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**EMC testing of the Tektelic Communications Inc. Enterprise Radio Module
in accordance with FCC Part 15.247, ANSI C63.4: 2014 and ANSI C63.10: 2013
as referenced by FCC OET KDB 558074 D01 DTS Measurement Guidance v03r02**

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REVISION RECORD

ISSUE	DATE	AUTHOR	REVISIONS
DRAFT 1	2017-11-03	D. Raynes	Initial draft submitted for review.
Release 1	2017-11-03	M. Rousseau	Sign off
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1.0 INTRODUCTION

1.1 Scope

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 15.247 as specified by Tektelic Communications Inc. All test procedures, limits, criteria, and results described in this report apply only to the Tektelic Communications Inc. Enterprise Radio Module test sample, referred to herein as the EUT (Equipment Under Test).

This report does not imply product endorsement by the Electronics Test Centre, SCC, NAVLP, A2LA, nor any Canadian Government agency.

1.2 Applicant

This test report has been prepared for Tektelic Communications Inc, located in Calgary, Alberta, Canada.

1.3 Test Sample Description

As provided to ETC (Airdrie) by Tektelic Communications Inc:

Product Name:		Enterprise Radio Module
Lora Radio	Frequency Range	923.3 – 927.5 MHz
	Type of Modulation	500KHz DTS
	Associated Antenna / Gain	Omni-directional antenna, 6 dBi Mfr: L-COM, model: HGV-906U
Model# / Serial#		T0004564 / 1730K0011
Power:		5.4 VDC

This product is “**Radio interface between LoRa nodes and server**”.

1.4 General Test Conditions and Assumptions

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated.

Where relevant, the EUT was only tested using the monitoring methods and test criteria defined in this report.

The environmental conditions are recorded during each test, and are reported in the relevant sections of this document.

1.5 Scope of Testing

Tests were performed in accordance with FCC Part 15.247, ANSI C63.4-2014, and ANSI C63.10-2013 as referenced in FCC KDB 558074 v03r02.

The EUT was also tested as an unintentional radiator, as reported separately.

1.5.1 Test Methodology

Test methods are specified in the Basic Standard as referenced and/or modified by the Product Standard in the part of Section 2 of this report associated with each particular test case.

1.5.2 Variations in Test Methodology

Any variance in methodology or deviation from the reference Standard is documented in the part of Section 2 of this report associated with each particular Test Case.

1.5.3 Test Sample Verification, Configuration & Modifications

EUT setup, configuration, protocols for operation and monitoring of EUT functions, and any modifications performed in order to meet the requirements, are detailed in each Test Case of Section 2 of this report.

2.0 TEST CONCLUSION

STATEMENT OF COMPLIANCE

The customer equipment referred to in this report was found to comply with the requirements, as summarized below.

The EUT was subjected to the following tests. Compliance status is reported as **Compliant** or **Non-compliant**. **N/A** indicates the test was Not Applicable to the EUT.

Note: Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the tests performed in terms of the specification, class or performance criterion applied, and the EUT modification state.

Test Case	Test Type	Specification	Test Sample	Modifications	Config.	Result
2.1	AC Conducted Emissions (Tx)	15.207	Enterprise Radio Module	None	see § 2.1	Compliant
2.2	Maximum O/P	15.247(d)	Enterprise Radio Module	None	see § 2.2	Compliant
2.3	PSD	15.247(e)	Enterprise Radio Module	None	see § 2.3	Compliant
2.4	Channel Bandwidth	15.247(a)(2)	Enterprise Radio Module	None	see § 2.4	Compliant
2.5	Band Edge	15.247(d)	Enterprise Radio Module	None	see § 2.5	Compliant
2.6	Conducted Spurious	15.247(d)	Enterprise Radio Module	None	see § 2.6	Compliant
2.7	EUT Position	ANSI C63.4	Enterprise Radio Module	None	N/A	N/A
2.8	Radiated Spurious	15.205, 15.209 15.247(d)	Enterprise Radio Module	None	see § 2.8	Compliant
2.9	Radiated Spurious (Co-Location)	15.205, 15.209 15.247(d)	Enterprise Radio Module	None	see § 2.9	Compliant
2.10	RF Exposure	15.247(i)	Enterprise Radio Module	None		Compliant

Refer to the test data for applicable test conditions.

2.1 AC Power Line Conducted Emissions: Transmit Mode

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel: David Raynes	Standard: FCC Part 15.207
Date: 2017-11-03 (19.8° C, 11.0% RH)	Basic Standard: ANSI C63.4-2014

EUT status: Compliant

Specification: FCC Part 15.207

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5	56	46
5 – 30	60	50
Criteria: The conducted emissions produced by a device shall not exceed the limits as specified.		

2.1.1 Test Guidance: ANSI C63.4-2014, Clause 7.3.1

Before any testing is performed, the Ambient (measurement noise floor) is recorded, and a QC check is performed to show that the system is functioning correctly.

Testing starts with a scan, performed under software control. After this is complete, the list of frequencies of interest is generated. These frequencies are then investigated for quasi-peak and average amplitude, as applicable. Emissions measured with a QP detector that fall below the Average limit are deemed to meet both requirements.

2.1.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.1.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” As based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expanded uncertainty expressed at approximately 95% confidence using a coverage factor of $k = 2$.

Test Method	Frequency	Uncertainty
Conducted Emissions Level	150 KHz – 30 MHz	±2.7 dB

2.1.4 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	N/A	
EMI receiver	Agilent	N9038A	6130	2017-06-20	2018-06-20
LISN	Com-Power	LI-150A	6121	2017-07-07	2019-07-07
LISN	Com-Power	LI-150A	6122	2017-07-07	2019-07-07
Temp/Humidity	Extech	42270	5892	2017-04-06	2018-04-06
DVM	Fluke	87	22208	2017-08-23	2018-08-23

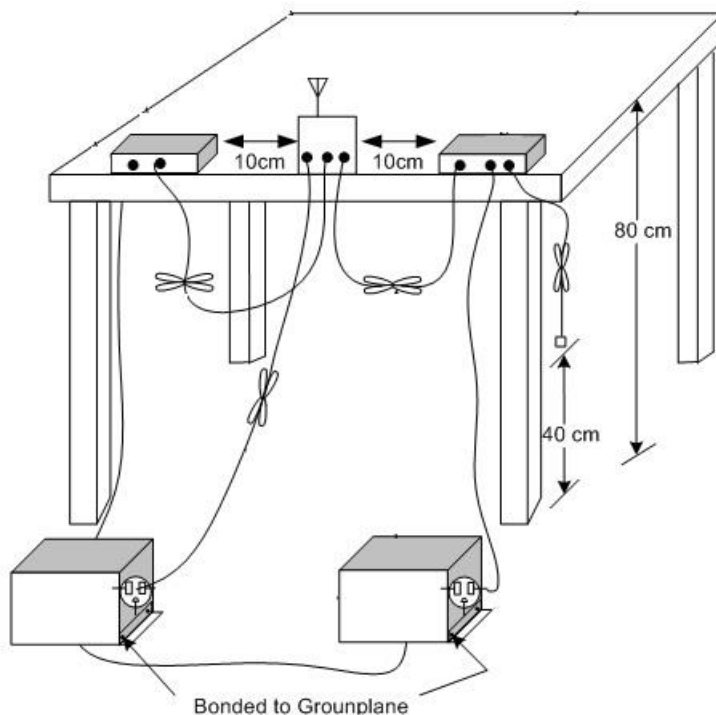
2.1.5 Test Sample Verification, Configuration & Modifications

The EUT was set to selected channels with test-specific software. The output was modulated as in normal operation. Configuration for 2-Carrier operation on Antenna 1 port at 923.9 MHz & 924.5 MHz, and 1-carrier operation on the Antenna 2 port at 926.3 MHz was selected as the worst-case for detailed examination. This selection was based on maximum EUT power dissipation, in the absence of harmonic emissions produced by any of the Tx channels selected. The antenna ports were terminated into 50Ω for this test.

The EUT was powered via a AC to DC power supply, manufacturer Kikusui, model PAB 8-3.

The EUT met the requirements without modification.

Test setup diagram:



2.1.6 Conducted Emissions Data:

The emissions data is presented in tabular form, showing the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value(s) of limit at the frequency measured, and the Delta between the result and the limit.

Freq. Marker	Freq. (MHz)	Raw Reading (dBμV)	Det.	LISN Factor (dB)	Cable Loss (dB)	Corrected Reading (dBμV)	FCC 15.207 Limit (dBμV)	Delta (dB)	L / N
1	0.23001	12.00	AV	0.0	9.9	21.90	52.45	-30.55	Line
2	0.39071	13.78	AV	0.0	10.0	23.78	48.05	-24.27	Line
3	1.14014	26.55	AV	0.0	10.0	36.55	46.00	-9.45	Line
4	3.9541	27.00	AV	0.0	10.0	37.00	46.00	-9.00	Line
1	0.21474	11.80	AV	0.0	9.9	21.70	53.02	-31.32	Neutral
2	0.38771	13.81	AV	0.0	10.0	23.81	48.11	-24.30	Neutral
3	1.14052	26.53	AV	0.0	10.0	36.53	46.00	-9.47	Neutral
4	1.47746	3.64	AV	0.0	10.0	13.64	46.00	-32.36	Neutral
5	2.70328	6.29	AV	0.0	10.0	16.29	46.00	-29.71	Neutral

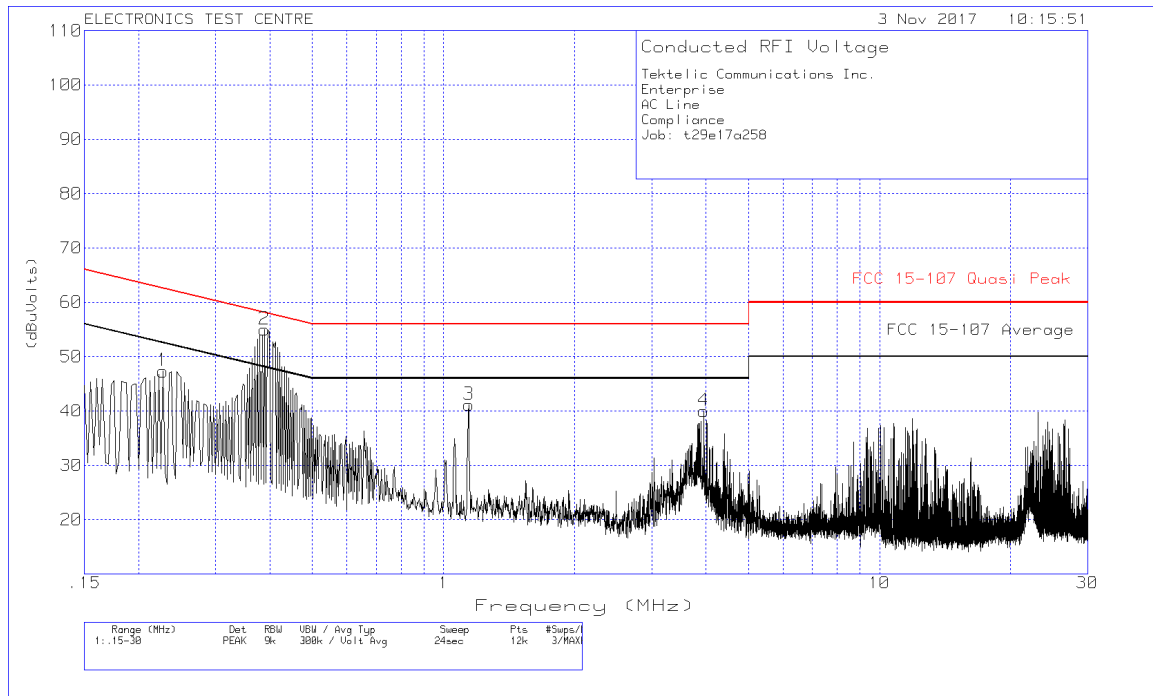
Raw Reading in dBμV + LISN factor in dB + Cable Loss in dB = Corrected Emission Voltage in dBμV.

Note: When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.

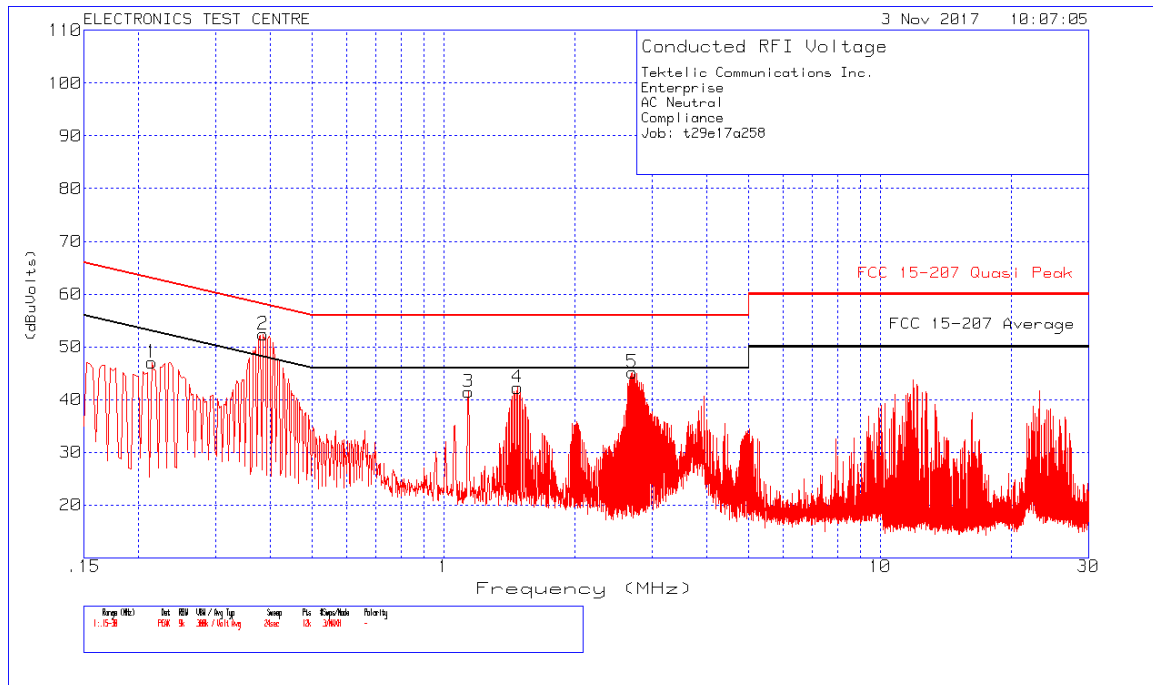
Negative values for Delta indicate compliance.

The Ground Bond was measured and found to be 1.2 mΩ.

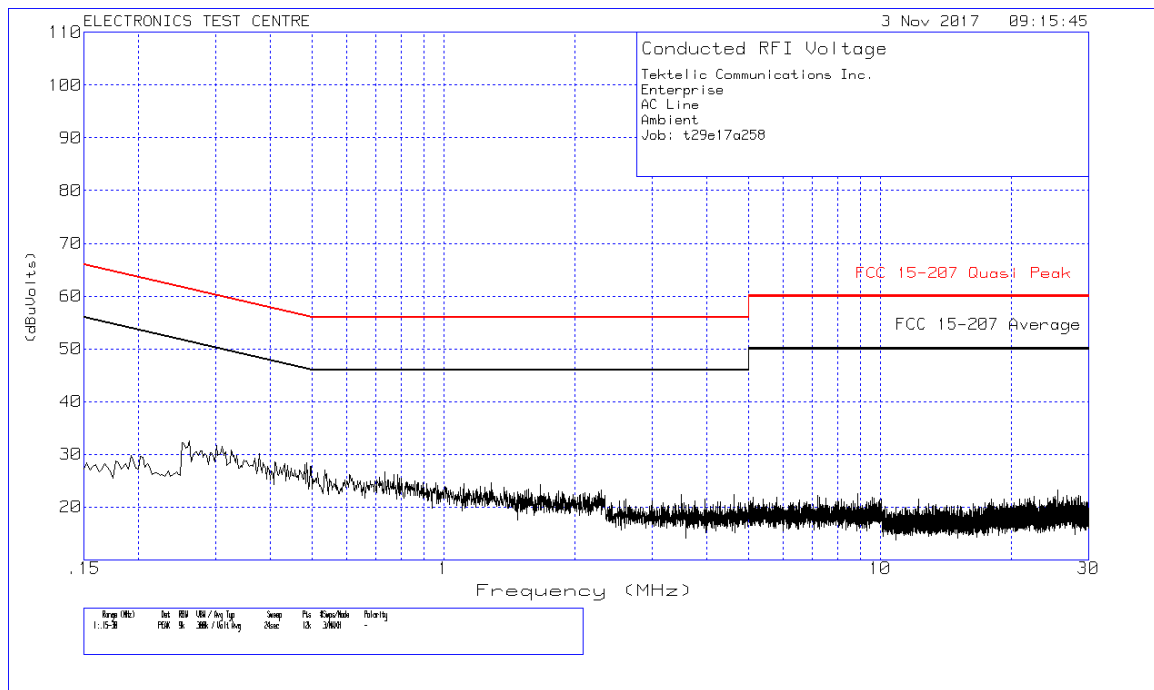
Plot of Conducted Emissions: Line



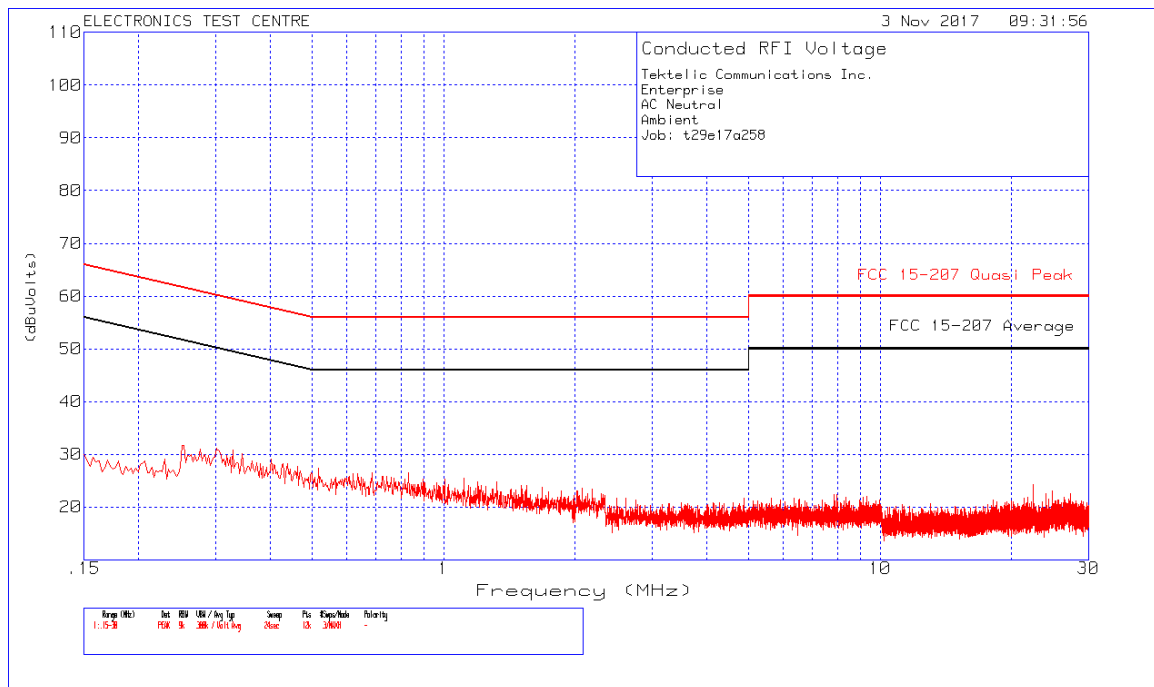
Plot of Conducted Emissions: Neutral



Plot of Test Chamber Ambient: (measurement noise floor): Line



Plot of Test Chamber Ambient: (measurement noise floor): Neutral



2.2 Maximum Conducted Average Output Power

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel: David Raynes	Standard: FCC Part 15.247
Date: 2017-10-02 (19.6° C, 25.0% RH)	Basic Standard: ANSI C63.10: 2013
EUT status: Compliant	

Specification: FCC Part 15.247(b)(3) & (4)

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2.2.1 Test Guidance: FCC KDB 558074 D01, Clause 9.2.2.2

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation.

The spectrum analyzer is set for a frequency span $\geq (1.5 \times \text{OBW})$ centered on a channel. The RBW is set to 1 – 5% (OBW) and VBW is set $\geq (3 \times \text{RBW})$. The RMS (power averaging) detector is used, with the trace set to Average 100. After the trace has processed 100 sweeps, the power is read from the analyzer display.

The reported power value is compensated for cable loss and attenuation.

2.2.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.2.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2017-06-20	2018-06-20
Attenuator (2)	Fairview Microwave	SA18N5WA-10	~	Monitored	
Attenuator	Narda	768-10	~	Monitored	
Temp/Humidity	Extech	42270	5892	2017-04-06	2018-04-06

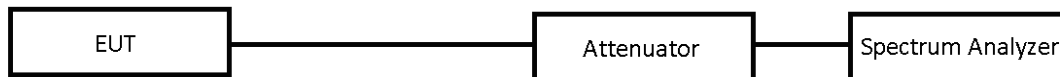
2.2.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

Testing was performed in 1-Carrier mode and in 2-Carrier mode.

The EUT met the requirements without modification.

Test setup diagram for Maximum Conducted Average Output Power testing:



2.2.5 Output Power Data

Measurements were performed via connection to the antenna ports, with attenuation between the EUT and the spectrum analyzer. Attenuation and cable loss are compensated by offsetting the analyzer readings.

Antenna 1: 1 Carrier

Frequency (MHz)	Corrected Reading (dBm)	RF Output (Watts)	Limit (Watts)	Margin (Watt) (Output - limit)
923.3	28.13	0.650	1	-0.350
923.9	28.44	0.698	1	-0.302
924.5	28.28	0.673	1	-0.327
925.1	28.45	0.700	1	-0.300

Antenna 1: 2 Carriers

Frequency (MHz)	Corrected Reading (dBm)	RF Output (Watts)	Limit (Watts)	Margin (Watt) (Output - limit)
923.3 + 923.9	29.85	0.966	1	-0.034
923.9 + 924.5	29.93	0.984	1	-0.016
924.5 + 925.1	29.54	0.899	1	-0.101

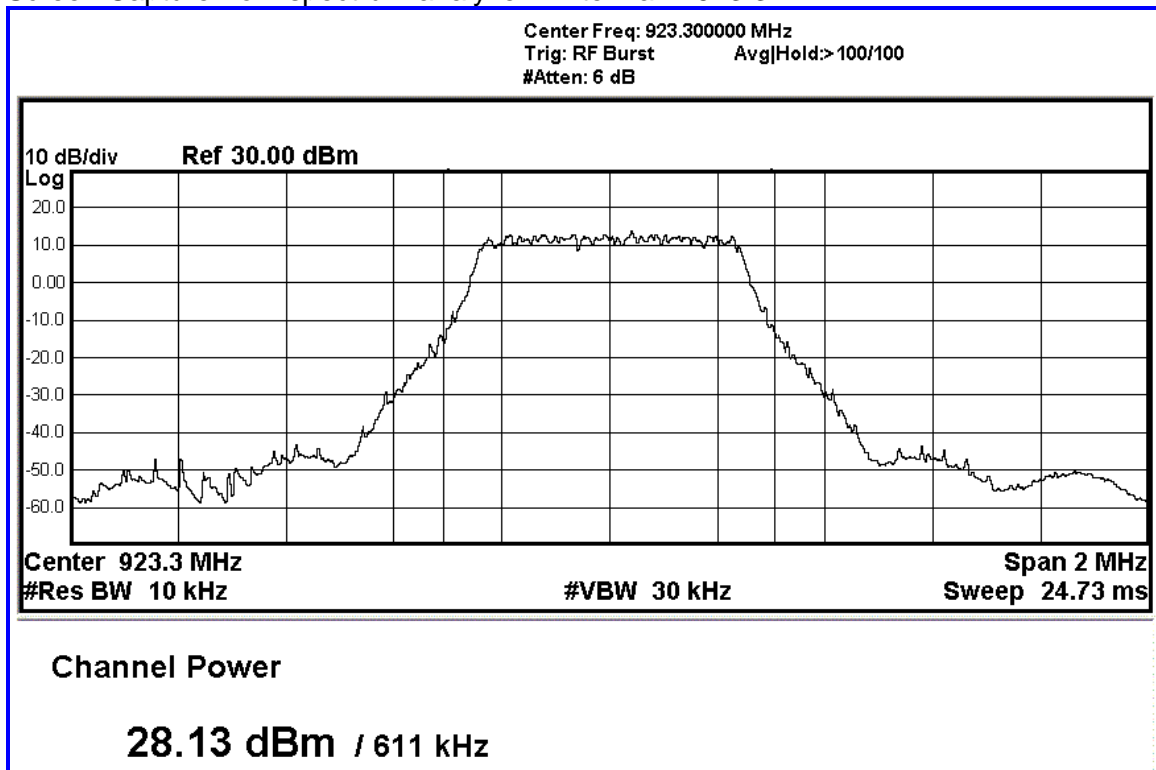
Antenna 2: 1 Carrier

Frequency (MHz)	Corrected Reading (dBm)	RF Output (Watts)	Limit (Watts)	Margin (Watt) (Output - limit)
925.7	28.18	0.658	1	-0.342
926.3	28.47	0.703	1	-0.297
926.9	27.85	0.610	1	-0.390
927.5	27.93	0.621	1	-0.379

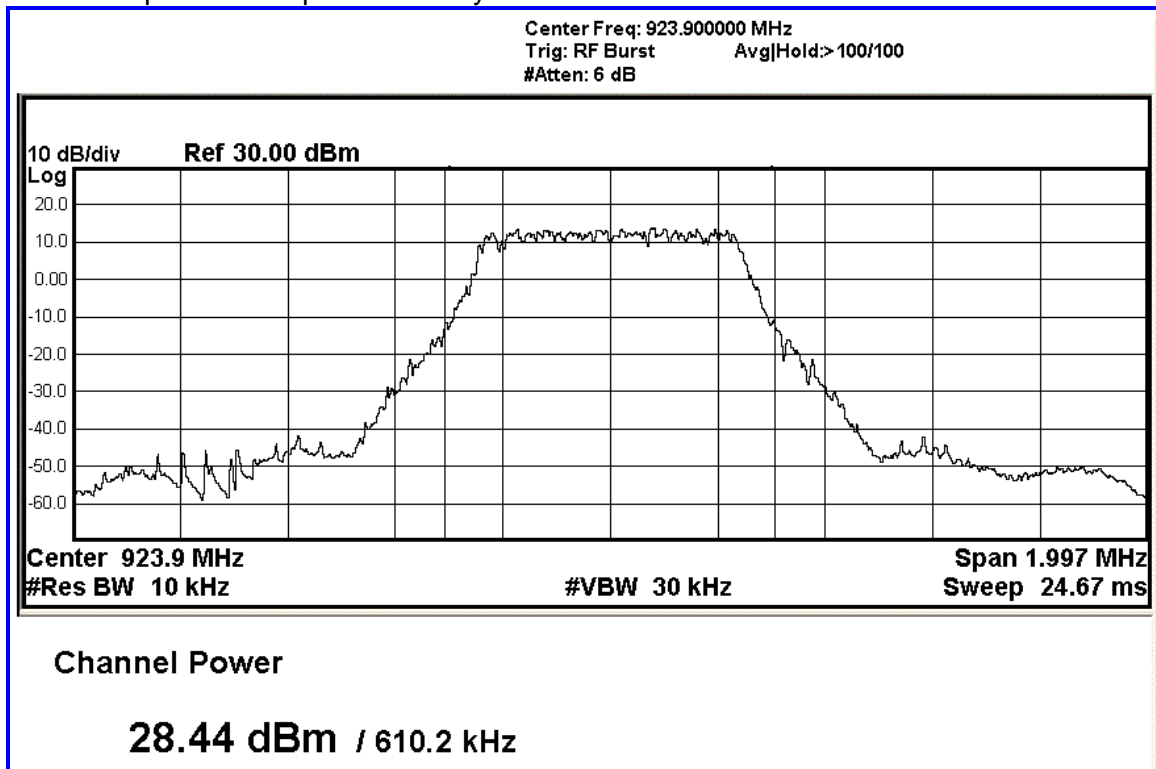
Antenna 2: 2 Carriers

Frequency (MHz)	Corrected Reading (dBm)	RF Output (Watts)	Limit (Watts)	Margin (Watt) (Output - limit)
925.7 + 926.3	29.61	0.914	1	-0.086
926.3 + 926.9	29.24	0.839	1	-0.161
926.9 + 927.5	29.48	0.887	1	-0.113

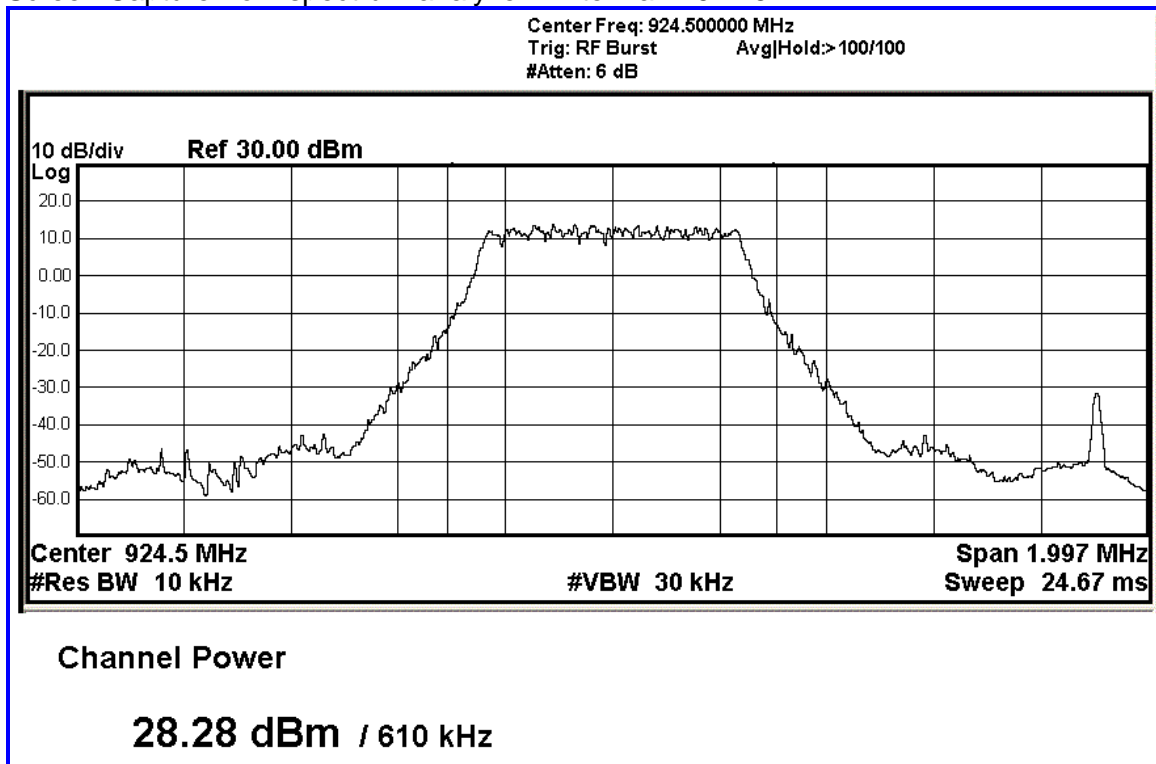
Screen Capture from spectrum analyzer: Antenna 1: 923.3 MHz



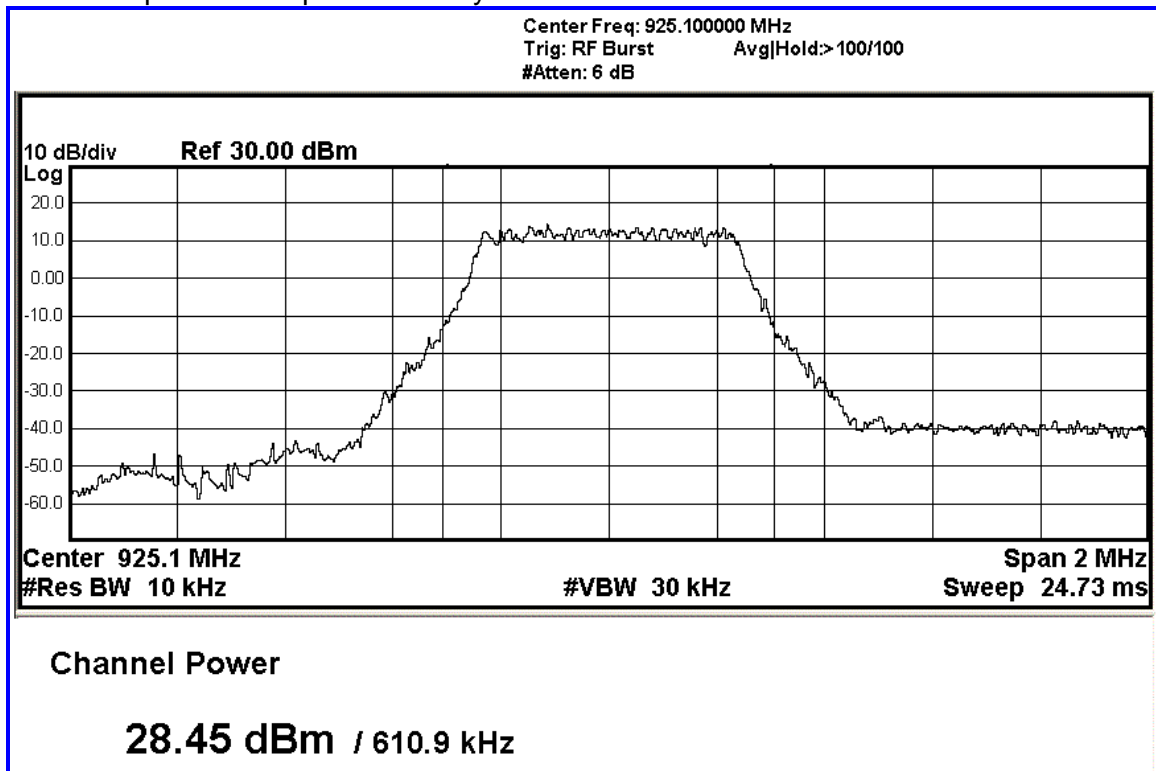
Screen Capture from spectrum analyzer: Antenna 1: 923.9 MHz



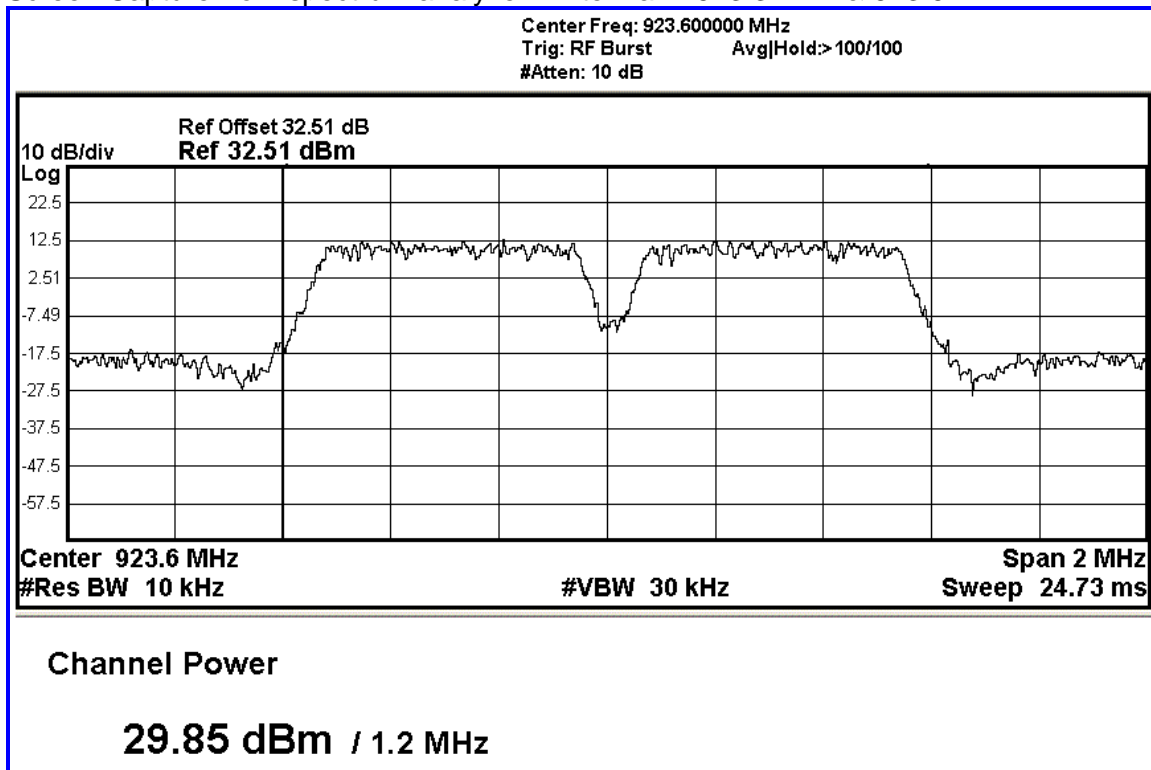
Screen Capture from spectrum analyzer: Antenna 1: 924.5 MHz



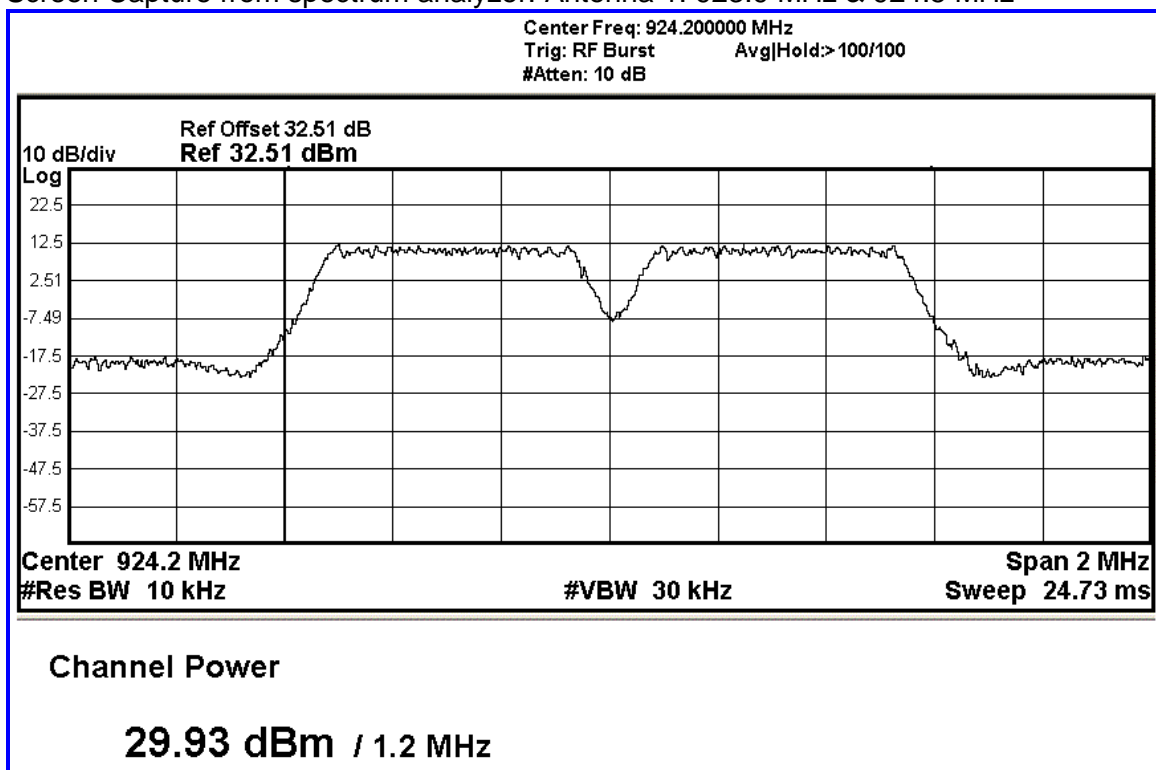
Screen Capture from spectrum analyzer: Antenna 1: 925.1 MHz



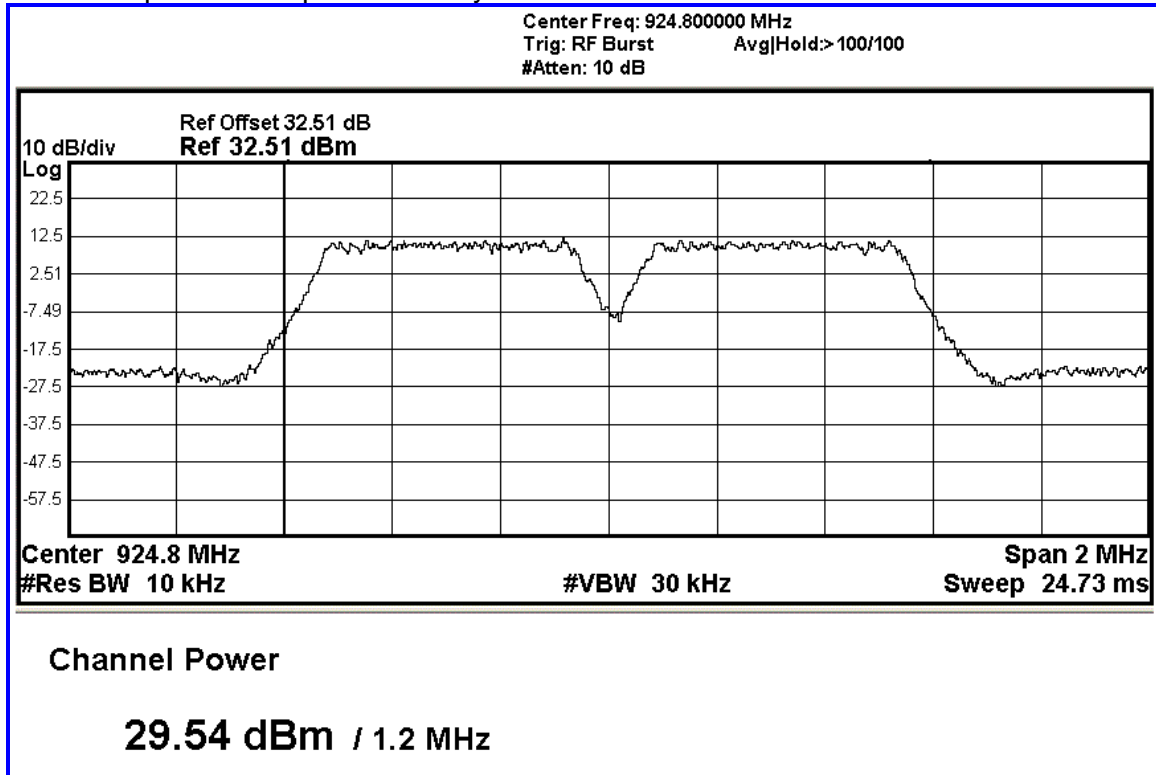
Screen Capture from spectrum analyzer: Antenna 1: 923.3 MHz & 923.9 MHz



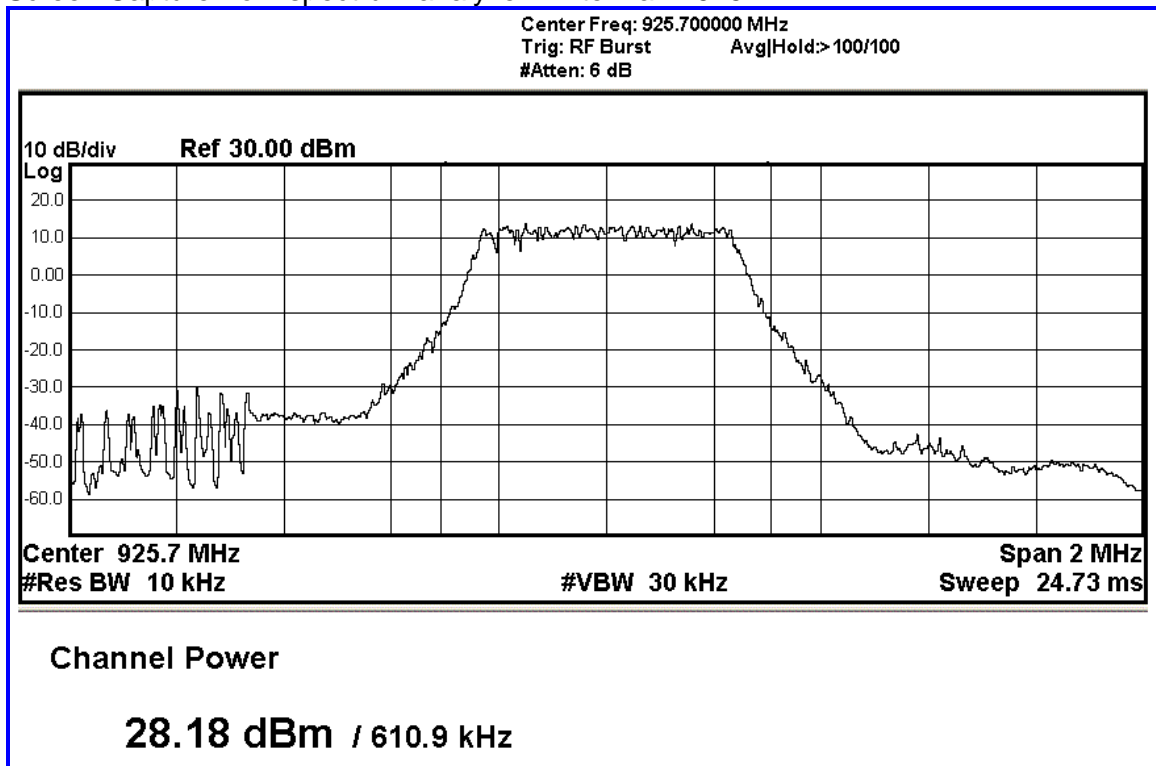
Screen Capture from spectrum analyzer: Antenna 1: 923.9 MHz & 924.5 MHz



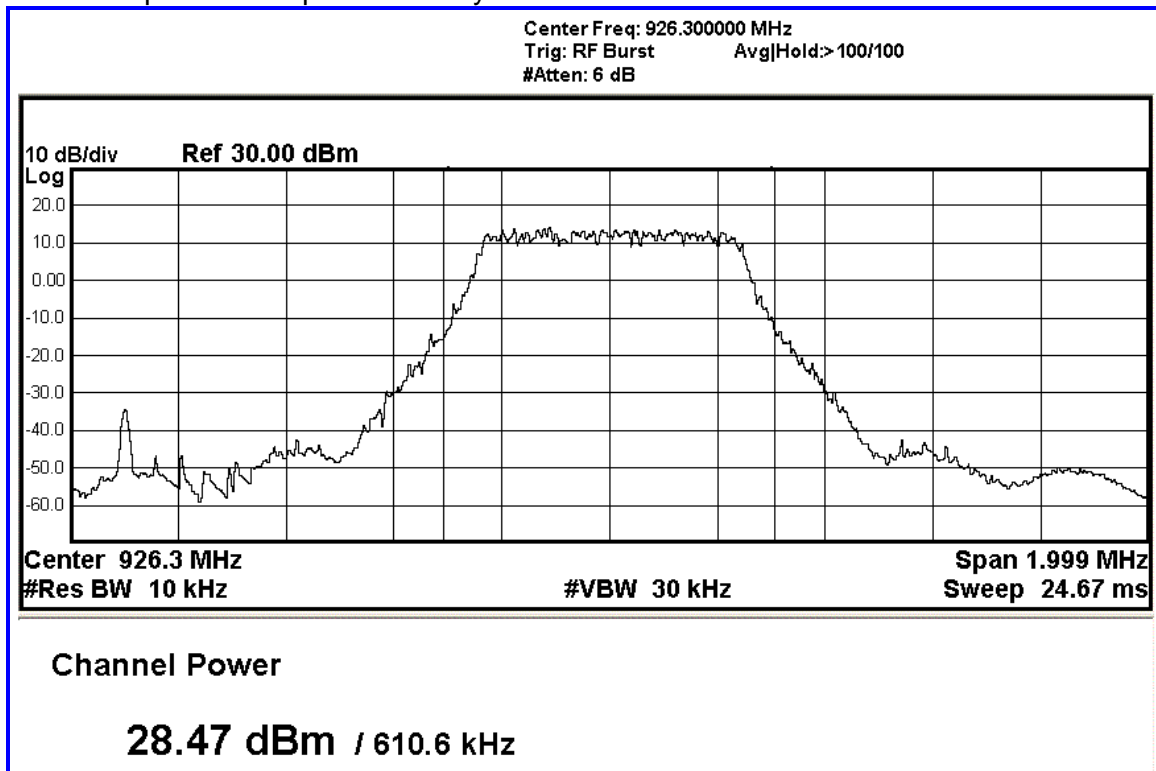
Screen Capture from spectrum analyzer: Antenna 1: 924.5 MHz & 925.1 MHz



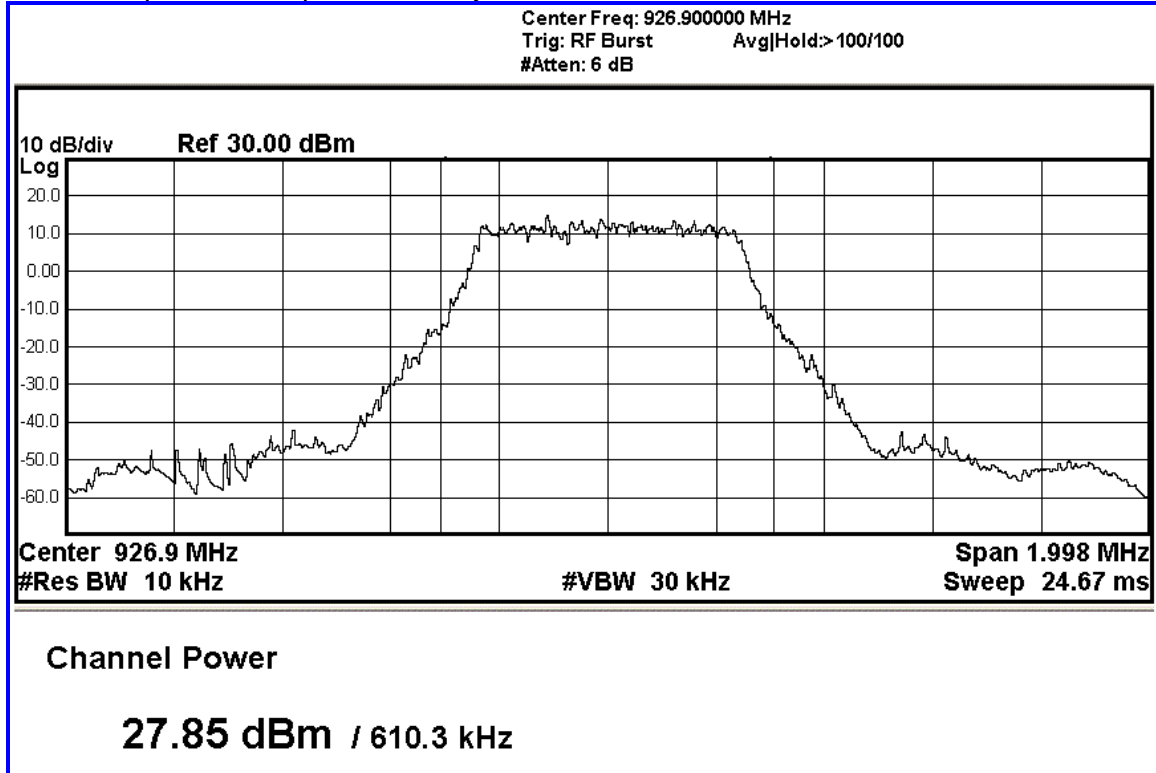
Screen Capture from spectrum analyzer: Antenna 2: 925.7 MHz



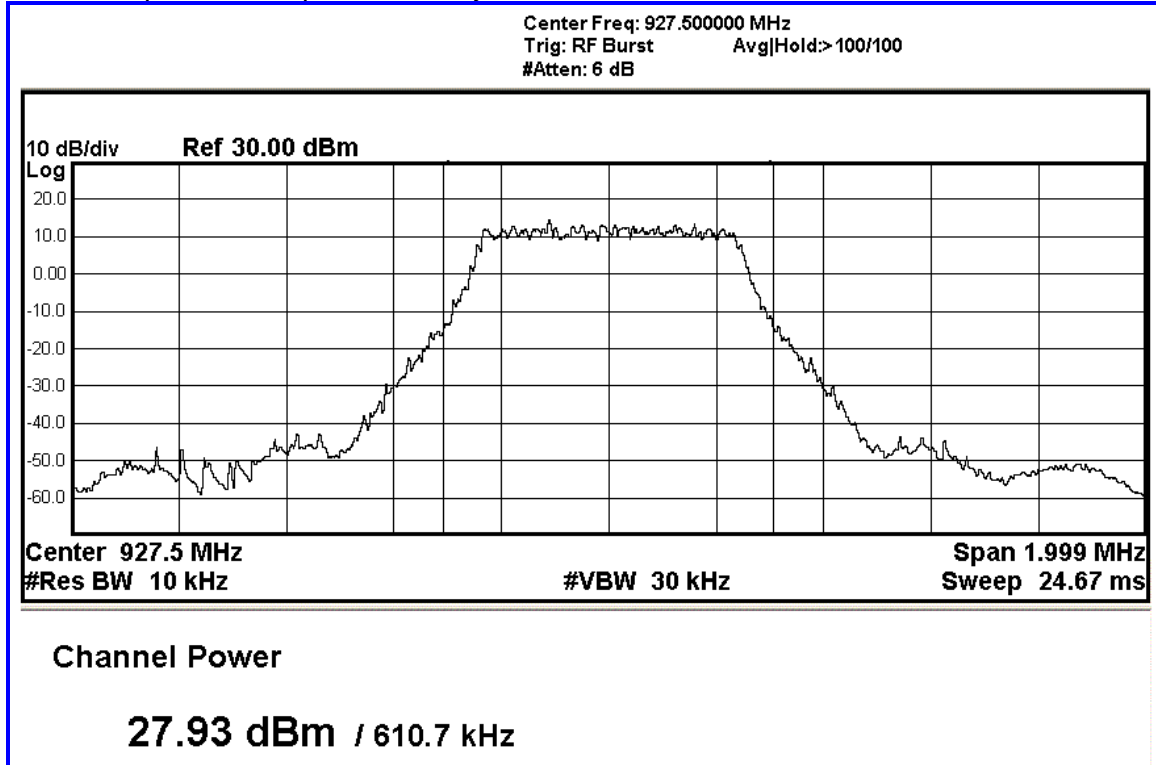
Screen Capture from spectrum analyzer: Antenna 2: 926.3 MHz



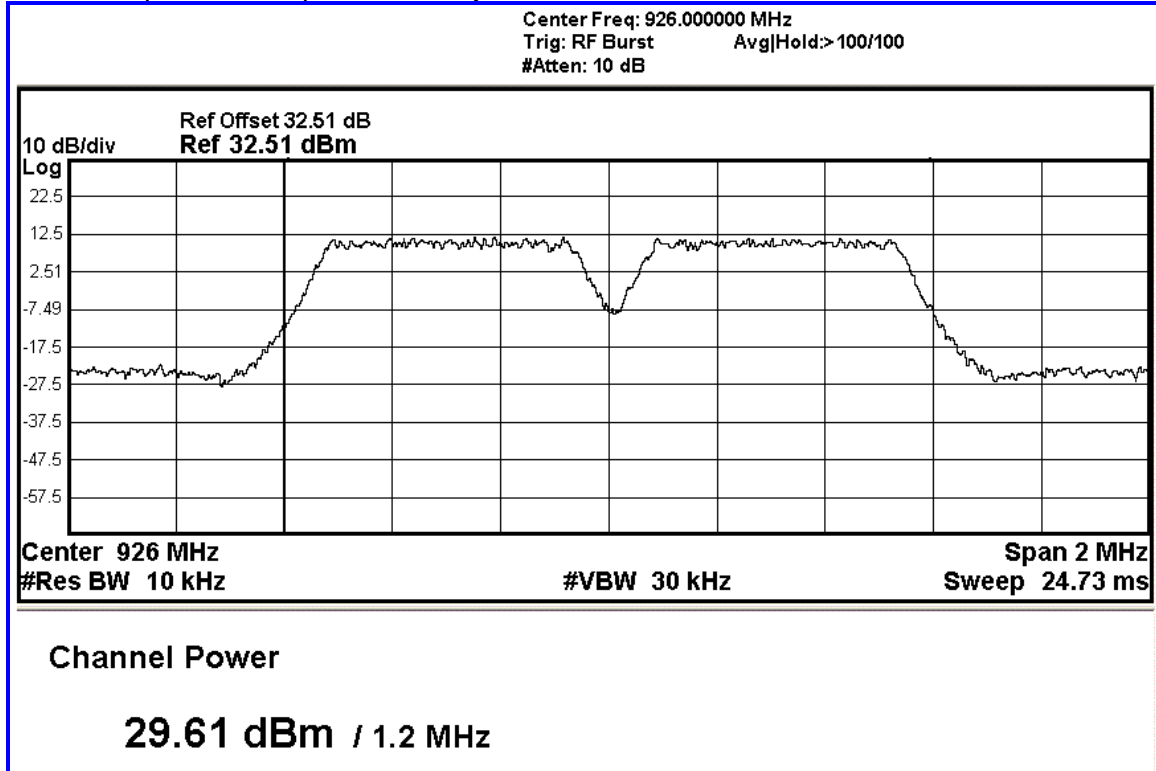
Screen Capture from spectrum analyzer: Antenna 2: 926.9 MHz



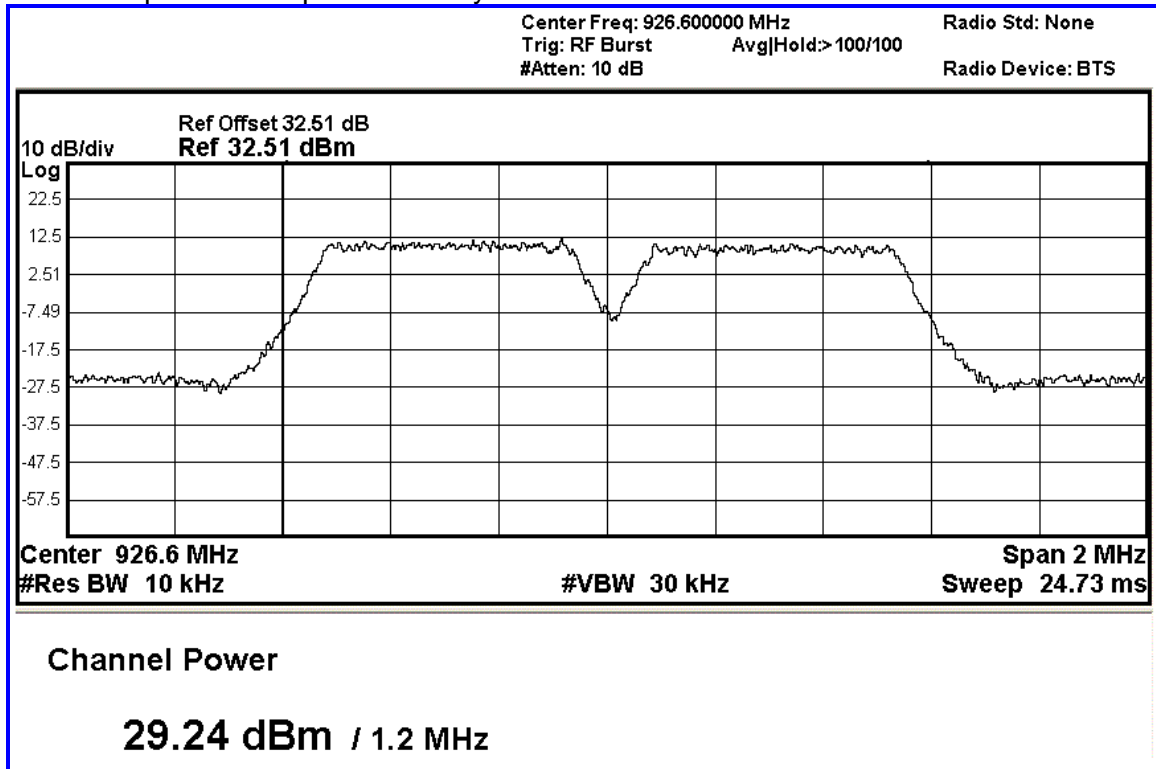
Screen Capture from spectrum analyzer: Antenna 2: 927.5 MHz



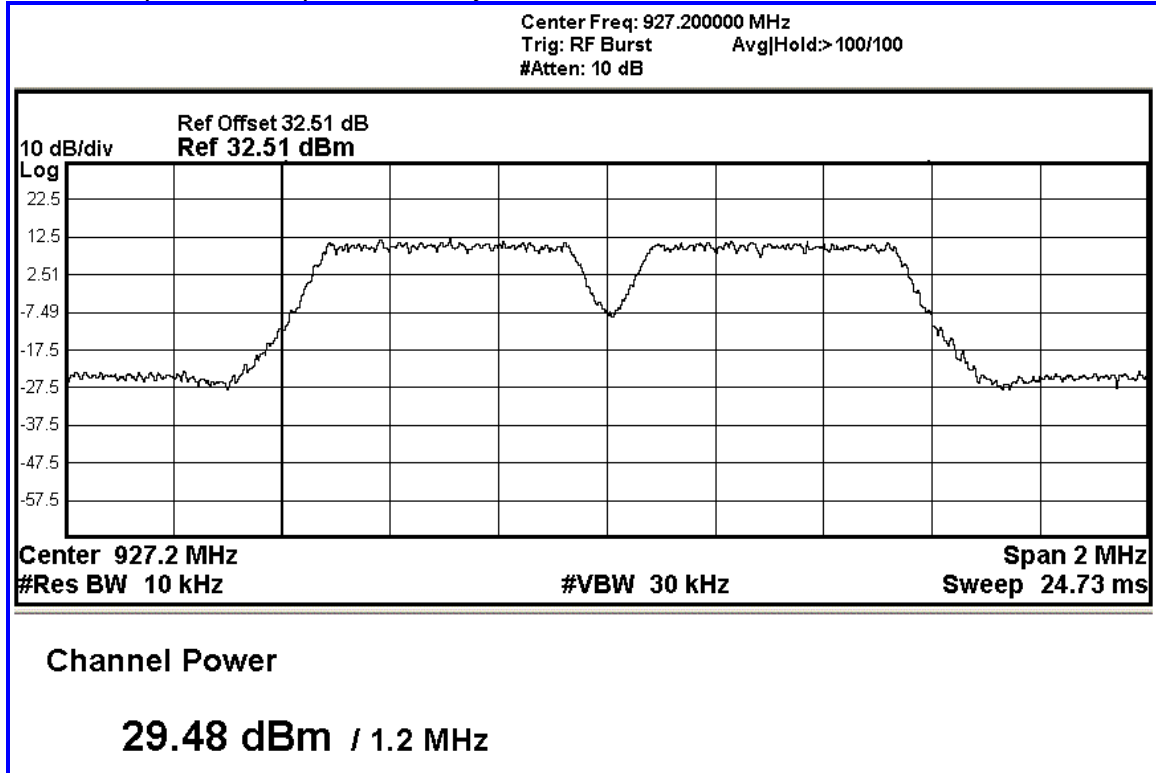
Screen Capture from spectrum analyzer: Antenna 2: 925.7 MHz & 926.3 MHz



Screen Capture from spectrum analyzer: Antenna 2: 926.3 MHz & 926.9 MHz



Screen Capture from spectrum analyzer: Antenna 2: 926.9 MHz & 927.5 MHz



2.3 Power Spectral Density

Test Lab: Electronics Test Centre, Airdrie

EUT: Enterprise Radio Module

Test Personnel: David Raynes

Standard: FCC PART 15.247

Date: 2017-10-03 (22.1° C, 17.4% RH)

Basic Standard: ANSI C63.10: 2013

EUT status: Compliant

Specification: FCC Part 15.247(e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

2.3.1 Test Guidance: FCC KDB 558074 D01, Clause 10.3

This measurement is performed at low, mid and high frequencies, in continuous transmission, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation.

The spectrum analyzer is set for a frequency span $\geq (1.5 \times \text{OBW})$ centered on a channel. The RBW is set to 3 kHz and VBW is set $\geq (3 \times \text{RBW})$. The RMS (power averaging) detector is used, with the trace set to Average 100. After the trace has processed 100 sweeps, the marker is placed on the highest peak of the resulting trace.

2.3.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.3.3 Test Equipment

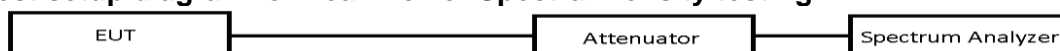
Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2017-06-20	2018-06-20
Attenuator (2)	Fairview Microwave	SA18N5WA-10	~	Monitored	
Attenuator	Narda	768-10	~	Monitored	
Temp/Humidity	Extech	42270	5892	2017-04-06	2018-04-06

2.3.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagram for Peak Power Spectral Density testing:



2.3.5 PSD Data

Measurements were performed via connection to the antenna ports, with attenuation between the EUT and the spectrum analyzer. Attenuation and cable loss are compensated by offsetting the analyzer readings.

Antenna 1: 1 Carrier

Frequency (MHz)	Corrected Reading (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB) (PSD – Limit)
923.3	7.07	8	-0.93
923.9	7.10	8	-0.90
924.5	7.76	8	-0.24
925.1	7.85	8	-0.15

Antenna 2: 1 Carrier

Frequency (MHz)	Corrected Reading (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB) (PSD – Limit)
925.7	7.78	8	-0.22
926.3	7.70	8	-0.30
926.9	7.77	8	-0.27
927.5	7.61	8	-0.39

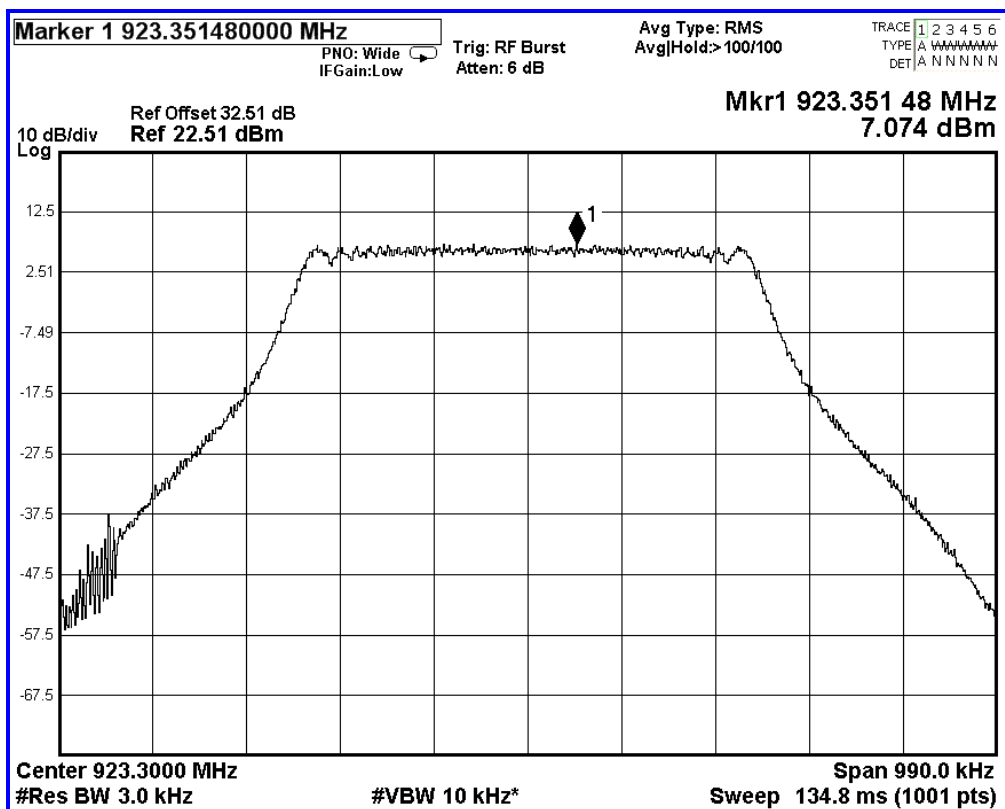
Antenna 1: 2 Carriers

Frequency (MHz)	Corrected Reading (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB) (PSD – Limit)
923.3 w/ 923.9	7.24	8	-0.76
923.9 w/ 923.3	7.33	8	-0.67
923.9 w/ 924.5	7.30	8	-0.70
924.5 w/ 923.9	7.35	8	-0.65
924.5 w/ 925.1	7.30	8	-0.70
925.1 w/ 924.5	7.51	8	-0.49

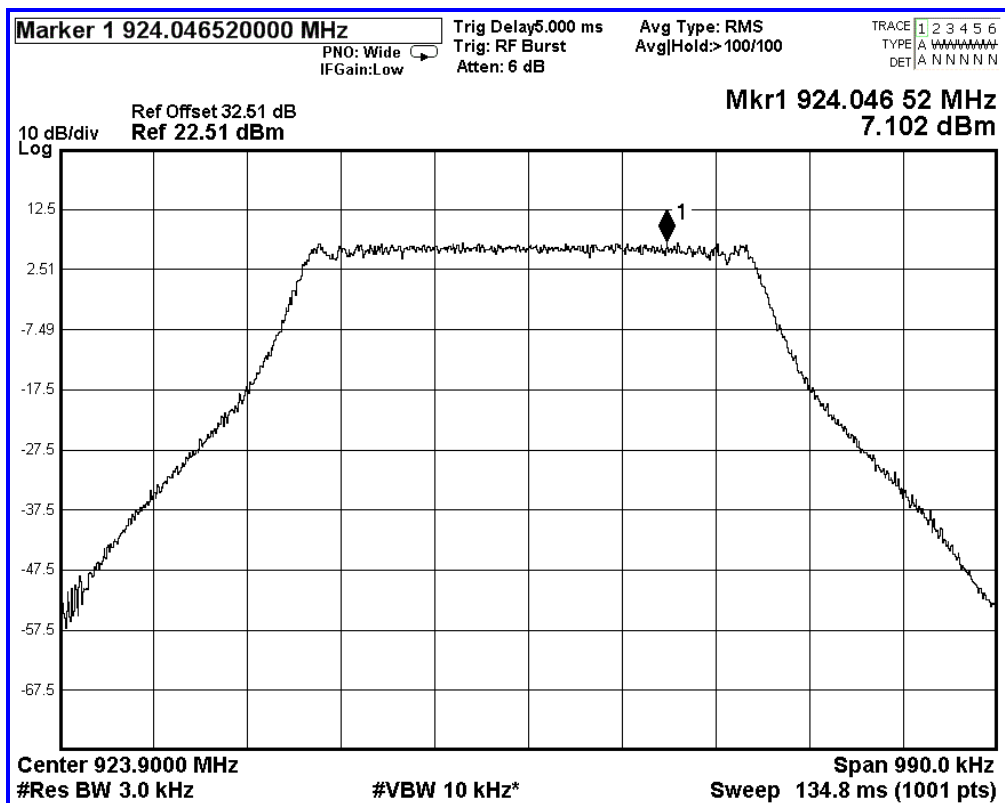
Antenna 2: 2 Carriers

Frequency (MHz)	Corrected Reading (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB) (PSD – Limit)
925.7 w/ 926.3	7.31	8	-0.69
926.3 w/ 925.7	7.65	8	-0.35
926.3 w/ 926.9	7.58	8	-0.42
926.9 w/ 926.3	7.71	8	-0.29
926.9 w/ 927.5	7.37	8	-0.63
927.5 w/ 926.9	7.66	8	-0.34

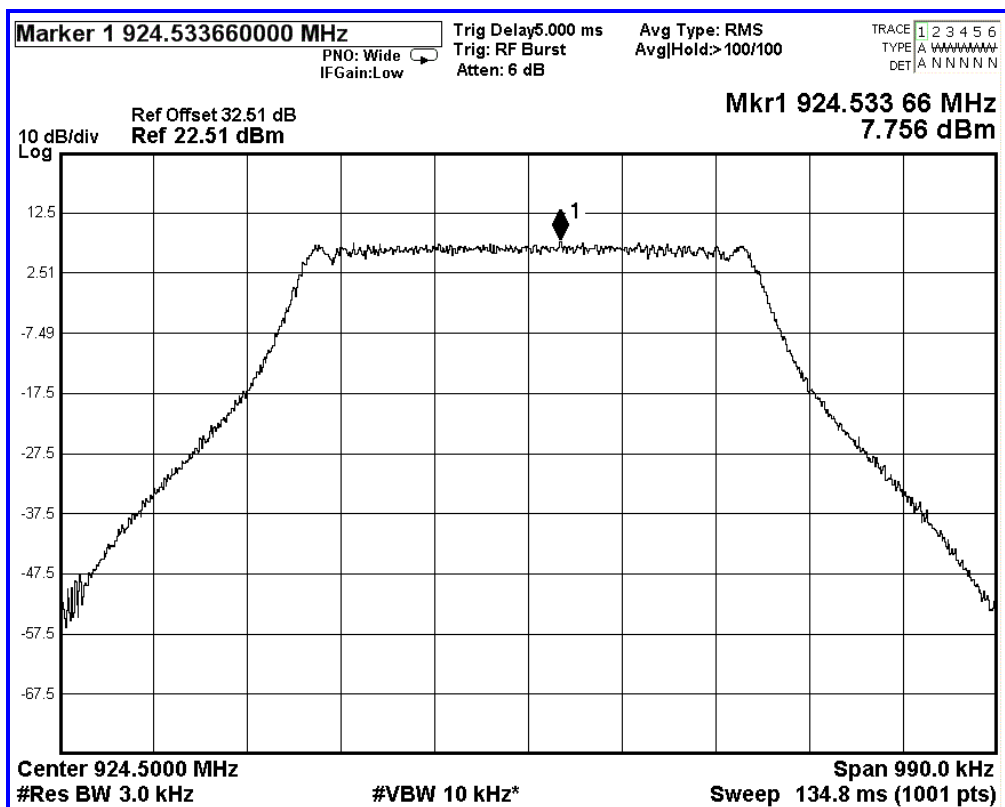
Screen Capture from spectrum analyzer: Antenna 1: 1 Carrier, 923.3 MHz



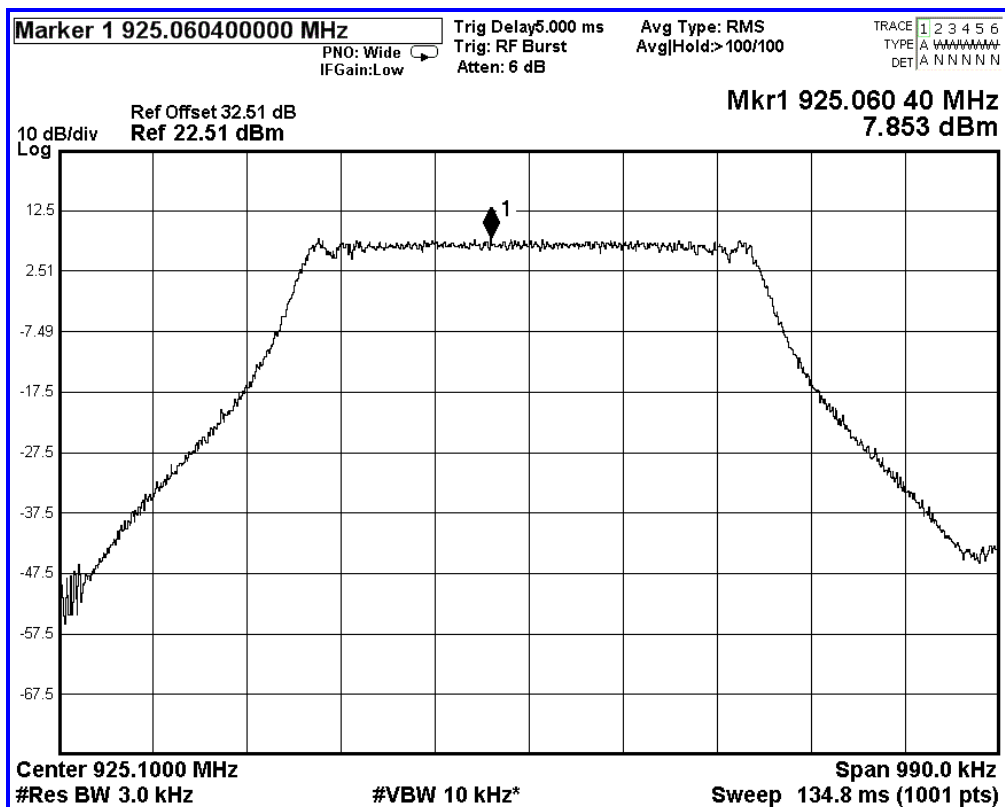
Screen Capture from spectrum analyzer: Antenna 1: 1 Carrier, 923.9 MHz



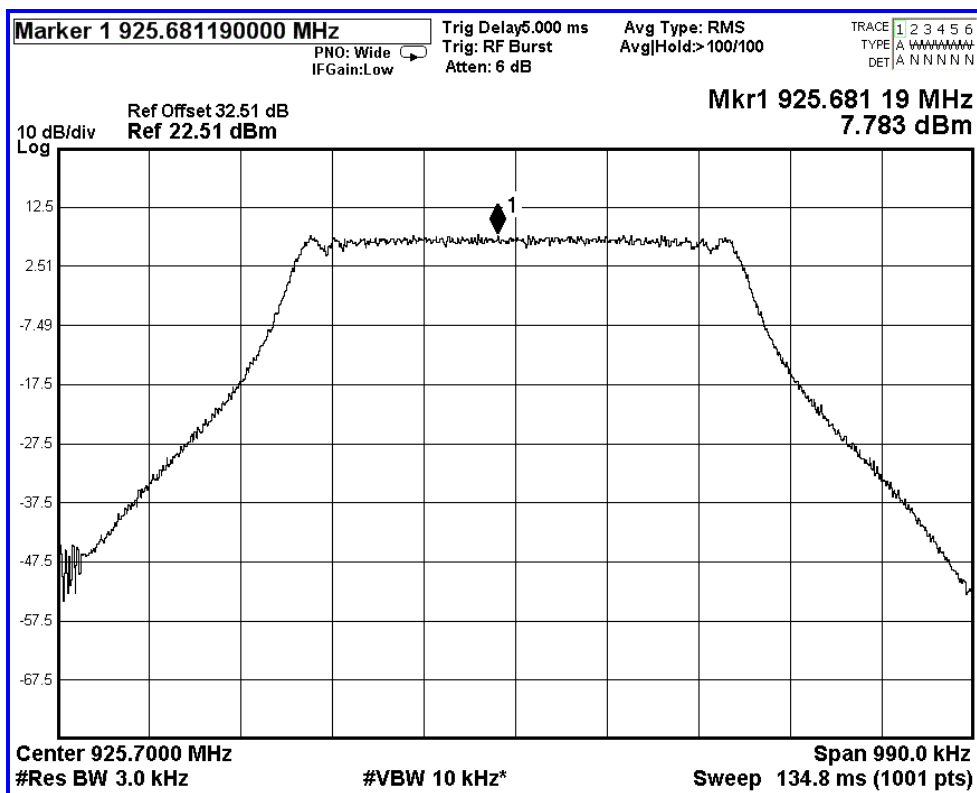
Screen Capture from spectrum analyzer: Antenna 1: 1 Carrier, 924.5 MHz



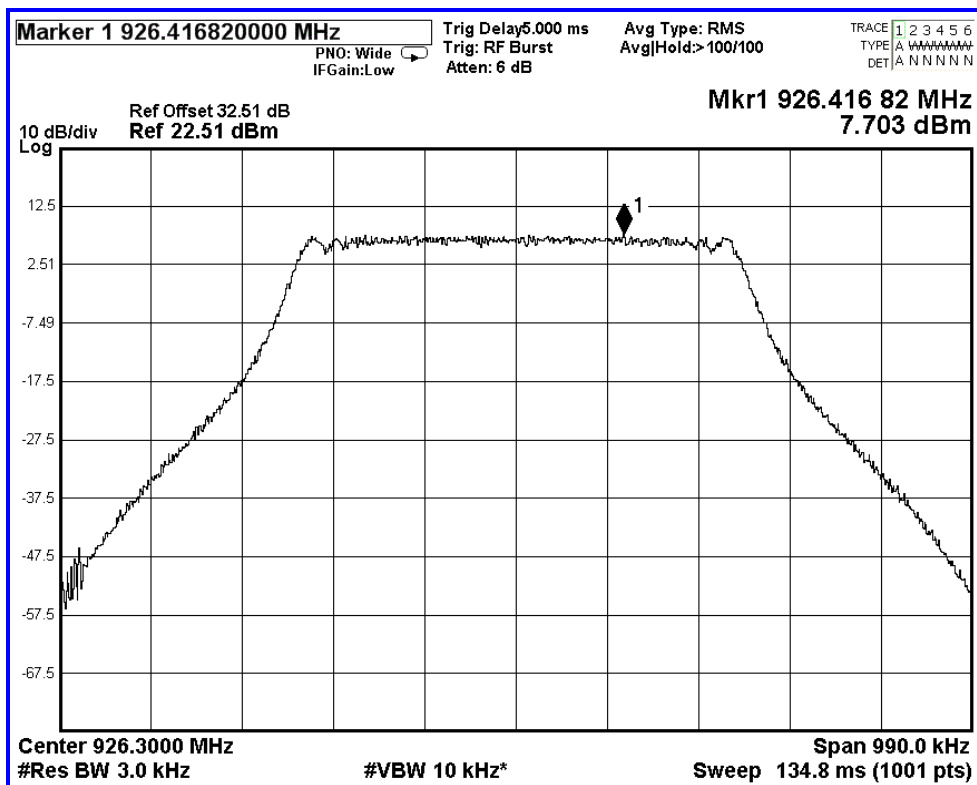
Screen Capture from spectrum analyzer: Antenna 1: 1 Carrier, 925.1 MHz



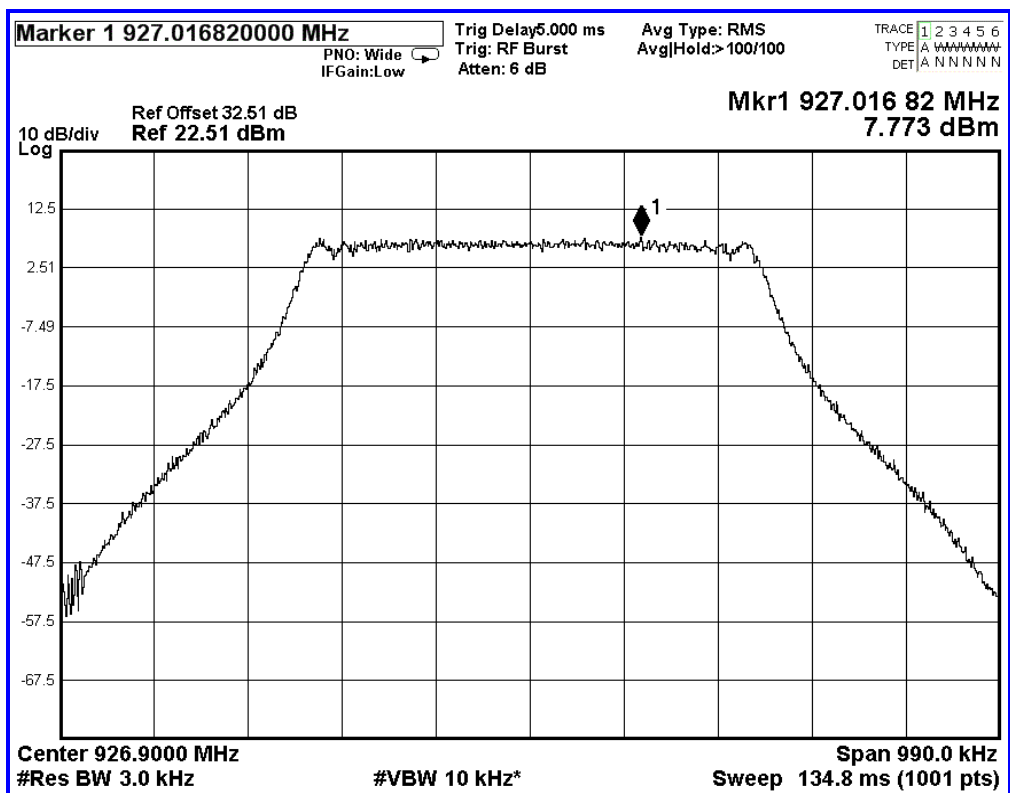
Screen Capture from spectrum analyzer: Antenna 2: 1 Carrier, 925.7 MHz



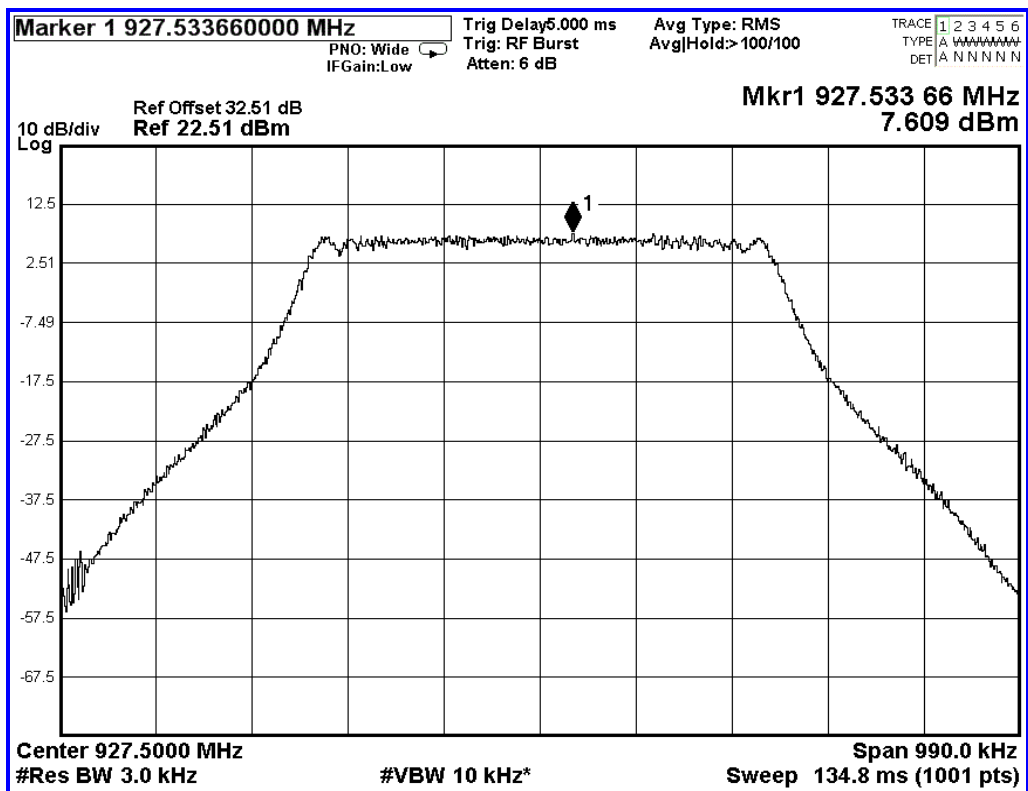
Screen Capture from spectrum analyzer: Antenna 2: 1 Carrier, 926.3 MHz



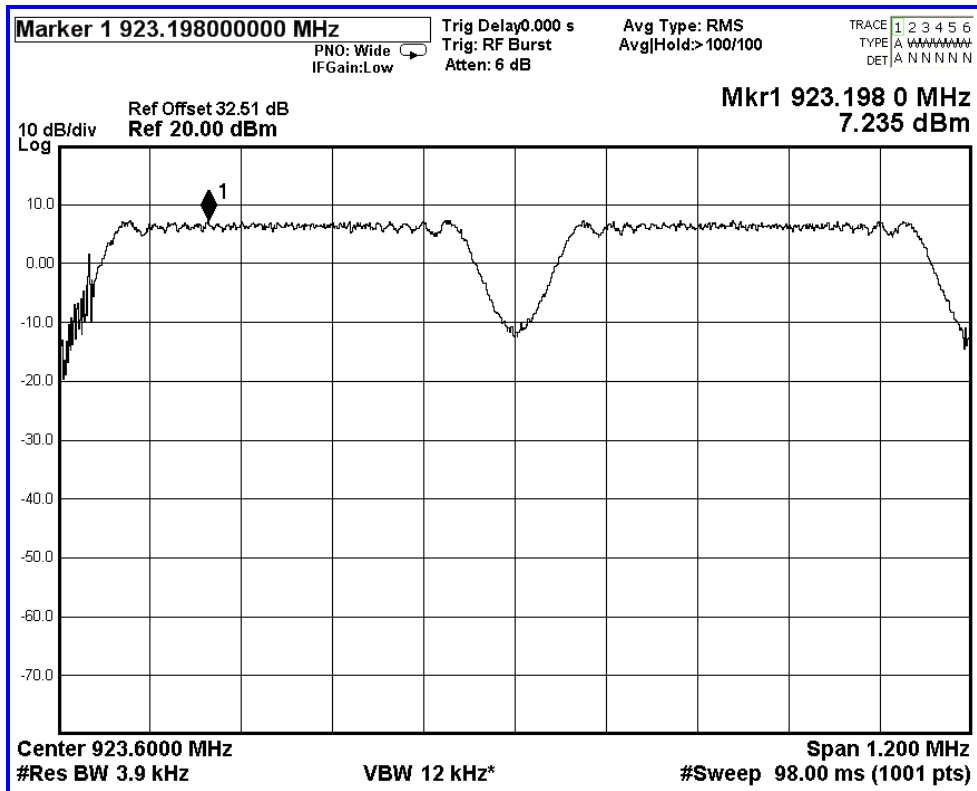
Screen Capture from spectrum analyzer: Antenna 2: 1 Carrier, 926.9 MHz



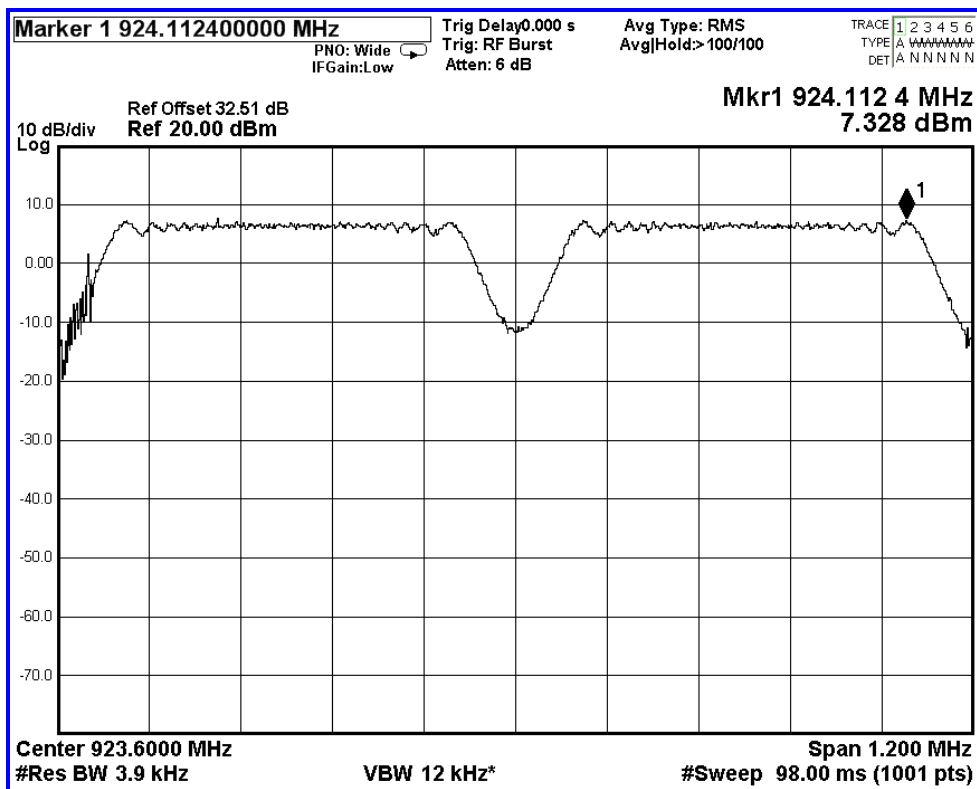
Screen Capture from spectrum analyzer: Antenna 2: 1 Carrier, 927.5 MHz



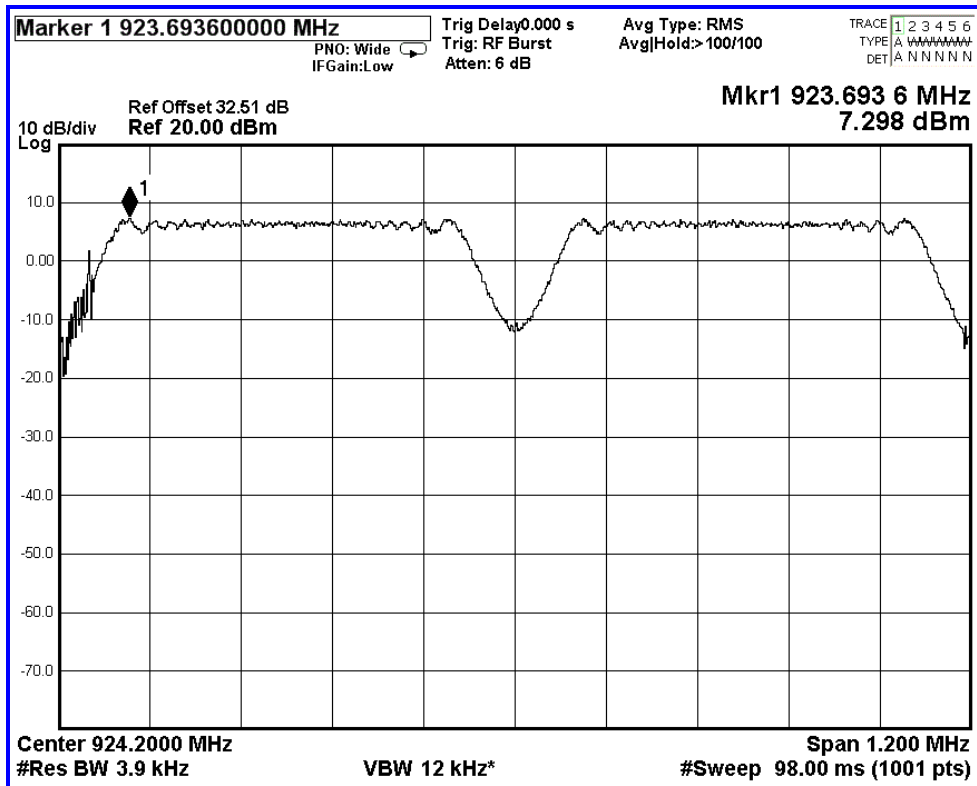
Screen Capture from spectrum analyzer: Antenna 1: 2 Carrier, 923.3 MHz w/ 923.9 MHz



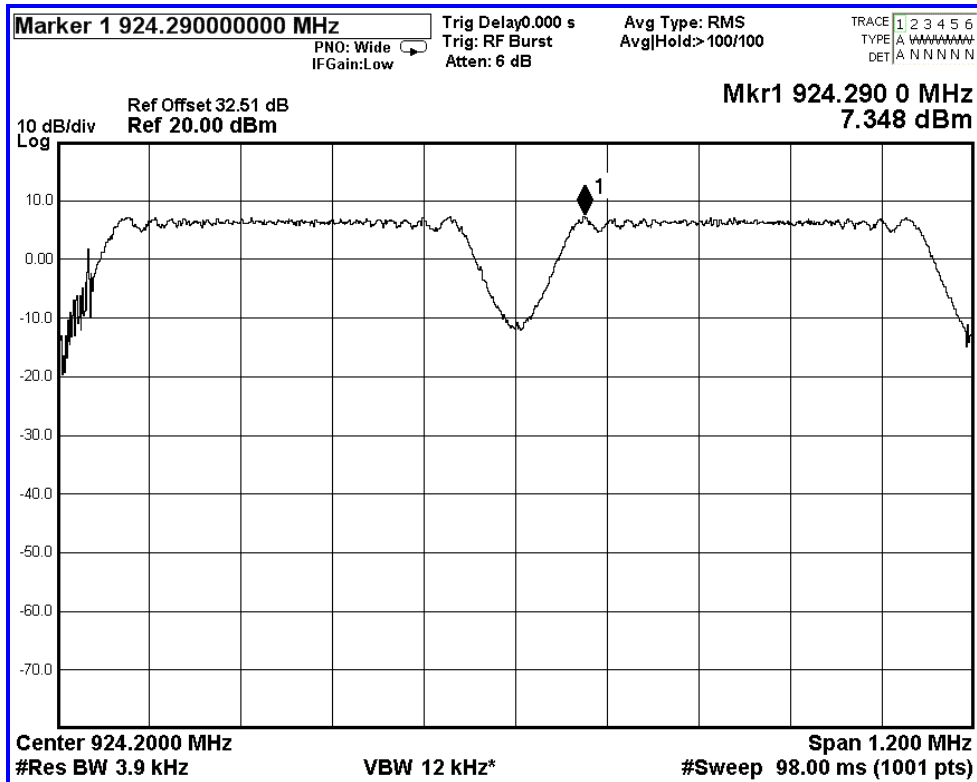
Screen Capture from spectrum analyzer: Antenna 1: 2 Carrier, 923.9 MHz w/ 923.3 MHz



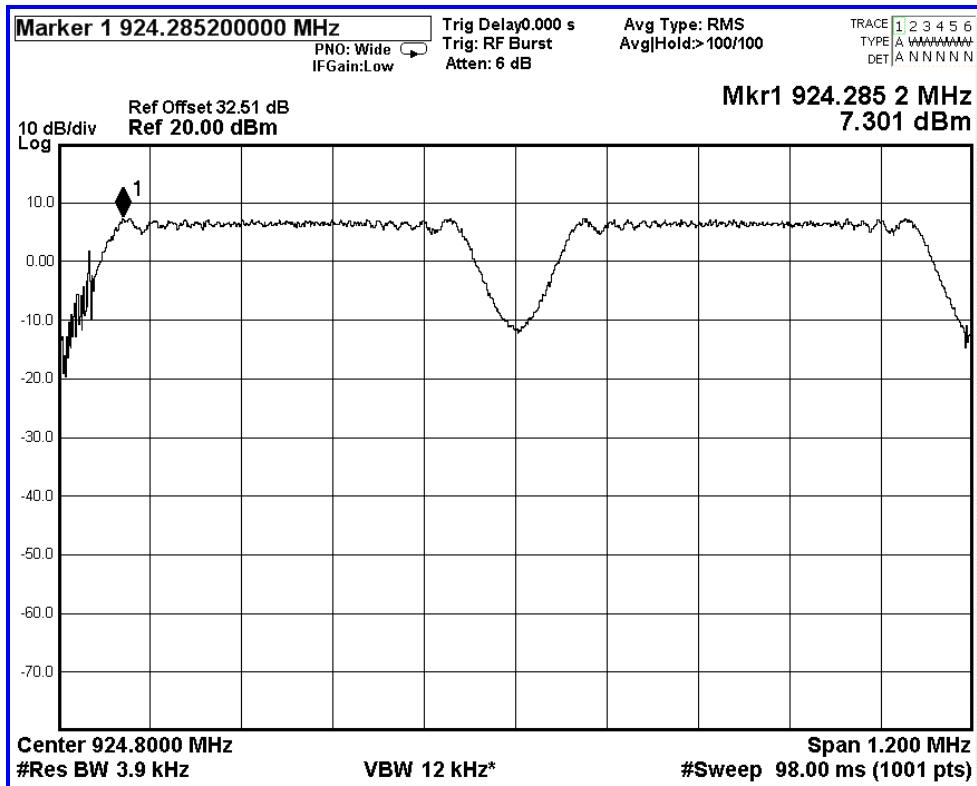
Screen Capture from spectrum analyzer: Antenna 1 2 Carrier, 923.9 MHz w/ 924.5 MHz



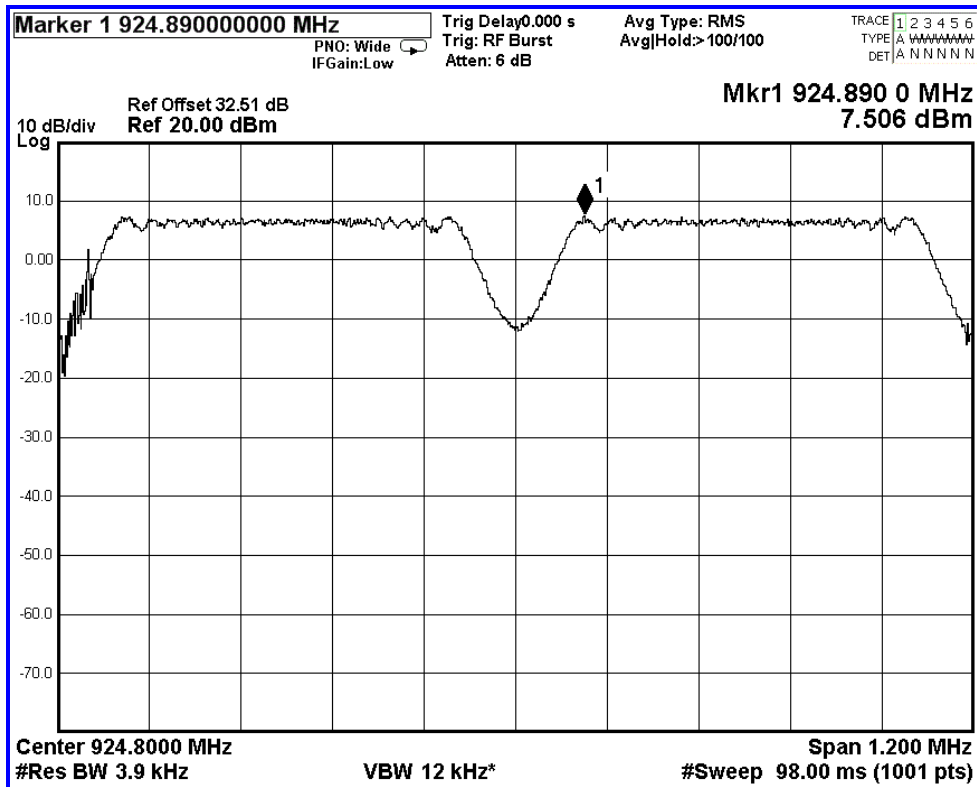
Screen Capture from spectrum analyzer: Antenna 1 2 Carrier, 924.5 MHz w/ 923.9 MHz



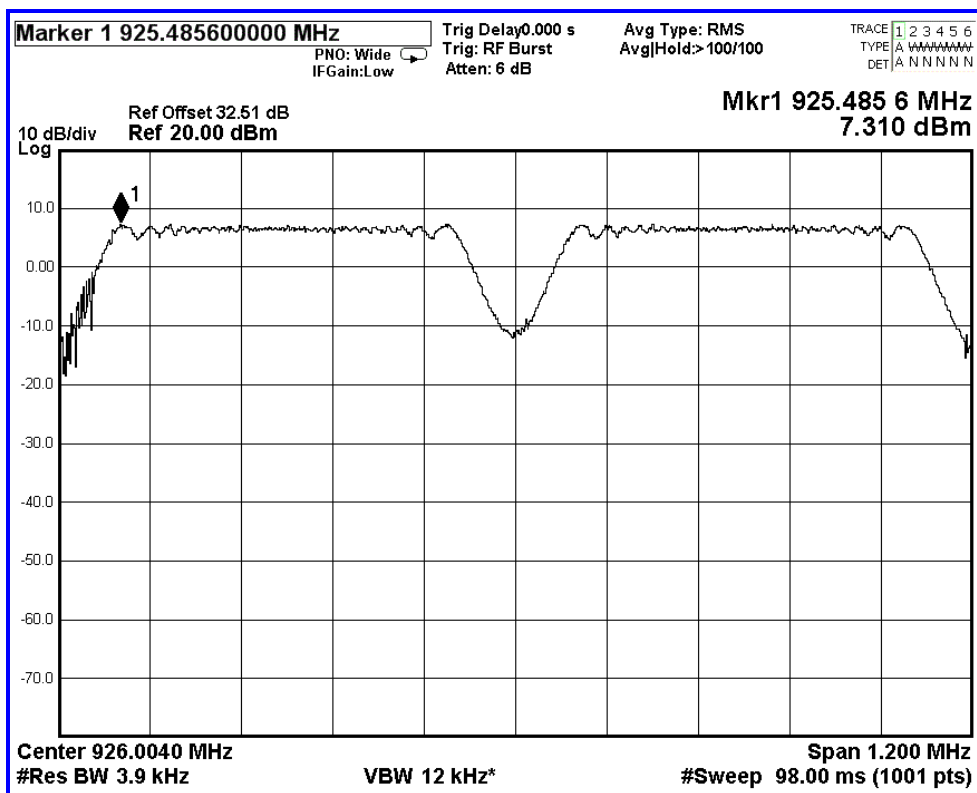
Screen Capture from spectrum analyzer: Antenna 2: 2 Carrier, 924.5 MHz w/ 925.1 MHz



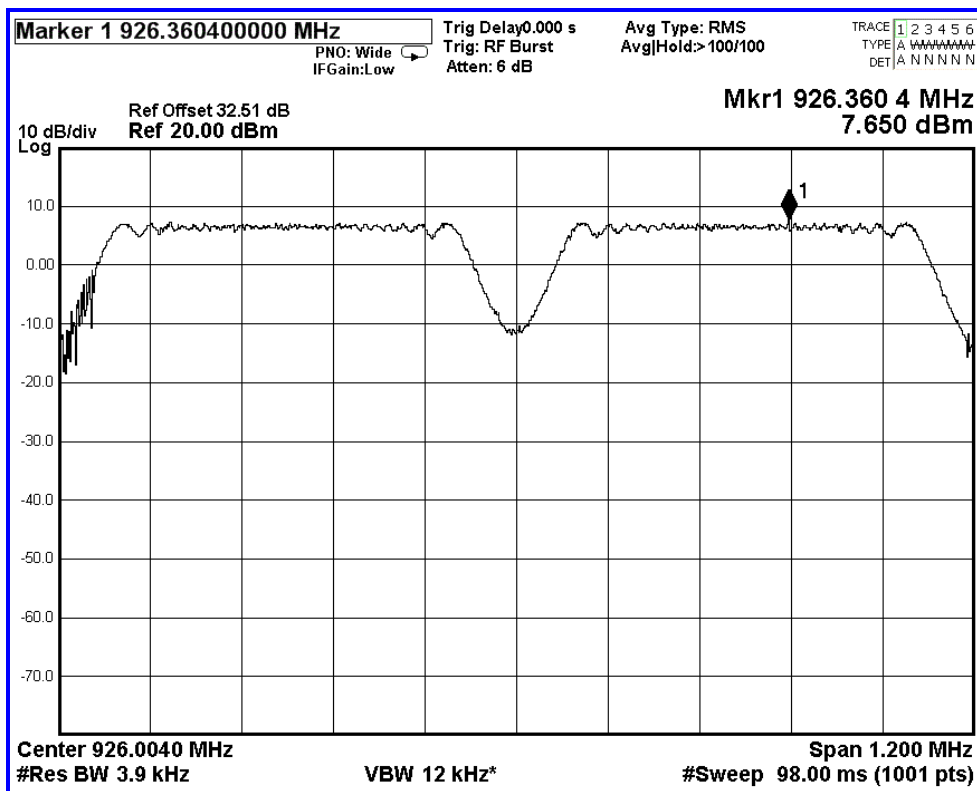
Screen Capture from spectrum analyzer: Antenna 2: 2 Carrier, 925.1 MHz w/ 924.5 MHz



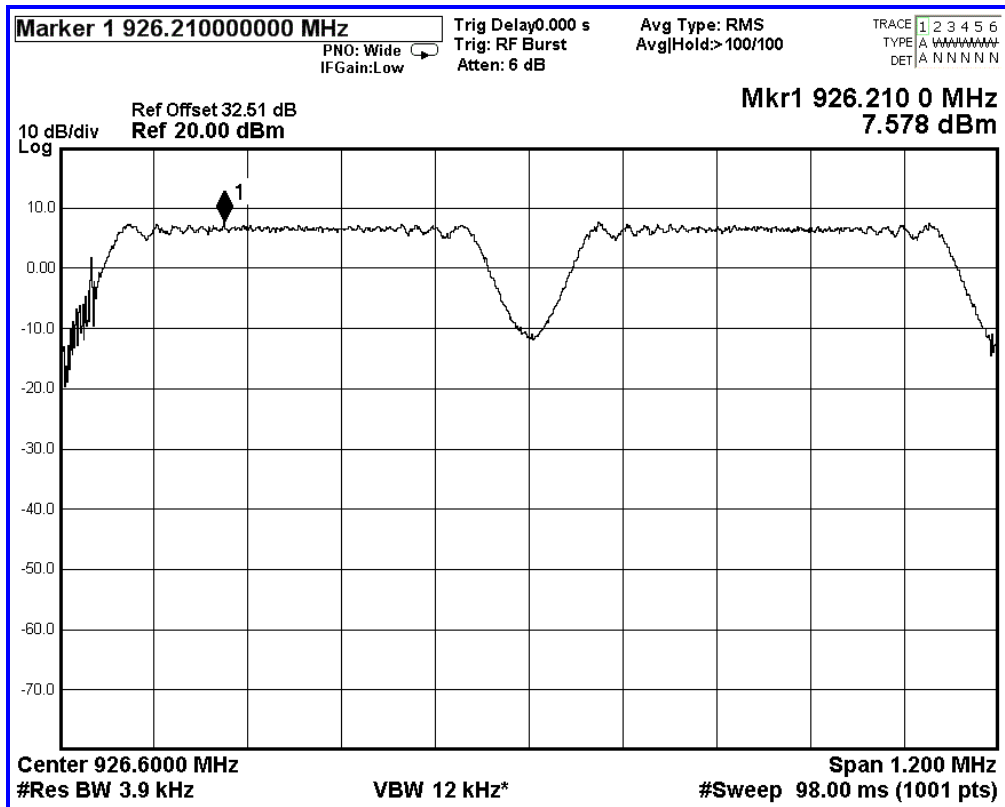
Screen Capture from spectrum analyzer: Antenna 2: 2 Carrier, 925.7 MHz & 926.3 MHz



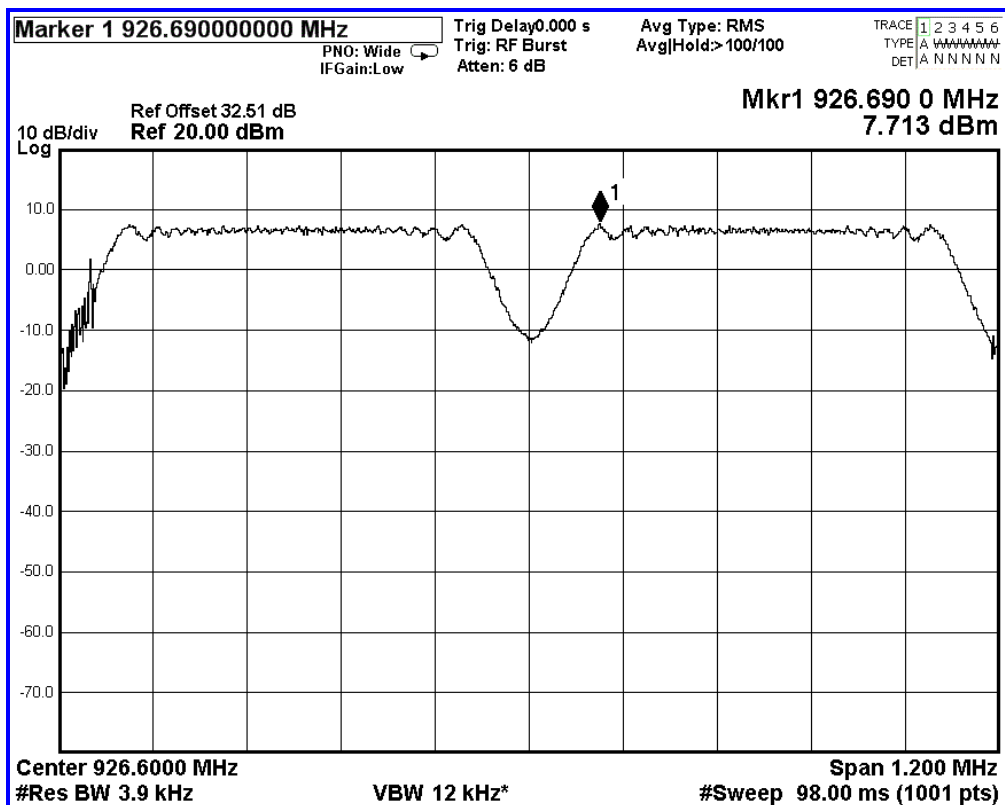
Screen Capture from spectrum analyzer: Antenna 2: 2 Carrier, 926.3 MHz & 925.7 MHz



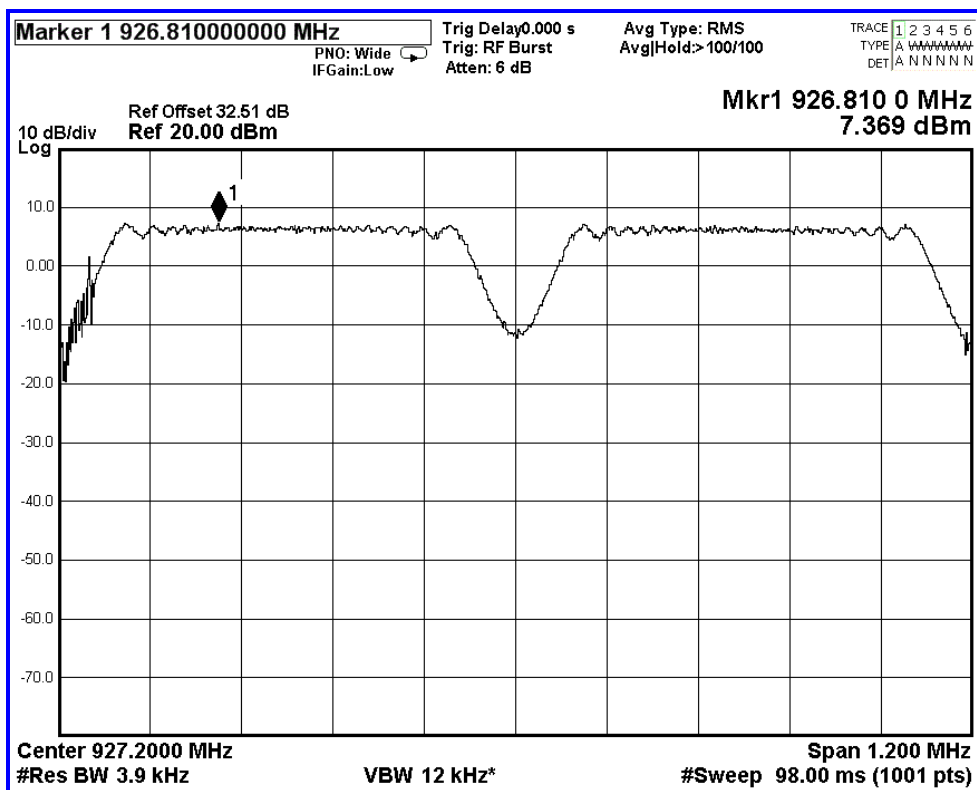
Screen Capture from spectrum analyzer: Antenna 2: 2 Carrier, 926.3 MHz w/ 926.9 MHz



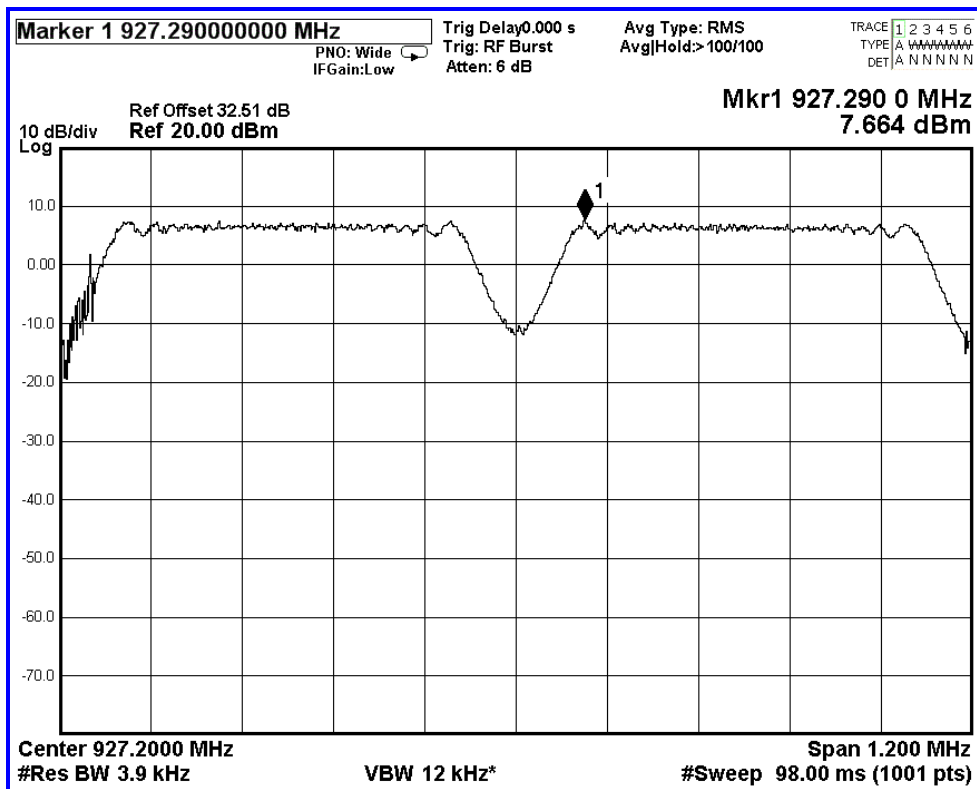
Screen Capture from spectrum analyzer: Antenna 2: 2 Carrier, 926.9 MHz w/ 926.3 MHz



Screen Capture from spectrum analyzer: Antenna 2: 2 Carrier, 926.9 MHz & 927.5 MHz



Screen Capture from spectrum analyzer: Antenna 2: 2 Carrier, 927.5 MHz & 926.9 MHz



2.4 Channel Occupied Bandwidth

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel: David Raynes	Standard: FCC PART 15.247
Date: 2017-10-02 (19.6° C, 25.0% RH)	Basic Standard: ANSI C63.10-2013
EUT status: Compliant	

Specification: FCC Part 15.247(a)(2)

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

2.4.1 Test Guidance: FCC KDB 558074 D01, Clause 8.2

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation.

The spectrum analyzer is set for a frequency span $\geq (2 * \text{OBW})$, $\leq (5 * \text{OBW})$, selected to clearly display the channel. The RBW is set to 100 kHz. The VBW is set to $\geq (3 * \text{RBW})$. The Peak detector is used, with the trace set to Max Hold.

The automated 99% BW function of the spectrum analyzer is engaged, and the 6 dB OBW is measured with the x dB function.

2.4.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.4.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2017-06-20	2018-06-20
Attenuator (2)	Fairview Microwave	SA18N5WA-10	~	Monitored	
Attenuator	Narda	768-10	~	Monitored	
Temp/Humidity	Extech	42270	5892	2017-04-06	2018-04-06

2.4.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagram for Occupied Bandwidth testing:

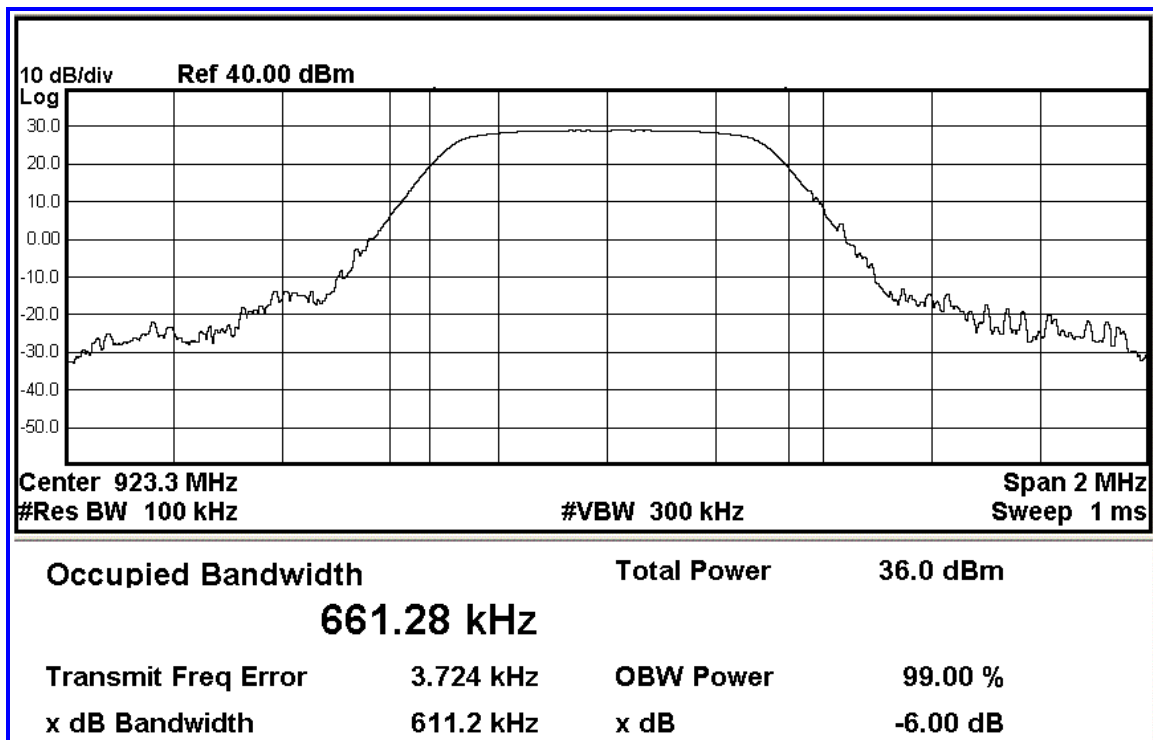


2.4.5 Channel Occupied Bandwidth Data:

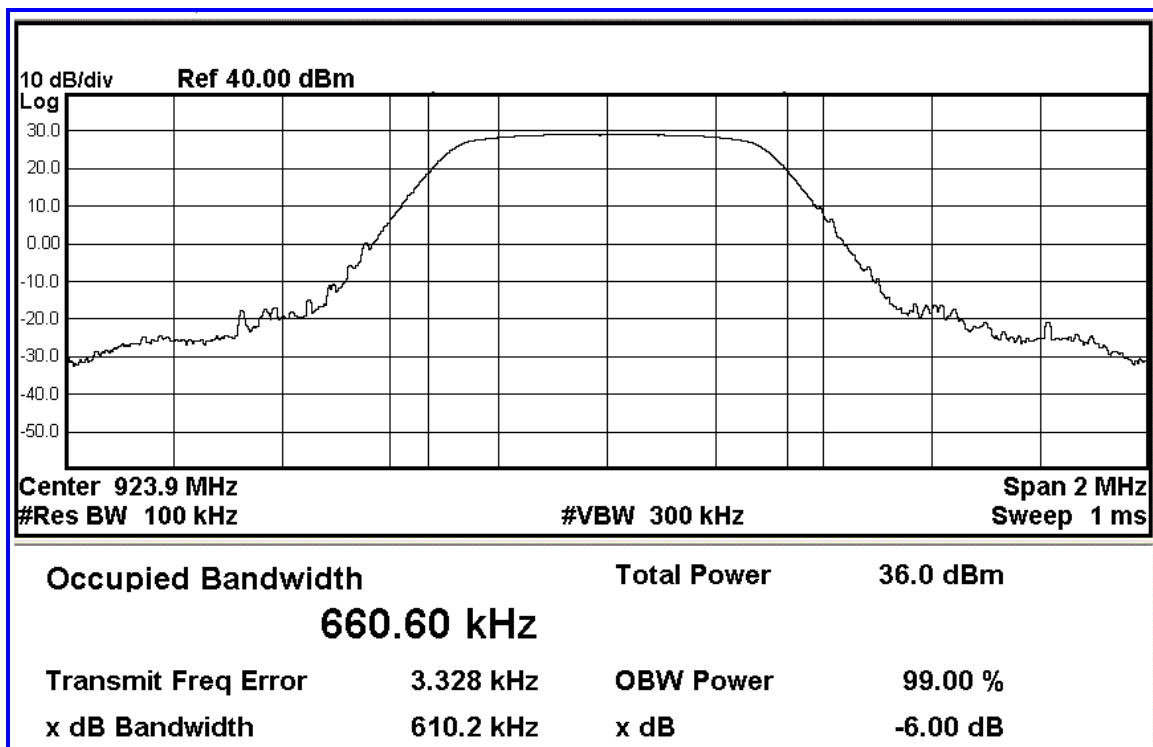
Freq. (MHz)	6 dB OBW (kHz)	99% OBW (kHz)
923.3	611.2	661.28
923.9	610.2	660.6
924.5	610.0	660.5
925.1	610.9	659.8
925.7	610.9	660.17
926.3	610.6	659.97
926.9	610.3	660.27
927.5	610.7	660.07

Screen Captures from the spectrum analyzer:

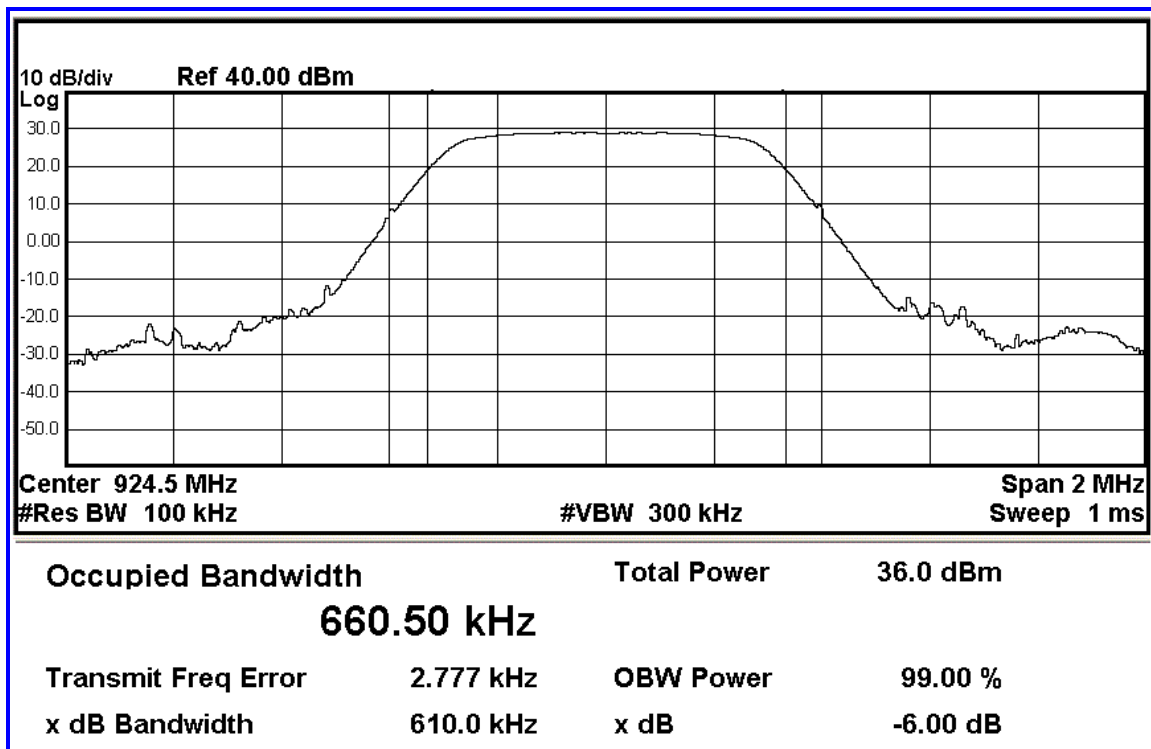
6 dB OBW, 923.3 MHz:



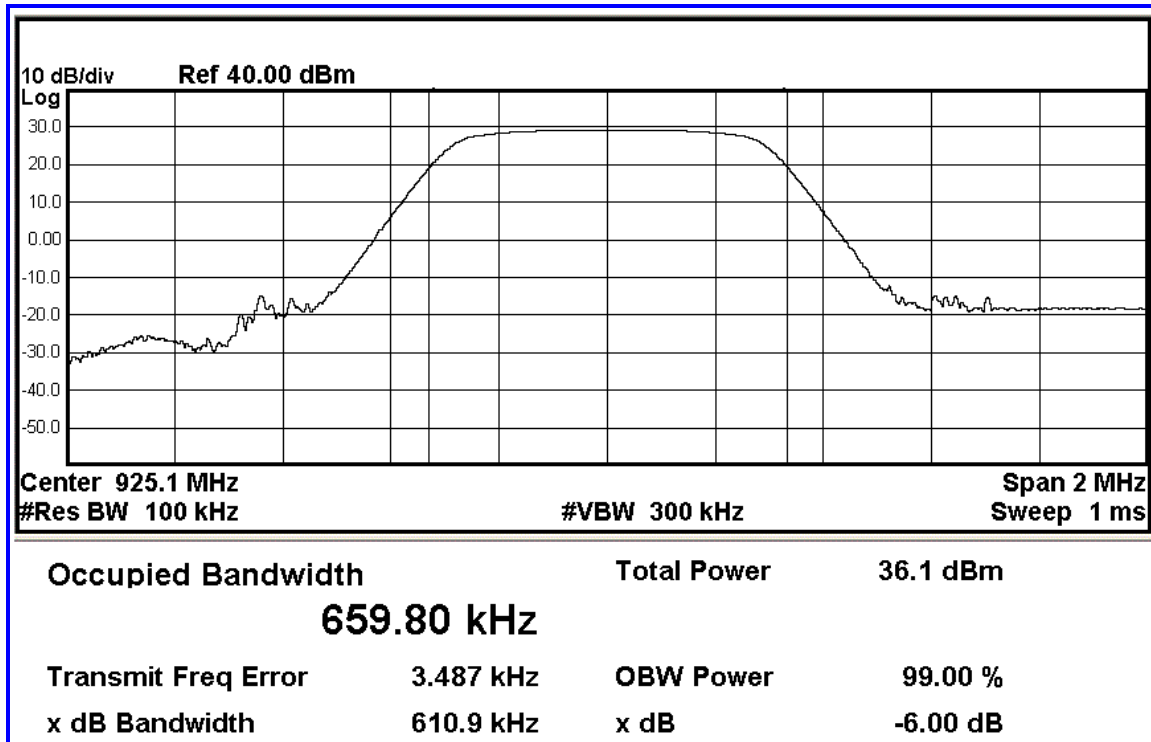
6 dB OBW, 923.9 MHz:



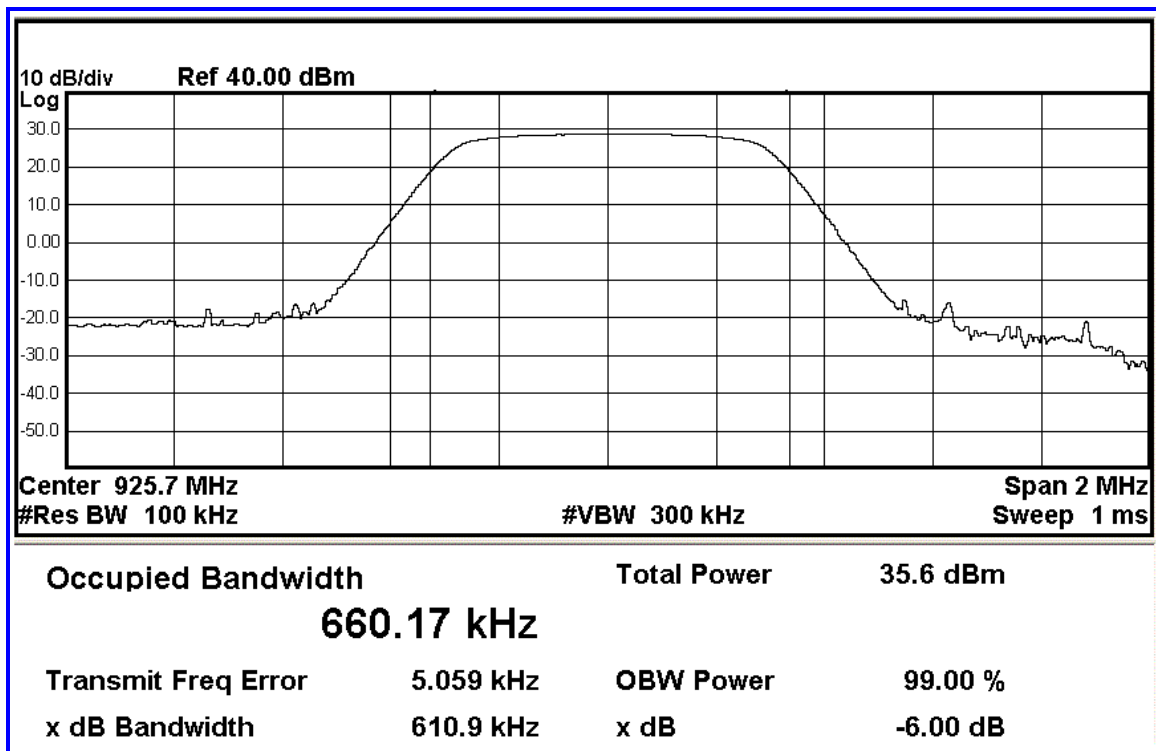
6 dB OBW, 924.5 MHz:



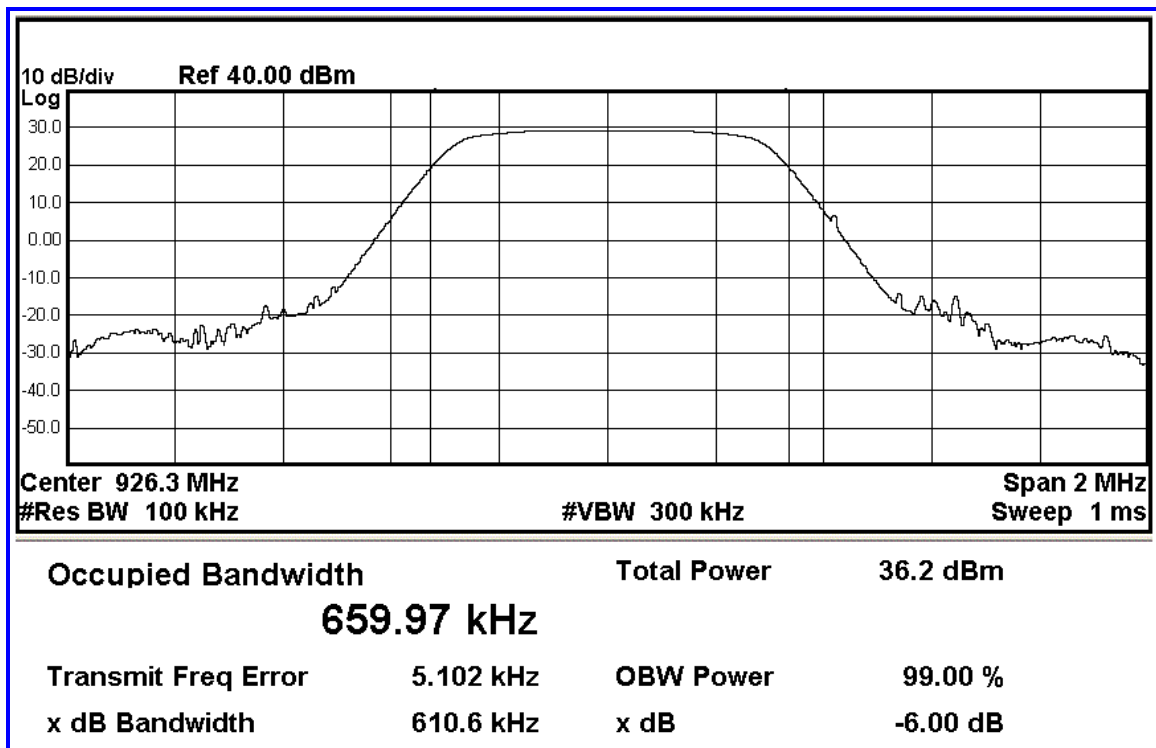
6 dB OBW, 925.1 MHz:



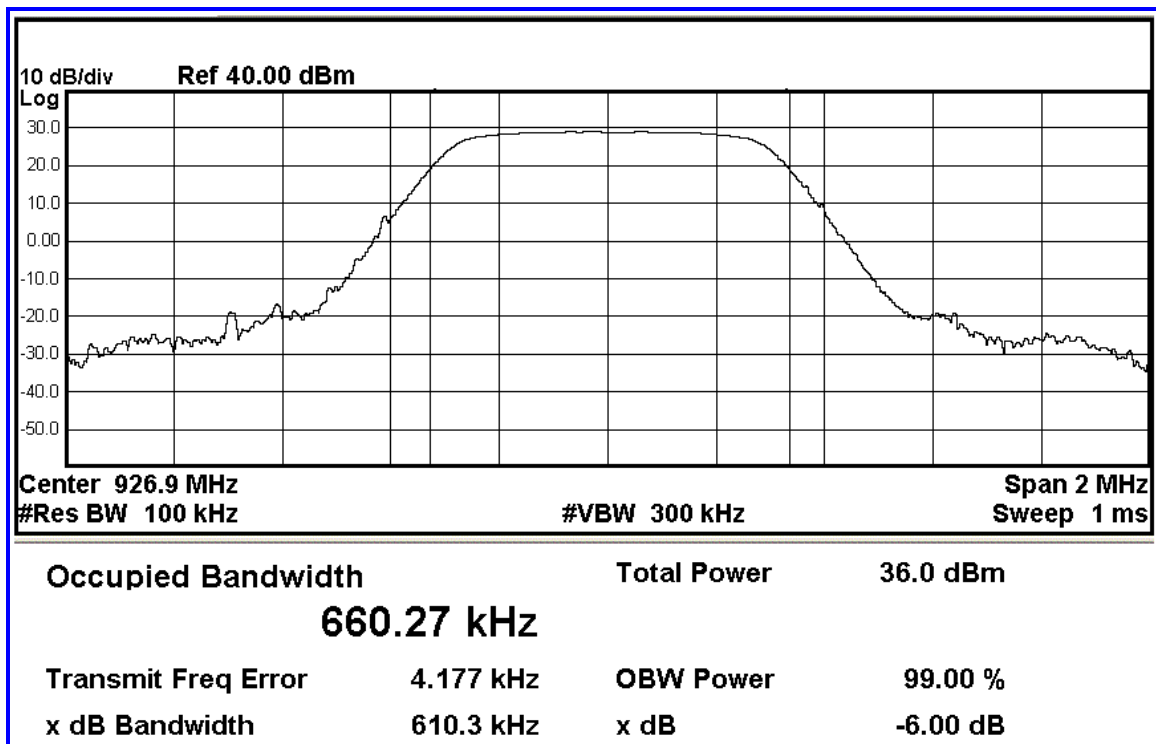
6 dB OBW, 925.7 MHz:



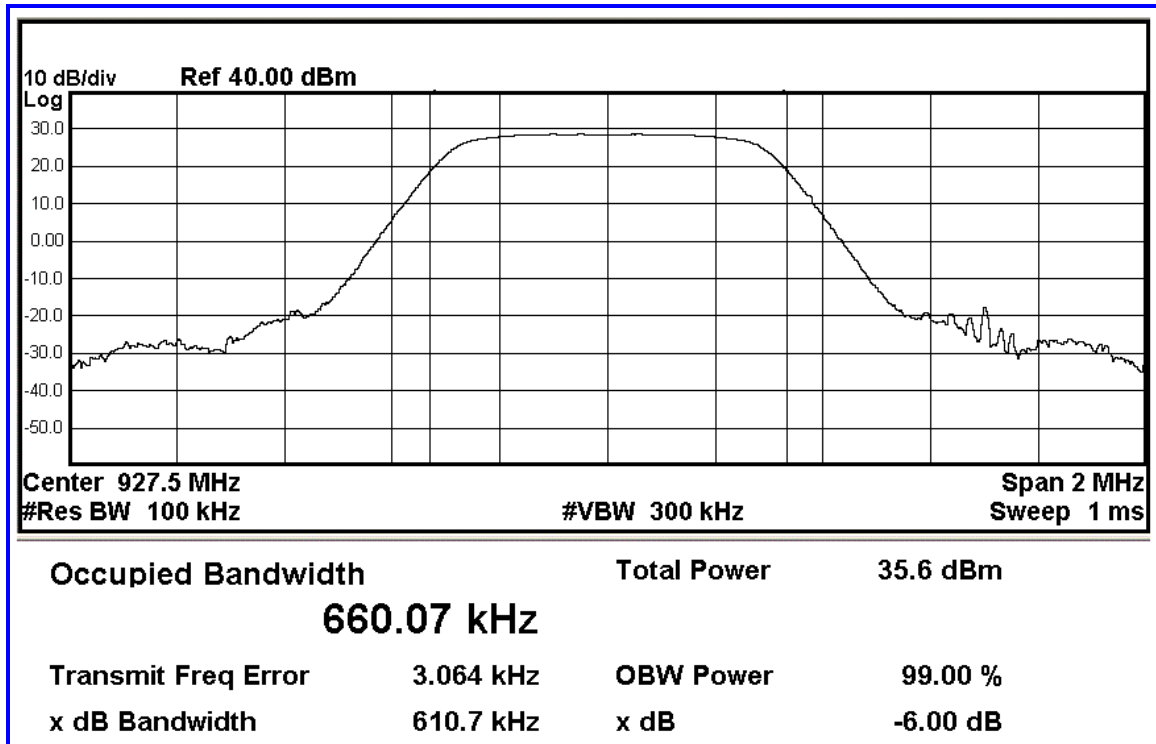
6 dB OBW, 926.3 MHz:



6 dB OBW, 926.9 MHz:



6 dB OBW, 927.5 MHz:



2.5 Band Edge Attenuation

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel: David Raynes	Standard: FCC PART 15.247
Date: 2017-10-03 (22.1° C, 17.4% RH)	Basic Standard: ANSI C63.10: 2013
EUT status: Compliant	

Specification: FCC Part 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.5.1 Test Guidance: ANSI C63.10-2013 Clause 11.13.2

This measurement is performed at the low and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation.

The spectrum analyzer is set for a frequency span to show the band edge and the nearest channel. The RBW is set to ≥ 100 kHz. The VBW is set to $\geq (\text{RBW} * 3)$. The Peak detector is used, with the trace set to Max Hold.

The attenuation is measured with the Marker Delta function.

2.5.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.5.3 Test Equipment

Testing was performed with the following equipment:

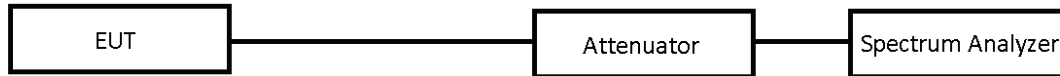
Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2017-06-20	2018-06-20
Attenuator (2)	Fairview Microwave	SA18N5WA-10	~	Monitored	
Attenuator	Narda	768-10	~	Monitored	
Temp/Humidity	Extech	42270	5892	2017-04-06	2018-04-06

2.5.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagram for Band Edge Attenuation testing:

Conducted:

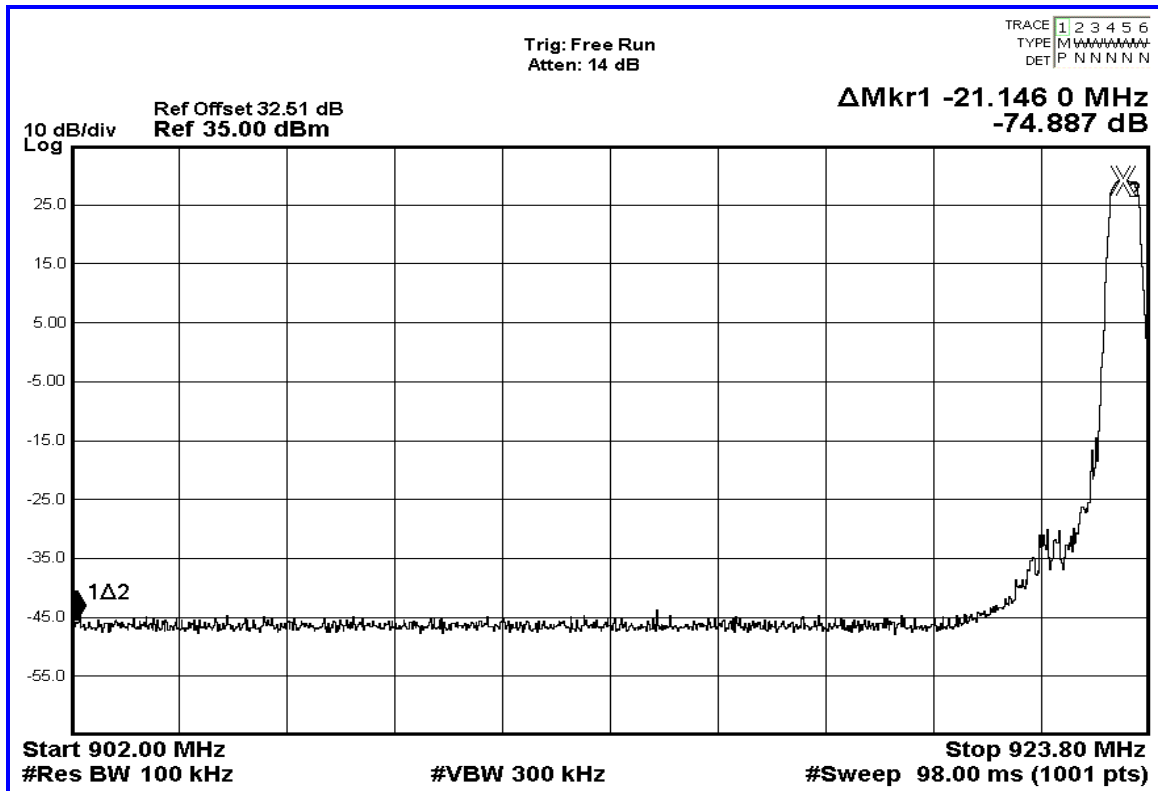


2.5.5 Band Edge Data

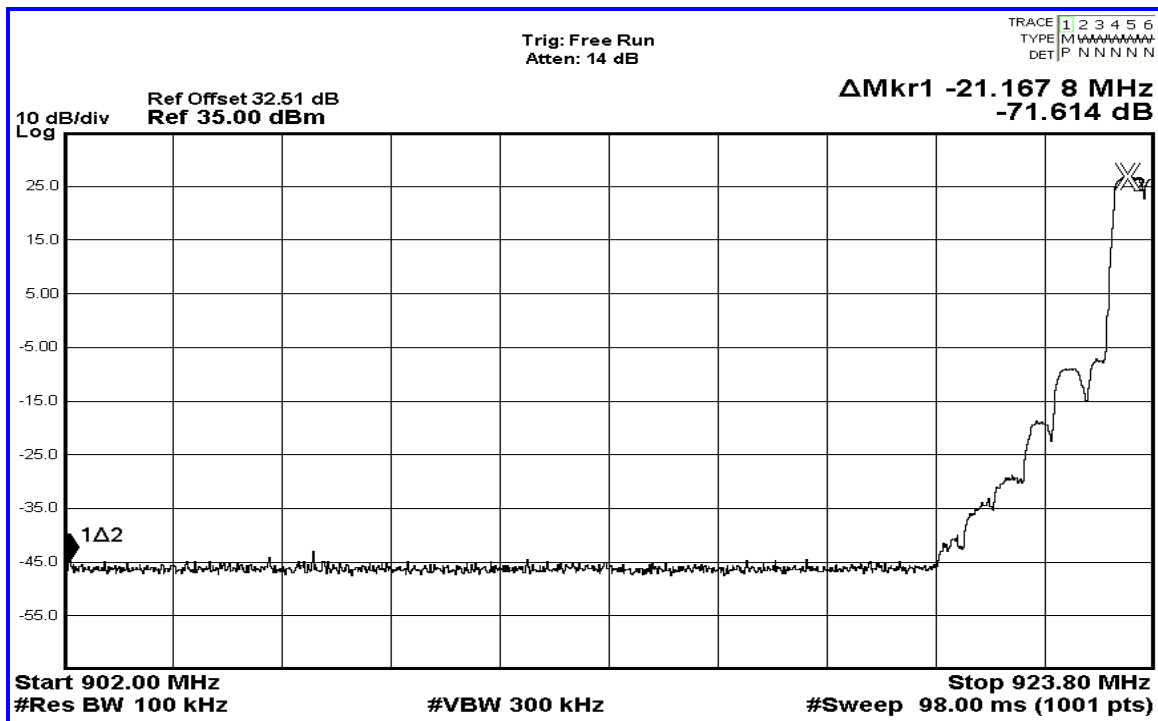
Worst-Case Data:

Channel Frequency	Attenuation at Band Edge
923.3 MHz & 923.9 MHz	71.61 dB (Lower Edge)
926.9 MHz & 927.5 MHz	34.40 dB (Upper Edge)

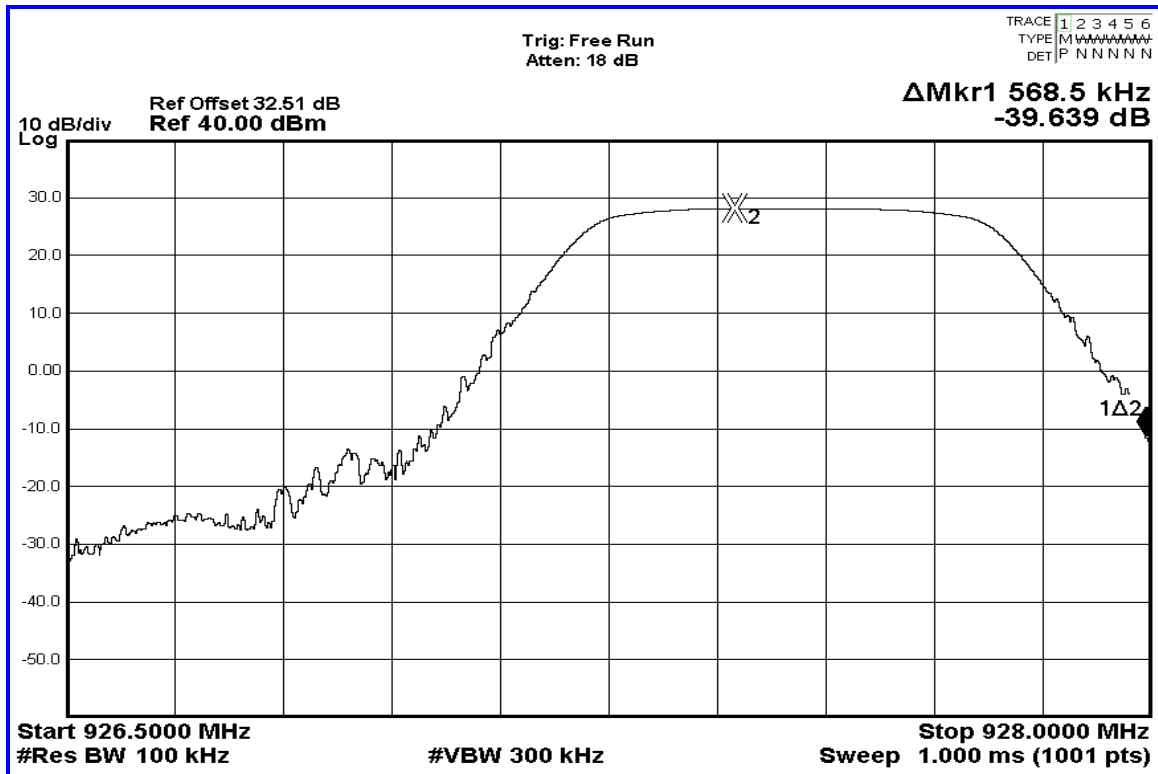
Screen Capture from the spectrum analyzer: Lower Band Edge, 1 carrier



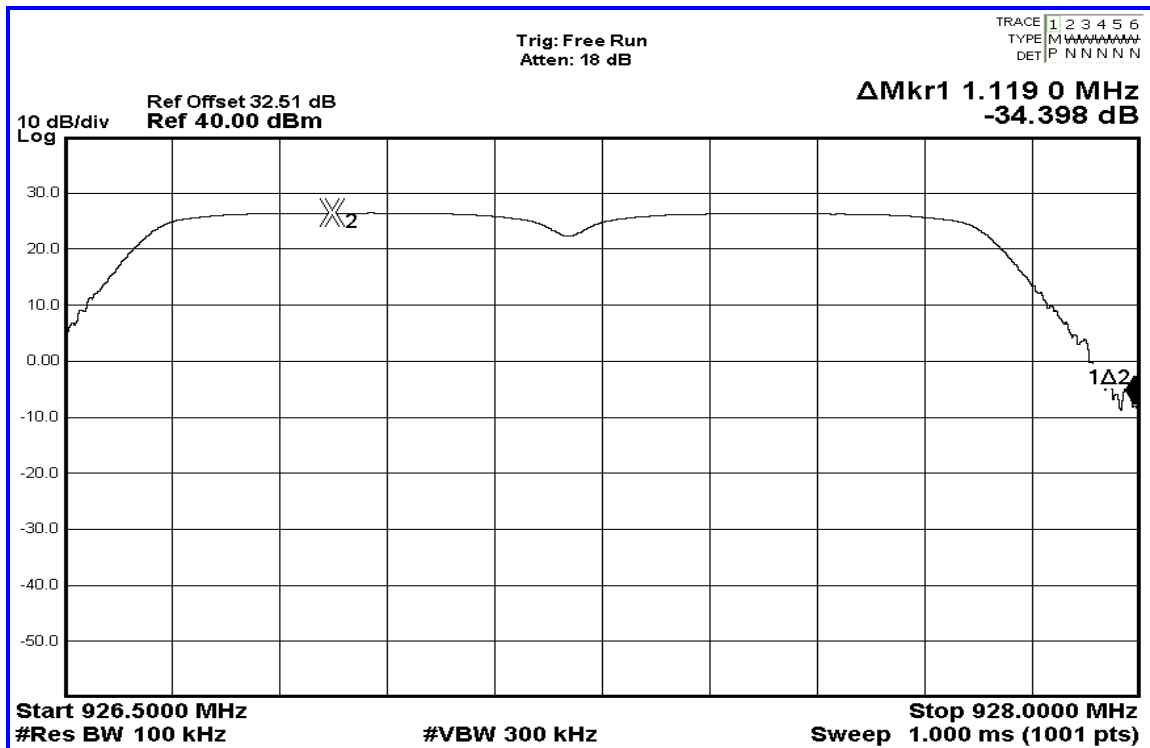
Screen Capture from the spectrum analyzer: Lower Band Edge, 2 carriers



Screen Capture from the spectrum analyzer: Upper Band Edge, 1 carrier



Screen Capture from the spectrum analyzer: Upper Band Edge, 2 carriers



2.6 Conducted Spurious Emissions

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel: David Raynes	Standard: FCC PART 15.247
Date: 2017-10-03 (22.1° C, 17.4% RH)	Basic Standard: ANSI C63.4-2014
EUT status: Compliant	

Specification: FCC Part 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

2.6.1 Test Guidance: ANSI C63.10-2013, Clause 6.7

This measurement is performed at the low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation.

The spectrum analyzer is stepped through the spectrum in frequency spans selected to ensure acceptable frequency resolution. The RBW is set to 100 kHz. The VBW is set to ≥ 300 kHz. The Peak detector is used, with the trace set to Max Hold.

2.6.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

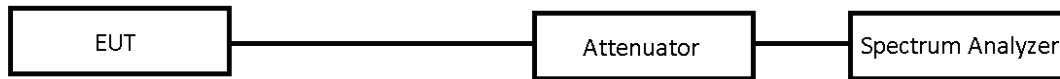
Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMI receiver	Agilent	N9038A	6130	2017-06-20	2018-06-20
Attenuator (2)	Fairview Microwave	SA18N5WA-10	~	Monitored	
Attenuator	Narda	768-10	~	Monitored	
Temp/Humidity	Extech	42270	5892	2017-04-06	2018-04-06

2.6.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagram for Conducted Spurious Emissions testing:



2.6.5 Conducted Emissions Data:

1 Carrier (Cable Loss + Attenuation = 32.51 dB):

Antenna 1: 923.3 MHz, 923.9 MHz, 924.5 MHz, 925.1 MHz

Antenna 2: 925.7 MHz, 926.3 MHz, 926.9 MHz, 927.5 MHz

There were no reportable emissions.

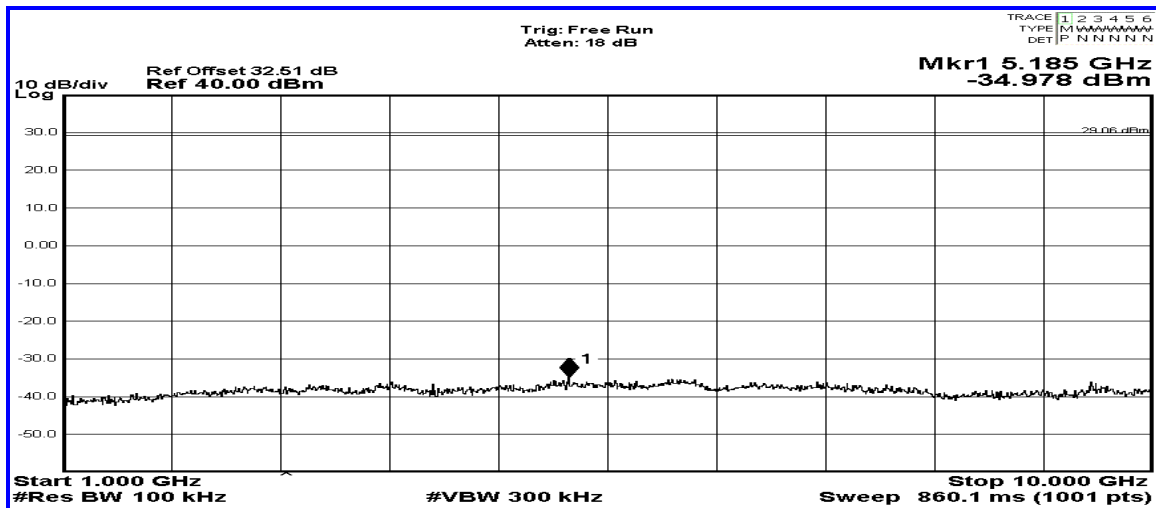
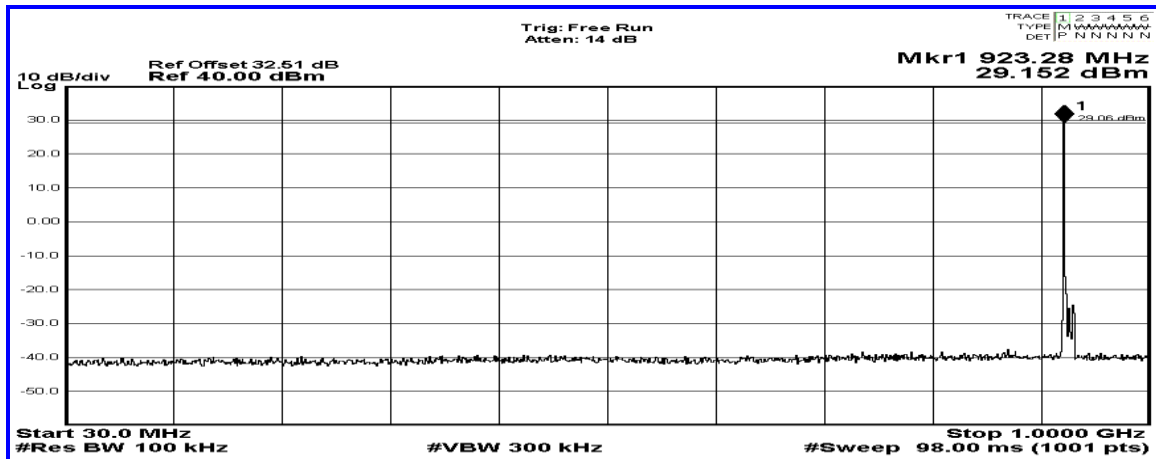
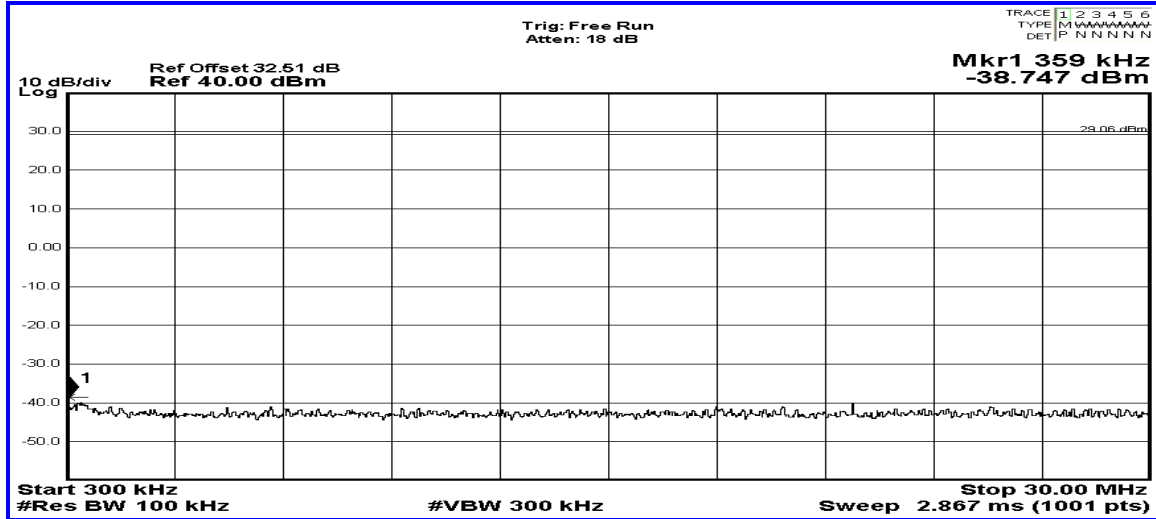
2 Carriers (Cable Loss + Attenuation = 32.51 dB):

Antenna 1: 923.3 MHz & 925.1 MHz (Cable Loss + Attenuation = 32.51 dB).

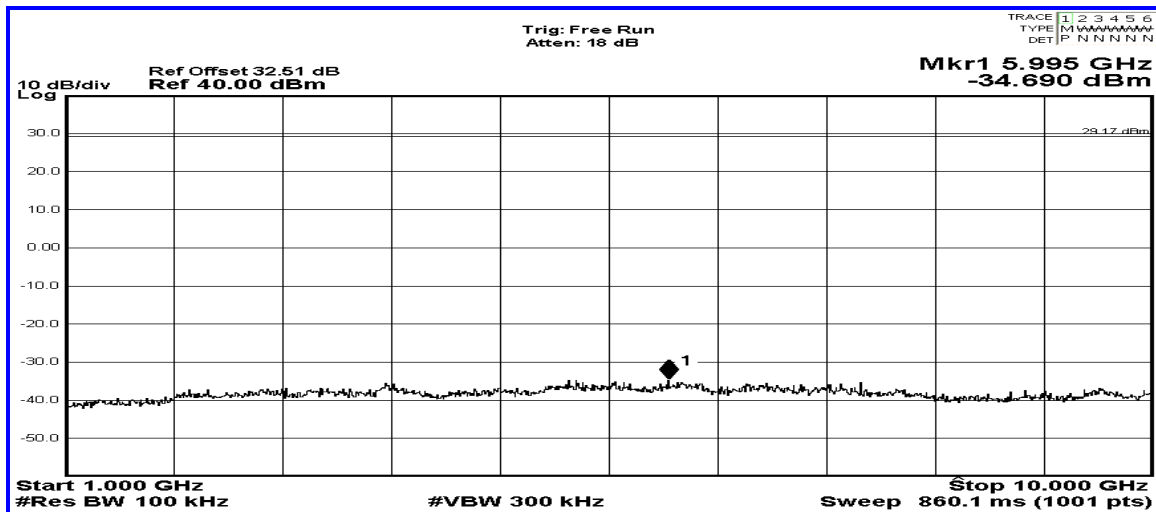
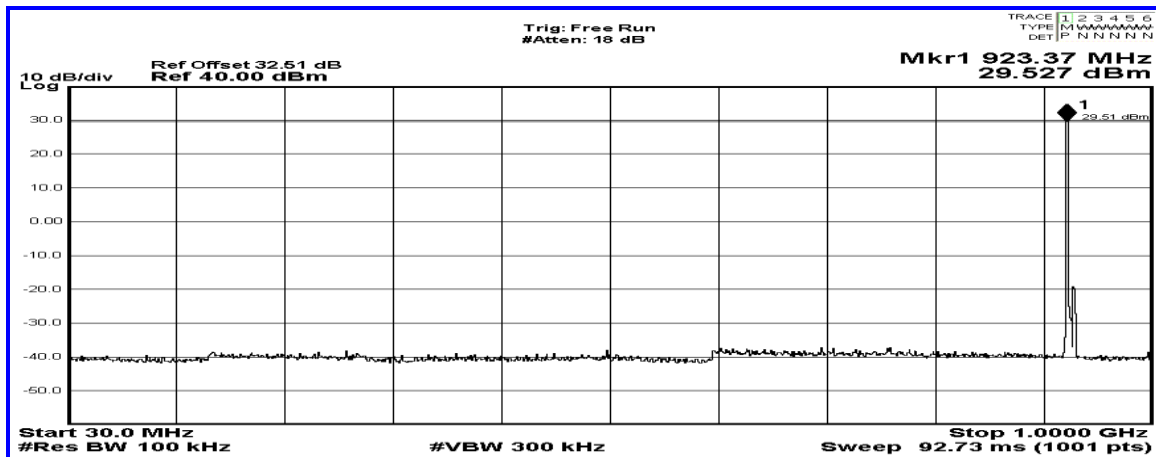
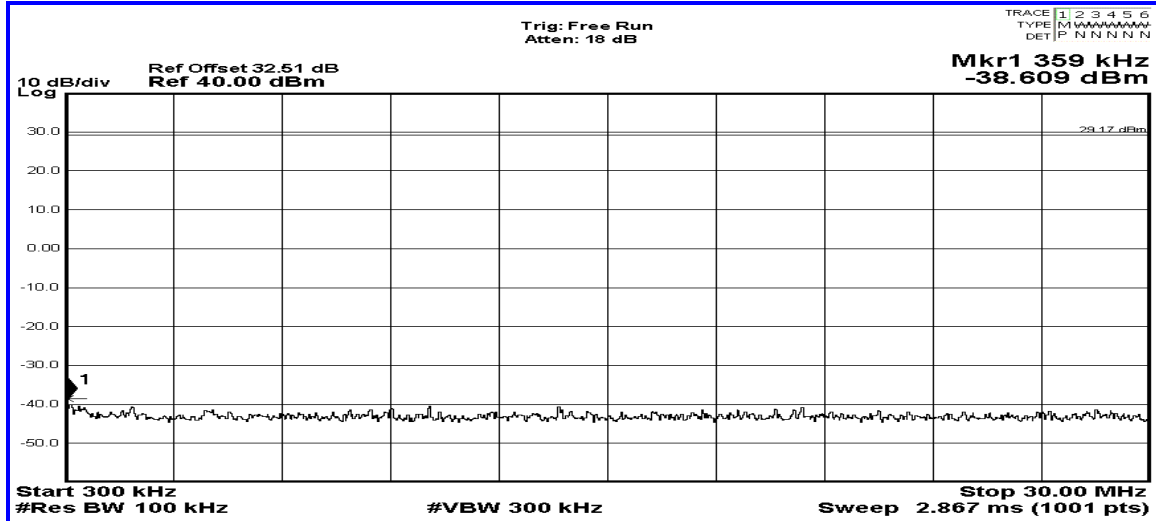
Ant 2: 926.9 MHz & 927.5 MHz (Cable Loss + Attenuation = 32.51 dB):

There were no reportable emissions.

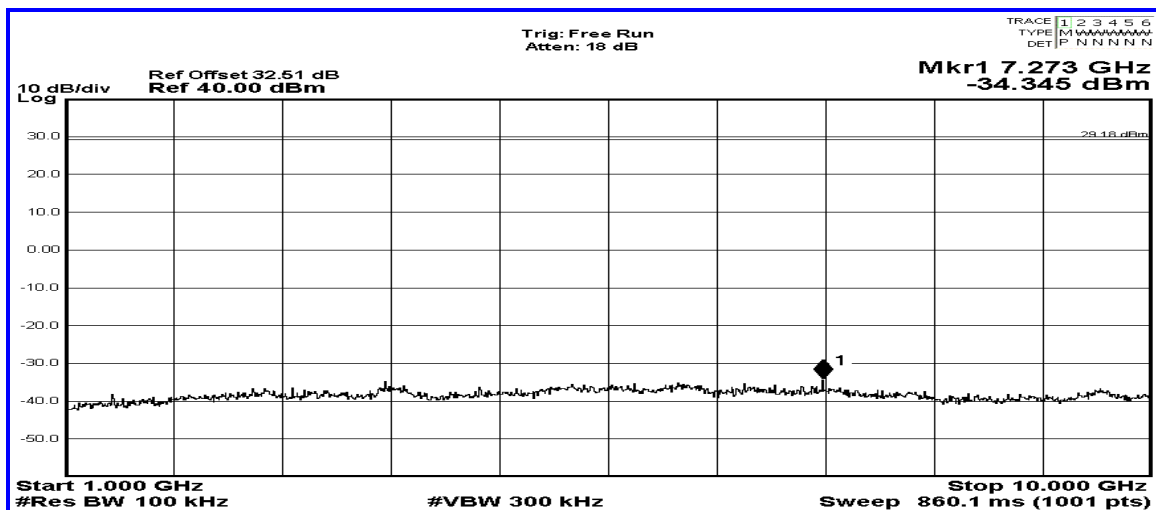
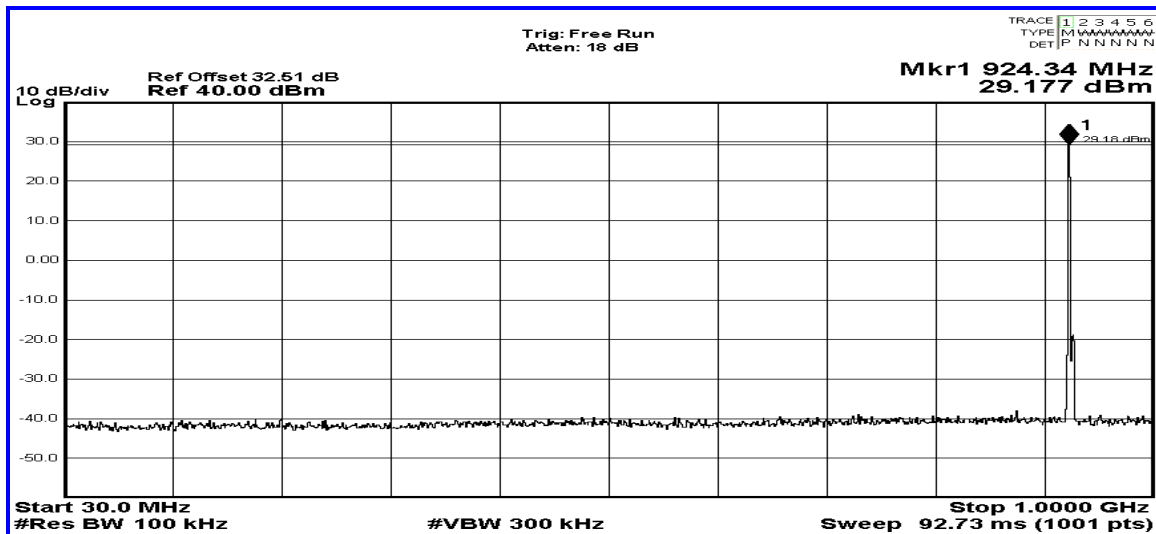
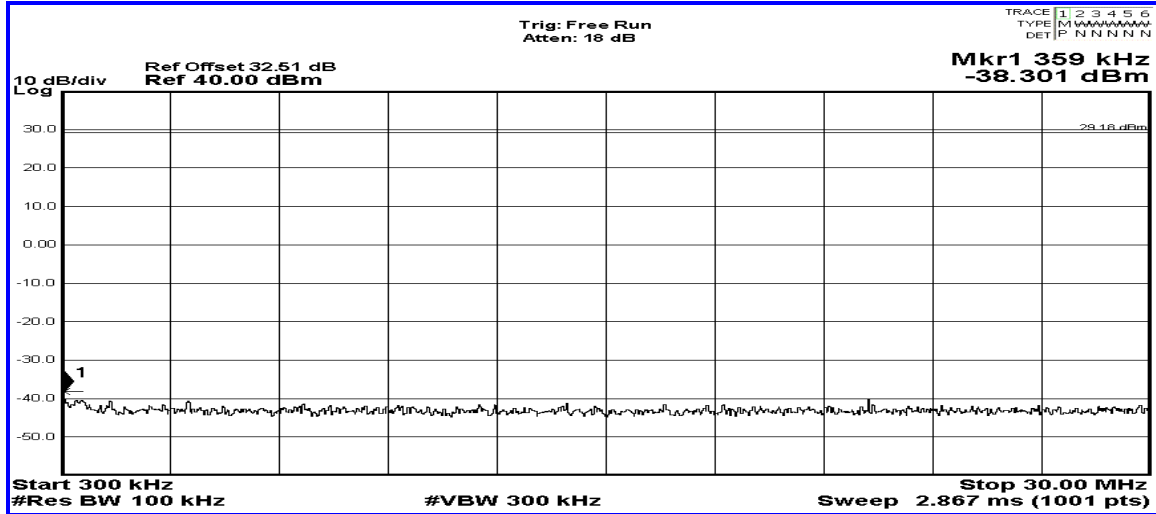
Conducted Emissions: Antenna 1: 1 Carrier, 923.3 MHz



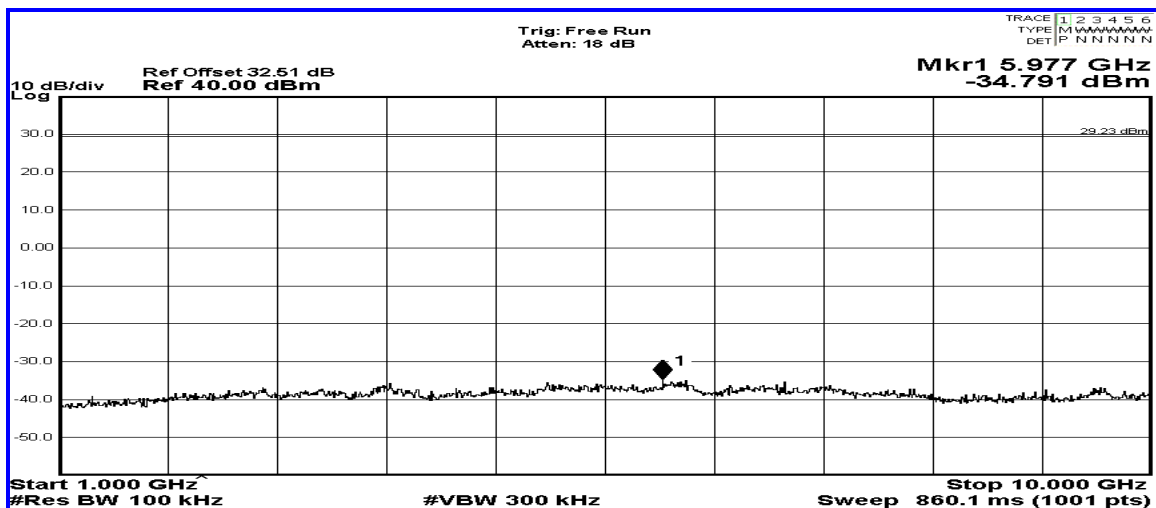
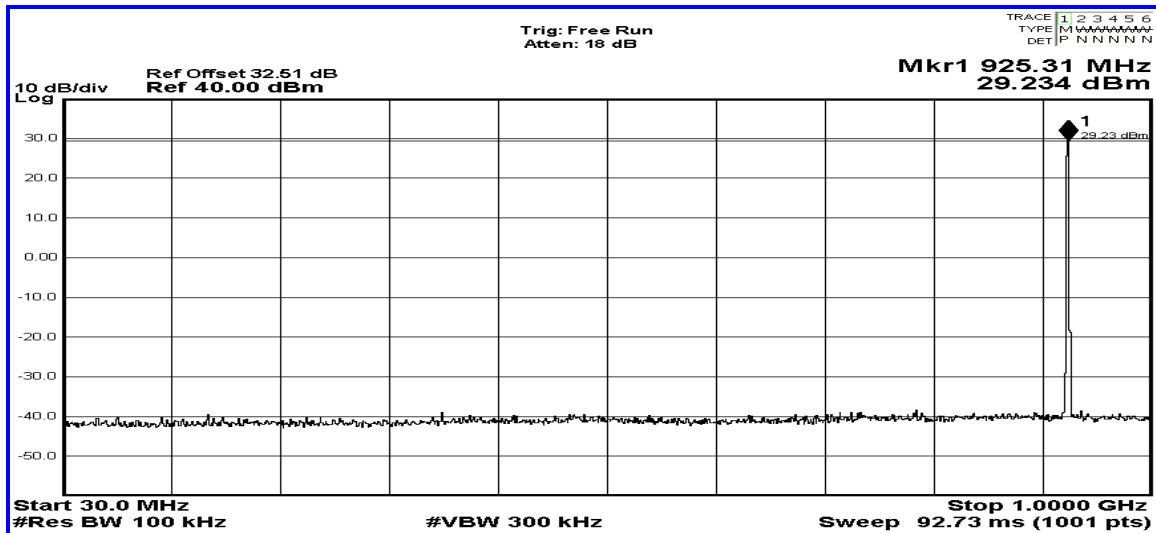
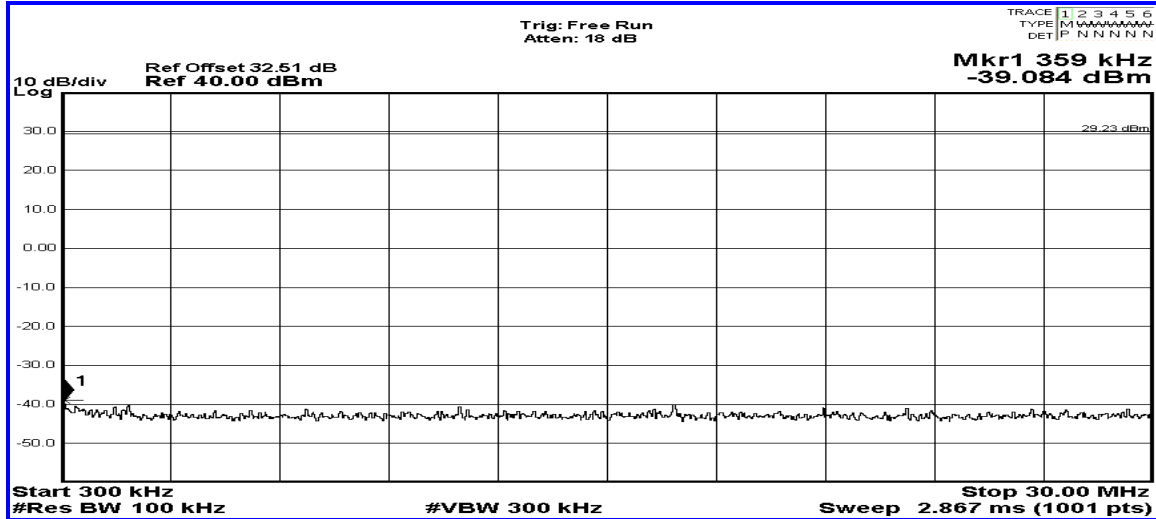
Conducted Emissions: Antenna 1: 1 Carrier, 923.9 MHz



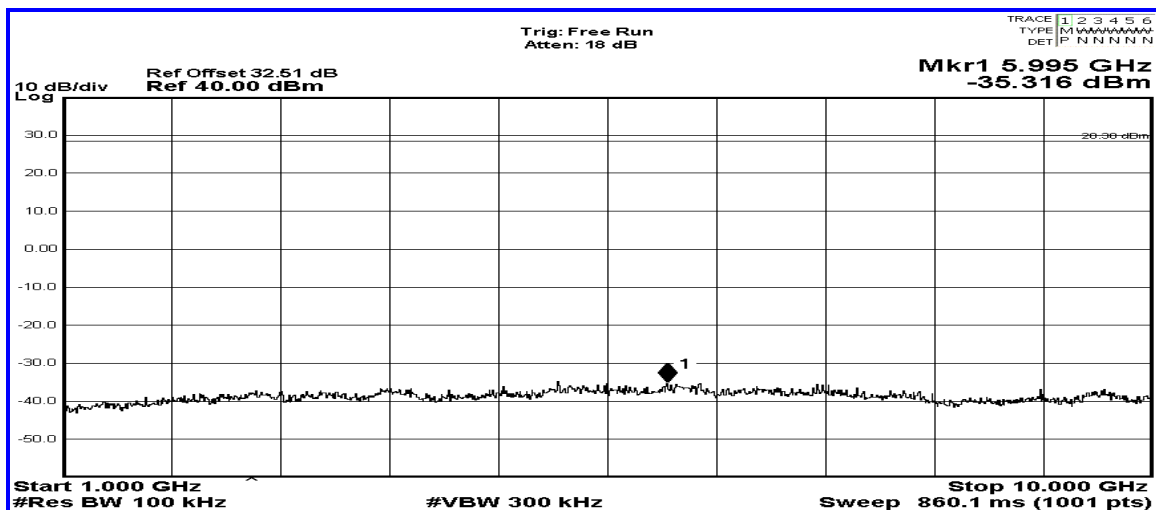
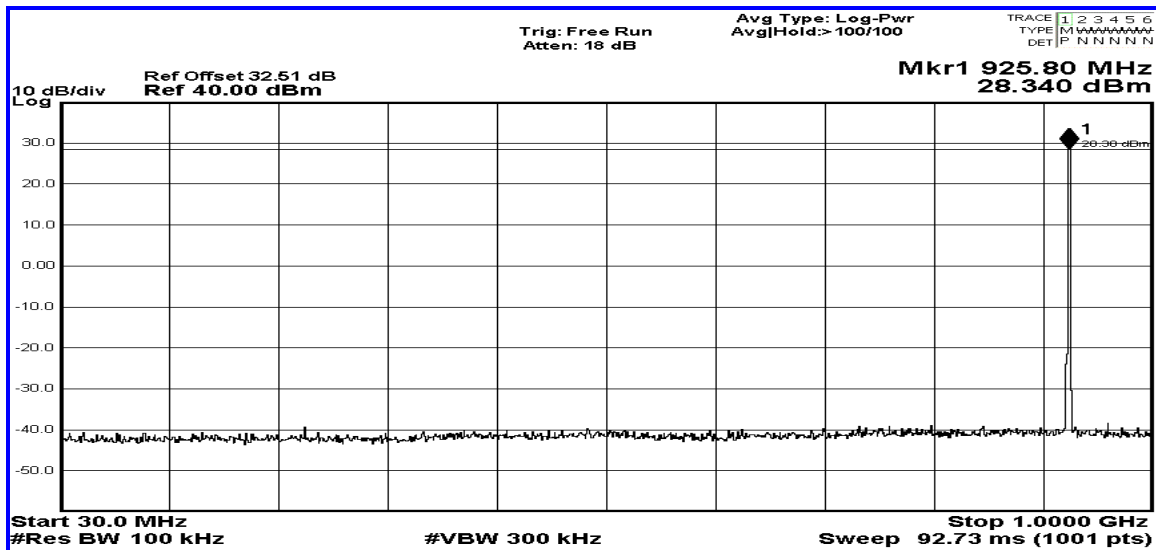
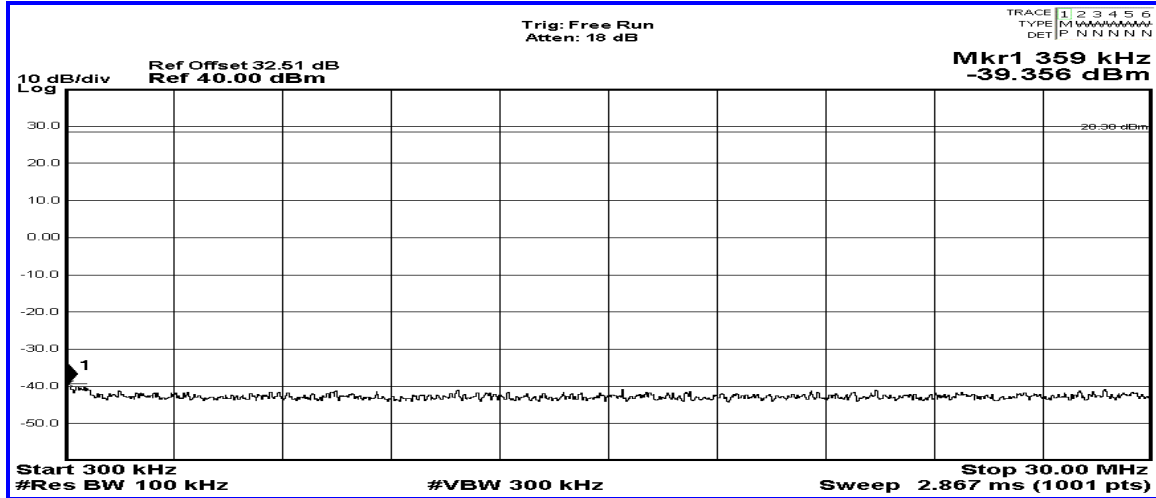
Conducted Emissions: Antenna 1: 1 Carrier, 924.5 MHz



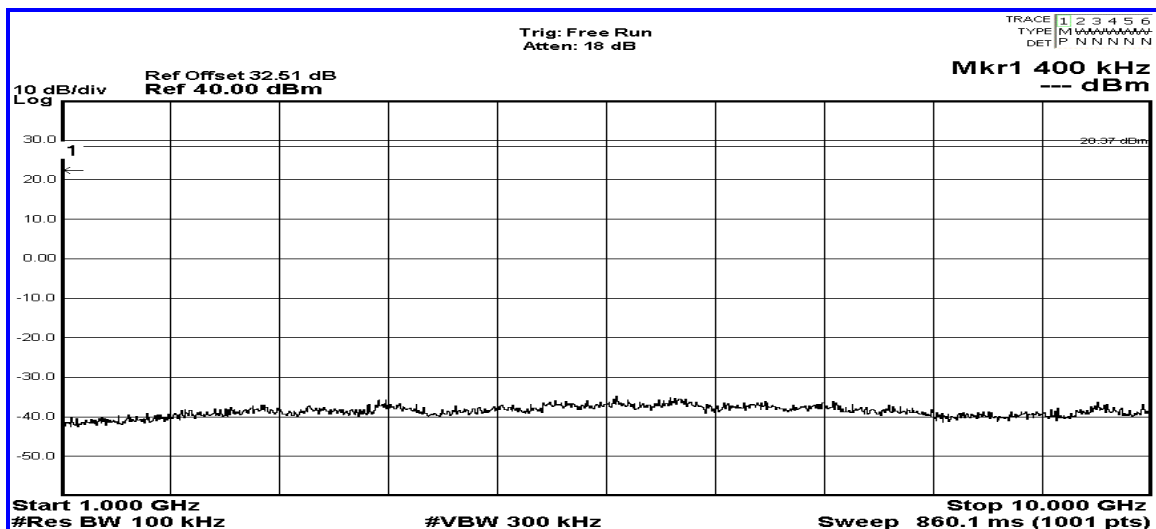
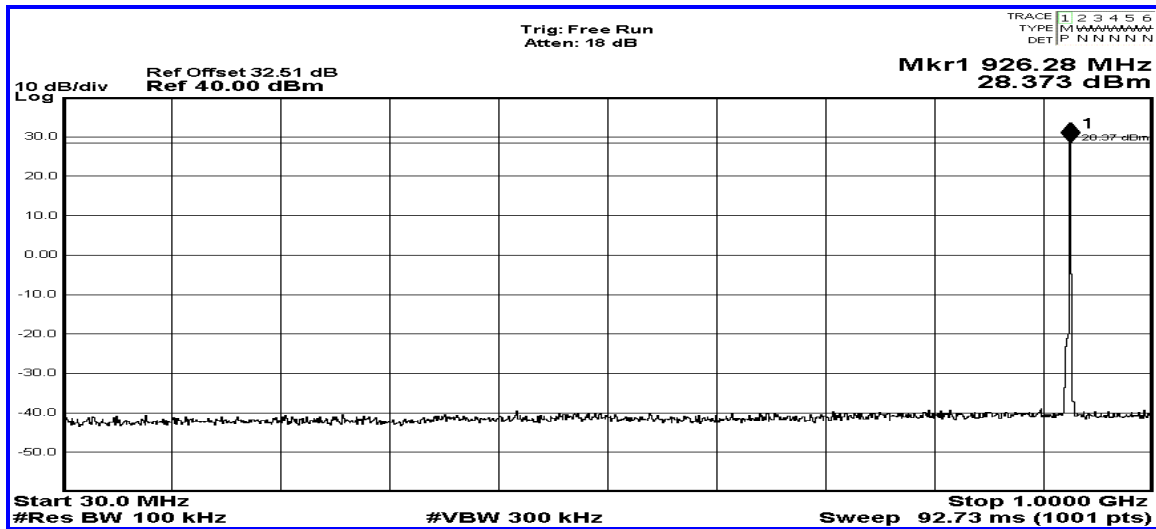
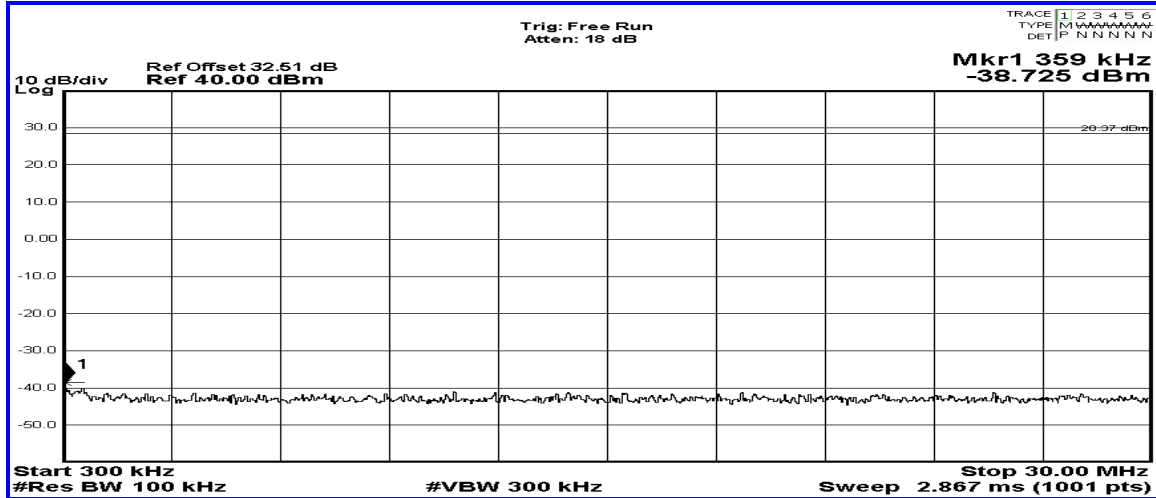
Conducted Emissions: Antenna 1: 1 Carrier, 925.1 MHz



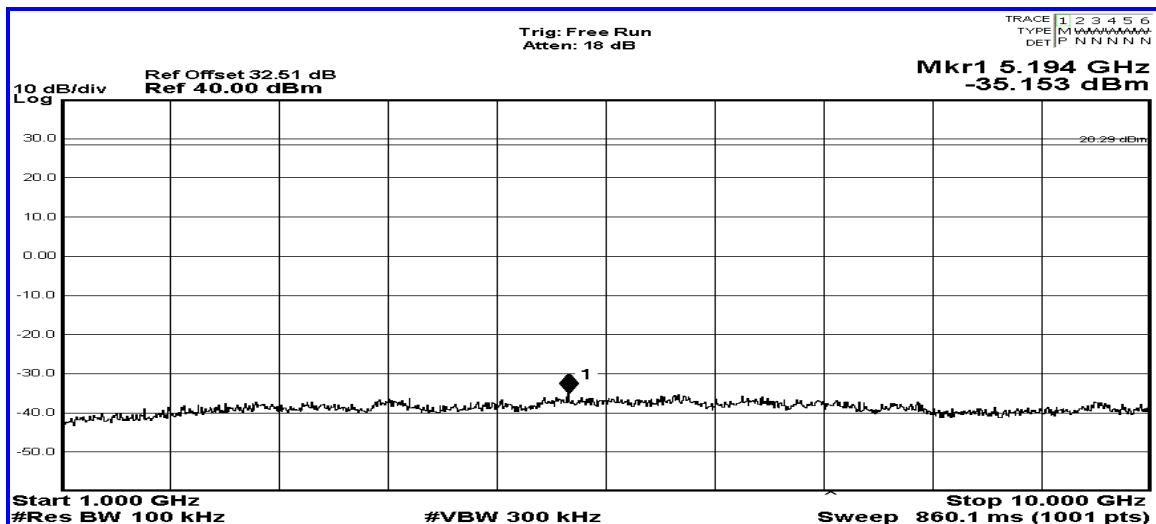
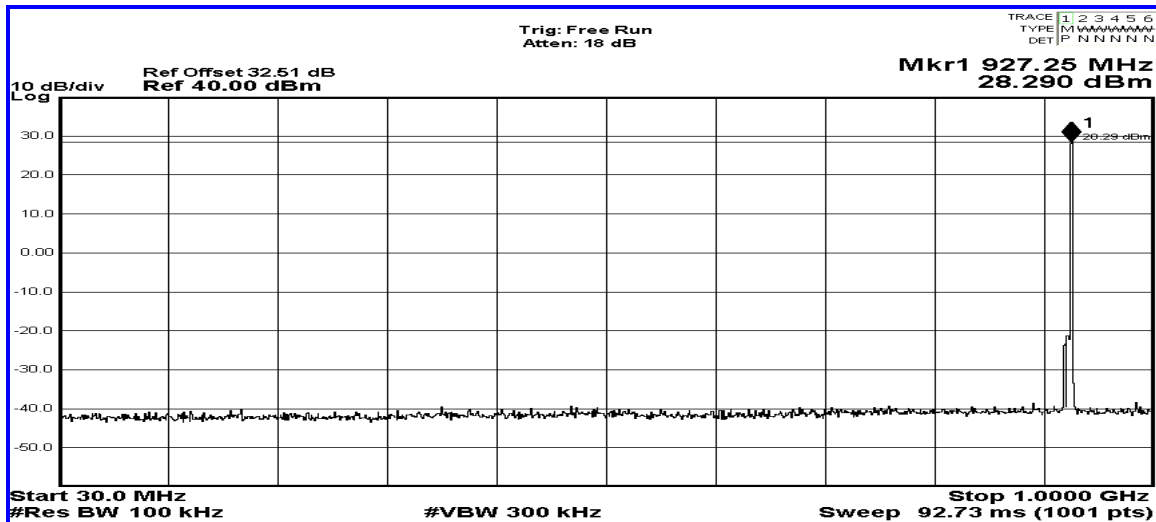
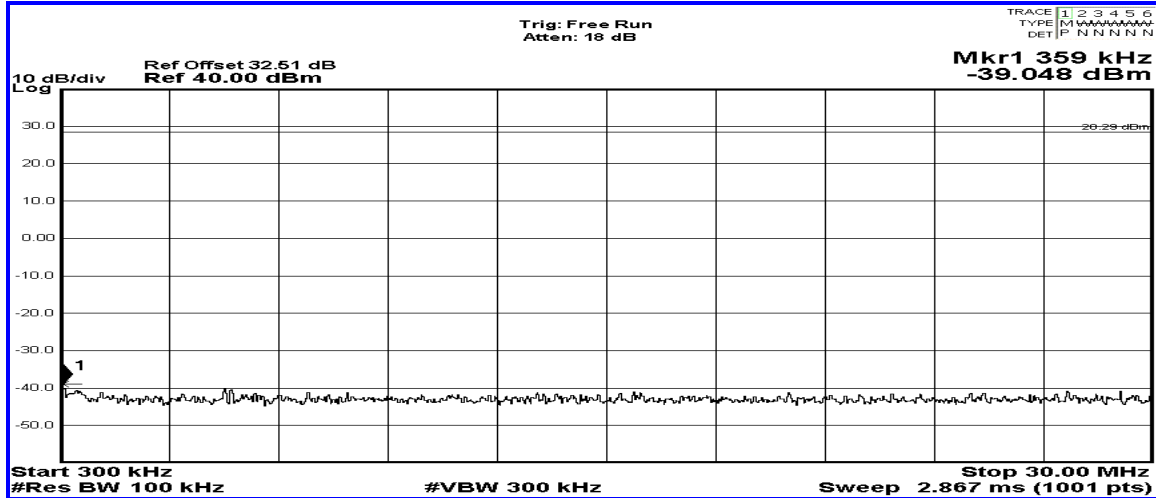
Conducted Emissions: Antenna 2: 1 Carrier, 925.7 MHz



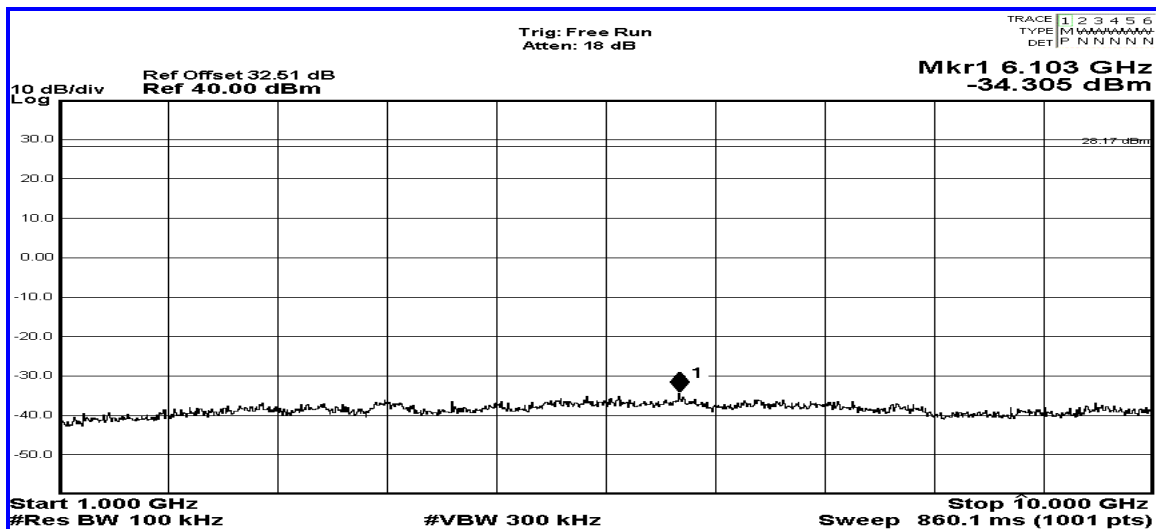
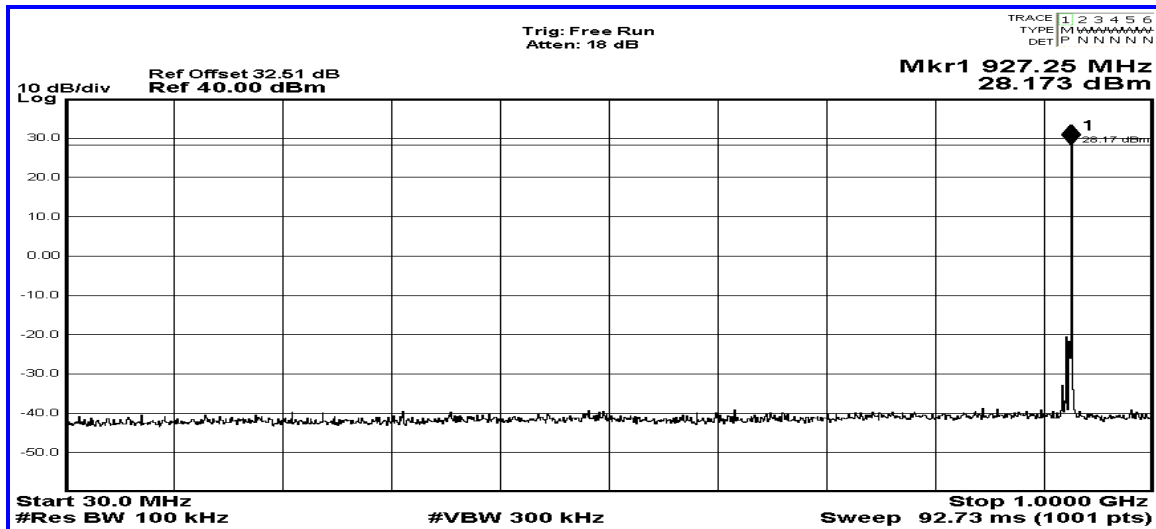
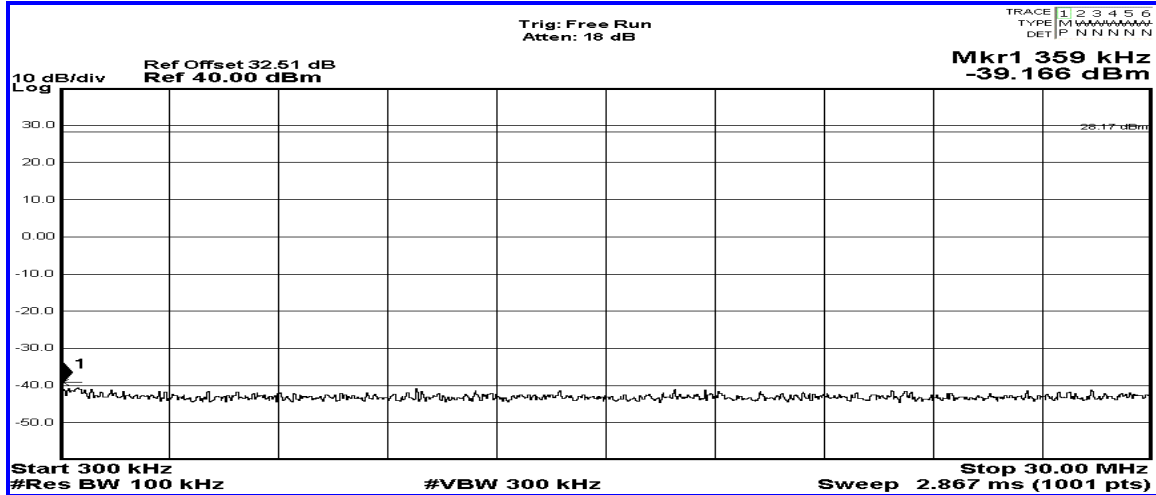
Conducted Emissions: Antenna 2: 1 Carrier, 926.3 MHz



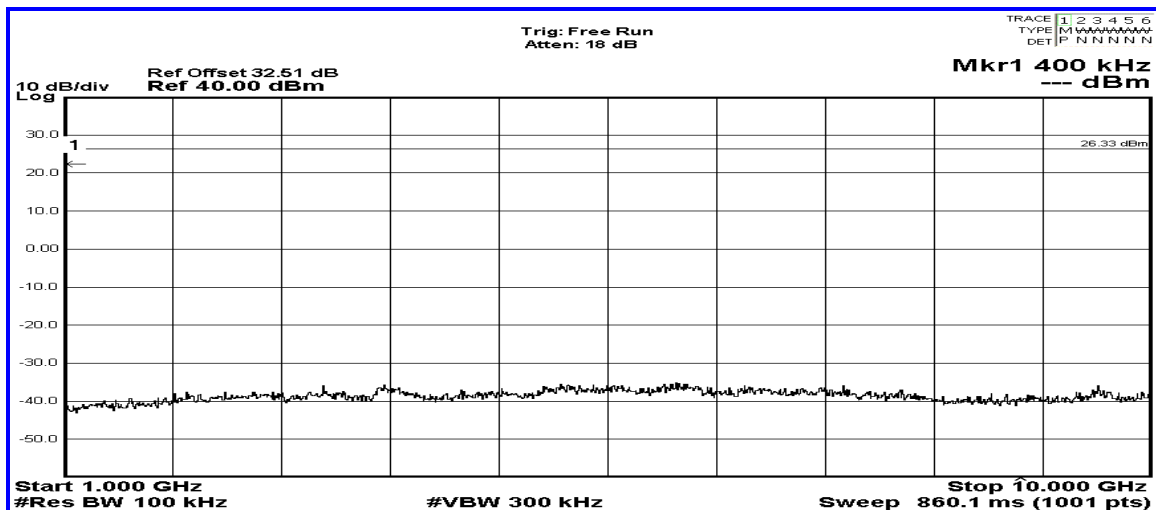
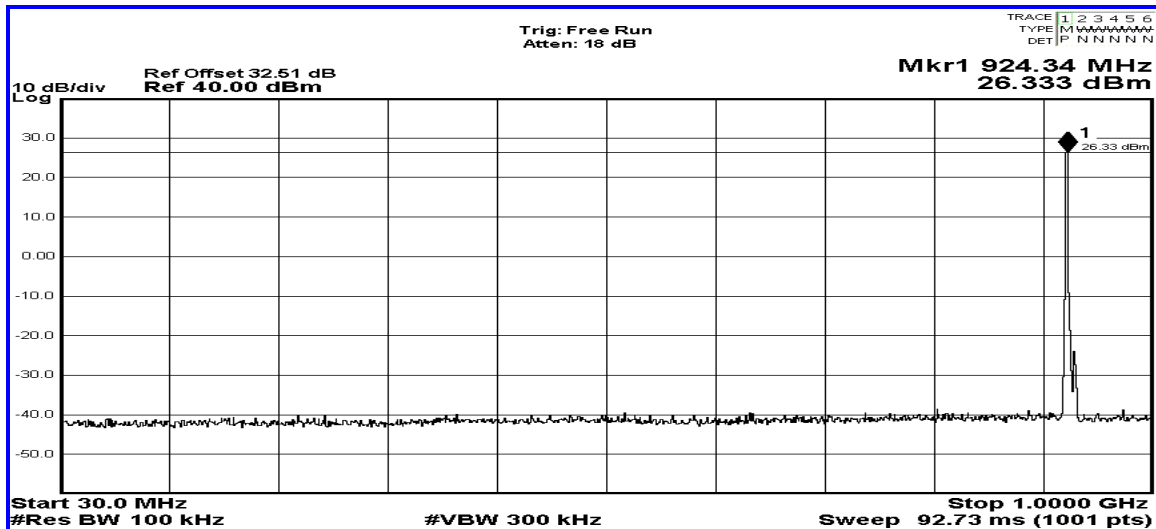
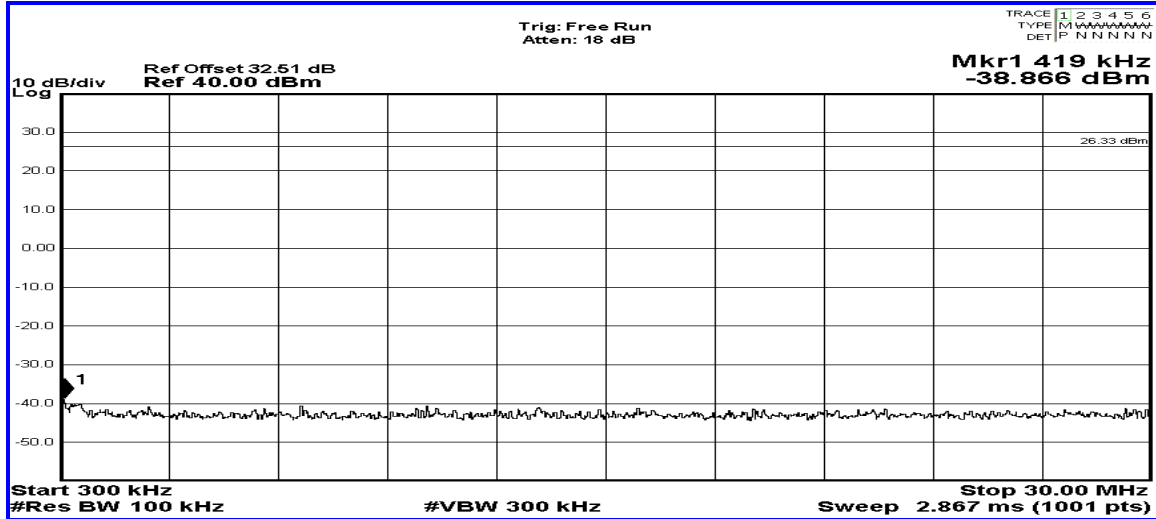
Conducted Emissions: Antenna 2: 1 Carrier, 926.9 MHz



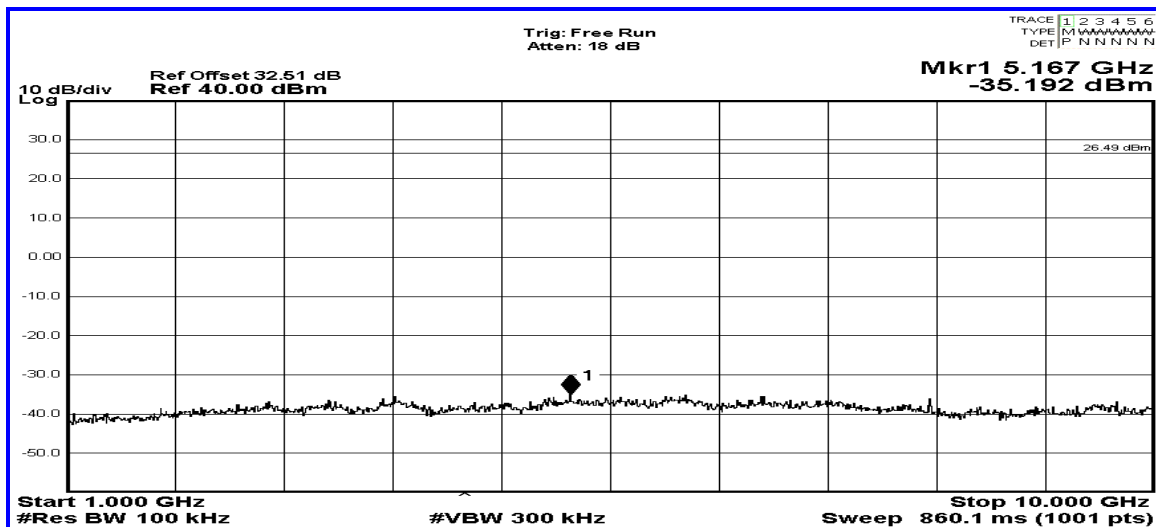
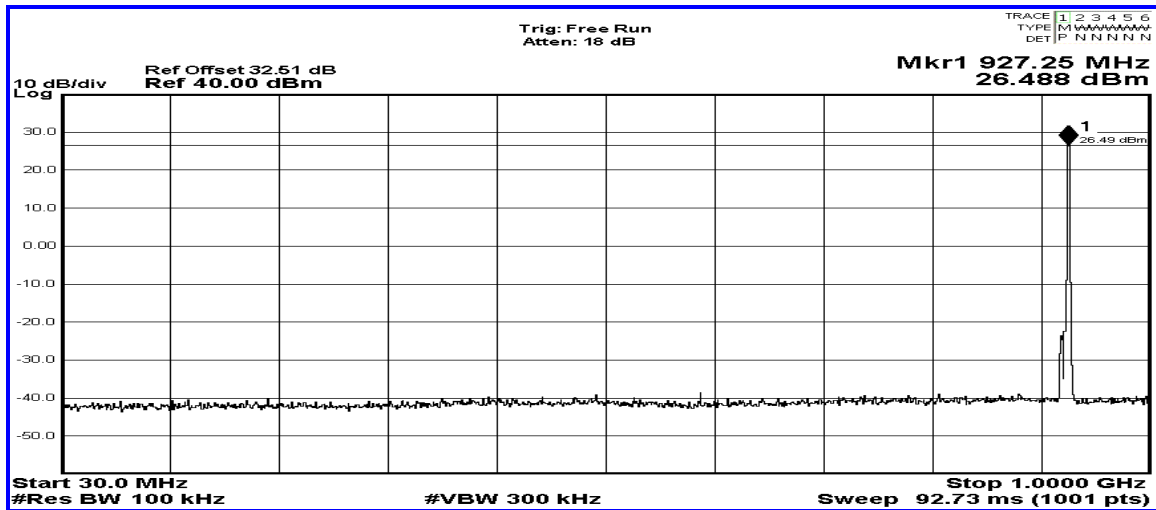
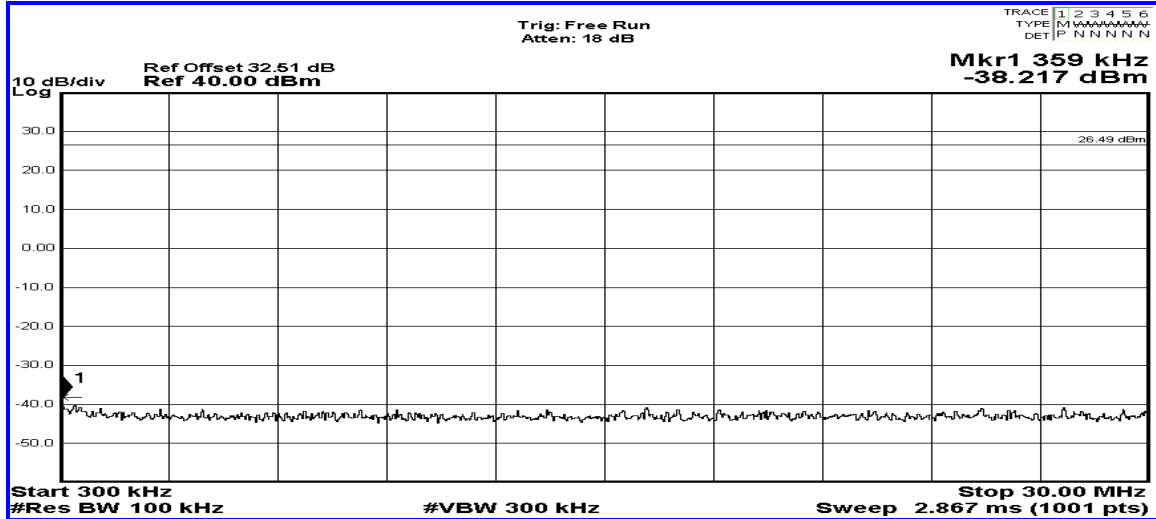
Conducted Emissions: Antenna 2: 1 Carrier, 927.5 MHz



Conducted Emissions: Antenna 1: 2 Carriers, 923.3 MHz and 923.9 MHz



Conducted Emissions: Antenna 2: 2 Carriers, 926.9 MHz and 927.5 MHz



2.7 EUT Positioning Assessment

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel:	Standard: FCC PART 15.247
Date:	Basic Standard: ANSI C63.4-2014
EUT status: Not Applicable	

The EUT is specified for fixed installation.

For details, refer to the installation instructions in the User Manual.

2.8 Radiated Spurious Emissions

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel: David Raynes	Standard: FCC PART 15.247
Date: 2017-10-03 (22.1° C, 17.4% RH)	Basic Standard: ANSI C63.10-2013
Date: 2017-10-04 (19.1° C, 22.8% RH)	
Date: 2017-10-13 (19.7° C, 21.6% RH)	
EUT status: Compliant	


Specification: FCC PART 15.247(d)


In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Restricted Bands of Operation:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.0900000 – 0.1100000	8.2910000 - 8.2940000	16.804250 - 16.804750	162.01250 - 167.17000	1660.0000 – 1710.0000	3.6000000 – 4.4000000	14.470000 – 14.500000
0.4950000 - 0.5050000	8.3620000 - 8.3660000	25.500000 - 25.670000	167.72000 - 173.20000	1718.8000 – 1722.2000	4.5000000 – 5.1500000	15.350000 – 16.200000
2.1735000 - 2.1905000	8.3762500 - 8.3867500	37.500000 - 38.250000	240.00000 – 285.00000	2200.0000 – 2300.0000	5.3500000 – 5.4600000	17.700000 – 21.400000
4.1250000 - 4.1280000	8.4142500 - 8.4147500	73.000000 - 74.600000	322.00000 - 335.40000	2310.0000 – 2390.0000	7.2500000 – 7.7500000	22.010000 – 23.120000
4.1772500 - 4.1777500	12.290000 - 12.293000	74.800000 - 75.200000	399.90000 – 410.00000	2483.5000 – 2500.0000	8.0250000 – 8.5000000	23.600000 – 24.000000
4.2072500 - 4.2077500	12.519750 - 12.520250	108.00000 - 121.94000	608.00000 – 614.00000	2655.0000 – 2900.0000	9.0000000 – 9.2000000	31.200000 – 31.800000
5.6770000 - 5.6830000	12.576750 - 12.577250	123.00000 - 138.00000	960.00000 – 1240.0000	3260.0000 – 3267.0000	9.3000000 – 9.5000000	36.430000 – 36.500000
6.2150000 - 6.2180000	13.360000 - 13.410000	149.90000 - 150.05000	1300.0000 – 1427.0000	3332.0000 – 3339.0000	10.600000 – 12.700000	Above 38.600000
6.2677500 - 6.2682500	16.420000 - 16.423000	156.52475 - 156.52525	1435.0000 – 1626.5000	3345.8000 – 3358.0000	13.250000 – 13.400000	
6.3117500 - 6.3122500	16.694750 - 16.695250	156.70000 - 156.90000	1645.5000 – 1646.5000	3500.0000 – 3600.0000		

 US only

 Canada 108 – 138 MHz

 Canada 960 – 1427 MHz

 Canada only

2.8.1 Test Guidance: ANSI C63.10-2013, Clause 13.4.2

From 9kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz), measurements are performed with a loop antenna.

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

2.8.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.8.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” as based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of $k = 2$.

Test Method	Frequency	Uncertainty
Radiated Emissions Level	30 MHz – 1 GHz	±4.6 dB
Radiated Emissions Level	1 GHz – 26.5 GHz	±5.31 dB

2.8.4 Test Equipment

Testing was performed with the following equipment:

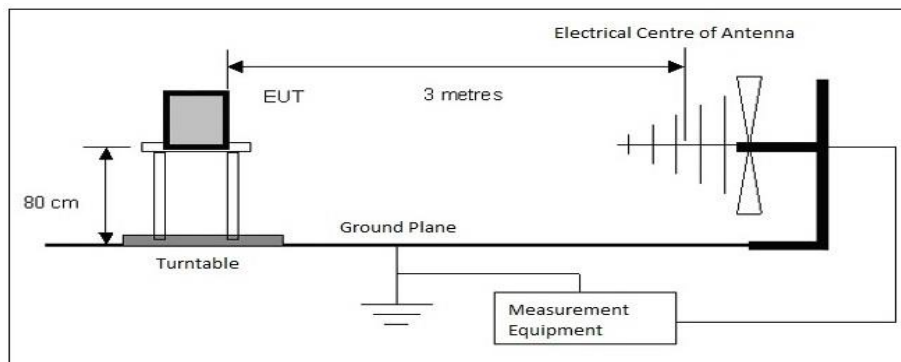
Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	N/A	
EMI receiver	Agilent	N9038A	6130	2017-06-20	2018-06-20
Loop Antenna	EMCO	6502	10868	2017-03-09	2019-03-09
Biconilog Antenna	ARA	LPB-2520/A	4318	2016-05-18	2018-05-18
Filter	K&L	D5TNF-800/1000-1.1-N/N-GRI	S/N 1	Monitored	
DRG Horn	EMCO	3115	19357	2016-08-24	2018-08-24
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800-21-5P	4354	Monitored	
Temp/Humidity	Extech	42270	5892	2017-04-06	2018-04-06

2.8.5 Test Sample Verification, Configuration & Modifications

The EUT was set to selected channels with test-specific software. The output was modulated as in normal operation. Configuration for 2-Carrier operation on Antenna 1 port at 923.9 MHz & 924.5 MHz, and 1-carrier operation on the Antenna 2 port at 926.3 MHz was selected as the worst-case for detailed examination. This selection was based on maximum EUT power dissipation, in the absence of harmonic emissions produced by any of the Tx channels selected. See §2.6 for details. The antenna ports were terminated into 50Ω for this test.

The EUT met the requirements without modification.

Test setup diagram for Radiated Spurious Emissions testing:



2.8.6 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

Meter Reading in dBμV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dBμV/m.

Delta = Field Strength - Limit

Notes:

- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- The EUT was assessed up to 10 GHz. To prevent LNA saturation, a high-pass filter was used to block frequencies below 926 MHz.
- Pursuant to Part 15.31(o), emissions that are more than 20 dB below the applicable limit are not reported.

Negative values for Delta indicate compliance.

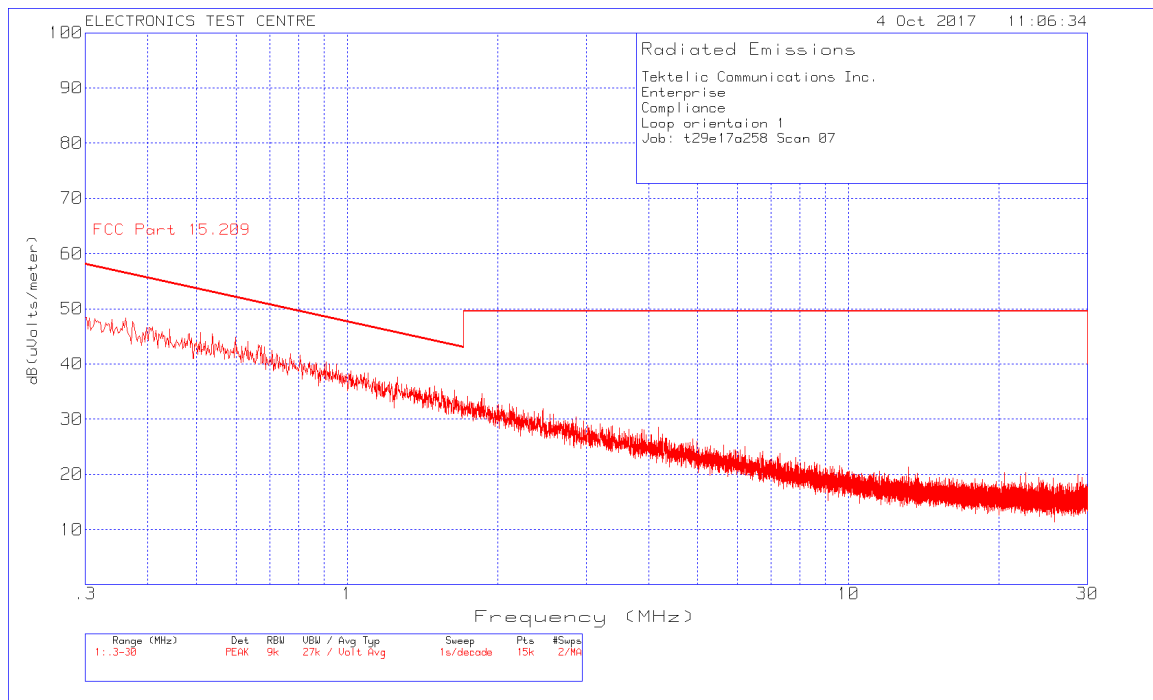
Transmit Mode; all antenna ports terminated in 50Ω:

Antenna 1, 2 carriers at 923.9 MHz & 924.5 MHz, and Antenna 2, 1 carrier at 926.3 MHz:

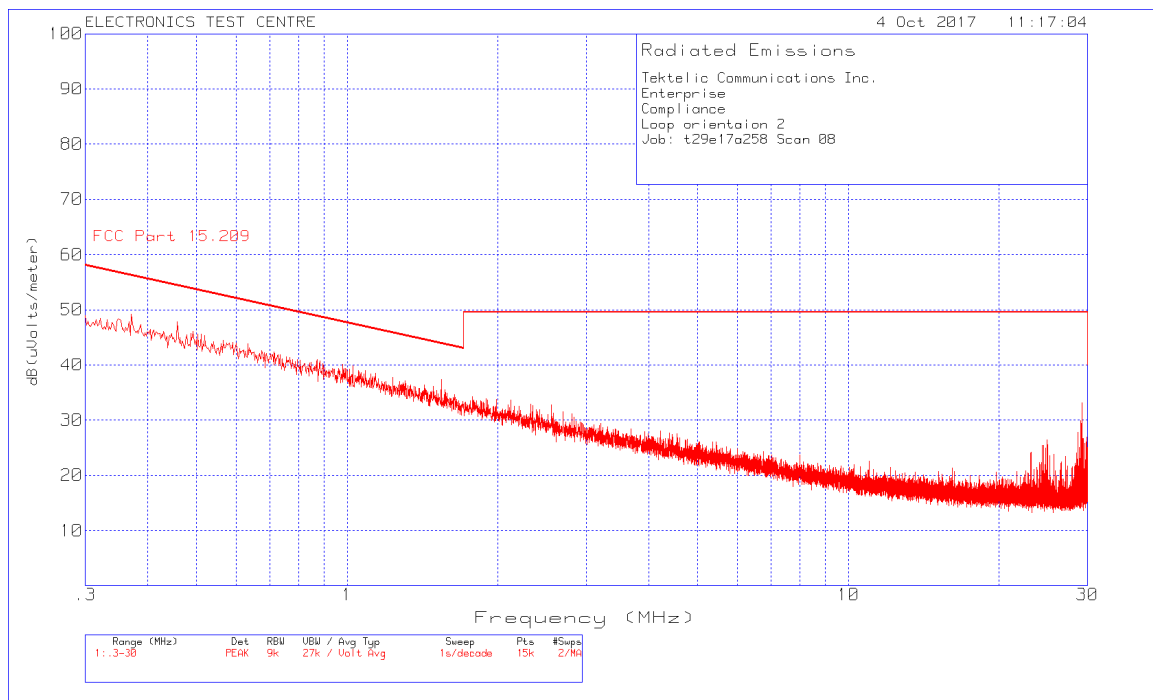
Freq. Marker	Freq. [MHz]	Raw reading [dBμV]	Det	Antenna Factor [dB/m]	Cable Loss [dB]	Corrected Reading [dBμV/m]	FCC 15.209 Limit [dBμV/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	34.0717	33.84	QP	21.6	-25.0	32.44	40	-7.56	25	100	Vertical
2	40.3265	38.20	QP	21.0	-24.9	34.30	40	-5.70	1	100	Vertical
3	43.7990	38.98	QP	20.2	-24.9	34.28	40	-5.72	147	110	Vertical
4	45.7400	34.67	QP	19.8	-24.8	29.67	40	-10.33	115	111	Vertical
5	50.4350	37.66	QP	18.3	-24.7	31.26	40	-8.74	333	100	Vertical
6	54.1748	42.09	QP	16.8	-24.7	34.19	40	-5.81	39	111	Vertical
1	2,449.1	24.99	Avg	28.7	-26.9	26.79	53.98	-27.19	240	312	Horizontal
1	7,391.9*	19.81	Avg	36.5	-27.7	28.61	53.98	-25.37	288	112	Horizontal
2	7,394.8*	23.92	Avg	36.5	-27.7	32.72	53.98	-21.26	293	101	Vertical

*** Restricted Band**

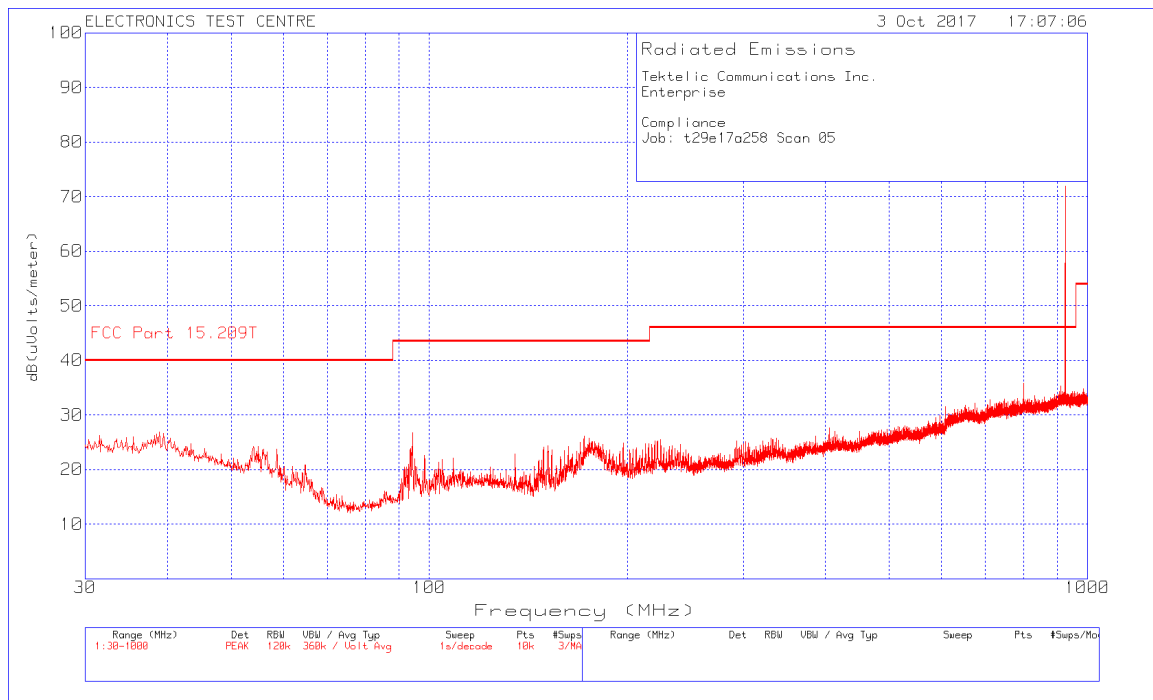
Plot of Radiated Emissions: Measuring Antenna 1st Orientation



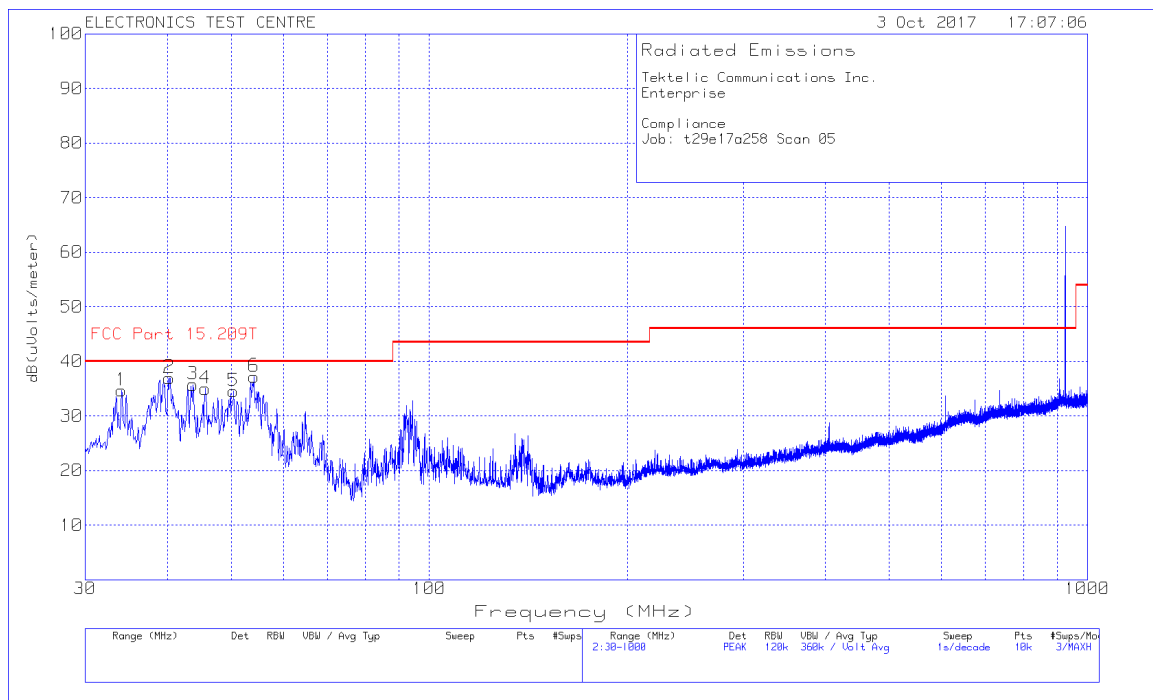
Plot of Radiated Emissions: Measuring Antenna 2nd Orientation



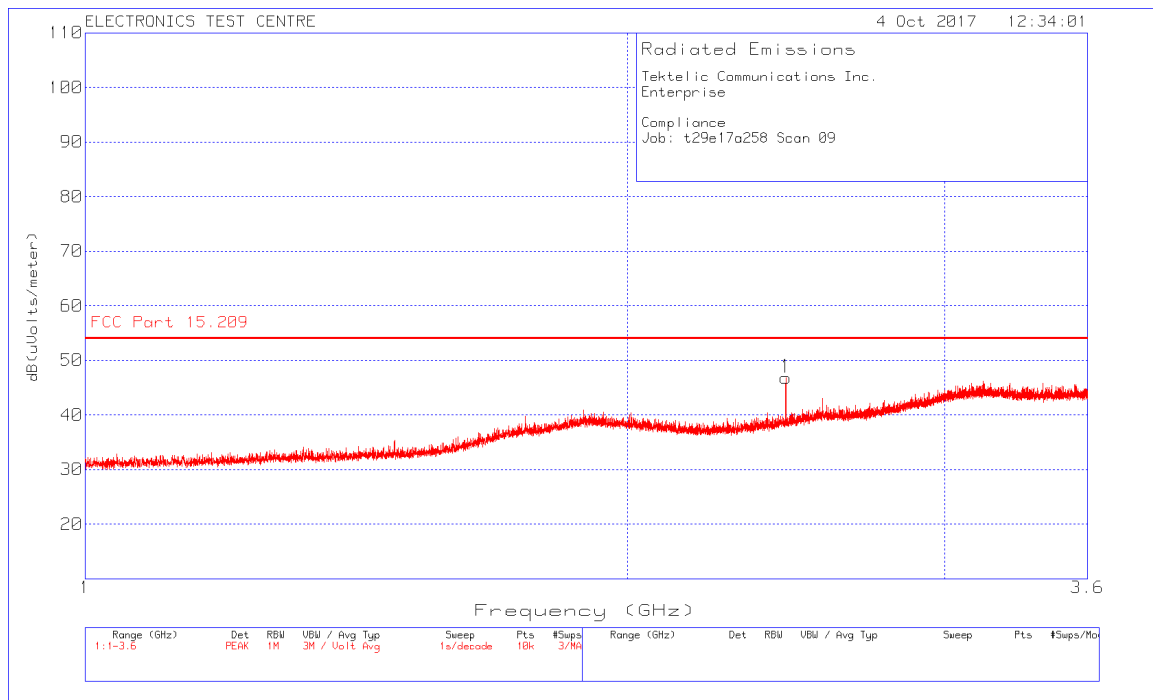
Plot of Radiated Emissions: Horizontal polarization



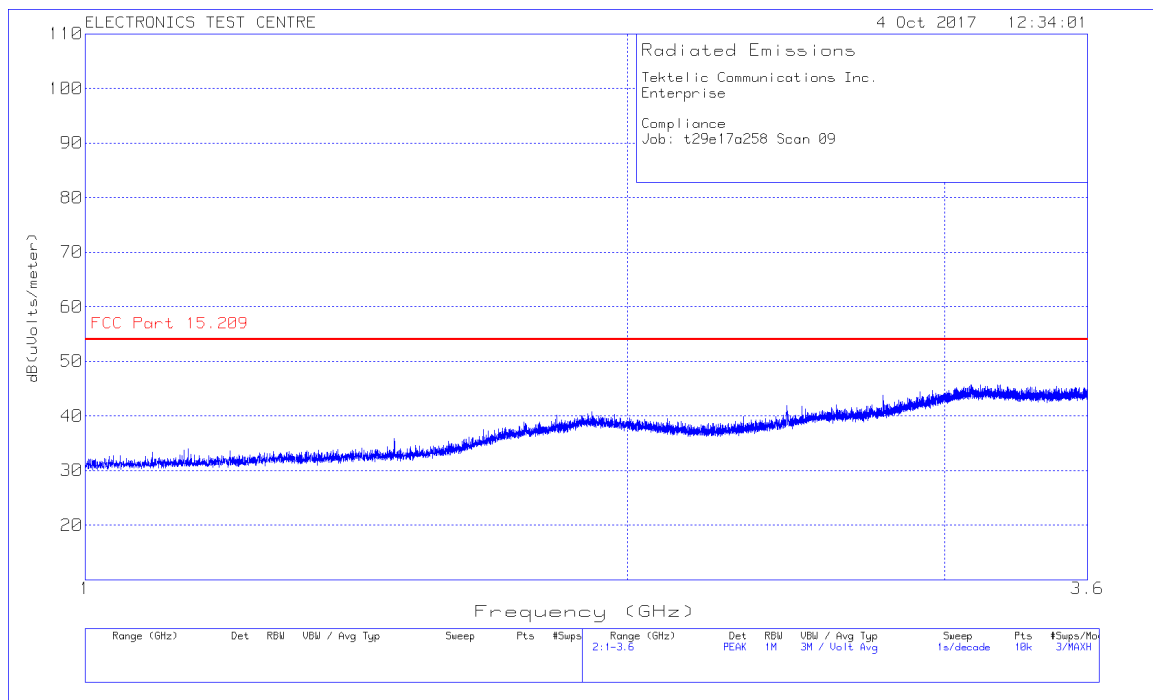
Plot of Radiated Emissions: Vertical polarization



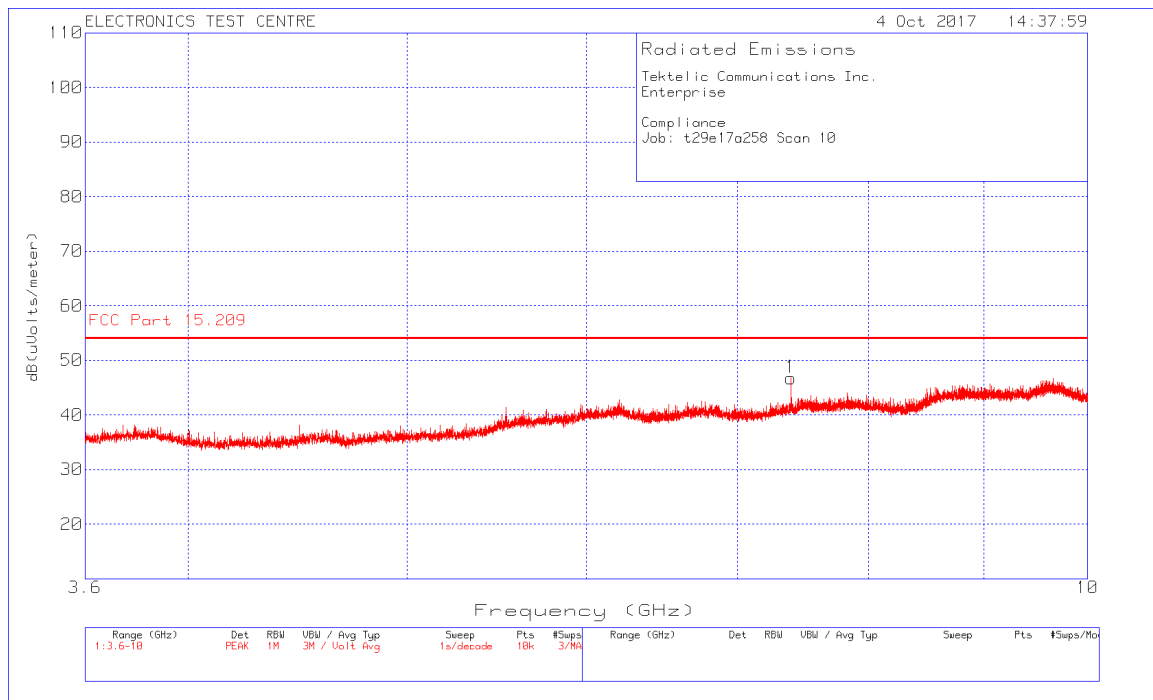
Plot of Radiated Emissions: Horizontal polarization



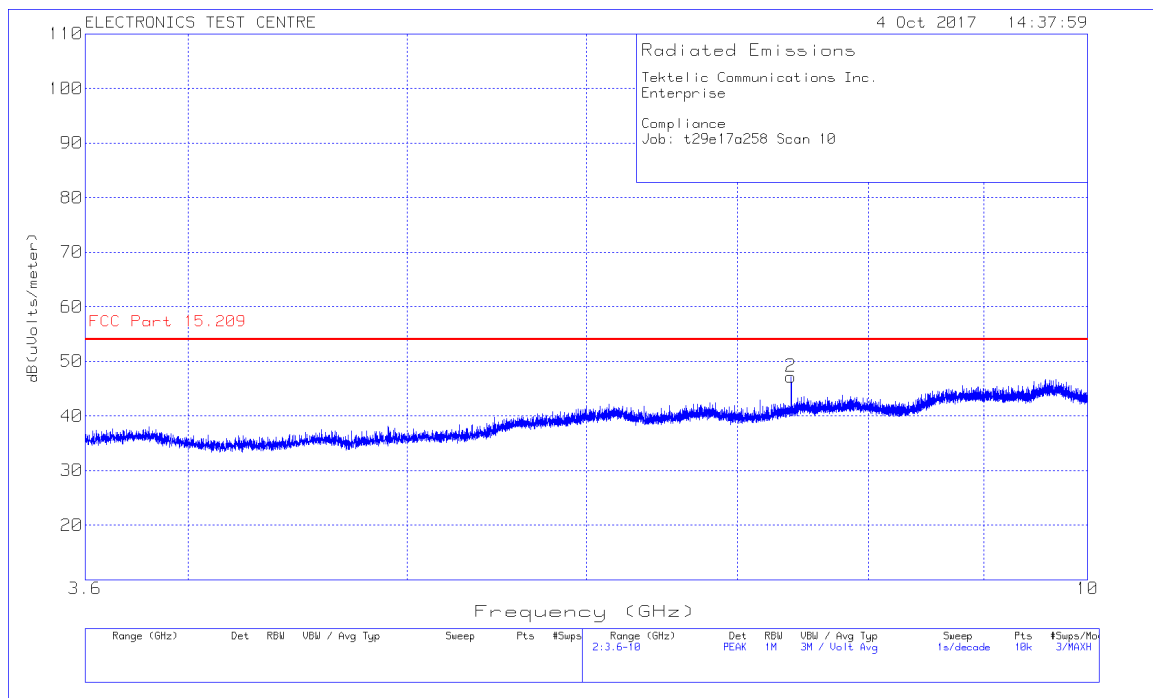
Plot of Radiated Emissions: Vertical polarization



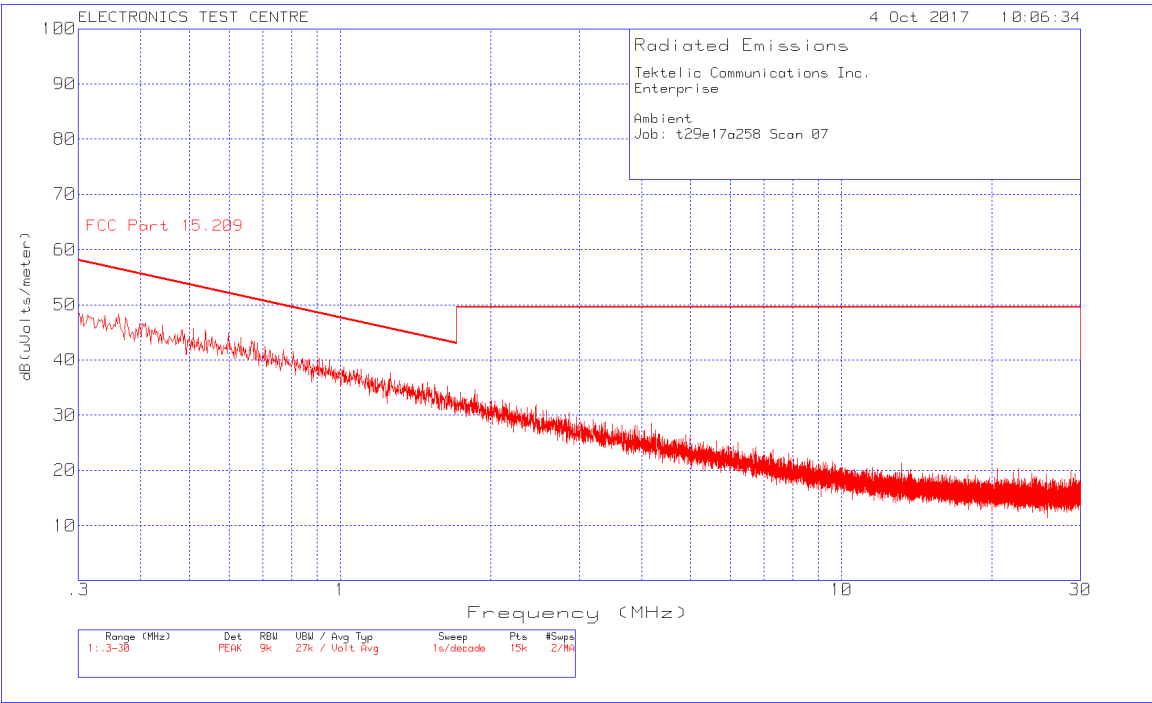
Plot of Radiated Emissions: Horizontal polarization



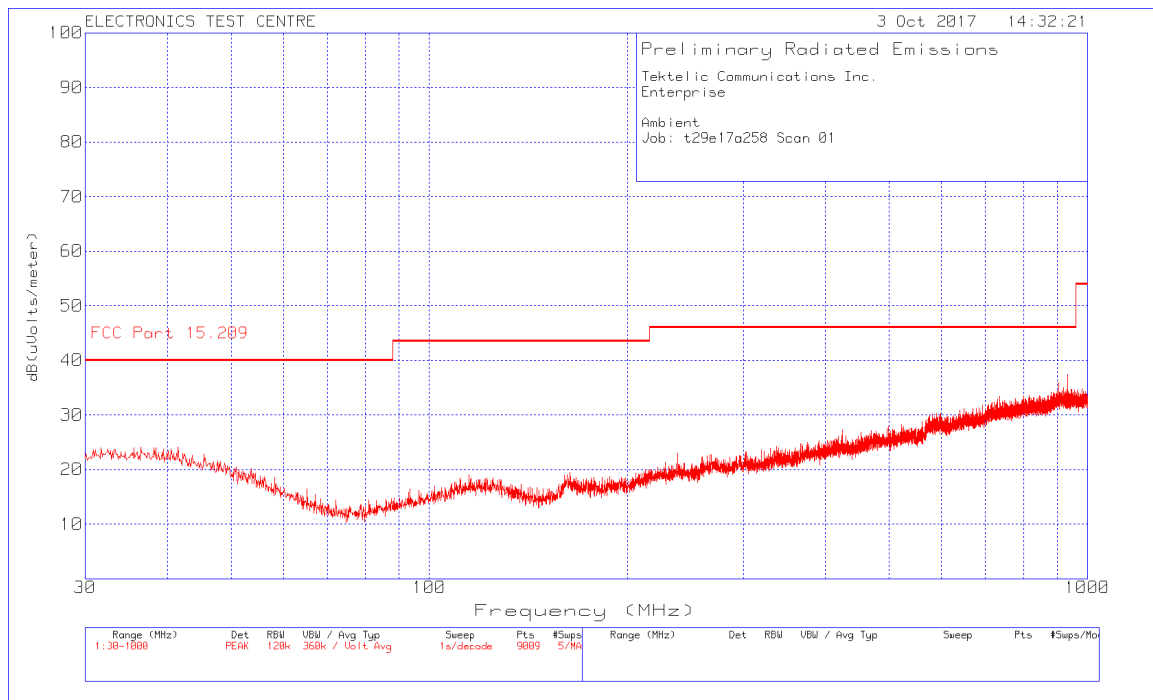
Plot of Radiated Emissions: Vertical polarization



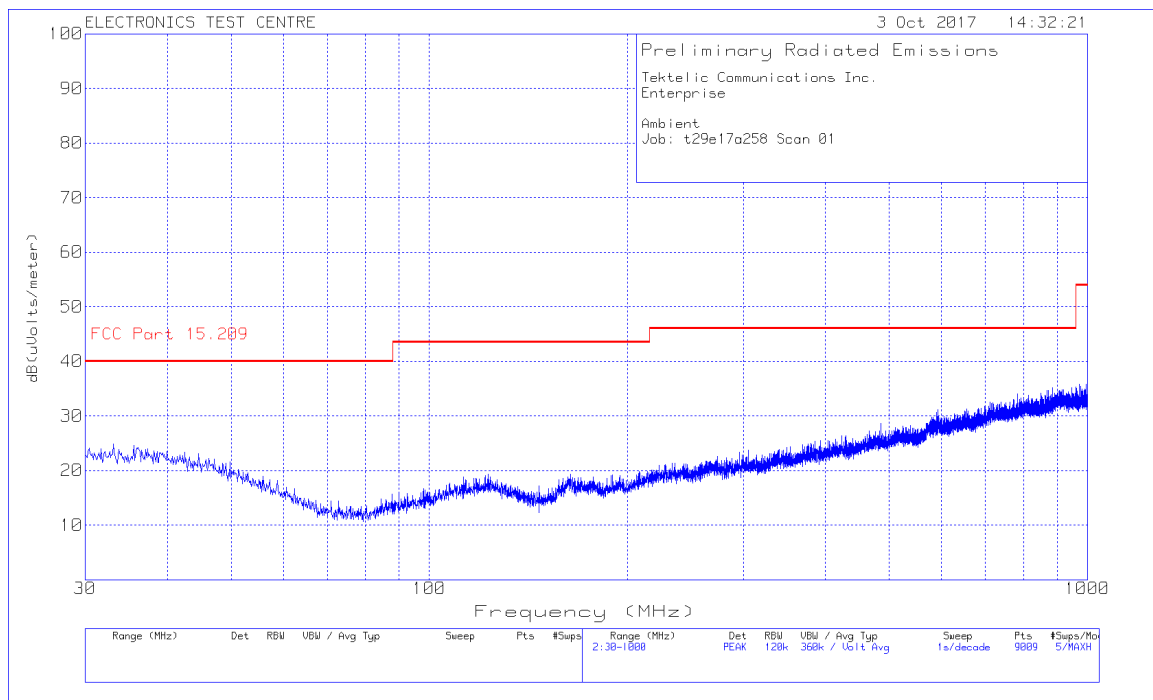
Plot of Test Chamber Ambient: (measurement noise floor):



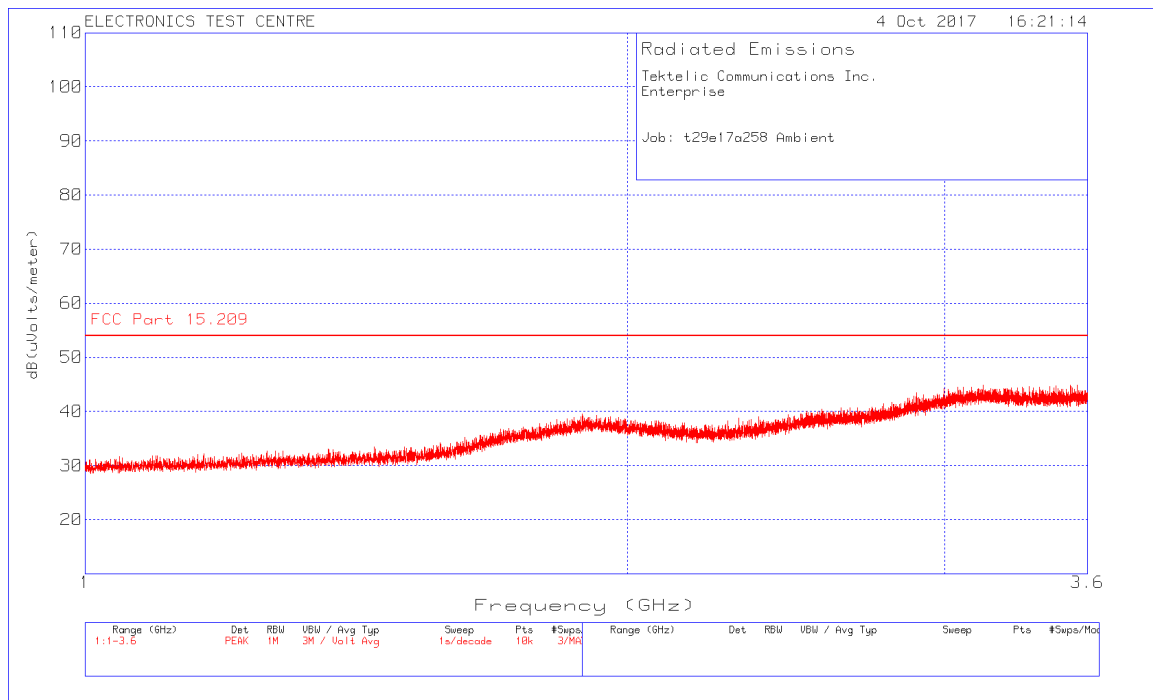
Plot of Test Chamber Ambient: (measurement noise floor):



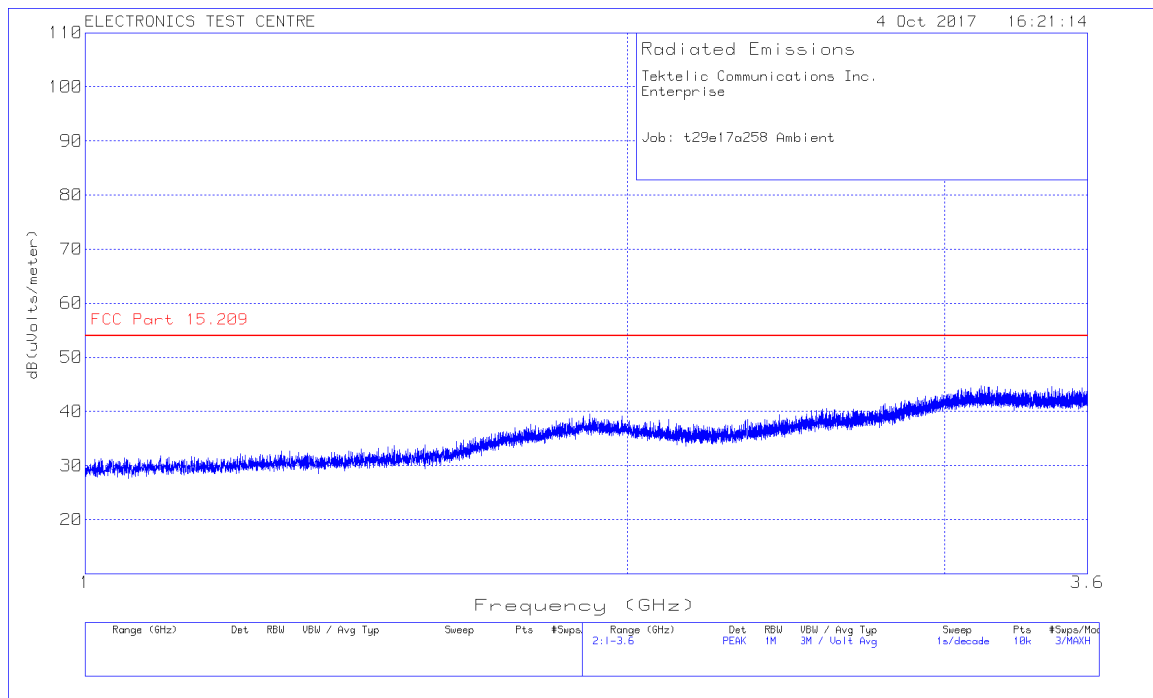
Plot of Test Chamber Ambient: (measurement noise floor):



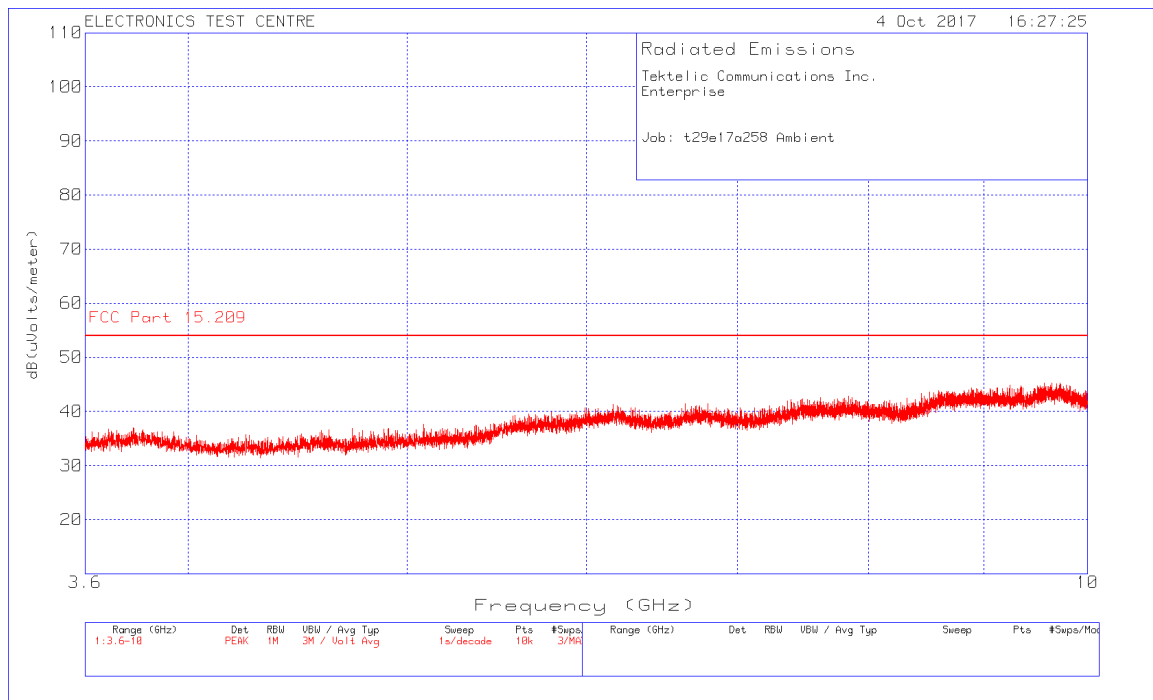
Plot of Test Chamber Ambient: (measurement noise floor):



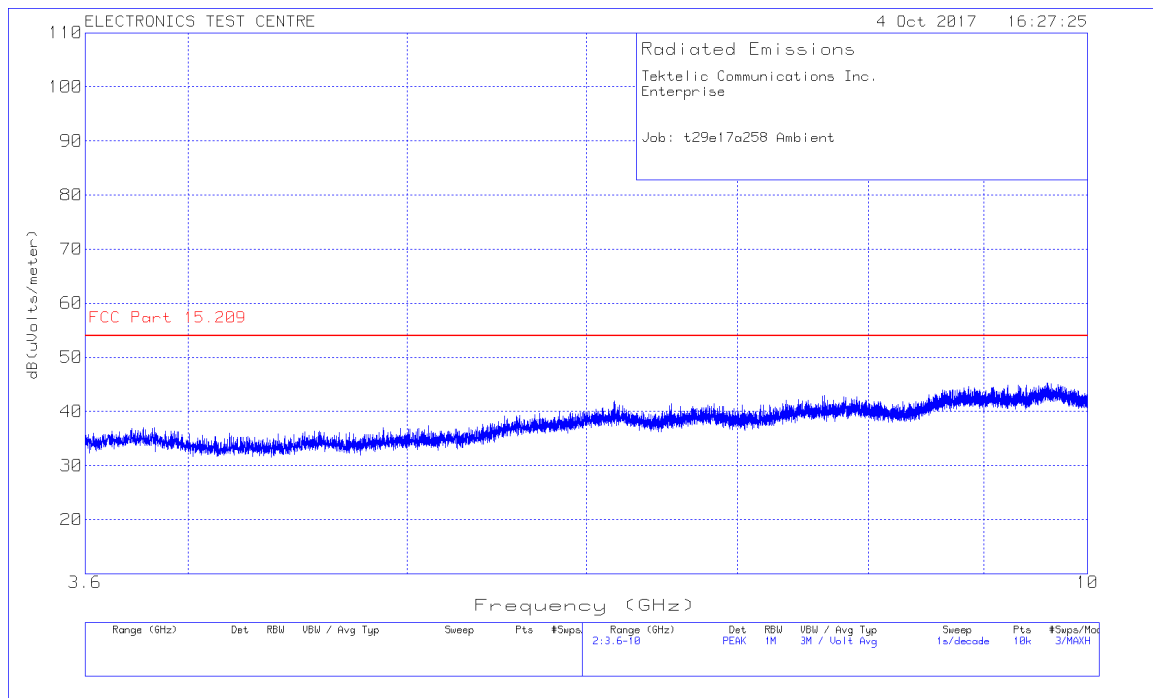
Plot of Test Chamber Ambient: (measurement noise floor):



Plot of Test Chamber Ambient: (measurement noise floor):



Plot of Test Chamber Ambient: (measurement noise floor):



2.9 Radiated Spurious Emissions (Co-Location)

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel: David Raynes	Standard: FCC PART 15.247/ FCC Part15.209
Date: 2017-10-13 (19.7° C, 21.6% RH)	Basic Standard: ANSI C63.10-2013
EUT status: Compliant	

Specification: FCC PART 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Restricted Bands of Operation:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.0900000 – 0.1100000	8.2910000 - 8.2940000	16.804250 - 16.804750	162.01250 - 167.17000	1660.0000 – 1710.0000	3.6000000 – 4.4000000	14.470000 – 14.500000
0.4950000 - 0.5050000	8.3620000 - 8.3660000	25.500000 - 25.670000	167.72000 - 173.20000	1718.8000 – 1722.2000	4.5000000 – 5.1500000	15.350000 – 16.200000
2.1735000 - 2.1905000	8.3762500 - 8.3867500	37.500000 - 38.250000	240.00000 – 285.00000	2200.0000 – 2300.0000	5.3500000 – 5.4600000	17.700000 – 21.400000
4.1250000 - 4.1280000	8.4142500 - 8.4147500	73.000000 - 74.600000	322.00000 - 335.40000	2310.0000 – 2390.0000	7.2500000 – 7.7500000	22.010000 – 23.120000
4.1772500 - 4.1777500	12.2900000 - 12.293000	74.800000 - 75.200000	399.90000 – 410.00000	2483.5000 – 2500.0000	8.0250000 – 8.5000000	23.600000 – 24.000000
4.2072500 - 4.2077500	12.519750 - 12.520250	108.00000 - 121.94000	608.00000 – 614.00000	2655.0000 – 2900.0000	9.0000000 – 9.2000000	31.200000 – 31.800000
5.6770000 - 5.6830000	12.576750 - 12.577250	123.00000 - 138.00000	960.00000 – 1240.0000	3260.0000 – 3267.0000	9.3000000 – 9.5000000	36.430000 – 36.500000
6.2150000 - 6.2180000	13.360000 - 13.410000	149.90000 - 150.05000	1300.0000 – 1427.0000	3332.0000 – 3339.0000	10.600000 – 12.700000	Above 38.600000
6.2677500 - 6.2682500	16.420000 - 16.423000	156.52475- 156.52525	1435.0000 – 1626.5000	3345.8000 – 3358.0000	13.250000 – 13.400000	
6.3117500 - 6.3122500	16.694750 - 16.695250	156.70000 - 156.90000	1645.5000 – 1646.5000	3500.0000 – 3600.0000		

US only

** Canada 108 – 138 MHz

*** Canada 960 – 1427 MHz

**** Canada only

2.9.1 Test Guidance: ANSI C63.10-2013, Clause 13.4.2

From 9 kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna (as per KDB 460108).

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

2.9.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.9.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” as based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of $k = 2$.

Test Method	Frequency	Uncertainty
Radiated Emissions Level	30 MHz – 1 GHz	±4.6 dB
Radiated Emissions Level	1 GHz – 10 GHz	±5.31 dB

2.9.4 Test Equipment

Testing was performed with the following equipment:

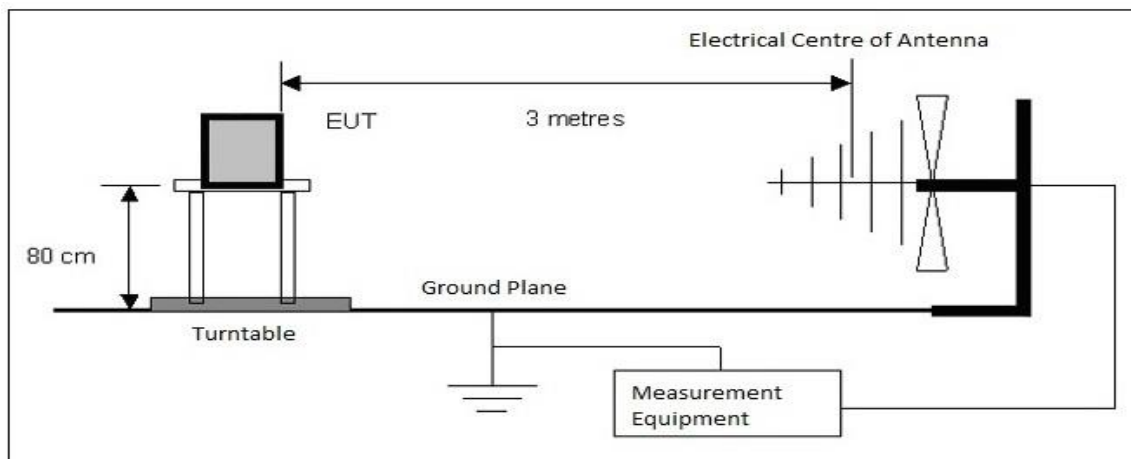
Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	N/A	
EMI receiver	Agilent	N9038A	6130	2017-06-20	2018-06-20
Loop Antenna	EMCO	6502	10868	2017-03-29	2019-03-29
Biconilog Antenna	ARA	LPB-2520/A	4318	2016-05-18	2018-05-18
DRG Horn	EMCO	3115	19357	2016-08-24	2018-08-24
Humidity/Temp Logger	Extech Ins. Corp.	42270	5892	2017-04-06	2018-04-06
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800-21-5P	4354	Monitored	
Pre-Amplifier	hp	8447D	9291	Monitored	

2.9.5 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. Both LoRa radios transmitting simultaneously at full power.

The EUT met the requirements without modification.

Test setup diagram for Radiated Spurious Emissions testing:



2.9.6 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

Meter Reading in dB μ V + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dB μ V/m.

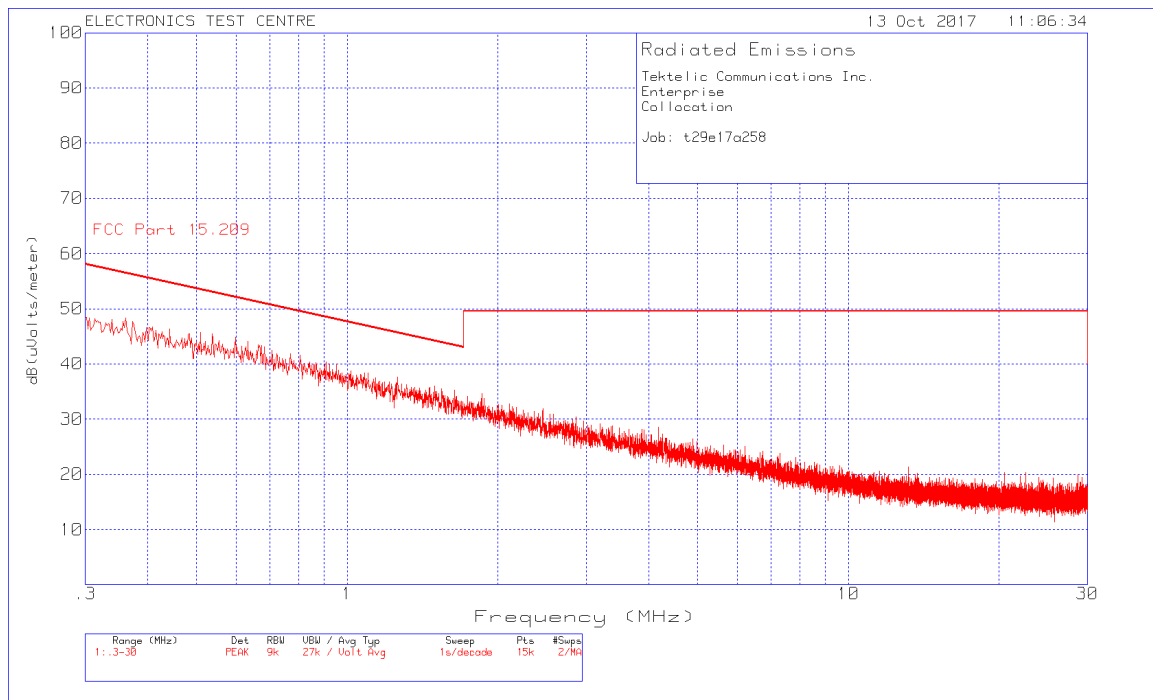
Delta = Field Strength - Limit

Notes:

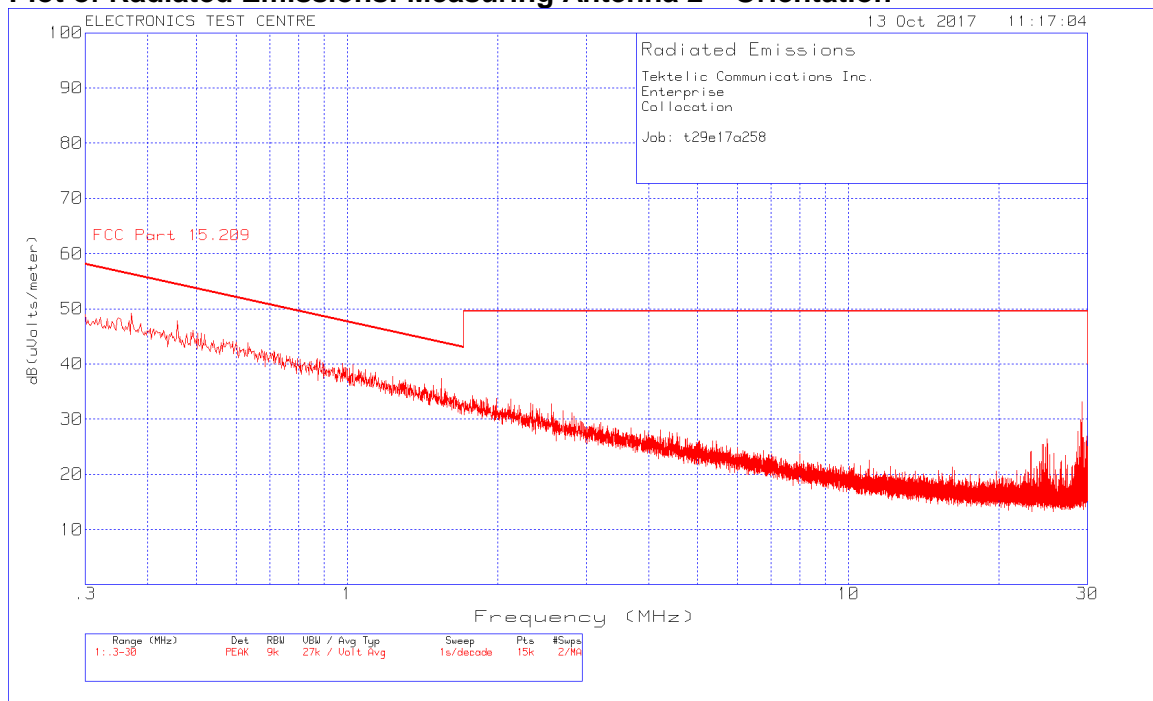
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- EUT both radio are transmitting at full power in single channel mode.
- In Transmit mode, the EUT was assessed up to 10 GHz.

There were no reportable emissions.

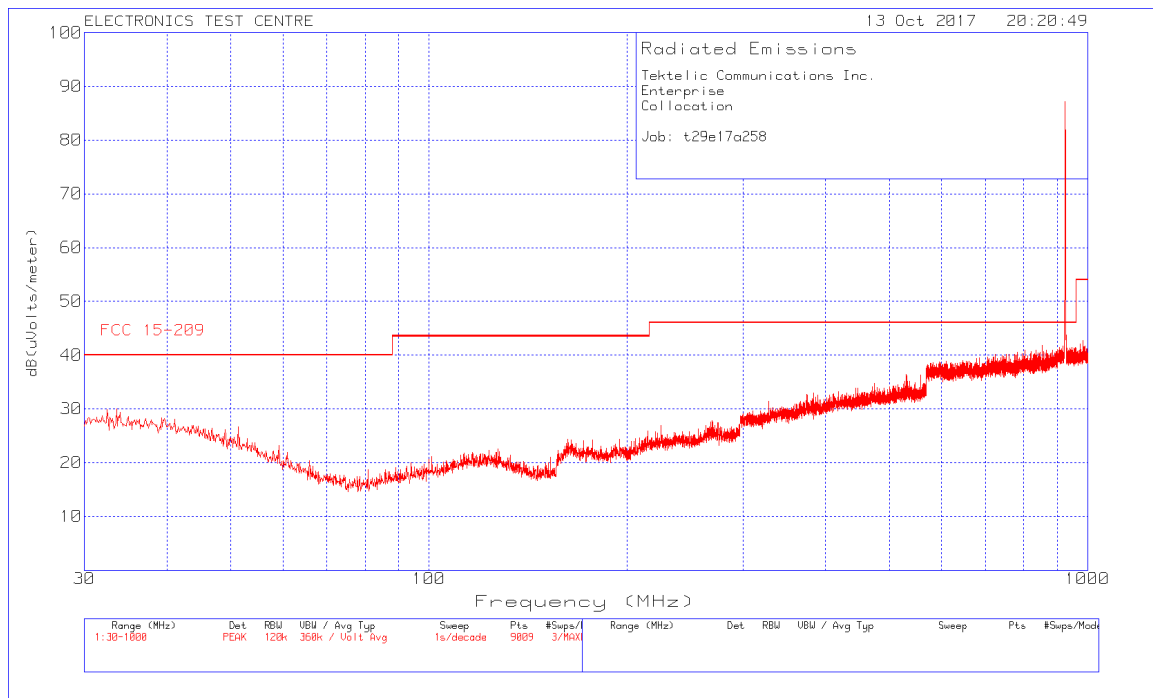
Plot of Radiated Emissions: Measuring Antenna 1st Orientation



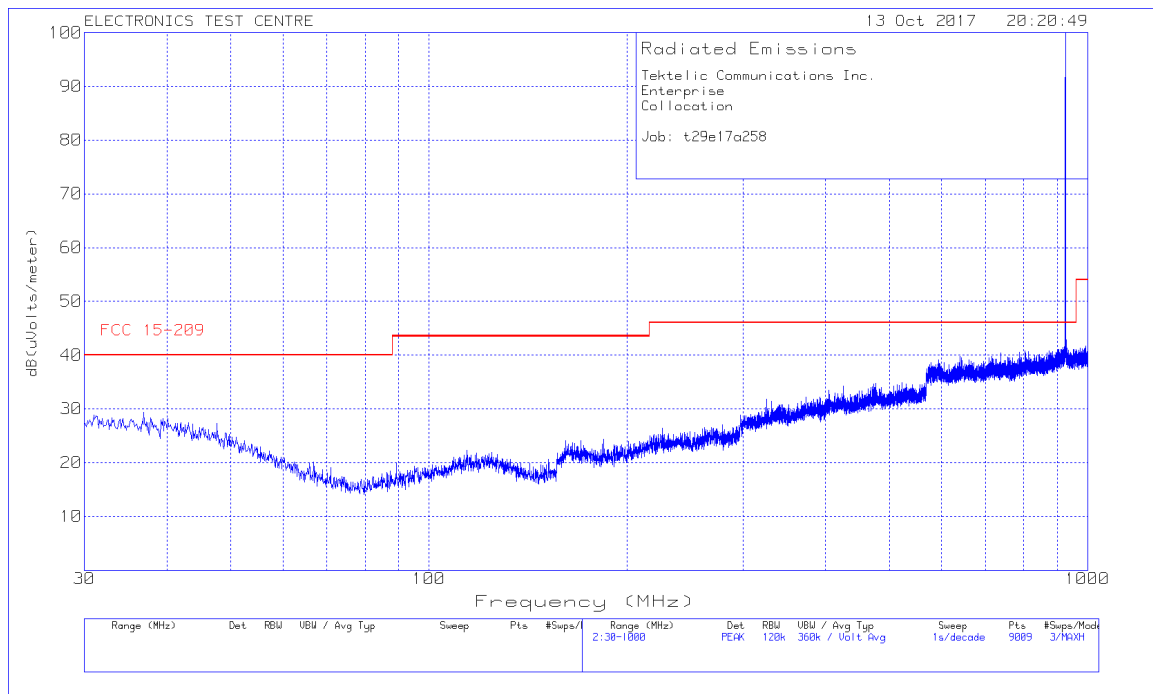
Plot of Radiated Emissions: Measuring Antenna 2nd Orientation



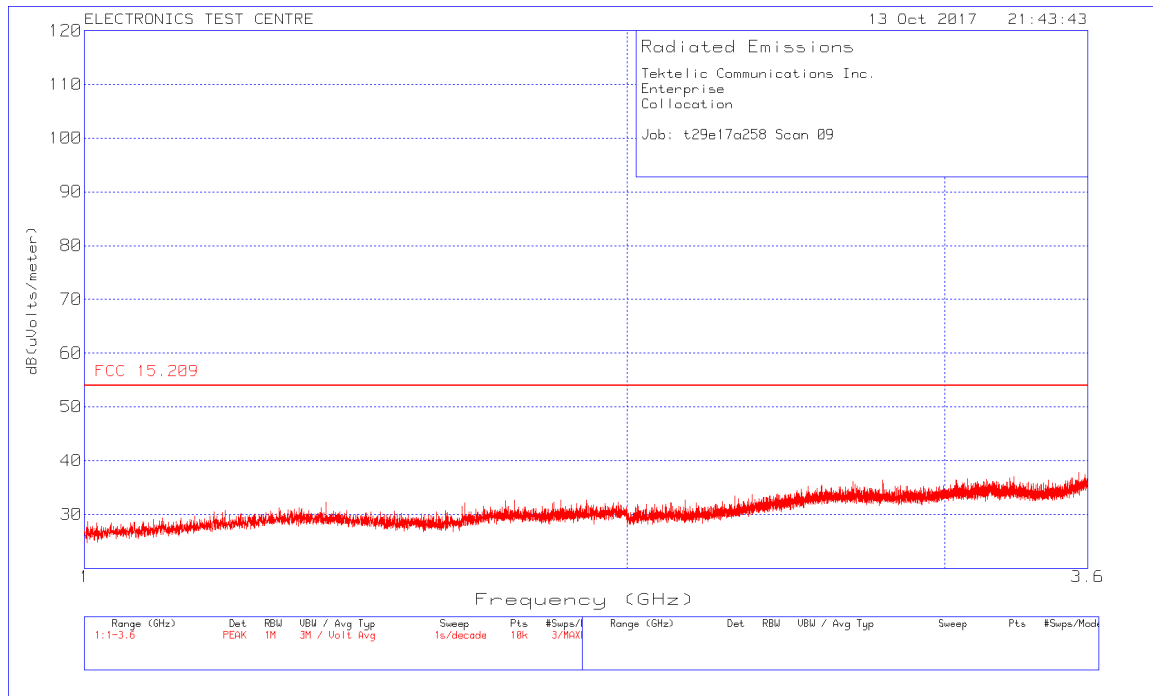
Plot of Radiated Emissions: Horizontal polarization



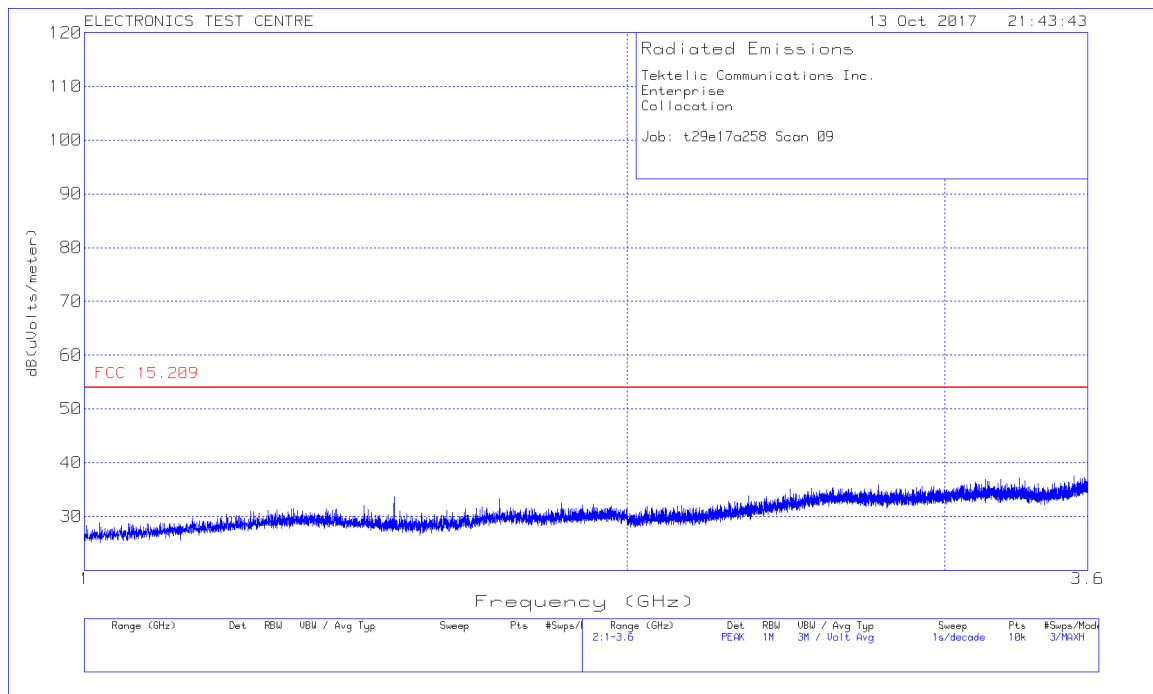
Plot of Radiated Emissions: Vertical polarization



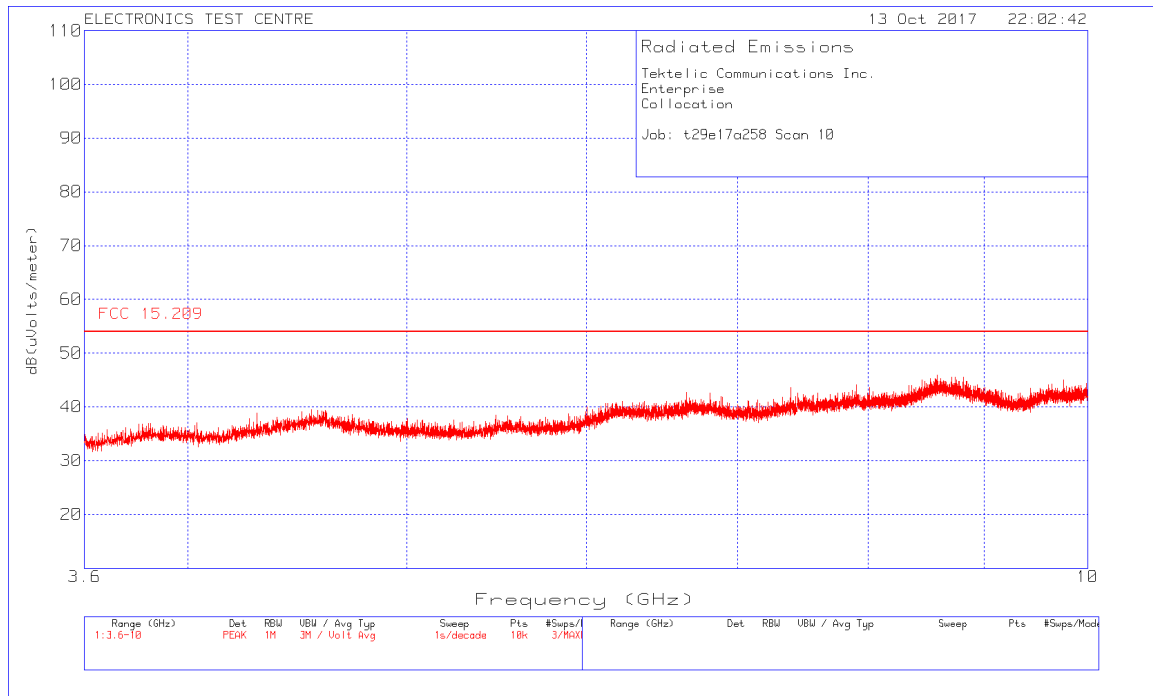
Plot of Radiated Emissions: Horizontal polarization



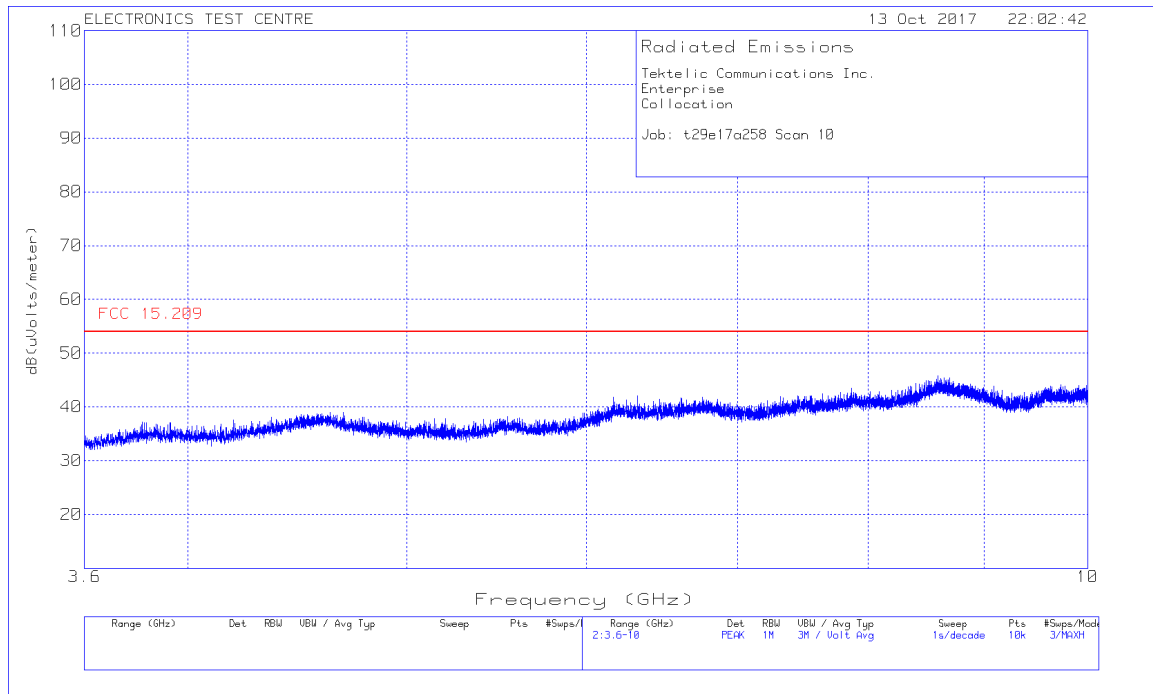
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



2.10 RF Exposure

Test Lab: Electronics Test Centre, Airdrie	EUT: Enterprise Radio Module
Test Personnel:	Standard: FCC PART 15.247
Date:	
EUT status: Compliant	

Compliant: Environmental Assessment provided in a separate Exhibit.

3.0 TEST FACILITY

3.1 Location

The Enterprise Radio Module was tested for emissions at the Electronics Test Centre laboratory located in Airdrie, Alberta, Canada. The Radio Frequency Anechoic Chamber (RFAC), identified as Chamber 1, has a usable working space measuring 10.6 m long x 7.3 m wide x 6.5 m high.

Measurements taken at this site are accepted by Industry Canada as evidence of conformity per registration file # 2046A. This site is also listed with the FCC under Registration Number CA2046.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment located in the Control Room. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in the Control Room, consisting of two shielded vestibules joined together at the side of the main room. Cables are routed through bulkhead panels between the rooms and the test chamber as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

Either floor mounted or table-top equipment can be tested at this facility.

3.2 Grounding Plan

The Enterprise Radio Module was placed at the centre of the test chamber turntable on a wooden mast. The antennas were mounted on metal masts 1.5 m apart. The EUT was grounded according to Tektelic Communications Inc specifications.

3.3 Power Supply

All EUT power was supplied by a filtered 48 VDC source.

3.4 Emissions Profile

Ambient emission profiles were generated throughout the tests and are included in the test data.

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