Test of Thinkify LLC, IDT T1000D

To: FCC 47 CFR Part 90 SubPart I, 90.353

Test Report Serial No.: THNK01-A2 Rev A

TEST REPORT

FROM

Test of Thinkify LLC, IDT T1000D

To FCC 47 CFR Part 90 SubPart I, 90.353

Test Report Serial No.: THNK01-A2 Rev A

This report supersedes None

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

Product Function: Wireless Broadband Access Point

Copy No: pdf **Issue Date:** 1st June 2009

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
Fax: +1 (925) 462-0306
www.micomlabs.com

ACCREDITED
CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS and RECOGNITION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS 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

THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

MICOM LABS
Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005*).

Presented this 26th day of February 2008.

President
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2009

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

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America
Federal Communications Commission (FCC) Listing #: 102167

Canada
Industry Canada (IC) Listing #:4143A-2

Japan Registration

VCCI Membership Number: 2959

- Radiation 3 meter site; Registration No. R-2881
- Line Conducted, Registration Nos. C-3181 & T-1470
- Emissions; Registration Nos. C-3180 & T-1469

RECOGNITION

APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)

Conformity Assessment Body (CAB) – MiCOM Labs

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
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	

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
A	1st June 2009	Initial Release

1. 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:	TF-3	Fax:	+1 925 462 0306
S/N:	FA0806105		
Test Date(s):	21st May '09	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.

ACCREDITED
CERTIFICATE #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 90	2004	Code of Federal Regulations
(ii)	ANSI C63.4	2003	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)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(iv)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(v)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vi)	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
(Vii)	A2LA	14th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy

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.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description	
Purpose:	Test of the Thinkify LLC, IDT T1000D 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:	THNK01-A2 Rev A	
Date EUT received:	21st May '09	
Dates of test (from - to):	21st May '09	
Standard(s) applied:	FCC 47 CFR Part 90 SubPart I, 90.353	
No of Units Tested:	1	
Type of Equipment:	RFID Reader	
Model:	TF-3	
Location for use:	Indoor use only	
Declared Frequency Range(s):	902 – 904 MHz & 909.75 - 921.75 MHz	
Type of Modulation:	Continuous Wave (CW), OOK	
Operational Bandwidths:	CW: 14.4289 kHz OOK: 63.1263 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	

3.2. Scope of Test Program

The scope of the test program was to test the Thinkify LLC, IDT T1000D for compliance against;-

FCC 47 CFR Part 90, Subpart I regulatory requirements.

The Thinkify LLC, IDT T1000D has two operational modes Continuous Wave and Modulated OOK and operates in the range 902 – 928 MHz.

Transmission Restrictions

The Thinkify LLC, IDT T1000D RFID Reader per Part 90 SubPart I, 90.357 falls into category (b) Non-multilatersation LMS systems authorized in the following frequency bands:

- 902 – 904 MHz
- 909.75 - 921.75 MHz

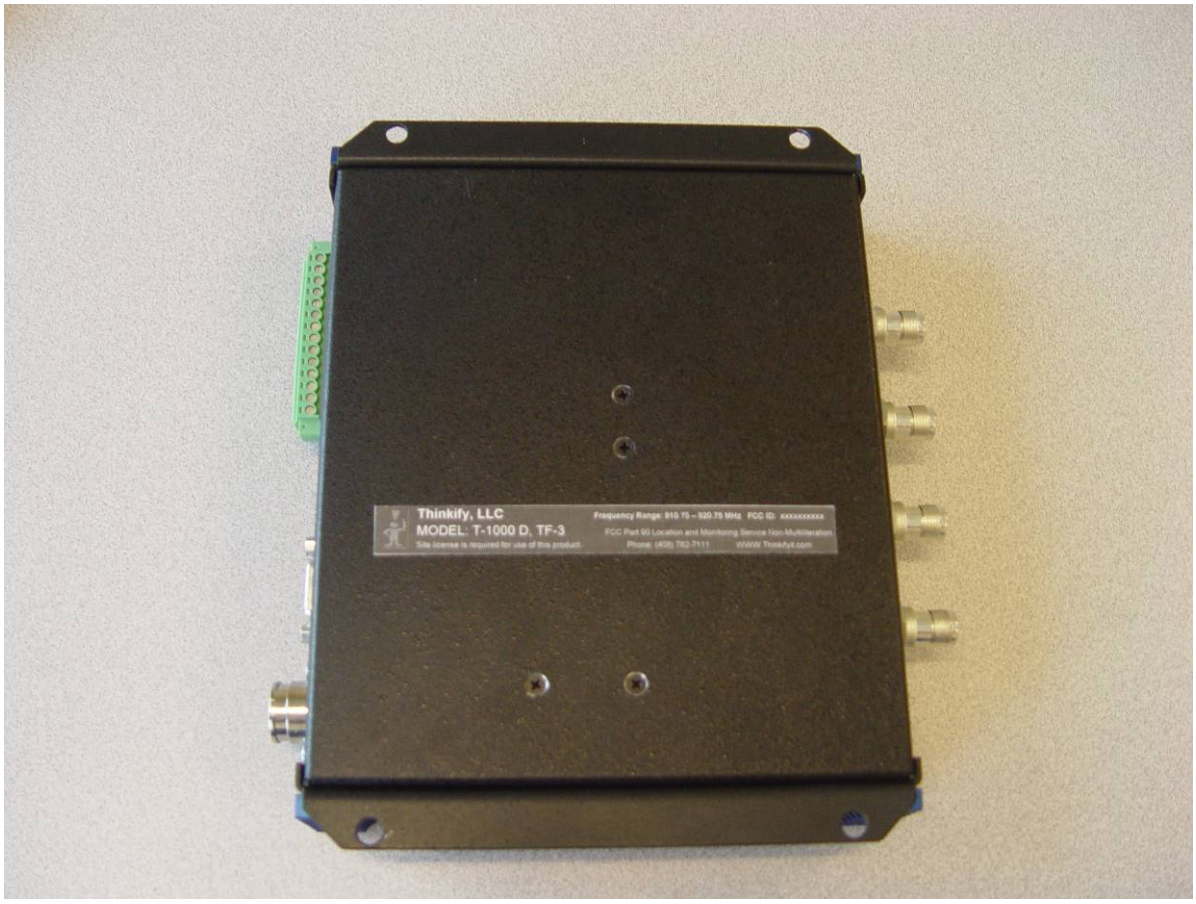
Definition of Non-Multilateration LMS System.
A non-multilateration LMS system employs any of a number of non-multilateration technologies to transmit information to and/or from vehicular units.

Thinkify LLC, IDT T1000D

Thinkify LLC, IDT T1000D Product Label

Thinkify, LLC
MODEL: T-1000 D, TF-3
Frequency Range: 902.75 – 920.75 MHz **FCC ID XE2TF3** FCC Part 90 Location and Monitoring Service Non-Multiliteration.
Site license is required for use of this product.

Thinkify LLC, IDT T1000D Product Label Position



Rong Horng PSU 115Vac/dc Converter

XP PSU 115Vac/dc Converter

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

EUT/ Support	Manufacturer	Equipment Description (Including Brand Name)	Model No.	Serial No.
EUT	Thinkify	RFID Reader 902-928 MHz	TF-3	FA0806105
EUT	by Rong Horng Electronic Co Ltd	115Vac/dc PSU 10 Vdc,2A 6 Vdc,2A -5Vdc/0.5A	RHL-975757202505-6	0538G
EUT	XP	115Vac/dc PSU 10 Vdc,2A 6 Vdc,2A -5Vdc/0.5A	Unknown	--
Support		Laptop Computer		

3.4. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Dipole Panel (76º Half Power	11.5	Scala	HP9-915N	N/A

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. RF Port (915 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

3.6. 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]
AC Wireline Emissions	15.207	CW	Ambient, Nominal Vdc

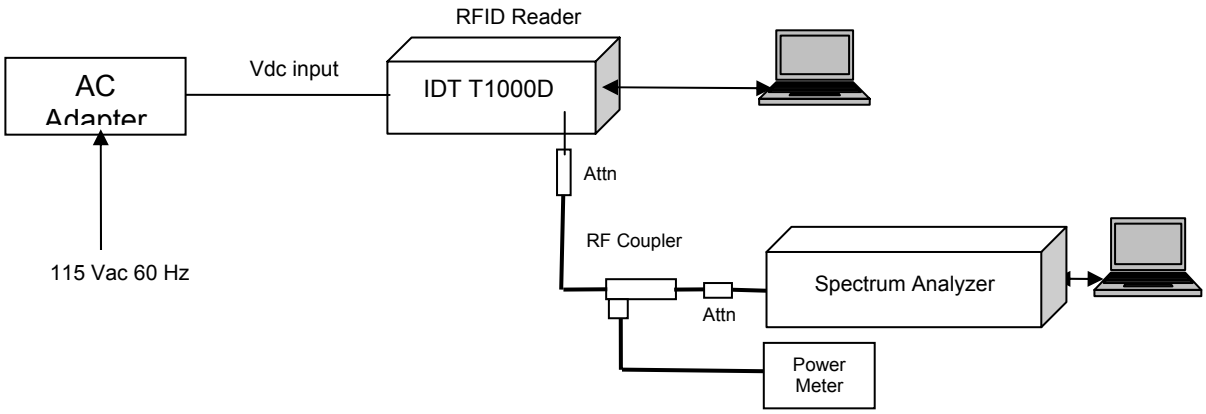
Note 1.. Fixed Non-Multilateration transmitters with an authorized bandwidth more than 40 kHz from the band-edge are not subject to Frequency Stability restrictions. The EUT was measured to show compliance with Part 2 requirements.
Note 2.. The EUT does not support audio modulation therefore Audio Frequency 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	903.25
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

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

4. TEST SUMMARY

List of Measurements

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

Section(s)	Test Items	Description	Condition	Result	Test Report Section
2.1049/ 90.210	99% Occupied Bandwidth + Band-edge	Bandwidth measurement(s)	Conducted	Complies	5.1.1
2.1046; 90.1321 (a)	Effective Radiated Power	CW & Modulated Output Power	Conducted	Complies	5.1.2
Subpart C 90.1217	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Calculated	--	5.1.3
2.1055(a)(1)	Frequency Stability	Includes temperature and voltage variations	Conducted	Complies	5.1.4
2.1051; 90.1323	Conducted Spurious Emissions	Emissions from the antenna port	Conducted	Complies	5.1.5
2.1053; 90.1323 ANSI/TIA-603	Radiated Spurious Emissions	Spurious emissions	Radiated	Complies **Class A Device**	5.1.6
15.207	AC Wireline Conducted	Emissions 150 kHz–30 MHz	Conducted	Complies	5.1.7

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*

5. TEST RESULTS

5.1. Device Characteristics

5.1.1. Occupied Bandwidth

FCC 47 CFR Part 90.210, 2.1049;

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 OFF (CW) and ON. Diagram in Section 3.6 Test Configurations depicts the test set-up.

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 is shown in Section 3.6 Test Configuration

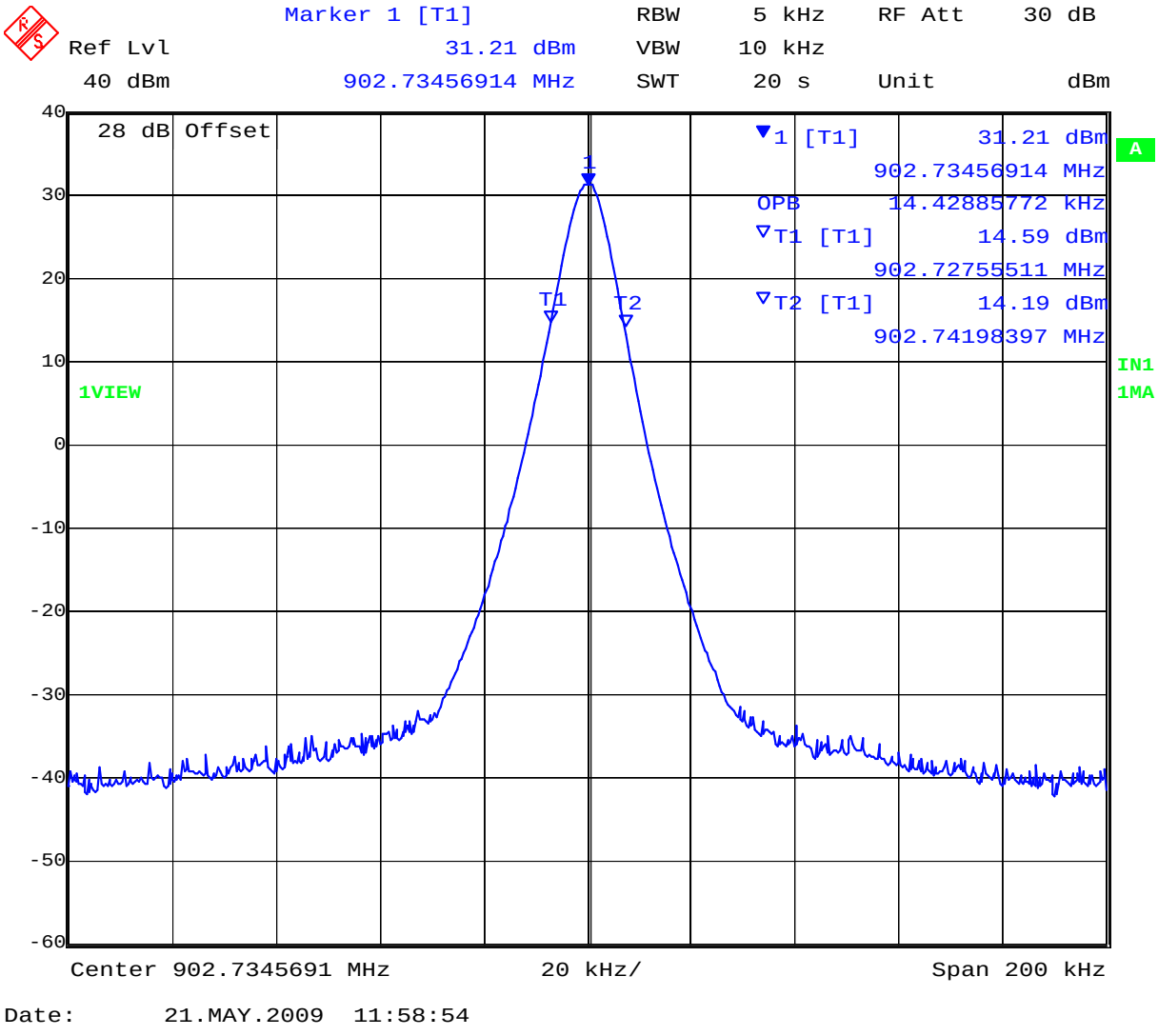
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Occupied Bandwidth

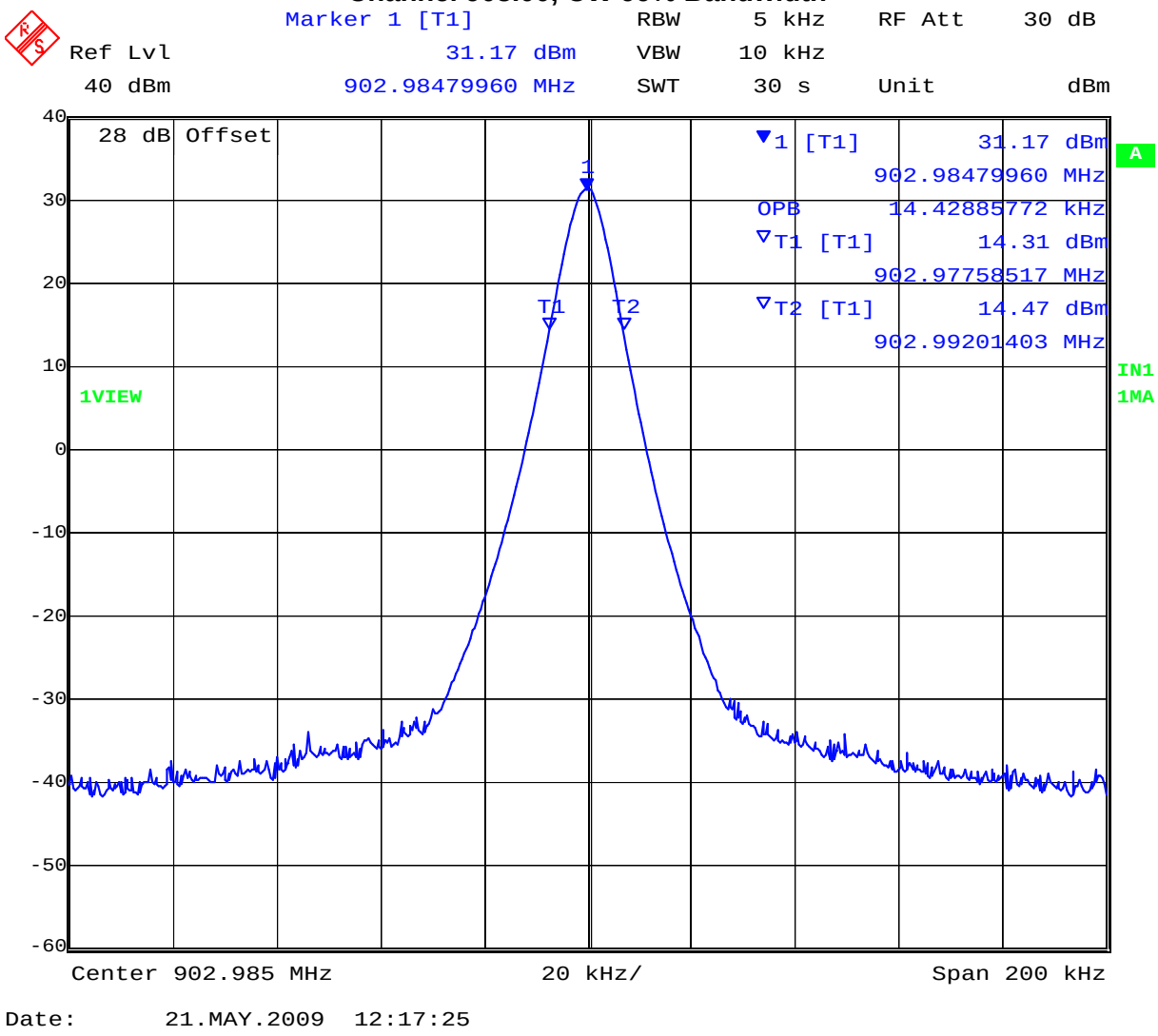
Modulation	Center Frequency (MHz)	99% Bandwidth (MHz)
CW	902.75	14.4289
	903.00	14.4289
	903.75	14.4289
	910.75	14.0281
	915.75	14.4289
	920.75	14.0281

Modulation	Center Frequency (MHz)	99% Bandwidth (MHz)
OOK	902.75	63.1263
	903.00	62.1242
	903.75	63.1263
	910.75	63.1263
	915.75	63.1263
	920.75	63.1263

Channel 902.75, CW 99% Bandwidth



Channel 903.00, CW 99% Bandwidth



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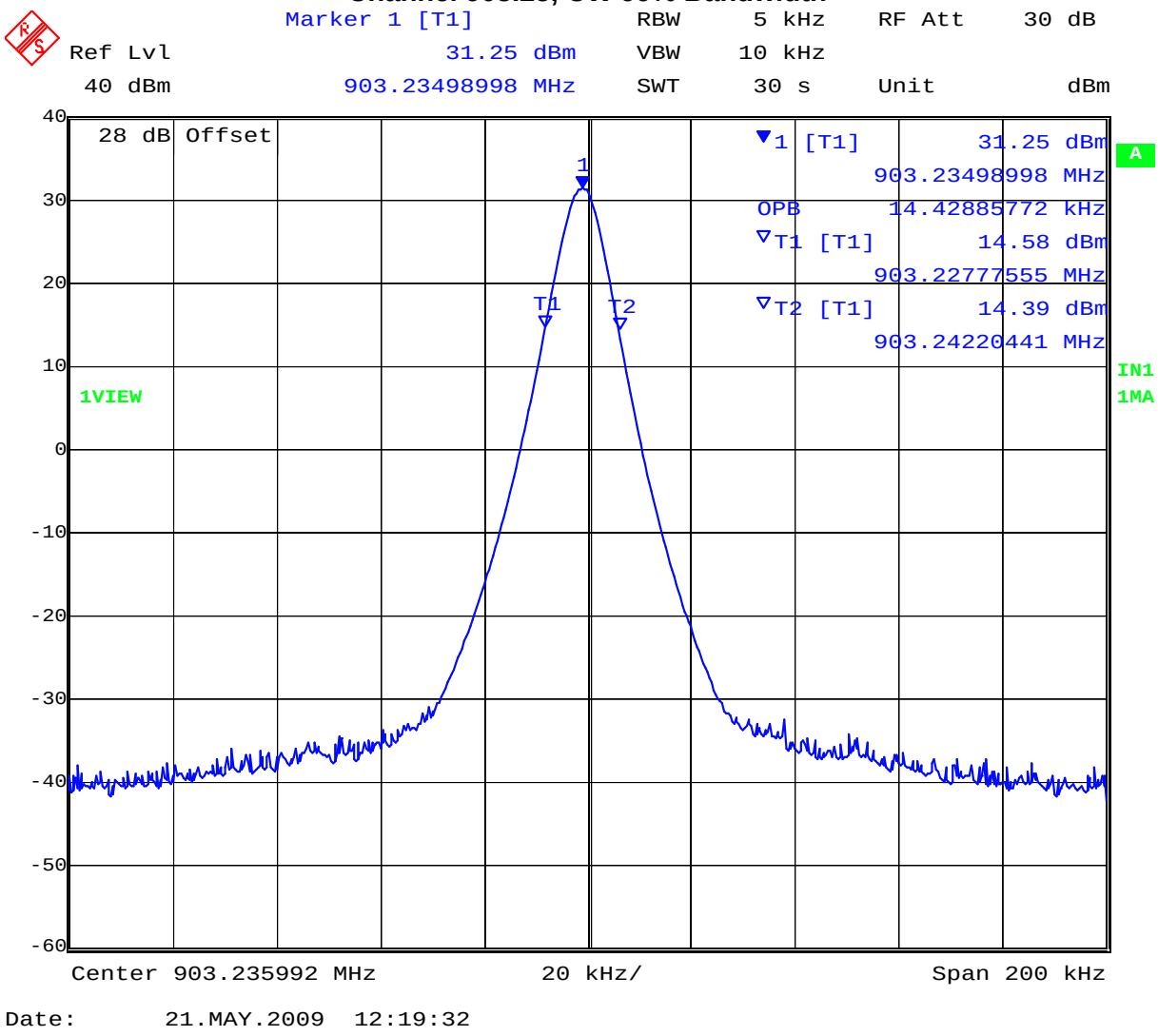
Channel 903.25, CW 99% Bandwidth



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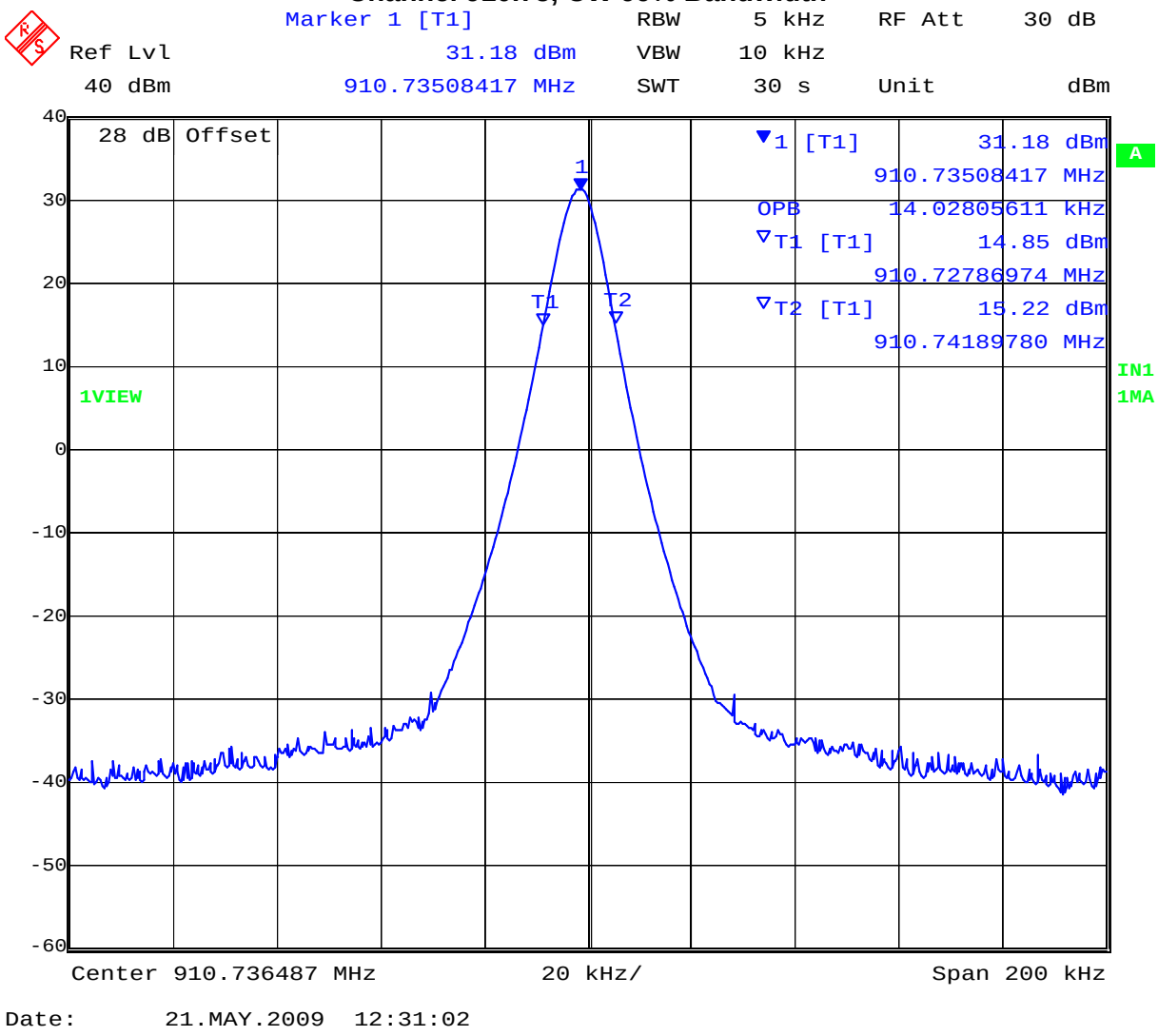
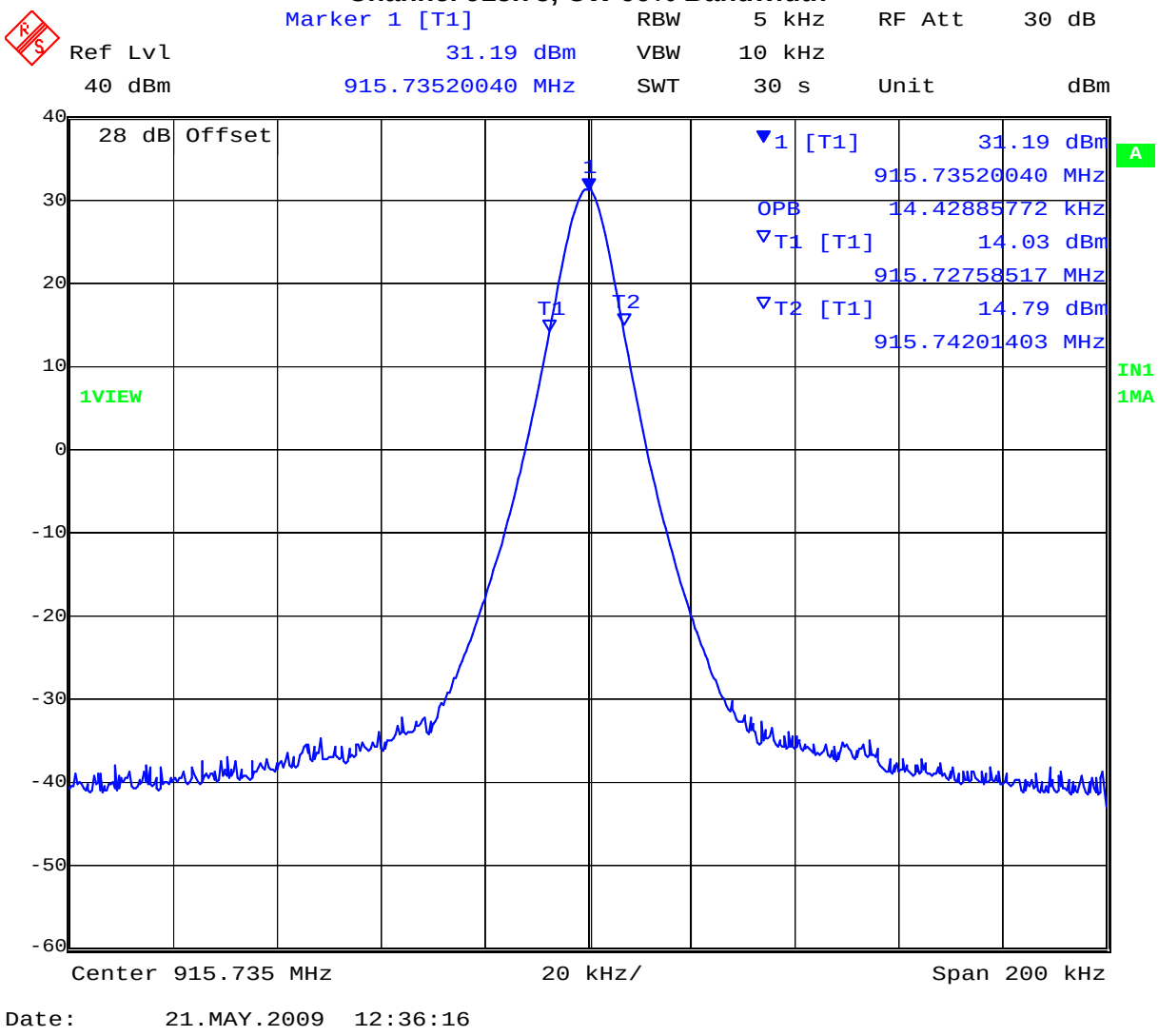
Channel 910.75, CW 99% Bandwidth



Channel 915.75, CW 99% Bandwidth



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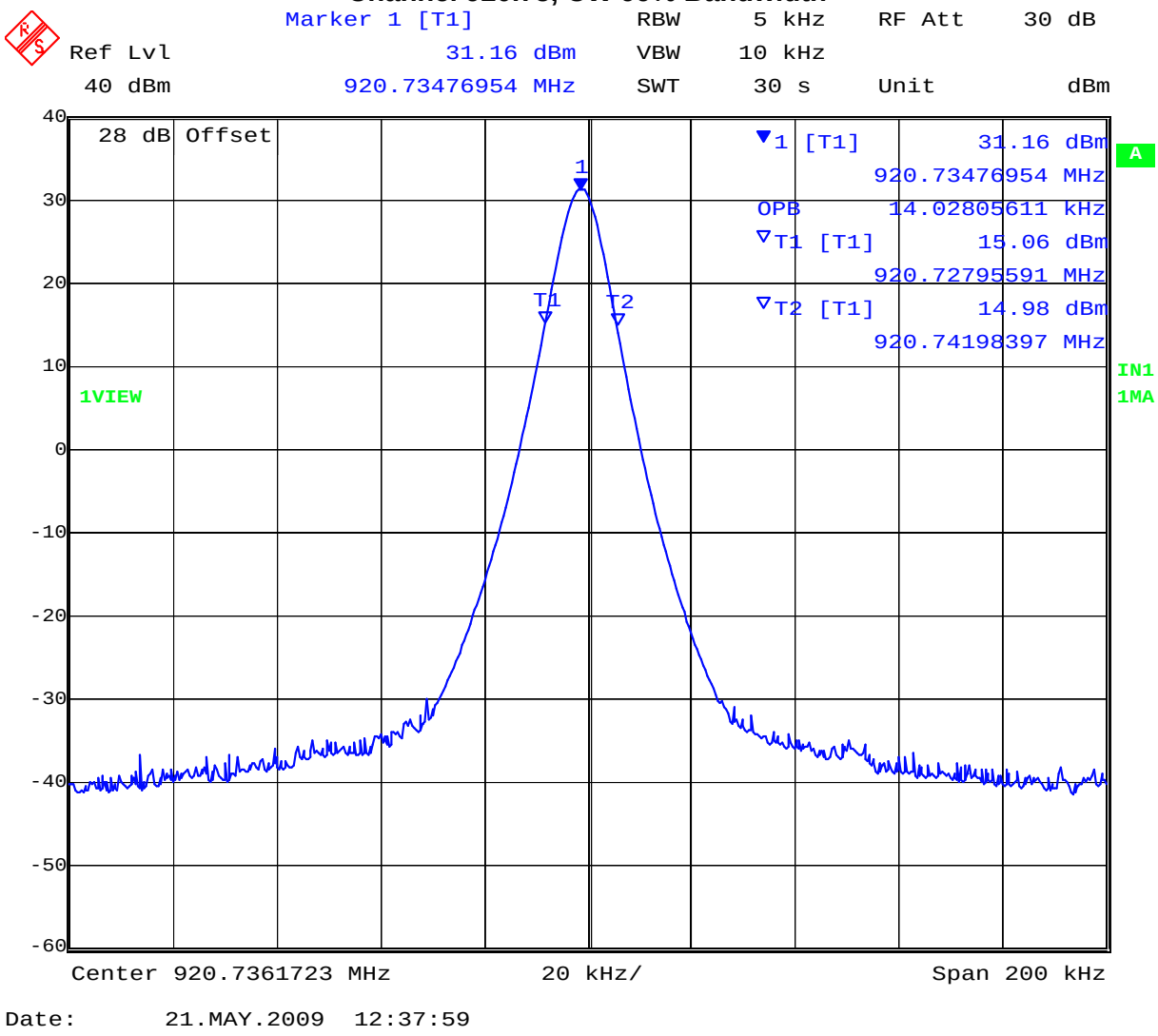
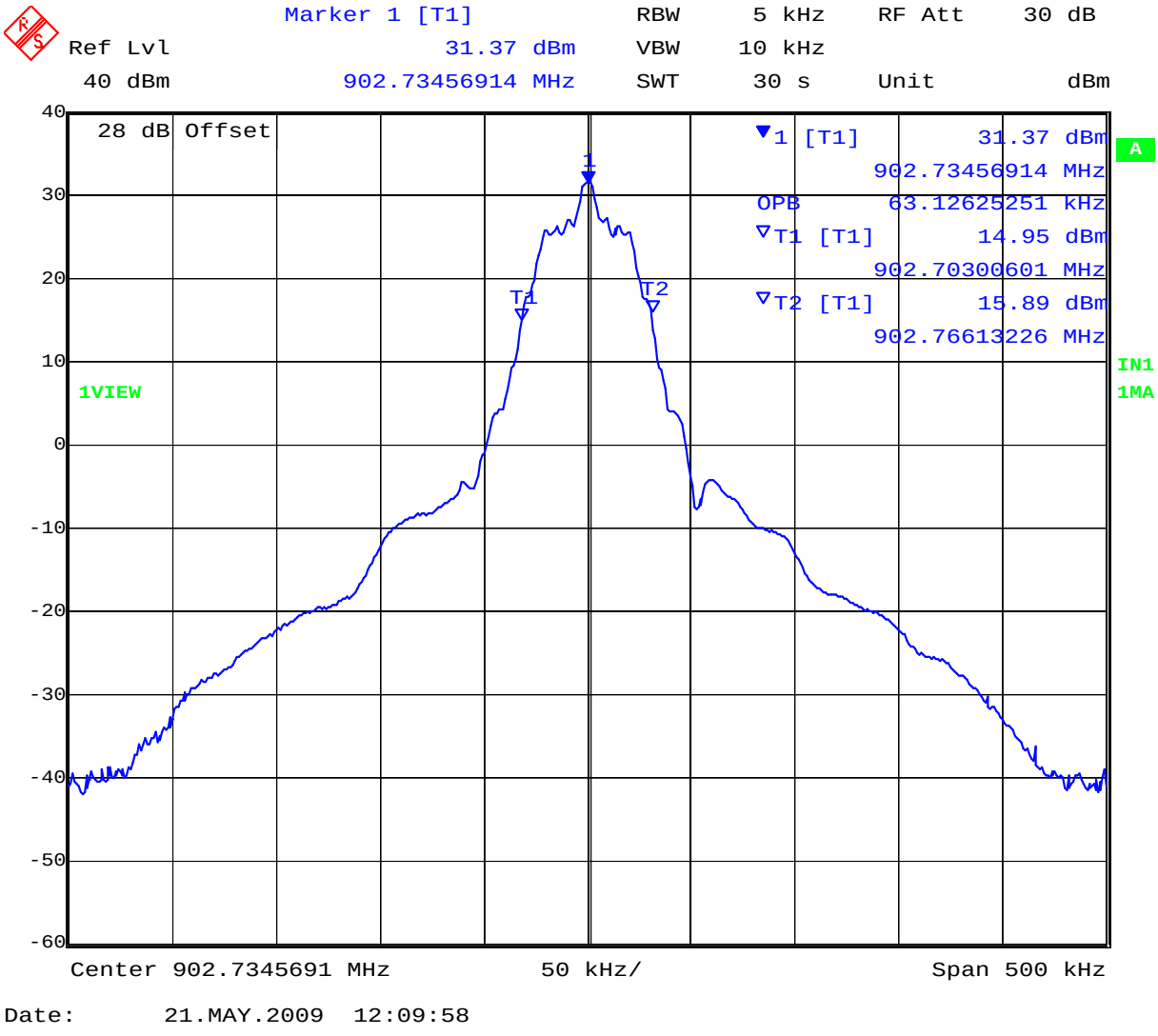
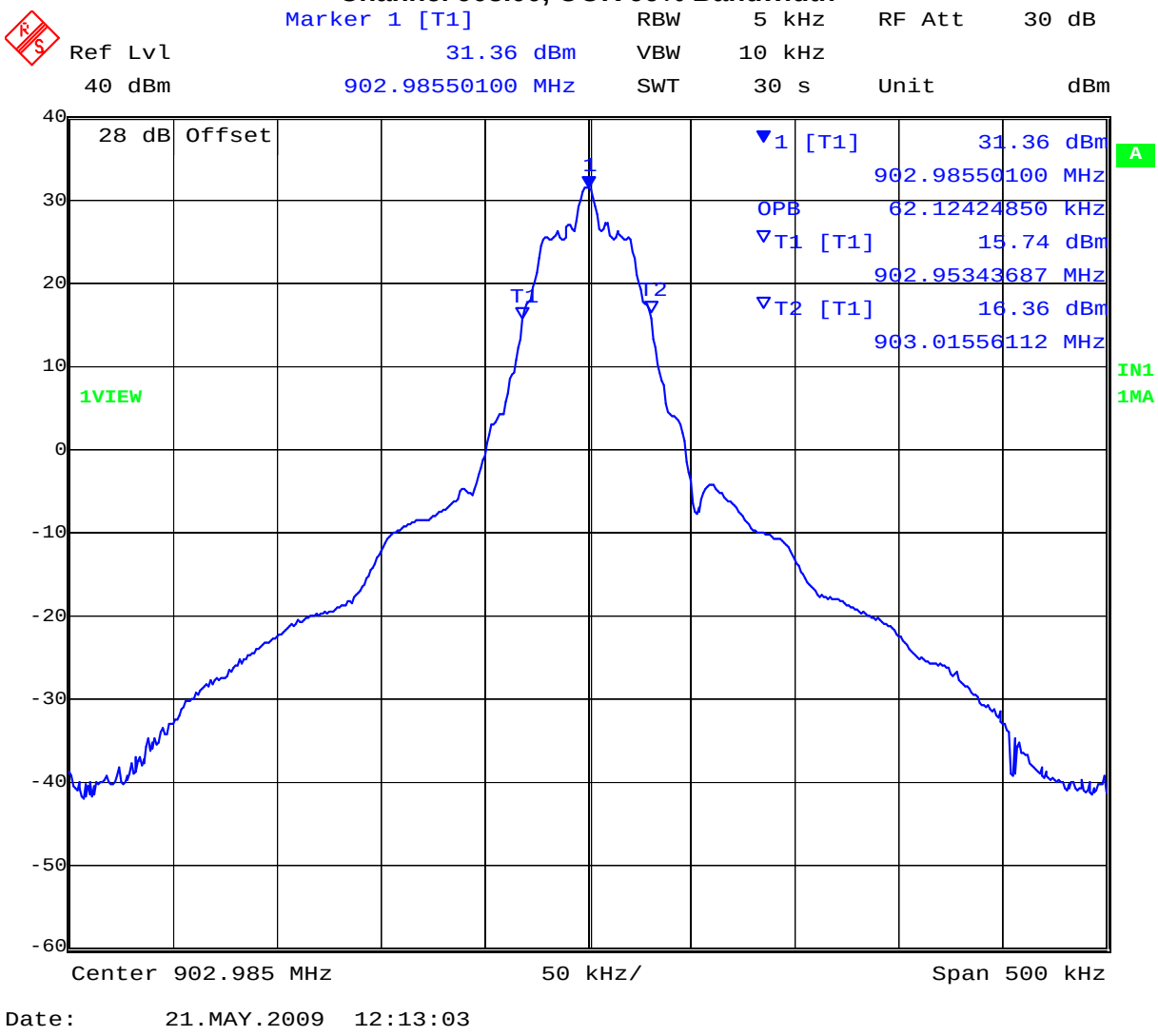
Channel 920.75, CW 99% Bandwidth



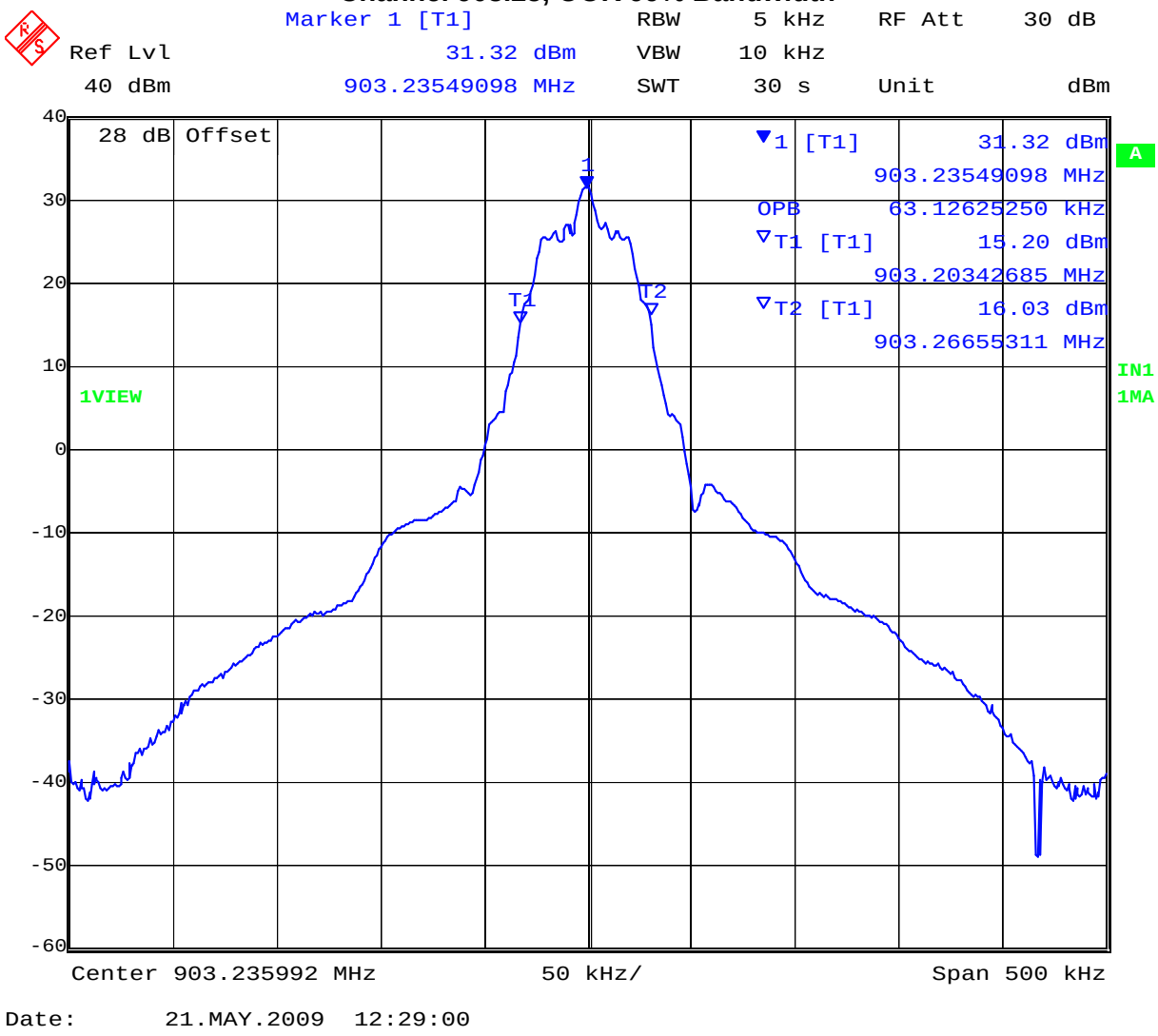
Channel 902.75, OOK 99% Bandwidth



Channel 903.00, OOK 99% Bandwidth



Channel 903.25, OOK 99% Bandwidth



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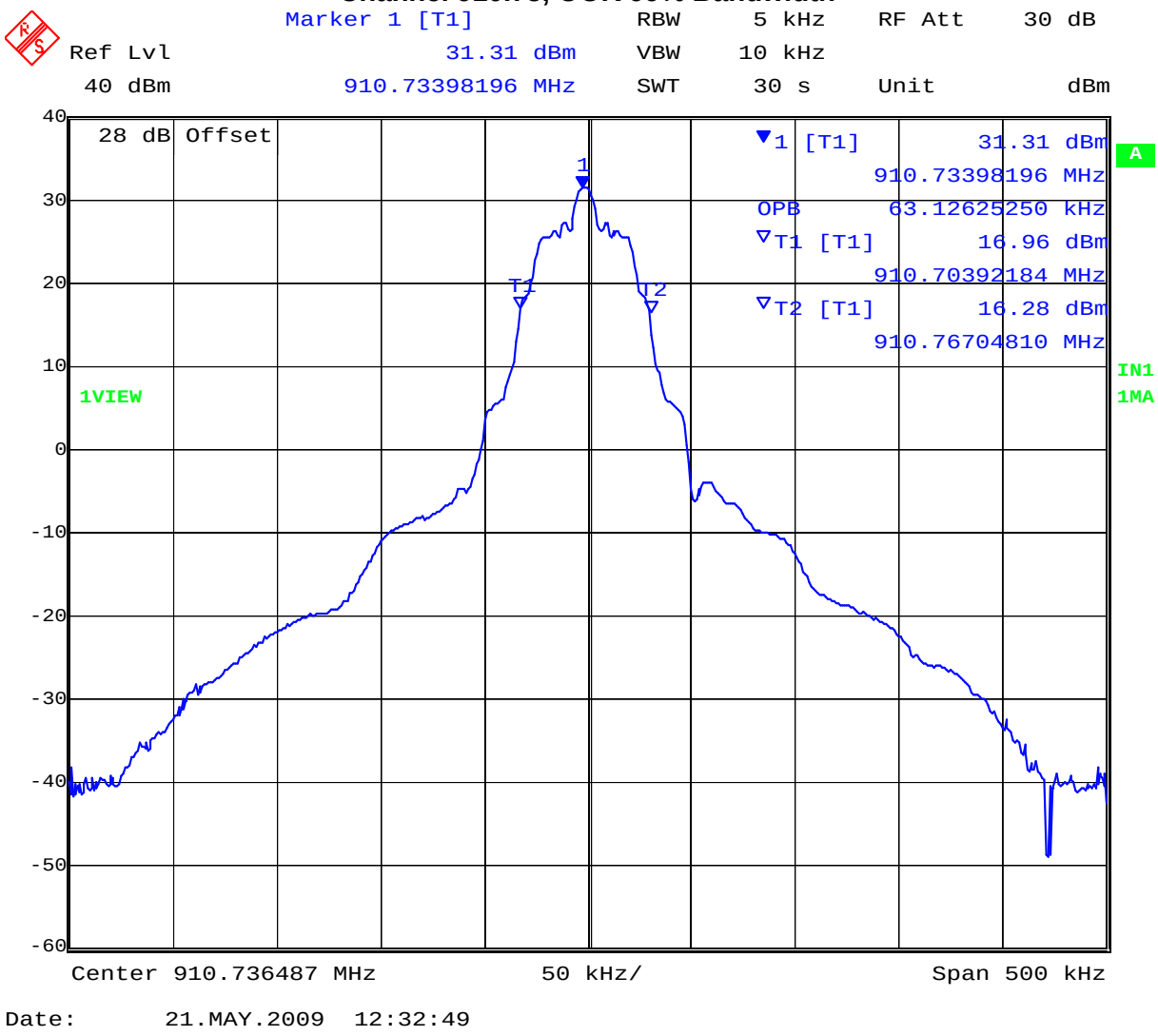
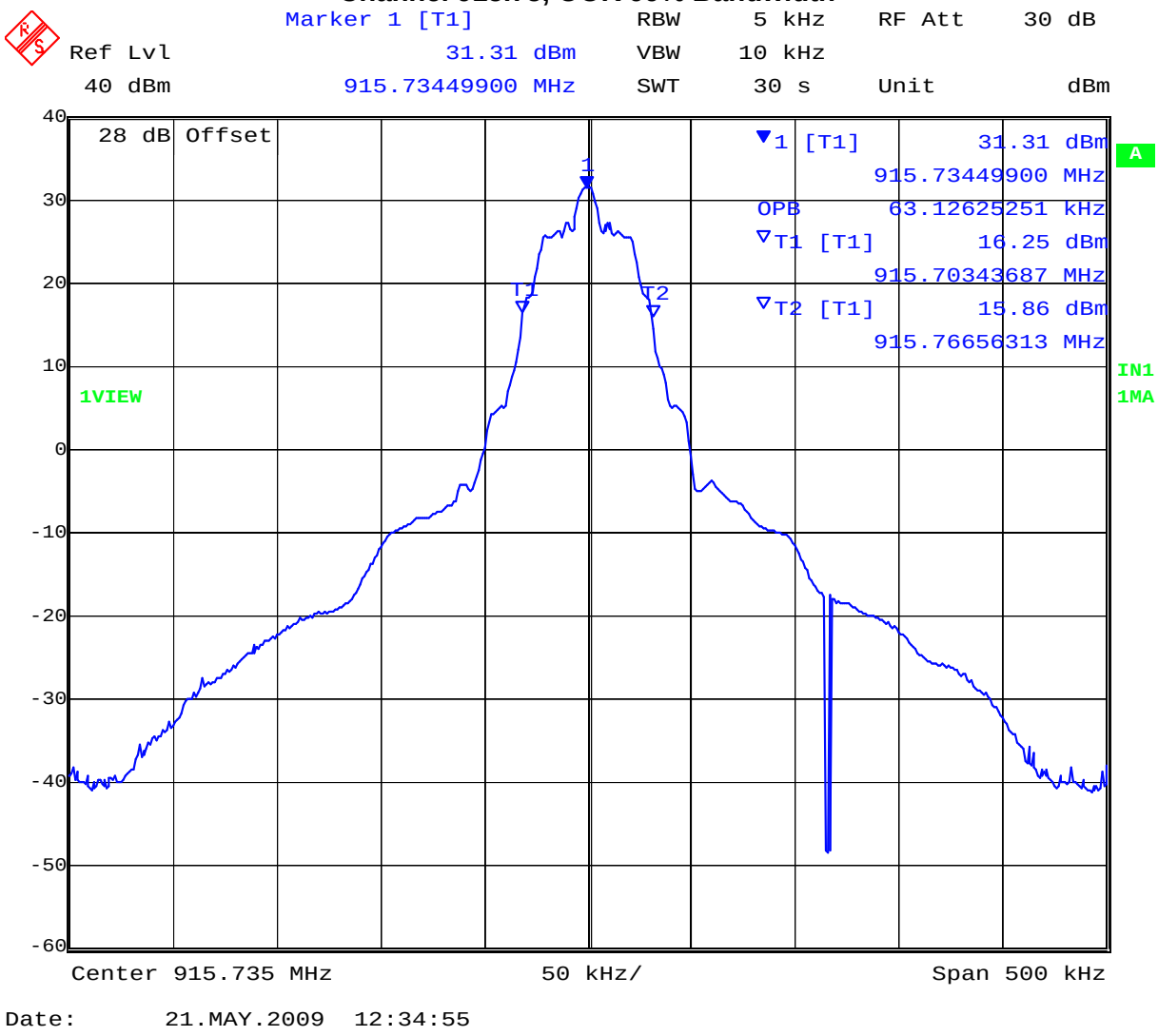
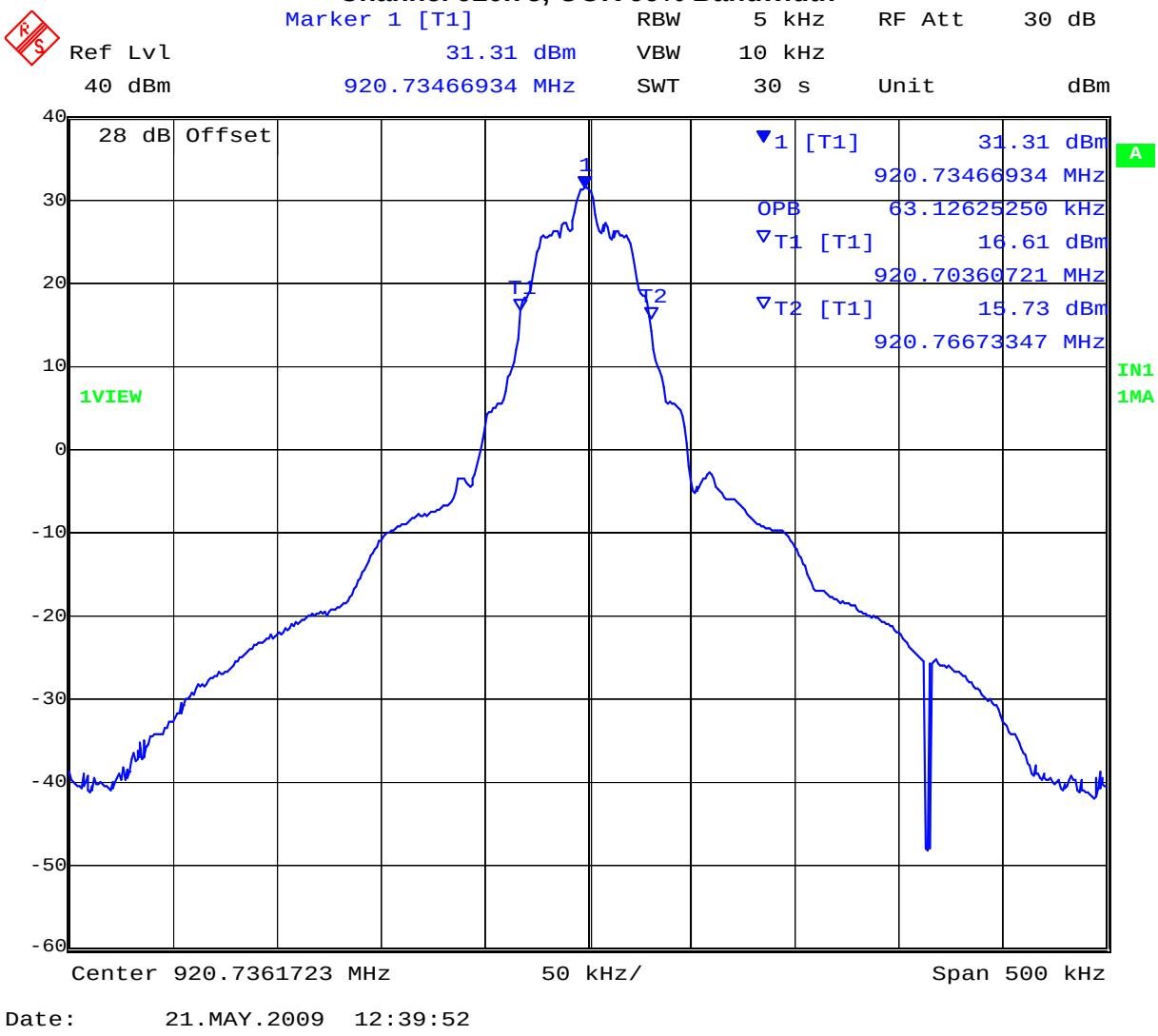
Channel 910.75, OOK 99% Bandwidth



Channel 915.75, OOK 99% Bandwidth



Channel 920.75, OOK 99% Bandwidth



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.

5.1.2. Effective Radiated Power

FCC 47 CFR Part 90.205, Subpart I; §2.1046
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).

Diagram in Section 3.6 Test Configurations depicts the test set-up.

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

Antenna Gain = 11.5 dBi

ERP (dBm) = Transmit Power (dBm) + 9.36 dB

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Modulation	Center Frequency (MHz)	Measured Power (dBm)	ERP (dBm)	ERP Limit		Margin (dB)
				W	dBm	
CW	902.75	+31.2	+40.56	30	+44.7	-4.14
	903.00	+31.1	+40.46			-4.24
	903.75	+31.2	+40.56			-4.14
	910.75	+31.1	+40.46			-4.24
	915.75	+31.1	+40.46			-4.24
	920.75	+31.1	+40.46			-4.24
OOK	902.75	+29.2	+38.56			-6.14
	903.00	+29.2	+38.56			-6.14
	903.75	+29.2	+38.56			-6.14
	910.75	+29.2	+38.56			-6.14
	915.75	+29.2	+38.56			-6.14
	920.75	+29.2	+38.56			-6.14

Laboratory Measurement Uncertainty for Power Measurement

Measurement uncertainty	±1.33 dB

Traceability

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

5.1.3. Maximum Permissible Exposure

FCC, Part 90 Subpart C §90.1217

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm^2) = EIRP/(4πd^2)

EIRP = P * G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = 10 ^ (G (dBi)/10)

The Thinkify TF-3 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.

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm^2

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Max Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm^2 Limit(cm)	Minimum Separation Distance (cm)
915	11.5	14.12	+31.2	1318.3	38.5	38.5

Specification
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 / cm^2 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

5.1.4. Frequency Stability; Temperature Variations, and Voltage Variations

FCC 47 CFR Part 90, Subpart Z; 2.1055(a)(1)

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 is shown in Section 3.6 Test Configuration

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

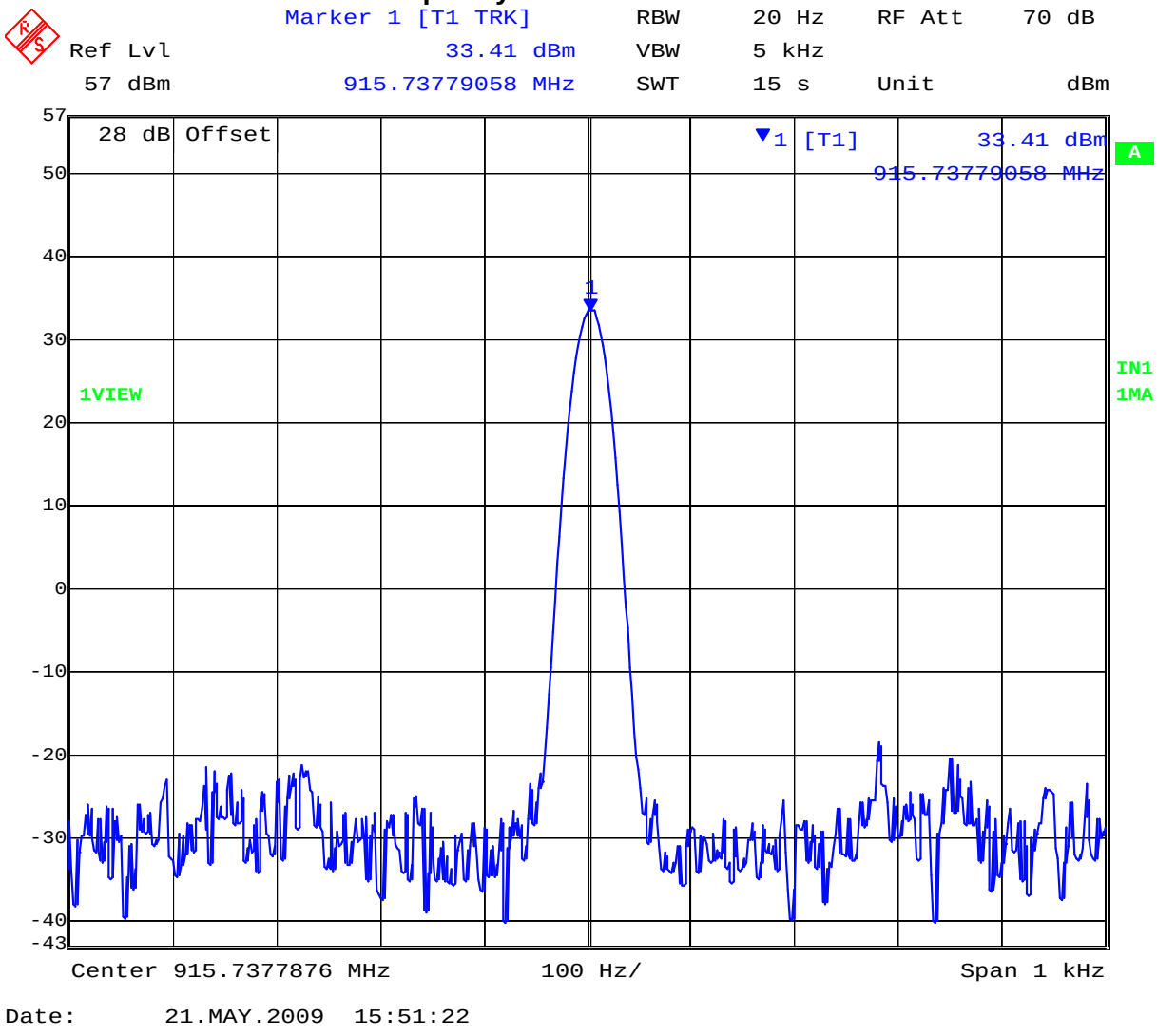
TABLE OF RESULTS Frequency Stability – Channel Measured 915.75 MHz

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

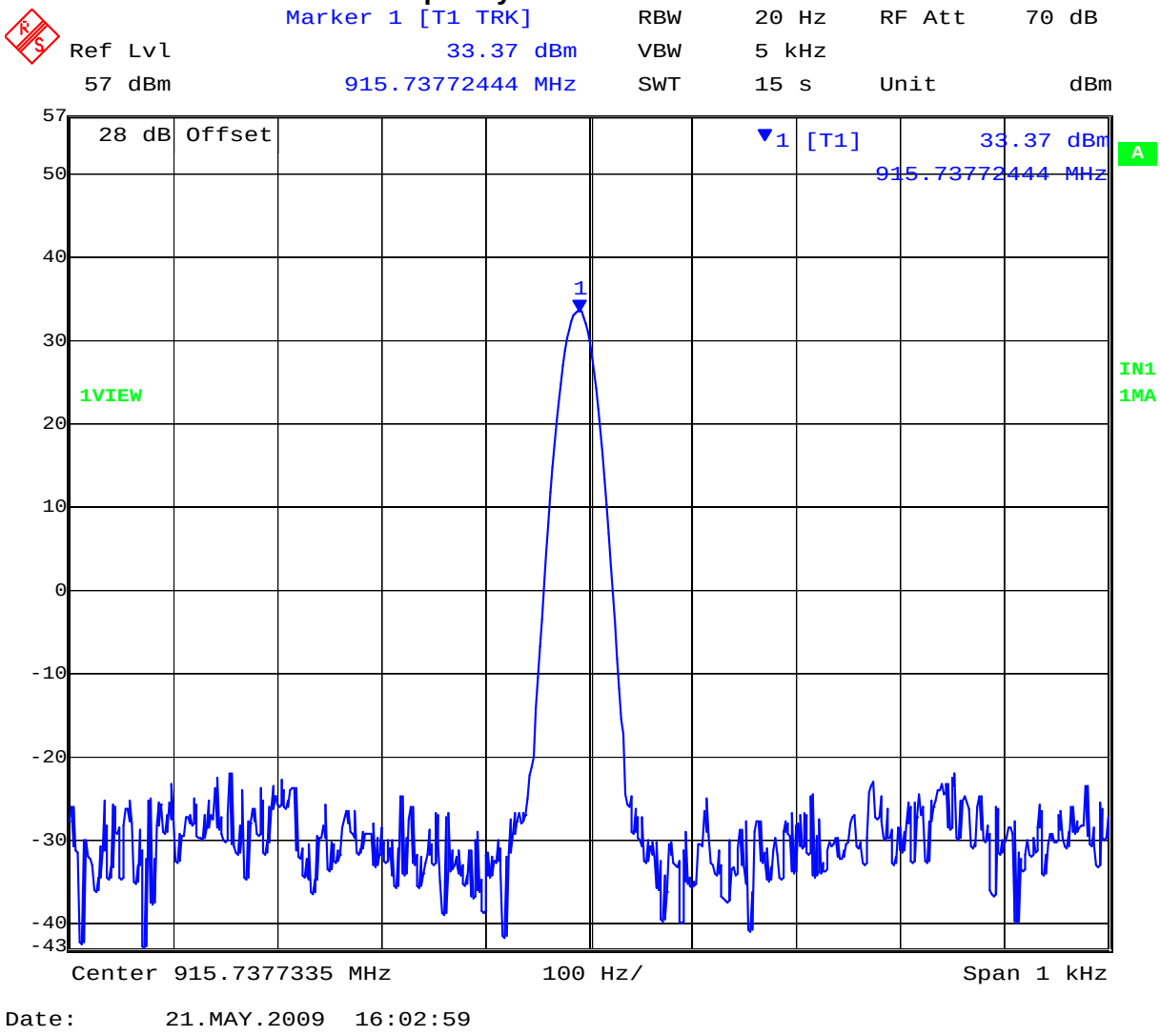
Voltage (Vdc)	Temperature (°C)	Marker Frequency (MHz)	Delta (kHz)	ppm
+9.85	-20	915.73779058	-12.209	-13.333
	-10	915.73772444	-12.276	-13.405
	+0	915.73674950	-13.251	-14.470
	+10	915.73547295	-14.527	-15.864
	+20	915.73461468	-15.385	-16.801
+8.37	+20	915.73447139	-15.529	-16.957
+11.3	+20	915.73456658	-15.433	-16.853
+9.85	+30	915.73417280	-15.827	-17.283
	+40	915.73561568	-14.384	-15.708
	+50	915.73853851	-11.461	-12.516
Maximum Frequency Drift with respect to the nominal frequency (lowest/highest)		-11.461 kHz / -15.827 kHz -12.516 ppm / -17.283 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.

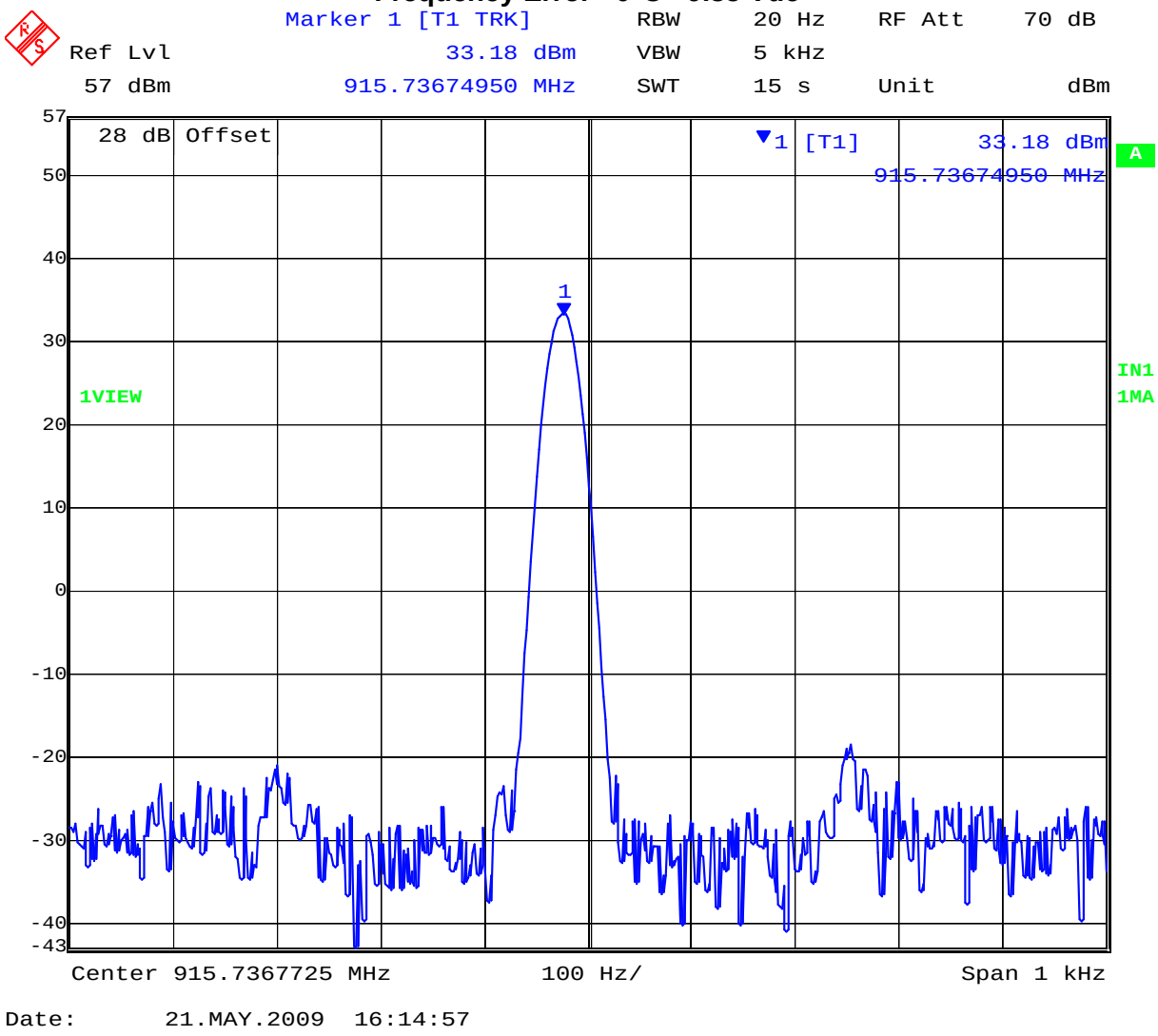
Frequency Error -20°C +9.85 Vdc



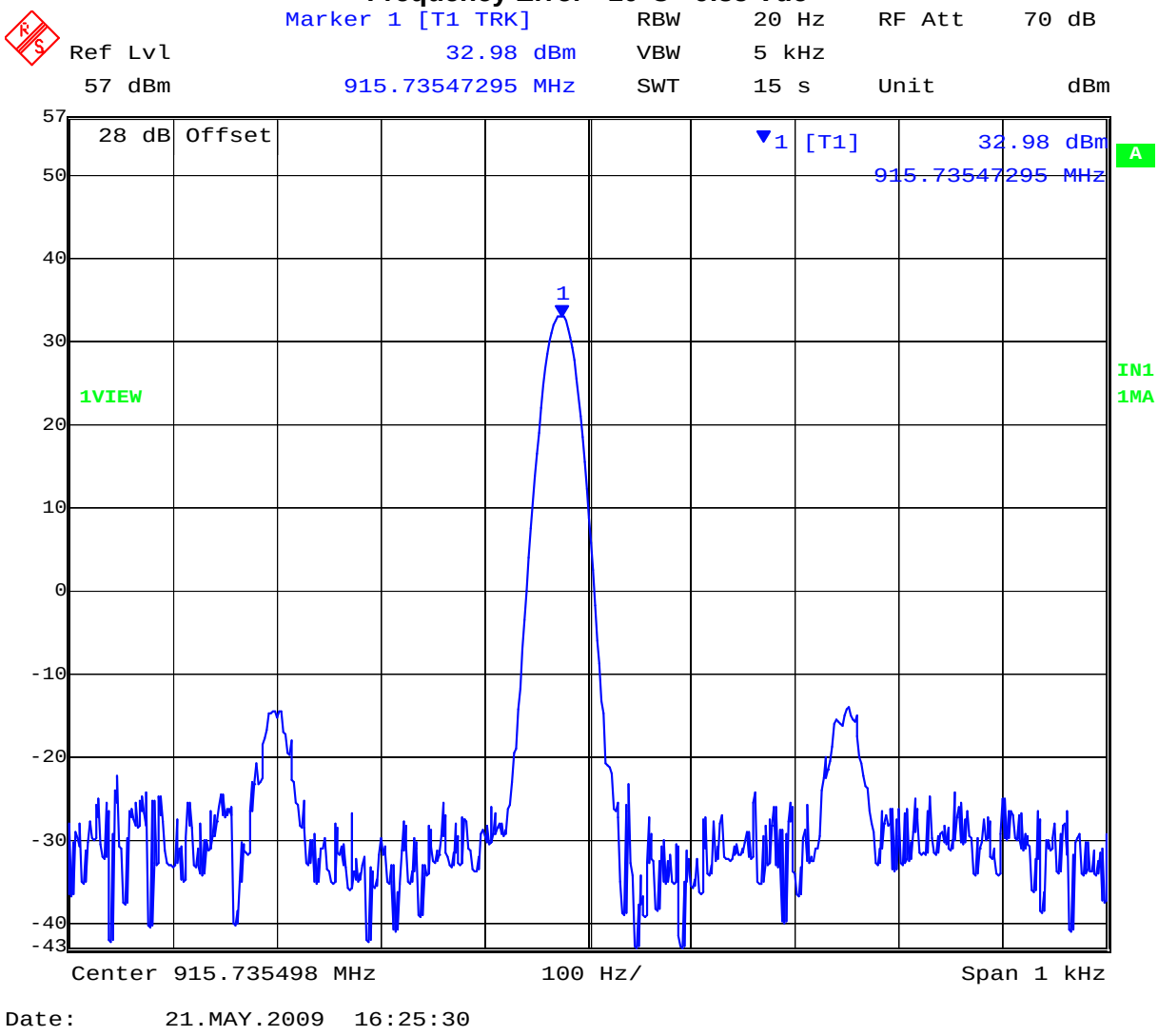
Frequency Error -10°C +9.85 Vdc



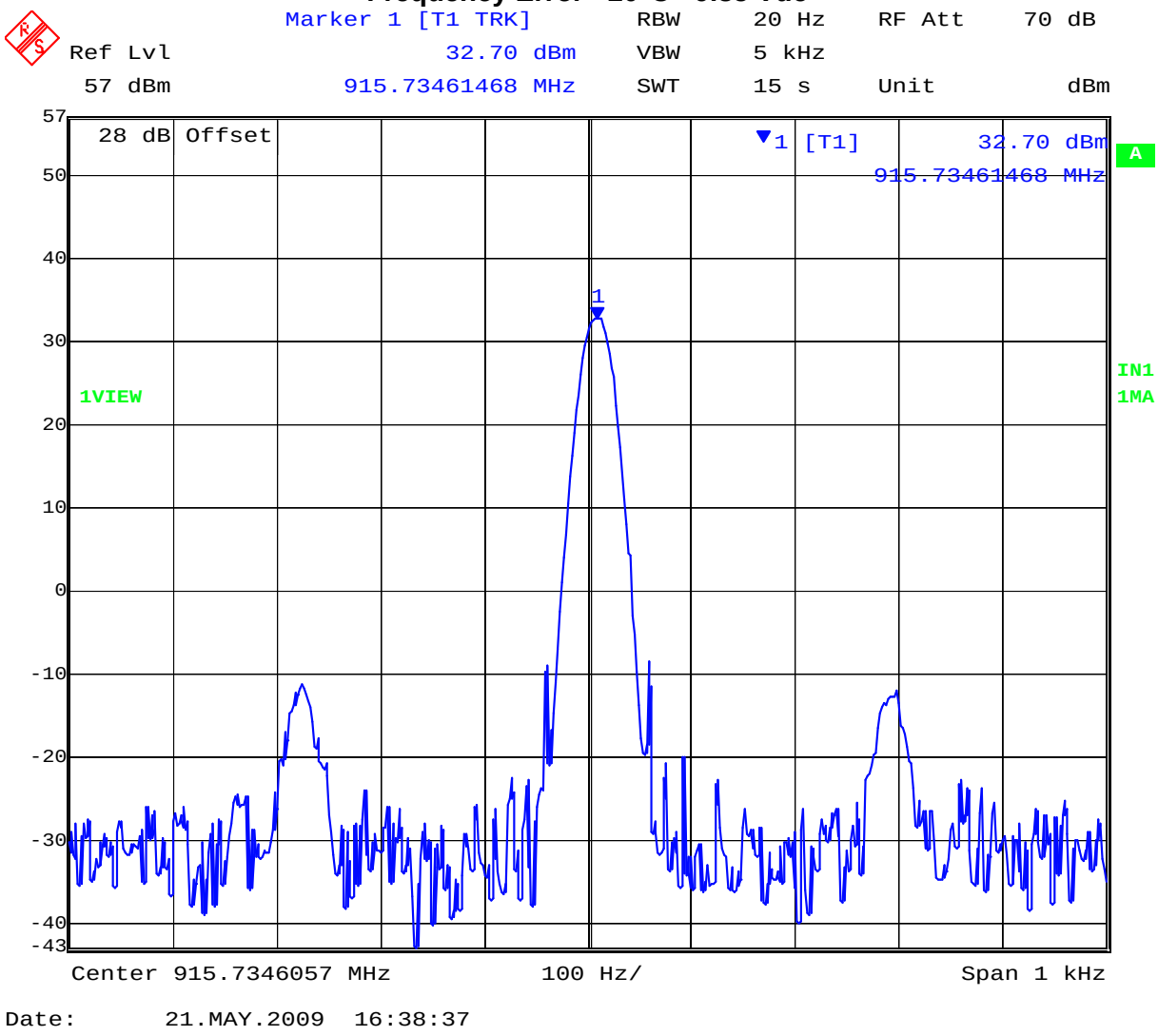
Frequency Error +0°C +9.85 Vdc



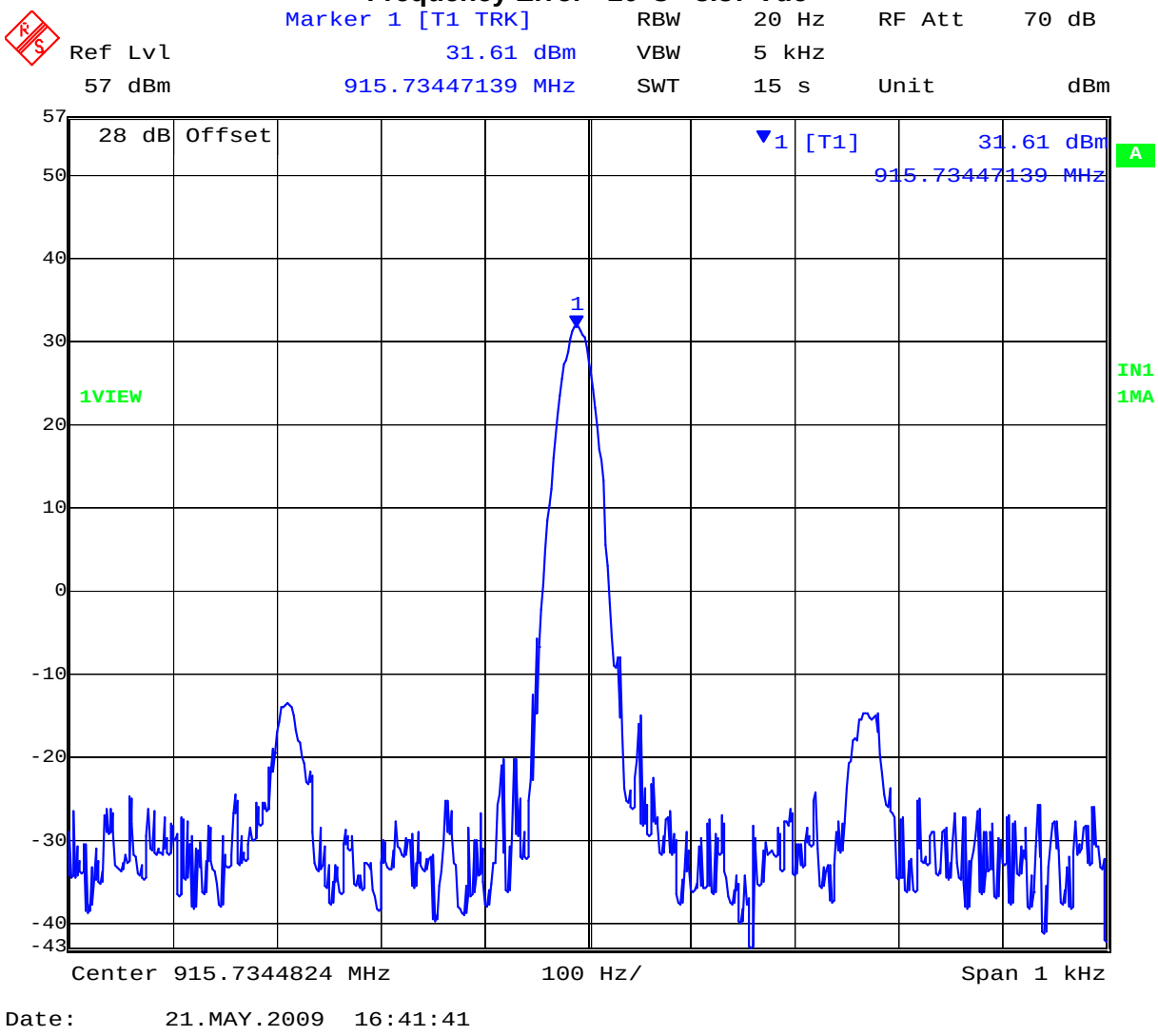
Frequency Error +10°C +9.85 Vdc



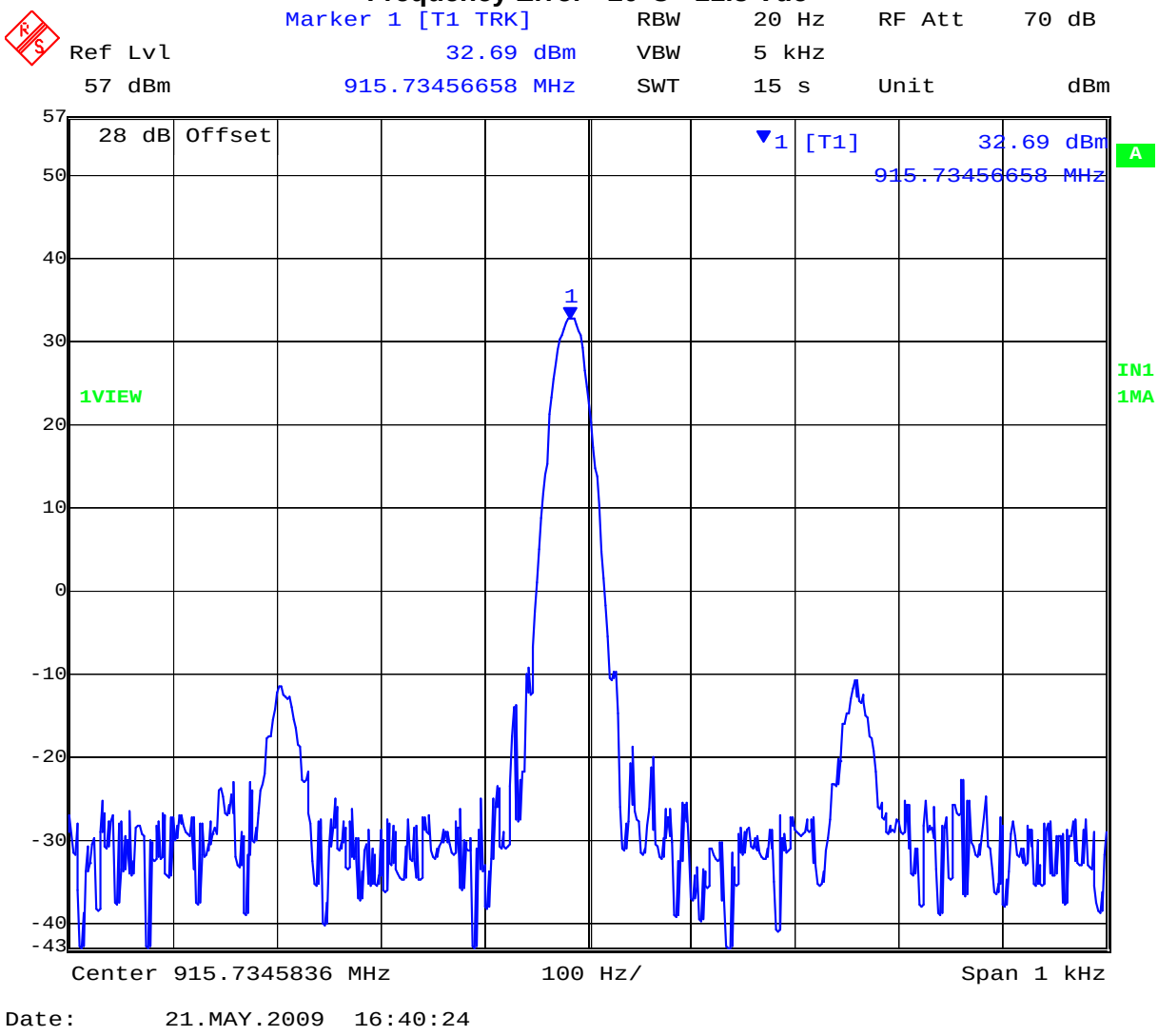
Frequency Error +20°C +9.85 Vdc



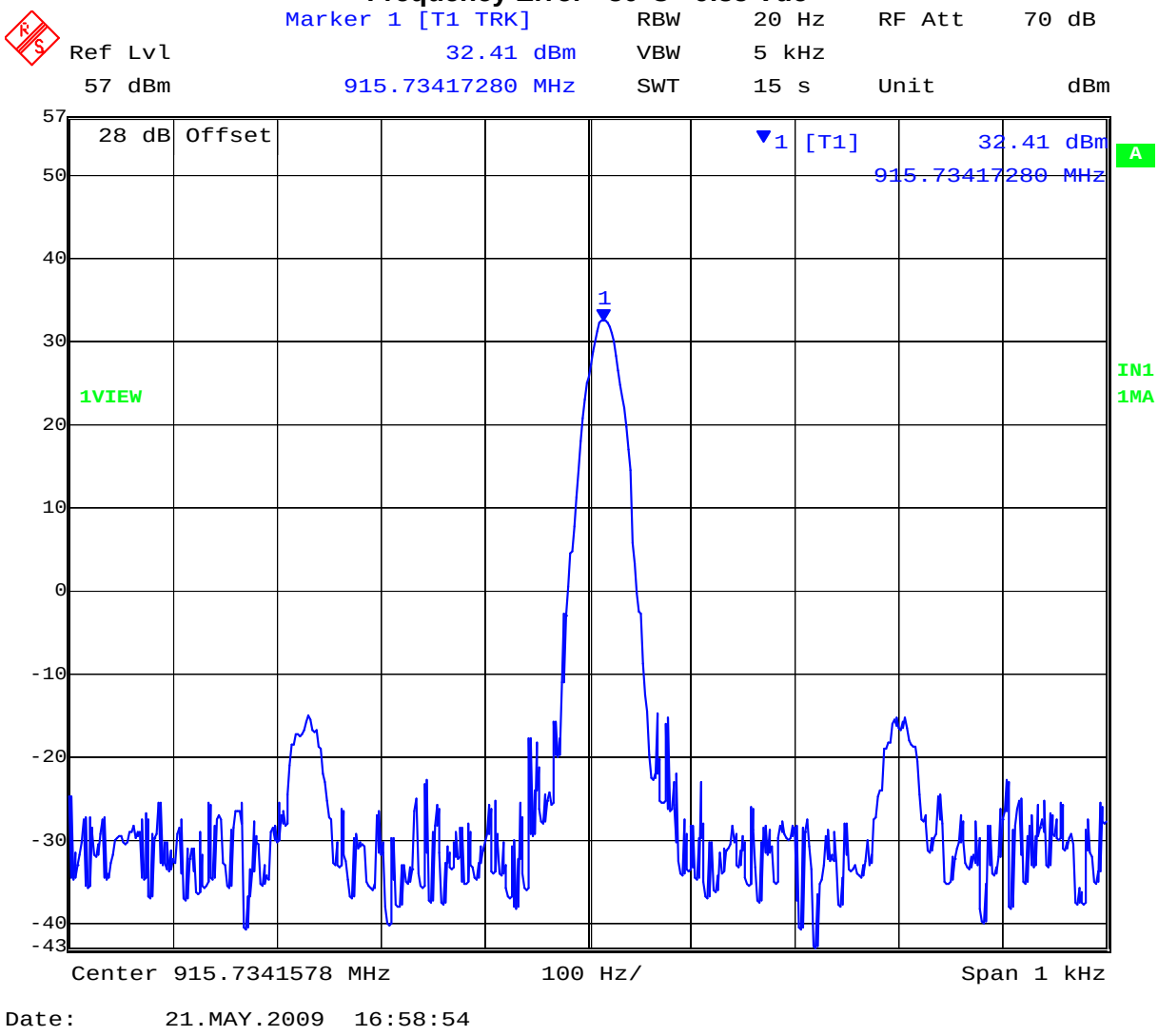
Frequency Error +20°C +8.37 Vdc



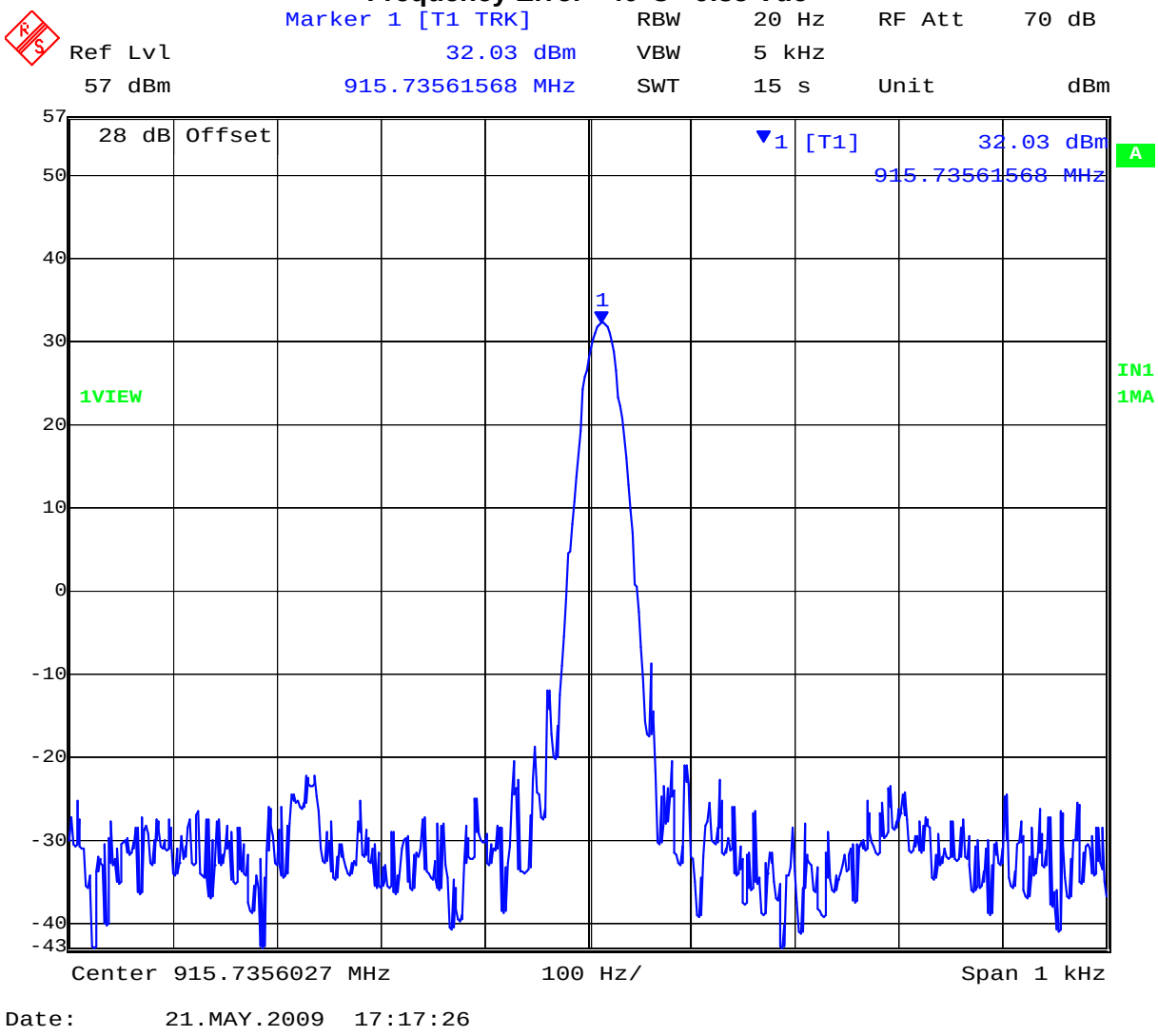
Frequency Error +20°C +11.3 Vdc



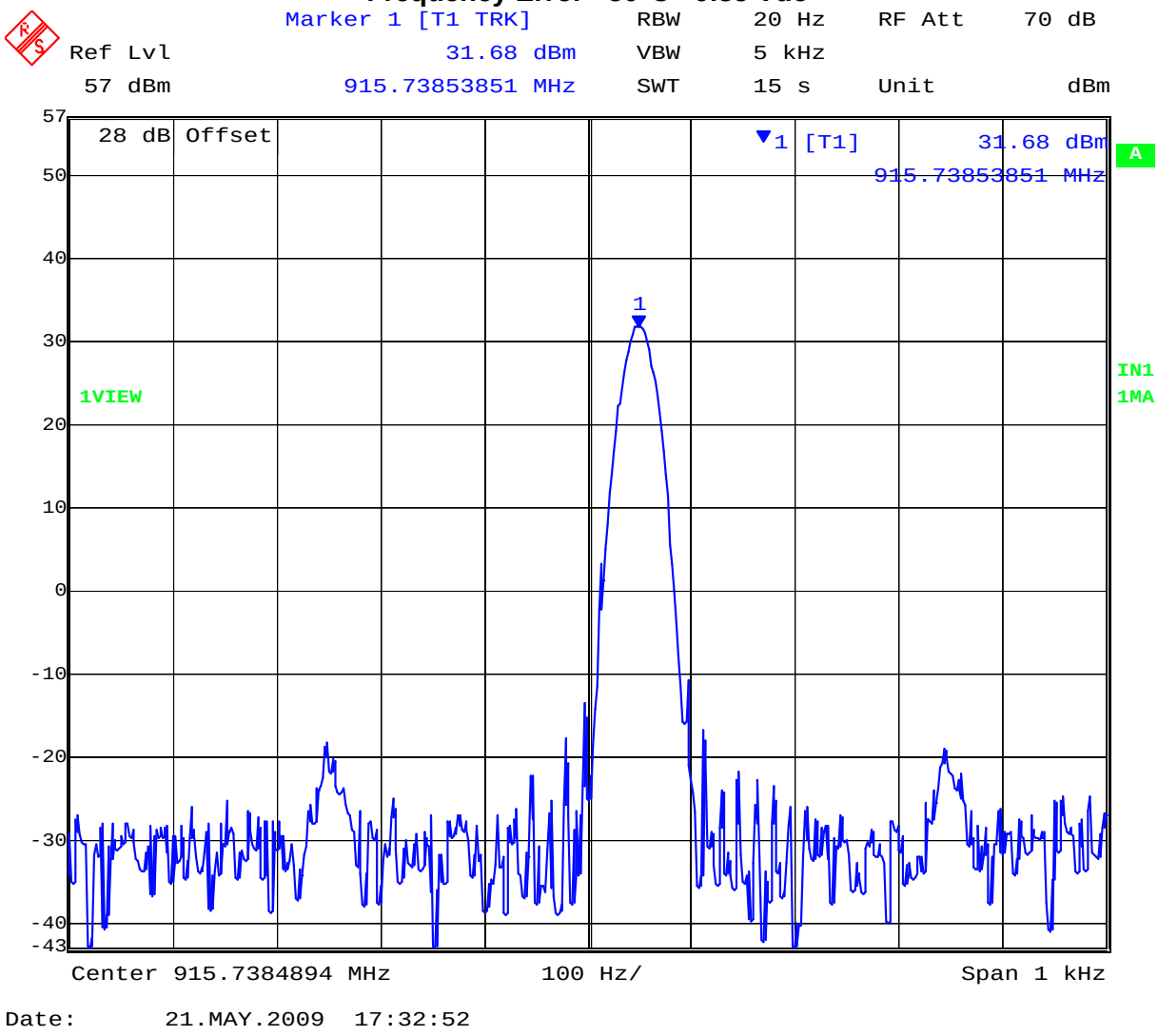
Frequency Error +30°C +9.85 Vdc



Frequency Error +40°C +9.85 Vdc



Frequency Error +50°C +9.85 Vdc



Laboratory Measurement Uncertainty for Frequency Stability

Measurement uncertainty	±0.866 ppm

Traceability

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

5.1.5. Spectrum Mask (Band-Edge) & Spurious Emissions

FCC 47 CFR Part 90, Subpart Z; §90.1323, 2.1051

5.1.5.1. Spectrum Mask (Band-Edge)

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 is shown in Section 3.6 Test Configuration

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.

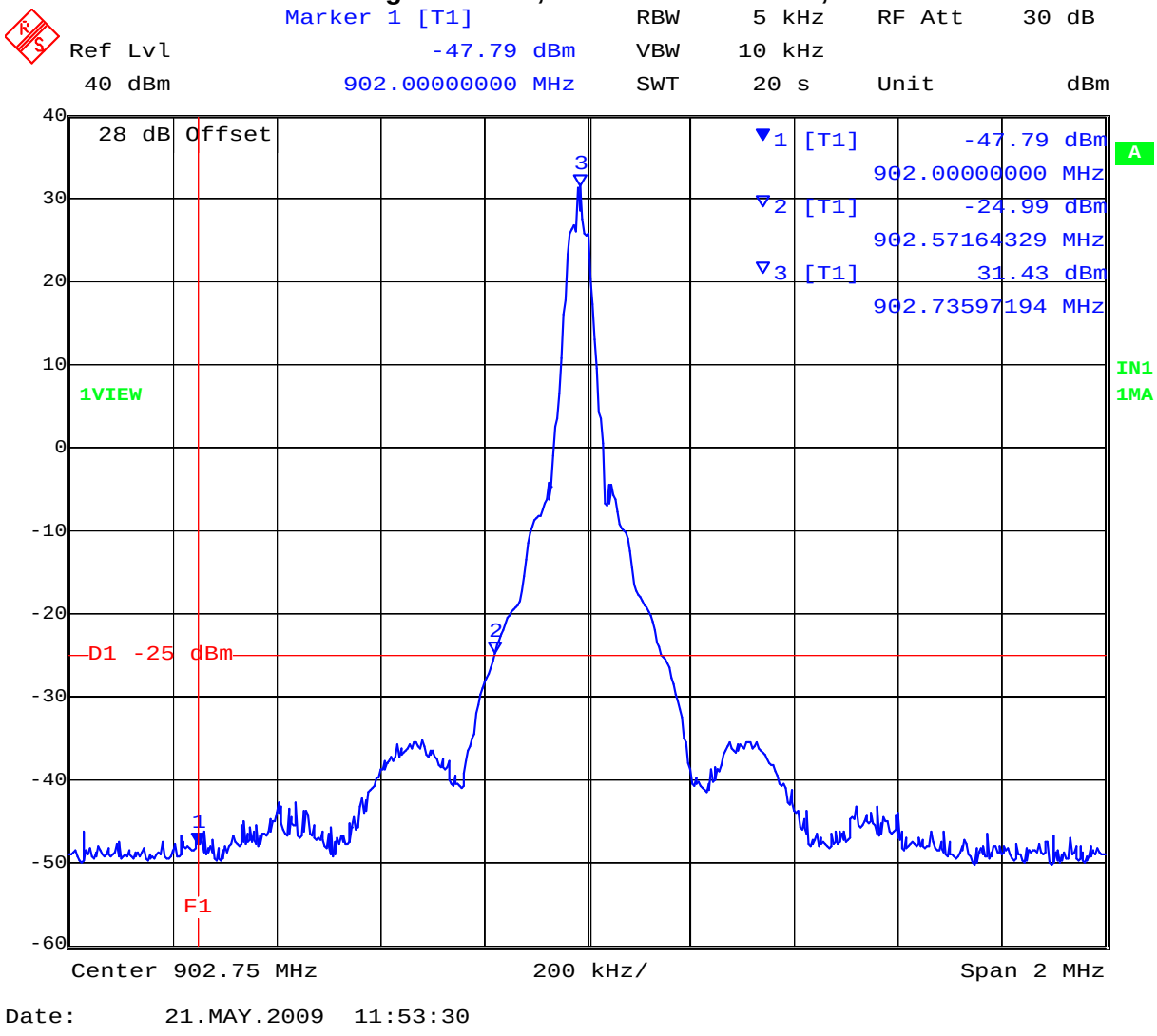
P = Maximum Power = +31.2 dBm = 1.3183 W
Attenuation = 56.2 dB

Limit = -25 dBm

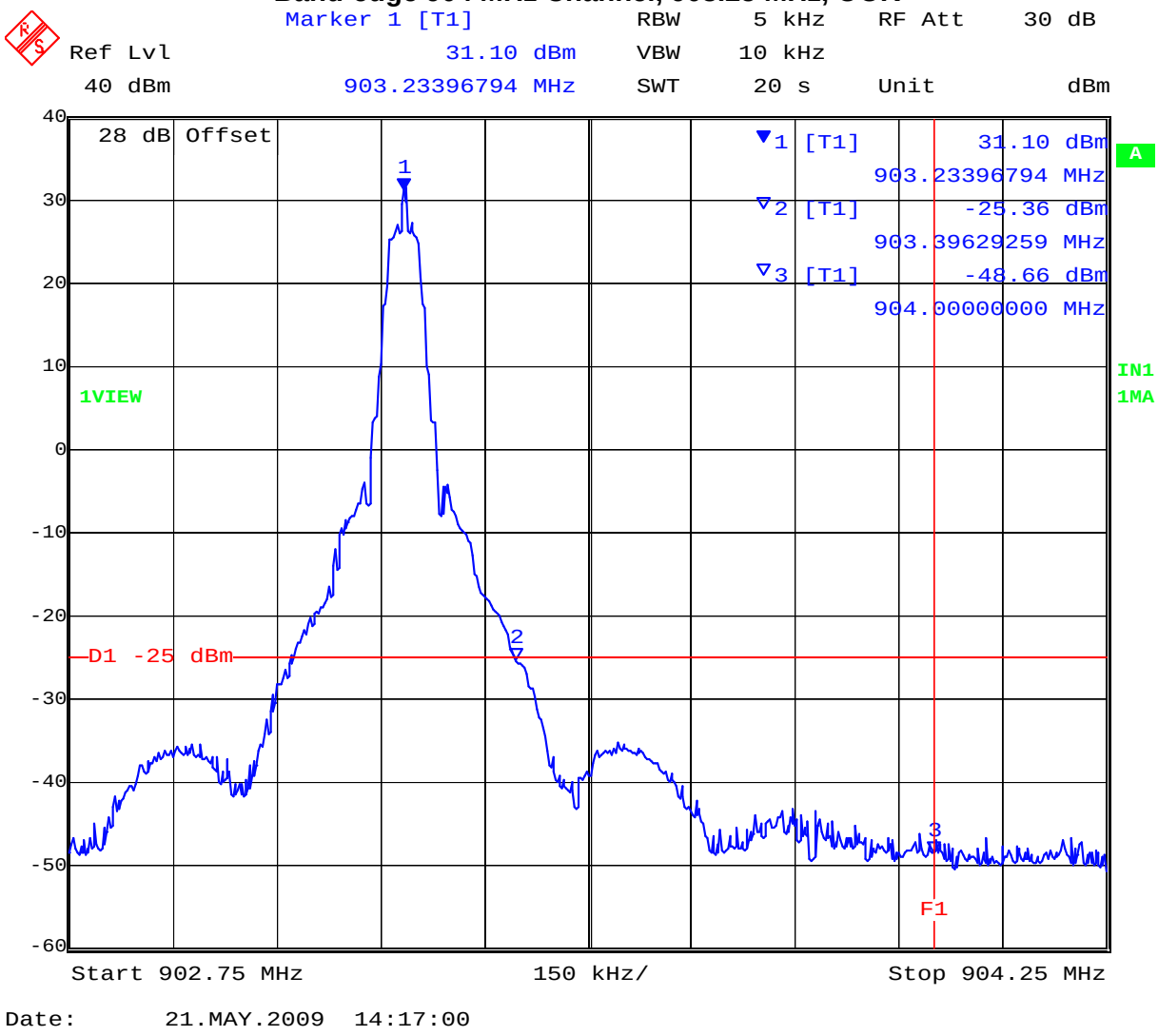
Band-edges
Lower Frequency Band 902 MHz, 904 MHz
Upper Frequency Band 909.75 MHz, 921.75 MHz

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

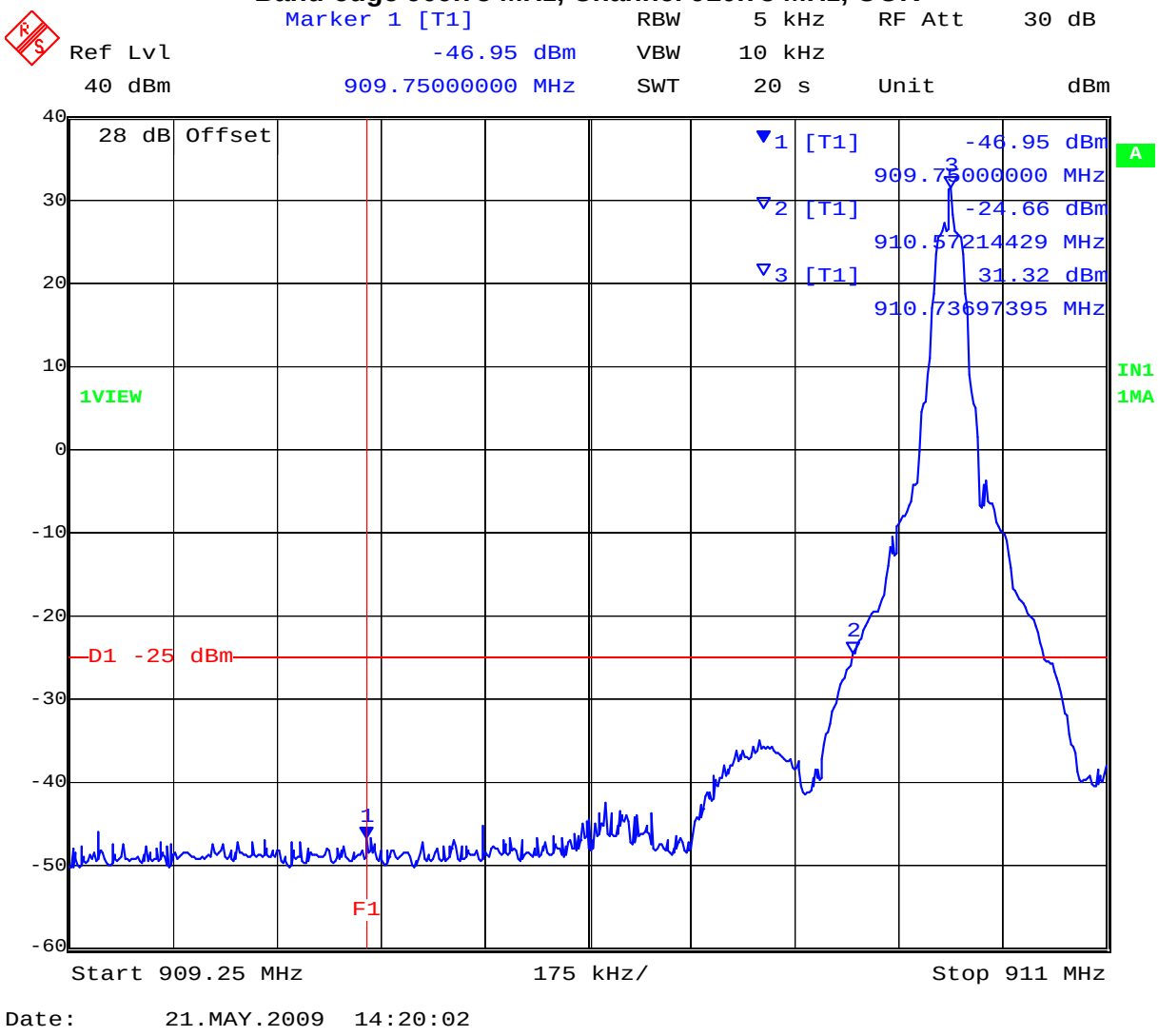
Band-edge 902 MHz, Channel 902.75 MHz, OOK



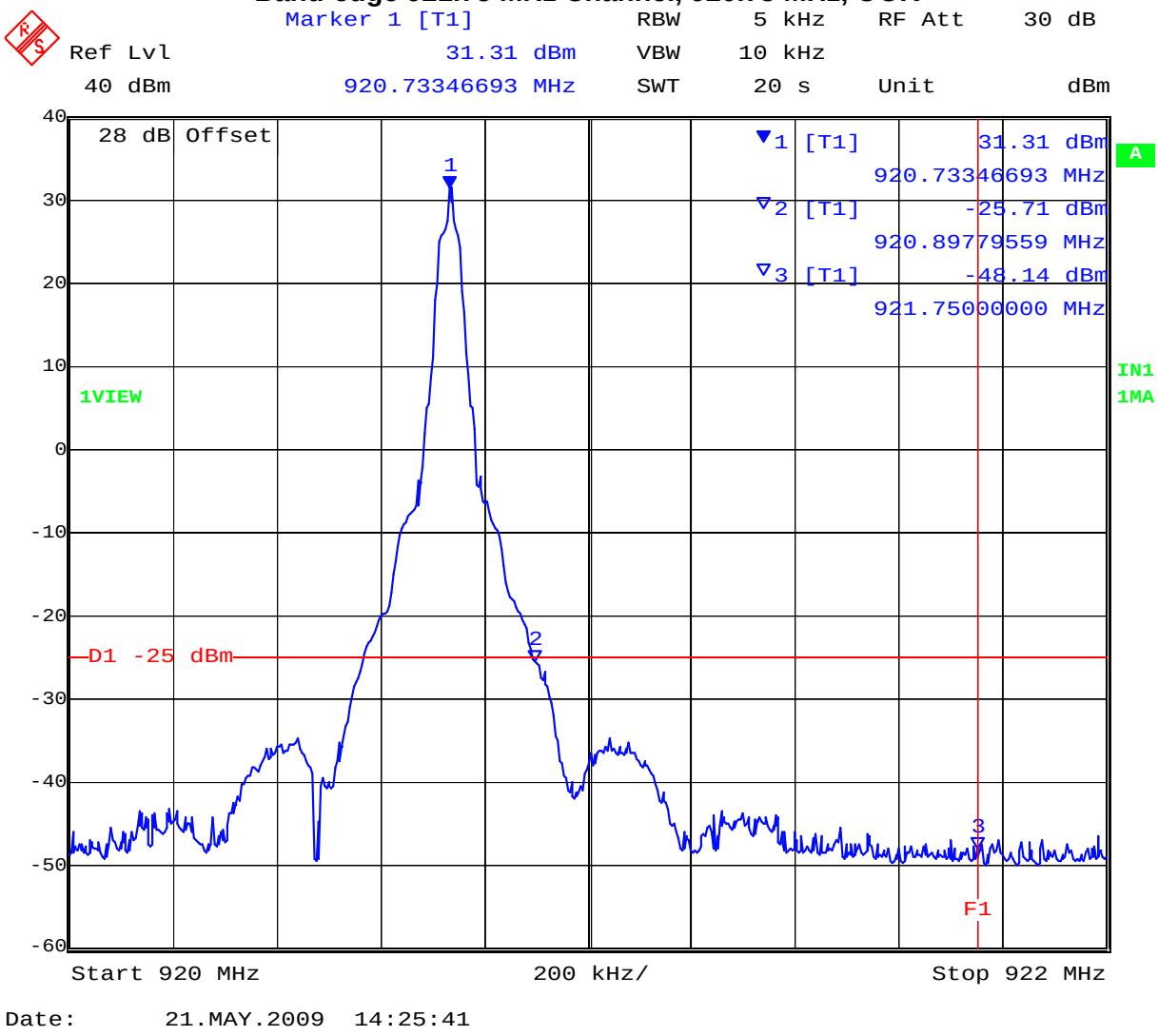
Band-edge 904 MHz Channel, 903.25 MHz, OOK



Band-edge 909.75 MHz, Channel 910.75 MHz, OOK



Band-edge 921.75 MHz Channel, 920.75 MHz, OOK



5.1.5.2. Transmitter Conducted Spurious Emissions (30 M- 10 GHz)

Spurious Emissions at Antenna Terminal

CW Operational Mode used in order to prove compliance

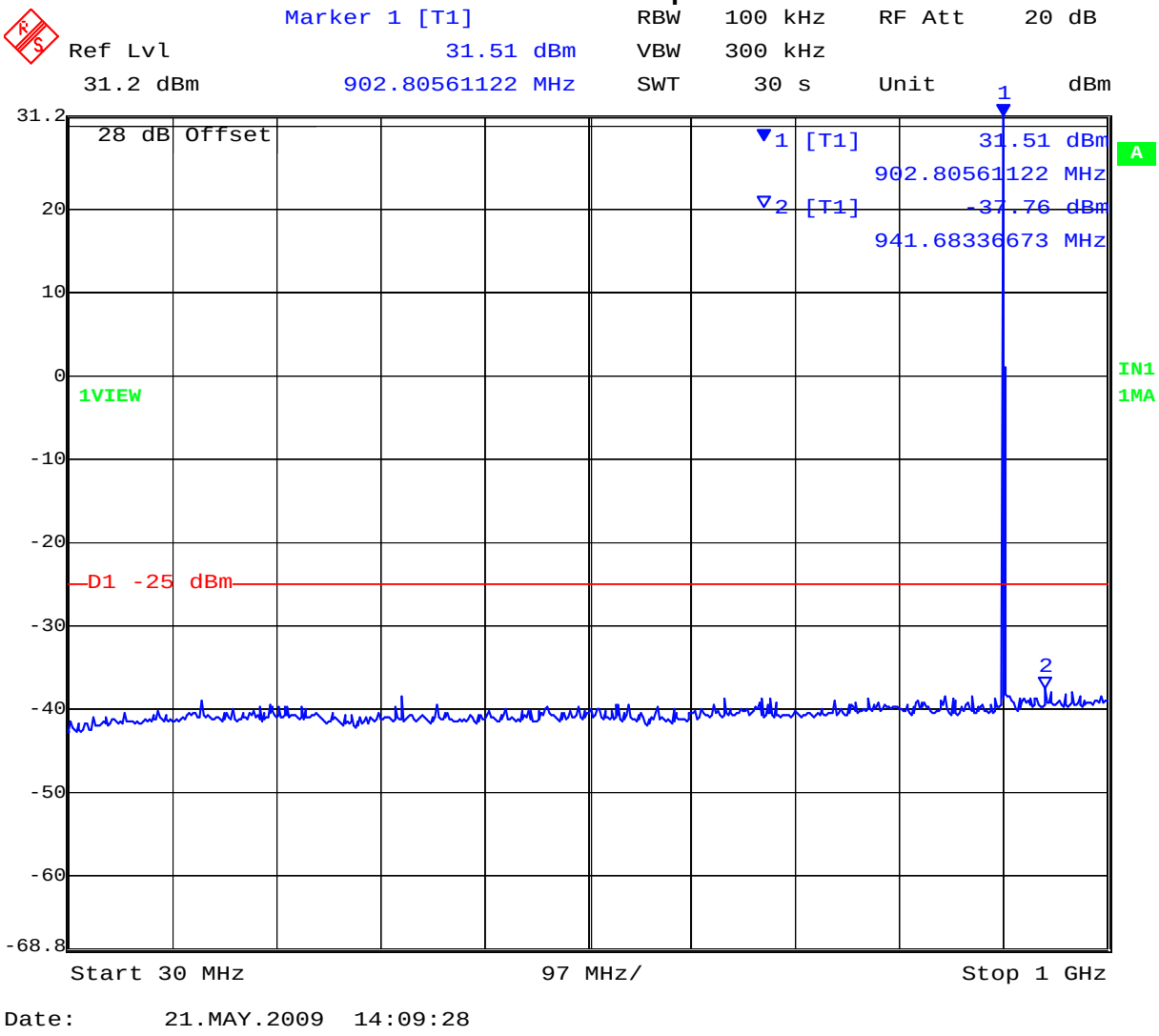
Frequency Band 902 – 904 MHz

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
902.75	30.00	1,000	-37.76	-25	-12.76
	1,000	10,000	-31.36		-6.36
903.00	30.00	1,000	-38.03		-13.03
	1,000	10,000	-31.21		-6.21
903.25	30.00	1,000	-38.18		-13.18
	1,000	10,000	-31.09		-6.09

Frequency Band 909.75 – 921.75 MHz

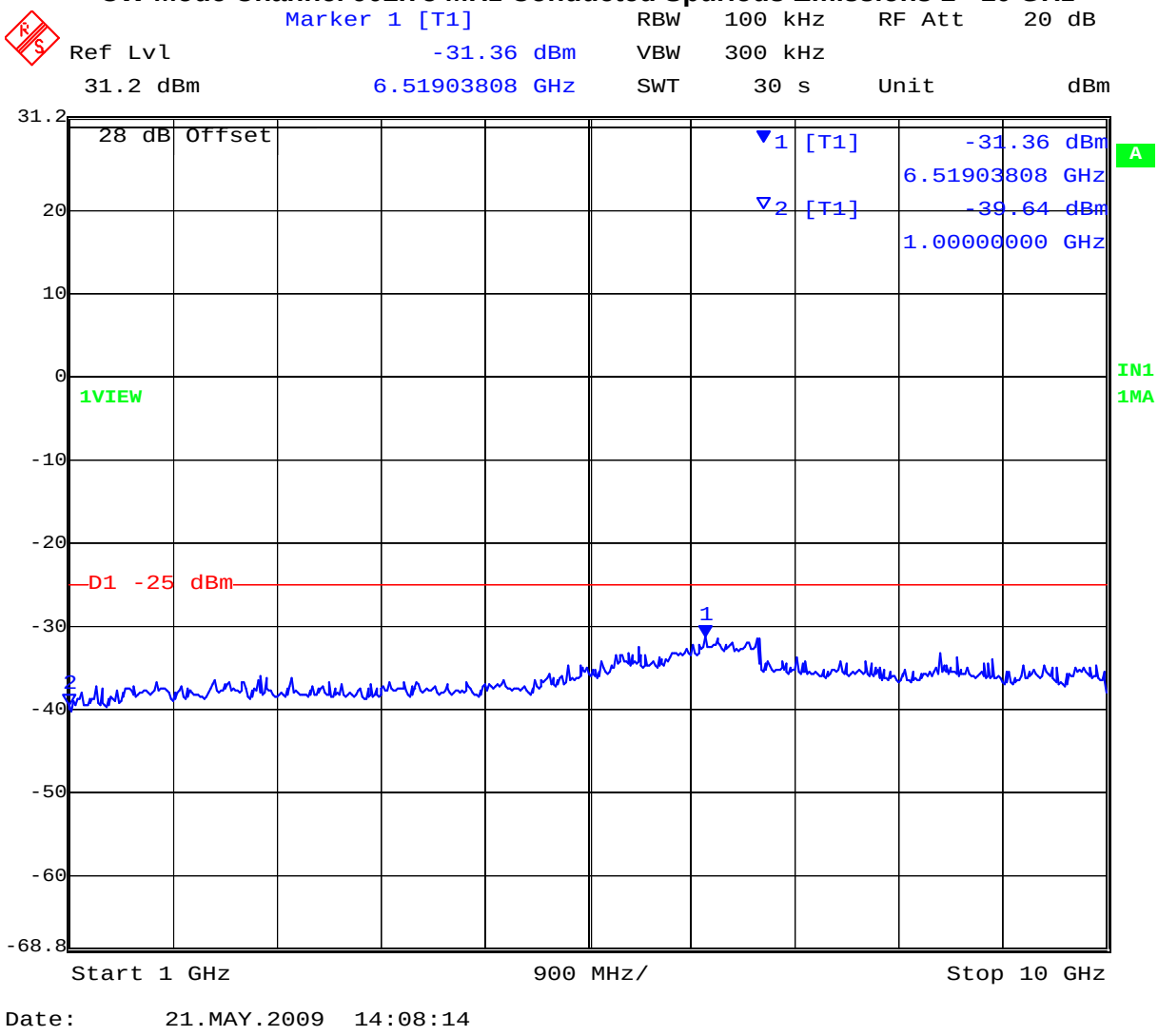
Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
910.75	30.00	1,000	-38.10	-25	-13.10
	1,000	10,000	-31.04		-6.04
915.75	30.00	1,000	-38.44		-13.44
	1,000	10,000	-31.61		-6.61
920.75	30.00	1,000	-37.39		-12.39
	1,000	10,000	-31.57		-6.57

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

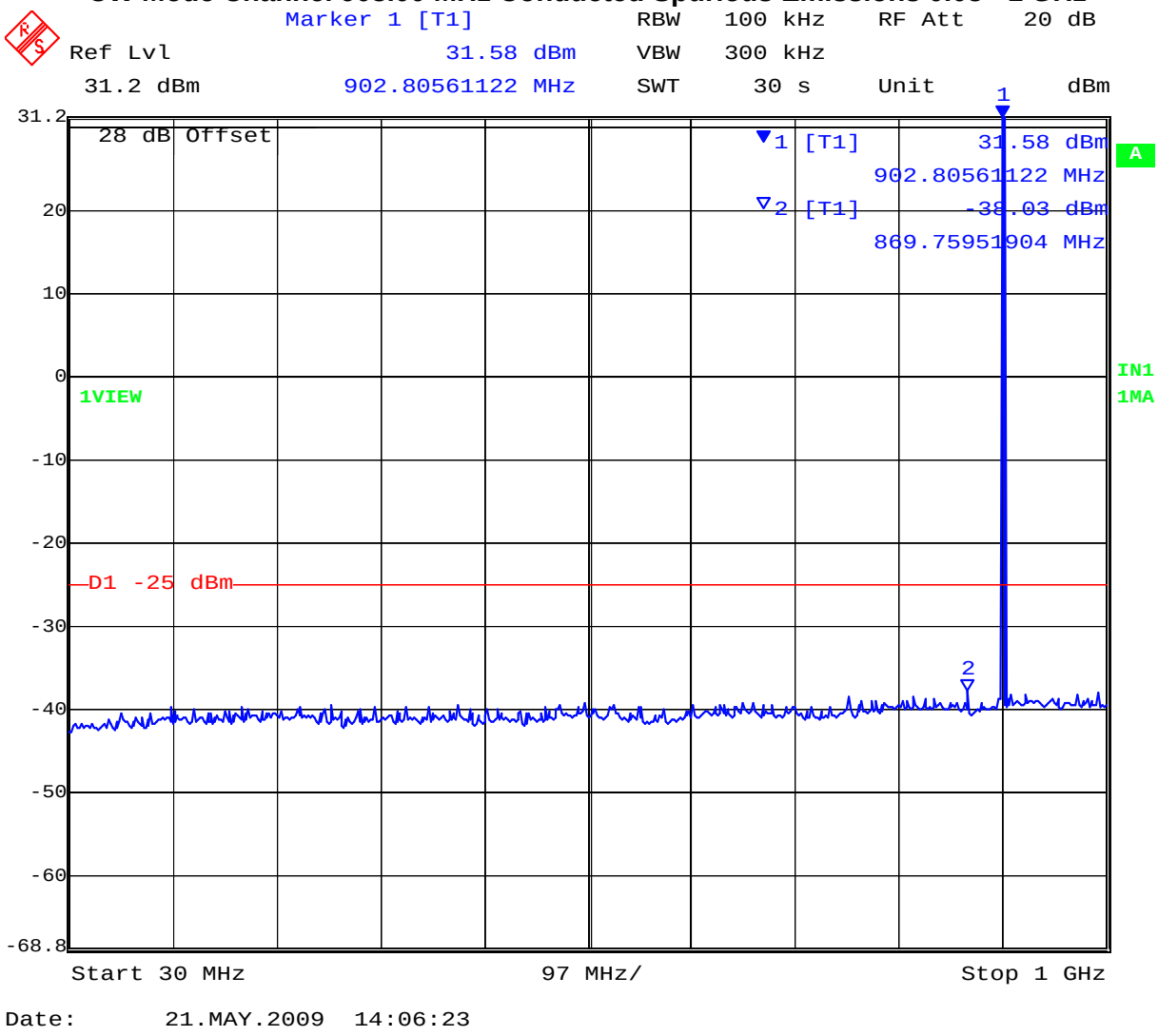


Note: The emission breaking the limit line is the fundamental carrier

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

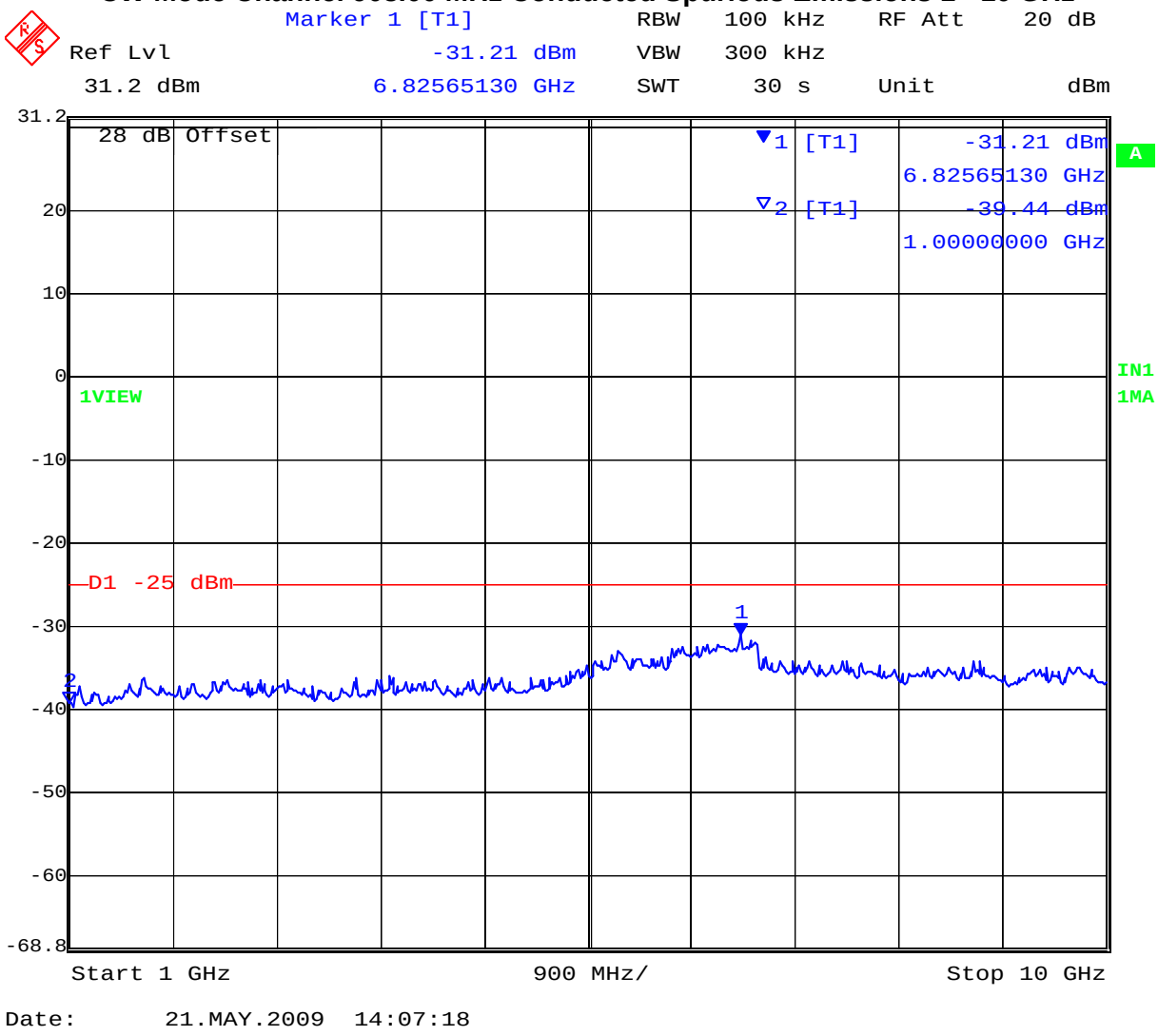


CW Mode Channel 903.00 MHz Conducted Spurious Emissions 0.03 - 1 GHz

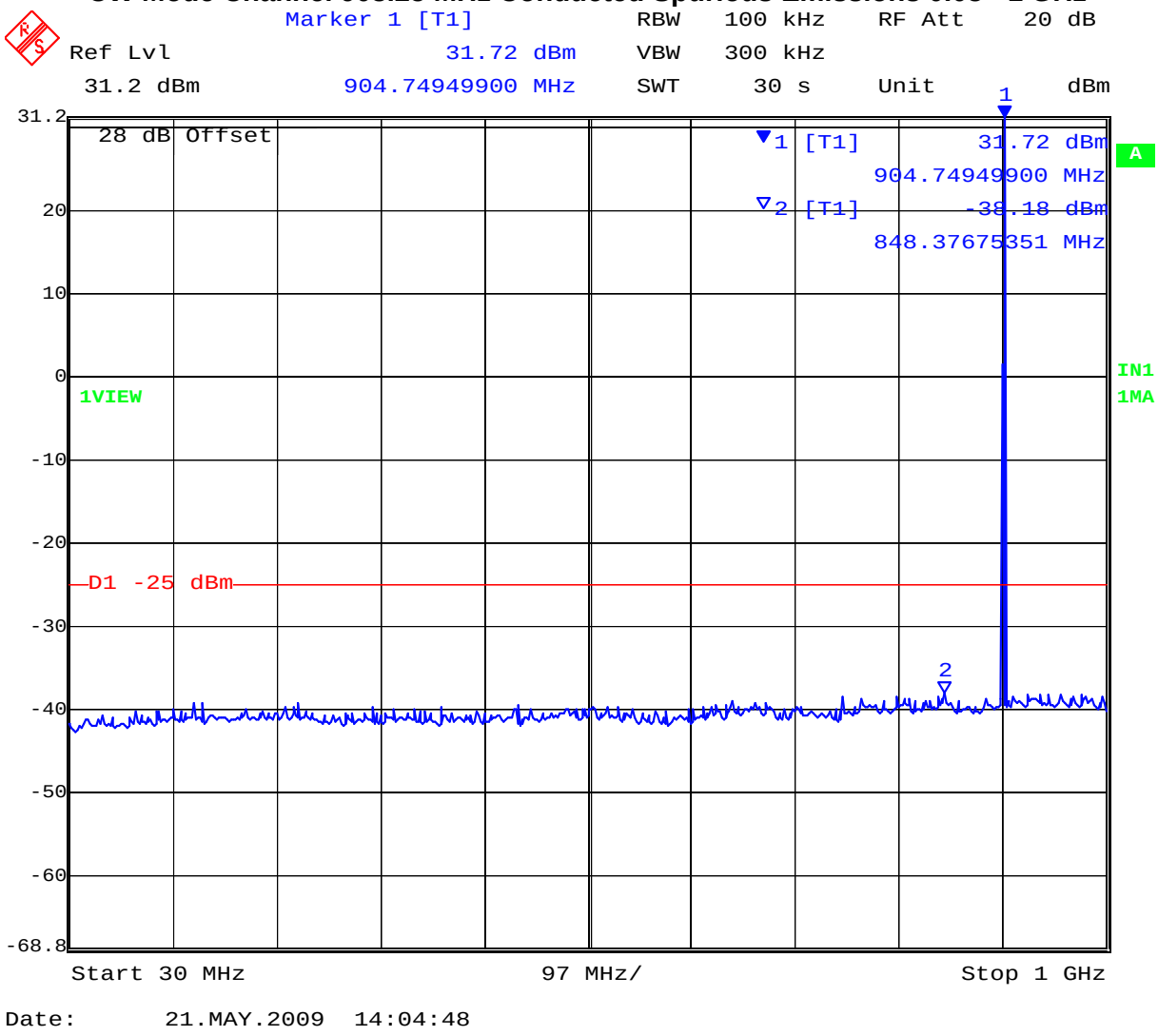


Note: The emission breaking the limit line is the fundamental carrier

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

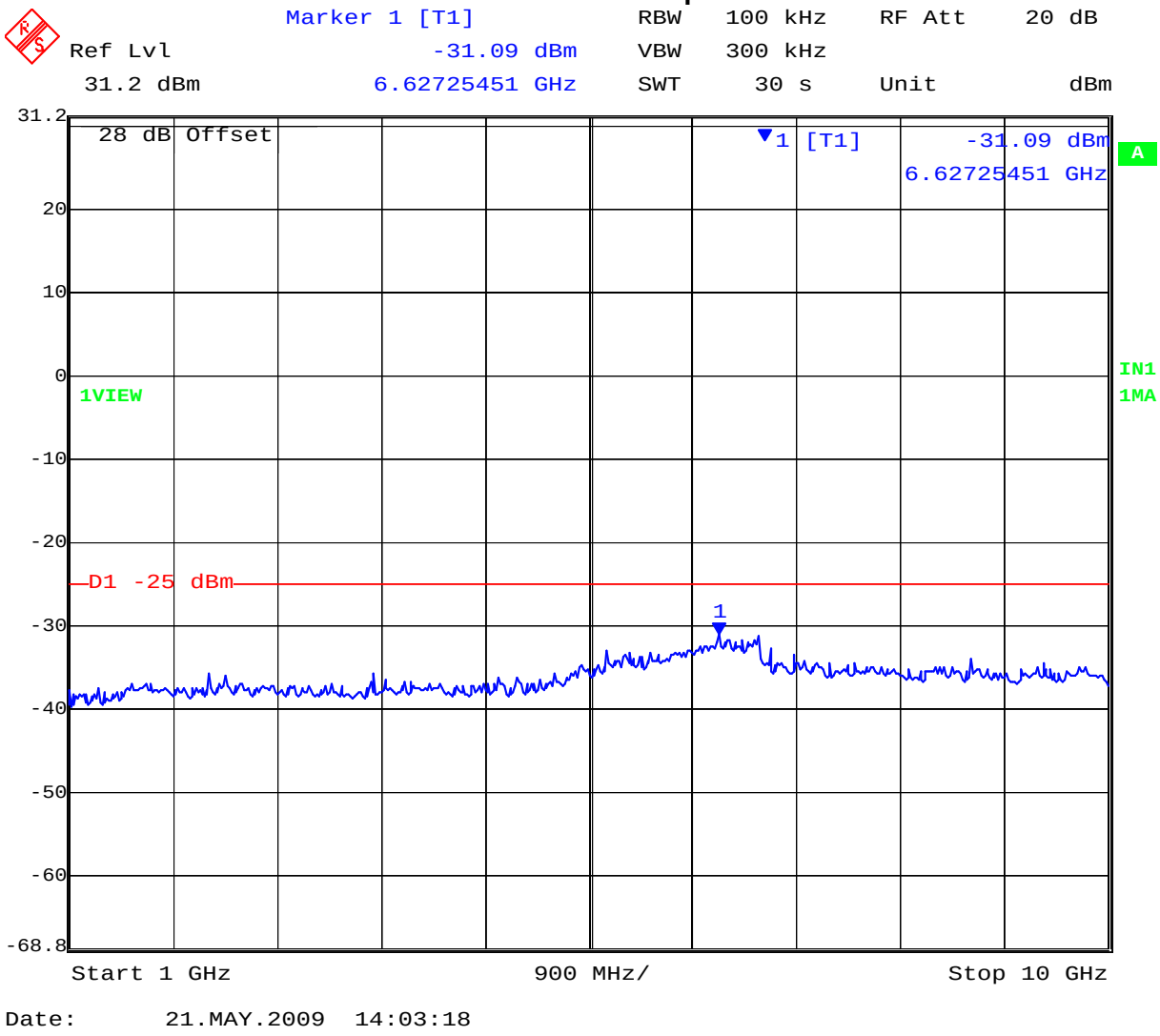


CW Mode Channel 903.25 MHz Conducted Spurious Emissions 0.03 - 1 GHz

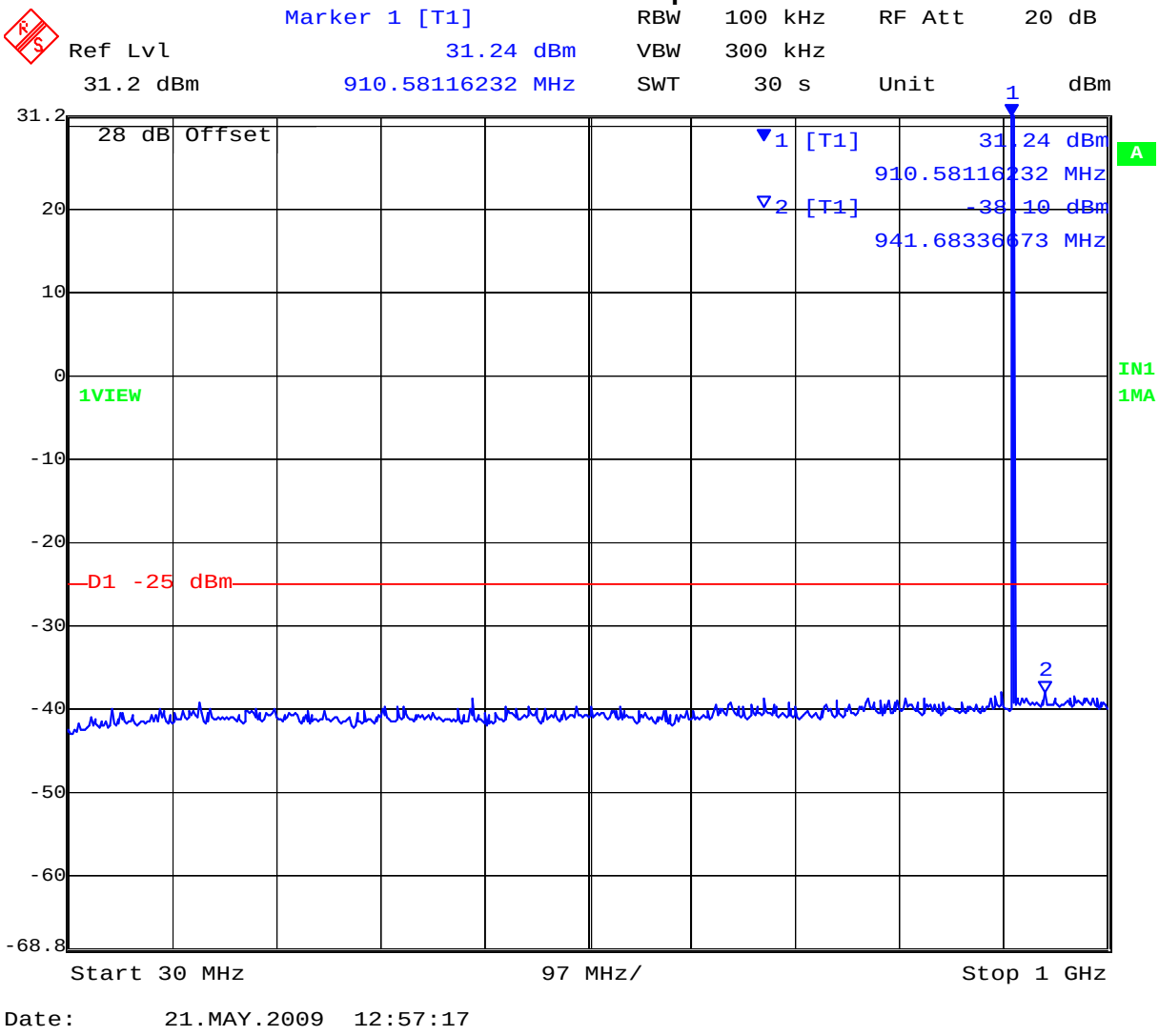


Note: The emission breaking the limit line is the fundamental carrier

CW Mode Channel 903.25 MHz Conducted Spurious Emissions 1 - 10 GHz

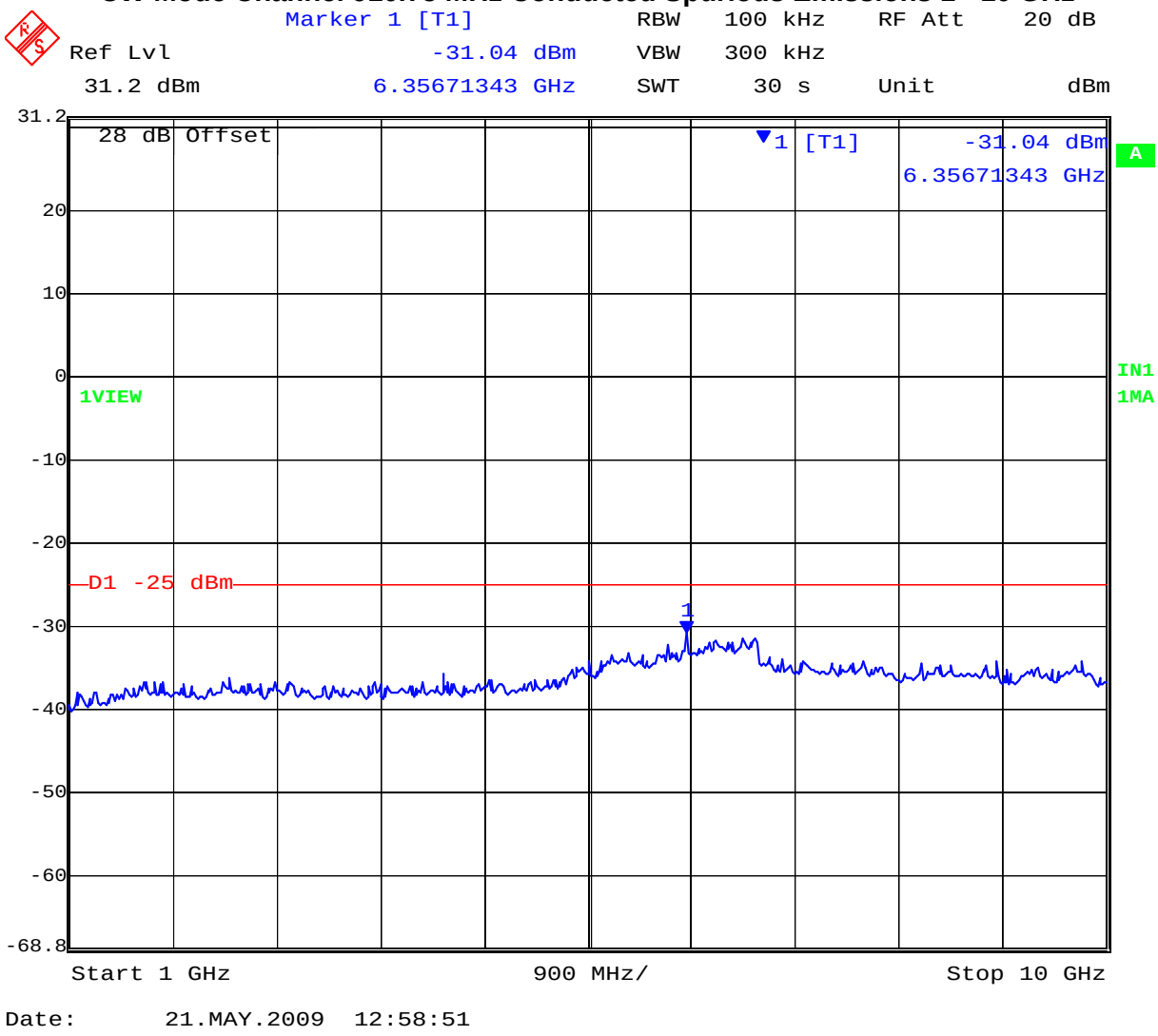


CW Mode Channel 910.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz

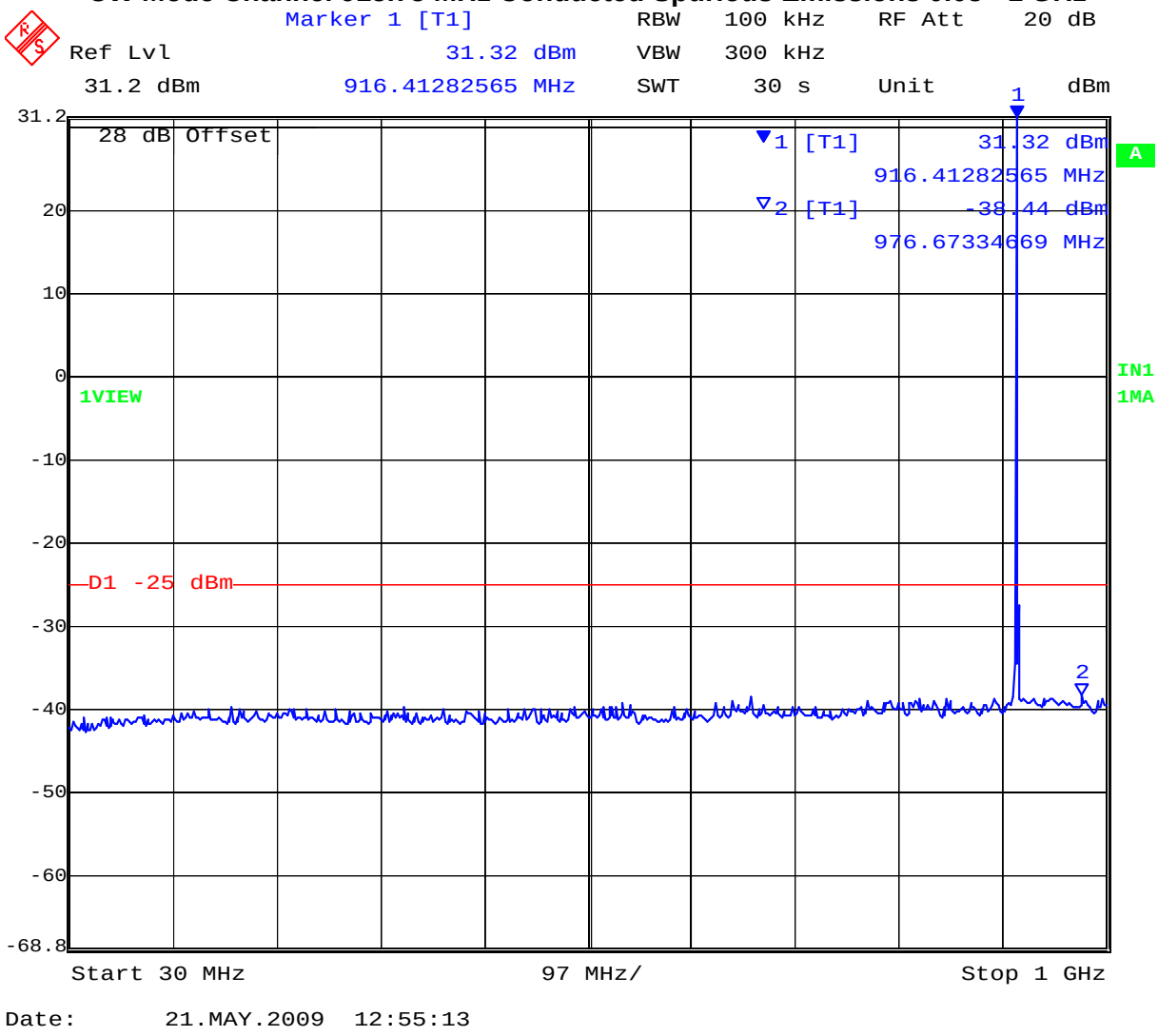


Note: The emission breaking the limit line is the fundamental carrier

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

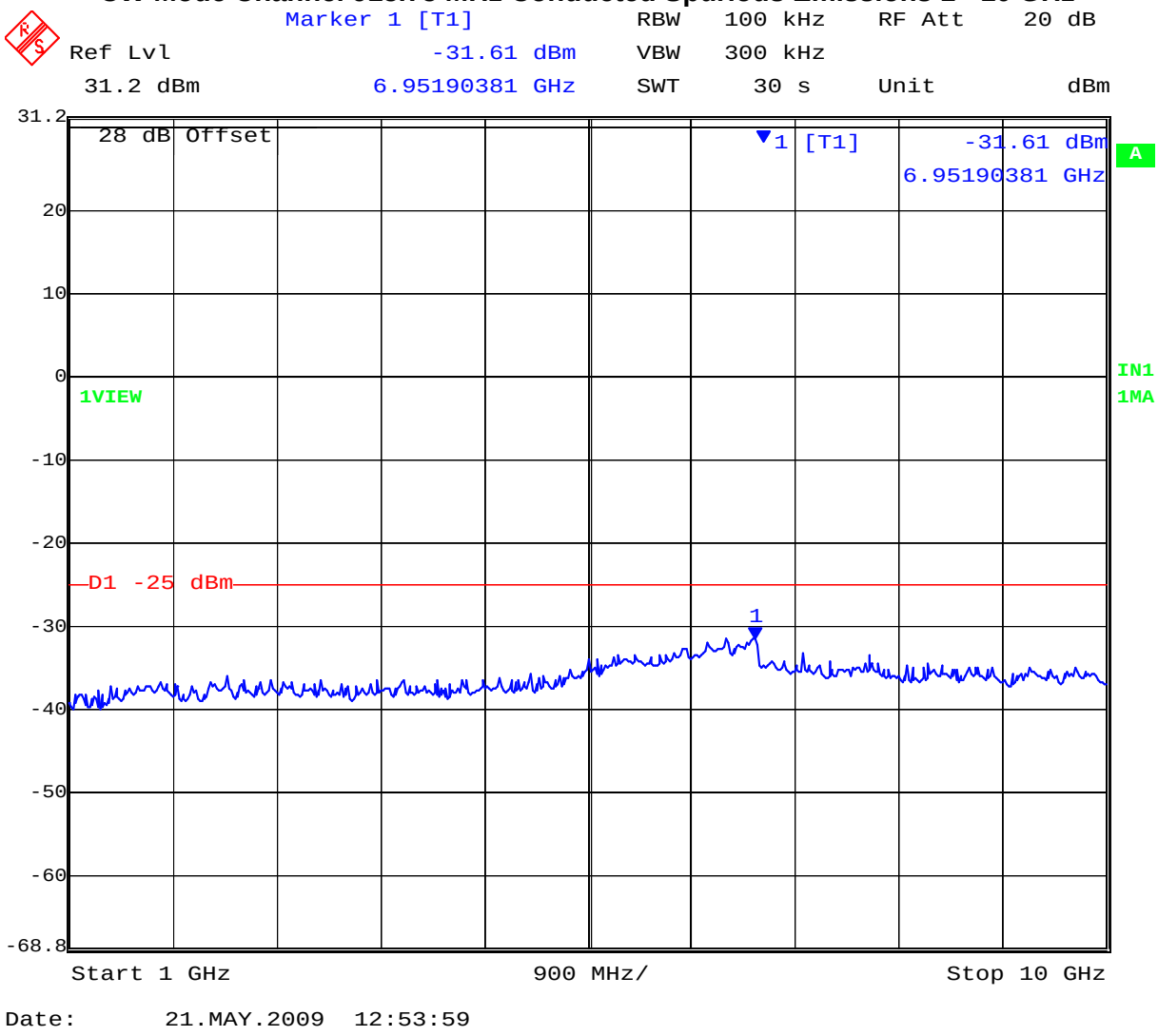


CW Mode Channel 915.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz

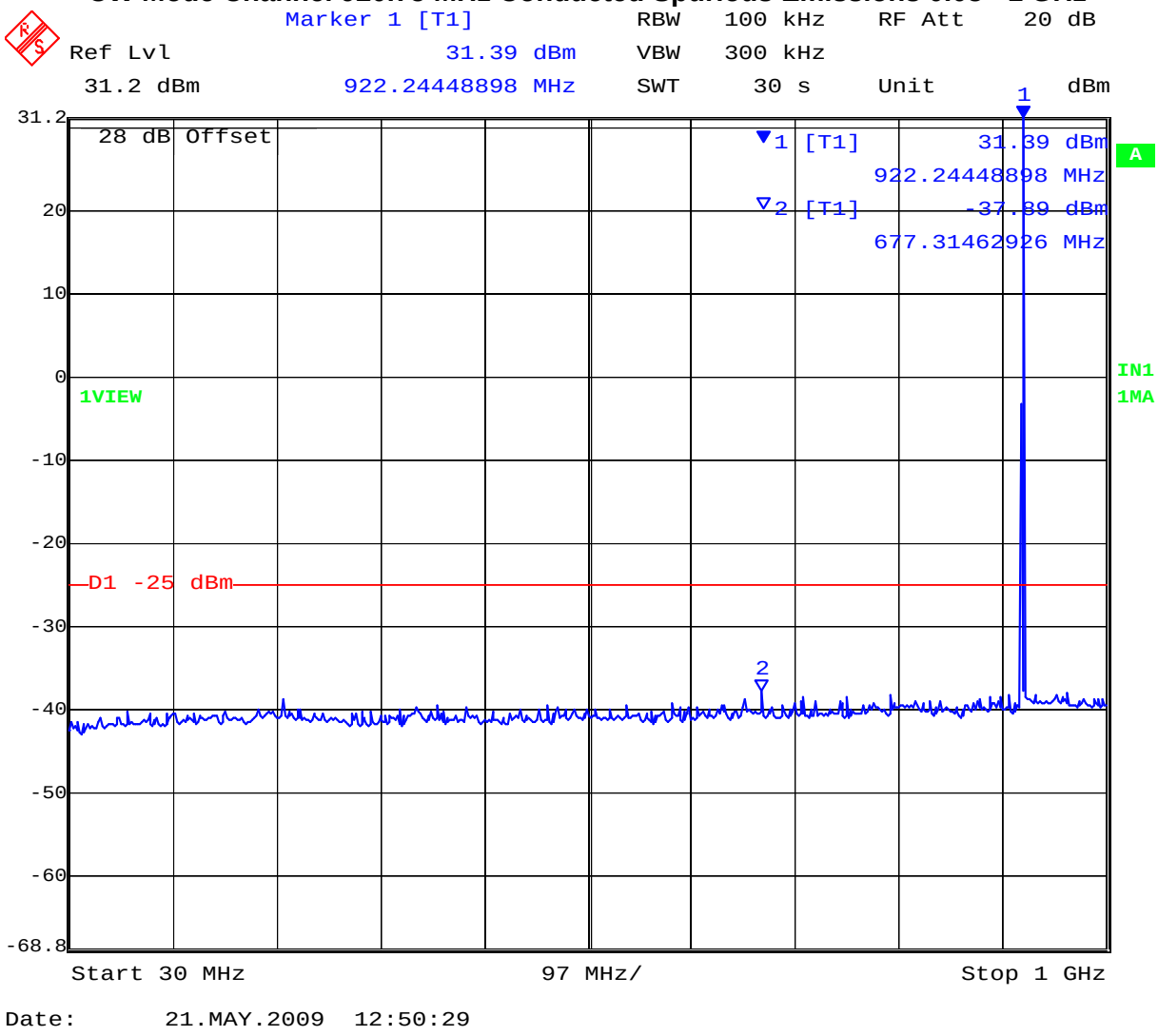


Note: The emission breaking the limit line is the fundamental carrier

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

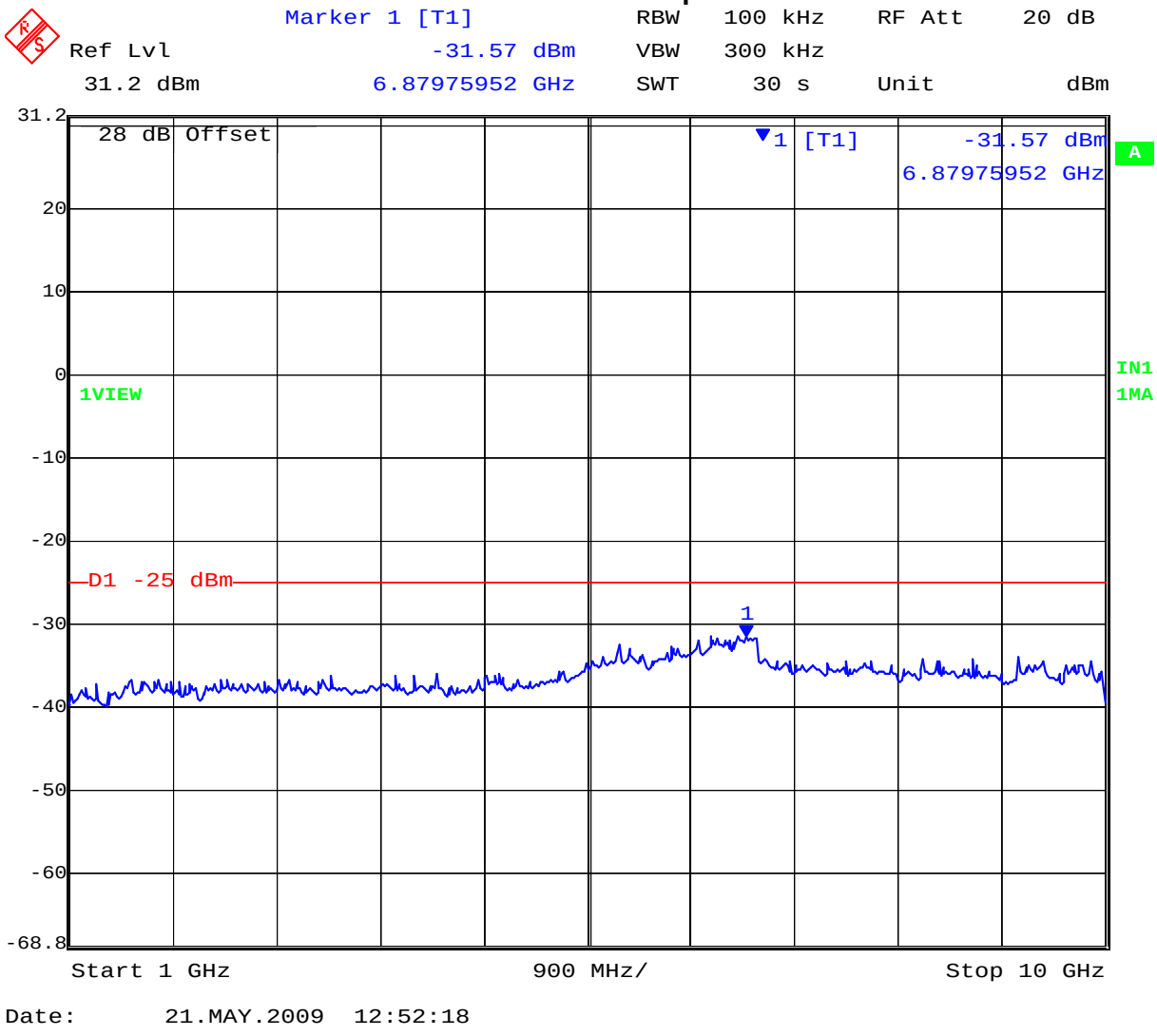


CW Mode Channel 920.75 MHz Conducted Spurious Emissions 0.03 - 1 GHz



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

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



Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

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

5.1.6. Radiated Spurious Emissions

5.1.6.1. Transmitter Radiated Emissions above 1 GHz

FCC 47 CFR Part 90, Subpart Z; §90.1323, 2.1053;
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.

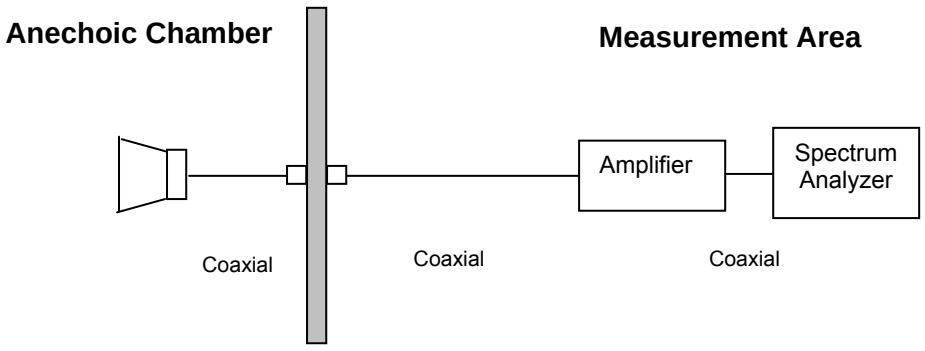
Limits

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 = +31.2 dBm = 1.3183 W
Attenuation = 56.2 dB

Limit = -25 dBm

Test Measurement Set up



Measurement set up for Radiated Emission Test

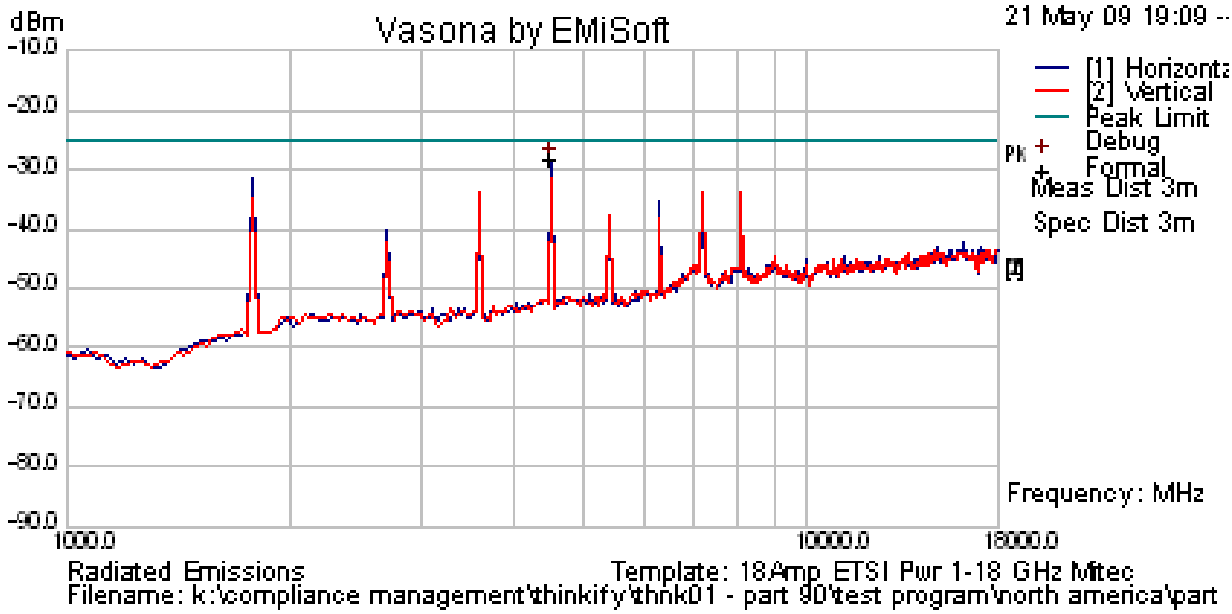
Radio parameters

Antenna port terminated in a 50 ohm load.
Radio transmitter set to maximum power.

Channel 902.75 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS		
Freq. (MHz)	Pol.	Raw (dBm)	Res BW (KHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)
4509.018	V	-29.60	1000	-28.45	-25	-3.45

Channel Frequency 902.75 MHz Results

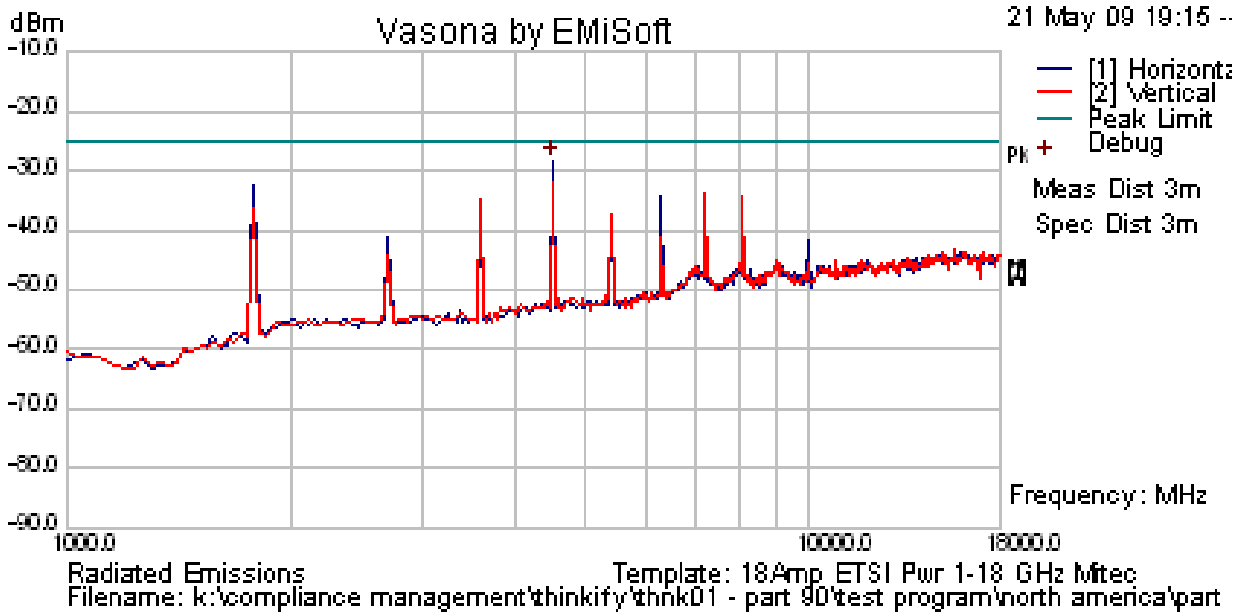


The above emission plot was recorded with the analyzer in peak hold mode

Channel 903.00 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS		
Freq. (MHz)	Pol.	Raw (dBm)	Res BW (KHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)
4509.018	V	-29.43	1000	-28.33	-25	-3.33

Channel Frequency 903.00 MHz Results

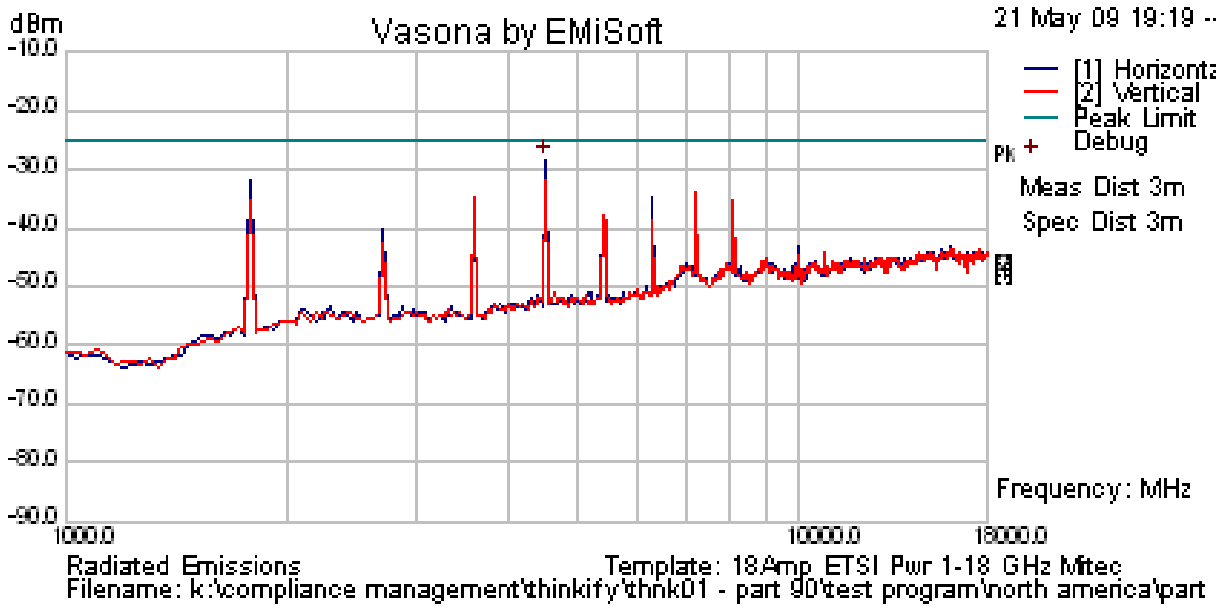


The above emission plot was recorded with the analyzer in peak hold mode

Channel 903.25 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS		
Freq. (MHz)	Pol.	Raw (dBm)	Res BW (KHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)
4509.018	H	-28.01	1000	-27.97	-25	-3.27

Channel Frequency 903.25 MHz Results



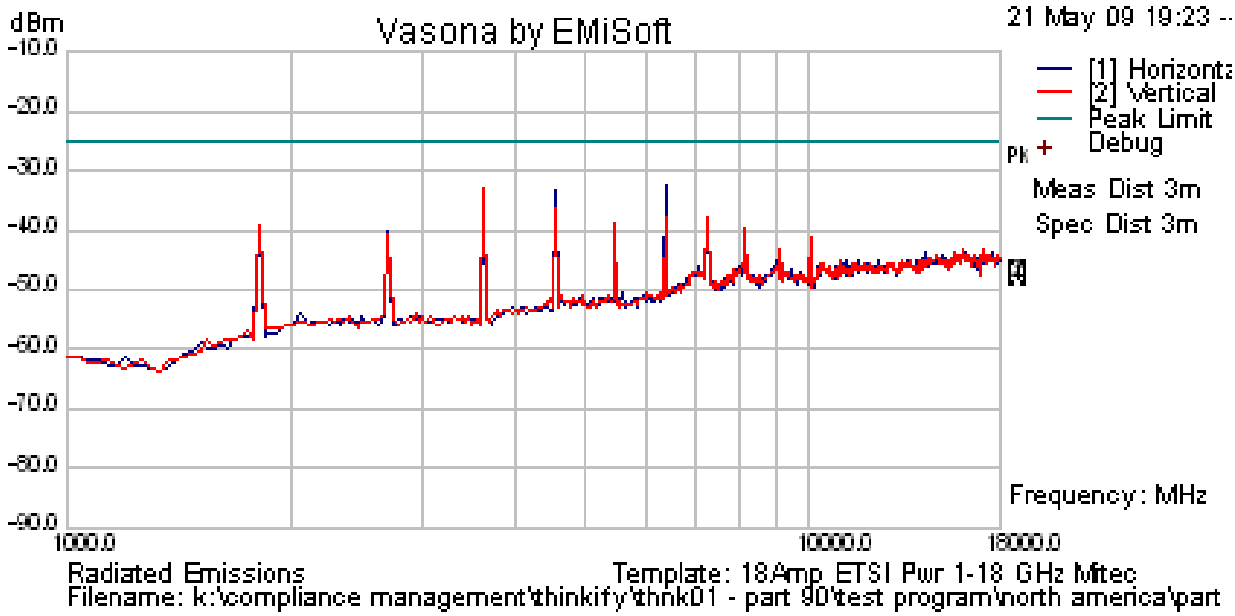
The above emission plot was recorded with the analyzer in peak hold mode

Channel 910.75 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS		
Freq. (MHz)	Pol.	Raw (dBm)	Res BW (KHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)

No emissions observed within 6 dB of the limit line

Channel Frequency 910.75 MHz Results



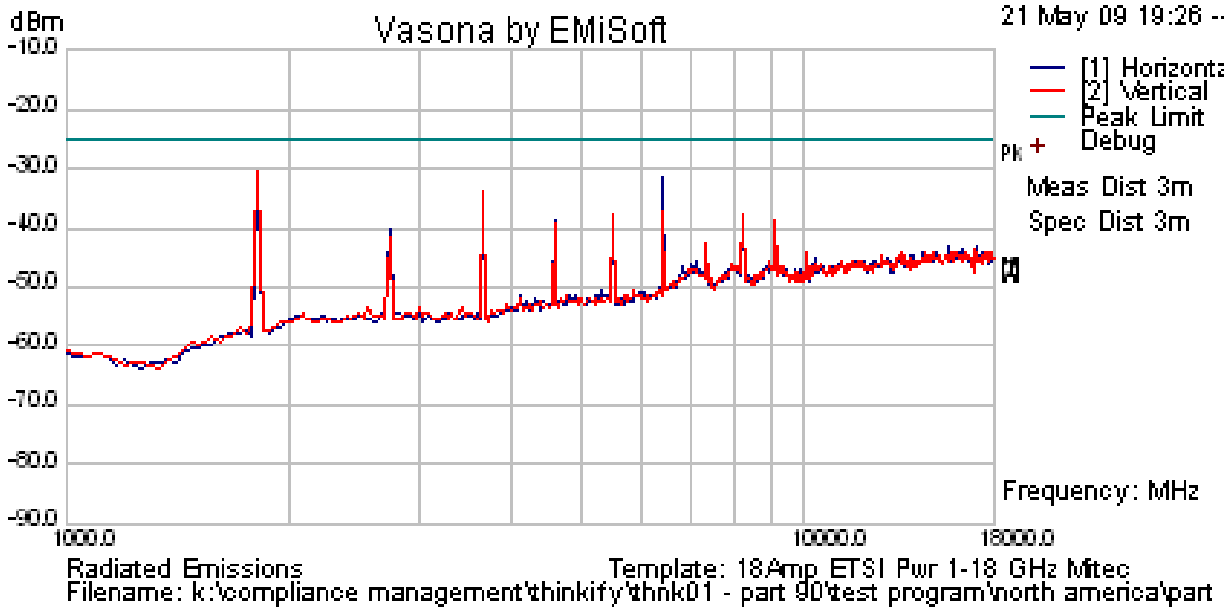
The above emission plot was recorded with the analyzer in peak hold mode

Channel 915.75 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS		
Freq. (MHz)	Pol.	Raw (dBm)	Res BW (KHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)

No emissions observed within 6 dB of the limit line

Channel Frequency 915.75 MHz Results

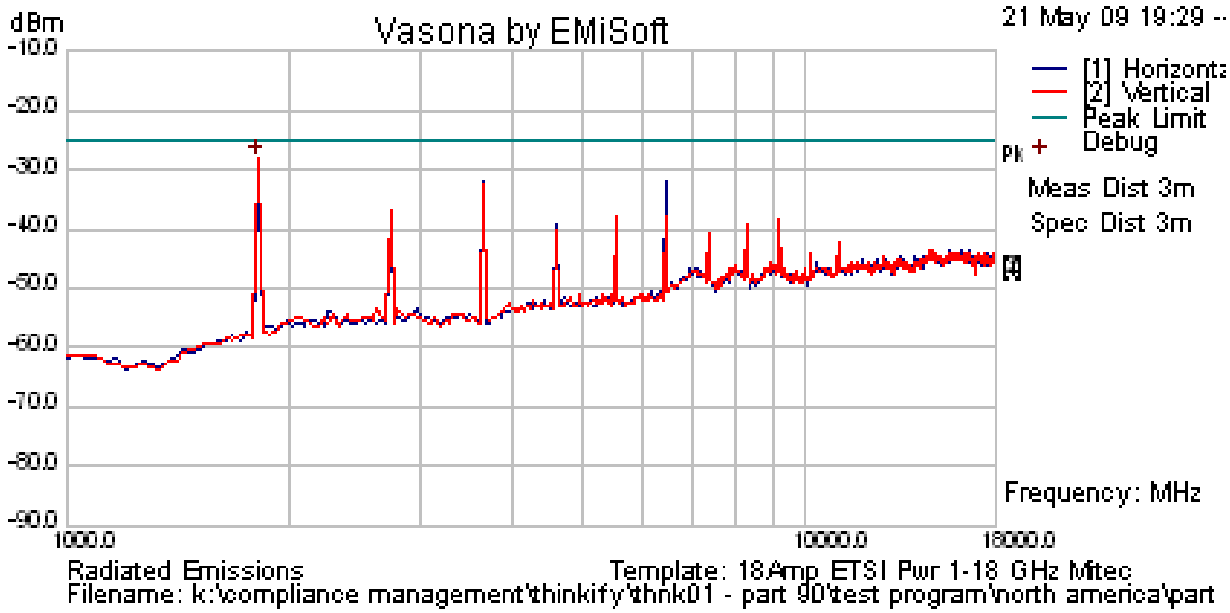


The above emission plot was recorded with the analyzer in peak hold mode

Channel 920.75 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS		
Freq. (MHz)	Pol.	Raw (dBm)	Res BW (KHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1817.635	V	-28.55	1000	-27.97	-25	-2.97

Channel Frequency 920.75 MHz Results



The above emission plot was recorded with the analyzer in peak hold mode

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

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

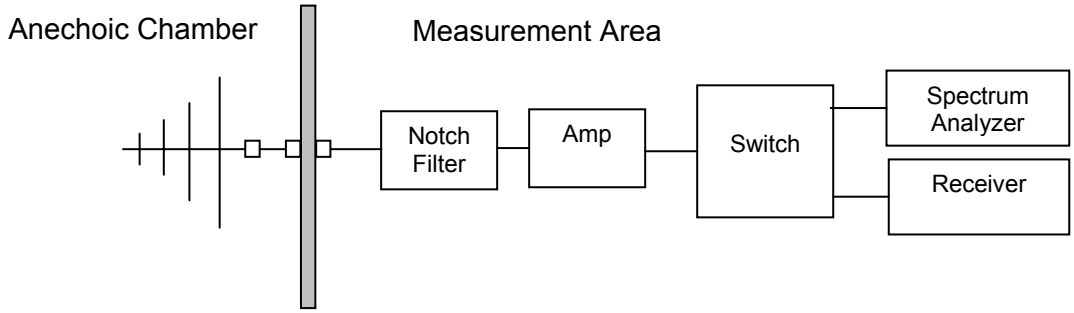
5.1.6.2. Transmitter Radiated Spurious Emissions (30M-1 GHz)

FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-111 §4.4

Test Procedure

Preliminary radiated emissions were measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarity. The emissions were recorded with a spectrum analyzer in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

System operation was completed with the antenna operating at center frequency. Antenna gain was 11.5 dBi. A notch filter was used to remove the fundamental frequency.



Test Measurement Set up

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain

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

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3dBμV/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 = 100μV/m
48 dBμV/m = 250μV/m

Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

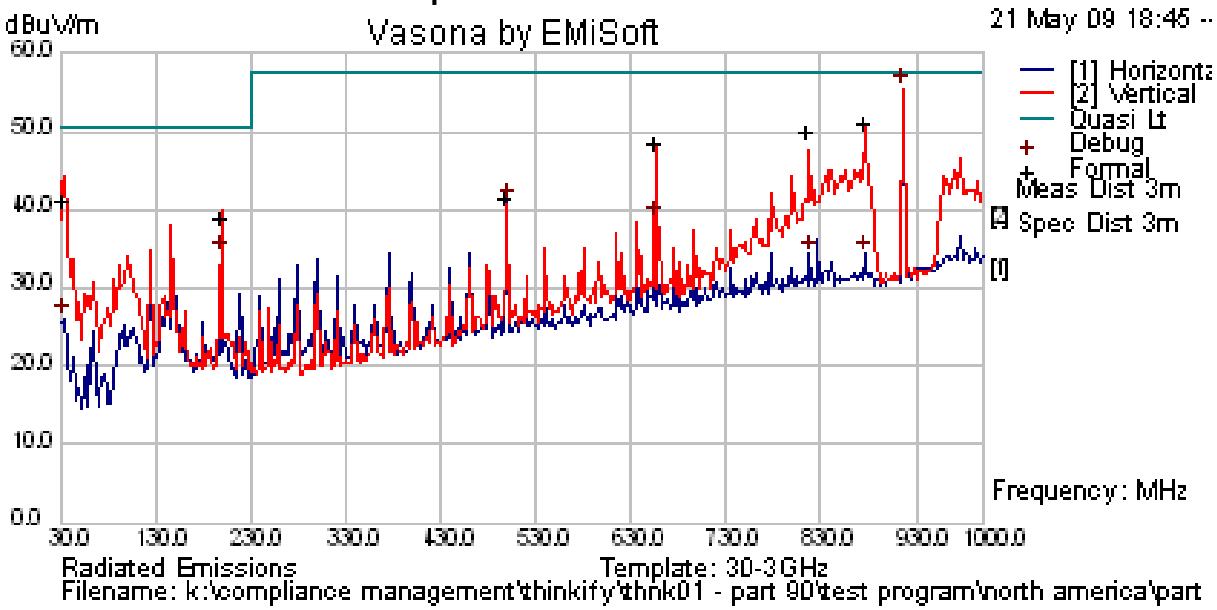
Radio parameters.

Modulation: CW
Full Power: +31.2dBm

TABLE OF RESULTS

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB
199.06	51.79	4.75	-17.68	38.85	Quasi Max	V	100	201	50.5	-11.65
499.971	47.99	6	-12.62	41.37	Quasi Max	H	199	359	57.5	-16.13
655.744	52.17	6.55	-10.19	48.54	Quasi Max	V	150	11	57.5	-8.96
875.741	51.75	7.24	-7.71	51.28	Quasi Max	V	106	335	57.5	-6.22
815.724	50.95	7.18	-8.13	49.99	Quasi Max	V	114	0	57.5	-7.51
34.658	50.89	3.47	-13.32	41.04	Quasi Max	V	110	1	50.5	-9.46

Radiated Spurious Emissions 30 MHz to 1 GHz



The RFID Reader is a Class A device

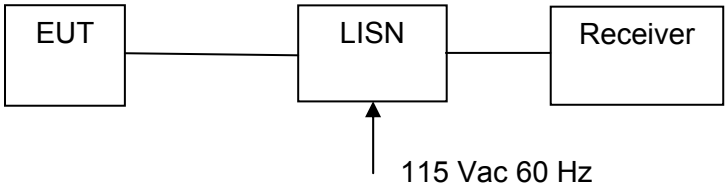
5.1.7. AC Wireline Conducted Emissions (0.15 – 30 MHz)

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

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.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio parameters.

Power: Full power +31.2 dBm
Transmitter Port: Terminated in 50 Ohm load

Two ac adapters were exercised (XP and Rong Horng) as part of the compliance program.

TABLE OF RESULTS – Rong Horng PSU

115 Vac 60 Hz

Freq (MHz)	Line	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)
1.986	Live	43.35	41.82	56	-14.18	43.45	46	-8.66
1.800	Live	43.32	42.29	56	-13.71	36.89	46	-9.11
2.175	Live	43.48	40.99	56	-13.47	34.88	46	-11.12
5.715	Live	49.31	43.83	60	-16.17	38.05	50	-11.95
4.657	Live	45.37	40.30	56	-15.70	33.64	46	-12.36
4.968	Live	46.50	40.10	56	-15.90	32.97	46	-13.03

AC Wireline - Conducted Emissions (150 kHz – 30 MHz)
Cable Connections PSU

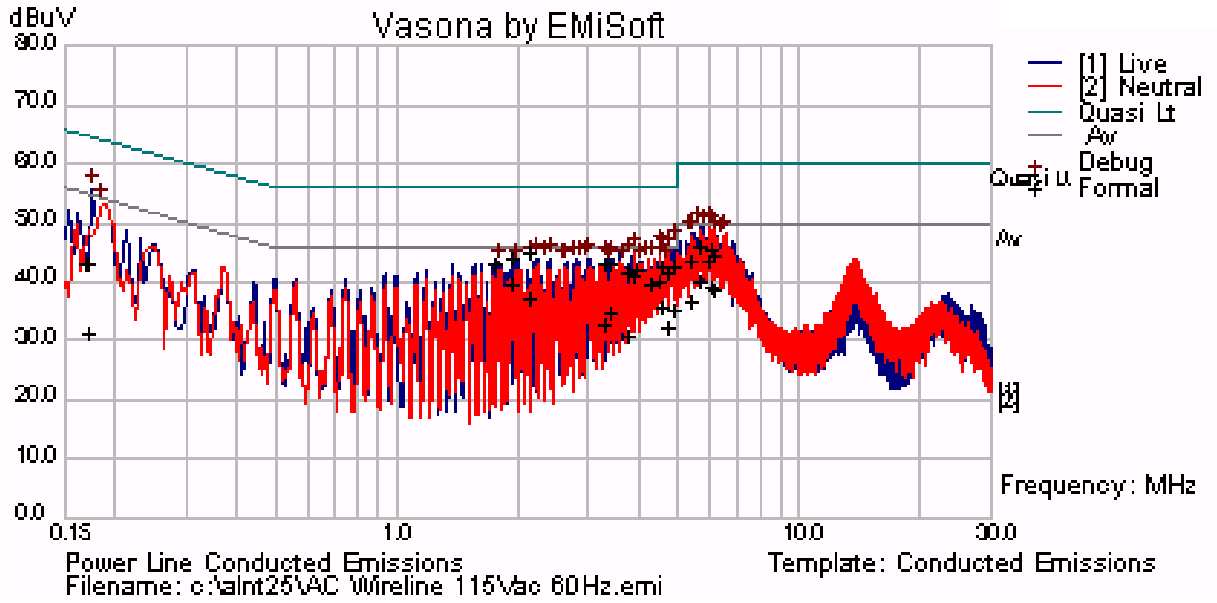
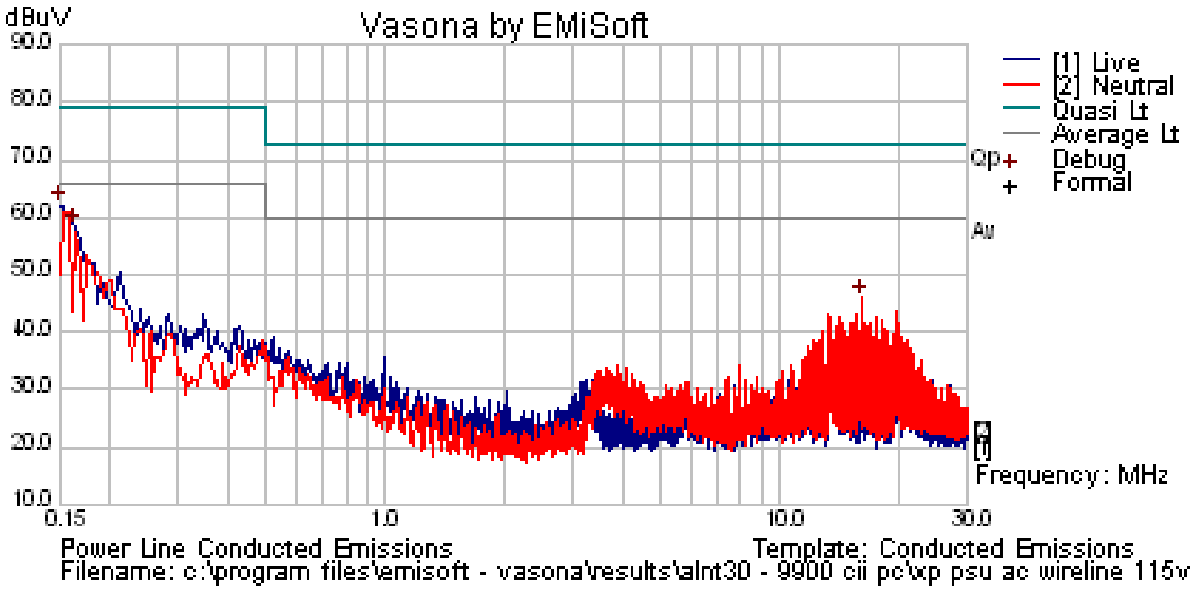


TABLE OF RESULTS – XP Power PSU

115 Vac 60 Hz

Freq (MHz)	Line	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)
0.15	Neut.	62.04	50.59	79	-28.41	37.59	66	-28.41
0.163	Neut.	58.50	45.98	79	-33.02	19.85	66	-46.15
16.229	Neut.	45.93	45.94	73	-27.06	44.39	60	-15.61

AC Wireline - Conducted Emissions (150 kHz – 30 MHz)
XP Power PSU



Specification

Limit

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator 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 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. 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.

§15.207 (a) Limit Matrix

The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

Laboratory Measurement Uncertainty for Conducted Emissions

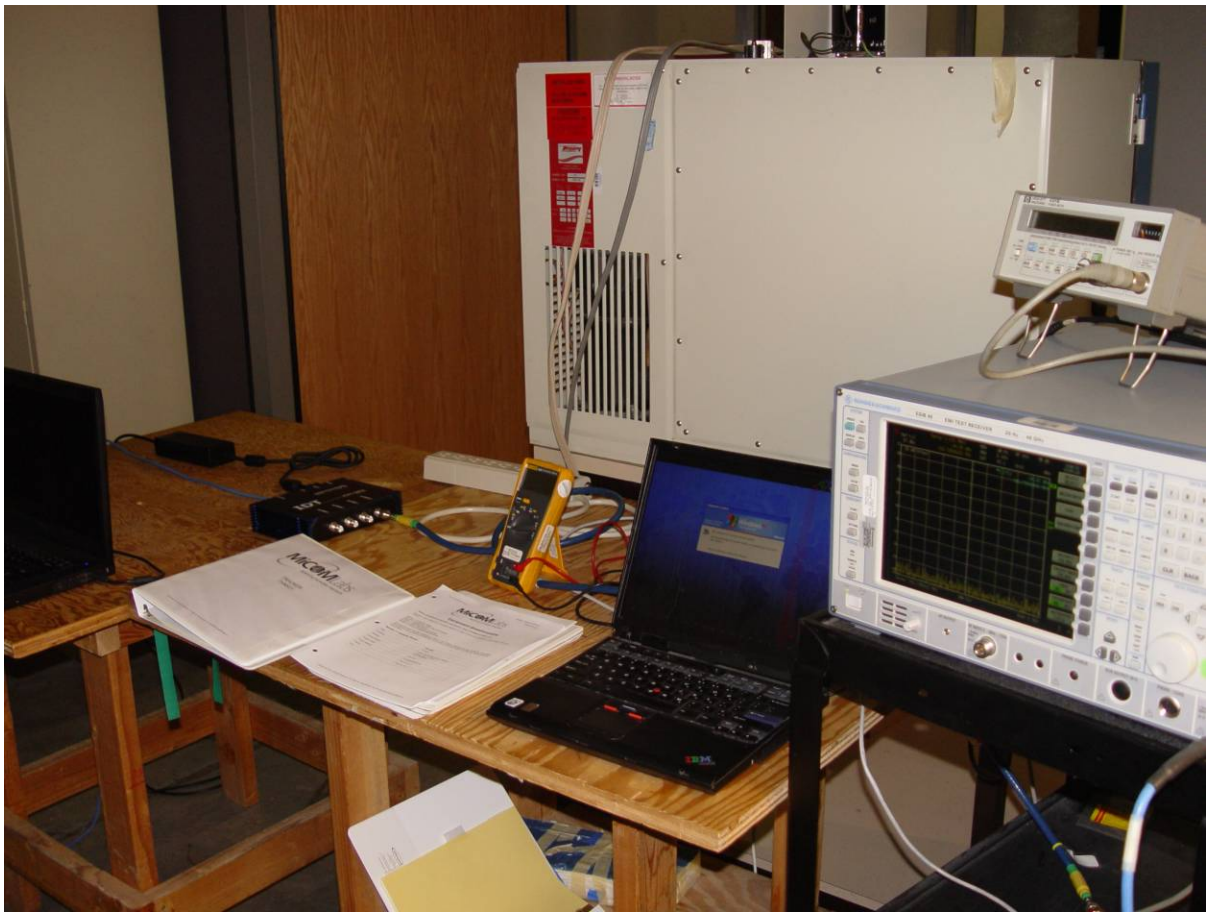
Measurement uncertainty	±2.64 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

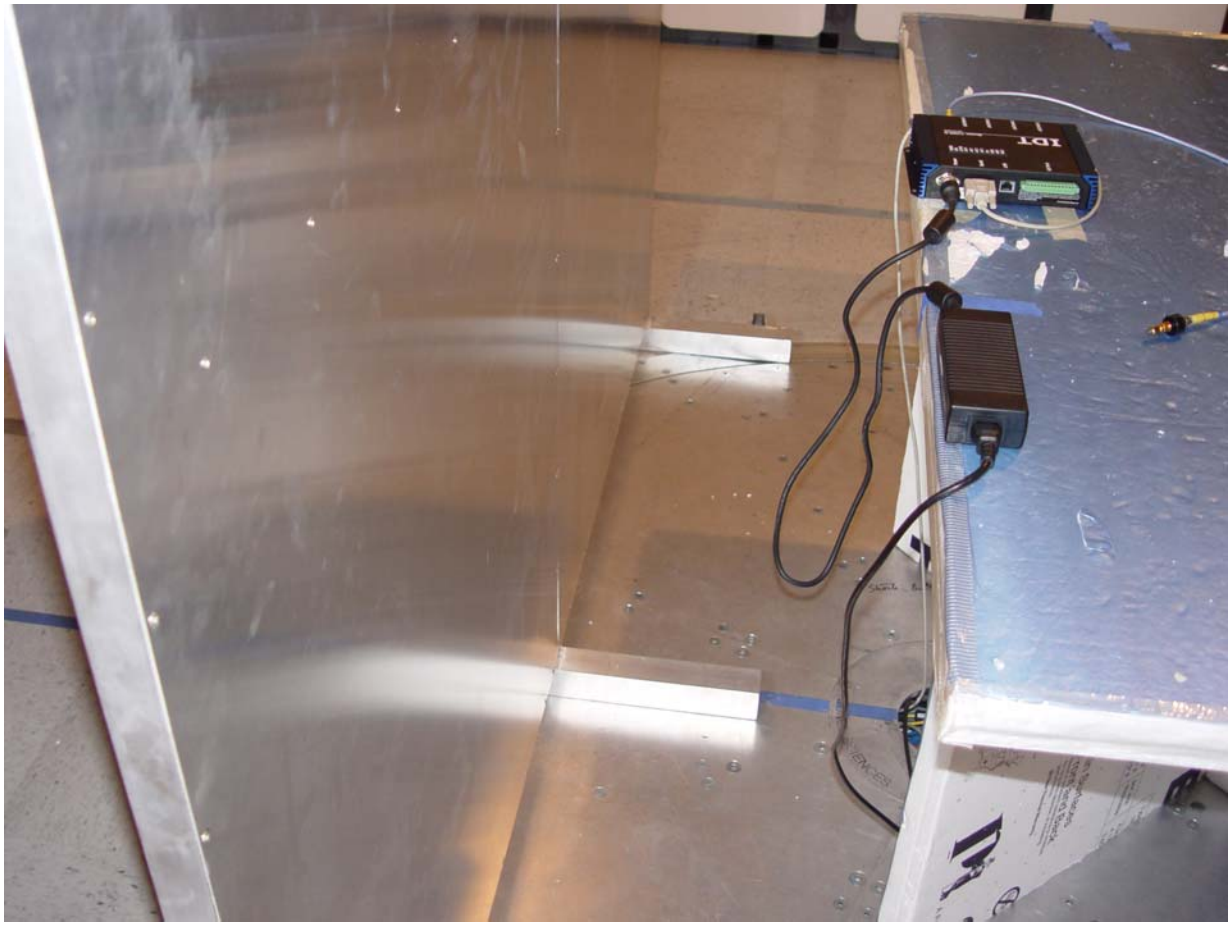
6. TEST SET-UP PHOTOGRAPHS

6.1. General Measurement Test Set-Up



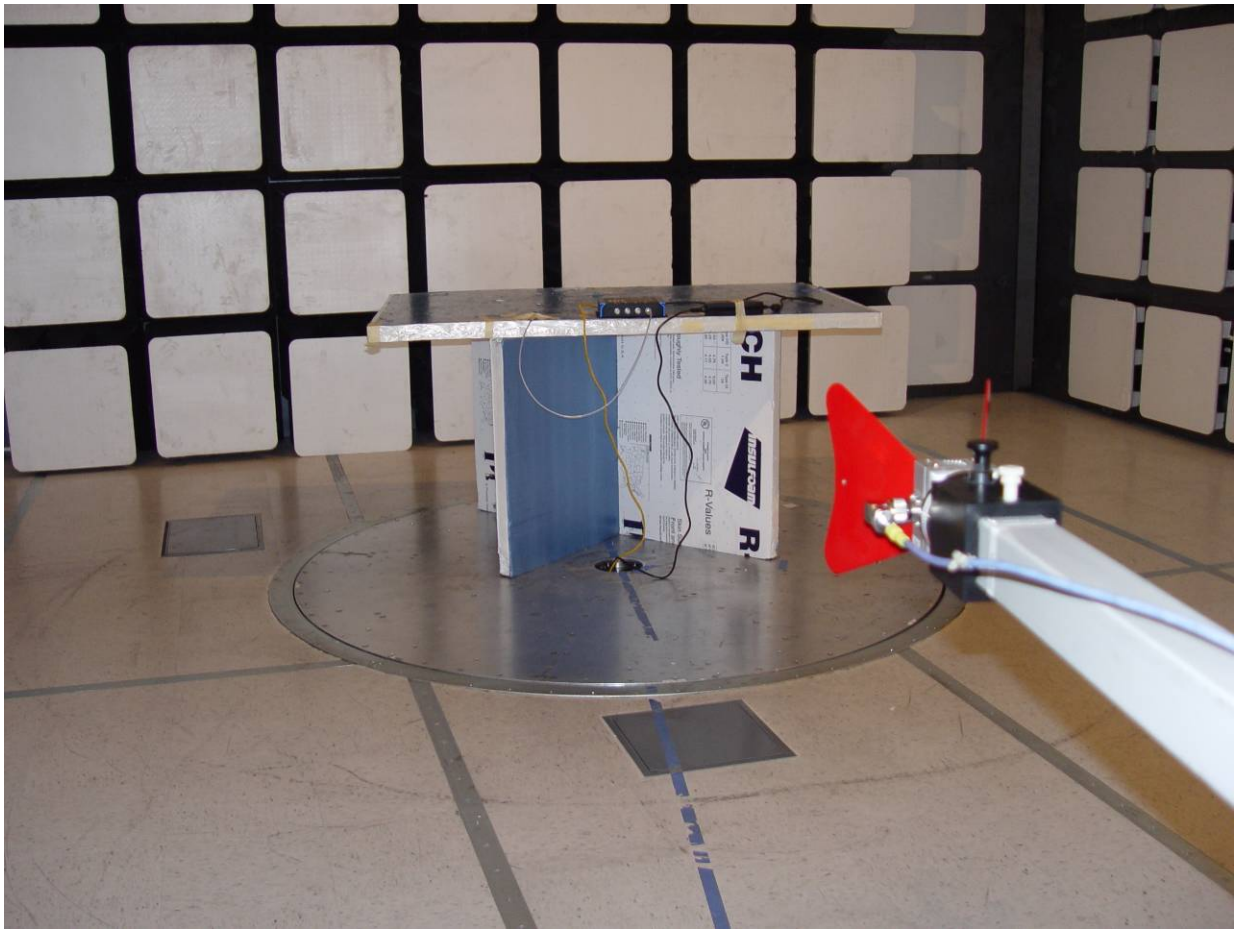
6.2. Frequency Error Test Set-Up – Environmental Chamber

6.3. AC Wireline Emissions



6.4. Radiated Emissions < 1GHz

6.5. Spurious Emissions > 1GHz



7. 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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