

NORTHWEST EMC

Walt Disney Parks and Resorts US, Inc.

MagicBand 2b

FCC 15.247:2016

2.4 GHz GFSK Radio Module

Report # SYNA0189.1



NVLAP Lab Code: 200629-0

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

CERTIFICATE OF TEST

Last Date of Test: May 11, 2016
Walt Disney Parks and Resorts US, Inc.
Model: MagicBand 2b

Radio Equipment Testing

Standards

Specification	Method
FCC 15.247:2016	ANSI C63.10:2013
	KDB 558074

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	AC – Powerline Conducted Emissions	No	N/A	Not required for a battery powered EUT
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	Pass	
11.8.2	Occupied Bandwidth	Yes	Pass	
11.9.2.2.4	Output Power	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	
11.11	Band Edge Compliance	Yes	Pass	
11.11	Spurious Conducted Emissions	Yes	Pass	

Deviations From Test Standards

None

Approved By:



Rod Munro, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information.

REVISION HISTORY

Revision Number		Description	Date	Page Number
00		None		

ACCREDITATIONS AND AUTHORIZATIONS

United States

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

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

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

IC - Recognized by Industry Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with IC.

European Union

European Commission – Validated by the European Commission as a Notified Body under the R&TTE Directive.

Australia/New Zealand

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

Korea

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

Japan

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

Taiwan

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

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

Singapore

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

Israel

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

Hong Kong

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

Vietnam

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

SCOPE

For details on the Scopes of our Accreditations, please visit:

<http://www.nwemc.com/accreditations/>

<http://gsi.nist.gov/global/docs/cabs/designations.html>

MEASUREMENT UNCERTAINTY

Measurement Uncertainty

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

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

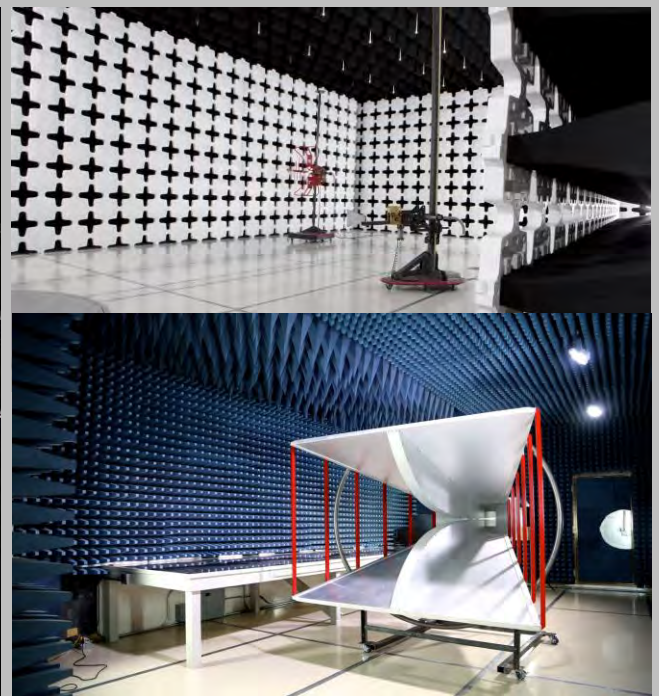
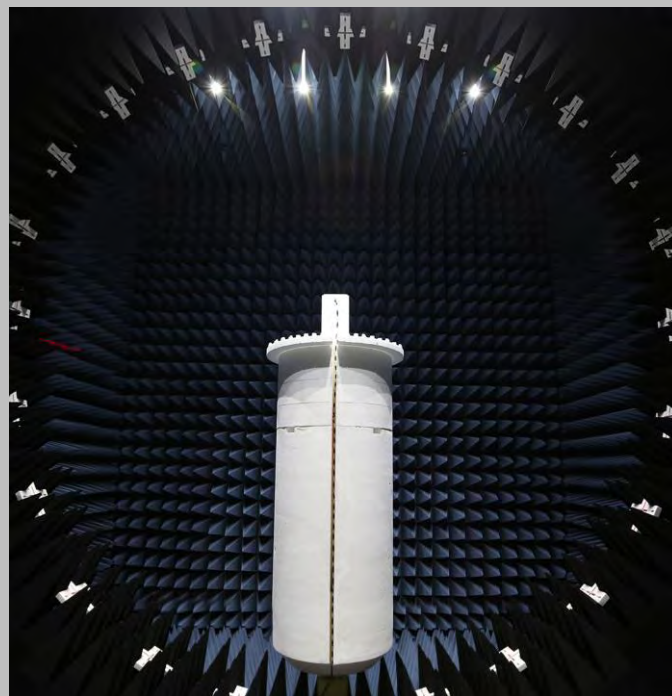
The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.0 dB	-5.0 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

FACILITIES



California Labs OC01-13 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-08, MN10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	New York Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Oregon Labs EV01-12 22975 NW Evergreen Pkwy Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP					
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200761-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Industry Canada					
2834B-1, 2834B-3	2834E-1	N/A	2834D-1, 2834D-2	2834G-1	2834F-1
BSMI					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Walt Disney Parks and Resorts US, Inc.
Address:	PO Box 10000
City, State, Zip:	Lake Buena Vista, Florida 32830
Test Requested By:	Brian Piquette of Synapse Product Development LLC on behalf of Walt Disney Parks and Resorts US, Inc.
Model:	MagicBand2b
First Date of Test:	May 11, 2016
Last Date of Test:	May 11, 2016
Receipt Date of Samples:	May 11, 2016
Equipment Design Stage:	Production
Equipment Condition:	No Damage

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Proprietary 2.4 GHz GFSK radio in a wristband form factor
Testing Objective:
To demonstrate compliance of the 2.4 GHz DTS radio to FCC 15.247 requirements.

CONFIGURATIONS

Configuration SYNA0189- 1

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Identity Band	Walt Disney Parks and Resorts US, Inc.	MagicBand 2b	0006D689FD
Identity Band	Walt Disney Parks and Resorts US, Inc.	MagicBand 2b	0006D68821

Configuration SYNA0189- 3

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Identity Band	Walt Disney Parks and Resorts US, Inc.	MagicBand 2b	0006D68961

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
External Battery Pack	None	None	None

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	5/11/2016	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
2	5/11/2016	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
3	5/11/2016	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
4	5/11/2016	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
5	5/11/2016	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
6	5/11/2016	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
7	5/11/2016	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

DUTY CYCLE

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	24
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	5/6/2016	12
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	12
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12

TEST DESCRIPTION

The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.


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

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum. A direct connection was made between the RF output of the EUT and a spectrum analyzer. Attenuation and a DC block were used

The test software provided for operation in a fixed, single channel mode allows the EUT to operate continuously at 86.7% Duty Cycle.

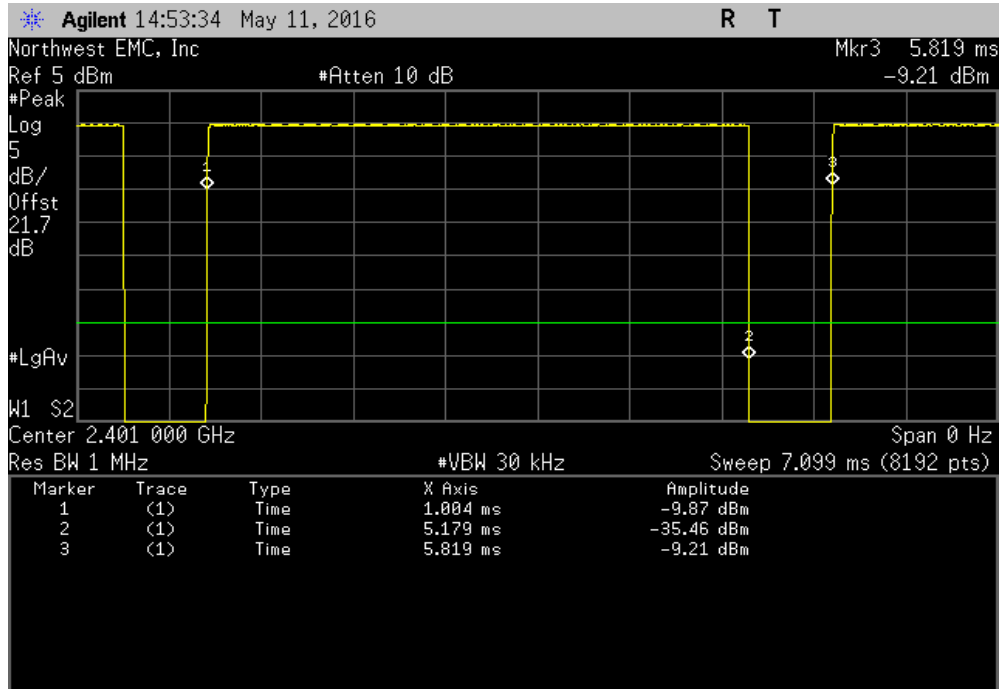
DUTY CYCLE

XMit 2015.01.14

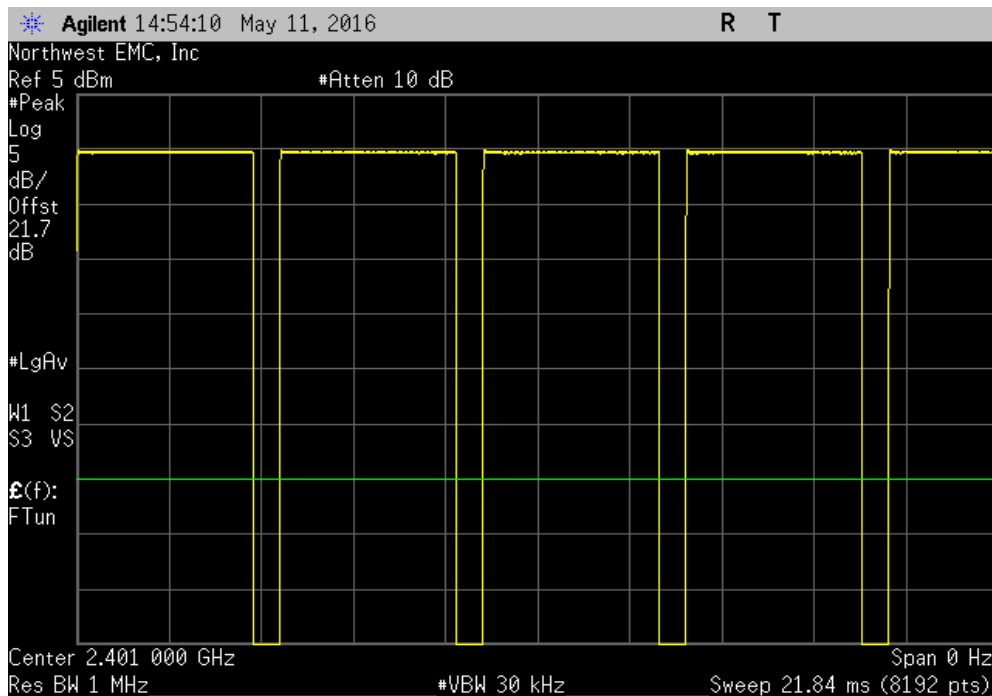
EUT: MagicBand 2b			Work Order: SYNA0189				
Serial Number: 0006D68961			Date: 05/11/16				
Customer: Walt Disney Parks and Resorts US, Inc.			Temperature: 24°C				
Attendees: Martha Calderon			Humidity: 27%				
Project: None			Barometric Pres.: 1016				
Tested by: Matthew Barnes		Power: Battery	Job Site: NC02				
TEST SPECIFICATIONS			Test Method				
FCC 15.247:2016			ANSI C63.10:2013				
COMMENTS							
Powered by external battery pack.							
DEVIATIONS FROM TEST STANDARD							
None							
Configuration #	3						
		Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
GFSK Low Channel, 2401 MHz		4.175 ms	4.814 ms	1	86.7	N/A	N/A
GFSK Low Channel, 2401 MHz		N/A	N/A	5	N/A	N/A	N/A
GFSK Mid Channel, 2450 MHz		4.175 ms	4.814 ms	1	86.7	N/A	N/A
GFSK Mid Channel, 2450 MHz		N/A	N/A	5	N/A	N/A	N/A
GFSK High Channel, 2476 MHz		4.174 ms	4.814 ms	1	86.7	N/A	N/A
GFSK High Channel, 2476 MHz		N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE

GFSK Low Channel, 2401 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	4.175 ms	4.814 ms	1	86.7	N/A	N/A

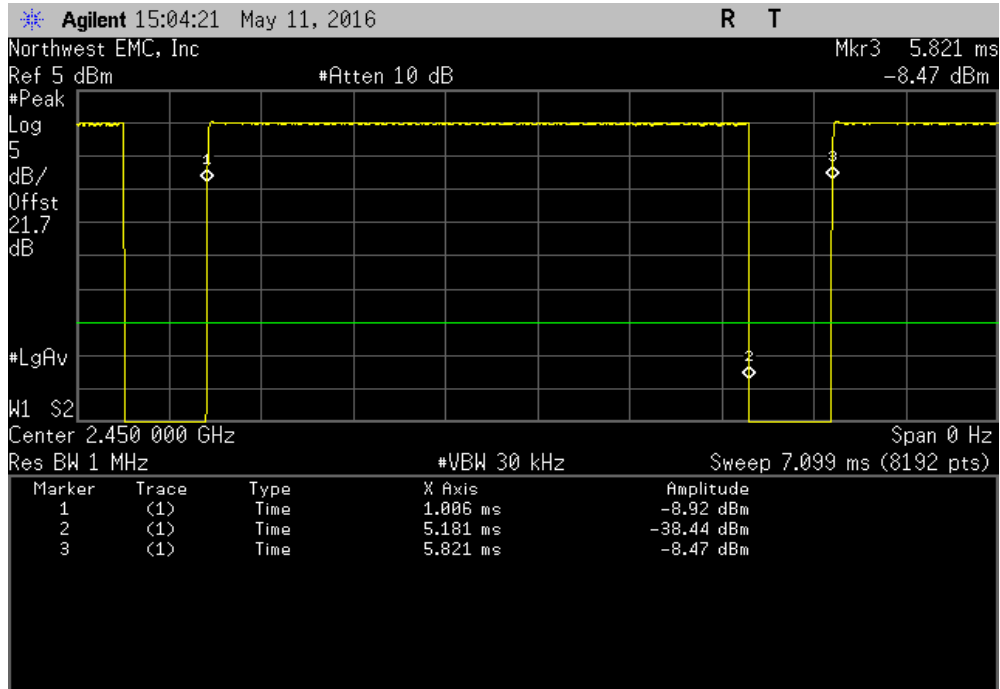


GFSK Low Channel, 2401 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

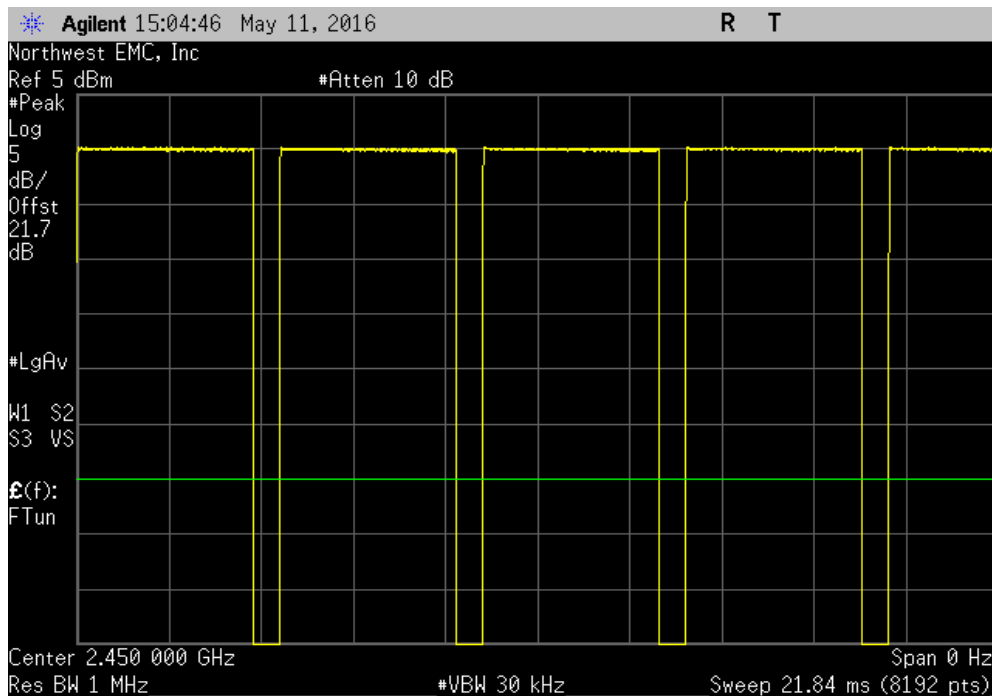


DUTY CYCLE

GFSK Mid Channel, 2450 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	4.175 ms	4.814 ms	1	86.7	N/A	N/A

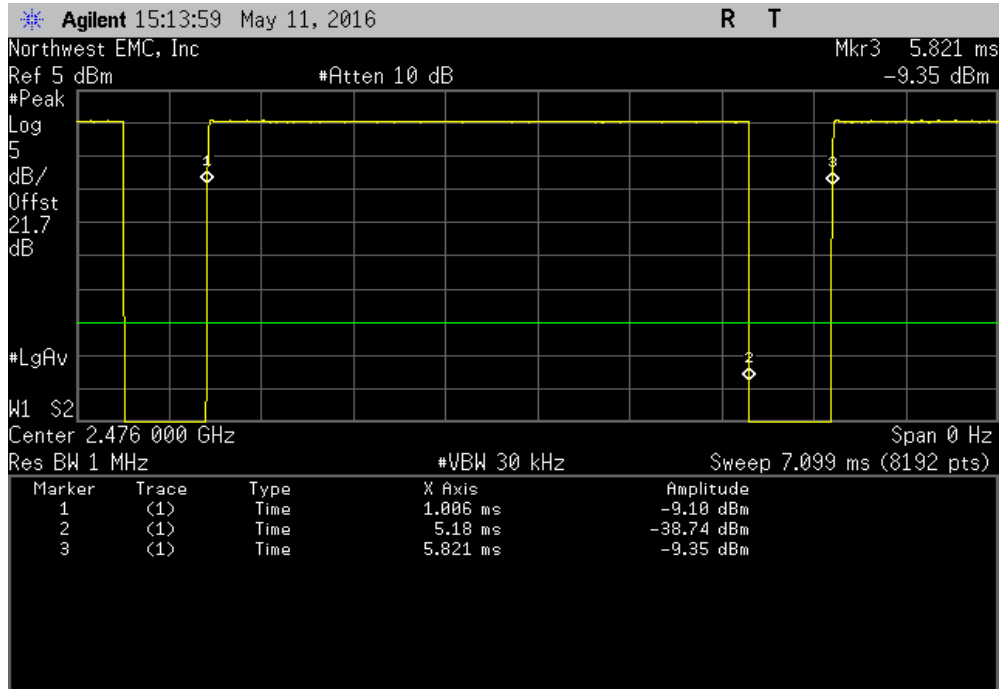


GFSK Mid Channel, 2450 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

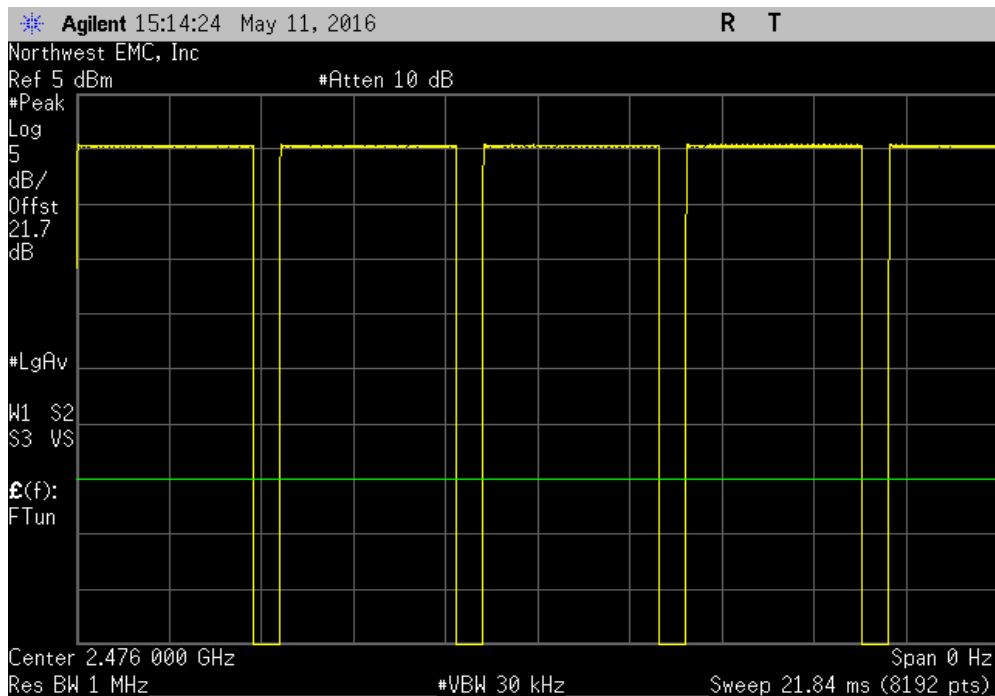


DUTY CYCLE

GFSK High Channel, 2476 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	4.174 ms	4.814 ms	1	86.7	N/A	N/A



GFSK High Channel, 2476 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



OCCUPIED BANDWIDTH

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

TEST EQUIPMENT

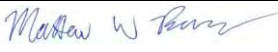
Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	24
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	5/6/2016	12
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	12
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12

TEST DESCRIPTION

The 6dB occupied bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The 99.0% occupied bandwidth was also measured at the same time.

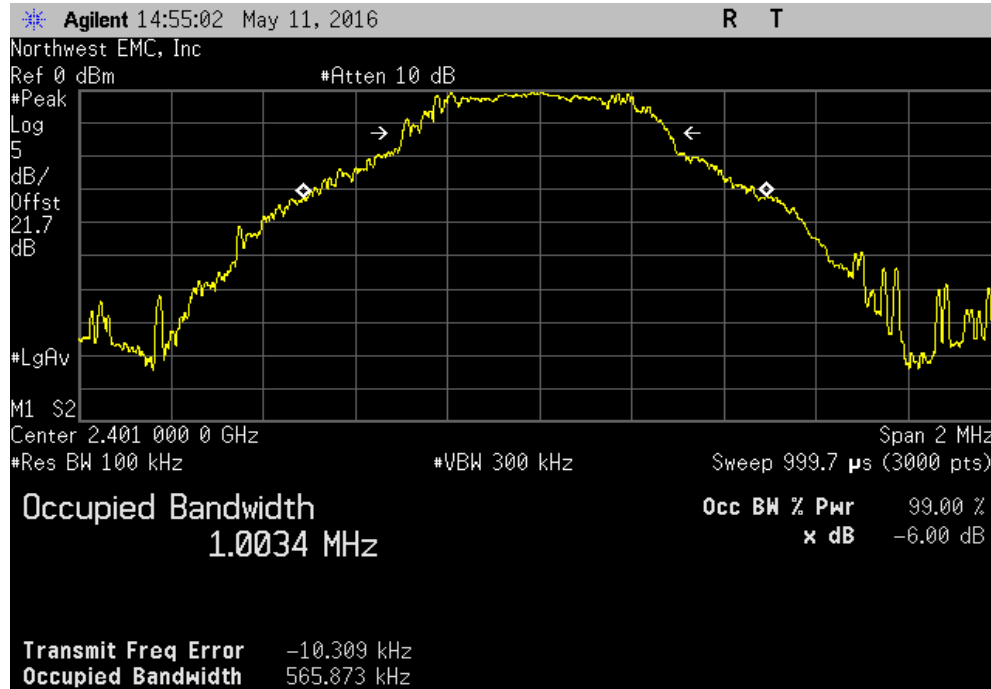
The EUT was set to the channels and modes listed in the datasheet. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer.

OCCUPIED BANDWIDTH

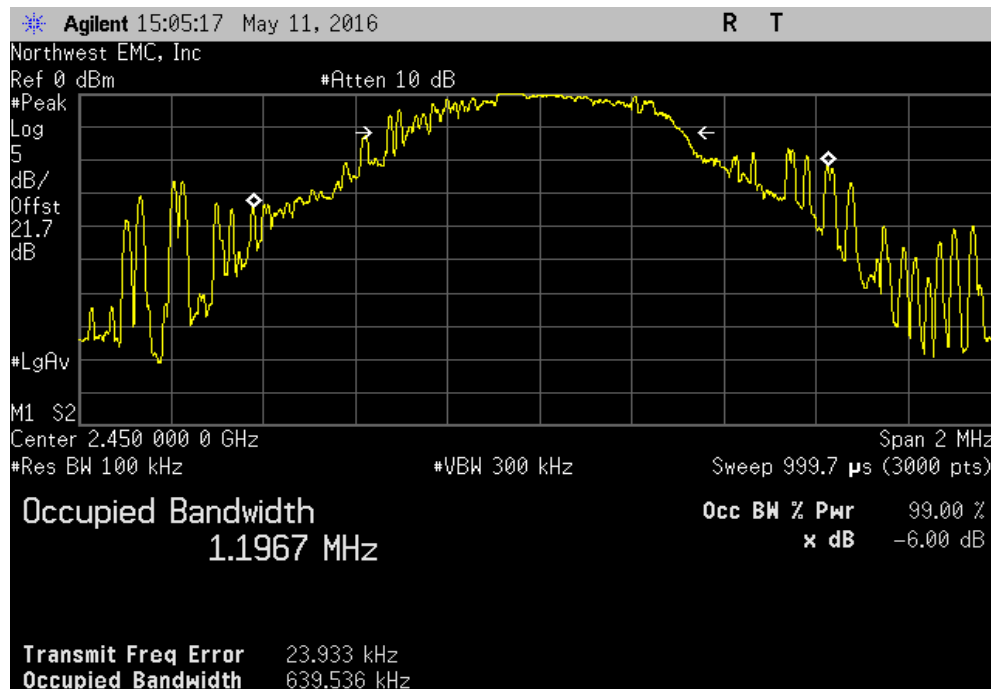
EUT: MagicBand 2b		Work Order: SYNA0189	
Serial Number: 0006D68961		Date: 05/11/16	
Customer: Walt Disney Parks and Resorts US, Inc.		Temperature: 24°C	
Attendees: Martha Calderon		Humidity: 27%	
Project: None		Barometric Pres.: 1016	
Tested by: Matthew Barnes	Power: Battery	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
Powered by external battery pack.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Value	Limit (>)
GFSK Low Channel, 2401 MHz		565.873 kHz	500 kHz
GFSK Mid Channel, 2450 MHz		639.536 kHz	500 kHz
GFSK High Channel, 2476 MHz		702.533 kHz	500 kHz
			Result
			Pass
			Pass
			Pass

OCCUPIED BANDWIDTH

GFSK Low Channel, 2401 MHz						
				Value	Limit (>)	Result
				565.873 kHz	500 kHz	Pass

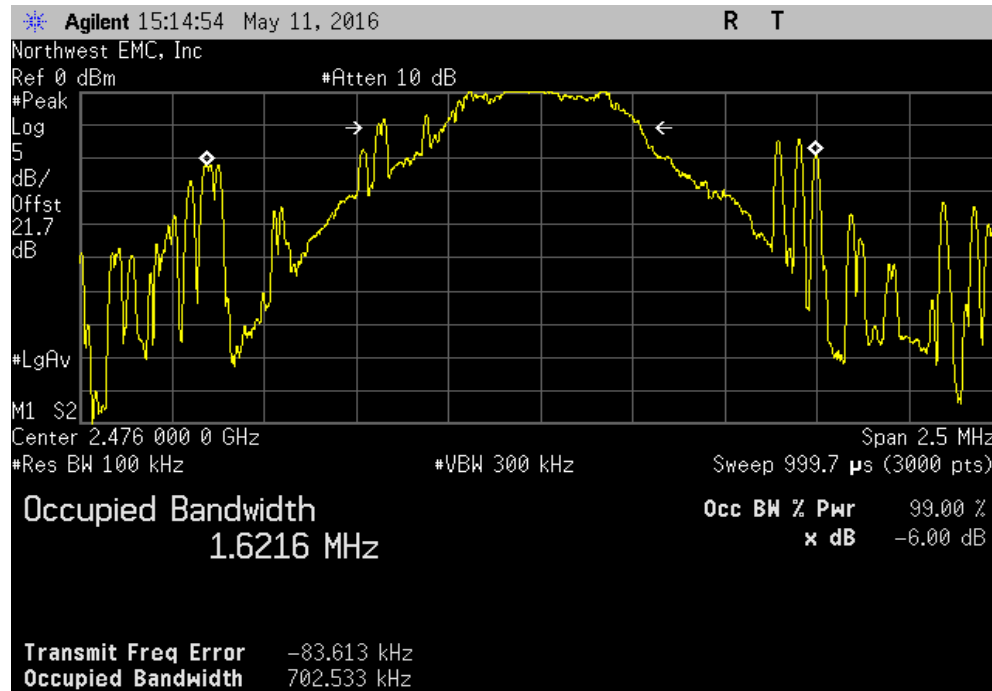


GFSK Mid Channel, 2450 MHz						
				Value	Limit (>)	Result
				639.536 kHz	500 kHz	Pass



OCCUPIED BANDWIDTH

GFSK High Channel, 2476 MHz						
				Value	Limit (>)	Result
				702.533 kHz	500 kHz	Pass



OUTPUT POWER

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	24
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	5/6/2016	12
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	12
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12

TEST DESCRIPTION


The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. A direct connection was made between the RF output of the EUT and a spectrum analyzer. Attenuation and a DC block were used. The reference level offset on the spectrum analyzer was adjusted to compensate for cable loss and the external attenuation used between the RF output and the spectrum analyzer input.

Prior to measuring peak transmit power the DTS bandwidth (B) and the transmission pulse duration (T) were measured. Both are required to determine the method of measuring Maximum Conducted Output Power. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The method found in ANSI C63.10:2013 Section 11.9.2.2.4 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio..

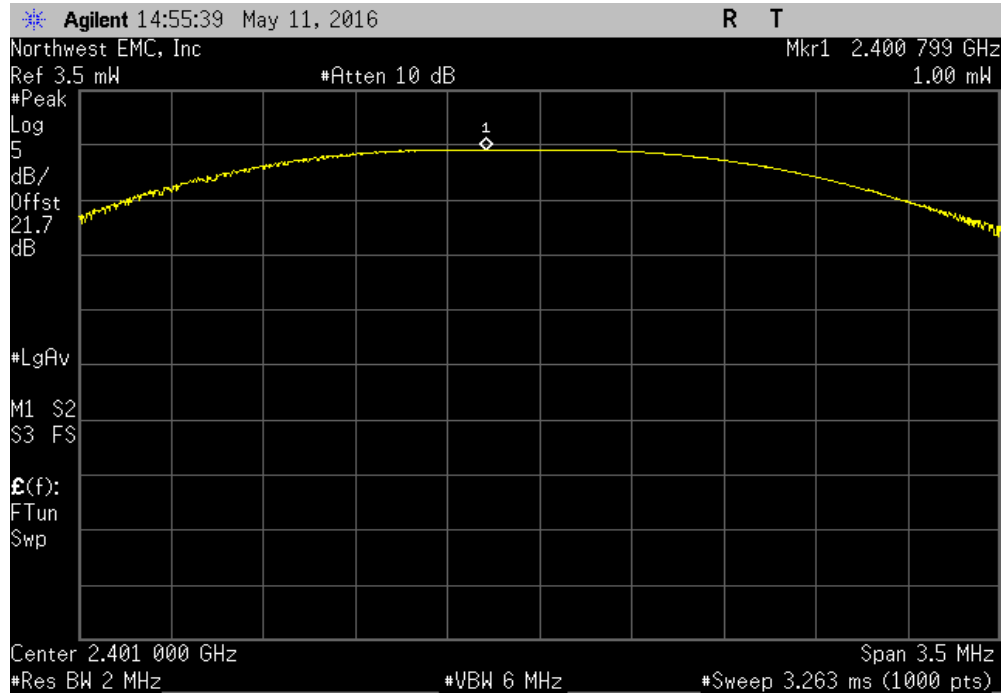
De Facto EIRP Limit: Per 47 CFR 15.247 (b)(1-3), the EUT meets the de facto EIRP limit of +36 dBm.

OUTPUT POWER

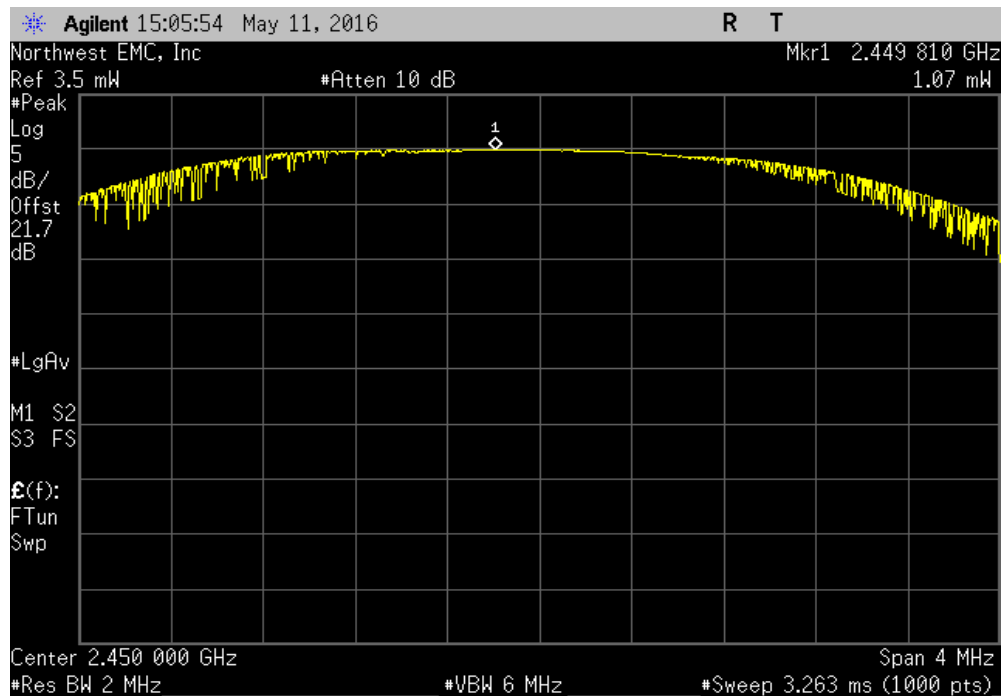
EUT: MagicBand 2b		Work Order: SYNA0189	
Serial Number: 0006D68961		Date: 05/11/16	
Customer: Walt Disney Parks and Resorts US, Inc.		Temperature: 24°C	
Attendees: Martha Calderon		Humidity: 27%	
Project: None		Barometric Pres.: 1016	
Tested by: Matthew Barnes	Power: Battery	Job Site: NC02	
TEST SPECIFICATIONS			
FCC 15.247:2016		Test Method: ANSI C63.10:2013	
COMMENTS			
Powered by external battery pack.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Value	Limit (<) Result
GFSK Low Channel, 2401 MHz		1.001 mW	1 W Pass
GFSK Mid Channel, 2450 MHz		1.074 mW	1 W Pass
GFSK High Channel, 2476 MHz		1.175 mW	1 W Pass

OUTPUT POWER

GFSK Low Channel, 2401 MHz						
				Value	Limit (<)	Result
				1.001 mW	1 W	Pass

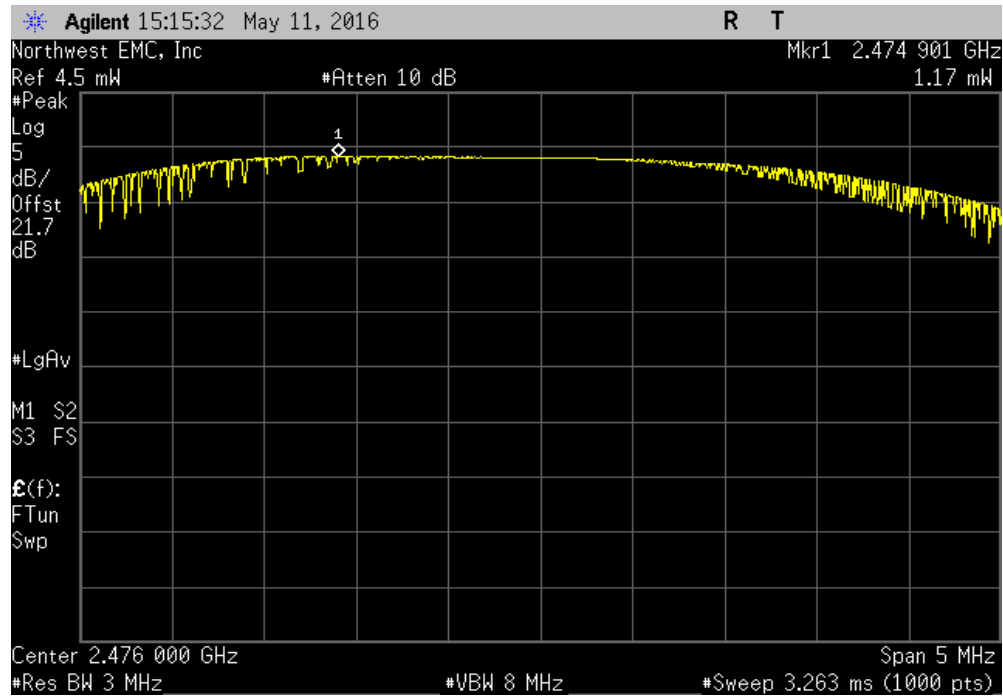


GFSK Mid Channel, 2450 MHz						
				Value	Limit (<)	Result
				1.074 mW	1 W	Pass



OUTPUT POWER

GFSK High Channel, 2476 MHz						
				Value	Limit (<)	Result
				1.175 mW	1 W	Pass



POWER SPECTRAL DENSITY

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	24
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	5/6/2016	12
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	12
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12


TEST DESCRIPTION

The maximum power spectral density measurements was measured using the channels and modes as called out on the following data sheets.

A direct connection was made between the RF output of the EUT and a spectrum analyzer. External attenuation and a DC block were used. The reference level offset on the spectrum analyzer was adjusted to compensate for cable loss and the external attenuation used between the RF output and the spectrum analyzer input.

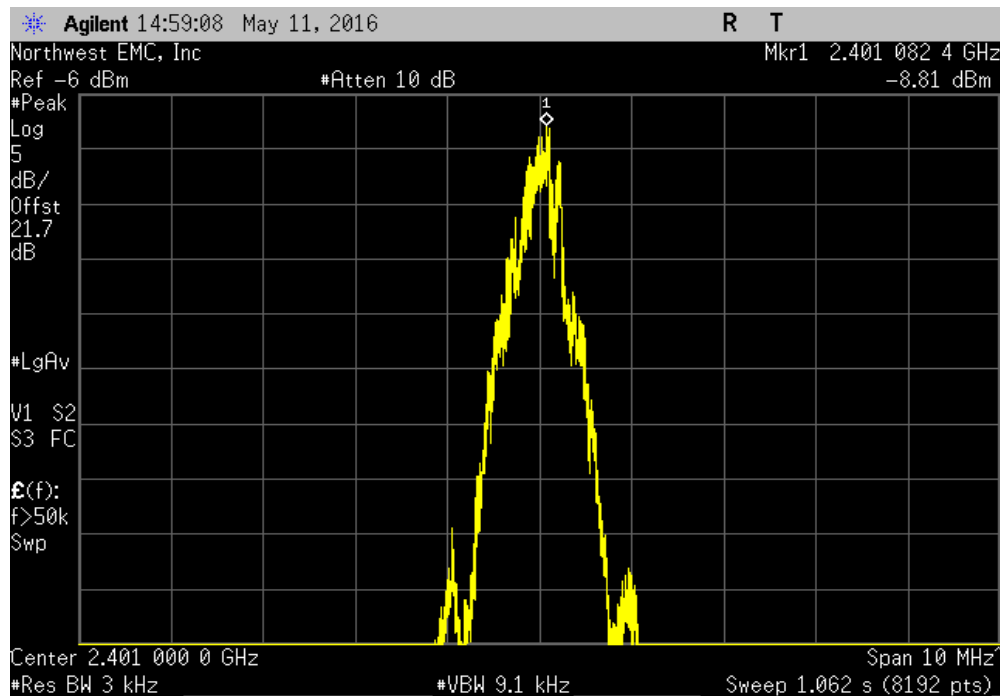
Per the procedure outlined in ANSI C63.10 the peak power spectral density was measured in a 3 kHz RBW.

POWER SPECTRAL DENSITY

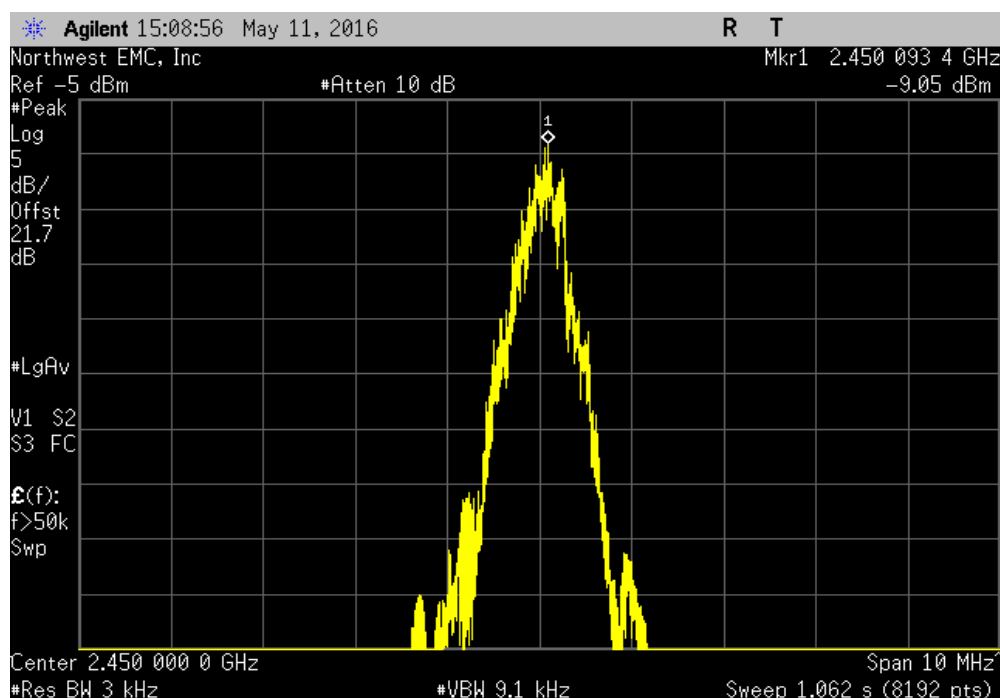
EUT: MagicBand 2b		Work Order: SYNA0189	
Serial Number: 0006D68961		Date: 05/11/16	
Customer: Walt Disney Parks and Resorts US, Inc.		Temperature: 24°C	
Attendees: Martha Calderon		Humidity: 27%	
Project: None		Barometric Pres.: 1016	
Tested by: Matthew Barnes	Power: Battery	Job Site: NC02	
TEST SPECIFICATIONS			
FCC 15.247:2016		Test Method: ANSI C63.10:2013	
COMMENTS			
Powered by external battery pack.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Value dBm/3kHz	Limit < dBm/3kHz
GFSK Low Channel, 2401 MHz		-8.807	8
GFSK Mid Channel, 2450 MHz		-9.051	8
GFSK High Channel, 2476 MHz		-9.959	8
			Results
			Pass
			Pass
			Pass

POWER SPECTRAL DENSITY

GFSK Low Channel, 2401 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-8.807	8	Pass

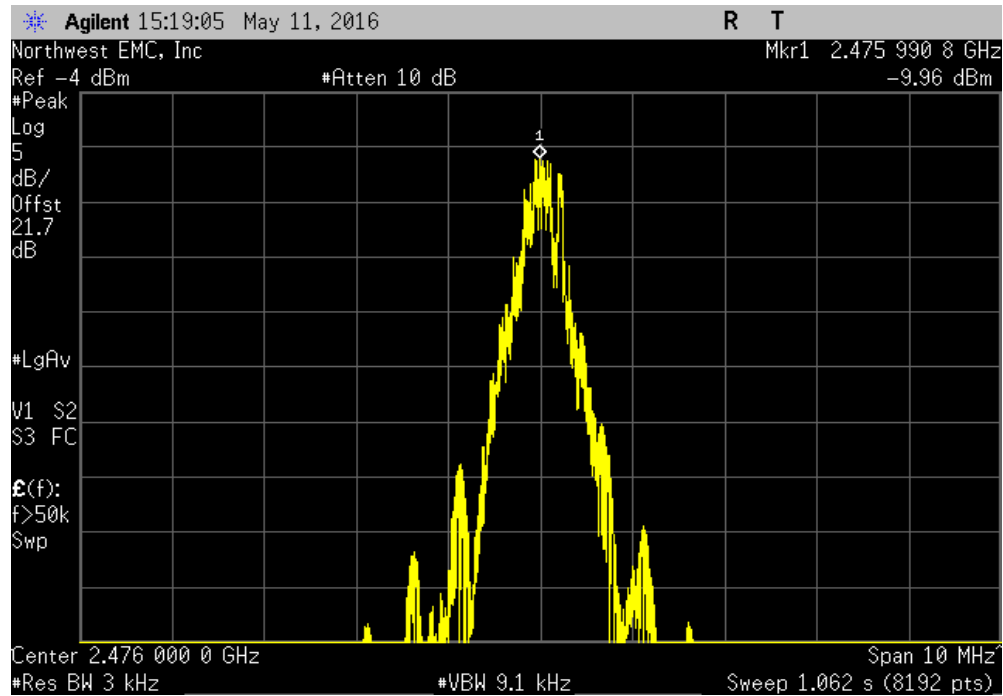


GFSK Mid Channel, 2450 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-9.051	8	Pass



POWER SPECTRAL DENSITY

GFSK High Channel, 2476 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-9.959	8	Pass



BAND EDGE COMPLIANCE

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	24
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	5/6/2016	12
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	12
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12

TEST DESCRIPTION

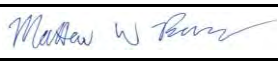
The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in each available band. The channels closest to the band edges were selected. The measurement was made using a direct connection between the RF output of the EUT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

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

BAND EDGE COMPLIANCE

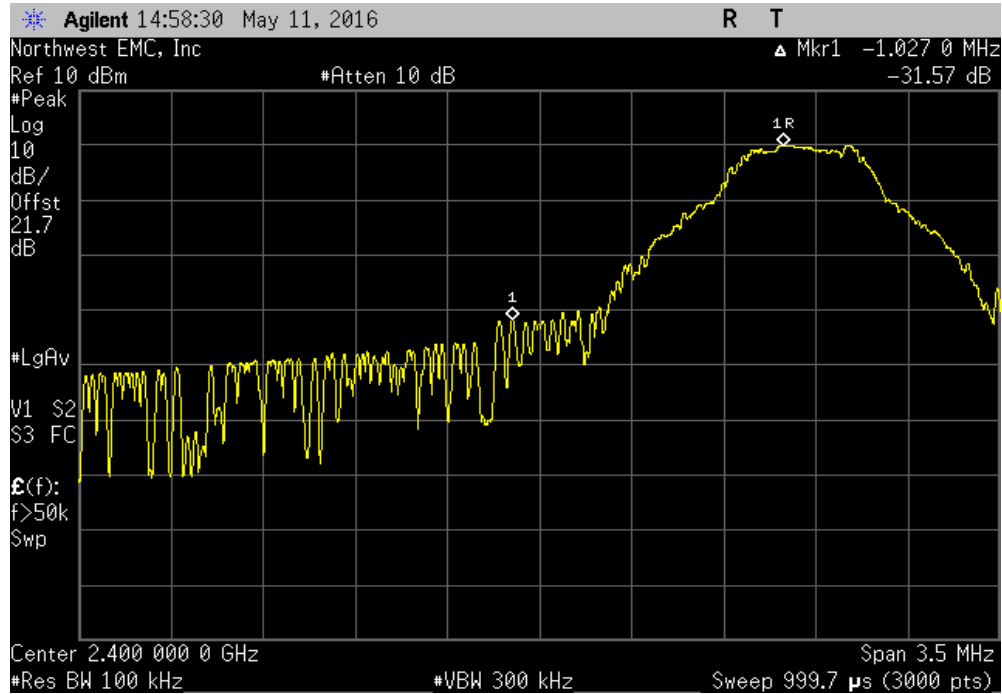


XMR 2015.01.14

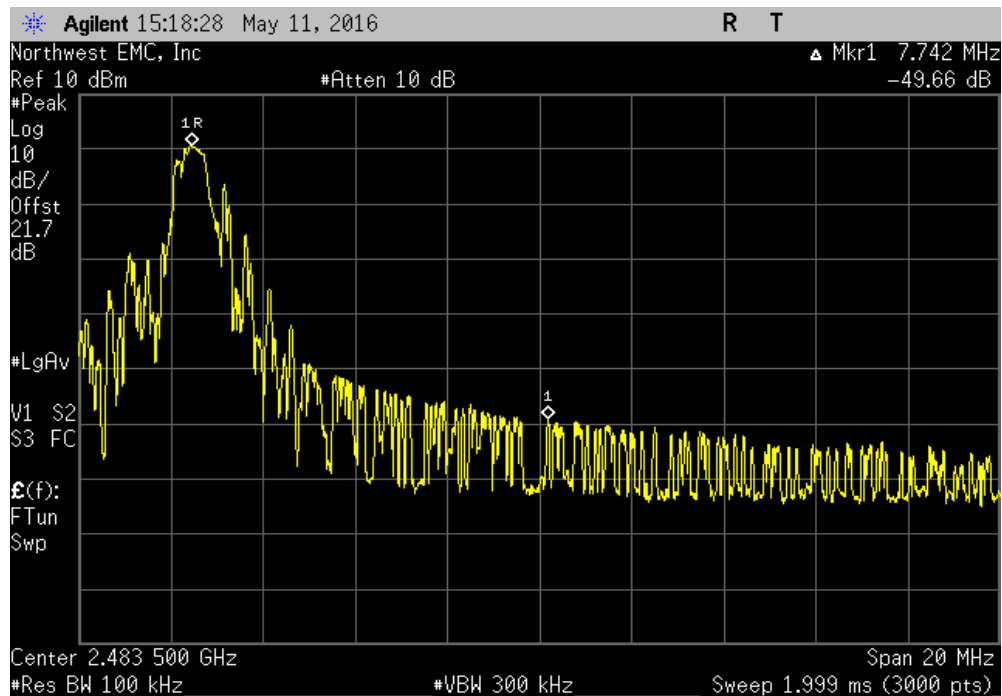
EUT: MagicBand 2b		Work Order: SYNA0189	
Serial Number: 0006D68961		Date: 05/11/16	
Customer: Walt Disney Parks and Resorts US, Inc.		Temperature: 24°C	
Attendees: Martha Calderon		Humidity: 27%	
Project: None		Barometric Pres.: 1016	
Tested by: Matthew Barnes	Power: Battery	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
Powered by external battery pack.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Value (dBc)	Limit ≤ (dBc) Result
GFSK Low Channel, 2401 MHz		-31.57	-20 Pass
GFSK High Channel, 2476 MHz		-49.66	-20 Pass

BAND EDGE COMPLIANCE

GFSK Low Channel, 2401 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-31.57	-20	Pass



GFSK High Channel, 2476 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-49.66	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

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


TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	24
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	5/6/2016	12
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	12
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12

TEST DESCRIPTION

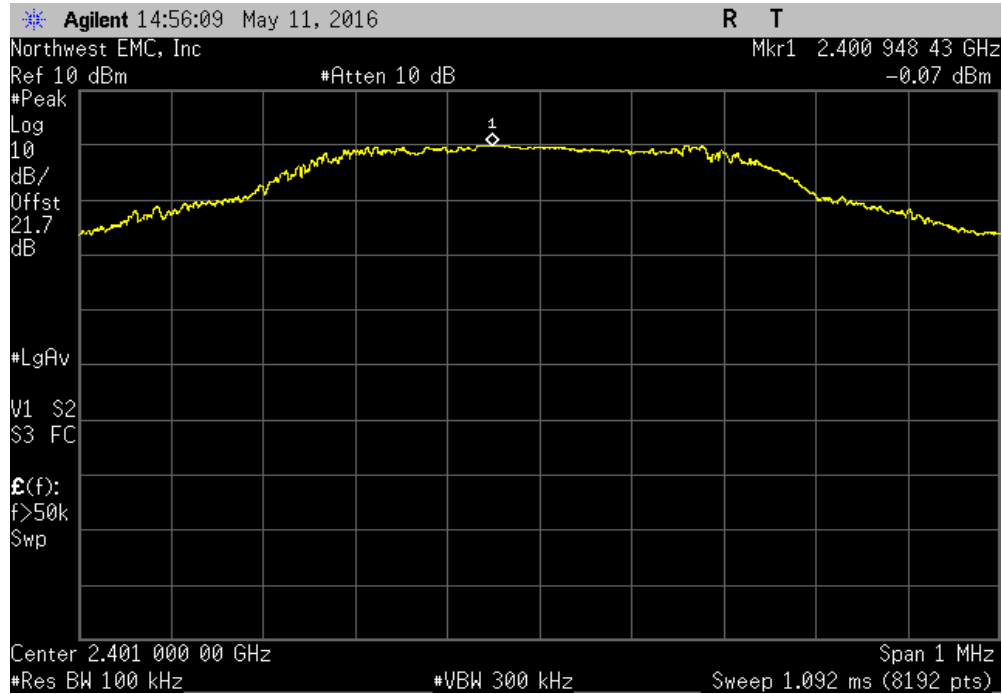
The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet. For each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

SPURIOUS CONDUCTED EMISSIONS

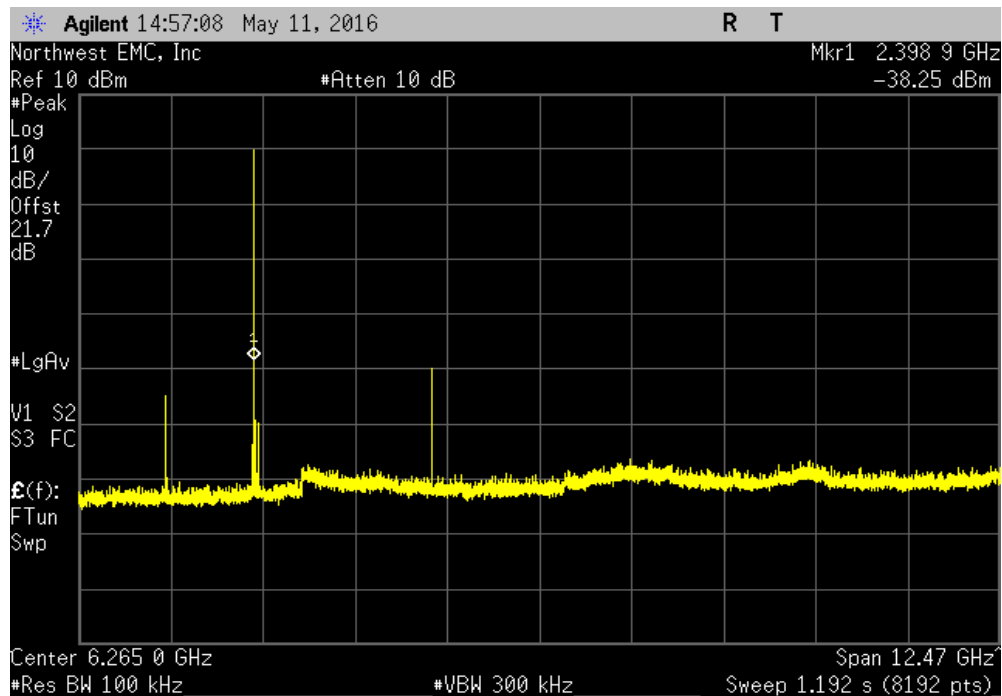
EUT: MagicBand 2b		Work Order: SYNA0189			
Serial Number: 0006D68961		Date: 05/11/16			
Customer: Walt Disney Parks and Resorts US, Inc.		Temperature: 24°C			
Attendees: Martha Calderon		Humidity: 27%			
Project: None		Barometric Pres.: 1016			
Tested by: Matthew Barnes		Power: Battery			
		Job Site: NC02			
TEST SPECIFICATIONS		Test Method			
FCC 15.247:2016		ANSI C63.10:2013			
COMMENTS					
Powered by external battery pack.					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	3	Signature 			
		Frequency Range	Max Value (dBc)		
			Limit ≤ (dBc)		
			Result		
GFSK Low Channel, 2401 MHz		Fundamental	N/A	N/A	
GFSK Low Channel, 2401 MHz		30 MHz - 12.5 GHz	-38.18	-20	Pass
GFSK Low Channel, 2401 MHz		12.5 GHz - 25 GHz	-52.28	-20	Pass
GFSK Mid Channel, 2450 MHz		Fundamental	N/A	N/A	N/A
GFSK Mid Channel, 2450 MHz		30 MHz - 12.5 GHz	-41.51	-20	Pass
GFSK Mid Channel, 2450 MHz		12.5 GHz - 25 GHz	-53.13	-20	Pass
GFSK High Channel, 2476 MHz		Fundamental	N/A	N/A	N/A
GFSK High Channel, 2476 MHz		30 MHz - 12.5 GHz	-43.34	-20	Pass
GFSK High Channel, 2476 MHz		12.5 GHz - 25 GHz	-52.96	-20	Pass

SPURIOUS CONDUCTED EMISSIONS

GFSK Low Channel, 2401 MHz						
Frequency Range		Max Value (dBc)		Limit ≤ (dBc)	Result	
Fundamental		N/A		N/A	N/A	

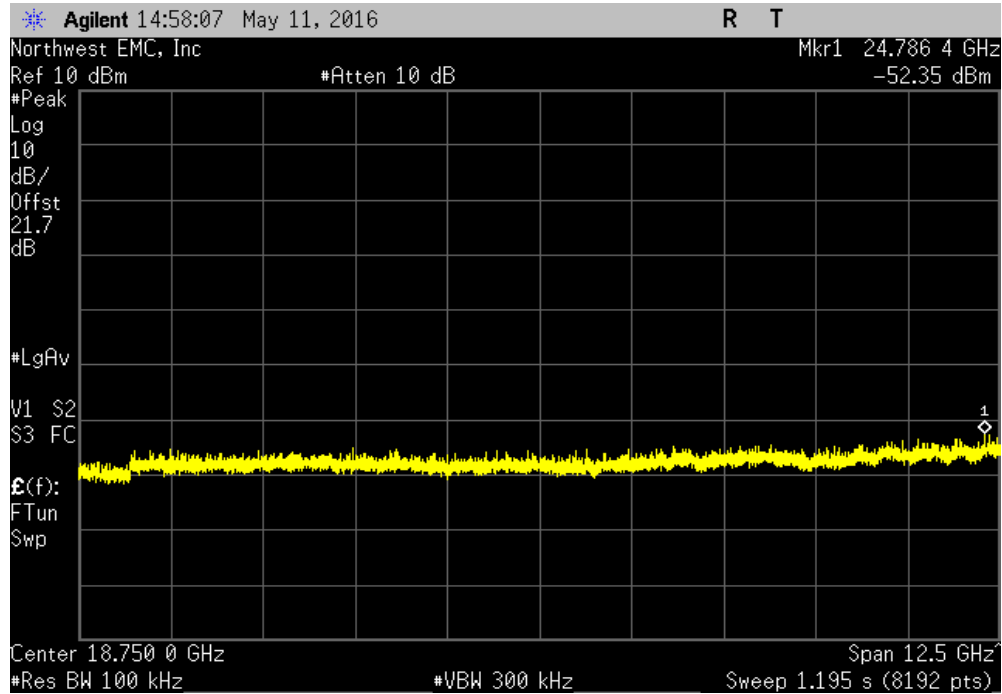


GFSK Low Channel, 2401 MHz						
Frequency Range		Max Value (dBc)		Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz		-38.18		-20	Pass	

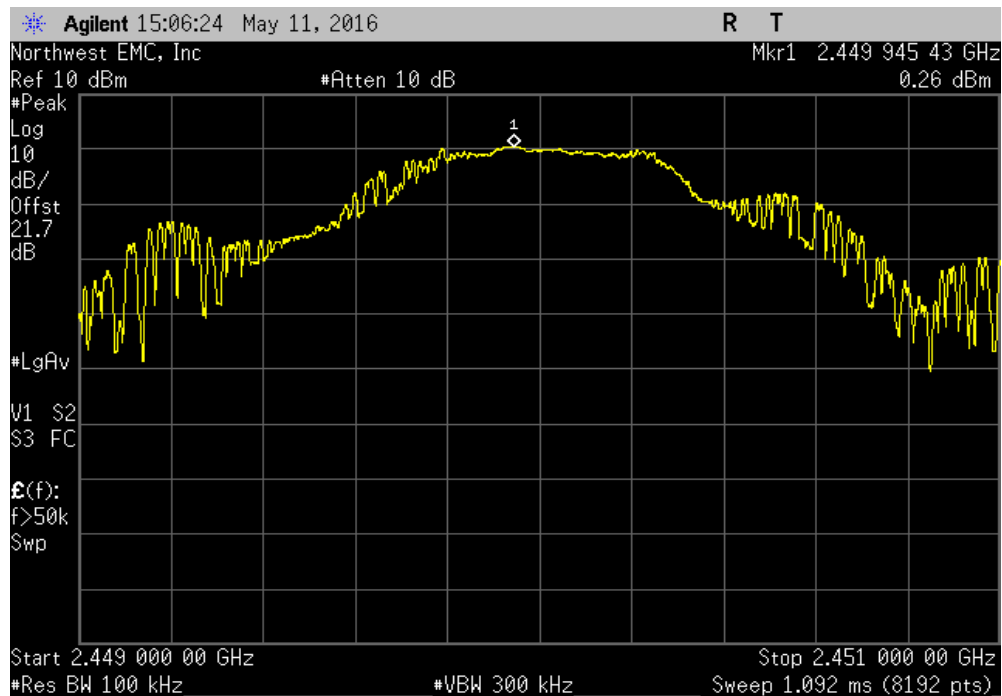


SPURIOUS CONDUCTED EMISSIONS

GFSK Low Channel, 2401 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-52.28	-20	Pass	

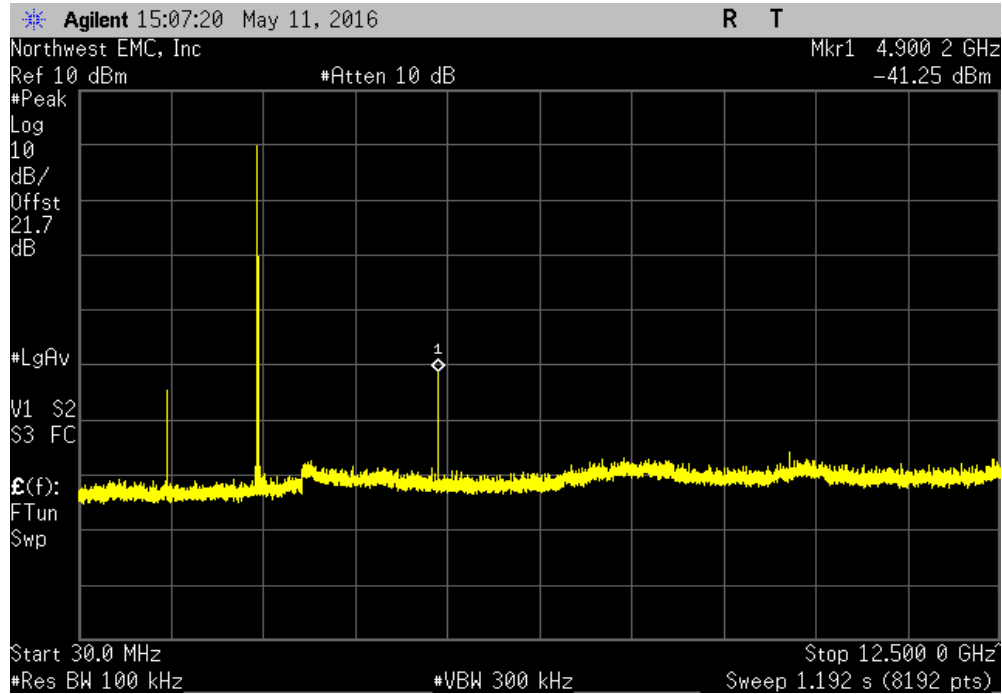


GFSK Mid Channel, 2450 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
Fundamental	N/A	N/A	N/A	

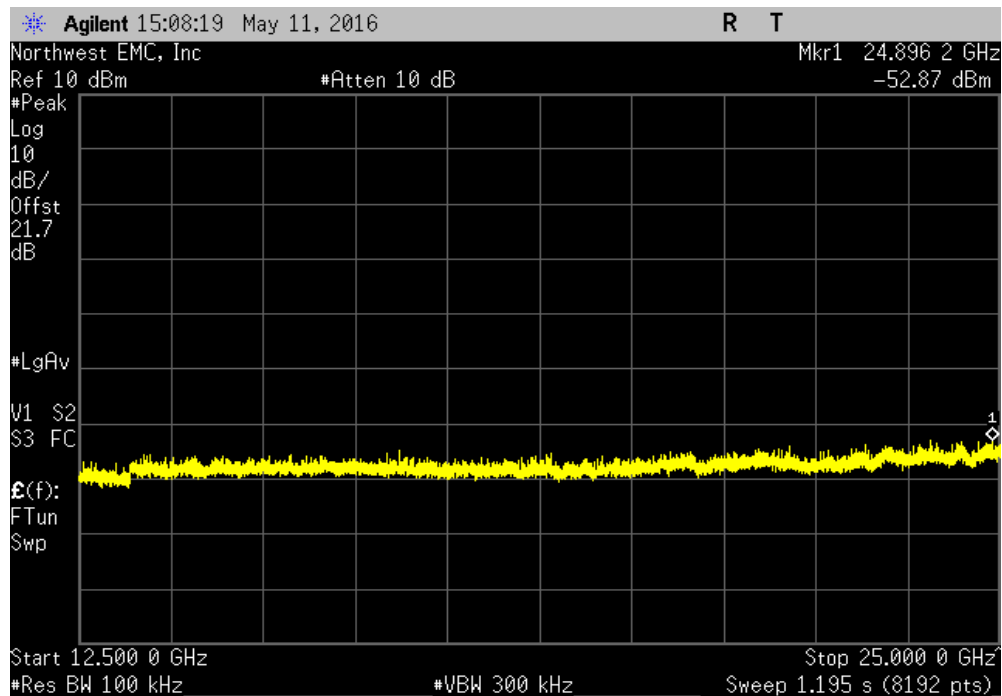


SPURIOUS CONDUCTED EMISSIONS

GFSK Mid Channel, 2450 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz	-41.51	-20	Pass	

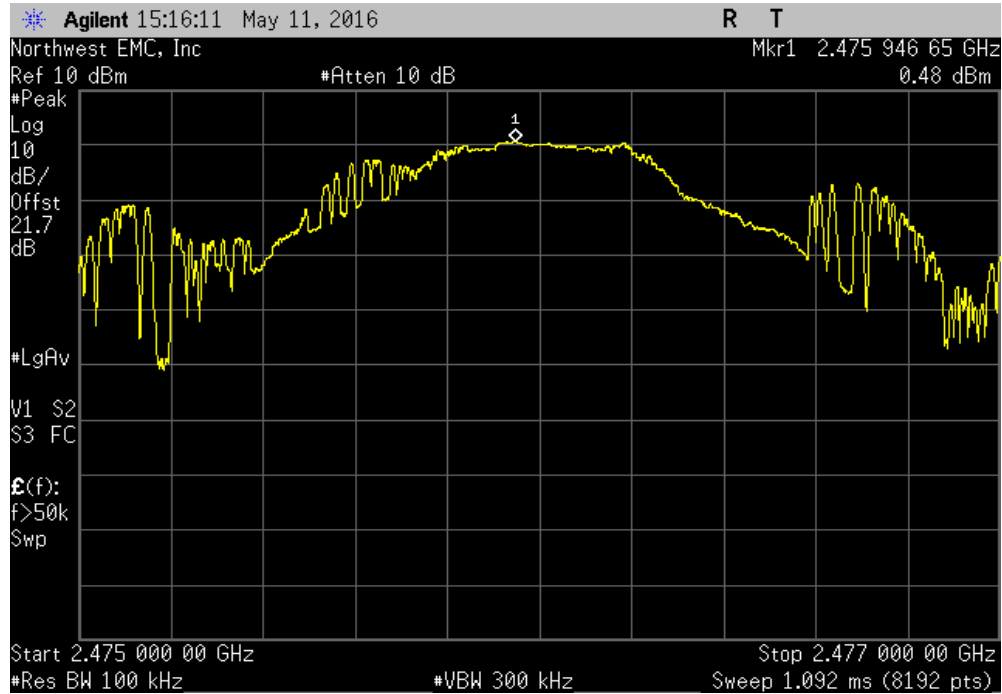


GFSK Mid Channel, 2450 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-53.13	-20	Pass	

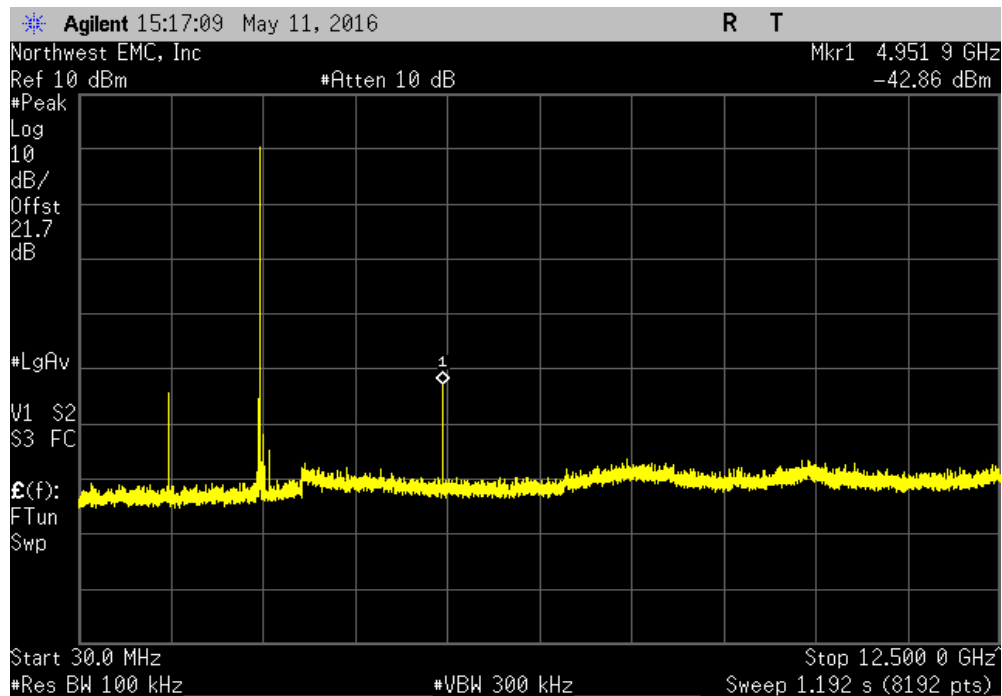


SPURIOUS CONDUCTED EMISSIONS

GFSK High Channel, 2476 MHz						
Frequency Range		Max Value (dBc)		Limit ≤ (dBc)	Result	
Fundamental		N/A		N/A	N/A	

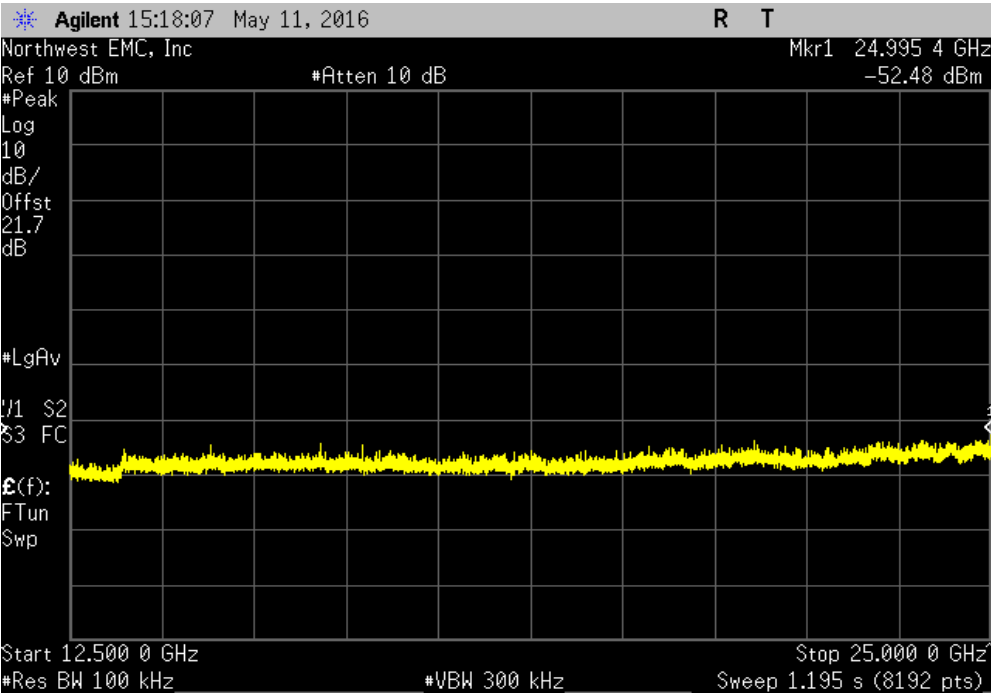


GFSK High Channel, 2476 MHz						
Frequency Range		Max Value (dBc)		Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz		-43.34		-20	Pass	



SPURIOUS CONDUCTED EMISSIONS

GFSK High Channel, 2476 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-52.96	-20	Pass	



SPURIOUS RADIATED EMISSIONS

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

MODES OF OPERATION

Low Channel - 2401 MHz - GFSK modulation

Mid Channel - 2450 MHz - GFSK modulation

High Channel - 2476 MHz - GFSK modulation

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

SYNA0189 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	26500 MHz
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SAMPLE CALCULATIONS


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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	PAB	7/31/2015	12
Antenna - Biconilog	Teseq	CBL 6141B	AYL	7/30/2015	12
Filter - Low Pass	Micro-Tronics	LPM50004	LFF	1/21/2016	12
Cable	Northwest EMC	Bilog Cables	NC1	8/27/2015	12
Cable	Northwest EMC	N/A	NC8	6/6/2015	12
Amplifier - Pre-Amplifier	Miteq	AMF-6F-18002650-25-10P	AOD	6/6/2015	12
Antenna - Standard Gain	ETS Lindgren	3160-09	AIY	NCR	0
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AOJ	9/21/2015	12
Antenna - Standard Gain	EMCO	3160-08	AHO	NCR	0
Cable	Northwest EMC	Standard Gain Horn Cable	NC3	6/17/2015	12
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AOK	9/21/2015	12
Antenna - Standard Gain	EMCO	3160-07	AHP	NCR	0
Filter - High Pass	Micro-Tronics	HPM50111	HHI	10/30/2015	12
Attenuator	Fairview Microwave	SA18E-20	AQV	9/28/2015	12
Cable	Northwest EMC	3115 Horn Cable	NC2	6/17/2015	12
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVZ	7/31/2015	12
Antenna - Double Ridge	EMCO	3115	AHM	6/3/2014	24
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	6/23/2015	12

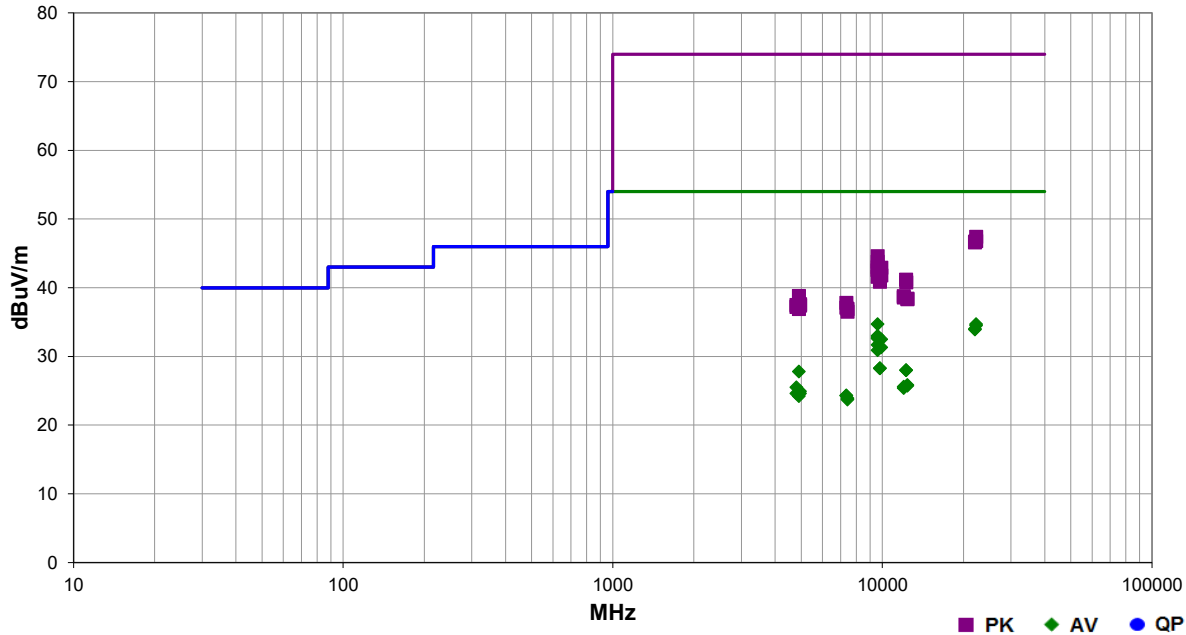
TEST DESCRIPTION

The highest gain of each type of antenna to be used with the EUT was tested. The EUT was configured for low, mid, and high band transmit frequencies. For each configuration, the spectrum was scanned throughout the specified range. In addition, measurements were made in the restricted bands to verify compliance. While scanning, emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and the EUT antenna in three orthogonal axis, and adjusting measurement antenna height and polarization. A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.

Work Order:	SYNA0189	Date:	05/11/16	
Project:	None	Temperature:	22.2 °C	
Job Site:	NC01	Humidity:	34.3% RH	
Serial Number:	See Comments	Barometric Pres.:	1022 mbar	Tested by: Matthew Barnes
EUT:	MagicBand 2b			
Configuration:	1			
Customer:	Walt Disney Parks and Resorts US, Inc.			
Attendees:	Martha Calderon			
EUT Power:	Battery			
Operating Mode:	See comments for transmit channel and EUT orientation, run on GFSK modulation			
Deviations:	None			
Comments:	Switching between 2 different devices, S/N: 0006D689FD and 0006D68821.			

Test Specifications	Test Method
FCC 15.247:2016	ANSI C63.10:2013

Run #	4	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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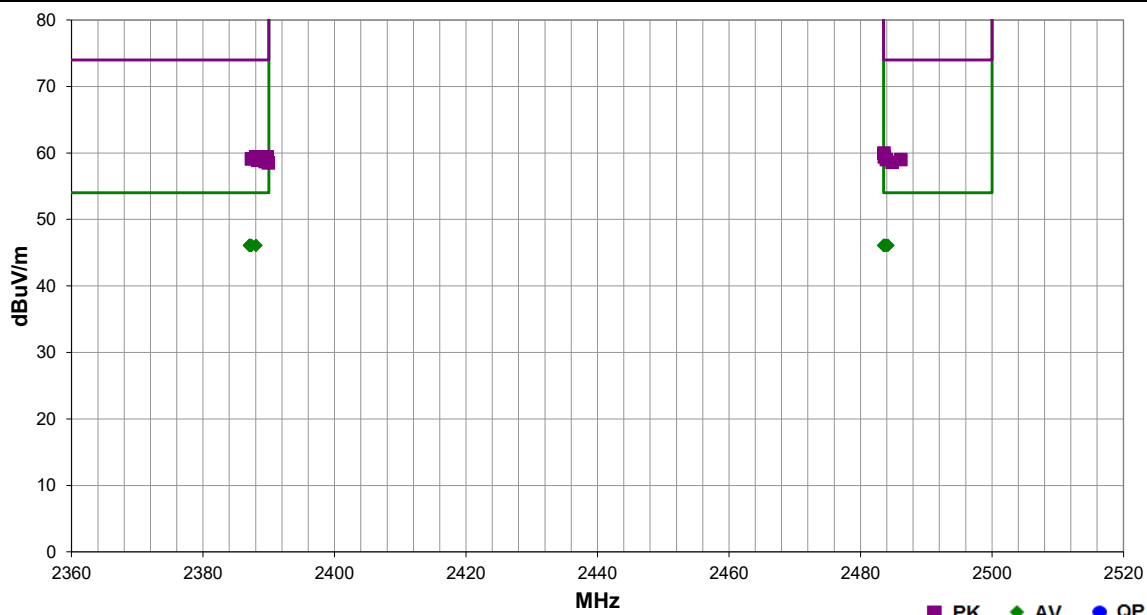
Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
22285.440	34.7	0.0	1.5	304.0	3.0	0.0	Horz	AV	0.0	34.7	54.0	-19.3	High Ch, On Side
9604.620	38.5	-3.8	1.0	266.0	3.0	0.0	Horz	AV	0.0	34.7	54.0	-19.3	Low Ch, On Side
22285.500	34.5	0.0	1.5	39.0	3.0	0.0	Vert	AV	0.0	34.5	54.0	-19.5	High Ch, On Side
22051.230	34.0	0.0	1.5	176.0	3.0	0.0	Horz	AV	0.0	34.0	54.0	-20.0	Mid Ch, On Side
22051.400	33.9	0.0	1.5	184.0	3.0	0.0	Vert	AV	0.0	33.9	54.0	-20.1	Mid Ch, On Side
9604.590	36.8	-3.8	2.5	291.0	3.0	0.0	Horz	AV	0.0	33.0	54.0	-21.0	Low Ch, Flat
9604.575	36.6	-3.8	2.3	267.0	3.0	0.0	Vert	AV	0.0	32.8	54.0	-21.2	Low Ch, On Side
9604.580	36.4	-3.8	1.0	350.0	3.0	0.0	Vert	AV	0.0	32.6	54.0	-21.4	Low Ch, Flat
9904.560	35.9	-3.4	1.0	266.0	3.0	0.0	Horz	AV	0.0	32.5	54.0	-21.5	High Ch, On Side
9604.535	35.5	-3.8	3.6	227.0	3.0	0.0	Vert	AV	0.0	31.7	54.0	-22.3	Low Ch, On End
9904.550	34.7	-3.4	1.2	265.0	3.0	0.0	Vert	AV	0.0	31.3	54.0	-22.7	High Ch, On Side
9604.540	34.7	-3.8	3.5	258.0	3.0	0.0	Horz	AV	0.0	30.9	54.0	-23.1	Low Ch, On End
9800.970	31.8	-3.5	1.0	219.0	3.0	0.0	Horz	AV	0.0	28.3	54.0	-25.7	Mid Ch, On Side
9801.220	31.8	-3.5	1.0	177.0	3.0	0.0	Vert	AV	0.0	28.3	54.0	-25.7	Mid Ch, On Side
12251.160	30.6	-2.6	1.0	40.0	3.0	0.0	Horz	AV	0.0	28.0	54.0	-26.0	Mid Ch, On Side
12250.930	30.6	-2.6	1.0	237.0	3.0	0.0	Vert	AV	0.0	28.0	54.0	-26.0	Mid Ch, On Side
4900.100	27.8	0.0	2.8	232.0	3.0	0.0	Horz	AV	0.0	27.8	54.0	-26.2	Mid Ch, On Side
22282.530	47.4	0.0	1.5	304.0	3.0	0.0	Horz	PK	0.0	47.4	74.0	-26.6	High Ch, On Side
22283.890	46.8	0.0	1.5	39.0	3.0	0.0	Vert	PK	0.0	46.8	74.0	-27.2	High Ch, On Side
22050.590	46.7	0.0	1.5	184.0	3.0	0.0	Vert	PK	0.0	46.7	74.0	-27.3	Mid Ch, On Side
22050.080	46.6	0.0	1.5	176.0	3.0	0.0	Horz	PK	0.0	46.6	74.0	-27.4	Mid Ch, On Side
12379.140	28.1	-2.3	1.0	259.0	3.0	0.0	Vert	AV	0.0	25.8	54.0	-28.2	High Ch, On Side

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
12378.640	28.0	-2.3	1.0	281.0	3.0	0.0	Horz	AV	0.0	25.7	54.0	-28.3	High Ch, On Side
12005.910	28.6	-3.0	1.0	336.0	3.0	0.0	Horz	AV	0.0	25.6	54.0	-28.4	Low Ch, On Side
4802.105	25.5	0.0	3.2	306.0	3.0	0.0	Horz	AV	0.0	25.5	54.0	-28.5	Low Ch, On Side
12005.300	28.4	-3.0	1.0	350.0	3.0	0.0	Vert	AV	0.0	25.4	54.0	-28.6	Low Ch, On Side
4952.105	24.9	0.0	2.7	72.0	3.0	0.0	Vert	AV	0.0	24.9	54.0	-29.1	High Ch, On Side
4952.065	24.6	0.0	1.0	248.0	3.0	0.0	Horz	AV	0.0	24.6	54.0	-29.4	High Ch, On Side
4802.095	24.6	0.0	1.0	178.0	3.0	0.0	Vert	AV	0.0	24.6	54.0	-29.4	Low Ch, On Side
9604.610	48.4	-3.8	1.0	266.0	3.0	0.0	Horz	PK	0.0	44.6	74.0	-29.4	Low Ch, On Side
7350.950	24.3	0.0	2.6	261.0	3.0	0.0	Vert	AV	0.0	24.3	54.0	-29.7	Mid Ch, On Side
7349.465	24.3	0.0	1.0	358.0	3.0	0.0	Horz	AV	0.0	24.3	54.0	-29.7	Mid Ch, On Side
4900.005	24.2	0.0	1.0	232.0	3.0	0.0	Vert	AV	0.0	24.2	54.0	-29.8	Mid Ch, On Side
7428.390	23.9	0.0	1.0	268.0	3.0	0.0	Horz	AV	0.0	23.9	54.0	-30.1	High Ch, On Side
9604.145	47.6	-3.8	2.5	291.0	3.0	0.0	Horz	PK	0.0	43.8	74.0	-30.2	Low Ch, Flat
7428.495	23.7	0.0	2.5	213.0	3.0	0.0	Vert	AV	0.0	23.7	54.0	-30.3	High Ch, On Side
9603.530	46.8	-3.8	2.3	267.0	3.0	0.0	Vert	PK	0.0	43.0	74.0	-31.0	Low Ch, On Side
9904.745	46.3	-3.4	1.0	266.0	3.0	0.0	Horz	PK	0.0	42.9	74.0	-31.1	High Ch, On Side
9604.820	46.4	-3.8	1.0	350.0	3.0	0.0	Vert	PK	0.0	42.6	74.0	-31.4	Low Ch, Flat
9603.445	46.4	-3.8	3.6	227.0	3.0	0.0	Vert	PK	0.0	42.6	74.0	-31.4	Low Ch, On End
9904.615	45.2	-3.4	1.2	265.0	3.0	0.0	Vert	PK	0.0	41.8	74.0	-32.2	High Ch, On Side
9604.470	45.4	-3.8	3.5	258.0	3.0	0.0	Horz	PK	0.0	41.6	74.0	-32.4	Low Ch, On End
9799.840	45.1	-3.5	1.0	177.0	3.0	0.0	Vert	PK	0.0	41.6	74.0	-32.4	Mid Ch, On Side
12248.600	43.8	-2.6	1.0	40.0	3.0	0.0	Horz	PK	0.0	41.2	74.0	-32.8	Mid Ch, On Side
9799.135	44.4	-3.5	1.0	219.0	3.0	0.0	Horz	PK	0.0	40.9	74.0	-33.1	Mid Ch, On Side
12251.110	43.4	-2.6	1.0	237.0	3.0	0.0	Vert	PK	0.0	40.8	74.0	-33.2	Mid Ch, On Side
4900.075	38.8	0.0	2.8	232.0	3.0	0.0	Horz	PK	0.0	38.8	74.0	-35.2	Mid Ch, On Side
12004.610	41.8	-3.0	1.0	350.0	3.0	0.0	Vert	PK	0.0	38.8	74.0	-35.2	Low Ch, On Side
12006.050	41.6	-3.0	1.0	336.0	3.0	0.0	Horz	PK	0.0	38.6	74.0	-35.4	Low Ch, On Side
12380.620	40.7	-2.3	1.0	259.0	3.0	0.0	Vert	PK	0.0	38.4	74.0	-35.6	High Ch, On Side
12378.880	40.6	-2.3	1.0	281.0	3.0	0.0	Horz	PK	0.0	38.3	74.0	-35.7	High Ch, On Side
7350.010	37.8	0.0	2.6	261.0	3.0	0.0	Vert	PK	0.0	37.8	74.0	-36.2	Mid Ch, On Side
4951.810	37.6	0.0	2.7	72.0	3.0	0.0	Vert	PK	0.0	37.6	74.0	-36.4	High Ch, On Side
4802.505	37.5	0.0	3.2	306.0	3.0	0.0	Horz	PK	0.0	37.5	74.0	-36.5	Low Ch, On Side
4952.020	37.4	0.0	1.0	248.0	3.0	0.0	Horz	PK	0.0	37.4	74.0	-36.6	High Ch, On Side
4801.620	37.2	0.0	1.0	178.0	3.0	0.0	Vert	PK	0.0	37.2	74.0	-36.8	Low Ch, On Side
7349.165	37.1	0.0	1.0	358.0	3.0	0.0	Horz	PK	0.0	37.1	74.0	-36.9	Mid Ch, On Side
7427.060	36.9	0.0	2.5	213.0	3.0	0.0	Vert	PK	0.0	36.9	74.0	-37.1	High Ch, On Side
4901.025	36.9	0.0	1.0	232.0	3.0	0.0	Vert	PK	0.0	36.9	74.0	-37.1	Mid Ch, On Side
7428.530	36.5	0.0	1.0	268.0	3.0	0.0	Horz	PK	0.0	36.5	74.0	-37.5	High Ch, On Side

Work Order:	SYNA0189	Date:	05/11/16	<i>Matthew W Barnes</i>
Project:	None	Temperature:	22.2 °C	
Job Site:	NC01	Humidity:	34.3% RH	
Serial Number:	See Comments	Barometric Pres.:	1022 mbar	
EUT:	MagicBand 2b			
Configuration:	1			
Customer:	Walt Disney Parks and Resorts US, Inc.			
Attendees:	Martha Calderon			
EUT Power:	Battery			
Operating Mode:	See comments for transmit channel and EUT orientation, run on GFSK modulation			
Deviations:	None			
Comments:	Switching between 2 different devices, S/N: 0006D689FD and 0006D68821.			

Test Specifications	Test Method
FCC 15.247:2016	ANSI C63.10:2013

Run #	4	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2484.195	26.1	0.0	3.7	200.0	3.0	20.0	Horz	AV	0.0	46.1	54.0	-7.9	High Ch, Flat
2483.880	26.1	0.0	3.4	254.0	3.0	20.0	Vert	AV	0.0	46.1	54.0	-7.9	High Ch, On End
2483.670	26.1	0.0	2.3	291.0	3.0	20.0	Horz	AV	0.0	46.1	54.0	-7.9	High Ch, On Side
2483.645	26.1	0.0	1.0	241.0	3.0	20.0	Vert	AV	0.0	46.1	54.0	-7.9	High Ch, On Side
2483.620	26.1	0.0	4.0	260.0	3.0	20.0	Horz	AV	0.0	46.1	54.0	-7.9	High Ch, On End
2483.500	26.1	0.0	1.8	274.0	3.0	20.0	Vert	AV	0.0	46.1	54.0	-7.9	High Ch, Flat
2388.060	26.1	0.0	1.0	289.0	3.0	20.0	Horz	AV	0.0	46.1	54.0	-7.9	Low Ch, On Side
2387.375	26.1	0.0	3.3	300.0	3.0	20.0	Vert	AV	0.0	46.1	54.0	-7.9	Low Ch, On End
2387.205	26.1	0.0	1.0	89.0	3.0	20.0	Horz	AV	0.0	46.1	54.0	-7.9	Low Ch, Flat
2387.100	26.1	0.0	1.8	282.0	3.0	20.0	Vert	AV	0.0	46.1	54.0	-7.9	Low Ch, Flat
2387.110	26.1	0.0	1.0	123.0	3.0	20.0	Vert	AV	0.0	46.1	54.0	-7.9	Low Ch, On Side
2387.075	26.1	0.0	1.0	273.0	3.0	20.0	Horz	AV	0.0	46.1	54.0	-7.9	Low Ch, On End
2483.560	40.0	0.0	1.8	274.0	3.0	20.0	Vert	PK	0.0	60.0	74.0	-14.0	High Ch, Flat
2483.635	39.4	0.0	3.4	254.0	3.0	20.0	Vert	PK	0.0	59.4	74.0	-14.6	High Ch, On End
2389.735	39.4	0.0	1.0	273.0	3.0	20.0	Horz	PK	0.0	59.4	74.0	-14.6	Low Ch, On End
2388.000	39.4	0.0	1.0	89.0	3.0	20.0	Horz	PK	0.0	59.4	74.0	-14.6	Low Ch, Flat
2387.370	39.1	0.0	1.8	282.0	3.0	20.0	Vert	PK	0.0	59.1	74.0	-14.9	Low Ch, Flat
2486.130	39.0	0.0	3.7	200.0	3.0	20.0	Horz	PK	0.0	59.0	74.0	-15.0	High Ch, Flat
2483.935	39.0	0.0	2.3	291.0	3.0	20.0	Horz	PK	0.0	59.0	74.0	-15.0	High Ch, On Side
2388.280	38.9	0.0	1.0	123.0	3.0	20.0	Vert	PK	0.0	58.9	74.0	-15.1	Low Ch, On Side
2389.455	38.7	0.0	3.3	300.0	3.0	20.0	Vert	PK	0.0	58.7	74.0	-15.3	Low Ch, On End
2484.815	38.6	0.0	4.0	260.0	3.0	20.0	Horz	PK	0.0	58.6	74.0	-15.4	High Ch, On End
2389.935	38.5	0.0	1.0	289.0	3.0	20.0	Horz	PK	0.0	58.5	74.0	-15.5	Low Ch, On Side