EMC Technologies (NZ) Ltd

Test Report No **71031.1**
Report date: 6 November 2007

TEST REPORT

Padl-R UFP-00-003 UHF Handheld RFID Reader

tested to the specification

Code of Federal Regulations (CFR) 47

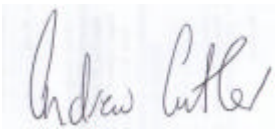
Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators

Section 15.247 – Operation in the bands 902 – 928 MHz

for

Tracient Technologies Ltd

This Test Report is issued with the authority of:



Andrew Cutler - General Manager

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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1. STATEMENT OF COMPLIANCE

The **Padl-R UFP-00-003 UHF Handheld RFID Reader** complies with FCC Part 15 section 15.247 when operating in the 902 – 928 band when tested in accordance with ANSI C63.4, 2003.

2. RESULTS SUMMARY

Testing was carried out in accordance with the test methods defined in 47 CFR Part 15 and in particular Sections 15.205, 15.207, 15.209 and 15.247.

CLAUSE	TEST PERFORMED	RESULT
15.203	Antenna requirement	Complies
15.205	Operation in restricted bands	Complies
15.207	Conducted emissions	Complies
15.209	Radiated emissions	Refer 15.247 (d)
15.247:		
(a)(1)	Hopping channel separation	Complies
(a)(1)(i)(iii)	Channel occupancy / bandwidth	Complies
(b)(1)(2)	Peak output power	Complies
(b)(4)	Antenna gain less than 6 dBi	Complies
(d)	Out of band emissions	Complies
(g)	Use of all available channels	Not applicable
(h)	Intelligent frequency hopping	Not applicable
(i)	Radio frequency hazards	Complies

3. CLIENT INFORMATION

Company Name	Tracient Technologies Ltd
Address	Unit 8 Amuri Park 404 Barbadoes Street
City	Christchurch 8013
Country	New Zealand
Contact	Mr Paul Reid

4. DESCRIPTION OF TEST SAMPLE

Brand Name	Padl-R
Model Number	UFP-00-003
Product	UHF Handheld RFID Reader
Manufacturer	Tracient Technologies Ltd
Country of Origin	New Zealand
Serial Number	01008
FCC ID	VRJUFP001007
Ancillaries	ASUS A3F Laptop Computer. Sn# 65N0AG003012

This device is a UHF Handheld RFID Reader that operates in the 900 MHz band using frequency hopping spread spectrum techniques with a rated output power of 500 mW.

The device also has a Bluetooth module which operates in the 2.4 GHz band which also uses frequency hopping spread spectrum techniques that has a rated power of approximately 1 mW.

Both transmitter use integral antennas.

The device has no operator controls and was supplied with set up software that allowed the device to be configured to operate.

5. RESULTS

Section 15.203 – Antenna requirement

Antennas are integral to the device

Section 15.205 – Restricted bands of operation

Refer to measurements made with reference to Section 15.247 (d).

Section 15.207 – Conducted emissions

Conducted emission testing has been carried out as the device is charged and can be operated when attached to a computer using a USB port.

Testing was carried out when the device was attached to a representative Laptop computer that was powered at 110 Vac.

The device was tested while being charged from the USB port and while transmitting and reading a tag continuously where the tag identification was displayed on the computer using the supplied set up software.

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

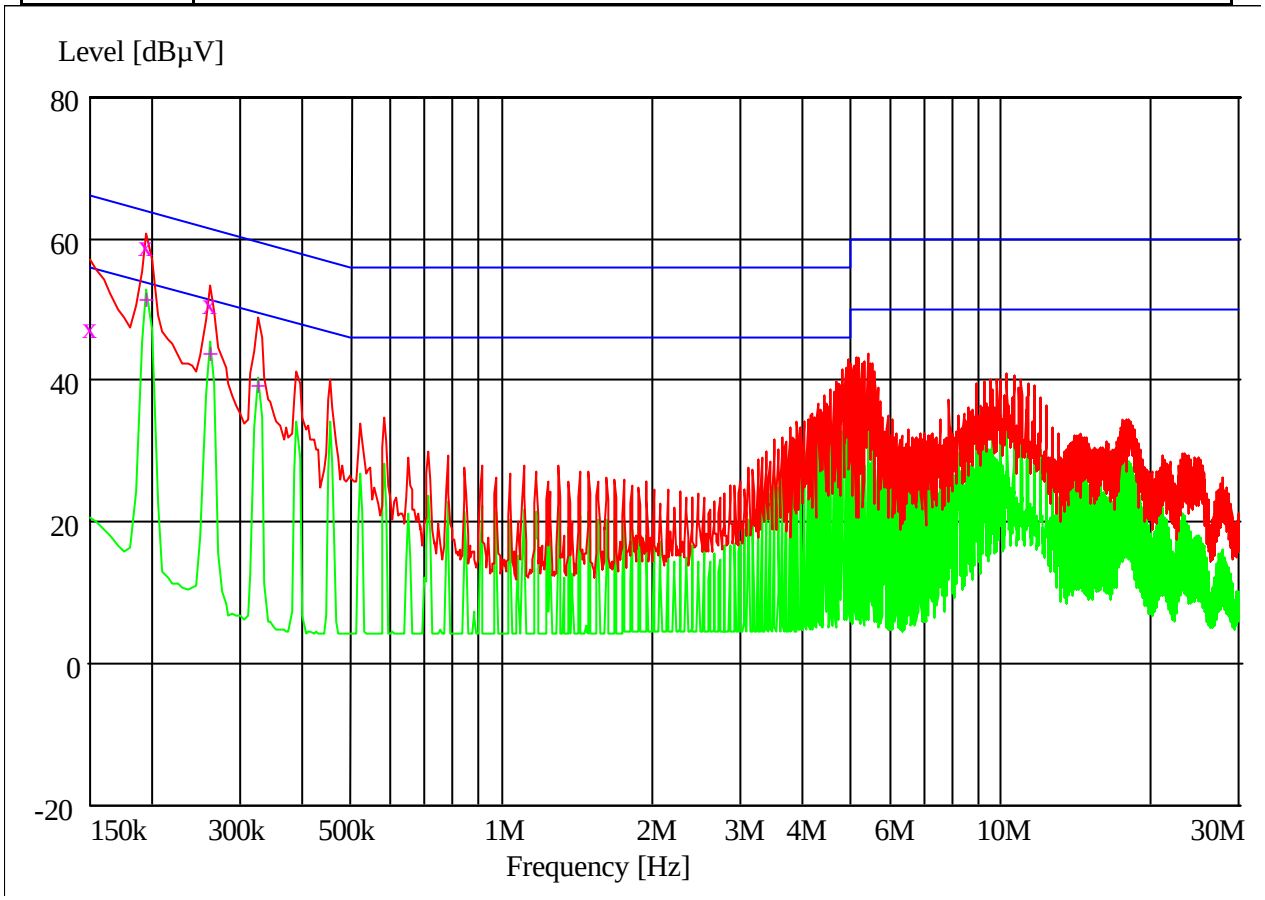
Measurements on both the phase and neutral lines were made using either a Quasi Peak or an Average detector with a 9 kHz bandwidth.

The supplied conducted emission plot is a combined plot showing the worst case of the Peak, Quasi Peak and Average levels for both phase and neutral.

Result: Complies with a 1.7 dB margin at 195 kHz (Average).
Measurement uncertainty: ± 2.2 dB

Conducted emissions

Comments:	Device tested when powered from the USB port of a representative laptop computer that was powered at 110 Vac while charging the device internal batteries.



Peak -------	Average -------	Quasi Peak X	Average +

Quasi-Peak Measurements

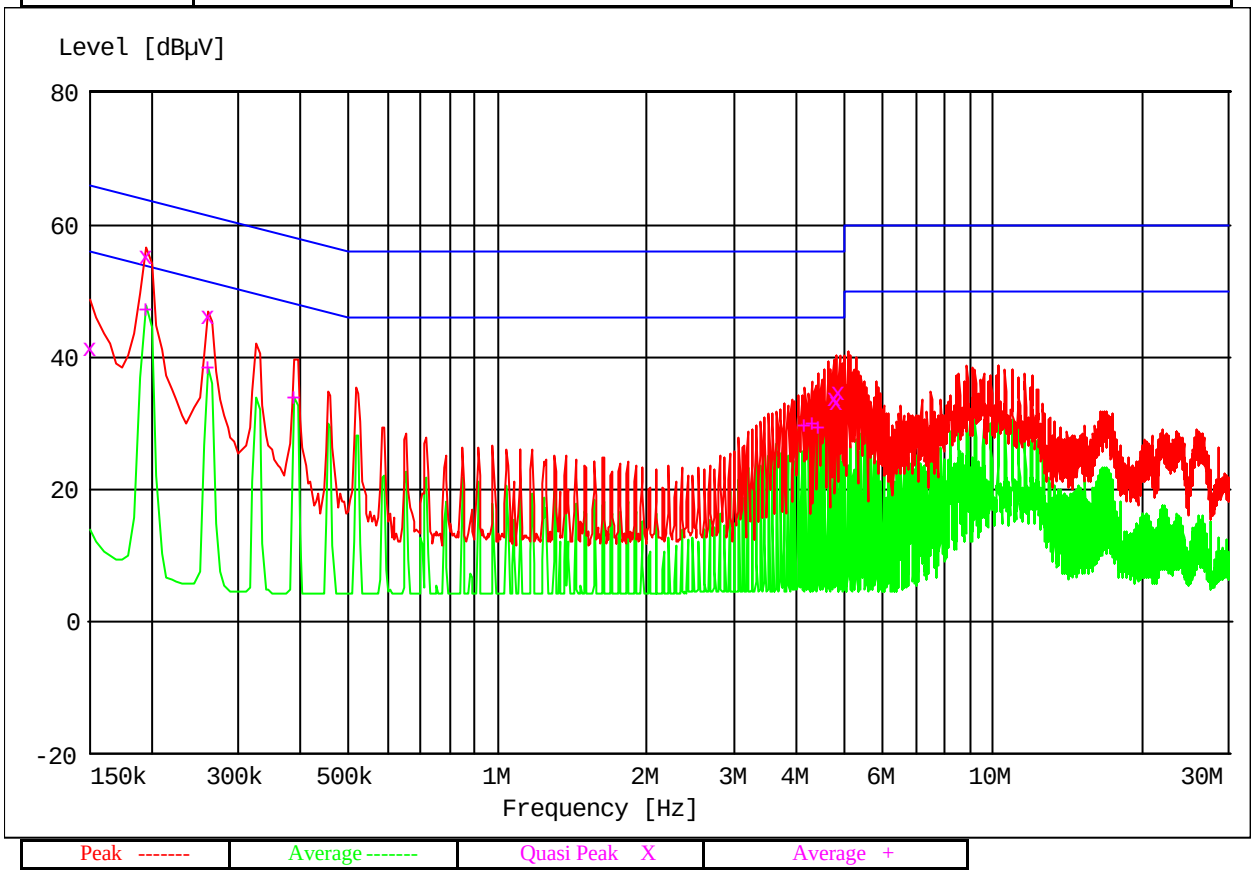
Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.150000	47.90	66.0	18.0	N	
0.195000	59.70	63.8	4.1	N	59.0
0.260000	51.30	61.4	10.0	N	
4.810000	19.20	56.0	36.8	N	
4.880000	19.30	56.0	36.6	N	
4.950000	25.60	56.0	30.3	L1	

Average Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.195000	52.00	53.8	1.7	N	51.0
0.260000	44.40	51.4	6.9	N	
0.325000	39.70	49.5	9.8	N	
4.690000	16.30	46.0	29.6	L1	
4.750000	28.3	46.0	37.7	N	
4.880000	29.0	46.0	38.3	N	

Conducted emissions

Comments:	Device tested when powered from the USB port of a representative laptop computer that was powered at 110 Vac while transmitting continuously while reading a tag.



Quasi-Peak Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.150000	41.50	66.0	24.4	L1	
0.195000	55.60	63.8	8.2	L1	55.9
0.260000	46.30	61.4	15.1	L1	
4.770000	34.10	56.0	21.8	N	
4.830000	33.30	56.0	22.6	N	
4.900000	34.80	56.0	21.1	N	

Average Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.195000	47.40	53.8	6.4	N	47.0
0.260000	38.40	51.4	12.9	L1	
0.390000	34.00	48.0	14.0	N	
4.180000	29.90	46.0	16.0	L1	
4.310000	30.10	46.0	15.8	L1	
4.440000	29.40	46.0	16.5	L1	

Section 15.247(a)(1)(i)+(iii) - Channel occupancy / bandwidth

Frequency hopping systems shall have hopping channel carrier frequencies separated by 25 kHz or the 20 dB bandwidth.

The 20 dB bandwidth has been measured to be 103 kHz

This device can be configured to have channels sizes of 200 or 300 kHz.

When the channel spacing changes the bandwidth of the emission does not change.

If the 20 dB bandwidth is less than 250 kHz then at least 50 hopping channels shall be used.

The device was cable of being configured to operate on any range of frequencies between 902 – 928 MHz in 100 kHz steps.

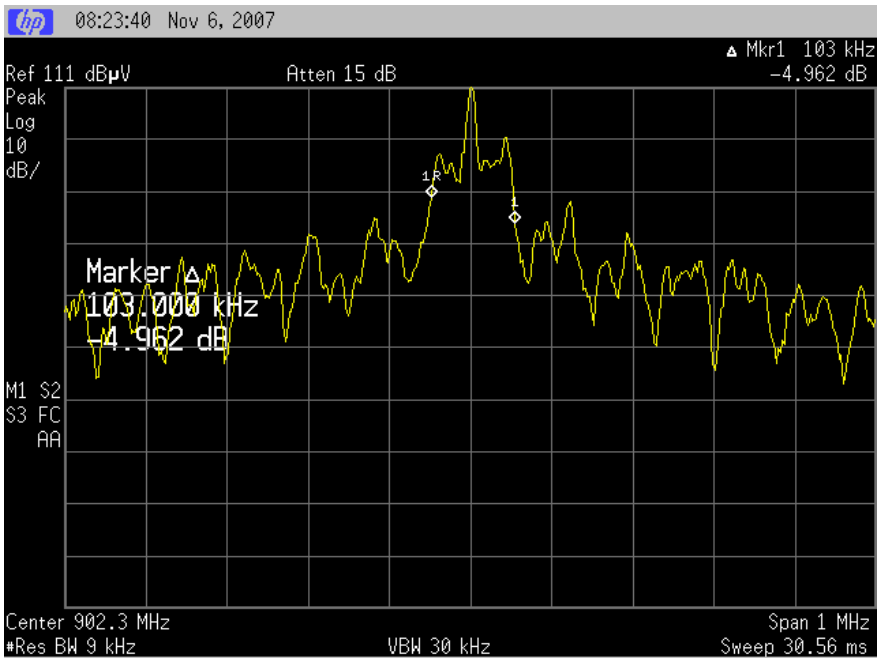
In the USA the device would be configured to operate between 902.3 – 927.7 MHz.

Band edge measurements have been made at these frequencies using a resolution bandwidth of 100 kHz.

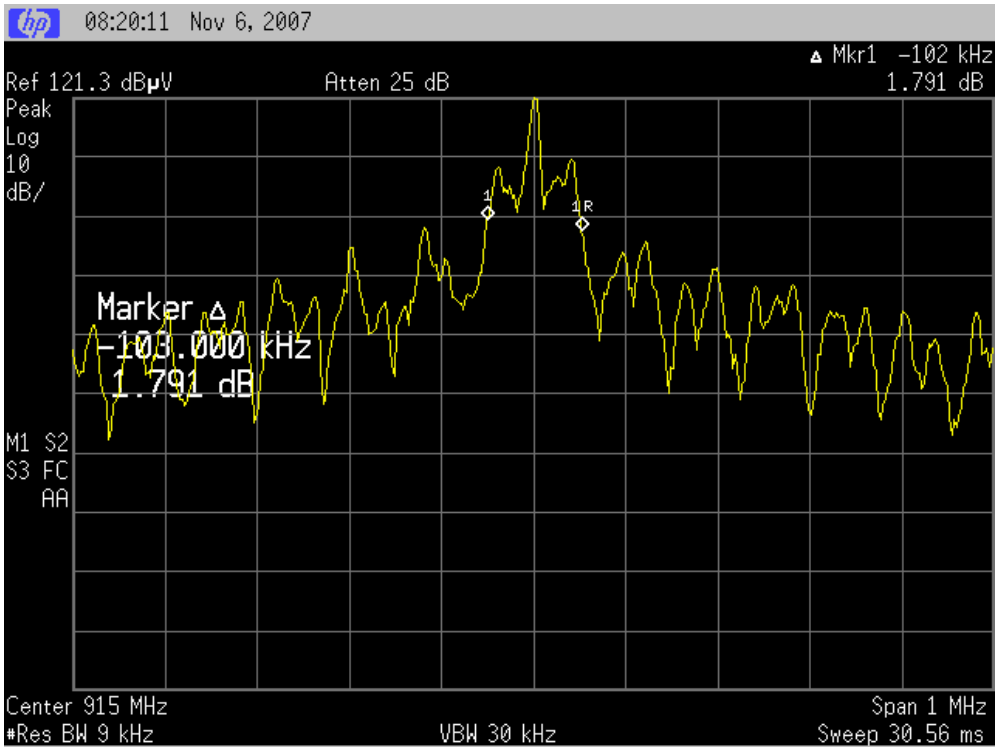
Using 300 kHz steps the device will operate between 902.3 – 927.5 MHz using 85 channels.

Using 200 kHz steps the device will operated between 902.3 – 927.7 MHz using 128 channels.

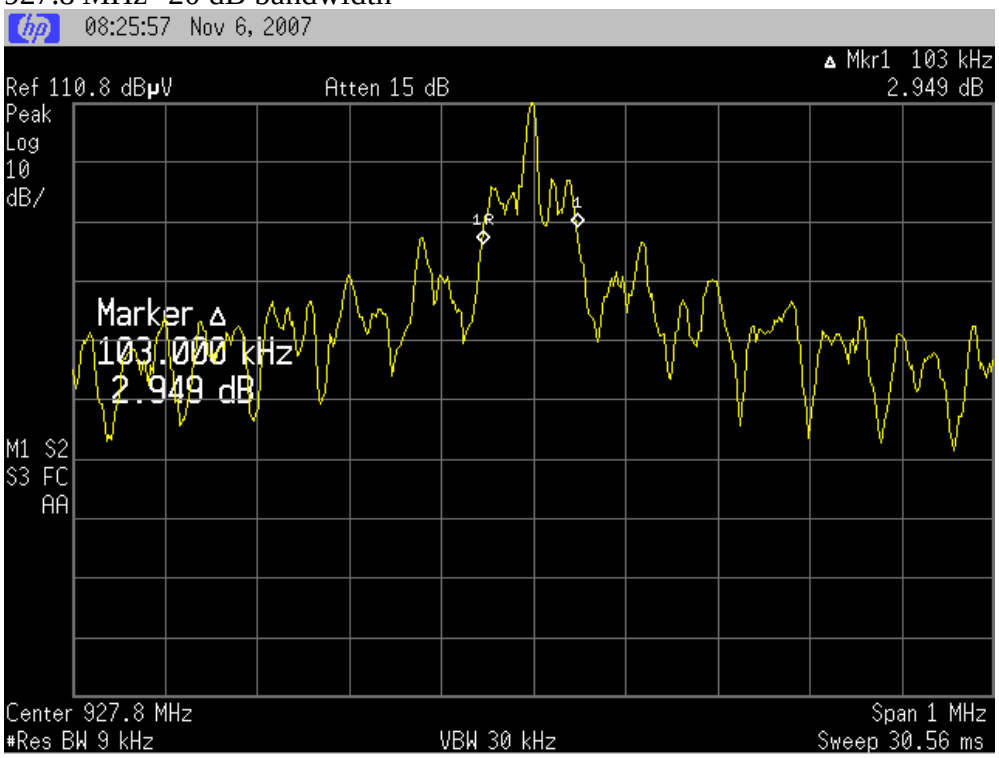
902.2 MHz -20 dB bandwidth



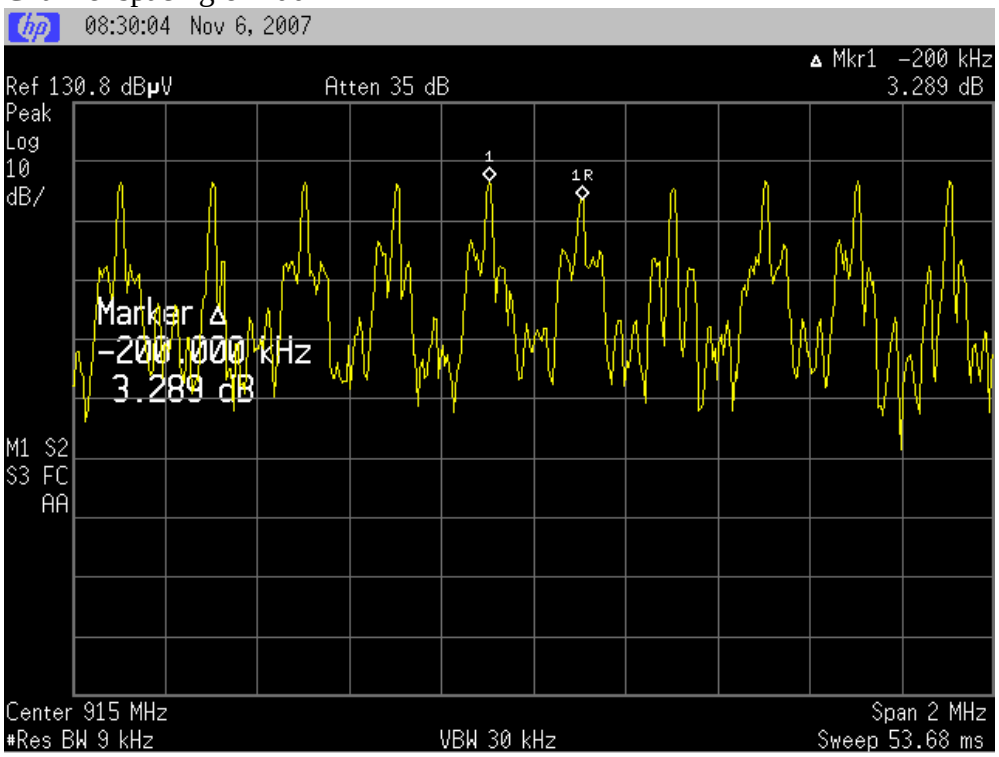
915.0 MHz -20 dB bandwidth



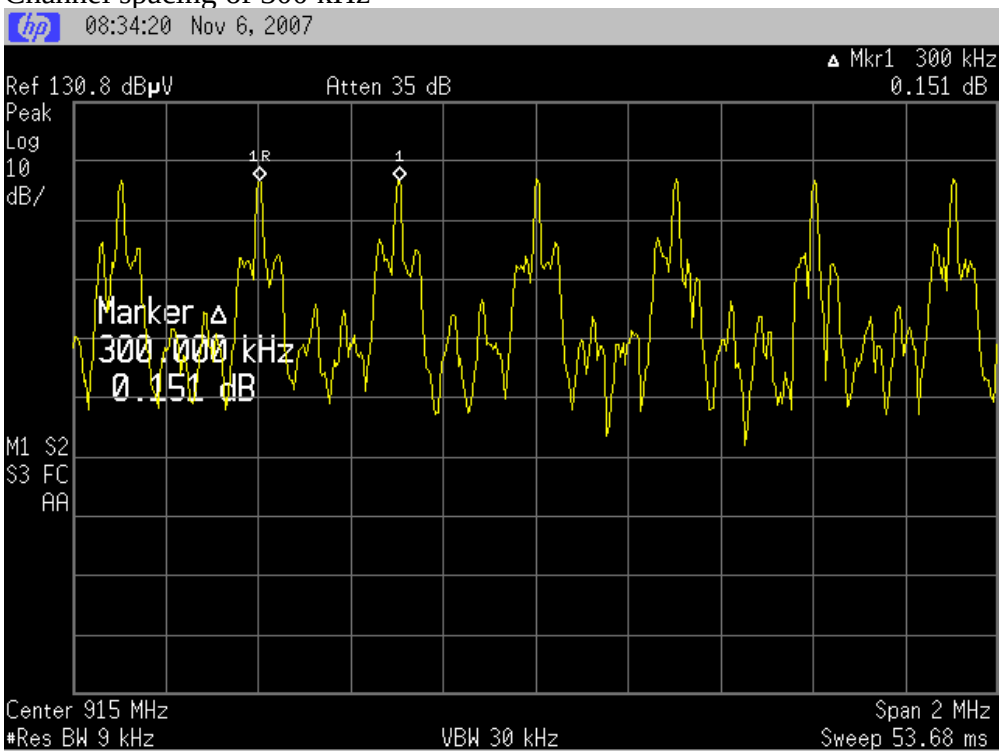
927.8 MHz -20 dB bandwidth



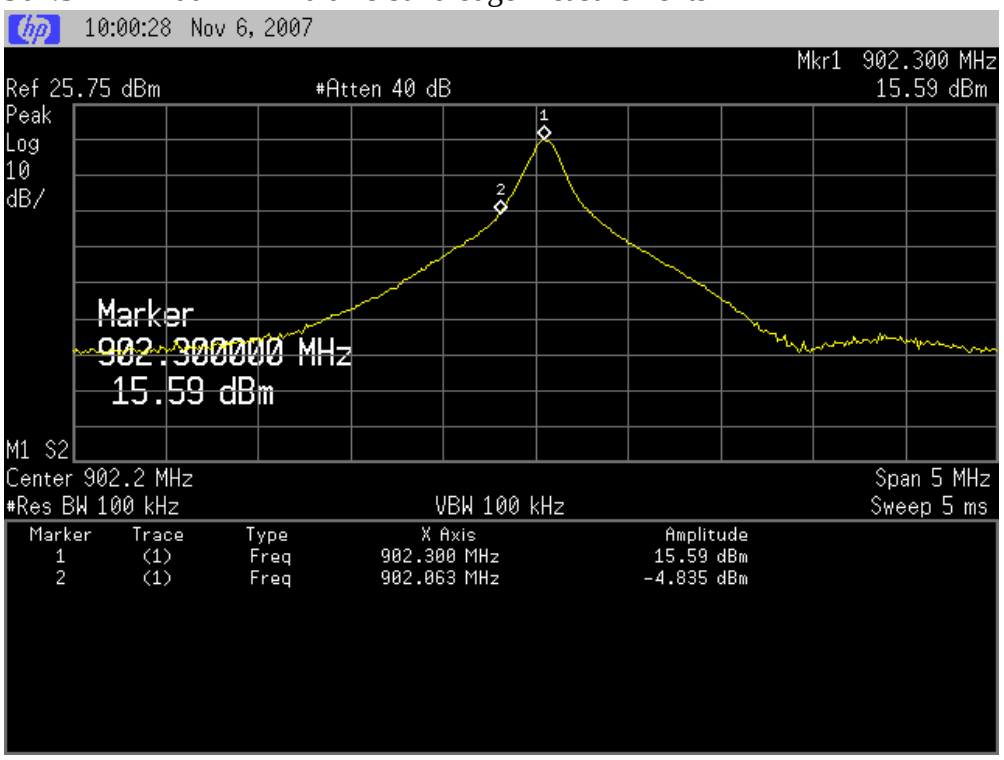
Channel spacing of 200 kHz



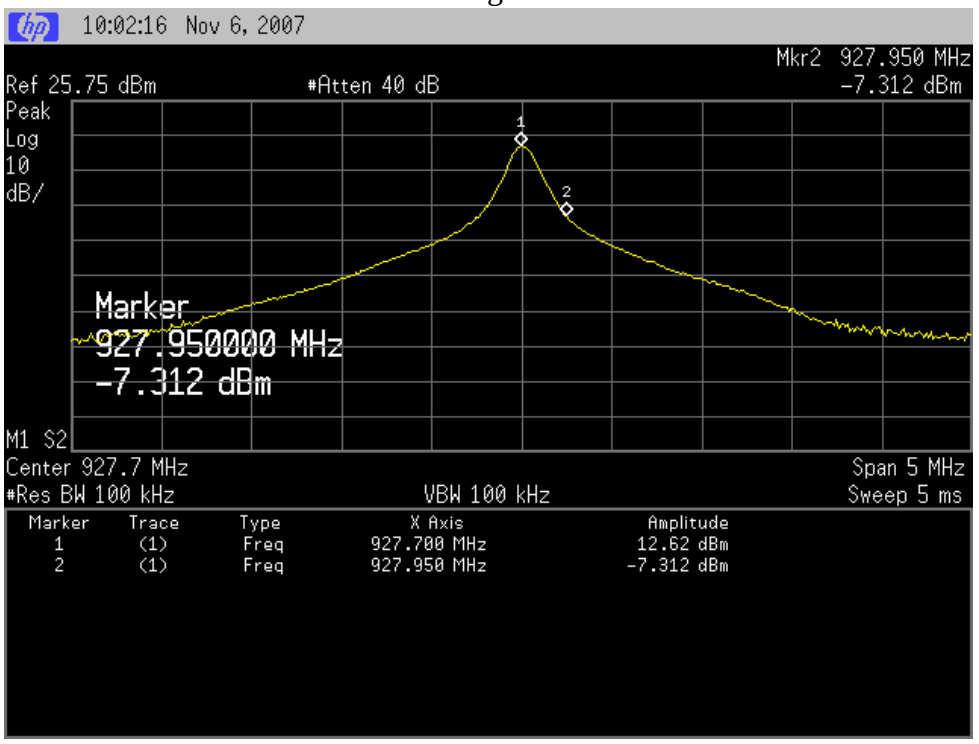
Channel spacing of 300 kHz



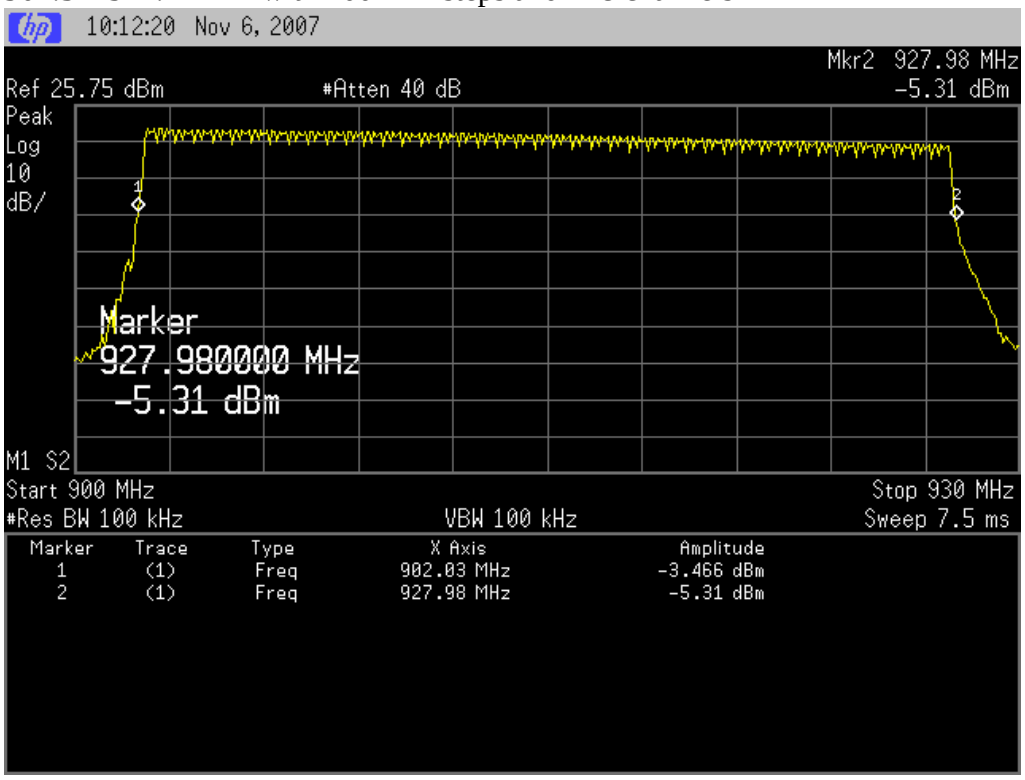
902.3 MHz 100 kHz -20 dBc band edge measurements



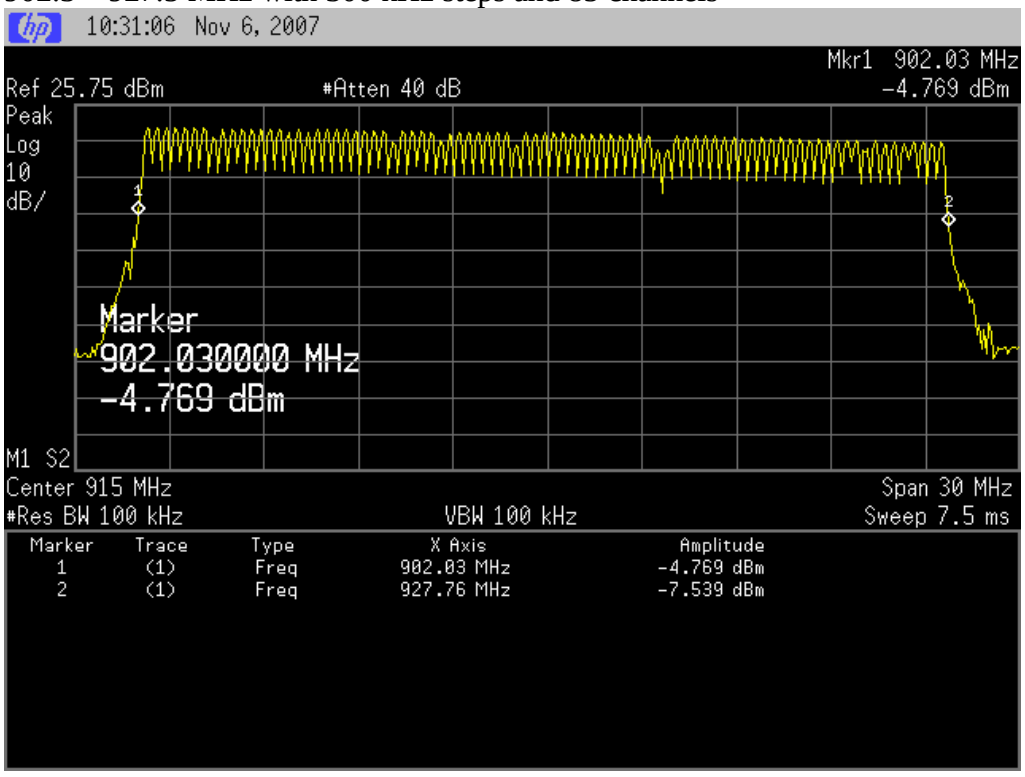
927.7 MHz 100 kHz -20 dBc band edge measurements



902.3 – 927.7 MHz with 200 kHz steps and 128 channels

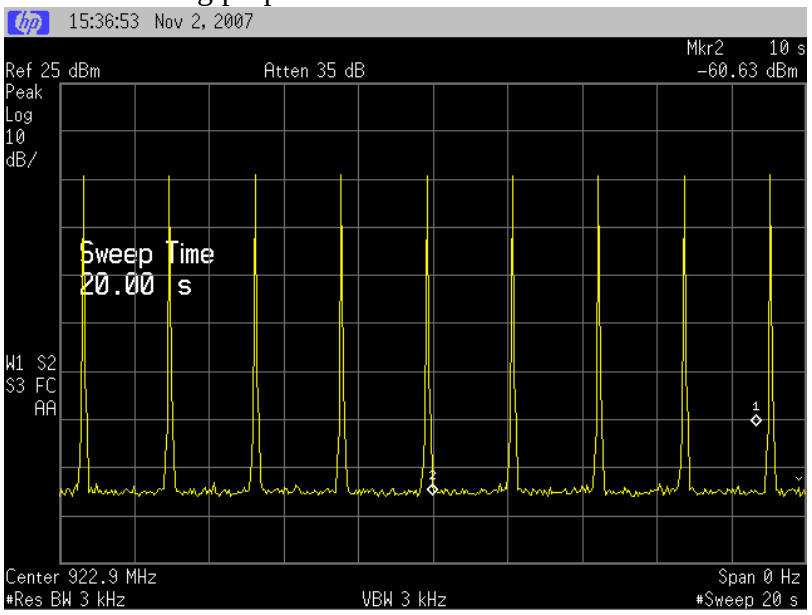


902.3 – 927.5 MHz with 300 kHz steps and 85 channels

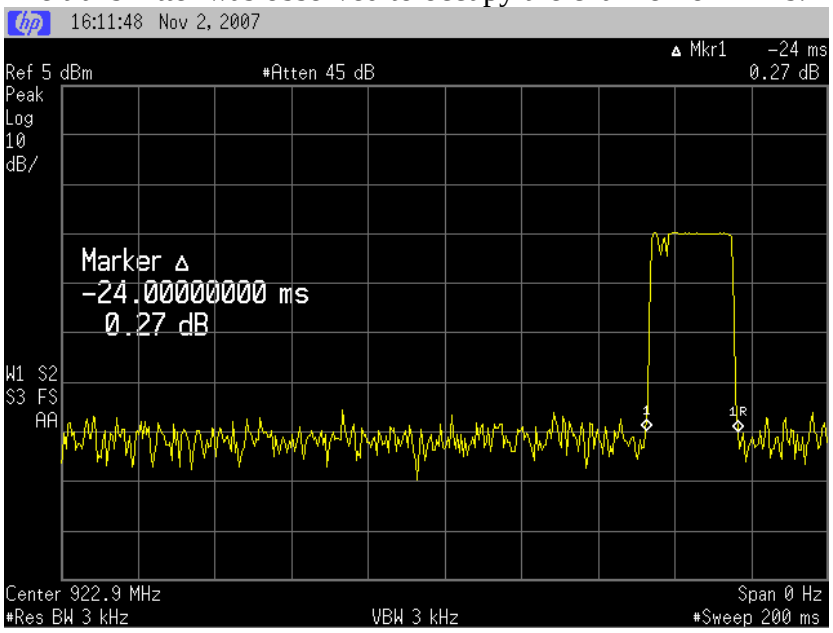


If a bandwidth of less than 250 kHz is used the average channel occupancy shall not exceed 0.4 seconds in any 20 second period.

The transmitter was observed to operate 9 times in 20 seconds when operating in sequential mode for testing purposes rather than the normal random mode



The transmitter was observed to occupy the channel for 24 ms.



9 x 24 ms = 216 mS

Result: Complies

Section 15.247(b)(1)+(2)– Peak output power

As the device uses integral antennas measurements were carried out using radiated techniques at an open area test site.

The antenna gain does not exceed 6 dBi therefore 15.247(b)(4) did not need to be applied.

The nominal power of this device is +27 dBm.

Testing was carried out on a low, high and middle frequency across the range

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)
902.300	115.3	20.1	30.0	Horizontal	9.9
902.300	123.5	28.3	30.0	Vertical	1.7
915.000	115.2	20.0	30.0	Vertical	10.0
915.000	122.9	27.7	30.0	Vertical	2.3
927.700	111.2	16.0	30.0	Vertical	14.0
927.700	119.3	24.1	30.0	Horizontal	5.9

The device was tested on an open area test site at a distance of 3.0 metres.

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.

The power level of each emission was determined by formula.

A limit of 1 watt (+30 dBm) has been applied as more than 50 channels are in use.

Result: Complies
Measurement Uncertainty: ±4.1 dB

Section 15.247 (d) – Out of band emissions

Band edge measurements:

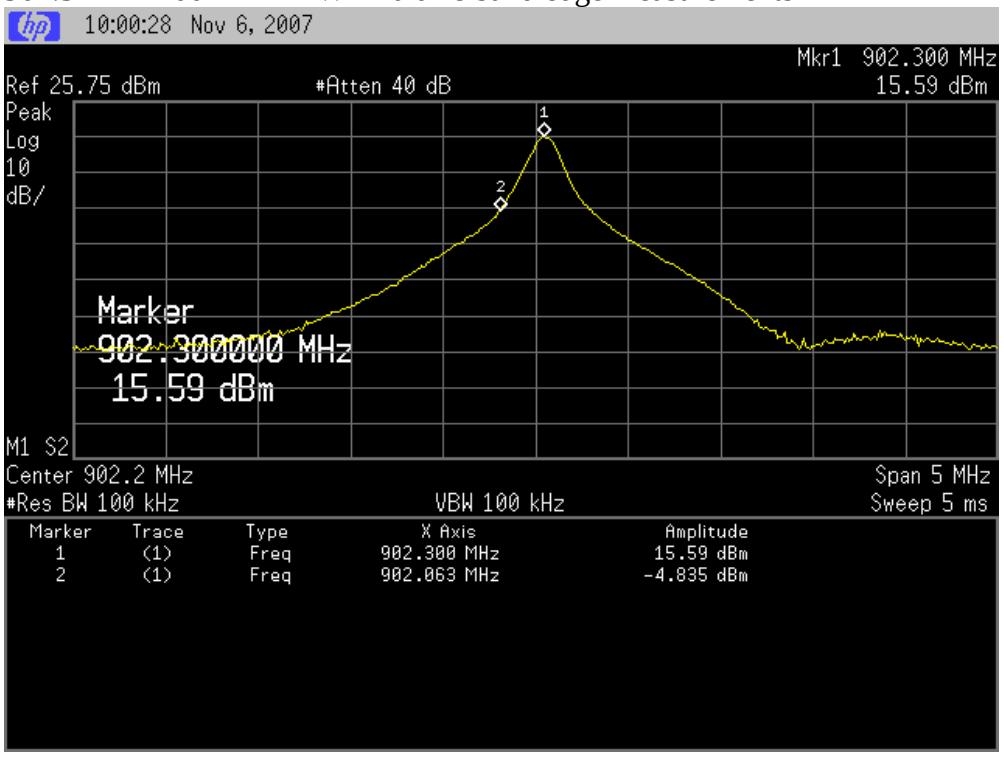
At the band edges of 902 MHz and 928 MHz all emissions are required to be attenuated by more than 20 dB relative to the highest 100 kHz resolution bandwidth emission level observed in the band of operation.

Measurements were made with the device operation at the band edges using a 100 kHz RBW.

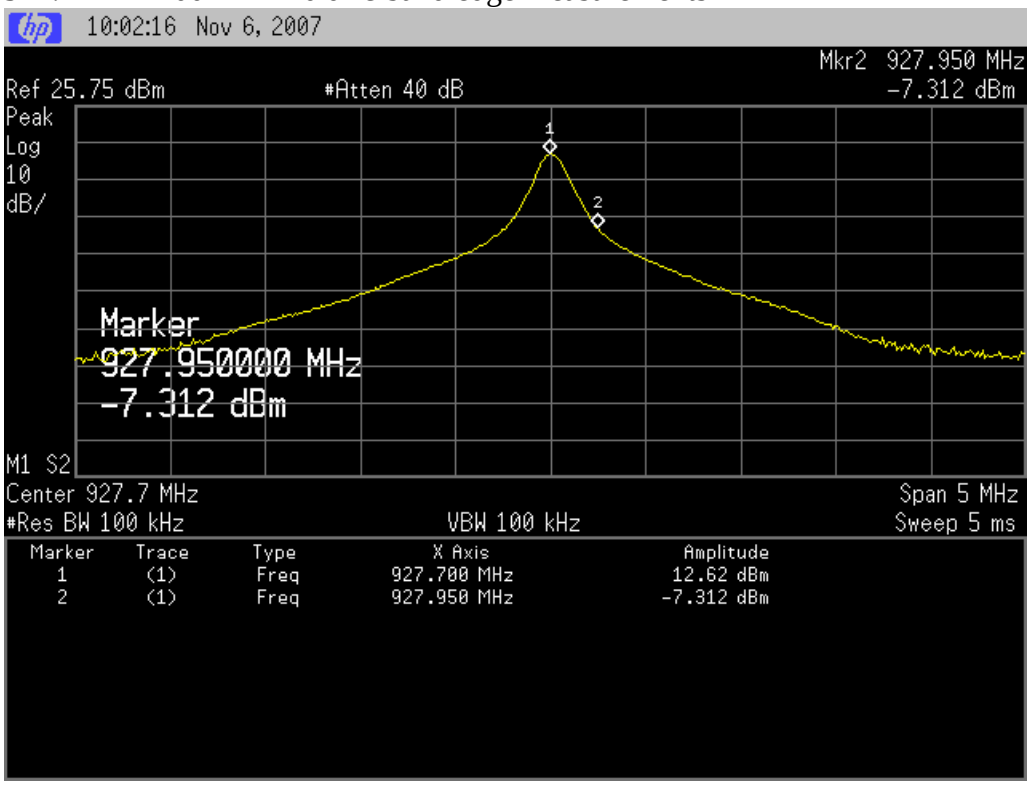
The bandwidth of the emission does not vary when the step size is changed from 200 to 300 kHz.

Measurements were then made in hop mode of the whole band.

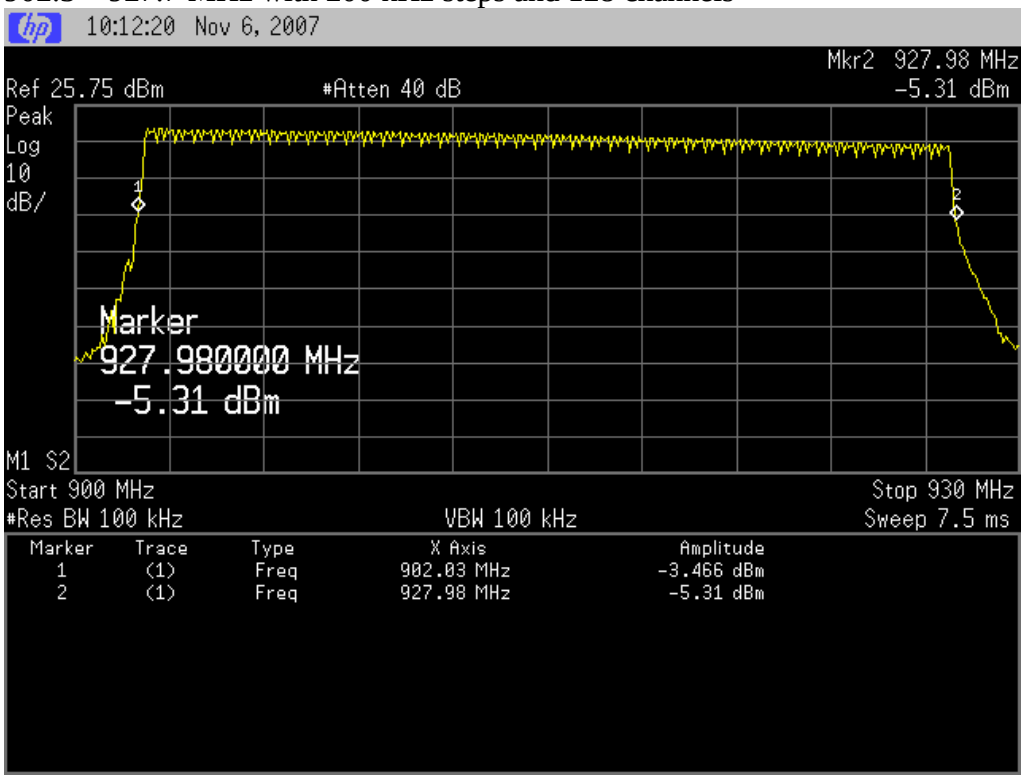
902.3 MHz 100 kHz RBW -20 dBc band edge measurements



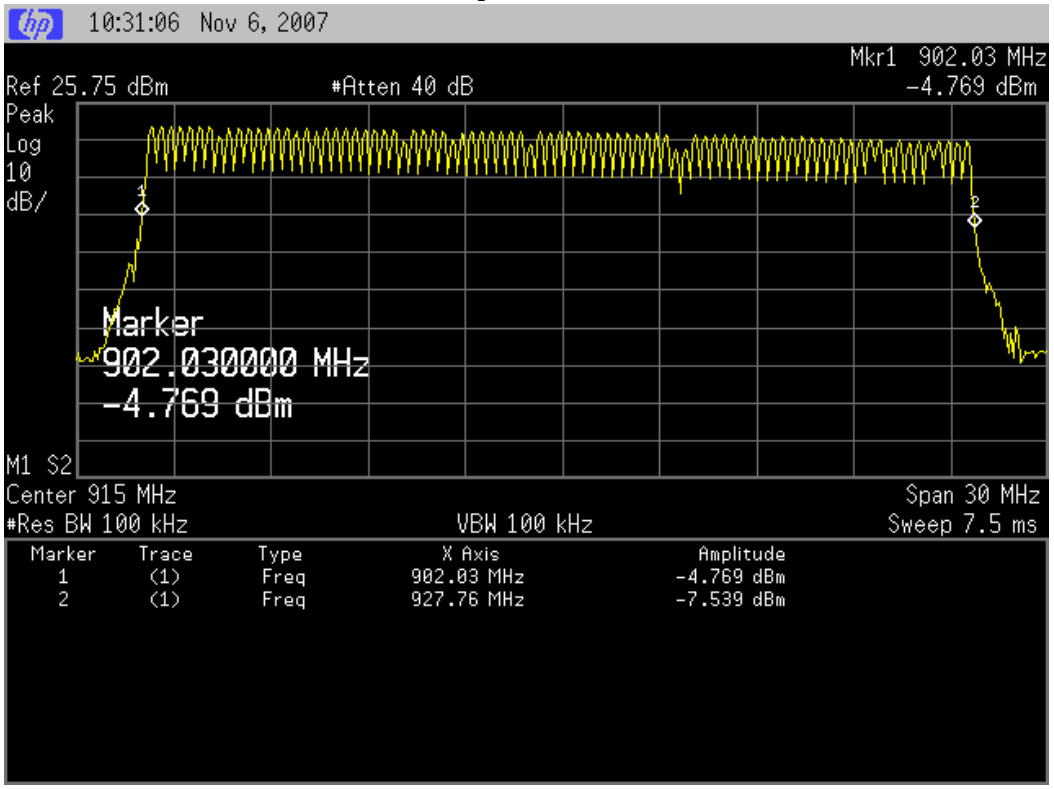
927.7 MHz 100 kHz -20 dBc band edge measurements



902.3 – 927.7 MHz with 200 kHz steps and 128 channels



902.3 – 927.5 MHz with 300 kHz steps and 85 channels



Spurious emissions and restricted band radiated emission measurements

A number of out of band emissions have been shown to fall within the restricted bands of operation as defined in section 15.205(a).

Radiated emission measurements were carried out with the limits as per section 15.209 applied when these emissions fell within the restricted bands.

All other emissions are required to meet a limit of -20 dBc with relation to the highest in band emission.

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 internal 3 Vdc Lithium while attached 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)

Standby emissions

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Polarity	Detector
84.298		21.6	40.0	18.4	Horizontal	QP
110.278	28.0		43.5	15.5	Vertical	QP
112.640	28.6		43.5	14.9	Vertical	QP
114.490	28.4		43.5	15.1	Vertical	QP
122.860	30.1		43.5	13.4	Vertical	QP
123.988	30.1		43.5	13.4	Vertical	QP
125.165	29.5		43.5	14.0	Vertical	QP
125.335		25.3	43.5	18.2	Horizontal	QP
126.250	29.1		43.5	14.4	Vertical	QP
126.478		26.7	43.5	16.8	Horizontal	QP
129.703	29.1		43.5	14.4	Vertical	QP
138.815	24.5		43.5	19.0	Vertical	QP
245.398		22.5	46.0	23.5	Horizontal	QP
360.000	34.2		46.0	11.8	Vertical	QP
451.619	25.1		46.0	20.9	Vertical	QP

Testing was carried out when the device was in standby with the laptop computer attached and the device connected using the USB port but with no transmissions activated.

When the USB port is attached to a computer the Bluetooth transmitter is inhibited by default.

The general limits described in section 15.209 have been applied.

Transmitting on 902.3 MHz.

The maximum field strength when transmitting on 902.3 MHz was observed to be 123.5 dBuV/m.

Therefore a -20 dBc limit of 103.5 dBuV/m has been applied to emissions falling outside of the restricted bands.

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Polarity	Detector
662.300	29.2	37.1	103.5	66.4	Horizontal	QP
782.300	40.8	50.0	103.5	53.5	Horizontal	QP
842.300	37.0	44.6	103.5	58.9	Horizontal	QP
962.300	36.5	41.4	54.0	12.6	Horizontal	QP
1022.300	39.1	42.4	54.0	11.6	Horizontal	Peak
1142.300	39.2	46.1	54.0	7.9	Horizontal	Peak
1262.300	39.3	43.6	54.0	10.4	Horizontal	Peak
1804.600	45.0	45.8	103.5	57.7	Horizontal	Peak
1804.600	33.5	37.8	103.5	65.7	Horizontal	Average
2706.900	52.0	50.1	74.0	22.0	Horizontal	Peak
2706.900	42.5	42.0	54.0	11.5	Horizontal	Average
3609.200	52.1	49.7	74.0	21.9	Horizontal	Peak
3609.200	45.9	42.7	54.0	8.1	Horizontal	Average
4511.500	39.7	40.4	74.0	33.6	Horizontal	Peak
4511.500	33.5	35.0	54.0	19.0	Horizontal	Average
5413.800	42.5	43.9	74.0	30.1	Horizontal	Peak
5413.800	37.2	36.9	54.0	16.8	Horizontal	Average
6316.100	-	-	103.5	-	Vert/Hort	Peak
6316.100	-	-	103.5	-	Vert/Hort	Average
7218.400	-	-	103.5	-	Vert/Hort	Peak
7218.400	-	-	103.5	-	Vert/Hort	Average
8120.700	-	-	74.0	-	Vert/Hort	Peak
8120.700	-	-	54.0	-	Vert/Hort	Average
9023.000	-	-	74.0	-	Vert/Hort	Peak
9023.000	-	-	54.0	-	Vert/Hort	Average

Where a peak measurement showed compliance with the average limit only the peak measurement has been recorded against the average limit.

Transmitting on 915 MHz.

The maximum field strength when transmitting on 915 MHz was observed to be 122.9 dBuV/m.

Therefore a -20 dBc limit of 102.9 dBuV/m has been applied to emissions falling outside of the restricted bands.

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Polarity	Detector
675.000	30.3	36.6	102.9	66.3	Horizontal	QP
795.000	38.6	47.7	102.9	55.2	Horizontal	QP
855.000	35.4	41.9	102.9	61.0	Horizontal	QP
975.000	30.5	38.4	54.0	15.6	Horizontal	QP
1035.000	36.3	46.0	54.0	8.0	Horizontal	Peak
1155.000	36.8	45.4	54.0	8.6	Horizontal	Peak
1275.000	37.7	39.5	54.0	14.5	Horizontal	Peak
1830.000	44.9	44.5	102.9	58.0	Vertical	Peak
1830.000	36.4	33.0	102.9	66.5	Vertical	Average
2745.000	52.6	53.4	74.0	20.6	Horizontal	Peak
2745.000	46.1	47.9	54.0	6.1	Horizontal	Average
3660.000	53.7	50.1	74.0	20.3	Vertical	Peak
3660.000	42.1	40.6	54.0	11.9	Vertical	Average
4575.000	42.4	40.5	74.0	31.6	Vertical	Peak
4575.000	40.5	35.2	54.0	13.5	Horizontal	Average
5490.000	-	-	102.9	-	Vert/Hort	Peak
5490.000	-	-	102.9	-	Vert/Hort	Average
6405.000	-	-	102.9	-	Vert/Hort	Peak
6405.000	-	-	102.9	-	Vert/Hort	Average
7320.000	-	-	74.0	-	Vert/Hort	Peak
7320.000	-	-	54.0	-	Vert/Hort	Average
8235.000	-	-	74.0	-	Vert/Hort	Peak
8235.000	-	-	54.0	-	Vert/Hort	Average
9150.000	-	-	74.0	-	Vert/Hort	Peak
9150.000	-	-	54.0	-	Vert/Hort	Average

Where a peak measurement showed compliance with the average limit only the peak measurement has been recorded against the average limit.

Transmitting on 927.7 MHz.

The maximum field strength when transmitting on 927.7 MHz was observed to be 119.3 dBuV/m.

Therefore a -20 dBc limit of 99.3 dBuV/m has been applied to emissions falling outside of the restricted bands.

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Polarity	Detector
687.700	31.0	36.0	99.3	63.3	Horizontal	QP
807.700	38.0	46.3	99.3	53.0	Horizontal	QP
867.700	34.0	41.0	99.3	58.3	Horizontal	QP
1047.700	38.1	42.1	54.0	11.9	Horizontal	QP
1167.700	37.5	41.1	54.0	12.9	Horizontal	Peak
987.700	31.0	36.5	54.0	17.5	Horizontal	Peak
1287.700	33.6	38.5	54.0	15.5	Horizontal	Peak
1855.400	45.1	45.0	99.3	54.2	Vertical	Peak
1855.400	34.3	36.5	99.3	62.8	Horizontal	Average
2783.100	50.1	52.2	74.0	21.8	Horizontal	Peak
2783.100	38.9	39.3	54.0	14.7	Horizontal	Average
3710.800	49.2	41.5	74.0	24.8	Vertical	Peak
3710.800	-	-	54.0	-	Vertical	Average
4638.500	-	-	74.0	-	Vertical	Peak
4638.500	-	-	54.0	-	Horizontal	Average
5566.200	47.9	47.1	74.0	26.1	Vertical	Peak
5566.200	40.1	39.9	54.0	13.9	Vertical	Average
6493.900	-	-	74.0	-	Vert/Hort	Peak
6493.900	-	-	54.0	-	Vert/Hort	Average
7421.600	-	-	74.0	-	Vert/Hort	Peak
7421.600	-	-	54.0	-	Vert/Hort	Average
8349.300	-	-	74.0	-	Vert/Hort	Peak
8349.300	-	-	54.0	-	Vert/Hort	Average
9277.000	-	-	74.0	-	Vert/Hort	Peak
9277.000	-	-	54.0	-	Vert/Hort	Average

Where a peak measurement showed compliance with the average limit only the peak measurement has been recorded against the average limit.

RFID and Bluetooth Transmitter Inter-modulation

As these two transmitters operate in close proximity a check was made to determine whether any inter modulation products were being generated.

The 900 MHz transmitter was operated in frequency hopping spread spectrum mode while continuously reading a tag.

The details of this tag were then continuously transmitted to a laptop computer using a Bluetooth data link.

No inter modulation products were observed within a 20 dB margin of the FCC general emission limits (Section 15.209) between 30 MHz and 18 GHz in either vertical or horizontal polarisations.

The only emissions observed were the 900 MHz and 2.4 GHz FHSS fundamental emissions and the associated harmonic spurious emissions.

Result: Complies
Measurement uncertainty: ± 4.1 dB

Section 15.247(i) – Radio Frequency Hazard Information

As per Section 15.247 (b) (4) spread spectrum transmitters operating in the 902 – 928 MHz band are required to be operated in a manner that ensures that the public is not exposed to RF energy levels in accordance with CFR 47, Section 1.1307(b)(1).

Section 1.1307 specifically excludes this device from further evaluation as it is a portable device.

The device is portable and is held in the hand however a 20 cm minimum distance can be maintained.

The device only operates when the read button is pushed by the user with the transmitter turning itself off once a card has been activated.

When the device is transmitting there is an audible and visual warning to the user.

The power output of the Bluetooth device has been measured to be less than 1 mW and has therefore been considered to be inconsequential.

In accordance with Section 1.1310 the Maximum Permissible Exposure (MPE) limits for the General Population / Uncontrolled Exposure of f/1500 have been applied.

The maximum distance from the antenna at which the MPE is met or exceeded is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain and separation distance in metres:

E, V/m = (√ (30 * P * G)) / d
Power density, mW/m2 = E2/3770
E for MPE: (902/1500) = E2/3770
E = √(902/1500)*3770
E = 47.6 V/m

The maximum radiated power measured was +28.3 dBm or 0.68 watts.
Therefore:
E = √ (30 * P * G) / d
d = √ (30 * P * G) / E
d = √ (30 * 0.68) / 47.6
d = 0.09 m or 9 cm

Result: Complies if a minimum safe distance of 20 cm is specified.

6. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Ref No
Aerial Controller	EMCO	1090	9112-1062	3710
Aerial Mast	EMCO	1070-1	9203-1661	3708
Turntable	EMCO	1080-1-2.1	9109-1578	3709
Environmental Chamber	Contherm	M180F	-	E1129
Thermometer	DSIR	RT200	035	E1049
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3776
VHF Balun	Schwarzbeck	VHA9103	-	3603
Biconical Antenna	Schwarzbeck	BBA 9106	-	3612
Log Periodic Antenna	Schwarzbeck	VUSLP 91111	9111-228	3785
Measurement Receiver	Rohde & Schwarz	ESCS-30	847124/020	E1595
Microwave Pre Amp	Hewlett Packard	8349B	2644A01659	-
Horn Antenna	Electrometrics	RGA -60	6234	E1494

7. ACCREDITATIONS

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated on January 25th, 2007.

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

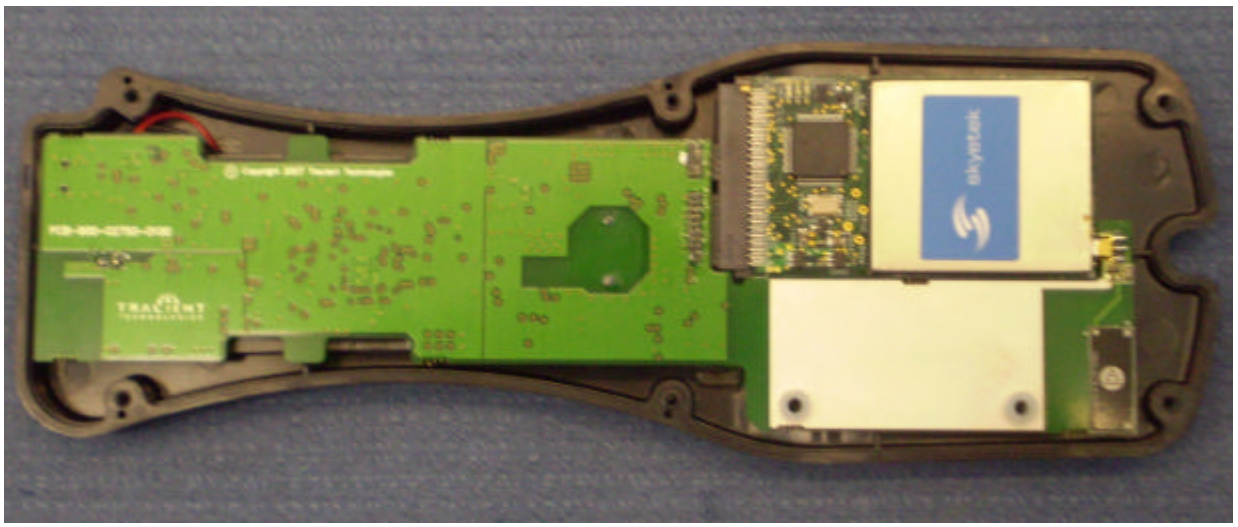
All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/IEC/ISO 17025.

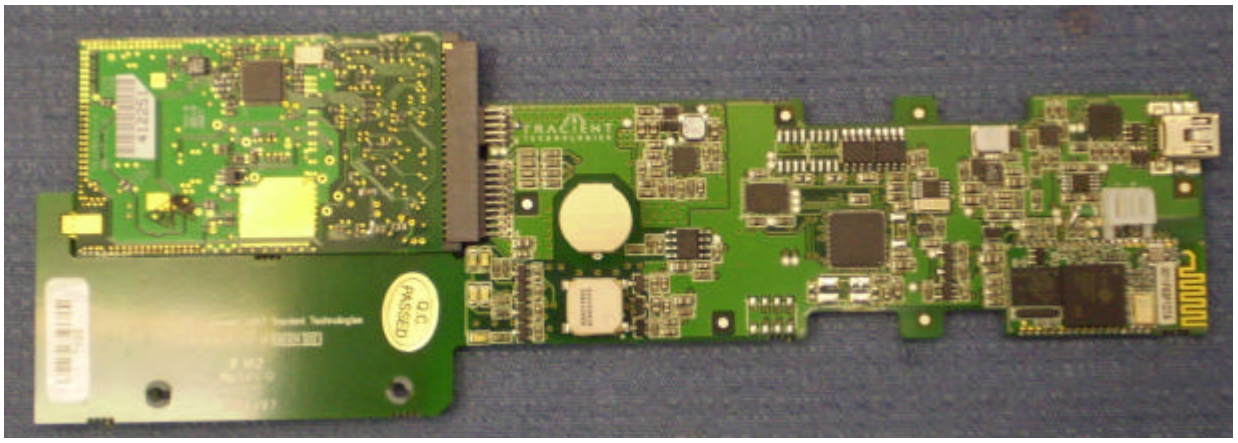
International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with a number of accreditation bodies in various economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied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

8. PHOTOGRAPHS

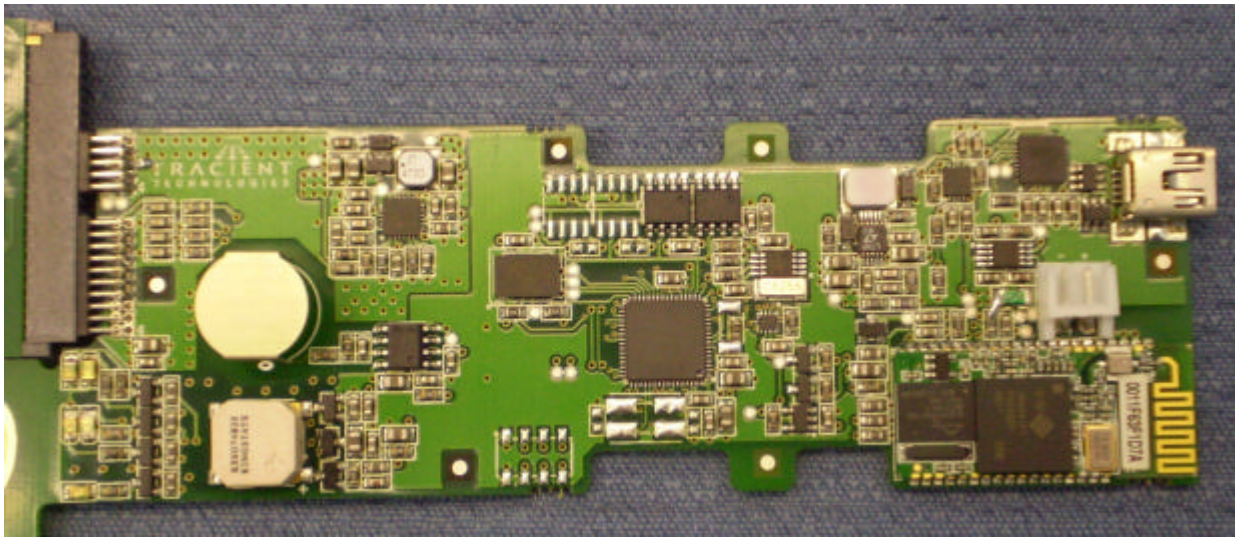
External photos

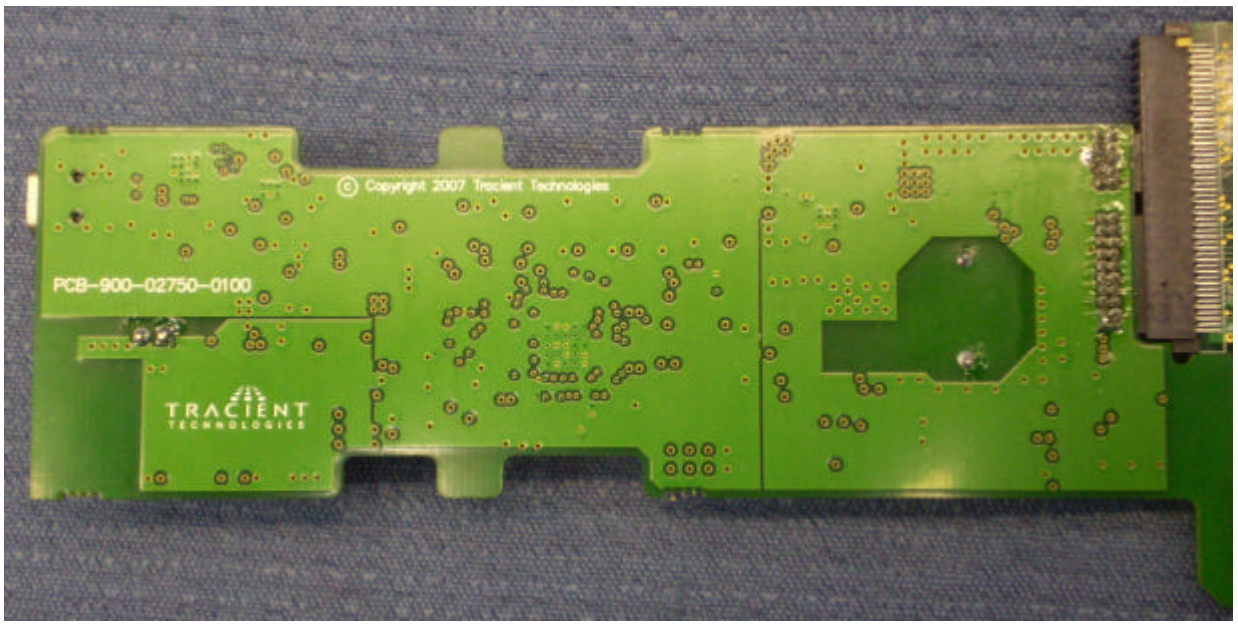
Internal Photos - Overall



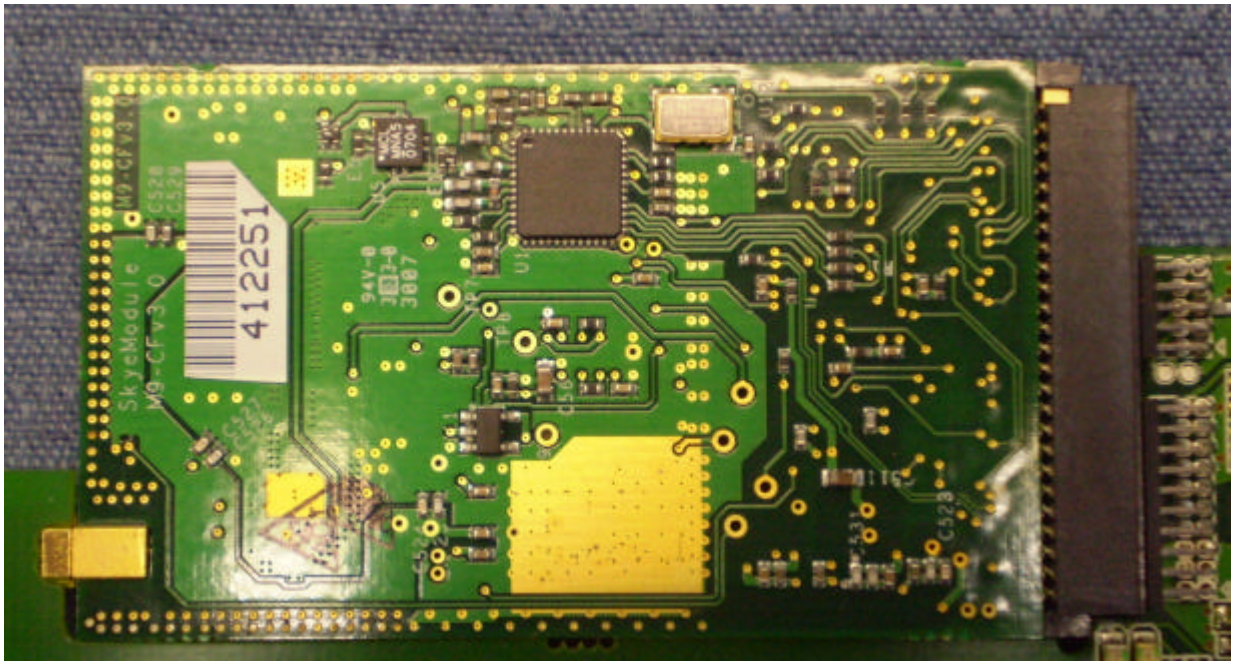


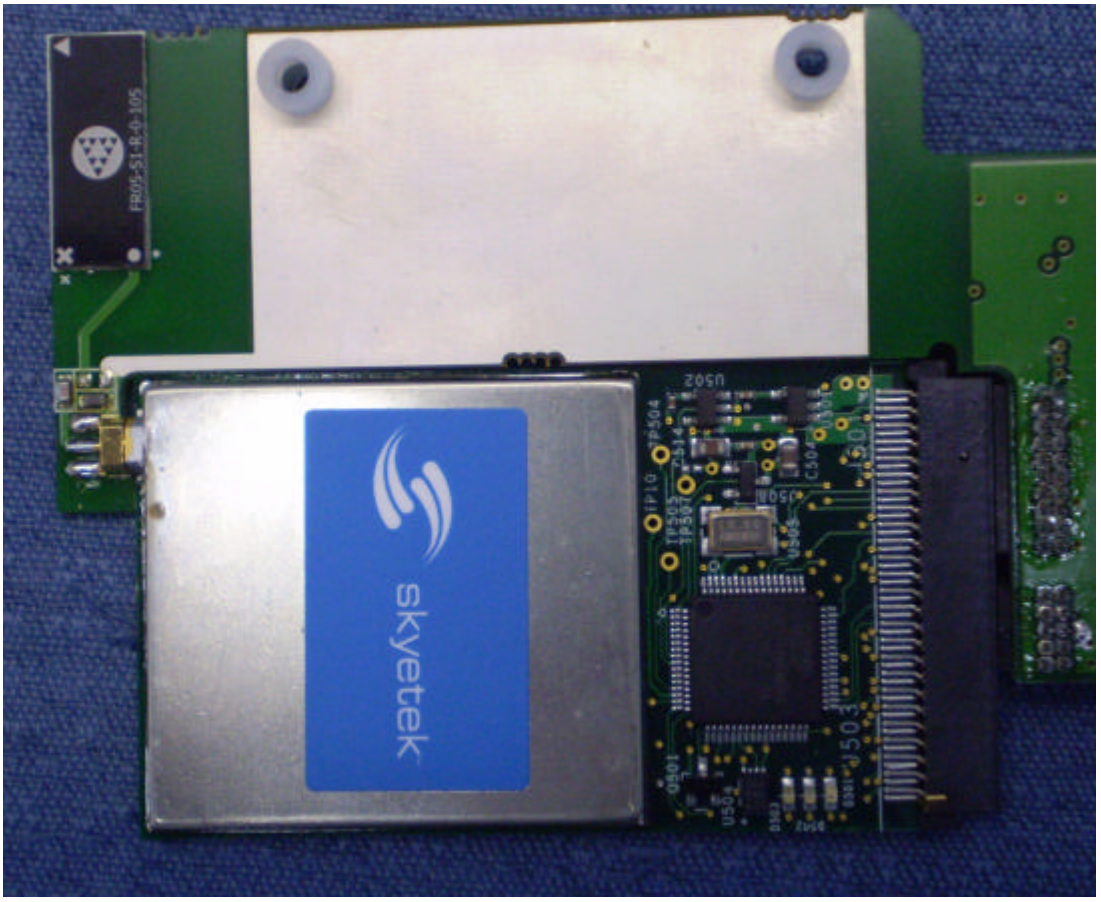
Main Board





RF Module Board





Radiated Emissions Test Set Up

Conducted emissions test set up