FCC 47CFR part 15C
Test Report
For
PTX
Production Sample

Reference Standard: FCC 47CFR part 15C
Manufacturer: Model Racing Technology
For type of equipment and serial number, refer to section 3
Report Number: 09-7024-1-12 Issue 02
This report supersedes report 09-7024-1-12 Issue 01
Report Produced by: -

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Certificate of Test 7024-1

The unit noted below has been tested by **R.N. Electronics Limited** and, where appropriate, conforms to the relevant subpart of FCC 47CFR Part 15. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	PTX
Model Number:	Production Sample
Proposed FCC ID:	Not stated
Unique Serial Number:	6213276
Manufacturer:	Model Racing Technology 258 Dover Road, Folkestone, Kent CT19 6NS
Full measurement results are detailed in Report Number:	09-7024-1-13 Issue 02
Test Standards:	FCC 47CFR Part 15.223 effective date **October 1st 2013,** Class DXX Intentional Radiator

DEVIATIONS:
No deviations from the standards have been applied.

This certificate relates only to the unit tested as identified by a unique serial number and in the condition at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of unit not meeting the intentions of the standard or the requirements of the Federal Regulations, particularly under different conditions to those during testing. Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Date of Test:	6th September 2013 & 4th March 2014
Test Engineer:	Graham Blake — Digitally signed by Graham Blake DN: CN = Graham Blake, C = GB, O = RN Electronics Date: 2014.03.10 13:17:48 Z
Approved By: Managing Director	Roger Ray
Customer Representative:	

1 Contents

2 Equipment Under Test (EUT)

2.1 Equipment Specification

Applicant	Model Racing Technology 258 Dover Road Folkestone Kent CT19 6NS
Manufacturer of EUT	Model Racing Technology
Brand name of EUT	PTX
Model Number of EUT	Production Sample
Serial Number of EUT	6213276
Date when equipment was received by RN Electronics	6th September 2013
Date of test:	6th September 2013 & 4th March 2014
Visual description of EUT:	Small plastic enclosure with a flying-lead connector assembly to connect to a battery pack.
Main function of the EUT:	Magnetic-induction transmitter for model car race timing.
Height	7 mm
Width	16 mm
Depth	23 mm
Weight	0.005 kg
Voltage	6VDC nominal from battery
Current required from above voltage source	0.007 A

2.2 EUT Configurations for testing

General parameters	
EUT Normal use position	Attached to model car
Choice of model(s) for type tests	Production Sample
Antenna details	Integral
Antenna port	No
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	20 MHz
Lowest Signal generated in EUT	5 MHz (Fundamental frequency)
TX Parameters	
Alignment range – transmitter	5 MHz
EUT Declared Modulation Parameters	BPSK
EUT Declared Power level	Not stated
EUT Declared Signal Bandwidths	0.8 MHz
EUT Declared Channel Spacings	N/A Single channel
EUT declared Duty Cycle	<10%
Unmodulated carrier available?	No
Declared frequency stability	Not stated

2.3 Functional Description

A small magnetic-induction transmitter designed to be attached to a model car. The module transmits on a single spot-frequency of 5 MHz, to a dedicated trackside receiver and is used to provide timing information during model car racing. The unit has a single LED status light to indicate that the unit is powered.

2.4 EUT Modes

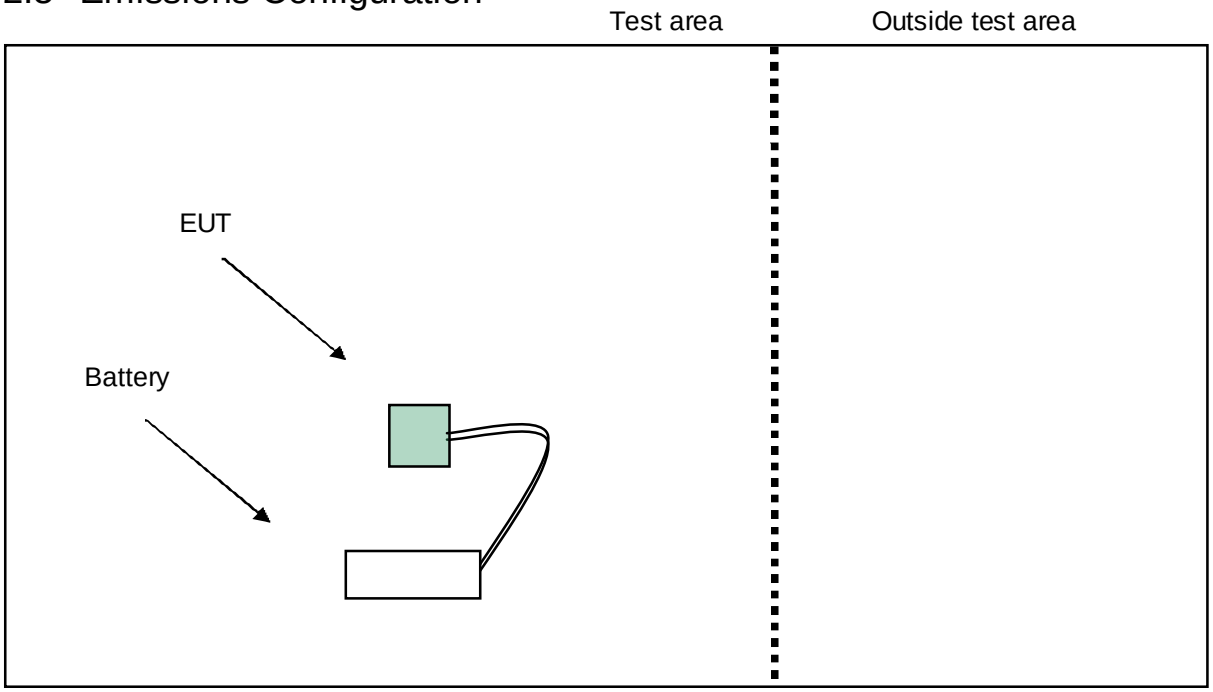
Mode Reference	Description	Used for testing
Continuous TX	Transmitting continuously with modulation at 5 MHz	Yes
Normal TX	Transmitting with 10% duty cycle at 5 MHz	No

Description of ancillary equipment connected to the equipment under test, for the purpose of tests, can be found in Section 10.

Any modifications made to the EUT, whilst under test, can be found in Section 11.

This report was printed on: 10 March 2014

2.5 Emissions Configuration



The EUT was powered via a fully charged battery at 6V.
The normal operational mode is EUT transmitting with a 10% duty cycle; however, the unit was programmed to a 100% TX duty for ease of test. Pre-scans were performed in both modes and showed no difference in emissions. Therefore, for the purposes of tests the 100% TX mode was used.

3 Summary of test results

The **EUT** was tested to the following standards: -

FCC 47CFR Part 15.223 (effective date October 1st, 2013); Class DXX Intentional Radiator

Any compliance statements are made reliant on the modes of operation as instructed to us by the Manufacturer based on their specific knowledge of the application and functionality of the equipment tested. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard, particularly under different conditions to those during testing.

Title	Reference	Results
1. AC power line conducted emissions	ANSI C63.10 §6.2.	NOT APPLICABLE[1]
2. Intentional radiator field strength	ANSI C63.10 §6.5.	PASSED
3. Radiated emissions	ANSI C63.10 §6.4 – 6.6.	PASSED
4. Frequency stability	ANSI C63.10 §6.8.	NOT APPLICABLE[2]
5. Occupied bandwidth & band edge	ANSI C63.10 §6.9.	PASSED

[1] EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines.
[2] No limits apply, however the emissions must remain within the band.

4 Specifications

The tests were performed and operated in accordance with the RN Electronics procedures and the basic standards listed below.

Reference	Standard Number	Year	Description
4.1.1	47CFR15	2012	Federal Communications Commission PART 15 – RADIO FREQUENCY DEVICES
4.1.2	ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
4.1.3	ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

R.N. Electronics Ltd sites M and OATS are listed with the FCC; Registration Number 293246
R.N. Electronics Ltd site H is listed with the FCC; Registration Number 823977

4.1 Deviations

ANSI C63-10-2009 deviations:
The reference standard ANSI C63.4-2003 was used, not the latest ANSI C63.4-2009

FCC Part 15 deviations:
None.

4.2 Tests at Extremes of Temperature & Voltage

Not required.

4.3 Measurement Uncertainties

Parameter	Uncertainty
Transmitter Tests	
Bandwidth	<± 1.9 %
Radiated RF Power	<± 3.5 dB
Radiated Spurious Emissions	<± 3.4 dB

5 Tests, Methods and Results

5.1 AC power line conducted emissions

NOT APPLICABLE: EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines.

5.2 Intentional radiator field strength

5.2.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.223)
Test Method:	ANSI C63.10, Reference (6.5)

5.2.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 1 metre. The EUT was rotated in all three orthogonal planes. The EUT was operated in Continuous TX mode.

5.2.3 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

Pre-scans were made in a semi-anechoic chamber and final measurements were made on an OATS without a ground plane.

Both the equipment and the antenna were rotated 360° to record the maximised emission.

Note: Since the measurement has been performed at a distance other than the EUT limit distance, the limit has been determined by using the square of an inverse linear distance extrapolation factor (40 dB/decade) see section 5.2.5.

5.2.4 Test Equipment used

TMS81, E226

See Section 9 for more details

5.2.5 Test results

Ambient conditions.
Temperature: 21°C Relative humidity: 52 % Pressure: 101 kPa

Radio Parameter 1

Band	5 MHz
Power level	Not Specified
Channel spacing	Single Channel
Mod scheme	BPSK
Low channel	5 MHz

Duty Cycle Table relating to Radio Parameters 1

	Low
Duty Cycle (%)	100.00
Duty Cycle correction	0.00

Results relating to Radio Parameters 1

	Low
Average Level (dBµV/m) @ 1 metres	61.40
Peak level (dBµV/m) @ 1 metres	63.40
Plot reference (max held sweep)	J7024-1 3MHz - 30MHz Q Parallel
Antenna Polarisation	Parallel
EUT Polarisation	Upright

Plot refers to a pre-scan measurement made in site Q. The measurement was repeated with the EUT re-maximized on the OATS using an average & Peak detector. The measurement was made using a test sample with 100% duty cycle which complies with the requirements, however, in normal use the duty cycle is 10%, and therefore, the actual average power would be further reduced. Due to the influence of ambient signals and noise floor on the EUT TX signal when measured on the OATS at a 3 metre distance, a 1 metre measurement distance was used instead.

Any Analyser plots can be found in Section 6.3 of this report.

LIMITS:

15.223(a) Average = 100 µV/m @ 30m = 40 dBµV/m @ 30m.

Adjusted Average Limits = 99.1 dBµV/m @ 1 metre by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

These results show that the EUT has **PASSED** this test.

5.3 Radiated emissions

5.3.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.209)
Test Method:	ANSI C63.10, Reference (6.4 – 6.6.)

5.3.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with a new battery.

The EUT was operated in Continuous TX mode.

5.3.3 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

Below 30MHz, pre-scans were made in a semi-anechoic chamber with final measurements made on an OATS without a ground plane. The antenna was placed 1m above the ground. The equipment and the antenna were rotated 360° to record the worst case emissions.

30MHz - 1GHz, measurements were made in a semi-anechoic chamber listed with the FCC. The equipment was rotated 360° and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst case emissions.

At least 6 signals within 20dB of the limit were investigated.

Tests were performed using Test Site M and OATS**.**

5.3.4 Test Equipment used

TMS81, TMS933, E410, E411, E410, E226**.**

See Section 9 for more details

5.3.5 Test results

Analyser plots showing peak values can be found in Section 6.2 of this report.

Note: The EUT was tested in a Continuous TX mode for ease of test.

5.3.5.1 Below 30MHz.

Plot references for Radiated emissions measurements (9 kHz - 30MHz)

Freq Range	Parallel Plots	Perpendicular Plots
9 kHz – 150 kHz	7024-1 9-150kHz, parallel antenna	7024-1 9-150kHz, perpendicular antenna
150 kHz – 30 MHz	7024-1 150k-30MHz, parallel antenna	7024-1 150k-30MHz, perpendicular antenna

No emissions below 30 MHz were observed in the pre-scan with the exception of the fundamental frequency.

5.3.5.2 30MHz - 1GHz.

Plot references for Radiated emissions measurements (30-1000MHz)

Frequency Range	Antenna Polarisation	Plot reference
30 – 300 MHz	Horizontal	7024-1 Rad 1 VHF Horiz
30 – 300 MHz	Vertical	7024-1 Rad 1 VHF Vert
300 – 1000 MHz	Horizontal	7024-1 Rad 1 UHF Horiz
300 – 1000 MHz	Vertical	7024-1 Rad 1 UHF Vert

Tables of results:

30-1000MHz Horizontal

Signal No.	Freq (MHz)	Peak Amp (dBuV)	QP Amp (dBuV)	QP - Lim1 (dB)
1	234.746	35.9	34.2	-11.8
2	239.739	34.8	32.4	-13.6
3	244.754	33.7	31.6	-14.4
4	354.617	27.4	23.0	-23.0
5	399.555	32.0	28.4	-17.6
6	464.513	36.1	33.5	-12.5
7	469.543	37.1	33.1	-12.9
8	474.500	35.4	32.5	-13.5

30-1000MHz Vertical
No signals found within 20dB of the limits.

Limits: 15.209, the limit lines are shown on the plots in section 6.3

5.3.5.3 Above 1GHz.

Not Applicable – Measurement of the EUT is required up to the 10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower. For unintentional radiator, emission is required up to 1000MHz, as highest frequency generated or used is 20 MHz (in the 1.705 – 108 MHz range).

5.4 Frequency stability

Not Applicable

5.5 Occupied bandwidth (6 dB) & band edge (20 dB)

5.5.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.215)
Test Method:	ANSI C63.10, Reference (6.9)

5.5.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 1 metre. The EUT was operated in Continuous TX mode.

5.5.3 Test Procedure

Tests were performed using Test Site M.
Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. Auto sweep time and max hold settings were used for the 6dB and 20 dB bandwidth.

5.5.4 Test Equipment used

TMS81, E410, E411, E412

See Section 9 for more details.

5.5.5 Test results

Ambient conditions.
Temperature: 21 °C Relative humidity: 50 % Pressure: 101 kPa

Analyser plots for the 6dB and 20 dB bandwidth can be found in Section 6.4 of this report.

RBW	VBW	6 dB BW	20 dB BW
30 kHz	100 kHz	886.4 kHz	1.71 MHz

LIMITS:

No limits apply however the emission should remain within the band (1.705 – 10 MHz).

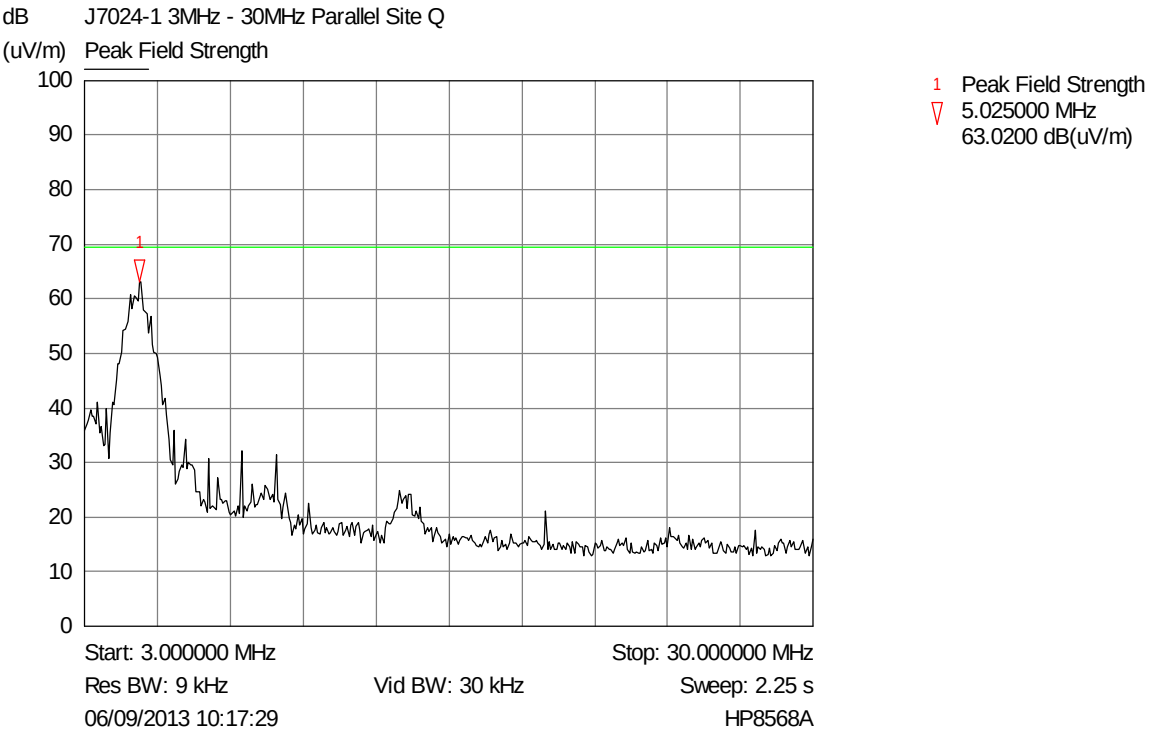
These results show that the EUT has PASSED this test.

6 Plots and Results

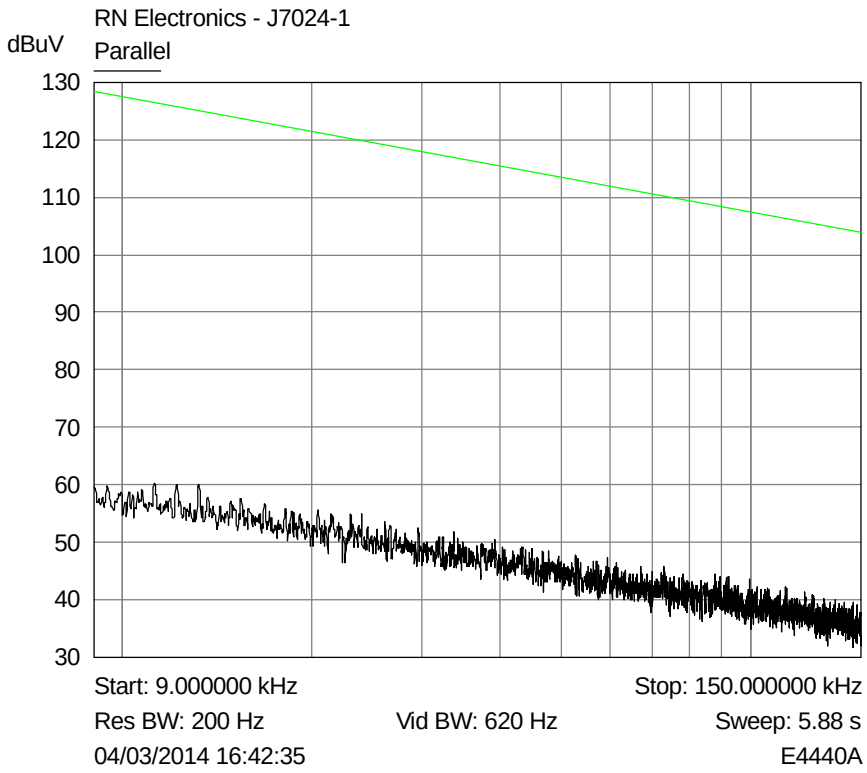
6.1 AC power line conducted emissions plots

NOT APPLICABLE: EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines.

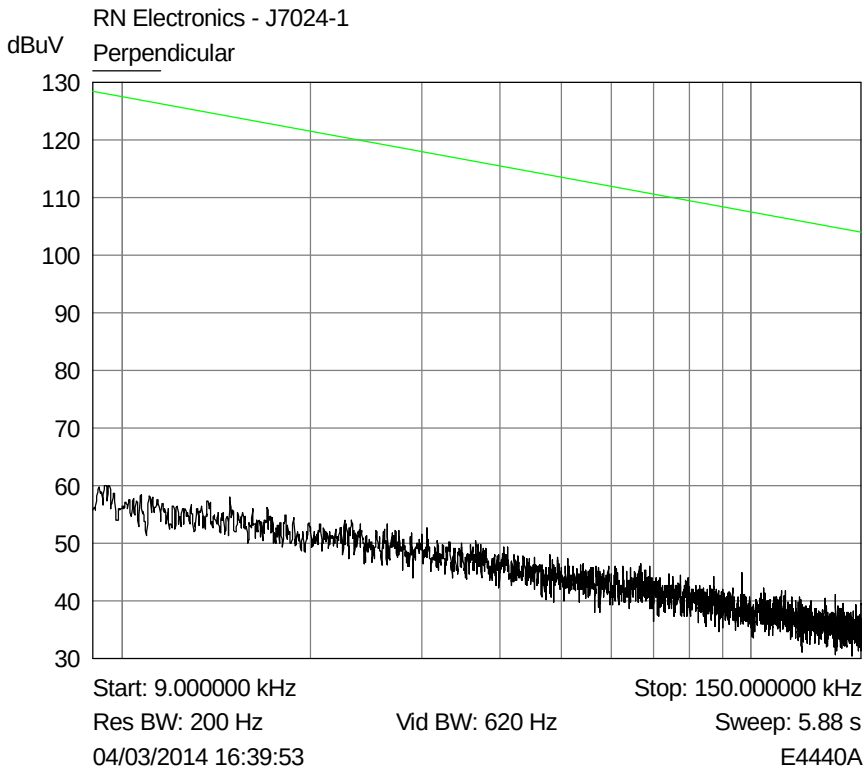
6.2 Intentional radiator field strength



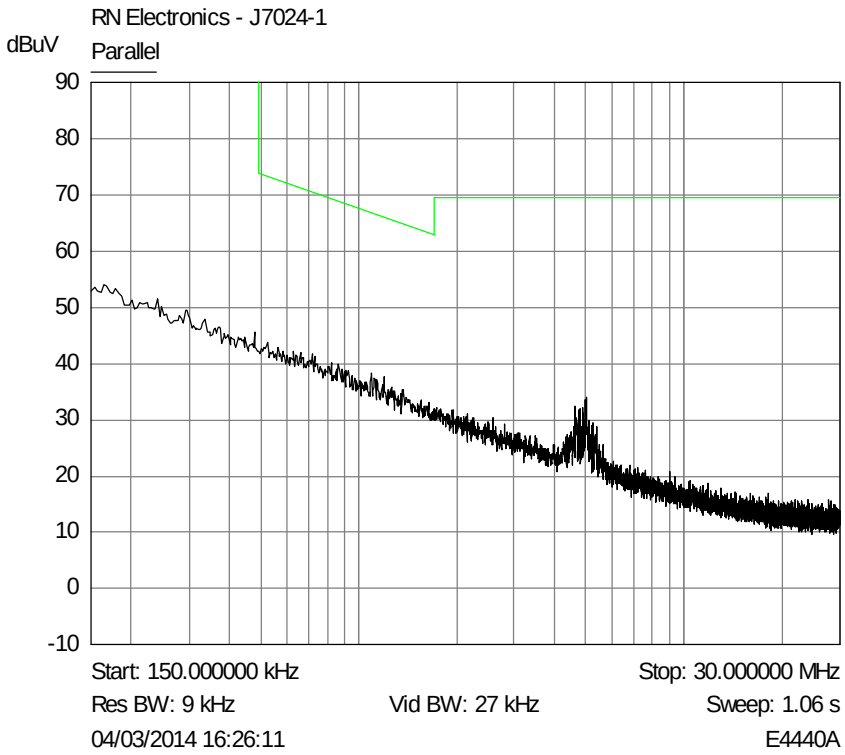
6.3 Radiated emissions plots 9kHz – 1GHz



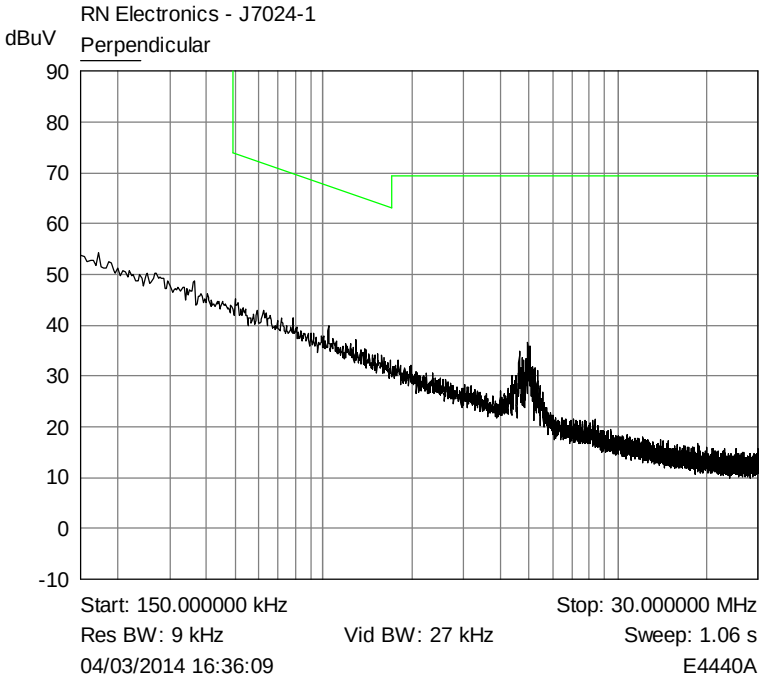
9 kHz – 150 kHz Parallel



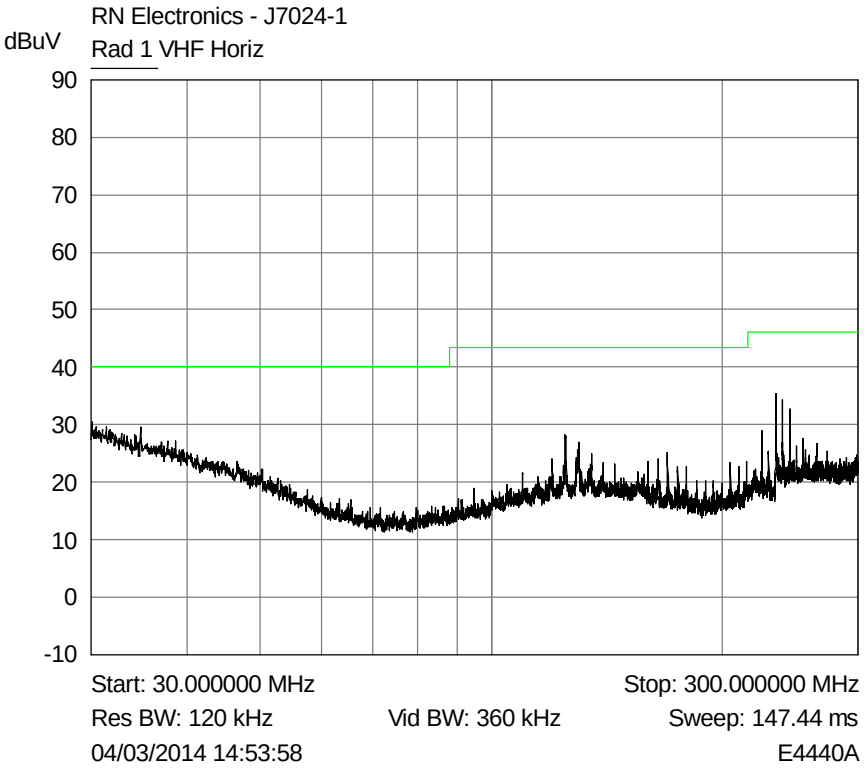
9 kHz – 150 kHz Perpendicular



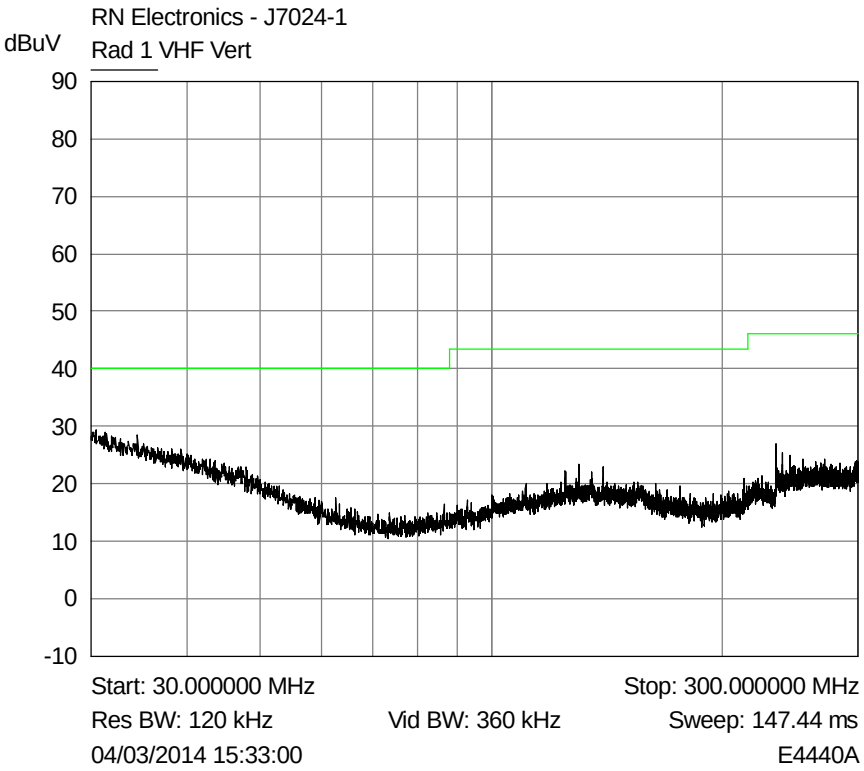
150 kHz – 30 MHz Parallel (only emission is fundamental)



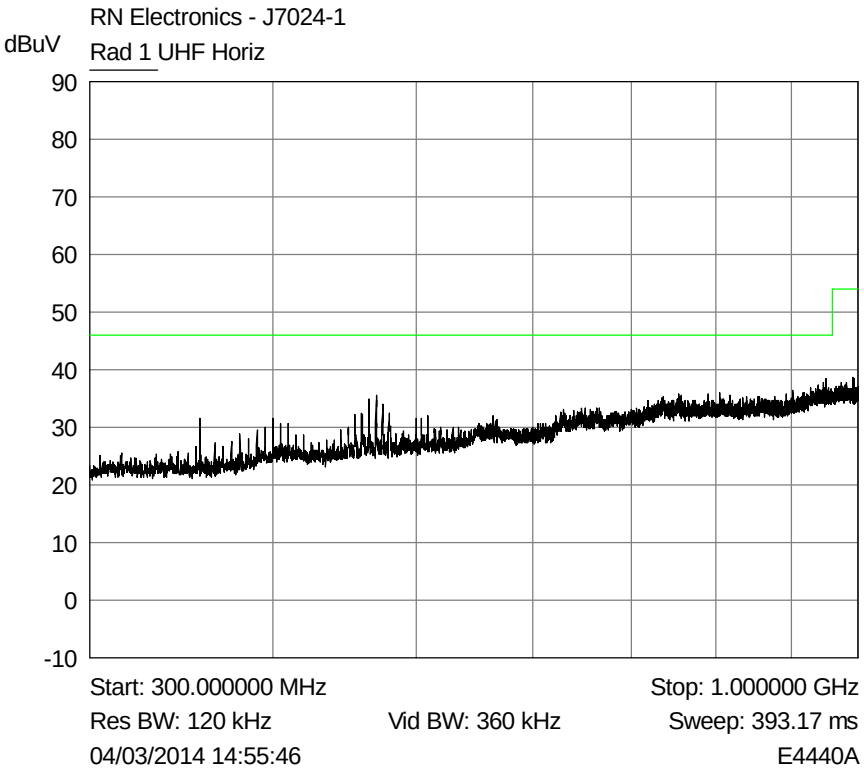
150 kHz – 30 MHz Perpendicular (only emission is fundamental)



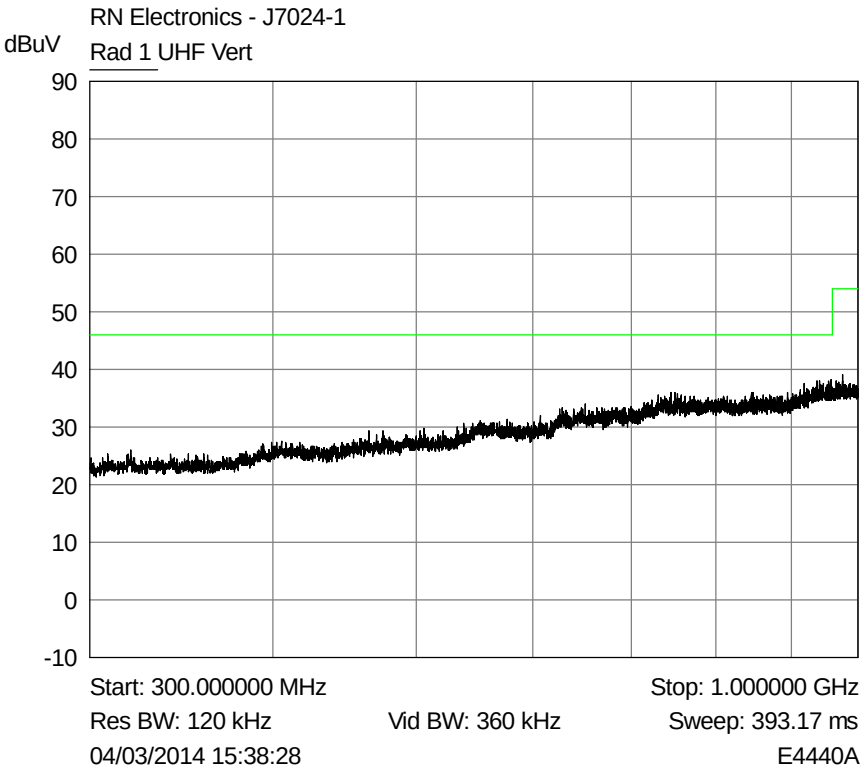
30 MHz – 300 MHz Horizontal



30 MHz – 300 MHz Vertical

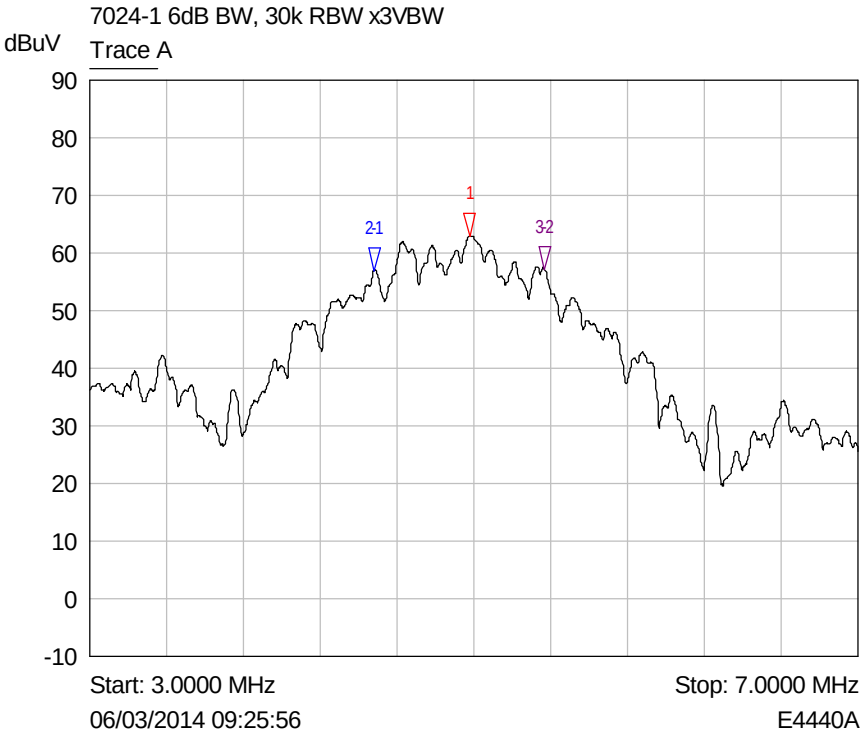


300 MHz – 1 GHz Horizontal



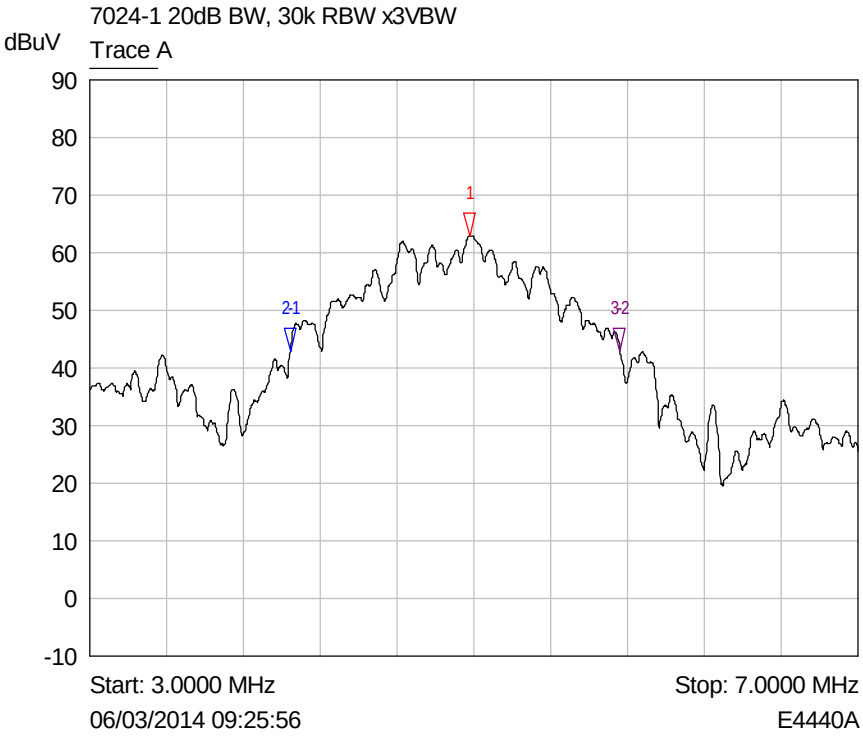
300 MHz – 1 GHz Vertical

6.4 Occupied bandwidth (6 dB) & band edge (20 dB) plots



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	4.9770 MHz	63.04 dBuV	
2-1	Trace A	-496.2481 kHz	-5.99 dB	
3-2	Trace A	886.4432 kHz	0.05 dB	

6 dB Occupied bandwidth plot using 30 kHz RBW



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	4.9770 MHz	63.04 dBuV	
2 1	Trace A	-934.4672 kHz	-20.00 dB	
3 2	Trace A	1.7149 MHz	-0.01 dB	

20 dB bandwidth plot using 30 kHz RBW

7 Explanation of Table of Signals Measured

Measurements are made as required by the standard. These measurements are made and recorded using detectors, either peak, quasi peak or average dependant on the test. A table of results has been given following the relevant plots. This table looks similar to the one illustrated below dependant on the measurements required by the test: -

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Pk – Lim 1 (dB)	QP Amp (dBuV)	QP - Lim1 (dB)	Av Amp (dBuV)	Av - Lim1 (dB)
1	12345	54.9	-10.5	48.0	-12.6	37.6	-14.4

Column One - Labelled Signal No. is an incremental number that the receiver has given to each signal that has been measured.

Column Two - Labelled Freq (MHz) is the approximate frequency of the signal received.

Column Three - Labelled Peak Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the peak detector.

Column Four - Labelled Pk - Lim1 (dB) is the difference in level from the peak signal given to the active limit line. If this column appears in the table the peak detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Column Five - Labelled QP Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the quasi-peak detector.

Column Six - Labelled QP - Lim1 (dB) is the difference in level from the quasi-peak signal given to the active limit line. If this column appears in the table the quasi-peak detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Column Seven - Labelled Av Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the average detector.

Column Eight - Labelled Av - Lim1 (dB) is the difference in level from the average signal given to the active limit line. If this column appears in the table the average detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.
Only signals highlighted in red are deemed to exceed the limit of the detector required.

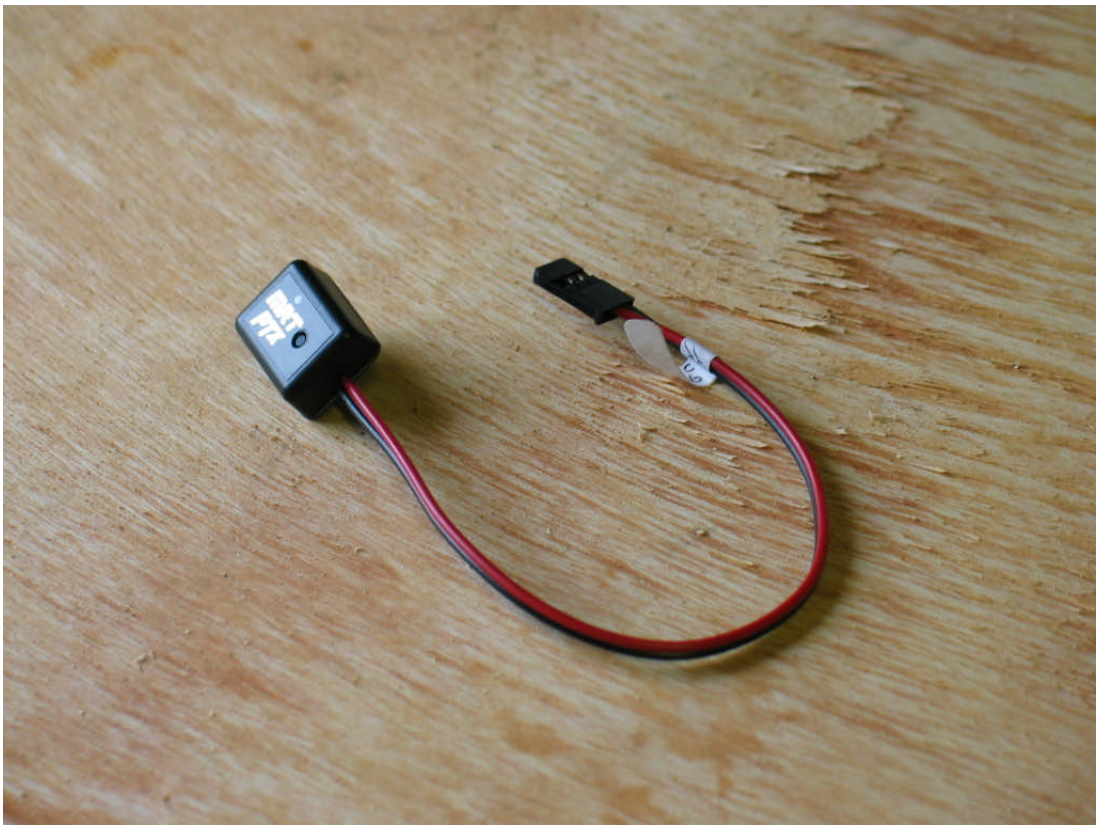
7.1 Explanation of limit line calculations for radiated measurements

The limits given in the test standard are normally expressed as absolute values (e.g. in μV/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dBμV/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to account for any path losses, antenna gains, etc. so that the value read at the receiver relates directly to the absolute value required, except that it is expressed in dB relative to one microVolt and may need to take account of any alternative measuring distance used. Examples:

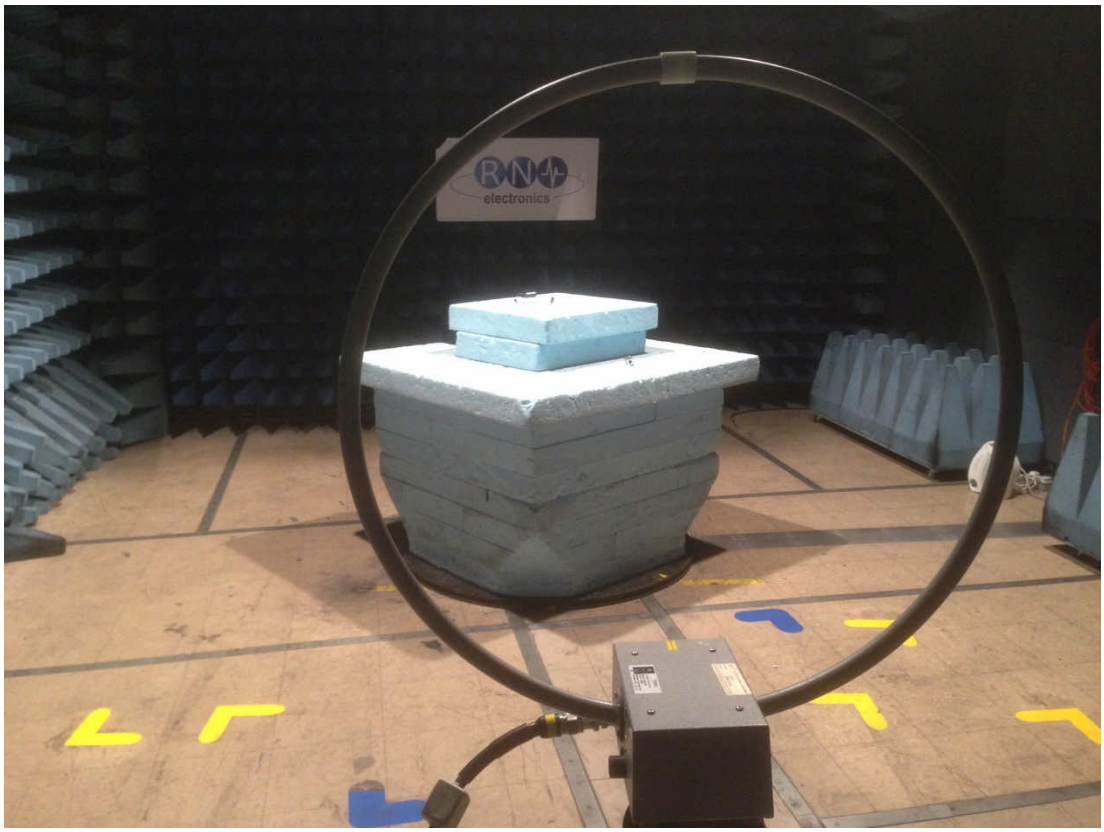
(a) limit of 500 μV/m equates to 20.log (500) = 54 dB μV/m.
(b) limit of 300 μV/m at 10m equates to 20.log (300 . 10/3) = 60 dB μV/m at 3m
(c) limit of 30 μV/m at 30m, but below 30MHz, equates to 20.log(30) + 40.log(30/3) = 69.5 dBμV/m at 3m, as extrapolation factor below 30MHz is 40dB/decade per 15.31(f)(2).

8 Photographs

8.1 EUT front view



8.2 Test set-up, spurious emissions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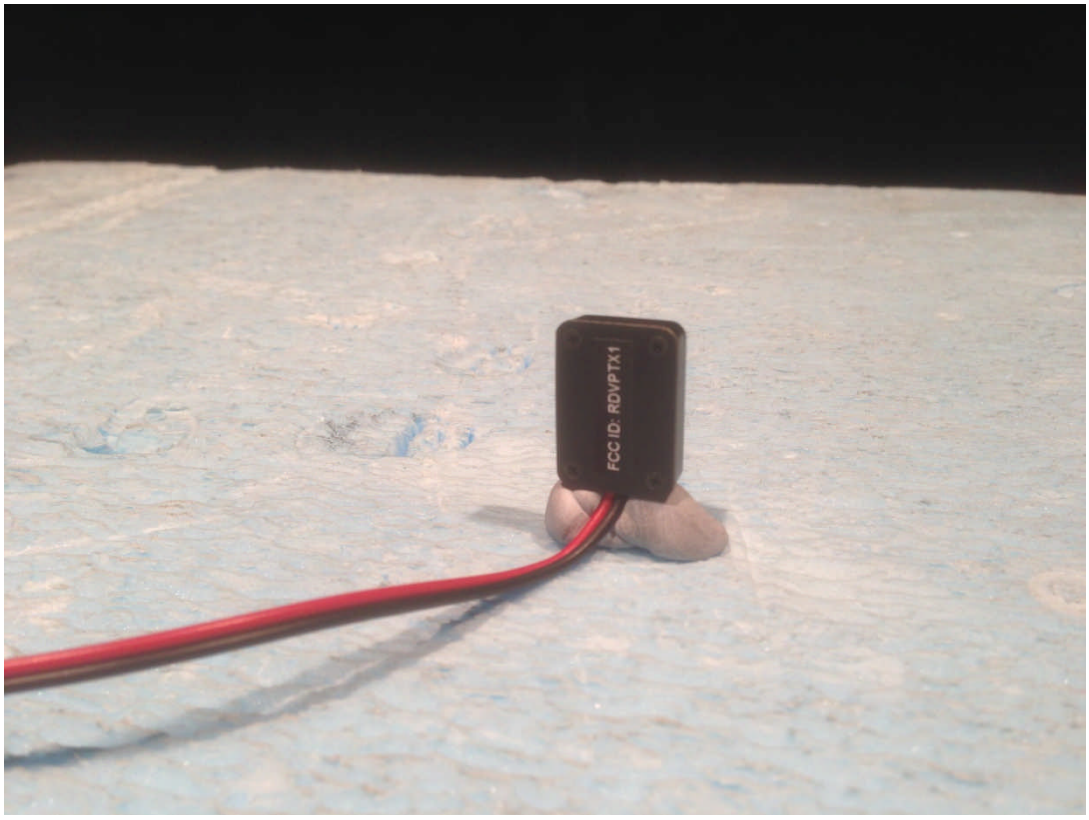
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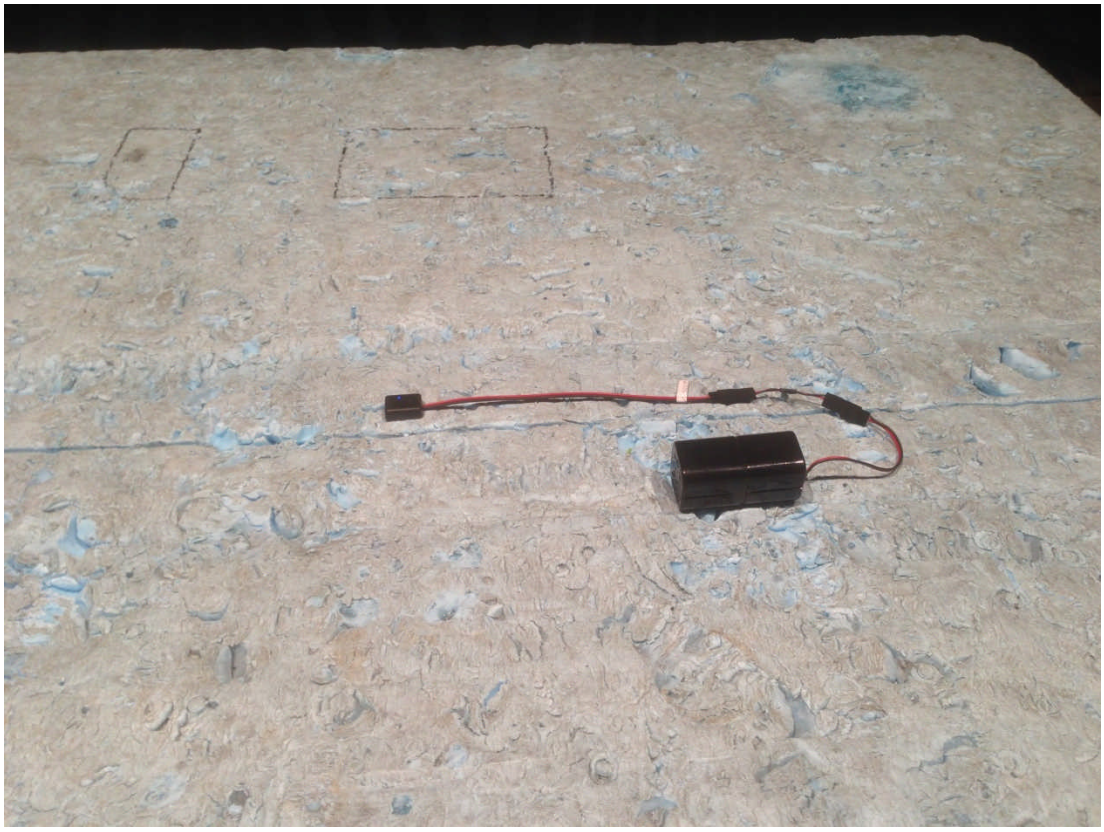
electronics



8.3 Test set-up diagram

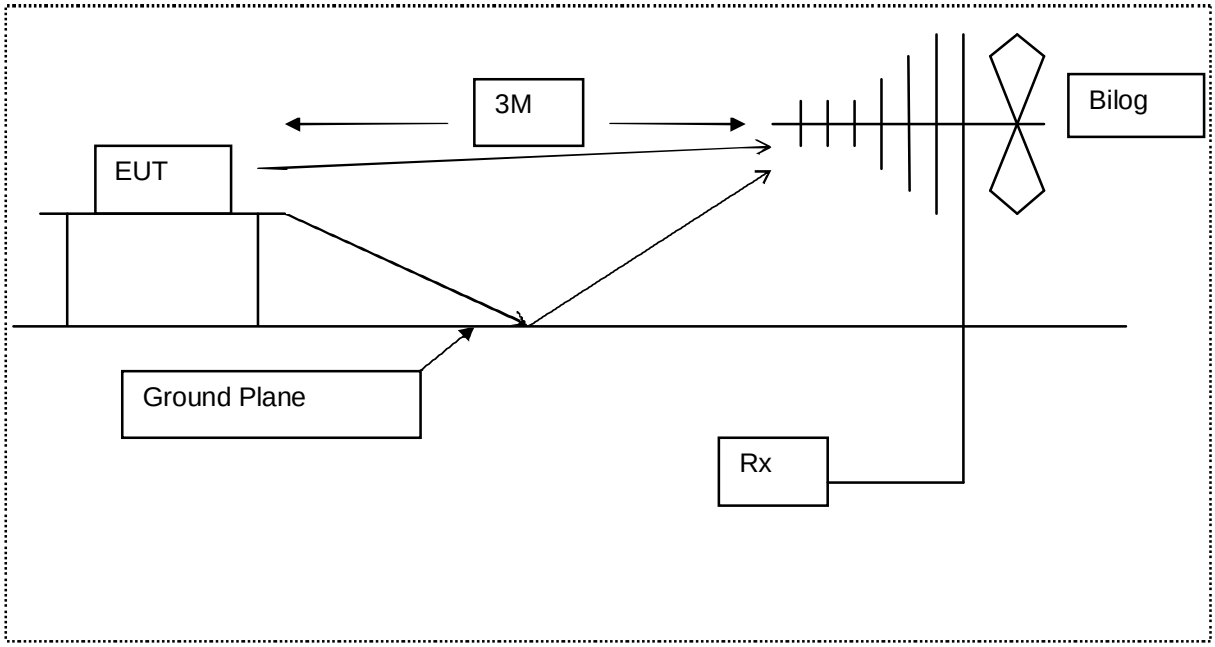


Diagram of the radiated emissions test setup.

9 Test Equipment Calibration list

The following table lists the test equipment used, last calibration date and calibration interval. All test equipment used has been maintained within the calibration requirements of ***R.N. Electronics Ltd.*** test facility quality system. Calibration intervals are regularly reviewed dependent on equipment manufacturer's recommendations and actual usage of the equipment.

RN No.	Model	Description	Manufacturer	Calibration date	Cal period
E226	8546A	EMI Receiver	Hewlett Packard	18-Jun-13	12 months
E410	N5181A	3 GHz MXG Signal Generator	Agilent Technologies	26-Oct-11	†36 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	*21-Jan-14	12 months
E412	E4440A	3 Hz - 26.5 GHz PSA	Agilent Technologies	*21-Jan-14	24 months
TMS81	6502	Active Loop Antenna	EMCO	24-Oct-12	24 months
TMS933	CBL6141A	Bilog Antenna 30MHz - 2GHz	York EMC	09-Sep-12	24 months

* Equipment items marked have been calibrated during the test period and were in calibration for all tests.
† Per manufacturer's recommendation.

10 Auxiliary equipment

10.1 Customer supplied Equipment

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

No customer supplied equipment was used

10.2 Supplied by RN Electronics Limited

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

No RN Electronics supplied equipment was used

11 Modifications

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

11.1 Modifications before test

No modifications were made before test by RN Electronics Ltd.

11.2 Modifications during test

No modifications were made during test by RN Electronics Ltd.

12 Description of Test Sites

Site A	Radio / Calibration Laboratory and anechoic chamber
Site B	Semi-anechoic chamber
Site B1	Control Room for Site B
Site C	Transient Laboratory
Site D	Screened Room (Conducted Immunity)
Site E	Screened Room (Control Room for Site D)
Site F	Screened Room (Conducted Emissions) VCCI Registration No. C-2823
Site G	Screened Room (Control Room for Site H)
Site H	3m Semi-anechoic chamber (indoor OATS) FCC Registration No. 823977
Site J	Screened Room
Site K	Screened Room (Control Room for Site M)
Site M	3m Semi-anechoic chamber (indoor OATS) FCC Registration No. 293246
Site Q	Fully-anechoic chamber
Site OATS	3m and 10m Open Area Test Site FCC Registration No. 293246 IC Registration No. 5612A-1 VCCI Registration No. R-2580
Site R	Screened Room (Conducted Immunity)
Site S	Safety Laboratory
Site T	Transient Laboratory

13 Abbreviations and Units

%	Percent
µV	microVolts
µW	microWatts
AC	Alternating Current
ALSE	Absorber Lined Screened Enclosure
AM	Amplitude Modulation
Amb	Ambient
ANSI	American National Standards Institute
ºC	Degrees Celsius
CFR	Code of Federal Regulations
CS	Channel Spacing
CW	Continuous Wave
dB	deciBels
dBµV	deciBels relative to 1µV
dBc	deciBels relative to Carrier
dBm	deciBels relative to 1mW
DC	Direct Current
DSC	Part 15 security / remote control transmitter
DSR	Part 15 remote control / security device transceiver
EIRP	Equivalent Isotropic Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
FM	Frequency Modulation
FSK	Frequency Shift Keying
g	Grams
GHz	GigaHertz
Hz	Hertz
IF	Intermediate Frequency
kHz	kiloHertz
LO	Local Oscillator
mA	milliAmps
max	maximum
kPa	milliBars
MHz	MegaHertz
min	minimum
mm	milliMetres
ms	milliSeconds
mW	milliWatts
NA	Not Applicable
nom	Nominal
nW	nanoWatt
OATS	Open Area Test Site
OFDM	Orthogonal Frequency Division Multiplexing
ppm	Parts per million
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
Ref	Reference
RF	Radio Frequency
RTP	Room Temperature and Pressure
s	Seconds
Tx	Transmitter
V	Volts