

EMC Technologies (NZ) Ltd

Test Report No: **091201.1**
Report date: 22nd April 2010

TEST REPORT

Explore-R HFE-00-003 RFID Reader

(FCC ID: VRJHFE001107)

tested to

47 Code of Federal Regulations

Part 15 - Radio Frequency Devices

Subpart C – Intentional Radiators

Section 15.225

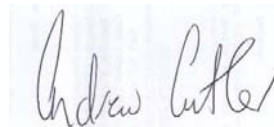
Operation within the band 13.110 -14.010 MHz

Section 15.249

Operation within the band of 2400 – 2483.5 MHz

for

Tracient Technologies Ltd



This Test Report is issued with the authority of:

Andrew Cutler- General Manager



EMC Technologies (NZ) Ltd

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1. STATEMENT OF COMPLIANCE

The **Explore-R HFE-00-003 RFID Reader** complies with FCC Part 15 Subpart C Section 15.225 and Section 15.249 as an Intentional Radiator when the methods as described in ANSI C63.4 - 2003 are applied.

2. RESULTS SUMMARY

The results from testing are summarised in the following table:

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Certification required.
15.203	Antenna requirement	Complies. Antennas internal to the device.
15.204	External PA and antenna modifications	Not applicable. No external devices.
15.205	Restricted bands of operation	Complies. Device transmits on 13.560 MHz and in the 2.4 GHz band.
15.207	Conducted limits	Complies.
15.209	Radiated emission limits - Spurious emissions <30 MHz	Complies with a 31.1 dB margin at 27.120 MHz
15.209	Radiated emission limits – Spurious emissions >30 MHz	Complies with a 0.6 dB margin at 149.160 MHz (Vertical).
15.215	Additional provisions	Complies
15.225	Radiated emission limits - Fundamental	Complies with a 55.1 dB margin at 13.560 MHz.
15.225	Frequency stability	Complies
15.249 (a)	Field strength of fundamental	Complies
15.249 (a)	Field strength of harmonics	Complies
15.249 (b)	Fixed, point to point operations	Not applicable
15.249 (c)	3 metre measurement distance	Noted
15.249 (d)	Spurious emission levels except harmonics	Complies. See 15.209 listed above
15.249 (e)	Detectors above 1000 MHz	Noted
15.249 (f)	Reference to section 15.37(d)	Noted

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3. INTRODUCTION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification.

The client selected the test sample.

This report relates only to the sample tested.

This report contains no corrections or erasures.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

4. CLIENT INFORMATION

Company Name	Tracient Technologies Ltd
Address	Unit 8 Amuri Park 404 Barbadoes Street
City	Christchurch
Country	New Zealand
Contact	Mr Paul Reid

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Explore-R
Model Number	HFE-00-003
Product	HF RFID Reader with Bluetooth option
Manufacturer	Tracient Technologies Ltd
Country of Origin	New Zealand
Serial Number	01650 (FCC ID: VRJHFE001107)

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6. SETUPS AND PROCEDURES

Standard

The sample was tested in accordance with 47 CFR Part 15 Subpart C.

Methods and Procedures

The measurement methods and procedures as described in ANSI C63.4 - 2003 were used.

Section 15.201: Equipment authorisation requirement

Certification as detailed in Subpart J of Part 2 is required for this device.

Section 15.203: Antenna requirement

This device has an internal antenna.

Result: Complies.

Section 15.204: External radio frequency power amplifiers and antenna modifications

It is not possible to attach an external power amplifier to this transmitter.

Result: Complies.

Section 15.205: Restricted bands of operation

The transmitter transmits on 13.561 MHz.

This falls into the band 13.110 – 14.010 MHz that is covered by Section 15.225.

The device also has a Bluetooth transmitter that operates in the band 2400 – 2483.5 MHz that is covered by Section 15.247

Result: Complies.

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Section 15.107: Conducted emissions testing

Conducted Emissions testing was carried out over the frequency range of 150 kHz to 30 MHz which was carried out at the laboratory's MacKelvie Street premises in a 2.4 m x 2.4 m x 2.4 m screened room

Testing was carried out using a representative AC adaptor as this can be connected to the AC mains supply either directly or indirectly.

Testing was carried out with the transmitter operating with the antenna attached and with the antenna removed and replaced with a dummy load when the device was connected to the USB port of the device.

It is not possible for the Bluetooth transmitter to operate when the device is connected to the USB port.

The HF transmitter operates on 13.561 MHz.

The device is deemed to comply providing it complies when the test is carried out with the dummy load attached and the overall emission signature for the product remains similar with no additional emissions being detected.

This is the case with this device.

The device was placed on top of the emissions table, which is 1 m x 1.5 m, 80 cm above the screened room floor which acts as the horizontal ground plane.

In addition the device was positioned 40cm away from the screened room wall which acts as the vertical ground plane.

The artificial mains network was bonded to the screened room floor.

At all times the device was kept more than 80 cm from the artificial mains network.

The Class B limits have been applied.

Measurement uncertainty with a confidence interval of 95% is:

- AC Mains port (0.15-30 MHz) ± 2.8 dB

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Conducted Emissions – AC Mains Port

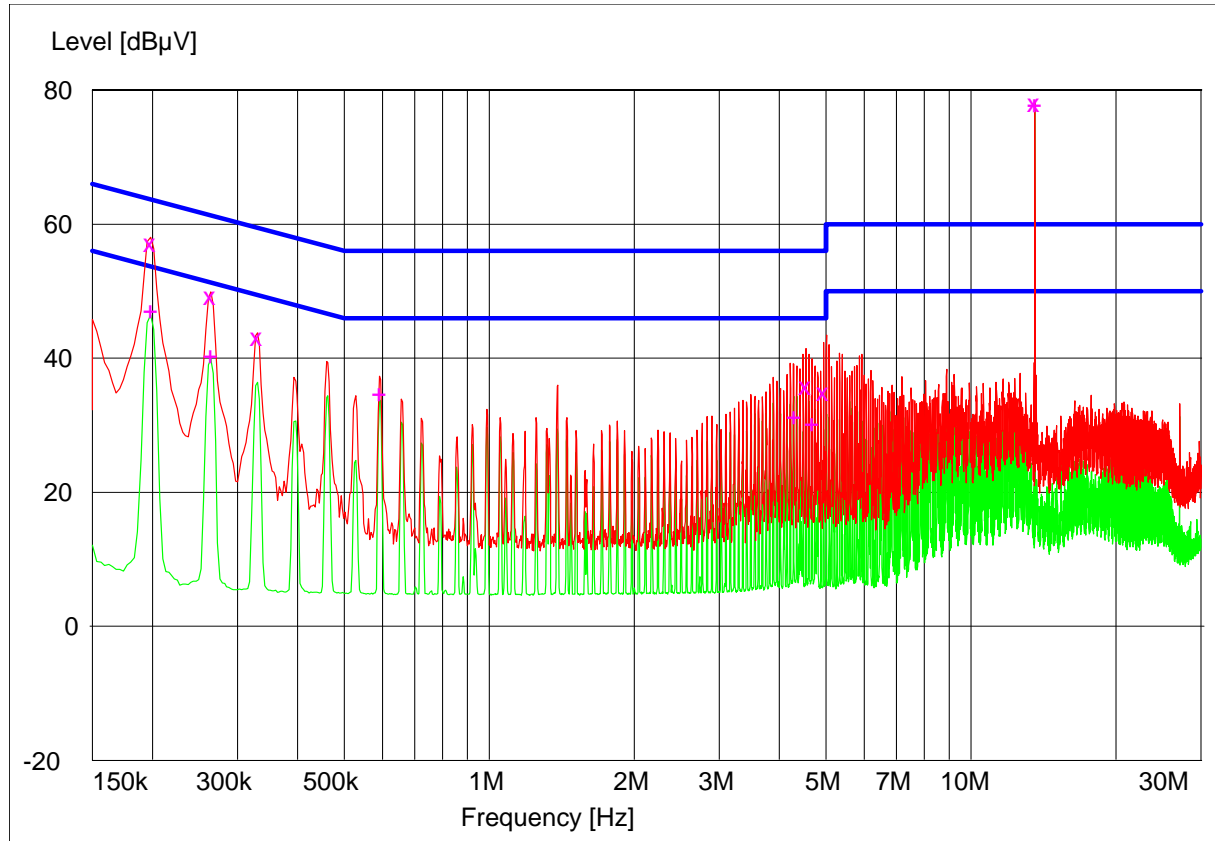
Setup: Device tested when transmitting continuously on 13.560 MHz when attached to the USB port of a laptop computer that was powered at 110 Vac using a representative AC adaptor

Peak -----

Average -----

Quasi Peak X

Average +



Final Quasi-Peak Measurements

Frequency MHz	Level dBμV	Limit dBμV	Margin dB	Phase	Rechecks dBμV
0.198000	57.10	63.7	6.6	L1	
0.264000	49.20	61.3	12.1	L1	
0.330000	43.20	60.0	16.2	N	
4.542500	35.90	56.0	20.1	L1	
4.938500	35.00	56.0	21.0	L1	
13.560500	78.10	60.0	-18.1	N	

Final Average Measurements

Frequency MHz	Level dBμV	Limit dBμV	Margin dB	Phase	Rechecks dBμV
0.198000	47.20	53.7	6.5	N	
0.264000	40.40	51.3	10.9	L1	
0.591000	34.80	46.0	11.2	N	
4.281500	31.50	46.0	14.5	L1	
4.673000	30.30	46.0	15.7	L1	
13.560500	78.00	50.0	-28.0	N	

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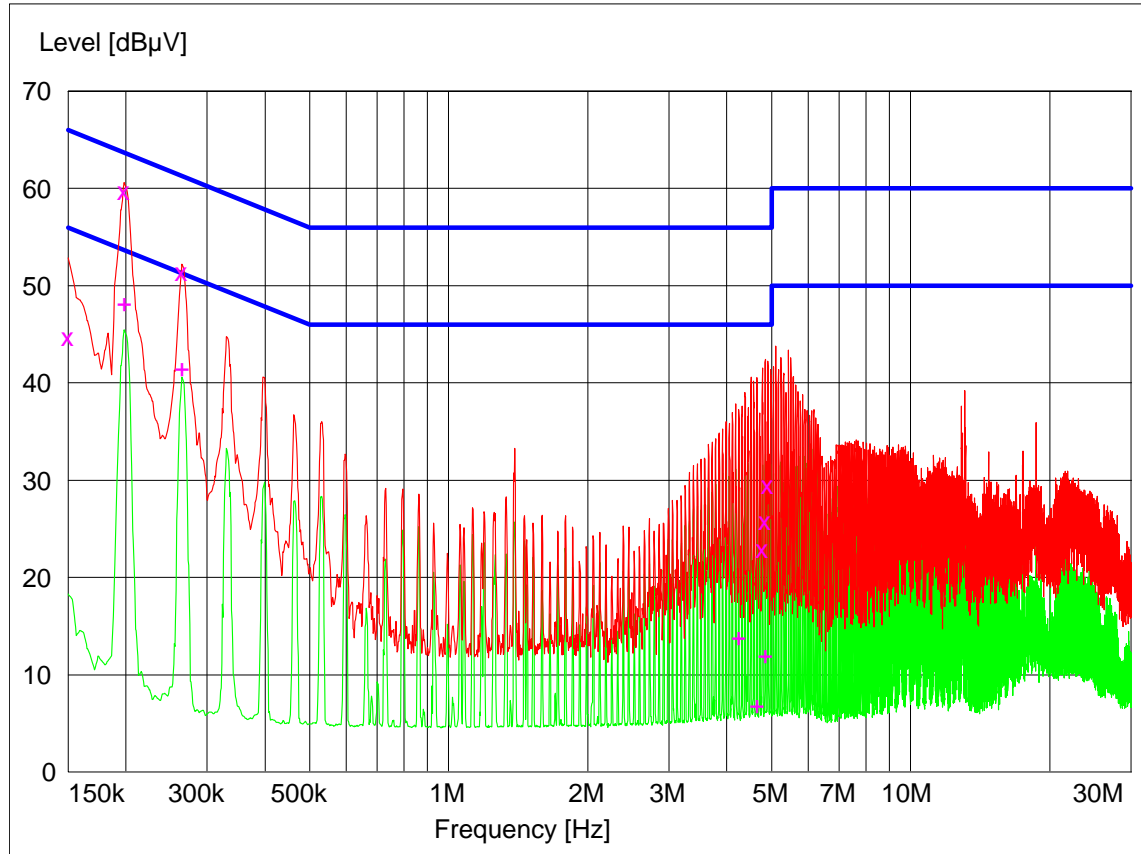
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Conducted Emissions – AC Mains Port

Setup:	Device tested when powered at 110 Vac using a laptop computer when transmitting continuously on 13.560 MHz with a dummy load attached to the HF transmitter output
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Peak ---	Average --	Quasi Peak X	Average +
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Final Quasi-Peak Measurements

Frequency MHz	Level dBμV	Limit dBμV	Margin dB	Phase	Rechecks dBμV
0.150000	44.70	66.0	21.3	N	
0.198000	59.80	63.7	3.9	L1	
0.264000	51.40	61.3	9.9	L1	
4.776500	23.00	56.0	33.0	N	
4.844000	25.90	56.0	30.1	N	
4.911500	29.50	56.0	26.5	N	

Final Average Measurements

Frequency MHz	Level dBμV	Limit dBμV	Margin dB	Phase	Rechecks dBμV
0.198000	48.30	53.7	5.4	L1	
0.264000	41.60	51.3	9.7	L1	
4.245500	13.90	46.0	32.1	N	
4.641500	6.90	46.0	39.1	N	
4.844000	12.00	46.0	34.0	N	

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Section 15.209: Radiated emission limits, general requirements

Radiated emissions testing was carried out over the frequency range of 13 MHz to 24 GHz.

Testing was carried out at the laboratory's open area test site - located at Driving Creek, Orere Point, Auckland, New Zealand.

This site conforms to the requirements of CISPR 16 and ANSI C63.4 - 2003.

Testing was carried out when the device was powered from an internal battery that was charged when connected to the USB port of a computer.

All testing was carried out when the device was attached to the USB port of a laptop computer that was running software supplied by the client which enabled the transmitter to be controlled.

Testing was also carried out when the device was operating with the Bluetooth transmitter operating.

The device was placed in the centre of the test table standing vertically upright which pre-testing showed to be the worst case axis.

Testing was carried out in this position as can be seen from the photographs.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height, where appropriate, with an automated antenna tower.

Below 30 MHz a magnetic loop is used with the centre of the loop being 1 metre above the ground.

Above 30 MHz the emission is measured in both vertical and horizontal antenna polarisations, where appropriate.

The emission level was determined in field strength by taking the following into consideration:

Level (dB μ V/m) = Receiver Reading (dB μ V) + Antenna Factor (dB) + Coax Loss (dB)

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 – 1000 MHz) \pm 4.1 dB
- Free radiation tests (100 kHz – 30 MHz) \pm 4.8 dB

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Section 15.209: Spurious Emissions (below 30 MHz)

Frequency MHz	Level dBuV/m	Distance metres	Limit (dBuV/m)	Margin (dB)
27.122	18.9	10	49.5	31.1

Testing was carried out when the device was transmitting continuously.

Magnetic loop measurements were attempted at a distance of 10 metres.

A receiver with a quasi peak detector with a 9 kHz bandwidth was used between 490 kHz – 30.0 MHz.

The 30 metre limit between 1.705 MHz – 30 MHz has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

The limit at 27.122 MHz when measured at 30 metres is 30 uV/m or 29.54 dBuV/m.

Therefore when scaled the limit at 10 metres will be 49.54 dBuV/m.

The spurious emission observed does not exceed the level of the fundament emission.

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Section 15.209: Spurious Emissions (above 30 MHz)

Measurements between 30 – 24,000 MHz have been made at a distance of 3 metres.

A receiver with a quasi peak detector with a 120 kHz bandwidth was used between 30 – 1000 MHz.

The spurious emissions observed do not exceed the level of the fundamental emission.

The limits as described in Section 15.209 have been applied.

Test carried out in USB mode

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Result	Antenna
40.680	25.1		40.0	14.9	Pass	Vertical
54.240	23.2		40.0	16.8	Pass	Vertical
67.800	21.5		40.0	18.5	Pass	Vertical
81.360	20.5		40.0	19.5	Pass	Vertical
94.920	29.0		43.5	14.5	Pass	Vertical
108.480	31.4	18.2	43.5	12.1	Pass	Vertical
122.040	37.6	24.6	43.5	5.9	Pass	Vertical
135.600	41.8	35.7	43.5	1.7	Pass	Vertical
149.160	42.9	36.4	43.5	0.6	Pass	Vertical
162.720	34.1	31.3	43.5	9.4	Pass	Vertical
176.280	31.5		43.5	12.0	Pass	Vertical
189.840	20.2		43.5	23.3	Pass	Vertical
203.400	20.6		43.5	22.9	Pass	Vertical
366.120	26.6	33.1	46.0	12.9	Pass	Horizontal
379.680	26.7	34.1	46.0	11.9	Pass	Horizontal
393.240	31.5	32.5	46.0	13.5	Pass	Horizontal
406.800	26.9		46.0	19.1	Pass	Vertical
420.360	25.8		46.0	20.2	Pass	Vertical

All other emissions observed at a margin to limit that exceeded 20 dB when measurements were attempted using vertical and horizontal polarisations.

When the USB connection to the computer was removed and the device was operated with a Bluetooth link there was no change to the emissions observed above and no new emissions were detected.

No inter-modulation products were observed when both transmitters were operating.

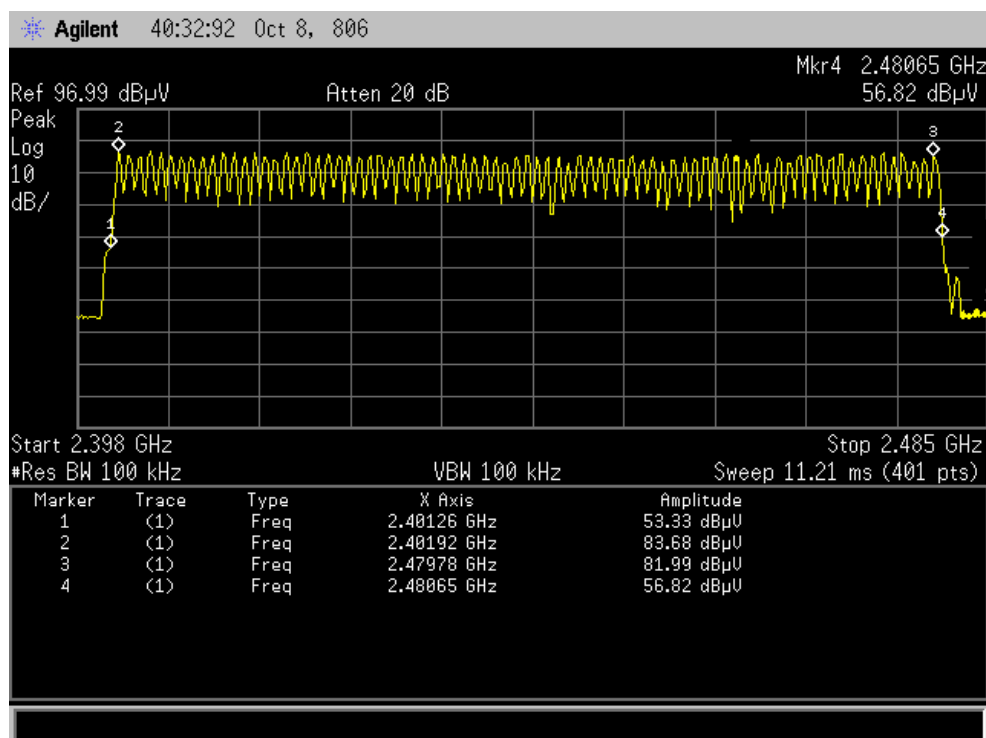
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Section 15.215(c) – Additional provisions to the general radiated emission limitations

At the band edges of 2400.000 MHz and 2483.500 MHz all emissions are required to be attenuated by more than 20 dB relative to the highest emission level observed in the band of operation.

The device can be seen to meet the band-edge -20 dBc requirements at 2401.260 MHz and 2480.650 MHz.



Either side of the 2400 – 2483.5 MHz there are restricted bands which need to be considered.

These bands are from 2310 – 2390 MHz and 2483.5 – 2500 MHz where emissions are not allowed to exceed 54 dBuV/m when measured using an Average detector or 74 dBuV/m when measured using a Peak detector.

Measurements were attempted in these restricted bands but no emissions were detected within 20 dB of the limits described above.

Result: Complies

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Section 15.225: Fundamental emission:

Measurements were made using a magnetic loop antenna and a receiver with a quasi peak detector using a 9 kHz bandwidth

Measurements were made at a distance of 10 metres with the limit being determined by using the extrapolation factor of 40 dB per decade limit, as detailed in section 15.31 f (2).

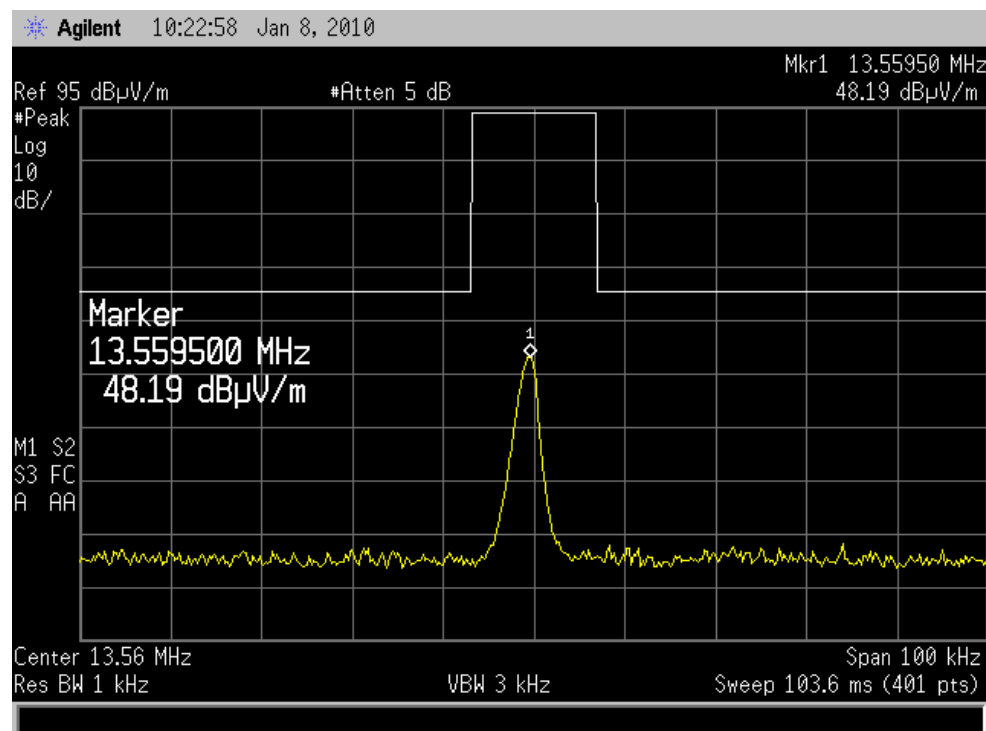
The limit at 30 m at 13.561 MHz is 15,848 uV/m or 84.0 dBuV/m.

Therefore applying the extrapolation factor of 40 dB/ per decade, the limit is 104 dBuV/m.

Testing was carried out when the device was transmitting continuously.

Frequency MHz	Level dBuV/m	Distance metres	Limit (dBuV/m)	Margin (dB)
13.559	48.9	10.0	104.0	55.1

A representative spectrum analyser plot shows that the carrier and modulation peaks do not exceed the spurious emission limits within +/- 50 kHz of the carrier and within +/- 1 MHz of the carrier.



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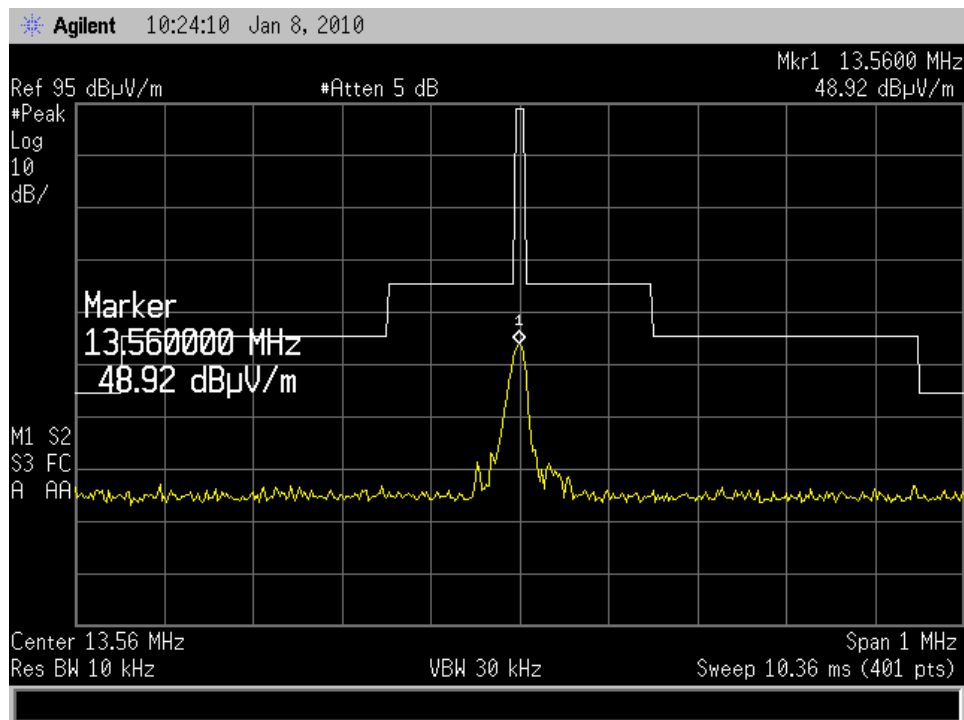
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Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

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Section 15.225: Frequency tolerance:

The frequency tolerance of carrier is required to be +/- 0.01% of operating frequency when the temperature is varied between -20 degrees and +50 degrees.

The device operates on approximately 13.560 MHz which gives a frequency tolerance of +/- 1,356 Hz.

Temperature	Frequency (MHz)	Difference (Hz)
-20.0	13.559 170	-830.0
-10.0	13.559 360	-640.0
+0.0	13.559 390	-610.0
+10.0	13.559 495	-505.0
+20.0	13.559 410	-590.0
+30.0	13.559 470	-530.0
+40.0	13.559 515	-485.0
+50.0	13.559 535	-465.0
-20.0	13.559 170	-830.0

Variation of the 120 Vac supply to the laptop computer, to when the device was attached to using the USB port, at +20 degrees did not vary the frequency output

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Frequency tolerance \pm 50 Hz

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Section 15.249(a) – Field strength of the Fundamental

The Bluetooth device operates between 2402 – 2480 MHz using 79 channels that are separated by 1 MHz.

As the device is portable when operating in Bluetooth mode pre testing was carried out in the X., Y and Z axis to determine the axis with the highest level.

It was found that the X axis gave the highest emission levels and hence all testing was carried out in this X axis.

The X axis were determined to be when the device was standing vertically upright which can be seen in the test set up photos.

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polarity	Detector
2402.000	81.5	94.0	12.5	Vertical	Peak
2402.000	82.6	94.0	11.4	Horizontal	Peak
2440.000	80.4	94.0	13.6	Vertical	Peak
2440.000	82.2	94.0	11.8	Horizontal	Peak
2480.000	81.9	94.0	12.1	Vertical	Peak
2480.000	82.4	94.0	11.6	Horizontal	Peak

Measurements were made using a peak detector with a 1 MHz bandwidth with the average limit being applied.

The device was tested on an open area test site at a distance of 3.0 metres with continuous Bluetooth link established to a laptop computer.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland.

The power maximum level is determined by rotating the automated turntable and by varying the antenna height with an automated antenna tower.

The emission was measured in both vertical and horizontal antenna polarisations.

Result: Complies

Measurement Uncertainty: ± 4.1 dB

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Section 15.249(a) – Field strength of the Harmonics

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland.

The device was placed on the test table top which was a total of 0.8 m above the test site ground plane.

The device was powered using an internal 3 Vdc Lithium battery with a continuous Bluetooth link established to a laptop computer.

Measurements of the radiated field were made with the antenna located at a 3 m horizontal distance from the boundary of the device under test.

Measurements below 1000 MHz were made using an Quasi Peak Detector with a bandwidth of 120 kHz.

Measurements above 1000 MHz were made using an average detector with a bandwidth of 1.0 MHz and also a peak detector with a bandwidth of 1.0 MHz.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height with an automated antenna tower.

The emission is measured in both vertical and horizontal antenna polarisations.

The emission level is determined in field strength by taking the following into consideration:

Level (dBμV/m) = Receiver Reading (dBμV) + Antenna Factor (dB) + Coax Loss (dB)

As it was not possible to control the transmitter measurements were carried while the device was operating.

Measurements were made at both 3 metres and at 10 cm with the same result being recorded on all 3 frequencies when using a measuring receiver with both peak and average detectors.

In addition a spectrum analyser operating with a 0 Hz span with a 1 MHz resolution bandwidth on each of the transmitting frequencies below.

Result: Complies

Measurement uncertainty: +/- 4.1 dB

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Transmitting on 2402 MHz

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Polarity	Detector
4804.000	-	-	54.0	-	Vert/Hort	Peak
4804.000	-	-	74.0	-	Vert/Hort	Average
7206.000	-	-	54.0	-	Vert/Hort	Peak
7206.000	-	-	74.0	-	Vert/Hort	Average
9608.000	-	-	54.0	-	Vert/Hort	Peak
9608.000	-	-	74.0	-	Vert/Hort	Average
12010.000	-	-	54.0	-	Vert/Hort	Peak
12010.000	-	-	74.0	-	Vert/Hort	Average
14412.000	-	-	54.0	-	Vert/Hort	Peak
14412.000	-	-	74.0	-	Vert/Hort	Average
16814.000	-	-	54.0	-	Vert/Hort	Peak
16814.000	-	-	74.0	-	Vert/Hort	Average
19216.000	-	-	54.0	-	Vert/Hort	Peak
19216.000	-	-	74.0	-	Vert/Hort	Average
21618.000	-	-	54.0	-	Vert/Hort	Peak
21618.000	-	-	74.0	-	Vert/Hort	Average
24020.000	-	-	54.0	-	Vert/Hort	Peak
24020.000	-	-	74.0	-	Vert/Hort	Average

Transmitting on 2442 MHz

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Polarity	Detector
4880.000	-	-	54.0	-	Vert/Hort	Peak
4880.000	-	-	74.0	-	Vert/Hort	Average
7320.000	-	-	54.0	-	Vert/Hort	Peak
7320.000	-	-	74.0	-	Vert/Hort	Average
9760.000	-	-	54.0	-	Vert/Hort	Peak
9760.000	-	-	74.0	-	Vert/Hort	Average
12200.000	-	-	54.0	-	Vert/Hort	Peak
12200.000	-	-	74.0	-	Vert/Hort	Average
14640.000	-	-	54.0	-	Vert/Hort	Peak
14640.000	-	-	74.0	-	Vert/Hort	Average
17080.000	-	-	54.0	-	Vert/Hort	Peak
17080.000	-	-	74.0	-	Vert/Hort	Average
19520.000	-	-	54.0	-	Vert/Hort	Peak
19520.000	-	-	74.0	-	Vert/Hort	Average
21960.000	-	-	54.0	-	Vert/Hort	Peak
21960.000	-	-	74.0	-	Vert/Hort	Average
24400.000	-	-	54.0	-	Vert/Hort	Peak
24400.000	-	-	74.0	-	Vert/Hort	Average

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Transmitting on 2480 MHz

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Polarity	Detector
4960.000	-	-	54.0	-	Vert/Hort	Peak
4960.000	-	-	74.0	-	Vert/Hort	Average
7440.000	-	-	54.0	-	Vert/Hort	Peak
7440.000	-	-	74.0	-	Vert/Hort	Average
9920.000	-	-	54.0	-	Vert/Hort	Peak
9920.000	-	-	74.0	-	Vert/Hort	Average
12400.000	-	-	54.0	-	Vert/Hort	Peak
12400.000	-	-	74.0	-	Vert/Hort	Average
14880.000	-	-	54.0	-	Vert/Hort	Peak
14880.000	-	-	74.0	-	Vert/Hort	Average
17360.000	-	-	54.0	-	Vert/Hort	Peak
17360.000	-	-	74.0	-	Vert/Hort	Average
19840.000	-	-	54.0	-	Vert/Hort	Peak
19840.000	-	-	74.0	-	Vert/Hort	Average
22320.000	-	-	54.0	-	Vert/Hort	Peak
22320.000	-	-	74.0	-	Vert/Hort	Average
24800.000	-	-	54.0	-	Vert/Hort	Peak
24800.000	-	-	74.0	-	Vert/Hort	Average

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EMC Technologies (NZ) Ltd

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7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	Not applic
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	Not applic
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applic
Receiver	R & S	ESHS 10	828404/005	3728	21 Aug 2010
Mains Network	R & S	ESH2-Z5	881362/032	3628	21 Aug 2010
Receiver	R & S	ESCS 30	847124/020	E1595	21 Feb 2011
Receiver	R & S	ESIB 40	100171	R-27-1	21 Aug 2010
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3771	20 April 2010
Microwave Preamp	Hewlett Packard	8349B	2644A01659	-	20 April 2010
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603	7 Feb 2011
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612	7 Feb 2011
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	7 Feb 2011
Horn Antenna	Electrometrics	RGA-60	6234	E1492	10 May 2010
Horn Antenna	EMCO	3116	2276	-	10 May 2010

8. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies Ltd registration with the Federal Communications Commission as a listed facility, registration number: 90838, which was updated on January 23rd, 2010.

All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025, 2005.

All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025, 2005

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

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9. PHOTOGRAPHS

External Photos



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Radiated Emission Test Set Ups – USB Mode



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Blue Tooth Mode



X – Plane mode standing upright



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Z Plane Mode – Standing on its edge



Y Plane Mode – Laying flat on top of the test table



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Conducted emissions test set up



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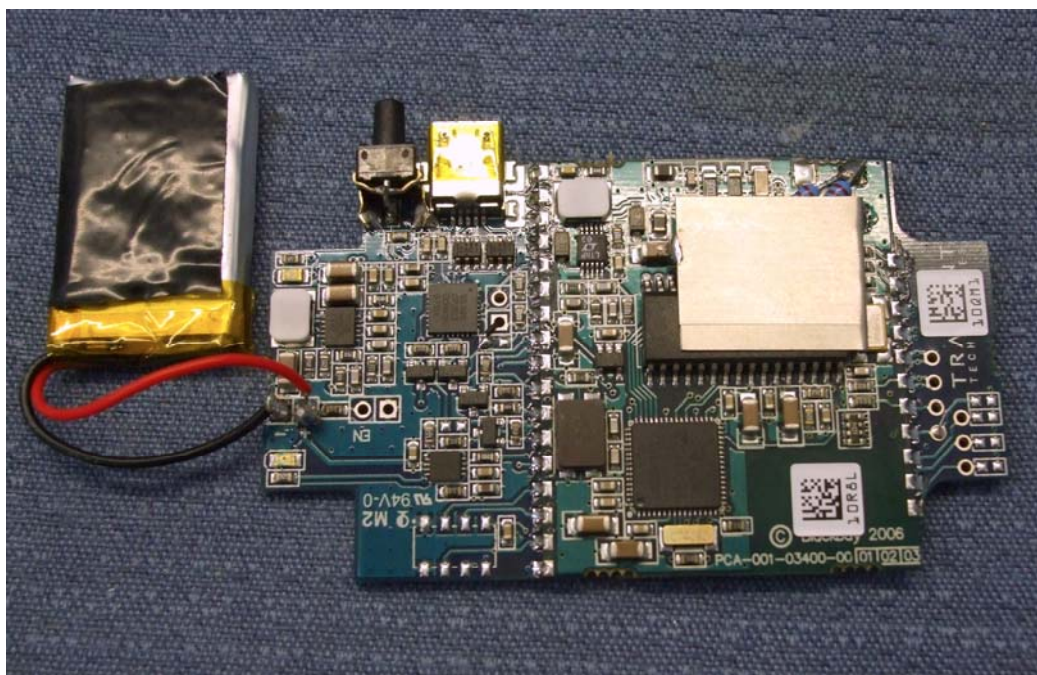
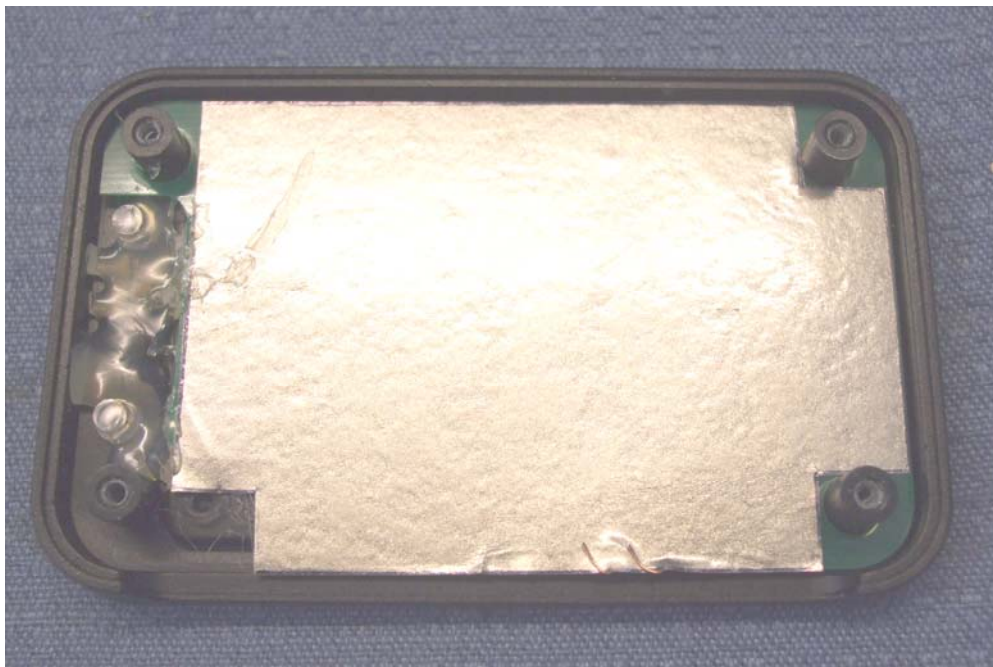
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Internal Views – HF Antenna



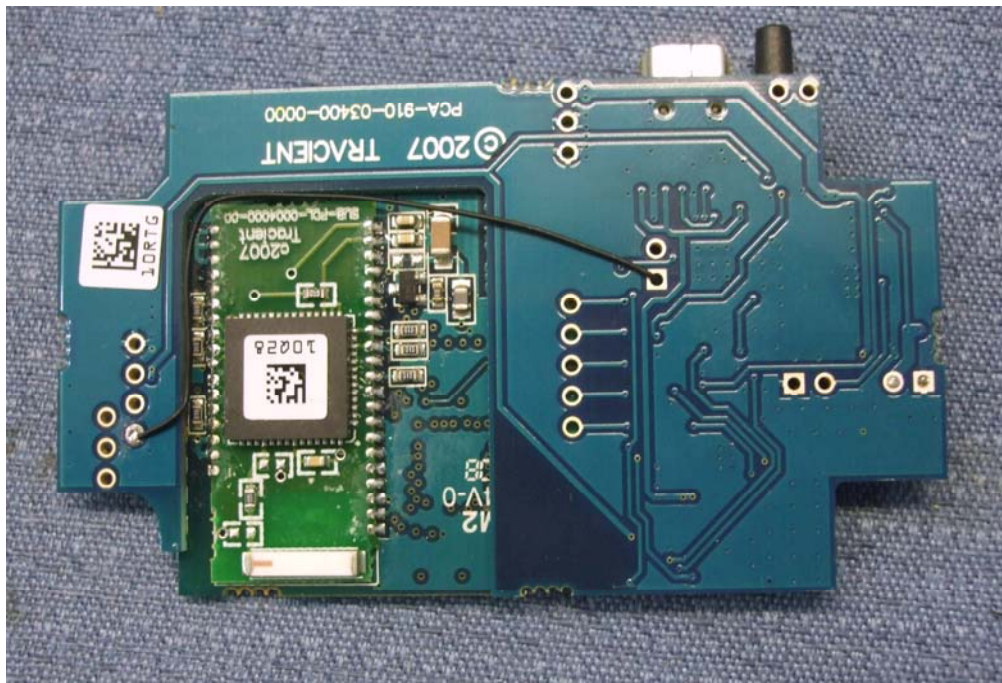
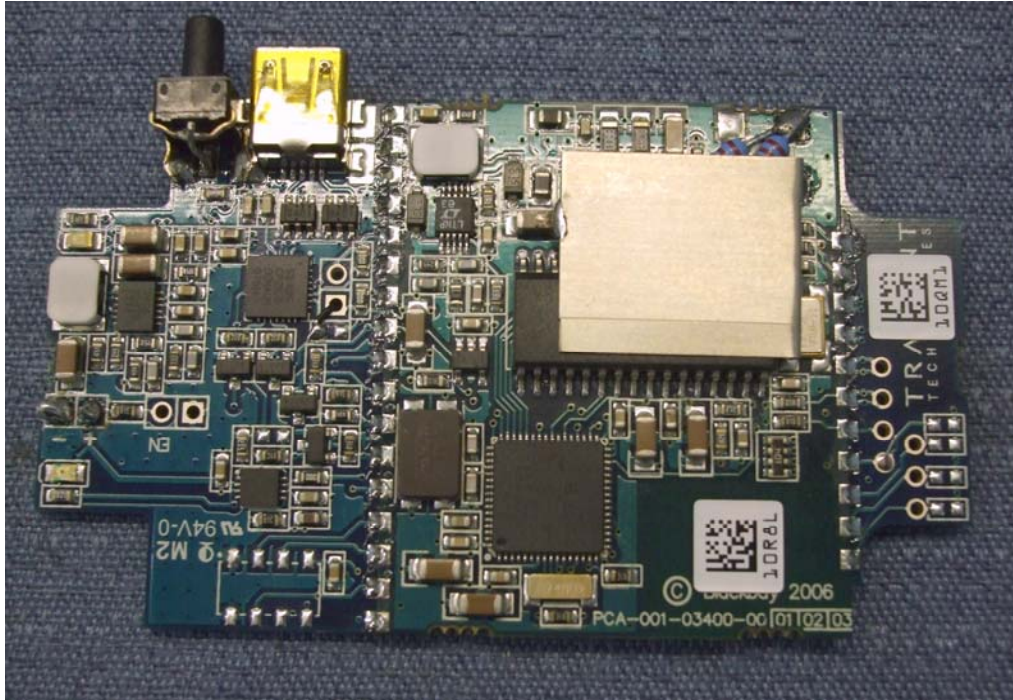
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