TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test Of: BiStar Technology Limited
MR-100 Identification Reader

To: FCC Part 15 Subpart C: 1998
and FCC Part 90 Subpart M:1998.

Test Report Serial No:
RFI/EMCB1/RP40978A

This Test Report Is Issued Under The Authority Of Brian Watson Technical Director: 	**Checked By:** 
Tested By: 	**Release Version No: PDF01**
Issue Date: 26 July 2000	**Test Date: 16th July 2000 to 23rd July 2000**

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1. Client Information

Company Name:	BiStar Technology Limited.
Address:	Box5365 Halfway House Midrand 1685 South Africa
Contact Name:	Mr C Turner.

2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification Of Equipment Under Test (EUT)

Brand Name:	BiStar Technology Limited
Model Name or Number:	MR-100
Unique Type Identification:	None Stated by Client
Serial Number:	EB000027
Country of Manufacture:	Republic of South Africa
FCC ID Number:	Awaiting Certification from the FCC
Date of Receipt:	16th June 2000

2.2. Description Of EUT

The equipment under test is a Radio Frequency Identification Reader.

2.3. Modifications Incorporated In EUT

None stated by client.

2.4. Additional Information Related To Testing

Power Supply Requirement:	115 Volt 60 Hz AC Mains Supply.
Intended Operating Environment:	Indoors in a commercial or industrial environment.
Weight:	4.5 kg
Dimensions:	310 x 430 x 120mm
Interface Ports:	1 x RS232

2.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop Computer
Brand Name:	Packard Bell
Model Name or Number:	P210000801
Serial Number:	I600300050
FCC ID Number:	Verified
Cable Length And Type:	3m Screened
Connected to Port:	RS232

3. Test Specification, Methods And Procedures

3.1. Test Specification

Reference:	FCC Part 15.247: 1998 and FCC Part 90 Subpart M: 1998.
Title:	Code of Federal Regulations, Part 90 (47CFR90) Private Land Mobile Radio Services
Comments:	A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules.
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

3.2. Methods And Procedures

The methods and procedures used were as detailed in:

ANSI C63.2 (1987)
Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (1992)
Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1988)
Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)
Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1 (1993)
Title: Specification for radio disturbance and immunity measuring apparatus and methods. Part 1. Radio disturbance and immunity measuring apparatus.

3.3. Definition Of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the Methods & Procedures section above. Appendix 1 contains a list of the test equipment used.

4. Deviations From The Test Specification

None.

5. Operation Of The EUT During Testing

5.1. Operating Conditions

The EUT was tested in a normal laboratory environment.

During testing, the EUT was powered by a 115 Volt 60 Hz AC Mains Supply

5.2. Operating Modes

The EUT was tested in the following operating modes:

Transmit Mode.

For all Part 15 tests: The EUT was operated at low power with modulation active. Frequency hoping is selected and the EUT frequency increases from 904.2MHz to 916.8MHz in 400kHz steps every 380mS. When the upper frequency is reached the EUT's frequency decreases from 916.6MHz to 904.4MHz, again in 400kHz steps every 380mS. The cycle is then repeated. The test software operated via the support PC is set to activate the worst case modulation sideband rate.

For all Part 90 tests: The EUT was operated at high power with modulation active on bottom (902.2MHz), middle (915.0 MHz) and top (927.8 MHz) channels.

Receive Mode. The EUT was set to operate in an idle state.

The reason for choosing these modes was that they were defined by the client as being likely to be the worst case with regards EMC.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

The EUT was connected to a remote PC via an RS232 connector.

The reason for choosing this configuration was that it was defined by the client as being likely to be the worst case with regards EMC.

NB Section 2 of this report contains a full list of support equipment used and Appendix 3 contains a schematic diagram of the test configuration.

6. Summary Of Test Results

6.1. FCC Part 15.

6.1.1. Conducted AC Emissions

Range Of Measurements	Specification Reference	Compliancy Status
AC Powerline Conducted Emissions, 450 kHz to 30 MHz	Section 15.207 of C.F.R. 47: 1998	Complied

6.1.2. Conducted Antenna Port Emissions

Range Of Measurements	Specification Reference	Compliancy Status
Conducted Antenna Port Transmit Power	Section 15.247 (b) of C.F.R. 47: 1998	Complied
Conducted Antenna Port Spurious Emissions (30 to 10000 MHz)	Section 15.247 (c) of C.F.R. 47: 1998	Complied
Modulation Requirements	Section 15.247 (a) of C.F.R. 47: 1998	Complied

6.1.3. Radiated Emissions

Range Of Measurements	Specification Reference	Compliancy Status
Radiated Electric Field Strength Spurious Emissions (30 to 10000 MHz)	Section 15.247 (c) of C.F.R. 47: 1998 (Part 15.209)	Complied

6.2. FCC Part 90.

6.2.1. Conducted AC Emissions

Range Of Measurements	Specification Reference	Compliancy Status
AC Powerline Conducted Emissions, 450 kHz to 30 MHz	Section 15.207 of C.F.R. 47: 1998	Complied

6.2.2. Conducted Antenna Port Emissions

Range Of Measurements	Specification Reference	Compliancy Status
Conducted Antenna Port Transmit Power	Section 2.1046 of C.F.R. 47: 1998	Complied
Modulation Requirements	Section 2.1047 of C.F.R. 47: 1998	Complied
Occupied Bandwidth	Section 2.1049 of C.F.R. 47: 1998	Complied
Conducted Antenna Port Spurious Emissions (30 to 10000 MHz)	Section 2.1051 of C.F.R. 47: 1998	Complied

6.2.3. Radiated Emissions

Range Of Measurements	Specification Reference	Compliancy Status
Radiated Electric Field Strength Spurious Emissions (30 to 10000 MHz)	Section 2.1053 of C.F.R. 47: 1998 (Part 15.209)	Complied
Frequency Stability	Section 2.1055 of C.F.R. 47: 1998	Complied

6.3. Location Of Tests

All the measurements described in this report were performed at the premises of Radio Frequency Investigation Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, England.

7. Measurements, Examinations And Derived Results

7.1. General Comments

7.1.1. This section contains test results only. Details of the test methods and procedures can be found in Appendix 2 of this report.

7.1.2. The measurement uncertainties stated were calculated in accordance with the requirements of NAMAS Document NIS 81 with a confidence level of 95%. Please refer to Section 8 for details of measurement uncertainties.

FCC Part 15.247. Low Power Results.

7.2. Test Results For AC Mains Conducted Emissions.

7.2.1. Quasi-Peak Detector Measurements On Live And Neutral Lines

7.2.1.1. The following table indicates measured results with the EUT operated as specified in section 5.2 to FCC Part 15.247.

7.2.1.2. Plots of the initial scans can be found in Appendix 4.

7.2.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector:

Results:

Frequency (MHz)	Line	Q-P Level (dBmV)	Q-P Limit (dBmV)	Margin (dB)	Result
0.450	Live	30.9	48.0	17.1	Complied
0.450	Neutral	29.9	48.0	18.1	Complied
0.496	Live	25.3	48.0	22.7	Complied
0.496	Neutral	24.4	48.0	23.6	Complied
4.021	Neutral	35.3	48.0	12.7	Complied
4.024	Live	35.2	48.0	12.8	Complied
5.453	Neutral	36.3	48.0	11.7	Complied
5.457	Live	35.7	48.0	12.3	Complied
7.226	Neutral	35.2	48.0	12.8	Complied
7.230	Live	34.9	48.0	13.1	Complied
13.565	Neutral	30.7	48.0	17.3	Complied
13.572	Live	29.8	48.0	18.2	Complied

7.3. Tests for Conducted Transmitter Power.

7.3.1. Tests were performed to identify the maximum transmit power to FCC Part 15.247(b2).

7.3.2. The client has specified that the EUT employs frequency hopping with a minimum of 50 hopping channels. Therefore the maximum transmitter power level under Part 15 of the FCC rules is 1 Watt.

7.3.3. Measurements were performed to identify the channel, which exhibited the highest level of transmitted output. Graphical plots showing the maximum transmitter power can be seen in Appendix 4 (Plot 001) of this test report.

Frequency Range (MHz)	Maximum Transmitter Output Level (dBm)	Maximum Transmitter Output Level (Watts)	Limit (Watts)	Margin	Result
904.2 to 916.8	29.87	0.971	1.0	0.029	Complied

7.3.4. It could be determined from Plot 001 in Appendix 4 the number of hopping channels employed by the EUT was 64.

7.4. Tests for Antenna Port Spurious Emissions.

7.4.1. Spurious emissions tests on the antenna port were performed to Part 15.407(c).

7.4.2. The limit specified is that of at least 20dB below the level of the highest level of desired power in any 100kHz band.

7.4.3. Measurements were performed between 30 and 10000MHz. Initial scans indicated that all spurious emissions were of an amplitude at least 20dB below the reference limit line.

7.4.4. Plots of the initial scans can be found in Appendix 4.

7.5. Tests for Channel Seperation and Time Occupancy.

7.5.1. Tests were performed to identify the Channel Separation to FCC Part 15.247(a).

7.5.2. Section 15.247(a) specifies that frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. For systems operating between 902 and 928 MHz, if the 20dB bandwidth of the hopping channel is less than 250kHz then the system shall employ at least 50 hopping channels, with an average time of occupancy on each channel shall not exceed 0.4 seconds in any 20 second period.

7.5.3. Measurements were performed on a single channel to determine the 20dB bandwidth of the carrier. Tests showed a bandwidth of 41.1kHz.

7.5.4. A graphical plot included to show the bandwidth level and can be seen in Appendix 4 (Plot 007) of this test report.

7.5.5. The time occupancy of the system was tested on a single carrier. These tests showed a time occupancy of 380mS, and the interval between transmissions being repeated on a single carrier was 24.5 seconds.

7.6. Radiated Emissions: Receive Mode

7.6.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

7.6.1.1. The following table indicates measured results with the EUT operated in an idle mode as specified in section 5.2 to the limits specified in Part 15.109.

7.6.1.2. Plots of the initial scans can be found in Appendix 4.

7.6.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector at a test distance of 3m (results incorporate antenna factors and cable losses):

Frequency (MHz)	Ant. Pol.	Q-P Level (dBmV/m)	Limit (dBmV/m)	Margin (dB)	Result
124.446	Vert.	31.3	43.5	12.2	Complied
256.000	Vert.	33.1	46.0	12.9	Complied
373.341	Vert.	44.6	46.0	1.4	Complied
746.626	Vert.	43.4	46.0	2.6	Complied
909.398	Vert.	34.1	46.0	11.9	Complied

7.6.2. Electric Field Strength Measurements (Frequency Range: Above 1.0 GHz)

7.6.2.1. The following table indicates measured results with the EUT operated in an idle mode as specified in section 5.2 to the limits specified in Part 15.109.

7.6.2.2. Plots of the initial scans can be found in Appendix 4.

7.6.2.3. The following table lists frequencies at which emissions were measured using an Average and Peak detector at a test distance of 3m (results incorporate antenna factors and cable losses):

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
4.557770	Horiz.	14.9	24.0	1.6	40.5	54.0	13.5	Complied
4.557770	Vert.	14.9	24.0	1.6	40.5	54.0	13.5	Complied

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Average Margin (dB)	Result
4.557770	Horiz.	28.7	24.0	1.6	54.3	74.0	13.5	Complied
4.557770	Vert.	28.7	24.0	1.6	54.3	74.0	13.5	Complied

7.7. Radiated Emissions: Transmit Mode

7.7.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

7.7.1.1. The following table indicates measured results with the EUT operated in a transmit frequency hopping mode as specified in section 5.2 to the limits specified in Part 15.209.

7.7.1.2. Plots of the initial scans can be found in Appendix 4.

7.7.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector at a test distance of 3m (results incorporate antenna factors and cable losses):

Frequency (MHz)	Ant. Pol.	Q-P Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
124.927	Vert.	33.2	43.5	10.3	Complied
248.947	Vert.	25.9	46.0	20.1	Complied
746.693	Vert.	24.2	46.0	21.8	Complied
878.000	Vert.	39.3	46.0	6.7	Complied
883.999	Vert.	39.4	46.0	6.6	Complied
898.315	Vert.	35.0	46.0	11.0	Complied
901.816	Vert.	37.4	46.0	8.6	Complied
930.499	Vert.	39.6	46.0	6.4	Complied
939.999	Vert.	45.6	46.0	0.4	Complied
942.999	Vert.	39.8	46.0	6.2	Complied
948.397	Vert.	44.1	46.0	1.9	Complied

7.7.2. Electric Field Strength Measurements (Frequency Range: Above 1.0 GHz)

7.7.2.1. The following table indicates measured results with the EUT operated in a transmit frequency hopping mode as specified in section 5.2 to the limits specified in Part 15.209.

7.7.2.2. Plots of the initial scans can be found in Appendix 4.

7.7.2.3. The following table lists frequencies at which emissions were measured using an Average and Peak detector at a test distance of 3m (results incorporate antenna factors and cable losses):

Average Levels:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
1.362000	Horiz.	5.5	22.0	1.1	28.6	54.0	25.4	Complied
1.362000	Vert.	5.5	22.0	1.1	28.6	54.0	25.4	Complied
1.364000	Horiz.	5.5	22.0	1.1	28.6	54.0	25.4	Complied
1.364000	Vert.	5.5	22.0	1.1	28.6	54.0	25.4	Complied
1.410410	Horiz.	15.4	22.0	1.1	38.5	54.0	15.5	Complied
1.410410	Vert.	13.0	22.0	1.1	36.1	54.0	17.9	Complied
1.827196	Horiz.	27.0	22.1	1.2	50.3	54.0	3.7	Complied
1.827196	Vert.	26.0	22.1	1.2	49.3	54.0	4.7	Complied
2.749080	Horiz.	26.6	22.3	1.3	50.2	54.0	3.8	Complied
2.749080	Vert.	19.8	22.3	1.3	43.4	54.0	10.6	Complied
3.628270	Horiz.	10.2	23.0	1.4	34.6	54.0	17.4	Complied
3.628270	Vert.	11.8	23.0	1.4	36.2	54.0	17.8	Complied
4.569010	Horiz.	14.9	24.0	1.6	40.5	54.0	13.5	Complied
4.569010	Vert.	15.0	24.0	1.6	40.6	54.0	13.4	Complied
9.872000	Horiz.	7.5	30.1	2.4	40.0	54.0	14.0	Complied
9.872000	Vert.	7.5	30.1	2.4	40.0	54.0	14.0	Complied

Electric Field Strength Measurements (Frequency Range: Above 1.0 GHz) continued

Peak Levels:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
1.362000	Horiz.	15.3	22.0	1.1	38.4	74.0	35.6	Complied
1.362000	Vert.	15.3	22.0	1.1	38.4	74.0	35.6	Complied
1.364000	Horiz.	15.3	22.0	1.1	38.4	74.0	35.6	Complied
1.364000	Vert.	15.3	22.0	1.1	38.4	74.0	35.6	Complied
1.410410	Horiz.	46.4	22.0	1.1	69.5	74.0	4.5	Complied
1.410410	Vert.	33.7	22.0	1.1	56.8	74.0	17.2	Complied
1.827196	Horiz.	44.1	22.1	1.2	67.4	74.0	6.6	Complied
1.827196	Vert.	42.4	22.1	1.2	65.7	74.0	8.3	Complied
2.749080	Horiz.	46.2	22.3	1.3	69.8	74.0	4.2	Complied
2.749080	Vert.	41.7	22.3	1.3	65.3	74.0	8.7	Complied
3.628270	Horiz.	24.2	23.0	1.4	48.6	74.0	25.4	Complied
3.628270	Vert.	25.4	23.0	1.4	49.8	74.0	25.2	Complied
4.569010	Horiz.	28.7	24.0	1.6	54.3	74.0	19.7	Complied
4.569010	Vert.	28.6	24.0	1.6	54.2	74.0	19.8	Complied
9.872000	Horiz.	10.5	30.1	2.4	43.0	74.0	31.0	Complied
9.872000	Vert.	10.5	30.1	2.4	43.0	74.0	31.0	Complied

FCC Part 90 Subpart M. High Power Results.

7.8. Test Results For AC Mains Conducted Emissions

7.8.1. Quasi-Peak Detector Measurements On Live And Neutral Lines

7.8.1.1. The following table indicates measured results with the EUT operated as specified in section 5.2 to FCC Part 90 Subpart M.

7.8.1.2. Plots of the initial scans can be found in Appendix 4.

7.8.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector:

Results:

Frequency (MHz)	Line	Q-P Level (dBmV)	Q-P Limit (dBmV)	Margin (dB)	Result
0.450	Live	28.2	48.0	19.8	Complied
0.450	Neutral	27.5	48.0	20.5	Complied
0.478	Live	25.2	48.0	22.8	Complied
0.478	Neutral	25.3	48.0	22.7	Complied
4.019	Live	35.4	48.0	12.6	Complied
4.019	Neutral	34.5	48.0	13.5	Complied
4.428	Live	35.9	48.0	12.1	Complied
4.428	Neutral	35.2	48.0	12.8	Complied
5.721	Live	34.1	48.0	13.9	Complied
5.721	Neutral	35.5	48.0	12.5	Complied
6.811	Live	35.8	48.0	12.2	Complied
6.811	Neutral	35.2	48.0	12.8	Complied

7.9. Radiated Emissions

7.9.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

7.9.1.1. The following table indicates measured results with the EUT operated in a transmit mode as specified in section 5.2 to the limits specified in Part 90.359.

7.9.1.2. Part 90.39 specifies that the maximum field strength of spurious emissions from MTA-licensed equipment shall not exceed 47 dBμV/m at the MTA boundary. The client has specified that the EUT is not categorised as MTA type equipment, and therefore measurements stated below are for reference only.

7.9.1.3. Plots of the initial scans can be found in Appendix 4.

7.9.1.4. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector at a test distance of 3m (results incorporate antenna factors and cable losses):

Results: Bottom (902.2 MHz) Channel

Frequency (MHz)	Ant. Pol.	Q-P Level (dBmV/m)	Q-P Limit (dBmV/m)	Margin (dB)	Result
124.447	Vert.	35.7	N/A	N/A	N/A
248.895	Vert.	39.5	N/A	N/A	N/A
569.799	Vert.	26.9	N/A	N/A	N/A
742.215	Vert.	25.3	N/A	N/A	N/A
870.199	Vert.	30.5	N/A	N/A	N/A
885.800	Horiz.	38.8	N/A	N/A	N/A
898.197	Vert.	35.8	N/A	N/A	N/A
927.999	Vert.	45.1	N/A	N/A	N/A

Radiated Emissions (continued)

Results: Middle (915.0 MHz) Channel

Frequency (MHz)	Ant. Pol.	Q-P Level (dBmV/m)	Q-P Limit (dBmV/m)	Margin (dB)	Result
124.447	Vert.	35.7	N/A	N/A	N/A
248.895	Vert.	39.5	N/A	N/A	N/A
531.000	Vert.	34.2	N/A	N/A	N/A
773.998	Vert.	26.7	N/A	N/A	N/A
863.999	Vert.	47.3	N/A	N/A	N/A
883.000	Vert.	52.6	N/A	N/A	N/A
894.391	Vert.	36.5	N/A	N/A	N/A
949.293	Vert.	42.8	N/A	N/A	N/A
960.726	Vert.	29.5	N/A	N/A	N/A

Results: Top (927.8 MHz) Channel

Frequency (MHz)	Ant. Pol.	Q-P Level (dBmV/m)	Q-P Limit (dBmV/m)	Margin (dB)	Result
124.447	Vert.	35.7	N/A	N/A	N/A
248.895	Vert.	39.5	N/A	N/A	N/A
831.798	Vert.	45.2	N/A	N/A	N/A
863.998	Vert.	46.8	N/A	N/A	N/A
895.798	Vert.	57.0	N/A	N/A	N/A
959.799	Vert.	56.9	N/A	N/A	N/A

7.9.2. Electric Field Strength Measurements (Frequency Range: Above 1.0 GHz)

7.9.2.1. The following table indicates measured results with the EUT operated in a transmit mode as specified in section 5.2 to the limits specified in Part 90.359.

7.9.2.2. Part 90.39 specifies that the maximum field strength of spurious emissions from MTA-licensed equipment shall not exceed 47 dBμV/m at the MTA boundary. The client has specified that the EUT is not categorised as MTA type equipment, and therefore measurements stated below are for reference only.

7.9.2.3. Plots of the initial scans can be found in Appendix 4.

7.9.2.4. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector at a test distance of 3m (results incorporate antenna factors and cable losses):

Test Of: **BiStar Technology Limited**
MR-100 Identification Reader
To: **FCC Part 15 Subpart C: 1998 and FCC Part 90 Subpart M: 1998**

Average Levels – Bottom Channel

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
2.714967	Horiz.	40.6	22.3	1.3	64.2	N/A	N/A	N/A
2.714967	Vert.	37.7	22.3	1.3	61.3	N/A	N/A	N/A
3.619995	Horiz.	21.1	23.0	1.4	45.5	N/A	N/A	N/A
3.619995	Vert.	29.7	23.0	1.4	54.1	N/A	N/A	N/A
4.511004	Horiz.	23.9	24.0	1.6	49.5	N/A	N/A	N/A
4.511004	Vert.	16.2	24.0	1.6	41.8	N/A	N/A	N/A
5.413195	Horiz.	22.5	27.0	1.7	51.2	N/A	N/A	N/A
5.413195	Vert.	20.3	27.0	1.7	49.0	N/A	N/A	N/A
6.315380	Horiz.	20.9	27.2	1.9	50.0	N/A	N/A	N/A
6.315380	Vert.	9.0	27.2	1.9	38.1	N/A	N/A	N/A
7.217570	Horiz.	14.6	27.3	2.0	43.9	N/A	N/A	N/A
7.217570	Vert.	9.8	27.3	2.0	39.1	N/A	N/A	N/A
1.118019	Horiz.	4.1	22.1	1.2	27.4	N/A	N/A	N/A
1.118019	Vert.	4.1	22.1	1.2	27.4	N/A	N/A	N/A
1.349194	Horiz.	3.7	22.0	1.1	26.8	N/A	N/A	N/A
1.349194	Vert.	3.7	22.0	1.1	26.8	N/A	N/A	N/A
1.498192	Horiz.	3.7	22.0	1.1	26.8	N/A	N/A	N/A
1.498192	Vert.	3.7	22.0	1.1	26.8	N/A	N/A	N/A
1.787980	Horiz.	3.5	22.1	1.2	26.8	N/A	N/A	N/A
1.787980	Vert.	3.5	22.1	1.2	26.8	N/A	N/A	N/A
1.816660	Horiz.	3.5	22.1	1.2	26.8	N/A	N/A	N/A
1.816660	Vert.	3.5	22.1	1.2	26.8	N/A	N/A	N/A

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Peak Levels – Bottom Channel

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
2.714967	Horiz.	43.2	22.3	1.3	66.8	N/A	N/A	N/A
2.714967	Vert.	40.0	22.3	1.3	63.6	N/A	N/A	N/A
3.619995	Horiz.	30.6	23.0	1.4	55.0	N/A	N/A	N/A
3.619995	Vert.	35.4	23.0	1.4	59.8	N/A	N/A	N/A
4.511004	Horiz.	31.8	24.0	1.6	57.4	N/A	N/A	N/A
4.511004	Vert.	28.9	24.0	1.6	54.5	N/A	N/A	N/A
5.413195	Horiz.	26.2	27.0	1.7	54.9	N/A	N/A	N/A
5.413195	Vert.	24.0	27.0	1.7	52.7	N/A	N/A	N/A
6.315380	Horiz.	26.8	27.2	1.9	55.9	N/A	N/A	N/A
6.315380	Vert.	21.2	27.2	1.9	50.3	N/A	N/A	N/A
7.217570	Horiz.	23.5	27.3	2.0	52.8	N/A	N/A	N/A
7.217570	Vert.	22.1	27.3	2.0	51.4	N/A	N/A	N/A
1.118019	Horiz.	27.1	22.1	1.2	50.4	N/A	N/A	N/A
1.118019	Vert.	27.1	22.1	1.2	50.4	N/A	N/A	N/A
1.349194	Horiz.	25.6	22.0	1.1	48.7	N/A	N/A	N/A
1.349194	Vert.	25.6	22.0	1.1	48.7	N/A	N/A	N/A
1.498192	Horiz.	25.6	22.0	1.1	48.7	N/A	N/A	N/A
1.498192	Vert.	25.6	22.0	1.1	48.7	N/A	N/A	N/A
1.787980	Horiz.	25.4	22.1	1.2	48.7	N/A	N/A	N/A
1.787980	Vert.	25.4	22.1	1.2	48.7	N/A	N/A	N/A
1.816660	Horiz.	25.4	22.1	1.2	48.7	N/A	N/A	N/A
1.816660	Vert.	25.4	22.1	1.2	48.7	N/A	N/A	N/A

Average Levels – Middle Channel

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
2.745000	Horiz.	51.3	22.3	1.3	74.9	N/A	N/A	N/A
2.745000	Vert.	43.2	22.3	1.3	66.8	N/A	N/A	N/A
3.659990	Horiz.	30.4	23.0	1.4	54.8	N/A	N/A	N/A
3.659990	Vert.	31.5	23.0	1.4	55.9	N/A	N/A	N/A
4.574996	Horiz.	29.5	24.0	1.6	55.1	N/A	N/A	N/A
4.574996	Vert.	18.0	24.0	1.6	43.6	N/A	N/A	N/A
5.489999	Horiz.	20.9	27.0	1.7	49.6	N/A	N/A	N/A
5.489999	Vert.	18.6	27.0	1.7	47.3	N/A	N/A	N/A
6.404984	Horiz.	21.5	27.2	1.9	50.6	N/A	N/A	N/A
6.404984	Vert.	12.3	27.2	1.9	41.4	N/A	N/A	N/A
7.319982	Horiz.	14.8	27.3	2.0	44.1	N/A	N/A	N/A
1.319982	Vert.	8.7	27.3	2.0	38.0	N/A	N/A	N/A
1.406722	Horiz.	31.5	22.0	1.1	54.6	N/A	N/A	N/A
1.406722	Vert.	21.4	22.0	1.1	44.5	N/A	N/A	N/A
1.570720	Horiz.	2.9	22.0	1.1	26.0	N/A	N/A	N/A
1.570720	Vert.	2.9	22.0	1.1	26.0	N/A	N/A	N/A
1.829830	Horiz.	54.3	22.1	1.2	77.6	N/A	N/A	N/A
1.829830	Vert.	45.8	22.1	1.2	69.1	N/A	N/A	N/A
1.869626	Horiz.	29.3	22.1	1.2	52.6	N/A	N/A	N/A
1.869626	Vert.	24.1	22.1	1.2	47.4	N/A	N/A	N/A

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Peak Levels – Middle Channel

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
2.745000	Horiz.	52.0	22.3	1.3	75.6	N/A	N/A	N/A
2.745000	Vert.	44.5	22.3	1.3	68.1	N/A	N/A	N/A
3.659990	Horiz.	34.7	23.0	1.4	59.1	N/A	N/A	N/A
3.659990	Vert.	35.4	23.0	1.4	59.8	N/A	N/A	N/A
4.574996	Horiz.	34.9	24.0	1.6	60.5	N/A	N/A	N/A
4.574996	Vert.	30.1	24.0	1.6	55.7	N/A	N/A	N/A
5.489999	Horiz.	26.5	27.0	1.7	55.2	N/A	N/A	N/A
5.489999	Vert.	25.0	27.0	1.7	53.7	N/A	N/A	N/A
6.404984	Horiz.	27.4	27.2	1.9	56.5	N/A	N/A	N/A
6.404984	Vert.	24.2	27.2	1.9	53.3	N/A	N/A	N/A
7.319982	Horiz.	24.1	27.3	2.0	53.4	N/A	N/A	N/A
1.319982	Vert.	22.4	27.3	2.0	51.7	N/A	N/A	N/A
1.406722	Horiz.	42.7	22.0	1.1	65.8	N/A	N/A	N/A
1.406722	Vert.	33.7	22.0	1.1	56.8	N/A	N/A	N/A
1.570720	Horiz.	23.9	22.0	1.1	47.0	N/A	N/A	N/A
1.570720	Vert.	23.9	22.0	1.1	47.0	N/A	N/A	N/A
1.829830	Horiz.	55.0	22.1	1.2	78.3	N/A	N/A	N/A
1.829830	Vert.	47.1	22.1	1.2	70.4	N/A	N/A	N/A
1.869626	Horiz.	35.1	22.1	1.2	58.4	N/A	N/A	N/A
1.869626	Vert.	31.9	22.1	1.2	55.2	N/A	N/A	N/A

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Average Levels – Top Channel

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
2.78390	Horiz.	36.7	22.3	1.3	60.3	N/A	N/A	N/A
2.783390	Vert.	42.7	22.3	1.3	66.3	N/A	N/A	N/A
3.711190	Horiz.	50.1	23.0	1.4	74.5	N/A	N/A	N/A
3.711190	Vert.	41.5	23.0	1.4	65.9	N/A	N/A	N/A
4.638880	Horiz.	23.7	24.0	1.6	49.3	N/A	N/A	N/A
4.638880	Vert.	-5.7	24.0	1.6	19.9	N/A	N/A	N/A
5.566789	Horiz.	-10.9	27.0	1.7	17.8	N/A	N/A	N/A
5.566789	Vert.	17.5	27.0	1.7	46.2	N/A	N/A	N/A
6.494582	Horiz.	-9.5	27.2	1.9	19.6	N/A	N/A	N/A
6.494582	Vert.	10.2	27.2	1.9	39.3	N/A	N/A	N/A
1.855602	Horiz.	45.3	22.1	1.2	68.6	N/A	N/A	N/A
1.855602	Vert.	42.9	22.1	1.2	66.2	N/A	N/A	N/A
1.465500	Horiz.	2.9	22.0	1.1	26.0	N/A	N/A	N/A
1.465500	Vert.	2.9	22.0	1.1	26.0	N/A	N/A	N/A
1.218590	Horiz.	2.7	22.1	1.2	26.0	N/A	N/A	N/A
1.218590	Vert.	2.7	22.1	1.2	26.0	N/A	N/A	N/A
1.000500	Horiz.	3.0	22.0	1.0	26.0	N/A	N/A	N/A
1.000500	Vert.	3.0	22.0	1.0	26.0	N/A	N/A	N/A

Peak Levels – Top Channel

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
2.78390	Horiz.	41.0	22.3	1.3	64.6	N/A	N/A	N/A
2.783390	Vert.	44.0	22.3	1.3	67.6	N/A	N/A	N/A
3.711190	Horiz.	51.4	23.0	1.4	75.8	N/A	N/A	N/A
3.711190	Vert.	44.9	23.0	1.4	69.3	N/A	N/A	N/A
4.638880	Horiz.	31.7	24.0	1.6	57.3	N/A	N/A	N/A
4.638880	Vert.	33.3	24.0	1.6	58.9	N/A	N/A	N/A
5.566789	Horiz.	25.0	27.0	1.7	53.7	N/A	N/A	N/A
5.566789	Vert.	23.9	27.0	1.7	52.6	N/A	N/A	N/A
6.494582	Horiz.	27.3	27.2	1.9	56.4	N/A	N/A	N/A
6.494582	Vert.	33.6	27.2	1.9	62.7	N/A	N/A	N/A
1.855602	Horiz.	47.2	22.1	1.2	70.5	N/A	N/A	N/A
1.855602	Vert.	45.6	22.1	1.2	68.9	N/A	N/A	N/A
1.465500	Horiz.	23.9	22.0	1.1	47.0	N/A	N/A	N/A
1.465500	Vert.	23.9	22.0	1.1	47.0	N/A	N/A	N/A
1.218590	Horiz.	23.7	22.1	1.2	47.0	N/A	N/A	N/A
1.218590	Vert.	23.7	22.1	1.2	47.0	N/A	N/A	N/A
1.000500	Horiz.	24.0	22.0	1.0	47.0	N/A	N/A	N/A
1.000500	Vert.	24.0	22.0	1.0	47.0	N/A	N/A	N/A

7.10. Tests for Transmitter Power

7.10.1. Tests were performed to identify the maximum transmit power to FCC Part 90.205.

7.10.2. The client has specified that the EUT operates over a frequency range of 902.2 to 927.8MHz. The maximum output power generated by the device shall not exceed 30 watts ERP. Tests were performed by measuring the output level from the transmitters antenna port.

7.10.3. Measurements were performed on bottom, middle and top channels to indicate the level of transmitted output. Graphical plots showing the maximum transmitter power can be seen in Appendix 4 (Plots 101, 102 and 103) of this test report.

Frequency Range (MHz)	**Maximum Transmitter Output Level (dBm)**	**Maximum Transmitter Output Level (Watts)**
902.2	34.53	2.84
915.0	34.45	2.79
927.8	34.12	2.58

7.10.4. A substitution measurement was performed to determine the ERP level of the EUT for each of the 3 operating channels. The client has stated that the antenna gain of the device is 6dBi.

Frequency Range (MHz)	**Measured ERP Level (Watts)**	**ERP Limit (Watts)**
902.2	9.3	30.0
915.0	9.2	30.0
927.8	9.2	30.0

7.11. Tests for Occupied Bandwidth

7.11.1. Tests were performed to identify the occupied bandwidth of the transmitted signal for each of the 3 channels as specified by section 90.209.

7.11.2. Measurements were performed with the device transmitting both a modulated and an un-modulated signal. The bandwidth was measured at the lower at upper levels of the frequency limits, where the mean powers are equal to 0.5% of the total power.

7.11.3. Plots showing the bandwidth characteristics can be seen in Appendix 4.

Frequency (MHz)	Modulation Status	Occupied Bandwidth (kHz)
902.2	On	66.48896
902.2	Off	45.86670
915.0	On	62.93329
915.0	Off	46.57769
927.8	On	59.02222
927.8	Off	47.28886

7.12. Tests for Antenna Port Spurious Emissions.

7.12.1. Spurious emissions tests on the antenna port were performed to Part 90.210.

7.12.2. The EUT was tested in accordance with emission mask k(3), where the amplitude of any emission outside of the authorised bandwidth, must be attenuated below the power of the highest emission by 55+10log(P), (where P is the highest emission in watts).

7.12.3. From the measurements performed in section 7.10 of this test report, the level highest emission generated by the EUT is 2.84 watts. Therefore all spurious emissions must be attenuated by at least 59.5dB, which results in a limit of –25dBm.

7.12.4. Measurements were performed between 30 and 10000MHz. All Initial scans can be seen in Appendix 4.

7.12.5. Levels where the amplitude of the spurious emissions were within 15dB of the reference limit line are shown below:

Results: Bottom Channel

Frequency (MHz)	Spurious Emission Level (dBm)	Spurious Emission Limit (dBm)	Margin (dB)	Result
1804.4	-28.5	-25.0	3.5	Complied
2706.6	-33.1	-25.0	8.1	Complied
3608.8	-36.4	-25.0	11.4	Complied

Results: Middle Channel

Frequency (MHz)	Spurious Emission Level (dBm)	Spurious Emission Limit (dBm)	Margin (dB)	Result
1830.0	-28.2	-25.0	3.2	Complied
2745.0	-36.8	-25.0	11.8	Complied
3660.0	-32.9	-25.0	7.9	Complied

Results: Top Channel

Frequency (MHz)	Spurious Emission Level (dBm)	Spurious Emission Limit (dBm)	Margin (dB)	Result
1855.6	-29.8	-25.0	4.8	Complied
3711.2	-29.9	-25.0	4.9	Complied

7.13. Tests for Modulation Requirements.

7.13.1. It was not possible to provide data for modulation characteristics due to the nature of the device. However the client has provided the following information.

The modulation consists of a series of pulses, which are transmitted by the reader in response to the reception of RF ID tags. If the reader detects the presence of a tag, it transmits a single pulse (i.e. a drop in RF output called a gap) for a duration of two bit periods. The reader then listens to the tag which transmits for approximately 128 bit periods and if it reads the tag correctly it transmits a pair of pulses as an acknowledge signal. The pulse pair is a 2bit RF dip followed by a 2bit full power followed by a further 2 bit dip. If the reader were reading tags at the highest possible rate, this sequence would repeat itself at 26 ms intervals. In practice however this is unlikely. Also if there were only a few tags to be read, then the modulation would occur sporadically with perhaps 100 ms or more between modulation burst by the reader. For test purposes the device is supplied with test software that simulates the absolute maximum repeat rate, giving the worst case of modulation sidebands.

7.14. Test for Frequency Stability

7.14.1. The EUT was testing in accordance with section 90.213 to demonstrate compliance with the frequency stability requirements.

7.14.2. The ambient temperature was originally recorded at 18°C and results were recorded for the fundamental frequency of the top channel. The temperature was then set from -30°C to +50°C in 10°C steps and the test repeated.

7.14.3. The limit specified in section 90.213 for a fixed station operating between 902 and 928 MHz is 2.5ppm.

Results: Top Channel

Lower Limit: 927.8023195 MHz
Upper Limit: 927.7976805 MHz

Temperature (°C)	Tx Frequency (MHz)
-30	927.8016
-20	927.7995
-10	927.8015
0	927.8018
10	927.8013
18 (Ambient)	927.8006
20	927.8006
30	927.7995
40	927.7994
50	927.8008

8. Measurement Uncertainty

8.1. Company Policy, as based on the NAMAS Accreditation Standard, M10, paragraph 12.11 (o), states that Test Reports shall include estimated uncertainty of the calibration or test result (this information need only appear in test reports and test certificates where it is relevant to the validity or application of the test result, where a client's instructions so require or where uncertainty affects compliance to a specification or limit).

8.2. The global uncertainties have been calculated in accordance with NAMAS NIS 81 (Edition 1, May 1994) as follows:

Measurement Type	Range	Confidence Level	Calculated Uncertainty
Conducted Emissions	0.15 MHz to 30 MHz	95%	+/- 2.2 dB
Radiated Emissions	30 MHz to 1000 MHz	95%	+/- 4.9 dB
Radiated Emissions	1000 MHz to 10000 MHz	95%	+/- 4.3 dB
Conducted Antenna Port Emissions, Transient Behaviour, Modulation Requirements	30 MHz to 10000 MHz	95%	+/- 2.9 dB
Frequency Stability	N/A	95%	+/- 20 Hz

8.3. Measurement uncertainties have been applied in accordance with NAMAS document NIS 81 (edition 1, May 1994), and in the absence of any specification criteria, guidance, or code of practice, compliance has been judged on the basis of shared risk.

8.4. In the case of emissions tests, the measured value of the disturbance from the product sample shall be compared directly with the limits. If the measured value is equal to or less than the limit the product is deemed to pass the test.

8.5. In the case of immunity tests, the equipment is deemed to pass the test if it fulfils the stated performance criteria at the required or a higher severity level. The measurement uncertainty has been taken into account in the calibration procedures stated in the relevant basic standard.

8.6. The methods used to calculate the above uncertainties are in line with those used for calibration laboratories contained in NAMAS document NIS 3003 Edition 8 “The Expression of Uncertainty and Confidence in Measurement” May 1995, which align with international recommendations “Guide to the Expression of Uncertainty in Measurement” ISO/IEC/OIML/BIPM (Prepared by ISO/TAG 4: January 1993).

Appendix 1. Test Equipment Used

Instrument	Manufacturer	Model	RFI No.
Test Receiver	R & S	ESBI	M090
Test Receiver	R & S	ESMI	M069
Spectrum Analyser	R & S	FSEB	M127
Plotter	H.P.	7440A	P001
Pulse Limiter	R & S	ESH3-Z2	A559
L.I.S.N. (1 ph.)	R & S	ESH3-Z5	A1069
Cable	Rosenberger	UFA210A-1-1182-704704	C1020
Cable	Rosenberger	UFA210A-1-1182-704704	C322
Cable	Rosenberger	UFA210A-1-1182-704704	C344
3dB Attenuator	Narda	779	A1138
10dB Attenuator	Narda	769-10	A217
10dB Attenuator	Narda	765-10	A235
10dB Attenuator	Schaffner	3810-17-B	A241
20dB attenuator	Narda	769-20	A075
6dB Attenuator	Schner	6806.17.B	A395
30dB Attenuator	Narda	768-30	A304
Insertion Probe	R & S	URY-Z4	M098
Test Load	Flann	374BNF	A410
Power Meter	R & S	URY	M094
Dipole Set	EMCO	3121C	A072
Signal Generator	R & S	SMY 02	G040
Bilog Antenna	Chase	CBL6111B	A1037
1 to 2 GHz Horn	Eaton	91888-2	A028
2 to 4 GHz Horn	Eaton	91889-2	A031
4 to 6 GHz Horn	Flann	12240-20	A253
6 to 8 GHz Horn	Flann	14240-20	A254
8 to 12.5 GHz Horn	Flann	16240-20	A255
Environmental Test Chamber	Design Environmental	BT190-70C	E003

NB In accordance with NAMAS requirements, all the measurement equipment is on a calibration schedule.

Appendix 2. Measurement Methods

A2.1. AC Mains Conducted Emissions: FCC Part 15

A2.1.1. AC mains conducted emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

A2.1.2. The test was performed in a shielded enclosure with the equipment arranged as detailed in the standard on a wooden bench using the floor of the screened enclosure as the ground reference plane and with the EUT powered via a 60 Hz AC mains supply.

A2.1.3. Initial measurements in the form of swept scans covering the entire measurement band were performed in order to identify frequencies on which the EUT was generating interference. In order to minimise the time taken for these swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidths (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

A2.1.4. Following the initial scans, a graph was produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested (at individual frequencies) using the appropriate detector function.

A2.1.5. The test equipment settings for conducted emissions measurements were as follows:

Receiver Function	**Initial Scan**	**Final Measurements**
Detector Type:	Peak	Quasi-Peak (CISPR)*
Mode:	Max Hold	Not applicable
Bandwidth:	10 kHz	9 kHz
Amplitude Range:	60 dB	20 dB
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

* In some instances an Average detector function may also have been used.

A2.2. Radiated Field Strength Emissions

A2.2.1. Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

A2.2.2. Initial measurements covering the entire measurement band in the form of swept scans in a shielded enclosure (for frequencies below 2 GHz) or on an open area test site (for frequencies above 2 GHz) were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

A2.2.3. The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. Where (at higher frequencies) the noise floor was found to be of a higher level, a test distance of 1m was used. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested on the open area test site, at the appropriate distance, using a measuring receivers with a Quasi-Peak detector (below 1000 MHz), where applicable, for measurements above 1000 MHz average and peak detectors were used.

A2.2.4. For the main (final) measurements the EUT was arranged on a non-conducting table on an open area test site, as detailed in the specification.

A2.2.5. All measurements on the open area test site were performed using broadband antennas.

A2.2.6. On the open area test site, at each frequency where a signal was found, the levels were maximised by initially rotating the turntable through 360°. In addition, for frequencies below 1000 MHz, the antenna height was varied between 1 and 4 m. For frequencies above 1000 MHz, the antenna was fixed at a height of 1.5m. At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

A2.2.7. The test equipment settings for radiated emissions measurements were as follows:

Receiver Function	**Initial Scan Below 1GHz**	**Final Measurements Below 1GHz**
Detector Type:	Peak	Quasi-Peak (CISPR)
Mode:	Max Hold	Not applicable
Bandwidth:	120 kHz	120 kHz
Amplitude Range:	60 dB	20 dB
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

Receiver Function	**Initial Scan Above 1GHz**	**Final Measurements Above 1 GHz**
Detector Type:	Peak	Peak/Average
Mode:	Max Hold	Not applicable
Bandwidth:	1 MHz	1 MHz
Amplitude Range:	60 dB	20 dB (typical)
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

A2.3. Conducted Antenna Port Emissions: FCC Part 15 and 90

A2.3.1. Conducted Antenna Port Emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

A2.3.2. Prior to testing being performed a suitable RF attenuator and cable were calibrated for the required frequency range. For each measurement range performed, the calibrated level of the attenuator and cable were entered as an offset into the spectrum analyser to compensate for the measurement setup.

A2.3.3. Initial measurements covering the entire measurement band in the form of swept scans were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which measurements were performed. In order to minimise the time taken for the swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

A2.4. Frequency Stability: FCC Part 90

A2.4.1. Frequency stability tests were performed to the limits specified in Part 90.213.

A2.4.2. The EUT was placed in an environmental chamber, which was capable of producing an ambient temperature of between –30 and +50°C. The EUT was positioned on a table within the chamber and a remote measurement antenna positioned in close proximity connected to a suitable measuring receiver.

A2.4.3. The EUT was set to operate on the top channel only and the power to the EUT was connected to obtain a frequency measurement whilst the EUT was at ambient temperature. The power to the EUT was then disconnected.

A2.4.4. The environmental chamber was set to -30°C and allowed to stabilise for a minimum of 30 minutes. After this time power was applied to the EUT and the frequency generated was recorded. The power to the EUT was then disconnected.

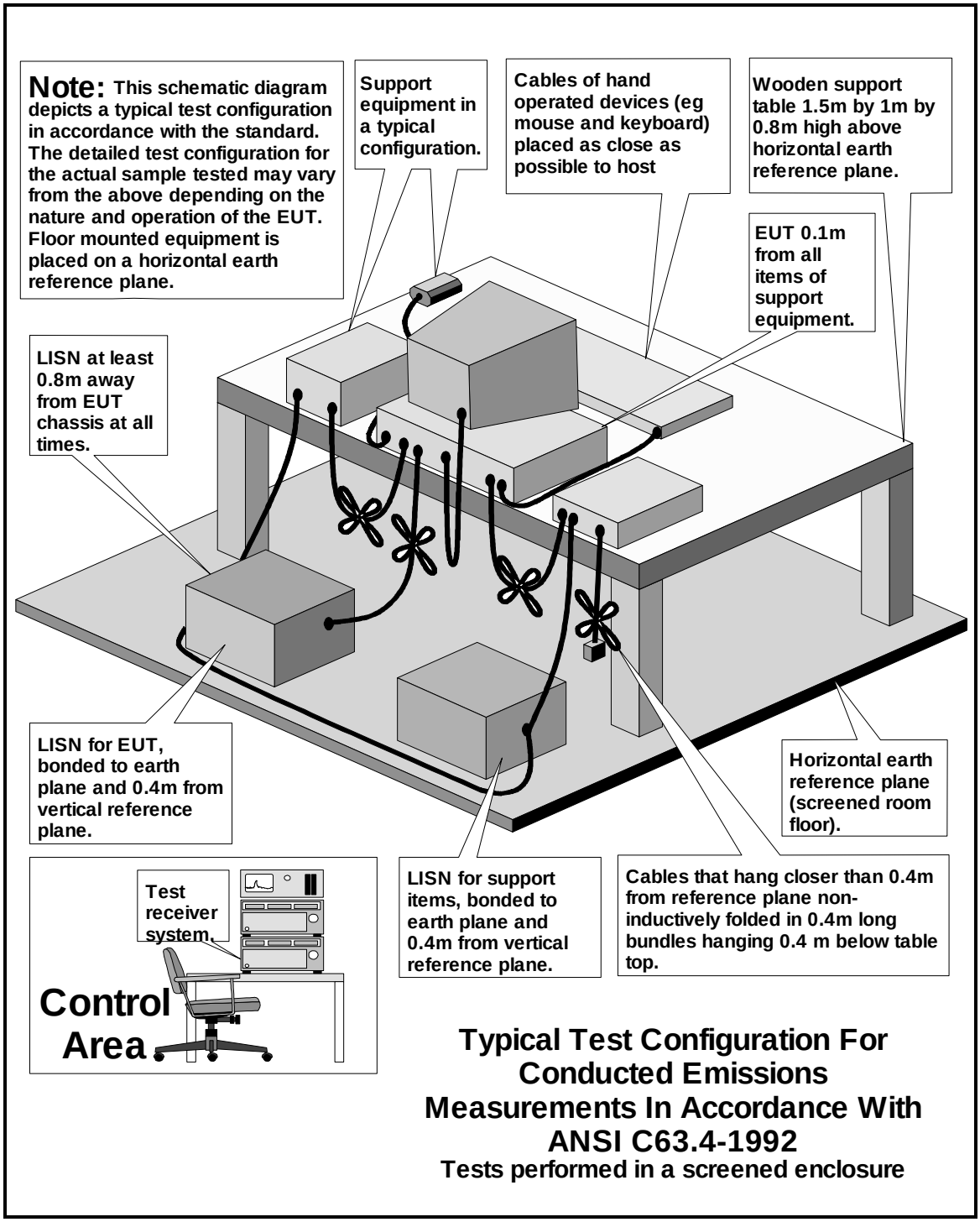
A.2.4.5. The chamber was then changed to -20°C, and A2.3.4. was repeated for 10°C frequency steps until +50°C was reached.

Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\40978ETF01\EMICON	Test configuration for measurement of conducted emissions
DRG\40978ETF01\EMIRAD	Test configuration for measurement of radiated emissions
DRG\40978ETF01\001	Conducted Antenna Port Test Set-Up

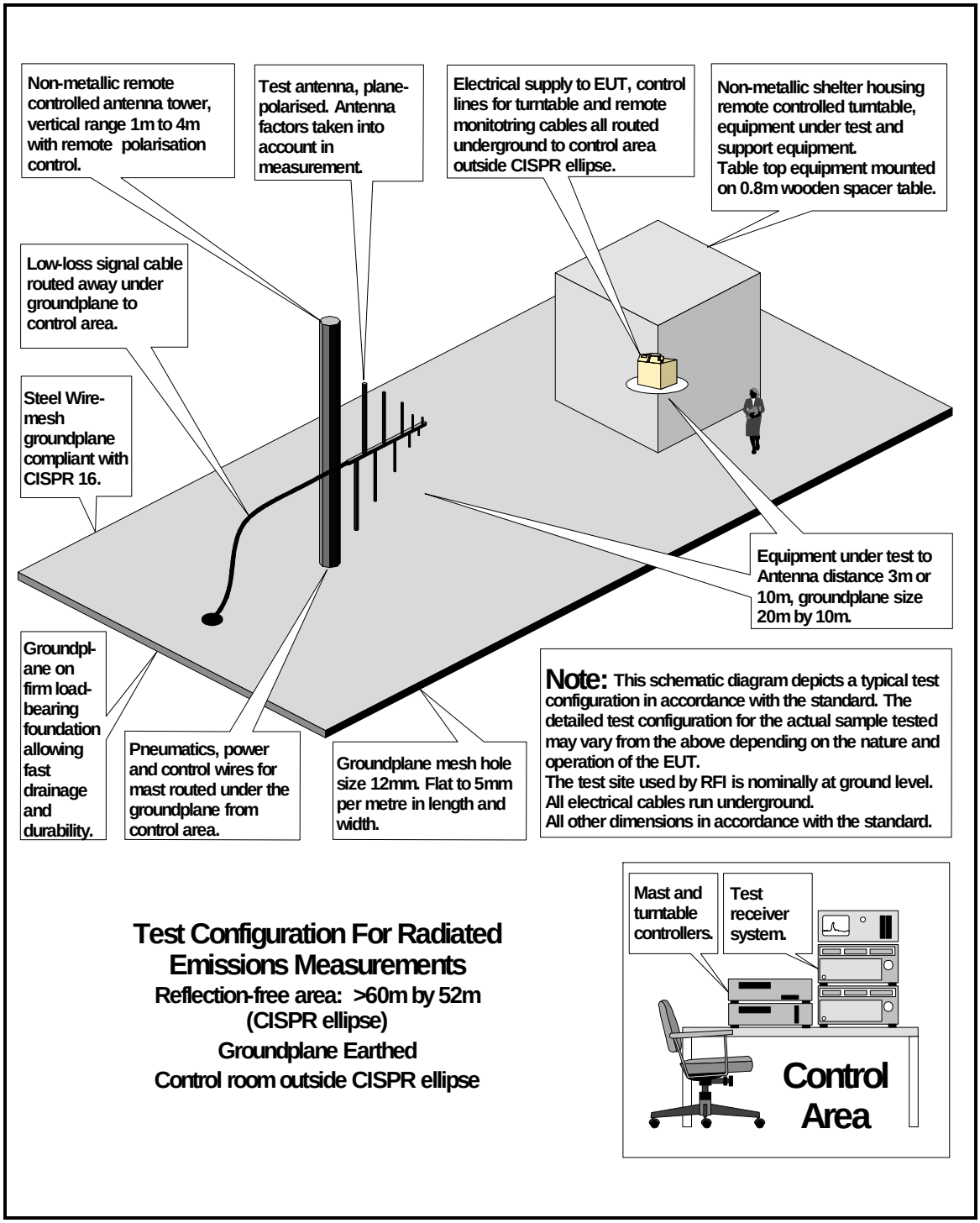
DRG\40978ETF01\EMICON



Typical Test Configuration For Conducted Emissions Measurements In Accordance With ANSI C63.4-1992
Tests performed in a screened enclosure

Test Of: **BiStar Technology Limited**
MR-100 Identification Reader
To: **FCC Part 15 Subpart C: 1998 and FCC Part 90 Subpart M: 1998**

DRG\40978ETF01\EMIRAD



Test Configuration For Radiated Emissions Measurements

Reflection-free area: >60m by 52m (CISPR ellipse)

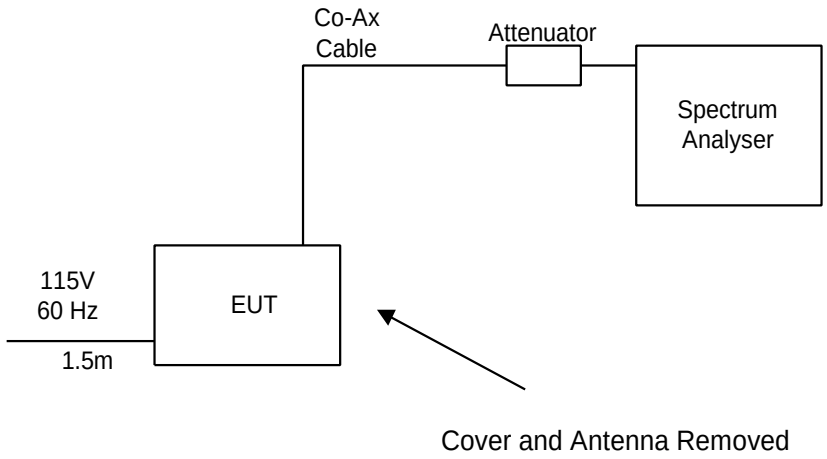
Groundplane Earthed

Control room outside CISPR ellipse

Test Of: **BiStar Technology Limited**
MR-100 Identification Reader
To: **FCC Part 15 Subpart C: 1998 and FCC Part 90 Subpart M: 1998**

DRG\40978ETF01\001

Conducted Antenna Port Test Set-Up



Appendix 4. Graphical Test Results

This appendix contains the following graphs:

Part 15.247

Graph Reference Number	Title
GPH\40978ETF01\001	Antenna Port. 904 to 917MHz. Transmit Power.
GPH\40978ETF01\002	Antenna Port. 30 to 904MHz. Spurious Emissions.
GPH\40978ETF01\003	Antenna Port. 900 to 904MHz. Spurious Emissions.
GPH\40978ETF01\004	Antenna Port. 917 to 920MHz. Spurious Emissions.
GPH\40978ETF01\005	Antenna Port. 917 to 1000MHz. Spurious Emissions.
GPH\40978ETF01\006	Antenna Port. 1000 to 5000MHz. Spurious Emissions.
GPH\40978ETF01\007	Antenna Port. 910MHz. Occupied Bandwidth.
GPH\40978ETF01\008	Antenna Port. 910MHz. Transmission Time.
GPH\40978ETF01\009	Antenna Port. 910MHz. Transmission Intervals.
GPH\40978ETF01\010	Antenna Port. 5000 to 10000MHz. Spurious Emissions.
GPH\40978ETF01\011	Conducted Emissions. 450kHz to 30MHz. Live Line.
GPH\40978ETF01\012	Conducted Emissions. 450kHz to 30MHz. Neutral Line.
GPH\40978ETF01\013	Radiated Emissions. 30 to 1000MHz. Receive Mode.
GPH\40978ETF01\014	Radiated Emissions. 30 to 800MHz.
GPH\40978ETF01\015	Radiated Emissions. 800 to 902MHz.
GPH\40978ETF01\016	Radiated Emissions. 928 to 1000MHz.
GPH\40978ETF01\017	Radiated Emissions. 1000 to 2000MHz. Receive Mode.
GPH\40978ETF01\018	Radiated Emissions. 1000 to 2000MHz.
GPH\40978ETF01\019	Radiated Emissions. 2000 to 4000MHz.
GPH\40978ETF01\020	Radiated Emissions. 2000 to 4000MHz. Receive Mode.
GPH\40978ETF01\021	Radiated Emissions. 4000 to 5000MHz.
GPH\40978ETF01\022	Radiated Emissions. 4000 to 5000MHz. Receive Mode.
GPH\40978ETF01\023	Radiated Emissions. 5000 to 6000MHz.
GPH\40978ETF01\024	Radiated Emissions. 6000 to 8200MHz.
GPH\40978ETF01\025	Radiated Emissions. 8200 to 10000MHz.

Graphical Test Results - (continued)

Part 90 Subpart M

Graph Reference Number	Title
GPH\40978ETF01\101	Antenna Port. 902.2MHz. Transmit Power. Bottom Channel.
GPH\40978ETF01\102	Antenna Port. 915.0MHz. Transmit Power. Middle Channel.
GPH\40978ETF01\103	Antenna Port. 927.8MHz. Transmit Power. Top Channel.
GPH\40978ETF01\104	Antenna Port. 902 to 928MHz. Spurious Emissions. Bottom Channel.
GPH\40978ETF01\105	Antenna Port. 902 to 928MHz. Spurious Emissions. Middle Channel.
GPH\40978ETF01\106	Antenna Port. 902 to 928MHz. Spurious Emissions. Top Channel.
GPH\40978ETF01\107	Antenna Port. 30 to 901MHz. Spurious Emissions. Bottom Channel.
GPH\40978ETF01\108	Antenna Port. 900 to 902MHz. Spurious Emissions. Bottom Channel.
GPH\40978ETF01\109	Antenna Port. 928 to 5000MHz. Spurious Emissions. Bottom Channel.
GPH\40978ETF01\110	Antenna Port. 30 to 902MHz. Spurious Emissions. Middle Channel.
GPH\40978ETF01\111	Antenna Port. 928 to 5000MHz. Spurious Emissions. Middle Channel.
GPH\40978ETF01\112	Antenna Port. 30 to 902MHz. Spurious Emissions. Top Channel.
GPH\40978ETF01\113	Antenna Port. 929 to 1000MHz. Spurious Emissions. Top Channel.
GPH\40978ETF01\114	Antenna Port. 1000 to 5000MHz. Spurious Emissions. Top Channel.
GPH\40978ETF01\115	Antenna Port. 928 to 930MHz. Spurious Emissions. Top Channel.
GPH\40978ETF01\116	Occupied Bandwidth. 902.2MHz. Bottom Channel. Modulation On.
GPH\40978ETF01\116a	Occupied Bandwidth. 902.2MHz. Bottom Channel. Modulation Off.
GPH\40978ETF01\117	Occupied Bandwidth. 915.0MHz. Middle Channel. Modulation On.
GPH\40978ETF01\117a	Occupied Bandwidth. 915.0MHz. Middle Channel. Modulation Off.
GPH\40978ETF01\118	Occupied Bandwidth. 915.0MHz. Middle Channel. Modulation On.
GPH\40978ETF01\118a	Occupied Bandwidth. 915.0MHz. Middle Channel. Modulation Off.
GPH\40978ETF01\119	Antenna Port. 50 to 10000MHz. Spurious Emissions. Bottom Channel.

Graphical Test Results (continued)

Graph Reference Number	Title
GPH\40978ETF01\120	Antenna Port. 50 to 10000MHz. Spurious Emissions. Middle Channel.
GPH\40978ETF01\121	Antenna Port. 50 to 10000MHz. Spurious Emissions. Top Channel.
GPH\40978ETF01\122	Conducted Emissions. 450kHz to 30MHz. Bottom Channel. Neutral Line.
GPH\40978ETF01\123	Conducted Emissions. 450kHz to 30MHz. Bottom Channel. Live Line.
GPH\40978ETF01\124	Conducted Emissions. 450kHz to 30MHz. Middle Channel. Live Line.
GPH\40978ETF01\125	Conducted Emissions. 450kHz to 30MHz. Middle Channel. Neutral Line.
GPH\40978ETF01\126	Conducted Emissions. 450kHz to 30MHz. Top Channel. Neutral Line.
GPH\40978ETF01\127	Conducted Emissions. 450kHz to 30MHz. Top Channel. Live Line.
GPH\40978ETF01\128	Radiated Emissions. 30 to 800MHz. All Channels.
GPH\40978ETF01\129	Radiated Emissions. 800 to 900MHz. Bottom Channel.
GPH\40978ETF01\130	Radiated Emissions. 904 to 1000MHz. Bottom Channel.
GPH\40978ETF01\131	Radiated Emissions. 800 to 914MHz. Middle Channel.
GPH\40978ETF01\132	Radiated Emissions. 917 to 1000MHz. Middle Channel.
GPH\40978ETF01\133	Radiated Emissions. 800 to 926MHz. Top Channel.
GPH\40978ETF01\134	Radiated Emissions. 930 to 1000MHz. Top Channel.
GPH\40978ETF01\135	Radiated Emissions. 1000 to 2000MHz. Bottom Channel.
GPH\40978ETF01\136	Radiated Emissions. 1000 to 2000MHz. Middle Channel.
GPH\40978ETF01\137	Radiated Emissions. 1000 to 2000MHz. Top Channel.
GPH\40978ETF01\138	Radiated Emissions. 2000 to 4000MHz. Bottom Channel.
GPH\40978ETF01\139	Radiated Emissions. 2000 to 4000MHz. Middle Channel.
GPH\40978ETF01\140	Radiated Emissions. 2000 to 4000MHz. Top Channel.
GPH\40978ETF01\141	Radiated Emissions. 4000 to 5000MHz. Bottom Channel.
GPH\40978ETF01\142	Radiated Emissions. 4000 to 5000MHz. Middle Channel.
GPH\40978ETF01\143	Radiated Emissions. 4000 to 5000MHz. Top Channel.
GPH\40978ETF01\144	Radiated Emissions. 5000 to 6000MHz. Bottom Channel.

Graphical Test Results (continued)

Graph Reference Number	Title
GPH\40978ETF01\145	Radiated Emissions. 5000 to 6000MHz. Middle Channel.
GPH\40978ETF01\146	Radiated Emissions. 5000 to 6000MHz. Top Channel.
GPH\40978ETF01\147	Radiated Emissions. 6000 to 8200MHz. Bottom Channel.
GPH\40978ETF01\148	Radiated Emissions. 6000 to 8200MHz. Middle Channel.
GPH\40978ETF01\149	Radiated Emissions. 6000 to 8200MHz. Top Channel.
GPH\40978ETF01\150	Radiated Emissions. 8200 to 10000MHz. Bottom Channel.
GPH\40978ETF01\151	Radiated Emissions. 8200 to 10000MHz. Middle Channel.
GPH\40978ETF01\152	Radiated Emissions. 8200 to 10000MHz. Top Channel.
GPH\40978ETF01\153	Frequency Stability. 928.8MHz. Ambient Temperature (18°C)
GPH\40978ETF01\154	Frequency Stability. 928.8MHz. -20°C.
GPH\40978ETF01\155	Frequency Stability. 928.8MHz. -10°C.
GPH\40978ETF01\156	Frequency Stability. 928.8MHz. 0°C.
GPH\40978ETF01\157	Frequency Stability. 928.8MHz. 10°C.
GPH\40978ETF01\158	Frequency Stability. 928.8MHz. 20°C.
GPH\40978ETF01\159	Frequency Stability. 928.8MHz. 30°C.
GPH\40978ETF01\160	Frequency Stability. 928.8MHz. 40°C.
GPH\40978ETF01\161	Frequency Stability. 928.8MHz. 50°C.
GPH\40978ETF01\162	Frequency Stability. 928.8MHz. -30°C.

These pages are not included in the total number of pages for this report.

Appendix 5. Photographs of EUT

This appendix contains the following photographs

Photo Reference Number	Title
PHT\40978JD01\001	Side View of Conducted Emissions
PHT\40978JD01\002	Front View of Conducted Emissions
PHT\40978JD01\003	Rear View of Radiated Emissions
PHT\40978JD01\004	Front View of Radiated Emissions

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PHT\40978JD01\001: Side View of Conducted Emissions

PHT\40978JD01\002: Front View of Conducted Emissions

PHT\40978JD01\003: Rear View of Radiated Emissions

PHT\40978JD01\004: Front View of Radiated Emissions