

FCC IC Test Report (BT)

Report No.: FCC_IC_SL19041701-SEV-040_BT_Rev1.0

FCC ID: AFJ382500

IC: 202D-382500

Test Model: IP501M

Received Date: 06/21/2019

Test Date: 06/21/2019 – 06/23/2019

Issued Date: 08/15/2019

FCC

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Manufacturer: ICOM Incorporated

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FCC Registration / 540430

Designation Number:

ISED# / CAB identifier: 4842D



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Release Control Record

Issue No.	Description	Date Issued
FCC_IC_SL19041701-SEV-040_BT	Original Release	07/19/2019
FCC_IC_SL19041701-SEV-040_BT_Rev1.0	Updated as per reviewer's comments	08/15/2019

1 Certificate of Conformity

Product: IP Advanced Radio System

Brand: Icom

Test Model: IP501M

Sample Status: ENGINEERING SAMPLE

FCC Applicant: ICOM Incorporated

IC Applicant: ICOM CANADA

Test Date: 06/21/2019 – 06/23/2019

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)

ANSI C63.10: 2013

RSS 247 Issue 2, February 2017

The above equipment has been tested by **by Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : , **Date:** 08/15/2019
Rachana Khanduri / Test Engineer

Approved by : , **Date:** 08/15/2019
Chen Ge / Engineer Reviewer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.247), RSS 247 Issue 2, February 2017			
FCC IC Clause	Test Item	Result	Remarks
15.207 RSS Gen 8.8	AC Power Conducted Emission	PASS	Pass*
15.247(a)(1) (iii) RSS247 (5.1.5)	Number of Hopping Frequency Used	PASS	Pass*
15.247(a)(1) (iii) RSS247 (5.1.5)	Dwell Time on Each Channel	PASS	Pass*
15.247(a)(1) RSS247 (5.1.5)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	PASS	Pass*
15.247(b) RSS247 (5.4.2)	Maximum Peak Output Power	PASS	Pass*
15.205 & 209 & 15.247(d) RSS247(5.5)	Radiated Emissions & Band Edge Measurement	PASS	Meet the requirement of limit.
15.247(d) RSS247(5.5)	Antenna Port Emission	PASS	Pass*
15.203	Antenna Requirement	PASS	No antenna connector is used. Chip antenna which is mounted on PC board.

NOTE:

- Note: Pass*: Only radiated spurious emission is tested in this report, for other test items please refer to the RF reports for module UT-133. FCC ID: AFJ356100, IC: 202D-356100 (FCC Report No: 10171657H-A-R1, IC Report No: 10171657H-B-R1).

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
Radiated Emission	22deg. C, 71%RH	13.8VDC	Rachana Khanduri

2.1 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	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.51dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.73dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	4.64dB
	6GHz ~ 18GHz	4.82dB
	18GHz ~ 40GHz	4.91dB

2.2 Modification Record

There were no modifications required for compliance.

2.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Test Receiver ROHDE & SCHWARZ	ESIB 40	100179	08/28/2018	08/28/2019
Spectrum Analyzer KEYSIGHT	N9030B	MY57140374	07/22/2018	07/22/2019
Hybrid Antenna SUNAR	JB6	A111717	03/09/2019	03/09/2020
DRG Horn Antenna ETS LINDGREN	3117	214309	11/22/2018	11/22/2019
Horn Antenna EMCO	3115	100059	01/26/2018	01/26/2020
Tuned Dipole Antenna COM-POWER	AD-100	40133	01/23/2018	01/23/2020
Preamplifier RF-LAMBDA	RAMP00M50GA	17032300047	09/19/2018	09/19/2019
Preamplifier RF-BAY	LPA-6-30	11170601	07/24/2018	07/24/2019
Signal Generator KEYSIGHT	N5182A	MY47071065	08/10/2018	08/10/2019

3 General Information

3.1 General Description of EUT

Product	IP Advanced Radio System
Brand	Icom
Test Model	IP501M
Serial No.	000000000300
Series Model	N/A
Model Difference	N/A
HVIN	382500-01
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	13.8VDC
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Modulation Technology	FHSS
Transfer Rate	Up to 3Mbps
Operating Frequency	2402MHz ~ 2480MHz
Number of Channel	79
Antenna Type	Chip Antenna
Antenna Gain	-6.5 dBi
Antenna Connector	Mounted on PCB board
Accessory Device	N/A

Note:

1. The EUT consumes power from the DC power supply

MODEL	RIGOL DP712
RATING	13.8Vdc

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

3.2 Description of Test Modes

79 channels are provided for BT mode:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE $\geq$ 1G	RE<1G	PLC	APCM	
-	√	√	-	-	

Where **RE $\geq$ 1G**: Radiated Emission above 1GHz **RE<1G**: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission **APCM**: Antenna Port Conducted Measurement

NOTE:

1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane**.
2. "-" means no effect.

Radiated Emission Test (Above 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	$\pi/4$ -DQPSK	2DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Radiated Emission Test (Below 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	78	FHSS	8DPSK	3DH5

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE $\geq$ 1G	25deg. C, 70%RH	13.8VDC	Rachana Khanduri
RE<1G	25deg. C, 70%RH	13.8VDC	Rachana Khanduri

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	DC Power Supply	RIGOL	DP712	DP7B182100095	N/A	-
B.						

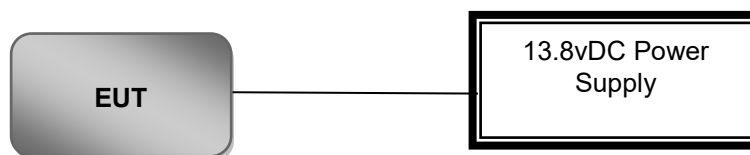
Note:

1. All power cords of the above support units are non-shielded (1.8m).

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB Cable	1	1	No	-	Connect USB cable between USB port on the Jig and USB port on PC.
2.	DC Cable	1		No	-	Supply DC13.8V to IP501M.
3.						

Note: The core(s) is(are) originally attached to the cable(s).

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247)
RSS247 Issue 2, February 2017

All test items have been performed and recorded as per the above standards.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.1.2 Test Instruments

Refer to section 2.3 to get information of above instrument.

4.1.3 Test Procedures

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of 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.
- d. 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 rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with

maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

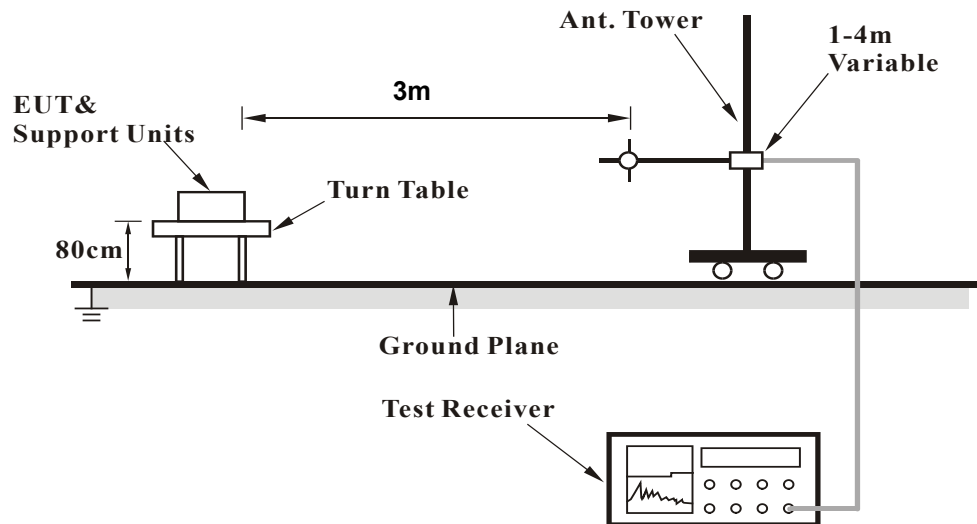
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
1. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

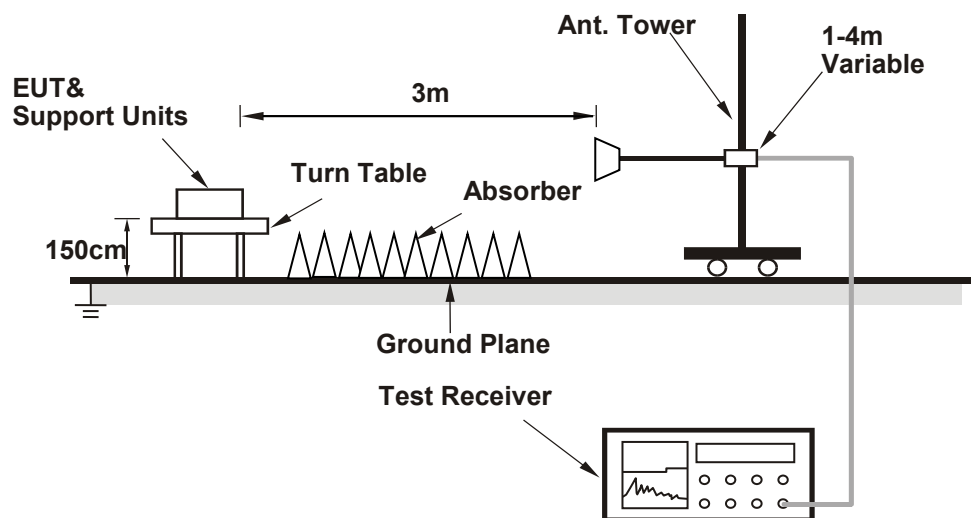
No deviation.

4.1.5 Test Setup

For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

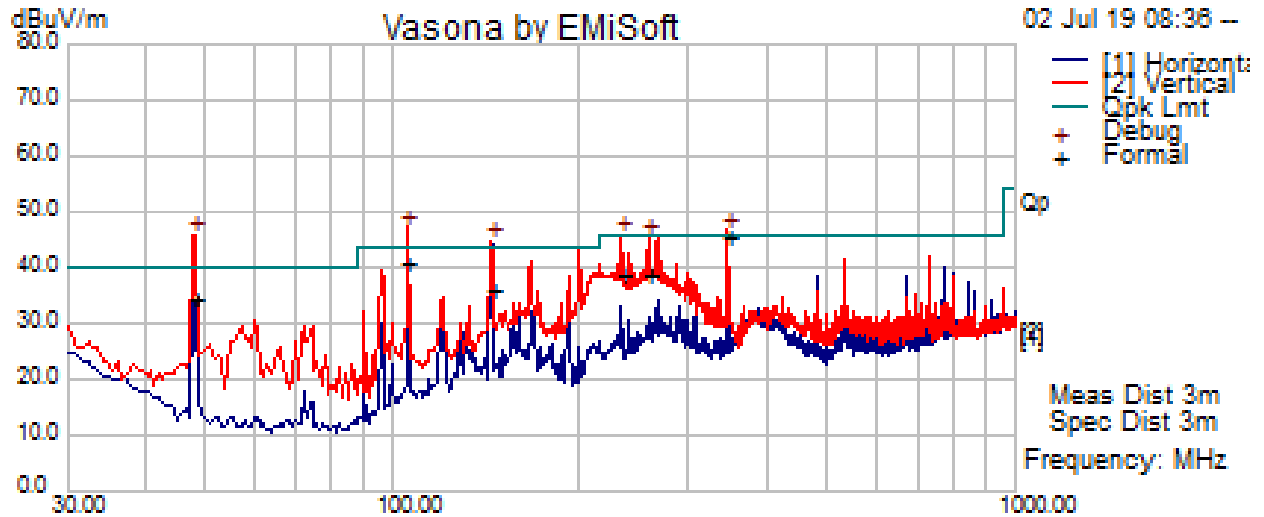
4.1.6 EUT Operating Conditions

- Supply DC13.8V to IP501M.
- Connect USB cable between USB port on the Jig and USB port on PC.
- The other ports of the JIG are not connected.
- Controlling software (Teraterm and Bluetest 3) has been activated to set the EUT on specific status.

4.1.7 Test Results

Below 1GHz Data:

BT_8DPSK-2441MHz



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
48.04	48.50	11.43	-25.10	34.83	Quasi Max	V	120	356	40	-5.17	Pass
105.76	53.43	11.92	-24.33	41.02	Quasi Max	V	101	156	43.5	-2.48	Pass
143.98	47.40	12.2	-23.63	35.98	Quasi Max	H	203	174	43.5	-7.53	Pass
345.00	53.41	13.52	-21.28	45.65	Quasi Max	V	101	7	46	-0.35	Pass
233.17	50.46	12.87	-24.73	38.59	Quasi Max	V	107	46	46	-7.41	Pass
257.75	49.84	12.99	-24.23	38.60	Quasi Max	V	101	214	46	-7.40	Pass

Above 1GHz Data:

BT_GFSK-2402 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
1521.85	58.62	2.36	-17.13	43.85	Peak Max	H	160	140	74	-30.15	Pass
4804.04	51.09	4.10	-11.05	44.15	Peak Max	V	142	288	74	-29.85	Pass
7206.45	48.42	5.15	-7.38	46.19	Peak Max	V	199	76	74	-27.81	Pass
1521.85	42.37	2.36	-17.13	27.60	Average Max	H	160	140	54	-26.40	Pass
4804.04	38.82	4.10	-11.05	31.87	Average Max	V	142	288	54	-22.13	Pass
7206.45	35.75	5.15	-7.38	33.52	Average Max	V	199	76	54	-20.48	Pass

BT_GFSK-2441 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
1500.11	55.61	2.81	-17.23	41.19	Peak Max	H	123	42	74	-32.81	Pass
7323.22	48.36	6.44	-7.28	47.52	Peak Max	V	112	93	74	-26.48	Pass
4882.16	52.03	5.46	-11.06	46.42	Peak Max	V	173	163	74	-27.58	Pass
1500.11	43.08	2.81	-17.23	28.66	Average Max	H	123	42	54	-25.34	Pass
7323.22	35.60	6.44	-7.28	34.76	Average Max	V	112	93	54	-19.24	Pass
4882.16	39.07	5.46	-11.06	33.46	Average Max	V	173	163	54	-20.54	Pass

BT_GFSK-2480 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
7440.23	47.20	6.53	-7.20	46.54	Peak Max	V	175	342	74	-27.46	Pass
1539.93	55.09	2.83	-17.05	40.88	Peak Max	H	138	244	74	-33.12	Pass
4960.16	50.85	5.54	-11.1	45.29	Peak Max	V	178	44	74	-28.71	Pass
7440.23	35.34	6.53	-7.20	34.68	Average Max	V	175	342	54	-19.32	Pass
1539.93	42.60	2.83	-17.05	28.39	Average Max	H	138	244	54	-25.61	Pass
4960.16	38.84	5.54	-11.1	33.28	Average Max	V	178	44	54	-20.72	Pass

BT_π/4-DQPSK -2402 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
1477.49	53.89	2.78	-17.09	39.59	Peak Max	V	114	247	74	-34.41	Pass
7206.38	48.02	6.76	-7.4	47.37	Peak Max	V	114	277	74	-26.63	Pass
4803.81	50.41	5.80	-11.05	45.17	Peak Max	V	192	5	74	-28.84	Pass
1477.49	41.80	2.78	-17.09	27.49	Average Max	V	114	247	54	-26.51	Pass
7206.38	35.84	6.76	-7.4	35.20	Average Max	V	114	277	54	-18.80	Pass
4803.81	38.87	5.80	-11.05	33.62	Average Max	V	192	5	54	-20.38	Pass

BT_π/4-DQPSK -2441 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
1437.14	60.94	2.75	-16.88	46.80	Peak Max	V	135	22	74	-27.20	Pass
7323.34	48.20	6.42	-7.29	47.33	Peak Max	V	184	317	74	-26.67	Pass
4882.12	50.91	5.48	-11.06	45.33	Peak Max	V	134	35	74	-28.68	Pass
1437.14	41.51	2.75	-16.88	27.37	Average Max	V	135	22	54	-26.63	Pass
7323.34	35.67	6.42	-7.29	34.80	Average Max	V	184	317	54	-19.21	Pass
4882.12	38.90	5.48	-11.06	33.32	Average Max	V	134	35	54	-20.68	Pass

BT_π/4-DQPSK -2480 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
7440.20	48.08	6.53	-7.19	47.42	Peak Max	V	164	109	74	-26.58	Pass
4960.08	50.71	5.49	-11.05	45.15	Peak Max	V	127	340	74	-28.85	Pass
1552.56	61.68	2.84	-16.99	47.54	Peak Max	V	139	68	74	-26.47	Pass
7440.20	35.41	6.53	-7.19	34.75	Average Max	V	164	109	54	-19.25	Pass
4960.08	38.73	5.49	-11.05	33.17	Average Max	V	127	340	54	-20.83	Pass
1552.56	42.18	2.84	-16.99	28.03	Average Max	V	139	68	54	-25.97	Pass

BT_8DPSK -2402 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
7206.13	48.04	6.74	-7.39	47.39	Peak Max	V	187	192	74	-26.61	Pass
4804.34	51.22	5.81	-11.05	45.98	Peak Max	V	185	152	74	-28.02	Pass
1598.66	65.28	2.88	-16.78	51.38	Peak Max	V	162	75	74	-22.62	Pass
7206.13	35.86	6.74	-7.39	35.20	Average Max	V	187	192	54	-18.80	Pass
4804.34	38.94	5.81	-11.05	33.70	Average Max	V	185	152	54	-20.30	Pass
1598.66	42.73	2.88	-16.78	28.83	Average Max	V	162	75	54	-25.17	Pass

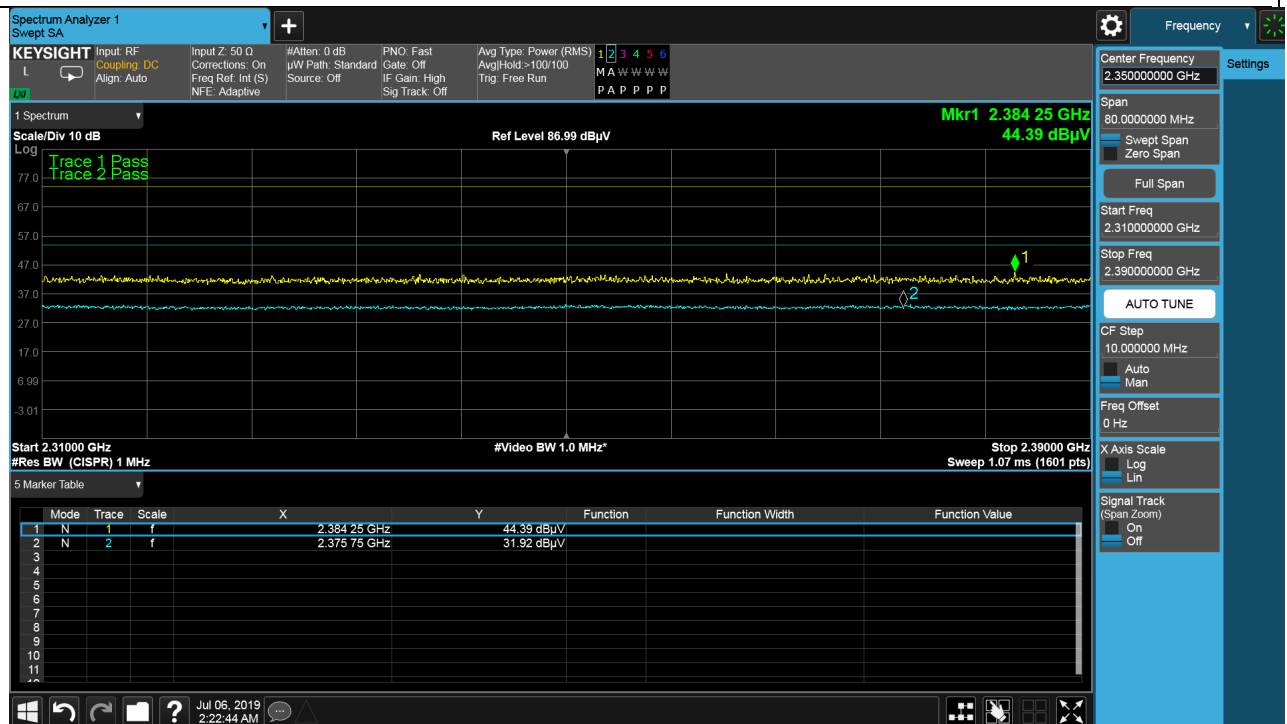
BT_8DPSK -2441 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
7322.69	48.40	6.47	-7.26	47.61	Peak Max	V	113	259	74	-26.39	Pass
4882.32	52.04	5.52	-11.05	46.51	Peak Max	V	148	267	74	-27.49	Pass
1606.11	53.76	2.88	-16.72	39.92	Peak Max	V	136	293	74	-34.08	Pass
7322.69	35.55	6.47	-7.26	34.75	Average Max	V	113	259	54	-19.25	Pass
4882.32	39.73	5.52	-11.05	34.21	Average Max	V	148	267	54	-19.79	Pass
1606.11	41.72	2.88	-16.72	27.89	Average Max	V	136	293	54	-26.11	Pass

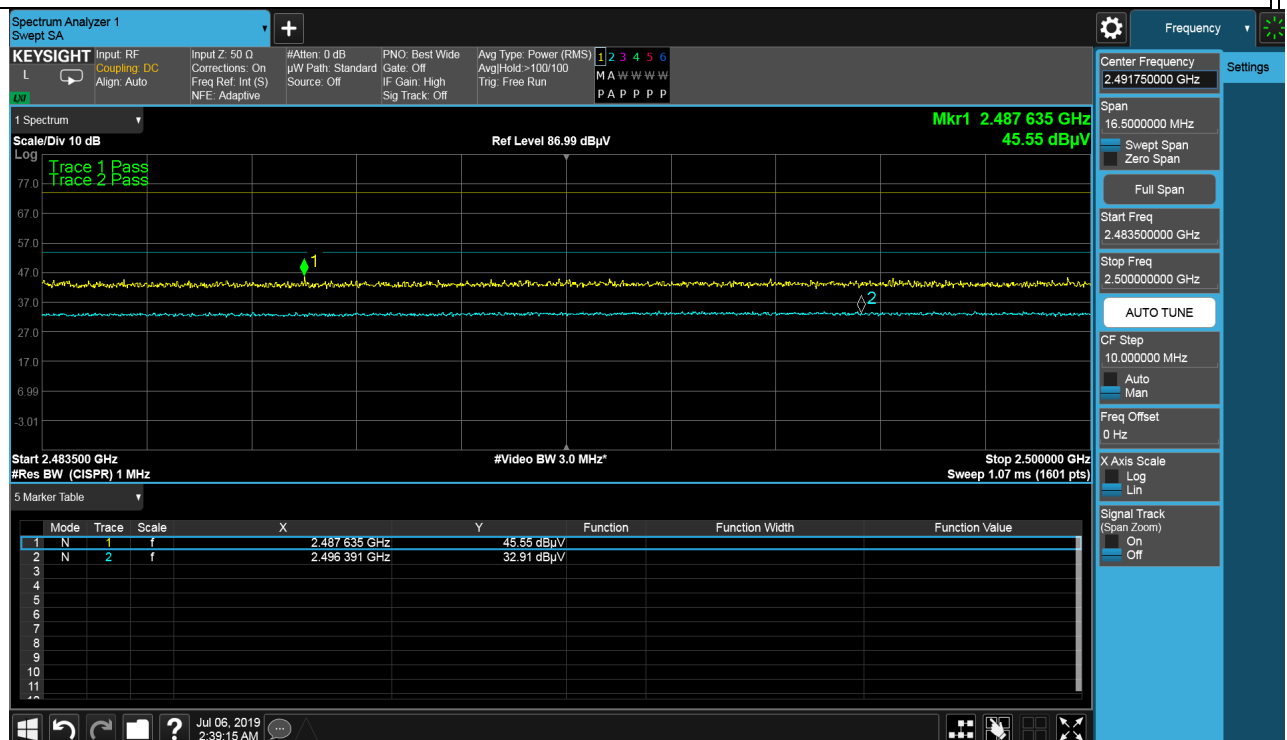
BT_8DPSK -2480 MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
7439.89	47.10	6.53	-7.20	46.44	Peak Max	V	167	5	74	-27.57	Pass
4960.15	50.55	5.5	-11.06	44.99	Peak Max	V	177	39	74	-29.01	Pass
1597.85	64.36	2.88	-16.78	50.45	Peak Max	V	122	49	74	-23.55	Pass
7439.89	35.32	6.53	-7.20	34.66	Average Max	V	167	5	54	-19.34	Pass
4960.15	38.52	5.5	-11.06	32.96	Average Max	V	177	39	54	-21.04	Pass
1597.85	42.72	2.88	-16.78	28.81	Average Max	V	122	49	54	-25.19	Pass

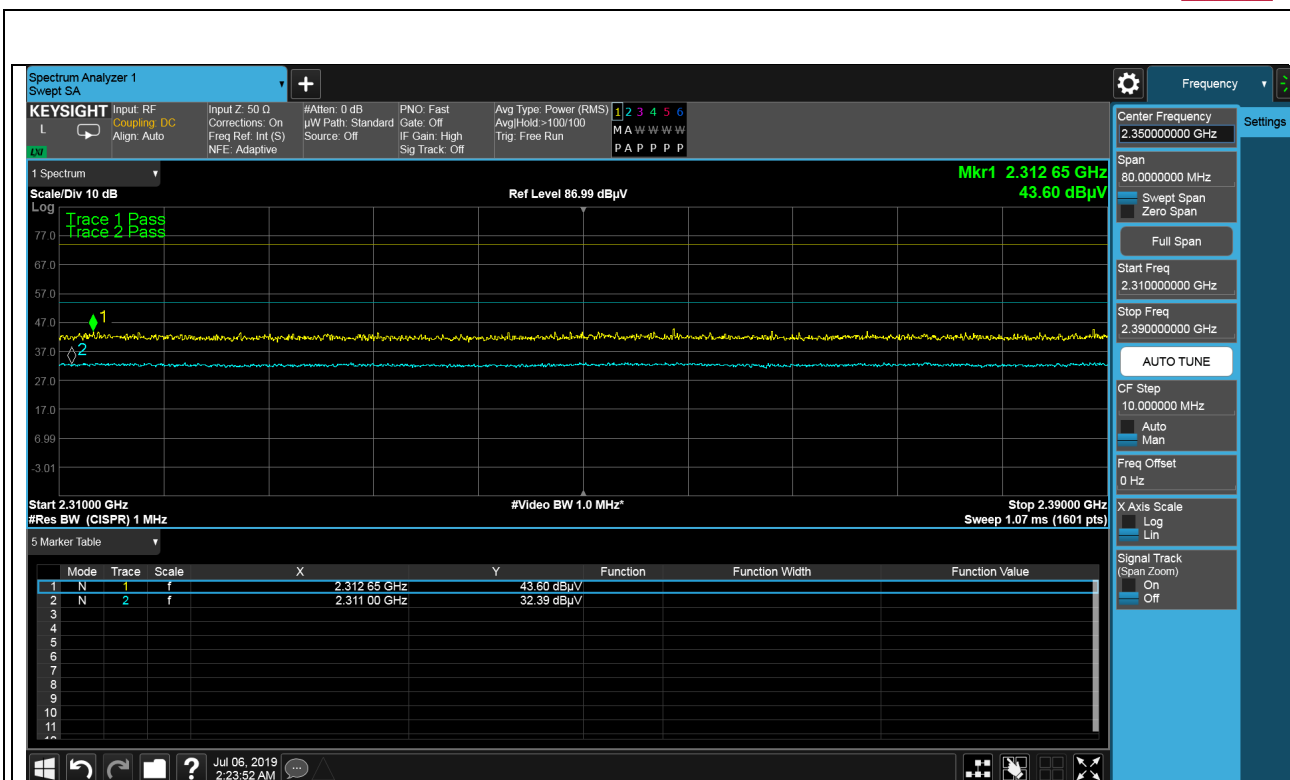
Restricted Band test results:



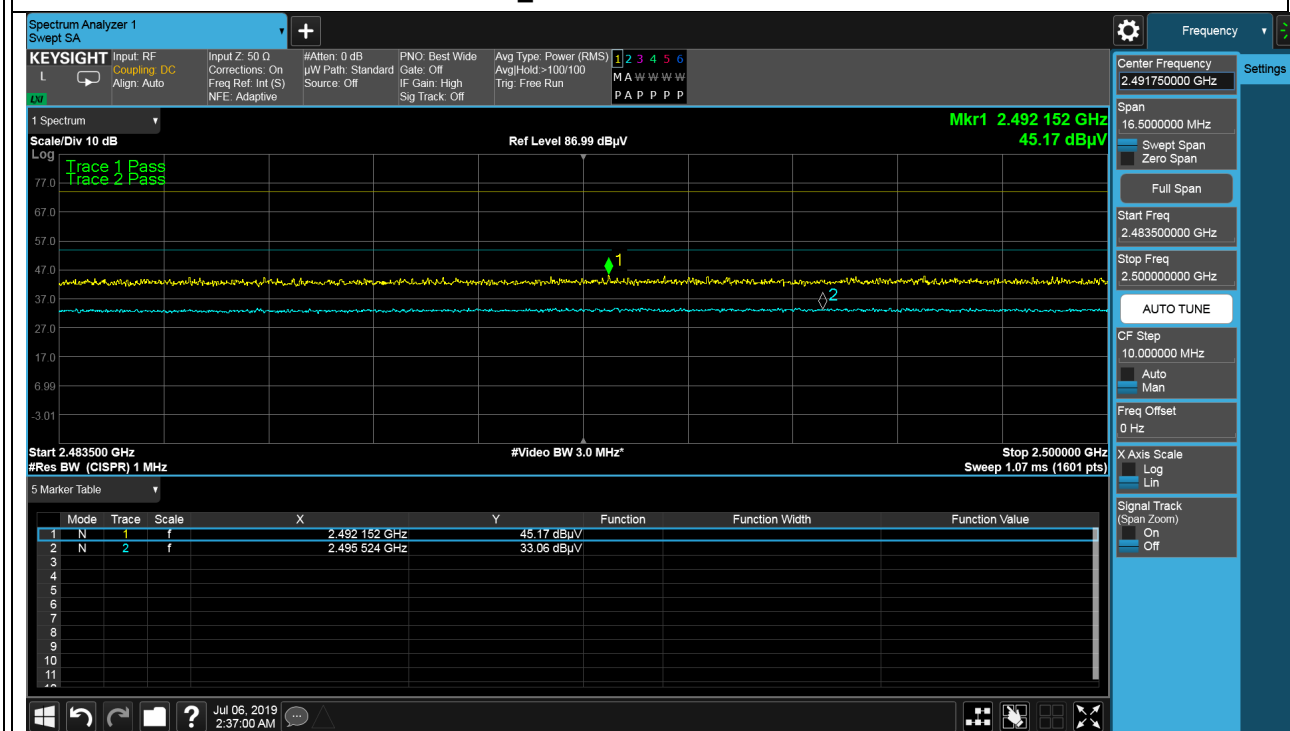
BT_GFSK-2402 MHz



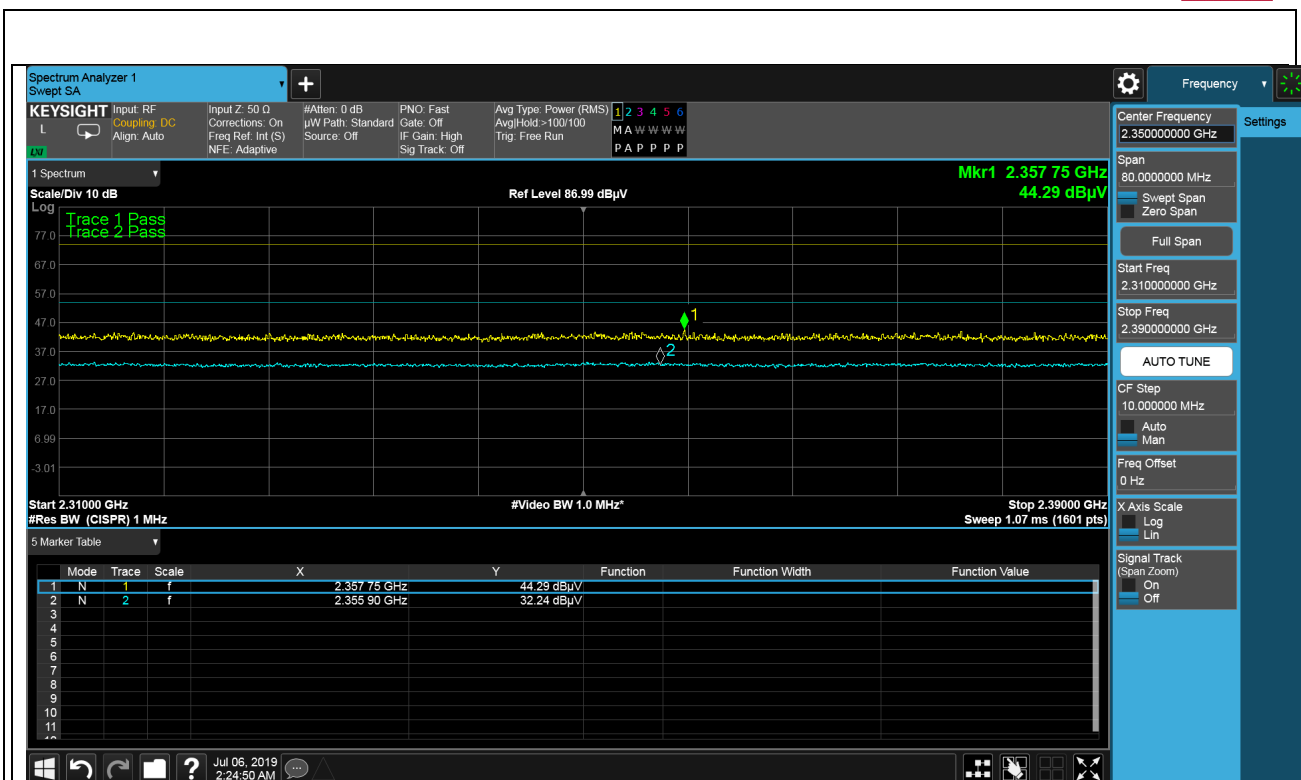
BT_GFSK-2480 MHz



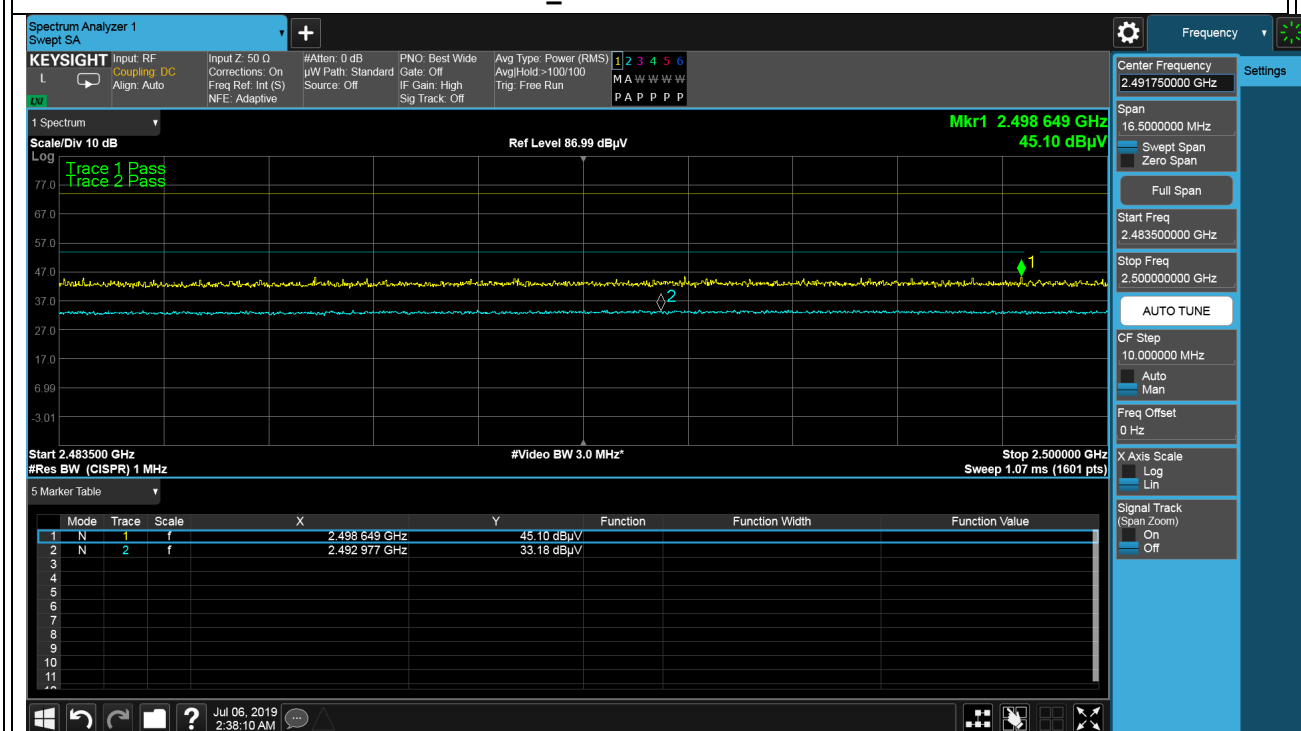
BT_ π /4-DQPSK -2402 MHz



BT_ π /4-DQPSK -2480 MHz



BT_8DPSK -2402 MHz



BT_8DPSK -2480 MHz

Appendix – Information of the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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