TRaC RADIO TEST REPORT

FOR

Ubisense

ON

UWB Watch Location Device
(model number UBIWATCH21, FCC ID SEAWATCH21)

DOCUMENT NO. TRA-011589-W-US-1

HULL
Unit E, South Orbital Trading Park, Hedon Road, Hull, HU9 1NJ, UK.
T +44 (0)1482 801801 **F** +44 (0)1482 801806 **E** test@tracglobal.com
www.tracglobal.com

TRaC Wireless Test Report : TRA-010248-W-US-1

Applicant : Ubisense

Apparatus : UWB Watch Location Device (model number UBIWATCH21)

Specification(s) : CFR47 Part 15 F 15.517: October 2012

FCCID : SEAWATCH21

Purpose of Test : Certification

Authorised by : 

: Radio Product Manager

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Contents

Section 1: Introduction

1.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

Test performed at:	TRaC Telecoms & Radio Unit E South Orbital Trading Park Hedon Road Hull, HU9 1NJ. United Kingdom. Telephone: +44 (0) 1482 801801 Fax: +44 (0) 1482 801806 Email: test@tracglobal.com Web site: http://www.tracglobal.com	[X]
Tests performed by:	K J Anderson	
Report author:	K J Anderson	

1.2 Tests Requested By

This testing in this report was requested by:

Ubisense
St Andrews House
St Andrews Road
Chesterton
Cambridge
CB4 1DL
United Kingdom

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between: 7/2/13 and 8/2/13

UWB Watch Location Device (model number UBIWATCH21, FCC ID SEAWATCH21).

The apparatus is a UWB Watch Location Device containing an UWB transmitter operating at around 7200 MHz in the 3100MHz to 10600 MHz UWB band.

The apparatus is designed for indoor use only, the client declaration is contained within Appendix D of this report.

1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

Test Type	Regulation	Measurement standard	Result
Transmitter bandwidth	Title 47 of the CFR: Part 15 Subpart F; 15.517(b)	-	
Radiated emissions below 960 MHz	Title 47 of the CFR: Part 15 Subpart F; 15.517(c)	ANSI C63.4 Section 8 and Title 47 of the CFR: Part 15 Subpart F 15.521	Pass
Radiated Emissions above 960 MHz	Title 47 of the CFR: Part 15 Subpart F; 15.517(c)(d)	ANSI C63.4 Section 8 and Title 47 of the CFR: Part 15 Subpart F 15.521	Pass
Radiated Peak Emissions	Title 47 of the CFR: Part 15 Subpart F; 15.517(e)	Title 47 of the CFR: Part 15 Subpart F; 15.521g	Pass
Radiated Spurious Emissions from digital circuitry	Title 47 of the CFR: Part 15 Subpart B; 15.209	ANSI C63.4	Pass

1.6 Notes Relating To The Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

Radiated emissions above 960MHz measured against average limits were made with the RMS detector function on the spectrum analyzer, with a sweep time set to 901ms or less - the spectrum analyzer scan had 901 points, and so a sweep time of 901ms 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 requirement listed in 47CFR Part 15.517(a) states that indoor UWB systems must be employed solely for indoor operation. The client has supplied a declaration of conformance to this section in a separate exhibit, included in Appendix D.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, “Pass” indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 17 to 23 °C
Humidity	: 45 to 75 %
Barometric Pressure	: 86 to 106 kPa

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Measurement Uncertainty Values

For test data recorded, the following measurement uncertainty was calculated:

Radiated Electric Field Emissions

Quantity Range	Quantity	Expanded Uncertainty
9kHz to 150 kHz	Amplitude dB(µV/m)	±1.6dB
150 kHz to 30 MHz	Amplitude dB(µV/m)	±2.1dB
30MHz to 300MHz Horizontal	Amplitude dB(µV/m)	±5.1dB
30MHz to 300MHz Vertical	Amplitude dB(µV/m)	±5.2dB
300MHz to 1GHz Horizontal	Amplitude dB(µV/m)	±5.4dB
300MHz to 1GHz Vertical	Amplitude dB(µV/m)	±5.2dB
1GHz to 18GHz Horizontal	Amplitude dB(µV/m)	±4.4dB
1GHz to 18GHz Vertical	Amplitude dB(µV/m)	±4.4dB
18GHz to 26.5GHz Horizontal	Amplitude dB(µV/m)	±4.2dB
18GHz to 26.5GHz Vertical	Amplitude dB(µV/m)	±4.2dB
26.5GHz to 40GHz Horizontal	Amplitude dB(µV/m)	±4.3dB
26.5GHz to 40GHz Vertical	Amplitude dB(µV/m)	±4.3dB

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector
CDN	: Coupling & decoupling network

ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation

A1 Transmitter Bandwidth

A scan was performed of the transmitter bandwidth using an RMS detector with the RBW/VBW of the analyser set to 1 MHz. The bandwidth was measured at the -10dB points on the modulation envelope.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : [ ] 3m alternative test site : [X]

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart F; 15.517(b)
Frequency range	6500MHz to 7500 MHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Lower UWB Edge (MHz)	Upper UWB Edge (MHz)	Allowable Frequency Band (MHz)		Result
6626.0	7307.1	3100	10600	Pass

A2 Transmit Radiated Emissions below 960MHz

Preliminary scans were performed using a peak detector with RBW=100kHz. Final measurements were made using a quasi-peak detector with RBW=100kHz.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : [ ] 3m alternative test site : [X]

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart F; 15.517(c)
Measurement standard	ANSI C63.4 Section 8 and Title 47 of the CFR: Part 15 Subpart F 15.521
Frequency range	30MHz to 960 MHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

The worst case radiated emission measurements for spurious emissions:

Frequency (MHz)	Polarization	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
31.100	Vertical	22.4	40.0	-17.6	Pass
942.200	Vertical	33.1	46.0	-12.9	Pass

Limits

Frequency of emission (MHz)	Field strength μV/m	Measurement Distance m	Field strength dBμV/m
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation}\,(\text{dB}) = 20\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

The results displayed take into account applicable antenna factors and cable losses.

(b) The levels may have been rounded for display purposes.

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		
Effect of Position of EUT cables & samples on emission levels		✓		

(i) Parameter defined by standard and / or single possible, refer to Appendix D
(ii) Parameter defined by client and / or single possible, refer to Appendix D
(iii) Parameter had a negligible effect on emission levels, refer to Appendix D
(iv) Worst case determined by initial measurement, refer to Appendix D

A3 Transmit Radiated Emissions above 960MHz

Scans and measurements were performed using an RMS average detector with the RBW of the analyser set to 1MHz, except for the bands 1164MHz to 1240MHz and 1559MHz to 1610MHz where the RBW of the analyser was set to 1kHz. The averaging time per point on the analyser scan was 1ms or less.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : [ ] 3m alternative test site : [X]

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart F; 15.517(c)(d)
Measurement standard	ANSI C63.4 Section 8 and Title 47 of the CFR: Part 15 Subpart F 15.521
Frequency range	960MHz to 40 GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

The worst case radiated emission measurements :

Frequency (MHz)	Polarization	Level (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
989.600	Vertical	-77.5	-75.3	-2.2	Pass
1504.300	Vertical	-77.8	-75.3	-3.5	Pass
1783.100	Vertical	-70.6	-53.3	-17.3	Pass
2993.900	Vertical	-64.2	-51.3	-12.9	Pass
6866.208	Vertical	-44.5	-41.3	-3.2	Pass
9941.700	Vertical	-56.1	-41.3	-24.8	Pass
17745.100	Vertical	-52.4	-51.3	-1.1	Pass
25140.000	Vertical	-54.6	-51.3	-3.3	Pass
39520.000	Vertical	-53.9	-51.3	-2.6	Pass

Bands 1164 to 1240 MHz and 1559 to 1610 MHz

Frequency (MHz)	Polarization	Level (dBm/kHz)	Limit (dBm/kHz)	Margin (dB)	Result
1204.8	Vertical	-95.8	-85.3	-10.5	Pass
1594.8	Vertical	-93.5	-85.3	-8.2	Pass

Limits 15.517(c)

Frequency Range (MHz)	EIRP Limit (dBm/MHz)
960–1610	-75.3
1610–1990	-53.3
1990–3100	-51.3
3100–10600	-41.3
Above 10600	-51.3

Limits 15.517(d)

Frequency Range (MHz)	EIRP Limit (dBm/kHz)
1164–1240	-85.3
1559–1610	-85.3

A4 Radiated Peak Emissions

Measurements were performed using a peak detector with RBW=3MHz .

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : ☐ 3m alternative test site : ☒

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart F; 15.517(e)
Measurement standard	Title 47 of the CFR: Part 15 Subpart F; 15.521g
Frequency range	6.5 to 7.5GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Frequency (MHz)	Polarization	Level (dBm/3MHz)	Limit (dBm/3MHz)	Margin (dB)	Result
6866.208	Horizontal	-34.6	-24.4(Note)	-10.2	Pass

Note:

The test limit is derived from the 15.517(e) limit of 0dBm/50 MHz.
The measurement bandwidth used was 3 MHz, therefore the correction factor used was 20 log (3/50) dB.

A5 Unintentional Radiated Electric Field Emissions - 15.109 (Receiver/Digital circuitry)

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109. The EUT was set to receive mode only on its lowest, centre and highest carrier frequency in turn.

The following test site was used for final measurements as specified by the standard tested to :

3m open area test site : [ ] 3m alternative test site : [X]

Test Details: Receive Mode	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4
Class	B – refer to specification limit table below.
Frequency range	30 MHz to 1 GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

No emissions were found within 20 dB of the emissions limit.

Specification limits :

The upper frequency of the measurement range was decided according to 47 CFR Part 15 Clause 15.33.

Radiated emission limits (47 CFR Part 15 Clause 15.109):

Except for a Class A digital device, the field strength of radiated emissions from unintentional radiators at a distance of 3m shall not exceed the following values:

Frequency of emission (MHz)	Field strength μV/m	Field strength dBμV/m
30-88	100	40.0 (quasi-peak)
88-216	150	43.5 (quasi-peak)
216-960	200	46.0 (quasi-peak)
960-1000	500	54.0 (quasi-peak)
Above 1000	500	54.0 (average)
Above 1000	-	74.0 (peak)

Notes:

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation}\,(\text{dB}) = 20\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

The results displayed take into account applicable antenna factors and cable losses.

(b) The levels may have been rounded for display purposes.

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See 1)	See 2)	See 3)	See 4)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		
Effect of Position of EUT cables & samples on emission levels		✓		

1) Parameter defined by standard and / or single possible.
2) Parameter defined by client and / or single possible.
3) Parameter had a negligible effect on emission levels.
4) Worst case determined by initial measurement.

A6 ac Power Line Conducted Emissions 15.107 (Receiver/Digital circuitry)

No ac Power Line emissions were performed as the EUT is exclusively battery powered

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

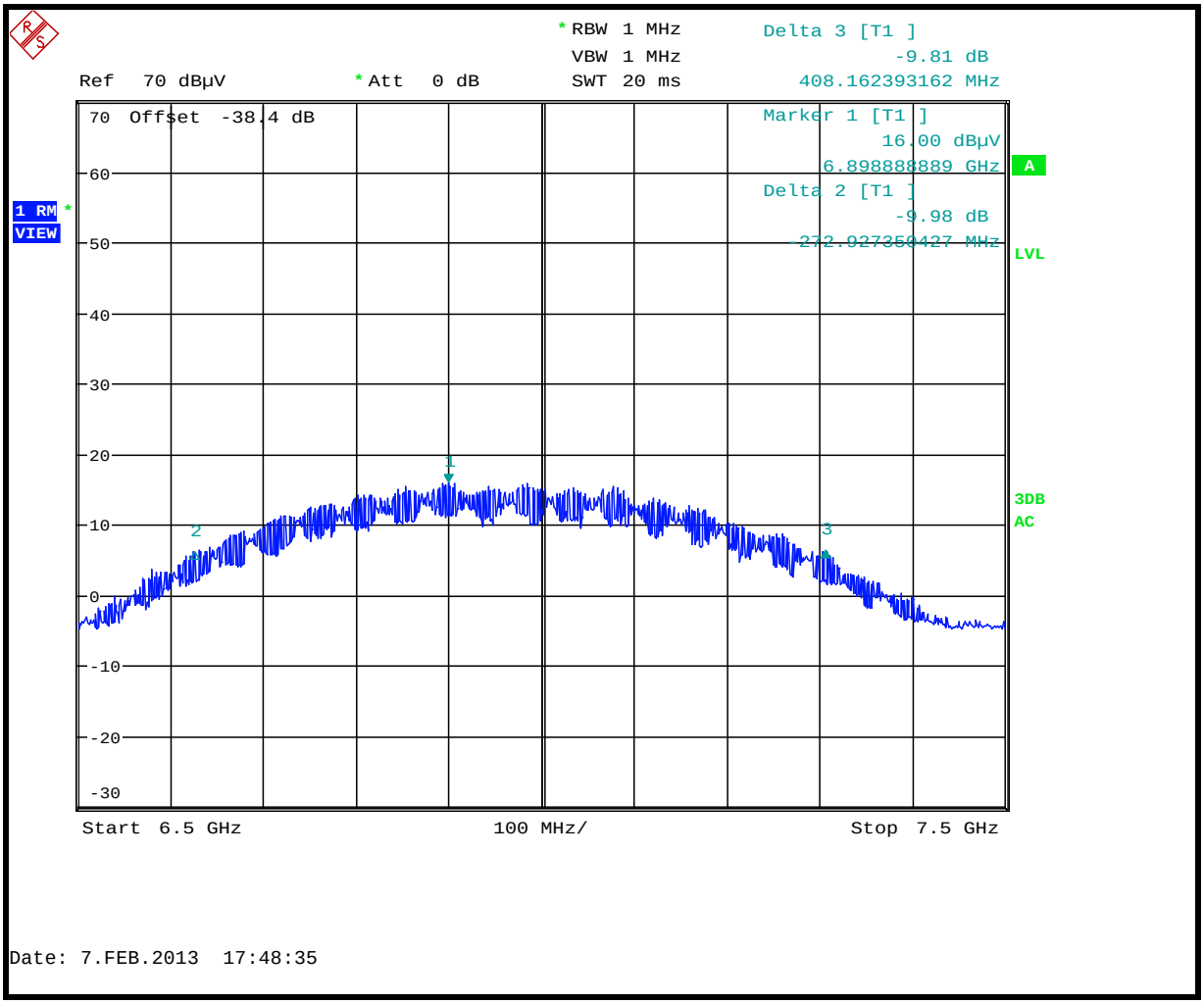
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

(b) The time and date on the plots do not necessarily equate to the time of the test.

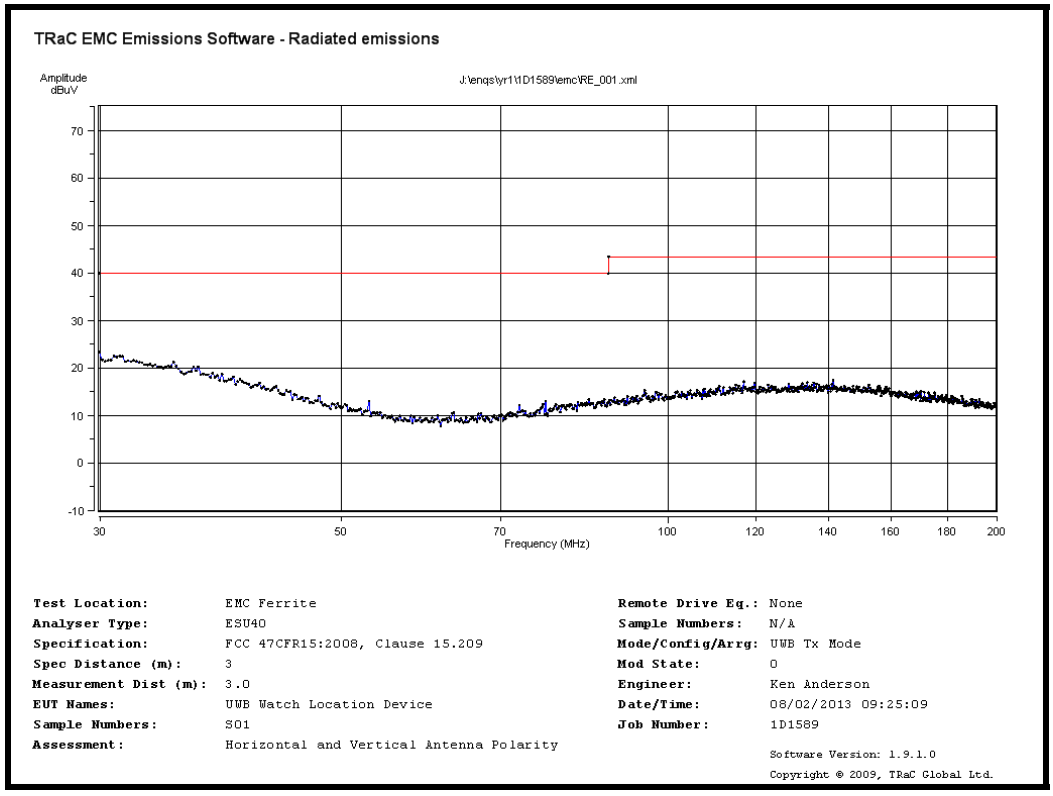
(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

(d) Appendix C details the numbering system used to identify the sample and its modification state.

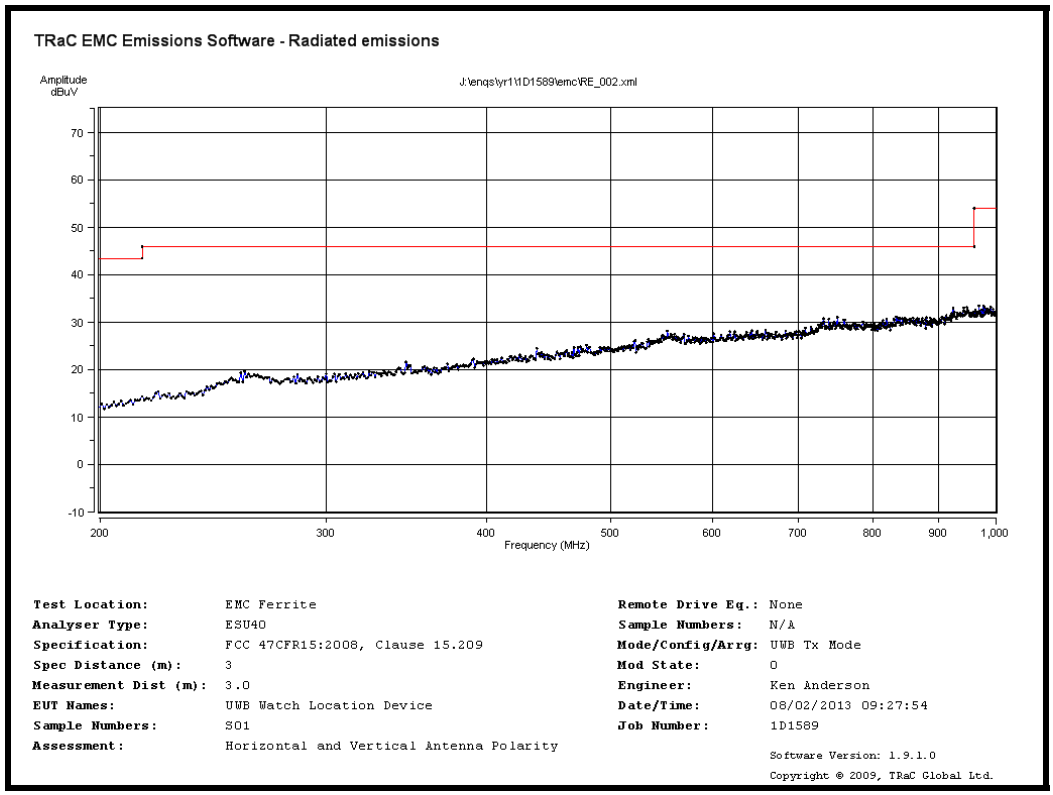
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.



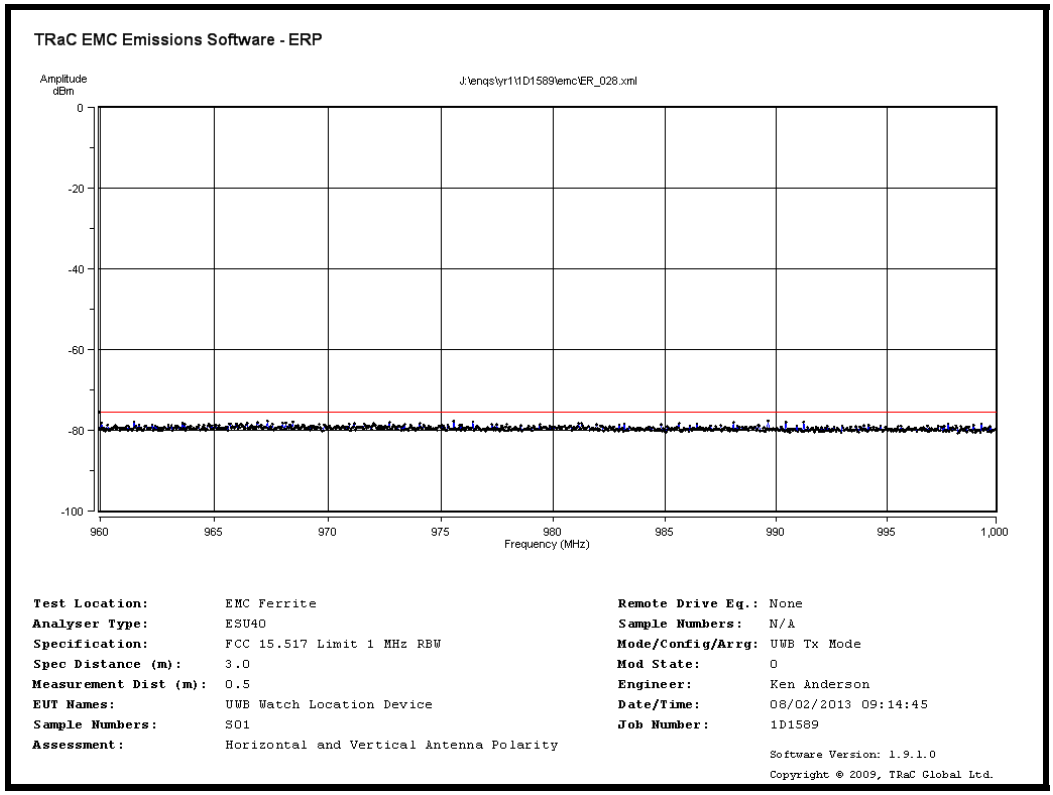
Transmitter Bandwidth



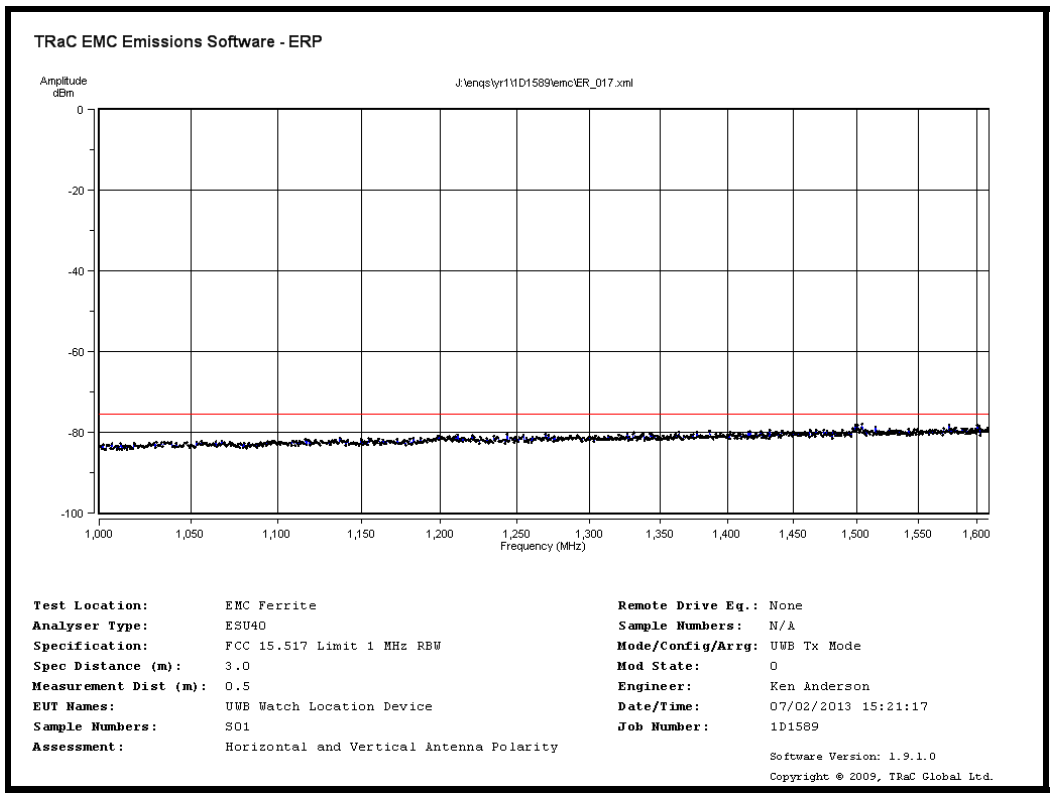
Radiated Emissions 30 MHz to 200 MHz



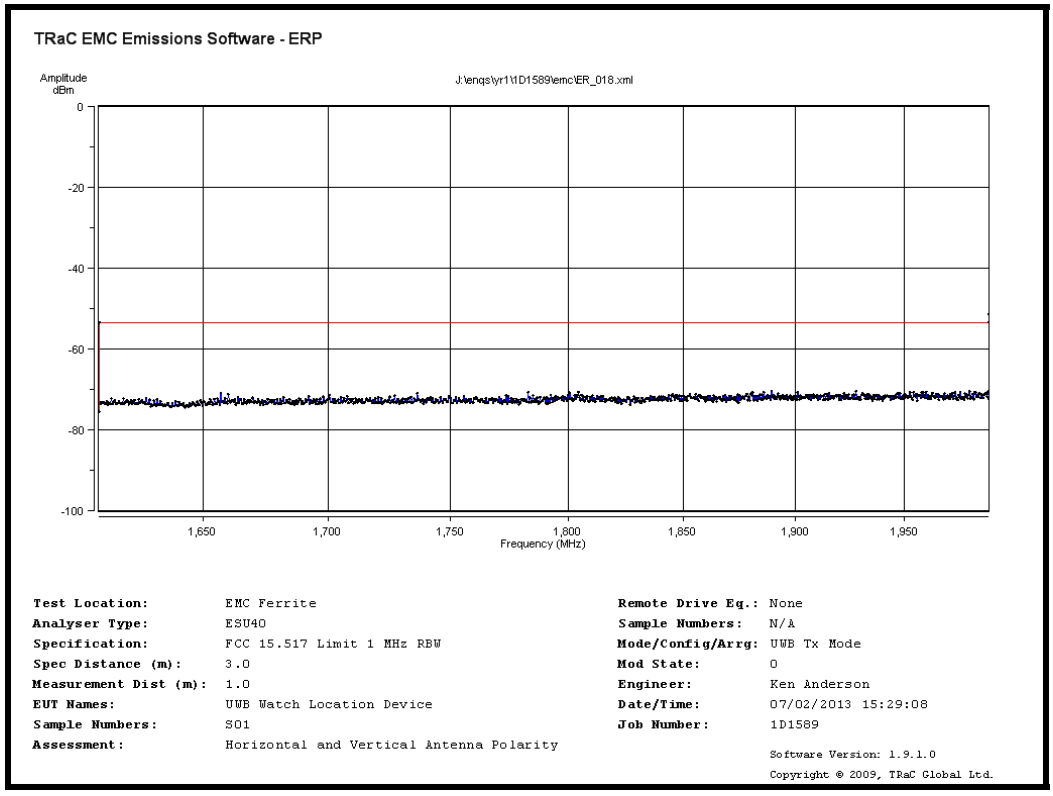
Radiated Emissions 200 MHz to 1000 MHz



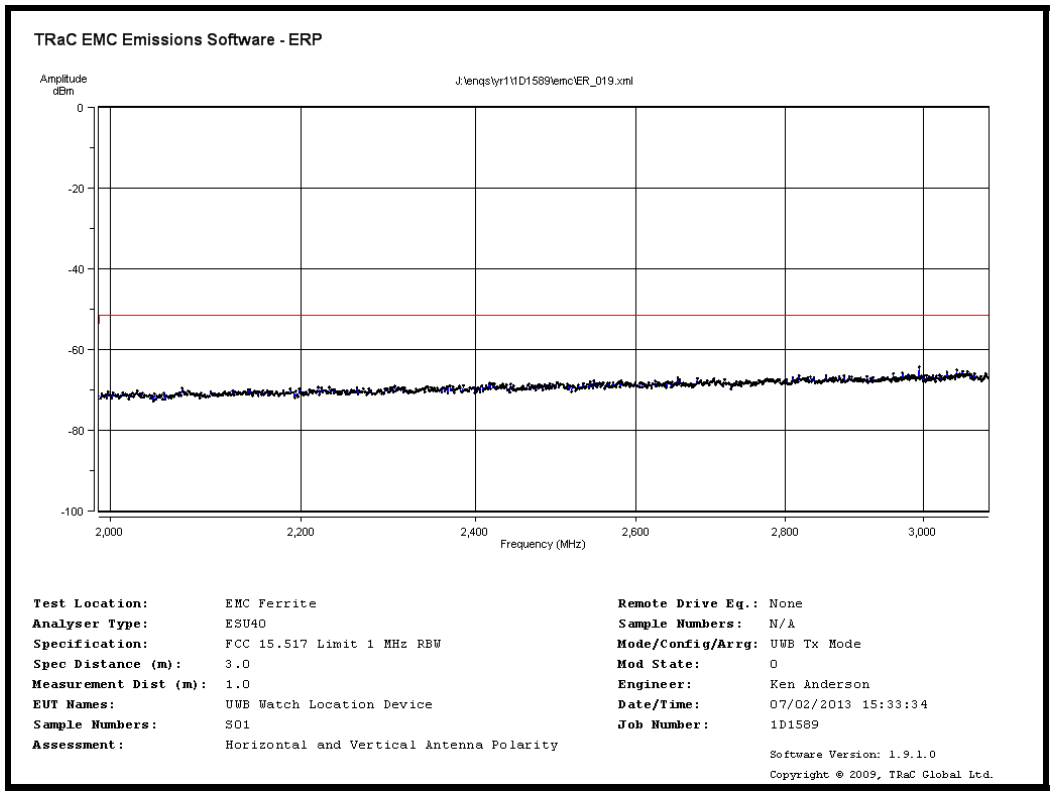
Radiated Emissions 960 MHz to 1000 MHz



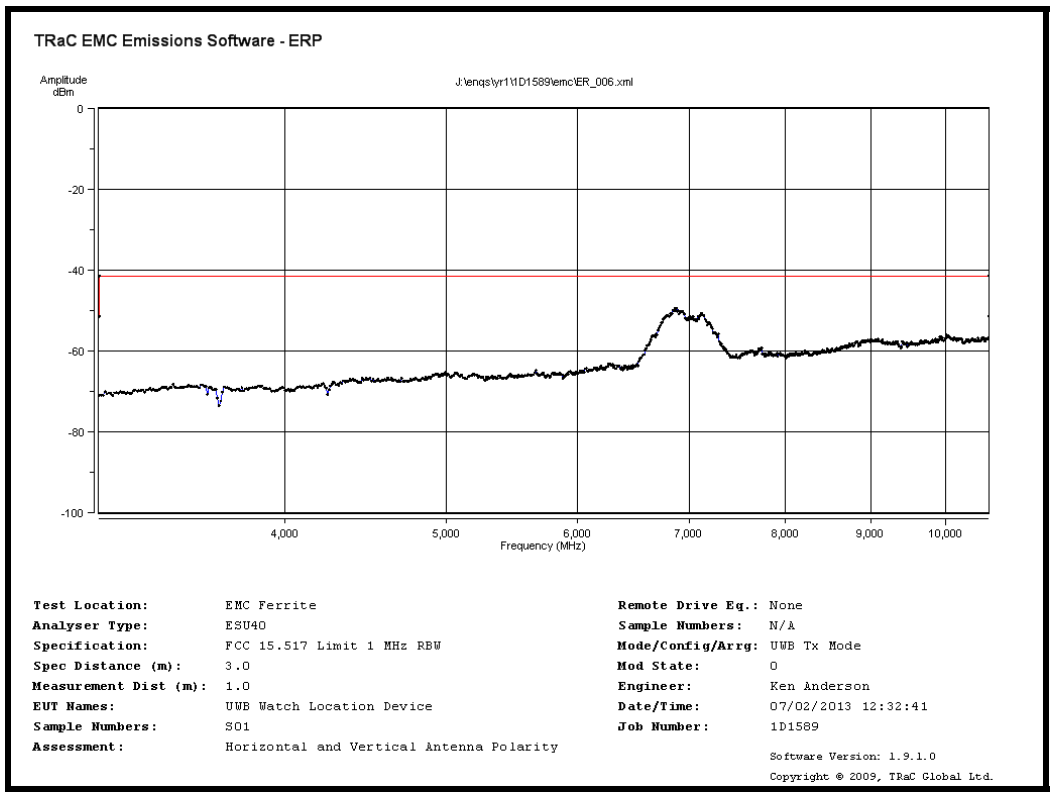
Radiated Emissions 1000 MHz to 1610 MHz



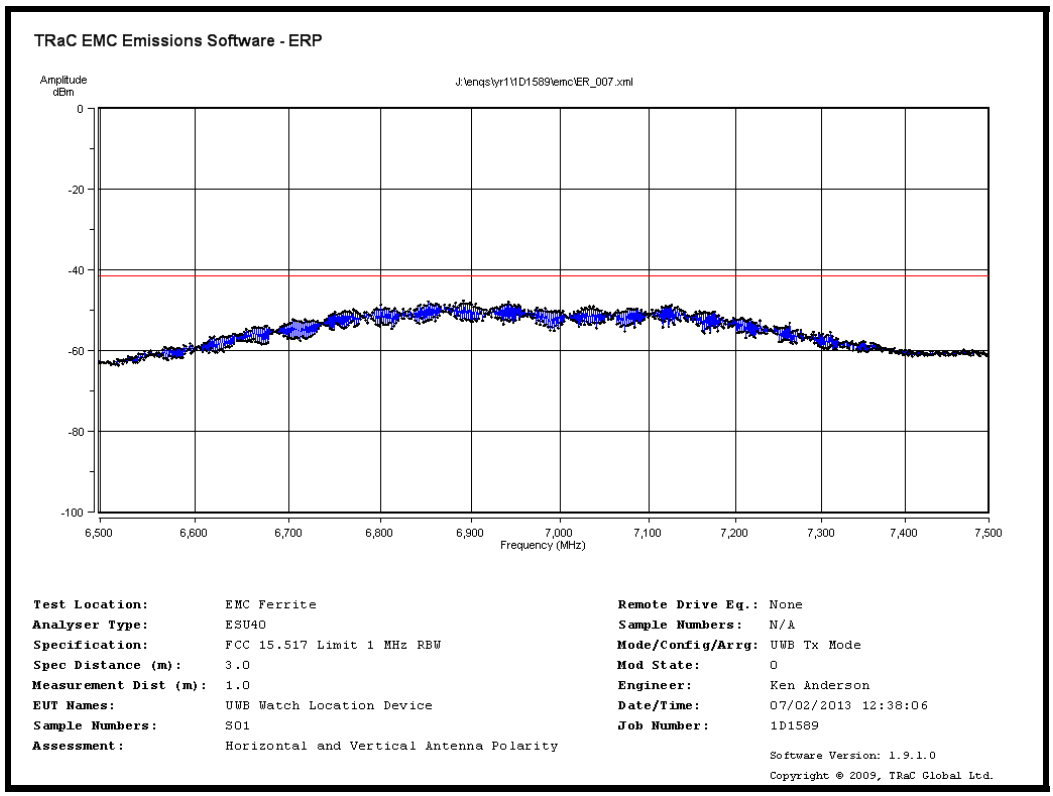
Radiated Emissions 1610 MHz to 1990 MHz



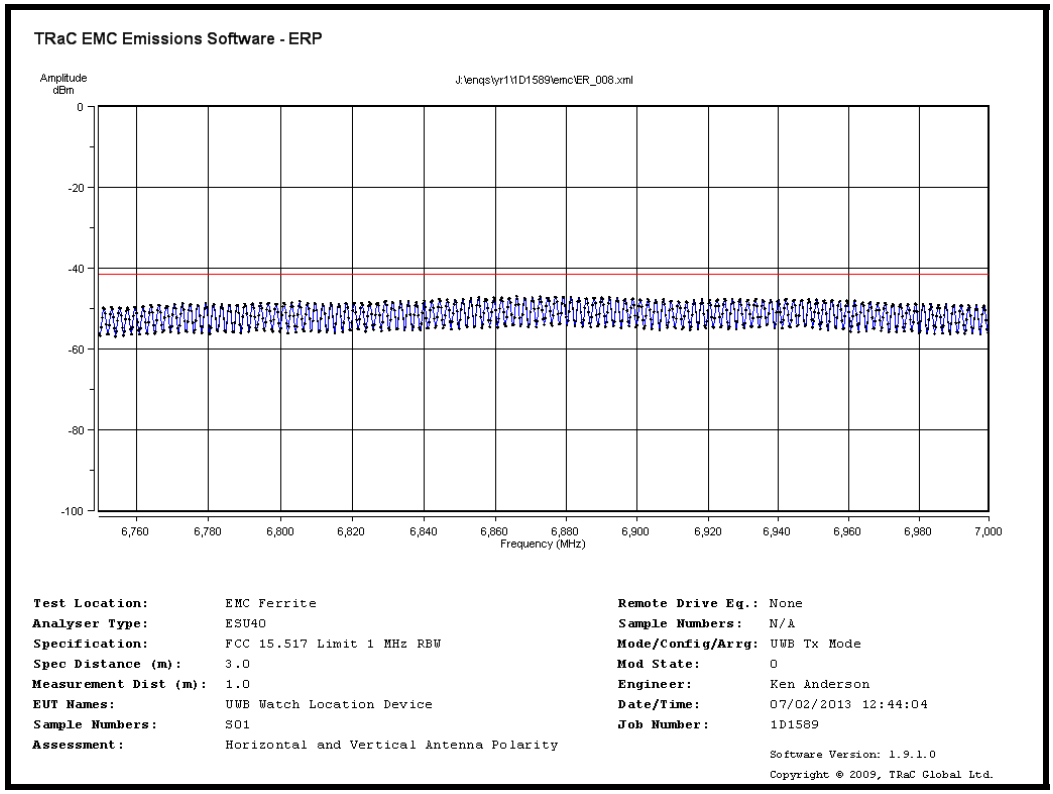
Radiated Emissions 1900 MHz to 3100 MHz



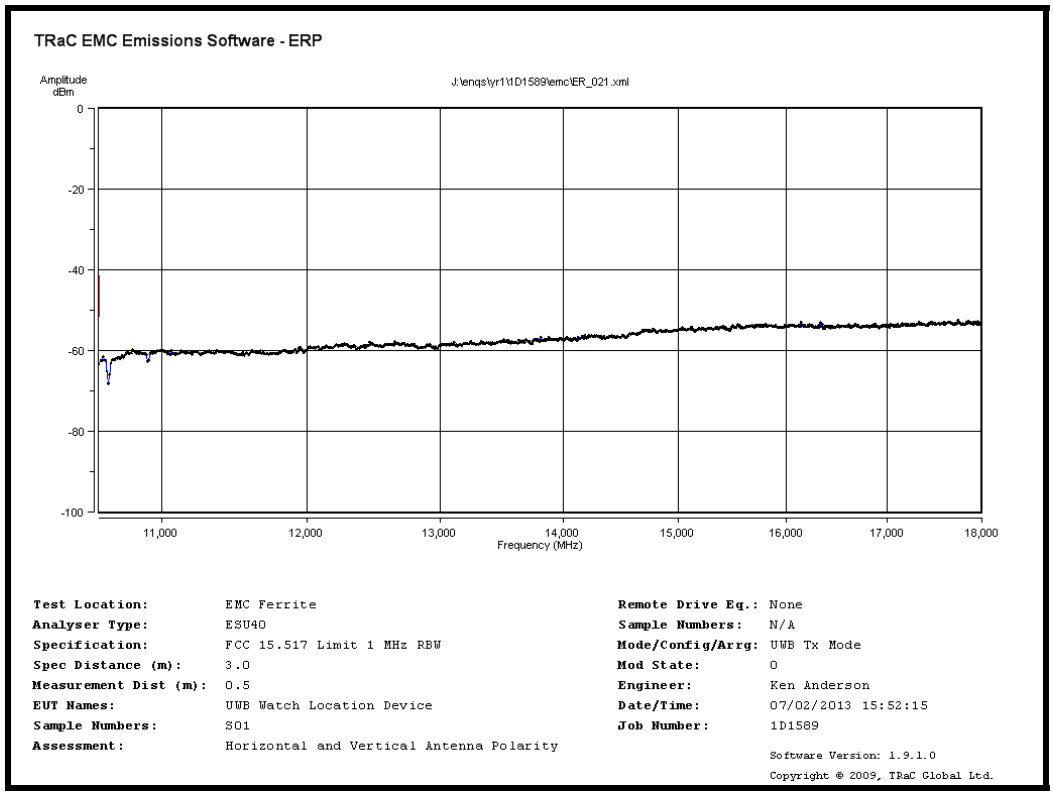
Radiated Emissions 3100 MHz to 10600 MHz



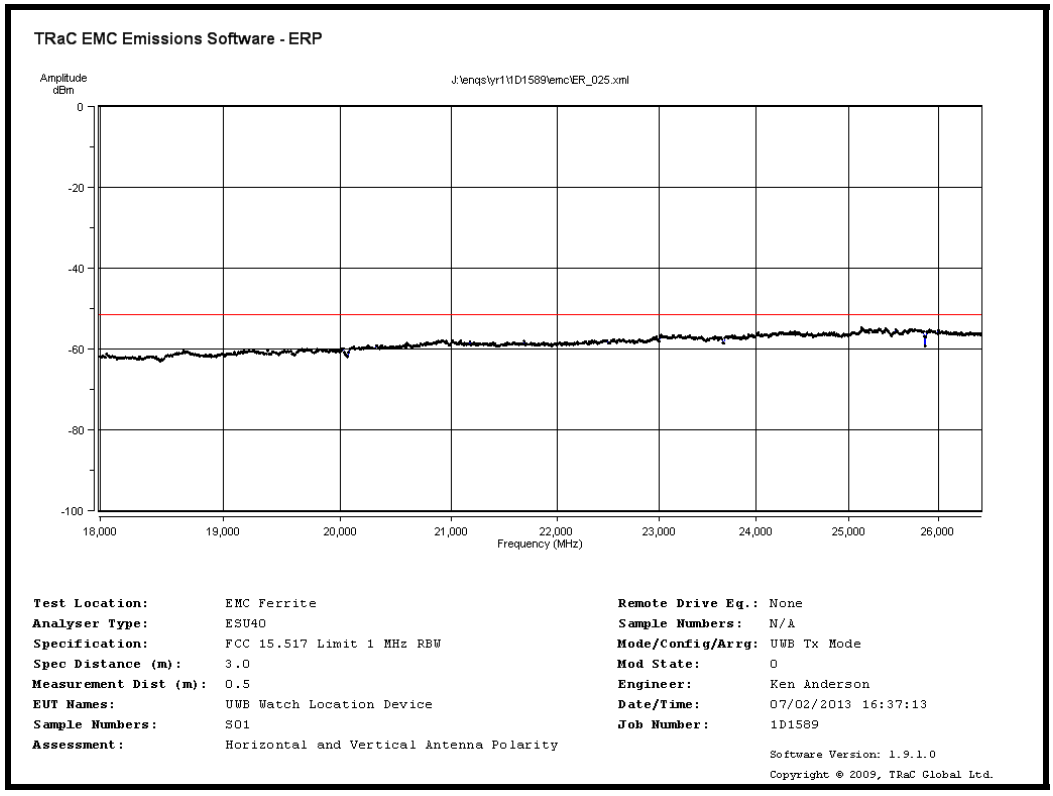
Carrier Emissions 6500 MHz to 7500 MHz



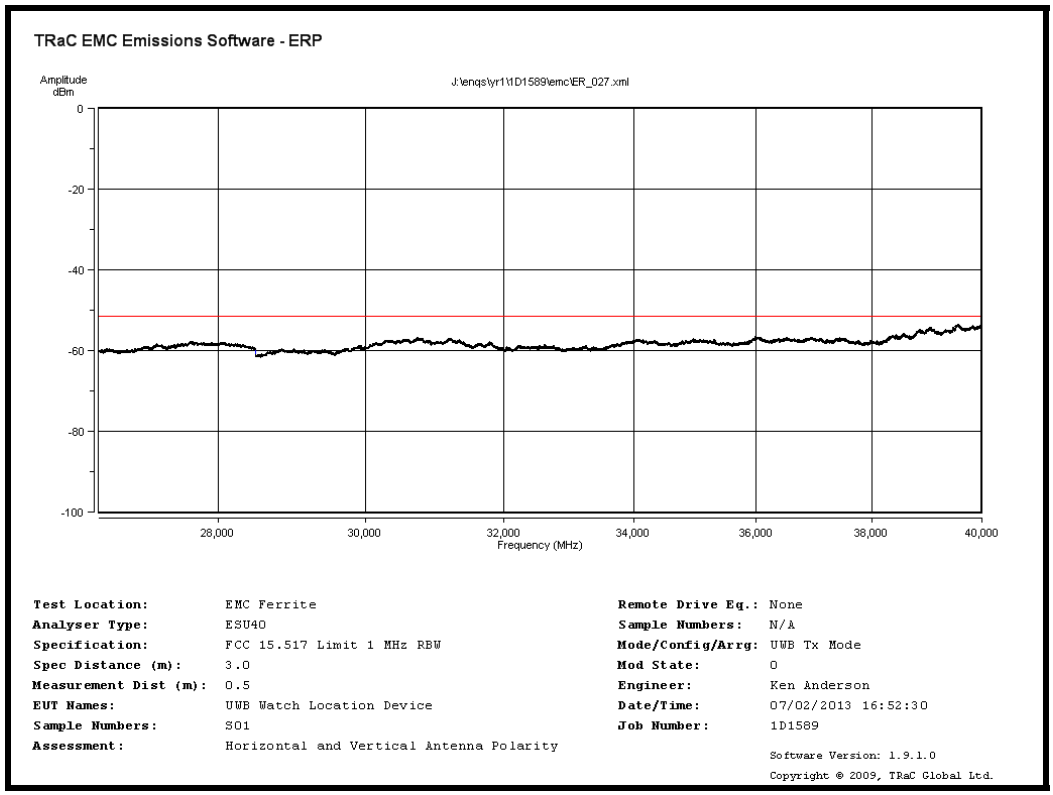
Carrier Emissions 6750 MHz to 7000 MHz



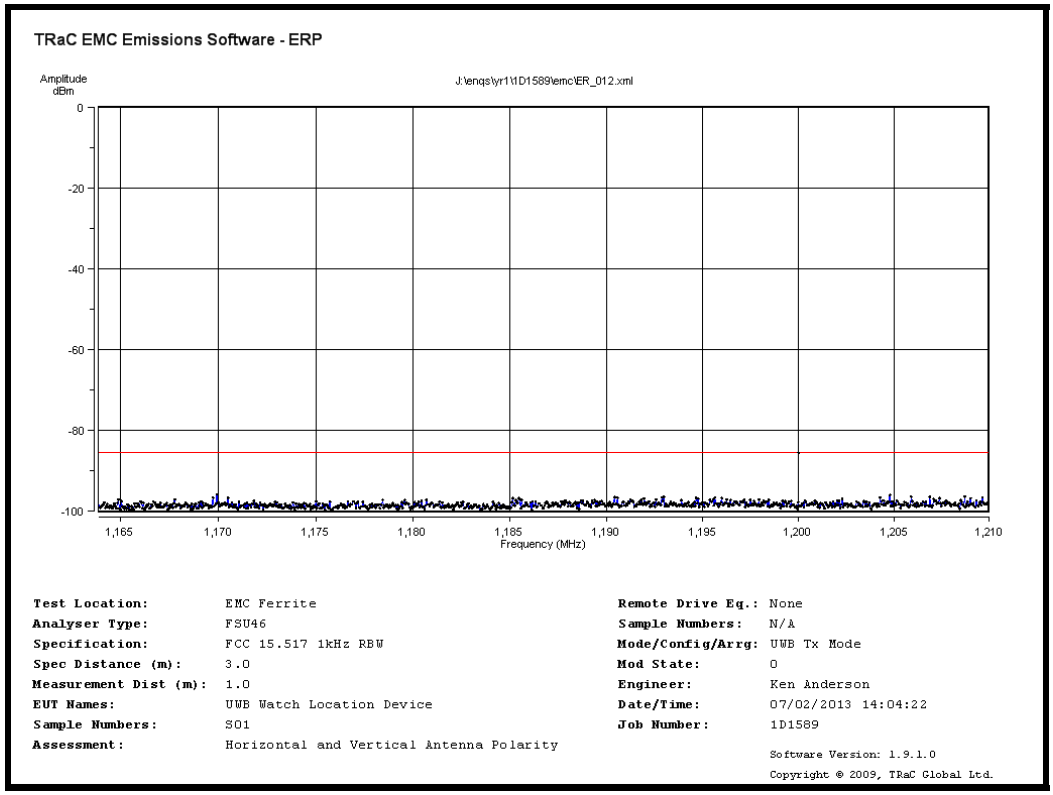
Radiated Emissions 10600 MHz to 18000 MHz



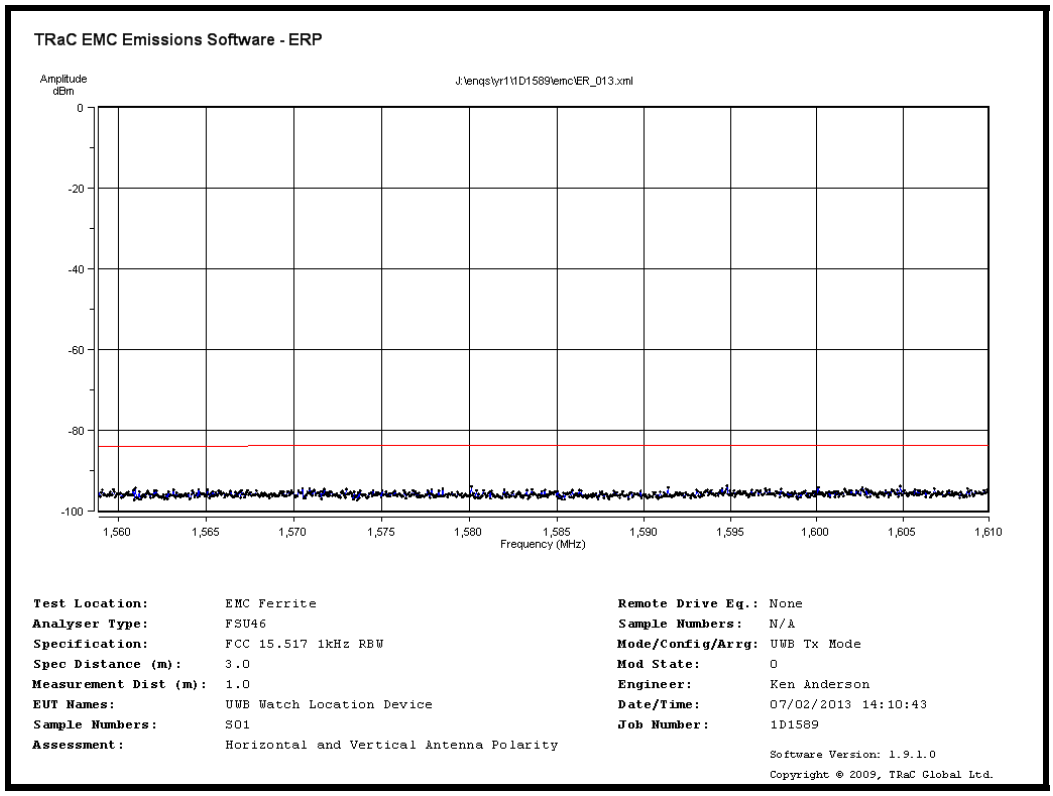
Radiated Emissions 18000 MHz to 26500 MHz



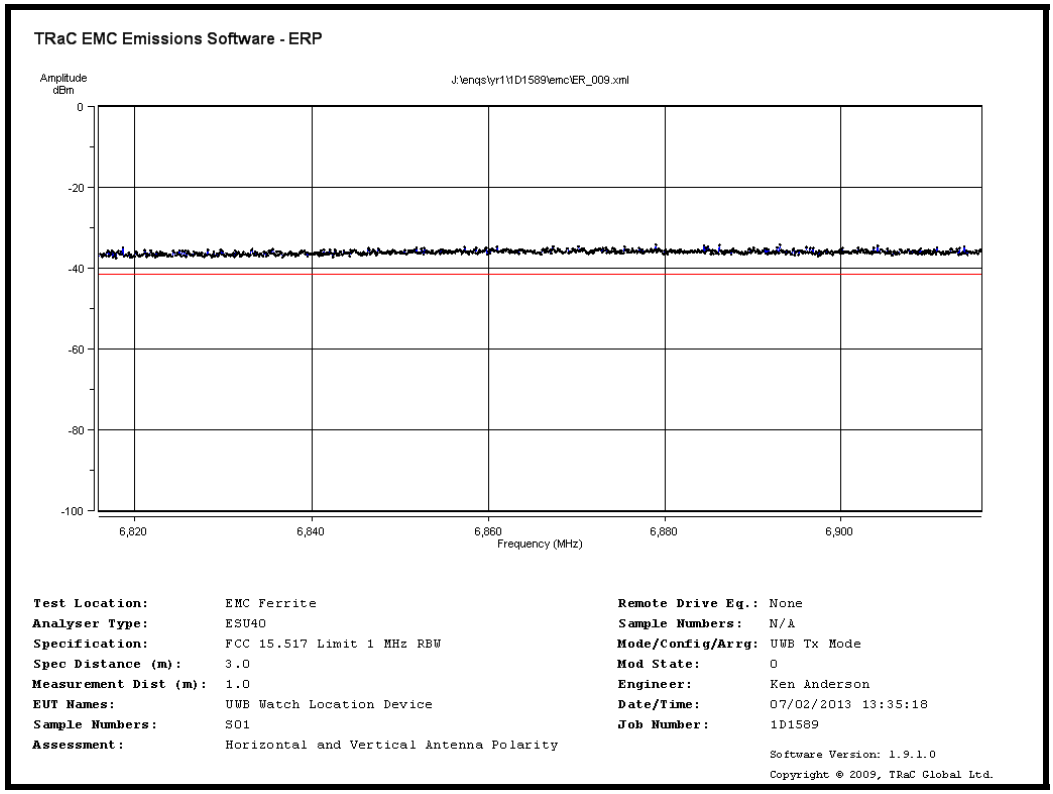
Radiated Emissions 26500 MHz to 40000 MHz



Radiated Emissions 1164 MHz to 1210 MHz



Radiated Emissions 1559 MHz to 1610 MHz



Radiated Peak Emissions 6816 MHz to 6916 MHz

Appendix C: Additional Test and Sample Details

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and it's modification state:

Sample No: Sxx Mod w

where:

xx = sample number eg. S01
w = modification number eg. Mod 2

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

Positioning of cards in a chassis.
Setting of any internal switches.
Circuit board jumper settings.
Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as “single possible configuration”.

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Telecoms & Radio upon request.

C1) Test samples

The following samples of the apparatus were submitted by the client for testing :

Sample No.	Description	Identification
S01	UWB Watch Location Device (model number UBIWATCH21, FCC ID SEAWATCH21)	Serial No. 0001

C2) EUT Operating Mode During Testing.

During testing, the EUT was exercised as described in the following tables:

Test	Description of Operating Mode: TX
All tests detailed in this report	EUT continuously transmitting using UWB Modulation

C3) EUT Configuration Information.

Sample	Internal Configuration Details
S01	Single possible internal configuration

C4) List of EUT Ports

The EUT was a battery powered device containing no external ports.

C5 Details of Equipment Used

For Radiated Electric Field Emissions 30MHz to 1GHz:

Lab 10				
RFG/REF No	Type	Description	Manufacturer	Date Calibrated.
274	ATS	Ferrite Lined Chamber	Panashield	10/07/11
679	CBL6111	Blue Bilog Antenna (0.03 – 1GHz)	Chase	05/05/11
008	8447D	Pre-amp (0.1 – 1300MHz)	H & P	16/02/11
126	ESV20	Test Receiver	R & S	18/05/11
404	E4407B	Spectrum Analyser	Agilent	17/05/11
643	N-type	Sucotest Microwave Cable 1m	Huber & Suhner	17/09/10
651	N-type	Sucotest Microwave Cable 7m	Huber & Suhner	17/09/10
678	N-type	Sucotest Microwave Cable 2m	Huber & Suhner	28/03/11
636	NSG1007	110Vac / 60Hz	Schaffner	N/A
REF887	34405A	Multi-meter	Agilent	25/08/10

For Radiated Electric Field Emissions 1GHz to 18GHz:

Lab 10				
RFG/REF No	Type	Description	Manufacturer	Date Calibrated
274	ATS	Ferrite Lined Chamber	Panashield	10/07/11
129	3115	Horn Antennas	EMCO	11/08/09
307	HP8449B	Microwave Pre-Amp (1-26.5GHz)	HP	01/03/10
643	N-type	Sucotest Microwave Cable 1m	Huber & Suhner	17/09/10
651	N-type	Sucotest Microwave Cable 7m	Huber & Suhner	17/09/10
678	N-type	Sucotest Microwave Cable 2m	Huber & Suhner	28/03/11
404	E4407B	Spectrum Analyser	Agilent	17/05/11
636	NSG1007	110Vac / 60Hz	Schaffner	N/A
REF887	34405A	Multi-meter	Agilent	25/08/10

For Radiated Electric Field Emissions 1GHz to 18GHz:

Lab 16				
RFG/REF No	Type	Description	Manufacturer	Date Calibrated
REF886	Lab 16	Large Anechoic Chamber	Rainford EMC systems	27/07/10
REF880	HL050	Log Perodic Antenna (1-26.5GHz)	R&S	14/05/10
913	HP8449B	Microwave Pre-Amp (1-26.5GHz)	HP	07/01/11
404	E4407B	Spectrum Analyser	Agilent	17/05/11
452	SMA	1m 50Ohm coaxial UTIFLEX cable	Teledyne Reynolds	25/05/11
REF881	N-type	50Ohm coaxial HF RF coaxial cable	Teledyne Reynolds	06/06/11
REF882	N-type	50Ohm coaxial HF RF coaxial cable	Teledyne Reynolds	06/06/11
REF884	N-type	50Ohm coaxial HF RF coaxial cable	Teledyne Reynolds	06/06/11
REF885	N-type	50Ohm coaxial HF RF coaxial cable	Teledyne Reynolds	06/06/11
REF915	PCR500L	ac/dc Power Supply	Kikusui	N/A
REF887	34405A	Multi-meter	Agilent	25/08/10

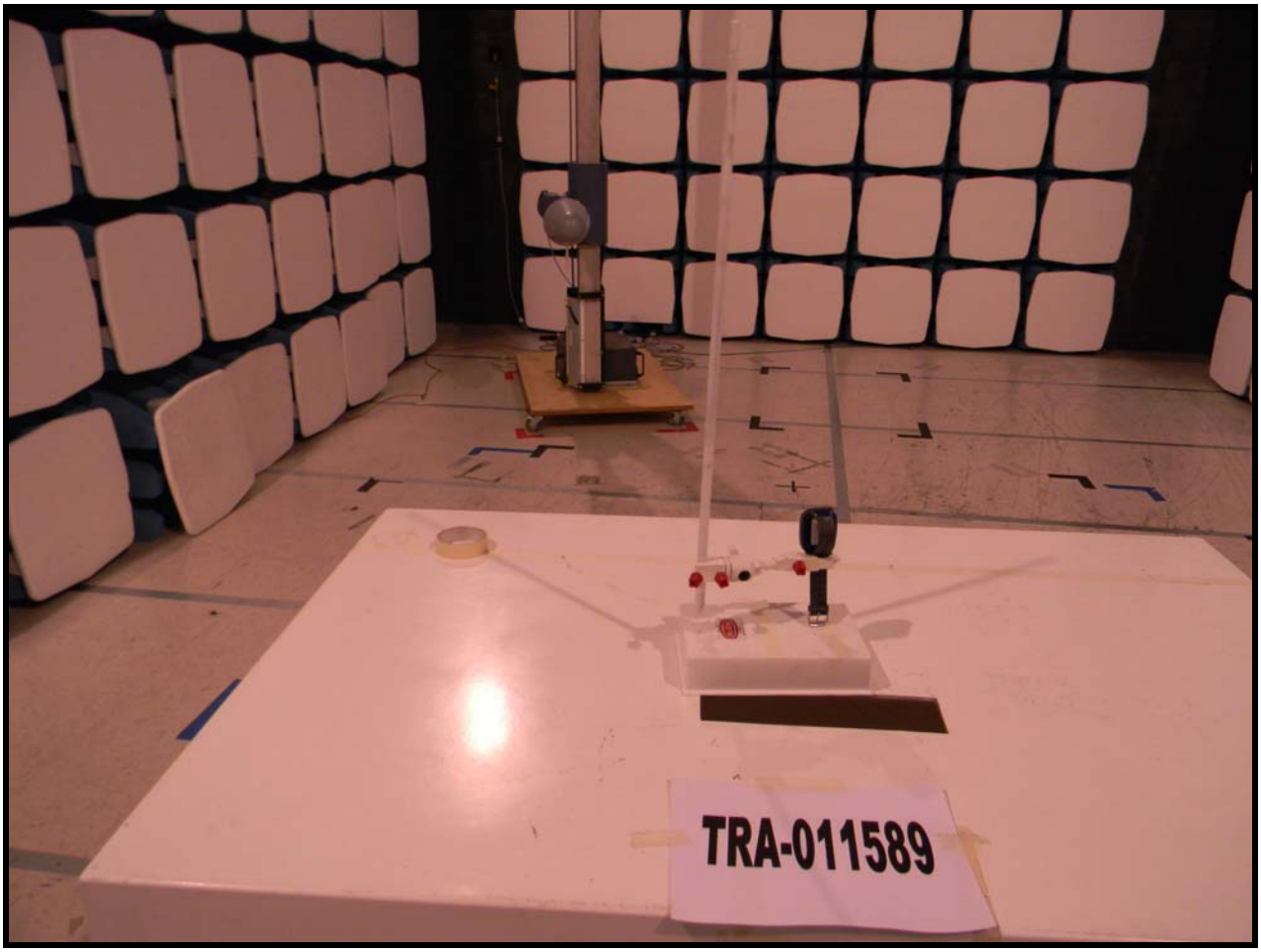
Appendix D: Additional Information

Declaration from the client regarding indoor use..

Appendix E: Photographs and Figures

Photograph 1 Radiated Spurious Emissions - Front View
Photograph 2 Radiated Spurious Emissions - Rear View

Photograph 1



Photograph 2