RADIO TEST REPORT

Test Report No. 15383311S-B-R1

Customer	**Panasonic Automotive Systems Co., Ltd.**
Description of EUT	**Car Navigation**
Model Number of EUT	**AT2401**
FCC ID	**ACJ932AT2401**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**January 22, 2025**
Remarks	**Wireless LAN (2.4 GHz band) and Bluetooth Low Energy part(s) Antenna Terminal Conducted Tests**

Representative Test Engineer	Approved By
Shiro Kobayashi Engineer	Shinichi Takano Engineer

CERTIFICATE 1266.03

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.

☒ There is no testing item of "Non-accreditation".

UL Japan, Inc. Shonan EMC Lab.
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 Japan / +81-463-50-6400

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  It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
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REVISION HISTORY

Original Test Report No.: 15383311S-B

This report is a revised version of 15383311S-B. 15383311S-B is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15383311S-B	September 12, 2024	-
1	15383311S-B-R1	January 22, 2025	Cover page: Addition of FCC ID
			1: Addition of remarks *1) The Grantee name in the FCC application is “Panasonic Corporation of North America”.
			1: Correction of remarks From: “- Customer, Description of EUT, Model Number of EUT on the cover and other relevant pages” To: “- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages”

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	ICES	Interference-Causing Equipment Standard
AC	Alternating Current	IEC	International Electrotechnical Commission
AFH	Adaptive Frequency Hopping	IEEE	Institute of Electrical and Electronics Engineers
AM	Amplitude Modulation	IF	Intermediate Frequency
Amp, AMP	Amplifier	ILAC	International Laboratory Accreditation Conference
ANSI	American National Standards Institute	ISED	Innovation, Science and Economic Development Canada
Ant, ANT	Antenna	ISO	International Organization for Standardization
AP	Access Point	JAB	Japan Accreditation Board
ASK	Amplitude Shift Keying	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	N/A	Not Applicable
BT	Bluetooth	NIST	National Institute of Standards and Technology
BT LE	Bluetooth Low Energy	NS	No signal detect.
BW	BandWidth	NSA	Normalized Site Attenuation
Cal Int	Calibration Interval	NVLAP	National Voluntary Laboratory Accreditation Program
CCK	Complementary Code Keying	OBW	Occupied Band Width
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	P/M	Power meter
CW	Continuous Wave	PCB	Printed Circuit Board
DBPSK	Differential BPSK	PER	Packet Error Rate
DC	Direct Current	PHY	Physical Layer
D-factor	Distance factor	PK	Peak
DFS	Dynamic Frequency Selection	PN	Pseudo random Noise
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SG	Signal Generator
Freq.	Frequency	SVSWR	Site-Voltage Standing Wave Ratio
FSK	Frequency Shift Keying	TR	Test Receiver
GFSK	Gaussian Frequency-Shift Keying	Tx	Transmitting
GNSS	Global Navigation Satellite System	VBW	Video BandWidth
GPS	Global Positioning System	Vert.	Vertical
Hori.	Horizontal	WLAN	Wireless LAN

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SECTION 1: Customer Information

Company Name	Panasonic Automotive Systems Co., Ltd. *1)
Address	4261, Ikonobe-cho, Tsuzuki-ku, Yokohama-shi, Kanagawa-ken 224-8520, Japan
Telephone Number	+81-50-1802-5117
Contact Person	Daisuke Takahata

*1) The Grantee name in the FCC application is “Panasonic Corporation of North America”.

The information provided by the customer is as follows;
- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Car Navigation
Model Number	AT2401
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	September 25, 2023
Test Date	September 25 to October 5, 2023

2.2 Product Description

General Specification

Rating	DC 13.2 V
Operating temperature	-30 deg. C to +65 deg. C

Radio Specification

This report contains data provided by the customer which can impact the validity of results. UL Japan, Inc. is only responsible for the validity of results after the integration of the data provided by the customer.
The data provided by the customer is marked “a)” in the table below.

Bluetooth (BR / EDR / BT LE)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS, GFSK / π/4-DQPSK, 8DPSK / GFSK
Antenna Gain[a)]	4.00 dBi

WLAN (IEEE802.11b/11g/11n-20)

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS, OFDM
Antenna Gain[a)]	4.00 dBi

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**FCC:** Section 15.207	-	N/A	*1)
	ISED: RSS-Gen 8.8	**ISED:** RSS-Gen 8.8			
6dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(a)(2)	See data.	Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.2(a)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(b)(3)		Complied	Conducted
	ISED: RSS-Gen 6.12	**ISED:** RSS-247 5.4(d)			
Power Density	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(e)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	See data.	Complied	Conducted (below 30 MHz)
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.
* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

*1) The test is not applicable since the EUT does not have AC Mains.

FCC Part 15.31 (e)
The EUT provides stable voltage constantly to the RF Part regardless of input voltage.
Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to Standard

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
99 % Occupied Bandwidth	**ISED:** RSS-Gen 6.7	**ISED:** -	N/A	-	Conducted

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor *k* = 2.

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)	1.3 dB
Power Measurement above 1 GHz (Peak Detector)	1.8 dB
Spurious Emission (Conducted) below 1 GHz	0.91 dB
Conducted Emissions Power Density Measurement 1 GHz to 3 GHz	1.3 dB
Conducted Emissions Power Density Measurement 3 GHz to 18 GHz	2.5 dB
Spurious Emission (Conducted) 18 GHz to 26.5 GHz	2.8 dB
Spurious Emission (Conducted) 26.5 GHz to 40 GHz	2.6 dB
Bandwidth Measurement	0.012 %
Duty Cycle and Time Measurement	0.27 %
Temperature	2.2 deg.C.
Humidity	4.0 %
Voltage	0.74 %

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 Japan
Telephone: +81-463-50-6400
A2LA Certificate Number: 1266.03
(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test room	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber (SAC1)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber (SAC2)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber (SAC3)	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber (SAC4)	8.1 x 5.1 x 3.55	8.1 x 5.1	-
Wireless anechoic chamber 1 (WAC1)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
Wireless anechoic chamber 2 (WAC2)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
No.1 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 Shielded room	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	2.55 x 4.1 x 2.5	-	-
No.2 Measurement room	4.5 x 3.5 x 2.5	-	-
Wireless shielded room 1	3.0 x 4.5 x 2.7	3.0 x 4.5	-
Wireless shielded room 2	3.0 x 4.5 x 2.7	3.0 x 4.5	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

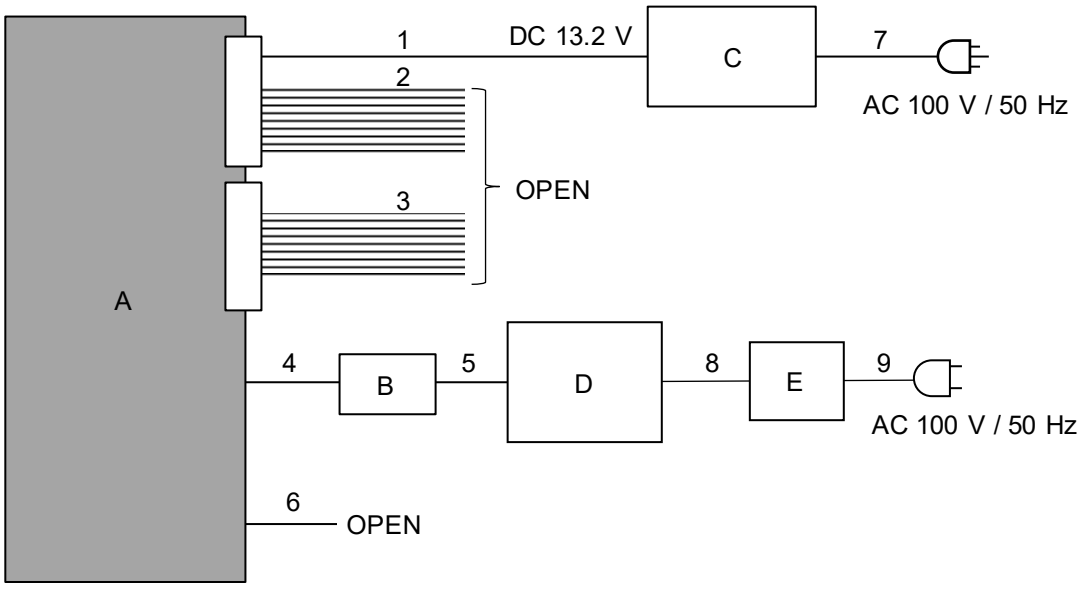
4.1 Operating Mode(s)

Mode	Remarks*
IEEE 802.11b (11b)	2 Mbps, PN9
IEEE 802.11g (11g)	36 Mbps, PN9
IEEE 802.11n SISO 20 MHz BW (11n-20)	MCS 6 (GI 400 ns), PN9
Bluetooth Low Energy (BT LE)	1M-PHY Uncoded PHY (1M-PHY), Maximum Packet Size, PRBS9
Bluetooth Low Energy (BT LE)	2M-PHY Uncoded PHY (2M-PHY), Maximum Packet Size, PRBS9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Low Channel)	
*Power of the EUT was set by the software as follows; Power Setting: 11b: 12 dBm, 11g/11n-20: 6 dBm BT LE: Fixed Software: For WLAN: wifi_2g_Lowgrade Version: 1 (Date: 2023.09.19, Storage location: Driven by connected PC) For BT LE: bluetooth_LowGrade Version: 3 (Date: 2023.09.27, Storage location: Driven by connected PC) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product. Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.	

*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Conducted Spurious Emission	Tx 11n-20 *1)	2412 MHz
	Tx BT LE, 2M-PHY *2)	2480 MHz
6 dB Bandwidth, Maximum Peak Output Power, Power Density, 99 % Occupied Bandwidth	Tx 11b Tx 11g Tx 11n-20	2412 MHz 2437 MHz 2462 MHz
	Tx BT LE, 1M-PHY Tx BT LE, 2M-PHY	2402 MHz 2440 MHz 2480 MHz
*1) The mode was tested as a representative, because it had the highest power at antenna terminal test. *2) Conducted emissions were limited to the channel that had the highest power during the antenna terminal test, as preliminary testing indicated that changing the operating frequency had no significant impact on the emissions in those frequency bands.		

4.2 Configuration and Peripherals



Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	Car Navigation	AT2401	045	Panasonic	EUT
B	Jig Board	-	-	-	-
C	Power Supply(DC)	PAN35-10A	DE001677	KIKUSUI	-
D	Laptop Computer	ThinkPad E14 Gen2	PF397TQG	LENOVO	-
E	AC Adapter	ADLX65YCC2D	8SSA10R16922 C2TJ19M1368	LENOVO	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC	1.0 + 1.9	Unshielded	Unshielded	-
2	Signal	1.0	Unshielded	Unshielded	-
3	Signal	1.0	Unshielded	Unshielded	-
4	Signal	0.1	Unshielded	Unshielded	-
5	USB	0.8	Shielded	Shielded	-
6	Signal	0.1	Unshielded	Unshielded	-
7	AC	2.0	Unshielded	Unshielded	-
8	DC	1.8	Unshielded	Unshielded	-
9	AC	0.9	Unshielded	Unshielded	-

SECTION 5: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument Used
6 dB Bandwidth	50 MHz, 3 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 160 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4) *5)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".
*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)
*5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 - 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

Test results are rounded off and limit are rounded down, so some differences might be observed.
The equipment and cables were not used for factor 0 dB of the data sheets.

Test Data : APPENDIX
Test Result : Pass

APPENDIX 1: Test Data

99 % Occupied Bandwidth and 6 dB Bandwidth

Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	September 25, 2023	September 27, 2023
Temperature / Humidity	25 deg. C / 55 % RH	26 deg. C / 48 % RH
Engineer	Shiro Kobayashi	Yosuke Murakami
Mode	Tx	

11b

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2412	13955.0	8.135	> 0.5000
2437	13932.0	8.135	> 0.5000
2462	13944.0	8.133	> 0.5000

11g

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2412	17279.0	16.530	> 0.5000
2437	17292.0	16.530	> 0.5000
2462	17283.0	16.540	> 0.5000

11n-20

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2412	18557.0	17.800	> 0.5000
2437	18540.0	17.800	> 0.5000
2462	18563.0	17.800	> 0.5000

BT LE 1M-PHY

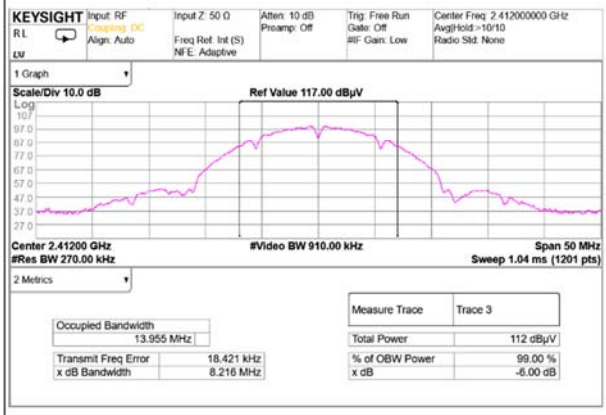
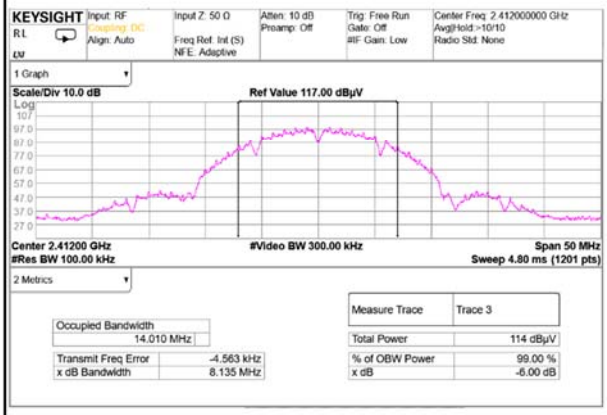
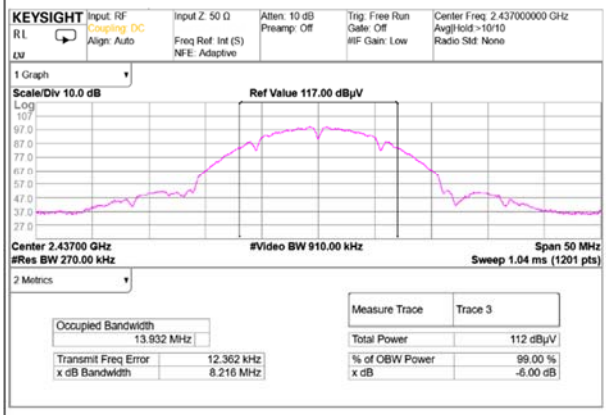
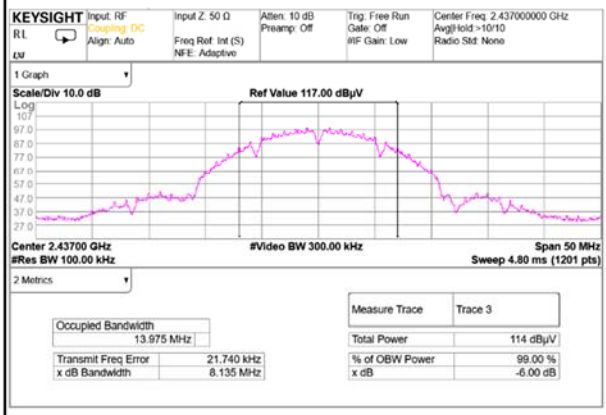
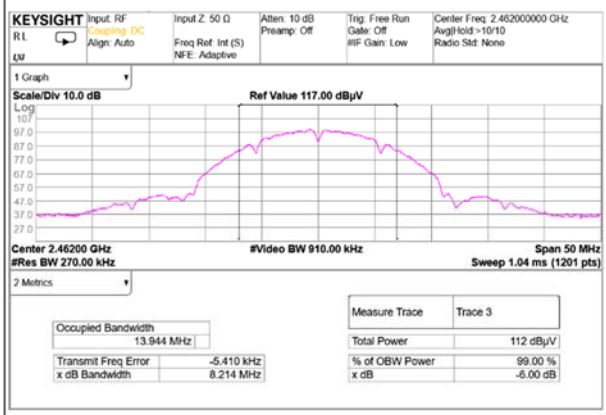
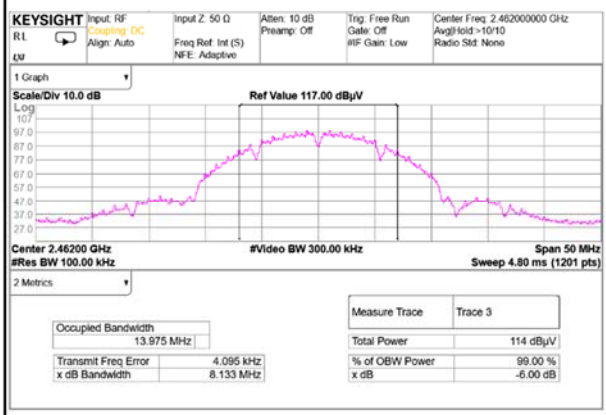
Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2402	1017.4	0.661	> 0.5000
2440	1017.2	0.660	> 0.5000
2480	1017.1	0.661	> 0.5000

BT LE 2M-PHY

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2402	1991.6	1.130	> 0.5000
2440	1991.8	1.126	> 0.5000
2480	1992.0	1.130	> 0.5000

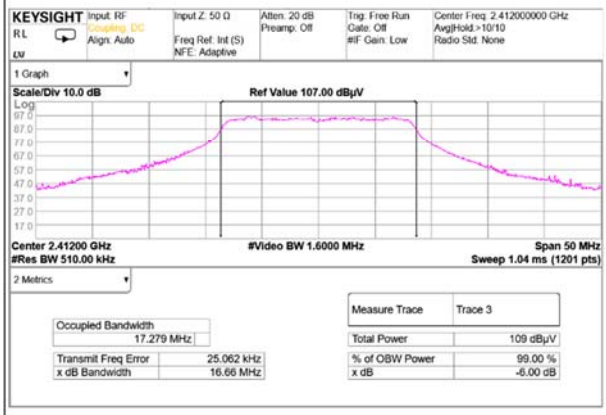
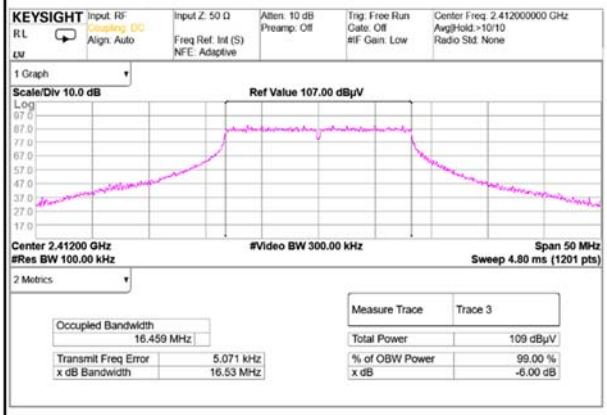
99 % Occupied Bandwidth and 6 dB Bandwidth

11b,

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	2412 MHz
	
2437 MHz	2437 MHz
	
2462 MHz	2462 MHz
	

99 % Occupied Bandwidth and 6 dB Bandwidth

11g,

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	2412 MHz
	
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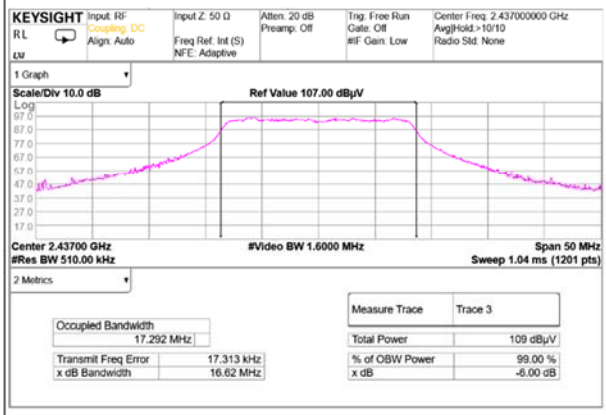
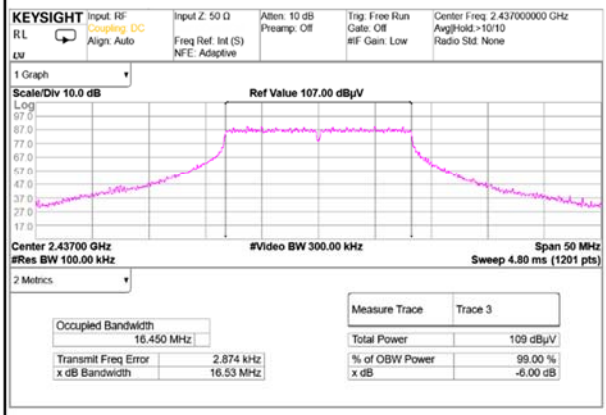
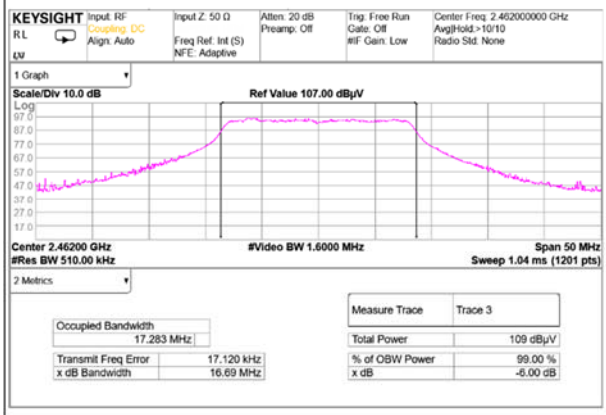
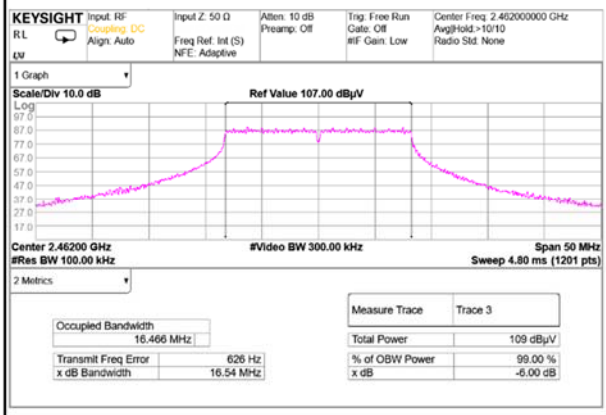
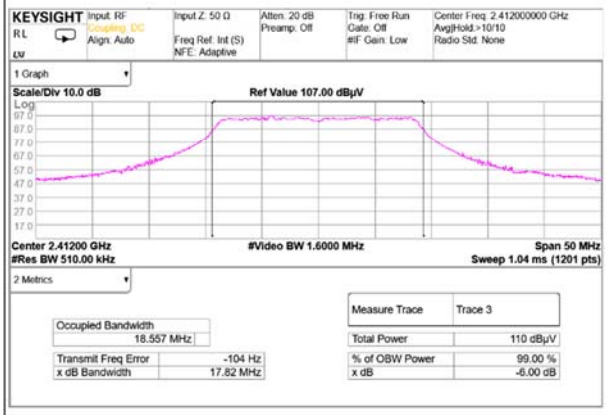
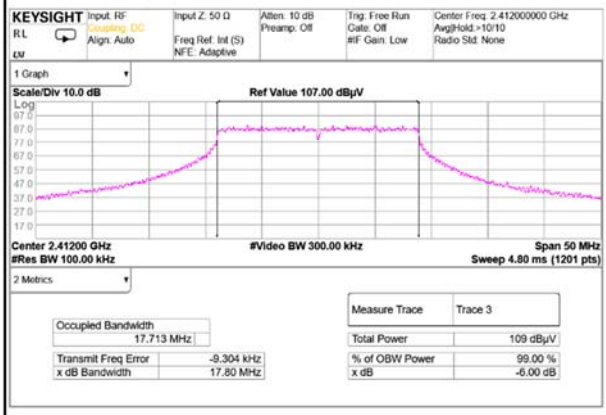
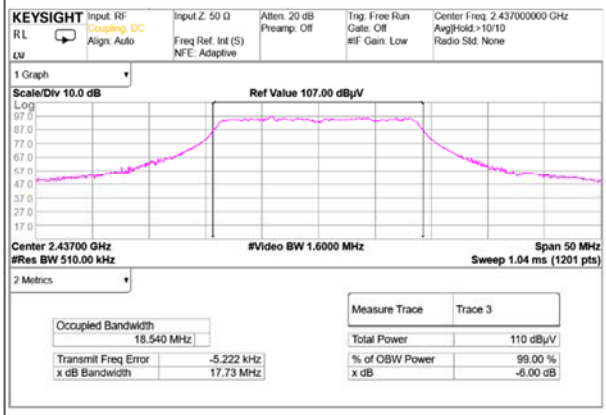
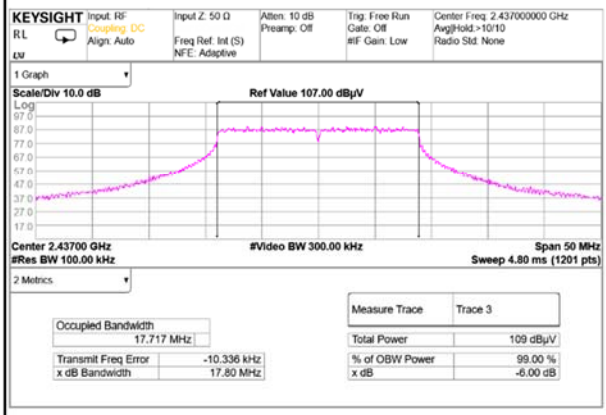
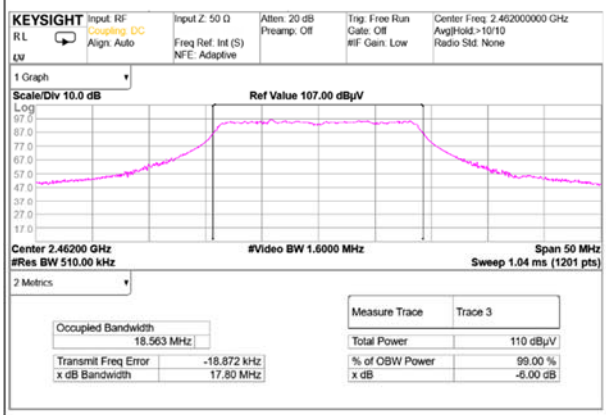
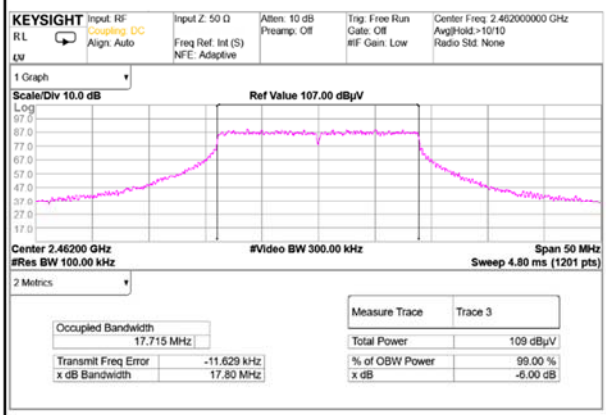
	
2462 MHz	2462 MHz
	

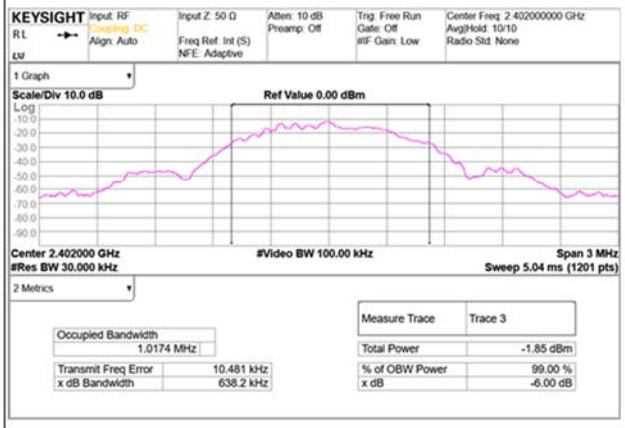
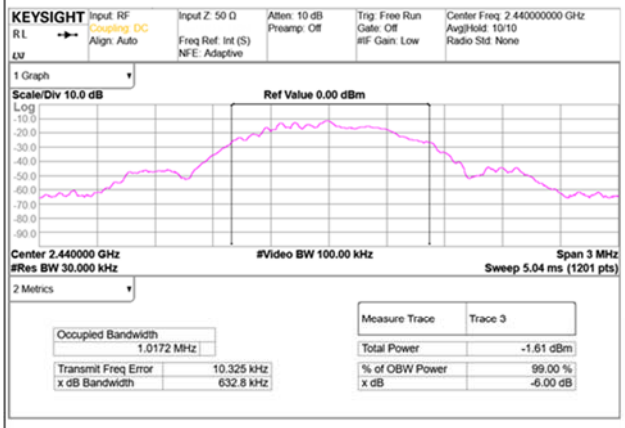
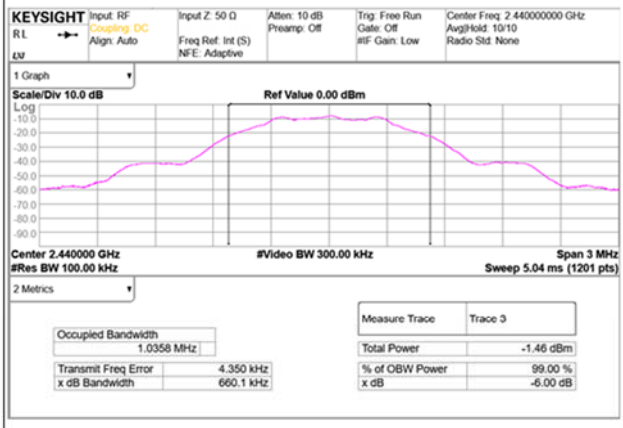
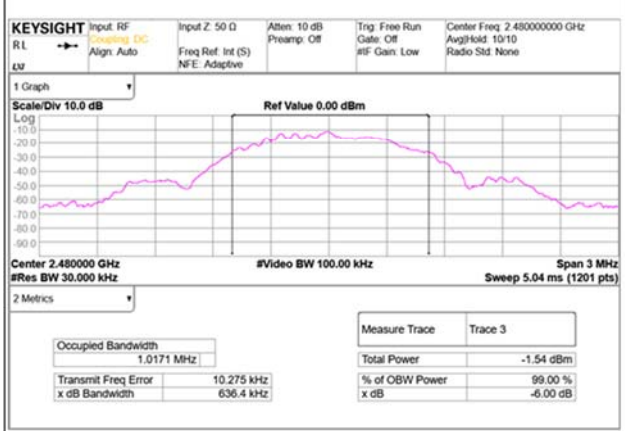
99 % Occupied Bandwidth and 6 dB Bandwidth

11n-20,

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	2412 MHz
	
2437 MHz	2437 MHz
	
2462 MHz	2462 MHz
	

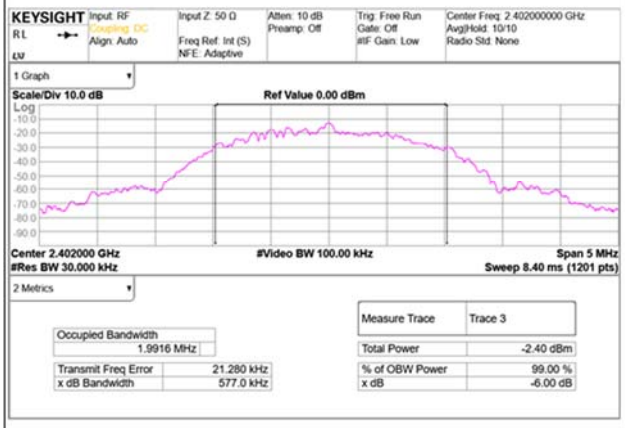
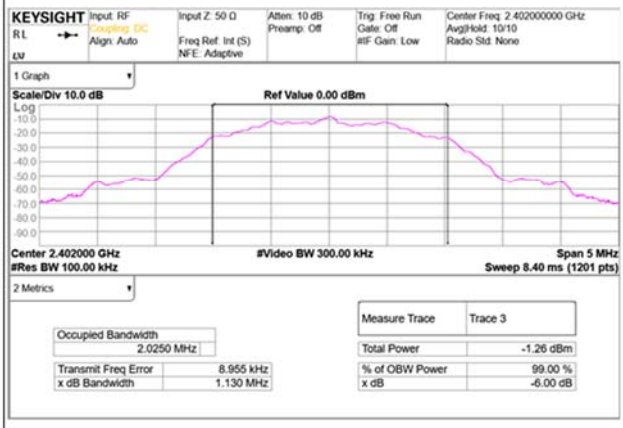
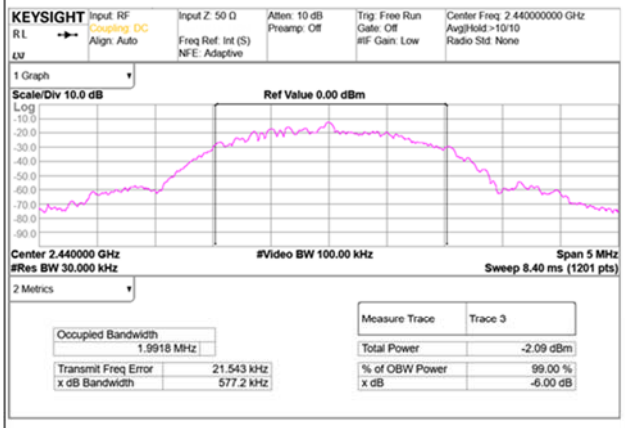
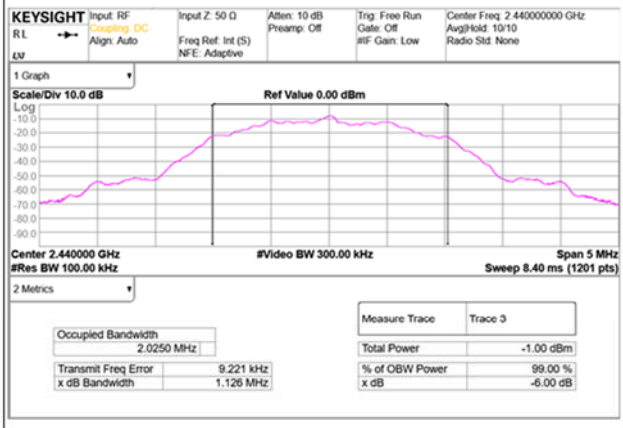
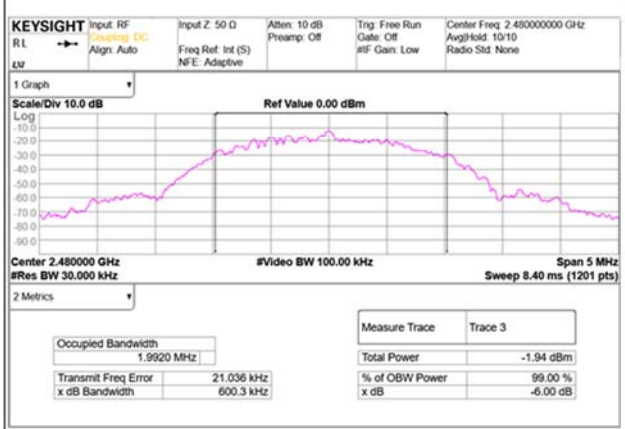
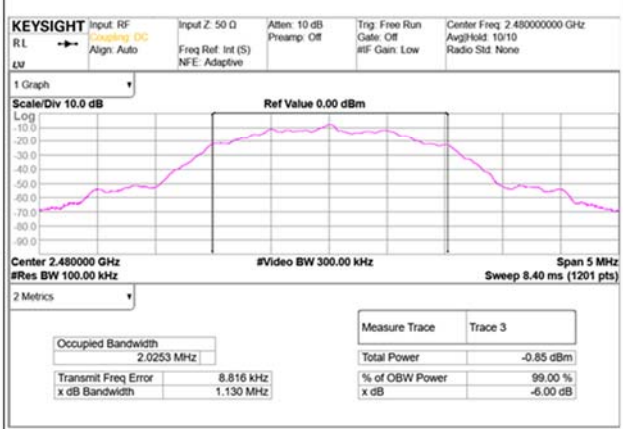
99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 1M-PHY,

99 % Occupied Bandwidth	6 dB Bandwidth
2402 MHz	2402 MHz
	
2440 MHz	2440 MHz
	
2480 MHz	2480 MHz
	

99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 2M-PHY,

99 % Occupied Bandwidth	6 dB Bandwidth
2402 MHz	2402 MHz
	
2440 MHz	2440 MHz
	
2480 MHz	2480 MHz
	

Maximum Peak Output Power

Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	September 25, 2023	September 29, 2023
Temperature / Humidity	25 deg. C / 55 % RH	24 deg. C / 47 % RH
Engineer	Shiro Kobayashi	Ken Fujita
Mode	Tx	

11b

Maximum peak output power 2 Mbps (worst)

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	2.66	2.13	9.82	14.61	28.91	30.00	1000	15.39	4.00	18.61	72.61	36.02	4000	17.41
2437	2.44	2.15	9.82	14.41	27.61	30.00	1000	15.59	4.00	18.41	69.34	36.02	4000	17.61
2462	2.45	2.16	9.82	14.43	27.73	30.00	1000	15.57	4.00	18.43	69.66	36.02	4000	17.59

11g

Maximum peak output power 36 Mbps (worst)

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	4.96	2.13	9.82	16.91	49.09	30.00	1000	13.09	4.00	20.91	123.31	36.02	4000	15.11
2437	4.80	2.15	9.82	16.77	47.53	30.00	1000	13.23	4.00	20.77	119.40	36.02	4000	15.25
2462	4.66	2.16	9.82	16.64	46.13	30.00	1000	13.36	4.00	20.64	115.88	36.02	4000	15.38

11n-20

Maximum peak output power MCS 6 (worst)

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	5.58	2.13	9.82	17.53	56.62	30.00	1000	12.47	4.00	21.53	142.23	36.02	4000	14.49
2437	5.40	2.15	9.82	17.37	54.58	30.00	1000	12.63	4.00	21.37	137.09	36.02	4000	14.65
2462	5.27	2.16	9.82	17.25	53.09	30.00	1000	12.75	4.00	21.25	133.35	36.02	4000	14.77

BT LE 1M-PHY

Maximum peak output power

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-7.40	2.03	10.18	4.81	3.03	30.00	1000	25.19	4.00	8.81	7.60	36.02	4000	27.21
2440	-7.17	2.05	10.18	5.06	3.21	30.00	1000	24.94	4.00	9.06	8.05	36.02	4000	26.96
2480	-7.02	2.07	10.18	5.23	3.33	30.00	1000	24.77	4.00	9.23	8.38	36.02	4000	26.79

BT LE 2M-PHY

Maximum peak output power

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-7.21	2.03	10.18	5.00	3.16	30.00	1000	25.00	4.00	9.00	7.94	36.02	4000	27.02
2440	-6.94	2.05	10.18	5.29	3.38	30.00	1000	24.71	4.00	9.29	8.49	36.02	4000	26.73
2480	-6.78	2.07	10.18	5.47	3.52	30.00	1000	24.53	4.00	9.47	8.85	36.02	4000	26.55

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

e.i.r.p. Result = Conducted Power Result + Antenna Gain

Maximum Peak Output Power

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 25, 2023
Temperature / Humidity	25 deg. C / 55 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11b 2412 MHz

Rate [Mbps]	Reading [dBm]	Remark
1	2.53	
2	2.66	*
5.5	2.64	
11	2.61	

*: Worst Rate

11g 2412 MHz

Rate [Mbps]	Reading [dBm]	Remark
6	-0.42	
9	-0.44	
12	-0.44	
18	1.82	
24	1.79	
36	4.96	*
48	4.79	
54	4.73	

*: Worst Rate

All comparisons were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 25, 2023
Temperature / Humidity	25 deg. C / 55 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11n-20 2412 MHz

G.I.	MCS	Reading [dBm]	Remark
800 ns	0	-0.46	
	1	-0.48	
	2	1.79	
	3	1.80	
	4	4.22	
	5	4.89	
	6	5.52	
	7	4.81	
400 ns	0	-0.38	
	1	-0.38	
	2	1.76	
	3	1.77	
	4	4.51	
	5	5.04	
	6	5.58	*
	7	4.52	

*: Worst Rate

All comparisons were carried out on same frequency and measurement factors.

Average Output Power
(Reference data for RF Exposure)

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 25, 2023
Temperature / Humidity	25 deg. C / 55 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11b

Average power

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	0.37	2.13	9.82	12.32	17.06	0.00	12.32	17.06
2437	0.13	2.15	9.82	12.10	16.22	0.00	12.10	16.22
2462	0.09	2.16	9.82	12.07	16.11	0.00	12.07	16.11

11g

Average power

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-4.47	2.13	9.82	7.48	5.60	0.00	7.48	5.60
2437	-4.67	2.15	9.82	7.30	5.37	0.00	7.30	5.37
2462	-4.68	2.16	9.82	7.30	5.37	0.00	7.30	5.37

11n-20

Average power

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-4.63	2.13	9.82	7.32	5.40	0.00	7.32	5.40
2437	-4.84	2.15	9.82	7.13	5.16	0.00	7.13	5.16
2462	-4.87	2.16	9.82	7.11	5.14	0.00	7.11	5.14

Sample Calculation:

Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Result (Burst power average) = Result (Time average) + Duty factor

*The Duty Factor is 0 dB, since this measurement was performed only on the on time using the gate function of power meter.

Average Output Power
(Reference data for RF Exposure)

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 29, 2023
Temperature / Humidity	24 deg. C / 47 % RH
Engineer	Ken Fujita
Mode	Tx

BT LE 1M-PHY

Average power

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-7.65	2.03	10.18	4.56	2.86	0.00	4.56	2.86
2440	-7.85	2.05	10.18	4.38	2.74	0.00	4.38	2.74
2480	-7.70	2.07	10.18	4.55	2.85	0.00	4.55	2.85

BT LE 2M-PHY

Average power

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-8.01	2.03	10.18	4.20	2.63	0.00	4.20	2.63
2440	-7.86	2.05	10.18	4.37	2.74	0.00	4.37	2.74
2480	-7.73	2.07	10.18	4.52	2.83	0.00	4.52	2.83

Sample Calculation:

Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Result (Burst power average) = Result (Time average) + Duty factor

*The Duty Factor is 0 dB, since this measurement was performed only on the on time using the gate function of power meter.

Average Output Power
(Reference data for RF Exposure)

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 25, 2023
Temperature / Humidity	25 deg. C / 55 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11b 2412 MHz

Rate [Mbps]	Reading [dBm]	Result [dBm]	Remark
1	0.18	0.18	
2	0.29	0.29	
5.5	0.37	0.37	*
11	0.33	0.33	

*: Worst Rate

11g 2412 MHz

Rate [Mbps]	Reading [dBm]	Result [dBm]	Remark
6	-5.04	-5.04	
9	-5.09	-5.09	
12	-5.11	-5.11	
18	-4.47	-4.47	*
24	-4.66	-4.66	
36	-5.06	-5.06	
48	-5.07	-5.07	
54	-5.09	-5.09	

*: Worst Rate

Average Output Power
(Reference data for RF Exposure)

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 25, 2023
Temperature / Humidity	25 deg. C / 55 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11n-20 2412 MHz

G.I.	MCS	Result [dBm]	Remark
800 ns	0	-5.30	
	1	-5.44	
	2	-4.64	
	3	-4.65	
	4	-5.12	
	5	-5.11	
	6	-5.05	
	7	-5.06	
400 ns	0	-5.23	
	1	-5.33	
	2	-4.63	*
	3	-4.67	
	4	-5.01	
	5	-5.09	
	6	-5.06	
	7	-5.09	

*: Worst Rate

* All comparisons were carried out on same frequency and measurement factors.

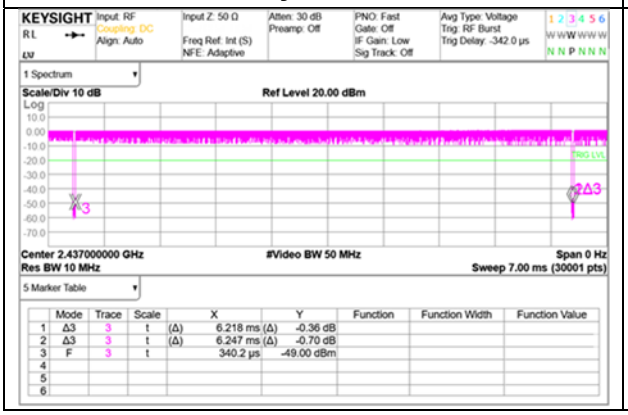
Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	October 5, 2023
Temperature / Humidity	25 deg. C / 45 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11b 2 Mbps

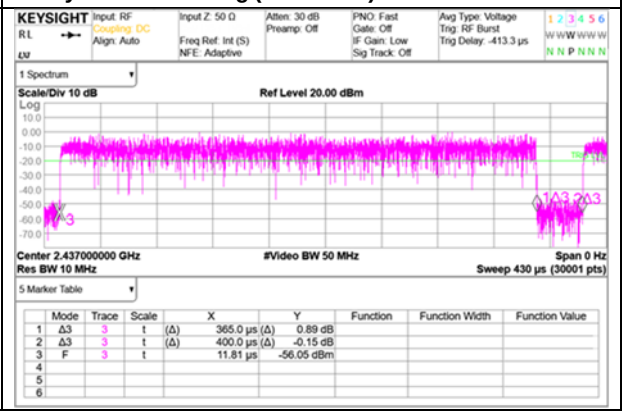
Tx on / (Tx on + Tx off) =	0.995
Tx on / (Tx on + Tx off) * 100 =	99.5 %

Duty > 98 %



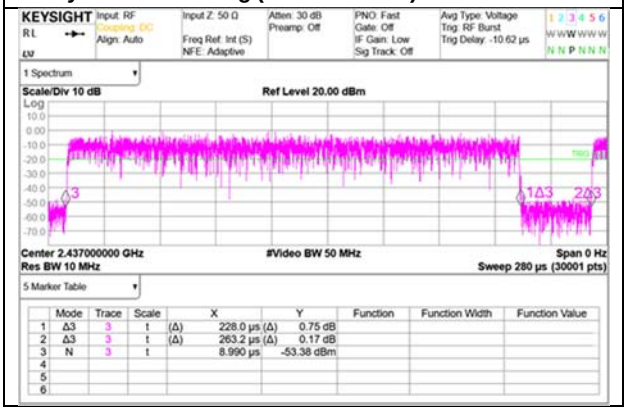
11g 36 Mbps

Tx on / (Tx on + Tx off) =	0.913
Tx on / (Tx on + Tx off) * 100 =	91.3 %
Duty factor = 20 * log (0.4 / 0.365) =	0.80 dB



11n-20 MCS 6 (GI 400 ns)

Tx on / (Tx on + Tx off) =	0.866
Tx on / (Tx on + Tx off) * 100 =	86.6 %
Duty factor = 20 * log (0.2632 / 0.228) =	1.25 dB

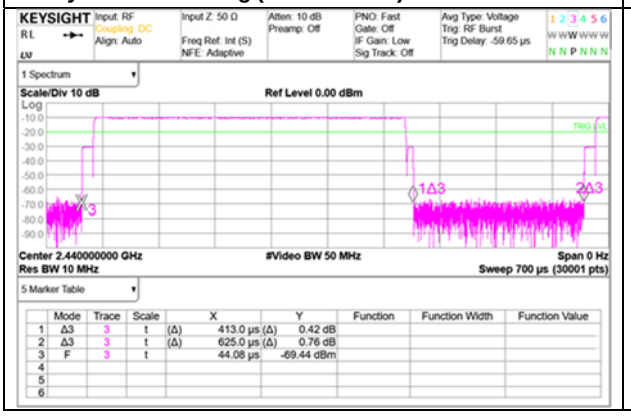


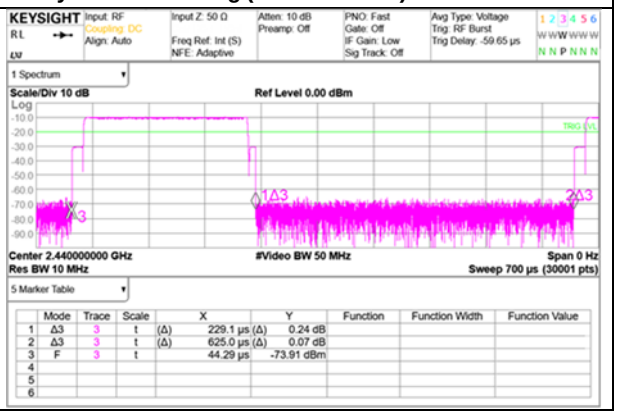
* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	October 5, 2023
Temperature / Humidity	25 deg. C / 45 % RH
Engineer	Shiro Kobayashi
Mode	Tx

BT LE 1M-PHY		BT LE 2M-PHY	
Tx on / (Tx on + Tx off) =	0.661	Tx on / (Tx on + Tx off) =	0.367
Tx on / (Tx on + Tx off) * 100 =	66.1 %	Tx on / (Tx on + Tx off) * 100 =	36.7 %
Duty factor = 20 * log (0.625 / 0.413) =	3.60 dB	Duty factor = 20 * log (0.625 / 0.2291) =	8.72 dB



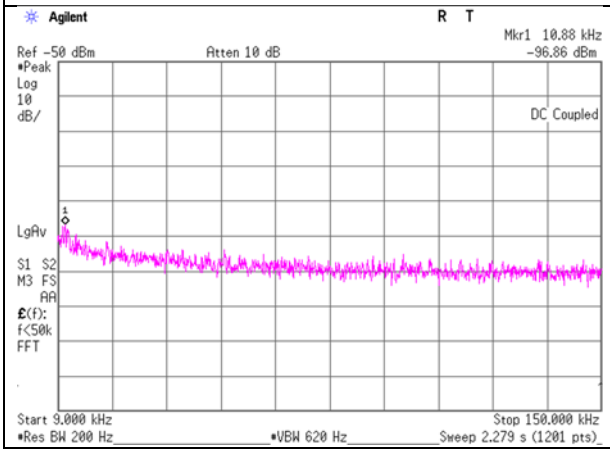


* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

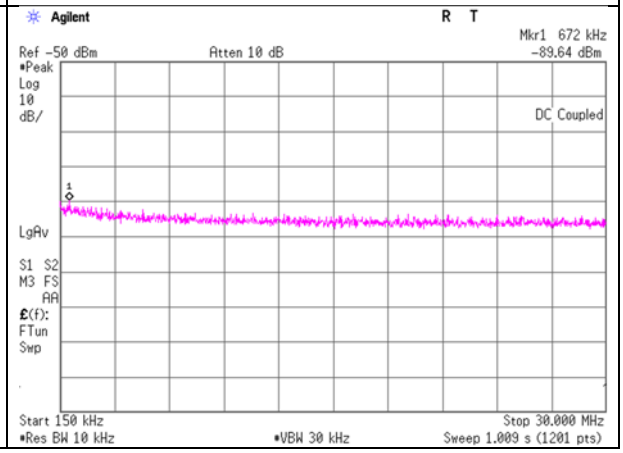
Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	October 5, 2023
Temperature / Humidity	25 deg. C / 45 % RH
Engineer	Shiro Kobayashi
Mode	Tx 11n-20 2412 MHz

9 kHz to 150 kHz



150 kHz to 30 MHz



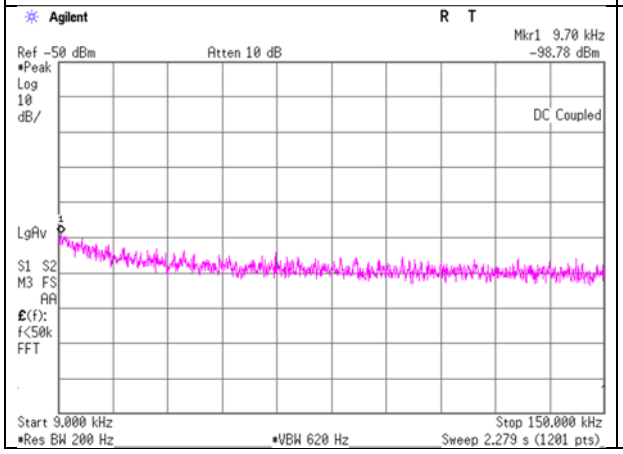
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.88	-96.86	0.01	9.80	4.0	1	-83.0	300	6.0	-21.8	46.8	68.6	-
672.00	-89.64	0.01	9.80	4.0	1	-75.8	30	6.0	5.4	31.0	25.6	-

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]
EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)
N: Number of output

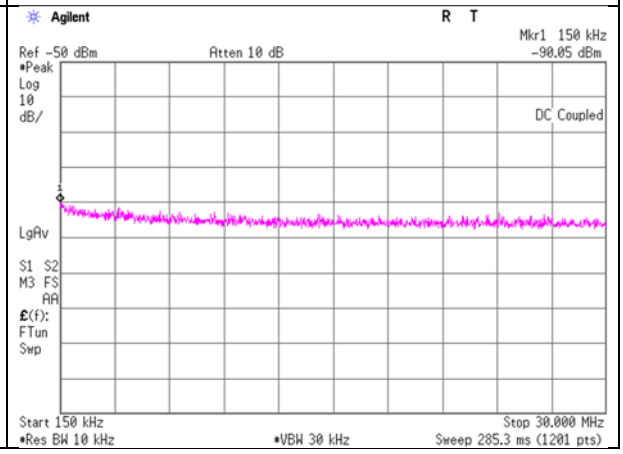
Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	October 5, 2023
Temperature / Humidity	25 deg. C / 45 % RH
Engineer	Shiro Kobayashi
Mode	Tx BT LE 2M-PHY 2480 MHz

9 kHz to 150 kHz



150 kHz to 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.70	-98.78	0.01	10.12	4.0	1	-84.7	300	6.0	-23.4	47.8	71.2	-
150.00	-90.05	0.01	10.12	4.0	1	-75.9	300	6.0	-14.7	24.0	38.7	-

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

Power Density

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	October 5, 2023
Temperature / Humidity	25 deg. C / 45 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11b

Frequency [MHz]	Measured Frequency [MHz]	Reading [dBm/3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]	Margin [dB]
2412	2410.996	-8.09	2.13	9.82	3.86	8.00	4.14
2437	2435.996	-8.40	2.15	9.82	3.57	8.00	4.43
2462	2460.996	-8.52	2.16	9.82	3.46	8.00	4.54

11g

Frequency [MHz]	Measured Frequency [MHz]	Reading [dBm/3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]	Margin [dB]
2412	2413.287	-30.17	2.13	9.82	-18.22	8.00	26.22
2437	2438.287	-30.48	2.15	9.82	-18.51	8.00	26.51
2462	2463.287	-30.27	2.16	9.82	-18.29	8.00	26.29

11n-20

Frequency [MHz]	Measured Frequency [MHz]	Reading [dBm/3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]	Margin [dB]
2412	2410.749	-31.00	2.13	9.82	-19.05	8.00	27.05
2437	2435.749	-31.15	2.15	9.82	-19.18	8.00	27.18
2462	2460.749	-31.14	2.16	9.82	-19.16	8.00	27.16

BT LE 1M-PHY

Frequency [MHz]	Measured Frequency [MHz]	Reading [dBm/3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]	Margin [dB]
2402	2401.980	-22.98	2.03	10.18	-10.77	8.00	18.77
2440	2439.980	-22.67	2.05	10.18	-10.44	8.00	18.44
2480	2479.980	-22.61	2.07	10.18	-10.36	8.00	18.36

BT LE 2M-PHY

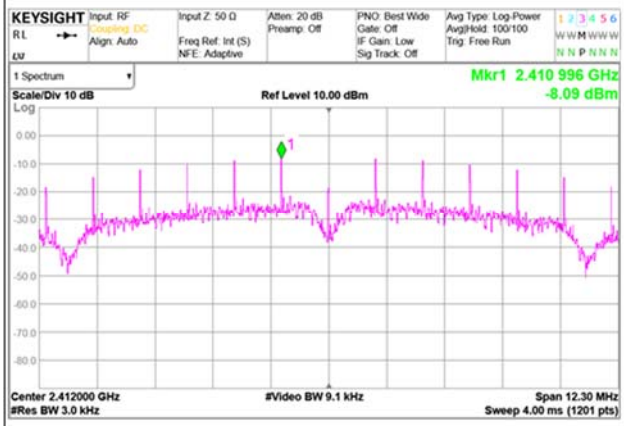
Frequency [MHz]	Measured Frequency [MHz]	Reading [dBm/3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]	Margin [dB]
2402	2401.959	-25.85	2.03	10.18	-13.64	8.00	21.64
2440	2439.959	-25.61	2.05	10.18	-13.38	8.00	21.38
2480	2479.959	-25.51	2.07	10.18	-13.26	8.00	21.26

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

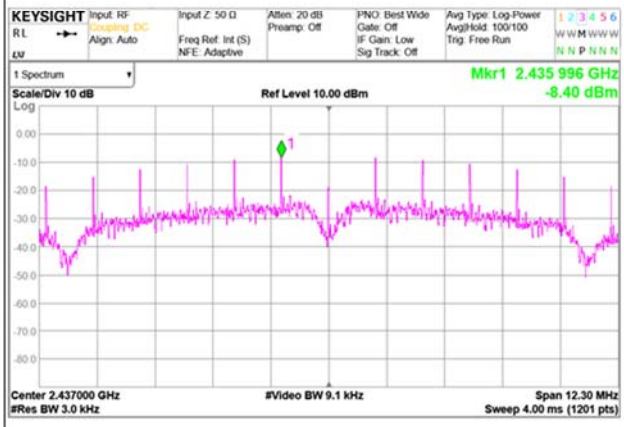
Power Density

11b, 2 Mbps

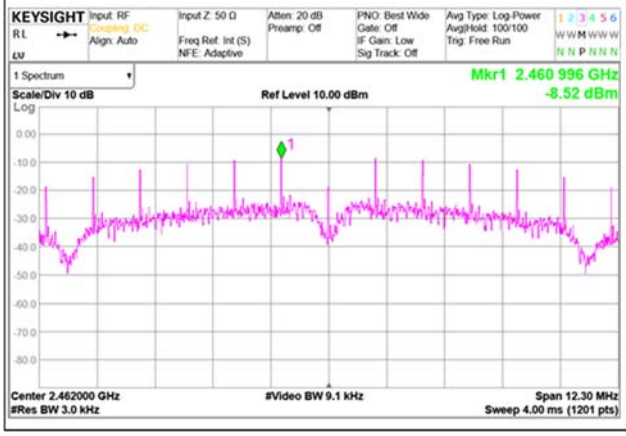
2412 MHz



2437 MHz

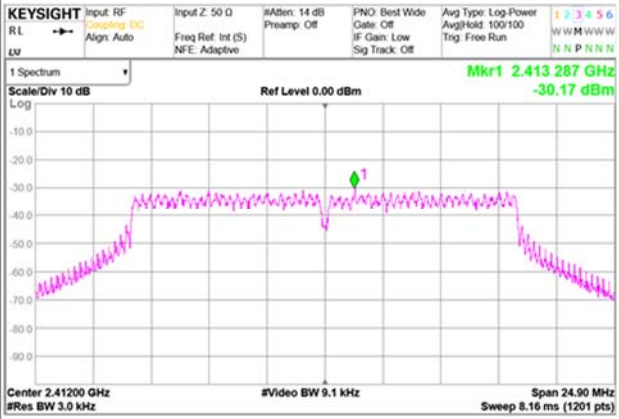


2462 MHz

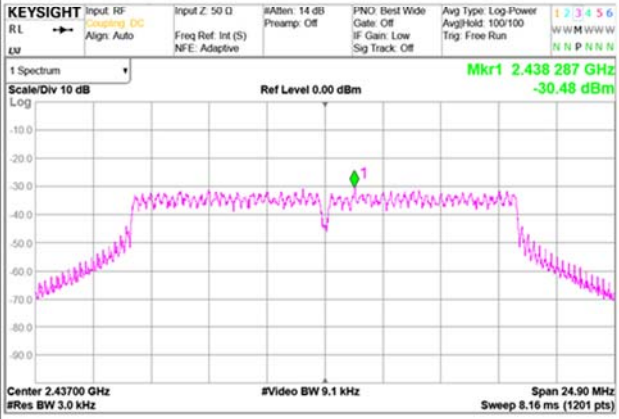


11g, 36 Mbps

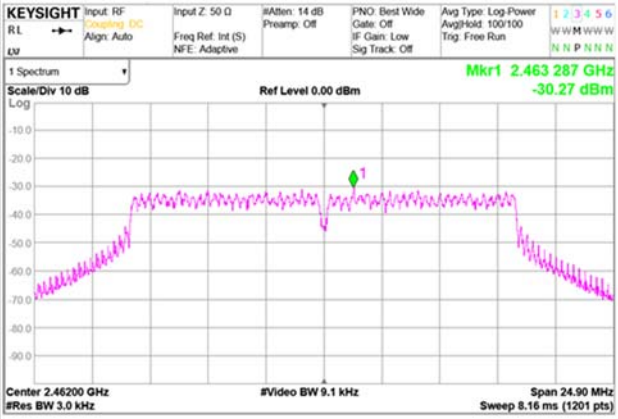
2412 MHz



2437 MHz



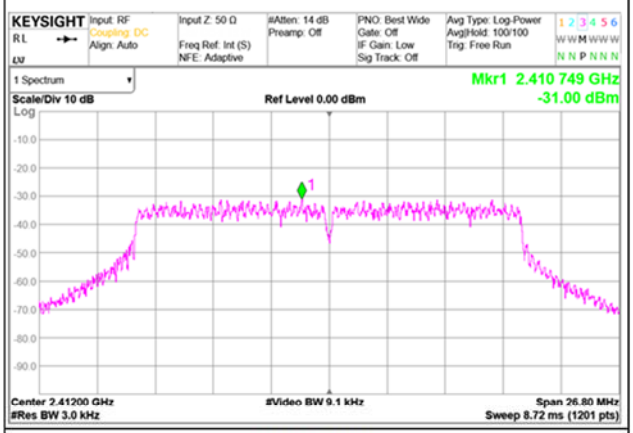
2462 MHz



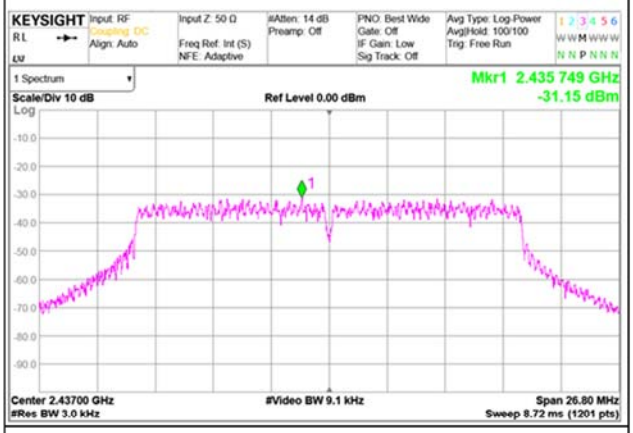
Power Density

11n-20, MCS 6 (GI 400 ns)

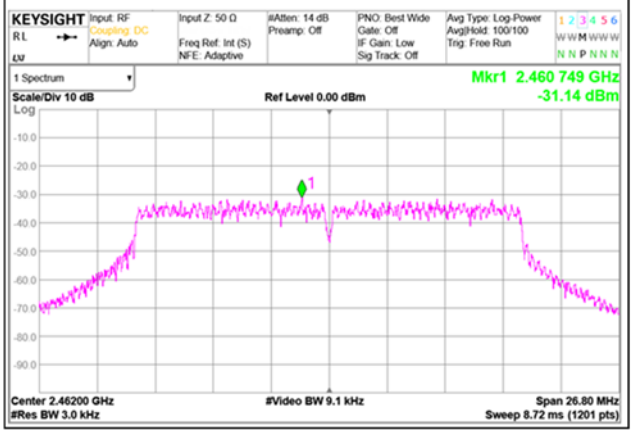
2412 MHz



2437 MHz

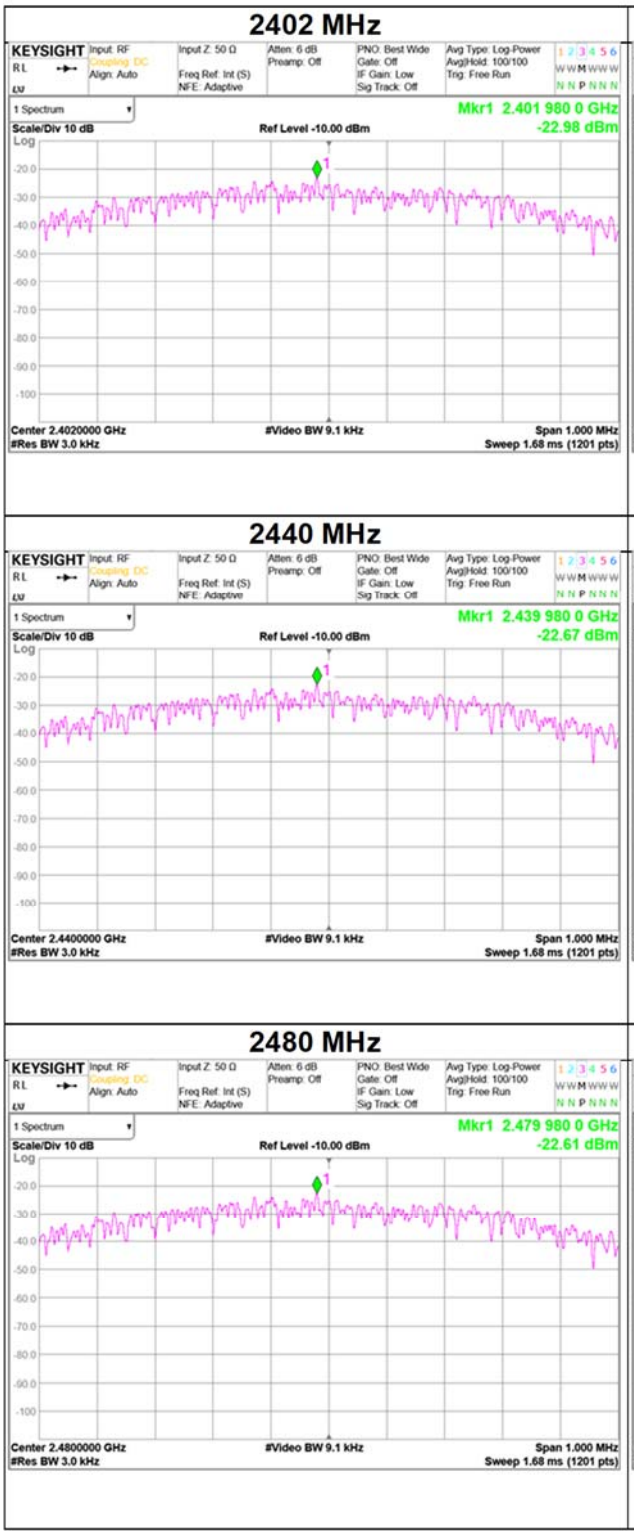


2462 MHz

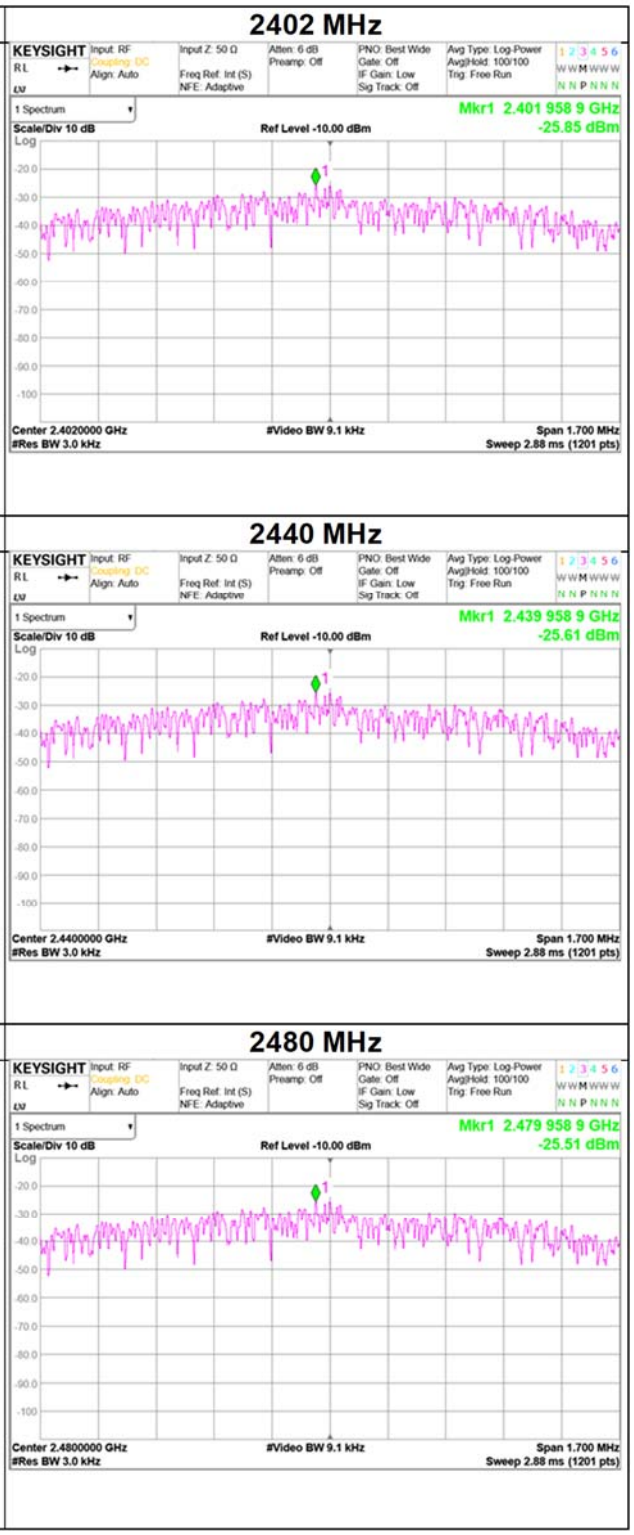


Power Density

BT LE 1M-PHY



BT LE 2M-PHY



APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	145111	Digital Tester	SANWA	PC500	7019232	2023/09/25	12
AT	146247	Power Meter	Keysight Technologies Inc	8990B	MY51000272	2023/05/29	12
AT	146310	Power sensor	Keysight Technologies Inc	N1923A	MY5326009	2023/05/29	12
AT	146311	Power sensor	Keysight Technologies Inc	N1923A	MY5349008	2023/05/29	12
AT	154591	Attenuator	Weinschel Corp.	54A-10	81595	2023/04/12	12
AT	160493	Attenuator	Weinschel Corp.	54A-10	83406	2022/12/01	12
AT	171614	Terminator	Weinschel - API Technologies Corp	M1459A	88995	2023/05/11	12
AT	191845	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2023/08/07	12
AT	196949	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803480/2	2023/03/02	12
AT	235604	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY45300743	2023/05/18	12
AT	236410	Spectrum Analyzer	Keysight Technologies Inc	N9030B	MY63050151	2023/04/10	12

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item:

AT: Antenna Terminal Conducted test