TEST REPORT

Report Number : 11910253-E1V2

Applicant	:	Texas Instrument 2900 Semiconductor Drive Santa Clara, CA 95051
Model	:	LMX9838
EUT Description	:	Bluetooth 2.0 module
Test Standard(s)	:	EN 300 328 v2.1.1 (Radiated Emissions)

Date of Issue:
Friday, August 25, 2017

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	08/17/17	Initial Issue	---
V2	08/25/17	Added RX blocking report and original report to appendix A and B	F. Ibrahim

UL VERIFICATION SERVICES INC.
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TABLE OF CONTENTS

UL VERIFICATION SERVICES INC.
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Texas Instrument
2900 Semiconductor Drive
Santa Clara, CA 95051

EUT DESCRIPTION: Bluetooth 2.0 Module

MODEL: LMX9838

DATE TESTED: June 17 – July 19, 2017

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
EN 300 328 v2.1.1 (Radiated Emissions)	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

FRANK IBRAHIM
CONSUMER TECHNOLOGY DIVISION
Program Manager
UL Verification Services Inc.

Prepared By:

Jason Qian
CONSUMER TECHNOLOGY DIVISION
Lab Engineer
UL Verification Services Inc.

2. TEST METHODOLOGY

All tests were performed in accordance with the procedures documented in EN 300 328 v2.1.1.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A(IC: 2324B-1)	☐ Chamber D(IC: 2324B-4)
☒ Chamber B(IC: 2324B-2)	☐ Chamber E(IC: 2324B-5)
☐ Chamber C(IC: 2324B-3)	☐ Chamber F(IC: 2324B-6)
	☐ Chamber G(IC: 2324B-7)
	☐ Chamber H(IC: 2324B-8)

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

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4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
RF frequency	±3 x 10^(-7)
RF power conducted	±0.35 dB
RF power radiated	±5.5 dB
Spurious emissions, conducted	±2.9 dB
Spurious emissions, radiated	±5.6 dB
Humidity	±4.5 % RH
Temperature	±0.9 deg C
Time	±0.02 %

Uncertainty figures are valid to a confidence level of 95%.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Bluetooth 2.0 Module, transmit only Basic data rate 1Mb/s GFSK mode.

The radio module is manufactured by Texas Instruments.

5.2. MAXIMUM OUTPUT POWER

Please refer to report “11364308-E1V1 EN 300 328 v1.9.1 BT Report Final”, section 3.2. See appendix B for convenience.

5.3. MODE(S) OF OPERATION

Mode	Description
Receive Mode	EUT powered on
Transmit Mode	EUT powered and transmitting

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

Please refer to report “11364308-E1V1 EN 300 328 v1.9.1 BT Report Final”, section 3.3. See appendix B for convenience.

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was v.02.12 (Patch 2).

The test utility software used during testing was Simply Blue Commander v1.6.0.1

5.6. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X,Y, Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Worst-case data rates as provided by the client were:

GFSK mode: 1-DH5

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5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	**Manufacturer**	**Model**	**Serial Number**
EUT's Adapter	Verifone	SC1402	1.7082E+12
Laptop	Dell	D620	C01089
Laptop AC Adapter	Dell	LA65NS-00	CN-00F263-71615-6AC-38D4

I/O CABLES

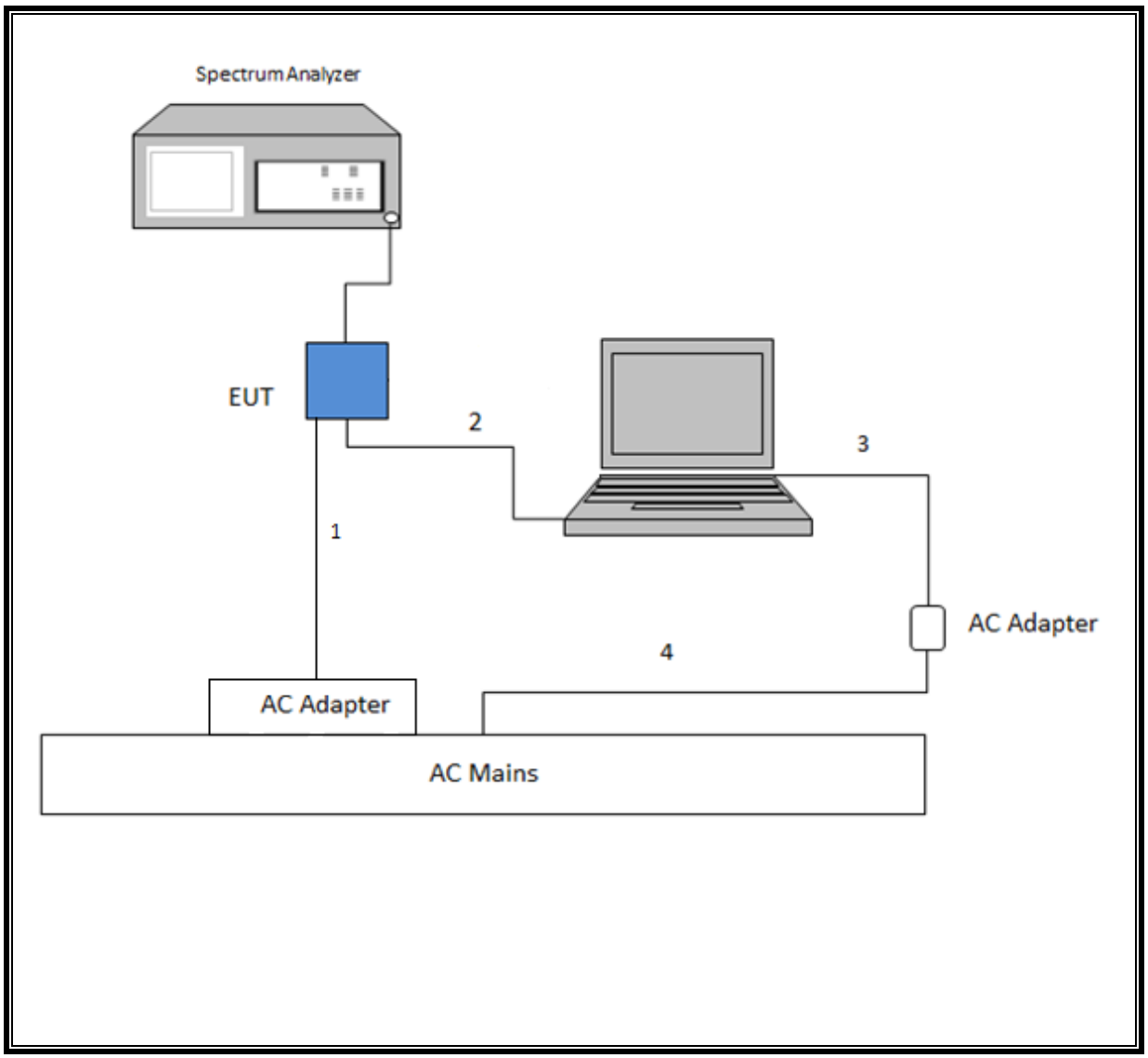
I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC	1	3.5mm	unshielded	0.9	USB to 3.5mm connector
2	Serial	1	DB9	shielded	2	USB to Serial cable
3	DC	1	barrel	unshielded	1.7	
4	AC	1	2 prong	unshielded	0.9	

TEST SETUP

The EUT was connected to a host laptop computer via a USB to Serial cable adapter during the tests. Test software exercised the radio card.

Note: after all the setting such as channel, output power, the host laptop and all support equipment were removed out of the chamber. Only EUT stayed on the turn table.

SETUP DIAGRAM FOR RADIATED TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	**Manufacturer**	**Model**	**T No.**	**Cal Date**	**Cal Due**
Amplifier, 1 - 18GHz	Miteq	AFS42	1165	08/01/17	08/01/18
Amplifier, 10KHz to 1GHz, 32dB	Keysight	8447D	10	02/01/17	02/01/18
Antenna, Broadband Hybrid 30MHz to 2000MHz	Sunol Science	JB1	130	09/01/16	09/01/17
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	711	01/30/17	01/30/18
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	907	01/23/17	01/23/18

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Antenna Port Software	UL	UL RF	Ver 6.8, June 08, 2017

NOTE: Testing was completed before equipment calibration expiration date.

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7. TEST RESULTS

7.1. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

LIMITS

ETSI EN 300 328 V2.1.1 (2016-11) Clause 4.3.1.10.3

Table 1: Transmitter limits for spurious emissions

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

TEST PROCEDURE

ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.9.2.1

TEST CONDITIONS

ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.9.1

The level of spurious emissions shall be measured as, either:

a) their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or

b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no temporary antenna connectors

Protocol (a) was used for emissions testing as covered by this report.

RESULTS

RADIATED SPURIOUS EMISSIONS BELOW 1 GHz

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Texas Instruments
Project #: 11760935
Date: 6/17/2017
Test Engineer: 50818 JQ
Configuration: EUT w/ Laptop
Mode: BT_TXBelow 1G

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 328 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	ERP @ TX Ant's End (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel 2402MHz										
105.66	-48.1	H	3.0	16.3	28.8		-60.5	-54.0	-6.5	
192.96	-53.6	H	3.0	19.6	28.5		-62.5	-54.0	-8.5	
329.73	-54.2	H	3.0	23.0	28.1		-59.3	-36.0	-23.3	
46.69	-46.5	V	3.0	18.0	28.9		-57.5	-36.0	-21.5	
88.20	-50.9	V	3.0	20.6	28.8		-59.0	-54.0	-5.0	
288.99	-57.0	V	3.0	22.9	28.0		-62.2	-36.0	-26.2	
High Channel 2480MHz										
33.88	-66.1	H	3.0	30.7	28.9		-64.3	-36.0	-28.3	
418.97	-72.8	H	3.0	24.5	28.7		-76.9	-36.0	-40.9	
773.99	-72.6	H	3.0	29.7	28.5		-71.4	-54.0	-17.4	
82.38	-68.8	V	3.0	20.1	28.7		-77.4	-36.0	-41.4	
466.50	-72.5	V	3.0	26.9	29.0		-74.5	-36.0	-38.5	
768.17	-73.3	V	3.0	31.9	28.5		-69.8	-54.0	-15.8	

RADIATED SPURIOUS EMISSIONS ABOVE 1 GHz

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Texas Instruments
Project #: 11760935
Date: 6/17/2016
Test Engineer: 50818 JQ
Configuration: EUT (Conducted Sample) w/ Laptop
Mode: BT_TX_Above 1G

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 328 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	EIRP @ TX Ant's End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel 2402MHz										
1.58	-78.2	H	3.0	-33.6	38.7	1.0	-71.3	-30.0	-41.3	
4.81	-48.8	H	3.0	5.1	38.6	1.0	-32.5	-30.0	-2.5	
7.09	-79.4	H	3.0	-21.4	38.6	1.0	-59.0	-30.0	-29.0	
1.58	-76.0	V	3.0	-31.4	38.7	1.0	-69.1	-30.0	-39.1	
4.81	-51.1	V	3.0	2.9	38.6	1.0	-34.7	-30.0	-4.7	
7.09	-78.1	V	3.0	-20.4	38.6	1.0	-57.9	-30.0	-27.9	
High Channel 2480MHz										
1.99	-76.4	H	3.0	-28.4	38.0	1.0	-65.4	-30.0	-35.4	
4.96	-49.5	H	3.0	4.7	38.7	1.0	-33.0	-30.0	-3.0	
7.09	-78.8	H	3.0	-20.8	38.6	1.0	-58.4	-30.0	-28.4	
1.94	-77.5	V	3.0	-29.6	38.1	1.0	-66.6	-30.0	-36.6	
4.96	-50.1	V	3.0	4.1	38.7	1.0	-33.5	-30.0	-3.5	
7.09	-79.8	V	3.0	-22.1	38.6	1.0	-59.6	-30.0	-29.6	

7.2. RECEIVER SPURIOUS EMISSIONS

LIMITS

ETSI EN 300 328 V2.1.1 (2016-11) Clause 4.3.1.11.3

TEST PROCEDURE

EN 300 328 V2.1.1 Clause 5.4.10.2.

Table 2: Spurious emission limits for receivers

Frequency range	Maximum power	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

TEST CONDITIONS

ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.10.1

The level of spurious emissions shall be measured as, either:

a) their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or

b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no temporary antenna connectors

Protocol (a) was used for emissions testing as covered by this report.

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RESULTS

RADIATED SPURIOUS EMISSIONS BELOW 1 GHz

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Texas Instruments
Project #: 11760935
Date: 7/2/2017
Test Engineer: 45256 JB
Configuration: EUT w/ Laptop
Mode: RX

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 328 Rx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	ERP @ TX Ant's End (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel 2402MHz										
95.96	-55.2	H	3.0	13.8	28.7		-70.1	-57.0	-13.1	
120.21	-54.4	H	3.0	20.6	28.7		-62.5	-57.0	-5.5	
333.61	-55.7	H	3.0	23.1	28.1		-60.7	-57.0	-3.7	
71.71	-59.8	V	3.0	17.0	28.7		-71.5	-57.0	-14.5	
328.76	-59.6	V	3.0	24.4	28.1		-63.3	-57.0	-6.3	
557.68	-62.6	V	3.0	29.1	29.1		-62.7	-57.0	-5.7	
High Channel 2480MHz										
95.96	-55.2	H	3.0	13.8	28.7		-70.1	-57.0	-13.1	
120.21	-54.4	H	3.0	20.6	28.7		-62.5	-57.0	-5.5	
333.61	-55.7	H	3.0	23.1	28.1		-60.7	-57.0	-3.7	
71.71	-59.8	V	3.0	17.0	28.7		-71.5	-57.0	-14.5	
328.76	-59.6	V	3.0	24.4	28.1		-63.3	-57.0	-6.3	
557.68	-62.6	V	3.0	29.1	29.1		-62.7	-57.0	-5.7	

RADIATED SPURIOUS EMISSIONS ABOVE 1 GHz

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Texas Instruments
Project #: 11760935
Date: 7/19/2017
Test Engineer: 37290
Configuration: EUT W/CHARGER
Mode: Rx

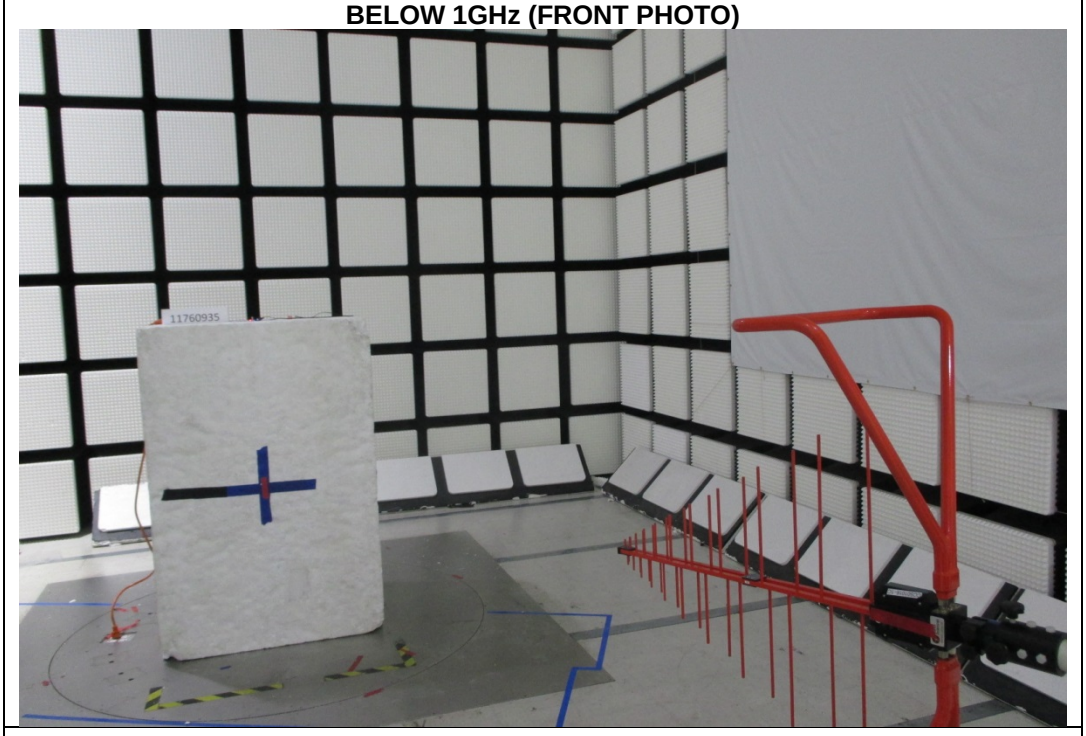
Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 328 Rx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	EIRP @ TX Ant's End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel 2402MHz										
1.54	-69.1	H	3.0	-24.8	38.8	1.0	-62.6	-47.0	-15.6	
3.88	-70.0	H	3.0	-17.9	38.4	1.0	-55.2	-47.0	-8.2	
4.88	-71.4	H	3.0	-17.3	38.6	1.0	-55.0	-47.0	-8.0	
1.54	-69.5	V	3.0	-25.3	38.8	1.0	-63.1	-47.0	-16.1	
3.84	-70.2	V	3.0	-17.7	38.4	1.0	-55.1	-47.0	-8.1	
4.85	-70.9	V	3.0	-16.9	38.6	1.0	-54.5	-47.0	-7.5	
High Channel 2480MHz										
1.54	-69.0	H	3.0	-24.7	38.8	1.0	-62.5	-47.0	-15.5	
3.88	-69.6	H	3.0	-17.4	38.4	1.0	-54.8	-47.0	-7.8	
4.88	-69.3	H	3.0	-15.3	38.6	1.0	-52.9	-47.0	-5.9	
1.54	-69.6	V	3.0	-25.4	38.8	1.0	-63.1	-47.0	-16.1	
3.84	-70.6	V	3.0	-18.1	38.4	1.0	-55.5	-47.0	-8.5	
4.85	-70.5	V	3.0	-16.5	38.6	1.0	-54.1	-47.0	-7.1	

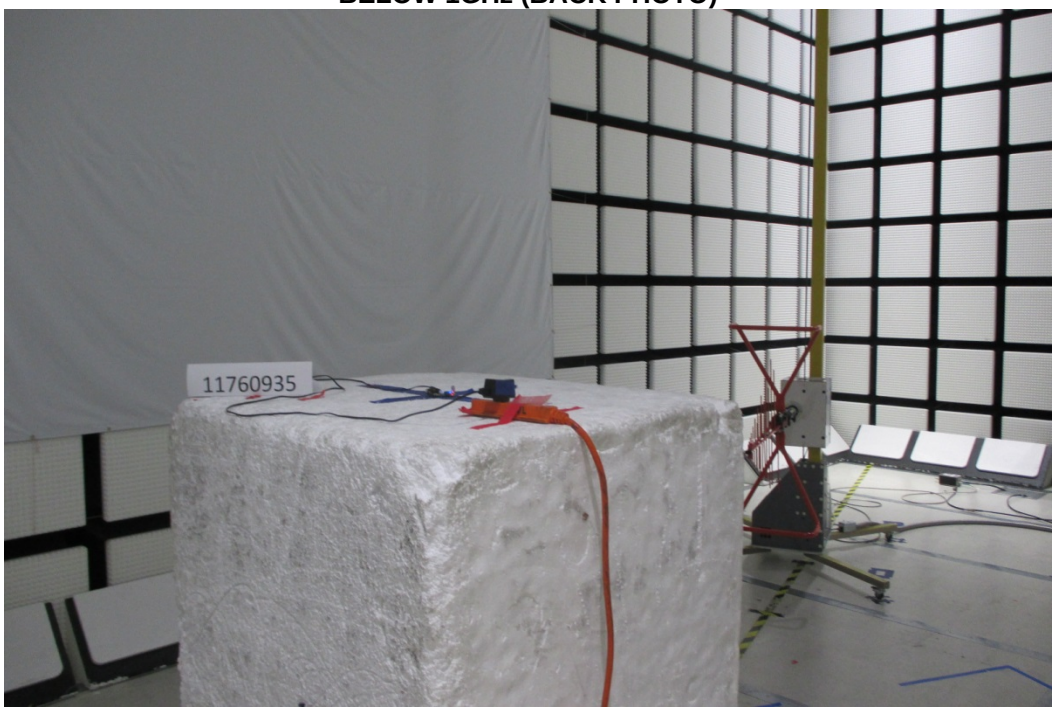
8. SETUP PHOTOS

RADIATED SPURIOUS EMISSIONS

BELOW 1GHz (FRONT PHOTO)



BELOW 1GHz (BACK PHOTO)



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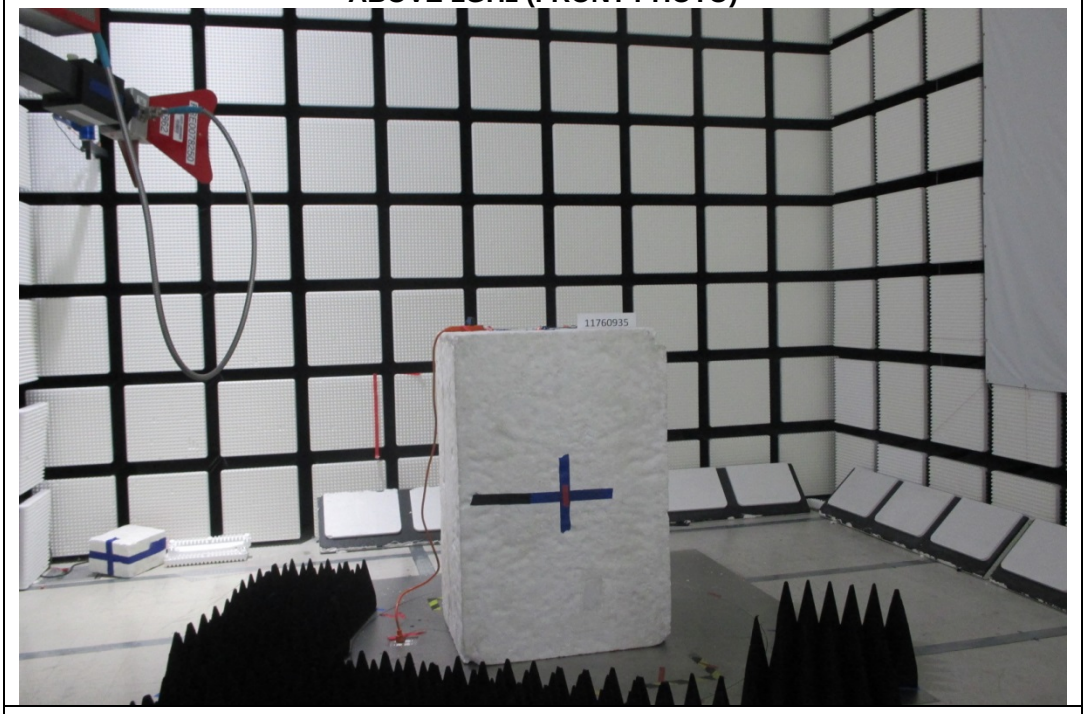
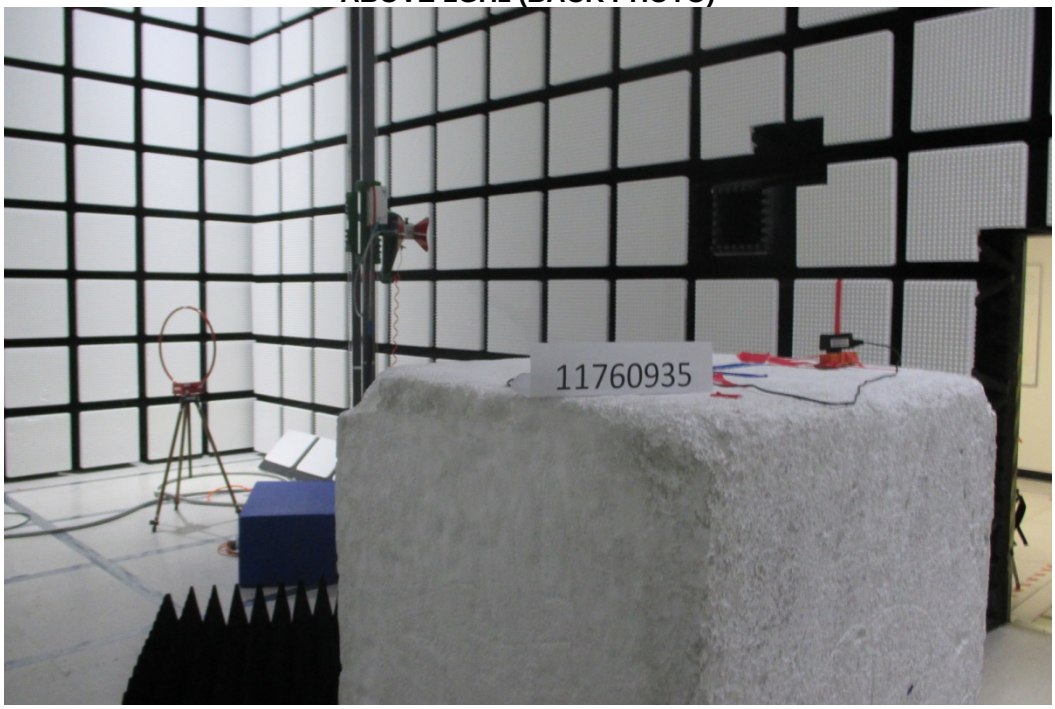
ABOVE 1GHz (FRONT PHOTO)



ABOVE 1GHz (BACK PHOTO)



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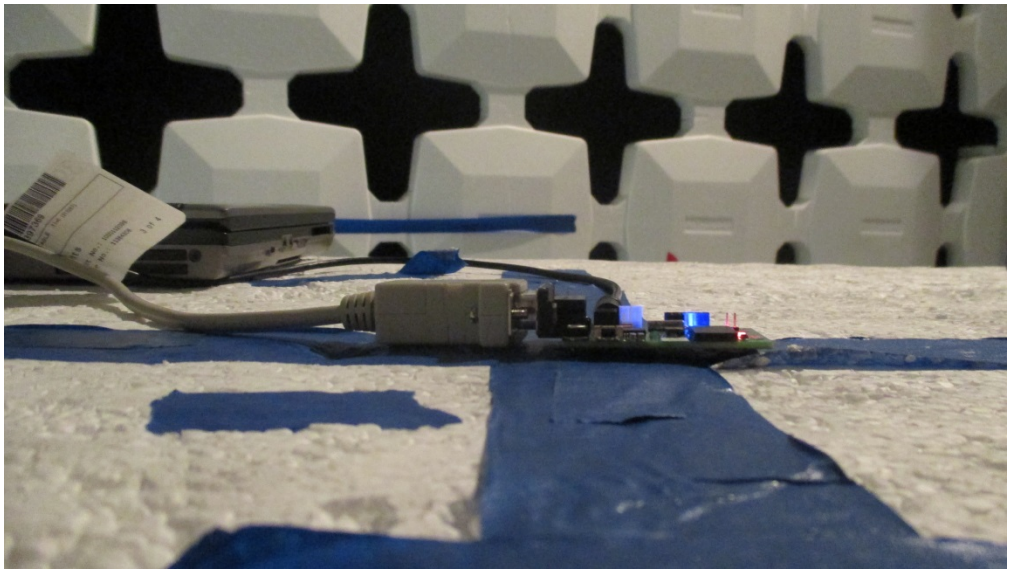
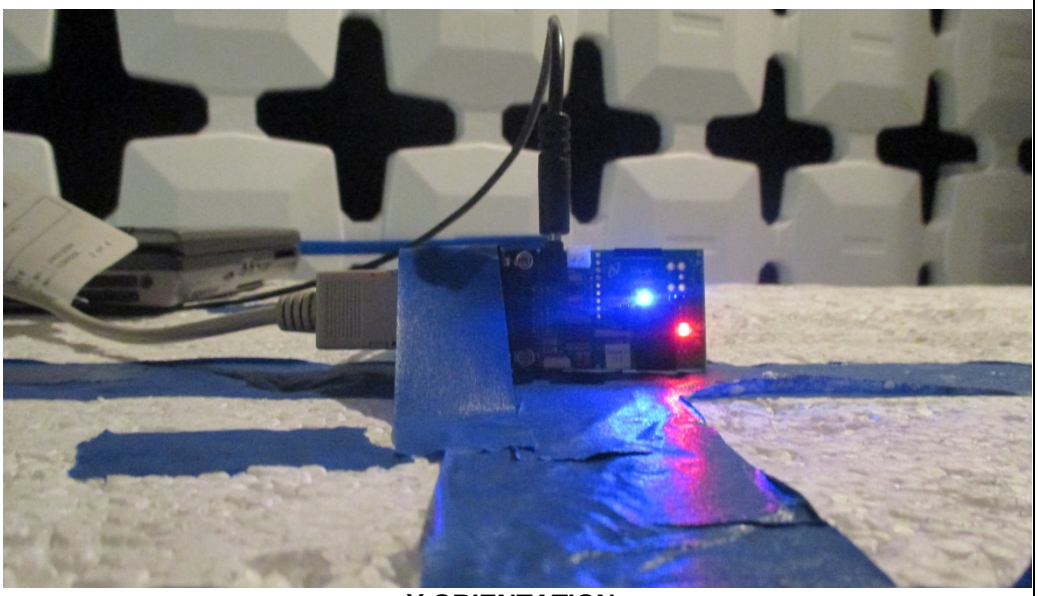
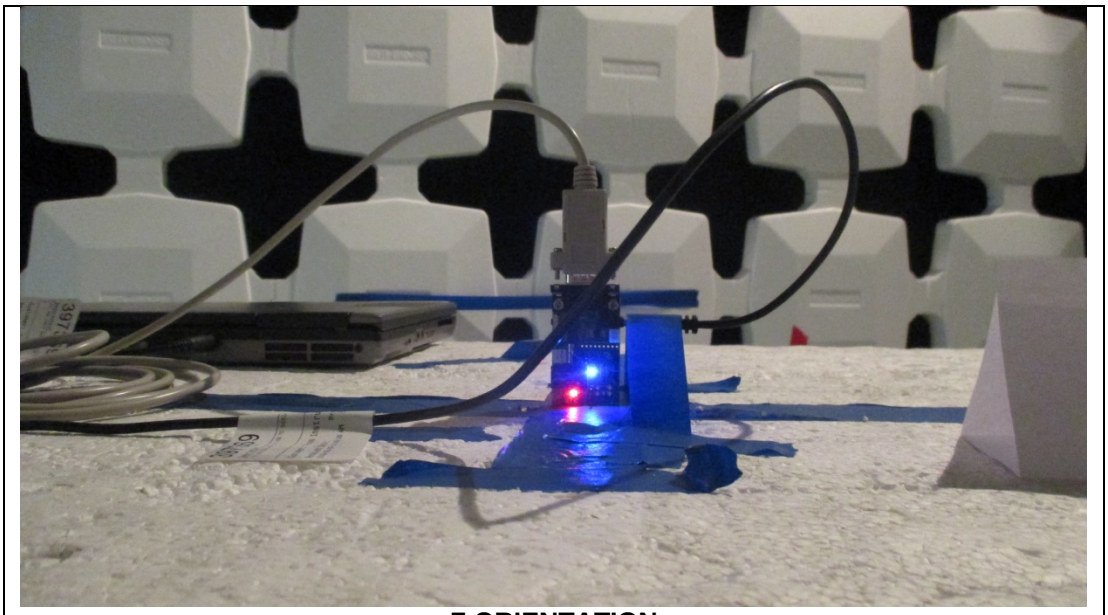
ORIENTATIONS



X ORIENTATION



Y ORIENTATION



Z ORIENTATION

END OF REPORT

UL VERIFICATION SERVICES INC.
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9. APPENDIX A (RX Blocking Report)

RECEIVER BLOCKING PORTION OF EN 300 328 v2.1.1

TEST REPORT

FOR

Bluetooth 2.0 Serial Port Module

MODEL NUMBER: LMX9838

REPORT NUMBER: 11760935 – E2V1

ISSUE DATE: June 07, 2017

Prepared for
Texas Instrument
2900 Semiconductor Drive
Santa Clara
CA 95051, USA

Prepared by
UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	06/07/17	Initial Issue	Conan Cheung

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TABLE OF CONTENTS

10. ATTESTATION OF TEST RESULTS

COMPANY NAME: Texas Instrument
2900 Semiconductor Drive
Santa Clara, CA 95051, USA

EUT DESCRIPTION: Bluetooth 2.0 Serial Port Module

MODEL: LMX 9838

SERIAL NUMBER: QS1021160

DATE TESTED: June 07, 2017

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
RECEIVER BLOCKING PORTION OF EN 300 328 v2.1.1	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

CONAN CHEUNG
PROJECT LEAD
UL Verification Services Inc.

Tested By:

RAY LI
EMC ENGINEER
UL Verification Services Inc.

11. TEST METHODOLOGY

All tests were performed in accordance with the Receiver Blocking portion of EN 300 328 v2.1.1.

12. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL Verification Services, Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

13. CALIBRATION AND UNCERTAINTY

13.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

13.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
RF frequency	3.5 x 10^(-8)
RF power conducted	0.47 dB
RF power radiated	5.5 dB
Spurious emissions, conducted	2.94 dB
Spurious emissions, radiated	5.64 dB
Humidity	4.5 % RH
Temperature	0.9 deg C
Time	0.028 %

Uncertainty figures are valid to a confidence level of 95%.

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14. EQUIPMENT UNDER TEST

14.1. DESCRIPTION OF EUT

The EUT is a Bluetooth 2.0 Module, transmit only Basic data rate 1Mb/s GFSK mode.

14.2. MAXIMUM EIRP AND MEDIUM UTILIZATION (MU) FACTOR

For purposes of determining the EUT classification:

The manufacturer has declared that the EUT is an Adaptive device.

14.2.1. EIRP for Adaptive Devices

The maximum Bluetooth FHSS EIRP in the 2.4 GHz band is -0.51 dBm.

The maximum EIRP is used for determining and setting Receiver Blocking test parameters of Adaptive devices and is not applicable to Receiver Blocking testing for a Non-Adaptive device.

14.2.2. MU for Non-Adaptive Devices

The maximum Medium Utilization (MU) factor is used for determining and setting Receiver Blocking test parameters of Non-Adaptive devices and is not applicable to Receiver Blocking testing for an Adaptive device.

14.3. DESCRIPTION OF AVAILABLE ANTENNAS

The highest gain antenna assembly has a peak gain of -4.9 dBi in the 2.4 GHz band.

14.4. BLUETOOTH FHSS CHANNEL AND CHANNEL BANDWIDTH

The lowest supported channel in the 2.4 GHz band is 2402 MHz. The highest supported channel in the 2.4 GHz band is 2480 MHz.

The minimum supported nominal channel bandwidth in the 2.4 GHz band is 1 MHz.

14.5. DATA RATE

The minimum supported Bluetooth FHSS data rate in the 2.4 GHz band is 1 Mbps.

14.6. SOFTWARE AND FIRMWARE

The software used in the controller/console laptop during testing was Simply Blue Commander, Version 1.6.0.1.

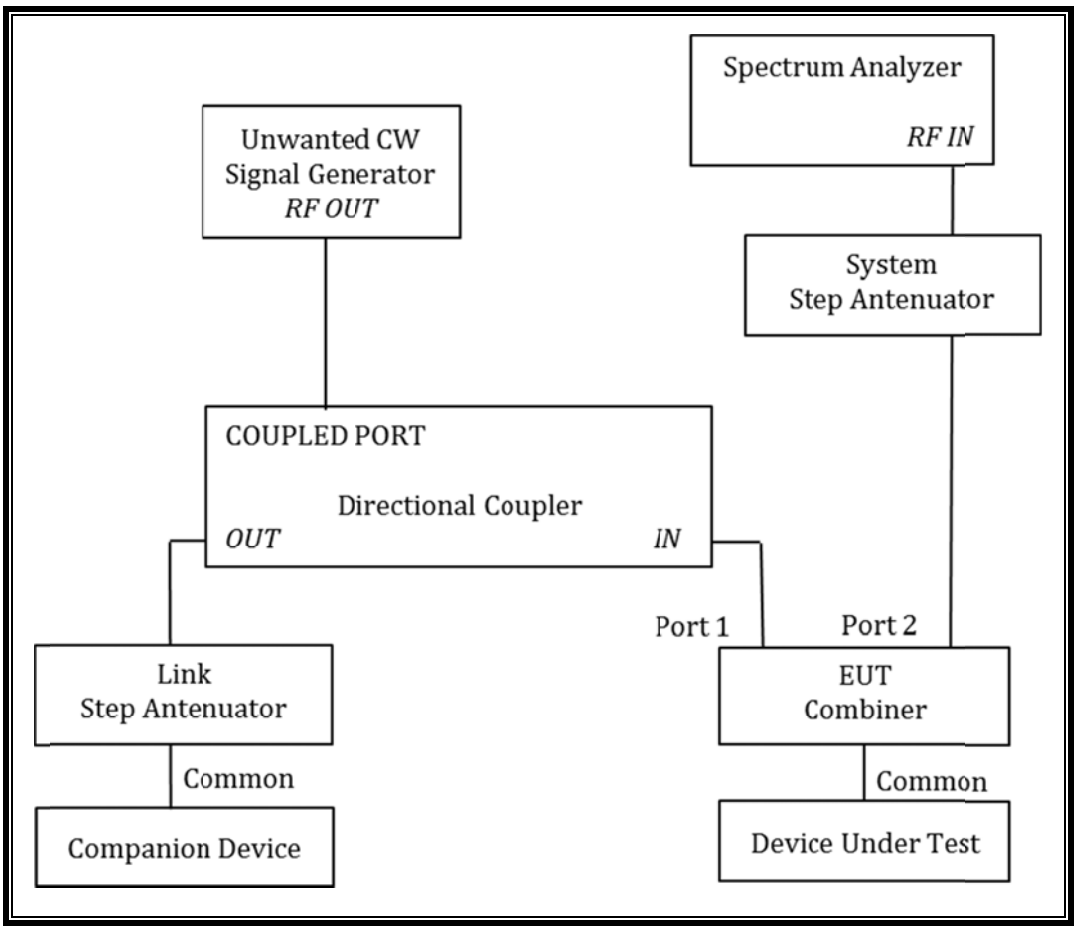
15. DESCRIPTION OF TEST SETUP

15.1. SYSTEM OVERVIEW

These tests were performed using a Conducted instrument configuration.

15.2. TEST AND MEASUREMENT SYSTEM

RECEIVER BLOCKING CONDUCTED TEST CONFIGURATION



15.3. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**Cal Due**
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	MY49430179	02/27/18
Signal Generator, MXG X-Series RF Vector	Agilent	N5182B	MY53050404	04/21/18
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	1201.0002K50135387-nG	02/05/20

TEST SETUP

The EUT is linked to a companion 802.11 wideband radio communications or Bluetooth tester. Traffic is sent from the companion radio testing device to the EUT and the EUT responds to successfully transmitted packets. The PER is calculated by dividing the quantity of successfully received packets by the quantity of packets sent and multiplying the quotient by 100.

15.4. TEST ROOM ENVIRONMENT

The test room temperature and humidity shall be maintained within normal temperature of 15~35 °C and normal humidity 20~75% (relative humidity).

ENVIRONMENT CONDITION

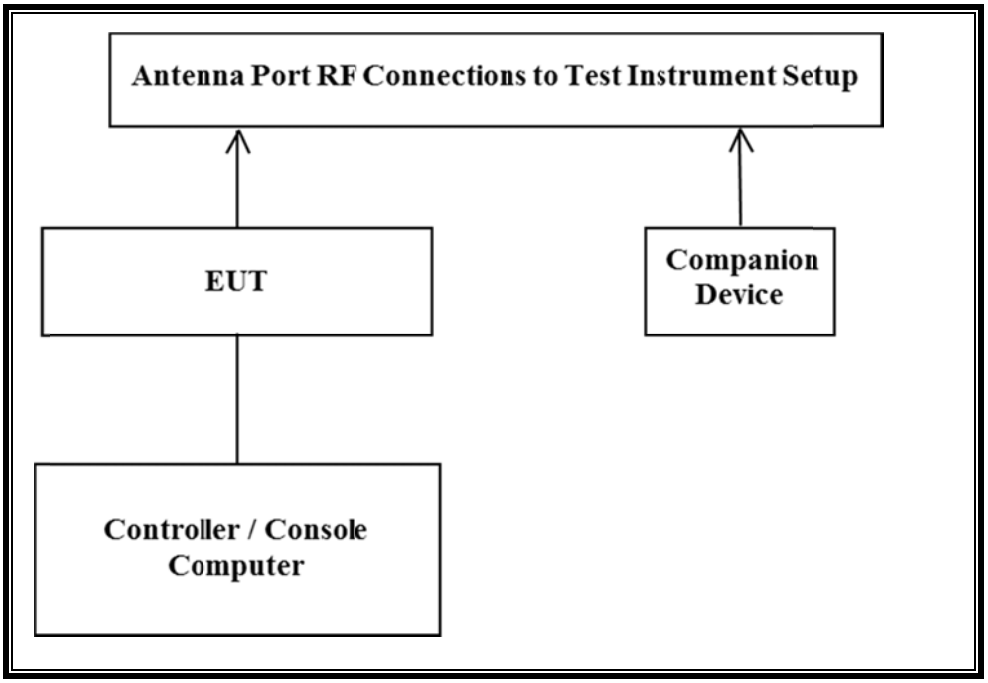
Parameter	Value
Temperature	26.3 °C
Humidity	27 %

15.5. TEST AND MEASUREMENT SOFTWARE

The test and measurement software utilized for the tests documented in this report is internal to the radio tester.

16. SETUP OF EUT

16.1. CONDUCTED METHOD EUT TEST SETUP



16.2. SUPPORT EQUIPMENT AND PERIPHERALS

The following support equipment was utilized for the tests documented in this report:

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	Dell	PP18L	(01)07898349890528
AC Adaptor(Laptop)	Dell	LA65NS0-00	CN-0DF263-71615 -6AC-38D4

17. RECEIVER BLOCKING

17.1. EN 300 328 v2.1.1 REQUIREMENTS

APPLICABILITY

ETSI EN 300 328 V2.1.1, Clause 4.3.1.12.1

This requirement applies to all of the following receiver categories as defined in clause 4.2.3.

Receiver Category 1 Equipment:
Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p.

Receiver Category 2 Equipment:
Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p.

Receiver Category 3 Equipment:
Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p.

DEFINITION

ETSI EN 300 328 V2.1.1, Clause 4.3.1.12.2

Receiver blocking is a measure of the ability of the equipment to receive a wanted signal on its operating channel without exceeding a given degradation in the presence of an unwanted signal (blocking signal) on frequencies other than those of the operating band provided in table 1:

Table 1: Service frequency bands

	Service frequency bands
Transmit	2 400 MHz to 2 483,5 MHz
Receive	2 400 MHz to 2 483,5 MHz

TEST CONDITIONS

ETSI EN 300 328 v2.1.1 Clause 5.4.11.1

These measurements shall only be performed at normal test conditions.

TEST CHANNELS

ETSI EN 300 328 v2.1.1 Clause 5.4.11.1

For non-frequency hopping equipment, having more than one operating channel, the equipment shall be tested operating at both the lowest and highest operating channels. Equipment which can change their operating channel automatically (adaptive channel allocation), and where this function cannot be disabled, shall be tested as a frequency hopping equipment.

If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz) and different data rates, then the smallest channel bandwidth shall be used together with the lowest data rate for this channel bandwidth. This mode of operation shall be aligned with the performance criteria defined in clause 4.3.1.12.3 or clause 4.3.2.11.3 as declared by the manufacturer (see clause 5.4.1 t)) and shall be described in the test report.

It shall be verified that this performance criteria as declared by the manufacturer is achieved.

TEST PROCEDURE

ETSI EN 300 328 v2.1.1 Clause 5.4.11.2.1

Note: For systems using multiple receive chains only one chain (antenna port) needs to be tested. All other receiver inputs shall be terminated.

Step 1:
For non-frequency hopping equipment, the EUT shall be set to the lowest operating channel.

Step 2:
The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.

Step 3:
With the blocking signal generator switched off, a communication link is established between the EUT and the associated companion device using the test setup shown in figure 6. The variable attenuator is set to a value that achieves the minimum specified performance criteria with a resolution of at least 1 dB. The resulting level for the wanted signal at the input of the EUT is Pmin. This value shall be measured and recorded in the test report.

The signal level is increased by the value provided in the table corresponding to the receiver category and type of equipment.

Step 4:
The blocking signal at the EUT is set to the level provided in the table corresponding to the receiver category and type of equipment. It shall be verified and recorded in the test report that the required specified performance criteria is met.

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Step 5:
Repeat step 4 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.

Step 6:
For non-frequency hopping equipment, repeat step 2 to step 5 with the EUT operating at the highest operating channel.

LIMITS

General:

ETSI EN 300 328 V2.1.1, Clause 4.3.1.12.4.1 & Clause 4.3.2.11.4.1

For Frequency Hopping Equipment
While maintaining the minimum performance criteria as defined in clause 4.3.1.12.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 6, table 7 or table 8.

For other types of Wide Band modulation
While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 14, table 15 or table 16.

Receiver Category 1 Equipment:

ETSI EN 300 328 V2.1.1, Clause 4.3.1.12.4.2 & Clause 4.3.2.11.4.2

Table 6 & 14: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device [dBm]	Blocking signal frequency [MHz]	Blocking signal power [dBm]	Type of blocking signal
P_{min} + 6 dB	2380 2503,5	-53	CW
P_{min} + 6 dB	2300 2330 2360	-47	CW
P_{min} + 6 dB	2523,5 2553,5 2583,5 2613,5 2643,5 2673,5	-47	CW
NOTE 1: Pmin is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 or 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Receiver Category 2 Equipment:

ETSI EN 300 328 V2.1.1, Clause 4.3.1.12.4.3 & Clause 4.3.2.11.4.3

Table 7 & 15: Receiver Blocking parameters receiver category 2 equipment

Wanted signal mean power from companion device [dBm]	Blocking signal frequency [MHz]	Blocking signal power [dBm]	Type of blocking signal
P_{min} + 6 dB	2380 2503,5	-57	CW
P_{min} + 6 dB	2300 2583,5	-47	CW
NOTE 1: Pmin is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 or 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Receiver Category 3 Equipment:

ETSI EN 300 328 V2.1.1, Clause 4.3.1.12.4.4 & Clause 4.3.2.11.4.4

Table 8 & 16: Receiver Blocking parameters receiver category 3 equipment

Wanted signal mean power from companion device [dBm]	Blocking signal frequency [MHz]	Blocking signal power [dBm]	Type of blocking signal
P_{min} + 12 dB	2380 2503,5	-57	CW
P_{min} + 12 dB	2300 2583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 or 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

PERFOMANCE CRITERIA

ETSI EN 300 328 V2.1.1, Clause 4.3.1.12.3 & Clause 4.3.2.11.3

The minimum performance criterion shall be a PER (*Packet Error Rate*) less than or equal to 10 %. The manufacturer may declare alternative performance criteria as long as that is appropriate for the intended use of the equipment.

17.2. BLUETOOTH FHSS RECEIVER BLOCKING TEST RESULTS

LIMIT

ETSI EN 300 328 V2.1.1, Clauses 4.3.1.12.4.1 - 4.3.1.12.4

The EUT is an adaptive device.

For Adaptive devices the maximum EIRP in the 2.4 GHz band is -0.51 dBm.

RECEIVER CATEGORY:

Parameter	
Adaptive Equipment (Yes/No) ?	Yes
E.I.R.P. (dBm)	-0.51
Medium Utilization Factor (%)	N/A

Receiver Category 1	No
Receiver Category 2	No
Receiver Category 3	Yes

Per manufacturer declaration the EUT is a Receiver Category 3 device.

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BLOCKER SIGNAL POWER PARAMETERS:

For an EUT with a non-zero dBi antenna gain, the final minimum Blocker Signal power level, B_L, at the port of the radio module in a conducted test setup shall be adjusted by the gain of the bypassed antenna and is calculated using the formula:

B_L = Blocker Signal Power + EUT Antenna Gain (dBi)

Receiver Category 3 Equipment:

Frequency (MHz)	Blocking Signal Power (dBm)	Antenna Gain (dBi)	B_L (dBm)
2300	-47	-4.9	-51.9
2380	-57	-4.9	-61.9
2503.5	-57	-4.9	-61.9
2583.5	-47	-4.9	-51.9

17.2.1. LOW CHANNEL, 1 MHz BANDWIDTH

All tests were performed at a channel center frequency of 2402 MHz.

TABULATED RESULTS

Receiver Category 3 Equipment:

Parameter	Units	
Link		
Data Rate Setting	Mbps	1
Modulation		GFSK
P_{min}	dBm	-67.6
P_{min} Attenuator Setting	dB	0
P_{min}+12	dBm	-55.6
P_{min}+12 Attenuator Setting	dB	0

Pmin PER without Blocker Present (Reference Only)		
At Channel Center Frequency	%	10.00

Pmin+12 PER without Blocker Present (Reference Only)		
At Channel Center Frequency	%	0

Packet Error Rate (PER) with Blocker Present		
At Channel Center Frequency / Blocker Set to 2300 MHz	%	0
At Channel Center Frequency / Blocker Set to 2380 MHz	%	0
At Channel Center Frequency / Blocker Set to 2503.5 MHz	%	0
At Channel Center Frequency / Blocker Set to 2583.5 MHz	%	0

Test Result		
Blocker Set to 2300 MHz	Pass/Fail	**PASS**
Blocker Set to 2380 MHz	Pass/Fail	**PASS**
Blocker Set to 2503.5 MHz	Pass/Fail	**PASS**
Blocker Set to 2583.5 MHz	Pass/Fail	**PASS**

17.2.2. HIGH CHANNEL, 1 MHz BANDWIDTH

All tests were performed at a channel center frequency of 2480 MHz.

TABULATED RESULTS

Receiver Category 3 Equipment:

Parameter	Units	
Link		
Data Rate Setting	Mbps	1
Modulation		GFSK
P_{min}	dBm	-68
P_{min} Attenuator Setting	dB	0
P_{min}+12	dBm	-56
P_{min}+12 Attenuator Setting	dB	0

Pmin PER without Blocker Present (Reference Only)		
At Channel Center Frequency	%	10.1

Pmin+12 PER without Blocker Present (Reference Only)		
At Channel Center Frequency	%	0

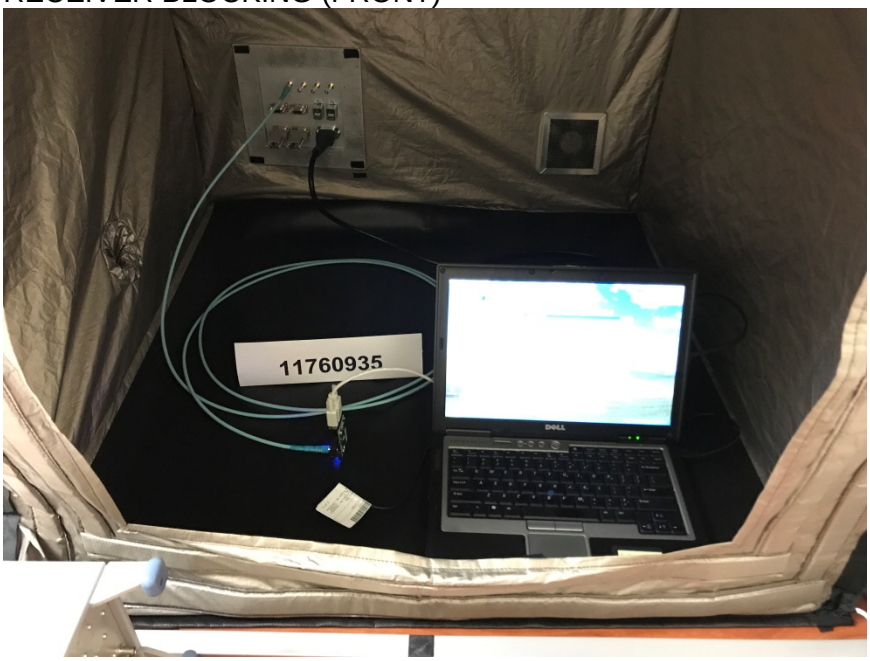
Packet Error Rate (PER) with Blocker Present		
At Channel Center Frequency / Blocker Set to 2300 MHz	%	0
At Channel Center Frequency / Blocker Set to 2380 MHz	%	0
At Channel Center Frequency / Blocker Set to 2503.5 MHz	%	0
At Channel Center Frequency / Blocker Set to 2583.5 MHz	%	0

Test Result		
Blocker Set to 2300 MHz	Pass/Fail	**PASS**
Blocker Set to 2380 MHz	Pass/Fail	**PASS**
Blocker Set to 2503.5 MHz	Pass/Fail	**PASS**
Blocker Set to 2583.5 MHz	Pass/Fail	**PASS**

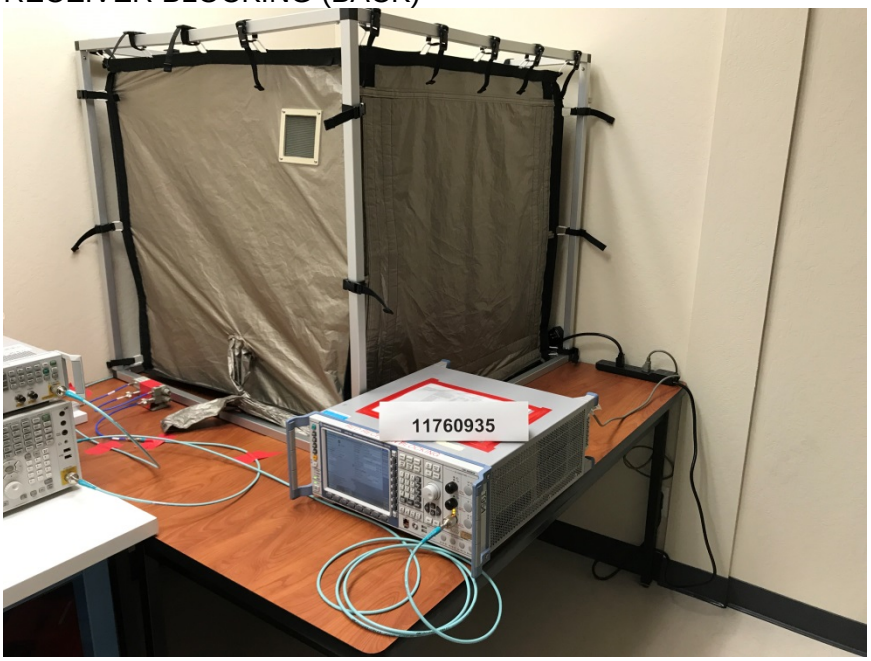
18. SETUP PHOTOS

18.1. RECEIVER BLOCKING TESTING

RECEIVER BLOCKING (FRONT)



RECEIVER BLOCKING (BACK)



END OF REPORT

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10. APPENDIX B (ORIGINAL REPORT)

TEST REPORT

Report Number : 11364308-E1V1

Applicant : Texas Instrument
2900 Semiconductor Drive
Santa Clara, CA 95051

Model : LMX9838

EUT Description : Bluetooth 2.0 module

Test Standard(s) : EN 300 328 v1.9.1

Date of Issue:
Wednesday, August 03, 2016

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538, U.S.A.
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FAX: (510) 661-0888

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	8/3/2016	Initial Issue	---

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TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Texas Instrument
2900 Semiconductor Drive
Santa Clara, CA 95051

EUT DESCRIPTION: Bluetooth 2.0 Module

MODEL: LMX9838

SERIAL NUMBER: QS1024013 (CONDUCTED), QS1024172 (RADIATED)

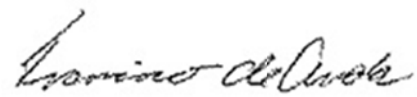
DATE TESTED: July 29th 2016 – August 02 2016

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
EN 300 328 v1.9.1	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:



Francisco de Anda
CONSUMER TECHNOLOGY DIVISION
Program Manager
UL Verification Services Inc.

Prepared By:

Clifford Susa
CONSUMER TECHNOLOGY DIVISION
Lab Engineer
UL Verification Services Inc.

2. SUMMARY OF TESTING

2.1. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A(IC: 2324B-1)	☐ Chamber D(IC: 2324B-4)
☐ Chamber B(IC: 2324B-2)	☐ Chamber E(IC: 2324B-5)
☒ Chamber C(IC: 2324B-3)	☐ Chamber F(IC: 2324B-6)
	☐ Chamber G(IC: 2324B-7)
	☐ Chamber H(IC: 2324B-8)

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

2.2. TEST METHODOLOGY

All tests were performed in accordance with the procedures documented in EN 300 328 v1.9.1.

2.3. CALIBRATION AND UNCERTAINTY

MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
RF frequency	±3 x 10^(-7)
RF power conducted	±0.35 dB
RF power radiated	±5.5 dB
Spurious emissions, conducted	±2.9 dB
Spurious emissions, radiated	±5.6 dB
Humidity	±4.5 % RH
Temperature	±0.9 deg C
Time	±0.02 %

Uncertainty figures are valid to a confidence level of 95%.

2.4. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Description	Manufacturer	Model	ID Num	Cal Due
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	T122	01/29/17
Antenna, Horn, 1-18GHz	ETS Lindgren	3117	T119	01/04/17
RF Preamplifier, 10kHz - 1GHz	HP	8447D	T15	08/13/16
RF Preamplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	T931	04/29/17
Spectrum Analyzer, 44 GHz	Keysight	N9030A	T1450	12/21/16
Spectrum Analyzer, 44 GHz	Keysight	N9030A	T339	09/14/16
Environmental Chamber	Thermotron	SE-600-10-10	T80	11/16/16
EMI Power Sensor	ETS-Lindgren	7002-006	T1081	12/03/16

Test Software List			
Description	Manufacturer	Model	Version
Antenna Port Software	UL	UL RF	v5.1.1, 7/15/16

3. EQUIPMENT UNDER TEST

3.1. DESCRIPTION OF EUT

The EUT is a Bluetooth 2.0 Module, transmit only Basic data rate 1Mb/s GFSK mode.

The radio module is manufactured by Texas Instruments.

3.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode	Output EIRP (dBm)	Output EIRP (mW)
2402 - 2480	GFSK	-0.51	0.89

3.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integral antenna with a maximum gain of -1.48dBi

3.4. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Worst-case data rates as provided by the client were:

GFSK mode: 1-DH5

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3.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Dell	D620	C01089	DoC
Laptop AC Adapter	Dell	LA65NS-00	CN-00F263-71615-6AC-38D4	DoC

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC	1	3.5mm	unshielded	0.9	USB to 3.5mm connector
2	Serial	1	DB9	shielded	2	USB to Serial cable
3	DC	1	barrel	unshielded	1.7	
4	AC	1	2 prong	unshielded	0.9	

TEST SETUP

The EUT was connected to a host laptop computer via a USB to Serial cable adapter during the tests. Test software exercised the radio card.

SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was v.02.12 (Patch 2).

The test utility software used during testing was Simply Blue Commander v1.6.0.1

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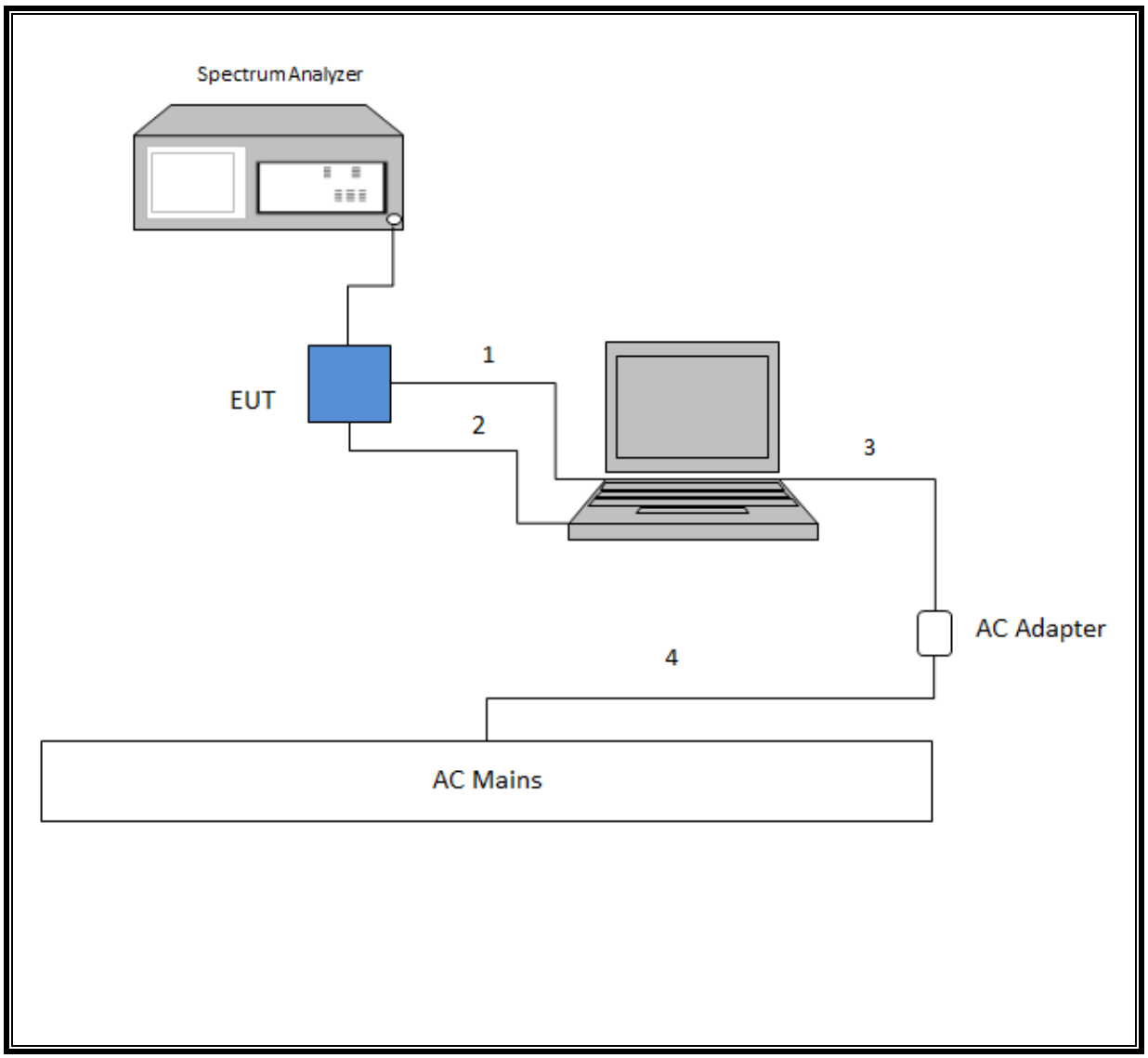
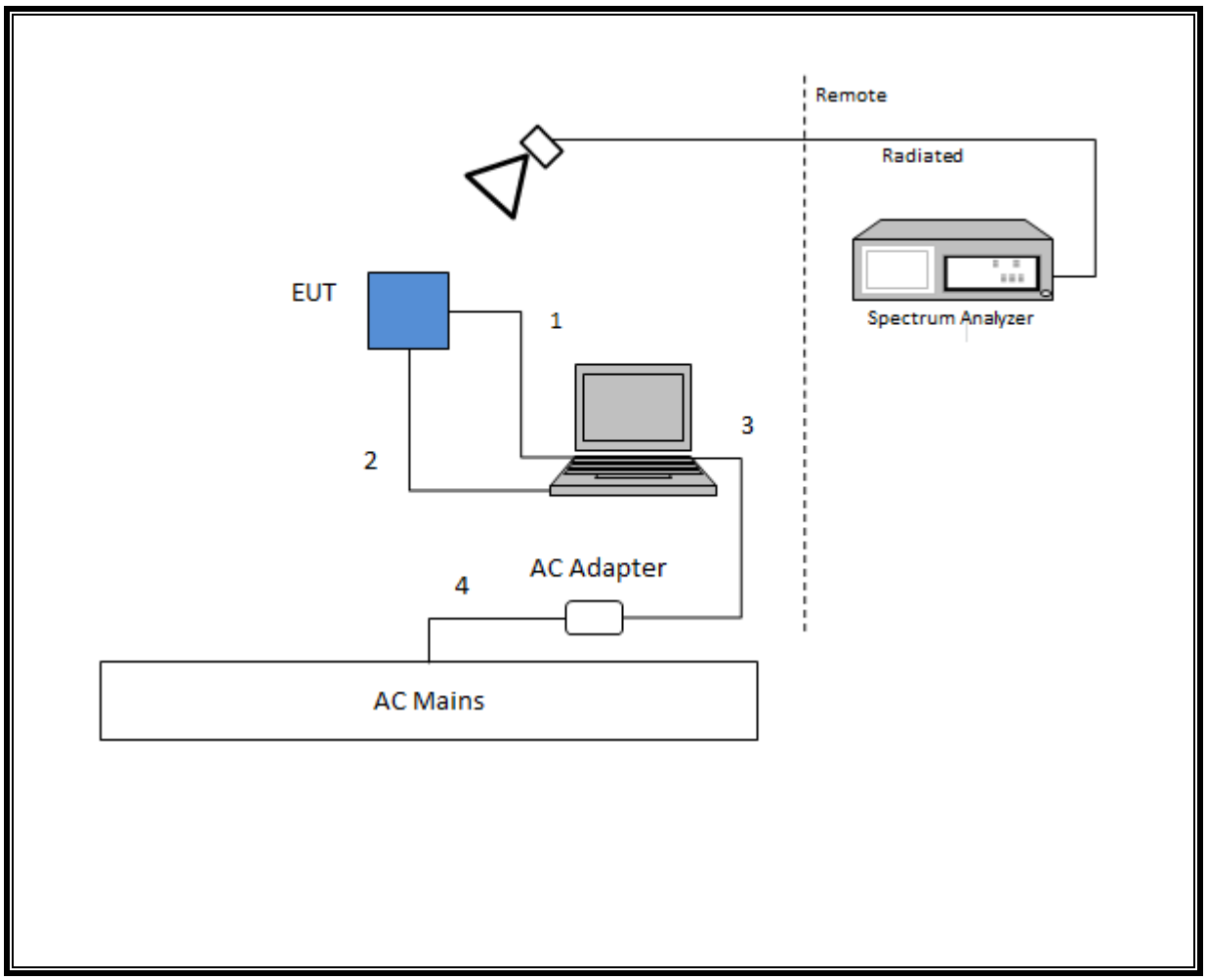
SETUP DIAGRAM FOR CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS



4. TEST RESULTS

4.1. NORMAL AND EXTREME CONDITIONS

LIMITS

None; for reporting purposes only.

RESULTS

The normal and extreme conditions, as provided by the manufacturer, are as follows:

Normal conditions are 25 deg C, 5 Vdc.
The low temperature condition is 0 deg C.
The high temperature condition is 40 deg C.

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4.2. OCCUPIED CHANNEL BANDWIDTH

LIMITS

The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band given in clause 1 (2400 MHz – 2483.5 MHz).

For non-adaptive Frequency Hopping equipment with e.i.r.p greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the Nominal Channel Bandwidth declared by the supplier. This declared value shall not be greater than 5 MHz.

TEST PROCEDURE

ETSI EN 300 328 V1.9.1 Section 5.3.8.2.1

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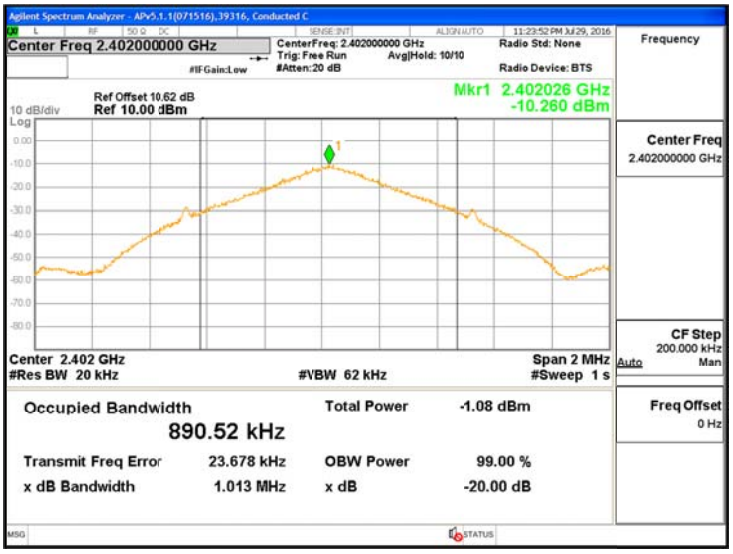
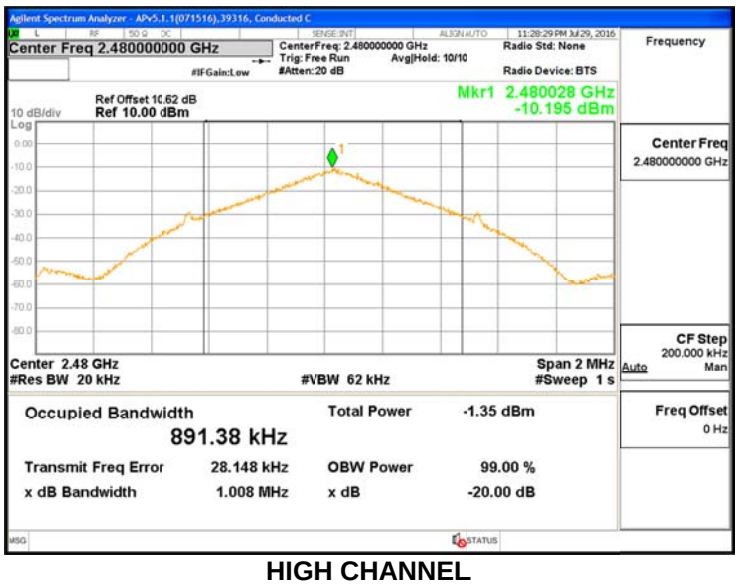
RESULTS

4.2.1. GFSK MODE

Channel	Frequency (MHz)	99% Bandwidth (kHz)
Low	2402	890.520
High	2480	891.380



LOW CHANNEL



HIGH CHANNEL

4.3. HOPPING FREQUENCY SEPARATION

LIMIT

Non-adaptive frequency hopping equipment:

For non-adaptive Frequency Hopping equipment, the Hopping Frequency Separation shall be equal or greater than the Occupied Channel Bandwidth (see clause 4.3.1.8), with a minimum separation of 100 kHz.

For equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for non-adaptive Frequency Hopping equipment operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. only the minimum Hopping Frequency Separation of 100 kHz applies.

Adaptive frequency hopping equipment:

For adaptive Frequency Hopping equipment, the minimum Hopping Frequency Separation shall be 100 kHz.

Adaptive Frequency Hopping equipment, which for one or more hopping frequencies, has switched to a non-adaptive mode because interference was detected on all these hopping positions with a level above the threshold level defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2, is allowed to continue to operate with a minimum Hopping Frequency Separation of 100 kHz on these hopping frequencies as long as the interference is present on these frequencies. The equipment shall continue to operate in an adaptive mode on other hopping frequencies.

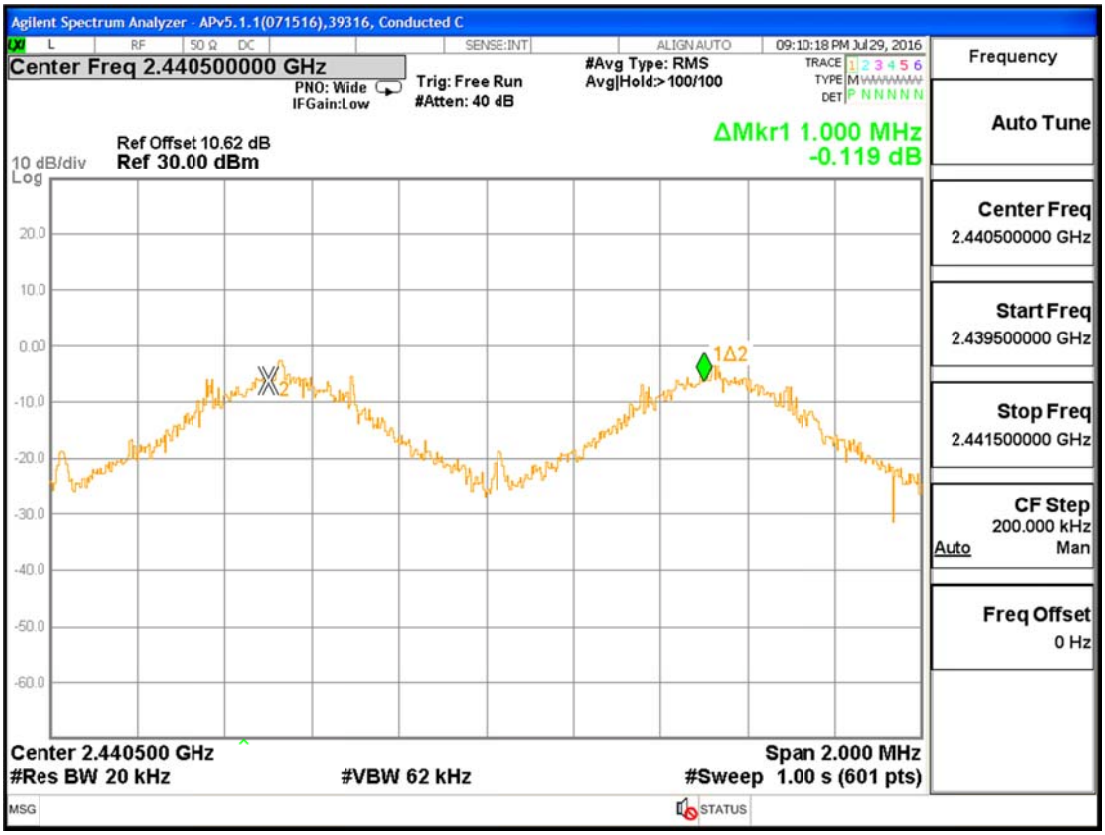
Adaptive Frequency Hopping equipment which decided to operate in a non-adaptive mode on one or more hopping frequencies without the presence of interference, shall comply with the limit in clause 4.3.1.5.3.1 for these hopping frequencies as well as with all other requirements applicable to non-adaptive frequency hopping equipment.

TEST PROCEDURE

ETSI EN 300 328 V1.9.1 Section 5.3.5.2.1

RESULTS

4.3.1. GFSK MODE



Hopping Mode

4.4. ACCUMULATED TRANSMIT TIME, FREQUENCY OCCUPATION AND HOPPING SEQUENCE

DEFINITIONS

The Accumulated Transmit Time is the total of the transmitter 'on' times, during an observation period, on a particular hopping frequency.

The Frequency Occupation is the number of times that each hopping frequency is occupied within a given period. A hopping frequency is considered to be occupied when the equipment selects that frequency from the hopping sequence.
The equipment may be transmitting, receiving or stay idle during the Dwell Time spent on that hopping frequency.

The Hopping Sequence of a frequency hopping equipment is the unrepeated pattern of the hopping frequencies used by the equipment

LIMITS

Non-adaptive frequency hopping equipment:

The Accumulated Transmit Time on any hopping frequency shall not be greater than 15 ms within any observation period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

> Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.
>
> Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The hopping sequence(s) shall contain at least N hopping frequencies where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

Adaptive frequency hopping equipment:

Adaptive Frequency Hopping equipment shall be capable of operating over a minimum of 70 % of the band specified in clause 1.

The Accumulated Transmit Time on any hopping frequency shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

> Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.
>
> Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The hopping sequence(s) shall contain at least N hopping frequencies at all times, where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

TEST PROCEDURE

ETSI EN 300 328 V1.9.1 Section 5.3.4.2.1

RESULTS

4.4.1. GFSK MODE

ACCUMULATED TRANSMIT TIME

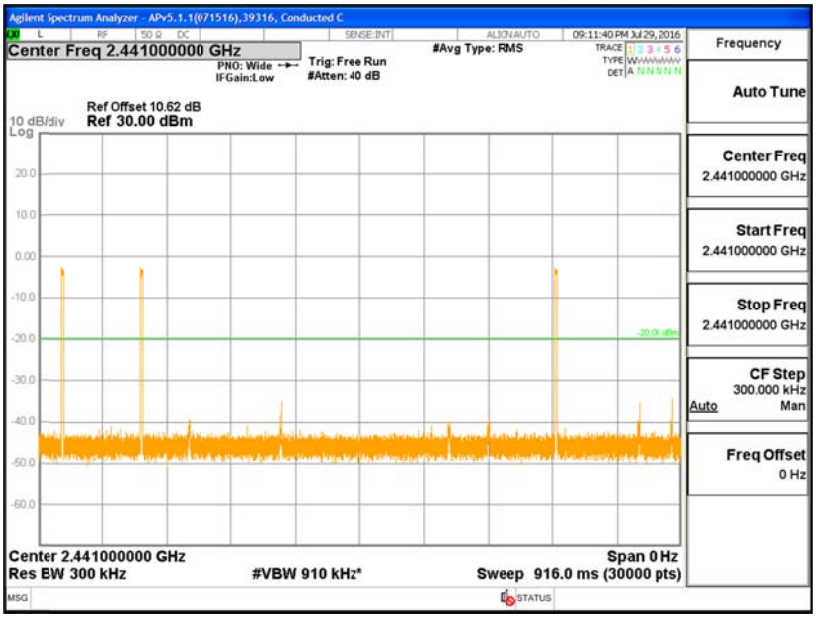
	Measured Value (ms)	Limit (ms)	Margin (ms)
A	55.82	400	-344.18
B	64.02	400	-335.98

CHANNEL A

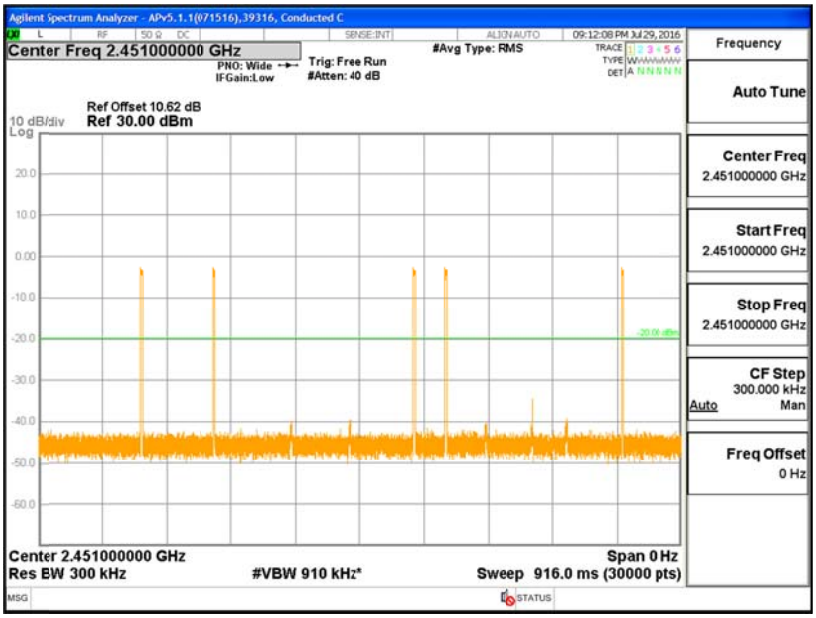
CHANNEL B

FREQUENCY OCCUPATION

	Measured Value (number of times)	Limit (number of times)
A	3.00	≥1
B	5.00	≥1



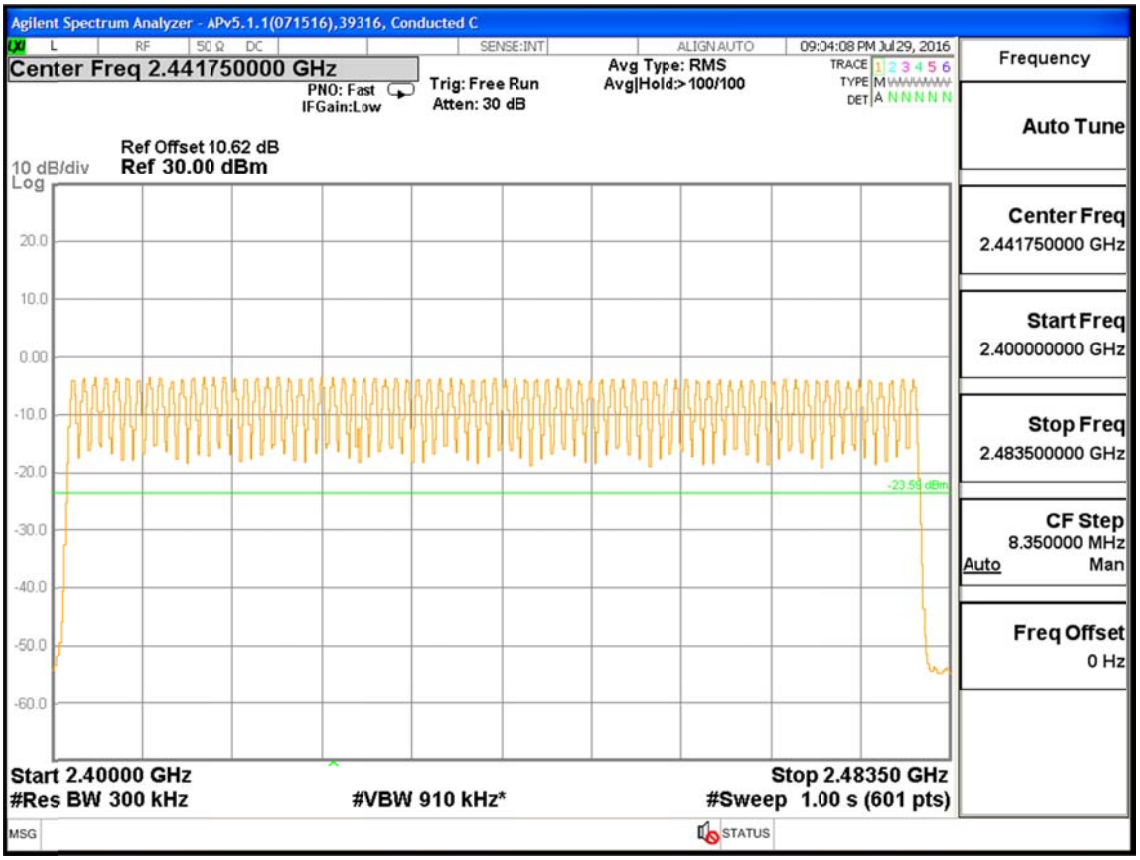
CHANNEL A



CHANNEL B

HOPPING SEQUENCE

	Measured Value (number of frequencies)	Limit (number of frequencies)	Margin (number of frequencies)
2402 - 2480MHz	79.00	15	-64.00



HOPPING MODE

4.5. EFFECTIVE RADIATED POWER

LIMIT

The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20 dBm.

The maximum RF output power for non-adaptive Frequency Hopping equipment shall be declared by the supplier. The maximum RF output power for this equipment shall be equal to or less than the value declared by the supplier. This declared value shall be equal to or less than 20 dBm.

This limit shall apply for any combination of power level and intended antenna assembly.

TEST PROCEDURE

ETSI EN 300 328 V1.9.1 Clause 5.3.2.2.1.2

CALCULATIONS

EIRP = A + G + Y

Where,

EIRP is the effective isotropic radiated power in dBm
A is the highest of all Pburst values as measured by the test system in dBm
G is stated assembly antenna gain of the individual antenna in dBi
Y is any additional beam-forming gain

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RESULTS

4.5.1. GFSK MODE

Tested By:	37699 CS
Date:	8/1/2016

EUT Antenna Gain (dBi) =	-1.48

Condition	Ouput Power (dBm)	EIRP (dBm)	Limit (dB)	Margin (dB)
HOPPING ON				
Normal	0.43	-1.05	20	-21.05
Extreme Low Temp	0.97	-0.51	20	-20.51
Extreme High Temp	0.06	-1.42	20	-21.42

4.6. TRANSMITTER UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN (OOB)

ETSI EN 300 328 V 1.9.1 Clause 4.3.1.9.3

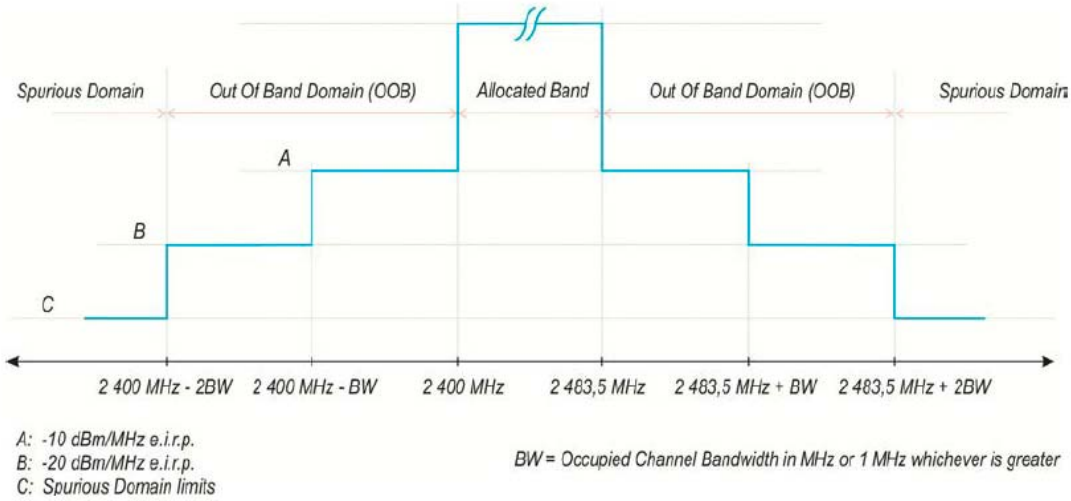


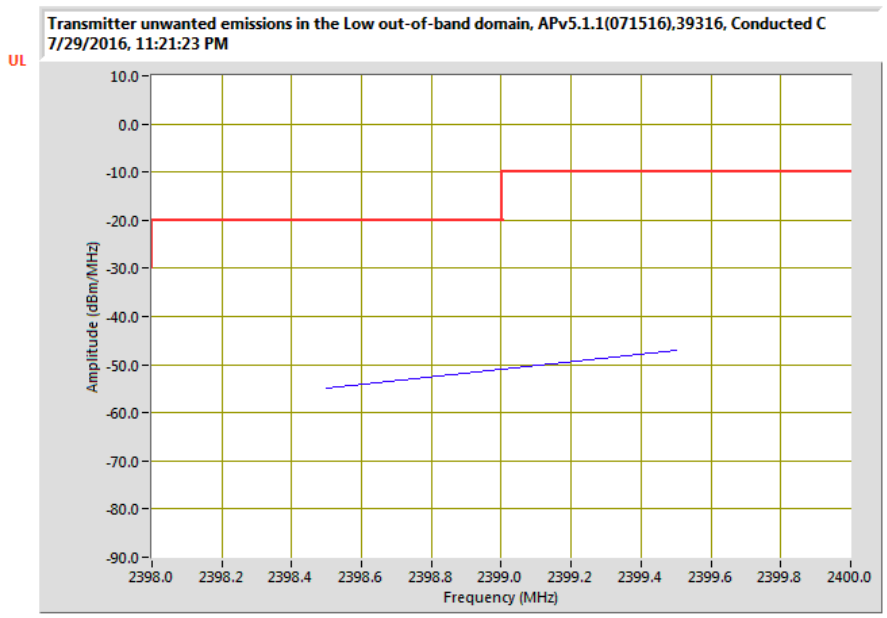
Figure 1: Transmit mask

TEST PROCEDURE

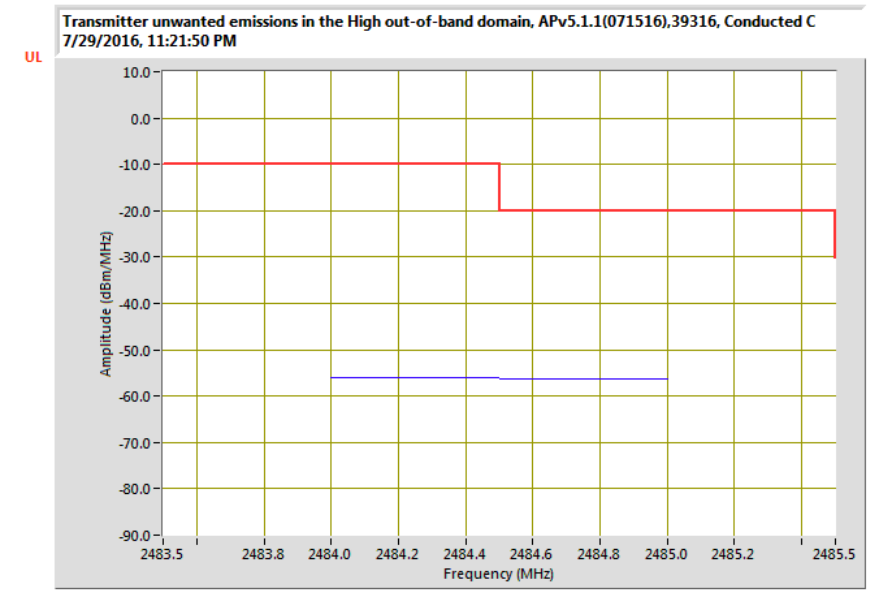
ETSI EN 300 328 V 1.9.1 Clause 5.3.9.2.1

RESULTS

4.6.1. GFSK MODE



LOW CHANNEL (Hopping ON)



HIGH CHANNEL (Hopping ON)

4.7. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

LIMITS

ETSI EN 300 328 V1.9.1 Clause 4.3.1.10.3

Table 1: Transmitter limits for spurious emissions

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

TEST PROCEDURE

ETSI EN 300 328 V1.9.1 Clause 5.3.10.2.1

TEST CONDITIONS

The level of spurious emissions shall be measured as, either:

a) their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or

b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no temporary antenna connectors

Protocol (b) was used for emissions testing as covered by this report.

RESULTS

4.7.1. GFSK MODE

RADIATED SPURIOUS EMISSIONS BELOW 1 GHz

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Project #: 11364308
Date: 08/01/16
Test Engineer: 39316 CX
Configuration: EUT W/ LAPTOP
Mode: BT, GFSK, TX

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber C	3m-C T15		ETSI 300 328 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	ERP @ TX Ant's End (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel 2402MHz										
72.02	-64.3	H	3.0	14.5	28.0		-77.8	-54.0	-23.8	
249.97	-65.1	H	3.0	21.9	27.1		-70.3	-36.0	-34.3	
332.12	-60.0	H	3.0	23.6	27.4		-63.8	-36.0	-27.8	
54.40	-63.0	V	3.0	14.4	28.2		-76.8	-54.0	-22.8	
332.82	-68.3	V	3.0	25.2	27.4		-70.6	-36.0	-34.6	
995.91	-82.4	V	3.0	34.9	27.1		-74.7	-36.0	-38.7	
High Channel 2480MHz										
249.97	-64.9	H	3.0	21.9	27.1		-70.1	-36.0	-34.1	
332.65	-76.0	H	3.0	23.6	27.4		-79.8	-36.0	-43.8	
380.25	-62.6	H	3.0	25.4	27.7		-64.9	-36.0	-28.9	
71.94	-61.2	V	3.0	17.6	28.0		-71.6	-54.0	-17.6	
333.02	-67.2	V	3.0	25.2	27.4		-69.5	-36.0	-33.5	
995.87	-80.7	V	3.0	34.9	27.1		-73.0	-36.0	-37.0	

RADIATED SPURIOUS EMISSIONS ABOVE 1 GHz

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company:	Texas Instruments
Project #:	11364308
Date:	8/1/2016
Test Engineer:	39316 CX
Configuration:	EUT w/ Laptop
Mode:	BT, GFSK. TX

Chamber	Pre-amplifer	Filter	Limit
3m Chamber C	3m Chamber C		ETSI 300 328 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	EIRP @ TX Ant's End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel 2402MHz										
1.66	-52.9	H	3.0	-8.4	36.5		-44.9	-30.0	-14.9	
1.75	-61.4	H	3.0	-16.0	36.4		-52.4	-30.0	-22.4	
4.80	-58.6	H	3.0	-5.6	33.5		-39.1	-30.0	-9.1	
1.08	-65.3	V	3.0	-23.1	36.5		-59.6	-30.0	-29.6	
1.66	-57.4	V	3.0	-12.1	36.5		-48.6	-30.0	-18.6	
3.83	-63.2	V	3.0	-11.5	34.0		-45.5	-30.0	-15.5	
High Channel 2480MHz										
1.66	-51.0	H	3.0	-6.6	36.5		-43.0	-30.0	-13.0	
1.74	-60.2	H	3.0	-14.8	36.4		-51.2	-30.0	-21.2	
4.96	-55.6	H	3.0	-2.3	33.4		-35.8	-30.0	-5.8	
1.66	-48.1	V	3.0	-2.8	36.5		-39.2	-30.0	-9.2	
1.73	-56.0	V	3.0	-9.8	36.4		-46.2	-30.0	-16.2	
4.96	-55.6	V	3.0	-2.5	33.4		-35.9	-30.0	-5.9	

4.8. RECEIVER SPURIOUS EMISSIONS

LIMITS

ETSI EN 300 328 V1.9.1 Clause 4.3.1.11.3

TEST PROCEDURE

EN 300 328 V1.9.1 Clause 5.3.11.2.1

Table 2: Spurious emission limits for receivers

Frequency range	Maximum power	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

TEST CONDITIONS

The level of spurious emissions shall be measured as, either:

a) their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or

b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no temporary antenna connectors

Protocol (b) was used for emissions testing as covered by this report.

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RESULTS

RADIATED SPURIOUS EMISSIONS BELOW 1 GHz

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Project #: 11364308
Date: 08/01/16
Test Engineer: 39316 CX
Configuration: EUT W/ LAPTOP
Mode: BT, GFSK, RX

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber C	3m-C T15		ETSI 300 328 Rx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	ERP @ TX Ant's End (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel 2402MHz										
72.02	-64.3	H	3.0	14.5	28.0		-77.8	-57.0	-20.8	
249.97	-65.1	H	3.0	21.9	27.1		-70.3	-57.0	-13.3	
332.12	-60.0	H	3.0	23.6	27.4		-63.8	-57.0	-6.8	
54.40	-63.0	V	3.0	14.4	28.2		-76.8	-57.0	-19.8	
332.82	-68.3	V	3.0	25.2	27.4		-70.6	-57.0	-13.6	
995.91	-82.4	V	3.0	34.9	27.1		-74.7	-57.0	-17.7	
High Channel 2480MHz										
249.97	-64.9	H	3.0	21.9	27.1		-70.1	-57.0	-13.1	
332.65	-76.0	H	3.0	23.6	27.4		-79.8	-57.0	-22.8	
380.25	-62.6	H	3.0	25.4	27.7		-64.9	-57.0	-7.9	
71.94	-61.2	V	3.0	17.6	28.0		-71.6	-57.0	-14.6	
333.02	-67.2	V	3.0	25.2	27.4		-69.5	-57.0	-12.5	
995.87	-80.7	V	3.0	34.9	27.1		-73.0	-57.0	-16.0	

RADIATED SPURIOUS EMISSIONS ABOVE 1 GHz

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

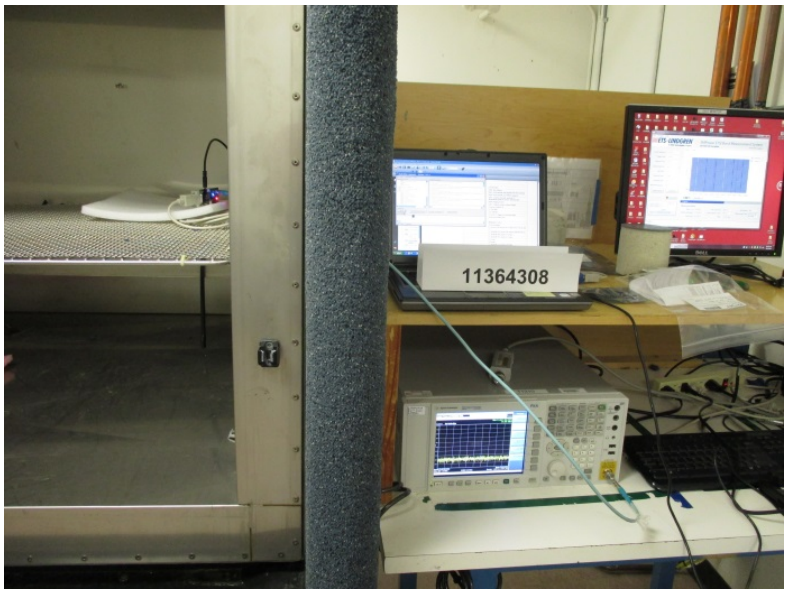
Company:	Texas Instruments
Project #:	11364308
Date:	42583
Test Engineer:	39316 CX
Configuration:	EUT w/ Laptop
Mode:	BT, GFSK, RX

Chamber	Pre-amplifer	Filter	Limit
3m Chamber C	3m Chamber C		ETSI 300 328 Rx

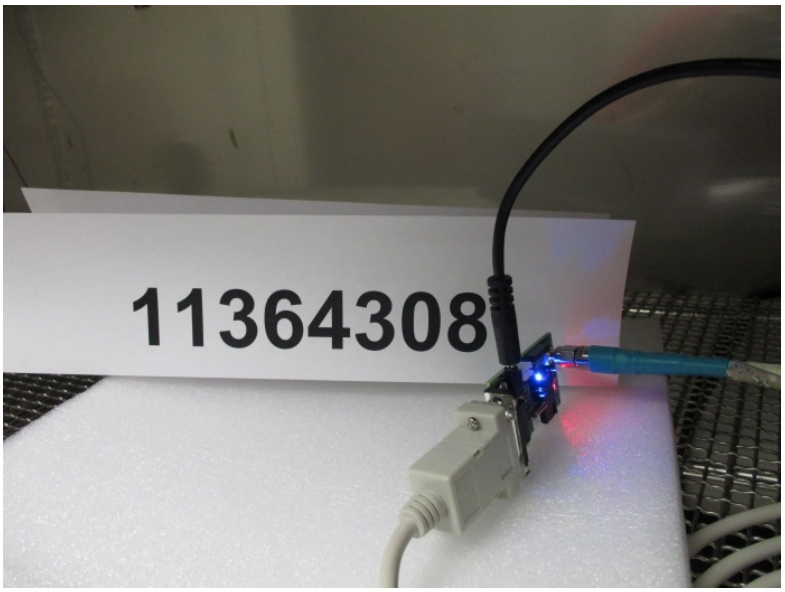
Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	EIRP @ TX Ant's End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel 2402MHz										
1.20	-59.2	H	3.0	-16.6	36.6		-53.2	-47.0	-6.2	
1.31	-60.4	H	3.0	-17.8	36.6		-54.4	-47.0	-7.4	
1.66	-67.7	H	3.0	-23.2	36.5		-59.7	-47.0	-12.7	
1.58	-76.0	V	3.0	-31.7	36.6		-68.3	-47.0	-21.3	
1.66	-59.2	V	3.0	-14.0	36.5		-50.5	-47.0	-3.5	
1.75	-68.2	V	3.0	-21.9	36.4		-58.3	-47.0	-11.3	
High Channel 2480MHz										
1.58	-62.4	H	3.0	-18.8	36.6		-55.4	-47.0	-8.4	
1.66	-66.8	H	3.0	-22.3	36.5		-58.8	-47.0	-11.8	
2.14	-66.4	H	3.0	-17.9	35.7		-53.7	-47.0	-6.7	
1.58	-69.6	V	3.0	-25.3	36.6		-61.9	-47.0	-14.9	
1.66	-69.5	V	3.0	-24.2	36.5		-60.7	-47.0	-13.7	
1.71	-68.9	V	3.0	-23.0	36.4		-59.4	-47.0	-12.4	

5. SETUP PHOTOS

RF CONDUCTED MEASUREMENT AT ANTENNA PORT



ANTENNA PORT CONDUCTED PHOTO



ENVIRONMENTAL CHAMBER PHOTO

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RADIATED SPURIOUS EMISSIONS

BELOW 1GHz (FRONT PHOTO)

BELOW 1GHz (BACK PHOTO)

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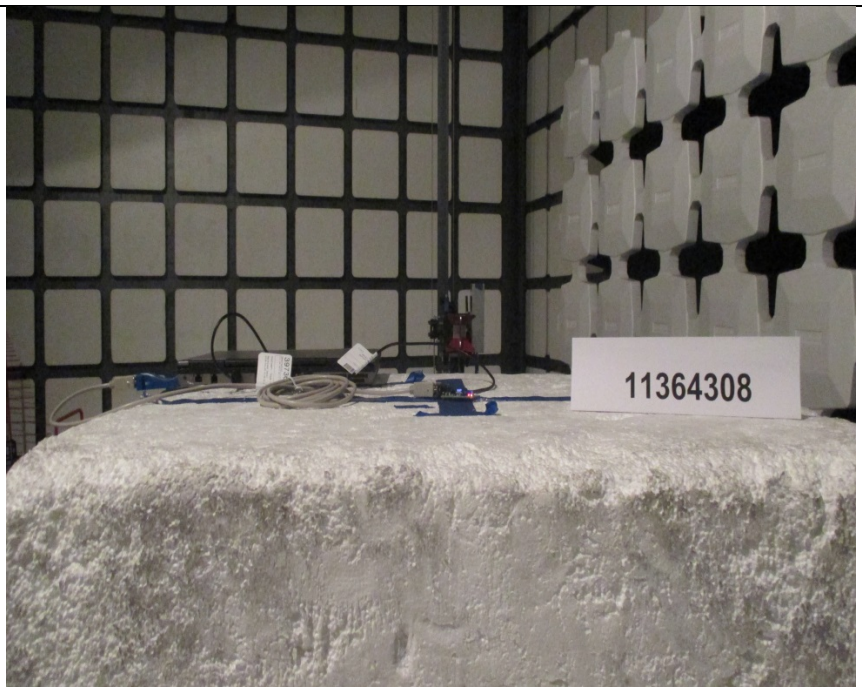
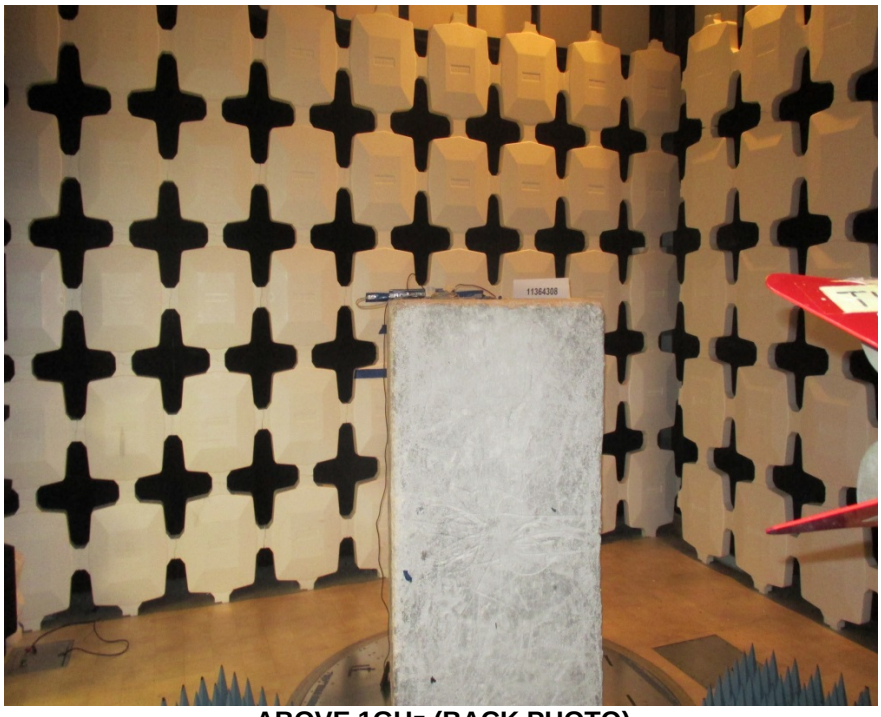


ABOVE 1GHz (FRONT PHOTO)



ABOVE 1GHz (BACK PHOTO)

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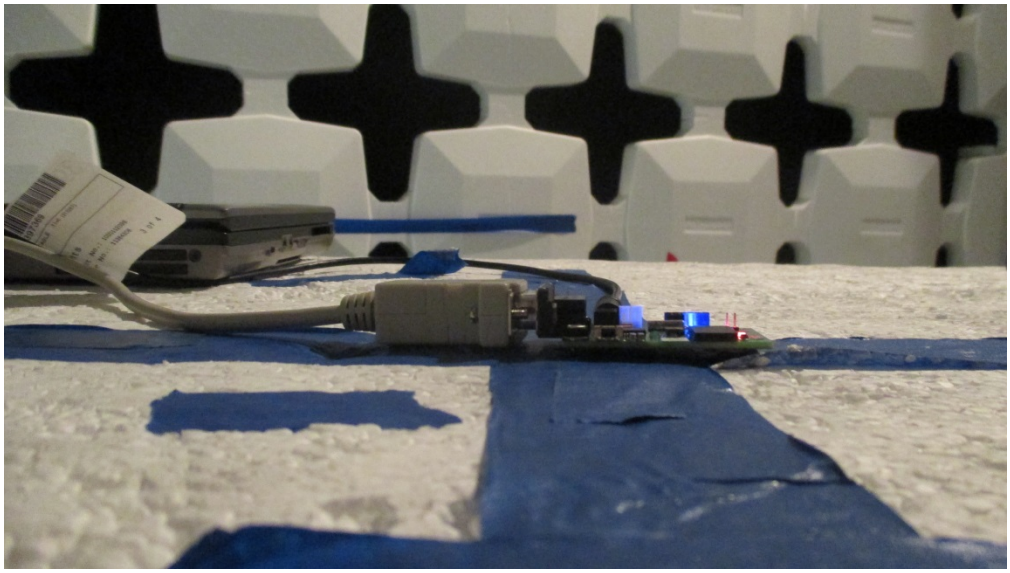
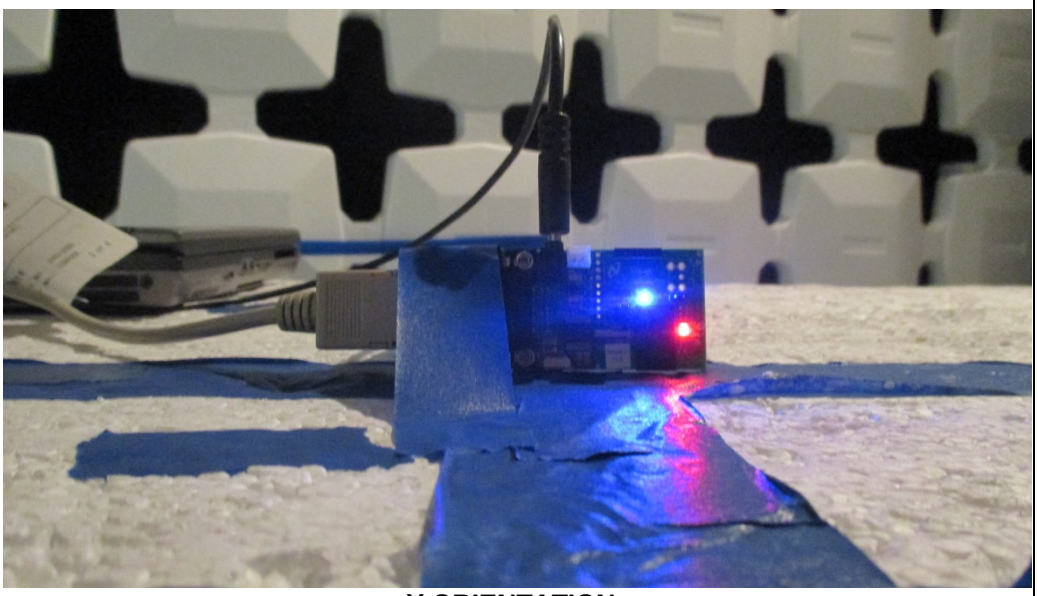
ORIENTATIONS



X ORIENTATION



Y ORIENTATION

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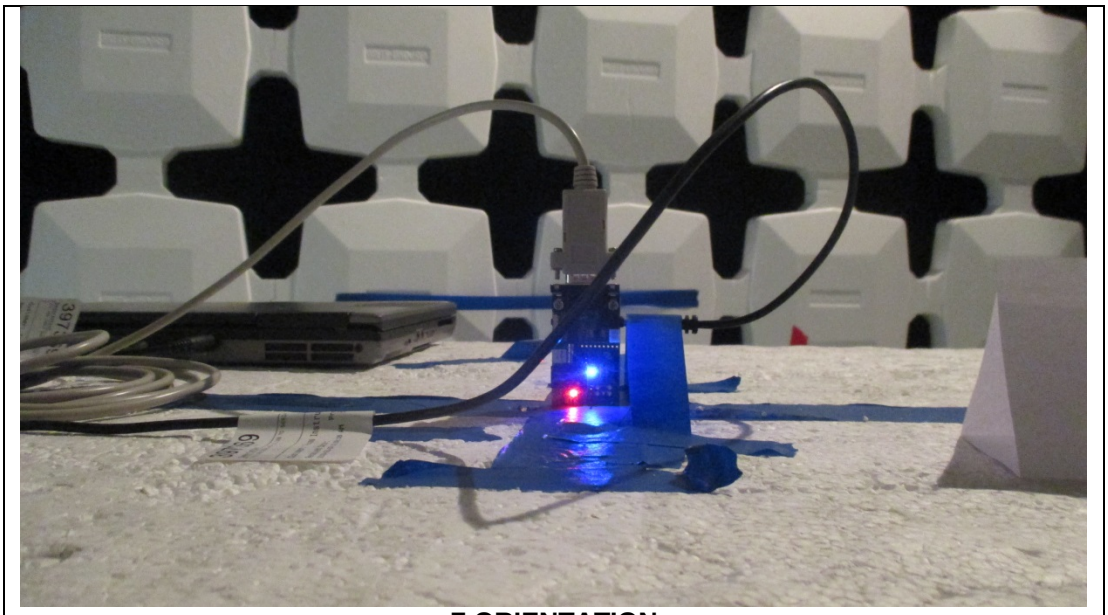

Z ORIENTATION

END OF REPORT

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