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FCC PT 15.517 & PT 15.249 COMPOSITE DEVICE

Pt 15.517 UWB TEST REPORT

APPLICANT	Ubisense Limited
ADDRESS	St Andrew's House, 90 St. Andrew's Road Chesterton, Cambridge CB4 1DL England
FCC ID	SEATAG21
MODEL NUMBER	UBITAG7021S
PRODUCT DESCRIPTION	UWB Tag
DATE SAMPLE RECEIVED	February 5, 2007
DATE TESTED	February 5, 2007
TESTED BY	Mario de Aranzeta
APPROVED BY	Mario de Aranzeta
TIMCO REPORT NO.	326BUT6TestReport.PDF
TEST RESULTS	☒ PASS ☐ FAIL

ACCREDITED

Certificate # 0955-01

TABLE OF CONTENTS

LETTER OF EXPLANATION

03/16/2007

Federal Communications Commission
Authorization and Evaluation Division
7435 Oakland Mills Road
Columbia, MD 21046 USA

Subject: Ubisense Limited

FCC ID: SEATAG21

To Whom It May Concern:

The attached application is for a device that is both a 6 to 8 GHz UWB operating under 15.517 and a 15.249 device operating in the band 2400 to 2483.5 MHz. The assembly consists of a handheld module with integral antennas. The whole device is powered by a 3Vdc coin type cell.

Previously a similar device from this applicant was certified as a Part 15.517/15.249 composite device (FCC ID: SEAUBITAG10), and we are again following the FCC's guidance relating to that previous certification, which included submitting test reports for both the 15.517 and 15.249 transmitters under a single FCC ID.

Should you have any questions or require any further information with regards to this, please feel free to contact me.

Sincerely,

Mario de Aranzeta C.E.T.
Engineer

STATEMENT OF COMPLIANCE

This equipment has been tested in accordance with the standards identified in the referenced test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report and demonstrate that the equipment complies with the appropriate standards.

All Timco instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made by me or under my supervision, at Timco Engineering, Inc. located at 849 N.W. State Road 45, Newberry, Florida 32669 USA.

ACCREDITED

Certificate #0955-01

Authorized by: Mario de Aranzeta

Signature: On file

Function: Engineer

Date: February 5, 2007

REPORT SUMMARY

Purpose of Test:	To demonstrate the DUT in compliance with FCC Pt 15.517 for indoor UWB systems.
Disclaimer:	The test results relate only to the items tested.
Applicable Standards:	Pt 15.517, Pt 15.209, Pt 15.207, ANSI C63.4: 2003
Related Reports:	1) 326AUT6TestReport for Pt 15.249 Low Power Device 2) 326CUT6TestReport.pdf for Pt 15.209 digital interface portion

TEST ENVIRONMENT AND TEST SETUP

Test Facilities:	All measurements were made at one or more of the test sites of TIMCO ENGINEERING INC. located at 849 N.W. State Road 45, Newberry, FL 32669.
Laboratory Test Conditions:	Temperature: 26°C, Humidity: 55%
Test Exercise (software etc):	The DUT was set in continuous transmit mode of operation unless stated otherwise.
Deviation to the Standards:	No deviation from the standard.
Modification to the DUT:	No modification was made.
Supporting Accessories:	None

DUT DESCRIPTION

Manufacturer:	Ubisense
Product Description:	A wireless device intended to be used for the real-time location of objects within buildings. It transmits an ultra-wideband (UWB) emission which are picked up by a network of base stations placed inside the building, allowing the 3D position of the tag to be found to an accuracy of six inches (15 cm).
FCC ID:	SEATAG21
Model Number:	UBITAG7021S (Ubitag V2.1)
Brand Name:	Ubisense
Operating Frequency:	6-8 GHz
Emission Designator:	
EUT Power Source:	Primary Power – 3 Vdc (Battery)
	Secondary Power – N/A
Test Item:	Prototype
Type of Equipment	Portable
Antennas	permanently attached
Antenna Connector	None

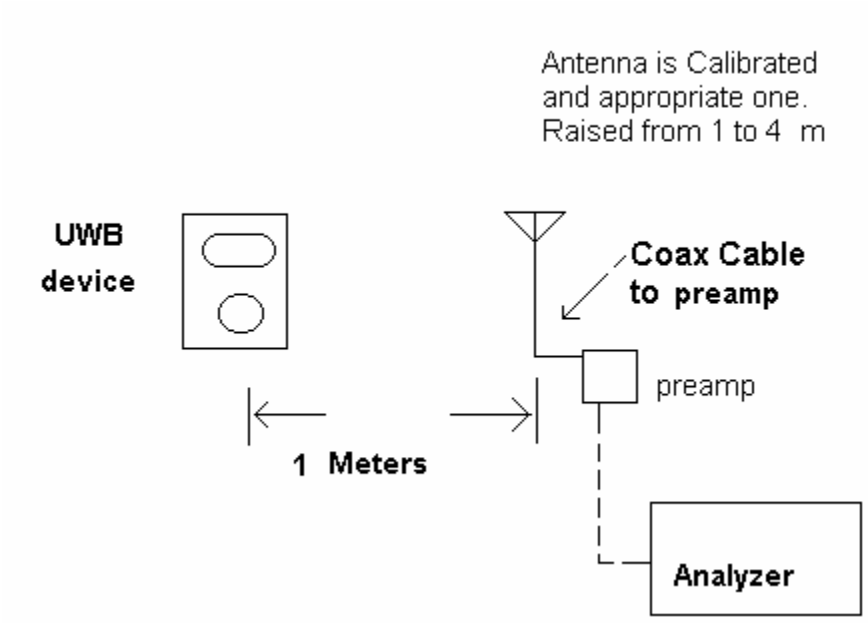
EMC EQUIPMENT LIST

Device	Manufacturer	Model Number	Serial Number	Cal/Char Date	Due Date
3-Meter OATS	TEI	N/A	N/A	Listed 1/11/06	1/10/09
Antenna: Biconnical	Eaton	94455-1	1057	CAL 12/12/05	12/12/07
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	CAL 4/29/05	4/29/07
Antenna: DR Horn	ETS	3117		CAL 12/29/06	12/29/08
LISN	Electro-Metrics	EM-7820	2682	CAL 4/28/05	4/28/07
Antenna: Log-Periodic	Eaton	96005	1243	CAL 12/14/05	12/14/07
Spectrum Analyzer	Rohde & Schwarz	ESIB 40		11/15/05	11/15/07
Preamp	AH Systems	PAM-0126	128	11/05/06	11/05/08
Mixer	Agilent	11970A,G,K	various	11/15/05	11/15/07

TEST PROCEDURES

Bandwidth 10 dB: The measurements were made with the spectrum analyzer using a RMS detector and the procedures outlined by the FCC in 15.521. The test distance was 1 meter. Emissions from the DUT were maximized by rotating the DUT and adjusting the height of the measurement antenna.

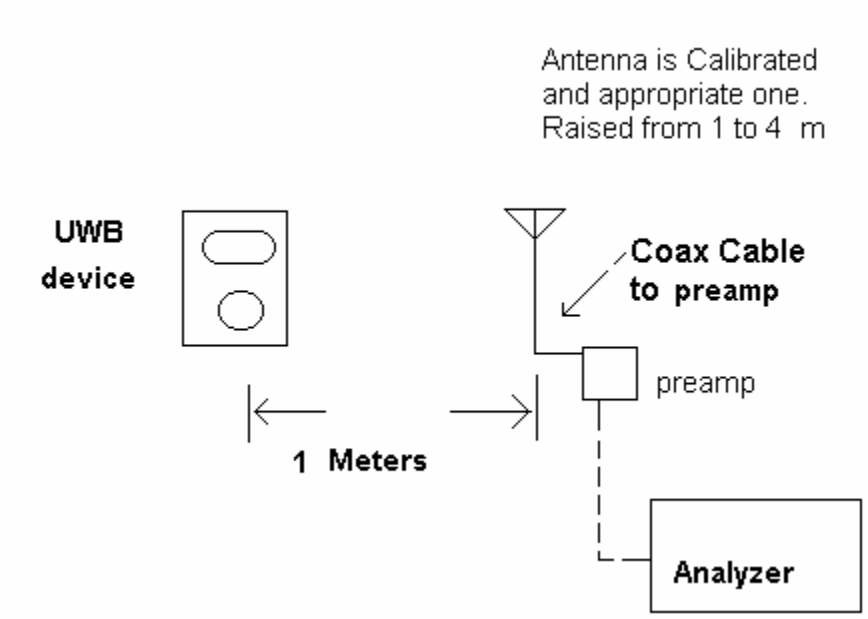
Bandwidth Test Setup Diagram



Radiation Interference: The test procedure used was ANSI C63.4-2003 using a R&S ESIB 40 spectrum analyzer/receiver. The bandwidth (RBW) of the spectrum analyzer was typically 100 kHz up to 1GHz and 1.0MHz above 1GHz. Measurements above 1GHz used the RMS detector function on the spectrum analyzer, with a sweep time set to 500ms or less – the spectrum analyzer scan had 500 points, and so a sweep time of 500ms or less ensured that the averaging time per point was 1ms or less. The VBW was always greater than or equal to the RBW unless noted. The analyzer was calibrated in dB above a microvolt at the output of the antenna.

As required by subpart 15.33 emissions were measured to 40 GHz.

Radiated Spurious Emissions: The procedure used was ANSI C63.4-2003 & the test setup was as follows:



Power Line Conducted Interference: The measurements were made in accordance with ANSI C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz".The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω / 50uH Line Impedance Stabilization Network (LISN).

OPERATIONAL RESTRICTIONS

Rule Parts No.: Pt 15.517(a)

Requirements: Section 15.517 Technical Requirements for indoor UWB systems.

(a) Operation under the provisions of this section is limited to UWB transmitters employed solely for indoor operation.

(1) Indoor UWB devices, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, e.g., a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.
(2) The emissions from equipment operated under this section shall not be intentionally directed outside of the building in which the equipment is located, such as through a window or a doorway, to perform an outside function, such as the detection of persons about to enter a building.
(3) The use of outdoor mounted antennas, e.g., antennas mounted on the outside of a building or on a telephone pole, or any other outdoors infrastructure is prohibited.
(4) Field disturbance sensors installed inside of metal or underground storage tanks are considered to operate indoors provided the emissions are directed towards the ground.
(5) A communications system shall transmit only when the intentional radiator is sending information to an associated receiver.

Results:

- The UBITAG7021S is a wireless device intended to be used for the real-time location of objects within buildings (applications include healthcare, workplace productivity, security, retail management and manufacturing), and will be marketed as such.
- The UBITAG7021S will not transmit ultra-wideband signals unless it receives suitable trigger commands (over a separate §15.249 conventional radio link) from an associated base station. Base stations will be professionally installed, in accordance with instructions detailing procedures for adjusting the power of the base stations' conventional radio signals to ensure that they cannot trigger Ubitags outside the building.
- The UBITAG7021S User's Guide (see Exhibits) also stresses the requirement for indoor use, and reiterates the technical requirements for indoor UWB systems listed in §15.517.
- Furthermore, each UBITAG7021S is clearly marked with a label indicating that it is for indoor use only.

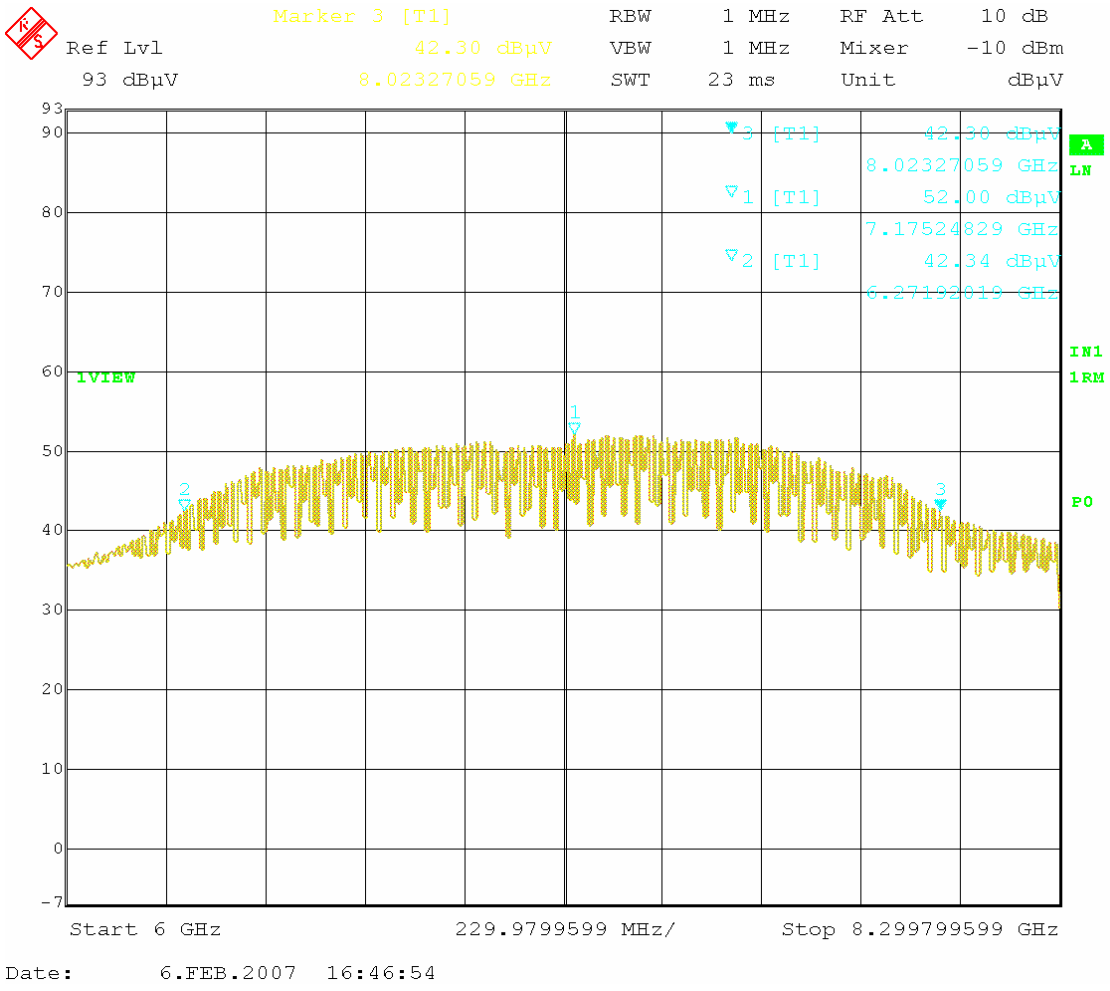
ULTRA-WIDEBAND 10 dB BANDWIDTH

Rules Part No.: Pt 15.517(b)

Requirements: The UWB bandwidth must be contained between 3100 MHz and 10.6 GHz.

The test distance was 1 meter.

Test Data:



The frequency with the highest emission is: 7.176 GHz
The lower -10dB point is: 6.272 GHz
The upper -10dB point is: 8.023 GHz
The 10 dB bandwidth is 1.751 GHz

FIELD STRENGTH SPURIOUS EMISSIONS (below 960 MHz)

Rules Part No.: Pt 15.517(c), Pt 15.209(a)

Requirements:

Frequency	Limits
Part 15.209	
9 to 490 kHz	2400/F (kHz) µV/m @ 300 meters
490 to 1705 kHz	24000/F (kHz) µV/m @ 30 meters
1705 kHz to 30 MHz	29.54 dBµV/m @ 30 meters
30 – 88	40.0 dBµV/m @ 3 meters
80 – 216	43.5 dBµV/m @ 3 meters
216 – 960	46.0 dBµV/m @ 3 meters
Above 960	54.0 dBµV/m @ 3 meters

Test Data:

Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Field Strength dBuV/m	Margin dB
85.78	6.7	V	0.61	8.07	15.38	24.62
343.25	5.6	H	1.14	14.87	21.61	24.39
381.38	7.9	H	1.18	15.46	24.54	21.46
390.94	6.5	H	1.19	15.83	23.52	22.48

No significant emissions found. Values in chart are noise floor measurements.

All measurements are peak unless indicated as average by an 'A'.

RADIATED EMISSIONS ABOVE 960 MHz

Rules Part No.: Pt 15.517(d)

Requirements: Radiated emissions above 960 MHz from a device operating under this section shall not exceed the following average limits when measured using a RBW of 1 MHz.

Frequency MHz	EIRP dBm
960 - 1610	-75.3
1610 - 1990	-53.3
1990 – 3100	-51.3
3100 – 10600	-41.3
Above 10600	-51.3

Measurement procedure: The procedures of ANSI C63.4:2003 were followed with the exception that the measurement distance was reduced to that shown in the table below and an RMS detector was used as required in 15.521 (d).

Correction factor is a combination of coax loss (CL), preamp gain (Gamp), antenna factor (AF), and 'measurement distance' correction factor (Dcf = 20 log [D/3], where D is the measurement distance in meters).
Example correction factor calculation: FS=MR+AF-(Gamp-CL)-Dcf

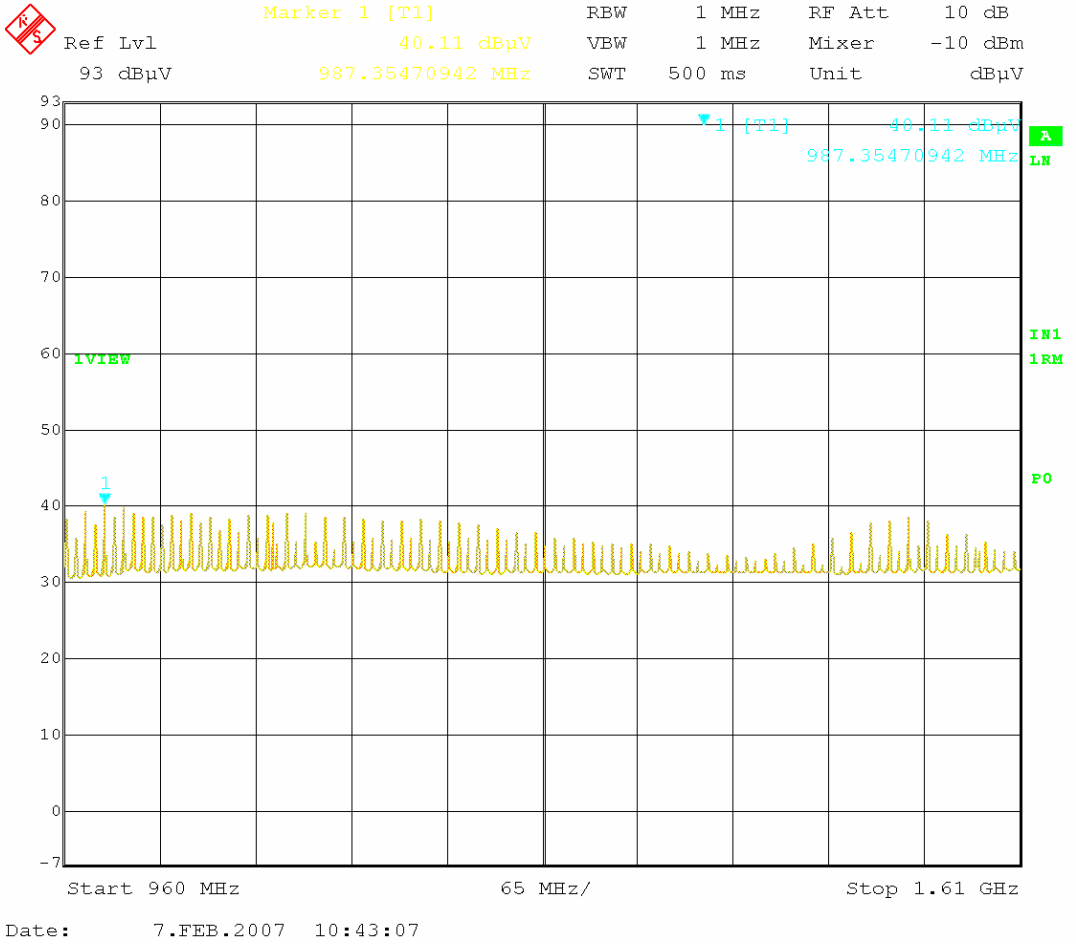
The EIRP limits in dBm were converted to field strength limits in dBuV/m @ 3m.
Example EIRP limit conversion: F.S.=EIRP+95.2

Emission Frequency MHz	Plot #	Meter Reading dBuV	Meas. Distance m	Correction Factor dB/m	Field Strength dBuV/m 3m(corrected)	Limit dBuV/m @ 3m
987.4	1	40.11	1	-21.4	18.71	19.9
1611.5	2	32	1	-13.12	18.88	41.9
2079	3	33.42	1	-10.01	23.41	43.9
7364.7	5	57.31	1	-6.37	50.94	53.9
12275.8	6	33.53	0.5	-8.04	25.49	43.9
22072.1	7	33.08	0.5	-6.26	26.82	43.9

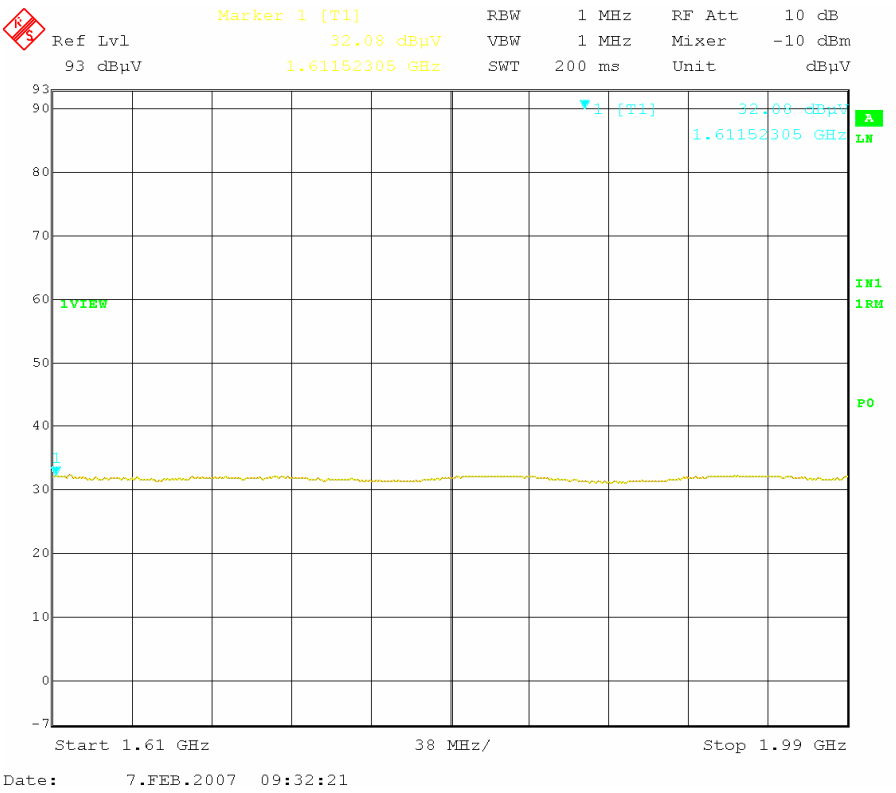
Both vertical and horizontal polarities were studied and the worst case presented. In all cases the vertical polarization resulted in the greatest signal.

There were no measurable emissions above 10.6 GHz, up to 40 GHz. The measurement noise floor is well below the specified limit. Measurements in the table above for emissions greater than 10.6 GHz are of the noise floor.

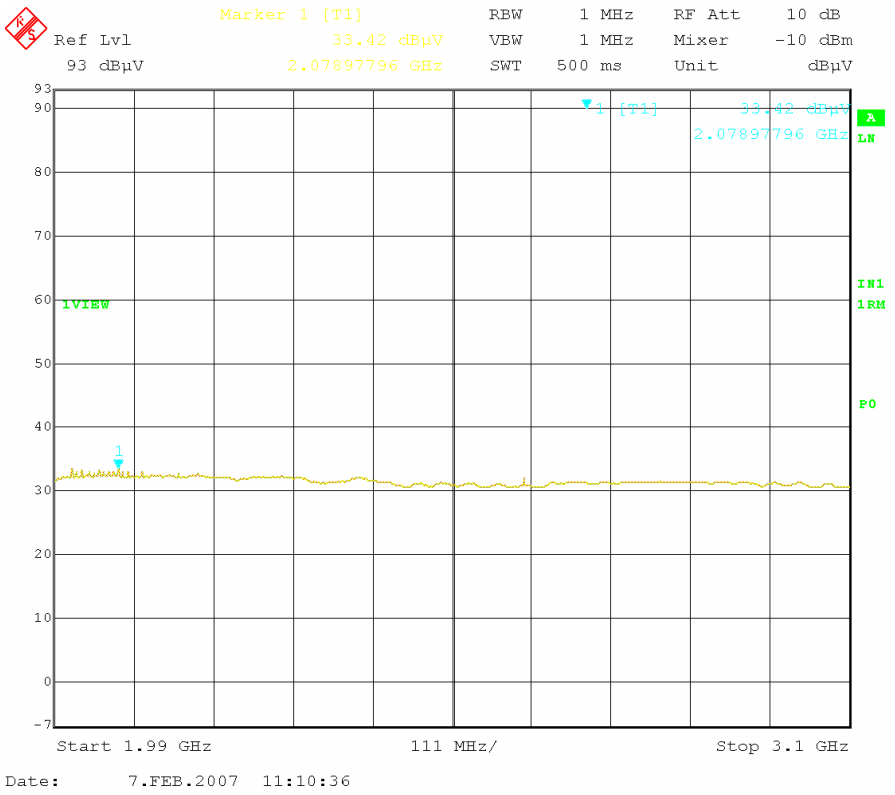
Plot 1


Marker 1 [T1]
Ref Lvl
93 dBµV
40.11 dBµV
987.35470942 MHz
RBW 1 MHz
VBW 1 MHz
SWT 500 ms
RF Att 10 dB
Mixer -10 dBm
Unit dBµV
1 [T1] 40.11 dBµV
987.35470942 MHz
A
LN
IN1
1RM
PO
1VIEW
Start 960 MHz
65 MHz/
Stop 1.61 GHz
Date: 7.FEB.2007 10:43:07

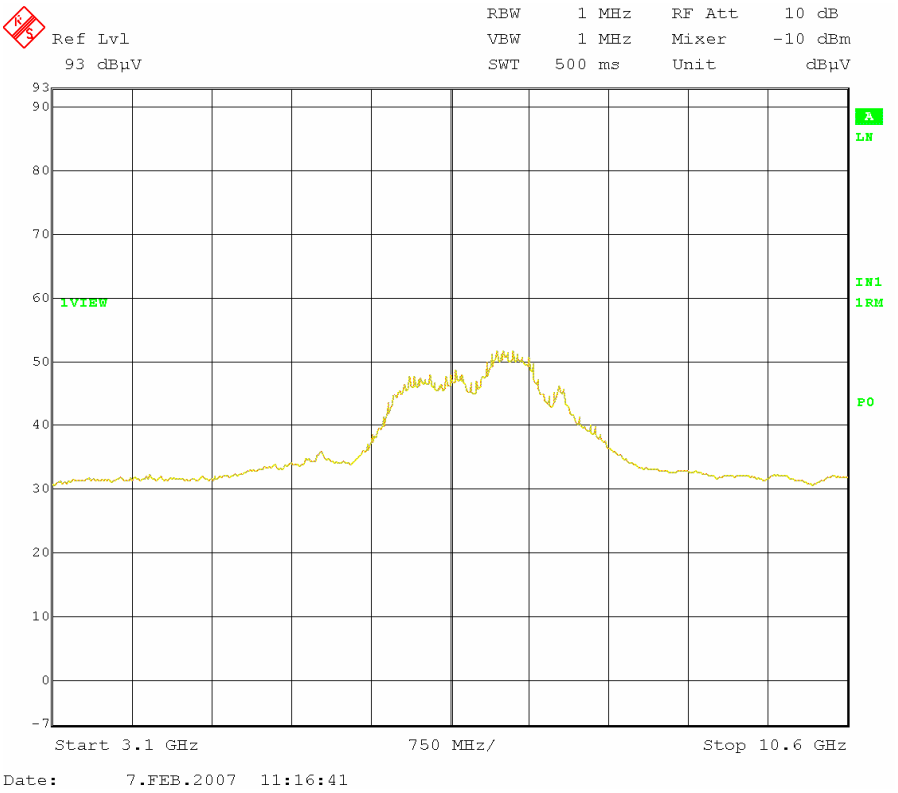
Plot 2


Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
32.08 dBµV
VBW 1 MHz
Mixer -10 dBm
93 dBµV
1.61152305 GHz
SWT 200 ms
Unit dBµV
1 [T1] 32.60 dBµV
1.61152305 GHz
A
LN
IN1
1RM
P0
1VIEW
Start 1.61 GHz
38 MHz/
Stop 1.99 GHz
Date: 7.FEB.2007 09:32:21

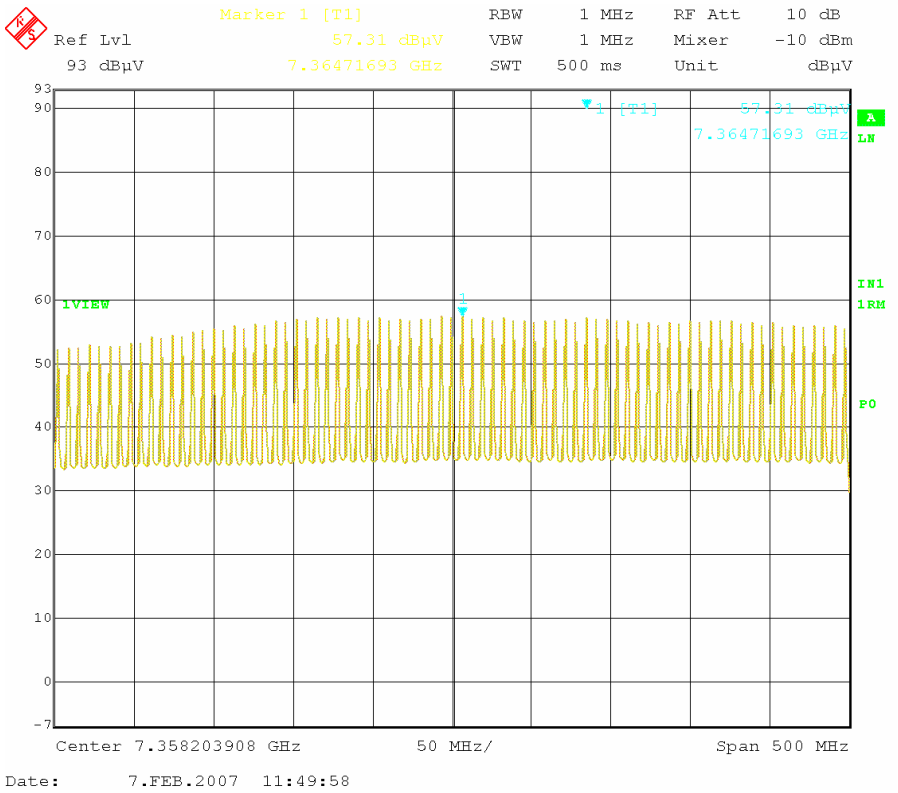
Plot 3


Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
33.42 dBµV
VBW 1 MHz
Mixer -10 dBm
93 dBµV
2.07897796 GHz
SWT 500 ms
Unit dBµV
1 [T1] 33.42 dBµV
2.07897796 GHz
A
LN
IN1
1RM
PO
1VIEW
Start 1.99 GHz
111 MHz/
Stop 3.1 GHz
Date: 7.FEB.2007 11:10:36

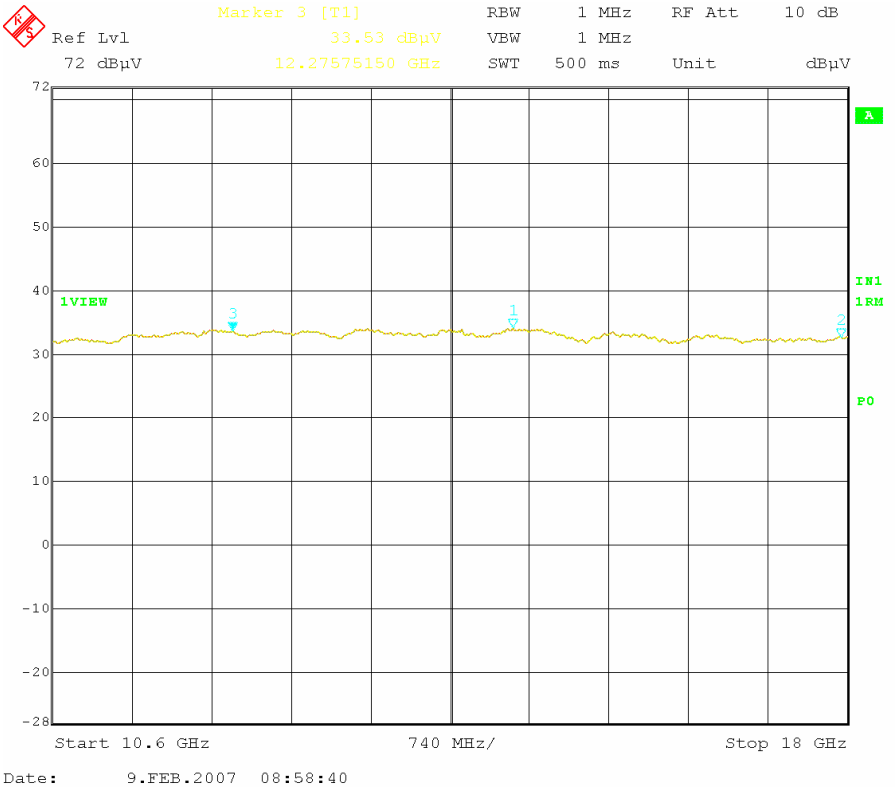
Plot 4


Ref Lvl
93 dBµV
RBW 1 MHz
VBW 1 MHz
SWT 500 ms
RF Att 10 dB
Mixer -10 dBm
Unit dBµV
93
90
80
70
60
50
40
30
20
10
0
-7
1VIEW
A
LN
IN1
1RM
P0
Start 3.1 GHz
750 MHz/
Stop 10.6 GHz
Date: 7.FEB.2007 11:16:41

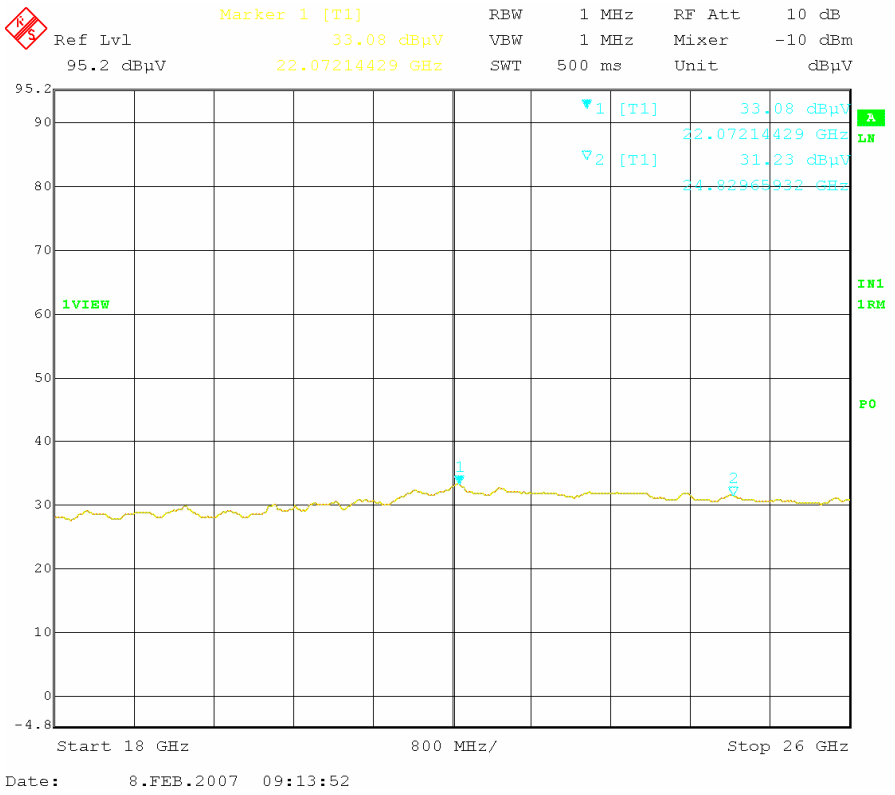
Plot 5


Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
57.31 dBµV
VBW 1 MHz
Mixer -10 dBm
93 dBµV
7.36471693 GHz
SWT 500 ms
Unit dBµV
1 [T1] 57.31 dBµV
7.36471693 GHz
A
LN
IN1
1RM
PO
1VIEW
Center 7.358203908 GHz
50 MHz/
Span 500 MHz
Date: 7.FEB.2007 11:49:58

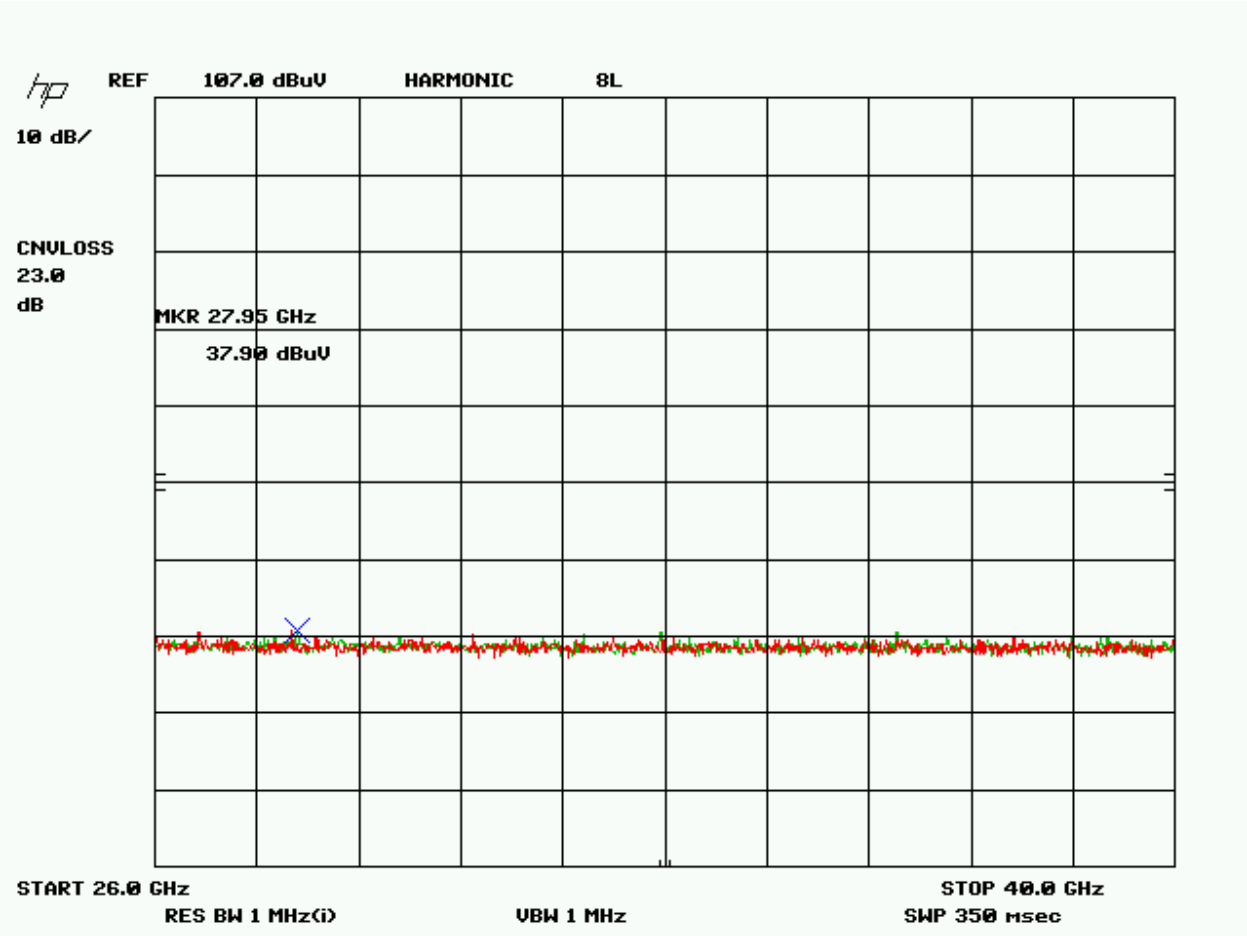
Plot 6


Marker 3 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
33.53 dBµV
VBW 1 MHz
72 dBµV
12.27575150 GHz
SWT 500 ms
Unit dBµV
72
60
50
40
30
20
10
0
-10
-20
-28
1VIEW
A
IN1
1RM
PO
Start 10.6 GHz
740 MHz/
Stop 18 GHz
Date: 9.FEB.2007 08:58:40

Plot 7


Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
33.08 dBµV
VBW 1 MHz
Mixer -10 dBm
95.2 dBµV
22.07214429 GHz
SWT 500 ms
Unit dBµV
1 [T1] 33.08 dBµV
22.07214429 GHz
2 [T1] 31.23 dBµV
24.82965932 GHz
1VIEW
A
LN
IN1
1RM
PO
95.2
90
80
70
60
50
40
30
20
10
0
-4.8
Start 18 GHz
800 MHz/
Stop 26 GHz
Date: 8.FEB.2007 09:13:52

Plot 8


REF 107.0 dBuV
HARMONIC
8L
10 dB/
CNVLOSS
23.0
dB
MKR 27.95 GHz
37.90 dBuV
START 26.0 GHz
STOP 40.0 GHz
RES BW 1 MHz(i)
VBW 1 MHz
SWP 350 msec

RADIATED EMISSIONS GPS BAND

Rules Part No.: Pt 15.517(d)

Requirements: Radiated emissions in this segment of the spectrum above 960 MHz shall not exceed the following average limits when measured using a RBW of no less than 1 kHz.

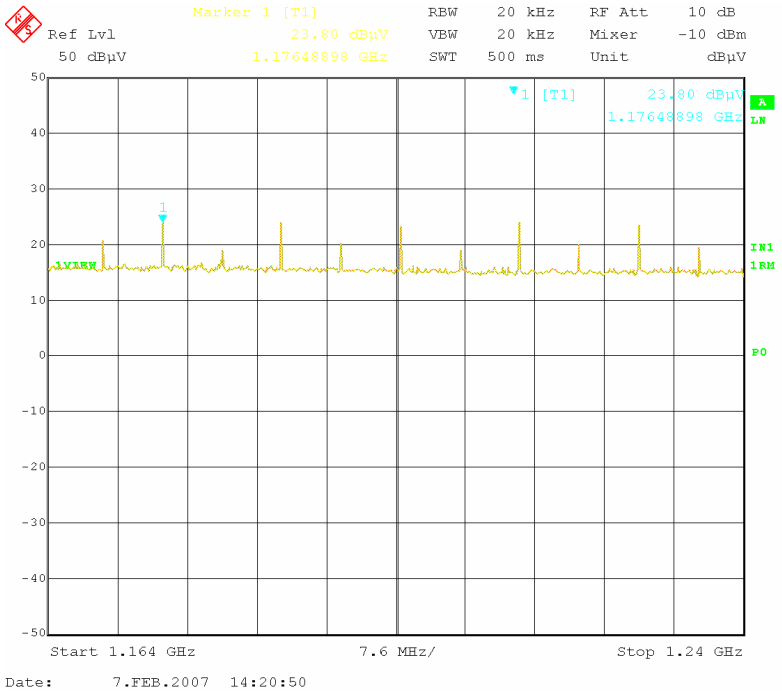
Frequency in MHz	EIRP in dBm	F.S. in dBuV/m
1164 – 1240	-85.3	9.9
1559 - 1610	-85.3	9.9

The equivalent field strength at 3m = (-85.3) + 95.2 = 9.9 dBuV/m

Test Data:

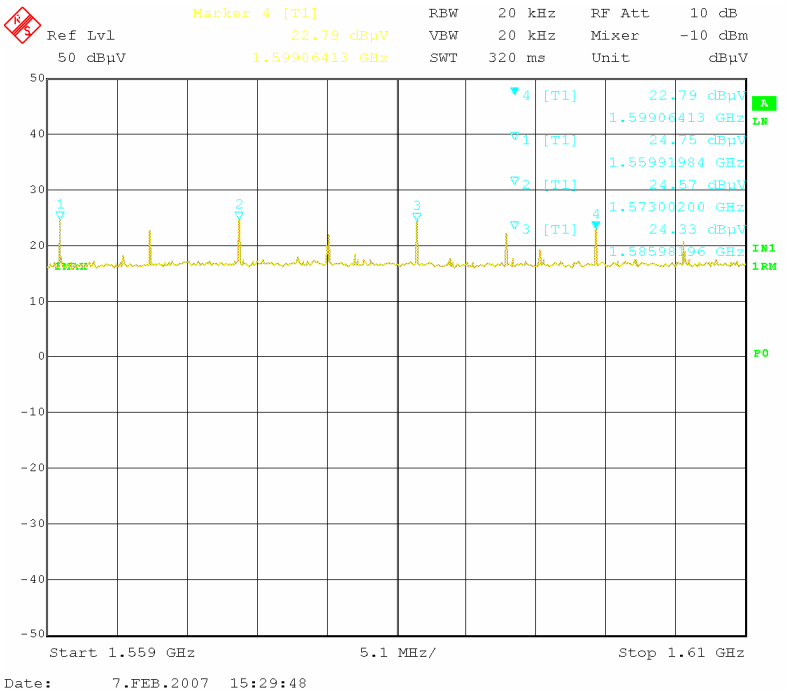
Emission Frequency MHz	Plot #	Meter Reading dBuV	Ant. Polarity V/H	Meas. Distance m	Correction Factor dB/m	Field Strength dBuV/m	Limit dBuV/m @3m
1176.5	1	23.8	V	1	-14.43	9.37	9.90
1559.9	2	24.75	V	1	-13.49	11.26	9.90
1573	2	24.57	V	1	-13.4	11.17	9.90
1586	2	24.33	V	1	-13.3	11.03	9.90
1599	2	22.79	V	1	-13.21	9.58	9.90

Plot 1:



APPLICANT: Ubisense Limited
FCC ID: SEATAG21
Report#: \\large\us\documents\FCC Certification\V2 certification\V2.1 Slim\326BUT7TestReport_final_mod1.DOC

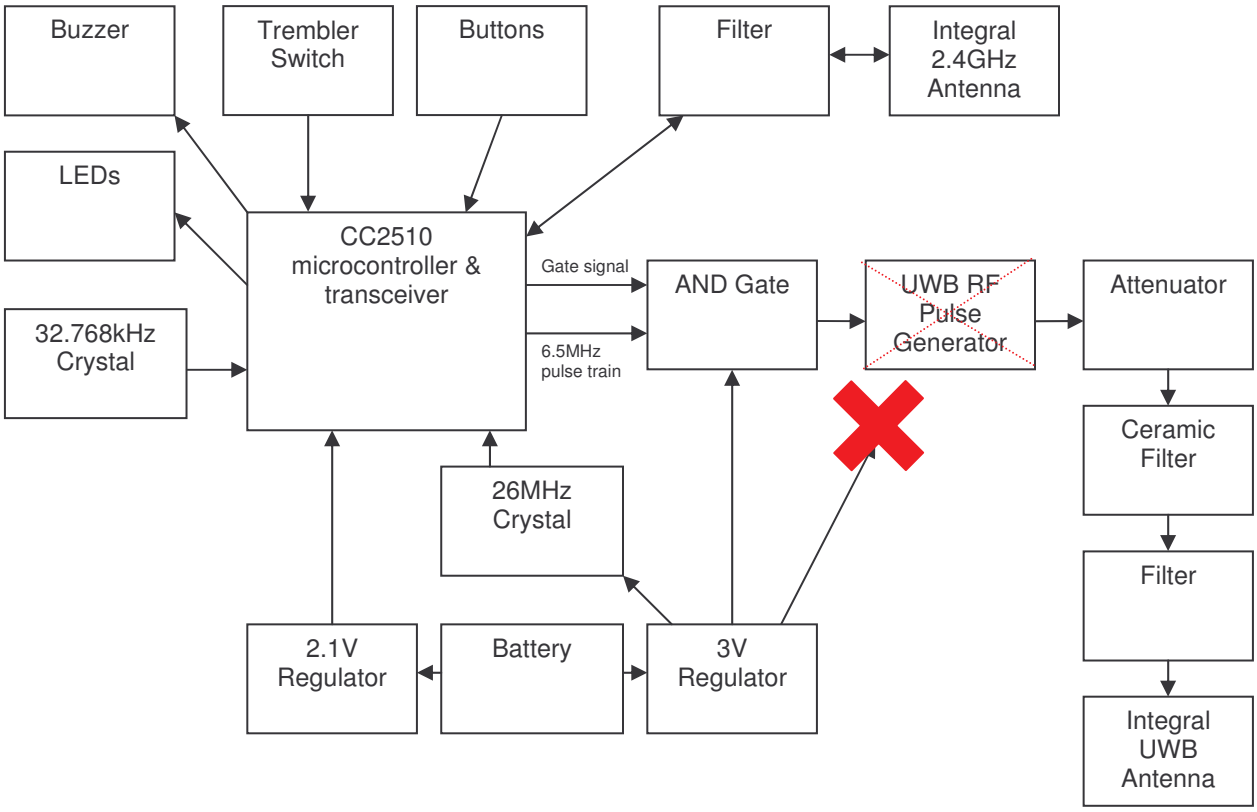
Plot 2:



As can be seen from the table, the emissions at 1559.9MHz, 1573MHz and 1586MHz exceed the relevant emissions limits by 1.36dB, 1.27dB and 1.13dB respectively. However, these emissions are digital in nature, and, as specified in §15.521(c):

§15.521(c) *Emissions from digital circuitry used to enable the operation of the UWB transmitter shall comply with the limits in Section 15.209 of this chapter, rather than the limits specified in this subpart, provided it can be clearly demonstrated that those emissions from the UWB device are due solely to emissions from digital circuitry contained within the transmitter and that the emissions are not intended to be radiated from the transmitter's antenna.*

To demonstrate that these emissions were from digital circuitry and were not intended to be radiated from the transmitter's antenna, the UWB RF pulse generator on the tag device (which is the only UWB RF source on the device and the only circuit connected to the UWB antenna. as shown in block diagram below) was disabled by disconnecting its power supply. The digital circuitry on the board was left unchanged.

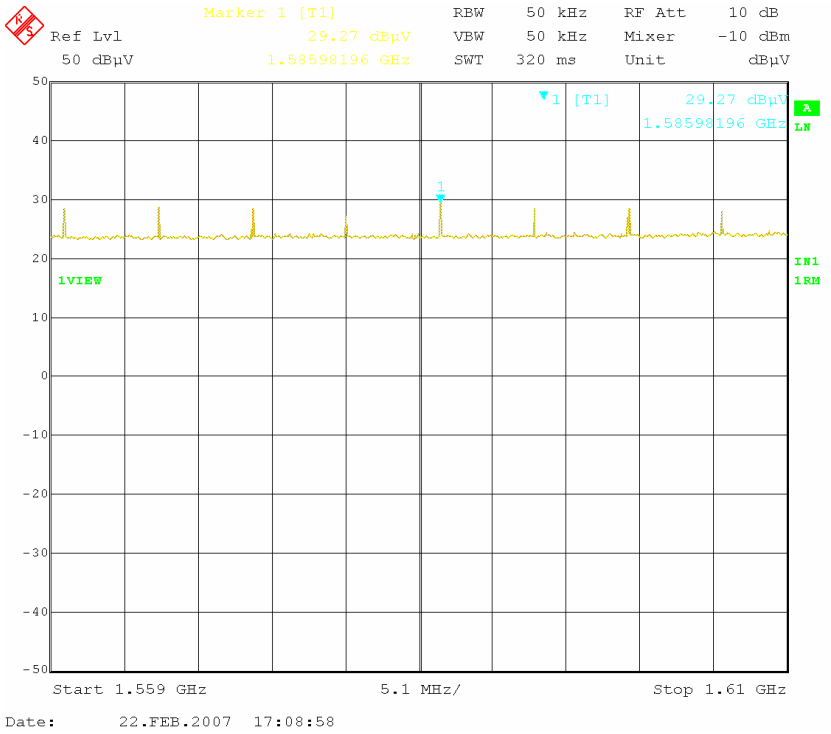


The device was retested in the modified configuration shown above in the bands 1.559-1.61GHz and 3.1-10.6GHz – the results are shown in Plot 3 and Plot 4 below.

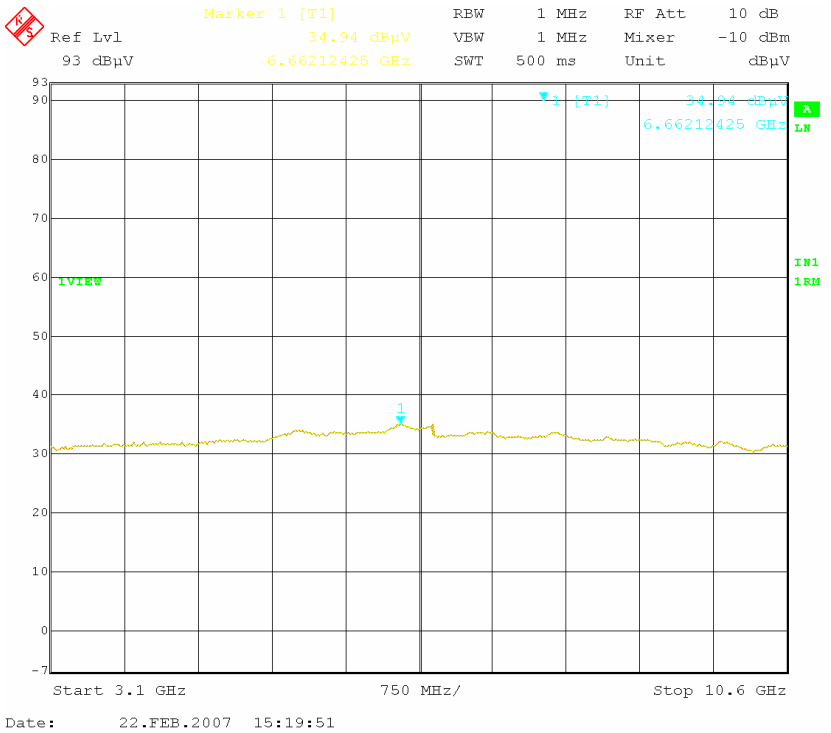
With the UWB transmitter disabled there were no emissions in the region 3.1-10.6GHz. However, the signals at 1559.9MHz, 1573MHz and 1586MHz were still present (at levels equal to or greater than those previously measured), demonstrating that these emissions are not generated by the UWB transmitter, but are radiated from supporting (digital) circuitry on the device. With reference to the block diagram above, it can be seen that a 6.5MHz digital clock signal is fed via an AND logic gate on the device. The emissions at 1559.9MHz, 1573MHz and 1586MHz represent the 240th, 242nd and 244th harmonics of this clock frequency, respectively.

Since the emissions at 1599.9MHz, 1573MHz and 1586MHz are digital in nature, they were compared against the limits in §15.209 and were found to meet those limits by margins of 35.1dB, 35.1dB, and 36.1dB respectively.

Plot 3: 1.559-1.61GHz, UWB transmitter circuit disabled:



Plot 4: 3.1-10.6GHz, UWB transmitter circuit disabled:



RADIATED EMISSIONS PEAK LEVEL

Rules Part No.: Pt 15.517(e)

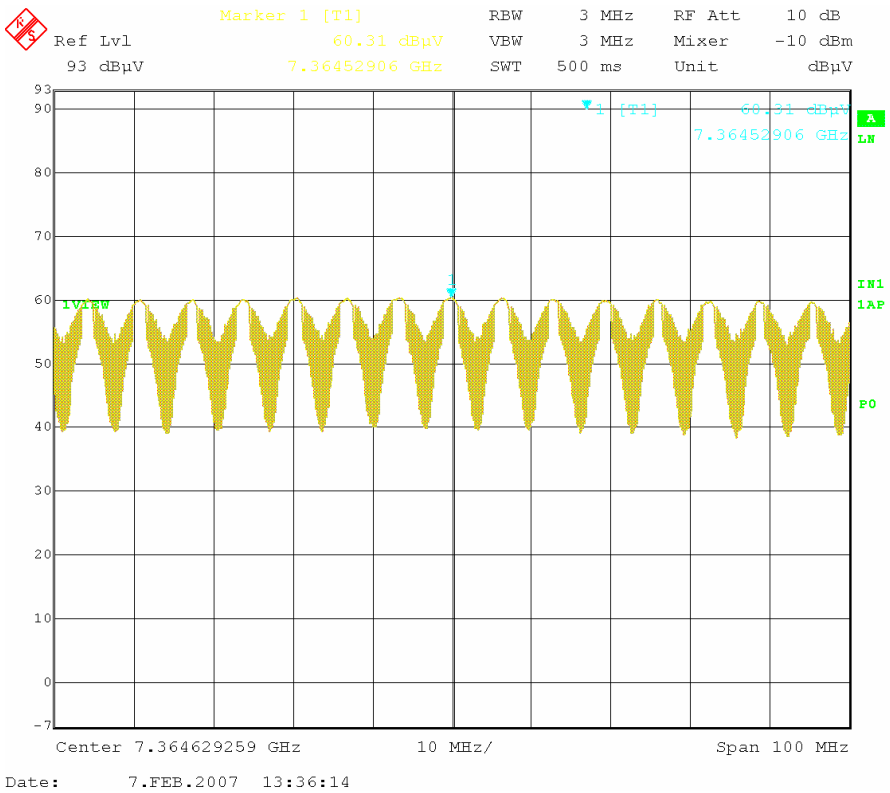
Requirements: The limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. A different resolution bandwidth can be used and a correspondingly different peak emission limit, following the procedures described in Pt 15.521.

Pursuant to Pt 15.521(g), the peak EIRP limit = 20log(3MHz/50) = -24.4 dBm. The equivalent filed strength at 3m = (-24.4) + 95.2 = 70.8 dBuV/m

Note: A RBW of 3 MHz was used to measure the peak radiated power.

Test Data:

Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity V/H	Meas. Distance m	Correction Factor dB/m	Field Strength dBuV/m	Limit dBuV/m @3m
7364.7	60.31	V	1	-6.37	53.94	70.76



POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: Pt 15.207

Requirements:

Frequency (MHz)	Quasi Peak Limits (dBuV)	Average Limits (dBuV)
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5.0	56	46
5.0 – 30	60	50

Test Data: Not applicable because the DUT is battery operated exclusively.