KTL EMC Test Report : 6C9433GUS1

Applicant : Technology Solutions (UK) Limited

Apparatus : 1059 HF Multi ISO Reader for the MC70 Handheld Computer

Authorised by :

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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.

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1.2 Tests Requested By

This test report has been prepared on behalf of:

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1.3 Manufacturer

As above.

1.4 Apparatus Assessed

The following apparatus was assessed between 03/08/06 and 19/08/06:

1059 HF Multi ISO Reader for the MC70 Handheld Computer

The above equipment was a short range scanning receiver operating at 13.56MHz.

Modulation: Pulse modulation with a modulation depth of 100%.

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.

Test Type	Regulation	Measurement standard	Range	Result
REFE**	Title 47 of the CFR:2005, Part 15 Subpart (c), Clause 15.225(a)	ANSI C63.4:2003	13.553MHz to 13.567MHz	Pass
REFE**	Title 47 of the CFR:2005, Part 15 Subpart (c), Clause 15.225(b)	ANSI C63.4:2003	13.410MHz to 13.553MHz and 13.567MHz to 13.710MHz	Pass
REFE**	Title 47 of the CFR:2005, Part 15 Subpart (c), Clause 15.225(c)	ANSI C63.4:2003	13.710MHz to 14.010MHz *	Pass
REFE**	Title 47 of the CFR:2005, Part 15 Subpart (c), Clause 15.209 (d)	ANSI C63.4:2003	30kHz to 30MHz	Pass
REFE	Title 47 of the CFR:2005, Part 15 Subpart (c), Clause 15.209	ANSI C63.4:2003	30MHz to 5GHz	Pass
PLCE	Title 47 of the CFR:2005, Part 15 Subpart (c), Clause 15.207	ANSI C63.4:2003	150kHz to 30MHz	Pass
Frequency Stability	Title 47 of the CFR:2005, Part 15 Subpart (c), Clause 15.225(e)	ANSI C63.4:2003	0.01% of nominal	Pass

*Excluding frequency bands identified in Clauses 15.225(a), 15.225(b) and 15.225(c).

**Measurements made using a screened magnetic loop antenna.

Abbreviations used in the above table:

CFR : Code of Federal Regulations
REFE : Radiated Electric Field Emissions
PLCE : AC power conducted emissions
Mod : Modification
ANSI : American National Standards Institution

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).

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

Temperature	: 17 to 23 degrees 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.

KTL’s facilities are listed with the Federal Communications Commission (FCC) as suitable for performing measurements in support of application for certification under parts 15 and 18 of the FCC rules: Registration number 90743.

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).

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 UKAS document LAB34 Edition 1 August 2002.

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

All results were recorded in accordance with Section 2.2(i).

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 state	OATS	: Open Area Test Site
CDN	: Coupling & decoupling network	ATS	: Alternative Test Site
EUT	: Equipment Under Test	Verd	: Verdict
SE	: Support Equipment	Deg	: Degree
Sum	: Summary	Det	: Detector
MD	: Measurement Distance	Ref	: Reference
SD	: Specification Distance	Freq	: Frequency
No	: Number	Res	: Result
L	: Live Power Line	Ang	: Angle
N	: Neutral Power Line	Pol	: Polarisation
E	: Earth Power Line	H	: Horizontal Polarisation
Pk	: Peak Detector	V	: Vertical Polarisation
QP	: Quasi-Peak Detector	Hgt	: Height
Av	: Average Detector		

A1 Radiated Electric Field Emissions Within the Bands 13.553MHz to13.567MHz

Preliminary radiated electric field emission 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.

Test Details	
Regulation	Title 47 of the CFR:2005, Part 15 Subpart 15.225(a)
Measurement standard	ANSI C63.4:2003
Frequency	13.553MHz to 13.567MHz
EUT sample number	S10
Modification state	0
SE in test environment	S01, S04, S05 and S12
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	Hgt (cm)	MD (m)	SD (m)	Res at SD (dBuV/m)	Spec Limit (dBuV/m)	Margin (dB)	Result Summary
1	13.560*	QP	0	100	10	30	34.9	84.0	-49.1	Pass
2	13.560*	QP	90	100	10	30	29.2	84.0	-54.8	Pass

*Carrier frequency.

The effect on the carrier of varying the supply voltage between 85% and 115% of the normal supply voltage (110Vac) was investigated pursuant to 47 CFR Part 15 section 15.31(e):

% variation	AC source (V)	Carrier level (dBuV/m)	Spec Limit (dBuV/m)	Margin (dB)	Result Summary
85	95.3	34.9	84.0	-49.1	Pass
115	126.5	34.9	84.0	-49.1	Pass

Specification limits:

The upper frequency of the measurement range was decided according to 47 CFR 15:2005 Clause

Radiated emission limits stated in 47 CFR 15:2005 Clause 15.225 (a):

Frequency of emission (MHz)	Field strength μV/m	Field strength dBμV/m	Measurement Distance (meters)
13.553 to 13.567	15848.0	84.0	30

Notes:

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

(b) Measurement of magnetic field strength were performed using an active magnetic field loop antenna, according to ANSIC63.4:2003 Section 4.1.5.1, referenced by 47 CFR Part 15 Section 15.31(3). The results were expressed as electric field strength assuming far field measurement conditions in order to compare with the limit which is expressed as electric field.

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

$$\text{Extrapolation}\left(\text{dB}\right) = 40\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

A2 Radiated Electric Field Emissions Within the Bands 13.410MHz to 13.553MHz and 13.567MHz to 13.710MHz

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.

Test Details	
Regulation	Title 47 of the CFR:2005, Part 15 Subpart 15.225(a)
Measurement standard	ANSI C63.4:2003
Frequency	13.553MHz to 13.567MHz
EUT sample number	S10
Modification state	0
SE in test environment	S01, S04, S05 and S12
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photograph 2

No emissions were detected that were within 20dB of the specification limit.

Specification limits:

The upper frequency of the measurement range was decided according to 47 CFR 15:2004 Clause

Radiated emission limits stated in 47 CFR 15:2005 Clause 15.229 (a):

Frequency of emission (MHz)	Field strength μV/m	Field strength dBμV/m	Measurement Distance (meters)
13.410MHz to 13.553MHz	334.0	50.5	30.0
13.567MHz to 13.710MHz	334.0	50.5	30.0

Notes:

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

(b) Measurement of magnetic field strength were performed using an active magnetic field loop antenna, according to ANSIC63.4:2003 Section 4.1.5.1, referenced by 47 CFR Part 15 Section 15.31(3). The results were expressed as electric field strength assuming far field measurement conditions in order to compare with the limit which is expressed as electric field.

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

$$\text{Extrapolation}\left(\text{dB}\right) = 40\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

A3 Radiated Electric Field Emissions Within the Bands 13.110MHz to 13.410MHz and 13.710MHz to 14.010MHz

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.

Test Details	
Regulation	Title 47 of the CFR:2005, Part 15 Subpart 15.225(a)
Measurement standard	ANSI C63.4:2003
Frequency	13.553MHz to 13.567MHz
EUT sample number	S10
Modification state	0
SE in test environment	S01, S04, S05 and S12
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photograph 2

No emissions were detected that were within 20dB of the specification limit.

Specification limits:

The upper frequency of the measurement range was decided according to 47 CFR 15:2005 Clause

Radiated emission limits stated in 47 CFR 15:2004 Clause 15.229 (a):

Frequency of emission (MHz)	Field strength μV/m	Field strength dBμV/m	Measurement Distance (meters)
13.110MHz to 13.410MHz	106.0	40.5	30
13.710MHz to 14.010MHz	106.0	40.5	30

Notes:

(a) Measurement of magnetic field strength were performed using an active magnetic field loop antenna, according to ANSIC63.4:2003 Section 4.1.5.1, referenced by 47 CFR Part 15 Section 15.31(3). The results were expressed as electric field strength assuming far field measurement conditions in order to compare with the limit which is expressed as electric field.

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

$$\text{Extrapolation}\left(\text{dB}\right) = 40\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

The levels may have been rounded for display purposes.

A4 Radiated Emissions 30kHz to 30MHz Outside the 13.110MHz to14.010MHz

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.

Test Details	
Regulation	Title 47 of the CFR:2005, Part 15 Subpart 15.225(a)
Measurement standard	ANSI C63.4:2003
Frequency	13.553MHz to 13.567MHz
EUT sample number	S10
Modification state	0
SE in test environment	S01, S04, S05 and S12
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photograph 2

No emissions were detected that were within 20dB of the specification limit.

Measurements were made at a 3m measurement distance, and the data extrapolated using 40dB/decade to the value expected at the specification distance; see note (a) below.

Specification limits :

The upper frequency of the measurement range was decided according to 47 CFR 15:2005 Clause 15.33.

Radiated emission limits (47 CFR 15:2004 Clause 15.209):

Frequency of emission (MHz)	Field strength μV/m	Field strength dBμV/m	Measurement Distance (meters)
0.009 to 0.490	2400/F(kHz)	67.6-20logF	300
0.490 to 1.705	24000/F(kHz)	87.6-20logF	30
1.705 to 30	30	29.5	30

Notes:

(a) Measurement of magnetic field strength were performed using an active magnetic field loop antenna, according to ANSIC63.4:2003 Section 4.1.5.1, referenced by 47 CFR Part 15 Section 15.31(3). The results were expressed as electric field strength assuming far field measurement conditions in order to compare with the limit which is expressed as electric field.

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

$$\text{Extrapolation}\left(\text{dB}\right) = 40\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

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

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

A5 Radiated Electric Field Emissions – 30MHz to 5GHz

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.

Test Details	
Regulation	Title 47 of the CFR:2005, Part 15 Subpart 15.225(a)
Measurement standard	ANSI C63.4:2003
Frequency	13.553MHz to 13.567MHz
EUT sample number	S10
Modification state	0
SE in test environment	S01, S04, S05 and S12
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photographs 3 and 4

The worst case radiated emission measurements are listed below:

Ref No	Freq (MHz)	Det	Ang Deg	Hgt (cm)	Pol	MD (m)	Res at MD (dBuV/m)	Spec Limit (dBuV/m)	Margin (dB)	Res Sum
1	40.681	QP	60	100	V	3	28.1	40	-11.9	Pass
2	420.354	QP	18	100	v	3	33.7	40	-12.3	Pass
3	433.915	QP	32	100	V	3	33.0	46	-13.0	Pass
4	461.033	QP	61	109	V	3	37.5	46	-8.5	Pass
5	474.590	QP	52	101	V	3	34.3	46	-11.7	Pass
6	850.000	QP	0	100	V	3	34.8	46	-11.2	Pass

Specification limits :

The upper frequency of the measurement range was decided according to 47 CFR 15:2005 Clause 15.33.

Radiated emission limits (47 CFR 15:2004 Clause 15.209):

Frequency of emission (MHz)	Field strength μV/m	Field strength dBμV/m	Measurement Distance (meters)
30 to 40.66	100	40.0	3
40.66 to 40.70*	1000	60.0	3
40.70 to 88	100	40.0	3
88 to 216	150	43.5	3
216 to 960	200	46.0	3
Above 960	500	54.0	3

*Results of measurements in this frequency band are contained within Appendix A3.

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:

$$\text{Extrapolation}\left(\text{dB}\right) = 40\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

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

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

A6 AC Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room.
The effect of the EUT set-up on the measurements is summarised in note (b) below.
Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The formal measurements are detailed below:

Test Details	
Regulation	Title 47 of the CFR:2005, Part 15 Subpart 15.225(a)
Measurement standard	ANSI C63.4:2003
Frequency	13.553MHz to 13.567MHz
EUT sample number	S10
Modification state	0
SE in test environment	S01, S04, S05 and S12
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photograph 1

The worst case ac power line conducted emission measurements are listed below:

Results measured using the quasi-peak detector compared to the quasi-peak limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.2048	L	44.9	63.4	-18.5	Pass
2	0.41028	L	35.4	57.6	-22.2	Pass
3	0.51297	L	37.1	56.0	-18.9	Pass
4	0.61443	L	38.8	56.0	-17.2	Pass
5	3.8900	L	19.6	56.0	-36.4	Pass
6	13.5600	L	47.8	60.0	-12.2	Pass
7	0.24800	N	45.0	63.4	-18.4	Pass
8	0.41028	N	36.9	57.6	-20.7	Pass
9	0.51297	N	38.4	56.0	-17.6	Pass
10	0.61443	N	36.9	56.0	-19.1	Pass
11	3.8900	N	22.8	56.0	-33.2	Pass
12	13.5600	N	47.0	60.0	-13.0	Pass

Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.2048	L	37.2	53.4	-16.2	Pass
2	0.41028	L	31.2	47.6	-16.4	Pass
3	0.51297	L	30.6	46.0	-15.4	Pass
4	0.61443	L	31.1	46.0	-14.9	Pass
5	3.8900	L	18.2	46.0	-27.8	Pass
6	13.5600	L	46.4	50.0	-3.6	Pass
7	0.24800	N	34.3	53.4	-19.1	Pass
8	0.41028	N	27.6	47.6	-20.0	Pass
9	0.51297	N	33.5	46.0	-12.5	Pass
10	0.61443	N	33.7	46.0	-12.3	Pass
11	3.8900	N	15.9	46.0	-30.1	Pass
12	13.5600	N	45.5	50.0	-4.5	Pass

Specification limits :

Title 47 of the CFR:2004, Part 15 Subpart (c) Section 15.207 limits for conducted disturbance at the mains ports of intentional radiators:

Frequency range MHz	Limits dBμV	
	Quasi-peak	Average
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5	56	46
5 to 30	60	50
Notes: 1. The lower limit shall apply at the transition frequency. 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.		

Notes:

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

(b) The following table summarises the effect of the EUT operating mode and internal configuration 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		✓		

(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

A7 Frequency Tolerance of the Carrier Signal

The frequency tolerance of the carrier signal was measured over the temperature range –20 degrees C to +50 degrees C.

Test Details	
Regulation	Title 47 of the CFR:2005, Part 15 Subpart 15.225(a)
Measurement standard	ANSI C63.4:2003
Frequency	13.553MHz to 13.567MHz
EUT sample number	S10
Modification state	0
SE in test environment	S01, S04, S05 and S12
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Frequency stability versus ambient temperature measurements, at t=0 (startup), t+2 minutes, t+5 minutes and t+10 minutes:

Temperature	t=0 (startup)	Frequency error (%)	t+2	Frequency Error (%)	t+5	Frequency Error (%)	t+10	Frequency error (%)
-20	13.559899	0.0007	13.559896	0.0008	13.559895	0.0008	13.559895	0.0008
-10	13.559903	0.0007	13.559899	0.0007	13.559897	0.0008	13.559893	0.0008
0	13.559872	0.0009	13.559852	0.0011	13.559848	0.0011	13.559842	0.0012
10	13.559763	0.0017	13.559766	0.0017	13.559766	0.0017	13.559762	0.0018
20	13.559785	0.0016	13.559779	0.0016	13.559778	0.0016	13.559782	0.0016
30	13.5597	0.0022	13.559691	0.0023	13.55969	0.0023	13.559692	0.0023
40	13.55966	0.0025	13.559654	0.0026	13.559648	0.0026	13.559647	0.0026
50	13.559598	0.003	13.559589	0.003	13.55959	0.003	13.55959	0.003

Graphical representation of the measured frequency versus temperature is contained within Appendic C.

The frequency tolerance of the carrier signal was measured over a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

Test Details	
Regulation	Title 47 of the CFR:2005, Part 15 Subpart 15.225(a)
Measurement standard	ANSI C63.4:2003
Frequency	13.553MHz to 13.567MHz
EUT sample number	S10
Modification state	0
SE in test environment	S01, S04, S05 and S12
SE isolated from EUT	None
EUT set up	Refer to Appendix C

The frequency tolerance from the nominal-rated at 20 degrees C :

Temperature	Voltage Supply (110 VAC 60Hz)		Frequency	Frequency error (%)
20	85%	93.5 VAC	13.559782	0.0016
20	115%	126.5 VAC	13.559788	0.0016

Specification limits :

The frequency tolerance of the carrier signal shall be maintained within 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

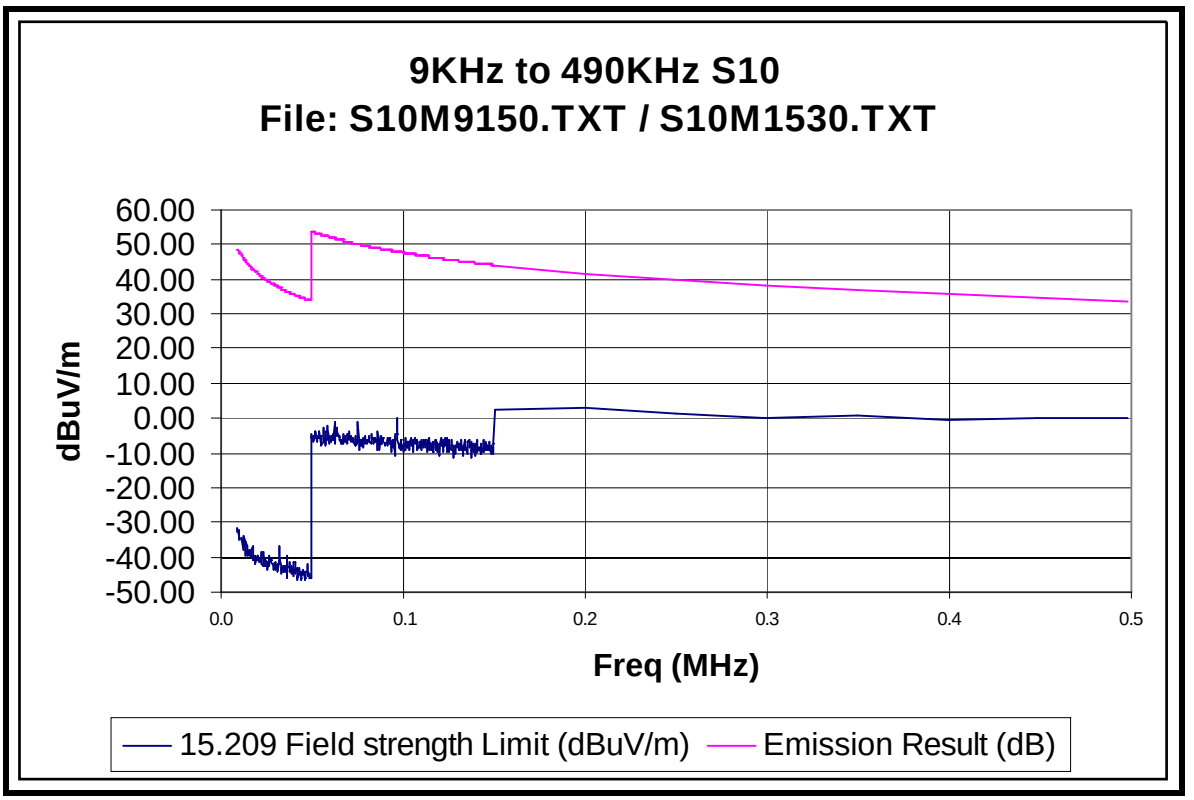
(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A.

(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.


9KHz to 490KHz S10
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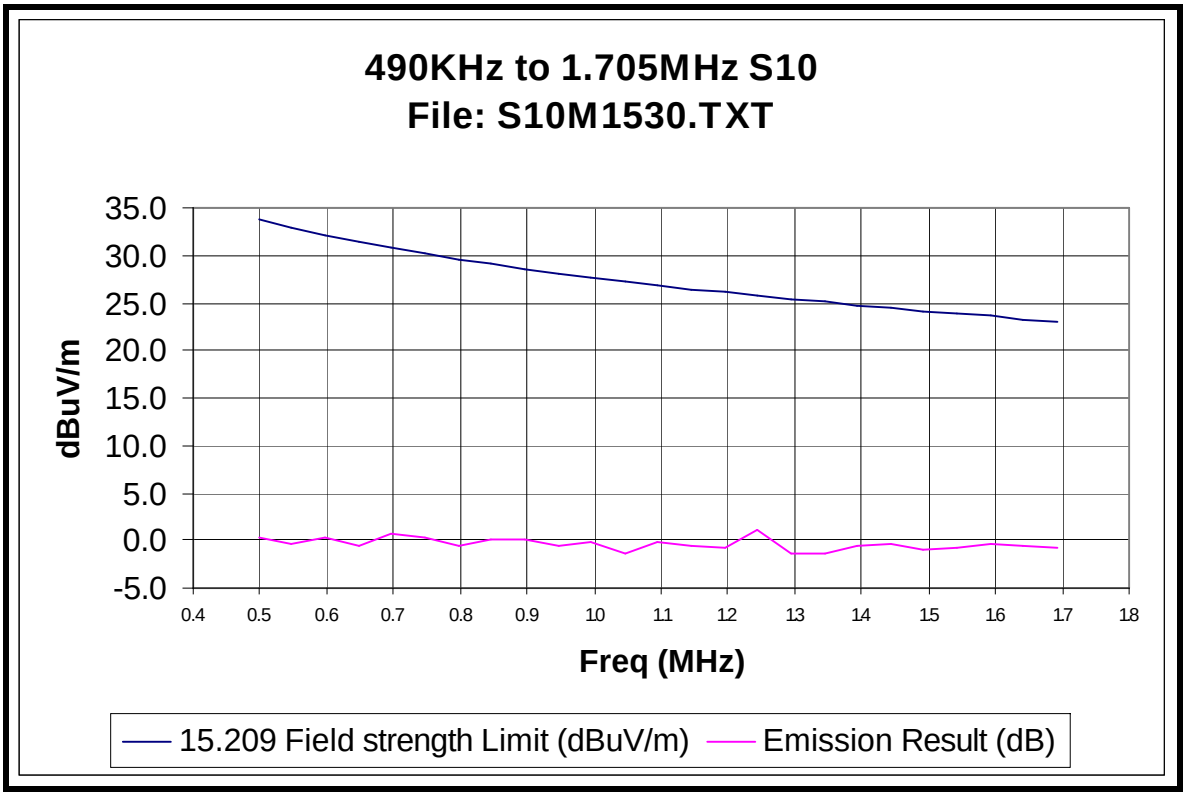
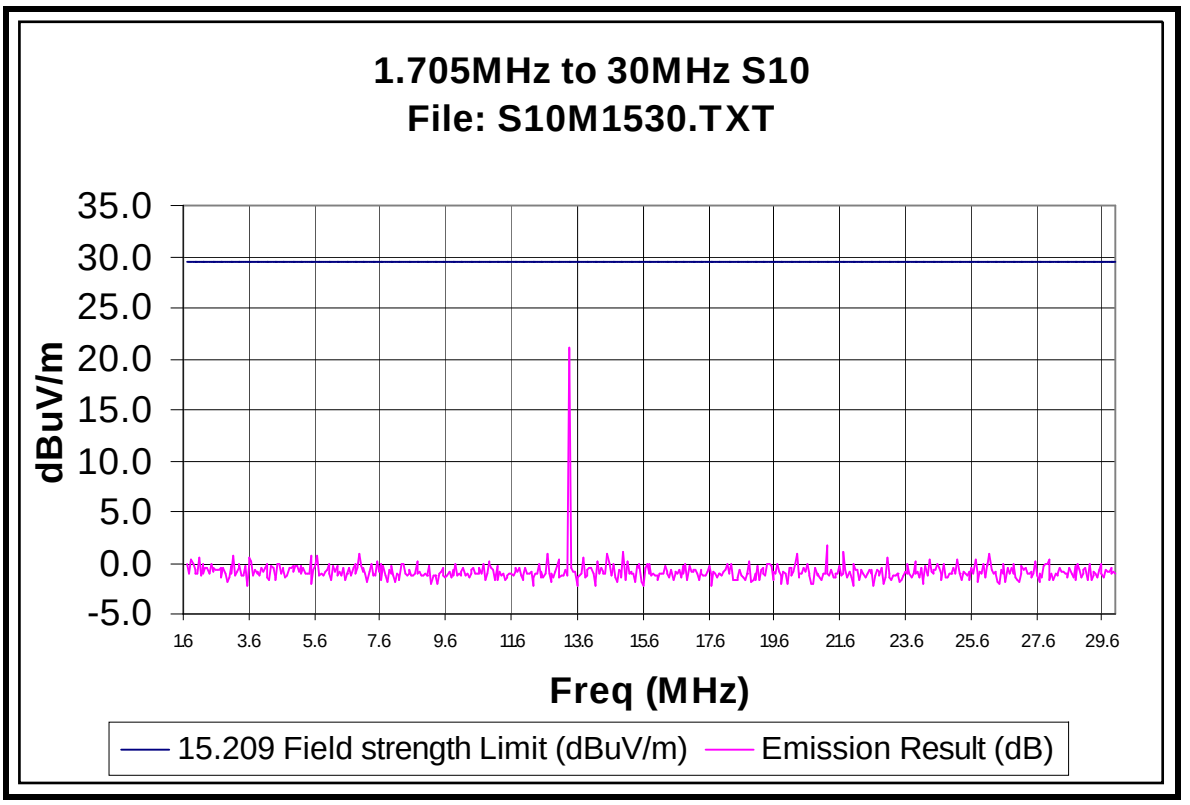
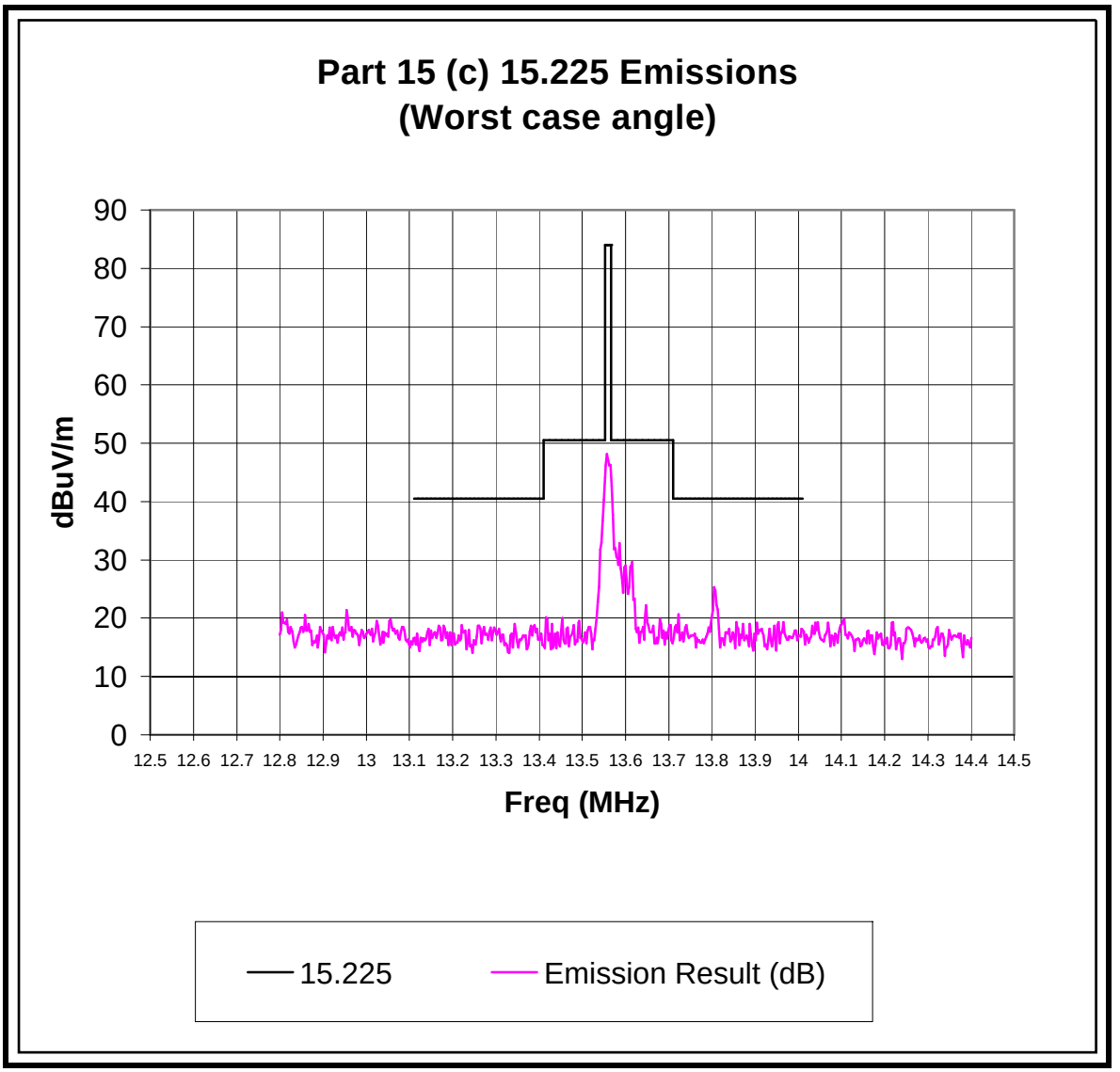
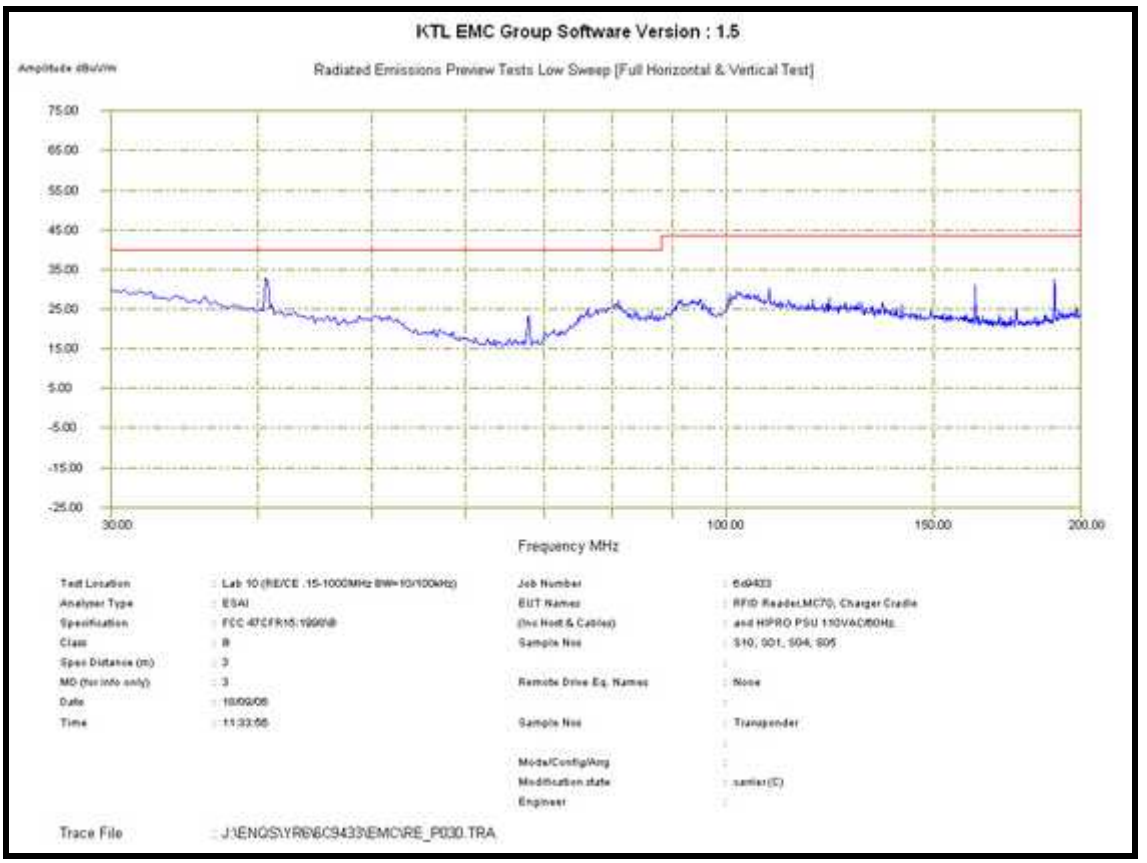
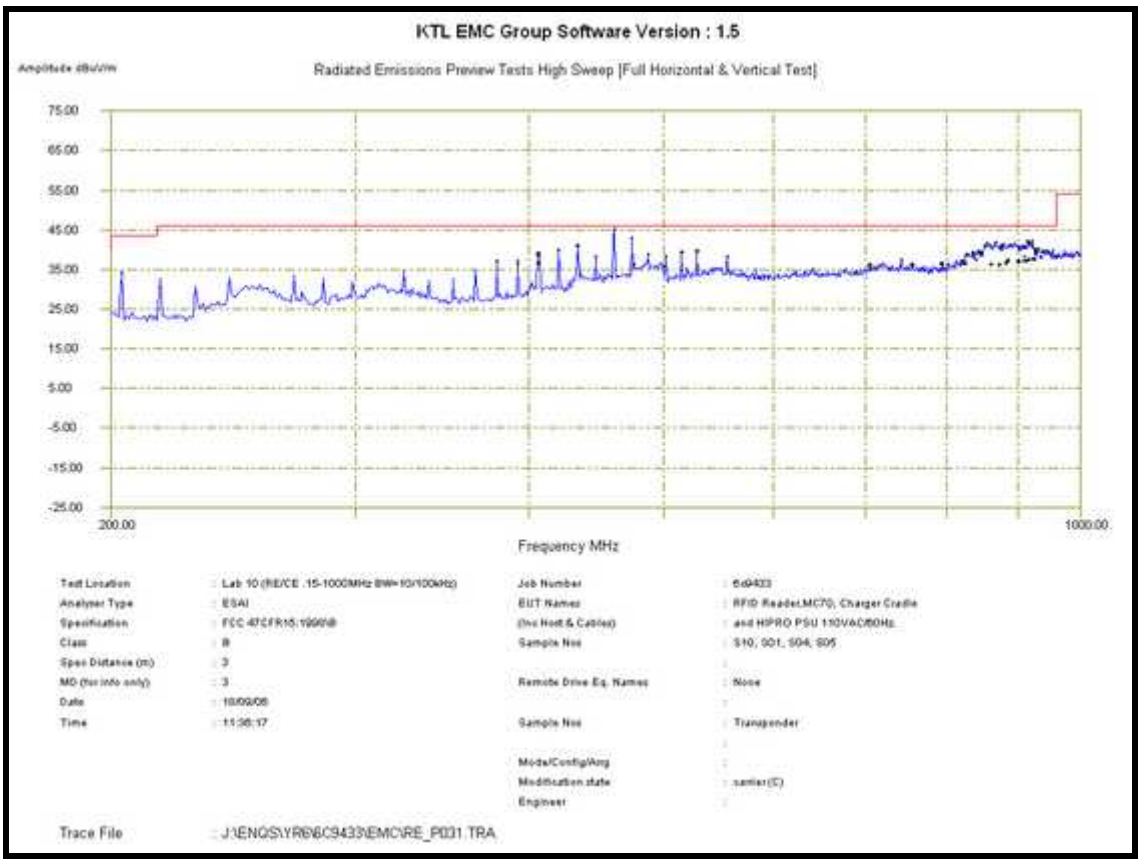
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
0.0
0.1
0.2
0.3
0.4
0.5
Freq (MHz)
15.209 Field strength Limit (dBuV/m)
Emission Result (dB)

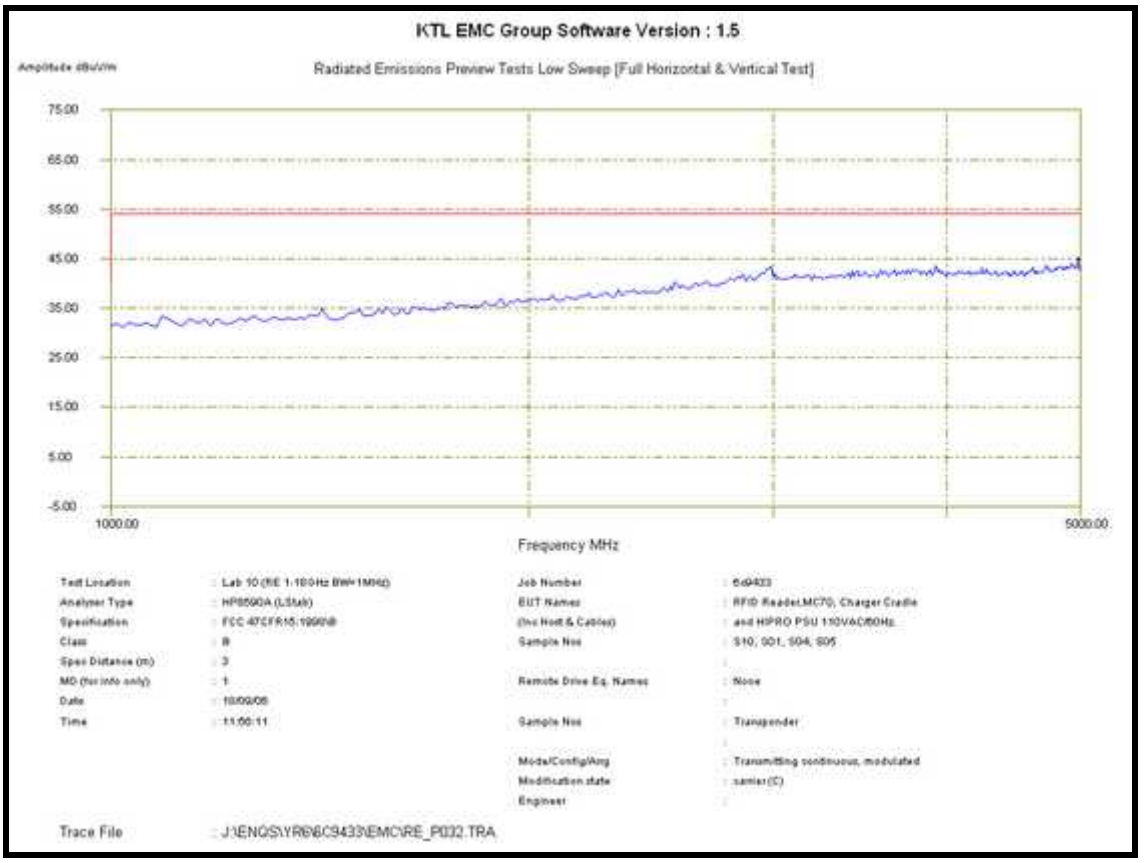

490KHz to 1.705MHz S10
File: S10M1530.TXT
dBuV/m
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
Freq (MHz)
15.209 Field strength Limit (dBuV/m)
Emission Result (dB)

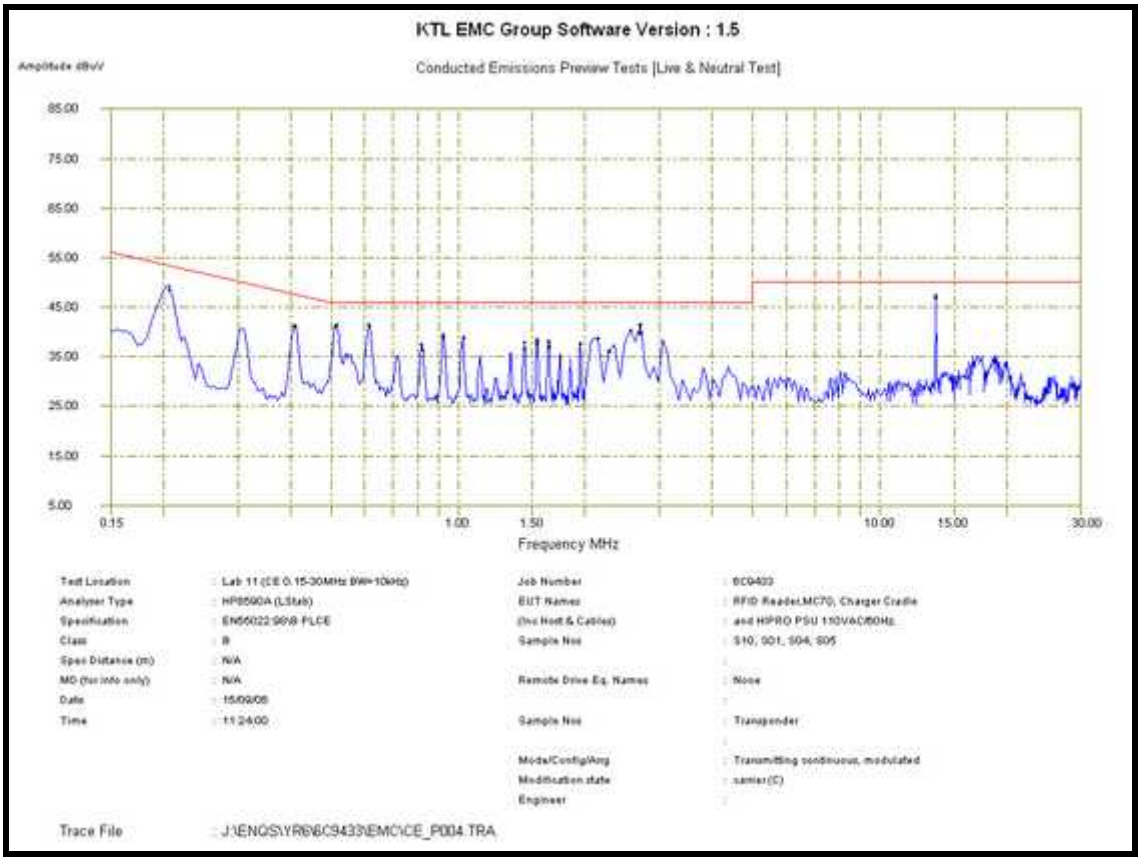

1.705MHz to 30MHz S10
File: S10M1530.TXT
dBuV/m
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
1.6
3.6
5.6
7.6
9.6
11.6
13.6
15.6
17.6
19.6
21.6
23.6
25.6
27.6
29.6
Freq (MHz)
15.209 Field strength Limit (dBuV/m)
Emission Result (dB)

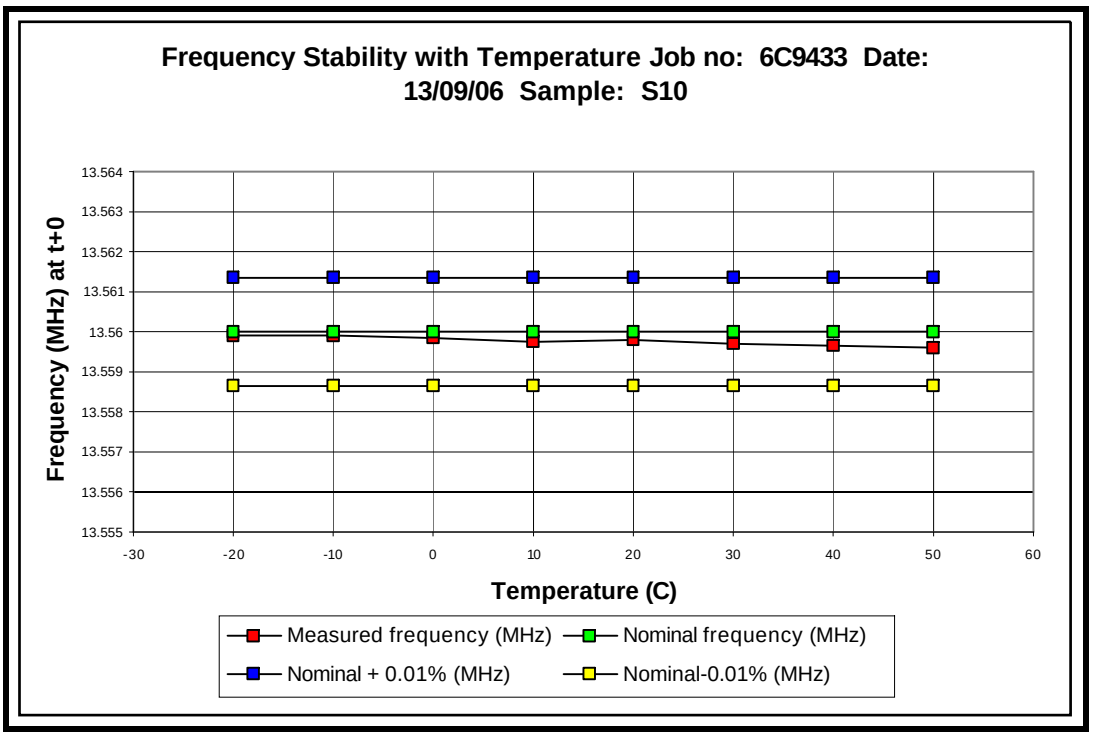

Part 15 (c) 15.225 Emissions
(Worst case angle)
dBuV/m
90
80
70
60
50
40
30
20
10
0
12.5 12.6 12.7 12.8 12.9 13 13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9 14 14.1 14.2 14.3 14.4 14.5
Freq (MHz)
15.225
Emission Result (dB)

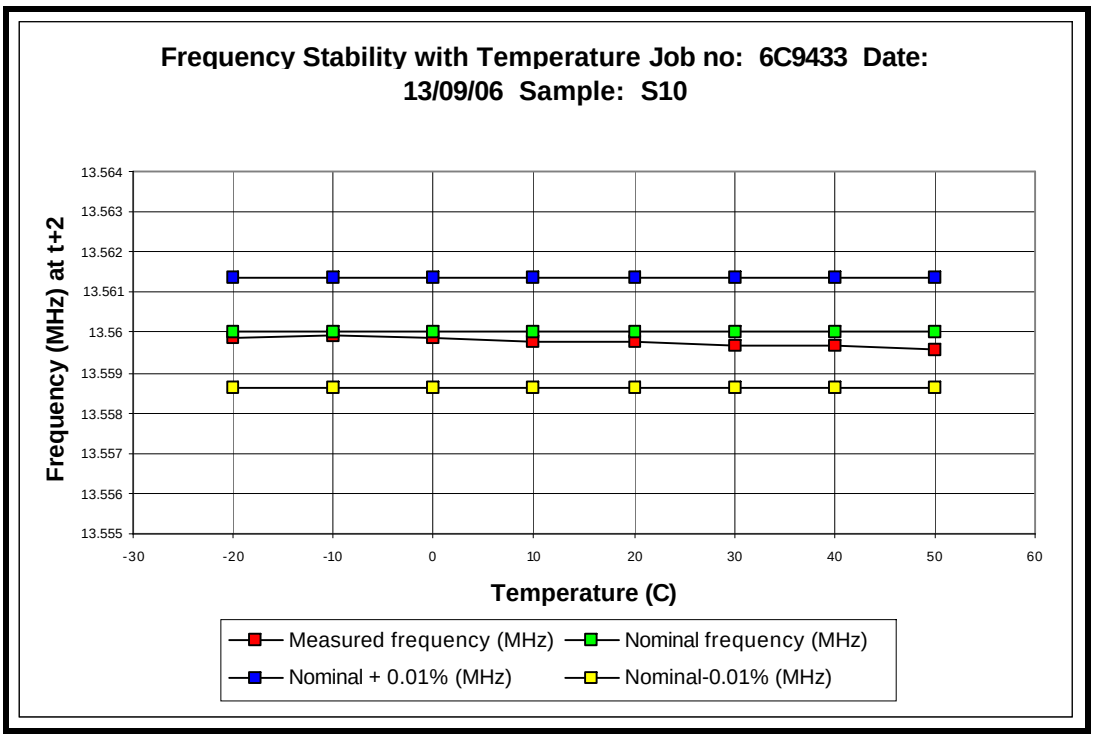

KTL EMC Group Software Version : 1.5
Radiated Emissions Preview Tests Low Sweep [Full Horizontal & Vertical Test]
Amplitude dBuV/m
75.00
65.00
55.00
45.00
35.00
25.00
15.00
5.00
-5.00
-15.00
-25.00
30.00
100.00
150.00
200.00
Frequency MHz
Test Location : Lab 10 (RE/CE .15-1000MHz BW=10/100kHz)
Analyser Type : ESAI
Specification : FCC 47CFR15:1999/B
Class : B
Spec Distance (m) : 3
MD (for info only) : 3
Date : 10/09/06
Time : 11:33:55
Job Number : 6c9433
EUT Names : RFID Reader,MC70, Charger Cradle
(Inc Host & Cables) : and HIPRO PSU 110VAC/60Hz
Sample Nos : S10, S01, S04, S05
Remote Drive Eq. Names : None
Sample Nos : Transponder
Mode/Config/Arrg :
Modification state : carrier(C)
Engineer :
Trace File : J:\ENGS\YR\6C9433\EMC\RE_P030.TRA

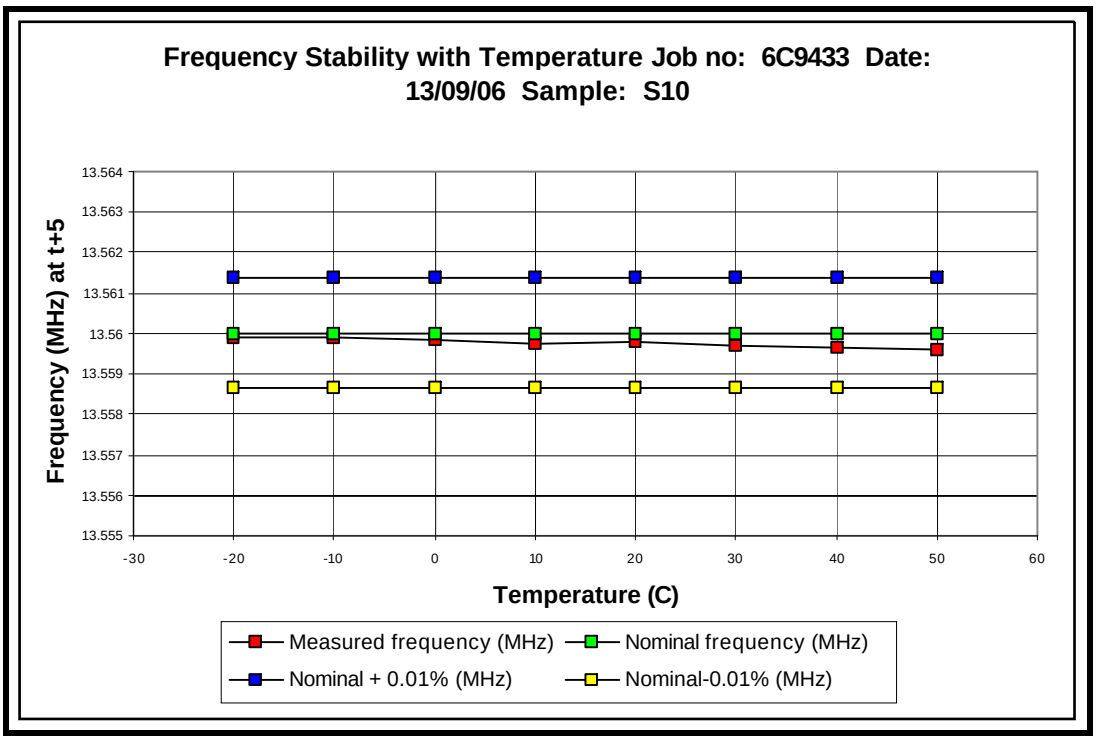

KTL EMC Group Software Version : 1.5
Radiated Emissions Preview Tests High Sweep [Full Horizontal & Vertical Test]
Amplitude dBuV/m
75.00
65.00
55.00
45.00
35.00
25.00
15.00
5.00
-5.00
-15.00
-25.00
200.00
1000.00
Frequency MHz
Test Location : Lab 10 (RE/CE .15-1000MHz BW=10/100kHz)
Analyser Type : ESAI
Specification : FCC 47CFR15:1999/B
Class : B
Spec Distance (m) : 3
MD (for info only) : 3
Date : 10/09/06
Time : 11:36:17
Job Number : 6c9433
EUT Names : RFID Reader,MC70, Charger Cradle
(Inc Host & Cables) : and HIPRO PSU 110VAC/60Hz
Sample Nos : S10, S01, S04, S05
Remote Drive Eq. Names : None
Sample Nos : Transponder
Mode/Config/Arrg :
Modification state : carrier(C)
Engineer :
Trace File : J:\ENGS\YR\6C9433\EMC\RE_P031.TRA

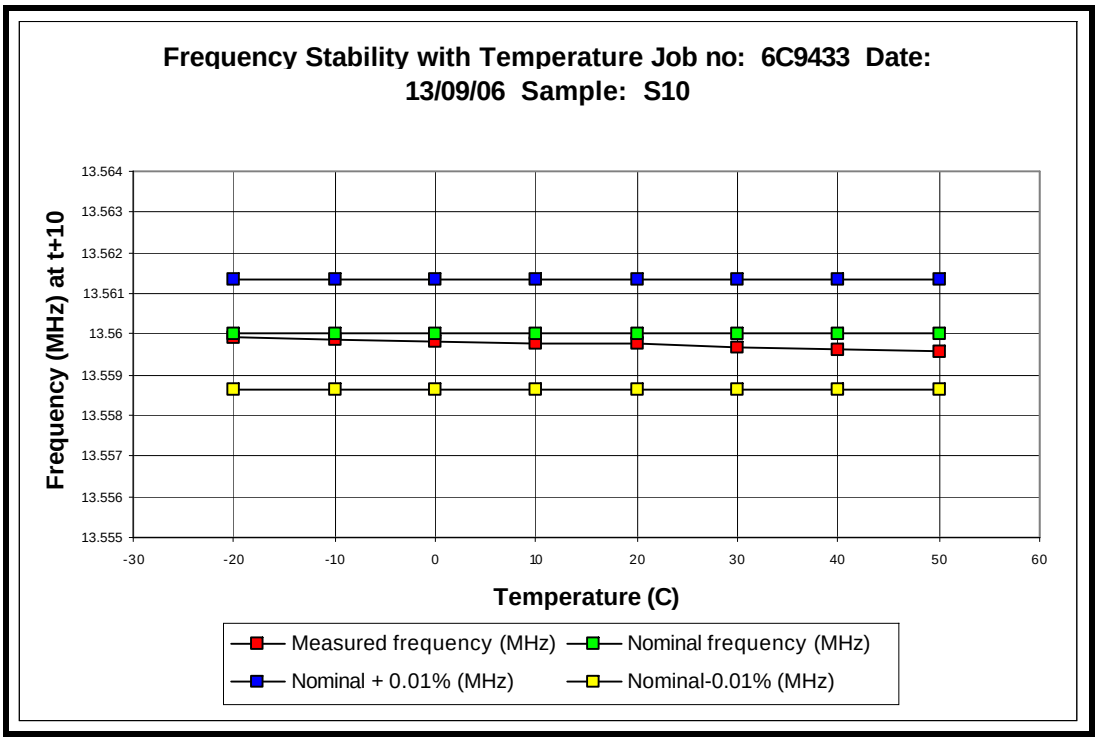

KTL EMC Group Software Version : 1.5
Amplitude dBuV/m
Radiated Emissions Preview Tests Low Sweep [Full Horizontal & Vertical Test]
75.00
65.00
55.00
45.00
35.00
25.00
15.00
5.00
-5.00
1000.00
5000.00
Frequency MHz
Test Location : Lab 10 (RE 1-18GHz BW=1MHz)
Analyser Type : HP8590A (LStab)
Specification : FCC 47CFR15:1999/B
Class : B
Spec Distance (m) : 3
MD (for info only) : 1
Date : 10/09/08
Time : 11:00:11
Job Number : 6d9433
EUT Names : RFID Reader,MC70, Charger Cradle
(Inc Host & Cables) : and HIPRO PSU 110VAC/60Hz
Sample Nos : S10, S01, S04, S05
Remote Drive Eq. Names : None
Sample Nos : Transponder
Mode/Config/Arrg : Transmitting continuous, modulated
Modification state : carrier(C)
Engineer :
Trace File : J:\ENGS\YR\6C9433\EMC\RE_P032.TRA


KTL EMC Group Software Version : 1.5
Amplitude dBuV
Conducted Emissions Preview Tests [Live & Neutral Test]
85.00
75.00
65.00
55.00
45.00
35.00
25.00
15.00
5.00
0.15
1.00
1.50
10.00
15.00
30.00
Frequency MHz
Test Location : Lab 11 (CE 0.15-30MHz BW=10kHz)
Analyser Type : HP8590A (LStab)
Specification : EN55022:98/B PLCE
Class : B
Spec Distance (m) : N/A
MD (for info only) : N/A
Date : 15/09/06
Time : 11:24:00
Job Number : 6C9433
EUT Names : RFID Reader,MC70, Charger Cradle
(Inc Host & Cables) : and HIPRO PSU 110VAC/60Hz
Sample Nos : S10, S01, S04, S05
Remote Drive Eq. Names : None
Sample Nos : Transponder
Mode/Config/Arrg : Transmitting continuous, modulated
Modification state : carrier(C)
Engineer :
Trace File : J:\ENGS\YR\6C9433\EMC\CE_P004.TRA


Frequency Stability with Temperature Job no: 6C9433 Date: 13/09/06 Sample: S10
Frequency (MHz) at t+0
13.564
13.563
13.562
13.561
13.56
13.559
13.558
13.557
13.556
13.555
-30
-20
-10
0
10
20
30
40
50
60
Temperature (C)
Measured frequency (MHz)
Nominal frequency (MHz)
Nominal + 0.01% (MHz)
Nominal-0.01% (MHz)


Frequency Stability with Temperature Job no: 6C9433 Date: 13/09/06 Sample: S10
Frequency (MHz) at t+2
13.564
13.563
13.562
13.561
13.56
13.559
13.558
13.557
13.556
13.555
-30
-20
-10
0
10
20
30
40
50
60
Temperature (C)
Measured frequency (MHz)
Nominal frequency (MHz)
Nominal + 0.01% (MHz)
Nominal-0.01% (MHz)


Frequency Stability with Temperature Job no: 6C9433 Date: 13/09/06 Sample: S10
Frequency (MHz) at t+5
13.564
13.563
13.562
13.561
13.56
13.559
13.558
13.557
13.556
13.555
-30
-20
-10
0
10
20
30
40
50
60
Temperature (C)
Measured frequency (MHz)
Nominal frequency (MHz)
Nominal + 0.01% (MHz)
Nominal-0.01% (MHz)


Frequency Stability with Temperature Job no: 6C9433 Date: 13/09/06 Sample: S10
Frequency (MHz) at t+10
13.564
13.563
13.562
13.561
13.56
13.559
13.558
13.557
13.556
13.555
-30
-20
-10
0
10
20
30
40
50
60
Temperature (C)
Measured frequency (MHz)
Nominal frequency (MHz)
Nominal + 0.01% (MHz)
Nominal-0.01% (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.

C1 Test Samples

The following samples of the apparatus were submitted for testing :

Sample No.	Description	Identification
S10	1059 HF Multi ISO Reader for the MC70 Handheld Computer	Revision 2

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

Sample No.	Description	Identification
S01	Symbol MC70 Handheld pc	None
S04	Symbol charging cradle for the MC70	P/N: CRD7000-1000R
S05	HIPRO in line power supply unit	P/N: 50-14000-148R
S12	Transponder	None

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	Transmitting 13.56MHz continuously. The modulation from the reader to the transponder uses pulse modulation with a modulation depth of 100%.

C3 EUT Configuration Information

Sample	Internal Configuration Details
S02	Single possible internal configuration.
S08	Single possible internal configuration.
S10	Single possible internal configuration.

C4 List of EUT and Support Equipment Ports

The table below describes the termination of EUT ports:

Sample : S02, S08, S10
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
Docking Input	Direct connection	N/A	S04 (Charging cradle)
Host Connector Port Output	Direct connection	N/A	S01 (Handheld pc)

Sample : S01
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
Host Connector Port Input	Direct connection	N/A	S02
IR	None	N/A	Un-terminated
Antenna Port	None	N/A	N/A
Barcode Scanner	None	N/A	N/A

Sample : S04
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
Docking Output	Direct connection	N/A	S02
DC Input	Two Core unshielded	1.8m	S05
RJ45 Serial	None	N/A	Un-terminated
USB	None	N/A	Un-terminated

Sample : S05
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
AC Input	Three core unshielded	2.0m	AC supply
DC Output	Two Core unshielded	1.8m	S01

Notes on the above:

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

C5 Details of Equipment Used

For Radiated Electric (magnetic) Field Emissions 30kHz to 30MHz

RFG No	Type	Description	Manufacturer	Date Calibrated.
RFG023		Magnetic Field Loop antenna	R&S	09/02/06
RFG127	HP8563E	Spectrum analyser	HP	15/09/05

For Radiated Electric Field Emissions 30MHz to 1GHz:

RFG No	Type	Description	Manufacturer	Date Calibrated.
274	ATS	Ferrite Lined Chamber	KTL	10/05/06
231	CBL6111	Blue Bilog Antenna (0.03 - 1GHz)	Chase	31/08/05
214	ESAI	Spec Analyser/Test Rxer (LF/HF)	R & S	27/09/05
249	N-type	RF coaxial cable (Lab 10)	KTL	12/08/05
255	N-type	RF coaxial cable (Lab 10)	KTL	12/08/05
270	N-type	RF coaxial cable (Lab 10)	KTL	12/08/05

For Frequency tolerance measurements

RFG / REF No	Type	Description	Manufacturer	Date Calibrated.
RFG365	-	Environmental chamber	JTS	08/11/05
REF 470	Fluke 45	Calibrated digital multi-meter	Fluke	19/09/05
REF113	PL320	Power supply	Thurlby	N/A
RFG404	E44077B	Spectrum analyser	Agilent	25/01/06
RFG408	7429-1	Magnetic loop antenna	Solar Electronics Company	N/A
RFG127	HP8563E	Spectrum analyser	HP	15/09/05

Appendix D: Additional Information

Product description supplied by the applicant:

The reader provides the Symbol™ MC70 with functionality of reading most 13.56MHz ISO transponders. The HF RFID reader is powered from the Symbol terminal and houses both the RFID reader and the antenna. The HF RFID reader provides the ability to read and write to a wide variety of transponders at 13.56 MHz including ISO 15693, ICODE (I & II) and the complete Mifare family of ISO14443 (A&B).

Appendix E: Photographs and Figures

The following photographs were taken of the test samples:

Photograph 1: Power line conducted emissions.

Photograph 2: Radiated emissions 9kHz to 30MHz showing use of the loop antenna.

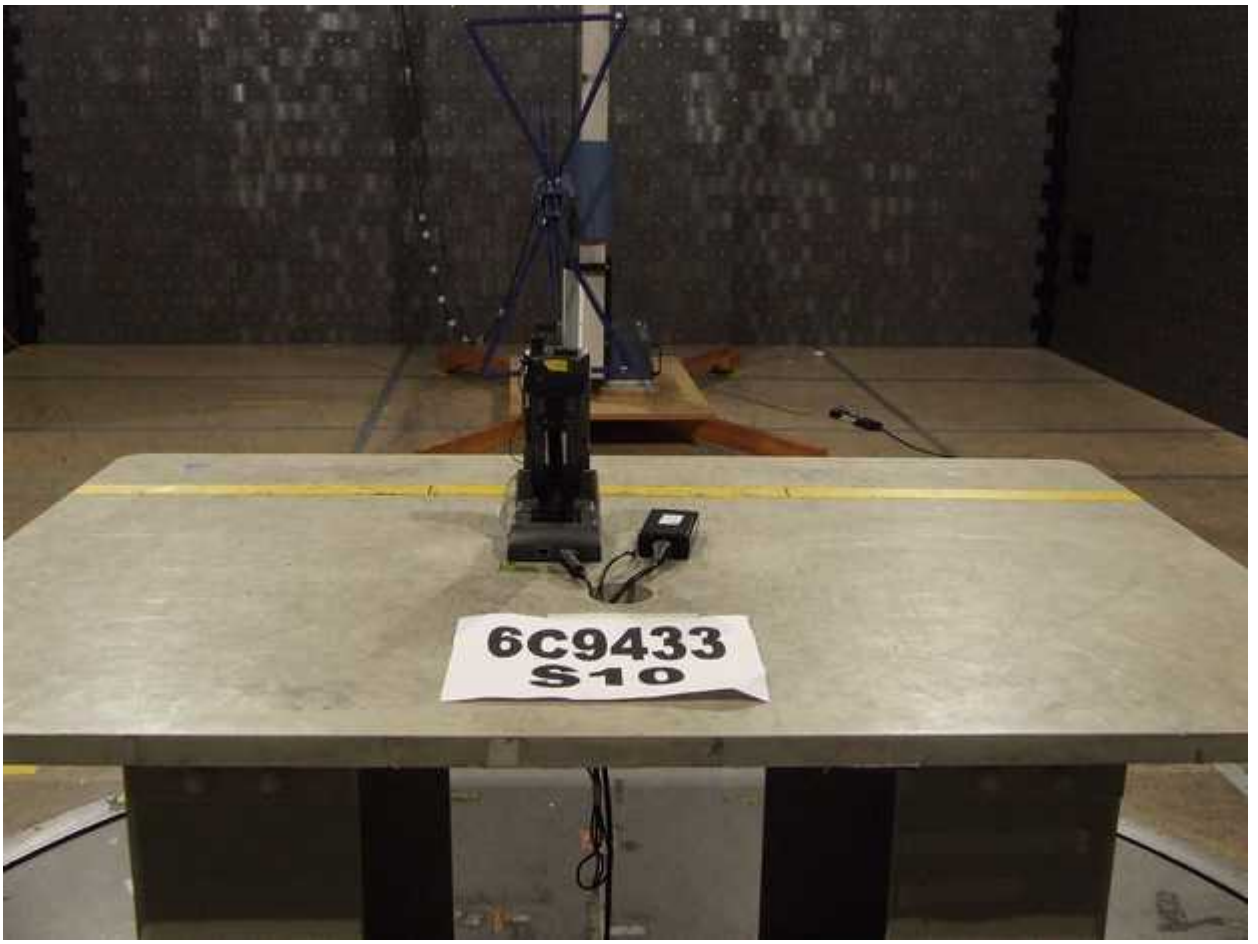
Photograph 3: Radiated emission measurements 30MHz to 5GHz – front view.

Photograph 4: Radiated emission measurements 30MHz to 5GHz – rear view.

Photograph 1

Photograph 2

Photograph 3



Photograph 4