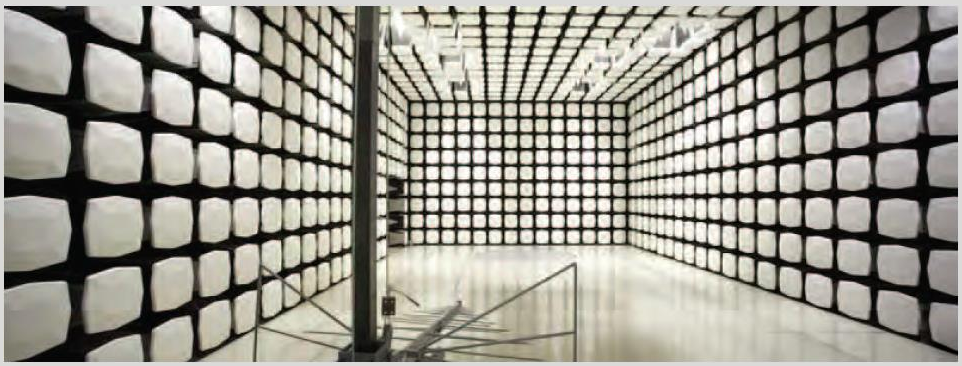
Koyo Electronics Industries Co., LTD

C2-03CPU

FCC 15.207:2020, FCC 15.247:2020

Bluetooth LE

Report # KOYO0001.15



NVLAP LAB CODE: 200881-0

CERTIFICATE OF TEST

Last Date of Test: March 4, 2020
Koyo Electronics Industries Co., LTD
EUT: C2-03CPU

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2020	ANSI C63.10:2013, KDB 558074
FCC 15.247:2020	

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	Pass	
11.8.2	Occupied Bandwidth	Yes	Pass	
11.9.1.1	Output Power	Yes	Pass	
11.9.1.1	Equivalent Isotropic Radiated Power	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	
11.11	Band Edge Compliance	Yes	Pass	
11.11	Spurious Conducted Emissions	Yes	Pass	
11.12.1, 11.13.2, 6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Eric Brandon, Department Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

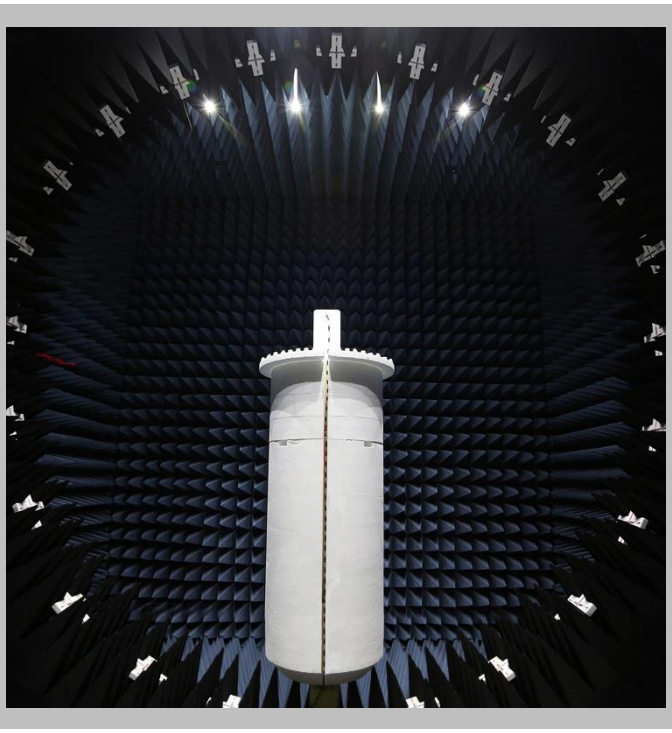
MIC – Recognized by MIC as a CAB for the acceptance of test data.

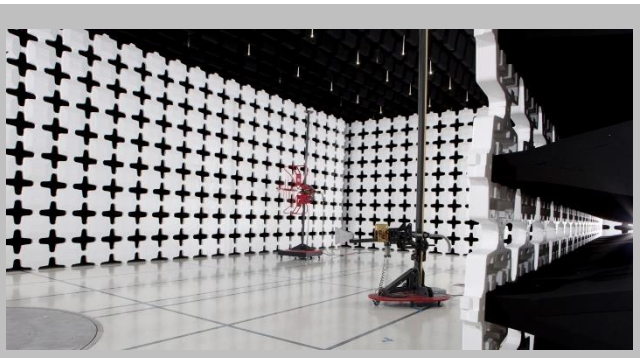
SCOPE

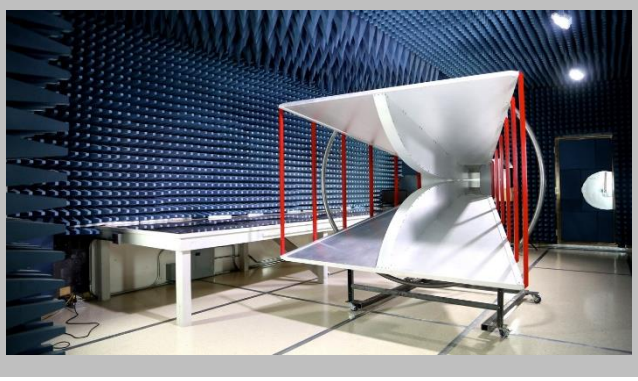
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

element
TMU.2015.07.10

Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

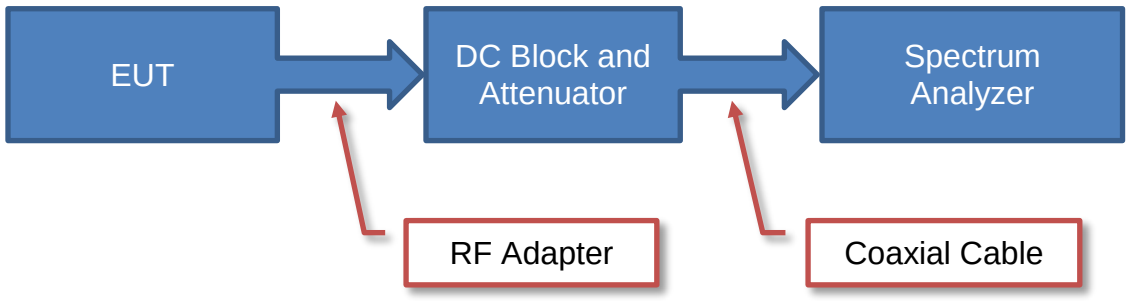
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable test description page. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

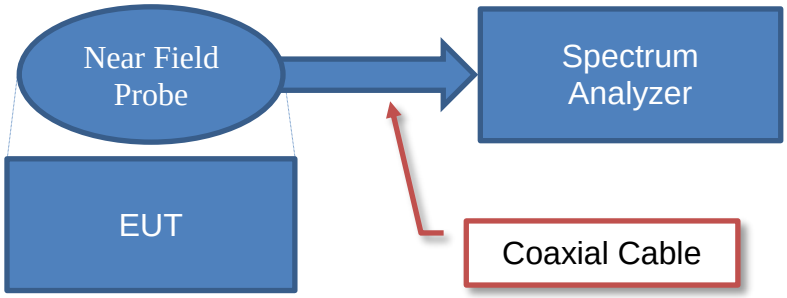
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams

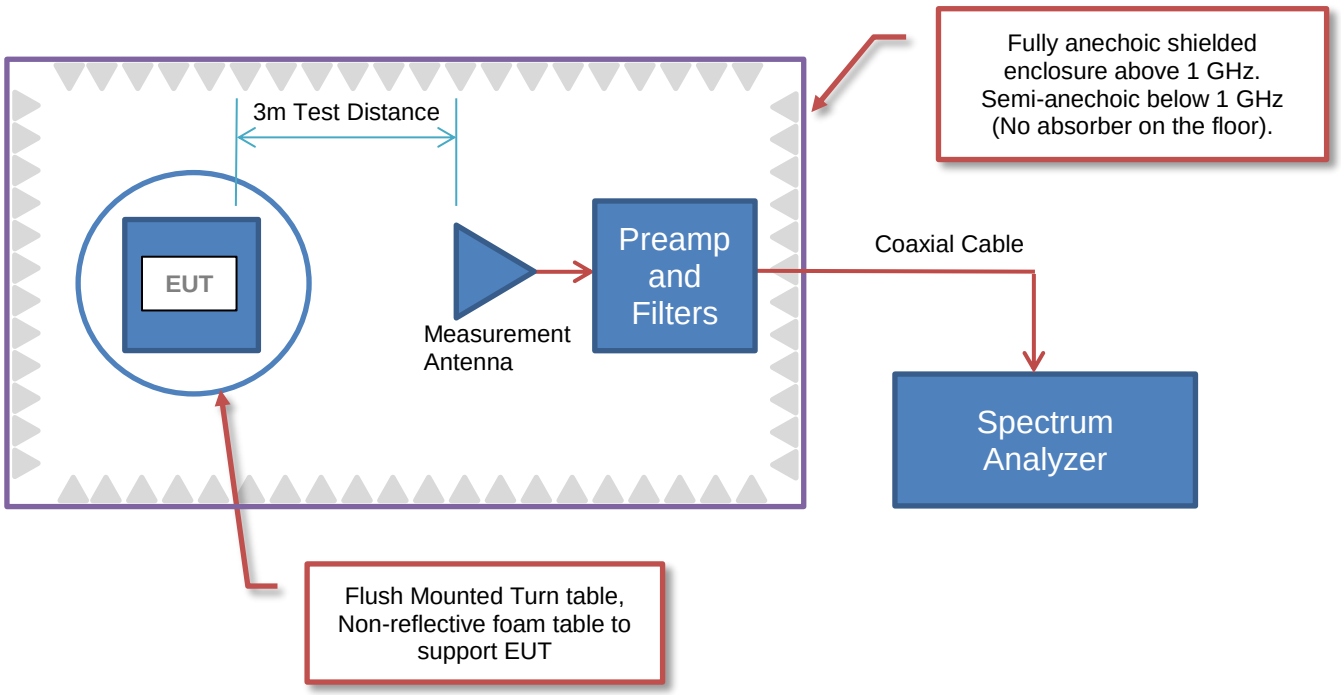
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Koyo Electronics Industries Co., LTD
Address:	4-9-1 Tenjin-cho
City, State, Zip:	Kodaira-City, Tokyo, 187-0004
Test Requested By:	Kuramoto Hiroyuki
EUT:	C2-03CPU
First Date of Test:	February 10, 2020
Last Date of Test:	March 4, 2020
Receipt Date of Samples:	January 27, 2020
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Embedded controller with 802.11 and BT

Testing Objective:
To demonstrate compliance of the Bluetooth radio under FCC 15.247 requirements.

CONFIGURATIONS

Configuration KOYO0001- 2

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
CLICK PLUS	Koyo Electronics Industries Co., LTD.	C2-03CPU	N/A

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
DC Power Module 2	Koyo Electronics Industries Co., LTD.	C0-01AC	C0-01AC+19923C443
Monopole Antenna	Automation Direct	SE-ANT210	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC Cable	No	2.9m	No	AC Mains	DC Power Module 2
DC Leads	No	0.1m	No	DC Power Module 2	C2-03CPU

Configuration KOYO0001- 3

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
CLICK PLUS	Koyo Electronics Industries Co., LTD.	C2-03CPU	N/A

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
DC Power Module 2	Koyo Electronics Industries Co., LTD.	C0-01AC	C0-01AC+19923C443
Dome Antenna	Automation Direct	SE-ANT250	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC Cable	No	2.9m	No	AC Mains	DC Power Module 2
DC Leads	No	0.1m	No	DC Power Module 2	C2-03CPU
Coax	Yes	3.0m	No	Dome Antenna	C2-03CPU

CONFIGURATIONS

Configuration KOYO0001- 10

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
CLICK PLUS	Koyo Electronics Industries Co., LTD.	C2-03CPU	N/A

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Dell	Vostro3360	HM7BPY1
Power Supply (Laptop)	Dell	6TM1C	CN-06TM1C-72438-3CP-6962-A01
DC Power Supply	Agilent	U8002A	TPZ

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Banana Cables (x2)	No	0.5m	No	CLICK PLUS	DC Power Supply
AC Cable (DC Power Supply)	No	1.8m	No	DC Power Supply	AC Mains
USB Cable	Yes	3.0m	No	CLICK PLUS	Laptop
AC Cable (Laptop)	No	0.9m	No	AC Mains	Power Supply (Laptop)
DC Cable (Laptop)	No	1.8m	Yes	Power Supply (Laptop)	Laptop

CONFIGURATIONS

Configuration KOYO0001- 11

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
CLICK PLUS	Koyo Electronics Industries Co., LTD.	C2-03CPU	N/A

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Monopole Antenna	Automation Direct	SE-ANT210	None
DC Power Supply 2	Kikusui	PMX35-3A	YB000467

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC Power	No	1.8m	No	AC Mains	DC Power Supply 2
DC Power Leads	No	0.3m	No	DC Power Supply 2	C2-03CPU

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2020-02-10	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2020-02-14	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2020-02-14	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2020-02-14	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2020-02-14	Equivalent Isotropic Radiated Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2020-02-14	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
7	2020-02-14	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2020-02-14	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
9	2020-02-17	Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
10	2020-03-04	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.10.29.0

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Rohde & Schwarz	ESR7	ARI	2019-07-08	2020-07-08
Cable - Conducted Cable Assembly	Northwest EMC	MNC, HGN, TYK	MNCA	2019-03-13	2020-03-13
LISN	Solar Electronics	9252-50-R-24-BNC	LIY	2019-03-15	2020-03-15

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

CONFIGURATIONS INVESTIGATED

KOYO0001-11

MODES INVESTIGATED

Continuous transmit on Bluetooth BLE, Monopole antenna, Mid channel (2442 MHz), BLE, power level 8.

POWERLINE CONDUCTED EMISSIONS

EUT:	C2-03CPU	Work Order:	KOYO0001
Serial Number:	N/A	Date:	2020-02-17
Customer:	Koyo Electronics Industries Co., LTD	Temperature:	22.3°C
Attendees:	None	Relative Humidity:	21.3%
Customer Project:	None	Bar. Pressure:	1014 mb
Tested By:	Dan Haas	Job Site:	MN03
Power:	24VDC	Configuration:	KOYO0001-11

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2020	ANSI C63.10:2013

TEST PARAMETERS

Run #:	18	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

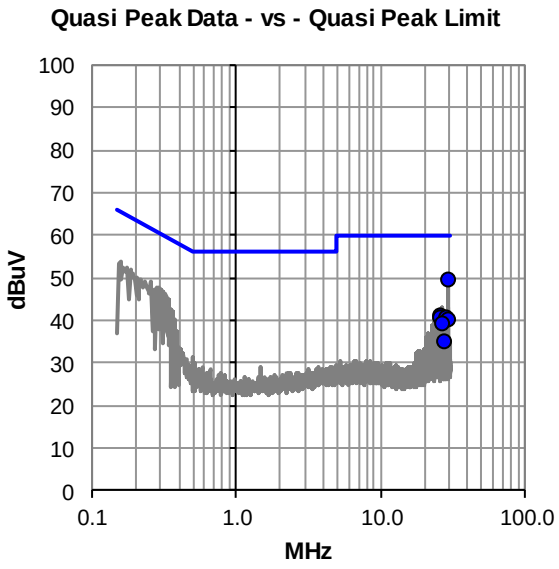
Kikusui 24VDC supply powered at 100VAC/60Hz.

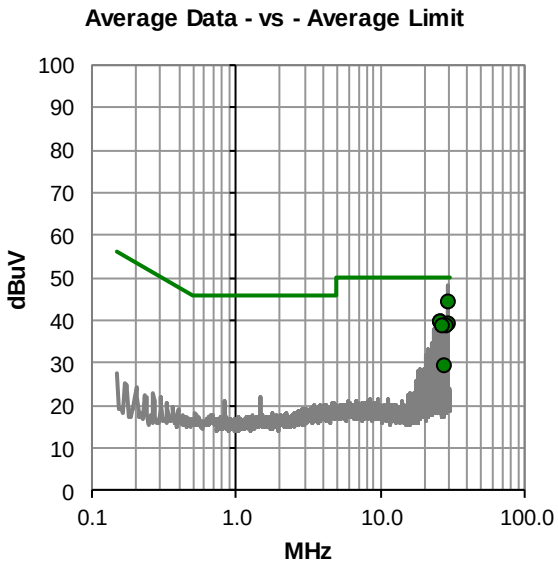
EUT OPERATING MODES

Continuous transmit on Bluetooth BLE, Monopole antenna, Mid channel (2442 MHz), BLE, power level 8.

DEVIATIONS FROM TEST STANDARD

None





POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.10.29.0

RESULTS - Run #18

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
29.5	28.300	21.2	49.5	60.0	-10.5
26.5	19.500	21.4	40.9	60.0	-19.1
25.9	19.200	21.4	40.6	60.0	-19.4
28.8	19.200	21.3	40.5	60.0	-19.5
29.4	18.700	21.2	39.9	60.0	-20.1
27.1	17.800	21.4	39.2	60.0	-20.8
28.2	13.600	21.3	34.9	60.0	-25.1

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
29.5	23.100	21.2	44.3	50.0	-5.7
26.5	18.100	21.4	39.5	50.0	-10.5
25.9	18.100	21.4	39.5	50.0	-10.5
29.4	17.900	21.2	39.1	50.0	-10.9
28.8	17.400	21.3	38.7	50.0	-11.3
27.1	17.100	21.4	38.5	50.0	-11.5
28.2	7.800	21.3	29.1	50.0	-20.9

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

EUT:	C2-03CPU	Work Order:	KOYO0001
Serial Number:	N/A	Date:	2020-02-17
Customer:	Koyo Electronics Industries Co., LTD	Temperature:	22.3°C
Attendees:	None	Relative Humidity:	21.3%
Customer Project:	None	Bar. Pressure:	1014 mb
Tested By:	Dan Haas	Job Site:	MN03
Power:	24VDC	Configuration:	KOYO0001-11

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2020	ANSI C63.10:2013

TEST PARAMETERS

Run #:	19	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

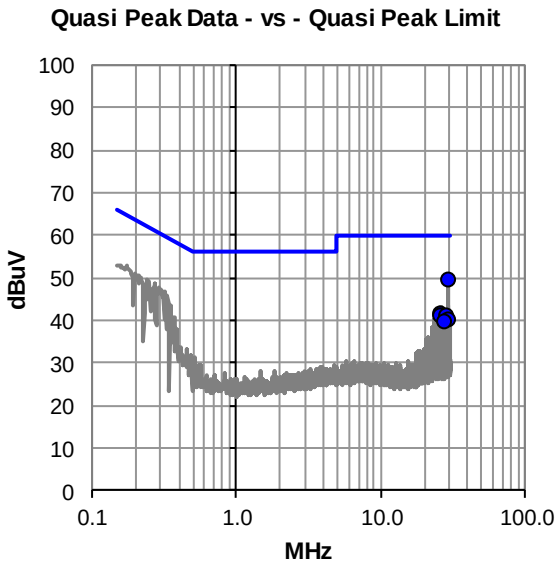
Kikusui 24VDC supply powered at 100VAC/60Hz.

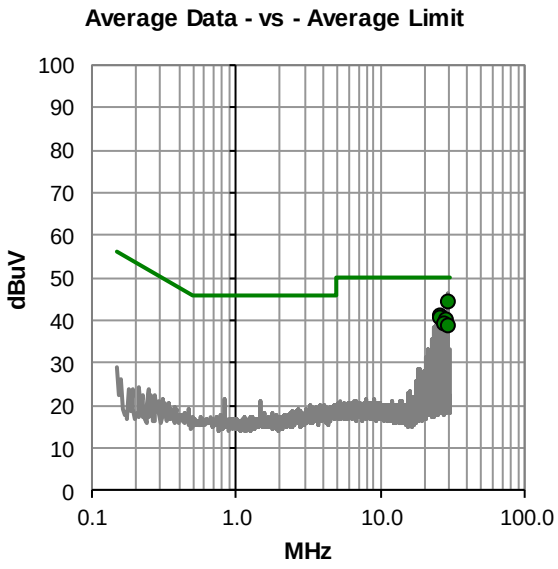
EUT OPERATING MODES

Continuous transmit on Bluetooth BLE, Monopole antenna, Mid channel (2442 MHz), BLE, power level 8.

DEVIATIONS FROM TEST STANDARD

None





POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.10.29.0

RESULTS - Run #19

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
29.5	28.400	21.2	49.6	60.0	-10.4
26.5	20.000	21.4	41.4	60.0	-18.6
25.9	19.600	21.4	41.0	60.0	-19.0
28.8	19.700	21.3	41.0	60.0	-19.0
29.4	18.600	21.2	39.8	60.0	-20.2
28.2	18.400	21.3	39.7	60.0	-20.3

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
29.5	23.200	21.2	44.4	50.0	-5.6
26.5	19.400	21.4	40.8	50.0	-9.2
25.9	18.900	21.4	40.3	50.0	-9.7
28.8	18.900	21.3	40.2	50.0	-9.8
28.2	17.700	21.3	39.0	50.0	-11.0
29.4	17.400	21.2	38.6	50.0	-11.4

CONCLUSION

Pass

Tested By

DUTY CYCLE

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Power Supply - DC	Agilent	U8002A	TPZ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Generator - Signal	Keysight	N5171B (EXG)	TEY	31-Dec-19	31-Dec-22
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	23-Dec-19	23-Dec-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

The duty cycle was calculated by dividing the transmission pulse duration (T) by the total period of a single on and total off time.

If the transmit duty cycle < 98 percent, burst gating may have been used during some of the other tests in this report to only take the measurement during the burst duration.

DUTY CYCLE

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	C2-03CPU			Work Order:	KOYO0001
Serial Number:	N/A			Date:	14-Feb-20
Customer:	Koyo Electronics Industries Co., LTD			Temperature:	22.8 °C
Attendees:	None			Humidity:	13.8% RH
Project:	None			Barometric Pres.:	1030 mbar
Tested by:	Andrew Rogstad	Power:	24 VDC	Job Site:	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

Reference level offset includes 20 dB attenuator, DC block, and measurement cable.

DEVIATIONS FROM TEST STANDARD

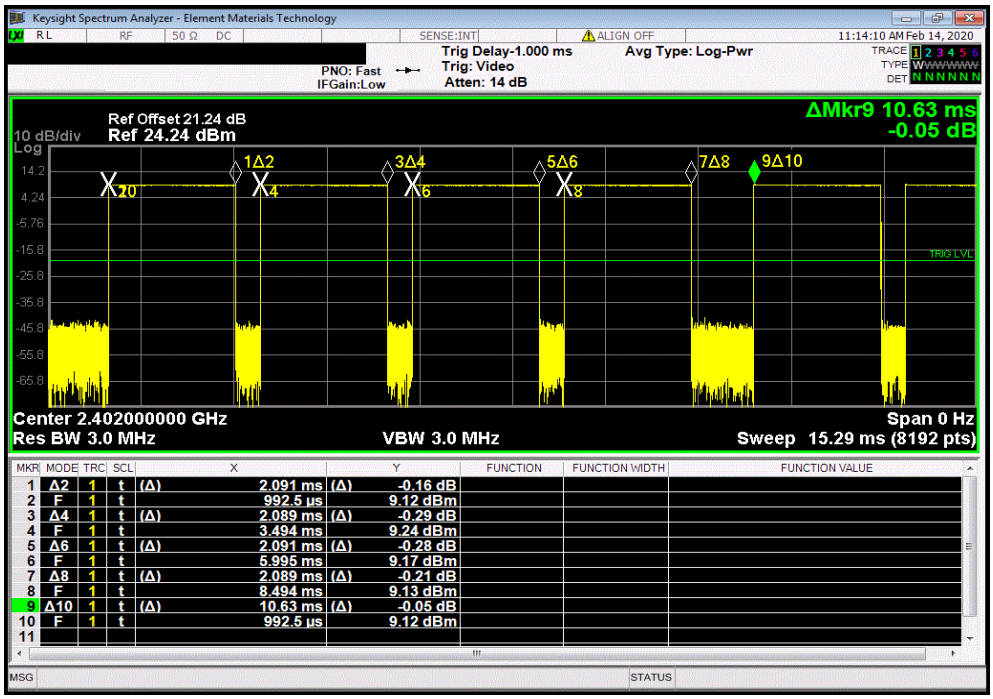
None

Configuration #	10	Signature

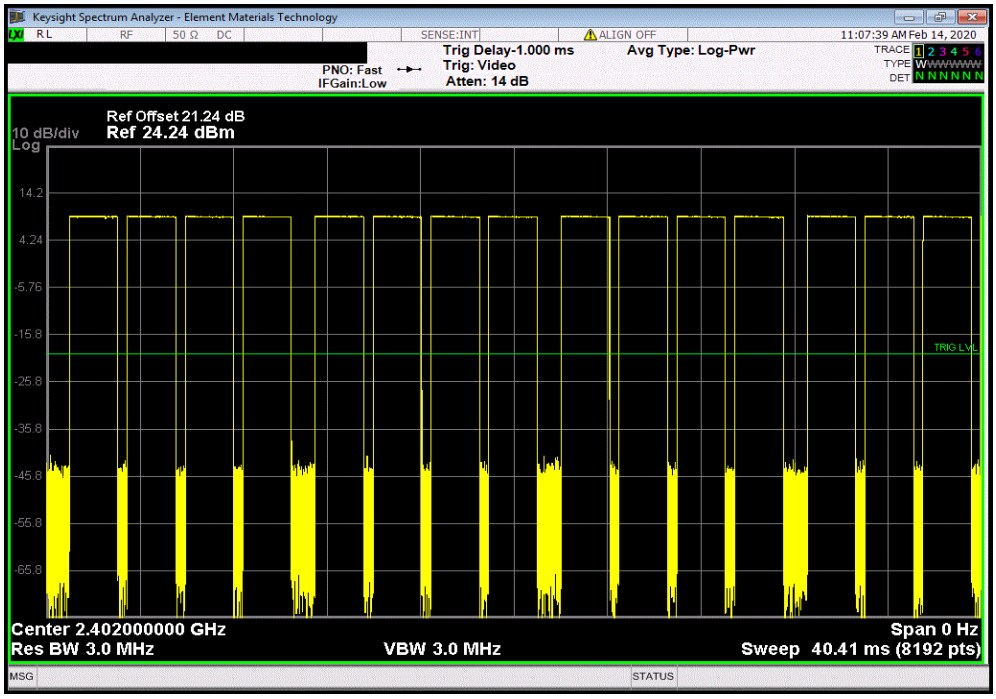
	Total On Time (ms)	Period (ms)	Number of Pulses	Value (%)	Limit (%)	Results
BLE/GFSK Low Channel, 2402 MHz	8.36	10.63	4	78.6	N/A	N/A
BLE/GFSK Low Channel, 2402 MHz	N/A	N/A	N/A	N/A	N/A	N/A
BLE/GFSK Mid Channel, 2442 MHz	8.354	10.63	4	78.6	N/A	N/A
BLE/GFSK Mid Channel, 2442 MHz	N/A	N/A	N/A	N/A	N/A	N/A
BLE/GFSK High Channel, 2480 MHz	8.36	10.63	4	78.6	N/A	N/A
BLE/GFSK High Channel, 2480 MHz	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE

BLE/GFSK Low Channel, 2402 MHz						
	Total On Time (ms)	Period (ms)	Number of Pulses	Value (%)	Limit (%)	Results
	8.36	10.63	4	78.6	N/A	N/A

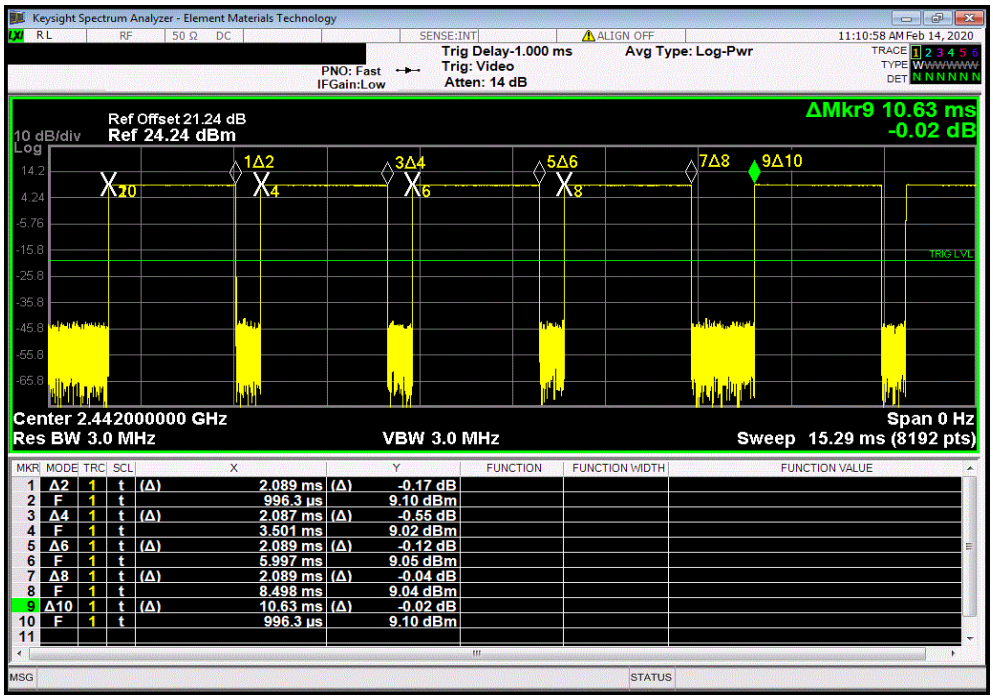


BLE/GFSK Low Channel, 2402 MHz						
	Total On Time (ms)	Period (ms)	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	N/A	N/A	N/A	N/A

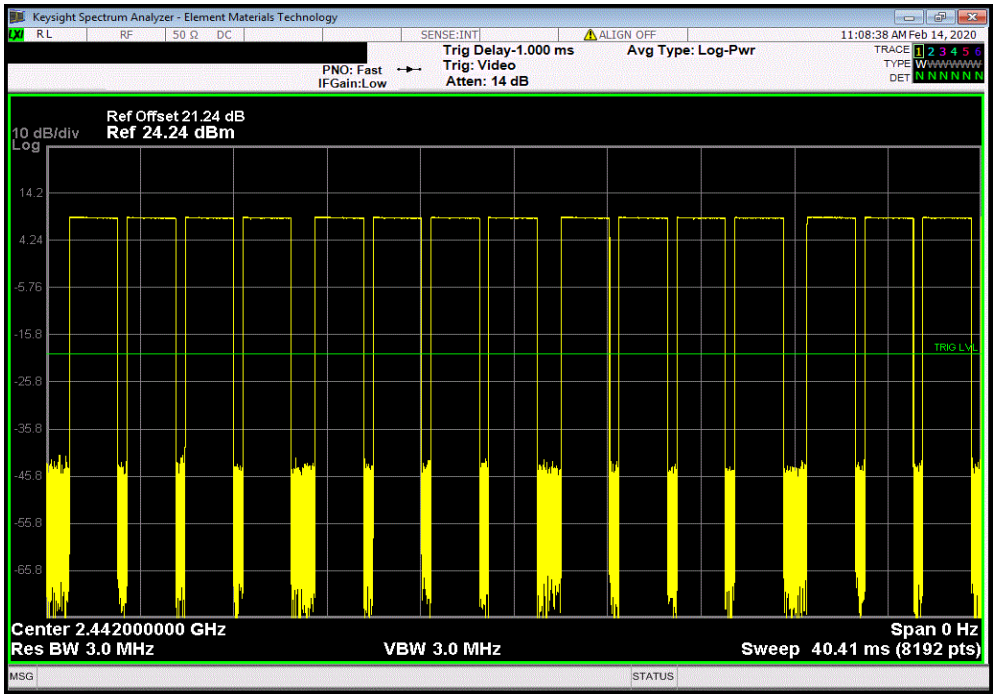


DUTY CYCLE

BLE/GFSK Mid Channel, 2442 MHz						
	Total On Time (ms)	Period (ms)	Number of Pulses	Value (%)	Limit (%)	Results
	8.354	10.63	4	78.6	N/A	N/A

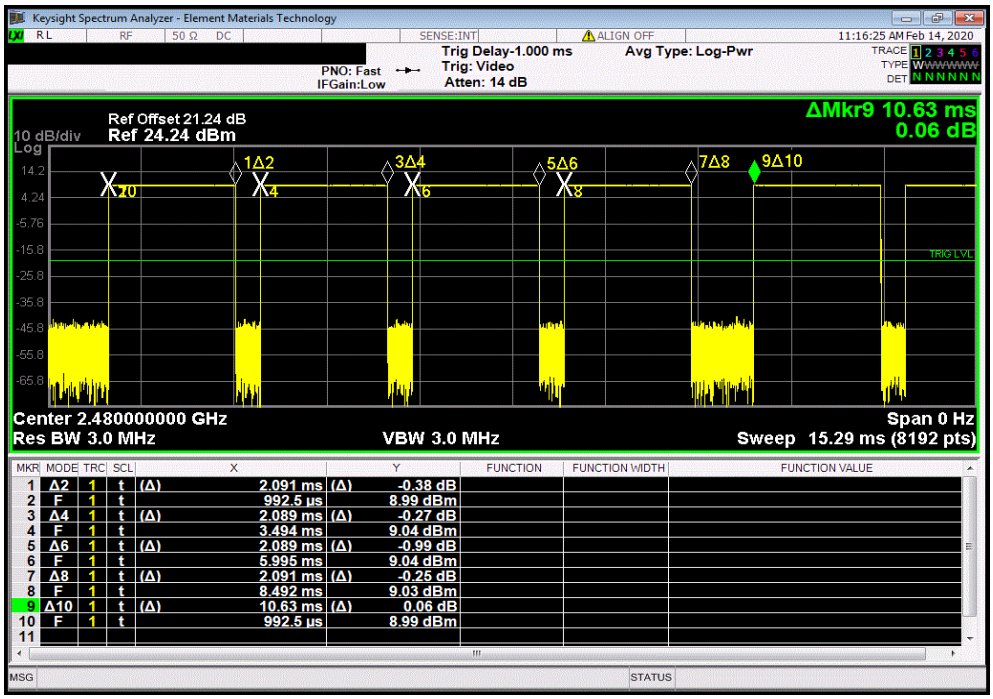


BLE/GFSK Mid Channel, 2442 MHz						
	Total On Time (ms)	Period (ms)	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	N/A	N/A	N/A	N/A

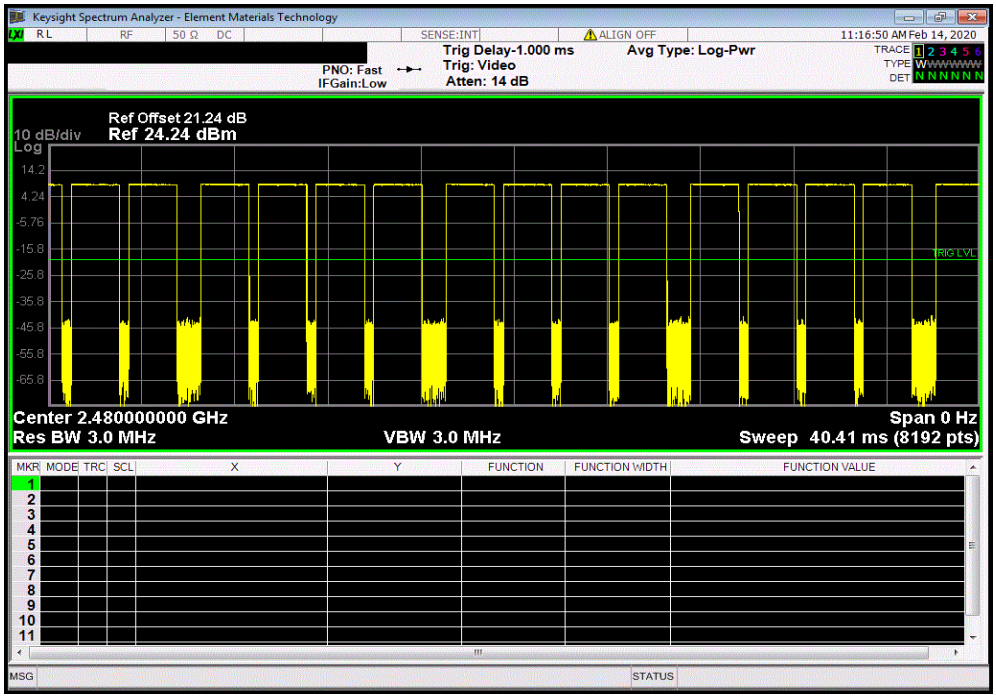


DUTY CYCLE

BLE/GFSK High Channel, 2480 MHz						
	Total On Time (ms)	Period (ms)	Number of Pulses	Value (%)	Limit (%)	Results
	8.36	10.63	4	78.6	N/A	N/A



BLE/GFSK High Channel, 2480 MHz						
	Total On Time (ms)	Period (ms)	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



OCCUPIED BANDWIDTH

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Power Supply - DC	Agilent	U8002A	TPZ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Generator - Signal	Keysight	N5171B (EXG)	TEY	31-Dec-19	31-Dec-22
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	23-Dec-19	23-Dec-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The EUT was set to the channels and modes listed in the datasheet.

The 6dB occupied bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The 99.0% occupied bandwidth was also measured at the same time which can be needed during Output Power depending on the applicable method.

OCCUPIED BANDWIDTH

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	C2-03CPU			**Work Order:**	KOYO0001
Serial Number:	N/A			**Date:**	14-Feb-20
Customer:	Koyo Electronics Industries Co., LTD			**Temperature:**	22.8 °C
Attendees:	None			**Humidity:**	13.9% RH
Project:	None			**Barometric Pres.:**	1030 mbar
Tested by:	Andrew Rogstad	**Power:**	24 VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

Reference level offset includes 20 dB attenuator, DC block, and measurement cable.

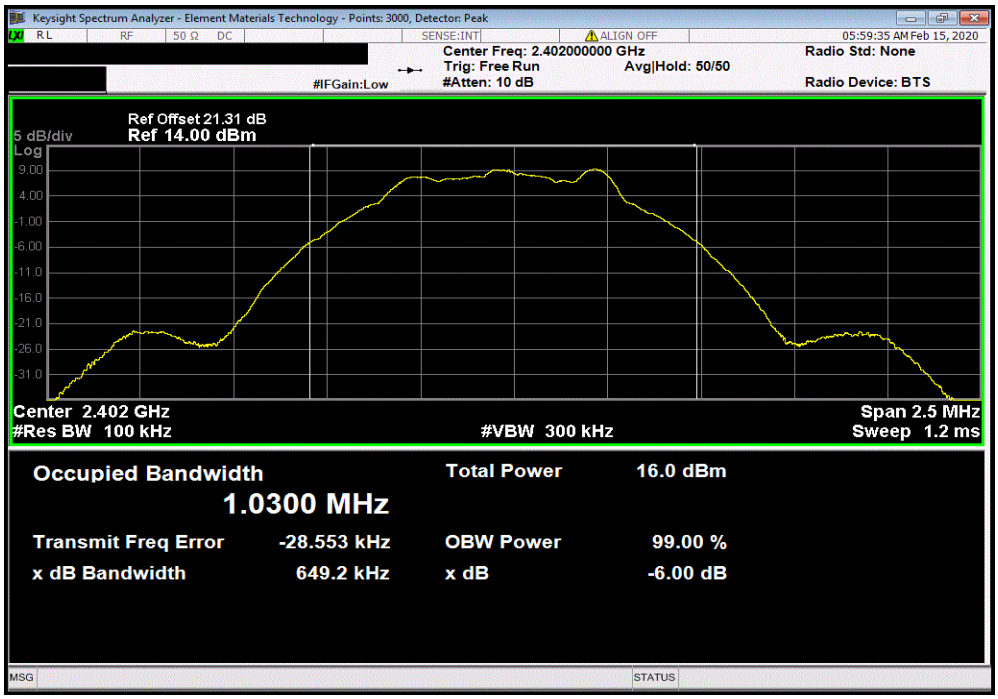
DEVIATIONS FROM TEST STANDARD

None

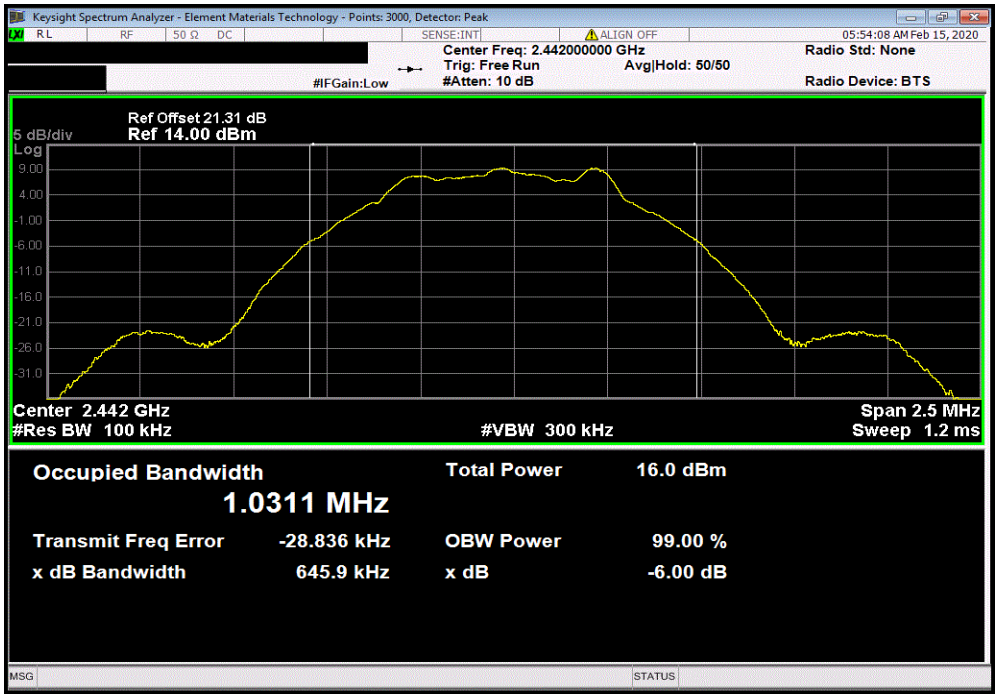
Configuration #	10	Signature

	Value	Limit (≥)	Result
BLE/GFSK Low Channel, 2402 MHz	649.209 kHz	500 kHz	Pass
BLE/GFSK Mid Channel, 2442 MHz	645.899 kHz	500 kHz	Pass
BLE/GFSK High Channel, 2480 MHz	648.892 kHz	500 kHz	Pass

BLE/GFSK Low Channel, 2402 MHz						
				Value	Limit (≥)	Result
				649.209 kHz	500 kHz	Pass

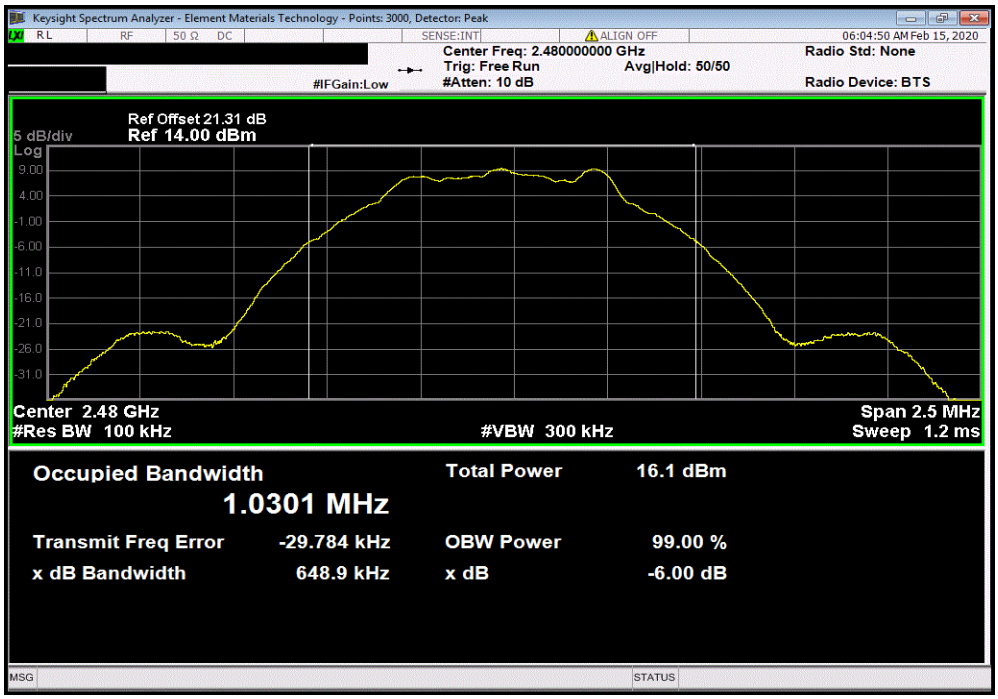


BLE/GFSK Mid Channel, 2442 MHz						
				Value	Limit (≥)	Result
				645.899 kHz	500 kHz	Pass



OCCUPIED BANDWIDTH

BLE/GFSK High Channel, 2480 MHz						
				Value	Limit (≥)	Result
				648.892 kHz	500 kHz	Pass



OUTPUT POWER

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Power Supply - DC	Agilent	U8002A	TPZ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Generator - Signal	Keysight	N5171B (EXG)	TEY	31-Dec-19	31-Dec-22
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	23-Dec-19	23-Dec-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the DTS bandwidth (B) was measured.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio.

OUTPUT POWER

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	C2-03CPU			**Work Order:**	KOYO0001
Serial Number:	N/A			**Date:**	14-Feb-20
Customer:	Koyo Electronics Industries Co., LTD			**Temperature:**	22.8 °C
Attendees:	None			**Humidity:**	13.8% RH
Project:	None			**Barometric Pres.:**	1030 mbar
Tested by:	Andrew Rogstad	**Power:**	24 VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

Reference level offset includes 20 dB attenuator, DC block, and measurement cable.

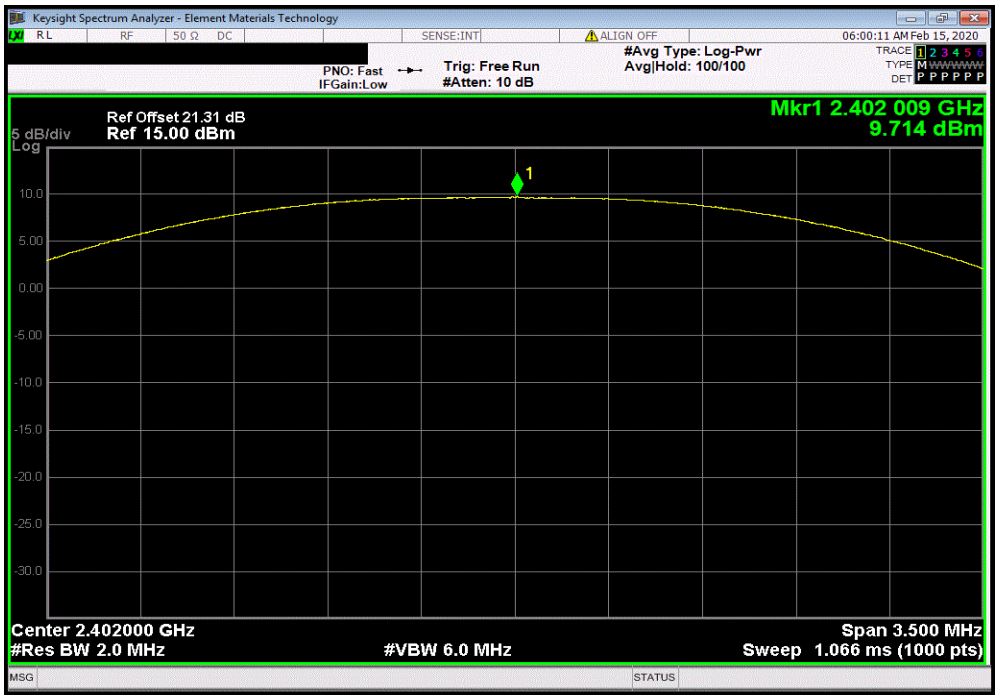
DEVIATIONS FROM TEST STANDARD

None

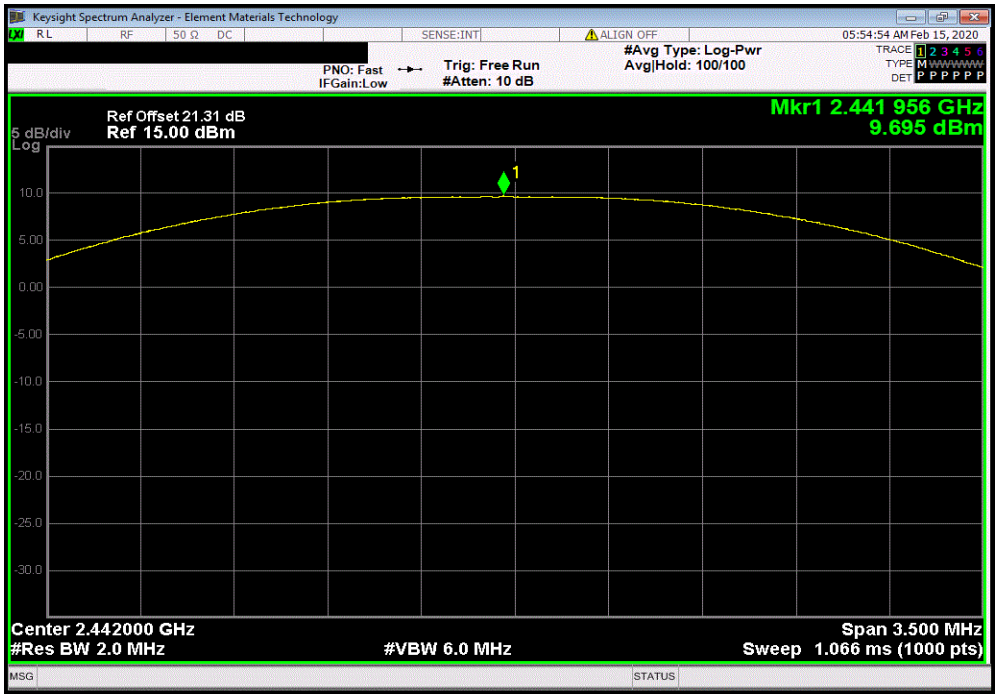
Configuration #	10	Signature

	Out Pwr (dBm)	Limit (dBm)	Result
BLE/GFSK Low Channel, 2402 MHz	9.714	30	Pass
BLE/GFSK Mid Channel, 2442 MHz	9.695	30	Pass
BLE/GFSK High Channel, 2480 MHz	9.805	30	Pass

BLE/GFSK Low Channel, 2402 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				9.714	30	Pass

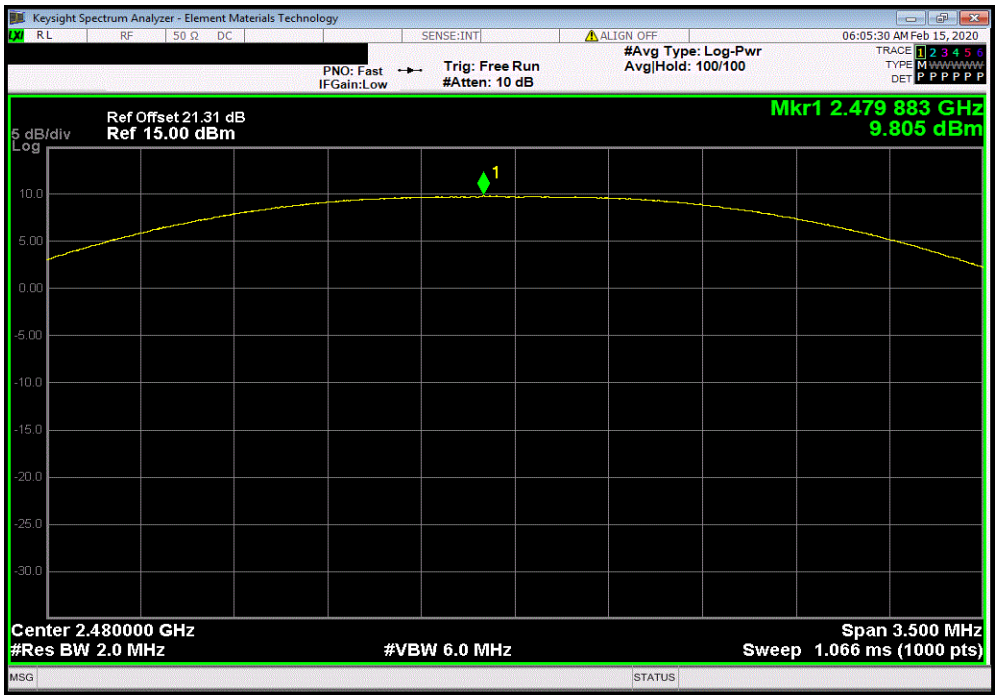


BLE/GFSK Mid Channel, 2442 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				9.695	30	Pass



OUTPUT POWER

BLE/GFSK High Channel, 2480 MHz						
				Out Pwr (dBm)	Limit (dBm)	Result
				9.805	30	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Power Supply - DC	Agilent	U8002A	TPZ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Generator - Signal	Keysight	N5171B (EXG)	TEY	31-Dec-19	31-Dec-22
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	23-Dec-19	23-Dec-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the DTS bandwidth (B) was measured.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio.

The antenna gain was added to the conducted output power to calculate the EIRP.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	C2-03CPU			**Work Order:**	KOYO0001
Serial Number:	N/A			**Date:**	14-Feb-20
Customer:	Koyo Electronics Industries Co., LTD			**Temperature:**	22.8 °C
Attendees:	None			**Humidity:**	14% RH
Project:	None			**Barometric Pres.:**	1030 mbar
Tested by:	Andrew Rogstad	**Power:**	24 VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

Reference level offset includes 20 dB attenuator, DC block, and measurement cable.

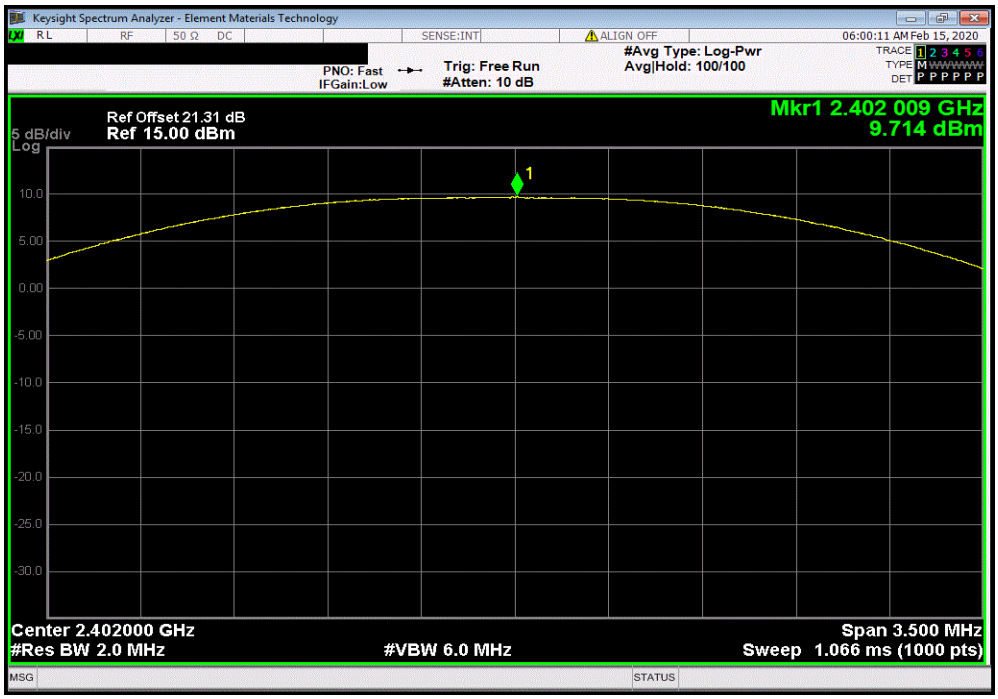
DEVIATIONS FROM TEST STANDARD

None

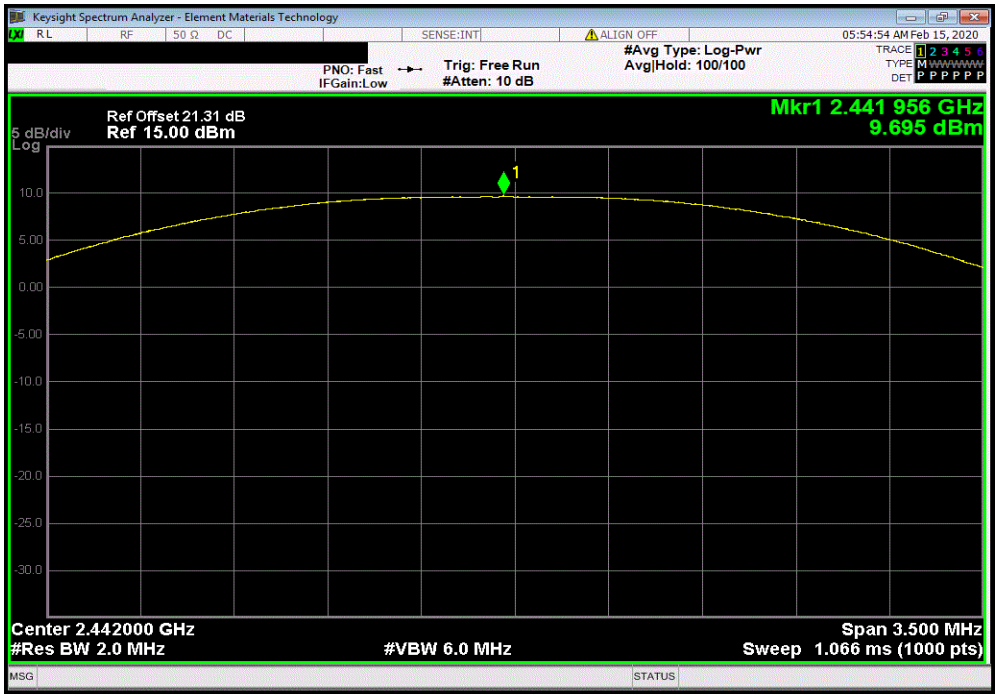
Configuration #	10	Signature

	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
BLE/GFSK Low Channel, 2402 MHz	9.714	1.8	11.514	36	Pass
BLE/GFSK Mid Channel, 2442 MHz	9.695	1.8	11.495	36	Pass
BLE/GFSK High Channel, 2480 MHz	9.805	1.8	11.605	36	Pass

BLE/GFSK Low Channel, 2402 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		9.714	1.8	11.514	36	Pass

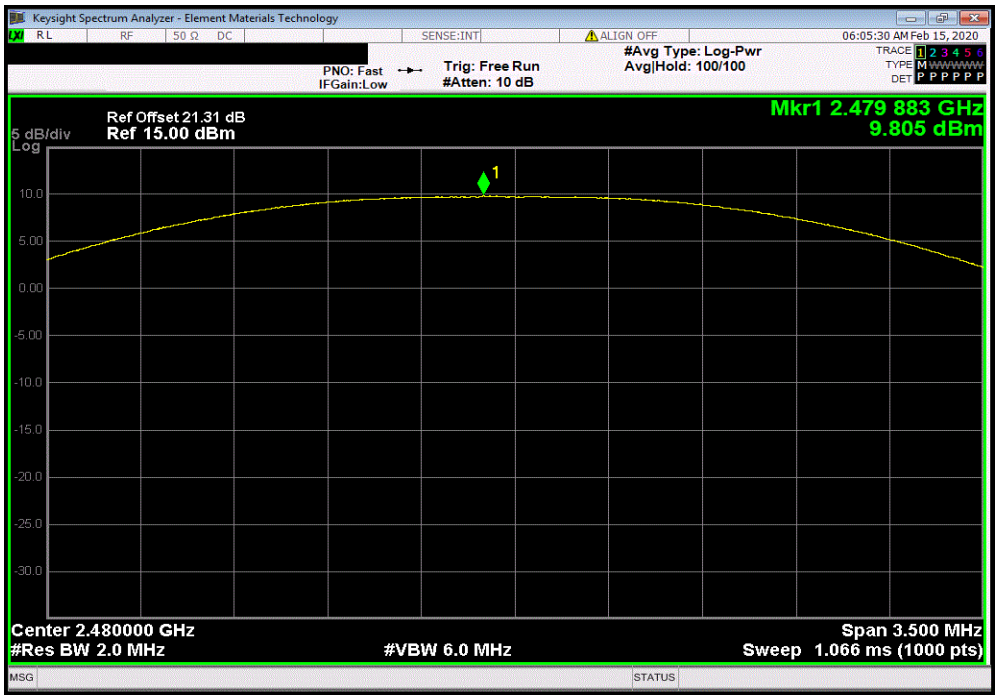


BLE/GFSK Mid Channel, 2442 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		9.695	1.8	11.495	36	Pass



EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

BLE/GFSK High Channel, 2480 MHz						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		9.805	1.8	11.605	36	Pass



POWER SPECTRAL DENSITY

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Power Supply - DC	Agilent	U8002A	TPZ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Generator - Signal	Keysight	N5171B (EXG)	TEY	31-Dec-19	31-Dec-22
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	23-Dec-19	23-Dec-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The maximum power spectral density measurements was measured using the channels and modes as called out on the following data sheets.

Per the procedure outlined in ANSI C63.10 the peak power spectral density was measured in a 3 kHz RBW.

POWER SPECTRAL DENSITY

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	C2-03CPU			**Work Order:**	KOYO0001
Serial Number:	N/A			**Date:**	14-Feb-20
Customer:	Koyo Electronics Industries Co., LTD			**Temperature:**	22.8 °C
Attendees:	None			**Humidity:**	13.8% RH
Project:	None			**Barometric Pres.:**	1030 mbar
Tested by:	Andrew Rogstad	**Power:**	24 VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

Reference level offset includes 20 dB attenuator, DC block, and measurement cable.

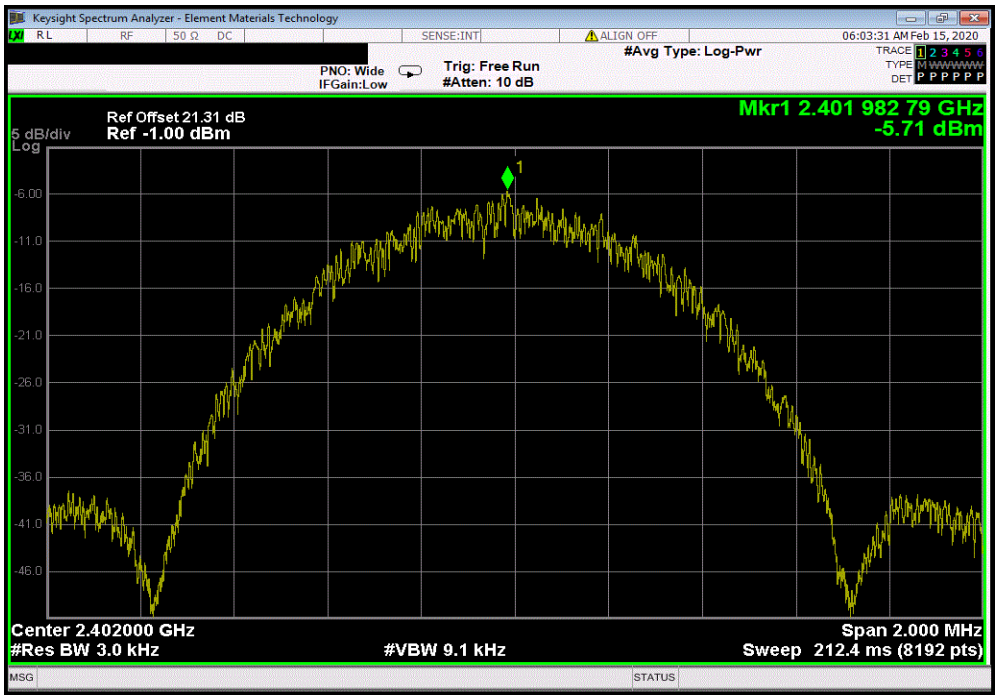
DEVIATIONS FROM TEST STANDARD

None

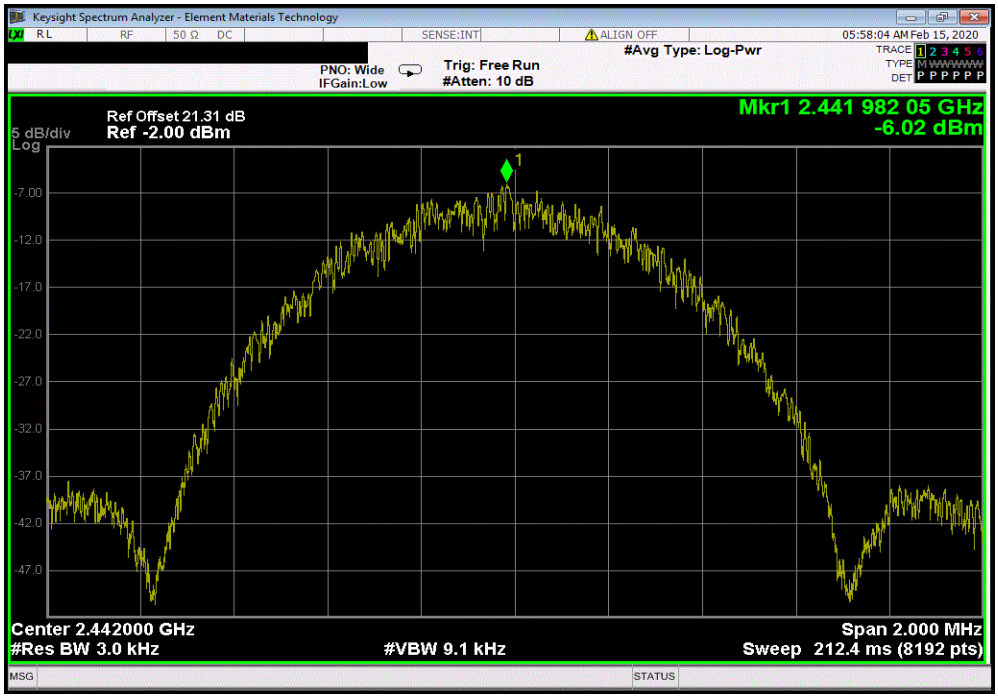
Configuration #	10	Signature

	Value dBm/3kHz	Limit < dBm/3kHz	Results
BLE/GFSK Low Channel, 2402 MHz	-5.705	8	Pass
BLE/GFSK Mid Channel, 2442 MHz	-6.018	8	Pass
BLE/GFSK High Channel, 2480 MHz	-5.768	8	Pass

BLE/GFSK Low Channel, 2402 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-5.705	8	Pass



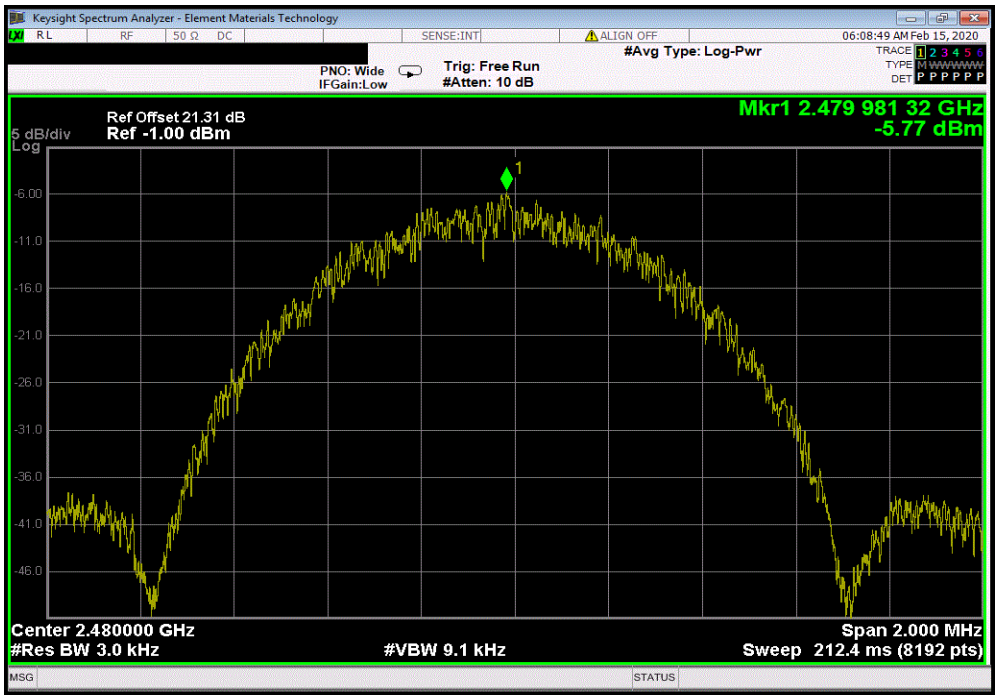
BLE/GFSK Mid Channel, 2442 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-6.018	8	Pass



POWER SPECTRAL DENSITY

TbtTx 2019.08.30.0 XMit 2019.09.05

BLE/GFSK High Channel, 2480 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-5.768	8	Pass



BAND EDGE COMPLIANCE

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Power Supply - DC	Agilent	U8002A	TPZ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Generator - Signal	Keysight	N5171B (EXG)	TEY	31-Dec-19	31-Dec-22
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	23-Dec-19	23-Dec-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in each available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet.

The spectrum was scanned below the lower band edge and above the higher band edge.

BAND EDGE COMPLIANCE

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	C2-03CPU			**Work Order:**	KOYO0001
Serial Number:	N/A			**Date:**	14-Feb-20
Customer:	Koyo Electronics Industries Co., LTD			**Temperature:**	22.8 °C
Attendees:	None			**Humidity:**	13.8% RH
Project:	None			**Barometric Pres.:**	1030 mbar
Tested by:	Andrew Rogstad	**Power:**	24 VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

Reference level offset includes 20 dB attenuator, DC block, and measurement cable.

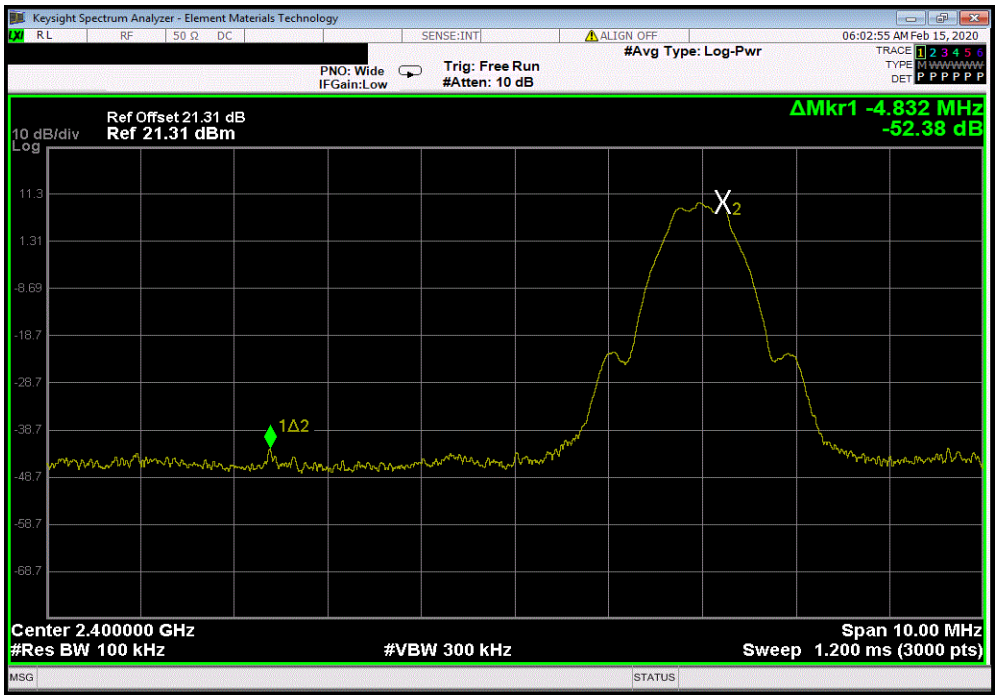
DEVIATIONS FROM TEST STANDARD

None

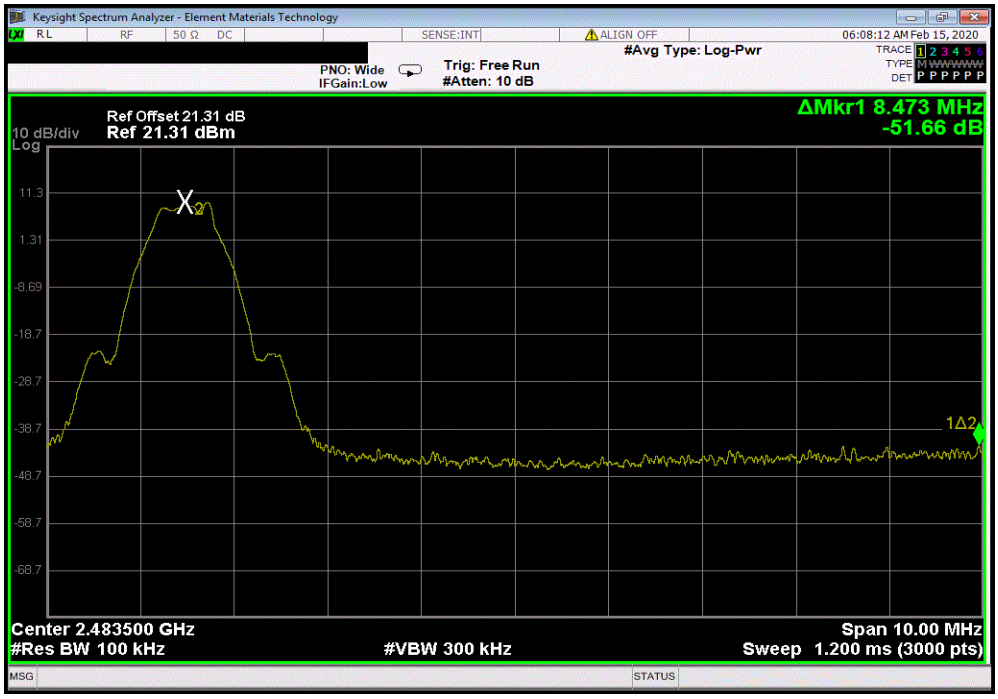
Configuration #	10	Signature

	Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK Low Channel, 2402 MHz	-52.38	-20	Pass
BLE/GFSK High Channel, 2480 MHz	-51.66	-20	Pass

BLE/GFSK Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-52.38	-20	Pass



BLE/GFSK High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-51.66	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Power Supply - DC	Agilent	U8002A	TPZ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Attenuator	S.M. Electronics	SA26B-20	TZP	9-Nov-19	9-Nov-20
Generator - Signal	Keysight	N5171B (EXG)	TEY	31-Dec-19	31-Dec-22
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	23-Dec-19	23-Dec-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting at the data rate(s) listed in the datasheet. For each transmit frequency, the spectrum was scanned throughout the specified frequency range.

SPURIOUS CONDUCTED EMISSIONS

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	C2-03CPU			**Work Order:**	KOYO0001
Serial Number:	N/A			**Date:**	14-Feb-20
Customer:	Koyo Electronics Industries Co., LTD			**Temperature:**	22.8 °C
Attendees:	None			**Humidity:**	13.8% RH
Project:	None			**Barometric Pres.:**	1030 mbar
Tested by:	Andrew Rogstad	**Power:**	24 VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

COMMENTS

Reference level offset includes 20 dB attenuator, DC block, and measurement cable.

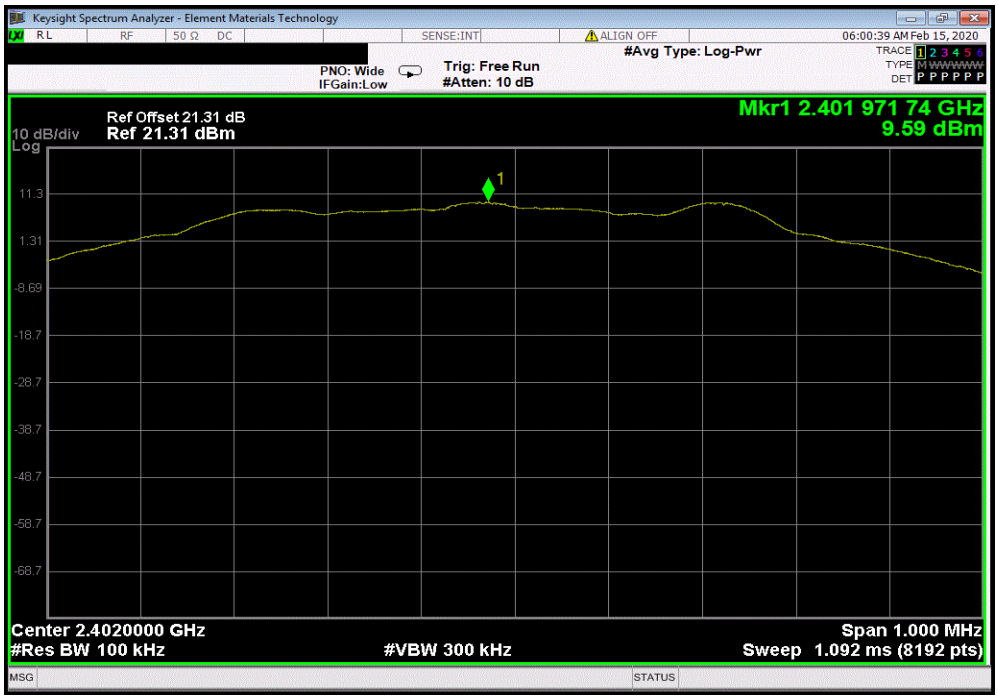
DEVIATIONS FROM TEST STANDARD

None

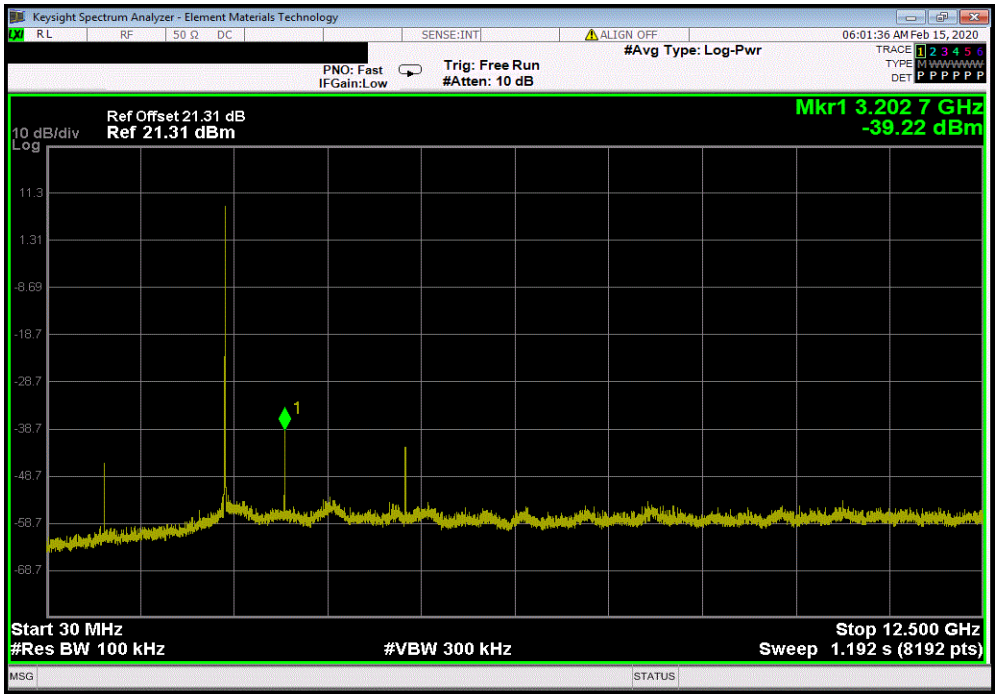
Configuration #	**10**	*Signature* Andrew Rogstad

	Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK Low Channel, 2402 MHz	Fundamental	2401.97	N/A	N/A	N/A
BLE/GFSK Low Channel, 2402 MHz	30 MHz - 12.5 GHz	3202.69	-48.81	-20	Pass
BLE/GFSK Low Channel, 2402 MHz	12.5 GHz - 25 GHz	23995.85	-60.29	-20	Pass
BLE/GFSK Mid Channel, 2442 MHz	Fundamental	2441.97	N/A	N/A	N/A
BLE/GFSK Mid Channel, 2442 MHz	30 MHz - 12.5 GHz	3255.97	-50.6	-20	Pass
BLE/GFSK Mid Channel, 2442 MHz	12.5 GHz - 25 GHz	22358.38	-60.24	-20	Pass
BLE/GFSK High Channel, 2480 MHz	Fundamental	2479.96	N/A	N/A	N/A
BLE/GFSK High Channel, 2480 MHz	30 MHz - 12.5 GHz	2487.16	-51.09	-20	Pass
BLE/GFSK High Channel, 2480 MHz	12.5 GHz - 25 GHz	24140.83	-60.77	-20	Pass

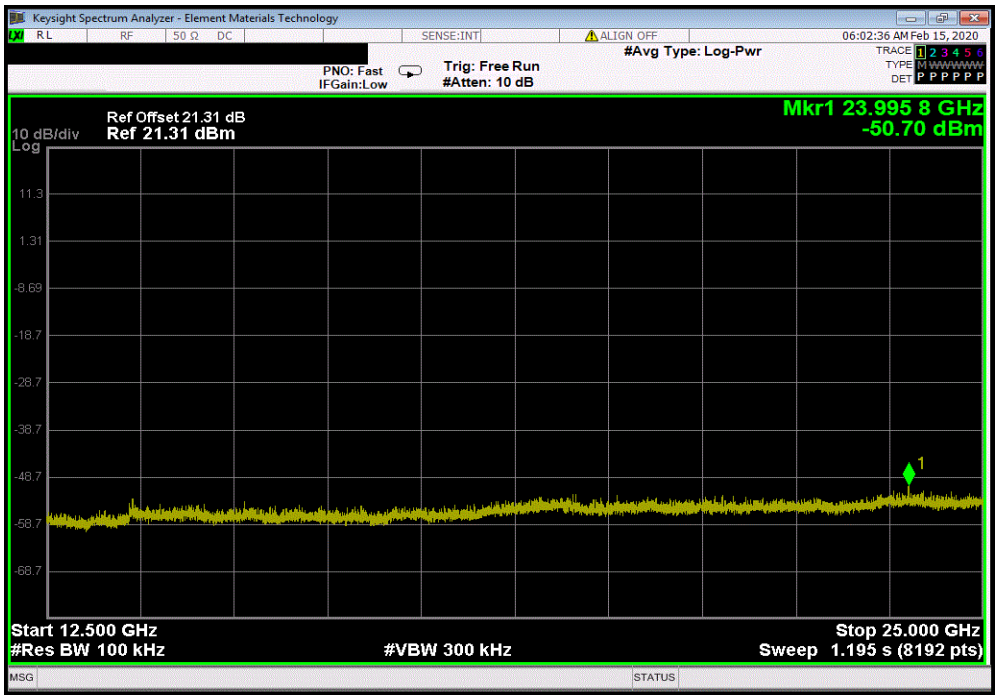
BLE/GFSK Low Channel, 2402 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2401.97	N/A	N/A	N/A



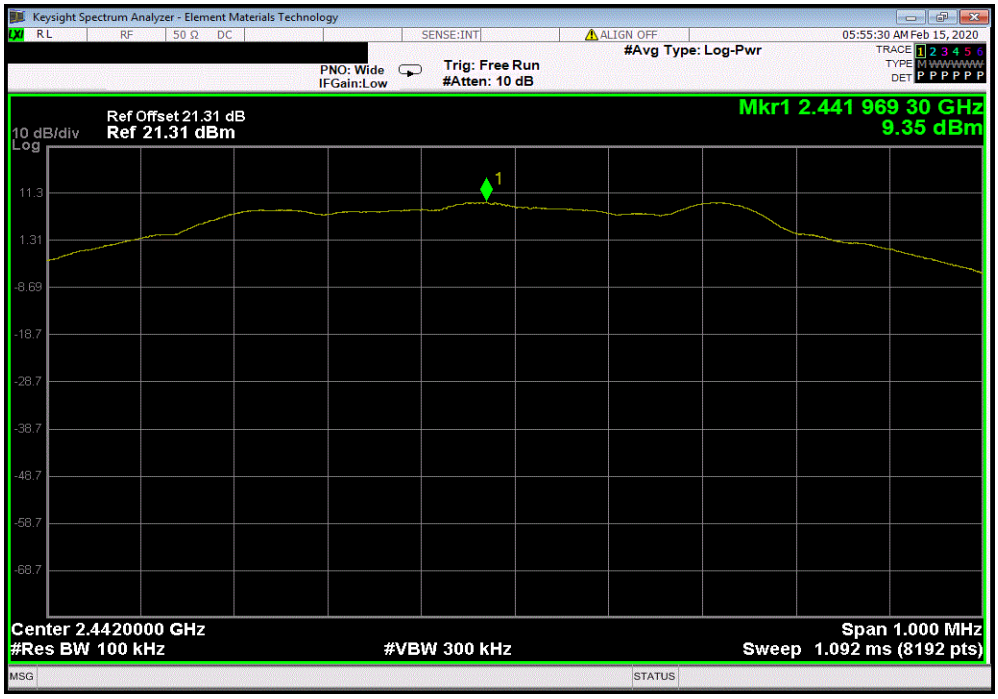
BLE/GFSK Low Channel, 2402 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	3202.69	-48.81	-20	Pass



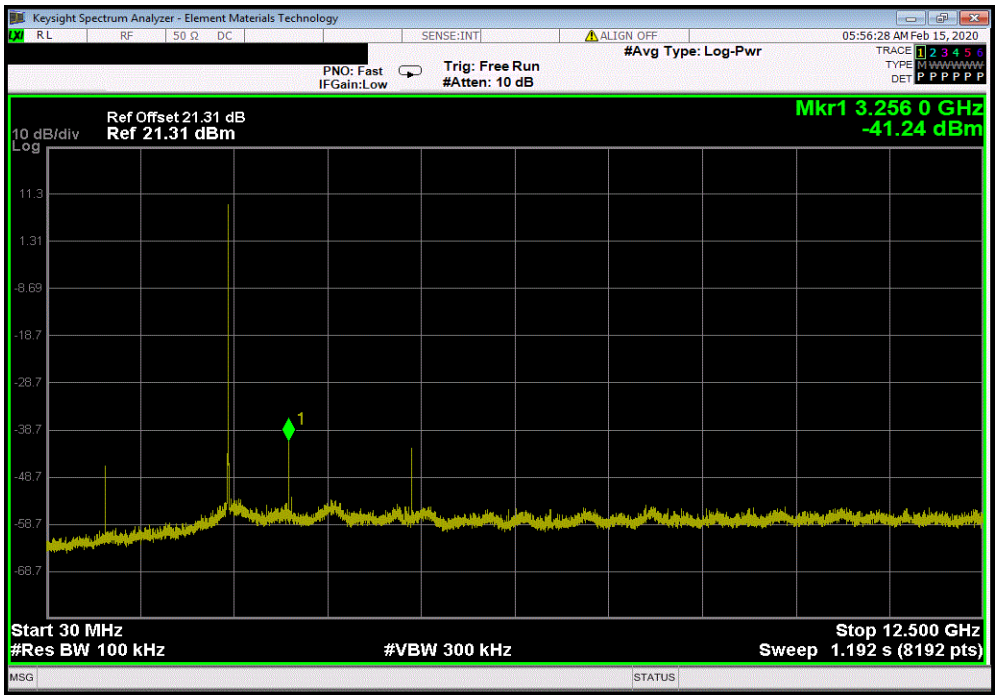
BLE/GFSK Low Channel, 2402 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	23995.85	-60.29	-20	Pass



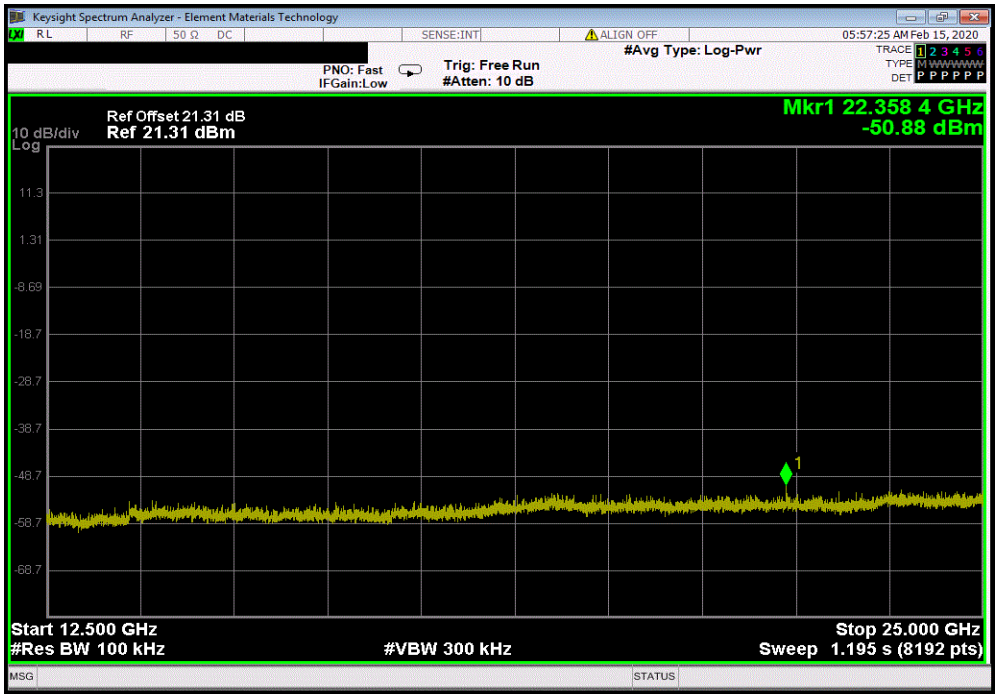
BLE/GFSK Mid Channel, 2442 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
Fundamental	2441.97	N/A	N/A	N/A



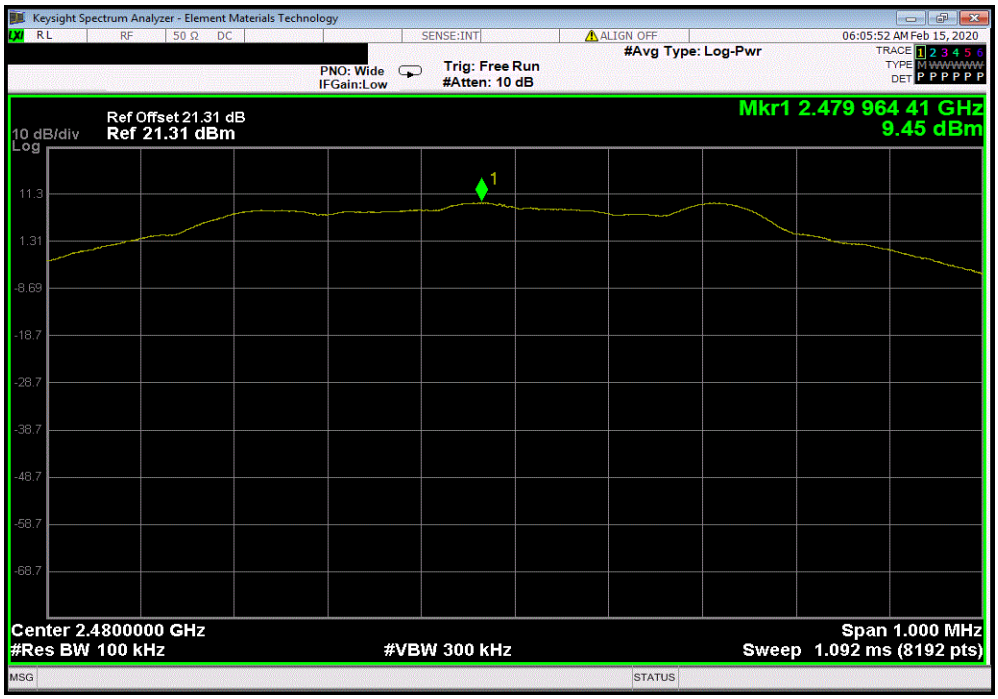
BLE/GFSK Mid Channel, 2442 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	3255.97	-50.6	-20	Pass



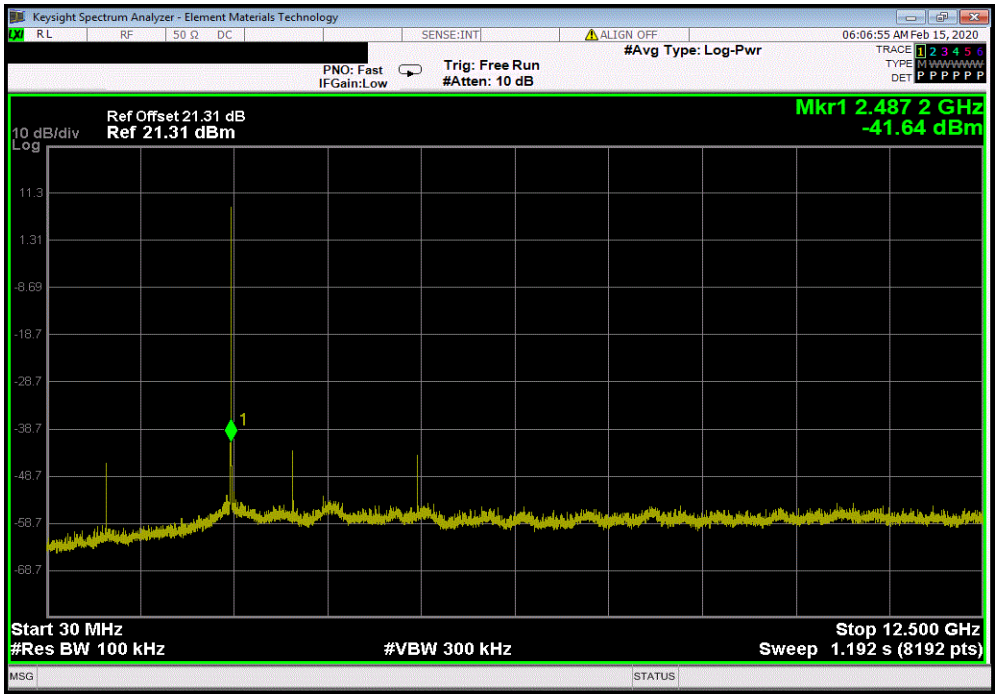
BLE/GFSK Mid Channel, 2442 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	22358.38	-60.24	-20	Pass



BLE/GFSK High Channel, 2480 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2479.96	N/A	N/A	N/A

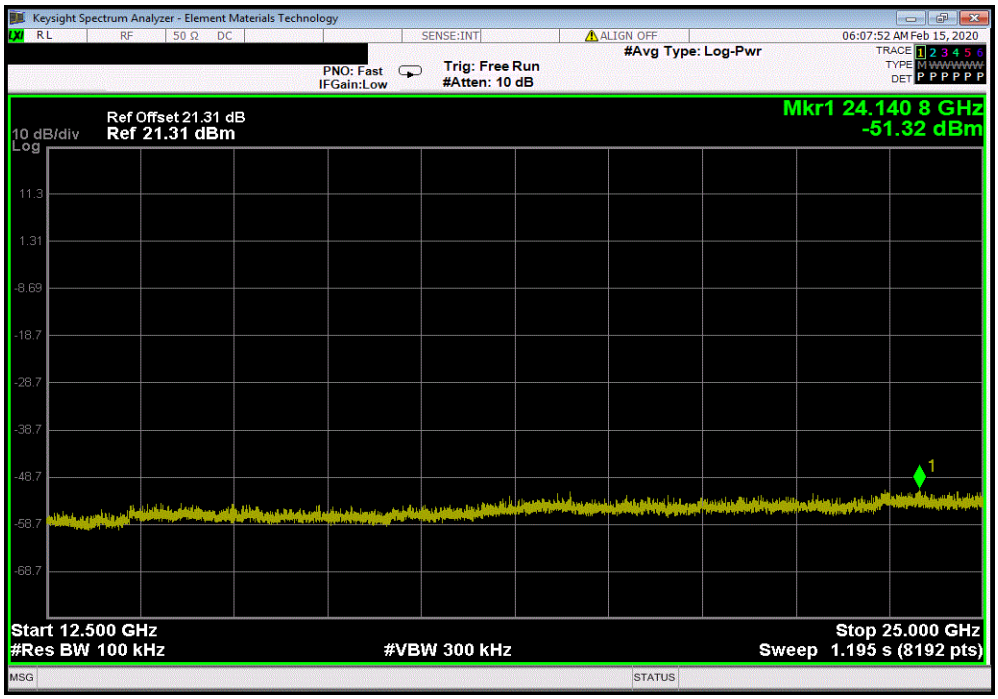


BLE/GFSK High Channel, 2480 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	2487.16	-51.09	-20	Pass



BLE/GFSK High Channel, 2480 MHz

Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24140.83	-60.77	-20	Pass



SPURIOUS RADIATED EMISSIONS

element

PSA-ESCI 2019.11.08.1

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Transmitting Bluetooth Low Energy on Low channel (2402 MHz), Mid channel (2442 MHz), and High channel (2480 MHz); Dome antenna; Power level 8
Transmitting Bluetooth Low Energy on Low channel (2402 MHz), Mid channel (2442 MHz), and High channel (2480 MHz); Monopole antenna; Power level 8
Transmitting Bluetooth Low Energy on Low channel (2402 MHz), and High channel (2480 MHz); Monopole antenna; Power level 8

POWER SETTINGS INVESTIGATED

24 VDC

CONFIGURATIONS INVESTIGATED

KOYO0001 - 3
KOYO0001 - 2

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	26500 MHz

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	JSD4-18002600-26-8P	APU	2019-09-11	12 mo
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNP	2019-09-11	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVX	2020-02-18	12 mo
Cable	Element	Double Ridge Guide Horn Cables	MNV	2020-02-18	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIB	2018-08-27	24 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	2019-12-23	12 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	2019-12-21	12 mo
Antenna - Biconilog	ETS Lindgren	3142D	AXO	2019-09-03	24 mo
Cable	ESM Cable Corp.	Bilog Cables	MNH	2019-10-18	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	2019-10-18	12 mo
Antenna - Double Ridge	ETS-Lindgren	3115	AJQ	2019-01-16	24 mo
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cables	MNI	2019-09-17	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	2020-01-17	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AXP	NCR	0 mo
Cable	ESM Cable Corp.	Standard Gain Horn Cables	MNJ	2019-03-08	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVV	2020-01-17	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AIQ	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVW	2020-01-17	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIP	2018-07-12	24 mo

SPURIOUS RADIATED EMISSIONS

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These “pre-scans” are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis if required, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector
PK = Peak Detector
AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions as well as the restricted band requirements.

If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

Measurements at the edges of the allowable band may be presented in an alternative method as provided for in the ANSI C63.10 Marker-Delta method. This method involves performing an in-band fundamental measurement followed by a screen capture of the fundamental and out-of-band emission using reduced measurement instrumentation bandwidths. The amplitude delta measured on this screen capture is applied to the fundamental emission value to show the out-of-band emission level as applied to the limit.

Where the radio test software does not provide for a duty cycle at continuous transmit conditions (> 98%) and the RMS (power average) measurements were made across the on and off times of the EUT transmissions, a duty cycle correction is added to the measurements using the formula of 10*LOG(dc).

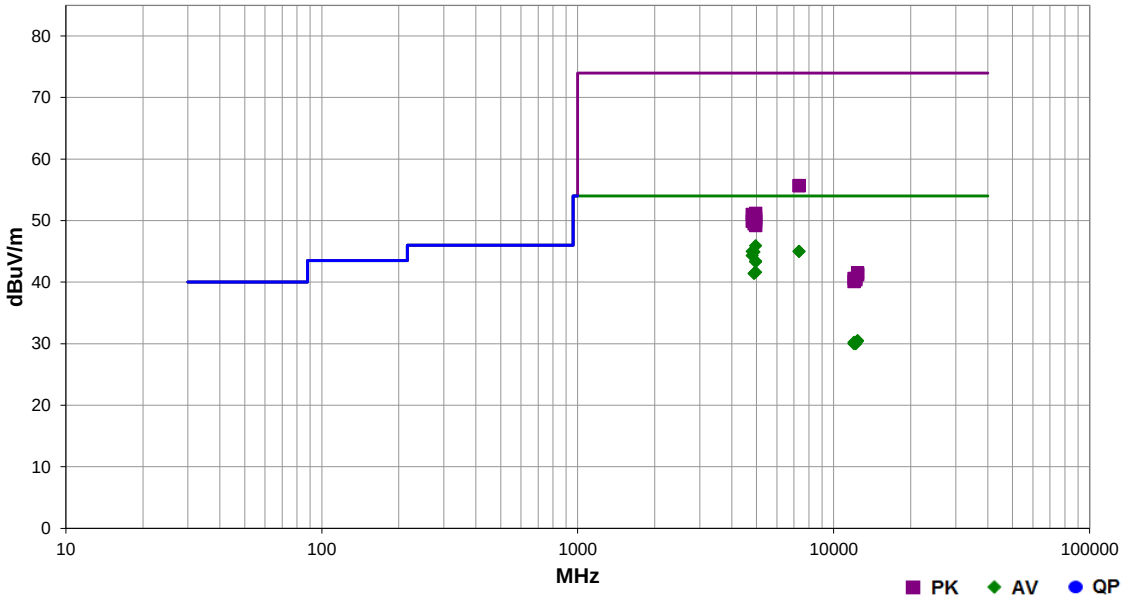
SPURIOUS RADIATED EMISSIONS

EmiR5 2019.08.15.1 PSA-ESCI 2019.11.08.1

Work Order:	KOYO0001	**Date:**	2020-02-10		
Project:	None	**Temperature:**	22.7 °C		
Job Site:	MN05	**Humidity:**	19% RH		
Serial Number:	N/A	**Barometric Pres.:**	1022 mbar	**Tested by:**	Dan Haas
EUT:	C2-03CPU				
Configuration:	2				
Customer:	Koyo Electronics Industries Co., LTD				
Attendees:	None				
EUT Power:	24 VDC				
Operating Mode:	Transmitting Bluetooth Low Energy on Low channel (2402 MHz), Mid channel (2442 MHz), and High channel (2480 MHz); Monopole antenna; Power level 8				
Deviations:	None				
Comments:	See data comments for EUT orientation and transmit channel. A duty cycle correction factor (DCCF) of 1.0 dB was added to the average measurments based on a measured duty cycle of 78.6%. DCCF=10*log(1/.786)=1				

Test Specifications	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

Run #	146	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
4959.858	40.3	4.6	4.0	278.0	1.0	0.0	Vert	AV	0.0	45.9	54.0	-8.1	EUT-Vert, High-2480 MHz
7323.733	30.6	13.4	1.5	235.9	1.0	0.0	Horz	AV	0.0	45.0	54.0	-9.0	EUT-Vert, Mid-2442 MHz
7325.458	30.6	13.4	1.5	193.9	1.0	0.0	Vert	AV	0.0	45.0	54.0	-9.0	EUT-Vert, Mid-2442 MHz
4803.983	39.4	4.6	1.8	328.0	1.0	0.0	Horz	AV	0.0	45.0	54.0	-9.0	EUT-Vert, Low-2402 MHz
4883.967	39.4	4.5	1.9	333.9	1.0	0.0	Horz	AV	0.0	44.9	54.0	-9.1	EUT-Vert, Mid-2442 MHz
4803.833	38.7	4.6	2.9	82.0	1.0	0.0	Vert	AV	0.0	44.3	54.0	-9.7	EUT-Vert, Low-2402 MHz
4959.925	37.8	4.6	2.5	322.9	1.0	0.0	Horz	AV	0.0	43.4	54.0	-10.6	EUT-Vert, High-2480 MHz
4959.983	37.7	4.6	2.4	289.0	1.0	0.0	Vert	AV	0.0	43.3	54.0	-10.7	EUT-Horiz, High-2480 MHz
4960.067	36.0	4.6	2.5	210.9	1.0	0.0	Horz	AV	0.0	41.6	54.0	-12.4	EUT-Horiz, High-2480 MHz
4884.025	35.9	4.5	1.3	268.9	1.0	0.0	Vert	AV	0.0	41.4	54.0	-12.6	EUT-Vert, Mid-2442 MHz
7324.783	42.3	13.4	1.5	235.9	0.0	0.0	Horz	PK	0.0	55.7	74.0	-18.3	EUT-Vert, Mid-2442 MHz
7324.942	42.3	13.4	1.5	193.9	0.0	0.0	Vert	PK	0.0	55.7	74.0	-18.3	EUT-Vert, Mid-2442 MHz
4960.508	46.6	4.6	4.0	278.0	0.0	0.0	Vert	PK	0.0	51.2	74.0	-22.8	EUT-Vert, High-2480 MHz
4803.992	46.4	4.6	1.8	328.0	0.0	0.0	Horz	PK	0.0	51.0	74.0	-23.0	EUT-Vert, Low-2402 MHz
4883.483	46.4	4.5	1.9	333.9	0.0	0.0	Horz	PK	0.0	50.9	74.0	-23.1	EUT-Vert, Mid-2442 MHz
12398.070	29.1	0.4	1.9	106.9	1.0	0.0	Horz	AV	0.0	30.5	54.0	-23.5	EUT-on side, High-2480 MHz, BLE
12397.530	29.0	0.4	1.3	289.9	1.0	0.0	Vert	AV	0.0	30.4	54.0	-23.6	EUT-Horiz, High-2480 MHz, BLE
4959.725	45.8	4.6	2.4	289.0	0.0	0.0	Vert	PK	0.0	50.4	74.0	-23.6	EUT-Horiz, High-2480 MHz
12009.580	30.1	-0.9	1.6	333.0	1.0	0.0	Vert	AV	0.0	30.2	54.0	-23.8	EUT-Horiz, Low-2402 MHz, BLE
12211.680	29.7	-0.6	1.5	102.0	1.0	0.0	Vert	AV	0.0	30.1	54.0	-23.9	EUT-Horiz, Mid-2442 MHz, BLE
12210.130	29.6	-0.6	1.4	154.0	1.0	0.0	Horz	AV	0.0	30.0	54.0	-24.0	EUT-on side, Mid-2442 MHz, BLE
12011.010	29.9	-0.9	1.5	281.9	1.0	0.0	Horz	AV	0.0	30.0	54.0	-24.0	EUT-on side, Low-2402 MHz, BLE
4803.433	45.3	4.6	2.9	82.0	0.0	0.0	Vert	PK	0.0	49.9	74.0	-24.1	EUT-Vert, Low-2402 MHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
4959.783	45.3	4.6	2.5	322.9	0.0	0.0	Horz	PK	0.0	49.9	74.0	-24.1	EUT-Vert, High-2480 MHz
4883.983	45.0	4.5	1.3	268.9	0.0	0.0	Vert	PK	0.0	49.5	74.0	-24.5	EUT-Vert, Mid-2442 MHz
4960.508	44.6	4.6	2.5	210.9	0.0	0.0	Horz	PK	0.0	49.2	74.0	-24.8	EUT-Horiz, High-2480 MHz
12399.730	41.1	0.4	1.3	289.9	0.0	0.0	Vert	PK	0.0	41.5	74.0	-32.5	EUT-Horiz, High-2480 MHz, BLE
12398.050	40.8	0.4	1.9	106.9	0.0	0.0	Horz	PK	0.0	41.2	74.0	-32.8	EUT-on side, High-2480 MHz, BLE
12208.290	41.3	-0.7	1.4	154.0	0.0	0.0	Horz	PK	0.0	40.6	74.0	-33.4	EUT-on side, Mid-2442 MHz, BLE
12010.650	41.5	-0.9	1.5	281.9	0.0	0.0	Horz	PK	0.0	40.6	74.0	-33.4	EUT-on side, Low-2402 MHz, BLE
12208.570	41.0	-0.6	1.5	102.0	0.0	0.0	Vert	PK	0.0	40.4	74.0	-33.6	EUT-Horiz, Mid-2442 MHz, BLE
12009.780	41.0	-0.9	1.6	333.0	0.0	0.0	Vert	PK	0.0	40.1	74.0	-33.9	EUT-Horiz, Low-2402 MHz, BLE

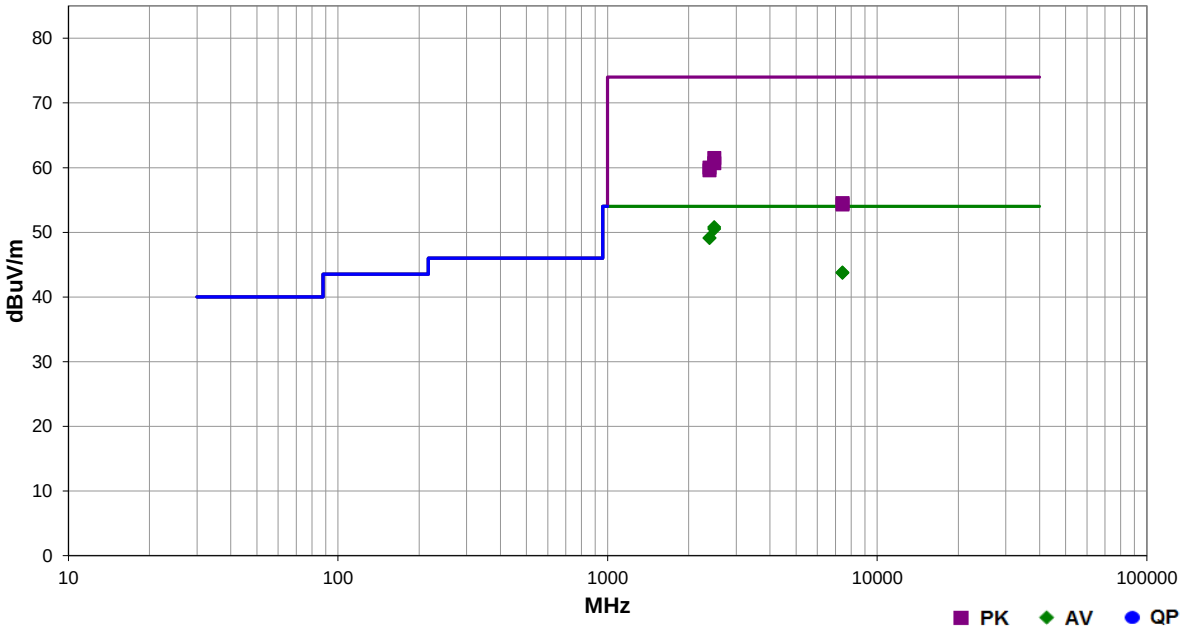
SPURIOUS RADIATED EMISSIONS

EmiR5 2019.08.15.1 PSA-ESCI 2019.11.08.1

Work Order:	KOYO0001	**Date:**	2020-03-04		
Project:	None	**Temperature:**	22.6 °C		
Job Site:	MN09	**Humidity:**	23.8% RH		
Serial Number:	N/A	**Barometric Pres.:**	1016 mbar	**Tested by:**	Andrew Rogstad
EUT:	C2-03CPU				
Configuration:	2				
Customer:	Koyo Electronics Industries Co., LTD				
Attendees:	None				
EUT Power:	24 VDC				
Operating Mode:	Transmitting Bluetooth Low Energy on Low channel (2402 MHz), and High channel (2480 MHz); Monopole antenna; Power level 8				
Deviations:	None				
Comments:	See data comments for EUT orientation and transmit channel. A duty cycle correction factor (DCCF) of 1.0 dB was added to the average measurments based on a measured duty cycle of 78.6%. DCCF=10*log(1/.786)=1				

Test Specifications	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

Run #	0	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2487.220	32.7	-2.9	2.8	277.0	1.0	20.0	Vert	AV	0.0	50.8	54.0	-3.2	EUT vert, High ch.
2487.160	32.4	-2.9	1.5	234.0	1.0	20.0	Horz	AV	0.0	50.5	54.0	-3.5	EUT on side, High ch.
2387.393	31.3	-3.2	1.5	262.0	1.0	20.0	Horz	AV	0.0	49.1	54.0	-4.9	EUT on side, Low ch.
2389.507	31.3	-3.2	1.5	274.0	1.0	20.0	Vert	AV	0.0	49.1	54.0	-4.9	EUT vert, Low ch.
7439.933	28.3	14.5	1.5	227.0	1.0	0.0	Horz	AV	0.0	43.8	54.0	-10.2	EUT vert, High ch.
7439.430	28.2	14.5	1.5	234.0	1.0	0.0	Vert	AV	0.0	43.7	54.0	-10.3	EUT vert, High ch.
2485.307	44.4	-2.9	2.8	277.0	0.0	20.0	Vert	PK	0.0	61.5	74.0	-12.5	EUT vert, High ch.
2485.927	43.6	-2.9	1.5	234.0	0.0	20.0	Horz	PK	0.0	60.7	74.0	-13.3	EUT on side, High ch.
2388.400	43.2	-3.2	1.5	274.0	0.0	20.0	Vert	PK	0.0	60.0	74.0	-14.0	EUT vert, Low ch.
2387.040	42.8	-3.2	1.5	262.0	0.0	20.0	Horz	PK	0.0	59.6	74.0	-14.4	EUT on side, Low ch.
7440.273	40.0	14.5	1.5	234.0	0.0	0.0	Vert	PK	0.0	54.5	74.0	-19.5	EUT vert, High ch.
7440.397	39.8	14.5	1.5	227.0	0.0	0.0	Horz	PK	0.0	54.3	74.0	-19.7	EUT vert, High ch.

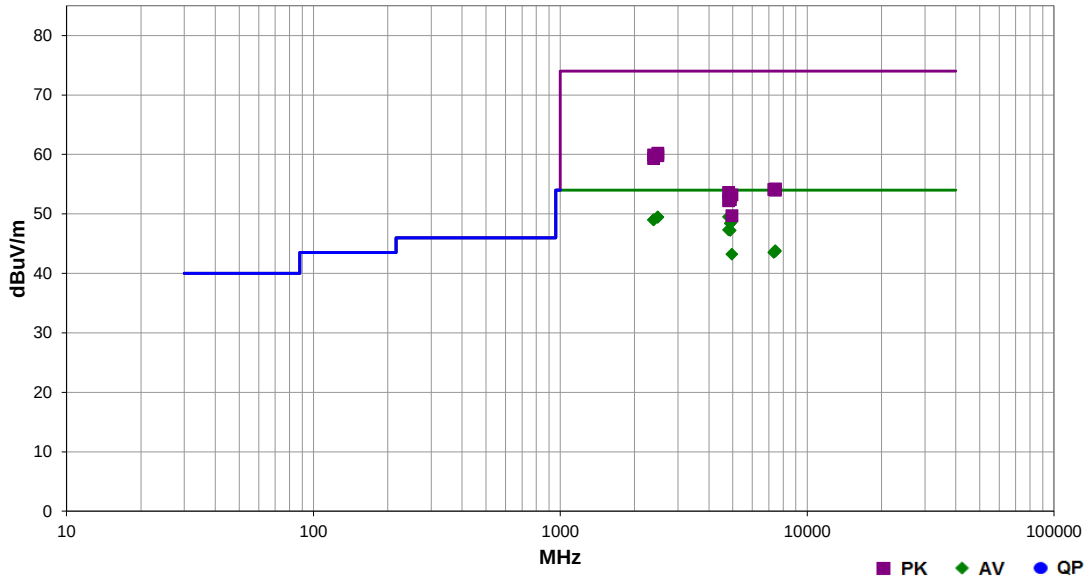
SPURIOUS RADIATED EMISSIONS

EmiR5 2019.08.15.1 PSA-ESCI 2019.11.08.1

Work Order:	KOYO0001	**Date:**	2020-03-04		
Project:	None	**Temperature:**	22.4 °C		
Job Site:	MN09	**Humidity:**	24.1% RH		
Serial Number:	N/A	**Barometric Pres.:**	1016 mbar	**Tested by:**	Andrew Rogstad
EUT:	C2-03CPU				
Configuration:	3				
Customer:	Koyo Electronics Industries Co., LTD				
Attendees:	None				
EUT Power:	24 VDC				
Operating Mode:	Transmitting Bluetooth Low Energy on Low channel (2402 MHz), Mid channel (2442 MHz), and High channel (2480 MHz); Dome antenna; Power level 8				
Deviations:	None				
Comments:	See data comments for EUT orientation, antenna orientation, and transmit channel. A duty cycle correction factor (DCCF) of 1.0 dB was added to the average measurments based on a measured duty cycle of 78.6%. DCCF=10*log(1/.786)=1				

Test Specifications	**Test Method**
FCC 15.247:2020	ANSI C63.10:2013

Run #	4	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
4803.900	43.3	5.2	2.9	163.0	1.0	0.0	Horz	AV	0.0	49.5	54.0	-4.5	PCB Horz, Ant Horz (Z), Low ch.
2485.393	31.4	-2.9	1.5	25.0	1.0	20.0	Horz	AV	0.0	49.5	54.0	-4.5	PCB Horz, Ant Horz (Z), High ch.
2484.467	31.3	-2.9	2.2	219.0	1.0	20.0	Vert	AV	0.0	49.4	54.0	-4.6	PCB Horz, Ant Horz (Z), High ch.
2389.560	31.2	-3.2	2.1	84.0	1.0	20.0	Horz	AV	0.0	49.0	54.0	-5.0	PCB Horz, Ant Horz (Z), Low ch.
2389.960	31.2	-3.2	1.5	253.0	1.0	20.0	Vert	AV	0.0	49.0	54.0	-5.0	PCB Horz, Ant Horz (Z), Low ch.
4959.880	42.2	5.5	4.0	218.0	1.0	0.0	Vert	AV	0.0	48.7	54.0	-5.3	PCB Horz, Ant Horz (X), High ch.
4884.000	42.1	5.3	3.5	209.0	1.0	0.0	Horz	AV	0.0	48.4	54.0	-5.6	PCB Horz, Ant Horz (Z), Mid ch.
4803.907	41.1	5.2	1.0	174.0	1.0	0.0	Vert	AV	0.0	47.3	54.0	-6.7	PCB Horz, Ant Horz (X), Low ch.
4883.953	40.9	5.3	3.3	207.0	1.0	0.0	Vert	AV	0.0	47.2	54.0	-6.8	PCB Horz, Ant Horz (X), Mid ch.
7439.093	28.3	14.5	1.7	332.0	1.0	0.0	Horz	AV	0.0	43.8	54.0	-10.2	PCB Horz, Ant Horz (Z), High ch.
7440.420	28.2	14.5	1.5	300.0	1.0	0.0	Vert	AV	0.0	43.7	54.0	-10.3	PCB Horz, Ant Horz (X), High ch.
7327.053	28.5	14.0	1.5	278.0	1.0	0.0	Vert	AV	0.0	43.5	54.0	-10.5	PCB Horz, Ant Horz (X), Mid ch.
4960.013	36.7	5.5	1.3	171.0	1.0	0.0	Horz	AV	0.0	43.2	54.0	-10.8	PCB Horz, Ant Horz (Z), High ch.
2486.060	43.1	-2.9	1.5	25.0	0.0	20.0	Horz	PK	0.0	60.2	74.0	-13.8	PCB Horz, Ant Horz (Z), High ch.
2386.887	43.1	-3.2	2.1	84.0	0.0	20.0	Horz	PK	0.0	59.9	74.0	-14.1	PCB Horz, Ant Horz (Z), Low ch.
2484.427	42.7	-2.9	2.2	219.0	0.0	20.0	Vert	PK	0.0	59.8	74.0	-14.2	PCB Horz, Ant Horz (Z), High ch.
2386.860	42.5	-3.2	1.5	253.0	0.0	20.0	Vert	PK	0.0	59.3	74.0	-14.7	PCB Horz, Ant Horz (Z), Low ch.
7439.333	39.7	14.5	1.7	332.0	0.0	0.0	Horz	PK	0.0	54.2	74.0	-19.8	PCB Horz, Ant Horz (Z), High ch.
7325.020	40.1	14.0	1.5	278.0	0.0	0.0	Vert	PK	0.0	54.1	74.0	-19.9	PCB Horz, Ant Horz (X), Mid ch.
7441.260	39.5	14.5	1.5	300.0	0.0	0.0	Vert	PK	0.0	54.0	74.0	-20.0	PCB Horz, Ant Horz (X), High ch.
4803.500	48.4	5.2	2.9	163.0	0.0	0.0	Horz	PK	0.0	53.6	74.0	-20.4	PCB Horz, Ant Horz (Z), Low ch.
4959.680	47.7	5.5	4.0	218.0	0.0	0.0	Vert	PK	0.0	53.2	74.0	-20.8	PCB Horz, Ant Horz (X), High ch.
4883.433	47.6	5.3	3.5	209.0	0.0	0.0	Horz	PK	0.0	52.9	74.0	-21.1	PCB Horz, Ant Horz (Z), Mid ch.
4883.493	47.1	5.3	3.3	207.0	0.0	0.0	Vert	PK	0.0	52.4	74.0	-21.6	PCB Horz, Ant Horz (X), Mid ch.
4804.333	47.0	5.2	1.0	174.0	0.0	0.0	Vert	PK	0.0	52.2	74.0	-21.8	PCB Horz, Ant Horz (X), Low ch.
4959.553	44.2	5.5	1.3	171.0	0.0	0.0	Horz	PK	0.0	49.7	74.0	-24.3	PCB Horz, Ant Horz (Z), High ch.