Test of Thinkify IDT T1000, TR 1000

To: FCC 47 CFR Part 90 SubPart I, 90.353

Test Report Serial No.: THNK03-U2 Rev A

TEST REPORT

FROM

MiCOM Labs

Test of Thinkify IDT T1000, TR 1000

To FCC 47 CFR Part 90 SubPart I, 90.353

Test Report Serial No.: THNK03-U2 Rev A

This report supersedes THNK01-A2 Rev A

Manufacturer: Thinkify LLC
18450 Technology Drive, Suite E
Morgan Hill, California 95037
USA

Product Function: Wireless Broadband Access Point

Copy No: pdf **Issue Date:** 18th October 2010

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
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A2LA ACCREDITED
TESTING CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1 ACCREDITATION, LISTINGS & RECOGNITION

1.1 TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard EN 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

1.2 RECOGNITION

MiCOM Labs, Inc is recognized by the following countries for Electrical testing.

Country	Recognition Body	CAB Phase	Identification No.
USA	Federal Communications Commission (FCC)	-	Listing #: 102167
Canada	Industry Canada (IC)	-	Listing #: 4143A
Japan	VCCI	-	No. 2959
Australia	Australian Communications and Media Authority (ACMA)	I	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	I I	
Vietnam	Ministry of Communication (MIC)	I	

1.3 PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. 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


The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence as a

Product Certification Body

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC Guide 65:1996 *General requirements for bodies operating product certification systems*. This accreditation demonstrates technical competence for a defined scope and the operation of a quality management system for a Telecommunications Certification Body (TCB) meeting FCC (U.S.), and IC (Canada) requirements.

Presented this 24th day of June 2010.

President & CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2011

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 US0159

2 DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
A	18th October 2010	Initial Release

3 TEST RESULT CERTIFICATE

Manufacturer:	Thinkify LLC 18450 Technology Drive, Suite E Morgan Hill, California 95037 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	915 MHz RFID Reader	Telephone:	+1 925 462 0304
Model:	IDT T1000, TR 1000	Fax:	+1 925 462 0306
S/N:	JA0903031		
Test Date(s):	9th September 2010	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 90 SubPart I, 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:

ACCREDITED

TESTING CERTIFICATE #2381.01

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

4 REFERENCES AND MEASUREMENT UNCERTAINTY

4.1 Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 90	2009	Code of Federal Regulations
(ii)	ANSI C63.4	2009	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
(iii)	CFR 47 FCC Part 15	2009	CFR 47 Part 15; Subpart B: Unintentional Radiators
(iv)	ICES-003	2004	Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard Digital Apparatus
(v)	CAN/CSA-CEI/IEC CISPR 22:02	2006	Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment.
(vi)	CISPR 22/ EN 55022	2008 2006+A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vii)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(viii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(iv)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(v)	A2LA	9th June 2010	Reference to A2LA Accreditation Status – A2LA Advertising Policy

4.2 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.

5 PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1 Technical Details

Details	Description	
Purpose:	Test of the Thinkify IDT T1000, TR 1000 to FCC 47 CFR Part 90 SubPart I, 90.353 regulations.	
Applicant:	Thinkify LLC 18450 Technology Drive, Suite E Morgan Hill, California 95037 USA	
Manufacturer:	As Applicant	
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA	
Test report reference number:	THNK03-U2 Rev A	
Date EUT received:	9th September 2010	
Dates of test (from - to):	9th September 2010	
Standard(s) applied:	FCC 47 CFR Part 90 SubPart I, 90.353	
No of Units Tested:	1	
Type of Equipment:	RFID Reader	
Model:	IDT T1000, TR 1000	
Location for use:	Indoor/Outdoor	
Declared Frequency Range(s):	902 – 904 MHz & 909.75 - 921.75 MHz	
Type of Modulation:	Continuous Wave (CW), OOK	
Operational Bandwidths:	CW: 15.25 kHz OOK: 72 kHz	
Declared Maximum Output Power:	+32 dBm	
ITU Emission Designator:	Modulation	ITU Designator
	Single Tone (CW)	14K4L1D
	OOK	63K1L1D
Transmit/Receive Operation:	Transceiver, Simplex	
Software Revision:	09.05.00	
Rated Input Voltage and Current:	115Vac 60 Hz Power Supply Unit 10 Vdc,2A : 6 Vdc,2A : -5Vdc/0.5A	
Operating Temperature Range:	-20ºC to +50ºC	
Clock/Oscillator(s):	20, 3.6864, 25 MHz, 32.768 kHz	
Frequency Stability:	Long Term: ±20ppm	
Equipment Dimensions:	8” x 7” x 1.6”	
Weight:	2.21 lbs	
Primary function of equipment:	Radio Frequency Identification (RFID) Reader, reading tags on rail cars	

5.2 Scope of Test Program

The scope of the test program was to test the Thinkify IDT T1000, TR 1000 for compliance against;-

FCC 47 CFR Part 90, Subpart I regulatory requirements.

The Thinkify IDT T1000, TR 1000 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

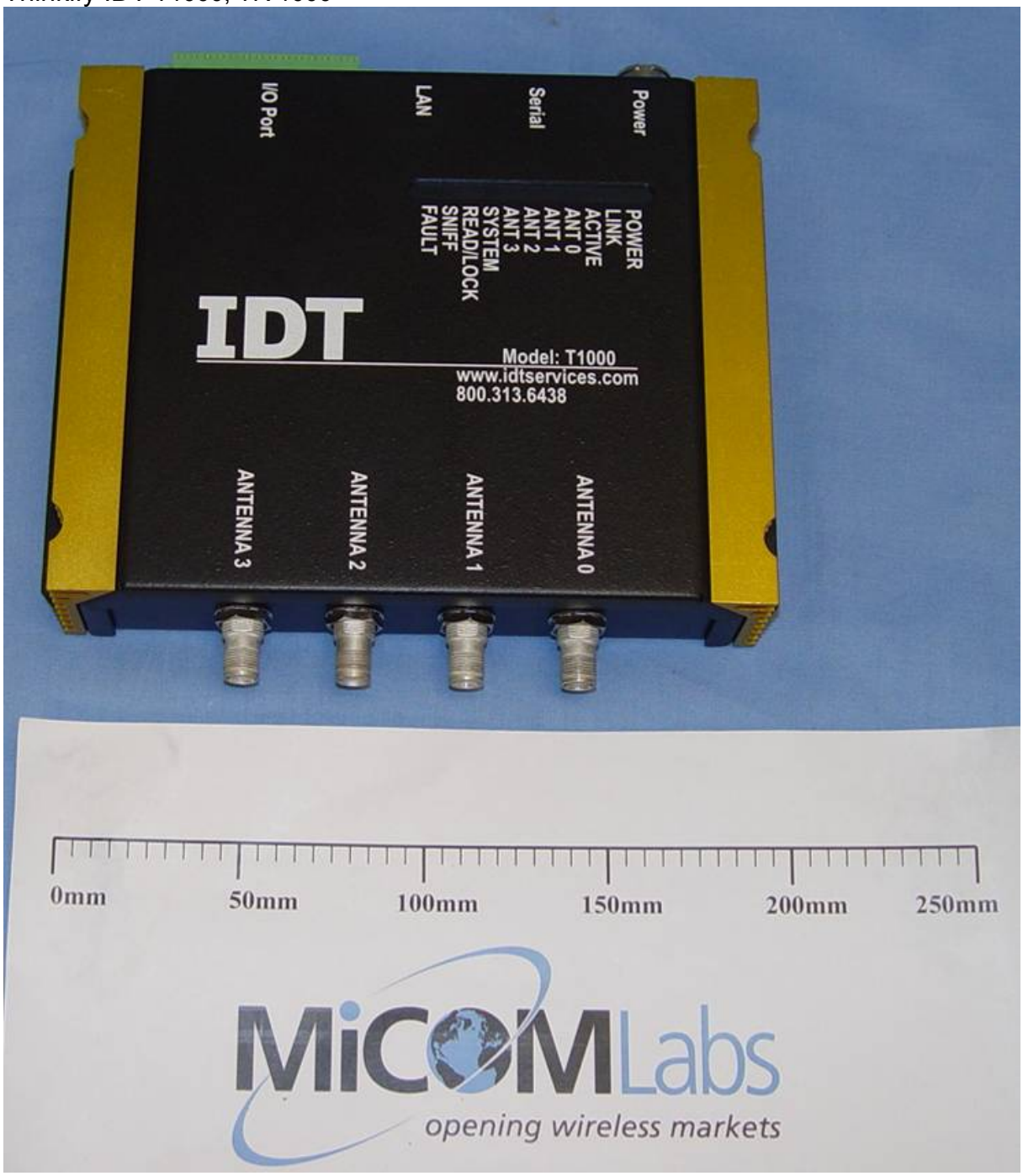
The Thinkify IDT T1000, TR 1000 RFID Reader per Part 90 SubPart I, 90.357 falls into category (b) Non- multilateriation LMS systems authorized in the following frequency bands:

- 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.

Thinkify IDT T1000, TR 1000



XP PSU ac/d Converter

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

EUT/ Support	Manufacturer	Equipment Description (Including Brand Name)	Model No.	Serial No.
EUT	Thinkify	RFID Reader 902 – 904 MHz and 909.75 - 921.75 MHz.	IDT T1000, TR 1000	JA0903031
EUT	XP Power	Power Supply Adaptor 100-240Vac 47-63Hz 1.35A 9.75 Vdc,2.5A 5.75 Vdc,3A -5.75 Vdc, 0.3A	HUP45-30 / #10045-01	05429146
Support	Dell	Laptop Computer	N/A	N/A

5.4 Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Directional	11.5	Kathrein	HP9-915N	N/A
Directional	12	Eahison	EHS900V1240D2	N/A

5.5 Cabling and I/O Ports

Number and type of I/O ports

1. RF Port (902 – 904 MHz and 909.75 - 921.75 MHz.)
1. 10/100BT Ethernet (unshielded)
2. dc Supply on single connector +10, +6, -5Vdc
3. Serial Port (9 pin) Local Maintenance Terminal
4. Control input/output (Optically Isolated)

5.6 Test Configurations

Test Matrix V's Variants

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

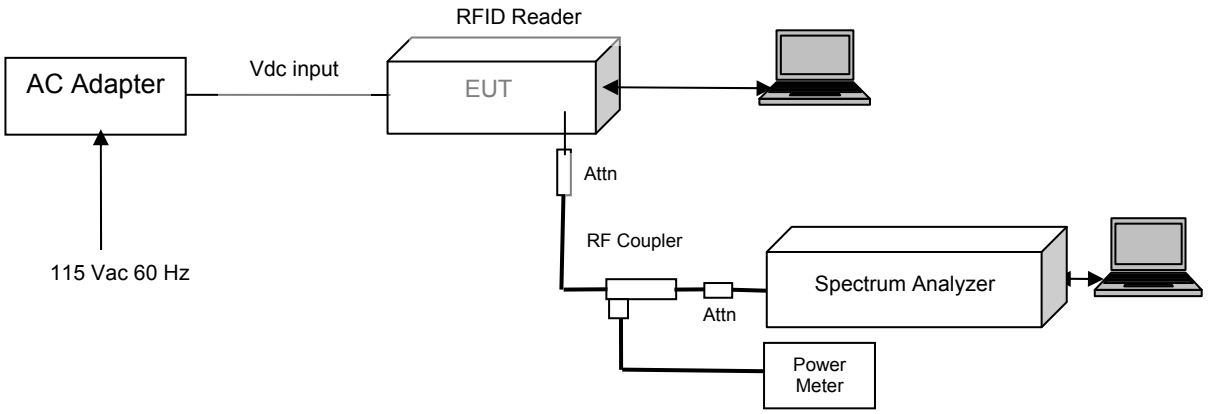
Note 1.. Fixed Non-Multilateration transmitters with an authorized bandwidth more than 40 kHz from the band-edge are not subject to Frequency Stability restrictions. The EUT was measured to show compliance with Part 2 requirements.
Note 2.. The EUT does not support audio modulation therefore Audio Frequency 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)	Frequency Channel (MHz)		
	Low	Mid	High
902.00 – 904.00	902.75	903.00	903.75
909.75 – 921.75	910.75	915.75	920.75

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

5.7 Equipment Modifications

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

1. NONE

5.8 Deviations from the Test Standard

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

1. NONE

5.9 Subcontracted Testing or Third Party Data

1. NONE

6 TEST SUMMARY

List of Measurements

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

Section(s)	Test Items	Description	Condition	Result	Test Report Section
2.1049/ 90.210	99% Occupied Bandwidth + Band-edge	Bandwidth measurement(s)	Conducted	Complies	7.1.1
2.1046; 90.205	Effective Radiated Power	CW & Modulated Output Power	Conducted	Complies	7.1.2
Subpart C 90.1217	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Calculated	--	7.1.3
2.1055(a)(1)/ 90.213	Frequency Stability	Includes temperature and voltage variations	Conducted	Complies	7.1.4
2.1051; 90.210(K)	Spectrum Mask / Band Edge	Emissions from the antenna port	Conducted	Complies	7.1.5
2.1051; 90.210(K)	Conducted Spurious Emissions	Emissions from the antenna port	Conducted	Complies	7.1.6
2.1053; 90.210 ANSI/TIA-603	Radiated Spurious Emissions	Spurious emissions from Transmitter	Radiated	Complies	7.1.7
15.109	Radiated Spurious Emissions	Spurious emissions from digital apparatus	Radiated	Complies Class A Device	7.1.8
15.107	AC Wireline Conducted	Emissions 150 kHz–30 MHz	Conducted	Complies Class A Device	7.1.9

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

7 TEST RESULTS

7.1 Device Characteristics

7.1.1 Occupied Bandwidth

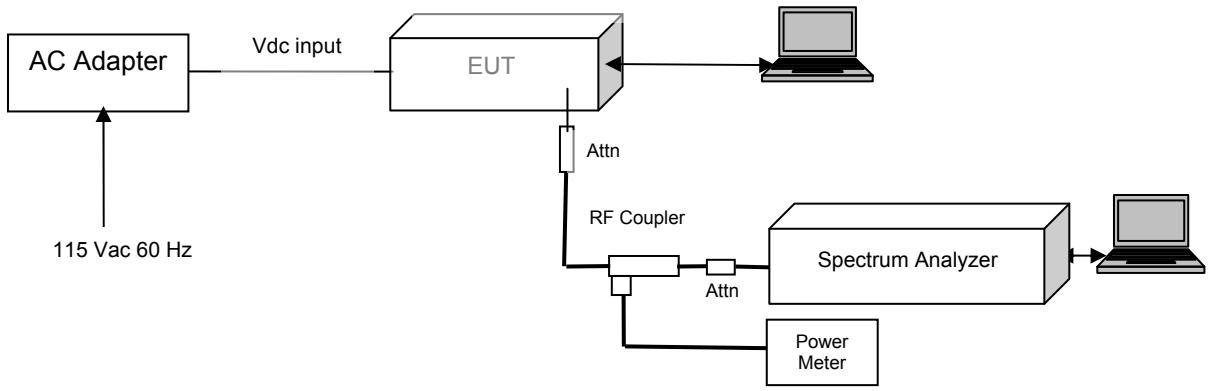
FCC CFR 47 2.1049, 90.210 (K), IC RSS-137 6.1.2

Test Procedure

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 Set-up



Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0070, 0116, 0158, 0193, 0252, 0313, 0314.

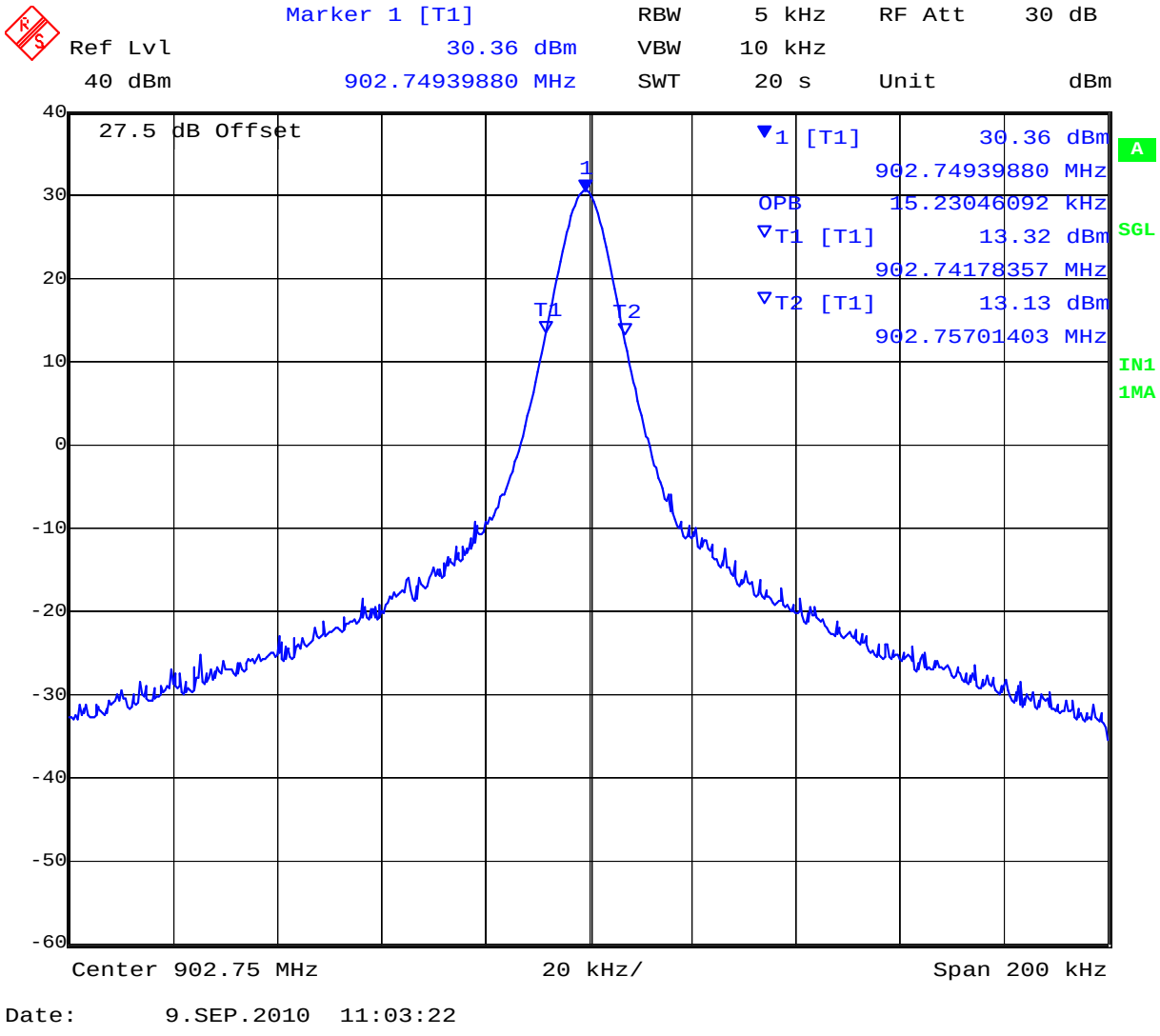
7.1.1.1 Test Results for Occupied Bandwidth

Temperature: 17 to 29 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

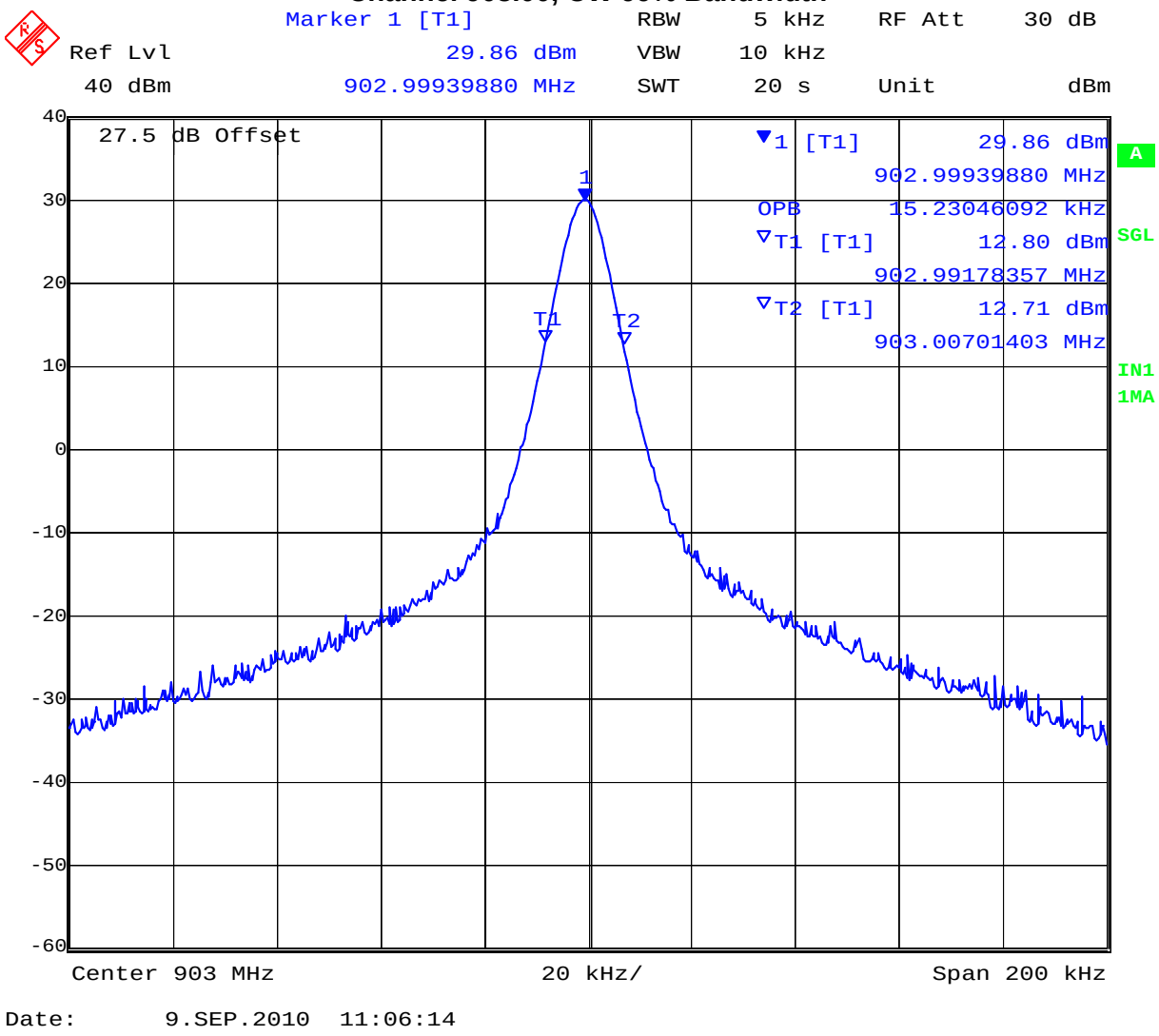
Modulation	Center Frequency (MHz)	99% Bandwidth (MHz)
CW	902.75	15.2304
	903.00	15.2305
	903.75	15.2305
	910.75	15.2305
	915.75	15.2305
	920.75	15.2305

Modulation	Center Frequency (MHz)	99% Bandwidth (MHz)
OOK	902.75	70.6413
	903.00	72.1443
	903.75	70.6413
	910.75	72.1443
	915.75	72.1443
	920.75	78.1563

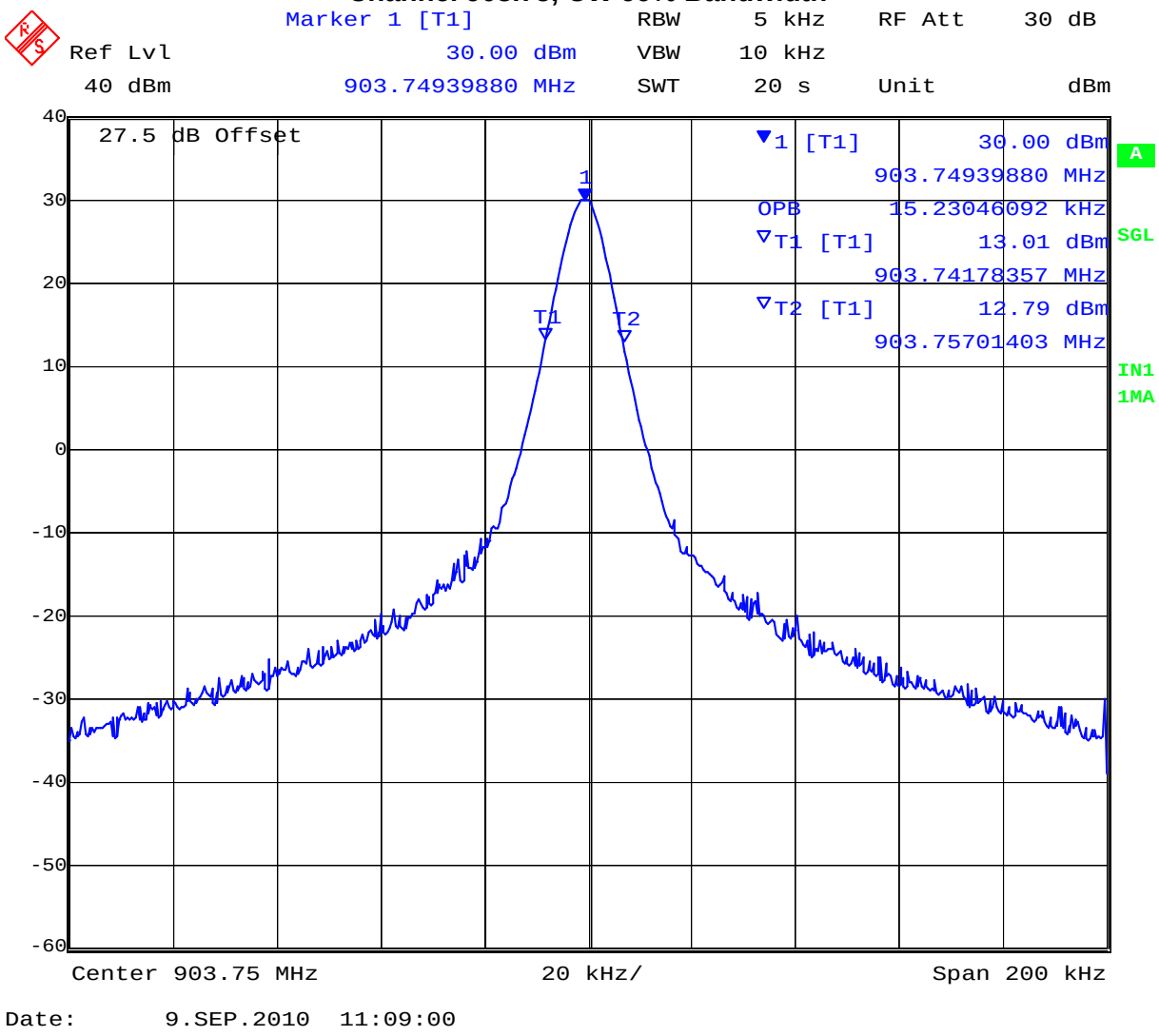
Channel 902.75, CW 99% Bandwidth



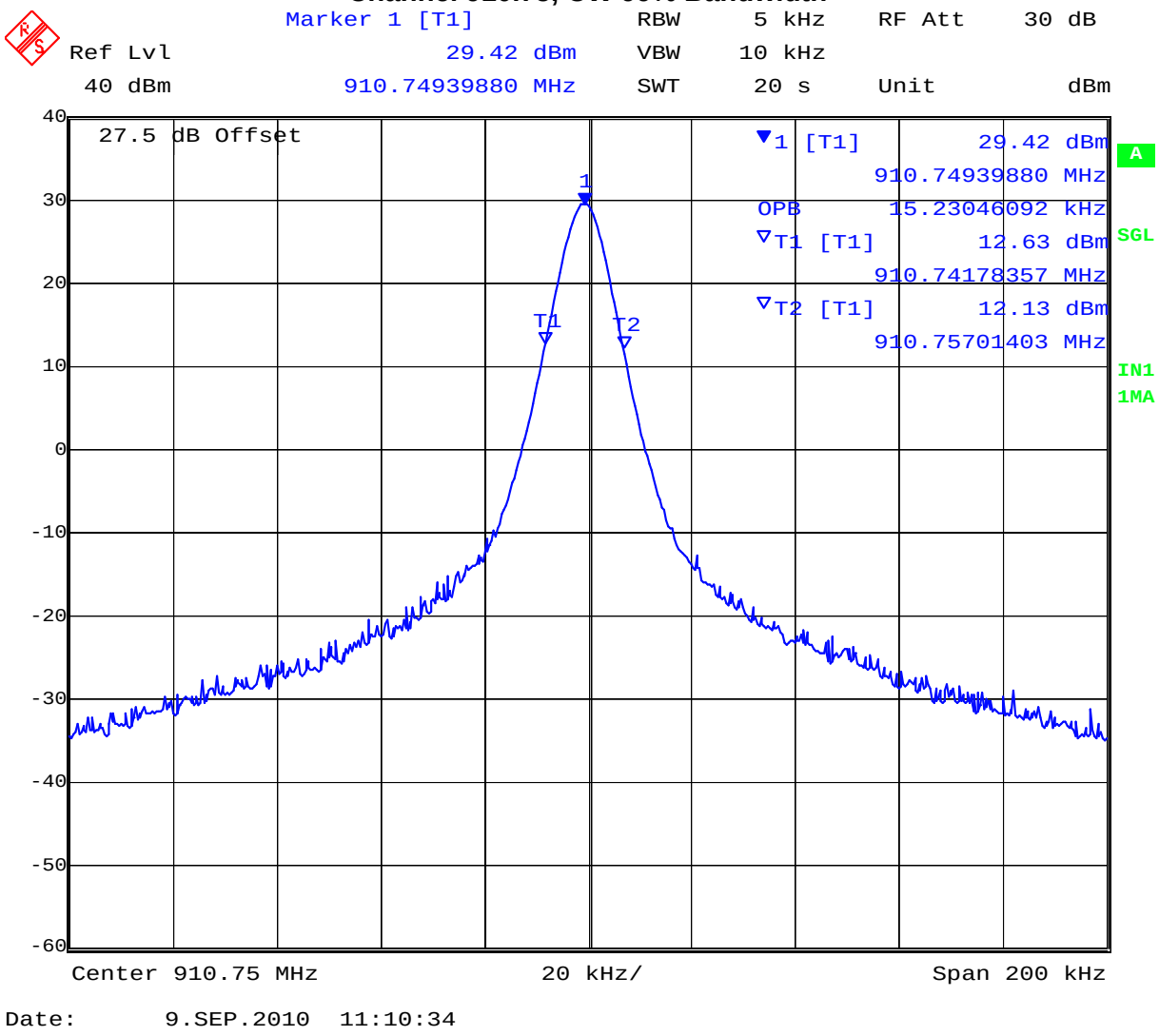
Channel 903.00, CW 99% Bandwidth



Channel 903.75, CW 99% Bandwidth



Channel 910.75, CW 99% Bandwidth



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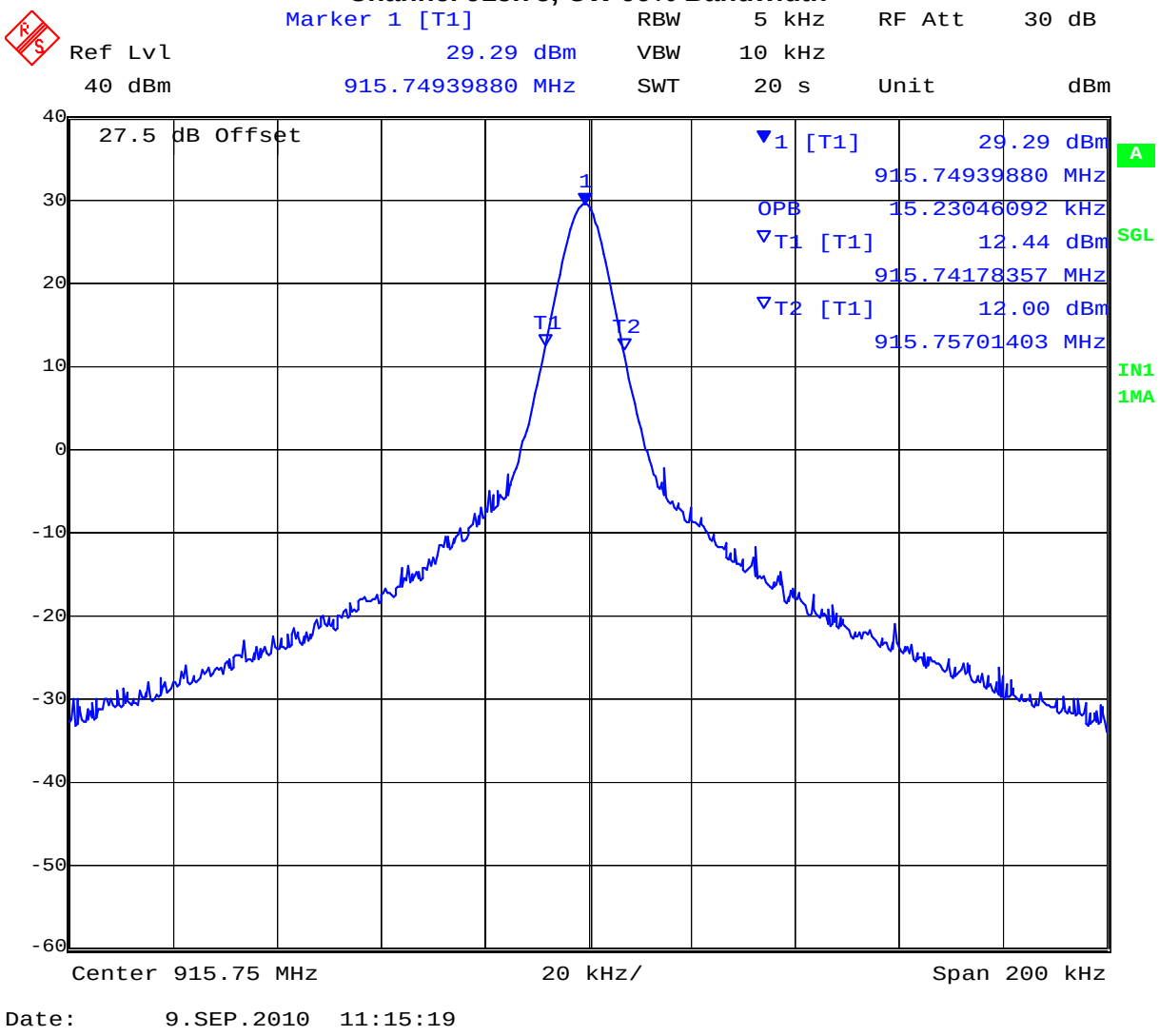
Channel 915.75, CW 99% Bandwidth



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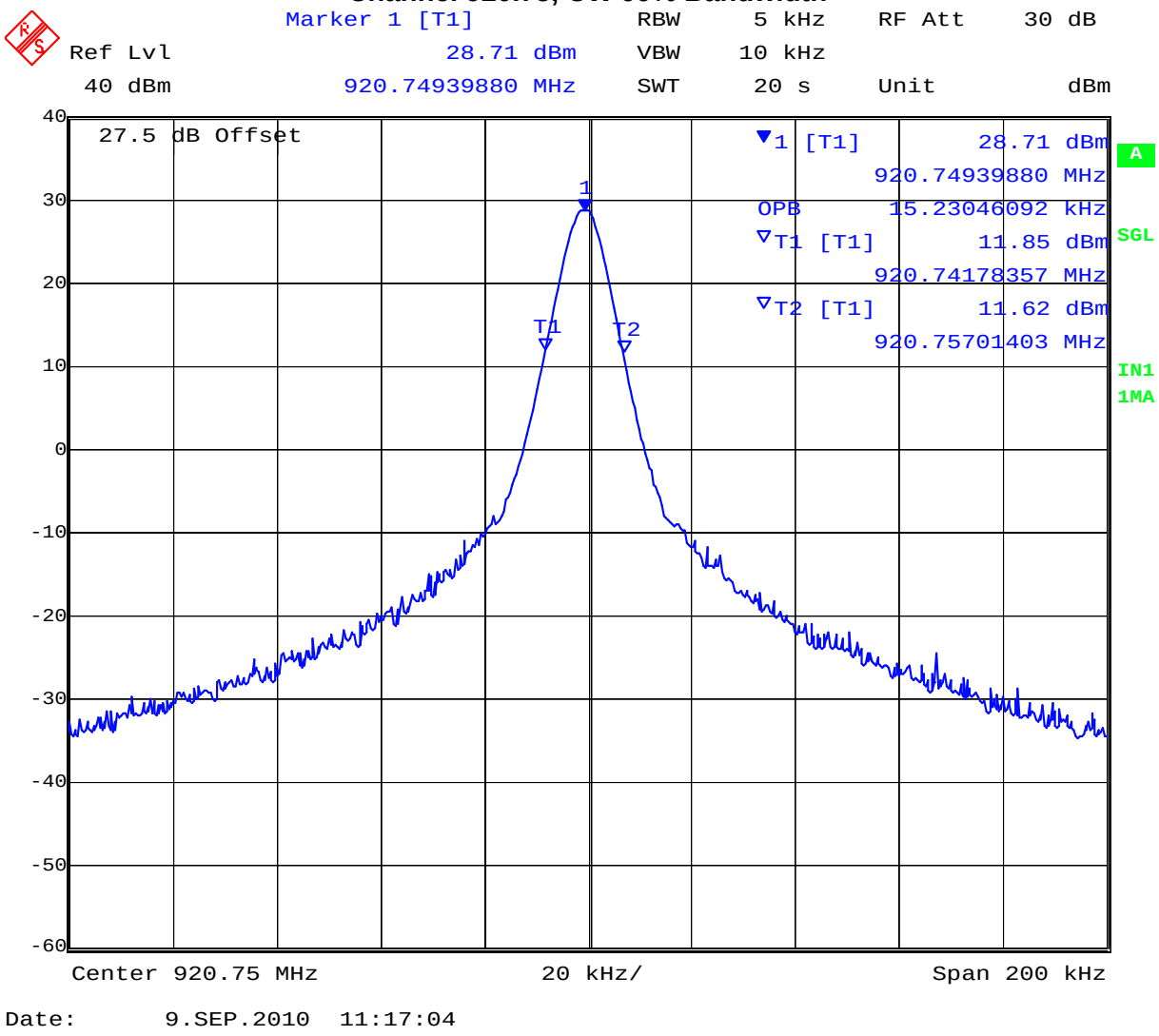
Channel 920.75, CW 99% Bandwidth



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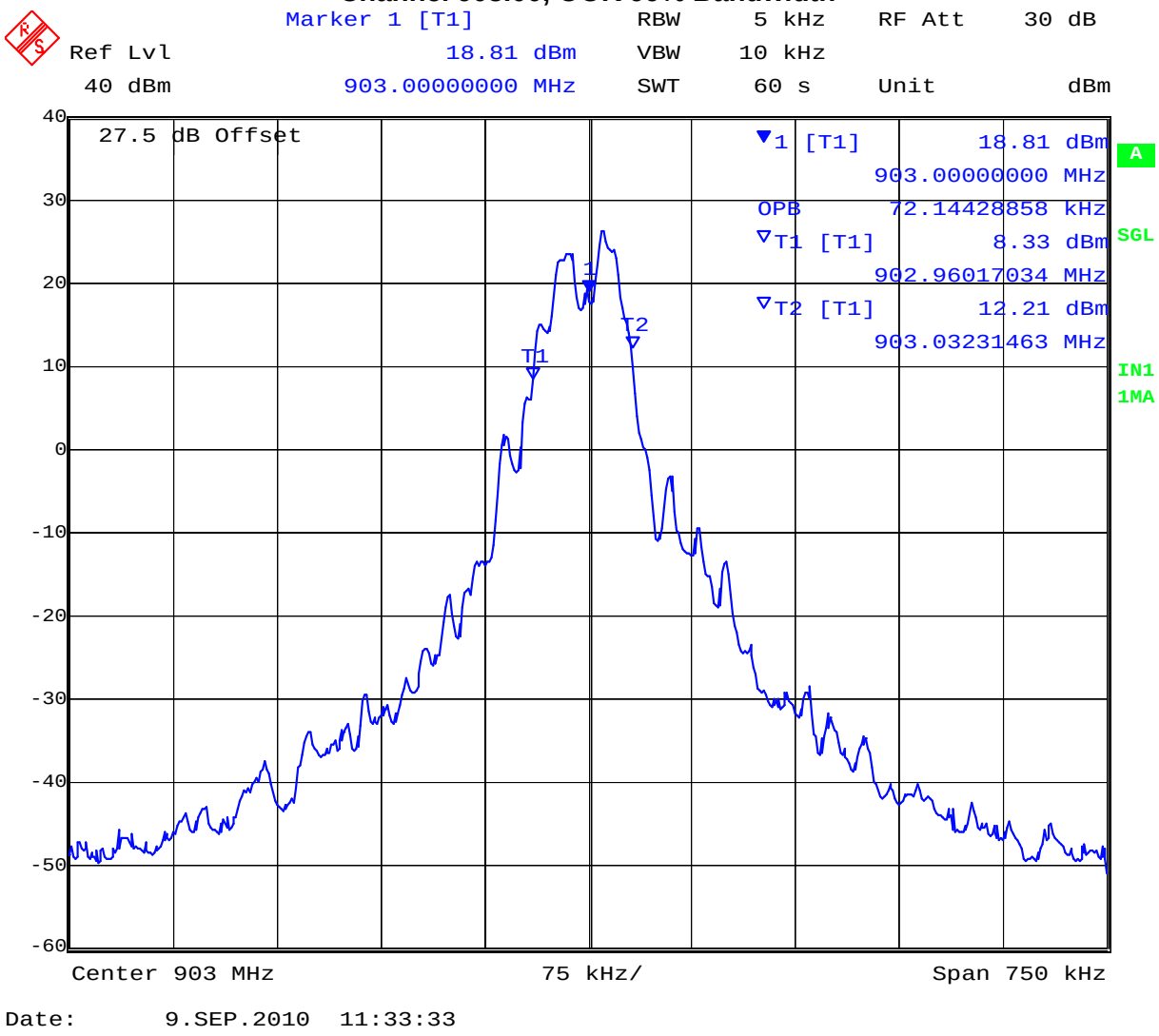
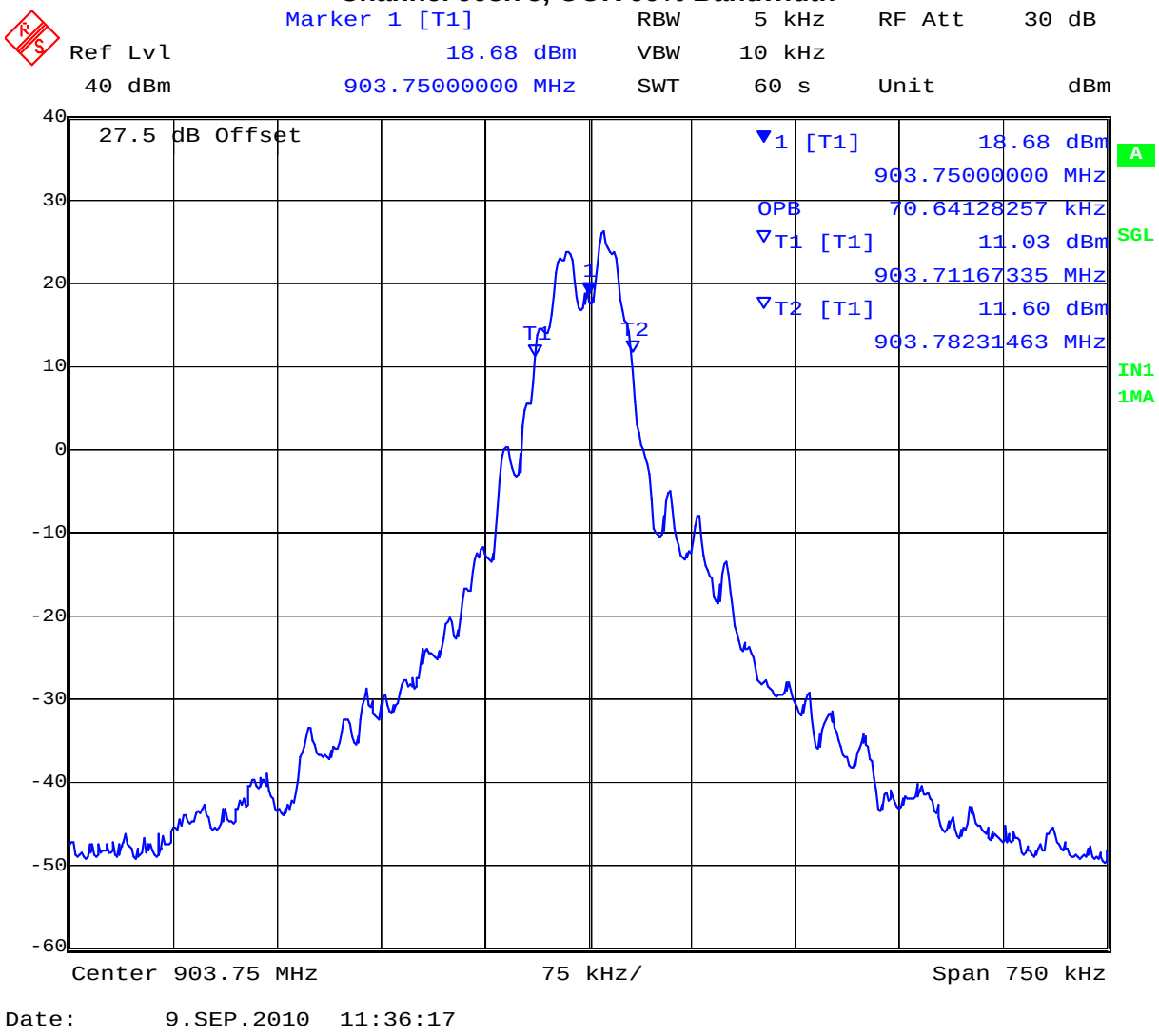
Channel 902.75, OOK 99% Bandwidth

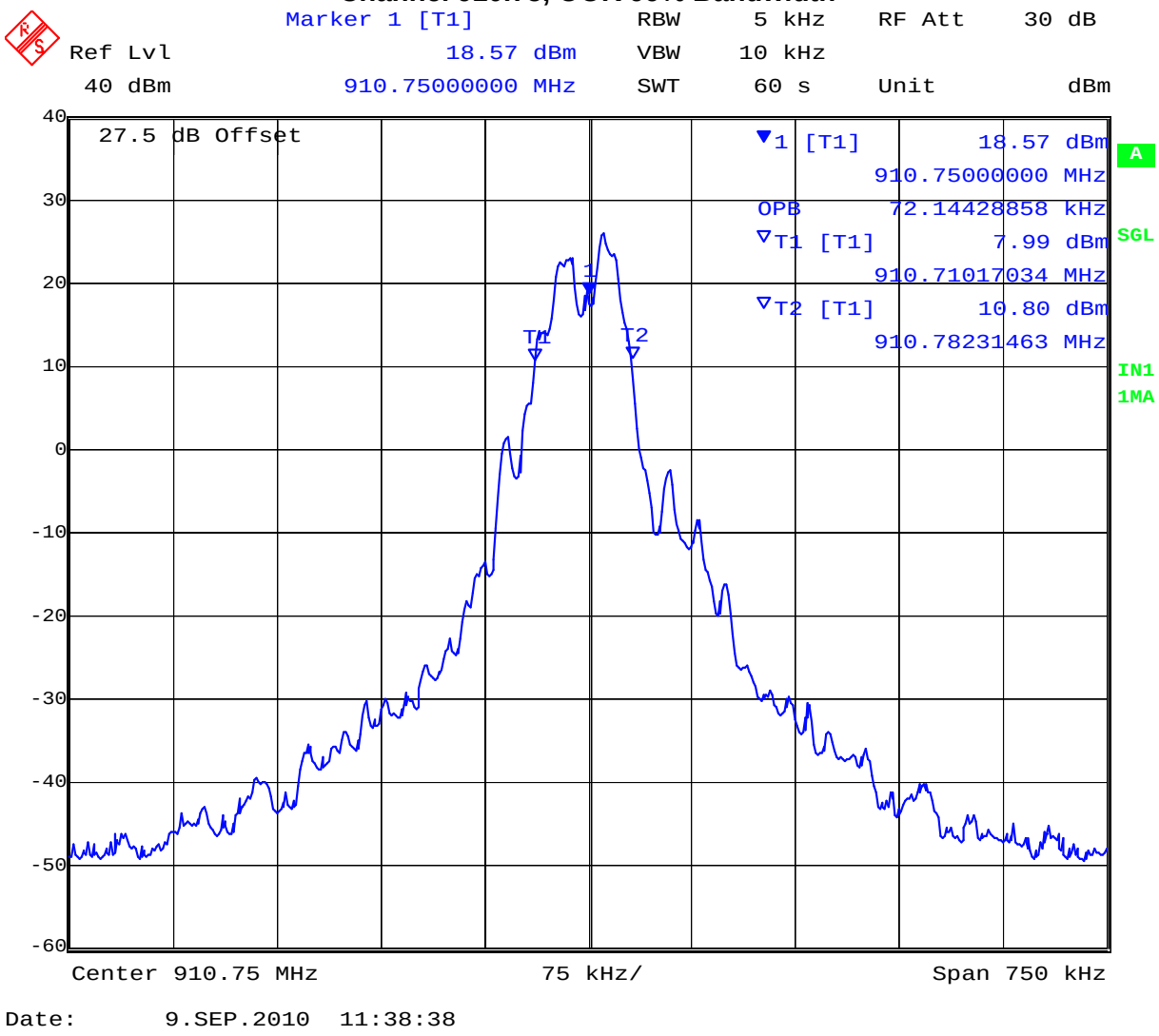
Channel 903.00, OOK 99% Bandwidth



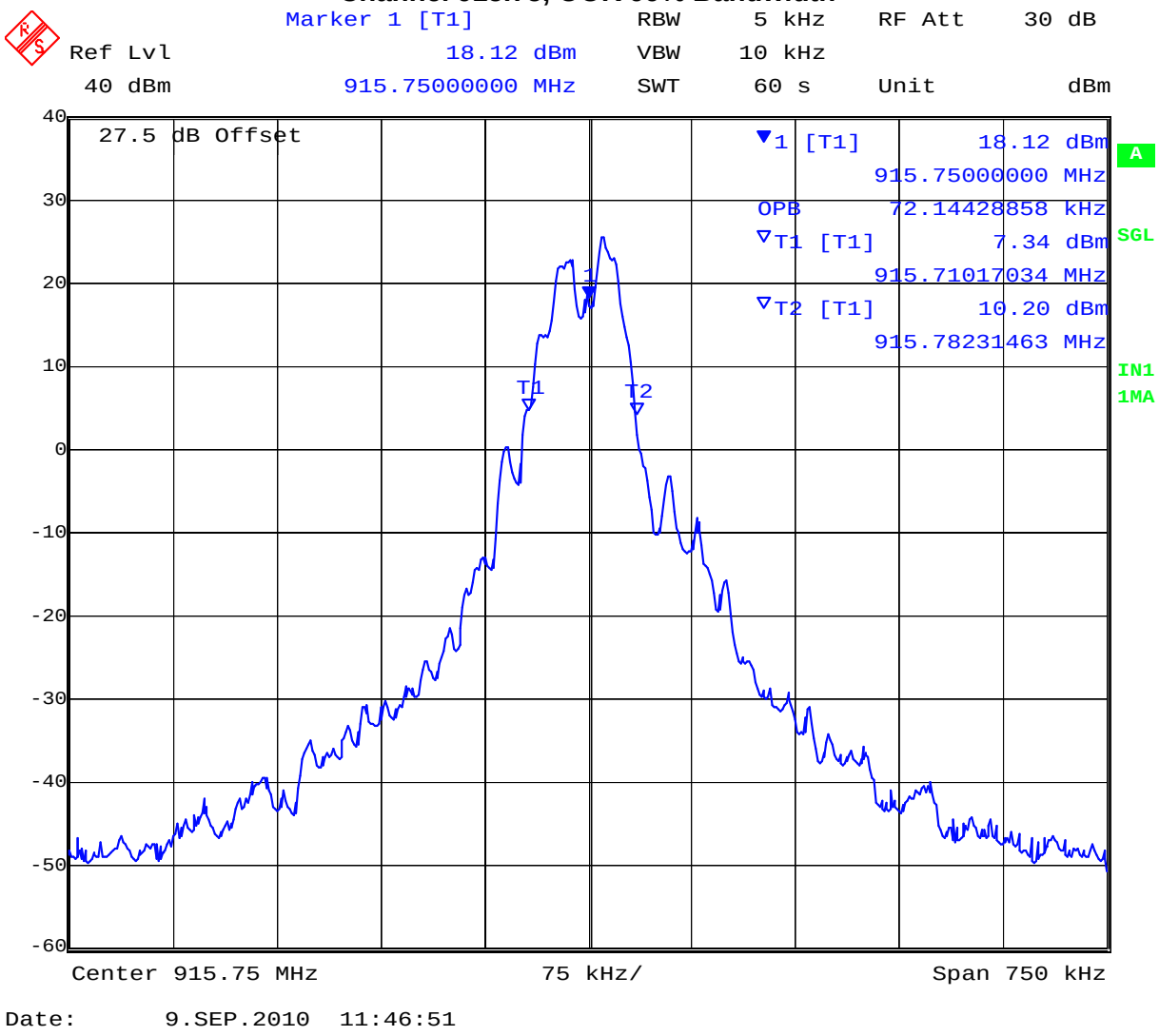
Channel 903.75, OOK 99% Bandwidth



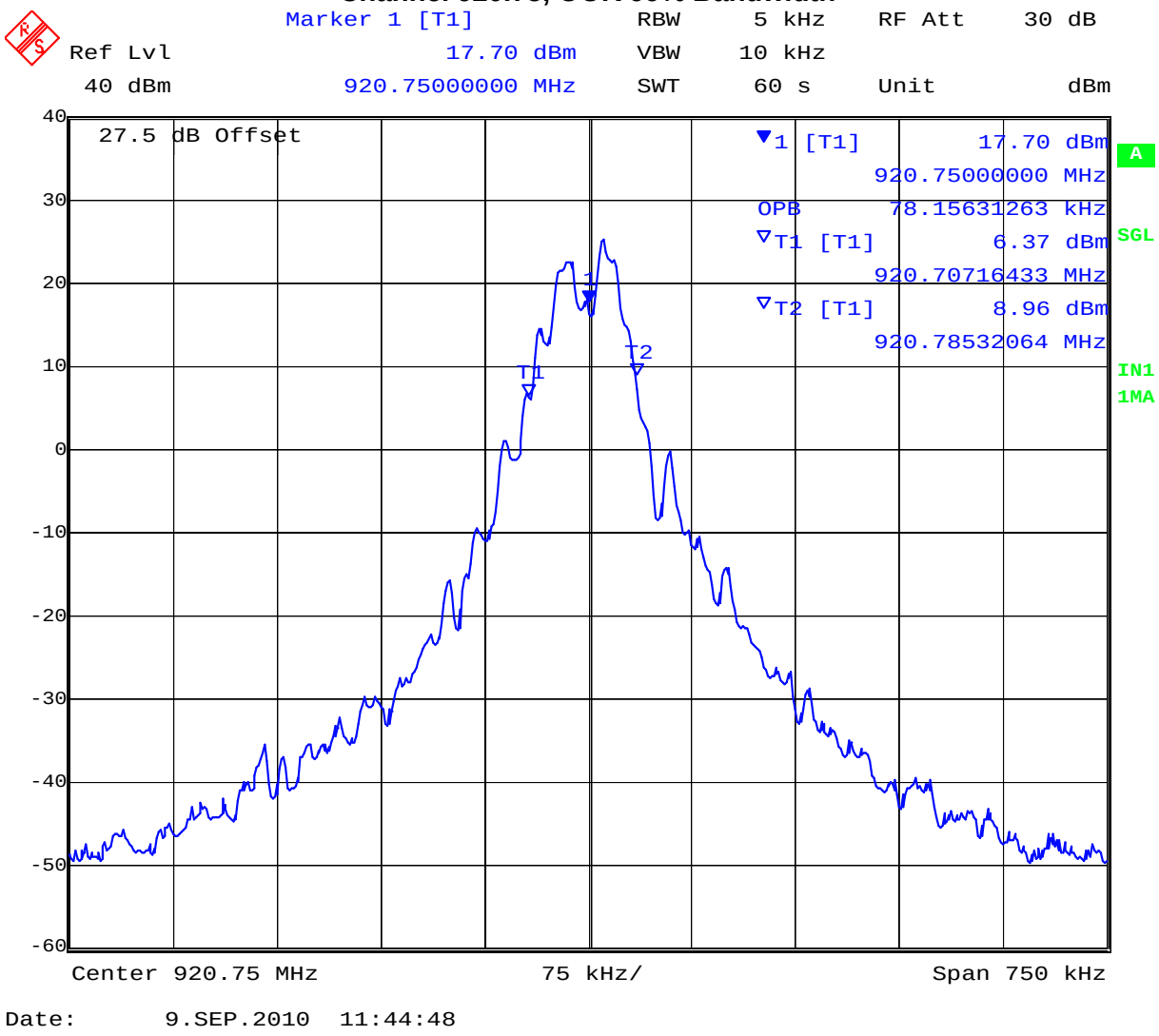
Channel 910.75, OOK 99% Bandwidth



Channel 915.75, OOK 99% Bandwidth



Channel 920.75, OOK 99% Bandwidth



7.1.2 Effective Radiated Power

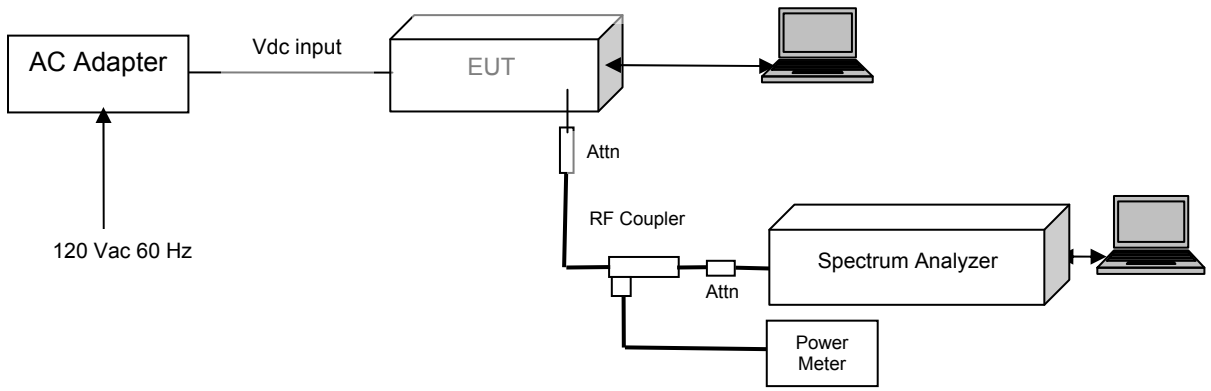
FCC CFR 47 Part 90.205, Subpart I; §2.1046; IC RSS-137 6.4

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).

Test Procedure

Average power measurements were measured with the use of an average power head. The system highest power setting was selected with modulation OFF (CW) and ON (OOK).

Test Set-up



Example Calculation:

ERP (dBm) = Transmit Power (dBm) + Antenna Gain (dBi) – Antenna Conversion to ERP (2.14dB)

Meaning of Life = 42

Antenna Gain = 11.5 dBi

ERP (dBm) = Transmit Power (dBm) + 11.5 dBi - 2.14 dB

Laboratory Measurement Uncertainty for Power Measurement

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03.	0070, 0116, 0158, 0193, 0252, 0313, 0314.

7.1.2.1 Measurement Results for Effective Radiated Power

Temperature: 17 to 29 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Modulation	Center Frequency	Measured Power	ERP	ERP Limit		Margin
	MHz	(dBm)	(dBm)	(W)	(dBm)	(dB)
CW	902.75	30.81	42.81	30	44.77	-1.96
	903	30.49	42.49			-2.28
	903.75	30.61	42.61			-2.16
	910.75	30.05	42.05			-2.72
	915.75	29.87	41.87			-2.90
	920.75	29.37	41.37			-3.40
OOK	902.75	28.58	40.58			-4.19
	903	28.42	40.42			-4.35
	903.75	28.39	40.39			-4.38
	910.75	27.98	39.98			-4.79
	915.75	27.59	39.59			-5.18
	920.75	27.31	39.31			-5.46

Highest antenna gain = 12 dBi

ERP (dBm) = Measured power + Antenna Gain - 2.14

Margin (dB) = ERP (dBm) - 44.7

7.1.3 Maximum Permissible Exposure

FCC, Part 90 Subpart C §90.1217

Maximum Permissible Exposure Limits

§90.1217 Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines. See §1.1307 (b)(1) of this chapter.

Limit = 1mW / cm2 from 1.310 Table 1

Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33dB

7.1.3.1 Calculations for Maximum Permissible Exposure Levels

The EUT has a single transmitter. The peak power in the table below is calculated by assuming a worst case scenario for the maximum gain antenna and output power. The calculated separation distance is for worst case highest power level.

Power Density = Pd (mW/cm2) = EIRP/(4πd2)
EIRP = P * G
P = Peak output power (mW)
G = Antenna numeric gain (numeric)
d = Separation distance (cm)
Numeric Gain = 10 ^ (G (dBi)/10)

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm2

Freq. Band (MHz)	Antenna Gain (dBi)	Peak Output Power (dBm)	Antenna Gain (numeric)	EIRP (mW)	Distance @ 1mW/cm2 Limit(cm)	Minimum Separation Distance (cm)
900	12	30.81	15.848932	19098.53	38.99	38.994664

7.1.4 Frequency Stability; Temperature Variations, and Voltage Variations

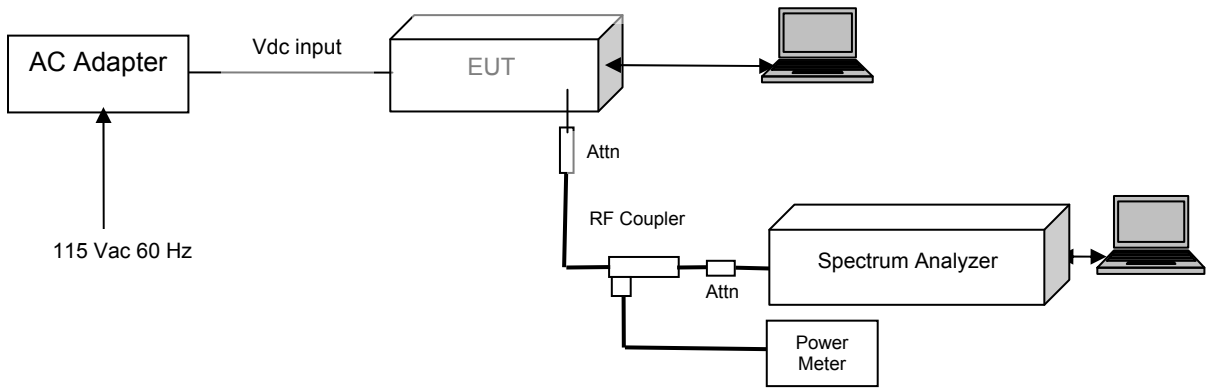
FCC CFR 47 2.1053, Part 90.213, IC RSS-137 6.3

Test Procedure

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 Set-up



Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±0.866 ppm

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-02	0070, 0116, 0158, 0193, 0252, 0313, 0314.

7.1.4.1 Measurement Results for Frequency Stability

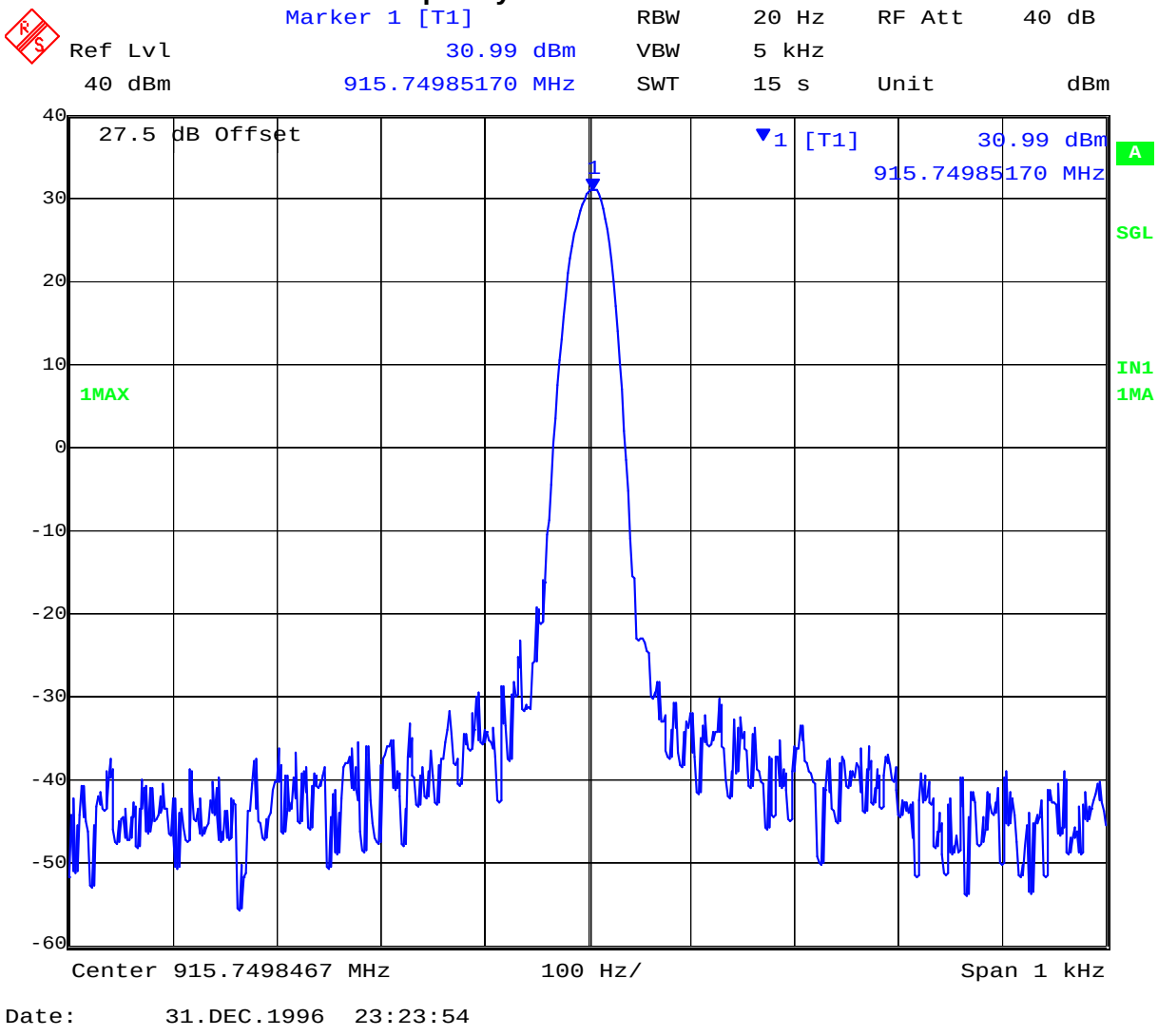
Temperature: 17 to 29 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

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

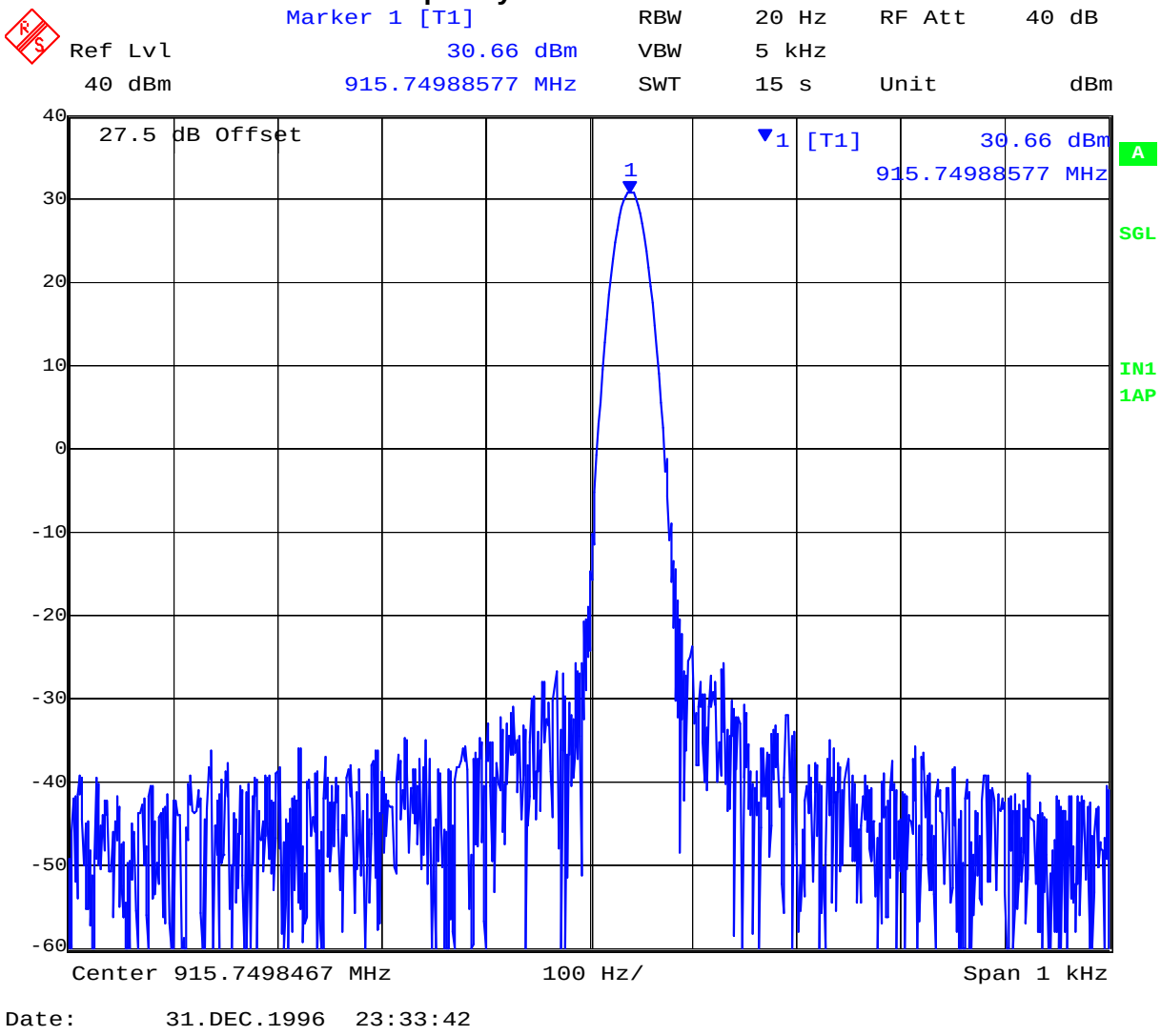
Voltage (Vdc)	Temperature (°C)	Marker Frequency (MHz)	Delta (kHz)	ppm
9.75	-20	915.74985170	0.14830000	0.161943762
	-10	915.74988577	0.11423000	0.124739285
	0	915.74984770	0.15230000	0.166311766
	+10	915.74959820	0.40180000	0.438766039
	+20	915.74940882	0.59118000	0.645569206
8.3	+20	915.74941082	0.58918000	0.643385203
11.22	+20	915.74939078	0.60922200	0.665271089
9.75	+30	915.74939479	0.60521000	0.660889981
	+40	915.74948297	0.51703000	0.564597325
	+50	915.74897996	1.02004000	1.113884794
Maximum Frequency Drift with respect to the nominal frequency.		1.02 kHz 1.114 p.p.m.		

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.

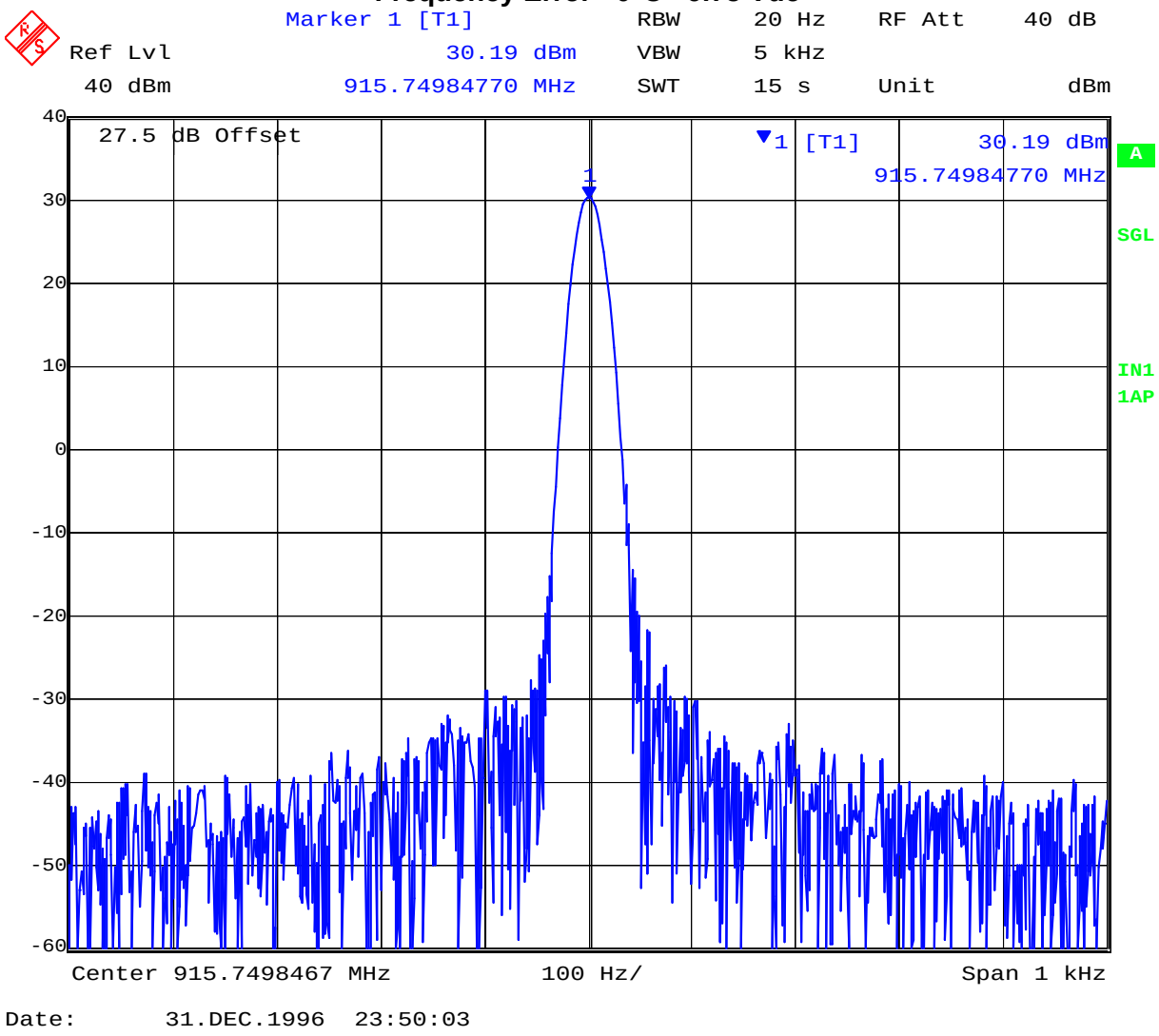
Frequency Error -20°C +9.75 Vdc



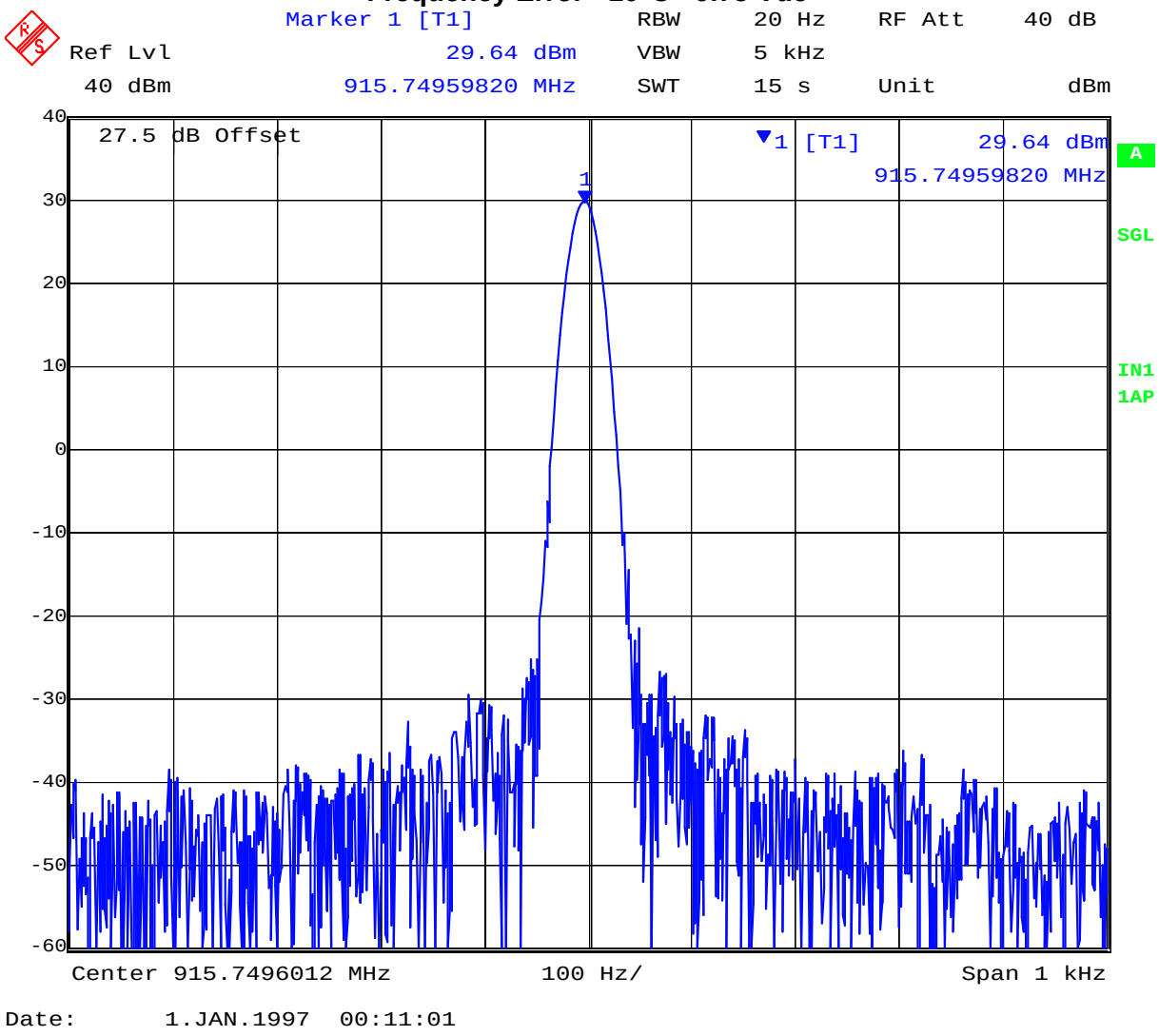
Frequency Error -10°C +9.75 Vdc



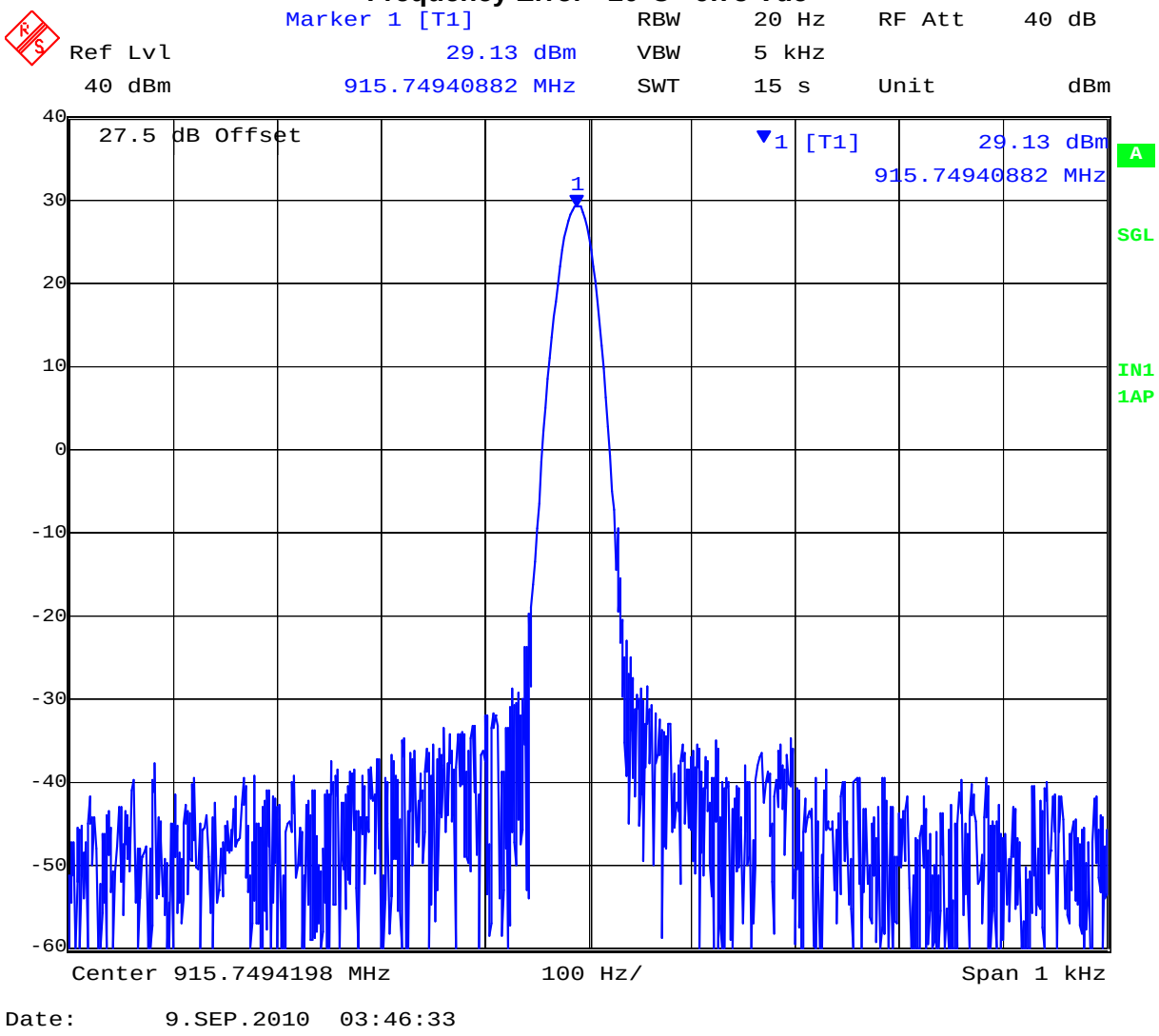
Frequency Error +0°C +9.75 Vdc



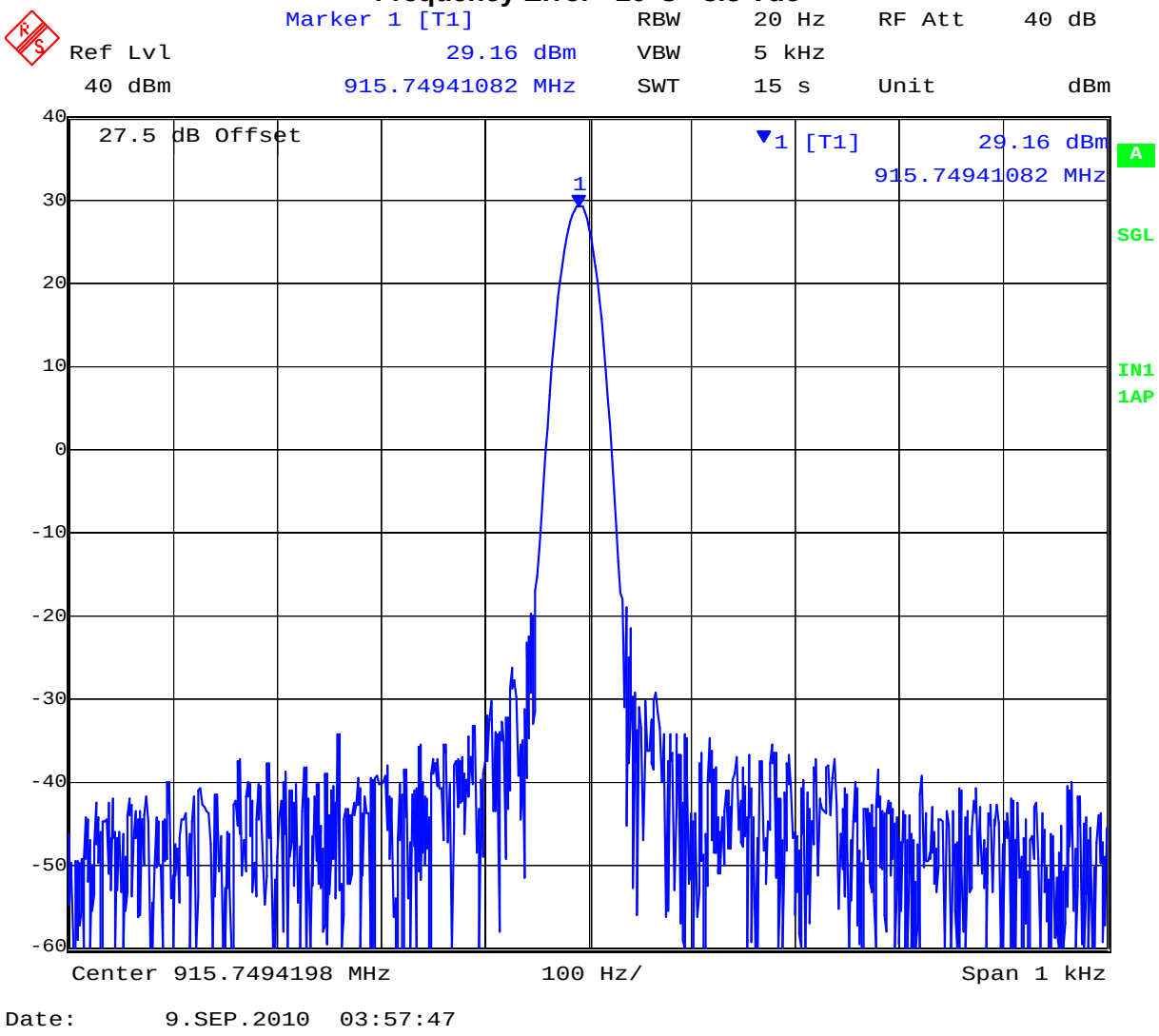
Frequency Error +10°C +9.75 Vdc



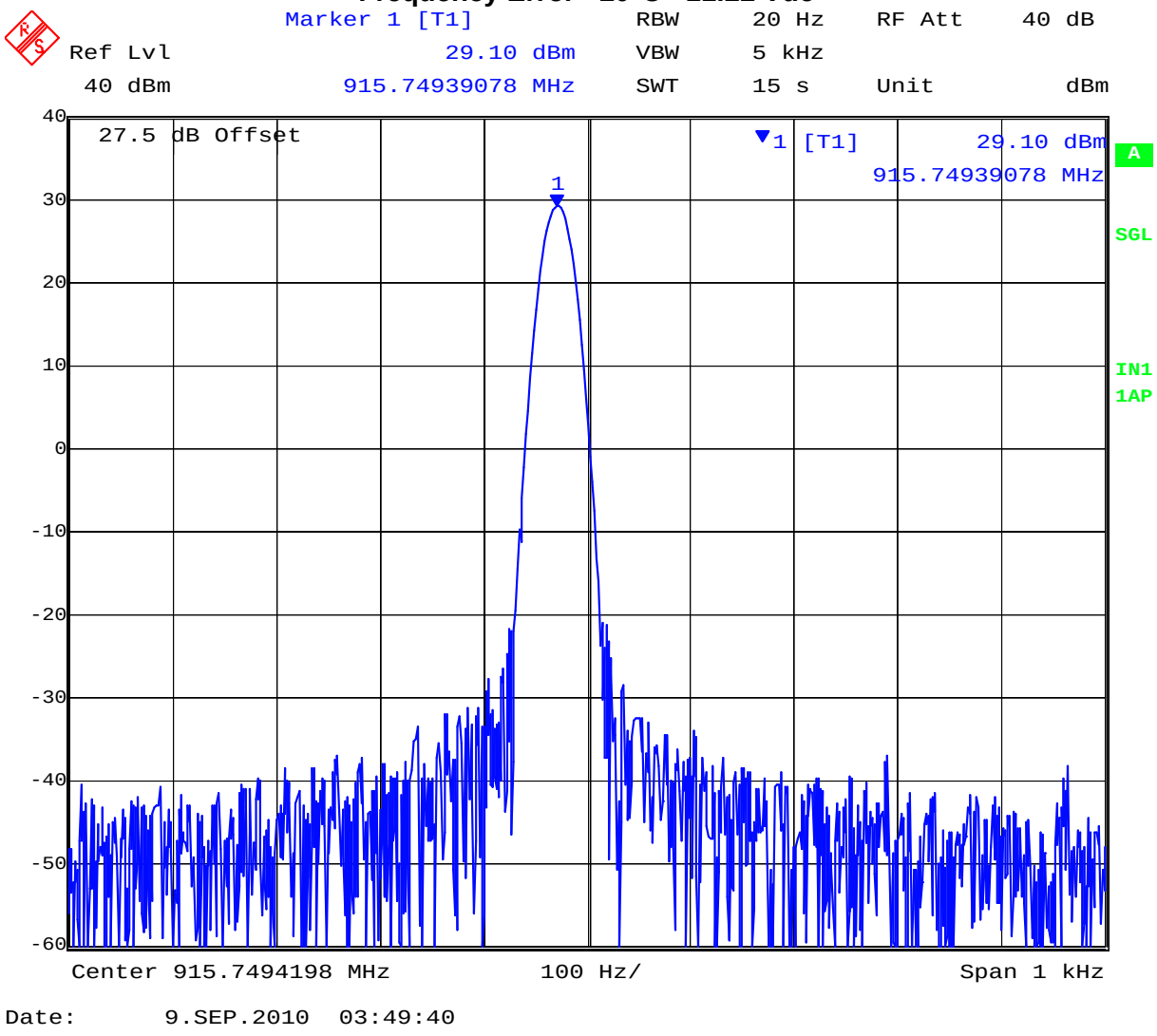
Frequency Error +20°C +9.75 Vdc



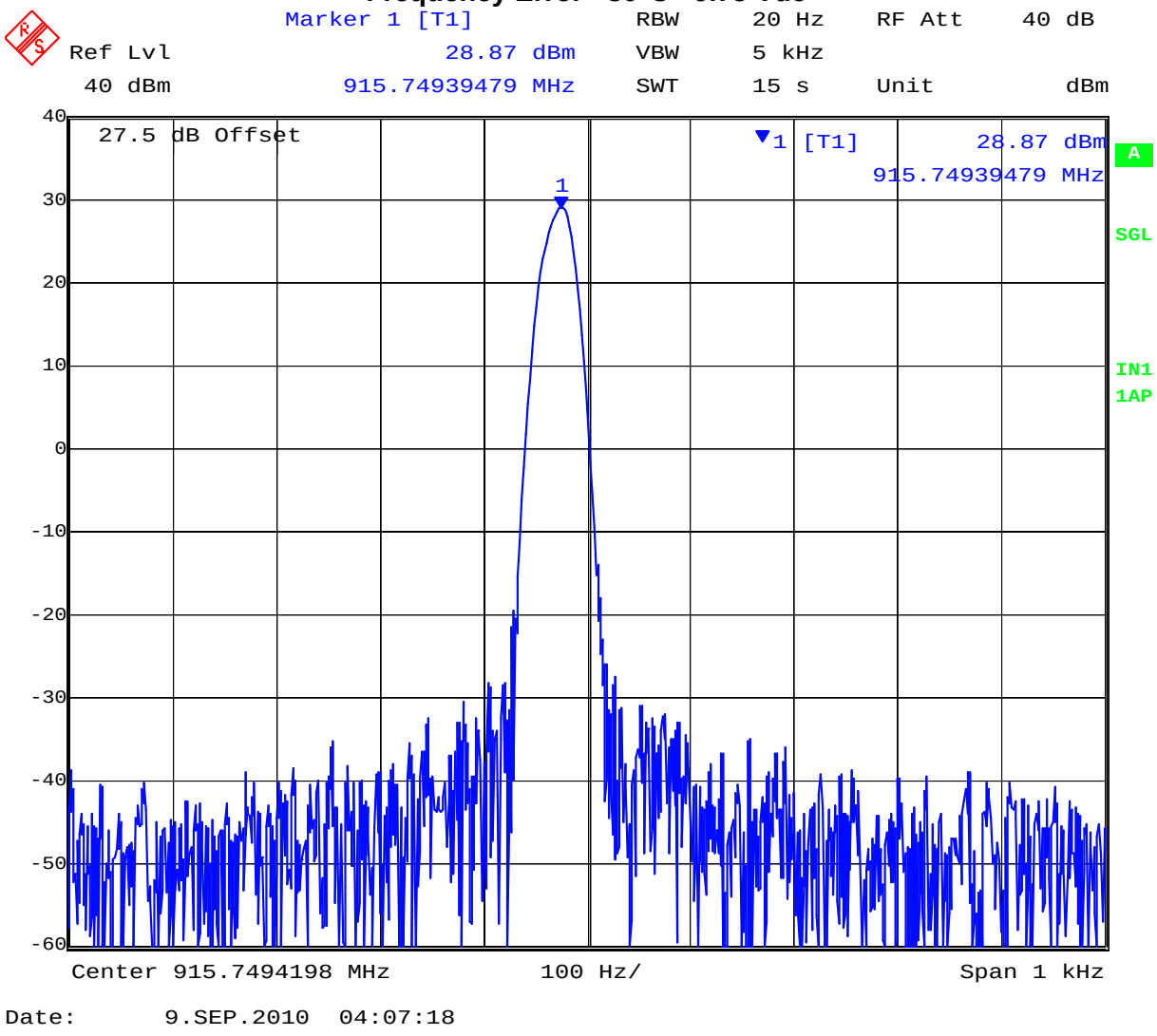
Frequency Error +20°C +8.3 Vdc



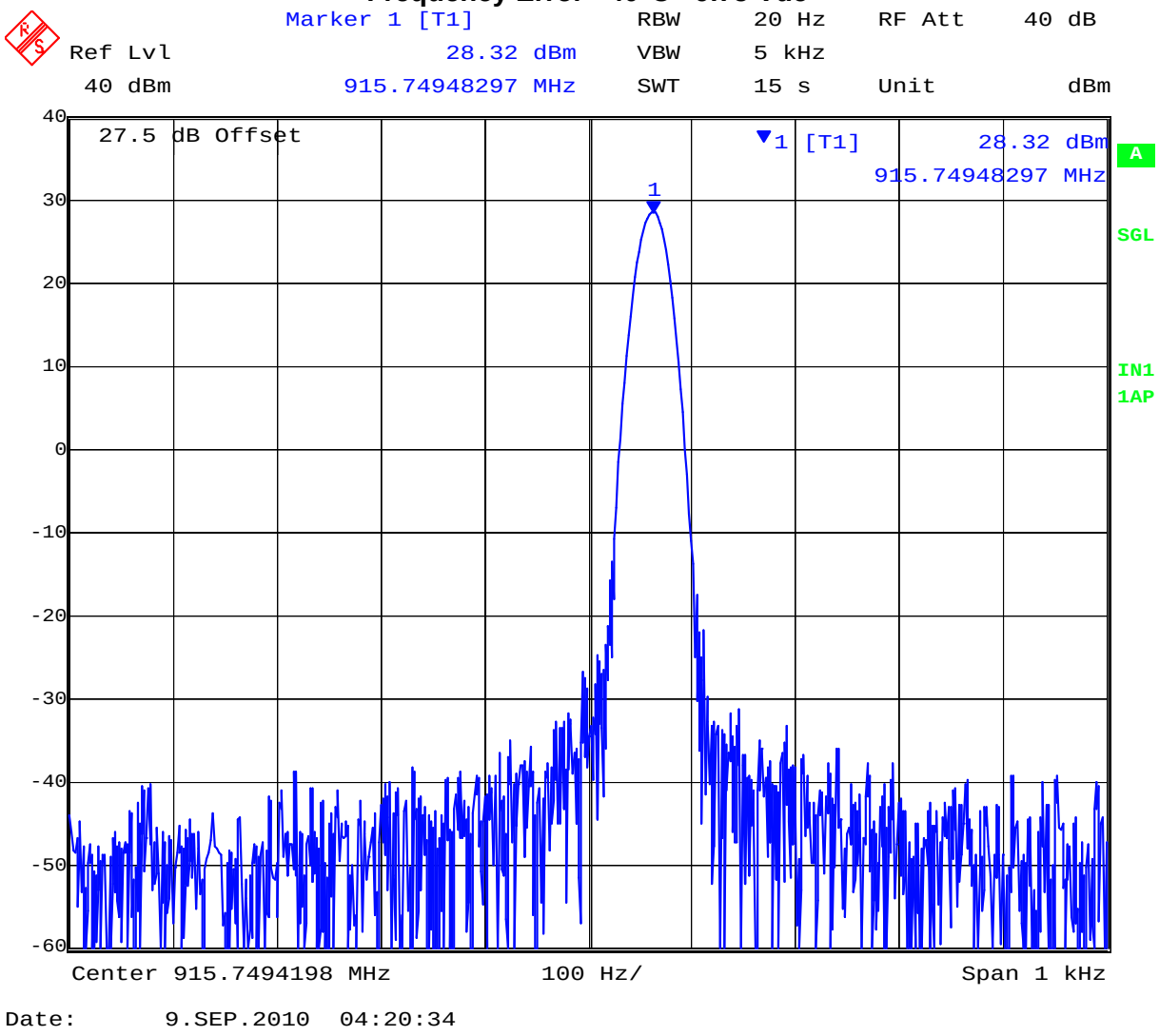
Frequency Error +20°C +11.22 Vdc



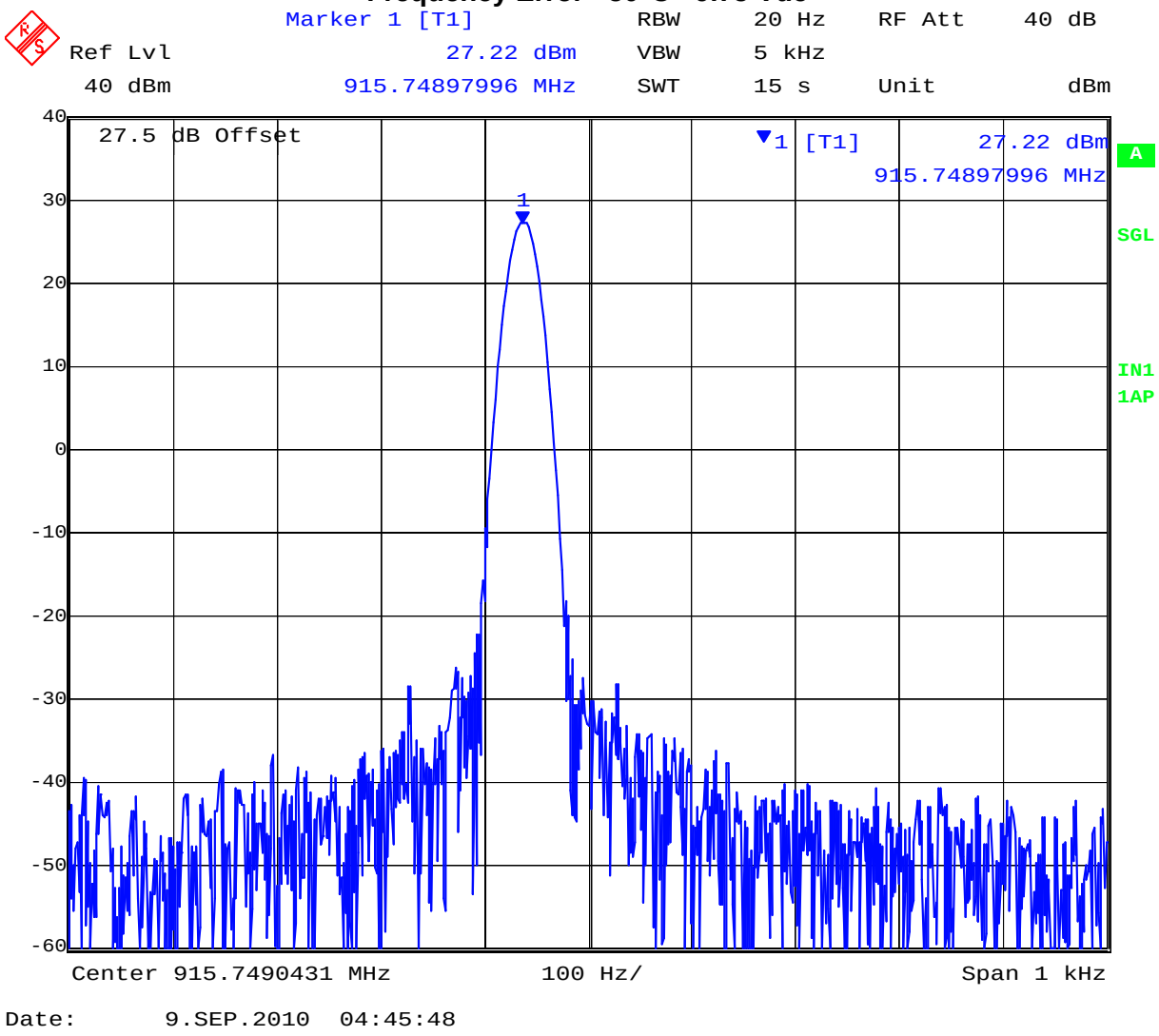
Frequency Error +30°C +9.75 Vdc



Frequency Error +40°C +9.75 Vdc



Frequency Error +50°C +9.75 Vdc



7.1.5 Spectrum Mask (Band-Edge)

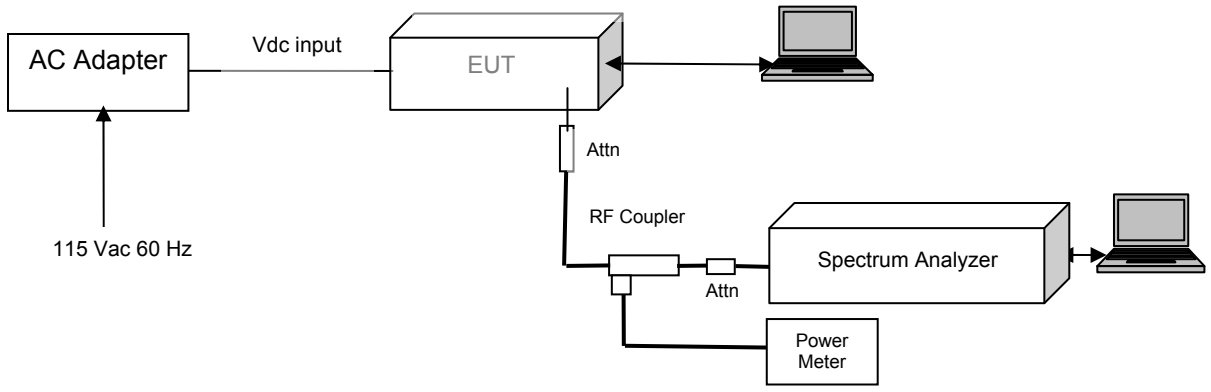
FCC CFR 47 2.1051, Part 90.210 (K), IC RSS-137 6.5.3

Test Procedure

The widest operational bandwidth was used in order to prove compliance with Spectrum Mask (Band-Edge) compliance. Maximum operational mode for 99% bandwidth was modulated (OOK) and therefore only these results are reported.

Conducted spurious emissions were measured to 10 GHz in a peak hold mode.

Test Set-up



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 = +30.81 dBm = 1.205 W
Attenuation = 55.81 dB
Limit = -25 dBm

Laboratory Measurement Uncertainty

Measurement uncertainty	±2.37 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05	0070, 0116, 0158, 0088, 0252, 0313, 0314

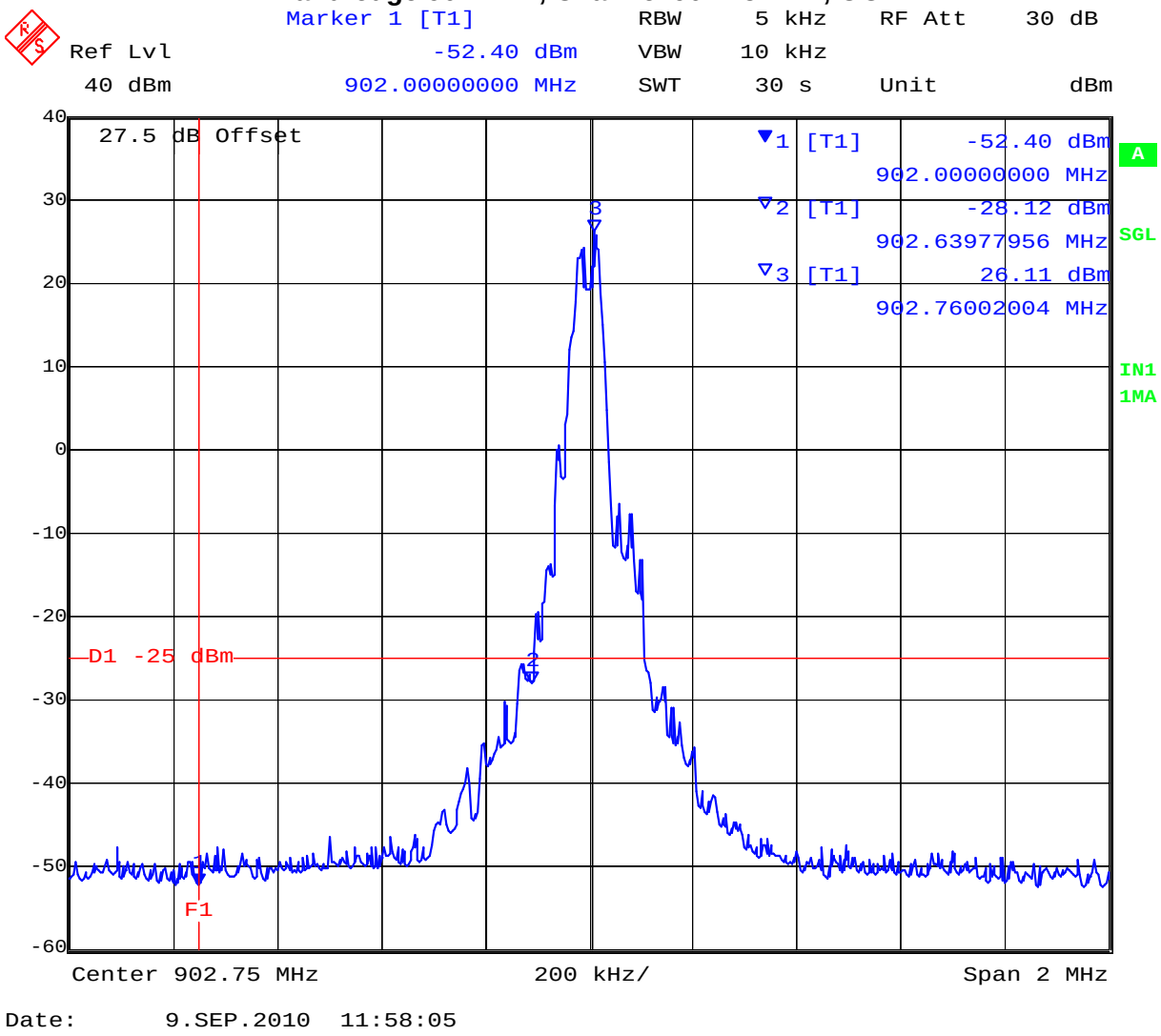
7.1.5.1 Measurement Results for Spectrum Mask (Band Edge) Emissions

Band-edges

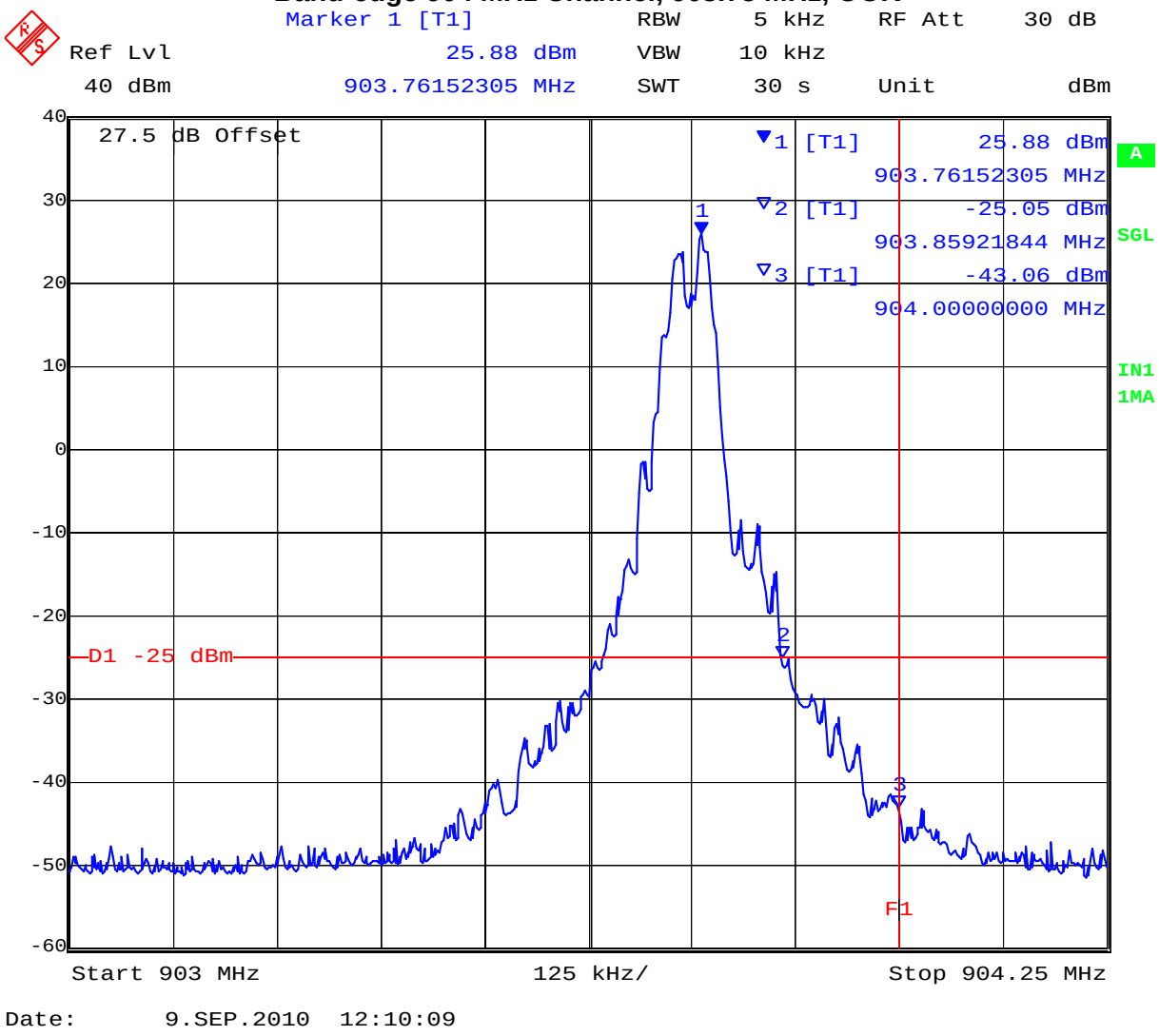
Lower Frequency Band 902 MHz, 904 MHz
Upper Frequency Band 909.75 MHz, 921.75 MHz

Temperature: 17 to 29 °C Rel. humidity: 31 to 57 % Pressure: 999 to 1012 mbar

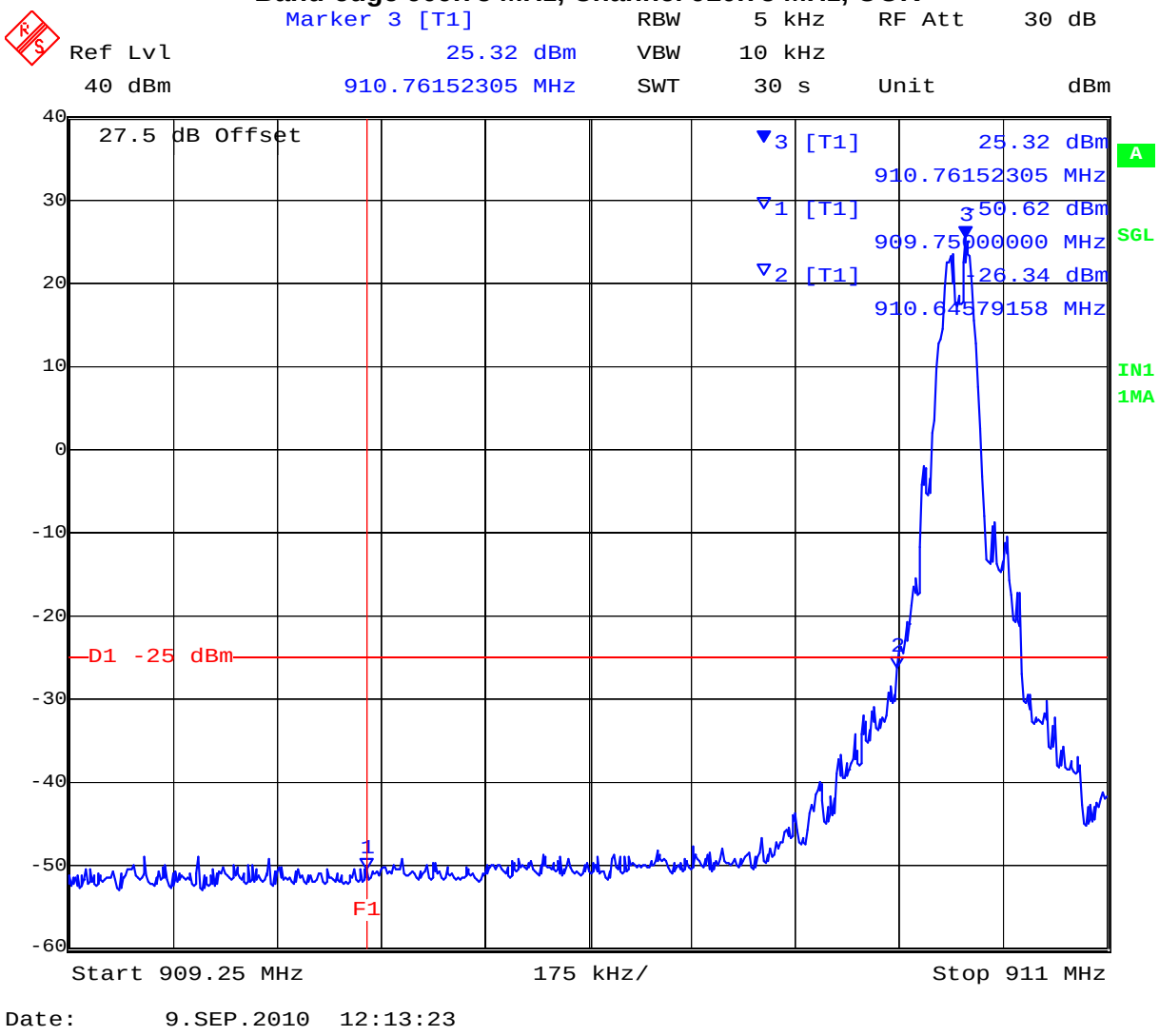
Band-edge 902 MHz, Channel 902.75 MHz, OOK



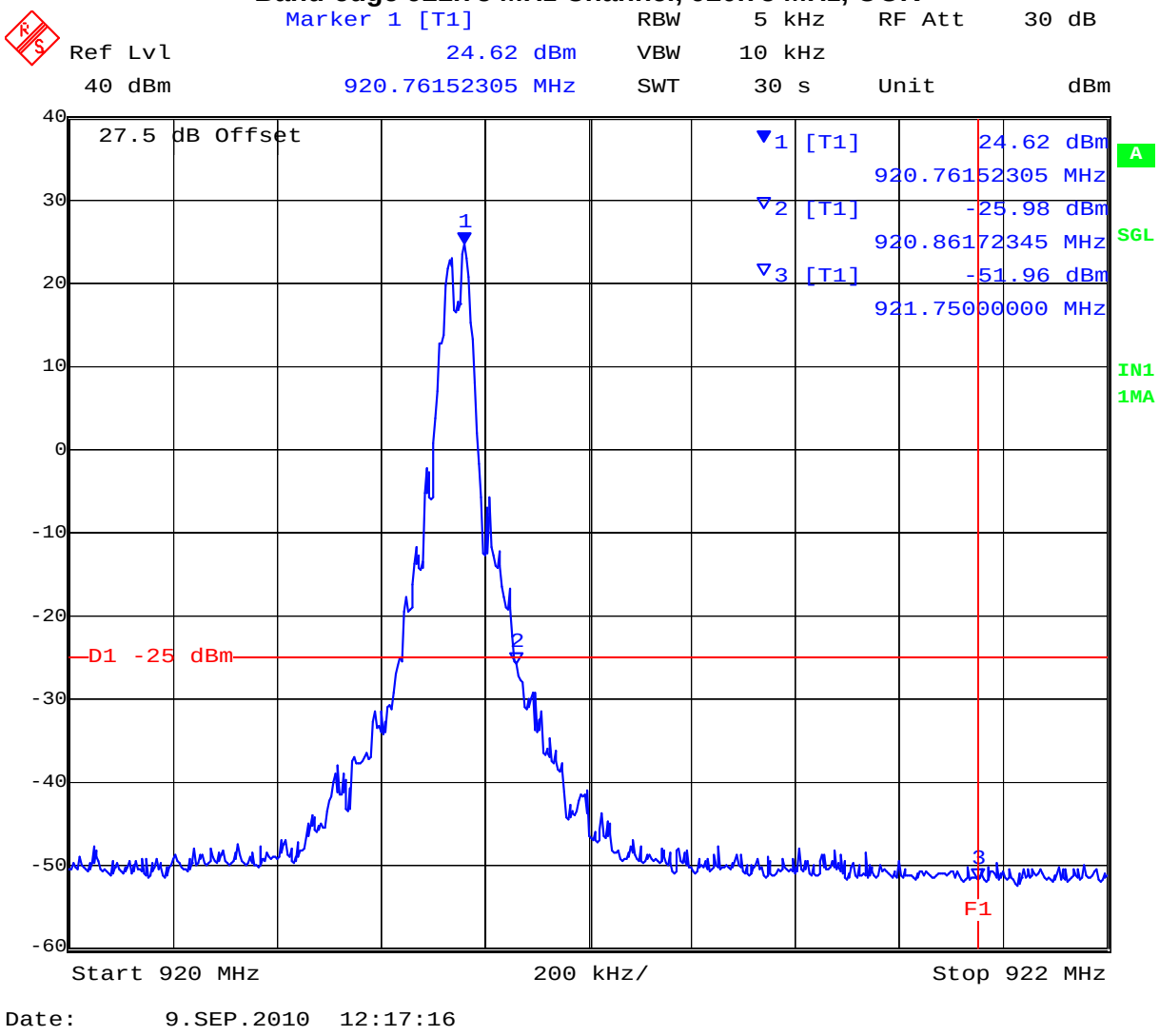
Band-edge 904 MHz Channel, 903.75 MHz, OOK



Band-edge 909.75 MHz, Channel 910.75 MHz, OOK



Band-edge 921.75 MHz Channel, 920.75 MHz, OOK



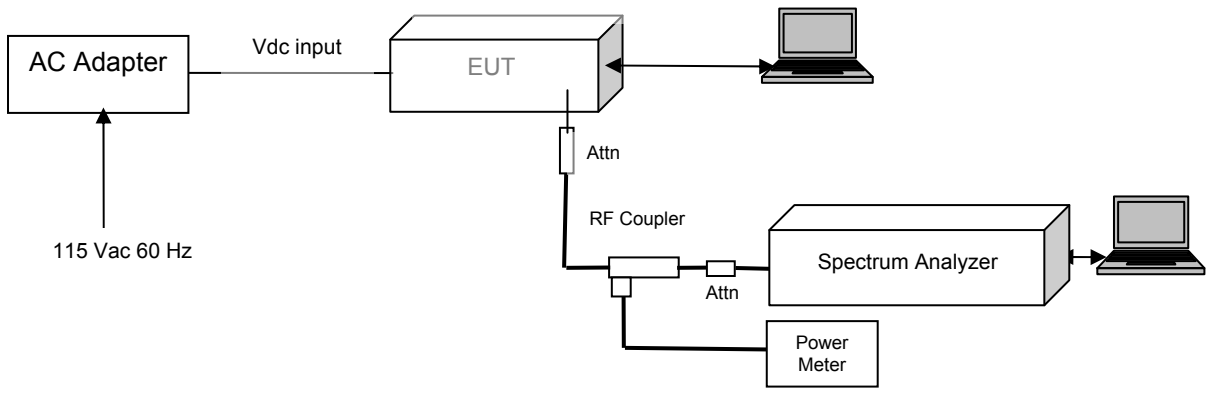
7.1.6 Conducted Spurious Emissions at Antenna Terminals

FCC CFR 47 2.1051, Part 90.210 (K), IC RSS-137 6.5.3

Test Procedure

Conducted spurious emissions were measured to 10 GHz in a peak hold mode.

Test Set-up



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 = +30.81 dBm = 1.205 W
Attenuation = 55.81 dB
Limit = -25 dBm

Laboratory Measurement Uncertainty

Measurement uncertainty	±2.37 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05	0070, 0116, 0158, 0088, 0252, 0313, 0314

7.1.6.1 Measurement Results for Transmitter Conducted Spurious Emissions at Antenna Terminals

CW Operational Mode used in order to prove compliance

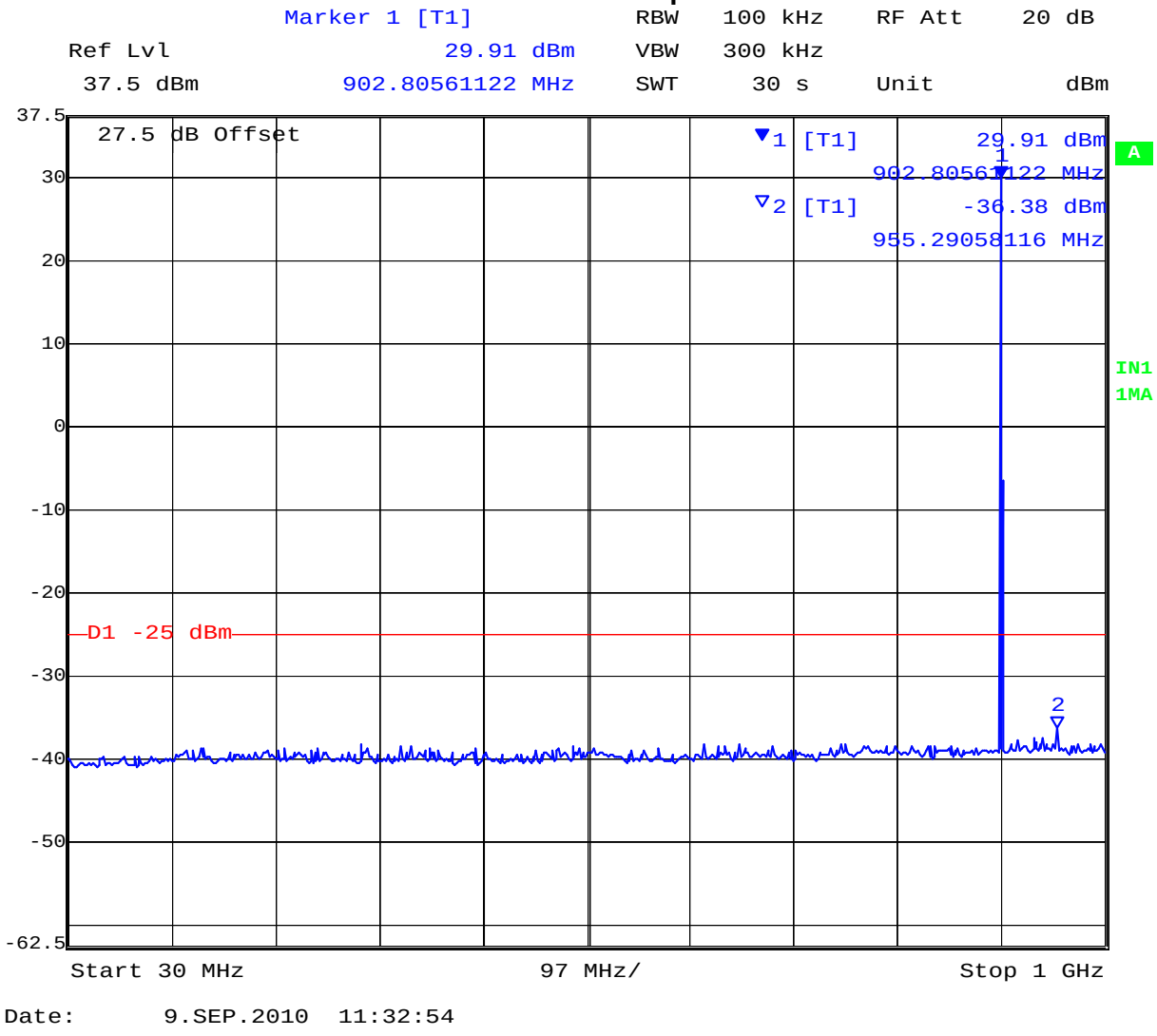
Frequency Band 902 – 904 MHz

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
902.75	30.00	1,000	-36.38	-25	-11.38
	1,000	10,000	-31.14		-6.14
903.00	30.00	1,000	-38.12		-13.12
	1,000	10,000	-31.44		-6.44
903.75	30.00	1,000	-38.12		-13.12
	1,000	10,000	-31.30		-6.30

Frequency Band 909.75 – 921.75 MHz

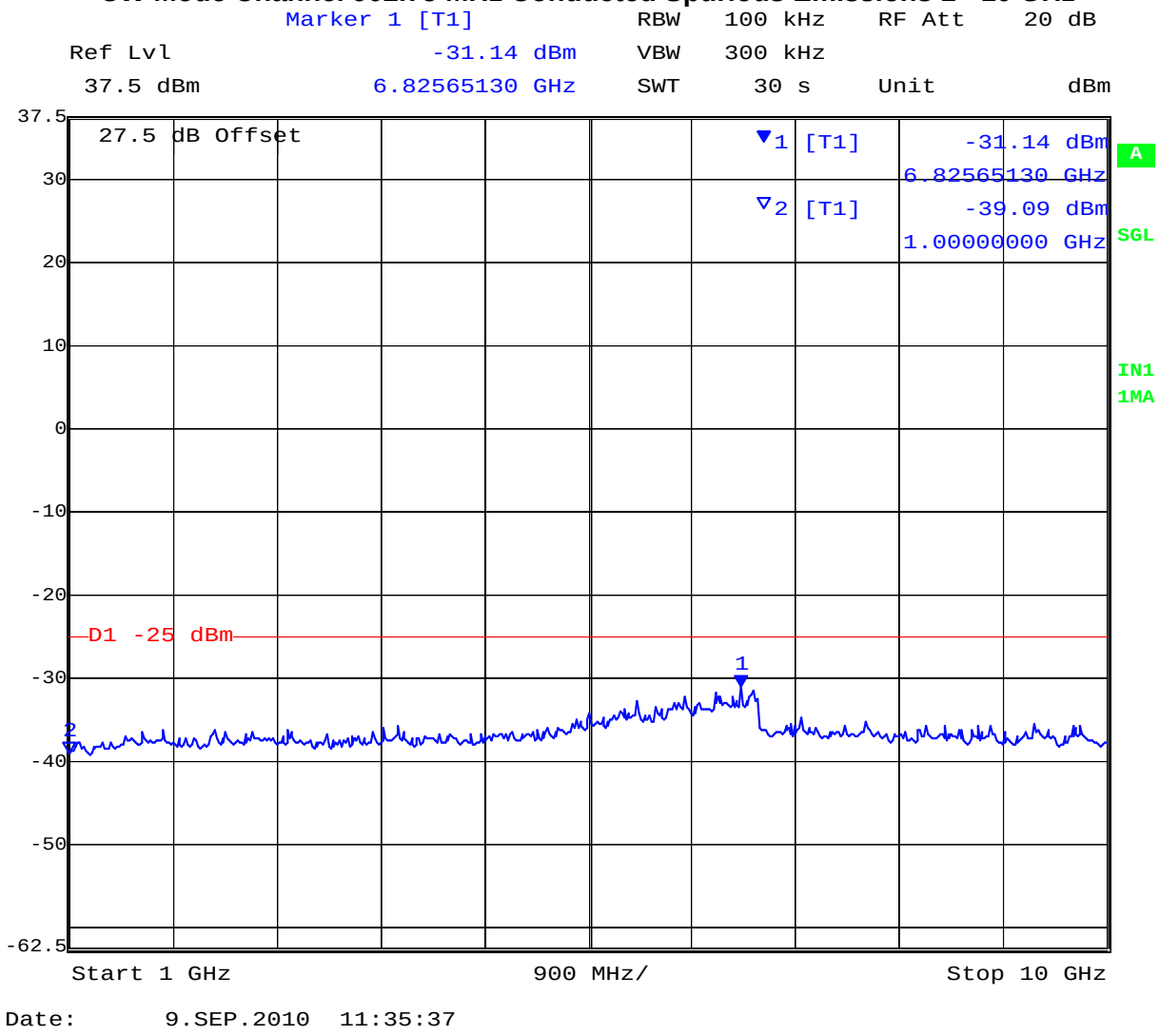
Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
910.75	30.00	1,000	-37.03	-25	12.03
	1,000	10,000	-31.32		6.32
915.75	30.00	1,000	-37.95		12.95
	1,000	10,000	-31.67		6.67
920.75	30.00	1,000	-37.38		12.38
	1,000	10,000	-31.63		6.63

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

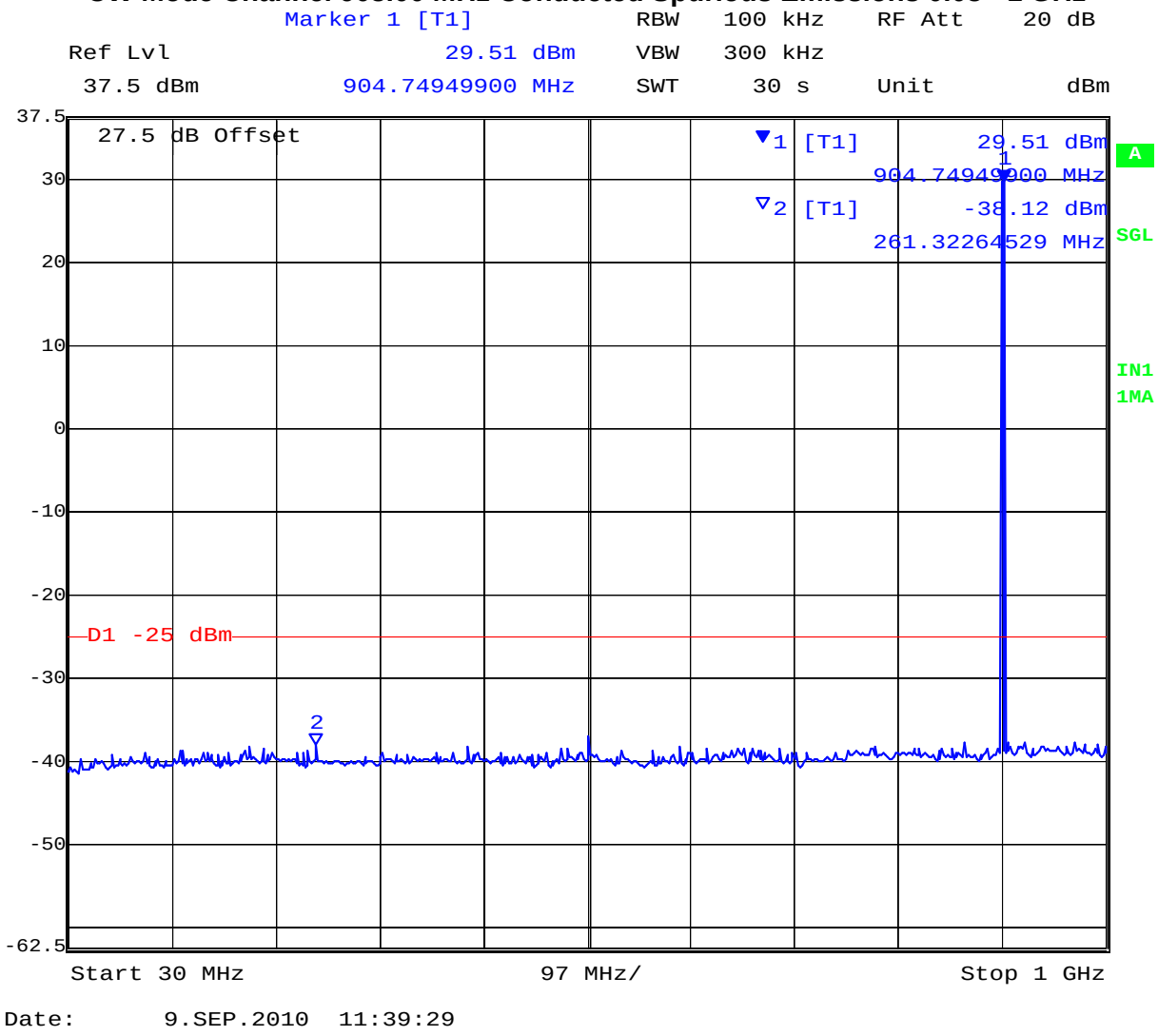


Note: The emission breaking the limit line is the fundamental carrier

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

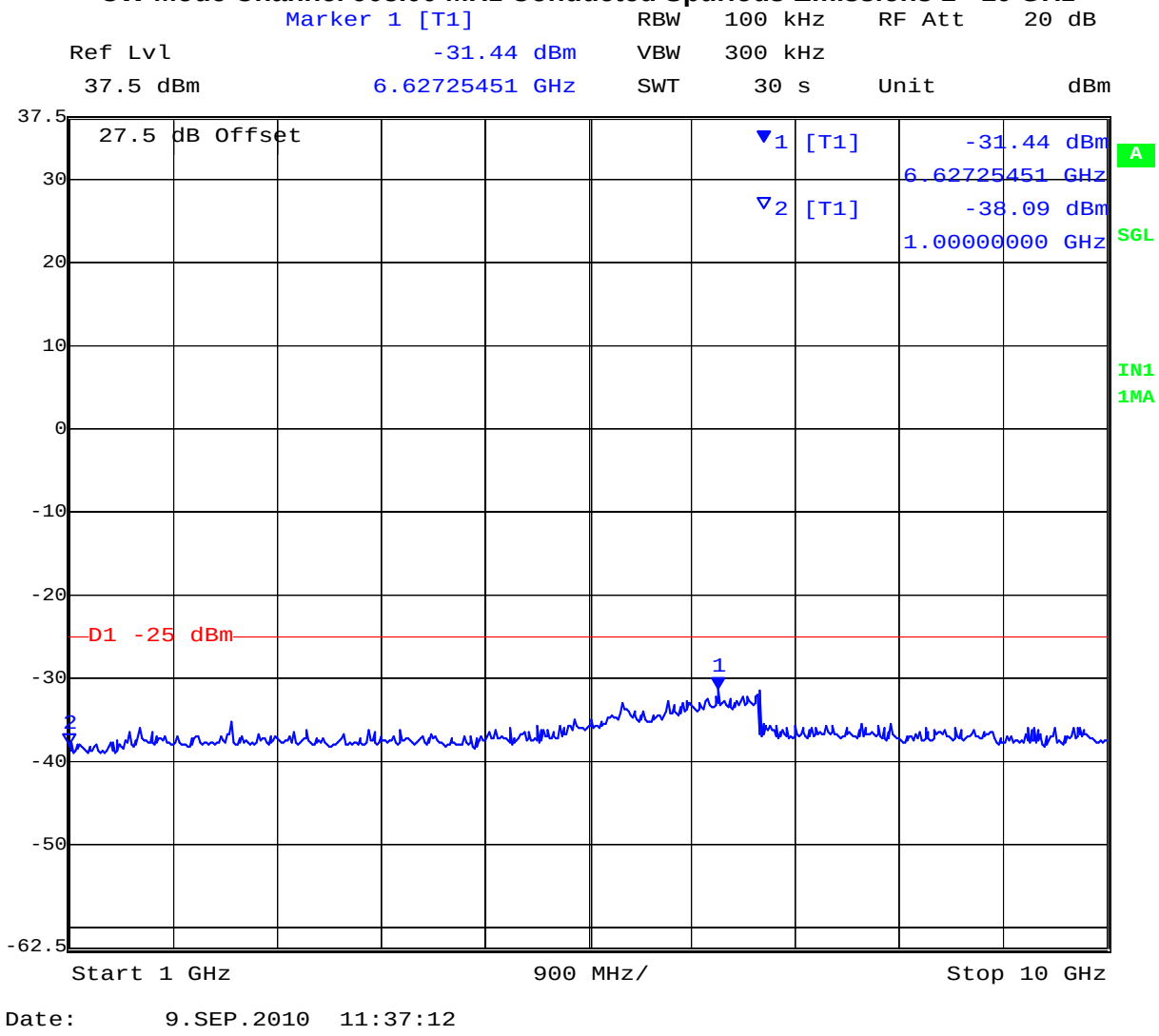


CW Mode Channel 903.00 MHz Conducted Spurious Emissions 0.03 - 1 GHz

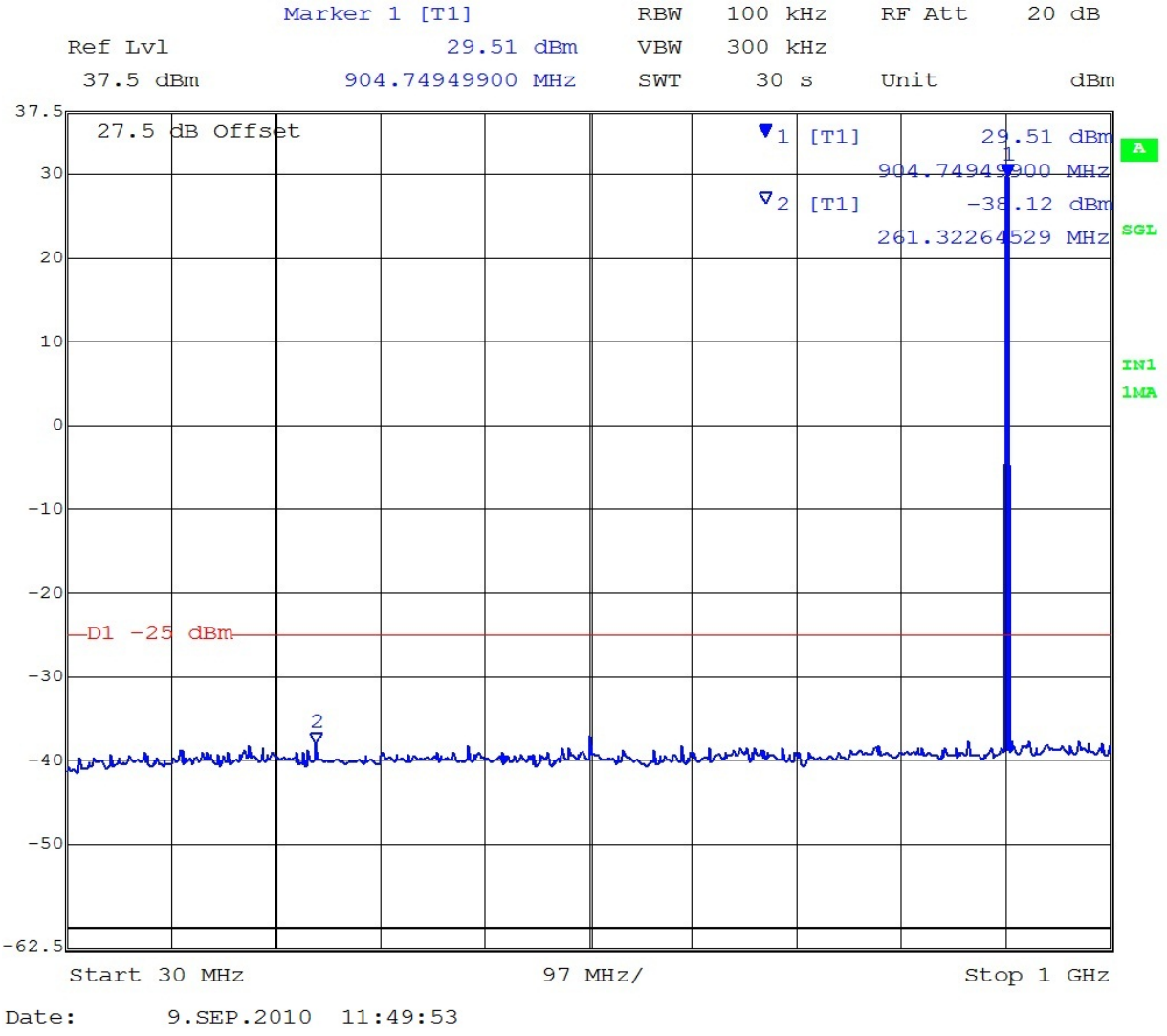


Note: The emission breaking the limit line is the fundamental carrier

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

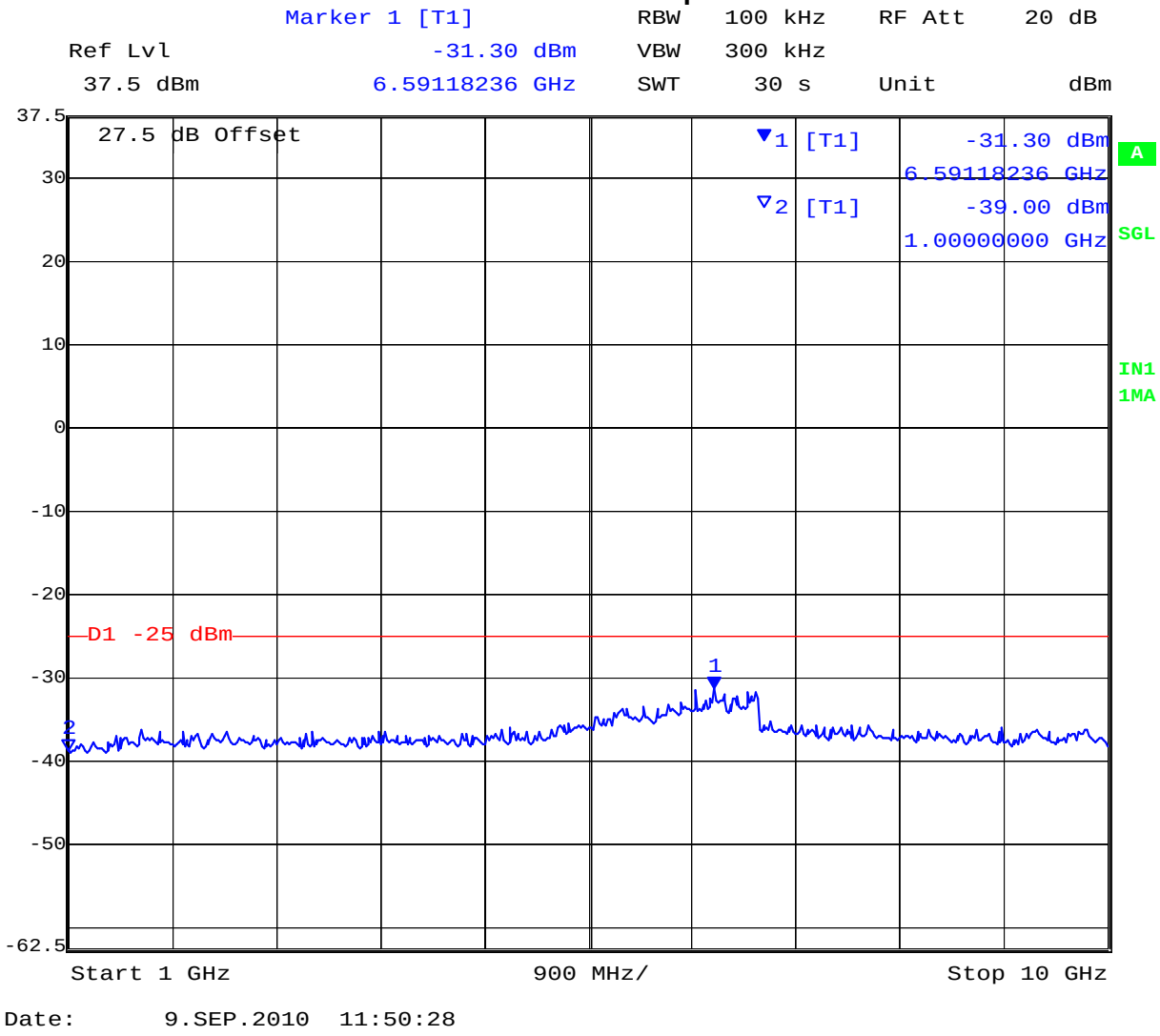


CW Mode Channel 903.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz

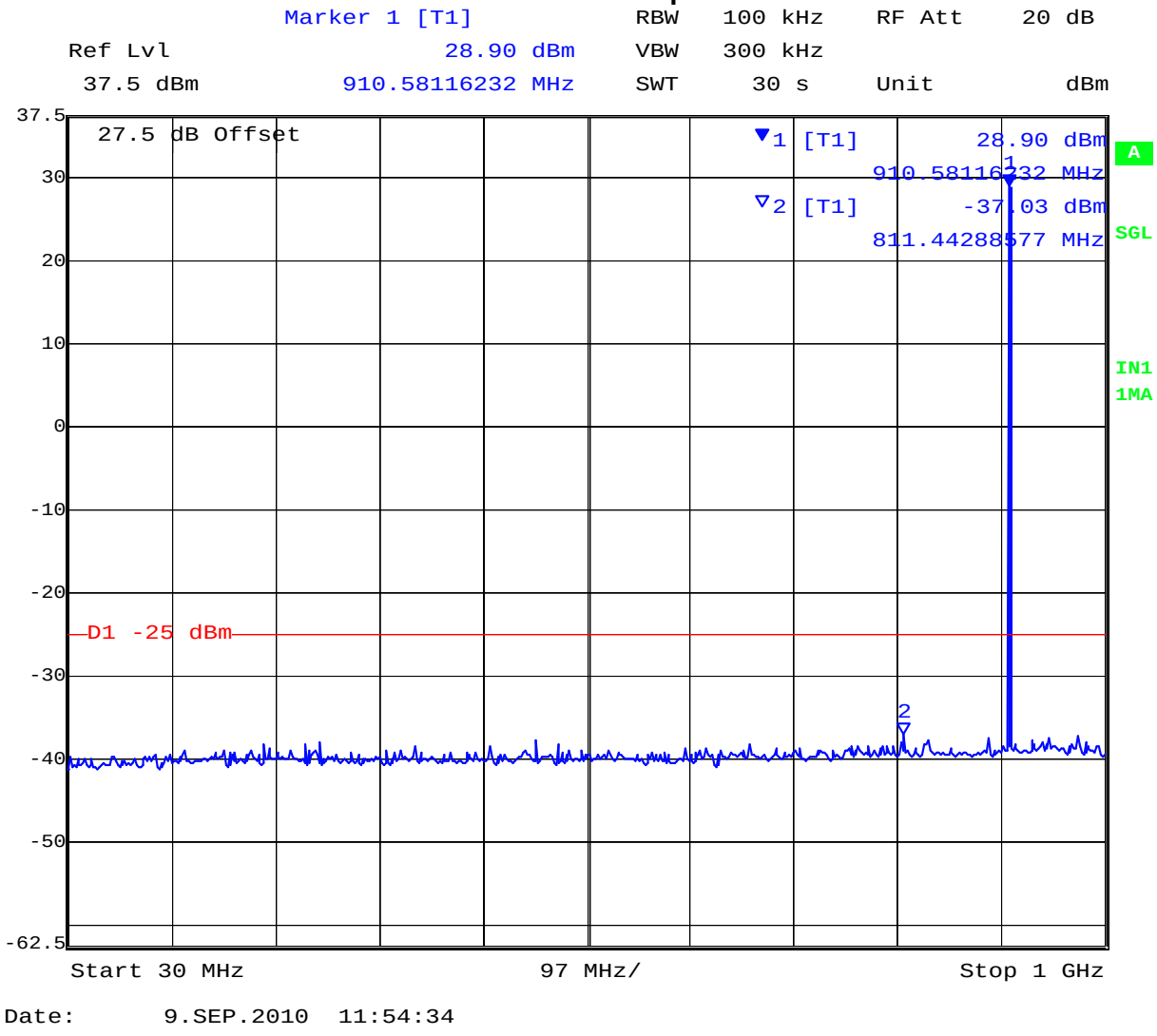


Note: The emission breaking the limit line is the fundamental carrier

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

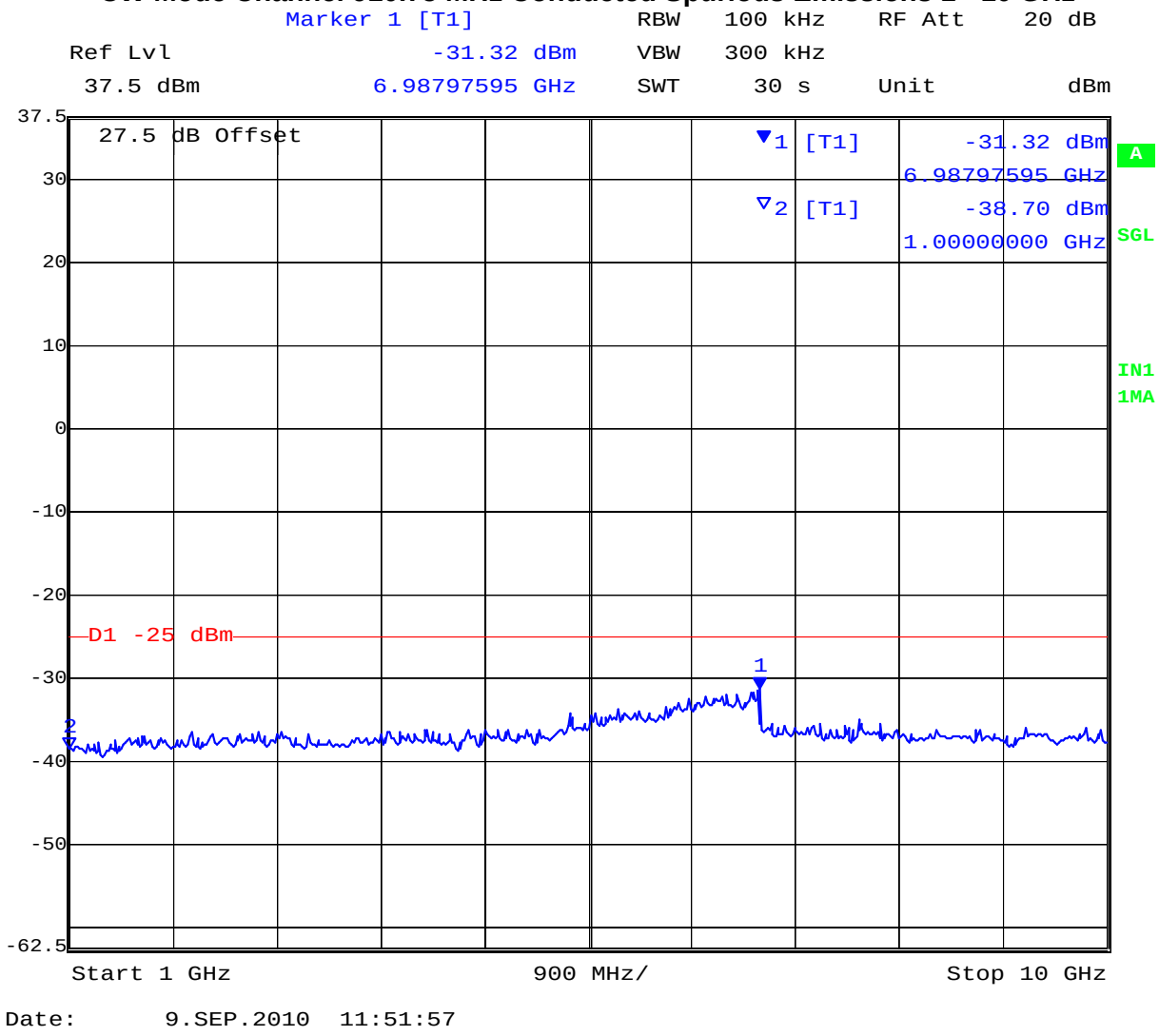


CW Mode Channel 910.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz

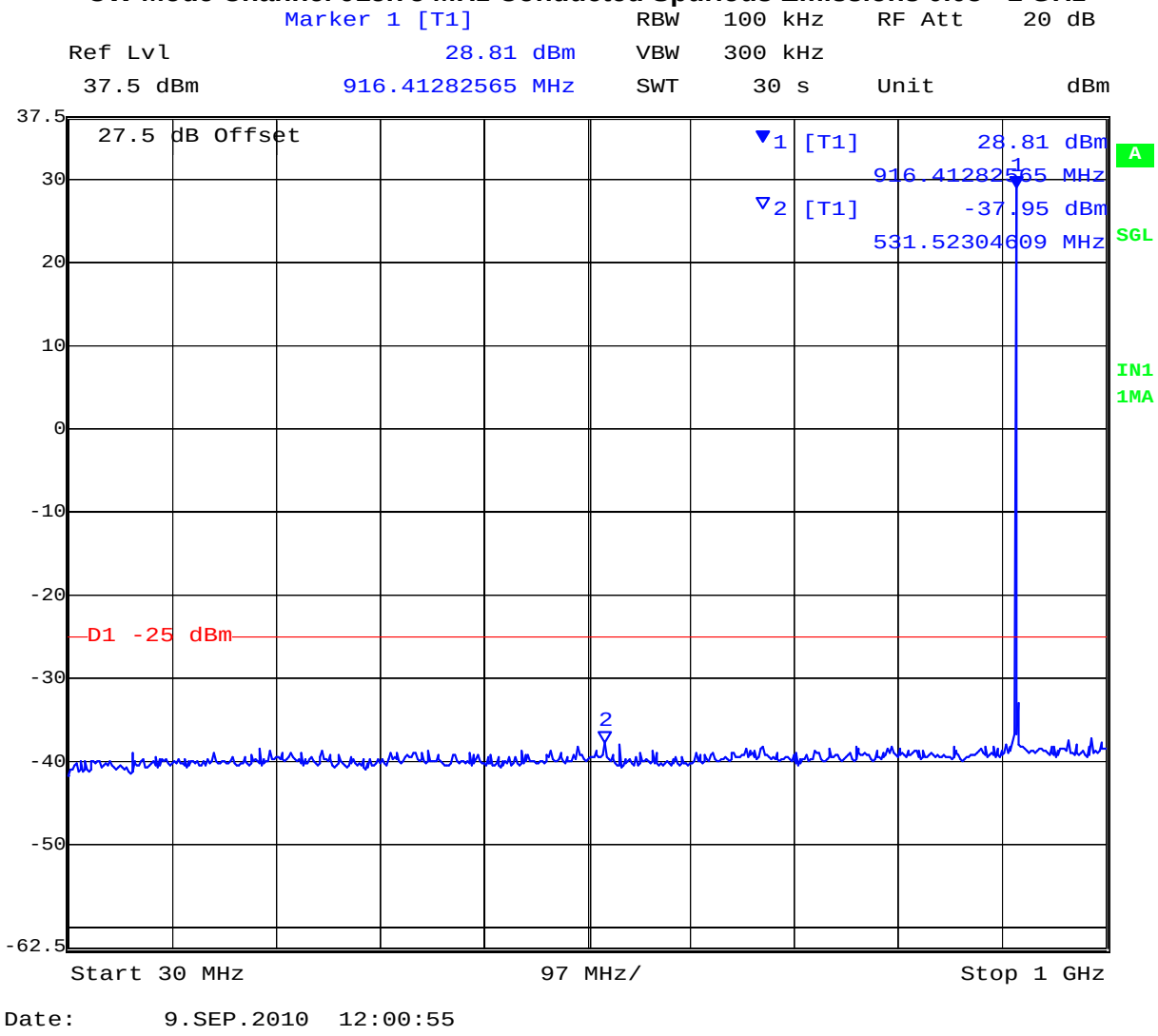


Note: The emission breaking the limit line is the fundamental carrier

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

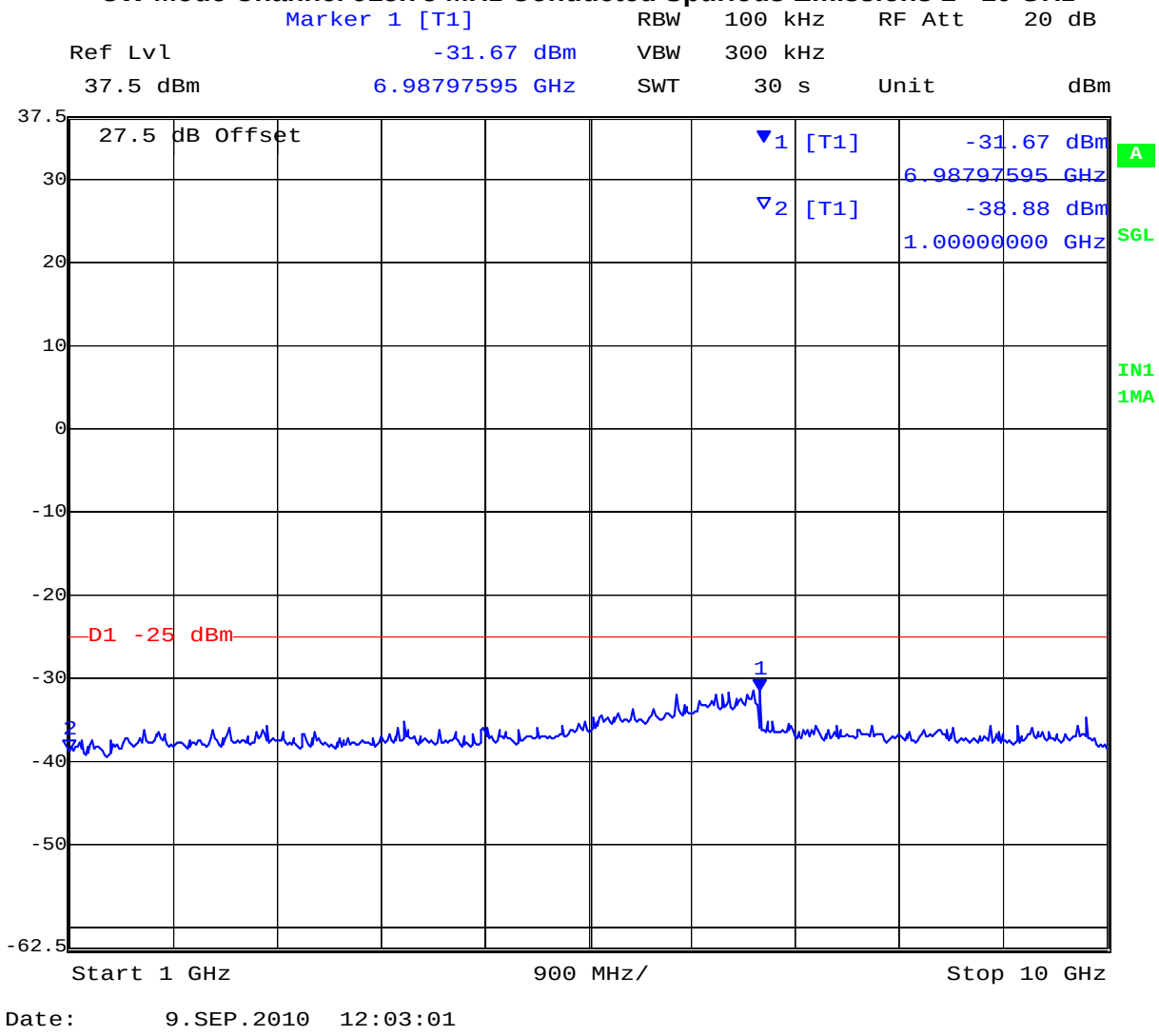


CW Mode Channel 915.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz

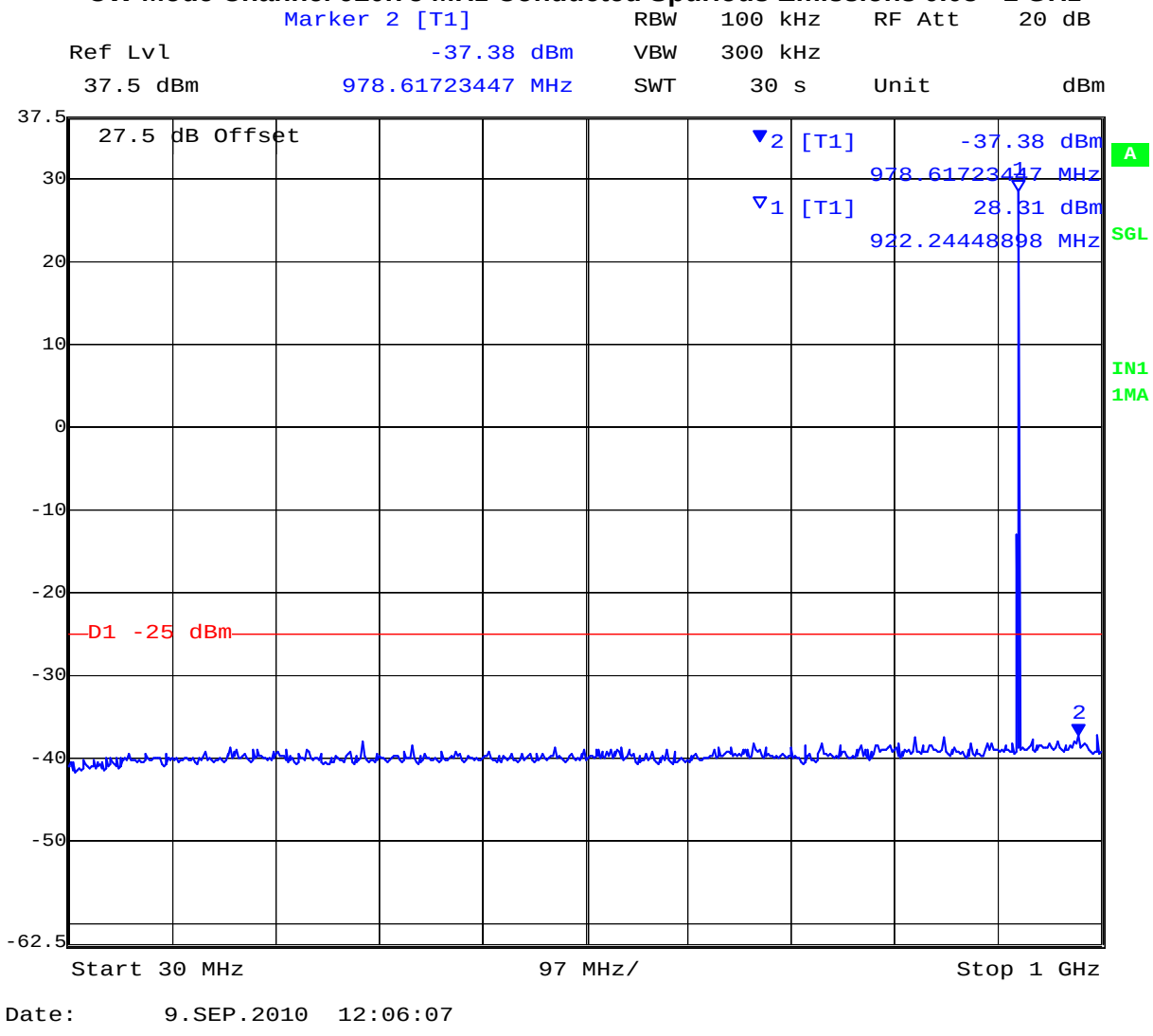


Note: The emission breaking the limit line is the fundamental carrier

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

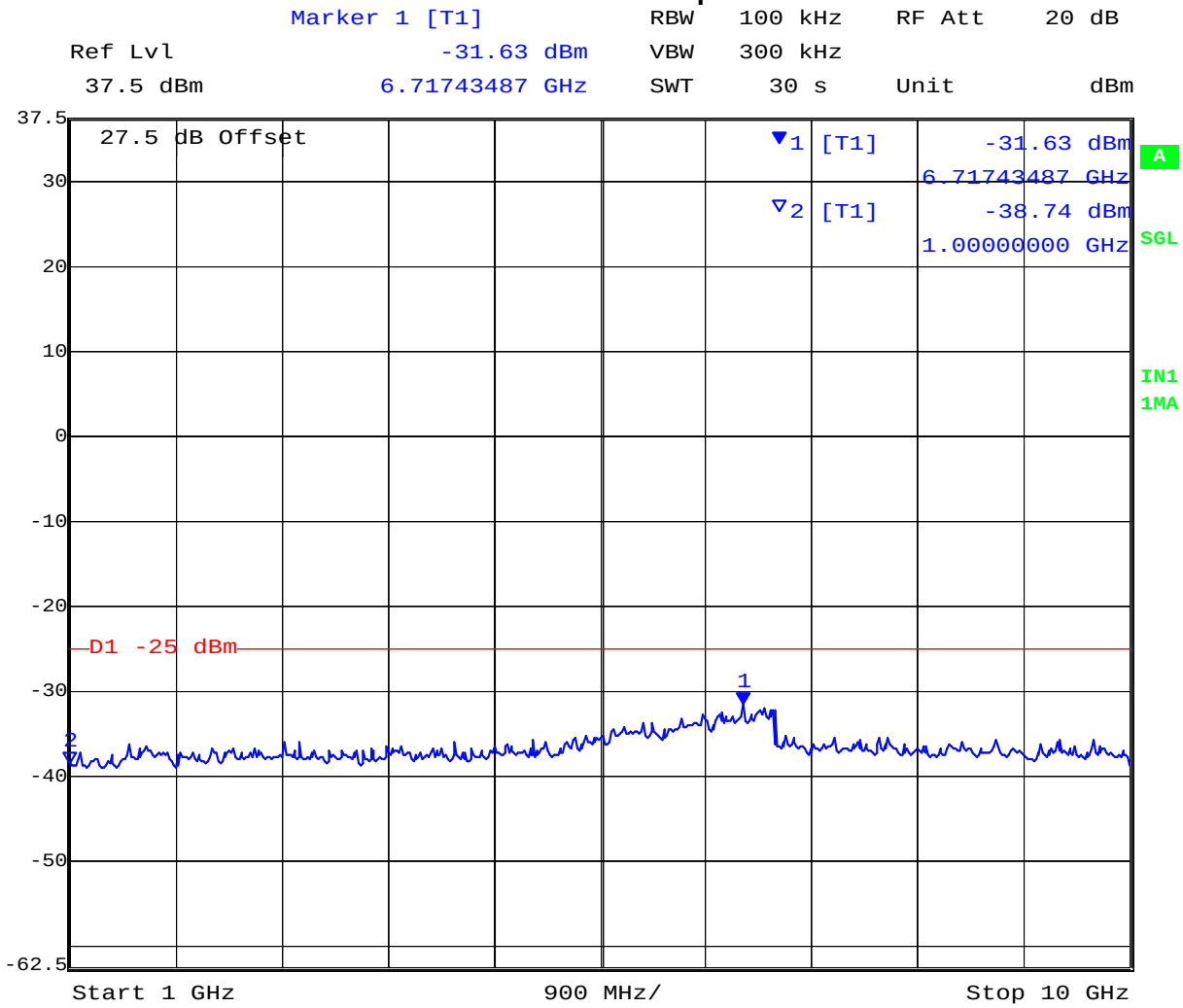


CW Mode Channel 920.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz



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

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



7.1.7 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.

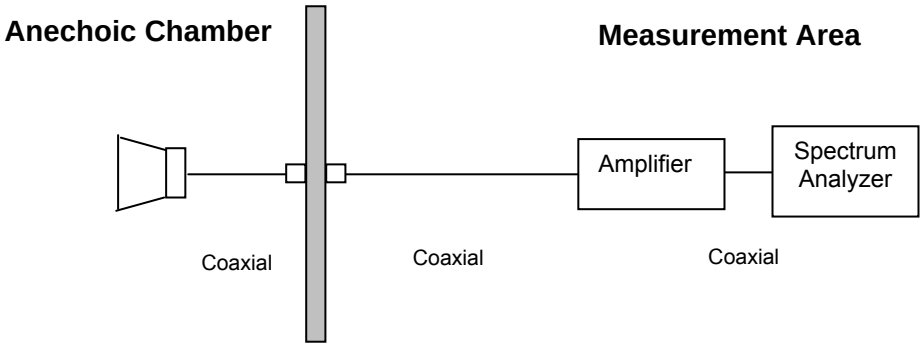
The highest emissions relative to the limit are listed for each frequency band measured.

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 = +30.81 dBm = 1.205 W
Attenuation = 55.81 dB
Limit = -25 dBm

Test Measurement Set up



Measurement set up for Radiated Emission Test

Laboratory Measurement Uncertainty for Spectrum Measurement

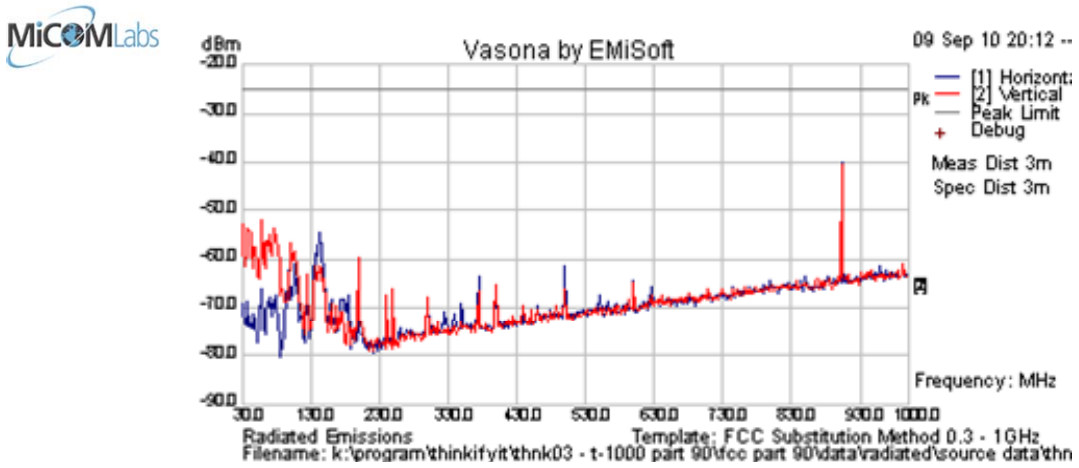
Measurement Uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03	0088, 0104, 0158, 0134, 0310, 0312, Dipole.

7.1.7.1 Measurement Results for Transmitter Spurious Emissions

Test Freq.	902.75 MHz	**Engineer**	SB
Variant	CW	**Temp (ºC)**	28
Freq. Range	30 - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

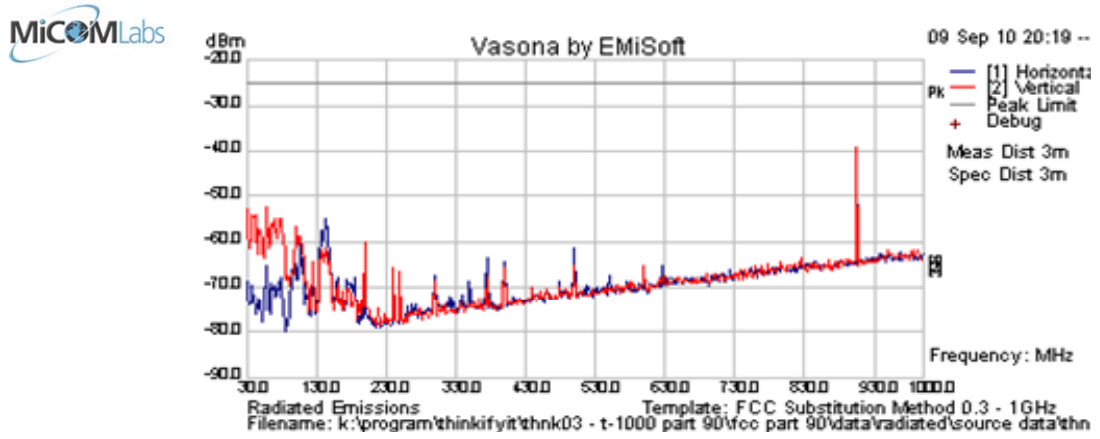


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 10 dB of limit												

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	903.00 MHz	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	30 - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

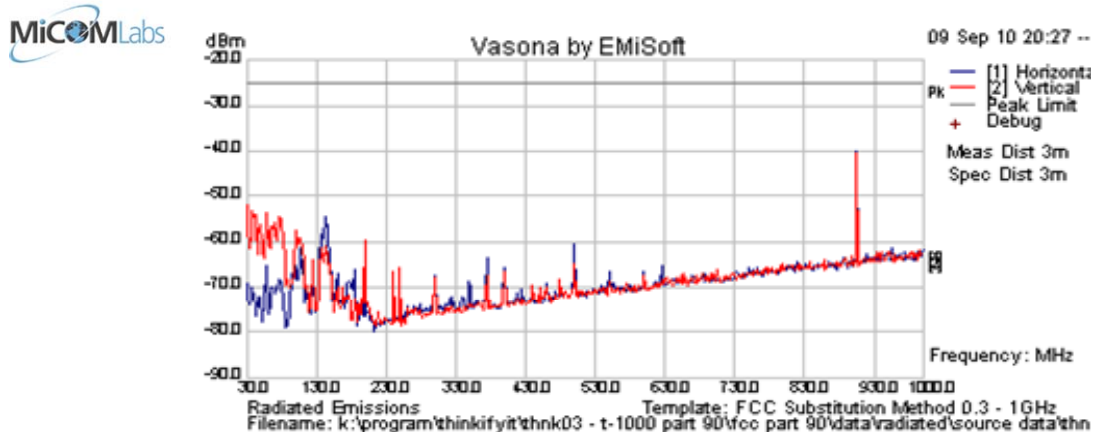


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 10 dB of limit												

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	903.75	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	30 - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

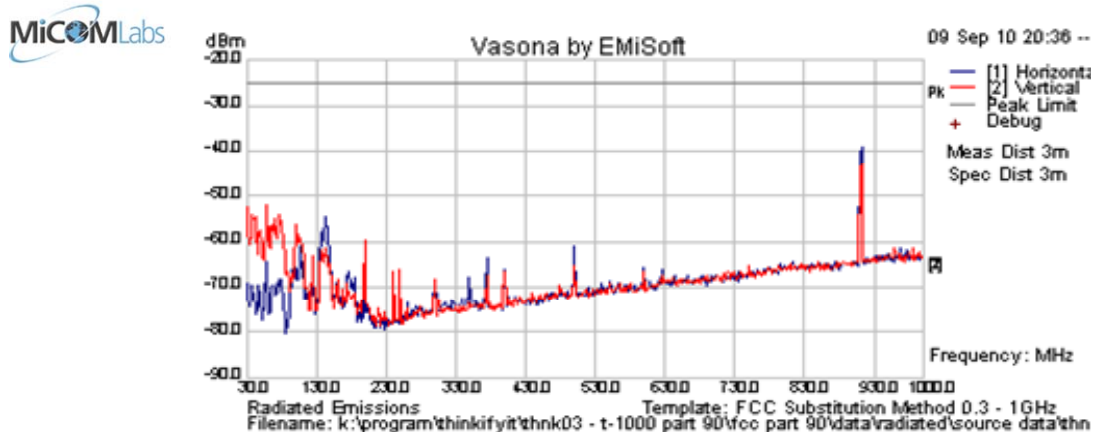


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 10 dB of limit												

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	910.75 MHz	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	30 - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

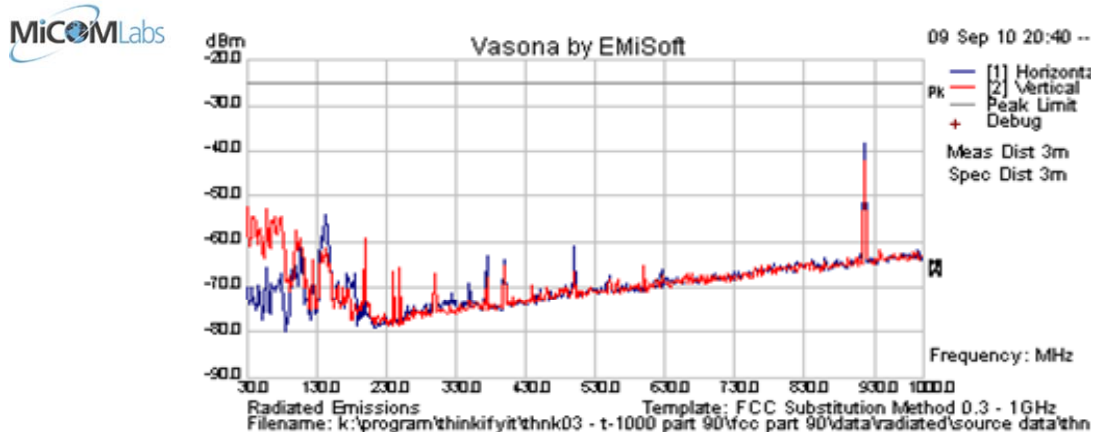


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 10 dB of limit												

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	915.75 MHz	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	30 - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

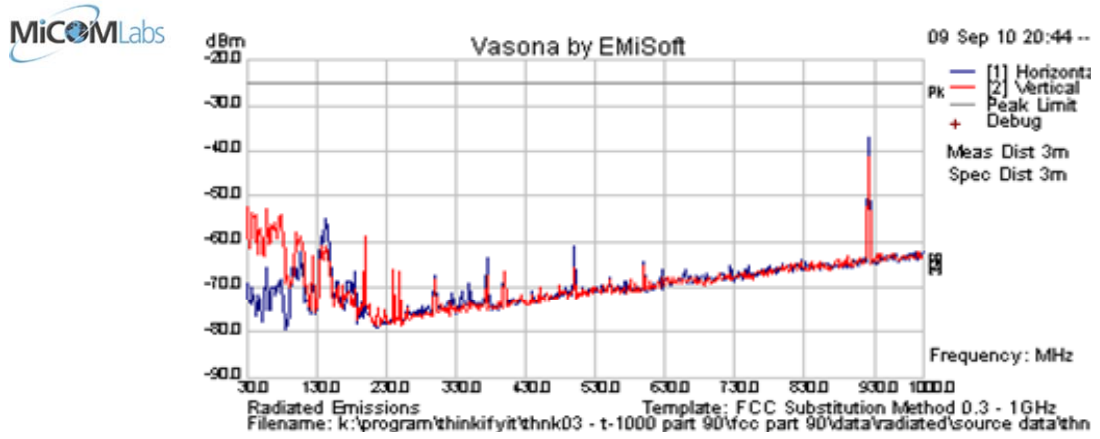


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 10 dB of limit												

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	920.75 MHz	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	30 - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

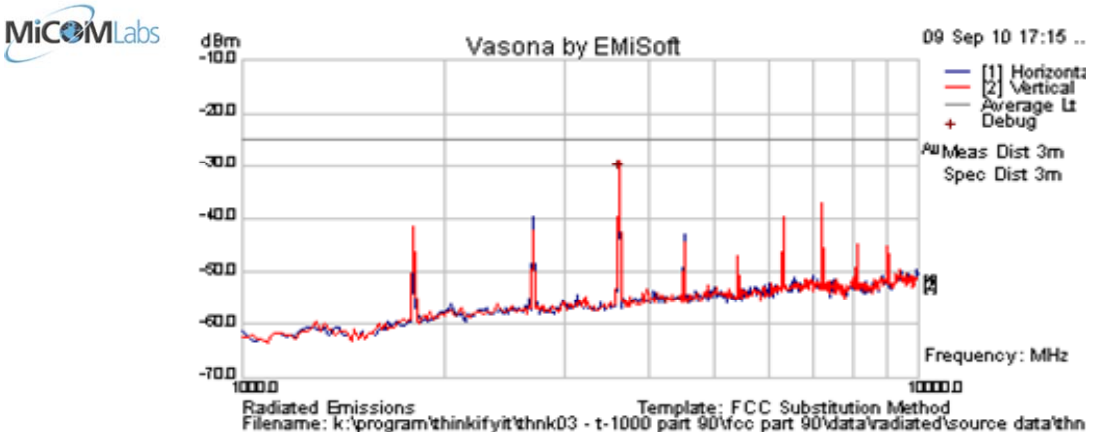


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 10 dB of limit												

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	902.75 MHz	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	1000 - 10000MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

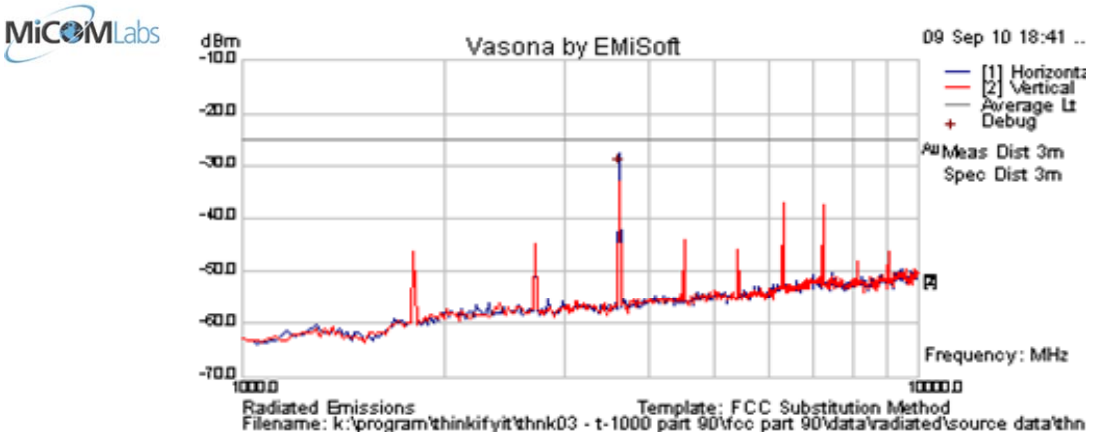


Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
3610.972	-37.2	3.7	2.3	-31.3	Peak	V	98	228	-25.0	--	--	
			Substitution:	-34.7	Substitution	V	--	--	-25.0	-9.7	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	903.00 MHz	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	1000 - 10000MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

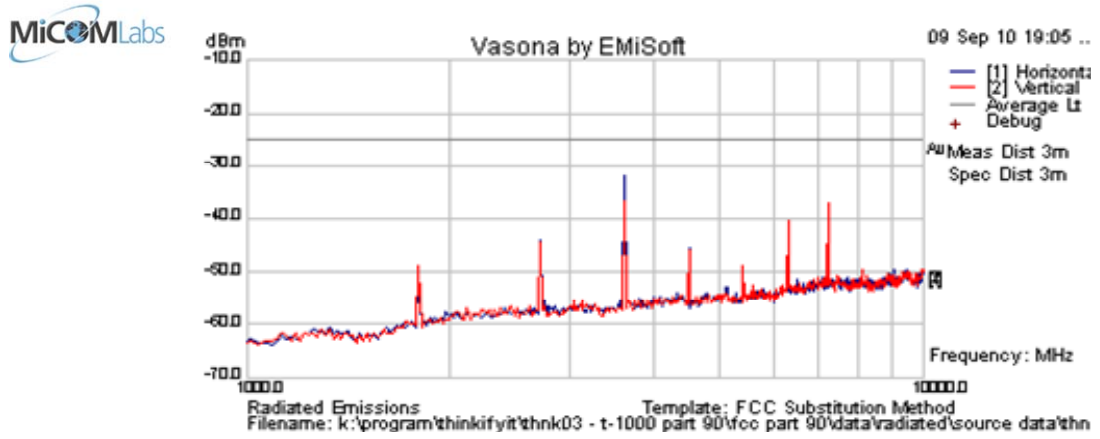


Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
3614.986	-36.3	3.7	2.3	-30.3	Peak	H	98	157	-25.0	--	--	
			Substitution:	-33.7	Substitution	V	--	--	-25.0	-8.7	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	903.75	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	1000 - 10000MHz	**Rel. Hum.(%)**	32
Power Setting	Default	**Press. (mBars)**	999
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

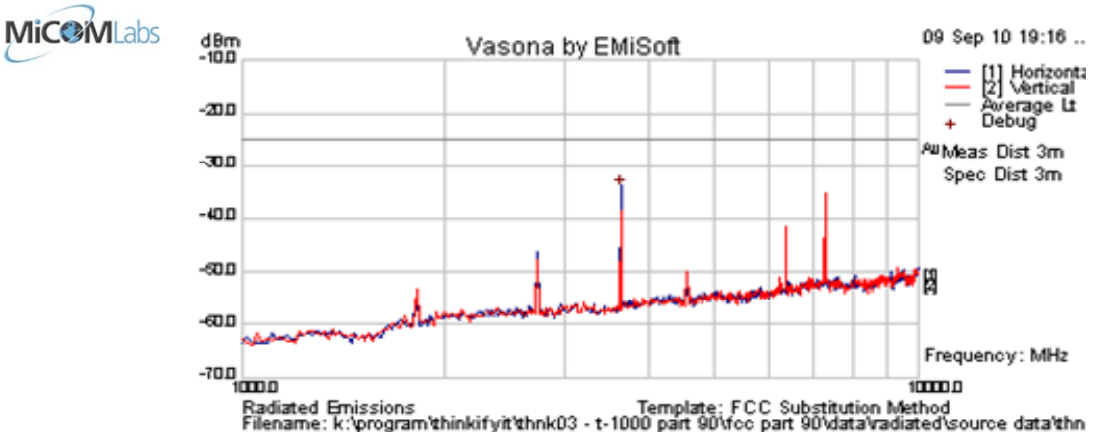


Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
3614.987	-36.9	3.7	2.3	-31.0	Peak	H	200	167	-25.0	--	--	
			Substitution:	-34.4	Substitution	V	--	--	-25.0	-9.4	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	910.75	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	1000 - 10000MHz	**Rel. Hum.(%)**	31
Power Setting	Default	**Press. (mBars)**	1000
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

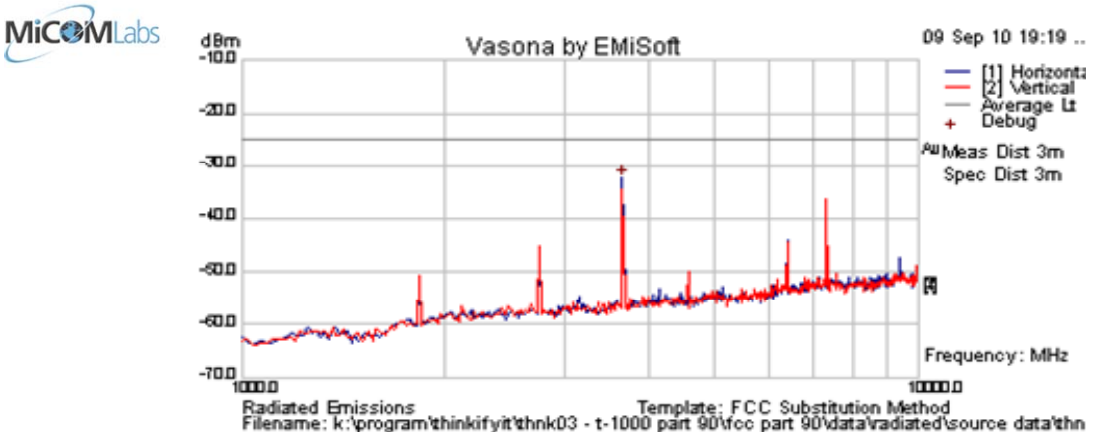


Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
3633.625	-40.3	3.7	2.4	-34.2	Peak [Scan]	H	148	0	-25.0	--	--	
			Substitution:	-37.6	Substitution	V	--	--	-25.0	-12.6	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	915.75 MHz	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	1000 - 10000MHz	**Rel. Hum.(%)**	31
Power Setting	Default	**Press. (mBars)**	1000
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			

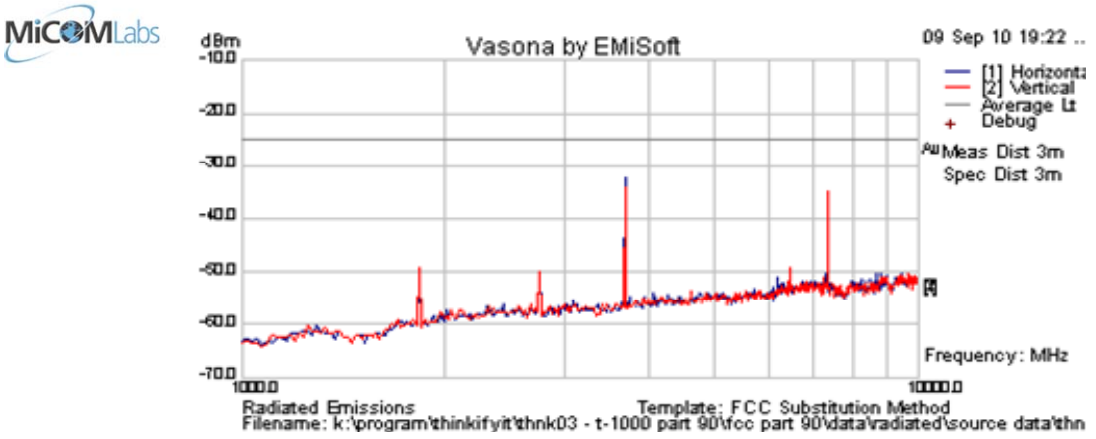


Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
3663.069	-38.3	3.7	2.3	-32.3	Peak [Scan]	H	148	0	-25.0	--	--	
			Substitution:	-35.7	Substitution	V	--	--	-25.0	-10.7	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

Test Freq.	920.75 MHz	**Engineer**	SB
Variant	CW	**Temp (°C)**	28
Freq. Range	1000 - 10000MHz	**Rel. Hum.(%)**	31
Power Setting	Default	**Press. (mBars)**	1000
Antenna	Coaxial cable with 50 Ohm termination	**Duty Cycle (%)**	CW
Test Notes 1			
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
3682.944	-38.4	3.7	2.3	-32.4	Peak [Scan]	H	148	0	-25.0	--	--	
			Substitution:	-35.8	Substitution	V	--	--	-25.0	-10.8	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

7.1.8 Radiated Spurious Emissions – Digital Apparatus

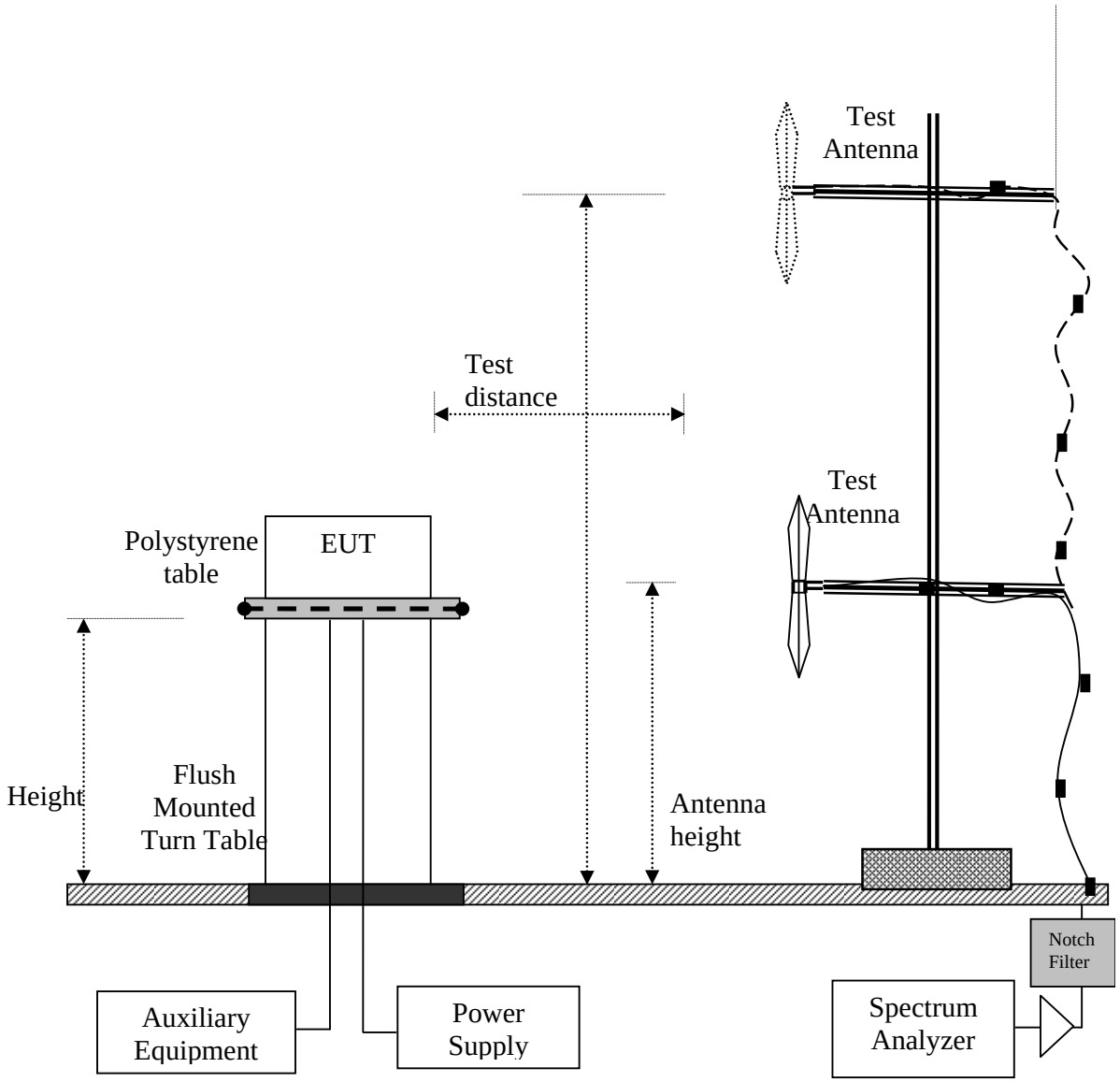
FCC, Part 15 Subpart B §15.109
Industry Canada ICES-003 §5; RSS-GEN

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.

Test Measurement Set up



Measurement set up for Radiated Emission Test

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

Specification

Radiated Spurious Emissions – Digital Apparatus

FCC, Part 15 Subpart B §15.109
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.

Industry Canada ICES-003
A representative type or model of each digital apparatus shall be tested in accordance with the measurement method described in the publication referred to in Section 7.1 [Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22:02, "Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment."].

FCC, Part 15 Subpart B §15.109 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

ICES-003 §5 Spurious Emissions Limits

Class A Digital Device: The field intensity of radio noise emissions that are radiated from a Class A digital apparatus shall not exceed the limits specified in Table 5 of the publication referred to in Section 7.1, within the indicated frequency range.

Frequency range MHz	Quasi-peak limits dB(µV/m) @ 10m	Quasi-peak limits dB(µV/m) @ 3m
30 to 230	40	50.5
230 to 1 000	47	57.5
Note 1	The lower limit shall apply at the transition frequency.	
Note 2	Additional provisions may be required for cases where interference occurs	

Class B Digital Device: The field intensity of radio noise emissions that are radiated from a Class B digital apparatus shall not exceed the limits specified in Table 6 of the publication referred to in Section 7.1, within the indicated frequency range.

Frequency range MHz	Quasi-peak limits dB(µV/m) @ 10m	Quasi-peak limits dB(µV/m) @ 3m
30 to 230	30	40.5
230 to 1 000	37	47.5
Note 1	The lower limit shall apply at the transition frequency.	
Note 2	Additional provisions may be required for cases where interference occurs	

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement Uncertainty	+5.6/ -4.5 dB

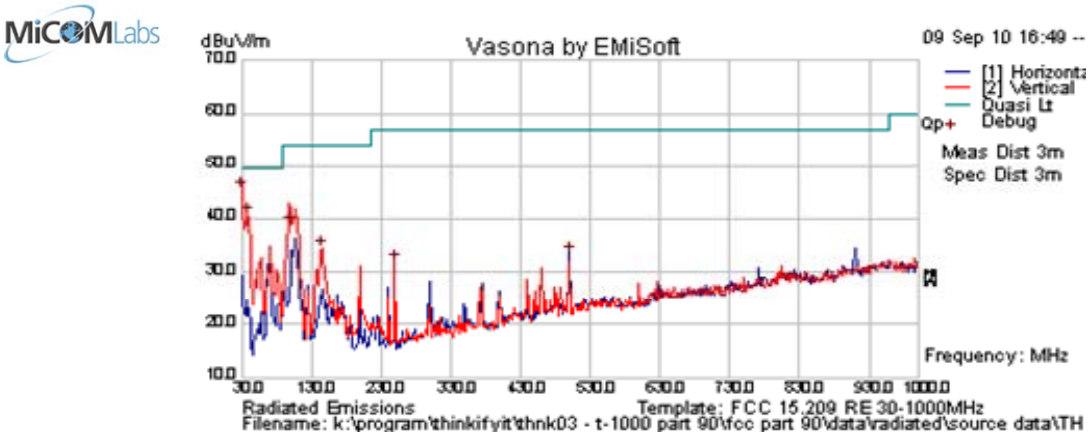
Traceability

Method	Test Equipment Used
Work instruction WI-03	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

7.1.8.1 Measurement Results for Radiated Spurious Emissions – Digital Apparatus

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

Test Freq.	N/A	**Engineer**	SB
Variant	Digital Emissions	**Temp (°C)**	28
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	31
Power Setting	120V AC 60 Hz	**Press. (mBars)**	1000
Antenna	Coaxial cable terminated with 50 Ohm Load		
Test Notes 1	Class A limits applied		
Test Notes 2	EUT powered by XP power Supply.		

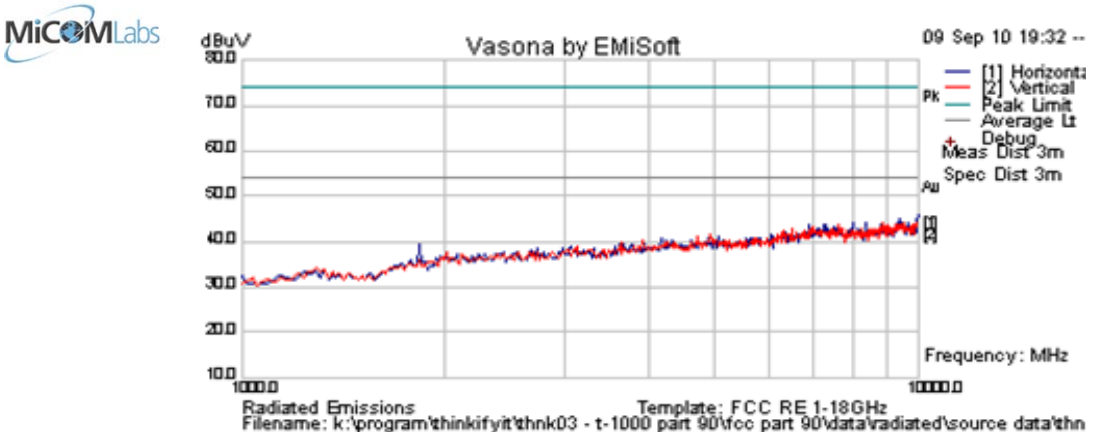


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
30.611	51.9	3.4	-10.0	45.3	Quasi Peak	V	98	284	49.5	-4.2	Pass	
38.926	53.4	3.6	-16.2	40.7	Quasi Peak	V	98	337	49.5	-8.8	Pass	
98.474	56.0	4.2	-21.5	38.7	Quasi Peak	V	127	142	54	-15.3	Pass	
144.662	48.3	4.5	-18.2	34.5	Peak [Scan]	V	127	142	54	-19.5	Pass	
249.579	45.5	5.0	-18.8	31.8	Peak [Scan]	V	127	142	57	-25.2	Pass	
499.986	39.8	6.0	-12.6	33.2	Peak [Scan]	H	127	142	57	-23.8	Pass	

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

Test Freq.	N/A	**Engineer**	SB
Variant	Digital Emissions	**Temp (°C)**	28
Freq. Range	1000 MHz - 10000 MHz	**Rel. Hum.(%)**	33
Power Setting	120V AC 60 Hz	**Press. (mBars)**	1000
Antenna	Coaxial cable terminated with 50 Ohm Load		
Test Notes 1	EUT powered by XP power supply		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No Emissions within 10 dB of limit.												

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

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

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

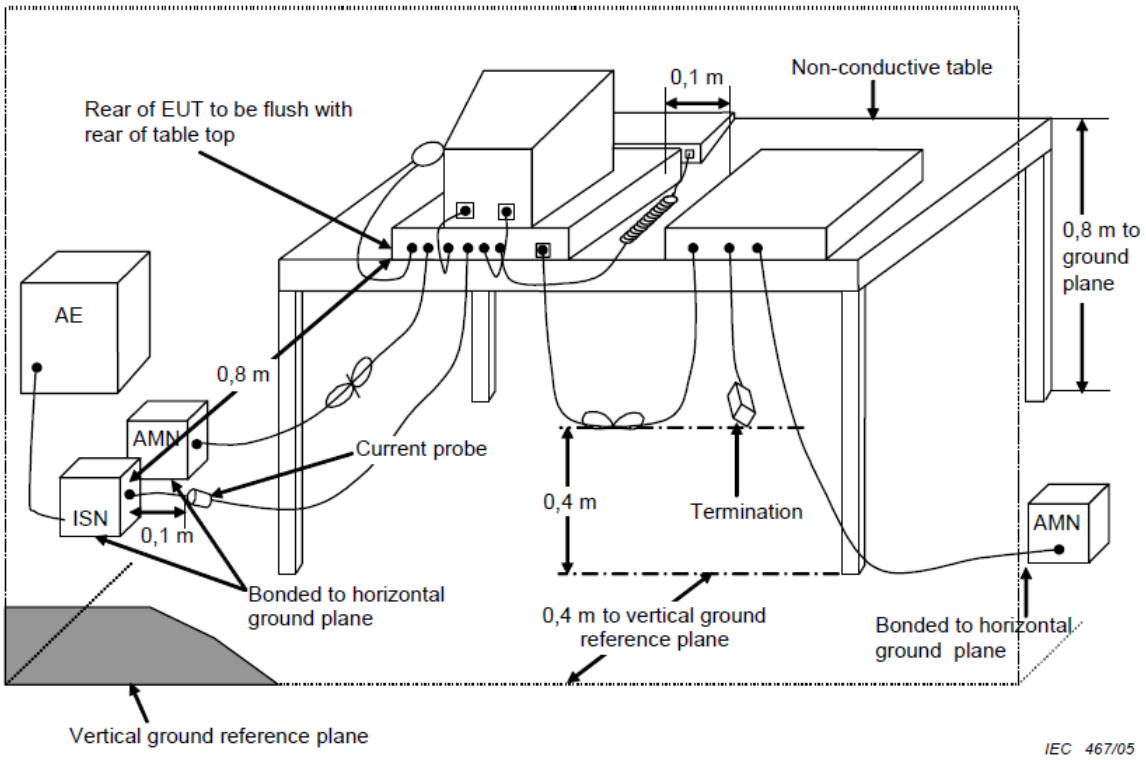
Test Procedure

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.

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
The voltage of radio noise emissions that are conducted along the power supply lines of a Class A digital apparatus shall not exceed the limits specified in Table 1 of the publication referred to in Section 7.1 [Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22:02, "Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment."], within the indicated frequency range.

The voltage of radio noise emissions that are conducted along the power supply lines of a Class B digital apparatus shall not exceed the limits specified in Table 2 of the publication referred to in Section 7.1 [Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22:02, "Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment."], within the indicated frequency range.

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

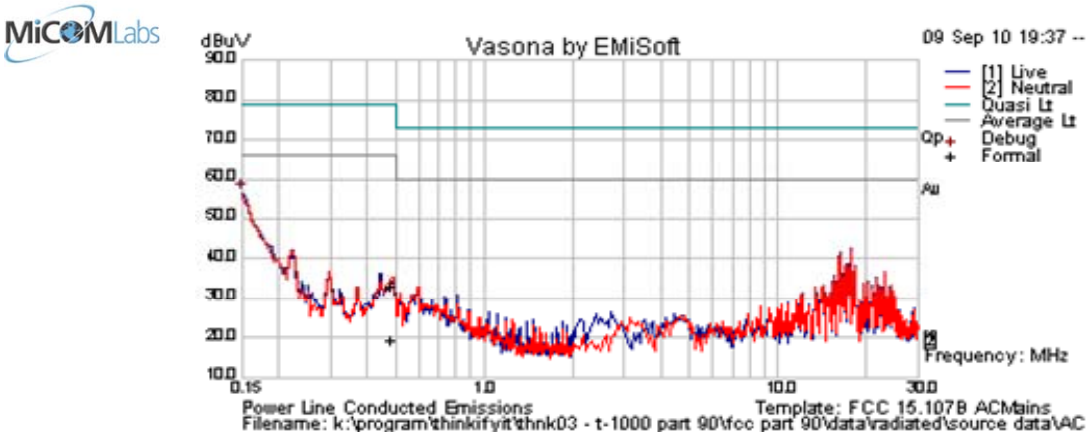
Traceability

Method	Test Equipment Used
Work instruction WI-EMC-01	0158, 0184, 0193, 0190, 0293, 0307

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

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

Test Freq.	N/A	**Engineer**	SB
Variant	AC Line Emissions	**Temp (°C)**	28
Freq. Range	0.150 MHz - 30 MHz	**Rel. Hum.(%)**	31
Power Setting	120V AC 60 Hz	**Press. (mBars)**	1000
Antenna	Coaxial antenna cable terminated with 50 Ohm load		
Test Notes 1			
Test Notes 2			



Formally measured emission peaks

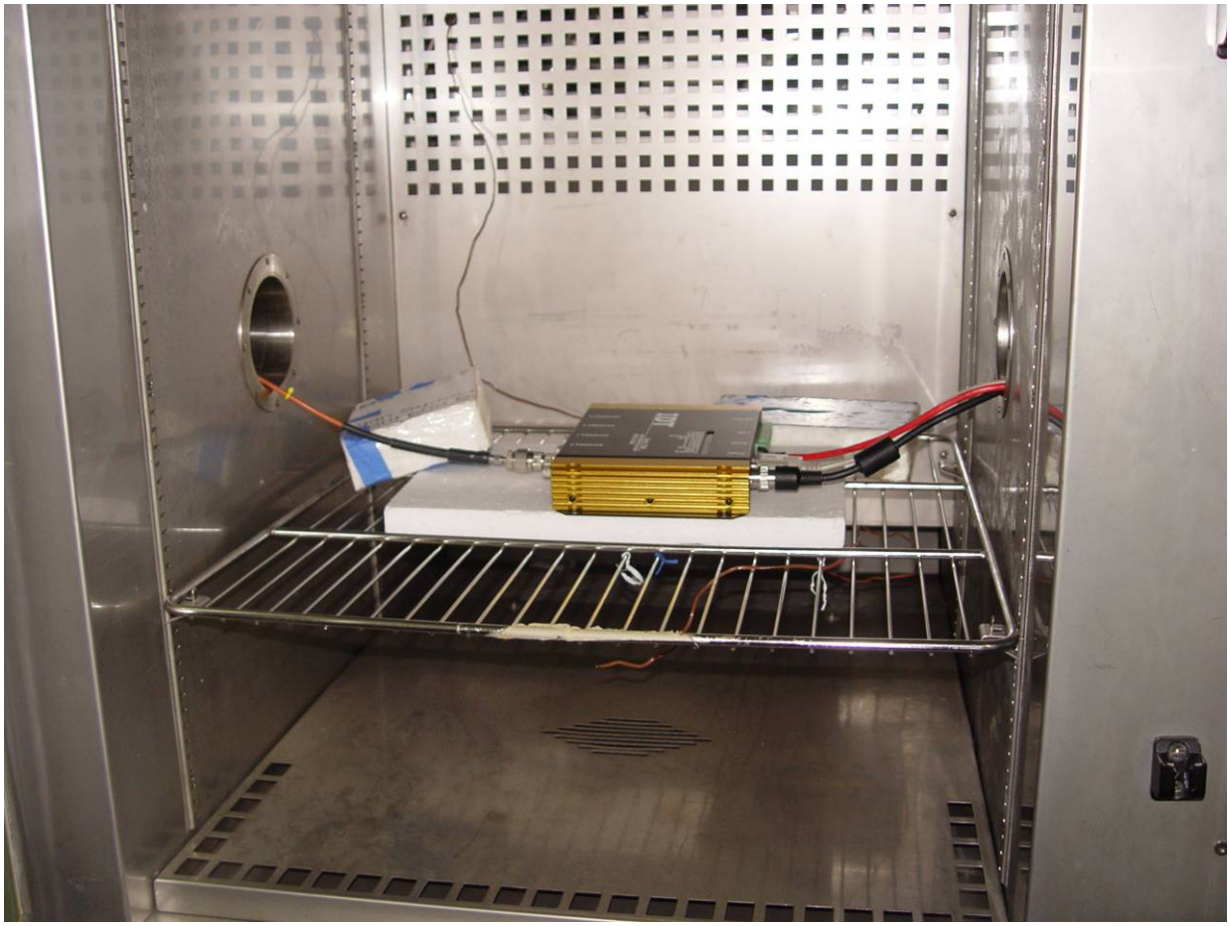
Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.150	44.1	9.9	0.1	54.0	Quasi Peak	Live	79	-25.0	Pass	
0.150	41.9	9.9	0.1	51.8	Average	Live	66	-14.2	Pass	
0.222	31.3	9.9	0.1	41.3	Average	Neutral	66	-24.7	Pass	
0.222	31.9	9.9	0.1	41.9	Quasi Peak	Neutral	79	-37.2	Pass	
0.296	26.0	9.9	0.1	35.9	Average	Neutral	66	-30.1	Pass	
0.296	26.7	9.9	0.1	36.6	Quasi Peak	Neutral	79	-42.4	Pass	
0.369	23.9	9.9	0.1	33.8	Quasi Peak	Neutral	79	-45.2	Pass	
0.369	23.0	9.9	0.1	32.9	Average	Neutral	66	-33.1	Pass	
0.444	23.1	9.9	0.1	33.1	Quasi Peak	Live	79	-45.9	Pass	
0.444	22.1	9.9	0.1	32.1	Average	Live	66	-33.9	Pass	
17.711	0.0	10.5	0.7	11.2	Average	Live	60	-48.9	Pass	
17.711	4.3	10.5	0.7	15.4	Quasi Peak	Live	73	-57.6	Pass	

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

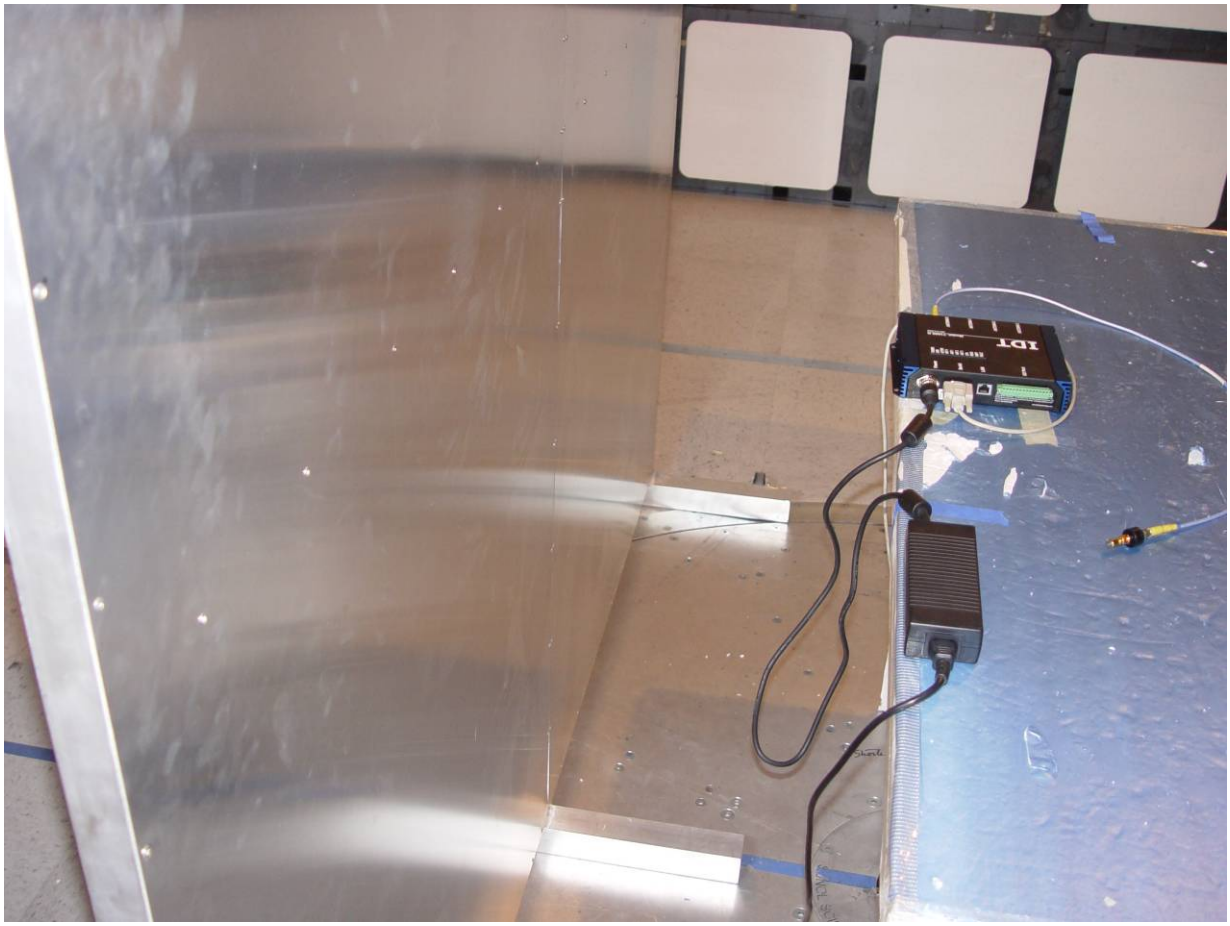
8 TEST SET-UP PHOTOGRAPHS

8.1 General Measurement Test Set-Up

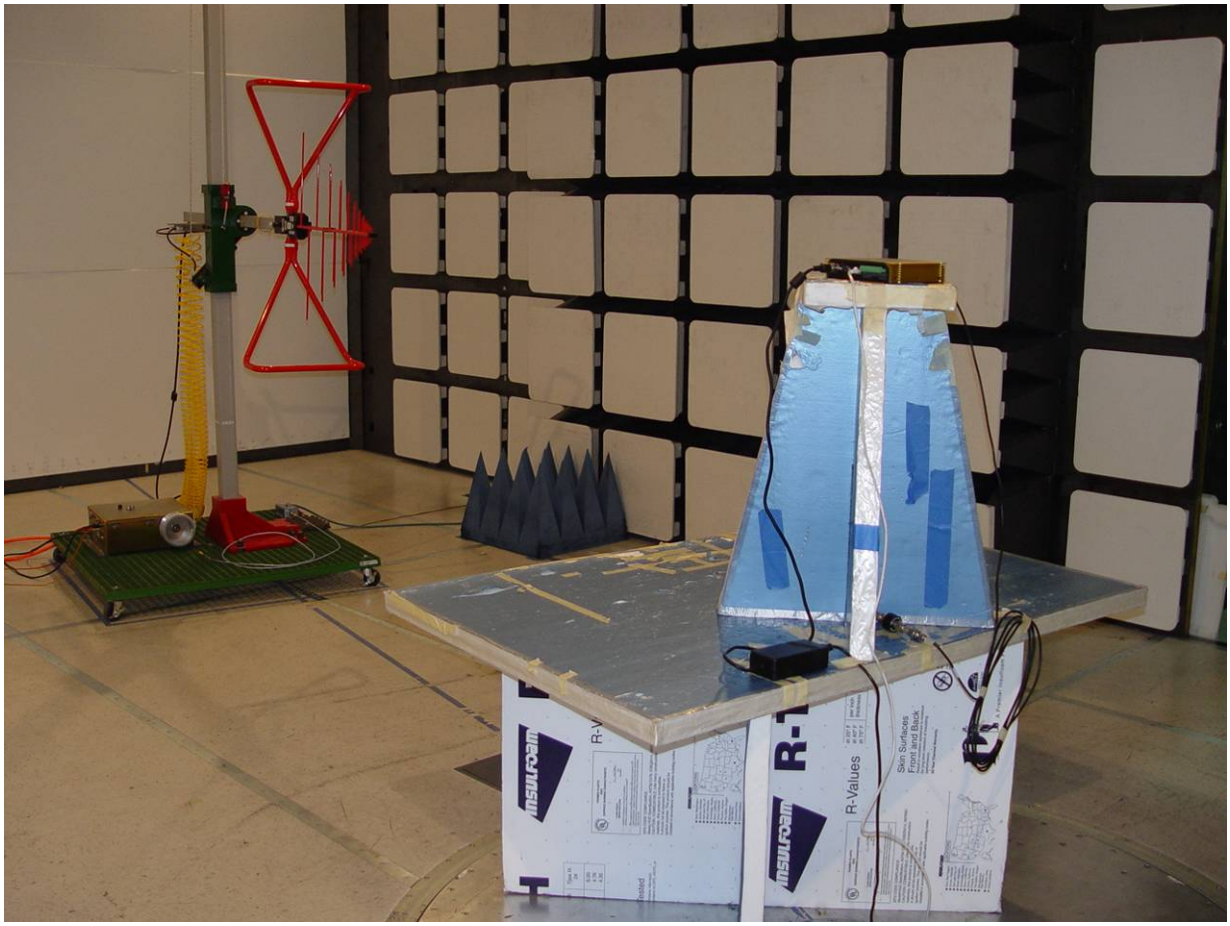
8.2 Frequency Error Test Set-Up – Environmental Chamber



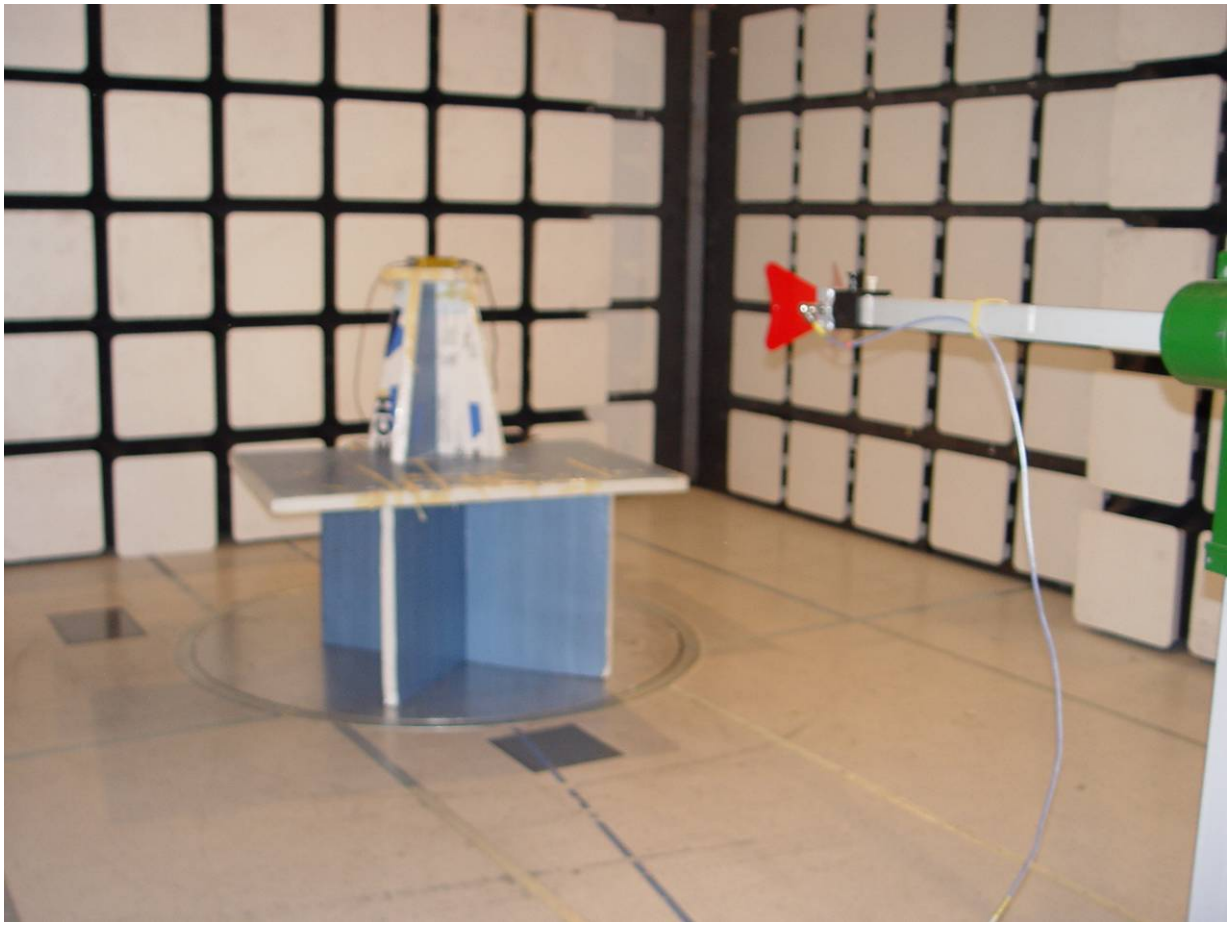
8.3 AC Wireline Emissions



8.4 Radiated Radio Emissions < 1GHz



8.5 Radiated Radio Emissions > 1GHz



8.6 Radiated Digital Emissions < 1GHz

8.7 Radiated Digital Emissions > 1GHz

9 TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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