Test of Thinkify LLC T265R

To: FCC 47 CFR Part 90 SubPart M, 90.353

Test Report Serial No.: THNK15-U2 Rev A

TEST REPORT

FROM

MiCOM Labs

Test of Thinkify LLC T265R

To FCC 47 CFR Part 90 SubPart M, 90.353

Test Report Serial No.: THNK15-U2 Rev A

This report supersedes NONE

Applicant : Thinkify LLC
18450 Technology Drive, Suite E1
Morgan Hill, California 95037
USA

Product Function: High Speed Wireless Programmer

Copy No: pdf **Issue Date:** 24th September 2018

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
575 Boulder Court,
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
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A2LA ACCREDITED
TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS & RECOGNITION

TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025. 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

ilac-MRA A2LA

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 April 2017*).

Presented this 14th day of May 2018.

President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2019

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

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 (FSB)	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

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PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065. 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

Accredited Product Certification Body

A2LA has accredited

MiCOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the *A2LA R322 – Specific Requirements – Notified Body Accreditation Requirements* and *A2LA R308 - Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 14th day of May 2018

President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2019

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

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

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DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	24th September 2018	Draft report for client review.
Rev A	24th September 2018	Initial release.

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1 TEST RESULT CERTIFICATE

Manufacturer:	Thinkify LLC 18450 Technology Drive, Suite E1 Morgan Hill, California 95037 USA	Tested By:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California, 94566, USA
EUT:	915 MHz High Speed Wireless Programmer	Telephone:	+1 925 462 0304
Model:	T265R	Fax:	+1 925 462 0306
S/N:	TR-65		
Test Date(s):	5th September 2018	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 90 SubPart M, 90.353	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.

Approved & Released for MiCOM Labs, Inc. by:

A2LA ACCREDITED
TESTING CERT #2381.01

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

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2 REFERENCES AND MEASUREMENT UNCERTAINTY

2.1 Normative Reference

REF.	PUBLICATION	YEAR	TITLE
I	FCC 47 CFR Part 90	2018	Code of Federation Regulations.
II	KDB 662911 D01 & D02	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	A2LA	August 2017	R105 - Requirement's When Making Reference to A2LA Accreditation Status
IV	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
V	ANSI C63.4	2014	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
VI	CISPR 32	2015	Electromagnetic compatibility of multimedia equipment - Emission requirements
VII	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	ICES-003	Issue 6 Jan 2016 Updated April 2017	Spectrum Management and Telecommunications; Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
X	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
XII	RSS-Gen Issue 5	April 2018	General Requirements and Information for the Certification of Radio communication Equipment
XIV	FCC 47 CFR Part 2.1033	2018	FCC requirements and rules regarding photographs and test setup diagrams.

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2.2 Test and Uncertainty Procedures

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.

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3 PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1 Technical Details

Details	Description
Purpose:	Test of the Thinkify LLC T265R to FCC 47 CFR Part 90 SubPart M, 90.353 regulations.
Applicant:	Thinkify LLC 18450 Technology Drive, Suite E1 Morgan Hill, California 95037, USA
Manufacturer:	As Applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court, Pleasanton, California 94566 USA
Test report reference number:	THNK15-U2 Rev A
Date EUT received:	13th August, 2018
Dates of test (from - to):	7th- 10th September, 2018
Standard(s) applied:	FCC 47 CFR Part 90 SubPart M, 90.353
No of Units Tested:	1
Type of Equipment:	High Speed Wireless Programmer
Model:	T265R
Location for use:	Indoor
Declared Frequency Range(s):	902 – 904 MHz & 909.75 - 921.75 MHz
Type of Modulation:	CW, OOK
Operational Bandwidths:	CW: 16 kHz OOK: 90 kHz
Declared Maximum Output Power:	46.0 mW
Transmit/Receive Operation:	Transceiver
Software Revision:	3.0.6
Rated Input Voltage and Current:	120Vac 60 Hz Power Supply Unit 10 Vdc,2A : 6 Vdc,2A : -5Vdc/0.5A
Operating Temperature Range:	-20ºC to +50ºC
Frequency Stability:	Long Term: ±20ppm
Equipment Dimensions:	18cm x 28cm x 8cm
Weight:	2.7 kg
Primary function of equipment:	RFID Reader
Firmware Rev:	4.4.0
Hardware Rev	TR-65 Rev.B

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3.2 Scope of Test Program

The scope of the test program was to test the Thinkify LLC T265R for compliance against;-

FCC 47 CFR Part 90, Subpart M regulatory requirements.

The Thinkify LLC T265R has two operational modes Continuous Wave and Modulated OOK and operates in the range 902 – 904 MHz and 909.75 - 921.75 MHz.

Transmission Restrictions

The Thinkify LLC T265R RFID Reader per Part 90 SubPart M, 90.357 falls into category (b) Non- multilateriation LMS systems authorized in the following frequency bands:

- 902 – 904 MHz
- 909.75 - 921.75 MHz

Definition of Non-Multilateration LMS System.

A non-multilateration LMS system employs any of a number of non-multilateration technologies to transmit information to and/or from vehicular units.

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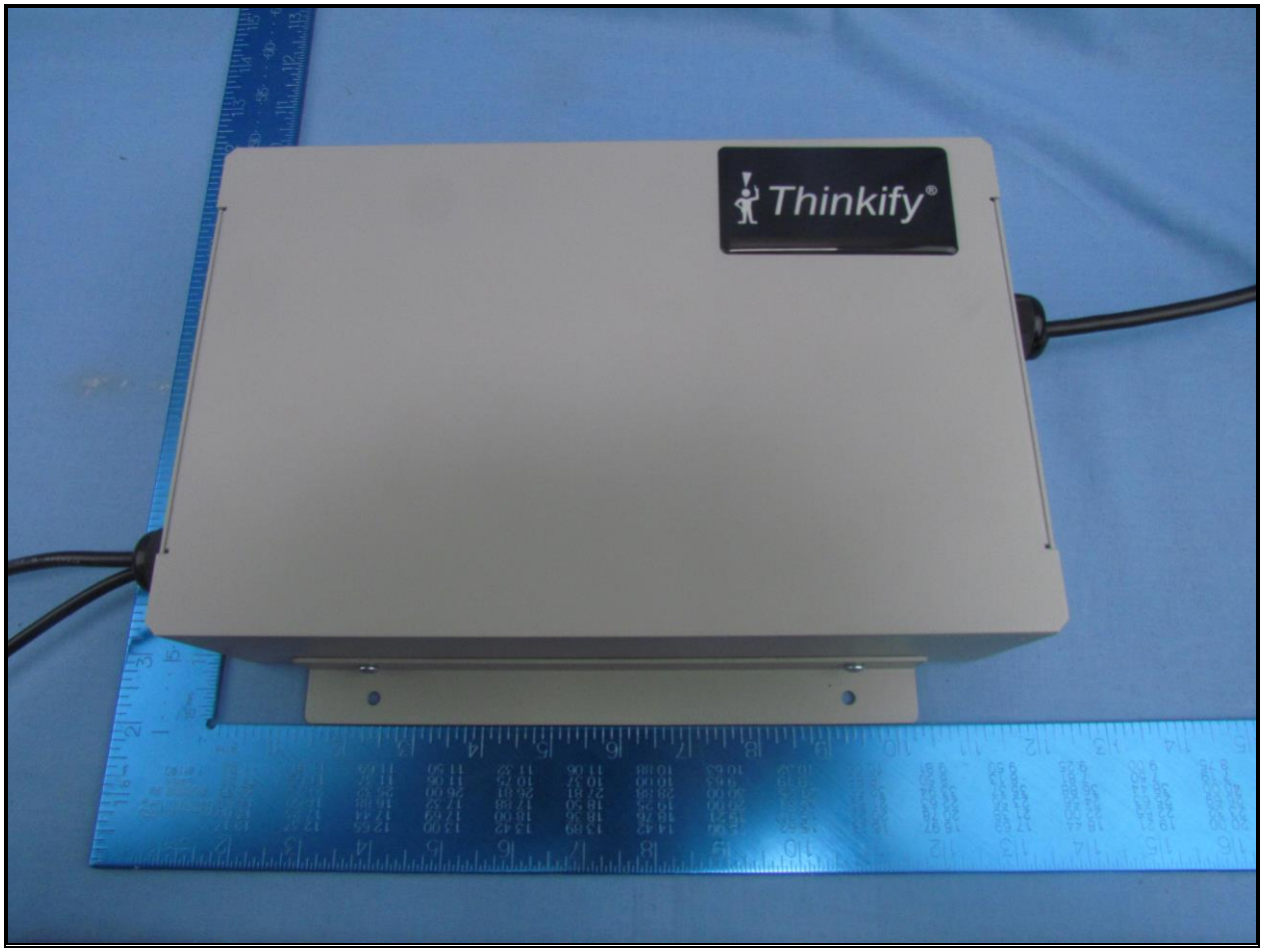
Thinkify LLC T265R



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3.3 Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	RFID Reader	Thinkify LLC	T265R	TR-65
Support	Laptop PC	Dell	E5440	None

3.4 Antenna Details

Type	Manufacturer	Model Number	Gain (dBi)	Frequency Band (MHz)
External Dipole	Linx Technologies	TAL-010	1.2	900-930

3.5 Cabling and I/O Ports

Port Type	Max Cable Length	# Of Ports	Screened	Conn Type	Data Type
Ethernet	< 3	1	N	Ethernet	Digital
AC/DC	N/A	1	Y	Power	N/A

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3.6 Test Configurations

Parameter	Standard Section #	Operational Mode	Test Conditions
Occupied Bandwidth	2.1049/ 90.210	CW, OOK	Ambient, Nominal Vdc
Effective Radiated Power	2.1046/ 90.205		
Exposure to Mobile Devices	2.1091/ 90.1217	Calculated	--
Frequency Stability	2.1055/ 90.213	CW	Ambient, -20ºC, 50ºC Nominal & Extremes of Voltage[1]
Audio Frequency Response	TIA EIA-603.3.2.6	--	N/A[2]
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	--	N/A[2]
Conducted Spurious Emissions	2.1053/ 90.210	CW	Ambient, Nominal Vdc
Radiated Spurious Emissions	2.1053/ 90.210	CW	Ambient, Nominal Vdc
Transient Frequency Response	90.214	--	N/A[3]
Digital Radiated Emissions	15.109	CW	Ambient, Nominal Vdc
AC Wireline Emissions	15.107	CW	Ambient, Nominal Vdc

Note 1.. Fixed Non-Multilateration transmitters with an authorized bandwidth more than 40 kHz from the band-edge are not subject to Frequency Stability restrictions. The EUT was measured to show compliance with Part 2 requirements.
Note 2.. The EUT does not support audio modulation therefore Audio Frequency Response and Audio Low-Pass Filter Response testing was not performed
Note 3.. The EUT is not a keyed carrier system therefore Transient Frequency Behavior was not performed

Test Frequencies

Frequency Band (MHz)	Data Rate KBit/S	Frequency Channel (MHz)		
		Low	Mid	High
902.00 – 904.00	110	902.75	903.00	903.75
909.75 – 921.75	110	910.75	915.75	920.75

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Voltage Variation Tolerance
The input voltage to the T265R was varied by 10% in order to determine the EUT's tolerance to differing voltage conditions. Test conditions;

USB 5 Vdc
Location of voltage, on PCB, EUT transmitting max power.

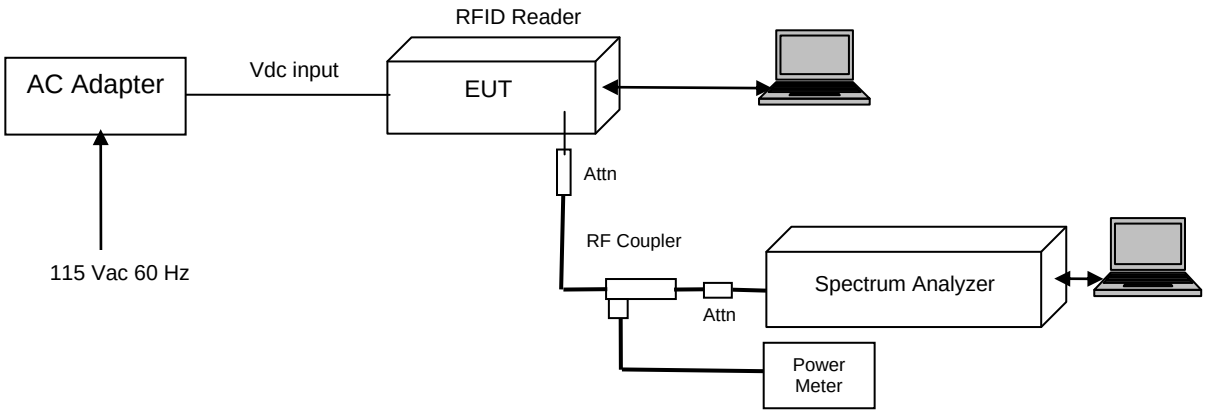
Nominal Input Voltage: +5.0 Vdc
Minimum Voltage: +4.50 Vdc
Maximum Voltage: +5.50 Vdc

Input Voltage (Vdc)	5.0 Vdc	Δ%
120.00	5.00	
108.00	5.00	-0.0
132.00	5.00	-0.0

As can be observed a 10% input voltage variation caused little or no change in voltage fed to the wireless chipset @ 5.0 Vdc

Test Set-Up

Test software was available to exercise the RFID Reader and the equipment was tested using the following test configuration.



Conducted Test Set-Up

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3.7 Equipment Modifications

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

1. NONE

3.8 Deviations from the Test Standard

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

1. NONE

3.9 Subcontracted Testing or Third Party Data

1. NONE

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4 TEST MEASUREMENT SETUP

4.1 Conducted

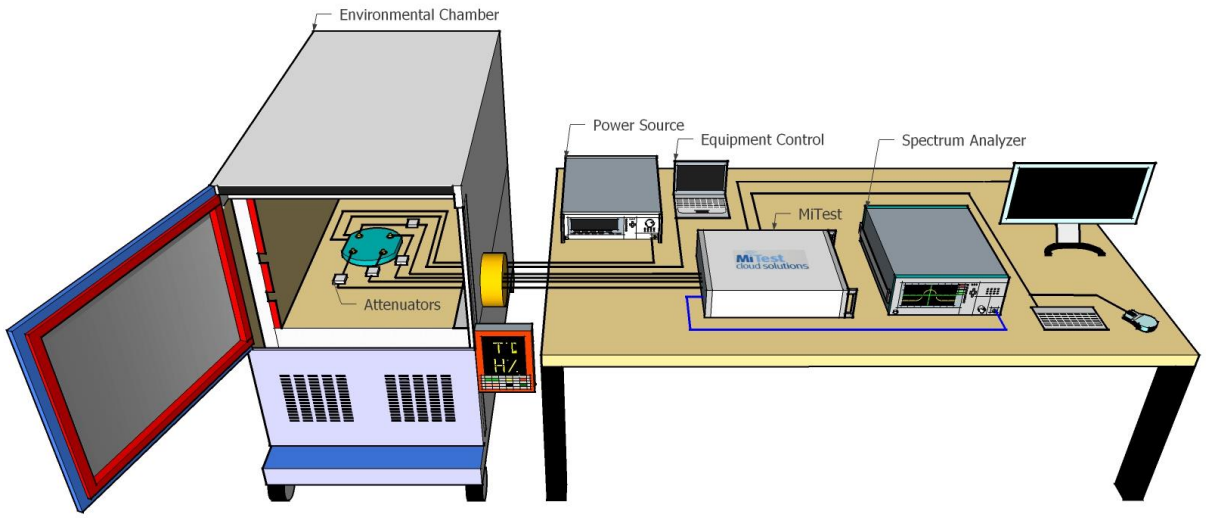
Conducted RF Emission Test Set-up(s)

Test	Report Section
Occupied Bandwidth	6.1
Effective Radiated Power	6.2
Frequency Stability	6.3
Conducted Spurious Emission	6.4
Radiated Spurious Emission - Transmitter	6.5
Radiated Spurious Emission – Digital Apparatus	6.6
Conducted Disturbance at Mains Terminal	6.7

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

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.

MiTest Automated Test System



Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
127	Power Supply	HP	6674A	US36370530	Cal when used
248	Resistance Thermometer	Thermotronics	GR2105-02	9340 #1	30 Oct 2018
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2018
398	MiTest RF Conducted Test Software	MiCOM	MiTest ATS	Version 4.1	Not Required
419	Laptop with Labview Software	Lenova	W520	TS02	Not Required
420	USB to GPIB Interface	National Instruments	GPIB-USB HS	1346738	Not Required
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
460	Dell Computer with installation of MiTest executable.	Dell	Optiplex330	BC944G1	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	20 Sep 2019
493	USB Wideband Power Sensor	Boonton	55006	9634	10 Mar 2019
494	USB Wideband Power Sensor	Boonton	55006	9726	10 Mar 2019
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2018
512	MiTest Cloud Solutions RF Test Box	MiCOM	2nd Gen with DFS	512	22 Sep 2018
516	USN Wideband Power Sensor	Boonton	RTP5006	10511	12 Jun 2019
517	USB Wideband Power Sensor	Boonton	RTP5006	10510	12 Jun 2019
74	Environmental Chamber Chamber 3	Tenney	TTC	12808-1	28 Sep 2018
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	22 Sep 2018
RF#2 SMA#2	EUT to Mitest box port 2	Flexco	SMA Cable port2	None	22 Sep 2018
RF#2 SMA#3	EUT to Mitest box port 3	Flexco	SMA Cable port3	None	22 Sep 2018
RF#2 SMA#4	EUT to Mitest box port 4	Flexco	SMA Cable port4	None	22 Sep 2018
RF#2 SMA#SA	Mitest box to SA	Flexco	SMA Cable SA	None	22 Sep 2018
RF#2 USB#1	USB Cable to Mitest Box	Dynex	USB Cable	None	Not Required

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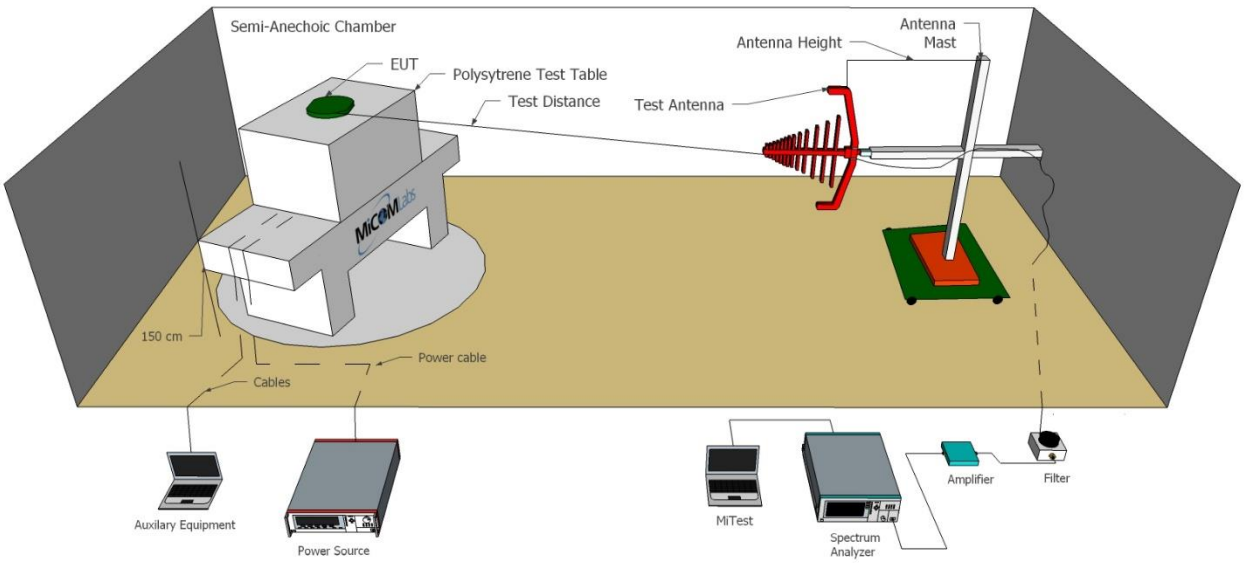
Radiated Emissions - 3m Chamber

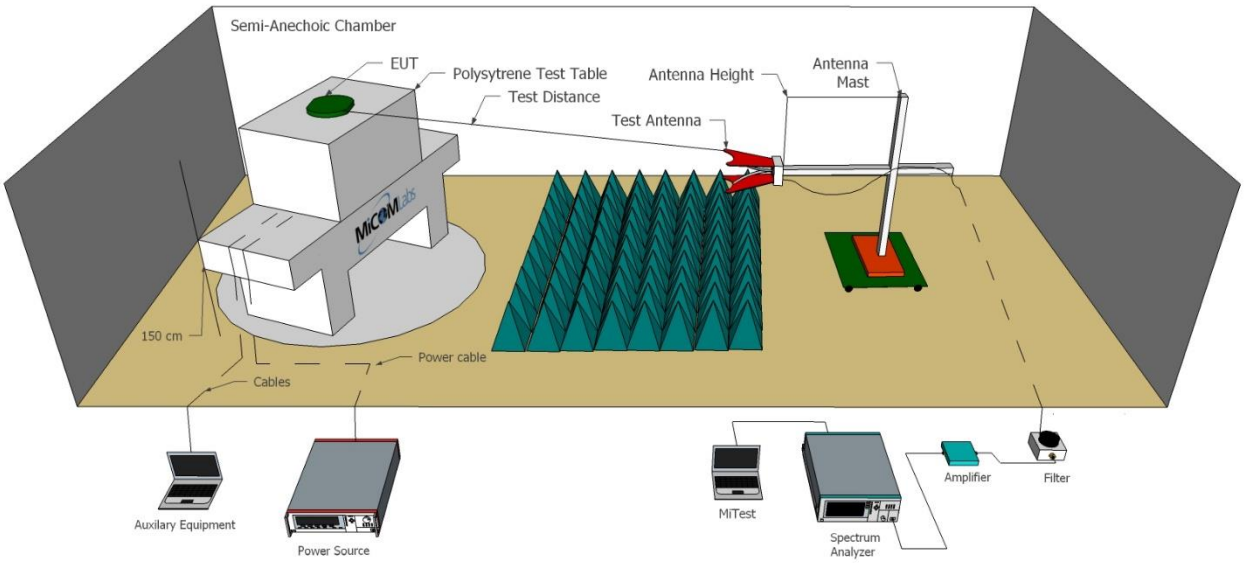
The following tests were performed using the radiated test set-up shown in the diagram below.

Radiated emissions below 1GHz.Radiated Emissions above 1GHz.

Radiated Emissions Below 1GHz Test Setup



Radiated Emissions Above 1GHz Test 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.

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Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	27 Sep 2018
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	4 Apr 2019
346	1.6 TO 10GHz High Pass Filter	EWT	EWT-57-0112	H1	6 Oct 2018
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2018
393	DC - 1050 MHz Low Pass Filter	Microcircuits	VLFX-1050	N/A	6 Oct 2018
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	12 Oct 2018
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	12 Oct 2018
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required
412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
414	DC Power Supply 0-60V	HP	6274	1029A01285	Cal when used
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required
447	MiTest Rad Emissions Test Software	MiCOM	Rad Emissions Test Software Version 1.0	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	4 Oct 2018
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	4 Oct 2018
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	4 Oct 2018
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	6 Oct 2018
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	6 Oct 2018
510	Barometer/Thermometer	Control	68000-49	170871375	11 Dec 2018

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		Company			
518	Cable - Amp to Antenna	SRC Haverhill	157-3051574	518	24 Aug 2019

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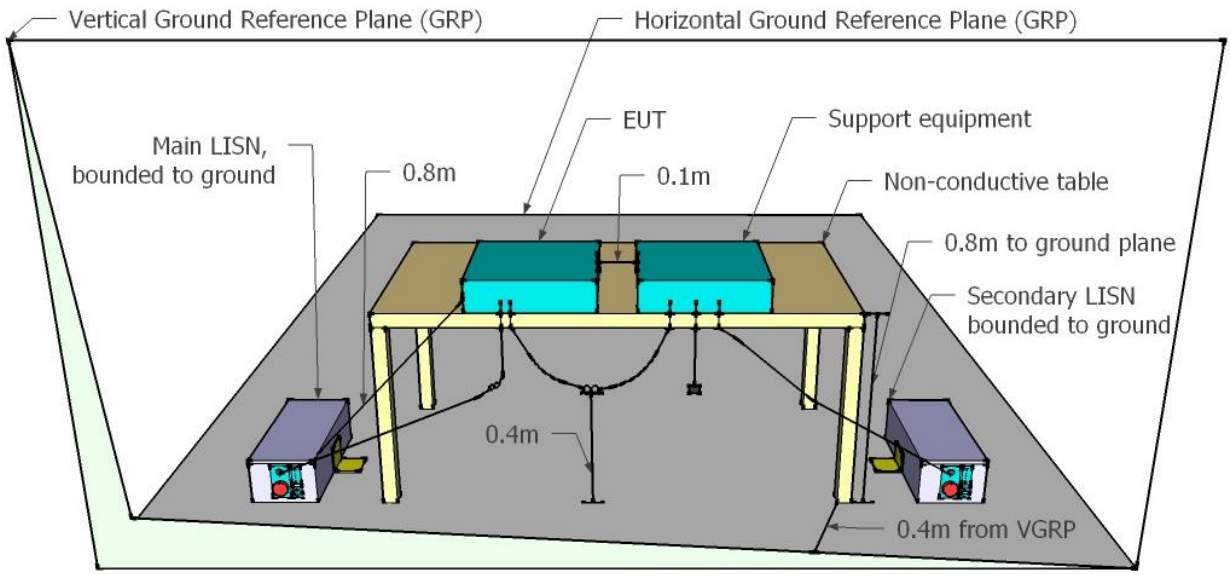
4.2 Conducted Disturbance at Mains Terminals

Conducted Disturbance at Mains Terminals test 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
184	Pulse Limiter	Rhode & Schwarz	ESH3Z2	357.8810.52	6 Oct 2018
190	LISN (two-line V-network)	Rhode & Schwarz	ESH3Z5	836679/006	18 Oct 2018
193	Receiver 20 Hz to 7 GHz	Rhode & Schwarz	ESI 7	838496/007	10 Oct 2018
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 May 2019
295	Conducted Emissions Chamber Maintenance Check	MiCOM	Conducted Emissions Chamber	295	19 Dec 2018
307	BNC-CABLE	Megaphase	1689 1GVT4	15F50B002	6 Oct 2018
316	Dell desktop computer workstation	Dell	Desktop	WS04	Not Required
372	AC Variable PS	California Instruments	1251P	L06951	Cal when used
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2018
388	LISN (3 Phase) 9kHz - 30MHz	Rohde & Schwarz	ESH2-Z5	892107/022	20 Oct 2018
496	MiTest Conducted Emissions test software.	MiCOM	Conducted Emissions Test Software	496	Not Required

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			Version 1.0		
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2018
CCEMC01	Confidence Check.	MiCOM	CCEMC01	None	2 Oct 2018

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5 TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 90**, **Subpart M.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
2.1049/ 90.210	99% Occupied Bandwidth	Bandwidth measurement(s)	Conducted	Complies	6.1
2.1046; 90.205	Effective Radiated Power	CW & Modulated Output Power	Conducted	Complies	6.2
2.1055(a)(1)/ 90.213	Frequency Stability	Includes temperature and voltage variations	Conducted	Complies	6.3
2.1051; 90.210(K)	Conducted Spurious Emissions	Emissions from the antenna port	Conducted	Complies	6.4
2.1053; 90.210 ANSI/TIA-603	Radiated Spurious Emissions	Spurious emissions from Transmitter	Radiated	Complies	6.5
15.109	Radiated Spurious Emissions	Spurious emissions from digital apparatus	Radiated	Complies Class A Device	6.6
15.107	AC Wireline Conducted	Emissions 150 kHz–30 MHz	Conducted	Complies Class A Device	6.7

Note 1: Test results reported in this document relate only to the items tested
Note 2: The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria
Note 3: Section 3.7 'Equipment Modifications' highlight the equipment modifications that were required to bring the product into compliance with the above matrix

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6 TEST RESULTS

6.1 Occupied Bandwidth

Conducted Test Conditions for 99% Bandwidth			
Standard:	FCC CFR 47:90.353	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	99 % Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	2.1049, 90.210 (K)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for 99% Bandwidth Measurement
The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure the 99% occupied bandwidth. The system highest power setting was selected with modulation ON and OFF (CW mode).

The measurement of channel bandwidth used a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth higher than the RBW.

Test configuration and setup used for the measurement was per the Conducted Test Set-up section specified in this document.

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Test Results for Occupied Bandwidth

Equipment Configuration for 99% Occupied Bandwidth			
Variant:	CW	**Duty Cycle (%):**	99
Data Rate:	110 KBit/s	**Antenna Gain (dBi):**	1.20
Modulation:	CW	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	VC
Engineering Test Notes:	None		

Test Frequency	Measured 99% Bandwidth (MHz)				99% Bandwidth (KHz)
	Port(s)				
MHz	a	b	c	d	
902.75	16.032	-	-	-	16.032
903.00	16.032	-	-	-	16.032
903.75	16.032	-	-	-	16.032
910.75	16.032	-	-	-	16.032
915.75	16.432	-	-	-	16.432
920.75	16.432	-	-	-	16.432

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

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Equipment Configuration for 99% Occupied Bandwidth			
Variant:	OOK	**Duty Cycle (%):**	99
Data Rate:	110 KBit/s	**Antenna Gain (dBi):**	1.20
Modulation:	OOK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	VC
Engineering Test Notes:	None		

Test Frequency	Measured 99% Bandwidth (KHz)				99% Bandwidth (KHz)
	Port(s)				
MHz	a	b	c	d	
902.75	90.180	-	-	-	90.180
903.00	90.180	-	-	-	90.180
903.75	90.180	-	-	-	90.180
910.75	90.180	-	-	-	90.180
915.75	90.180	-	-	-	90.180
920.75	90.180	-	-	-	90.180

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

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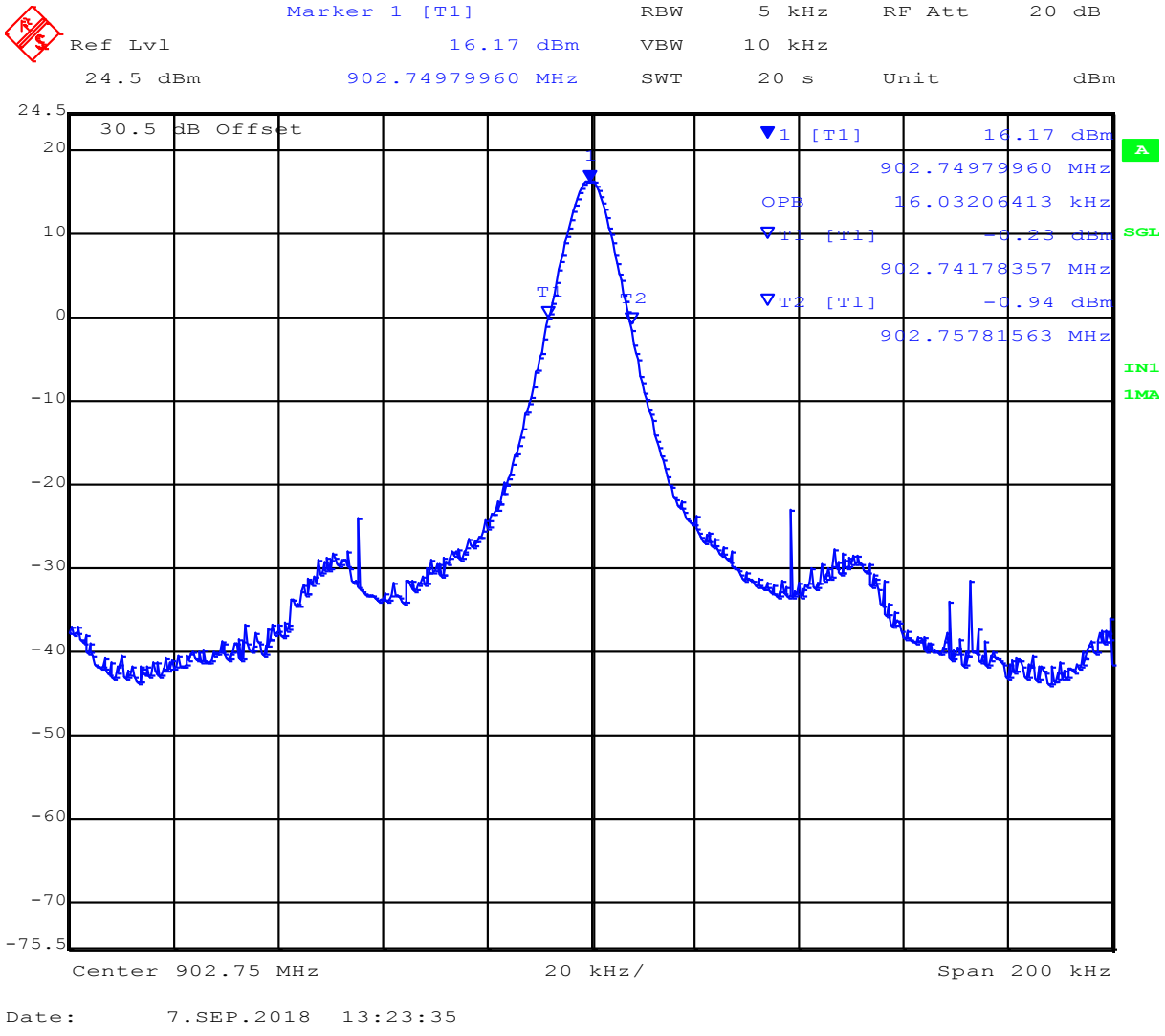
Channel 902.75, CW 99% Bandwidth



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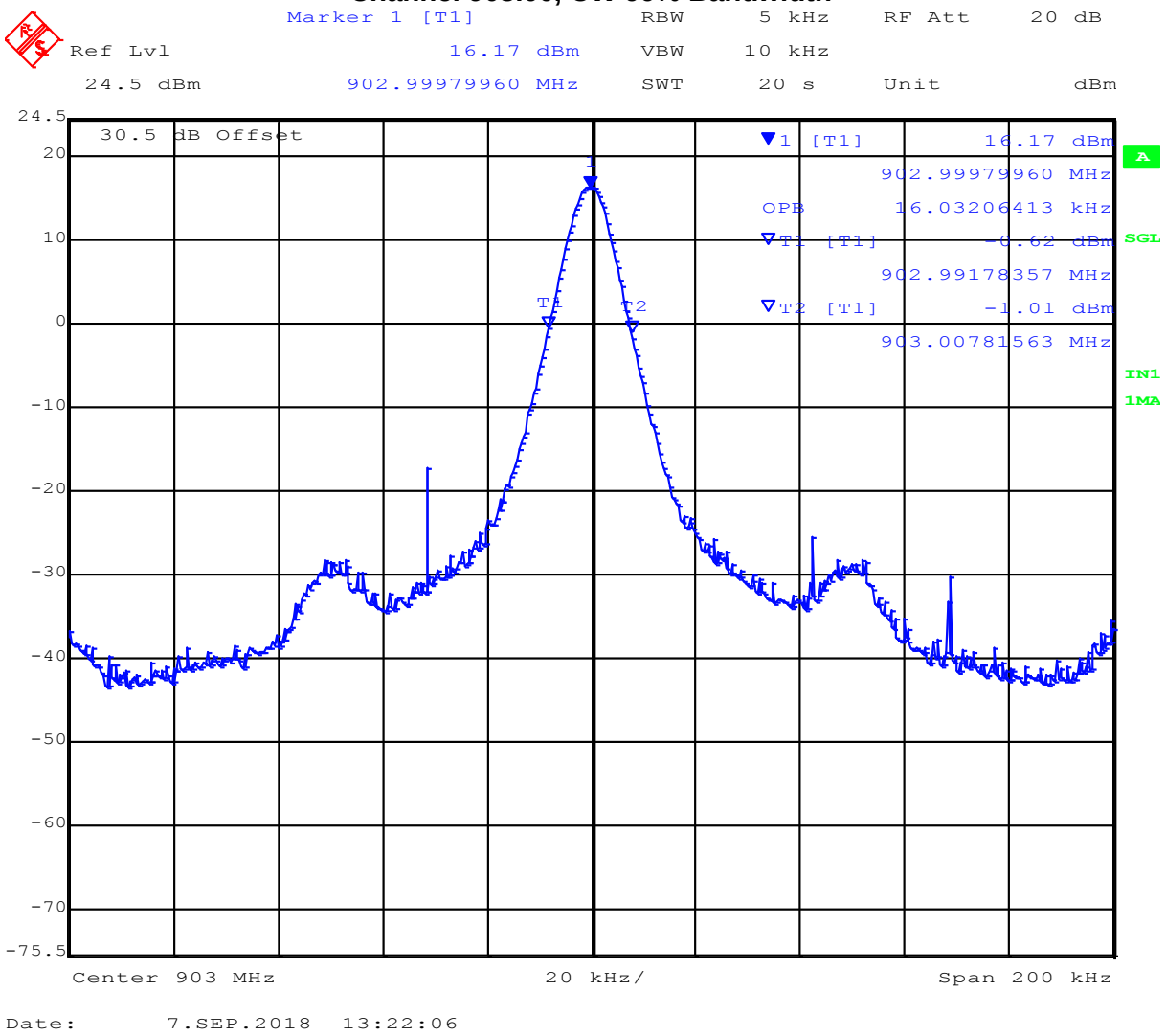
Channel 903.00, CW 99% Bandwidth



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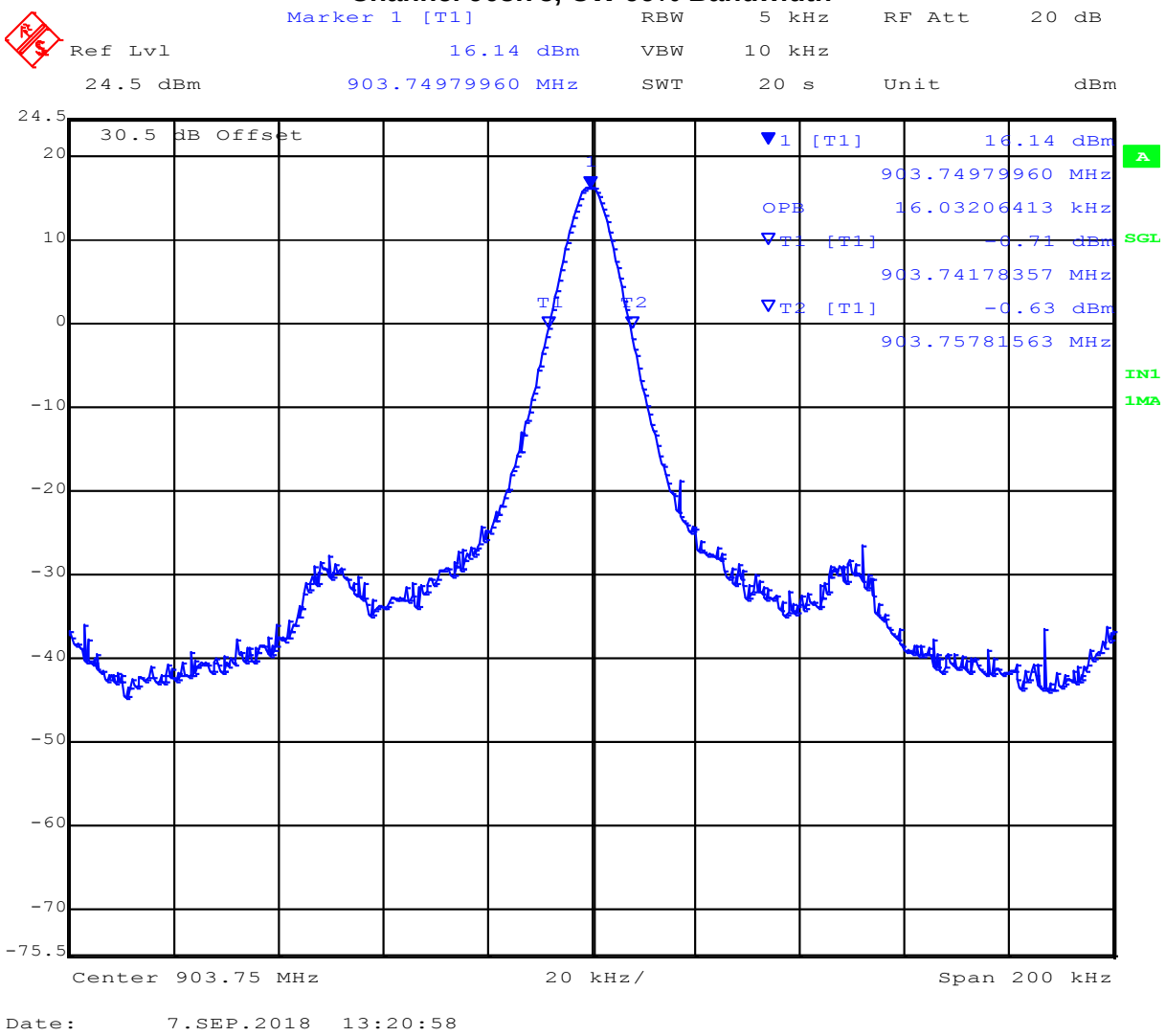
Channel 903.75, CW 99% Bandwidth



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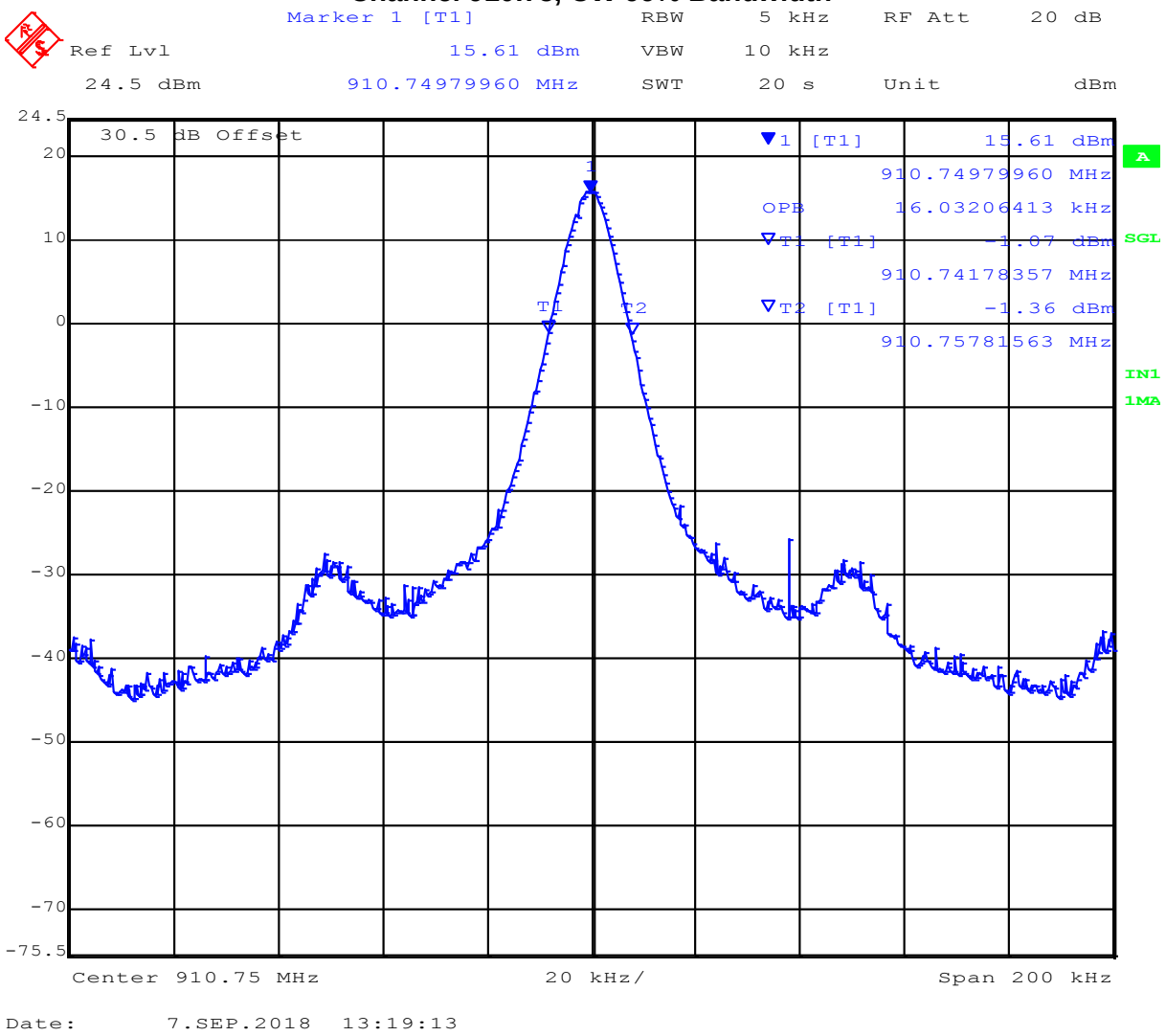
Channel 910.75, CW 99% Bandwidth



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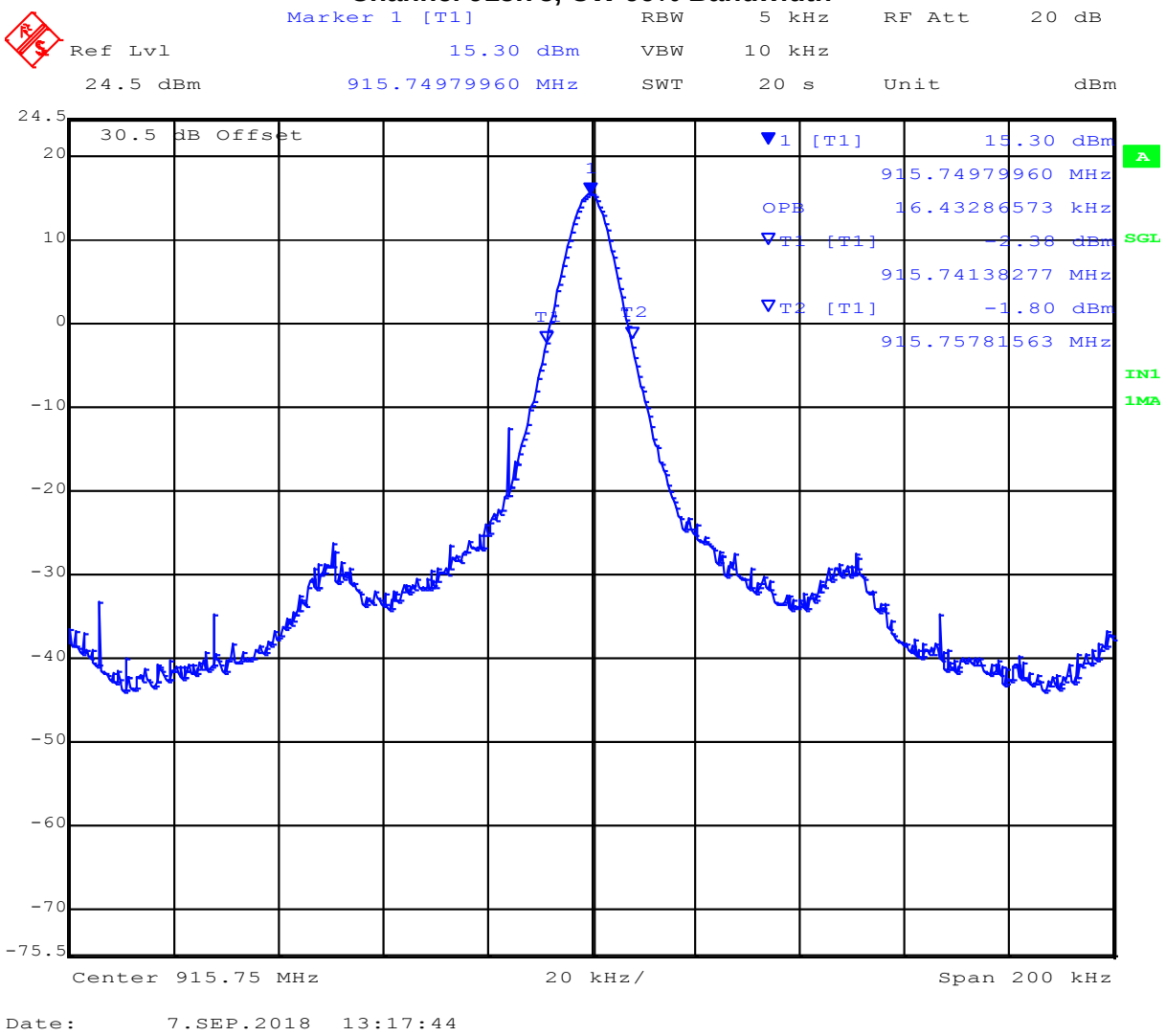
Channel 915.75, CW 99% Bandwidth



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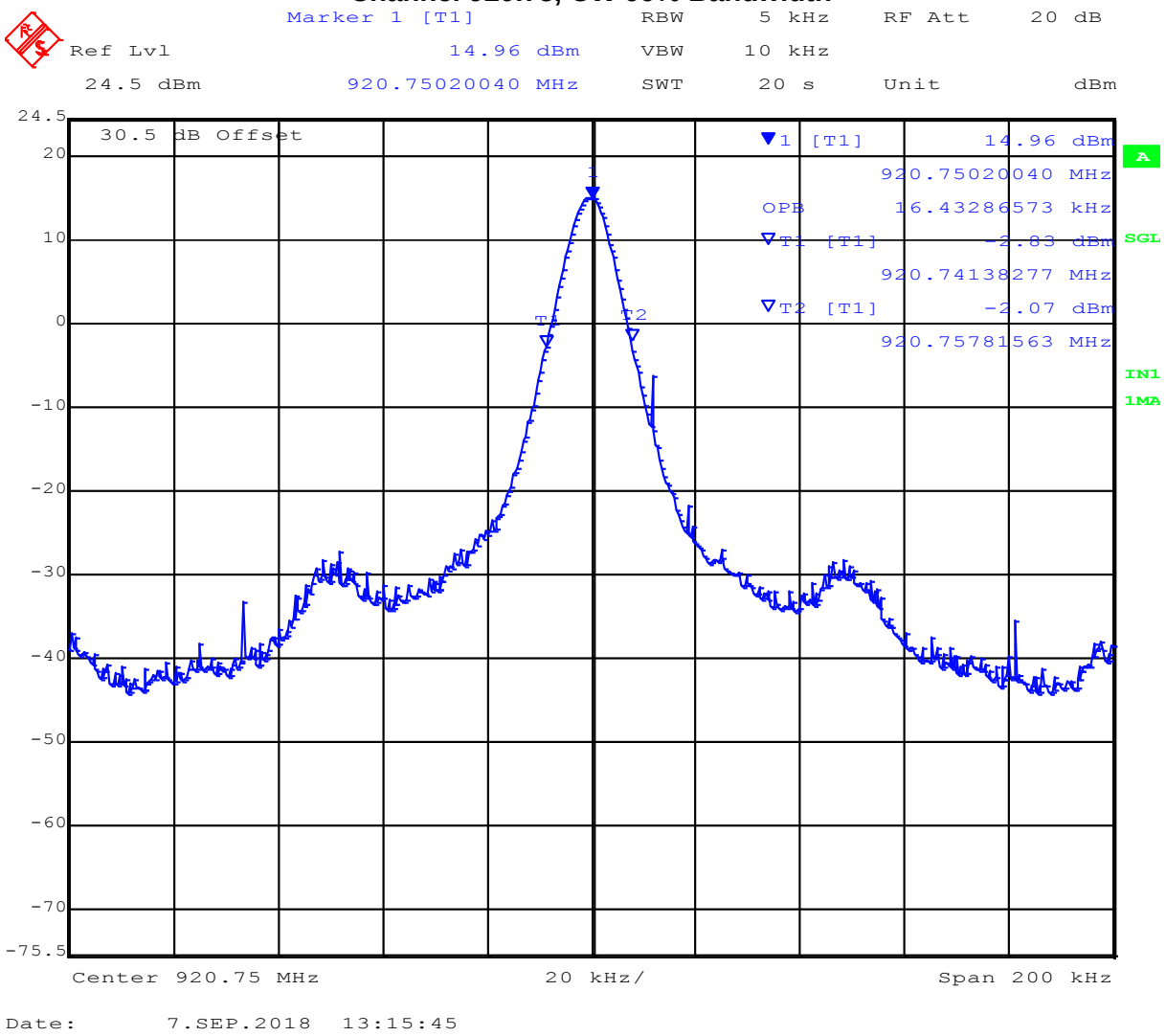
Channel 920.75, CW 99% Bandwidth



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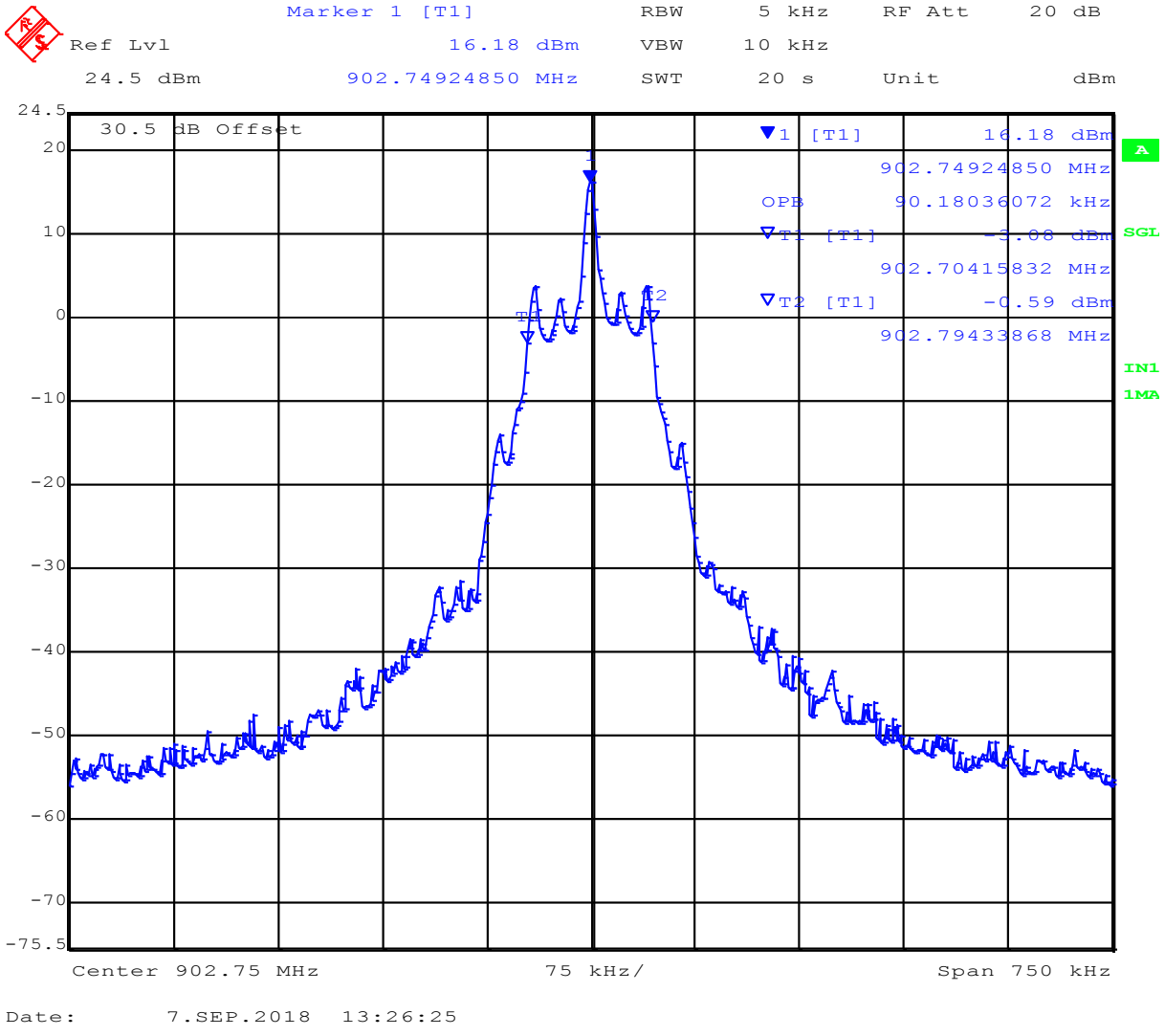
Channel 902.75, OOK 99% Bandwidth



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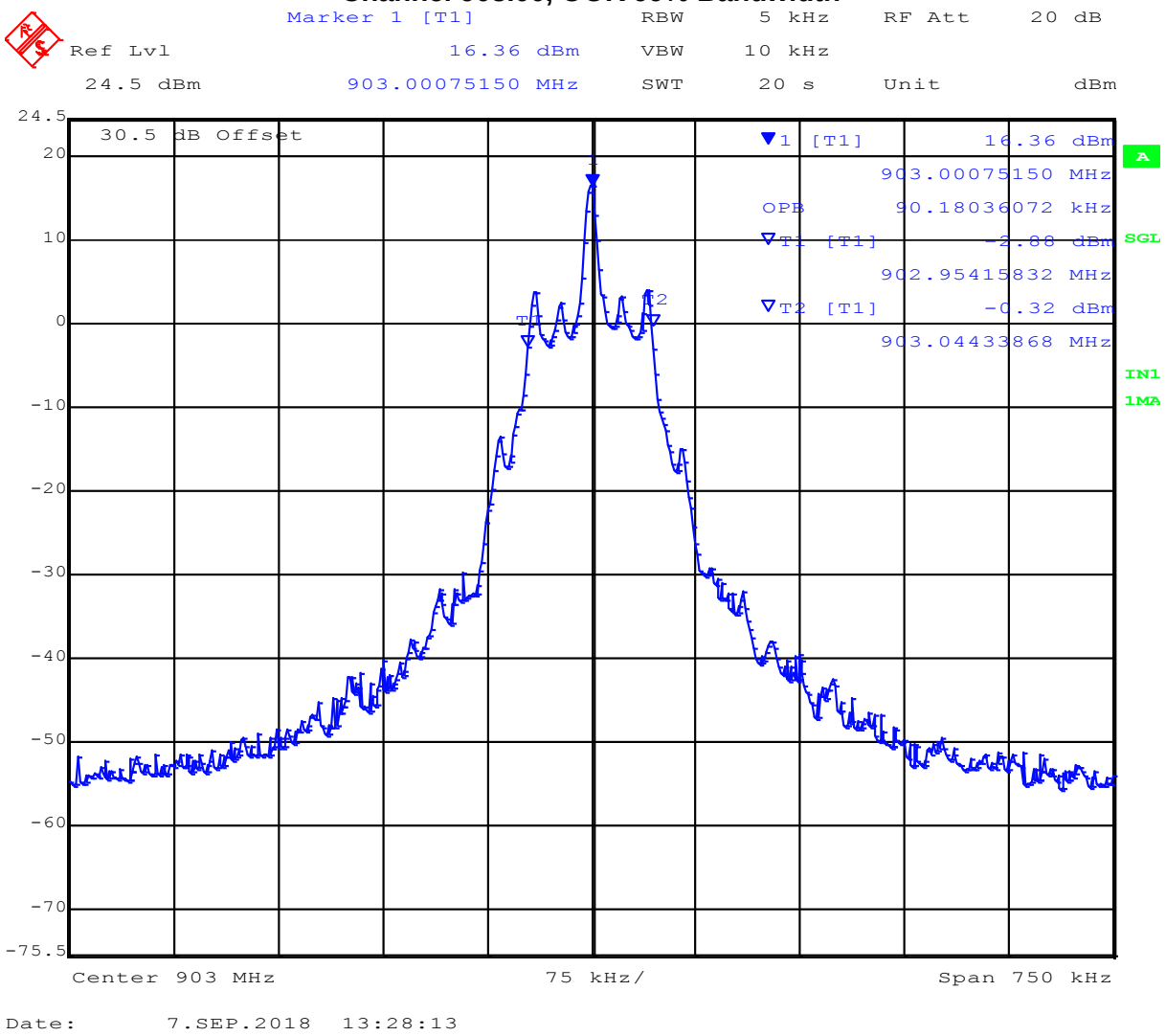
Channel 903.00, OOK 99% Bandwidth



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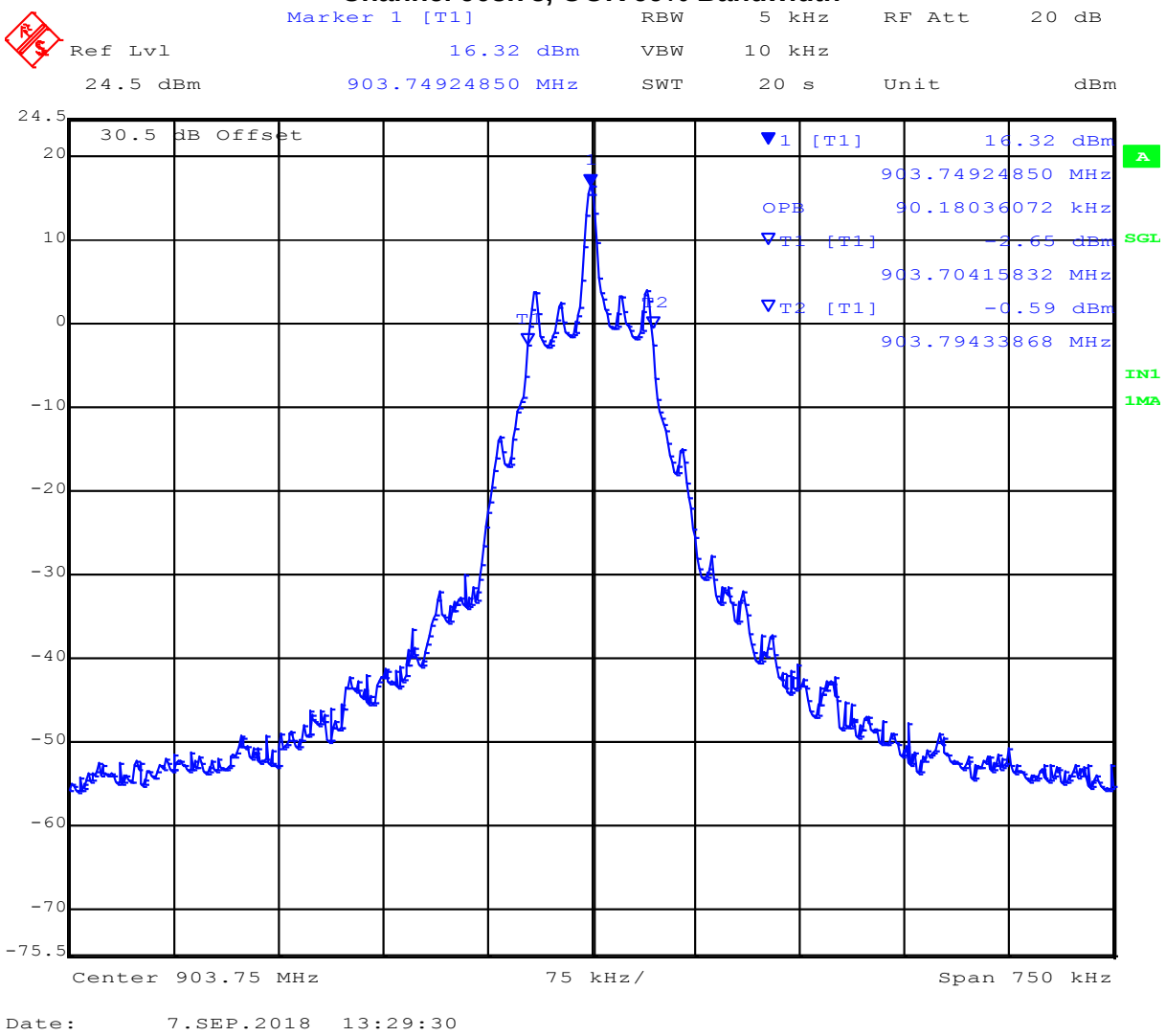
Channel 903.75, OOK 99% Bandwidth



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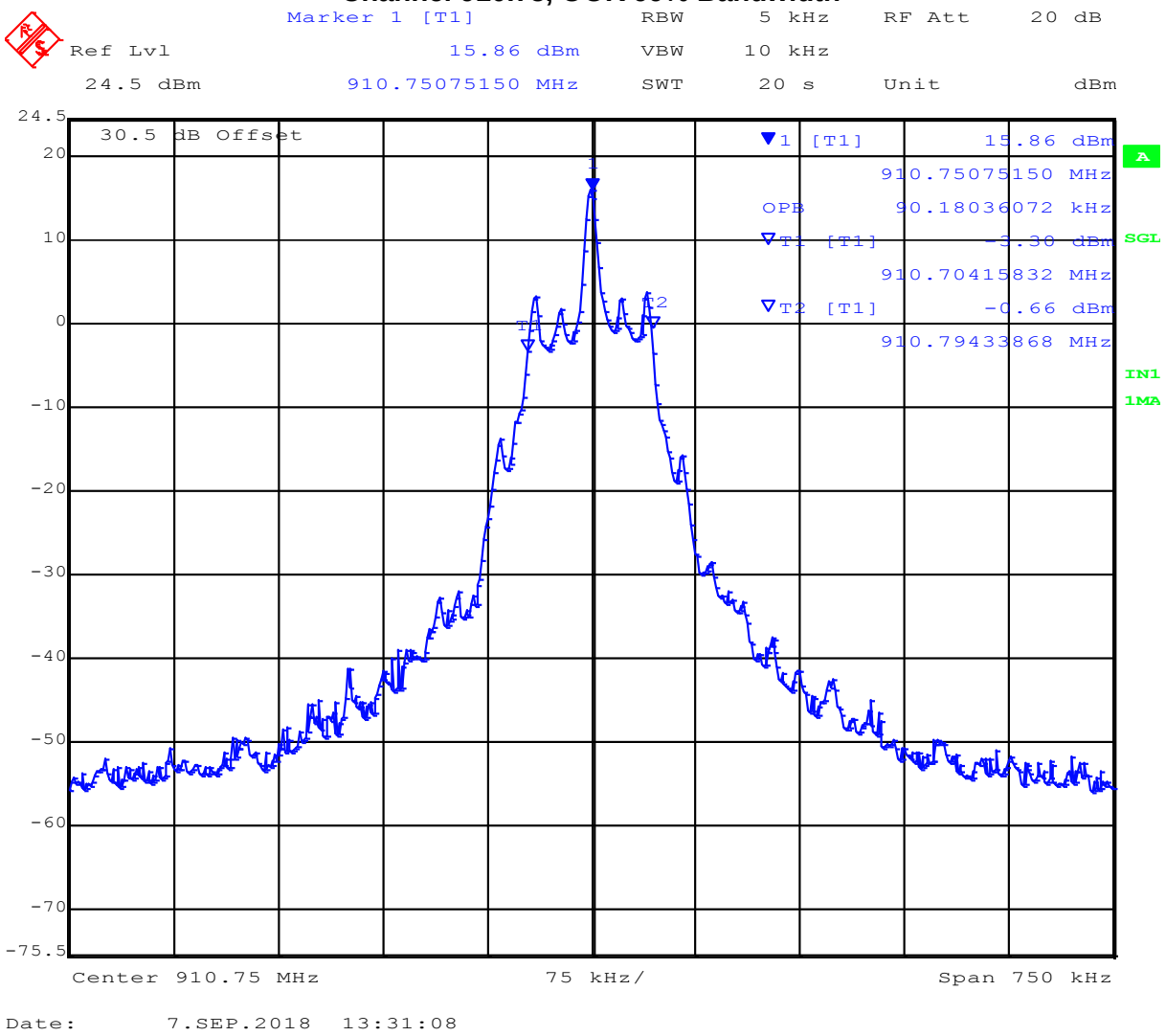
Channel 910.75, OOK 99% Bandwidth



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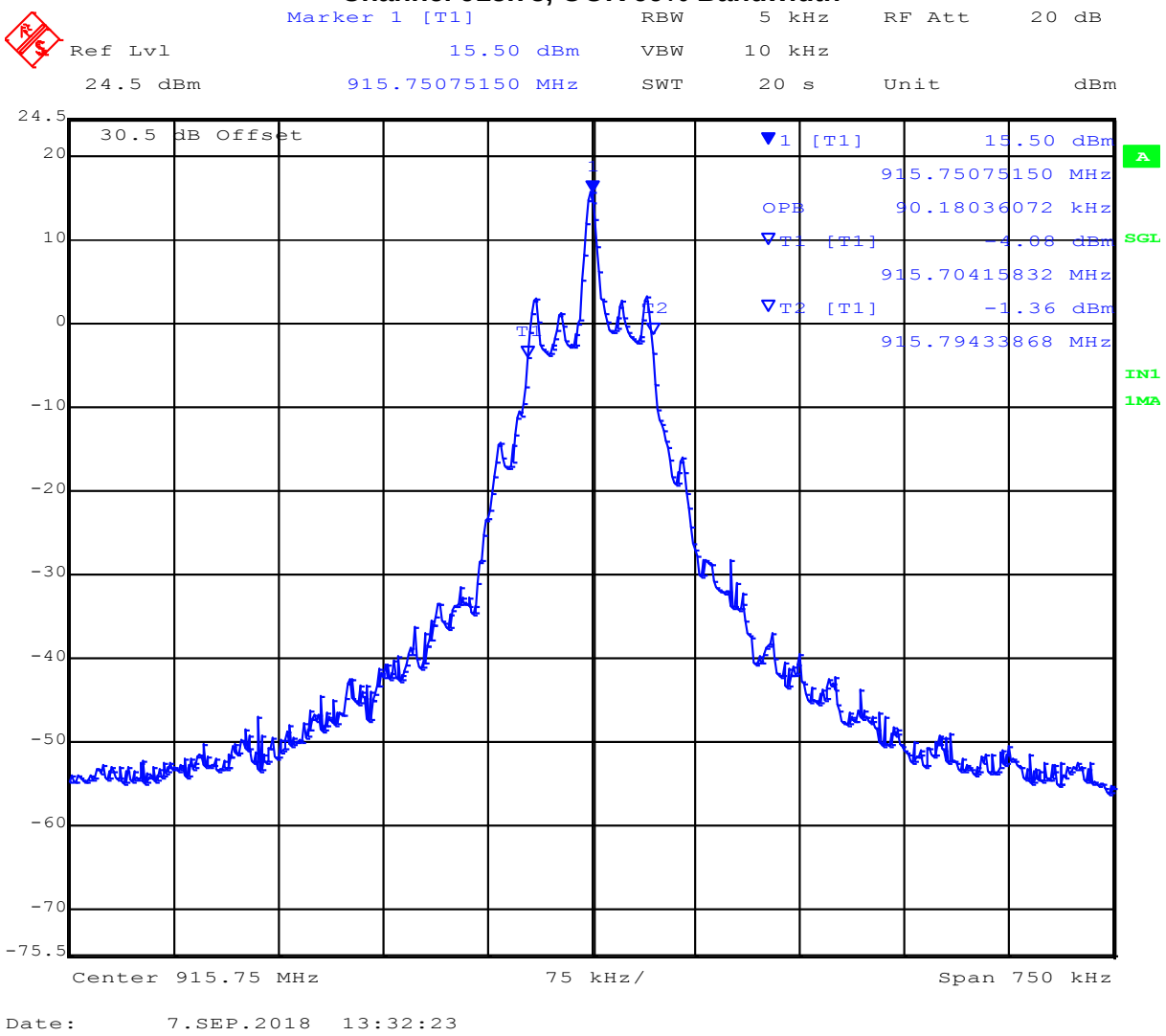
Channel 915.75, OOK 99% Bandwidth



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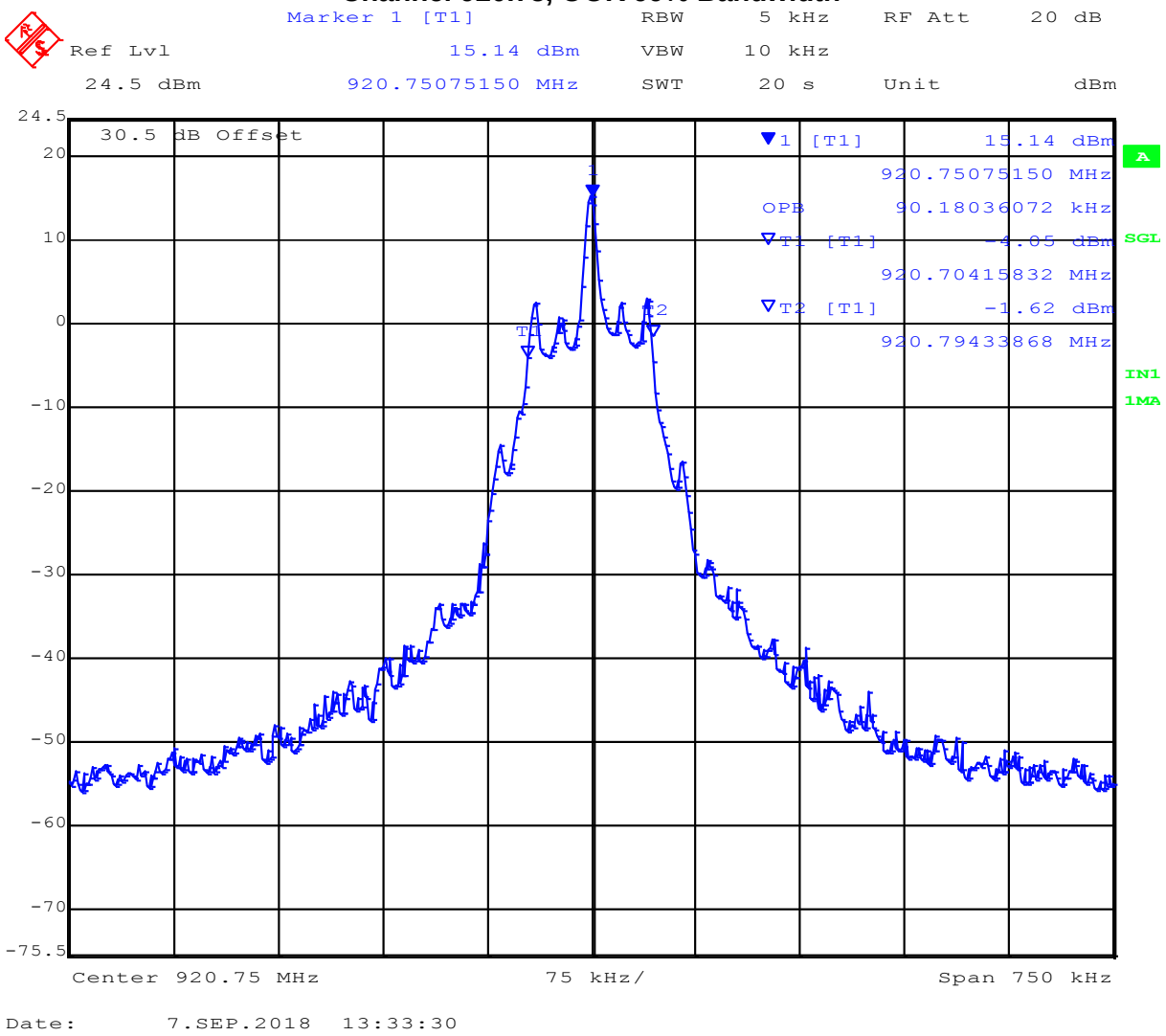
Channel 920.75, OOK 99% Bandwidth



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6.2 Effective Radiated Power

Conducted Test Conditions for Effective Radiated Power			
Standard:	FCC CFR 47:90.353	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Effective Radiated Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	90.205(l)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Effective Radiated Power Measurement
The following power limits apply to the 902 – 928 MHz frequency band MHz band. Power is limited to 30W (44.7 dBm) equivalent effective radiated power (ERP).
ERP (dBm) = Transmit Power (dBm) + Antenna Gain (dBi) – Antenna Conversion to ERP (2.14dB)

Antenna Gain = 1.20 dBi

ERP (dBm) = Transmit Power (dBm) + 1.20 dBi -2.14 dB

Test Procedure
Peak power measurements were measured with the use of a peak power head. The system highest power setting was selected with modulation OFF (CW) and ON (OOK).

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Equipment Configuration for Effective Radiated Power			
Variant:	CW	**Duty Cycle (%):**	99.0
Data Rate:	110 KBit/s	**Antenna Gain (dBi):**	1.20
Modulation:	CW	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	VC
Engineering Test Notes:	None		

Test Measurement Results

Test Frequency	Measured Conducted Output Power (dBm) Port(s)				Calculated Total ERP	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	Σ Port(s) dBm + AG -2.14	dBm	dB	
902.75	16.22	-	-	-	15.28	44.77	-29.49	10
903.00	15.44	-	-	-	14.50	44.77	-30.27	10
903.75	15.32	-	-	-	14.38	44.77	-30.39	10
910.75	15.09	-	-	-	14.15	44.77	-30.62	10
915.75	14.37	-	-	-	13.43	44.77	-31.34	10
920.75	14.12	-	-	-	13.18	44.77	-31.59	10

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

*Total ERP = Conducted Power (dBm) + Antenna Gain (dBi) – 2.14 (dB)

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Equipment Configuration for Effective Radiated Power			
Variant:	OOK	**Duty Cycle (%):**	99.0
Data Rate:	110 KBit/s	**Antenna Gain (dBi):**	1.20
Modulation:	OOK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	VC
Engineering Test Notes:	None		

Test Measurement Results

Test Frequency	Measured Conducted Output Power (dBm) Port(s)				Calculated Total ERP	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	Σ Port(s) dBm +AG-2.14	dBm	dB	
902.75	15.22	-	-	-	14.28	44.77	-30.49	10
903.00	15.31	-	-	-	14.37	44.77	-30.40	10
903.75	15.45	-	-	-	14.51	44.77	-30.26	10
910.75	14.72	-	-	-	13.78	44.77	-30.99	10
915.75	14.71	-	-	-	13.77	44.77	-31.00	10
920.75	14.20	-	-	-	13.26	44.77	-31.51	10

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

*Total ERP = Conducted Power (dBm) + Antenna Gain (dBi) – 2.14 (dB)

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6.3 Frequency Stability; Temperature Variations, and Voltage Variations

Conducted Test Conditions for Frequency Stability			
Standard:	FCC CFR 47:90.353	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Frequency Stability	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	90.213	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Frequency Stability Measurement
The transmitter output was connected to a spectrum analyzer and the frequency stability was measured in a CW (un-modulated) operational mode.

Frequency stability was measured through the extremes of temperature on the mid channel only. Before measurements were taken at each temperature the equipment waited until thermal balance was obtained.

Test Procedure
Peak power measurements were measured with the use of a peak power head. The system highest power setting was selected with modulation OFF (CW) and ON (OOK).

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Measurement Results for Frequency Stability

Delta kHz and ppm were measured from the actual channel frequency **915.75** MHz

Limit per Pt 90.213 is ±2.5 ppm.

Voltage (Vdc)	Temperature (°C)	Marker Frequency (MHz)	Delta (kHz)	ppm
5.00	-20	915.7500040	0.004	0.004
	-10	915.7499860	-0.014	-0.015
	0	915.7500321	0.032	0.035
	+10	915.7499479	-0.052	-0.057
	+20	915.7497158	-0.284	-0.310
	+30	915.7497615	-0.238	-0.260
	+40	915.7498156	-0.184	-0.201
	+50	915.7497515	-0.248	-0.271
4.50	+20	915.7497535	-0.246	-0.269
5.50	+20	915.7497275	-0.273	-0.298
Maximum Frequency Drift with respect to the nominal frequency.		284 kHz -0.310 ppm. Limit = ±2.5 ppm		
Measurement uncertainty		±0.866 ppm		

With reference to the band-edge plots in Section 5.1 Occupied Bandwidth and Band-edge the above Frequency Error proves that the EUT remains inside the frequency band of operation during changes in environmental conditions.

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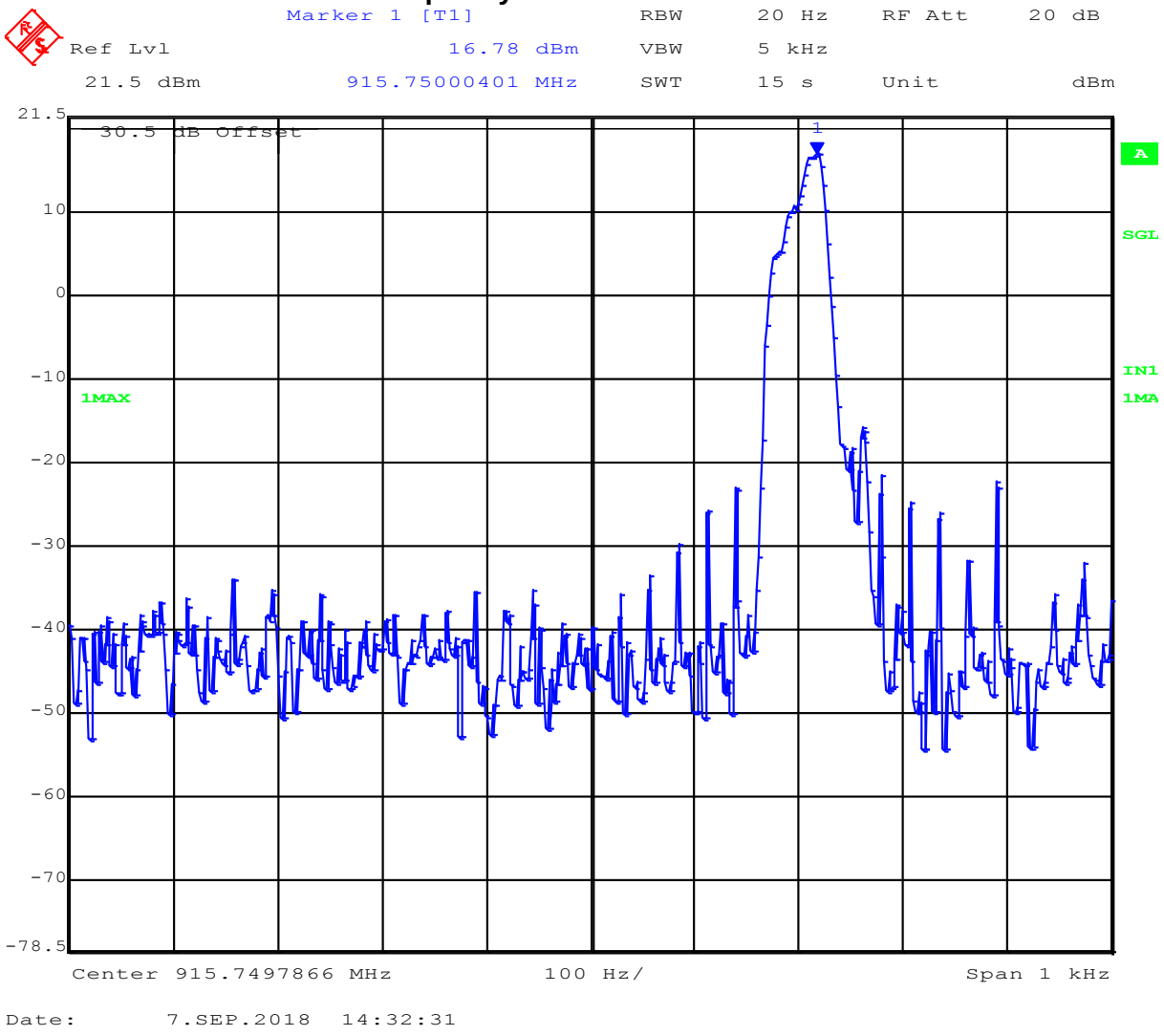
Frequency Error -20°C +5.00 Vdc



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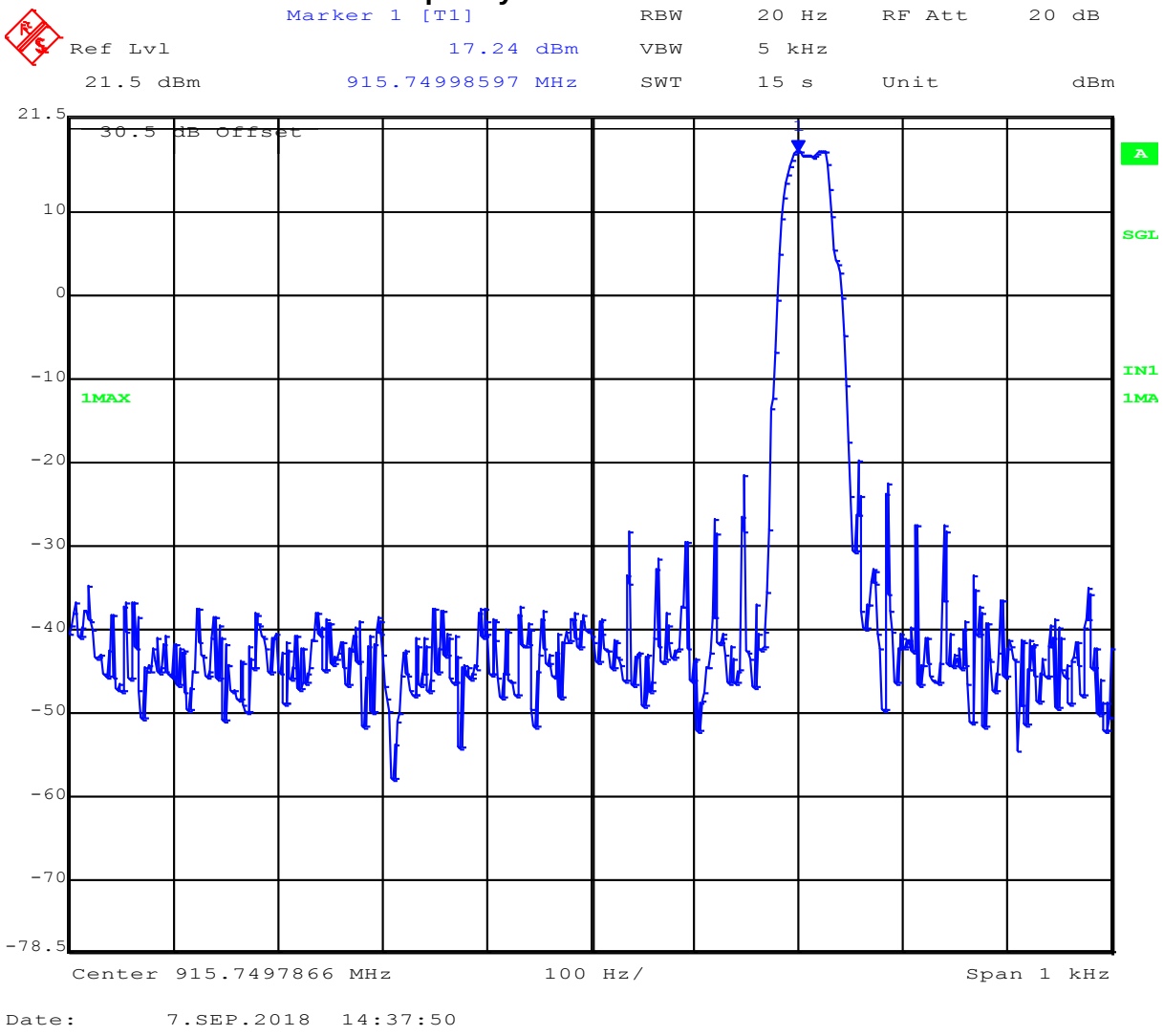
Frequency Error -10°C +5.00 Vdc



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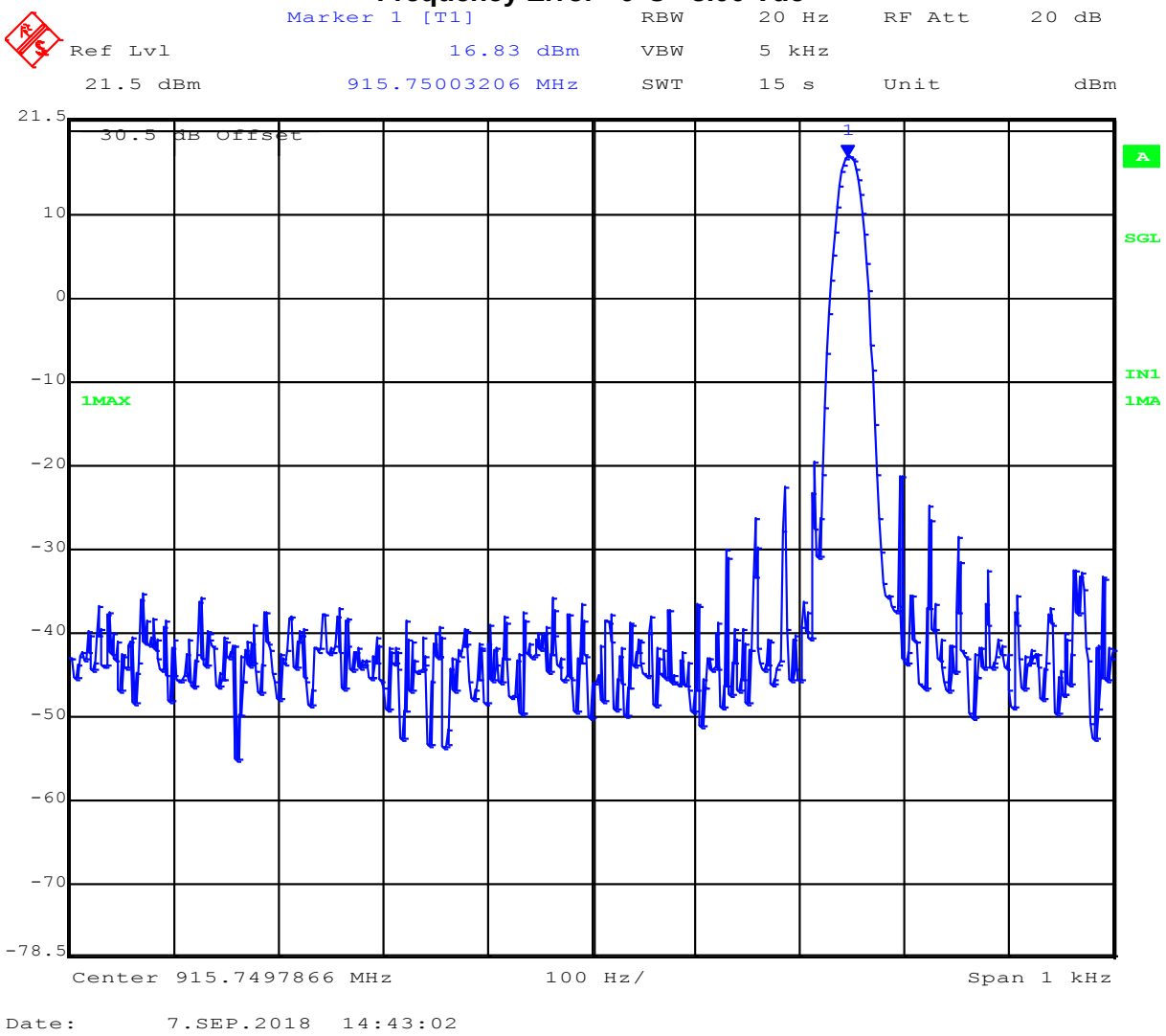
Frequency Error +0°C +5.00 Vdc



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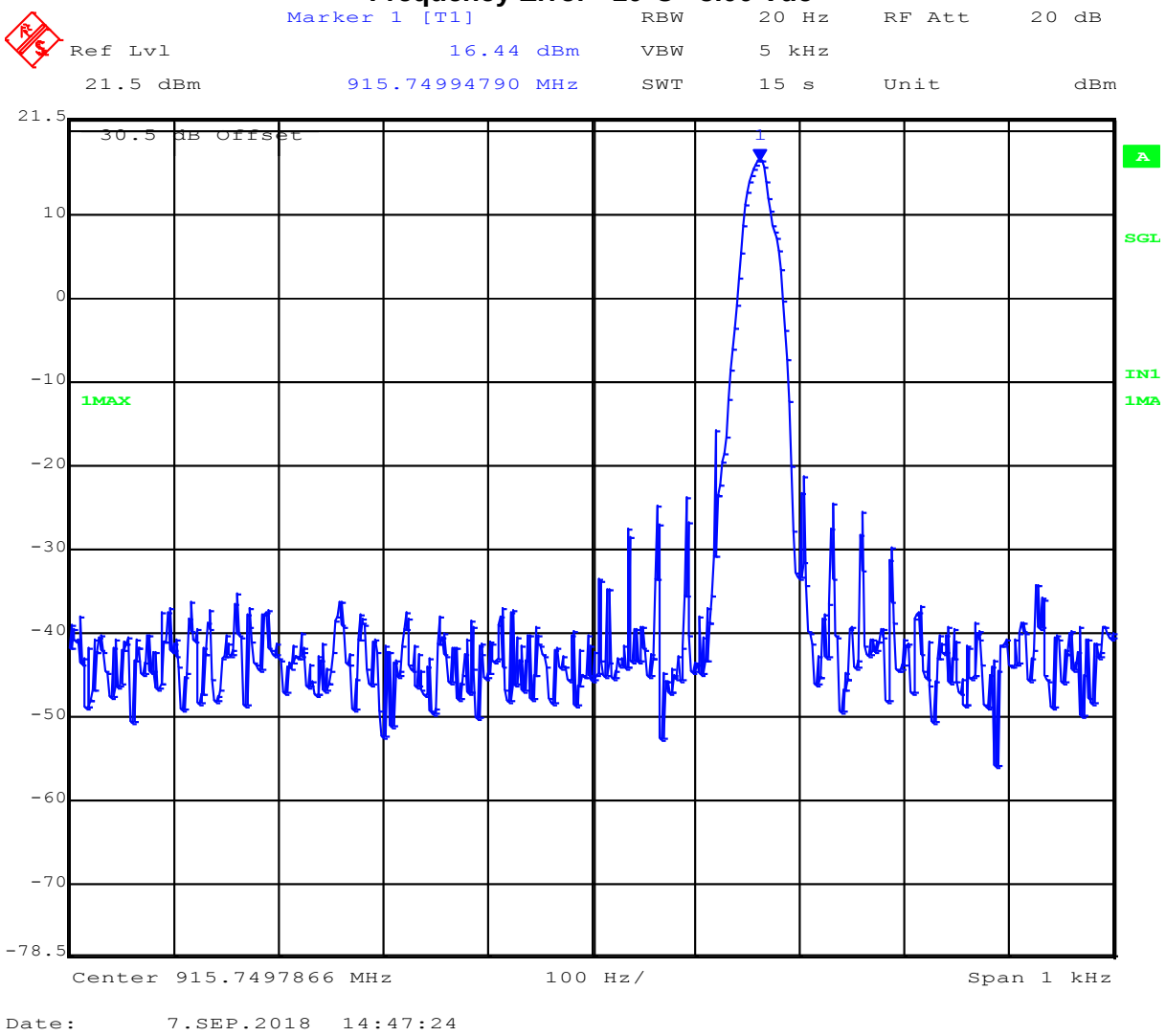
Frequency Error +10°C +5.00 Vdc



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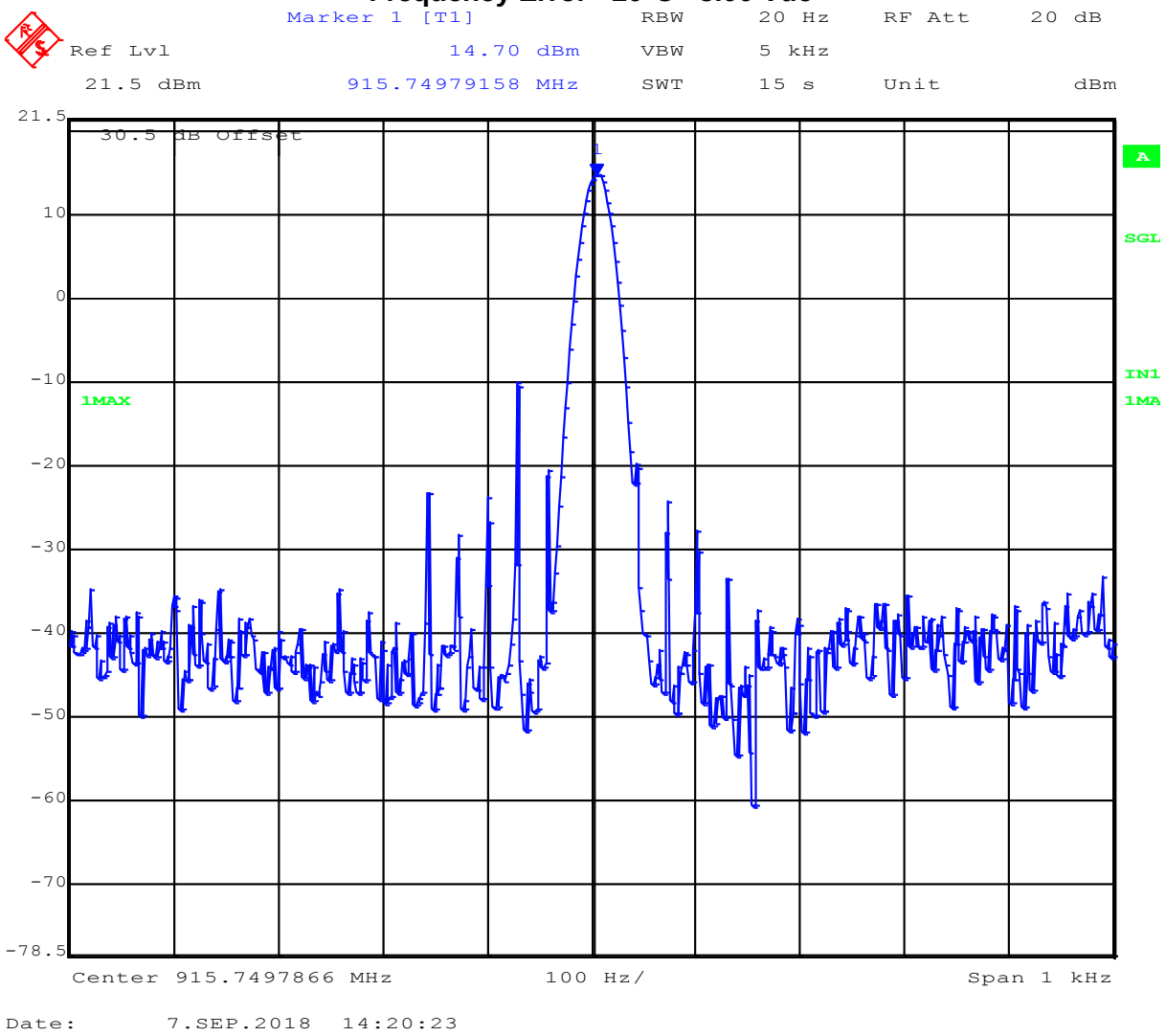
Frequency Error +20°C +5.00 Vdc



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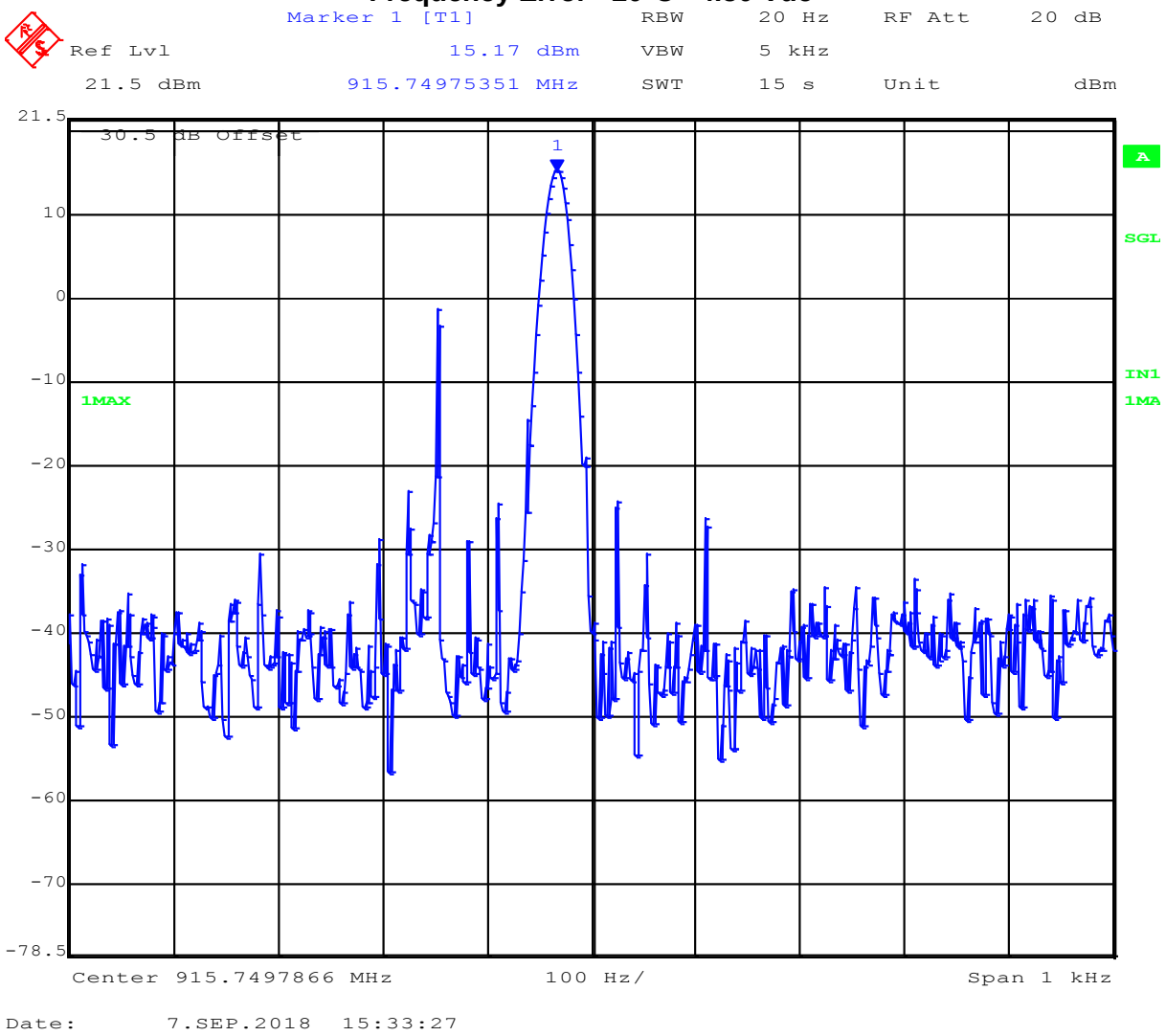
Frequency Error +20°C +4.50 Vdc



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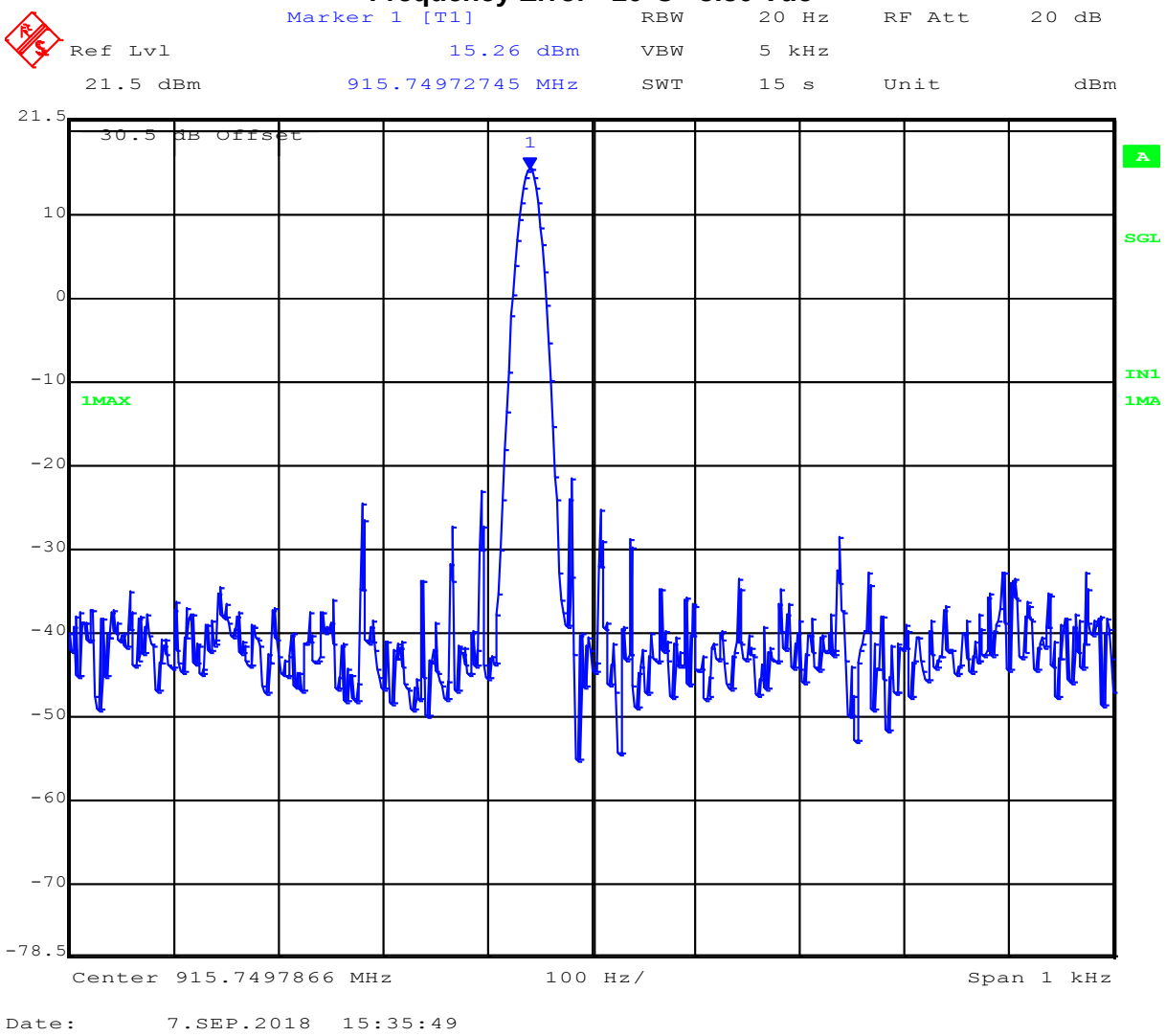
Frequency Error +20°C +5.50 Vdc



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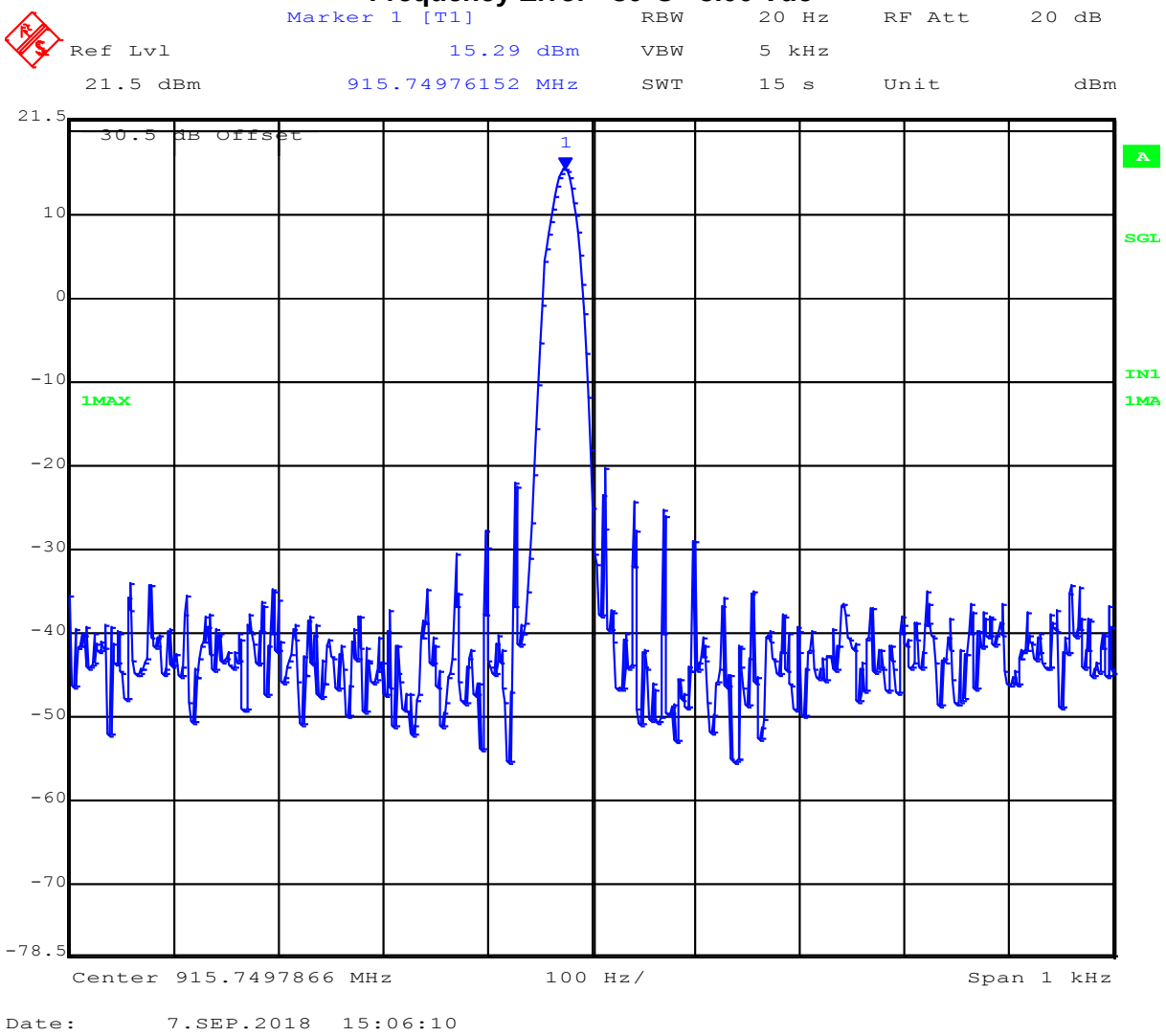
Frequency Error +30°C +5.00 Vdc



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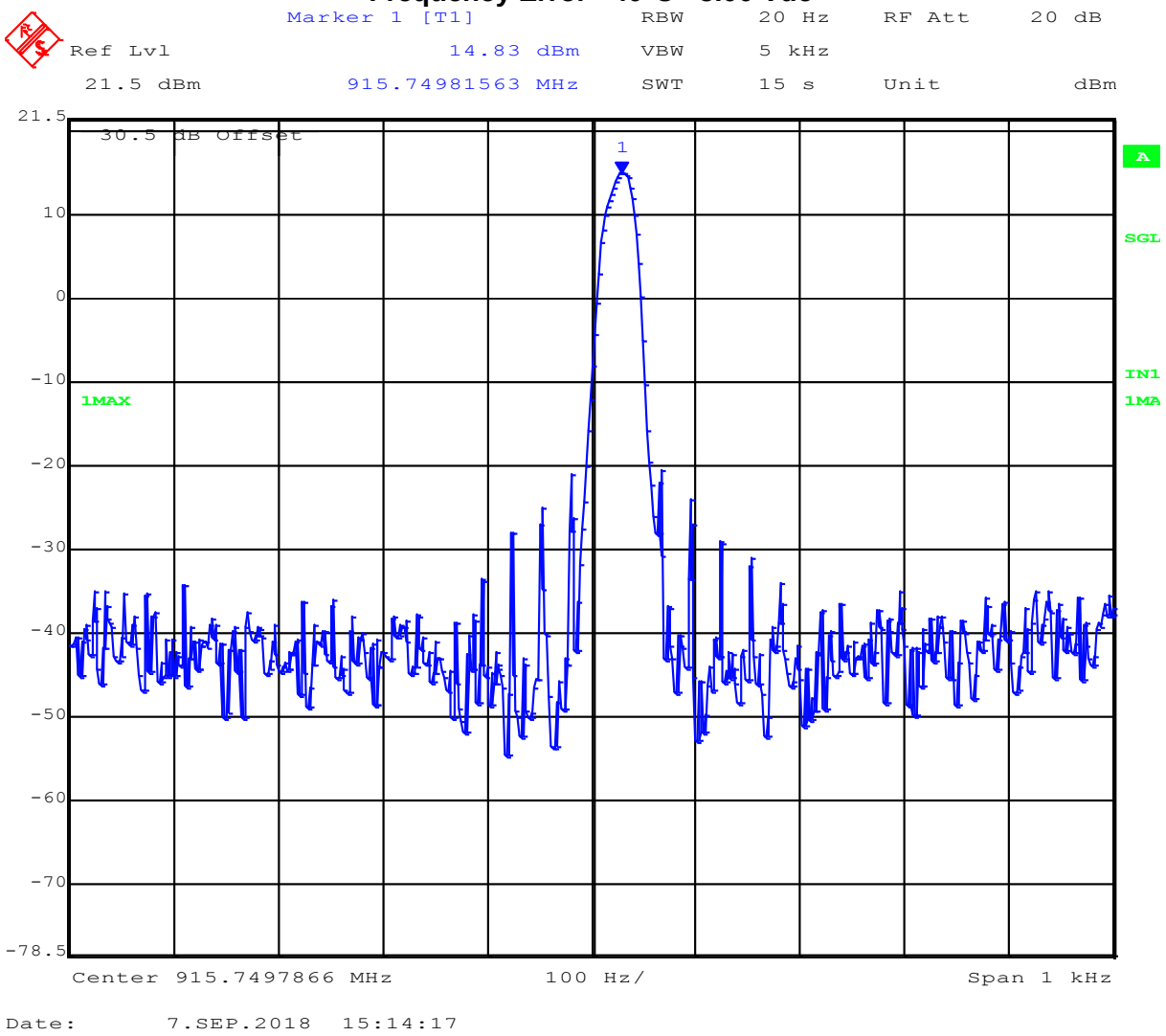
Frequency Error +40°C +5.00 Vdc



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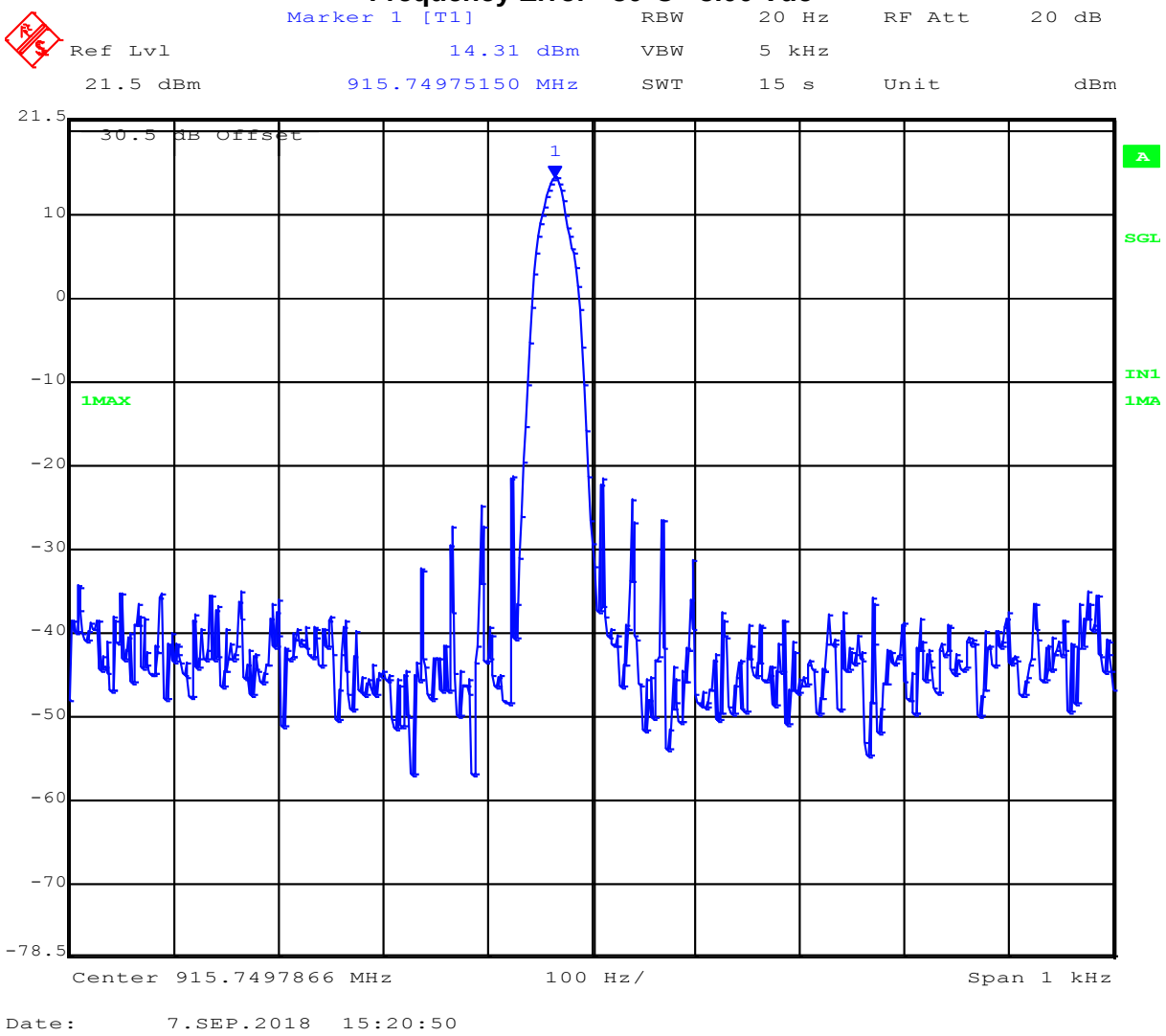
Frequency Error +50°C +5.00 Vdc



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6.4 Conducted Spurious Emissions

Conducted Test Conditions for Transmitter Conducted Spurious Emissions			
Standard:	FCC CFR 47:90.353	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Max Unwanted Emission Levels	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	2.1051, 90.210(k)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Transmitter Conducted Spurious Emissions Measurement
Transmitter Conducted Spurious emissions were measured at a limit of -25.00 dBm below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Measurements were made while EUT was operating in transmit mode of operation at the appropriate centre frequency closest to the band-edge. Emissions were maximized during the measurement and limits derived from the peak spectral power and drawn on each plot.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limits
For operation in the 902 – 928 MHz band the limits are defined as the power of any emission outside the frequency band of operation being attenuated below the transmitter power (P) within the licensed band of operation, measured in Watts, by at least

55 + 10*Log (P) = -25 dBm.
P = Maximum Power = +16.22 dBm = 0.042 W
Attenuation = 41.22 dB
Limit = -25 dBm

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Equipment Configuration for Conducted Spurious Emissions			
Variant:	CW	**Duty Cycle (%):**	99
Data Rate:	110 KBit/s	**Antenna Gain (dBi):**	1.20
Modulation:	CW	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	OC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Conducted Spurious Emissions - Peak (dBm)		Margin
		Port a		
MHz	MHz	SE	Limit	
902.75	30.0 - 1000.0	-37.71	-25.00	-12.71
	1000.00 - 10000.0	-36.42	-25.00	-11.42
903.00	30.0 - 1000.0	-37.59	-25.00	-12.59
	1000.00 - 10000.0	-36.26	-25.00	-11.26
903.75	30.0 - 1000.0	-36.39	-25.00	-11.39
	1000.00 - 10000.0	-36.26	-25.00	-11.26
910.75	30.0 - 1000.0	-36.90	-25.00	-11.9
	1000.00 - 10000.0	-36.42	-25.00	-11.42
915.75	30.0 - 1000.0	-36.66	-25.00	-11.66
	1000.00 - 10000.0	-36.42	-25.00	-11.42
920.75	30.0 - 1000.0	-38.81	-25.00	-13.81
	1000.00 - 10000.0	-36.42	-25.00	-11.42

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

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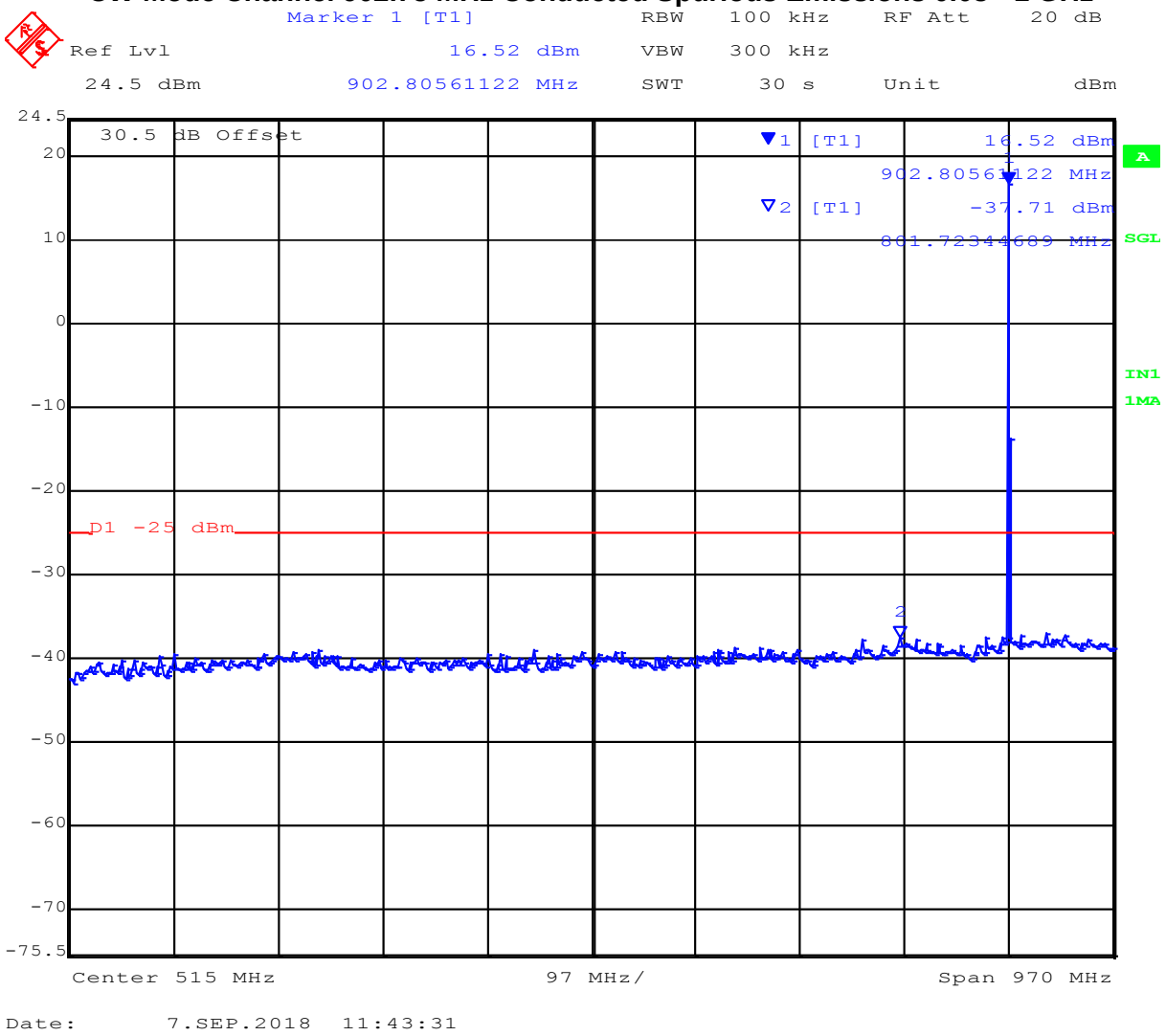
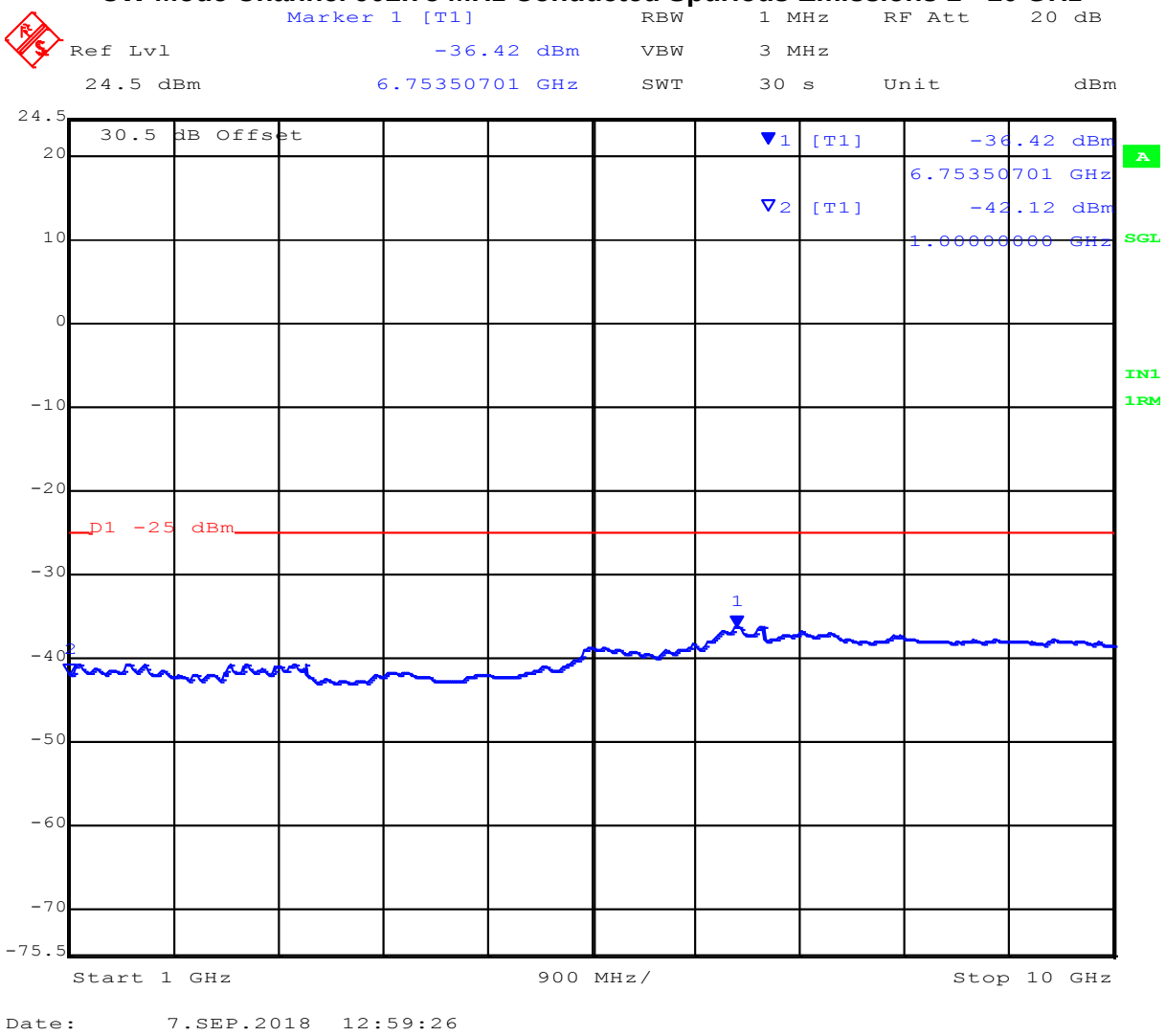
CW Mode Channel 902.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz



Note: The emission breaking the limit line is the fundamental carrier

CW Mode Channel 902.75 MHz Conducted Spurious Emissions 1 - 10 GHz



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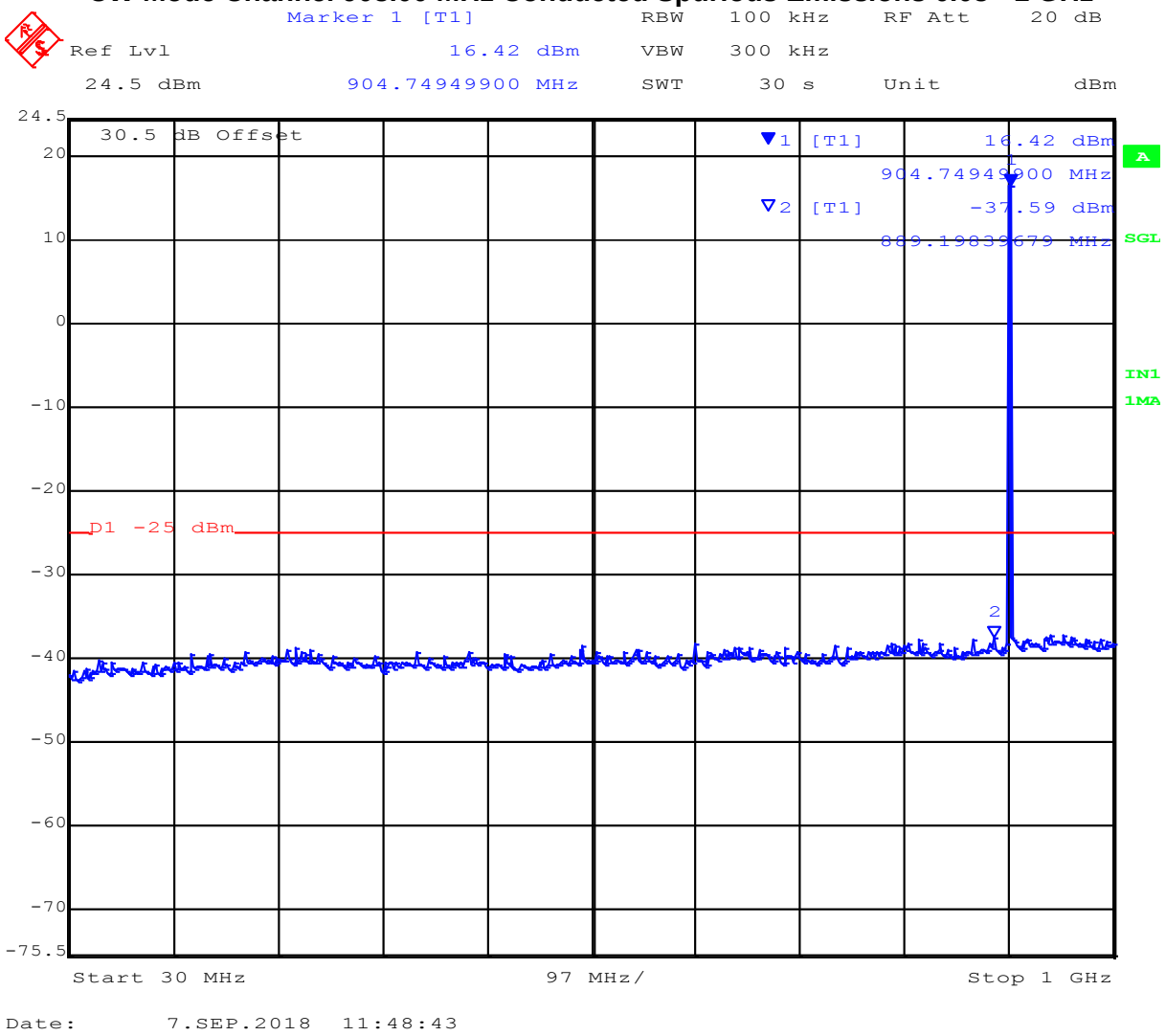
CW Mode Channel 903.00 MHz Conducted Spurious Emissions 0.03 - 1 GHz



Note: The emission breaking the limit line is the fundamental carrier

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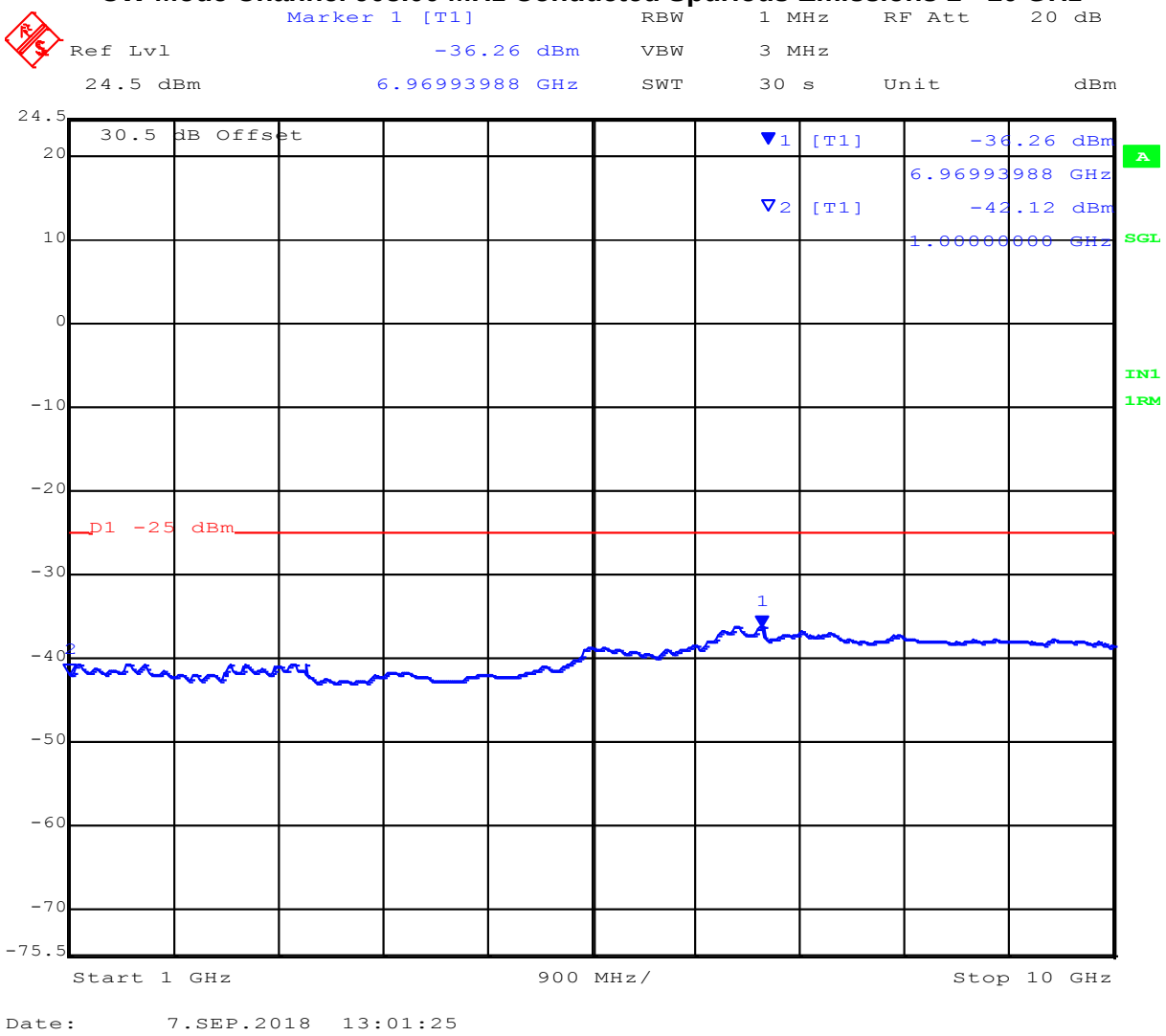
CW Mode Channel 903.00 MHz Conducted Spurious Emissions 1 - 10 GHz



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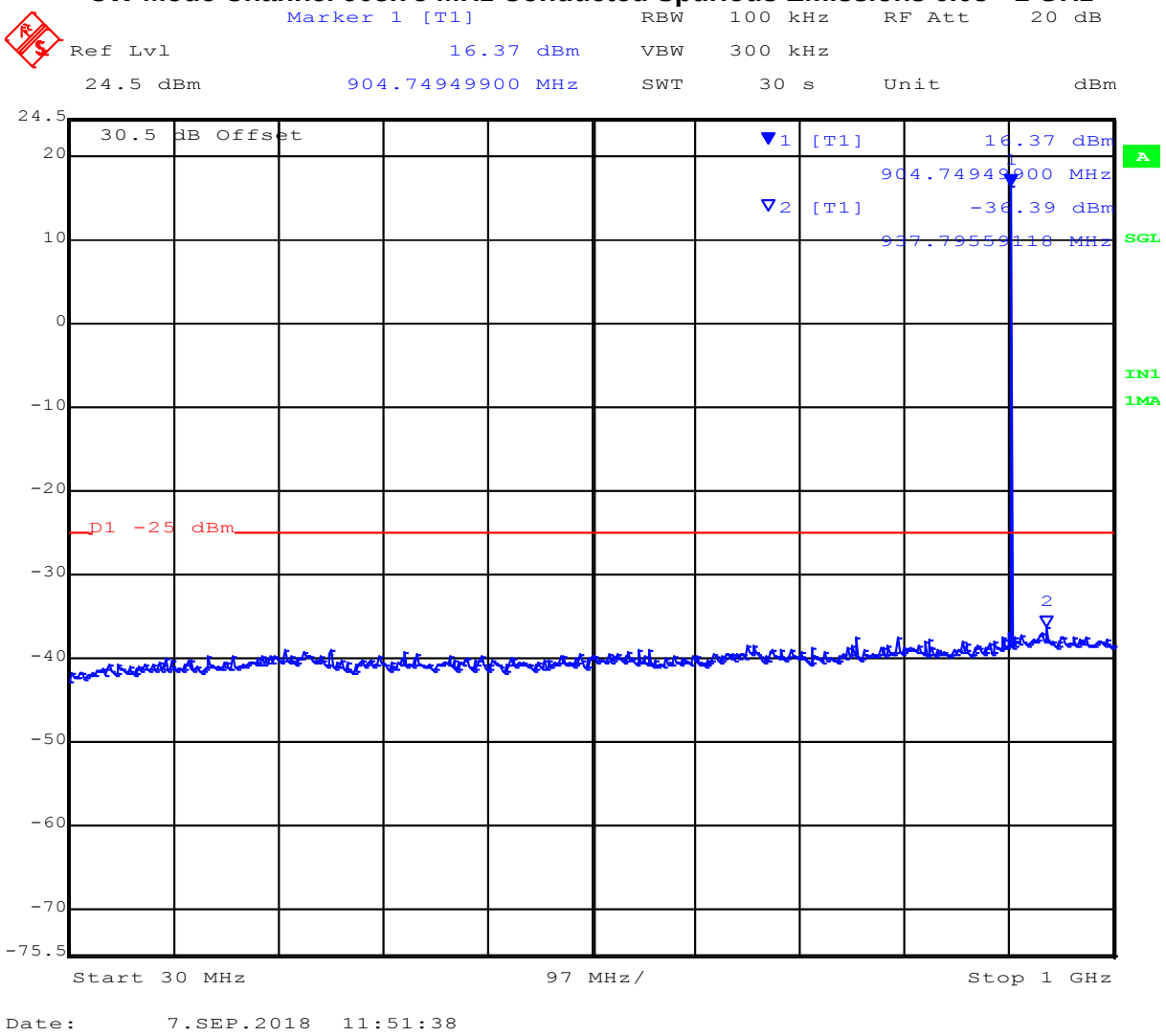
CW Mode Channel 903.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz



Note: The emission breaking the limit line is the fundamental carrier

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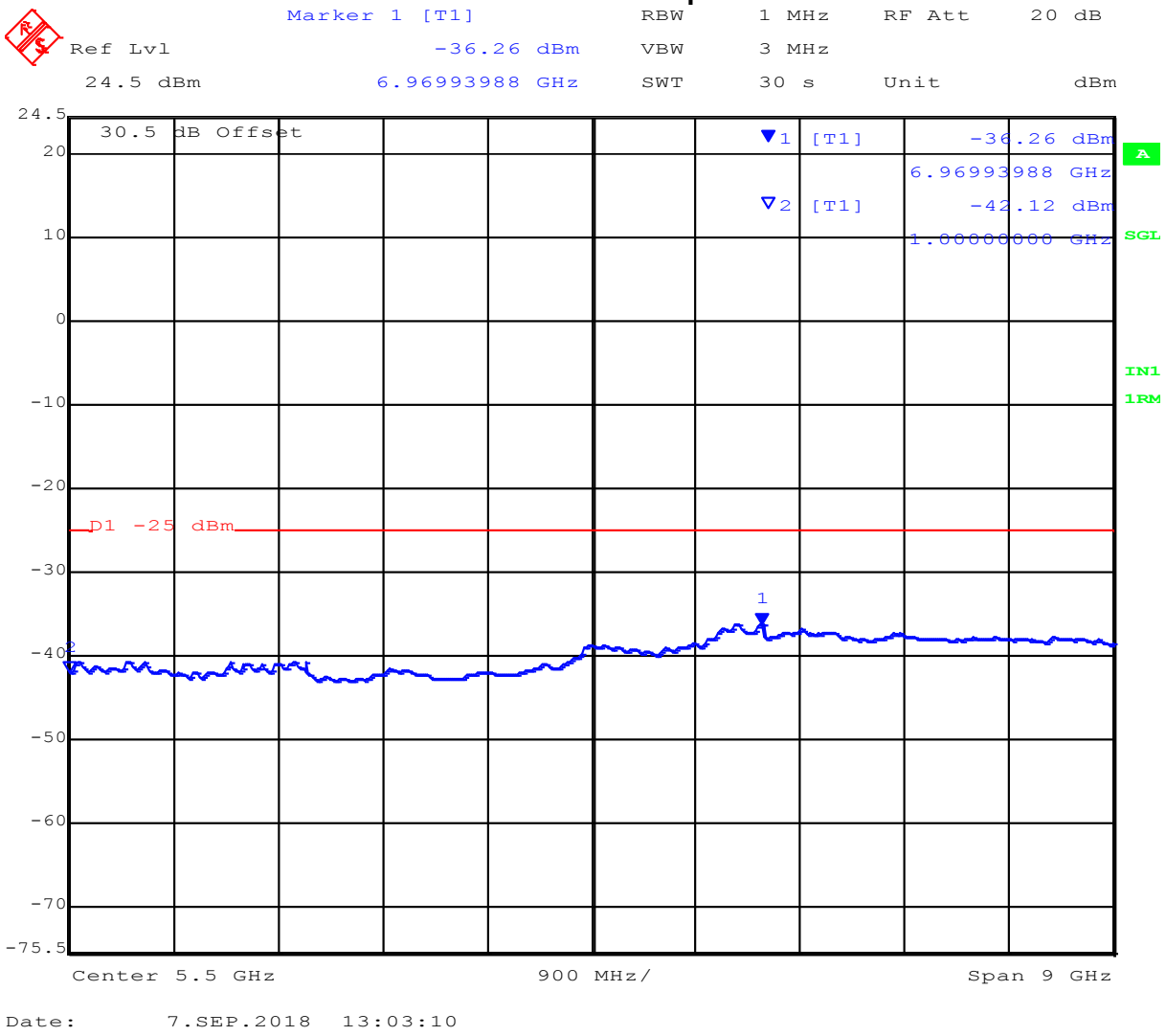
CW Mode Channel 903.75 MHz Conducted Spurious Emissions 1 - 10 GHz



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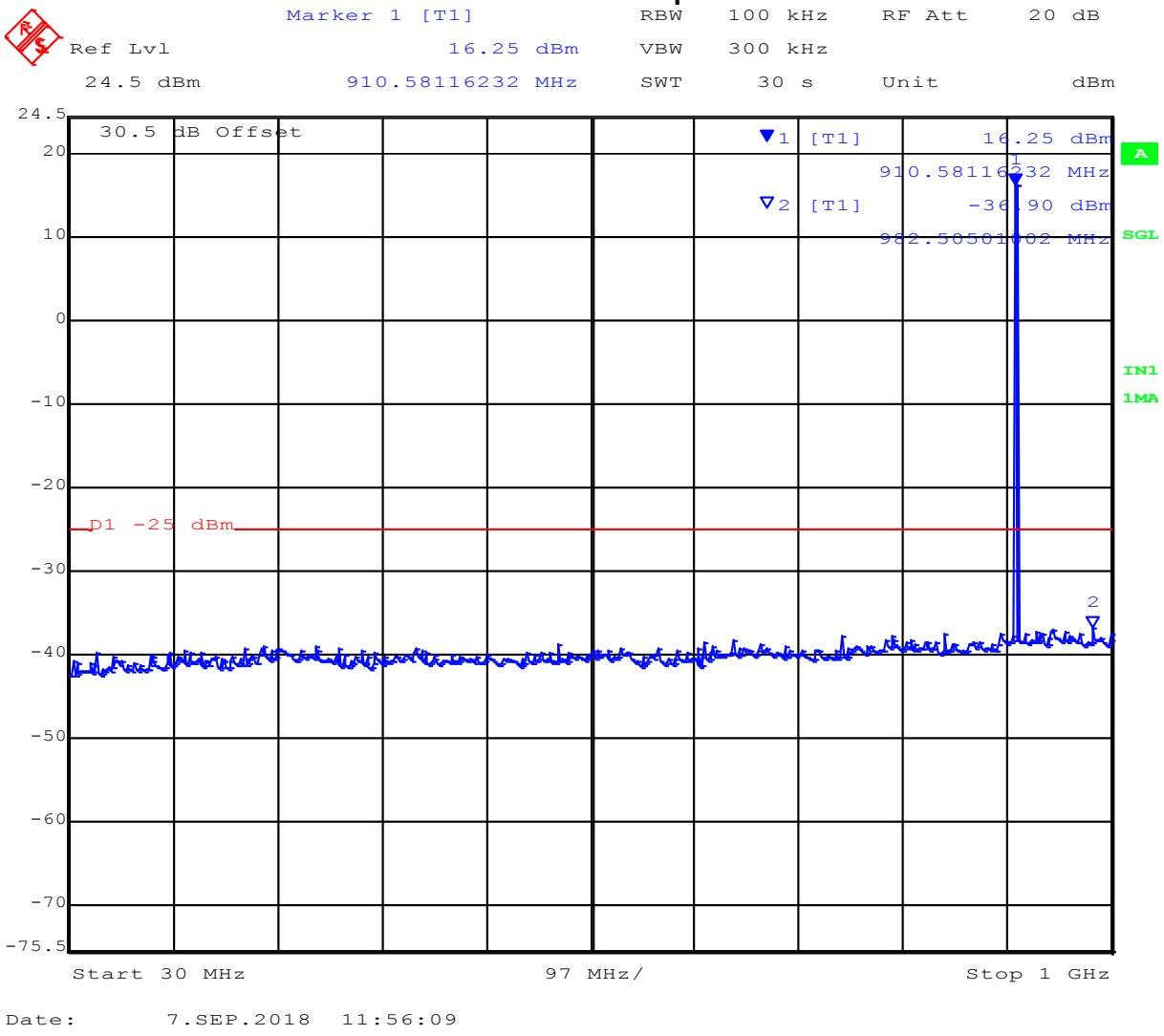
CW Mode Channel 910.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz



Note: The emission breaking the limit line is the fundamental carrier

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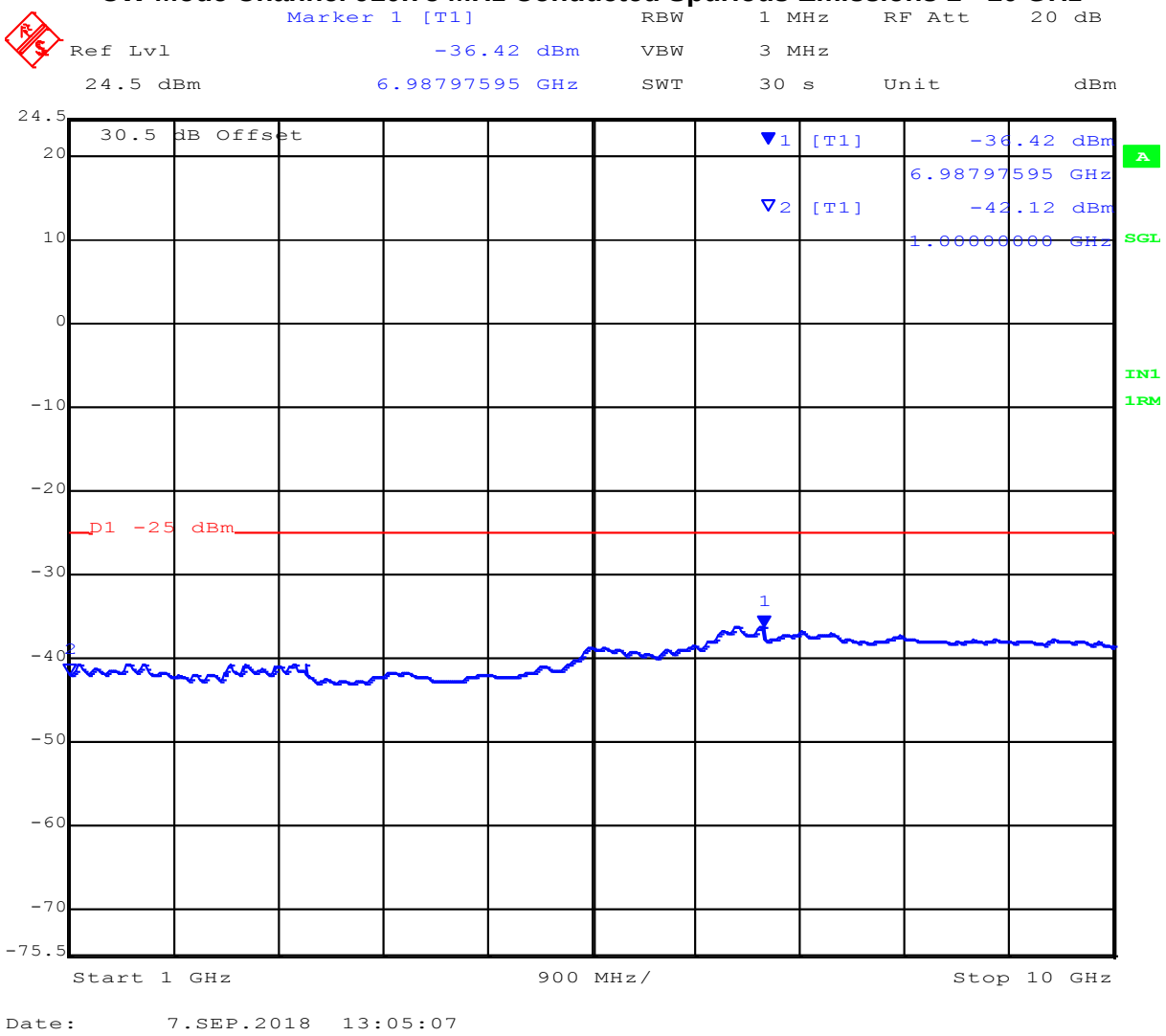
CW Mode Channel 910.75 MHz Conducted Spurious Emissions 1 - 10 GHz



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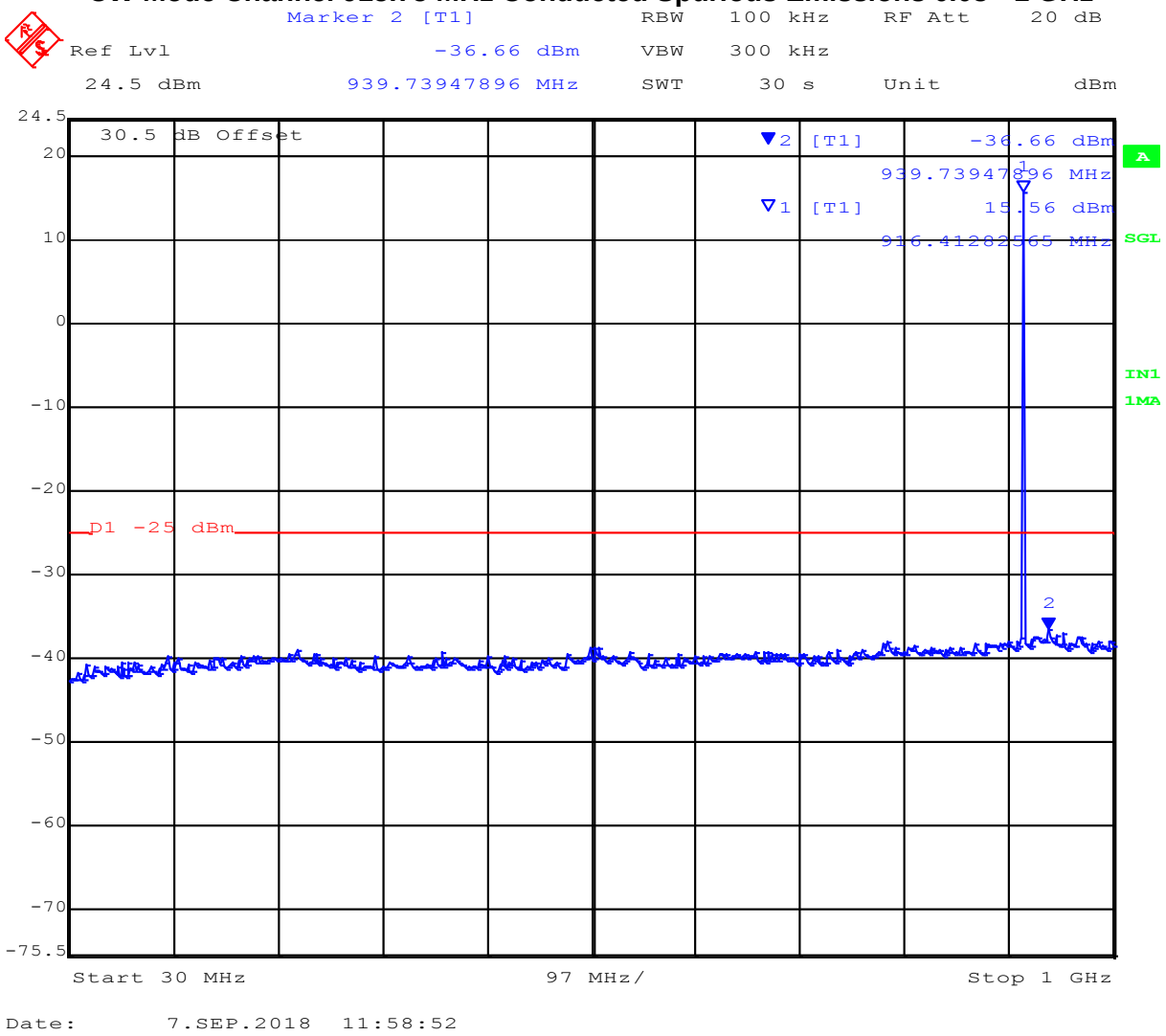
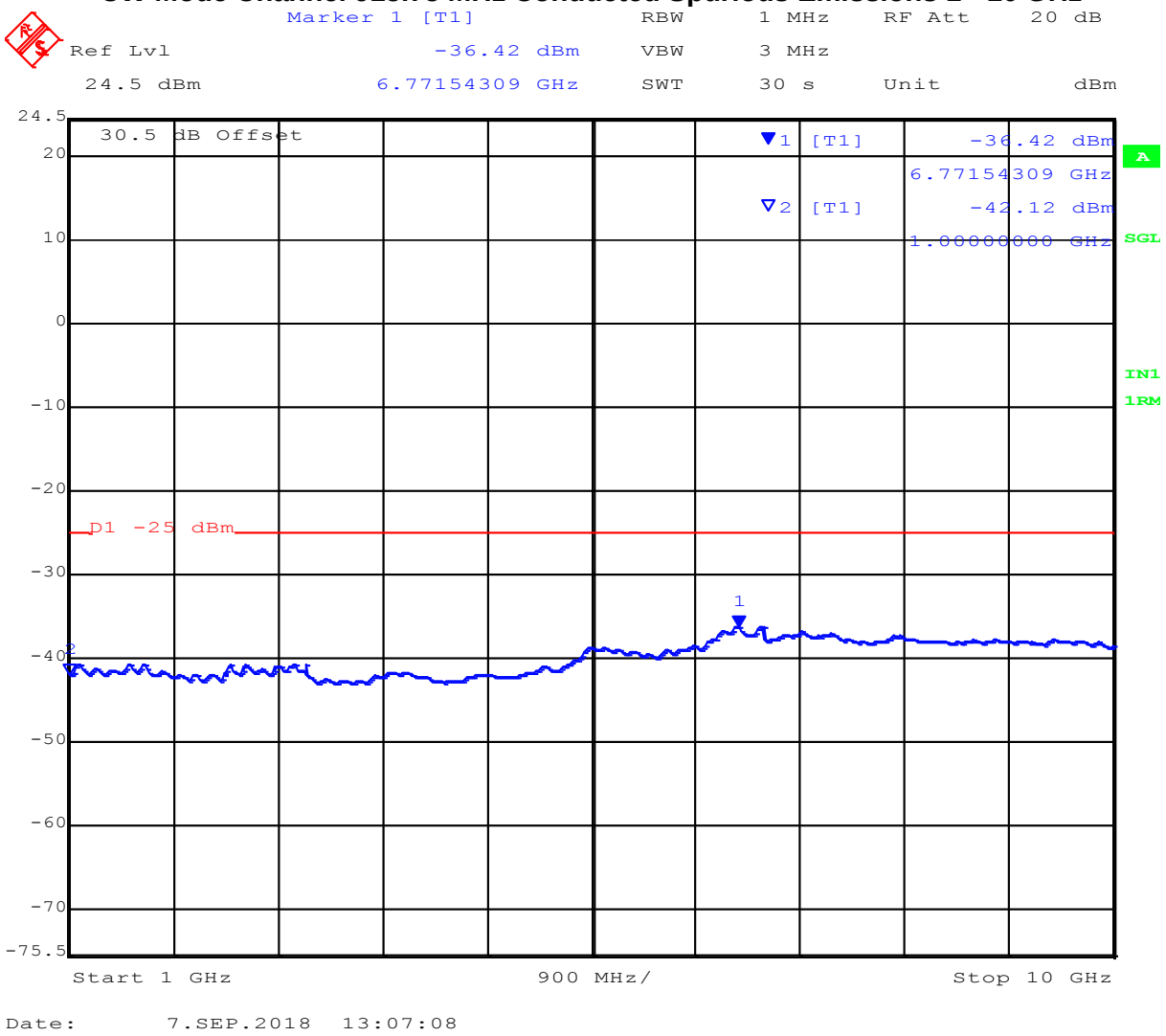
CW Mode Channel 915.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz



Note: The emission breaking the limit line is the fundamental carrier

This test report may be reproduced in full only. The document may only be updated by MiCOM Labs personnel. Any changes will be noted in the Document History section of the report.

CW Mode Channel 915.75 MHz Conducted Spurious Emissions 1 - 10 GHz



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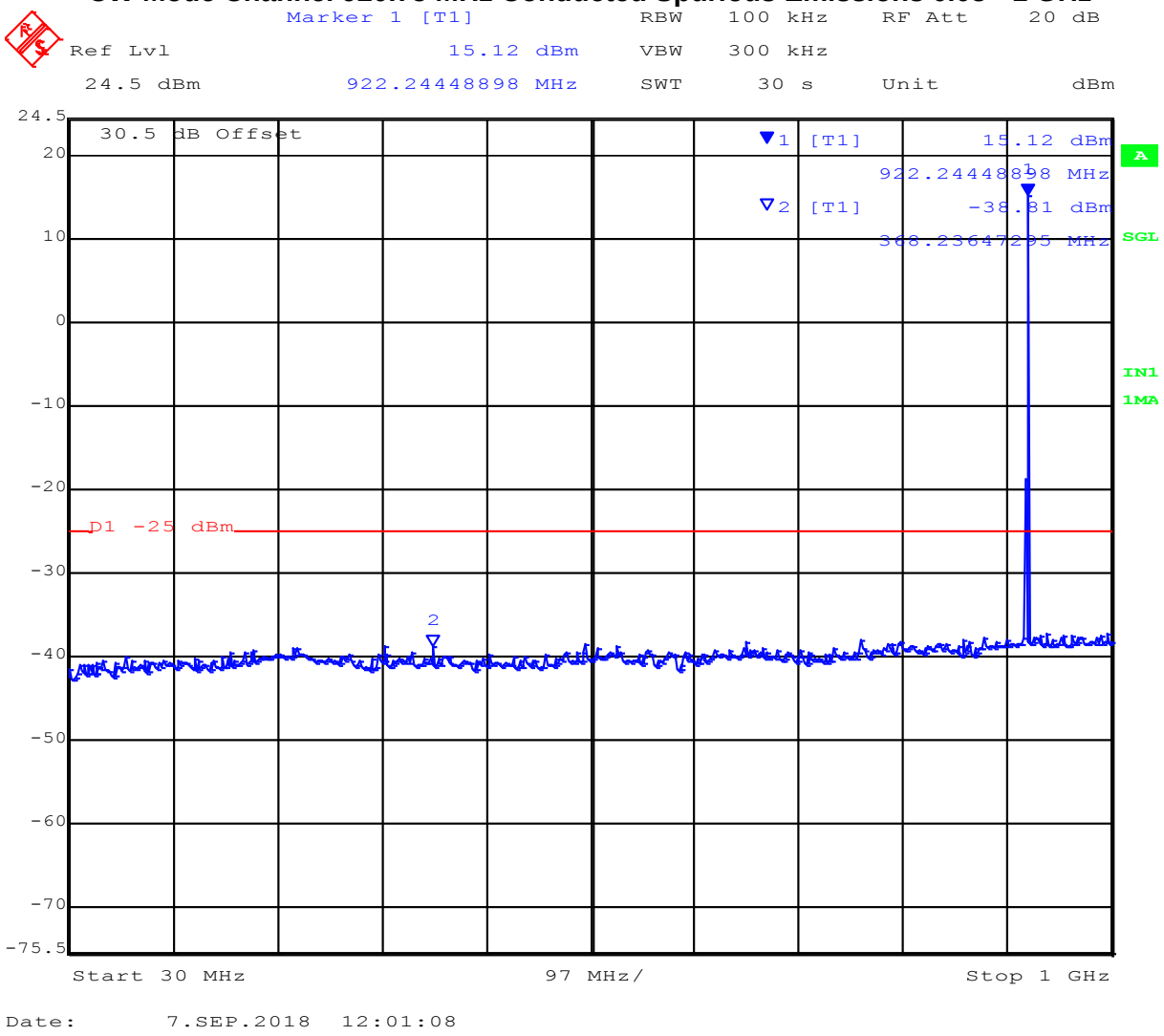
CW Mode Channel 920.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz



Note: The emission breaking the limit line is the fundamental carrier

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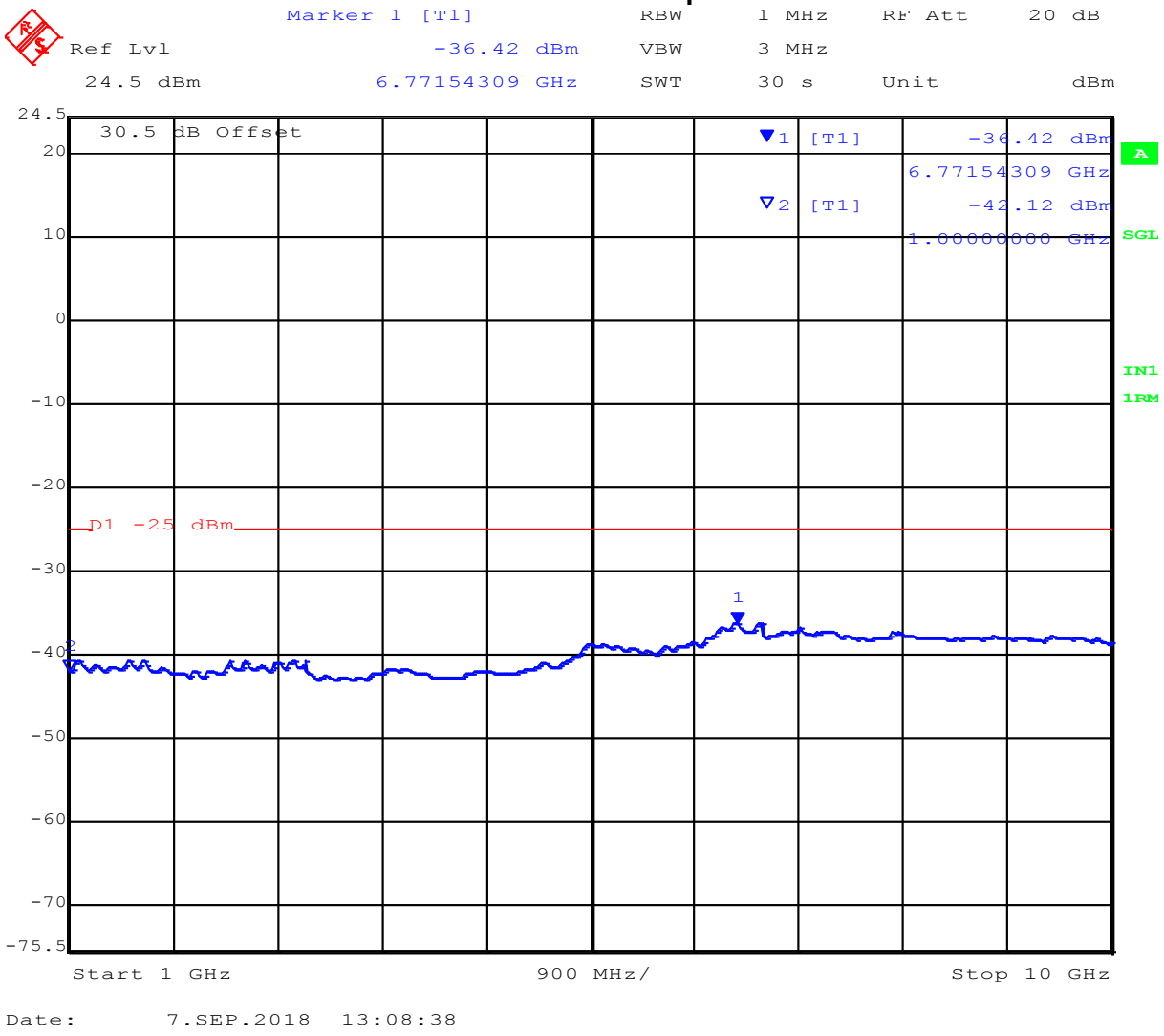
CW Mode Channel 920.75 MHz Conducted Spurious Emissions 1 - 10 GHz



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6.5 Radiated Spurious Emissions - Transmitter

FCC CFR 47 2.1051, Part 90.210 (K), IC RSS-137 6.5.3
ANSI/TIA-603

Test Procedure

Measurements were made while EUT was operating in the worst case CW mode of operation at the appropriate center frequency. Substitution was performed on any emissions observed. The antenna port was attenuated with a 50 Ω termination.

The measurement equipment was set to measure in peak hold mode. The emissions were measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode.

The highest emissions relative to the limit are listed for each frequency band measured.

Limits

For operation in the 902 – 928 MHz band the limits are defined as the power of any emission outside the frequency band of operation being attenuated below the transmitter power (P) within the licensed band of operation, measured in Watts, by at least

55 + 10*Log (P) = -25 dBm.
P = Maximum Power = +16.22 dBm = 0.042 W
Attenuation = 41.22 dB
Limit = -25 dBm

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement Uncertainty	+5.6/ -4.5 dB

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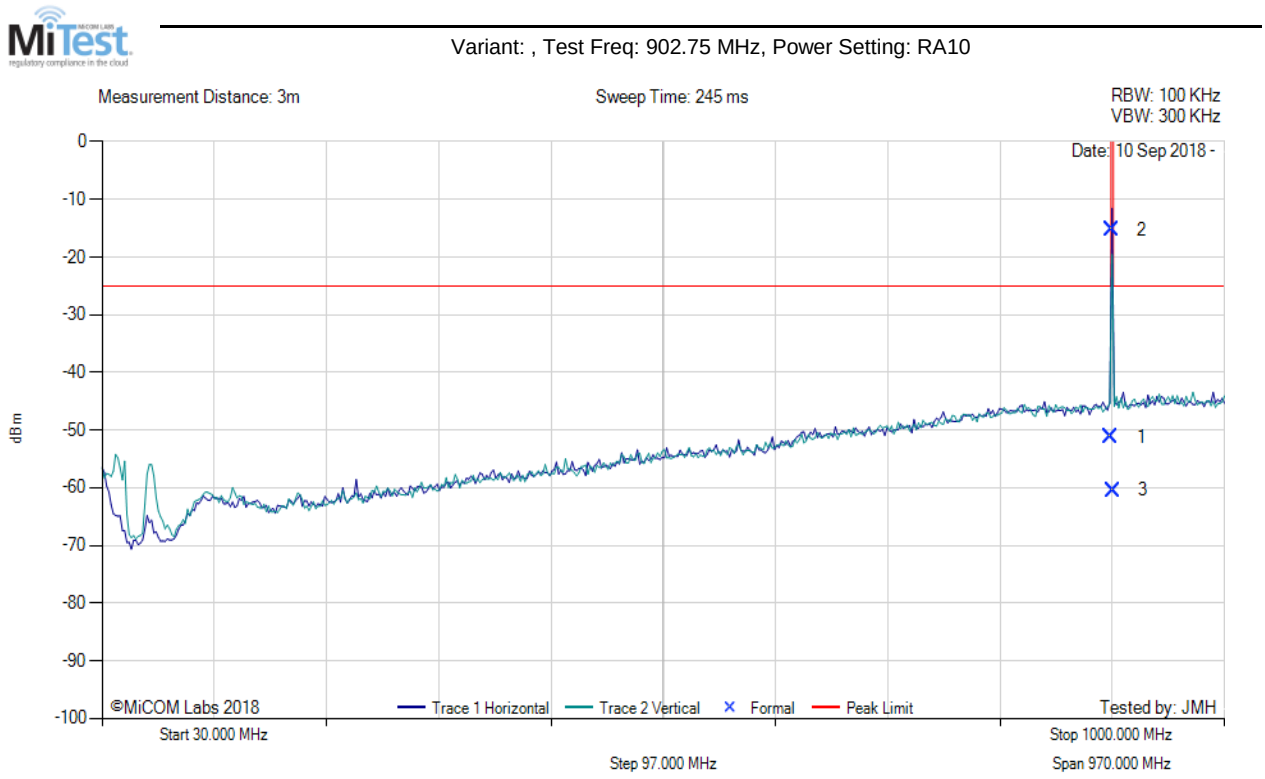
6.5.1.1 Measurement Results for Transmitter Spurious Emissions

Equipment Configuration for Radiated Transmitter Unwanted Emissions in the Spurious Domain (30-1G)

Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	902.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBm**	**Cable Loss dB**	**AF dB**	**Level dBm**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBm**	**Margin dB**	**Pass /Fail**
1	902.00	-52.39	6.24	-5.10	-51.25	Peak	Horizontal	102	16	-25.0	-26.3	Pass
2	902.81	-16.35	6.24	-5.10	-15.21	Fundamental	Horizontal	100	0	--	--	
3	904.03	-61.74	6.23	-4.90	-60.41	Peak	Horizontal	110	318	-25.0	-35.4	Pass

Test Notes: EUT powered by AC/DC PS.

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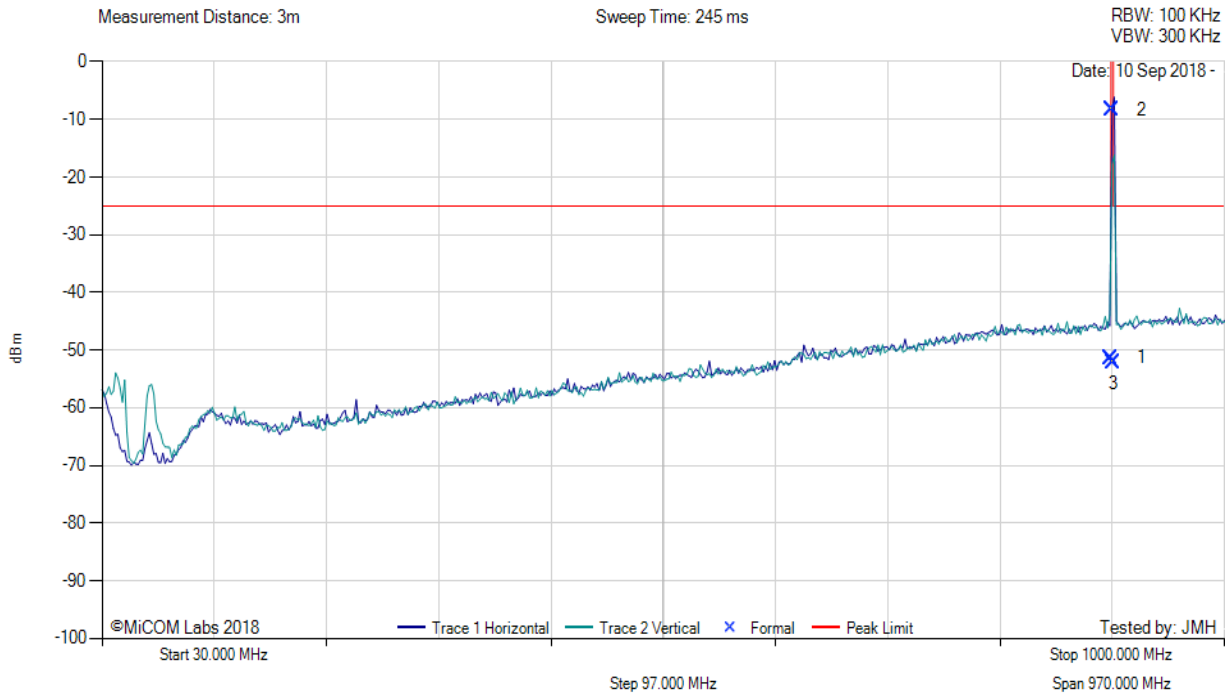
Equipment Configuration for Radiated Transmitter Unwanted Emissions in the Spurious Domain (30-1G)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	903.00	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 903.00 MHz, Power Setting: RA10



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBm**	**Cable Loss dB**	**AF dB**	**Level dBm**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBm**	**Margin dB**	**Pass /Fail**
1	901.94	-53.48	6.24	-5.10	-51.34	Peak	Horizontal	108	43	-25.0	-26.3	Pass
2	903.00	-9.46	6.24	-5.10	-8.32	Fundamental	Horizontal	100	0	--	--	
3	904.22	-53.51	6.23	-4.90	-52.18	Peak	Horizontal	103	23	-25.0	-27.2	Pass

Test Notes: EUT powered by AC/DC PS.

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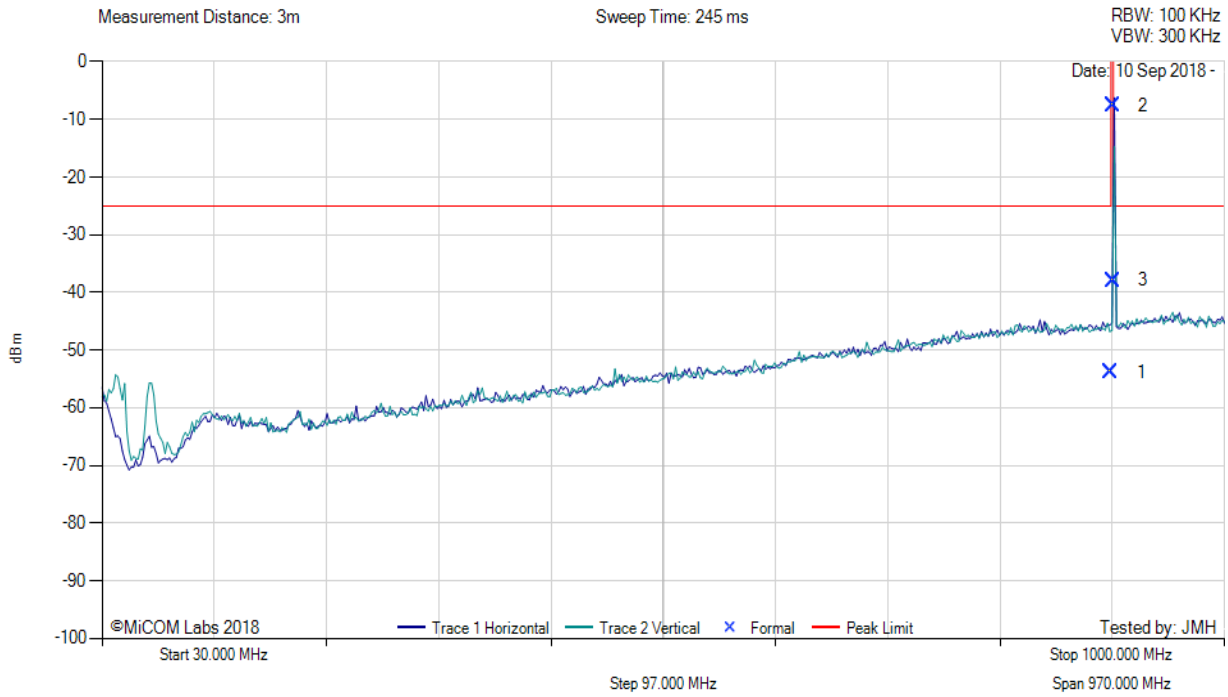
Equipment Configuration for Radiated Transmitter Unwanted Emissions in the Spurious Domain (30-1G)

Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	903.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 903.75 MHz, Power Setting: RA10



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBm**	**Cable Loss dB**	**AF dB**	**Level dBm**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBm**	**Margin dB**	**Pass /Fail**
1	902.00	-55.01	6.24	-5.10	-53.87	Peak	Horizontal	112	2	-25.0	-28.9	Pass
2	903.75	-8.95	6.23	-4.90	-7.62	Fundamental	Horizontal	100	0	--	--	
3	904.00	-39.26	6.23	-4.90	-37.93	Peak	Horizontal	104	27	-25.0	-12.9	Pass

Test Notes: EUT powered by AC/DC PS.

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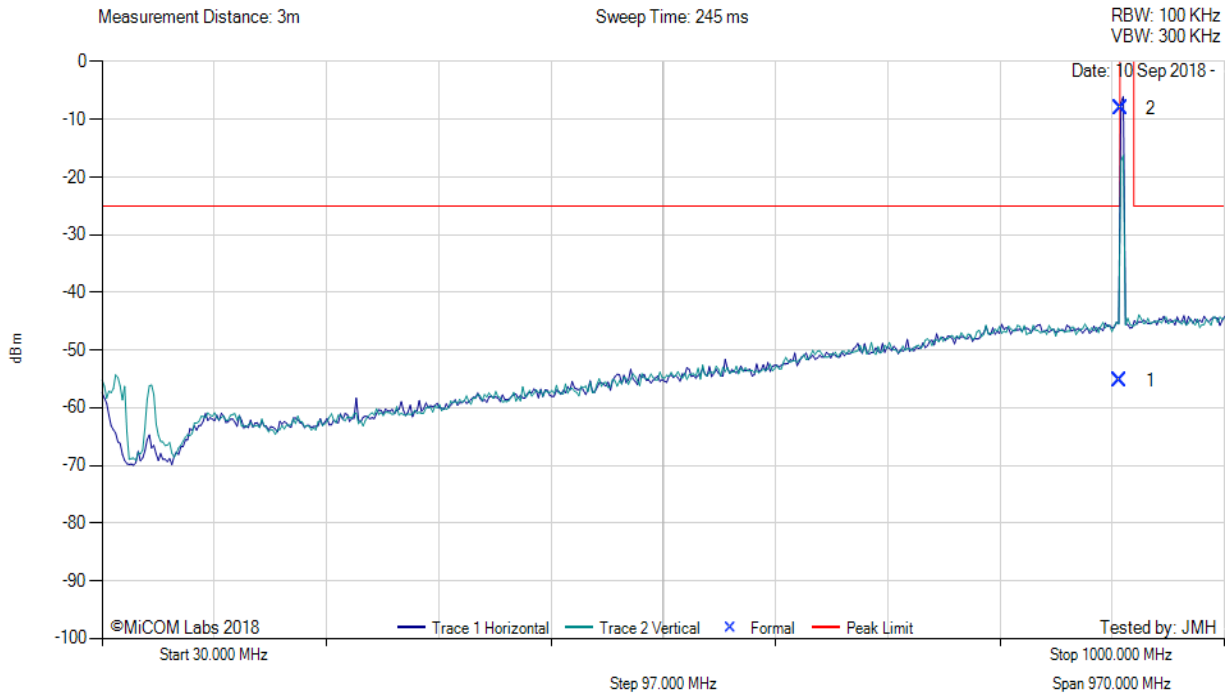
Equipment Configuration for Radiated Transmitter Unwanted Emissions in the Spurious Domain (30-1G)

Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	910.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 910.75 MHz, Power Setting: RA10



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBm**	**Cable Loss dB**	**AF dB**	**Level dBm**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBm**	**Margin dB**	**Pass /Fail**
1	909.75	-56.79	6.25	-4.80	-55.34	Peak	Horizontal	101	187	-25.0	-30.3	Pass
2	910.75	-9.49	6.25	-4.90	-8.14	Fundamental	Horizontal	100	0	--	--	

Test Notes: EUT powered by AC/DC PS.

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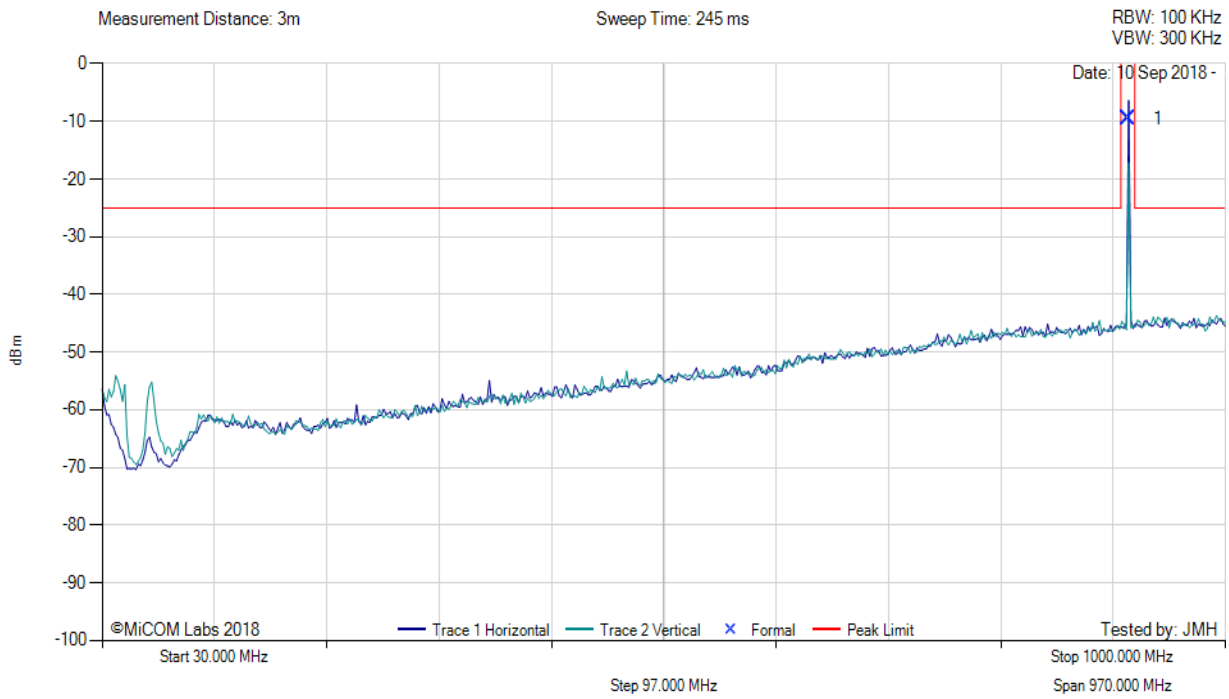
Equipment Configuration for Radiated Transmitter Unwanted Emissions in the Spurious Domain (30-1G)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	915.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 915.75 MHz, Power Setting: RA10



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBm**	**Cable Loss dB**	**AF dB**	**Level dBm**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBm**	**Margin dB**	**Pass /Fail**
1	915.74	-11.03	6.25	-4.80	-9.58	Fundamental	Horizontal	100	0	--	--	

Test Notes: EUT powered by AC/DC PS.

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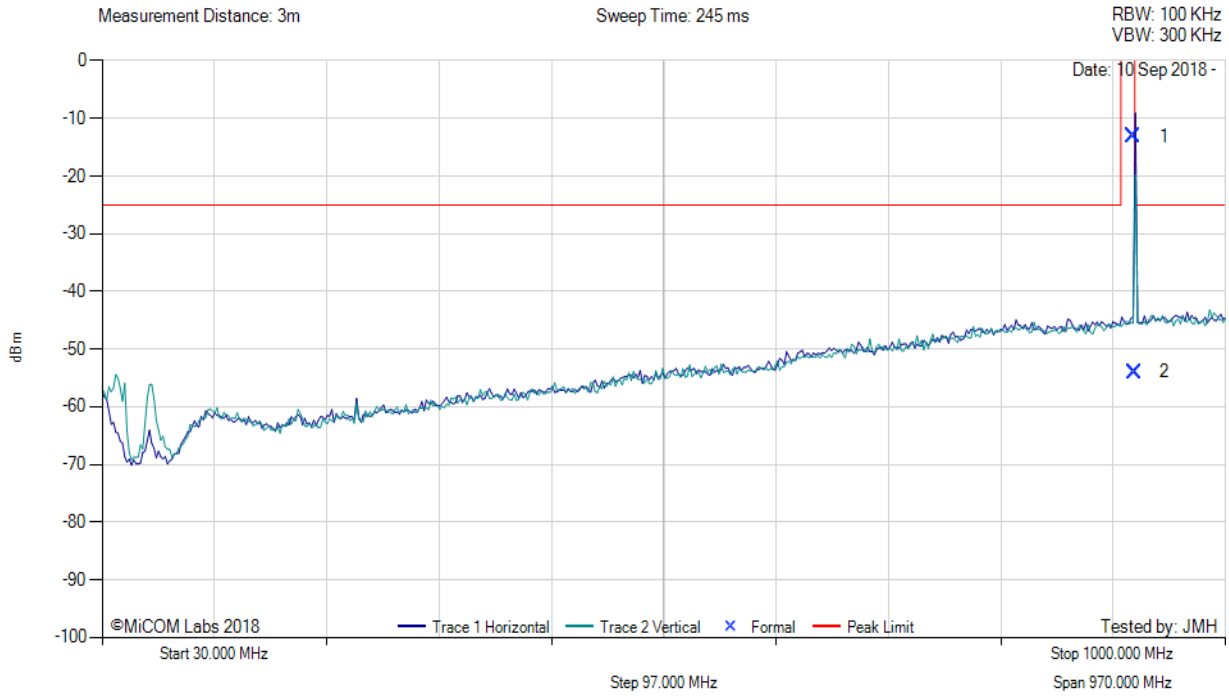
Equipment Configuration for Radiated Transmitter Unwanted Emissions in the Spurious Domain (30-1G)

Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	920.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 920.75 MHz, Power Setting: RA10



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBm**	**Cable Loss dB**	**AF dB**	**Level dBm**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBm**	**Margin dB**	**Pass /Fail**
1	920.74	-14.59	6.28	-4.80	-13.11	Fundamental	Horizontal	100	0	--	--	
2	921.75	-55.26	6.28	-5.00	-53.98	Peak	Horizontal	104	50	-25.0	-29.0	Pass

Test Notes: EUT powered by AC/DC PS.

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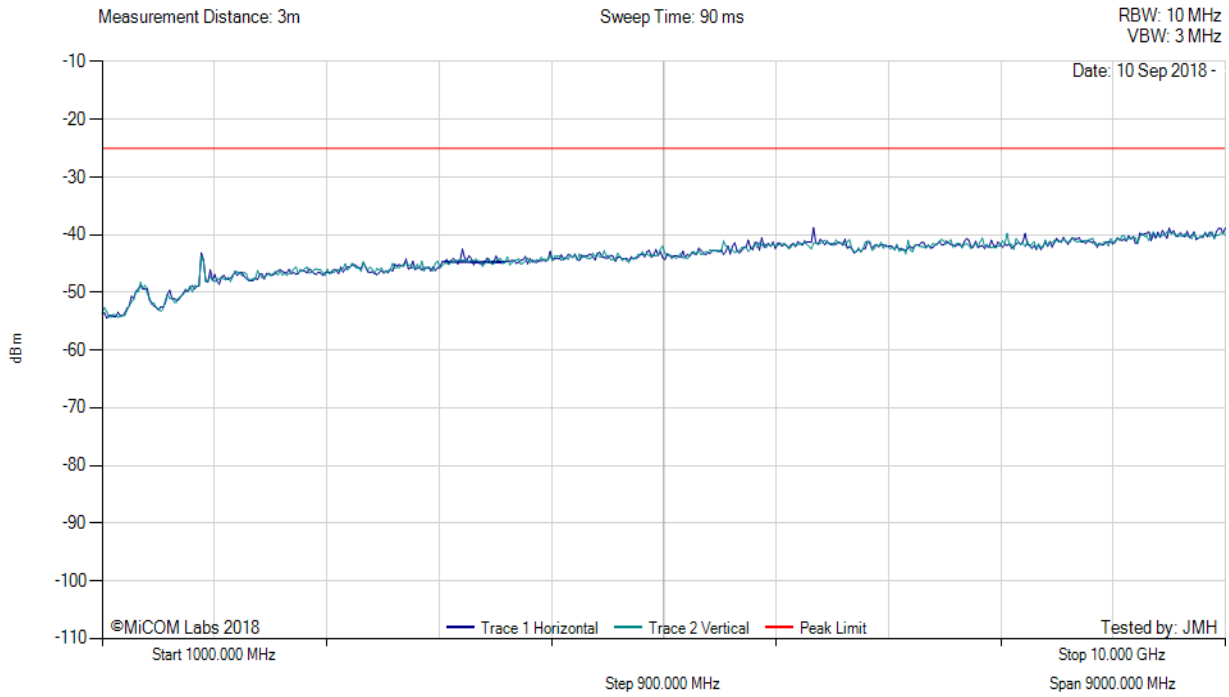
Equipment Configuration for Radiated Transmitter Spurious Emissions (1G-10G)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	902.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 902.75 MHz, Power Setting: RA10



There are no emissions found within 6dB of the limit line.

Test Notes: EUT powered by AC/DC PS.

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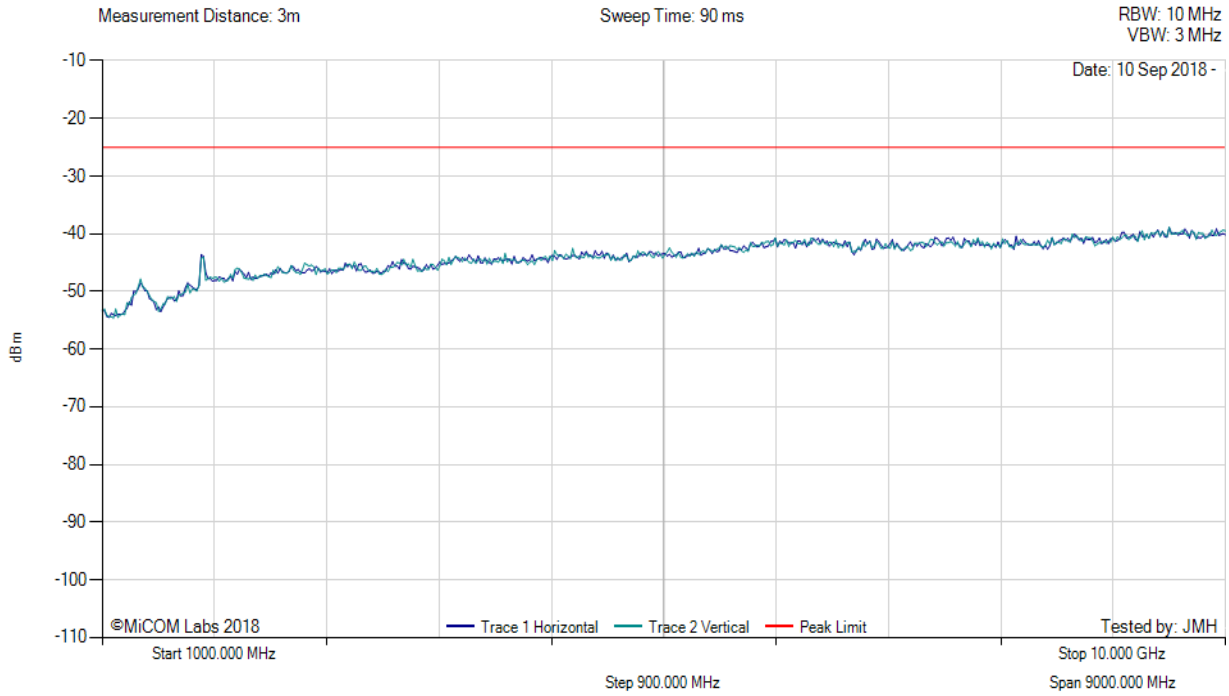
Equipment Configuration for Radiated Transmitter Spurious Emissions (1G-10G)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	903.00	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 903.00 MHz, Power Setting: RA10



There are no emissions found within 6dB of the limit line.

Test Notes: EUT powered by AC/DC PS.

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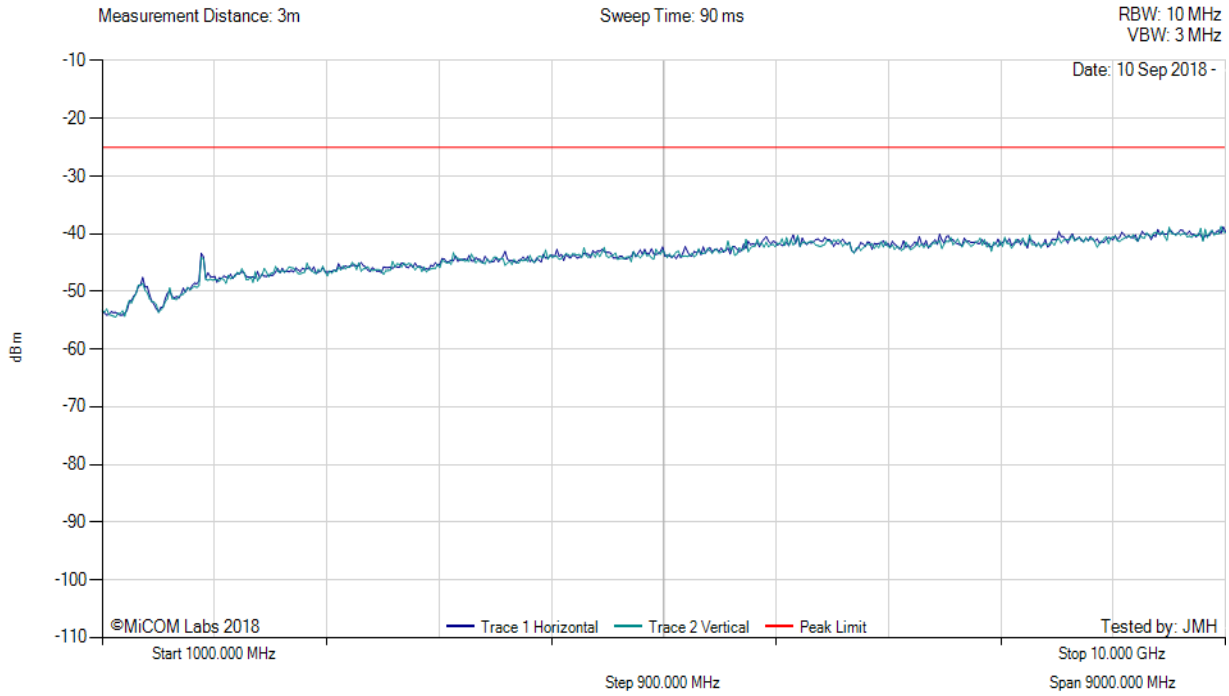
Equipment Configuration for Radiated Transmitter Spurious Emissions (1G-10G)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	903.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 903.75 MHz, Power Setting: RA10



There are no emissions found within 6dB of the limit line.

Test Notes: EUT powered by AC/DC PS.

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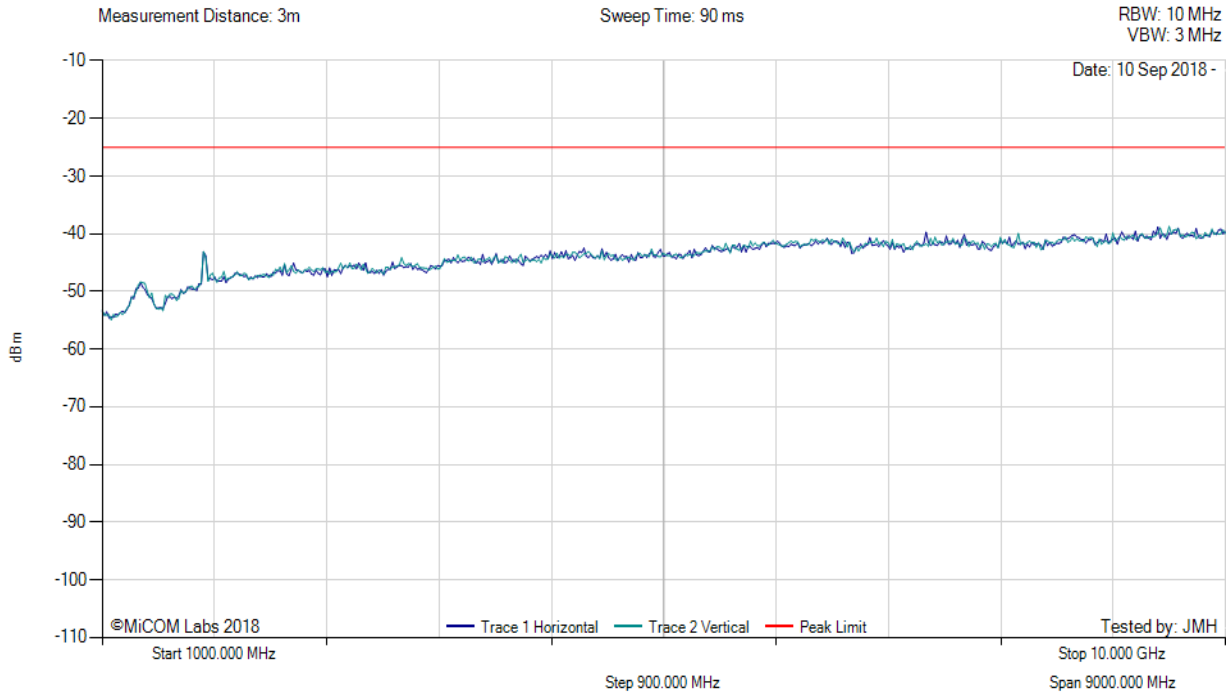
Equipment Configuration for Radiated Transmitter Spurious Emissions (1G-10G)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	910.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 910.75 MHz, Power Setting: RA10



There are no emissions found within 6dB of the limit line.

Test Notes: EUT powered by AC/DC PS.

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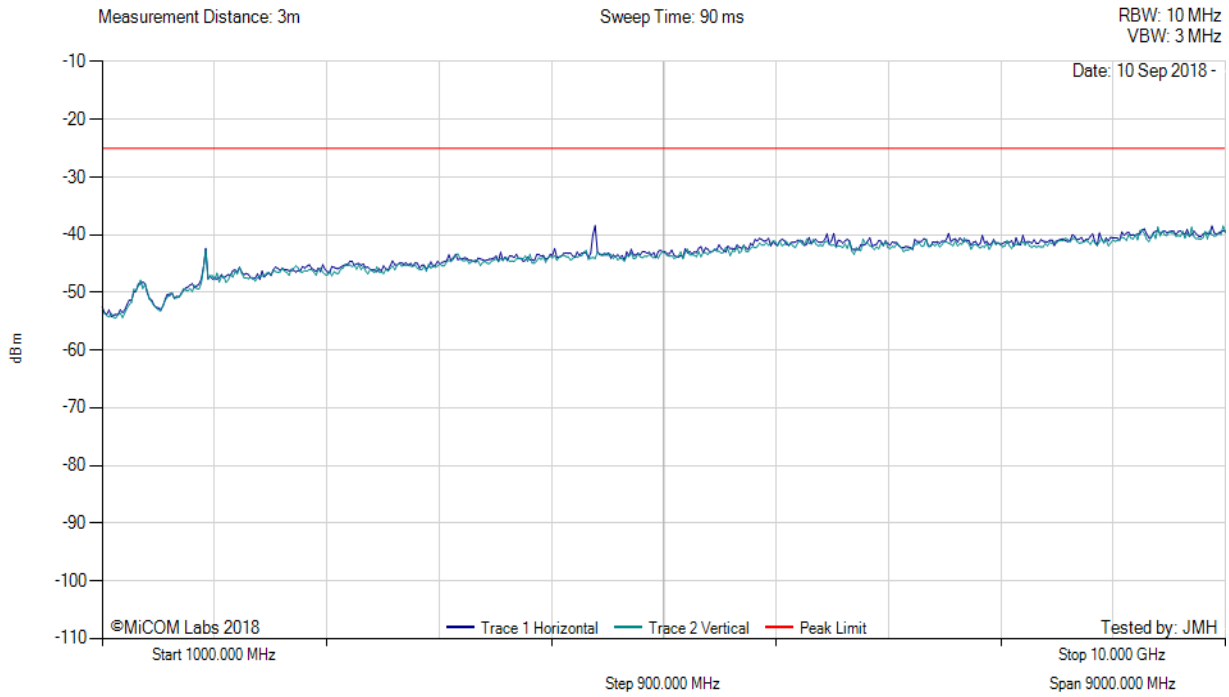
Equipment Configuration for Radiated Transmitter Spurious Emissions (1G-10G)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	915.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 915.75 MHz, Power Setting: RA10



There are no emissions found within 6dB of the limit line.

Test Notes: EUT powered by AC/DC PS.

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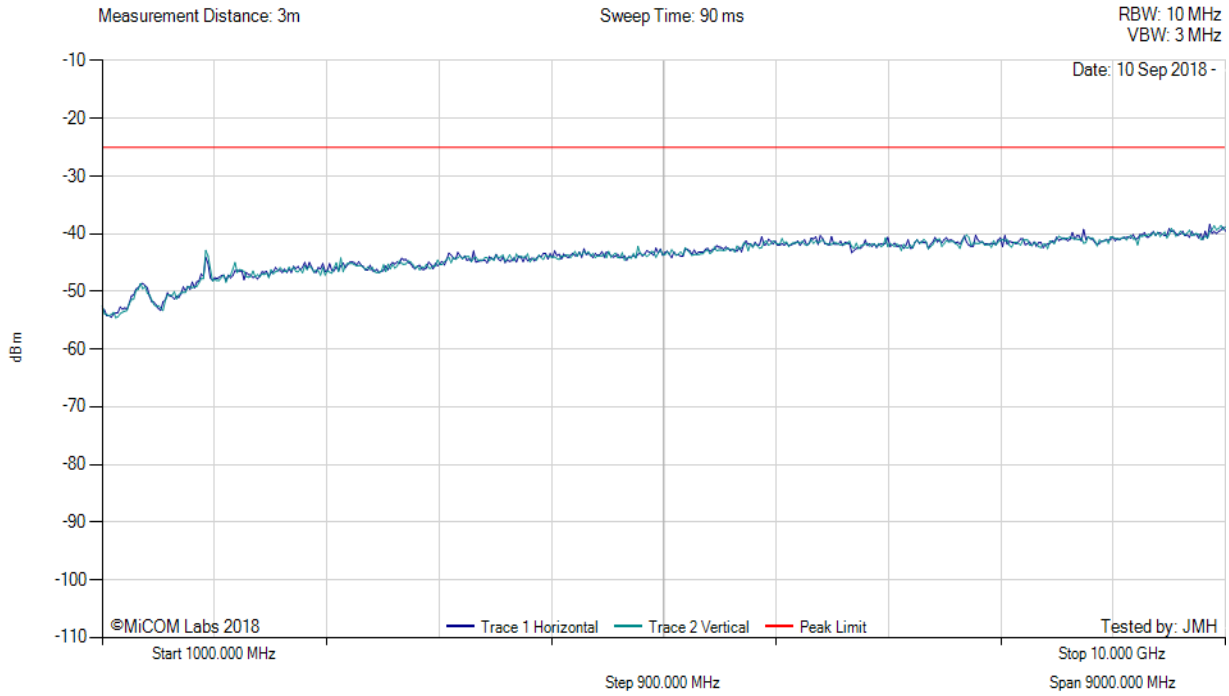
Equipment Configuration for Radiated Transmitter Spurious Emissions (1G-10G)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	ASK
Antenna Gain (dBi):	1.20	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	920.75	**Data Rate:**	110.00 KBit/s
Power Setting:	RA10	**Tested By:**	JMH

Variant: , Test Freq: 920.75 MHz, Power Setting: RA10



There are no emissions found within 6dB of the limit line.

Test Notes: EUT powered by AC/DC PS.

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6.6 Radiated Spurious Emissions – Digital Apparatus

FCC, Part 15 Subpart B §15.109
Industry Canada ICES-003 §5; RSS-GEN

Test Procedure

Testing was performed in a 3-meter semi-anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak hold mode.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Only the highest emissions relative to the limit are listed.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR – FO

FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

Field Strength Calculation Example:

Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))
40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

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Specification

Radiated Spurious Emissions – Digital Apparatus

FCC, Part 15 Subpart B §15.109; ISED ICES-003

A representative type or model of each digital apparatus shall be tested in accordance with the measurement methods described in FCC Part 15; Subpart A - General and FCC Subpart B – Unintentional Radiators.

FCC, Part 15 Subpart B §15.109; ISED ICES-003 Radiated Spurious Emissions Limits

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values.

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Field Strength of radiated emissions for a Class A digital device are as follows.

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance (meters)
30-88	100	49.5	3
88-216	150	54.0	3
216-960	200	57.0	3
Above 960	500	60.0	3

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement Uncertainty	+5.6/ -4.5 dB

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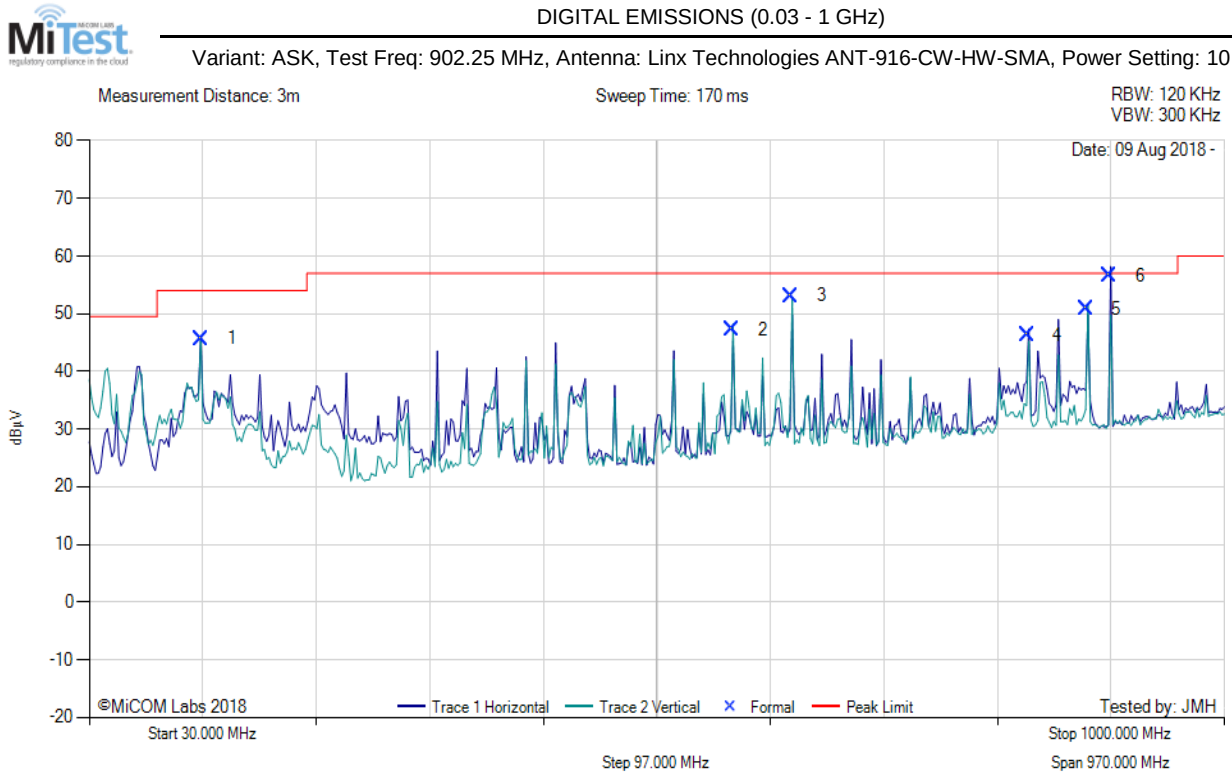
6.6.1.1 Measurement Results for Radiated Spurious Emissions – Digital Apparatus

EUT is a Class A Digital Device. Class A limits were applied.

Equipment Configuration for Digital Emissions (0.03 - 1 GHz)			
Antenna:	Linx Technologies ANT-916-CW-HW-SMA	**Variant:**	NA
Antenna Gain (dBi):	1.20	**Modulation:**	NA
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	NA
Channel Frequency (MHz):	N/A	**Data Rate:**	110.00 KBit/s
Power Setting:	10	**Tested By:**	JMH



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	126.00	56.47	3.93	-14.70	45.70	MaxQP	Vertical	100	149	54.0	-8.3	Pass
2	579.63	50.48	5.41	-8.70	47.19	MaxQP	Vertical	100	146	57.0	-9.8	Pass
3	630.01	55.28	5.54	-7.70	53.12	MaxQP	Vertical	100	139	57.0	-3.9	Pass
4	831.61	45.66	6.06	-5.50	46.22	MaxQP	Vertical	100	187	57.0	-10.8	Pass
5	882.00	49.99	6.20	-5.30	50.89	MaxQP	Vertical	100	184	57.0	-6.1	Pass
6	902.01	55.45	6.24	-5.10	56.59	Fundamental	Horizontal	100	0	--	--	

Test Notes: EUT powered by AC/DC PS and connected via HDMI to monitor for control purposes. 900 MHz notch in front of amp to prevent overloads. Digital Emissions Class A

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6.7 Conducted Disturbance at Mains Terminal (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §15.107
Industry Canada ICES-003 §5.3

Test Procedure

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

If the average limit is met when using a quasi-peak detector receiver, the EUT shall be Deemed to meet both limits and measurement with the average detector receiver is unnecessary.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

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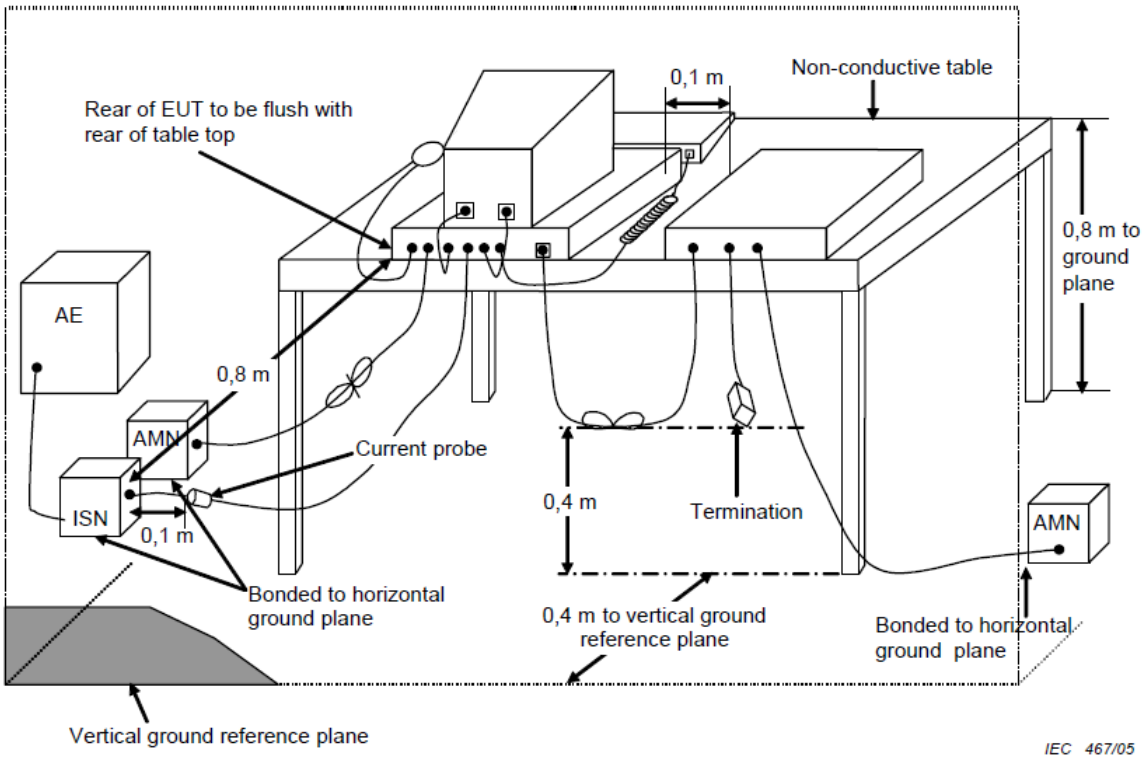
Test Measurement Set up



Measurement set up for Conducted Disturbance at Mains Terminals

Specification

Conducted Disturbance at Mains Terminal – Digital Apparatus

FCC, Part 15 Subpart B §15.107
(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Industry Canada ICES-003
For power line conducted emissions and radiated emissions measurements below 1 GHz, compliance with ICES-003, Issue 6, can be demonstrated in one of three ways:

i. by complying with the power line conducted emission limits and radiated emissions limits and employing the methods of measurement contained in the publication referenced in Section 3(a) (CAN/CSA-CISPR 22-10);
ii. by complying with the power line conducted emission limits and radiated emissions limits, shown in Section 6 of this ICES-003 (Issue 6), and employing the methods of measurement described in the publication referenced in Section 3(b) (ANSI C63.4-2014); or
iii. by complying with the power line conducted emissions limits in Section 6 of ICES-003, Issue 6, and the radiated emissions limits contained in the publications referenced in Section 3(a) (CAN/CSA-CISPR 22-10), while employing the methods of measurement contained in the publication referenced in Section 3(b) (ANSI C63.4-2014).

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FCC, Part 15 Subpart B §15.107 & Industry Canada ICES-003 Limits

Limits for conducted disturbance at the mains ports of class B ITE

Frequency of emission (MHz)	Quasi-peak dBuV	Average dBuV
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50
Note 1	* Decreases with the logarithm of the frequency	
Note 2	* The lower limit applies at the boundary between frequency ranges	

Limits for conducted disturbance at the mains ports of class A ITE

Frequency of emission (MHz)	Quasi-peak dBuV	Average dBuV
0.15–0.5	79	66
0.5–30	73	60
Note 1	* The lower limit shall apply at the transition frequency.	

Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	±2.64 dB

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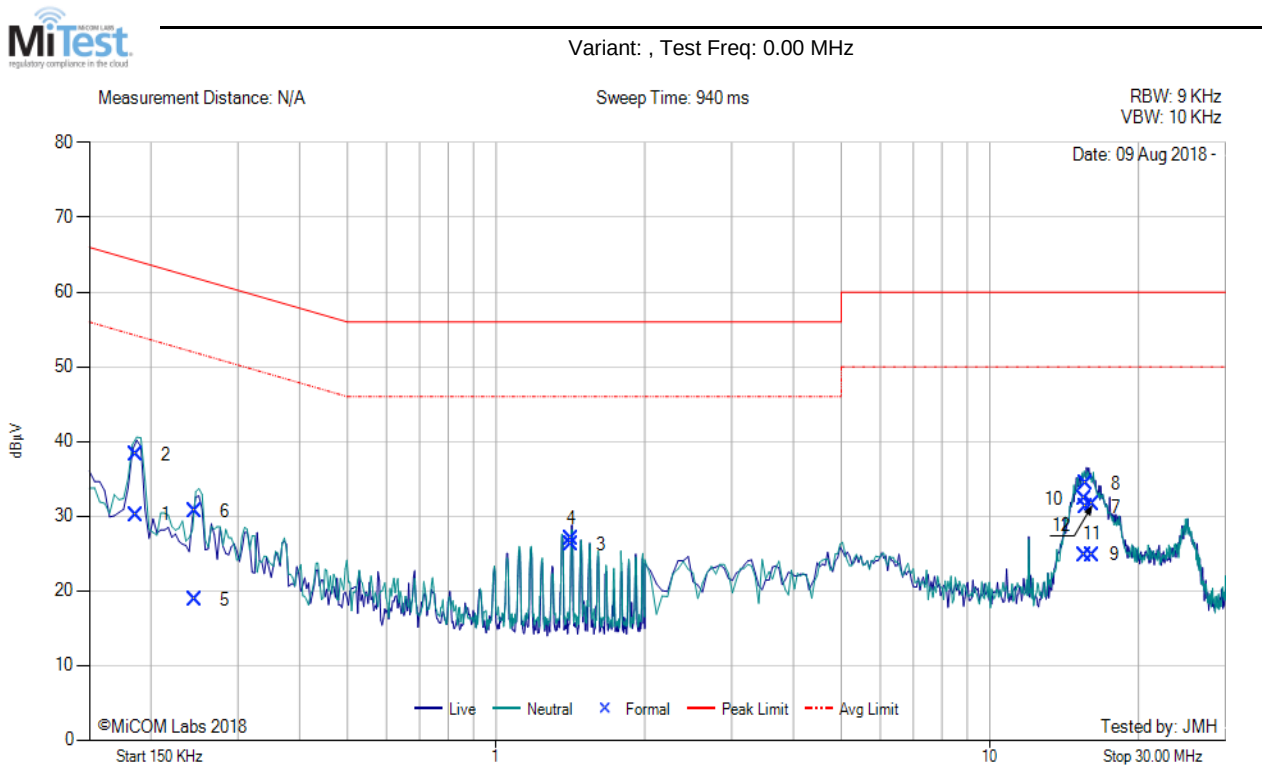
6.7.1.1 Conducted Disturbance at Mains Terminal (150 kHz – 30 MHz)

EUT is a Class A Digital Device. Class A limits were applied.

Model:	T265	Configuration tested:	AC/DC PS
Input power:	120V_{AC}/60Hz	Standard:	FCC Part 15



Num	Frequency MHz	Raw dBµV	Cable Loss dB	Factor dB	Total Correction dBµV	Corrected Value dBµV	Measurement Type	Line	Limit dBµV/m	Margin dB	Pass /Fail
1	0.186	20.19	0.06	9.92	9.98	30.17	Max Avg	Neutral	55.0	-24.8	Pass
2	0.186	28.24	0.06	9.92	9.98	38.22	Max Qp	Neutral	65.0	-26.8	Pass
3	1.419	16.14	0.12	9.95	10.07	26.21	Max Avg	Live	46.0	-19.8	Pass
4	1.419	16.91	0.12	9.95	10.07	26.98	Max Qp	Live	56.0	-29.0	Pass
5	0.245	8.80	0.07	9.92	9.99	18.79	Max Avg	Neutral	53.3	-34.5	Pass
6	0.245	20.65	0.07	9.92	9.99	30.64	Max Qp	Neutral	63.3	-32.7	Pass
7	15.666	20.10	0.54	10.52	11.06	31.16	Max Avg	Live	50.0	-18.8	Pass
8	15.666	23.32	0.54	10.52	11.06	34.38	Max Qp	Live	60.0	-25.6	Pass
9	15.533	13.77	0.54	10.51	11.05	24.82	Max Avg	Neutral	50.0	-25.2	Pass
10	15.533	21.24	0.54	10.51	11.05	32.29	Max Qp	Neutral	60.0	-27.7	Pass
11	16.149	13.72	0.55	10.54	11.09	24.81	Max Avg	Neutral	50.0	-25.2	Pass
12	16.149	20.46	0.55	10.54	11.09	31.55	Max Qp	Neutral	60.0	-28.5	Pass

Test Notes: EUT powered by AC/DC PS. Transmitting on 921 MHz. Monitor connected via HDMI cable

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