



TEST REPORT

Applicant & Manufacturer: NiceRF Wireless Technology Co., Ltd.
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Report Number : 2404T38102E-RF-22A

Test Standard (s)

ETSI EN 300 220-1 V3.1.1 (2017-02), ETSI EN 300 220-2 V3.2.1 (2018-06)

Sample Description

Product Type: Wireless Module
Model No.: LoRa1278-C1-433
Trade Name: G-NiceRF®
Date Received: 2024-05-21
Date of Test: 2024-05-23 to 2024-06-14
Report Date: 2024-06-14

Test Result:	The EUT complied with the standards above.
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Prepared and Checked By:

Matt_Liang

Matt Liang
EMC Engineer

Approved By:

Bob. Liao
EMC Engineer

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 but no need marked.
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
Rev.00	2404T38102E-RF-22A	Original Report	2024-06-14

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Wireless Module
Tested Model	LoRa1278-C1-433
Frequency Range	433.5MHz-434.5MHz
Transmit Maximum ERP	9.95dBm
Modulation Technique	CSS
Antenna Specification [#]	2.5 dBi(It is provided by the manufacturer)
Voltage Range [#]	DC3.3V
Sample serial number	2LOB-1 (RF Radiated Test &RF Conducted Test) (Assigned by ATC)
Sample/EUT Status	Good condition
Normal/Extreme Condition [#]	L.T.: Low Temperature: -20 °C N.T.: Normal Temperature: +25 °C H.T.: High Temperature: +55 °C L.V.: Low Voltage: 1.8 V _{DC} N.V.: Nominal Voltage: 3.3 V _{DC} H.V.: High Voltage: 3.7 V _{DC} (Note: the extreme test condition was declared by manufacturer.)

Objective

The test report is in accordance with ETSI EN 300 220-2 V3.2.1 (2018-06), short range devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 2: Harmonised standard covering the essential requirements of article 3.2 of Directive 2014/53/EU for non specific radio equipment

The objective is to determine the compliance of the EUT with ETSI EN 300 220-2 V3.2.1 (2018-06).

Test Methodology

All measurements contained in this report were conducted with ETSI EN 300 220-1 V3.1.1 (2017-02).

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, Shenzhen, Guangdong, China.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5 %
RF Frequency		0.064×10^{-7}
RF output power, conducted		0.3 dB
Unwanted Emission, conducted		1.2 dB
Emissions Spurious Radiated	9kHz - 30MHz	2.1 dB
	30MHz - 1GHz	4.3 dB
	1GHz - 18GHz	4.9 dB
Temperature		1 °C
Humidity		7 %
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.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 433.5MHz-434.5MHz, 2 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	433.5	2	434.5

EUT was tested with Channel 1 and 2.

EUT Exercise Software and Power Level#

No software was used during testing and the power level was 2.

Special Accessories

No special accessories.

Support Equipment List and Details

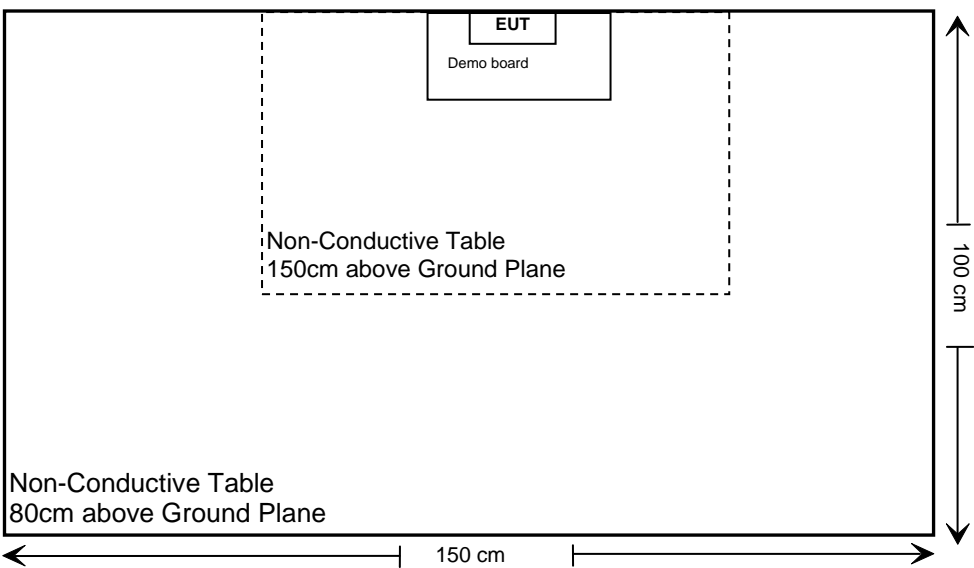
Manufacturer	Description	Model	Serial Number
NANFU	1.5V Dry Battery*4	LR6 1.5V	Unknown
Doublepow	Battery	XH2.54	Unknown
Unknown	DEMO Board#	Unknown	Unknown

Note: The DEMO Board# is provided by the applicant for testing.

External I/O Cable

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

Block Diagram of Test Setup



Note: The support table edge was flush with the center of turntable.

SUMMARY OF TEST RESULTS

ETSI EN 300 220-2 V3.2.1 (2018-06)

Rules	Description of Test	Result	Condition
§4.2.1	Operating frequency	Compliance	/
§4.2.2	Unwanted emissions in the spurious domain	Compliance	/
§4.3.1	TX Effective radiated power	Compliance	/
§4.3.2	TX Maximum e.r.p. spectral density	Not Applicable	Applies to EUT using annex B band I. Applies to EUT using DSSS or wideband techniques other than FHSS modulation, using annex C band W, AA or AC.
§4.3.3	TX Duty cycle	Compliance	/
§4.3.4	TX Occupied Bandwidth	Compliance	/
§4.3.5	TX Out of Band Emissions	Compliance	Applies to EUT with OCW > 25 kHz.
§4.3.6	TX Transient Power	Compliance	/
§4.3.7	TX Adjacent channel power	Not Applicable	Applies to EUT with OCW ≤ 25 kHz.
§4.3.8	TX behaviour under Low Voltage Conditions	Compliance	Applies to battery powered EUT.
§4.3.9	TX Adaptive Power Control	Not Applicable	Applies to EUT with adaptive power control using annex C band AF
§4.3.10	TX FHSS equipment	Not Applicable	Applies to FHSS EUT using the band 863 MHz to 870 MHz.
§4.3.11	TX Short term behaviour	Not Applicable	Applies to EUT using annex C bands AD, AE, AF, AG, AH, or AI.
§4.4.1	RX sensitivity	Not Applicable	Applies to EUT employing polite spectrum access.
§4.4.2	RX Blocking	Compliance	/
§4.5.2	Clear Channel Assessment threshold	Not Applicable	Applies to EUT employing polite spectrum access.
§4.5.3	Polite spectrum access timing parameters	Not Applicable	Applies to EUT employing polite spectrum access.
§4.5.4	Adaptive Frequency Agility	Not Applicable	Applies to EUT with AFA.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test(Below 1GHz)					
Rohde & Schwarz	Test Receiver	ESR	102725	2023/11/17	2024/11/16
SONOMA INSTRUMENT	Amplifier	310 N	186131	2023/06/02	2024/06/01
Schwarzbeck	Bilog Antenna	VULB9163	9163-194	2023/02/14	2026/02/13
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Mini-Circuits	High Pass Filter	NHP-600+	15542	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.12	N040	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.13	N300	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.14	N800	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.16	N200	2023/11/17	2024/11/16
Agilent	Signal Generator	N5183A	MY51040755	2023/11/17	2024/11/16
Radiated Emission Test Software:e3 191218 (V9)					
Radiated Emission Test(Above 1GHz)					
Rohde & Schwarz	Spectrum Analyzer	FSV40	101949	2023/11/17	2024/11/16
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2023/06/02	2024/06/01
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-655	2023/11/27	2026/11/26
Schwarzbeck	Horn Antenna	BBHA9120D	837	2023/02/22	2026/02/21
Unknown	RF Coaxial Cable	No.10	N050	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.11	N1000	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.15	N600	2023/11/17	2024/11/16
Unknown	RF Coaxial Cable	No.16	N200	2023/11/17	2024/11/16
Agilent	Signal Generator	N5183A	MY51040755	2023/11/17	2024/11/16
Radiated Emission Test Software:e3 191218 (V9)					
RF Conducted Test					
AGILENT	Vector Signal Generator	N5182A	MY50143401	2023/11/17	2024/11/16
Agilent	Signal Generator	N5183A	MY51040755	2023/11/17	2024/11/16
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101948	2023/11/17	2024/11/16
WEINSCHHEL	10dB Attenuator	5324	AU 3842	2024/04/16	2025/04/15
Mini-Circuits	Power Splitter	DC-18000MHz	SF10944151S	2024/04/16	2025/04/15
UNI-T	DC Power Supply	UTP8305M	/	2024/04/16	2025/04/15
BACL	Temp. & Humid. Chamber	BTH-150-40	30192	2024/01/12	2025/01/11
Unknown	RF Coaxial Cable	No.33	RF-03	Each time	
Unknown	RF Coaxial Cable	No.34	RF-04	Each time	

* **Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

ETSI EN 300 220-2 V3.2.1 (2018-06) §4.2.1 - OPERATING FREQUENCY

Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.1.1, the nominal operating frequency is the centre of a channel of width OCW.

Limit: The manufacturer may declare either one or more operating frequencies and operating channels. Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI

The below information shall be recorded in the test report

Value	Note
Operational Frequency band or bands	Declared by the manufacturer
Nominal Operating Frequency or Frequencies	Declared by the manufacturer
Operating Channel width(s) - OCW	Declared by the manufacturer

Test Result

The operational frequency band or bands, nominal operating frequency or Frequencies and operating channel width(s) – OCW are declared by the manufacturer

Note: Compliance, which is declared by the manufacturer.

Operating frequency (MHz)	Operating frequency band (MHz)	Operating channel width (kHz)
433.5	433.05 MHz to 434.79 MHz (Band H)	62.5
	433.05 MHz to 434.79 MHz (Band H)	125
	433.05 MHz to 434.79 MHz (Band H)	250
	433.05 MHz to 434.79 MHz (Band H)	500
434.5	433.05 MHz to 434.79 MHz (Band H)	62.5
	433.05 MHz to 434.79 MHz (Band H)	125
	433.05 MHz to 434.79 MHz (Band H)	250
	433.05 MHz to 434.79 MHz (Band H)	500

ETSI EN 300 220-2 V3.2.1 (2018-06) §4.2.2 - UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.9.1.

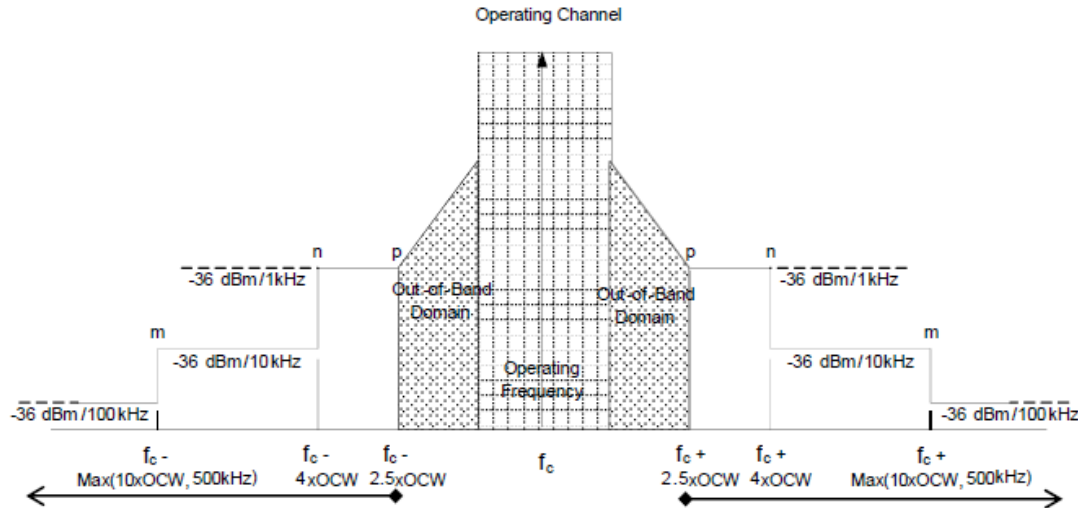


Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Spurious emissions are unwanted emissions in the spurious domain at frequencies other than those of the Operating Channel and its Out Of Band Domain. The relevant spurious domain is shown in Figure 7. Limit: The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
State			
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

Method of Measurement

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.9.3.

Test Data

Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	46-59 %
ATM Pressure:	100.6 kPa

For radiated emission below 1GHz, the testing was performed by Jason Liu on 2024-05-28.
For radiated emission above 1GHz, the testing was performed by Jimi Zheng on 2024-05-23.
For conducted emission test, the testing was performed by Benny Li from 2024-05-23 to 2024-05-29.

EUT operation mode: Transmitting/Standby/Receiving

Test Result: Compliance, please refer to following data.

Radiated Emission:**Transmitting:**

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
	Reading (dBm)	PK/Ave		Height (m)	Polar (H/V)				
433.5 MHz 62.5kHz									
867	-59.79	PK	318	2.0	H	12.02	-47.77	-36	-11.77
867	-64.2	PK	223	1.4	V	12.01	-52.19	-36	-16.19
1300.5	-50.16	PK	313	1.5	H	1.25	-48.91	-30	-18.91
1300.5	-50.19	PK	283	1.3	V	2.64	-47.55	-30	-17.55
3034.5	-53.1	PK	268	1.8	H	4.93	-48.17	-30	-18.17
3034.5	-50.36	PK	67	1.1	V	5.46	-44.9	-30	-14.9
433.5 MHz 125kHz									
867	-59.44	PK	355	1.5	H	12.02	-47.42	-36	-11.42
867	-64.01	PK	241	1.4	V	12.01	-52	-36	-16
1300.5	-50.33	PK	53	2.2	H	1.25	-49.08	-30	-19.08
1300.5	-50.32	PK	271	1.7	V	2.64	-47.68	-30	-17.68
3034.5	-54.03	PK	285	1.7	H	4.93	-49.1	-30	-19.1
3034.5	-50.16	PK	337	2.2	V	5.46	-44.7	-30	-14.7
433.5 MHz 250kHz									
867	-59.71	PK	318	1.5	H	12.02	-47.69	-36	-11.69
867	-63.75	PK	151	1.5	V	12.01	-51.74	-36	-15.74
1300.5	-49.41	PK	331	2.1	H	1.25	-48.16	-30	-18.16
1300.5	-50.92	PK	169	1.6	V	2.64	-48.28	-30	-18.28
3034.5	-53.21	PK	229	1.1	H	4.93	-48.28	-30	-18.28
3034.5	-50.76	PK	255	1.3	V	5.46	-45.3	-30	-15.3
433.5 MHz 500kHz									
867	-60.14	PK	91	1.6	H	12.02	-48.12	-36	-12.12
867	-64.54	PK	103	1.7	V	12.01	-52.53	-36	-16.53
1300.5	-50.84	PK	126	1.4	H	1.25	-49.59	-30	-19.59
1300.5	-50.36	PK	344	1.8	V	2.64	-47.72	-30	-17.72
3034.5	-53.45	PK	244	1.8	H	4.93	-48.52	-30	-18.52
3034.5	-50.5	PK	96	2.2	V	5.46	-45.04	-30	-15.04
434.5 MHz 62.5kHz									
869	-61.26	PK	91	1.4	H	11.9	-49.36	-36	-13.36
869	-64.99	PK	214	1.3	V	12.1	-52.89	-36	-16.89
1303.5	-50.32	PK	229	1.1	H	1.27	-49.05	-30	-19.05
1303.5	-49.5	PK	255	1.3	V	2.56	-46.94	-30	-16.94
3041.5	-54.12	PK	104	1.6	H	4.92	-49.2	-30	-19.2
3041.5	-50.07	PK	141	1.6	V	5.46	-44.61	-30	-14.61
434.5 MHz 125kHz									
869	-60.77	PK	253	1.6	H	11.9	-48.87	-36	-12.87
869	-64.97	PK	156	1.3	V	12.1	-52.87	-36	-16.87
1303.5	-50.06	PK	244	1.8	H	1.27	-48.79	-30	-18.79
1303.5	-49.78	PK	96	2.2	V	2.56	-47.22	-30	-17.22
3041.5	-53.24	PK	75	1.9	H	4.92	-48.32	-30	-18.32
3041.5	-50.07	PK	57	1.9	V	5.46	-44.61	-30	-14.61

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
	Reading (dBm)	PK/Ave		Height (m)	Polar (H/V)				
434.5 MHz 250kHz									
869	-60.81	PK	231	1.3	H	11.9	-48.91	-36	-12.91
869	-64.82	PK	344	1.5	V	12.1	-52.72	-36	-16.72
1303.5	-49.34	PK	352	1.8	H	1.27	-48.07	-30	-18.07
1303.5	-48.9	PK	272	1.2	V	2.56	-46.34	-30	-16.34
3041.5	-53.13	PK	83	1.4	H	4.92	-48.21	-30	-18.21
3041.5	-49.98	PK	340	1.9	V	5.46	-44.52	-30	-14.52
434.5 MHz 500kHz									
869	-60.64	PK	198	1.5	H	11.9	-48.74	-36	-12.74
869	-65.1	PK	318	2.0	V	12.1	-53	-36	-17
1303.5	-49.7	PK	224	1.7	H	1.27	-48.43	-30	-18.43
1303.5	-49.65	PK	117	1.9	V	2.56	-47.09	-30	-17.09
3041.5	-53.93	PK	242	2.2	H	4.92	-49.01	-30	-19.01
3041.5	-50.17	PK	150	1.7	V	5.46	-44.71	-30	-14.71

Standby:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
	Reading (dBm)	PK/Ave		Height (m)	Polar (H/V)				
48.25	-79.86	PK	305	2.0	H	5.91	-73.95	-57	-16.95
705.46	-79.73	PK	71	2.1	V	9.57	-70.16	-57	-13.16
1288.5	-59.14	PK	300	1.7	H	1.35	-57.79	-47	-10.79
3257.5	-58.48	PK	104	2.2	V	4.69	-53.79	-47	-6.79

Receiving:

Receiving:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
	Reading (dBm)	PK/Ave		Height (m)	Polar (H/V)				
433.5 MHz 62.5kHz									
48.95	-84.52	PK	240	1.8	H	5.79	-78.73	-57	-21.73
740.63	-79.54	PK	274	1.4	V	11.28	-68.26	-57	-11.26
1344.5	-59.74	PK	187	1.6	H	1.48	-58.26	-47	-11.26
2657.5	-57.9	PK	126	1.3	V	3.87	-54.03	-47	-7.03
433.5 MHz 125kHz									
48.95	-84.4	PK	338	1.1	H	5.79	-78.61	-57	-21.61
740.63	-79.43	PK	142	2.1	V	11.28	-68.15	-57	-11.15
1344.5	-59.01	PK	113	1.7	H	1.48	-57.53	-47	-10.53
2657.5	-57.82	PK	66	2.2	V	3.87	-53.95	-47	-6.95
433.5 MHz 250kHz									
48.95	-84.24	PK	308	1.8	H	5.79	-78.45	-57	-21.45
740.63	-79.35	PK	274	1.9	V	11.28	-68.07	-57	-11.07
1344.5	-59.72	PK	191	1.8	H	1.48	-58.24	-47	-11.24
2657.5	-58.3	PK	87	1.2	V	3.87	-54.43	-47	-7.43
433.5 MHz 500kHz									
48.95	-84.44	PK	68	1.7	H	5.79	-78.65	-57	-21.65
740.63	-79.5	PK	300	1.3	V	11.28	-68.22	-57	-11.22
1344.5	-58.74	PK	265	2.1	H	1.48	-57.26	-47	-10.26
2657.5	-57.72	PK	34	1.3	V	3.87	-53.85	-47	-6.85

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
	Reading (dBm)	PK/Ave		Height (m)	Polar (H/V)				
434.5 MHz 62.5kHz									
48.95	-84.66	PK	150	2.1	H	5.79	-78.87	-57	-21.87
740.63	-79.44	PK	318	2.0	V	11.28	-68.16	-57	-11.16
1344.5	-60.22	PK	293	1.6	H	1.48	-58.74	-47	-11.74
2657.5	-58.25	PK	140	1.4	V	3.87	-54.38	-47	-7.38
434.5 MHz 125kHz									
48.95	-84.2	PK	80	2.1	H	5.79	-78.41	-57	-21.41
740.63	-79.63	PK	251	1.2	V	11.28	-68.35	-57	-11.35
1344.5	-59.42	PK	174	1.7	H	1.48	-57.94	-47	-10.94
2657.5	-57.54	PK	313	1.4	V	3.87	-53.67	-47	-6.67
434.5 MHz 250kHz									
48.95	-84.13	PK	291	2.0	H	5.79	-78.34	-57	-21.34
740.63	-79.5	PK	357	1.6	V	11.28	-68.22	-57	-11.22
1344.5	-59.51	PK	98	1.7	H	1.48	-58.03	-47	-11.03
2657.5	-57.75	PK	261	1.0	V	3.87	-53.88	-47	-6.88
434.5 MHz 500kHz									
48.95	-84.36	PK	114	1.3	H	5.79	-78.57	-57	-21.57
740.63	-79.36	PK	356	1.1	V	11.28	-68.08	-57	-11.08
1344.5	-59.94	PK	217	2.2	H	1.48	-58.46	-47	-11.46
2657.5	-58.18	PK	193	1.4	V	3.87	-54.31	-47	-7.31

Note 1: Absolute Level = Reading Level + Substituted Factor

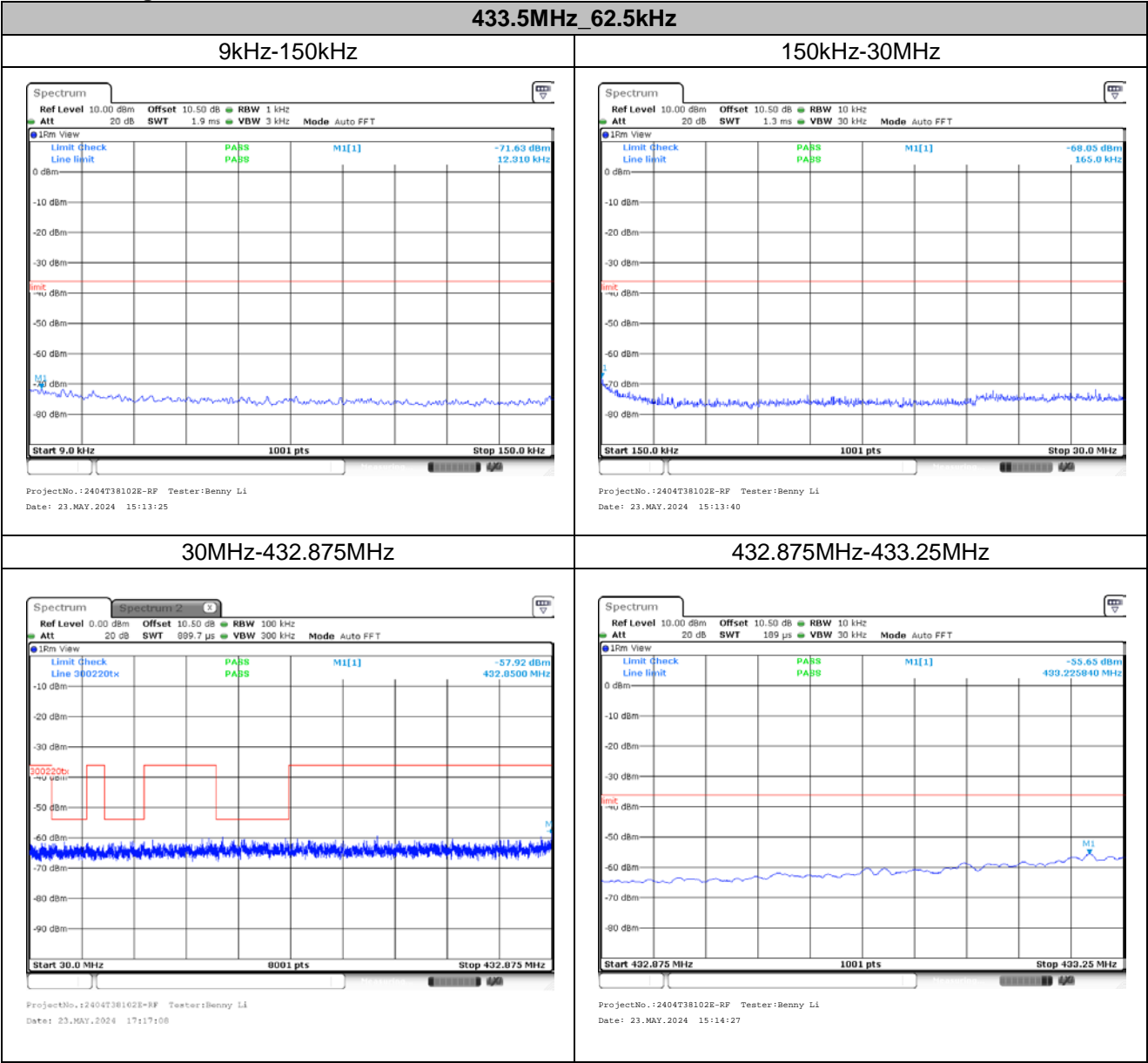
Note 2: Substituted Factor contains: SG Level - Cable loss+ Antenna Gain

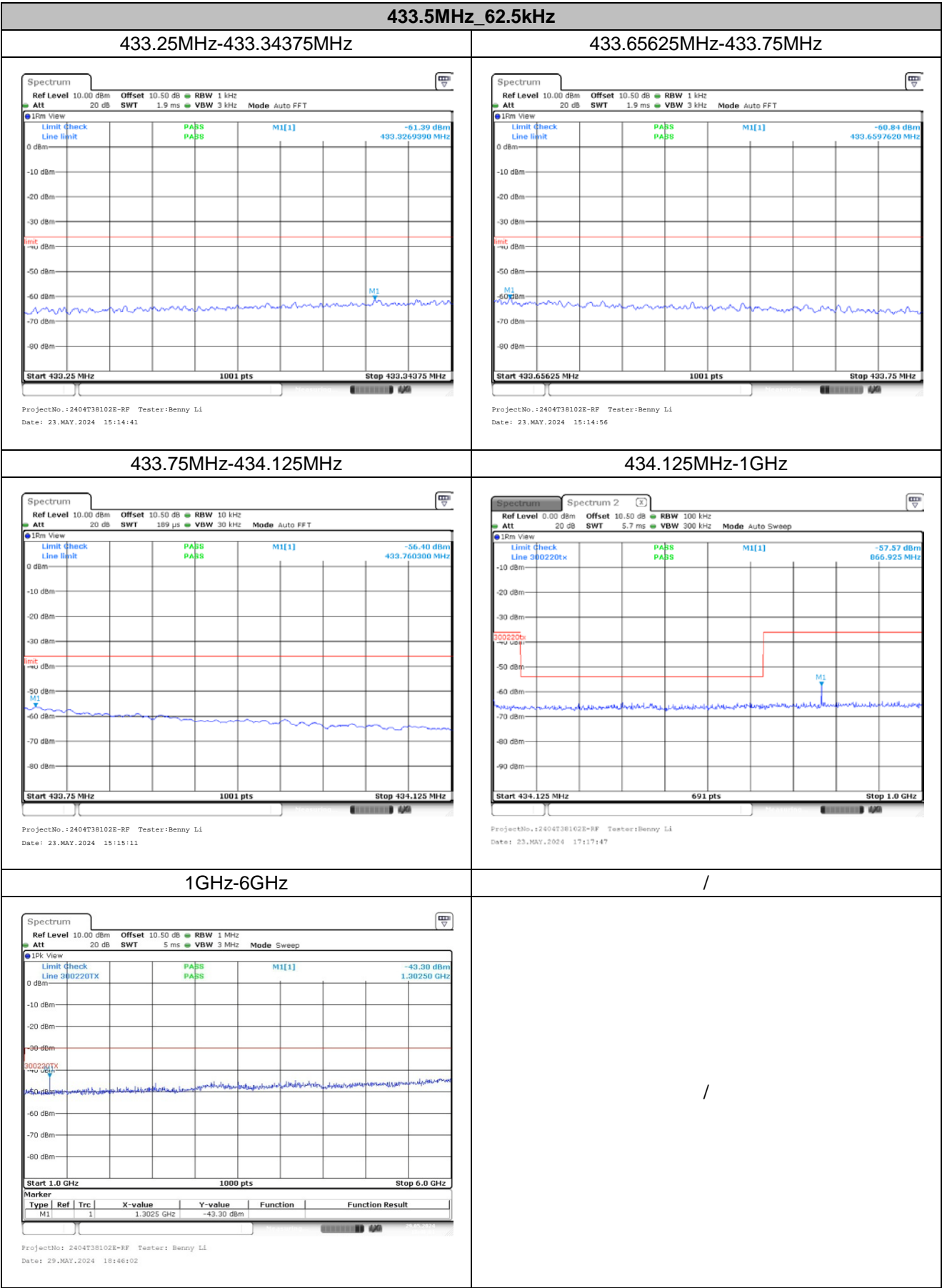
Note 3: Margin = Absolute Level – Limit

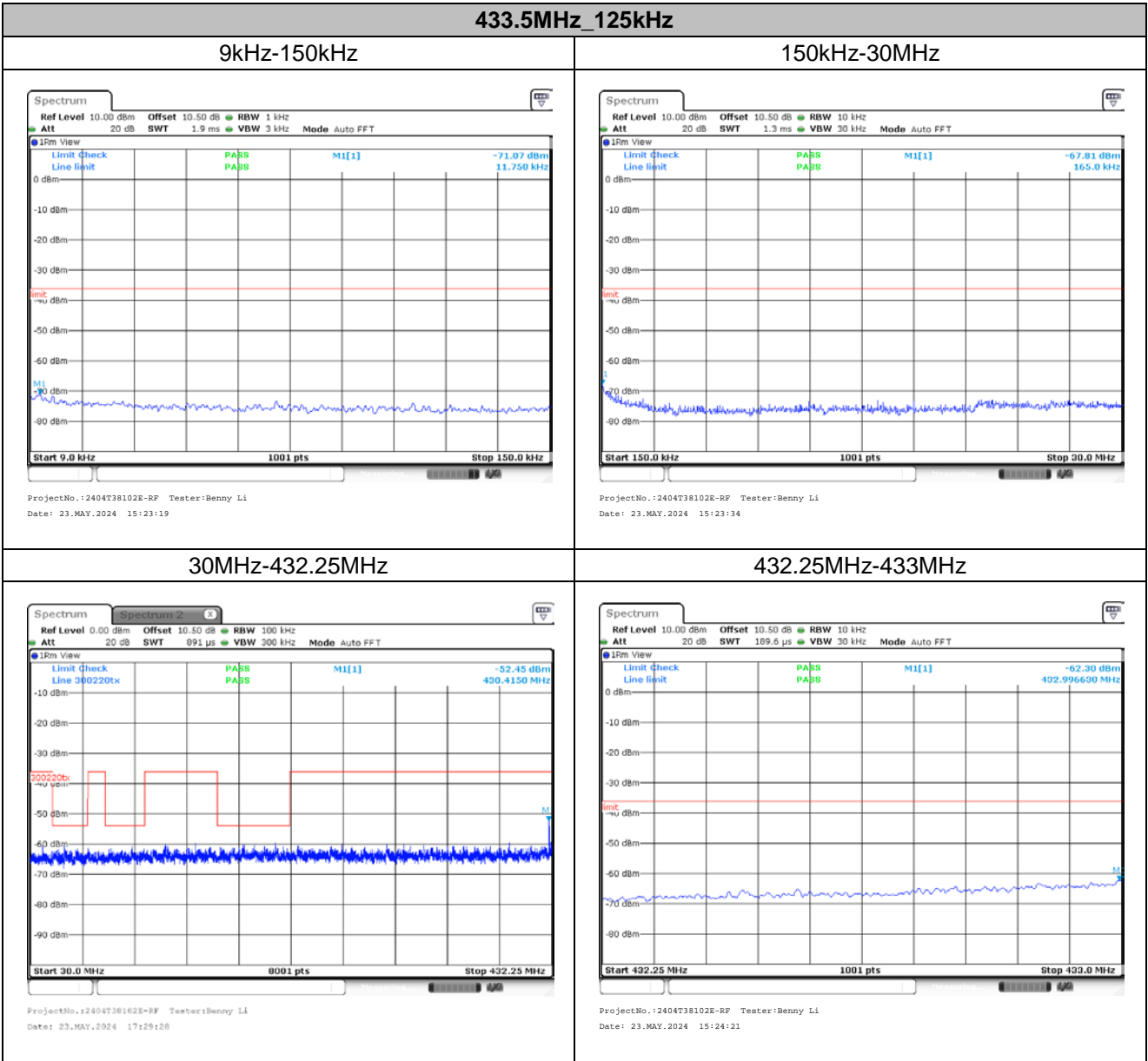
Note 4: Other emissions below limit more than 20dB or in noise floor was not recorded

Conducted Emission:

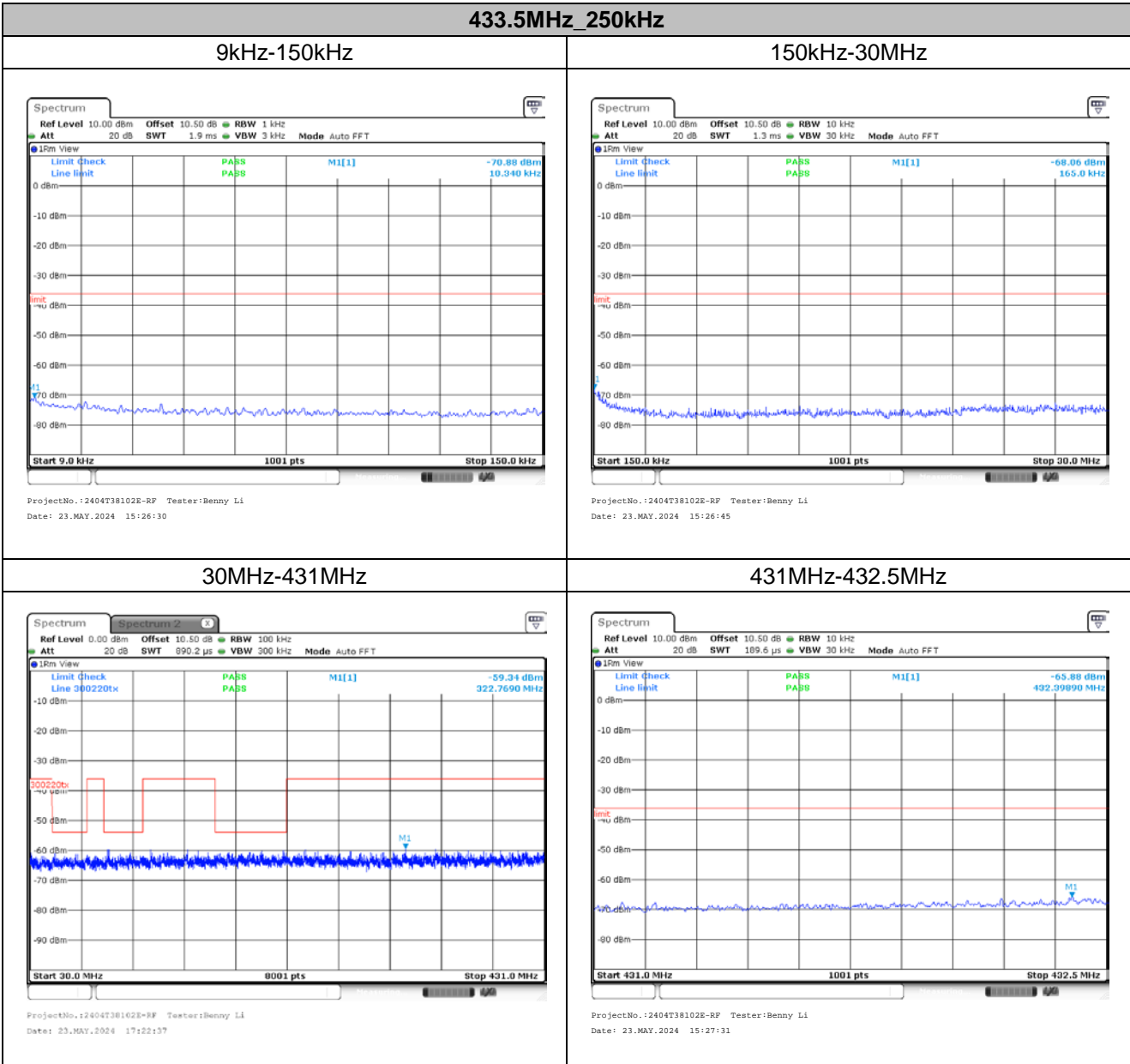
Transmitting:

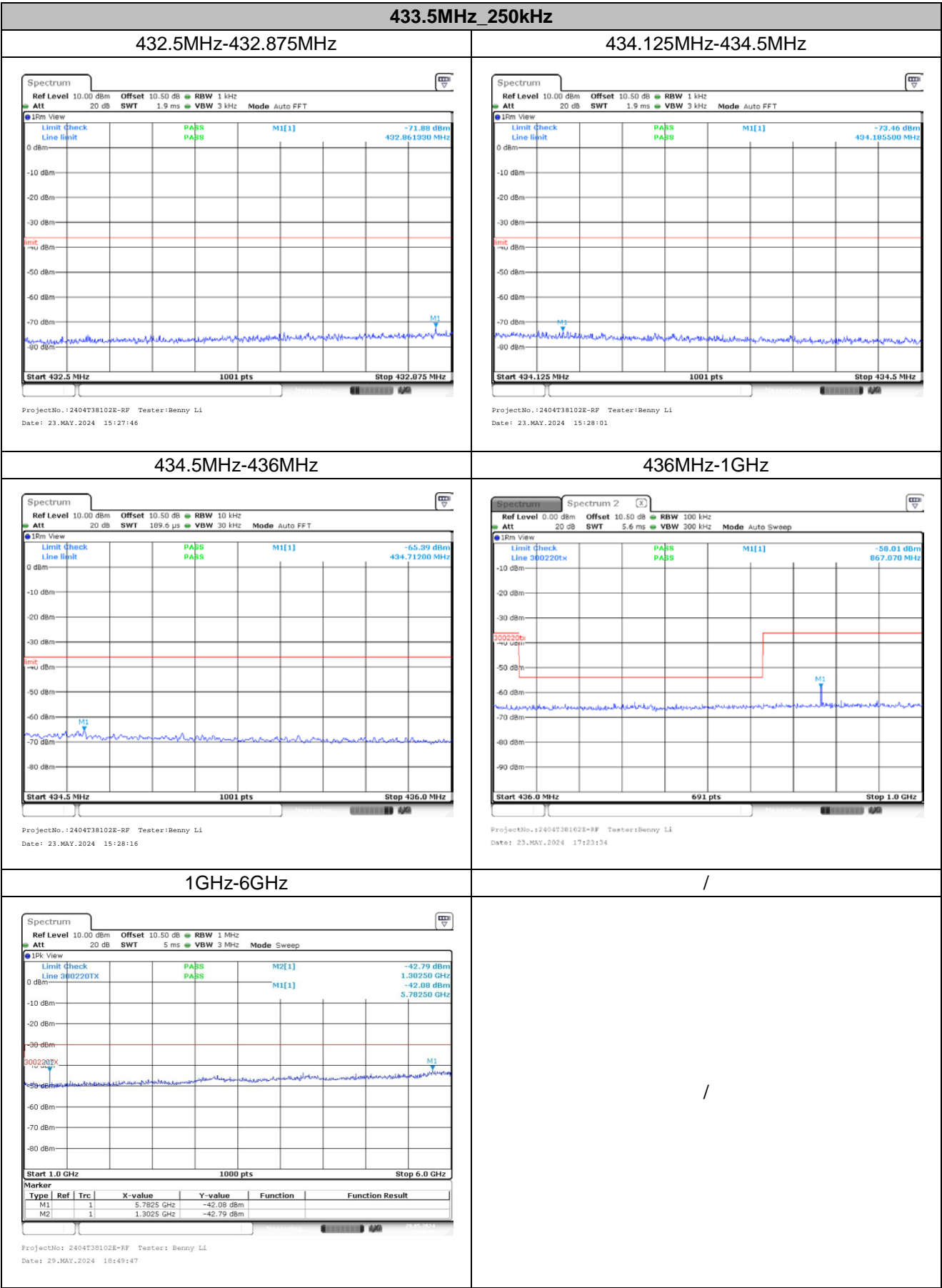


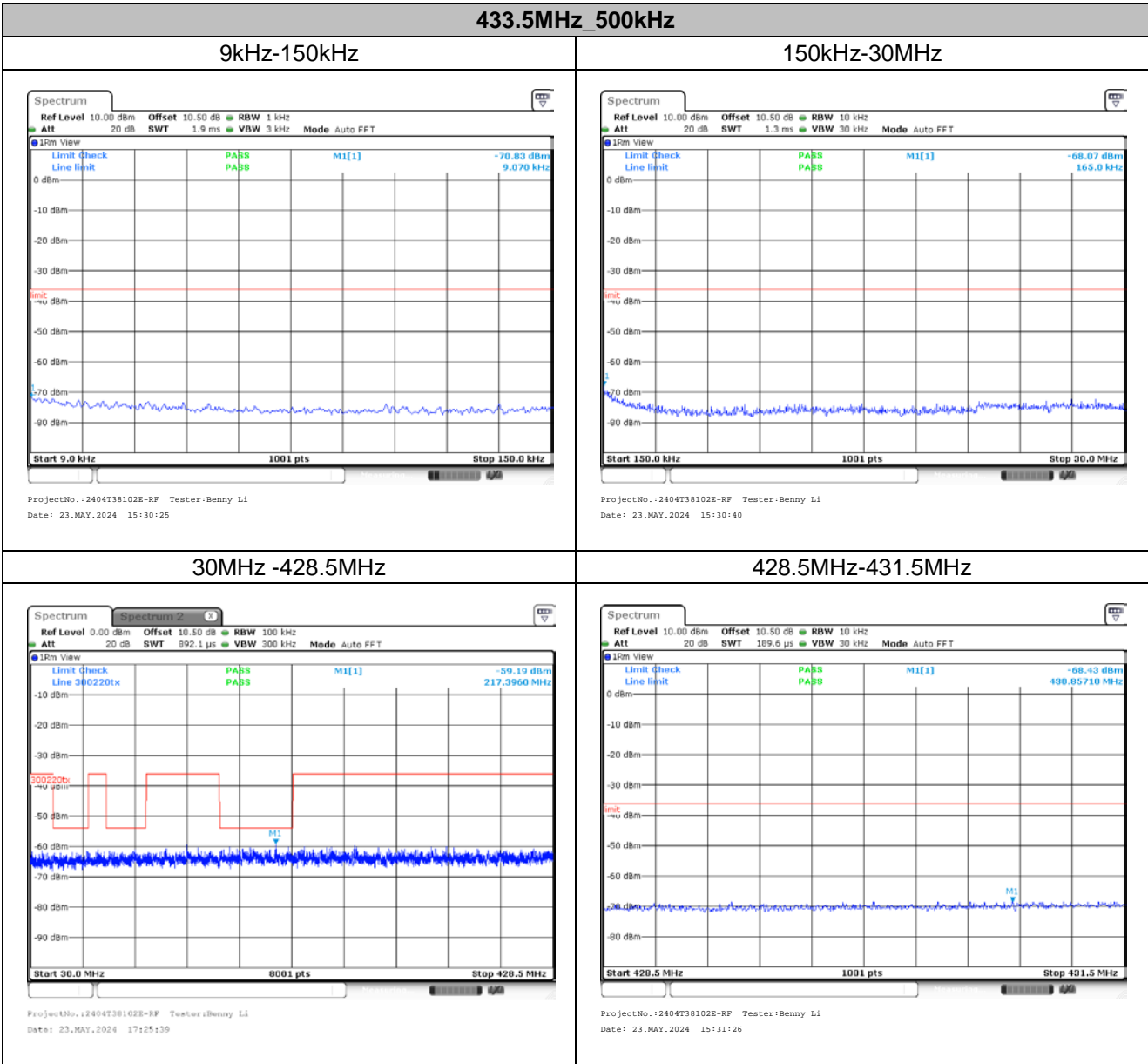


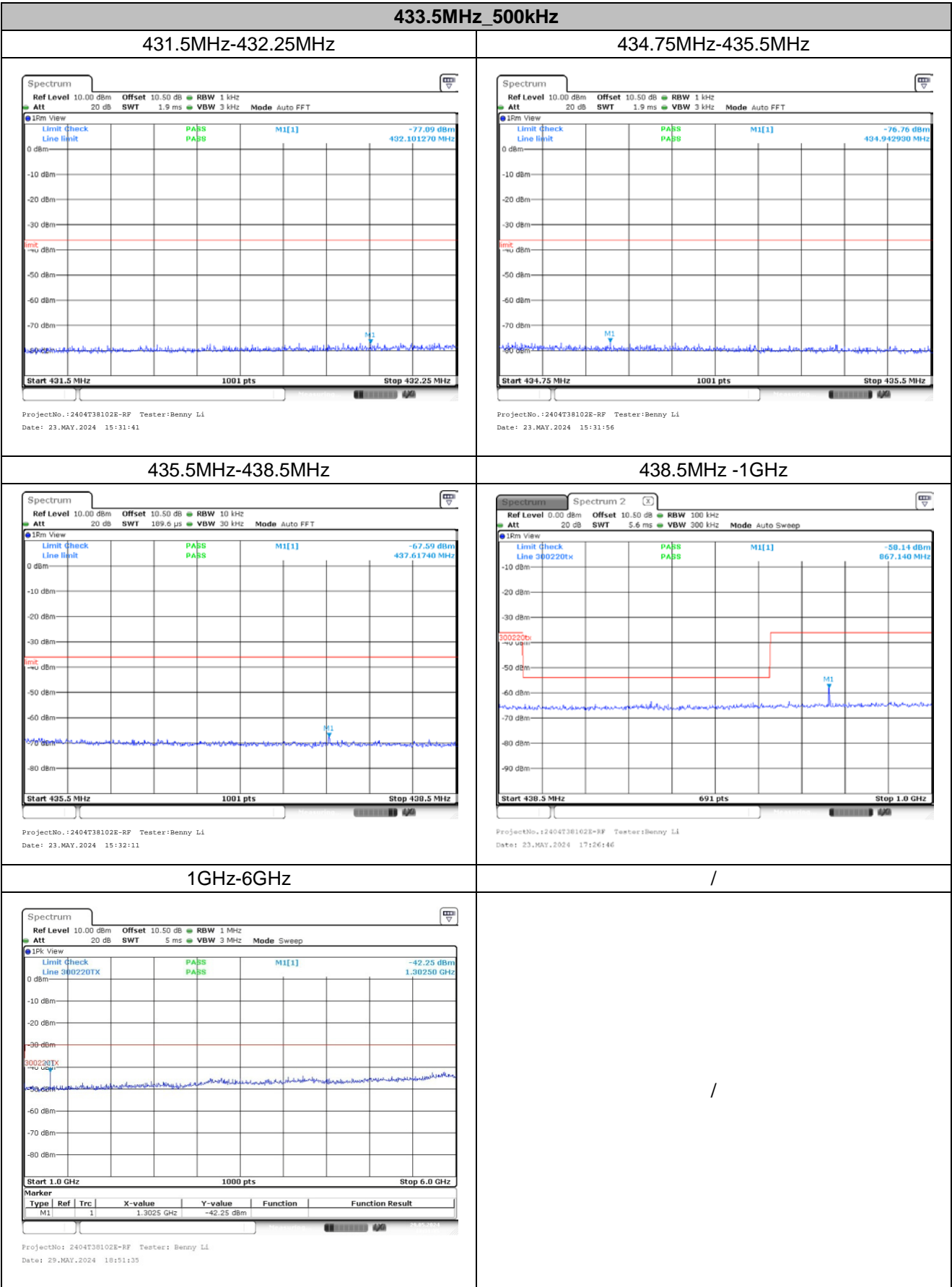


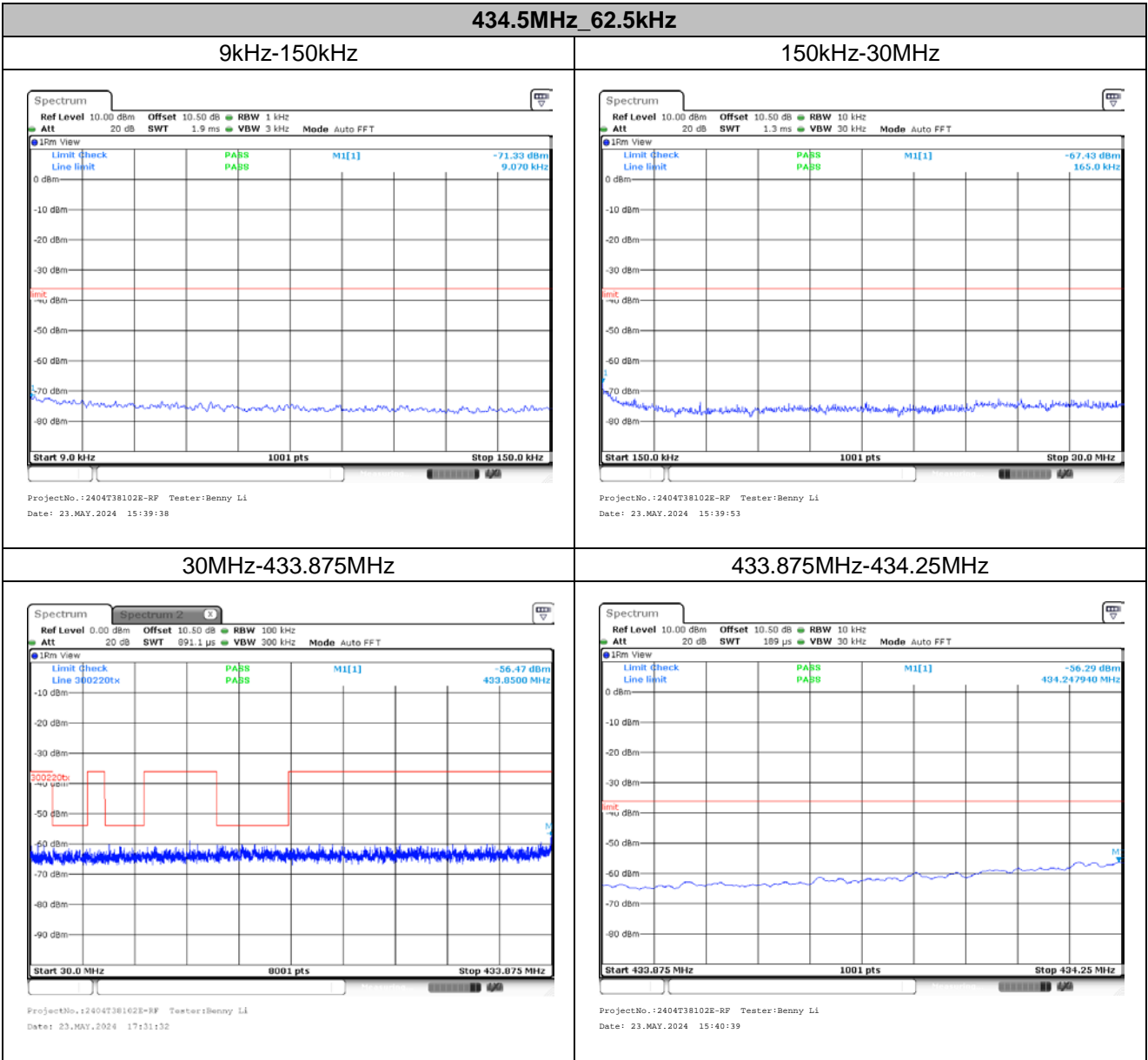


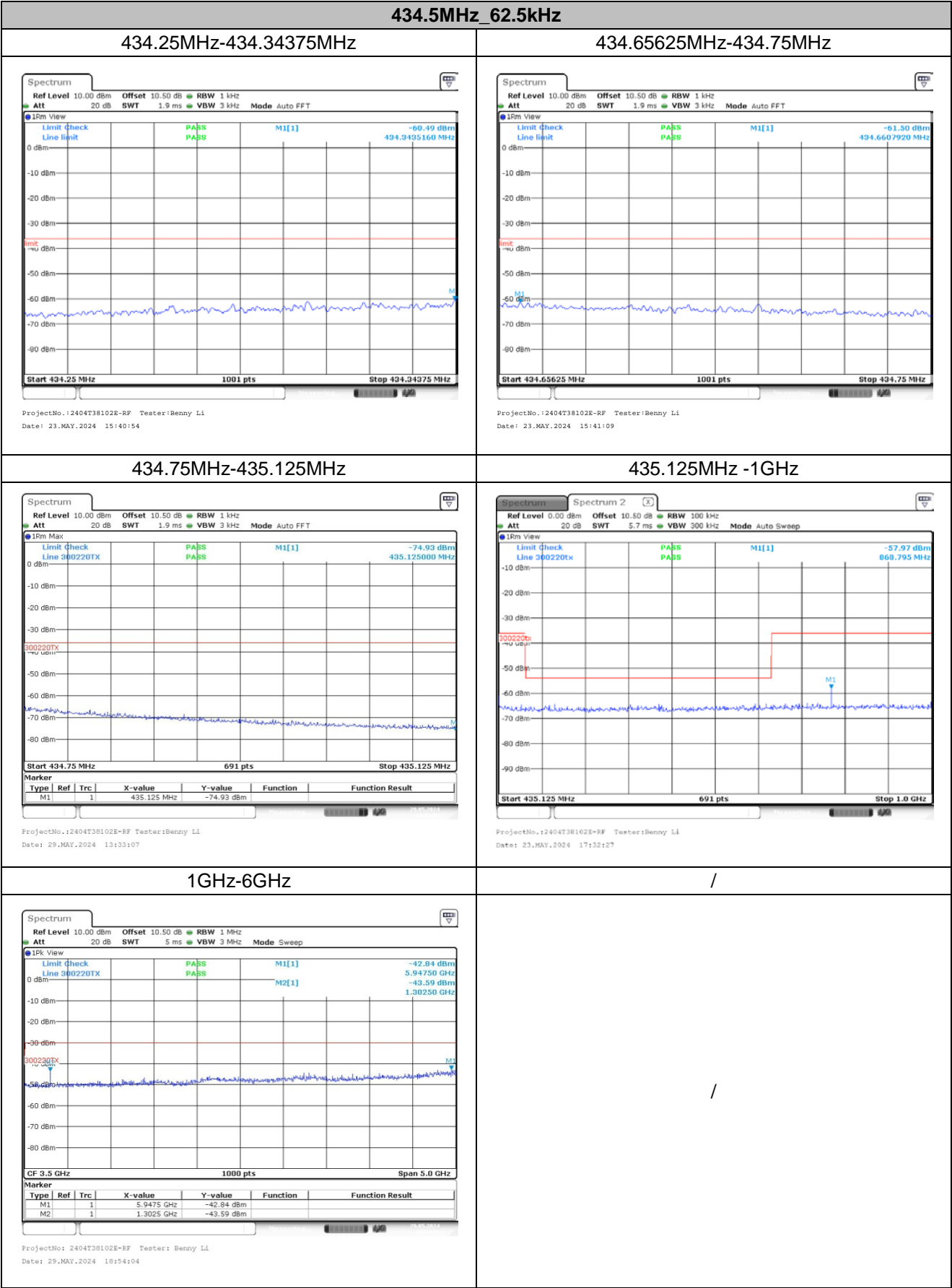


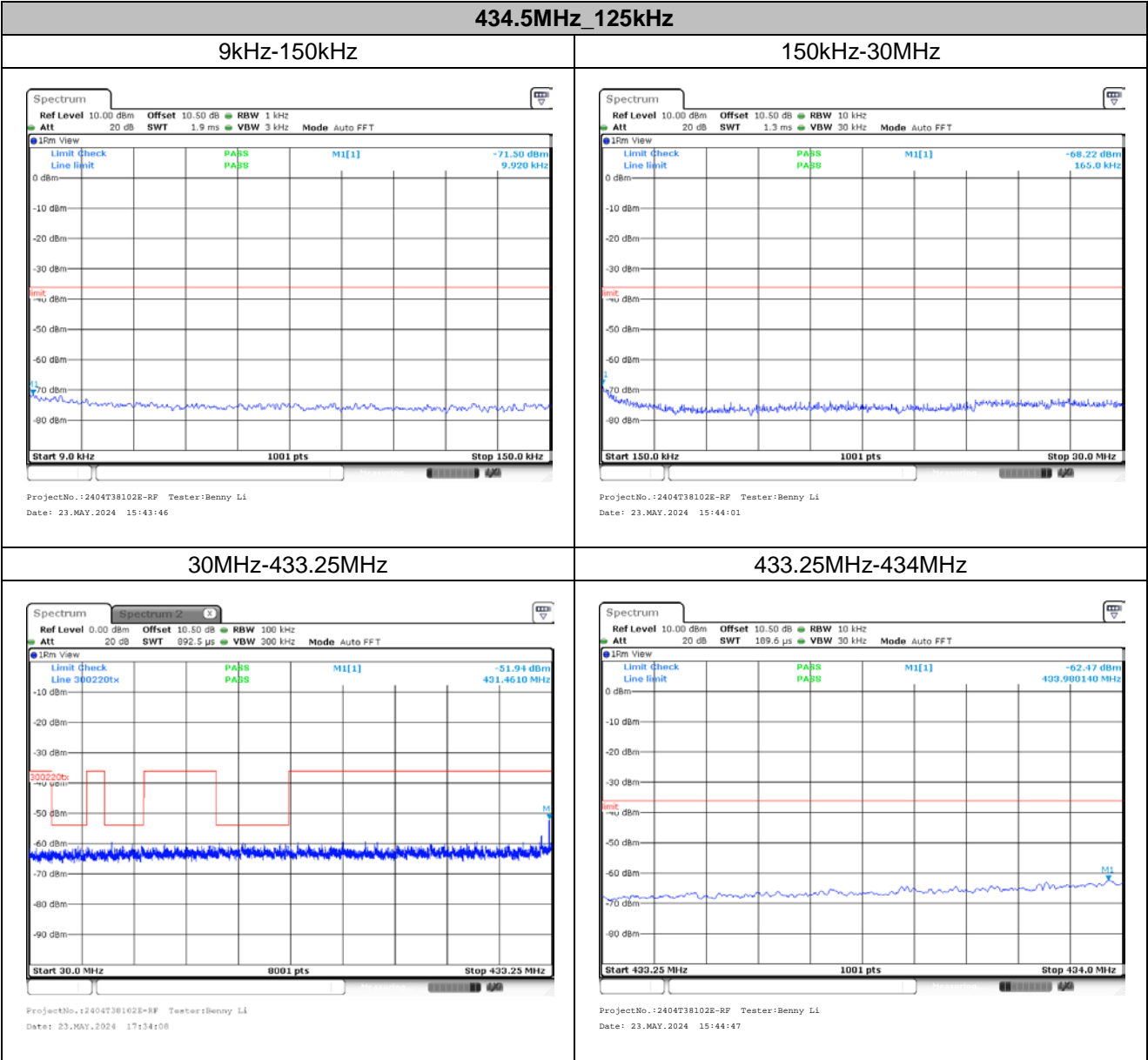


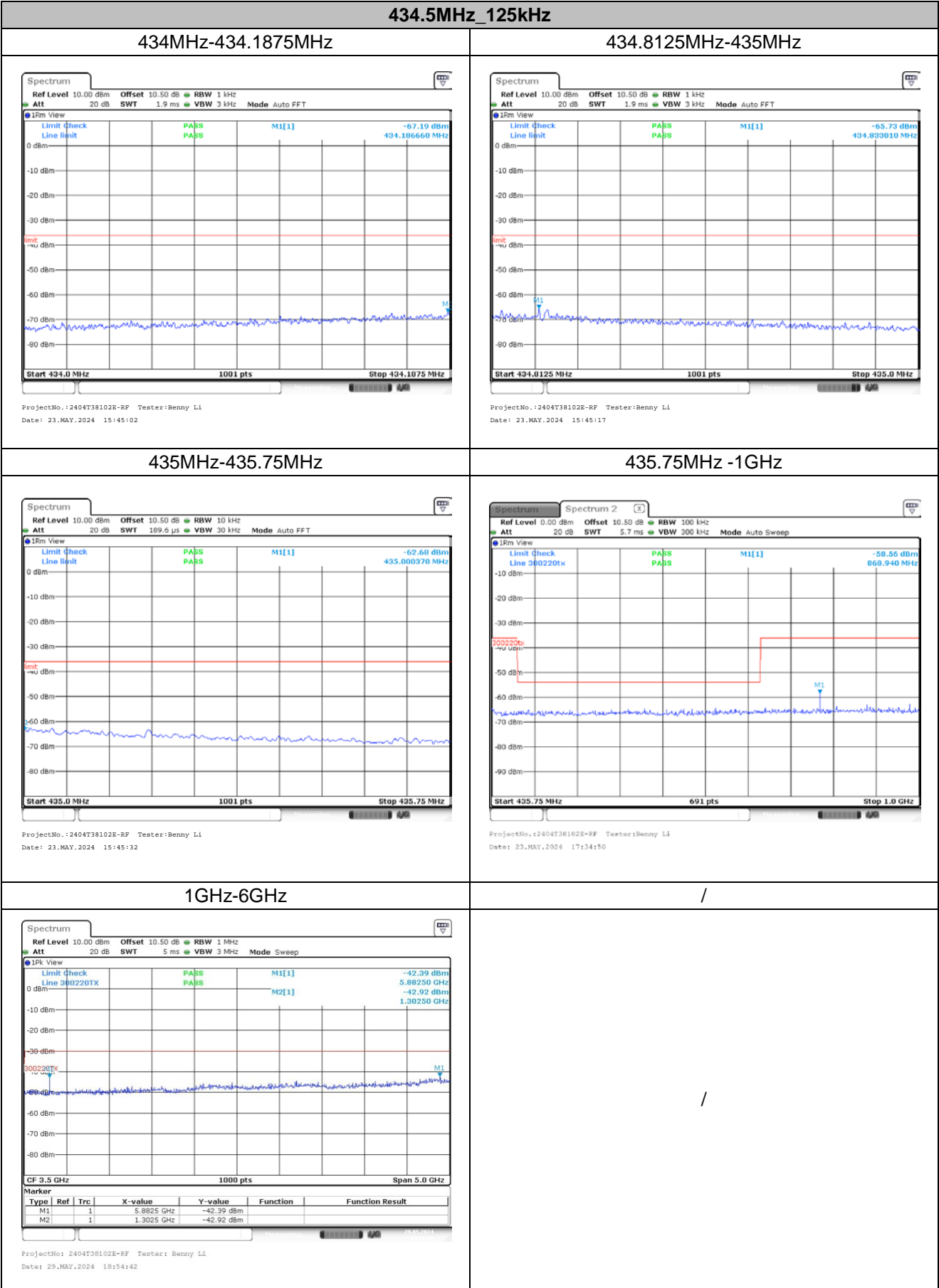


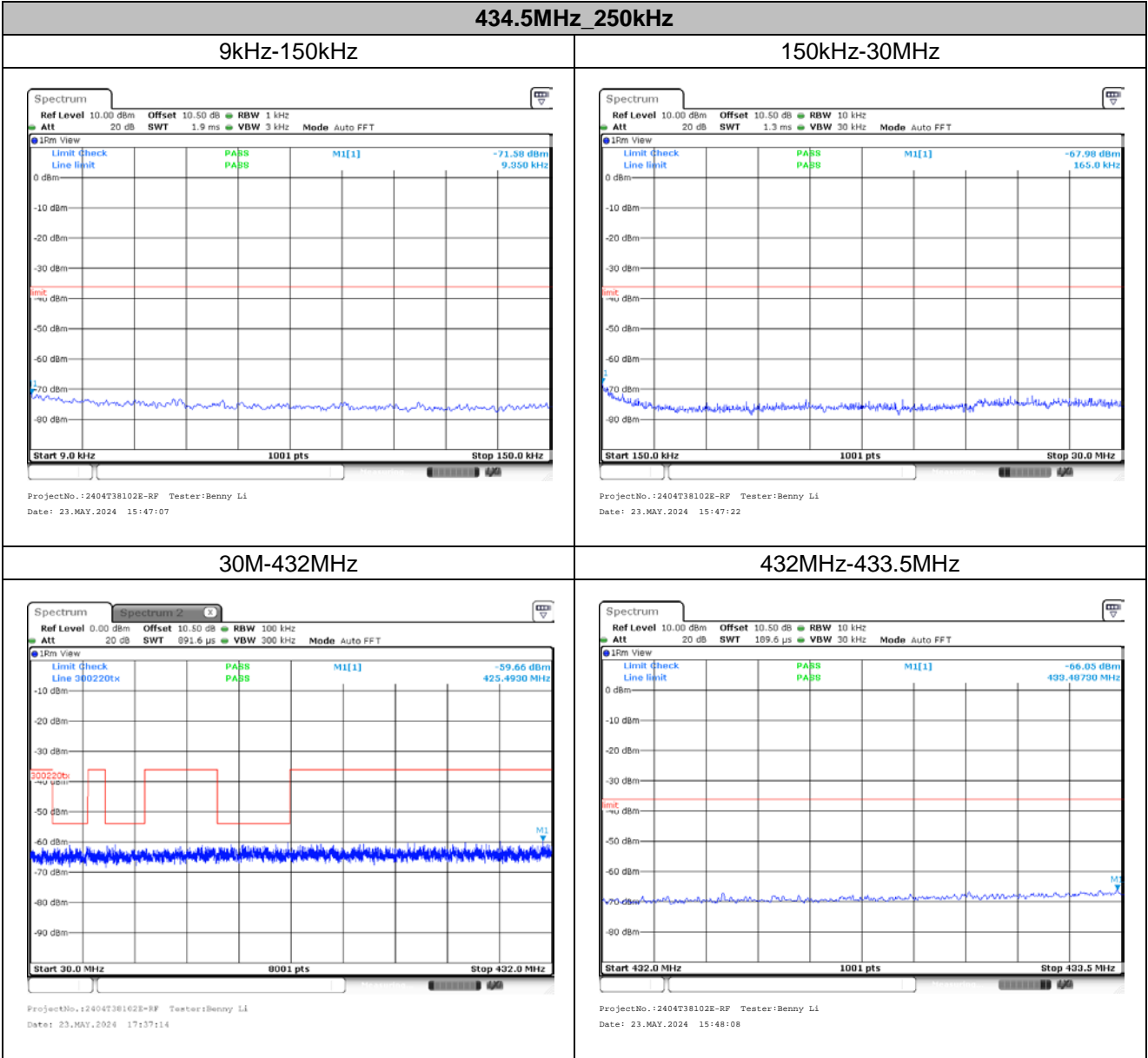


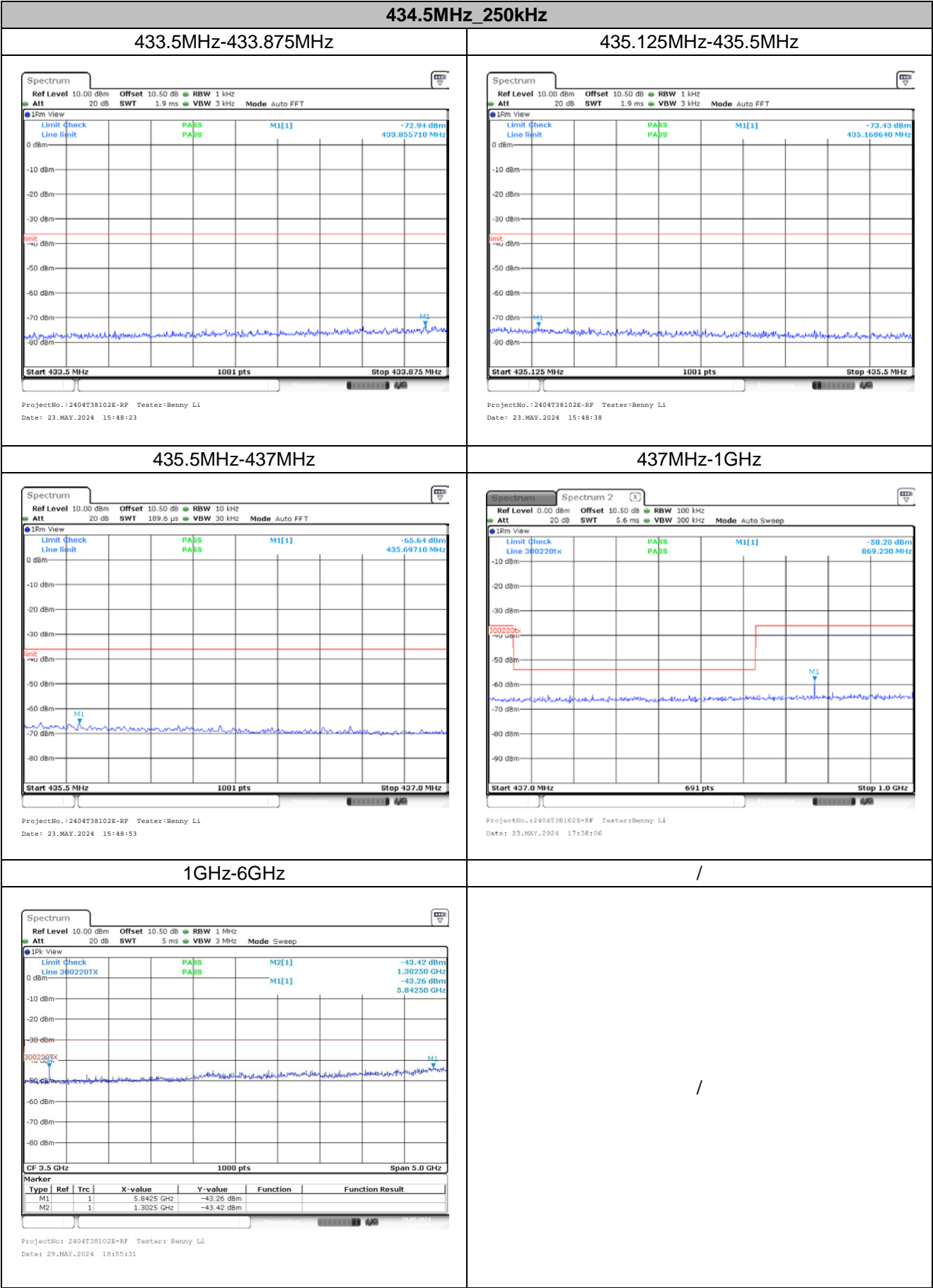


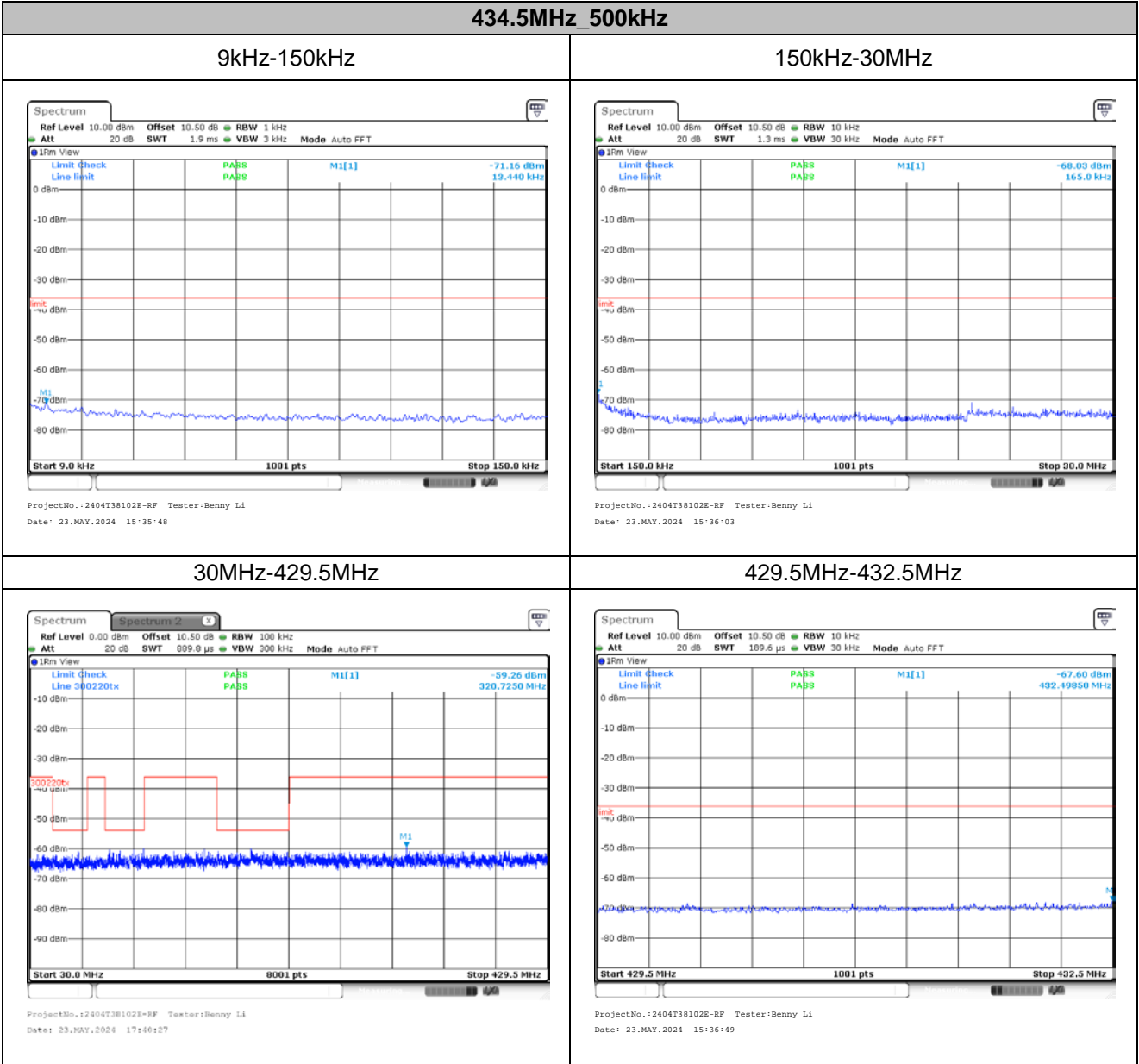


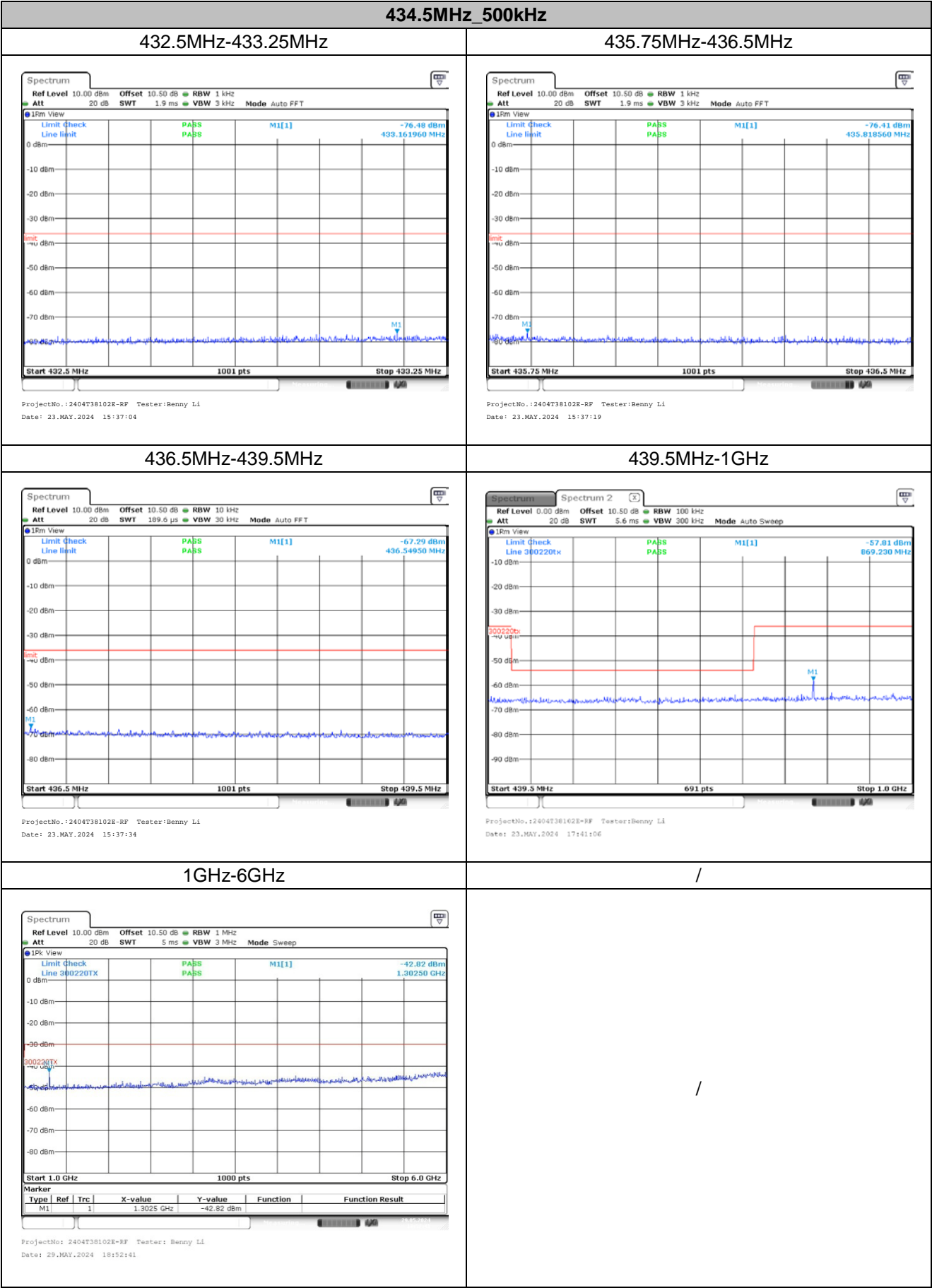




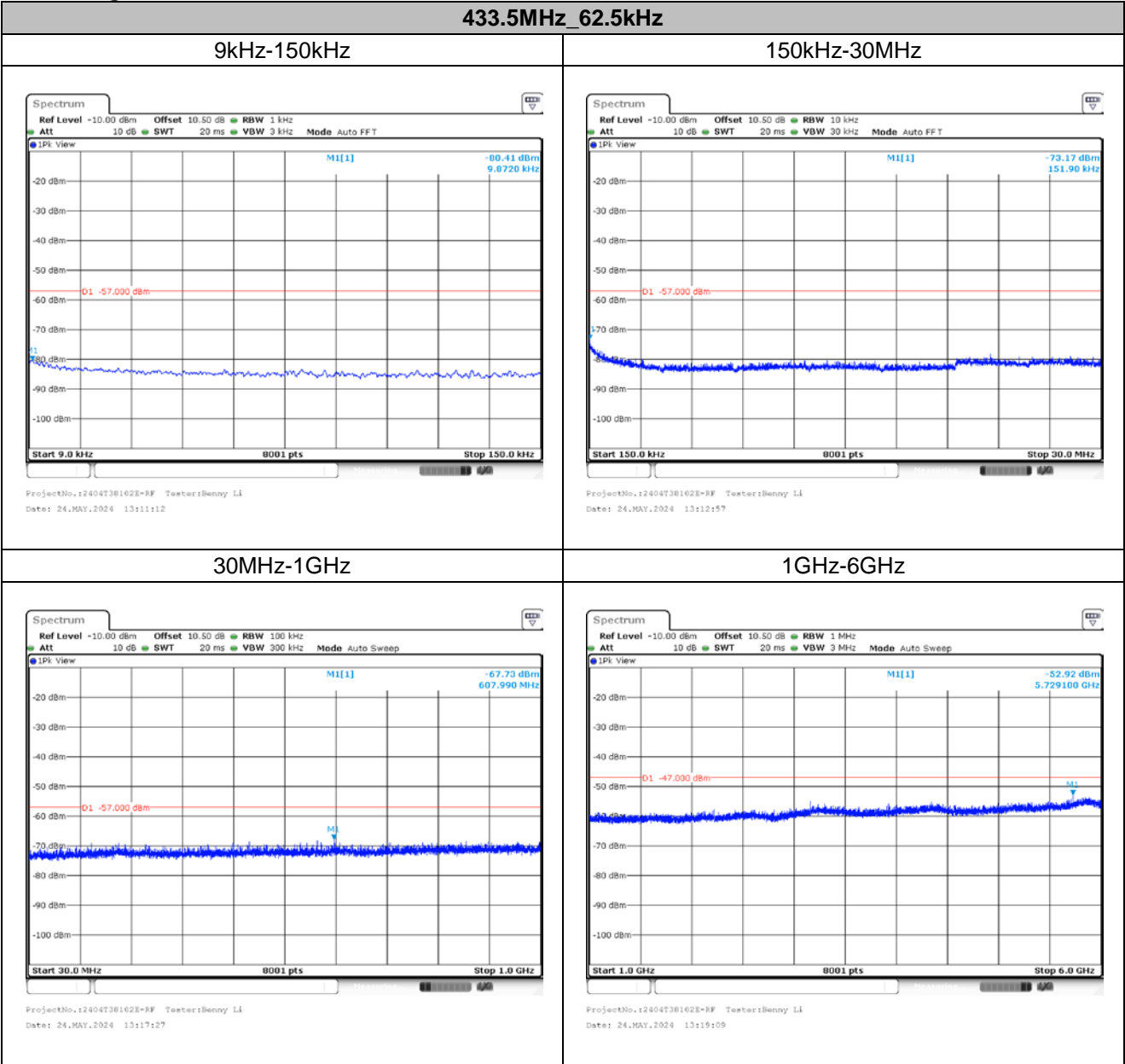


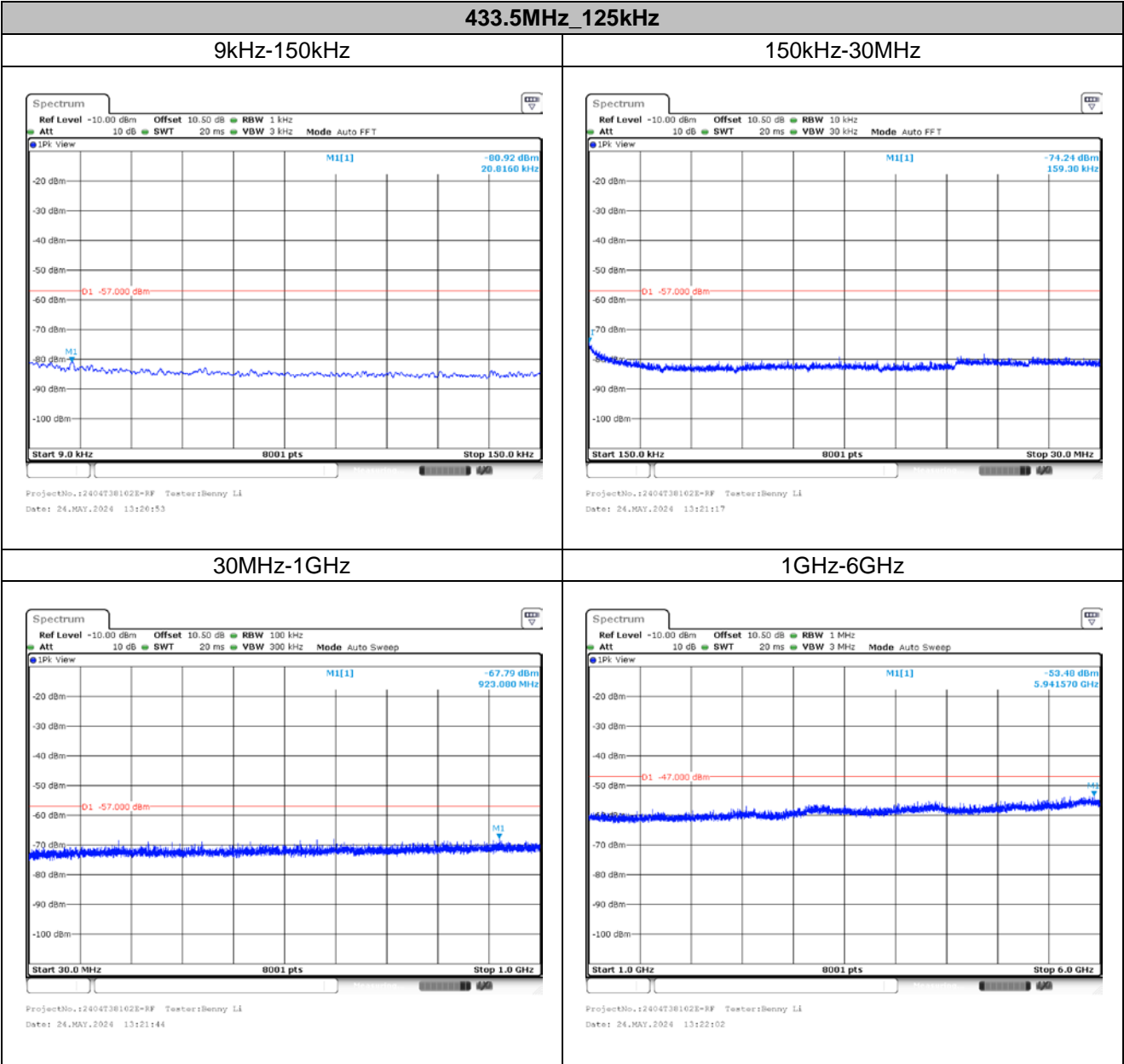


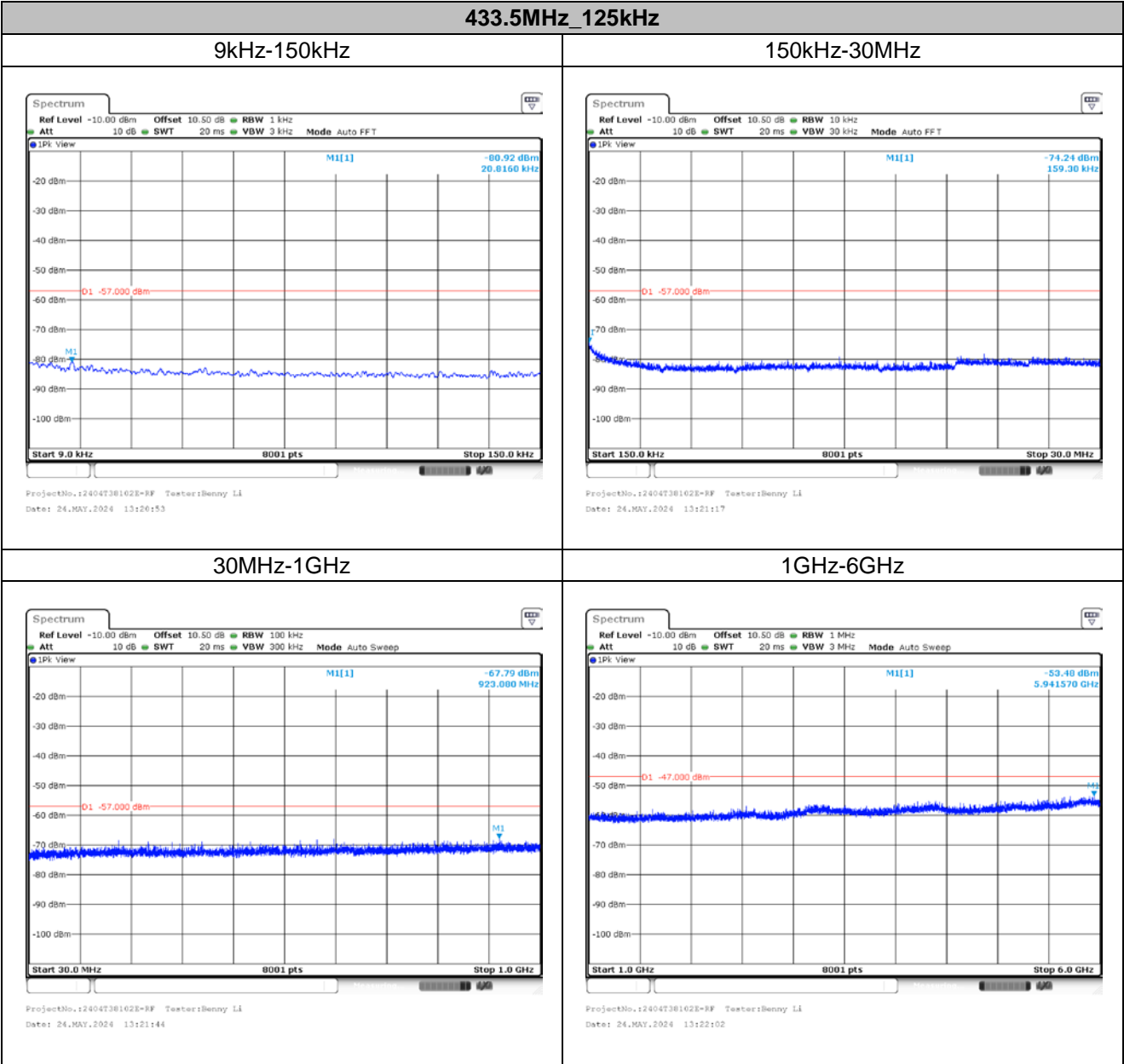


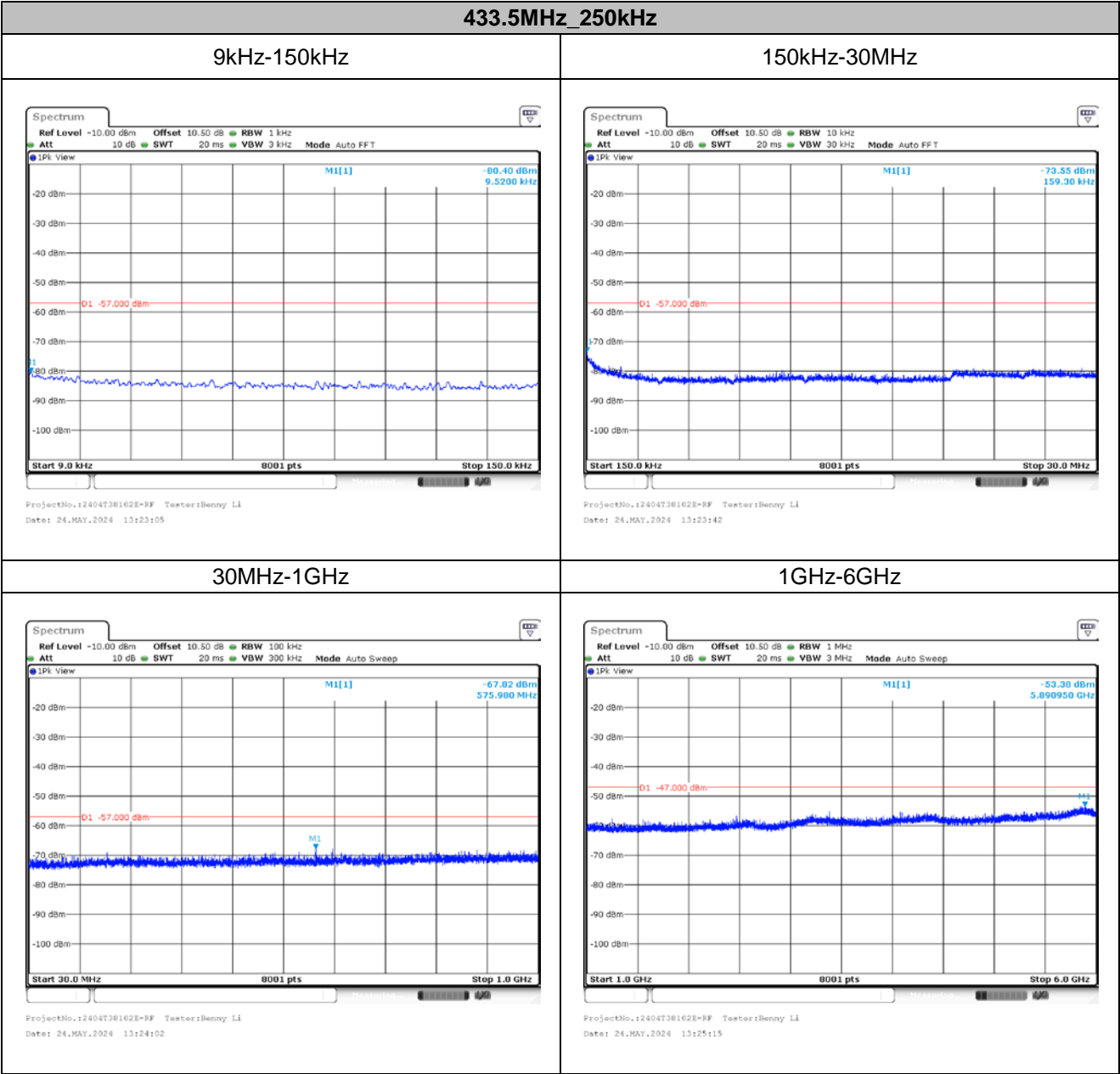


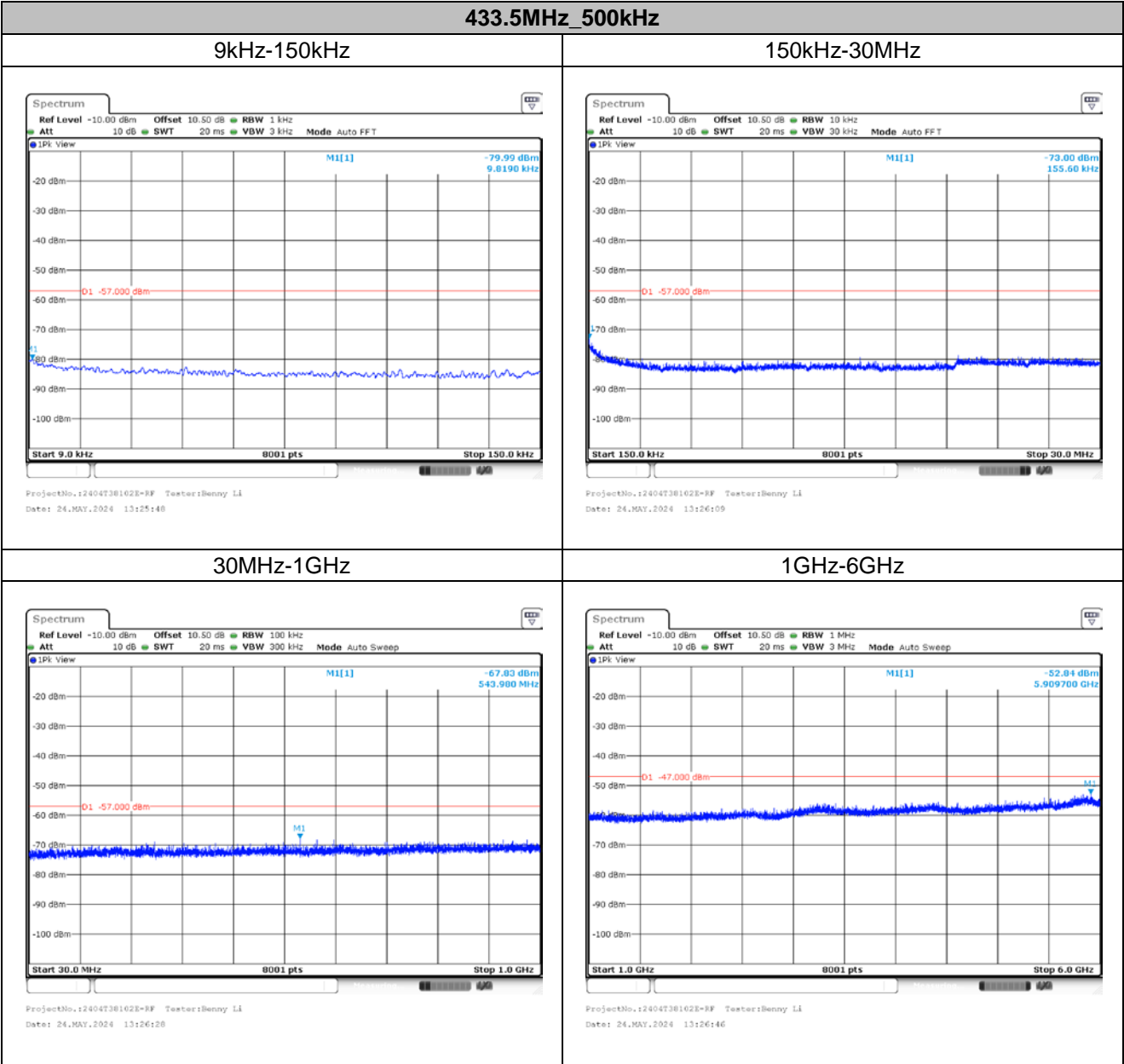
Receiving:

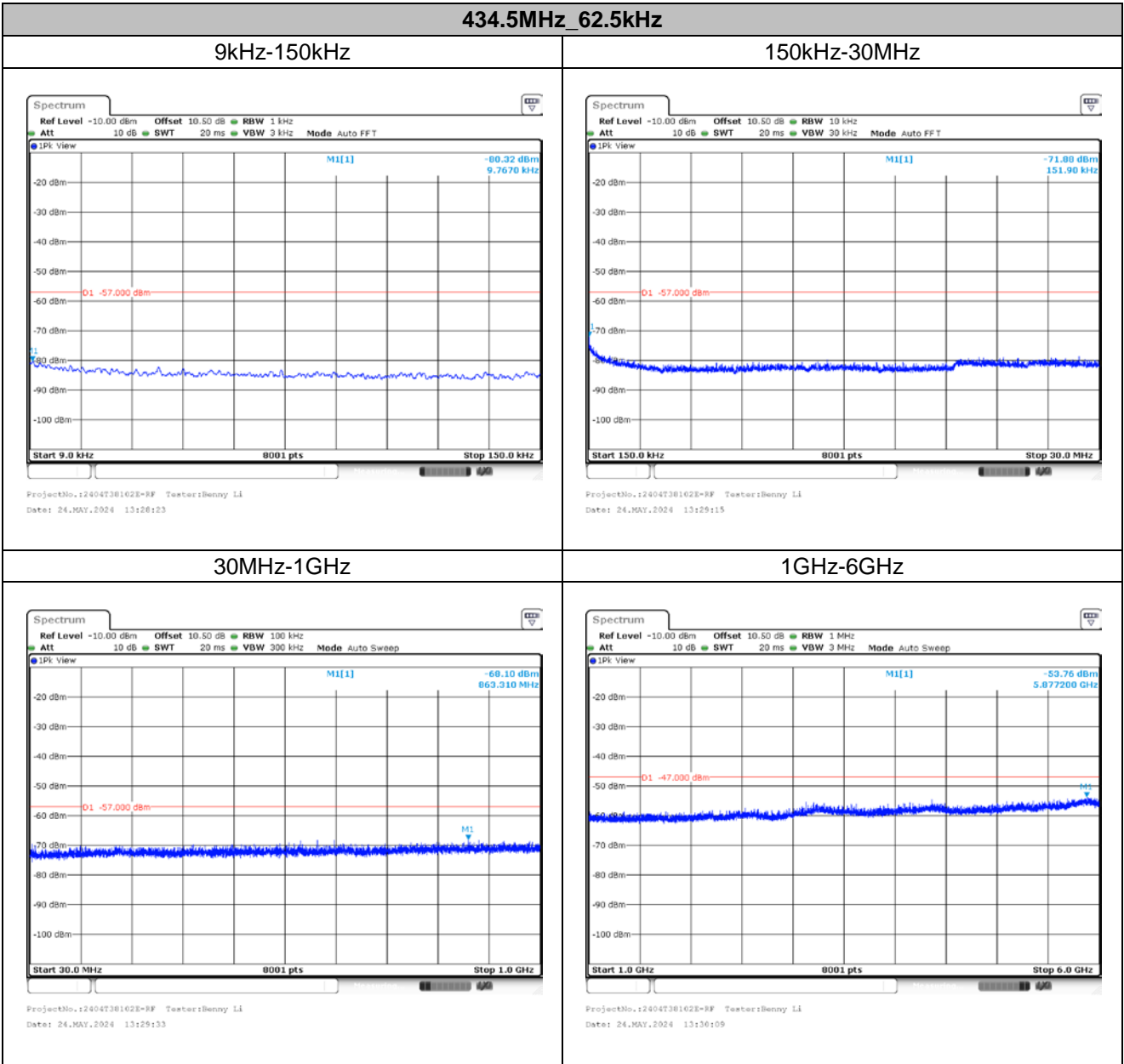


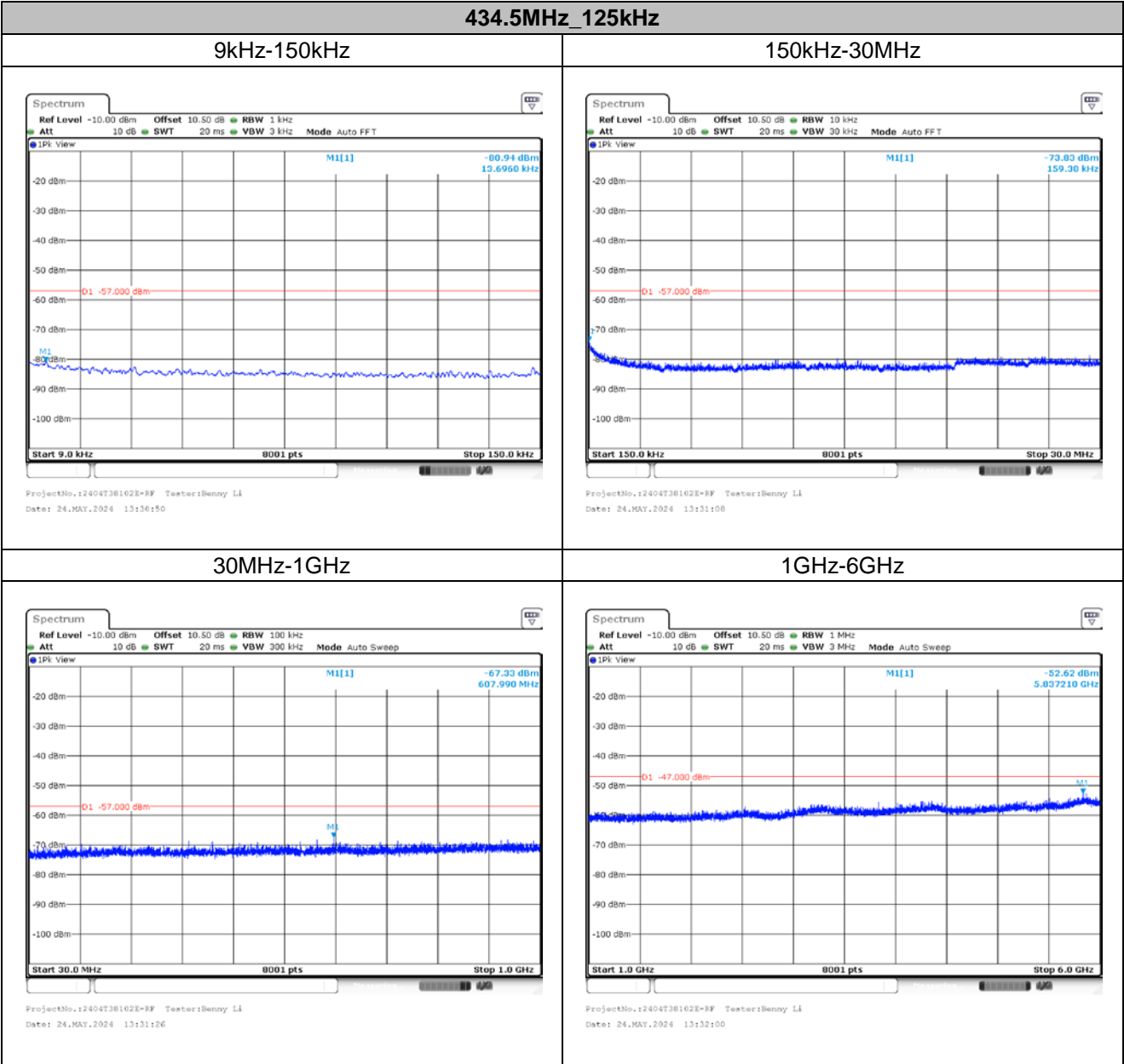


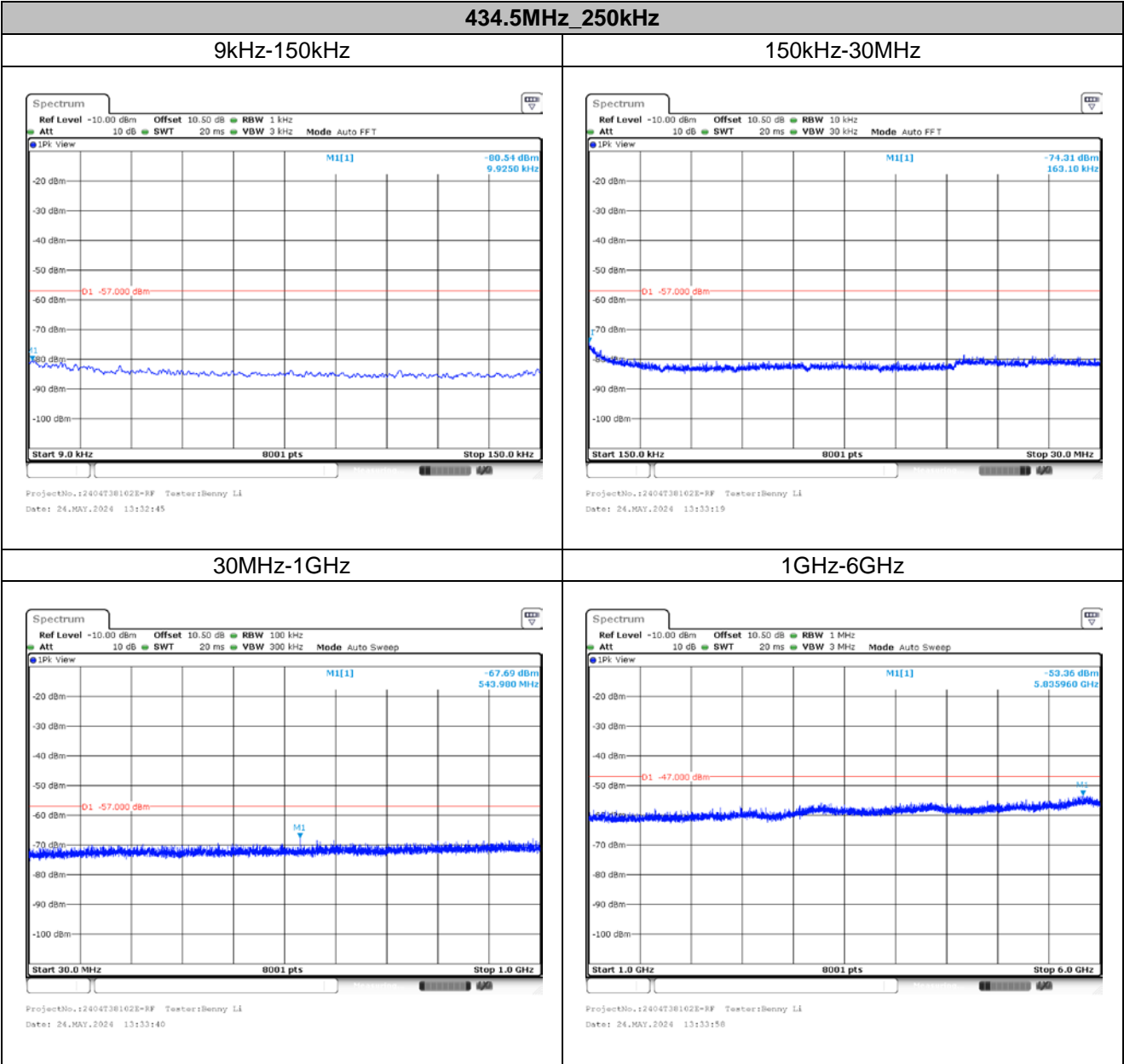


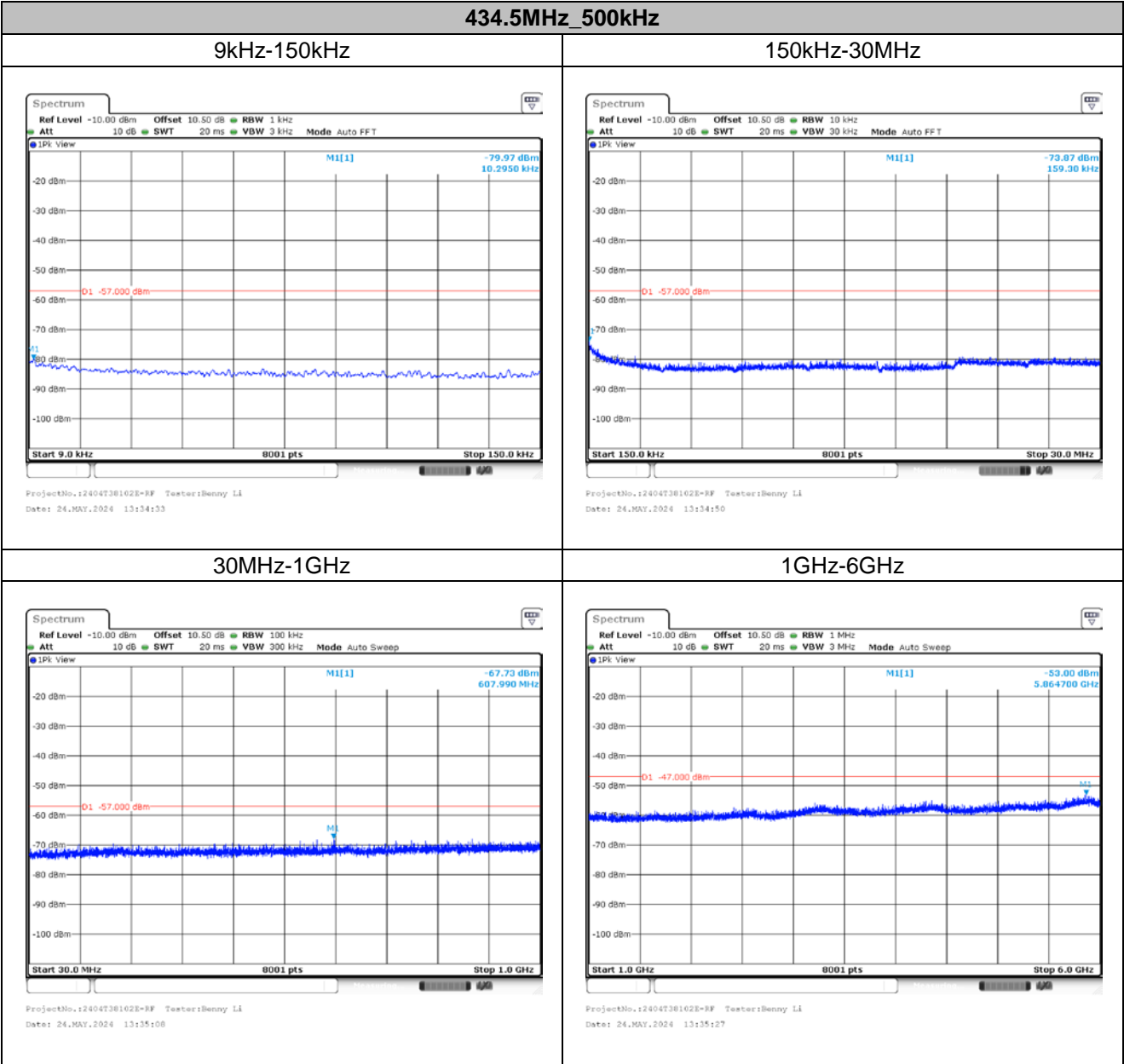




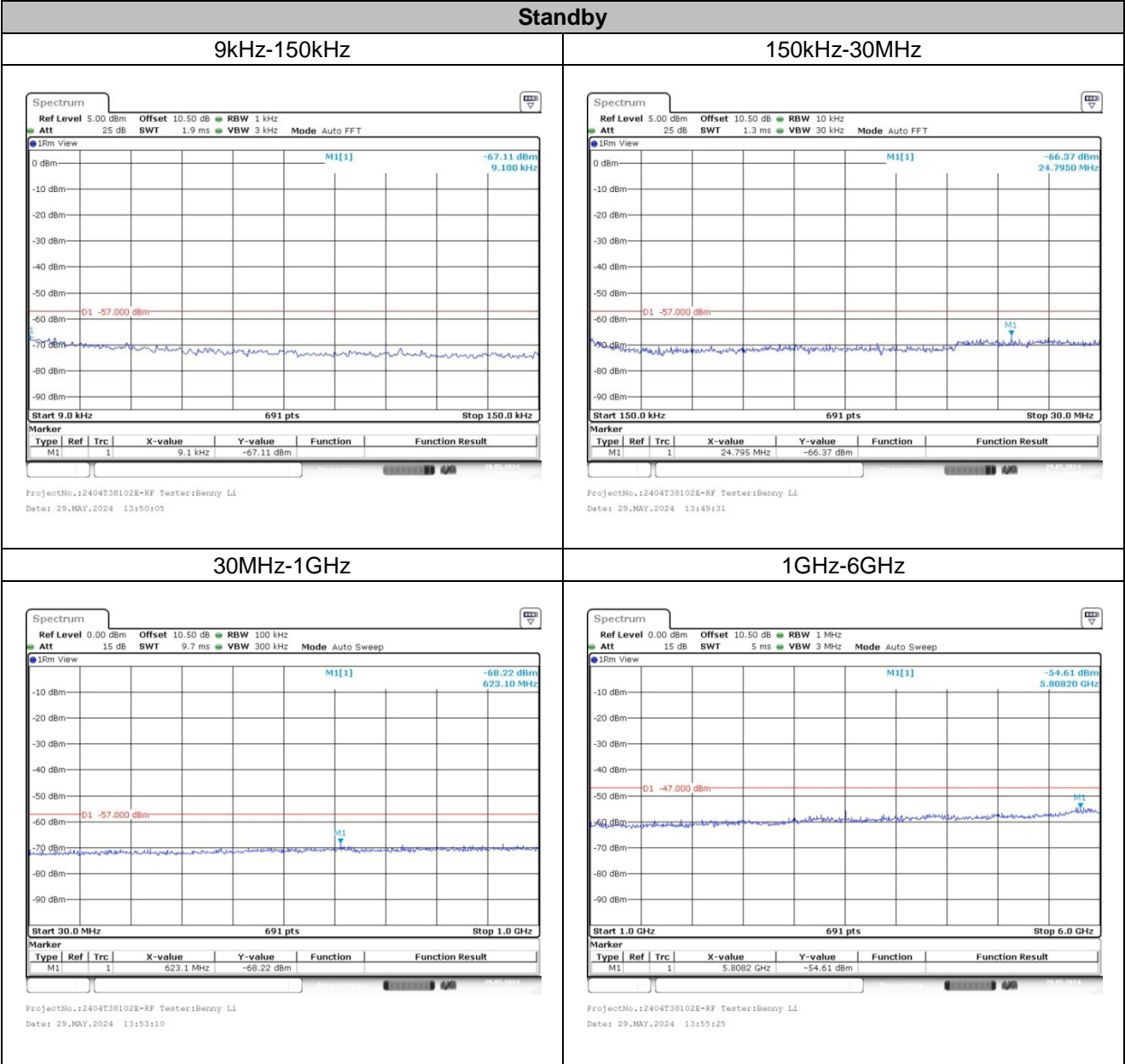








Standby:



ETSI EN 300 220-2 V3.2.1 (2018-06) §4.3.1 - EFFECTIVE RADIATED POWER

Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.2.1:

The effective radiated power (e.r.p) is the power radiated in the direction of the maximum radiated power under specified conditions of measurements for any condition of modulation. For equipment with a permanent or temporary antenna connection it may be taken as the power delivered from that connector taking into account the antenna gain.

According to ETSI EN 300 220-2 V3.2.1 (2018-06) clause 4.3.1.2:

Limit: The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

Method of Measurement

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.2.2.1:

Effective Radiated Power (conducted measurement):

This method applies only to EUT with a permanent external antenna connector.

The transmitter shall be connected to a dummy load as described in clause 4.3.7 and the conducted power delivered shall be measured with a measurement receiver according to clause 4.3.10.

In the case of non-constant envelope modulation, a peak detector shall be used.

The maximum gain of the antenna to be used together with the equipment shall be declared by the manufacturer and this shall be recorded in the test report.

Perp, the radiated power (e.r.p.) limit applies to the maximum measured conducted power ($P_{\text{conducted}}$) value adjusted by the antenna gain (relative to a dipole) ($\text{Perp} = P_{\text{conducted}} + \text{antenna gain}$).

The information shown in Table 7 shall be recorded in the test report.

**Table 7: Information Recorded in the Test Report
for conducted Effective Radiated Power**

Value	Notes
Test environment	Normal operation or unmodulated carrier
Centre frequency	Nominal Operating Frequency
Measured Effective Radiated Power	maximum measured conducted power value adjusted by the antenna gain (relative to a dipole)
NOTE: In case of a dedicated antenna the antenna gain (in dB, i.e. relative to a dipole) is declared by the manufacturer.	

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.2.2.2:

Effective radiated power (radiated measurement):

This measurement method applies to EUT other than those measured using clause 5.2.2.1.

A suitable test site shall be selected from those described in clause C.1 and the radiated power established using the procedures described in clause C.5.1 (or clause C.5.2) depending on the test site, followed by clause C.5.3.

In the case of non-constant envelope modulation, a peak detector shall be used.

The information shown in Table 8 shall be recorded in the test report.

Table 8: Information Recorded in the Test Report for Effective Radiated Power

Value	Notes
Test environment	Normal operation or unmodulated carrier
Centre frequency	Nominal Operating Frequency
Measure of Effective Radiated Power	Larger value from horizontal and vertical measurement equivalent radiated power, plus equipment antenna gain
NOTE: In case of a removable antenna the antenna gain (in dB, i.e. relative to a dipole) is declared by the manufacturer.	

Test Data

Environmental Conditions

Temperature:	24-25 °C
Relative Humidity:	51-52 %
ATM Pressure:	100.6 kPa

The testing was performed by Benny Li from 2024-05-23 to 2024-05-27.

EUT operation mode: Transmitting

Test Condition					Result
Normal	L.V. L.T.	L.V. H.T.	H.V.L.T	H.V. H.T	Compliance

Test Result: Please refer to following Normal Condition data.

Test Condition	Mode (kHz)	Frequency (MHz)	Conducted Power Reading (dBm)	Antenna gain (dBd)	ERP (dBm)	Limit (dBm)
NTNV	62.5	433.5	9.58	0.35	9.93	10
		434.5	9.57	0.35	9.92	10
	125	433.5	9.15	0.35	9.50	10
		434.5	9.59	0.35	9.94	10
	250	433.5	9.60	0.35	9.95	10
		434.5	9.59	0.35	9.94	10
	500	433.5	9.59	0.35	9.94	10
		434.5	9.58	0.35	9.93	10
LTLV	62.5	433.5	9.54	0.35	9.89	10
		434.5	9.45	0.35	9.80	10
	125	433.5	9.21	0.35	9.56	10
		434.5	9.46	0.35	9.81	10
	250	433.5	9.33	0.35	9.68	10
		434.5	9.46	0.35	9.81	10
	500	433.5	9.35	0.35	9.70	10
		434.5	9.46	0.35	9.81	10
LTHV	62.5	433.5	9.34	0.35	9.69	10
		434.5	9.41	0.35	9.76	10
	125	433.5	9.21	0.35	9.56	10
		434.5	9.42	0.35	9.77	10
	250	433.5	9.17	0.35	9.52	10
		434.5	9.28	0.35	9.63	10
	500	433.5	9.36	0.35	9.71	10
		434.5	9.28	0.35	9.63	10
HTLV	62.5	433.5	9.16	0.35	9.51	10
		434.5	9.35	0.35	9.70	10
	125	433.5	9.22	0.35	9.57	10
		434.5	9.41	0.35	9.76	10
	250	433.5	9.28	0.35	9.63	10
		434.5	9.21	0.35	9.56	10
	500	433.5	9.07	0.35	9.42	10
		434.5	9.15	0.35	9.50	10
HTHV	62.5	433.5	9.43	0.35	9.78	10
		434.5	9.31	0.35	9.66	10
	125	433.5	9.38	0.35	9.73	10
		434.5	9.44	0.35	9.79	10
	250	433.5	9.04	0.35	9.39	10
		434.5	9.02	0.35	9.37	10
	500	433.5	9.38	0.35	9.73	10
		434.5	9.43	0.35	9.78	10

Note1: Maximum Antenna Gain=2.5dBi (0.35dBd), which was declared by manufacturer.

Note2: 0dBd=2.15dBi

ETSI EN 300 220-2 V3.2.1 (2018-06) §4.3.3 - DUTY CYCLE

Applicable Standard

According to ETSI EN 300 220-2 V3.2.1 (2018-06) clause 4.3.3:

Duty cycle applies to all transmitters except EUT with polite spectrum access (described in clause 4.5) where permitted in annex B, table B.1 or annex C, table C.1 or any NRI.

Limit: The Duty Cycle at the operating frequency shall not be greater than values in annex B or C for the chosen operational frequency band(s).

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.4.1:

Duty cycle is the ratio expressed as a percentage, of the cumulative duration of transmissions T_{on_cum} within an observation interval T_{obs} . $DC = \left(\frac{T_{on_cum}}{T_{obs}} \right)_{F_{obs}}$ on an observation bandwidth F_{obs} .

Unless otherwise specified, T_{obs} is 1 hour and the observation bandwidth F_{obs} is the operational frequency band. Each transmission consists of an RF emission, or sequence of RF emissions separated by intervals $< T_{Dis}$.

An equipment may operate on several bands simultaneously (i.e. multi transmissions), Duty Cycle limit of each individual band applies to each transmission within that band.

In case of a multicarrier modulation in a band, the duty cycle applies to the whole signal used for a transmission (e.g. OFDM).

It has to be noted that on some bands Duty Cycle value may depend on the presence of a primary radio service.

Equipment may be triggered manually, by internal timing or by external stimulus. Depending on the method of triggering the timing may be predictable or random.

Method of Measurement

An assessment of the overall Duty Cycle shall be made for a representative period of T_{obs} over the observation bandwidth F_{obs} . Unless otherwise specified, T_{obs} is 1 hour and the observation bandwidth F_{obs} is the operational frequency band.

The representative period shall be the most active one in normal use of the device. As a guide "Normal use" is considered as representing the behaviour of the device during transmission of 99 % of transmissions generated during its operational lifetime.

Procedures such as setup, commissioning and maintenance are not considered part of normal operation.

Where an acknowledgement is used, the additional transmitter on-time from a message responder shall be declared only once whether included in the message initiator Duty Cycle or in the message responder Duty Cycle.

NOTE: The intention of this rule is not to allow EUT to exceed the maximum duty cycle value.

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52 %
ATM Pressure:	100.6 kPa

The testing was performed by Benny Li on 2024-05-23.

EUT operation mode: Transmitting

Test Result: Compliance, please refer to following data.

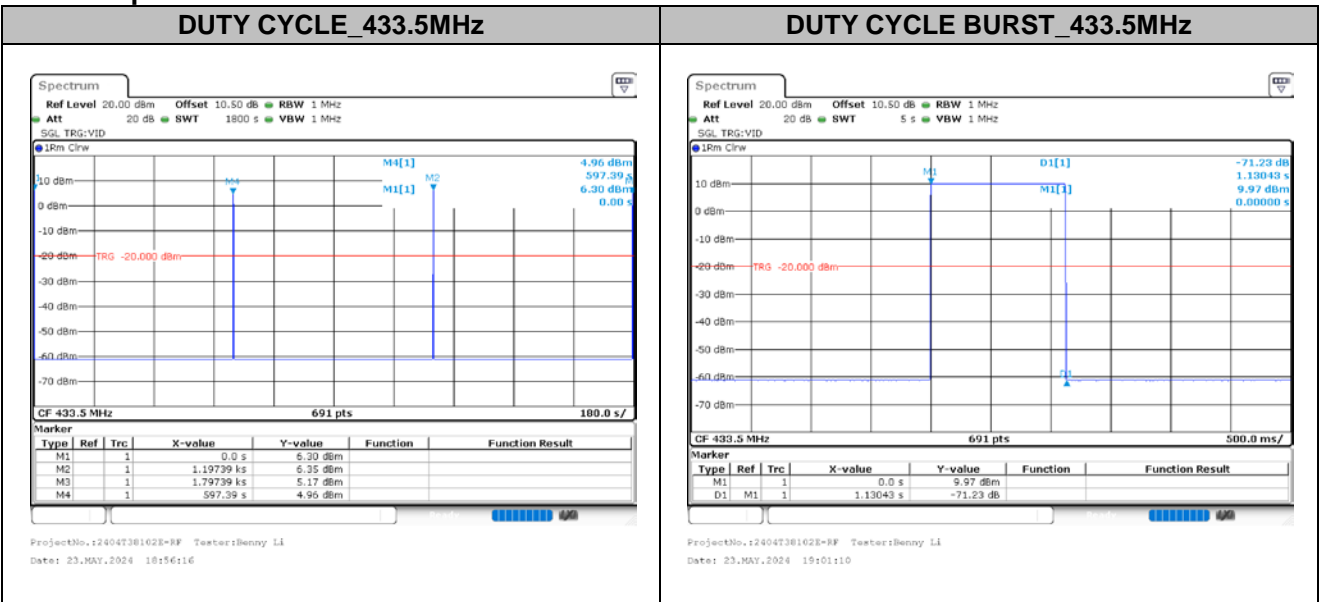
Test Frequency (MHz)	Transmit On Time (s)	T _{on} cumulative in 1 hour (s)	Observation period T _{obs} (s)	Duty cycle (%)	Limit (%)
433.5	1.13043	9.04344	3600	0.2512067	10

Note: Test the diagram from below:

For 433.5MHz:

1. It transmits 4times in 1800s, so 1 hour total pulses=(3600/1800)*4=8.
2. The one pulse is 1.13043s.
3. Ton cumulative(s) in 1 hour=8*1.13043s=9.04344s
4. Duty cycle= Ton cumulative(s) in 1 hour/ Observation period T_{obs} (s)*100%
=9.04344/3600*100%=0.2512067%

Test Graphs



ETSI EN 300 220-2 V3.2.1 (2018-06) §4.3.4 - OCCUPIED BANDWIDTH

Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.6:

The occupied bandwidth (OBW) is the Frequency Range in which 99 % of the total mean power of a given emission falls. The residual part of the total power being denoted as β , which, in cases of symmetrical spectra, splits up into $\beta/2$ on each side of the spectrum. Unless otherwise specified, $\beta/2$ is taken as 0,5 % as described in Figure 3.

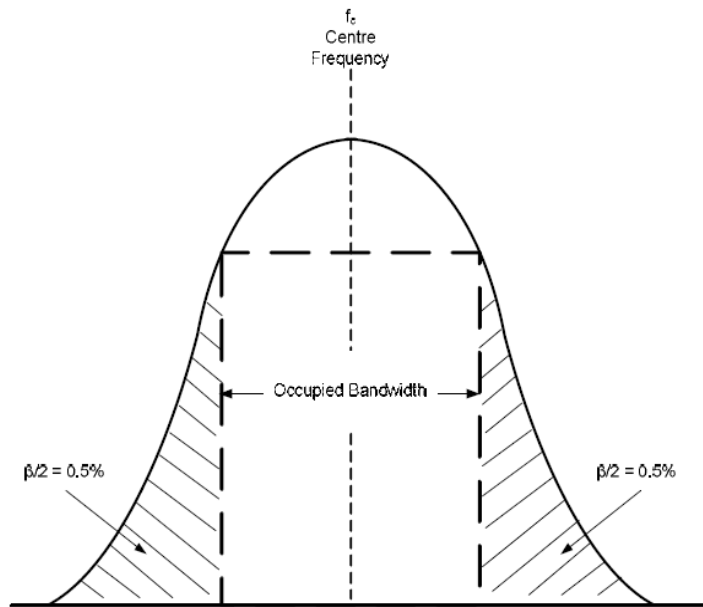


Figure 3: Signal occupied bandwidth

The maximum occupied bandwidth includes all associated side bands above the appropriate emissions level and the frequency error or drift under extreme test conditions.

Limit:

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band.

The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high} .

Method of measurement

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.6.3:

The spectrum analyser shall be configured as appropriate for the parameters shown in Table 12.

Table 12: Test Parameters for Max Occupied Bandwidth Measurement

Setting	Value	Notes
Centre frequency	The nominal Operating Frequency	The highest or lowest Operating Frequency as declared by the manufacturer
RBW	1 % to 3 % of OCW without being below 100 Hz	
VBW	3 x RBW	Nearest available analyser setting to 3 x RBW
Span	At least 2 x Operating Channel width	Span should be large enough to include all major components of the signal and its side bands
Detector Mode	RMS	
Trace	Max hold	

If the equipment is capable of producing an unmodulated carrier and the test in clause 5.7 is performed, then the OBW measurements need only be performed under normal test conditions. Any required results for Maximum OBW under extreme conditions are obtained by addition and subtraction of the upper and lower frequency error results to each bandwidth measurement obtained in this test.

Step 1: Operation of the EUT shall be started, on the highest operating frequency as declared by the manufacturer, with the appropriate test signal.

The signal attenuation shall be adjusted to ensure that the signal power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals on either side of the power envelope being included in the measurement.

Step 2: When the trace is completed the peak value of the trace shall be located and the analyser marker placed on this peak.

Step 3: The 99 % occupied bandwidth function of the spectrum analyser shall be used to measure the occupied bandwidth of the signal.

Test Data

Environmental Conditions

Temperature:	24-25 °C
Relative Humidity:	51-52 %
ATM Pressure:	100.6 kPa

The testing was performed by Benny Li on 2024-05-23 and 2024-06-14.

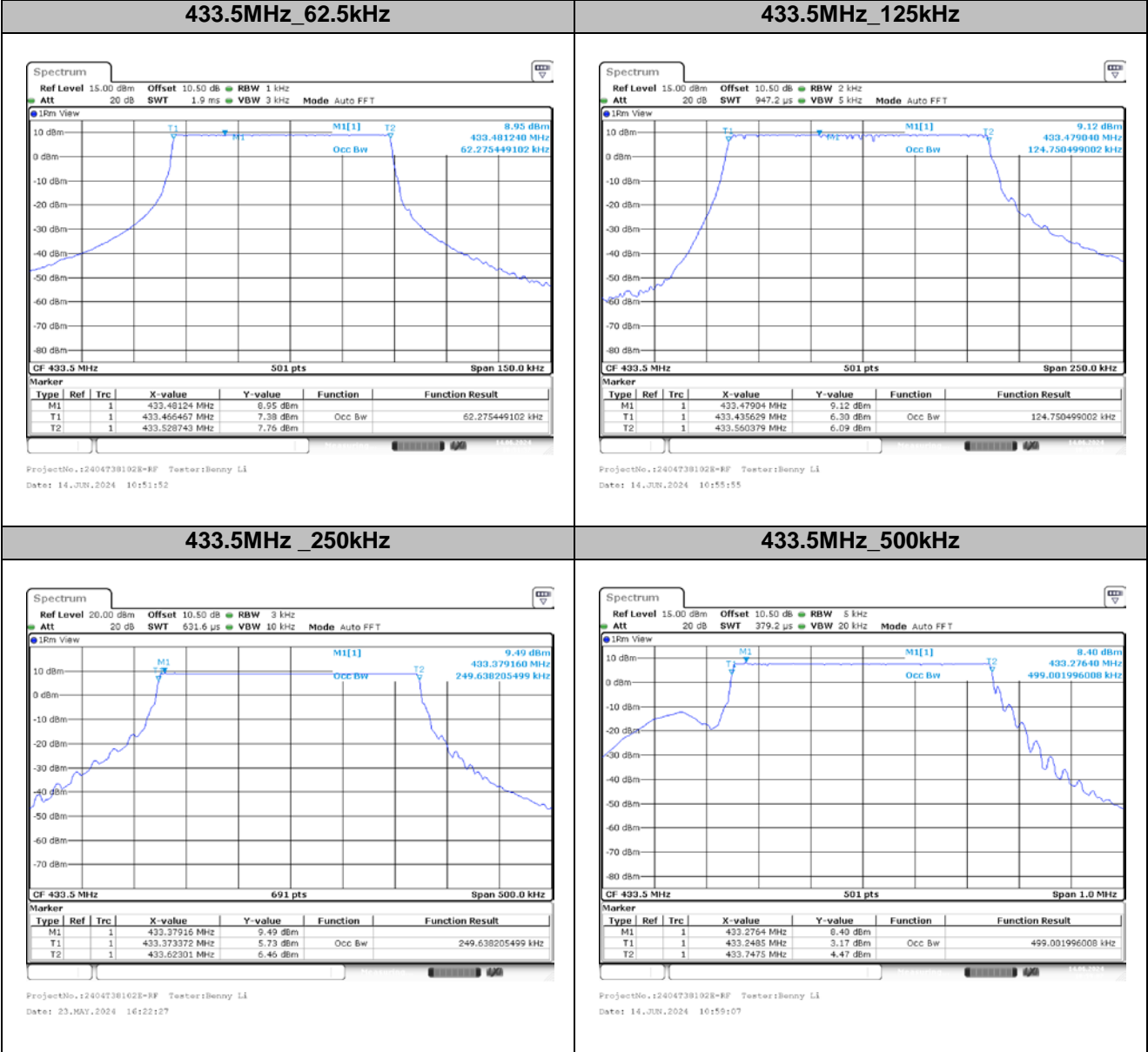
EUT operation mode: Transmitting

Test Condition					Result
Normal	L.V. L.T.	L.V. H.T.	H.V.L.T	H.V. H.T	Compliance

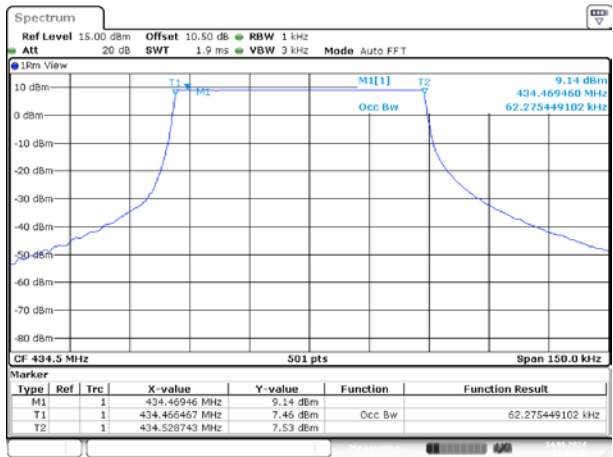
Test Result: Please refer to following Normal Condition data.

Test Frequency (MHz)	Occupied Bandwidth (kHz)	FL (MHz)	FH (MHz)	Limit (MHz)
433.5	62.275	433.466467	433.528743	Within 433.05-434.79
	124.750	433.435629	433.560379	Within 433.05-434.79
	249.638	433.373372	433.62301	Within 433.05-434.79
	499.002	433.2485	433.7475	Within 433.05-434.79
434.5	62.275	434.466467	434.528743	Within 433.05-434.79
	124.750	434.43513	434.55988	Within 433.05-434.79
	249.638	434.373372	434.62301	Within 433.05-434.79
	499.002	434.2485	434.7475	Within 433.05-434.79

Test Graphs (Normal)

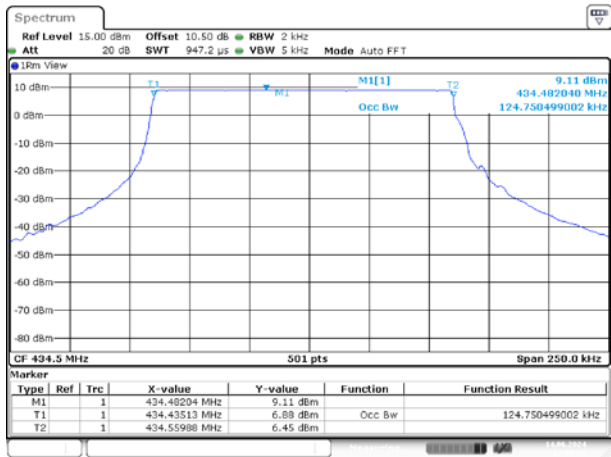


434.5MHz_62.5kHz



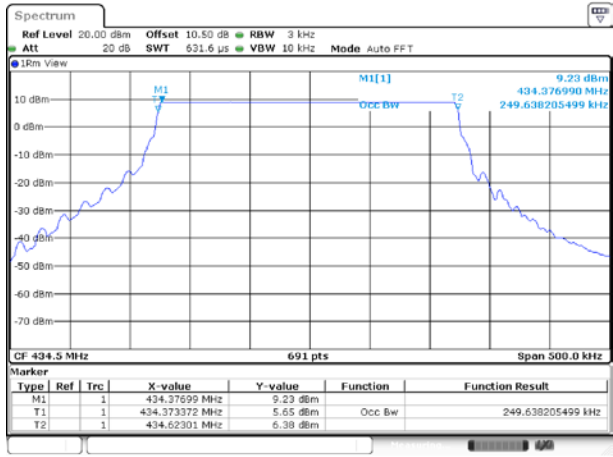
ProjectNo.:2404T38102E-RF Tester:Benny Li
Date: 14.JUN.2024 11:01:16

434.5MHz_125kHz



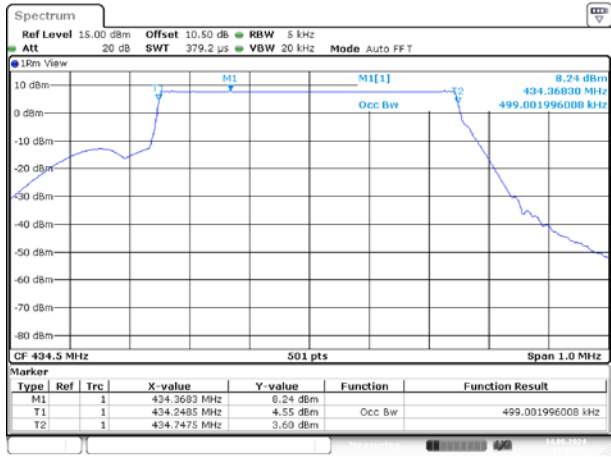
ProjectNo.:2404T38102E-RF Tester:Benny Li
Date: 14.JUN.2024 11:05:32

434.5MHz_250kHz



ProjectNo.:2404T38102E-RF Tester:Benny Li
Date: 23.MAY.2024 16:15:56

434.5MHz_500kHz



ProjectNo.:2404T38102E-RF Tester:Benny Li
Date: 14.JUN.2024 11:07:15

ETSI EN 300 220-2 V3.2.1 (2018-06) §4.3.5 - TX OUT OF BAND EMISSIONS

Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.8:

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

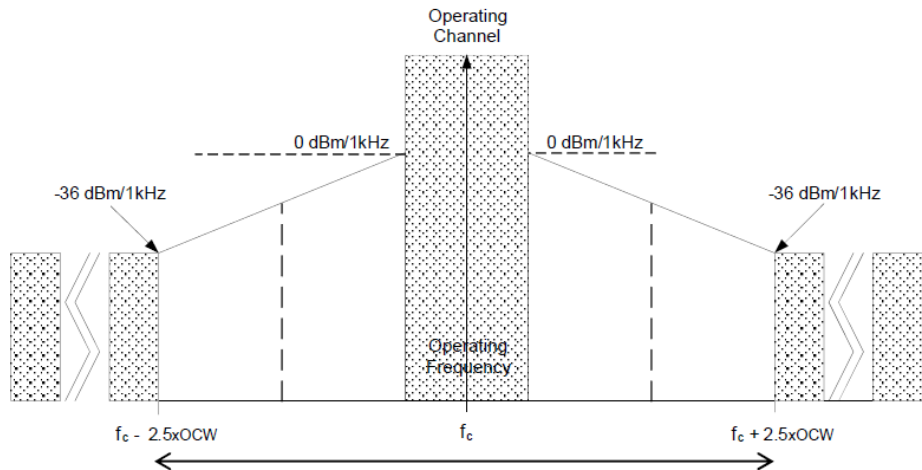


Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.

The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

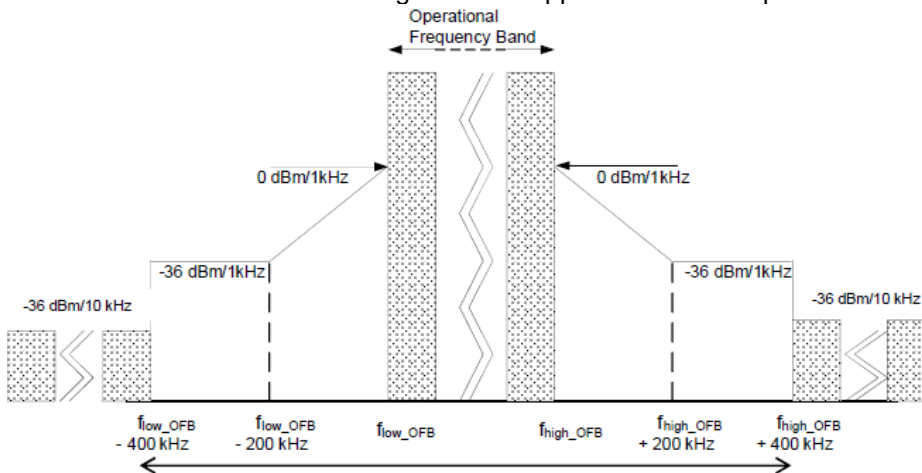


Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.

NOTE: f_{low_OFB} is the lower edge of the Operational Frequency Band.

f_{high_OFB} is the upper edge of the Operational Frequency Band.

Limit: The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW _{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \leq f_{\text{low_OFB}} - 400 \text{ kHz}$	10 kHz	-36 dBm
	$F_{\text{low_OFB}} - 400 \text{ kHz} \leq f \leq f_{\text{low_OFB}} - 200 \text{ kHz}$	1 kHz	-36 dBm
	$f_{\text{low}} - 200 \text{ kHz} \leq f < f_{\text{low_OFB}}$	1 kHz	See Figure 6
	$f = f_{\text{low_OFB}}$	1 kHz	0 dBm
	$f = f_{\text{high_OFB}}$	1 kHz	0 dBm
	$F_{\text{high_OFB}} < f \leq f_{\text{high_OFB}} + 200 \text{ kHz}$	1 kHz	See Figure 6
	$F_{\text{high_OFB}} + 200 \text{ kHz} \leq f \leq f_{\text{high_OFB}} + 400 \text{ kHz}$	1 kHz	-36 dBm
	$F_{\text{high_OFB}} + 400 \text{ kHz} \leq f$	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c - 2.5 \times \text{OCW}$	1 kHz	-36 dBm
	$f_c - 2.5 \times \text{OCW} \leq f \leq f_c - 0.5 \times \text{OCW}$	1 kHz	See Figure 5
	$f = f_c - 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f = f_c + 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f_c + 0.5 \times \text{OCW} \leq f \leq f_c + 2.5 \times \text{OCW}$	1 kHz	See Figure 5
	$f = f_c + 2.5 \times \text{OCW}$	1 kHz	-36 dBm
NOTE: f is the measurement frequency. f _c is the Operating Frequency. F _{low_OFB} is the lower edge of the Operational Frequency Band. F _{high_OFB} is the upper edge of the Operational Frequency Band. OCW is the operating channel bandwidth.			

Method of measurement

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.8.3.

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52 %
ATM Pressure:	100.6 kPa

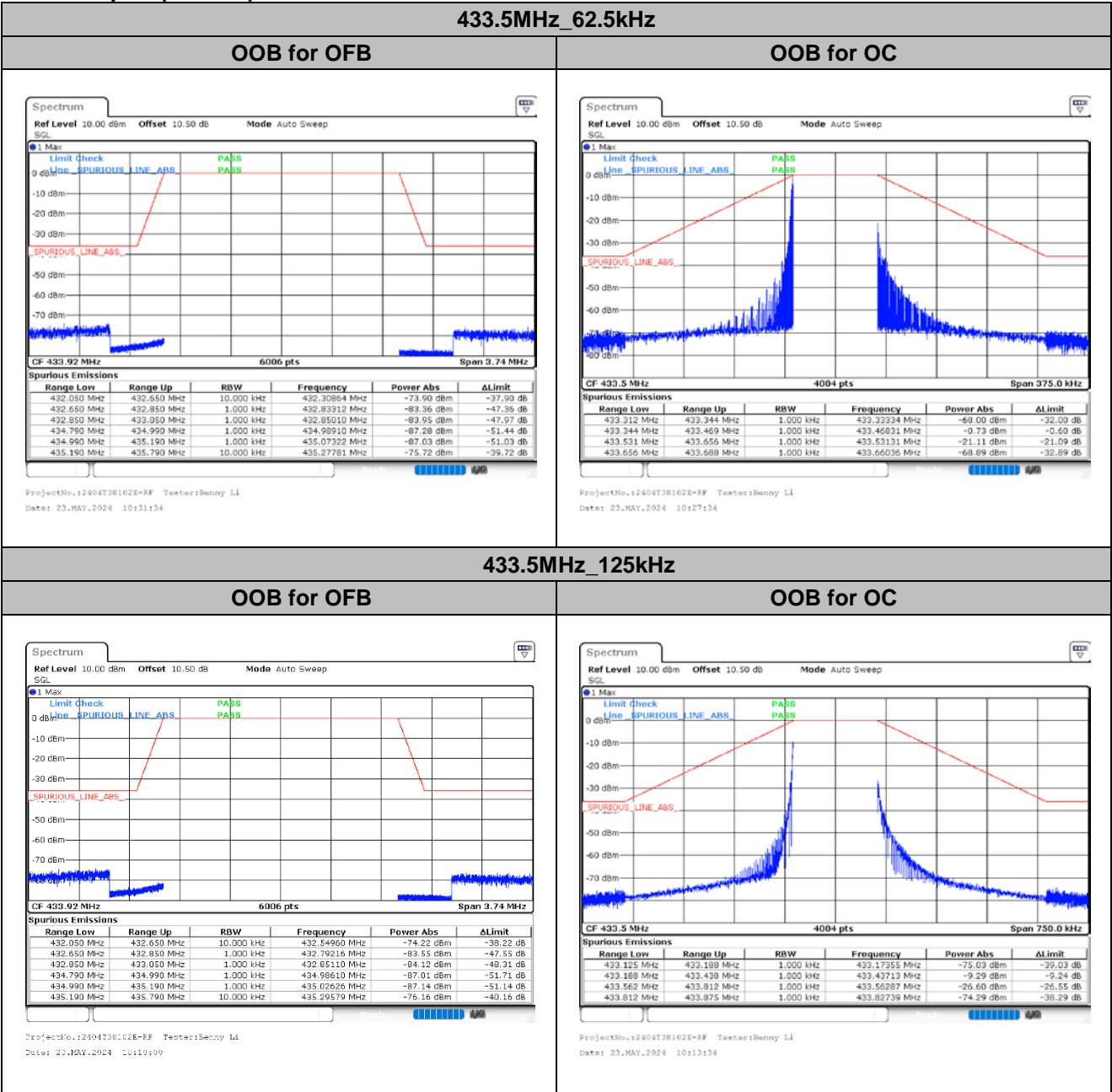
The testing was performed by Benny Li on 2024-05-23.

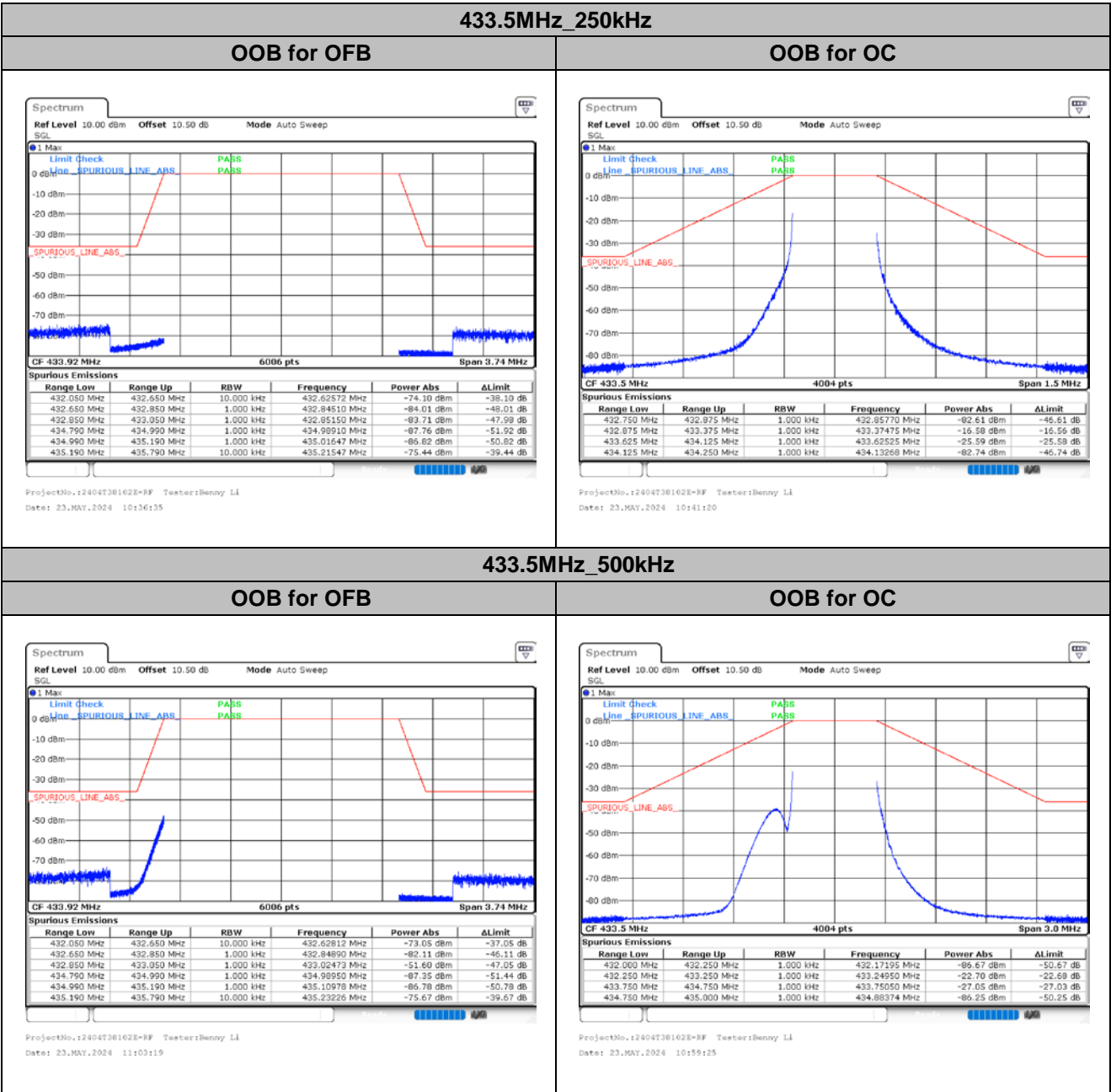
Test Mode: Transmitting (Test with conducted measurement.)

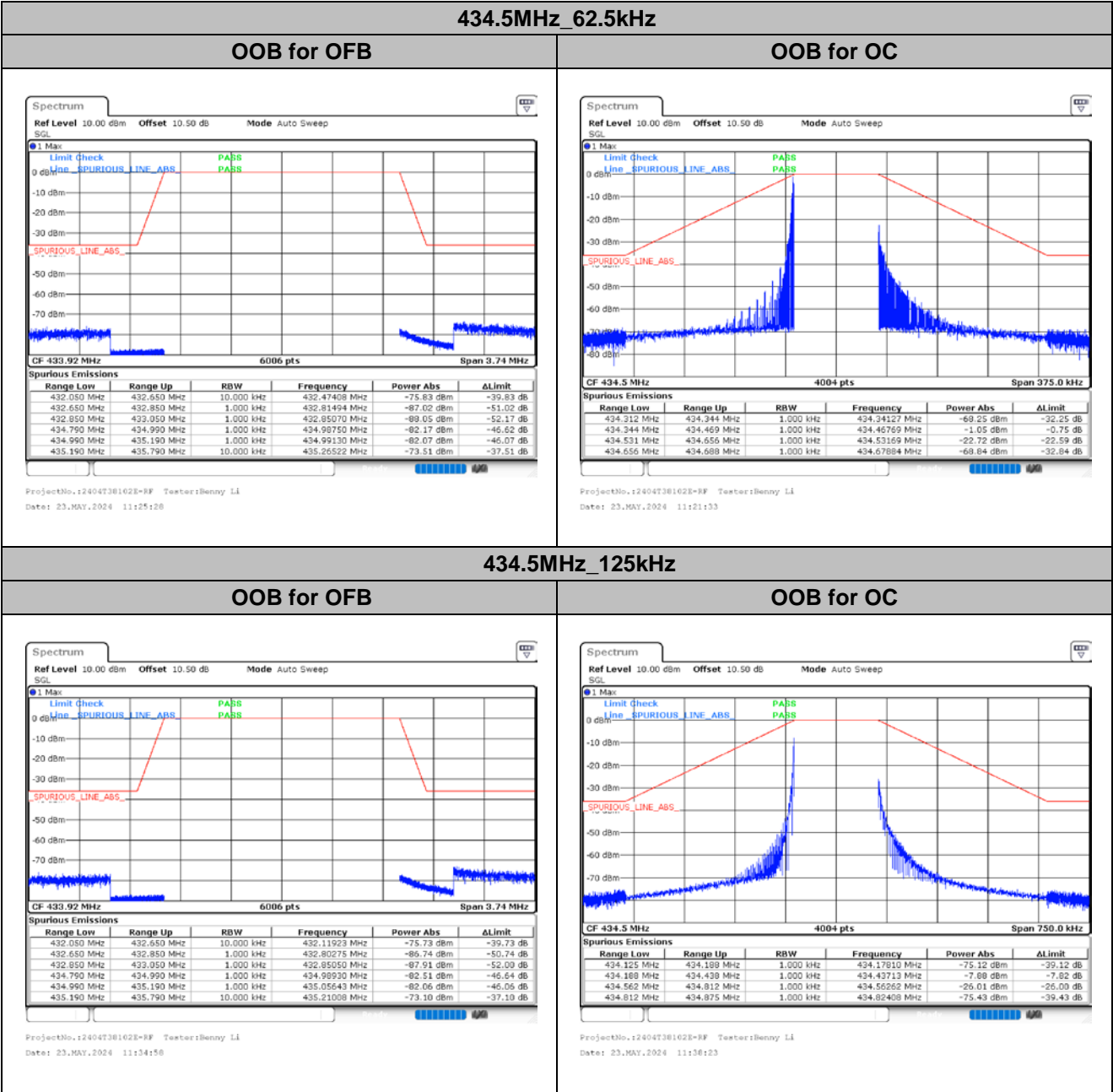
Test Condition					Result
Normal	L.V. L.T.	L.V. H.T.	H.V.L.T	H.V. H.T	Compliance

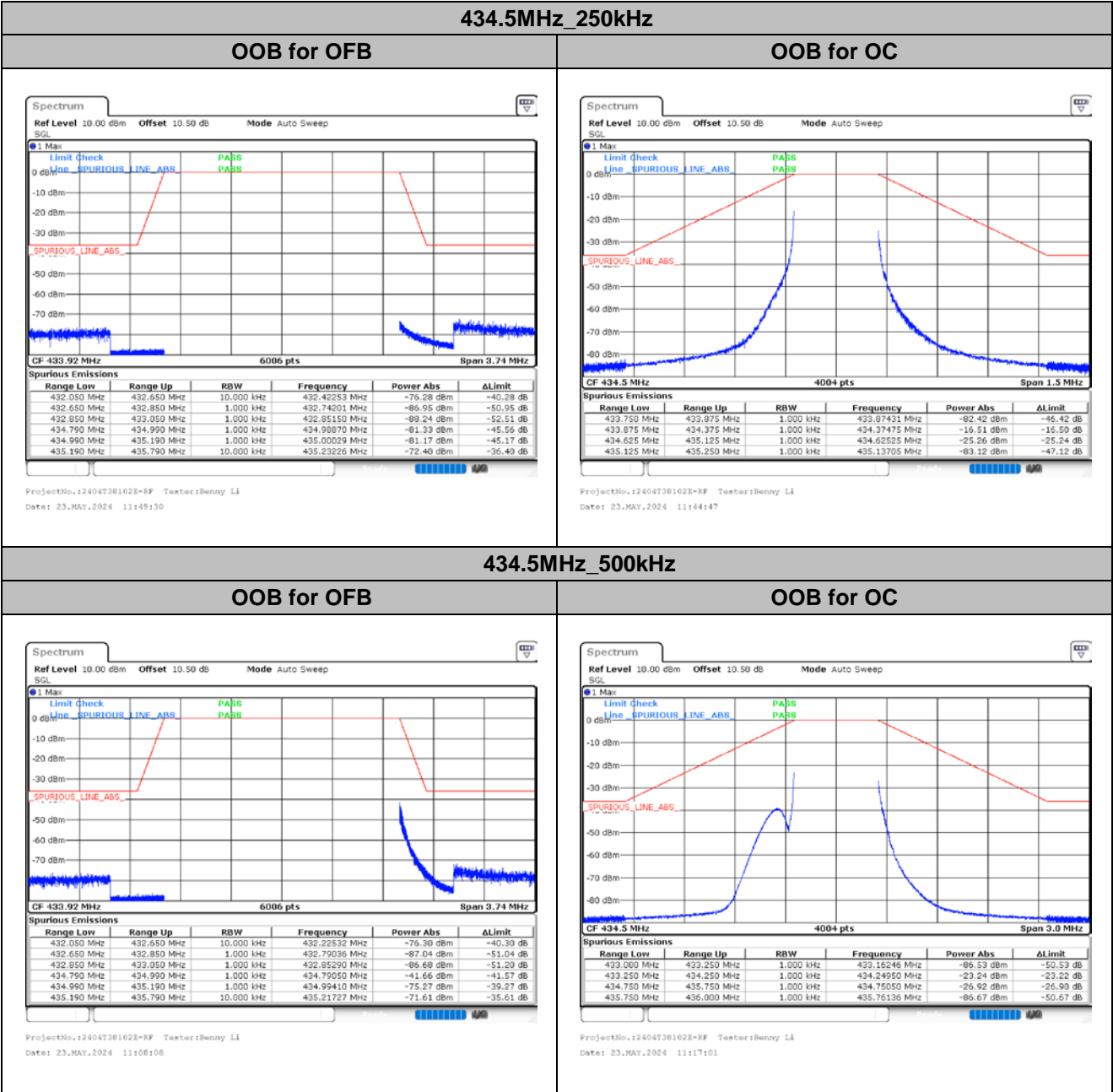
Test Result: Please refer to following Normal Condition data.

Test Graphs (Normal)









ETSI EN 300 220-2 V3.2.1 (2018-06) §4.3.6 - TRANSIENT POWER

Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.10:

Transmitter transient power is power falling into frequencies other than the operating channel as a result of the transmitter being switched on and off.

Limit: The transient power shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW _{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

Method of measurement

The output of the EUT shall be connected to a spectrum analyser or equivalent measuring equipment.

The measurement shall be undertaken in zero span mode. The analyser's centre frequency shall be set to an offset from the operating centre frequency. These offset values and their corresponding RBW configurations are listed in Table 24.

Table 24: RBW for Transient Measurement

Measurement points: offset from centre frequency	Analyser RBW	RBW _{REF}
-0,5 x OCW - 3 kHz 0,5 x OCW + 3 kHz Not applicable for OCW < 25 kHz	1 kHz	1kHz
±12,5 kHz or ±OCW whichever is the greater	Max (RBW pattern 1, 3, 10 kHz) ≤ Offset frequency/6 (see note)	1 kHz
-0,5 x OCW - 400 kHz 0,5 x OCW + 400 kHz	100 kHz	1 kHz
-0,5 x OCW -1 200 kHz 0,5 x OCW + 1 200 kHz	300 kHz	1 kHz
NOTE: Max (RBW pattern 1, 3, 10 kHz) means the maximum bandwidth that falls into the commonly implemented 1, 3, 10 kHz RBW filter bandwidth incremental pattern of spectrum analysers. EXAMPLE: If OCW is 25 kHz then the RBW value corresponding to one OCW offset frequency is 3 kHz. The rest of the analyser settings are listed in Table 25, and if OCW is 250 kHz then the RBW value corresponding to one OCW offset frequency is 30 kHz.		

The used modulation shall be D-M3. The analyser shall be set to the settings of Table 25 and a measurement shall be started for each offset frequency. The EUT shall transmit at least five D-M3 test signal. The peak value shall be recorded and the measurement shall be repeated at each offset frequency mentioned in Table 24.

The recorded power values shall be converted to power values measured in RBW_{REF} by the formula in clause 4.3.10.1.

Table 25: Parameters for Transient Measurement

Spectrum Analyser Setting	Value	Notes
VBW/RBW	10	At higher RBW values VBW may be clipped to its maximum value
Sweep time	500 ms	
RBW filter	Gaussian	
Trace Detector Function	RMS	
Trace Mode	Max hold	
Sweep points	501	
Measurement mode	Continuous sweep	
NOTE: The ratio between the number of sweep points and the sweep time shall be the same ratio as above if different number of sweep points is used.		

The used modulation shall be D-M3. The analyser shall be set to the settings of Table 25 and a measurement shall be started for each offset frequency. The EUT shall transmit at least five D-M3 test signal. The peak value shall be recorded and the measurement shall be repeated at each offset frequency mentioned in Table 24.

The recorded power values shall be converted to power values measured in RBWREF by the formula in clause 4.3.10.1.

When $RBW_{measured} > RBW_{REF}$ the result for broadband emissions should be normalized to the bandwidth Ratio according to the formula (2):

$$B = A + 10 \log \frac{RBW_{ref}}{RBW_{MEASURED}} \tag{2}$$

Where:

- A is the measured value at the wider measurement bandwidth $RBW_{measured}$;
- B is the corresponding value at RBW_{REF} .

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52 %
ATM Pressure:	100.6 kPa

The testing was performed by Benny Li on 2024-05-23.

EUT operation mode: Transmitting.

Test Result: Please refer to following data.

For 433.5MHz:

Operating channel width (kHz)	Item	Test Frequency Offset From Centre Frequency	Reading (dBm)	RBWref/ RBWmeas (kHz)	Correct Factor (dB)	Transient Power (dBm)	Limit (dBm)	Result
62.5	Offset *1	-0.5 x OCW-3kHz	-5.43	1/1	0	-5.43	0	PASS
	Offset *2	-OCW	-33.2	1/10	-10	-43.2	0	PASS
	Offset *3	-0.5 x OCW-400kHz	-59.8	1/100	-20	-79.8	-27	PASS
	Offset *4	-0.5 x OCW-1200kHz	-62.11	1/300	-24.8	-86.91	-27	PASS
	Offset *5	0.5 x OCW+3kHz	-19.82	1/1	0	-19.82	0	PASS
	Offset *6	OCW	-34.97	1/10	-10	-44.97	0	PASS
	Offset *7	0.5 x OCW + 400kHz	-60.12	1/100	-20	-80.12	-27	PASS
	Offset *8	0.5 x OCW + 1200kHz	-62.11	1/300	-24.8	-86.91	-27	PASS

Operating channel width (kHz)	Item	Test Frequency Offset From Centre Frequency	Reading (dBm)	RBWref/ RBWmeas (kHz)	Correct Factor (dB)	Transient Power (dBm)	Limit (dBm)	Result
125	Offset *1	-0.5 x OCW-3kHz	-6.73	1/1	0	-6.73	0	PASS
	Offset *2	-OCW	-40.3	1/10	-10	-50.3	0	PASS
	Offset *3	-0.5 x OCW-400kHz	-60.21	1/100	-20	-80.21	-27	PASS
	Offset *4	-0.5 x OCW-1200kHz	-62.07	1/300	-24.8	-86.87	-27	PASS
	Offset *5	0.5 x OCW+3kHz	-15.84	1/1	0	-15.84	0	PASS
	Offset *6	OCW	-41.53	1/10	-10	-51.53	0	PASS
	Offset *7	0.5 x OCW + 400kHz	-60.35	1/100	-20	-80.35	-27	PASS
	Offset *8	0.5 x OCW + 1200kHz	-62.23	1/300	-24.8	-87.03	-27	PASS

Operating channel width (kHz)	Item	Test Frequency Offset From Centre Frequency	Reading (dBm)	RBWref/ RBWmeas (kHz)	Correct Factor (dB)	Transient Power (dBm)	Limit (dBm)	Result
250	Offset *1	-0.5 x OCW-3kHz	-8.42	1/1	0	-8.42	0	PASS
	Offset *2	-OCW	-40.93	1/30	-14.77	-55.7	0	PASS
	Offset *3	-0.5 x OCW-400kHz	-60.35	1/100	-20	-80.35	-27	PASS
	Offset *4	-0.5 x OCW-1200kHz	-62.23	1/300	-24.8	-87.03	-27	PASS
	Offset *5	0.5 x OCW+3kHz	-15.89	1/1	0	-15.89	0	PASS
	Offset *6	OCW	-44.17	1/30	-14.77	-58.94	0	PASS
	Offset *7	0.5 x OCW + 400kHz	-60.10	1/100	-20	-80.1	-27	PASS
	Offset *8	0.5 x OCW + 1200kHz	-62.18	1/300	-24.8	-86.98	-27	PASS

Operating channel width (kHz)	Item	Test Frequency Offset From Centre Frequency	Reading (dBm)	RBWref/ RBWmeas (kHz)	Correct Factor (dB)	Transient Power (dBm)	Limit (dBm)	Result
500	Offset *1	-0.5 x OCW-3kHz	-14.44	1/1	0	-14.44	0	PASS
	Offset *2	-OCW	-32.26	1/30	-14.77	-47.03	-27	PASS
	Offset *3	-0.5 x OCW-400kHz	-48.99	1/100	-20	-68.99	-27	PASS
	Offset *4	-0.5 x OCW-1200kHz	-62.12	1/300	-24.8	-86.92	-27	PASS
	Offset *5	0.5 x OCW+3kHz	-16.63	1/1	0	-16.63	0	PASS
	Offset *6	OCW	-53.24	1/30	-14.77	-68.01	-27	PASS
	Offset *7	0.5 x OCW + 400kHz	-57.77	1/100	-20	-77.77	-27	PASS
	Offset *8	0.5 x OCW + 1200kHz	-62.41	1/300	-24.8	-87.21	-27	PASS

For 434.5MHz:

Operating channel width (kHz)	Item	Test Frequency Offset From Centre Frequency	Reading (dBm)	RBWref/ RBWmeas (kHz)	Correct Factor (dB)	Transient Power (dBm)	Limit (dBm)	Result
62.5	Offset *1	-0.5 x OCW-3kHz	-5.37	1/1	0	-5.37	0	PASS
	Offset *2	-OCW	-33.11	1/10	-10	-43.11	0	PASS
	Offset *3	-0.5 x OCW-400kHz	-60.22	1/100	-20	-80.22	-27	PASS
	Offset *4	-0.5 x OCW-1200kHz	-61.91	1/300	-24.8	-86.71	-27	PASS
	Offset *5	0.5 x OCW+3kHz	-19.77	1/1	0	-19.77	0	PASS
	Offset *6	OCW	-35.04	1/10	-10	-45.04	0	PASS
	Offset *7	0.5 x OCW + 400kHz	-60.03	1/100	-20	-80.03	-27	PASS
	Offset *8	0.5 x OCW + 1200kHz	-62.14	1/300	-24.8	-86.94	-27	PASS

Operating channel width (kHz)	Item	Test Frequency Offset From Centre Frequency	Reading (dBm)	RBWref/ RBWmeas (kHz)	Correct Factor (dB)	Transient Power (dBm)	Limit (dBm)	Result
125	Offset *1	-0.5 x OCW-3kHz	-6.79	1/1	0	-6.79	0	PASS
	Offset *2	-OCW	-40.15	1/10	-10	-50.15	0	PASS
	Offset *3	-0.5 x OCW-400kHz	-60.27	1/100	-20	-80.27	-27	PASS
	Offset *4	-0.5 x OCW-1200kHz	-62.16	1/300	-24.8	-86.96	-27	PASS
	Offset *5	0.5 x OCW+3kHz	-15.6	1/1	0	-15.6	0	PASS
	Offset *6	OCW	-41.5	1/10	-10	-51.5	0	PASS
	Offset *7	0.5 x OCW + 400kHz	-60.33	1/100	-20	-80.33	-27	PASS
	Offset *8	0.5 x OCW + 1200kHz	-62.21	1/300	-24.8	-87.01	-27	PASS

Operating channel width (kHz)	Item	Test Frequency Offset From Centre Frequency	Reading (dBm)	RBWref/ RBWmeas (kHz)	Correct Factor (dB)	Transient Power (dBm)	Limit (dBm)	Result
250	Offset *1	-0.5 x OCW-3kHz	-8.78	1/1	0	-8.78	0	PASS
	Offset *2	-OCW	-40.98	1/30	-14.77	-55.75	0	PASS
	Offset *3	-0.5 x OCW-400kHz	-60.25	1/100	-20	-80.25	-27	PASS
	Offset *4	-0.5 x OCW-1200kHz	-62.28	1/300	-24.8	-87.08	-27	PASS
	Offset *5	0.5 x OCW+3kHz	-15.79	1/1	0	-15.79	0	PASS
	Offset *6	OCW	-44.06	1/30	-14.77	-58.83	0	PASS
	Offset *7	0.5 x OCW + 400kHz	-60.27	1/100	-20	-80.27	-27	PASS
	Offset *8	0.5 x OCW + 1200kHz	-62.22	1/300	-24.8	-87.02	-27	PASS

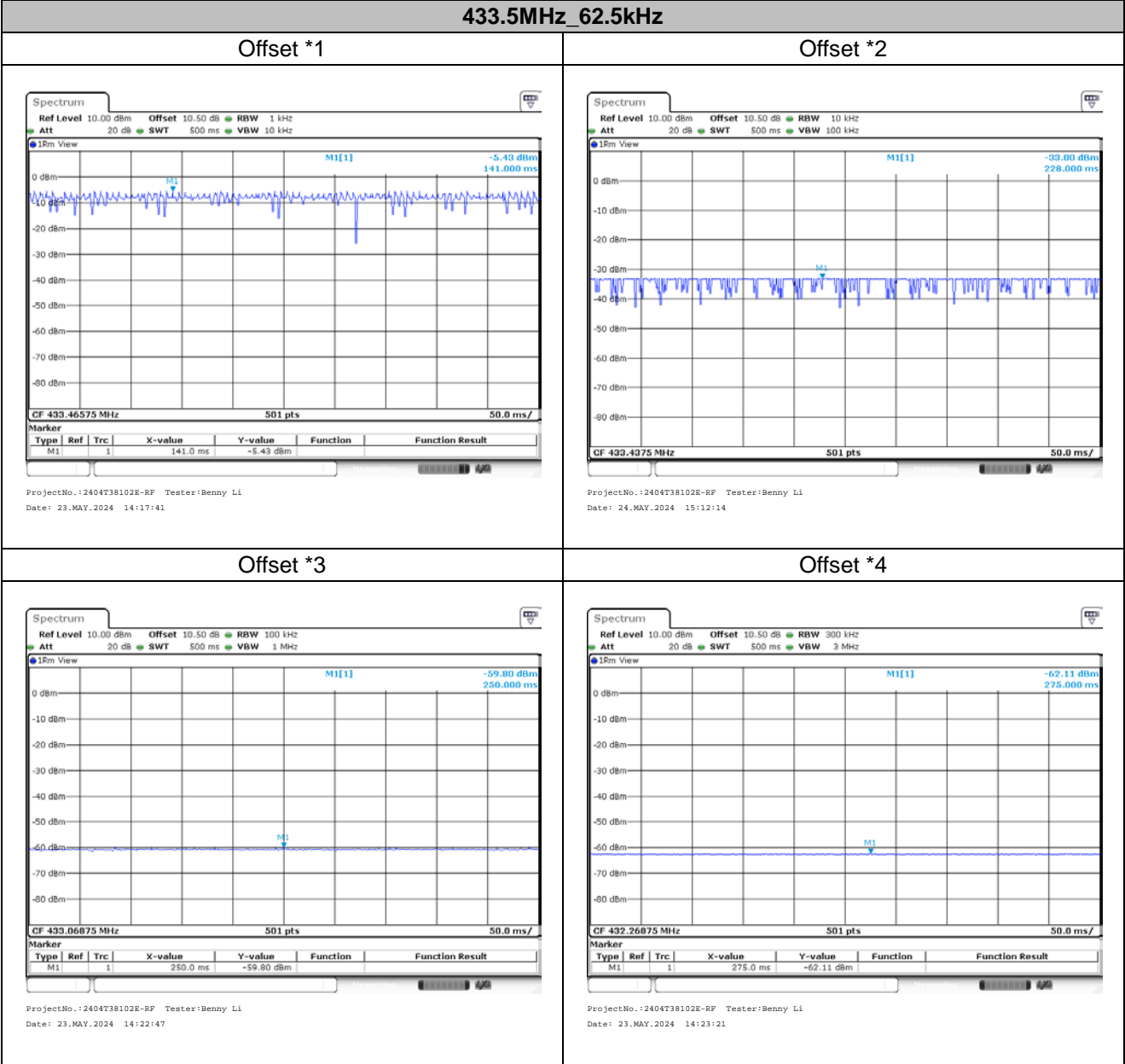
Operating channel width (kHz)	Item	Test Frequency Offset From Centre Frequency	Reading (dBm)	RBWref/ RBWmeas (kHz)	Correct Factor (dB)	Transient Power (dBm)	Limit (dBm)	Result
500	Offset *1	-0.5 x OCW-3kHz	-14.41	1/1	0	-14.41	0	PASS
	Offset *2	-OCW	-32.52	1/30	-14.77	-47.29	-27	PASS
	Offset *3	-0.5 x OCW-400kHz	-49.14	1/100	-20	-69.14	-27	PASS
	Offset *4	-0.5 x OCW-1200kHz	-62.27	1/300	-24.8	-87.07	-27	PASS
	Offset *5	0.5 x OCW+3kHz	-16.66	1/1	0	-16.66	0	PASS
	Offset *6	OCW	-53.34	1/30	-14.77	-68.11	-27	PASS
	Offset *7	0.5 x OCW + 400kHz	-57.92	1/100	-20	-77.92	-27	PASS
	Offset *8	0.5 x OCW + 1200kHz	-62.13	1/300	-24.8	-86.93	-27	PASS

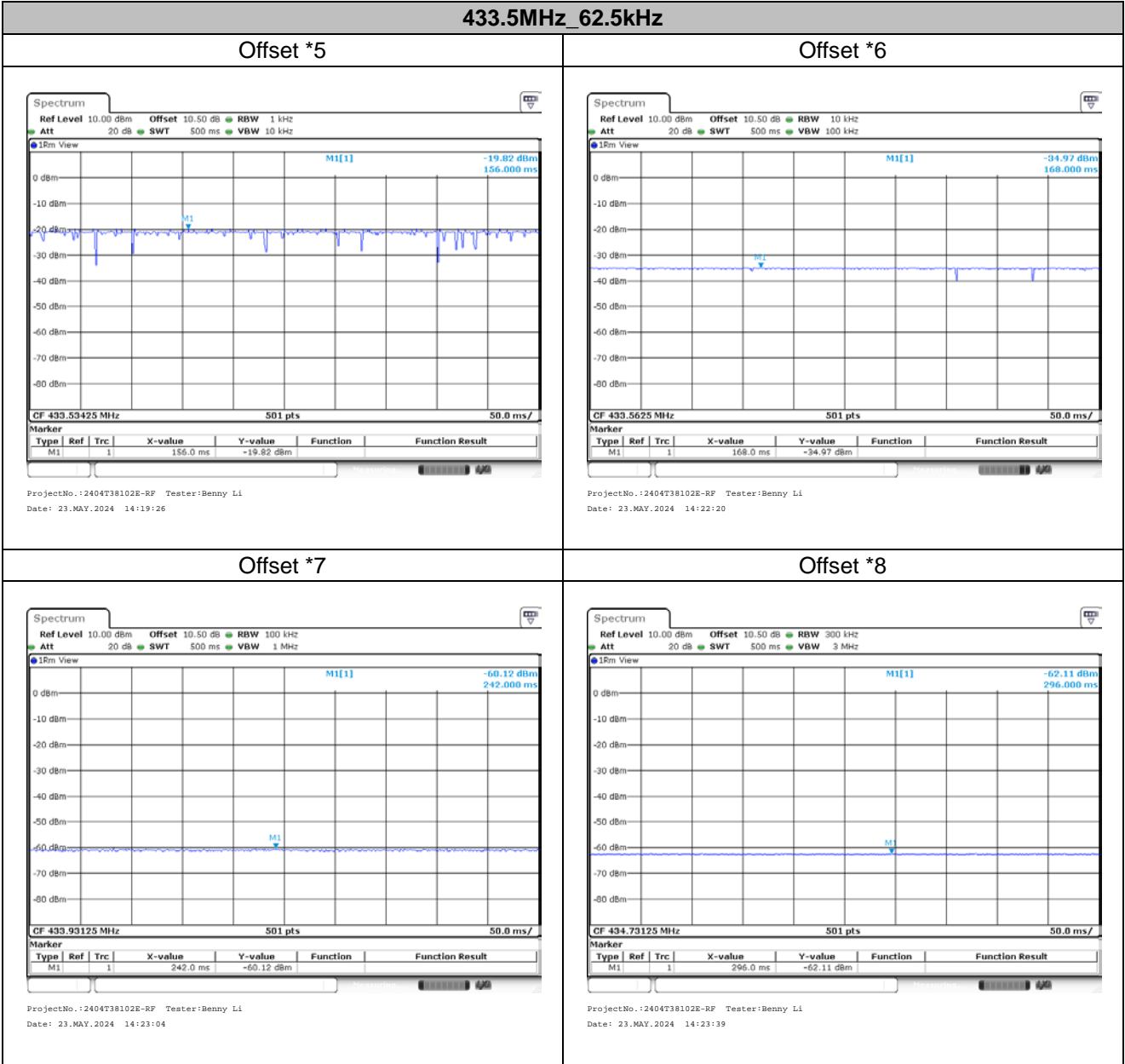
Note 1: Correct factor= $10 \cdot \log(\text{RBWref}/\text{RBWmeas})$

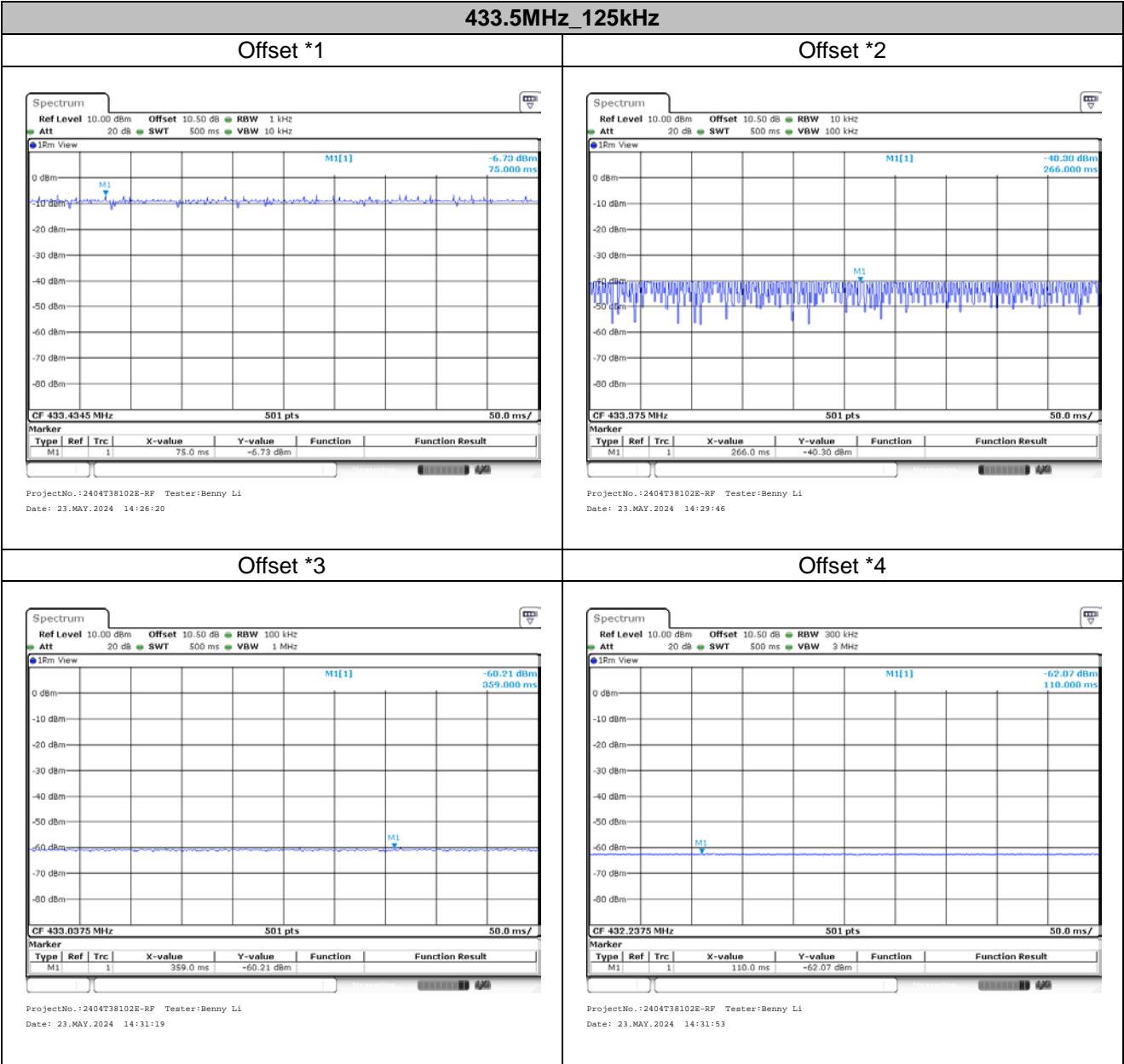
Note 2: Transient power=Reading + Correct factor

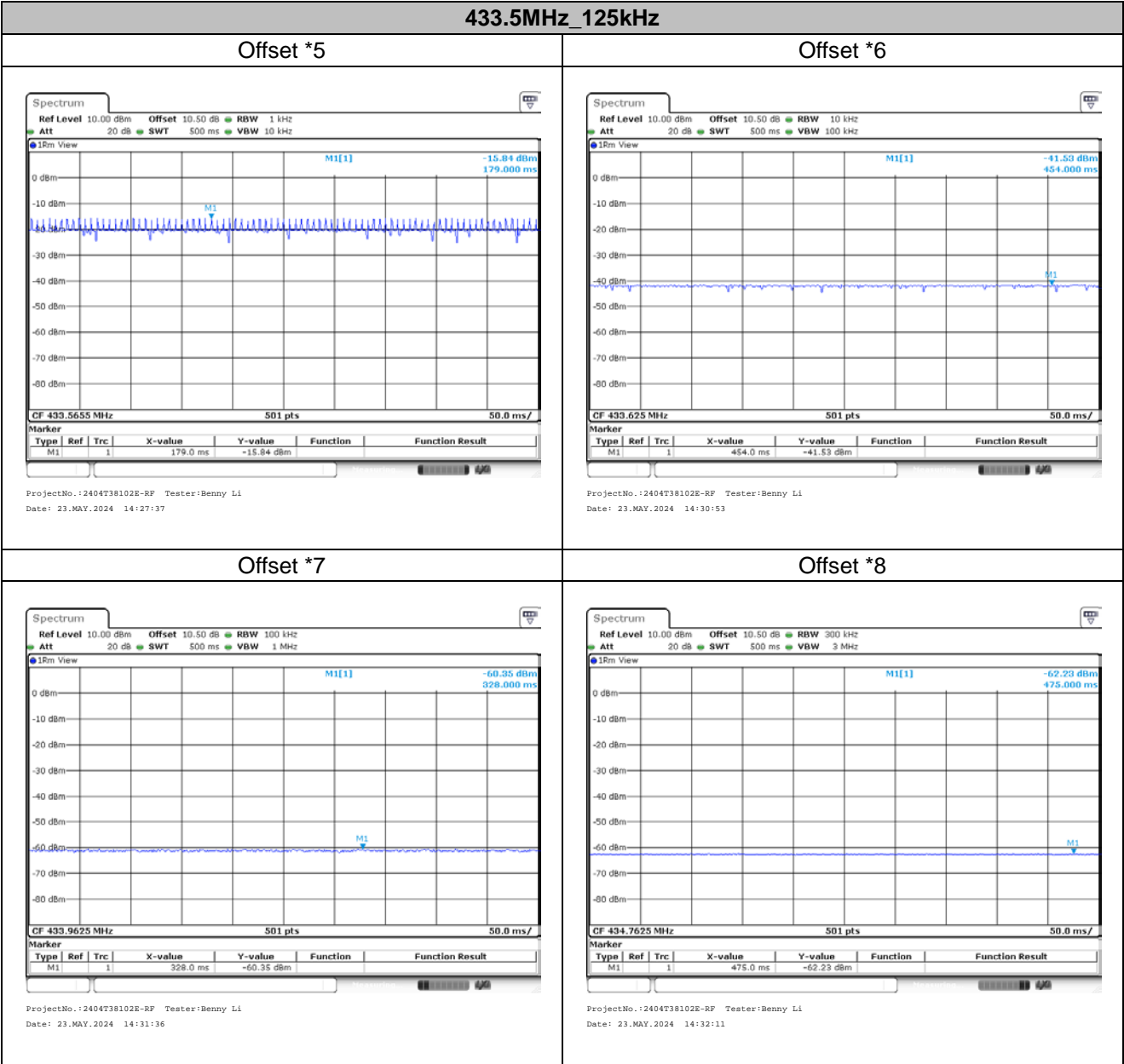
Note 3: Test with conducted method.

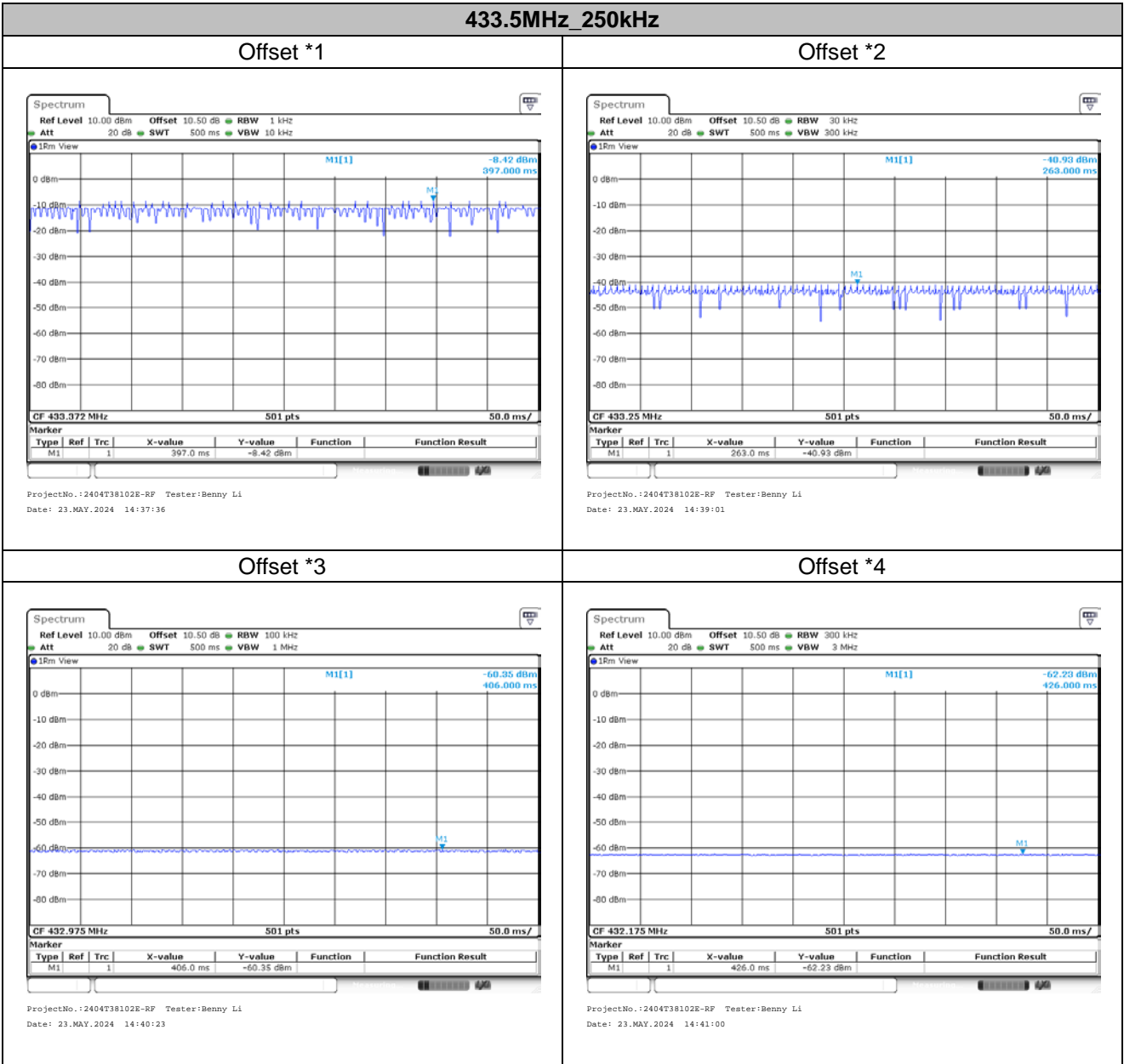
Test Graphs

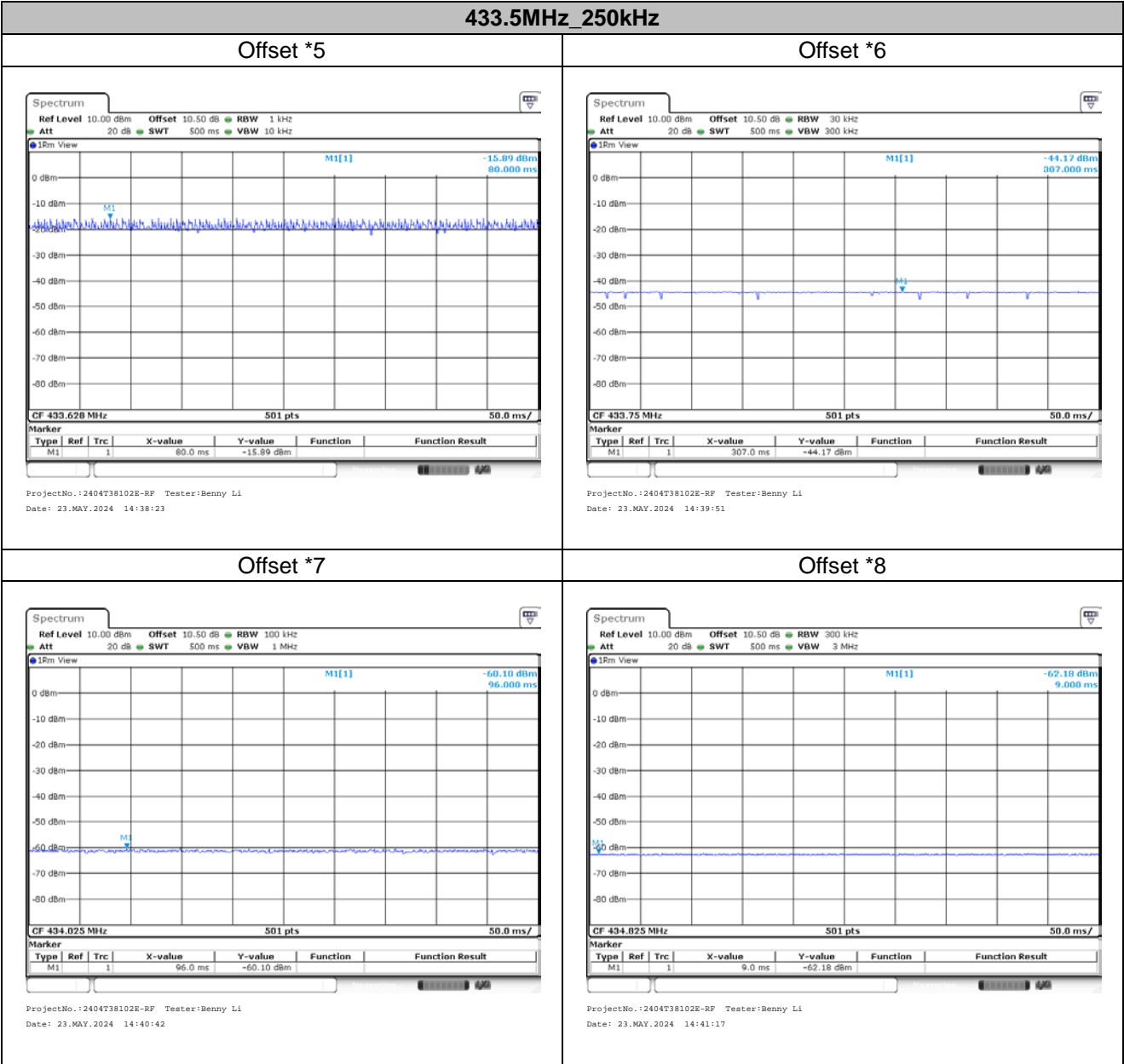


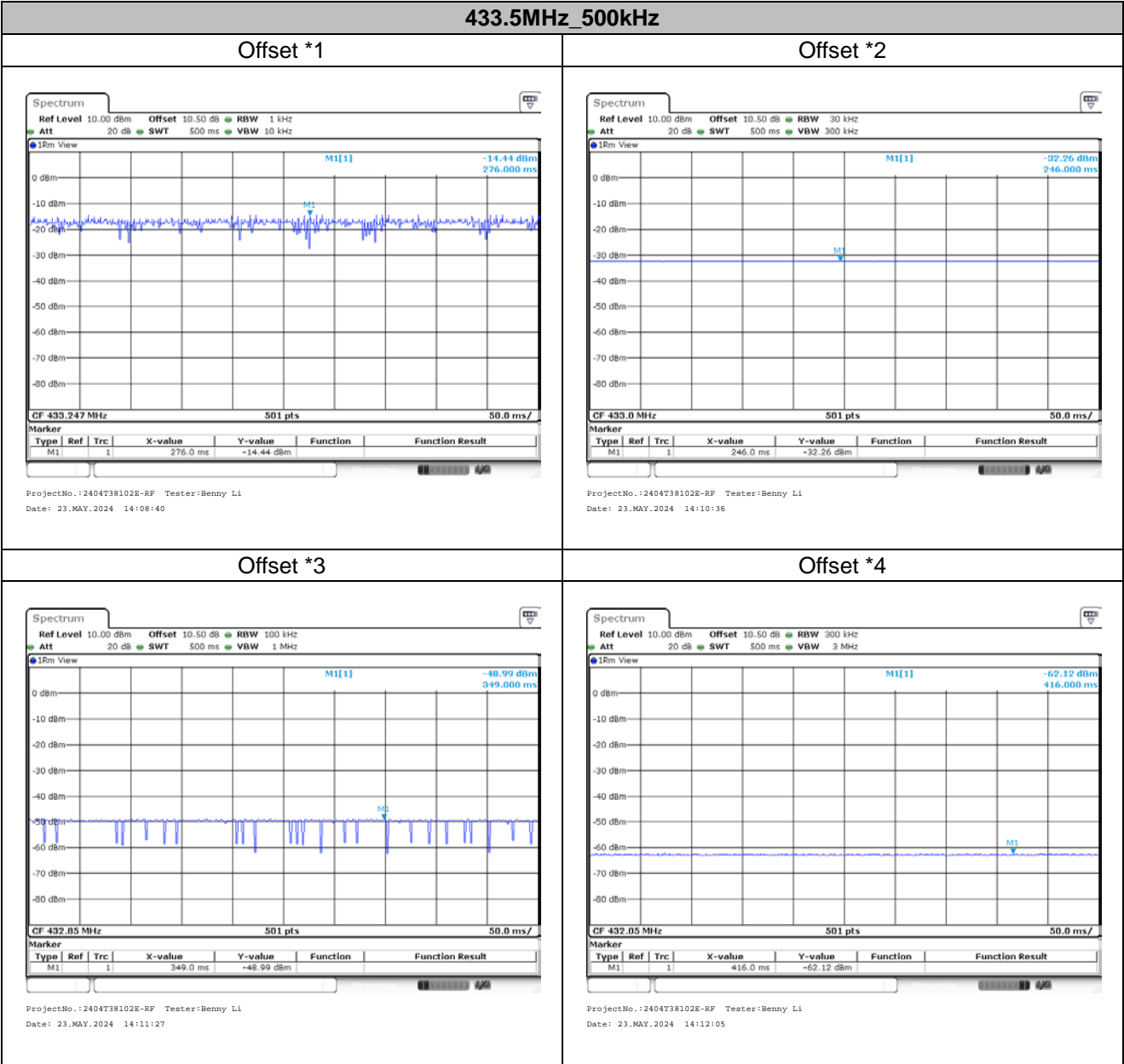




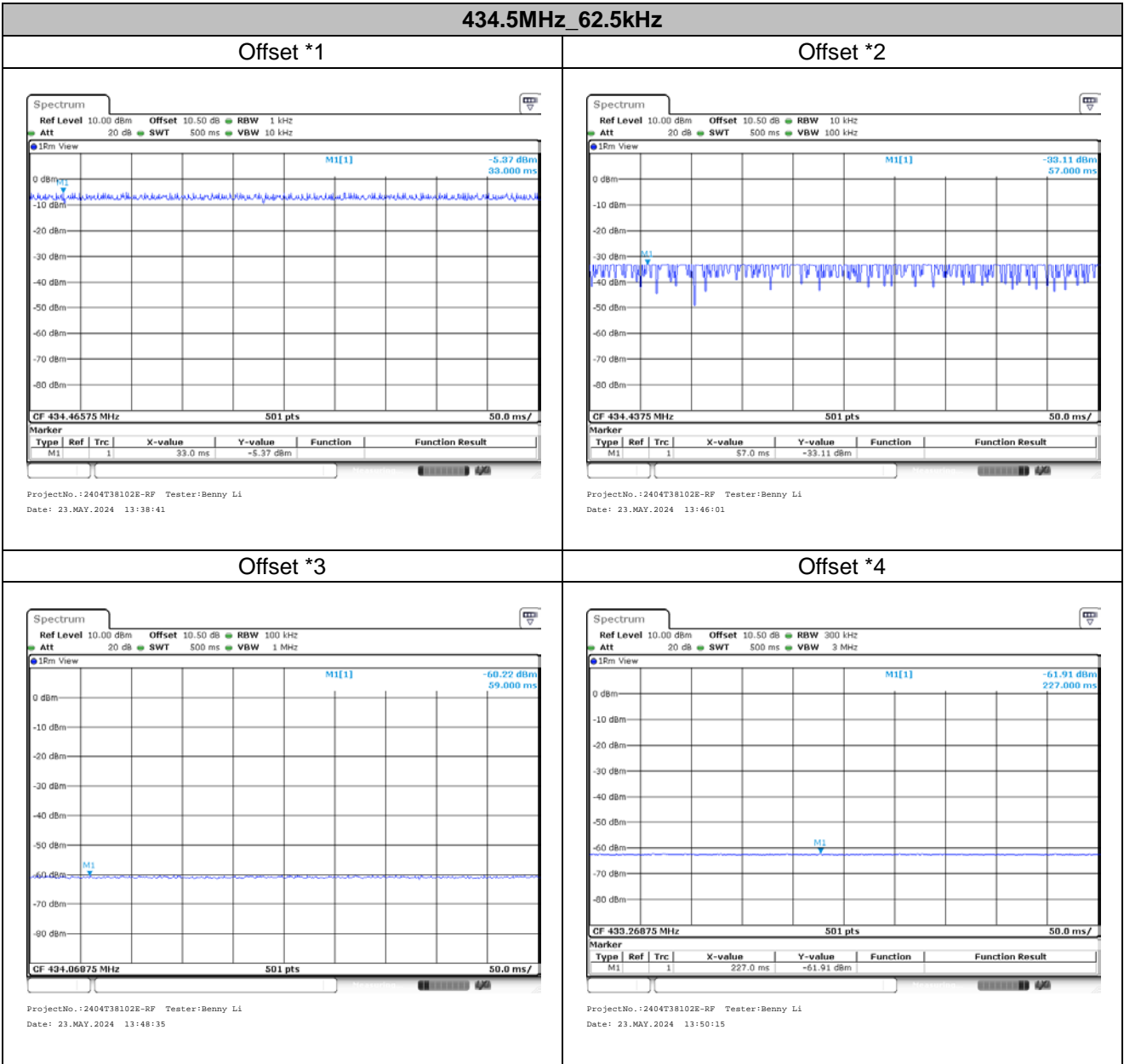


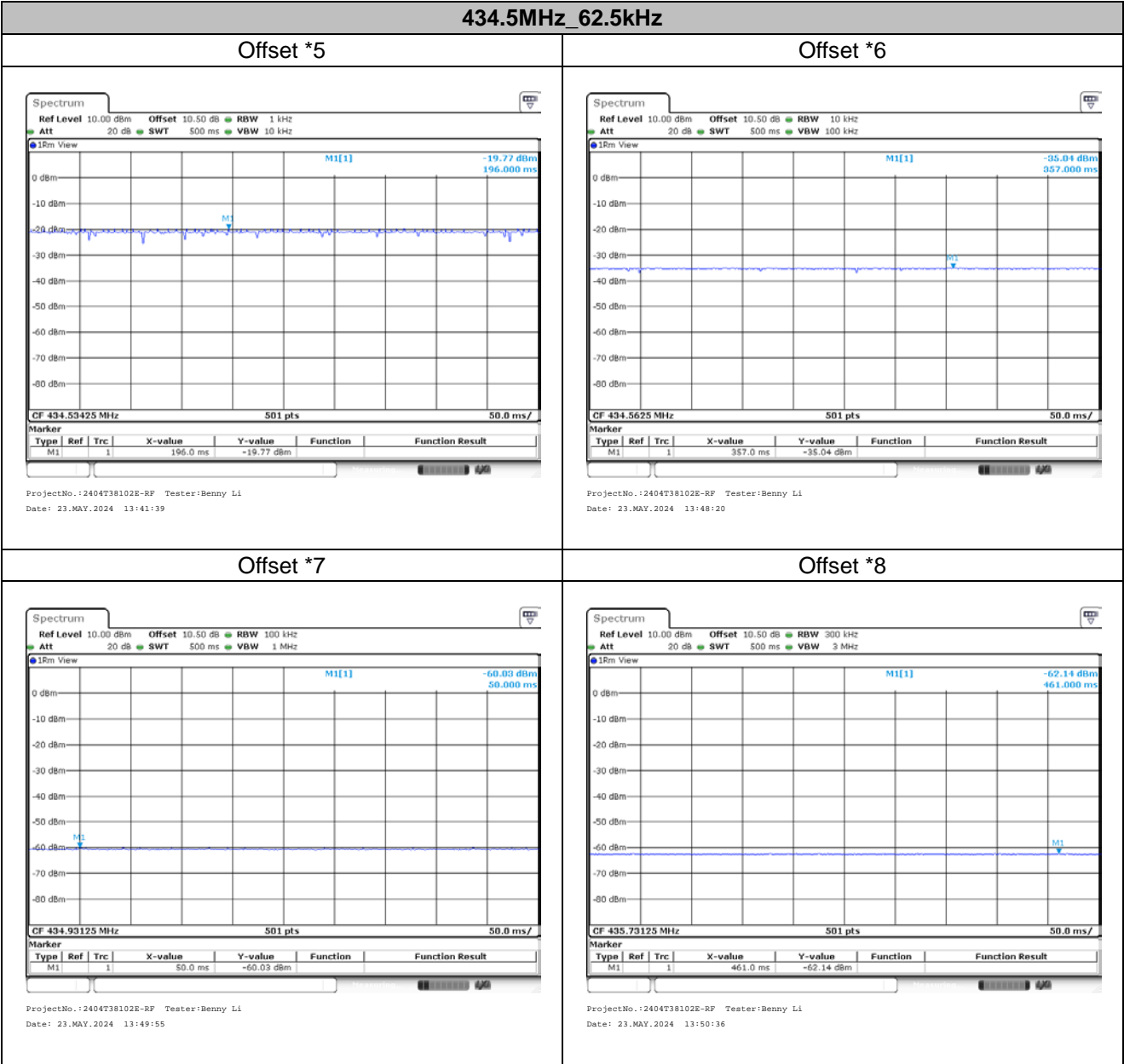


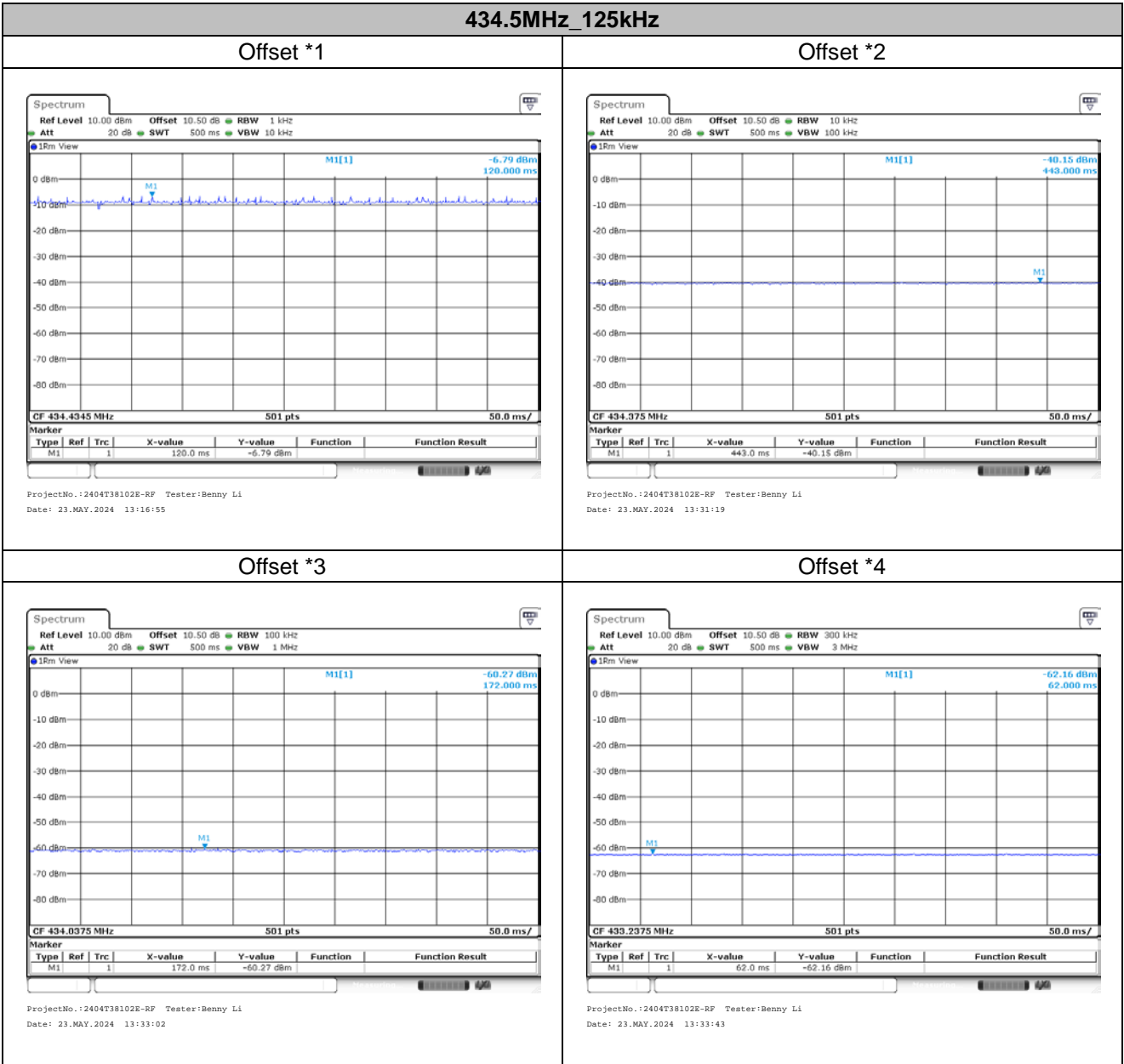


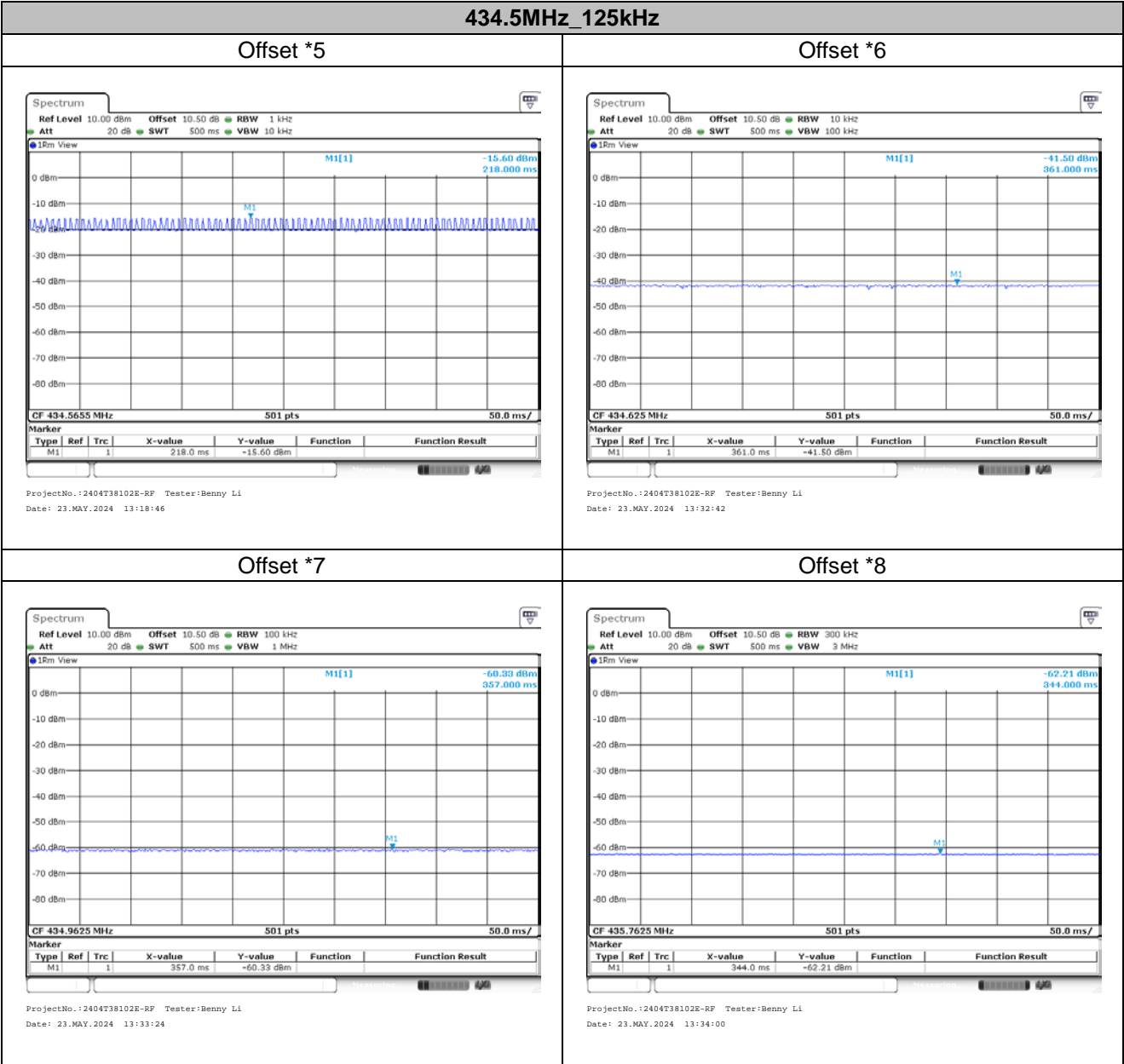


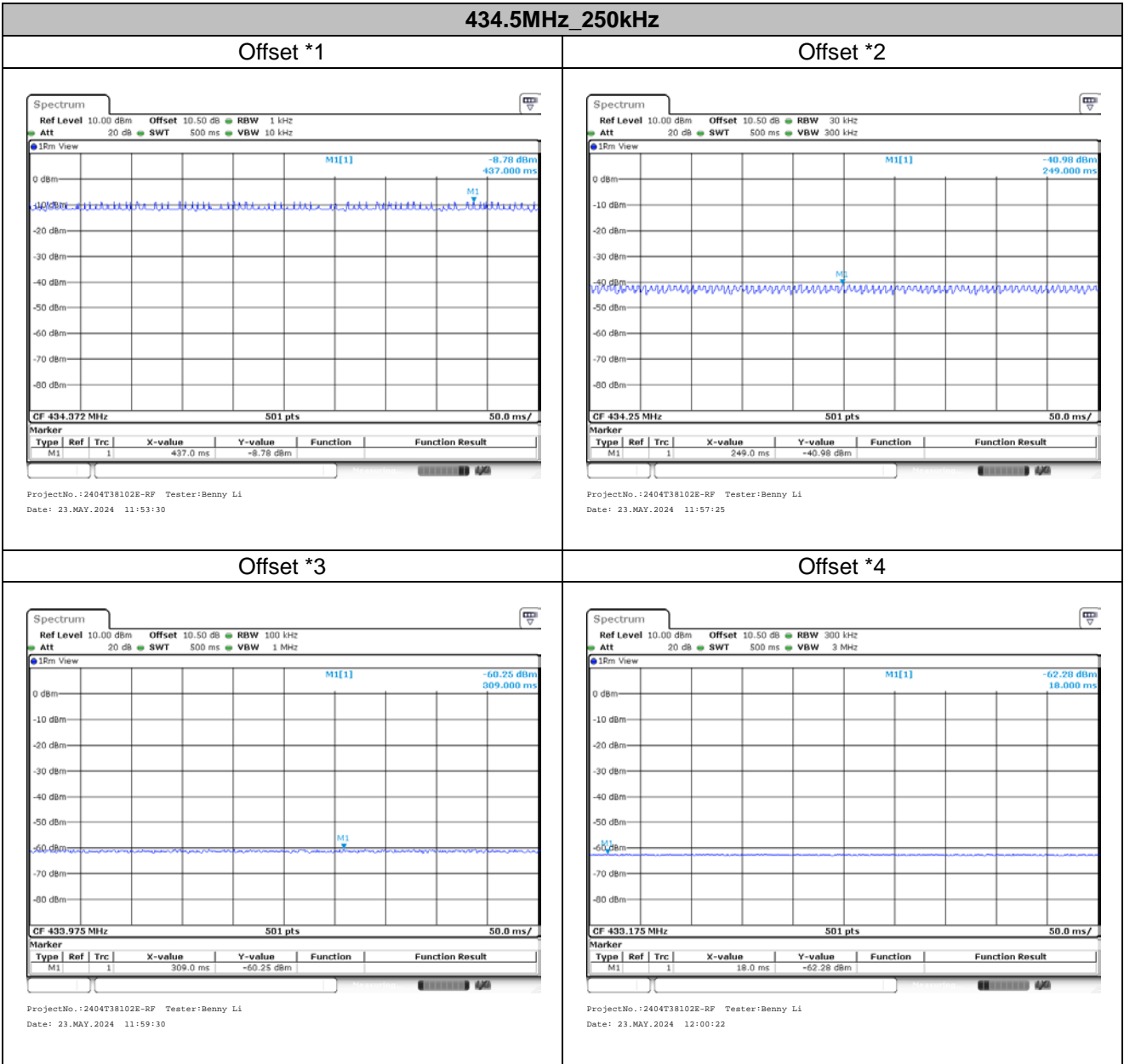






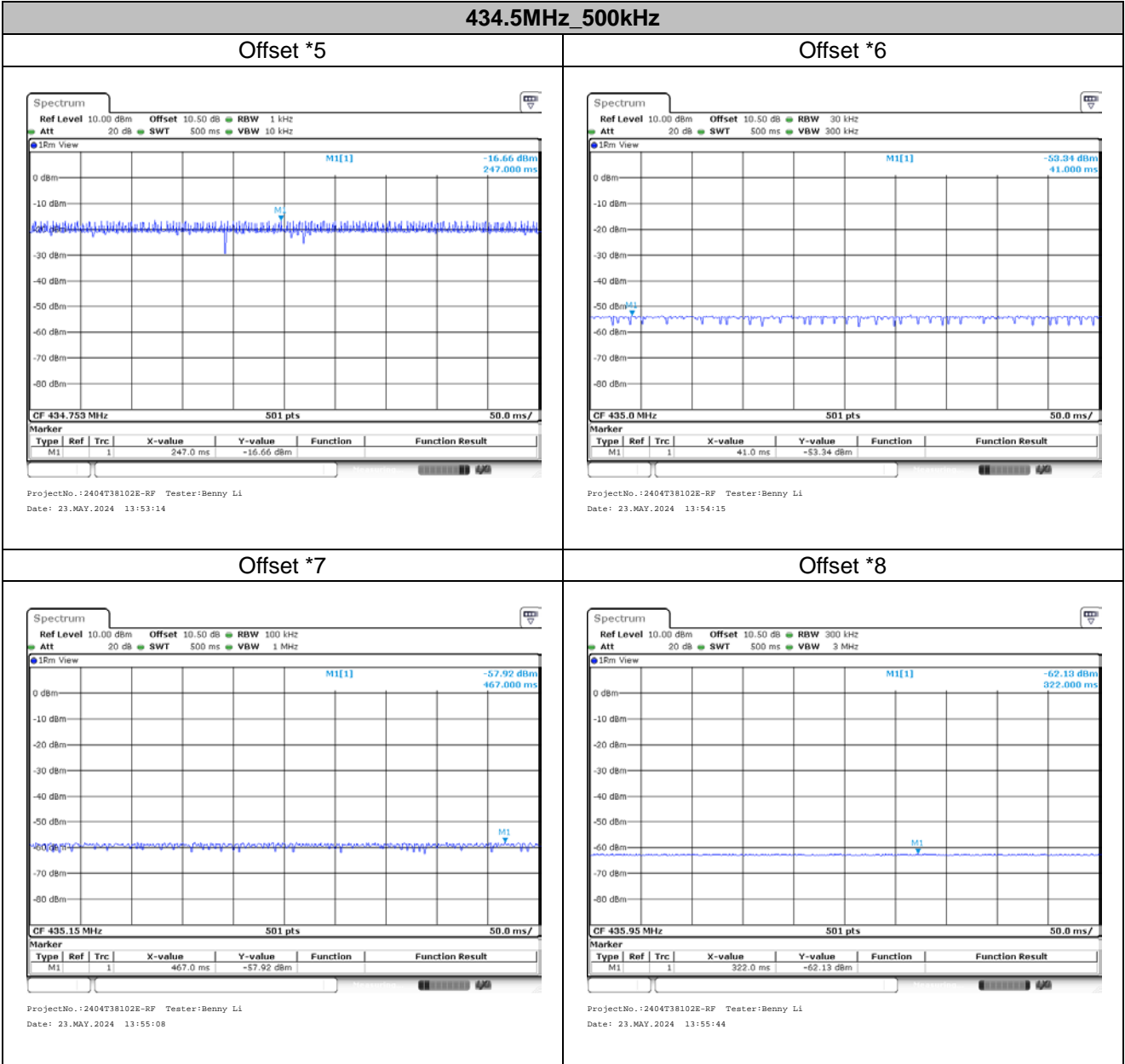












ETSI EN 300 220-2 V3.2.1 (2018-06) §4.3.8 - TX BEHAVIOUR LOW VOLTAGE CONDITIONS

Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.12:

The TX behaviour under low voltage condition is the ability of the equipment to maintain its operating frequency and not produce emissions which exceed any relevant limit when the battery voltage falls below the lower extreme voltage level.

Limit

The equipment shall either:

- a) remain in the Operating Channel OC without exceeding any applicable limits (e.g. Duty Cycle); or
 - b) reduce its effective radiated power below the Spurious Emission limits without exceeding any applicable limits(e.g. Duty Cycle); or
 - c) shut down, (ceasing function);
- as the voltage falls below the manufacturers declared operating voltage.

Method of measurement

Step 1:

Operation of the EUT shall be started, on Operating Frequency as declared by the manufacturer, with the appropriate test signal and with the EUT operating at nominal operating voltage.
The centre frequency of the transmitted signal shall be measured and noted.

Step 2:

The operating voltage shall be reduced by appropriate steps until the voltage reaches zero.
The centre frequency of the transmitted signal shall be measured and noted.
Any abnormal behaviour shall be noted.

Test Data

Environmental Conditions

Temperature:	24 °C
Relative Humidity:	51 %
ATM Pressure:	100.6 kPa

The testing was performed by Benny Li on 2024-05-24.

EUT operation mode: Transmitting.

Test Result: Please refer to following data.

Nominal Frequency: 433.5MHz, OCW=62.5kHz				
Temperature & Humidity (°C & %)	Voltage (V _{DC})	Frequency of Lower point (MHz)	Frequency of Upper point (MHz)	Result (Note)
24°C & 51%	3.3	433.466467	433.528743	Within Operating frequency band and without exceeding any applicable limits
	3.0	433.4672103	433.529715	Within Operating frequency band and without exceeding any applicable limits
	2.5	433.4671729	433.5296963	Within Operating frequency band and without exceeding any applicable limits
	2.0	433.4672853	433.5297525	Within Operating frequency band and without exceeding any applicable limits
	1.9	433.4672103	433.52979	Within Operating frequency band and without exceeding any applicable limits
	1.8	433.4672478	433.5298275	Within Operating frequency band and without exceeding any applicable limits
	1.7	/	/	Shut down

Nominal Frequency: 434.5MHz, OCW=62.5kHz				
Temperature & Humidity (°C & %)	Voltage (V _{DC})	Frequency of Lower point (MHz)	Frequency of Upper point (MHz)	Result (Note)
24°C & 51%	3.3	434.466467	434.528743	Within Operating frequency band and without exceeding any applicable limits
	3.0	434.4669854	434.5295276	Within Operating frequency band and without exceeding any applicable limits
	2.5	434.4670041	434.5295651	Within Operating frequency band and without exceeding any applicable limits
	2.0	434.4670791	434.5296025	Within Operating frequency band and without exceeding any applicable limits
	1.9	434.4671916	434.5297338	Within Operating frequency band and without exceeding any applicable limits
	1.8	434.4671354	434.529715	Within Operating frequency band and without exceeding any applicable limits
	1.7	/	/	Shut down

Nominal Frequency: 433.5MHz, OCW=125kHz				
Temperature & Humidity (°C & %)	Voltage (V _{DC})	Frequency of Lower point (MHz)	Frequency of Upper point (MHz)	Result (Note)
24°C & 51%	3.3	433.435629	433.560379	Within Operating frequency band and without exceeding any applicable limits
	3.0	433.4348831	433.5617735	Within Operating frequency band and without exceeding any applicable limits
	2.5	433.4349456	433.5618048	Within Operating frequency band and without exceeding any applicable limits
	2.0	433.4351331	433.5619298	Within Operating frequency band and without exceeding any applicable limits
	1.9	433.4349769	433.5619923	Within Operating frequency band and without exceeding any applicable limits
	1.8	433.4349144	433.5621172	Within Operating frequency band and without exceeding any applicable limits
	1.7	/	/	Shut down

Nominal Frequency: 434.5MHz, OCW=125kHz				
Temperature & Humidity (°C & %)	Voltage (V _{DC})	Frequency of Lower point (MHz)	Frequency of Upper point (MHz)	Result (Note)
24°C & 51%	3.3	434.43513	434.55988	Within Operating frequency band and without exceeding any applicable limits
	3.0	434.4351331	434.5620922	Within Operating frequency band and without exceeding any applicable limits
	2.5	434.4352081	434.5620172	Within Operating frequency band and without exceeding any applicable limits
	2.0	434.4350956	434.5618673	Within Operating frequency band and without exceeding any applicable limits
	1.9	434.4350206	434.5619423	Within Operating frequency band and without exceeding any applicable limits
	1.8	434.4351706	434.5619423	Within Operating frequency band and without exceeding any applicable limits
	1.7	/	/	Shut down

Nominal Frequency: 433.5MHz, OCW=250kHz				
Temperature & Humidity (°C & %)	Voltage (V _{DC})	Frequency of Lower point (MHz)	Frequency of Upper point (MHz)	Result (Note)
24°C & 51%	3.3	433.373372	433.62301	Within Operating frequency band and without exceeding any applicable limits
	3.0	433.3736408	433.6229221	Within Operating frequency band and without exceeding any applicable limits
	2.5	433.3738283	433.6227972	Within Operating frequency band and without exceeding any applicable limits
	2.0	433.3738908	433.6231096	Within Operating frequency band and without exceeding any applicable limits
	1.9	433.3740157	433.6227347	Within Operating frequency band and without exceeding any applicable limits
	1.8	433.3740782	433.6227972	Within Operating frequency band and without exceeding any applicable limits
	1.7	/	/	Shut down

Nominal Frequency: 434.5MHz, OCW=250kHz				
Temperature & Humidity (°C & %)	Voltage (V _{DC})	Frequency of Lower point (MHz)	Frequency of Upper point (MHz)	Result (Note)
24°C & 51%	3.3	434.373372	434.62301	Within Operating frequency band and without exceeding any applicable limits
	3.0	434.3739533	434.6229221	Within Operating frequency band and without exceeding any applicable limits
	2.5	434.3738283	434.6229221	Within Operating frequency band and without exceeding any applicable limits
	2.0	434.3735158	434.6231096	Within Operating frequency band and without exceeding any applicable limits
	1.9	434.3740157	434.6229221	Within Operating frequency band and without exceeding any applicable limits
	1.8	434.3740157	434.6226722	Within Operating frequency band and without exceeding any applicable limits
	1.7	/	/	Shut down

Nominal Frequency: 433.5MHz, OCW=500kHz				
Temperature & Humidity (°C & %)	Voltage (V _{DC})	Frequency of Lower point (MHz)	Frequency of Upper point (MHz)	Result (Note)
24°C & 51%	3.3	433.2485	433.7475	Within Operating frequency band and without exceeding any applicable limits
	3.0	433.249281	433.748844	Within Operating frequency band and without exceeding any applicable limits
	2.5	433.249406	433.747969	Within Operating frequency band and without exceeding any applicable limits
	2.0	433.249281	433.746969	Within Operating frequency band and without exceeding any applicable limits
	1.9	433.249406	433.749094	Within Operating frequency band and without exceeding any applicable limits
	1.8	433.249531	433.748719	Within Operating frequency band and without exceeding any applicable limits
	1.7	/	/	Shut down

Nominal Frequency: 434.5MHz, OCW=500kHz				
Temperature & Humidity (°C & %)	Voltage (V _{DC})	Frequency of Lower point (MHz)	Frequency of Upper point (MHz)	Result (Note)
24°C & 51%	3.3	434.2485	434.7475	Within Operating frequency band and without exceeding any applicable limits
	3.0	434.250531	434.748969	Within Operating frequency band and without exceeding any applicable limits
	2.5	434.249531	434.749344	Within Operating frequency band and without exceeding any applicable limits
	2.0	434.250031	434.746719	Within Operating frequency band and without exceeding any applicable limits
	1.9	434.249781	434.749719	Within Operating frequency band and without exceeding any applicable limits
	1.8	434.249156	434.748344	Within Operating frequency band and without exceeding any applicable limits
	1.7	/	/	Shut down

ETSI EN 300 220-2 V3.2.1 (2018-06) §4.4.2 - BLOCKING

Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.18.1.

Limit: The blocking level shall be better or equal to category 3 reference limits level defined in ETSI EN 300 220-1 [1], clause 5.18.2.

NOTE: After December 31st, 2018, the receiver category 3 will be withdrawn, therefore receiver category 2 will be the minimum applicable level.

Method of measurement

Signal generator A shall be set to an appropriate modulated test signal at the operating frequency of the EUT receiver.

Signal generator B shall be unmodulated.

Measurements shall be carried out at frequencies of the unwanted signal at approximately the frequency(ies) offset(s) defined in technical requirement avoiding those frequencies at which spurious responses occur. Additional measurement points may be requested by technical requirements clause.

If several operational frequency bands are used by the equipment, at least one blocking measurement by bands has to be performed.

Step 1: Signal generator B shall be powered off. Signal generator A shall be set to the minimum level which gives the wanted performance criterion of EUT or the reference level in Table 32, whichever is the higher. The output level of generator A shall then be increased by 3 dB unless otherwise specified in technical requirement.

Step 2: Signal generator B is powered on and set to operate at the nominal operating frequency - offset frequency.

Signal generator B is then switched on and the signal amplitude is adjusted to the minimum level at which the wanted performance criterion is not achieved.

With signal generator B settings unchanged, the receiver shall be replaced with a suitable RF power measuring equipment. The power into the measuring equipment shall be measured and noted.

The blocking level is then the conducted power received from generator B at the EUT antenna connector.

This can either be measured on the antenna connector for conducted test or be calculated for radiated test (see clause C.5.4).

The blocking level shall be higher or equal to the blocking power level requested in the technical requirement clause.

Step 3: The measurement in steps 1 to 3 shall be repeated with signal offsets at required frequencies.

Step 4: The information shown in Table 44 shall be recorded in the test report for each measured signal level and unwanted signal offset.

Table 44: Information Recorded in the Test Report

Value	Notes
Operating Frequency	Nominal centre frequency of the receiver
Signal generator A	Power level of signal generator A
Blocking level	Power level of signal generator B

For equipment using CCA whatever is the receiver category, steps 1 to 4 shall be repeated with signal generator A level adjusted +13 dB higher than in the measurements in clause 5.18.6.4

Test Data

Environmental Conditions

Temperature:	24 °C
Relative Humidity:	51 %
ATM Pressure:	100.6 kPa

The testing was performed by Benny Li on 2024-05-25.

Test Result: Compliance, please refer to following data.

For OCW=62.5 kHz

Frequency (MHz)	Frequency Offset (MHz)	Wanted signal (dBm)	Test Result (dBm)	Limit (dBm)	Result
433.5MHz	-2 MHz from OC edge f_{low}	-96.04	-59.7	-69	PASS
	+2 MHz from OC edge f_{high}	-96.04	-56.7	-69	PASS
	-10 MHz from OC edge f_{low}	-96.04	-38.0	-44	PASS
	+10 MHz from OC edge f_{high}	-96.04	-40.6	-44	PASS
	-5 % of Centre Frequency	-96.04	-41.1	-44	PASS
	+5 % of Centre Frequency	-96.04	-41.6	-44	PASS

Frequency (MHz)	Frequency Offset (MHz)	Wanted signal (dBm)	Test Result (dBm)	Limit (dBm)	Result
434.5MHz	-2 MHz from OC edge f_{low}	-96.04	-59.0	-69	PASS
	+2 MHz from OC edge f_{high}	-96.04	-59.7	-69	PASS
	-10 MHz from OC edge f_{low}	-96.04	-41.4	-44	PASS
	+10 MHz from OC edge f_{high}	-96.04	-38.2	-44	PASS
	-5 % of Centre Frequency	-96.04	-38.9	-44	PASS
	+5 % of Centre Frequency	-96.04	-38.9	-44	PASS

Note1: The equipment provider declared that the receiver category for the EUT is 2.

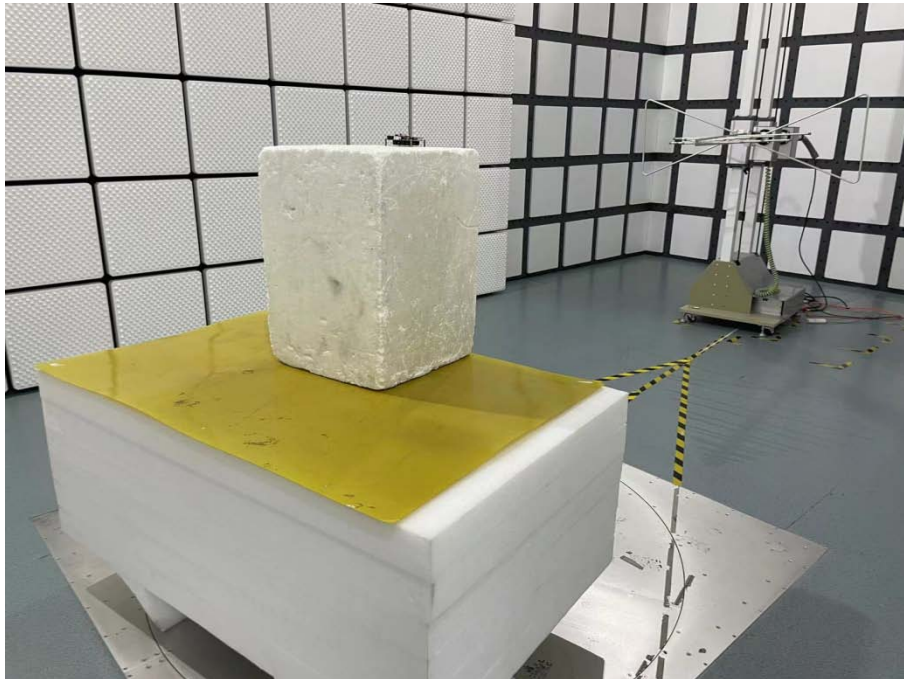
Note2: f_{low} is the low edge of OC, f_{high} is the high edge of OC, f_c is the center frequency.

EXHIBIT A - EUT PHOTOGRAPHS

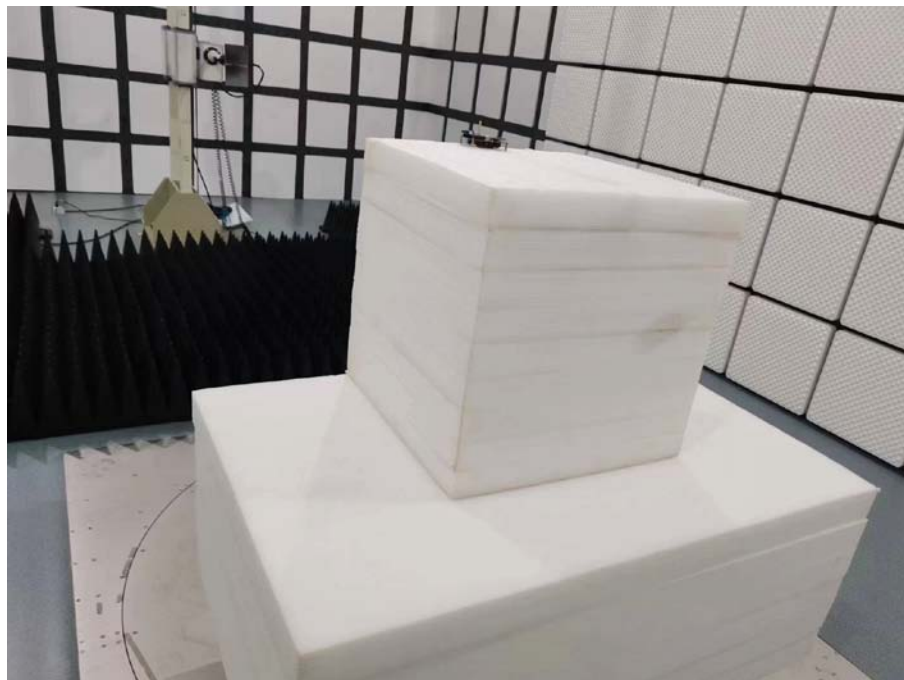
Please refer to the Attachment of 2404T38102E EUT Photographs

EXHIBIT B - TEST SETUP PHOTOGRAPHS

Radiated Spurious Emissions Test View (Below 1GHz)



Radiated Spurious Emissions Test View (Above 1GHz)



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