

Japan Radio Test Report

Report No. : BTL-JPAP-1-1409T021C
Equipment : Wireless USB Adapter
Model Name : OPA-3201
Brand Name : OPTICON
Applicant : OPTOELECTRONICS CO., LTD.
Address : 4-12-17, Tsukagoshi, 335-0002 Warabi-shi, Saitama Pref. Japan
Manufacturer : OPTOELECTRONICS CO., LTD.
Address : 4-12-17, Tsukagoshi, 335-0002 Warabi-shi, Saitama Pref. Japan
Factory : Hokkaido Electronic Industry Co., Ltd.
Address : 118-122 Kamiashibetsu-cho, Ashibetsu-shi, Hokkaido 079-1371 Japan.

Function : Bluetooth EDR

Standard(s) : Article 2 Paragraph 1 Item 19 of the Certification Ordinance
MIC Notice No.88 Appendix No.43

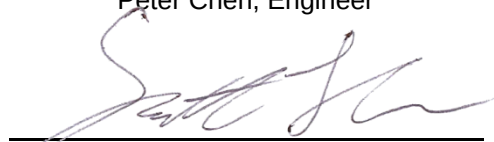
Date of Receipt : 2020/6/22
Date of Test : 2020/6/22~ 2020/10/28
Issued Date : 2020/11/10

The above equipment has been tested and found in compliance with the requirement of the above standards by BTL Inc.

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Declaration

BTL represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with standards traceable to international standard(s) and/or national standard(s).

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The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

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REPORT ISSUED HISTORY

Report Version	Description	Issued Date
R00	Original Issue. This is a supplementary report to the original test report (BTL-JPAP-1-1409021). The difference compared with original report is change the capacitance and inductance of Module to ant antenna. All tests had been tested.	2020/9/11
R01	Revised applicant, manufacturer name and address.	2020/9/26
R02	Updated AFH power test data. Revised applicant, manufacturer name and address.	2020/11/9
R03	Revised typo.	2020/11/10

1 SUMMARY OF TEST RESULTS

Section Number	Description of Test	ORRE	Result
3.1	Frequency Tolerance	Article 5, Table 1	Pass
3.2	Occupied Bandwidth (99%) and Spread-spectrum Bandwidth (90%) / Spreading Factor (diffusion rate)	Article 6, Table 2 Article 49-20, Item1-h & 1-i	Pass
3.3	Unwanted Emission Intensity	Article 7, Table 3	Pass
3.4	Antenna Power Tolerance	Article 14	Pass
3.5	Limitation of Collateral Emission of Receiver	Article 24, Paragraph 2	Pass
3.6	Transmission Antenna Gain (EIRP Antenna Power)	Article 49-20, Item 1-e & 1-f	Pass
3.7	Transmission Radiation Angle Width (3 dB Beamwidth)	Article 49-20, Item 1-f	N/A
3.8	Radio Interference Prevention Capability	Article 9-4, Item 9-C Article 6-2, Item 3 of the Regulation for Enforcement of the Radio Law	Pass
3.9	Hopping Frequency Dwell Time	Article 49-20, Item1-k	Pass
3.10	Construction Protection Confirmation	Article 49-20, Item1-a	Pass

NOTE:

- (1) "N/A" denotes test is not applicable in this Test Report.
- (2) The report format version is TP.1.1.1.

Measurement Method	MIC Notice No.88 Appendix No.43
Test Condition	Conductive, RF test program provided by the customer was used to control the operating channel as well as the output power level.

Abbreviations

For the purposes of the present document, the following abbreviations apply:

NC	Normal Condition
EC	Extreme Condition
EUT	Equipment Under Test
DS	Direct spreading
FH	Frequency hopping
OFDM	Orthogonal frequency division multiplexing

1.1 TEST FACILITY

The test facilities used to collect the test data in this report:

☒ **SR06:** No. 68-1, Ln. 169, Sec. 2, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)

1.2 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty	Remark
Frequency Tolerance / 99% & 90% Bandwidth	$\pm 6.25 \times 10^{-7}$	Confidence levels of 95%
Antenna power / Unwanted Emission Strength / Secondary Radiated Emission Strength	$\pm 0.5\text{dB}$	Confidence levels of 95%
Carrier Sense Capability	$\pm 0.76\text{dB}$	Confidence levels of 95%

1.3 TEST ENVIRONMENT CONDITIONS

Test Item	Environment Condition	Tested by
Frequency Tolerance	25.1 °C, 51 %	Tim Lee
Occupied Bandwidth (99%) and Spread-spectrum Bandwidth (90%) / Spreading Factor (diffusion rate)	25.1 °C, 51 %	Tim Lee
Unwanted Emission Intensity	25.1 °C, 51 %	Tim Lee
Antenna Power Tolerance	25.1 °C, 51 %	Tim Lee
Limitation of Collateral Emission of Receiver	25.1 °C, 51 %	Tim Lee
Radio Interference Prevention Capability	25.1 °C, 51 %	Tim Lee
Hopping Frequency Dwell Time	25.1 °C, 51 %	Tim Lee

2 GENERAL INFORMATION

2.1 DESCRIPTION OF EUT

Equipment	Wireless USB Adapter
Model Name	OPA-3201
Brand Name	OPTICON
Model Difference	N/A
Power Source	Supplied from USB port.
Power Rating	DC 4.5-5.5V
Products Covered	N/A
Operation Frequency	2402 MHz ~ 2480 MHz
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Data Rate	1/2/3 Mbps
Occupied Bandwidth (Maximum)	78.16 MHz
Spread Bandwidth (Minimum)	70.81 MHz
Software version	TD02J01
Hardware version	TD02J01
Antenna Power (Rated)	1 Mbps: 0.0463 mW/MHz 3 Mbps: 0.0258 mW/MHz
Antenna Power (Maximum Conducted)	1 Mbps: 0.0463 mW/MHz 3 Mbps: 0.0258 mW/MHz
Antenna Power (AFH)	1 Mbps: 0.1853 mW/MHz 3 Mbps: 0.1879 mW/MHz
Test Model	OPA-3201
Sample Status	Engineering Sample
EUT Modification(s)	N/A

NOTE:

- (1) For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

(2) Channel List:

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

(3) Table for Filed Antenna:

Ant.	Brand	Model	Type	Connector	Gain (dBi)
1	OPTOELEC TRONICS Co.,Ltd	OPA-3201	PCB	N/A	0.37

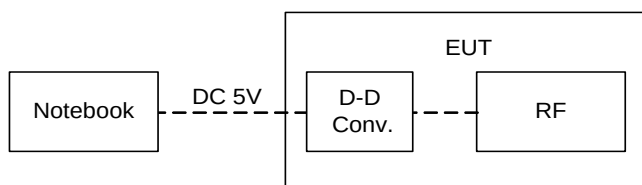
2.2 DESCRIPTION OF TEST MODES

The test system was pre-tested based on the consideration of all possible combinations of EUT operation modes according to test plan.

Following mode(s) as (were) found to be the worst case(s) and selected for the final test.

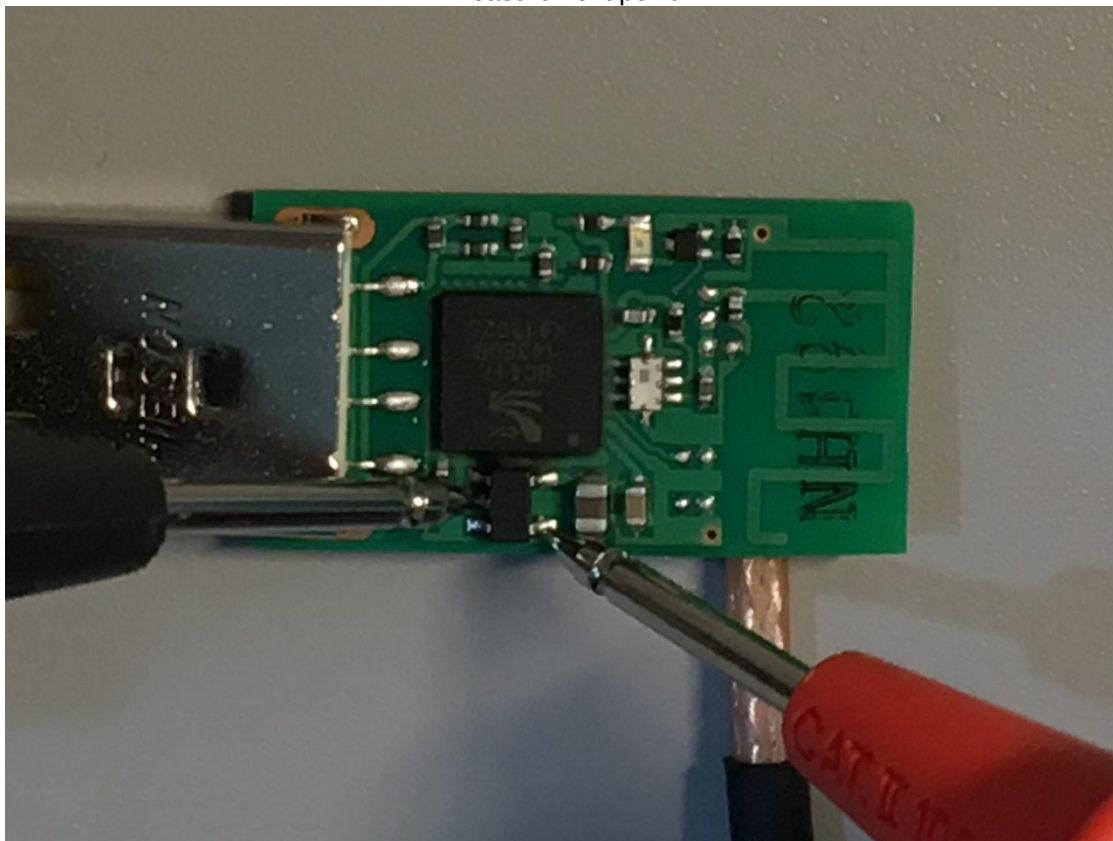
Test Mode	Description
1	1M_2402/2441/2480 MHz
2	3M_2402/2441/2480 MHz
3	AFH_2430/2439/2449 MHz

Power Supply Voltage Fluctuation Test



Voltage fluctuation test	Normal Voltage	High Voltage + 10% of Normal Voltage	Low Voltage - 10% of Normal Voltage
Input: DC Power (V)	5	5.5	4.5
Output: DC Power (V)	5	5.01	4.99
Voltage Variation (%)	-	0.200000	-0.200000

Measurement point



NOTE:

Voltage Variation (%)

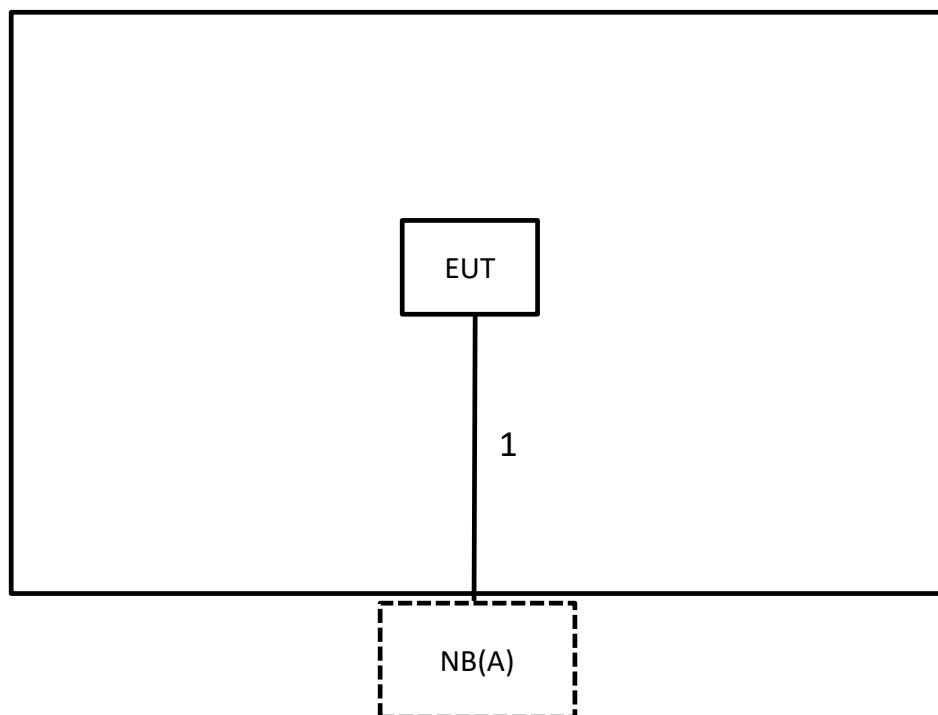
= (Output High or Low Voltage - Output Normal Voltage)/Output Normal Voltage * 100

During the input supply voltage to the EUT from the external power source is varied by $\pm 10\%$, if output voltage had been confirmed that the fluctuation of power supply to the RF circuit of EUT (excluding power source) is equal to or less than $\pm 1\%$.

Exempt extremely high and low supply voltage condition tests, EUT only operated in normal voltage to test all regulation.

2.3 TESTED CONFIGURATION DIAGRAM

Equipment letters and Cable numbers refer to item numbers described in the tables of clause 2.4.



2.4 SUPPORT UNITS

Item	Equipment	Brand	Model No.	Series No.	Remarks
A	NB	HP	TPN-11I9	NA	Furnished by test lab.

Item	Shielded	Ferrite Core	Length	Cable Type	Remarks
1	NO	NO	3m	USB Cable	Furnished by test lab.

2.5 PARAMETERS OF TEST SOFTWARE

Test Software Version		BlueTest3			
Mode	Frequency (MHz)	2402	2441	2480	Data Rate
	1M	20	20	20	1 Mbps
	3M	75	75	75	3 Mbps

3 TEST RESULTS

3.1 FREQUENCY TOLERANCE TEST

3.1.1 LIMIT

Item	Limits (See Article 5, Table 1 of the Ordinance Regulating Radio Equipment)
Frequency Tolerance	≤ 50 ppm

3.1.2 MEASURING INSTRUMENTS AND SETTING

Please refer to section 4 in this report. The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Span Frequency	200 kHz
RBW / VBW	10 kHz / 10 kHz

3.1.3 TEST PROCEDURE

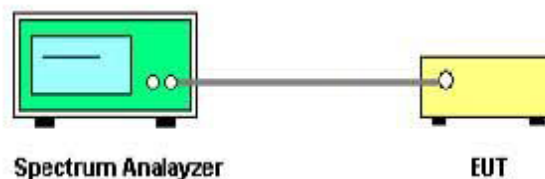
Test method which surpass to Claus 3 of Annex No.43 of MIC Notification No.88.

- Frequency accuracy of SA shall be less than 10 % of limits tolerance (5 ppm).
- Setting of SA is following as: RBW: 10 kHz / VBW: 10 kHz / SPAN: 200 kHz / AT: 30 dB / Ref: 20 dBm.
- Center Frequency: The center frequency of testing for EUT.
- Sweep time: Auto.
- Sweep mode: Continuous sweep.
- Detect mode: Positive peak.
- Mark function: Frequency Counter (Resolution 100 Hz).
- EUT have transmitted absence of modulation signal and fixed channelize. f is using the mark cursor to mark the peak frequency value , fc is declaring of channel frequency. Then the frequency error formula is $(f_c - f) / f_c \times 10^6$ ppm and the limit is less than ± 50 ppm

3.1.4 DEVIATION FROM TEST STANDARD

No deviation.

3.1.5 TEST SETUP



3.1.6 EUT OPERATING CONDITIONS

The EUT was placed on the test table and programmed in un-modulation function.

3.1.7 TEST RESULT

Please refer to the APPENDIX A.

3.2 OCCUPIED BANDWIDTH (99%) AND SPREAD-SPECTRUM BANDWIDTH (90%) / SPREADING FACTOR (DIFFUSION RATE) TEST

3.2.1 LIMIT

Item	Limits (See Article 6, Table 2 and Article 49-20, Item1-h,i of the Ordinance Regulating Radio Equipment)
Occupied Bandwidth	FHSS $\leq$ 83.5MHz; OFDM,DSSS $\leq$ 26MHz; Others $\leq$ 26MHz HT40 $\leq$ 38 MHz
Spreading Bandwidth	$\geq$ 500 kHz (FHSS, DSSS)
Spreading Factor	$\geq$ 5, Operating Frequency 2400 - 2483.5 MHz

3.2.2 MEASURING INSTRUMENTS AND SETTING

Please refer to section 4 in this report. The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Span Frequency	8.35 MHz
RBW / VBW	300 kHz

3.2.3 TEST PROCEDURE

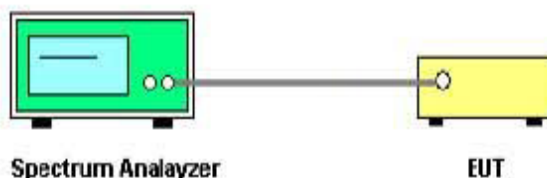
Test method which surpass to Clause 4 of Annex No.43 of MIC Notification No.88.

- Setting of SA is following as: RBW: 300 kHz / VBW: 300 kHz / SPAN: 8.35 MHz / AT: 30 dB Ref: 20 dBm / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
- EUT have transmitted the maximum modulation signal and fixed channelize (For DSSS or OFDM Device) or continuous maximum power of hopping mode (For FHSS Device). SA set to 99 % of occupied bandwidth to measure occupied bandwidth. The limit is less than 26 MHz (For DSSS or OFDM Device) or 83.5 MHz (For FHSS Device).
- SA set to 90% of occupied bandwidth to measure Spread Spectrum Bandwidth and must greater than 500 kHz.
- Spread Spectrum Factor = Spread Spectrum Bandwidth / modulation rate of EUT.
- Spread Spectrum Factor limit is greater than 5.

3.2.4 DEVIATION FROM TEST STANDARD

No deviation.

3.2.5 TEST SETUP



3.2.6 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

3.2.7 TEST RESULT

Please refer to the APPENDIX B.

3.3 UNWANTED EMISSION INTENSITY TEST

3.3.1 LIMIT

Item	Limits (See Article 7, Table 3 of the Ordinance Regulating Radio Equipment)
	≤ 2.5 μW/MHz (30 MHz ≤ f ≤ 1000 MHz)
TX Spurious Emission	≤ 2.5 μW/MHz (1000 MHz ≤ f < 2387 MHz; 2496.5 MHz < f)
	≤ 25 μW/MHz (2387 MHz ≤ f < 2400 MHz) and (2483.5 MHz < f ≤ 2496.5 MHz)
Measurement range: 30 MHz - 5th harmonics	

3.3.2 MEASURING INSTRUMENTS AND SETTING

Please refer to section 4 in this report. The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Attenuation	Auto
RBW	100 kHz (below 1 GHz emissions) 1 MHz (above 1 GHz emissions)
VBW	100 kHz (below 1 GHz emissions) 1 MHz (above 1 GHz emissions)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

3.3.3 TEST PROCEDURE

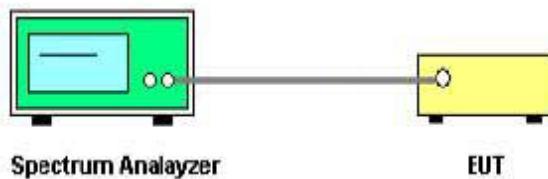
Test method which surpass to Clause 5 of Annex No.43 of MIC Notification No.88.

- EUT have transmitted the maximum modulation signal and fixed channelize.
- Setting of SA is following as: RBW/VBW: 100 kHz (below 1 GHz emissions) / 1 MHz (above 1 GHz emissions) / AT: 30 dB / Ref: 20 dBm / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
- Setting of SA is following as 30 MHz and stop frequency 1000 MHz then to mark peak reading value + cable loss shall be less than 2.5 μW.
- Setting of SA is following as 1000 MHz and stop frequency 2387 MHz then to mark peak reading value + cable loss shall be less than 2.5 μW.
- SA adjusted to start frequency 2387 MHz and stop frequency 2400 MHz then to mark peak reading value + cable loss shall be less than 25 μW.
- SA adjusted to start frequency 2483.5 MHz and stop frequency 2496.5 MHz then to mark peak reading value + cable loss shall be less than 25 μW.
- SA adjusted to start frequency 2496.5 MHz and stop frequency 12500 MHz then to mark peak reading value + cable loss shall be less than 2.5 μW.
- Measure side band spurious as follows: For 2.4GHz band: 2374MHz~2400MHz and 2483.5MHz~2509.5MHz RBW = VBW = 30 kHz, Result_Value = Measured_Value + 15.2 [dBm].
- If the Result_Value is over the requirement, take total sum of 1MHz band centered at the spur frequency like ACLP measurement as Result_Value.

3.3.4 DEVIATION FROM TEST STANDARD

No deviation.

3.3.5 TEST SETUP



3.3.6 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

Note:

- ※1: Frequency Band 1 ($30 \text{ MHz} \leq f \leq 1000 \text{ MHz}$)
- ※2: Frequency Band 2 ($1000 \text{ MHz} \leq f \leq 2387 \text{ MHz}$)
- ※3: Frequency Band 3 ($2387 \text{ MHz} < f \leq 2400 \text{ MHz}$)
- ※4: Frequency Band 4 ($2483.5 \text{ MHz} \leq f < 2496.5 \text{ MHz}$)
- ※5: Frequency Band 5 ($2496.5 \text{ MHz} \leq f < 12.5 \text{ GHz}$)

3.3.7 TEST RESULT

Please refer to the APPENDIX C.

3.4 ANTENNA POWER TOLERANCE TEST

3.4.1 LIMIT

Item	Limits (See Article 14 and 49-20 Item 1-e of the Ordinance Regulating Radio Equipment)
Antenna Power Density	$\leq 3 \text{ mW/MHz}$ (FHSS 2427 - 2470.75 MHz) $\leq 10 \text{ mW/MHz}$ (OFDM,DSSS 2400~2483.5 MHz) $\leq 10 \text{ mW}$ (Other modulation method 2400~2483.5 MHz)
Antenna Power Error	+20%, -80% (Base on manufacturer declare antenna power density)

3.4.2 MEASURING INSTRUMENTS AND SETTING

Please refer to section 4 in this report. The following table is the setting of the spectrum.

Power Meter Parameter	Setting
Filter No.	Auto
Measurement time	0.135 s ~ 26 s
Used Average Sensor	MA2491A

3.4.3 TEST PROCEDURE

Test method which surpass to Clause 7 of Annex No.43 of MIC Notification No.88.

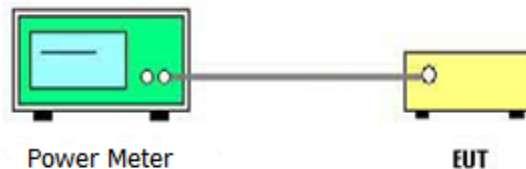
Step 1:

Measure the timed average power with power meter in enough number of burst.

3.4.4 DEVIATION FROM TEST STANDARD

No deviation.

3.4.5 TEST SETUP



3.4.6 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

3.4.7 TEST RESULT

Please refer to the APPENDIX D.

3.5 LIMITATION OF COLLATERAL EMISSION OF RECEIVER TEST

3.5.1 LIMIT

Item	Limits (See Article 24, Paragraph 2 of the Ordinance Regulating Radio Equipment)
RX Spurious Emission	$\leq 4 \text{ nW } (-54 \text{ dBm}) (f < 1 \text{ GHz})$
	$\leq 20 \text{ nW } (-47 \text{ dBm}) (1 \text{ GHz} \leq f)$
Measurement range: 30 MHz - 5th harmonics.	

3.5.2 MEASURING INSTRUMENTS AND SETTING

Please refer to section 4 in this report. The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Attenuation	Auto
RBW	100 kHz (below 1 GHz emissions) 1 MHz (above 1 GHz emissions)
VBW	100 kHz (below 1 GHz emissions) 1 MHz (above 1 GHz emissions)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

3.5.3 TEST PROCEDURE

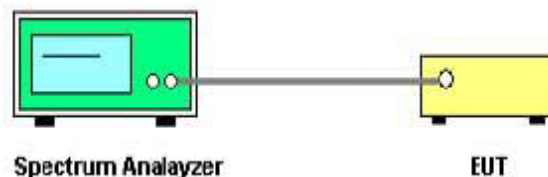
Test method which surpass to Clause 7 of Annex No.43 of MIC Notification No.88.

- EUT have the continuous reception mode and fixed only one channelize.
- Setting of SA is following as RBW / VBW: 100 kHz (below 1 GHz emissions) / 1 MHz (above 1 GHz emissions) AT: 0 dB / Ref: -10 dBm / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
- SA set RBW: 100 kHz and VBW: 100 kHz. Then adjust to start frequency 30 MHz and stop frequency 1000 MHz. Search to mark peak reading value + cable loss shall be less than 4 nW.
- SA set RBW: 1 MHz and VBW: 1 MHz. Then adjust to start frequency 1000 MHz and stop frequency 12500 MHz. Search to mark peak reading value + cable loss shall be less than 20 nW.
- If power level of lower emissions are more than 1/10 of limit (0.4 nW for $f < 1 \text{ GHz}$, 2 nW for $f \geq 1 \text{ GHz}$), all those are to be indicated in the 2nd and 3rd lines. If others are 1/10 or less more of the limit, no necessary to be indicated.

3.5.4 DEVIATION FROM TEST STANDARD

No deviation.

3.5.5 TEST SETUP



3.5.6 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously reception mode.

Note:

※6: Frequency Band 6 ($30 \text{ MHz} \leq f < 1000 \text{ MHz}$)

※7: Frequency Band 7 ($1000 \text{ MHz} \leq f < 12.5 \text{ GHz}$)

3.5.7 TEST RESULT

Please refer to the APPENDIX E

3.6 TRANSMISSION ANTENNA GAIN (EIRP ANTENNA POWER) TEST

3.6.1 LIMIT

Item	Limits (See Article 49-20, Item1-f of the Ordinance Regulating Radio Equipment)
EIRP Power Density	$\leq 6.91 \text{ dBm/MHz}$ (FHSS 2427 - 2470.75 MHz) $\leq 12.14 \text{ dBm/MHz}$ (OFDM, DSSS 2400~2483.5 MHz) $\leq 12.14 \text{ dBm/MHz}$ (Other modulation method 2400~2483.5 MHz)
Note: This test item will not be applied to the transmission antenna which has a gain of 2.14 dBi or less	

3.6.2 MEASURING INSTRUMENTS AND SETTING

Please refer to section 4 in this report. The following table is the setting of the spectrum.

Power Meter Parameter	Setting
Filter No.	Auto
Measurement time	0.135 s ~ 26 s
Used Average Sensor	MA2491A

3.6.3 TEST PROCEDURE

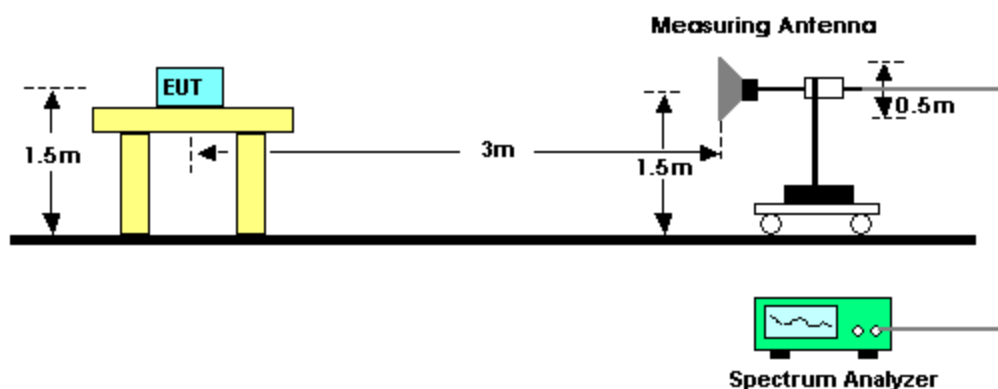
Please refer to 3.4.3 and the $EIRP = PD + \text{Gain}$.

3.6.4 DEVIATION FROM TEST STANDARD

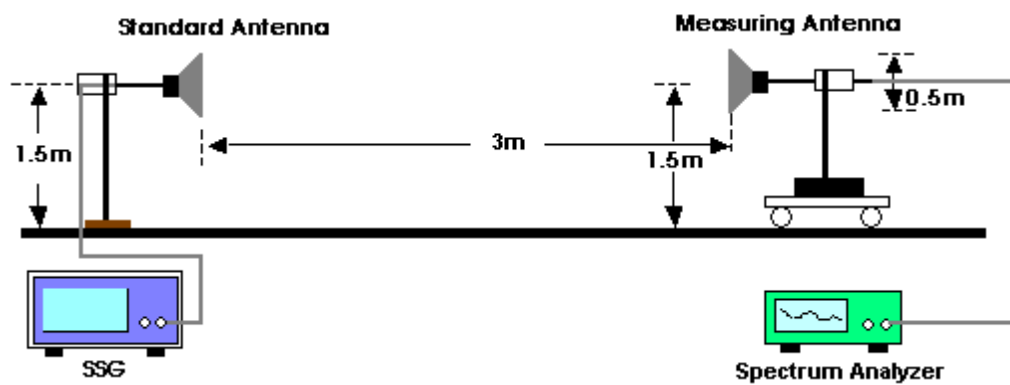
No deviation.

3.6.5 TEST SETUP

For EUT radiation measurement



For standard antenna measurement



3.6.6 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

3.6.7 TEST RESULT

Please refer to the APPENDIX D

3.7 TRANSMISSION RADIATION ANGLE WIDTH (3 DB BEAMWIDTH) TEST

3.7.1 LIMIT

Item	Limits (See Article 49-20, Item1-f of the Ordinance Regulating Radio Equipment)
3 dB antenna beamwidth	$360/A$ (If $A < 1$; then $A = 1$) $A = \{\text{EIRP Power [mW]} / 16.36 \text{ for DSSS, OFDM}\}$ or $A = \{\text{EIRP Power [mW]} / 4.9 \text{ for FHSS}\}$
Note: This test item will not be applied to the transmission antenna which has a gain of 2.14 dBi or less	

3.7.2 MEASURING INSTRUMENTS AND SETTING

Please refer to section 4 in this report. The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Attenuation	Auto
Span	0 MHz
RBW	1 MHz
VBW	1 kHz
Y scale	5 dB
Detector	Peak
Trace	Max Hold

3.7.3 TEST PROCEDURE

Test method which surpass to Clause 22 of Annex No.43 of MIC Notification No.88.

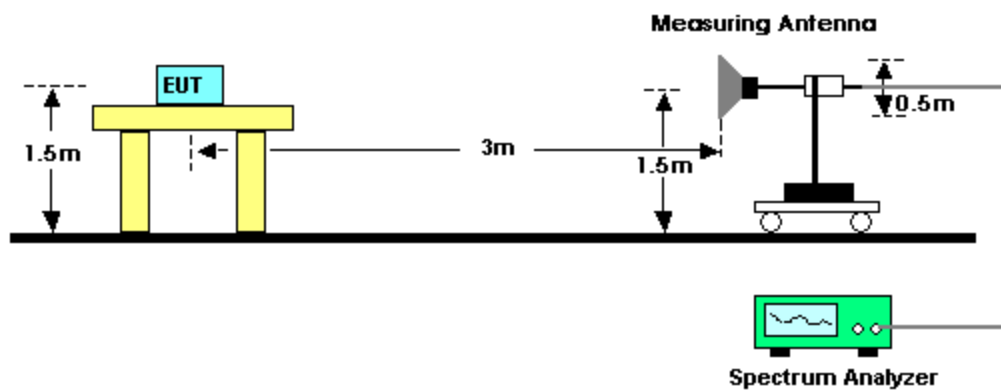
For Adjacent Channel Leakage Power:

- Set EUT and measuring antenna at the same height and roughly facing each other.
- Set spectrum analyzer with condition in section 3.7.2 and tune reference level to observe receiving signal position.
- Rotate directions of the EUT horizontally and vertically to find the maximum receiving power.
- Move the measuring antenna height up and down within ± 50 cm of EUT height and swing it to find the maximum output of measuring antenna. The output level at the spectrum analyzer is read as "E".
- Calculate permitted radiation angle in horizontal and vertical using EIRP measured in another test method.
- Calculate 3 dB antenna beam width by the formula below $360/A$ (If $A < 1$; then $A = 1$).
 $A = \{\text{EIRP Power [mW]} / 16.36 \text{ for DSSS, OFDM}\}$ or
 $A = \{\text{EIRP Power [mW]} / 4.9 \text{ for FHSS}\}$

3.7.4 DEVIATION FROM TEST STANDARD

No deviation.

3.7.5 TEST SETUP



3.7.6 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously reception mode.

Note: C : Cable loss 0 dB

3.7.7 TEST RESULT

Method of measurement:	See MIC Notice No.88 Appendix No.43 Clause 22
Results:	N/A

3.8 RADIO INTERFERENCE PREVENTION CAPABILITY TEST

3.8.1 LIMIT

Item	Limits (See Article 9-4, Item9-C of the Ordinance Regulating Radio Equipment)
Identification code	≥ 48 bits

3.8.2 MEASURING INSTRUMENTS AND SETTING

PC with NetTool	Setting
MAC IP List	MAC Scan

3.8.3 TEST PROCEDURE

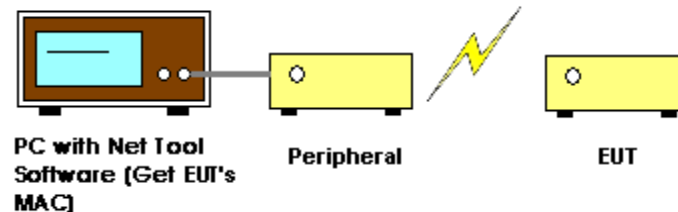
Test method which surpass to Clause 23 of Annex No.43 of MIC Notification No.88.

- a. In the case that the EUT has the function of automatically transmitting the identification code:
 - i. Transmit the predetermined identification codes form EUT.
 - ii. Check the transmitted identification codes with the demodulator.
- b. In the case of receiving the identification code:
 - i. Transmit the predetermined identification codes form the counterpart.
 - ii. Check if communication is normal.
 - iii. Transmit the signals other than predetermined ID codes form the counterpart.
 - iv. Check if the EUT stops the transmission, or if it displays that identification codes are different from the predetermined ones.

3.8.4 DEVIATION FROM TEST STANDARD

No deviation.

3.8.5 TEST SETUP



3.8.6 EUT OPERATING CONDITIONS

The EUT was programmed to be in normal transmitting mode.

3.8.7 TEST RESULT

Test Mode	TX Mode
Test Voltage	Normal Voltage
Test Result	Good, MAC Address: 0X00126A04A020

3.9 HOPPING FREQUENCY DWELL TIME TEST

3.9.1 LIMIT

Item	Limits (See Article 49-20, Item1-k of the Ordinance Regulating Radio Equipment)
Hopping Freq. Dwell Time	$\leq 0.4 \text{ sec}$ (In $0.4 \text{ sec} \times \text{spreading rate}$)

3.9.2 MEASURING INSTRUMENTS AND SETTING

Please refer to section 4 in this report. The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Attenuation	Auto
RBW / VBW	1 MHz
Span	0 MHz
Sweep	Continuous
Detector	Peak
Trigger mode	Video

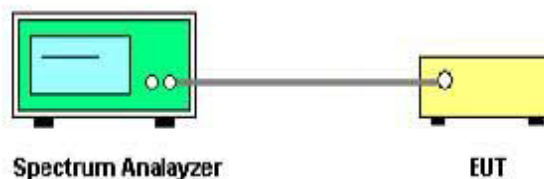
3.9.3 TEST PROCEDURE

- The transmitter output (antenna port) was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 1 MHz and VBW to 1 MHz.
- Use a video trigger with the trigger level set to enable triggering only on full pulses.
- Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- Measure the maximum time duration of one single pulse.
- Set the EUT for DH5, DH3 and DH1 packet transmitting.
- Measure the maximum time duration of one single pulse.
- Dwell time = $[\text{spreading rate}/79] \times \text{duty-cycle} \times 0.4 \text{ seconds}$ (to be determined for each mode, DH1, DH3, DH5).

3.9.4 DEVIATION FROM TEST STANDARD

No deviation.

3.9.5 TEST SETUP



3.9.6 EUT OPERATING CONDITIONS

The EUT was programmed to be in DH5/DH3/DH1 transmitting mode.

3.9.7 TEST RESULT

Please refer to the APPENDIX F.

3.10 CONSTRUCTION PROTECTION CONFIRMATION

3.10.1 LIMIT

(See Article 49-20, Item1-a of the Ordinance Regulating Radio Equipment)

The high-frequency section and modulation section of the radio equipment except for the antenna system shall not be capable of being opened easily.

3.10.2 CONFIRMATION METHOD

The RF and modulation portions are protected against illegal modification as following method:

Tick the appropriate item	
	1. Sealed with special screws.
X	2. Plastic chassis is being welded using ultrasonic waves.
	3. Chassis is glued using a special adhesive.
	4. Metal covers are spot-fused.
	5. Cover is specially interlocked.
	6. RF and Modulation components are covered with shielding case and this shielding case is soldered.
	7. Shield case is welded at RF and modulation parts, and ID-ROM is welded using the BGA Method.
	8. Shield case is welded at RF and modulation parts, and ID-ROM is glued at its lead with a special adhesive
	9. Shield case is welded at RF and modulation parts, and ID-ROM is glued with a non-transparent laminating agent.
	10. RF and Modulation parts are mounted on PCB with surface mount technology, and there is no any adjustable part on PCB or adjustable parts are not exposed.

4 LIST OF MEASURING EQUIPMENTS

Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated Date	Validity Date	Calibration Agency
Spectrum Analyzer	R&S	FSP38	101139	2020/3/30	2021/3/29	Great & Vast Technology Co., Ltd

Remark:

1. "N/A" denotes no model name, no serial no. or no calibration specified.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

5 EUT TEST PHOTO

Please refer to document Appendix No.: TP-1409T021C-JPAP-1 (APPENDIX-TEST PHOTOS).

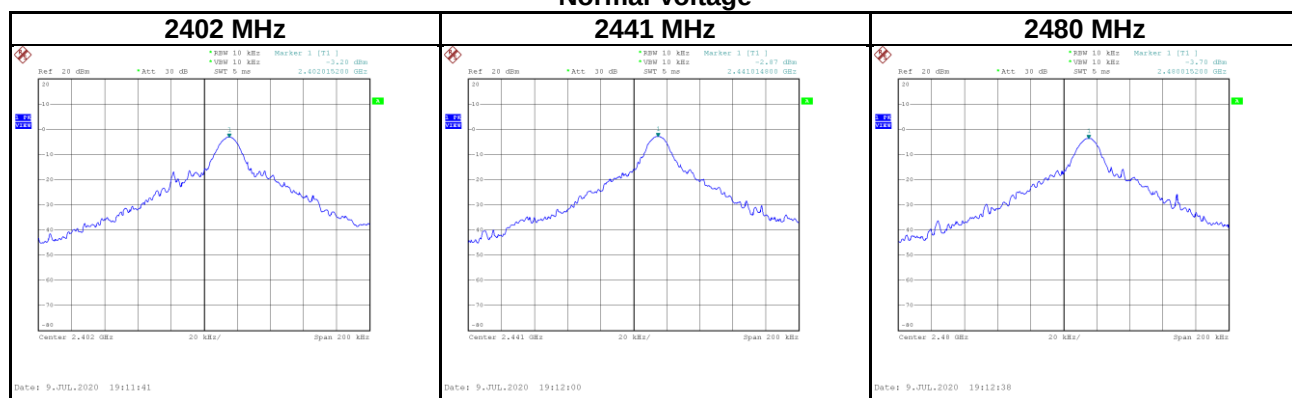
6 EUT PHOTOS

Please refer to document Appendix No.: EP-1409T021C-1 (APPENDIX-EUT PHOTOS).

APPENDIX A REQUENCY TOLERANCE

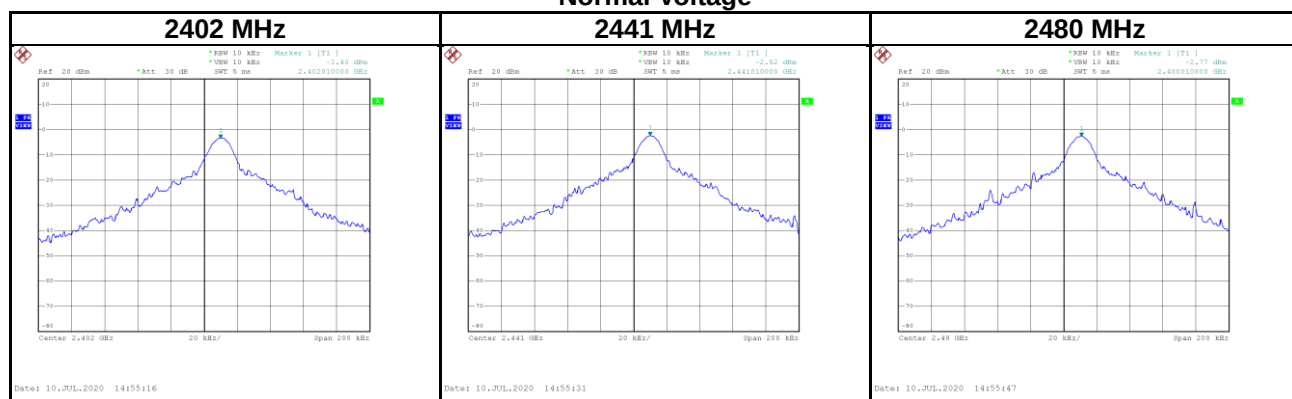
Test Mode	1M			
Test Voltage (V)	Normal Voltage			Remark
Test Frequency (MHz)	2402	2441	2480	Low/Middle/High of test frequency range
Measured Frequency (MHz)	2402.01520	2441.0148	2480.0152	
Frequency Tolerance (ppm)	6.33	6.06	6.13	Limit ≤ 50 ppm

Normal Voltage



Test Mode	3M			
Test Voltage (V)	Normal Voltage			Remark
Test Frequency (MHz)	2402	2441	2480	Low/Middle/High of test frequency range
Measured Frequency (MHz)	2402.0100	2441.0100	2480.0108	
Frequency Tolerance (ppm)	4.16	4.10	4.35	Limit ≤ 50 ppm

Normal Voltage

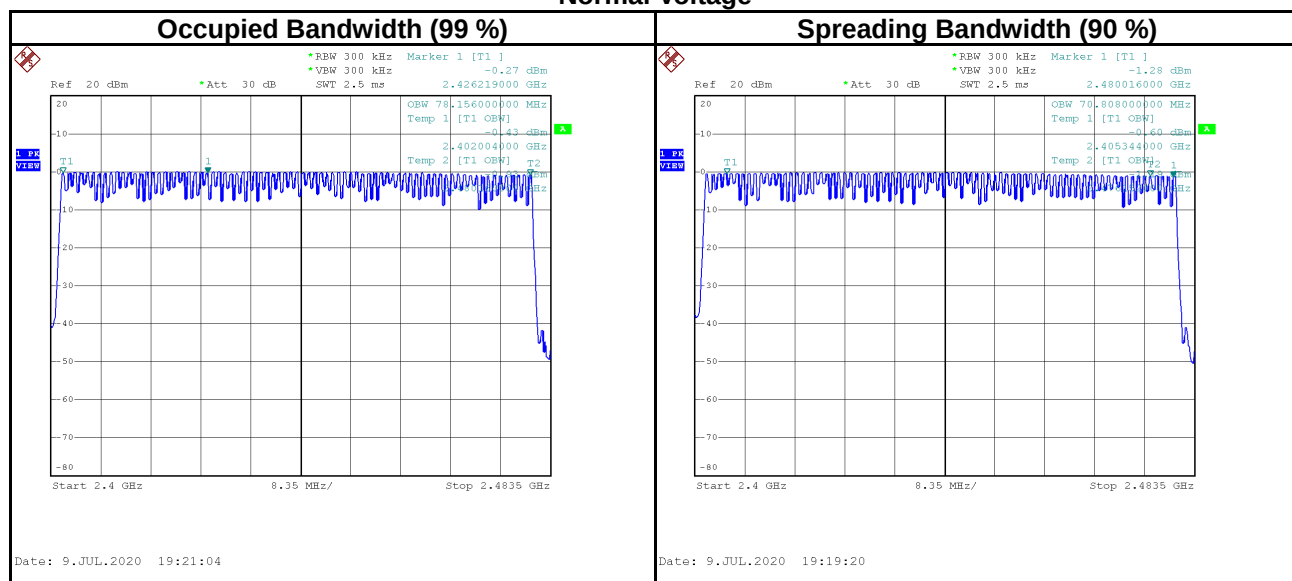


**APPENDIX B OCCUPIED BANDWIDTH (99%) AND
SPREAD-SPECTRUM BANDWIDTH (90%) / SPREADING FACTOR
(DIFFUSION RATE)**

Test Mode	1M_Hopping Mode	
Test Voltage (V)	Normal Voltage	Remark
Occupied Bandwidth (MHz)	78.16	Limit ≤ 26 MHz (RBW/VBW: 300 kHz)
Spreading Bandwidth (MHz)	70.81	Limit ≥ 500 kHz (FHSS, DSSS)
Spread Factor	70.81	Limit ≥ 5 (DSSS and FHSS)

Note: Spread Factor = Spread Bandwidth / TR (TR = 1)

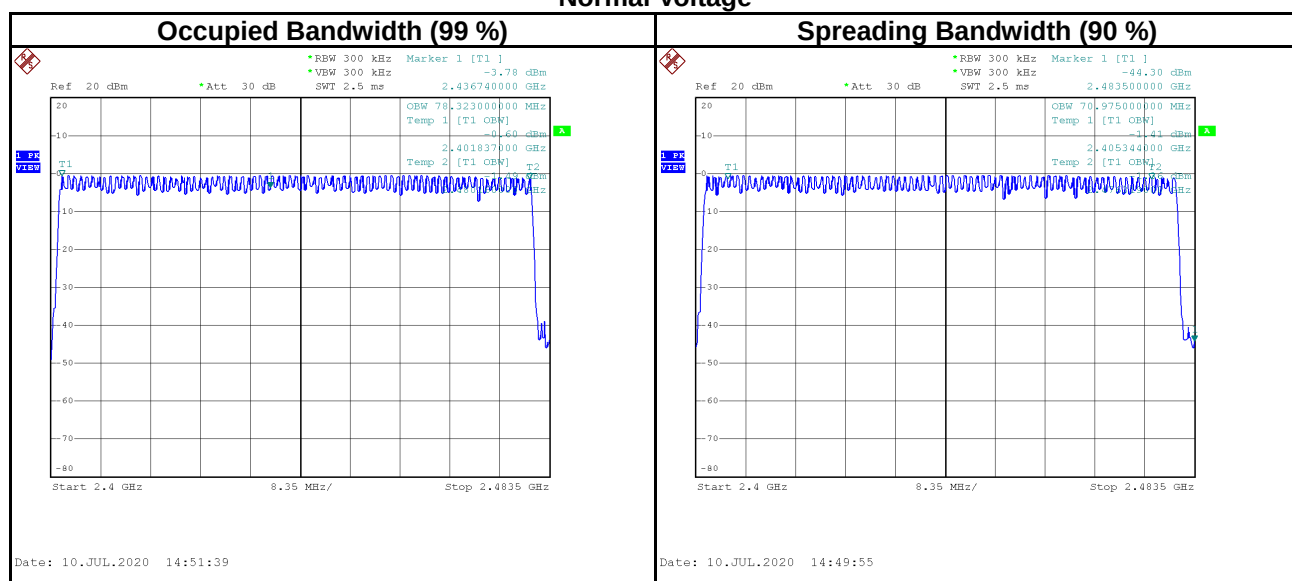
Normal Voltage



Test Mode	3M_Hopping Mode	
Test Voltage (V)	Normal Voltage	Remark
Occupied Bandwidth (MHz)	78.32	Limit ≤ 26 MHz (RBW/VBW: 300 kHz)
Spreading Bandwidth (MHz)	70.98	Limit ≥ 500 kHz (FHSS, DSSS)
Spread Factor	70.98	Limit ≥ 5 (DSSS and FHSS)

Note: Spread Factor = Spread Bandwidth / TR (TR = 1)

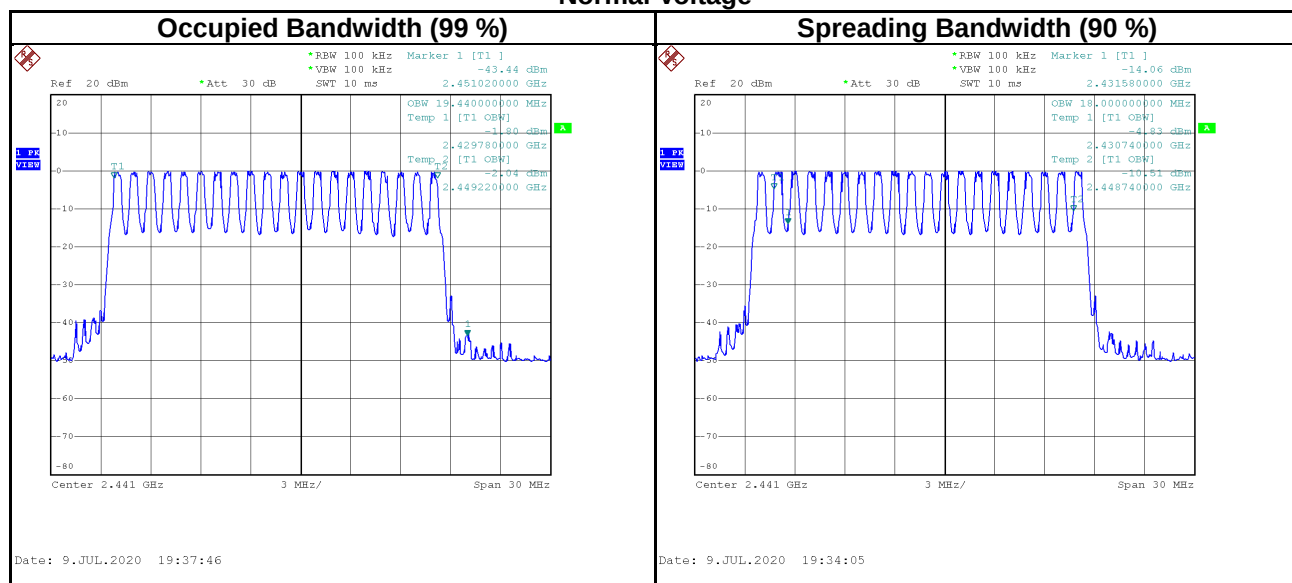
Normal Voltage



AFH mode		
Test Mode	1M_Hopping Mode	
Test Voltage (V)	Normal Voltage	Remark
Occupied Bandwidth (MHz)	19.44	Limit ≤ 26 MHz (RBW/VBW: 300 kHz)
Spreading Bandwidth (MHz)	18.00	Limit ≥ 500 kHz (FHSS, DSSS)
Spread Factor	18.00	Limit ≥ 5 (DSSS and FHSS)

Note: Spread Factor = Spread Bandwidth / TR (TR = 1)

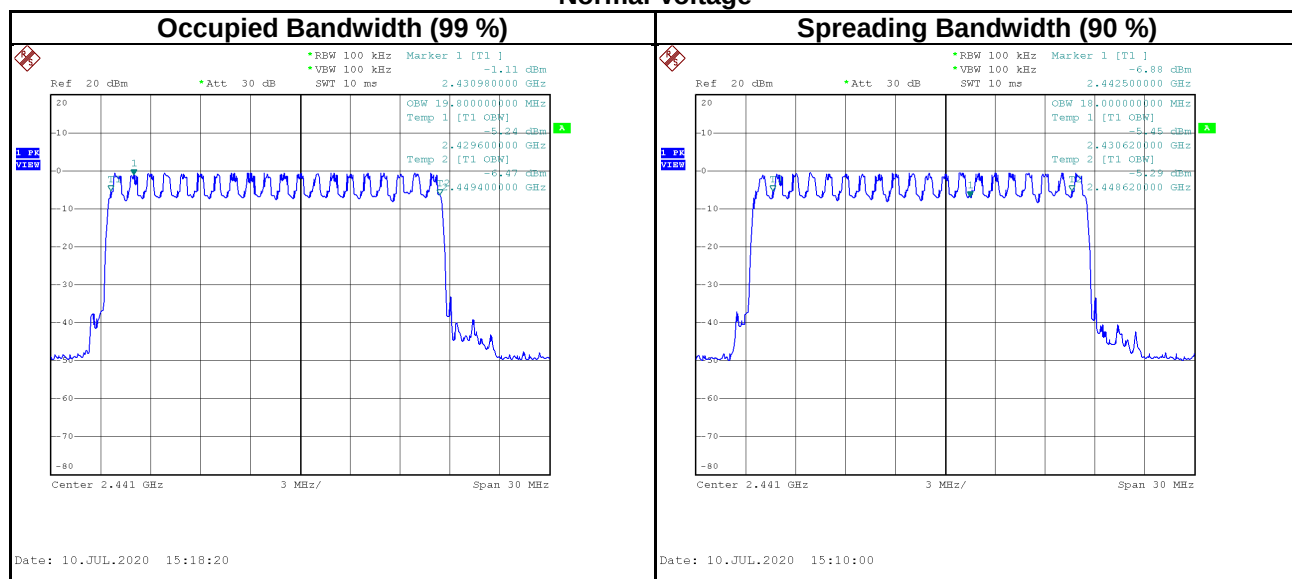
Normal Voltage



AFH mode		
Test Mode	3M_Hopping Mode	
Test Voltage (V)	Normal Voltage	Remark
Occupied Bandwidth (MHz)	19.80	Limit ≤ 26 MHz (RBW/VBW: 300 kHz)
Spreading Bandwidth (MHz)	18.00	Limit ≥ 500 kHz (FHSS, DSSS)
Spread Factor	18.00	Limit ≥ 5 (DSSS and FHSS)

Note: Spread Factor = Spread Bandwidth / TR (TR = 1)

Normal Voltage



APPENDIX C UNWANTED EMISSION INTENSITY

Test Mode		1M				
Test Voltage		V	Normal Voltage			Remark
Test Frequency		MHz	2402	2441	2480	Low/Middle/High of test frequency range
Unwanted Emission Intensity	※1	Raw (dBm/100kHz)	-56.60	-56.80	-56.98	
		Cable Loss (dB)	0.56	0.56	0.56	
		Measured (dBm/100kHz)	-56.04	-56.24	-56.42	Limit ≦ 0.25 μW/100kHz (-26 dBm/MHz)
		Measured (μW/100kHz)	0.0025	0.0024	0.0023	
	※2	Raw (dBm/MHz)	-59.69	-56.75	-57.14	
		Cable Loss (dB)	1.02	1.02	1.02	
		Measured (dBm/MHz)	-58.67	-55.73	-56.12	Limit ≤ 2.5 μW/MHz (-26 dBm/MHz)
		Measured (μW/MHz)	0.0014	0.0027	0.0024	
	※3	Raw (dBm/MHz)	-24.74	-55.94	-56.74	
		Cable Loss (dB)	1.02	1.02	1.02	
		Measured (dBm/MHz)	-23.72	-54.92	-55.72	Limit ≤ 25 μW/MHz (-16 dBm/MHz)
		Measured (μW/MHz)	4.2462	0.0032	0.0027	
	※4	Raw (dBm/MHz)	-57.14	-56.52	-40.23	
		Cable Loss (dB)	1.02	1.02	1.02	
		Measured (dBm/MHz)	-56.12	-55.50	-39.21	Limit ≤ 25 μW/MHz (-16 dBm/MHz)
		Measured (μW/MHz)	0.0024	0.0028	0.1199	
	※5	Raw (dBm/MHz)	-48.88	-50.25	-50.46	
		Cable Loss (dB)	5.59	5.59	5.59	
		Measured (dBm/MHz)	-43.29	-44.66	-44.87	Limit ≤ 2.5 μW/MHz (-26 dBm/MHz)
		Measured (μW/MHz)	0.0469	0.0342	0.0326	

NOTE: Measured Value = Raw + Cable Loss

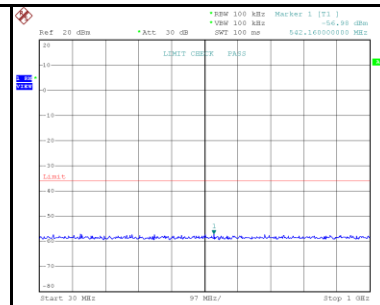
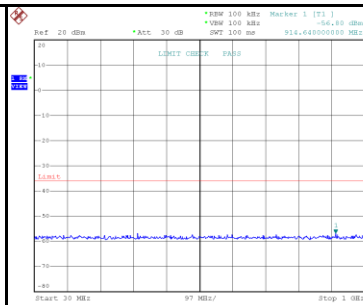
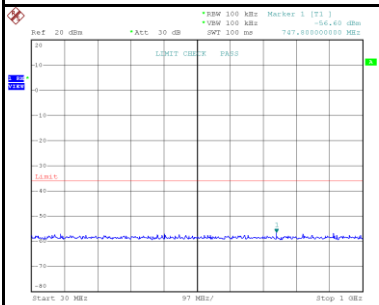
Normal Voltage

2402 MHz

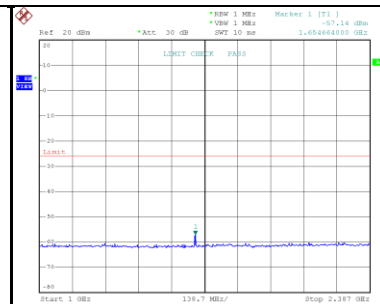
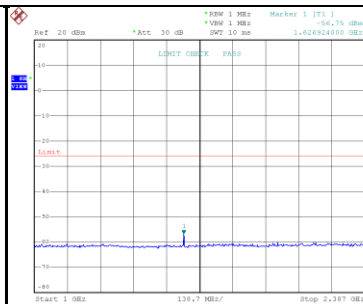
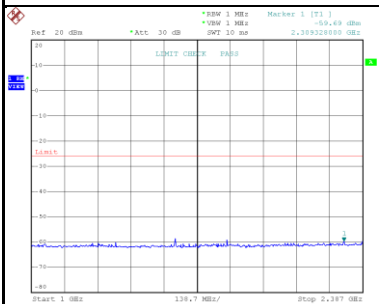
2441 MHz

2480 MHz

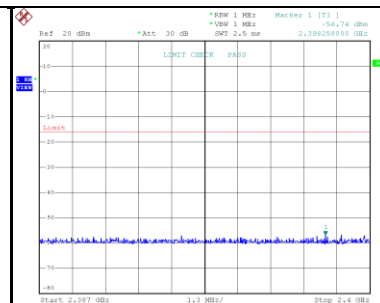
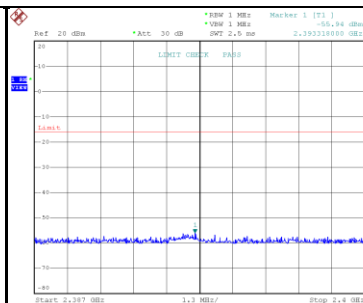
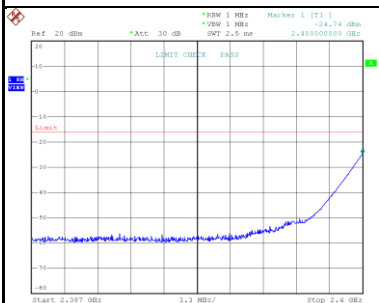
※1: 30 MHz to 1000 MHz



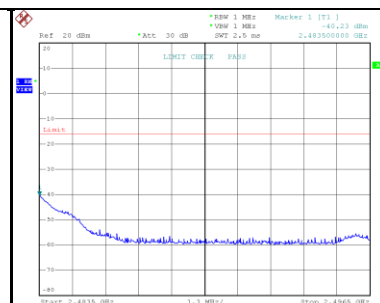
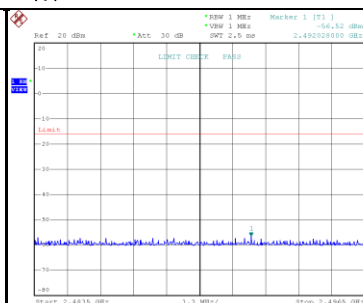
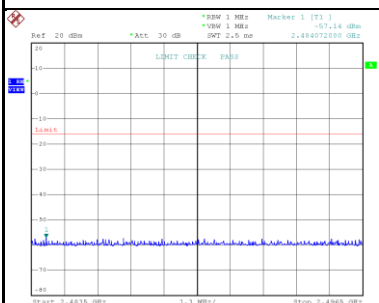
※2: 1000 MHz to 2387 MHz

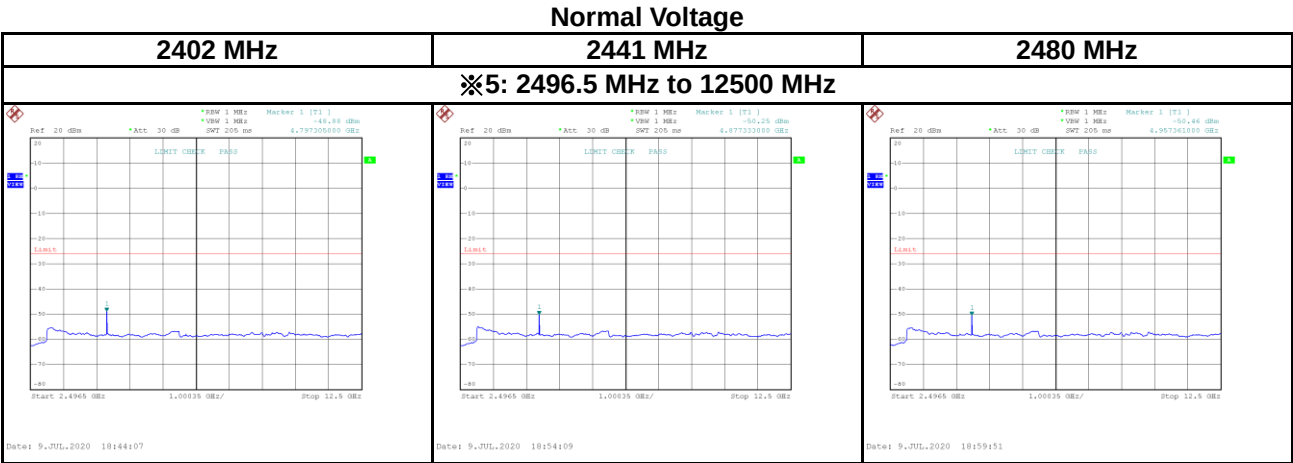


※3: 2387 MHz to 2400 MHz



※4: 2483.5 MHz to 2496.5 MHz





Test Mode		3M				
Test Voltage		V	Normal Voltage			Remark
Test Frequency		MHz	2402	2441	2480	Low/Middle/High of test frequency range
Unwanted Emission Intensity	※1	Raw (dBm/100kHz)	-56.38	-56.47	-56.72	
		Cable Loss (dB)	0.56	0.56	0.56	
		Measured (dBm/100kHz)	-55.82	-55.91	-56.16	Limit ≦ 0.25 μW/100kHz (-26 dBm/MHz)
		Measured (μW/100kHz)	0.0026	0.0026	0.0024	
	※2	Raw (dBm/MHz)	-57.91	-57.48	-55.54	
		Cable Loss (dB)	1.02	1.02	1.02	
		Measured (dBm/MHz)	-56.89	-56.46	-54.52	Limit ≤ 2.5 μW/MHz (-26 dBm/MHz)
		Measured (μW/MHz)	0.0020	0.0023	0.0035	
	※3	Raw (dBm/MHz)	-24.45	-56.95	-57.47	
		Cable Loss (dB)	1.02	1.02	1.02	
		Measured (dBm/MHz)	-23.43	-55.93	-56.45	Limit ≤ 25 μW/MHz (-16 dBm/MHz)
		Measured (μW/MHz)	4.5394	0.0026	0.0023	
	※4	Raw (dBm/MHz)	-56.93	-56.20	-40.44	
		Cable Loss (dB)	1.02	1.02	1.02	
		Measured (dBm/MHz)	-55.91	-55.18	-39.42	Limit ≤ 25 μW/MHz (-16 dBm/MHz)
		Measured (μW/MHz)	0.0026	0.0030	0.1143	
	※5	Raw (dBm/MHz)	-54.84	-55.22	-55.33	
		Cable Loss (dB)	5.59	5.59	5.59	
		Measured (dBm/MHz)	-49.25	-49.63	-49.74	Limit ≤ 2.5 μW/MHz (-26 dBm/MHz)
		Measured (μW/MHz)	0.0119	0.0109	0.0106	

NOTE: Measured Value = Raw + Cable Loss

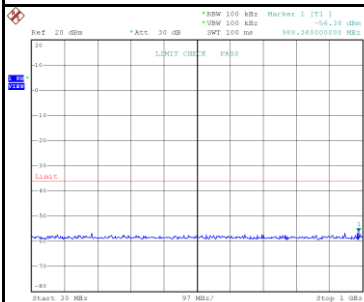
Normal Voltage

2402 MHz

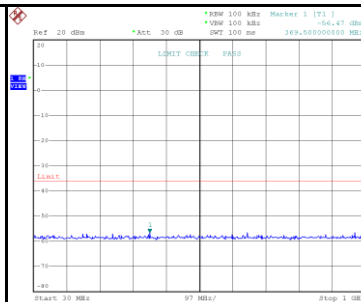
2441 MHz

2480 MHz

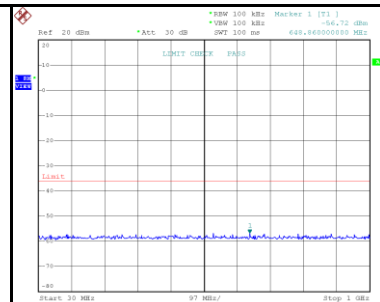
※1: 30 MHz to 1000 MHz



Date: 10.JUL.2020 14:22:57

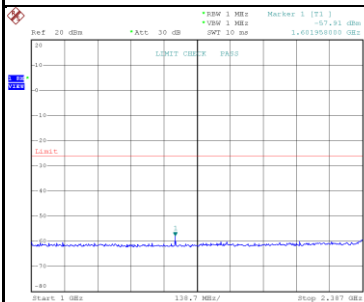


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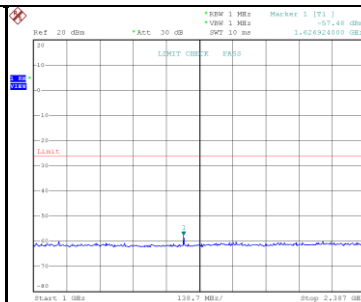


Date: 10.JUL.2020 14:42:54

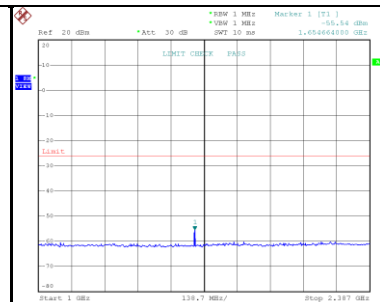
※2: 1000 MHz to 2387 MHz



Date: 10.JUL.2020 14:23:06

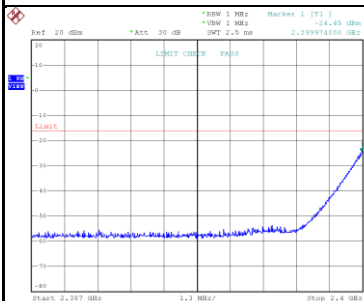


Date: 10.JUL.2020 14:44:10

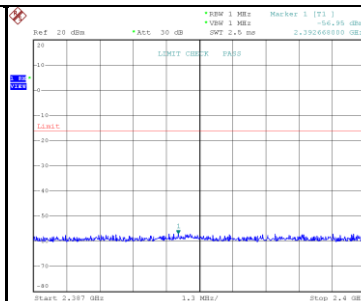


Date: 10.JUL.2020 14:43:03

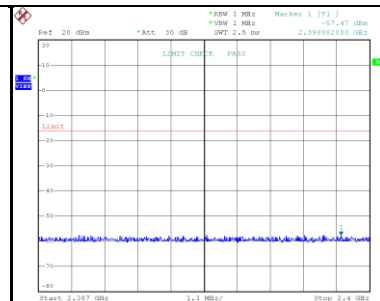
※3: 2387 MHz to 2400 MHz



Date: 10.JUL.2020 14:23:15

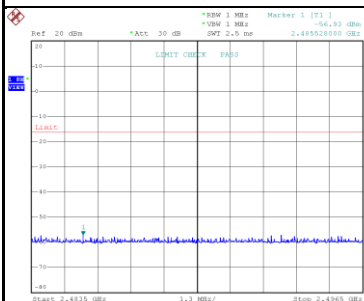


Date: 10.JUL.2020 14:44:19

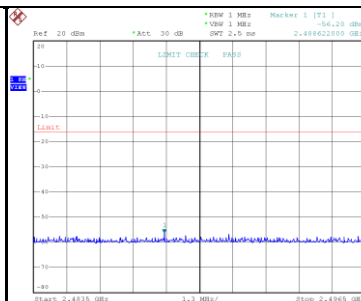


Date: 10.JUL.2020 14:43:12

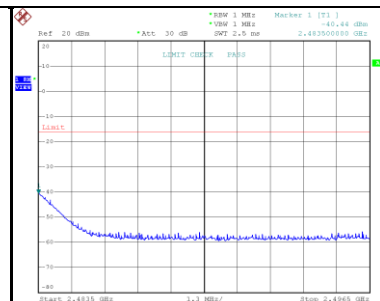
※4: 2483.5MHz to 2496.5 MHz



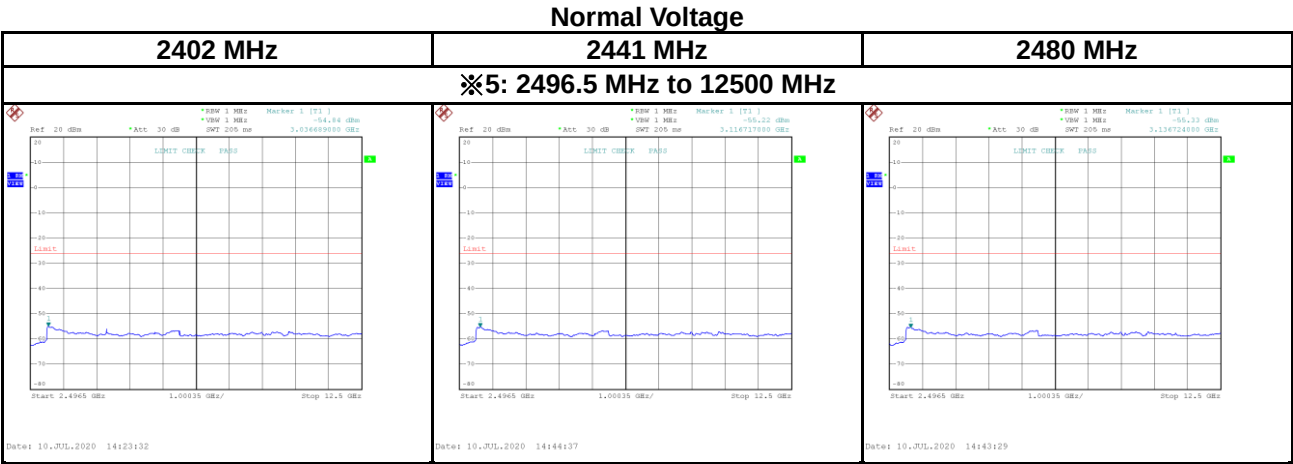
Date: 10.JUL.2020 14:23:23



Date: 10.JUL.2020 14:44:28



Date: 10.JUL.2020 14:43:20



APPENDIX D ANTENNA POWER TOLERANCE

Test Mode	1M				
Test Voltage	V	Normal Voltage			Remark
Test Frequency	MHz	2402	2441	2480	Low/Middle/High of test frequency range
Spreading Bandwidth	MHz	70.81			
Duty Cycle	%	77.13			
Bust Rate	-	1.30			
Power Meter Raw from EUT	dBm	-14.17	-13.59	-13.34	
Antenna Power (Conducted)	dBm/MHz	-14.17	-13.59	-13.34	
	mW/MHz	0.0383	0.0438	0.0463	Limit ≤ 3 mW/MHz
Rated Power	mW/MHz	0.0463			
Antenna Power Error	%	-17.40	-5.59	0.00	Limit + 20% ~ - 80%
Antenna Gain	dBi	0.37			
EIRP Power Density	dBm/MHz	-13.80	-13.22	-12.97	Limit ≤ 6.91 dBm/MHz
	mW/MHz	0.0417	0.0476	0.0505	Limit ≤ 4.9 mW/MHz

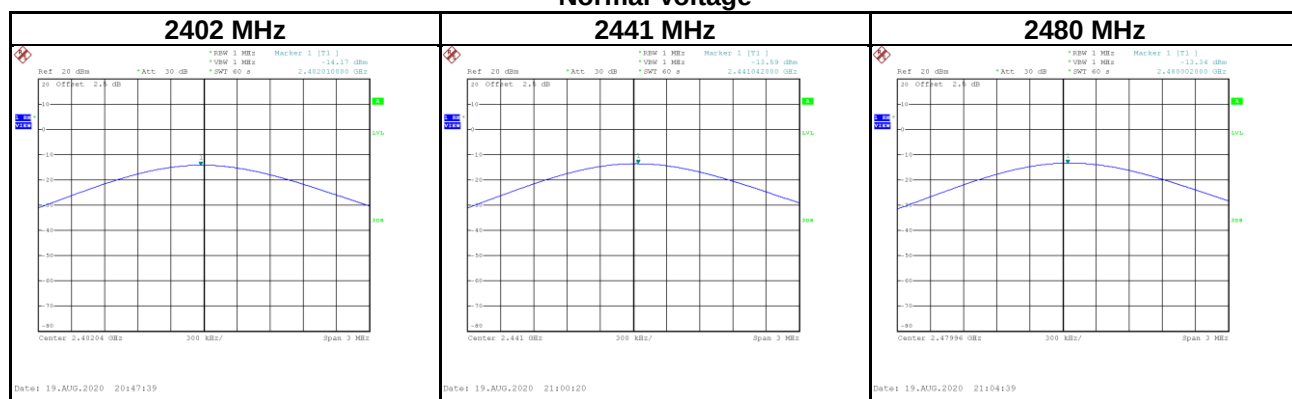
Note:

79 hop Result [mW/MHz] =

$10^{(\text{Power Meter Raw (EIRP)}[\text{dBm}] / 10)} / \text{Spread-Bandwidth (90\% OBW)} [\text{MHz}] \times \text{Bust Rate}$

Bust Rate= 1/Duty Cycle

Normal Voltage



Test Mode	3M				
Test Voltage	V	Normal Voltage			Remark
Test Frequency	MHz	2402	2441	2480	Low/Middle/High of test frequency range
Spreading Bandwidth	MHz	70.98			
Duty Cycle	%	76.66			
Bust Rate	-	1.30			
Power Meter Raw from EUT	dBm	-15.88	-16.13	-16.69	
Antenna Power (Conducted)	dBm/MHz	-15.88	-16.13	-16.69	
	mW/MHz	0.0258	0.0244	0.0214	Limit ≤ 3 mW/MHz
Rated Power	mW/MHz	0.0258			
Antenna Power Error	%	0.00	-5.59	-17.01	Limit + 20% ~ - 80%
Antenna Gain	dBi	0.37			
EIRP Power Density	dBm/MHz	-15.51	-15.76	-16.32	Limit ≤ 6.91 dBm/MHz
	mW/MHz	0.0281	0.0265	0.0233	Limit ≤ 4.9 mW/MHz

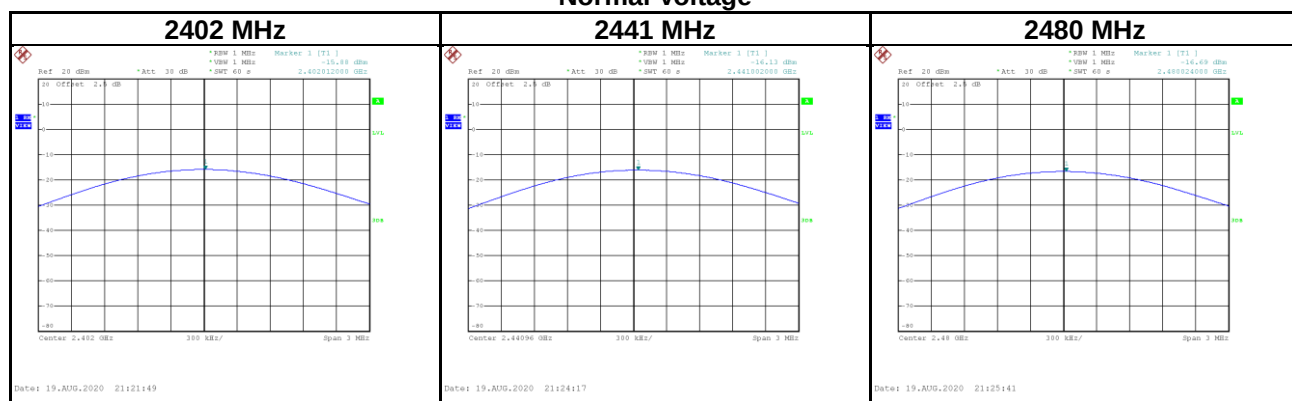
Note:

79 hop Result [mW/MHz] =

$10^{(\text{Power Meter Raw (EIRP)}[\text{dBm}] / 10) / \text{Spread-Bandwidth (90\% OBW)} [\text{MHz}] \times \text{Bust Rate}}$

Bust Rate= 1/Duty Cycle

Normal Voltage



AFH mode					
Test Mode	1M				
Test Voltage	V	Normal Voltage			Remark
Test Frequency	MHz	2430	2439	2449	Low/Middle/High of test frequency range
Power Meter Raw from EUT	dBm	-7.40	-7.32	-7.33	
Antenna Power (Conducted)	dBm/MHz	-7.40	-7.32	-7.33	
	mW/MHz	0.1819	0.1853	0.1849	Limit ≤ 3 mW/MHz
AFH Rated Power	mW/MHz	0.1853			
Antenna Power Error	%	-1.83	0.00	-0.23	Limit + 20% ~ - 80%

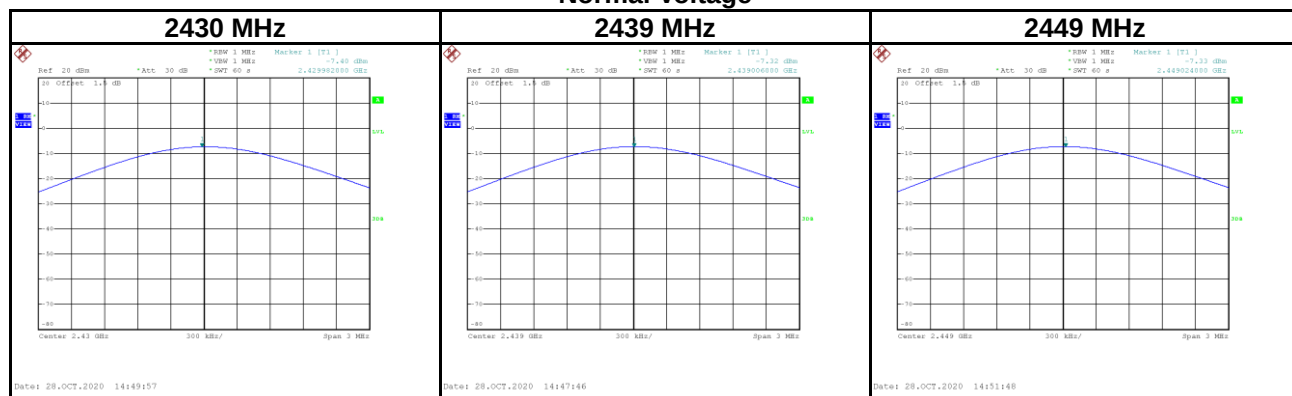
Note:

79 hop Result [mW/MHz] =

$10^{(\text{Power Meter Raw (EIRP)[dBm]} / 10)} / \text{Spread-Bandwidth (90\% OBW) [MHz]} \times \text{Burst Rate}$

Burst Rate= 1/Duty Cycle

Normal Voltage



AFH mode					
Test Mode	3M				
Test Voltage	V	Normal Voltage			Remark
Test Frequency	MHz	2430	2439	2449	Low/Middle/High of test frequency range
Power Meter Raw from EUT	dBm	-7.26	-7.33	-7.51	
Antenna Power (Conducted)	dBm/MHz	-7.26	-7.33	-7.51	
	mW/MHz	0.1879	0.1849	0.1774	Limit ≤ 3 mW/MHz
AFH Rated Power	mW/MHz	0.1879			
Antenna Power Error	%	0.00	-1.60	-5.59	Limit + 20% ~ - 80%

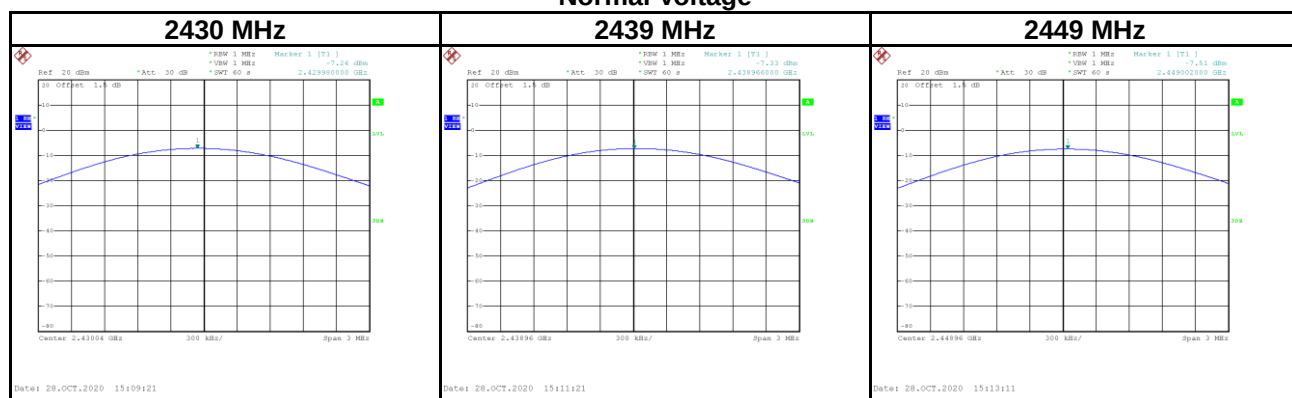
Note:

79 hop Result [mW/MHz] =

$10^{(\text{Power Meter Raw (EIRP)}[\text{dBm}] / 10)} / \text{Spread-Bandwidth (90\% OBW)} [\text{MHz}] \times \text{Burst Rate}$

Burst Rate= 1/Duty Cycle

Normal Voltage

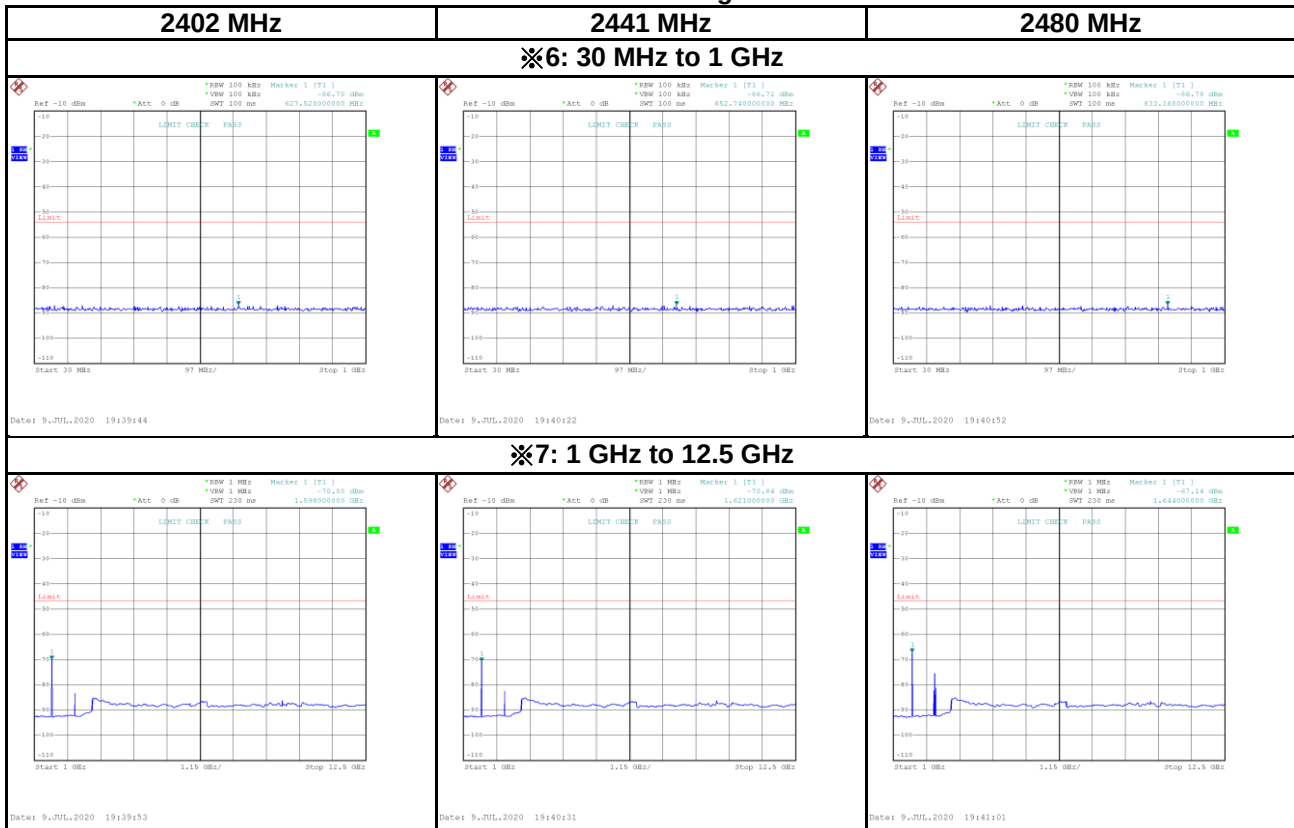


APPENDIX E LIMITATION OF COLLATERAL EMISSION OF RECEIVER

Test Mode		1 M			
Test Voltage		V	Normal Voltage		
Test Frequency		MHz	2402	2441	2480
Limitation of Collateral Emission of Receiver		Raw (dBm)	-86.70	-86.72	-86.78
		Cable Loss (dB)	0.56	0.56	0.56
		Measured (dBm)	-86.14	-86.16	-86.22
		Measured (μW)	0.0024	0.0024	0.0024
		Limit ≤ 4 nW (-54 dBm)			
		Raw (dBm)	-70.00	-70.84	-67.14
		Cable Loss (dB)	5.59	5.59	5.59
		Measured (dBm)	-64.41	-65.25	-61.55
		Measured (μW)	0.3622	0.2985	0.6998
		Limit ≤ 20 nW (-47 dBm)			

NOTE: Measured Value = Raw + Cable Loss

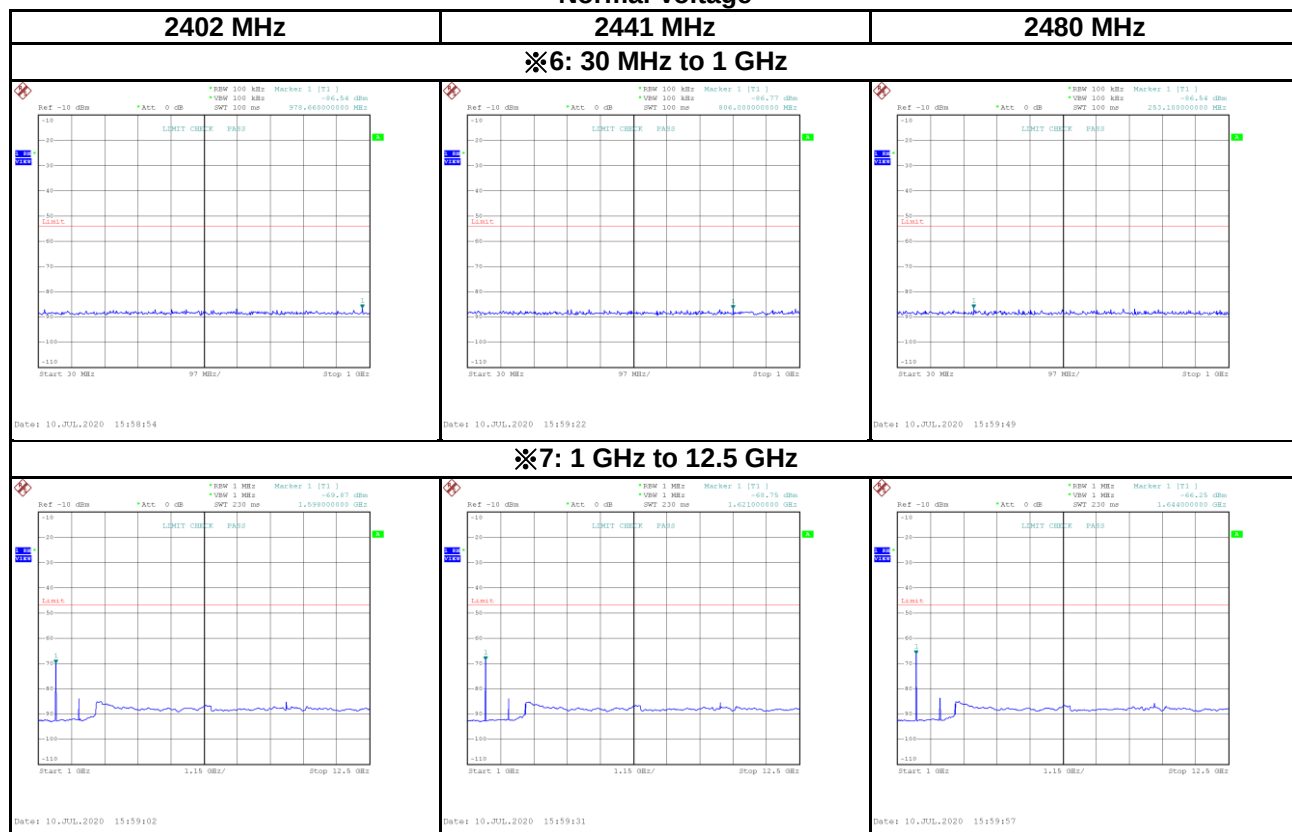
Normal Voltage



Test Mode		3 M			
Test Voltage		V	Normal Voltage		
Test Frequency		MHz	2402	2441	2480
Limitation of Collateral Emission of Receiver		Raw (dBm)	-86.54	-86.77	-86.54
		Cable Loss (dB)	0.56	0.56	0.56
		Measured (dBm)	-85.98	-86.21	-85.98
		Measured (μW)	0.0025	0.0024	0.0025
		Limit ≤ 4 nW (-54 dBm)			
		Raw (dBm)	-69.87	-68.75	-66.25
		Cable Loss (dB)	5.59	5.59	5.59
		Measured (dBm)	-64.28	-63.16	-60.66
		Measured (μW)	0.3733	0.4831	0.8590
		Limit ≤ 20 nW (-47 dBm)			

NOTE: Measured Value = Raw + Cable Loss

Normal Voltage

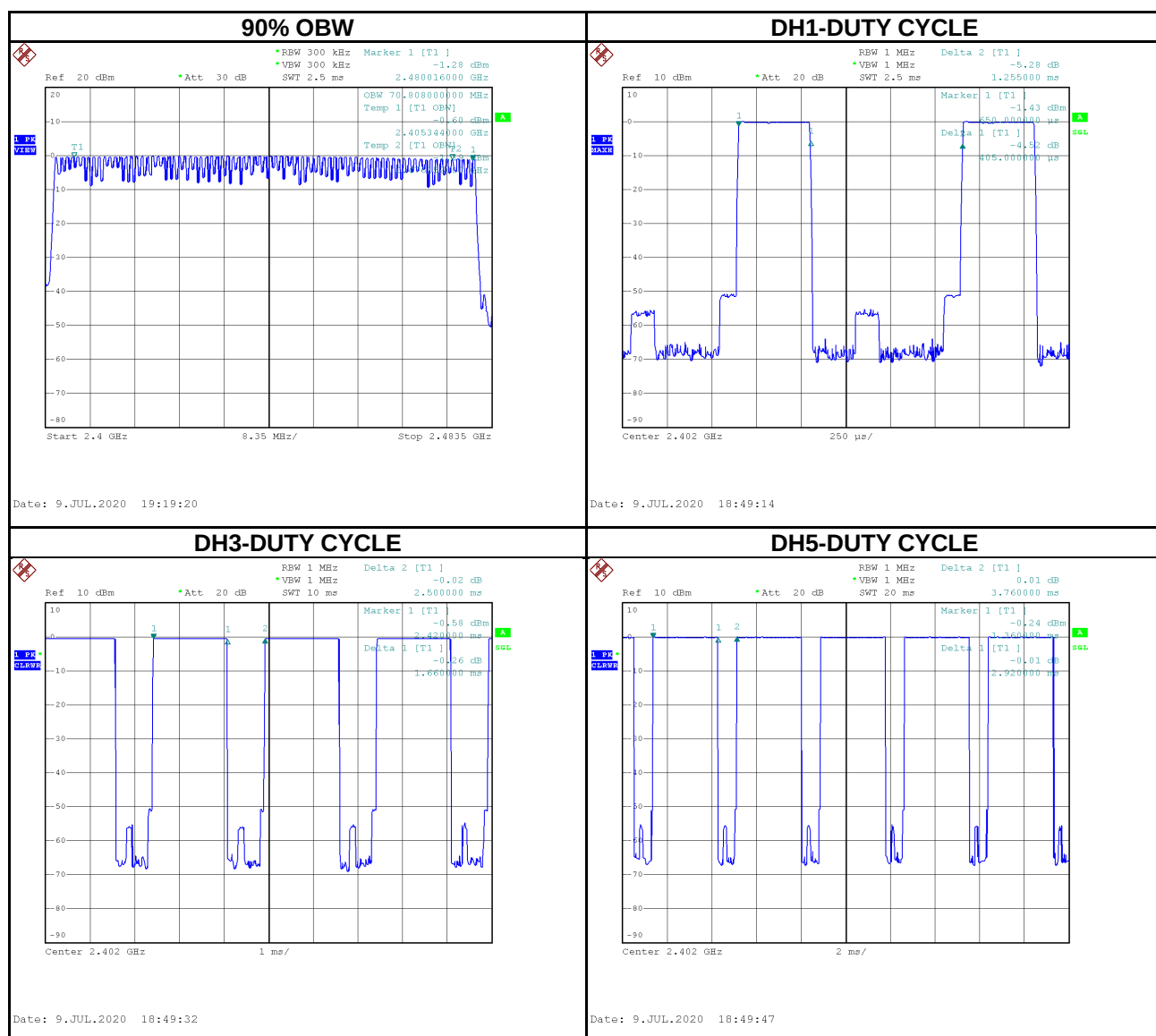


APPENDIX F HOPPING FREQUENCY DWELL TIME

Test Mode	1M_2402 MHz			
Test Voltage	V	Normal Voltage		Remark
Data Packet	90% OBW	Duty cycle	Dwell Time	Limits
	(MHz)	(%)	(s)	(s)
DH1	70.81	0.3227	0.1157	0.4
DH3	70.81	0.6640	0.2381	0.4
DH5	70.81	0.7766	0.2784	0.4

Duty-cycle = [on time/total time] x 100%

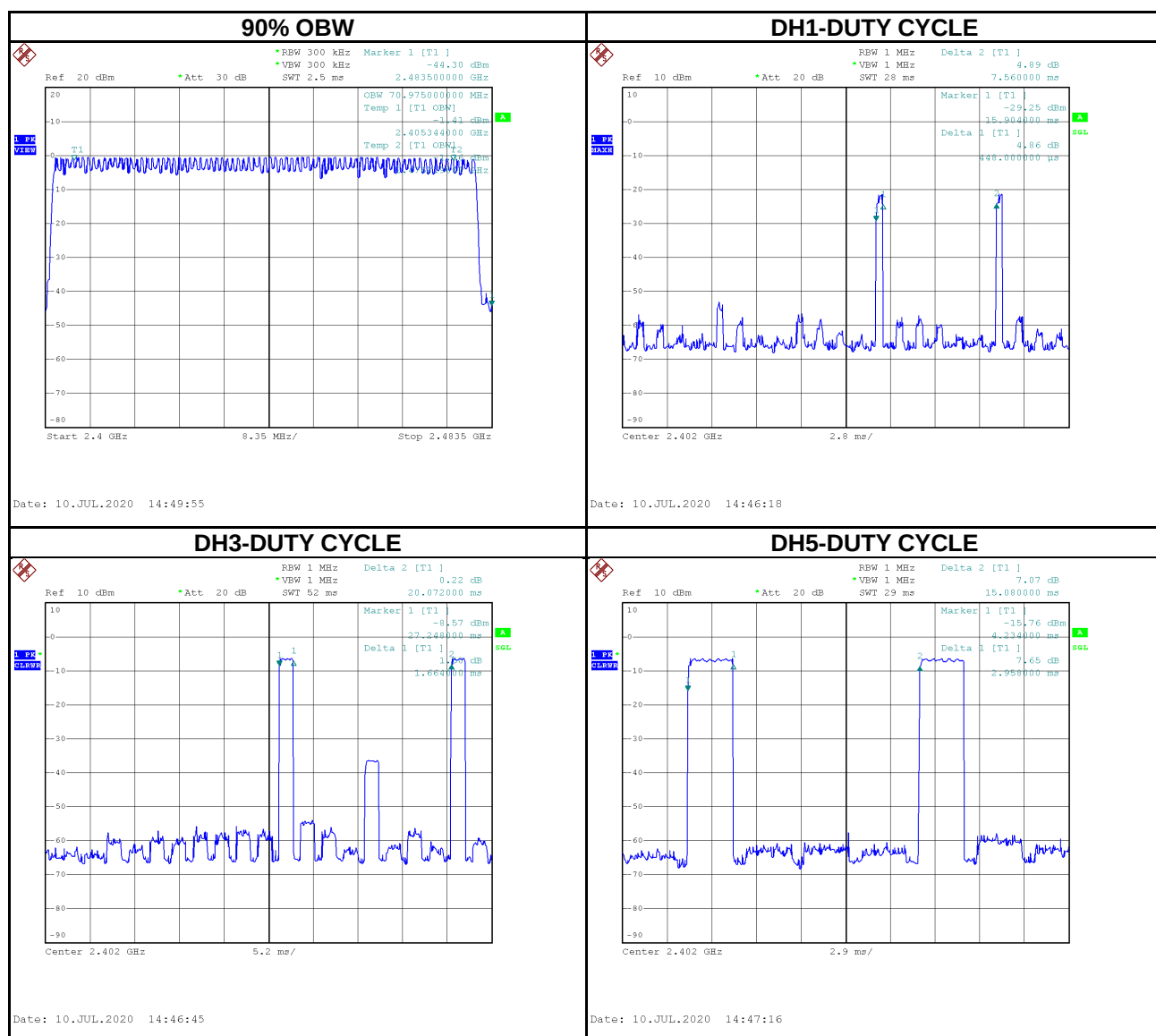
Dwell time = [spreading rate/79] x duty-cycle x 0.4 seconds



Test Mode	3M_2402 MHz			
Test Voltage	V	Normal Voltage		Remark
Data Packet	90% OBW	Duty cycle	Dwell Time	Limits
	(MHz)	(%)	(s)	(s)
DH1	70.98	0.0593	0.0213	0.4
DH3	70.98	0.0829	0.0298	0.4
DH5	70.98	0.1962	0.0705	0.4

Duty-cycle = [on time/total time] x 100%

Dwell time = [spreading rate/79] x duty-cycle x 0.4 seconds



End of Test Report