

FCC 15.247 2.4 GHz Report

for

Tatung Company

22, Chungshan N. Rd., 3rd Sec. Taipei Taiwan

Product Name : IOT Gateway
Model Name : IOT-3352
Brand : TATUNG
FCC ID : BJM-IOT3352

**Prepared by: : AUDIX Technology Corporation,
EMC Department**



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APPENDIX A TEST DATA AND PLOTS
APPENDIX B TEST PHOTOGRAPHS

TEST REPORT CERTIFICATION

Applicant : Tatung Company
EUT Description
(1) Product : IOT Gateway
(2) Model : IOT-3352
(3) Brand : TATUNG

Applicable Standards:

47 CFR FCC Part 15 Subpart C
ANSI C63.10:2013
FCC Public Notice DA 00-705

Audix Technology Corp. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Audix Technology Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Report: 2017. 05. 19

Reviewed by:



(Annie Yu/Administrator)

Approved by:



(Ben Cheng/Manager)

1. REVISION RECORD OF TEST REPORT

Edition No	Issued Data	Revision Summary	Report Number
0	2017. 05. 19	Original Report	EM-F170246

2. SUMMARY OF TEST RESULTS

Rule	Description	Results
15.207	Conducted Emission	PASS
15.247(d)/15.205	Radiated Band Edge and Radiated Spurious Emission	PASS
15.247(a)(1)	20dB Bandwidth	PASS
15.247(a)(1)	Carrier Frequency Separation	PASS
15.247(a)(1)(iii)	Time of Occupancy	PASS
15.247(a)(1)(iii)	Number of Hopping Channels	PASS
15.247(b)(1)	Maximum Peak Output Power	PASS
15.247(d)	Conducted Band Edges and Conducted Spurious Emission	PASS
15.203	Antenna Requirement	PASS

3. GENERAL INFORMATION

3.1. Description of Application

Applicant	Tatung Company 22, Chungshan N. Rd., 3rd Sec. Taipei Taiwan
Product	IOT Gateway
Model	IOT-3352
Brand	TATUNG

3.2. Description of EUT

Test Model	IOT-3352												
Serial Number	N/A												
Power Rating	DC 12V												
RF Features	WLAN: 802.11b/g/n Bluetooth: BT and BLE												
Transmit Type	<table border="1"><thead><tr><th colspan="2">2.4 GHz</th></tr></thead><tbody><tr><td>802.11b</td><td>1T1R</td></tr><tr><td>802.11g</td><td>1T1R</td></tr><tr><td>802.11n-HT20</td><td>1T1R</td></tr><tr><td>802.11n-HT40</td><td>1T1R</td></tr><tr><td>BT/BLE</td><td>1T1R</td></tr></tbody></table>	2.4 GHz		802.11b	1T1R	802.11g	1T1R	802.11n-HT20	1T1R	802.11n-HT40	1T1R	BT/BLE	1T1R
2.4 GHz													
802.11b	1T1R												
802.11g	1T1R												
802.11n-HT20	1T1R												
802.11n-HT40	1T1R												
BT/BLE	1T1R												
Interface Ports of EUT	One DC IN port One LAN port Two USB ports												
Accessories	<ul style="list-style-type: none">LTE USB Stick (HUAWEI, Model: E3327h-510, FCC ID: QISE3372H-510)I.T.E. Power Supply (Wall-mount, 2C) (UNIFIVE, M/N: UV324-1220, Input: AC 100-240V, 50/60Hz, 0.6A, Output: DC 12V, 2A, Power Cord: Unshielded, Ubdetachable, 1.1m)												
Date of Receipt	2017. 03. 23												
Date of Test	2017. 05. 11 ~ 15												

3.3. Antenna Information

Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Max Gain (dBi)
AN2400-5533RS	INVAX System Technology Corp.	Omni-Directional	2400 to 2500	2.2

3.4. EUT Specifications Assessed in Current Report

Mode	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (Mbps)
Bluetooth	2402-2480	79	FHSS (GFSK, $\pi/4$ DQPSK, 8-DPSK)	1/2/3

Channel List					
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

3.5. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Factor (dB)
BT	N/A	2.900	N/A

AC Conduction	
Test Case	Normal operation

Item		Modulation	Data Rate	Test Channel
Radiated Test Case	Radiated Band Edge ^{Note1}	GFSK	1Mbps	00/78
		8-DPSK	3Mbps	00/78
	Radiated Spurious Emission ^{Note1}	GFSK	1Mbps	00/39/78
Conducted Test Case ^{Note2}	20dB Bandwidth	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Carrier Frequency Separation	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Time of Occupancy	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Number of Hopping Channels	GFSK	1Mbps	39
		8-DPSK	3Mbps	39
	Maximum Peak Output Power	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Band Edges	GFSK	1Mbps	00/78
		8-DPSK	3Mbps	00/78
Spurious Emission	GFSK	1Mbps	00/39/78	
	8-DPSK	3Mbps	00/39/78	

Note 1:

- Mobile Device
- Portable Device, and 3 axis were assessed.
 - Lie
 - Side
 - Stand

Note 2: We performed testing of the highest and lowest data rate.

3.6. Tested Supporting System List

3.6.1. Support Peripheral Unit

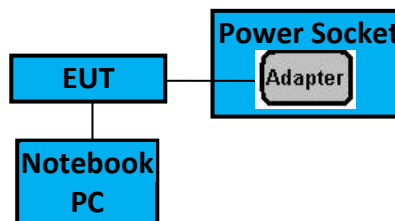
No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Notebook PC	ASUS	PU301L	N/A	N/A
2.	Power Socket	N/A	N/A	N/A	N/A

3.6.2. Cable Lists

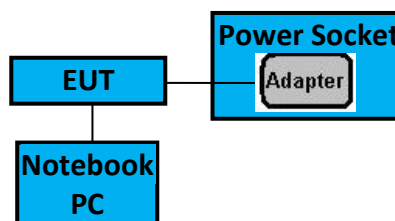
No.	Cable Description Of The Above Support Units
1.	LAN Cable: Shielded, Detachable, 1.5m Adapter: ACBEL, M/N AA90PM111 Cord: Unshielded, Detachable, 1.8m AC Power Cord: Shielded, Undetachable, 1.8m, with one ferrite core
2.	Power Cable: Unshielded, Detachable, 1.5m

3.7. Setup Configuration

3.7.1. EUT Configuration for Power Line & Radiated Emission



3.7.2. EUT Configuration for RF Conducted Test Items



3.8. Operating Condition of EUT

Test programs "tftpd32" and "PuTTY" are used for enabling EUT WLAN function under continues transmitting and choosing data rate/ channel.

3.9. Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: sales@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2005 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724 (3) FCC OET Designation No. TW1004 & TW1090
Test Facilities	(1) No. 8 Shielding Room (2) Semi-Anechoic Chamber (IC Test Site Registration No.: 5183B-1) (3) Fully Anechoic Chamber (IC Test Site Registration No.: 5183B-4)

3.10. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz~30MHz	±3.50dB
Radiation Test (Distance: 3m)	30MHz~1000MHz	± 3.68dB
	Above 1GHz	± 5.82dB

Remark : Uncertainty = $ku_c(y)$

Test Item	Uncertainty
20dB Bandwidth	±0.2kHz
Carrier Frequency Separation	±0.2kHz
Time of Occupancy	±0.03sec
Maximum peak Output power	± 0.52dB
Conducted Emission Limitations	± 0.13dB

4. MEASUREMENT EQUIPMENT LIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2017. 02. 07	1 Year
2.	A.M.N.	R&S	ENV4200	100169	2016. 11. 11	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2016. 12. 23	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2017. 01. 16	1 Year
5.	Test Software	Audix	e3	V.6.120424	N.C.R.	N.C.R.

4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2016. 09. 19	1 Year
2.	Test Receiver	R&S	ESCS30	100338	2016. 06. 22	1 Year
3.	Amplifier	HP	8447D	2944A06305	2017. 02. 16	1 Year
4.	Amplifier	HP	8449B	3008A00529	2017. 02. 08	1 Year
5.	Bilog Antenna	CHASE	CBL6112D	33821	2017. 01. 21	1 Year
6.	Loop Antenna	R&S	HFH2-Z2	891847/27	2016. 12. 23	1 Year
7.	Double-Ridged Waveguide Horn	ETS-Lindgren	3117	00135902	2017. 03. 07	1 Year
8.	2.4GHz Notch Filter	K&L	7NSL10-244 1.5E130.5-00	1	2016. 07. 28	1 Year
9.	Test Software	Audix	e3	V.6.110601	N.C.R.	N.C.R.

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
1.	Spectrum Analyzer	Agilent	N9010A-526	MY52220368	2016. 12. 01	1 Year
2.	Bluetooth Test Set	Anritsu	MT8852B	6K00005697	2017. 03. 23	1年
3.	Power Divider	Anritsu	K240C	19728	2017. 02. 08	1年

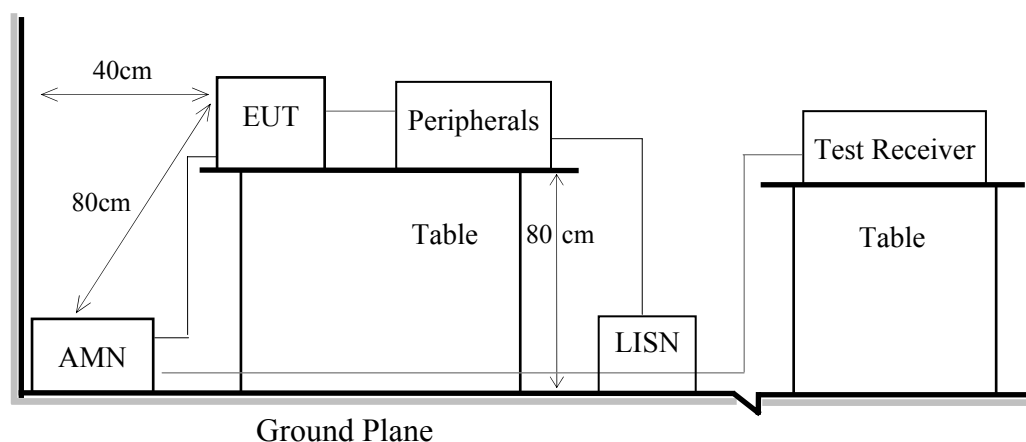
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.8

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

Frequency	Conducted Limit	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dB μ V	56 ~ 46 dB μ V
500kHz ~ 5MHz	56 dB μ V	46 dB μ V
5MHz ~ 30MHz	60 dB μ V	50 dB μ V

Remark 1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.

2.: The lower limit applies to the band edges.

5.3. Test Procedure

- 5.3.1. To set up the EUT as indicated in ANSI C 63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.
- 5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).
- 5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)
- 5.3.4. Checking frequency range from 150 kHz to 30 MHz and record the emission which does not have 20 dB below limit.

5.4. Test Results

Please refer to Appendix A.

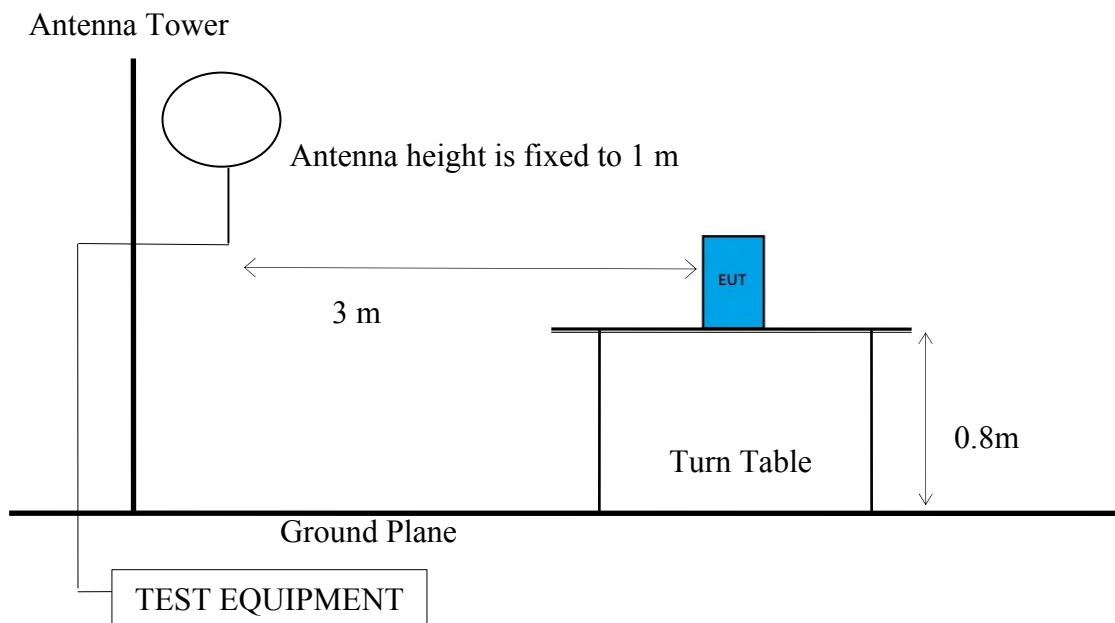
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

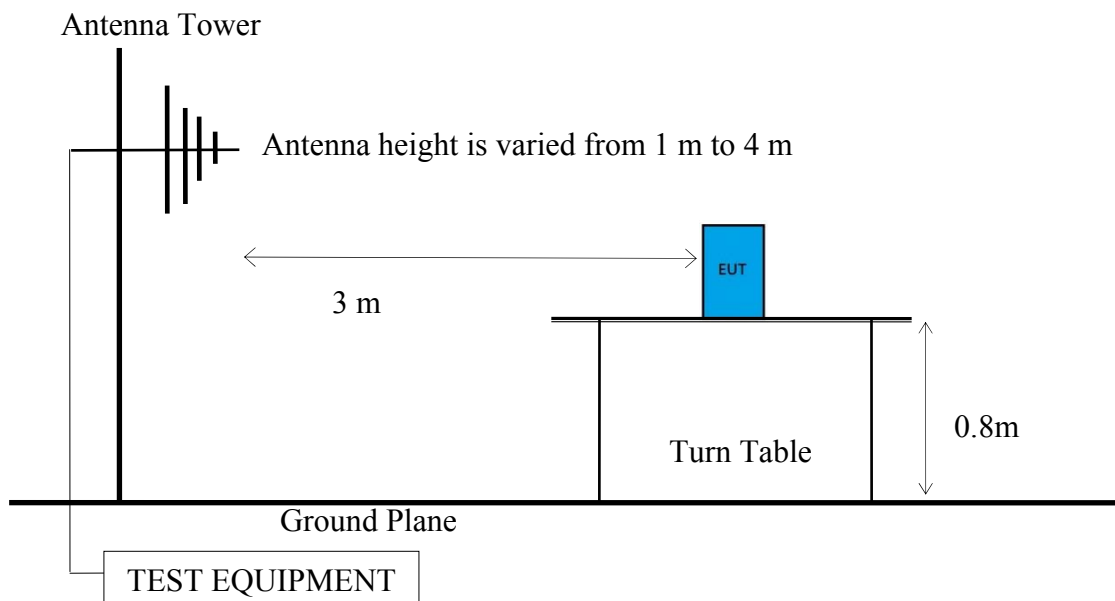
6.1.1. Block Diagram of EUT

Indicated as section 3.8

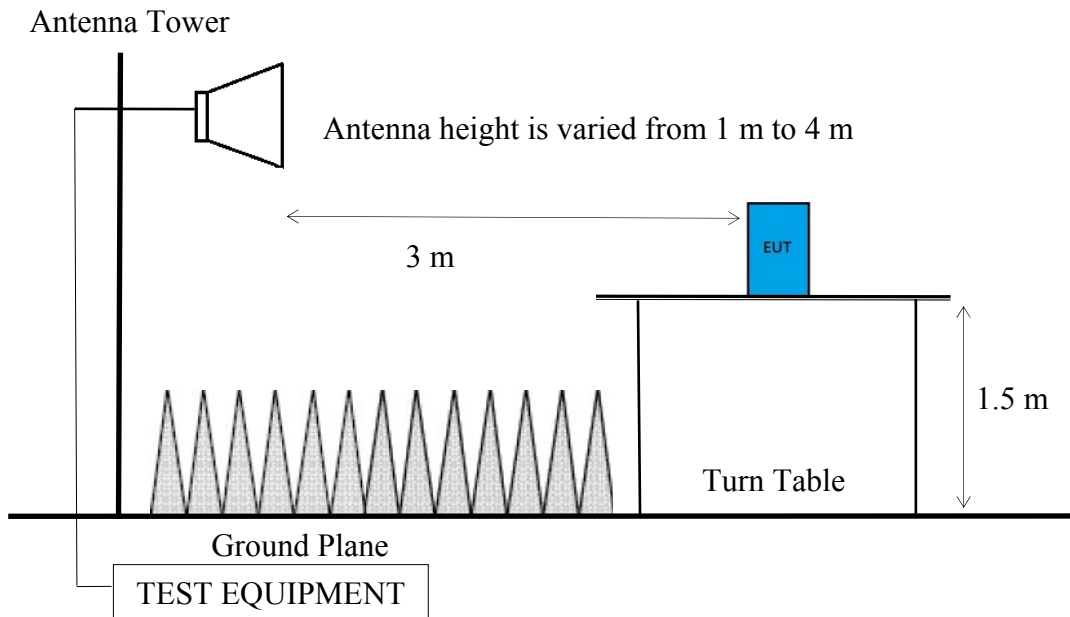
6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000 MHz



6.1.4. Setup Diagram for above 1GHz



6.2. Radiated Emission Limits

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205 must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance (m)	Limits	
		dB μ V/m	μ V/m
0.009 - 0.490	300	67.6	2400/kHz
0.490 - 1.705	30	87.6	24000/kHz
1.705 - 30	30	29.5	30
30 - 88	3	40.0	100
88- 216	3	43.5	150
216- 960	3	46.0	200
Above 960	3	54.0	500
Above 1000	3	74.0 dB μ V/m (Peak) 54.0 dB μ V/m (Average)	

Remark : (1) dB μ V/m = 20 log (μ V/m)

- (2) The tighter limit applies to the edge between two frequency bands.
- (3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
- (4) Fundamental and emission fall within operation band are exempted from this section.
- (5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

6.3. Test Procedure

Frequency Range 9kHz~30MHz:

The EUT setup on the turn table which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

- (1) RBW = 9kHz with peak and average detector.
- (2) Detector: average and peak (9kHz-490kHz)
Q.P. (490kHz-30MHz)

Frequency Range 30MHz ~ 25GHz:

The EUT setup on the turn find table which has 80 cm (for 30-1000 MHz) and 1.5m (for above 1GHz) height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

Frequency below 1 GHz:

Spectrum Analyzer is used for pre-testing with following setting:

- (1)RBW = 120KHz
- (2)VBW $\geq 3 \times$ RBW.
- (3)Detector = Peak.
- (4)Sweep time = auto.
- (5)Trace mode = max hold.
- (6)Allow sweeps to continue until the trace stabilizes.
- (7)When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required. Otherwise using Q.P. for finally measurement.

Frequency above 1GHz to 10th harmonic (up to 25 GHz):

Peak Detector:

- (1)RBW = 1MHz
- (2)VBW $\geq 3 \times$ RBW.
- (3)Detector = Peak.
- (4)Sweep time = auto.
- (5)Trace mode = max hold.
- (6)Allow sweeps to continue until the trace stabilizes.
- (7)When peak-detected value is lower than limit that the measurement using the average detector is not required. Otherwise using average detector for finally measurement.

Average Detector: **Option 1:**

- (1) RBW = 1MHz
- (2) VBW \geq 1/ T.
- (3) Detector = Peak.
- (4) Sweep time = auto.
- (5) Trace mode = max hold.
- (6) Allow sweeps to continue until the trace stabilizes.

 Option 2:

Average Emission Level = Peak Emission Level + D.C.C.F.

6.4. Measurement Result Explanation

Peak Emission Level = Antenna Factor + Cable Loss + Meter Reading

Average Emission Level = Antenna Factor + Cable Loss + Meter Reading

Average Emission Level = Peak Emission Level + DCCF

Duty Cycle Correction Factor (DCCF) = $20 \log (TX_{on} / TX_{on+off})$ presented in section 3.6

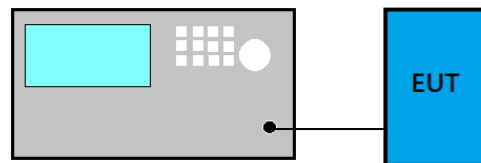
ERP = Peak Emission Level - 95.2dB - 2.14dB

6.5. Test Results

Please refer to Appendix A.

7. 20dB BANDWIDTH

7.1. Block Diagram of Test Setup



7.2. Specification Limits

Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

7.3. Test Procedure

Following measurement procedure is reference to DA00-705:

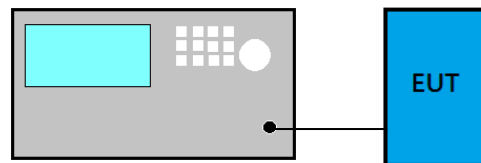
- (1) Set RBW close to 1% of OBW.
- (2) Set $VBW \geq RBW$.
- (3) Detector = Peak.
- (4) Trace mode = max hold.
- (5) Sweep = auto couple.
- (6) Allow the trace to stabilize.
- (7) Setting channel bandwidth function x dB to -20 dB to record the final bandwidth.

7.4. Test Results

Please refer to Appendix A

8. CARRIER FREQUENCY SEPARATION

8.1. Block Diagram of Test Setup



8.2. Specification Limits

Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output no greater than 125mW.

8.3. Test Procedure

Following measurement procedure is reference to DA00-705:

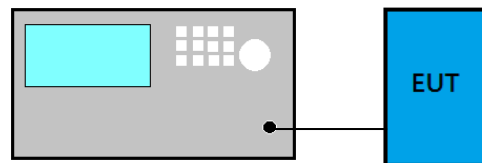
- (1) Span = wide enough to capture the peaks of two adjacent channels
- (2) RBW \geq 1% of the span
- (3) VBW \geq RBW
- (4) Sweep = auto
- (5) Detector function = peak
- (6) Trace = max hold

8.4. Test Results

Please refer to Appendix A

9. TIME OF OCCUPANCY

9.1. Block Diagram of Test Setup



9.2. Specification Limits

Frequency hopping systems in the 2400-2483.5MHz shall use at least 15 non-overlapping 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 number of hopping channels employed.

9.3. Test Procedure

Following measurement procedure is reference to DA00-705:

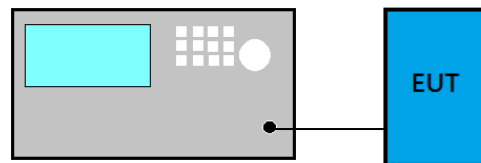
- (1) Span = zero span, centered on a hopping channel
- (2) RBW = 1 MHz
- (3) VBW \geq RBW
- (4) Sweep = as necessary to capture the entire dwell time per hopping channel
- (5) Detector function = peak
- (6) Trace = max hold

9.4. Test Results

Please refer to Appendix A

10. NUMBER OF HOPPING CHANNELS

10.1. Block Diagram of Test Setup



10.2. Specification Limits

Frequency hopping systems which use fewer than 20 hopping frequencies may employ intelligent hopping techniques to avoid interference to other transmissions. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 non-overlapping channels.

10.3. Test Procedure

Following measurement procedure is reference to DA00-705:

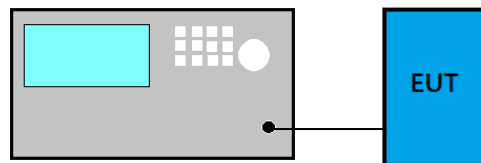
- (1) Span = the frequency band of operation
- (2) RBW \geq 1% of the span
- (3) VBW \geq RBW
- (4) Sweep = auto
- (5) Detector function = peak
- (6) Trace = max hold

10.4. Test Results

Please refer to Appendix A

11. MAXIMUM PEAK OUTPUT POWER

11.1. Block Diagram of Test Setup



11.2. Specification Limits

The Limits of maximum Peak Output Power for frequency hopping systems in 2400-2483.5MHz is: 0.125Watt. (21dBm)

11.3. Test Procedure

Following measurement procedure is reference to DA00-705:

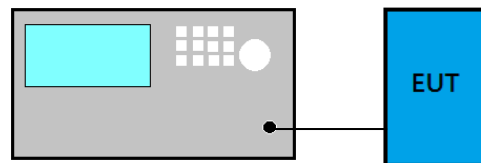
- (1) Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- (2) RBW \geq 1% of the span
- (3) VBW \geq RBW
- (4) Sweep = auto
- (5) Detector function = peak
- (6) Trace = max hold

11.4. Test Results

Please refer to Appendix A

12. EMISSION LIMITATIONS

12.1. Block Diagram of Test Setup



12.2. Specification Limits

In any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, that the required attenuation shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in 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)).

12.3. Test Procedure

Following measurement procedure is reference to DA00-705:

- (1) Set span wide enough to capture the peak level of the in-band emission and all spurious emissions; up to 10th harmonic.
- (2) RBW = 100 kHz
- (3) VBW \geq RBW
- (4) Sweep = auto
- (5) Detector function = peak
- (6) Trace = max hold

12.4. Test Results

Please refer to Appendix A

13.DEVIATION TO TEST SPECIFICATIONS

【NONE】



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APPENDIX A

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APPDNDIX A

TEST DATA AND PLOTS

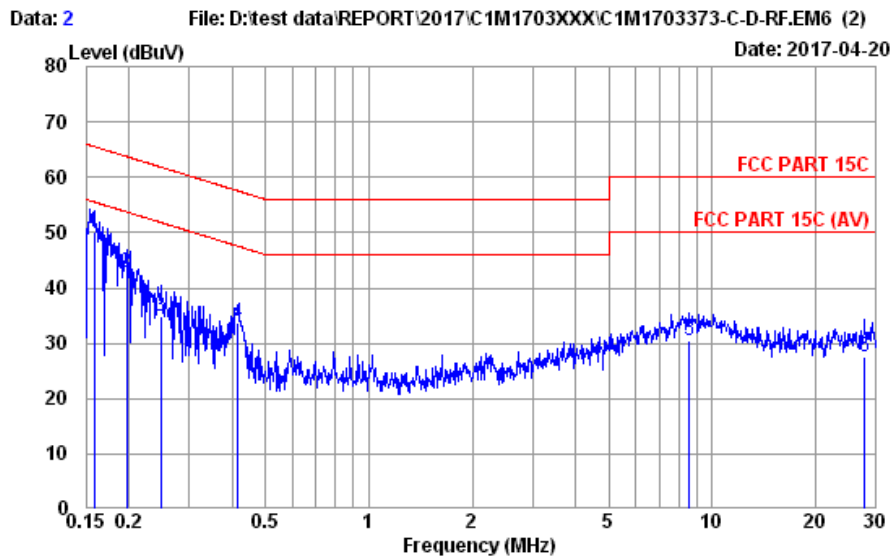
(Model: IOT-3352)

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A.1 CONDUCTED EMISSION

Test Date	2017/04/20	Temp./Hum.	22 /57%
Test Voltage	AC 120V, 60Hz (Via Power Supply)		

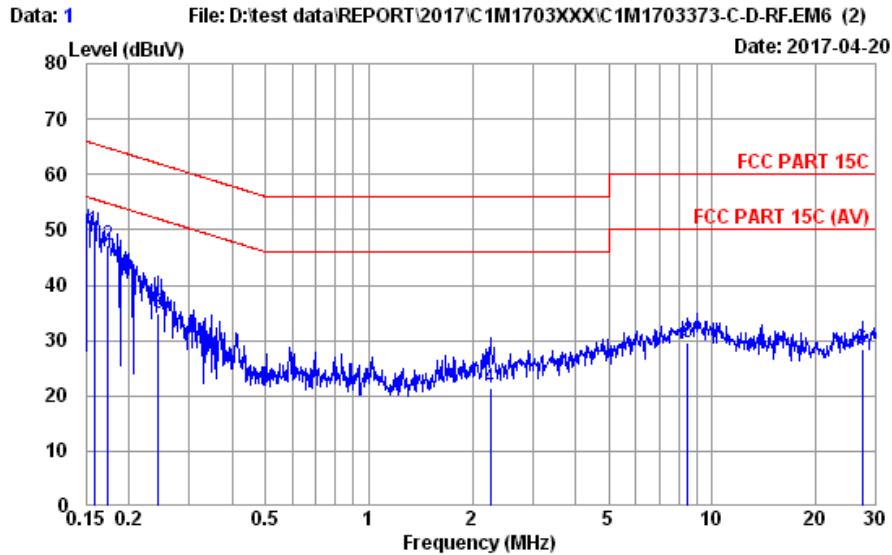


Site no. : No.8 Shielded Room Data no. : 2
 Condition : ENV4200 100169 LISN Phase : NEUTRAL
 Limit : FCC PART 15C
 Env. / Ins. : 22°C / 57% ESR3 (1774) Engineer : Jemy
 EUT : IOT-3352
 Power Rating : 120Vac/60Hz
 Test Mode : Operating

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.158	11.47	0.03	9.86	28.76	50.12	65.56	15.44	QP
2	0.197	11.30	0.03	9.86	21.74	42.93	63.76	20.83	QP
3	0.248	11.21	0.03	9.86	13.72	34.82	61.82	27.00	QP
4	0.415	11.05	0.04	9.86	12.67	33.62	57.55	23.93	QP
5	8.592	11.98	0.18	9.88	8.40	30.44	60.00	29.56	QP
6	27.855	16.35	0.32	9.98	0.99	27.64	60.00	32.36	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
 2. If the average limit is met when using a quasi-peak detector,
 the EUT shall be deemed to meet both limits and measurement
 with average detector is unnecessary.

Test Date	2017/04/20	Temp./Hum.	23 /52%
Test Voltage	AC 120V, 60Hz (Via Power Supply)		



Site no. : No.8 Shielded Room Data no. : 1
 Condition : ENV4200 100169 LISN Phase : LINE
 Limit : FCC PART 15C
 Env. / Ins. : 22°C / 57% ESR3 (1774) Engineer : Jemy
 EUT : IOT-3352
 Power Rating : 120Vac/60Hz
 Test Mode : Operating

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.158	10.78	0.03	9.86	29.19	49.86	65.56	15.70	QP
2	0.174	10.77	0.03	9.86	26.55	47.21	64.77	17.56	QP
3	0.243	10.71	0.03	9.86	14.25	34.85	62.00	27.15	QP
4	2.261	10.61	0.09	9.86	0.88	21.44	56.00	34.56	QP
5	8.501	11.18	0.18	9.88	8.33	29.57	60.00	30.43	QP
6	27.271	15.31	0.32	9.98	2.71	28.32	60.00	31.68	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
 2. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

A.2 RADIATED EMISSION

Test Date	2017/05/15	Temp./Hum.	24 /41%
Test Voltage	AC 120V, 60Hz (Via Power Supply)		

A.2.1 Emissions within Restricted Frequency Bands

A.2.1.1 Frequency 9kHz~30MHz

The emissions (9kHz~30MHz) not reported for there is no emission be found.

A.2.1.2 Frequency Below 1 GHz

Mode	8-DPSK	Frequency	TX 2441MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
72.68	12.91	1.91	11.37	26.19	40.00	13.81	Peak
125.06	18.47	2.56	10.28	31.31	43.50	12.19	Peak
151.25	16.89	2.84	11.75	31.48	43.50	12.02	Peak
431.58	23.08	5.85	6.99	35.92	46.00	10.08	Peak

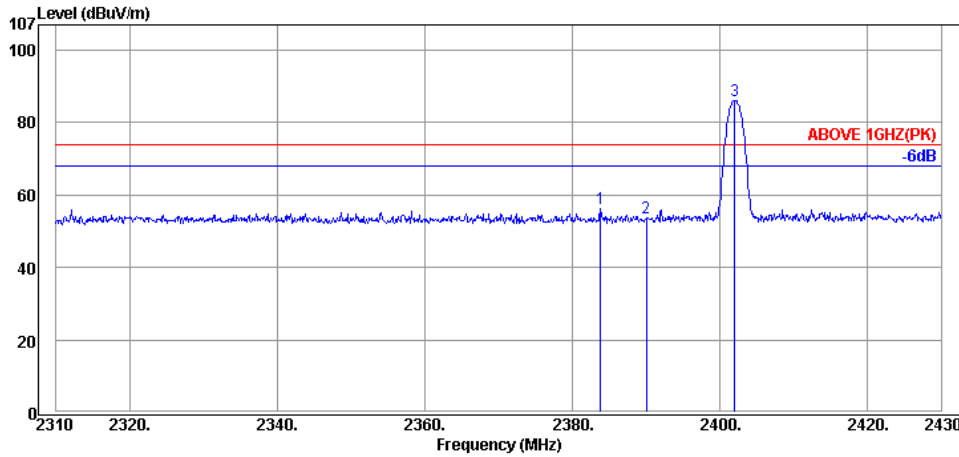
Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
125.06	18.47	2.56	16.33	37.36	43.50	6.14	Peak
143.49	17.48	2.76	14.20	34.44	43.50	9.06	Peak
238.55	18.22	3.71	7.36	29.29	46.00	16.71	Peak
749.74	26.12	7.35	3.60	37.07	46.00	8.93	Peak

A.2.1.3 Frequency Above 1 GHz to 10th harmonics

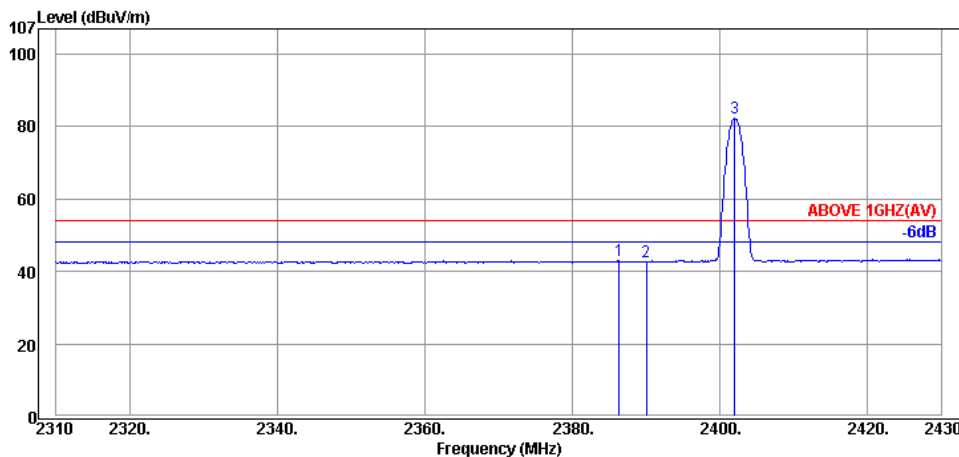
Band Edge:

Mode	8-DPSK	Frequency	TX 2402MHz
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Antenna at Horizontal Polarization

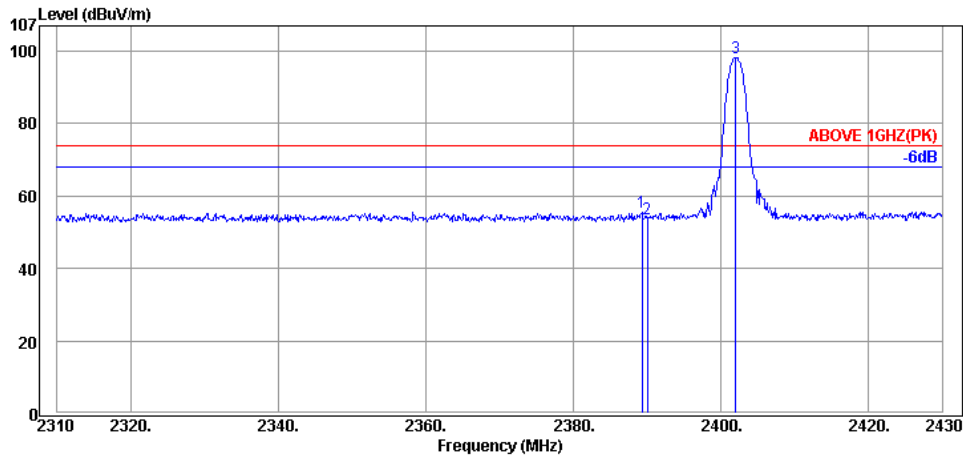
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2383.80	31.68	6.07	18.39	56.14	74.00	17.86	Peak
2390.04	31.68	6.08	15.78	53.54	74.00	20.46	Peak
2402.04	31.69	6.09	48.36	86.14	---	---	Peak



Antenna at Horizontal Polarization

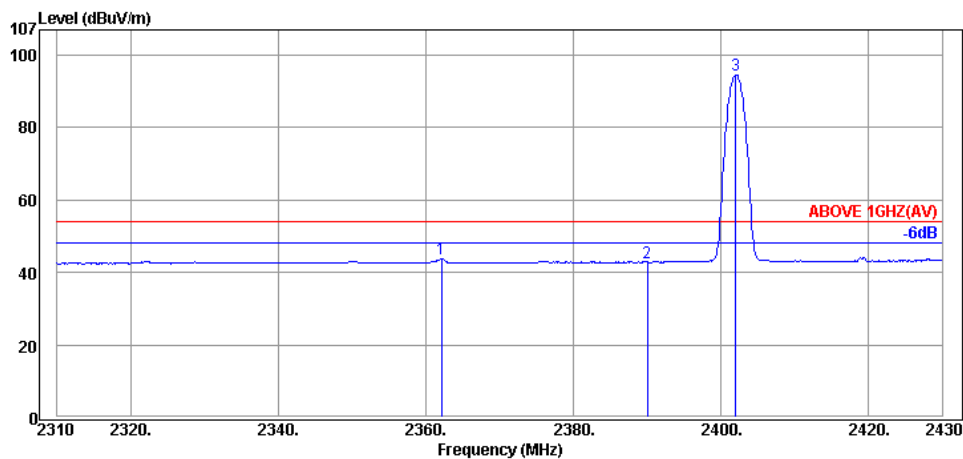
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2386.32	31.68	6.07	5.26	43.01	54.00	10.99	Average
2390.04	31.68	6.08	5.00	42.76	54.00	11.24	Average
2402.04	31.69	6.09	44.64	82.42	---	---	Average

Mode	8-DPSK	Frequency	TX 2402MHz
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Antenna at Vertical Polarization

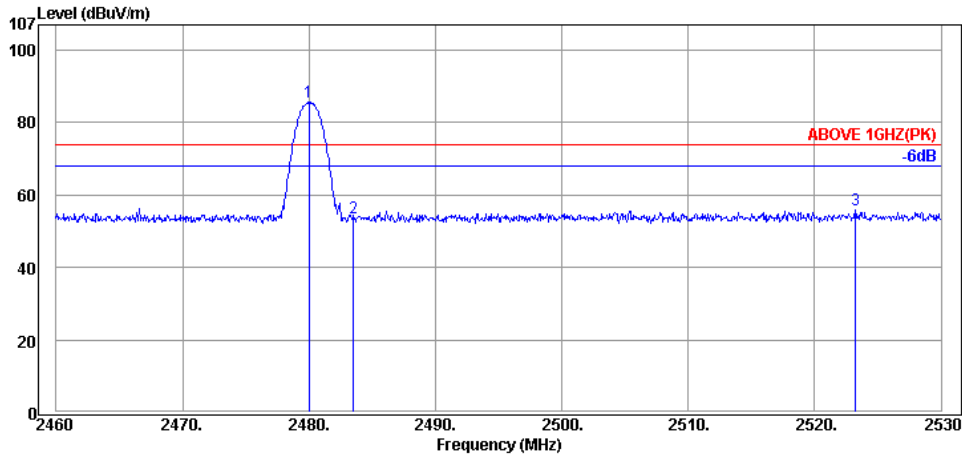
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.32	31.68	6.08	17.70	55.46	74.00	18.54	Peak
2390.04	31.68	6.08	15.78	53.54	74.00	20.46	Peak
2402.04	31.69	6.09	60.57	98.35	---	---	Peak



Antenna at Vertical Polarization

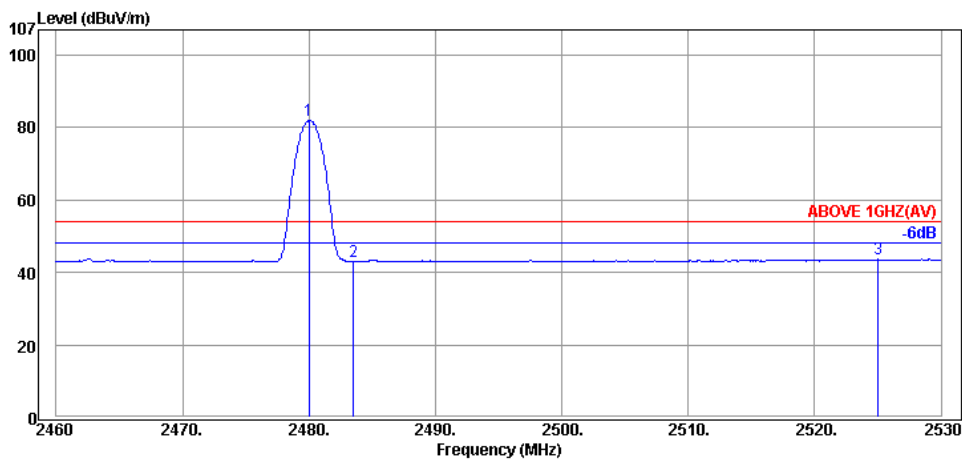
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2362.08	31.64	6.04	5.98	43.66	54.00	10.34	Average
2390.04	31.68	6.08	5.04	42.80	54.00	11.20	Average
2402.04	31.69	6.09	56.85	94.63	---	---	Average

Mode	8-DPSK	Frequency	TX 2480MHz
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Antenna at Horizontal Polarization

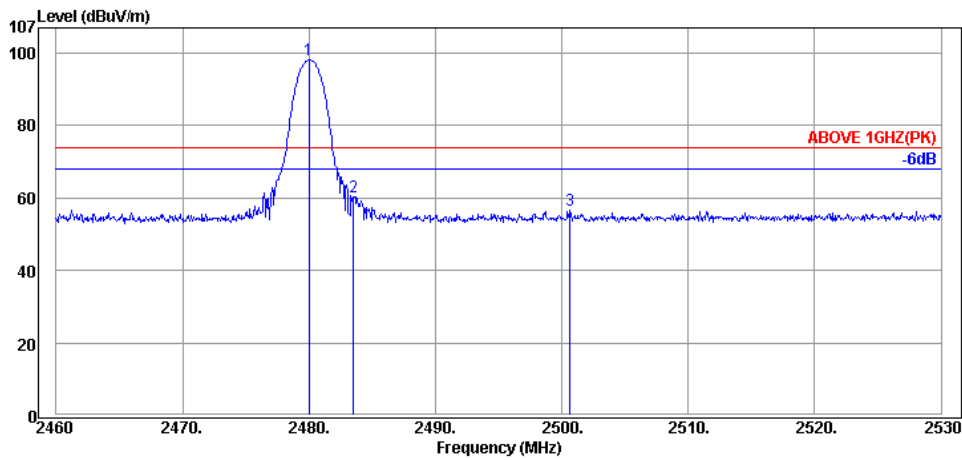
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.02	31.78	6.18	47.77	85.73	---	---	Peak
2483.52	31.78	6.19	15.68	53.65	74.00	20.35	Peak
2523.21	31.82	6.23	17.77	55.82	74.00	18.18	Peak



Antenna at Horizontal Polarization

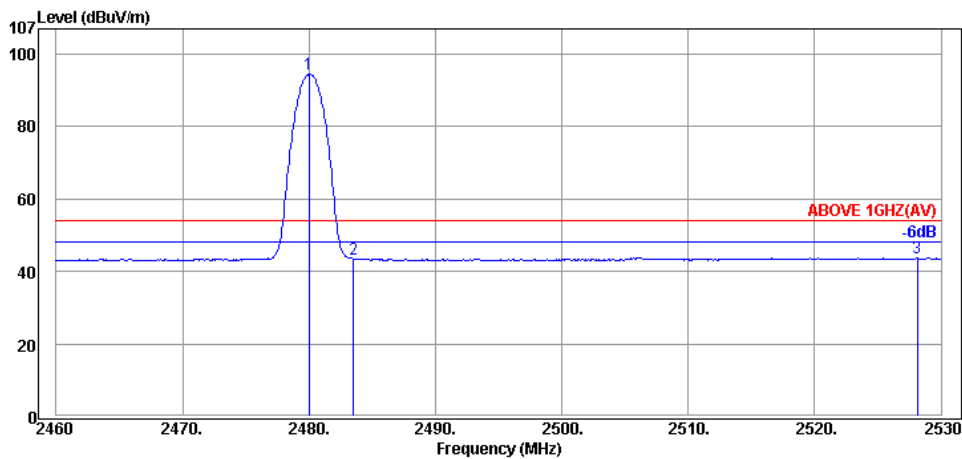
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.02	31.78	6.18	43.92	81.88	---	---	Average
2483.52	31.78	6.19	5.03	43.00	54.00	11.00	Average
2525.03	31.82	6.25	5.55	43.62	54.00	10.38	Average

Mode	8-DPSK	Frequency	TX 2480MHz
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Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.02	31.78	6.18	60.24	98.20	---	---	Peak
2483.52	31.78	6.19	22.24	60.21	74.00	13.79	Peak
2500.67	31.80	6.21	18.62	56.63	74.00	17.37	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.02	31.78	6.18	56.48	94.44	---	---	Average
2483.52	31.78	6.19	5.45	43.42	54.00	10.58	Average
2528.11	31.83	6.25	5.60	43.68	54.00	10.32	Average

A.2.2 Emissions outside the frequency band:

The emissions (up to 25GHz) not reported for there is no emission be found.

Mode	8-DPSK	Frequency	TX 2402MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4805.00	33.82	8.87	1.60	44.29	54.00	9.71	Peak
7205.00	35.66	11.27	0.10	47.03	54.00	6.97	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4805.00	33.82	8.87	1.04	43.73	54.00	10.27	Peak
7205.00	35.66	11.27	-0.10	46.83	54.00	7.17	Peak

Mode	8-DPSK	Frequency	TX 2441MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4880.00	33.85	9.14	0.56	43.55	54.00	10.45	Peak
7325.00	35.63	11.95	1.07	48.65	54.00	5.35	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4880.00	33.85	9.14	0.17	43.16	54.00	10.84	Peak
7325.00	35.63	11.95	0.73	48.31	54.00	5.69	Peak

Mode	8-DPSK	Frequency	TX 2480MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4945.00	33.88	9.35	2.47	45.70	54.00	8.30	Peak
7440.00	35.61	12.56	-1.34	46.83	54.00	7.17	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4945.00	33.88	9.35	2.84	46.07	54.00	7.93	Peak
7440.00	35.61	12.56	-0.93	47.24	54.00	6.76	Peak

A.2.3 Emissions in Non-restricted Frequency Bands:

All emission levels below the 15.209 general radiated emissions limits is not required.

A.3 20dB BANDWIDTH

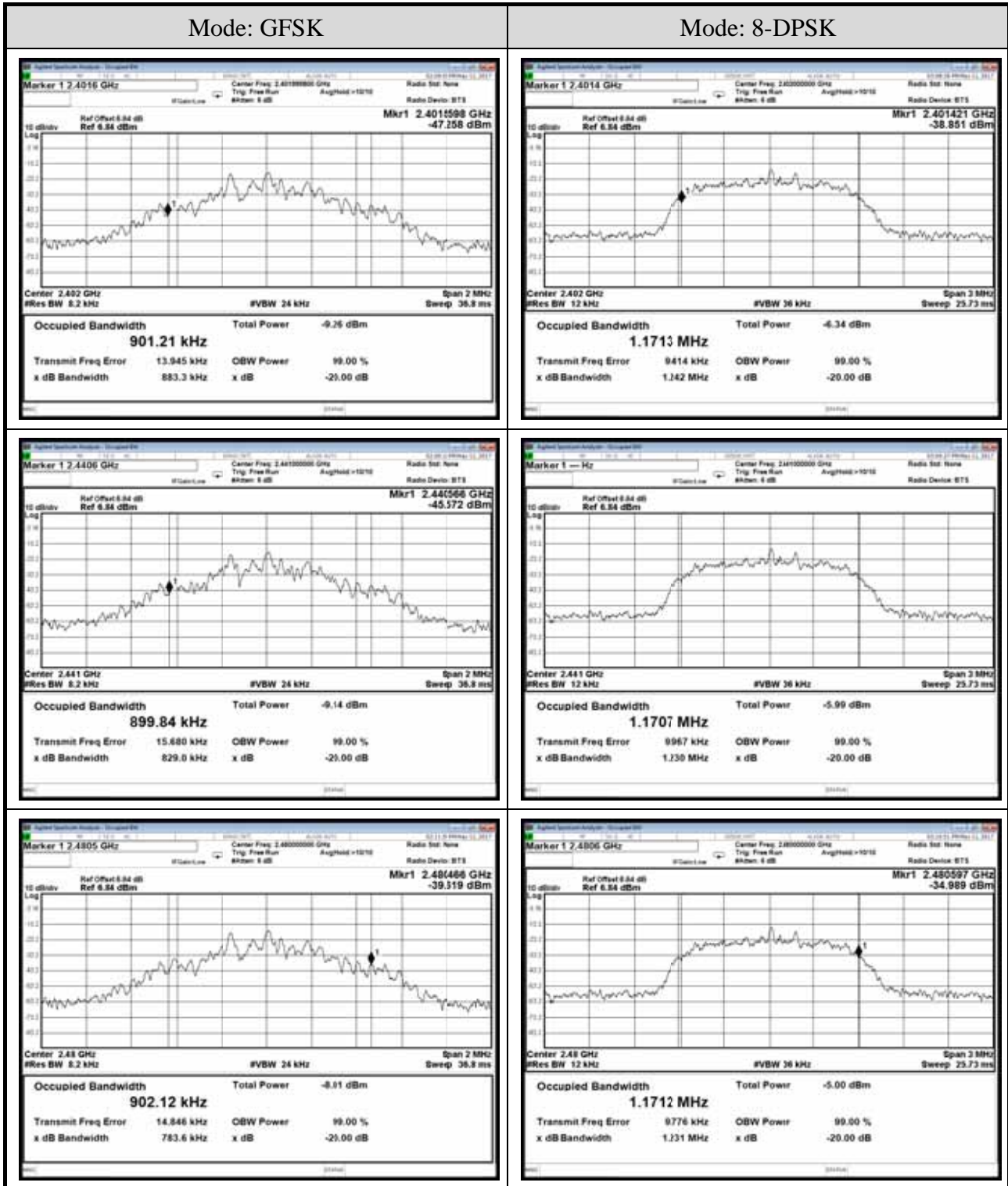
Test Date	2017/05/11	Temp./Hum.	26 /42%
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)

A.3.1 6dB Bandwidth Result

Mode	Centre Frequency (MHz)	20dB Bandwidth (MHz)	2/3 (20dB Bandwidth)
GFSK	2402	0.8833	0.589
	2441	0.8290	0.553
	2480	0.7836	0.522
8-DPSK	2402	1.242	0.828
	2441	1.230	0.820
	2480	1.231	0.821

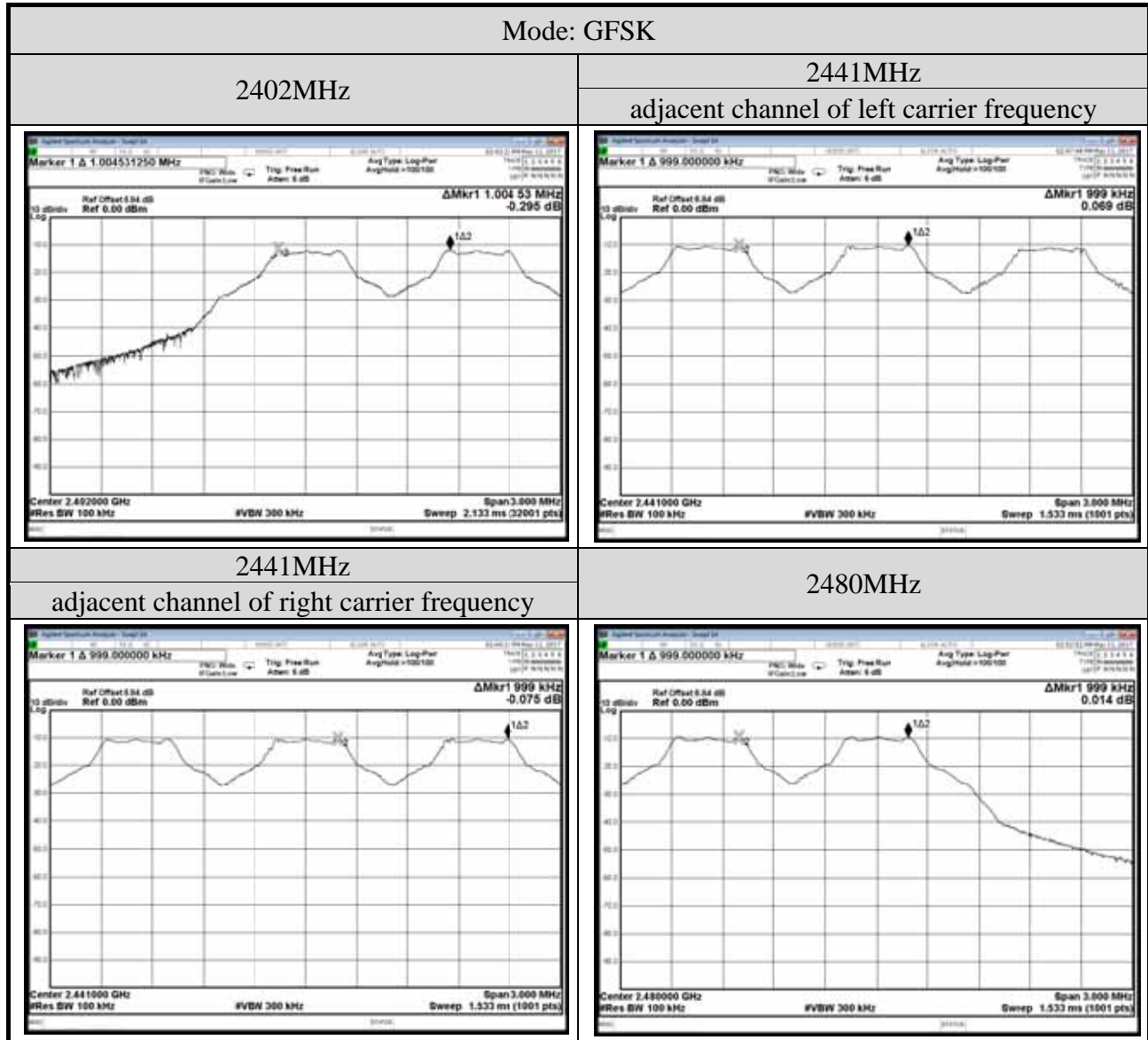
Remark: The maximum two-thirds of the 20dB bandwidth is the limit for carrier frequency separation presented.

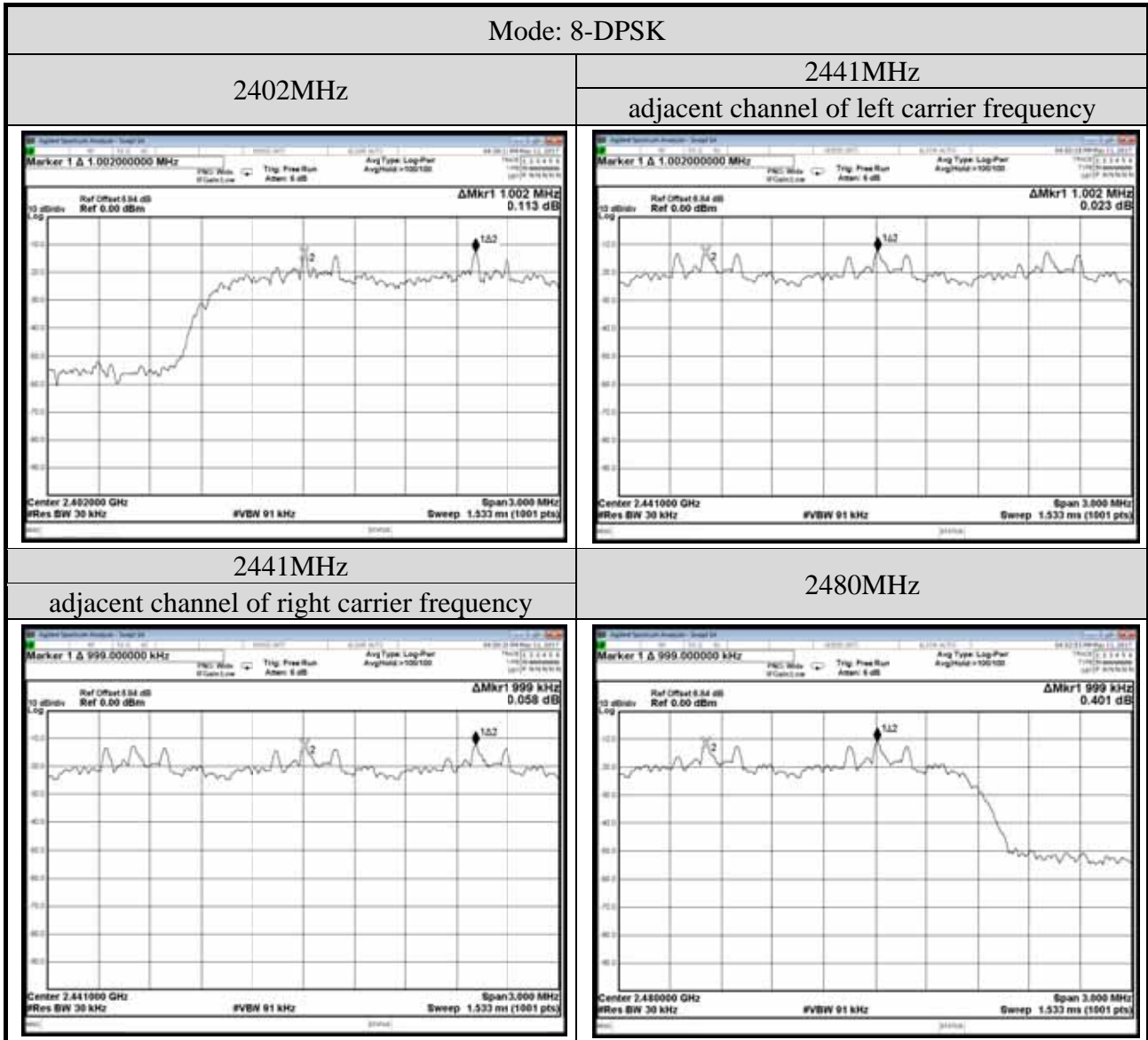
A.3.2 Measurement Plots



A.4 CARRIER FREQUENCY SEPARATION

Test Date	2017/05/11	Temp./Hum.	26 /42%
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)





A.5 TIME OF OCCUPANCY

Test Date	2017/05/11	Temp./Hum.	26 /42%
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)

A.5.1 Time of Occupancy

Mode	Centre Frequency (MHz)	Mode	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
GFSK	2402	DH1	0.165	52.14	<400
		DH3	1.650	104.28	
		DH5	2.900	183.28	
	2441	DH1	0.165	52.14	<400
		DH3	1.650	104.28	
		DH5	2.900	183.28	
	2480	DH1	0.165	52.14	<400
		DH3	1.650	208.56	
		DH5	2.900	183.28	

Observation Period: 79 channels*0.4 seconds = 31.6 seconds

Centre Frequency: 2402MHz

DH1: For each second of 10 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$10 \text{ channels} * 31.6 \text{ seconds} * 0.165 \text{ ms} = 52.140 \text{ ms}$$

DH3: For each second of 2channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$2 \text{ channels} * 31.6 \text{ seconds} * 1.650 \text{ ms} = 104.280 \text{ ms}$$

DH5: For each second of 2channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$2 \text{ channels} * 31.6 \text{ seconds} * 2.900 \text{ ms} = 183.280 \text{ ms}$$

Centre Frequency: 2441MHz

DH1: For each second of 10 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$10 \text{ channels} * 31.6 \text{ seconds} * 0.165 \text{ ms} = 52.140 \text{ ms}$$

DH3: For each second of 2 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$2 \text{ channels} * 31.6 \text{ seconds} * 1.650 \text{ ms} = 104.280 \text{ ms}$$

DH5: For each second of 2 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$2 \text{ channels} * 31.6 \text{ seconds} * 2.900 \text{ ms} = 183.280 \text{ ms}$$

Centre Frequency: 2480MHz

DH1: For each second of 10 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$10 \text{ channels} * 31.6 \text{ seconds} * 0.165 \text{ ms} = 52.140 \text{ ms}$$

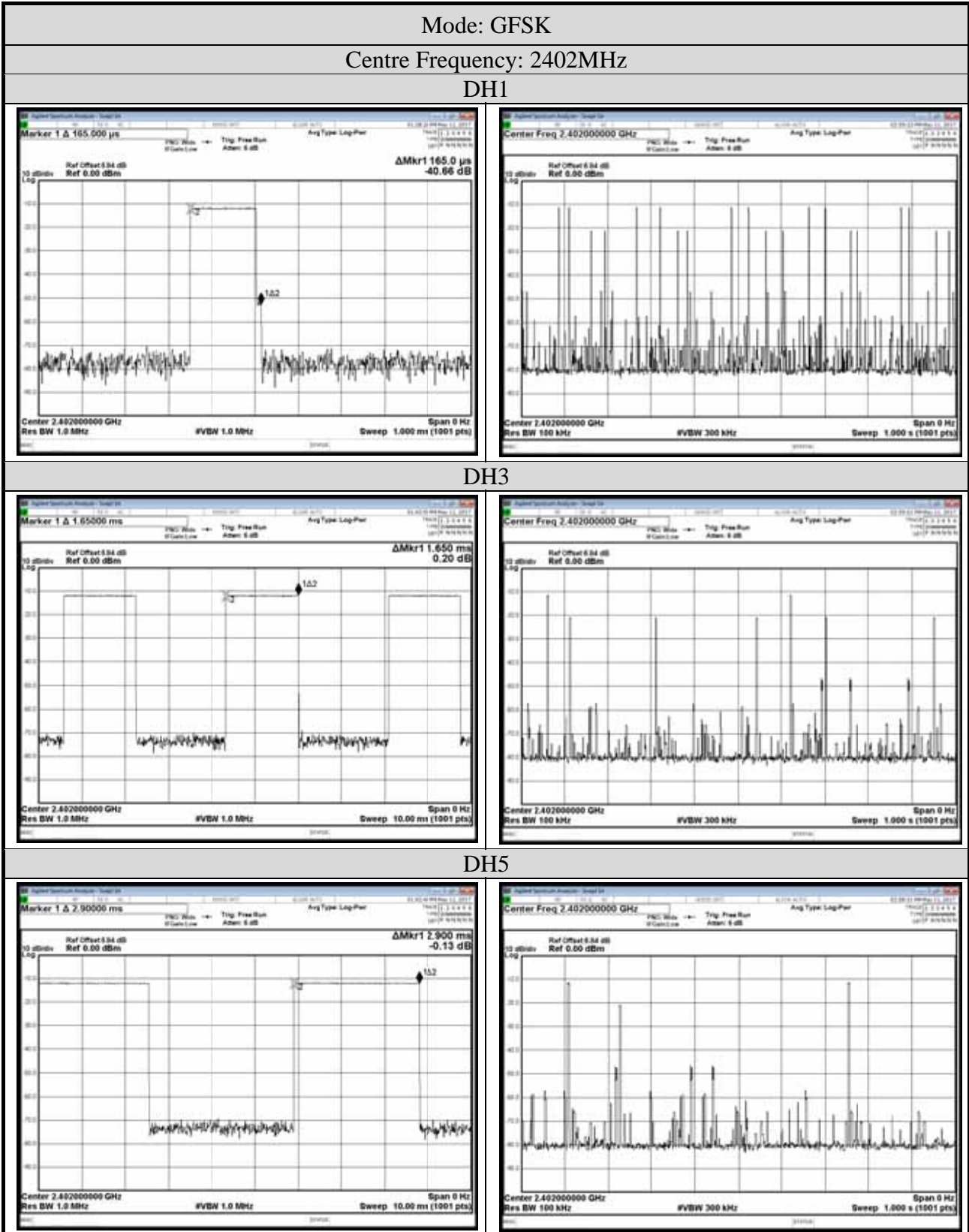
DH3: For each second of 4 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$4 \text{ channels} * 31.6 \text{ seconds} * 1.650 \text{ ms} = 208.560 \text{ ms}$$

DH5: For each second of 2 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$2 \text{ channels} * 31.6 \text{ seconds} * 2.900 \text{ ms} = 183.280 \text{ ms}$$

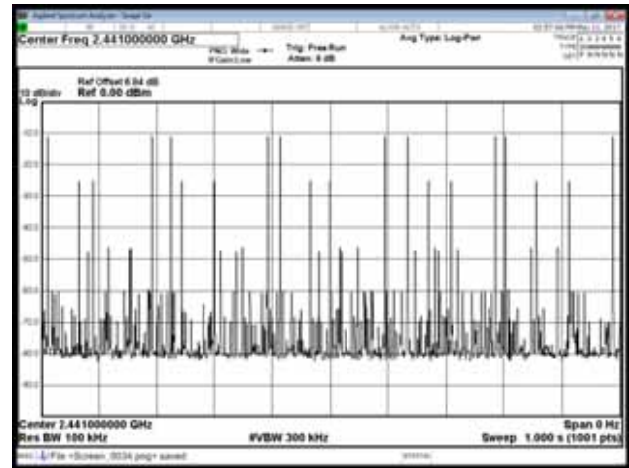
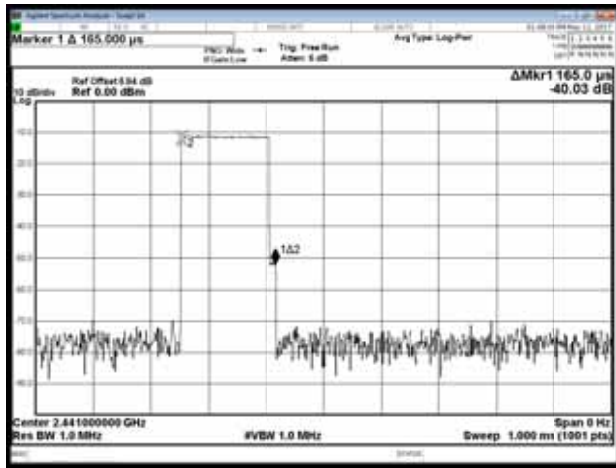
● Measurement Plots



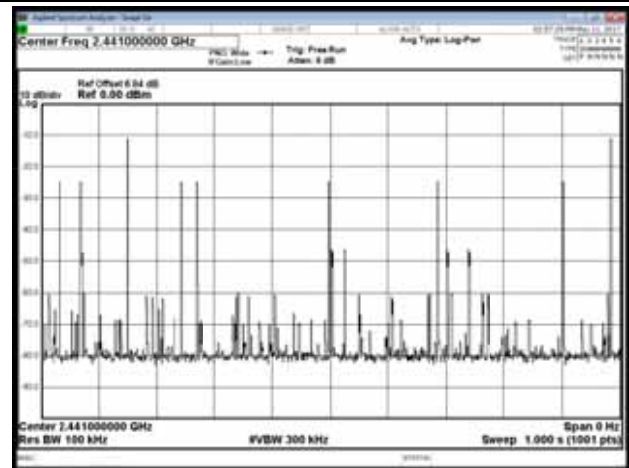
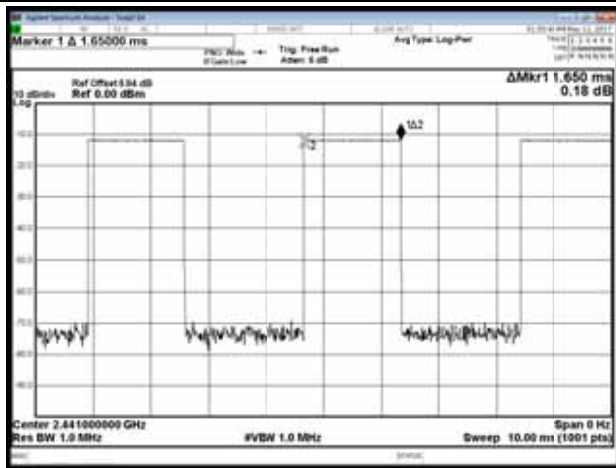
Mode: GFSK

Centre Frequency: 2441MHz

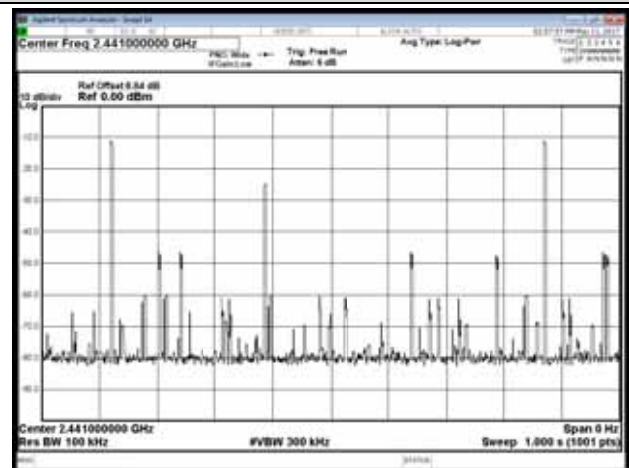
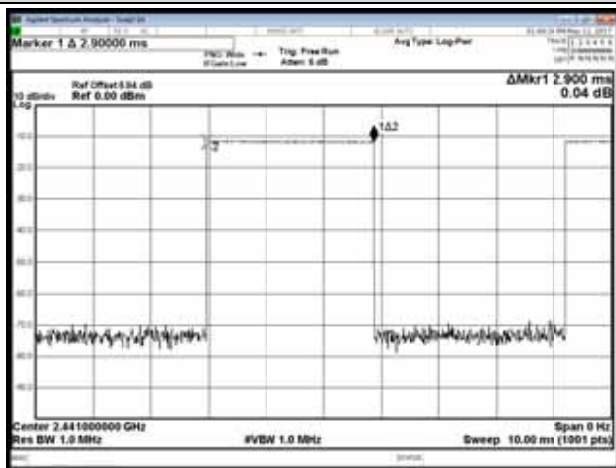
DH1

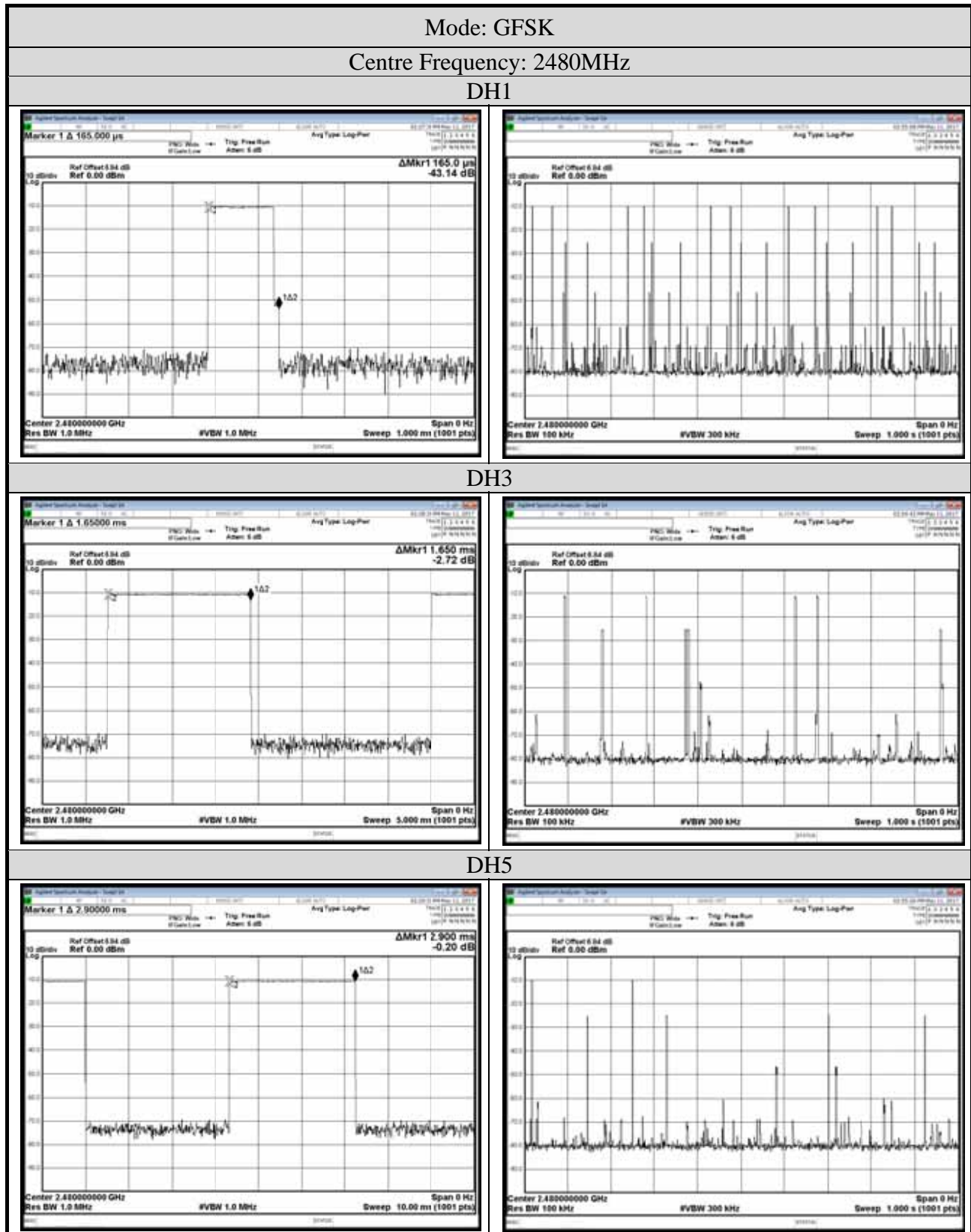


DH3



DH5





Mode	Centre Frequency (MHz)	Mode	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
8-DPSK	2402	DH1	0.400	126.40	<400
		DH3	1.650	208.56	
		DH5	2.900	274.92	
	2441	DH1	0.400	126.40	<400
		DH3	1.650	208.56	
		DH5	2.900	274.92	
	2480	DH1	0.400	126.40	<400
		DH3	1.650	208.56	
		DH5	2.900	274.92	

Observation Period: 79 channels*0.4 seconds = 31.6 seconds

Centre Frequency: 2402MHz

3DH1: For each second of 10 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$10 \text{ channels} * 31.6 \text{ seconds} * 0.400 \text{ ms} = 126.400 \text{ ms}$$

3DH3: For each second of 4 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$4 \text{ channels} * 31.6 \text{ seconds} * 1.650 \text{ ms} = 208.560 \text{ ms}$$

3DH5: For each second of 3 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$3 \text{ channels} * 31.6 \text{ seconds} * 2.900 \text{ ms} = 274.920 \text{ ms}$$

Centre Frequency: 2441MHz

3DH1: For each second of 10 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$10 \text{ channels} * 31.6 \text{ seconds} * 0.400 \text{ ms} = 126.400 \text{ ms}$$

3DH3: For each second of 4 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$4 \text{ channels} * 31.6 \text{ seconds} * 1.650 \text{ ms} = 208.560 \text{ ms}$$

3DH5: For each second of 3 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$3 \text{ channels} * 31.6 \text{ seconds} * 2.900 \text{ ms} = 274.920 \text{ ms}$$

Centre Frequency: 2480MHz

3DH1: For each second of 10 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$10 \text{ channels} * 31.6 \text{ seconds} * 0.400 \text{ ms} = 126.400 \text{ ms}$$

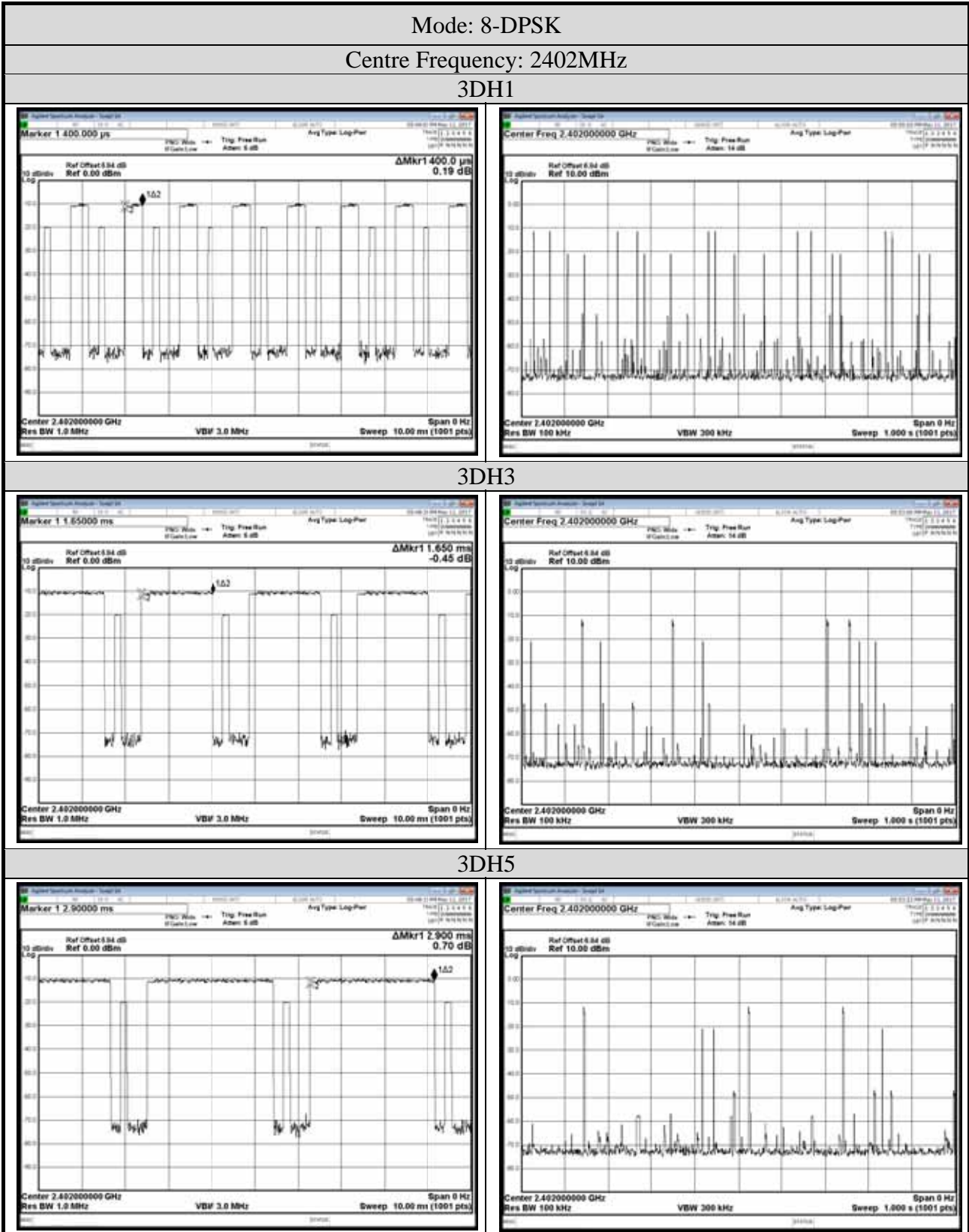
3DH3: For each second of 4 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

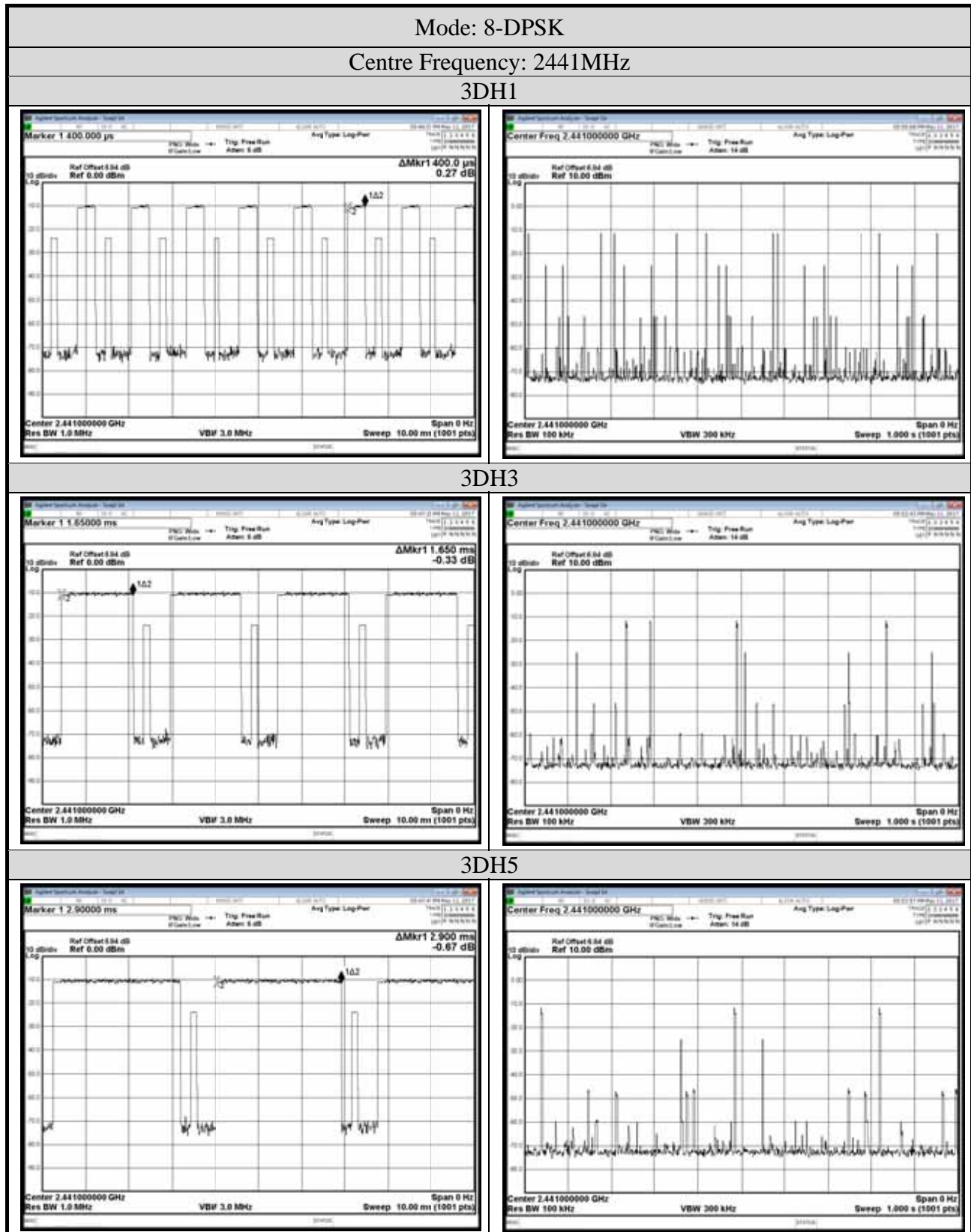
$$4 \text{ channels} * 31.6 \text{ seconds} * 1.650 \text{ ms} = 208.560 \text{ ms}$$

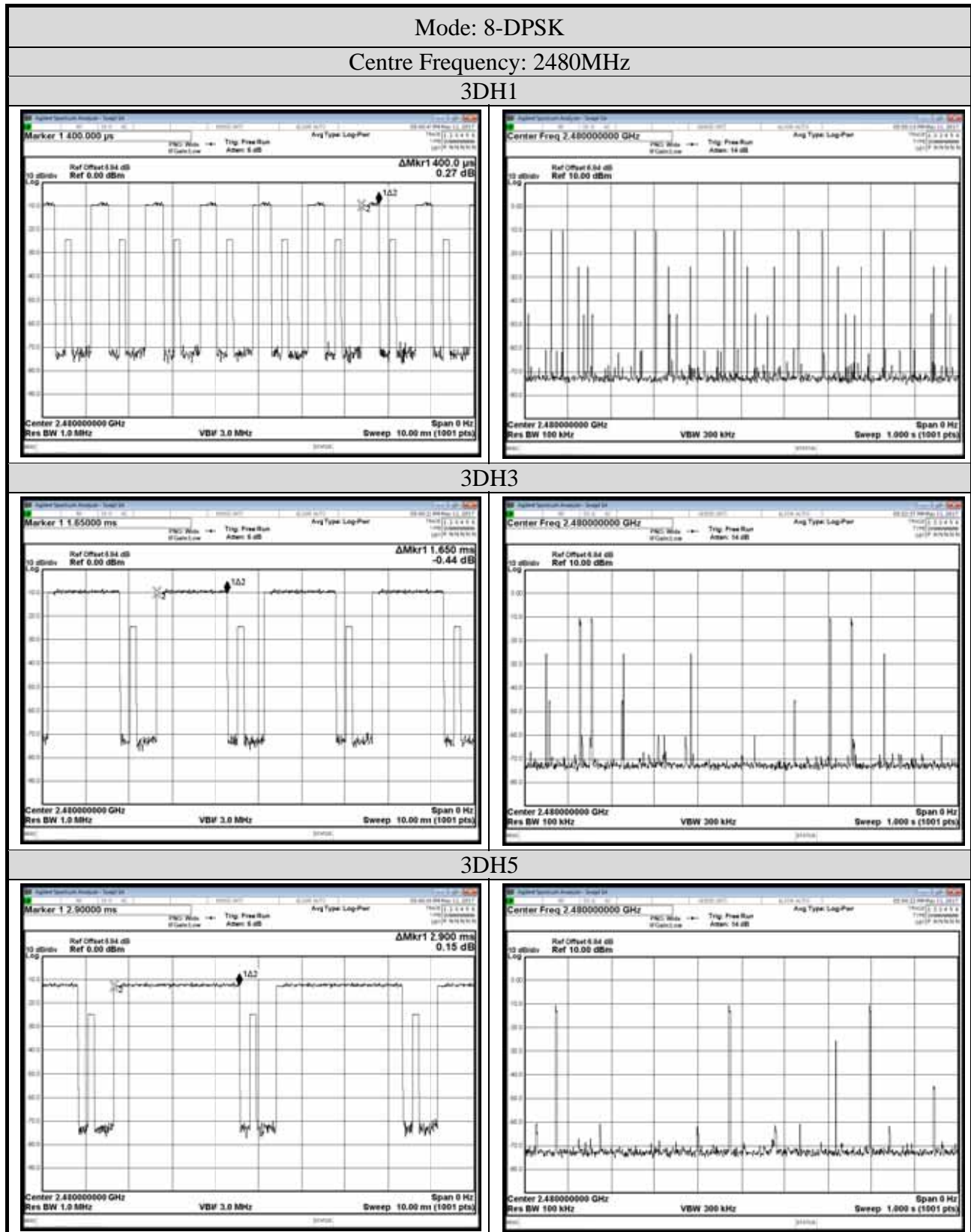
3DH5: For each second of 3 channel appearance, the longest time of occupancy for each of 31.6 seconds is:

$$3 \text{ channels} * 31.6 \text{ seconds} * 2.900 \text{ ms} = 274.920 \text{ ms}$$

● Measurement Plots

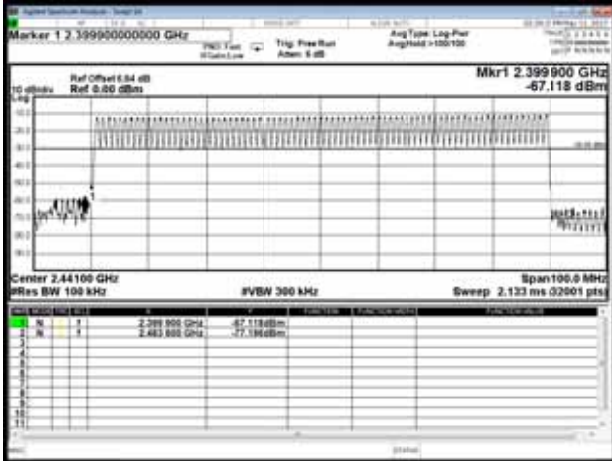
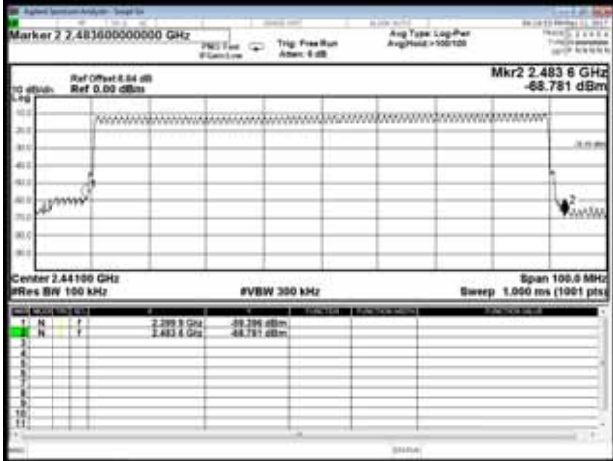






A.6 NUMBER OF HOPPING CHANNELS

Test Date	2017/05/11	Temp./Hum.	26 /42%
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)

Mode: GFSK	Mode: 8-DPSK
	
The number hopping channel is 79.	The number hopping channel is 79.

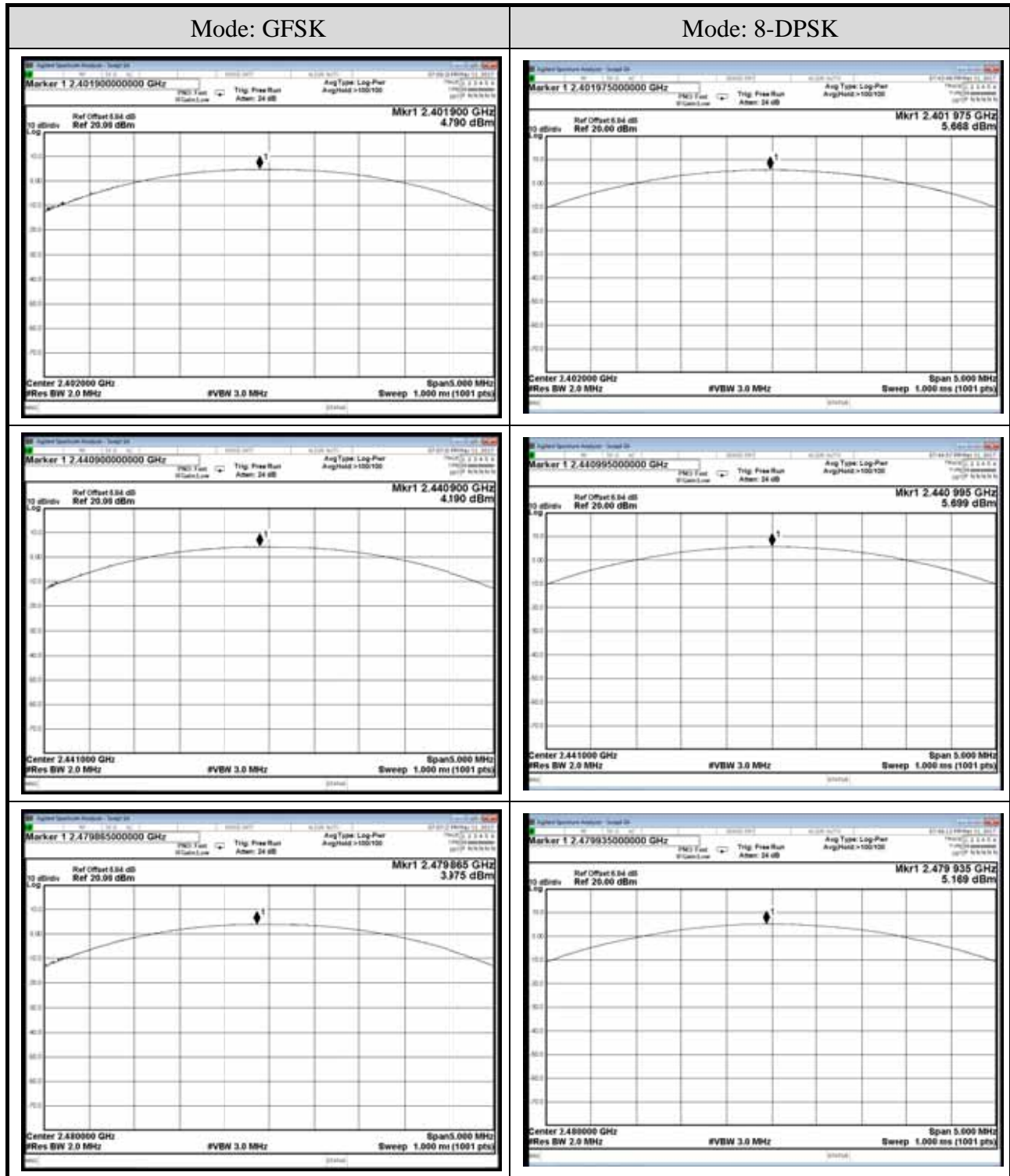
A.7 MAXIMUM PEAK OUTPUT POWER

Test Date	2017/05/11	Temp./Hum.	26 /42%
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)

A.7.1 Maximum Peak Output Power

Modulation	Centre Frequency (MHz)	Maximum Peak Output Power		Limit
		dBm	W	
GFSK	2402	4.790	0.003013	21dBm (0.125W)
	2441	4.190	0.002624	
	2480	3.975	0.002497	
8-DPSK	2402	5.668	0.003688	21dBm (0.125W)
	2441	5.699	0.003714	
	2480	5.169	0.003288	

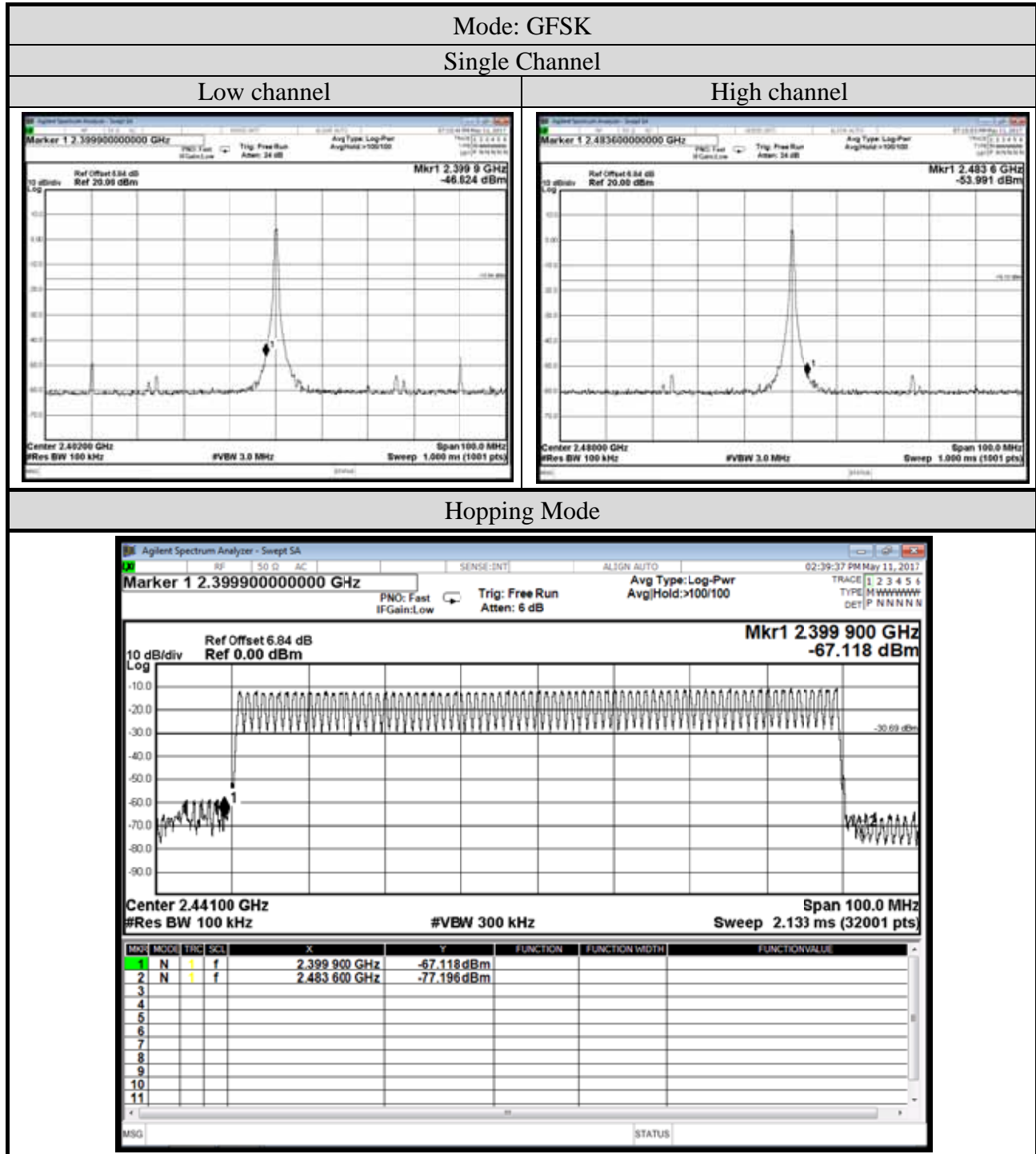
A.7.2 Measurement Plots

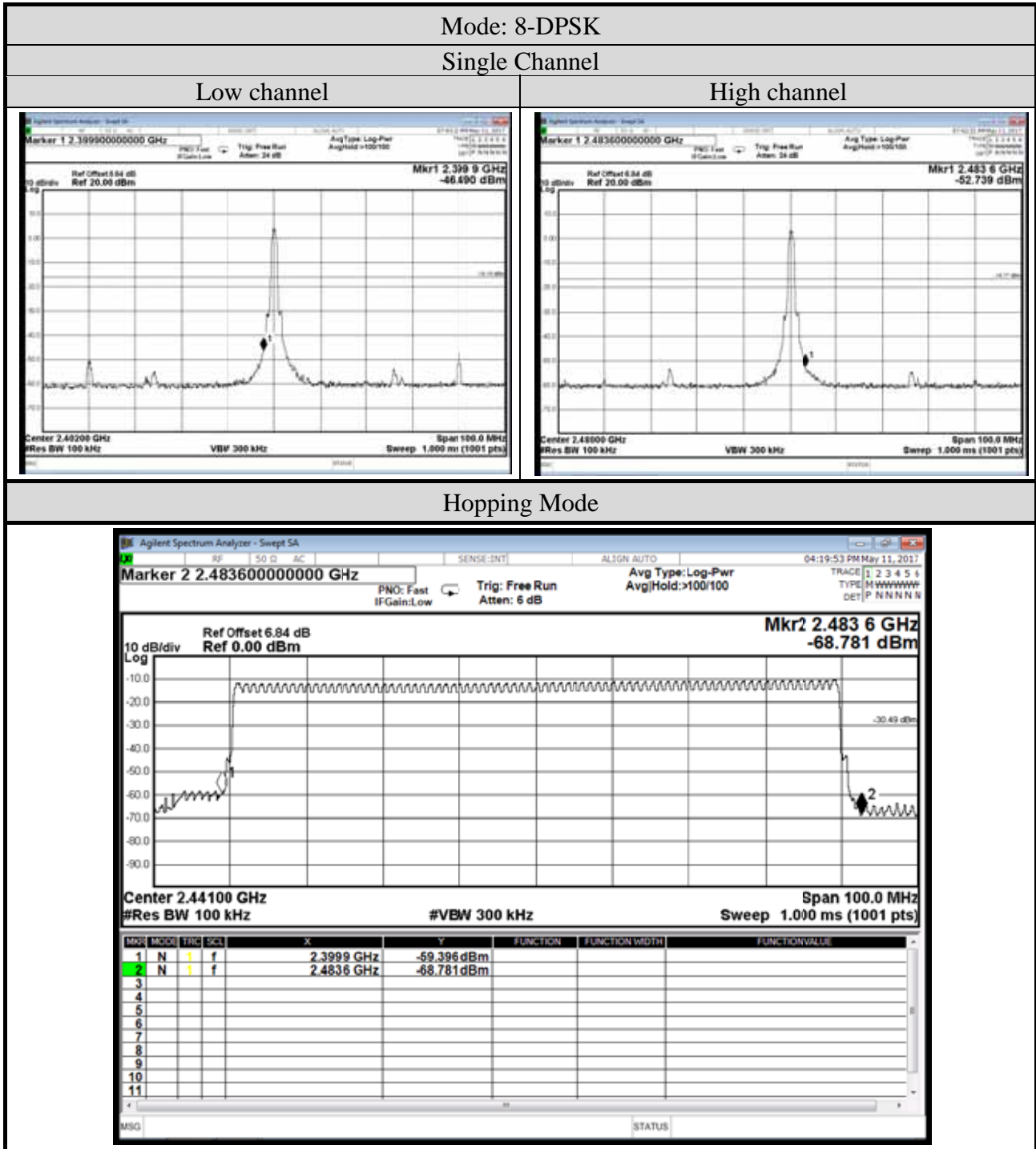


A.8 EMISSION LIMITATIONS MEASUREMENT

Test Date	2017/05/11	Temp./Hum.	26 /42%
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)

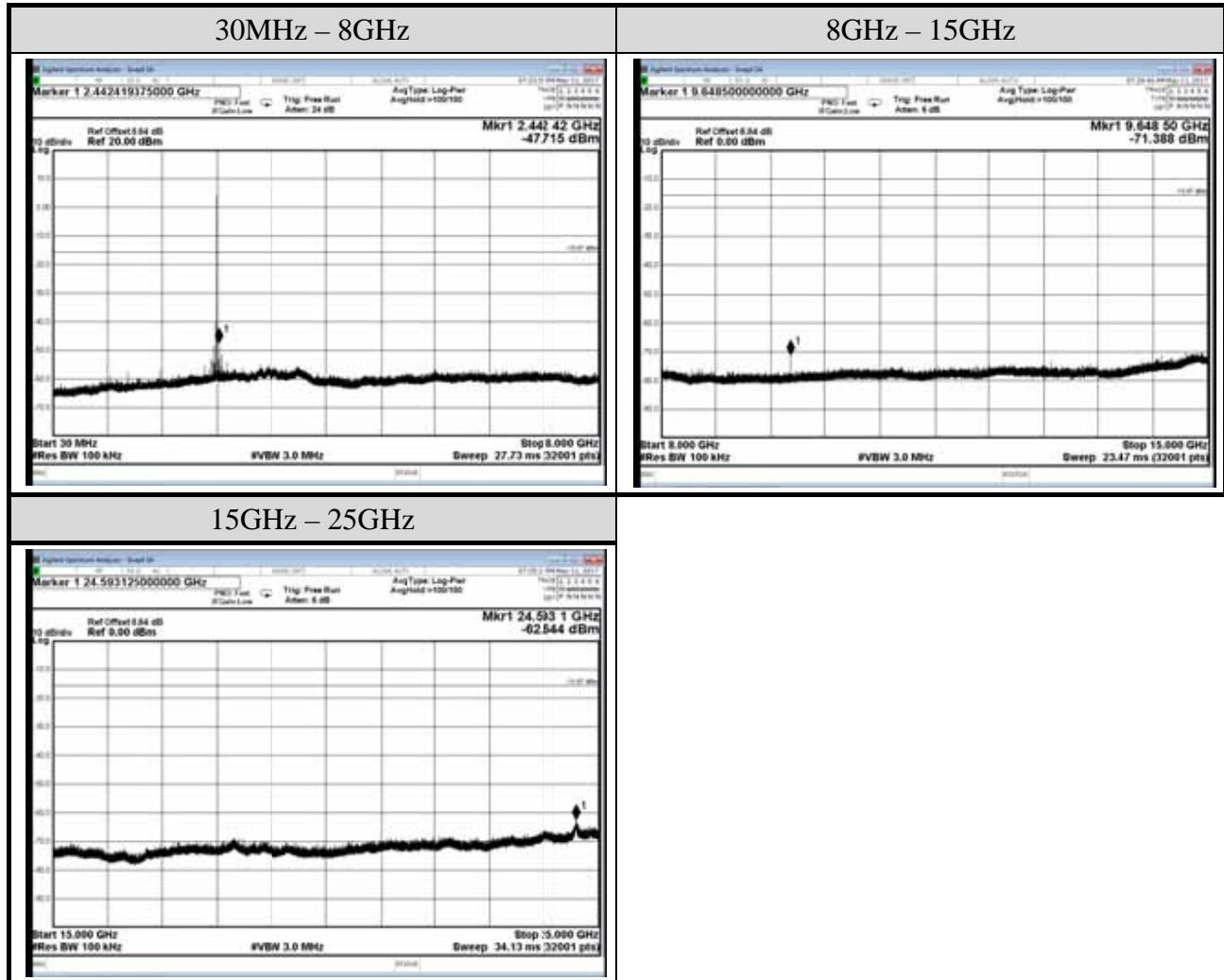
A.8.1 Band Edge





A.8.2 Spurious Emission

Test Date	2017/05/11	Temp./Hum.	26 /42%
Mode	GFSK	Frequency	2402MHz
Cable Loss	6.84B	Test Voltage	AC 120V, 60Hz (Via Power Supply)

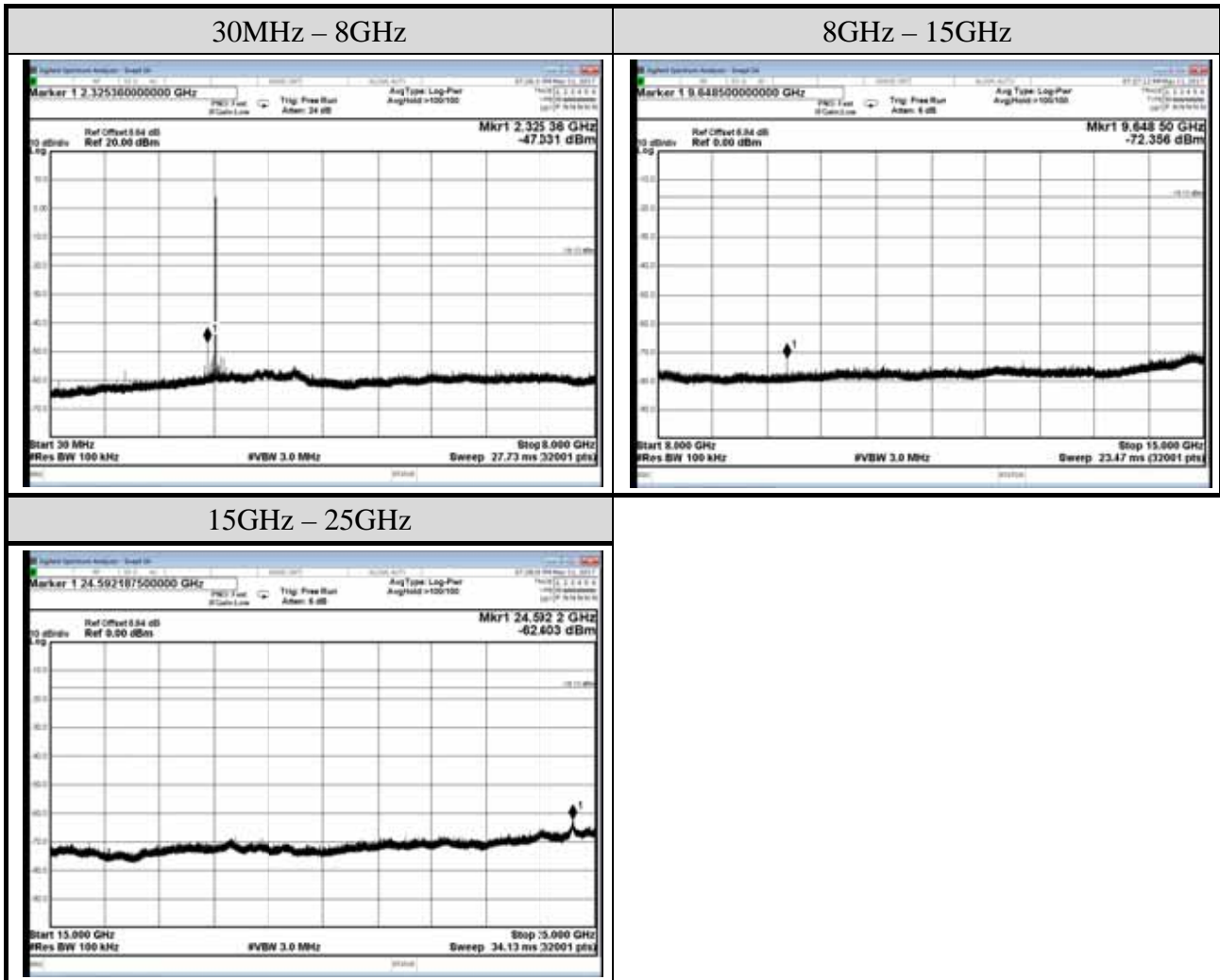


Note: All results have been included cable loss.

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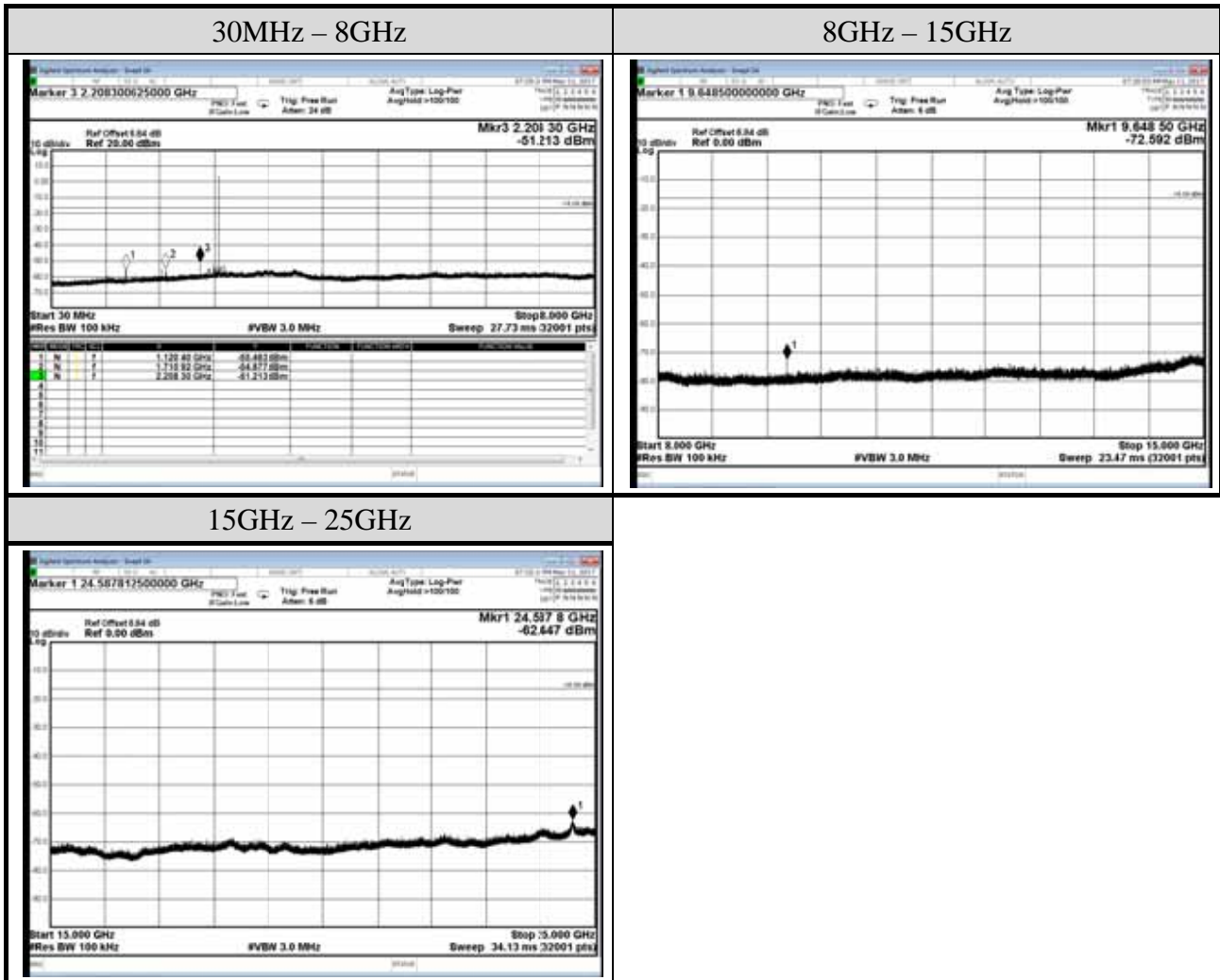
Tel: +886 2 26099301
 Fax: +886 2 26099303

Test Date	2017/05/11	Temp./Hum.	26 /42%
Mode	GFSK	Frequency	2441MHz
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)



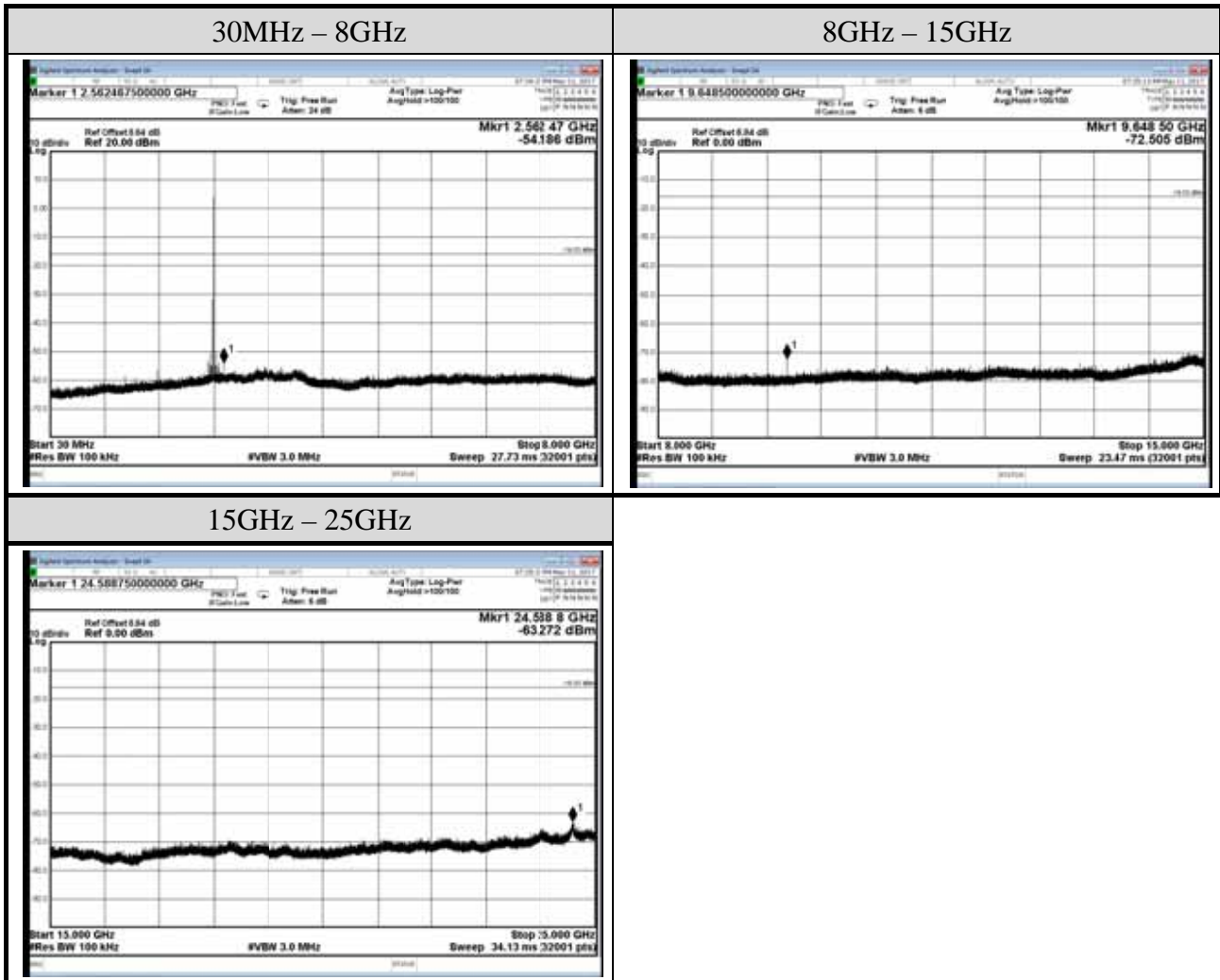
Note: All results have been included cable loss.

Test Date	2017/05/11	Temp./Hum.	26 /42%
Mode	GFSK	Frequency	2480MHz
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)



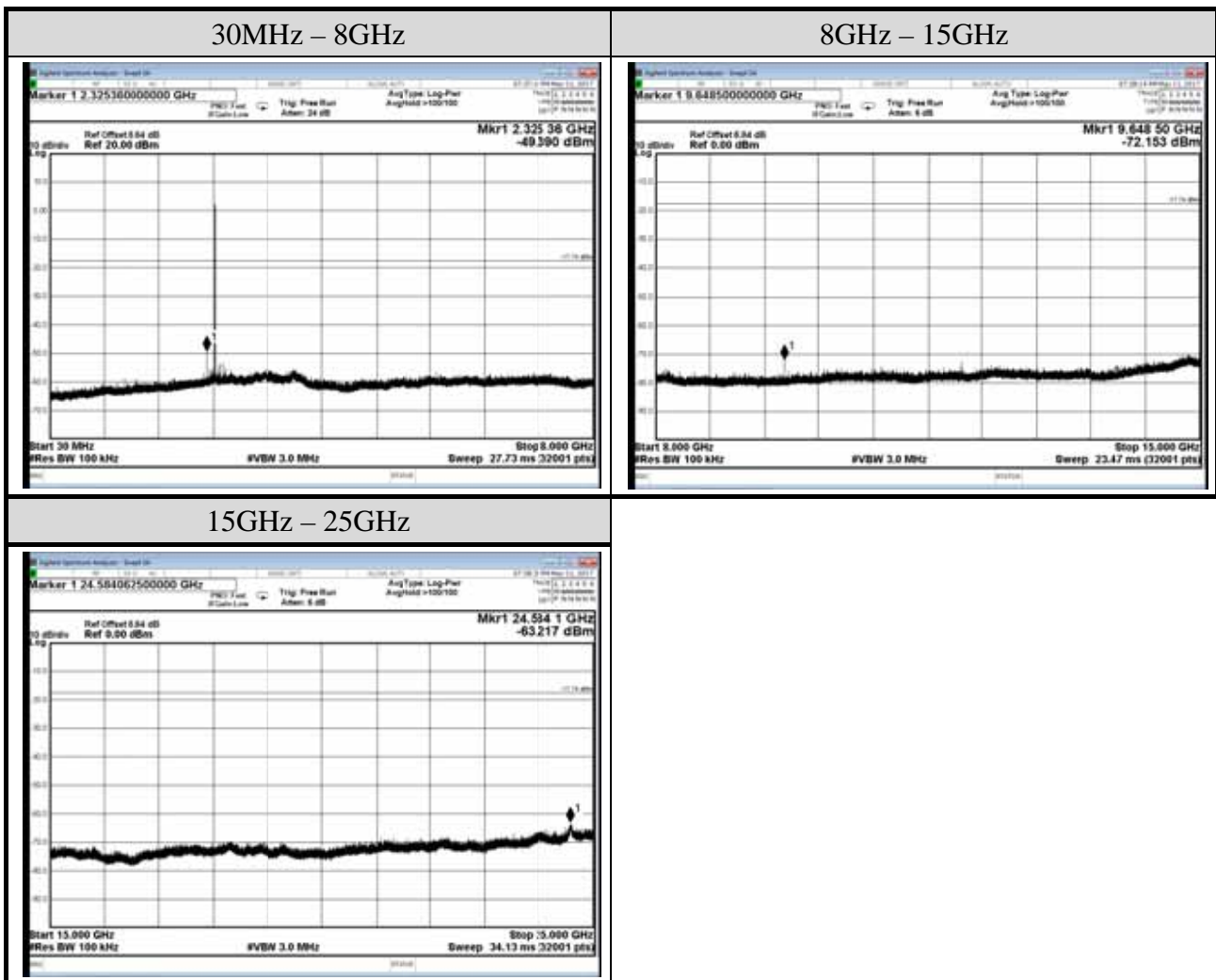
Note: All results have been included cable loss.

Test Date	2017/05/11	Temp./Hum.	26 /42%
Mode	8-DPSK	Frequency	2402MHz
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)



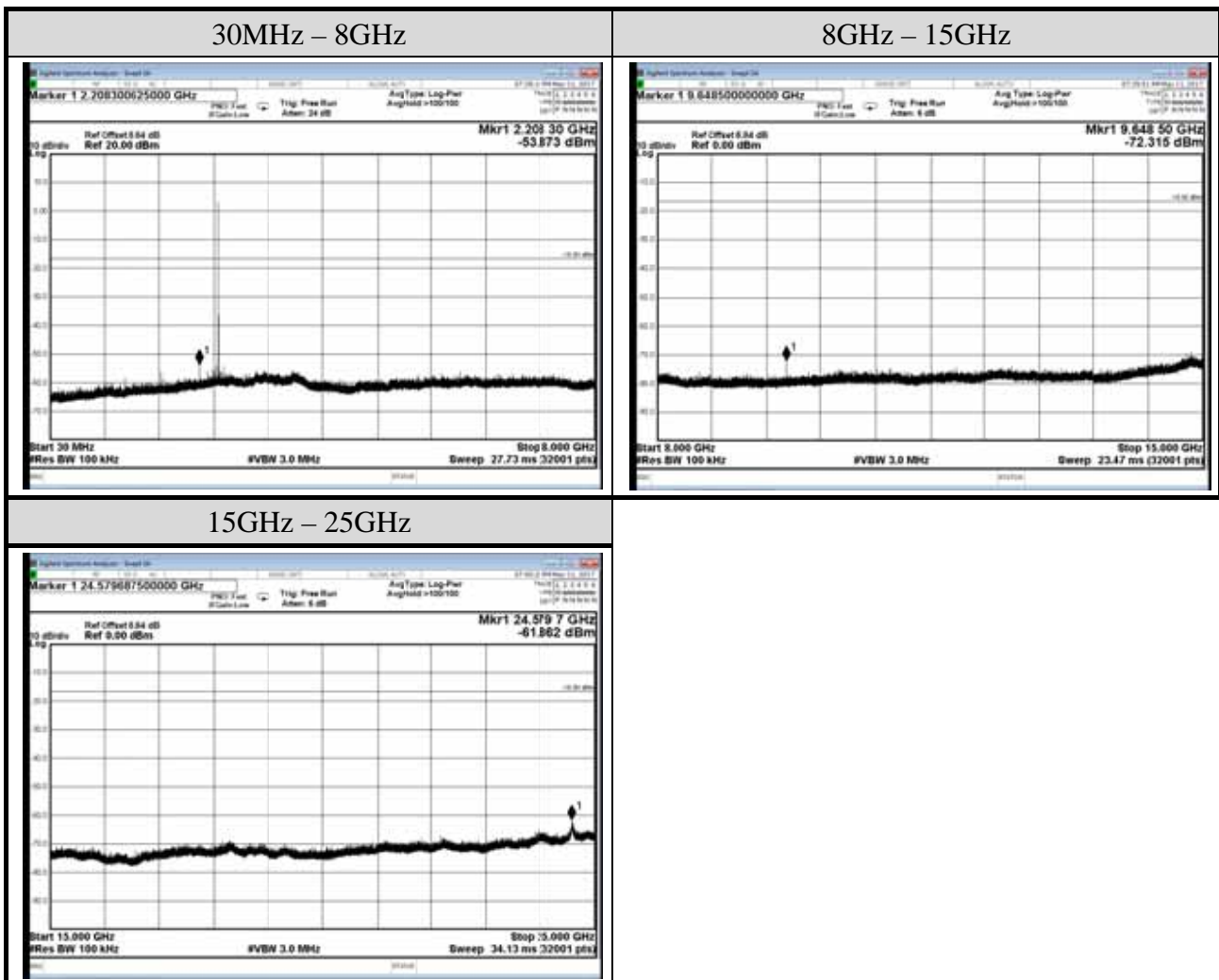
Note: All results have been included cable loss.

Test Date	2017/05/11	Temp./Hum.	26 /42%
Mode	8-DPSK	Frequency	2441MHz
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)



Note: All results have been included cable loss.

Test Date	2017/05/11	Temp./Hum.	26 /42%
Mode	8-DPSK	Frequency	2480MHz
Cable Loss	6.84dB	Test Voltage	AC 120V, 60Hz (Via Power Supply)



Note: All results have been included cable loss.



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APPENDIX B

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APPDNDIX B

TEST PHOTOGRAPHS

(Model: IOT-3352)

B.1 Conducted Emission Measurement



FRONT VIEW



BACK VIEW

B.2 Radiated Measurement at Chamber

Frequency Below to 1GHz



Frequency Above to 1GHz



B.3 RF Conducted Measurement

