

RF Test Report

Applicant : BUFFALO INC.

Product Type : Bluetooth USB Adapter

Trade Name : BUFFALO

Model Number : DFE00001

Applicable Standard : Notification No.88 of MIC, 2004, Annex 43
2.4 GHz band wide-band low-power data communication system
(Item 19 of Article 2 Paragraph 1)

Received Date : Feb. 15, 2022

Test Period : Mar. 07 ~ Mar. 31, 2022

Issued Date : Apr. 25, 2022

Issued by

A Test Lab Techno Corp.
No. 140-1, Changan Street, Bade District,
Taoyuan City 334025, Taiwan (R.O.C)
Tel : +886-3-2710188 / Fax : +886-3-2710190

Note:

- 1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
- 2.This report shall not be reproduced except in full, without the written approval of A Test Lab Technology Corporation.
- 3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Revision History

Rev.	Issued Date	Revisions	Revised By
00	Apr. 25, 2022	Initial Issue	Snow Wang

Verification of Compliance

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2.4 GHz band wide-band low-power data communication system
(Item 19 of Article 2 Paragraph 1)

Test Result : Complied

Performed Lab. : A Test Lab Techno Corp.
No. 140-1, Changan Street, Bade District,
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The above equipment has been tested by A Test Lab Techno Corp., and found compliance with the requirements set forth in the 2.4 GHz band wide-band low-power data communication system (Item 19 of Article 2 Paragraph 1) and technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved By : 

(Kai Yu Yang)

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1 General Information

1.1. EUT Description

Applicant	BUFFALO INC. AKAMONDORI Bldg., 30-20, Ohsu 3-chome, Naka-ku, Nagoya-shi, Aichi 460-8315 Japan		
Product Type	Bluetooth USB Adapter		
Trade Name	BUFFALO		
Model Number	DFE00001		
Antenna Information	Trade Name: LYNwave Model Number: ALX19M-052AA3 Antenna Type: PIFA Max. Gain: -1.2 dBi		
Radio Equipment	2.4 GHz Band Wide-Band Low-Power Data Communication System		
Classification of Specified Radio Equipment	Article 2 Clause 1 Item 19		
Frequency Band	Bluetooth LE : 1 Mbps Bluetooth 2LE : 2 Mbps		
Frequency Range	2402-2480 MHz		
Channel Number	40		
Channel Separated	2 MHz		
Modulation Type	GFSK		
Type of Emissions	F1D		
Declared Rated Power	Bluetooth LE	4.613 mW	6.640 dBm
	Bluetooth 2LE	4.130 mW	6.160 dBm
E.I.R.P.	Bluetooth LE	5.440 dBm	
	Bluetooth 2LE	4.960 dBm	
Tested Circuit Insertion Loss	1 dB		
Operate Temp. Range	0 ~ 40 °C		
EUT Power Rating	DC 5 V		

1.2. Summary of Test Result

Item	Result	Remark
Frequency Error	PASS	----
Occupied Bandwidth	PASS	----
Antenna Power (Conducted)	PASS	----
Unwanted Emission Strength	PASS	----
Secondarily Emitted Radio Wave Strength	PASS	----
Radio Interference Prevention Capability Measurement	PASS	----

Decision Rule

- Uncertainty is not included.
- Uncertainty is included.

2 Test Methodology

2.1. Mode of Operation

Test Category

2.4 GHz Band Wideband Low-Power Data Communication System

Test Mode
Mode 1: LE Continuous TX mode
Mode 2: 2LE Continuous TX mode

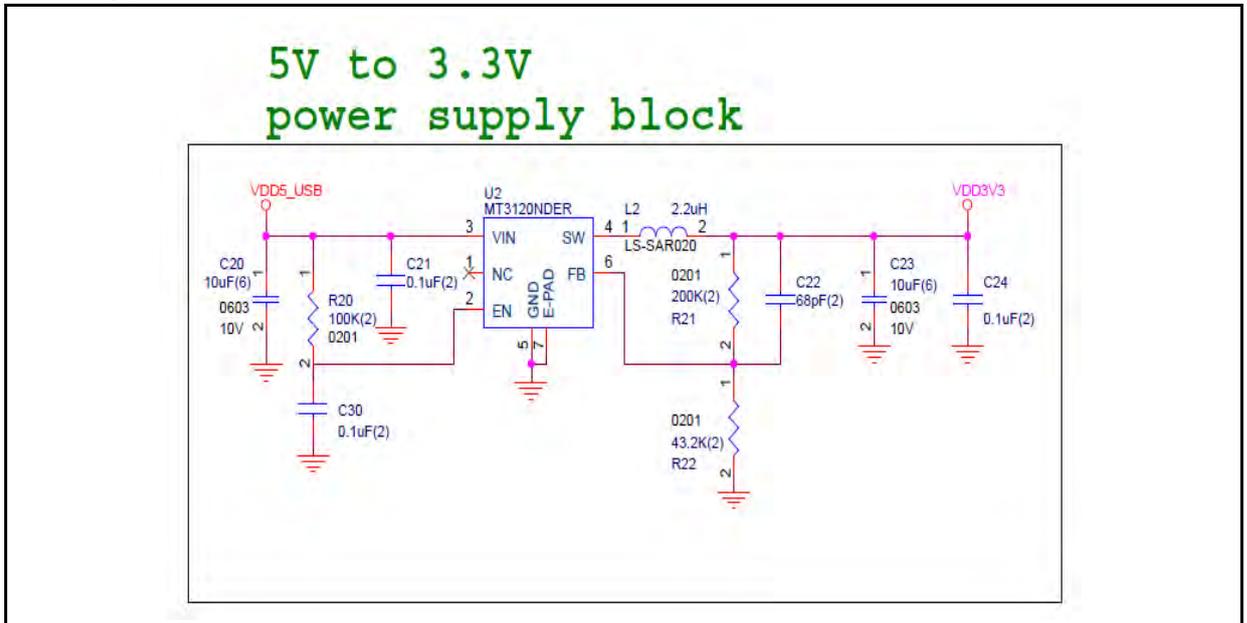
Comprehensive operation test

The normal voltage settings are respectively adopted during the test. Because the voltage error are less than 1 %.

Constant voltage check

EUT and Module Power tables				
EUT Setup Value (Vdc)		Normal	Hight(+10 %)	Low(-10 %)
		5	5.5	4.5
Module Vdd Power Measurement Value (Vdc)		Normal	Hight(+10 %)	Low(-10 %)
		3.31	3.32	3.31
Voltage error (%)	Result	Ref. level	-0.3021	0.0000
	Limit	---	± 1	
Judgment		---	PASS	PASS

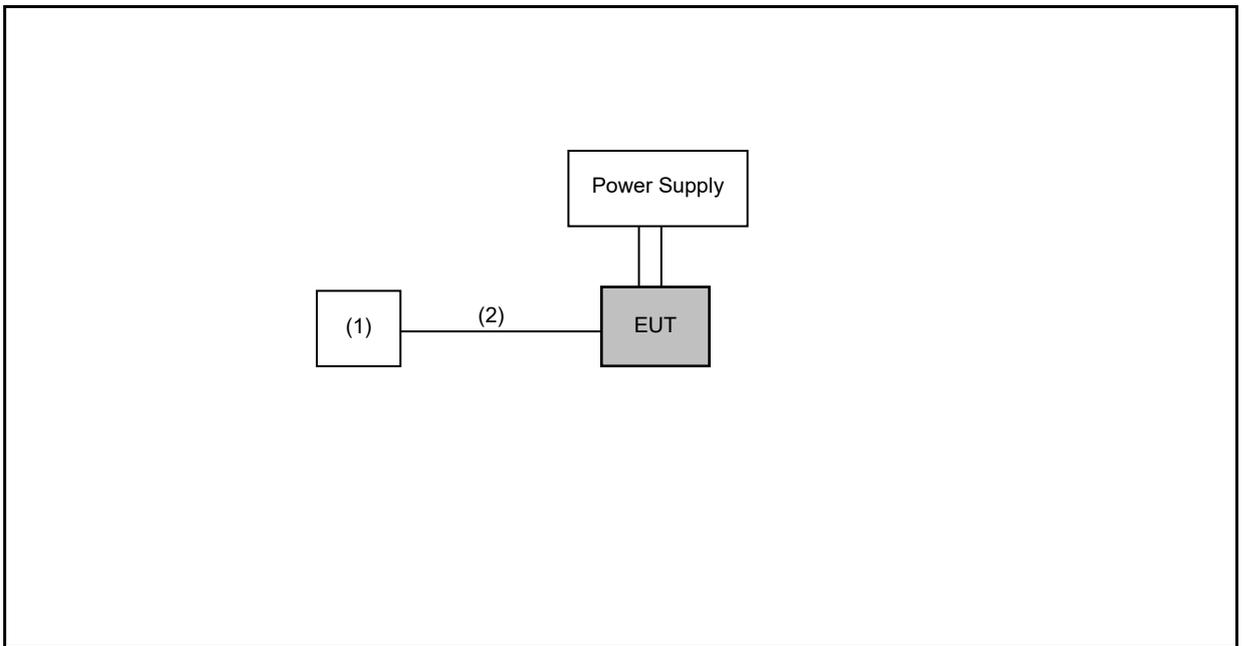
Measuring point



2.2. EUT Test Step

1.	Setup the EUT shown on "Configuration of Test System Details".
2.	Turn on Bluetooth function.
3.	EUT run test program.

2.3. Configuration of Test System Details



	Product	Manufacturer	Model Number	Serial Number	Power Cord
(1)	Notebook	ASUS	BU400A	---	---
(2)	USB Cable	ATL	ATL-001		

2.4. Test Instruments

For Conducted

Test Period: Mar. 07 ~ Mar. 31, 2022

Testing Engineer: Peter Shui

Use	Equipment	Manufacturer	Model Number	Serial Number	Calibration Authority	Cal. Date	Cal. Period	Cal. Method
<input checked="" type="checkbox"/>	Power Sensor	Anritsu	MA2411B	1126022	ETC	Sep. 03, 2021	1 year	(C)
<input checked="" type="checkbox"/>	Power Meter	Anritsu	ML2495A	1135009	ETC	Sep. 03, 2021	1 year	(C)
<input type="checkbox"/>	Power Sensor	Agilent	N1921A	MY45241957	ETC	Dec. 06, 2021	1 year	(C)
<input type="checkbox"/>	Power Meter	Agilent	N1911A	MY45101619	ETC	Dec. 06, 2021	1 year	(C)
<input type="checkbox"/>	Spectrum Analyzer (10 Hz~26.5 GHz)	Keysight	N9010B	MY59071418	ETC	Mar. 17, 2021	1 year	(C)
<input type="checkbox"/>	Spectrum Analyzer (9 kHz~26.5 GHz)	Agilent	N9010A	MY48030518	ETC	Jul. 23, 2021	1 year	(C)
<input checked="" type="checkbox"/>	Spectrum Analyzer (20 Hz~26.5 GHz)	Agilent	N9020A	US47520902	ETC	Sep. 09, 2021	1 year	(C)
<input type="checkbox"/>	Spectrum Analyzer (3 Hz~50 GHz)	Agilent	N9030A	MY53120541	ETC	Jan. 05, 2022	1 year	(C)
<input type="checkbox"/>	Signal Generator	Keysight	N5182B	MY53052569	ETC	Apr. 20, 2021	1 year	(C)
<input type="checkbox"/>	Signal Generator	Keysight	N5182BX07	MY59360221	ETC	Apr. 20, 2021	1 year	(C)
<input type="checkbox"/>	Wireless Connectivity Tester	R&S	CMW270	102208	R&S	Jun. 02, 2021	1 year	(C)
<input checked="" type="checkbox"/>	Power Supply	KEITHLEY	2303	4045290	OCL	Jan. 19, 2022	1 year	(C)

Remark :

- (a) Calibration conducted by the National Institute of Information and Communications Technology (NICT) in Japan (hereinafter referred to as "NICT") or a designated calibration agency under Article 102-18 paragraph (1) in JRL.
- (b) Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Act (Act No. 51 of 1992).
- (c) Calibration conducted in countries except Japan, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).
- (d) Calibration, etc. conducted by using measuring instruments and other equipment listed in the right column of appended table No. 3, which shall have been given any type of calibration, etc. listed above from (a) to (c)

From JRL Article 24-2, paragraph 4, Item 2

2.5. Uncertainty of Measured Value

Test Item	Uncertainty
Frequency Error	1.3×10^{-7}
Occupied Bandwidth	4.5%
Spread Bandwidth	4.5%
Antenna Power Error	1.1 dB
Unwanted Emission Strength	1.1 dB
Secondarily Emitted Radio Wave Strength	1.1 dB

2.6. Test Site Environment

Items	Test Item	Required	Actual
Temperature (°C)	Conducted	5-35	20-30
Humidity (%RH)		45-85	45-75

Site Name: A Test Lab Techno Corp.
 Site Address: No. 140-1, Changan Street, Bade District,
 Taoyuan City 334025, Taiwan (R.O.C)
 TEL : 886-3-271-0188 / FAX : 886-3-271-0190
<http://www.atl-lab.com.tw/e-index.htm>

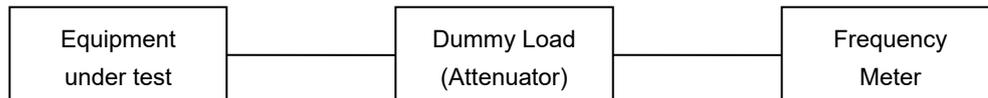
3 Measurement Procedure

3.1. Frequency Error Measurement

- **Limit**

Frequency Tolerances ≤ 50 ppm.

- **Test Setup**



- **Measuring Equipment Conditions**

- (1) Use a frequency counter that has sensitivity of -20 dBm or better or a spectrum analyzer that has synthesized local oscillator.
- (2) Accuracy of the frequency counter shall be one tenth of the tolerance specified for EUT or less (e.g. 5×10^{-6} or less)
- (3) Attenuation of the attenuator shall be adjusted to give the optimum operation input level to the frequency meter in order to avoid the effect from the amplitude fluctuation of measurement wave.
- (4) When measuring burst waves, use the pulse measuring function of the counter and set the gate open time to a value that enables the measurement though entire period of burst as long as possible.

- **Conditions of Equipment under Test**

- (1) Set the EUT to the test frequency and transmit RF signal.
- (2) The modulation state is "continuous wave without modulation" by stopping spread spectrum in principle. But, if it is not possible, it shall be "continuous burst wave without modulation".

- **Measuring Operation Procedures**

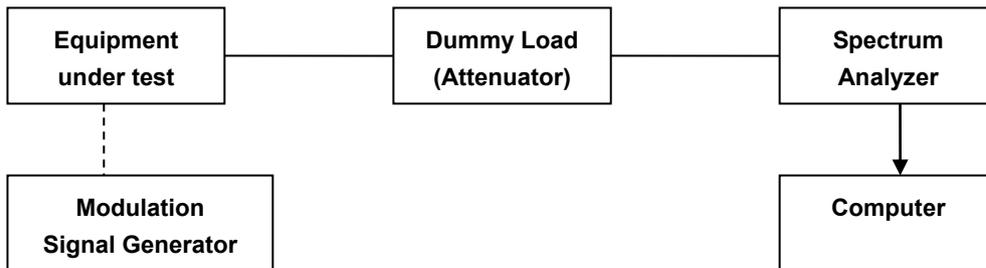
In case of burst waves, the measurement shall be done for enough time (e.g. covering 20 or more of burst waves) in order to obtain the enough measuring accuracy, and the average of the measured values becomes the final value.

3.2. Occupied Bandwidth Measurement

- **Limit**

Max. Occupied Bandwidth: 26 MHz.

- **Test Setup**



- **Measuring Equipment Conditions**

Spectrum Analyzer Setting

SPAN : 200 MHz

RBW : 300 kHz

VBW : 300 kHz

Sweep Time : AUTO (Minimum time to ensure measurement accuracy.)

Data Points : 401 points or more

Indication mode : Max hold

Detection Mode : Positive Peak

Storage Mode : Normal

Y-axis Scale : 10 dB/Div.

Reference Level : Enough level for maximum dynamic range

- **Conditions of Equipment under Test**

Set to testing frequency and modulate using standard encoding test signals.

■ Measuring Operation Procedures

- (1) Configure the setting of the spectrum analyzer to 3.3(1).
- (2) After repeating sweeps until no display changes are found, import the values of all the data points as array variables of the computer.
- (3) Convert the dB value into the antilog of the power dimension (i.e. mW) for all the data.
- (4) Find the total power of the all the data and record as "Total Power" in mW.
- (5) Add power to the minimum frequency data in order and find the value of the limiting data point that is 0.5 % of the "Total Power". Convert the limiting point into a frequency and record as the "lower limit" frequency.
- (6) Add power to the maximum frequency data in order and find the value of the limiting data point that is 0.5 % of the "Total Power". Convert the limiting point into a frequency and record as the "upper limit" frequency.

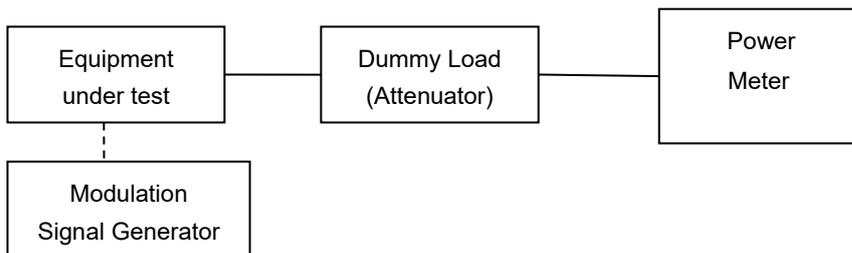
3.3. Antenna Power (Conducted) Measurement

- **Limit**

RF Output Power ≤ 10 mW.

RF Output Power Tolerance $\leq -80\% \sim +20\%$.

- **Test Setup**



- **Measuring Equipment Conditions**

a. Use power meter to measure burst power.

- **Conditions of Equipment under Test**

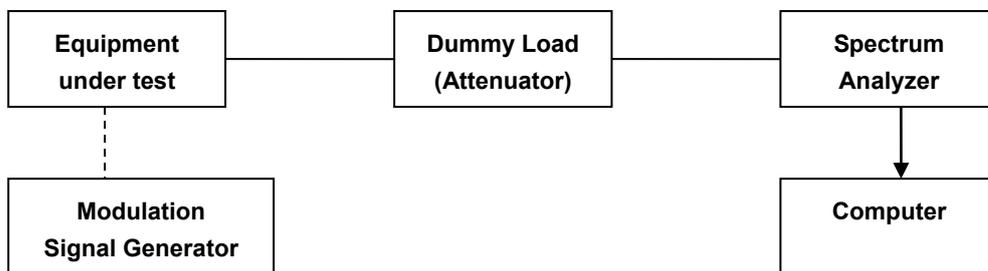
a. Connect the high frequency power meter to the output of the attenuator and measure the total power (without bandwidth limitation)

3.4. Unwanted Emission Strength Measurement

■ **Limit**

Frequency (MHz)	Limit (μW/MHz)
Under 2387 MHz	≤ 2.5
2387-2400 MHz	≤ 25
2483.5-2496.5 MHz	≤ 25
2496.5 - 12.5 GHz	≤ 2.5

■ **Test Setup**



Note 1: The computer is used for calculating the mean value of amplitude levels.

■ **Measuring Equipment Conditions**

(1) The setting of the spectrum analyzer during spurious searches are as follow:

- Sweep Bandwidth: Starts spurious searches from the smallest possible frequencies to more than 5 times the carrier frequencies..
- Resolution bandwidth: 1 MHz
- Video bandwidth: 1 MHz
- Y-axis scale: 10 dB/Div.
- Input level: Maximum dynamic range value
- Sweep time: Minimum amount of time to ensure measurement accuracy.
- Sweep mode: Continuous mode
- Data Points: Over 400 points
- Detection mode: Positive peak
- Display mode: Maximum hold

(2) The setting of spectrum analyzer while conducting spurious amplitude measurement are as follows:

Center Frequency: Acquired spurious frequency in (1)

Frequency sweep width: 0 MHz

Resolution bandwidth: 1 MHz

Video bandwidth: Same as Resolution bandwidth

Note: take into account that the requirement limits the power in a bandwidth of 1 MHz. If the measurement is carried out with a bandwidth of 100 kHz (for frequencies below 1 GHz), the limit shall be reduced with 10 dB

Y-axis scale: 10 dB/Div

Input level: Choose input level within the linear range of the SA mixer (so that no additional spurious are generated by the mixer).

Sweep mode: Minimum amount of time to ensure measurement accuracy.

Data Points: Over 400 points

Sweep mode: Single sweep

Detection mode: Sample (BIN-Width \ll RBW, so that all spurious emissions are captured). [BIN-width is the frequency difference between 2 adjacent sample points on the display.]

■ **Conditions of Equipment under Test**

Set the testing frequency and testing spread codes and modulate using standard encoding test signals. Choose a frequency / channel according to specified range (Low, Middle and High).

Note: If the spurious limit is specified with the EIRP value, the effective (maximum) antenna gain shall be taken into account.

■ **Measuring Operation Procedures**

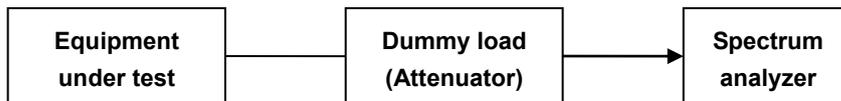
- (1) Configure the settings of the spectrum analyzer to 8.3(1) and search for spurious frequencies by sweeping. Do not conduct the measurements in 8.3(2) if the amplitude value of the acquired spurious frequencies meets the standard value.
- (2) If the acquired spurious amplitude value exceeds the standard value, narrow the sweep Bandwidth, in the order of 100 MHz, 10 MHz, and 1 MHz, to increase the frequency accuracy of the spectrum analyzer and accurately find the spurious frequency. Configure the spectrum analyzer to the settings in 8.3(2), find the average of the spurious amplitude values (in the case of burst waves, the average values are within the respective burst and set this as the measured value. Averaging can be done by summing up the power (display must give the linear power in uW) according to 8.3(2) and dividing by the amount of points. Correction on the equivalent noise bandwidth shall be necessary (if not realized automatically).

3.5. Secondarily Emitted Radio Wave Strength Measurement

■ **Limit**

Frequency (MHz)	Limit (nW)
Under 1 GHz	≤ 4
1 - 12.5 GHz	≤ 20

■ **Test Setup**



■ **Measuring Equipment Conditions**

- (1) Set the attenuation of the attenuator to under 20 dB because the subject for measurement is of low level.
- (2) Set the spectrum analyzer as follow:
 - Frequency sweep width: See 7.5 Measuring Operation Procedures
 - Resolution bandwidth: A value determined by the specified dynamic range and the sweep time. (e.g. 30 kHz for 8 GHz sweep width and 30 second sweep time.).
 - Video bandwidth: Approximately the same bandwidth as resolution bandwidth.
 - Y-axis scale: 10 dB/Div
 - Input level: 0 dB, if possible.
 - Sweep mode: Single sweep
 - Detection mode: Positive peak

■ **Conditions of Equipment under Test**

Set the EUT to receiver the test frequency with forced continuous receiving control.

■ **Measuring Operation Procedures**

Sweep the spectrum analyzer from a low frequency to a frequency of 3 times if the carrier or over (e.g. 10 MHz to about 8 GHz) and measure the collateral radio emissions.

3.6. Radio Interference Prevention Capability Measurement

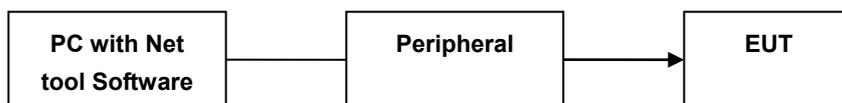
- **Limit**

Identification code \geq 48 bits

- **Measuring Id Code Software**

MAC IP List: MAC Scan

- **Test Setup**



- **Measuring Operation Procedures**

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

3.7. Construction Protection Confirmation Method

- **Limit**

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

4 Test Results

Mode 1: LE Continuous TX mode

2. TEST RESULTS DATA FOR JAPANESE CERTIFICATION

Peak Antenna Gain	-1.200	dBi
Declaration Output Power	4.613	mW
Declaration Output Power	6.640	dBm
EIRP	5.440	dBm
Input Power Voltage	5	Vdc

Tested Circit Insertion Loss		1	dB
Burst	ON TIME	-Not applicable-	sec
	OFF TIME	-Not applicable-	sec
	Ratio	-Not applicable-	%
Packet Type (Mode)		-Not applicable-	mode

Frequency equal to the transmission rate of the modulation signal	
0	MHz

Test Category ; 2.4GHz Band Wideband Low-Power Data Communication System

Comprehensive operation test
: In order to receive constant voltage from DC power supply, power supply voltage examines only by usual state voltage.

2.1 TEST Results (Normal Voltage)

Measurement Frequency	MHz	2402	2440	2480	Result	Limit	
Channel Number	Ch.	0	19	39	-----		
Reading Frequency	MHz	2401.9835	2439.9850	2479.9832	-----		
Frequency Tolerance	ppm	-6.87	-6.15	-6.77	PASS	$-50 \leq x \leq +50$	
Occupied Bandwidth	MHz	1.2243	1.2250	1.2285	PASS	≤ 26 MHz	
RF Output Power	mW	4.613	4.130	4.375	PASS	≤ 10 mW	
RF Output Power Tolerance	%	0.000	-10.470	-5.159	PASS	$-80 \leq x \leq +20$	
EIRP	dBm	5.440	4.960	5.210			
Unwanted Emission Strength (TX1)	Under 2387MHz	μ W/MHz	0.004	0.003	0.003	PASS	≤ 2.5 uW/MHz
		MHz	2382.300	2382.300	2363.400	-----	
	2387-2400MHz	μ W/MHz	1.284	0.004	0.003	PASS	≤ 25 uW/MHz
		MHz	2400.000	2399.584	2399.701	-----	
	2483.5-2496.5MHz	μ W/MHz	0.003	0.003	0.015	PASS	≤ 25 uW/MHz
		MHz	2487.205	2483.682	2483.552	-----	
	2496.5 - 12.5GHz	μ W/MHz	0.045	0.033	0.015	PASS	≤ 2.5 uW/MHz
		MHz	4807.000	4877.000	4957.000	-----	
Secondarily Emitted Radio Wave Strength (RX Spurious) (RX1)	Under 1GHz	nW	0.001	0.001	0.001	PASS	≤ 4 nW
		MHz	730.340	932.100	716.760	-----	
	1 - 12.5GHz	nW	0.018	0.028	0.022	PASS	≤ 20 nW
		MHz	5750.000	2426.000	4795.000	-----	
Interference Prevention Function	-----	good			PASS		

Mode 2: 2LE Continuous TX mode

2. TEST RESULTS DATA FOR JAPANESE CERTIFICATION

Peak Antenna Gain	-1.200	dBi
Declaration Output Power	4.130	mW
Declaration Output Power	6.160	dBm
EIRP	4.960	dBm
Input Power Voltage	5	Vdc

Tested Circuit Insertion Loss		1	dB
Burst	ON TIME	-Not applicable-	sec
	OFF TIME	-Not applicable-	sec
	Ratio	-Not applicable-	%
Packet Type (Mode)		-Not applicable-	mode

Frequency equal to the transmission rate of the modulation signal	
0	MHz

Test Category ; 2.4GHz Band Wideband Low-Power Data Communication System

Comprehensive operation test

: In order to receive constant voltage from DC power supply, power supply voltage examines only by usual state voltage.

2.1 TEST Results (Normal Voltage)

Measurement Frequency	MHz	2402	2440	2480	Result	Limit	
Channel Number	Ch.	0	19	39	-----		
Reading Frequency	MHz	2401.9829	2439.9826	2479.9814	-----		
Frequency Tolerance	ppm	-7.12	-7.13	-7.50	PASS	$-50 \leq x \leq +50$	
Occupied Bandwidth	MHz	2.1749	2.1686	2.1678	PASS	≤ 26 MHz	
RF Output Power	mW	4.130	3.981	3.828	PASS	≤ 10 mW	
RF Output Power Tolerance	%	0.000	-3.608	-7.312	PASS	$-80 \leq x \leq +20$	
EIRP	dBm	4.960	4.800	4.630			
Unwanted Emission Strength (TX1)	Under 2387MHz	μ W/MHz	0.004	0.003	0.002	PASS	≤ 2.5 uW/MHz
		MHz	2382.300	2363.400	2384.600	-----	
	2387-2400MHz	μ W/MHz	0.068	0.003	0.003	PASS	≤ 25 uW/MHz
		MHz	2400.000	2399.766	2399.987	-----	
	2483.5-2496.5MHz	μ W/MHz	0.003	0.003	0.041	PASS	≤ 25 uW/MHz
		MHz	2484.475	2495.317	2483.500	-----	
	2496.5 - 12.5GHz	μ W/MHz	0.047	0.031	0.016	PASS	≤ 2.5 uW/MHz
		MHz	4807.000	4877.000	4957.000	-----	
Secondarily Emitted Radio Wave Strength (RX Spurious) (RX1)	Under 1GHz	nW	0.001	0.001	0.001	PASS	≤ 4 nW
		MHz	797.270	777.870	796.300	-----	
	1 - 12.5GHz	nW	0.022	0.020	0.020	PASS	≤ 20 nW
		MHz	3197.000	3197.000	4795.000	-----	
Interference Prevention Function	-----	good			PASS		

■ **Antenna List**

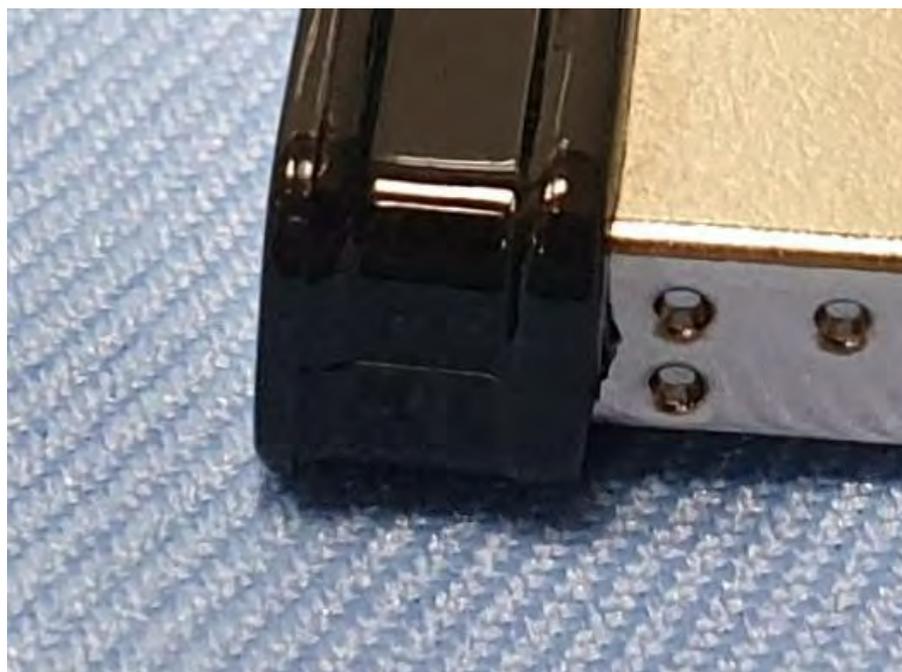
Antenna			Gain Specification			Notes (Cable or Others)
No	Type	Model Name	Max Gain (dBi)	Attenuation (dB)	Net Gain (dBi)	
1	PIFA	ALX19M-052AA3	-1.2	0	0	Polarization(Horizontal+Vertical)

■ **Construction Protection Confirmation Method**

Confirmation Method

<input type="checkbox"/>	1. Sealed with special screws (indicate the special screws used in Exterior View Drawings, and also attach its technical drawings of such screws).
<input checked="" type="checkbox"/>	2. Plastic chassis is being welded using ultrasonic waves.
<input type="checkbox"/>	3. Chassis is glued using a special adhesive.
<input type="checkbox"/>	4. Metal covers are spot-fused (indicate the fused points in Exterior View Drawings).
<input type="checkbox"/>	5. Cover is specially interlocked (indicate the interlocked part in Exterior View Drawings).
<input type="checkbox"/>	6. Shield case is welded at RF and modulation parts, and ID-ROM is welded using the BGA Method.
<input type="checkbox"/>	7. Shield case is welded at RF and modulation parts, and ID-ROM is glued at its lead with a special adhesive.
<input type="checkbox"/>	8. Shield case is welded at RF and modulation parts, and ID-ROM is glued with a non-transparent laminating agent.
<input type="checkbox"/>	9. Other ()

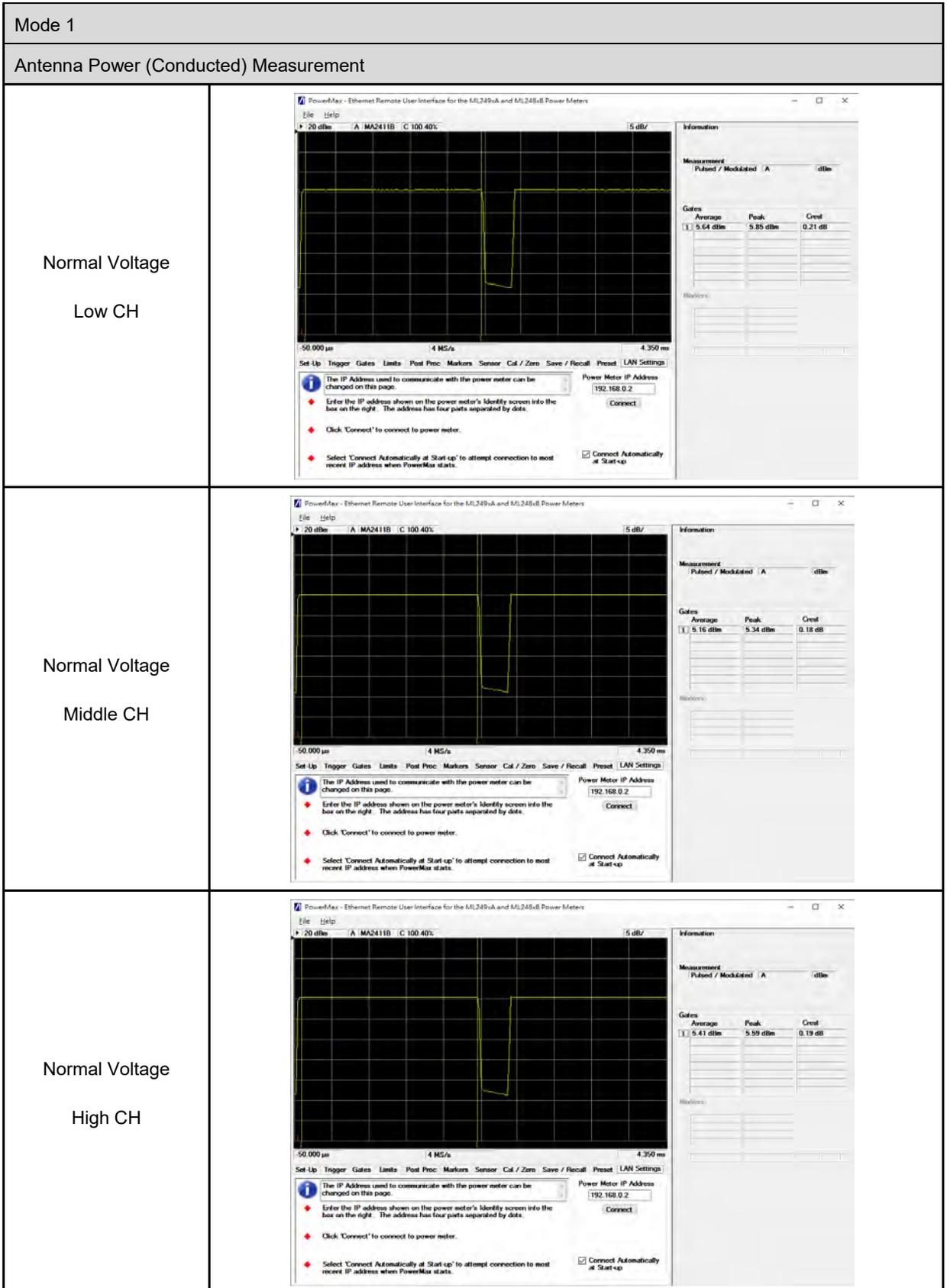
Photo



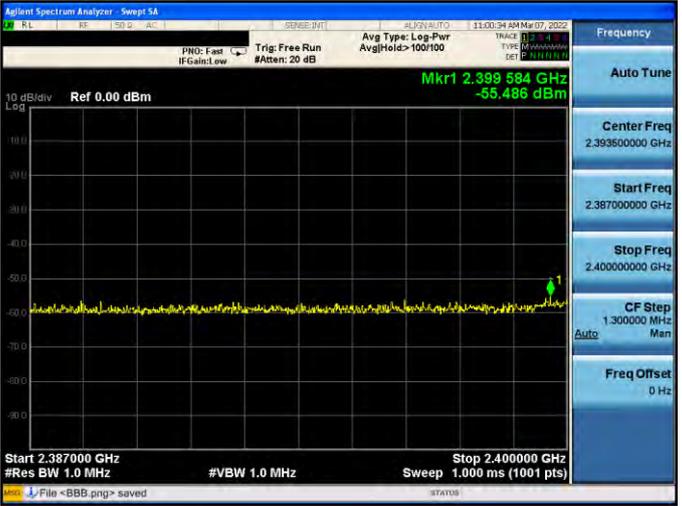
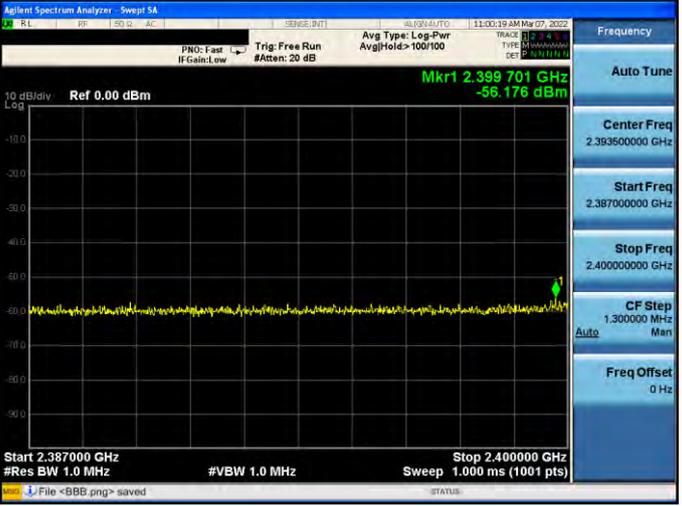
■ Test Graphs

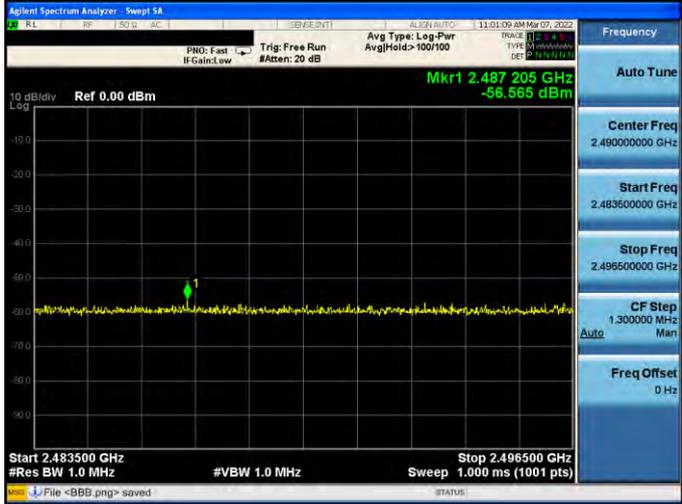
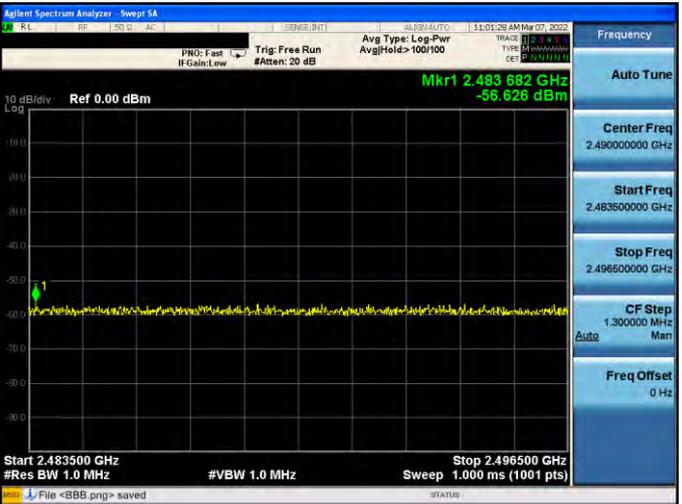
Mode 1	
Frequency Error Measurement	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

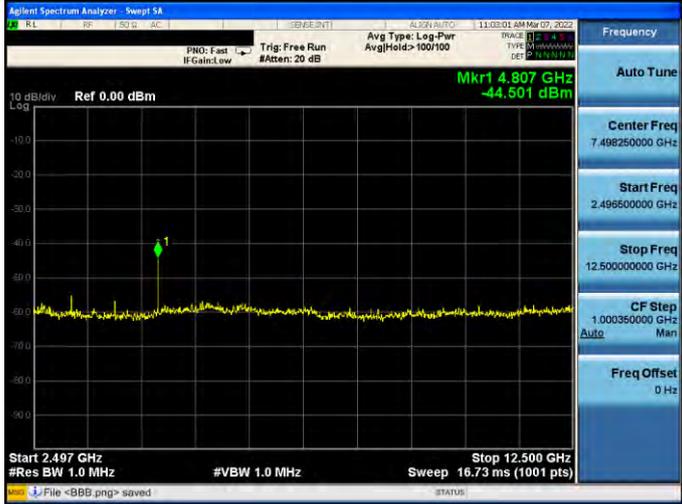
Mode 1	
Occupied Bandwidth Measurement	
<p>Normal Voltage Low CH</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.40200000 GHz Trig: Free Run #Att: 30 dB</p> <p>Ref 20.00 dBm</p> <p>10 dB/div Log</p> <p>Center 2.402 GHz #Res BW 300 kHz #VBW 300 kHz Span 3 MHz Sweep 1 ms</p> <p>Occupied Bandwidth: 1.2243 MHz Total Power: 9.86 dBm</p> <p>Transmit Freq Error: -18.034 kHz OBW Power: 99.00 % x dB Bandwidth: 1.760 MHz x dB: -26.00 dB</p> <p>Frequency: 2.40200000 GHz CF Step: 300.000 kHz Freq Offset: 0 Hz</p>
<p>Normal Voltage Middle CH</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.44000000 GHz Trig: Free Run #Att: 30 dB</p> <p>Ref 20.00 dBm</p> <p>10 dB/div Log</p> <p>Center 2.44 GHz #Res BW 300 kHz #VBW 300 kHz Span 3 MHz Sweep 1 ms</p> <p>Occupied Bandwidth: 1.2250 MHz Total Power: 9.88 dBm</p> <p>Transmit Freq Error: -18.707 kHz OBW Power: 99.00 % x dB Bandwidth: 1.757 MHz x dB: -26.00 dB</p> <p>Frequency: 2.44000000 GHz CF Step: 300.000 kHz Freq Offset: 0 Hz</p>
<p>Normal Voltage High CH</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.48000000 GHz Trig: Free Run #Att: 30 dB</p> <p>Ref 20.00 dBm</p> <p>10 dB/div Log</p> <p>Center 2.48 GHz #Res BW 300 kHz #VBW 300 kHz Span 3 MHz Sweep 1 ms</p> <p>Occupied Bandwidth: 1.2285 MHz Total Power: 9.34 dBm</p> <p>Transmit Freq Error: -16.634 kHz OBW Power: 99.00 % x dB Bandwidth: 1.774 MHz x dB: -26.00 dB</p> <p>Frequency: 2.48000000 GHz CF Step: 300.000 kHz Freq Offset: 0 Hz</p>



Mode 1	
Unwanted Emission Strength Measurement	
30 MHz – 2387 MHz	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

Mode 1	
Unwanted Emission Strength Measurement	
2387 MHz – 2400 MHz	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

Mode 1	
Unwanted Emission Strength Measurement	
2483.5 MHz – 2496.5 MHz	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

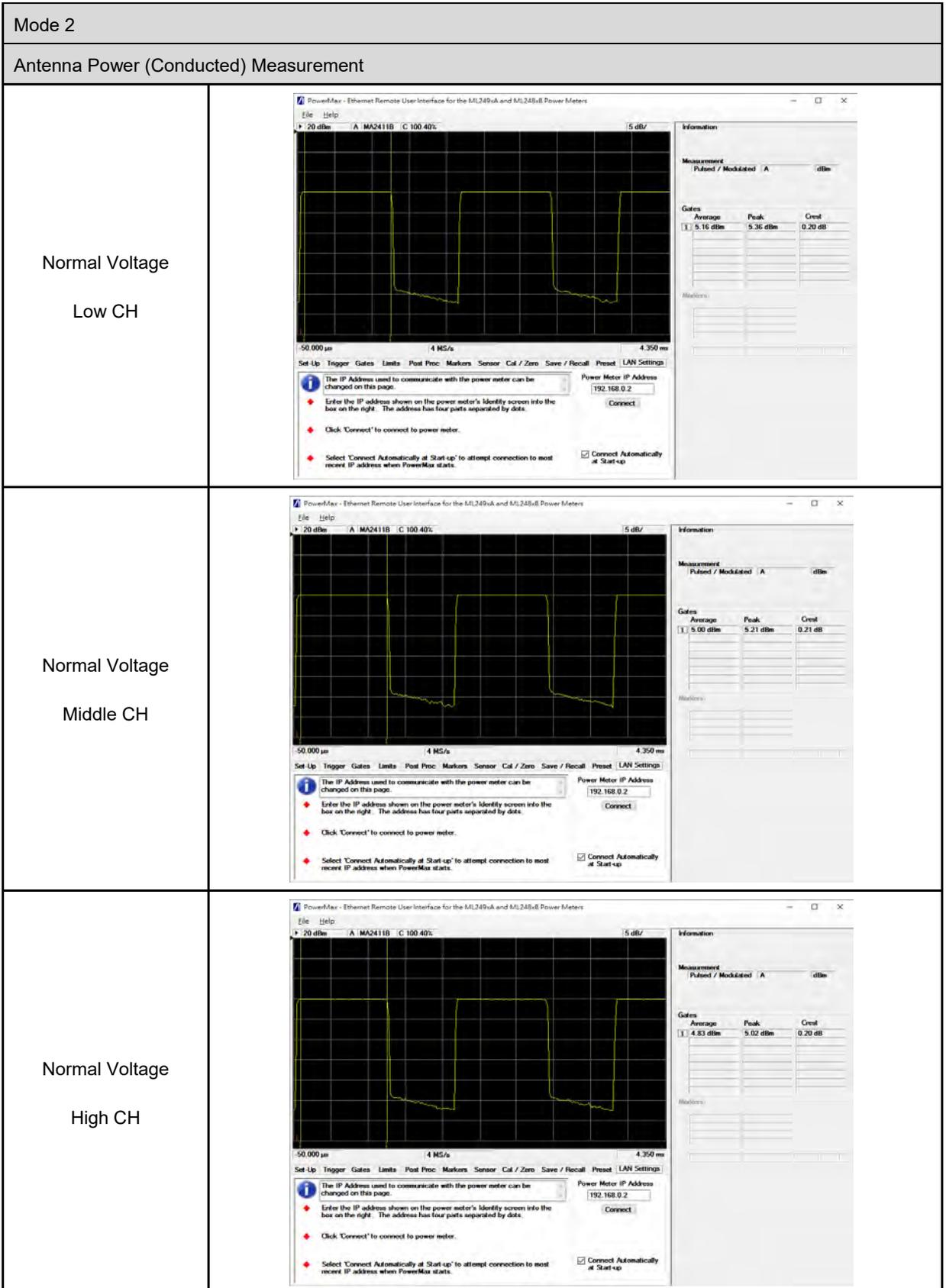
Mode 1	
Unwanted Emission Strength Measurement	
2496.5 MHz – 12.5 GHz	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

Mode 1	
Secondarily Emitted Radio Wave Strength Measurement	
30 MHz – 1 GHz	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

Mode 1	
Secondarily Emitted Radio Wave Strength Measurement	
1 GHz – 12.5 GHz	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

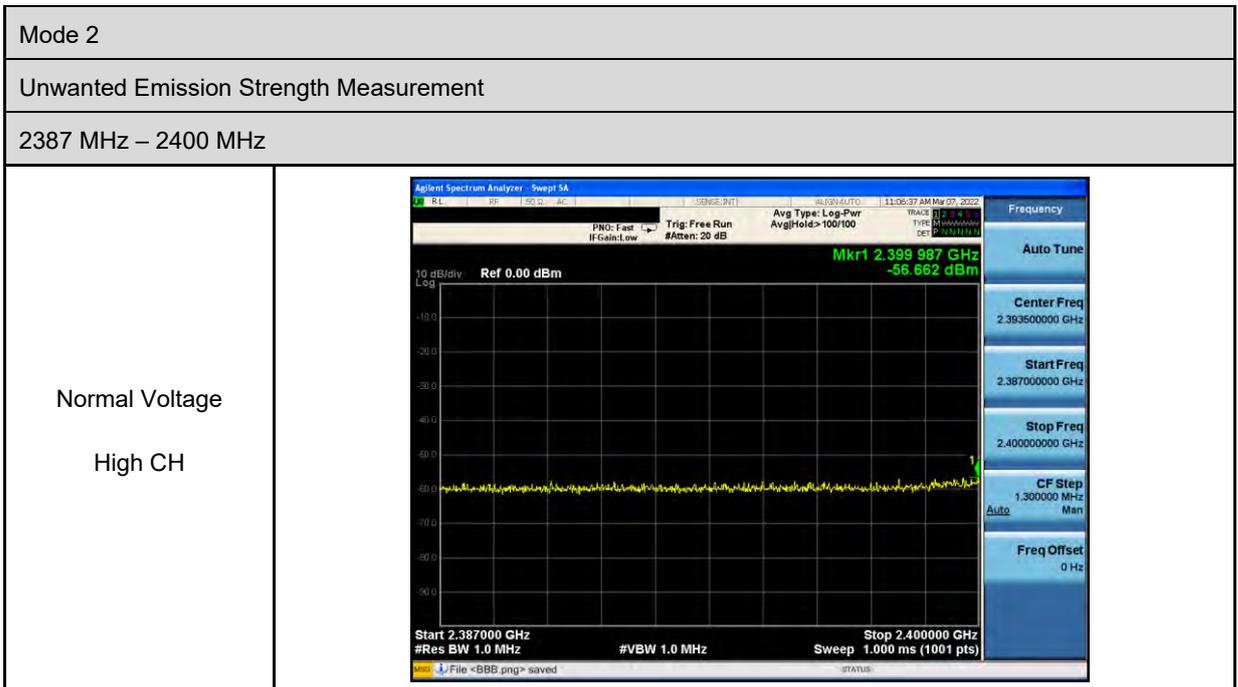
Mode 2	
Frequency Error Measurement	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

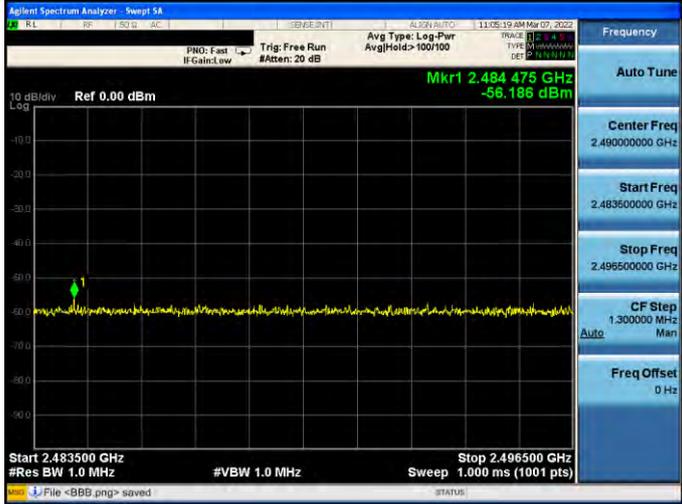
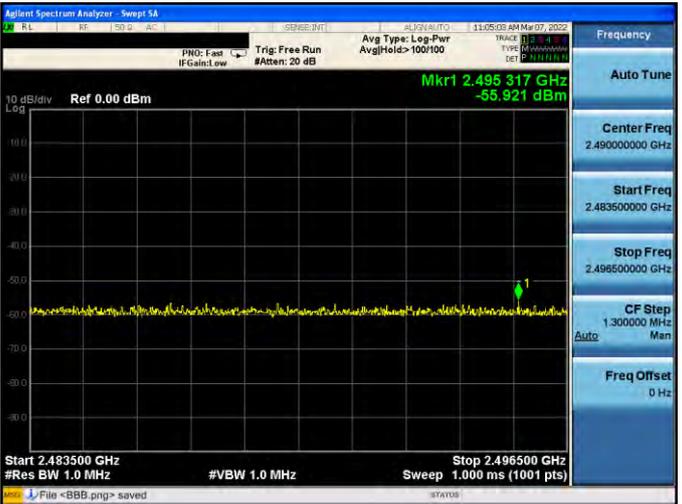
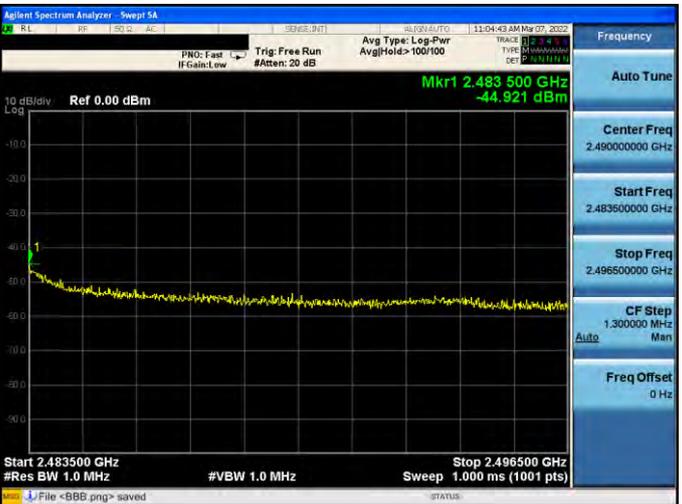
Mode 2	
Occupied Bandwidth Measurement	
<p>Normal Voltage Low CH</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.40200000 GHz Trig: Free Run #Att: 30 dB</p> <p>Ref 20.00 dBm</p> <p>10 dB/div Log</p> <p>Center 2.402 GHz #Res BW 300 kHz #VBW 300 kHz Span 6 MHz Sweep 1 ms</p> <p>Occupied Bandwidth: 2.1749 MHz Total Power: 11.3 dBm Transmit Freq Error: -14.040 kHz x dB Bandwidth: 2.820 MHz OBW Power: 99.00 % x dB: -26.00 dB</p> <p>Frequency: 2.40200000 GHz CF Step: 600.000 kHz Freq Offset: 0 Hz</p>
<p>Normal Voltage Middle CH</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.44000000 GHz Trig: Free Run #Att: 30 dB</p> <p>Ref 20.00 dBm</p> <p>10 dB/div Log</p> <p>Center 2.44 GHz #Res BW 300 kHz #VBW 300 kHz Span 6 MHz Sweep 1 ms</p> <p>Occupied Bandwidth: 2.1686 MHz Total Power: 10.8 dBm Transmit Freq Error: -13.616 kHz x dB Bandwidth: 2.827 MHz OBW Power: 99.00 % x dB: -26.00 dB</p> <p>Frequency: 2.44000000 GHz CF Step: 600.000 kHz Freq Offset: 0 Hz</p>
<p>Normal Voltage High CH</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.48000000 GHz Trig: Free Run #Att: 30 dB</p> <p>Ref 20.00 dBm</p> <p>10 dB/div Log</p> <p>Center 2.48 GHz #Res BW 300 kHz #VBW 300 kHz Span 6 MHz Sweep 1 ms</p> <p>Occupied Bandwidth: 2.1678 MHz Total Power: 10.5 dBm Transmit Freq Error: -12.413 kHz x dB Bandwidth: 2.810 MHz OBW Power: 99.00 % x dB: -26.00 dB</p> <p>Frequency: 2.48000000 GHz CF Step: 600.000 kHz Freq Offset: 0 Hz</p>



Mode 2	
Unwanted Emission Strength Measurement	
30 MHz – 2387 MHz	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

Mode 2	
Unwanted Emission Strength Measurement	
2387 MHz – 2400 MHz	
Normal Voltage Low CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Ref 0.00 dBm</p> <p>Mkr1 2.400 000 GHz -15.862 dBm</p> <p>Start 2.387000 GHz #Res BW 1.0 MHz #VBW 1.0 MHz Sweep 1.000 ms (1001 pts)</p> <p>Center Freq 2.393500000 GHz Start Freq 2.387000000 GHz Stop Freq 2.400000000 GHz CF Step 1.300000 MHz Freq Offset 0 Hz</p>
Normal Voltage Low CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Ref 0.00 dBm</p> <p>Mkr1 984.0 μs -42.699 dBm</p> <p>Center 2.400000000 GHz Res BW 1.0 MHz #VBW 1.0 MHz Sweep 1.000 ms (1001 pts) Span 0 Hz</p> <p>Center Freq 2.400000000 GHz Start Freq 2.400000000 GHz Stop Freq 2.400000000 GHz CF Step 1.000000 MHz Freq Offset 0 Hz</p>
Normal Voltage Middle CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Ref 0.00 dBm</p> <p>Mkr1 2.399 766 GHz -55.886 dBm</p> <p>Start 2.387000 GHz #Res BW 1.0 MHz #VBW 1.0 MHz Sweep 1.000 ms (1001 pts)</p> <p>Center Freq 2.393500000 GHz Start Freq 2.387000000 GHz Stop Freq 2.400000000 GHz CF Step 1.300000 MHz Freq Offset 0 Hz</p>

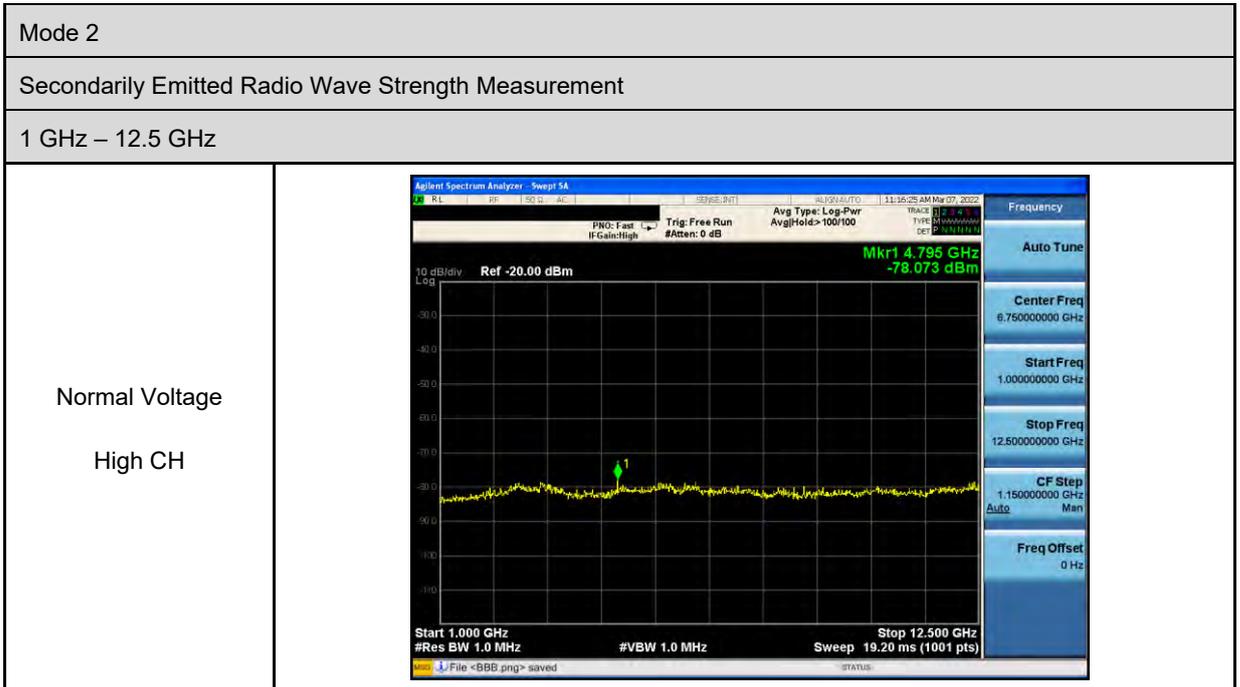


Mode 2	
Unwanted Emission Strength Measurement	
2483.5 MHz – 2496.5 MHz	
Normal Voltage Low CH	
Normal Voltage Middle CH	
Normal Voltage High CH	

Mode 2	
Unwanted Emission Strength Measurement	
2496.5 MHz – 12.5 GHz	
Normal Voltage Low CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>11:03:30 AM Mar 07, 2022</p> <p>Ref: 0.00 dBm</p> <p>Mkr1 4.807 GHz -44.261 dBm</p> <p>Start 2.497 GHz #Res BW 1.0 MHz #VBW 1.0 MHz Sweep 16.73 ms (1001 pts)</p> <p>Center Freq 7.498250000 GHz</p> <p>Start Freq 2.496500000 GHz</p> <p>Stop Freq 12.500000000 GHz</p> <p>CF Step 1.000350000 GHz</p> <p>Freq Offset 0 Hz</p>
Normal Voltage Middle CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>11:04:04 AM Mar 07, 2022</p> <p>Ref: 0.00 dBm</p> <p>Mkr1 4.877 GHz -46.088 dBm</p> <p>Start 2.497 GHz #Res BW 1.0 MHz #VBW 1.0 MHz Sweep 16.73 ms (1001 pts)</p> <p>Center Freq 7.498250000 GHz</p> <p>Start Freq 2.496500000 GHz</p> <p>Stop Freq 12.500000000 GHz</p> <p>CF Step 1.000350000 GHz</p> <p>Freq Offset 0 Hz</p>
Normal Voltage High CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>11:04:28 AM Mar 07, 2022</p> <p>Ref: 0.00 dBm</p> <p>Mkr1 4.957 GHz -48.830 dBm</p> <p>Start 2.497 GHz #Res BW 1.0 MHz #VBW 1.0 MHz Sweep 16.73 ms (1001 pts)</p> <p>Center Freq 7.498250000 GHz</p> <p>Start Freq 2.496500000 GHz</p> <p>Stop Freq 12.500000000 GHz</p> <p>CF Step 1.000350000 GHz</p> <p>Freq Offset 0 Hz</p>

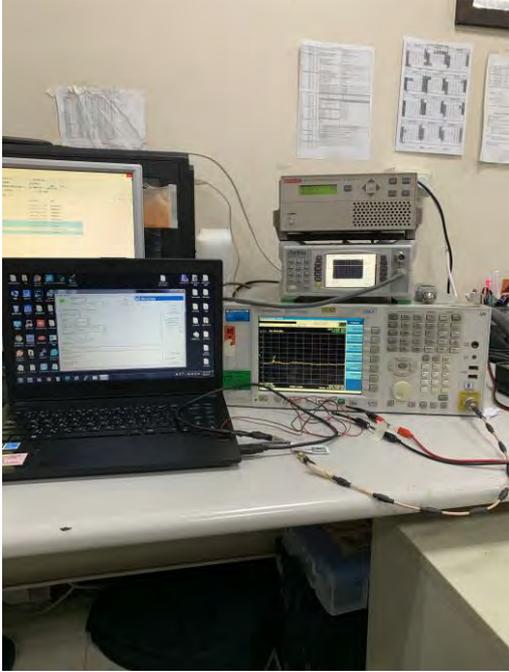
Mode 2	
Secondarily Emitted Radio Wave Strength Measurement	
30 MHz – 1 GHz	
Normal Voltage Low CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Ref: -20.00 dBm</p> <p>Mkr1 797.27 MHz -90.359 dBm</p> <p>Start 30.0 MHz #Res BW 100 kHz #VBW 100 kHz Sweep 117.0 ms (1001 pts)</p> <p>Stop 1.0000 GHz</p> <p>Frequency: 515.000000 MHz Start Freq: 30.000000 MHz Stop Freq: 1.000000000 GHz CF Step: 97.000000 MHz Freq Offset: 0 Hz</p>
Normal Voltage Middle CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Ref: -20.00 dBm</p> <p>Mkr1 777.87 MHz -90.025 dBm</p> <p>Start 30.0 MHz #Res BW 100 kHz #VBW 100 kHz Sweep 117.0 ms (1001 pts)</p> <p>Stop 1.0000 GHz</p> <p>Frequency: 515.000000 MHz Start Freq: 30.000000 MHz Stop Freq: 1.000000000 GHz CF Step: 97.000000 MHz Freq Offset: 0 Hz</p>
Normal Voltage High CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Ref: -20.00 dBm</p> <p>Mkr1 796.30 MHz -89.869 dBm</p> <p>Start 30.0 MHz #Res BW 100 kHz #VBW 100 kHz Sweep 117.0 ms (1001 pts)</p> <p>Stop 1.0000 GHz</p> <p>Frequency: 515.000000 MHz Start Freq: 30.000000 MHz Stop Freq: 1.000000000 GHz CF Step: 97.000000 MHz Freq Offset: 0 Hz</p>

Mode 2	
Secondarily Emitted Radio Wave Strength Measurement	
1 GHz – 12.5 GHz	
Normal Voltage Low CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Ref -20.00 dBm</p> <p>Mkr1 3.197 GHz -77.666 dBm</p> <p>Start 1.000 GHz #Res BW 1.0 MHz #VBW 1.0 MHz Stop 12.500 GHz Sweep 19.20 ms (1001 pts)</p> <p>File <BBB.png> saved</p>
Normal Voltage Middle CH	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Ref -20.00 dBm</p> <p>Mkr1 3.197 GHz -78.003 dBm</p> <p>Start 1.000 GHz #Res BW 1.0 MHz #VBW 1.0 MHz Stop 12.500 GHz Sweep 19.20 ms (1001 pts)</p> <p>File <BBB.png> saved</p>



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Appendix A. Test Setup Photographs

Description:	Test Circuit Photo
	
Description:	Conducted Measurement Photo
