Company: Tehama Wireless

Test of: TW-191-R Diversity Repeater

To: FCC CFR 47 Part 15 Subpart C 15.247 (DTS)

Report No.: TEHA05-U2 Rev A Conducted

CONDUCTED TEST REPORT

CONDUCTED TEST REPORT

FROM

MiCOM Labs
opening wireless markets

Test of: Tehama Wireless TW-191-R Diversity Repeater

to

To: FCC CFR 47 Part 15 Subpart C 15.247 (DTS)

Test Report Serial No.: TEHA05-U2 Rev A Conducted

This report supersedes: None

Applicant:	Tehama Wireless 2607 7th St. Suite G Berkeley California 94710 United States
Product Function:	Wireless signal repeater
Issue Date:	1st May 2015

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
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Pleasanton, California 94566
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A2LA ACCREDITED
TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

Contents

1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 28th day of February 2014.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2015

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

1.2. RECOGNITION

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

EU MRA – European Union Mutual Recognition Agreement.
NB – Notified Body
APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement. Recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.
Phase I - recognition for product testing
Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf

United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft #1	10th March 2015	
Draft #2	22nd April 2015	
Rev A	1st May 2015	Initial Release
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In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

Manufacturer: Tehama Wireless 2607 7th St. Suite G Berkeley California 94710, USA	**Tested By:** MiCOM Labs, Inc. 575 Boulder Court Pleasanton California, 94566, USA
EUT: Diversity Repeater	**Telephone:** +1 925 462 0304 **Fax:** +1 925 462 0306
Model: TW-191-R	
S/N's: SN4030384	
Test Date(s): From 9th – 10th February 2015	**Website:** www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 Subpart C 15.247 (DTS)	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.

2. Details of test methods used have been recorded and kept on file by the laboratory.

3. Test results apply only to the item(s) tested.

A2LA ACCREDITED
TESTING CERT #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	KDB 644545 D01 v01r02	Oct 31 2013	Guidance for IEEE 802.11ac Old rules.
II	662911	Oct 31 2013	Guidance for measurement of output emission of devices that employ single transmitter with multiple outputs or systems with multiple transmitters operating simultaneously in the same frequency band
III	558074 D01	June 6,2014	DTS Meas Guidance v03r02 Guidance for performing compliance measurements on Digital Transmission Systems (DTS) operating under section 15.247.
IV	558074 D02	June 5,2014	DTS Part 15.247 Old Rule. Guidance for performing compliance measurements on Digital Transmission Systems (DTS) operating under section 15.247.
V	A2LA	April 2014	Reference to A2LA Accreditation Status – A2LA Advertising Policy
VI	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
VII	CISPR 22	2008	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
VIII	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
IX	FCC 47 CFR Part 15.247	2014	CFR Title 47 Part 15.247 – Radio Frequency Devices; Subpart C – Intentional Radiators
X	ICES-003	Issue 5 2012	Spectrum Management and Telecommunications; Interference-Causing Equipment Standard. Information Technology Equipment (ITE) – Limits and methods of measurement.
XI	LAB34	Edition 1 August 2002	The expression of uncertainty in EMC Testing
XII	M 3003	Edition 3 Nov. 2012	Expression of Uncertainty and Confidence in Measurements
XIII	RSS-210 Annex 8	2010	Radio Standards Specification 210; License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
XIV	RSS-Gen	2010	General Requirements and Information for the Certification of Radiocommunication Equipment
XV	KDB 644545 D02 v01	June 7th 2012	Alternative Guidance for IEEE 802.11ac and pre-ac Device emissions testing, old rules.
XVI	KDB 644545 D03	August 14th 2014	Guidance for IEEE 802.11ac New Rules v01
XVII	FCC 47 CFR Part 2.1033	2014	FCC requirements and rules regarding photographs and test setup diagrams.

4.2. Test And Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

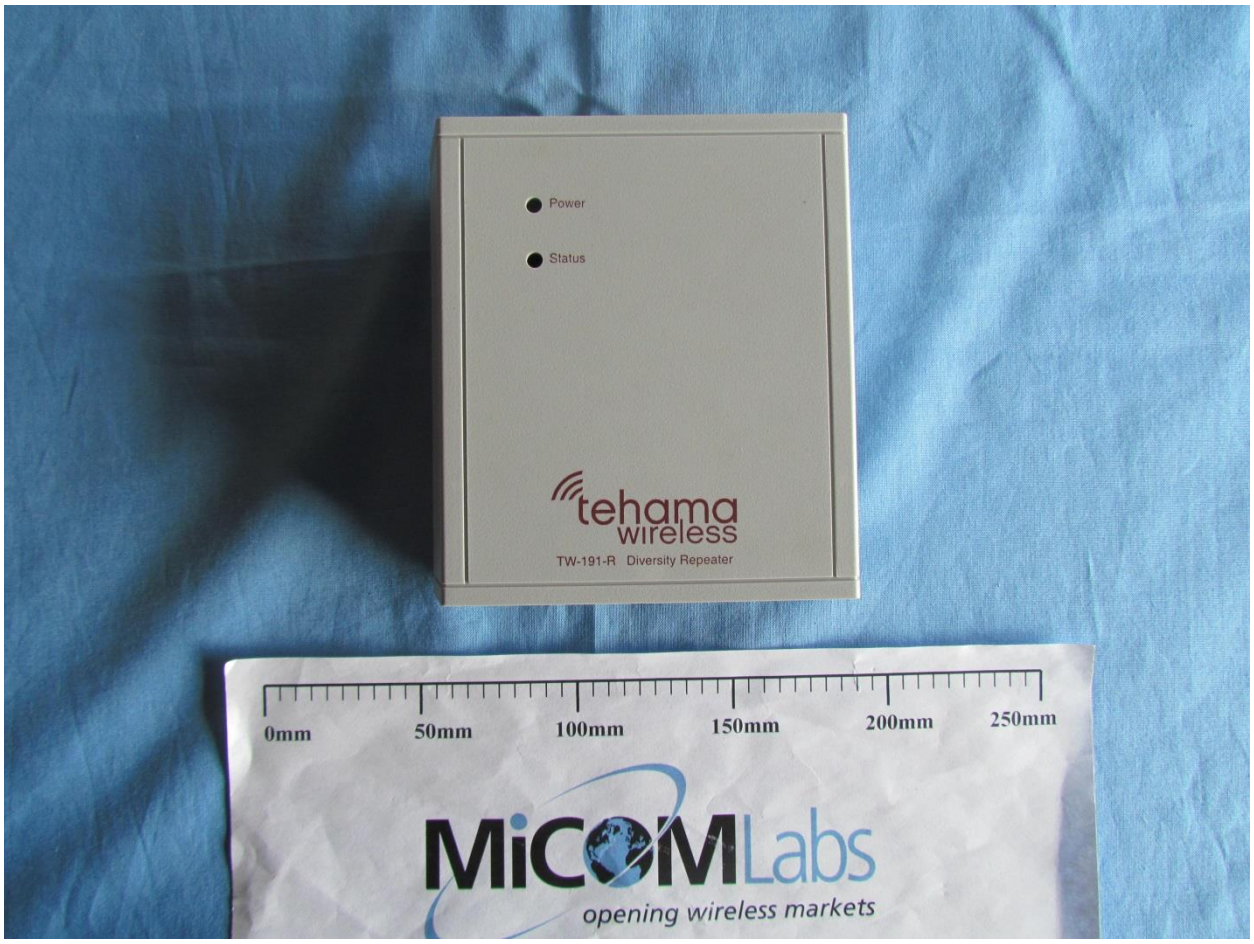
Details	Description
Purpose:	Test of the Tehama Wireless TW221 to FCC CFR 47 Part 15 Subpart C 15.247 (DTS) and IC RSS-210 Annex 8
Applicant:	Tehama Wireless 2607 7th St. Suite G Berkeley California 94710 USA
Manufacturer:	As Applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court, Pleasanton, California 94566 USA
Test report reference number:	TEHA05-U2
Date EUT received:	6th February 2015
Standard(s) applied:	FCC CFR 47 Part 15 Subpart C 15.247 (DTS)
Dates of test (from - to):	9th to 10th February 2015
No of Units Tested:	1
Type of Equipment:	900 MHz Wireless signal repeater
Product Trade Name:	Tehama Wireless Design Group
Model(s):	TW-191-R
Location for use:	Indoor
Declared Frequency Range(s):	902 - 928 MHz;
Hardware Rev	TW-221-FAB-V3
Software Rev	3277M
Type of Modulation:	GFSK
EUT Modes of Operation:	FHSS: 902 - 928 MHz:
Declared Nominal Output Power (Ave):	+20.00 dBm
Transmit/Receive Operation:	Transceiver - Simplex
System Beam Forming:	This device has no beam-forming capability
Rated Input Voltage and Current:	AC/ DC adaptor (adaptor sold with unit) Input: AC 120/240V 50-60 Hz Output: 12Vdc, 450 mA
Operating Temperature Range:	Declared Range 0°C to 50°C
ITU Emission Designator:	173KF1D
Equipment Dimensions:	127mm x 127mm x 49mm / 5.0" x 5.0" x 1.9" (W x D x H)
Weight:	0.213 kg
Primary function of equipment:	Wireless signal repeater
Secondary function of equipment:	None provided

5.2. Scope Of Test Program

Tehama Wireless TW-191-R Diversity Repeater

The scope of the test program was to test the Tehama Wireless TW221 FHSS Diversity Repeater in the frequency range 902 - 928 MHz; for compliance against FCC CFR 47 Part 15 Subpart C 15.247 (DTS) specifications.

Tehama Wireless TW-191-R Diversity Repeater



5.3. Equipment Model(s) and Serial Number(s)

Model / Description	Serial no.	Hardware ver.	SoftWare ver.
TW-191-R	Development	TW-221-FAB-V3	101B

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
Integral #1	Tehama Wireless	PCB	PCB	2.5	-	360	-	902 - 928
Integral #2	Tehama Wireless	PCB	PCB	2.5	-	360	-	902 - 928

BF Gain - Beamforming Gain
Dir BW - Directional BeamWidth
X-Pole – Cross Polarization

5.5. Cabling and I/O Ports

Number and type of I/O ports

1. Audio stereo jack 3.5mm (3 pins UART), 1m length cable
2. 6 Vdc jack connector, maximum 3m length cable

5.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. The variant with the highest power was used to exercise the product.

Operational Mode(s) (802.11a/b/g/n/ac)	Data Rate with Highest Power MBit/s	Channel Frequency (MHz)		
		Low	Mid	High
902 - 928 MHz				
FHSS	25 KBit/s	903.00	914.90	926.00

Results for the above configurations are provided in this report

5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

5.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

6. TEST SUMMARY

List of Measurements

Test Header	Result	Data Link
15.247(a)(2) 20 dB & 99% Bandwidth	Complies	View Data
15.247(a)(1) Channel Spacing	Complies	View Data
15.247(a)(1) Number of Hopping Channels	Complies	View Data
15.247(a)(1) Channel Occupancy	Complies	View Data
15.247(b), 15.31(e) Conducted Output Power	Complies	View Data
15.247(d) Emissions	-	-
(1) Conducted Emissions	-	-
(i) Conducted Spurious Emissions	Complies	View Data
(ii) Conducted Band-Edge Emissions	Complies	View Data
15.247(e) Power Spectral Density	*Not Tested	-

*No requirement to test Power Spectral Density for FHSS type equipment

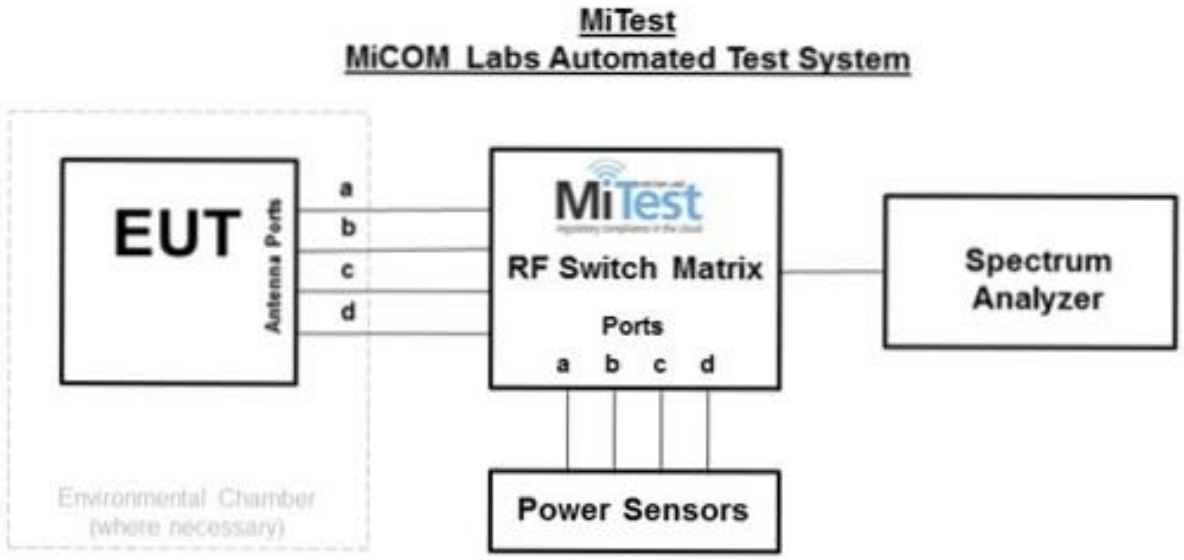
7. TEST EQUIPMENT CONFIGURATION(S)

Conducted

Conducted RF Emission Test Set-up(s) with Environmental Chamber
The following tests were performed using the conducted test set-up shown in the diagram below.

1. RF Output Power
2. 20 dB & 99% Bandwidth
3. Dwell Time, Channel Occupancy, Channel Spacing, No. of Hopping Channels
4. Transmitter Spurious Emisdsions (Conducted)

*environmental chamber utilized



Conducted Test Measurement Setup

A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
127	Power Supply	HP	6674A	US36370530	Cal when used
158	Barometer/Thermometer	Control Company	4196	E2846	04 Dec 2015
193	Receiver 20 Hz to 7 GHz	Rhode & Schwarz	ESI 7	838496/007	14 Jan 2016
248	Resistance Thermometer	Thermotronics	GR2105-02	9340 #1	30 Oct 2015
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	31 Jul 2015
376	USB 10MHz - 18GHz Average Power Sensor	Agilent	U2000A	MY51440005	28 Oct 2015
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	17 Jul 2015
381	4x4 RF Switch Box	MiCOM Labs	MiTest RF Switch Box	MIC002	30 Jun 2015
419	Laptop with Labview Software	Lenova	W520	TS02	Not Required
420	USB to GPIB Interface	National Instruments	GPIB-USB HS	1346738	Not Required
435	USB Wideband Power Sensor	Boonton	55006	8730	31 Jul 2015
436	USB Wideband Power Sensor	Boonton	55006	8731	31 Jul 2015
437	USB Wideband Power Sensor	Boonton	55006	8759	31 Jul 2015
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
460	Dell Computer with installation of MiTest executable.	Dell	Optiplex330	BC944G1	Not Required
74	Environmental Chamber Chamber 3	Tenney	TTC	12808-1	30 Sep 2015
RF#2 GPIB#1	GPIB cable to Power Supply	HP	GPIB	None	Not Required
RF#2 SMA#1	EUT to Mitest box port 1	Flexco	SMA Cable port1	None	30 Jun 2015
RF#2 SMA#2	EUT to Mitest box port 2	Flexco	SMA Cable port2	None	30 Jun 2015
RF#2 SMA#3	EUT to Mitest box port 3	Flexco	SMA Cable port3	None	30 Jun 2015
RF#2 SMA#4	EUT to Mitest box port 3	Flexco	SMA Cable port4	None	30 Jun 2015
RF#2 SMA#SA	Mitest box to SA	Flexco	SMA Cable SA	None	30 Jun 2015
RF#2 USB#1	USB Cable to Mitest Box	Dynex	USB Cable	None	Not Required

8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by MiTest. MiTest is an automated test system developed by MiCOM Labs. MiTest is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.

The MiCOM Labs "MiTest" Automated Test System" (Patent Pending)

9. TEST RESULTS

9.1. 20 dB & 99% Bandwidth

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1

Test Procedure
The 20 dB and 99% bandwidth is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

Section 4.1 Conducted RF Emission Test Set-up identifies the test configuration

Equipment Configuration for 20 dB & 99% Bandwidth			
Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	3
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz) Port(s)				20 dB Bandwidth (MHz)		Limit	Lowest Margin
MHz	a	b	c	d	Highest	Lowest	KHz	MHz
903.0	0.173	--	--	--	0.173	0.173	≤250.00	-0.77
914.9	0.171	--	--	--	0.171	0.171	≤250.00	-0.79
926.0	0.171	--	--	--	0.171	0.171	≤250.00	-0.79

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)		
MHz	a	b	c	d			
903.0	0.160	--	--	--	0.160		
914.9	0.159	--	--	--	0.159		
926.0	0.160	--	--	--	0.160		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.2. FHSS Transmitter Characteristics

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1

Test Procedure

The number of channels and channel occupancy is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

Section 7 Test Equipment Configurations - Conducted identifies the test configuration used to prove compliance

9.2.1. Frequency Hopping – Number Of Channels

Equipment Configuration for Frequency Hopping – Number of Channels

Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	3
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Modulation	Frequency Range (MHz)	Number of Hopping	Total Hopping Channels
25 Kbit/s	902-912	26	60
	912-9290	16	
	920-928	18	

9.2.2. Channel Spacing

Equipment Configuration for Channel Spacing

Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	3
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Modulation	Channel Spacing (KHz)	Maximum 20 dB Bandwidth (KHz)	Specification	Compliant
25 Kbit/s	350	173	Greater than maximum 20 dB Bandwidth	√

9.2.3. Dwell Time

Equipment Configuration for Channel Dwell Time			
Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	3
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Modulation	Dwell Time (ms)
25 Kbit/s	18.87

9.2.4. Channel Occupancy

Equipment Configuration for Channel Spacing

Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	3
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Modulation	Number of Hops in 10 seconds	Dwell Time (ms)	Channel Occupancy (ms)	Limit (ms)	Compliant
25 Kbit/s	9	18.87	169.83	400.0	√

9.3. Conducted Output Power

FCC, Part 15 Subpart C §15.247(b)(2)
Industry Canada RSS-210 §A8.4

Test Procedure
The transmitter terminal of EUT was set for CW (continuous wave) operation and connected to the input of the power meter which was calibrated to measure power. The value of measured power including antenna cable loss was reported.

15.247 (c) Operation with directional antenna gains greater than 6 dBi.
If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Section 7 Test Equipment Configurations - Conducted identifies the test configuration used to prove compliance

Equipment Configuration for Peak Output Power

Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	2.5
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm) Port(s)				Calculated Total Power Σ Port(s)	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	dBm	dBm	dBm	
903.0	25.44	--	--	--	25.44	30.00	-4.56	Max
914.9	25.67	--	--	--	25.67	30.00	-4.33	Max
926.0	25.81	--	--	--	25.81	30.00	-4.19	Max

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.4. Conducted Spurious Emissions

FCC, Part 15 Subpart C §15.247(d)
Industry Canada RSS-210 §A8.5

Test Procedure
Conducted emissions were measured at a limit of 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

Section 4.1 Conducted RF Emission Test Set-up identifies the test configuration

9.4.1. Conducted Spurious Emissions

Equipment Configuration for Transmitter Conducted Spurious Emissions			
Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
903.0	30.0 - 10000.0	-7.960	4.78	--	--	--	--	--	--
914.9	30.0 - 10000.0	-7.907	5.12	--	--	--	--	--	--
926.0	30.0 - 10000.0	-6.996	5.29	--	--	--	--	--	--

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.4.2. Conducted Band-Edge Emissions

Equipment Configuration for Conducted Low Band-Edge Emissions - Peak			
Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	3
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	903.0 MHz					
Band-Edge Frequency:	902.0 MHz					
Test Frequency Range:	850.0 - 915.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Revised Limit**		**Margin**
	M1 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-36.52	5.10	902.80	--	--	-0.800

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted High Band-Edge Emissions - Peak			
Variant:	FHSS	**Duty Cycle (%):**	100
Data Rate:	25 KBit/s	**Antenna Gain (dBi):**	3
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	926.0 MHz					
Band-Edge Frequency:	928.0 MHz					
Test Frequency Range:	915.0 - 978.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Revised Limit**		**Margin**
	M3 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-43.99	5.55	926.20	--	--	-1.800

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

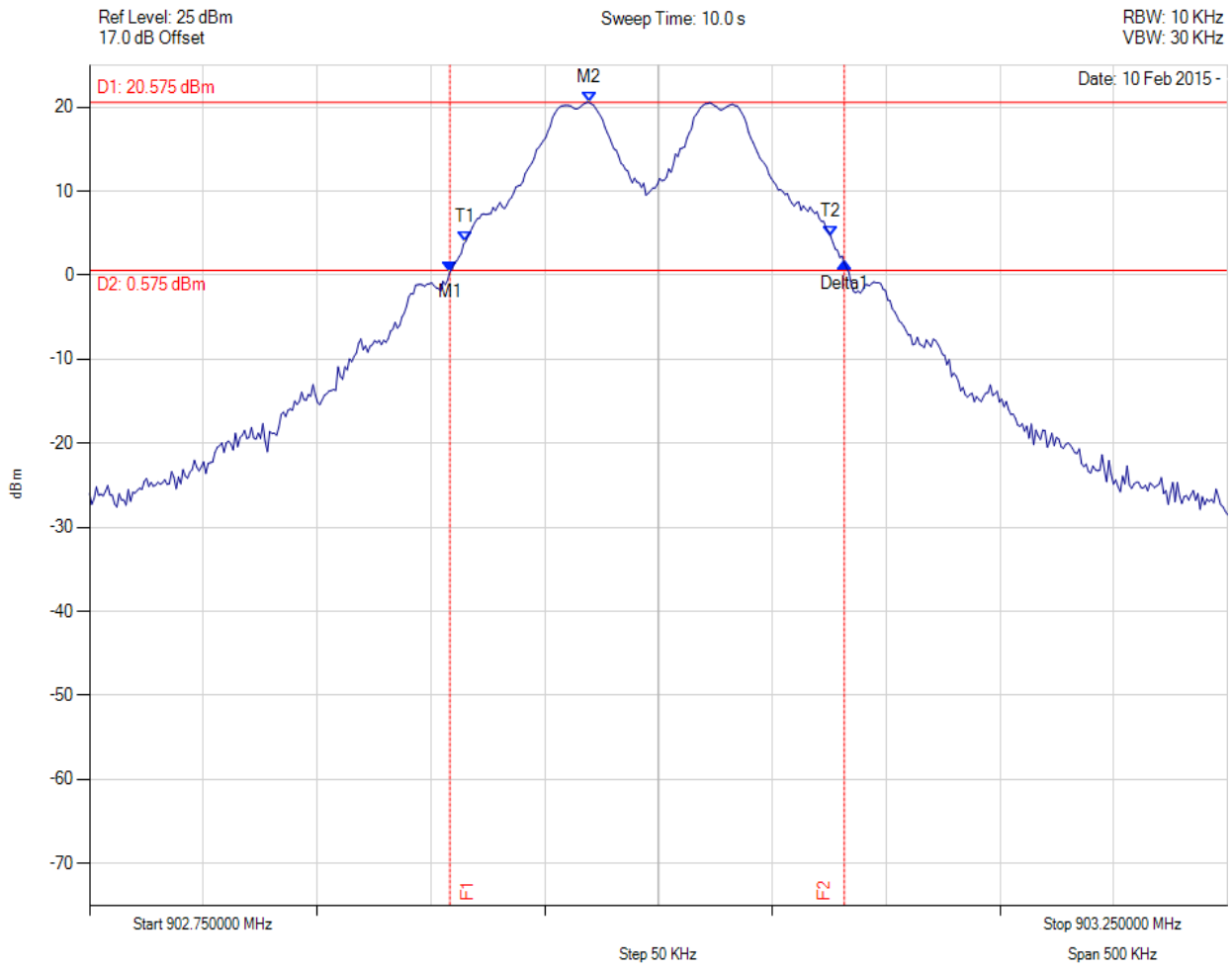
Note: click the links in the above matrix to view the graphical image (plot).

10. APPENDIX

10.1. 20 dB & 99% Bandwidth

20 dB & 99% BANDWIDTH

Variant: FHSS, Channel: 903.00 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 902.908 MHz : 0.422 dBm M2 : 902.969 MHz : 20.575 dBm Delta1 : 173 KHz : 1.031 dB T1 : 902.915 MHz : 4.000 dBm T2 : 903.076 MHz : 4.622 dBm OBW : 160 KHz	Measured 6 dB Bandwidth: 0.173 MHz Limit: ≥500.0 kHz Margin: 0.33 MHz

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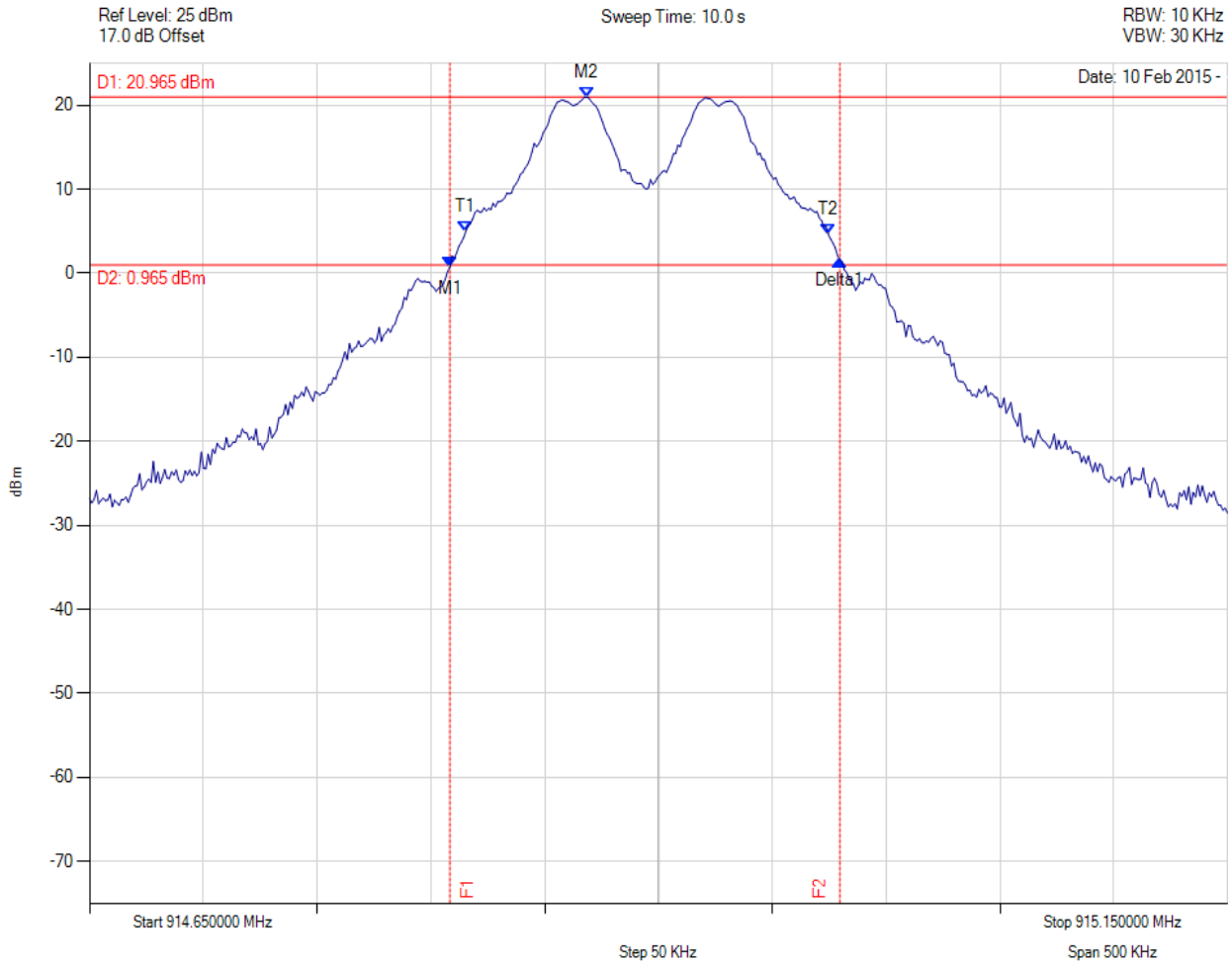
20 dB & 99% BANDWIDTH

Variant: FHSS, Channel: 914.90 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 914.808 MHz : 0.707 dBm M2 : 914.868 MHz : 20.965 dBm Delta1 : 171 KHz : 0.901 dB T1 : 914.815 MHz : 4.980 dBm T2 : 914.975 MHz : 4.577 dBm OBW : 159 KHz	Measured 6 dB Bandwidth: 0.171 MHz Limit: ≥500.0 kHz Margin: 0.33 MHz

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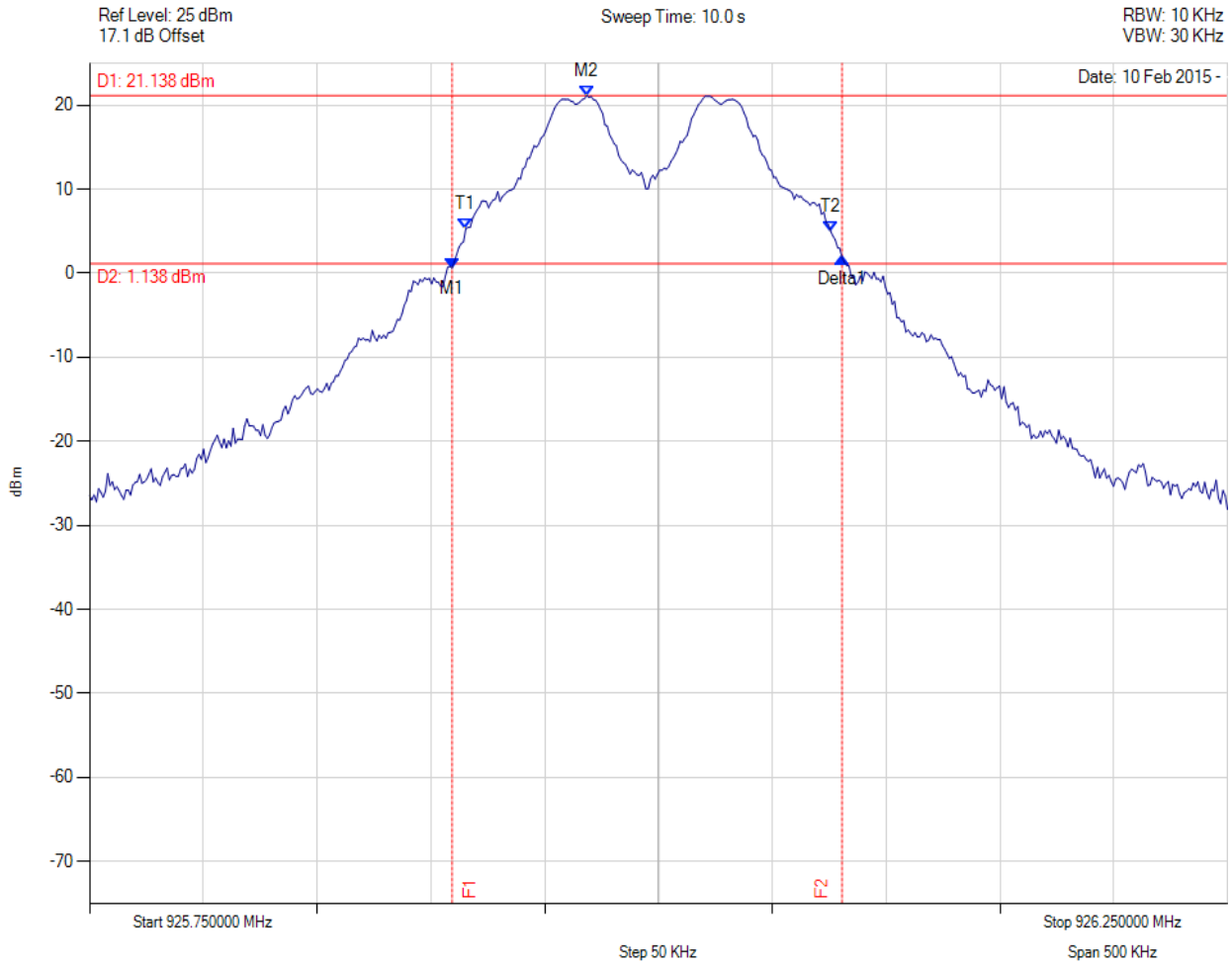
20 dB & 99% BANDWIDTH

Variant: FHSS, Channel: 926.00 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 925.909 MHz : 0.626 dBm M2 : 925.968 MHz : 21.138 dBm Delta1 : 171 KHz : 1.165 dB T1 : 925.915 MHz : 5.299 dBm T2 : 926.076 MHz : 4.994 dBm OBW : 160 KHz	Measured 6 dB Bandwidth: 0.171 MHz Limit: ≥500.0 kHz Margin: 0.33 MHz

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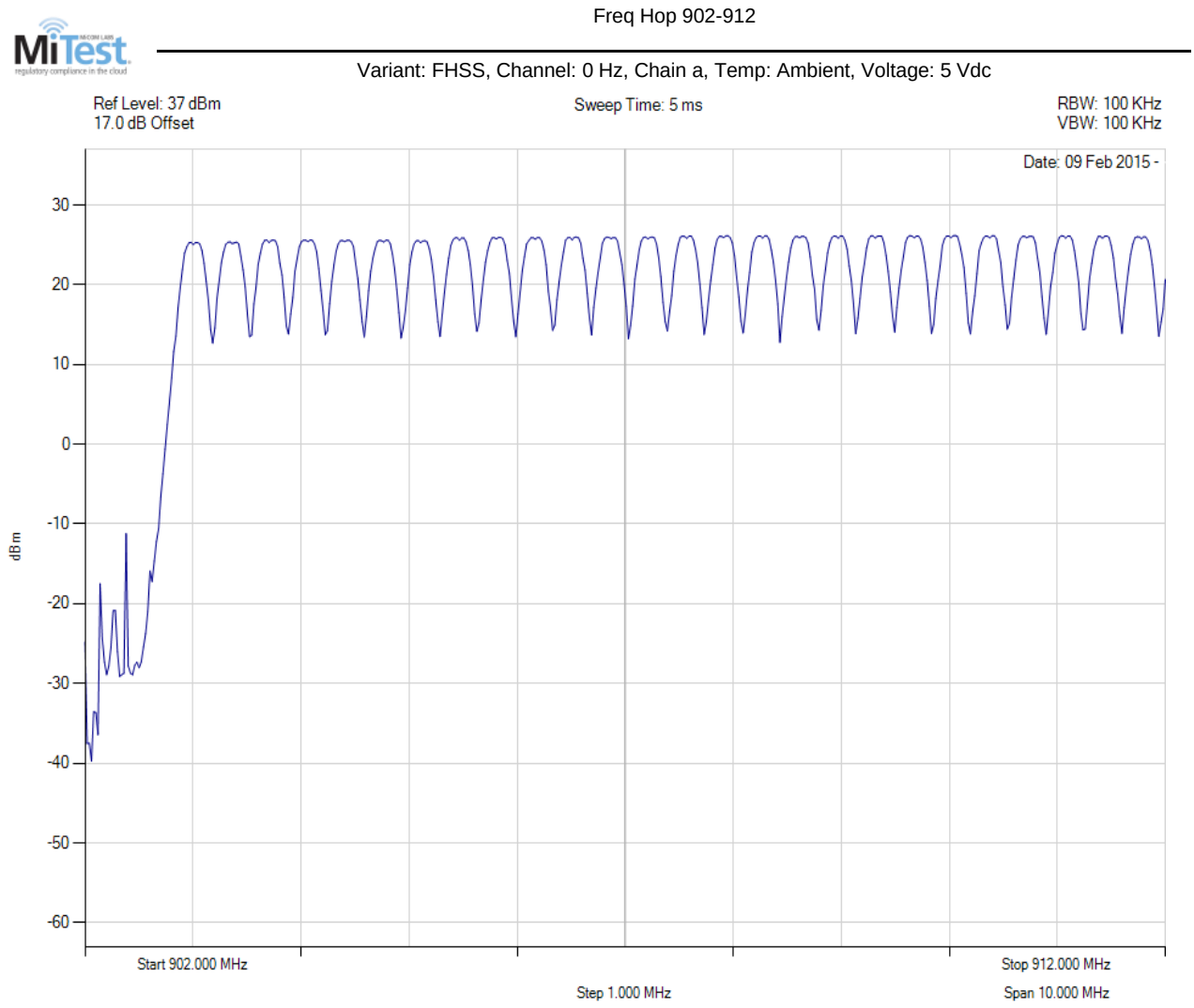
10.2. FHSS Transmitter Characteristics

10.2.1. Frequency Hopping – Number Of Channels



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Number of Hopping Channels: 26

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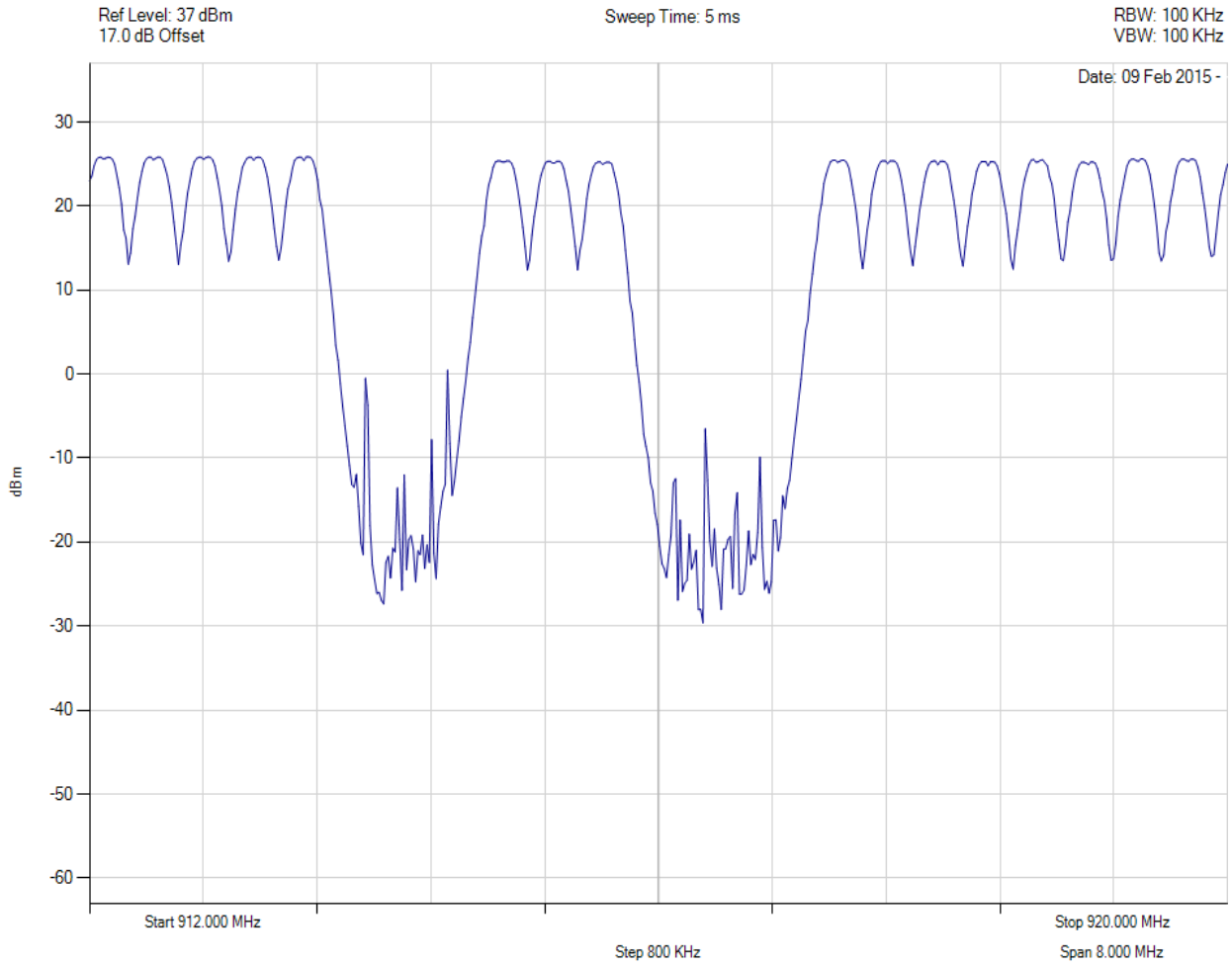
Freq Hop 912-920

Variant: FHSS, Channel: 0 Hz, Chain a, Temp: Ambient, Voltage: 5 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Number of Hopping Channels: 16

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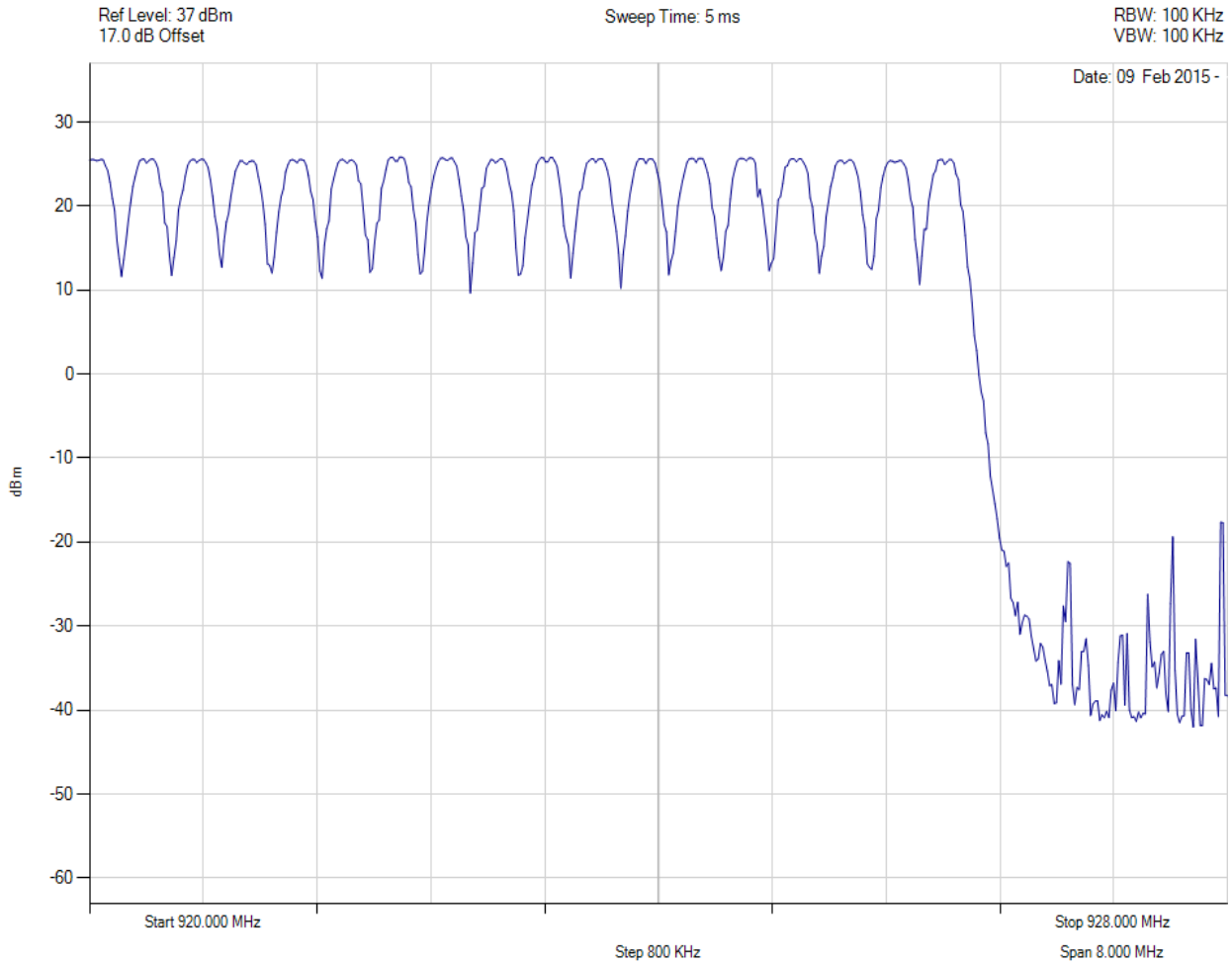
Freq Hop 920-928

Variant: FHSS, Channel: 0 Hz, Chain a, Temp: Ambient, Voltage: 5 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Number of Hopping Channels: 18

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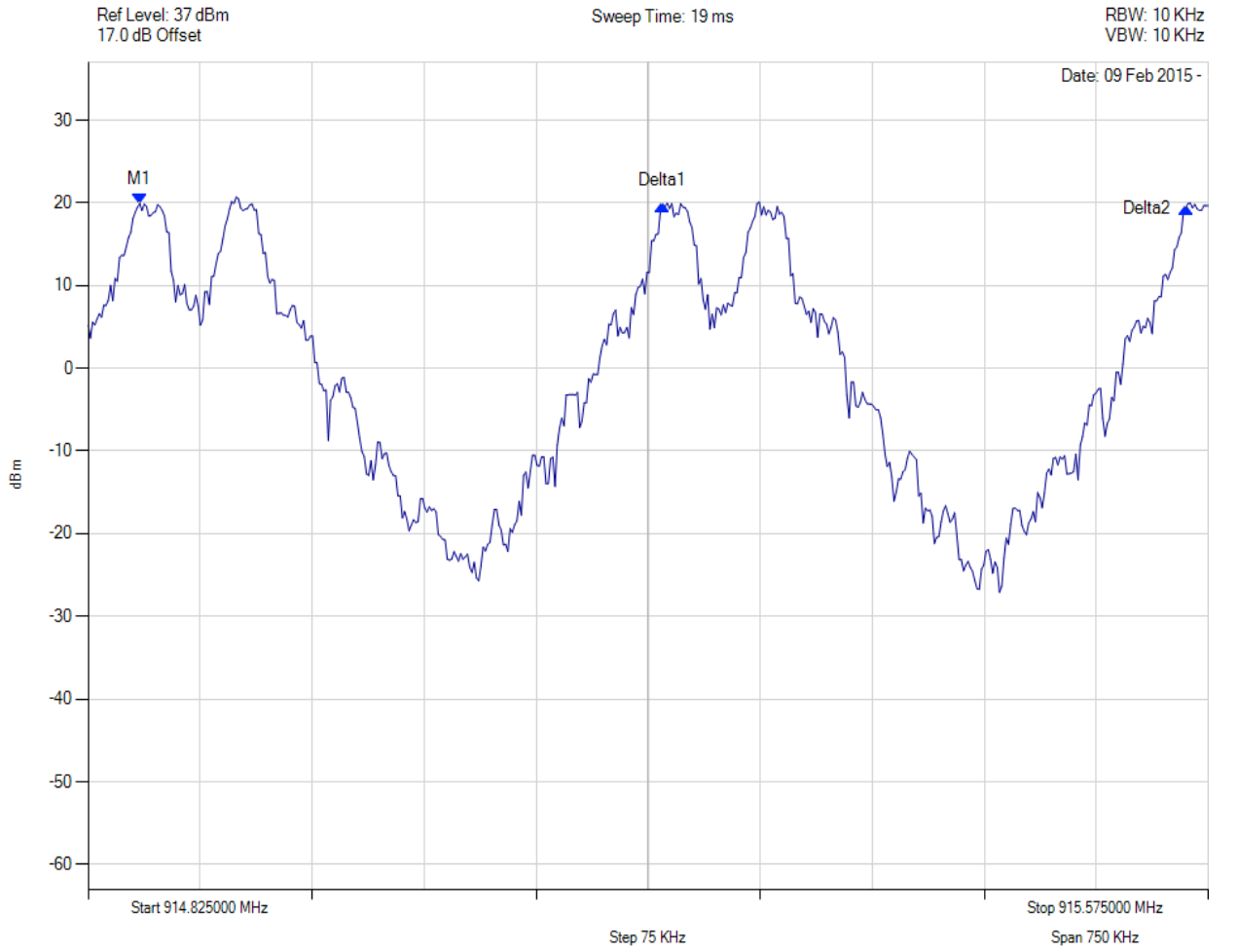
10.2.2. Channel Spacing

Channel Spacing

Variant: FHSS, Chain a, Temp: Ambient, Voltage: 5 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 914.860 MHz : 19.925 dBm Delta1 : 350 KHz : -0.171 dB Delta2 : 700 KHz : -0.508 dB	Channel Frequency: Not Applicable

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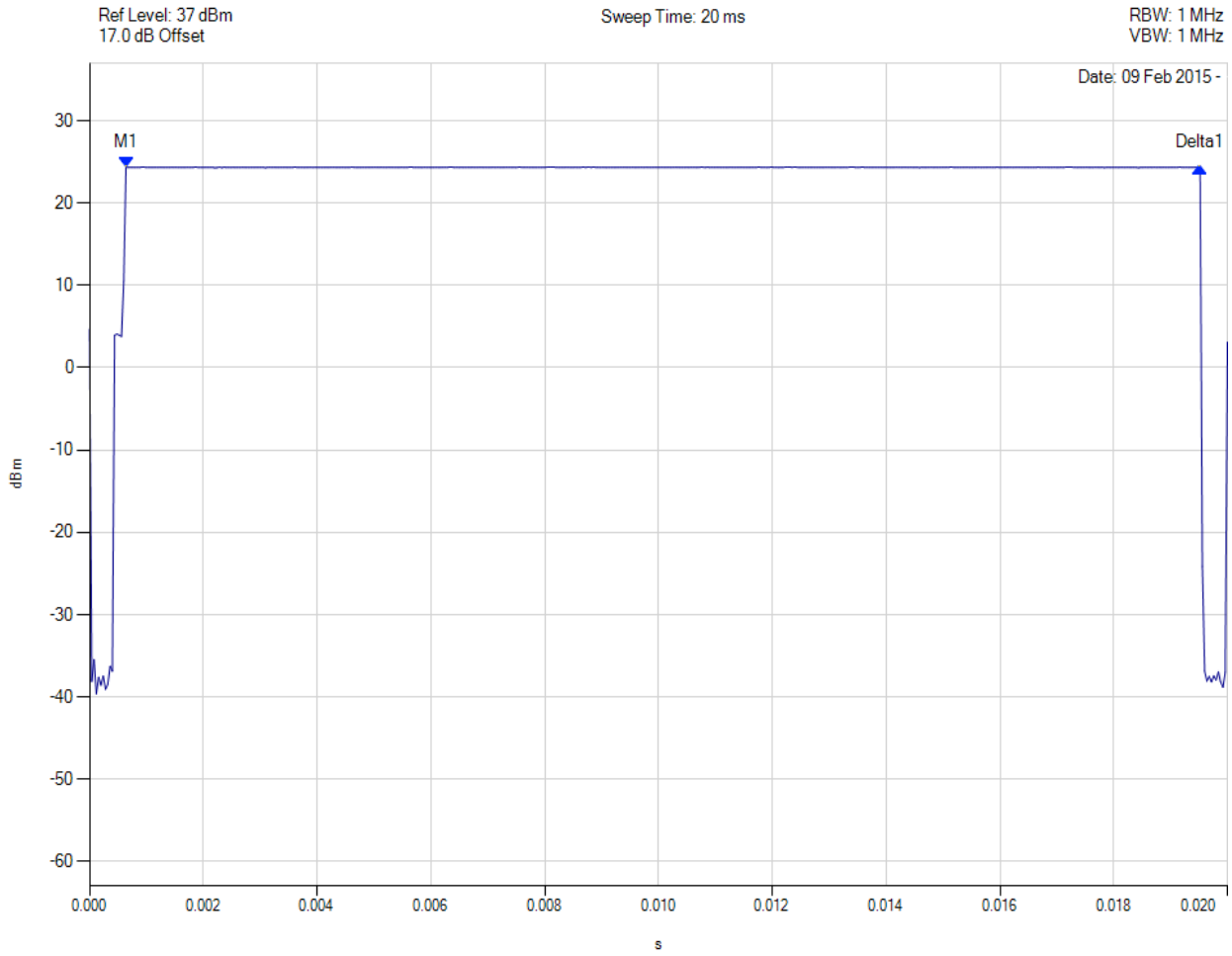
10.2.3. Dwell Time

Dwell Time

Variant: FHSS, Channel: 903 MHz, Chain a, Temp: Ambient, Voltage: 5 Vdc



Analyser Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 0.001 s : 24.330 dBm Delta1 : 0.019 s : 0.002 dB	Channel Frequency: 903.00 Hz

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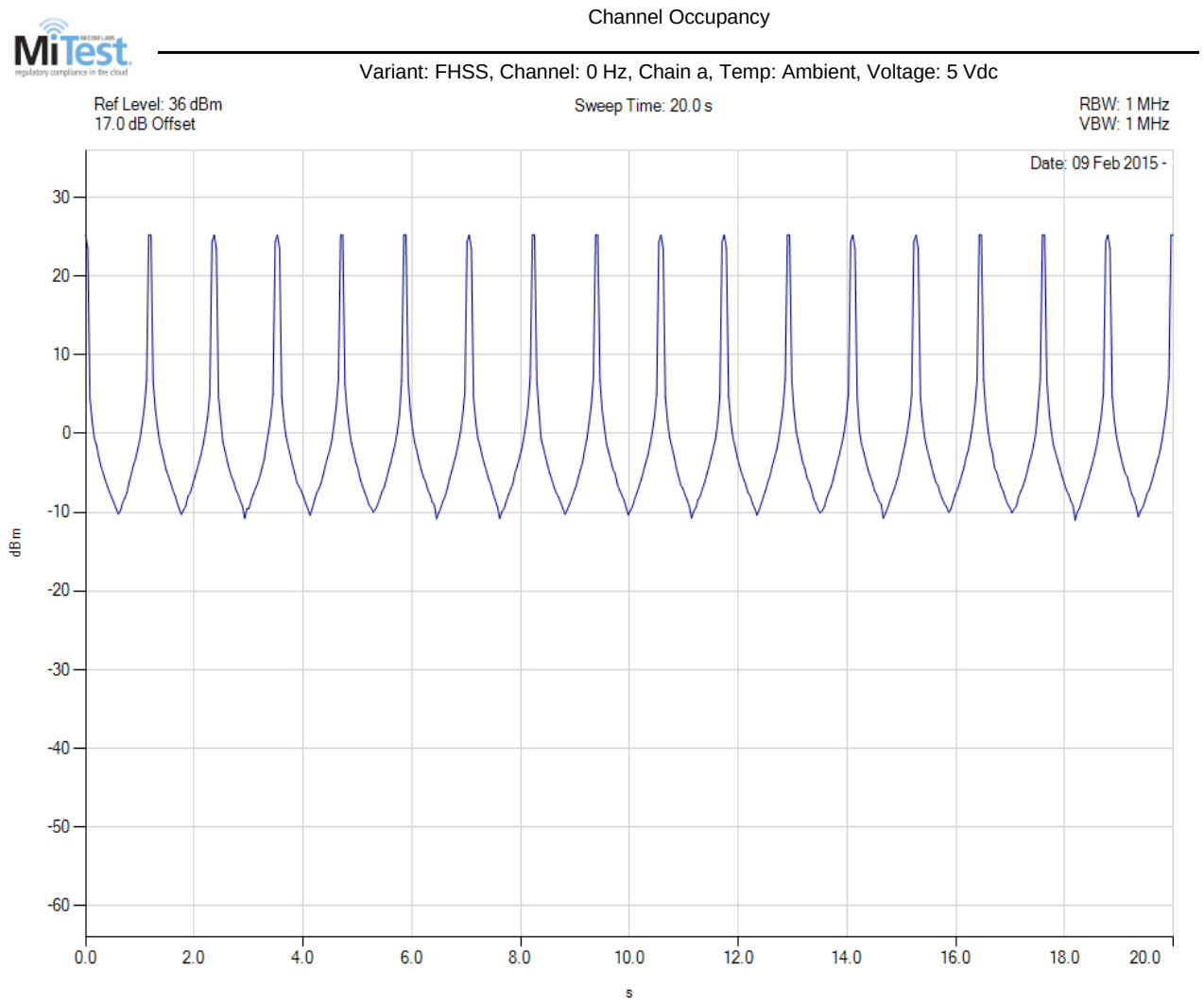
10.2.4. Channel Occupancy



Analyser Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Channel Frequency: 0 Hz

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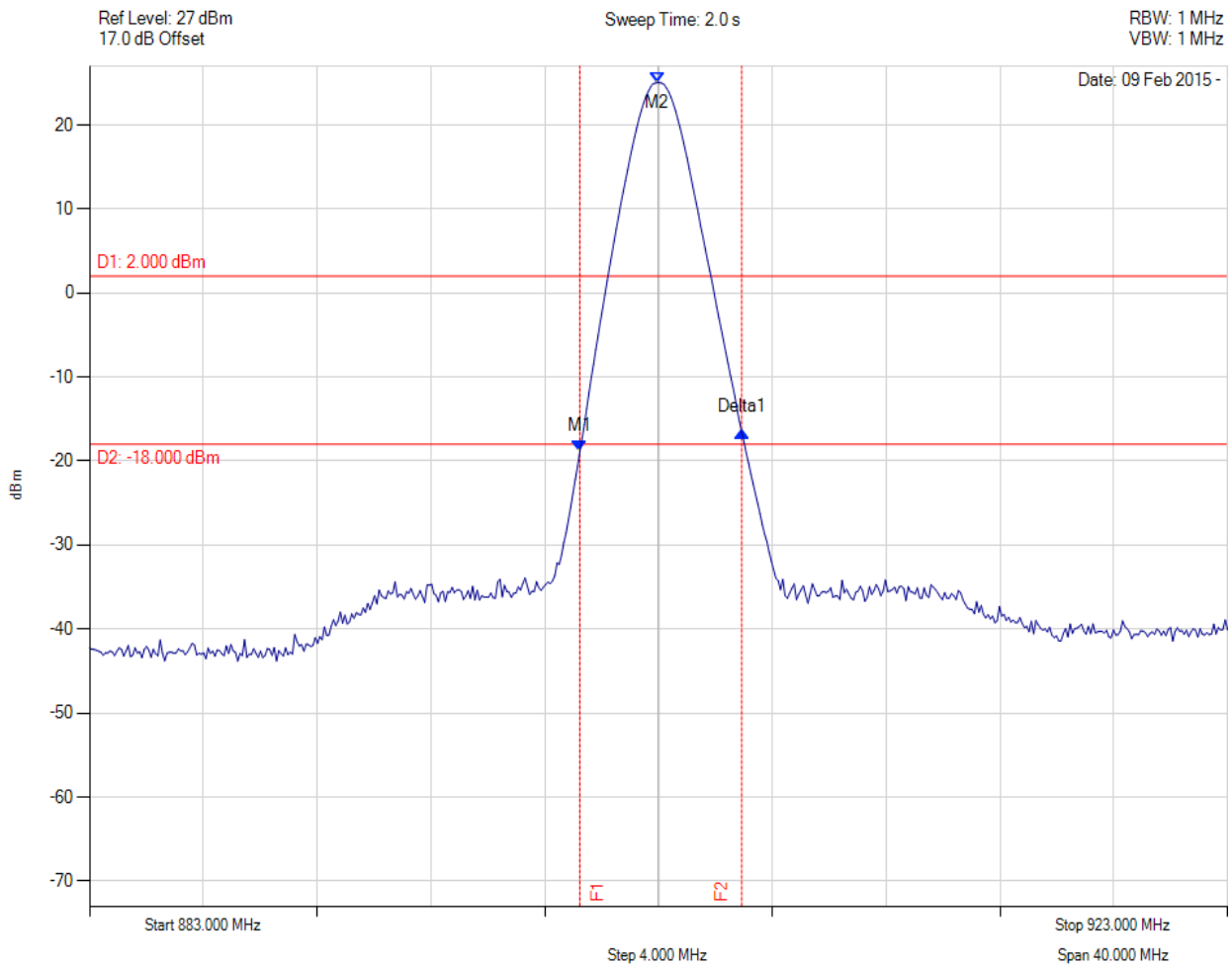
10.3. Conducted Output Power

PEAK OUTPUT POWER

Variant: FHSS, Channel: 903.00 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 900.234 MHz : -18.861 dBm M2 : 902.960 MHz : 25.052 dBm Delta1 : 5.691 MHz : 2.302 dB	Channel Power: 25.44 dBm Limit: 30.00 dBm Margin: -4.56 dB

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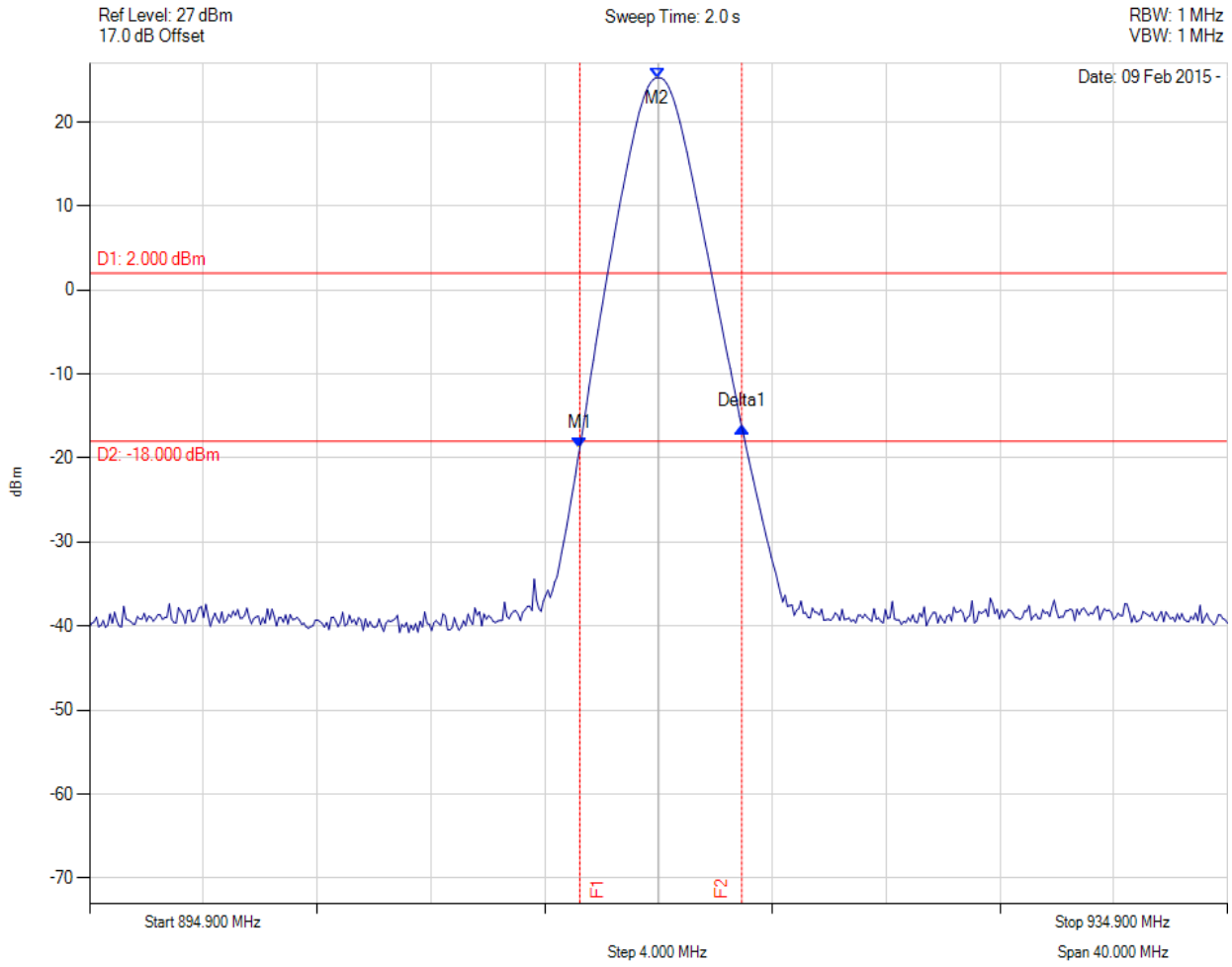
PEAK OUTPUT POWER

Variant: FHSS, Channel: 914.90 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 912.134 MHz : -18.778 dBm M2 : 914.860 MHz : 25.273 dBm Delta1 : 5.691 MHz : 2.520 dB	Channel Power: 25.67 dBm Limit: 30.00 dBm Margin: -4.33 dB

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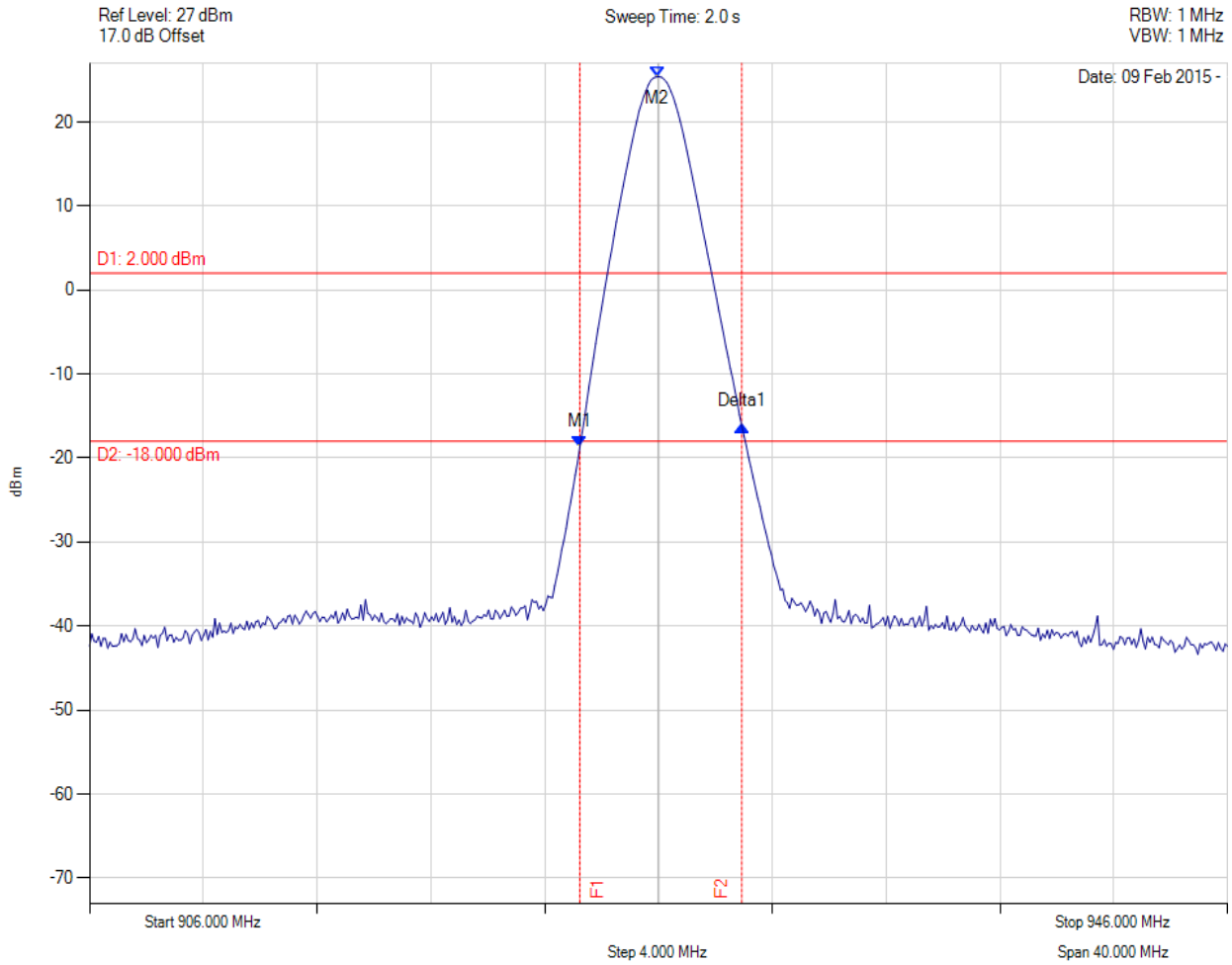
PEAK OUTPUT POWER

Variant: FHSS, Channel: 926.00 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 923.234 MHz : -18.682 dBm M2 : 925.960 MHz : 25.373 dBm Delta1 : 5.691 MHz : 2.565 dB	Channel Power: 25.81 dBm Limit: 30.00 dBm Margin: -4.19 dB

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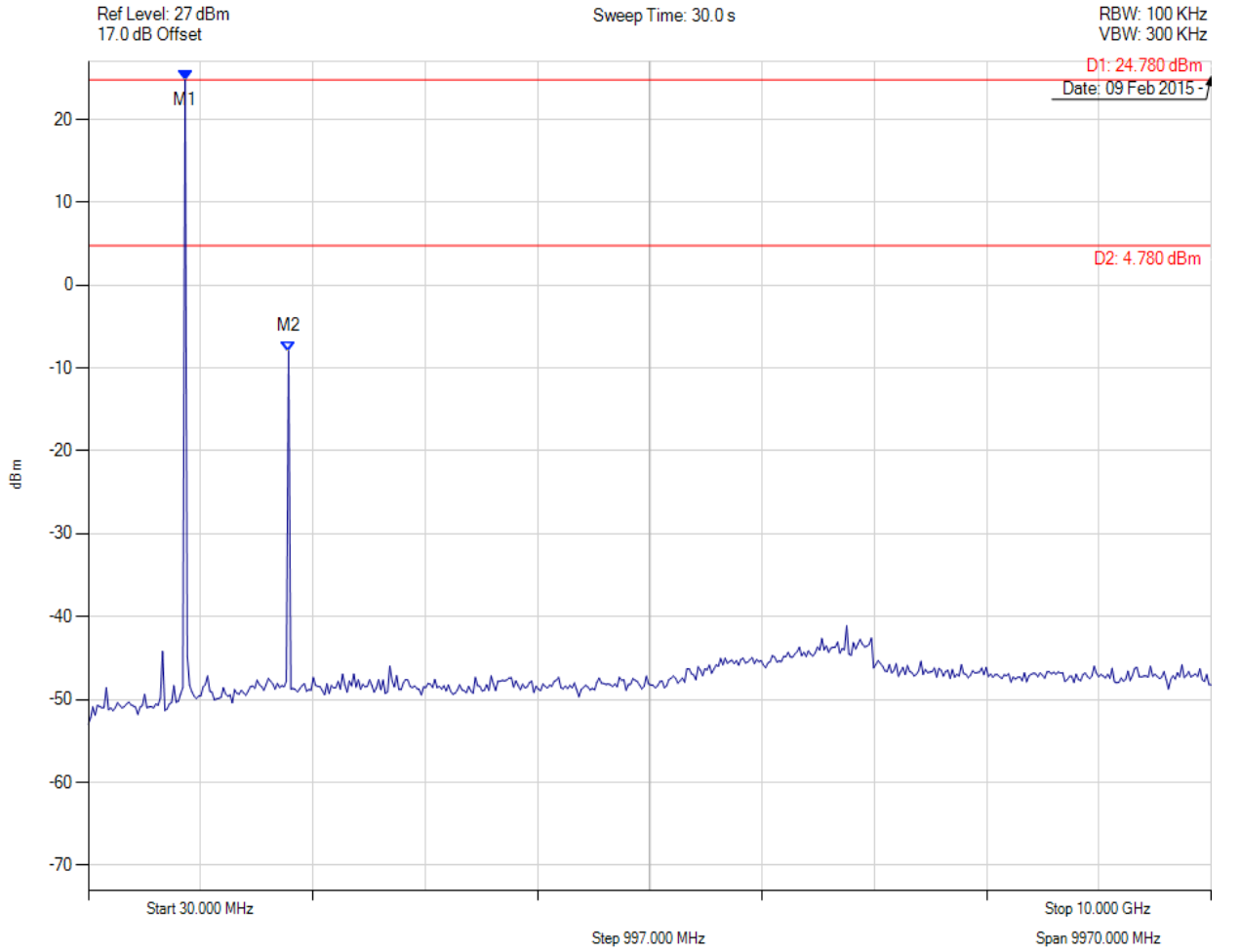
10.4. Emissions

10.4.1. Conducted Spurious Emissions

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: FHSS, Channel: 903.00 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 889.138 MHz : 24.779 dBm M2 : 1808.216 MHz : -7.960 dBm	Limit: 4.78 dBm Margin: -12.74 dB

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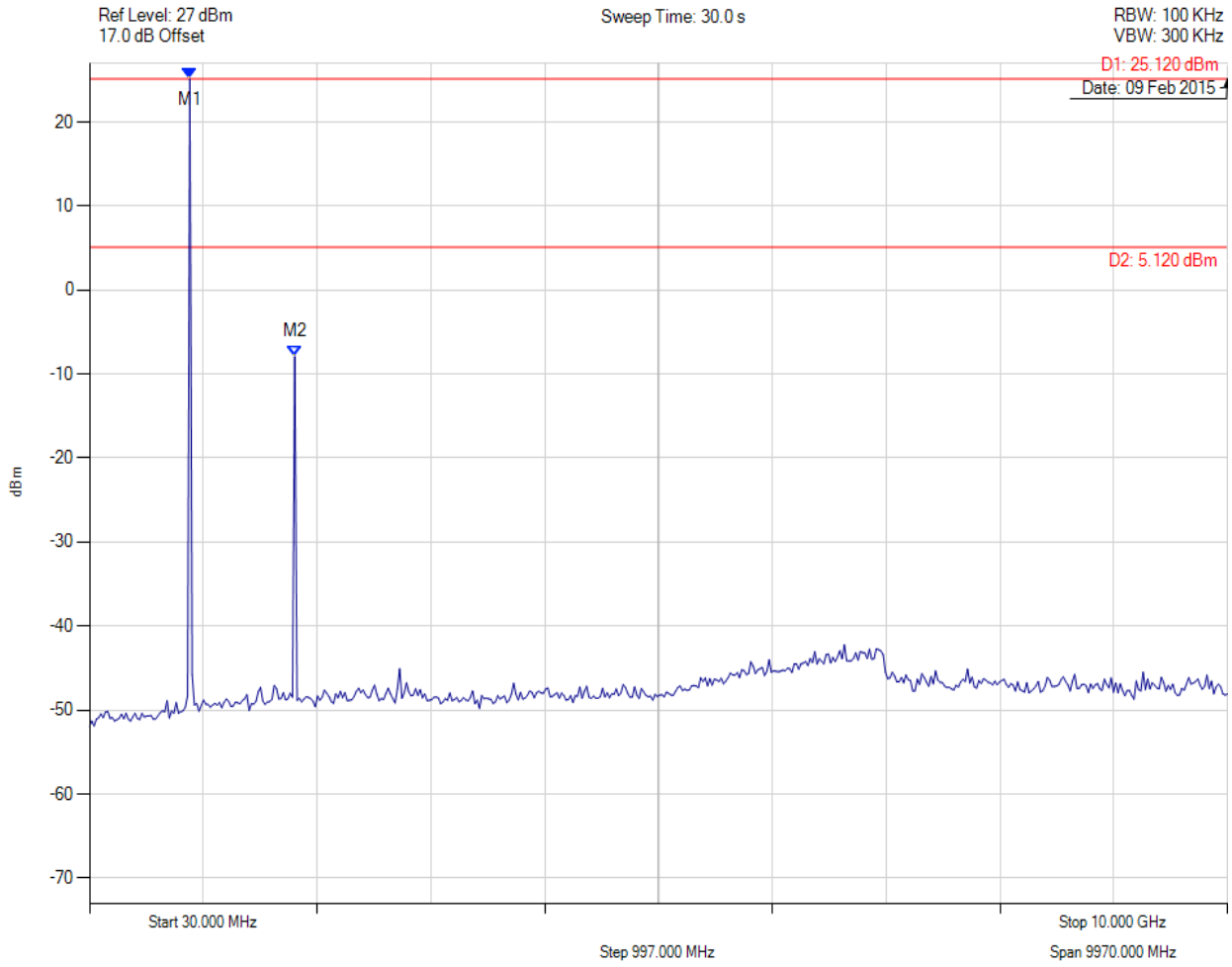
CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: FHSS, Channel: 914.90 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 909.118 MHz : 25.119 dBm M2 : 1828.196 MHz : -7.907 dBm	Limit: 5.12 dBm Margin: -13.03 dB

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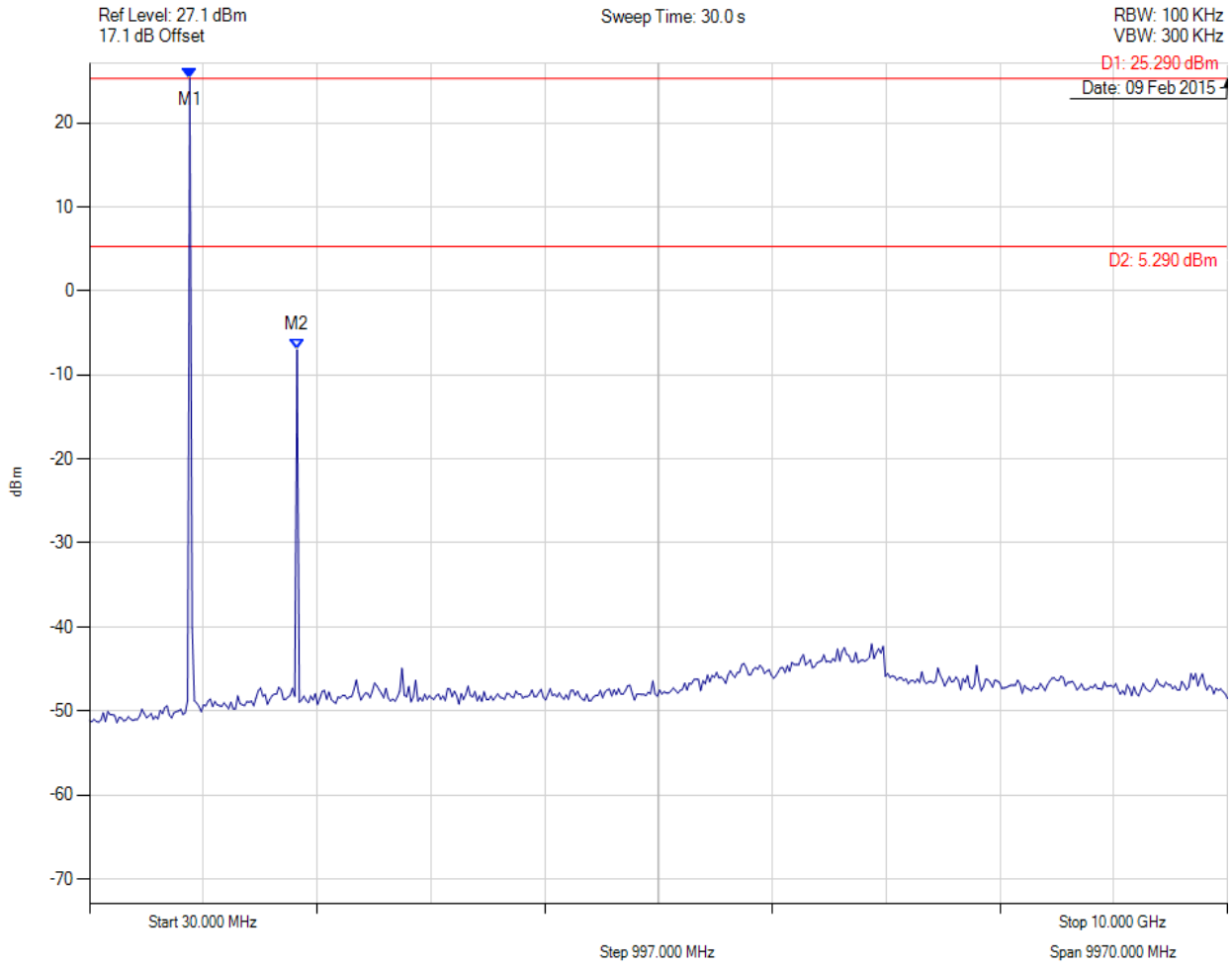
CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: FHSS, Channel: 926.00 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 909.118 MHz : 25.286 dBm M2 : 1848.176 MHz : -6.996 dBm	Limit: 5.29 dBm Margin: -12.29 dB

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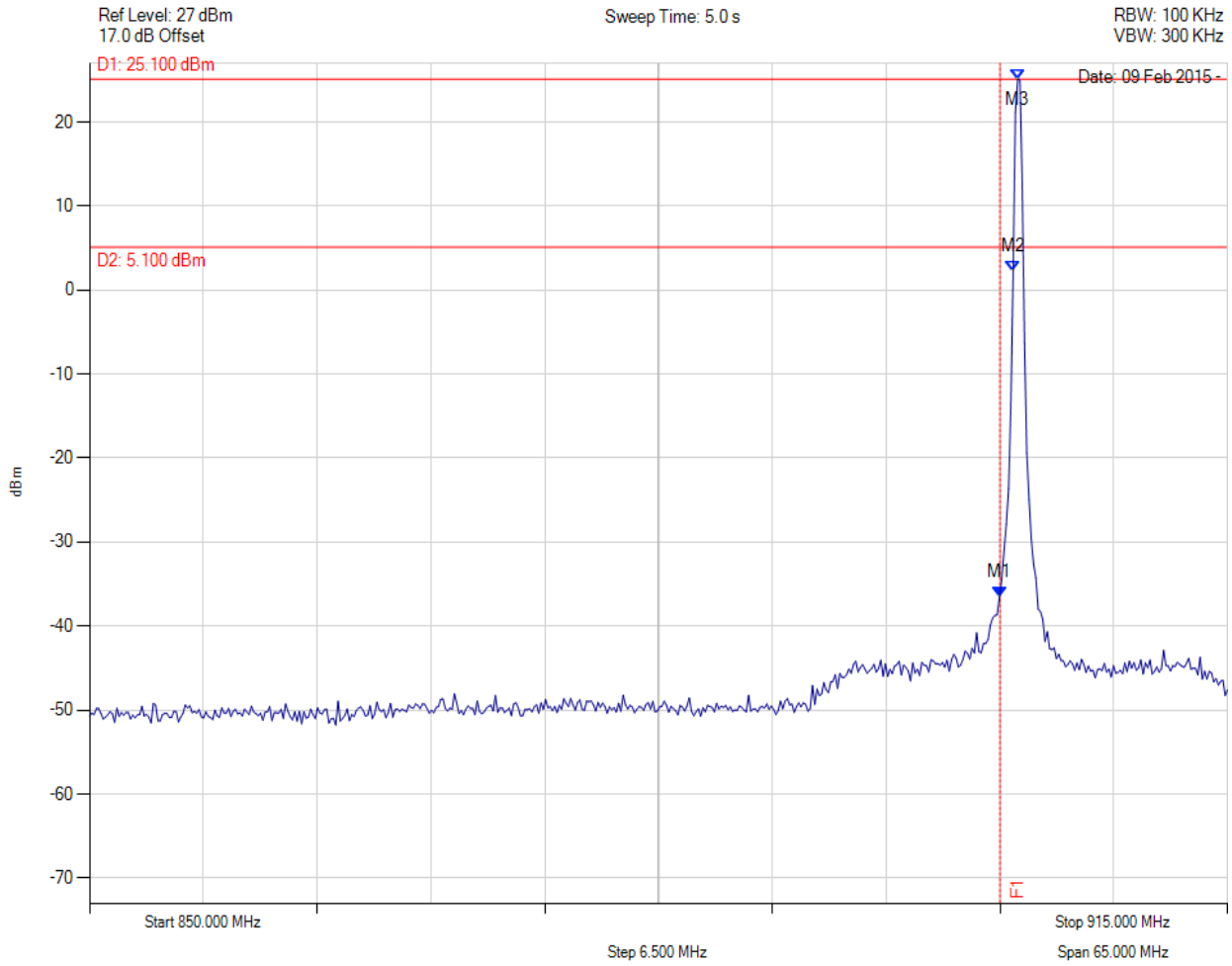
10.4.2. Conducted Band-Edge Emissions

CONDUCTED LOW BAND-EDGE EMISSION - PEAK

Variant: FHSS, Channel: 903.00 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 902.000 MHz : -36.522 dBm M2 : 902.756 MHz : 2.282 dBm M3 : 903.016 MHz : 25.096 dBm	Channel Frequency: 903.00 MHz

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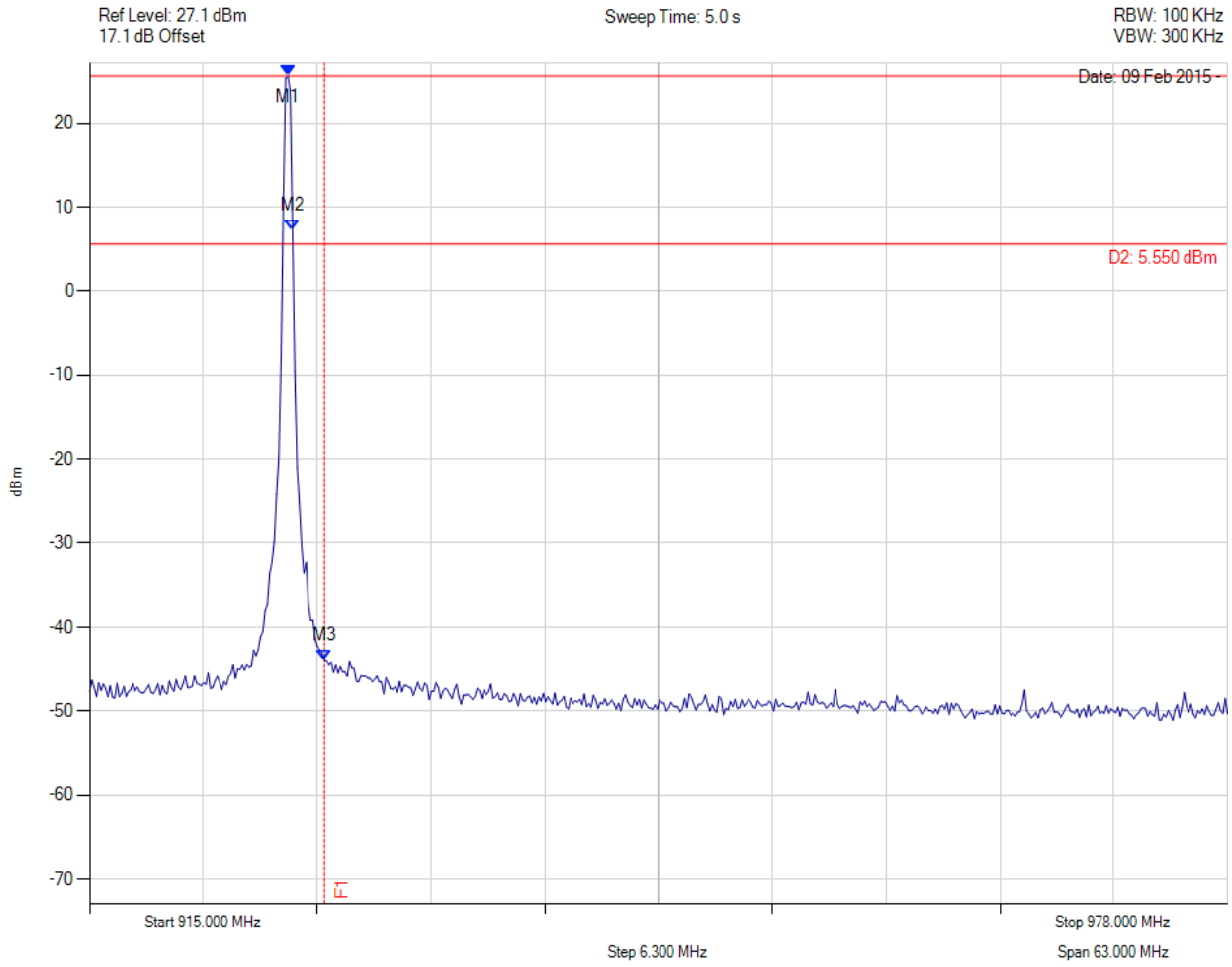
CONDUCTED HIGH BAND-EDGE EMISSION - PEAK

Variant: FHSS, Channel: 926.00 MHz, Chain a, Temp: Ambient, Voltage: 12 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 925.984 MHz : 25.548 dBm M2 : 926.236 MHz : 7.149 dBm M3 : 928.000 MHz : -43.986 dBm	Channel Frequency: 926.00 MHz

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