

TEST REPORT

Applicant: Autel Intelligent Tech. Corp., Ltd.

Address of Applicant: 7th-8th, 10th Floor, Bldg. B1, Zhiyuan, Xueyuan Rd. Xili, Nanshan, Shenzhen 518055, China

Manufacturer: Autel Intelligent Tech. Corp., Ltd.

Address of Manufacturer: 7th-8th, 10th Floor, Bldg. B1, Zhiyuan, Xueyuan Rd. Xili, Nanshan, Shenzhen 518055, China

Factory: 1: AUTEL VIETNAM COMPANY LIMITED
2: Autel Intelligent Technology Corp., Ltd. Guangming Branch

Address of Factory: 1: 4th Floor, Factory#6, Land#CN1, An Duong Industrial Zone, Hong Phong Township, An Duong County, Hai Phong, VietNam
2: 7F&6F, East Wing, Building 2, and 6F of Electronical Building, Yanxiang Industrial Zone, Gaoxin Rd, Dongzhou Community of Guangming New District, Shenzhen

Equipment Under Test (EUT)

Product Name: MX-Sensor

Model No.: MX-Sensor 315MHz

Trade Mark: AUTEL

FCC ID: WQ8301C315

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.231

Date of sample receipt: May 20, 2021

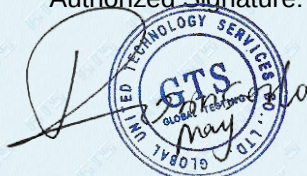
Date of Test: May 20-21, 2021

Date of report issued: May 21, 2021

Test Result : PASS *

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Robinson Luo

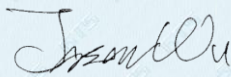
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
00	May 21, 2021	Original

Prepared By:

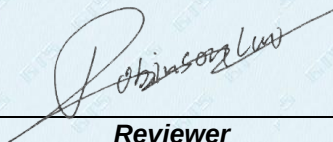


Date:

May 21, 2021

Project Engineer

Check By:



Date:

May 21, 2021

Reviewer

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203	Pass
Field strength of the fundamental signal	15.231 (e)	Pass
Spurious emissions	15.231 (e)/15.209	Pass
20dB Bandwidth	15.231 (c)	Pass
Dwell time	15.231 (e)	Pass

Pass: The EUT complies with the essential requirements in the standard.

Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	30MHz-200MHz	3.8039dB	(1)
Radiated Emission	200MHz-1GHz	3.9679dB	(1)
Radiated Emission	1GHz-18GHz	4.29dB	(1)
Radiated Emission	18GHz-40GHz	3.30dB	(1)
Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.			

5 General Information

5.1 General Description of EUT

Product Name:	MX-Sensor
Model No.:	MX-Sensor 315MHz
Test sample(s) ID:	GTS202105000155-1
Sample(s) Status:	Engineer sample
Serial No.:	C330EJ1JAC001142
Hardware version:	V4
Software version:	V1.4.18
Operation Frequency:	315MHz
Modulation technology:	FSK or ASK
Antenna Type:	Integral Antenna
Antenna gain:	0dBi (declare by applicant)
Power supply:	DC 3V by Button battery

Remark: Though the pre built-in firmware, this TPMS sensor transmit per 30s

5.2 Test mode

Transmitting mode	Keep the EUT in transmitting mode.
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Per-test mode.

We have verified the construction and function in typical operation, The EUT was placed on three different polar directions; i.e. X axis, Y axis, Z axis. Which only the worst case was shown in this test report and defined as follows:

Axis	X	Y	Z
Field Strength(dBuV/m)	65.31	66.00	64.19

5.3 Description of Support Units

None.

5.4 Deviation from Standards

None.

5.5 Abnormalities from Standard Conditions

None.

5.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **FCC —Registration No.: 381383**

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383.

- **IC —Registration No.: 9079A**

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A

- **NVLAP (LAB CODE:600179-0)**

Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). LAB CODE:600179-0

5.7 Test Location

All tests were performed at:
Global United Technology Services Co., Ltd. Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102 Tel: 0755-27798480 Fax: 0755-27798960

5.8 Additional Instructions

Test Software	Continuous transmitter provided by manufacturer
Power level setup	Default

6 Test Instruments list

Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 02 2020	July. 01 2025
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 25 2020	June. 24 2021
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 25 2020	June. 24 2021
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 25 2020	June. 24 2021
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 25 2020	June. 24 2021
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 25 2020	June. 24 2021
9	Coaxial Cable	GTS	N/A	GTS211	June. 25 2020	June. 24 2021
10	Coaxial cable	GTS	N/A	GTS210	June. 25 2020	June. 24 2021
11	Coaxial Cable	GTS	N/A	GTS212	June. 25 2020	June. 24 2021
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 25 2020	June. 24 2021
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 25 2020	June. 24 2021
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 25 2020	June. 24 2021
15	Band filter	Amindeon	82346	GTS219	June. 25 2020	June. 24 2021
16	Power Meter	Anritsu	ML2495A	GTS540	June. 25 2020	June. 24 2021
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 25 2020	June. 24 2021
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 25 2020	June. 24 2021
19	Splitter	Agilent	11636B	GTS237	June. 25 2020	June. 24 2021
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 25 2020	June. 24 2021
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 18 2020	Oct. 17 2021
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 18 2020	Oct. 17 2021
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 18 2020	Oct. 17 2021
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 25 2020	June. 24 2021

RF Conducted Test:						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	MXA Signal Analyzer	Agilent	N9020A	GTS566	June. 25 2020	June. 24 2021
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 25 2020	June. 24 2021
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June. 25 2020	June. 24 2021
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	June. 25 2020	June. 24 2021
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	June. 25 2020	June. 24 2021
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	June. 25 2020	June. 24 2021
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	June. 25 2020	June. 24 2021
8	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	June. 25 2020	June. 24 2021

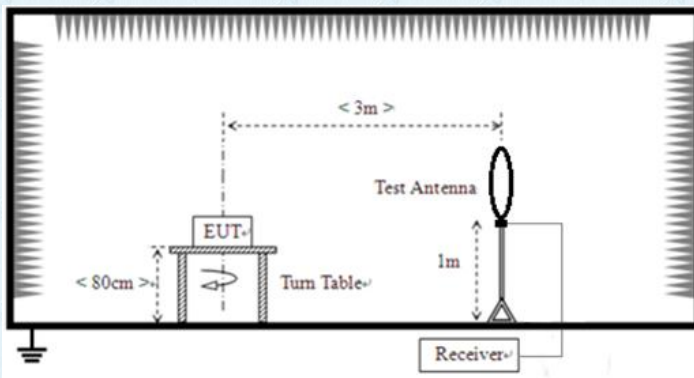
General used equipment:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 25 2020	June. 24 2021
2	Barometer	ChangChun	DYM3	GTS255	June. 25 2020	June. 24 2021

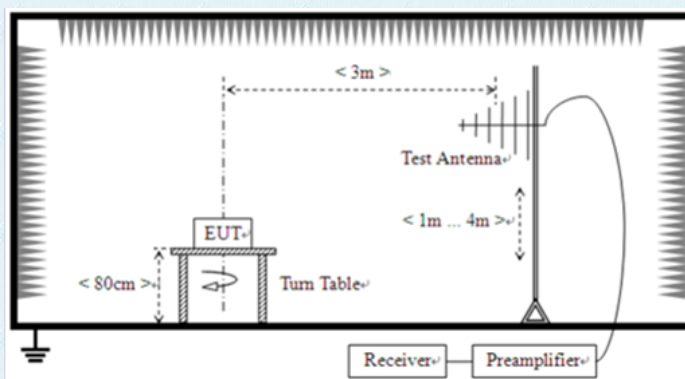
7 Test results and Measurement Data

7.1 Antenna requirement

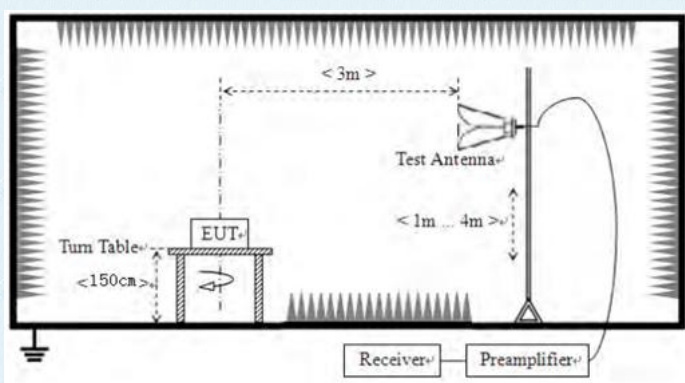
Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
EUT Antenna:	
The antenna is integral antenna, the best case gain of the antenna is 0dBi, reference to the appendix II for details	

7.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 6000MHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
Peak		1MHz	10Hz	Average	
Limit: (Field strength of the fundamental signal)	Frequency	Limit (dBuV/m @3m)		Remark	
	315MHz	67.66		Average Value	
		87.66		Peak Value	
Limit: (Spurious Emissions)	Frequency	Limit (uV/m)	Value	Measurement Distance	
	0.009MHz-0.490MHz	2400/F(KHz)	PK,AV,QP	300m	
	0.490MHz-1.705MHz	24000/F(KHz)	QP	30m	
	1.705MHz-30MHz	30	QP	30m	
	30MHz-88MHz	100	QP	3m	
	88MHz-216MHz	150	QP		
	216MHz-960MHz	200	QP		
	960MHz-1GHz	500	QP		
	Above 1GHz	500	Average		
		5000	Peak		
Or The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level whichever limit permits a higher field strength.					
Test setup:	Below 30MHz				
					
Below 1GHz					



Above 1GHz



Test Procedure:

1. The EUT was placed on the top of a rotating table (0.8 meters for below 1GHz and 1.5 meters for above 1GHz) above the ground at a 3 meter camber. 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. The antenna height 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. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
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 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Test Instruments:

Refer to section 6.0 for details

Test mode:

Refer to section 5.2 for details

Test environment:

Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
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Test voltage:	AC 120V, 60Hz
Test results:	Pass

Measurement data:

7.2.1 Field Strength of The Fundamental Signal

ASK

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
315	87.10	13.90	2.44	37.44	66.00	87.66	-21.66	Horizontal
315	86.07	13.90	2.44	37.44	64.97	87.66	-22.69	Vertical

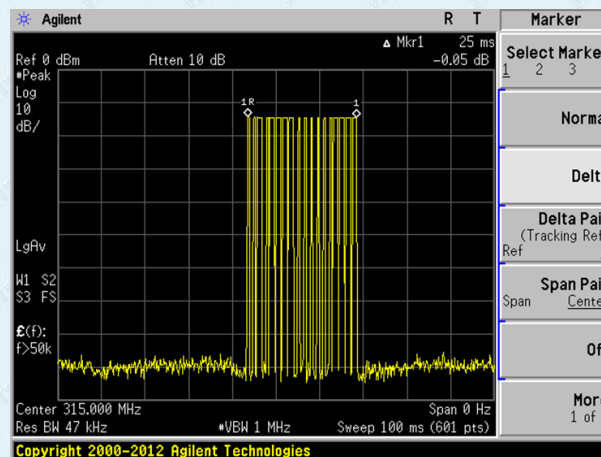
Average value:

Frequency (MHz)	Peak Value (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
315	66.00	-12.04	53.96	67.66	-13.70	Horizontal
315	64.97	-12.04	52.93	67.66	-14.73	Vertical

Average value:

Calculate Formula:	Average value=Peak value + Duty Cycle Factor
	Duty cycle factor=20 log(Duty cycle)
	Duty cycle=on time/100 milliseconds or period, whichever is less
Test data:	T on time =25(ms)
	T period =100ms
	Duty cycle=0.25
	duty cycle factor= -12.04

Test plot as follows:



FSK

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
315	87.10	13.90	2.44	37.44	66.00	87.66	-21.66	Horizontal
315	87.07	13.90	2.44	37.44	65.97	87.66	-21.69	Vertical

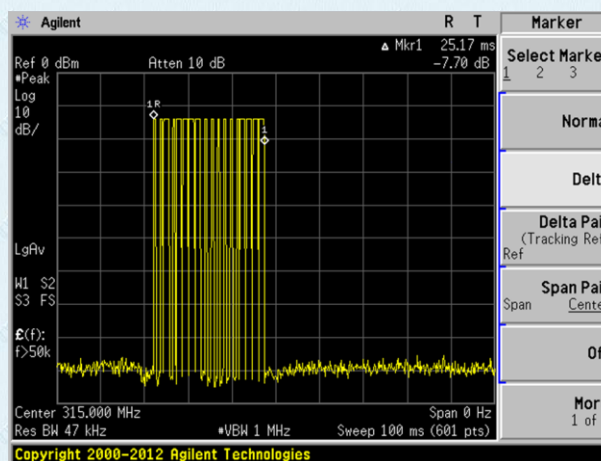
Average value:

Frequency (MHz)	Peak Value (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
315	66.00	-11.98	54.02	67.66	-13.64	Horizontal
315	65.97	-11.98	53.99	67.66	-13.67	Vertical

Average value:

Calculate Formula:	Average value=Peak value + Duty Cycle Factor
	Duty cycle factor=20 log(Duty cycle)
	Duty cycle=on time/100 milliseconds or period, whichever is less
Test data:	T on time =25.17(ms)
	T period =100ms
	Duty cycle=0.2517
	duty cycle factor=-11.98

Test plot as follows:



7.2.2 Spurious emissions

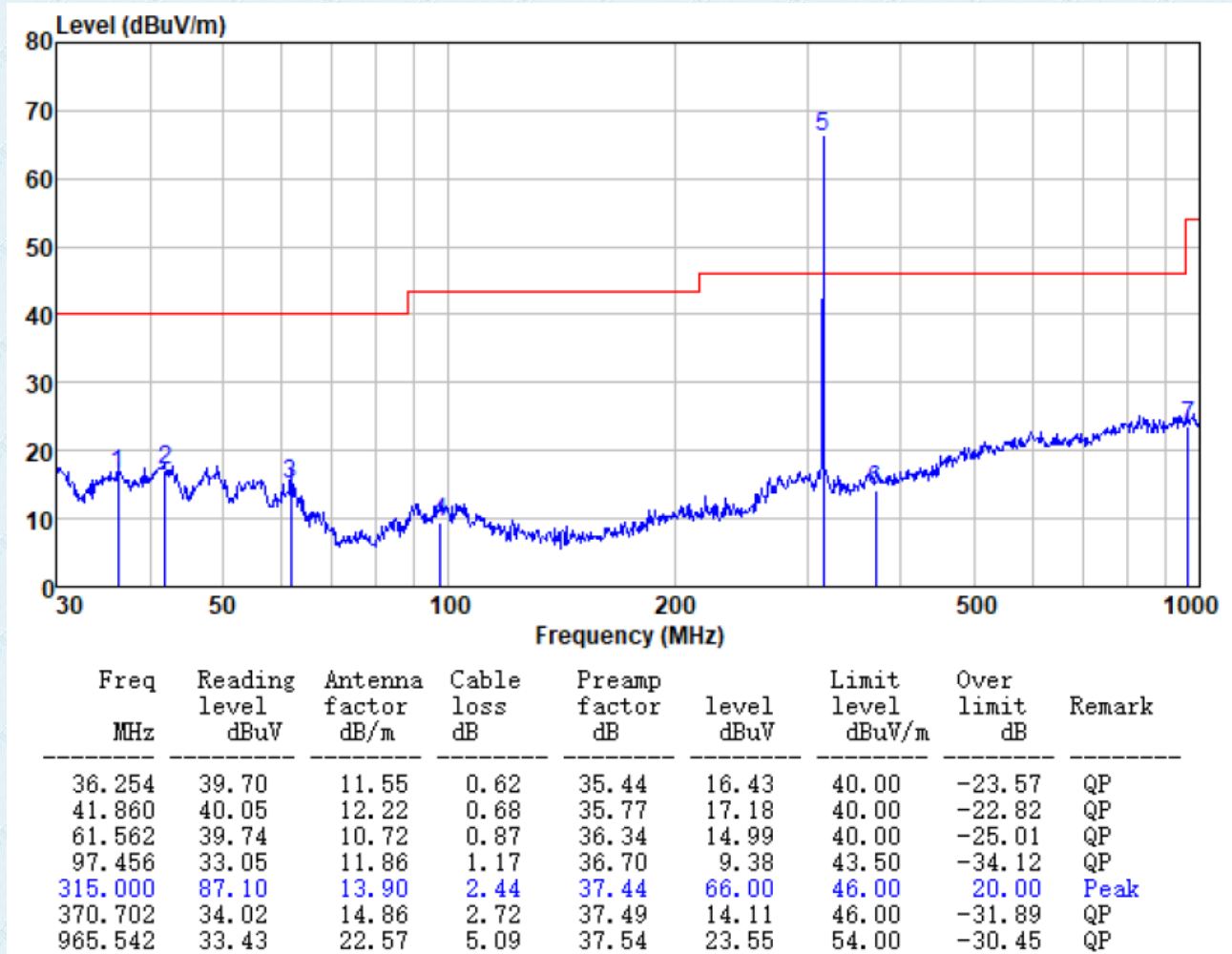
Below 30MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

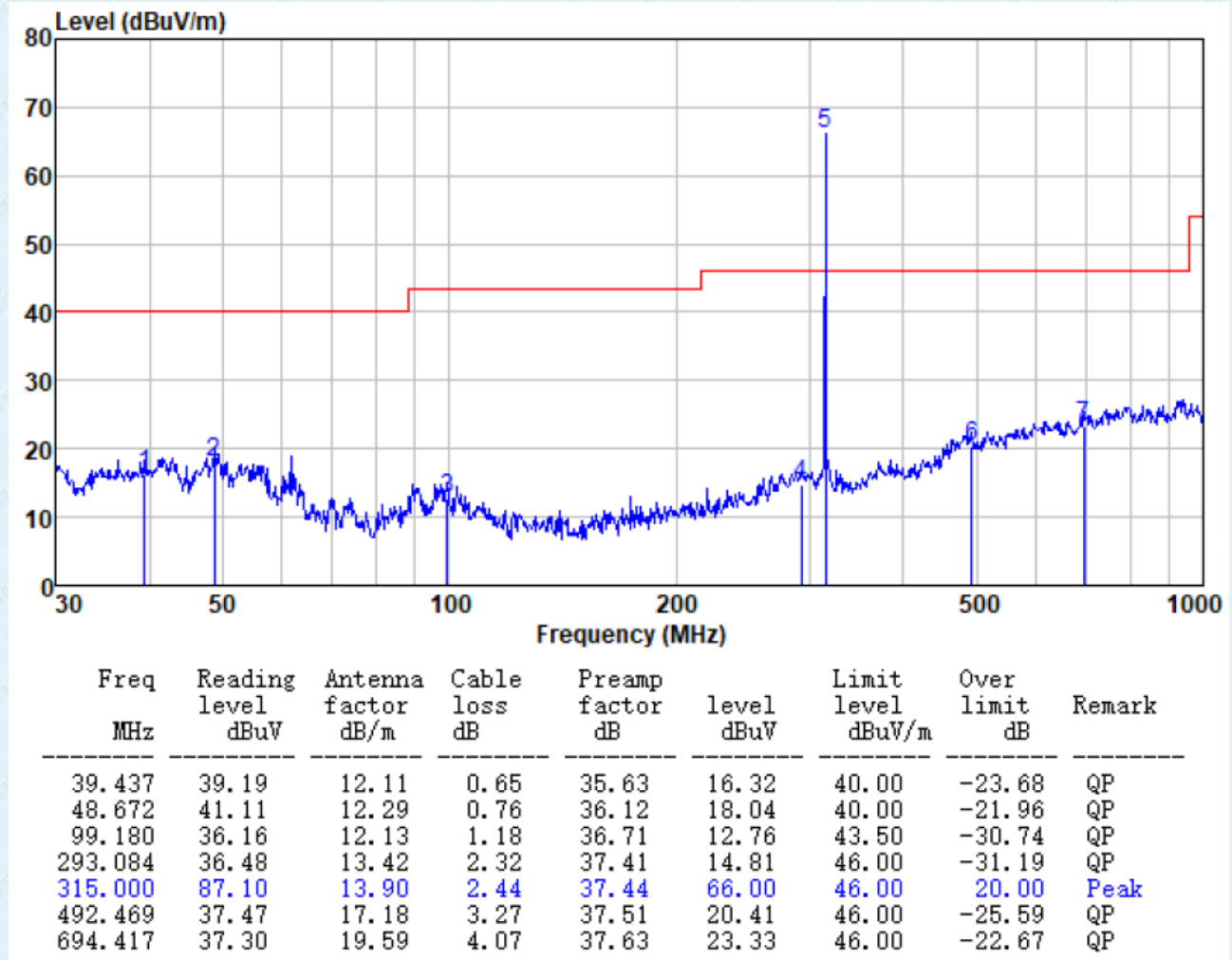
Below 1GHz

Horizontal:

ASK:

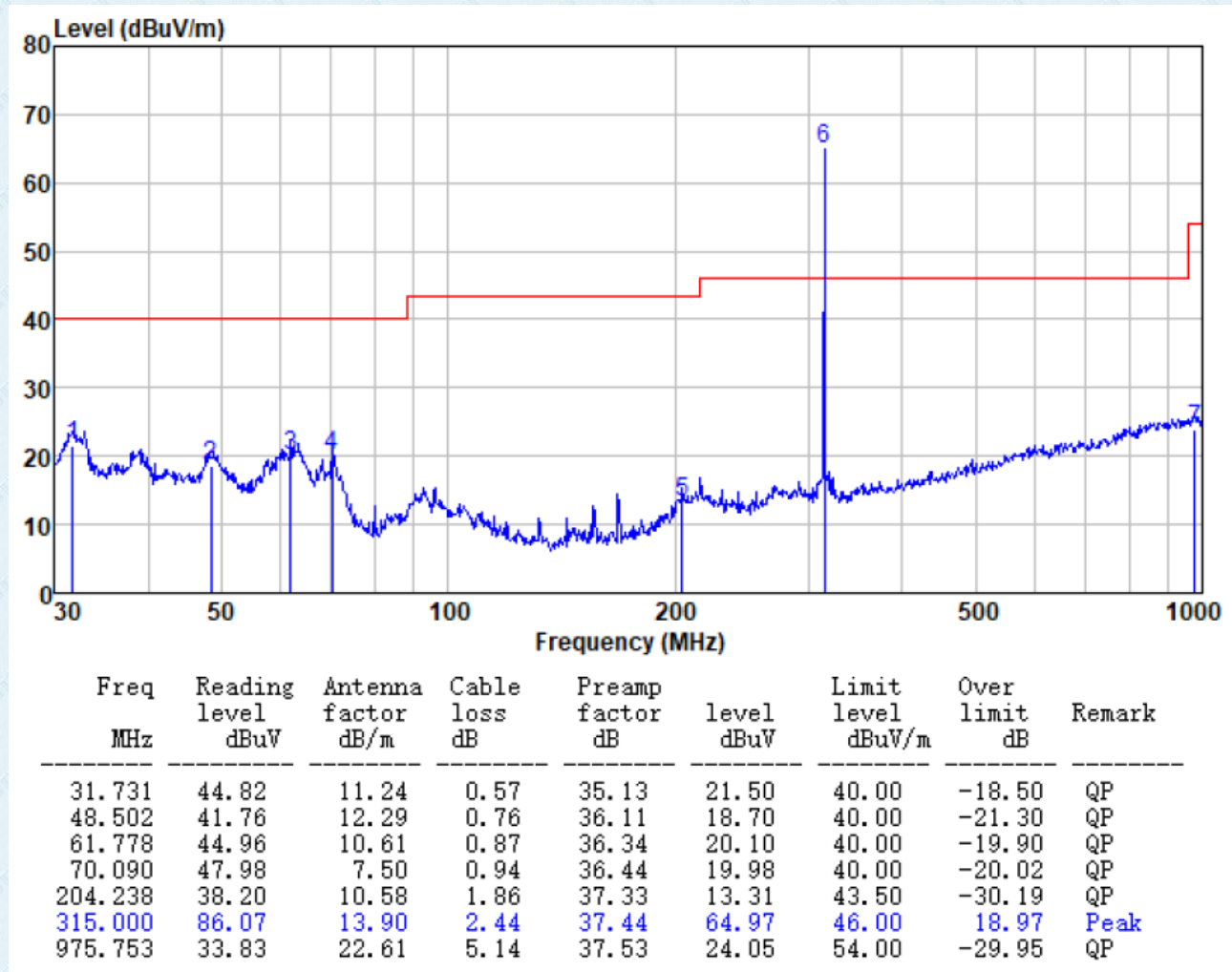


FSK:

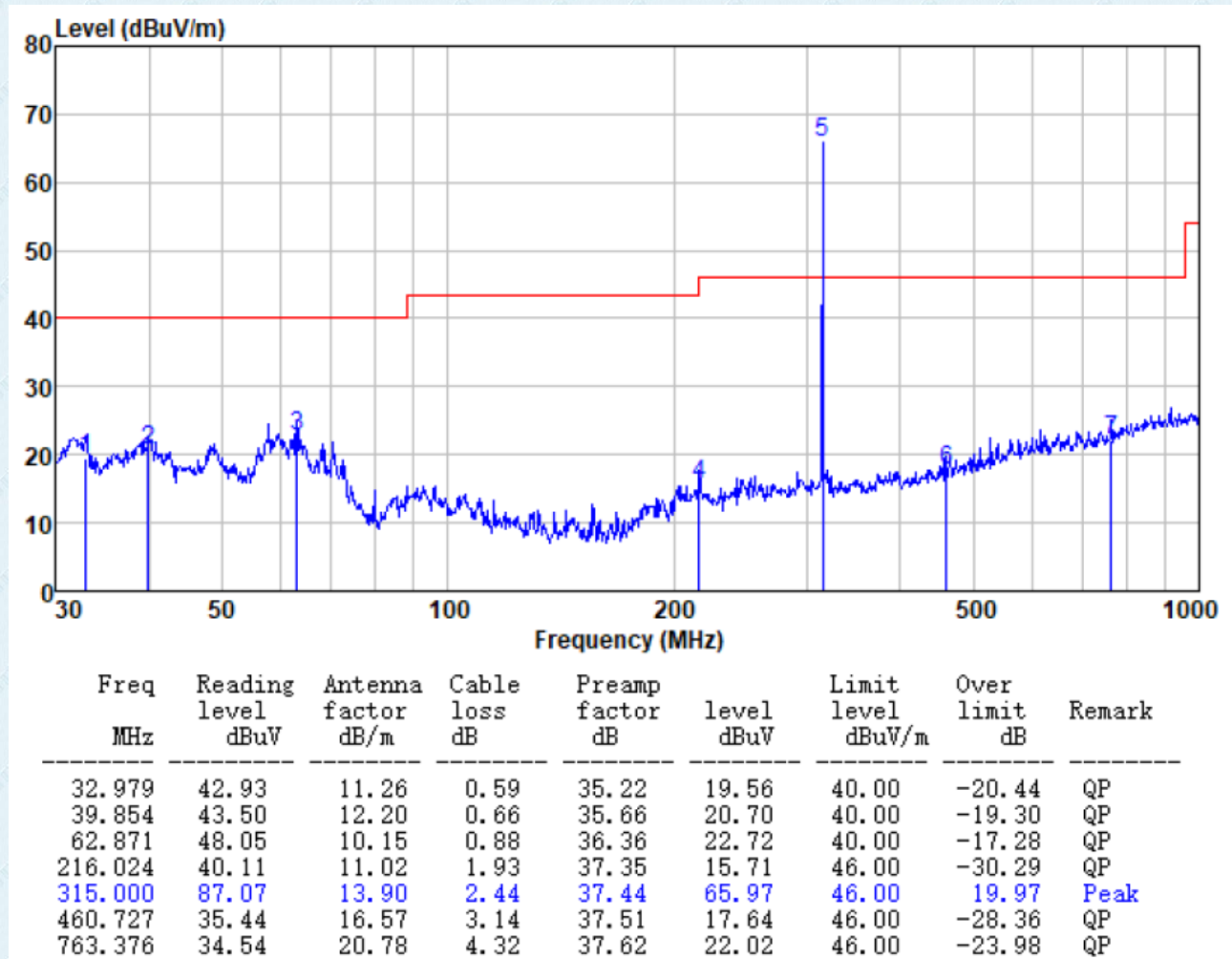


Vertical:

ASK:



FSK :



Above 1G

Peak value:

ASK:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1455.00	35.61	25.39	4.89	36.13	29.76	74.00	-44.24	Vertical
2510.00	36.04	27.72	6.49	36.95	33.30	74.00	-40.70	Vertical
2895.00	35.08	28.41	7.07	37.23	33.33	74.00	-40.67	Vertical
3415.00	36.00	28.35	7.85	37.35	34.85	74.00	-39.15	Vertical
4035.00	33.47	29.68	8.77	37.42	34.50	74.00	-39.50	Vertical
4690.00	31.61	31.14	9.27	37.69	34.33	74.00	-39.67	Vertical
1635.00	37.21	25.74	5.17	36.27	31.85	74.00	-42.15	Horizontal
2710.00	35.36	28.08	6.79	37.10	33.13	74.00	-40.87	Horizontal
3385.00	37.18	28.37	7.81	37.34	36.02	74.00	-37.98	Horizontal
4210.00	33.48	30.10	8.90	37.49	34.99	74.00	-39.01	Horizontal
4855.00	31.91	31.44	9.40	37.75	35.00	74.00	-39.00	Horizontal
5740.00	30.20	32.18	10.09	36.73	35.74	74.00	-38.26	Horizontal

FSK:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1630.00	36.59	25.73	5.16	36.26	31.22	74.00	-42.78	Vertical
2005.00	36.28	26.41	5.72	36.51	31.90	74.00	-42.10	Vertical
2690.00	36.40	28.04	6.76	37.08	34.12	74.00	-39.88	Vertical
3475.00	36.80	28.31	7.95	37.35	35.71	74.00	-38.29	Vertical
3855.00	32.87	29.22	8.52	37.39	33.22	74.00	-40.78	Vertical
4325.00	30.48	30.38	8.99	37.54	32.31	74.00	-41.69	Vertical
1915.00	36.17	26.25	5.59	36.45	31.56	74.00	-42.44	Horizontal
2915.00	35.64	28.45	7.10	37.24	33.95	74.00	-40.05	Horizontal
3515.00	35.64	28.34	8.01	37.35	34.64	74.00	-39.36	Horizontal
4310.00	31.85	30.34	8.98	37.53	33.64	74.00	-40.36	Horizontal
5020.00	30.55	31.70	9.52	37.78	33.99	74.00	-40.01	Horizontal
5585.00	30.72	31.80	9.97	36.96	35.53	74.00	-38.47	Horizontal

Average value:

ASK

Frequency (MHz)	Level (dBuV/m)	Duty cycle factor	Average Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1085	29.76	-12.04	17.72	54.00	-36.28	Vertical
1780	33.30	-12.04	21.26	54.00	-32.74	Vertical
2535	33.33	-12.04	21.29	54.00	-32.71	Vertical
3530	34.85	-12.04	22.81	54.00	-31.19	Vertical
4370	34.50	-12.04	22.46	54.00	-31.54	Vertical
5150	34.33	-12.04	22.29	54.00	-31.71	Vertical
1100	31.85	-12.04	19.81	54.00	-34.19	Horizontal
1740	33.13	-12.04	21.09	54.00	-32.91	Horizontal
2545	36.02	-12.04	23.98	54.00	-30.02	Horizontal
3515	34.99	-12.04	22.95	54.00	-31.05	Horizontal
4335	35.00	-12.04	22.96	54.00	-31.04	Horizontal
5125	35.74	-12.04	23.70	54.00	-30.30	Horizontal

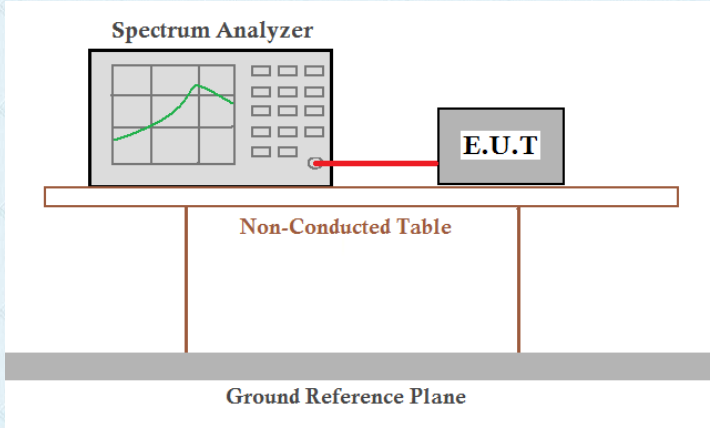
FSK

Frequency (MHz)	Level (dBuV/m)	Duty cycle factor	Average Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1080	31.22	-11.98	19.24	54.00	-34.76	Vertical
1765	31.90	-11.98	19.92	54.00	-34.08	Vertical
2510	34.12	-11.98	22.14	54.00	-31.86	Vertical
3460	35.71	-11.98	23.73	54.00	-30.27	Vertical
4360	33.22	-11.98	21.24	54.00	-32.76	Vertical
5145	32.31	-11.98	20.33	54.00	-33.67	Vertical
1060	31.56	-11.98	19.58	54.00	-34.42	Horizontal
1735	33.95	-11.98	21.97	54.00	-32.03	Horizontal
2495	34.64	-11.98	22.66	54.00	-31.34	Horizontal
3485	33.64	-11.98	21.66	54.00	-32.34	Horizontal
4350	33.99	-11.98	22.01	54.00	-31.99	Horizontal
5110	35.53	-11.98	23.55	54.00	-30.45	Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. Average value = Peak value + Duty cycle factor

7.3 20dB Occupy Bandwidth

Test Requirement:	FCC Part15 C Section 15.231 (c)
Test Method:	ANSI C63.10:2013
Limit:	The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900MHz. 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.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

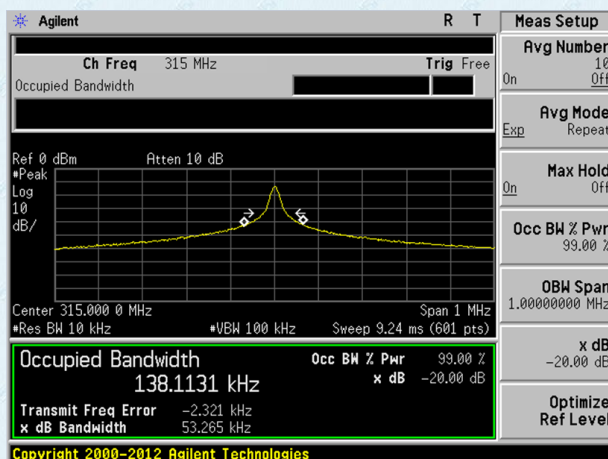
Measurement Data

Modulation	Test Frequency (MHz)	20dB bandwidth (MHz)	Limit (MHz)	Result
ASK	315	0.053	0.7875	Pass
FSK	315	0.117	0.7875	Pass

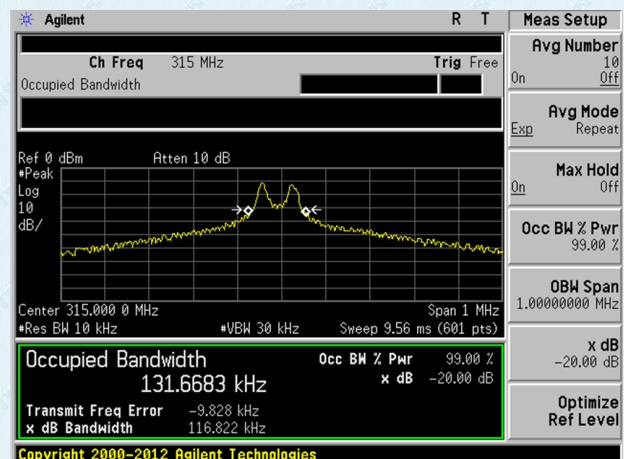
Note: Limit= Fundamental frequency×0.25%=315×0.25%=0.7875MHz

Test plot as follows:

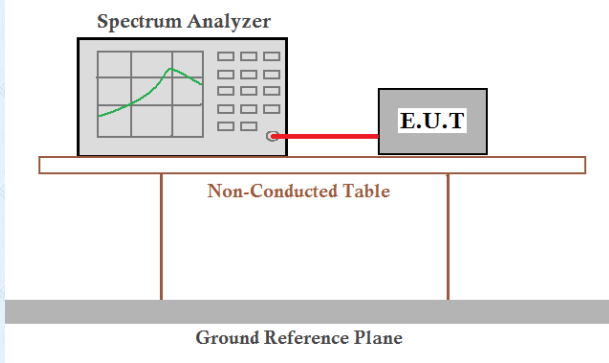
ASK



FSK



7.4 Dwell time & Silent Time

Test Requirement:	FCC Part15 C Section 15.231 (e)
Test Method:	ANSI C63.10:2013
Limit:	Dwell Time: Not more than 1s Silent Time: no case less than 10s
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement data:

Dwell Time

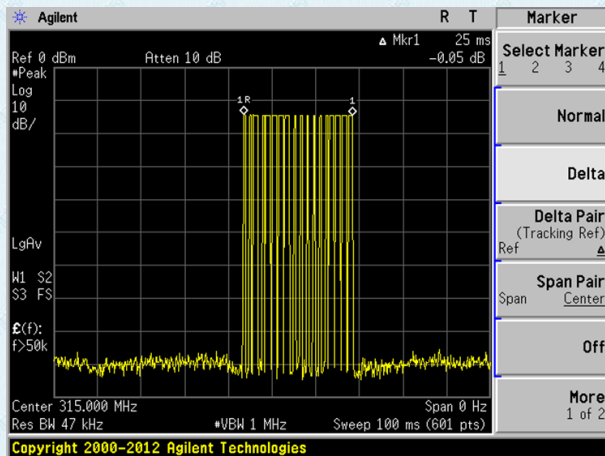
Modulation	Duration of each TX(second):	Limit (second)	Result
ASK	0.025	<1.0	Pass
FSK	0.02517	<1.0	Pass

Silent Time

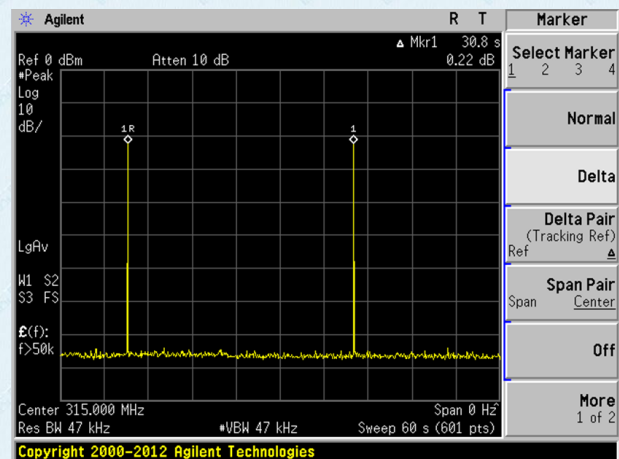
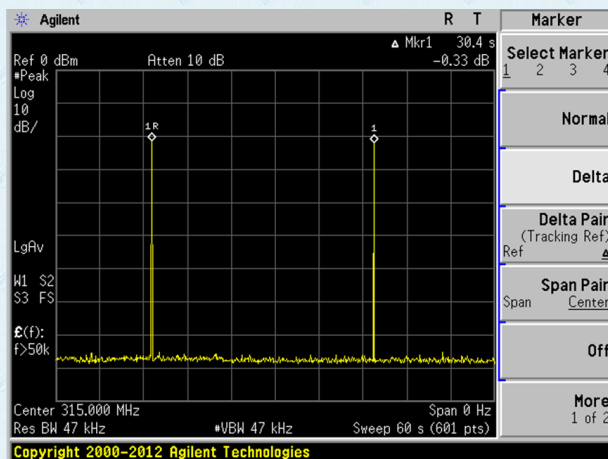
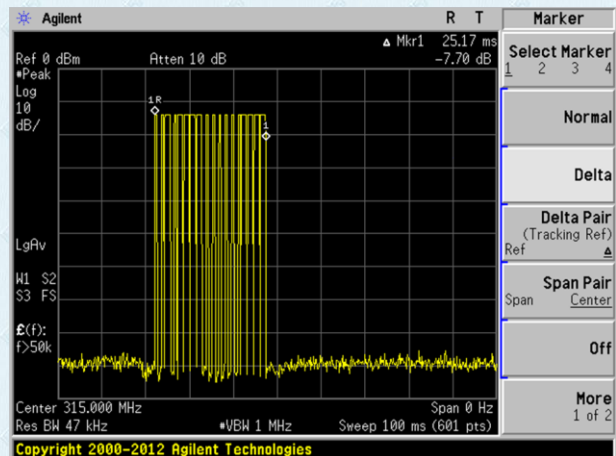
Modulation	Silent of each TX(second):	Limit (second)	Result
ASK	30.4	>10	Pass
FSK	30.8	>10	Pass

Test plot as follows:

ASK



FSK



8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

-----End-----