

Prüfbericht-Nr.: <i>Test Report No.:</i>	50290243 001	Auftrags-Nr.: <i>Order No.:</i>	238108766	Seite 1 von 62 Page 1 of 62
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	13-Aug-2019	
Auftraggeber: <i>Client:</i>	TAIYO YUDEN CO., LTD. 43-1, Yawatabara-machi, Takasaki-shi, Gunma, 370-0024, Japan			
Prüfgegenstand: <i>Test item:</i>	Bluetooth low energy/ ANT/ 802.15.4 Module			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	EYSKDN			
Auftrags-Inhalt: <i>Order content:</i>	FCC Part 15C / IC RSS-247 Test report			
Prüfgrundlage: <i>Test specification:</i>	FCC 47CFR Part 15: Subpart C Section 15.247(DTS) RSS-247 (02-2017)			
Wareneingangsdatum: <i>Date of receipt:</i>	20-Aug-2019			
Prüfmuster-Nr.: <i>Test sample No.:</i>	A000978745-001 to 002			
Prüfzeitraum: <i>Testing period:</i>	30-Aug-2019 – 19-Sep-2019			
Ort der Prüfung: <i>Place of testing:</i>	EMC/RF Laboratory Taipei			
Prüflaboratorium: <i>Testing laboratory:</i>	TUV Rheinland Taiwan Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
Report date / tested by: 15-Oct-2019 Jack Chang/Project Manager <i>Datum Name / Stellung Unterschrift</i> <i>Date Name / Position Signature</i>		kontrolliert von / reviewed by: 15-Oct-2019 Arvin Ho/Vice General Manager <i>Datum Name / Stellung Unterschrift</i> <i>Date Name / Position Signature</i>		
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: *Passed*

5.1.2 MAXIMUM CONDUCTED PEAK OUTPUT POWER

RESULT: *Passed*

5.1.3 6dB BANDWIDTH AND 99% BANDWIDTH

RESULT: *Passed*

5.1.4 POWER DENSITY

RESULT: *Passed*

5.1.5 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100kHz BANDWIDTH

RESULT: *Passed*

5.1.6 SPURIOUS EMISSION

RESULT: *Passed*

5.2.1 MAINS CONDUCTED EMISSIONS

RESULT: *Passed*

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: *Passed*

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Produkte
Products

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1. General Remarks

1.1 Complementary Materials

The following attachments are integral parts of this test report:

Appendix P: Photo Documentation internal view
(File Name: 50290243 001 APPENDIXP)

Appendix D: Test Result of Radiated Emissions
(File Name: 50290243 001 APPENDIXD)

Test Specifications

The following standards were applied.

Table 1: Applied Standard and Test Levels

Radio
FCC 47CFR Part 15: Subpart C Section 15.247 FCC 47CFR Part 2: Subpart J Section 2.1091 RSS-247 Issue 2, Feb 2017 RSS-102 Issue 5, March 2015 RSS-Gen, Issue 5, March 2019 ANSI C63.10:2013 KDB558074 D01 DTS Meas Guidance v05r02 KDB447498 D01 General RF Exposure Guidance v06

1.2 Decision Rule of conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.
Taipei Testing Laboratories

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

2.2 Test Facility

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

FCC RegistrationNo.: 180491
IC Canada Registration No.: 9465A
TAF Accredited NCC Test Lab. No.:3567
TAF ISO17025 Certification effective period: 6th-May-2019 to 05th-May-2022



Testing Laboratory
3567

2.3 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manu-facturer	Type	S/N	Last Calibration	Next Calibration
Test Software	Audix	e3	Ver. 9	N/A	N/A
Power Meter	Anritsu	ML2495A	1901008	2019/4/29	2020/4/28
Power Sensor	Anritsu	MA2411B	1725269	2019/4/29	2020/4/28
EMI Test Receiver	R&S	ESR 7	101062	2018/10/01	2019/10/01
Spectrum Analyzer	R&S	FSV 40	101514	2019/02/07	2020/02/07
EXA Signal Analyzer	KEYSIGHT	N9010A	MY52221334	2019/02/15	2020/02/15
Preamplifier (30MHz -1GHz)	HP	8447D	2944A06641	2019/01/08	2020/01/08
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM01G18G	060558	2018/11/30	2019/11/30
Bilog Antenna	TESEQ	CBL 6111D	29804	2019/07/12	2020/07/12
Horn Antenna	ETS-Lindgren	3117	00218931	2018/12/27	2019/12/27
Horn Antenna (18GHz~40GHz)	COM-POWER	AH-840	101029	2018/12/22	2019/12/22
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2019/07/11	2020/07/11
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100797	2019/01/16	2020/01/16
Two-Line V-Network	Rohde & Schwarz	ENV216	101262	2019/07/16	2020/07/16

2.4 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.5 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular schedule using in house standards or comparisons.

2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements .

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	± 1.5 dB
RF power density, conducted	± 3 dB
spurious emissions, conducted	± 3 dB
all emissions, radiated	± 6 dB
Temperature	± 1 °C
Humidity	± 5 %

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Bluetooth low energy/ ANT/ 802.15.4 Module. It contains a 2.4GHz compatible module enabling the user to communicate data through a Wireless interface.

For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Bluetooth low energy/ ANT/ 802.15.4 Module
Type Designation	EYSKDN
FCC ID	RYYEYSKDN
IC	4389B-EYSKDN
HVIN	EYSKDN

Table 5: Technical Specification of EUT

Bluetooth Low Energy(1 Mbps, 2Mbps), BLE ; Long range(500kbps, 125kbps)	
Technical Specification	Value
Operating Frequencies	2402~2480MHz
Channel number	40
Operation Voltage	3.3Vdc
Modulation	GFSK
Antenna gain	2.5dBi

ANT(1Mbps)	
Technical Specification	Value
Operating Frequencies	2402~2480MHz
Channel number	15
Operation Voltage	3.3Vdc
Modulation	GFSK
Antenna gain	2.5dBi

Nordic Original (2Mbps)	
Technical Specification	Value
Operating Frequencies	2402~2480MHz
Channel number	15
Operation Voltage	3.3Vdc
Modulation	GFSK
Antenna gain	2.5dBi

IEEE802.15.4	
Technical Specification	Value
Operating Frequencies	2405~2475MHz
Channel number	15
Operation Voltage	3.3Vdc
Modulation	O-QPSK
Antenna gain	2.5dBi

3.3 Independent Operation Modes

Basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving
- C. Standby
- D. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Circuit Diagram
- Block Diagram
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Setup for testing: The module is mounted on an Evaluation Board provided by the manufacturer. The EVB is provided with an USB-UART interface which makes it possible to control the module through the test software installed on a notebook computer.

This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed in section 3.3 as appropriate.

Software: Radio_test_tool_20190801.xls
Power setting is +8.

The samples were used as follows:
Conducted sample: A000978745-002
Radiation sample: A000978745-001

Full test was applied on all test modes, but only worst case was shown

BLE mode:

Channel Low (2402MHz), Channel Mid (2440MHz) and Channel High (2480MHz) were chosen for full testing. The worst condition was determined based on the test result of Maximum peak output power.

ANT, Nordic Original mode:

Channel Low (2402MHz), Channel Mid (2441MHz) and Channel High (2480MHz) were chosen for full testing.

IEEE802.15.4 mode:

Channel Low (2405MHz), Channel Mid (2440MHz) and Channel High (2475MHz) were chosen for full testing.

Mode	On Time(ms)	On+Off Time(ms)	Duty Cycle(%)
GFSK	2.13	2.245	94.88

4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

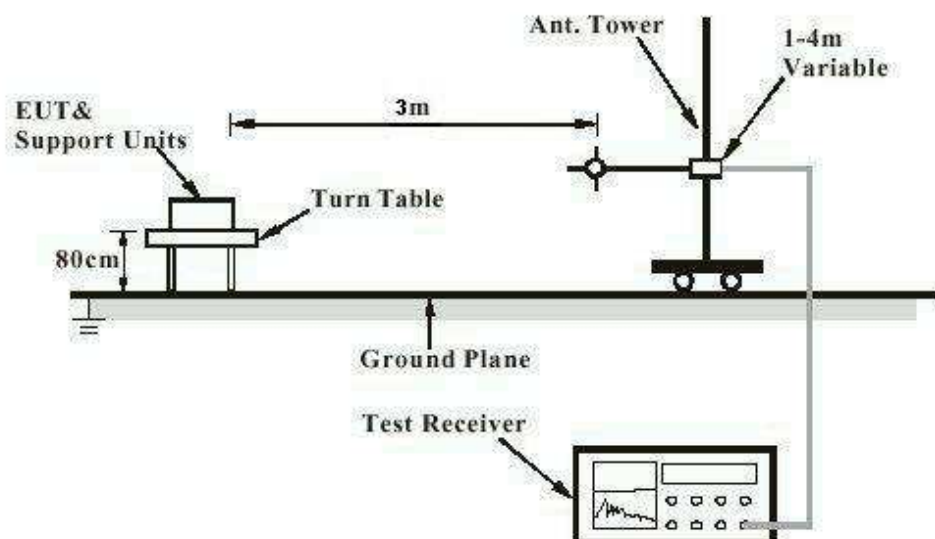
Description	Manufacturer	Model No.
Notebook (Setup)	Panasonic	CF-T2

4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m

Diagram of Measurement Equipment Configuration for Mains Conduction Measurement (if applicable)

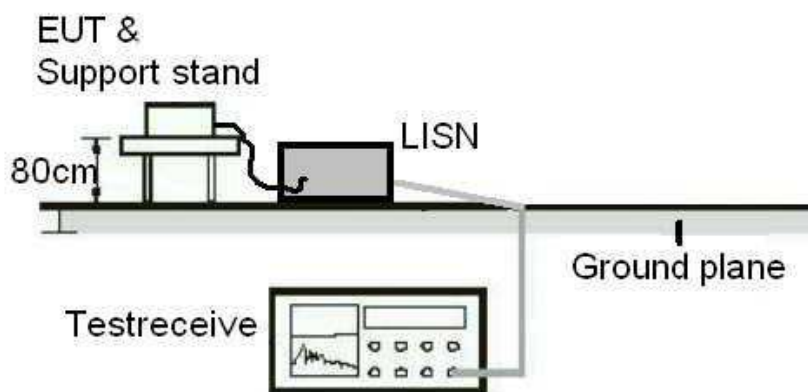
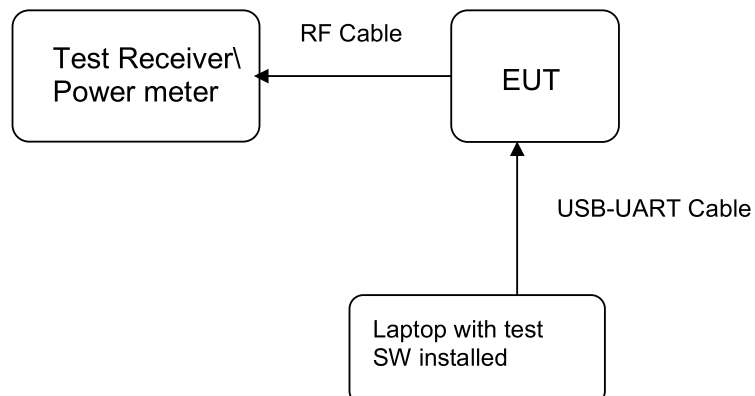


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



Note: The output power is measured by power meter according to 8.3.1.3 KDB558074 D01 Meas Guidance v05r02 8.3.1.3.

5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

Test standard : FCC Part 15.247(b)(4), Part 15.203 and RSS-Gen 6.8

Requirement : use of approved antennas only with directional gains that do not exceed 6 dBi

According to the manufacturer declaration, the EUT has an antenna with Max directional gain of 2.5dBi. The antenna is a printed PCB trace with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.

5.1.2 Maximum conducted Peak output power

RESULT:
Passed

Test standard : FCC Part 15.247(b)(3), RSS-247 5.4(b)
 Basic standard : ANSI C63.10:2013, KDB558074(8.3.1.3)
 Limit : 1 Watt
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A

 Ambient temperature : 20-24 °C
 Relative humidity : 50-65 %
 Atmospheric pressure : 100-103 kPa

Table 6: Test result of Maximum conducted Peak output power, LE 1M

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	8.67	0.00736	1
Middle Channel	2440	8.71	0.00743	1
High Channel	2480	8.76	0.00752	1

Pmax: 8.76dBm, 7.52mW

Table 7: Test result of Maximum conducted Peak output power, LE 2M

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	8.65	0.00733	1
Middle Channel	2440	8.70	0.00741	1
High Channel	2480	8.74	0.00748	1

Pmax: 8.74dBm, 7.48mW

Table 8: Test result of Maximum conducted Peak output power, ANT (1Mbps)

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	8.65	0.00733	1
Middle Channel	2441	8.71	0.00743	1
High Channel	2480	8.74	0.00748	1

Pmax: 8.74dBm, 7.48mW

Table 9: Test result of Maximum conducted Peak output power, Nordic Original (2Mbps)

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	8.65	0.00733	1
Middle Channel	2441	8.71	0.00743	1
High Channel	2480	8.74	0.00748	1

Pmax: 8.74dBm, 7.48mW

Table 10: Test result of Maximum conducted Peak output power, IEEE 802.15.4

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2405	8.66	0.00735	1
Middle Channel	2440	8.71	0.00743	1
High Channel	2475	8.74	0.00748	1

Pmax: 8.74dBm, 7.48mW

5.1.3 6dB Bandwidth and 99% Bandwidth

RESULT:
Passed

Test standard : FCC Part 15.247(a)(2), RSS-247 5.2(a)
 RSS-Gen (Issue 5) 6.7
 Basic standard : ANSI C63.10:2013, KDB558074
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A
 Ambient temperature : 20-24°C
 Relative humidity : 50-65%
 Atmospheric pressure : 100-103 kPa

Table 11: Test result of 6dB Bandwidth, LE 1M

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	698.9	>500	Pass
Mid Channel	2440	700.9	>500	Pass
High Channel	2480	704.2	>500	Pass

Table 12: Test result of 6dB Bandwidth, LE 2M

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	1167	>500	Pass
Mid Channel	2440	1169	>500	Pass
High Channel	2480	1167	>500	Pass

Table 13: Test result of 6dB Bandwidth, ANT (1Mbps)

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	501.3	>500	Pass
Mid Channel	2441	501.0	>500	Pass
High Channel	2480	500.1	>500	Pass

Table 14: Test result of 6dB Bandwidth, Nordic Original (2Mbps)

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	850.4	>500	Pass
Mid Channel	2441	847.6	>500	Pass
High Channel	2480	630.8	>500	Pass

Table 15: Test result of 6dB Bandwidth, IEEE 802.15.4

Channel	Channel Frequency (MHz)	6dB Bandwidth (KHz)	Limit (kHz)	Result
Low Channel	2405	1204	>500	Pass
Mid Channel	2440	1221	>500	Pass
High Channel	2475	1209	>500	Pass

Table 16: Test result of 99% Bandwidth, LE 1M

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2440	1.0507

Table 17: Test result of 99% Bandwidth, LE 2M

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2440	2.0399

Table 18: Test result of 99% Bandwidth, ANT (1Mbps)

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2441	0.90412

Table 19: Test result of 99% Bandwidth, Nordic Original (2Mbps)

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2441	1.7163

Table 20: Test result of 99% Bandwidth, IEEE 802.15.4

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2440	2.2368

Test Plot of 6dB Bandwidth, LE 1M

Low Channel



Middle Channel



High Channel



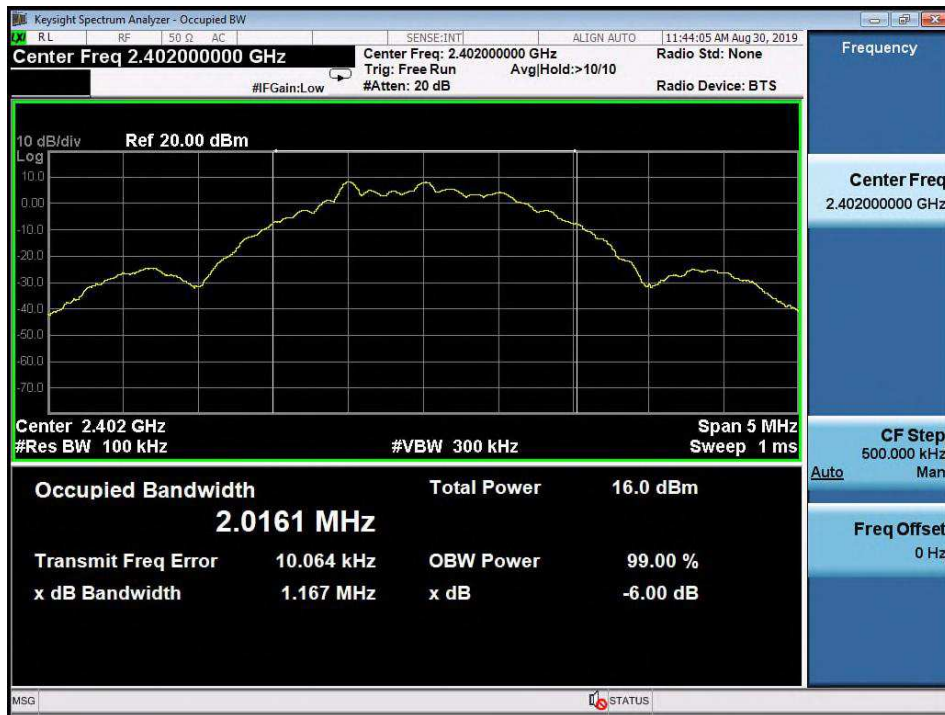
Test Plot of 99% Bandwidth, LE 1M

Middle Channel



Test Plot of 6dB Bandwidth, LE 2M

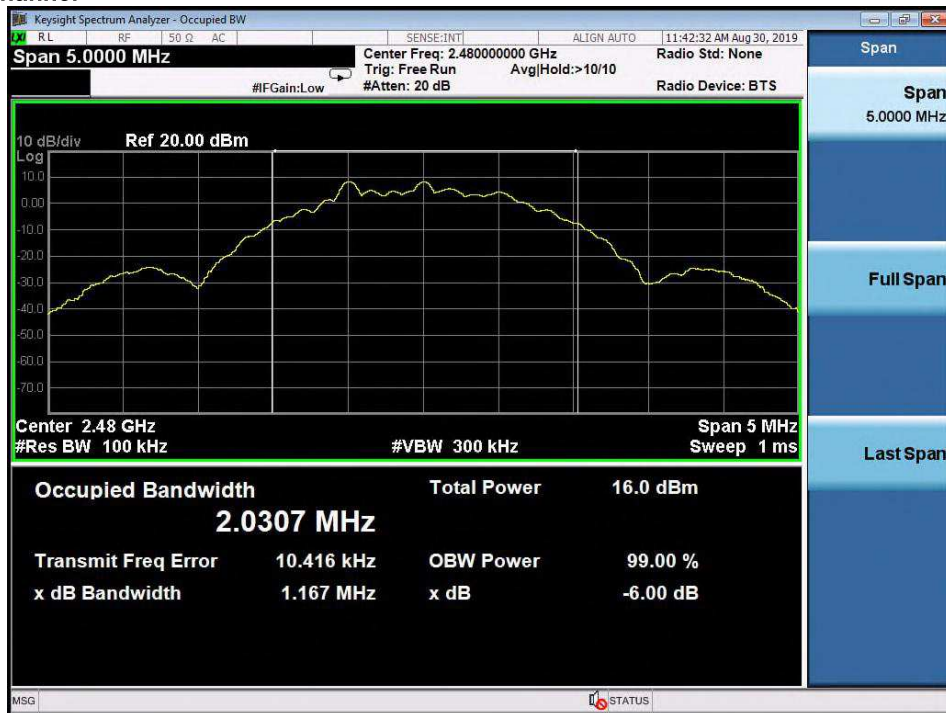
Low Channel



Middle Channel



High Channel



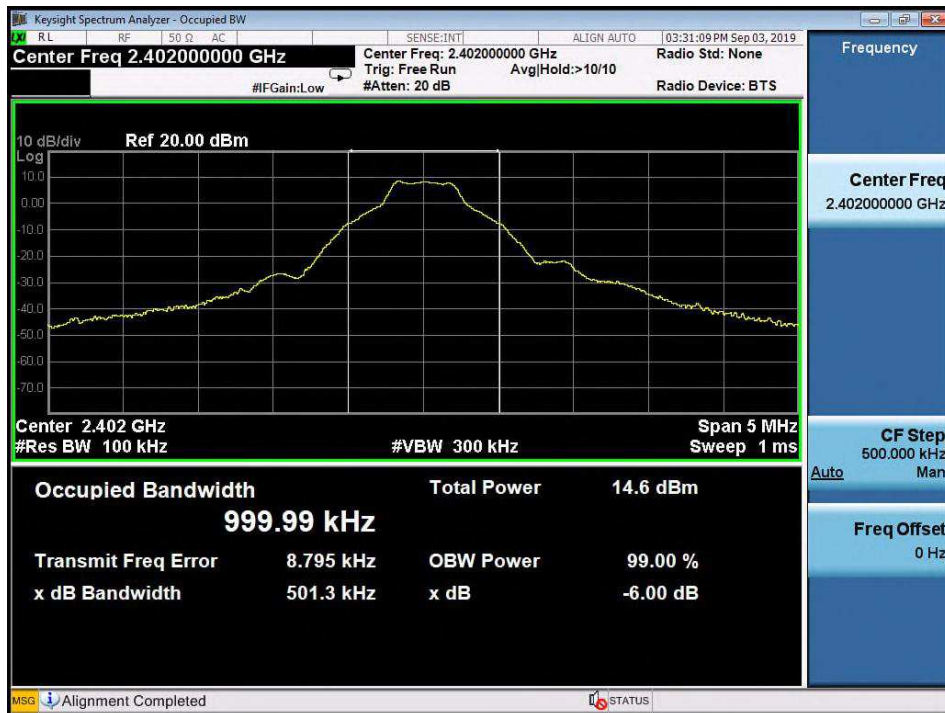
Test Plot of 99% Bandwidth, LE 2M

Middle Channel



Test Plot of 6dB Bandwidth, ANT (1Mbps)

Low Channel



Middle Channel

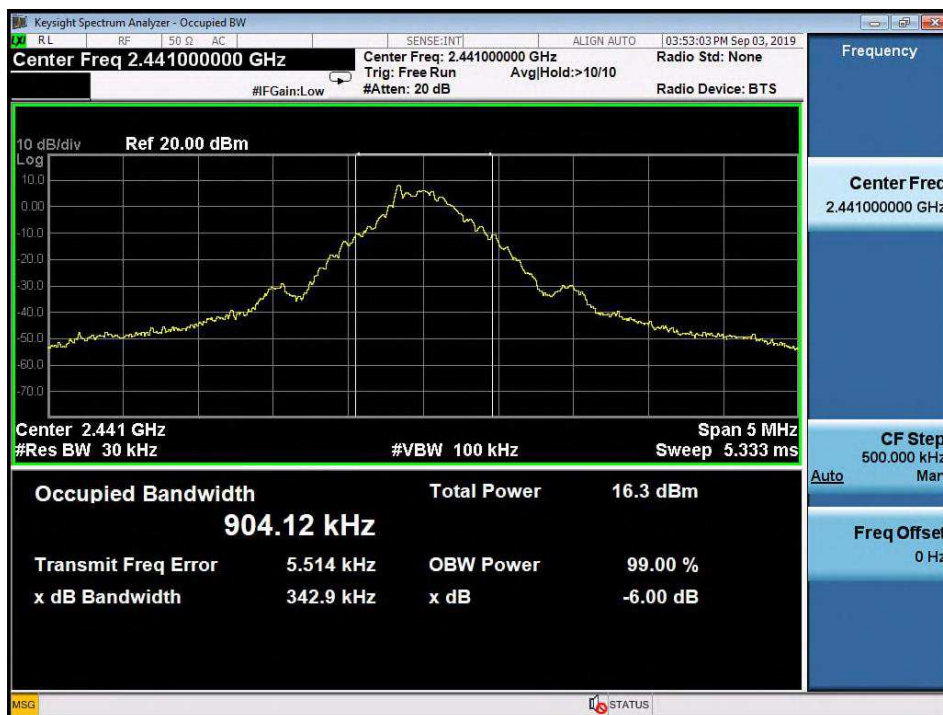


High Channel



Test Plot of 99% Bandwidth, ANT (1Mbps)

Middle Channel



Test Plot of 6dB Bandwidth, Nordic Original (2Mbps)

Low Channel



Middle Channel



High Channel



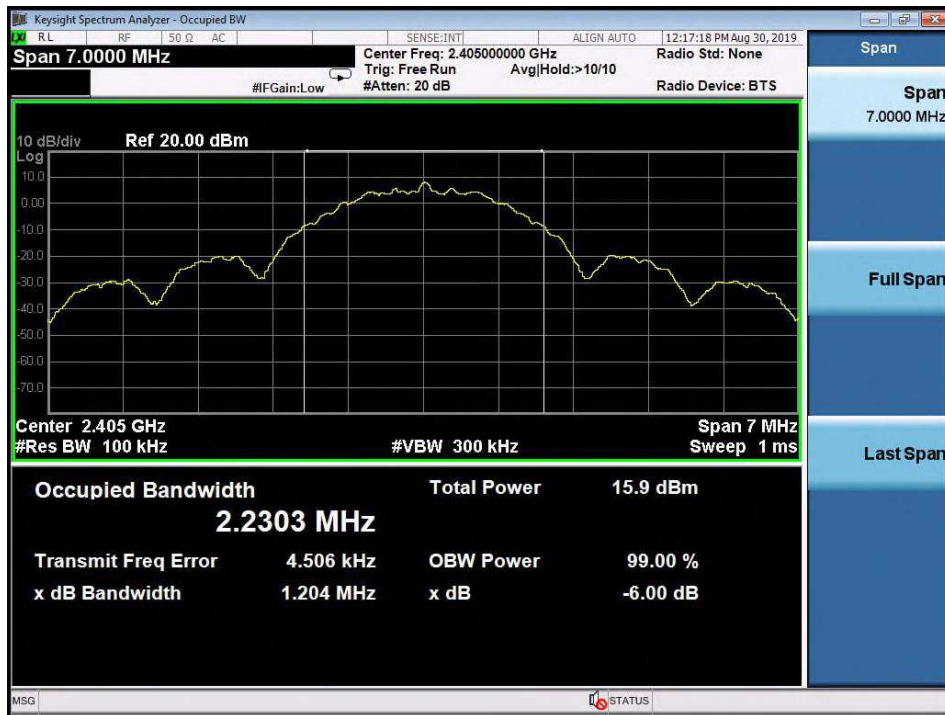
Test Plot of 99% Bandwidth, Nordic Original (2Mbps)

Middle Channel



Test Plot of 6dB Bandwidth, IEEE 802.15.4

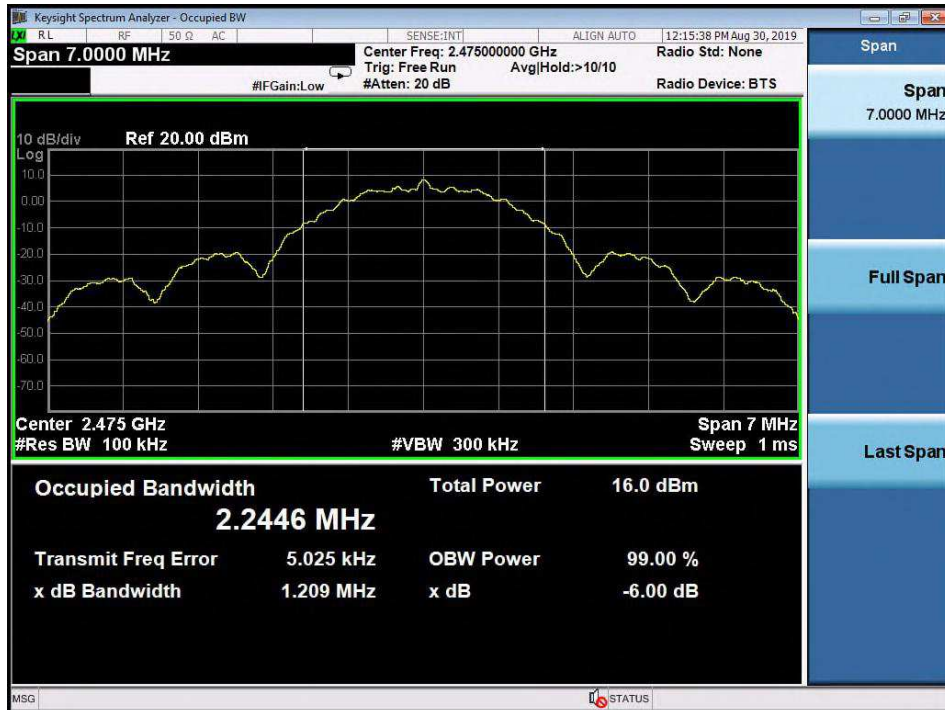
Low Channel



Middle Channel



High Channel



Test Plot of 99% Bandwidth, IEEE 802.15.4

Middle Channel

