

COMPLIANCE WORLDWIDE INC. TEST REPORT 240-18

**In Accordance with the Requirements of
ETSI EN 302 065-2 V2.1.1 (2016-11)
Short Range Devices (SRD) using Ultra Wide Band technology (UWB)
Harmonized Standard covering the essential requirements of article
3.2 of the Directive 2014/53/EU
Part 2: Requirements for UWB location tracking
LT1 Equipment operating from 6-9 GHz**

Issued to

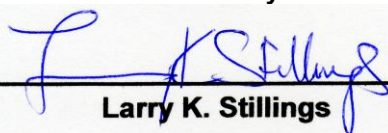
**DecaWave Ltd.
Adelaide Chambers, Peter Street
Dublin, Ireland D08 T6YA**

For the

DWM1001


Report Issued on September 28, 2018

Tested By

A blue ink signature of Larry K. Stillings, written over a horizontal line.

Larry K. Stillings

Reviewed By

A black ink signature of Brian F. Breault, written over a horizontal line.

Brian F. Breault

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1. Scope

This test report certifies that Decawave Ltd DWM1001, as tested, meets the ETSI EN 302 065-2 requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required.

2. Product Details

- 2.1. Manufacturer:** Decawave Ltd
- 2.2. Model Number:** DWM1001
- 2.3. Serial Number:** 18230049E4
- 2.4. Description:** The DWM1001 RTLS Module is a full-function real-time location system (or RTLS) subsystem in a compact factor. The DWM1001 module system enables customers to quickly get a RTLS system up-and-running. The system is design to operate on 6.490 GHz (Channel 5) Centre Frequencies Nominal with a 500 MHz Bandwidth and a data rate of 6.8 Mbps only.
- 2.5. Power Source:** 2.8 - 3.6 VDC
- 2.6. Hardware Revision:** N/A
- 2.7. Software Revision:** N/A
- 2.8. Modulation Type:** Pulse Modulation, Frequency Hopping
- 2.9. Operating Frequency:** CH 5 – 6.49 GHz Nominal
- 2.10. EMC Modifications:** None

3. Product Configuration

3.1 Operational Characteristics & Software

Using a terminal emulator the DWM1001 was configured to transmit on Channel 5 using a preamble length of 128, a 64M PRF with a data rate of 6.8 MBPS.

3.2. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Freq (Hz)	Description/Function
Decawave	DWM1001	18230049E4	3.6	DC	UWB/BLE Module

3.3. EUT Cables/Transducers

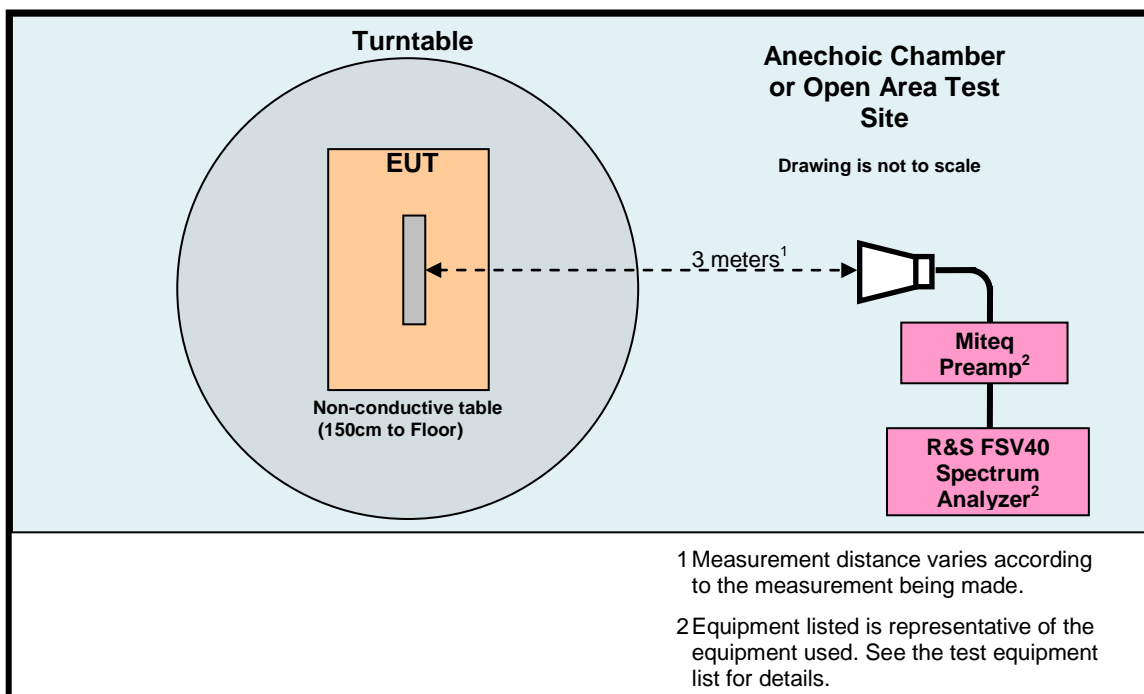
Cable Type	Length	Shield	From	To
None				

3. Product Configuration (continued)

3.4. Support Equipment

Manufacturer	Model/Part # / Options	Serial Number	Input Voltage	Freq (Hz)	Description/Function
Dell	Inspiron E1505	5573349937	N/A	-	For setting up the DUT operation. Not used during testing.

3.5. Test Setup Diagram



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4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Interval
Spectrum Analyzer 10 Hz to 40 GHz	Rohde & Schwarz	FSVR40	100909	5/3/2019	2 Years
Spectrum Analyzer 3 Hz to 26.5 GHz	Rohde & Schwarz	FSW26	102057	12/7/2018	2 Years
Bilog Antenna 30 to 2000 MHz	Sunol Sciences	JB1	A050913	6/3/2019	3 Years
Preamplifier 100 MHz to 7 GHz	Miteq	AFS3-00100200-10-15P-4	988773	4/17/2020	2 Years
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D-00101800-30-10P	1953081	4/16/2019	1 Year
084 Preamplifier 1 to 26.5 GHz	Hewlett Packard	8449B	3008A01323	9/11/2020	2 Years
279 Preamplifier 1 to 26.5 GHz	Hewlett Packard	8449B H02	3008A00329	9/11/2020	2 Years
Preamplifier 18 to 40 GHz	Avantek	AWT-40039	FM22038832	3/19/2019	1 Year
Horn Antenna 1 to 18 GHz	ETS-Lindgren	3117	00143292	2/22/2019	3 Years
082 Horn Antenna 18 to 40 GHz	Com Power	AH-840	3075	10/11/2018	2 Years
High Pass Filter 8 to 18 GHz	Micro-Tronics	HPM50107	G036	7/20/2019	1 Year
Barometer	Control Company	4195	Cal ID# 236	10/8/2018	2 Years

¹ ESR7 Firmware revision: V3.36, SP2 Date installed: 11/02/2017 Previous V3.36, installed 05/16/2017.
² FSV40 Firmware revision: V2.30 SP4, Date installed: 05/04/2016 Previous V2.30 SP1, installed 10/22/2014.
³ FSVR40 Firmware revision: V2.23 SP1, Date installed: 08/19/2016 Previous V2.23, installed 10/20/2014.
⁴ FSW26 Firmware revision: V3.21, Date installed: 9/24/2018 Previous V3.20, installed 9/5/2018.

4. Measurements Parameters (continued)**4.2. Measurement & Equipment Setup**

Test Dates:	9/18/2018, 9/26/2018, 9/28/2018, 10/1/2018
Test Engineers:	Larry Stillings
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	35
Frequency Range:	30 MHz to 18 GHz (40 GHz)
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	100 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth (min):	300 kHz - 30 MHz to 1 GHz 3 MHz - Above 1 GHz
Detector Function:	Peak, Quasi-Peak & Average, RMS Power

4.3. Measurement Procedure

Test measurements were made in accordance with ETSI EN 302 065-2 V2.1.1 and ETSI TS 102 883 V1.1.1.

4.4. Measurement Uncertainty

The following uncertainties are expressed for an expansion/coverage factor of K=2.

RF Frequency (out of band)	$\pm 1 \times 10^{-8}$
Radiated Emission of Transmitter to 100 GHz	± 4.55 dB
Radiated Emission of Receiver	± 4.55 dB
Temperature	$\pm 0.91^{\circ}$ C
Humidity	$\pm 5\%$

5. Measurements Summary

Test Requirement	ETSI EN 302 065-2 Clause	Test Report Section	Result	Comment
Operating Bandwidth	4.3.1	6.1	Compliant	EN 303 883 Clause 7.2.2
Maximum Value of Mean Power Spectral Density	4.3.2	6.2	Compliant	EN 303 883 Clause 7.2.3
Maximum Value of Peak Power	4.3.3	6.3	Compliant	EN 303 883 Clause 7.2.4
Other Emissions	4.3.6	6.4	Compliant	EN 303 883 Clauses 7.2.5 and 7.3
Receiver Spurious Emissions	4.4.2	6.5	N/A	Applies only to receive only equipment
Receiver interference Handling	4.4.3	6.6	Compliant	TS 103 361 Clauses 9.2.1 and 9.4
Detect And Avoid (DAA)	4.5.1	n/a	N/A	The EUT does not implement DAA
Low Duty Cycle (LDC)	4.5.3	n/a	N/A	Only applicable for LT2 and LAES systems
Antenna Requirements	4.6	n/a	N/A	Only applicable for fixed LT2 equipment
Other Requirements and Mitigation Techniques	4.7	n/a	N/A	Additional site registration requirements apply to LT2 and LAES terminals
Application Form for Testing	5.2.1, 4.3, 4.4, 4.5, 4.6	7.0	Compliant	

6. Measurement Data (continued)

6.1. Operation Bandwidth

Requirement: Operating Bandwidth(s) is/are the frequency range(s) bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L . The frequency at which the highest radiated mean power spectral density emission occurs is designated f_M .

Any operating bandwidth of the DUT shall lie within one permitted frequency range of operate of the device and shall be > 50 MHz.

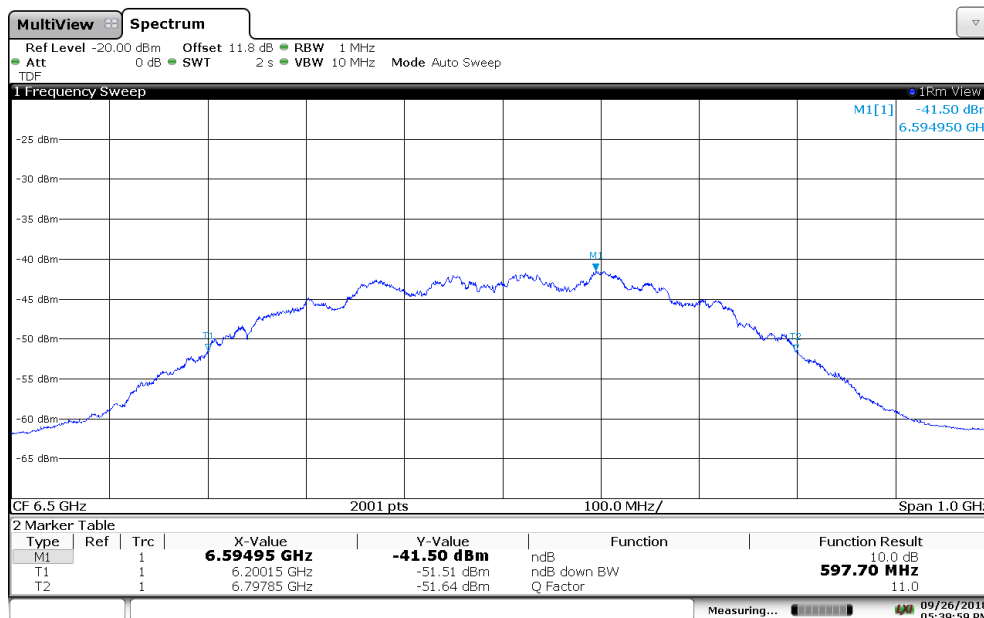
In addition of the lowest and highest frequency divided by two is the center frequency F_C which shall be recorded.

Result: Compliant

f_M	The highest emission peak GHz	6.59495
f_L	10 dB below the highest peak GHz	6.20015
f_H	10 dB above the highest peak GHz	6.79785
f_C	Calculated: $(f_H + f_L)/2$ (GHz)	6.49900
Bandwidth	Calculated: $(f_H - f_L)$ (MHz)	597.70

6.1.1 Plot of Operation Bandwidth

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05:39:59 PM 09/26/2018

6. Measurement Data (continued)

6.2. Mean Power Spectral Density

Requirement: The maximum value of mean power spectral density (e.i.r.p. in (dBm / MHz). The limits for LT1 and LT2 Equipment without DAA function is outlined in the tables below.

Result: Compliant

Mean Power Spectral Density Limit for LT1 Equipment without DAA

Frequency (GHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/m)
<= 1.6	-90	5.2
1.6 to 2.7	-85	10.2
2.7 to 3.1	-70	25.2
3.1 to 3.4	-70	25.2
3.4 to 3.8	-80	15.2
3.8 to 4.8	-70	25.2
4.8 to 6.0	-70	25.2
6.0 to 8.5	-41.3	53.9
8.5 to 9.0	-65	30.2
9.0 to 10.6	-65	30.2
> 10.6	-85	10.2

Mean Power Spectral Density Limit for LT2 Equipment without DAA

Frequency (GHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/m)
<= 1.6	-90	5.2
1.6 to 2.7	-85	10.2
2.7 to 3.1	-70	25.2
3.1 to 3.4	-70	25.2
3.4 to 3.8	-41.3	53.9
3.8 to 4.8	-41.3	53.9
4.8 to 6.0	-70	25.2
6.0 to 10.6	-70	25.2
> 10.6	-85	10.2

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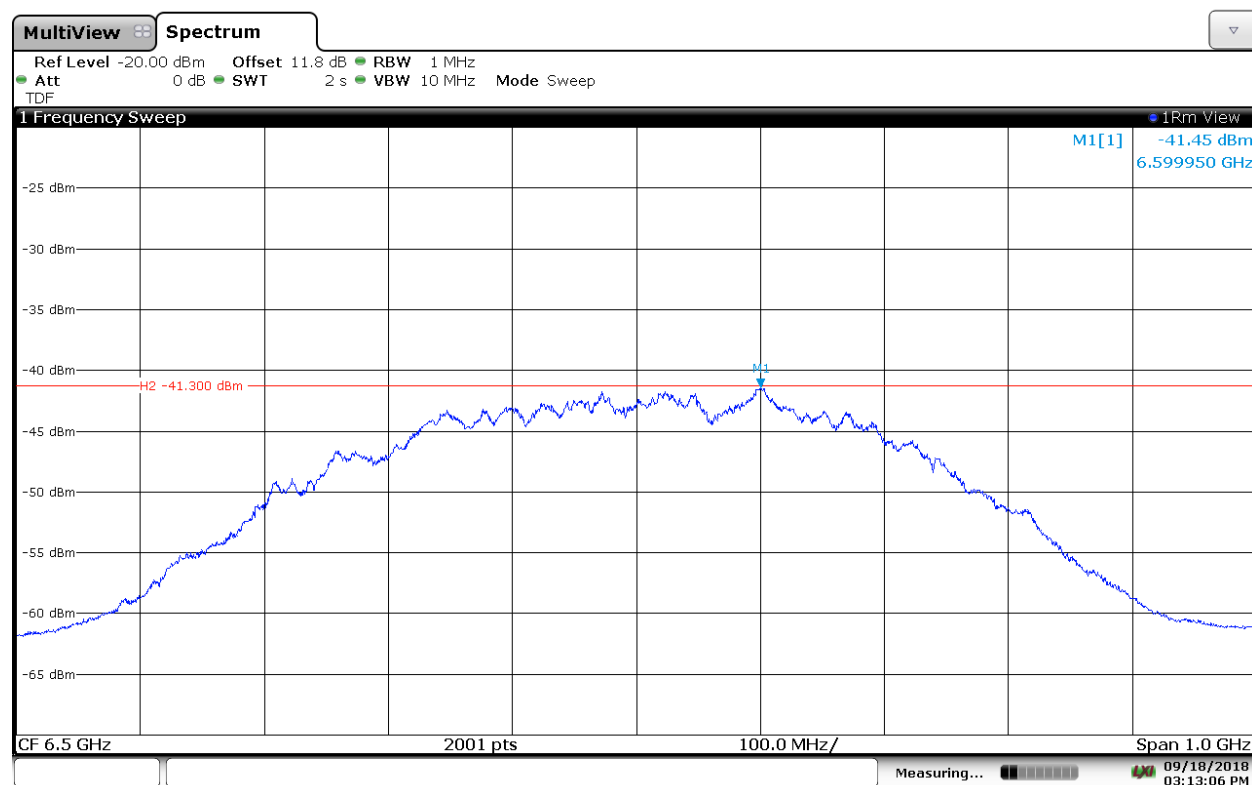
Issue Date: 9/28/2018

6. Measurement Data (continued)

6.2. Mean Power Spectral Density

6.2.1 Plot of Mean Power Spectral Density

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03:13:07 PM 09/18/2018

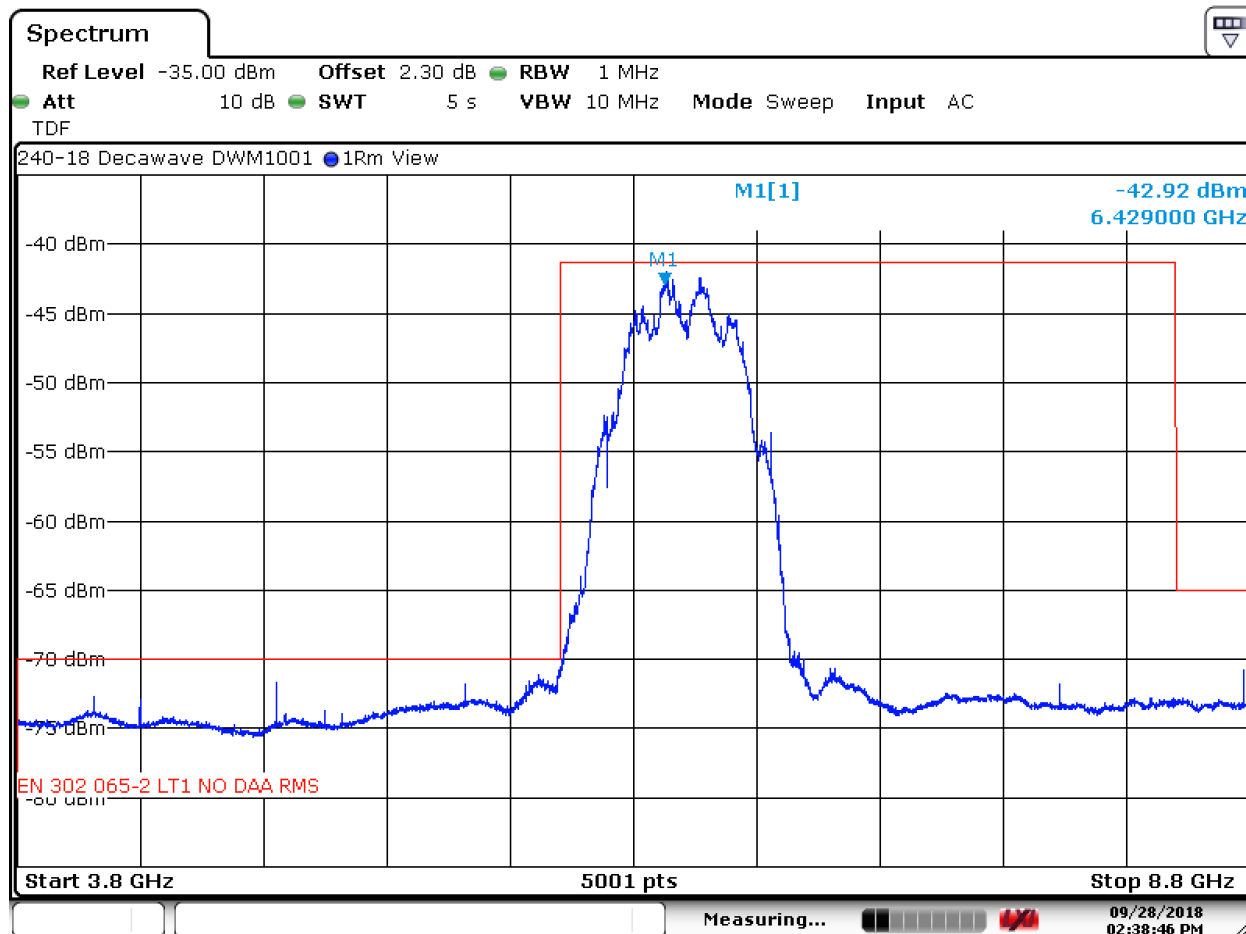
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.2. Mean Power Spectral Density (continued)

6.2.2 Plot of Mean Power Spectral Density Horizontal out of band at 1 Meter



Date: 28.SEP.2018 14:38:43

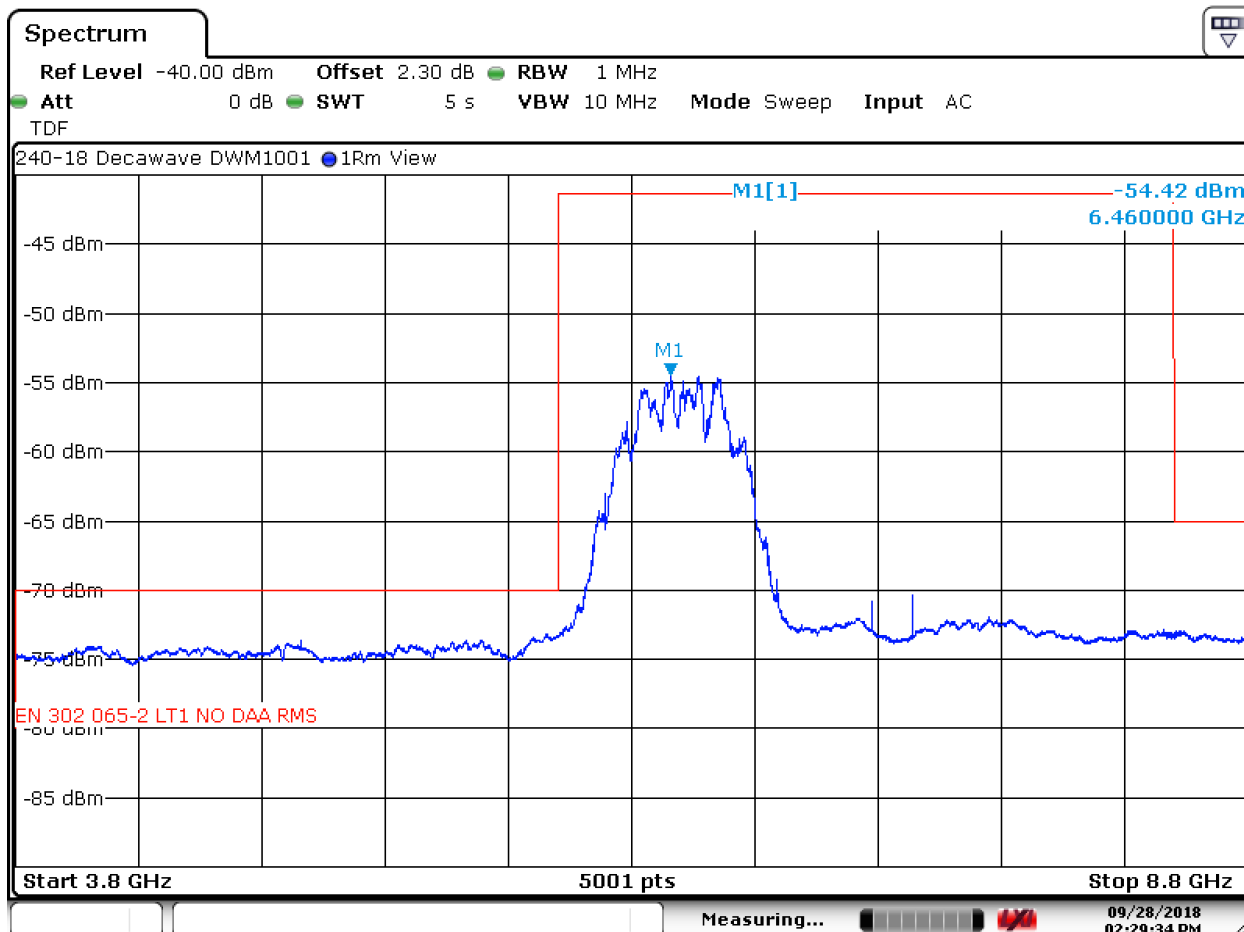
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.2. Mean Power Spectral Density (continued)

6.2.3 Plot of Mean Power Spectral Density Vertical out of band at 1 Meter



Date: 28.SEP.2018 14:29:31

6. Measurement Data (continued)

6.3. Maximum Value of Peak Power

Requirement: The maximum value of peak power spectral density in (dBm / 50 MHz).
The limits for LT1 and LT2 equipment without DAA function is outlined in the tables below.

Maximum Peak Power Limit for LT1 Equipment without DAA

Frequency (GHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/m)
<= 1.6	-50	45.2
1.6 to 2.7	-45	50.2
2.7 to 3.1	-36	59.2
3.1 to 3.4	-36	59.2
3.4 to 3.8	-50	45.2
3.8 to 4.8	-30	65.2
4.8 to 6.0	-30	65.2
6.0 to 8.5	0	95.2
8.5 to 9.0	-25	70.2
9.0 to 10.6	-25	70.2
> 10.6	-45	50.2

Maximum Peak Power Limit for LT2 Equipment without DAA

Frequency (GHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/m)
<= 1.6	-50	45.2
1.6 to 2.7	-45	50.2
2.7 to 3.1	-36	59.2
3.1 to 3.4	-36	59.2
3.4 to 3.8	0	95.2
3.8 to 4.8	0	95.2
4.8 to 6.0	-30	65.2
6.0 to 10.6	-30	65.2
> 10.6	-45	50.2

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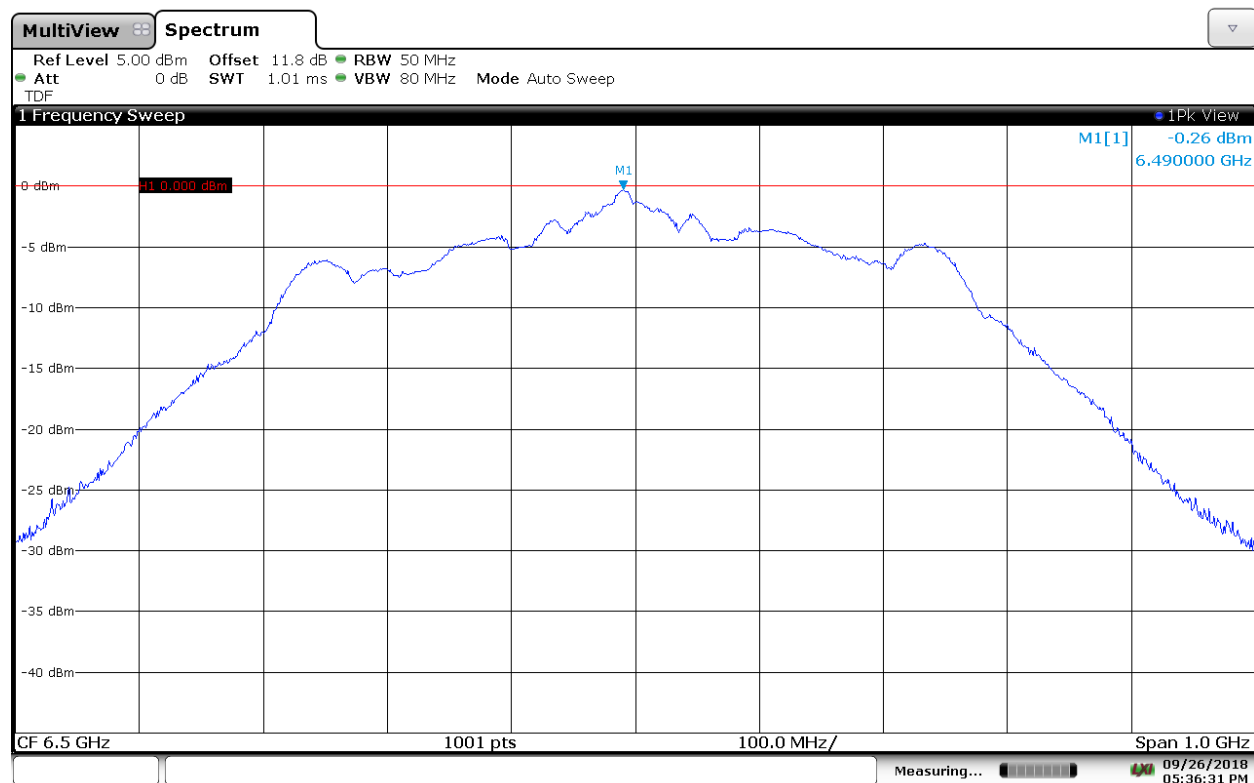
Issue Date: 9/28/2018

6. Measurement Data (continued)

6.3. Maximum Value of Peak Power

6.3.1 Plot of Maximum Value of Peak Power

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6. Measurement Data (continued)

6.4. Other Emissions

Requirement: Applies only to equipment whose emissions in transmit mode do not meet the appropriate UWB regulations. Other Emissions (OE) can be determined by disabling the UWB emissions.

Result: Compliant

Note: There were no UWB (UE) signals that were over the limit(s).

Limits:

Frequency Range	Limit Values for Other Emissions (OE)	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 40 GHz	-30 dBm (see note)	1 MHz

Note: Not applicable for UE emissions within the permitted range of frequencies

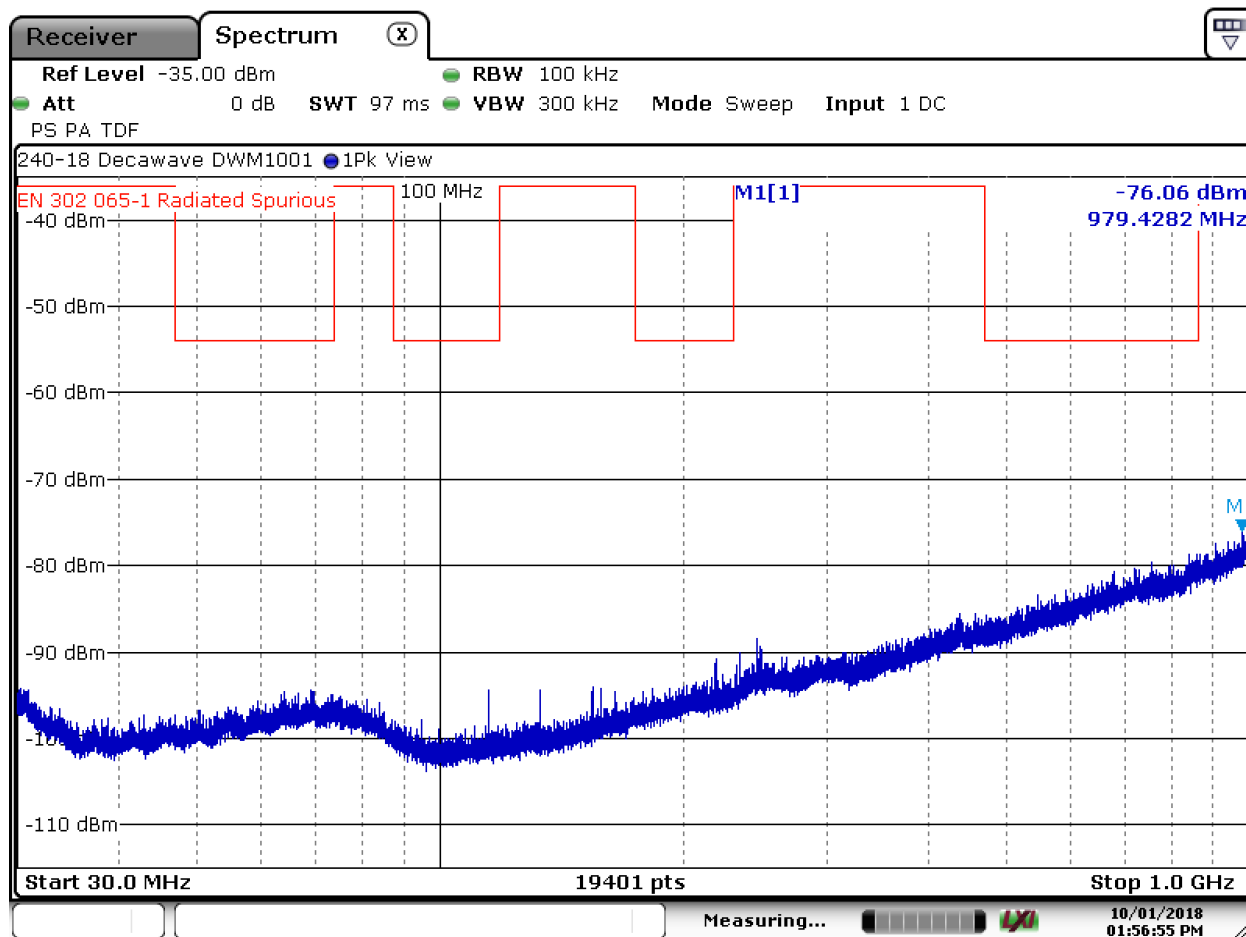
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.4. Other Emissions (continued)

6.4.1. 30 to 1000 MHz Horizontal Measurement Polarity



Date: 1.OCT.2018 13:56:55

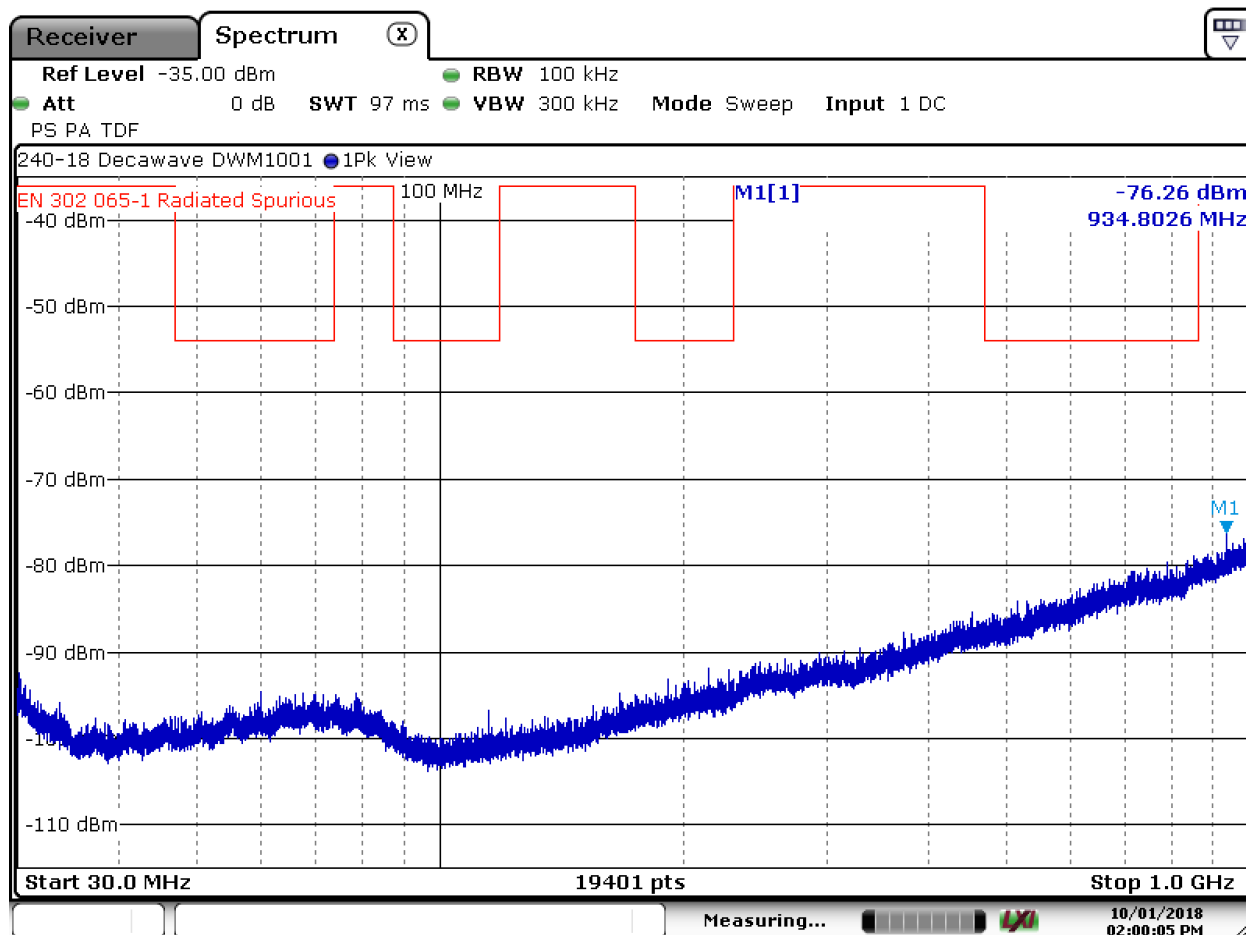
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.4. Other Emissions (continued)

6.4.2. 30 to 1000 MHz Vertical Measurement Polarity



Date: 1.OCT.2018 14:00:02

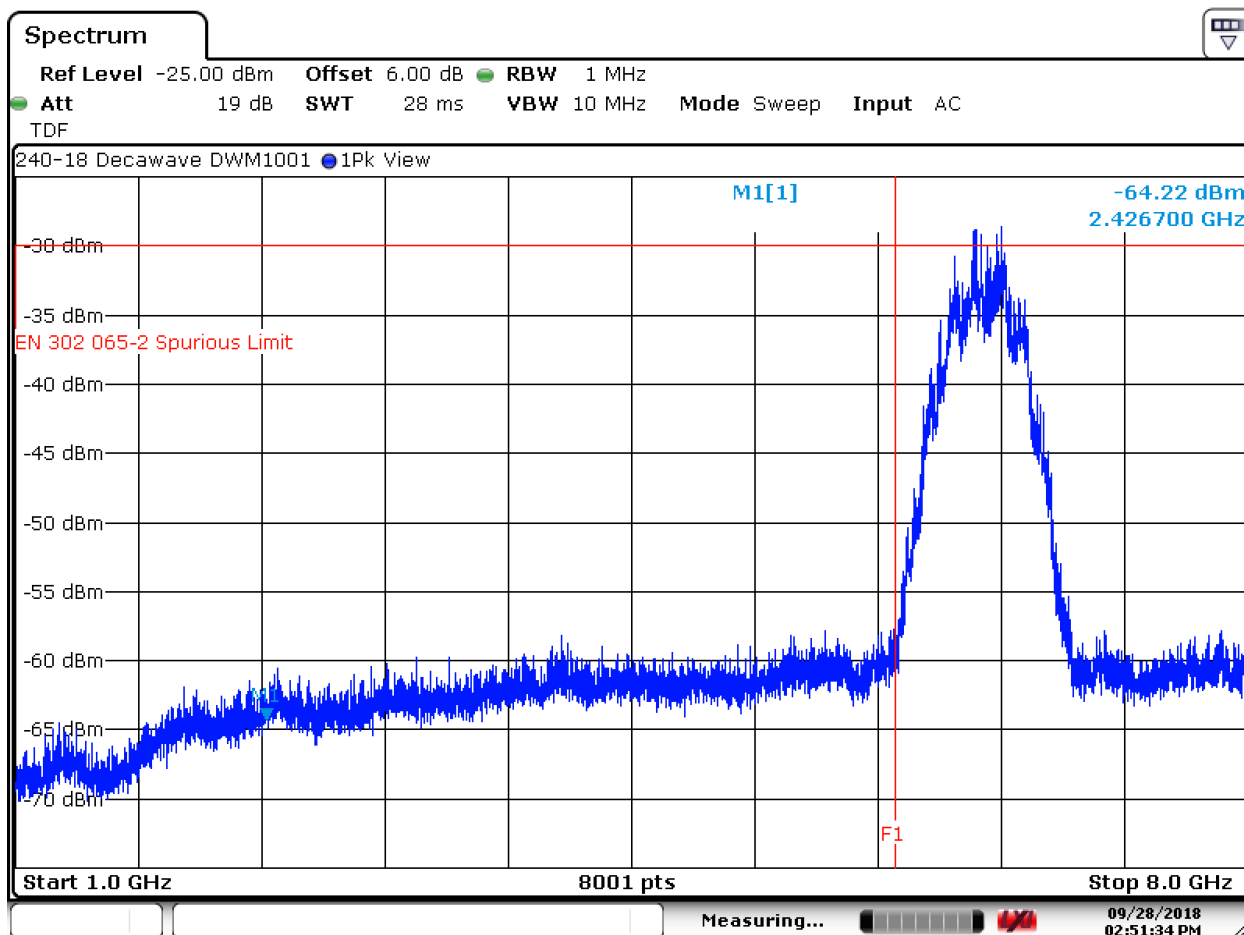
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.4. Other Emissions (continued)

6.4.3. 1 to 8 GHz Horizontal Measurement Polarity, measured at 1.5 Meters



Date: 28.SEP.2018 14:51:30

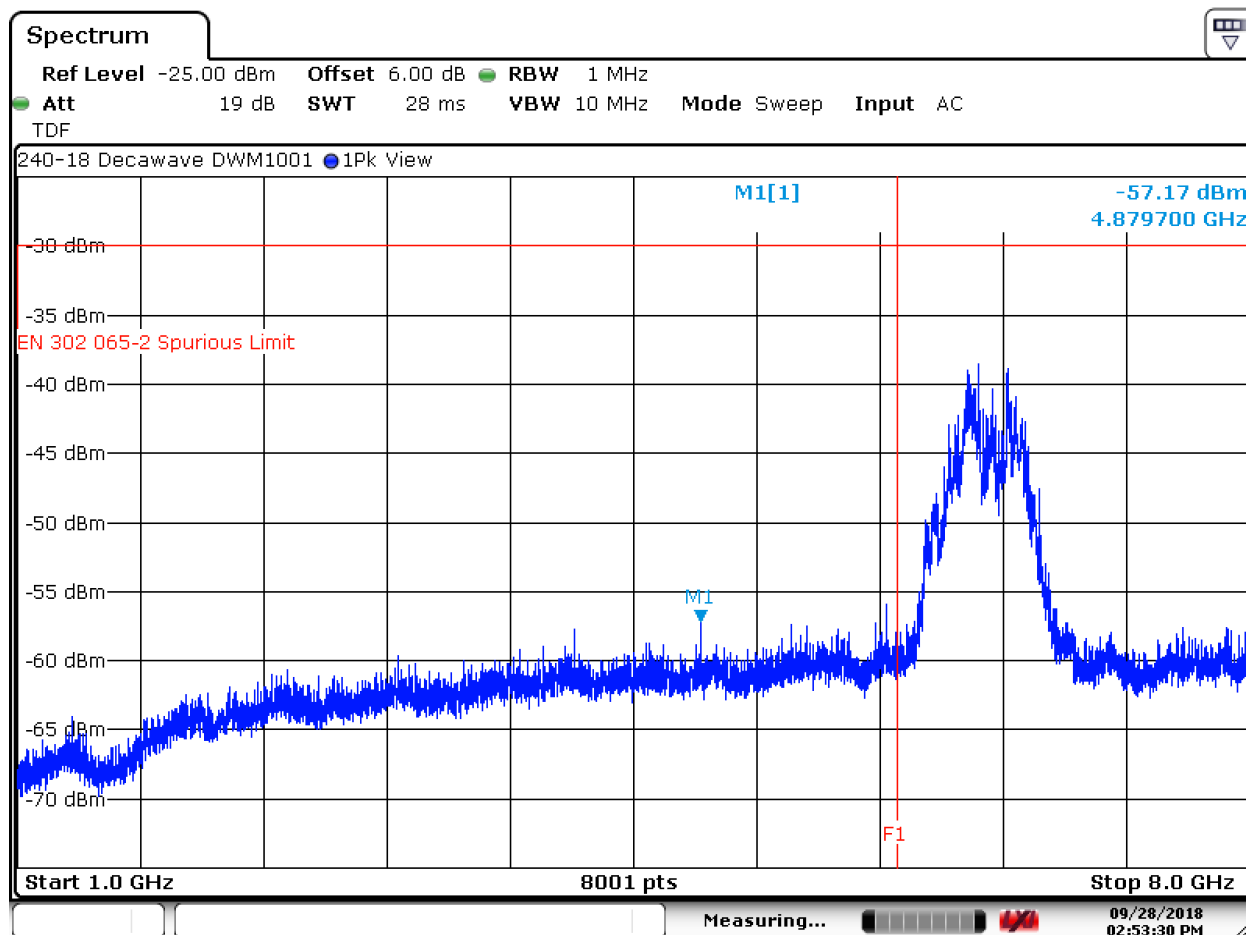
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.4. Other Emissions (continued)

6.4.4. 1 to 8 GHz Vertical Measurement Polarity, measured at 1.5 Meters



Date: 28.SEP.2018 14:53:27

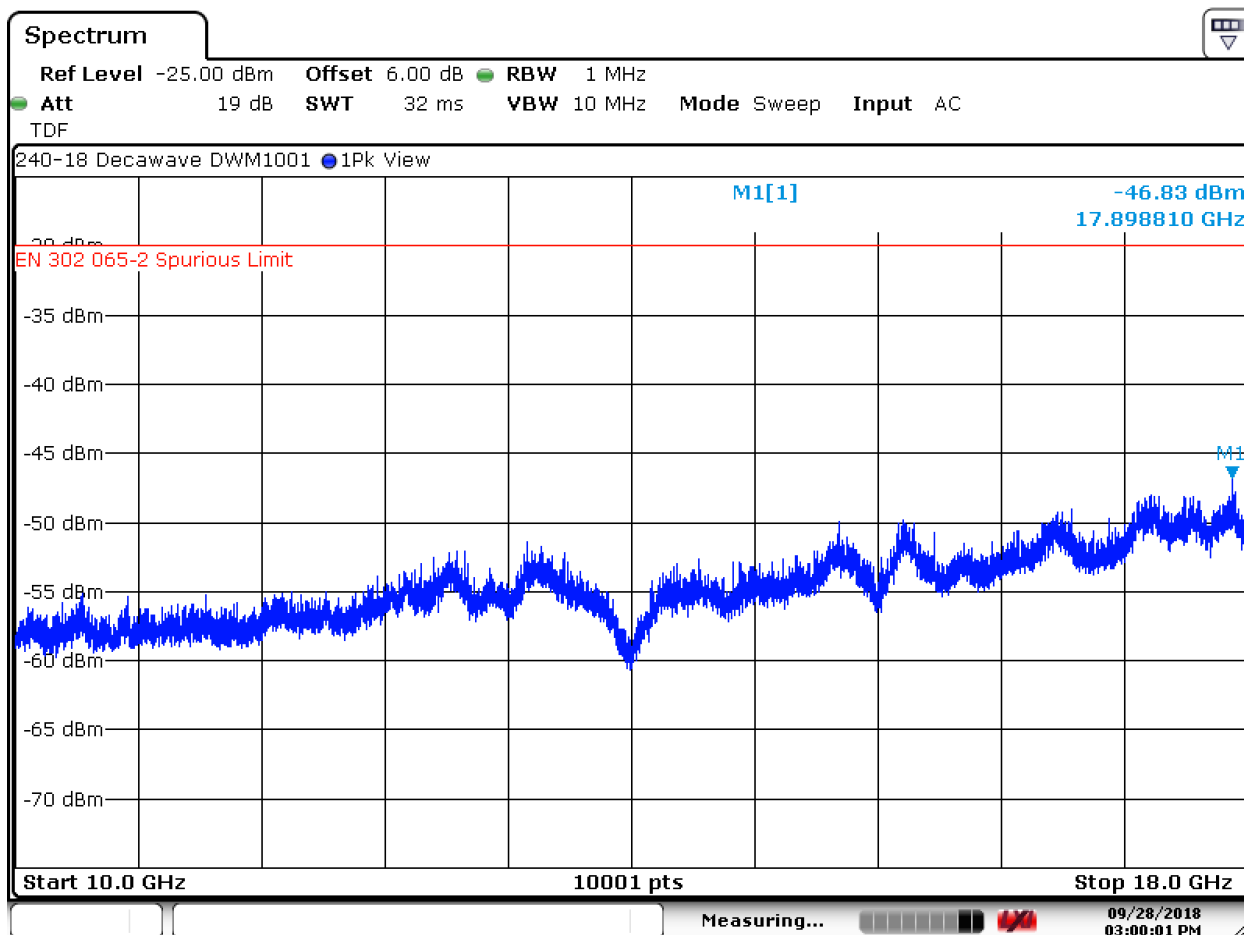
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.4. Other Emissions (continued)

6.4.5. 10 to 18 GHz Horizontal Measurement Polarity, measured at 1.5 Meters



Date: 28.SEP.2018 14:59:58

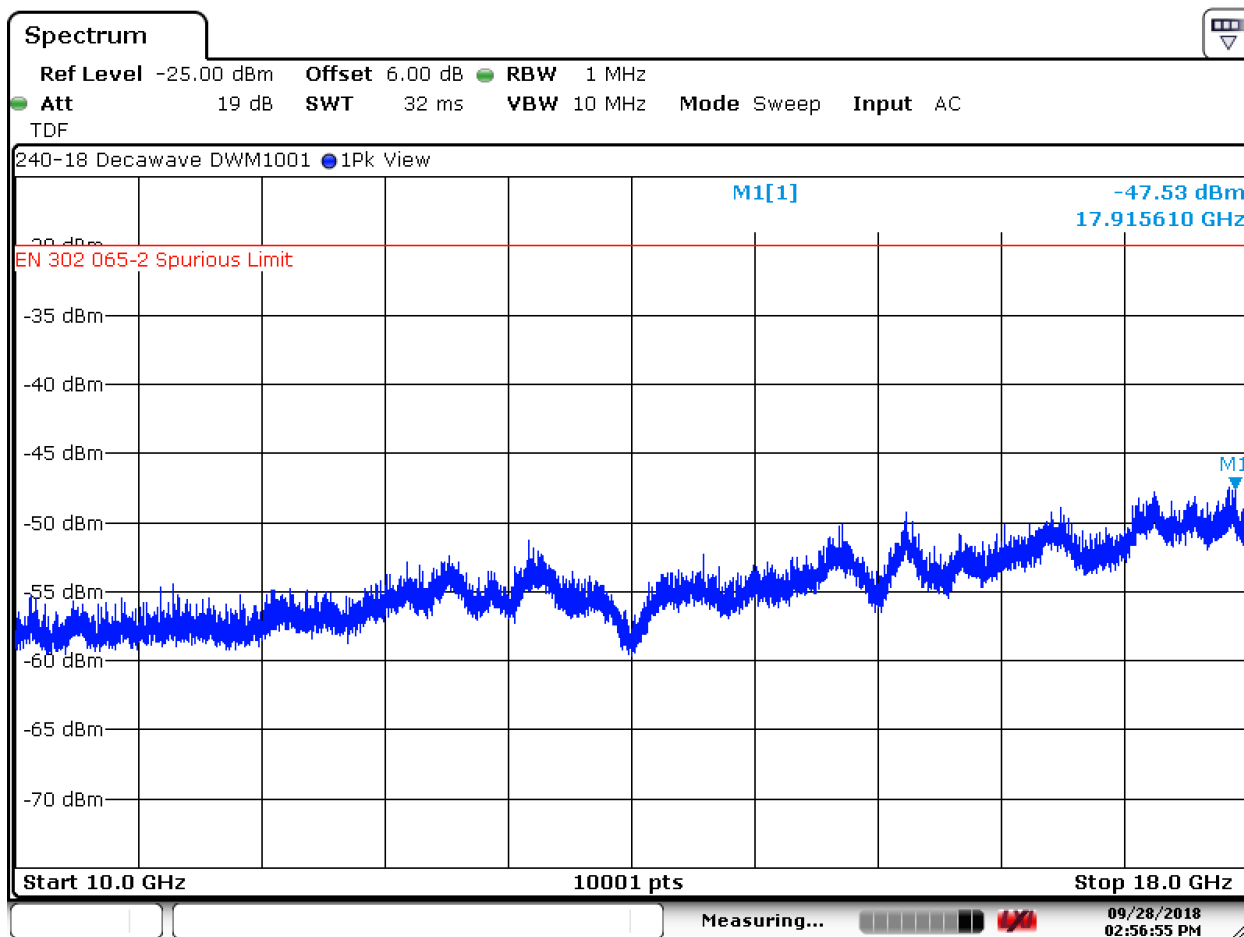
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.4. Other Emissions (continued)

6.4.6. 10 to 18 GHz Vertical Measurement Polarity, measured at 1.5 Meters



Date: 28.SEP.2018 14:56:52

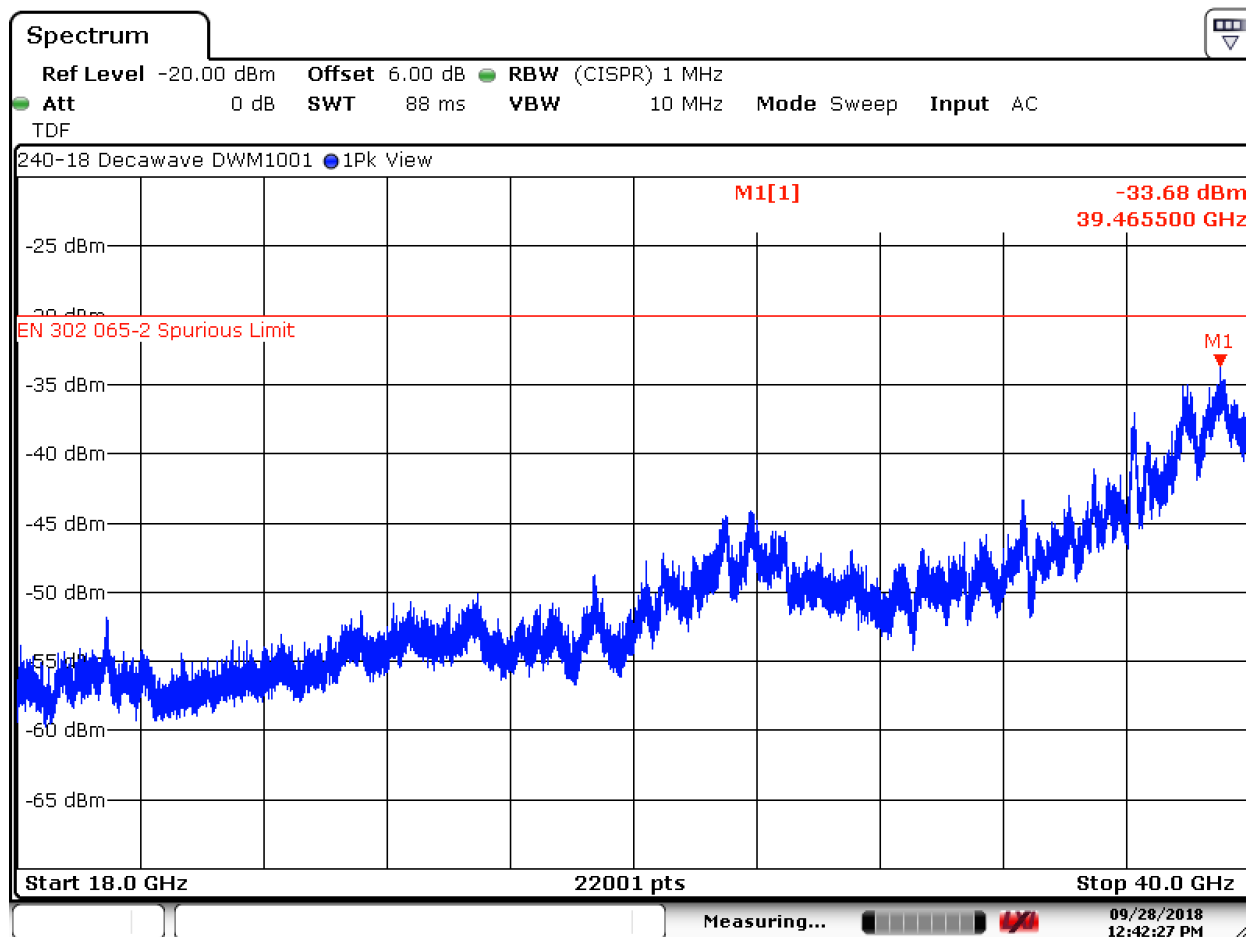
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.4. Other Emissions (continued)

6.4.7. 18 to 40 GHz Horizontal Measurement Polarity



Date: 28.SEP.2018 12:42:27

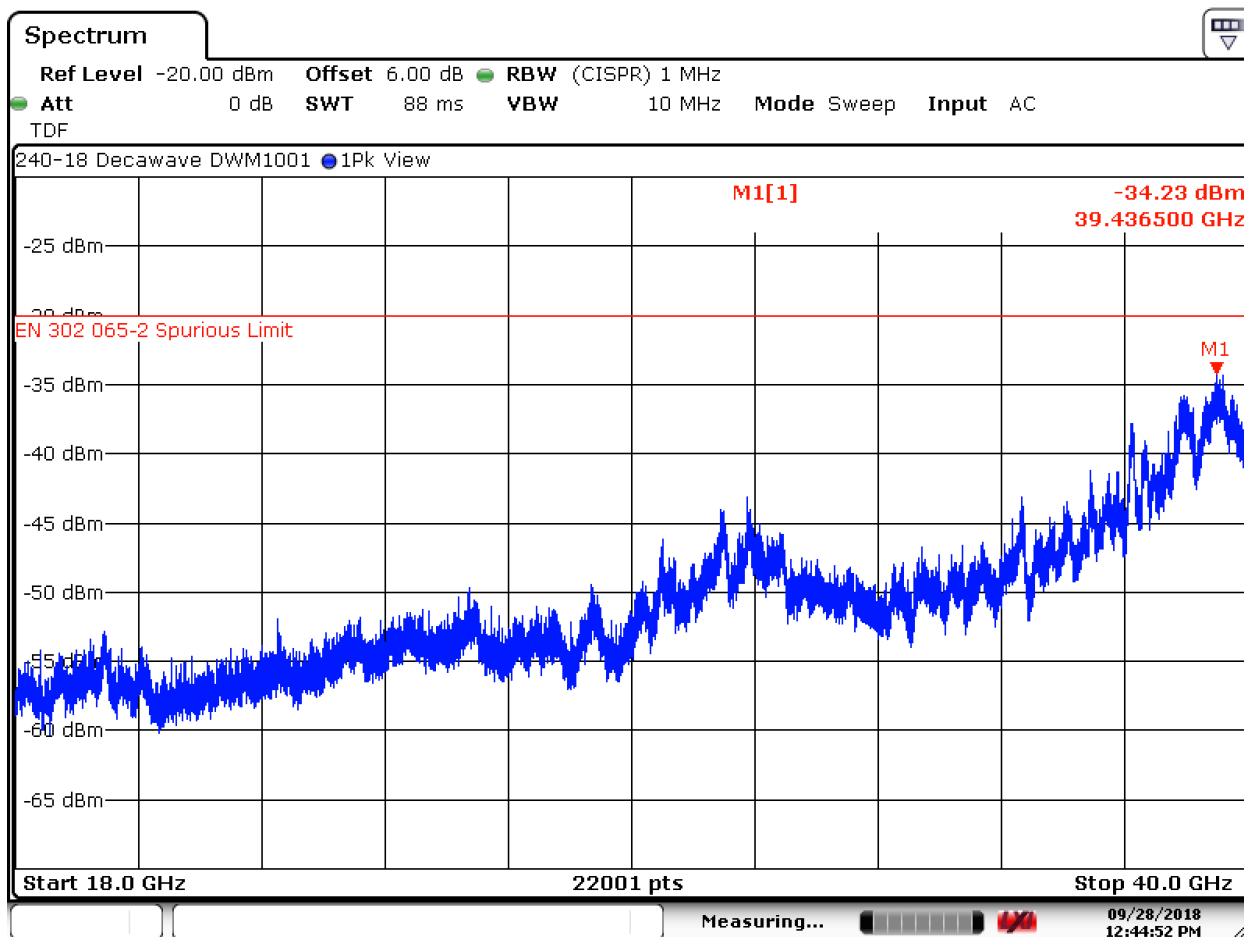
Test Number: 240-18

Issue Date: 9/28/2018

6. Measurement Data (continued)

6.4. Other Emissions (continued)

6.4.8. 18 to 40 GHz Vertical Measurement Polarity



Date: 28.SEP.2018 12:44:51

6. Measurement Data (continued)

6.5. Receiver Spurious Emissions

Requirement: Applies only to equipment that can be operated in a receive-only mode or is a receive-only device. Measurements shall be carried out over the frequency range from 30 MHz to 40 GHz.

Result: Compliant

Note: The device does not operate in a receive-only mode.

Limits:

Narrowband Spurious Emissions

Frequency Range	Maximum Power, ERP (≤ 1 GHz) EIRP (> 1 GHz)	Bandwidth
30 MHz to 1000 MHz	-57 dBm	100 kHz
1 GHz to 40 GHz	-47 dBm	1 MHz

Wideband Spurious Emissions

Frequency Range	Maximum Power, ERP (≤ 1 GHz) EIRP (> 1 GHz)	Bandwidth
30 MHz to 1000 MHz	-47 dBm	100 kHz
1 GHz to 40 GHz	-37 dBm	1 MHz

6. Measurement Data (continued)**6.6. Receiver Interference Handling**

Requirement: Interferer signal handling, defined as the capability of the device to operate as intended in the presence of interferers, is the receiver parameter for UWB applications.

Operation as intended is evaluated using a performance criterion. Section 9.4.6 for Communications device of ETSI TS 103 361 defines a methodology for determining a performance criterion, however telecommunications standards do not exist for UWB communication, therefore performance level shall be provided by the manufacturer.

Result: Compliant

Maximum Operational Bandwidth of the device from Section 6.1:

6.200 to 6.798 GHz

Largest 3 Interferers within the largest Occupied BW of the device as defined in ETSI TS103 361 V1.1.1 Section 7.4 Table 3, Section 7.5 Table 4, and Section 7.6 Table 7 shall be used as defined in Section 9.3.

There are no interferers defined in the above referenced tables within the 6.200 to 6.798 GHz operation band of the device.

7. Application Form for Testing

The application form should be an integral part of the test report.

7.1 General Information as required by ETSI EN 302 065-2, Clause 5.2.1

7.1.1 Type of equipment (stand-alone, combined, plug-in radio device, etc.)

- ☒ Stand-alone
- ☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)
- ☐ Plug-in radio device (Equipment intended for a variety of host systems)
- ☐ Other

7.1.2 The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices

Details provided are for the: ☒ stand-alone equipment
☐ combined (or host) equipment
☐ test jig

Supply Voltage ☐ AC mains State AC voltage V
☒ DC State DC voltage 2.8-3.6 V

In case of DC, indicate the type of power source
☐ Internal Power Supply
☐ External Power Supply or AC/DC adapter
☒ Battery
☐ Other:

7.2 Signal-related information as required by ETSI EN 302 065-2, Clause 4.3

7.2.1 Operating Bandwidth(s) of the equipment

- Operating Bandwidth 1: 6200 MHz to 6798 MHz

7.2.2 The worst case mode for each of the following tests

- Operating Bandwidth(s)
One Mode of Operation
- Mean Power Spectral Density / Peak Power Spectral Density / Exterior Limits / Total Power
/ Other Emissions / Transmitter unwanted emissions
One Mode of Operation

7. Application Form for Testing (continued)

7.3 RX test Information as required by ETSI EN 302 065-2, Clause 4.4

7.3.1 Performance criterion and level of performance - N/A

- performance criterion (e.g. accuracy, sensitivity)
.....
- level of performance (e.g. for accuracy $\pm 10\%$, level of sensitivity)
.....

7.3.2 Interfering Signals – N/A

Frequency [MHz]	Power [dBm]	Type of signal (e.g. CW, CW with DC other modulation)

7.4 Information on spectrum access techniques as required by ETSI EN 302 065-2, clause 4.5

7.4.1 Spectrum Access – N/A

- ☐ DAA
- ☐ LDC
 - a) ☐ Frequency range A
 - ☐ Frequency range B
 - ☐ Frequency range C
 - b) Ton, max
 - c) Toff, mean
 - d) Σ Toff in 1 s
 - e) Σ Ton in 1 h
 - f) Tdis

7. Application Form for Testing (continued)

7.5 Information on antenna requirements as required by ETSI EN 302 065-2, Clause 4.6

7.5.1 Antenna Requirements (Only required for LT2 equipment) – N/A

- ☐ Fixed use
- ☐ Mobile use

For Fixed LT2 equipment:

Description of, and method of identification of vertical axis and upward direction of equipment:

7.6 Additional information provided by the applicant

7.6.1 About the UUT

- X The equipment submitted are representative production models
- ☐ If not, the equipment submitted are pre-production models?
- ☐ If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested
- ☐ If not, supply full details
.....
.....
- ☐ The equipment submitted is CE marked

7.6.2 Additional items and/or supporting equipment provided

- ☐ Spare batteries (e.g. for portable equipment)
- ☐ Battery charging device
- ☐ External Power Supply or AC/DC adapter
- X Test Jig or interface box
- ☐ RF test fixture (for equipment with integrated antennas)
- ☐ Host System Manufacturer:
 Model # :
 Model name:
- ☐ Combined equipment Manufacturer:
 Model # :
 Model name:
- ☐ User Manual
- ☐ Technical documentation (Handbook and circuit diagrams)

8. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with the Federal Communications Commission (FCC) and Industry Canada standards. Through our American Association for Laboratory Accreditation (A2LA) ISO Guide 17025:2005 Accreditation our test sites are designated with the FCC (designation number **US1091**), Industry Canada (file number **IC 3023A-1**) and VCCI (Member number 3168) under registration number A-0274.

Compliance Worldwide is also designated as a Phase 1 CAB under APEC-MRA (US0132) for Australia/New Zealand AS/NZS CISPR 22, Chinese-Taipei (Taiwan) BSMI CNS 13438 and Korea (RRA) KN 11, KN 13, KN 14-1, KN 22, KN 32, KN 61000-6-3, KN 61000-6-4.

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane. A second conducted emissions site is also located in the basement of the OATS site with a 2.3 x 2.5 meter ground plane and a 2.4 x 2.4 meter vertical wall.

Both sites are designed to test products or systems 1.5 meters W x 1.5 meters L x 2.0 meters H, floor standing or table top.

9. Test Images

9.1. Operating Frequency Measurement Setup at 3 Meters - Front



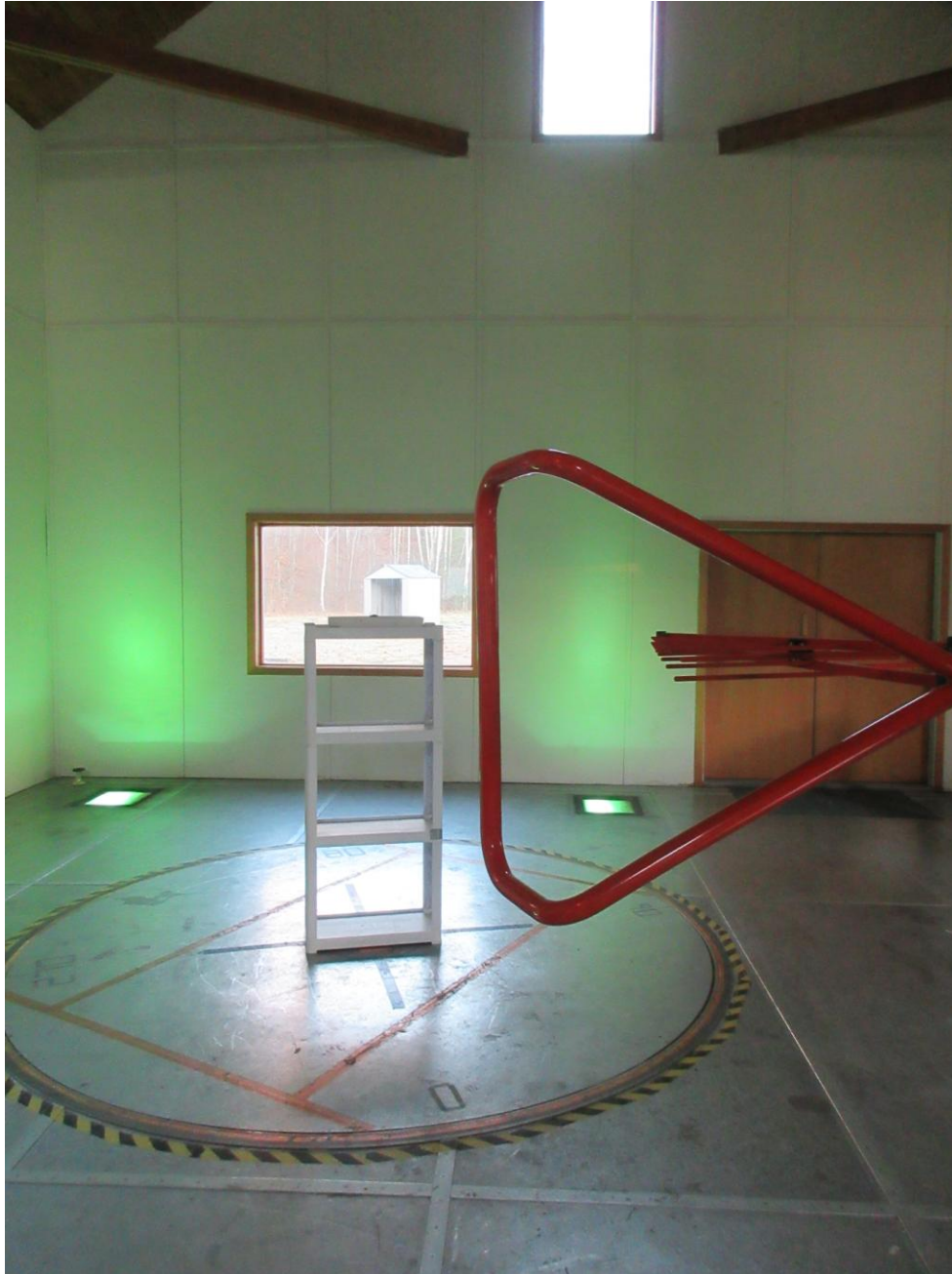
9. Test Images

9.2. Operating Frequency Measurement Setup at 3 Meters - Rear



9. Test Images

9.3. Radiated Spurious Emissions 30 to 1000 MHz at 3 Meters - Front



9. Test Images

9.4. Radiated Spurious Emissions 30 to 1000 MHz at 3 Meters - Rear



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10. Product Images

10.1. EUT – Front/Top View

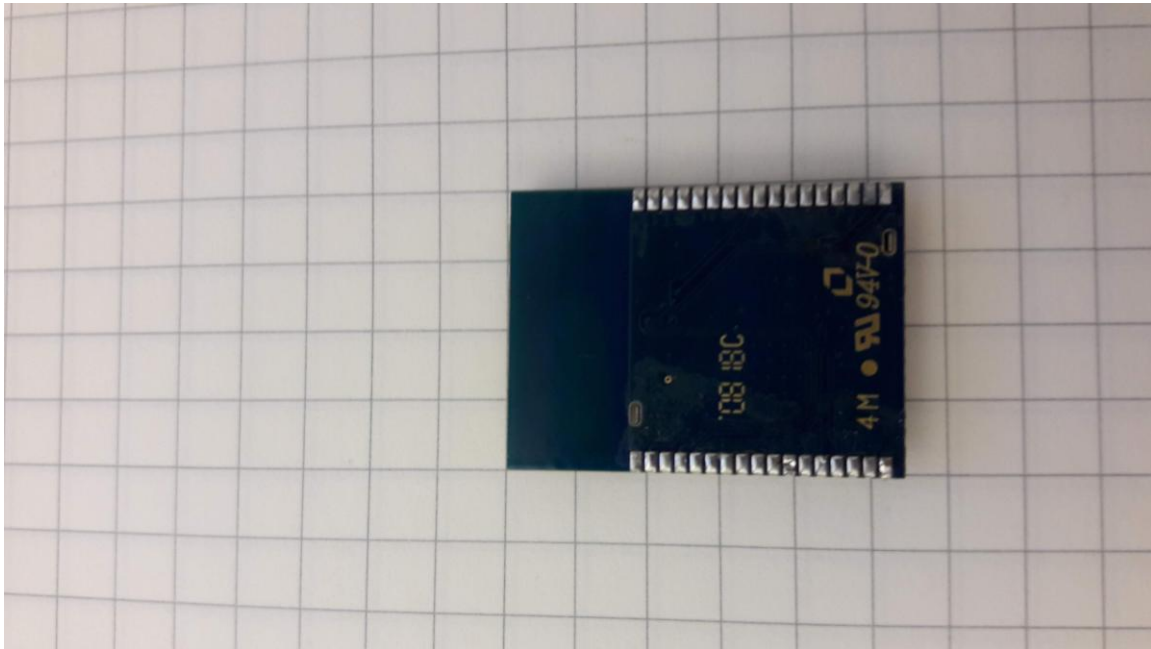


Test Number: 240-18

Issue Date: 9/28/2018

10. Product Images

10.2. EUT – Bottom/Rear View



10. Product Images

10.3. EUT – Top Circuit Board View

