

TEST REPORT

Reference No..... : WTF17S0680868E
FCC ID : BRWAR8010T
Applicant..... : Horizon Hobby, LLC
Address..... : 4105 Fieldstone Road, Champaign, Illinois 61821, Unite States
Manufacturer : Horizon Hobby, LLC
Address..... : 4105 Fieldstone Road, Champaign, Illinois 61821, Unite States
Product Name..... : TELEMETRY RECEIVER
Model No..... : AR8010T, AR9030T
Standards..... : FCC CFR47 Part 15 Section 15.247:2016
Date of Receipt sample : Jun. 02, 2017
Date of Test : Jun. 05 - 23, 2017
Date of Issue..... : Jul. 04, 2017
Test Result..... : **Pass**

Remarks:

The 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.

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3 Report Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF17S0680868E	Jun. 02, 2017	Jun. 05 - 23, 2017	Jun. 26, 2017	Original	-	Replaced
WTF17S0680868E	Jun. 02, 2017	Jun. 05 - 23, 2017	Jul. 04, 2017	Revision1	Revised Antenna Type	Valid

4 General Information

4.1 General Description of E.U.T.

Product Name:	TELEMETRY RECEIVER
Model No.:	AR8010T, AR9030T
Model Description:	The above models are the same in PCB circuit, PCB Layout, components and internal structure, The only difference is the number of channels used. The model AR8010T is the tested sample.
Frequency Range:	2404MHz ~ 2476MHz, 23 channels in total
Type of Modulation:	GFSK
The lowest oscillator:	12MHz
Antenna installation:	Permanent wire whip antenna
Antenna Gain:	ANT1: 2 dBi ANT2: 2 dBi
Remark:	This device does not support MIMO. RF module employee two identical antennas.

4.2 Details of E.U.T.

Technical Data:	DC 4V-10V by battery
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4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2404	1	2407	2	2411	3	2414
4	2417	5	2420	6	2424	7	2427
8	2430	9	2433	10	2437	11	2440
12	2443	13	2446	14	2450	15	2453
16	2456	17	2459	18	2463	19	2466
20	2469	21	2473	22	2476	23	

4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting	2404MHz	2440MHz	2476MHz

4.5 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 7760A-1**

Waltek Services(Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration 7760A-1, October 15, 2015

- **FCC Test Site– Registration No.: 328995**

Waltek Services(Shenzhen) Co., Ltd. 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 our files. Registration 328995, December 3, 2014.

5 Equipment Used during Test

5.1 Equipments List

3m Semi-anechoic Chamber for Radiation Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Spectrum Analyzer	R&S	FSP	100091	Apr. 29, 2017	Apr. 28, 2018
2	Amplifier	Agilent	8447D	2944A10178	Jan. 12, 2017	Jan. 11, 2018
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	0703	Oct. 17, 2016	Oct. 16, 2017
4	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr. 07, 2017	Apr. 06, 2018
5	SHF-EHF Horn, 15-40GHz	SCHWARZBECK	BBHA 9170	BBHA917058 2	Aug. 13, 2016	Aug. 12, 2017
6	Broadband Preamplifier	SCHWARZBECK	BBV 9719	18-26.5GHz	Aug. 13, 2016	Aug. 12, 2017
7	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.12, 2016	Sep.11, 2017
8	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr. 07, 2017	Apr. 06, 2018
9	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Apr. 07, 2017	Apr. 06, 2018
10	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	Apr. 07, 2017	Apr. 06, 2018
11	Test Receiver	R&S	ESCI	101296	Apr. 06, 2017	Apr. 05, 2018
12	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Apr. 07, 2017	Apr. 06, 2018
13	Amplifier	ANRITSU	MH648A	M43381	Apr. 07, 2017	Apr. 06, 2018
14	Cable	HUBER+SUHNER	CBL2	525178	Apr. 07, 2017	Apr. 06, 2018
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	Sep.15,2016	Sep.14,2017
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.15,2016	Sep.14,2017
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	Sep.15,2016	Sep.14,2017

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)
Conducted Spurious Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by GUANG ZHOU GRG METROLOGY & TEST CO., LTD. address is No.163, Pingyun Rd. West of Huangpu Ave, Tianhe District, Guangzhou, Guangdong, China.

6 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	C
Band edge	15.247(d) 15.205(a)	C
Conduct Emission	15.207	N/A
Bandwidth	15.247(a)(1)	C
Maximum Peak Output Power	15.247(b)(1)	C
Frequency Separation	15.247(a)(1)	C
Number of Hopping Frequency	15.247(a)(1)(iii)	C
Dwell time	15.247(a)(1)(iii)	C
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	C
Antenna Requirement	15.203	C
Note: C=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable		

7 Radiated Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: ANSI C63.10:2013&ANSI C63.4:2014

Test Result: PASS

Measurement Distance: 3m

Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Distance	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

7.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

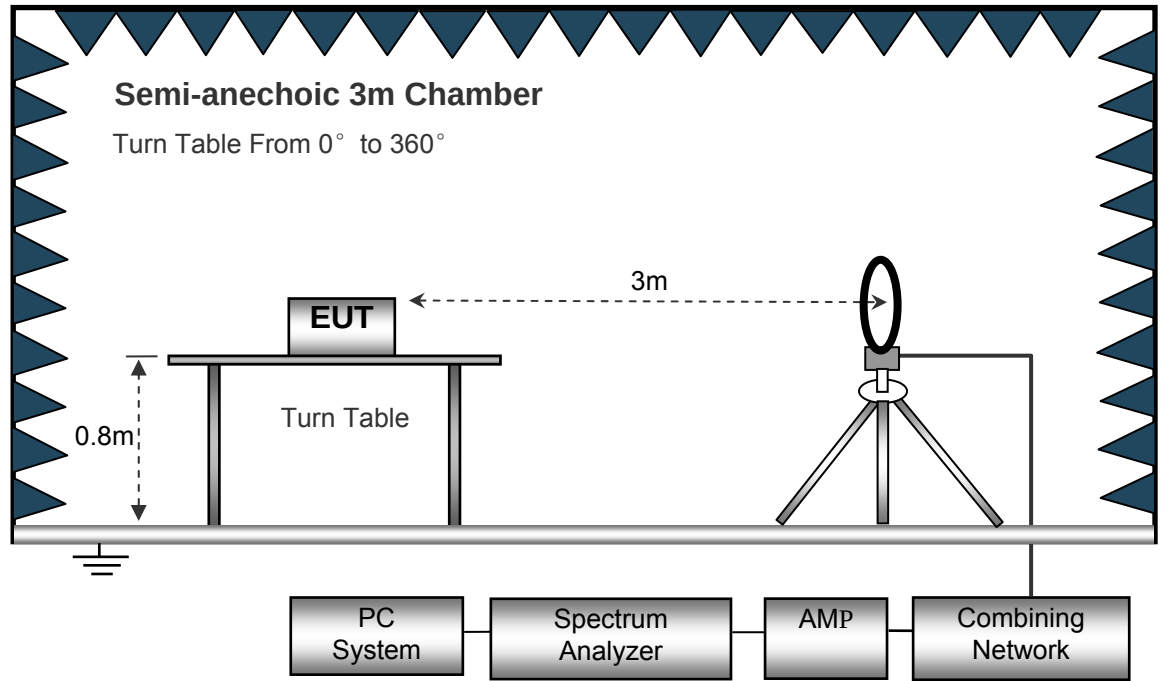
EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

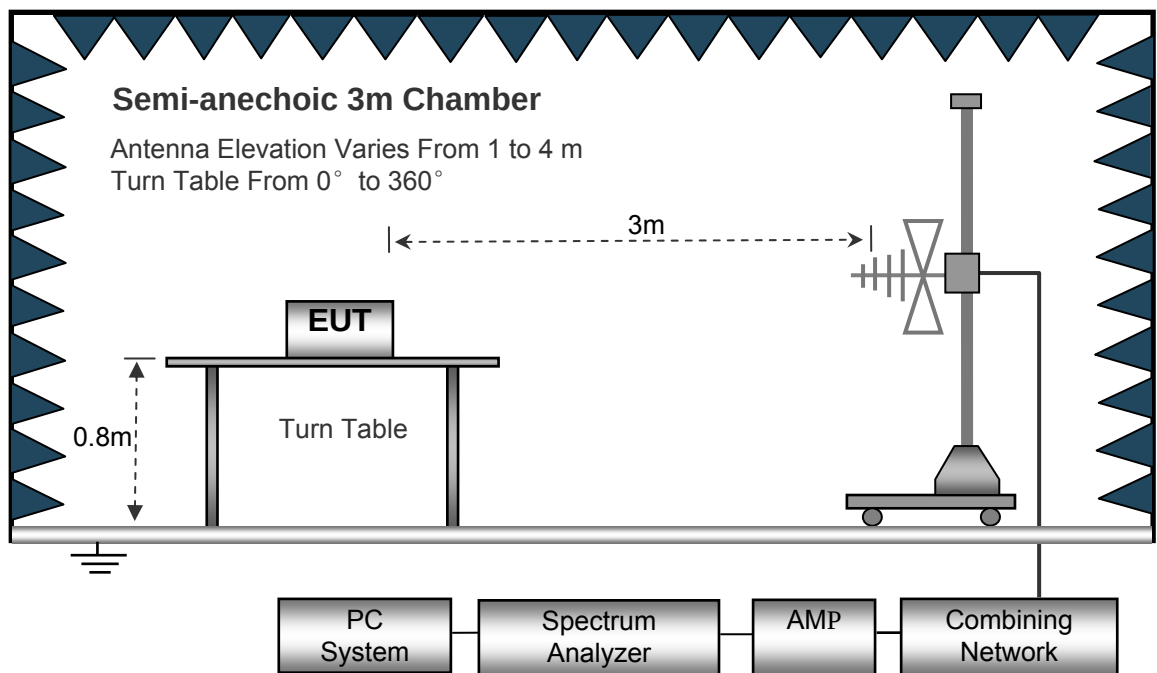
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10:2013.

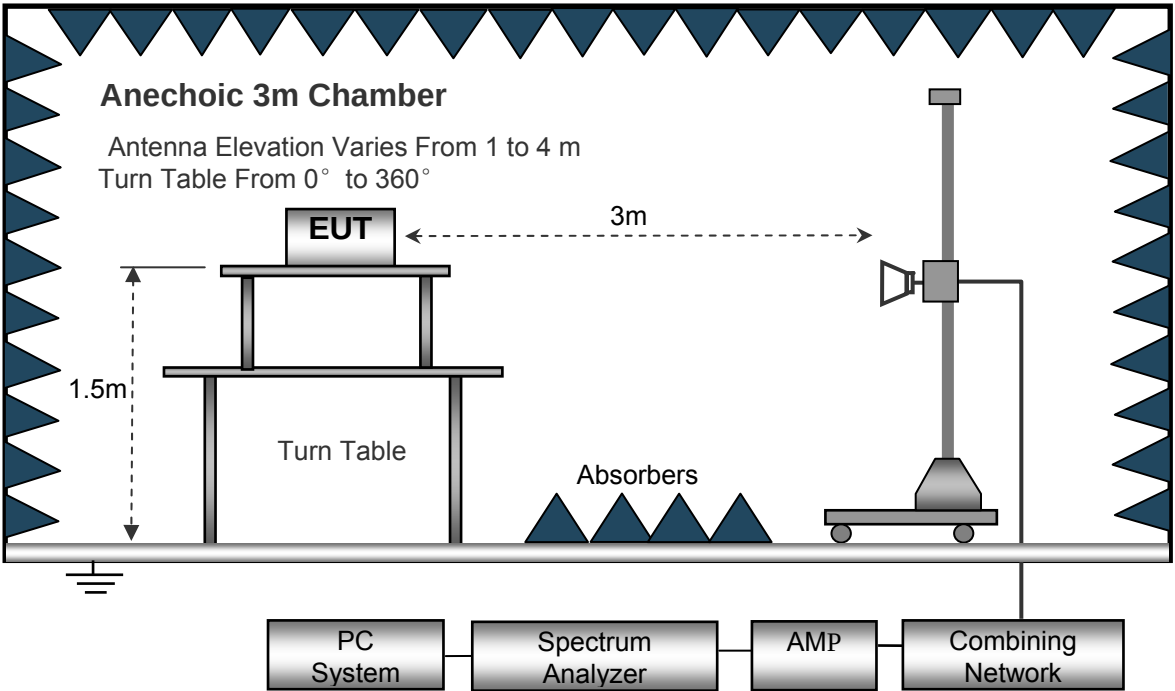
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Below 30MHz	
Sweep Speed	Auto
IF Bandwidth.....	10kHz
Video Bandwidth.....	10kHz
Resolution Bandwidth.....	10kHz
30MHz ~ 1GHz	
Sweep Speed	Auto
Detector	PK
Resolution Bandwidth.....	100kHz
Video Bandwidth.....	300kHz
Above 1GHz	
Sweep Speed	Auto
Detector	PK
Resolution Bandwidth.....	1MHz
Video Bandwidth.....	3MHz
Detector	Ave.
Resolution Bandwidth.....	1MHz
Video Bandwidth.....	10Hz

7.4 Test Procedure

1. The EUT is placed on a turntable, which is above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
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.

7.5 Summary of Test Results

ANT1

Test Frequency: 9KHz ~ 30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 18GHz

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel									
252.06	36.05	QP	261	1.3	H	-13.35	22.70	46.00	-23.30
252.06	41.26	QP	346	1.2	V	-13.35	27.91	46.00	-18.09
4808.00	45.03	PK	342	1.5	V	-1.06	43.97	74.00	-30.03
4804.00	43.66	Ave	342	1.5	V	-1.06	42.60	54.00	-11.40
7212.00	40.32	PK	62	1.9	H	1.33	41.65	74.00	-32.35
7212.00	35.60	Ave	62	1.9	H	1.33	36.93	54.00	-17.07
2345.54	46.31	PK	212	1.0	V	-13.19	33.12	74.00	-40.88
2345.54	38.19	Ave	212	1.0	V	-13.19	25.00	54.00	-29.00
2364.03	43.71	PK	305	1.1	H	-13.14	30.57	74.00	-43.43
2364.03	36.50	Ave	305	1.1	H	-13.14	23.36	54.00	-30.64
2484.81	44.80	PK	326	1.9	V	-13.08	31.72	74.00	-42.28
2484.81	38.38	Ave	326	1.9	V	-13.08	25.30	54.00	-28.70

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Middle Channel									
252.06	37.09	QP	141	1.6	H	-13.35	23.74	46.00	-22.26
252.06	42.45	QP	285	1.2	V	-13.35	29.10	46.00	-16.90
4880.00	46.20	PK	289	1.1	V	-0.62	45.58	74.00	-28.42
4880.00	42.23	Ave	289	1.1	V	-0.62	41.61	54.00	-12.39
7320.00	38.90	PK	89	1.5	H	2.21	41.11	74.00	-32.89
7320.00	34.56	Ave	89	1.5	H	2.21	36.77	54.00	-17.23
2343.58	46.10	PK	36	1.8	V	-13.19	32.91	74.00	-41.09
2343.58	38.72	Ave	36	1.8	V	-13.19	25.53	54.00	-28.47
2382.89	44.40	PK	248	1.7	H	-13.14	31.26	74.00	-42.74
2382.89	37.80	Ave	248	1.7	H	-13.14	24.66	54.00	-29.34
2493.64	42.91	PK	199	1.6	V	-13.08	29.83	74.00	-44.17
2493.64	38.54	Ave	199	1.6	V	-13.08	25.46	54.00	-28.54

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK High Channel									
252.06	38.22	QP	242	1.8	H	-13.35	24.87	46.00	-21.13
252.06	42.56	QP	238	1.5	V	-13.35	29.21	46.00	-16.79
4952.00	43.89	PK	321	1.5	V	-0.24	43.65	74.00	-30.35
4952.00	40.39	Ave	321	1.5	V	-0.24	40.15	54.00	-13.85
7428.00	39.26	PK	242	1.8	H	2.84	42.10	74.00	-31.90
7428.00	36.23	Ave	242	1.8	H	2.84	39.07	54.00	-14.93
2329.08	46.66	PK	342	1.0	V	-13.19	33.47	74.00	-40.53
2329.08	39.17	Ave	342	1.0	V	-13.19	25.98	54.00	-28.02
2354.21	42.18	PK	222	1.9	H	-13.14	29.04	74.00	-44.96
2354.21	38.66	Ave	222	1.9	H	-13.14	25.52	54.00	-28.48
2495.95	42.63	PK	279	1.9	V	-13.08	29.55	74.00	-44.45
2495.95	38.05	Ave	279	1.9	V	-13.08	24.97	54.00	-29.03

Test Frequency: Above 18GHz

The measurements were more than 20 dB below the limit and not reported

ANT2

Test Frequency: 9KHz ~ 30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 18GHz

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel									
232.68	35.23	QP	143	1.6	H	-13.35	21.88	46.00	-24.12
232.68	40.56	QP	36	1.4	V	-13.35	27.21	46.00	-18.79
4808.00	44.78	PK	333	1.3	V	-1.06	43.72	74.00	-30.28
4808.00	42.88	Ave	333	1.3	V	-1.06	41.82	54.00	-12.18
7212.00	41.63	PK	141	1.7	H	1.33	42.96	74.00	-31.04
7212.00	36.78	Ave	141	1.7	H	1.33	38.11	54.00	-15.89
2318.47	46.88	PK	306	1.1	V	-13.19	33.69	74.00	-40.31
2318.47	37.40	Ave	306	1.1	V	-13.19	24.21	54.00	-29.79
2373.30	43.42	PK	342	1.8	H	-13.14	30.28	74.00	-43.72
2373.30	38.25	Ave	342	1.8	H	-13.14	25.11	54.00	-28.89
2493.89	42.92	PK	159	1.3	V	-13.08	29.84	74.00	-44.16
2493.89	38.14	Ave	159	1.3	V	-13.08	25.06	54.00	-28.94

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Middle Channel									
232.68	37.09	QP	123	1.5	H	-13.35	23.74	46.00	-22.26
232.68	42.45	QP	48	1.7	V	-13.35	29.10	46.00	-16.90
4880.00	46.20	PK	61	1.8	V	-0.62	45.58	74.00	-28.42
4880.00	42.23	Ave	61	1.8	V	-0.62	41.61	54.00	-12.39
7320.00	38.90	PK	206	1.1	H	2.21	41.11	74.00	-32.89
7320.00	34.56	Ave	206	1.1	H	2.21	36.77	54.00	-17.23
2338.91	46.13	PK	327	1.5	V	-13.19	32.94	74.00	-41.06
2338.91	37.64	Ave	327	1.5	V	-13.19	24.45	54.00	-29.55
2375.03	43.86	PK	175	1.3	H	-13.14	30.72	74.00	-43.28
2375.03	38.19	Ave	175	1.3	H	-13.14	25.05	54.00	-28.95
2493.14	42.06	PK	258	1.3	V	-13.08	28.98	74.00	-45.02
2493.14	37.79	Ave	258	1.3	V	-13.08	24.71	54.00	-29.29

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dB μ V)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
GFSK High Channel									
232.68	38.22	QP	2	1.7	H	-13.35	24.87	46.00	-21.13
232.68	42.56	QP	58	1.9	V	-13.35	29.21	46.00	-16.79
4952.00	43.89	PK	157	1.5	V	-0.24	43.65	74.00	-30.35
4952.00	40.39	Ave	157	1.5	V	-0.24	40.15	54.00	-13.85
7428.00	39.26	PK	269	1.7	H	2.84	42.10	74.00	-31.90
7428.00	36.23	Ave	269	1.7	H	2.84	39.07	54.00	-14.93
2340.28	45.53	PK	16	1.2	V	-13.19	32.34	74.00	-41.66
2340.28	37.03	Ave	16	1.2	V	-13.19	23.84	54.00	-30.16
2387.61	42.36	PK	49	1.6	H	-13.14	29.22	74.00	-44.78
2387.61	37.55	Ave	49	1.6	H	-13.14	24.41	54.00	-29.59
2497.87	42.24	PK	114	1.8	V	-13.08	29.16	74.00	-44.84
2497.87	38.18	Ave	114	1.8	V	-13.08	25.10	54.00	-28.90

Test Frequency: Above 18GHz

The measurements were more than 20 dB below the limit and not reported

8 Band Edge Measurement

Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	ANSI C63.10:2013
Test Limit:	Regulation 15.247 (d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
Test Mode:	Transmitting and Hopping

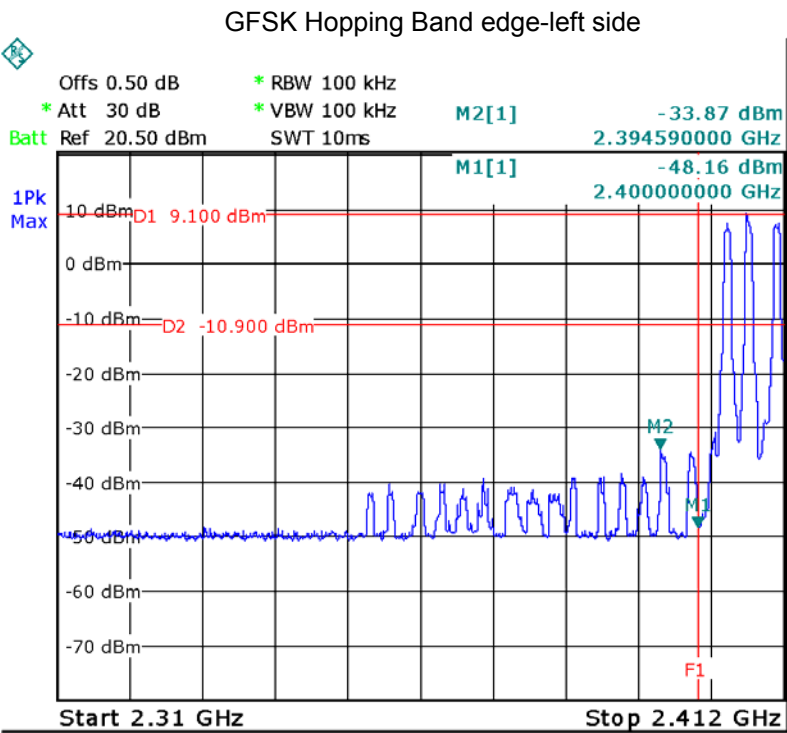
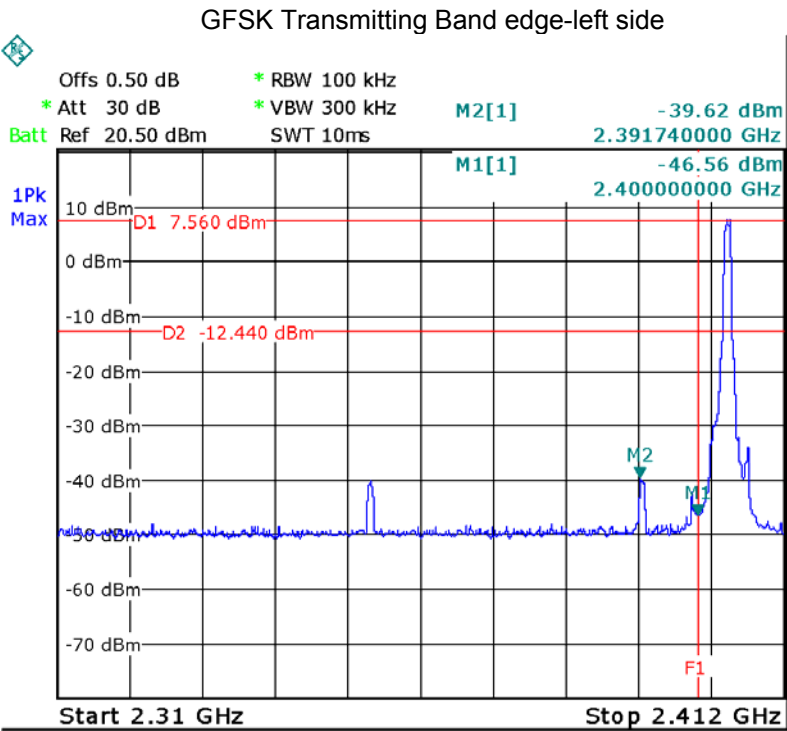
8.1 Test Procedure

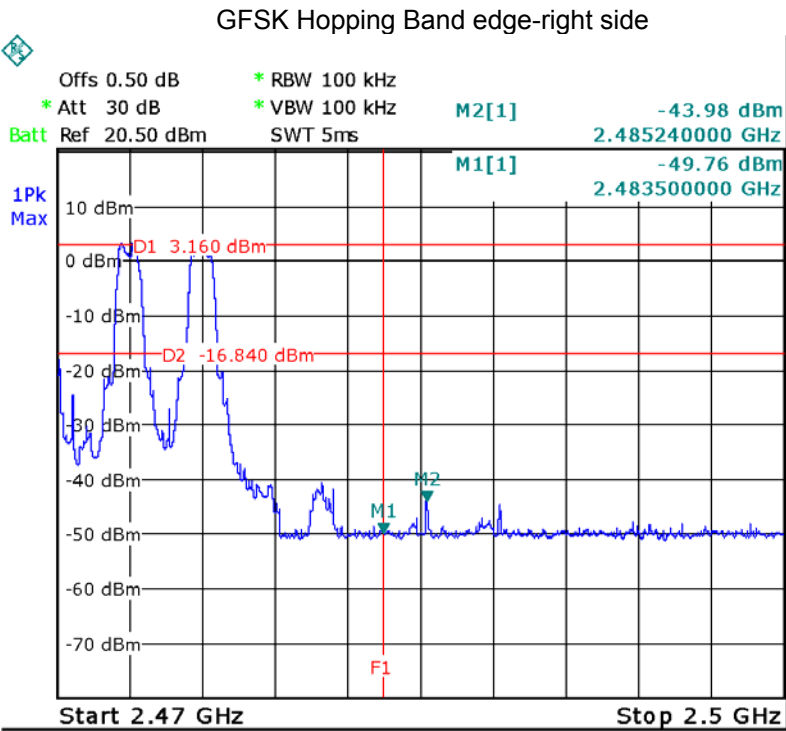
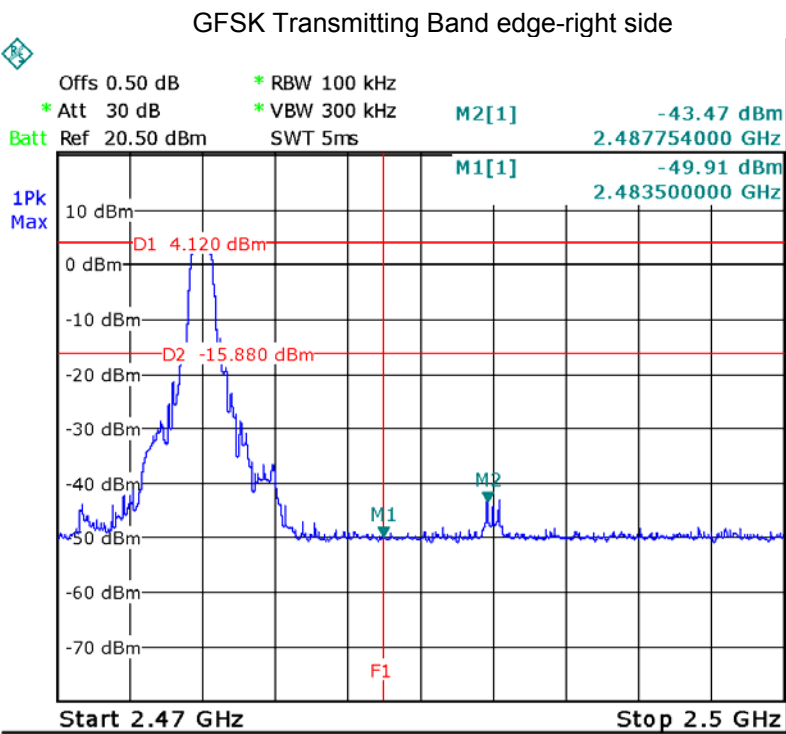
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyser: RBW = 100 kHz, VBW = 300 kHz, Sweep = auto
Detector function = peak, Trace = max hold

8.2 Test Result

ANT1

Test plots

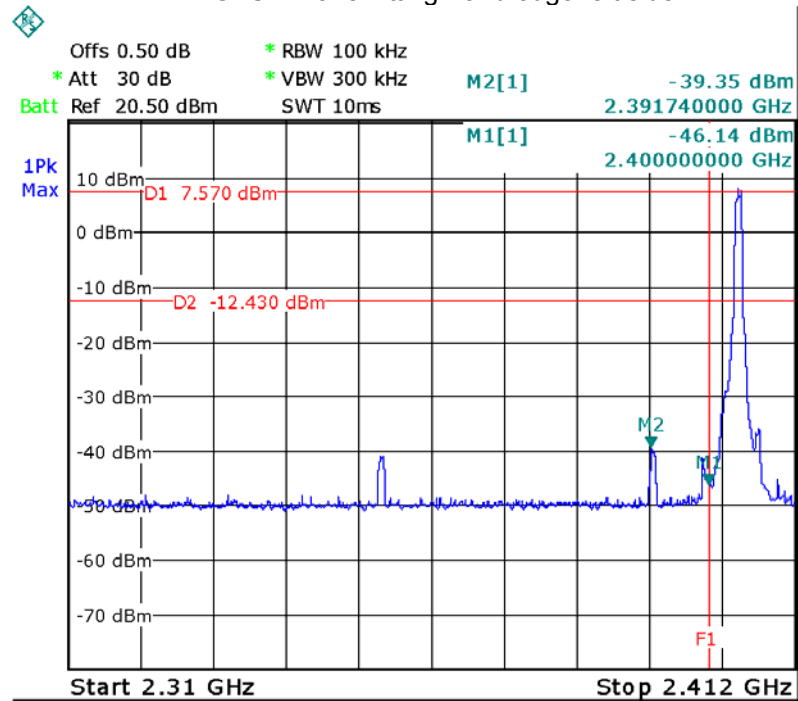




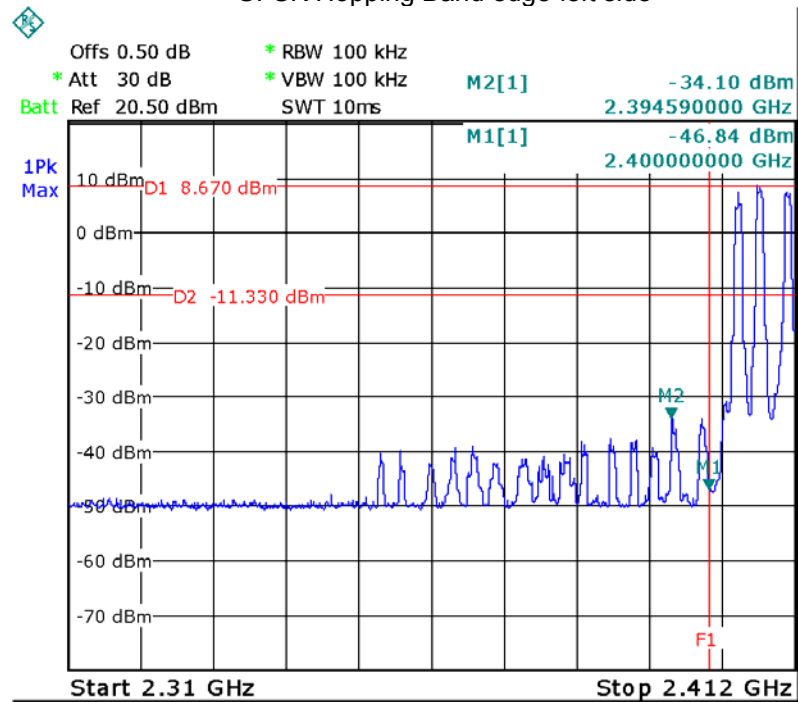
ANT2

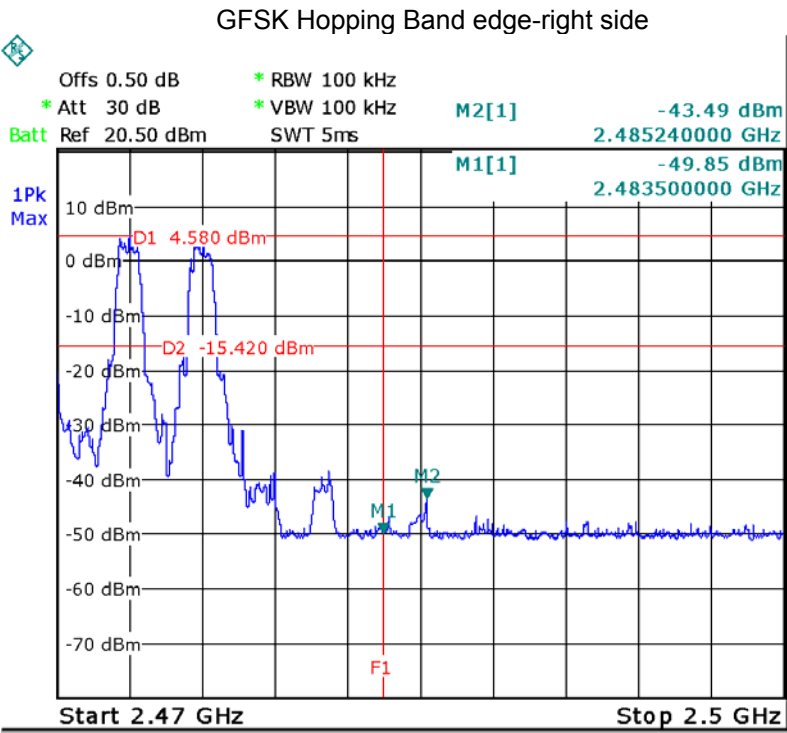
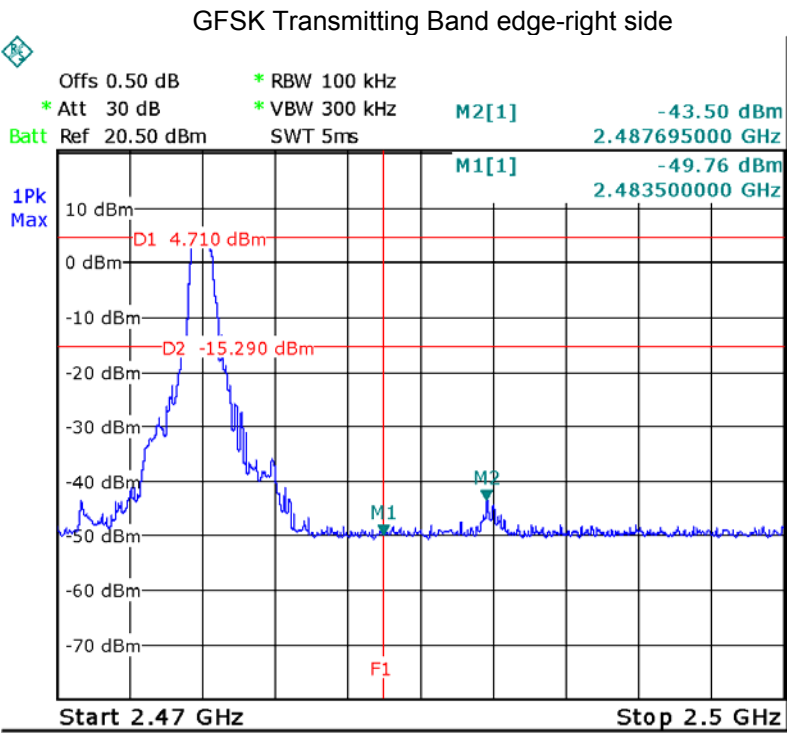
Test plots

GFSK Transmitting Band edge-left side



GFSK Hopping Band edge-left side





9 Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247
Test Method: ANSI C63.10:2013
Test Mode: Test in fixing operating frequency at low, Middle, high channel.

9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyser: RBW = 30 kHz, VBW = 100 kHz

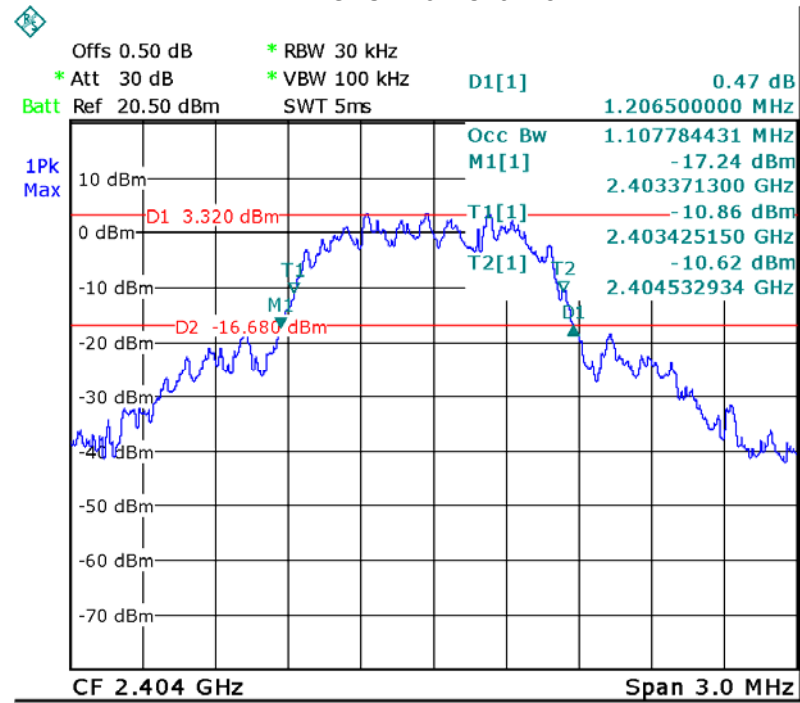
9.2 Test Result

ANT	Modulation	Test Channel	20 dB Bandwidth	99% Bandwidth
ANT1	GFSK	Low	1.207MHz	1.108MHz
	GFSK	Middle	1.228MHz	1.108MHz
	GFSK	High	1.258MHz	1.138MHz
ANT2	GFSK	Low	1.195MHz	1.096MHz
	GFSK	Middle	1.204MHz	1.102MHz
	GFSK	High	1.240MHz	1.144MHz

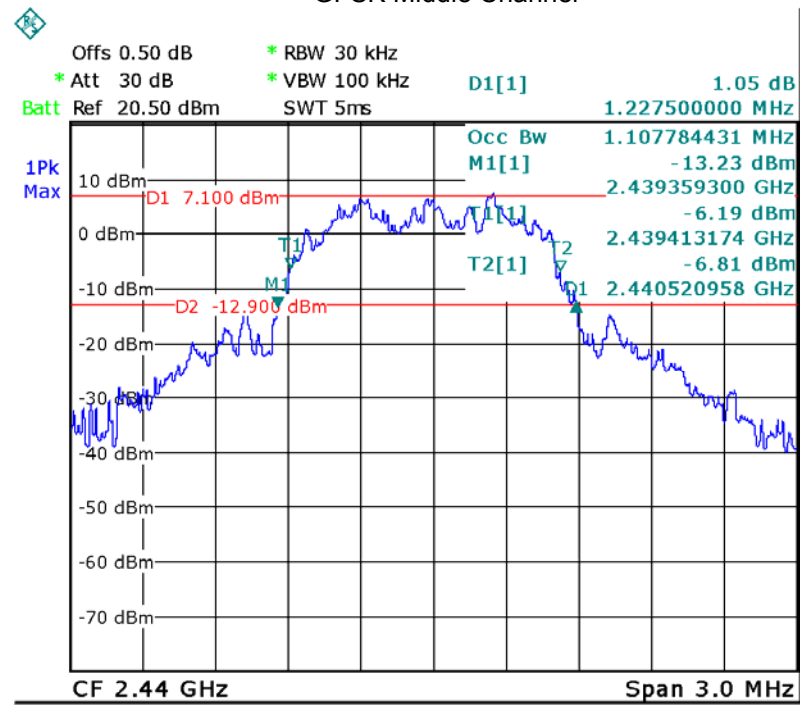
ANT1

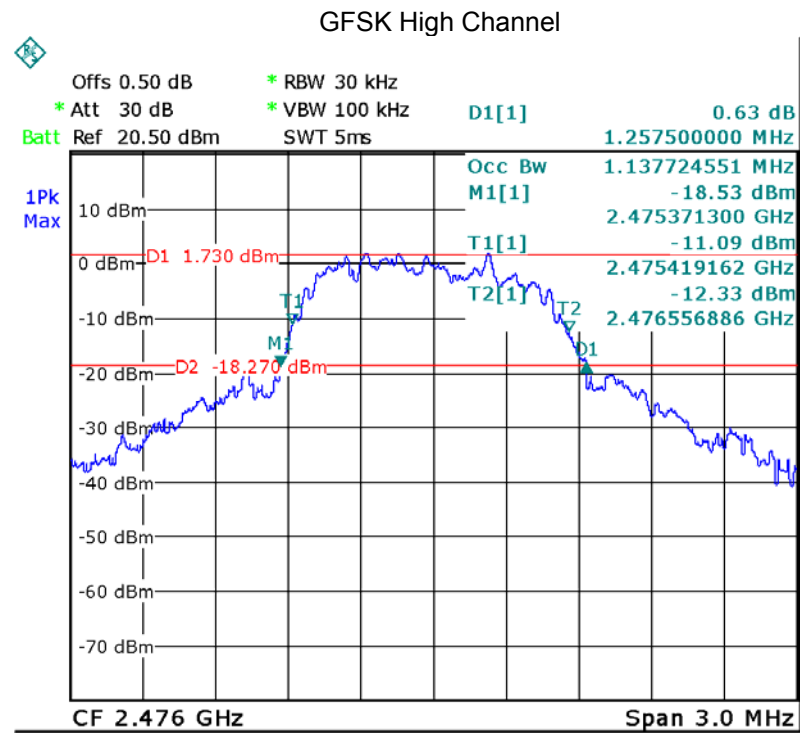
Test plots

GFSK Low Channel



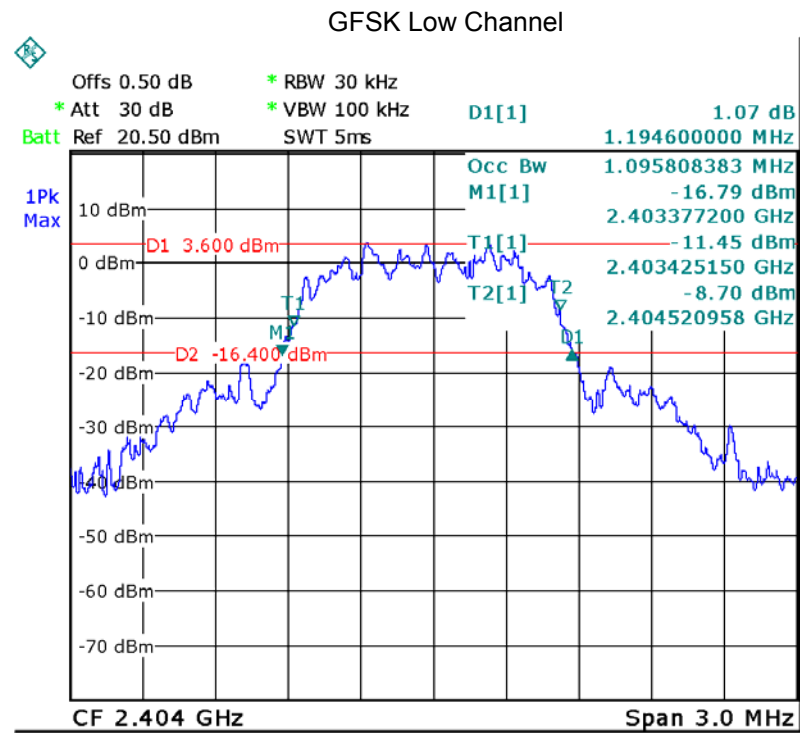
GFSK Middle Channel



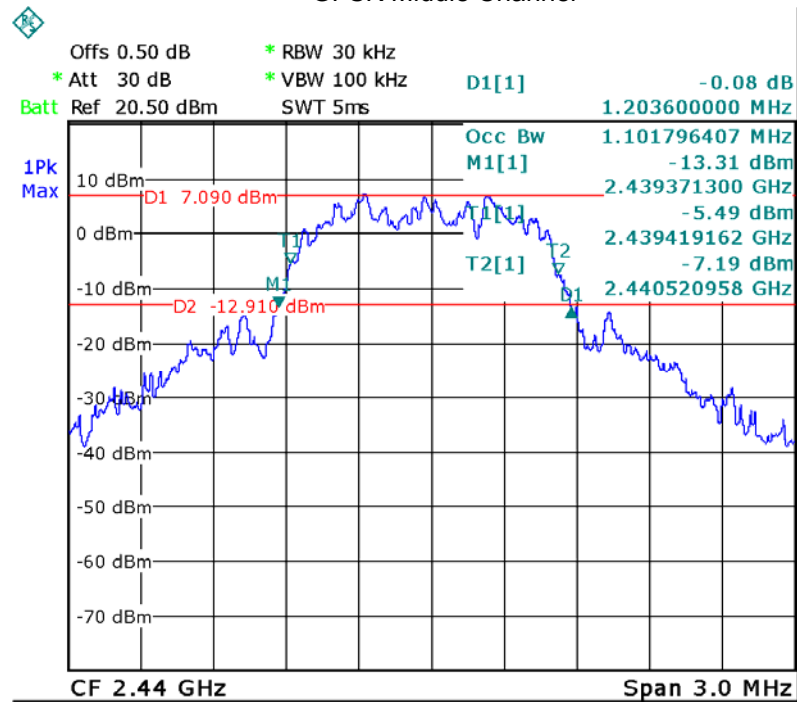


ANT2

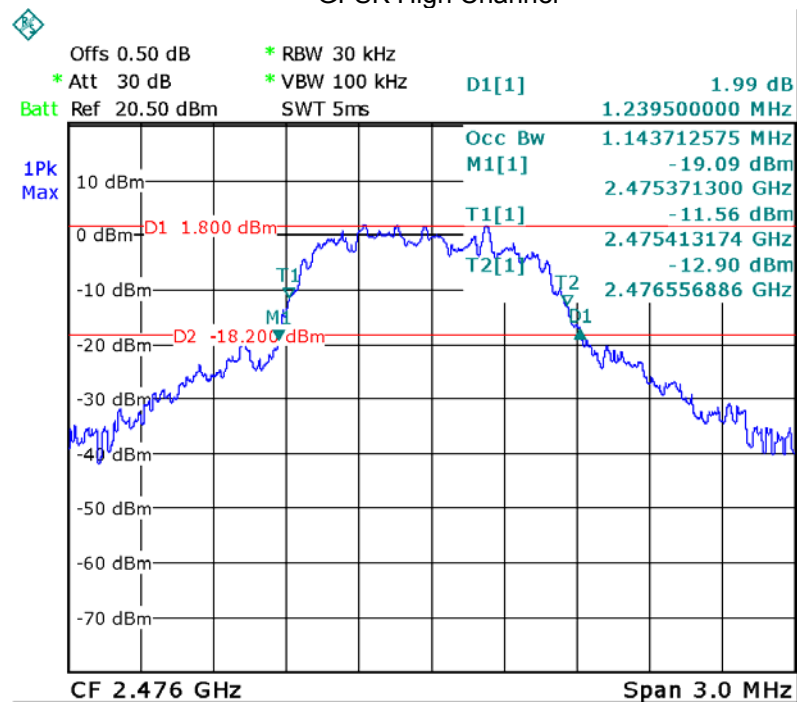
Test plots



GFSK Middle Channel



GFSK High Channel



10 Maximum Peak Output Power

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
Test Limit:	Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. Refer to the result "Number of Hopping Frequency" of this document. The 0.125watts (20.97 dBm) limit applies.
Test mode:	Test in fixing frequency transmitting mode.

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyser: RBW = 3 MHz VBW =3 MHz Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

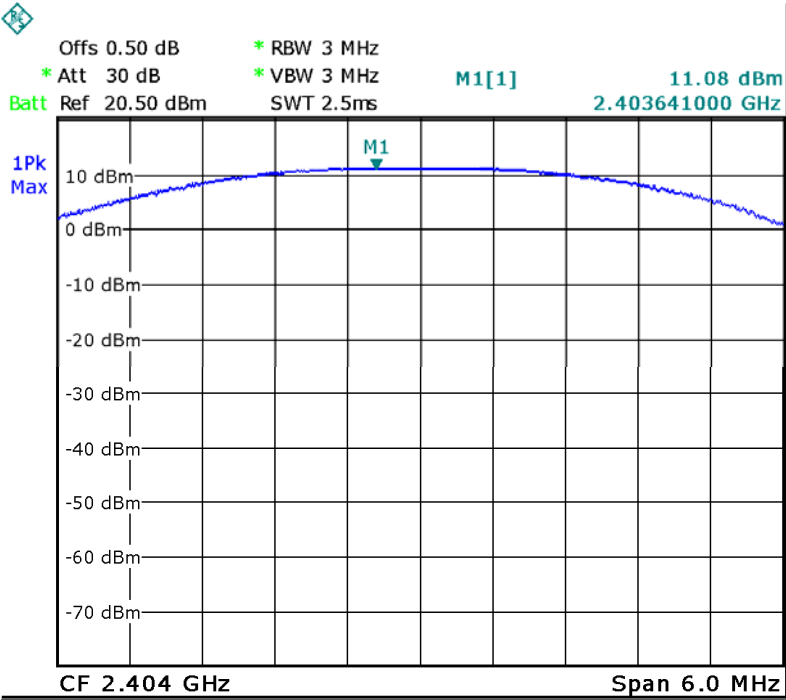
10.2 Test Result

ANT	Test Mode	Data Rate	Peak Power(dBm)			Limit (dBm)
			Low Channel	Middle Channel	High Channel	
ANT1	GFSK	1Mbps	11.08	12.45	7.26	20.97
ANT2	GFSK	1Mbps	10.06	12.53	7.36	20.97

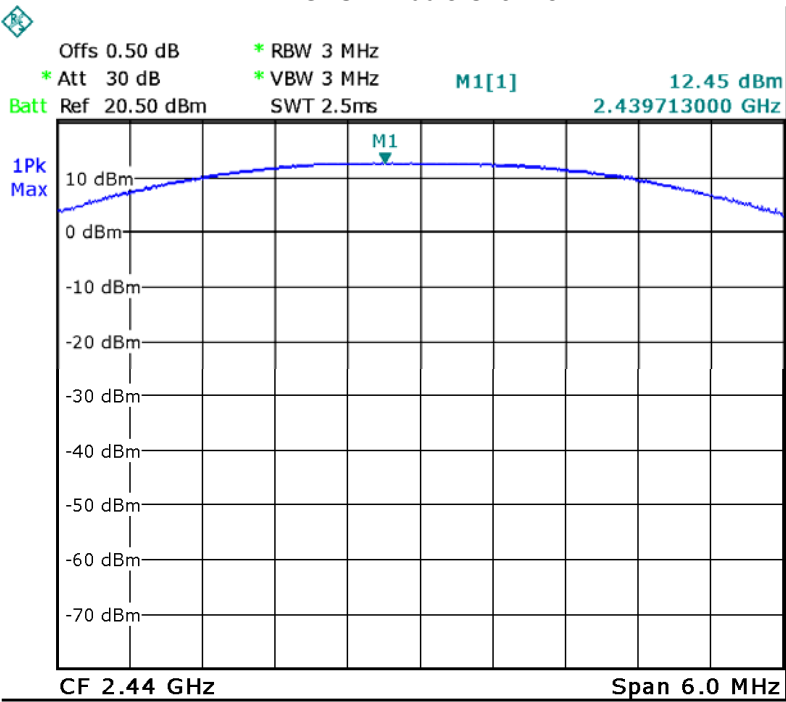
ANT1

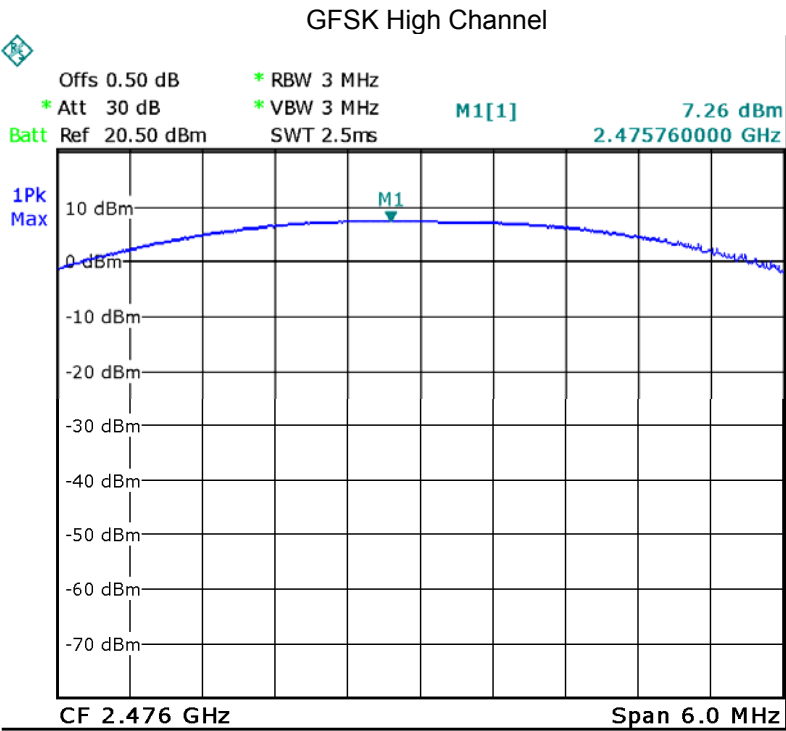
Test plots

GFSK Low Channel



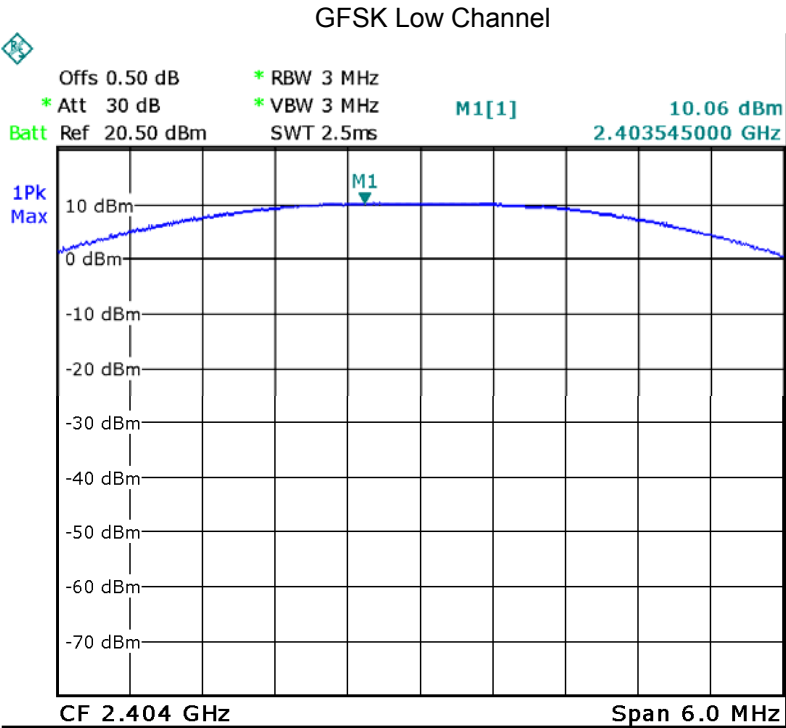
GFSK Middle Channel

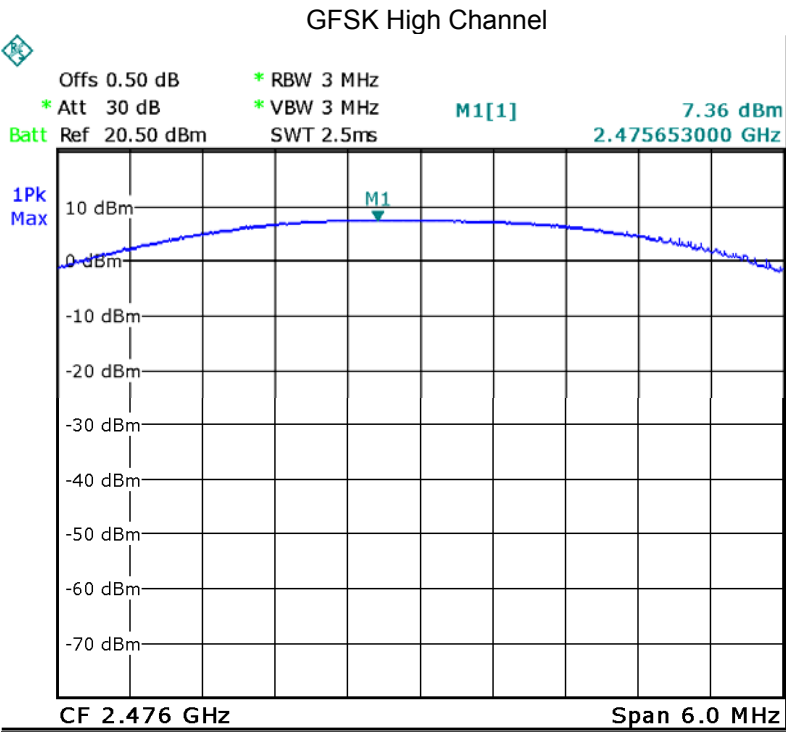
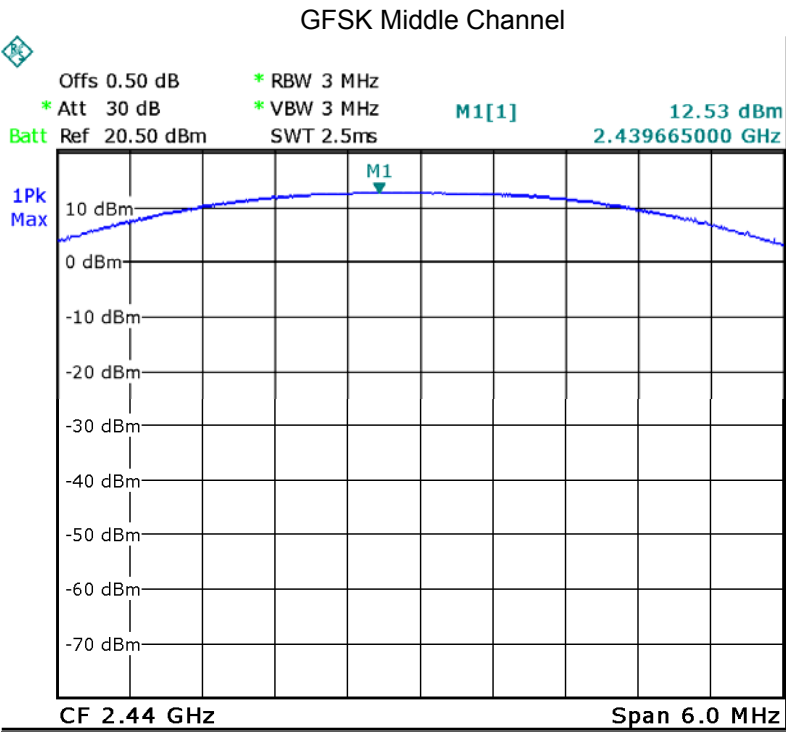




ANT2

Test plots





11 Hopping Channel Separation

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
Test Limit:	Regulation 15.247(a) (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 1W.
Test Mode:	Test in hopping transmitting operating mode.

11.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyser: RBW = 30KHz. VBW = 100 KHz, Span = 3MHz Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

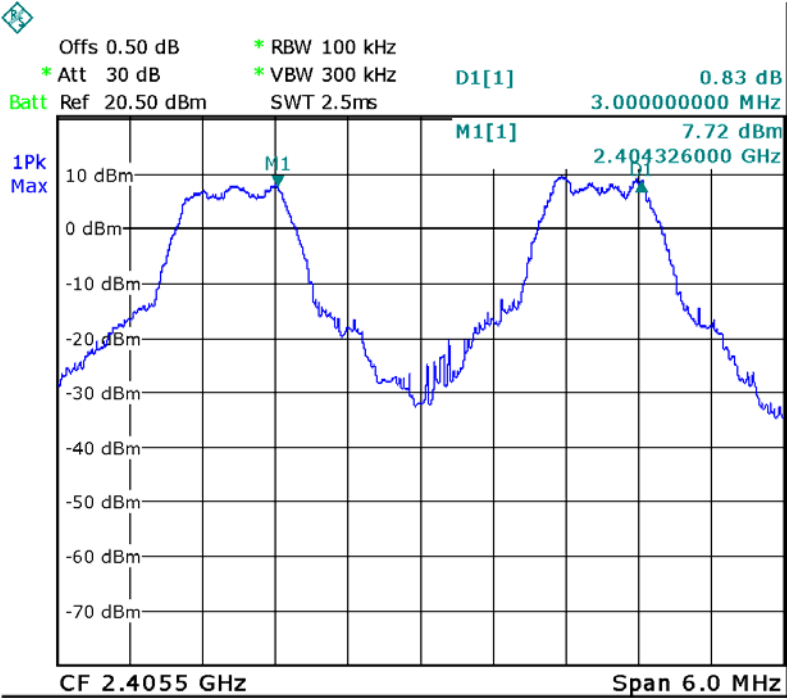
11.2 Test Result

ANT	Modulation	Test Channel	Separation (MHz)	Result
ANT1	GFSK	Low	3.00	PASS
	GFSK	Middle	3.00	PASS
	GFSK	High	3.00	PASS
ANT2	GFSK	Low	3.00	PASS
	GFSK	Middle	3.00	PASS
	GFSK	High	3.00	PASS

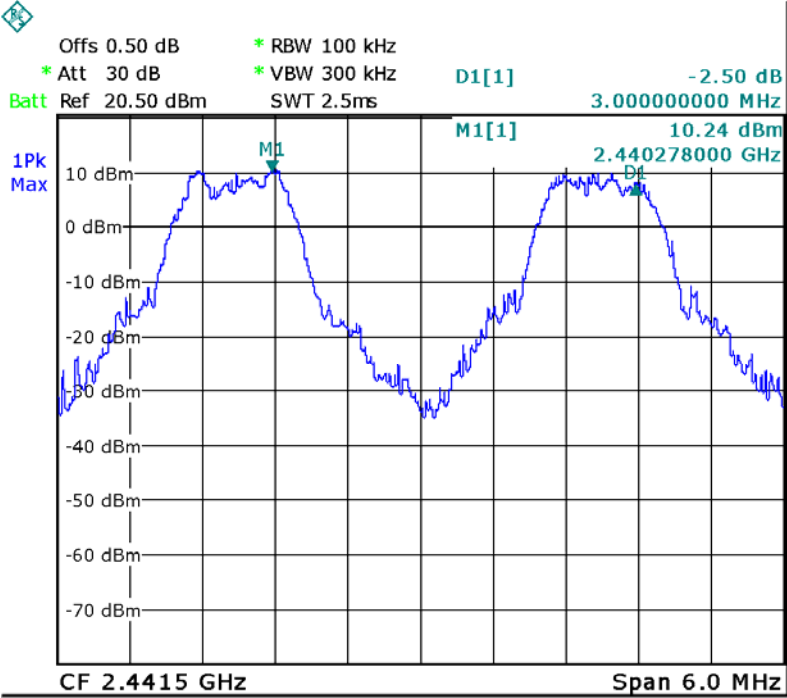
ANT1

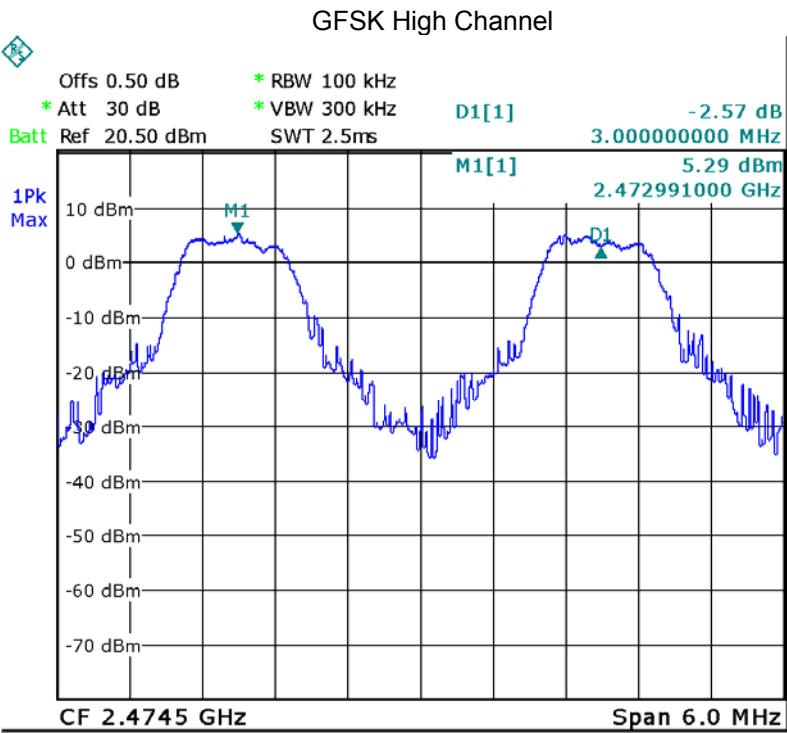
Test plots

GFSK Low Channel



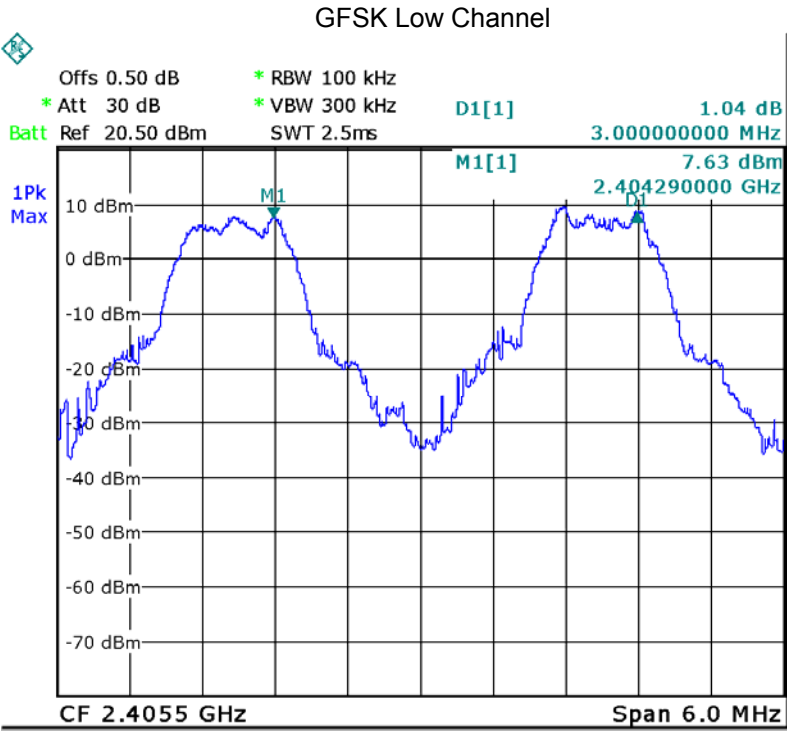
GFSK Middle Channel

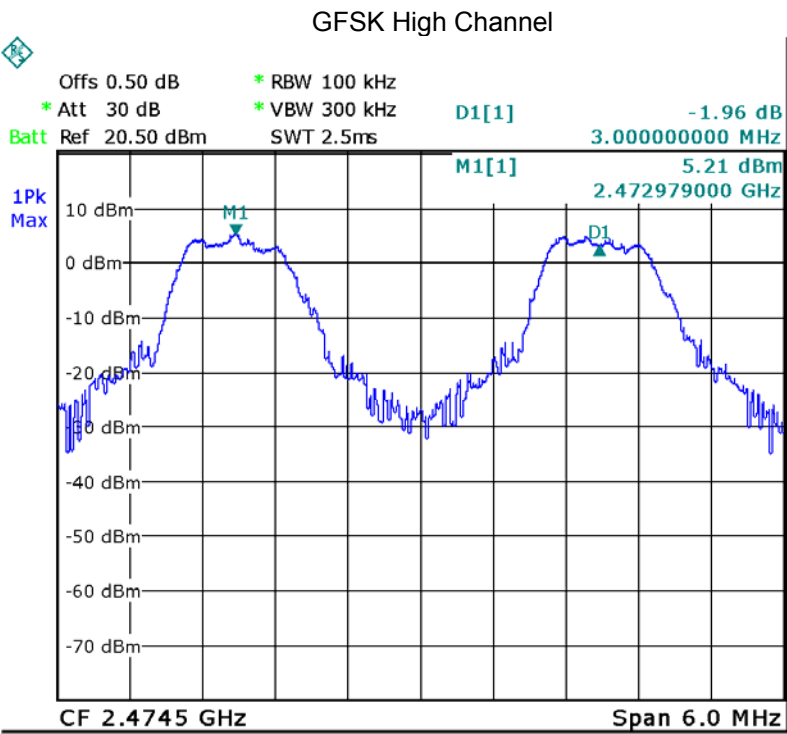
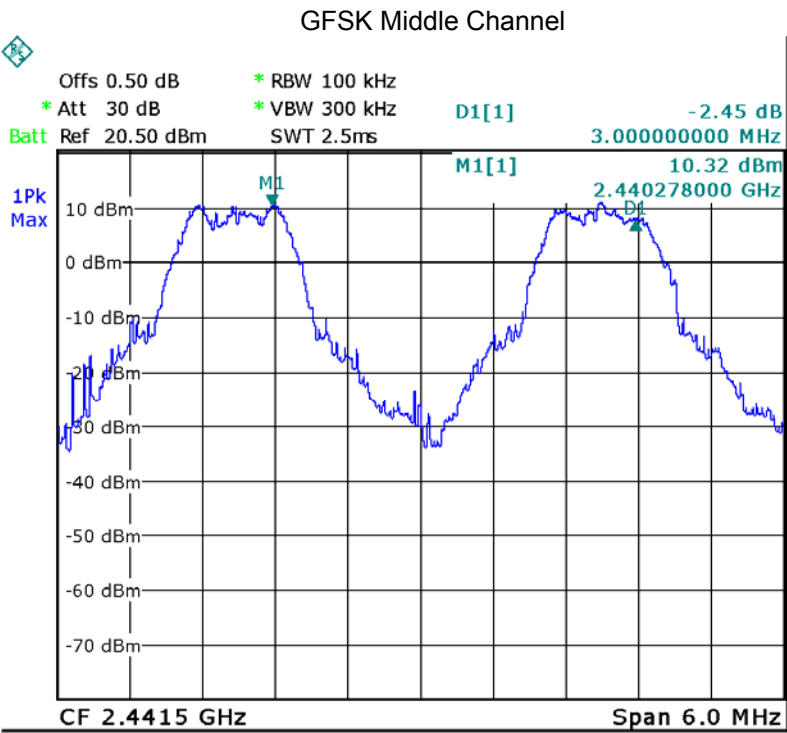




ANT2

Test plots





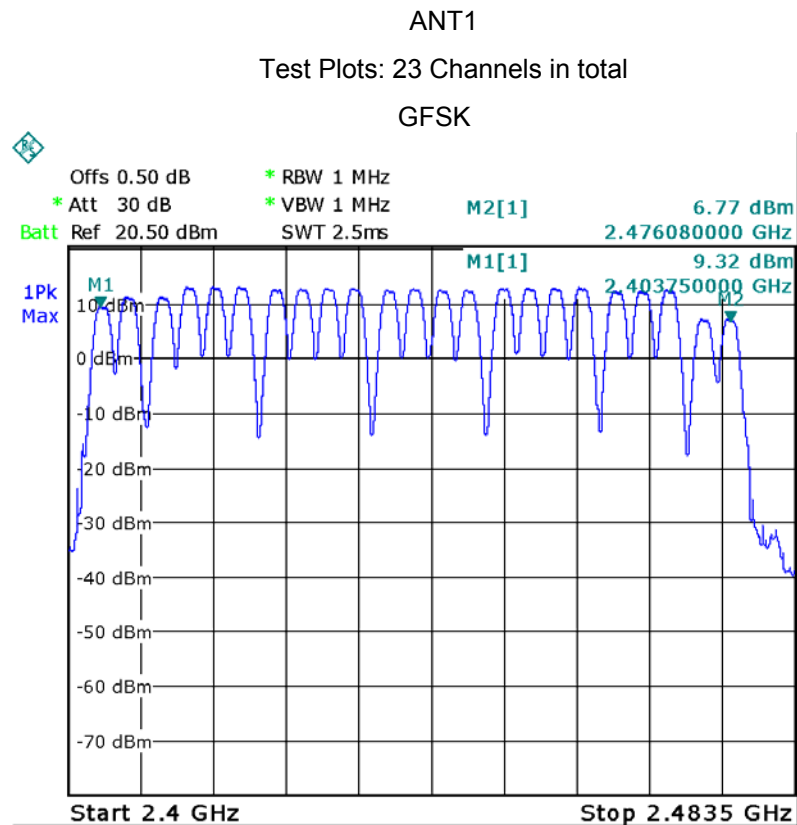
12 Number of Hopping Frequency

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
Test Limit:	Regulation 15.247 (a) (1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode:	Test in hopping transmitting operating mode.

12.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyser: RBW = 1MHz. VBW = 1MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyser: Start Frequency = 2.4GHz, Stop Frequency = 2.483GHz. Sweep=auto;

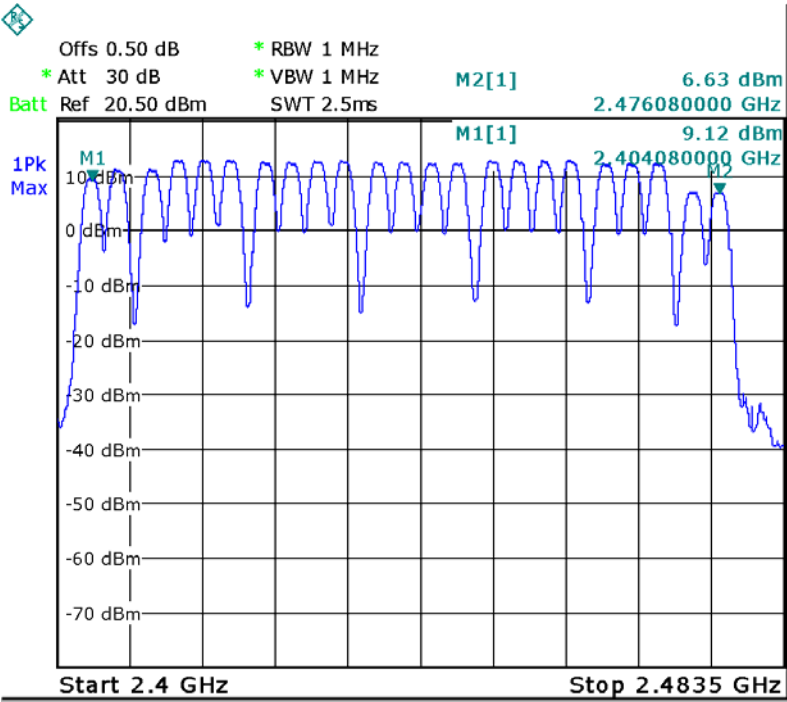
12.2 Test Result



ANT2

Test Plots: 23 Channels in total

GFSK



13 Dwell Time

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
Test Limit:	Regulation 15.247(a) (1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Test Mode:	Test in hopping transmitting operating mode.

13.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyser span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g. data rate. modulation format. etc.). Repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

13.2 Test Result

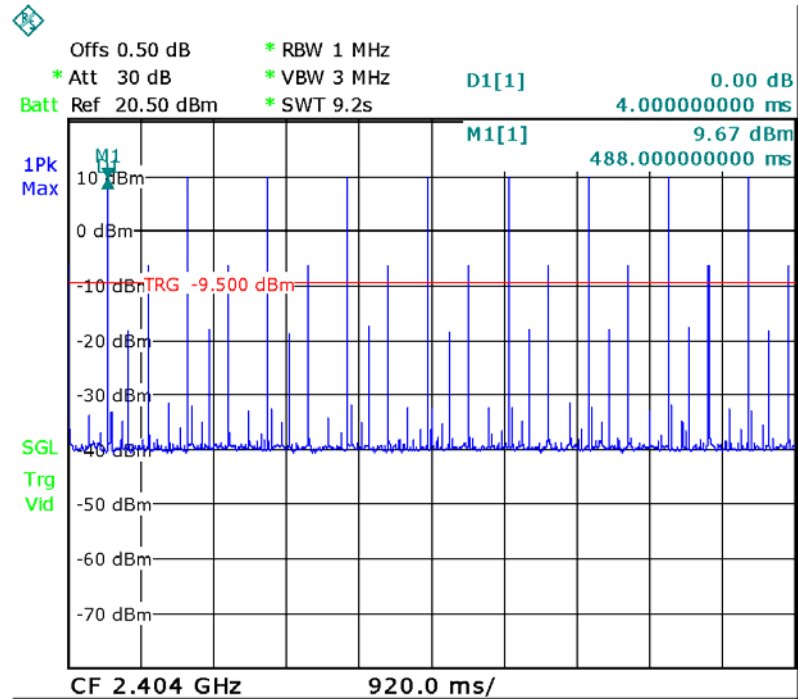
ANT	Channel	T _{on} (ms)	T _{period} (ms)	N _(channels)	Dwell Time(ms)	Limits(ms)
ANT1	low	36	9200	23	36	400
	Middle	36	9200	23	36	400
	high	36	9200	23	36	400
ANT2	low	36	9200	23	36	400
	Middle	36	9200	23	36	400
	high	36	9200	23	36	400

Remark: Dwell Time = T_{on} (ms)*1s/T_{period}(ms)*400ms*N_(channels)

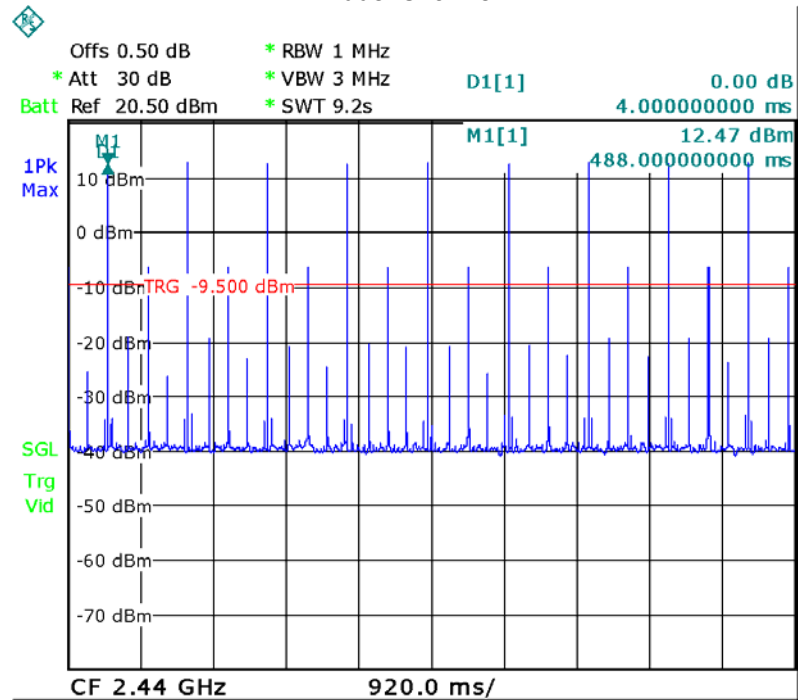
ANT1

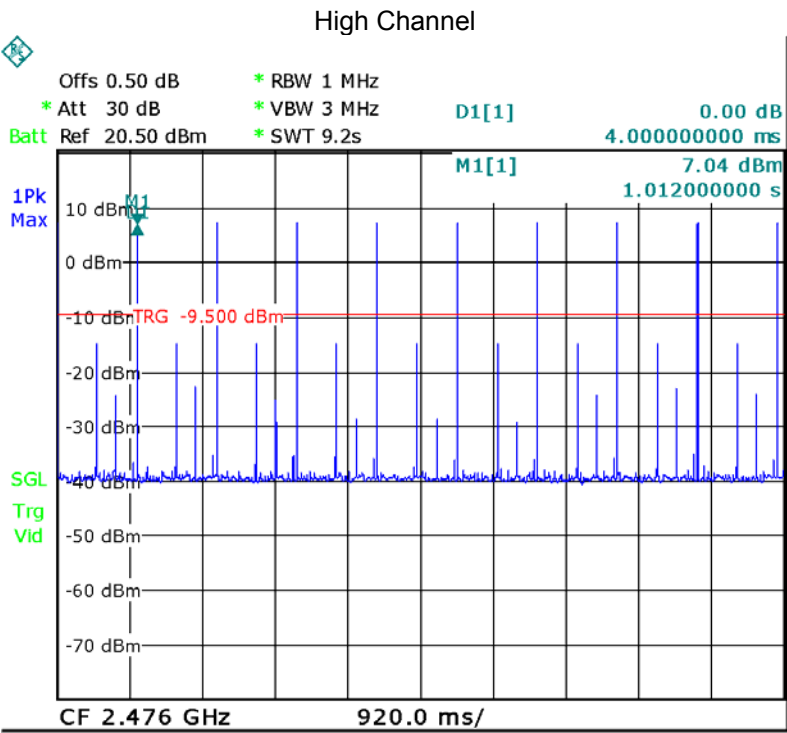
Test Plots

Low Channel



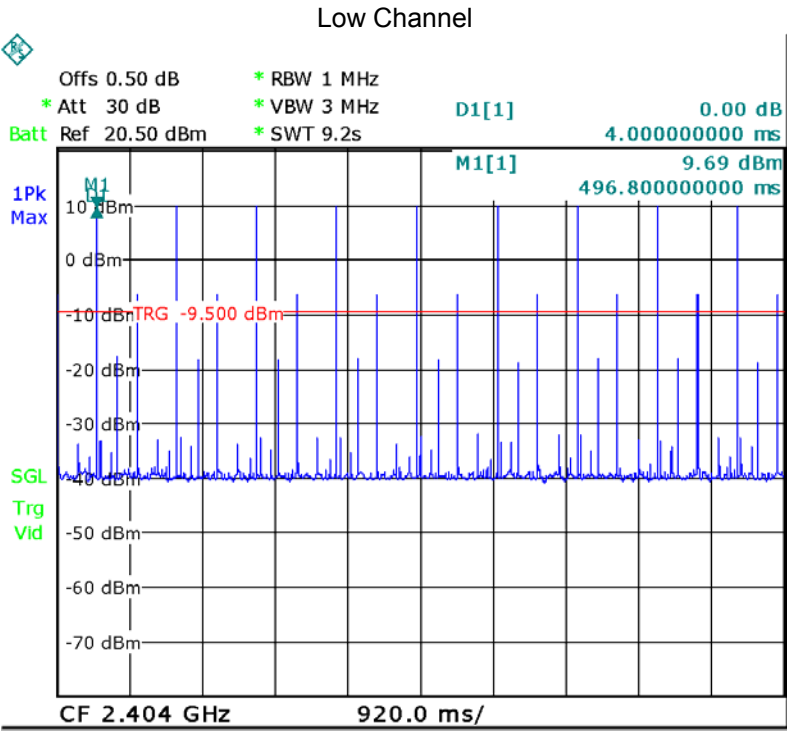
Middel Channel

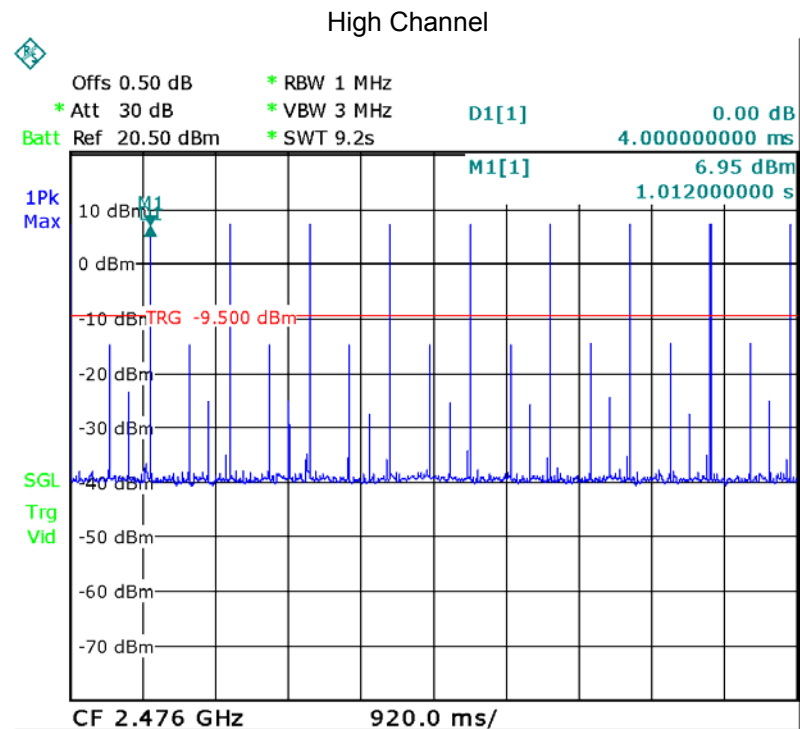
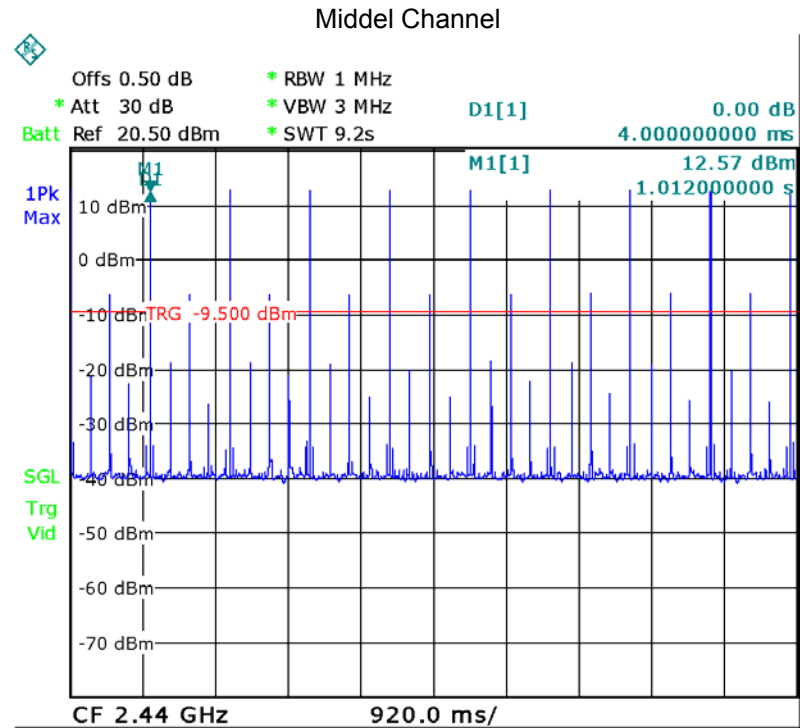




ANT2

Test Plots





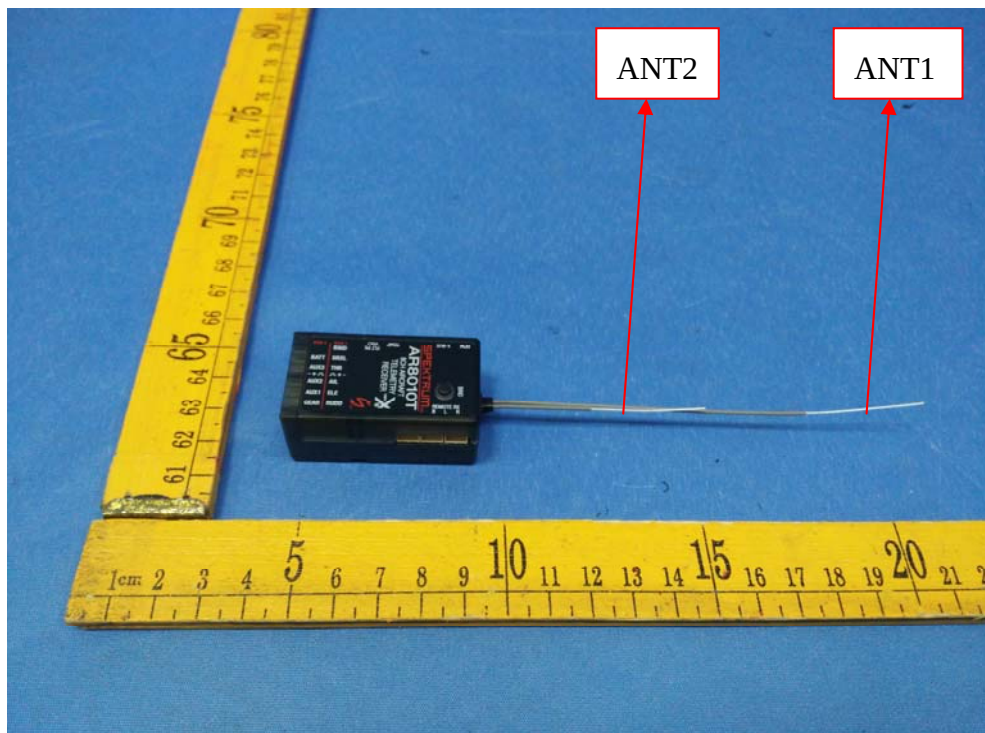
14 Antenna Requirement

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 shall be considered sufficient to comply with the provisions of this section. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 15.203, 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.

Result:

The EUT has two Permanent wire whip antenna, the gain is 2 dBi. meets the requirements of FCC 15.203.



15 RF Exposure

Test Requirement: FCC Part 1.1307

Evaluation Method: FCC Part 2.1091 & KDB 447498 D01 General RF Exposure Guidance v06

15.1 Requirements

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

15.2 The procedures / limit

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz; *Plane-wave equivalent power density

15.3 MPE Calculation Method

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

S = power density (in appropriate units, e.g. mW/cm²)

P = output power to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator,
the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

From the peak EUT RF output power, the minimum mobile separation distance, R=20cm, as well as the gain of the used antenna, the RF power density can be obtained

ANT1

Antenna Gain (dBi)	Antenna Gain (numeric)	Max. Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Result
2.00	1.585	12.45	17.58	0.00554	1	Compliance

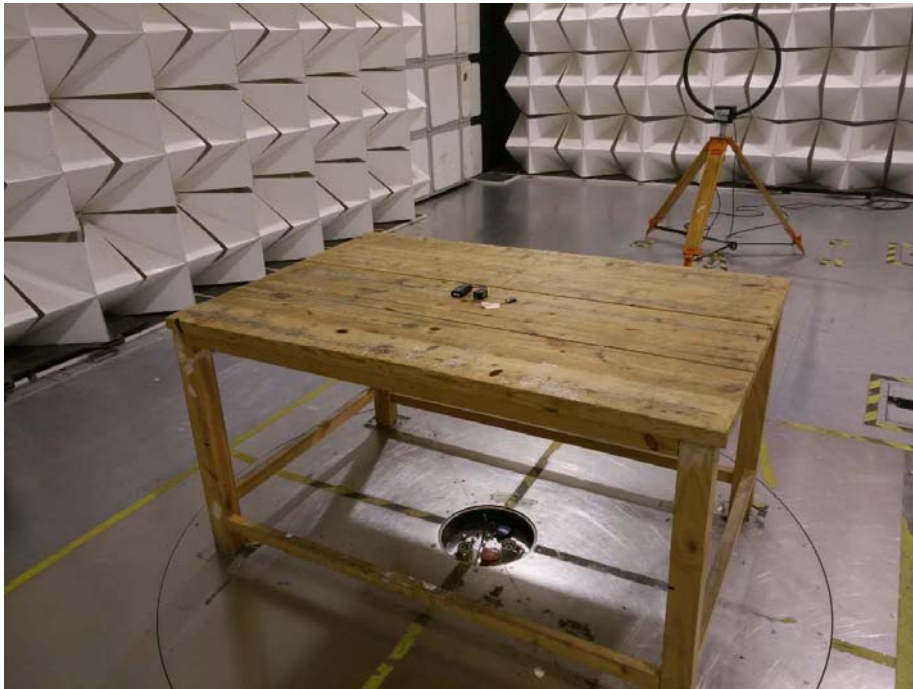
ANT2

Antenna Gain (dBi)	Antenna Gain (numeric)	Max. Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Result
2.00	1.585	12.53	17.91	0.0056	1	Compliance

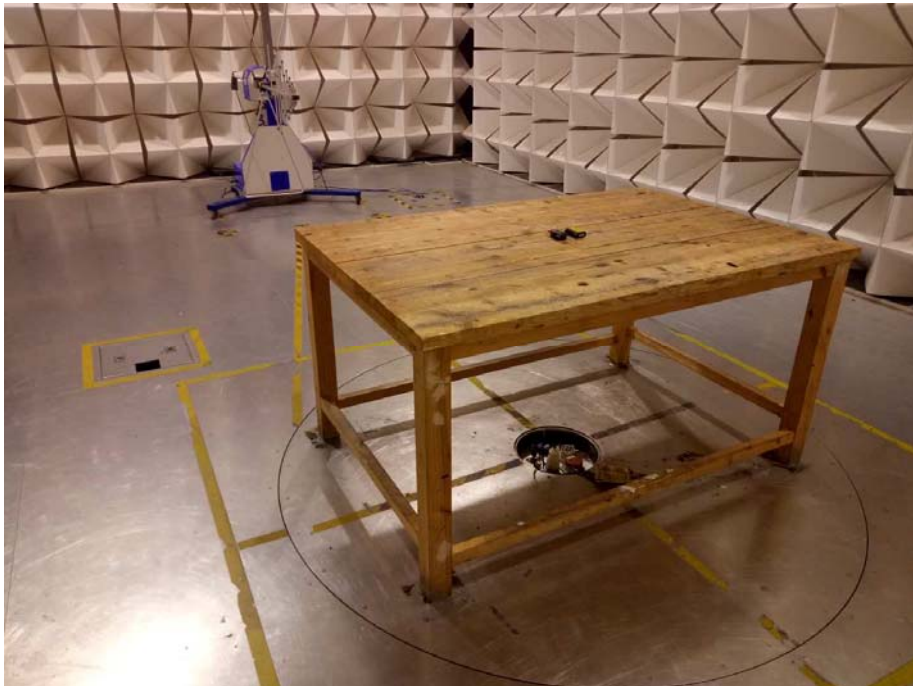
16 Photographs – Model AR8010T Test Setup

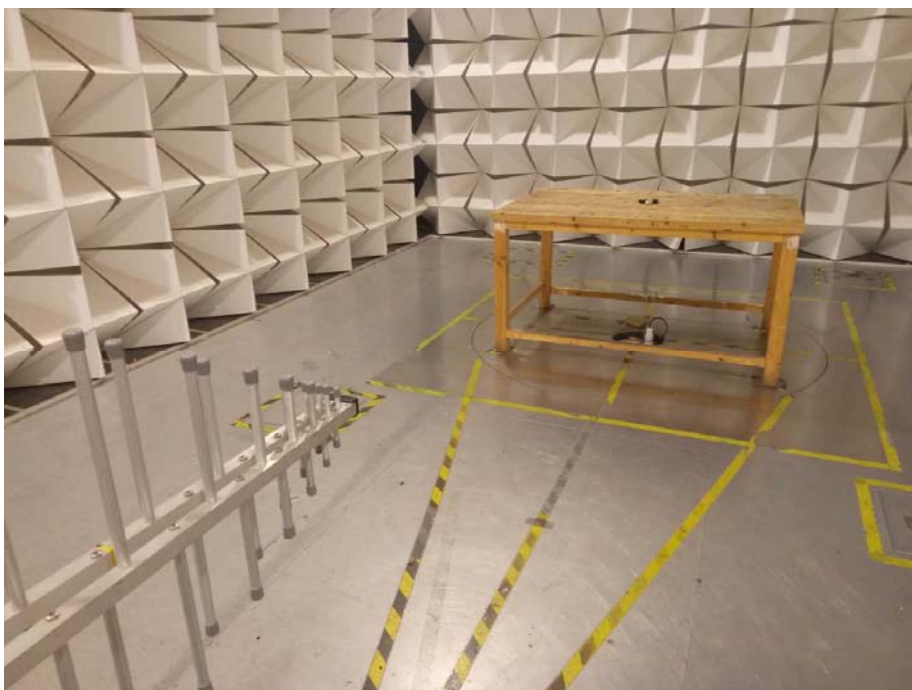
16.1 Photograph – Radiation Spurious Emission Test Setup

9 KHz to 30MHz

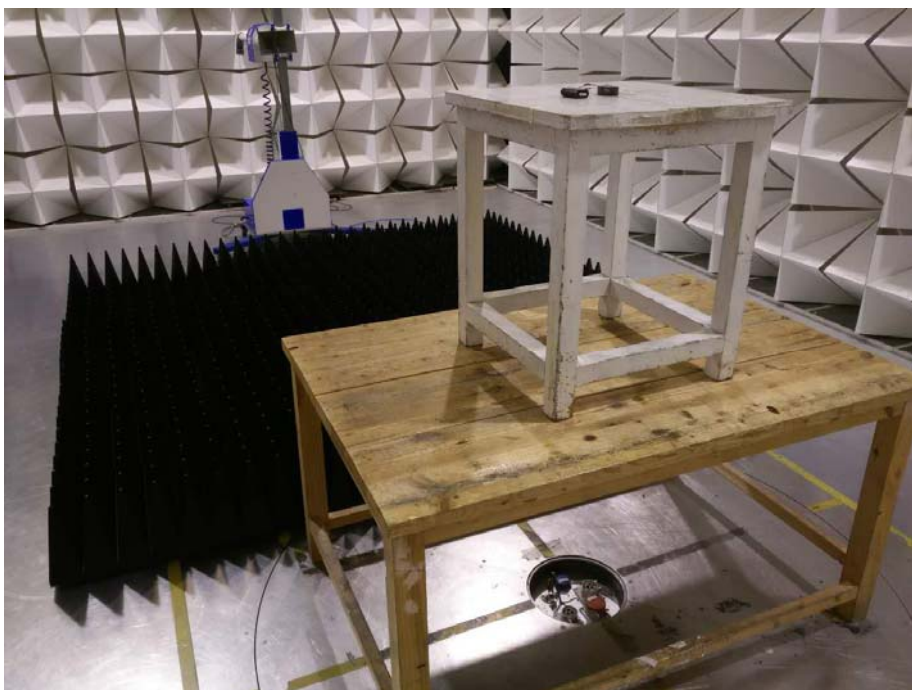


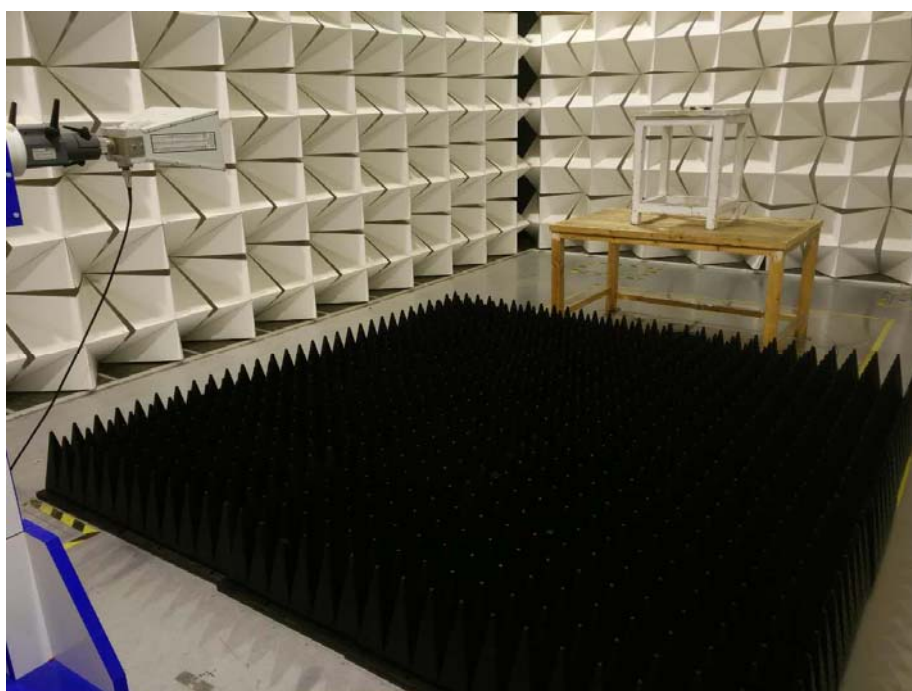
30MHz-1GHz





Above 1GHz



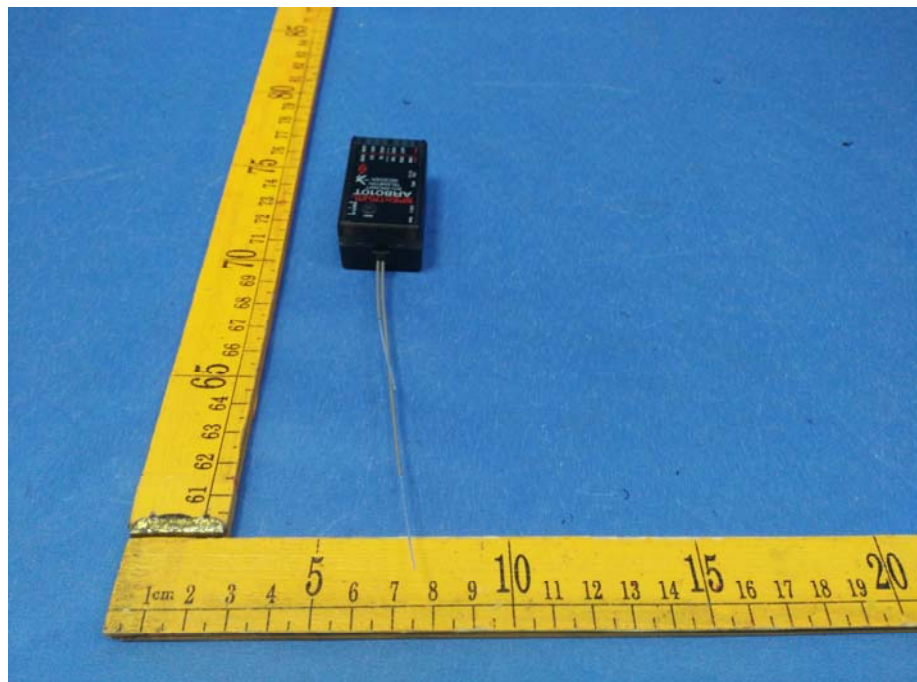
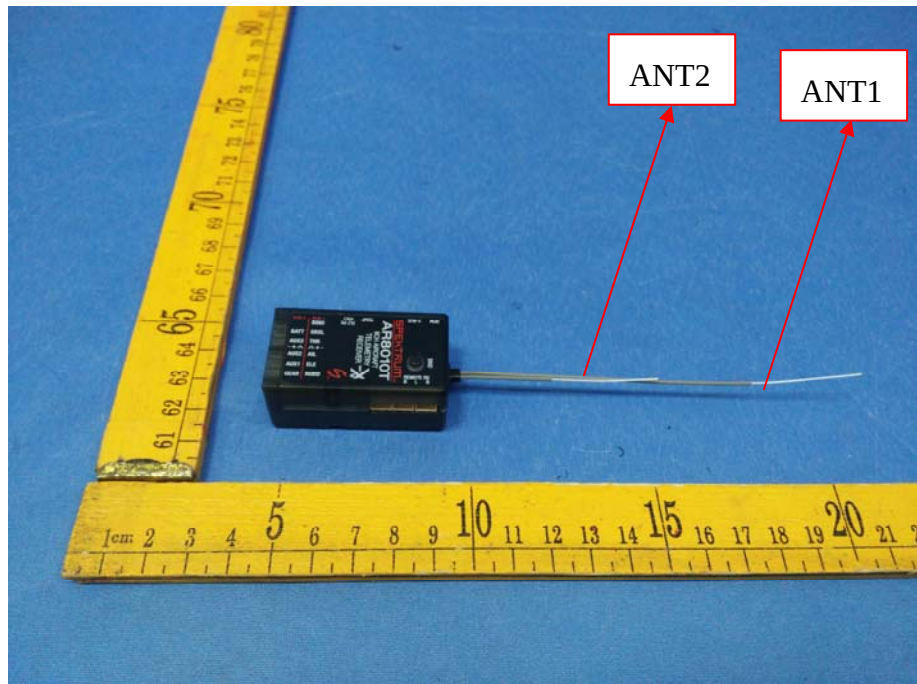


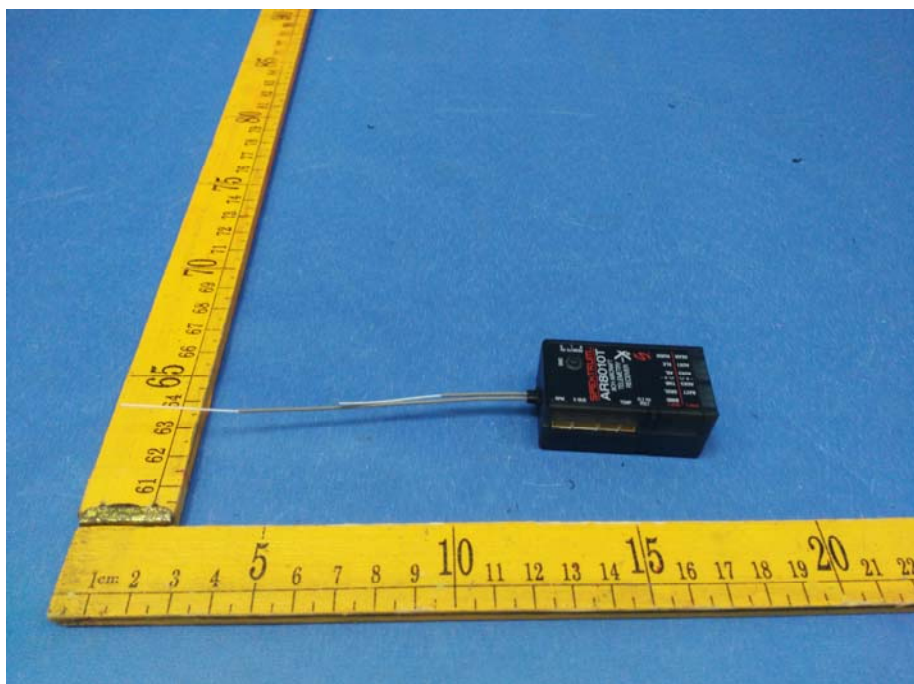
17 Photographs - Constructional Details

17.1 EUT-External Photos

Model: AR8010T

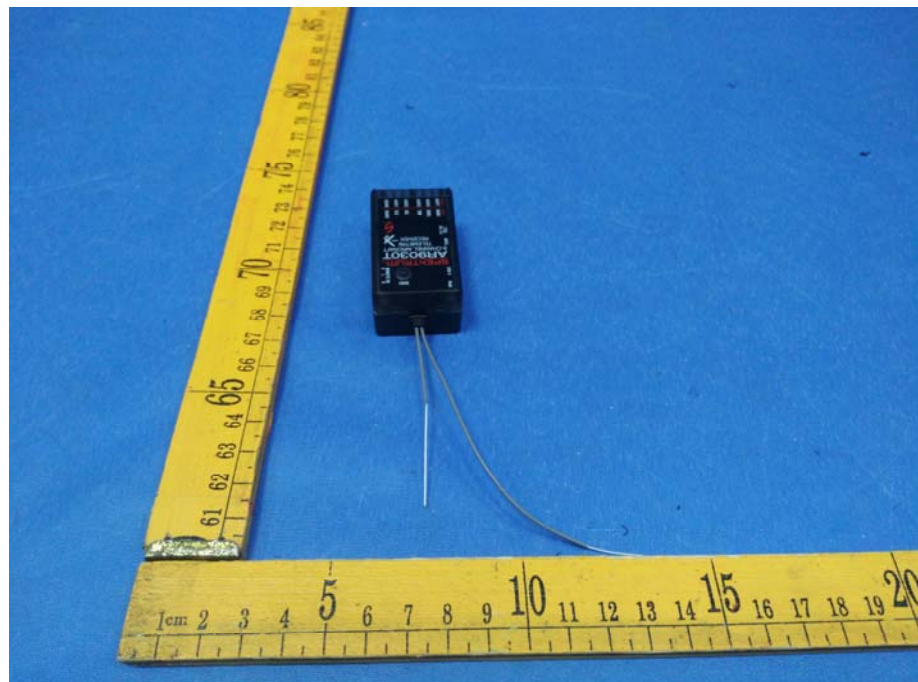
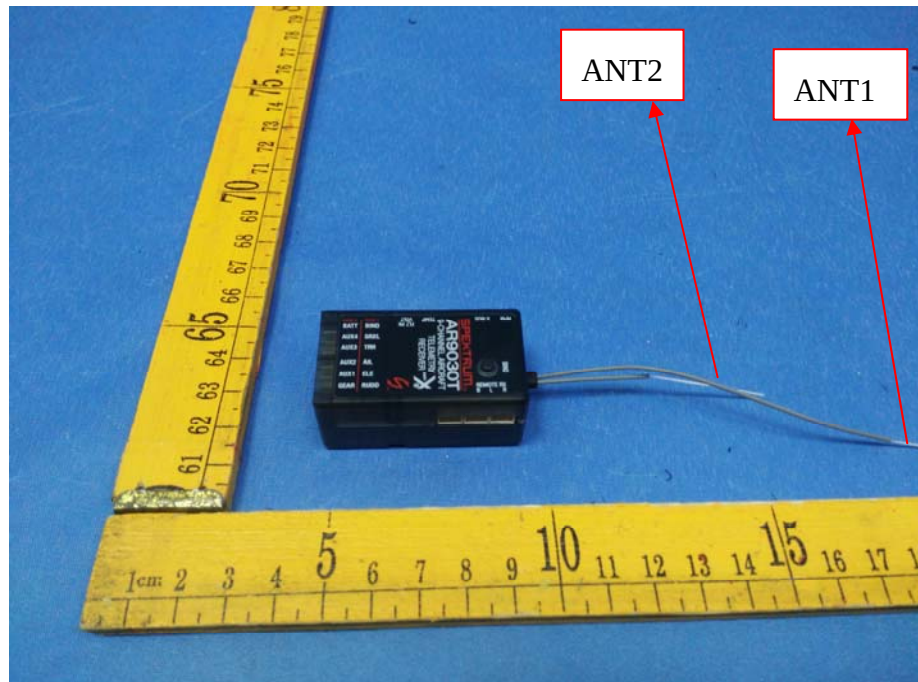


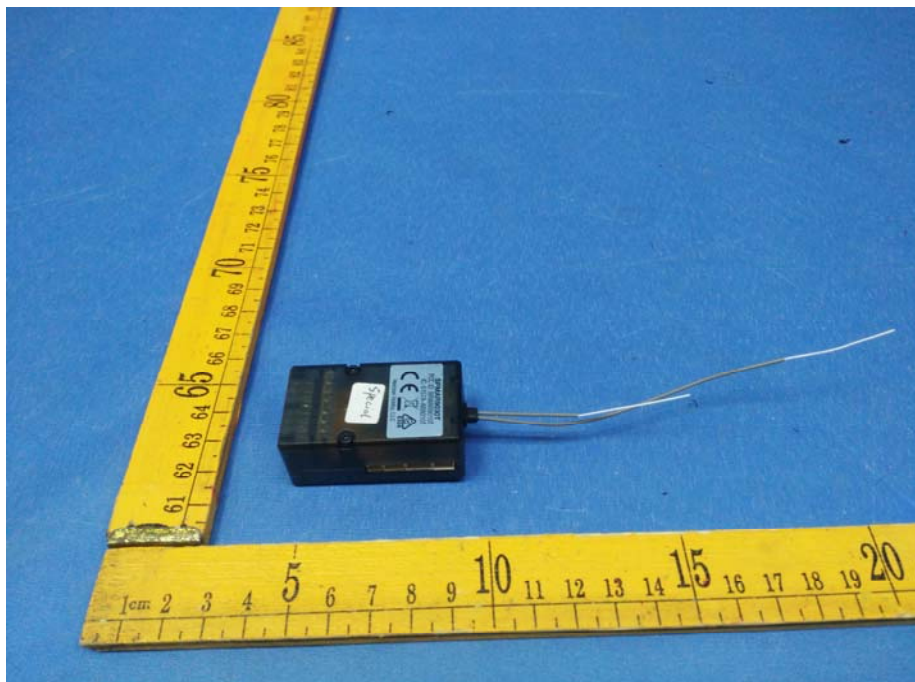
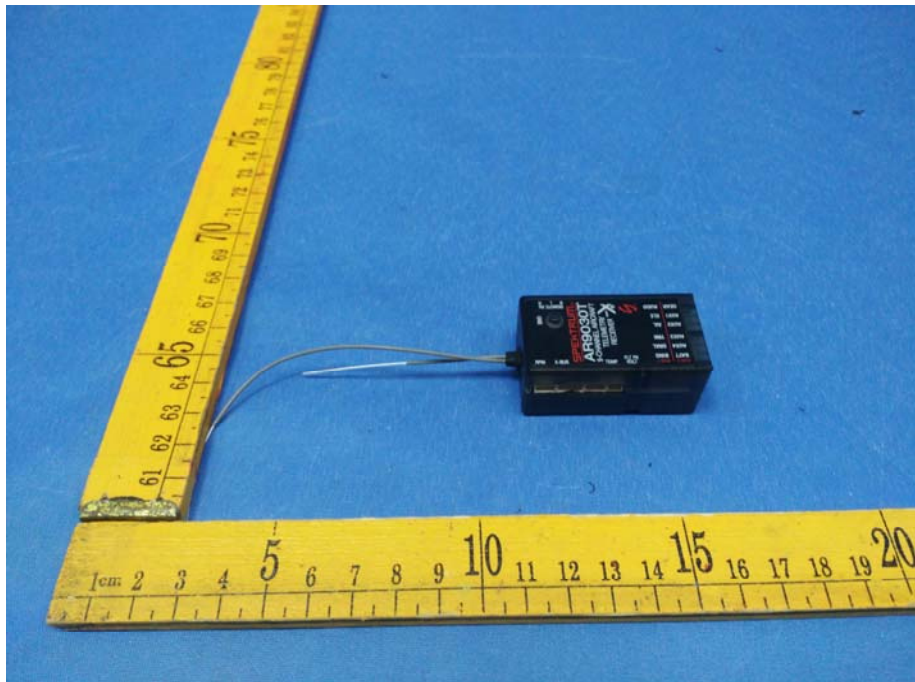




Model: AR9030T

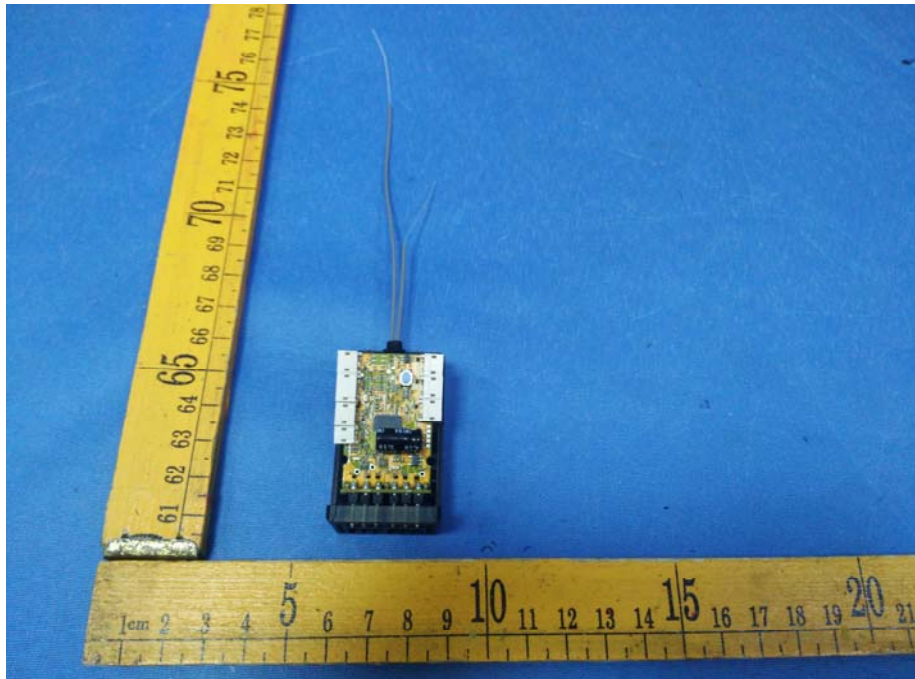
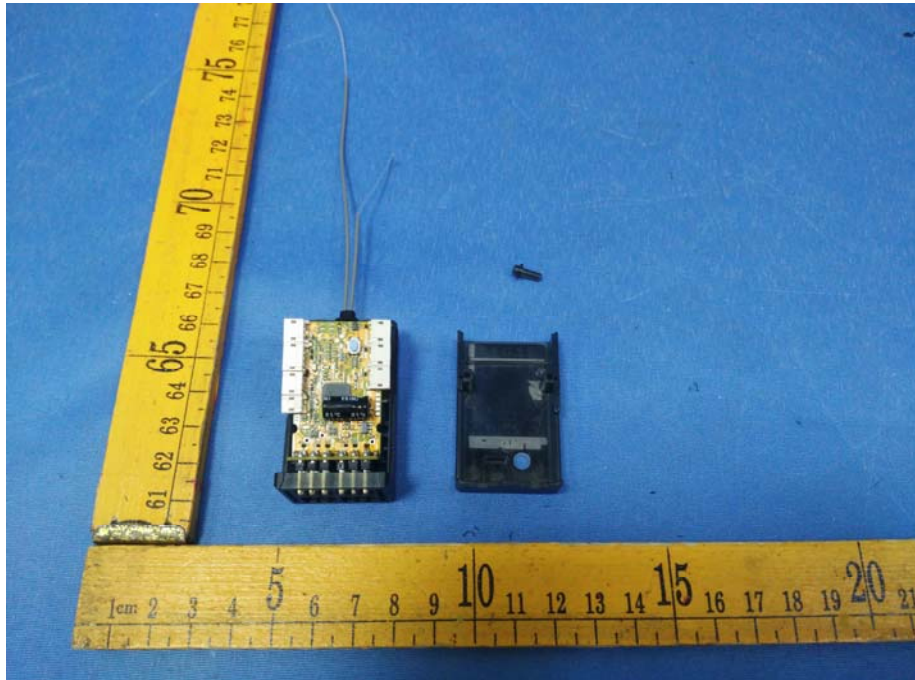


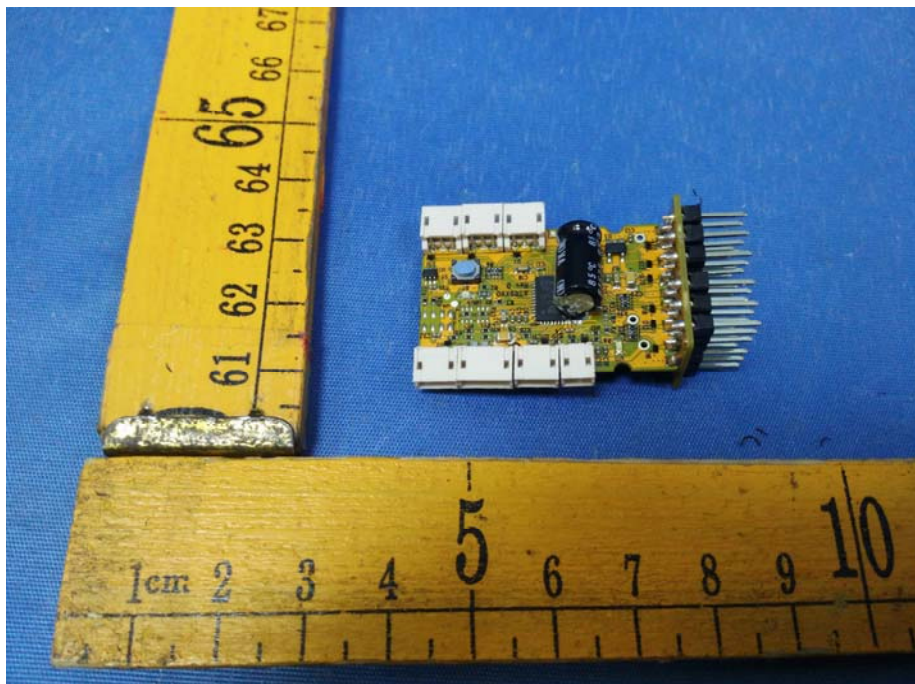
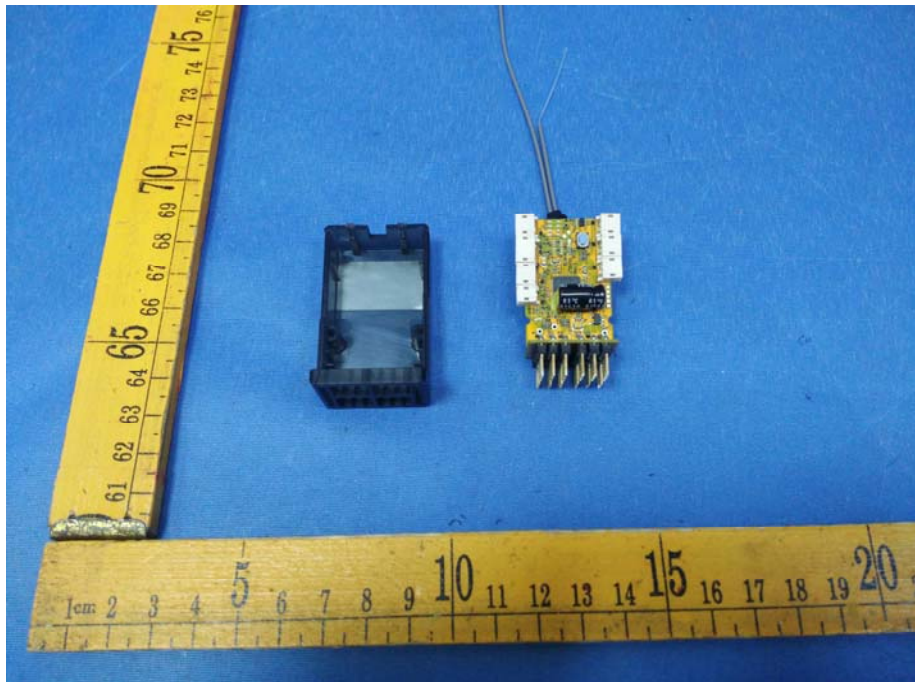


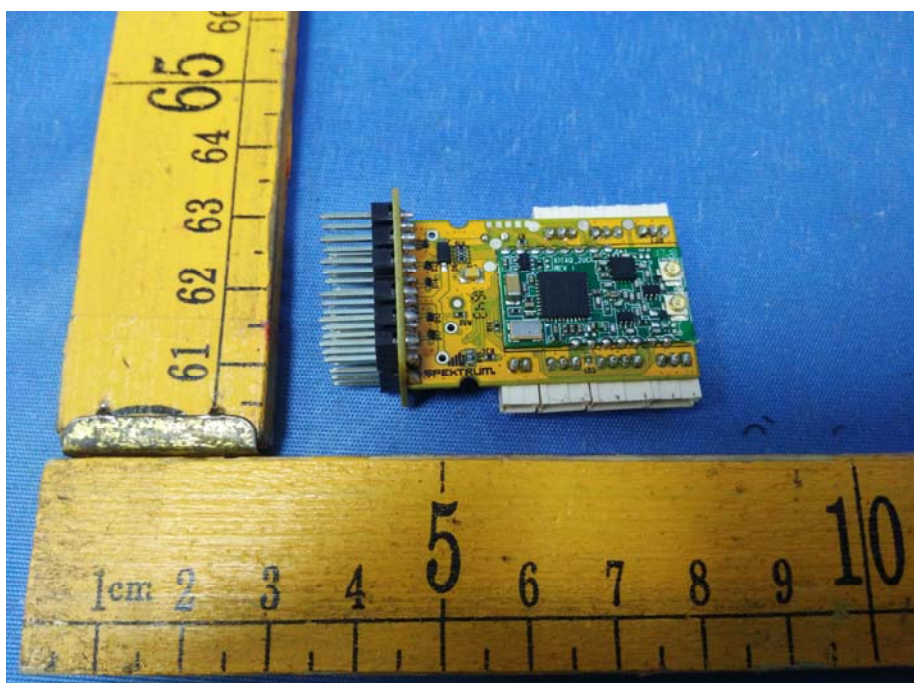
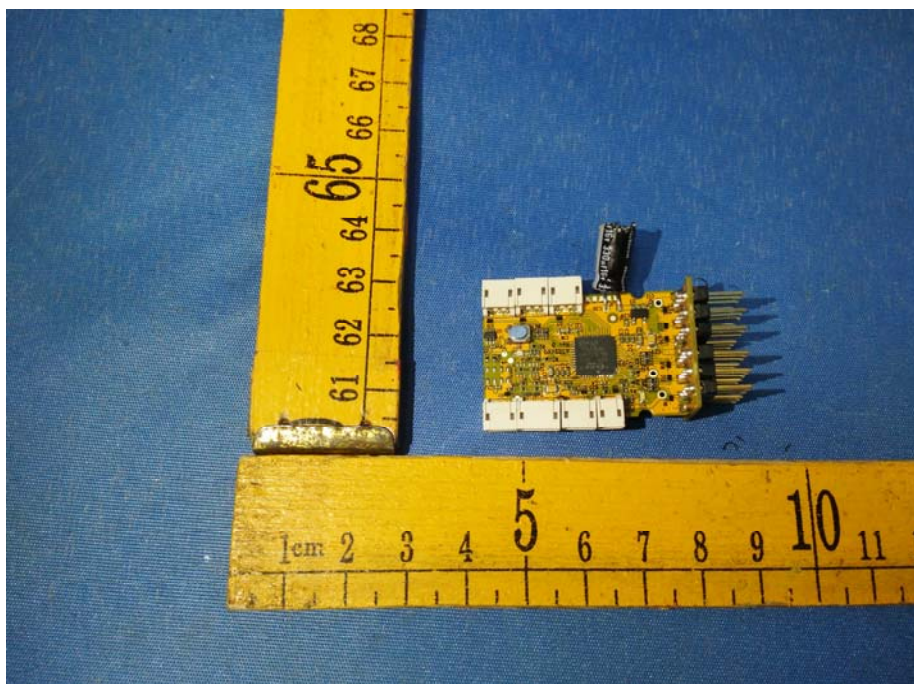


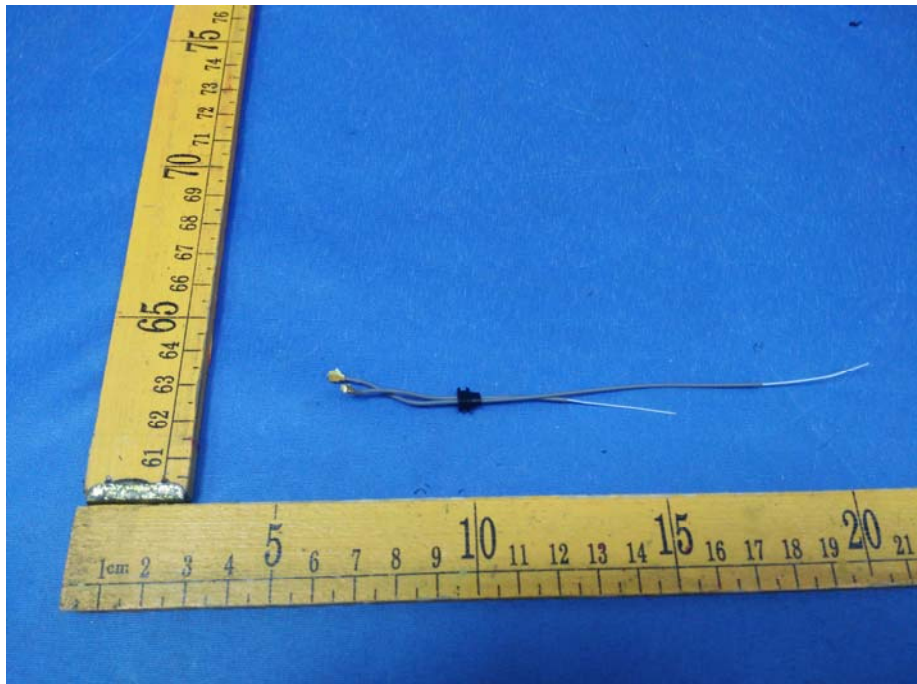
17.2 EUT-Internal Photos

Model: AR8010T

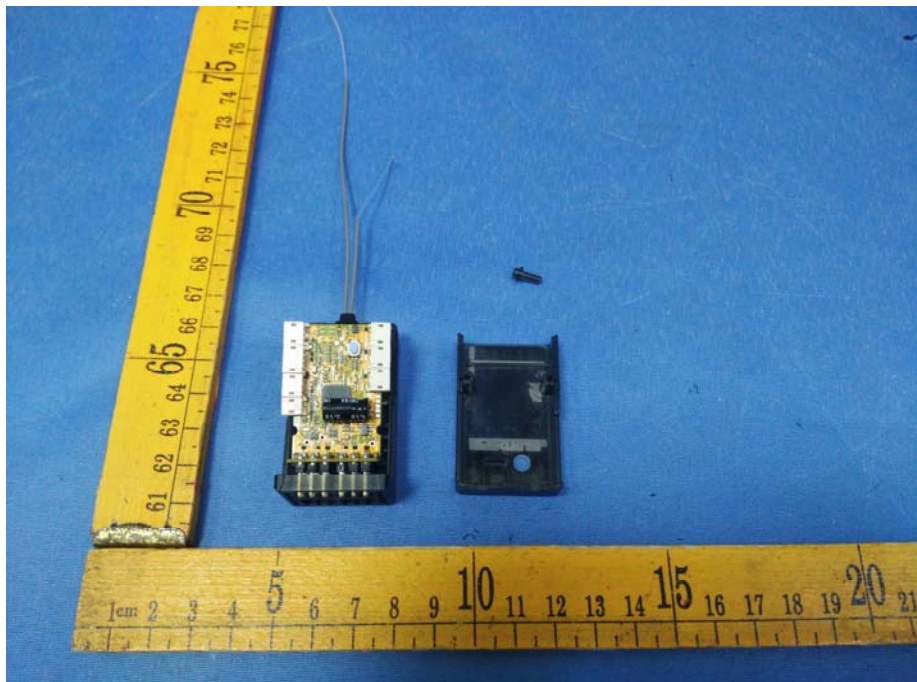


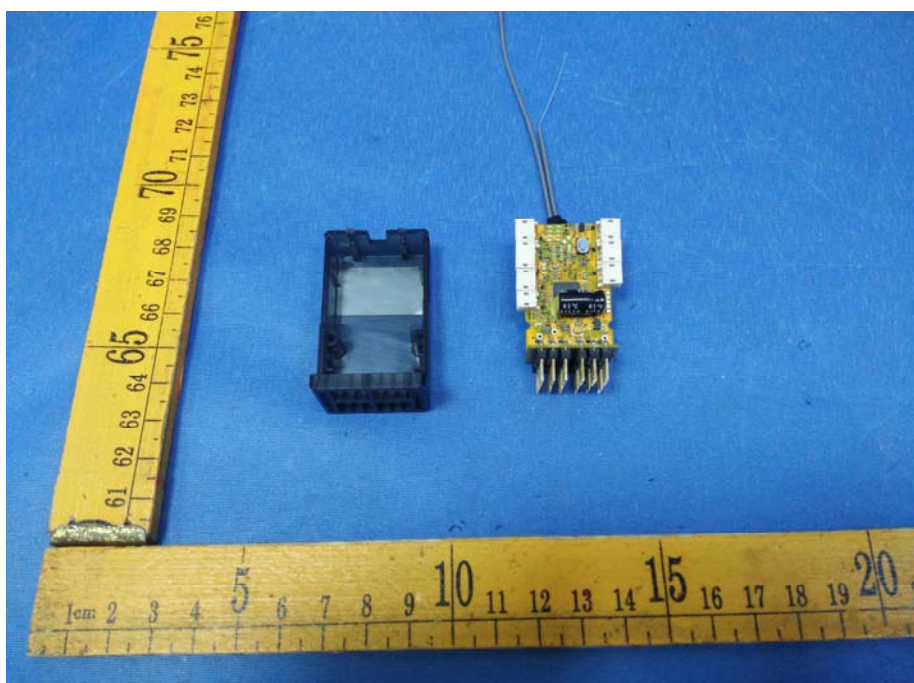
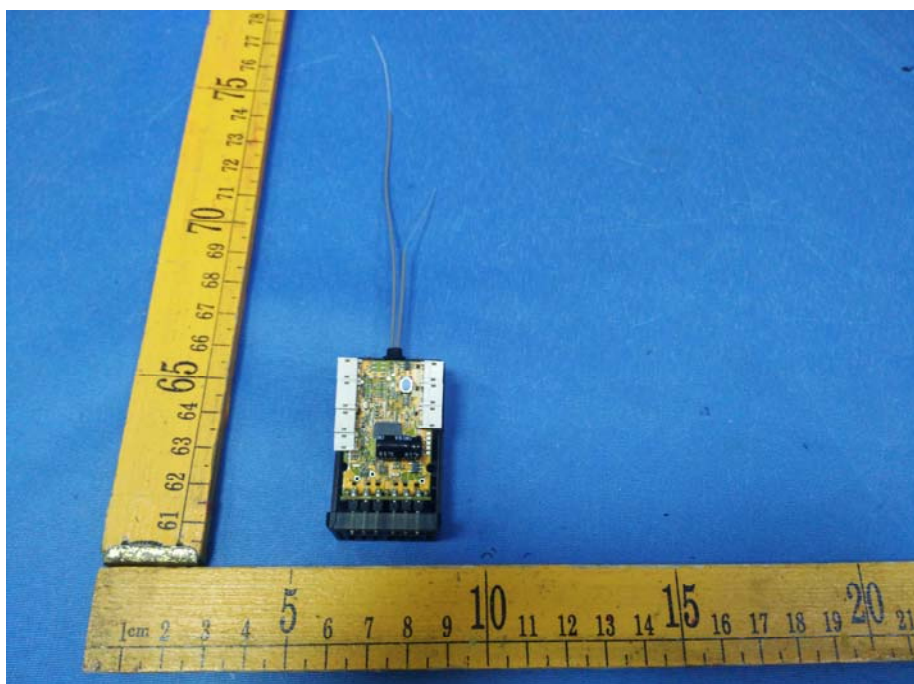


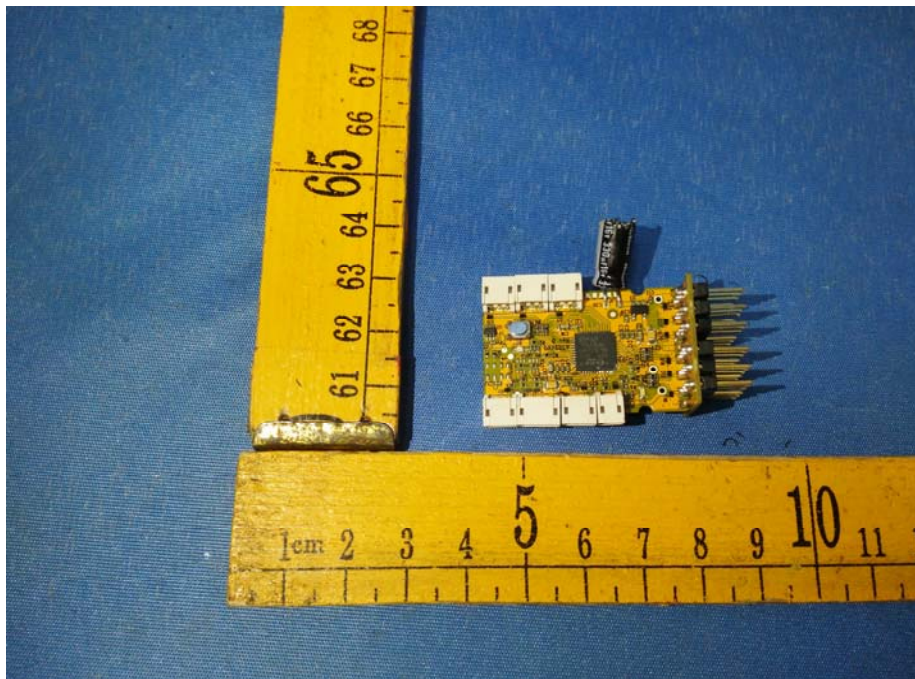
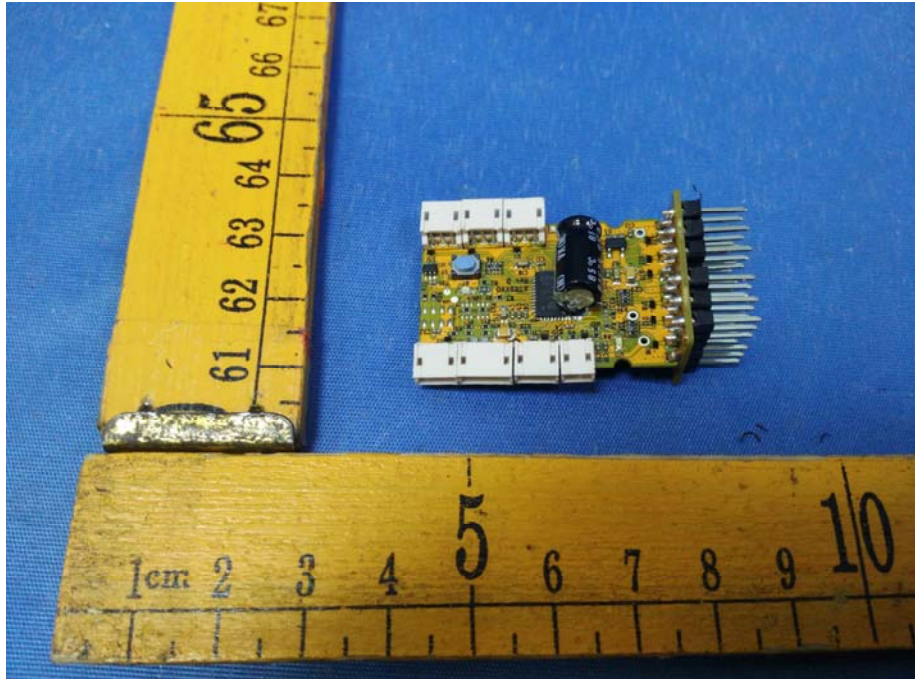


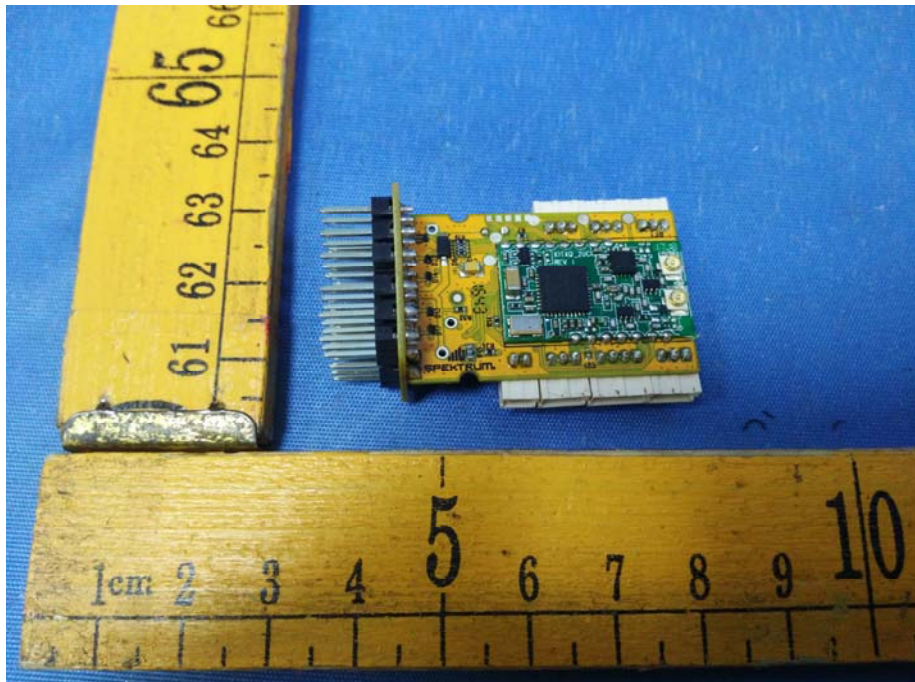


Model: AR9030T









===== End of Report =====