: 7th-8th, 10th Floor, Bldg. B1, Zhiyuan, Xueyuan Rd., Xili, Nanshan
Shenzhen China

2.2. MANUFACTURER

Name: Autel Intelligent Tech. Corp., Ltd.
Address: 7th-8th, 10th Floor, Bldg. B1, Zhiyuan, Xueyuan Rd., Xili, Nanshan
Shenzhen China

2.3. FACTORY

Factory 1

Name: Autel Intelligent Technology Corp., Ltd. Guangming Branch
Address: 7F&6F, East Wing, Building 2, and 6F of Electronical Building, Yanxiang
Industrial Zone, Gaoxin Rd, Dongzhou Community of Guangming New
District, Shenzhen

Factory 2

Name: AUTEL VIETNAM COMPANY LIMITED
Address: 4th Floor, Factory#6, Land#CN1, An Duong Industrial Zone, Hong Phong
Township, An Duong County, Hai Phong, Viet Nam

2.4. BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: MX-Sensor
Model No.: 1 Sensor(Screw In)
Adding Model: /
Model Differences: /
Trade Name: AUTEL
Sample No: E202106032722-0001
FCC ID: WQ8N8PS2012D
Power Supply: DC3V power from button battery
Battery specification: DC3V
Frequency Range: 433.8MHz to 434.4MHz
Max Antenna gain: Loop antenna, -3.27dBi(Max)
Sample submitting way : ☒ Provided by customer ☐ Sampling

Type of Modulation: FSK, ASK
Temperature Range: -40 °C ~+125 °C
Hardware Version: V1
Software Version: V4.18
Note: /

2.5. TEST MODE

Mode No.	Description of the modes
Mode 1	Transmitting

3. LABORATORY AND ACCREDITATIONS

3.1. LABORATORY

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

Add.: No.1301 Guangguang Road Xinlan Community, Guanlan Street, Longhua District Shenzhen, 518110, People's Republic of China.
P.C.: 518000
Tel : 0755-61180008
Fax: 0755-61180008

3.2. ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

USA A2LA(Certificate#:2861.01)

China CNAS(L0446)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada ISED (Company Number: 24897, CAB identifier:CN0069)

USA FCC (Registration Number: 759402, Designation Number:CN1198)

Copies of granted accreditation certificates are available for downloading from our web site, <http://www.grgtest.com>

3.3. MEASUREMENT UNCERTAINTY

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

Measurement		Frequency	Uncertainty
Radiated Emission	Horizontal	9kHz~30MHz	4.5dB
		30MHz~1000MHz	4.3dB
		1GHz~18GHz	5.6dB
	Vertical	30MHz~1000MHz	4.3dB
		1GHz~18GHz	5.6dB

This uncertainty represents an expanded uncertainty factor of $k=2$.

4. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Radiated Spurious Emission				
Receiver	ROHDE&SCHW ARZ	ESCI	100783	2021-10-08
Loop antenna	TESEQ	HLA6121	52599	2022-04-21
Spectrum Analyzer	Agilent	N9010A	MY52221469	2022-04-16
Bilog Antenna	TESEQ	CBL6143A	32399	2021-11-25
Horn Antenna	Schwarzbeck	BBHA9120d(12 01)	02143	2021-12-11
Amplifier	EMEC	EM330	/	2022-03-21
Amplifier	tonscend	TAP9E6343	AP20E806065	2022-06-03
Amplifier	tonscend	TAP01018048	AP20E806075	2022-06-07
EZ-EMC	EZ	CCS-3A1-CE		
Test SW	tonscend	JS32-RE/2.5.2.4		
20dB bandwidth/Duty cycle/Transmission time				
Spectrum Analyzer	R&S	FSV30	104381	2022-02-21
Spectrum Analyzer	Keysight	N9020B	MY59050667	2022-02-21

5. RADIATED SPURIOUS EMISSIONS

5.1 LIMITS

§15.231(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	¹ 1,250 to 3,750	¹ 125 to 375
174-260	3,750	375
260-470	¹ 3,750 to 12,500	¹ 375 to 1,250
Above 470	12,500	1,250

1. ** linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, $\mu\text{V/m}$ at 3 meters = $56.81818(F) - 6136.3636$; for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667 \cdot F - 7083.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

§15.231(b)(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Frequency (MHz)	Quasi-peak($\mu\text{V/m}$)	Measurement distance(m)	Quasi-peak($\text{dB}\mu\text{V/m}$)@distance 3m
0.009-0.490	$2400/F(\text{kHz})$	300	53.8~88.5
0.490-1.705	$24000/F(\text{kHz})$	30	43~53.8
1.705-30.0	30	30	49.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

NOTE: (1) The lower limit shall apply at the transition frequencies.

5.2 TEST PROCEDURES

- 1) The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 3) Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

- 4) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 5) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 6) If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- 7) The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

5.3 TEST SETUP

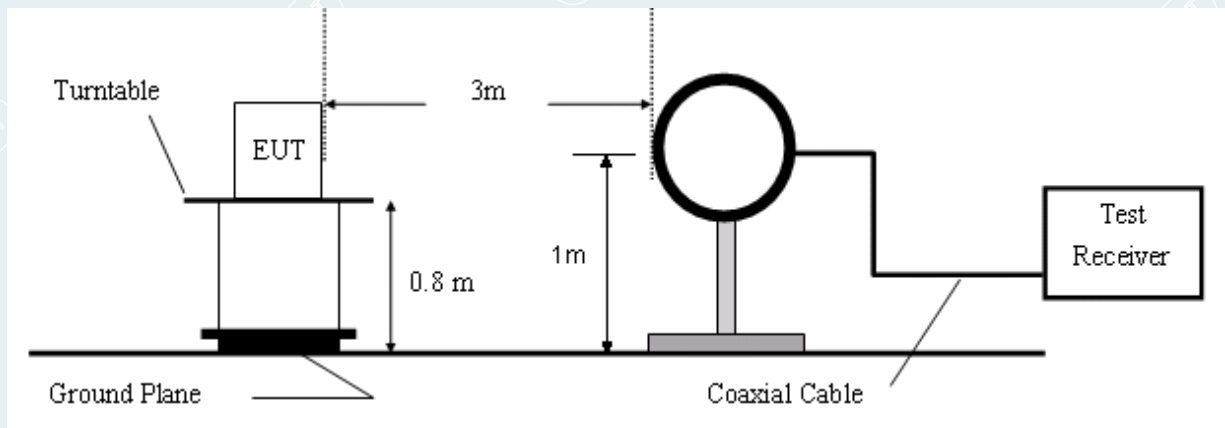


Figure 1. 9KHz to 30MHz radiated emissions test configuration

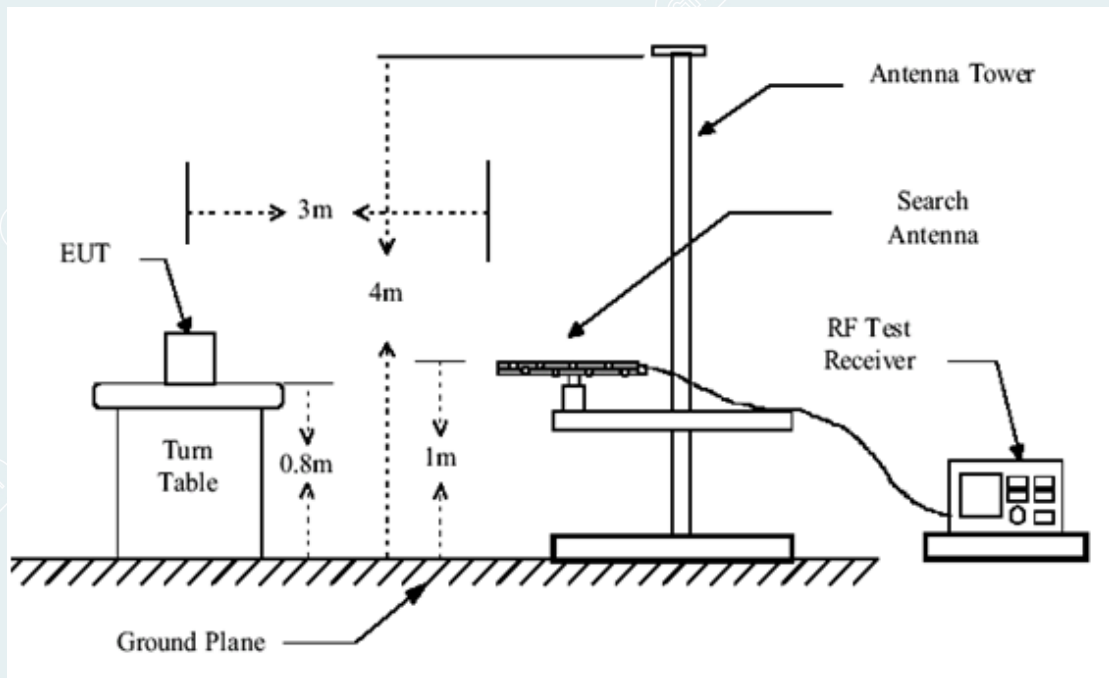


Figure 2. 30MHz to 1GHz radiated emissions test configuration

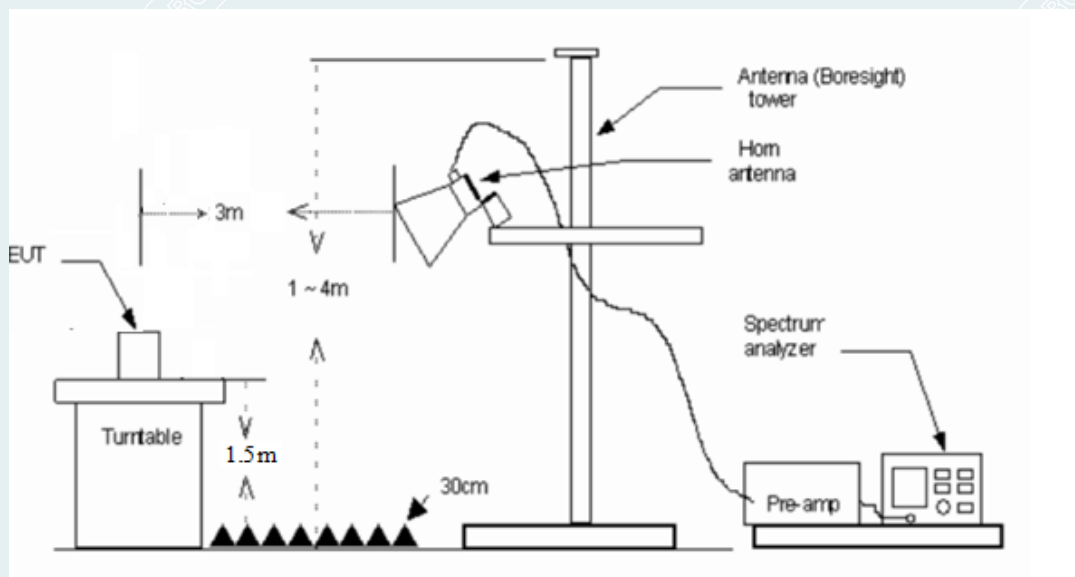


Figure 3. Above 1GHz radiated emissions test configuration

5.4 DATA SAMPLE

Below 1GHz

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Pole (V/H)	Remark
XXX.XXXX	37.47	-16.41	21.06	40.00	-18.94	V	QP

Above 1GHz

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Pole (V/H)	Remark
XXXX.XXXX	55.54	4.56	60.10	74.00	-13.90	V	Peak
XXXX.XXXX	29.66	4.56	34.22	54.00	-19.78	V	AVG

Frequency (MHz) = Emission frequency in MHz

Reading (dBuV) = Uncorrected Analyzer / Receiver reading

Correction Factor (dB/m) = Antenna factor + Cable loss – Amplifier gain

Result (dBuV/m) = Reading (dBuV) + Corr. Factor (dB/m)

Limit (dBuV/m) = Limit stated in standard

Margin (dB) = Result (dBuV/m) – Limit(dBuV/m)

Q.P. = Quasi-peak Reading

Peak = Peak Reading

AVG = Average Reading

5.5 TEST RESULTS

Fundamental:

434MHz FSK

Frequency	Reading	Correct	Result	Limit	Margin	Height	Degree	Antenna Pole	Remark
(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(deg)	(V/H)	
434.49	79.11	-19.72	59.39	100.84	-41.45	200	97	H	peak
434.49	79.01	-19.72	59.29	100.84	-41.55	100	115	V	peak

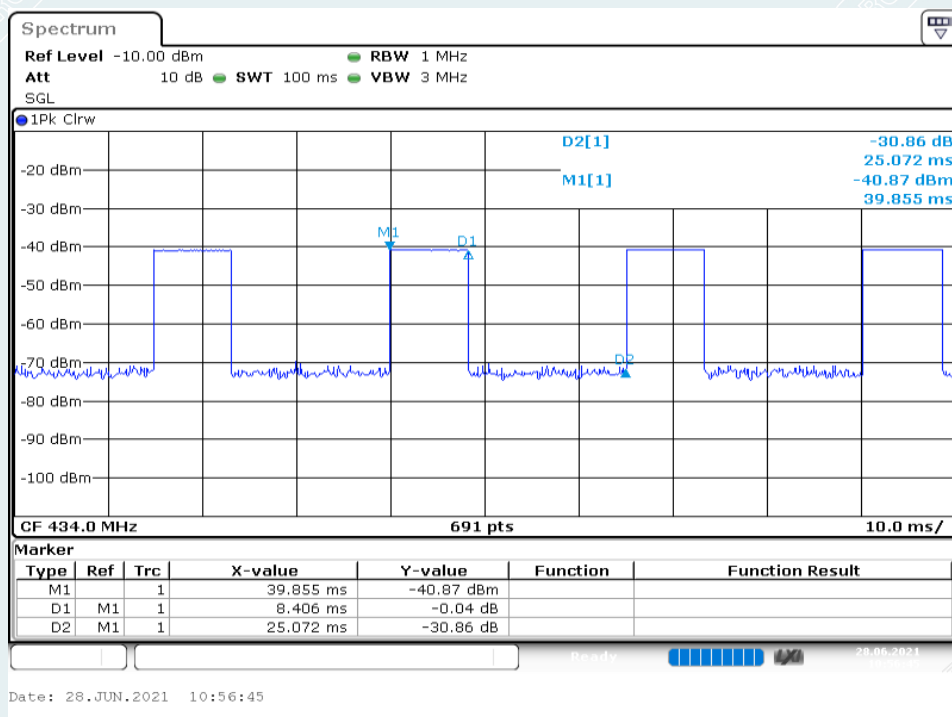
Frequency	PK Result	Duty Cycle Correction	Result	Limit	Margin	Antenna Pole(V/H)	Remark
(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)		
434.49	59.39	-9.37	50.02	80.84	-30.82	H	AVG
434.49	59.29	-9.37	49.92	80.84	-30.92	V	AVG

Remark:

1. $AVG = Peak + 20 \log(Duty\ Cycle)$
2. $Duty\ Cycle = \frac{On\ time}{Total\ time} = \frac{25.072ms}{84.06ms} = 34\%$
3. $Duty\ Cycle\ Correction\ Factor: 20 \log(0.34) = -9.37$

Transmitting conditions:

Duty Cycle: 434MHz FSK



434MHz ASK

Frequency	Reading	Correct	Result	Limit	Margin	Height	Degree	Antenna Pole	Remark
(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(deg)	(V/H)	
434.49	78.96	-19.72	59.24	100.84	-41.60	200	108	H	peak
434.49	78.77	-19.72	59.05	100.84	-41.79	300	99	V	peak

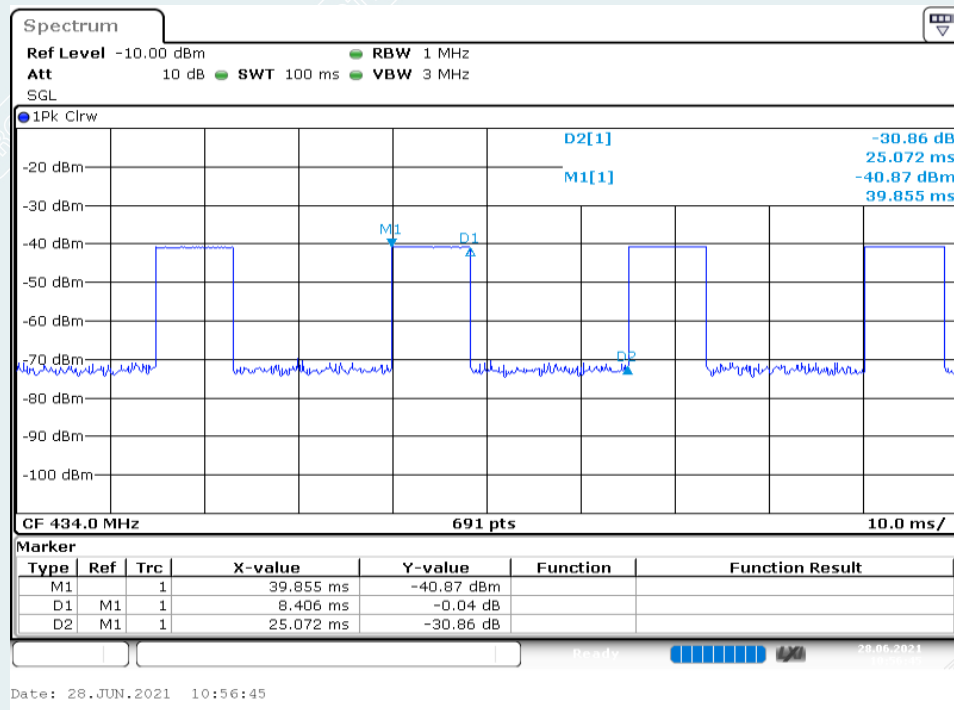
Frequency	PK Result	Duty Cycle Correction	Result	Limit	Margin	Antenna Pole	Remark
(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	Pole(V/H)	
434.49	59.24	-9.37	49.87	80.84	-30.97	H	AVG
434.49	59.05	-9.37	49.68	80.84	-31.16	V	AVG

Remark:

1. $AVG = Peak + 20 \log(Duty\ Cycle)$
2. $Duty\ Cycle = On\ time / Total\ time\ (25.072ms) = 8.406ms / 25.072ms = 34\%$
3. $Duty\ Cycle\ Correction\ Factor: 20 \log(0.34) = -9.37$

Transmitting conditions:

Duty Cycle: 434MHz FSK



Radiated Spurious Emission

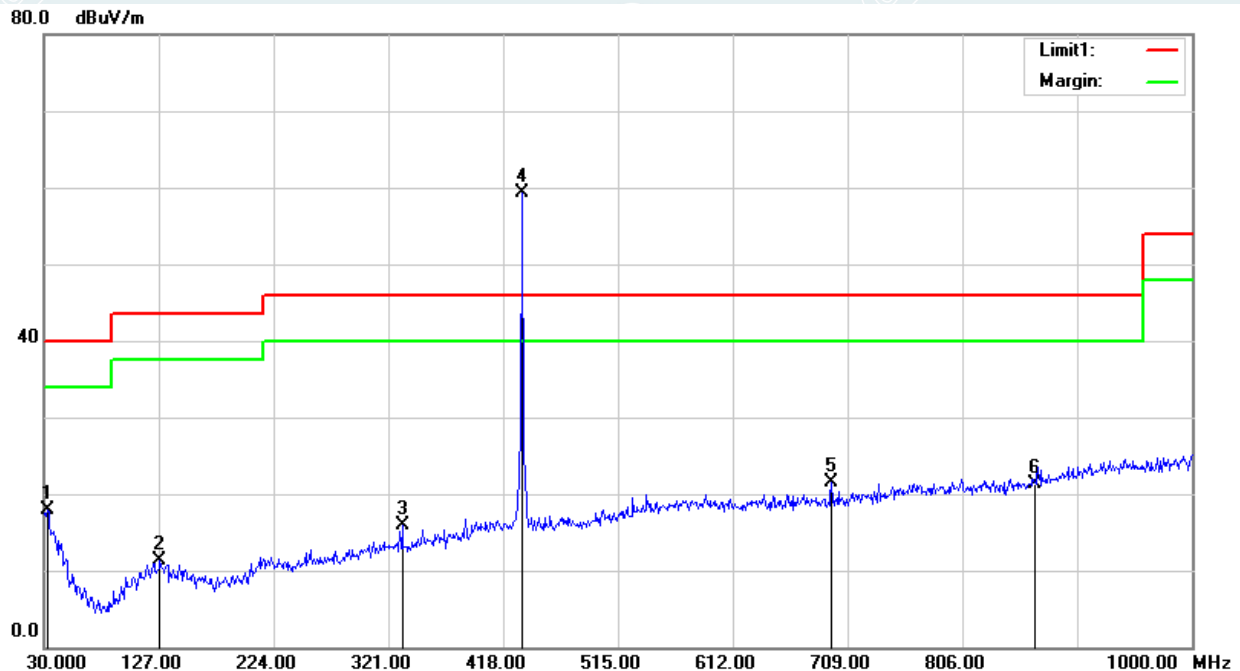
For 9 kHz to 30MHz

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

For 30MHz – 1GHz

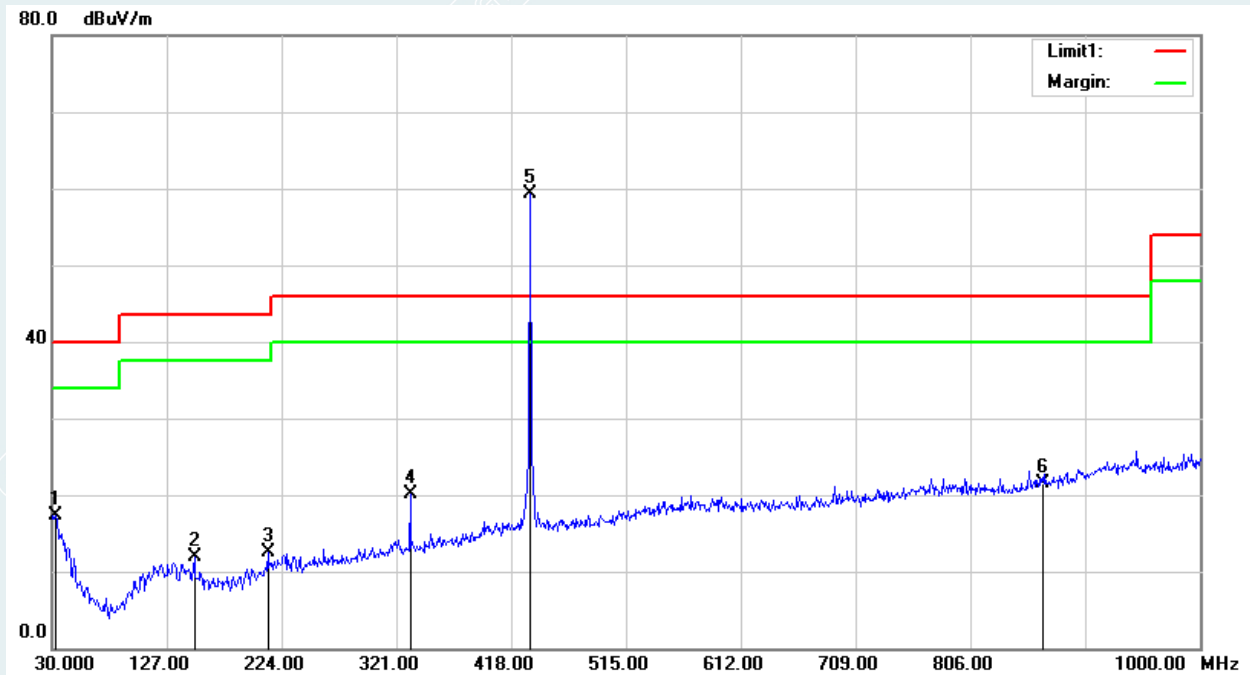
Test Voltage:	3.0V dc
Test Mode:	TX
Ambient temperature:	24.7°C
Relative humidity:	51%

434MHz FSK



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg)	Polarity
1	32.9100	35.55	-17.60	17.95	40.00	-22.05	300	251	Horizontal
2	127.9700	36.74	-25.36	11.38	43.50	-32.12	100	114	Horizontal
3	332.6400	38.75	-22.78	15.97	46.00	-30.03	100	121	Horizontal
4* ¹	434.4900	79.11	-19.72	59.39	80.84	-21.45	200	97	Horizontal
5	695.4200	37.39	-15.85	21.54	46.00	-24.46	300	358	Horizontal
6* ²	868.0000	35.27	-13.88	21.39	60.84	-39.45	100	2	Horizontal

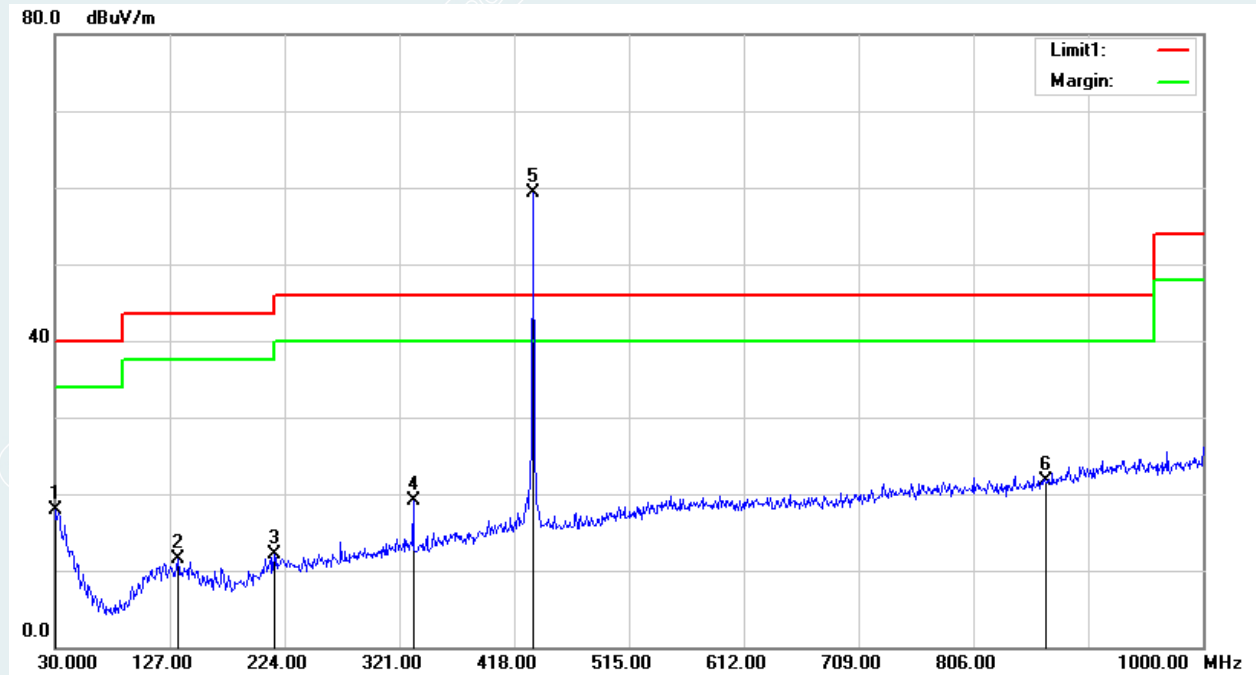
Note: “4*¹” is field strength of fundamental, “6*²” is second harmonic, it is limit is 60.84dBuV/m.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg)	Polarity
1	32.9100	34.95	-17.60	17.35	40.00	-22.65	400	232	Vertical
2	150.2800	38.08	-26.27	11.81	43.50	-31.69	185	0	Vertical
3	212.3600	37.81	-25.35	12.46	43.50	-31.04	400	112	Vertical
4	332.6400	42.81	-22.78	20.03	46.00	-25.97	300	107	Vertical
5* ¹	434.4900	79.01	-19.72	59.29	80.84	-21.55	100	115	Vertical
6* ²	868.0000	35.47	-13.88	21.59	60.84	-39.25	200	346	Vertical

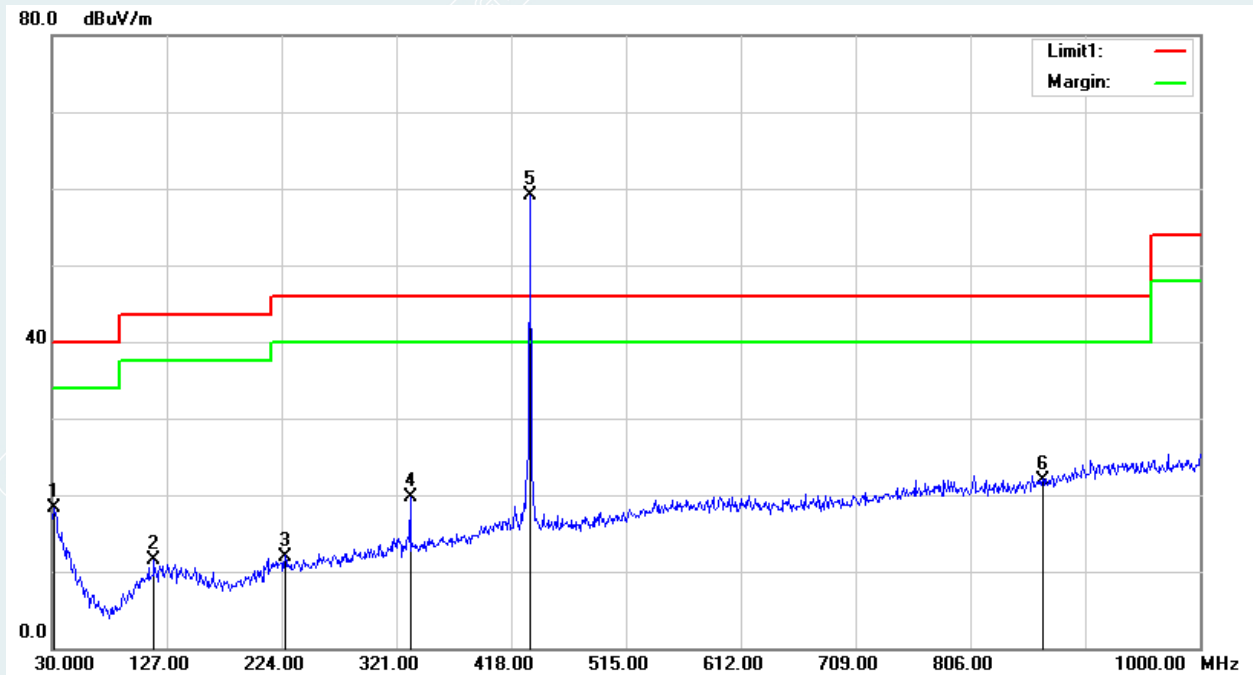
Note: "5*¹" is field strength of fundamental, "6*²" is second harmonic, it is limit is 60.84dBuV/m.

434MHz ASK



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg)	Polarity
1	30.9700	34.68	-16.71	17.97	40.00	-22.03	100	73	Horizontal
2	133.7900	37.01	-25.47	11.54	43.50	-31.96	300	69	Horizontal
3	215.2700	37.16	-25.12	12.04	43.50	-31.46	106	0	Horizontal
4	332.6400	41.86	-22.78	19.08	46.00	-26.92	366	0	Horizontal
5* ¹	434.4900	78.96	-19.72	59.24	80.84	-21.60	200	108	Horizontal
6* ²	868.0000	35.65	-13.88	21.77	60.84	-39.07	100	57	Horizontal

Note: "5*¹" is field strength of fundamental, "6*²" is second harmonic, it is limit is 60.84dBuV/m.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg)	Polarity
1	31.9400	35.52	-17.15	18.37	40.00	-21.63	248	360	Vertical
2	116.3300	37.14	-25.71	11.43	43.50	-32.07	100	251	Vertical
3	226.9100	36.87	-24.87	12.00	46.00	-34.00	400	358	Vertical
4	332.6400	42.51	-22.78	19.73	46.00	-26.27	318	0	Vertical
5* ¹	434.4900	78.77	-19.72	59.05	80.84	-21.79	300	99	Vertical
6* ²	868.0000	35.69	-13.88	21.81	60.84	-39.03	200	76	Vertical

Note: “5*¹” is field strength of fundamental, “6*²” is second harmonic, it is limit is 60.84dBuV/m.

For Emission above 1GHz:

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Test Voltage:	3.0V dc
Test Mode:	TX
Test frequency:	434MHz(FSK), 434MHz(ASK)
Ambient temperature:	25°C
Relative humidity:	60%

434MHz FSK

Frequency (MHz)	Reading (dBuV/m)	Level (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Height [cm]	Angle [°]	Pole
1012.0000	61.08	35.94	-25.14	74.00	38.06	150	102	Vertical
1278.0000	62.63	38.48	-24.15	74.00	35.52	150	152	Vertical
1998.0000	60.96	39.39	-21.57	74.00	34.61	150	307	Vertical
2664.0000	60.52	41.19	-19.33	74.00	32.81	150	241	Vertical
3330.4000	59.32	41.67	-17.65	74.00	32.33	150	224	Vertical
4662.0000	58.06	47.80	-10.26	74.00	26.20	150	335	Vertical
1166.0000	64.40	39.76	-24.64	74.00	34.24	150	76	Horizontal
1302.0000	64.68	40.62	-24.06	74.00	33.38	150	347	Horizontal
2604.0000	67.39	47.32	-20.07	74.00	26.68	150	14	Horizontal
3472.4000	63.63	46.00	-17.63	74.00	28.00	150	14	Horizontal
3906.0000	63.62	49.56	-14.06	74.00	24.44	150	131	Horizontal
4662.0000	57.37	47.11	-10.26	74.00	26.89	150	319	Horizontal

434MHz ASK

Frequency (MHz)	Reading (dBuV/m)	Level (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Height [cm]	Angle [°]	Pole
1278.0000	63.23	39.08	-24.15	74.00	34.92	150	330	Vertical
1830.8000	56.75	34.74	-22.01	74.00	39.26	150	252	Vertical
1998.0000	60.93	39.36	-21.57	74.00	34.64	150	330	Vertical
2664.0000	60.03	40.70	-19.33	74.00	33.30	150	247	Vertical
3330.0000	60.31	42.65	-17.66	74.00	31.35	150	120	Vertical
4662.0000	58.45	48.19	-10.26	74.00	25.81	150	335	Vertical
2604.0000	67.39	47.32	-20.07	74.00	26.68	150	14	Horizontal
3472.0000	63.64	46.01	-17.63	74.00	27.99	150	14	Horizontal
3906.4000	63.05	48.99	-14.06	74.00	25.01	150	256	Horizontal
4662.0000	58.35	48.09	-10.26	74.00	25.91	150	307	Horizontal

6. 20DB BANDWIDTH

6.1 LIMITS

§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. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

6.2 TEST PROCEDURES

- 1) Set resolution bandwidth (RBW) = 2kHz. Set the video bandwidth (VBW) $\geq 3 \times$ RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 20dB bandwidth value.
- 2) Repeat above procedures until all frequencies measured were complete.

6.3 TEST SETUP



6.4 TEST RESULTS

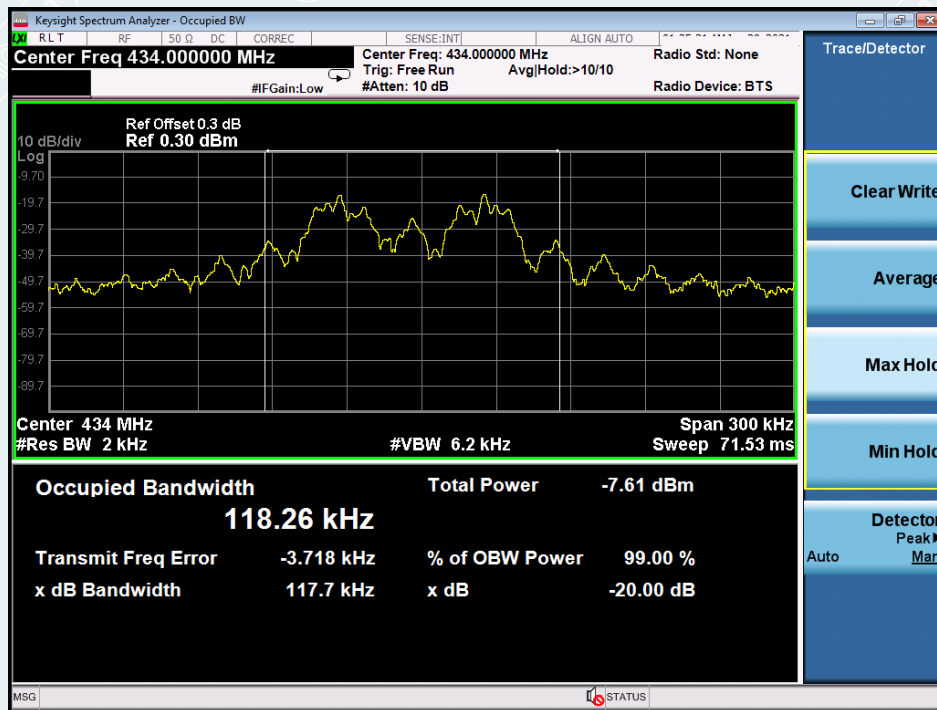
Test mode: 434MHz FSK

Frequency(MHz)	Bandwidth(kHz)	Limit(kHz)	Test Result
434	117.7	1085	PASS

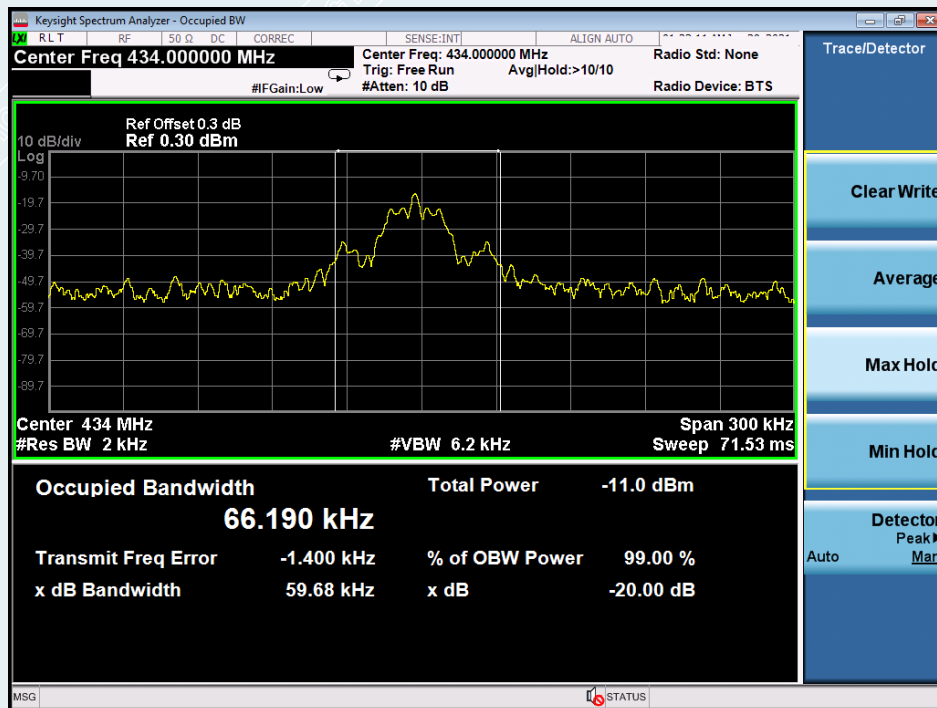
Test mode: 434MHz ASK

Frequency(MHz)	Bandwidth(kHz)	Limit(kHz)	Test Result
434	59.68	1085	PASS

Test Plot



434MHz FSK



434MHz ASK

7. TRANSMISSION TIME

7.1 LIMITS

§15.231(a) for this periodic operation:

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

7.2 TEST PROCEDURES

- 1) The spectrum analyzer resolution bandwidth that is $\leq$ EBW. So we test the Maximum Conducted Output Power —Integrated band power method.
- 2) Set Set the analyzer span = 0Hz. RBW = 1MHz. Set VBW = 3MHz. Detector = Peak. Sweep = Adjust according to actual conditions.
- 3) Allow the trace to stabilize, record value.

7.3 TEST SETUP



7.4 TEST RESULTS

Test Data

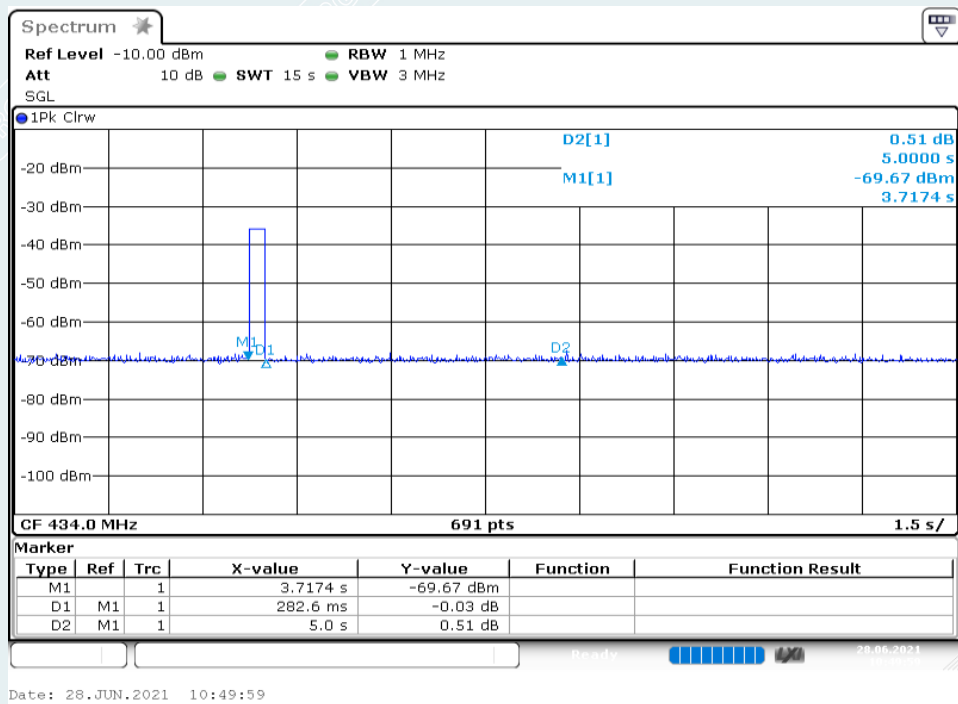
Vehicle Stationary, driving and Tire leak conditions (This is not periodic):

434MHz FSK

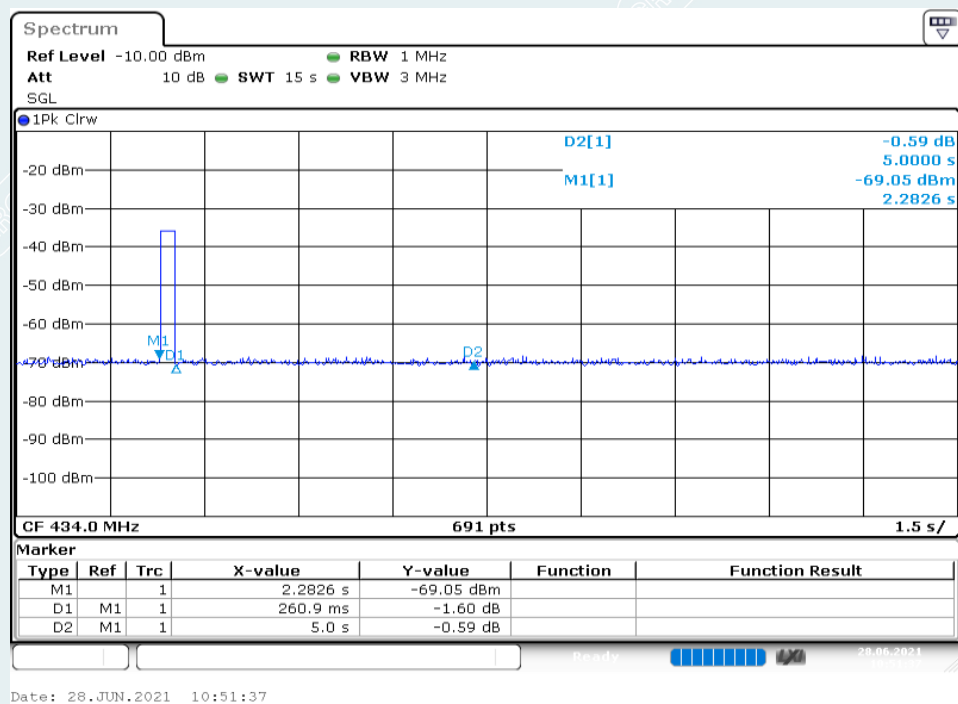
Frequency (MHz)	Transmission Time (s)	Limit (s)	Result
434	0.2826	≤ 5	Pass

434MHz ASK

Frequency (MHz)	Transmission Time (s)	Limit (s)	Result
434	0.2609	≤ 5	Pass

Test Plot

434MHz FSK



434MHz ASK

8. APPENDIX: PHOTOGRAPH OF THE TEST ARRANGEMENT

Below 1GHz



Above 1GHz



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