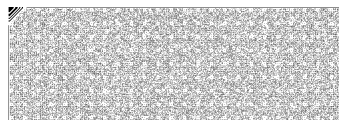




KIEL2603-YW90042

RF TEST REPORT

Report Number		KIEL2603-YW90042	
Applicant	Company Name	ZEROM CO. , Ltd.	
	Address	324ho, 57, Jeonpa-ro 44beon-gil, Manan-gu, Anyang-si, Gyeonggi-do, Republic of Korea	
Product	Product Name	ZEROPUTT	
	Model Name	ZPL21	
	Manufacturer	ZEROM CO. , Ltd.	
Other	Receipt Date	2026.02.23	Receipt Number RQW2602-0803
	Issued Date	2026.03.31	Tested Date 2026.02.25 ~ 2026.03.04
Standards		Certification Ordinance Article 2 Clause 1 Item19 MIC notice No.88 appendix No.43.	
Tested by		Dominic Sim (Sig: )	
Approved by		David Jang (Sign: )	
 KIEL Institute Daewoo Technopark A-403, 261, Doyak-ro, Bucheon-si, Gyeonggi-do, 14523, Korea. Tel : +82-32-670-8888, Fax : +82-32-670-8889 <i>o This is certified that the above mentioned products have been tested for the sample provided by client.</i> <i>o No part of this document may not be duplicated or reproduced by any means without the express written permission of KIEL Institute.</i> <i>o This test report is irrelevant to KS Q ISO/IEC 17025 and KOLAS accreditation</i>			





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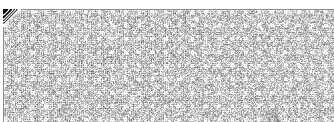
Revision History

Issued Date	Issued Report No.	Revisions
2026.03.31	KIEL2603-YW90042	Initial Issue



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1.0 Laboratory Information

Laboratory Name	KIEL Institute
Location	1-1, Gilju-ro, Bucheon-city, Gyeonggi-do, Korea 14505
FCC Registration No.	KR0167 (RRA accredited Lab.)
IC Registration No.	KR0167 (31291)
Phone	+82-32-325-7045
Fax	+82-32-670-8889

2.0 Applicant Information

Applicant Name	ZEROM CO. , Ltd.
Applicant Address	324, 57, Jeonpa-ro 44beon-gil, Manan-gu, Anyang-si, Gyeonggi-do, Republic of Korea
Manufacturer Name	ZEROM CO. , Ltd.
Manufacturer Address	324, 57, Jeonpa-ro 44beon-gil, Manan-gu, Anyang-si, Gyeonggi-do, Republic of Korea



3.0 Summary of Test Results

Applied standard: Certification Ordinance Article 2 Clause 1 Item19

Test Item	Reference	Result
Frequency Deviation	Section 6.1	P
Occupied Bandwidth	Section 6.2	P
Spreading Bandwidth	Section 6.3	P
Antenna Power Deviation	Section 6.4	P
TX Spurious Emission	Section 6.5	P
RX Spurious Emission	Section 6.6	P
Anti-interference Function	Section 6.7	P
Carrier Sensing Functon	-	NA ^{note4)}
TX Antenna Gain	-	NA ^{note5)}
The main transmission antenna radiation angle range	-	NA ^{note5)}

(Note 1) P = Pass, NC = Not comply, NT = Not Tested, NA = Not Applicable

(Note 2) The general test methods used to test on this devices are MIC notice No.88 appendix No.43

(Note 3) Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

(Note 4) The EUT does not use OFDM & OBW is less than 26 MHz.

(Note 5) The EUT's EIRP is less 12.14 dBi.



3.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2

Measurement Items	Expanded Uncertainty $U = kU_c (k = 2)$
Occupied Bandwidth	$\pm 1.77 \text{ kHz}$
RF Output Power	$\pm 1.36 \text{ dB}$
Frequency Deviation	$\pm 1.76 \text{ kHz}$
Unwanted Emission	$\pm 1.46 \text{ dB}$

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of $k = 2$.





KIEL2603-YW90042

4.0 General Information

4.1 EUT Description

Product name	ZEROPUTT
Basic model	ZPL21
Product S/N	-
Variant model(s)	-
Model Difference	-
Power supply	DC 5 V
Modulation	LE1M: GFSK
Transfer Rate	1 Mbps
Operating Frequency	2 402 MHz ~ 2 480 MHz
Number of channel	40 channels
Output Power	LE1M: 0.477 mW
Antenna Type	PCB Pattern Antenna
Antenna Connector	Permanently Attached

(Note 1) The above equipment has been tested by KIEL Institute, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

4.1.1 List of Accessories

Accessories	Brand	Model	Manufacturer	Specification
-	-	-	-	-

4.1.2 Auxiliary Test equipment

Accessories	Brand	Model	Manufacturer	Specification

4.1.3 Antenna Information

Antenna	Type	Frequency Range	Peak Gain
BT Antenna	Pattern Antenna	2 400 MHz – 2 483.5 MHz	0.278 dBi



4.1.4 Channel List of EUT

LE1M							
Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]
1	2 402	11	2 422	21	2 442	31	2 462
2	2 404	12	2 424	22	2 444	32	2 464
3	2 406	13	2 426	23	2 446	33	2 466
4	2 408	14	2 428	24	2 448	34	2 468
5	2 410	15	2 430	25	2 450	35	2 470
6	2 412	16	2 432	26	2 452	36	2 472
7	2 414	17	2 434	27	2 454	37	2 474
8	2 416	18	2 436	28	2 456	38	2 476
9	2 418	19	2 438	29	2 458	39	2 478
10	2 420	20	2 440	30	2460	40	2 480

4.1.5 Test Condition

Test condition	Voltage
$V_{\min}$ (-10 %)	DC 4.5 V
V_{normal} (Rated)	DC 5.0 V
$V_{\max}$ (+10 %)	DC 5.5 V

Test condition	Unit
Temperature	$(25.3 \pm 1)^{\circ}\text{C}$
Humidity	$(51.6 \pm 3) \% \text{ R.H.}$

Test condition	Tested Frequency
Low Frequency	2 402 MHz
Middle Frequency	2 440 MHz
High Frequency	2 480 MHz



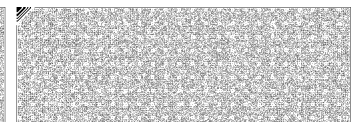
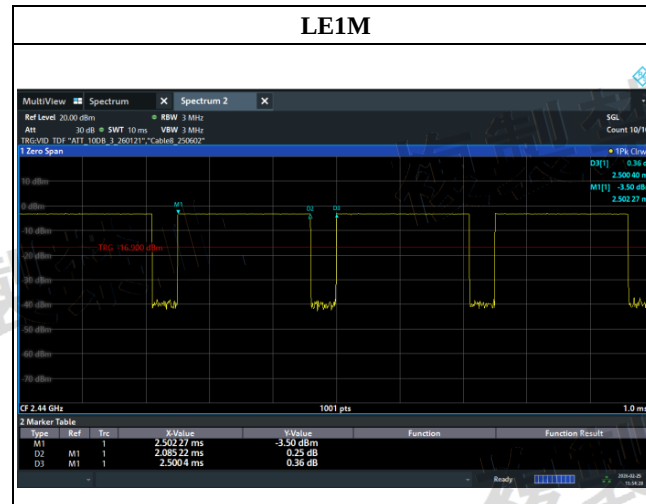


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- Duty Cycle of Test Signal

Test Mode	On Time [msec]	Period [msec]	Duty cycle X [Linear]	Duty Cycle [%]	DCCF [dB]
LE1M	2.085 2	2.500 4	0.833 95	83.40	0.79

- Test Plots of Duty Cycle





KIEL2603-YW90042

5.0 Test Equipment

Test Equipment is traceable to the National Institute of Standards and Technology (NIST). Measurement antenna used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

	Equipment	Manufacturer	Model	S/N	Description	Cal Due
☐	Spectrum Analyzer	Rohde & Schwarz	FSV3044	101034	10 Hz ~ 44 GHz	2027-01-20
☒	Spectrum Analyzer	Rohde & Schwarz	FSV3030	102117	10 Hz ~ 30 GHz	2026-05-20
☒	DC Power Supply	ODA	OPM-305D	ODA-04-0923-07961	DC 30 V, 5 A	2027-01-19
☐	DC Power Supply	ODA	OPM-6010D	ODA-04-0923-07962	DC 60 V, 10 A	2027-01-19
☒	Signal Generator	Rohde & Schwarz	SMBV100B	101818	8 kHz ~ 6 GHz	2027-01-21
☒	Vector Signal Generator	Rohde & Schwarz	SMB100A	180880	100 kHz ~ 40 GHz	2026-05-19
☒	Attenuator	INMET	26A-10	3	DC to 26.5 GHz, 10 dB	2027-01-21
☒	True RMS Multimeter	FLUKE	177	59570153	1000 V, 10 A	2027-01-19
☒	Power Meter	Rohde & Schwarz	NRX	101971	DC ~ 40 GHz	2027-01-22
☒	Power Sensor	Rohde & Schwarz	NRP-Z86	104137	50 MHz ~ 40 GHz	2026-05-22



6.0 Test Results

6.1 Frequency deviation

6.1.1 Test Procedure

The method of measurement used to MIC notice No.88 appendix No.43

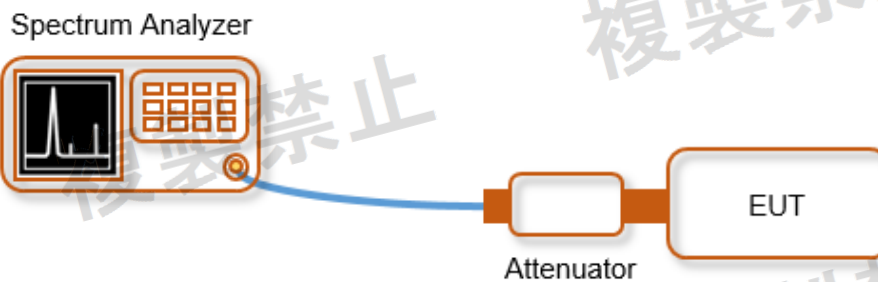
Use the following spectrum analyzer settings:

- 1) Center frequency = Operating frequency
- 2) RBW = 3 kHz.
- 3) VBW $\geq$ [3 x RBW].
- 4) Span = 300 kHz
- 5) Detector = Peak.
- 6) Trace mode = Max hold.
- 7) Sweep = Auto

6.1.2 Limit

$\pm 50 \times 10^{-6}$ (50 ppm or below)

6.1.3 Test Setup





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6.1.4 Test Result

Mode	Test Voltage	Measurement	Frequency		
			Low	Middle	High
LE1M	V _{min}	Measurement(MHz)	2401.987 577	2439.987 193	2479.987 248
		Tolerance(ppm)	-5.171 86	-5.248 77	-5.142 06
	V _{normal}	Measurement(MHz)	2401.987498	2439.987175	2479.987274
		Tolerance(ppm)	-5.20475	-5.25615	-5.13149
	V _{max}	Measurement(MHz)	2401.987484	2439.987144	2479.987248
		Tolerance(ppm)	-5.21070	-5.26869	-5.14185

- Limit: $\pm 50 \times 10^{-6}$ (50 ppm or below)

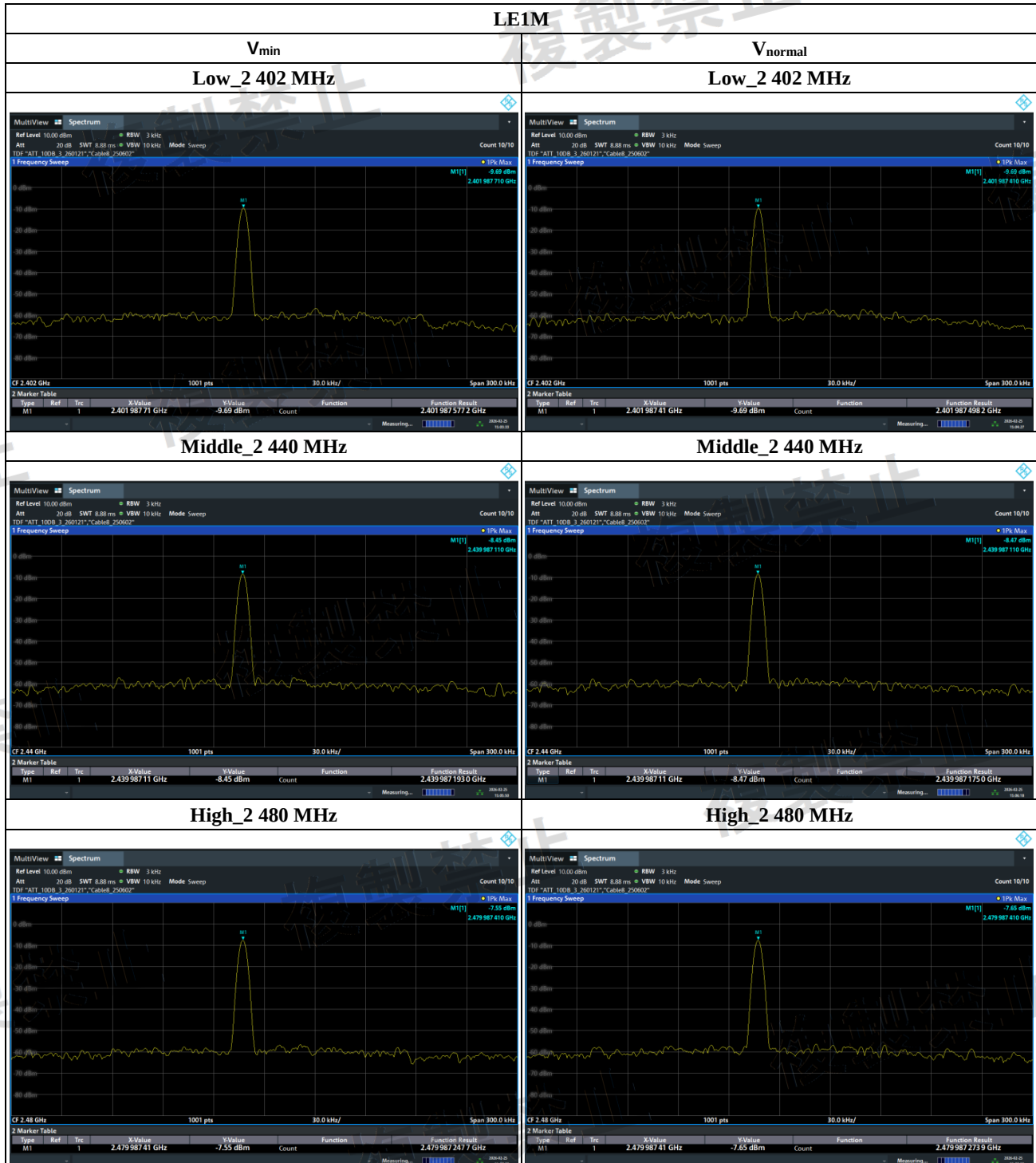
- Pass





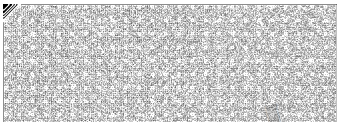
KIEL2603-YW90042

Test Plot of Frequency deviation





KIEL2603-YW90042



6.2 Occupied Bandwidth(99 %)

6.2.1 Test Procedure

The method of measurement used to MIC notice No.88 appendix No.43

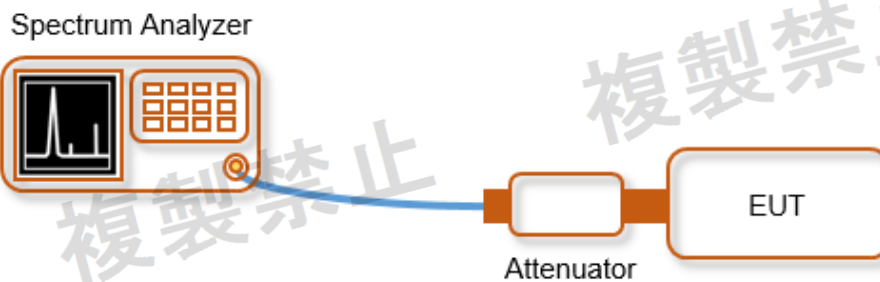
Use the following spectrum analyzer settings:

- 1) Center frequency = Operating frequency
- 2) RBW = Tolerance 3 % of the facilities
- 3) VBW = similar RBW
- 4) Span = 2 to 3.5 times of tolerances
- 5) Sweep time = Auto
- 6) Detector = Peak
- 7) Trace mode = Max hold
- 8) Use OBW function and Set 99 % bandwidth

6.2.2 Limit

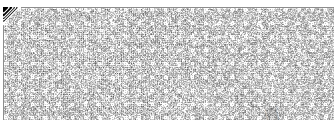
26 MHz or below

6.2.3 Test Setup



6.2.4 Test Result

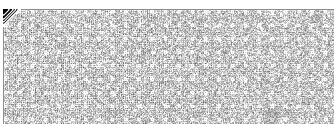
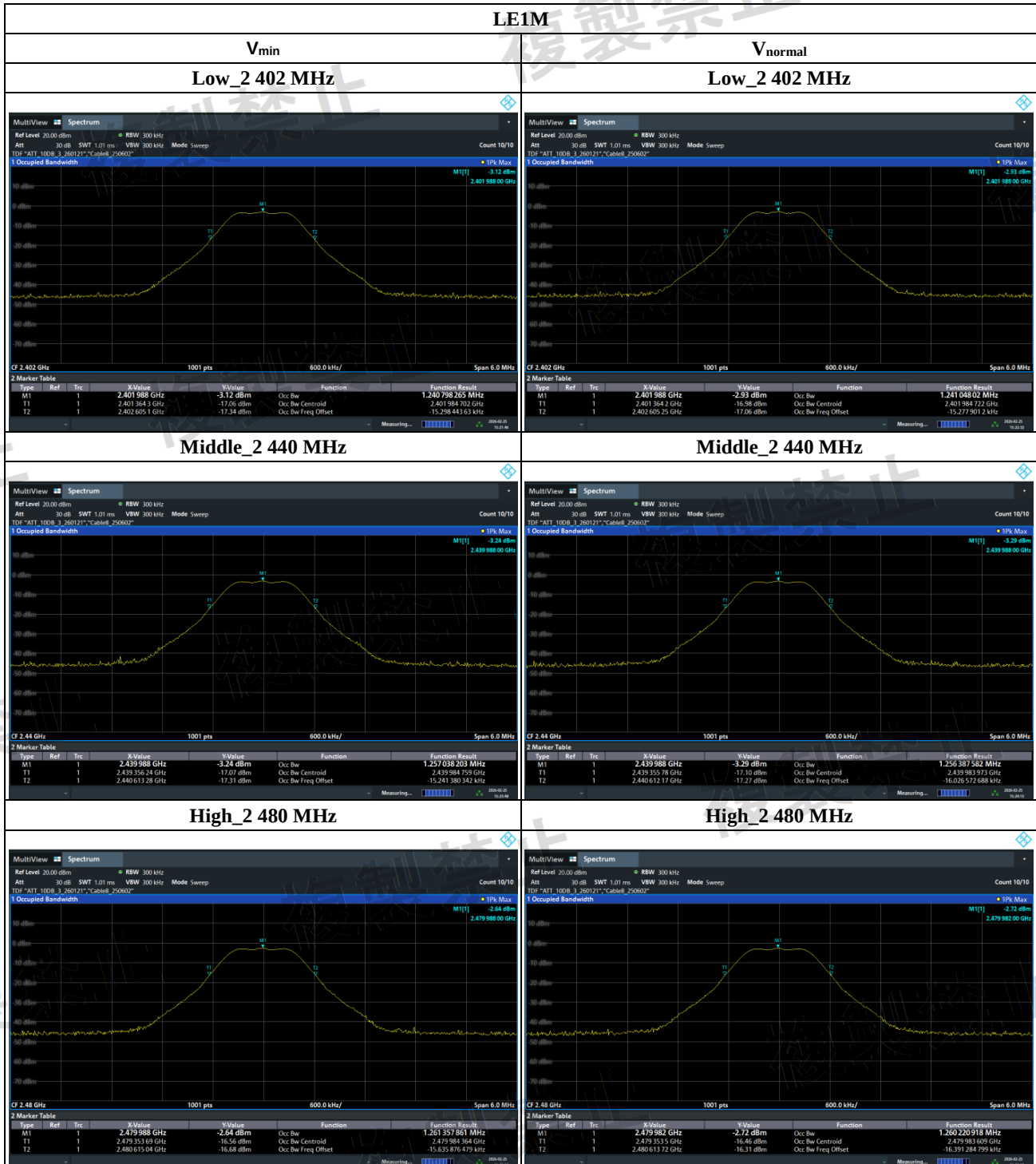
Mode	Test Voltage	Occupied Bandwidth(MHz)			Limit	Result
		Low	Middle	High		
LE1M	V _{min}	1.24	1.26	1.26	26 MHz or below	Pass
	V _{normal}	1.24	1.26	1.26		
	V _{max}	1.24	1.26	1.26		





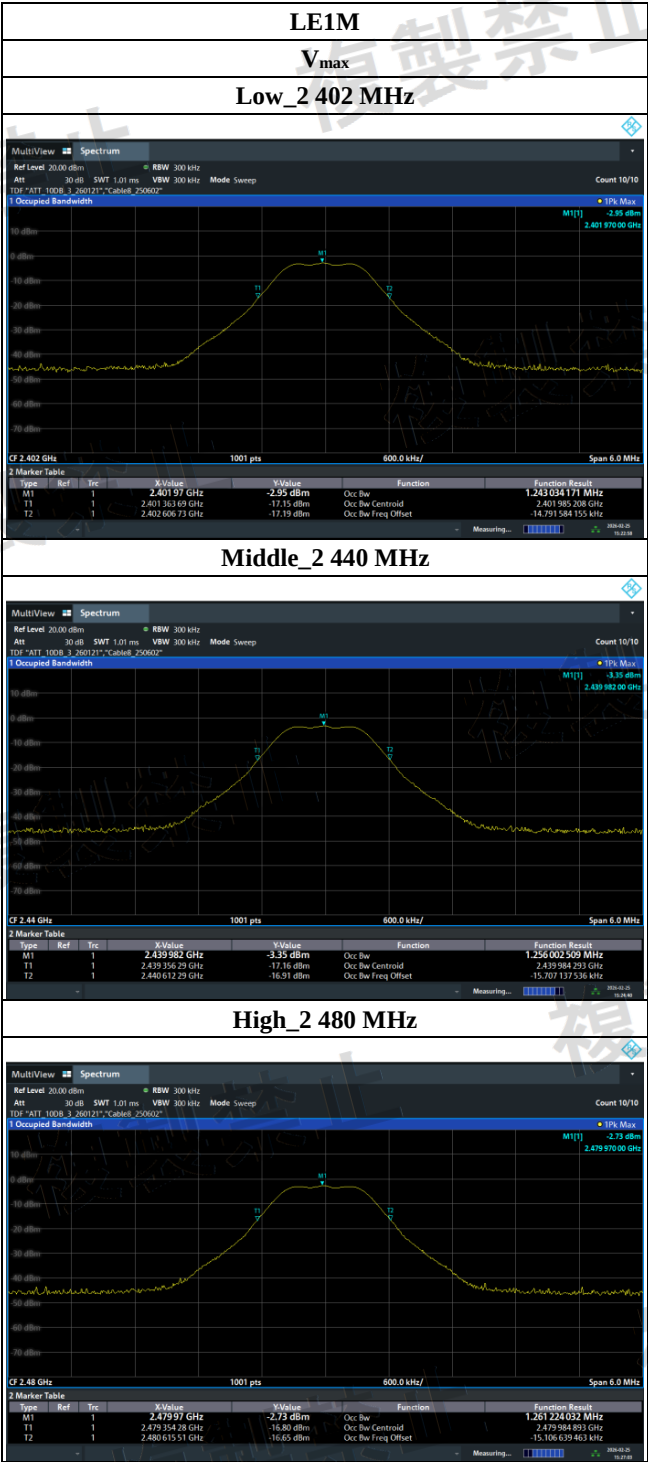
KIEL2603-YW90042

Test Plot of Occupied Bandwidth(99%)





KIEL2603-YW90042



6.3 Spreading Bandwidth(90 %)

6.3.1 Test Procedure

The method of measurement used to MIC notice No.88 appendix No.43

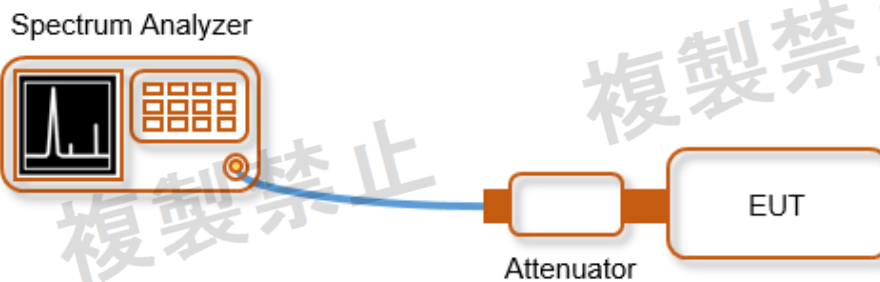
Use the following spectrum analyzer settings:

- 1) Center frequency = Operating frequency
- 2) RBW = Tolerance 3 % of the facilities
- 3) VBW = similar RBW
- 4) Span = 2 to 3.5 times of tolerances
- 5) Sweep time = Auto
- 6) Detector = Peak
- 7) Trace mode = Max hold
- 8) Use OBW function and Set 90 % bandwidth

6.3.2 Limit

More than 0.5 MHz

6.3.3 Test Setup



6.3.4 Test Result

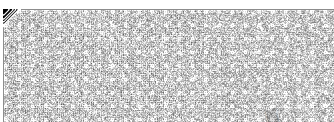
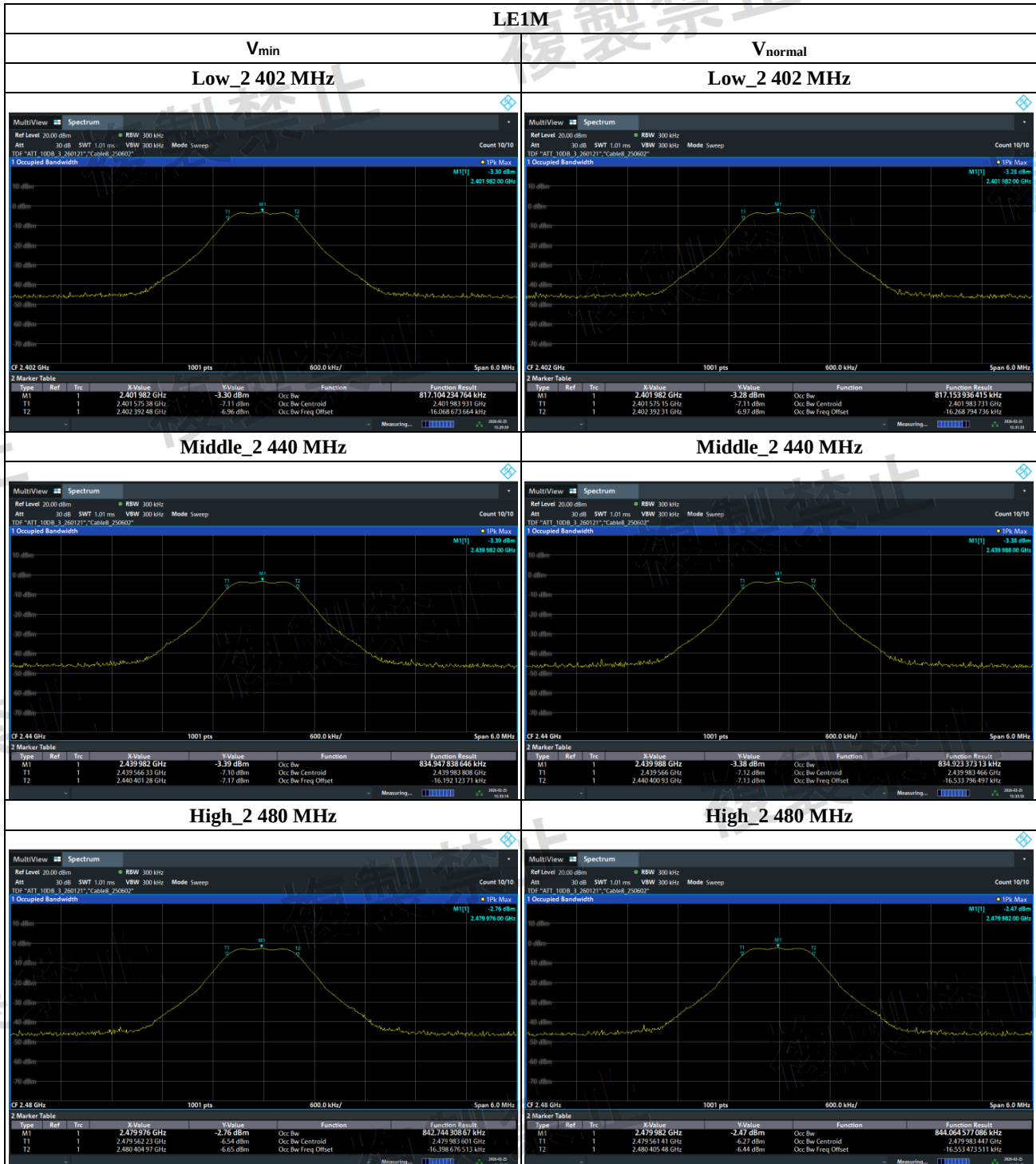
Mode	Test Voltage	Spreading Bandwidth(MHz)			Limit	Result
		Low	Middle	High		
LE1M	V _{min}	0.82	0.83	0.84	More than 0.5 MHz	Pass
	V _{normal}	0.82	0.83	0.84		
	V _{max}	0.82	0.84	0.84		





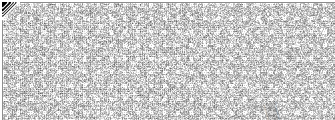
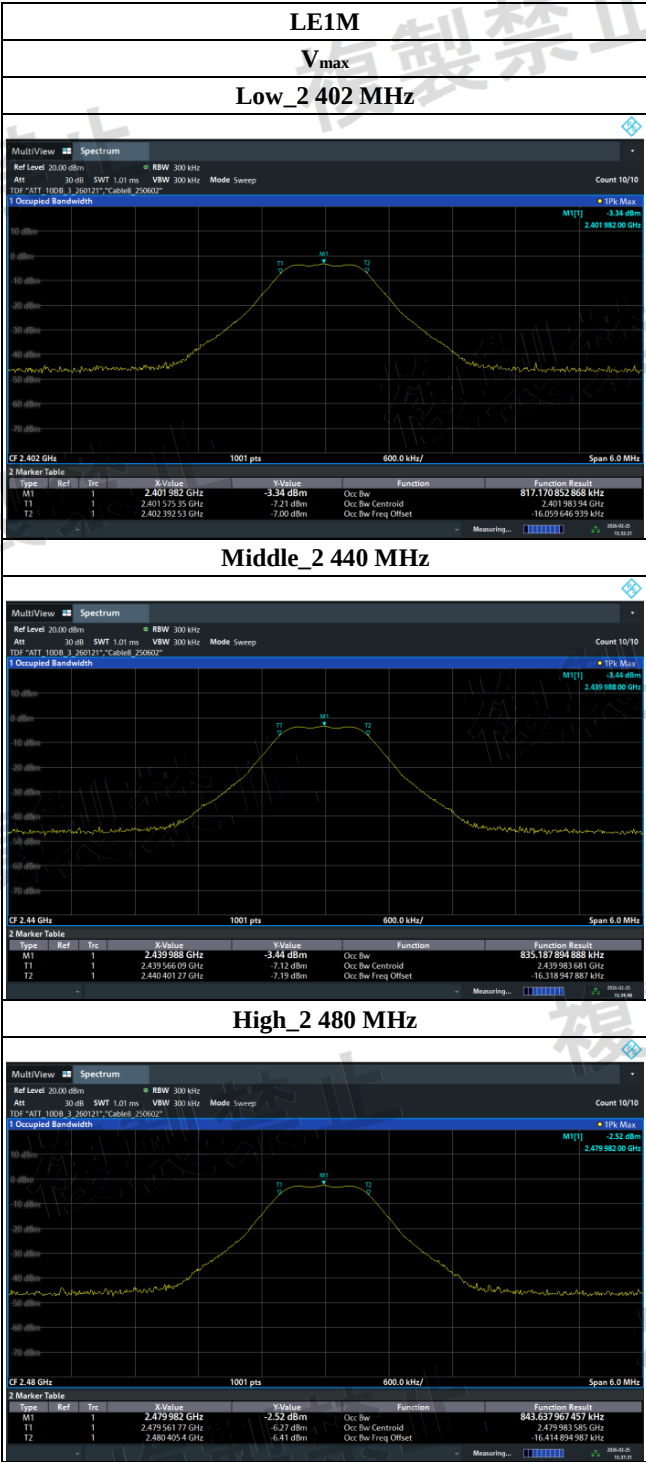
KIEL2603-YW90042

Test Plot of Spreading Bandwidth(90%)





KIEL2603-YW90042



6.4 Antenna Power Deviation

6.4.1 Test Procedure

The method of measurement used to MIC notice No.88 appendix No.43

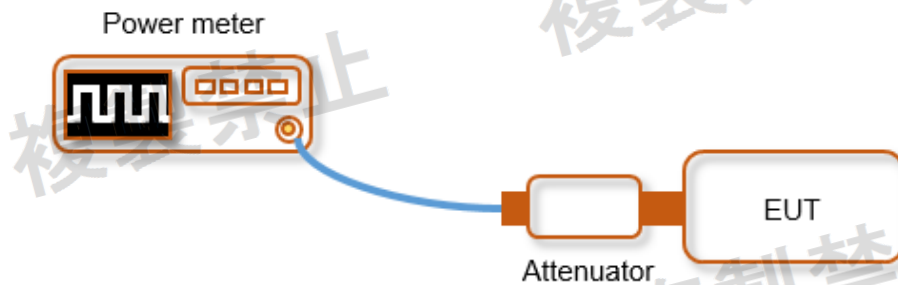
The EUT's output is connected to the Power Meter

6.4.2 Limit

RF Output power: 10 mW or below

RF Output Power Tolerance: +20 % of Declaration Output Power

6.4.3 Test Setup





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6.4.4 Test Result

Mode	Test Voltage	Measurement	Output Power			Limit	Result	
			Low	Middle	High			
LE1M	V _{min}	Output Power(mW)	0.41	0.43	0.48	10 mW or Less	Pass	
		Tolerance (%)	-59.09	-56.76	-52.26	+20 % or Less		
	V _{normal}	Output Power(mW)	0.41	0.44	0.46	10 mW or Less		
		Tolerance (%)	-59.09	-55.55	-53.56	+20 % or Less		
	V _{max}	Output Power(mW)	0.40	0.44	0.46	10 mW or Less		
		Tolerance (%)	-59.56	-55.65	-53.78	+20 % or Less		
	Declared Power(mW)		1					
	Antenna gain(dBi)		0.278					
	E.I.R.P(dBm)		0.278					

Note) Output Power(mW) = $10^{((\text{Output Power(dBm)} + \text{duty cycle Factor(dB)})/10)}$
 Duty Cycle Factor = 0.79 dB



6.5 Tx Spurious Emission

6.5.1 Test Procedure

The method of measurement used to MIC notice No.88 appendix No.43

Use the following spectrum analyzer settings:

- 1) Set Frequency = 30 MHz to 2 387 MHz
2 387 MHz to 2 400 MHz
2483.5 MHz to 2 496.5 MHz
2 496.5 MHz to 12.5 GHz
- 2) RBW = 1 MHz
- 3) VBW = similar RBW
- 4) Sweep time = Auto
- 5) Detector = Peak
- 6) Trace mode = Max hold

6.5.2 Limit

30 MHz to 2 387 MHz = 2.5 μ W or below
2 387 MHz to 2 400 MHz = 25 μ W or below
2483.5 MHz to 2 496.5 MHz = 25 μ W or below
2 496.5 MHz to 12.5 GHz = 2.5 μ W or below

6.5.3 Test Setup

Spectrum Analyzer



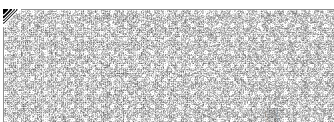
6.5.4 Test Result

- LE1M

Test range	Test Voltage	Measurement	Tx Spurious Emission		
			Low	Middle	High
30 MHz to 2 387 MHz	V _{min}	Value(uW)	0.016	0.018	0.015
		Frequency(MHz)	2261.030	2100.540	2374.860
2 387 MHz to 2 400 MHz		Value(uW)	0.265	0.013	0.013
		Frequency(MHz)	2399.997	2392.062	2392.997
2483.5 MHz to 2 496.5 MHz		Value(uW)	0.014	0.015	0.018
		Frequency(MHz)	2494.583	2492.806	2484.078
2 496.5 MHz to 12.5 GHz		Value(uW)	0.064	0.055	0.061
		Frequency(MHz)	7231.200	7465.200	7434.200
30 MHz to 2 387 MHz	V _{normal}	Value(uW)	0.016	0.015	0.017
		Frequency(MHz)	2185.850	2287.190	2266.450
2 387 MHz to 2 400 MHz		Value(uW)	0.273	0.012	0.014
		Frequency(MHz)	2399.999	2399.552	2399.132
2483.5 MHz to 2 496.5 MHz		Value(uW)	0.014	0.015	0.015
		Frequency(MHz)	2383.945	2487.671	2484.950
2 496.5 MHz to 12.5 GHz		Value(uW)	0.058	0.056	0.060
		Frequency(MHz)	7487.200	7474.20	7481.200
30 MHz to 2 387 MHz	V _{max}	Value(uW)	0.023	0.016	0.016
		Frequency(MHz)	2154.270	2190.560	2100.300
2 387 MHz to 2 400 MHz		Value(uW)	0.293	0.015	0.016
		Frequency(MHz)	2399.989	2387.291	2391.760
2483.5 MHz to 2 496.5 MHz		Value(uW)	0.014	0.015	0.020
		Frequency(MHz)	2488.382	2490.265	2485.214
2 496.5 MHz to 12.5 GHz		Value(uW)	0.055	0.067	0.058
		Frequency(MHz)	7437.200	7443.200	7420.200

- Limit: 30 MHz to 2 387 MHz = 2.5 uW or below(-26 dBm or below)
 2 387 MHz to 2 400 MHz = 25 uW or below(-16 dBm or below)
 2483.5 MHz to 2 496.5 MHz = 25 uW or below(-16 dBm or below)
 2 496.5 MHz to 12.5 GHz = 2.5 uW or below(-26 dBm or below)

- Pass

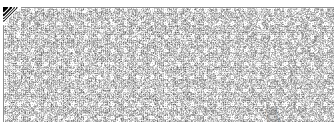
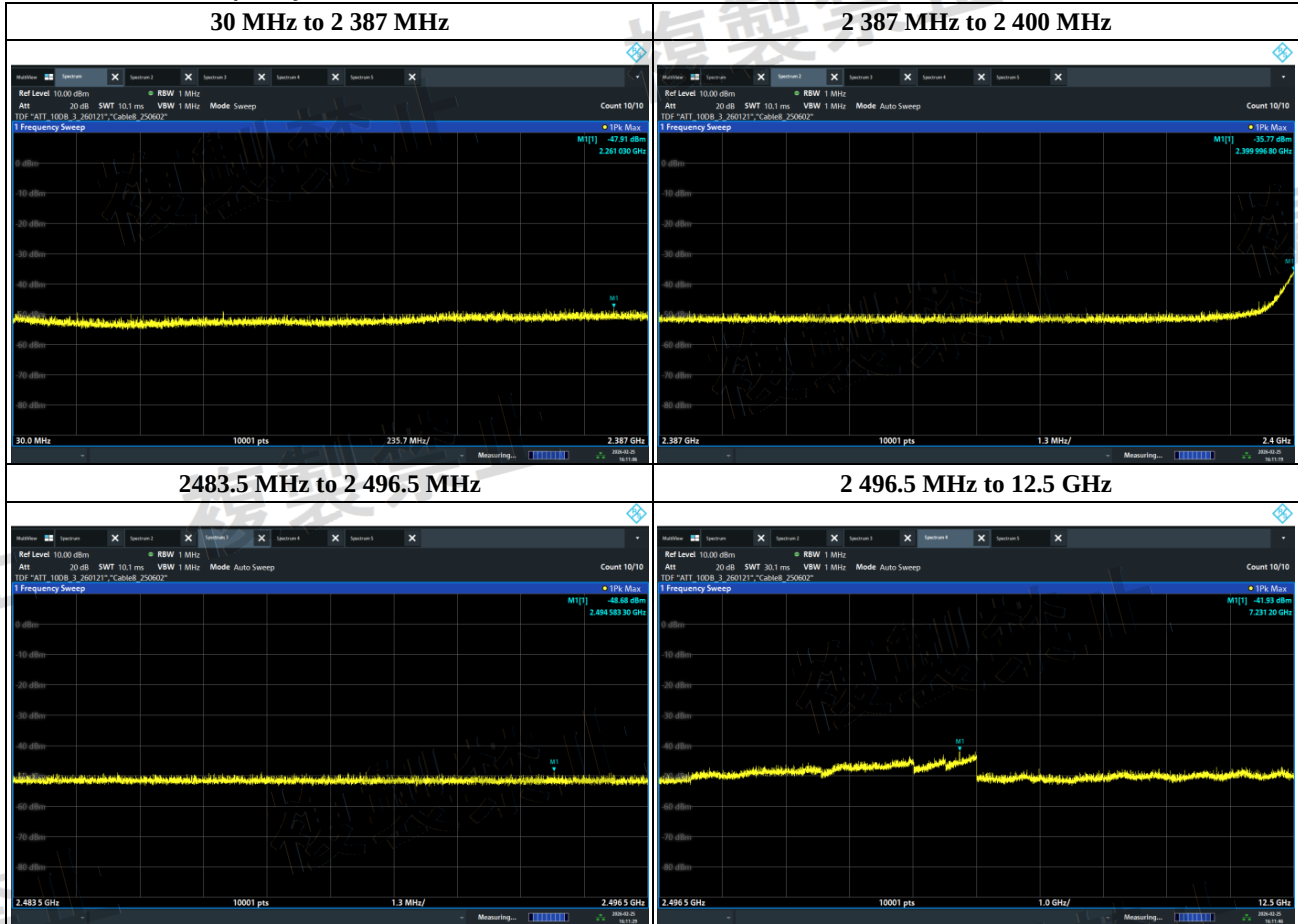




KIEL2603-YW90042

Test Plot of Tx Spurious Emission

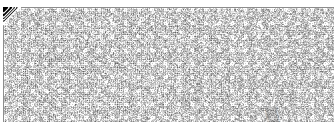
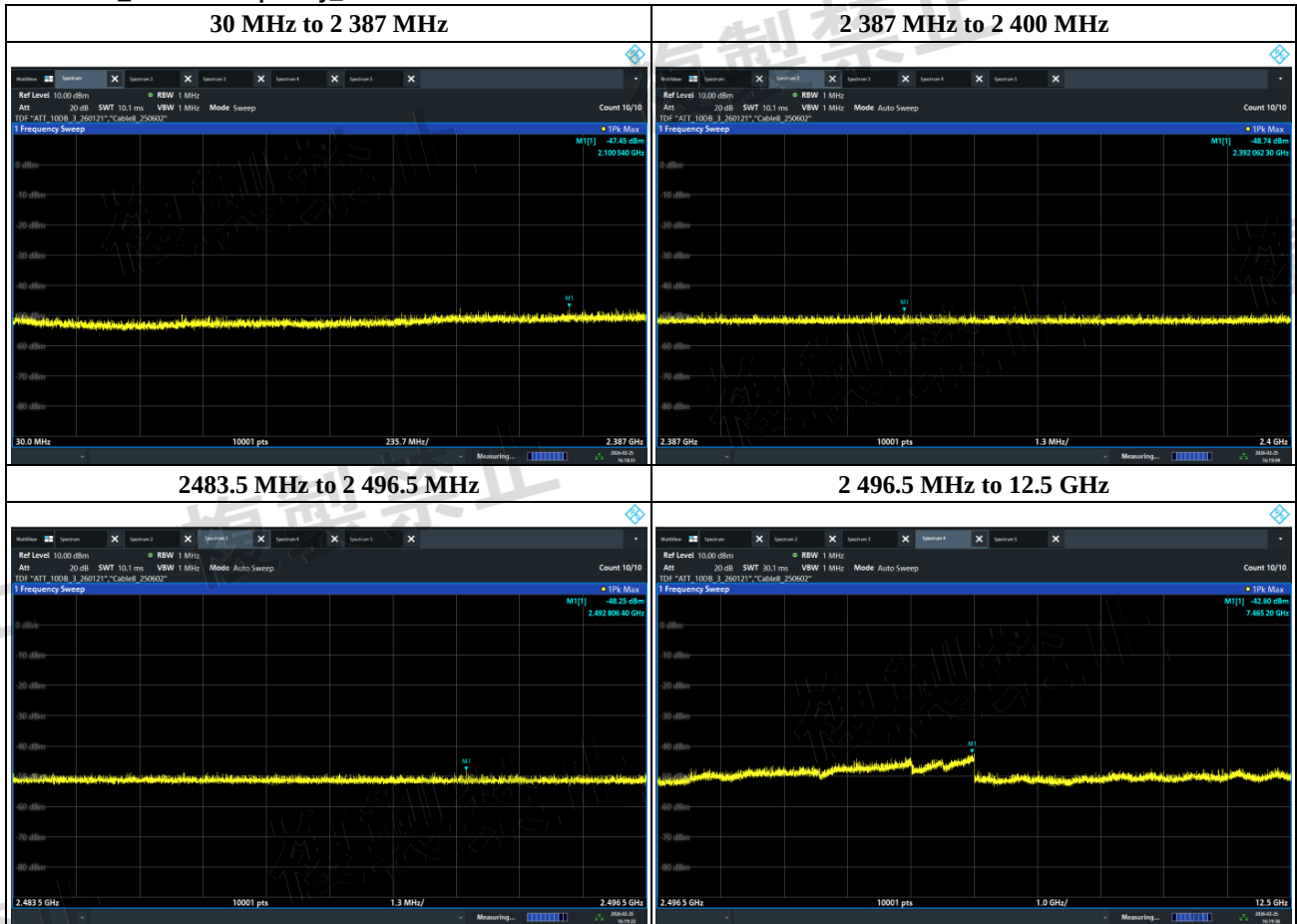
- LE1M_ Low Frequency_ V_{min}





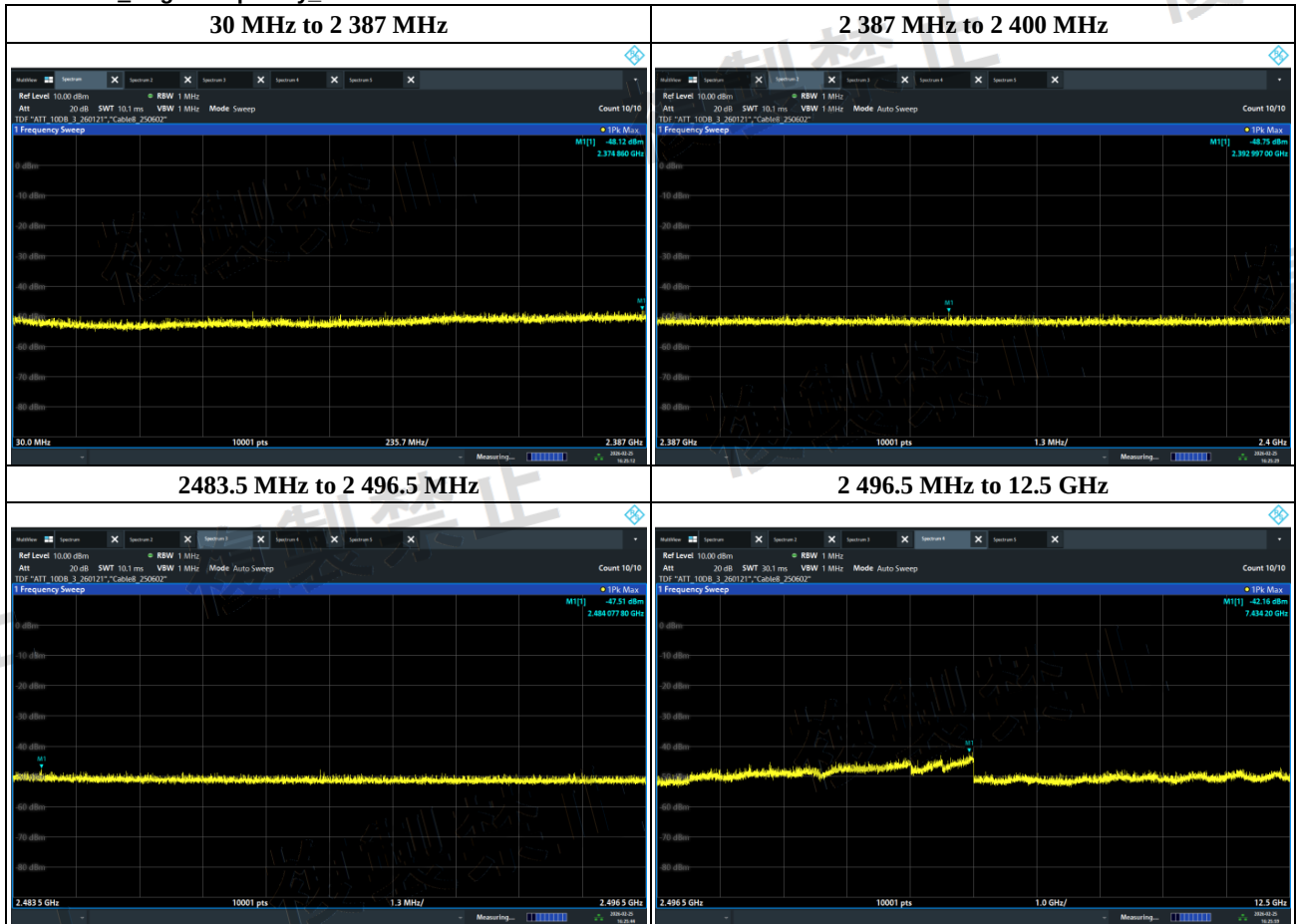
KIEL2603-YW90042

- LE1M_ Middle Frequency_Vmin





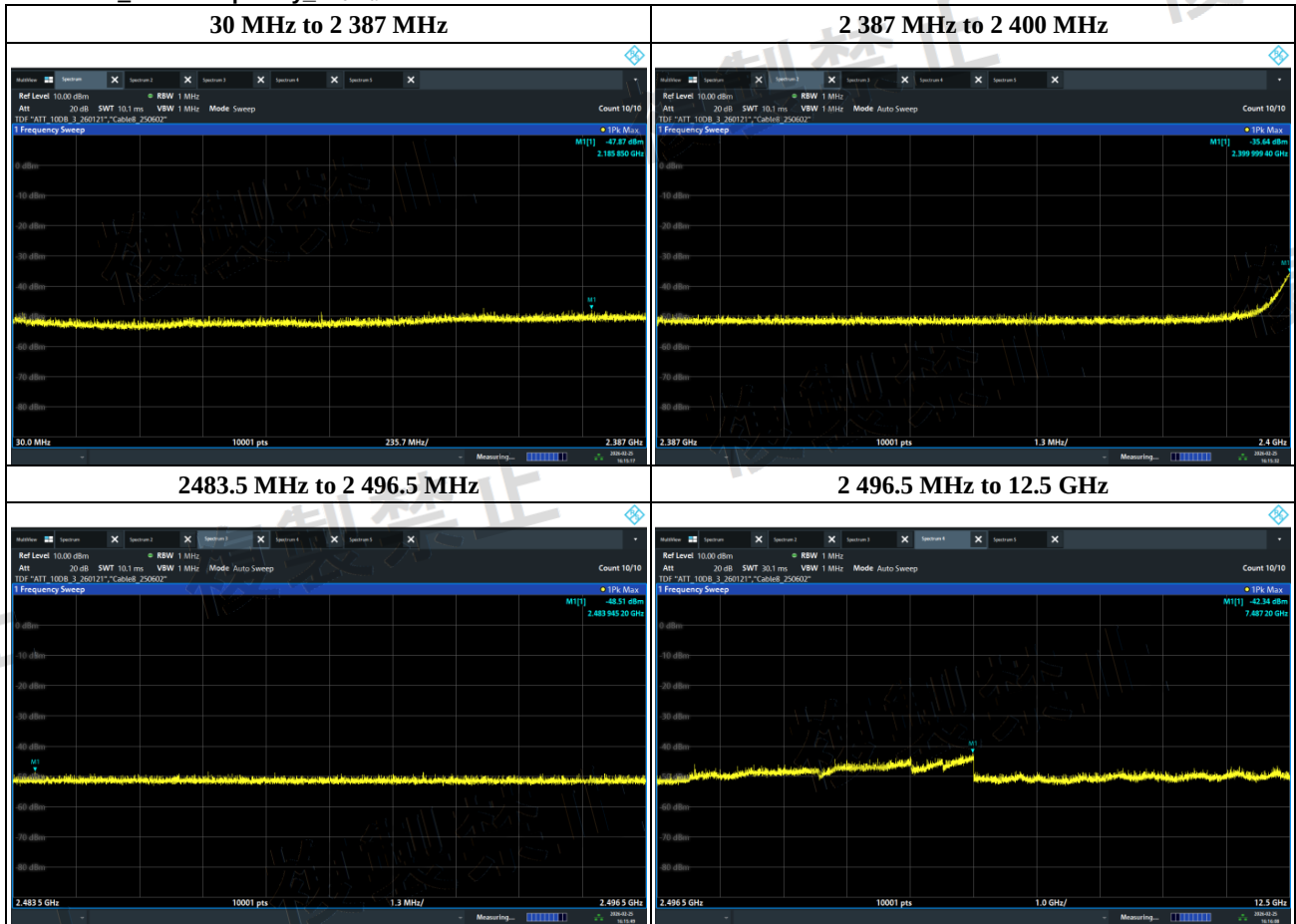
KIEL2603-YW90042

- LE1M_ High Frequency V_{min}



KIEL2603-YW90042

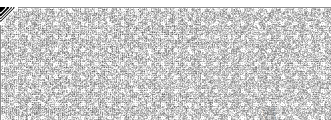
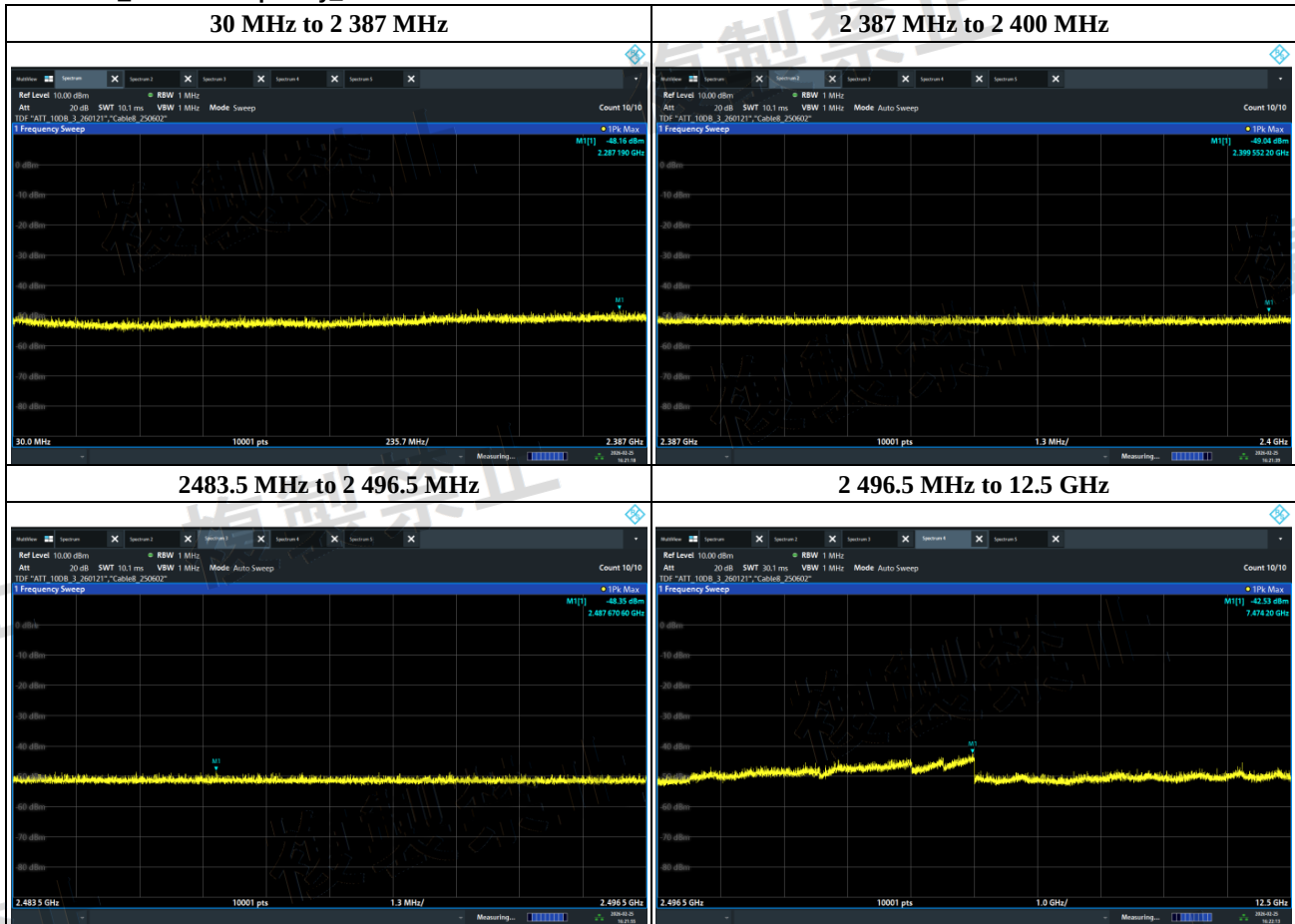
- LE1M_ Low Frequency_Vnormal





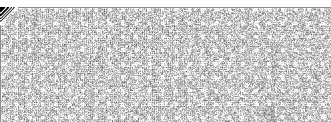
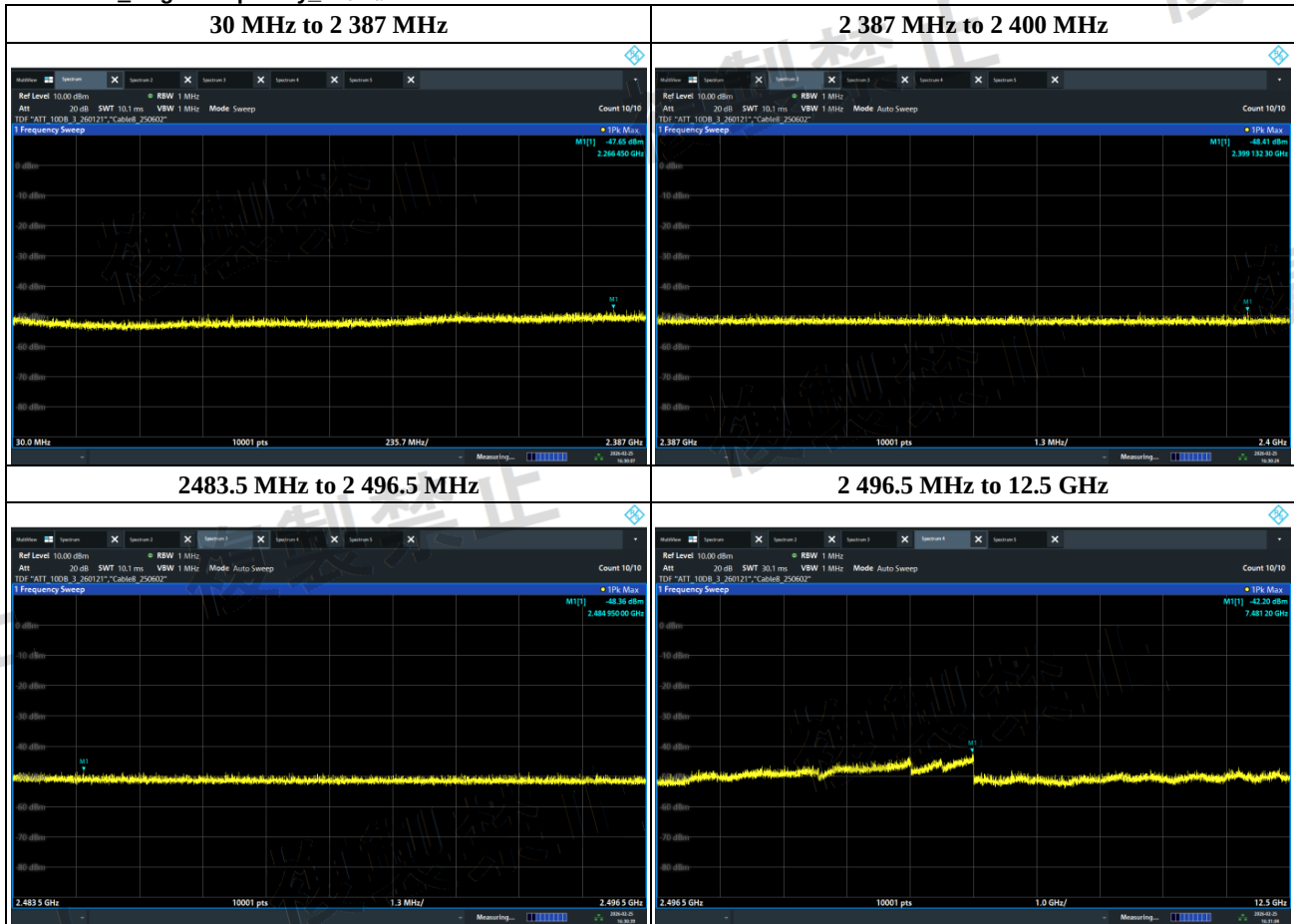
KIEL2603-YW90042

- LE1M_ Middle Frequency_Vnormal



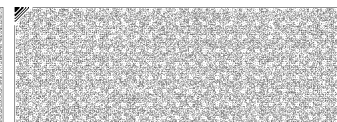
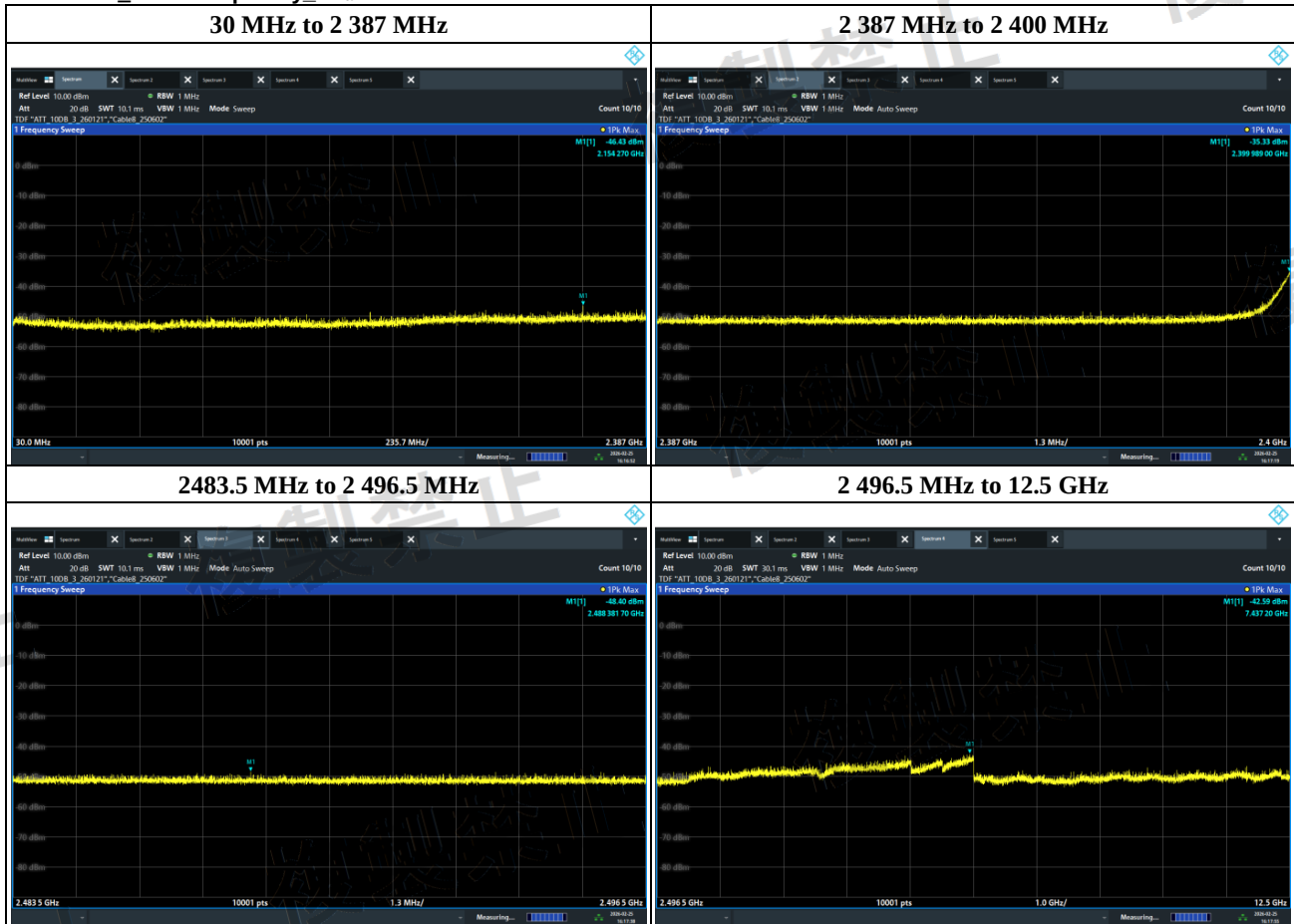


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- LE1M_ High Frequency V_{normal}



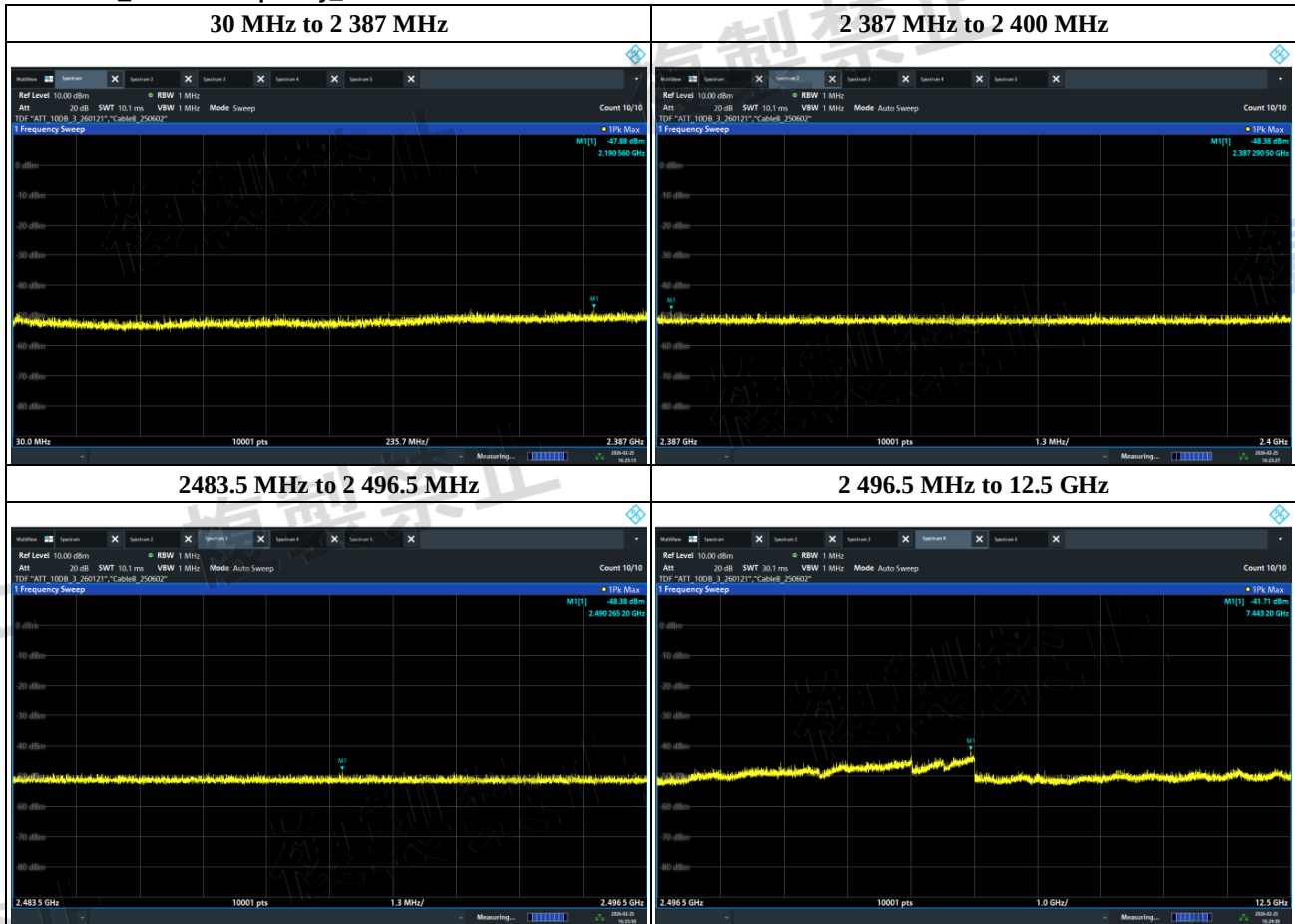
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- LE1M_ Low Frequency_ V_{max}



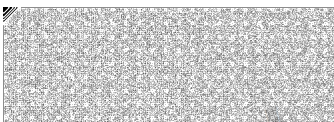
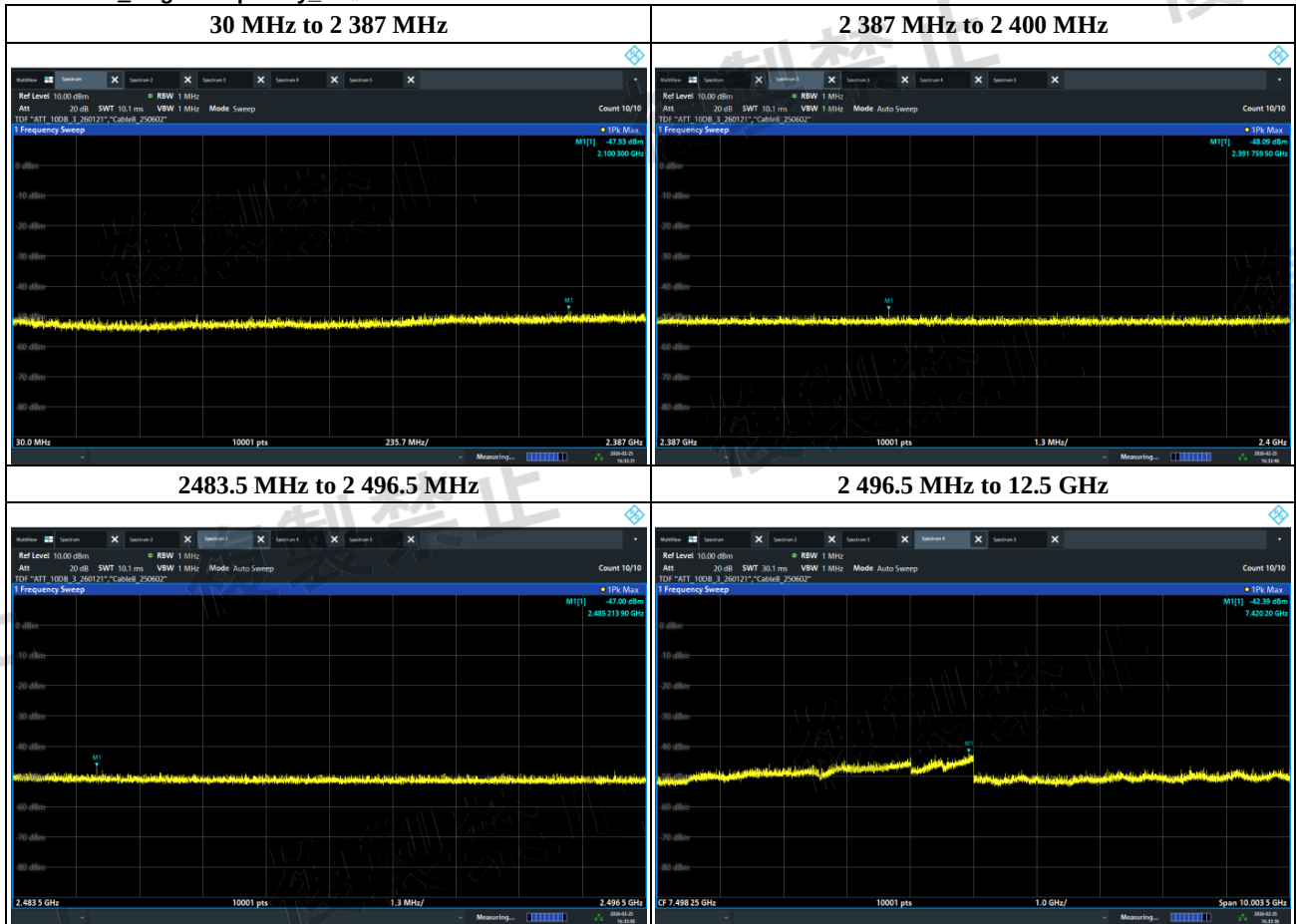
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- LE1M_ Middle Frequency_Vmax





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- LE1M_ High Frequency V_{max}

6.6 Rx Spurious Emission

6.6.1 Test Procedure

The method of measurement used to MIC notice No.88 appendix No.43

Use the following spectrum analyzer settings:

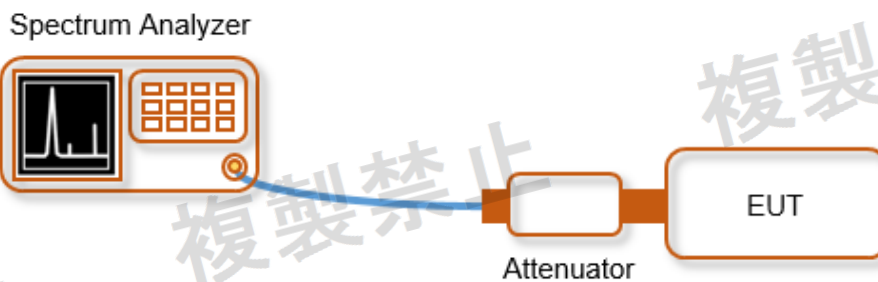
- 1) Set Frequency = 30 MHz to 1 GHz
1 GHz to 12.5 GHz
- 2) RBW = 100 kHz (Less than 1 GHz) / 1 MHz (1 GHz or more)
- 3) VBW = similar RBW
- 4) Sweep time = Auto
- 5) Detector = Peak
- 6) Trace mode = Max hold

6.6.2 Limit

30 MHz to 1 GHz = 4 nW or below

1 GHz to 12.5 GHz = 20 nW or below

6.6.3 Test Setup



6.6.4 Test Result

- LE1M

Test range	Test Voltage	Measurement	Rx Spurious Emission		
			Low	Middle	High
30 MHz to 1 GHz	V _{min}	Value(nW)	0.239	0.230	0.225
		Frequency(MHz)	239.936	239.936	239.936
1 GHz to 12.5 GHz		Value(nW)	1.667	2.415	0.313
		Frequency(MHz)	3204.900	3256.600	3309.500
30 MHz to 1 GHz	V _{normal}	Value(nW)	0.237	0.222	0.220
		Frequency(MHz)	239.936	239.936	239.936
1 GHz to 12.5 GHz		Value(nW)	1.667	2.455	2.455
		Frequency(MHz)	3204.900	3255.500	3309.500
30 MHz to 1 GHz	V _{max}	Value(nW)	0.236	0.223	0.219
		Frequency(MHz)	239.936	239.936	239.936
1 GHz to 12.5 GHz		Value(nW)	1.698	2.432	2.377
		Frequency(MHz)	3204.900	3255.500	3309.500

- Limit: 30 MHz to 1 GHz = 4 nW or below(-53.98 dBm or below)
 1 GHz to 12.5 GHz = 20 nW or below(-46.99 dBm or below)

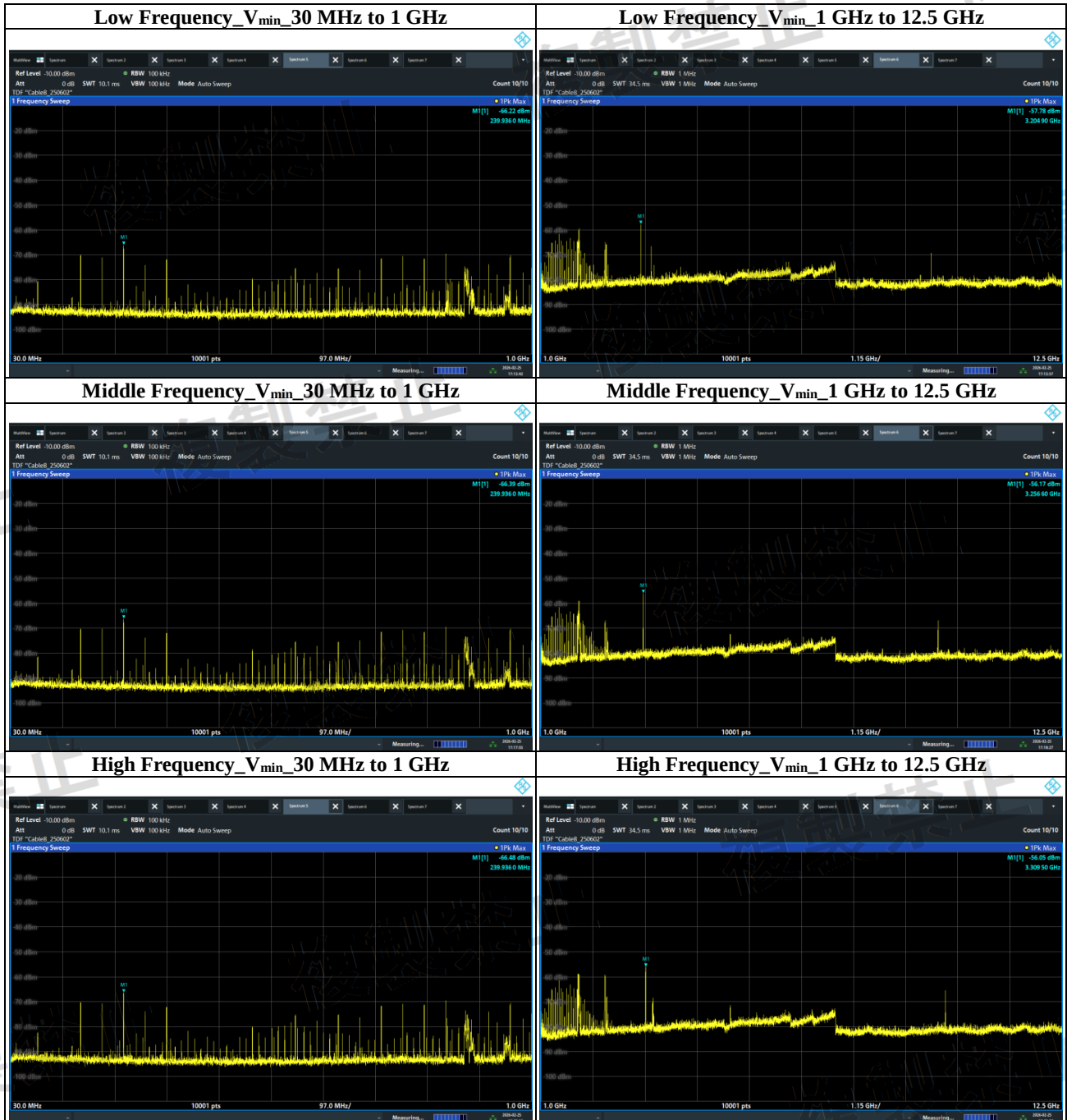
- Pass





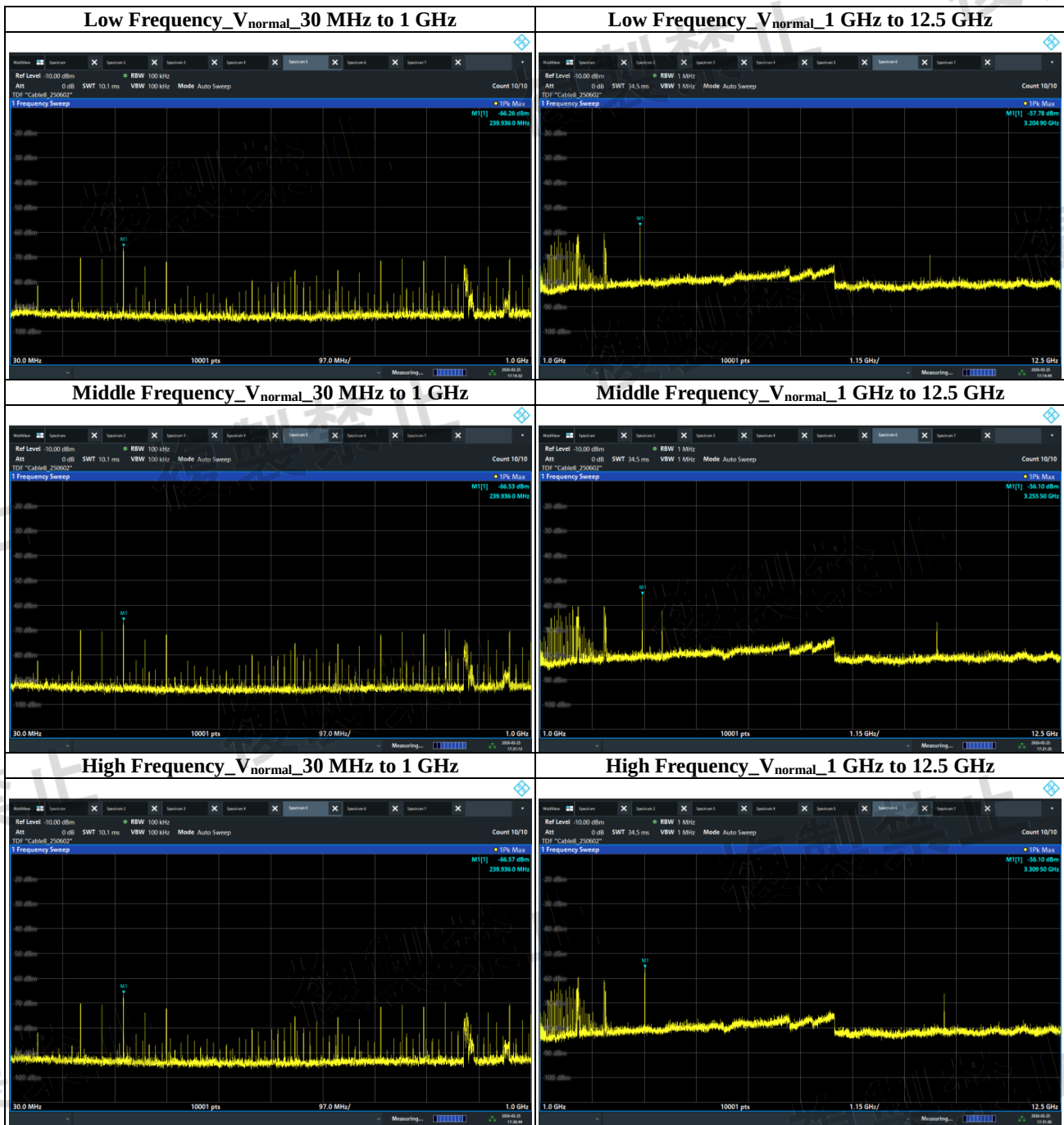
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Test Plot of Rx Spurious Emission



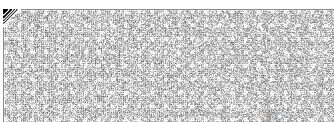
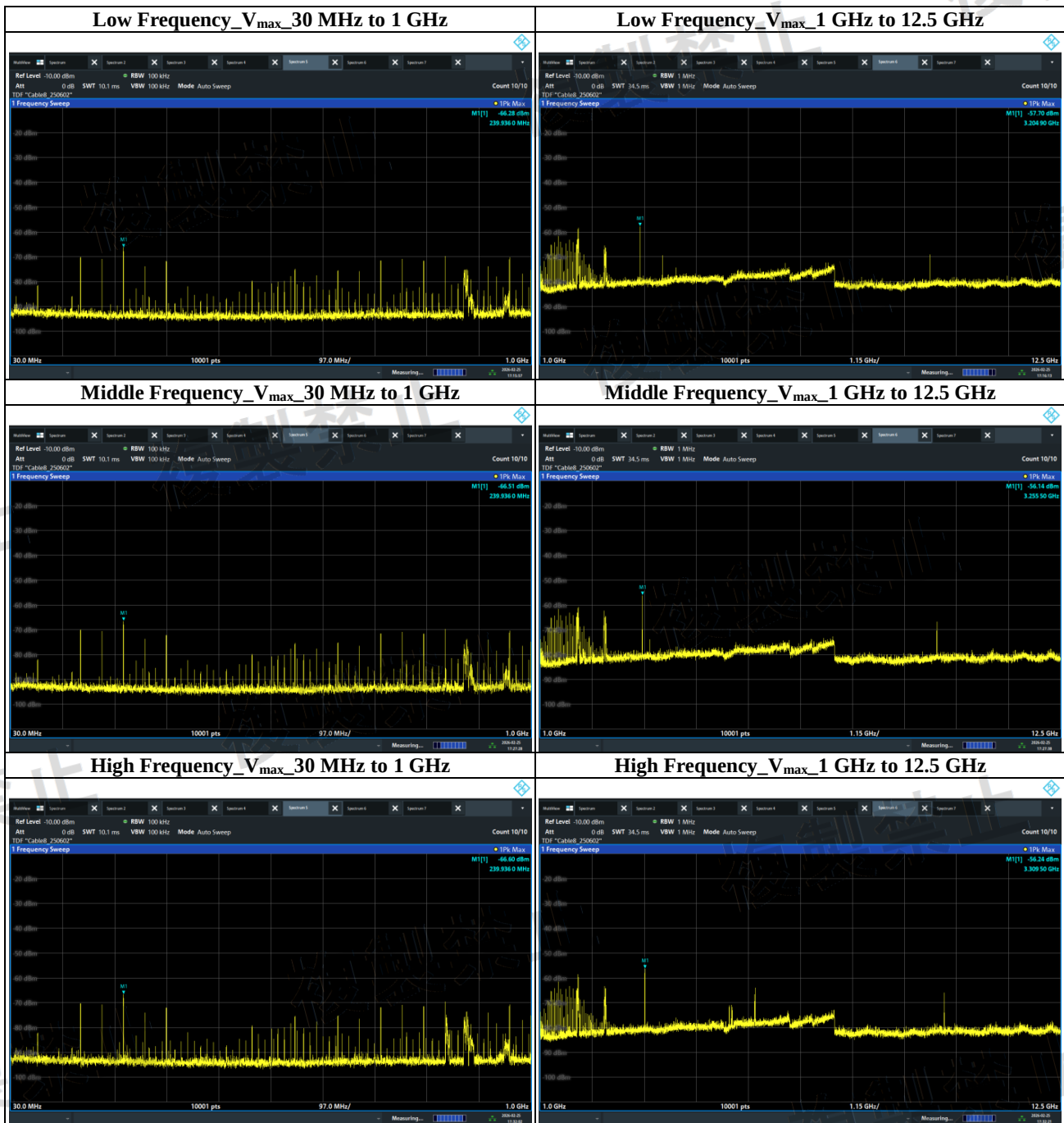


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6.7 Anti-interference Function

6.7.1 Test Procedure

The method of measurement used to MIC notice No.88 appendix No.43

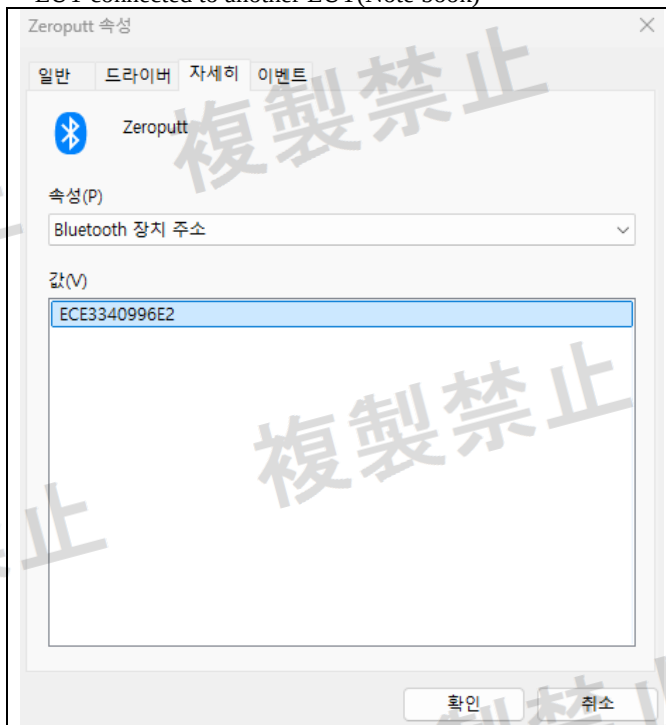
Connect to demodulator or modulator

Note: it is acceptable to use another EUT as demodulator or modulator

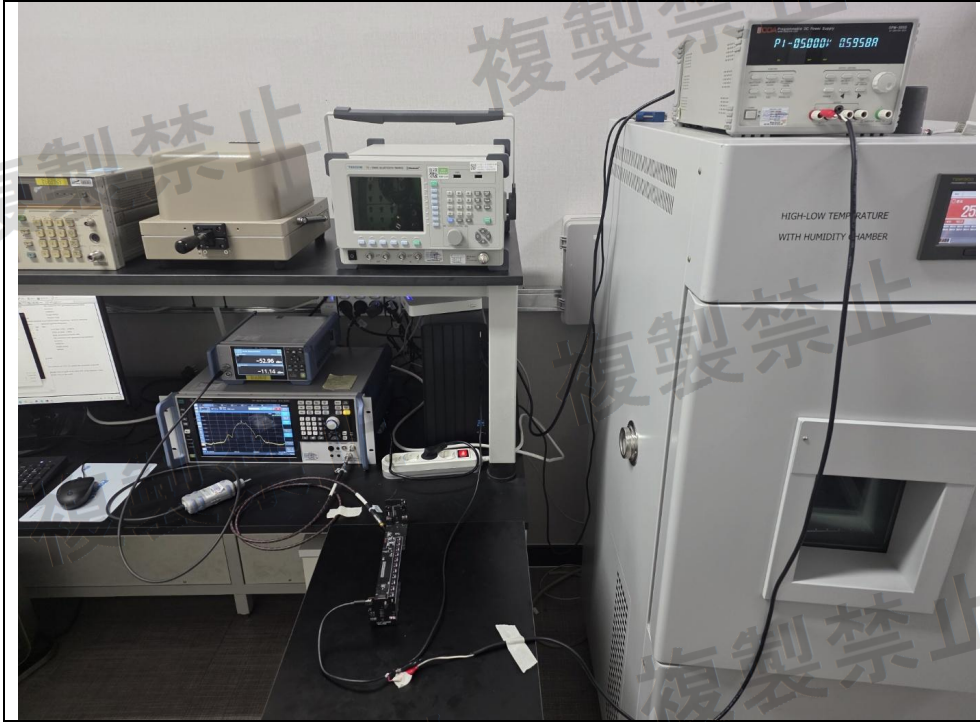
Check display the contents of the identification code

6.7.2 Test Result

- Pass
- EUT connected to another EUT(Note book)



7.0 Photographs of test configuration



- END of report -

