KTL EMC Test Report **:** 3A6511GUS1

Applicant **:** Homerider Systems

Apparatus **:** Track Modules

Authorised by

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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.

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1.2 Tests Requested By

This testing in this report was requested by:

Homerider Systems SA
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1.3 Manufacturer

As above.

1.4 Apparatus Assessed

The following apparatus was assessed between: 15/07/03 to 18/07/03:
Watertrak Module
Fueltrak Module
Propanetrak Module

The above equipment were RF telemetry modules for the remote monitoring of storage tank levels.

1.5 Test Result Summary

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

1.5.1 Watertrak Module – Sample No. S12

Test Type	Regulation	Measurement standard	Result
REFE	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247	ANSI C63.4:2001	PASS*
20dB Bandwidth	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)	N/A	PASS
Maximum Peak Power	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(b)(2)	N/A	PASS
Hopping Frequencies	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)	N/A	PASS
Channel Occupancy	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)	N/A	PASS

1.5.2 Fueltrak Module – Sample No. S13

Test Type	Regulation	Measurement standard	Result
REFE	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247	ANSI C63.4:2001	PASS*
20dB Bandwidth	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)	N/A	PASS
Maximum Peak Power	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(b)(2)	N/A	PASS
Hopping Frequencies	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)	N/A	PASS
Channel Occupancy	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)	N/A	PASS

1.5.3 Propanetrak Module – Sample No. S14

Test Type	Regulation	Measurement standard	Result
REFE	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247	ANSI C63.4:2001	PASS
20dB Bandwidth	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)	N/A	PASS
Maximum Peak Power	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(b)(2)	N/A	PASS
Hopping Frequencies	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)	N/A	PASS
Channel Occupancy	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)	N/A	PASS

*Marginal results were recorded. See Appendix A for details.

Abbreviations used in the above table:

Mod : Modification
CFR : Code of Federal Regulations
REFE : Radiated Electric Field Emissions
ANSI : American National Standards Institution
PLCE : Power Line Conducted Emissions

*See section 2.2 Note (C).

1.6 Notes Relating To The Assessment

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

a) 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.

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

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

d) 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

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

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

g) KTL Hull is a listed electromagnetic compatibility Conformance Assessment Body (CAB) for EC access to the US market. (Decision No 3/2000 of the Joint Committee established under the Agreement on Mutual Recognition between the European Community and the United States of America. This decision was effective from 16th January 2001).

KTL has submitted the information required by Section 2.948 of the FCC Rules for measuring specific types of intentionally radiating devices subject to the requirements in Part 15 of the FCC Rules. The FCC registration numbers for KTL's facilities are :

3m Alternative Test Sit: 90743

3m and 10m Open Area Test Site 90744

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Introduction

The standard ISO/IEC 17025 used for laboratory accreditation requires laboratories to estimate measurement uncertainty using accepted methods of analysis.

Where required, the reported expanded uncertainty is based on a standard uncertainty providing a confidence level of approximately 95%.

Measurement uncertainty is calculated using the methods defined in the NAMAS document NIS81: May 1994.

KTL measurement uncertainty is recorded in the KTL document UNC/RFG/001 Issue 16.

2.2 Application of Measurement Uncertainty

The following procedure is used when determining the result of a measurement :

(i) If specification limits are not exceeded by the measured result, extended by the positive component of the expanded uncertainty interval at a confidence level of 95%, then a pass result is recorded.

(ii) Where a specification limit is exceeded by the result even when the result is decreased by the negative component of the expanded uncertainty interval, a fail result is recorded.

(iii) Where measured result is below a limit, but by a margin less than the positive measurement uncertainty component, it is not possible to record a pass based on a 95% confidence level. However, the result indicates that a pass result is more probable than a fail result.

(iv) Where a measured result is above a limit, but by a margin less than the negative measurement uncertainty component, it is not possible to record a fail based on a 95% confidence level. However the result indicates that a fail is more probable than a pass.

2.3 Measurement Uncertainty Values

For the test data recorded in accordance with note (iii) of Section 2.2 the following measurement uncertainty was calculated :

Test type	Quantity	Quantity range	Expanded uncertainty
Radiated electric field emissions at the 3m alternative test site	Amplitude	30MHz to 100MHz	+4.3 / -4.1dB
		100MHz to 200MHz	+4.2 / -4.0dB
		200MHz to 700MHz	+4.2 / -3.5dB
		700MHz to 1000MHz	+4.3 / -3.7dB
		1 GHz to 18 GHz	+4.7 / -3.1 dB

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment:

Appendix A: Formal 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
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
CDN	: Coupling & decoupling network

A1 Radiated Electric Field Emissions

Preliminary radiated electric field emissions testing was performed using a peak detector in an absorber lined screened room.

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

10m open area test site : ☐ 3m alternative test site : ☑

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

A1.1 Watertrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c)
Measurement standard	ANSI C63.4:2001
Frequency range	9 kHz to 10 GHz
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photograph 1

The worst case radiated emission measurements are listed below:

Ref No.	Freq (MHz)	Det.	Ang. Deg.	Height (cm)	Pol.	MD (m)	SD (m)	Result at SD (dBµV/m)	Spec. Limit (dBµV/m)	Margin (dB)	Result Summary
1	115.00	QP	6	100	V	3	3	17.6	43.5	-25.9	Pass
2	499.556	QP	219	121	V	3	3	27.9	46	-18.1	Pass
3	894.532	QP	359	100	H	3	3	38.4	46	-7.6	Pass
4	900.596	QP	0	100	H	3	3	37.6	46	-8.4	Pass
5	935.471	QP	219	121	V	3	3	40.5	46	-5.5	Pass
6	957.333	QP	219	121	V	3	3	36.2	46	-9.8	Pass
7	1830	Av	0	100	V	3.3	3	45.4	54	-8.6	Pass
8	2745	Av	0	100	V	3.3	3	37.6	54	-16.4	Pass
9	3660	Av	0	100	V	3.3	3	44.3	54	-9.7	Pass
10	4580	Av	0	100	V	3.3	3	39.7	54	-14.3	Pass
11	5490	Av	0	100	V	1.35	3	52.2	54	-1.8	Pass*
12	6405	Av	0	100	V	1.35	3	52.9	54	-1.1	Pass*
13	7320	Av	0	100	V	1.35	3	46.2	54	-7.8	Pass
14	8236	Av	0	100	V	1.35	3	44.8	54	-9.2	Pass
15	9147	Av	0	100	V	1.35	3	47.0	54	-7.0	Pass

*See section 2.2 Note (iii).

A1.2 Fueltrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c)
Measurement standard	ANSI C63.4:2001
Frequency range	9 kHz to 10 GHz
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photograph 2

The worst case radiated emission measurements are listed below:

Ref No.	Freq (MHz)	Det.	Ang. Deg.	Height (cm)	Pol.	MD (m)	SD (m)	Result at SD (dBµV/m)	Spec. Limit (dBµV/m)	Margin (dB)	Result Summary
1	30.189	QP	66	100	H	3	3	23.7	40	-16.3	Pass
2	485.333	QP	3	100	V	3	3	27.3	46	-18.7	Pass
3	879.111	QP	3	100	V	3	3	34.7	46	-11.3	Pass
4	894.535	QP	197	186	V	3	3	38.5	46	-7.5	Pass
5	944	QP	3	100	V	3	3	36.4	46	-9.6	Pass
6	958.222	QP	3	100	V	3	3	36.2	46	-9.8	Pass
7	1830	Av	0	100	V	3.3	3	51.4	54	-2.6	Pass*
8	2745	Av	220	100	V	3.3	3	49.19	54	-4.8	Pass
9	4575	Av	120	100	H	3.3	3	51.6	54	-2.4	Pass*
10	5520	Av	120	100	V	1.35	3	41.6	54	-12.4	Pass
11	6430	Av	120	100	V	1.35	3	44.7	54	-9.3	Pass

*See section 2.2 Note (iii).

A1.1 Propanetrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c)
Measurement standard	ANSI C63.4:2001
Frequency range	9 kHz to 10 GHz
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photograph 3

The worst case radiated emission measurements are listed below:

Ref No.	Freq (MHz)	Det.	Ang. Deg.	Height (cm)	Pol.	MD (m)	SD (m)	Result at SD (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Result Summary
1	104.003	QP	121	100	V	3	3	29.1	43.5	-14.4	Pass
2	152.005	QP	116	100	V	3	3	27.2	43.5	-16.3	Pass
3	487.111	QP	116	100	H	3	3	27.5	46	-18.5	Pass
4	697.778	QP	116	100	H	3	3	30.5	46	-15.5	Pass
5	827.556	QP	116	100	H	3	3	34.7	46	-11.3	Pass
6	1830	Av	120	100	V	3.3	3	40.2	54	-13.8	Pass

The upper frequency of the measurement range was decided according to 47 CFR 15:2002 Clause 15.33.

Radiated emission limits are derived from 47 CFR 15:2002 Clause 15.249

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 (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

A2 20 dB Bandwidth

Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i) requires the measurement of the bandwidth of the transmission between the -20 dB points on the transmitted spectrum. The results of this test determine the limits for other tests. The formal measurements are detailed below:

A2.1 Watertrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured 20 dB Bandwidth	130 kHz
Limit	500KHz

A2.2 Fueltrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured 20 dB Bandwidth	132 kHz
Limit	500KHz

A2.3 Propanetrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured 20 dB Bandwidth	120 kHz
Limit	500KHz

A3 Maximum Peak Power

A3.1 Watertrak Module

Test Details	
Regulation	Title 47 of the CFR2002, Part15 Subpart (c) 15.247(b)(2)
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Peak Power	4.4 mW (6.5 dBm)
Limit	1 W

A3.2 Fueltrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(b)(2)
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Peak Power	5.9 mW (7.7 dBm)
Limit	1 W

A3.3 Propanetrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(b)(2)
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Peak Power	2 mW (3.1 dBm)
Limit	1 W

A4 Hopping frequencies

A4.1 Watertrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Hopping Channels	64 Channels spaced at 200 kHz intervals
47CFR15 Requirement	Minimum of 50 Channels spaced by at least the 20dB bandwidth (130 kHz)

A4.2 Fueltrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Hopping Channels	64 Channels spaced at 200 kHz intervals
47CFR15 Requirement	Minimum of 50 Channels spaced by at least the 20dB bandwidth (132 kHz)

A4.3 Propanetrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Hopping Channels	64 Channels spaced at 200 kHz intervals
47CFR15 Requirement	Minimum of 50 Channels spaced by at least the 20dB bandwidth (120 kHz)

A5 Channel Occupancy

A5.1 Watertrak Module

Test Details	
Regulation	Title 47 of the CFR2002, Part15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S12
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Channel Occupancy Time 5 ms
Limit 400 ms

A5.2 Fueltrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S13
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Channel Occupancy Time 5 ms
Limit 400 ms

A5.3 Propanetrak Module

Test Details	
Regulation	Title 47 of the CFR :2002, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Channel Occupancy Time 5 ms
Limit 400 ms

Appendix B: **Supporting Graphical Data**

This appendix contains no graphical data

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 KTL upon request.

C1) Test Samples

The following samples of the apparatus were submitted for testing:

Sample No.	Description	Identification
S12	WaterTrak Module	Serial No 5322/02 8134561235
S13	FuelTrak Module	Serial No 5322/02 8734561235
S14	PropaneTrak Module	Serial No 5322/02 8634561235

C2) EUT Operating Mode During Testing.

During testing, the EUTs were exercised as described in the following tables :

Test	Description of Operating Mode
All tests detailed in this report	EUT in normal operating mode, transmitting data from attached transducer

C3) EUT Configuration Information.

Sample	Internal Configuration Details
All Samples	Single possible configuration

C4) Termination of EUT Ports.

The table below describes the termination of EUT ports:

Samples : All
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected (sample no.)
S12 Transducer	2 core Unscreened	1.5	Water Meter (part of EUT)
S13 Transducer	6 core Unscreened	4.5	Fuel Sensor (part of EUT)
S14 Transducer	2 core Unscreened	4.5	Propane Sensor (part of EUT)

Notes on the above:

The connection of cables and drive or support equipment was identical for all tests.
.

C5) Details of test equipment used

For Radiated Electric Field Emissions 9kHz to 1GHz:

RFG No	Type	Description	Manufacturer	Date Calibrated.	Date of next calibration.
274	ATS	Ferrite Lined Chamber	KTL	16/09/02	16/09/03
231	CBL6111	Blue BILOG Antenna (0.03 - 1GHz)	Chase	19/03/03	19/03/04
214	ESAI	Spec Analyser/Test Receiver (LF/HF)	R & S	20/06/03	20/06/04

For Radiated Electric Field Emissions 1GHz to 18GHz

RFG No	Type	Description	Manufacturer	Date Calibrated	Date of next calibration.
274	ATS	Ferrite Lined Chamber	KTL	16/09/02	16/09/03
129	3115	Horn Antennas	EMCO	19/03/03	19/03/04
307	HP8449B	Microwave Pre-Amp (1-26.5GHz)	HP	01/02/03	01/02/04
311	-	Sucoflex uW Adapter Cable 1m	Suhner	10/11/02	10/11/03
312	-	Sucoflex uW Adapter Cable 1m	Suhner	10/11/02	10/11/03
137	N-104	Sucoflex uW Cable 2m	Suhner	01/11/02	01/11/03
138	N-104	Sucoflex uW Cable 2m	Suhner	01/11/02	01/11/03
158	N-106	Sucoflex uW Cable 6m	Suhner	01/11/02	01/11/03
404	E4407B	Spectrum Analyser	Agilent	30/09/02	30/09/03

All other tests

RFG No	Type	Description	Manufacturer	Date Calibrated	Date of next calibration.
404	E4407B	Spectrum Analyser	Agilent	30/09/02	30/09/03

Appendix D: Additional Information

No additional information is included.

Appendix E: Photographs and Figures

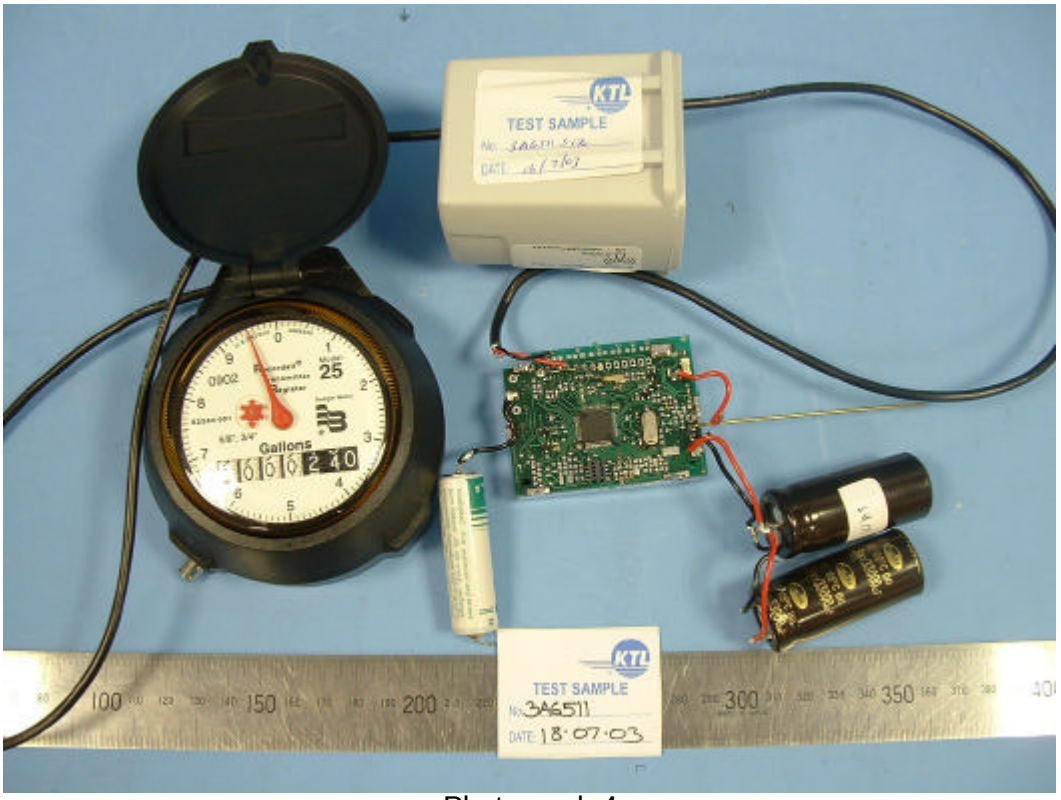
The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: Watertrak
2. Radiated electric field emissions arrangement: Fueltrak
3. Radiated electric field emissions arrangement: Propanetrak
4. Internal View: Watertrak
5. Internal View: Fueltrak
6. Internal View: Propanetrak

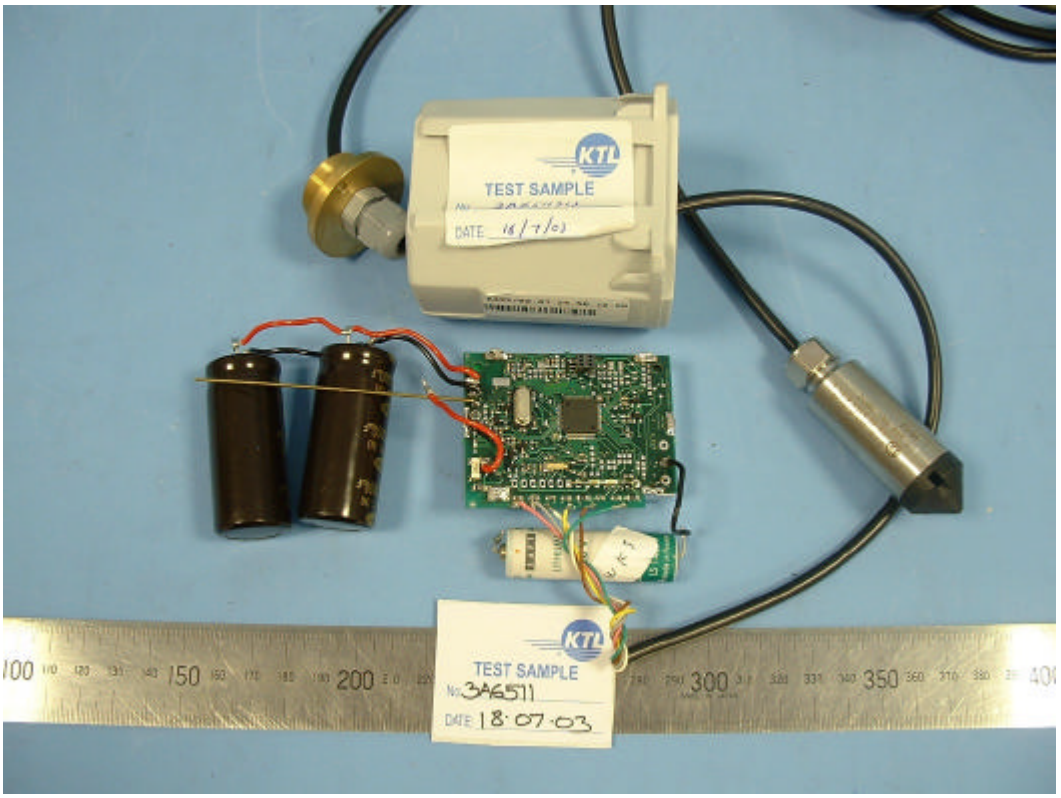
Photograph 1

Photograph 2

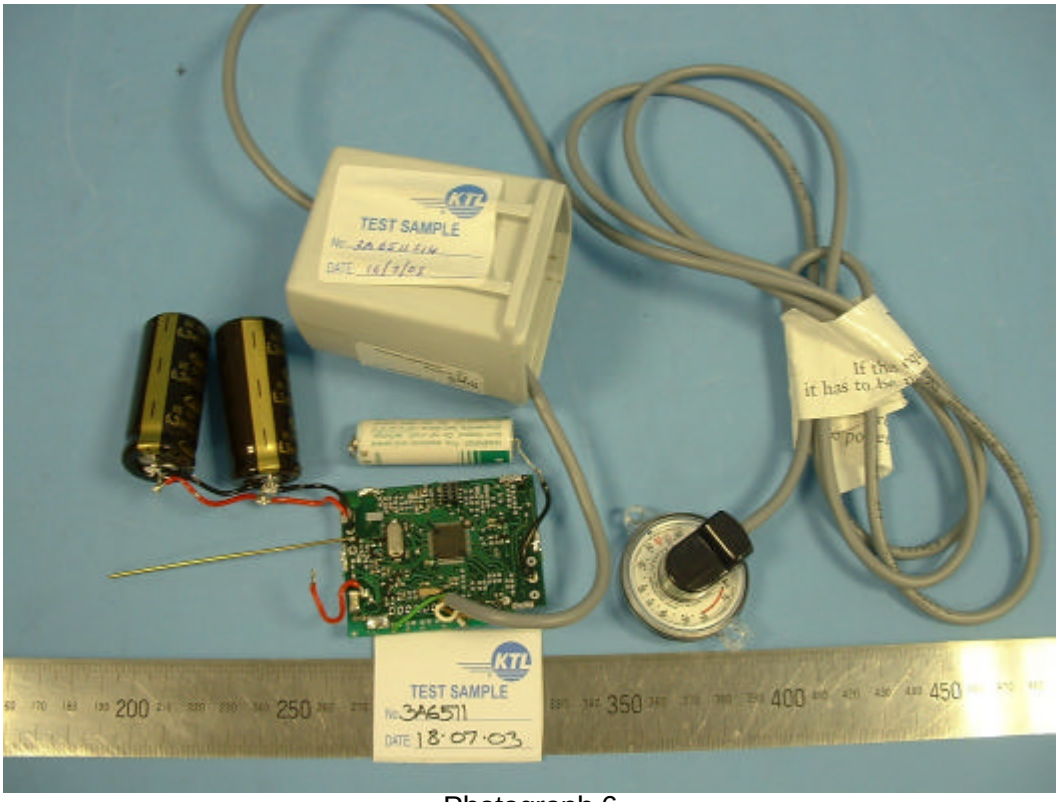
Photograph 3



Photograph 4



Photograph 5



Photograph 6