



EMC Technologies Pty Ltd

ABN 82 057 105 549
Unit 3/87 Station Road
Seven Hills NSW 2147 Australia

Telephone +61 2 9624 2777
Facsimile +61 2 9838 4050
Email syd@emctech.com.au
www.emctech.com.au

**EMI TEST REPORT
for
CERTIFICATION of
FCC PART 15.225 & FCC PART 15.207 TRANSMITTER**

FCC ID: TVN-MARS-1
Manufacturer: Magellan Technologies Pty Ltd
Test Sample: RFID Read Write Device
Model: Mars-1-2-4-6
Serial No: Production Prototype

Date: 12th October 2006

EMC Technologies Pty Ltd reports apply only to the specific samples tested under stated test conditions. All samples tested were in good operating condition throughout the entire test program. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. EMC Technologies Pty Ltd shall have no liability for any deductions, interferences or generalisations drawn by the client or others from EMC Technologies Pty Ltd issued reports. This report shall not be used to claim, constitute or imply product endorsement by EMC Technologies Pty Ltd.



**NATA Accredited
Laboratory
Number: 5292**

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Melbourne
57 Assembly Drive
Tullamarine Vic 3043
Tel: +61 3 9335 3333
Fax: +61 3 9338 9260

Sydney
Unit 3/87 Station Road
Seven Hills NSW 2147
Tel: +61 2 9624 2777
Fax: +61 2 9838 4050

Brisbane
1/15 Success Street
Acacia Ridge Qld 4110
Tel: +61 7 3875 2455
Fax: +61 7 3875 2466

Auckland (NZ)
47 MacKelvie Street
Grey Lynn Auckland
Tel: +64 9 360 0862
Fax: +64 9 360 0861

**EMI TEST REPORT FOR CERTIFICATION
FOR
CERTIFICATION OF FCC Part 15.225 & FCC PART 15.207 TRANSMITTER**

**FCC ID: TVN-MARS-1
EMC Technologies Report No. T60919_F
Date: 12th October 2006**

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**EMI TEST REPORT FOR CERTIFICATION
OF
FCC PART 15.225 & FCC PART 15.207 TRANSMITTER**

Report Number: T60919_F
Test Sample Name: RFID Read Write Device
Model Number: Mars-1-2-4-6
Serial Number: Production Prototype
FCC ID: TVN MARS-1
Manufacturer: Magellan Technologies Pty Ltd
Tested For: Magellan Technologies Pty Ltd
Address: 65 Johnston Street
Annandale NSW 2038
Phone: (02) 9562 9800
Fax: (02) 9518 7620
Responsible Party: Graham Murdoch
Test Standards: **FCC Part 15.225 Intentional Radiators**
FCC Part 15.207 Conducted Limits
ANSI C63.4:2003
OET Bulletin No. 65
Test Dates: 28/09/06, 29/09/06, 3/10/06, 04/10/06, 05/10/06 and
10/10/06

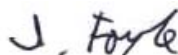
Testing Officers:



Deepesh Rao



Bruce Holdsworth



Jodie Foyle

Attestation:

I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.

Authorised Signature:



Les Dickenson
Branch Manager
EMC Technologies Pty Ltd

Issued by EMC Technologies Pty Ltd, Unit 3/87 Station Road, Seven Hills, NSW, 2147, Australia.
Phone: +61 2 9624 2777 Fax: +61 2 9838 4050

EMI TEST REPORT FOR CERTIFICATION
of
FCC PART 15.225 & FCC PART 15.207 TRANSMITTER
on the
RFID Read Write Device

1. SUMMARY of RESULTS

This report details the results of EMI tests and measurements performed on the RFID Read Write Device, Model: Mars-1-2-4-6, in accordance with the Federal Communications Commission (FCC) regulations as detailed in Title 47 CFR, Part 15 Rules for intentional radiators. All results are detailed in this report.

Part 15.31e

Amplitude stability with supply variation: Complied

Part 15.207

Conducted Emissions: Complied

Part 15.225 a, b &c

Carrier Signal Field Strength 13.110 – 14.010MHz: Complied

Part 15.225 d (15.209)

Field Strength Outside 13.110 – 14.010MHz: Complied

Part 15.225 e

Frequency Tolerance: Complied

2. GENERAL INFORMATION

2.1 General Description of Test Sample

Manufacturer : Magellan Technologies Pty Ltd
Test Sample : RFID Read Write Device
Model : Mars-1-2-4-6
Serial Number : Production Prototype
FCC ID : TVN-MARS-1

Equipment Type : Intentional Radiator

2.2 Test Sample Description

Refer to customers' test plan.

2.3 Technical Specifications and System Overview

Transmit Frequency	:	13.56MHz
Clock Circuit Speed	:	50MHz, 27.120MHz and 18.432MHz
Real Time Clock	:	32,768kHz
Microprocessor	:	AT91RM9200
Case Style & Material	:	Metal Case
Power Supply	:	Input: 100-240V, 1.6A, 50-60Hz Output: 12Vdc and 4.17A Model: GT-21097-5012

Refer to Appendix L User Manual and Appendix H Customer Test Plan.

2.4 EUT Configurations

MARS-1-2-4-6 will be tested separately with each type of antenna. These results will be used to determine the worst case future testing for Australia and the European Union. EUT is to be tested as a tabletop unit with all ports connected as shown below.

2.5 Test Sample Support Equipment

- Laptop "Toshiba Tecra 8100"
- Laptop "Toshiba TE2000"
- USB Flash drive "ASTONE 256MB 80X"
- USB AtoB cables, shielded type cable, unknown brand, shorter than 3m
- USB AtoA (extension) cables, shielded type cable, unknown brand, shorter than 3m
- Loopback with LEDs and ribbon cable, shorter than 3m
- test tags, type "TAGSTAR SYSTEMS ST-104-2.5" and "TAGSTAR SYSTEMS IT-104"

2.6 Test Sample Block Diagram

Refer to customer test plan in Appendix H.

2.7 EUT Operation Conditions

Refer to customer test plan in Appendix H.

2.8 Modifications

No modifications were performed.

2.9 Test Procedure

Radiated Emissions measurements were performed in accordance with the procedures of ANSI C63.4:2003. The measurement distance for radiated emissions was 3 metres from the EUT for range 9kHz-1000MHz.

2.10 Test Facility

- **General**

Conducted Emission measurements of fundamental frequency 13.56 MHz were performed at EMC Technologies Laboratory in Seven Hills, New South Wales, Australia. Radiated Emission measurements in the ranges 9kHz-1000MHz were performed at EMC Technologies' open area test site (OATS) situated at Upper Colo, NSW, Australia.

The above sites have been fully described in a report submitted to the FCC office, and accepted in a letter dated October 18th 2005, **FCC Registration number is 90561.**

- **NATA Accreditation**

EMC Technologies is accredited in Australia to test to the following standards by the National Association of Testing Authorities (NATA).

“FCC Part 15 unintentional and intentional emitters in the frequency range 9kHz to 18GHz excluding TV receivers (15.117 and 15.119), TV interface devices (15.115), cable ready consumer electronic equipment (15.118), cable locating equipment (15.213) and unlicensed national information infrastructure devices (Sub part E).”

The current full scope of accreditation can be found on the NATA website:

www.nata.asn.au

It also includes a large number of emission, immunity, SAR, EMR and Safety standards.

NATA is the Australian national laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A²LA).

2.11 Units of Measurements

2.11.1 Conducted Emissions

Measurements are reported in units of dB relative to one microvolt (dB μ V).

- **Radiated Emissions**

Measurements are reported in units of dB relative to one microvolt per metre (dB μ V/m). The measurement distance was 3 metres from the EUT for ranges 9kHz-1000MHz.

2.12 Test Equipment Calibration

All measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Agilent Technologies (Australia) Pty Ltd or the National Measurement Institute (NMI). All equipment calibration is traceable to Australia national standards at the National Measurement Institute. The reference antenna calibration was performed by NMI and the working antennas (biconical and log-periodic) calibrated by the NATA approved procedures. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in Appendix A of this report.

- **Ambients at OATS**

The Open Area Test Site (OATS) is an area of low background ambient signals. No significant broadband ambients are present however commercial radio and TV signals exceed the limit in the FM radio, VHF and UHF television bands. Radiated prescan measurements were performed in the shielded enclosure to check for possible radiated emissions at the frequencies where the OATS ambient signals exceeded the test limit.

3. CONDUCTED EMISSION MEASUREMENTS

- **Test Procedure**

The arrangement specified in ANSI C63.4:2003 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2-1987 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all duration peaks were captured.

- **Peak Maximizing Procedure**

For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector was then invoked to measure the actual Quasi-Peak level of the most significant peaks which were detected.

The highest recorded EMI signals are shown on the Peaks List on the bottom right side of the graph. Peaks that were greater than 20dB below the limit were not measured. For each numbered peak the frequency, peak field strength, Quasi-peak field strength, Average field strength and the margin relative to the limit in dB is listed. A negative margin is the level below the limit.

- **Calculation of Voltage Levels**

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

$$V_{EMI} = V_{Rx} + L_{BPF}$$

Where:

V_{EMI}	=	The Measured EMI voltage in dB μ V to be compared to the limit.
V_{Rx}	=	The Voltage in dB μ V read directly at the EMI receiver.
L_{BPF}	=	The insertion loss in dB of the cables and the Limiter and Pass Filter.

3.4 Plotting of Conducted Emission Measurement Data

The measurement data pertaining to each frequency sub-range were then concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph was subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graphs.

3.5 Conducted EMI Results

- **Transmitter Terminals Connected to Antenna**
Results for the GT-21097, Antenna 64-10-002

Frequency MHz	Line	Measured QP Value dB μ V	QP Limit dB μ V	Δ QP \pm dB	Measured Av. Value dB μ V	AV Limit dB μ V	Δ AV \pm dB
13.56*	Active	103.8	60.0	+43.8	104.1	50.0	+54.1
13.56*	Neutral	103.7	60.0	+43.7	104.1	50.0	+54.1
13.61*	Neutral	71.1	60.0	+11.1	30.5	50.0	-19.5
13.77*	Active	66.5	60.0	+6.5	41.8	50.0	-8.2
13.34*	Neutral	60.0	60.0	+0.0	35.6	50.0	-14.4
14.20	Active	58.4	60.0	-1.6	43.8	50.0	-6.2
14.20	Neutral	58.1	60.0	-2.0	43.8	50.0	-6.2
12.92	Neutral	56.3	60.0	-3.7	42.2	50.0	-7.8
14.62	Active	53.9	60.0	-6.1	39.6	50.0	-10.4
12.92	Active	53.8	60.0	-6.2	40.4	50.0	-9.6
14.60	Neutral	53.4	60.0	-6.6	39.5	50.0	-10.5
13.84	Neutral	52.8	60.0	-7.2	32.7	50.0	-17.3
14.22	Active	52.2	60.0	-7.8	39.8	50.0	-10.2
14.22	Neutral	52.2	60.0	-7.8	40.0	50.0	-10.0
27.12	Neutral	42.0	60.0	-18.0	41.8	50.0	-8.2
27.12	Active	41.4	60.0	-18.6	41.3	50.0	-8.7

* Fundamental Frequency of Transmitter

Note: The transmit carrier was excluded from the test with the antenna connected. The highest emission was 14.20MHz on the Active line, which were measured -1.6dB below the Quasi-peak and -6.2dB below the Average limits.

The measurement uncertainty for conducted emissions is ± 1.8 dB.

Refer to Appendix K, Graphs 1 and 2.

Results for the GT-21097, Antenna 63-10-004(P2)

Frequency MHz	Line	Measured QP Value dB μ V	QP Limit dB μ V	Δ QP \pm dB	Measured Av. Value dB μ V	AV Limit dB μ V	Δ AV \pm dB
13.56*	Neutral	101.6	60.0	41.6	101.9	50.0	51.9
13.56*	Active	101.4	60.0	41.4	101.8	50.0	51.8
14.20	Neutral	58.9	60.0	-1.1	37.4	50.0	-12.6
14.20	Active	58.7	60.0	-1.3	37.7	50.0	-12.3
12.92	Neutral	57.0	60.0	-3.0	35.5	50.0	-14.5
12.92	Active	56.6	60.0	-3.4	34.8	50.0	-15.2
14.62	Active	55.7	60.0	-4.3	38.8	50.0	-11.2
14.62	Neutral	55.3	60.0	-4.7	38.6	50.0	-11.4

* Fundamental Frequency of Transmitter

Note: The transmit carrier was excluded from the test with the antenna connected. The highest emission was 14.20MHz on the Neutral line, which were measured 1.1dB below the Quasi-peak and 12.6dB below the Average limits.

The measurement uncertainty for conducted emissions is ± 1.8 dB.

Refer to Appendix K, Graphs 5 and 6.

3.5.2 Transmitter Terminals Connected to a Resistive Load

Results for the GT-21097, Antenna Terminated 1K

Frequency MHz	Line	Measured QP Value dB μ V	QP Limit dB μ V	Δ QP \pm dB	Measured Av. Value dB μ V	AV Limit dB μ V	Δ AV \pm dB
13.56	Neutral	48.8	60.0	-11.2	49.1	50.0	-0.9
13.56	Active	48.7	60.0	-11.3	49.0	50.0	-1.0

The transmit antenna was replaced by a 1k Ω load and the conducted emissions measurements were repeated.

The highest emission was 13.56MHz on the Neutral line, which were measured 11.2dB below the Quasi-peak and 0.9dB below the Average limits.

The measurement uncertainty for conducted emissions is ± 1.8 dB.

Refer to Appendix K, Graphs 3 and 4.

3.6 Results of Conducted Emission Measurement

The EUT complied with the limits of FCC Rule Part 15 Subpart C – Intentional Radiators. Emissions at the fundamental frequency of 13.56 MHz are excluded from the results with the antenna loop connected.

4. RADIATED EMISSION MEASUREMENTS – 9 kHz to 1 GHz

4.1 Frequency Range of Radiated Measurements

The highest frequency of the EUT is 50MHz (refer to section 2.3 of this report).

Highest frequency generated or used in the device or on which the device operates or tunes [MHz]	Upper frequency of measurement range [MHz]
1.705 - 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	10 th harmonic of the highest frequency or 40 GHz, whichever is lower

Frequencies above 1 GHz: Average trace taken (RBW 1MHz, VBW 100 kHz)

According to the table in FCC Part 15, Section 15.33 and the highest radio frequency signal generated or used in the EUT is 50MHz, the radiated emissions measurement were performed from 9kHz up to 1GHz.

4.2 Test Procedure

Radiated emissions measurements were performed in accordance with the procedures of ANSI C63.4:2003 Radiated emission tests from 9 kHz to 1GHz were performed at the Open Area Test Site (OATS) an EUT distance of 3 metres. OET Bulletin 65 was used for reference.

The EUT was placed on a timber table 0.8m above an inground and operated in accordance with section 2 of this report. The EMI Receiver was operated under software control via the PC Controller.

4.2.1 0.009 – 30 MHz Range

The 0.009 MHz to 30 MHz test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks while also permitting fast frequency scan times. The EUT was slowly rotated with the Peak Detector set to Max-Hold. The receive loop antenna was set to 1m above the ground plane with the Quasi-Peak detector ON. The measurement data for each frequency range was automatically corrected by the software for cable losses, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. The orientation of the receive loop antenna was varied to ensure that the emissions were maximised. The EUT was further rotated through three orthogonal directions to ensure worst case emissions are measured. The carrier test was performed at the worst-case operation voltage.

4.2.2 30 – 1000 MHz Range

The 30 MHz to 1000 MHz test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks while also permitting fast frequency scan times. The EUT was slowly rotated with the Peak Detector set to Max-Hold. The EUT was further rotated through three orthogonal directions to ensure worst case emissions are measured. This was performed for two receiver antenna heights. Each significant peak was then investigated and maximised by rotating the turntable and scanning the height of the receiver antenna between 1 to 4 metres with the Quasi-Peak detector ON. The measurement data for each frequency range was automatically corrected by the software for cable losses, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical receive antenna polarisation.

4.3 Plotting of Measurement Data for Radiated Emissions

4.3.1 0.009 – 30 MHz Range

The stored measurement data was combined to form a single graph which comprised of all the frequency sub-ranges over the range 0.009 – 30 MHz. The fundamental frequency was measured at the OATS. The worst case radiated EMI peak measurements as recorded using the Max-Hold data are presented as the **RED** trace while the respective ambient signals are presented as the lower or **GREEN** trace. Occasionally, an intermittent ambient arose during the EUT ON measurement (RED trace) and could not be captured when the Ambient trace was being stored. The ambient peaks of significant amplitude with respect to the limit are tagged with the “#” symbol while EMI peaks are identified with a numeral. Ambient peaks that were present during the EUT ON measurement (RED trace) and not captured during the AMBIENT measurement were also tagged with “#” symbol.

The highest recorded EMI signals are shown on the Peaks List on the bottom right hand side of the graph. For radiated EMI, each numbered peak is listed as a frequency, peak field strength, Quasi-peak field strength, limit and the margin relative to the limit in dB. A negative margin is the deviation of the recorded value below the limit. At times, the quasi-peak level may appear to be higher than the peak level. This happens because the individual peak is further maximised with the QP detector AFTER the MAX-HOLD trace has been stored. This will be apparent when the peaks list at the foot of the graphs shows the quasi peak level higher than the peak level.

4.3.2 30 – 1000 MHz

The stored measurement data was combined to form a single graph which comprised of all the frequency sub-ranges over the range 30 – 1000 MHz. The accumulated EMI (EUT ON) was plotted as the Red trace while the Ambient signals (AMBIENT) were plotted as Green trace. The worst case radiated EMI peak measurements (as recorded using the Max-Hold data are presented as the upper or **RED** trace while the respective ambient signals are presented as the lower or **GREEN** trace. Occasionally, an intermittent ambient arose during the EUT ON measurement (RED trace) and could not be captured when the Ambient trace was being stored. The ambient peaks of significant amplitude with respect to the limit are tagged with the “#” symbol while EMI peaks are identified with a numeral. Ambient peaks that were present during the EUT ON measurement (RED trace) and not captured during the AMBIENT measurement were also tagged with “#” symbol.

The highest recorded EMI signals are shown on the Peaks List on the bottom right hand side of the graph. For radiated EMI, each numbered peak is listed as a frequency, peak field strength, Quasi-peak field strength, limit and the margin relative to the limit in dB. A negative margin is the deviation of the recorded value below the limit. At times, the quasi-peak level may appear to be higher than the peak level. This happens because the individual peak is further maximised with the QP detector AFTER the MAX-HOLD trace has been stored. This will be apparent when the peaks list at the foot of the graphs shows the quasi peak level higher than the peak level.

4.4 Calculation of Field Strength

The field strength was calculated automatically by the software using all the pre-stored calibration data. The method of calculation is shown below:

$$E = V + AF - G + L$$

Where:

- E** = Radiated Field Strength in dB μ V/m.
- V** = EMI Receiver Voltage in dB μ V. (measured value)
- AF** = Antenna Factor in dB/m (stored as a data array)
- G** = Preamplifier Gain in dB. (stored as a data array)
- L** = Cable insertion loss in dB. (stored as a data array)

Example Field Strength Calculation

Assuming a receiver reading of 34.0 dB μ V is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB. The cable loss is 1.9dB while the preamplifier gain is 20dB.

$$34.0 + 9.2 + 1.9 - 20 = 25.1 \text{ dB}\mu\text{V/m}$$

4.5 Radiated Field Strength Measurement Results – Section 15.225

4.5.1 13.56 MHz Carrier Field Strength Measurement

Results for the Antenna 64-10-002

Frequency MHz	Peak Level dB μ V/m	Limit @ 3m dB μ V/m	Result \pm dB
13.56	89.4	124.0	-34.6

The mains supply was varied as per Section 15.31e between 100V 60 Hz to 138V 60Hz to determine if the carrier amplitude varies with supply voltage. No variation was recorded. The test was performed at 120V 60Hz.

Complied with a margin of greater than 20dB with Section 15.225 Subpart a, b & c. The measurement uncertainty was ± 4.6 dB. **Refer to Appendix K, Graph 8**

Results for the Antenna 63-10-004

Frequency MHz	Peak Level dB μ V/m	Limit @ 3m dB μ V/m	Result \pm dB
13.56	85.5	124.0	-38.5

The mains supply was varied as per Section 15.31e between 100V 60 Hz to 138V 60Hz to determine if the carrier amplitude varies with supply voltage. No variation was recorded. The test was performed at 120V 60Hz.

Complied with a margin of greater than 20dB with Section 15.225 Subpart a, b & c. The measurement uncertainty was ± 4.6 dB. **Refer to Appendix K, Graph 10.**

4.5.2 9 kHz to 30 MHz Field Strength Spurious Emissions

Results for the Antenna 64-10-002

Complied with a margin of greater than 20dB with Section 15.225 Supart d (15.209). The measurement uncertainty was ± 4.6 dB. **Refer to Appendix K, Graph 7.**

Results for the Antenna 63-10-004

Complied with a margin of greater than 20dB with Section 15.225 Supart d (15.209). The measurement uncertainty was ± 4.6 dB. **Refer to Appendix K, Graph 9.**

30 - 1000MHz Field Strength Spurious Emissions –Section 15.225 d (15.209)**Results for the Antenna 64-10-002**

Frequency (MHz)	Rx Antenna Polarisation	Quasi Peak Level (dB μ V/m)	Limit @ 3m (dB μ V/m)	Δ Result (dB)
499.86	Horizontal	43.7	46.0	-2.3
368.63	Vertical	43.5	46.0	-2.5
40.69	Vertical	36.8	40.0	-3.2
816.11	Horizontal	42.3	46.0	-3.7
499.73	Vertical	41.7	46.0	-4.3
60.02	Vertical	35.5	40.0	-4.5
366.13	Horizontal	41.5	46.0	-4.5
663.54	Horizontal	41.5	46.0	-4.5
366.13	Horizontal	41.3	46.0	-4.7
700.41	Horizontal	41.3	46.0	-4.7
47.77	Vertical	35.0	40.0	-5.0
48.17	Vertical	34.6	40.0	-5.4
324.92	Vertical	40.1	46.0	-5.9
519.86	Vertical	40.0	46.0	-6.0
688.12	Horizontal	40.0	46.0	-6.0
675.83	Horizontal	40.0	46.0	-6.0
189.82	Horizontal	37.4	43.5	-6.1
300.00	Vertical	39.8	46.0	-6.2
51.90	Vertical	33.8	40.0	-6.2
651.26	Horizontal	39.8	46.0	-6.2
49.94	Vertical	33.6	40.0	-6.4
54.24	Vertical	33.6	40.0	-6.5
55.99	Vertical	33.5	40.0	-6.5
61.45	Vertical	33.2	40.0	-6.8
57.52	Vertical	33.2	40.0	-6.8
352.57	Horizontal	39.1	46.0	-6.9
675.82	Vertical	39.0	46.0	-7.0
516.09	Horizontal	38.8	46.0	-7.2
725.00	Horizontal	38.7	46.0	-7.3
638.98	Horizontal	38.6	46.0	-7.4
480.06	Horizontal	37.5	46.0	-8.5
626.68	Horizontal	36.3	46.0	-9.7

Summary of Results

The highest radiated spurious emission was 2.3dB below the limit at 499.86MHz for Horizontal Polarisation. The highest 16 point on both Vertical and Horizontal are reported on the graphs Appendix K. The measurement uncertainty was ± 4.6 dB.

Refer to Appendix K, Graphs 11 and 12.

Results for the Antenna 63-10-004

Frequency (MHz)	Rx Antenna Polarisation	Quasi Peak Level (dB μ V/m)	Limit @ 3m (dB μ V/m)	Δ Result (dB)
108.49	Horizontal	40.0	43.5	-3.5
149.17	Horizontal	38.2	43.5	-5.3
162.71	Horizontal	36.2	43.5	-7.3
840.73	Horizontal	38.2	46.0	-7.8
135.60	Horizontal	35.6	43.5	-7.9
827.18	Horizontal	38.1	46.0	-8.0
881.41	Horizontal	37.8	46.0	-8.2
800.06	Horizontal	37.7	46.0	-8.3
813.63	Horizontal	37.7	46.0	-8.3
122.05	Horizontal	35.1	43.5	-8.4
854.30	Horizontal	37.3	46.0	-8.7
339.01	Vertical	37.3	46.0	-8.8
34.11	Vertical	31.2	40.0	-8.8
786.49	Horizontal	37.0	46.0	-9.0
81.37	Horizontal	31.0	40.0	-9.0
867.86	Horizontal	36.8	46.0	-9.2
34.56	Vertical	30.5	40.0	-9.5
203.40	Horizontal	33.9	43.5	-9.7
54.25	Vertical	30.2	40.0	-9.8
894.98	Horizontal	36.2	46.0	-9.8

Summary of Results

The highest radiated spurious emission was 3.5dB below the limit at 108.49MHz for Horizontal Polarisation. The highest 16 point on both Vertical and Horizontal are reported on the graphs Appendix K. The measurement uncertainty was ± 4.6 dB.

Refer to Appendix K, Graphs 13 and 14.

5.0 FREQUENCY TOLERANCE (FCC Part 15 Sections 15.225e)

The frequency stability of the unit was verified under abnormal operating supply voltage and temperature. The nominal frequency is 13.560MHz.

FCC Sub Part C Section 15.225 e.

Results for Antenna 64-10-002

Supply Voltage Variation

The mains supply was lowered from 120V 60Hz to 102V (85% of nominal supply) and maintained until the frequency was stable. The mains supply was then increased from 120V 60Hz to 138V (115% of nominal supply) and maintained until the frequency was stable.

Nominal Voltage	Temperature	Voltage Variation	Frequency Reading [MHz]	Frequency Variation [%]
120 V	20°C	85% (102 V)	13.56030	0.00220
120 V	20°C	115 % (138 V)	13.56020	0.00150

Maximum Frequency Variation to Nominal Frequency:

0.00030	0.00220
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The frequency tolerance of the carrier signal was maintained within $\pm 0.01\%$ of the operating frequency during the voltage variation test.

Temperature Variation

The ambient temperature with a supply voltage of 120V 60Hz was varied between -20°C and +50°C. At each 10°C interval the temperature was maintained until the EUT temperature had stabilised. The frequency of the carrier was observed at each 10°C increments and compared to the nominal frequency.

Nominal Voltage	Ambient Temperature	Frequency Reading [MHz]	Frequency Variation [%]
120 V	-20°C	13.56020	0.00150
120 V	-10°C	13.56035	0.00260
120 V	0°C	13.56020	0.00150
120 V	10°C	13.56025	0.00180
120 V	20°C	13.56025	0.00180
120 V	30°C	13.56010	0.00070
120 V	40°C	13.56010	0.00070
120 V	50°C	13.56005	0.00040

Maximum Frequency Variation to Nominal Frequency:

0.00035	0.00260
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The frequency tolerance of the carrier signal was maintained within $\pm 0.01\%$ of the operating frequency during the temperature variation test.

Results for Antenna 63-10-004

Supply Voltage Variation

The mains supply was lowered from 120V 60Hz to 102V (85% of nominal supply) and maintained until the frequency was stable. The mains supply was then increased from 120V 60Hz to 138V (115% of nominal supply) and maintained until the frequency was stable.

Nominal Voltage	Temperature	Voltage Variation	Frequency Reading [MHz]	Frequency Variation [%]
120 V	20°C	85% (102 V)	13.56020	0.00150
120 V	20°C	115 % (138 V)	13.56020	0.00150

Maximum Frequency Variation to Nominal Frequency:

0.00020	0.00150
---------	----------------

The frequency tolerance of the carrier signal was maintained within $\pm 0.01\%$ of the operating frequency during the voltage variation test.

Temperature Variation

The ambient temperature with a supply voltage of 120V 60Hz was varied between -20°C and +50°C. At each 10°C interval the temperature was maintained until the EUT temperature had stabilised. The frequency of the carrier was observed at each 10°C increments and compared to the nominal frequency.

Nominal Voltage	Ambient Temperature	Frequency Reading [MHz]	Frequency Variation [%]
120 V	-20°C	13.56015	0.00110
120 V	-10°C	13.56045	0.00330
120 V	0°C	13.56020	0.00150
120 V	10°C	13.56015	0.00110
120 V	20°C	13.56015	0.00110
120 V	30°C	13.56015	0.00110
120 V	40°C	13.56010	0.00070
120 V	50°C	13.56010	0.00070

Maximum Frequency Variation to Nominal Frequency:

0.00045	0.00330
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The frequency tolerance of the carrier signal was maintained within $\pm 0.01\%$ of the operating frequency during the temperature variation test.

6. CONCLUSION

The RFID Read Write Device, Model: Mars-1-2-4-6, FCC ID: TVN-MARS-1, complied with the requirements of FCC Part 15 Rules for linternal radiator when tested in accordance with FCC Part 15.31e, 15.207 and 15.225.

Part 15.31e

Amplitude stability with supply viariation: Complied

Part 15.207

Conducted Emissions: Complied

Part 15.225 a, b &c

Carrier Signal Field Strength 13.110 – 14.010MHz: Complied

Part 15.225 d (15.209)

Field Strength Outside 13.110 – 14.010MHz: Complied

Part 15.225 e

Frequency Tolerance: Complied

APPENDIX A
MEASUREMENT INSTRUMENTATION DETAILS

SUBMITTED AS ATTACHMENT

APPENDIX B
PHOTOGRAPHS TEST SETUP

SUBMITTED AS ATTACHMENT

APPENDIX C
PHOTOGRAPHS TEST SAMPLE (EXTERIOR)

SUBMITTED AS ATTACHMENT

APPENDIX D
PHOTOGRAPHS TEST SAMPLE (INTERIOR)

SUBMITTED AS ATTACHMENT

APPENDIX E
BLOCK DIAGRAM

SUBMITTED AS ATTACHMENT

APPENDIX F
TEST SAMPLE SCHEMATICS

SUBMITTED AS ATTACHMENT

APPENDIX G
TEST SAMPLE PCB LAYOUTS

SUBMITTED AS ATTACHMENT

APPENDIX H
TEST SAMPLE CUSTOMER TEST PLAN

SUBMITTED AS ATTACHMENT

APPENDIX I
FCC ID LABELLING - LOCATION

SUBMITTED AS ATTACHMENT

APPENDIX K
GRAPHS OF EMI MEASUREMENTS

SUBMITTED AS ATTACHMENT

APPENDIX L
USER MANUAL

SUBMITTED AS ATTACHMENT