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EATON 915U-2 900 MHz Frequency Hopping Transceiver

tested to the

47 Code of Federal Regulations

Part 15 - Radio Frequency Devices

Subpart C – Intentional Radiators

Section 15.247 - Operation in the band 902 – 928 MHz

for

ELPRO Technologies Pty Ltd

This Test Report is issued with the authority of:

A handwritten signature in black ink, appearing to read "Andrew Cutler", is shown on a light blue background.

Andrew Cutler - General Manager



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

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EMC
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1. COMPLIANCE STATEMENT

The **EATON 915U-2 900 MHz Frequency Hopping Spread Spectrum Transceiver** complies with FCC Part 15 Subpart C Section 15.247 as an Intentional Radiator when the methods as described in ANSI C63.10 - 2013 are applied along with the requirements contained in FCC Public Notice DA 00-705.

2. RESULT SUMMARY

The results of testing carried out in June 2016 are summarised below.

Clause	Parameter	Result
15.201	Equipment authorisation requirement	This device is subject to a Class 2 permissive change certification due to changes that have been made.
15.203	Antenna requirement	Not applicable. Unique antenna connector not required as equipment is installed by professional installers.
15.204	External PA and antenna modifications	Noted.
15.205	Restricted bands of operation	Complies.
15.207	Conducted limits	Not tested.
15.209	Radiated emission limits	Not tested
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	Not tested
(d)	Out of band emissions	Complies
(g)	Use of all channels	Not applicable
(h)	Intelligent frequency hopping	Not applicable
(i)	Radio frequency hazards	Complies

3. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The client selected the test sample.

The report relates only to the sample tested.

This report does not contain corrections or erasures.

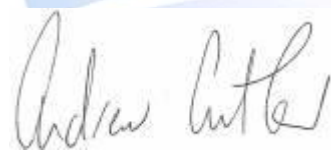
Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler
General Manager
EMC Technologies NZ Ltd

4. CLIENT INFORMATION

Company Name ELPRO Technologies Pty Ltd
Address 9/12 Billabong Street
City Stafford
State Queensland 4053
Country Australia
Contact Mr Scott Bowman

5. TEST SAMPLE DESCRIPTION

Brand Name EATON
Model Number 915U-2
Product 900 MHz Frequency Hopping Spread Spectrum Transceiver
Manufacturer ELPRO Technologies Pty Ltd
Designed in Australia
Manufactured in Malaysia
Serial Number 04141255093
FCC ID O9PE2900AA1

The device tested is a 900 MHz Frequency Hopping Spread Spectrum Transceiver that operates in the 902 - 928 MHz band.

Class 2 permissive change testing was carried out in order confirm the existing certification of this transceiver.

The device tested had the following specifications:

Rated Transmitter Conducted Output Power

1.0 Watts (30.0 dBm)

FCC Band:

902 - 928 MHz

Transmitter Frequency Operating Range

902 - 928 MHz

Channel Spacing:

250 kHz

Modes of operation:

Binary 2FSK at 115 kb/s

Modulation Designator:

F1D

Test frequencies / No of channels etc

Device operates using:

50 channels between 902.625 - 914.875 MHz

50 channels between 915.125 - 927.375 MHz

Testing was therefore carried out on various channels but specific tests were carried out on:

902.625 MHz, 915.125 MHz, 927.375 MHz

Power Supply

DC voltage supply from 10.8 - 30 Vdc.

Typically the device would be powered at 24 Vdc using 2 x 12 Vdc lead acid batteries.

Intended Use

The client has declared that this device will typically be used in Class A Commercial, Industrial or Business environments.

6. TEST RESULTS

Standard

The sample was tested in accordance with 47 CFR Part 15 Subpart C and in particular section 15.247

Methods and Procedures

The following measurement methods and procedures have been applied:

- ANSI C63.10 – 2013
- FCC Public Notice DA 00-0705

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 uses a standard SMA connector, which is not unique, as this equipment will be installed by professional installers..

Result: Complies

Section 15.204: External radio frequency power amplifiers and antenna modifications

The device is NOT supplied with an external power amplifier and the user manual defines the types of antennas that can be used with this device.

Result: Complies.

Section 15.205: Restricted bands of operation

The device tested can operate between 902 - 928 MHz

Specifically it transmits on 50 channels between 902.625 - 914.875 MHz and 50 channels between 915.625 - 927.625 MHz using frequency hopping spread spectrum techniques.

Section 15.247 allows this between 902.0 – 928.0 MHz

The requirements of the restricted bands have been noted

Result: Complies.

Section 15.247(a)(1) - Channel occupancy / bandwidth

The results are summarised as follows:

Parameter	Limit	Observation	Result
Number of channels	Minimum of 50 channels	50 channels observed in each band of operation.	Pass
20 dB bandwidth	Less than the channel spacing	A worst case bandwidth of 232.646 kHz was measured	Pass
Hop interval	Greater than 20 dB bandwidth	250.5 kHz was measured.	Pass
Dwell time	Not to exceed 400 ms in any 20 second period	329 ms was measured	Pass

Result: Complies.

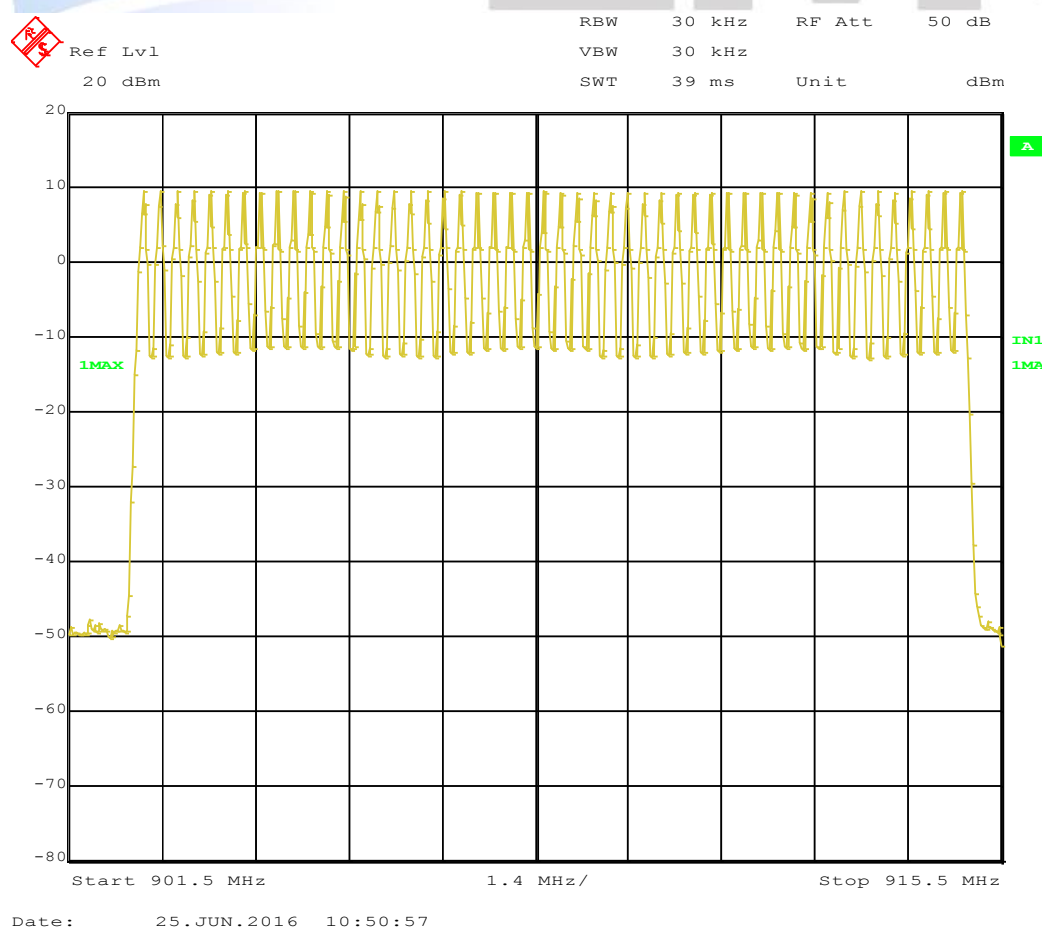
This device operates using Frequency Hopping Spread Spectrum techniques in the 902 - 928 MHz band with two bands of operation between 902 - 915 MHz and 915 MHz to 928 MHz.

50 channels were observed in operation in each band as can be seen below.

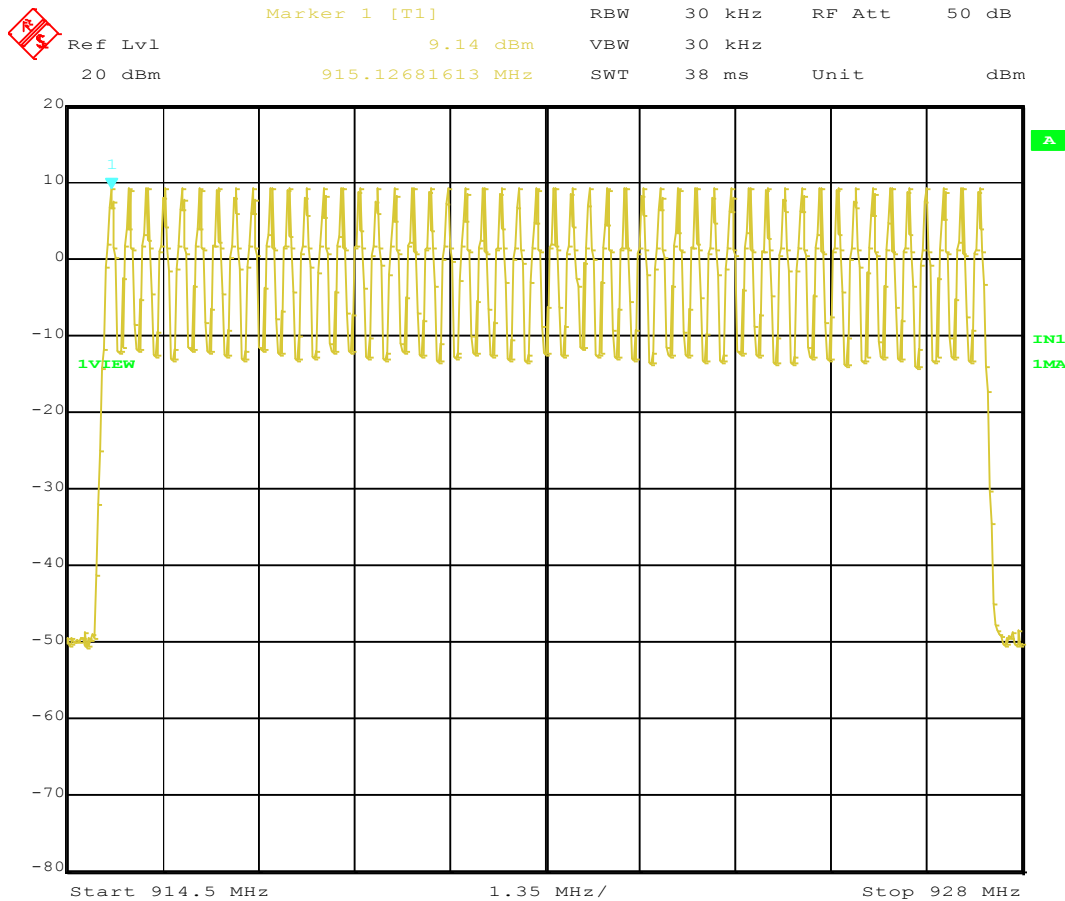
$$914.875 - 902.625 \text{ MHz} / 250 \text{ kHz} = 49 + 1 = 50$$

$$927.375 - 915.125 \text{ MHz} / 250 \text{ kHz} = 49 + 1 = 50$$

50 channels can be seen to be in operation between 902 - 915 MHz



50 channels can be seen to be in operation between 915 - 928 MHz



Date: 27.JUN.2016 09:39:38

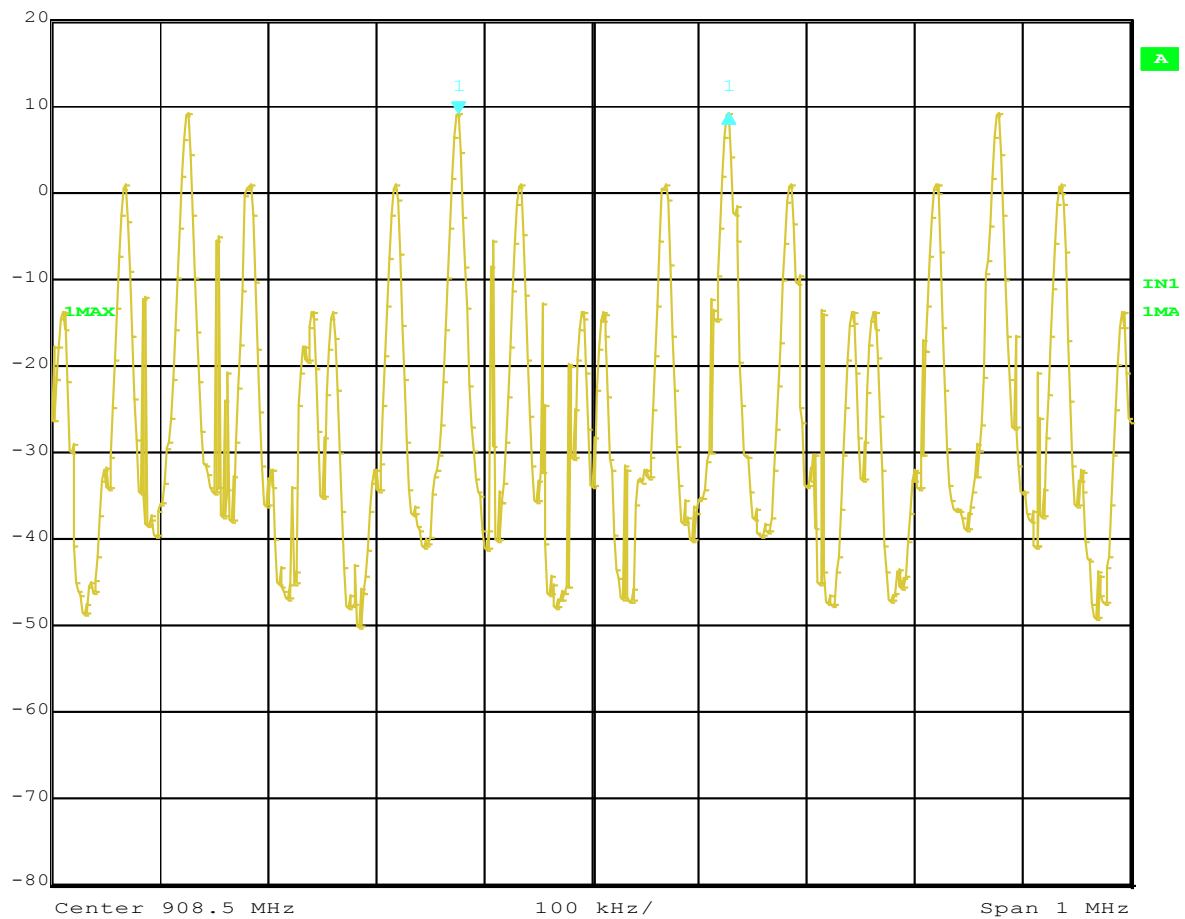
Result: Complies

Technologies

A channel spacing of 250.5 kHz was observed to be in operation in the 902 - 915 MHz band

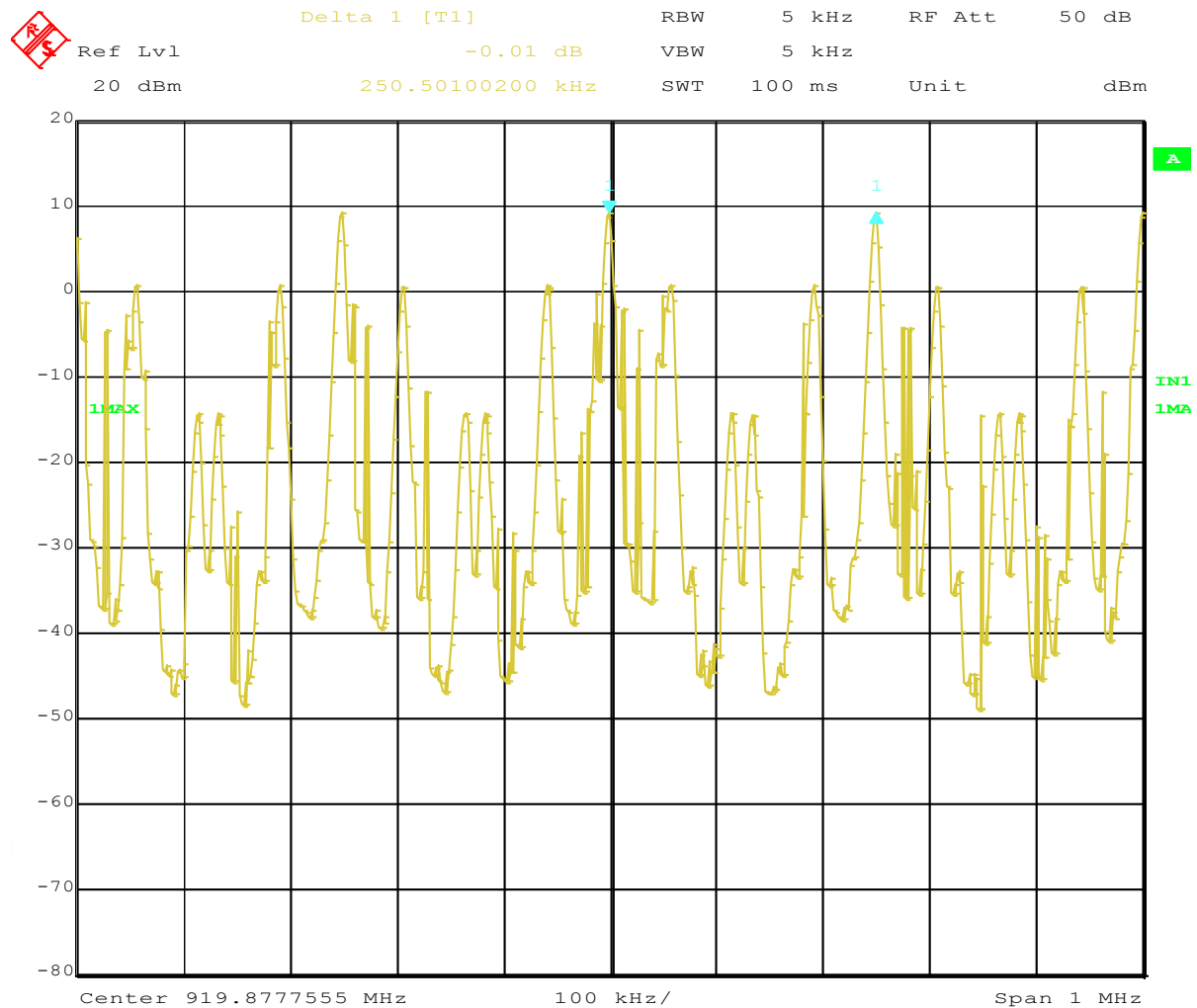


Delta 1 [T1] RBW 5 kHz RF Att 50 dB
Ref Lvl 0.02 dB VBW 5 kHz
20 dBm 250.50100200 kHz SWT 100 ms Unit dBm



Date: 25.JUN.2016 10:55:27

A channel spacing of 250.5 kHz was observed to be in operation in the 915 - 928 MHz band

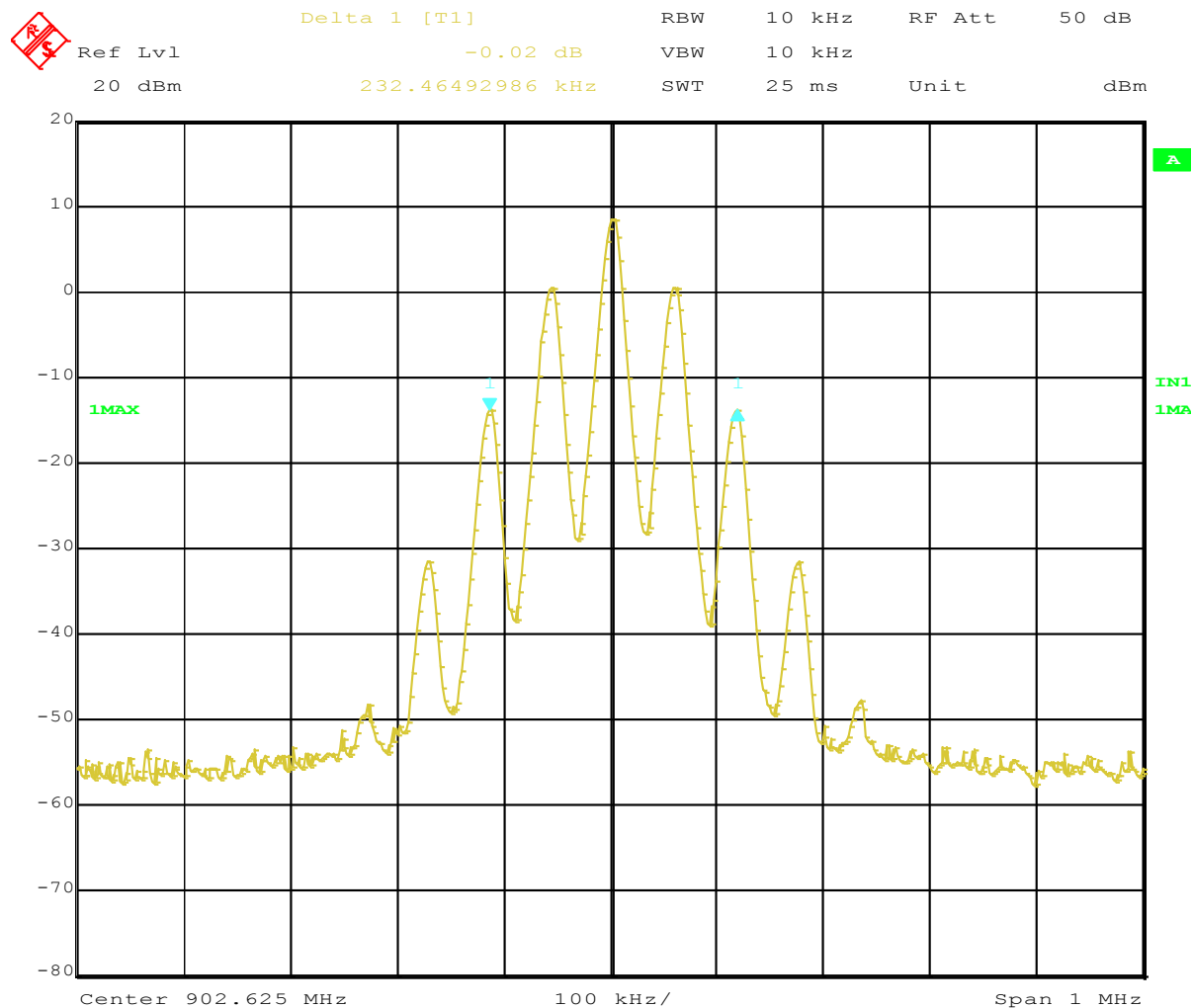


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Result: Complies

The -20 dB bandwidth has been determined below.

902.625 MHz. Bandwidth = 232.465 kHz

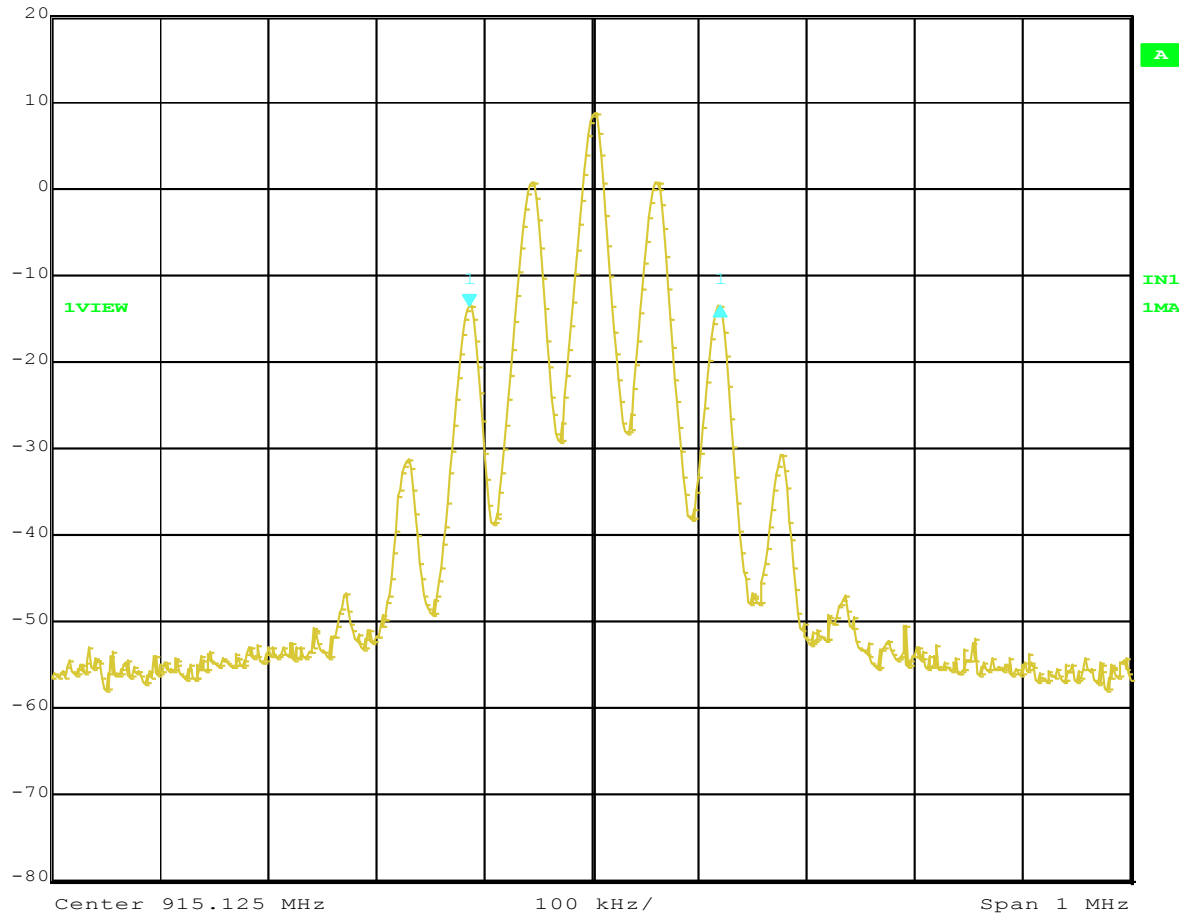


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915.125 MHz. Bandwidth = 232.646 kHz.

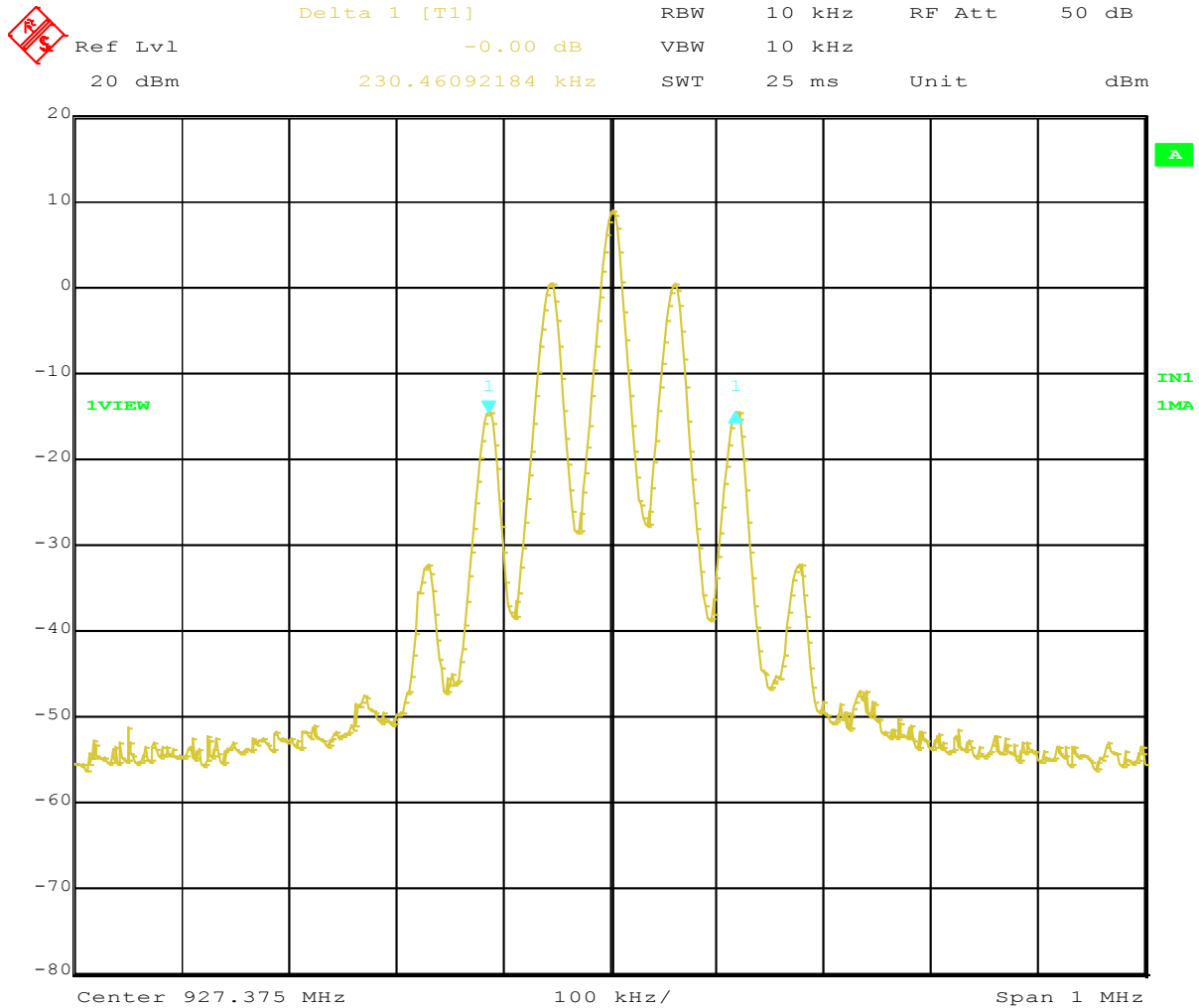


Delta 1 [T1] RBW 10 kHz RF Att 50 dB
Ref Lvl 0.00 dB VBW 10 kHz
20 dBm 232.84569138 kHz SWT 25 ms Unit dBm



Date: 25.JUN.2016 12:19:18

927.375 MHz. Bandwidth = 230.461 kHz

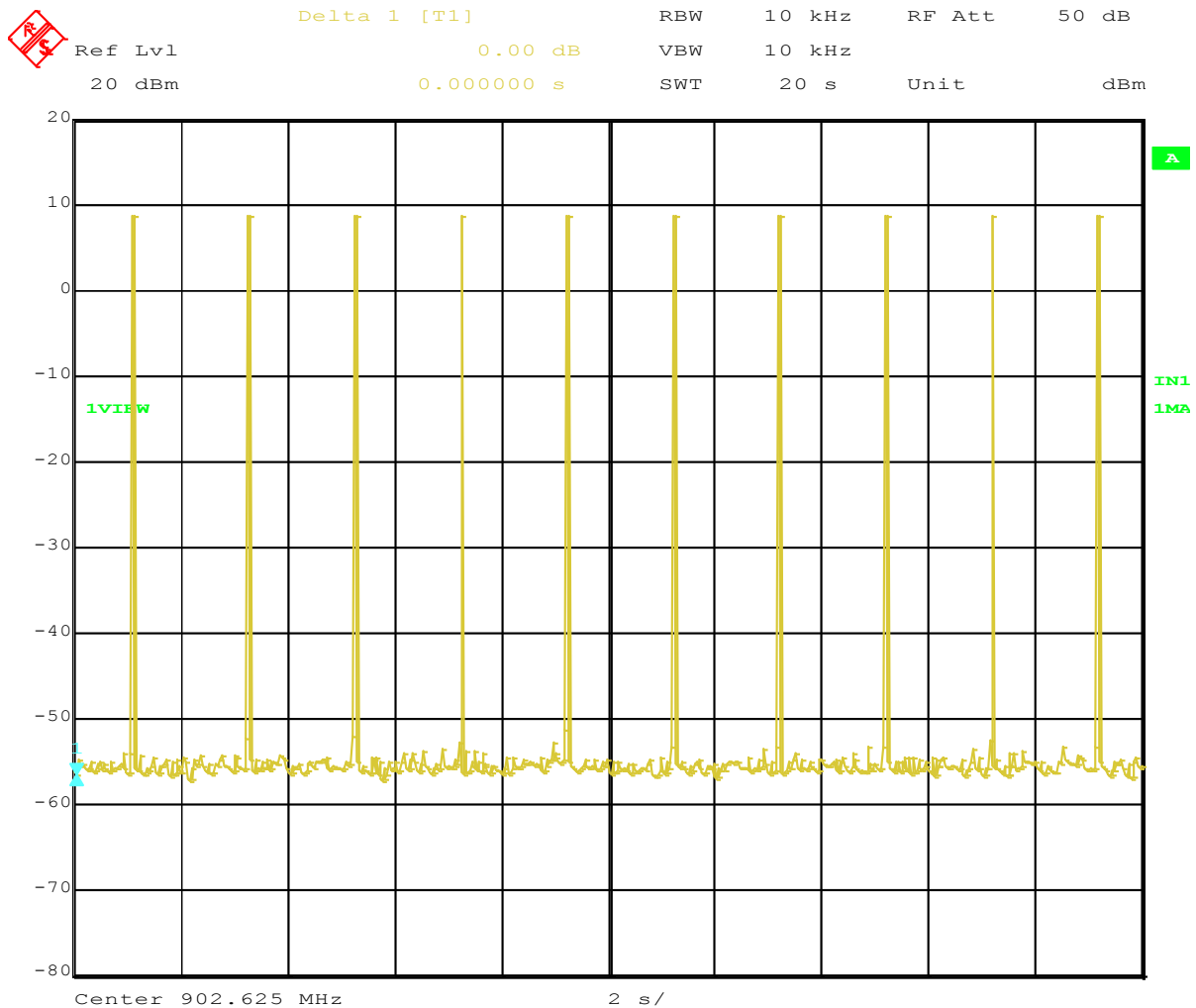


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A worst case -20 dB bandwidth of 232.646 kHz was measured which is less than the step size of 250.5 kHz.

Result: Complies

Dwell time



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When operating continuously the device was observed to operate on average 10 times in a period of 20 seconds.

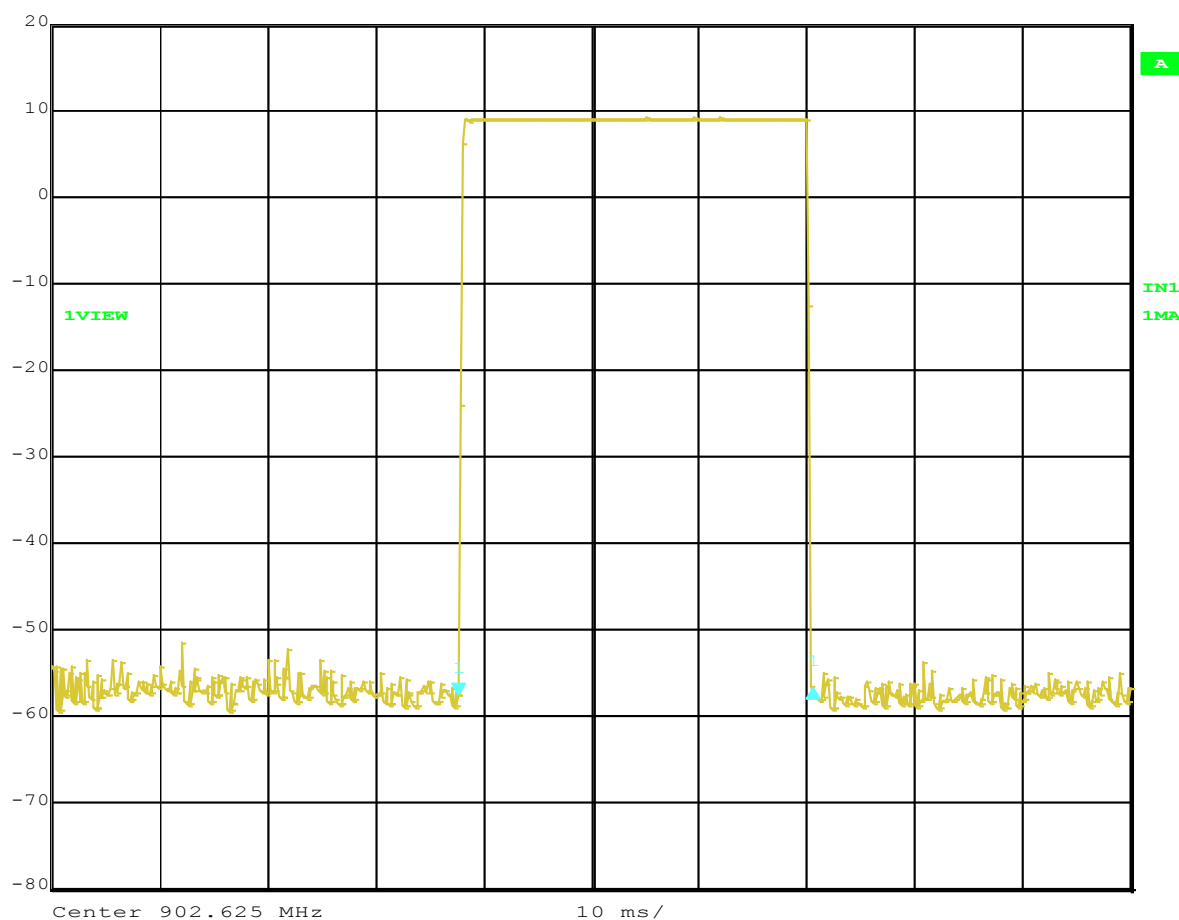
A 20 second observation time was applied as a worst case option.

While the channel spacing has been measured to be 250.5 kHz the declared channel spacing is 250 kHz.

Therefore this assessment has been carried out based upon the requirements for a channel spacing of 250 kHz or less.



Ref Lvl 20 dBm Delta 1 [T1] 0.64 dB RBW 10 kHz RF Att 50 dB
VBW 10 kHz Unit dBm
SWT 100 ms



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The transmitter was observed to operate for 32.9 ms each time it transmitted

Therefore the dwell time will be $10 \times 32.9 \text{ ms} = 329.0 \text{ ms}$

In any 20 second period the transmitter dwell time cannot exceed 400 ms

Result: Complies.

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

Conducted Power

Conducted power measurements were made on the low, mid and high frequency using a spectrum analyser with a 1 MHz resolution bandwidth that was connected to the antenna port

The following levels were recorded.

Frequency (MHz)	Level (dBm)	Limit (dBm)
902.6250	30.0	30.0
915.1250	30.0	30.0
927.3750	30.0	30.0

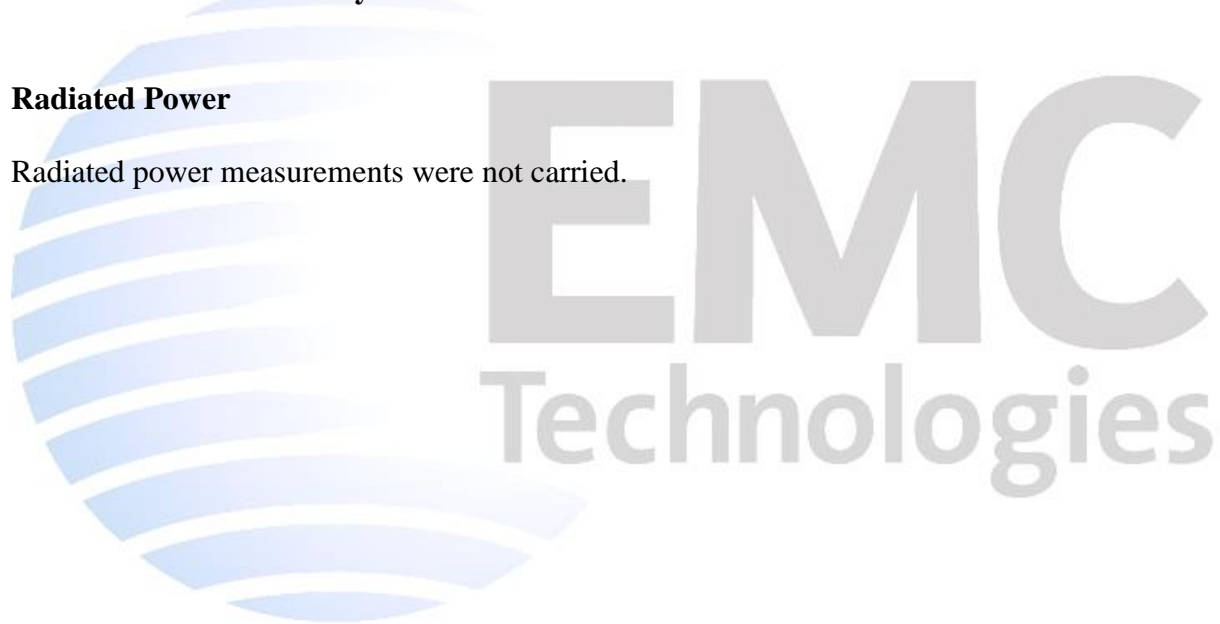
A conducted power limit of 1 watt (+30 dBm) is specified for this device

Result: Complies.

Measurement Uncertainty: ± 2.1 dB

Radiated Power

Radiated power measurements were not carried.



Section 15.247 (d) – Out of band emissions

Band edge measurements:

At the band edges of 902 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 at the antenna port showing that the -20 dBc points remain within the 902 to 928 MHz band.

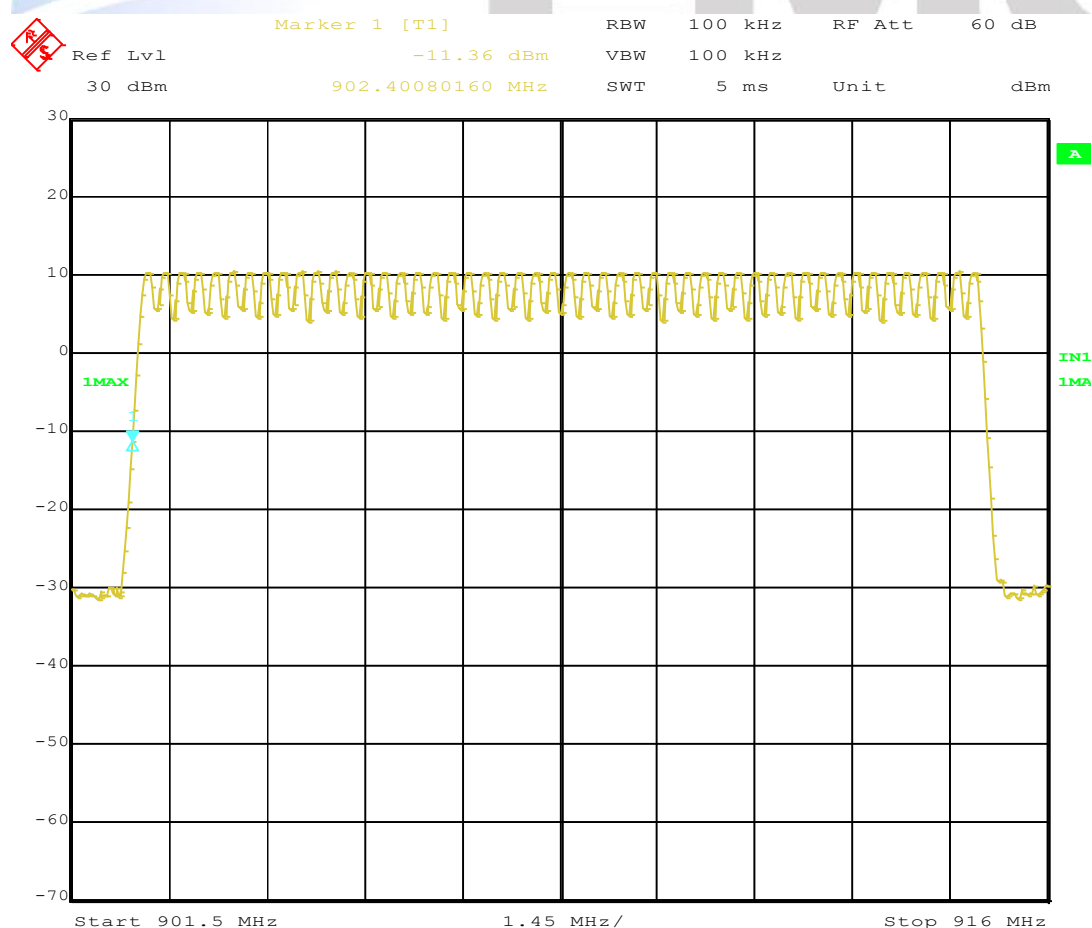
Measurements were made when the device was operating in hopping and not hopping modes.

All measurements were made using a spectrum analyser with a 20 dB external attenuator attached that has not been automatically accounted for in the plots below.

Hopping mode:

Band (MHz)	-20 dBc (MHz)	Limit (MHz)
902 - 915	902.4008	> 902.000
915 - 928	927.6172	< 928.000

902 - 915 MHz low band

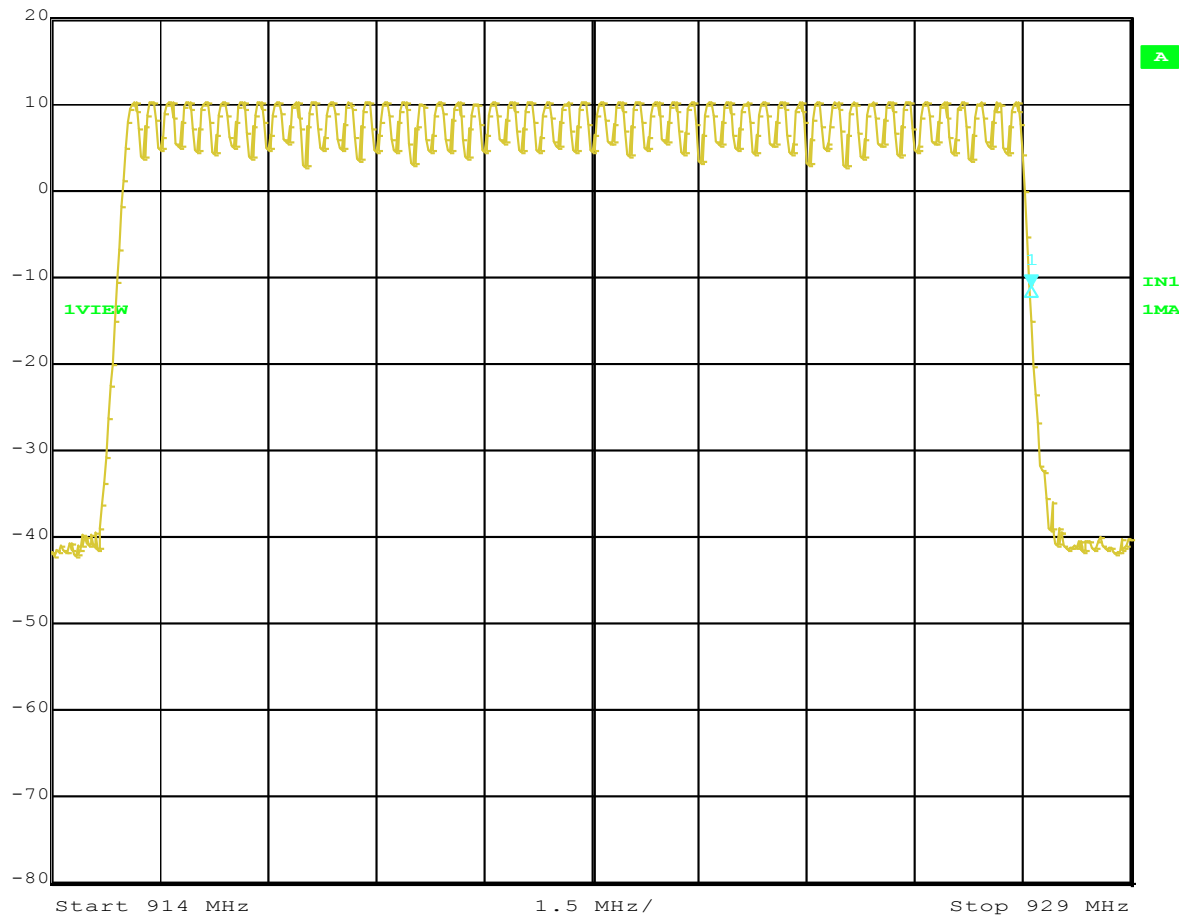


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915 - 928 MHz high band



Ref Lvl 20 dBm
Marker 1 [T1] -11.21 dBm
927.61723447 MHz
RBW 100 kHz
RF Att 50 dB
VBW 100 kHz
SWT 5 ms
Unit dBm



Date: 27.JUN.2016 09:54:26

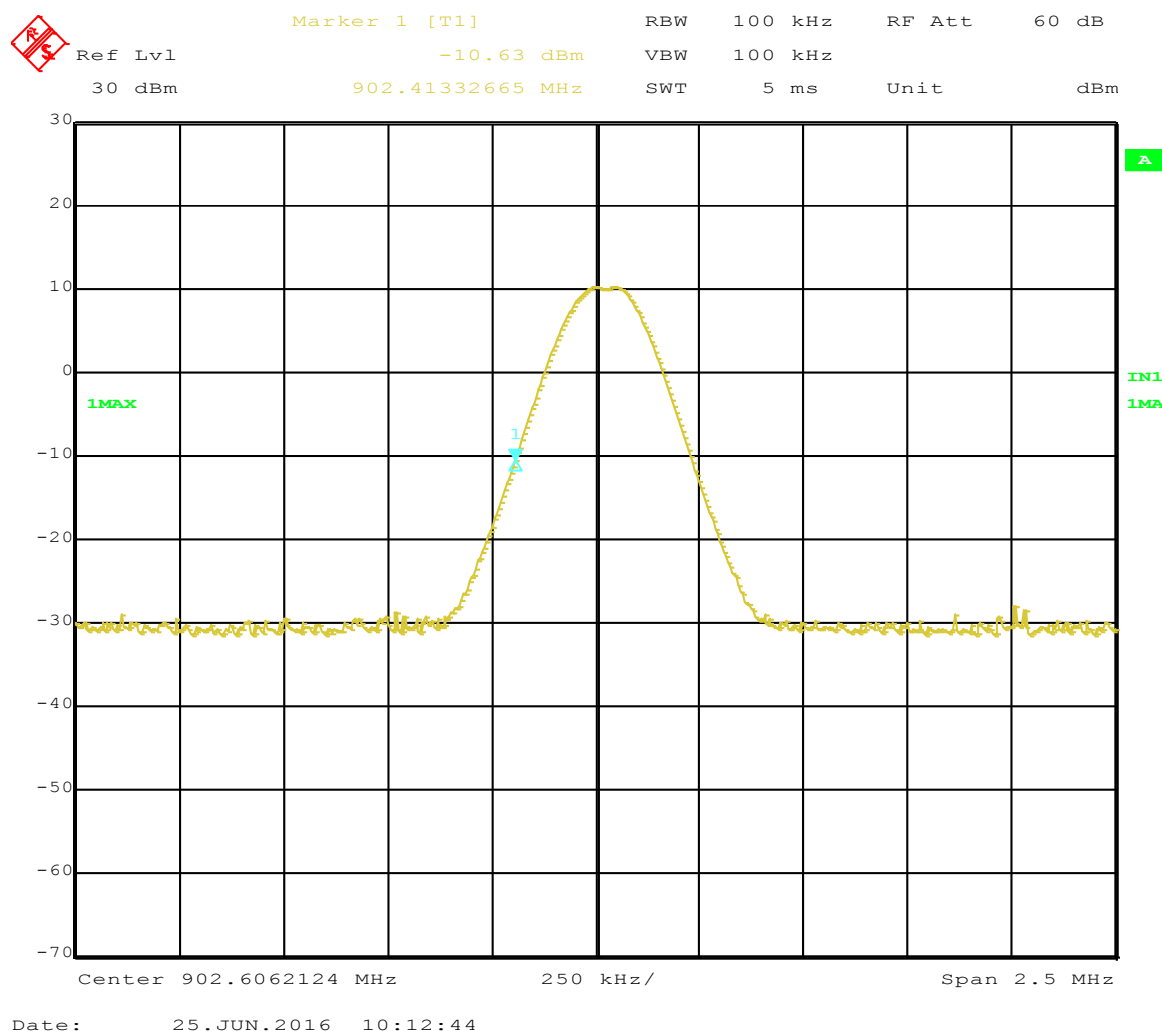
Measurements were also made when the device was made to transmit continuously on 902.625 MHz and 927.375 MHz.

Measurements were made using a resolution bandwidth of 100 kHz with the -20 dB point being located 20 dB down on the emission peak.

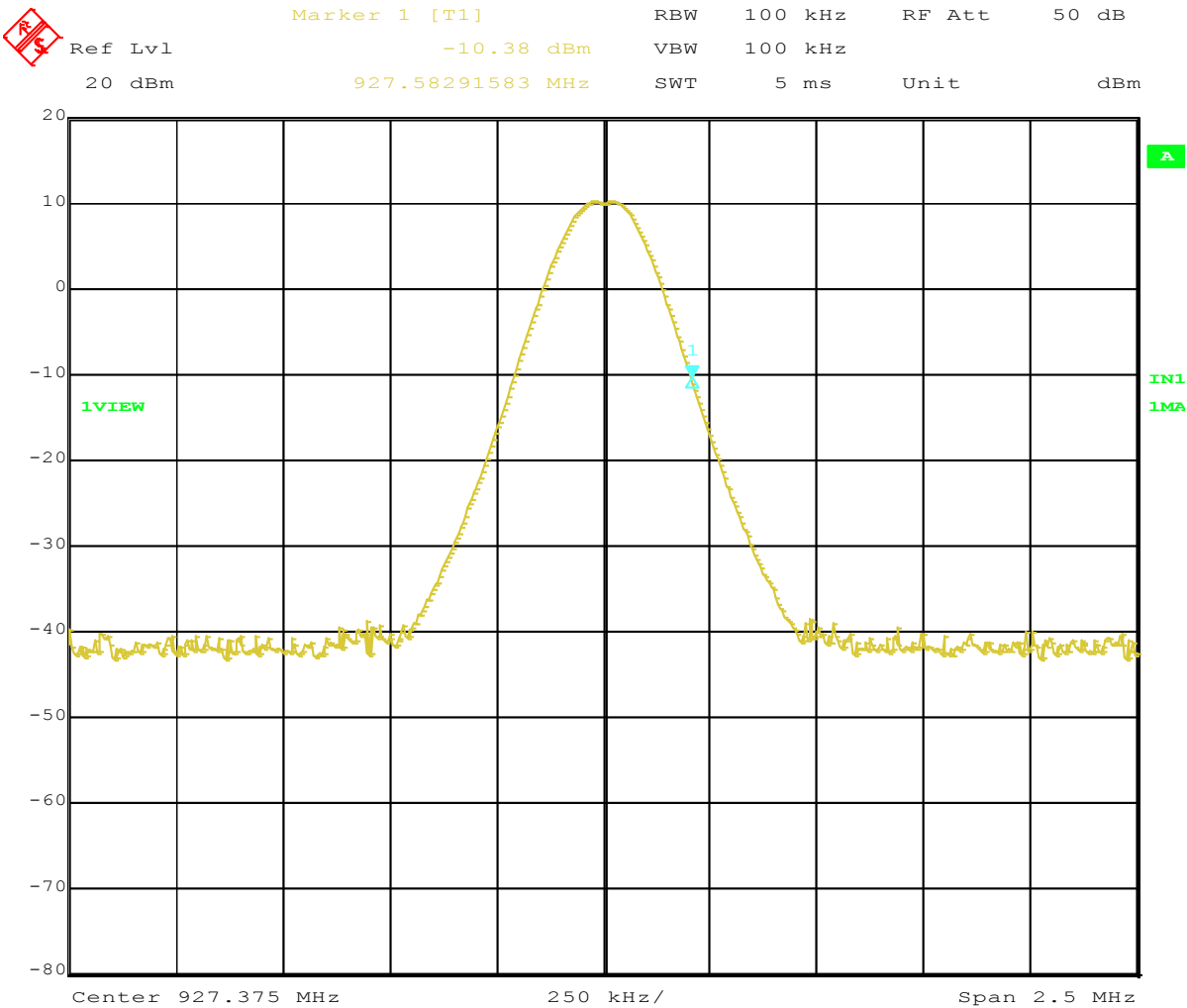
Not hopping mode:

Band Edge (MHz)	-20 dBc (MHz)	Limit (MHz)
902.000	902.4133	> 902.000
928.000	927.5829	< 928.000

Not hopping mode: 902.625 MHz



Not hopping mode: 927.375 MHz



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Result: Complies.

Conducted emissions at the antenna terminal

Testing for conducted spurious emissions was carried out at the antenna port of the transmitter.

The transmitter was made to transmit continuously on a low, middle and high frequency over the operating band of 902 - 928 MHz with modulation applied.

As the device operates in the 900 MHz band measurements were attempted between 1 MHz and up to 10Fc on each transmit frequency.

Measurements were made using a spectrum analyser with a resolution bandwidth of 100 kHz.

A limit of -20 dBc with reference to the highest emission observed in the operating band when measured using a bandwidth of 100 kHz has been applied.

The highest emission level observed in the 902 - 928 MHz band was +30.0 dBm

A limit of +10 dBm has therefore been applied

Frequency (MHz)	Level (dBm)	Frequency (MHz)	Level (dBm)	Frequency (MHz)	Level (dBm)	Limit (dBm)
902.6250	+30.0	915.1250	+30.0	927.3750	+30.0	+30.0
1805.2500	< -40.0	1830.2500	< -40.0	1854.7500	< -40.0	+10.0
2707.8750	< -45.0	2745.3750	< -45.0	2782.1250	< -45.0	+10.0
3610.5000	< -50.0	3660.5000	< -50.0	3709.5000	< -50.0	+10.0
4513.1250	< -50.0	4575.6250	< -50.0	4636.8750	< -50.0	+10.0
5415.7500	< -50.0	5490.7500	< -50.0	5564.2500	< -50.0	+10.0
6318.3750	< -50.0	6405.8750	< -50.0	6491.6250	< -50.0	+10.0
7221.0000	< -50.0	7321.0000	< -50.0	7419.0000	< -50.0	+10.0
8123.6250	< -50.0	8236.1250	< -50.0	8346.3750	< -50.0	+10.0
9026.2500	< -50.0	9151.2500	< -50.0	9273.7500	< -50.0	+10.0

No other spurious emissions were detected at the antenna terminal except for the harmonic emissions recorded above.

Result: Complies.

Measurement uncertainty: ± 2.1 dB.

Section 15.247(i) – Radio Frequency Hazard Information

As per Section 15.247 (i) 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).

In accordance with this section, and also Section 2.1091, this device has been defined as a mobile device whereby a distance of 20 cm or greater can normally be maintained between the user and the device antenna.

In accordance with Section 1.1310 a Maximum Permissible Exposure (MPE) limit of 0.601 mW/cm² (902 MHz / 1500) or the General Population / Uncontrolled Exposure has 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:

$$E, \text{ V/m} = (\sqrt{30 * P * G}) / d$$

$$\text{Power density, mW/cm}^2 = E^2 / 3770 = 0.601$$

$$\begin{aligned} E \text{ for MPE} &= \sqrt{0.601 * 3770} \\ E &= \underline{47.6 \text{ V/m}} \end{aligned}$$

The maximum radiated power measured was +36.0 dBm or 4 Watts

Therefore:

$$\begin{aligned} E &= \sqrt{30 * P * G} / d \\ d &= \sqrt{30 * P * G} / E \\ d &= \sqrt{30 * 4} / 47.6 \\ d &= \underline{0.23 \text{ m or } 23 \text{ cm}} \end{aligned}$$

In order to meet the MPE requirement for mobile devices a minimum safe distance of at least 23 cm will be required when the highest gain antenna is applied to the output of this transmitter.

Result: Complies

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset	Cal Due	Interval
Receiver	Rohde & Schwarz	ESIB-40	100171	EMC4003	16/02/2017	1 year
Spectrum Analyzer	Hewlett Packard	E7405A	US39150142	RFS 3776	21/12/2016	1 year
Power Supply	Hewlett Packard	6032A	2743A-02859	E1069	N/a	N/a

At the time of testing all test equipment was within calibration.

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 in June 2014.

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.

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.

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.

9. PHOTOGRAPHS

