

TEST REPORT

Applicant Name: Bytech NY Inc.
Address: 2585 West 13th Street Brooklyn NY 11223 USA
Report Number: SZ3240111-02322E-RF-00
FCC ID: 2AHN6-AUBE167

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type: BE Digital Display-ASST
Model No.: BY-AU-BE-167-AC
Multiple Model(s) No.: N/A
Trade Mark: N/A
Date Received: 2024/01/17
Report Date: 2024/02/02

Test Result:	Pass [▲]
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▲ In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

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Note: The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included.

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	SZ3240111-02322E-RF-00	Original Report	2024/02/02

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	BE Digital Display-ASST
Tested Model	BY-AU-BE-167-AC
Multiple Model(s)	N/A
UPC Number	805112123209, 805112123216, 805112123193
SKU Number	9123351
Lot Number	BY020624
Frequency Range	Bluetooth: 2402~2480MHz
Transmit Peak Power	-1.73dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification [#]	1.58dBi (provided by the applicant)
Voltage Range	DC 3.7V from battery
Sample serial number	2GGD-4 for Radiated Emissions Test 2GGD-3 for RF Conducted Test (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	N/A

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Frequency		213.55 Hz(k=2, 95% level of confidence)
RF output power, conducted		0.72 dB(k=2, 95% level of confidence)
Unwanted Emission, conducted		1.75 dB(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9kHz-150kHz	3.94dB(k=2, 95% level of confidence)
	150kHz-30MHz	3.84dB(k=2, 95% level of confidence)
Radiated Emissions	9kHz - 30MHz	3.30dB(k=2, 95% level of confidence)
	30MHz~200MHz (Horizontal)	4.48dB(k=2, 95% level of confidence)
	30MHz~200MHz (Vertical)	4.55dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Horizontal)	4.85dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Vertical)	5.05dB(k=2, 95% level of confidence)
	1GHz - 6GHz	5.35dB(k=2, 95% level of confidence)
	6GHz - 18GHz	5.44dB(k=2, 95% level of confidence)
18GHz - 40GHz		5.16dB(k=2, 95% level of confidence)
Temperature		±1°C
Humidity		±1%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 715558, the FCC Designation No. : CN5045.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	40	2442
1	2403	41	2443
2	2404	42	2444
...	...	...	...
...	...	...	...
36	2438	75	2477
37	2439	76	2478
38	2440	77	2479
39	2441	78	2480

EUT was tested with Channel 0, 39 and 78.

EUT Exercise Software

“bt_tool_V1.1.2”[#] exercise software was used and the power level is 2[#]. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

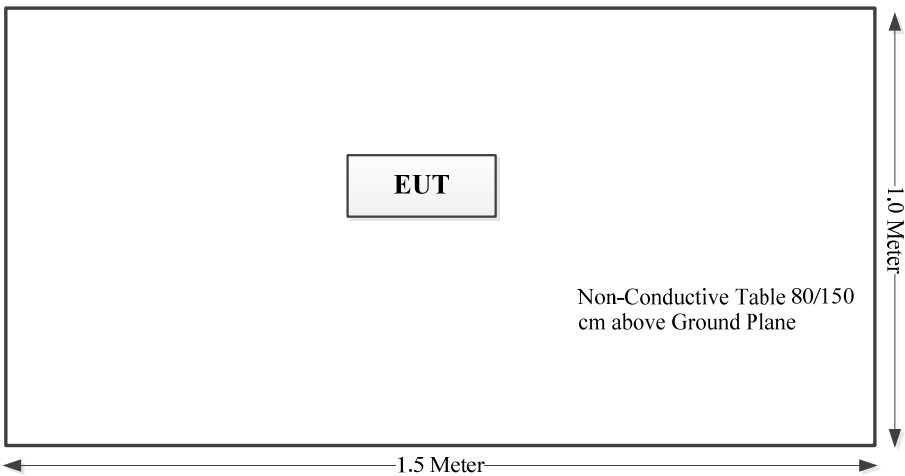
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/	/

Block Diagram of Test Setup

Spurious emissions:



SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1) & §2.1093	RF Exposure	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207(a)	AC Line Conducted Emissions	Not Applicable
FCC §15.205, §15.209, §15.247(d)	Radiated Emissions	Compliant
FCC §15.247(a)(1)	20 dB Emission Bandwidth & 99% Occupied Bandwidth	Compliant
FCC §15.247(a)(1)	Channel Separation Test	Compliant
FCC §15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
FCC §15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
FCC §15.247(b)(1)	Peak Output Power Measurement	Compliant
FCC §15.247(d)	Band edges	Compliant

Not Applicable, the device was powered by battery when operating.

Note: The left earbud and the right earbud are electrically identical. All tests were performed with left earbud.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2024/01/16	2025/01/15
Sonoma instrument	Pre-amplifier	310 N	186238	2023/06/08	2024/06/07
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2024/07/19
ETS	Passive Loop Antenna	6512	29604	2023/07/07	2024/07/06
Unknown	Cable	Chamber Cable 1	F-03-EM236	2023/08/03	2024/08/02
Unknown	Cable	Chamber Cable 4	EC-007	2023/08/03	2024/08/02
Audix	EMI Test software	E3	19821b(V9)	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40	101605	2023/04/18	2024/04/17
COM-POWER	Pre-amplifier	PA-122	181919	2023/06/29	2024/06/28
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2024/07/25
Unknown	RF Cable	KMSE	0735	2023/10/08	2024/10/07
Unknown	RF Cable	UFA147	219661	2023/10/08	2024/10/07
SNSD	2.4G Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2023/08/03	2024/08/02
A.H.System	Pre-amplifier	PAM-1840VH	190	2023/08/03	2024/08/02
Electro-Mechanics Co	Horn Antenna	3116	2026	2023/09/18	2026/09/17
UTIFLEX	RF Cable	NO. 13	232308-001	2023/08/03	2024/08/02
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
RF Conducted Test					
R&S	SPECTRUM ANALYZER	FSU26	200120	2024/01/08	2025/01/07
MARCONI	10dB Attenuator	6534/3	2942	2023/07/04	2024/07/03
Micro-Tronics	RF Cable	8082135	W1113	2023/07/04	2024/07/03

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1307 (b) (1) &§2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

1. $f(\text{GHz})$ is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

Measurement Result

For worst case:

Mode	Frequency (MHz)	Max tune-up conducted power [#] (dBm)	Max tune-up conducted power [#] (mW)	Distance (mm)	Calculated value	Threshold (1-g SAR)	SAR Test Exclusion
BT	2402-2480	-1.0	0.79	5	0.2	3.0	Yes

Result: Compliant.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has one internal antenna arrangement, which was permanently attached, the maximum antenna gain[#] is 1.58dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant

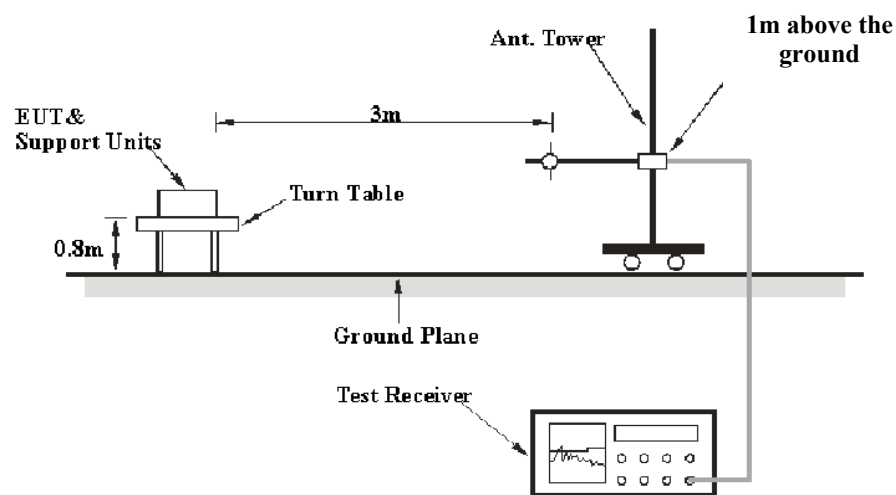
FCC §15.205, §15.209 & §15.247(d) - RADIATED EMISSIONS

Applicable Standard

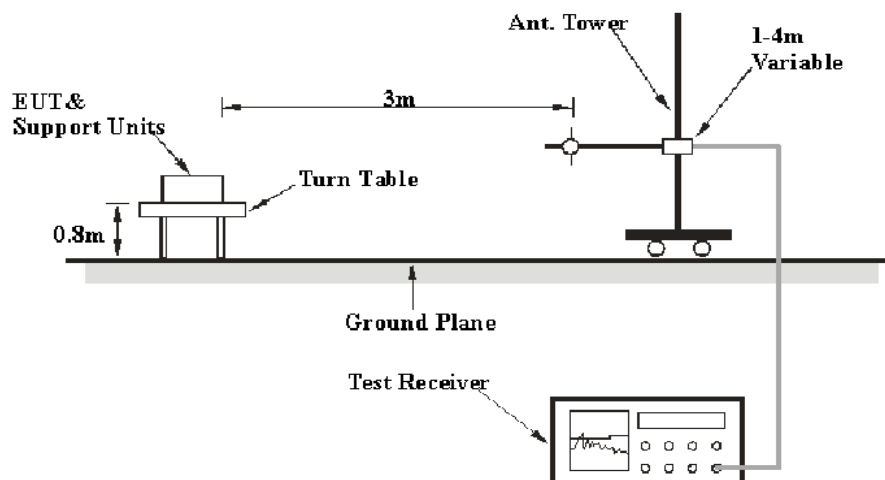
FCC §15.205; §15.209; §15.247(d)

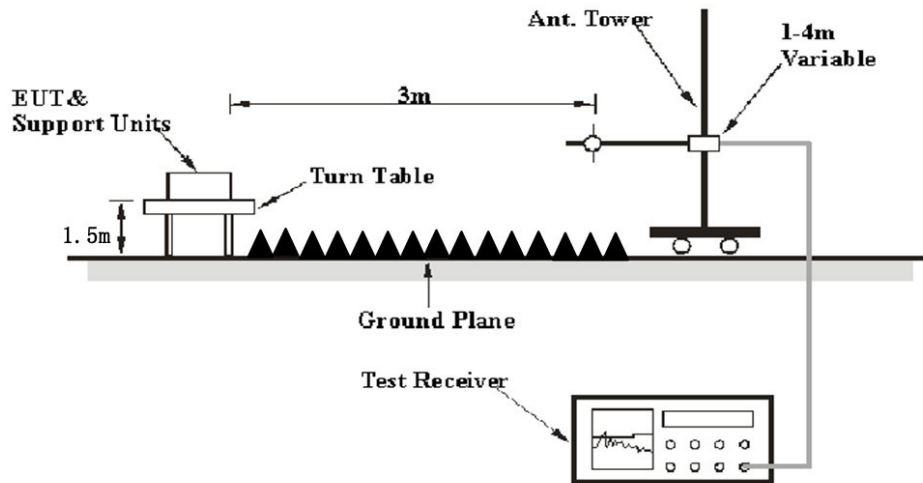
EUT Setup

9 kHz-30MHz:



30MHz-1GHz:



Above 1GHz:

The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
9 kHz – 150 kHz	/	/	200 Hz	QP
	300 Hz	1 kHz	/	PK
150 kHz – 30 MHz	/	/	9 kHz	QP
	10 kHz	30 kHz	/	PK
30 MHz – 1000 MHz	/	/	120 kHz	QP
	100 kHz	300 kHz	/	PK
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz, average detection modes for frequency bands 9–90 kHz and 110–490 kHz, peak and average detection modes for frequencies above 1 GHz.

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

All emissions under the average limit and under the noise floor have not recorded in the report.

Factor & Over Limit/Margin Calculation

The Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Over Limit/Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

$$\begin{aligned}\text{Over Limit/Margin} &= \text{Level/Corrected Amplitude} - \text{Limit} \\ \text{Level / Corrected Amplitude} &= \text{Read Level} + \text{Factor}\end{aligned}$$

Test Data

Environmental Conditions

Temperature:	22~25.6 °C
Relative Humidity:	50~54 %
ATM Pressure:	101 kPa

The testing was performed by Anson Su on 2024-01-18 for below 1GHz and Dylan Yang from 2024-01-24 to 2024-02-02 for above 1GHz.

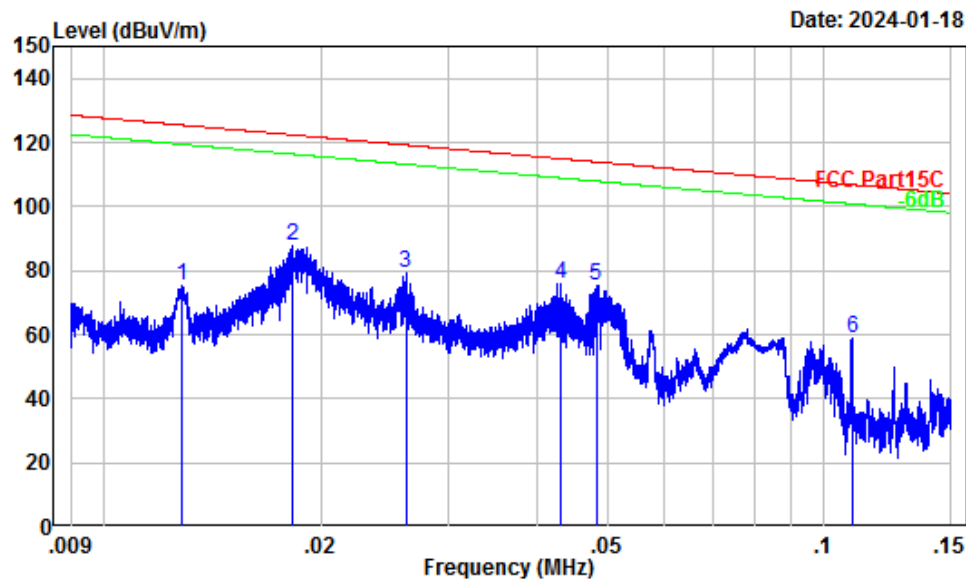
Test mode: Transmitting

Note: After pre-scan in the X, Y and Z axes of orientation, the worst case z-axis of orientation were recorded.

9 kHz ~ 30 MHz: (Maximum output power mode, EDR Mode (8DPSK) Low channel)

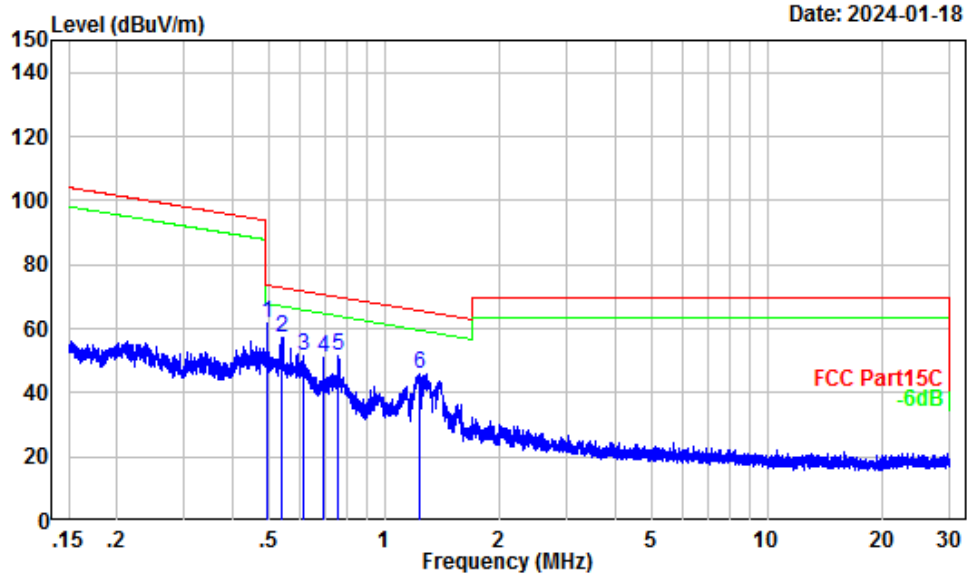
Note: When the test result of peak was less than the limit of QP/Average more than 6dB, just peak value were recorded.

Parallel (worst case):



Site : chamber
Condition : 3m
Project Number: SZ3240111-02322E-RF
Note : BT
Tester : Anson Su

	Freq	Factor	Read Level	Limit Level	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB
1	0.01	52.43	22.59	75.02	125.43	-50.41 Peak
2	0.02	50.77	37.06	87.83	122.38	-34.55 Peak
3	0.03	48.31	30.97	79.28	119.22	-39.94 Peak
4	0.04	43.13	32.73	75.86	114.92	-39.06 Peak
5	0.05	41.53	33.63	75.16	113.93	-38.77 Peak
6	0.11	33.66	24.98	58.64	106.83	-48.19 Peak

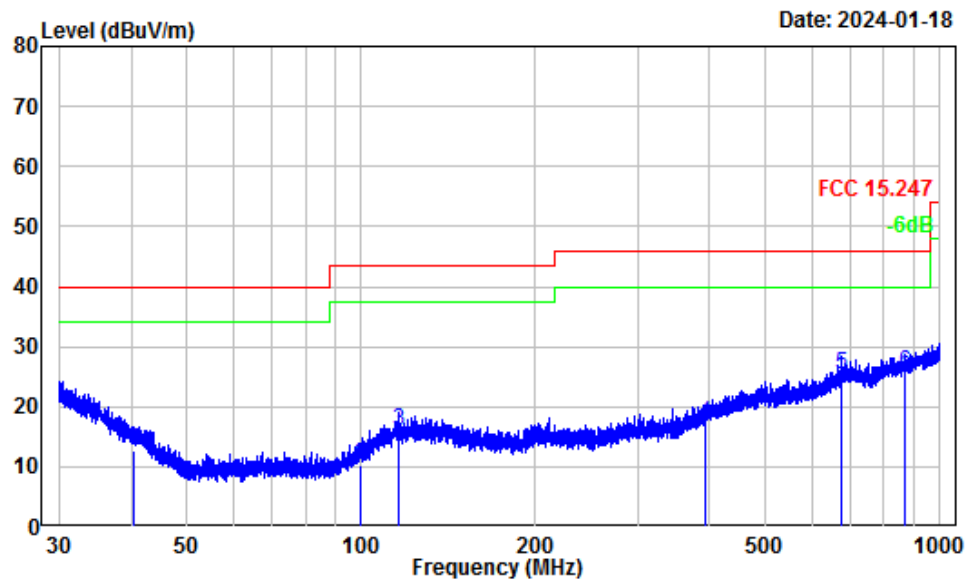


Site : chamber
Condition : 3m
Project Number: SZ3240111-02322E-RF
Note : BT
Tester : Anson Su

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	0.50	21.02	40.41	61.43	73.71	-12.28	Peak
2	0.54	20.43	36.93	57.36	72.91	-15.55	Peak
3	0.62	19.47	32.24	51.71	71.78	-20.07	Peak
4	0.69	18.31	32.70	51.01	70.71	-19.70	Peak
5	0.76	17.46	34.06	51.52	69.90	-18.38	Peak
6	1.23	14.30	31.79	46.09	65.62	-19.53	Peak

30MHz-1GHz: (Maximum output power mode, EDR Mode (8DPSK) Low channel)

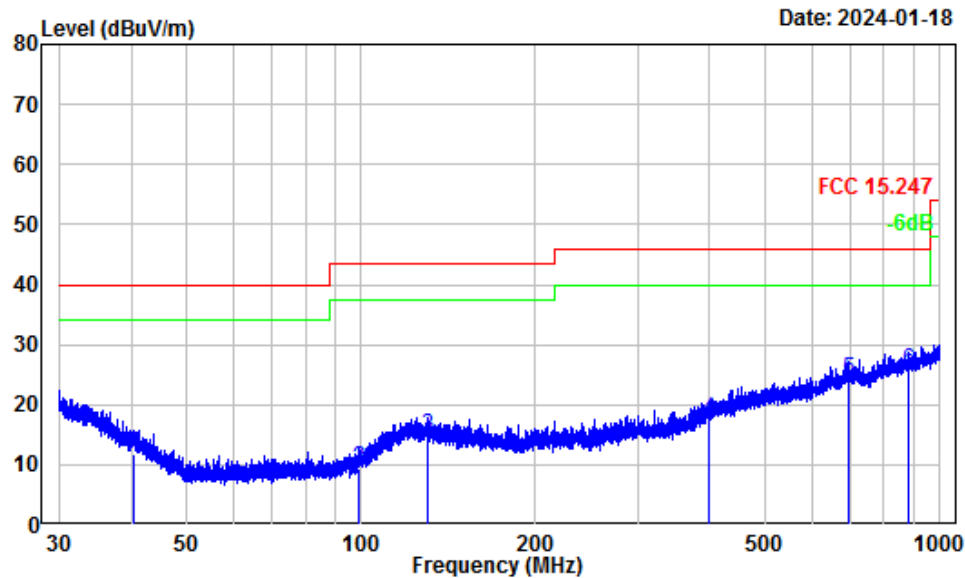
Horizontal



Site : chamber
Condition : 3m Horizontal
Project Number: SZ3240111-02322E-RF
Note : BT
Tester : Anson Su

	Freq Factor		Read Level	Level	Limit	Over	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.52	-10.72	23.31	12.59	40.00	-27.41	QP
2	99.79	-13.79	24.18	10.39	43.50	-33.11	QP
3	115.93	-10.67	26.65	15.98	43.50	-27.52	QP
4	393.99	-7.66	24.88	17.22	46.00	-28.78	QP
5	677.88	-1.93	27.31	25.38	46.00	-20.62	QP
6	867.61	0.48	25.11	25.59	46.00	-20.41	QP

Vertical



Site : chamber
Condition : 3m Vertical
Project Number: SZ3240111-02322E-RF
Note : BT
Tester : Anson Su

	Freq Factor		Read Level	Limit Level	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB
1	40.35	-12.08	23.79	11.71	40.00	-28.29 QP
2	99.18	-15.40	24.62	9.22	43.50	-34.28 QP
3	129.81	-10.78	25.48	14.70	43.50	-28.80 QP
4	399.38	-7.59	25.12	17.53	46.00	-28.47 QP
5	697.16	-1.96	26.13	24.17	46.00	-21.83 QP
6	884.12	0.38	25.30	25.68	46.00	-20.32 QP

Above 1GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
GFSK									
Low Channel 2402MHz									
4804.00	54.72	PK	9	1.9	H	2.42	57.14	74	-16.86
4804.00	45.94	AV	9	1.9	H	2.42	48.36	54	-5.64
4804.00	53.89	PK	23	2.5	V	2.42	56.31	74	-17.69
4804.00	44.62	AV	23	2.5	V	2.42	47.04	54	-6.96
Middle Channel 2441MHz									
4882.00	54.37	PK	224	1.6	H	2.56	56.93	74	-17.07
4882.00	45.77	AV	224	1.6	H	2.56	48.33	54	-5.67
4882.00	54.00	PK	159	1.0	V	2.56	56.56	74	-17.44
4882.00	44.22	AV	159	1.0	V	2.56	46.78	54	-7.22
High Channel 2480MHz									
4960.00	54.04	PK	189	1.4	H	2.68	56.72	74	-17.28
4960.00	45.91	AV	189	1.4	H	2.68	48.59	54	-5.41
4960.00	53.28	PK	327	2.4	V	2.68	55.96	74	-18.04
4960.00	44.87	AV	327	2.4	V	2.68	47.55	54	-6.45
π/4-DQPSK									
Low Channel 2402MHz									
4804.00	55.19	PK	26	2.5	H	2.42	57.61	74	-16.39
4804.00	47.12	AV	26	2.5	H	2.42	49.54	54	-4.46
4804.00	54.89	PK	149	1.1	V	2.42	57.31	74	-16.69
4804.00	46.89	AV	149	1.1	V	2.42	49.31	54	-4.69
Middle Channel 2441MHz									
4882.00	58.98	PK	317	1.6	H	2.56	61.54	74	-12.46
4882.00	46.91	AV	317	1.6	H	2.56	49.47	54	-4.53
4882.00	56.96	PK	121	2.2	V	2.56	59.52	74	-14.48
4882.00	46.02	AV	121	2.2	V	2.56	48.58	54	-5.42
High Channel 2480MHz									
4960.00	58.88	PK	28	1.6	H	2.68	61.56	74	-12.44
4960.00	47.11	AV	28	1.6	H	2.68	49.79	54	-4.21
4960.00	57.32	PK	35	2.2	V	2.68	60.00	74	-14.00
4960.00	46.14	AV	35	2.2	V	2.68	48.82	54	-5.18

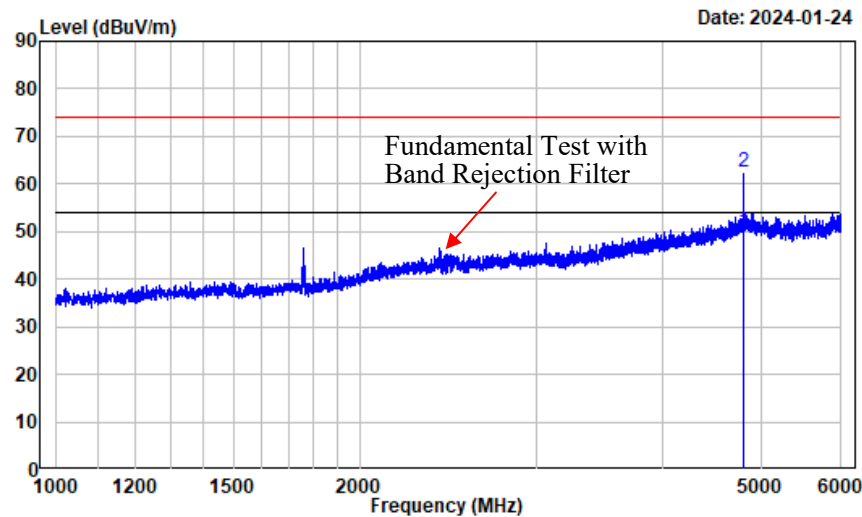
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
8DPSK									
Low Channel 2402MHz									
4804.00	60.23	PK	284	1.7	H	2.42	62.65	74	-11.35
4804.00	47.54	AV	284	1.7	H	2.42	49.96	54	-4.04
4804.00	59.23	PK	80	2.3	V	2.42	61.65	74	-12.35
4804.00	46.11	AV	80	2.3	V	2.42	48.53	54	-5.47
Middle Channel 2441MHz									
4882.00	60.43	PK	114	1.8	H	2.56	62.99	74	-11.01
4882.00	47.20	AV	114	1.8	H	2.56	49.76	54	-4.24
4882.00	58.61	PK	234	1.6	V	2.56	61.17	74	-12.83
4882.00	46.28	AV	234	1.6	V	2.56	48.84	54	-5.16
High Channel 2480MHz									
4960.00	59.79	PK	90	2.1	H	2.68	62.47	74	-11.53
4960.00	47.21	AV	90	2.1	H	2.68	49.89	54	-4.11
4960.00	58.33	PK	212	1.2	V	2.68	61.01	74	-12.99
4960.00	46.63	AV	212	1.2	V	2.68	49.31	54	-4.69

Listed with the worst harmonic margin test plot:

1-6GHz

Pre-scan, 8DPSK Low Channel (worst case)

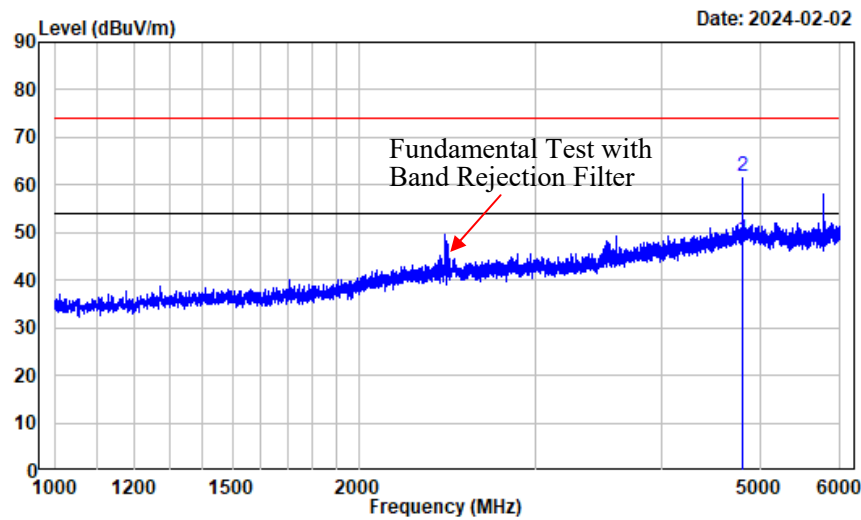
Horizontal



Project No. : SZ3240111-02322E
Tester : Dylan
Polarization: Horizontal
Note : BT

Freq Factor		Read Level	Level	Limit Line	Remark	Over Limit
MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	4804.000	2.42	47.54	49.96	54.00 Average	-4.04
2	4804.000	2.42	60.23	62.65	74.00 Peak	-11.35

Vertical

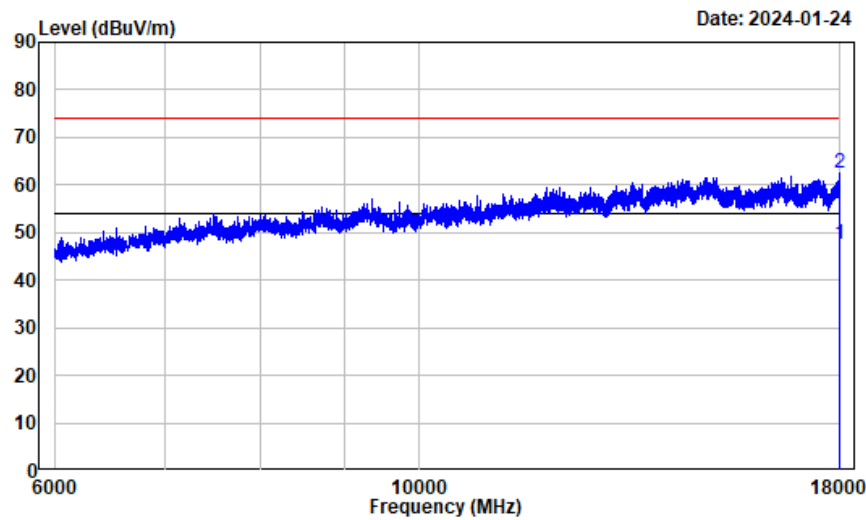


Project No. : SZ3240111-02322E
Tester : Dylan
Polarization: Vertical
Note : BT

Freq Factor		Read Level	Level	Limit Line	Remark	Over Limit
MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1 4804.000	2.42	46.11	48.53	54.00	Average	-5.47
2 4804.000	2.42	59.23	61.65	74.00	Peak	-12.35

6-18GHz

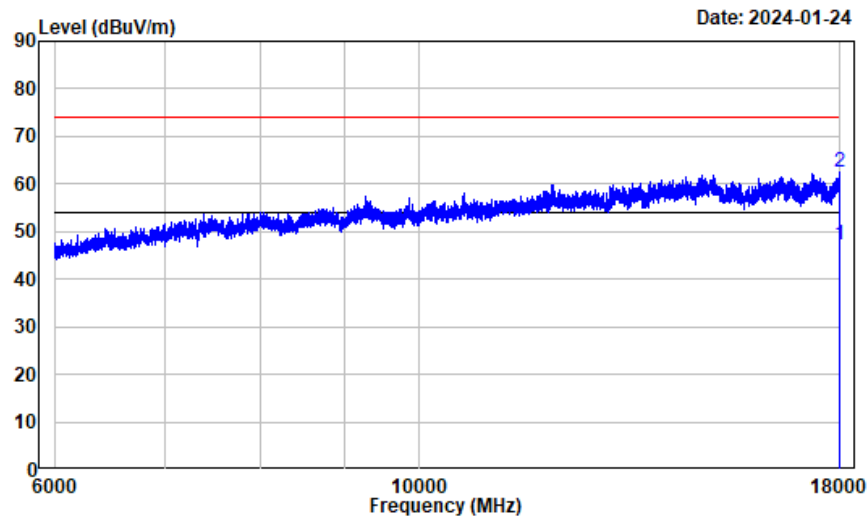
Pre-scan, 8DPSK Low Channel (worst case)
Horizontal



Project No. : SZ3240111-02322E
Tester : Dylan
Polarization: Horizontal
Note : BT

Freq Factor		Read Level		Limit	Remark	Over
MHz	dB/m	dBuV	dBuV/m	dBuV/m		Limit
1	17992.500	24.57	23.11	47.68	54.00 Average	-6.32
2	17992.500	24.57	37.86	62.43	74.00 Peak	-11.57

Vertical



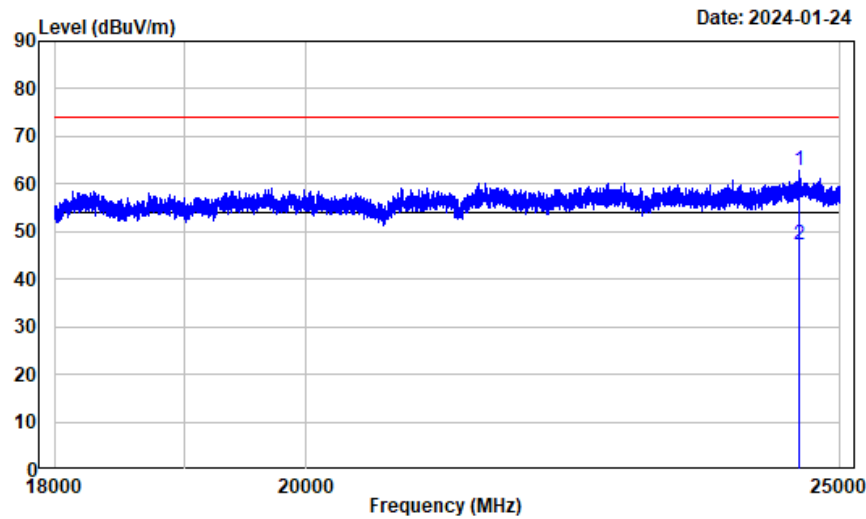
Project No. : SZ3240111-02322E
Tester : Dylan
Polarization: Vertical
Note : BT

	Freq	Factor	Read		Limit	Remark	Over
			Level	Level	Line		Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	17982.000	24.48	22.63	47.11	54.00	Average	-6.89
2	17982.000	24.48	37.98	62.46	74.00	Average	-11.54

18-25GHz

Pre-scan, 8DPSK Low Channel (worst case)

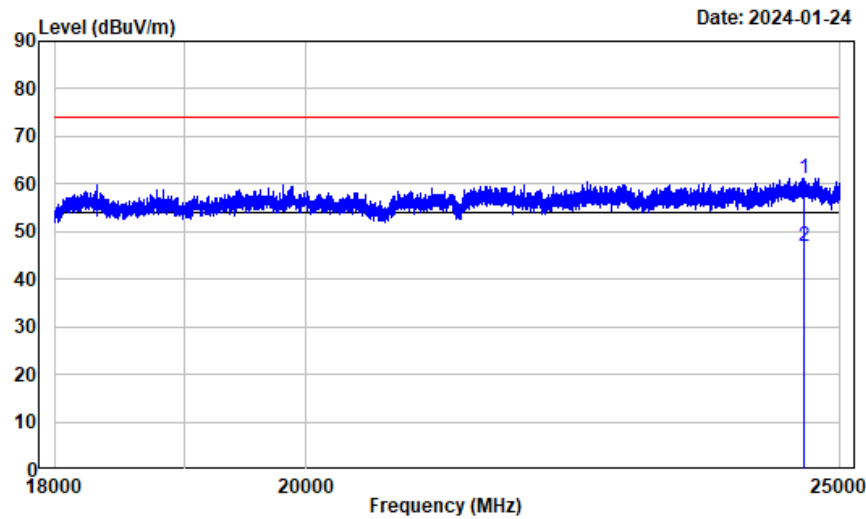
Horizontal



Project No. : SZ3240111-02322E
Tester : Dylan
Polarization: Horizontal
Note : BT

Freq Factor		Read Level	Level	Limit Line	Remark	Over Limit
MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1 24570.380	18.91	43.99	62.90	74.00	Peak	-11.10
2 24570.380	18.91	28.43	47.34	54.00	Average	-6.66

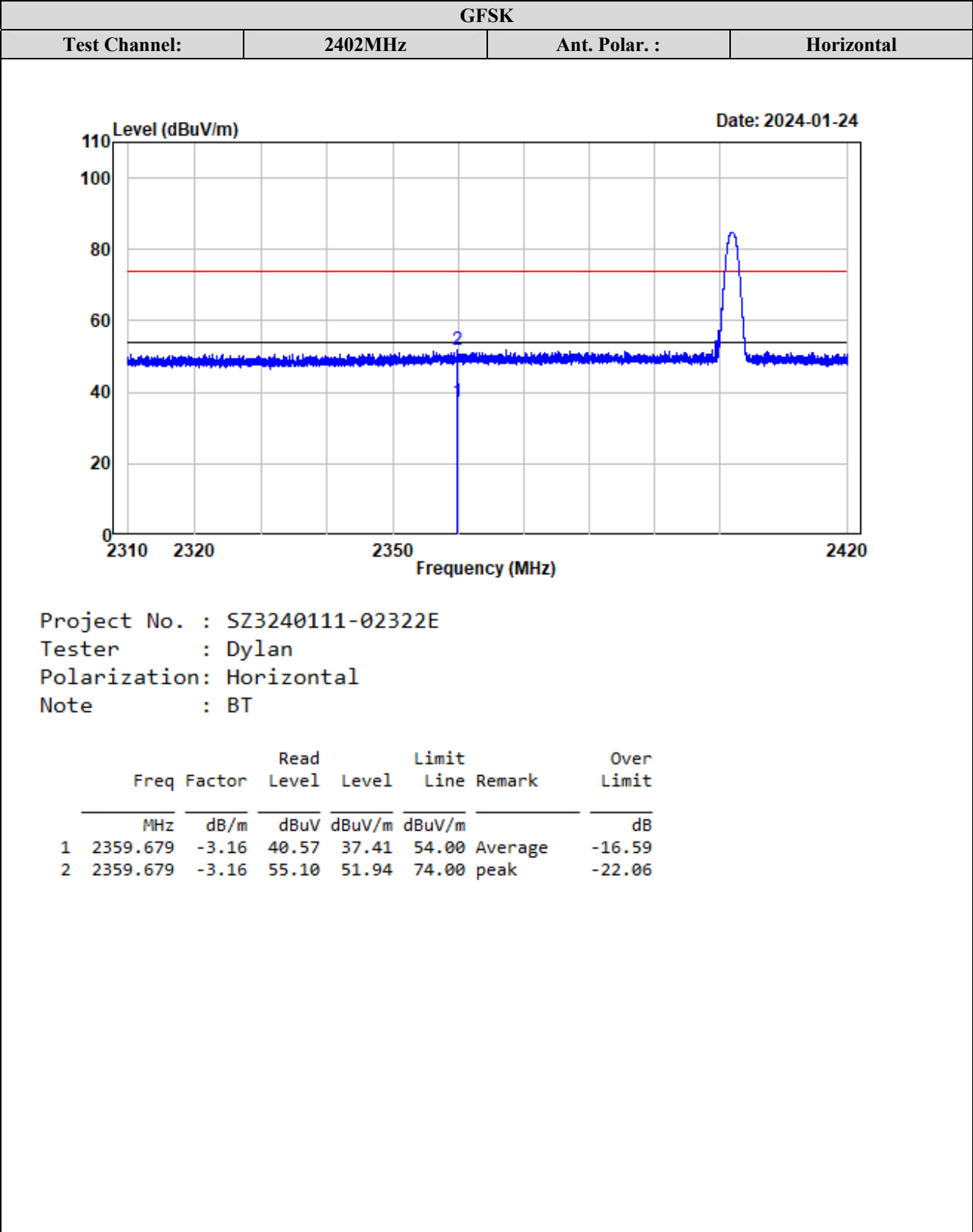
Vertical

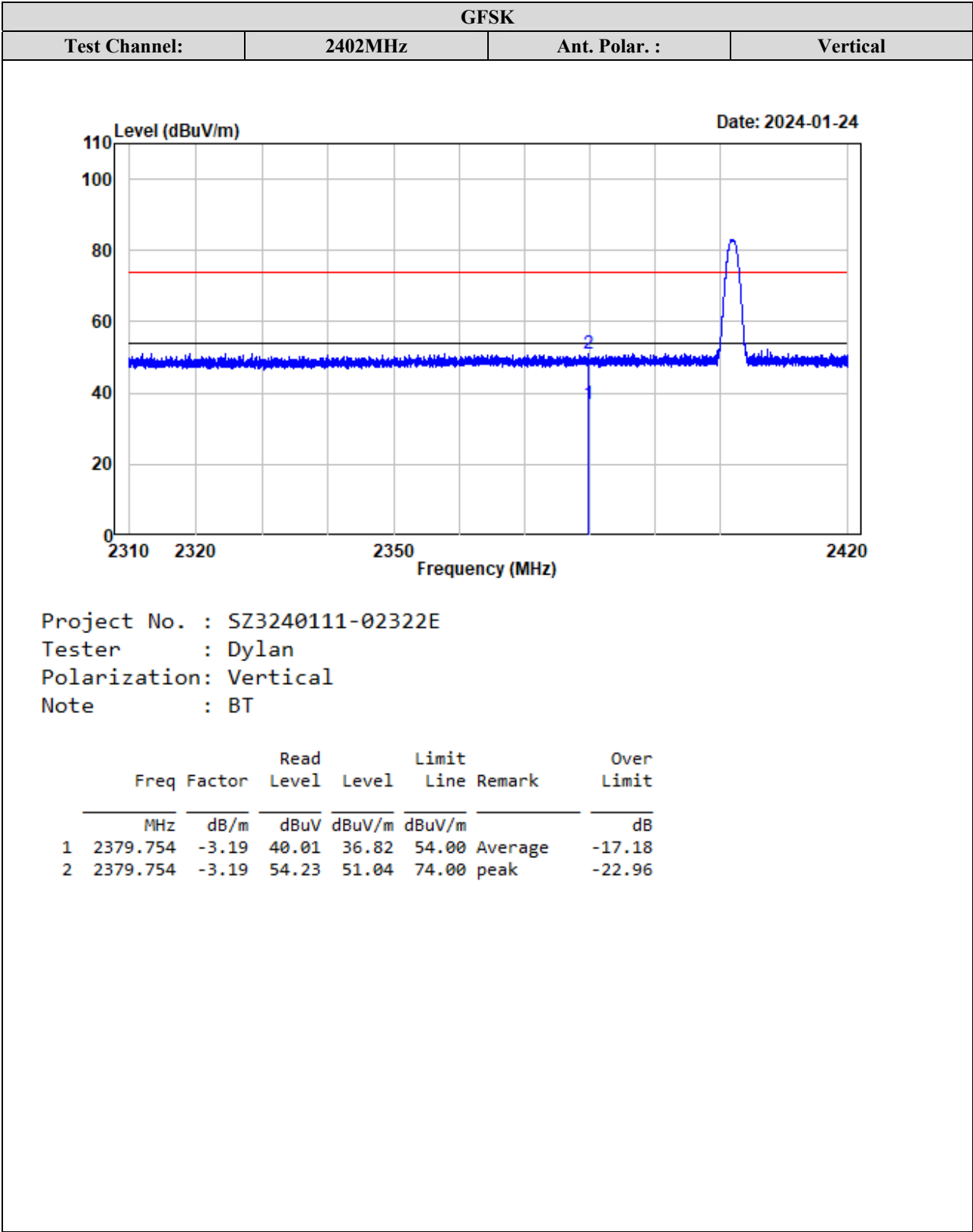


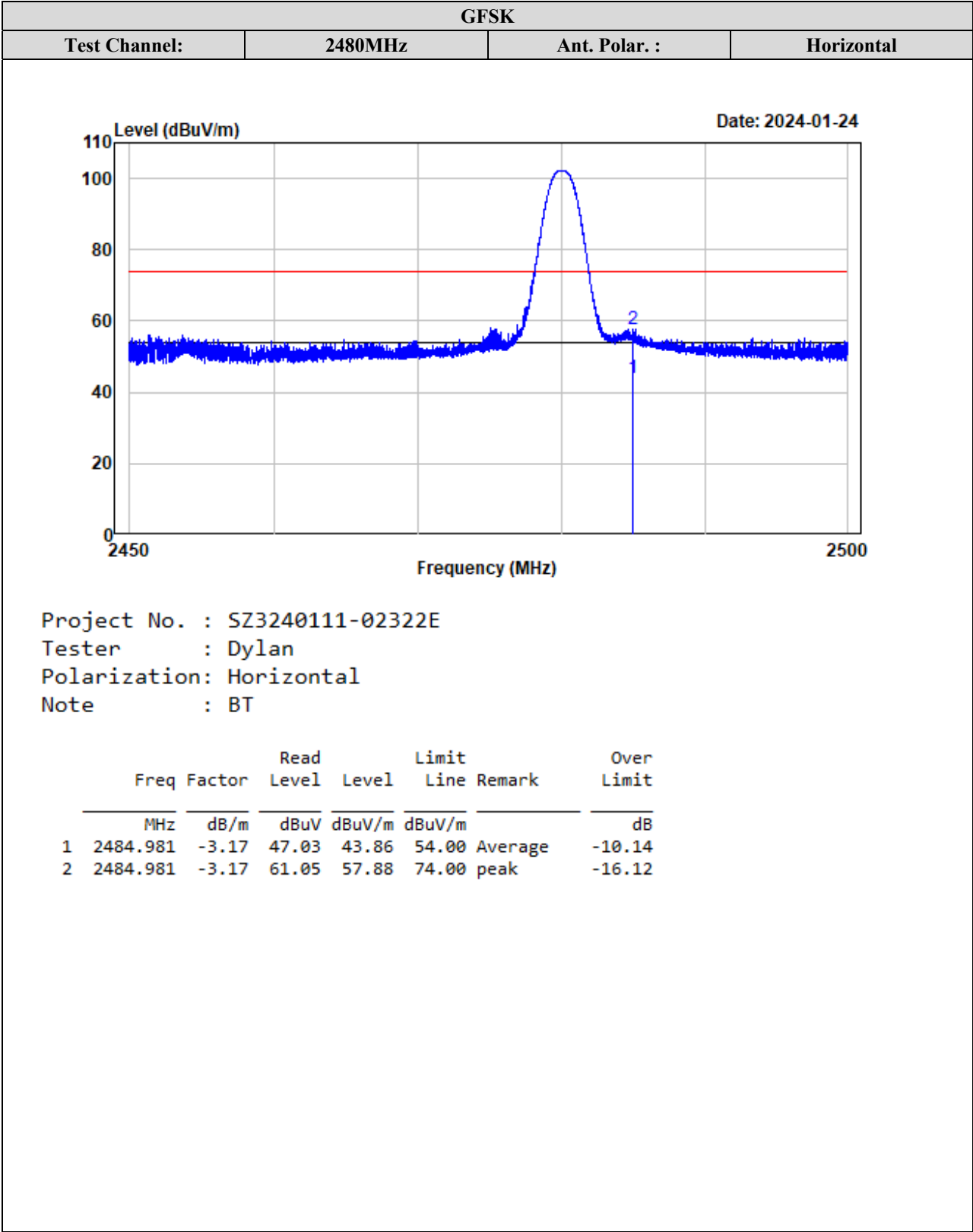
Project No. : SZ3240111-02322E
Tester : Dylan
Polarization: Vertical
Note : BT

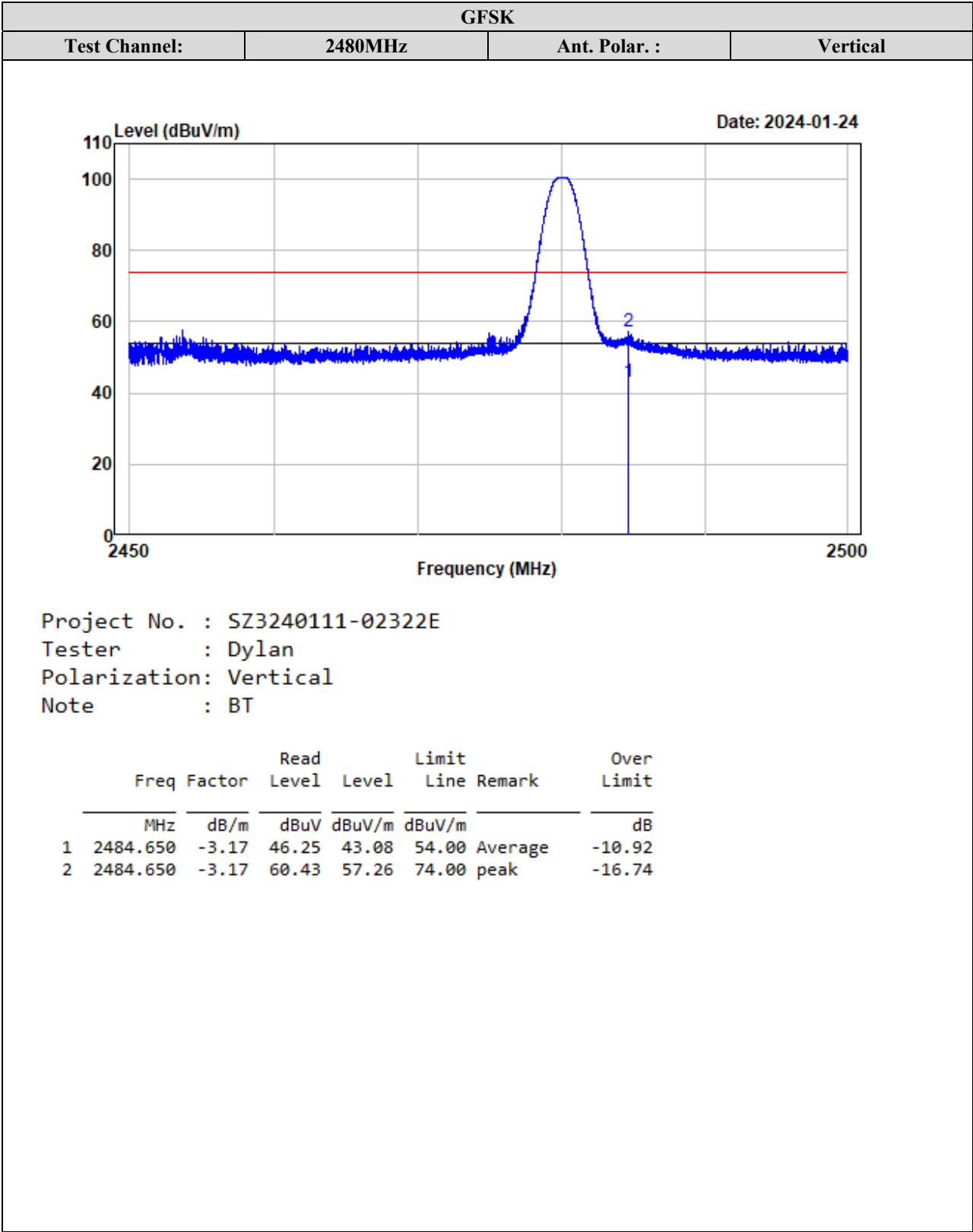
Freq Factor		Read Level		Limit Line	Remark	Over Limit
MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1 24628.130	18.84	42.38	61.22	74.00	Peak	-12.78
2 24628.130	18.84	28.14	46.98	54.00	Average	-7.02

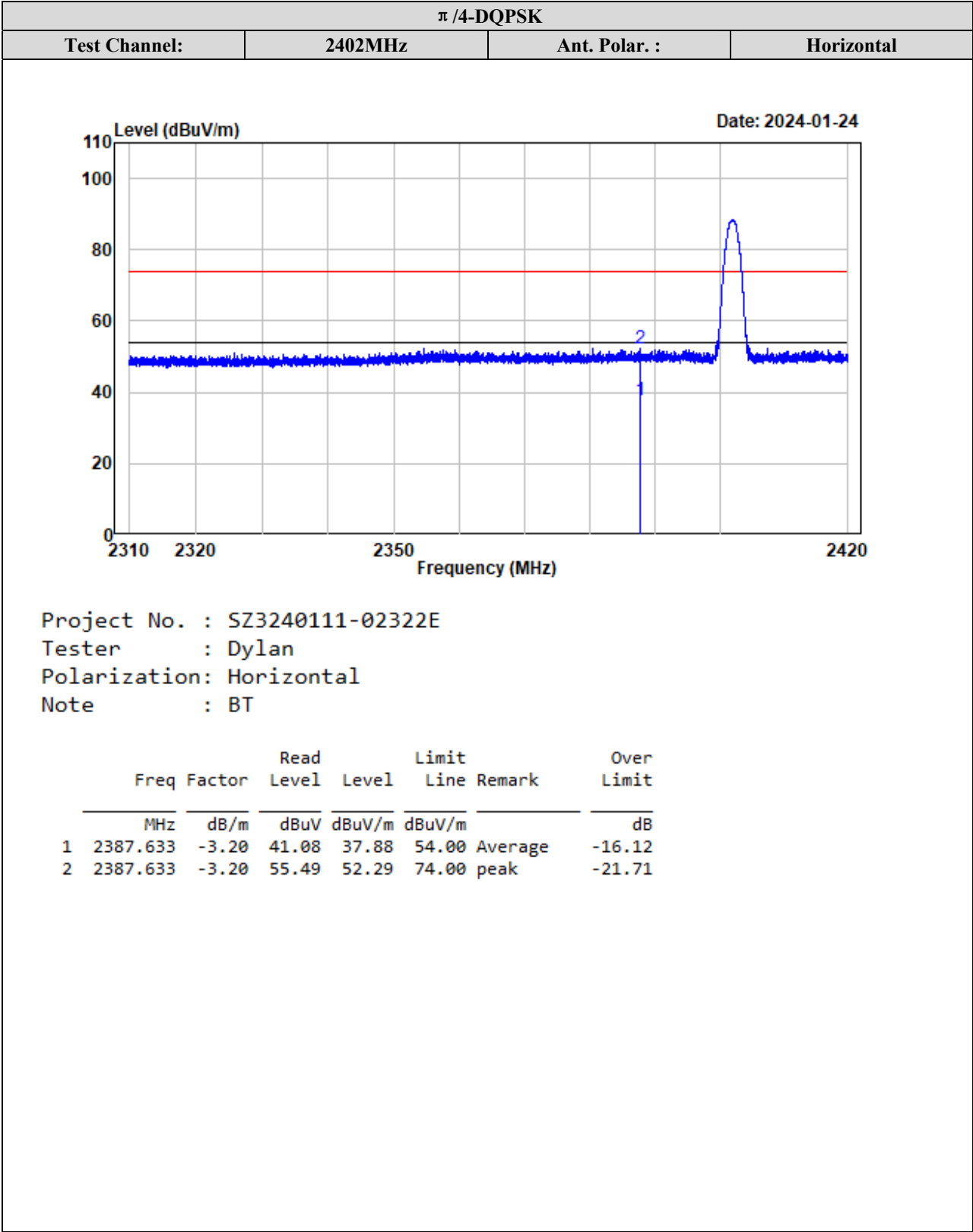
Test plots for Band Edge Measurements (Radiated):

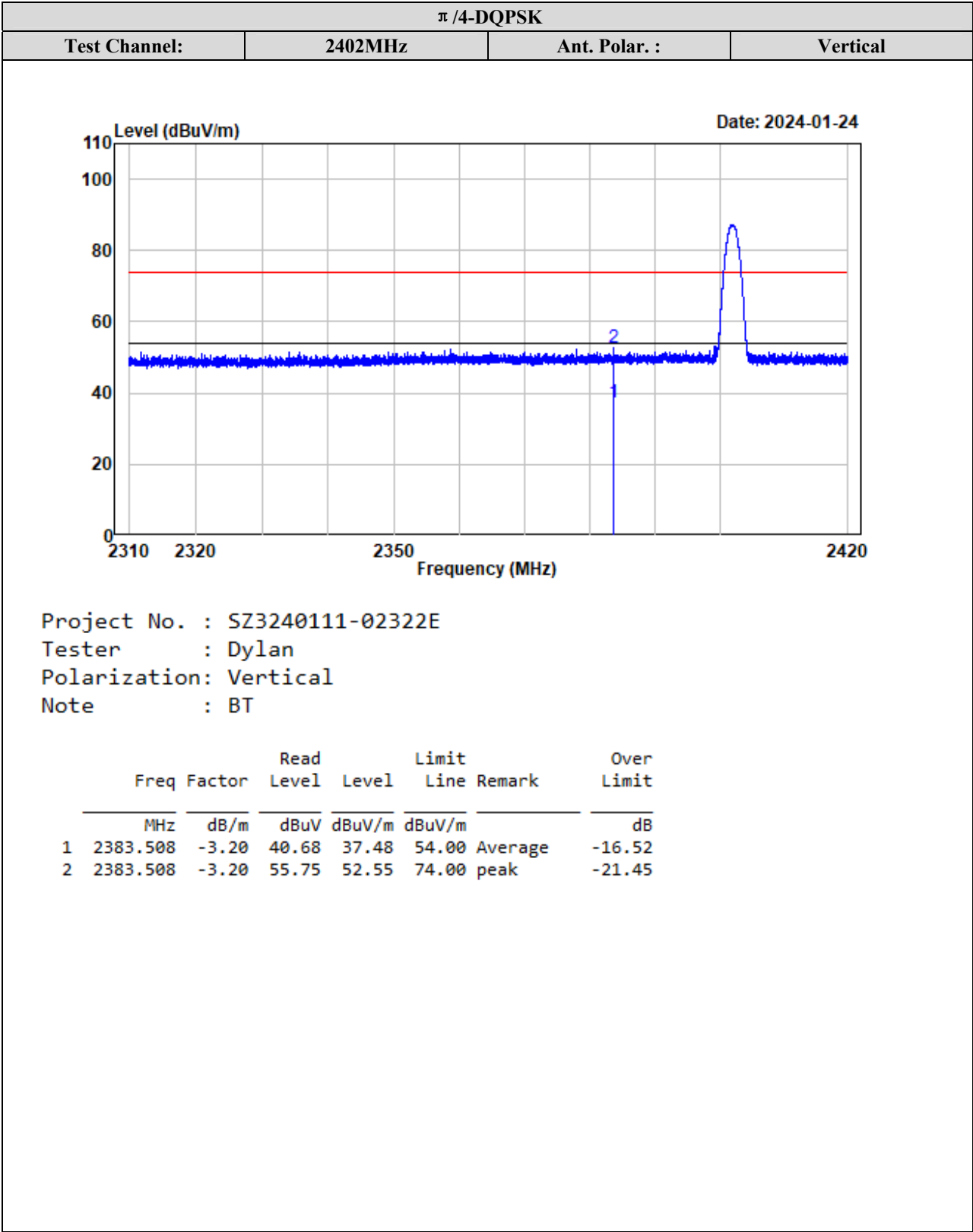


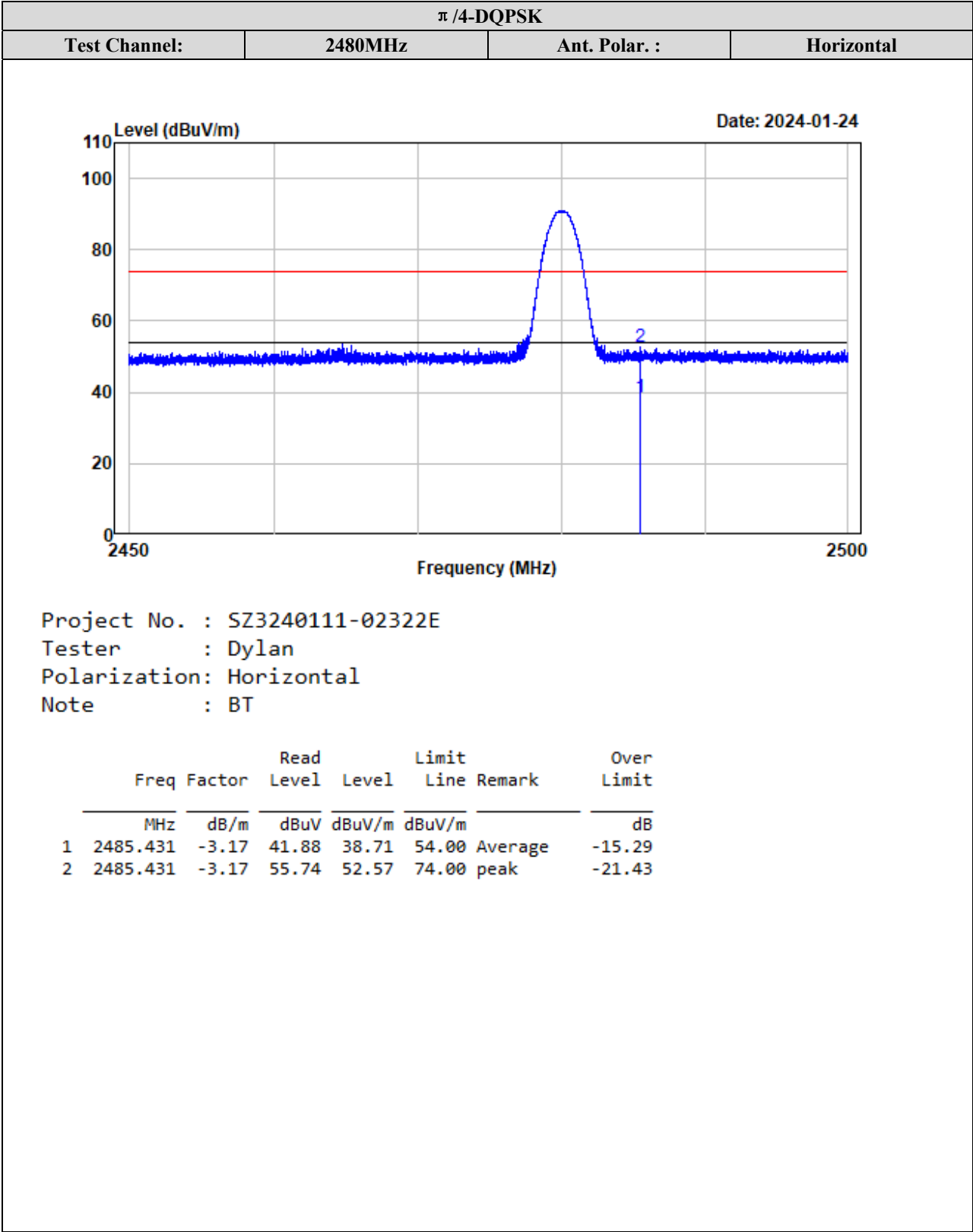


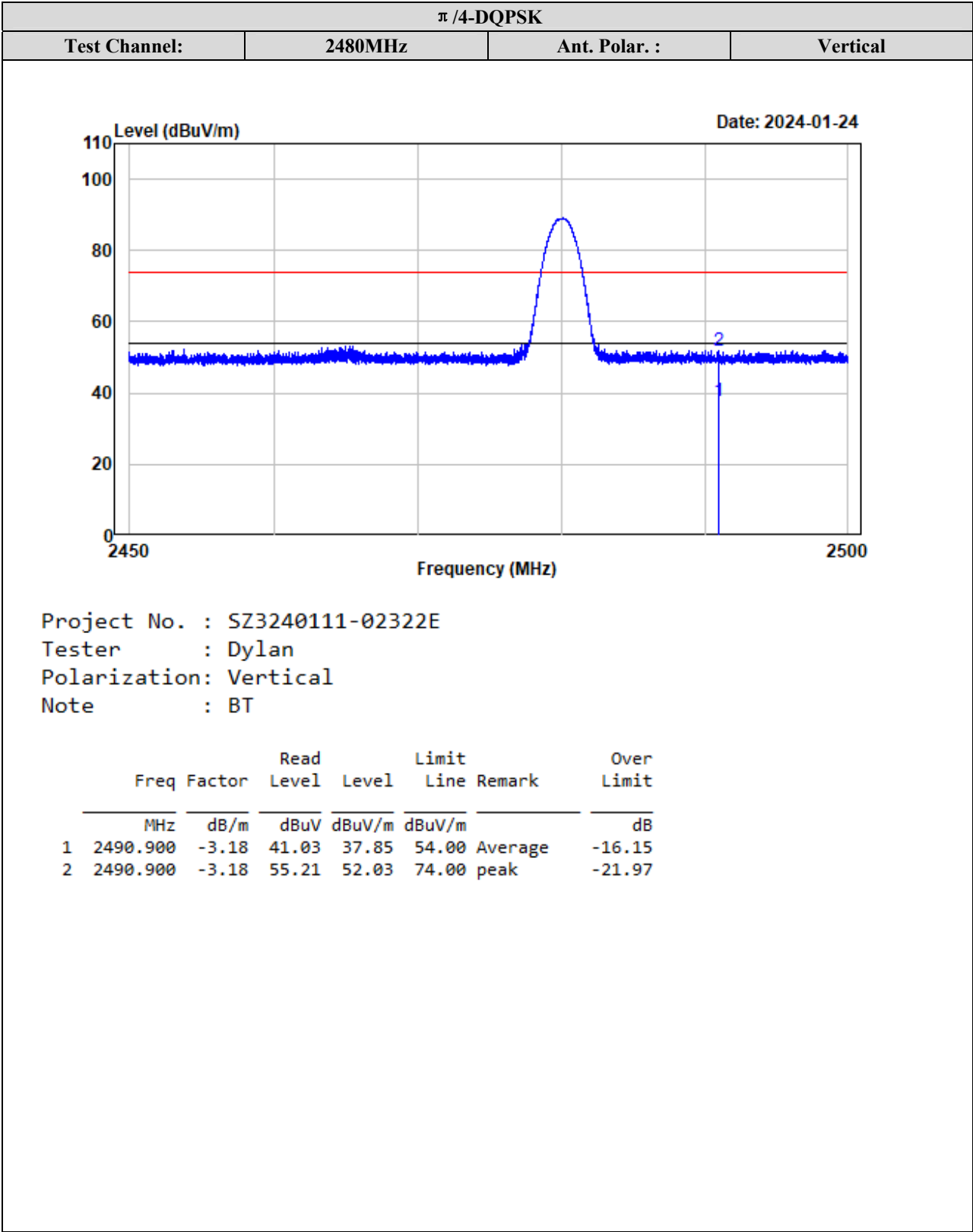


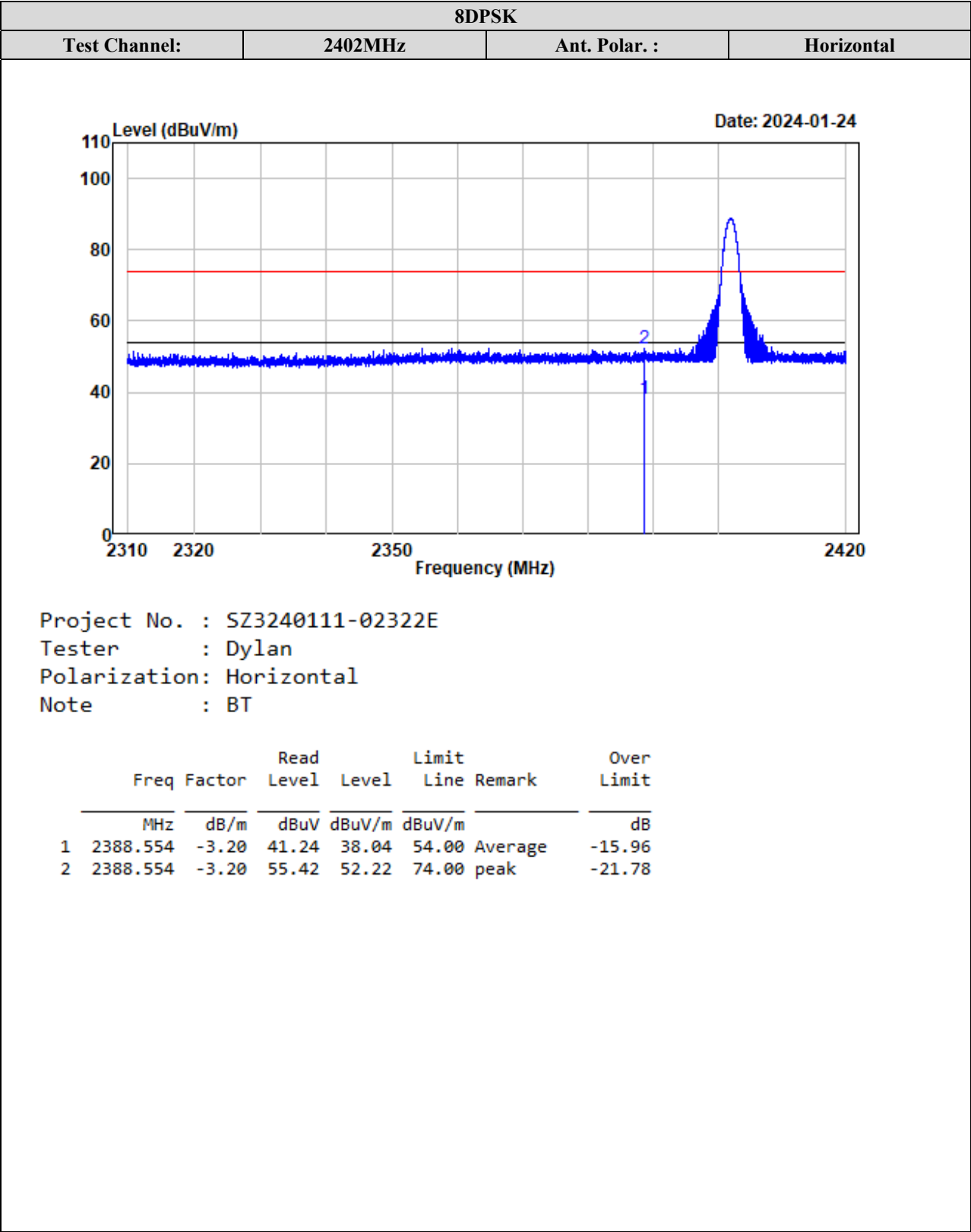


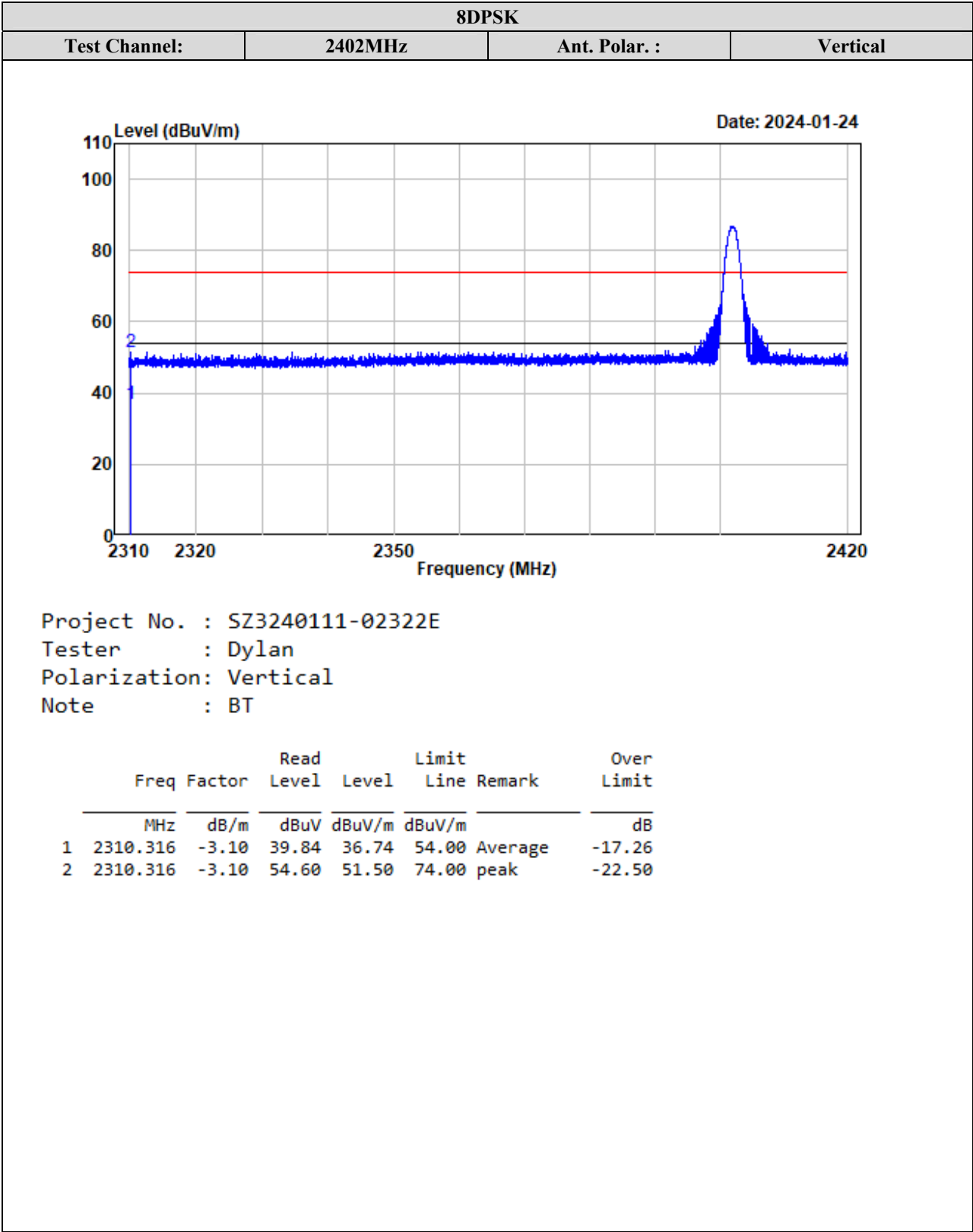


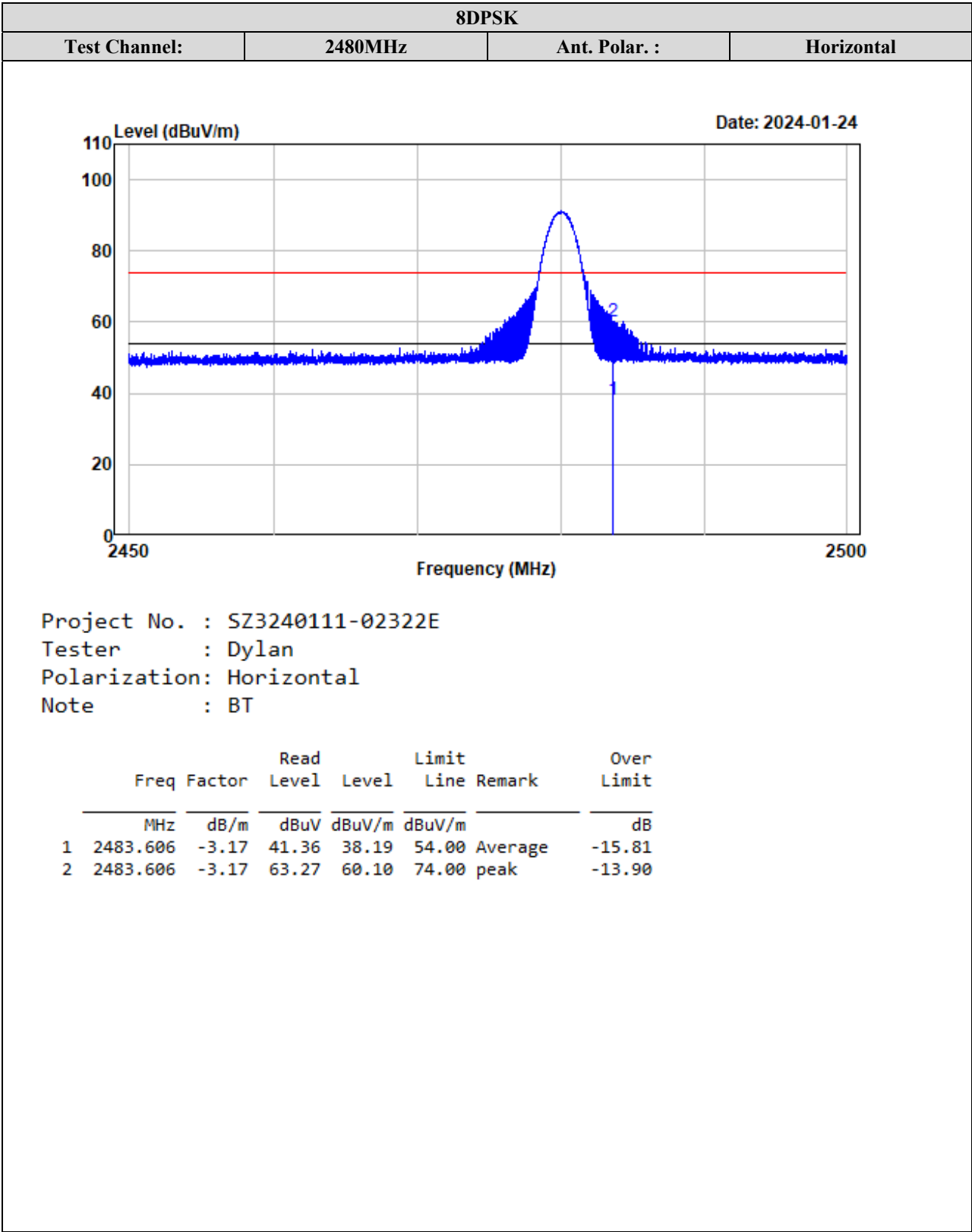


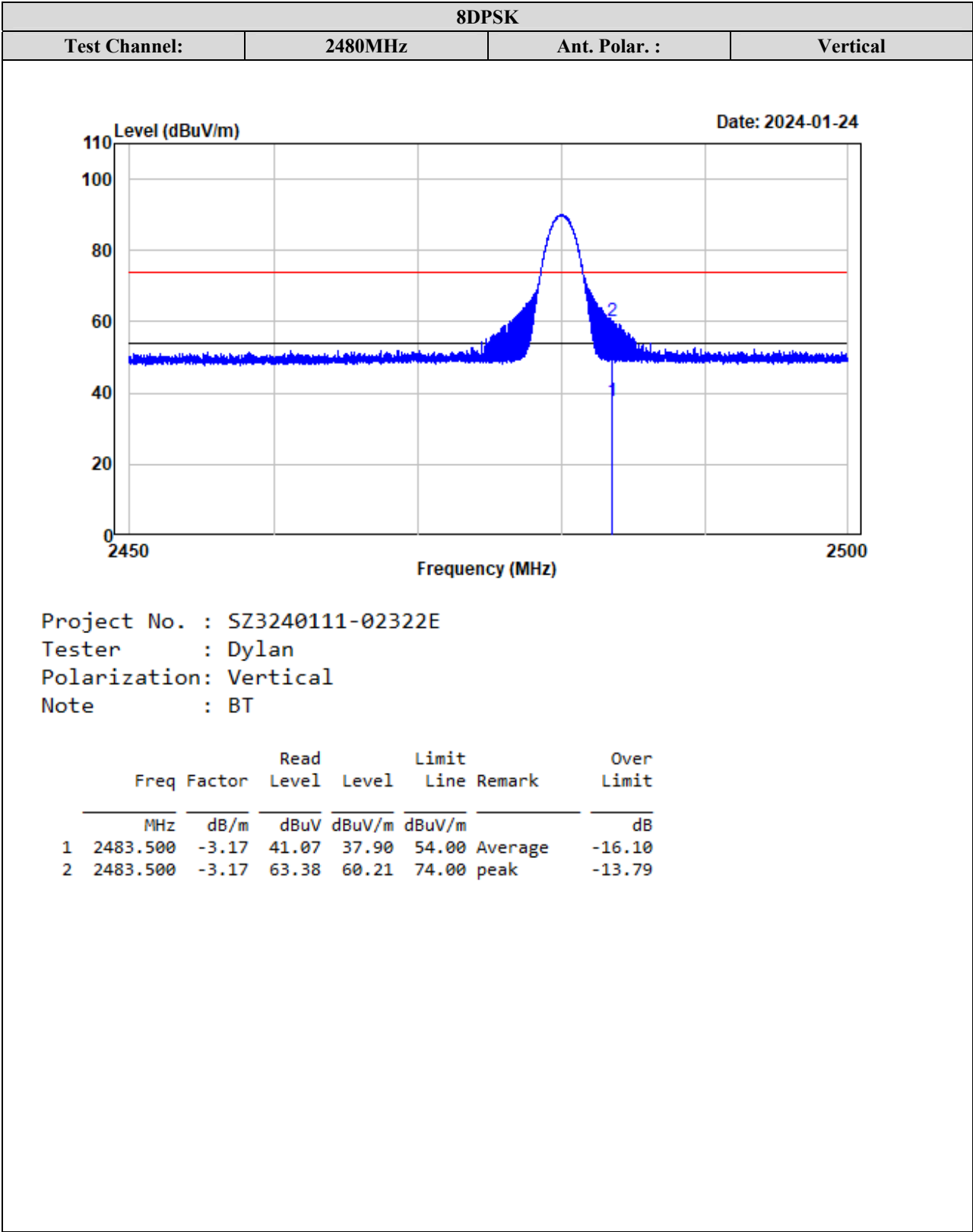












FCC §15.247(a) (1) - CHANNEL SEPARATION TEST

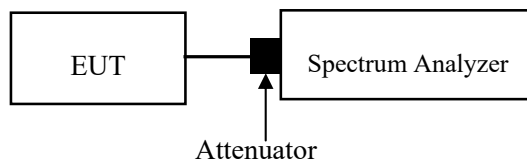
Applicable Standard

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.2

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.



Test Data

Environmental Conditions

Temperature:	25.7 °C
Relative Humidity:	48 %
ATM Pressure:	101 kPa

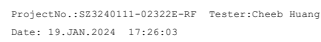
The testing was performed by Cheeb Huang on 2024/01/19.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Modes	Test Frequency (MHz)	Channel Separation (MHz)	Limits (MHz)
BDR Mode (GFSK)	2402	1.008	0.629
	2441	1.002	0.629
	2480	1.002	0.629
EDR Mode ($\pi/4$ -DQPSK)	2402	1.002	0.837
	2441	1.002	0.837
	2480	1.002	0.837
EDR Mode (8DPSK)	2402	1.008	0.848
	2441	1.002	0.845
	2480	1.002	0.845

Low Channel



ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:26:42

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:27:22

FCC §15.247(a) (1) - 20 dB EMISSION BANDWIDTH & 99% OCCUPIED BANDWIDTH

Applicable Standard

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

Test Procedure

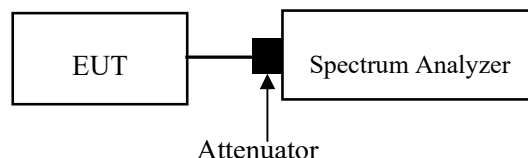
Test Method: ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

The following conditions shall be observed for measuring the occupied bandwidth and 20dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20dB bandwidth if the device is not transmitting continuously.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW/ 20dB bandwidth and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	25.7 °C
Relative Humidity:	48 %
ATM Pressure:	101 kPa

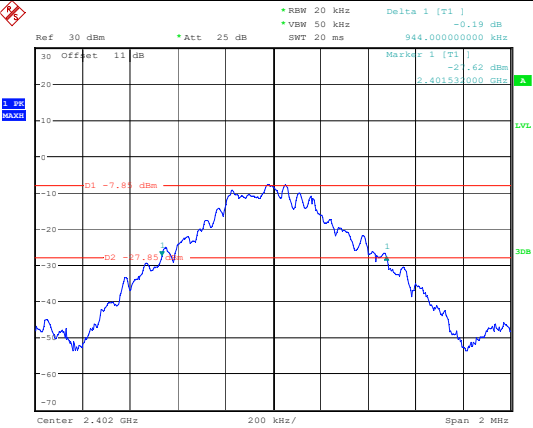
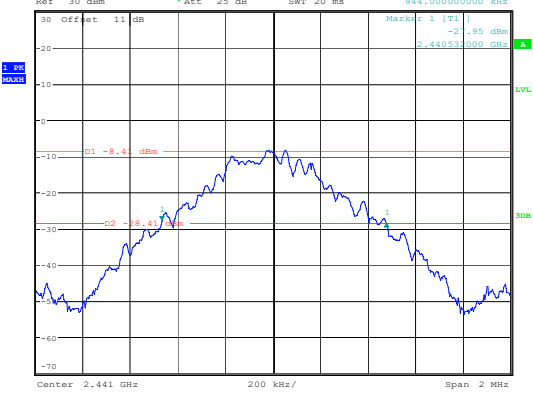
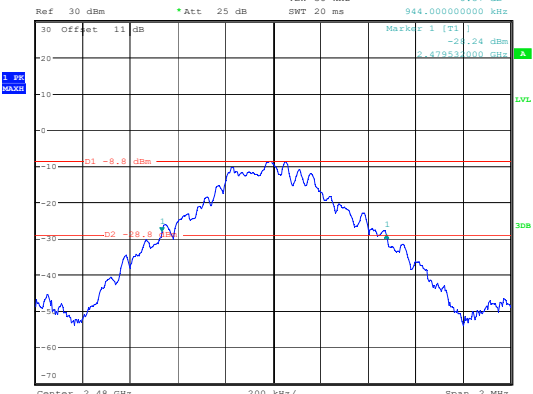
The testing was performed by Cheeb Huang on 2024/01/19.

EUT operation mode: Transmitting

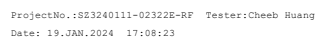
Test Result: Compliant.

Test Modes	Test Channel	Test Frequency (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
BDR Mode (GFSK)	Lowest	2402	0.944	0.860
	Middle	2441	0.944	0.860
	Highest	2480	0.944	0.860
EDR Mode ($\pi/4$ -DQPSK)	Lowest	2402	1.256	1.160
	Middle	2441	1.256	1.160
	Highest	2480	1.256	1.160
EDR Mode (8DPSK)	Lowest	2402	1.272	1.168
	Middle	2441	1.268	1.168
	Highest	2480	1.268	1.168

20 dB Bandwidth

Low Channel	BDR Mode (GFSK)  ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Ruang Date: 19.JAN.2024 17:02:42
Middle Channel	 ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Ruang Date: 19.JAN.2024 17:06:21
High Channel	 ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Ruang Date: 19.JAN.2024 17:07:11

Low Channel



Ref 30 dBm Att 25 dB SMT 20 ms Delta 1 [T1] -0.19 dB 1.256000000 MHz

30 Offset 11 dB

20

10

0

-10

-20

-30

-40

-50

-60

-70

Center 2.441 GHz 200 kHz/ Span 2 MHz

Marker 1 [T1] -28.06 dBm 2.440160000 GHz

DI -8.4 dBm

DO -28.4 dBm

3

LVL

3dB

4

MAG

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:09:25

Ref 30 dBm Att 25 dB SWT 50 ms 1.256000000 MHz

30 Offset 11 dB

Mask 1 [T1] -0.00 dB -28.75 dBm 2.479450000 MHz

1 30 Max

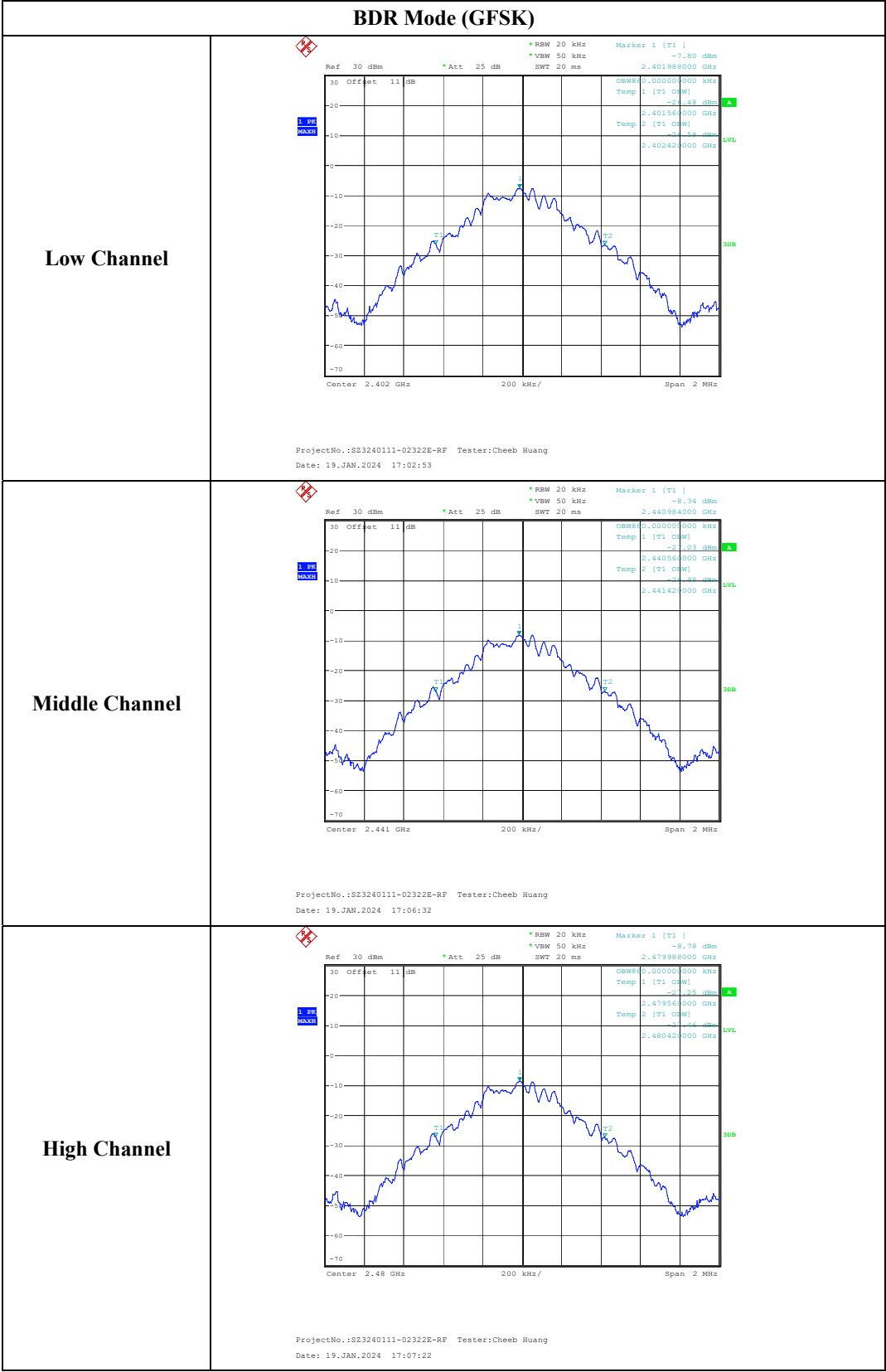
D1 -18.91 dBm

D2 -28.75 dBm

Center 200 kHz Span 2 MHz

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:10:55

99% Occupied Bandwidth



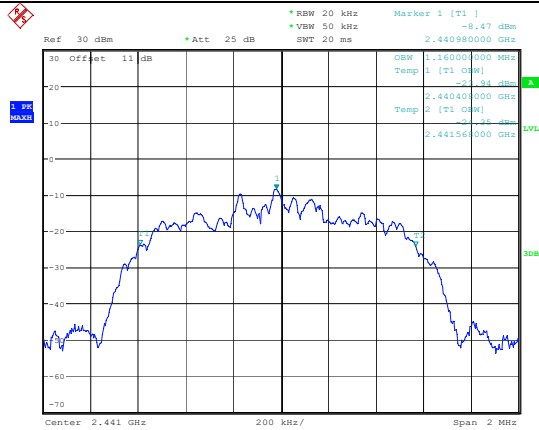
The image shows a Spectrum Analyzer interface with the following details:

- Top Bar:**
 - Buttons: **1.995** (blue), **NOISE** (blue), **Ref** (red), **Off** (red), **Set** (red), **Att** (green), **SMT** (green).
 - Readouts: **30 dBm**, **25 dB**, **20 kHz**, **50 kHz**, **20 ms**.
 - Marker 1 [T1] at **2.401976000 GHz** with a level of **-7.95 dBm**.
- Plot Area:**
 - A blue line graph showing a noisy signal centered at **2.402 GHz**.
 - The y-axis represents power in dBm, ranging from **-70** to **30**.
 - The x-axis represents frequency in kHz, ranging from **200 kHz** to **2 MHz**.
 - Two vertical black lines are present: one at the center frequency (**2.402 GHz**) and another at the marker frequency (**2.401976 GHz**).
 - Additional readouts on the right side of the plot area:
 - OSW** (Occupied Signal Width) at **1.160000000 MHz**.
 - Temp 1 [T1 OSW]** at **-2.35 dBm**.
 - Temp 2 [T1 OSW]** at **-1.22 dBm**.
 - 2.402564000 GHz** (likely the upper frequency limit of the span).
- Bottom Bar:**
 - Center: **2.402 GHz**
 - Span: **2 MHz**

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:08:34

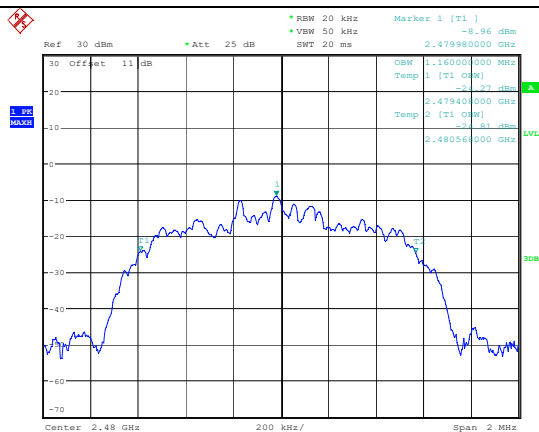
Low Channel

Middle Channel



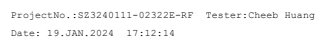
ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:09:36

High Channel



ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:11:06

Low Channel



* RBW 20 kHz
 * VBW 50 kHz
 SMT 20 ms
 Marker 1 [T1]
 -8.48 dBm
 2.440980000 GHz

Ref 30 dBm
 Att 25 dB

30 Offset 11 dB
 -20
 -10
 0
 -10
 -20
 -30
 -40
 -50
 -60
 -70

1.168000000 MHz
 Temp 1 [T1 OVM]
 2.404000000 GHz
 Temp 2 [T1 OVM]
 2.441570000 GHz

1.99
 MAG

Center 2.441 GHz
 200 kHz/
 Span 2 MHz

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:13:30

The screenshot shows a spectrum analyzer interface with a blue trace representing a signal. The signal is centered at 2.48 GHz with a span of 2 MHz. The frequency axis ranges from 2.478 GHz to 2.490 GHz. The power axis ranges from -70 dBm to 30 dBm. A peak is visible at approximately -10 dBm. The display includes a grid and various measurement parameters.

Parameters displayed at the top:

- Ref 30 dBm
- Att 25 dB
- SWT 20 ms
- Marker 1 [T1]
- 2.47998000 GHz
- 2.47998000 GHz
- Temp 1 [T1 QW]
- 2.47998000 GHz
- Temp 2 [T1 QW]
- 2.48057000 GHz

Axis labels:

- Center 2.48 GHz
- Span 2 MHz
- 200 kHz/

Grid lines are visible at 10 dB intervals on the power axis and 100 kHz intervals on the frequency axis.

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:14:16

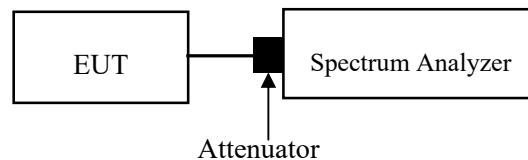
FCC §15.247(a) (1) (iii) - QUANTITY OF HOPPING CHANNEL TEST**Applicable Standard**

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.3

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the max-hold function record the quantity of the channel.

**Test Data****Environmental Conditions**

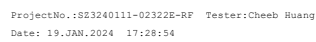
Temperature:	25.7 °C
Relative Humidity:	48 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-19.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Modes	Frequency Range (MHz)	Number of Hopping Channel	Limits
GFSK	2400-2483.5	79	≥15
$\pi/4$ -DQPSK	2400-2483.5	79	≥15
8DPSK	2400-2483.5	79	≥15

GFSK

Ref 30 dBm Att 25 dB BW 100 kHz Delta 1 [T1] -1.01 dB
 VBN 300 kHz SMT 10 ms 77.98900000 MHz
 Marker 1 [T1] -1.24 dB
 2.40183000 MHz
 1
 30 dB
 20
 10
 0
 -10
 -20
 -30
 -40
 -50
 -60
 -70
 Start 2.4 GHz 8.35 MHz/ Stop 2.4835 MHz

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:33:19

Ref 30 dBm Att 25 dB SWT 10 ms Delta 1 [71] ~0.88 dB
VVM 300 kHz 78.156000000 MHz

30 Offset 11 dB

MaxHz 1 [71] ~0.52 dBm
2.402000000 MHz

1 30 MaxZ

Start 2.4 GHz 8.35 MHz/ Stop 2.4835 GHz

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:41:05

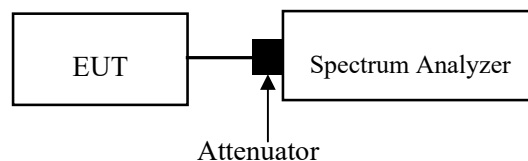
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)**Applicable Standard**

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.4

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

**Test Data****Environmental Conditions**

Temperature:	25.7 °C
Relative Humidity:	48 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-19.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Modes	Packet Type	Test Frequency (MHz)	Pulse width (ms)	Result (s)	Limit (s)
BDR Mode (GFSK)	DH1	2441	0.406	0.130	0.400
	DH3	2441	1.662	0.266	0.400
	DH5	2441	2.930	0.313	0.400
EDR Mode ($\pi/4$ -DQPSK)	2DH1	2441	0.417	0.133	0.400
	2DH3	2441	1.671	0.267	0.400
	2DH5	2441	2.935	0.313	0.400
EDR Mode (8DPSK)	3DH1	2441	0.419	0.134	0.400
	3DH3	2441	1.671	0.267	0.400
	3DH5	2441	2.935	0.313	0.400

Note:

DH1:Dwell time=Pulse time (ms) $\times$ (1600/2/79) $\times$ 31.6 s

DH3:Dwell time=Pulse time (ms) $\times$ (1600/4/79) $\times$ 31.6 s

DH5:Dwell time=Pulse time (ms) $\times$ (1600/6/79) $\times$ 31.6 s

Version 1.0 (2023/10/07)

Version 1.0 (2023/10/07)

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

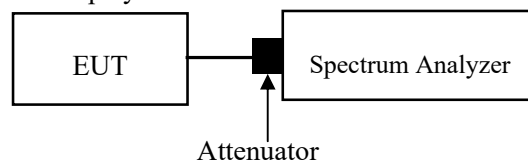
Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.5

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	25.7 °C
Relative Humidity:	48 %
ATM Pressure:	101 kPa

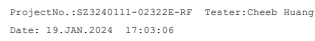
The testing was performed by Cheeb Huang on 2024-01-19.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Modes	Test Frequency (MHz)	Peak Conducted Output Power (dBm)	Limits (dBm)
BDR Mode (GFSK)	2402	-2.91	21
	2441	-3.48	21
	2480	-3.91	21
EDR Mode ($\pi/4$ -DQPSK)	2402	-2.31	21
	2441	-2.85	21
	2480	-3.35	21
EDR Mode (8DPSK)	2402	-1.73	21
	2441	-2.28	21
	2480	-2.76	21

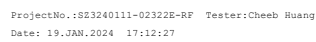
Low Channel



ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:06:45

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:07:35

Low Channel



ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:13:43

ProjectNo.:SZ3240111-02322E-RF Tester:Cheeb Huang
Date: 19.JAN.2024 17:14:29

FCC §15.247(d) § 5.5 - BAND EDGES TESTING

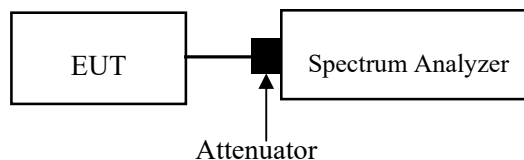
Applicable Standard

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

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.6 & Clause 6.10

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

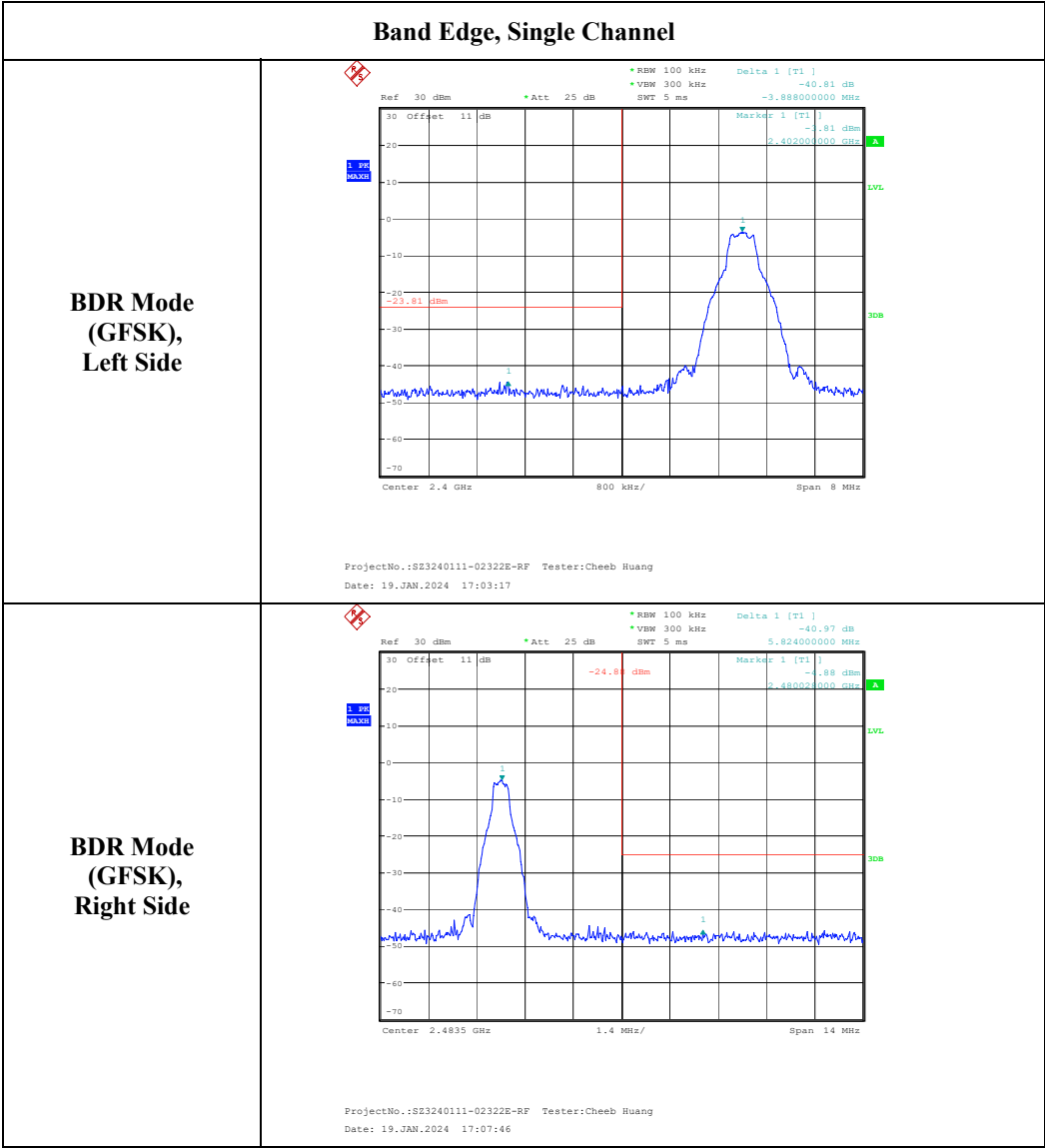
Environmental Conditions

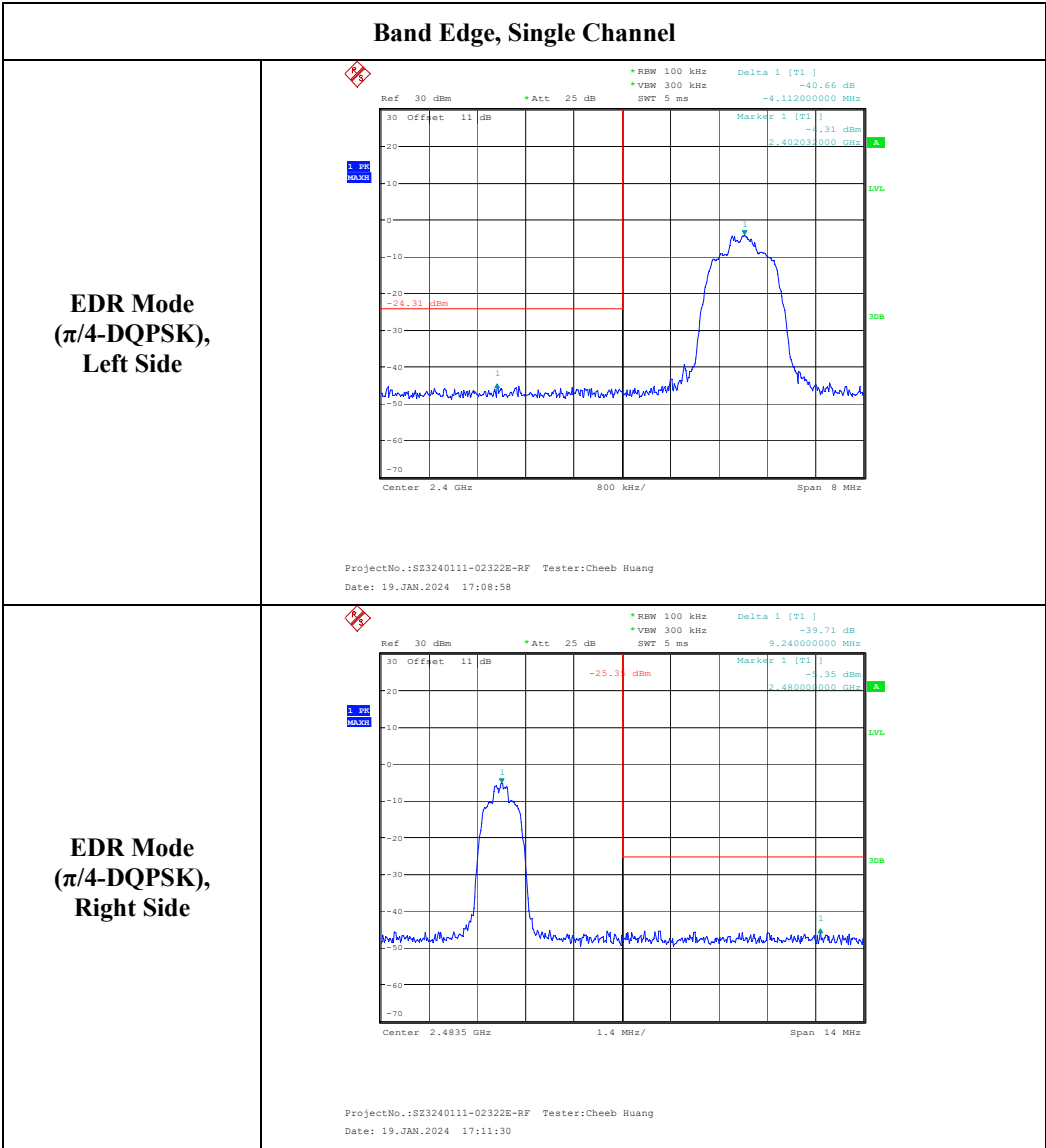
Temperature:	25.7 °C
Relative Humidity:	48 %
ATM Pressure:	101 kPa

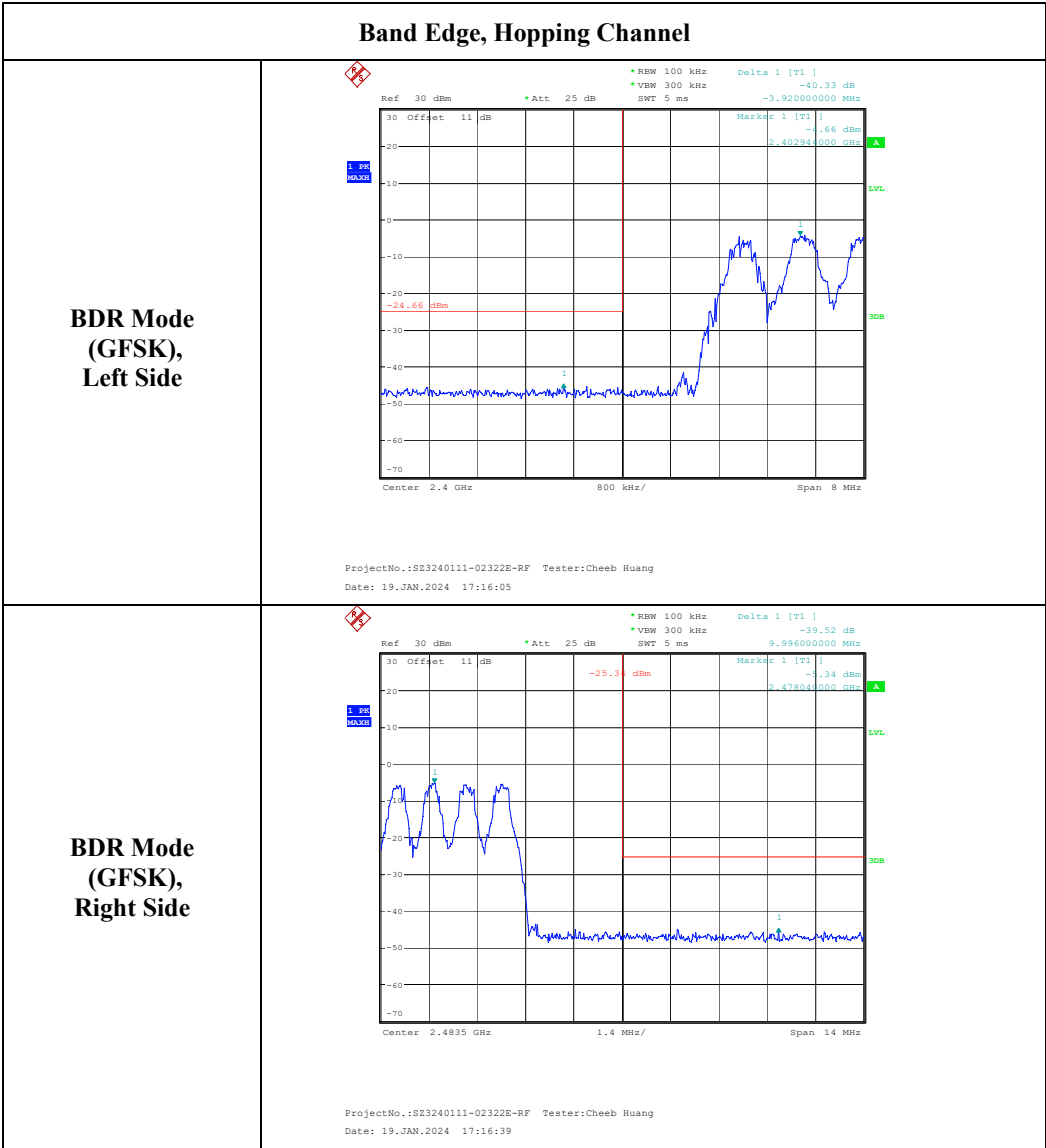
The testing was performed by Cheeb Huang on 2024-01-19.

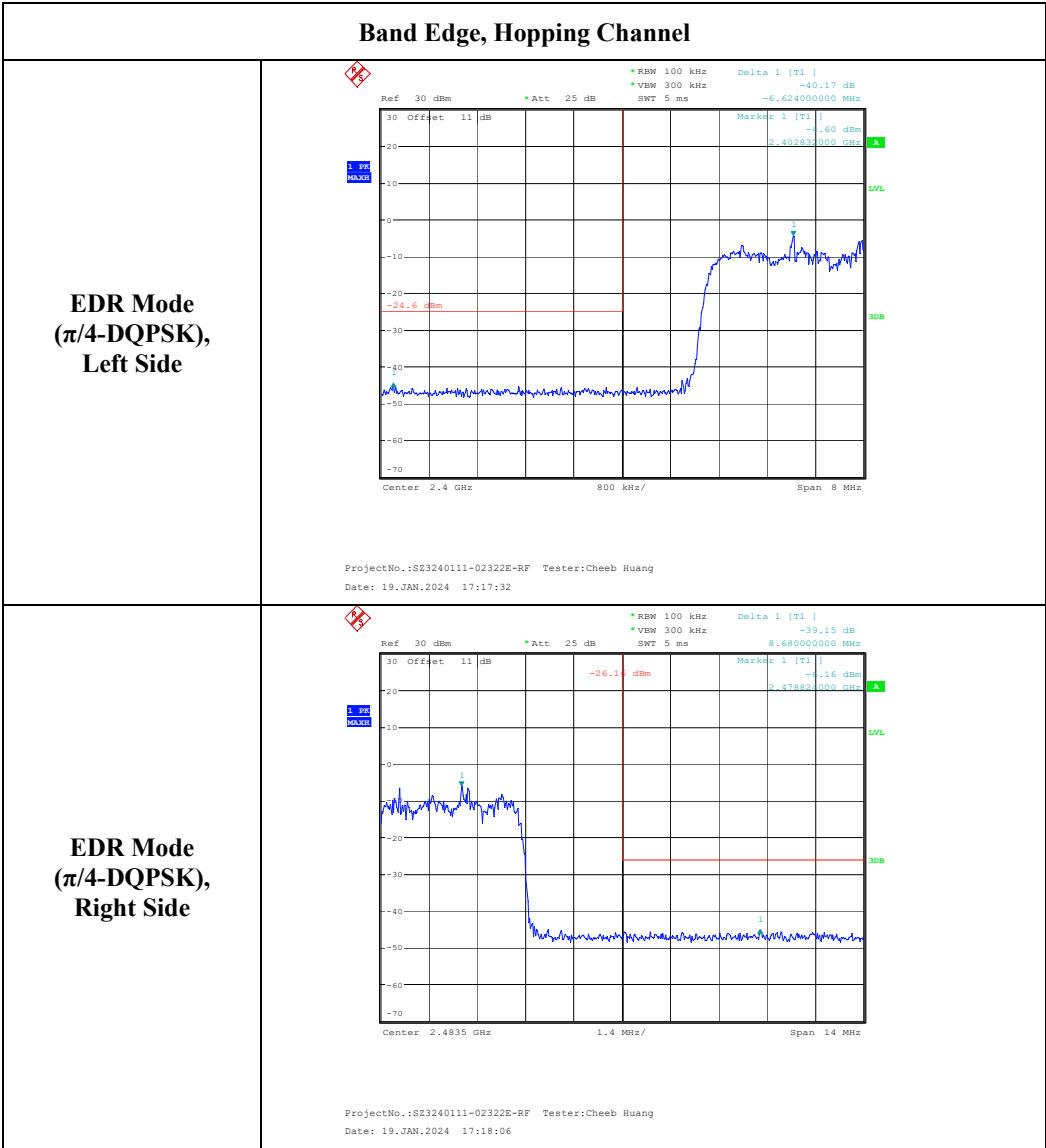
EUT operation mode: Transmitting

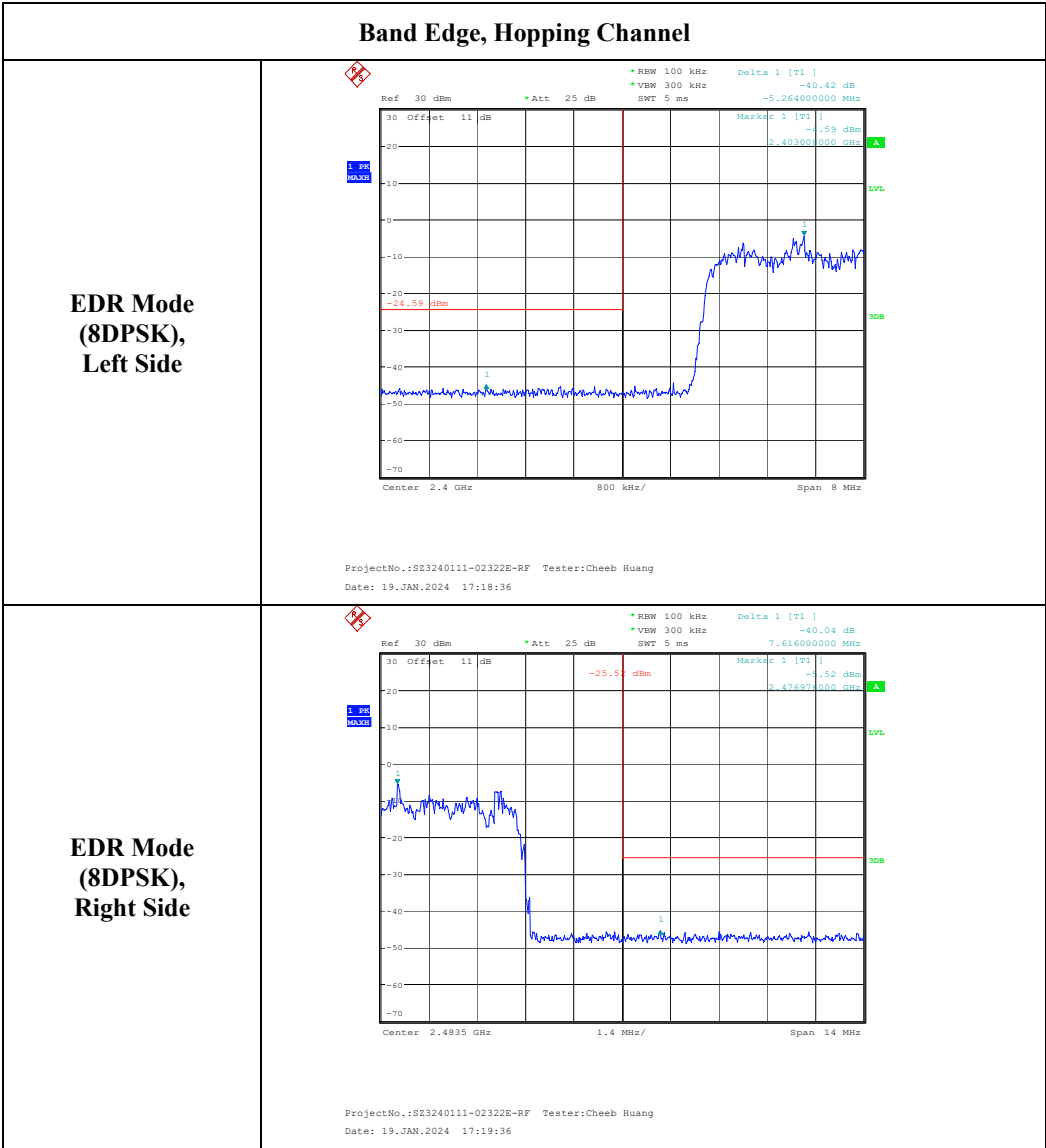
Test Result: Compliant.











***** END OF REPORT *****