



America

**Choose certainty.
Add value.**

Report On

Radio Testing of the
St. Jude Medical IESD
SJM Confirm™ DM3500 and JOT DX Model DM4500
Implantable Cardiac Monitor

ARIB STD-T66 V3.7

Report No. SD72118359-0716 Rev.02

June 2019

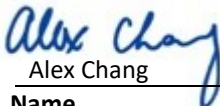


REPORT ON Radio Testing of the
St. Jude Medical IESD
SJM Confirm™ DM3500 and JOT DX Model DM4500 Implantable Cardiac
Monitor

TEST REPORT NUMBER SD72118359-0716 Rev.02

PREPARED FOR St. Jude Medical IESD
15900 Valley View Court
Sylmar, CA 91342
USA

CONTACT PERSON Jorge Amely-Velez
Sr. Principal Engineer
(818) 493-2818
jamely-velez@sjm.com

PREPARED BY 
Alex Chang
Name
Authorized Signatory
Title: Senior EMC/RF Wireless Test Engineer

APPROVED BY 
Ferdinand S. Custodio
Name
Authorized Signatory
Title: Senior EMC Test Engineer/Wireless Team Lead

DATED June 27, 2019

Revision History

SD72118359-0716 Rev.02 St. Jude Medical IESD SJM Confirm™ DM3500 and JOT DX Model DM4500 Implantable Cardiac Monitor					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
02/28/2017	—	Initial Release			Ferdinand Custodio
06/27/2019	Initial Release	Rev.01	Added column with missing Cal due date	37	Ferdinand Custodio
06/07/2021	Rev.01	Rev.02	Added a new model variant: JOT DX Model DM4500		Ferdinand Custodio

CONTENTS

Section	Page No
1	REPORT SUMMARY..... 5
1.1	Introduction 6
1.2	Brief Summary Of Results 7
1.3	Product Information 8
1.4	EUT Test Configuration 10
1.5	Deviations From The Standard 12
1.6	Modification Record 12
1.7	Test Methodology 12
1.8	Test Facility Location..... 12
1.9	Test Facility Registration 12
2	TEST DETAILS 14
2.1	Modulation System..... 15
2.2	Antenna Power 16
2.3	Allowable Deviations In Frequency..... 18
2.4	Permissible Value Of Spurious Or Unnecessary Intensity..... 21
2.5	Permissible Value Of Occupied Frequency Bandwidth And Spread Bandwidth 24
2.6	Process Gain..... 30
2.7	Limit On Secondary Radiation (Receiver Test)..... 31
2.8	Antenna Gain 33
2.9	Limitations Of Sector Directive Antennas 34
3	TEST EQUIPMENT USED 36
3.1	Test Equipment Used 37
3.2	Measurement Uncertainty 38
4	ACCREDITATION, DISCLAIMERS AND COPYRIGHT 39
4.1	Accreditation, Disclaimers And Copyright 40



SECTION 1

REPORT SUMMARY

Radio Testing of the
St. Jude Medical IESD
SJM Confirm™ DM3500 and JOT DX Model DM4500 Implantable Cardiac Monitor



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the St. Jude Medical IESD SJM Confirm™ DM3500 and JOT DX Model DM4500 Implantable Cardiac Monitor to the requirements of ARIB STD-T66 V3.7.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	St. Jude Medical IESD
Model Name	SJM Confirm™
Model Number(s)	DM3500 and JOT DX Model DM4500
Serial Number(s)	N/A
Number of Samples Tested	1
Test Specification/Issue/Date	ARIB STD-T66 V3.7 Second Generation Low Power Data Communication System/Wireless Lan System ARIB Standard (October 02, 2014)
Start of Test	February 06, 2017
Finish of Test	February 07, 2017
Name of Engineer(s)	Alex Chang
Related Document(s)	• ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices. • Telec-T401. Technical Regulations Conformity Certification Of Specified Radio Equipment. Characteristic Test Method For Radio Equipment Used For 2.4 GHz Band Wide-Band Low Power Data Communications System (Radio Station Using 2400 To 2483.5 MHz).

1.2 BRIEF SUMMARY OF RESULTS

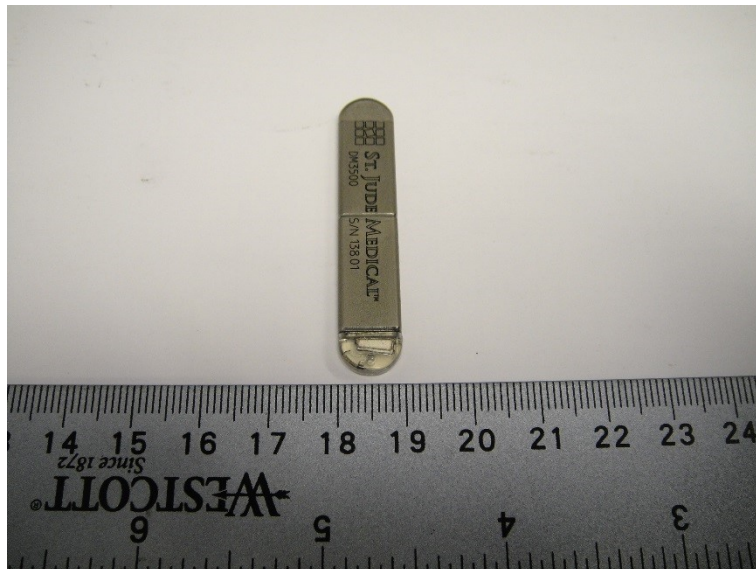
A brief summary of the tests carried out in accordance with ARIB STD-T66 V3.7 is shown below.

Section	Spec Clause	Test Description	Result	Comments/Base Standard
2.1	3.2(1)	Modulation System	Compliant	
2.2	3.2(2)	Antenna Power	Compliant	
-	3.2(3)	Allowable Deviation in Antenna Power	N/A	Not Regulated
2.3	3.2(4)	Allowable Deviation in Frequency	Compliant	
-	3.2(5)	Transmission Rate	N/A	Not Regulated
2.4	3.2(6)	Permissible Value of Spurious or Unnecessary Intensity	Compliant	
2.5	3.2(7)	Permissible Value of Occupied Frequency Bandwidth	Compliant	
2.5	3.2(8)	Spread Bandwidth	Compliant	
2.6	3.2(9)	Process Gain	Compliant	
-	3.2(10)	Number of Carriers	N/A	Applicable only to FHSS
-	3.2(11)	Dwell Time	N/A	Applicable only to FHSS
2.7	3.3 (1)	Limit on Secondary Radiation	Compliant	
2.8	3.6 (2)	Antenna Gain	Compliant	
2.9	Annex 2 Clause 4.4.3	Limitations of Sector Directive Antennas	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a St. Jude Medical IESD Implantable Cardiac Monitor SJM Confirm™ Model DM3500 and JOT DX Model DM4500. The EUT is an implantable patient-activated and automatically activated monitoring system that records subcutaneous ECGs via Bluetooth technology for communication. Both models share the same hardware, the JOT DX Model DM4500 has an updated software not related to radio functions. Bluetooth Low Energy (BLE) mode was verified and evaluated in this test report.



Equipment Under Test



1.3.2 EUT General Description

EUT Description	Implantable Cardiac Monitor
Model Name	SJM Confirm™
Model Number(s)	DM3500 and JOT DX Model DM4500
Rated Voltage	Internal 3.2VDC (non-rechargeable)
Mode Verified	Bluetooth LE
Capability	Bluetooth LE
Primary Unit (EUT)	☐ Production ☒ Pre-Production ☐ Engineering
Antenna Type	Monopole
Antenna Manufacturer	St. Jude Medical IESD
Antenna Gain	-12.5 dBi

1.3.3 Maximum Conducted Output Power

Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
Bluetooth LE	2402 – 2480	-4.39	0.36

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	Antenna conducted port test configuration. All measurements were performed on the temporary antenna port and associated with support equipment/programmable boards. The EUT is programmed via USB-to-Serial port using IDLE commands to modify channels number and Tx power level.

1.4.2 EUT Exercise Software

EUT is programmed via USB-to-Serial connection using IDLE commands to exercise the EUT. IDLE version 2.7.9 was used during evaluation.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Lenovo	Support Laptop	Model X100e
Lenovo	External Power Supply for Support Laptop	Model 92P1156

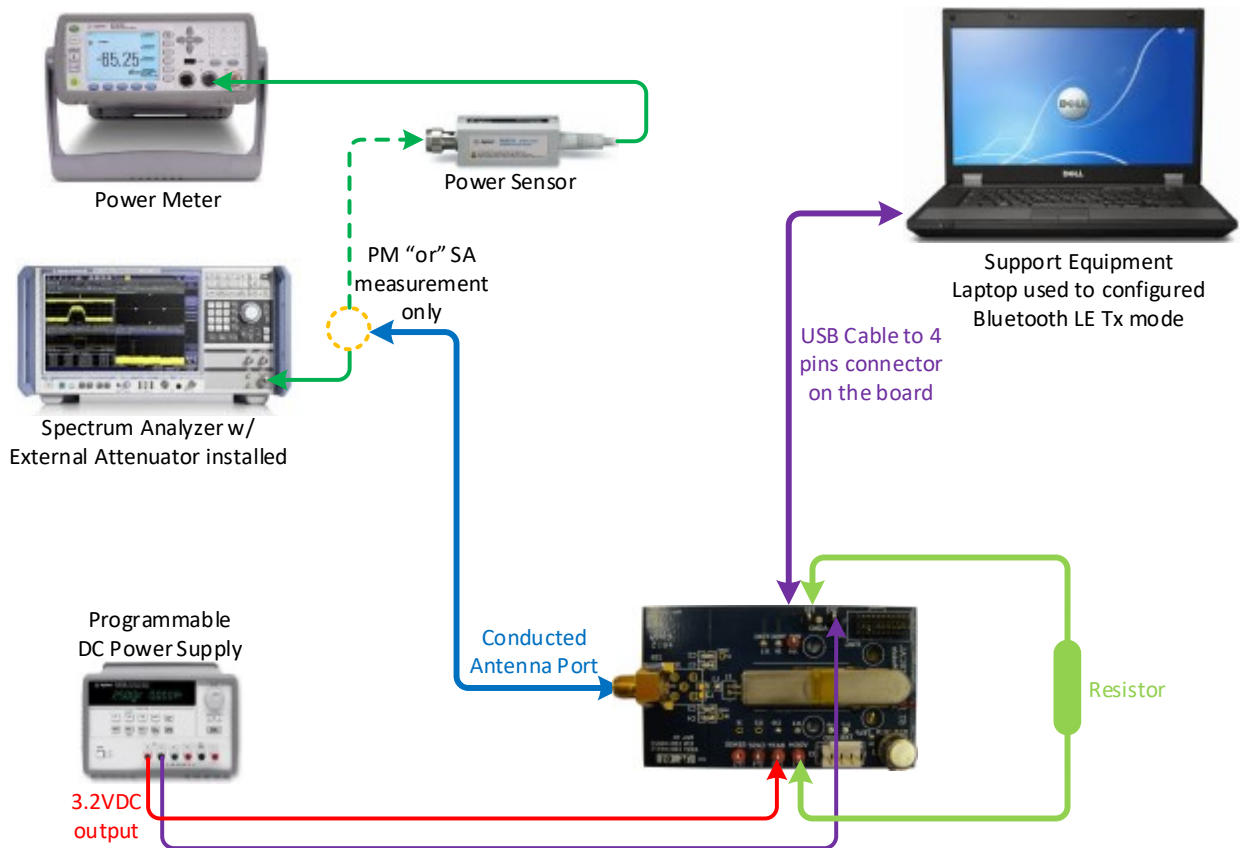
1.4.4 Worst Case Configuration

Worst-case configuration used in this test report as per maximum conducted output power measurements:

Mode	Channel	Data Rate
Bluetooth LE	Low Channel (2402 MHz)	1Mbps

1.4.5 Simplified Test Configuration Diagram

Conducted (Antenna Port) Test Configuration



Not To Scale – Illustration Purpose Only
Objects may not represent actual image of original equipment/s or set-up.



1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number: N/A		
N/A	—	—

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, America National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.10-2013. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 Fax: 858 546 0364.

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678 1400 Fax: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.



1.9.2 Innovation, Science and Economic Development Canada (ISED) Registration No.: 3067A

The 10m Semi-anechoic chamber of TÜV SÜD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) for radio equipment testing with Registration No. 3067A.

1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TÜV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.9.4 VCCI – Registration No. A-0230

TÜV SÜD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.



SECTION 2

TEST DETAILS

Radio Testing of the
St. Jude Medical IESD
SJM Confirm™ DM3500 and JOT DX Model DM4500 Implantable Cardiac Monitor

2.1 MODULATION SYSTEM

2.1.1 Specification Reference

ARIB STD-T66 V3.7 Section 3.2(1)

2.1.2 Standard Applicable

- (a) Spread spectrum systems and orthogonal frequency division multiplexing system
The spread spectrum system should be a direct sequencing system (henceforth called a "DS system,") a frequency hopping system (henceforth called a "FH system,") a hybrid of those two systems, or a hybrid of a FH system and an orthogonal frequency division multiplexing system (henceforth called an "OFDM system.")
A DS system is a system where the signal intended to spread the spectrum is directly multiplied by a higher-frequency signal to spread across a greater bandwidth.
A FH system is a system where the main signal, modulated by an information signal, is made to sweep a given frequency band by pseudo-randomly and discretely switching the main signal's carrier frequency within the band.
- (b) Information modulation
Within spread spectrum systems, the information modulation system to transmit information is not particularly regulated.
- (c) Spread spectrum system and modulation systems besides the OFDM system
The modulation system must be an amplitude modulation system, frequency modulation system, phase modulation system, or some digital hybrid of those.

2.1.3 Modulation Table

Mode	Modulation
Bluetooth LE	GFSK (Frequency Modulation System)



2.2 ANTENNA POWER

2.2.1 Specification Reference

ARIB STD-T66 V3.7 Section 3.2(2)

2.2.2 Standard Applicable

- (a) Given a receiving device that uses a spread spectrum system that is a FH system, a hybrid of a DS system and a FH system, or a hybrid of a FH system and an OFDM system, and uses a frequency band that ranges from above or equal to 2,427MHz and below or equal to 2,470.75MHz, then if the antenna power of the receiving device is modulated by a standard encoding test signal of the same transmission rate as the modulation signal, the mean power for a bandwidth of 1MHz is at most 3mW.
- (b) Given a transmission device that uses a spread spectrum system other than the types listed in (a), if the antenna power of the receiving device is modulated by a standard encoding test signal of the same transmission rate as the modulation signal, the mean power for a bandwidth of 1MHz is at most 10mW.
- (c) Given a transmission device that uses an OFDM system, if the antenna power of the receiving device is modulated by a standard encoding test signal of the same transmission rate as the modulation signal, the mean power for a bandwidth of 1MHz is one of the following:
 - (1) If the transmission device occupies a frequency bandwidth of at most 26MHz, that it be at most 10mW.
 - (2) If the transmission device occupies a frequency bandwidth of over 26MHz but at most 38MHz, that it be at most 5mW.
- (d) For transmission devices that do not fall under the categories indicated by (a), (b), or (c), the antenna power must be at most 10mW under the same circumstances.

2.2.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

2.2.4 Date of Test/Initial of test personnel who performed the test

February 06, 2017 / AC

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2 °C
Relative Humidity	43.7 %
ATM Pressure	99.2 kPa

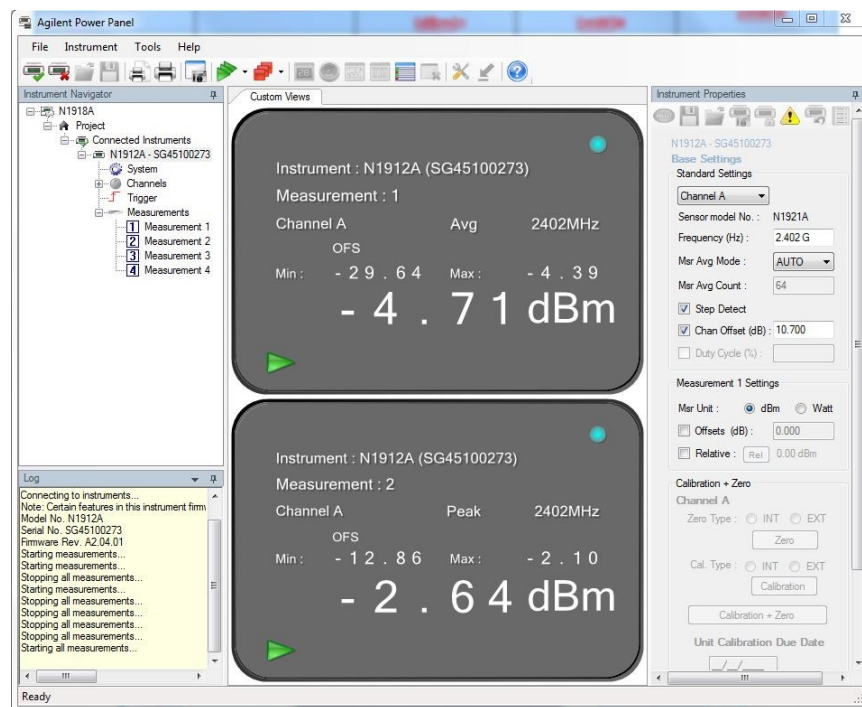
2.2.7 Additional Observations

- This is a conducted test using direct connection to a power meter.
- An offset of 10.7dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.

2.2.8 Test Results

Mode	Channel	Measured Average Power (dBm)	Measured Average Power (mW)	Limit (mW/MHz)
Bluetooth LE	2402 MHz	-4.39	0.36	10
	2440 MHz	-4.99	0.32	10
	2480 MHz	-6.08	0.25	10

2.2.9 Sample Test Display



Bluetooth LE. Low Channel



2.3 ALLOWABLE DEVIATIONS IN FREQUENCY

2.3.1 Specification Reference

ARIB STD-T66 V3.7 Section 3.2(4)

2.3.2 Standard Applicable

Deviations must be within $\pm 50 \times 10^{-6}$

2.3.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

2.3.4 Date of Test/Initial of test personnel who performed the test

February 06, 2017 / AC

2.3.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2 °C
Relative Humidity	43.7 %
ATM Pressure	99.2 kPa

2.3.7 Additional Observations

- This is a conducted test using a spectrum analyzer.
- An offset of 10.7dB was added to compensate for the external attenuator and cable used.
- RBW is 100 kHz, VBW is 3X RBW.
- Detector is RMS.
- Trace is set to max hold.
- The EUT was set to transmit in CW mode for this test.

2.3.8 Sample Calculation

$$\text{Frequency Error (ppm)} = \left(\frac{\text{Channel frequency} - \text{Measured Channel Frequency}}{\text{Channel frequency}} \right) 1000000$$

$$\text{Frequency Error (ppm)} = \left(\frac{2402 \text{ MHz} - 2402.0376819 \text{ MHz}}{2402 \text{ MHz}} \right) 1000000$$

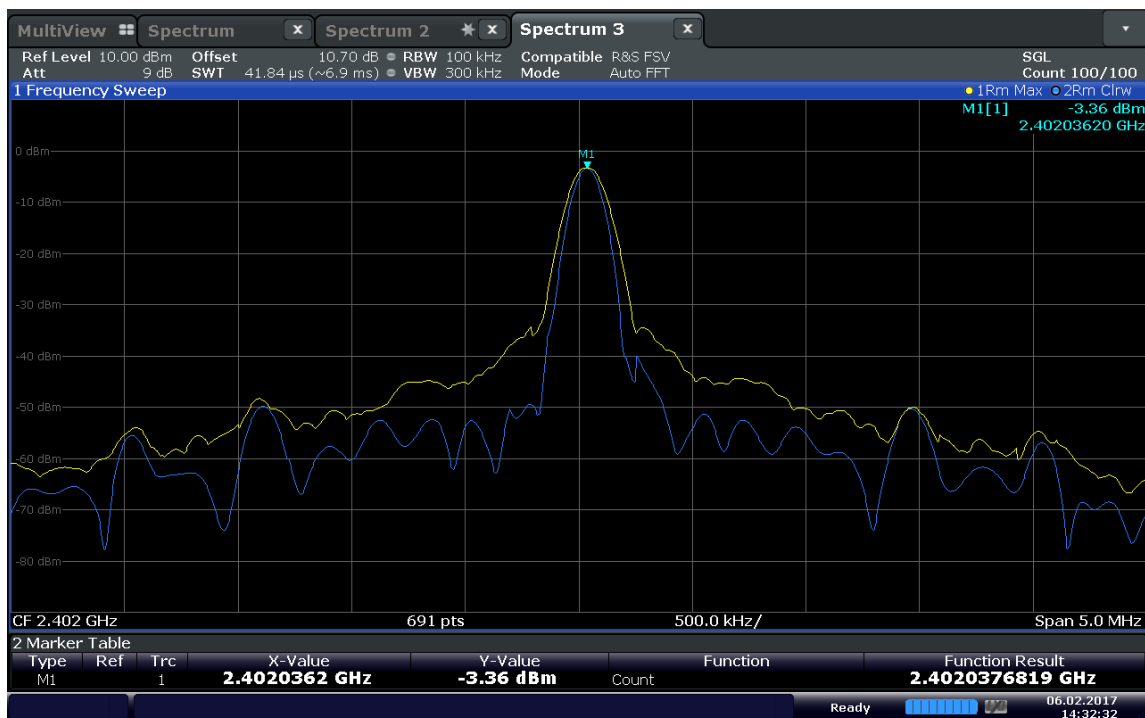
$$\text{Frequency Error (ppm)} = \left(\frac{-0.0376819 \text{ MHz}}{2402 \text{ MHz}} \right) 1000000$$

$$\text{Frequency Error (ppm)} = -15.69$$

2.3.9 Test Results

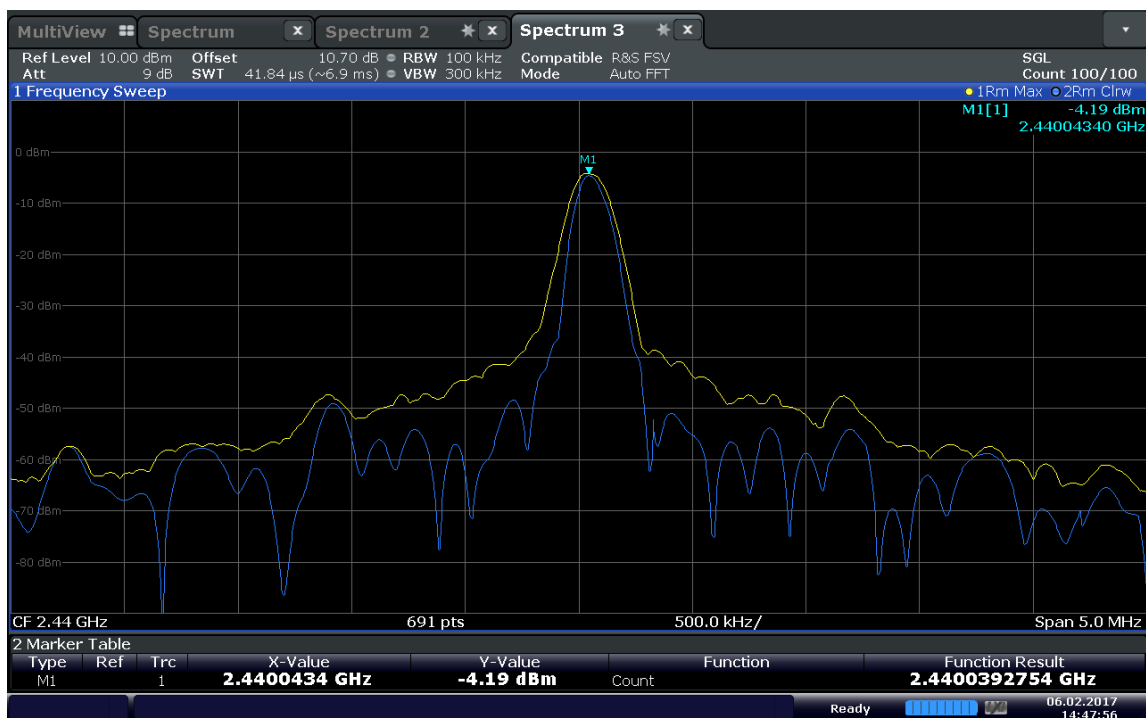
Mode	Channel	Measured Frequency (MHz)	Frequency Error (ppm)	Limit (ppm)
Bluetooth LE	2402 MHz	2402.0376819	-15.69	±50
	2440 MHz	2440.0392754	-16.09	±50
	2480 MHz	2480.0384741	-15.51	±50

2.3.10 Sample Test Plots



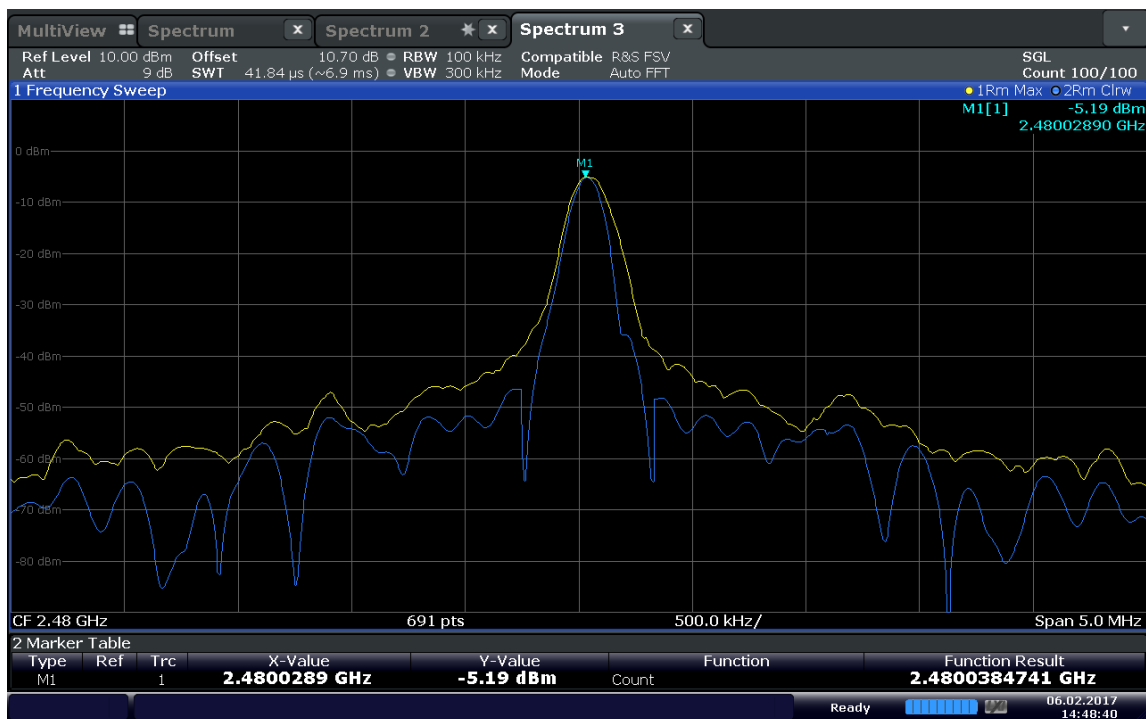
14:32:33 06.02.2017

Bluetooth LE, Low Channel



14:47:57 06.02.2017

Bluetooth LE, Mid Channel



14:48:40 06.02.2017

Bluetooth LE, High Channel

2.4 PERMISSIBLE VALUE OF SPURIOUS OR UNNECESSARY INTENSITY

2.4.1 Specification Reference

ARIB STD-T66 V3.7 Section 3.2(6)

2.4.2 Standard Applicable

(a) Permissible value applicable starting December 1, 2005 (RE Article 7, Attached table No.3)
The permissible value of unnecessary radiation power is the mean power of unnecessary radiation per frequency supplied to a feeder during modulation, and is regulated as follows:

Frequency band	Permissible value of unnecessary radiation power
Below 2,387MHz or above 2,496.5MHz	Mean power for an arbitrary 1MHz bandwidth is at most 2.5μW
Above or equal to 2,387MHz and below 2,400MHz, or above 2,483.5MHz and below or equal to 2,496.5MHz	Mean power for an arbitrary 1MHz bandwidth is at most 25μW

However, there are transitional measures due to RE Supplementary Provisions (Ordinance from the Ministry of Internal Affairs and Communications, No. 119, August 9, 2005.)

(b) Permissible value based on Radio Equipment Regulations before November 30, 2005

(6) Spurious radiation intensity	(RE Article 7)
Mean power of spurious radiation per frequency supplied to a feeder is calculated as the mean power of spurious radiation in a 1 MHz bandwidth at a frequency f outside of the frequency band used. The permissible value of this mean power is as follows:	
(a) $2,387\text{MHz} \leq f < 2,400\text{MHz}$ and $2,483.5\text{MHz} < f \leq 2,496.5\text{MHz}$	at most 25μW
(b) $2,387\text{MHz} > f$ and $2,496.5\text{MHz} < f$	at most 2.5μW
(ARIB STD-T66 version 2.2)	

2.4.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

2.4.4 Date of Test/Initial of test personnel who performed the test

February 06, 2017 / AC

2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions

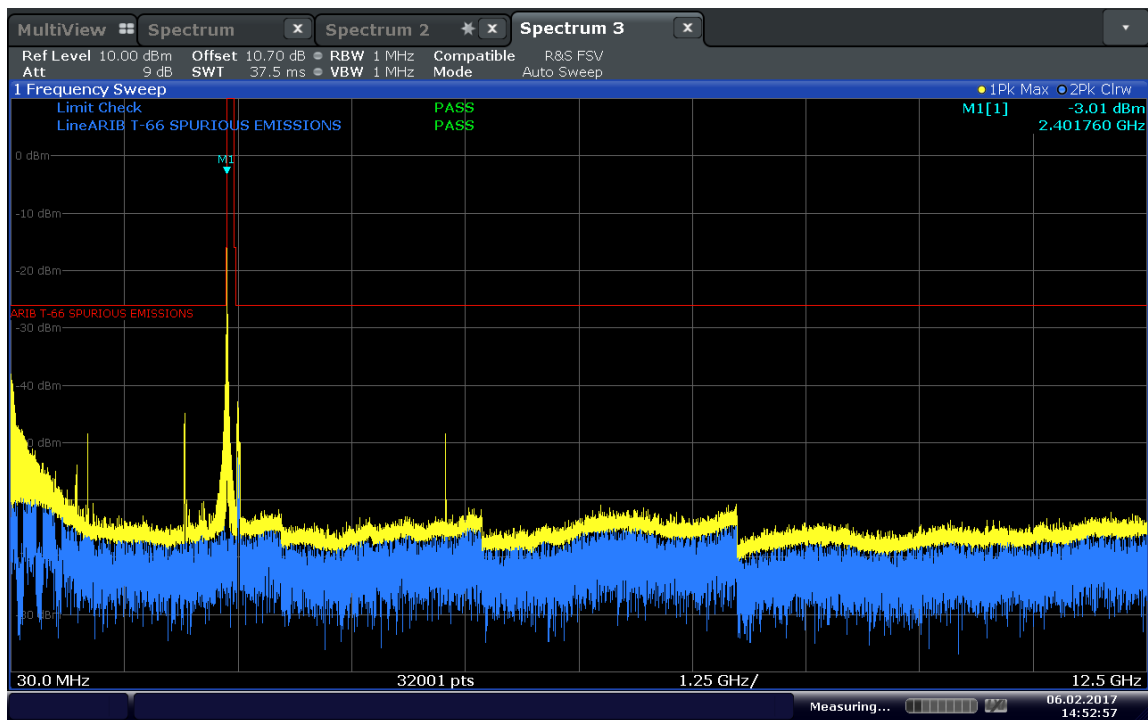
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2 °C
Relative Humidity	43.7 %
ATM Pressure	99.2 kPa

2.4.7 Additional Observations

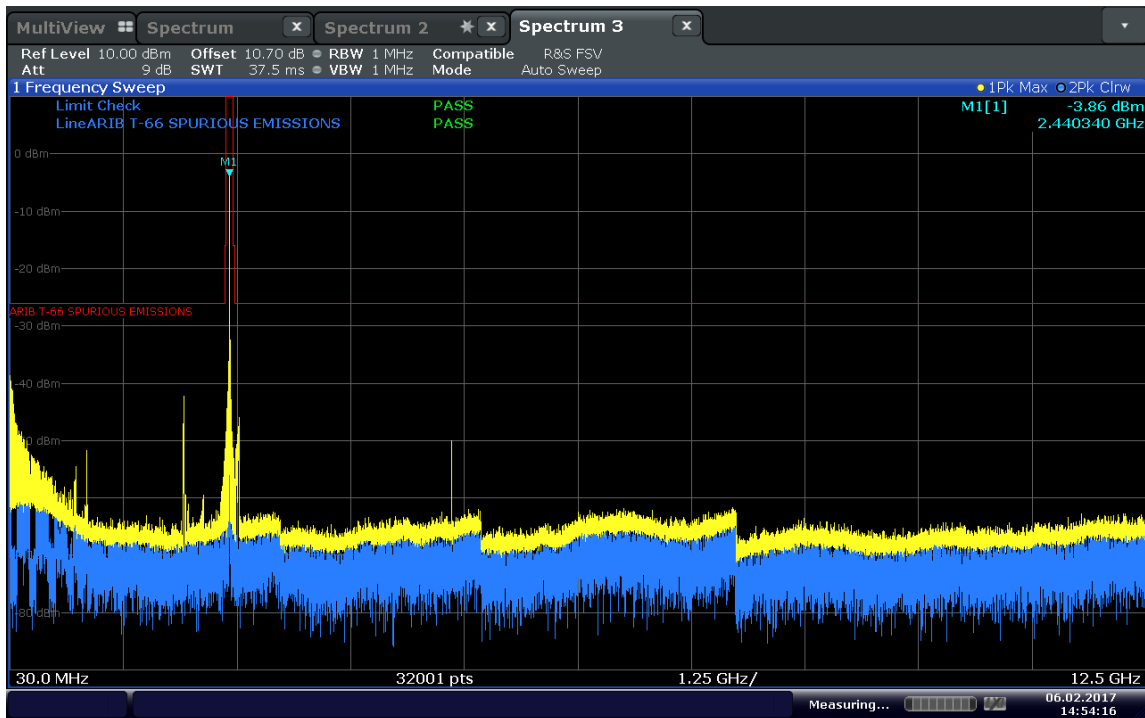
- This is a conducted test using a spectrum analyzer.
- An offset of 10.7dB was added to compensate for the external attenuator and cable used.
- RBW and VBW is 1MHz.
- Detector is Positive Peak.
- Trace is set to Max Hold
- Spectrum was searched from 30MHz up to 5x of the carrier frequency or 12.5GHz.
- Sweep points was set to maximum.

2.4.8 Sample Test Plots



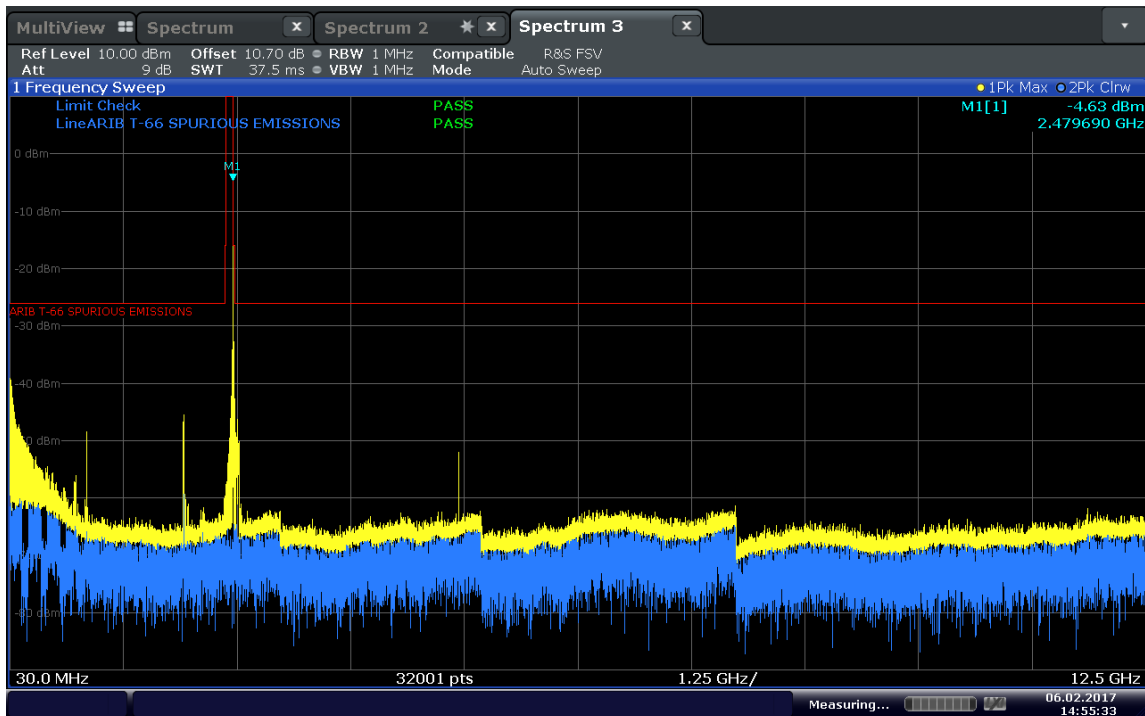
14:52:58 06.02.2017

Bluetooth LE, Low Channel



14:54:17 06.02.2017

Bluetooth LE, Mid Channel



14:55:34 06.02.2017

Bluetooth LE, High Channel

2.5 PERMISSIBLE VALUE OF OCCUPIED FREQUENCY BANDWIDTH AND SPREAD BANDWIDTH

2.5.1 Specification Reference

ARIB STD-T66 V3.7 Section 3.2(7) and Section 3.2(8)

2.5.2 Standard Applicable

Permissible value of occupied frequency bandwidth for transmission devices using a FH system, a DS-FH hybrid system, or a FH-OFDM hybrid system is at most 83.5MHz; for transmission devices using a OFDM system is at most 38MHz; and for transmission devices using any other system the necessary frequency bandwidth is at most 26MHz. Necessary frequency bandwidth is the smallest bandwidth necessary to occupy in order to ensure the required data transmission rate and quality for the system used under specific conditions for a given radiation type.

For spread spectrum systems, the spread bandwidth must be at least 500kHz. Spread bandwidth is a bandwidth whose upper and lower limits are set such that the average radiations emitted at frequencies above the upper limit and below the lower limit are each equal to 5% of the total mean power radiated. The same definition is used henceforth.

2.5.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

2.5.4 Date of Test/Initial of test personnel who performed the test

February 06 and 07, 2017 / AC

2.5.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2 °C
Relative Humidity	43.7 %
ATM Pressure	99.2 kPa

2.5.7 Additional Observations

- This is a conducted test.
- An offset of 10.7dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW and VBW were set to 300 kHz
- Detector is Positive Peak.
- Trace is set to Max Hold.
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% for OBW measurements.

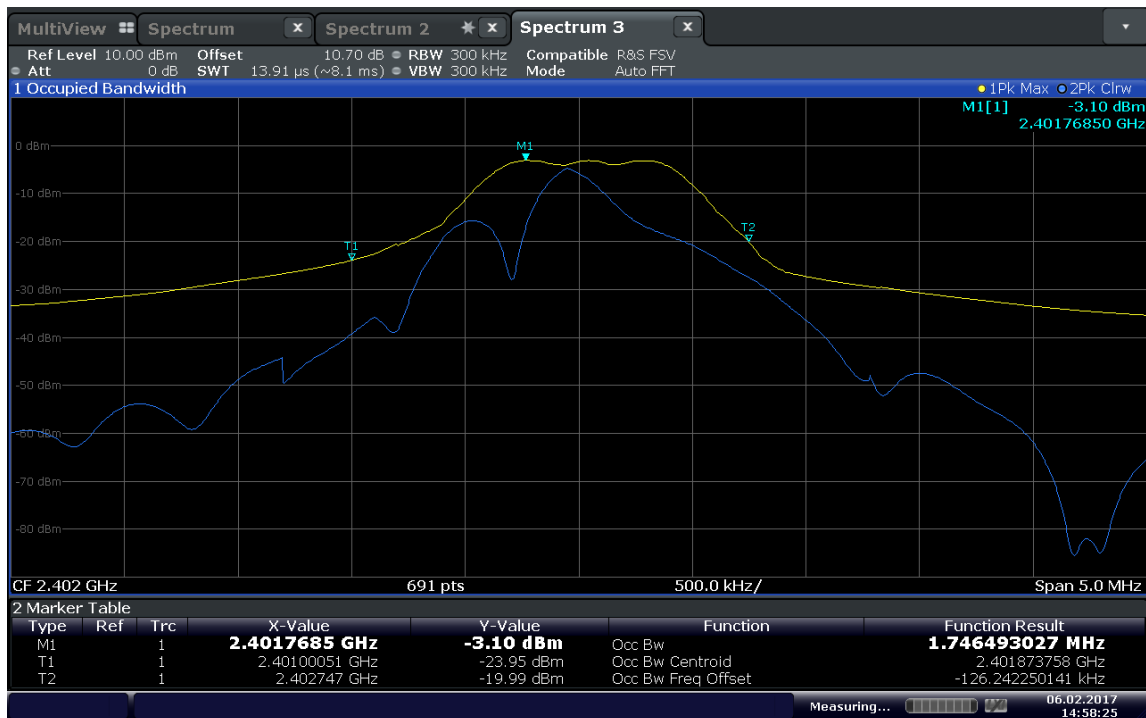


- The % Power Bandwidth setting in the spectrum analyzer was set to 95% for Spreading Bandwidth measurements.
- To demonstrate Spreading Bandwidth for Bluetooth LE, the EUT was “forced” in hopping mode.

2.5.8 Test Results

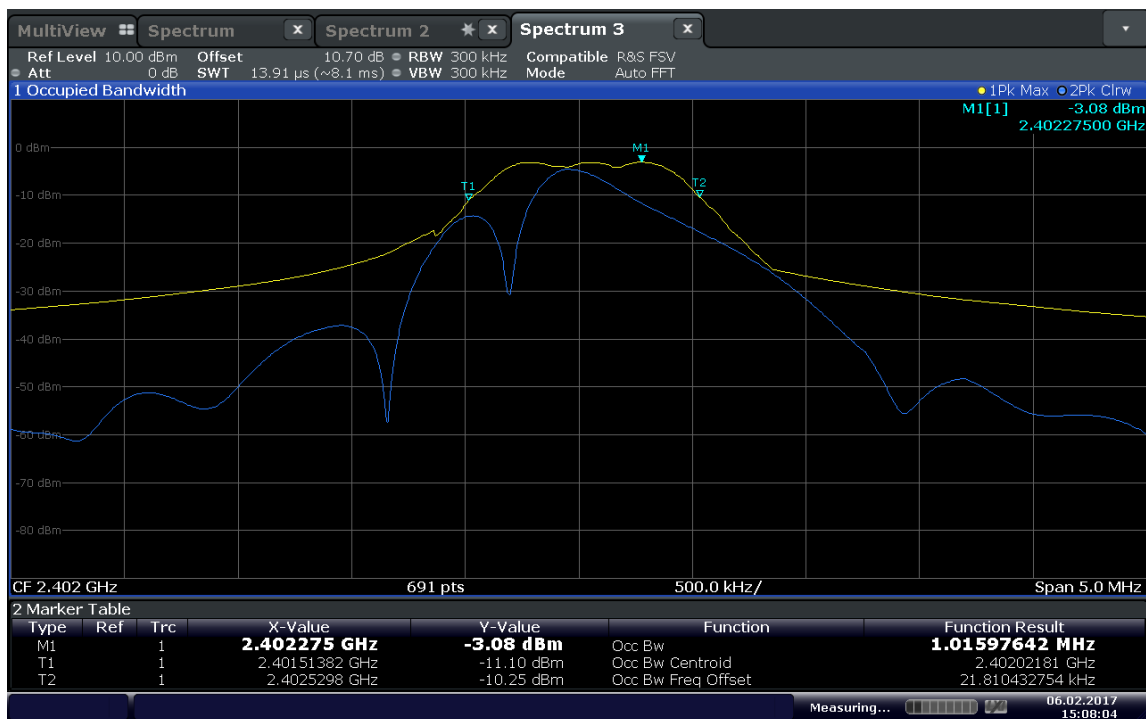
Mode	Channel	Occupied Bandwidth (MHz)	Limit for Occupied Bandwidth	Spreading Bandwidth (MHz)	Limit for Spreading Bandwidth
Bluetooth LE	2402 MHz	1.75	≤ 26 MHz	1.02	> 500 kHz
	2440 MHz	1.54		1.03	
	2480 MHz	1.64		1.06	

2.5.9 Sample Test Plots



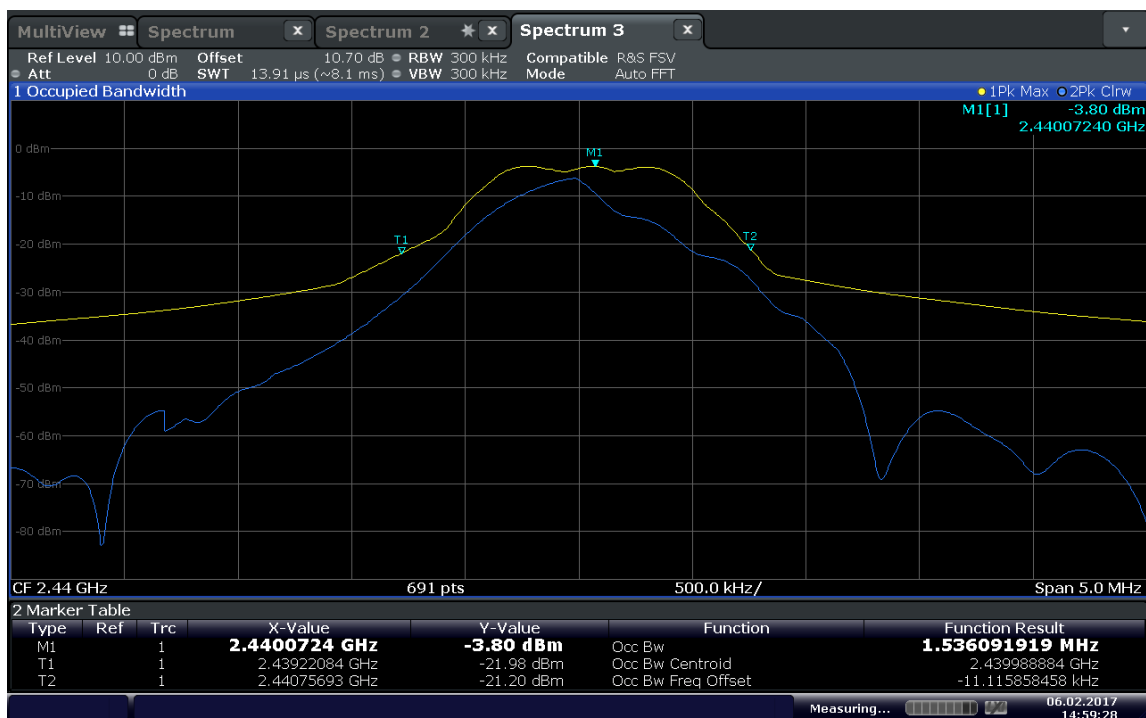
14:58:26 06.02.2017

Bluetooth LE, Low Channel, OBW



15:08:04 06.02.2017

Low Channel (2402 MHz) Spreading Bandwidth



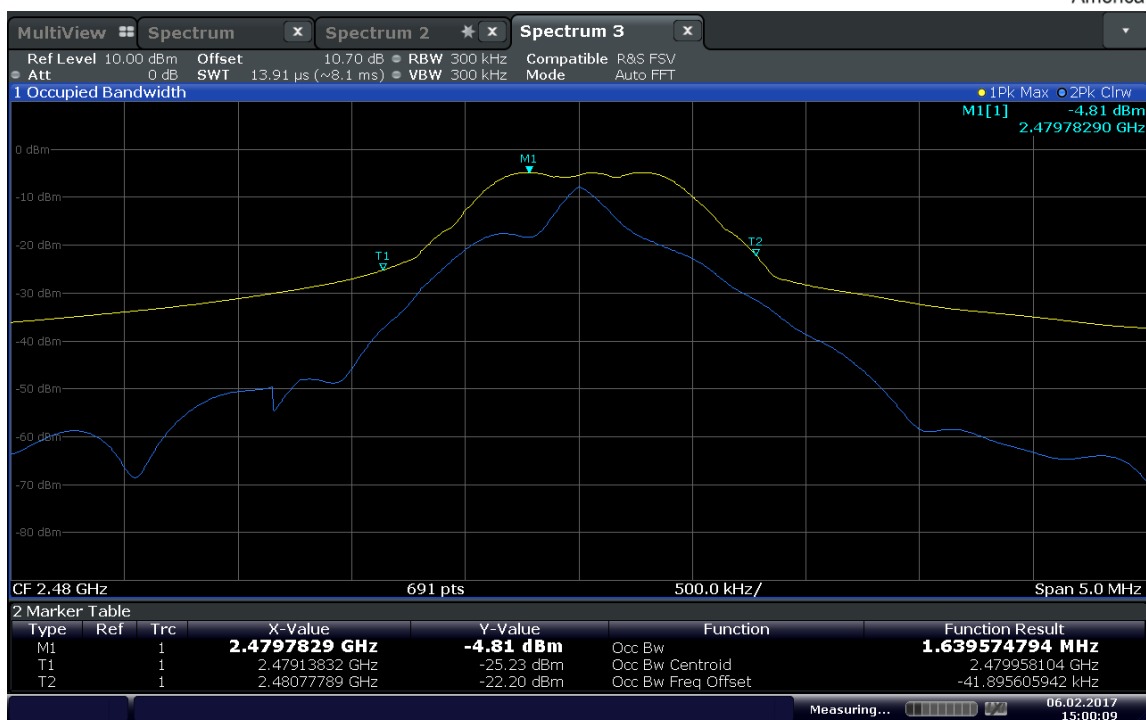
14:59:30 06.02.2017

Bluetooth LE, Mid Channel, OBW



15:07:03 06.02.2017

Mid Channel (2440 MHz) Spreading Bandwidth



15:00:10 06.02.2017

Bluetooth LE, High Channel, OBW



15:05:37 06.02.2017

High Channel (2480 MHz) Spreading Bandwidth



16:31:07 07.02.2017

Bluetooth LE, Spreading Bandwidth

(The EUT was in a "Force" hopping mode to demonstrate the spread bandwidth to covering the whole spectrum)

2.6 PROCESS GAIN**2.6.1 Specification Reference**

ARIB STD-T66 V3.7 Section 3.2(9)

2.6.2 Standard Applicable

For spread spectrum systems, the process gain must be at least 5. Process gain is the value obtained by dividing the spread bandwidth by a frequency equal to the transmission rate of the modulating signal. The same definition is used henceforth.

2.6.3 Equipment Under Test and Modification State

Serial No: N/A / Calculation Only

2.6.4 Date of Test/Initial of test personnel who performed the calculation

February 07, 2017 / AC

2.6.5 Additional Observations

- Spread Bandwidth is from Section 2.6.9 of this test report.
- If applicable, only the worst Symbol rate was presented otherwise the standard Symbol rate of each mode was used for the calculation.

2.6.6 Calculations

Mode	Symbol Rate (Msym/s)	Spread Bandwidth (MHz)	Spreading Factor (Spread BW/ Transmission Rate Frequency)	Limit	Compliance
Bluetooth LE	1.000	79.254	79.254	> 5	Complies



2.7 LIMIT ON SECONDARY RADIATION (RECEIVER TEST)

2.7.1 Specification Reference

ARIB STD-T66 V3.7 Clause 3.3(1)

2.7.2 Standard Applicable

The limit at which secondary radiation will not hinder the function of other radio equipment is, if a fictional antenna circuit with the same electrical constant as the receiving antenna were to be used in calculations, at most 4nW if using a frequency below 1GHz and at most 20nW if using a frequency above or equal to 1GHz.

2.7.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

2.7.4 Date of Test/Initial of test personnel who performed the test

February 06, 2017 / AC

2.7.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2 °C
Relative Humidity	43.7 %
ATM Pressure	99.2 kPa

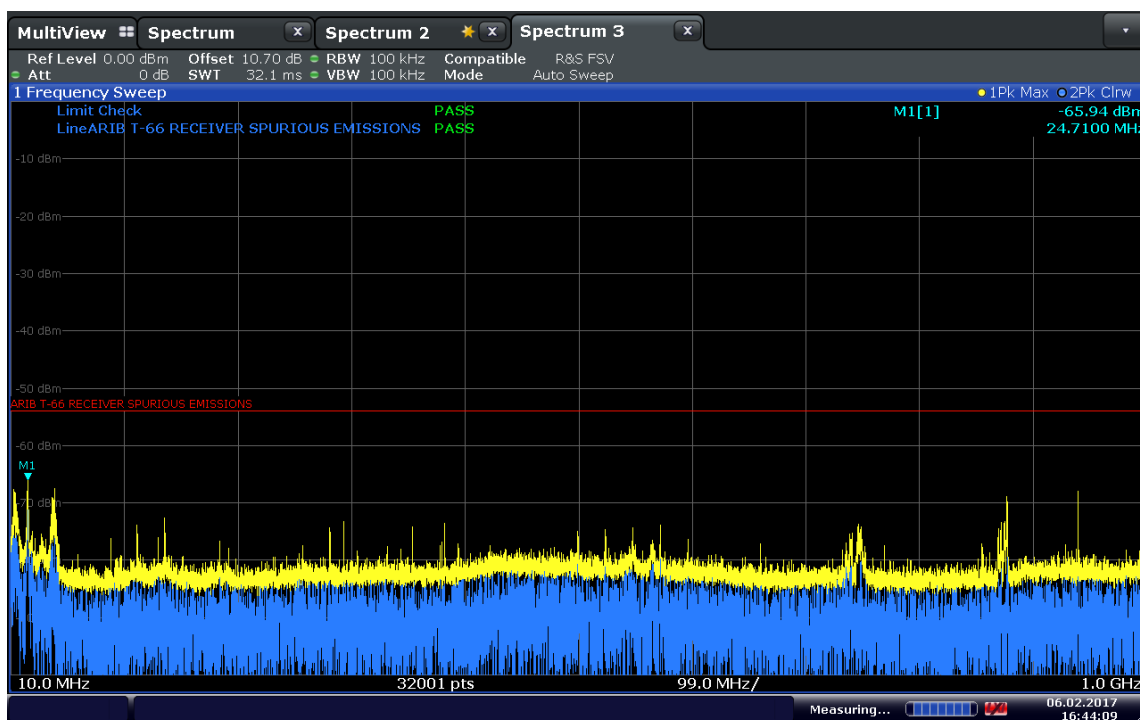
2.7.7 Additional Observations

- This is a conducted test.
- The EUT was configured in receive mode.
- RBW below 1GHz is 100 kHz and 1 MHz above 1GHz. VBW is equal to RBW.
- Detector is Positive Peak.
- Spectrum observed from 10 MHz to 3x the carrier frequency (8 GHz).
- No secondary radiated emissions observed.

2.7.8 Test Results

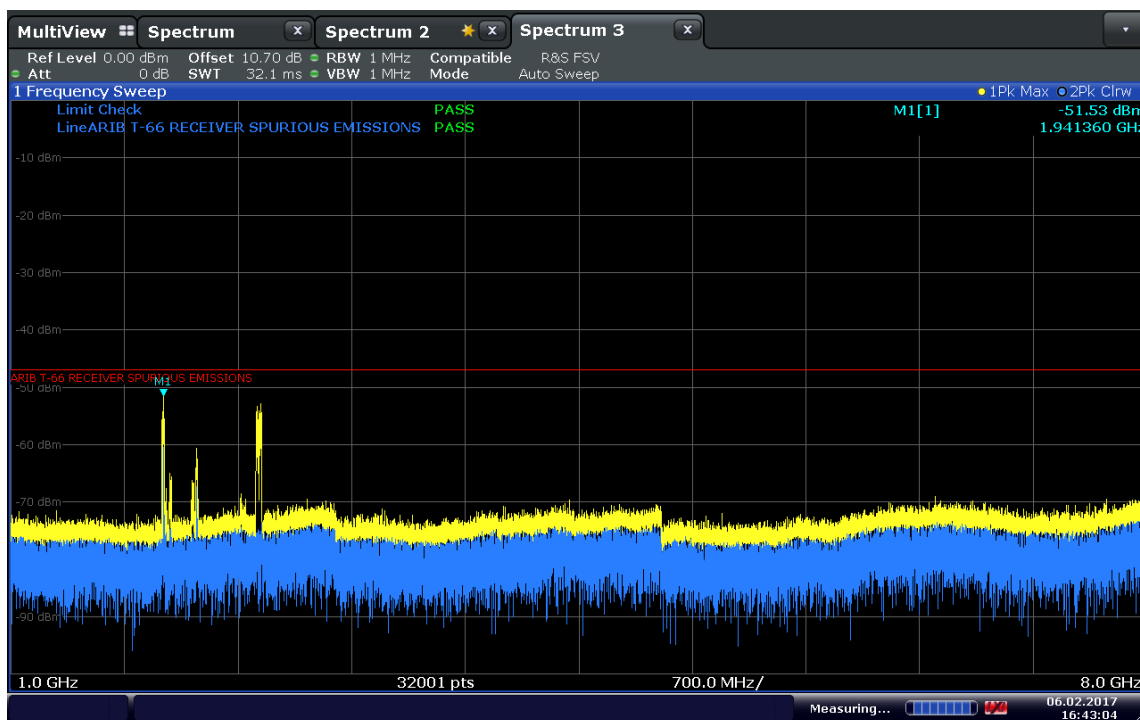
See attached plots

2.7.9 Test Plots



16:44:10 06.02.2017

Bluetooth LE in Rx mode below 1GHz



16:43:05 06.02.2017

Bluetooth LE in Rx mode above 1GHz

2.8 ANTENNA GAIN

2.8.1 Specification Reference

ARIB STD-T66 V3.7 Clause 3.6(2)

2.8.2 Standard Applicable

The absolute gain of transmitting antennas must be at most 12.14dB. However, if the equivalent isotropic radiated power is at most the value obtained by applying antenna power with an absolute gain of 12.14dB and the mean of 10mW, the loss may be compensated with the gain of the transmitting antenna. (When using a spread spectrum system or using an OFDM system when the occupied frequency bandwidth is at most 26MHz, the mean power over 1MHz of bandwidth is 10mW. If using an OFDM system when the occupied frequency bandwidth is over 26MHz and at most 38MHz, the mean power is 5mW. However, if using a FH system, DS-FH hybrid system, or hybrid system involving an OFDM system and using frequencies above or equal to 2,427MHz and below or equal to 2,470.75MHz, the mean power over 1MHz of bandwidth is 3mW.)

Equivalent isotropic radiated power is equivalent isotropic radiated power within a bandwidth of 1MHz if using a spread spectrum system or an OFDM system.

(b) The half-power beam width (angle between the two points at which the radiation power is halved) of the transmitting antenna's horizontal and vertical airplanes may not exceed the value calculated by the following formula:

$$360 / A \text{ [degrees]}$$

Here, the constant A is the equivalent isotropic radiated power divided by the value calculated by applying a mean antenna power of 10mW to an antenna with an absolute gain of 2.14dB. If the value is less than 1, it will be rounded up to 1. (When using a spread spectrum system or using an OFDM system when the occupied frequency bandwidth is at most 26MHz, the mean power over 1MHz of bandwidth is 10mW. If using an OFDM system when the occupied frequency bandwidth is over 26MHz and at most 38MHz, the mean power is 5mW. However, if using a FH system, DS-FH hybrid system, or hybrid system involving an OFDM system and using frequencies above or equal to 2,427MHz and below or equal to 2,470.75MHz, the mean power over 1MHz of bandwidth is 3mW.)

Equivalent isotropic radiated power is equivalent isotropic radiated power within a bandwidth of 1MHz if using a spread spectrum system or an OFDM system.

2.8.3 Verification Results

Antenna	Type	Requirement	Antenna Gain	Result
St. Jude	Monopole	< 2.14 dBi if conducted power is maximum 10mW/MHz	-12.5 dBi	Pass

2.9 LIMITATIONS OF SECTOR DIRECTIVE ANTENNAS

2.9.1 Specification Reference

ARIB STD-T66 V3.7 Annex 2 Clause 4.4.3

2.9.2 Standard Applicable

The half-power beam width of antennas is limited so that an increase in EIRP will not cause an increase in the interference-causing area. However, if multiple radio stations are installed in the same area and the antenna beams are pointed in different directions, the interference-causing area will increase. Because of this, if the transmitting antenna used has a gain of over 2.14dBi, and the EIRP is greater than the value indicated in the "Nondirectional" column in Table 4.1, there must not be more than one radio station operating in the area, the area being the interference-causing area listed in Table 2.2.

Table 4.1 Upper Limit of EIRP for Modulation Systems

Modulation system	Frequency band used	Antenna power (maximum)	EIRP (maximum)	
			Nondirectional	Directed beam
DS	2,400 to 2,483.5MHz	10mW/MHz	12.14dBm/MHz	22.14dBm/MHz
OFDM1	2,400 to 2,483.5MHz	10mW/MHz	12.14dBm/MHz	22.14dBm/MHz
OFDM2	2,400 to 2,483.5MHz	5mW/MHz	9.14dBm/MHz	19.14dBm/MHz
FH, DS-FH, FH-OFDM	2,400 to 2,483.5MHz	3mW/MHz	6.91dBm/MHz	16.91dBm/MHz
	Except 2,427 to 2,470.75MHz	10mW/MHz	12.14dBm/MHz	22.14dBm/MHz
Other	2,400 to 2,483.5MHz	10mW	12.14dBm/MHz	22.14dBm/MHz

Note(1): The half-power beam width for the directed beam must be equal to or less than 360 / A degrees. A is a ratio such that the EIRP for the directed beam is greater than the upper limit of the nondirectional.

Note(2): OFDM1 in the modulation system column is for when the occupied frequency bandwidth is at most 26MHz. OFDM2 is for when the occupied frequency bandwidth is over 26MHz and at most 38MHz.

2.9.3 Equipment Under Test and Modification State

Serial No: N/A / Calculation Only

2.9.4 Date of Test/Initial of test personnel who performed the calculation

February 07, 2017 / AC

2.9.5 Additional Observations

- Only the worst channel presented.
- Calculated EIRP is from the antenna power data (Section 2.2) + antenna gain (Section 2.9.3 of this test report).



2.9.6 Test Results

Mode	Wort Case Channel	Antenna Power (dBm/MHz)	Calculated EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Compliance
Bluetooth LE	2402 MHz	-4.39	-16.89	12.14	Complies



SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Antenna Conducted Port Setup						
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	06/29/16	06/29/17
7604	P-Series Power Meter	N1912A	SG45100273	Agilent	07/27/16	07/27/17
7605	50MHz-18GHz Wideband Power Sensor	N1921A	MY51100054	Agilent	04/19/16	04/19/17
Miscellaneous						
7560	Barometer/Temperature/Humidity Transmitter	iBTHX-W	1240476	Omega	01/17/17	01/17/18
7539	DC Power Supply	6434B	1140A01866	Hewlett Packard	Verified by 6452	
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/29/16	08/26/17

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Conducted Antenna Port Measurement

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.30	0.17	0.03
2	Cables	Rectangular	0.50	0.29	0.08
3	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.67
Coverage Factor (k):					2
Expanded Uncertainty:					1.34



SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.

TÜV SÜD America, Inc. and its professional staff hold government and professional organization certifications for AAMI, ACIL, AEA, ANSI, IEEE, A2LA, NIST and VCCI.



A2LA Cert. No. 2955.13

