

TEST REPORT NO: RL1038/4876

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**REPORT ON THE
CERTIFICATION TESTING OF AN
I. D. SYSTEMS LTD.
MODEL oem-msr1
IDENTITY TAG DATA TRANSCEIVER
WITH RESPECT TO
THE FCC 47CFR, Pt's 15.107, 15.109, 15.207 & 15.225
INTENTIONAL RADIATOR
& UNINTENTIONAL RADIATOR
CLASS B
SPECIFICATIONS**

TEST DATE(s): 17th September to 25th October 1999

TESTED BY:

R P I
PARRY

APPROVED BY:

S P HAYES

ISSUE DATE:

Distribution Copy No's:-

- 1 I. D. SYSTEMS LTD.
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- 3 TRL EMC Ltd

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Notes:-		
1. Component failure during test	YES [] NO [X]	
2. If Yes, details of failure:-		
3. All measurement uncertainty calculations detailed in this report are carried out in accordance with UKAS Publication NIS 81, Edition 1, May 1994, for a 95% confidence level.		
4. The contents of the attached applicant's declarations and other supplied information are not covered by the scope of this laboratory's UKAS or FCC accreditations and is provided in good faith.		

APPLICANT'S SUMMARY

EQUIPMENT UNDER TEST (EUT): oem-msr1

EQUIPMENT TYPE: IDENTITY DATA TAG TRANSCEIVER

SERIAL NUMBER OF EUT: ENGINEERING SAMPLE

PURPOSE OF TEST: FCC CERTIFICATION

TEST SPECIFICATION(s): FCC 47CFR Pt's 15.107, 15.109, 15.207 & 15.225

TEST RESULT: COMPLIANT YES NO

APPLICANT'S CATEGORY: (a) MANUFACTURER (b) IMPORTER (c) DISTRIBUTOR (d) AGENT

APPLICANT'S ORDER No(s): 2363 / 0399

APPLICANT'S CONTACT PERSON: Dr. ADAM RZADKIEWICZ

APPLICANT: I. D. SYSTEMS LTD.,

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EUT(s) COUNTRY OF ORIGIN: UNITED KINGDOM

TEST LABORATORY: TRL EMC LTD

UKAS ACCREDITATION No: 0728

TEST DATE(s): 17th September to 25th October 1999

TEST REPORT No: RL1038/4876

CERTIFICATE OF CONFORMITY & COMPLIANCE

FCC IDENTITY: OCTOEM-MSR1

PURPOSE OF TEST: FCC Certification

TEST SPECIFICATION: FCC 47CFR, Parts 15.107, 15.109, 15.207 & 15.225

TEST RESULT: Compliant to specification

EQUIPMENT UNDER TEST: oem-msr1

EQUIPMENT SERIAL No: Engineering sample

ITU EMISSION CODE: 13k3K1DAN or 13k3M1DAN

EQUIPMENT TYPE: Identity Data Tag Transceiver

UTILISATION: Identification and security

CARRIER EMISSION: +41.6dBV/m @ 30m

ANTENNA TYPE: Fixed, or Integral

ALTERNATIVE AE: None, as per Part 15.203

BAND OF OPERATION: 13.553MHz to 13.567MHz

CHANNEL SPACING: not applicable

No. of CHANNELS: 1 (one)

FREQUENCY CONVERSION: Superhet ; Direct ; Regenerative ;

INTERMEDIATE FREQUENCY: 1st = 455kHz ; 2nd ; 3rd ;

LOCAL OSCILLATOR: Higher ; Lower ; not applicable ;

FREQUENCY GENERATION: SAW Resonator ; Crystal ; Synthesizer ;

MODULATION METHOD: Amplitude ; Digital ; Angle ;

POWER SOURCE(s): +5Vdc

TEST DATE(s): 17th September to 25th October 1999

ORDER No(s): 2363 / 0399

APPLICANT: i. d. Systems Ltd.,
Rutherford House,
Pencroft Way,
Manchester Science Park,
Manchester,
M15. 6SZ.
United Kingdom.

TESTED BY: R P I PARRY

APPROVED BY: S P HAYES
EMC MANAGER

EQUIPMENT TEST CONDITIONS

1.

EQUIPMENT SERIAL / MODEL IDENTITY	CHANNEL NUMBER	Tx NOMINAL FREQUENCY MHz	Rx NOMINAL FREQUENCY MHz	TESTS REQUIRED	REMARKS
oem-msr1	1	13.5625	13.5625	Rx ac cond.	Pt. 15.107
				Rx radiated	Pt. 15.109
				Rx radiated	Pt. 15.209
				Tx ac cond.	Pt. 15.207
				Tx radiated	Pt. 15.209
				Tx carrier	Pt. 15.225
				Tx frequency	Pt. 15.225

2. Equipment category:

Single channel
 Two channel
 Multi-channel

3. Supply voltages:

Vnom = +5.0Vdc

Note:- Vnom voltages are as stated above unless otherwise shown on the test report page.

4. Temperatures:

(Ambient)	Tnom	=	[see test]
(Extreme)	Tmin	=	-20EC
(Extreme)	Tmax	=	+50EC

5. Transmitter maximum deviation or shift:

kHz = n/a

6. Transmitter maximum bit or pulse rate & level:

bps	=	26,500
Level	=	RS232

7. Receiver rated output & impedance:

dBW	=	RS232
Ohms	=	RS232

8. Channel spacing:

kHz	=	n/a
Narrowband	[X]	
Wholeband	[]	

TESTS REQUIRED

TRANSMITTER & RECEIVER TESTS

Receiver Spurious Emissions	- Powerline - Part 15.107	[X]
Receiver Spurious Emissions	- Radiated - Part 15.109 - >30MHz	[X]
Receiver Spurious Emissions	- Radiated - Part 15.209 - <30MHz	[X]
Transmitter Spurious Emissions - Powerline	- Part 15.207	[X]
Transmitter Spurious Emissions - Radiated	- Part 15.209.c - <30MHz	[X]
Transmitter Spurious Emissions - Radiated	- Part 15.209.c - >30MHz	[X]
Transmitter Carrier Emission	- Radiated - Part 15.225.a	[X]
Transmitter Carrier Frequency	- Radiated - Part 15.225.c	[X]

Notes:-

1. Equipment tested for (mains ac) 110V powerline emissions. [X]
2. Equipment tested as (fixed) integral antenna configuration. [X]
3. All tests were carried out with new batteries, as per Part 15.31.e. [n/a]
4. Equipment tested for radiated emissions as per Part 15.109. [X]
5. Equipment tested for radiated emissions as per Part 15.225.b {15.209.c}. [X]
6. Equipment tested for unintentional radiator digital device Class B. [X]

SAMPLE CALCULATIONS

Parts 15.107 & 15.207 - Powerline.

Frequency (MHz)	Rx (dBVF)	LISN Correction (dB)	Cable loss (dB)	Powerline (dBVF)
13.562	+34.2	+0.6	+0.1	+34.9

Parts 15.109, 15.209 & 15.225 - Radiated.

Frequency (MHz)	Rx (dBVF)	3m Correction (dB)	Ae AF & Cable loss (dB/m & dB)	Field Strength @ ?m (dBVF/m)
13.563	+66.7 *	-25.1	n/a	+41.6 @ 30m
27.125	+4.7 *	-20.0	n/a	-15.3 @ 30m
40.688	+18.2	n/a	+15.6	+33.8 @ 3m

* Reading using directly calibrated loop antenna in dBVF/m.

RECEIVER TESTS

RECEIVER SPURIOUS EMISSIONS - POWERLINE - PART 15.107

Ambient temperature	=	+19EC	Class A digital device	[]
Relative humidity	=	62%	Class B digital device	[X]
Conditions	=	Indoors		
Supply voltage	=	V _{nom}		
Channel number	=	1		

Frequency & Level 450kHz to 1705kHz	all emissions	\$-20dB below limit
Frequency & Level 1705kHz to 30MHz	13.565MHz	+16.7dB _F
Limits	450kHz to 1705kHz	+60.0 dB _F [] ; +48.0 dB _F [X]
	1705kHz to 30MHz	+69.5 dB _F [] ; +48.0 dB _F [X]
Measurement Uncertainty		±4.0dB

Notes:-

1. Receiver detector = CISPR, Quasi-Peak, 10kHz bandwidth.
2. Sample calculation, see page 6.
3. PSU used for test = Radio Shack 273 1662.

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. EUT located 0.4m from wall of shielded room, 0.8m from LISN. & above the ground plane.
3. EUT emissions evaluated for live and neutral lines at power terminals of the ac mains supply.
4. EUT emissions evaluated with an ac mains supply frequency of 50Hz.
5. EUT emissions evaluated with an ac mains supply voltage of 110V.
6. Worst case results recorded and reported.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRLUH03, TRLUH05, TRLUH21

RECEIVER TESTS

RECEIVER SPURIOUS EMISSIONS - RADIATED - PART 15.109 - >30MHz

Ambient temperature	=	+21EC (<1GHz), n/a (>1GHz)	Class A digital device	[]
Relative humidity	=	48% (<1GHz), n/a (>1GHz)	Class B digital device	[X]
Conditions	=	Open Area Test Site (OATS)	10m measurements <1GHz	[]
Supply voltage	=	Vnom	3m measurements <1GHz	[X]
Channel number	=	1	1m measurements >1GHz	[]

Frequency & Level 30MHz to 88MHz	nil emissions	\$ -20dB below limit
Frequency & Level 88MHz to 216MHz	nil emissions	\$ -20dB below limit
Frequency & Level 216MHz to 960MHz	nil emissions	\$ -20dB below limit
Frequency & Level 960MHz to (x) MHz	nil emissions	\$ -20dB below limit
Limits	30MHz to 88MHz	+39.0dBV/m @ 10m [] ; +40.0dBV/m @ 3m [X]
	88MHz to 216MHz	+43.5dBV/m @ 10m [] ; +43.5dBV/m @ 3m [X]
	216MHz to 960MHz	+46.4dBV/m @ 10m [] ; +46.0dBV/m @ 3m [X]
	960MHz to (x) MHz	+49.5dBV/m @ 10m [] ; +54.0dBV/m @ 3m [X]
Measurement Uncertainty		±4.1dB

Notes:-

1. Results quoted are extrapolated as indicated.
2. Emissions were searched to:- (x) 1000MHz inclusive, as per Part 15.33b.
3. Extrapolation factor @ 20dB/decade from 10m to 1m, as per Part 15.31f.
4. Extrapolation factor @ 10.5dB from 10m to 3m.
5. Extrapolation factor @ 9.5dB from 3m to 1m.
6. Measurements <1GHz @ 10m (Class A), or @ 3m (Class B), as per Part 15.109.
7. Measurements >1GHz @ 1m, as per Part 15.31f (1).
8. Receiver Detector <1GHz = CISPR, Quasi-Peak, 120kHz Bandwidth.
9. Receiver Detector >1GHz = Peak Hold, 1MHz Resolution Bandwidth.
10. Sample calculation, see page 6.

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. Measuring distances as Notes 1, 2 & 3 above.
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 in horizontal and vertical polarisations, with worst case results recorded.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL08, TRL317, TRL251, TRL203, TRLUH04, TRLUH06, TRLUH93

RECEIVER TESTS

RECEIVER SPURIOUS EMISSIONS - RADIATED - PART 15.209 - <30MHz

Ambient temperature	=	+20EC (<30MHz)	Class A digital device	[]
Relative humidity	=	80% (<30MHz)	Class B digital device	[X]
Conditions	=	Open Area Test Site (OATS)	300m extrapolated from 3m	[X]
Supply voltage	=	Vnom	30m extrapolated from 3m	[X]
Channel number	=	1	30m extrapolated from 10m	[]

Frequency & Level 9kHz to 490kHz	nil emissions	\$ -10dB below limit
Frequency & Level 490kHz to 1705kHz	0.75021MHz	-47.9dBV/m @ 30m
Frequency & Level 1705kHz to 30MHz	2.25068MHz 13.56250MHz 27.12500MHz	-45.9dBV/m @ 30m +1.9dBV/m @ 30m -15.3dBV/m @ 30m
Limits	9kHz to 490kHz	$20\log_{10}[2400/F(\text{kHz})]\text{dBV/m} @ 300m$
	490kHz to 1705kHz	$20\log_{10}[24000/F(\text{kHz})]\text{dBV/m} @ 30m$
	1705kHz to 30MHz	+29.5dBV/m @ 30m
Measurement Uncertainty		±4.2dB

Notes:-

1. Results quoted are extrapolated as indicated.
2. Emissions were searched from 9kHz to 30MHz inclusive, as per Part 15.109e.
3. Extrapolation factor @ 40dB/decade from 300m to 30m, as per Part 15.31f.
4. Extrapolation factor @ graph values from 30m to 3m, as per Annex D.
5. Measurements <490kHz @ 3m, as per Part 15.31f (2).
6. Measurements <1705kHz @ 3m, as per Part 15.31f (2).
7. Measurements <30MHz @ 3m, as per Part 15.31f (2).
8. Receiver detector <30MHz = CISPR, Quasi-Peak, 10kHz Bandwidth.
9. Nil emissions sensitivity of +36dBV/m @ 3m.
10. Sample calculation, see page 6.

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. Measuring distances as Notes 1 to 7 (inc) above.
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 in horizontal and vertical polarisations, with worst case results recorded.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL08, TRL07, TRL237

TRANSMITTER TESTS

TRANSMITTER SPURIOUS EMISSIONS - POWERLINE - PART 15.207

Ambient temperature = +19EC
Relative humidity = 62%
Conditions = Indoors
Supply voltage = Vnom
Channel number = 1

Frequency & Level 450kHz to 30MHz	13.565MHz other emissions	+34.9dBV \$-20dB below limit
Limit	450kHz to 30MHz	+48.0 dBV
Measurement Uncertainty		±4.0dB

Notes:-

1. Receiver detector = CISPR, Quasi-Peak, 10kHz bandwidth.
2. Sample calculation, see page 6.
3. PSU used for test = Radio Shack 273 1662.

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. EUT located 0.4m from wall of shielded room, 0.8m from LISN. & above the ground plane.
3. EUT emissions evaluated for live and neutral lines at power terminals of the ac mains supply
4. EUT emissions evaluated with an ac mains supply frequency of 50Hz.
5. EUT emissions evaluated with an ac mains supply voltage of 110V.
6. Worst case results recorded and reported.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRLUH03, TRLUH05, TRLUH21

TRANSMITTER TESTS

TRANSMITTER SPURIOUS EMISSIONS - RADIATED - PART 15.209.c - <30MHz

Ambient temperature	=	+20EC	3m measurements <30MHz	[]
Relative humidity	=	80%	300m extrapolated from 3m	[X]
Conditions	=	Open Area Test Site (OATS)	30m extrapolated from 3m	[X]
Supply voltage	=	Vnom	30m extrapolated from 10m	[]
Channel number	=	1		

Frequency & Level 9kHz to 490kHz	nil emissions	\$-10dB below limit
Frequency & Level 490kHz to 1705kHz	0.75021MHz 1.50301MHz	-36.9dBV/m @ 30m -39.8dBV/m @ 30m
Frequency & Level 1705kHz to 30MHz	2.25068MHz 27.12535MHz	-41.8dBV/m @ 30m -15.3dBV/m @ 30m
Limits	9kHz to 490kHz	20Log ₁₀ [2400/F(kHz)]dBV/m @ 300m
	490kHz to 1705kHz	20Log ₁₀ [24000/F(kHz)]dBV/m @ 30m
	1705kHz to 30MHz	+29.5dBV/m @ 30m
Measurement Uncertainty		±4.2dB

Notes:-

1. Results quoted are extrapolated as indicated.
2. Emissions were searched to:- (x) 1000MHz inclusive, as per Part 15.33a.
3. Extrapolation factor @ 40dB/decade from 300m to 30m, as per Part 15.31f.
4. Extrapolation factor @ graph values from 30m to 3m, as per Annex D.
5. Measurements <490kHz @ 3m, as per Part 15.31f (2).
6. Measurements <1705kHz @ 3m, as per Part 15.31f (2).
7. Measurements <30MHz @ 3m, as per Part 15.31f (2).
8. Receiver detector <30MHz = CISPR, Quasi-Peak, 10kHz bandwidth.
9. Nil emissions sensitivity of +36dBV/m @ 3m.
10. Sample calculation, see page 6.

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. Measuring distances as Notes 1 to 7 (inc) above.
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 in horizontal and vertical polarisations, with worst case results recorded.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL08, TRL07, TRL237

TRANSMITTER TESTS

TRANSMITTER SPURIOUS EMISSIONS - RADIATED - PART 15.209.c - >30MHz

Ambient temperature	=	+21EC (<1GHz), n/a (>1GHz)	3m measurements <1GHz	[X]
Relative humidity	=	48% (<1GHz), n/a (>1GHz)	1m measurements >1GHz	[]
Conditions	=	Open Area Test Site (OATS)	3m extrapolated from 1m	[]
Supply voltage	=	Vnom		
Channel number	=	1		

Frequency & Level 30MHz to 88MHz	40.6879MHz 54.2506MHz 67.8133MHz 81.3760MHz	+33.8dBV/m @ 3m +12.3dBV/m @ 3m +7.6dBV/m @ 3m +13.8dBV/m @ 3m	
Frequency & Level 88MHz to 216MHz	108.5012MHz 122.0639MHz 203.4397MHz	+31.2dBV/m @ 3m +31.3dBV/m @ 3m +28.7dBV/m @ 3m	
Frequency & Level 216MHz to 960MHz	nil emissions	\$ -20dB below limit	
Frequency & Level 960MHz to (x) MHz	nil emissions	\$ -20dB below limit	
Limits	30MHz to 88MHz 88MHz to 216MHz 216MHz to 960MHz 960MHz to (x) MHz	+40.0dBV/m @ 3m +43.5dBV/m @ 3m +46.0dBV/m @ 3m +54.0dBV/m @ 3m	
Measurement Uncertainty		±4.1dB	

Notes:-

1. Results quoted are extrapolated as indicated.
2. Emissions were searched to:- (x) 1000MHz inclusive, as per Part 15.33a.
3. Extrapolation factor @ 9.5dB from 1m to 3m, as per Part 15.31f.
4. Measurements >1GHz @ 1m, as per Part 15.31f (1).
5. Receiver detector <1GHz = CISPR, Quasi-Peak, 120kHz bandwidth.
6. Receiver detector >1GHz = Peak Hold, 1MHz resolution bandwidth.
7. Sample calculation, see page 6.

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. Measuring distances as Notes 1 to 4 above.
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 in horizontal and vertical polarisations, with worst case results recorded.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL08, TRL317, TRL251, TRL203, TRLUH04, TRLUH06, TRLUH93

TRANSMITTER TESTS

TRANSMITTER CARRIER EMISSION - RADIATED - PART 15.225.a

Ambient temperature	=	+20EC	3m measurements @ fc	[X]
Relative humidity	=	80%	10m measurements @ fc	[]
Conditions	=	Open Area Test Site (OATS)	30m measurements @ fc	[]
Supply voltage	=	V _{nom}	30m extrapolated from 3m	[]
Channel number	=	1	30m extrapolated from 10m	[]

Frequency & Level		13.56265MHz	+41.6dB _{BFV} /m @ 30m
Limit		13.553MHz to 13.567MHz	+80.0dB _{BFV} /m @ 30m
Measurement Uncertainty			±4.2dB

Notes:-

1. Results quoted are extrapolated as indicated.
2. Extrapolation factor @ 9.5dB from 10m to 30m, as per Part 15.31f.
3. Extrapolation factor @ graph values from 3m to 10m, or 30m, as per Annex D.
4. Receiver detector @ fc = CISPR, Quasi-Peak, 10kHz bandwidth.
5. Sample calculation, see page 6.

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. Measuring distances as Notes 1 to 7 (inc) above.
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 in horizontal and vertical polarisations, with worst case results recorded.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL08, TRL07, TRL237

TRANSMITTER TESTS

TRANSMITTER CARRIER FREQUENCY - RADIATED - PART 15.225.c

Ambient temperature = +20EC
 Relative humidity = 75%
 Conditions = Indoors
 Supply voltage = Vnom
 Channel number = 1
 Period after startup = 0mins

T _{nom} +20EC	V _{min} (-15%)	13.562640MHz	0.00103%	+150Hz
	V _{nom} (±00%)	13.562650MHz	0.00111%	+150Hz
	V _{max} (+15%)	13.562630MHz	0.00096%	+130Hz
T _{min}	V _{nom} (±00%)	13.562650MHz	0.00111%	+150Hz
T _{max}	V _{nom} (±00%)	13.563410MHz	0.00671%	+910Hz
Limit		13.5625MHz ±0.01% = ±1356Hz(nom)		
Measurement Uncertainty		±2.7 x 10 ⁻⁷ Hz [X] ; ±0.0002% ±200Hz []		

Notes:-

1. Equipment carrier frequency graph(s) @ Annex E [X].

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. EUT operated and tested with a new battery [n/a].
3. EUT operated and tested @ 0, 2, 5 & 10mins after startup.
4. RF Spectrum Analyser set to:-
 - Res BW = \$100Hz @ fc.
 - Video BW = as per Res BW.
 - Detector = Peak Hold.
 - Freq. Span = as appropriate.
 - Res/Span = as appropriate.
 - Scan Rate = Auto.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL11, TRL05, TRL164, TRL165, TRL166

Conclusion:-

1. Total maximum to minimum variation = 970Hz = 0.00715%.

TRANSMITTER TESTS

TRANSMITTER CARRIER FREQUENCY - RADIATED - PART 15.225.c

Ambient temperature = +20EC
 Relative humidity = 75%
 Conditions = Indoors
 Supply voltage = Vnom
 Channel number = 1
 Period after startup = 2mins

T _{nom} +20EC	V _{min} (-15%)	13.562650MHz	0.00111%	+150Hz
	V _{nom} (±00%)	13.562640MHz	0.00103%	+140Hz
	V _{max} (+15%)	13.562630MHz	0.00096%	+130Hz
T _{min}	V _{nom} (±00%)	13.562670MHz	0.00125%	+170Hz
T _{max}	V _{nom} (±00%)	13.563450MHz	0.00700%	+950Hz
Limit		13.5625MHz ±0.01% = ±1356Hz(nom)		
Measurement Uncertainty		±2.7 x 10 ⁻⁷ Hz [X] ; ±0.0002% ±200Hz []		

Notes:-

1. Equipment carrier frequency graph(s) @ Annex E [X].

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. EUT operated and tested with a new battery [n/a].
3. EUT operated and tested @ 0, 2, 5 & 10mins after startup.
4. RF Spectrum Analyser set to:-
 - Res BW = \$100Hz @ fc.
 - Video BW = as per Res BW.
 - Detector = Peak Hold.
 - Freq. Span = as appropriate.
 - Res/Span = as appropriate.
 - Scan Rate = Auto.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL11, TRL05, TRL164, TRL165, TRL166

Conclusion:-

1. Total maximum to minimum variation = 970Hz = 0.00715%.

TRANSMITTER TESTS

TRANSMITTER CARRIER FREQUENCY - RADIATED - PART 15.225.c

Ambient temperature = +20EC
 Relative humidity = 75%
 Conditions = Indoors
 Supply voltage = Vnom
 Channel number = 1
 Period after startup = 5mins

Tnom	Vmin (-15%)	13.562640MHz	0.00103%	+140Hz
+20EC	Vnom (±00%)	13.562650MHz	0.00111%	+150Hz
	Vmax (+15%)	13.562630MHz	0.00096%	+130Hz
Tmin	Vnom (±00%)	13.562690MHz	0.00140%	+190Hz
Tmax	Vnom (±00%)	13.563510MHz	0.00745%	+1010Hz
Limit		13.5625MHz ±0.01% = ±1356Hz(nom)		
Measurement Uncertainty		±2.7 x 10 ⁻⁷ Hz [X] ; ±0.0002% ±200Hz []		

Notes:-

1. Equipment carrier frequency graph(s) @ Annex E [X].

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. EUT operated and tested with a new battery [n/a].
3. EUT operated and tested @ 0, 2, 5 & 10mins after startup.
4. RF Spectrum Analyser set to:-
 - Res BW = \$100Hz @ fc.
 - Video BW = as per Res BW.
 - Detector = Peak Hold.
 - Freq. Span = as appropriate.
 - Res/Span = as appropriate.
 - Scan Rate = Auto.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL11, TRL05, TRL164, TRL165, TRL166

Conclusion:-

1. Total maximum to minimum variation = 970Hz = 0.00715%.

TRANSMITTER TESTS

TRANSMITTER CARRIER FREQUENCY - RADIATED - PART 15.225.c

Ambient temperature = +20EC
 Relative humidity = 75%
 Conditions = Indoors
 Supply voltage = Vnom
 Channel number = 1
 Period after startup = 10mins

T _{nom} +20EC	V _{min} (-15%)	13.562640MHz	0.00103%	+140Hz
	V _{nom} (±00%)	13.562640MHz	0.00103%	+140Hz
	V _{max} (+15%)	13.562630MHz	0.00096%	+130Hz
T _{min}	V _{nom} (±00%)	13.562760MHz	0.00192%	+260Hz
T _{max}	V _{nom} (±00%)	13.563600MHz	0.00811%	+1100Hz
Limit		13.5625MHz ±0.01% = ±1356Hz(nom)		
Measurement Uncertainty		±2.7 x 10 ⁻⁷ Hz [X] ; ±0.0002% ±200Hz []		

Notes:-

1. Equipment carrier frequency graph(s) @ Annex E [X].

Test Method:-

1. As per Radio - Noise Emissions, ANSI C63.4: 1992.
2. EUT operated and tested with a new battery [n/a].
3. EUT operated and tested @ 0, 2, 5 & 10mins after startup.
4. RF Spectrum Analyser set to:-
 - Res BW = \$100Hz @ fc.
 - Video BW = as per Res BW.
 - Detector = Peak Hold.
 - Freq. Span = as appropriate.
 - Res/Span = as appropriate.
 - Scan Rate = Auto.

Test Equipment Used:-

1. Full description at Annex B.
2. TRL190, TRL191, TRL11, TRL05, TRL164, TRL165, TRL166

Conclusion:-

1. Total maximum to minimum variation = 970Hz = 0.00715%.

ANNEX A

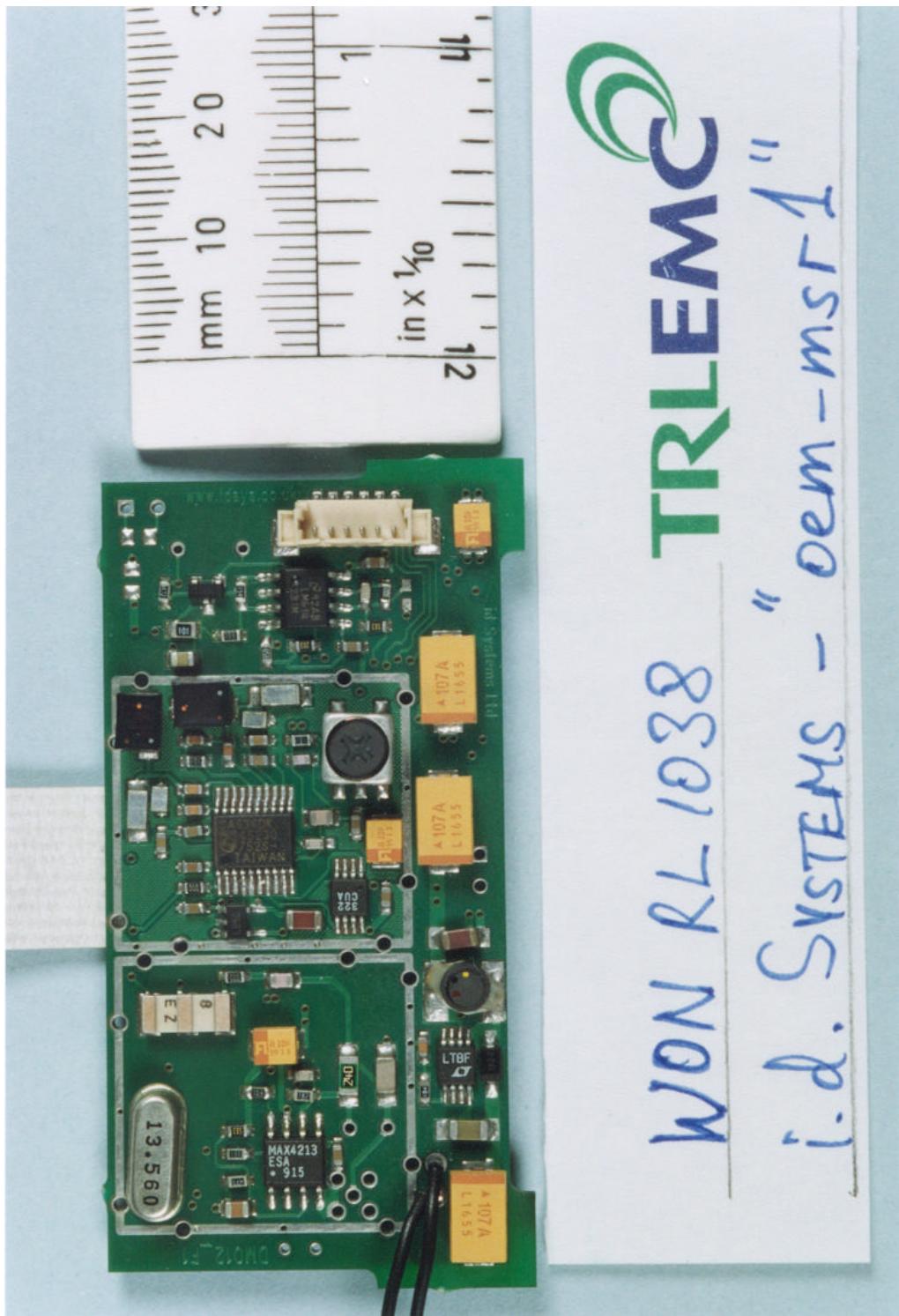
PHOTOGRAPHS OF THE EQUIPMENT: (taken on completion of all tests)



Photograph A-1
Title: Test site with Tx/Rx, radiated & conducted.

ANNEX A

PHOTOGRAPHS OF THE EQUIPMENT:
(taken on completion of all tests)

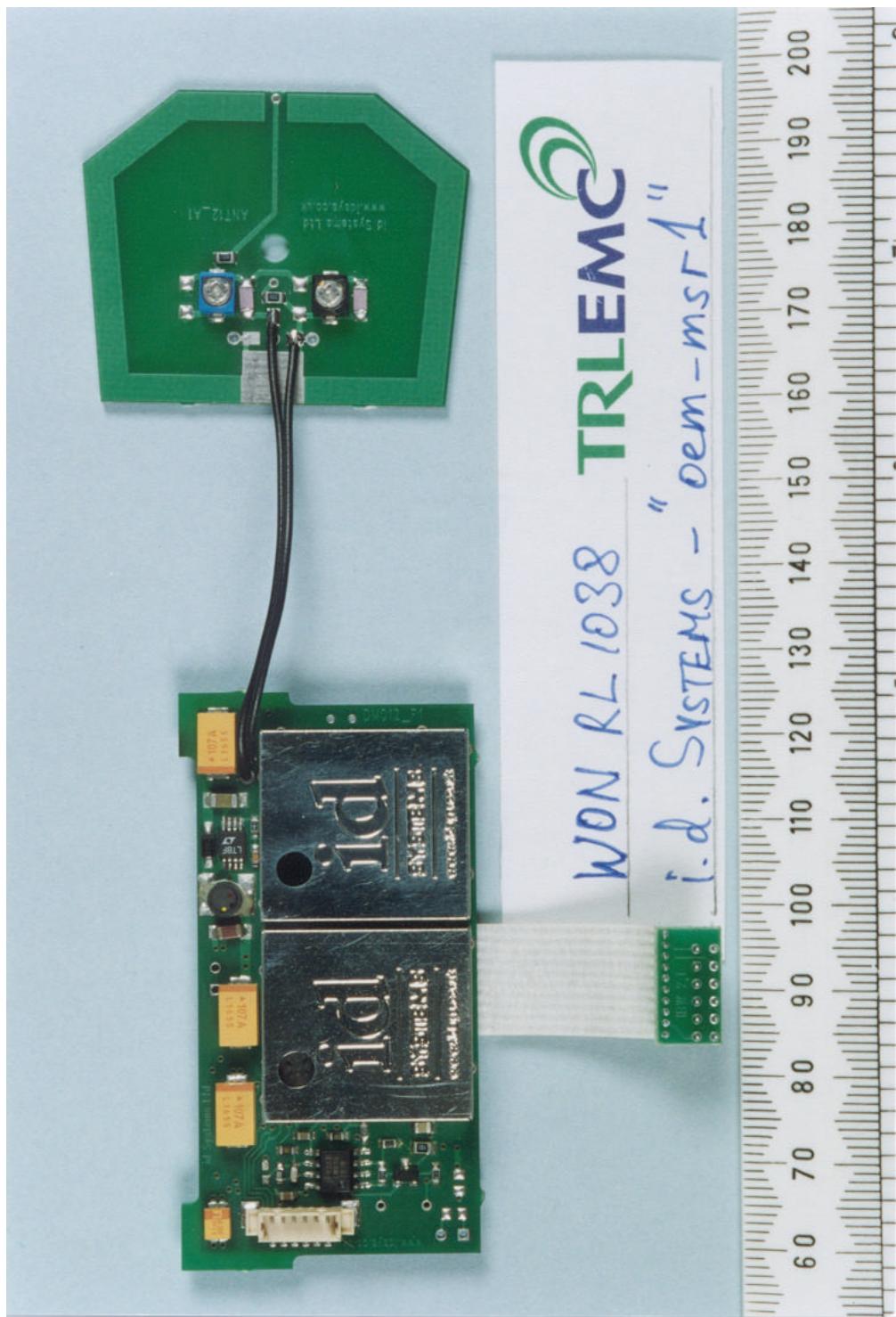


Photograph A2
Title: Tx/Rx, rf pcb, w/o shields.

ANNEX A

PHOTOGRAPHS OF THE EQUIPMENT:

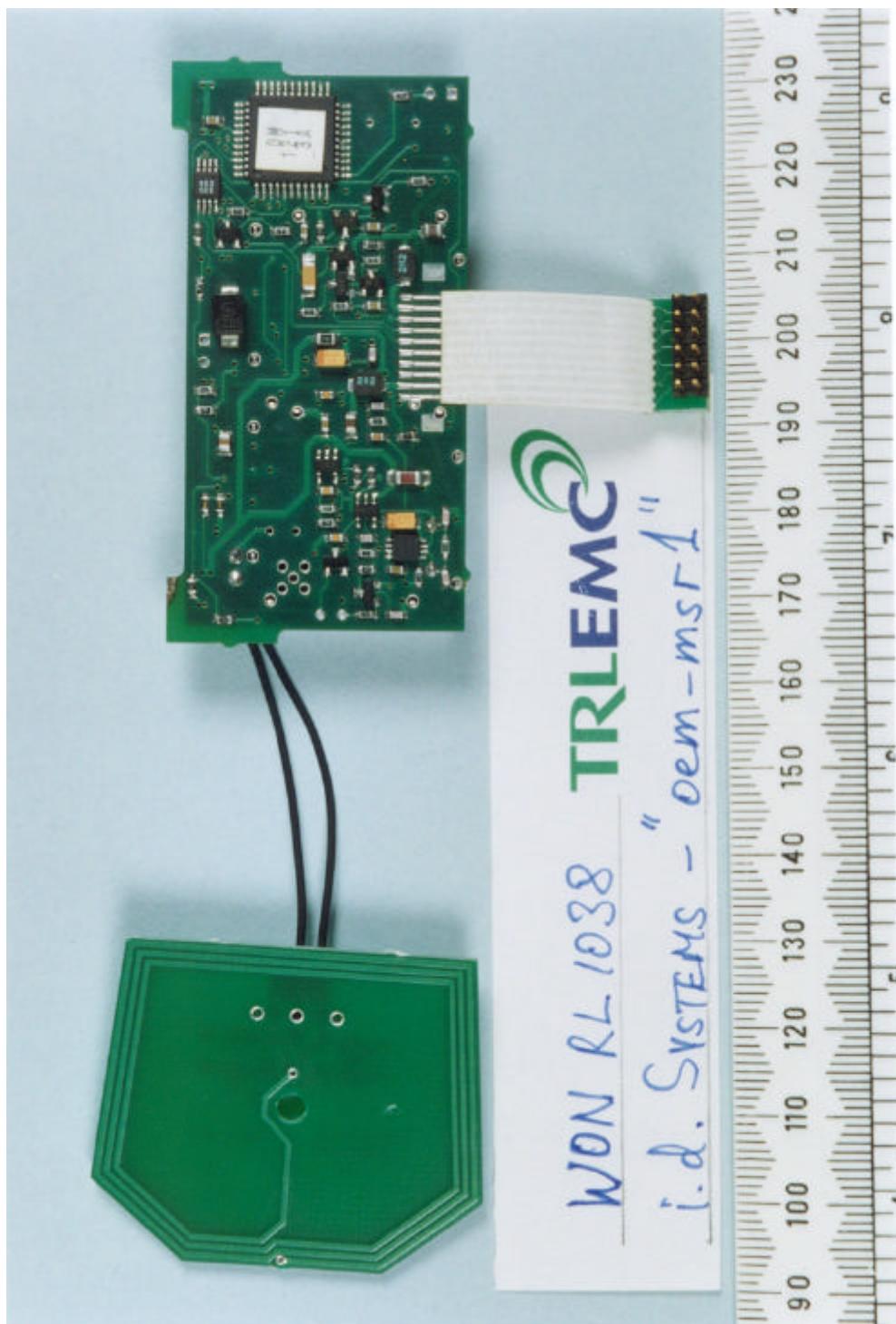
(taken on completion of all tests)



Photograph A3

ANNEX A

PHOTOGRAPHS OF THE EQUIPMENT: (taken on completion of all tests)



Photograph A4
Title: Tx/Rx, rf pcb, bottom, with Ae.

ANNEX B

TEST EQUIPMENT LIST

INSTRUMENT	SUPPLIER	TYPE No	SERIAL No	TRL EMC No
LF / HF RECEIVER, 9kHz - 30MHz	ROHDE&SCHWARZ	ESH2	879014 / 028	TRL 06
RF PULSE LIMITER	ROHDE&SCHWARZ	ESH3Z2	M494	TRL 06A
AE, LOOP, Z2, 9kHz - 30MHz	ROHDE&SCHWARZ	HFH2	881058 - 53	TRL 07
RANGE 1 (3 - 30m)	TRL	N/A	N/A	TRL 08
VARIAC, 230V, 10A	ZENITH	100R	V265537	TRL 12
dc PSU, VARIABLE, 30v, 10A, 300W	TOPWARD ELECTRONIC	23010	899672	TRL 15
RF SIGNAL GEN, 10kHz - 1000MHz	MARCONI	2022	119022 / 205	TRL 17
LISN, ac MAINS	CHASE	MN2050	1431	TRL 25
HF RECEIVER, 150kHz - 30MHz	CHASE	HFR2000	2158	TRL 26
LF RECEIVER, 9kHz - 150kHz	CHASE	LFR1000	1020	TRL 27
HF RECEIVER, 150kHz - 30MHz	CHASE	HFR2000	2187	TRL 28
AE, DIPOLE, 20MHz - 300MHz	CHASE	VHA9103	7106	TRL 35
AE, DIPOLE, 20MHz - 300MHz	CHASE	VHA9103	7011	TRL 36
AE, DIPOLE, 300MHz - 1GHz	CHASE	VHA9105	7107	TRL 37
AE, DIPOLE, 300MHz - 1GHz	CHASE	VHA9105	N/A	TRL 38
ATU, RECEIVER, 9kHz - 30MHz	SCHWARZBECK	FMZL1514	1514338	TRL 42
COAX LOAD, 2W, N, 50Ù, dc - 4GHz	BIRD	8360NM	N/A	TRL 113
COAX LOAD, 2W, N, 50Ù, dc - 4GHz	BIRD	8360NM	N/A	TRL 114
COAX LOAD, 2W, BNC, 50Ù, dc - 4GHz	BIRD	8360B	N/A	TRL 115
COAX LOAD, 2W, BNC, 50Ù, dc - 4GHz	BIRD	8360B	N/A	TRL 116
COAX LOAD, 1W, BNC, 50Ù, dc - 1GHz (min)	SUHNER	65BNC - 50 - 0 - 1	N/A	TRL 117

ANNEX B

TEST EQUIPMENT LIST

INSTRUMENT	SUPPLIER	TYPE No	SERIAL No	TRL EMC No
AE, DRG HORN, 1GHz - 18GHz	EMCO	3115	9010 - 3580	TRL 138
AE, DRG HORN, 1GHz - 18GHz	EMCO	3115	9010 - 3581	TRL 139
RF ANALYSER, 10kHz - 60GHz	TEKTRONIX	2756P	B010109	TRL 164
MULTIMETER (mc) 20kÙ / V (sens)	AVO	MODEL 8, MK.V.	0545248	TRL 169
RF SIGNAL GEN, LOW NOISE -90dBc, 10kHz - 5.4GHz	MARCONI	2042	119388 / 080	TRL 176
RANGE 2 (3 - 10m)	TRL	N/A	N/A	TRL 182
VARIAC, 230V, 10A	VARATRAN	Z710R	N/A	TRL 186
ANTENNA MAST	CHASE	HM9104	N/A	TRL 189
MULTIMETER (dig)	ISOTECH	IDM91	00606606	TRL 190
THERMOMETER & HYGROMETER	RS	212 - 146	N/A	TRL 191
AE, BICONIC, 20MHz - 300MHz	CHASE	BBA 9106	N/A	TRL 193
SCOPE, 20MHz, 2CH, DIG STORAGE	BECKMAN	9302	2090044	TRL 197
AE, LOG PERIODIC, 300MHz - 1GHz	CHASE	UPA6108	1061	TRL 203
ac PSU, VARIABLE, 300V, 5A, 1kVA, 45Hz - 440Hz	MAGNUS	MP500	1108	TRL 204
TRANSFORMER, ISOLATION, 240Vac	RS	209 - 099	N/A	TRL 205
TRANSFORMER, ISOLATION, 110Vac	RS	208 - 636	N/A	TRL 206
LISN, 3ph MAINS ac	SCHWARZBECK	NSKL8128	8128151	TRL 207
COAX LOAD, 5W, BNC, 50Ù, dc - 4GHz	BIRD	80BNCM	5866	TRL 223
dc PSU, VARIABLE, 15/30V, 2/1A, 30W	WIER	731	88829	TRL 224
VARIAC, 230V, 2A	REGULAC	RB3 - MT	N/A	TRL 225
VARIAC, 230V, 2A	REGULAC	RB3 - MT	N/A	TRL 226
THERMOMETER & HYGROMETER	RS	212 - 124	227	TRL 227
THERMOMETER & HYGROMETER	RS	212 - 124	228	TRL 228

ANNEX B

TEST EQUIPMENT LIST

INSTRUMENT	SUPPLIER	TYPE No	SERIAL No	TRL EMC No
THERMOMETER & HYGROMETER	RS	212 - 124	229	TRL 229
THERMOMETER & HYGROMETER	RS	212 - 124	230	TRL 230
THERMOMETER & HYGROMETER	RS	212 - 124	231	TRL 231
AE, LOG PERIODIC, 300MHz - 1GHz	EMCO	3146	N/A	TRL 233
dc PSU, VARIABLE, (2x) 32V, 3A, 100W	THURLBY THANDAR	PL330	046542	TRL 235
LF / HF RECEIVER, 9kHz - 30MHz	ROHDE&SCHWARZ	ESHS20	837960 / 003	TRL 237
LISN, ac MAINS	ROHDE&SCHWARZ	ESHS3 - Z5	839135 / 013	TRL 238
MULTIMETER, (dig)	ISOTECH	IDM97	32202147	TRL 239
THERMOMETER & BAROMETER	RS	216435	N/A	TRL 240
COAX CABLE, 50Ù, 18GHz, TNC, 1.25m	W L GORE	3390 / 265 / 1	8420202	TRL 249
COAX CABLE, 50Ù, 18GHz, TNC, 1.25m	W L GORE	3390 / 265 / 1	8420223	TRL 250
AE, BICONIC, 20MHz - 300MHz	CHASE	VBA6106A	1193	TRL 251
AE, EASY 1, 30MHz - 1GHz	FARNELL	S30280	017	TRL 253
RF SIGNAL GEN, LOW NOISE -90dBc, 10kHz - 5.4GHz	MARCONI	2042	119562 / 021	TRL 254
SCOPE, 400MHz, 4CH, DIG STORAGE	TEKTRONIX	TDS460A	B020781	TRL 258
RF SIGNAL GEN, 10kHz - 1GHz	MARCONI	2022D	119224 - 023	TRL 264
MULTIMETER, (dig)	ISOTECH	IDM97 RMS	32202307	TRL 273
AE, BILOG, 20MHz - 2GHz	CHASE	CBL6112	2098	TRL 274
COAX ADAPTOR, 18GHz, TNC / N	ROSENBERGER	05S106 - K0053	N/A	TRL 275
COAX ADAPTOR, 18GHz, TNC / N	ROSENBERGER	05S106 - K0053	N/A	TRL 276
COAX ADAPTOR, 18GHz, TNC / N	ROSENBERGER	05S106 - K0053	N/A	TRL 277
COAX ADAPTOR, 18GHz, TNC / N	ROSENBERGER	05S106 - K0053	N/A	TRL 278

ANNEX B

TEST EQUIPMENT LIST

INSTRUMENT	SUPPLIER	TYPE No	SERIAL No	TRL EMC No
COAX CABLE, 18GHz, N, 0.5M	ROSENBERGER	RTK161 - GP - Nm90 - 50cms	N/A	TRL 279
COAX CABLE, 18GHz, N, 3.0M	ROSENBERGER	RTK161 - GP - Nm90 - 300cms	N/A	TRL 280
COAX CABLE, 50Ù, 4GHz, N, 12m	TRL	WESTFLEX 103	N/A	TRL 286
COAX CABLE, 50Ù, 4GHz, N, 12m	TRL	WESTFLEX 103	N/A	TRL 287
LISN, ac MAINS	ROHDE&SCHWARZ	ESH3 - Z5	837469 / 010	TRL 289
AE, BILOG, 20MHz - 1GHz	CHASE	CBL6111B	1945	TRL 290
MULTIMETER (dig)	ISOTECH	IDM97 RMS	32202547	TRL 291
MULTIMETER (dig)	ISOTECH	IDM97 RMS	32202565	TRL 292
THERMOMETER & BAROMETER	RS	216435	N/A	TRL 293
COAX CABLE, 50Ù, 26.5GHz, SMA, 2m, c/w 3 ADAPTORS	GORE	145	MFR65474	TRL 308
V / UHF RECEIVER, 20MHz - 1GHz	ROHDE&SCHWARZ	ESVS10	837948 / 003	TRL 317
RF PULSE LIMITER	ROHDE&SCHWARZ	ESH3Z2	A400	TRL 318
RF SIGNAL GEN, 9kHz - 1.2GHz	MARCONI	2023	112224 / 036	TRL 320
AE, LOG PERIODIC, 300MHz - 1GHz	CHASE	UPA6108	1016	TRL 344
V / UHF RECEIVER, 20MHz - 1GHz	ROHDE&SCHWARZ	ESVS10	844594 / 0003	TRL 352
LF / HF RECEIVER, 9kHz - 30MHz	ROHDE&SCHWARZ	ESHS10	844077 / 019	TRL 353
COAX CABLE, 50Ù, 4GHz, N, 0.5m	TRL	NA	NA	TRL 358
COAX CABLE, 50Ù, 4GHz, N, 16m	TRL	NA	NA	TRL 359
COAX CABLE, 50Ù, 4GHz, N, 1m	TRL	NA	NA	TRL 360
THERMOMETER & HYGROMETER	RS	204 - 072	NA	TRL 363
THERMOMETER & HYGROMETER	RS	204 - 072	NA	TRL 364
THERMOMETER & HYGROMETER	RS	204 - 072	NA	TRL 365

ANNEX B

TEST EQUIPMENT LIST

INSTRUMENT	SUPPLIER	TYPE No	SERIAL No	TRL EMC No
THERMOMETER & HYGROMETER	RS	204 - 072	NA	TRL 366
V / UHF RECEIVER, 20MHz - 1GHz	ROHDE&SCHWARZ	ESVS20	838804 / 005	TRL 415
RF ANALYSER, 9kHz - 1GHz	WAYNE KERR	SSA1000A	9800001488	TRL 416
LF / HF RECEIVER, 9kHz - 30MHz	ROHDE&SCHWARZ	ESHS10	830051 / 001	TRLUH 03
V / UHF RECEIVER 20MHz - 1GHz	ROHDE&SCHWARZ	ESVS10	825892 / 003	TRLUH 04
LISN, ac MAINS	ROHDE&SCHWARZ	ESH3-Z5	863906 / 018	TRLUH 05
RANGE 1, 3m	TRL	N/A	N/A	TRLUH 06
RANGE 2, 10m	TRL	N/A	N/A	TRLUH 07
COAX CABLE, 50Ù, 1GHz, BNC, (x)m	TRL	N/A	N/A	TRLUH 21
AE, LOOP, Z2, 9kHz - 30MHz	ROHDE&SCHWARZ	HFH - Z2	892246 / 023	TRLUH 23
AE, BILOG, 20MHz - 2GHz	CHASE	CBL6112	2129	TRLUH 93
RF ANALYSER, dc - 26.5GHz	MARCONI	2380	152089 / 009	TRLUH 120
		2386	152076 / 044	

ANNEX C
APPLICANT'S SUBMISSION OF DOCUMENTATION LIST

a. FEDERAL COMMUNICATIONS COMMISSION	- APPLICATION	[X]
	- FEE	[X]
b. AGENT'S LETTER OF AUTHORISATION		[X]
c. MODEL(s) vs IDENTITY		[X]
d. ALTERNATIVE TRADE NAME DECLARATION(s)		[]
e. LABELLING	- PHOTOGRAPHS	[]
	- DECLARATION	[X]
	- DRAWINGS	[X]
f. TECHNICAL DESCRIPTION		[X]
g. BLOCK DIAGRAMS	- Tx	[X]
	- Rx	[X]
	- PSU	[]
	- AUX	[]
h. CIRCUIT DIAGRAMS	- Tx	[X]
	- Rx	[X]
	- PSU	[]
	- AUX	[]
i. COMPONENT LOCATION	- Tx	[X]
	- Rx	[X]
	- PSU	[]
	- AUX	[]
j. PCB TRACK LAYOUT	- Tx	[X]
	- Rx	[X]
	- PSU	[]
	- AUX	[]
k. BILL OF MATERIALS	- Tx	[X]
	- Rx	[X]
	- PSU	[]
	- AUX	[]
l. USER INSTALLATION / OPERATING INSTRUCTIONS		[X]

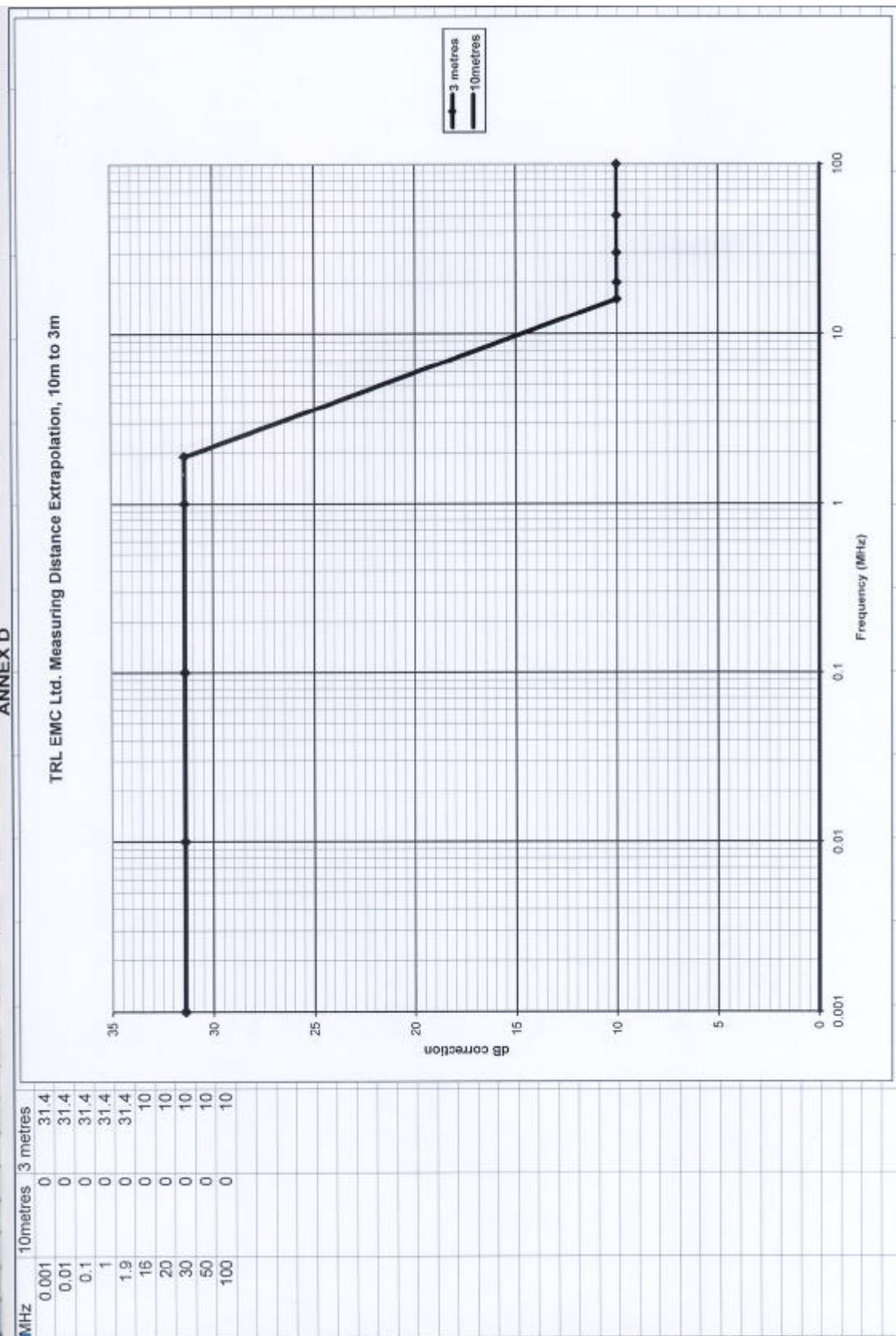
ANNEX D
MEASURING DISTANCE EXTRAPOLATION GRAPH(s)

Appended graphical page(s) follow(s)

- 1. 10m to 3m, 10kHz to 100MHz.**
- 2. 30m to 10m, 10kHz to 100MHz.**

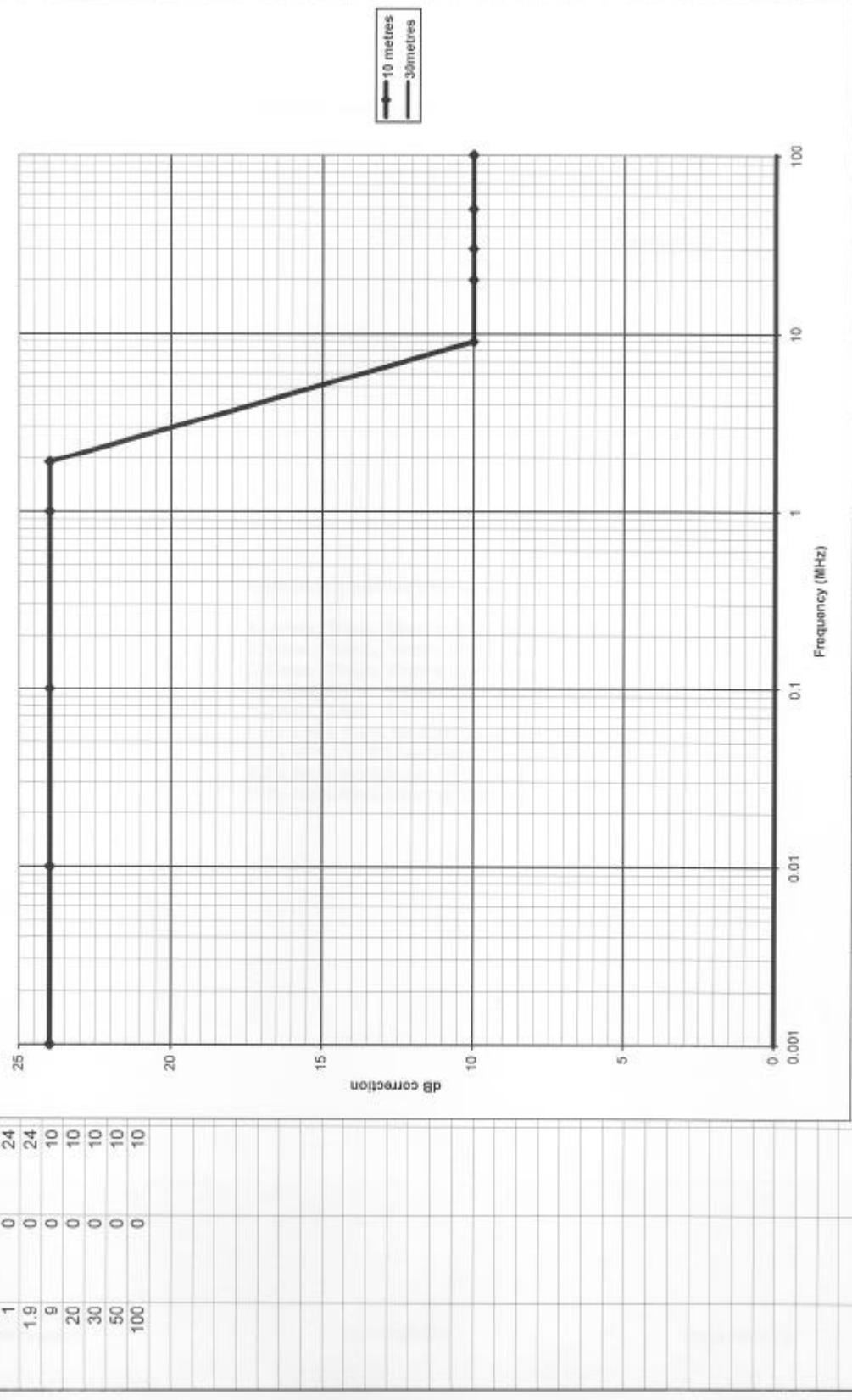
ANNEX D

TRL EMC Ltd. Measuring Distance Extrapolation, 10m to 3m



ANNEX D

TRL EMC Ltd. Measuring Distance Extrapolation, 30m to 10m



ANNEX E

TRANSMITTER CARRIER FREQUENCY GRAPH(s)

Appended graphical page(s) follow(s)

1. V_{nom}, T_{nom}, 10mins @ 200Hz/div.
2. V_{min}, T_{nom}, 10mins @ 200Hz/div.
3. V_{max}, T_{nom}, 10mins @ 200Hz/div.
4. V_{nom}, T_{min}, 10mins @ 200Hz/div.
5. V_{nom}, T_{max}, 10mins @ 200Hz/div.
6. Tx CW & 100% Modulation @ 500kHz/div.
7. Tx 10% & 100% Modulation @ 500kHz/div.
8. Tx 100% Modulation @ 10kHz/div.
9. Tx 100% Modulation @ 2kHz/div.

