

**TRaC Wireless Test Report : TTR-000623WUS1**

**Applicant** : Unipar Services

**Apparatus** : Sentinel Camera Unit

**Specification(s)** : CFR47 Part 15 July 2008

**Purpose of Test** : Certification

**FCCID** : YRQSEN1

**Authorised by** :



: Radio Product Manager

**Issue Date** : 8<sup>th</sup> September 10

**Authorised Copy Number** : *PDF*

## Contents

Section 1:	Introduction	4
1.1	General	4
1.2	Tests Requested By	5
1.3	Manufacturer	5
1.4	Apparatus Assessed	5
1.5	Test Result Summary	6
1.6	Notes Relating To The Assessment	7
1.7	Deviations from Test Standards	7
Section 2:	Measurement Uncertainty	8
2.1	Measurement Uncertainty Values	8
Section 3:	Modifications	10
3.1	Modifications Performed During Assessment	10
Appendix A:	Formal Emission Test Results	11
A1	Transmitter Intentional Emission Radiated	12
A2	Radiated Electric Field Emissions	13
Appendix C:	Additional Test and Sample Details	24
Appendix D:	Additional Information	30
Appendix E:	Calculation of the duty cycle correction factor	31
Appendix F:	Photographs and Figures	32

**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 by: 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

TRaC Telecoms & Radio [X]

Unit 1  
Pendle Place  
Skelmersdale  
West Lancashire, WN8 9PN  
United Kingdom

Telephone: +44 (0) 1695 556666  
Fax: +44 (0) 1695 577077

Email: [test@tracglobal.com](mailto:test@tracglobal.com)  
Web site: <http://www.tracglobal.com>

Tests performed by: D. Winstanley

Report author: D. Winstanley

**This report must not be reproduced except in full without prior written permission from TRaC Telecoms & Radio.**

## **1.2 Tests Requested By**

This testing in this report was requested by :

Unipar Services  
The Old Stables  
65 Lower Green Road  
Rushall  
Tunbridge Wells  
Kent  
TN4 8TW

## **1.3 Manufacturer**

As Above

## **1.4 Apparatus Assessed**

The following apparatus was assessed between 26<sup>th</sup> – 30<sup>th</sup> July 2010:

Sentinel Camera unit.

The Sentinel Camera unit is a speed detection device with built-in digital camera for recording video of speeding events.

## 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
Spurious Emissions Radiated <1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209	ANSI C63.10	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209 & 12.245	ANSI C63.10	Pass
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.245	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.245	ANSI C63.10	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.245	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10	Pass
Antenna Arrangements Integral:	Title 47 of the CFR: Part 15 Subpart (c) 15.203	-	Pass
Antenna Arrangements External Connector	Title 47 of the CFR: Part 15 Subpart (c) 15.204	-	Pass
Restricted Bands	Title 47 of the CFR: Part 15 Subpart (c) 15.205	-	Pass
Maximum Frequency of Search	Title 47 of the CFR: Part 15 Subpart (c) 15.33	-	Pass
Extrapolation Factor	Title 47 of the CFR: Part 15 Subpart (c) 15.31(f)	-	Pass

Abbreviations used in the above table:

CFR : Code of Federal Regulations  
REFE : Radiated Electric Field Emissions

ANSI : American National Standards Institution  
PLCE : Power Line Conducted Emissions

## **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.

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 the test data recorded in accordance with note (iii) of Section 2.1 the following measurement uncertainty was calculated:

**Radio Testing – General Uncertainty Schedule**

*All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.*

**[1] Adjacent Channel Power**

Uncertainty in test result = **1.86dB**

**[2] Carrier Power**

Uncertainty in test result (Equipment - TRLUH120) = **2.18dB**  
 Uncertainty in test result (Equipment – TRL05) = **1.08dB**  
 Uncertainty in test result (Equipment – TRL479) = **2.48dB**

**[3] Effective Radiated Power**

Uncertainty in test result = **4.71dB**

**[4] Spurious Emissions**

Uncertainty in test result = **4.75dB**

**[5] Maximum frequency error**

Uncertainty in test result (Equipment - TRLUH120) = **119ppm**  
 Uncertainty in test result (Equipment – TRL05) = **0.113ppm**  
 Uncertainty in test result (Equipment – TRL479) = **0.265ppm**

**[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field**

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**, Uncertainty in test result (30MHz – 1GHz) = **4.6dB**, Uncertainty in test result (1GHz-18GHz) = **4.7dB**

**[7] Frequency deviation**

Uncertainty in test result = **3.2%**

**[8] Magnetic Field Emissions**

Uncertainty in test result = **2.3dB**

**[9] Conducted Spurious**

Uncertainty in test result (Equipment TRL479) Up to 8.1GHz = **3.31dB**  
 Uncertainty in test result (Equipment TRL479) 8.1GHz – 15.3GHz = **4.43dB**  
 Uncertainty in test result (Equipment TRL479) 15.3GHz – 21GHz = **5.34dB**  
 Uncertainty in test result (Equipment TRLUH120) Up to 26GHz = **3.14dB**

**[10] Channel Bandwidth**

Uncertainty in test result = **15.5%**

**[11] Amplitude and Time Measurement – Oscilloscope**

Uncertainty in overall test level = **2.1dB**, Uncertainty in time measurement = **0.59%**, Uncertainty in Amplitude measurement = **0.82%**

**[11] Power Line Conduction**

Uncertainty in test result = **3.4dB**

**[12] Spectrum Mask Measurements**

Uncertainty in test result = **2.59% (frequency)**  
Uncertainty in test result = **1.32dB (amplitude)**

**[13] Adjacent Sub Band Selectivity**

Uncertainty in test result = **1.24dB**

**[14] Receiver Blocking – Listen Mode, Radiated**

Uncertainty in test result = **3.42dB**

**[15] Receiver Blocking – Talk Mode, Radiated**

Uncertainty in test result = **3.36dB**

**[16] Receiver Blocking – Talk Mode, Conducted**

Uncertainty in test result = **1.24dB**

**[17] Receiver Threshold**

Uncertainty in test result = **3.23dB**

**[18] Transmission Time Measurement**

Uncertainty in test result = **7.98%**

**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	ALSR	: Absorber Lined Screened Room
Mod	: Modification	OATS	: Open Area Test Site
		ATS	: Alternative Test Site
EUT	: Equipment Under Test		
SE	: Support Equipment	Ref	: Reference
L	: Live Power Line	Freq	: Frequency
N	: Neutral Power Line	MD	: Measurement Distance
E	: Earth Power Line	SD	: Spec Distance
Pk	: Peak Detector	Pol	: Polarisation
QP	: Quasi-Peak Detector	H	: Horizontal Polarisation
Av	: Average Detector	V	: Vertical Polarisation
CDN	: Coupling & decoupling network		

**A1 Transmitter Intentional Emission Radiated**

Carrier power was verified with the EUT transmitting <b>Test Details:</b>	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.245 (b)(1)
Measurement standard	ANSI C63.10:2003
EUT sample number	01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	58%

FREQ. (GHz)	MEASUREMENT Rx. READING (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	FIELD STRENGTH (dB $\mu$ V/m)	FIELD STRENGTH (mV/m)
10.52	78.90	1.37	38.28	-	118.55	846.252
Limit value @ fc		2500 mV/m				
Band occupancy @ -20 dBc			f lower		f higher	
			10.520410256 GHz		10.522052885 GHz	
			1.64263 MHz			
Limits			f lower		f higher	
			10.500 GHz		10.550 GHz	

**Notes:**

- 1 Results quoted are extrapolated as indicated
- 2 Receiver detector @ fc = Average, 1MHz bandwidth
- 3 When battery powered the EUT was powered with new batteries
- 4 See Annex B For occupied bandwidth plot.

**Test Method:**

- 1 As per Radio – Noise Emissions, ANSI C63.10
- 2 Measuring distances 3m
- 3 EUT 0.8 metre above ground plane
- 4 Emissions maximised by rotation of EUT, on an automatic turntable. Raising and lowering the receiver antenna between 1m & 4m. Horizontal and vertical polarisations, of the receive antenna. EUT orientation in three orthogonal planes. Maximum results recorded

## A2 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric field emission test applies to all spurious emissions and harmonics emissions. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit as required.

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 (c) Clause 15.209 & 15.245 (b)(1)(iii)
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 55GHz
EUT sample number	01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18°C
Photographs (Appendix F)	48%

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
1.	216.0	26.4	1.7	8.2	-	36.3	-	65.31	150
2.	504.0	15.5	2.6	17.3	-	35.4	-	58.88	200
3.	576.0	14.5	2.7	18.5	-	35.7	-	60.95	200
4.	600.0	13.4	2.8	18.8	-	35.0	-	56.23	200
5.	624.0	17.8	2.8	18.9	-	39.5	-	94.40	200
6.	21042.852	57.6	4.1	37.2	33.8	65.1	3.5	1202.2	7500

**Notes:**

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1 For emissions below 30MHz the cable losses are assumed to be negligible.
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
- 4 For Frequencies below 1 GHz, RBW= 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW=VBW= 1MHz
Average	RBW=VBW= 1MHz

The upper and lower frequency of the measurement range was decided according to 47 CFR 15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR 15: Clause 15.209 for all emissions:

Frequency of emission (MHz)	Field strength $\mu$ V/m	Measurement Distance m	Field strength $\text{dB}\mu\text{V/m}$
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:

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

(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				

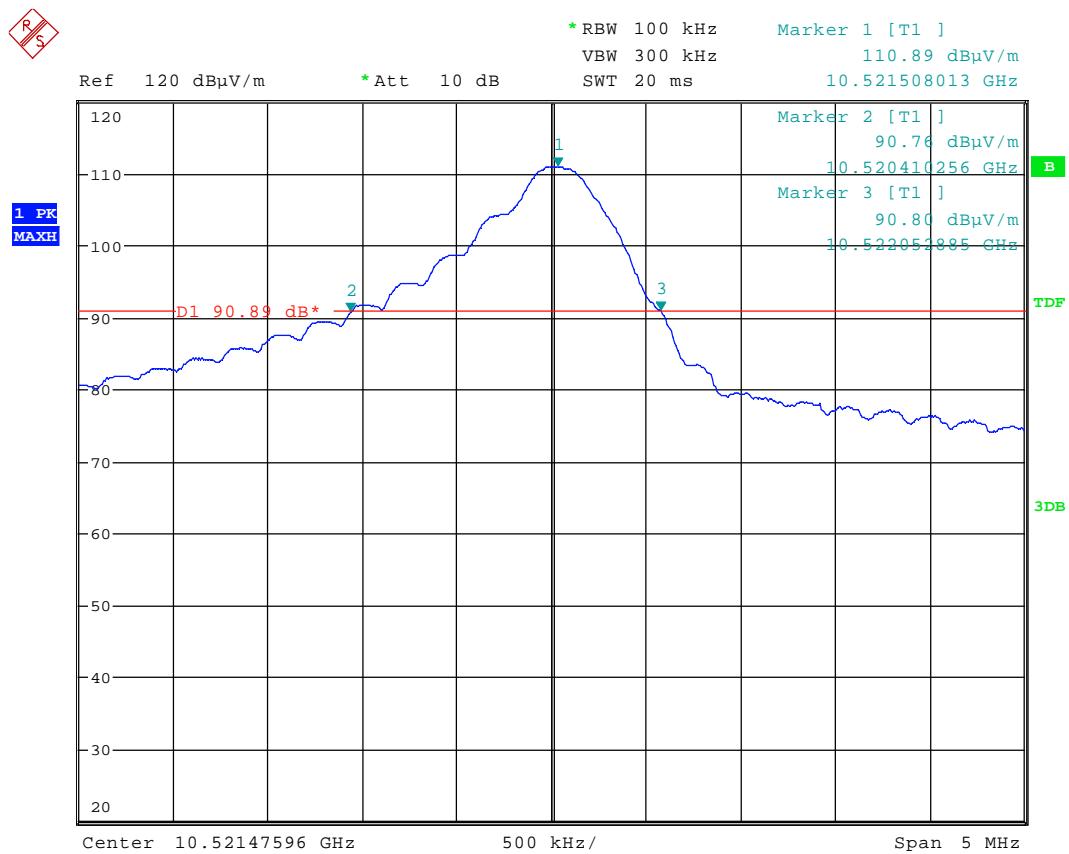
**Appendix B:**

**Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

Notes:

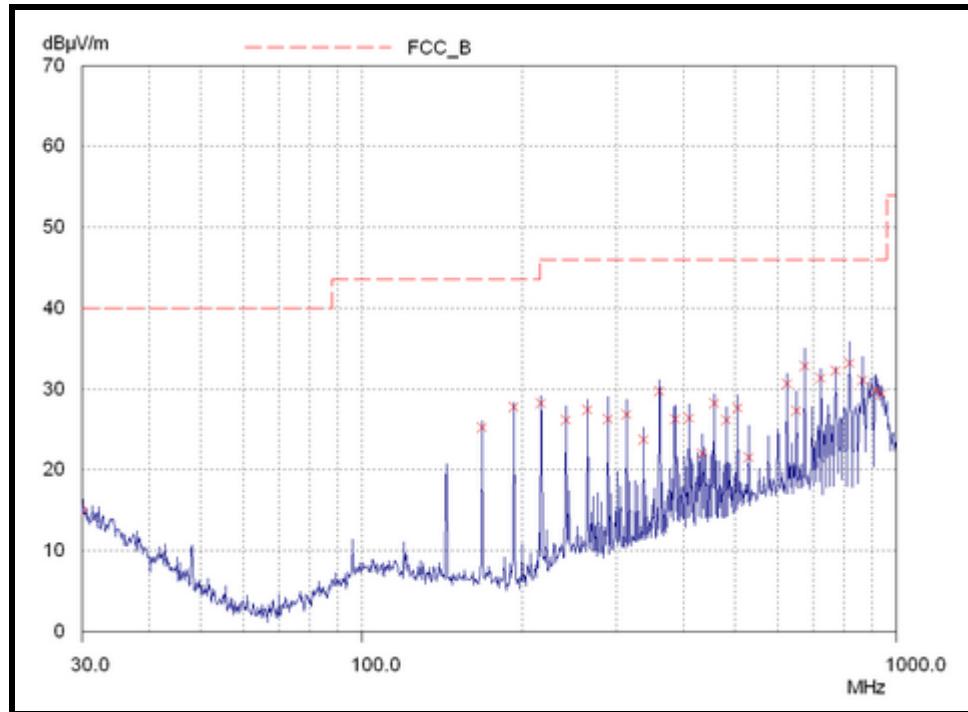
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power 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.



Date: 3.AUG.2010 14:49:40

### 20dB Bandwidth

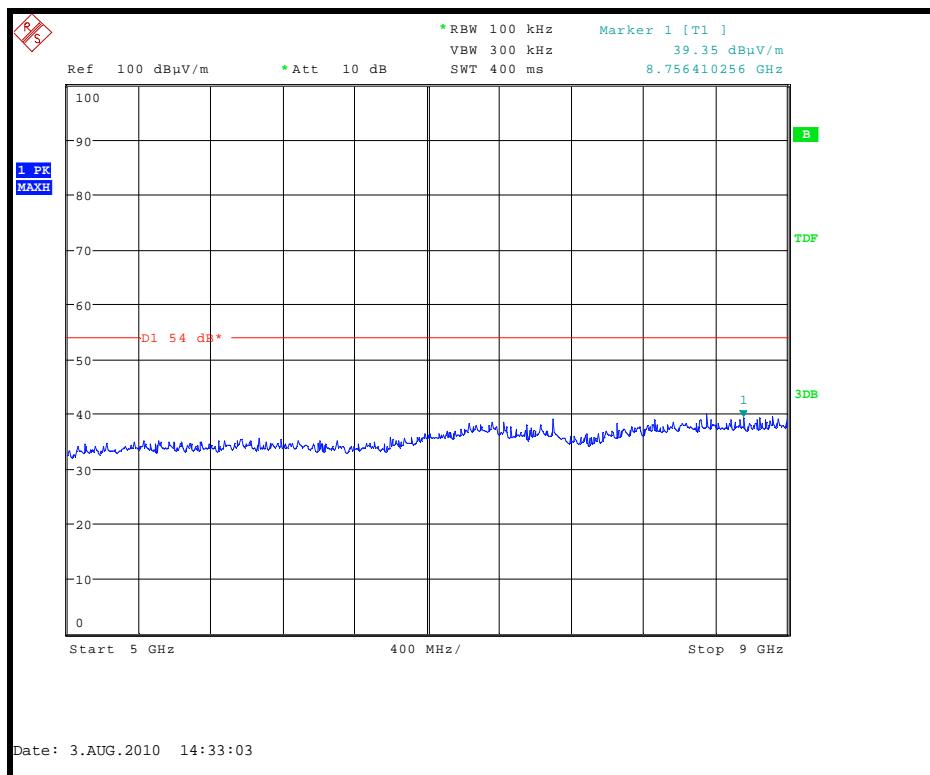
$$\begin{aligned}
 F_{\text{lower}} &= 10.520410256 \text{ GHz} \\
 F_{\text{higher}} &= 10.522052885 \text{ GHz} \\
 \text{Occupied Bandwidth} &= 1.64263 \text{ MHz}
 \end{aligned}$$



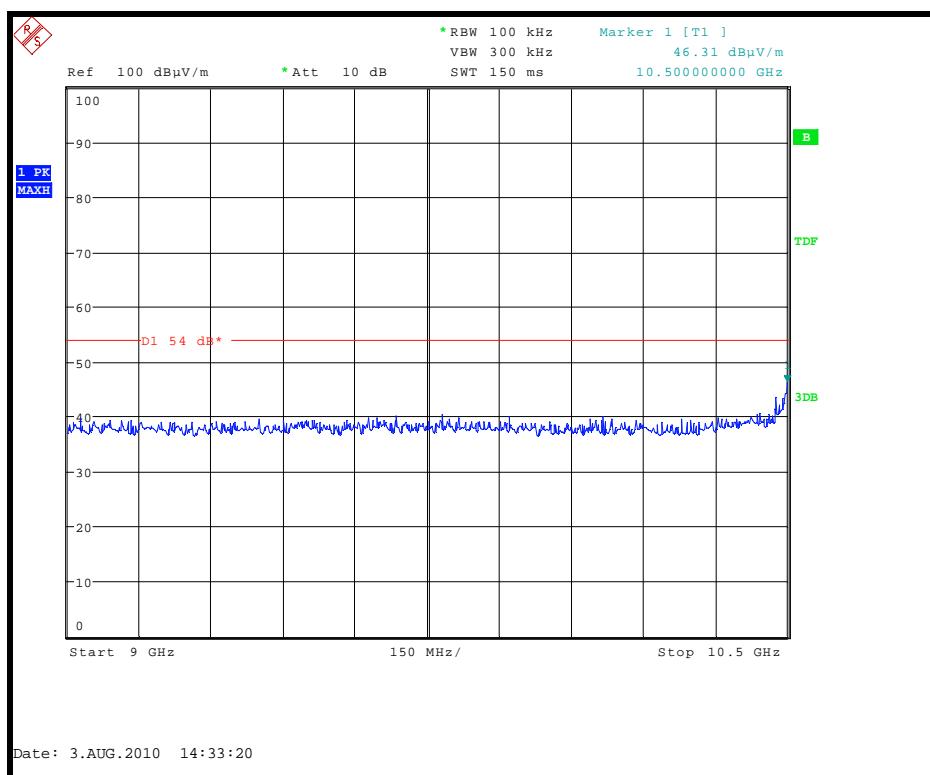
Radiated spurious emissions 30 MHz to 1 GHz



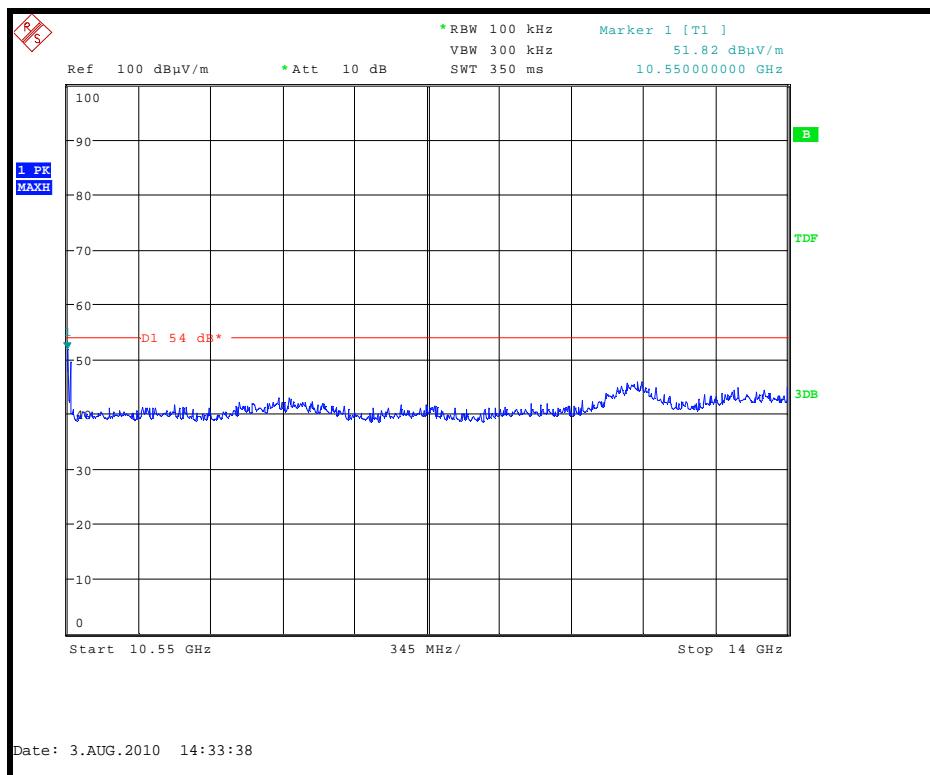
Radiated spurious emissions 1 GHz to 5 GHz



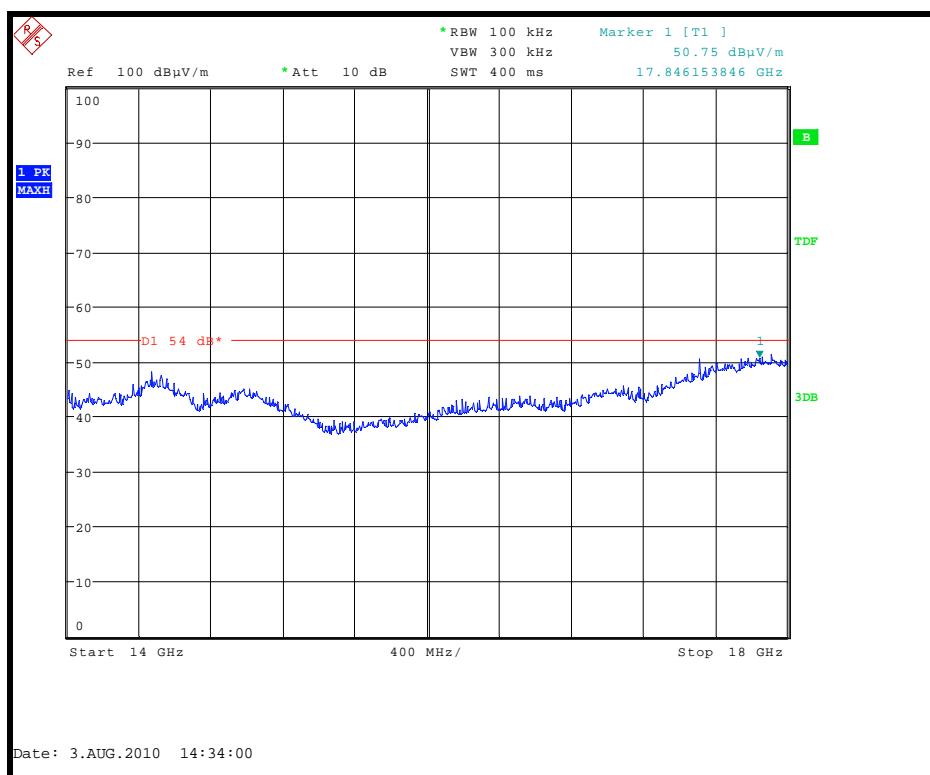
Radiated spurious emissions 5 GHz to 9 GHz



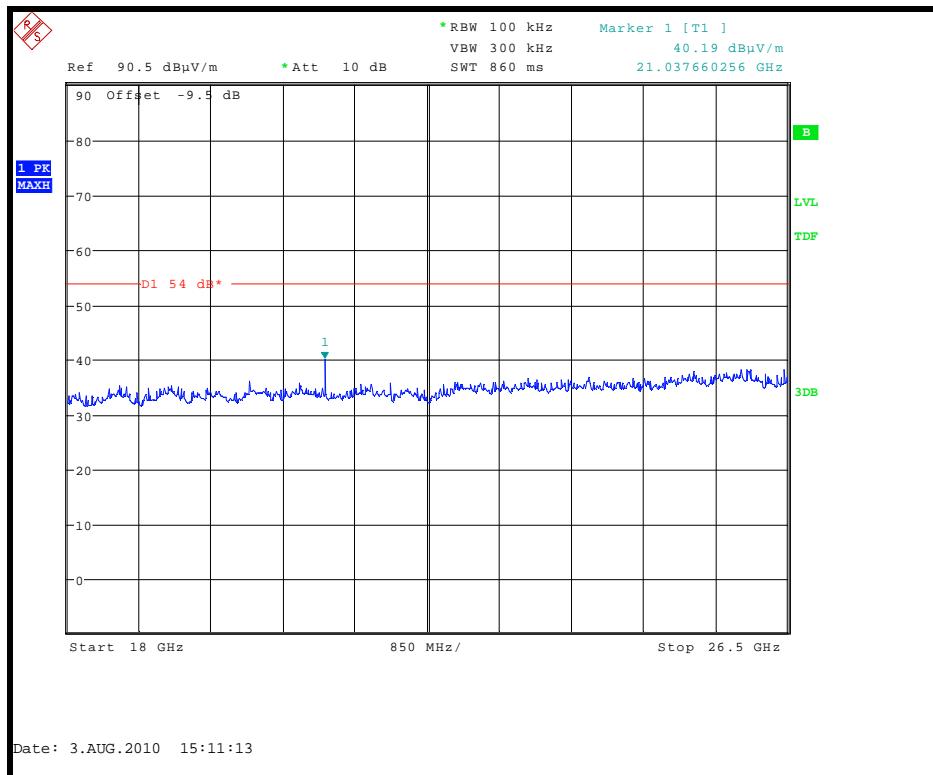
Radiated spurious emissions 9 GHz to 10.500 GHz



Radiated spurious emissions 10.550 GHz to 14 GHz

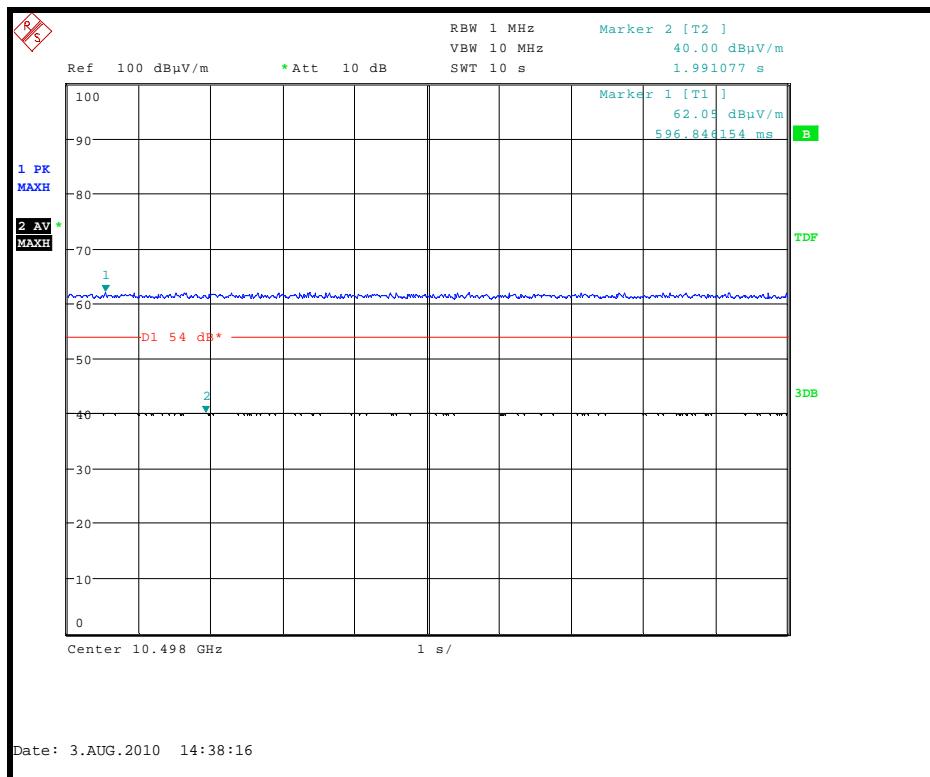


Radiated spurious emissions 14 GHz to 18 GHz

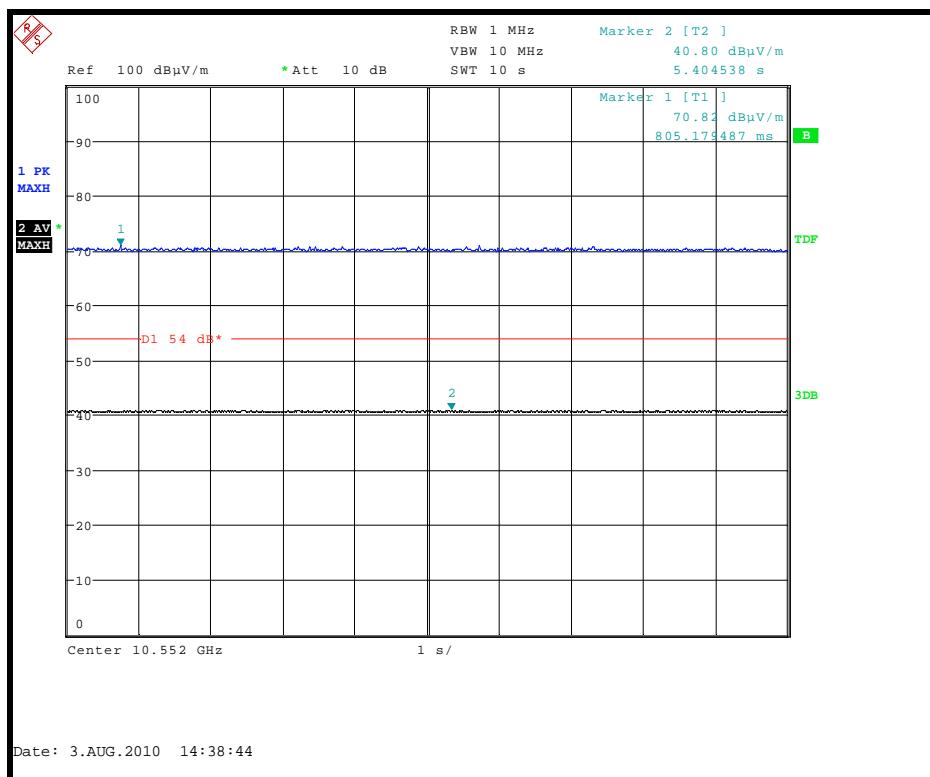


Radiated spurious emissions 18 GHz to 26.5GHz

## Radiated Bandedge Compliance



## Lower Bandedge



## Upper Bandedge



## In band Radiated emissions

## 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 its 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
01	Sentinel Camera Unit	None

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

Sample No.	Description	Identification
02	Battery Charger	None

The following samples of apparatus were supplied by TRaC Telecoms & Radio as support or drive equipment (auxiliary equipment):

Identification	Description

**C2) EUT Operating Mode During Testing.**

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

Test	Description of Operating Mode
All tests detailed in this report	EUT on Transmitting Permanently

**C3) EUT Configuration Information.**

The EUT was submitted for testing in one single possible configuration.

**C4) List of EUT Ports**

The tables below describe the termination of EUT ports:

Sample : 01  
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
No ports populated during normal use.			

\* Only connected during setup.

## C5 Details of Equipment Used

For Radiated Measurements:

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	29/01/2010
TRL138	3115	1-18GHz Horn Antenna	EMCO	10/09/2009
TRL139	3115	1-18GHz Horn Antenna	EMCO	17/08/2009
TRL300	20240-20	18-26.5GHz Horn Antenna	Flann	12/06/2008
TRL301	22240-20	26.5-40GHz Horn Antenna	Flann	
TRL572	8499B	1 – 26.5 GHz Pre Amplifier	Agilent	15/07/2009
TRLUH93	CBL6112B	Bilog Antenna	Chase	03/06/2009
TRLUH186	ESHS10	Receiver	Rhode & Schwarz	10/12/2009
TRLUH372	6201-69	30MHz – 1 GHz Pre Amplifier	Watkins Johnson	14/04/2010
TRLUH380	ALSR	Chamber 1	Rainford EMC	26/06/2010

**Appendix D:**

**Additional Information**

No additional information is included within this test report.

**Appendix E:****Calculation of the duty cycle correction factor**

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1MHz and a video Bandwidth of 1MHz the sweep time was set accordingly to capture the pulse train. The transmit pulsewidths and period was measured. A plots of the pulse train is contained in Appendix B of this test report.

If the pulse train was less than 100 ms, including blanking intervals, the duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsewidths over the 100ms width with the highest average value. (The duty cycle is the value of the sum of the pulse widths in one period (or 100ms), divided by the length of the period (or 100ms). The duty cycle correction factor was then expressed in dB and the peak emissions adjusted accordingly to give an average value of the emission.

Correction factor dB =  $20 \times (\log_{10} \text{Calculated Duty Cycle})$

Therefore the calculated duty cycle was determined:

The pulse train period was greater than >100ms and in as shown from the plots in contained in appendix B of this test report.

Duty cycle =  $\frac{\text{the sum of the highest average value pulsewidths over 100ms}}{100ms}$

e.g

$$= \frac{7.459ms}{100ms} = 0.07459$$

0.07459 or 7.459%

Correction factor (dB) =  $20 \times (\log_{10} 0.07459) = -22.54\text{dB}$

## **Appendix F:**

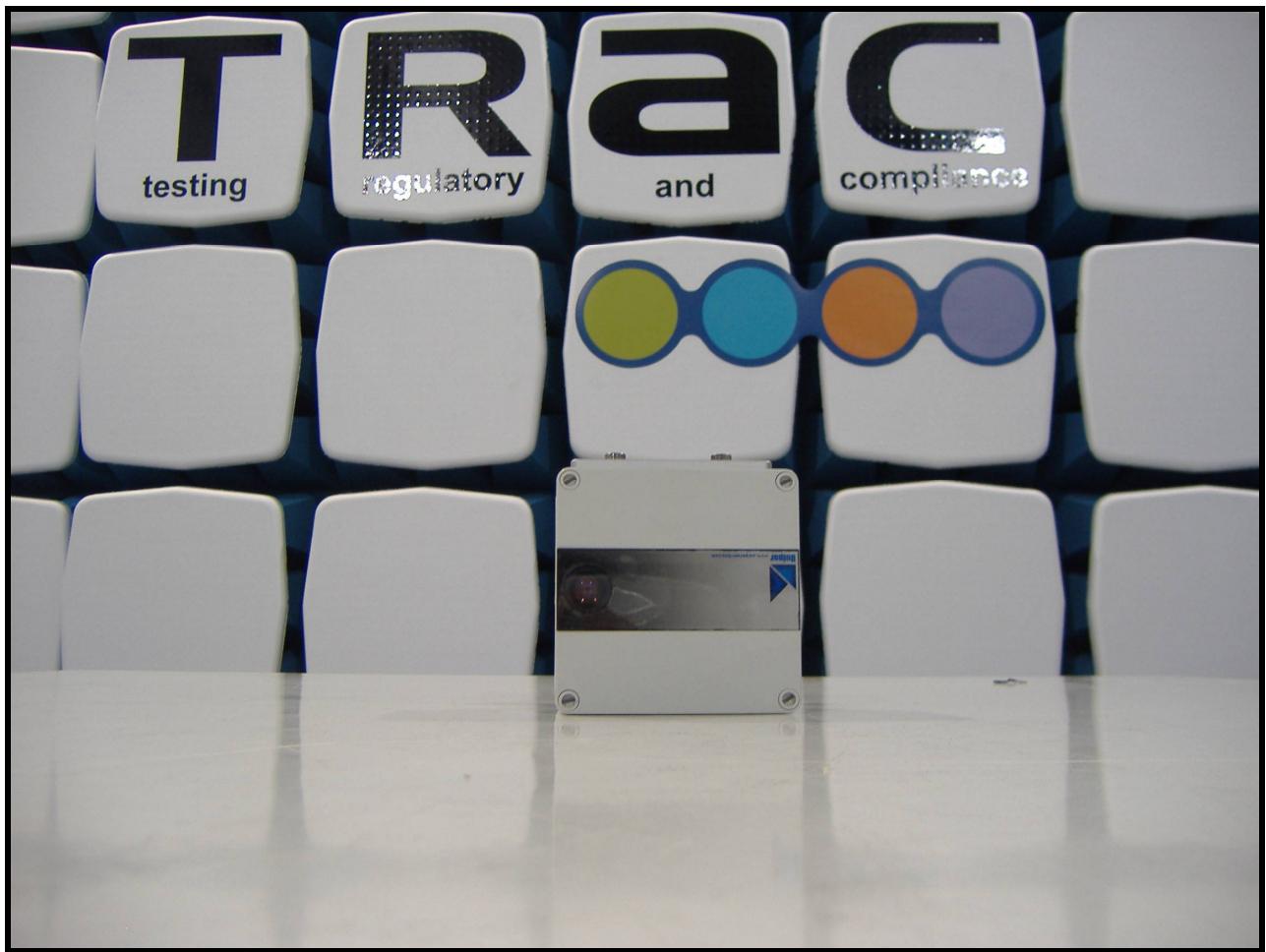
## **Photographs and Figures**

The following photographs were taken of the test samples:

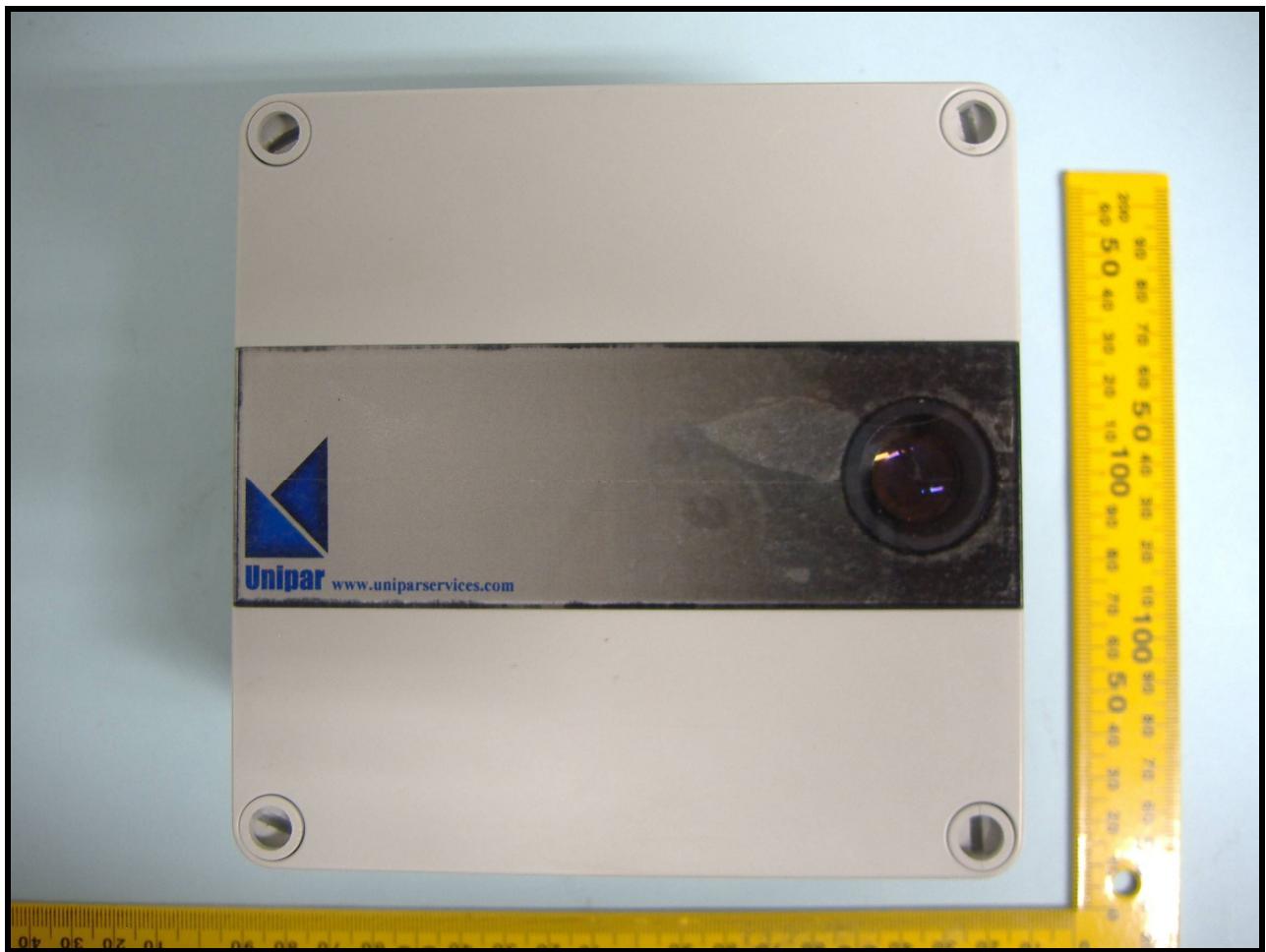
1. Radiated electric field emissions arrangement: Overview.
2. Radiated electric field emissions arrangement: Close up.
3. Photo of the Sentinel Camera unit Overview
4. Photo of the Sentinel Camera unit Overview



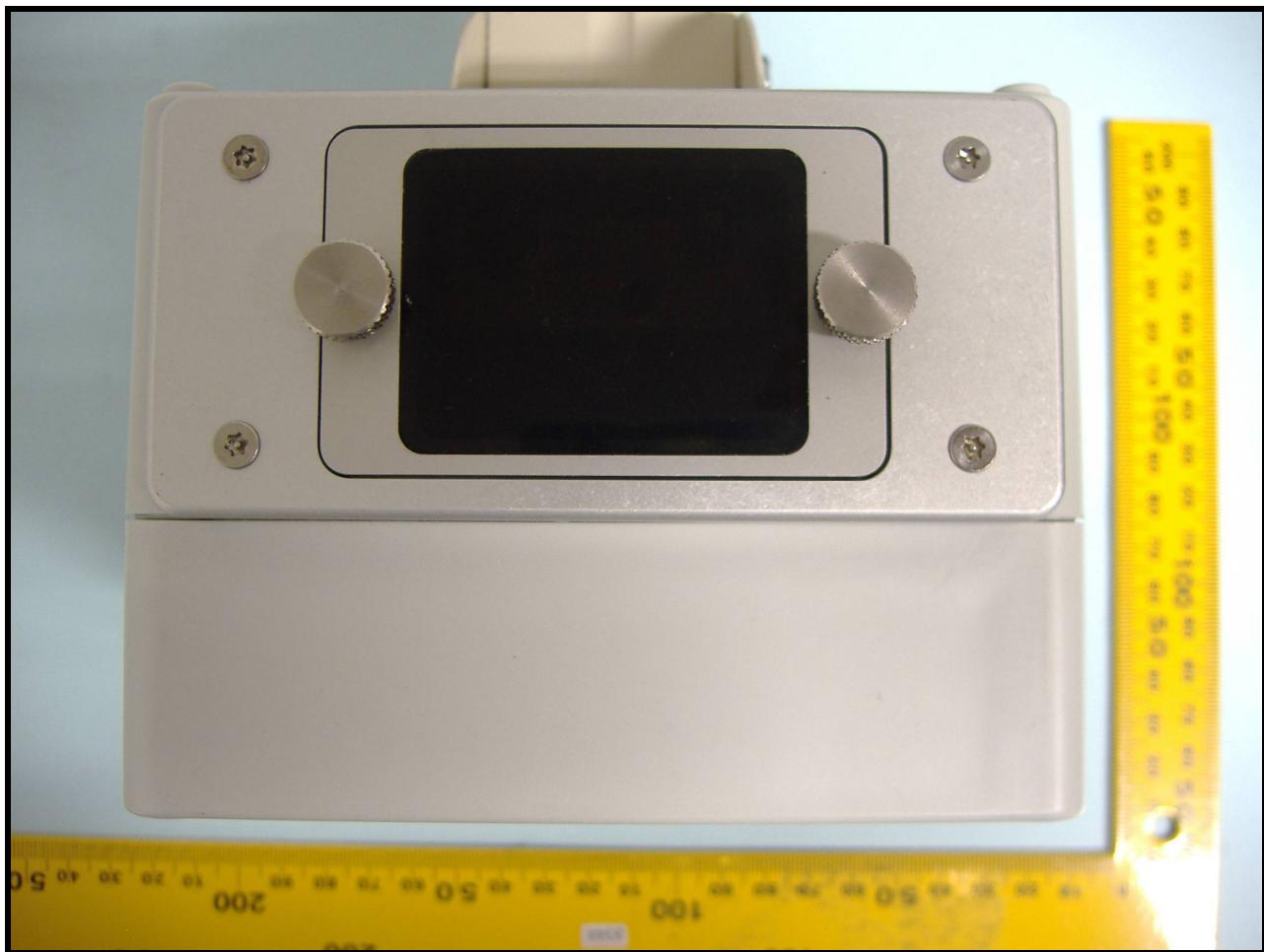
Photograph 1



Photograph 2



Photograph 3



Photograph 4

