

# TEST REPORT

## No. AR17-0018006-01

performed in accordance with

FCC Rules: Code of Federal Regulations (CFR) no. 47  
Part 15 Subpart F Section 15.509

<b>PRODUCT</b>	Ground penetrating radar
<b>MODEL(s) TESTED</b>	CTHRUE
<b>FCC ID</b>	UFW-CTHRUE
<b>TRADE MARK(s)</b>	IDS GeoRadar S.r.l.

<b>APPLICANT</b>	IDS GeoRadar S.r.l. Via E. Calabresi, 24 – I-56121 PISA
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Tested by	Robertino Torri <i>[Laboratory Technician]</i>	
Approved by	Gianluca Mastrodomenico <i>[Operations Area manager]</i>	

### Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2017-11-14	First edition Digital signed - AR17-0018006-01_TR_FCC Part 15F 15.509_IDS Georadar - Cthru
Rev. 1	2017-11-14	Adjustment after evaluation of reviser Digital signed - AR17-0018006-02 rev.1_TR_IC RSS-200_2009_IDS Georadar - Cthru
Rev. 2	2018-02-22	§ 7.8 RMS detector integration time duration and graphics have been added. Digital signed - AR17-0018006-01 rev.2_TR_FCC Part 15F 15.509_IDS Georadar - Cthru

The results of tests and checks reported in this Test Report refer exclusively to the samples tested and described in the Report itself.

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## 1. GENERAL DATA

SAMPLE		
Samples received on	2017-10-30	(Item(s) sampled and sent by applicant)
IMQ reference samples	BEM	88464
Samples tested No.	1	
Object under analysis recognition	<b>Not carried out</b> Except where stated, characteristics of products were taken from client description and were not verified by the laboratory	
Date of acceptance of test item	2017-10-30	
TEST LOCATION		
Testing dates	2017-10-30 ÷ 2017-11-13	
Testing laboratory.	IMQ S.p.A. - Via Quintiliano, 43 – I-20138 Milano	
Testing site	Viale Lombardia, 20 – I-20021 Bollate (MI)	
ENVIRONMENTAL CONDITIONING		
<i>Parameter</i>	<i>Measured</i>	
Ambient Temperature	18 ÷ 20 °C	
Relative Humidity	45 ÷ 55 %	
Atmospheric Pressure	990 ÷ 1000 mbar	
REMARKS		
Throughout this report a point is used as the decimal separator. The ability or reliability of this product to perform its intended function in a particular application has not been investigated. IMQ declines any responsibility derived from missing or wrong information provided aside by the applicant.		

## 2. REFERENCE DOCUMENT

	DOCUMENT	DATE	TITLE
<input checked="" type="checkbox"/>	47 CFR Part 15	2015	Radio Frequency Device
<input checked="" type="checkbox"/>	ANSI C63.4	2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
<input checked="" type="checkbox"/>	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
<input checked="" type="checkbox"/>	FCC Order, ET Docket No. 98-153 (FCC 02-48)	2002	Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems
<input checked="" type="checkbox"/>	KDB Publication No. 393764	2007	UWB Compliance Measurements

### 3. UNIT UNDER TEST (EUT) DETAILS

#### GENERAL DATA

<b>Model</b>	CTHRUE
<b>FCC ID</b>	UFW-CTHRUE

<b>Manufacturer</b>	IDS GeoRadar S.r.l. Via E. Calabresi, 24 – I-56121 PISA
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<b>EUT classification</b>	Ground penetrating radar (GPR)
<b>General overview</b>	<p>The <b>CTHRUE</b> system is a Ground penetrating radar (GPR) system, i.e., according to the FCC definition, a field disturbance sensor that is designed to operate only when in contact with the ground for the purpose of detecting or obtaining the images of buried objects or determining the physical properties within the ground.</p> <p>The energy from the GPR is intentionally directed down into the ground for this purpose.</p> <p>The <b>CTHRUE</b> product includes</p> <ul style="list-style-type: none"> <li>• The <b>CTHRUE</b> antenna (including two couples of transmitting and receiving dipoles)</li> <li>• The <b>CTHRUE</b> integrated control unit and display.</li> </ul>
<b>Power supply type</b>	DC 15 V 3200 mAh by Li-Ion battery
<b>Operating frequency</b>	1.0 to 2.5 GHz (10 dB Bandwidth)
<b>Channel Spacing</b>	Not applicable
<b>Pulse Repetition Frequency (PRF)</b>	400 KHz
<b>Antenna description</b>	Integral permanently attached
<b>Antenna Type</b>	Dipole

## 4. TEST CONFIGURATION OF UNIT UNDER TEST

### EUT CONFIGURATION

The Equipment under test was powered with a battery and placed directly on the dry sand with no ground plane under it.



### STATE OF THE EUT DURING TESTS

Ref.	Mode	Description
#1	Operating	Continuous transmission with the antenna fitted in a manner typical of normal indented use.

## SUPPORT EQUIPMENT

Defined as equipment needed for correct operation or loading of the EUT, but not considered as tested:

Equipment	Manufacturer	Model
None	/	/

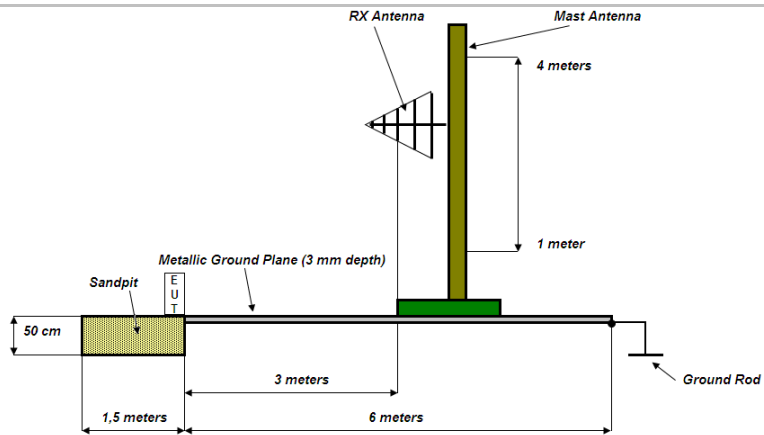
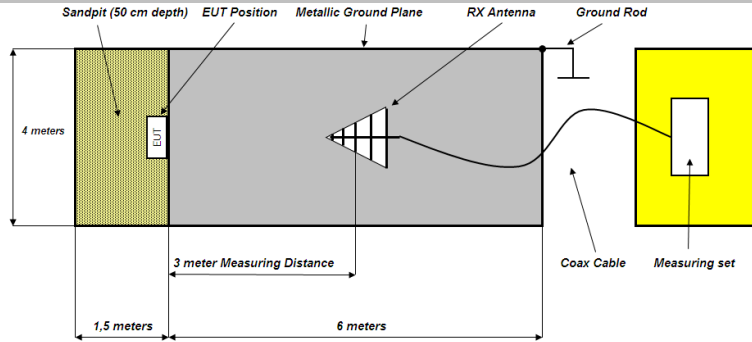
## EUT TECHNICAL DOCUMENTATION

Document	Reference
DAD & antenna block diagrams	/
Safe Rail System User Guide	Protocol: MN/2017/011 rev. 1.0
Technical description of the system	Technical description of the unit - CTHRUE

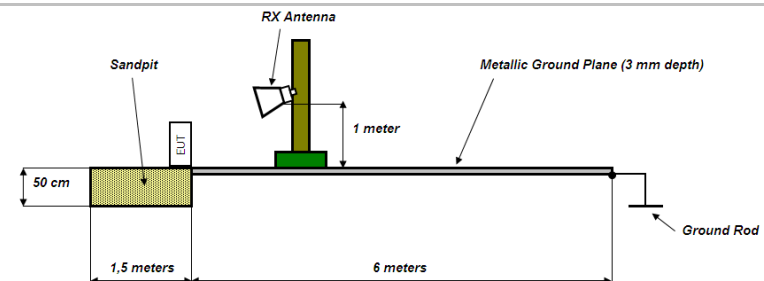
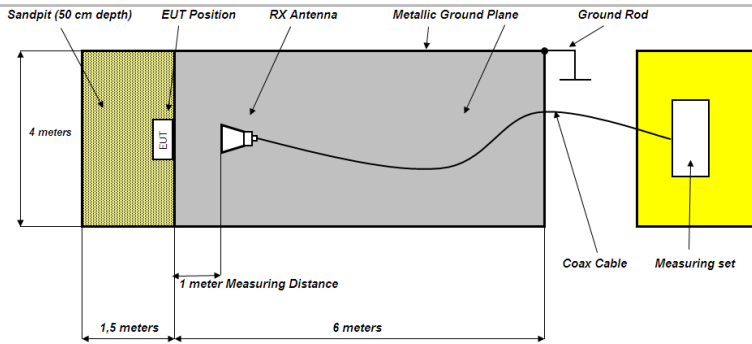
## 5. TEST SET-UP DESCRIPTION

<b>Type of test facilities</b>	Open Area Test Site (OATS) The test site is flat and the level area is clear of overhead wires and reflecting structures, it is sufficiently large to permit measuring antenna placement at specified distance. Adequate spacing distance is assured between the EUT and measuring antenna to any adjacent large reflecting structures.
<b>Test distance</b>	<ul style="list-style-type: none"> <li>• 3 meters measuring distance.</li> <li>• 1 meter above 960 MHz for measurement to device not placed on the ground plane with the antenna pointed in the direction of the radiating head.</li> </ul>
<b>Ground plane</b>	Galvanized sheet steel soldered panels is installed on the floor, electric contact between the individual plates is provided via continues metallic strips. Dimensions: 6.0m x 4.0m x 3.0mm (LxWxD)
<b>Antenna positioner</b>	Semi-Automatic remotely controlled Antenna mast, scan over a range of 1 to 4 meters above the ground plane. Manual antenna polarization change.
<b>Sandpit</b>	2.0m x 4.0m x 50cm (LxWxD) sandpit area filled with dry sand placed in front of the ground plane (test on UWB Ground penetrating radar).

**Drawing**



**Radiated measurement below 960 MHz**



**Radiated measurement above 960 MHz**



## 6. SUMMARY OF TEST RESULTS

### POSSIBLE TEST CASE VERDICTS:

Test object meets the requirement	PASS
Test object does not meet the requirement	FAIL
Test case does not apply to the test object	N.A.
Test not performed	N.P.

CFR47 Part 15	TITLE	RESULT
§ 15.207(a)	Conducted Emission	N.A. <sup>1</sup>
§ 15.505	Cross reference	PASS
§ 15.507	Marketing of UWB equipment	PASS
§ 15.509	Pulse Repetition Frequency (PRF)	PASS
§ 15.509(a)	UWB Bandwidth	PASS
§ 15.509(c)	Transmission duration	PASS
§ 15.509(c) § 15.209	Radiated emission ≤ 960 MHz	PASS
§ 15.509(d)	Radiated emission > 960 MHz	PASS
§ 15.509(e)	Radiated emission in GPS bands	PASS
§ 15.509(f)	Highest radiated emission at $f_M$	PASS
§ 15.521	Technical requirements applicable to all UWB devices	PASS
§ 15.525 § 15.509(b)	Coordination requirement	PASS

<b>Note 1</b>	Port not present, battery operating device
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## 7. TEST RESULTS

### 7.1 CROSS REFERENCE

#### TEST REQUIREMENT

- a) Except where specifically stated otherwise within this subpart, the provisions of Subparts A and B and of Sections 15.201 through 15.204 and Section 15.207 of Subpart C of this part apply to unlicensed UWB intentional radiators. The provisions of Sections 15.35(c) and 15.205 do not apply to devices operated under this subpart. The provisions of Footnote US 246 to the Table of Frequency Allocations contained in Section 2.106 of this chapter does not apply to devices operated under this subpart.
- b) The requirements of Subpart F apply only to the radio transmitter, i.e., the intentional radiator, contained in the UWB device. Other aspects of the operation of a UWB device may be subject to requirements contained elsewhere in this chapter. In particular, a UWB device that contains digital circuitry not directly associated with the operation of the transmitter also is subject to the requirements for unintentional radiators in Subpart B of this chapter. Similarly, an associated receiver that operates (tunes) within the frequency range 30 MHz to 960 MHz is subject to the requirements in Subpart B of this chapter.

Testing dates	2017-10-30
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REQUIREMENT	DESCRIPTION
15.505(a)	Equipment under test complies with all the relevant and applicable requirements of Subpart A, Subpart B and Section 15.201 through 15.204 and Section 15.207 of Subpart C.
15.505(b)	The Digital circuitry portion of the EUT has been tested and verified to comply with 47 CFR Part 15, subpart B.

#### TEST RESULT

The EUT meets the requirements of sections 15.505.

## 7.2 MARKETING OF UWB EQUIPMENT

### TEST REQUIREMENT

In some cases, the operation of UWB devices is limited to specific parties, e.g., law enforcement, fire and rescue organizations operating under the auspices of a state or local government. The marketing of UWB devices must be directed solely to parties eligible to operate the equipment. The responsible party, as defined in Section 2.909 of this chapter, is responsible for ensuring that the equipment is marketed only to eligible parties. Marketing of the equipment in any other manner may be considered grounds for revocation of the grant of certification issued for the equipment

Testing dates	2017-10-30
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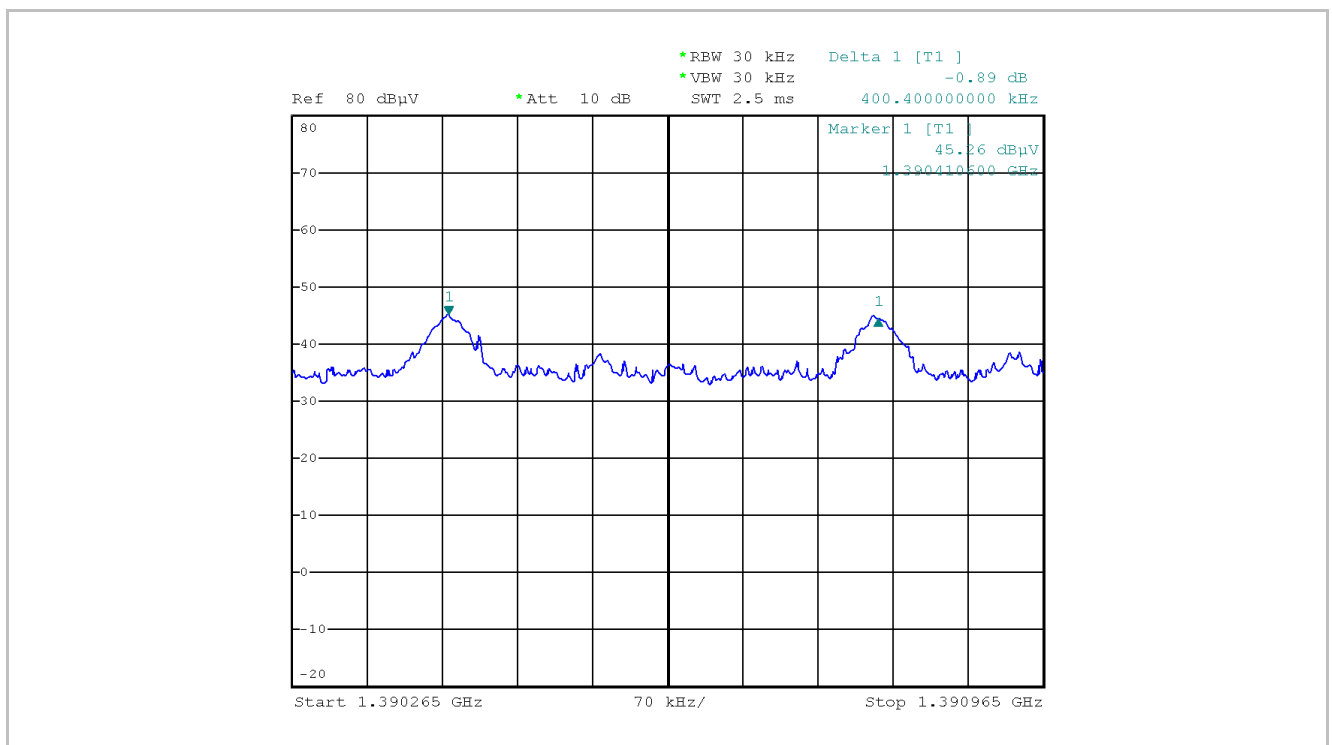
REQUIREMENT	DESCRIPTION
§ 15.507 § 2.909	The responsible party is properly informed about the responsible for ensuring that the equipment is marketed only to eligible parties, and provide correct information on the customers and users. (See Important note for the US customers of the "CTHRUE - User manual")

### TEST RESULT

The EUT meets the requirements of sections 15.507.

### 7.3 PULSE REPETITION FREQUENCY (PRF)

TEST REQUIREMENT	
Test definition	Pulse Repetition Frequency (PRF) is the trigger repetition frequency
Test setup	ANSI C63.4
Test facility	Open Area Test Site (OATS)
Test distance	3 meters
RBW bandwidth	30 kHz
VBW bandwidth	30 kHz
Detector	A-Peak
Deviation to test procedure	None
EUT operating condition	#1
Remark	None
Testing dates	2017-10-30



PRF Declared	PRF Measured	Result
400 kHz	400 kHz	PASS

## 7.4 UWB BANDWIDTH

TEST REQUIREMENT	
UWB definition	The bandwidth of a UWB emission is defined by the points on the emission spectrum where the amplitude is 10 dB below the maximum emission amplitude (i.e., the -10 dB points). In cases where the measured emission spectrum contains multiple (more than two) -10 dB points, the outermost points define the bandwidth (i.e., the widest bandwidth is assumed).
Test setup	ANSI C63.4
Test facility	Open Area Test Site (OATS)
Test distance	3 meters
RBW bandwidth	1 MHz
VBW bandwidth	3 MHz
Detector	Peak
Deviation to test procedure	None
EUT operating condition	#1
Remark	Frequency span is large enough to display a full spectrum of the RF emission
Testing dates	2017-10-30

### LIMITS

The UWB bandwidth of an imaging system operating under the provisions of this section must be below 10.6 GHz.

### TEST PROCEDURE

- 1) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
- 2) Measure the Highest radiated emission at  $f_M$  as described in the test No. 8.
- 3) Recorded the upper and lower frequency that are at the side of the band bounded by the points at 10 dB below the highest radiated UWB emission level.  
Measuring the bandwidth of a UWB device using a radiated test set-up, it is imperative that appropriate adjustments be made to the measured amplitude levels to account for the frequency-dependent components of the measurement system (e.g., antenna gain or factor, pre-amplifier gain, cable loss, etc). Since UWB emissions can have bandwidths several GHz wide, these frequency-dependent characteristics can vary dramatically over the fundamental emission.  
According to the nature of the broadband emission characteristics, significant care must be taken to capture the true spectrum of emission, extremely narrow sweep widths is recommended.
- 4) The UWB bandwidth is the different of the upper and lower frequency recorded.

### SUMMARY OF TEST RESULT DATA

Frequency of Maximum emission level $f_M$	Receiver Antenna polarization	Maximum emission level @ 1 MHz RBW (Peak/QP)	Lower and Upper -10 dB frequencies		10 dB Bandwidth	Result
			Lower $f_L$	Upper $f_H$		
(GHz)	[V/H]	(dB $\mu$ V/m)	(GHz)	(GHz)	(GHz)	
1.44010	V	58.56	1.0	2.5	1.5	PASS

### TEST RESULT

The EUT meets the requirements of sections 15.509(a)

## 7.5 TRANSMISSION DURATION

### TEST REQUIREMENT

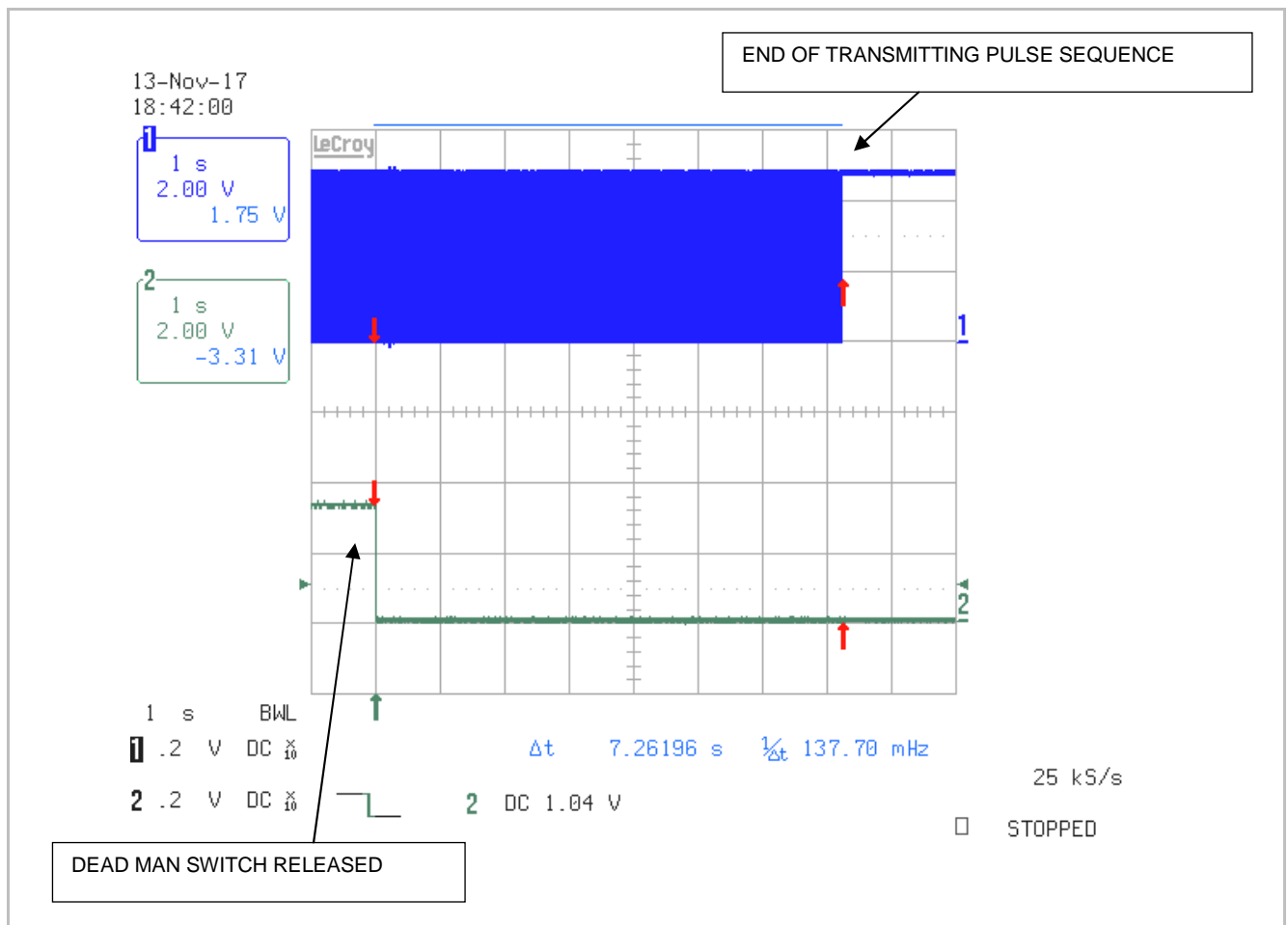
c) A GPR that is designed to be operated while being hand held and a wall imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of a switch located on the imaging system, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator

Testing dates

2017-11-13

### DESCRIPTION

The EUT is provided with a manually operated switch ("dead-man switch") that causes the transmitter to cease operation within 10 seconds of being released by the operator.



The measured time of switch-off is: < 8 seconds

### TEST RESULT

The EUT meets the requirements of sections 15.509(c)

## 7.6 RADIATED DISTURBANCES $\leq$ 960 MHz

TEST REQUIREMENT	
Test definition	The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209
Test setup	ANSI C63.4
Test facility	Open Area Test Site (OATS)
Test distance	3 meters
RBW bandwidth	120 kHz
VBW bandwidth	1 MHz
Detector	Quasi-Peak
EUT operating condition	#1
Remark	Frequency range: 30 MHz – 960 MHz
Testing dates	2017-10-30

LIMITS			
Frequency (MHz)	Field Strengths Limits (dB $\mu$ V/m)	Measuring RBW (kHz)	Distance (meters)
0.009-0.490	67.6-20*Logf(kHz)	1	300
0.490-1.705	87.6-20*Logf(kHz)	9	30
1.705-30	29.5	9	30
30-88	40.0	120	3
88-216	43.5	120	3
216-960	46.0	120	3



### TEST PROCEDURE

- 1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
- 2) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
- 3) The receiving antenna was positioned in horizontal polarization.
- 4) The measurements were made with the detector set to peak with a bandwidth of 120 kHz during monitoring the frequency range below 960 MHz.
- 5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
- 6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
- 7) At the worst case combination of the EUT operating mode and antenna height , the field strength measure was recorded. At each of the frequencies were a field strength was recorded the final measurement was performed with a Quasi-Peak detector.
- 8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 was repeated.
- 9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
- 10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

### SUMMARY OF TEST RESULT DATA

Frequency (MHz)	EUT Position (angle °)	Antenna Polarization (V/H)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
57.16	90	V	27.30	40	-12.70	PASS
66.00	0	V	31.80	40	-8.20	PASS
190.16	0	H	31.92	43.5	-11.58	PASS
233.58	0	V	31.05	46	-14.95	PASS
239.52	0	V	44.51	46	-1.49	PASS
299.66	0	V	45.47	46	-0.53	PASS
316.26	270	H	25.62	46	-20.38	PASS
359.80	270	V	39.31	46	-6.69	PASS
374.46	0	V	30.34	46	-15.66	PASS
563.75	0	V	32.44	46	-13.56	PASS
840.92	0	V	39.81	46	-6.19	PASS
853.64	135	H	26.34	46	-19.66	PASS
866.14	180	V	34.65	46	-11.35	PASS
894.38	225	H	27.76	46	-18.24	PASS
901.06	180	V	33.71	46	-12.29	PASS

Remark: Ambient signal were detected in the different frequency ranges, each of measured signal close or above the limits was examined with relation to the EUT.

### TEST RESULT

The EUT meets the requirements of sections 15.509(d) and 15.209.

## TEST DATA DETAILS

EUT Position (angle °)			0	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	5.71	11.6	0.32	4.7	22.33	40.00	-17.67
66.00	9.34	10.3	0.38	4.7	24.72	40.00	-15.28
190.16	16.97	9.7	0.55	4.7	31.92	43.50	-11.58
233.58	7.14	12	0.73	4.7	24.57	46.00	-21.43
239.52	5.71	12.7	0.75	4.7	23.86	46.00	-22.14
299.66	3.89	13.4	0.81	4.7	22.80	46.00	-23.20
316.26	5.18	13.2	0.82	4.7	23.90	46.00	-22.10
359.80	2.52	14.3	0.88	4.7	22.40	46.00	-23.60
374.46	3.89	15	0.89	4.7	24.48	46.00	-21.52
563.75	0.32	17.4	1.06	4.7	23.48	46.00	-22.52
840.92	-1.15	20.6	1.30	4.7	25.45	46.00	-20.55
853.64	-0.87	20.2	1.33	4.7	25.36	46.00	-20.64
866.14	1.3	20.6	1.36	4.7	27.96	46.00	-18.04
894.38	-3.54	21.1	1.32	4.7	23.58	46.00	-22.42
901.06	-3.43	21.1	1.35	4.7	23.72	46.00	-22.28

EUT Position (angle °)			45	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	7.61	11.6	0.32	4.7	24.23	40.00	-15.77
66.00	11.04	10.3	0.38	4.7	26.42	40.00	-13.58
190.16	15.41	9.7	0.55	4.7	30.36	43.50	-13.14
233.58	6.91	12	0.73	4.7	24.34	46.00	-21.66
239.52	6.58	12.7	0.75	4.7	24.73	46.00	-21.27
299.66	6.1	13.4	0.81	4.7	25.01	46.00	-20.99
316.26	5.69	13.2	0.82	4.7	24.41	46.00	-21.59
359.80	4.79	14.3	0.88	4.7	24.67	46.00	-21.33
374.46	4.22	15	0.89	4.7	24.81	46.00	-21.19
563.75	2.15	17.4	1.06	4.7	25.31	46.00	-20.69
840.92	3.56	20.6	1.30	4.7	30.16	46.00	-15.84
853.64	-1.42	20.2	1.33	4.7	24.81	46.00	-21.19
866.14	0.00	20.6	1.36	4.7	26.66	46.00	-19.34
894.38	-1.43	21.1	1.32	4.7	25.69	46.00	-20.31
901.06	2.98	21.1	1.35	4.7	30.13	46.00	-15.87

EUT Position (angle °)			90	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	9.66	11.6	0.32	4.7	26.28	40.00	-13.72
66.00	8.87	10.3	0.38	4.7	24.25	40.00	-15.75
190.16	15.7	9.7	0.55	4.7	30.65	43.50	-12.85
233.58	7.16	12	0.73	4.7	24.59	46.00	-21.41
239.52	5.94	12.7	0.75	4.7	24.09	46.00	-21.91
299.66	6.11	13.4	0.81	4.7	25.02	46.00	-20.98
316.26	5.8	13.2	0.82	4.7	24.52	46.00	-21.48
359.80	4.73	14.3	0.88	4.7	24.61	46.00	-21.39
374.46	3.56	15	0.89	4.7	24.15	46.00	-21.85
563.75	1.62	17.4	1.06	4.7	24.78	46.00	-21.22
840.92	2.93	20.6	1.30	4.7	29.53	46.00	-16.47
853.64	-0.68	20.2	1.33	4.7	25.55	46.00	-20.45
866.14	-0.72	20.6	1.36	4.7	25.94	46.00	-20.06
894.38	-0.74	21.1	1.32	4.7	26.38	46.00	-19.62
901.06	0.59	21.1	1.35	4.7	27.74	46.00	-18.26

EUT Position (angle °)			135	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	8.7	11.6	0.32	4.7	25.32	40.00	-14.68
66.00	8.72	10.3	0.38	4.7	24.10	40.00	-15.90
190.16	14.87	9.7	0.55	4.7	29.82	43.50	-13.68
233.58	7.92	12	0.73	4.7	25.35	46.00	-20.65
239.52	5.73	12.7	0.75	4.7	23.88	46.00	-22.12
299.66	5.74	13.4	0.81	4.7	24.65	46.00	-21.35
316.26	5.57	13.2	0.82	4.7	24.29	46.00	-21.71
359.80	4.58	14.3	0.88	4.7	24.46	46.00	-21.54
374.46	3.87	15	0.89	4.7	24.46	46.00	-21.54
563.75	1.72	17.4	1.06	4.7	24.88	46.00	-21.12
840.92	0.53	20.6	1.30	4.7	27.13	46.00	-18.87
853.64	0.11	20.2	1.33	4.7	26.34	46.00	-19.66
866.14	0.38	20.6	1.36	4.7	27.04	46.00	-18.96
894.38	-1.93	21.1	1.32	4.7	25.19	46.00	-20.81
901.06	0.36	21.1	1.35	4.7	27.51	46.00	-18.49

EUT Position (angle °)			180	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	8.28	11.6	0.32	4.7	24.90	40.00	-15.10
66.00	9.37	10.3	0.38	4.7	24.75	40.00	-15.25
190.16	14.31	9.7	0.55	4.7	29.26	43.50	-14.24
233.58	6.58	12	0.73	4.7	24.01	46.00	-21.99
239.52	6.08	12.7	0.75	4.7	24.23	46.00	-21.77
299.66	5.86	13.4	0.81	4.7	24.77	46.00	-21.23
316.26	5.93	13.2	0.82	4.7	24.65	46.00	-21.35
359.80	4.23	14.3	0.88	4.7	24.11	46.00	-21.89
374.46	3.65	15	0.89	4.7	24.24	46.00	-21.76
563.75	1.12	17.4	1.06	4.7	24.28	46.00	-21.72
840.92	-1.3	20.6	1.30	4.7	25.30	46.00	-20.70
853.64	-0.38	20.2	1.33	4.7	25.85	46.00	-20.15
866.14	-0.72	20.6	1.36	4.7	25.94	46.00	-20.06
894.38	-2.56	21.1	1.32	4.7	24.56	46.00	-21.44
901.06	-2.21	21.1	1.35	4.7	24.94	46.00	-21.06

EUT Position (angle °)			225	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	8.06	11.6	0.32	4.7	24.68	40.00	-15.32
66.00	8.83	10.3	0.38	4.7	24.21	40.00	-15.79
190.16	15.47	9.7	0.55	4.7	30.42	43.50	-13.08
233.58	6.98	12	0.73	4.7	24.41	46.00	-21.59
239.52	6.88	12.7	0.75	4.7	25.03	46.00	-20.97
299.66	6.97	13.4	0.81	4.7	25.88	46.00	-20.12
316.26	4.91	13.2	0.82	4.7	23.63	46.00	-22.37
359.80	5.52	14.3	0.88	4.7	25.40	46.00	-20.60
374.46	3.48	15	0.89	4.7	24.07	46.00	-21.93
563.75	1.65	17.4	1.06	4.7	24.81	46.00	-21.19
840.92	-1.27	20.6	1.30	4.7	25.33	46.00	-20.67
853.64	-1.66	20.2	1.33	4.7	24.57	46.00	-21.43
866.14	0.17	20.6	1.36	4.7	26.83	46.00	-19.17
894.38	0.64	21.1	1.32	4.7	27.76	46.00	-18.24
901.06	0.05	21.1	1.35	4.7	27.20	46.00	-18.80

EUT Position (angle °)			270	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	8.72	11.6	0.32	4.7	25.34	40.00	-14.66
66.00	8.83	10.3	0.38	4.7	24.21	40.00	-15.79
190.16	15.51	9.7	0.55	4.7	30.46	43.50	-13.04
233.58	6.00	12	0.73	4.7	23.43	46.00	-22.57
239.52	7.88	12.7	0.75	4.7	26.03	46.00	-19.97
299.66	7.57	13.4	0.81	4.7	26.48	46.00	-19.52
316.26	6.90	13.2	0.82	4.7	25.62	46.00	-20.38
359.80	4.37	14.3	0.88	4.7	24.25	46.00	-21.75
374.46	4.03	15	0.89	4.7	24.62	46.00	-21.38
563.75	1.08	17.4	1.06	4.7	24.24	46.00	-21.76
840.92	1.91	20.6	1.30	4.7	28.51	46.00	-17.49
853.64	-1.67	20.2	1.33	4.7	24.56	46.00	-21.44
866.14	2.63	20.6	1.36	4.7	29.29	46.00	-16.71
894.38	-1.28	21.1	1.32	4.7	25.84	46.00	-20.16
901.06	0.57	21.1	1.35	4.7	27.72	46.00	-18.28

EUT Position (angle °)			315	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	8.43	11.6	0.32	4.7	25.05	40.00	-14.95
66.00	9.40	10.3	0.38	4.7	24.78	40.00	-15.22
190.16	14.59	9.7	0.55	4.7	29.54	43.50	-13.96
233.58	6.11	12	0.73	4.7	23.54	46.00	-22.46
239.52	8.06	12.7	0.75	4.7	26.21	46.00	-19.79
299.66	8.45	13.4	0.81	4.7	27.36	46.00	-18.64
316.26	5.97	13.2	0.82	4.7	24.69	46.00	-21.31
359.80	4.90	14.3	0.88	4.7	24.78	46.00	-21.22
374.46	3.80	15	0.89	4.7	24.39	46.00	-21.61
563.75	0.96	17.4	1.06	4.7	24.12	46.00	-21.88
840.92	2.10	20.6	1.30	4.7	28.70	46.00	-17.30
853.64	-1.20	20.2	1.33	4.7	25.03	46.00	-20.97
866.14	0.12	20.6	1.36	4.7	26.78	46.00	-19.22
894.38	-1.09	21.1	1.32	4.7	26.03	46.00	-19.97
901.06	2.77	21.1	1.35	4.7	29.92	46.00	-16.08

EUT Position (angle °)			0	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	13.12	11.6	0.32	4.7	29.74	40.00	-10.26
66.00	16.42	10.3	0.38	4.7	31.80	40.00	-8.20
190.16	15.74	9.7	0.55	4.7	30.69	43.50	-12.81
233.58	13.62	12	0.73	4.7	31.05	46.00	-14.95
239.52	26.36	12.7	0.75	4.7	44.51	46.00	-1.49
299.66	26.56	13.4	0.81	4.7	45.47	46.00	-0.53
316.26	10.48	13.2	0.82	4.7	29.20	46.00	-16.80
359.80	22.93	14.3	0.88	4.7	42.81	46.00	-3.19
374.46	9.75	15	0.89	4.7	30.34	46.00	-15.66
563.75	9.28	17.4	1.06	4.7	32.44	46.00	-13.56
840.92	13.21	20.6	1.30	4.7	39.81	46.00	-6.19
853.64	3.07	20.2	1.33	4.7	29.30	46.00	-16.70
866.14	11.26	20.6	1.36	4.7	37.92	46.00	-8.08
894.38	4.66	21.1	1.32	4.7	31.78	46.00	-14.22
901.06	10.87	21.1	1.35	4.7	38.02	46.00	-7.98

EUT Position (angle °)			45	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	8.42	11.6	0.32	4.7	25.04	40.00	-14.96
66.00	11.72	10.3	0.38	4.7	27.10	40.00	-12.90
190.16	11.04	9.7	0.55	4.7	25.99	43.50	-17.51
233.58	8.92	12	0.73	4.7	26.35	46.00	-19.65
239.52	21.66	12.7	0.75	4.7	39.81	46.00	-6.19
299.66	21.86	13.4	0.81	4.7	40.77	46.00	-5.23
316.26	5.78	13.2	0.82	4.7	24.50	46.00	-21.50
359.80	18.23	14.3	0.88	4.7	38.11	46.00	-7.89
374.46	5.05	15	0.89	4.7	25.64	46.00	-20.36
563.75	4.58	17.4	1.06	4.7	27.74	46.00	-18.26
840.92	8.51	20.6	1.30	4.7	35.11	46.00	-10.89
853.64	-1.63	20.2	1.33	4.7	24.60	46.00	-21.40
866.14	6.56	20.6	1.36	4.7	33.22	46.00	-12.78
894.38	-0.04	21.1	1.32	4.7	27.08	46.00	-18.92
901.06	6.17	21.1	1.35	4.7	33.32	46.00	-12.68

EUT Position (angle °)			90	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	10.68	11.6	0.32	4.7	27.30	40.00	-12.70
66.00	11.01	10.3	0.38	4.7	26.39	40.00	-13.61
190.16	10.95	9.7	0.55	4.7	25.90	43.50	-17.60
233.58	7.37	12	0.73	4.7	24.80	46.00	-21.20
239.52	20.04	12.7	0.75	4.7	38.19	46.00	-7.81
299.66	19.70	13.4	0.81	4.7	38.61	46.00	-7.39
316.26	6.21	13.2	0.82	4.7	24.93	46.00	-21.07
359.80	19.10	14.3	0.88	4.7	38.98	46.00	-7.02
374.46	4.18	15	0.89	4.7	24.77	46.00	-21.23
563.75	2.10	17.4	1.06	4.7	25.26	46.00	-20.74
840.92	2.24	20.6	1.30	4.7	28.84	46.00	-17.16
853.64	-0.69	20.2	1.33	4.7	25.54	46.00	-20.46
866.14	7.94	20.6	1.36	4.7	34.60	46.00	-11.40
894.38	-1.12	21.1	1.32	4.7	26.00	46.00	-20.00
901.06	1.86	21.1	1.35	4.7	29.01	46.00	-16.99

EUT Position (angle °)			135	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	9.94	11.6	0.32	4.7	26.56	40.00	-13.44
66.00	10.44	10.3	0.38	4.7	25.82	40.00	-14.18
190.16	12.60	9.7	0.55	4.7	27.55	43.50	-15.95
233.58	6.86	12	0.73	4.7	24.29	46.00	-21.71
239.52	18.96	12.7	0.75	4.7	37.11	46.00	-8.89
299.66	18.36	13.4	0.81	4.7	37.27	46.00	-8.73
316.26	6.03	13.2	0.82	4.7	24.75	46.00	-21.25
359.80	17.72	14.3	0.88	4.7	37.60	46.00	-8.40
374.46	4.79	15	0.89	4.7	25.38	46.00	-20.62
563.75	1.46	17.4	1.06	4.7	24.62	46.00	-21.38
840.92	6.28	20.6	1.30	4.7	32.88	46.00	-13.12
853.64	-1.49	20.2	1.33	4.7	24.74	46.00	-21.26
866.14	-0.02	20.6	1.36	4.7	26.64	46.00	-19.36
894.38	-0.70	21.1	1.32	4.7	26.42	46.00	-19.58
901.06	3.51	21.1	1.35	4.7	30.66	46.00	-15.34

EUT Position (angle °)			180	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	9.98	11.6	0.32	4.7	26.60	40.00	-13.40
66.00	10.32	10.3	0.38	4.7	25.70	40.00	-14.30
190.16	11.30	9.7	0.55	4.7	26.25	43.50	-17.25
233.58	7.22	12	0.73	4.7	24.65	46.00	-21.35
239.52	18.31	12.7	0.75	4.7	36.46	46.00	-9.54
299.66	18.08	13.4	0.81	4.7	36.99	46.00	-9.01
316.26	5.76	13.2	0.82	4.7	24.48	46.00	-21.52
359.80	19.08	14.3	0.88	4.7	38.96	46.00	-7.04
374.46	4.78	15	0.89	4.7	25.37	46.00	-20.63
563.75	1.15	17.4	1.06	4.7	24.31	46.00	-21.69
840.92	6.54	20.6	1.30	4.7	33.14	46.00	-12.86
853.64	-1.21	20.2	1.33	4.7	25.02	46.00	-20.98
866.14	7.99	20.6	1.36	4.7	34.65	46.00	-11.35
894.38	0.03	21.1	1.32	4.7	27.15	46.00	-18.85
901.06	6.56	21.1	1.35	4.7	33.71	46.00	-12.29

EUT Position (angle °)			225	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	9.88	11.6	0.32	4.7	26.50	40.00	-13.50
66.00	10.29	10.3	0.38	4.7	25.67	40.00	-14.33
190.16	11.09	9.7	0.55	4.7	26.04	43.50	-17.46
233.58	6.71	12	0.73	4.7	24.14	46.00	-21.86
239.52	18.87	12.7	0.75	4.7	37.02	46.00	-8.98
299.66	19.01	13.4	0.81	4.7	37.92	46.00	-8.08
316.26	5.89	13.2	0.82	4.7	24.61	46.00	-21.39
359.80	19.12	14.3	0.88	4.7	39.00	46.00	-7.00
374.46	4.01	15	0.89	4.7	24.60	46.00	-21.40
563.75	1.56	17.4	1.06	4.7	24.72	46.00	-21.28
840.92	2.76	20.6	1.30	4.7	29.36	46.00	-16.64
853.64	-1.01	20.2	1.33	4.7	25.22	46.00	-20.78
866.14	4.46	20.6	1.36	4.7	31.12	46.00	-14.88
894.38	-0.18	21.1	1.32	4.7	26.94	46.00	-19.06
901.06	5.49	21.1	1.35	4.7	32.64	46.00	-13.36



EUT Position (angle °)			270	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	8.06	11.6	0.32	4.7	24.68	40.00	-15.32
66.00	10.77	10.3	0.38	4.7	26.15	40.00	-13.85
190.16	11.20	9.7	0.55	4.7	26.15	43.50	-17.35
233.58	7.10	12	0.73	4.7	24.53	46.00	-21.47
239.52	19.51	12.7	0.75	4.7	37.66	46.00	-8.34
299.66	20.18	13.4	0.81	4.7	39.09	46.00	-6.91
316.26	5.83	13.2	0.82	4.7	24.55	46.00	-21.45
359.80	19.43	14.3	0.88	4.7	39.31	46.00	-6.69
374.46	4.42	15	0.89	4.7	25.01	46.00	-20.99
563.75	2.61	17.4	1.06	4.7	25.77	46.00	-20.23
840.92	1.72	20.6	1.30	4.7	28.32	46.00	-17.68
853.64	-1.48	20.2	1.33	4.7	24.75	46.00	-21.25
866.14	4.10	20.6	1.36	4.7	30.76	46.00	-15.24
894.38	-2.56	21.1	1.32	4.7	24.56	46.00	-21.44
901.06	1.55	21.1	1.35	4.7	28.70	46.00	-17.30

EUT Position (angle °)			315	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Sand factor	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
57.16	8.19	11.6	0.32	4.7	24.81	40.00	-15.19
66.00	9.99	10.3	0.38	4.7	25.37	40.00	-14.63
190.16	11.61	9.7	0.55	4.7	26.56	43.50	-16.94
233.58	7.53	12	0.73	4.7	24.96	46.00	-21.04
239.52	20.59	12.7	0.75	4.7	38.74	46.00	-7.26
299.66	20.85	13.4	0.81	4.7	39.76	46.00	-6.24
316.26	5.28	13.2	0.82	4.7	24.00	46.00	-22.00
359.80	18.49	14.3	0.88	4.7	38.37	46.00	-7.63
374.46	4.75	15	0.89	4.7	25.34	46.00	-20.66
563.75	1.01	17.4	1.06	4.7	24.17	46.00	-21.83
840.92	7.42	20.6	1.30	4.7	34.02	46.00	-11.98
853.64	-1.14	20.2	1.33	4.7	25.09	46.00	-20.91
866.14	4.17	20.6	1.36	4.7	30.83	46.00	-15.17
894.38	0.18	21.1	1.32	4.7	27.30	46.00	-18.70
901.06	4.79	21.1	1.35	4.7	31.94	46.00	-14.06

## 7.7 RADIATED DISTURBANCES > 960 MHz

TEST REQUIREMENT	
Test definition	The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.
Test setup	ANSI C63.4
Test facility	Open Area Test Site (OATS)
Test distance	1 meter
RBW bandwidth	1 MHz
VBW bandwidth	1 MHz
Detector	RMS
EUT operating condition	#1
Remark	Frequency range: 960 MHz – 40 GHz
Testing dates	2017-10-30

LIMITS			
Frequency (MHz)	EIRP @ 3 meters (1 MHz BW) (dBm)	Field strength @ 3 meters (1 MHz BW) (dBµV/m)	Field strength @ 1 meters (1 MHz BW) (dBµV/m)
960-1610	-65.3	29.9	39.4
1610-1990	-53.3	41.9	51.4
1990-3100	-51.3	43.9	53.4
3100-10600	-41.3	53.9	63.4
Above 10600	-51.3	43.9	53.4

**Note:** The limits were converted from EIRP to field strength at 3 and 1 meter according to FCC 15.503(k).

### TEST PROCEDURE

- 1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
- 2) The receiving antenna is placed at 1 meter away from the EUT and it is pointed in the direction of the radiating head with an inclination of -10° to find the highest emission.
- 3) The receiving antenna was positioned in horizontal polarization.
- 4) The measurements were made with the detector set to RMS with a bandwidth of 1 MHz during monitoring the frequency range above 960 MHz.
- 5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
- 6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
- 7) At the worst case combination of the EUT operating mode and antenna height , the field strength measure was recorded.
- 8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 was repeated.
- 9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
- 10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

### SUMMARY OF TEST RESULT DATA

All maximum Field strength emission are found at the following test set-up conditions

Frequency (MHz)	EUT Position (angle °)	Antenna Polarization (V/H)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
1,051	315	V	38.58	39.40	-0.82	PASS
1,080	315	V	38.60	39.40	-0.80	PASS
1,106	315	H	38.50	39.40	-0.90	PASS
1,390	90	V	37.63	39.40	-1.77	PASS
1,650	270	H	40.60	51.40	-10.80	PASS
1,990	225	V	39.19	51.40	-12.21	PASS
2,050	270	V	39.75	53.40	-13.65	PASS
3,170	45	V	39.87	53.40	-13.53	PASS
3,330	315	V	42.83	53.40	-10.57	PASS
>3,330	No emission found above this frequency					

### TEST RESULT

The EUT meets the requirements of sections 15.509(d)

## TEST DATA DETAILS

EUT Position (angle °)			0	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	44.38	24.50	1.30	38.82	31.36	39.40	-8.04
1,080	46.65	24.50	1.35	38.82	33.68	39.40	-5.72
1,106	46.38	24.60	1.42	38.83	33.57	39.40	-5.83
1,390	42.48	24.80	1.57	38.85	30.00	39.40	-9.40
1,650	48.44	25.80	1.70	38.50	37.44	51.40	-13.96
1,990	47.12	26.40	1.85	37.47	37.90	51.40	-13.50
2,050	46.56	26.40	1.94	37.50	37.40	53.40	-16.00
3,170	44.89	28.80	2.26	37.59	38.36	53.40	-15.04
3,330	40.57	28.80	2.40	37.30	34.47	53.40	-18.93

EUT Position (angle °)			45	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	46.70	24.50	1.30	38.82	33.68	39.40	-5.72
1,080	46.70	24.50	1.35	38.82	33.73	39.40	-5.67
1,106	45.06	24.60	1.42	38.83	32.25	39.40	-7.15
1,390	42.92	24.80	1.57	38.85	30.44	39.40	-8.96
1,650	48.40	25.80	1.70	38.50	37.40	51.40	-14.00
1,990	45.50	26.40	1.85	37.47	36.28	51.40	-15.12
2,050	45.65	26.40	1.94	37.50	36.49	53.40	-16.91
3,170	44.04	28.80	2.26	37.59	37.51	53.40	-15.89
3,330	46.60	28.80	2.40	37.30	40.50	53.40	-12.90

EUT Position (angle °)			90	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	45.92	24.50	1.30	38.82	32.90	39.40	-6.50
1,080	46.21	24.50	1.35	38.82	33.24	39.40	-6.16
1,106	45.79	24.60	1.42	38.83	32.98	39.40	-6.42
1,390	44.64	24.80	1.57	38.85	32.16	39.40	-7.24
1,650	44.36	25.80	1.70	38.50	33.36	51.40	-18.04
1,990	41.79	26.40	1.85	37.47	32.57	51.40	-18.83
2,050	42.09	26.40	1.94	37.50	32.93	53.40	-20.47
3,170	46.32	28.80	2.26	37.59	39.79	53.40	-13.61
3,330	42.27	28.80	2.40	37.30	36.17	53.40	-17.23

EUT Position (angle °)			135	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	47.70	24.50	1.30	38.82	34.68	39.40	-4.72
1,080	44.70	24.50	1.35	38.82	31.73	39.40	-7.67
1,106	44.80	24.60	1.42	38.83	31.99	39.40	-7.41
1,390	44.75	24.80	1.57	38.85	32.27	39.40	-7.13
1,650	44.10	25.80	1.70	38.50	33.10	51.40	-18.30
1,990	44.05	26.40	1.85	37.47	34.83	51.40	-16.57
2,050	44.50	26.40	1.94	37.50	35.34	53.40	-18.06
3,170	44.41	28.80	2.26	37.59	37.88	53.40	-15.52
3,330	46.65	28.80	2.40	37.30	40.55	53.40	-12.85

EUT Position (angle °)			180	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	48.16	24.50	1.30	38.82	35.14	39.40	-4.26
1,080	48.21	24.50	1.35	38.82	35.24	39.40	-4.16
1,106	47.98	24.60	1.42	38.83	35.17	39.40	-4.23
1,390	44.92	24.80	1.57	38.85	32.44	39.40	-6.96
1,650	44.90	25.80	1.70	38.50	33.90	51.40	-17.50
1,990	41.89	26.40	1.85	37.47	32.67	51.40	-18.73
2,050	43.76	26.40	1.94	37.50	34.60	53.40	-18.80
3,170	43.35	28.80	2.26	37.59	36.82	53.40	-16.58
3,330	40.45	28.80	2.40	37.30	34.35	53.40	-19.05

EUT Position (angle °)			225	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	45.97	24.50	1.30	38.82	32.95	39.40	-6.45
1,080	46.54	24.50	1.35	38.82	33.57	39.40	-5.83
1,106	45.12	24.60	1.42	38.83	32.31	39.40	-7.09
1,390	48.45	24.80	1.57	38.85	35.97	39.40	-3.43
1,650	48.92	25.80	1.70	38.50	37.92	51.40	-13.48
1,990	45.10	26.40	1.85	37.47	35.88	51.40	-15.52
2,050	48.38	26.40	1.94	37.50	39.22	53.40	-14.18
3,170	44.12	28.80	2.26	37.59	37.59	53.40	-15.81
3,330	40.30	28.80	2.40	37.30	34.20	53.40	-19.20

EUT Position (angle °)			270	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	47.07	24.50	1.30	38.82	34.05	39.40	-5.35
1,080	49.90	24.50	1.35	38.82	36.93	39.40	-2.47
1,106	48.60	24.60	1.42	38.83	35.79	39.40	-3.61
1,390	48.37	24.80	1.57	38.85	35.89	39.40	-3.51
1,650	51.60	25.80	1.70	38.50	40.60	51.40	-10.80
1,990	47.04	26.40	1.85	37.47	37.82	51.40	-13.58
2,050	46.76	26.40	1.94	37.50	37.60	53.40	-15.80
3,170	37.06	28.80	2.26	37.59	30.53	53.40	-22.87
3,330	41.23	28.80	2.40	37.30	35.13	53.40	-18.27

EUT Position (angle °)			315	Antenna Polarization			H
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	48.20	24.50	1.30	38.82	35.18	39.40	-4.22
1,080	50.59	24.50	1.35	38.82	37.62	39.40	-1.78
1,106	51.31	24.60	1.42	38.83	38.50	39.40	-0.90
1,390	48.52	24.80	1.57	38.85	36.04	39.40	-3.36
1,650	48.78	25.80	1.70	38.50	37.78	51.40	-13.62
1,990	44.31	26.40	1.85	37.47	35.09	51.40	-16.31
2,050	45.67	26.40	1.94	37.50	36.51	53.40	-16.89
3,170	40.45	28.80	2.26	37.59	33.92	53.40	-19.48
3,330	40.45	28.80	2.40	37.30	34.35	53.40	-19.05

EUT Position (angle °)			0	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	44.38	24.50	1.30	38.82	31.36	39.40	-8.04
1,080	46.65	24.50	1.35	38.82	33.68	39.40	-5.72
1,106	46.38	24.60	1.42	38.83	33.57	39.40	-5.83
1,390	42.48	24.80	1.57	38.85	30.00	39.40	-9.40
1,650	48.44	25.80	1.70	38.50	37.44	51.40	-13.96
1,990	47.12	26.40	1.85	37.47	37.90	51.40	-13.50
2,050	46.56	26.40	1.94	37.50	37.40	53.40	-16.00
3,170	44.89	28.80	2.26	37.59	38.36	53.40	-15.04
3,330	40.57	28.80	2.40	37.30	34.47	53.40	-18.93

EUT Position (angle °)			45	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	51.06	24.50	1.30	38.82	38.04	39.40	-1.36
1,080	48.95	24.50	1.35	38.82	35.98	39.40	-3.42
1,106	49.35	24.60	1.42	38.83	36.54	39.40	-2.86
1,390	48.83	24.80	1.57	38.85	36.35	39.40	-3.05
1,650	45.63	25.80	1.70	38.50	34.63	51.40	-16.77
1,990	42.21	26.40	1.85	37.47	32.99	51.40	-18.41
2,050	39.43	26.40	1.94	37.50	30.27	53.40	-23.13
3,170	46.40	28.80	2.26	37.59	39.87	53.40	-13.53
3,330	36.56	28.80	2.40	37.30	30.46	53.40	-22.94

EUT Position (angle °)			90	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	49.36	24.50	1.30	38.82	36.34	39.40	-3.06
1,080	48.56	24.50	1.35	38.82	35.59	39.40	-3.81
1,106	48.24	24.60	1.42	38.83	35.43	39.40	-3.97
1,390	50.11	24.80	1.57	38.85	37.63	39.40	-1.77
1,650	48.40	25.80	1.70	38.50	37.40	51.40	-14.00
1,990	43.40	26.40	1.85	37.47	34.18	51.40	-17.22
2,050	39.50	26.40	1.94	37.50	30.34	53.40	-23.06
3,170	43.30	28.80	2.26	37.59	36.77	53.40	-16.63
3,330	45.30	28.80	2.40	37.30	39.20	53.40	-14.20

EUT Position (angle °)			135	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	48.23	24.50	1.30	38.82	35.21	39.40	-4.19
1,080	48.32	24.50	1.35	38.82	35.35	39.40	-4.05
1,106	48.02	24.60	1.42	38.83	35.21	39.40	-4.19
1,390	49.62	24.80	1.57	38.85	37.14	39.40	-2.26
1,650	48.95	25.80	1.70	38.50	37.95	51.40	-13.45
1,990	47.32	26.40	1.85	37.47	38.10	51.40	-13.30
2,050	47.99	26.40	1.94	37.50	38.83	53.40	-14.57
3,170	45.13	28.80	2.26	37.59	38.60	53.40	-14.80
3,330	44.30	28.80	2.40	37.30	38.20	53.40	-15.20

EUT Position (angle °)			180	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	44.55	24.50	1.30	38.82	31.53	39.40	-7.87
1,080	46.06	24.50	1.35	38.82	33.09	39.40	-6.31
1,106	48.99	24.60	1.42	38.83	36.18	39.40	-3.22
1,390	49.09	24.80	1.57	38.85	36.61	39.40	-2.79
1,650	46.57	25.80	1.70	38.50	35.57	51.40	-15.83
1,990	43.89	26.40	1.85	37.47	34.67	51.40	-16.73
2,050	46.20	26.40	1.94	37.50	37.04	53.40	-16.36
3,170	44.97	28.80	2.26	37.59	38.44	53.40	-14.96
3,330	44.28	28.80	2.40	37.30	38.18	53.40	-15.22

EUT Position (angle °)			225	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	49.19	24.50	1.30	38.82	36.17	39.40	-3.23
1,080	47.42	24.50	1.35	38.82	34.45	39.40	-4.95
1,106	46.83	24.60	1.42	38.83	34.02	39.40	-5.38
1,390	42.95	24.80	1.57	38.85	30.47	39.40	-8.93
1,650	44.56	25.80	1.70	38.50	33.56	51.40	-17.84
1,990	48.41	26.40	1.85	37.47	39.19	51.40	-12.21
2,050	47.90	26.40	1.94	37.50	38.74	53.40	-14.66
3,170	44.85	28.80	2.26	37.59	38.32	53.40	-15.08
3,330	45.81	28.80	2.40	37.30	39.71	53.40	-13.69



EUT Position (angle °)			270	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	48.40	24.50	1.30	38.82	35.38	39.40	-4.02
1,080	48.57	24.50	1.35	38.82	35.60	39.40	-3.80
1,106	48.59	24.60	1.42	38.83	35.78	39.40	-3.62
1,390	47.50	24.80	1.57	38.85	35.02	39.40	-4.38
1,650	47.66	25.80	1.70	38.50	36.66	51.40	-14.74
1,990	48.01	26.40	1.85	37.47	38.79	51.40	-12.61
2,050	48.91	26.40	1.94	37.50	39.75	53.40	-13.65
3,170	45.01	28.80	2.26	37.59	38.48	53.40	-14.92
3,330	46.58	28.80	2.40	37.30	40.48	53.40	-12.92

EUT Position (angle °)			315	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1,051	51.60	24.50	1.30	38.82	38.58	39.40	-0.82
1,080	51.57	24.50	1.35	38.82	38.60	39.40	-0.80
1,106	49.82	24.60	1.42	38.83	37.01	39.40	-2.39
1,390	49.98	24.80	1.57	38.85	37.50	39.40	-1.90
1,650	48.08	25.80	1.70	38.50	37.08	51.40	-14.32
1,990	45.95	26.40	1.85	37.47	36.73	51.40	-14.67
2,050	47.15	26.40	1.94	37.50	37.99	53.40	-15.41
3,170	44.84	28.80	2.26	37.59	38.31	53.40	-15.09
3,330	48.93	28.80	2.40	37.30	42.83	53.40	-10.57

## 7.8 RADIATED EMISSION IN GPS BANDS

TEST REQUIREMENT	
Test definition	In addition to the radiated emission limits specified for frequency above 960 MHz, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz in the GPS frequency bands.
Test setup	ANSI C63.4
Test facility	Open Area Test Site (OATS)
Test distance	1 meter
RBW bandwidth	10 kHz
VBW bandwidth	3 MHz
Detector	RMS – Integration time duration: 1 ms
EUT operating condition	#1
Remark	None
Testing dates	2017-10-30

LIMITS			
Frequency (MHz)	EIRP @ 3 meters (1 kHz BW) (dBm)	Field strength @ 3 meters (1 kHz BW) (dBµV/m)	Field strength @ 1 meters (1 kHz BW) (dBµV/m)
1164-1240	-75.3	19.9	29.4
1559-1610	-75.3	19.9	29.4

**Note:** The limits were converted from EIRP to field strength at 3 and 1 meter according to FCC 15.503(k).

## TEST PROCEDURE

- 1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
- 2) The receiving antenna is placed at 1 meter away from the EUT and it is pointed in the direction of the radiating head with an inclination of -10° to find the highest emission.
- 3) The receiving antenna was positioned in horizontal polarization.
- 4) The measurements were made with the detector set to RMS with a bandwidth of 1 kHz during monitoring the GPS frequency ranges.
- 5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
- 6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
- 7) At the worst case combination of the EUT operating mode and antenna height , the field strength measure was recorded.
- 8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 was repeated.
- 9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
- 10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

## SUMMARY OF TEST RESULT DATA

All maximum Field strength emission are found at the following test set-up conditions (see PLOT 1)

EUT Position (angle °)			315	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1176.01	19.14	24.70	1.92	38.79	6.97	29.40	-22.43
1198.05	21.24	24.70	1.93	38.79	9.08	29.40	-20.32
1204.44	20.89	24.70	1.93	38.79	8.73	29.40	-20.67
1208.38	21.10	24.75	1.94	38.80	8.78	29.40	-20.62

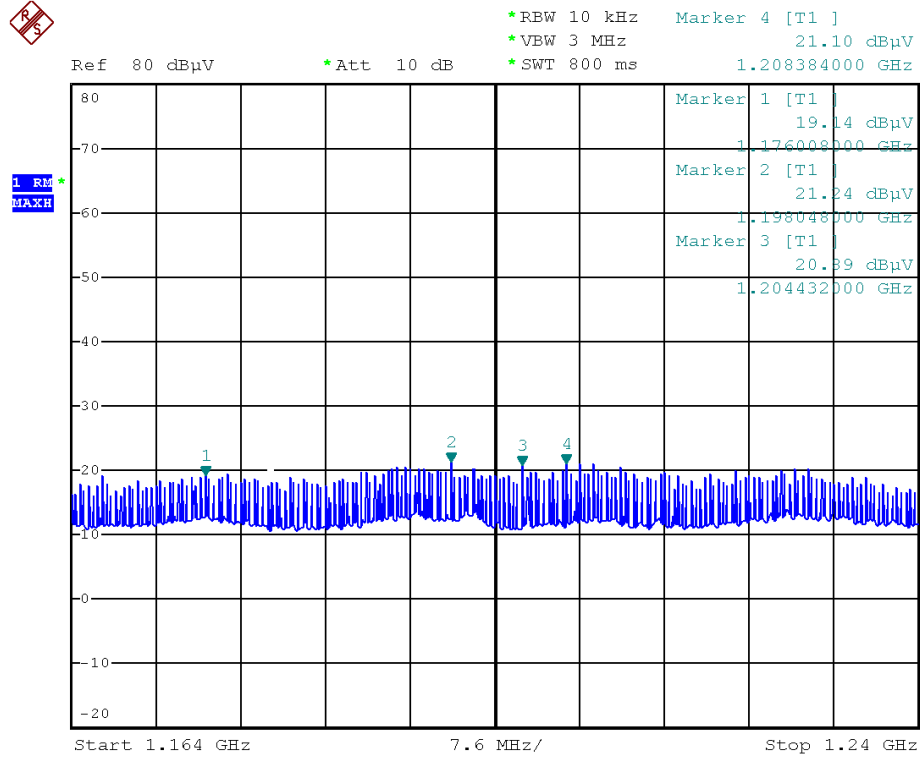
All maximum Field strength emission are found at the following test set-up conditions (see PLOT 2)

EUT Position (angle °)			270	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1561.22	22.38	25.30	2.16	37.96	11.88	29.40	-17.52
1576.04	21.84	25.30	2.16	37.96	11.34	29.40	-18.06
1583.99	21.24	25.30	2.18	37.94	10.78	29.40	-18.62
1600.01	23.75	25.30	2.18	37.94	13.29	29.40	-16.11

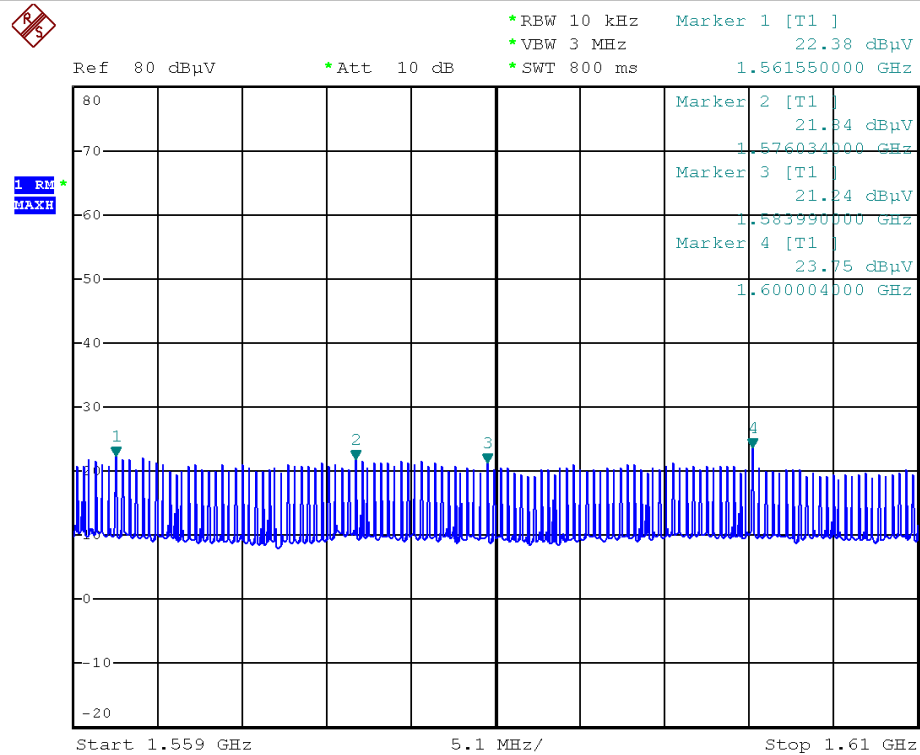
## TEST RESULT

The EUT meets the requirements of sections 15.509(d)

### PLOT 1



### PLOT 2



## 7.9 HIGHEST RADIATED EMISSION AT $f_M$

TEST REQUIREMENT	
Test definition	For UWB devices where the frequency at which the highest radiated emission occurs, $f_M$ , is above 960 MHz, there is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on $f_M$ .
Test setup	ANSI C63.4
Test facility	Open Area Test Site (OATS)
Test distance	3 meters
RBW bandwidth	1 MHz
VBW bandwidth	3 MHz
Detector	Peak
EUT operating condition	#1
Remark	None
Testing dates	2017-10-30

LIMITS		
The peak emission level contained within a 50 MHz bandwidth centered on $f_M$ must be limited to a maximum of 0 dBm EIRP.		
EIRP limit (dBm)	Field strength limit @ 3 meters (dB $\mu$ V/m)	Field strength limit @ 3 meters (measured with 1 MHz RBW) (dB $\mu$ V/m)
0	95.2	61.2
<p><b>Note:</b> The limits were converted from EIRP to field strength at 3 meter according to FCC 15.503(k). As the measurement was employed with a 1 MHz resolution bandwidth the applicable limit is adjusted with a <math>20\log(1/50)</math> dB factor.</p>		

## TEST PROCEDURE

- 1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
- 2) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
- 3) The receiving antenna was positioned in horizontal polarization.
- 4) The measurements were made with the detector set to peak with a bandwidth of 1 MHz during monitoring the frequency range inside the UWB of the EUT..
- 5) At the worst case combination of the EUT operating mode and antenna height , the field strength measure was recorded.
- 6) The receiving antenna was positioned in vertical polarization and the steps 4 to 6 was repeated.
- 7) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
- 8) Record the peak emission from the EUT.

## SUMMARY OF TEST RESULT DATA

Maximum Peak emission contained within 50 MHz is found at the following test set-up conditions

EUT Position (angle °)			315	Antenna Polarization			V
Frequency	Reading value	Antenna Factor	Cable Loss	Pre-Amp. Gain	Correcting reading	Limit	Margin
(MHz)	(dBµV)	(dB1/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
1440.10	58.56	25.00	1.89	38.00	47.45	61.20	-13.75

## TEST RESULT

The EUT meets the requirements of sections 15.509(f)

## 7.10 TECHNICAL REQUIREMENTS APPLICABLE TO ALL UWB DEVICES

REQUIREMENT	DESCRIPTION
§ 15.521(a)	The EUT is not employed for the operation of toys, operation onboard an aircraft, ship and satellite.
§ 15.521(b)	Permanent attached antenna, no External radio frequency power amplifiers and antenna modifications are permitted.
§ 15.521(c)	The Digital circuitry portion of the EUT has been tested and verified to comply with 47 CFR Part 15, subpart B.
§ 15.521(d)	Considered
§ 15.521(e)	The fM, frequency at which the highest radiated emission occurs is contained within the measured UWB bandwidth.
§ 15.521(f)	The EUT is not intended to detection of tags or the transfer or data or voice information.
§ 15.521(g)	Considered
§ 15.521(h)	Considered
§ 15.521(i)	Prohibition in Sections 2.201(f) and 15.5(d) of this chapter against Class B (damped wave) emissions is not applied.
§ 15.521(j)	Battery operating device not connected to AC power lines.

### TEST RESULT

The EUT meets the requirements of sections 15.521.

## 7.11 COORDINATION REQUIREMENT

### TEST REQUIREMENT

- (a) UWB imaging systems require coordination through the FCC before the equipment may be used. The operator shall comply with any constraints on equipment usage resulting from this coordination.
- (b) The users of UWB imaging devices shall supply operational areas to the FCC Office of Engineering and Technology, which shall coordinate this information with the Federal Government through the National Telecommunications and Information Administration.
- (c) The manufacturers, or their authorized sales agents, must inform purchasers and users of their systems of the requirement to undertake detailed coordination of operational areas with the FCC prior to the equipment being operated.
- (d) Users of authorized, coordinated UWB systems may transfer them to other qualified users, and to different locations upon coordination of change of ownership or location to the FCC and coordination with existing authorized operations.
- (e) The FCC/NTIA coordination report shall identify those geographical areas within which the operation of an imaging system requires additional coordination or within which the operation of an imaging system is prohibited.
- (f) The coordination of routine UWB operations shall not take longer than 15 business days from the receipt of the coordination request by NTIA.

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REQUIREMENT	DESCRIPTION
§ 15.525 § 15.509(b)	The responsible party is properly informed about the required coordination requirement and provide correct information to the customers and users about their specific care and legislative obligations.  (See Important note for the US customers of the "CTHRUE - User manual")

### TEST RESULT

The EUT meets the requirements of sections 15.525 and 15.509(b).



## 8. MEASUREMENTS AND TESTS UNCERTAINTY

Unless otherwise stated the uncertainties for the tests and measurements are evaluated in according to IMQ Operational Instruction IO-LAB-001 and IO-LAB-004. and requirement of NIST Technical Note 1297 and NIS 81:1994 "The Treatment of Uncertainty in EMC Measurements"

The expanded uncertainty was calculated for all measurements and tests listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainty in EMC Measurements", with UKAS document LAB 34 and is documented in the quality system accordance to ISO/IEC 17025.

Internal Procedure PG-037 ensures that the requirements for traceability of calibrations, of all test equipment requiring calibration, and calibration intervals are met.

Methods	Expanded Uncertainty	Unit	confidence level	Coverage factor	Degree of freedom
Radiated emission (30 ÷ 200 MHz)	5.1	dB	95 %	2	9
Radiated emission (200 ÷ 1000 MHz)	5.2	dB	95 %	2	9
Radiated emission (1 ÷ 6 GHz)	5.1	dB	95 %	2	9
Radiated emission (above 6 GHz)	5.4	dB	95 %	2	9

## 9. LIST OF MEASURING EQUIPMENT AND CALIBRATION INFORMATION

IMQ Serial Number	Instrument	Manufacturer	Type	Last Cal.	Cal. Period.	Calibration Company
S03463	Horn Antenna	Schwarzbeck	BBHA 9120D	07-17	36	NPL
S04271	Log-Per. Antenna	Ara	LPB-2513/A	07-17	36	NPL
S03629	Spectrum Analyzer	Rohde & Schwarz	FSP40	08-17	12	Rohde & Schwarz
S03542	Preamplifier	Hewlett Packard	HP 8449B	05-16	24	IMQ
S05585	RF Coax Cable	Rosenberger micro-coax	N 50 Ohm	04-17	12	IMQ
S03745	Oscilloscope	Yokogawa	DL 7200	01-17	12	AVIATRONIK
P01723	Antenna Mast	Sunol Sciences	TWR 93-4	/	/	/

## 10. PHOTOGRAPHIC DOCUMENTATION

### EUT IDENTIFICATION



**SET-UP**

**Test set-up below 960 MHz**



**Test set-up above 960 MHz**



## 11. OPINIONS AND INTERPRETATIONS - NOT OBJECT TO ACCREDIA ACCREDITATION

Not Applicable

END OF REPORT