



KTL EMC Test Report : 5G9152GUS1

Applicant : Hidalgo Limited

Apparatus : Equivital EQ-01-001 Vital Signs Monitor

A handwritten signature in black ink that reads "K J Anderson". The signature is written in a cursive style with "K" and "J" being the initials.

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 :

Hidalgo Limited
Stable Block at The Grange
20 Market Street
Swavesey
Cambridge
CB4 5QG

1.3 Manufacturer

As above.

1.4 Apparatus Assessed

The following apparatus was assessed between 03/04/06 and 28/04/06:

Equivital EQ-01-001 Vital Signs Monitor

The above equipment was a non-intrusive ambulatory monitoring wireless telemetry device intended to allow monitoring of a users vital signs physiology. The apparatus transmits physiological data (respiratory and ECG) at 40.68MHz :

Modulation scheme: binary FSK,
Frequency Deviation: $\pm 4\text{kHz}$
2400 BAUD
Nominal 15 second packet frequency

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:2004, Part 15 Subpart (c), Clause 15.229(c)	ANSI C63.4:2003	30kHz to 30MHz	PASS
REFE	Title 47 of the CFR:2004, Part 15 Subpart (c), Clause 15.229(c)	ANSI C63.4:2003	30MHz to 1GHz	PASS
REFE	Title 47 of the CFR:2004, Part 15 Subpart (c), Clause 15.229(a)	ANSI C63.4:2003	40.66 to 40.7MHz	PASS
Frequency Stability	Title 47 of the CFR:2004, Part 15 Subpart (c), Clause 15.229(d)	ANSI C63.4:2003	0.01% of nominal	PASS

Abbreviations used in the above table:

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

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 Variations In Test Methods

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 Emissions 30kHz to 30MHz

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

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

Test Details	
Regulation	Title 47 of the CFR:2004, Part 15 Subpart (c) Section 15.229 (c)
Measurement standard	ANSI C63.4:2003
Frequency range	30kHz to 30MHz
EUT sample number	S01
Modification state	0
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photographs 1 and 2

The worst case radiated emission measurements are listed below:

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 15:2004 Clause 15.33.

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

Frequency of emission (MHz)	Field strength μ V/m	Field strength $\text{dB}\mu\text{V/m}$	Measurement Distance (meters)
0.009 to 0.490	$2400/F(\text{kHz})$	$67.6 - 20\log F$	300
0.490 to 1.705	$24000/F(\text{kHz})$	$87.6 - 20\log F$	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 ANSI C63.4:2003 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:

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

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

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

A2 Radiated Electric Field Emissions – 30MHz to 1GHz

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:2004, Part 15 Subpart (c) Section 15.229 (c)
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 1000MHz
EUT sample number	S01
Modification state	0
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photographs 1 and 2

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	50	QP	0	100	V	3	18.1	40	-21.9	PASS
2	200	QP	0	100	V	3	20	43.5	-23.5	PASS
3	400	QP	321	100	V	3	28.6	46	-17.4	PASS
4	600	QP	321	100	V	3	33.7	46	-12.3	PASS
5	800	QP	321	100	V	3	38.7	46	-7.3	PASS
6	1000	QP	321	100	V	3	40.9	54	-13.1	PASS

Specification limits :

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

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

Frequency of emission (MHz)	Field strength μ V/m	Field strength $\text{dB}\mu$ V/m	Measurement Distance (meters)
30 to 40.66	100	40.0	3
40.66 to 40.70*	1000	60	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:

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

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

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

A3 Radiated Electric Field Emissions Within the Band 40.66MHz to 40.70MHz

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:2004, Part 15 Subpart (c) Section 15.229 (a)
Measurement standard	ANSI C63.4:2003
Frequency	40.66MHz to 40.70MHz
EUT sample number	S01
Modification state	0
EUT set up	Refer to Appendix C
Photographs (Appendix E)	Photographs 1 and 2

The worst case radiated emission measurements are listed below:

Ref No	Freq (MHz)	Det	Ang Deg	Hgt (cm)	Pol	MD (m)	Res at MD (dB _u V/m)	Spec Limit (dB _u V/m)	Margin (dB)	Res Sum
1	40.68*	QP	61	100	V	3	38.6	60	-21.4	PASS

*Carrier frequency. The effect on the carrier of varying the supply voltage between 85% and 115% of the normal supply voltage (3Vdc) was investigated pursuant to 47 CFR Part 15 section 15.31(e).

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 15:2004 Clause 15.229 (a):

Frequency of emission (MHz)	Field strength μ V/m	Field strength dB μ V/m	Measurement Distance (meters)
40.66 to 40.70	1000	60	3

Notes:

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

The levels may have been rounded for display purposes.

A4 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:2004, Part 15 Subpart (c) Section 15.229 (d)
Measurement standard	ANSI C63.4:2003
Nominal Frequency	40.68MHz
EUT sample number	S01
Modification state	0
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	40.67767	0.0057	40.67775	0.0055	40.67767	0.0057	40.67775	0.0055
-10	40.6785	0.0037	40.67858	0.0035	40.67875	0.0031	40.67892	0.0027
0	40.67833	0.0041	40.67859	0.0035	40.67867	0.0033	40.67858	0.0035
10	40.6785	0.0037	40.67833	0.0041	40.67833	0.0041	40.67842	0.0039
20	40.678	0.0049	40.678	0.0049	40.678	0.0049	40.678	0.0049
30	40.67808	0.0047	40.678	0.0049	40.67792	0.0051	40.67792	0.0051
40	40.678	0.0049	40.67775	0.0055	40.67767	0.0057	40.67758	0.0059
50	40.67775	0.0055	40.6775	0.0061	40.67758	0.0059	40.67742	0.0063

Graphical representation of the measured frequency versus temperature is contained within Appendix 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:2004, Part 15 Subpart (c) Section 15.229 (d)
Measurement standard	ANSI C63.4:2003
Nominal Frequency	40.68MHz
Rated supply voltage	3Vdc
EUT sample number	S01
Modification state	0
EUT set up	Refer to Appendix C

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

Supply voltage (V dc)	Frequency deviation (%) from nominal-rated at 20 degrees C.
2.55 (85%)	0.0086
3.45 (115%)	0.0028

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

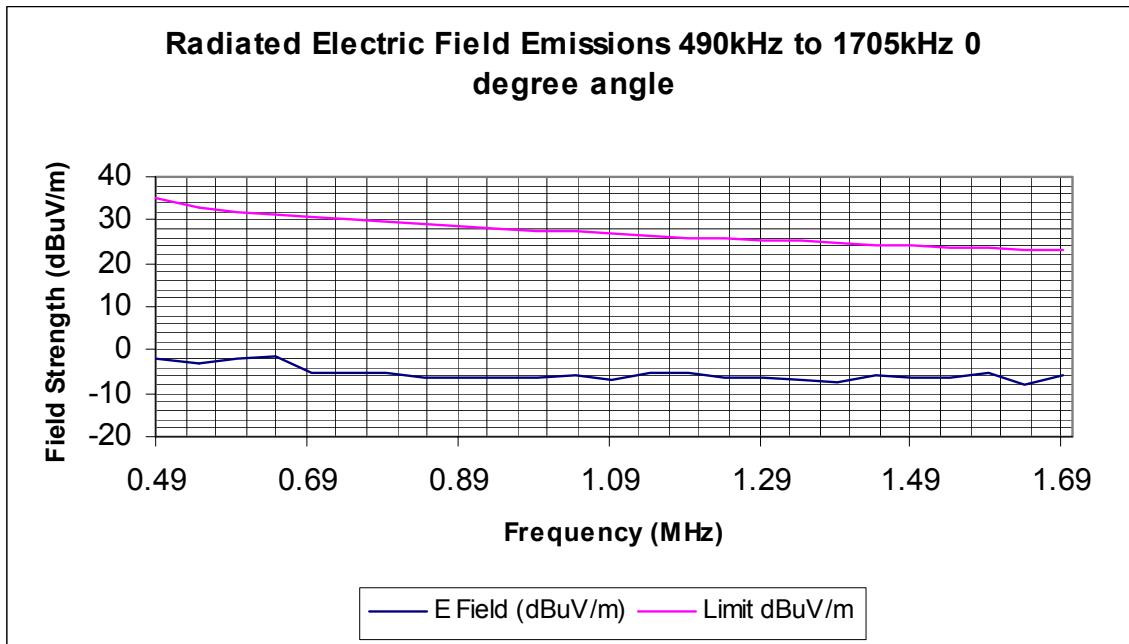
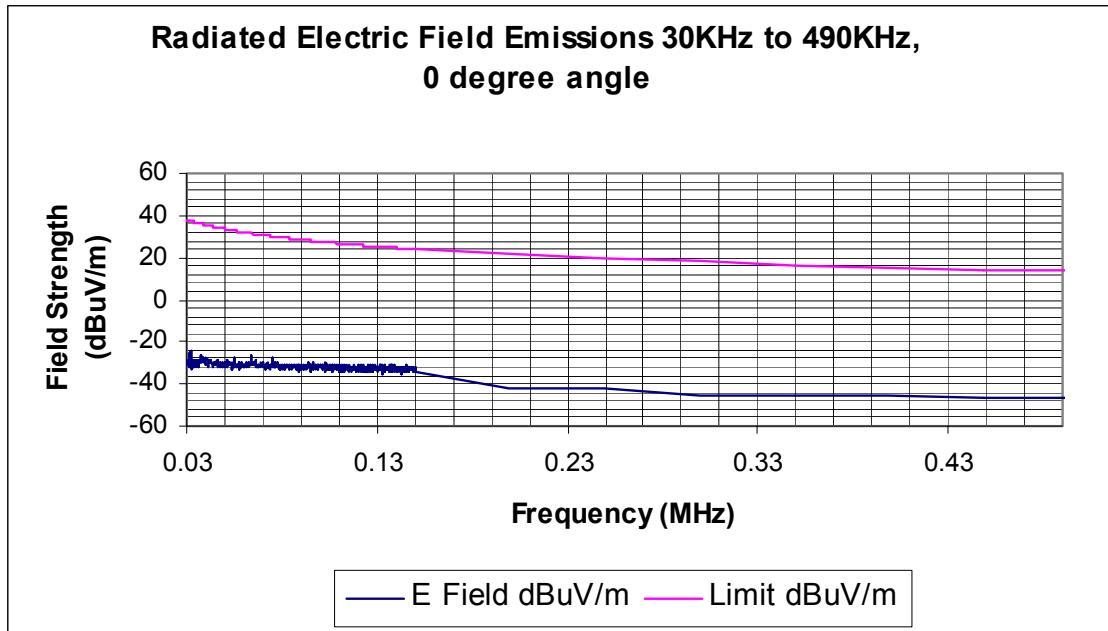
Appendix B:

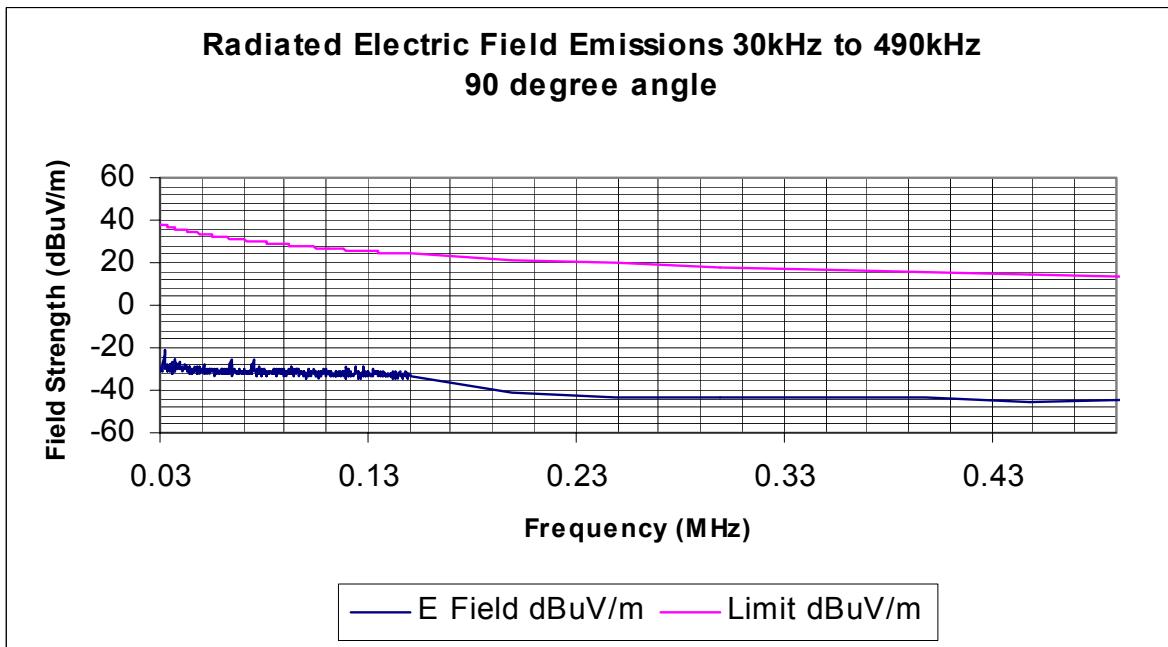
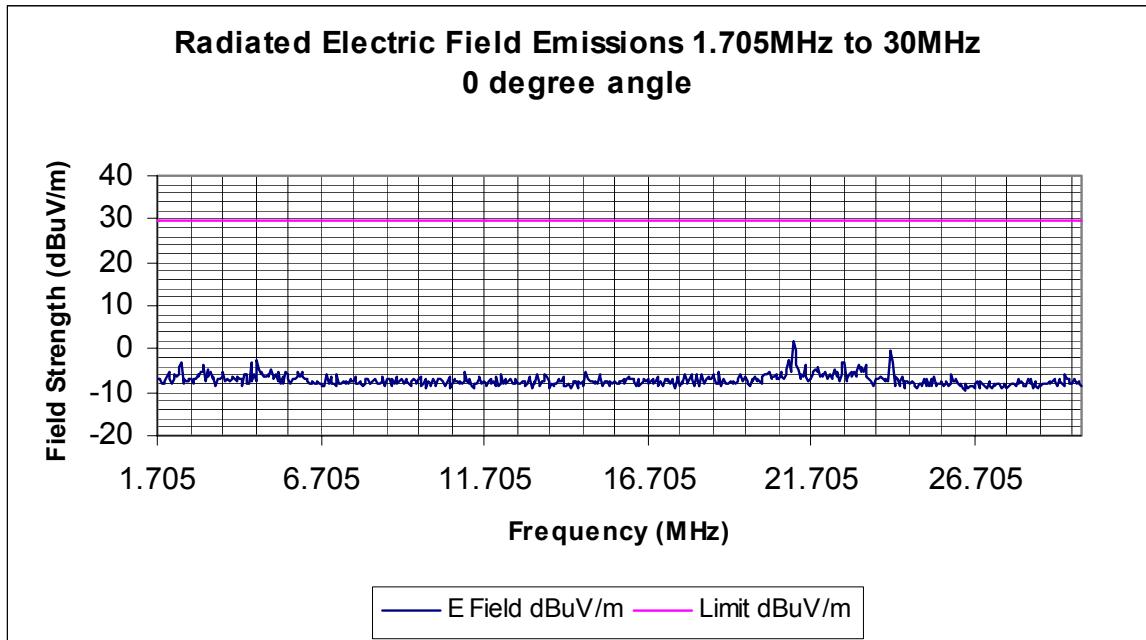
Supporting Graphical Data

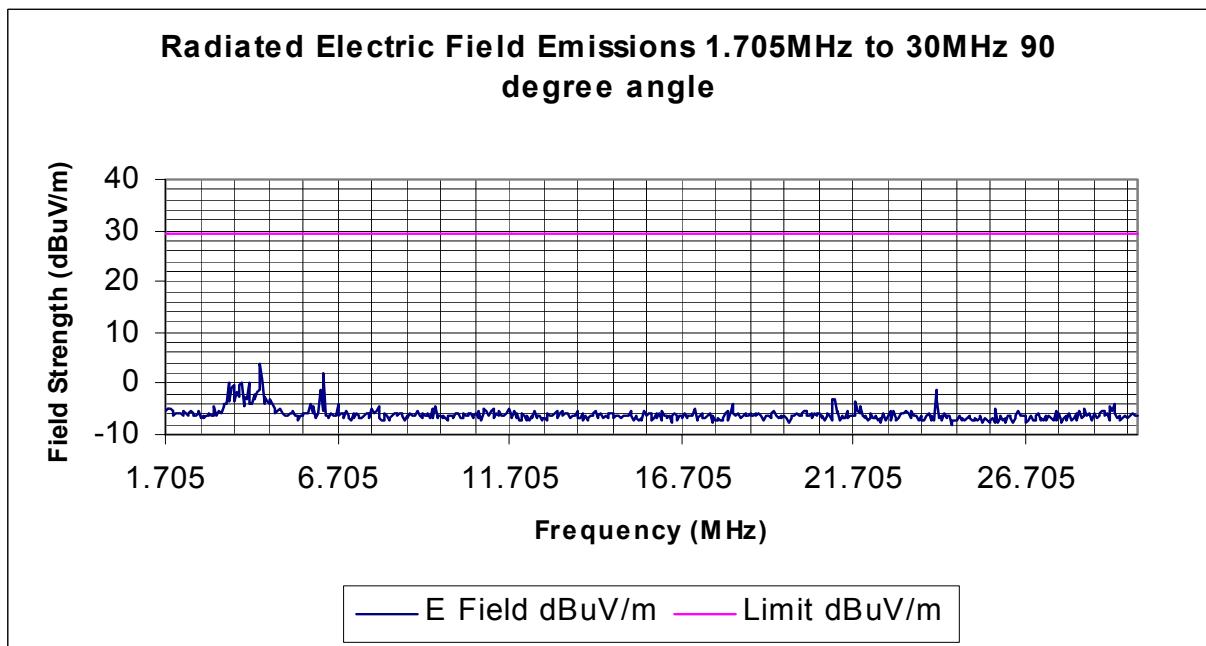
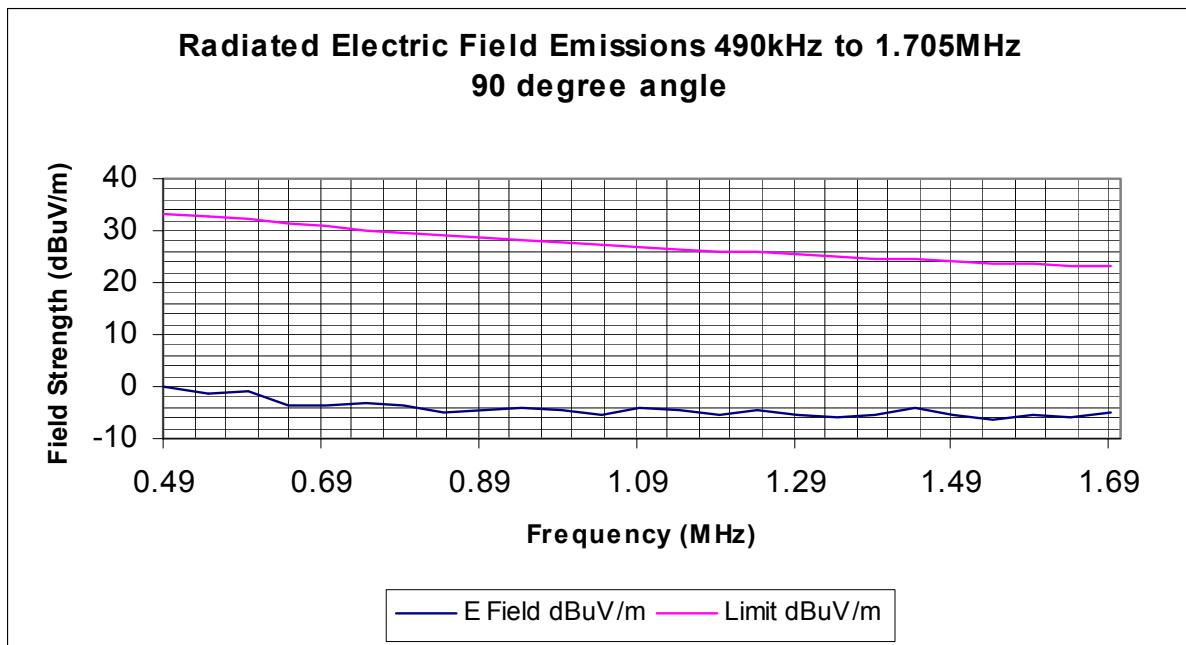
This appendix contains graphical data obtained during testing.

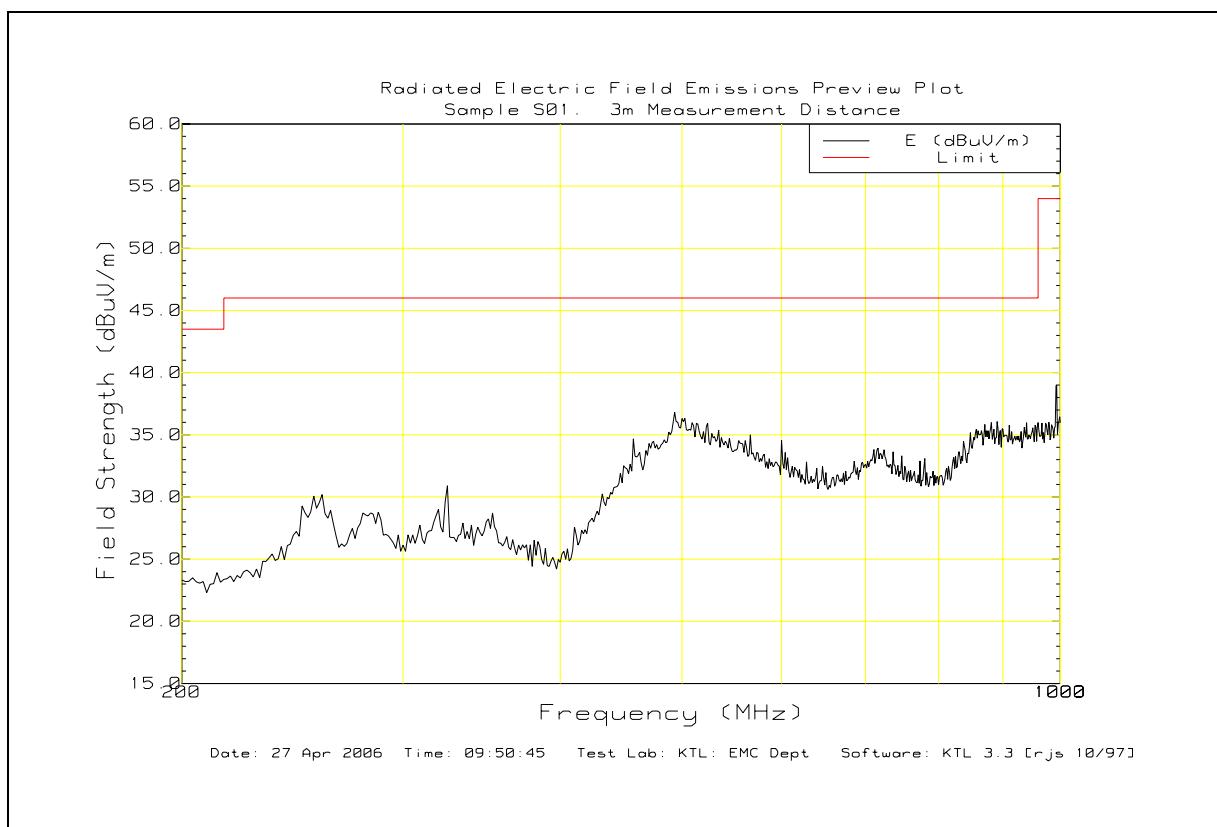
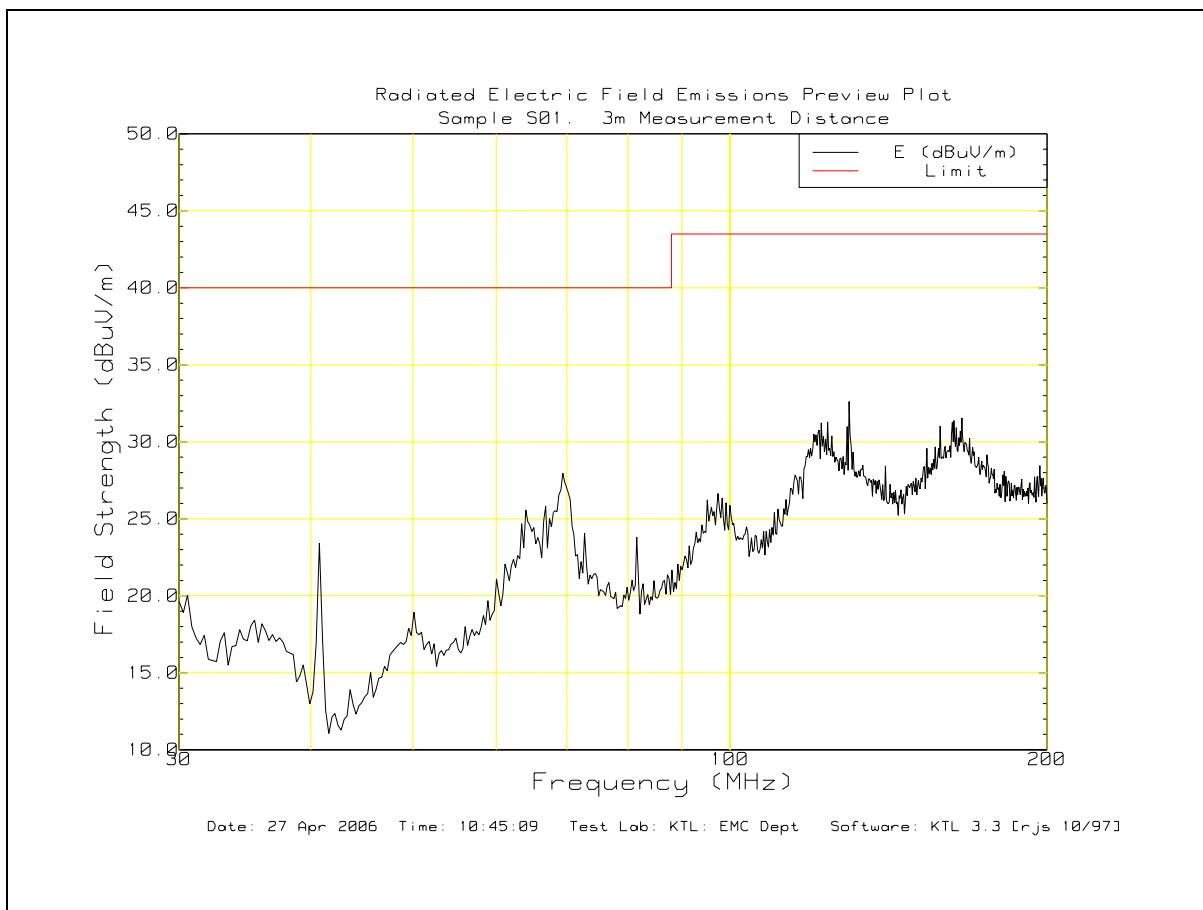
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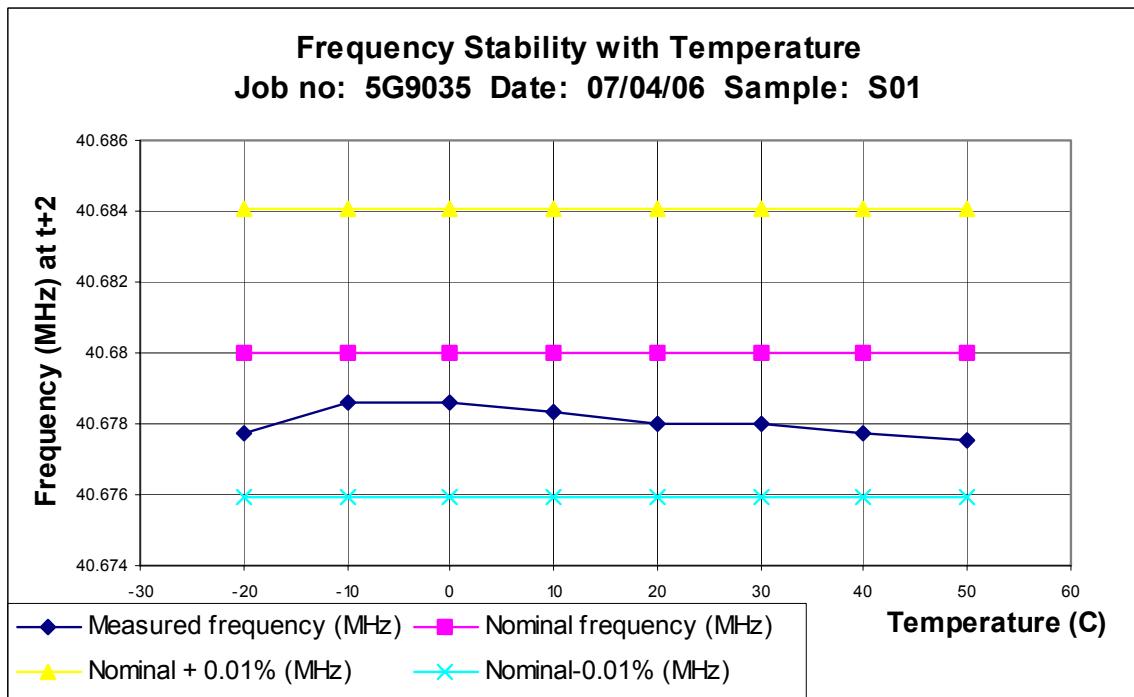
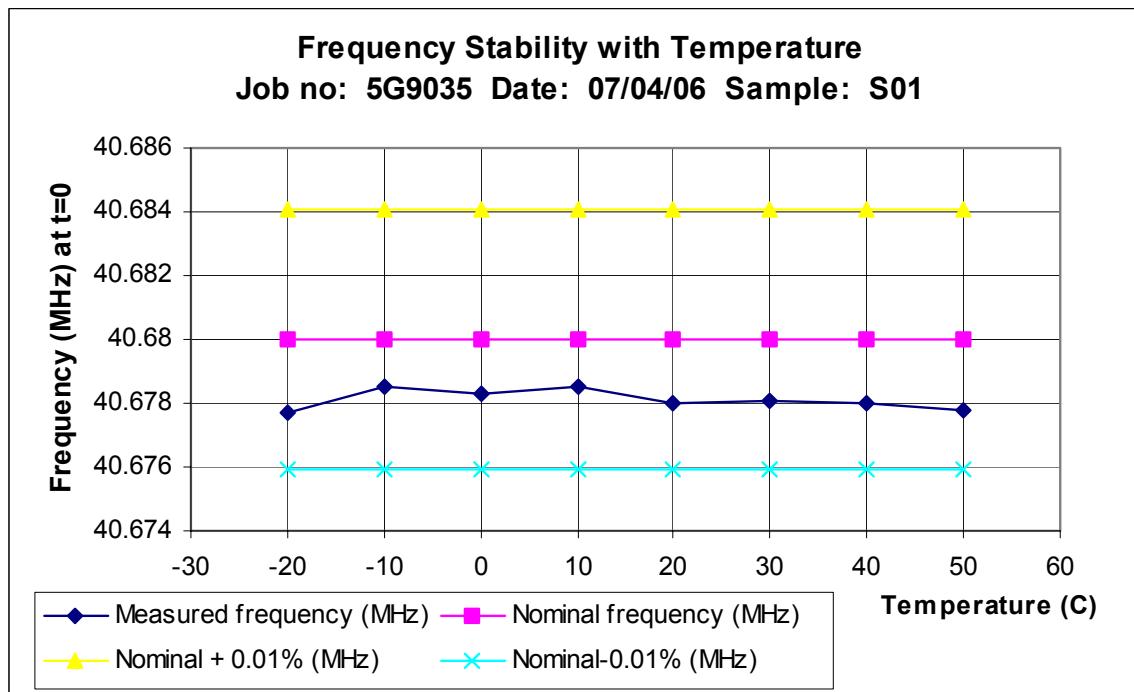
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted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

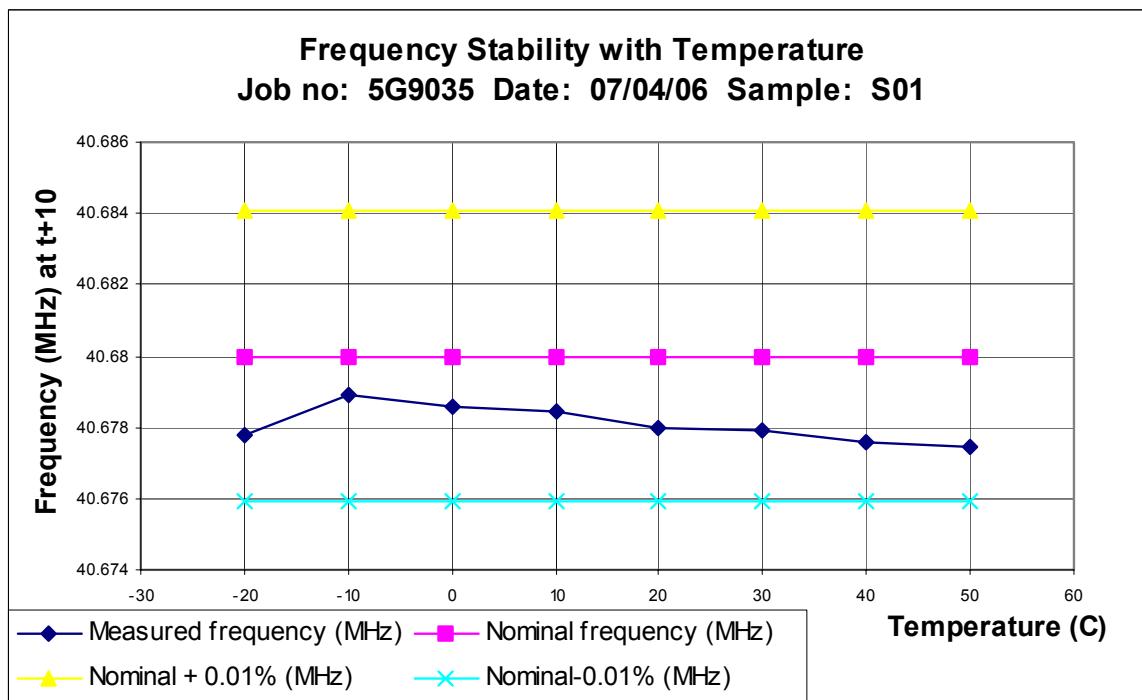
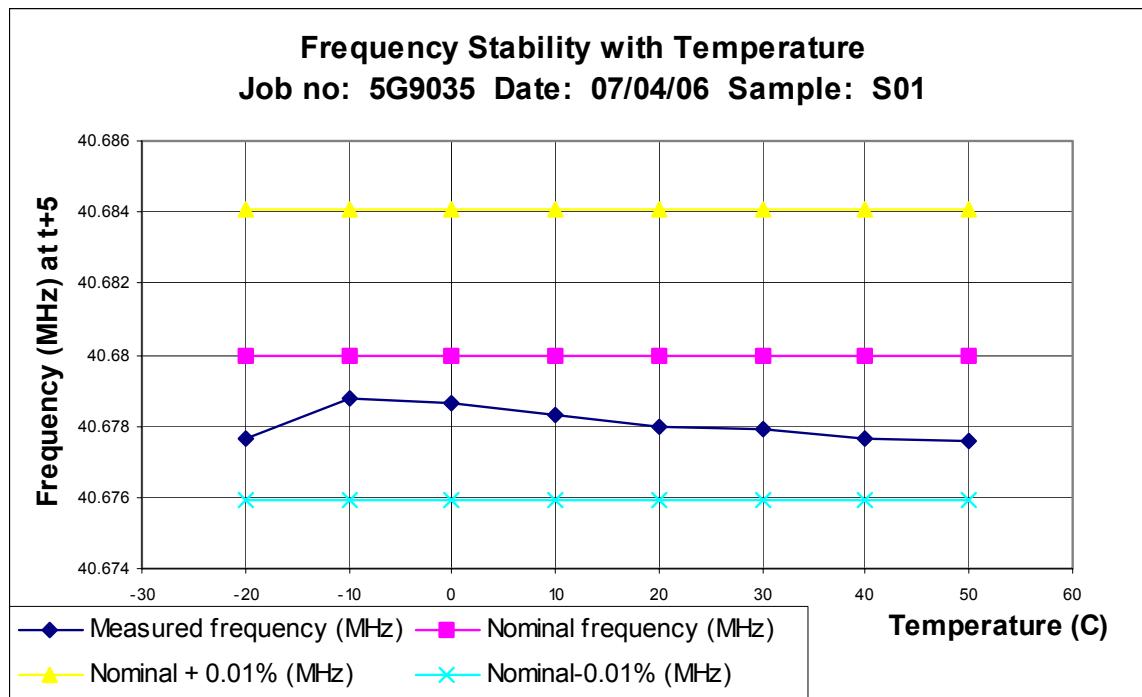












Appendix C:**Additional Test and Sample Details**

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 KTL upon request.

C1 Test Samples

The following samples of the apparatus were submitted for testing :

Sample No.	Description	Identification
S01	Equivital Physiological Monitor	M/N EQ01-002

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 continuously at 40.68MHz. Modulation scheme: binary FSK, $\pm 4\text{kHz}$ frequency deviation, 2400 BAUD Nominal 15 second packet frequency.

C3 EUT Configuration Information

Sample	Internal Configuration Details
S01	Single possible internal configuration

C4 List of EUT Ports

The table below describes the termination of EUT ports:

Sample : S01
 Tests : All Tests detailed within this report.

Port	Description of Cable Attached	Cable length
ECG LHF sensor connection	Single core wire containing 50KΩ in parallel with 47nF – connected to RHF	10cm
ECG RHF sensor connection	Connected to LHF via the above wire and RHR with a single core wire containing 50KΩ in parallel with 47nF	10cm
ECG RHR sensor connection	Connected to RHR via the above wire	10cm
Respiratory sensor connection	Respiratory sensors connected via a single core wire containing a 3KΩ resistor.	10cm
Respiratory sensor connection		

Notes on the above:

1. The connection of cables and drive or support equipment was identical for all tests.
2. The above connections were used for testing purposes specified by the document “Cardiac monitors, heart rate meters, and alarms [American National Standard (ANSI/AAMI EC13:2002)]”.
3. Abbreviations used in the above table:

LHF : Left Hand Front
 RHF : Right Hand Front
 RHR : Right and Rear

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	24/05/05
231	CBL6111	Blue Bilog Antenna (0.03 - 1GHz)	Chase	10/05/00
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

No additional information is included.

Appendix E:

Photographs and Figures

The following photographs were taken of the test samples:

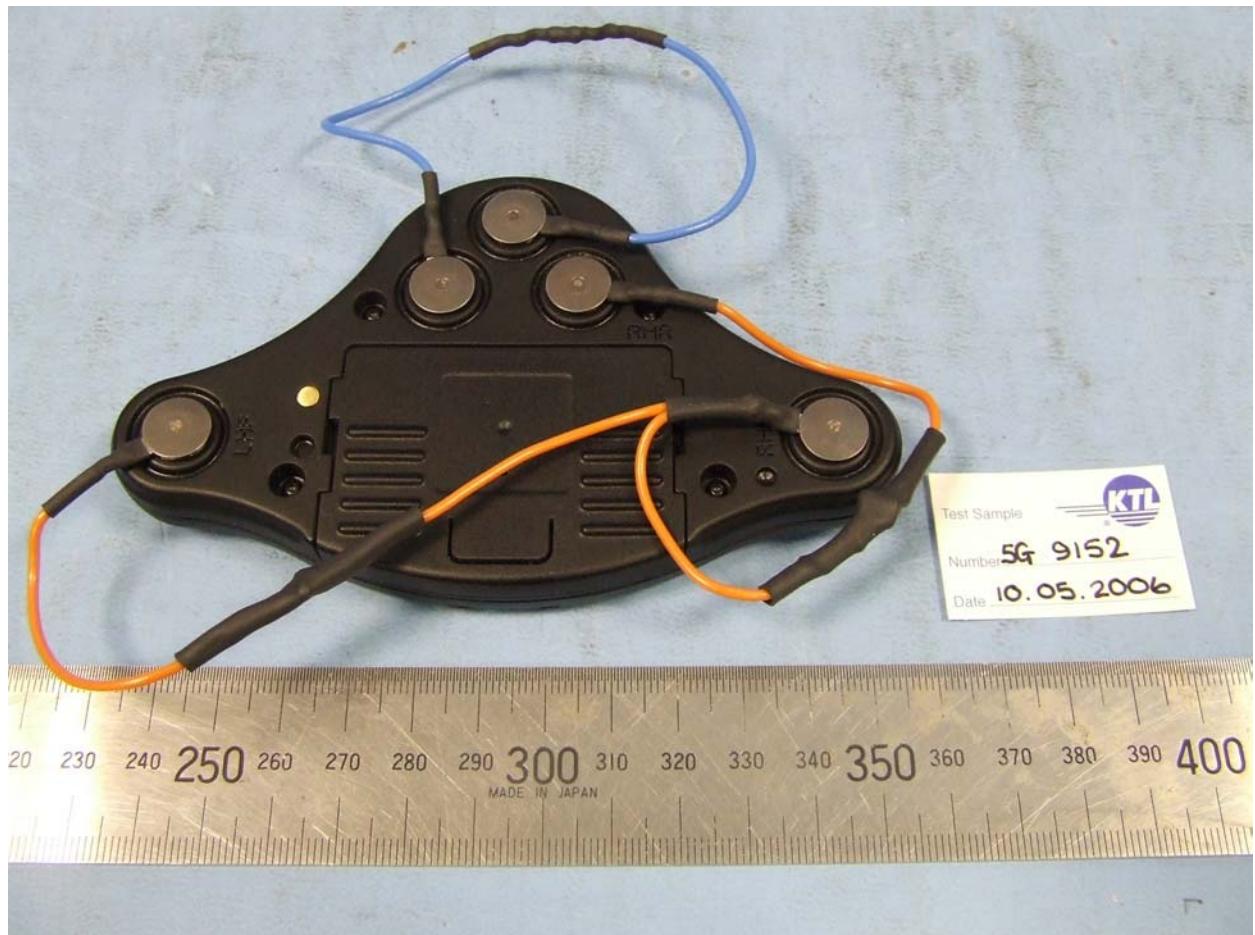
Photograph 1 : External view

Photograph 2 : External view

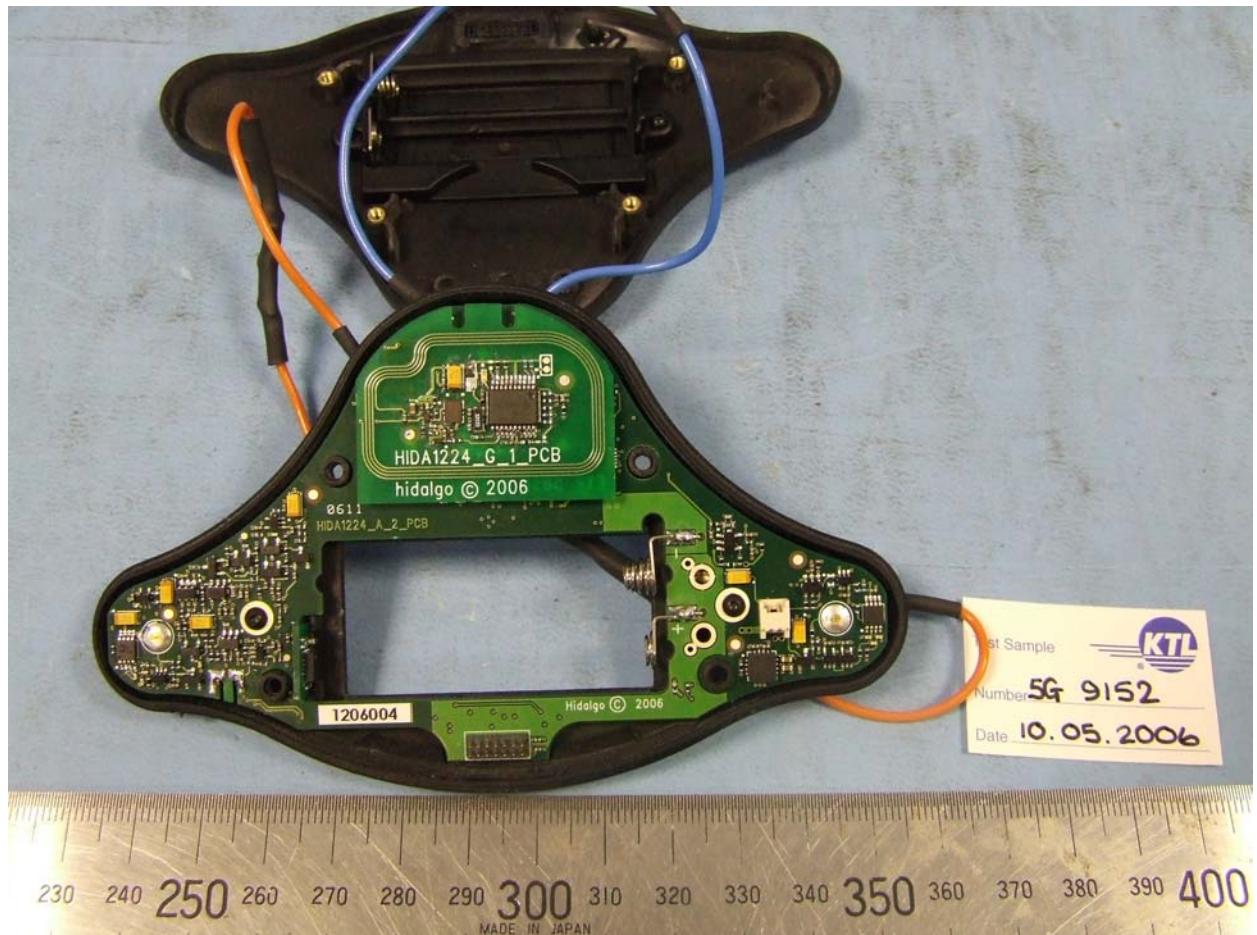
Photograph 3 : Internal view



Photograph 1



Photograph 2



Photograph 3