

FCC 15.247 2.4GHz Test Report

for

Elitegroup Computer Systems Co., Ltd.

No. 239, Sec. 2., TiDing Blvd., Taipei, Taiwan 11493

Product Name : Ultra tiny PC
Model Name : (1)LIVA Q1AXXXXXX (2)PB01AX
(X=A to Z,a-z,0-9 or blank)
Brand : (1)LIVA (2)ECS
FCC ID : WL6LIVA-Q1APLUS

Prepared by: : AUDIX Technology Corporation,
EMC Department



The test report is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo.
The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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TEST REPORT

Applicant : Elitegroup Computer Systems Co., Ltd.
EUT Description
(1) Product : Ultra tiny PC
(2) Model : (1)LIVA Q1AXXXXX (2)PB01AX (X=A to Z,a-z,0-9 or blank)
(3) Brand : (1)LIVA (2)ECS
(4) Power Supply : DC 12V, 2A

Applicable Standards:

Title 47 CFR FCC Part 15 Subpart C
ANSI C63.10:2013

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: 2021. 05. 31

Reviewed by:

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Date	Revision Summary	Report Number
0	2021. 05. 31	Original Report	EM-F210267

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/Occupied 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	Compliance
Note: The uncertainties value is not used in determining the result.		

3. GENERAL INFORMATION

3.1. Description of Application

Applicant	Elitegroup Computer Systems Co., Ltd. No. 239, Sec. 2., TiDing Blvd., Taipei, Taiwan 11493
Product	Ultra tiny PC
Brand	(1)LIVA (2)ECS
Model	(1)LIVA Q1AXXXXXX (2)PB01AX (X=A to Z,a-z,0-9 or blank) The differences between above models are for marketing purpose. The details of differences description refer to below table 1.

Table 1: Model different list

Marketing Type (Appearance)	Model Series	Brand	IO Board	Mother Board	CPU	Resolution (Display)
Type A	LIVA Q1A	LIVA	AR3288-Q1AIO	AR3288-Q1A	RK3288	HDMI: 4090x2160/60Hz
	PB01A	ECS				
Type B	LIVA Q1A PLUS	LIVA	AR3399-Q1AIO	AR3399-Q1A	RK3399	HDMI: 4090x2160/60Hz DP: 2560x1440/60Hz
	PB01AP	ECS				

Note: Marketing Type A and B used same WLAN Chip on IO Board, difference for some support IO ports and Layout.

3.2. Description of EUT

Test Model	(1)LIVA Q1A (2)LIVA Q1A PLUS		
Serial Number	N/A		
Power Rating	DC 12V, 2A (Refer to AC adapter rating)		
RF Features	WLAN:802.11 b/g/n Bluetooth: BT and BLE (BT 5.2)		
Transmit Type	2.4 GHz		
	802.11b		1T1R
	802.11g		1T1R
	802.11n-HT20		1T1R
	BT/BLE		1T1R
Test Sample	Sample No.	Test Item	Firmware
	03-LIVA Q1A	AC Conduction, RSE, Output Power	N/A
	07-LIVA Q1A PLUS	AC Conduction, RSE	N/A
Sample Status	Mass production		
Date of Receipt	2021. 04. 08		
Date of Test	2021. 04. 28 ~ 05. 12		
Interface Ports of EUT	Marketing Type A Test Model: LIVA Q1A • USB 2.0 Port x3 • Micro USB Port x1 • LAN Port x1 • HDMI Port x1 • Micro SD Slot x1 • DC In Port x1	Marketing Type B Test Model: LIVA Q1A PLUS • USB 2.0 Port x2 • USB 3.0 Port x1 • LAN Port x1 • HDMI Port x1 • DP Port x1 • Micro SD Slot x1 • DC In Port x1	
Accessories Supplied	• AC Adapter • VESA Mount		

3.3. Reference Test Guidance

None

3.4. Antenna Information

Antenna Part Number	Supplier	Antenna Type	Frequency (MHz)	Max Gain(dBi)
T-543-9291173-1	Linking	PIFA Antenna	2400~2500	1.83

3.5. 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)	Channel Number	Frequency (MHz)
00	2402	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	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		

3.6. Descriptions of Key Components

Marketing Type A

Item	Supplier	Model / Type	Character
Mother Board	ECS	AR3288-Q1A	
CPU	Rockchip	RK3288	1.6GHz (Socket: FCBGA 636P)
eMMC (Storage)	BIWIN	BWCTASC11P32G	32GB
DRAM	BIWIN	BW52L256M32D1P	LPDDR3 1600MHz 2GB
WLAN+BT(Combo card)	AMPAK	AP6236	802.11 b/g/n+BT 5.2 +BLE
Antenna	Linking	T-543-9291173-1	Black, PIFA Antenna
Adapter (Wall-mounted 2C)	APD	WB-24J12R	I/P: 100-240Vac, 50-60Hz, 0.7A Max. O/P: 12Vdc, 2.0A BSMI: R43017
	DC Power Cord: Non-Shielded, Undetached, 1.0m		

Remark: For more detailed features description, please refer to the manufacturer's specifications or the user manual.

Marketing Type B

Item	Supplier	Model / Type	Character
Mother Board	ECS	AR3399-Q1A	
CPU	Rockchip	RK3399	1.4GHz (Socket: FCBGA 828P)
eMMC (Storage)	Kingston	EMMC32G-TA28	32GB
DRAM	BIWIN	BW52L256M32D1P	LPDDR3 1600MHz 2GB
WLAN+BT(Combo card)	AMPAK	AP6236	802.11 b/g/n+BT 5.2 +BLE
Antenna	Linking	T-543-9291173-1	Black, PIFA Antenna
Adapter (Wall-mounted 2C)	APD	WB-24J12R	I/P: 100-240Vac, 50-60Hz, 0.7A Max. O/P: 12Vdc, 2.0A BSMI: R43017
	DC Power Cord: Non-Shielded, Undetached, 1.0m		

Remark: For more detailed features description, please refer to the manufacturer's specifications or the user manual.

3.7. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Correction Factor (dB)
BT	N/A	2.930	N/A

AC Conduction
Normal operation

Item		Modulation	Data Rate	Test Channel
Radiated Test Case	Radiated Band Edge ^{Note 1 & 2}	8-DPSK	3Mbps	00/78
	Radiated Spurious Emission ^{Note 1 & 2}	8-DPSK	3Mbps	00/39/78
Conducted Test Case	20dB/Occupied 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. The worst scenario for Radiated Spurious Emission as follow: ☐ Lie ☐ Side ☐ Stand

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

Note 3: The marketing Type A (Test Model: LIVA Q1A) and Type B (Test model: LIVA Q1A PLUS) device embedded same WLAN+BT(Combo card). So we select the test model LIVA Q1A to measurement all RF conducted test items.

3.8. Output Power Setting

Mode	Centre Frequency (MHz)	Power Setting	
		GFSK	8-DPSK
BLE	2402	default	default
	2440	default	default
	2480	default	default

3.9. Tested Supporting System List

3.9.1. Support Peripheral Unit

Test Model: LIVA Q1A					
No.	Product	Brand	Model No.	Serial No.	Approval
1.	LCD Monitor	DELL	U2718Qb	N/A	FCC By DoC
2.	USB Mouse	acer	SM-9020 B	N/A	FCC By DoC
3.	Notebook PC	HP	HSTNN-Q98C	N/A	FCC By DoC
Test Model: LIVA Q1A PLUS					
No.	Product	Brand	Model No.	Serial No.	Approval
1.	LCD Monitor	DELL	U2718Qb	N/A	FCC By DoC
2.	Notebook PC	HP	HSTNN-Q98C	N/A	FCC By DoC
3.	USB Mouse (Emission Test Used)	acer	SM-9020 B	N/A	FCC By DoC
4.	USB Dongle (Emission Test Used)	SanDisk	SDCZ48-O32G	N/A	N/A

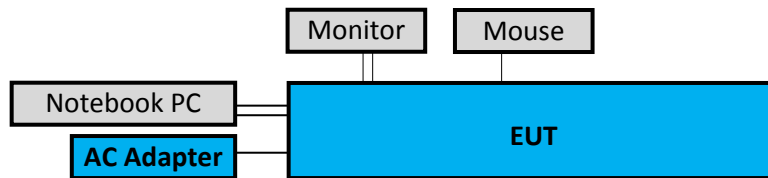
3.9.2. Cable Lists

Test Model: LIVA Q1A	
No.	Cable Description Of The Above Support Units
1.	HDMI Cable: Shielded, Detachable, 1.8m AC Power Cord: Unshielded, Detachable, 1.8m
2.	USB Cable: Unshielded, Undetachable, 1.8m
3.	Micro USB Cable (Emission Test Used): HTC, M/N: M410 Micro USB, 1.2m LAN Cable: Shielded, Detachable, 1.8m AC adapter: hp, M/N PPP-012C-S DC Power Cord: Unshielded, Detachable, 1.8m with a core AC Power Cord: Unshielded, Detachable, 1.8m
Test Model: LIVA Q1A PLUS	
No.	Cable Description Of The Above Support Units
1.	DP Cable (Emission Test Used): Shielded, Detachable, 1.8m HDMI Cable: Shielded, Detachable, 1.8m AC Power Cord: Unshielded, Detachable, 1.8m
2.	LAN Cable (Emission Test Used): Shielded, Detachable, 1.8m AC adapter: hp, M/N PPP-012C-S DC Power Cord: Unshielded, Detachable, 1.8m with a core AC Power Cord: Unshielded, Detachable, 1.8m
3.	USB Cable: Unshielded, Undetachable, 1.8m
4.	---

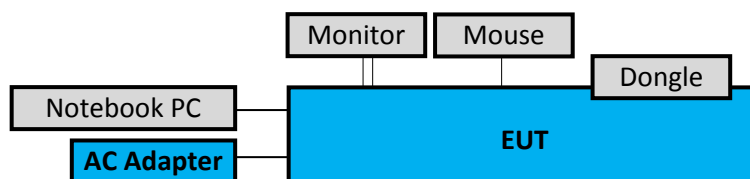
3.10. Setup Configuration

3.10.1. EUT Configuration for Power Line & Radiated Emission

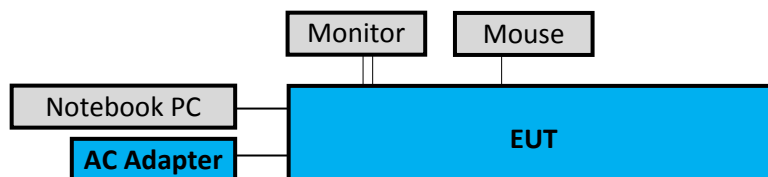
Test Model: LIVA Q1A



Test Model: LIVA Q1A PLUS



3.10.2. EUT Configuration for RF Conducted Test Items



3.11. Operating Condition of EUT

Test program “RF Test Tool” is used for enabling EUT BT function under continues transmitting and choosing data rate/ channel.

3.12. Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 491, Zhongfu Rd., Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: attemc_report@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2017 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724
Test Facilities	FCC OET Designation Number under APEC MRA by NCC is : TW1724 ISED CAB Identifier Number under APEC TEL MRA by NCC is TW1724 (1) No.8 Shielded Room (2) No.1 3m Semi Anechoic Chamber (3) Fully Anechoic Chamber

3.13.Measurement Uncertainty

Test Items/Facilities			Frequency Range	Uncertainty
Conduction Test			9kHz-150kHz	±3.7dB
			150kHz-30MHz	±3.4dB
Radiation Test	☒	No.1 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.8dB
			200MHz-1000MHz, 3m, Horizontal	±4.1dB
			30MHz-200MHz, 3m, Vertical	±4.5dB
			200MHz-1000MHz, 3m, Vertical	±4.5dB
			1GHz-6GHz, 3m	±4.7dB
			6GHz-18GHz, 3m	±4.1dB
	☐	No.3 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.9dB
			200MHz-1000MHz, 3m, Horizontal	±4.2dB
			30MHz-200MHz, 3m, Vertical	±4.3dB
			200MHz-1000MHz, 3m, Vertical	±4.5dB
	☐	No.4 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.1dB
			200MHz-1000MHz, 3m, Horizontal	±4.5dB
			30MHz-200MHz, 3m, Vertical	±4.4dB
			200MHz-1000MHz, 3m, Vertical	±4.8dB
			1GHz-6GHz, 3m	±5.0dB
			6GHz-18GHz, 3m	±4.7dB
	☐	No.5 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.2dB
			200MHz-1000MHz, 3m, Horizontal	±4.3dB
			30MHz-200MHz, 3m, Vertical	±4.3dB
			200MHz-1000MHz, 3m, Vertical	±4.7dB
			1GHz-6GHz, 3m	±4.8dB
			6GHz-18GHz, 3m	±4.5dB
	☒	Fully Anechoic Chamber	30MHz~1000MHz	±4.6dB
			1GHz~18GHz	±5.4dB
			18GHz~40GHz	±3.52dB
			40GHz~260GHz	±3.56dB

Remark : Uncertainty = $ku_c(y)$

Test Item	Uncertainty
20dB Bandwidth	±0.2kHz
99% Occupied Bandwidth	±0.38%
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	2021.02.02	1 Year
2.	A.M.N.	R&S	ENV432	101567	2021.04.21	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2020.12.10	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2021.01.04	1 Year
5.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.8 S/R	2021.04.15	1 Year
6.	Coaxial Cable	Yeida	RG/58AU	CE-08	2020.09.19	1 Year
7.	Test Software	Audix	e3	V6.120619c	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	2020.09.16	1 Year
2.	Spectrum Analyzer	Agilent	N9030A-526	MY53310269	2021.01.14	1 Year
3.	Test Receiver	R&S	ESCS30	100039	2020.06.05	1 Year
4.	Amplifier	HP	8447D	2944A07178	2020.04.29	1 Year
5.	Microwave Amplifier	Keysight	83051A	MY53010042	2020.08.05	1 Year
6.	Microwave Amplifier	Agilent	8449B	3008A02678	2021.02.27	1 Year
7.	Loop Antenna	R&S	HFH2-Z2	891847/27	2019.12.26	2 Years
8.	Bilog Antenna	TESEQ	CBL6112D	33821	2021.01.15	1 Year
9.	Horn Antenna	ETS-Lindgren	3117	00135902	2020.03.10	1 Year
10.	Horn Antenna	COM-POWER	AH-840	101092	2020 05.08	1 Year
11.	2.4GHz Notch Filter	K&L Microwave	7NSL10-2441.5 /E130.5-O/O	1	2020 07.24	1 Year
12.	3GHz Notch Filter	Microwave	H3G018G1	484796	2020.08.20	1 Year
13.	Coaxial Cable	MIYAZAKI	5D2W	CLAMP-01	2020.09.19	1 Year
14.	Coaxial Cable	MIYAZAKI	5D2W	RE-11	2021.01.29	1 Year
15.	Coaxial Cable	HUBER+ SUHNER	SUCOFLEX 104	RE-29	2020.09.19	1 Year
16.	Coaxial Cable	HUBER+ SUHNER	SUCOFLEX 102	RE-30	2020.09.19	1 Year
17.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.1 3m A/C	2020.04.17	1 Year
18.	Digital Thermo-Hygro Meter	EVERY DAY	E-512	RF-02	2020.04. 17	1 Year
19.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.
20.	Test Software	Audix	e3	V6.110601	N.C.R.	N.C.R.

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4.3.RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9020B-544	MY57120357	2021.01.06	1 Year
2.	Digital Thermo-Hygro Meter	Shenzhen Datronn Electronics	KT-905	RF	2020.04.17	1 Year

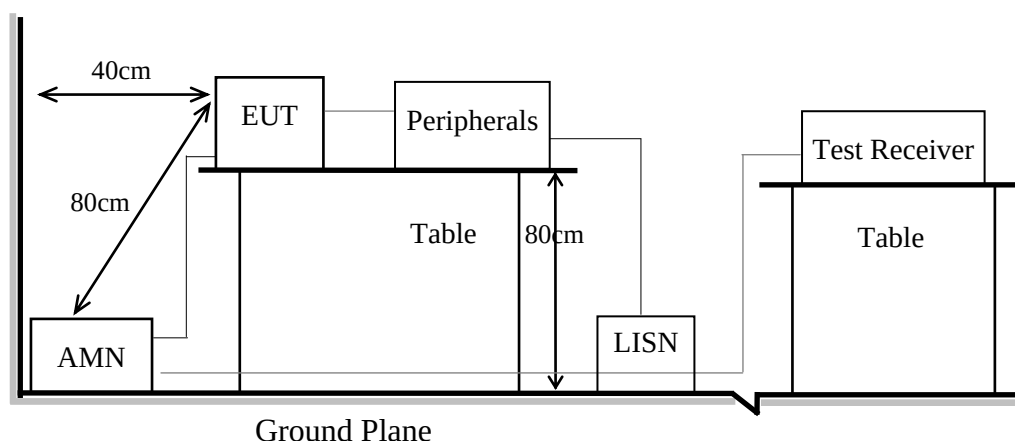
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.10

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

Remark1.: 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 C63.10. 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 150kHz to 30 MHz and record the emission which does not have 20 dB below limit.

5.4. Test Results

Please refer to Appendix A.

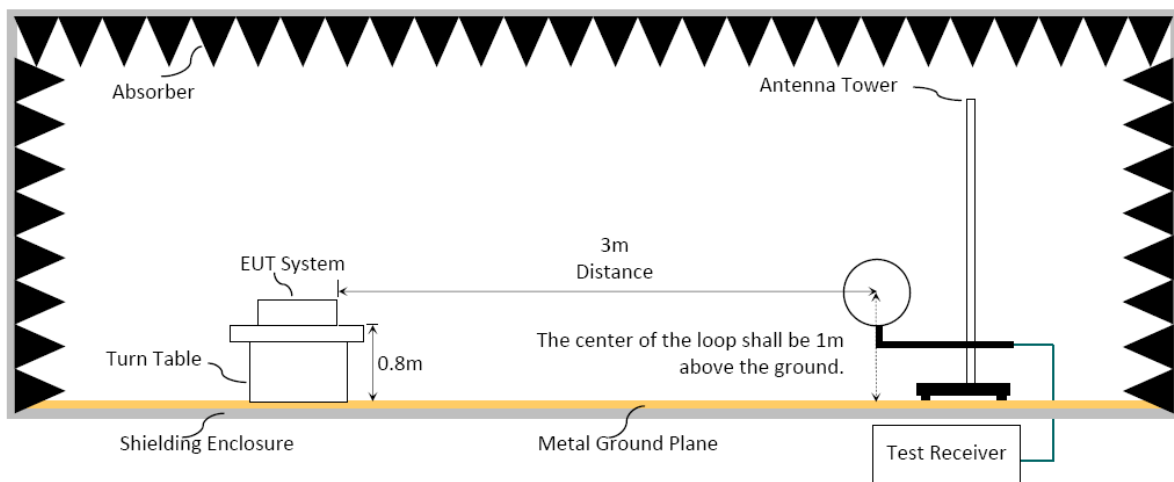
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

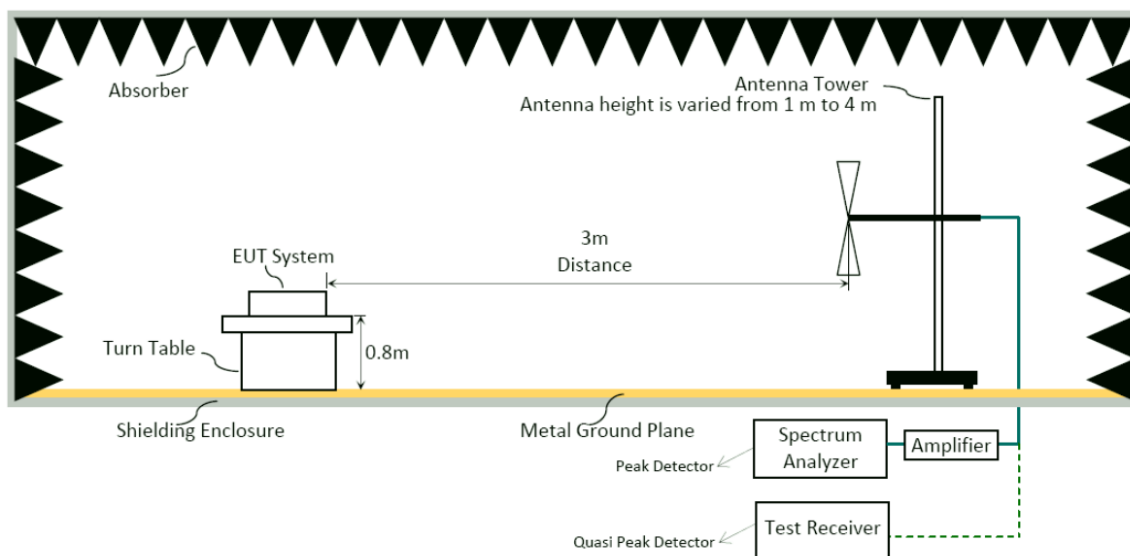
6.1.1. Block Diagram of EUT

Indicated as section 3.10

6.1.2. Setup Diagram for 9kHz-30MHz

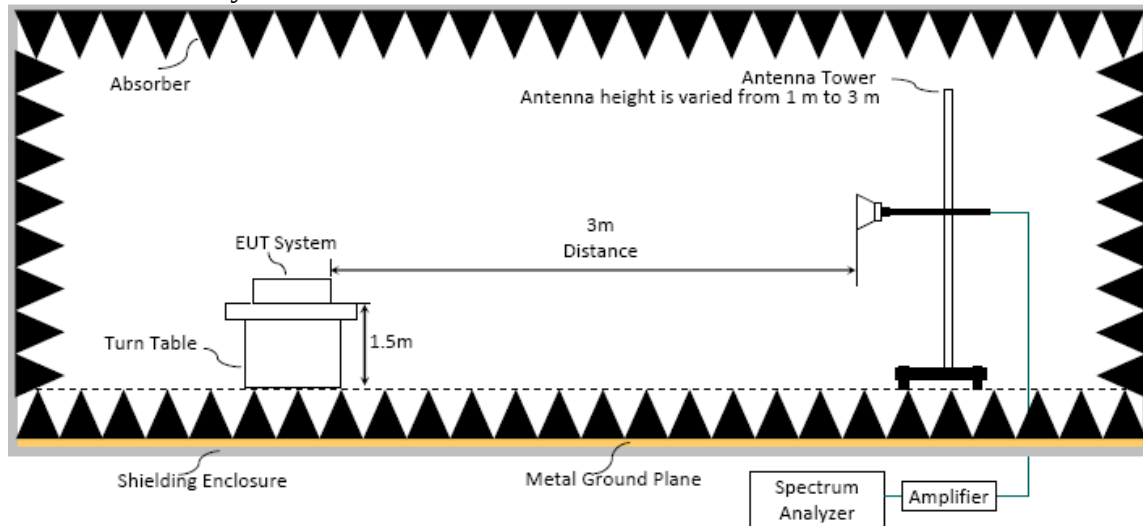


6.1.3. Setup Diagram for 30-1000MHz

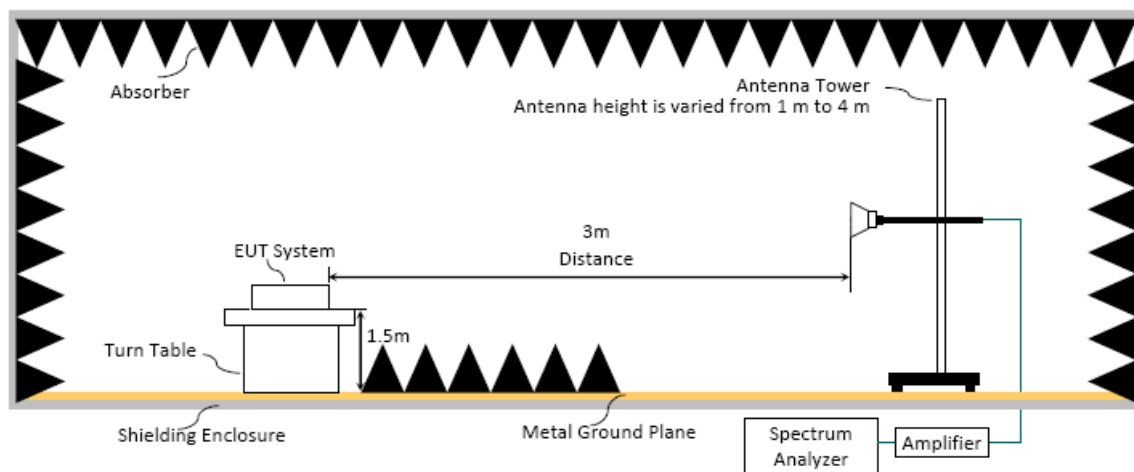


6.1.4. Setup Diagram for above 1GHz

Fully Anechoic Chamber



Semi Anechoic Chamber



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 Section 8.10 table 6, 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	67.6-20 log f(kHz)	2400/f kHz
0.490 - 1.705	30	87.6-20 log f(kHz)	24000/f 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 turntable 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 C63.10:2020 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 table which has 80cm (for 30-1000MHz) 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 (for 30-1000MHz) and from 1m to 3m (for above 1GHz at fully Anechoic Chamber) or from 1 m to 4 m (for above 1GHz at Semi Anechoic Chamber) 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 1GHz:

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.

Note 1: When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required, otherwise using Q.P. for final measurement.

Note 2: When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

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.

Note: When peak-detected value is lower than limit that the measurement using the average detector is not required, otherwise using average detector for final 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 (including Preamp factor if test used)

☒ Average Emission Level = Antenna Factor + Cable Loss + Meter Reading (including Preamp factor if test used)

☐ Average Emission Level = Peak Emission Level + DCCF

Duty Cycle Correction Factor (DCCF) = $20\log(TX_{on}/TX_{on+off})$ presented in section 3.7

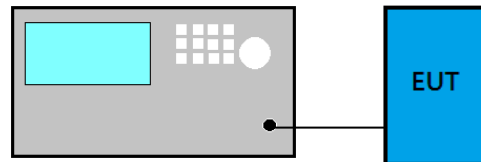
☐ ERP = Peak Emission Level - 95.2dB - 2.14dB

6.5. Test Results

Please refer to Appendix A.

7. 20dB/OCCUPIED 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 ANSI C63.10:2020:

For 20dB Bandwidth

- (1) Set Span range 2~5 times the OBW
- (2) Set $VBW \geq 3 \times RBW$.
- (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.

For 99% Occupied Bandwidth

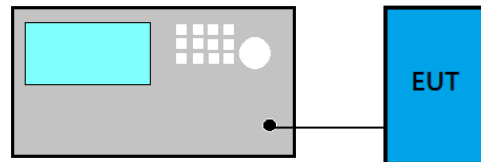
- (8) Set Span range 1.5~5 times the OBW
- (9) Set RBW close to 1% to 5% of OBW.
- (10) Set $VBW \geq 3 \times RBW$.
- (11) Detector = Peak.
- (12) Trace mode = Max hold
- (13) Sweep = Auto couple.
- (14) Allow the trace to stabilize.

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 ANSI C63.10:2020:

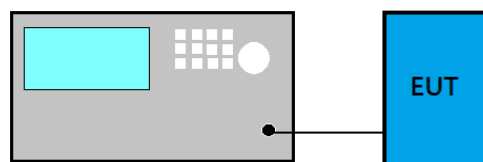
- (1) Span = Wide enough to capture the peaks of two adjacent channels
- (2) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- (3) $VBW \geq RBW$
- (4) Sweep = Auto
- (5) Detector function = Peak
- (6) Trace = Max hold
- (7) Allow the trace to stabilize.

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 ANSI C63.10:2020:

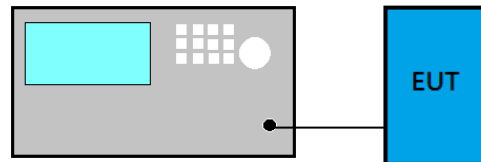
- (1) Span: Zero span, centered on a hopping channel.
- (2) RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel.
- (3) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- (4) Detector function = Peak
- (5) 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 ANSI C63.10:2020:

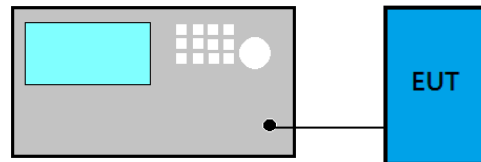
- (1) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- (2) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- (3) VBW $\geq$ RBW
- (4) Sweep = Auto
- (5) Detector function = Peak
- (6) Trace = m=Max hold
- (7) Allow the trace to stabilize.

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 ANSI C63.10:2020:

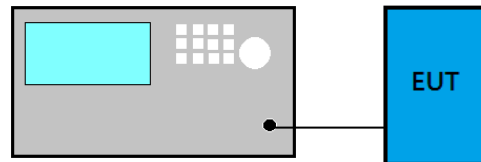
- (a) Use the following spectrum analyzer settings
 - (1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
 - (2) RBW > 20 dB bandwidth of the emission being measured.
 - (3) VBW $\geq$ RBW
 - (4) Sweep: Auto
 - (5) Detector function: Peak
 - (6) Trace: Max hold
- (b) Allow trace to stabilize.
- (c) Use the marker-to-peak function to set the marker to the peak of the emission.

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) Section 8.9 table 4 is not required. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a) Section 8.10 table 6,, must also comply with the radiated emission limits specified in Section 15.209(a) Section 8.9 table 4 (See Section 15.205(c)).

12.3.Test Procedure

Following measurement procedure is reference to ANSI C63.10:2020:

- (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



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13.DEVIATION TO TEST SPECIFICATIONS

【NONE】



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APPENDIX A

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APPDNDIX A

TEST DATA AND PLOTS

(Model: (1)LIVA Q1A (2)LIVA Q1A PLUS)

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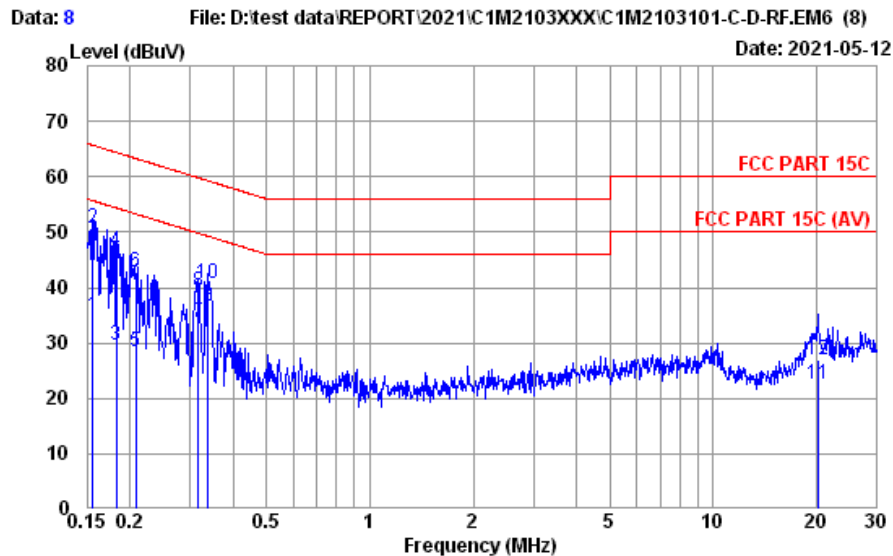
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A.1 CONDUCTED EMISSION

Test Date	2021/05/12	Temp./Hum.	26°C/50%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Tested By	Roy Hung
		Test Model	LIVA Q1A



Site No. : No.8 Shielded Room Data No. : 8
Instrument 1 : Receiver ESR3(774)
Instrument 2 : ENH432 (567)(A)|CE-08|ESH3-Z2 (354)
Limit : FCC PART 15C Phase : NEUTRAL
Environment : 26°C / 50% Engineer : Roy Hung
EUT Model : LIVA Q1A Test Rating : 120Vac/60Hz
Test Mode : Operating

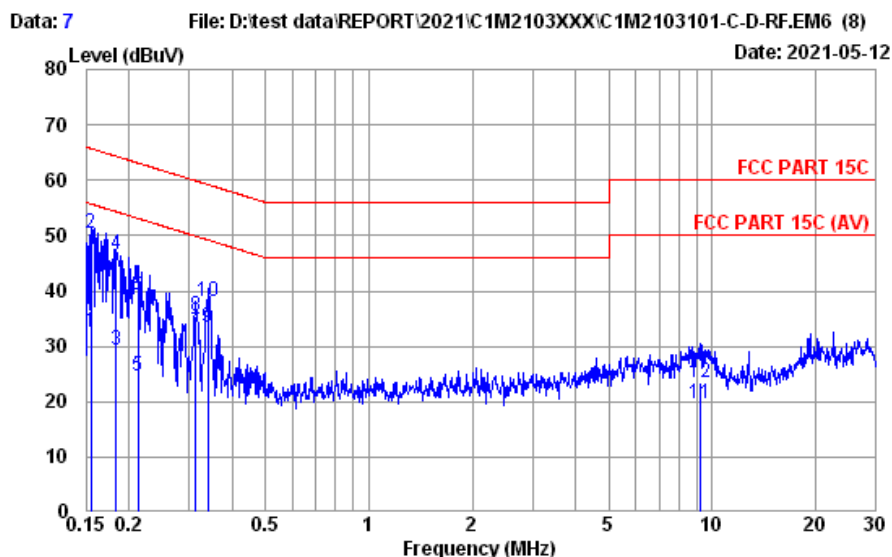
	Freq. (MHz)	AMM Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.156	10.20	0.03	9.85	14.78	34.86	55.69	20.83	Average
2	0.156	10.20	0.03	9.85	30.68	50.76	65.69	14.93	QP
3	0.182	10.20	0.03	9.85	9.61	29.69	54.37	24.68	Average
4	0.182	10.20	0.03	9.85	26.56	46.64	64.37	17.73	QP
5	0.208	10.20	0.03	9.85	8.46	28.54	53.27	24.73	Average
6	0.208	10.20	0.03	9.85	22.84	42.92	63.27	20.35	QP
7	0.317	10.20	0.03	9.85	13.64	33.72	49.80	16.08	Average
8	0.317	10.20	0.03	9.85	19.33	39.41	59.80	20.39	QP
9	0.337	10.20	0.03	9.85	16.65	36.73	49.27	12.54	Average
10	0.337	10.20	0.03	9.85	20.76	40.84	59.27	18.43	QP
11	20.162	10.90	0.20	9.94	1.63	22.67	50.00	27.33	Average
12	20.162	10.90	0.20	9.94	5.87	26.91	60.00	33.09	QP

Remarks: 1. Emission Level= AMM Factor + Cable Loss + Pulse Att. + Reading.

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Test Date	2021/05/12	Temp./Hum.	26°C/50%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Tested By	Roy Hung
		Test Model	LIVA Q1A



Site No. : No.8 Shielded Room Data No. : 7
Instrument 1 : Receiver ESR3(774)
Instrument 2 : ENH432 (567)(A)|CE-08|ESH3-Z2 (354)
Limit : FCC PART 15C Phase : LINE
Environment : 26°C / 50% Engineer : Roy Hung
EUT Model : LIVA Q1A Test Rating : 120Vac/60Hz
Test Mode : Operating

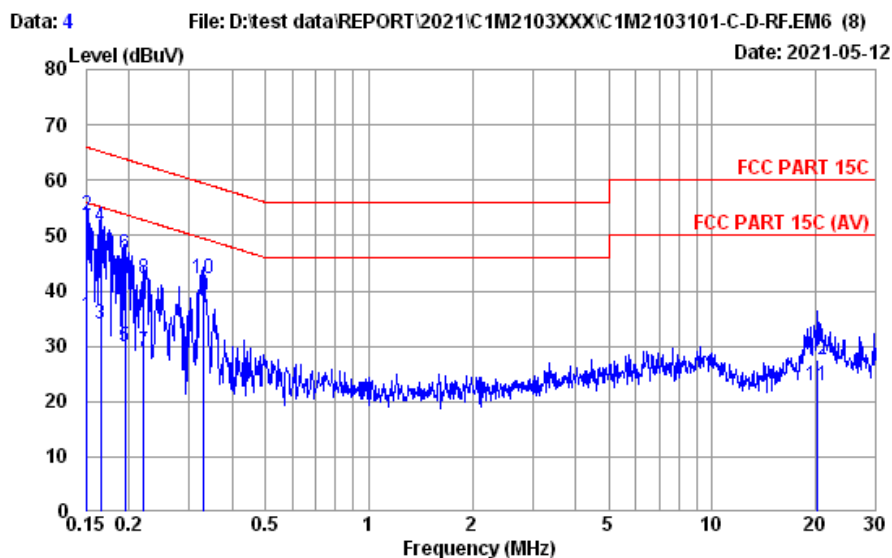
	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.155	10.20	0.03	9.85	12.53	32.61	55.74	23.13	Average
2	0.155	10.20	0.03	9.85	30.33	50.41	65.74	15.33	QP
3	0.183	10.20	0.03	9.85	9.18	29.26	54.33	25.07	Average
4	0.183	10.20	0.03	9.85	26.49	46.57	64.33	17.76	QP
5	0.213	10.20	0.03	9.85	4.44	24.52	53.10	28.58	Average
6	0.213	10.20	0.03	9.85	19.24	39.32	63.10	23.78	QP
7	0.313	10.20	0.03	9.85	12.44	32.52	49.88	17.36	Average
8	0.313	10.20	0.03	9.85	15.30	35.38	59.88	24.50	QP
9	0.339	10.20	0.03	9.85	13.42	33.50	49.22	15.72	Average
10	0.339	10.20	0.03	9.85	18.12	38.20	59.22	21.02	QP
11	9.204	10.38	0.13	9.88	-0.76	19.63	50.00	30.37	Average
12	9.204	10.38	0.13	9.88	3.06	23.45	60.00	36.55	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.

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Test Date	2021/05/12	Temp./Hum.	26°C/50%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Tested By	Roy Hung
		Test Model	LIVA Q1A PLUS



Site No. : No.8 Shielded Room Data No. : 4
Instrument 1 : Receiver ESR3(774)
Instrument 2 : ENH432 (567)(A)|CE-08|ESH3-Z2 (354)
Limit : FCC PART 15C Phase : NEUTRAL
Environment : 26°C / 50% Engineer : Roy Hung
EUT Model : LIVA Q1A Plus Test Rating : 120Vac/60Hz
Test Mode : Operating

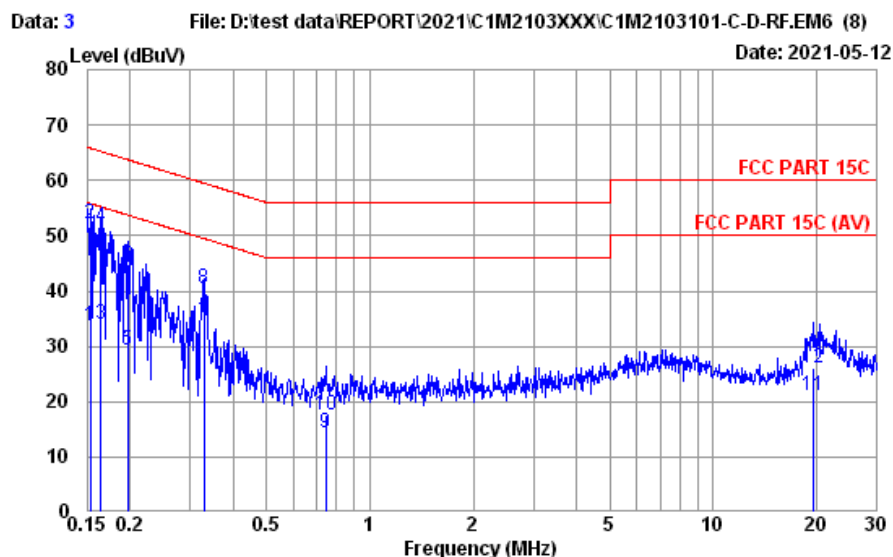
	Freq. (MHz)	AMM Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.151	10.20	0.03	9.85	15.26	35.34	55.96	20.62	Average
2	0.151	10.20	0.03	9.85	33.41	53.49	65.96	12.47	QP
3	0.166	10.20	0.03	9.85	13.85	33.93	55.16	21.23	Average
4	0.166	10.20	0.03	9.85	31.59	51.67	65.16	13.49	QP
5	0.194	10.20	0.03	9.85	9.95	30.03	53.84	23.81	Average
6	0.194	10.20	0.03	9.85	26.58	46.66	63.84	17.18	QP
7	0.221	10.20	0.03	9.85	8.88	28.96	52.79	23.83	Average
8	0.221	10.20	0.03	9.85	22.14	42.22	62.79	20.57	QP
9	0.330	10.20	0.03	9.85	18.78	38.86	49.44	10.58	Average
10	0.330	10.20	0.03	9.85	22.26	42.34	59.44	17.10	QP
11	20.270	10.91	0.20	9.94	1.76	22.81	50.00	27.19	Average
12	20.270	10.91	0.20	9.94	6.45	27.50	60.00	32.50	QP

Remarks: 1. Emission Level= AMM Factor + Cable Loss + Pulse Att. + Reading.

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Test Date	2021/05/12	Temp./Hum.	26°C/50%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Tested By	Roy Hung
		Test Model	LIVA Q1A PLUS



Site No. : No.8 Shielded Room Data No. : 3
Instrument 1 : Receiver ESR3(774)
Instrument 2 : EMV432 (567)(A)|CE-08|ESH3-Z2 (354)
Limit : FCC PART 15C Phase : LINE
Environment : 26°C / 50% Engineer : Roy Hung
EUT Model : LIVA Q1A Plus Test 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	0.153	10.20	0.03	9.85	13.65	33.73	55.82	22.09	Average
2	0.153	10.20	0.03	9.85	32.16	52.24	65.82	13.58	QP
3	0.165	10.20	0.03	9.85	13.97	34.05	55.21	21.16	Average
4	0.165	10.20	0.03	9.85	31.60	51.68	65.21	13.53	QP
5	0.197	10.20	0.03	9.85	9.18	29.26	53.76	24.50	Average
6	0.197	10.20	0.03	9.85	24.73	44.81	63.76	18.95	QP
7	0.329	10.20	0.03	9.85	14.13	34.21	49.49	15.28	Average
8	0.329	10.20	0.03	9.85	20.28	40.36	59.49	19.13	QP
9	0.743	10.20	0.04	9.85	-5.69	14.40	46.00	31.60	Average
10	0.743	10.20	0.04	9.85	-2.48	17.61	56.00	38.39	QP
11	19.635	10.59	0.20	9.94	0.23	20.96	50.00	29.04	Average
12	19.635	10.59	0.20	9.94	5.34	26.07	60.00	33.93	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.

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A.2 RADIATED EMISSION

Test Date	2021/05/07~10	Temp./Hum.	22~24°C /63~63%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Tested By	Sam Chang
		Test Model	(1)LIVA Q1A (2)LIVA Q1A PLUS

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.

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A.2.1.2 Frequency Below 1GHz

● Test model: LIVA Q1A

Mode	8-DPSK	Frequency	TX 2441MHz
------	--------	-----------	------------

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
35.820	22.12	1.30	26.50	31.48	28.40	40.00	11.60	Peak
116.330	18.47	2.48	26.19	32.95	27.71	43.50	15.79	Peak
216.240	16.75	3.53	25.78	34.19	28.69	46.00	17.31	Peak
288.020	19.51	4.20	25.70	33.72	31.73	46.00	14.27	Peak
926.280	27.13	8.58	26.94	28.39	37.16	46.00	8.84	Peak
981.570	27.75	8.88	26.75	28.92	38.80	54.00	15.20	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
35.820	22.12	1.30	26.50	35.42	32.34	40.00	7.66	Peak
116.330	18.47	2.48	26.19	35.58	30.34	43.50	13.16	Peak
216.240	16.75	3.53	25.78	34.16	28.66	46.00	17.34	Peak
321.970	20.34	4.61	25.90	30.80	29.85	46.00	16.15	Peak
919.490	27.06	8.55	26.98	28.51	37.14	46.00	8.86	Peak
995.150	27.89	8.95	26.69	27.65	37.80	54.00	16.20	Peak

● Test model: LIVA Q1A PLUS

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

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
35.820	22.12	1.30	26.50	31.25	28.17	40.00	11.83	Peak
116.330	18.47	2.48	26.19	32.67	27.43	43.50	16.07	Peak
221.090	17.09	3.59	25.78	33.59	28.49	46.00	17.51	Peak
283.170	19.42	4.16	25.71	33.96	31.83	46.00	14.17	Peak
933.070	27.20	8.62	26.91	29.03	37.94	46.00	8.06	Peak
998.060	27.89	8.95	26.69	28.49	38.64	54.00	15.36	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
34.850	22.70	1.28	26.50	35.35	32.83	40.00	7.17	Peak
117.300	18.56	2.49	26.19	36.11	30.97	43.50	12.53	Peak
216.240	16.75	3.53	25.78	34.27	28.77	46.00	17.23	Peak
319.060	20.25	4.57	25.88	31.30	30.24	46.00	15.76	Peak
863.230	26.76	8.22	27.13	29.10	36.95	46.00	9.05	Peak
971.870	27.64	8.83	26.79	28.07	37.75	54.00	16.25	Peak

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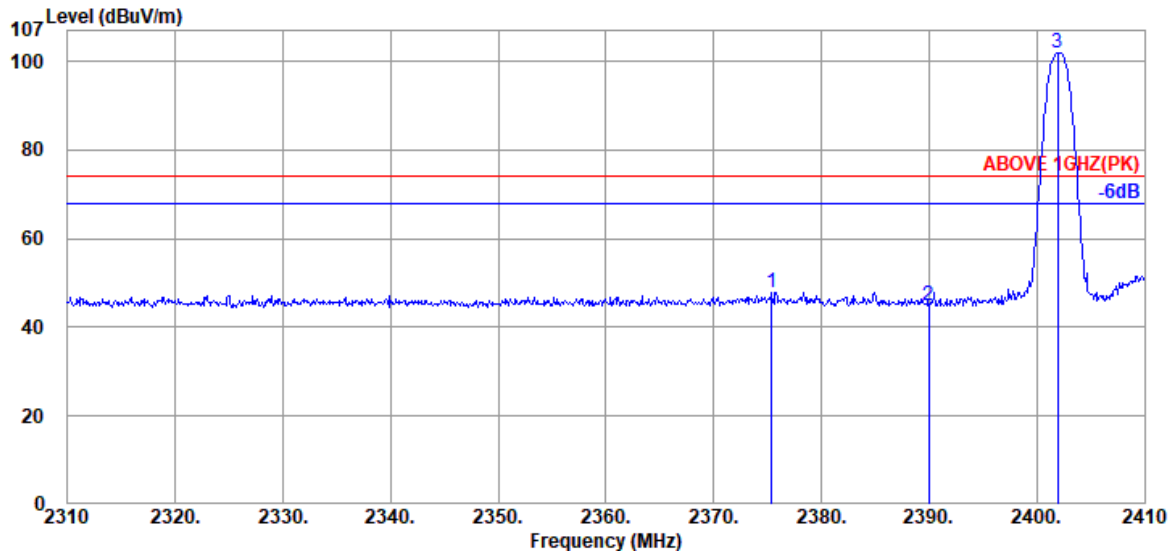
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Fax: +886 2 26099303

A.2.1.3 Frequency Above 1 GHz to 10th harmonics

Band Edge:

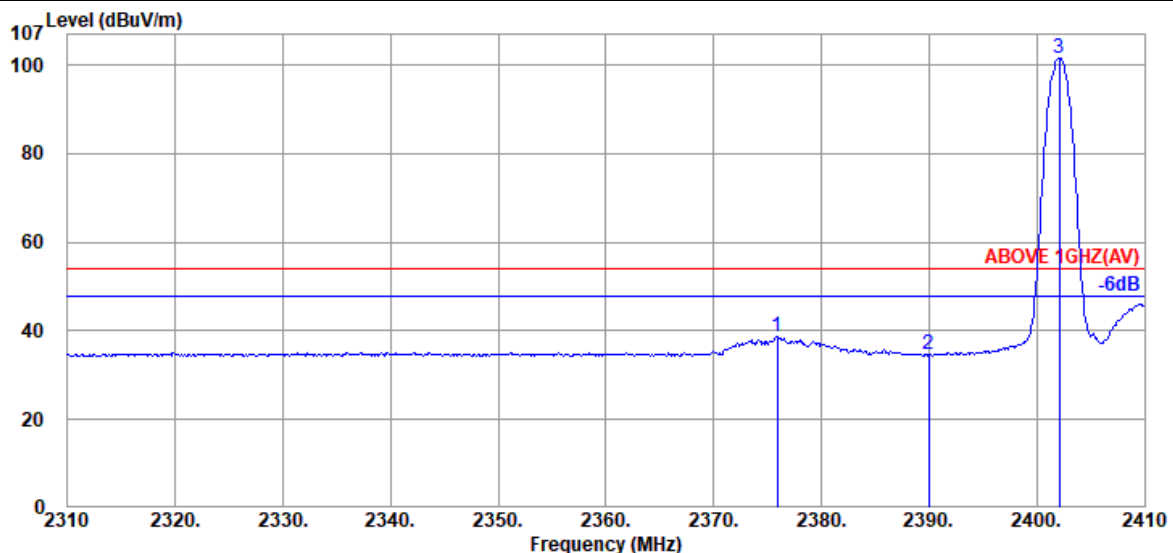
- Test model: LIVA Q1A

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

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2375.400	31.97	7.94	34.53	42.64	48.02	74.00	25.98	Peak
2390.000	31.89	7.95	34.54	39.72	45.02	74.00	28.98	Peak
@ 2401.900	31.80	7.95	34.54	96.62	101.83	---	---	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2375.900	31.97	7.94	34.53	33.30	38.68	54.00	15.32	Average
2390.000	31.89	7.95	34.54	29.24	34.54	54.00	19.46	Average
@ 2402.100	31.80	7.95	34.54	96.40	101.61	---	---	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

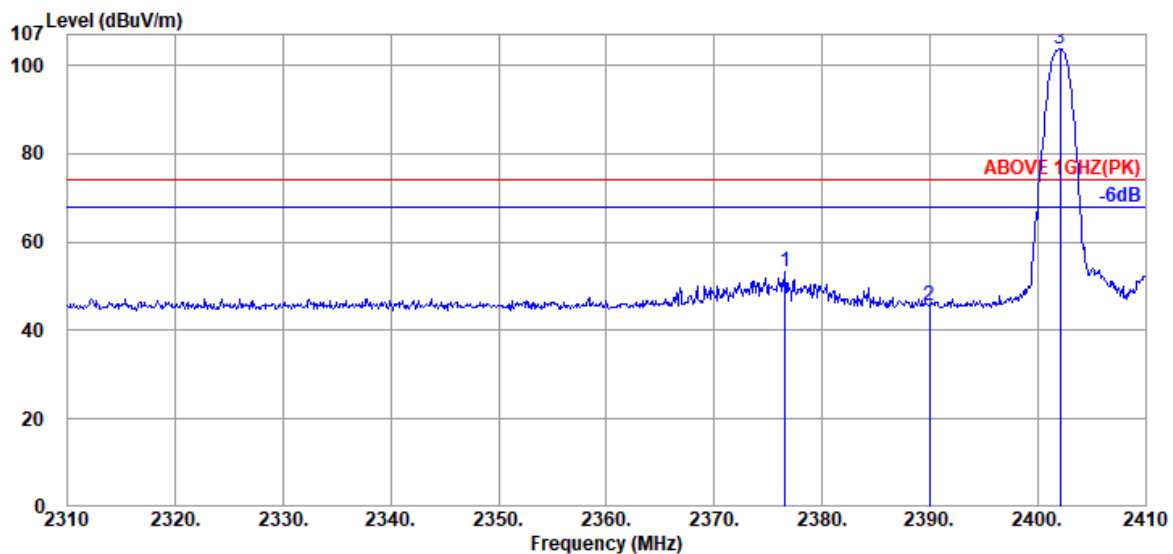
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Tel: +886 2 26099301

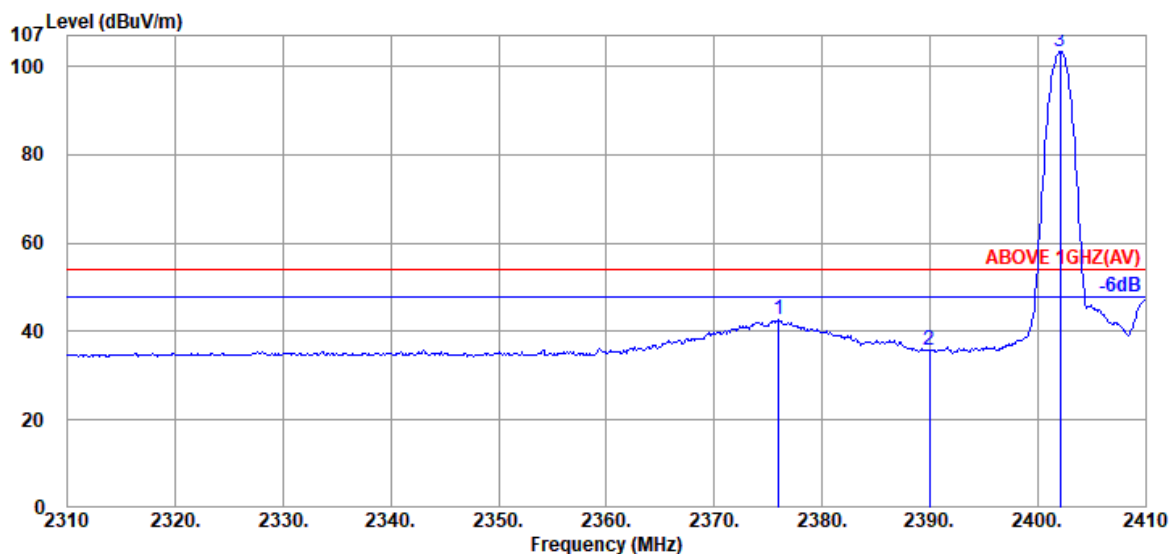
Fax: +886 2 26099303

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

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2376.600	31.93	7.94	34.53	47.81	53.15	74.00	20.85	Peak
2390.000	31.89	7.95	34.54	40.29	45.59	74.00	28.41	Peak
@ 2402.100	31.80	7.95	34.54	98.42	103.63	---	---	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2376.000	31.97	7.94	34.53	37.32	42.70	54.00	11.30	Average
2390.000	31.89	7.95	34.54	30.62	35.92	54.00	18.08	Average
@ 2402.100	31.80	7.95	34.54	98.08	103.29	---	---	Average

Remark: The "@" means fundamental frequency, it is ignored in this section.

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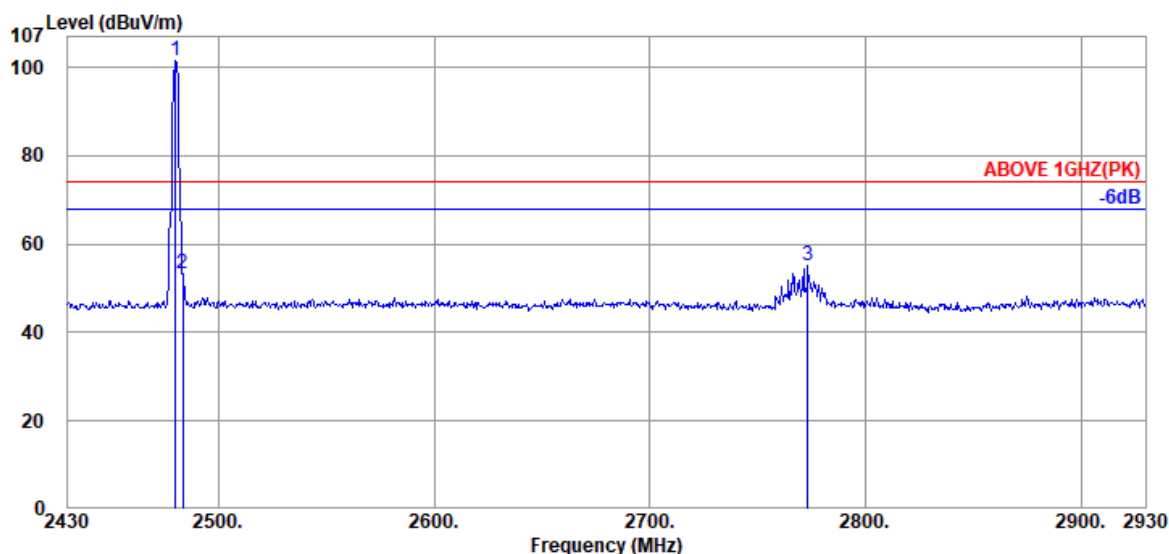
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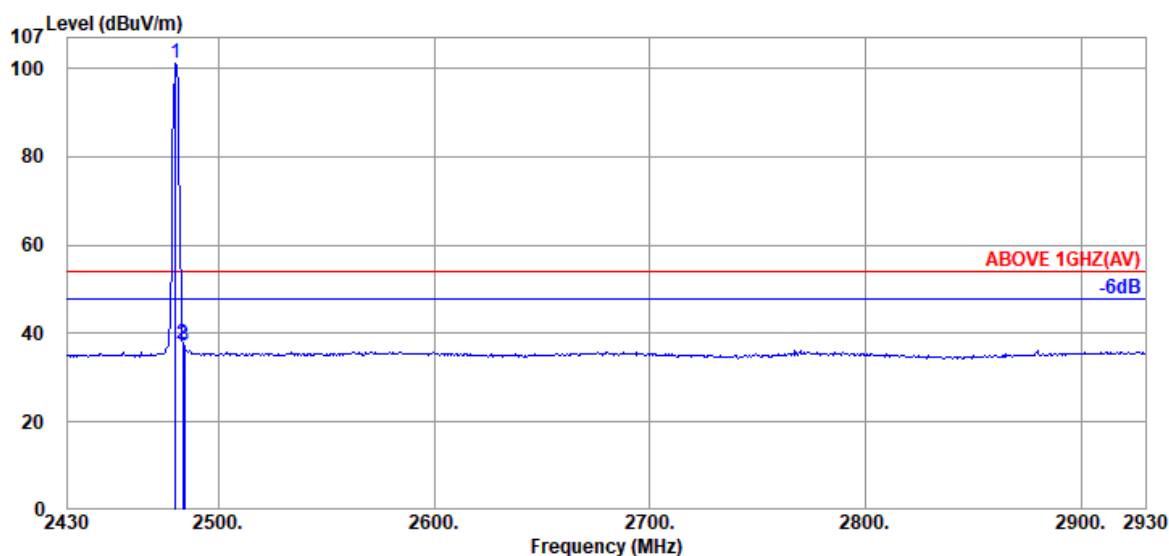
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Mode	8-DPSK	Frequency	TX 2480MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2480.000	32.30	7.99	34.55	95.63	101.37	---	---	Peak
2483.500	32.30	7.99	34.55	47.58	53.32	74.00	20.68	Peak
2773.500	32.30	8.13	34.62	49.20	55.01	74.00	18.99	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2480.000	32.30	7.99	34.55	95.40	101.14	---	---	Average
2483.500	32.30	7.99	34.55	31.86	37.60	54.00	16.40	Average
2484.000	32.30	7.99	34.55	31.44	37.18	54.00	16.82	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

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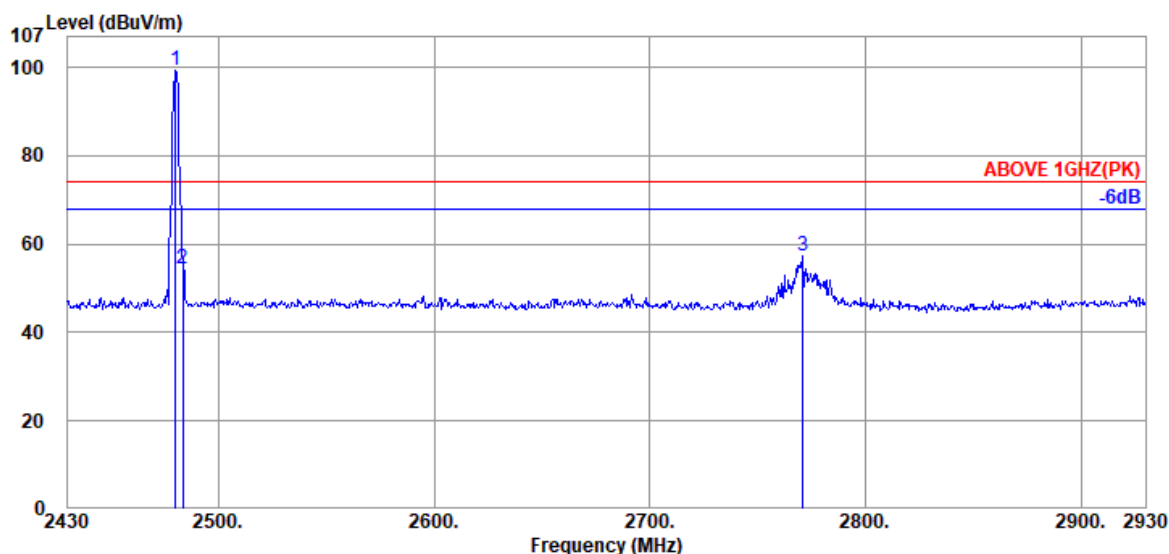
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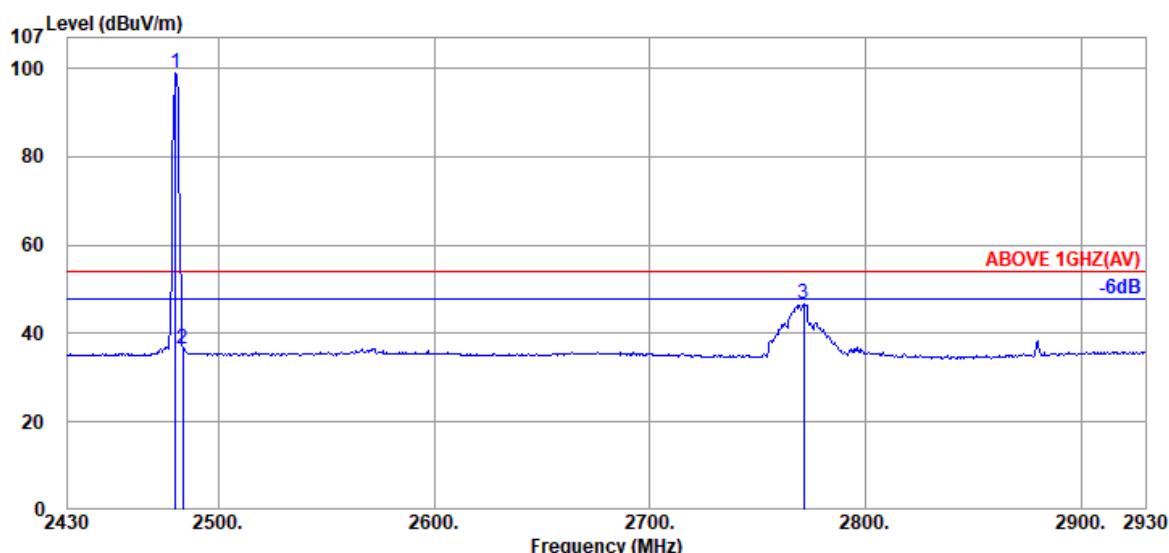
Fax: +886 2 26099303

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

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2480.000	32.30	7.99	34.55	93.47	99.21	---	---	Peak
2483.500	32.30	7.99	34.55	48.67	54.41	74.00	19.59	Peak
2771.000	32.30	8.12	34.61	51.40	57.21	74.00	16.79	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2480.000	32.30	7.99	34.55	93.13	98.87	---	---	Average
2483.500	32.30	7.99	34.55	30.96	36.70	54.00	17.30	Average
2771.500	32.30	8.13	34.61	40.90	46.72	54.00	7.28	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

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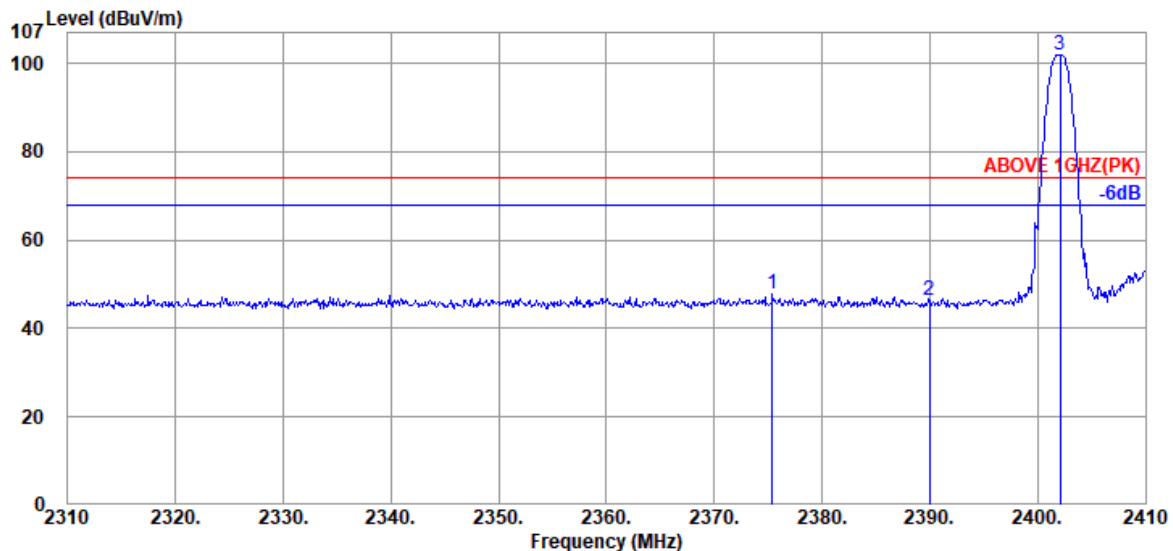
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Fax: +886 2 26099303

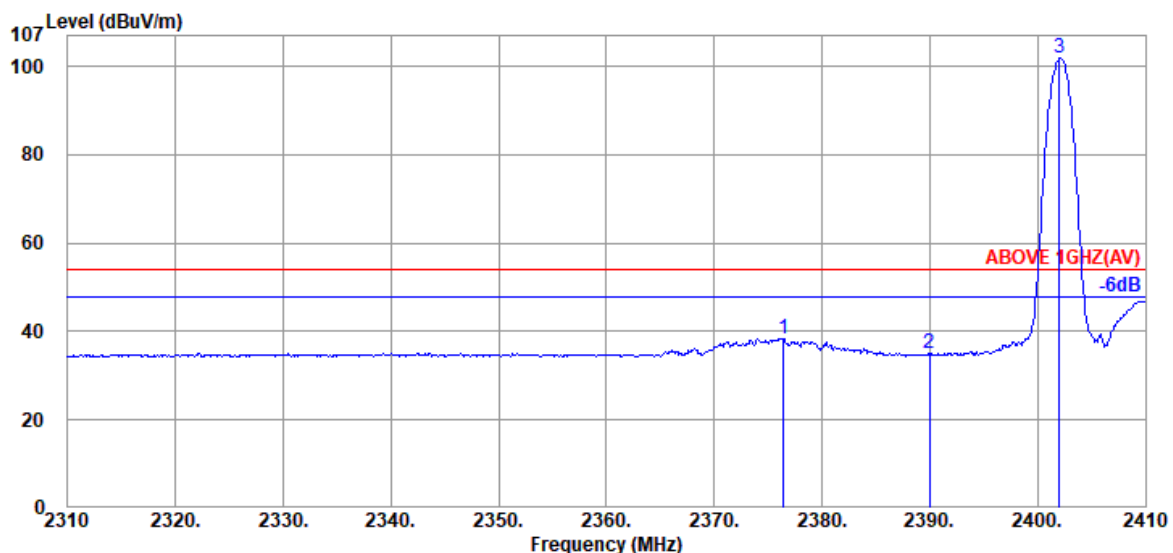
● Test model: LIVA Q1A PLUS

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

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2375.400	31.97	7.94	34.53	42.39	47.77	74.00	26.23	Peak
2390.000	31.89	7.95	34.54	41.22	46.52	74.00	27.48	Peak
@ 2402.100	31.80	7.95	34.54	96.82	102.03	---	---	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2376.400	31.97	7.94	34.53	33.08	38.46	54.00	15.54	Average
2390.000	31.89	7.95	34.54	29.84	35.14	54.00	18.86	Average
@ 2402.000	31.80	7.95	34.54	96.59	101.80	---	---	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

Audix Technology Corp.

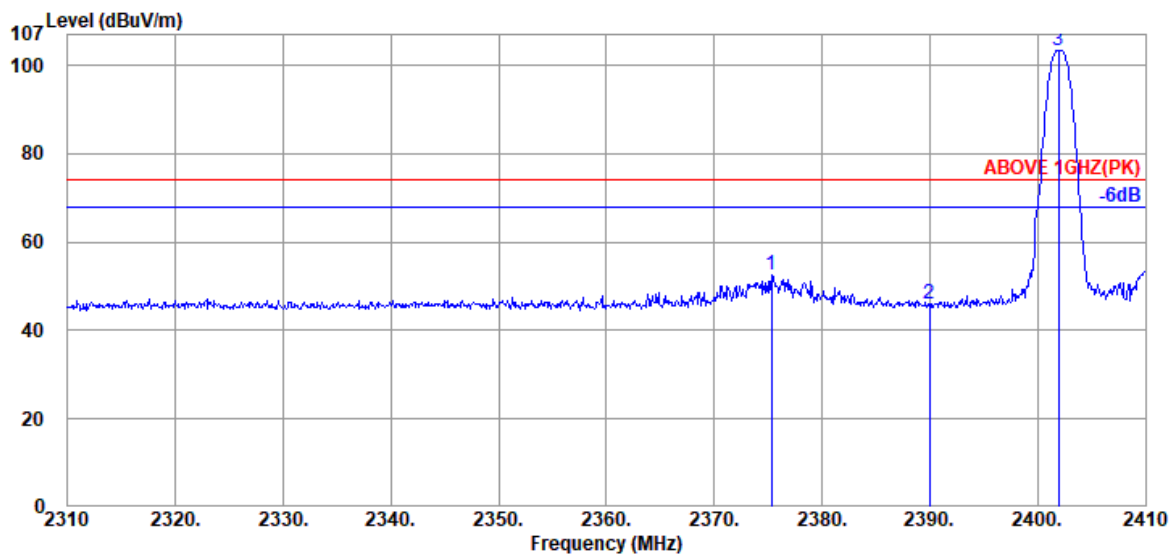
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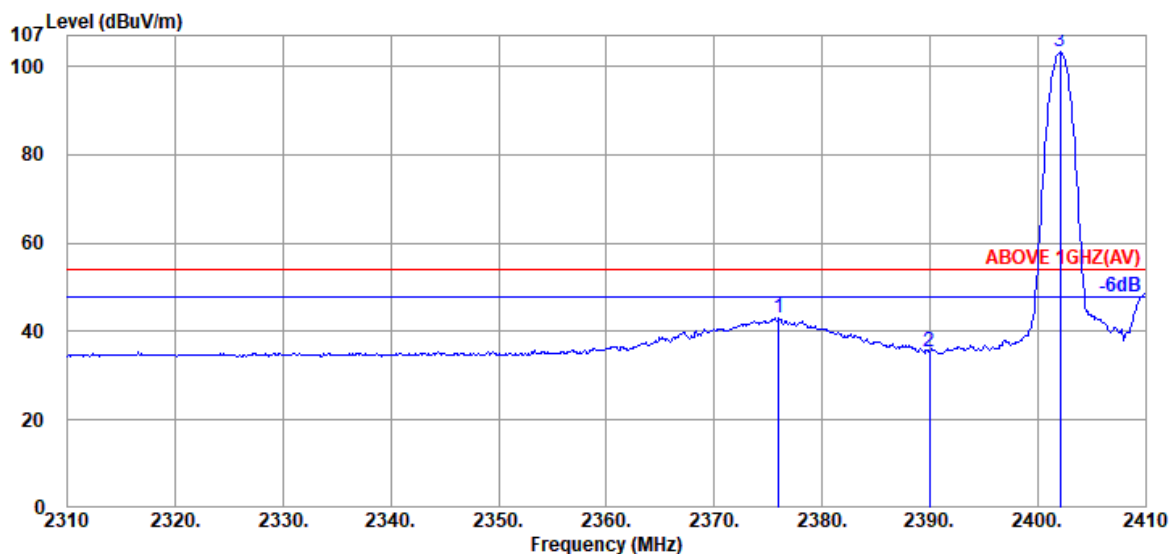
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Mode	8-DPSK	Frequency	TX 2402MHz
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Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2375.300	31.97	7.94	34.53	47.12	52.50	74.00	21.50	Peak
2390.000	31.89	7.95	34.54	40.63	45.93	74.00	28.07	Peak
@ 2401.900	31.80	7.95	34.54	98.13	103.34	---	---	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2376.000	31.97	7.94	34.53	37.59	42.97	54.00	11.03	Average
2390.000	31.89	7.95	34.54	30.30	35.60	54.00	18.40	Average
@ 2402.100	31.80	7.95	34.54	98.00	103.21	---	---	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

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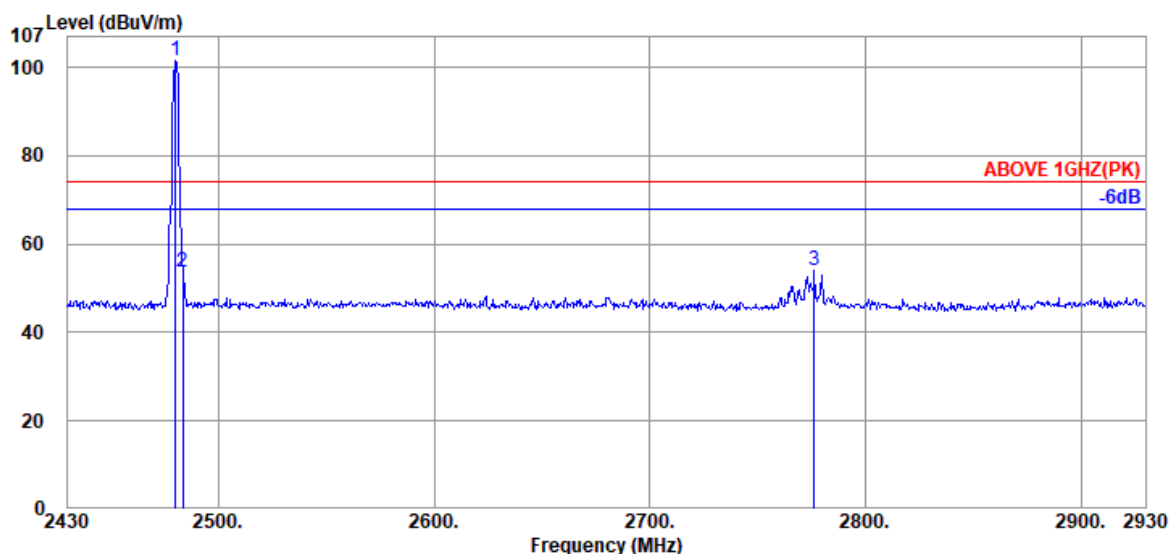
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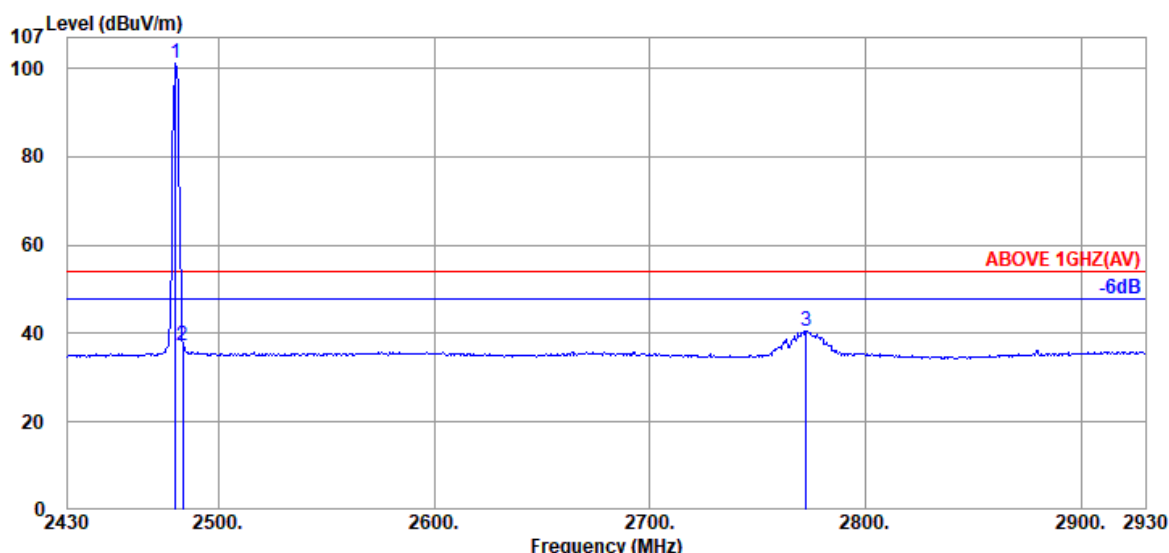
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Mode	8-DPSK	Frequency	TX 2480MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2480.000	32.30	7.99	34.55	95.60	101.34	---	---	Peak
2483.500	32.30	7.99	34.55	48.00	53.74	74.00	20.26	Peak
2776.500	32.30	8.13	34.62	48.16	53.97	74.00	20.03	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2480.000	32.30	7.99	34.55	95.29	101.03	---	---	Average
2483.500	32.30	7.99	34.55	31.37	37.11	54.00	16.89	Average
2772.500	32.30	8.13	34.62	34.60	40.41	54.00	13.59	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

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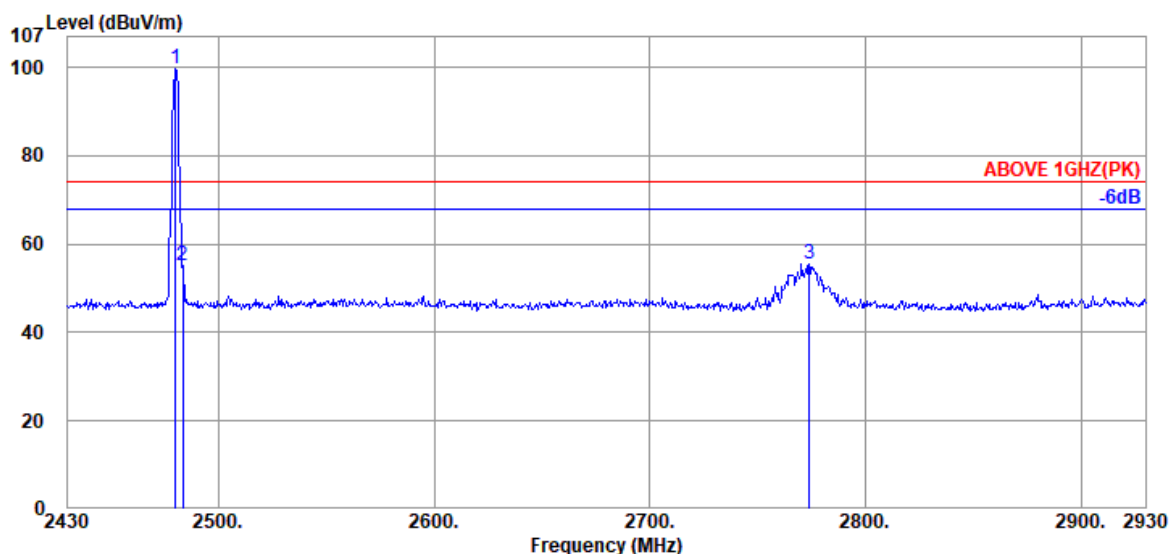
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New Taipei City244, Taiwan

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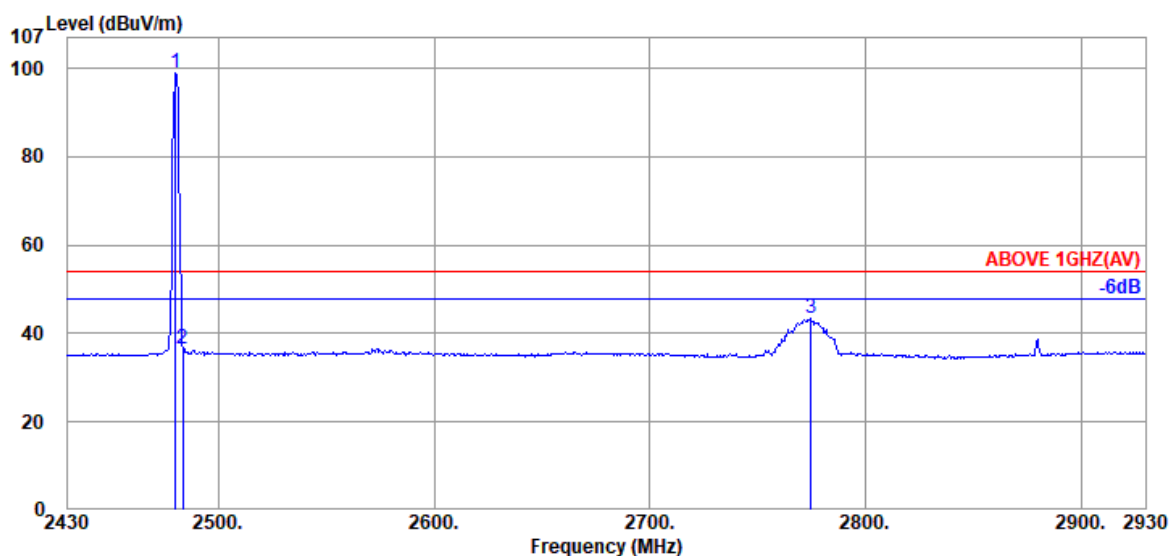
Fax: +886 2 26099303

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

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2480.000	32.30	7.99	34.55	93.92	99.66	---	---	Peak
2483.500	32.30	7.99	34.55	49.41	55.15	74.00	18.85	Peak
2774.000	32.30	8.13	34.62	49.83	55.64	74.00	18.36	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2480.000	32.30	7.99	34.55	93.35	99.09	---	---	Average
2483.500	32.30	7.99	34.55	30.85	36.59	54.00	17.41	Average
2775.000	32.30	8.13	34.62	37.47	43.28	54.00	10.72	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

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A.2.2 Emissions outside the frequency band:

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

● Test model: LIVA Q1A

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

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4804.000	33.60	10.49	34.44	33.65	43.30	54.00	10.70	Peak
7205.000	35.60	12.25	34.63	32.38	45.60	54.00	8.40	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4804.000	33.60	10.49	34.44	34.68	44.33	54.00	9.67	Peak
7205.000	35.60	12.25	34.63	31.66	44.88	54.00	9.12	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)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4882.000	33.88	10.54	34.43	31.71	41.70	54.00	12.30	Peak
7322.000	35.60	12.29	34.71	31.09	44.27	54.00	9.73	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4882.000	33.88	10.54	34.43	33.15	43.14	54.00	10.86	Peak
7322.000	35.60	12.29	34.71	31.80	44.98	54.00	9.02	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)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4960.000	33.83	10.60	34.41	31.56	41.58	54.00	12.42	Peak
7439.000	35.80	12.36	34.78	31.55	44.93	54.00	9.07	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4960.000	33.83	10.60	34.41	32.14	42.16	54.00	11.84	Peak
7439.000	35.80	12.36	34.78	31.83	45.21	54.00	8.79	Peak

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● Test model: LIVA Q1A PLUS

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

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4804.000	33.60	10.49	34.44	33.63	43.28	54.00	10.72	Peak
7205.000	35.60	12.25	34.63	31.94	45.16	54.00	8.84	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4804.000	33.60	10.49	34.44	33.92	43.57	54.00	10.43	Peak
7205.000	35.60	12.25	34.63	31.92	45.14	54.00	8.86	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)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4882.000	33.88	10.54	34.43	31.29	41.28	54.00	12.72	Peak
7322.000	35.60	12.29	34.71	31.17	44.35	54.00	9.65	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4882.000	33.88	10.54	34.43	32.89	42.88	54.00	11.12	Peak
7322.000	35.60	12.29	34.71	32.62	45.80	54.00	8.20	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)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4960.000	33.83	10.60	34.41	31.34	41.36	54.00	12.64	Peak
7439.000	35.80	12.36	34.78	31.32	44.70	54.00	9.30	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4960.000	33.83	10.60	34.41	32.24	42.26	54.00	11.74	Peak
7439.000	35.80	12.36	34.78	31.33	44.71	54.00	9.29	Peak

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A.2.3 Emissions in Non-restricted Frequency Bands:

All emission levels below the FCC 15.209(a) Section 8.9 table 4 general radiated emissions limits is not required.

A.3 20dB BANDWIDTH

Test Date	2021/04/29	Temp./Hum.	24°C /63%
Cable Loss	1.45dB	Tested By	Sam Chang
Test Voltage	AC 120V 60Hz (Via AC Adapter)		

A.3.1 20dB Bandwidth Result

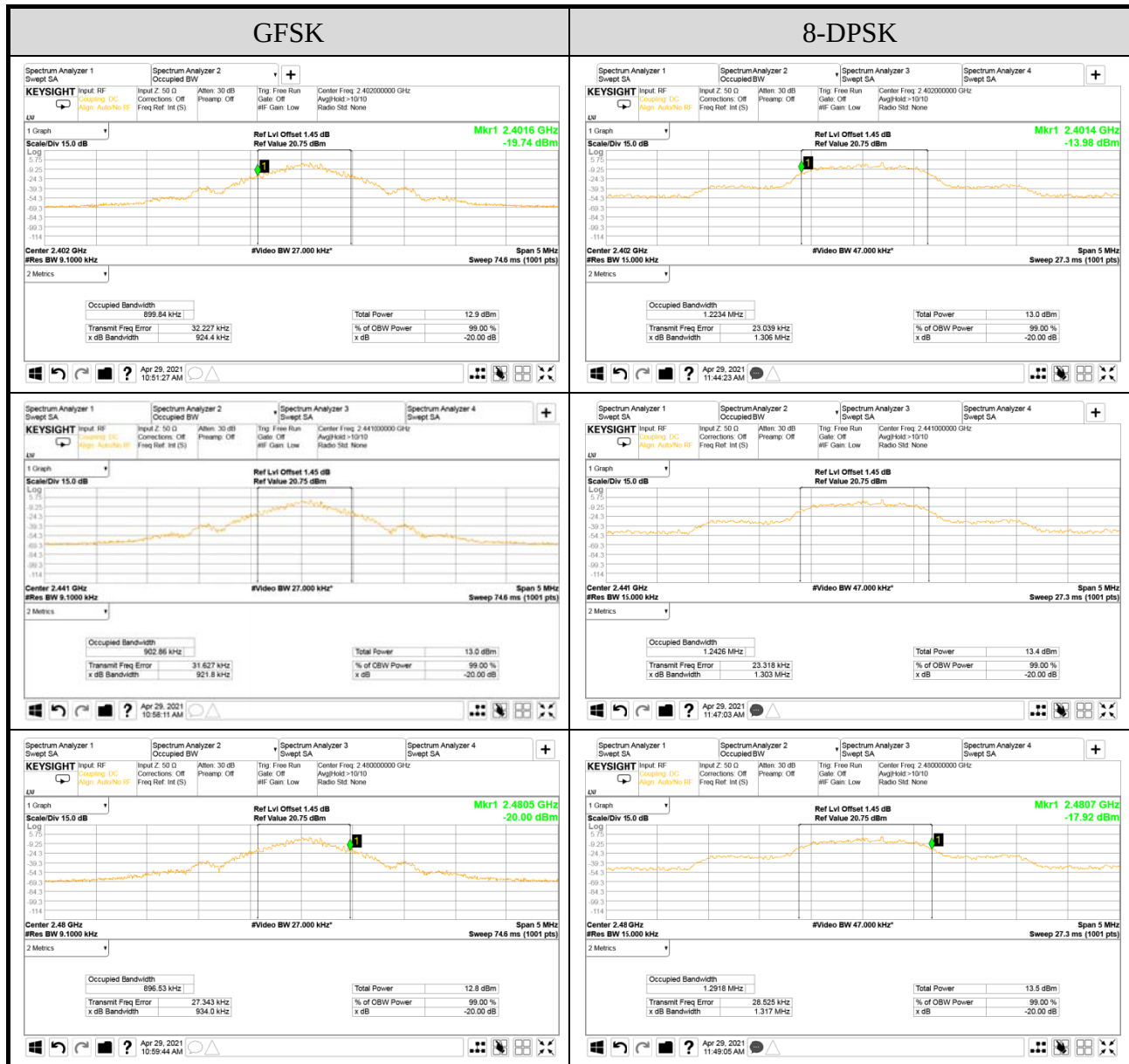
Mode	Centre Frequency (MHz)	20dB Bandwidth (MHz)	99%Occupied Bandwidth (MHz) (Reference only)	2/3 (20dB Bandwidth)
GFSK	2402	0.9244	0.89984	0.616
	2441	0.9217	0.90286	0.614
	2480	0.9340	0.89653	0.623
8-DPSK	2402	1.306	1.2234	0.871
	2441	1.303	1.2426	0.869
	2480	1.317	1.2918	0.878

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

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A.3.2 Measurement Plots

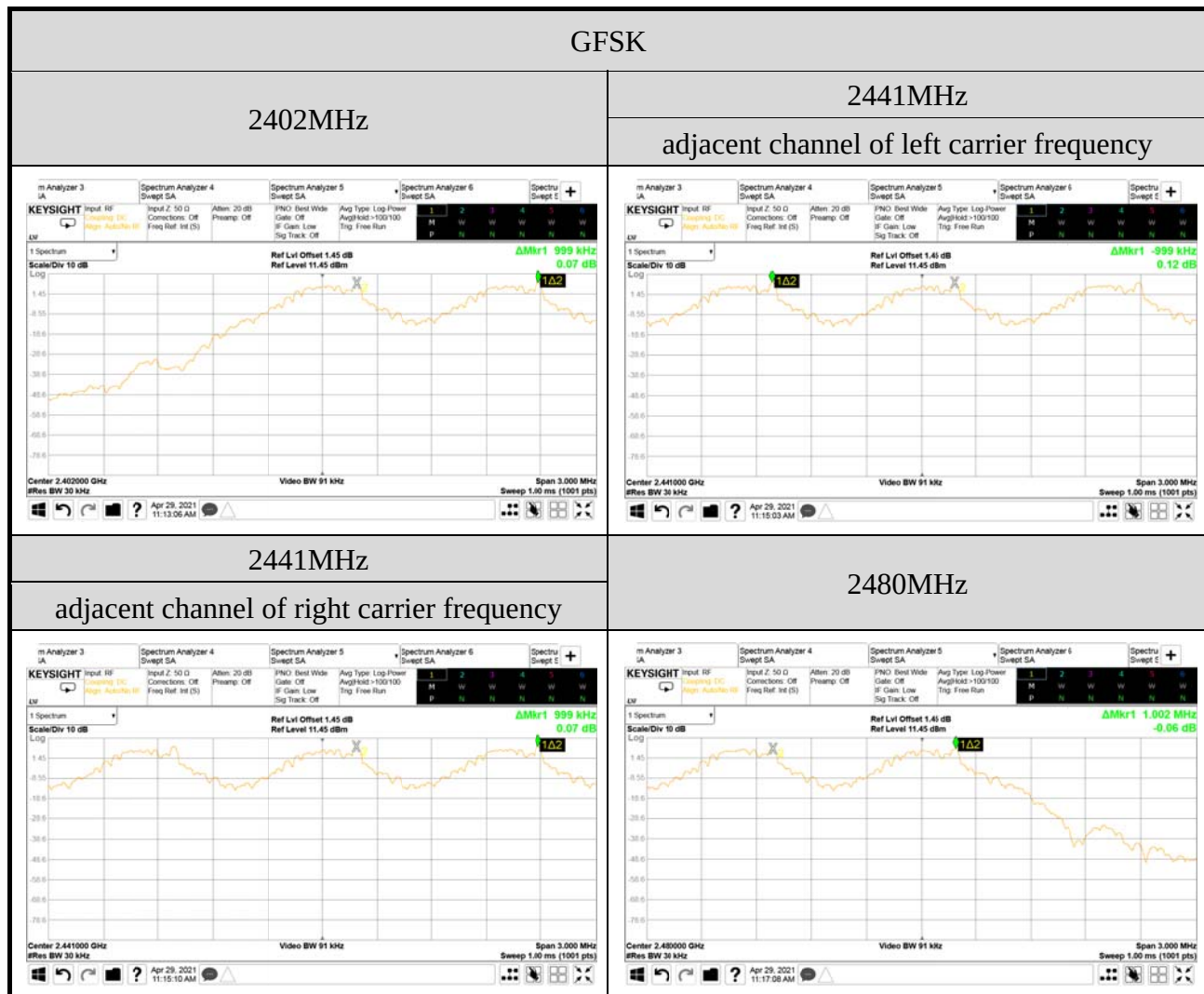


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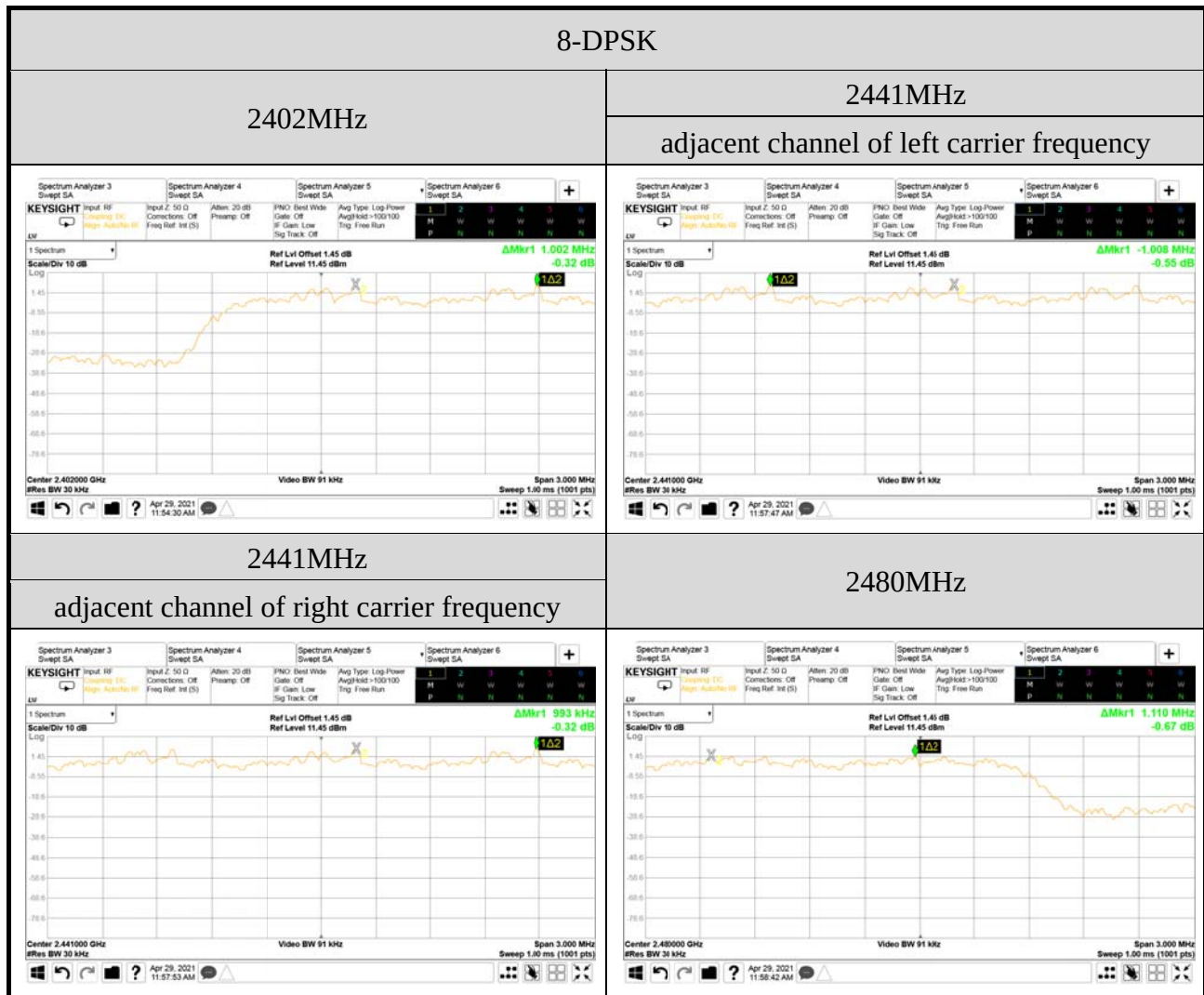
A.4 CARRIER FREQUENCY SEPARATION

Test Date	2021/04/29	Temp./Hum.	24°C /63%
Cable Loss	1.45dB	Tested By	Sam Chang
Test Voltage	AC 120V 60Hz (Via AC Adapter)		



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A.5 TIME OF OCCUPANCY

Test Date	2021/04/29	Temp./Hum.	24°C /63%
Cable Loss	1.45dB	Tested By	Sam Chang
Test Voltage	AC 120V 60Hz (Via AC Adapter)		

A.5.1 Time of Occupancy

Mode	Centre Frequency (MHz)	Mode	Each second appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
GFSK	2402	DH1	10	0.4219	133.320	<400
		DH3	5	1.6800	265.440	<400
		DH5	3	2.9300	277.764	<400

Observation Period:

79 channels * 0.4 seconds = 31.6 seconds

DH1 Mode

For each second of **10** transmission appearance, the longest time of occupancy is

10 transmission * 31.6 seconds * 0.422 ms = 133.320 ms (<400ms)

DH3 Mode

For each second of **5** transmission appearance, the longest time of occupancy is

5 transmission * 31.6 seconds * 1.680 ms = 265.440 ms (<400ms)

DH5 Mode

For each second of **3** transmission appearance, the longest time of occupancy is

3 transmission * 31.6 seconds * 2.930 ms = 277.764 ms (<400ms)

Mode	Centre Frequency (MHz)	Mode	Each second appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
GFSK	2441	DH1	10	0.4219	133.320	<400
		DH3	5	1.6800	265.440	<400
		DH5	3	2.9300	277.764	<400

Observation Period:

79 channels * 0.4 seconds = 31.6 seconds

DH1 Mode

For each second of **10** transmission appearance, the longest time of occupancy is

10 transmission * 31.6 seconds * 0.422 ms = 133.320 ms (<400ms)

DH3 Mode

For each second of **5** transmission appearance, the longest time of occupancy is

5 transmission * 31.6 seconds * 1.680 ms = 265.440 ms (<400ms)

DH5 Mode

For each second of **3** transmission appearance, the longest time of occupancy is

3 transmission * 31.6 seconds * 2.930 ms = 277.764 ms (<400ms)

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Mode	Centre Frequency (MHz)	Mode	Each second appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
GFSK	2480	DH1	10	0.4219	133.320	<400
		DH3	5	1.6800	265.440	<400
		DH5	3	2.9300	277.764	<400

Observation Period:

 $79 \text{ channels} * 0.4 \text{ seconds} = 31.6 \text{ seconds}$ **DH1 Mode**

For each second of 10 transmission appearance, the longest time of occupancy is

 $10 \text{ transmission} * 31.6 \text{ seconds} * 0.422 \text{ ms} = 133.320 \text{ ms} (<400\text{ms})$ **DH3 Mode**

For each second of 5 transmission appearance, the longest time of occupancy is

 $5 \text{ transmission} * 31.6 \text{ seconds} * 1.680 \text{ ms} = 265.440 \text{ ms} (<400\text{ms})$ **DH5 Mode**

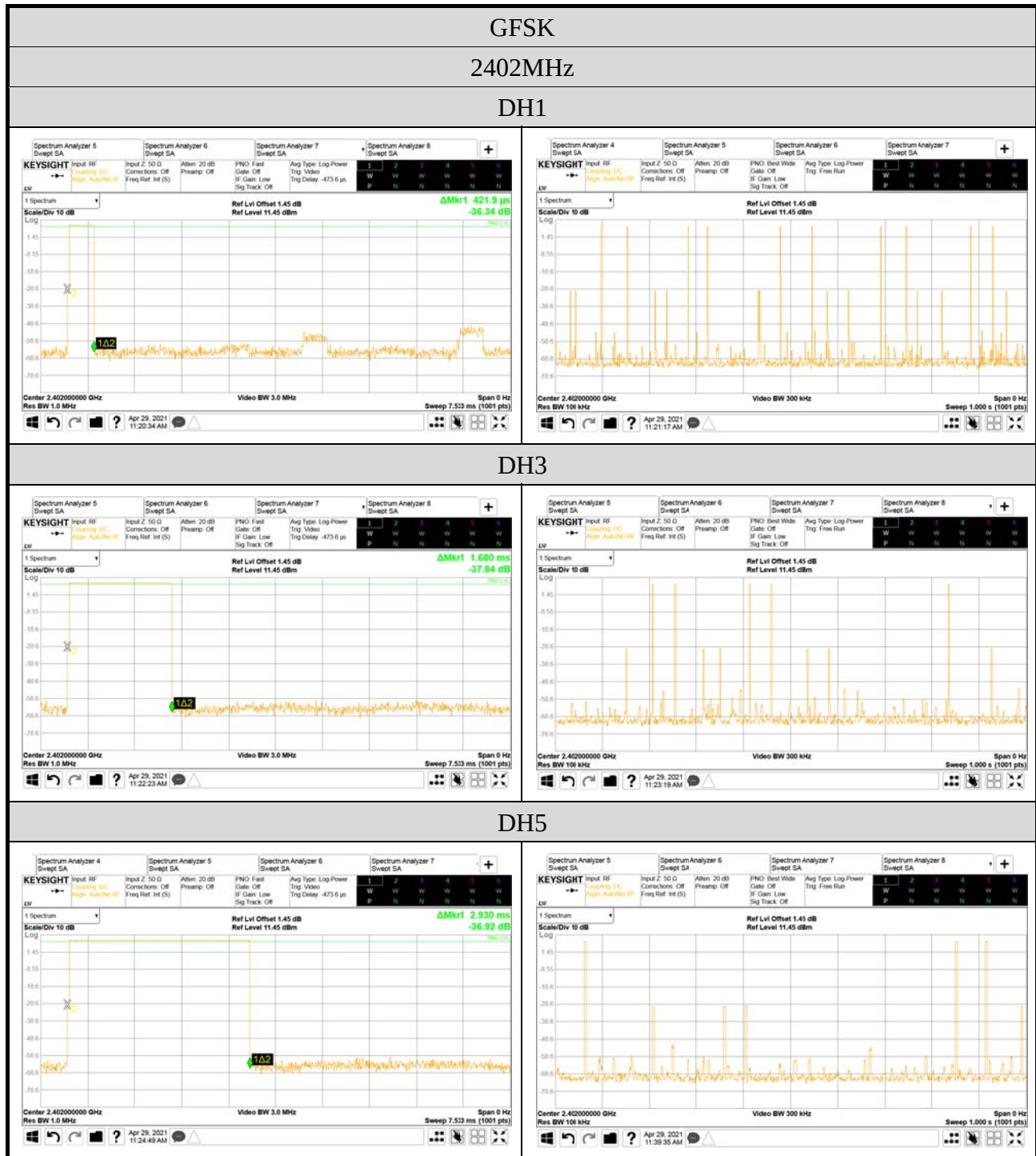
For each second of 3 transmission appearance, the longest time of occupancy is

 $3 \text{ transmission} * 31.6 \text{ seconds} * 2.930 \text{ ms} = 277.764 \text{ ms} (<400\text{ms})$

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● Measurement Plots



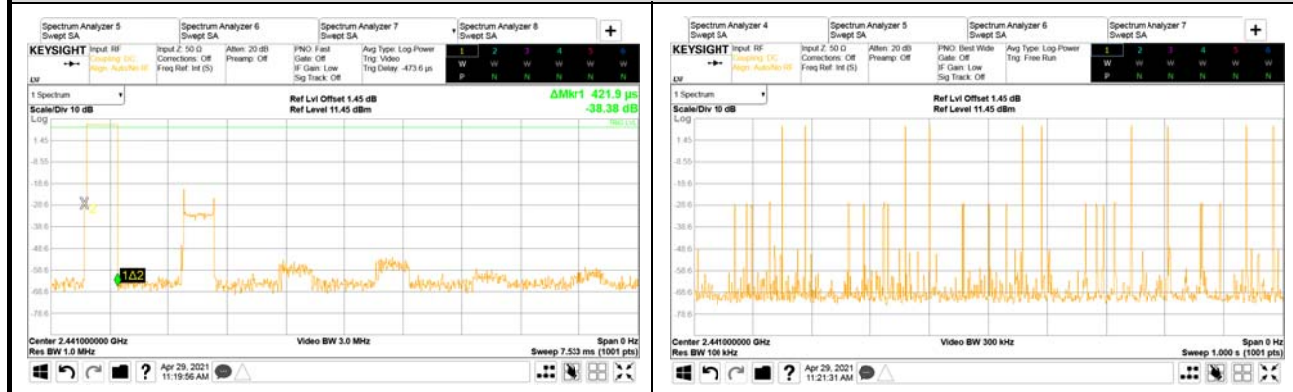
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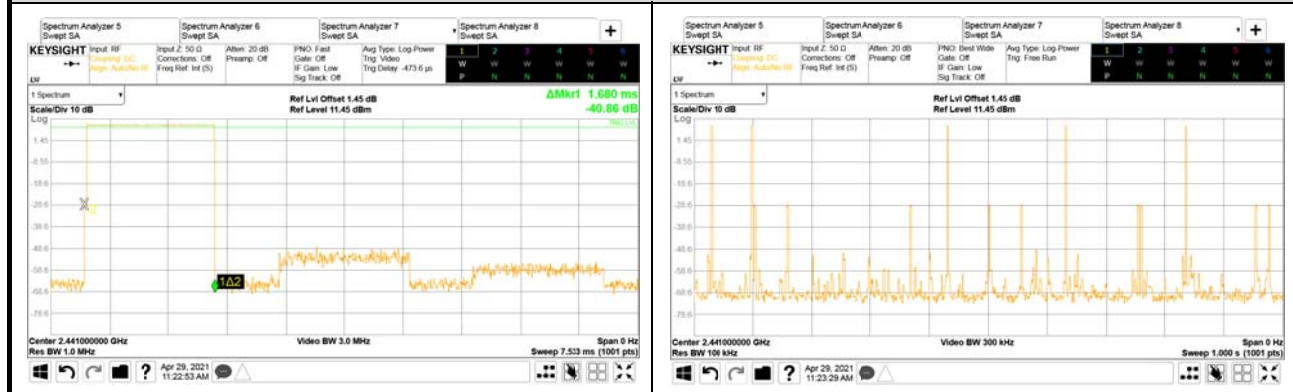
GFSK

2441MHz

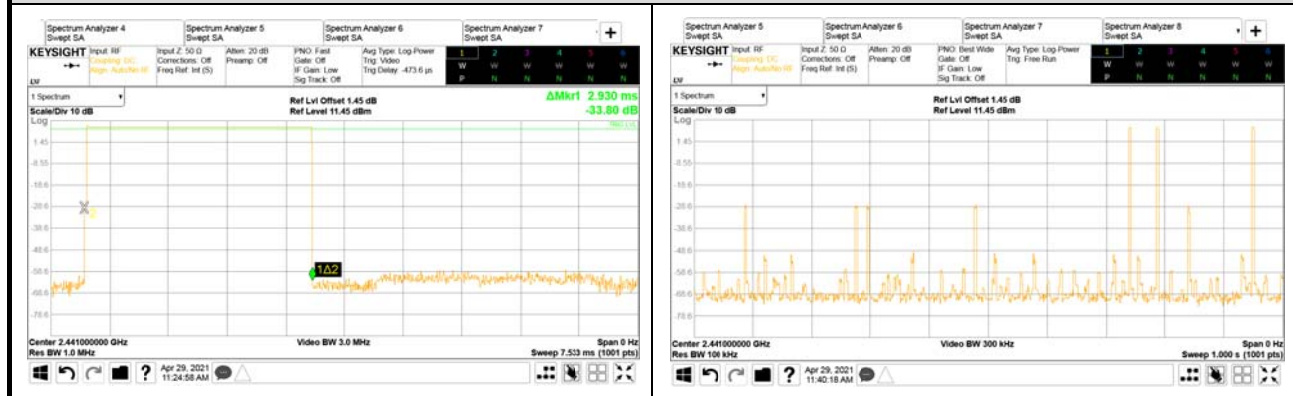
DH1



DH3



DH5



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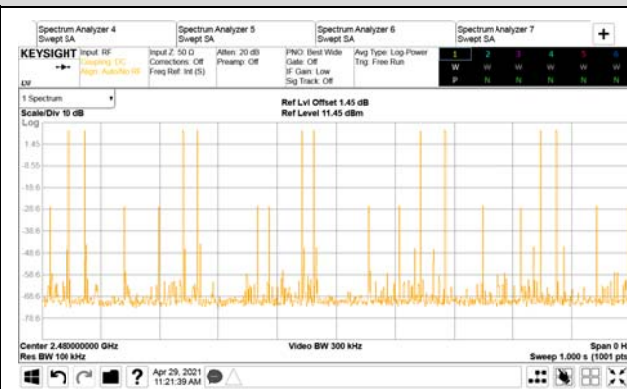
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GFSK

2480MHz

DH1



DH3



DH5



Mode	Centre Frequency (MHz)	Mode	Each second appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
8-DPSK	2402	3DH1	10	0.4294	135.690	<400
		3DH3	5	1.6870	266.546	<400
		3DH5	4	2.9300	370.352	<400

Observation Period:

79 channels* 0.4 seconds= 31.6 seconds

3DH1 Mode

For each second of 10 transmission appearance, the longest time of occupancy is

10 transmission* 31.6 seconds* 0.429 ms= 135.690 ms (<400ms)

3DH3 Mode

For each second of 5 transmission appearance, the longest time of occupancy is

5 transmission* 31.6 seconds* 1.687 ms= 266.546 ms (<400ms)

3DH5 Mode

For each second of 4 transmission appearance, the longest time of occupancy is

4 transmission* 31.6 seconds* 2.930 ms= 370.352 ms (<400ms)

Mode	Centre Frequency (MHz)	Mode	Each second appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
8-DPSK	2441	3DH1	10	0.4294	135.690	<400
		3DH3	5	1.6870	266.546	<400
		3DH5	4	2.9300	370.352	<400

Observation Period:

79 channels* 0.4 seconds= 31.6 seconds

3DH1 Mode

For each second of 10 transmission appearance, the longest time of occupancy is

10 transmission* 31.6 seconds* 0.429 ms= 135.690 ms (<400ms)

3DH3 Mode

For each second of 5 transmission appearance, the longest time of occupancy is

5 transmission* 31.6 seconds* 1.687 ms= 266.546 ms (<400ms)

3DH5 Mode

For each second of 4 transmission appearance, the longest time of occupancy is

4 transmission* 31.6 seconds* 2.930 ms= 370.352 ms (<400ms)

Mode	Centre Frequency (MHz)	Mode	Each second appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
8-DPSK	2480	3DH1	10	0.4294	135.690	<400
		3DH3	5	1.6870	266.546	<400
		3DH5	4	2.9300	370.352	<400

Observation Period:

79 channels* **0.4** seconds= **31.6** seconds

3DH1 Mode

For each second of **10** transmission appearance, the longest time of occupancy is
10 transmission* **31.6** seconds* **0.429** ms= **135.690** ms (<400ms)

3DH3 Mode

For each second of **5** transmission appearance, the longest time of occupancy is
5 transmission* **31.6** seconds* **1.687** ms= **266.546** ms (<400ms)

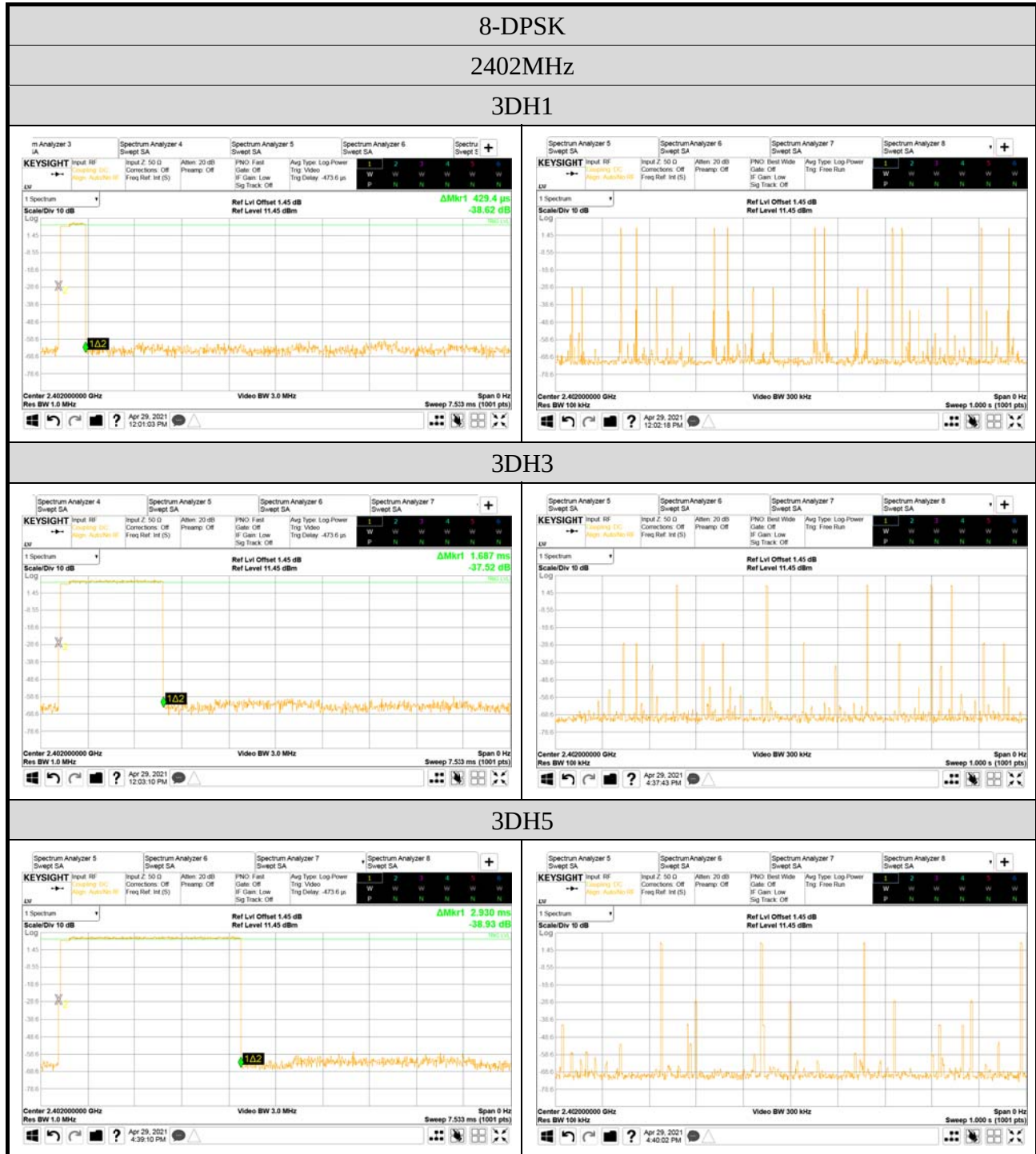
3DH5 Mode

For each second of **4** transmission appearance, the longest time of occupancy is
4 transmission* **31.6** seconds* **2.930** ms= **370.352** ms (<400ms)

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● Measurement Plots



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8-DPSK

2441MHz

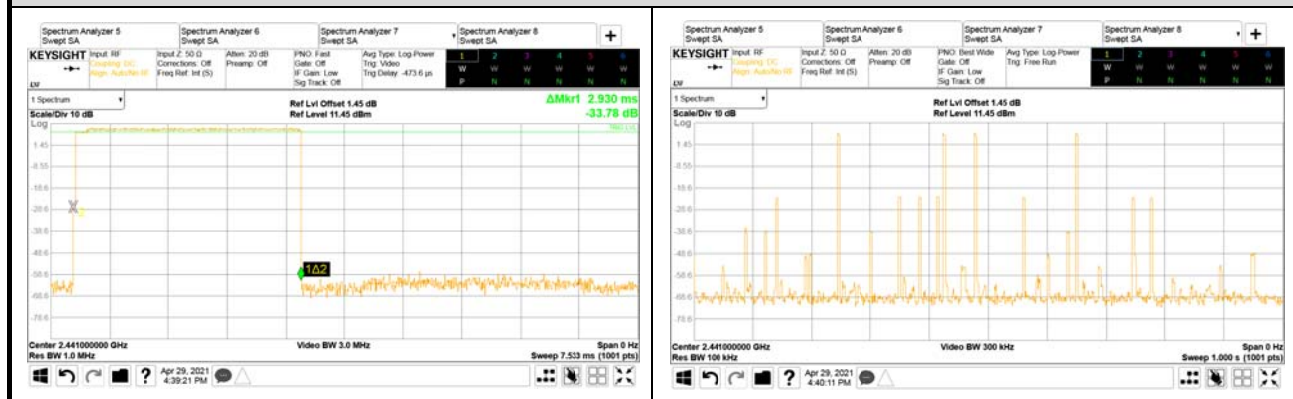
3DH1



3DH3



3DH5



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8-DPSK

2480MHz

3DH1



3DH3



3DH5

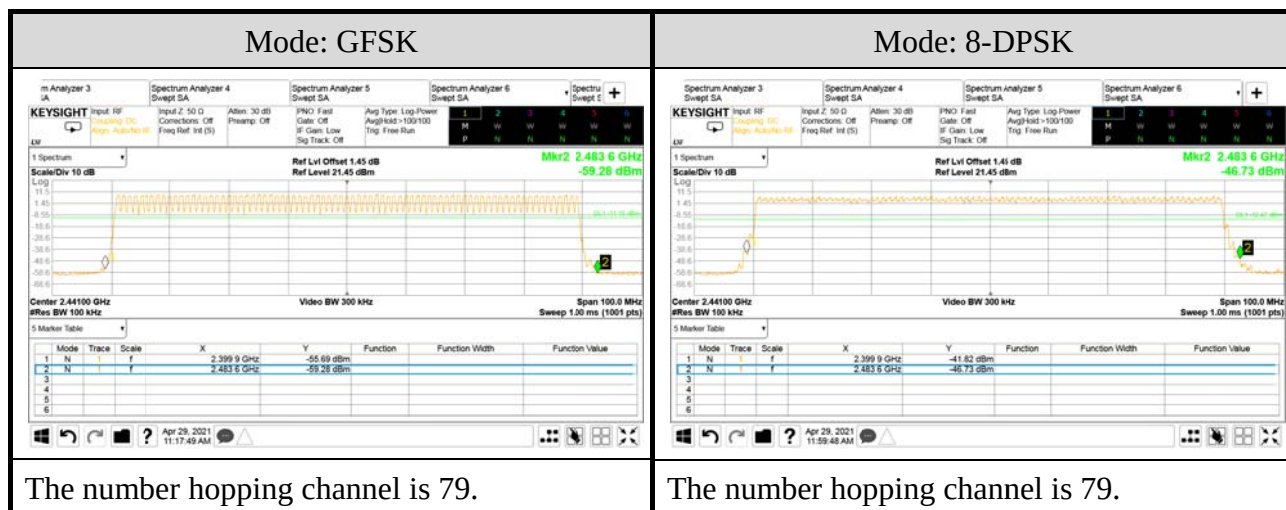


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A.6 NUMBER OF HOPPING CHANNELS

Test Date	2021/04/29	Temp./Hum.	24°C /63%
Cable Loss	1.45dB	Tested By	Sam Chang
Test Voltage	AC 120V 60Hz (Via AC Adapter)		



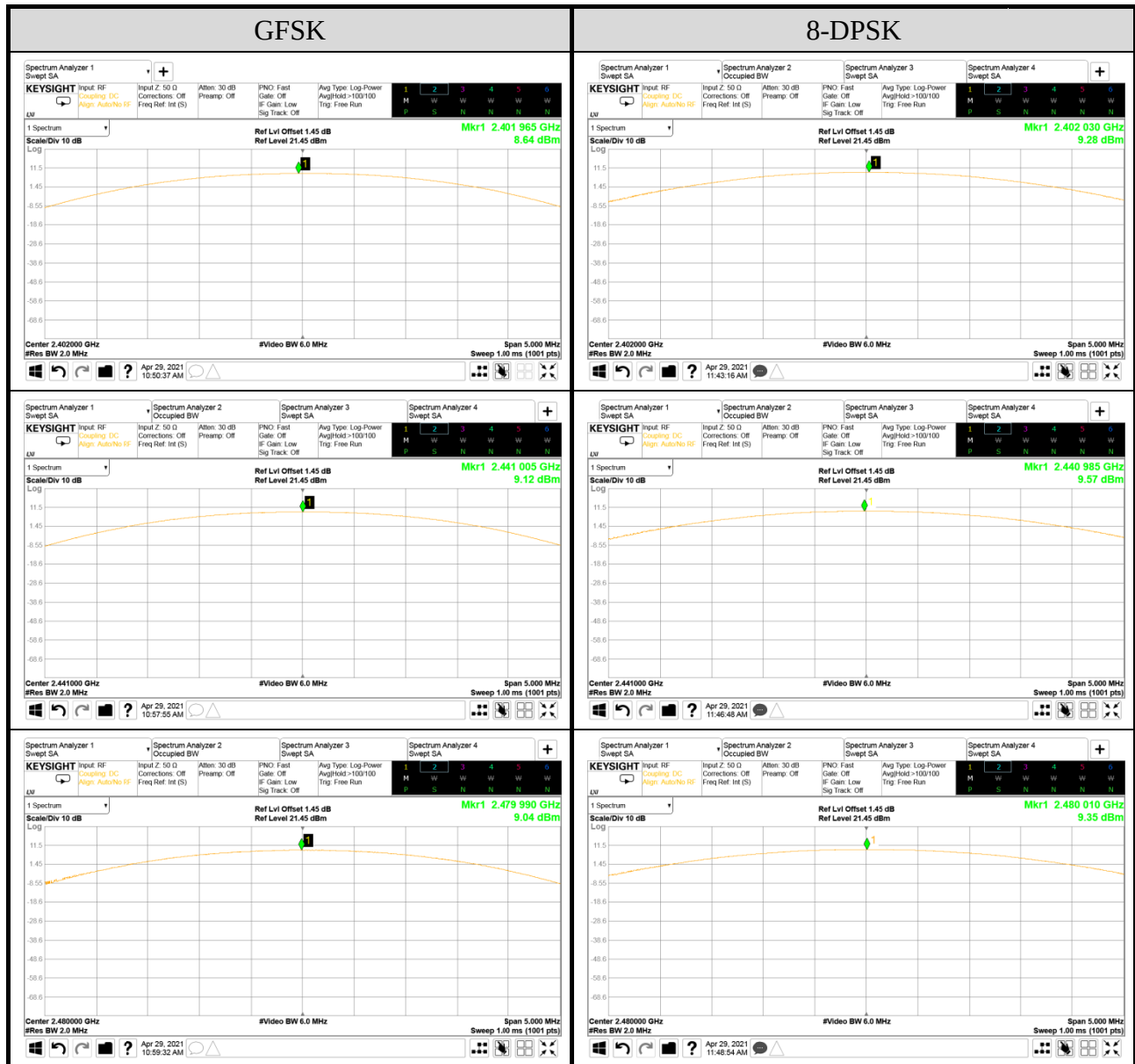
A.7 MAXIMUM PEAK OUTPUT POWER

Test Date	2021/04/29	Temp./Hum.	24°C /63%
Cable Loss	1.45dB	Tested By	Sam Chang
Test Voltage	AC 120V 60Hz (Via AC Adapter)		

A.7.1 Maximum Peak Output Power

Mode	Centre Frequency (MHz)	Maximum Peak Output Power		Limit
		dBm	W	
GFSK	2402	8.64	0.007	21dBm (0.125W)
	2441	9.12	0.008	
	2480	9.04	0.008	
8-DPSK	2402	9.28	0.008	
	2441	9.57	0.009	
	2480	9.35	0.009	

A.7.2 Measurement Plots



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A.8 EMISSION LIMITATIONS MEASUREMENT

Test Date	2021/04/29	Temp./Hum.	24°C /63%
Cable Loss	1.45dB	Tested By	Sam Chang
Test Voltage	AC 120V 60Hz (Via AC Adapter)		

A.8.1 Band Edge



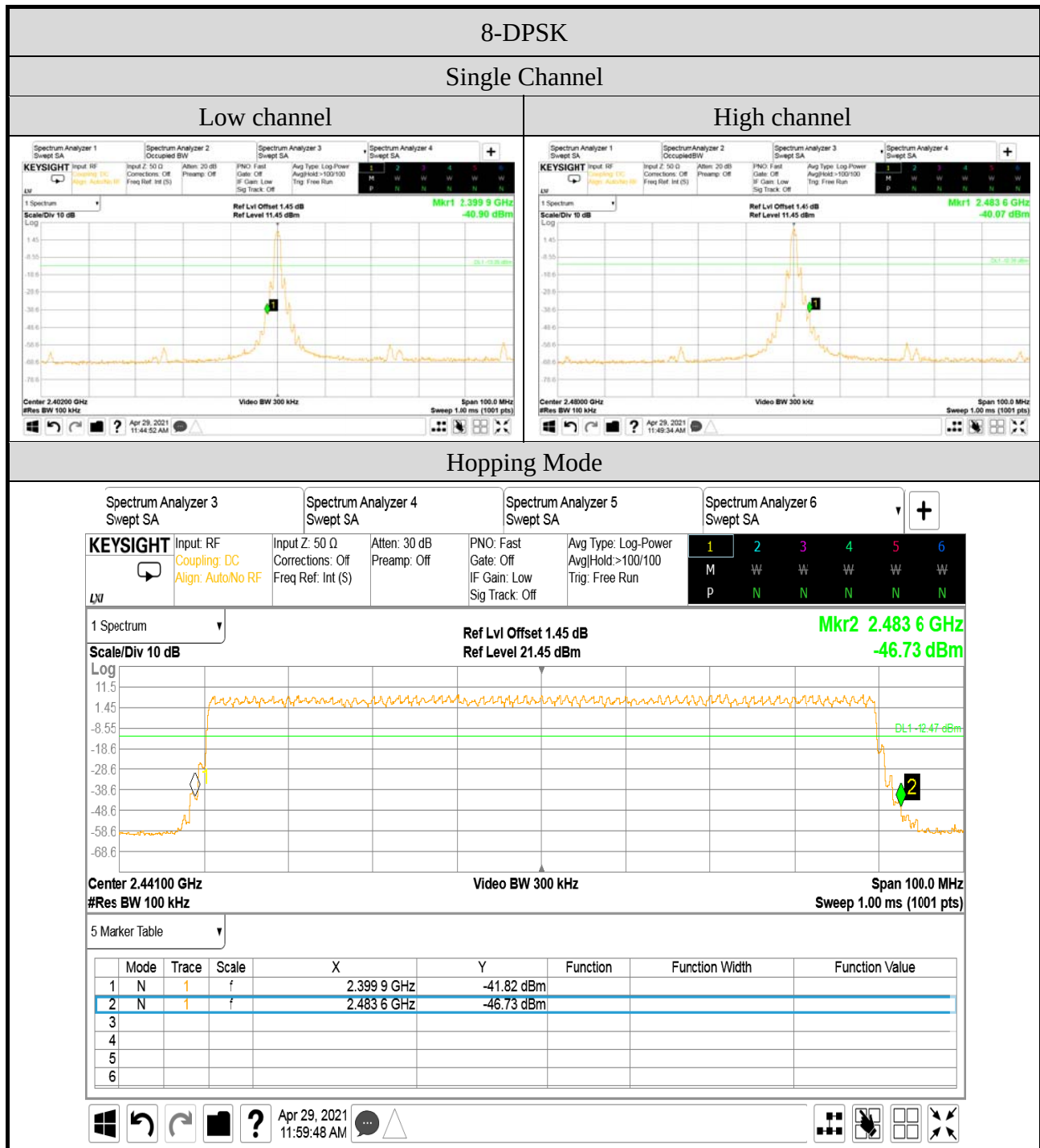
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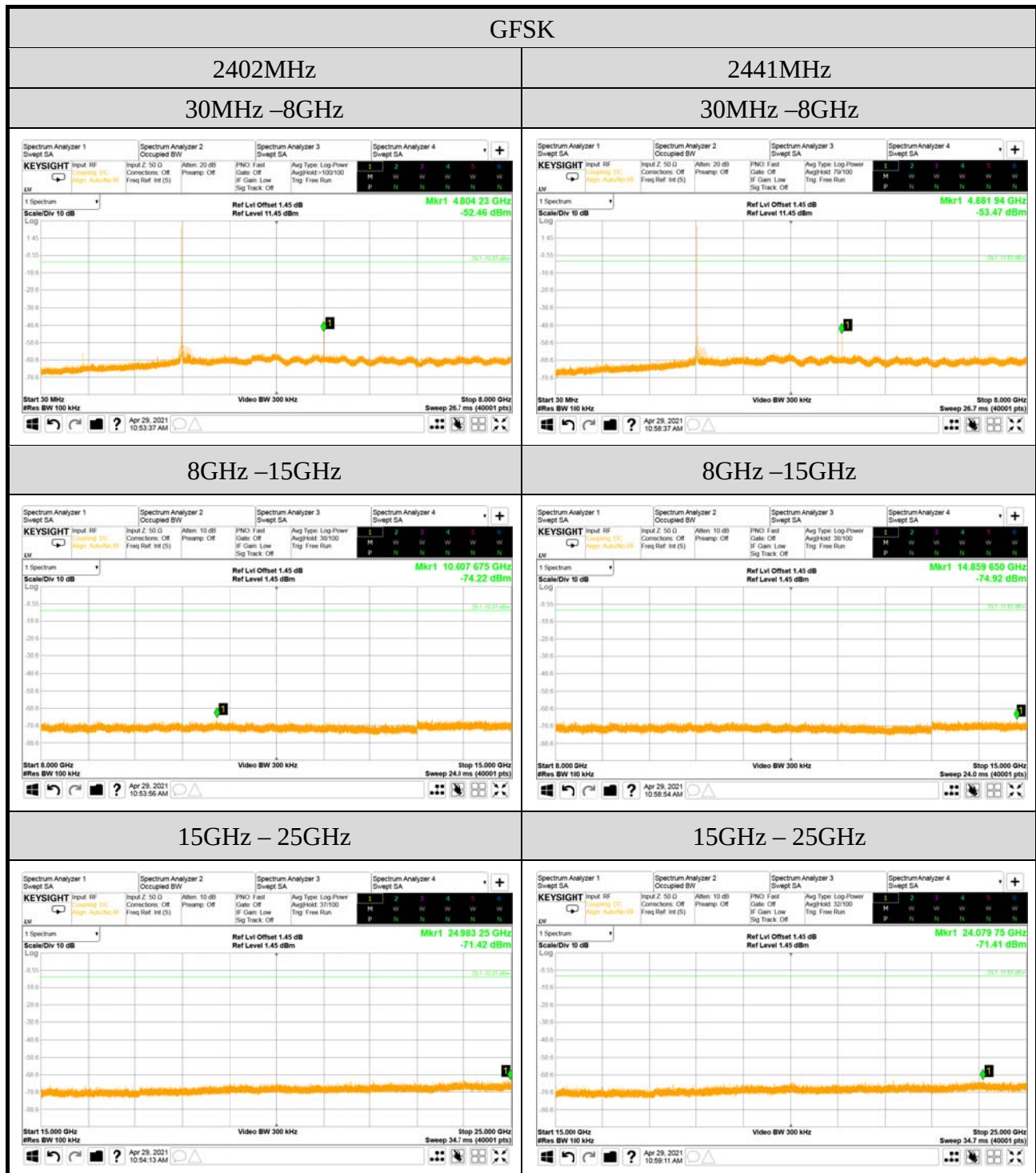


Note: All results have been included cable loss.

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A.8.2 Spurious Emission



Note: All results have been included cable loss.

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Note: All results have been included cable loss.

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Note: All results have been included cable loss.