Test of Proxim Wireless Corp. Tsunami MP.16 3650

To: FCC Part 90 Subpart Z

Test Report Serial No.: PROX16-A2 Rev A

TEST REPORT

FROM

MiCOM Labs

Test of Proxim Wireless Corp. Tsunami MP.16 3650

To FCC Part 90 Subpart Z

Test Report Serial No.: PROX16-A2 Rev A

This report supersedes NONE

Manufacturer: Proxim Wireless Corporation
1561 Buckeye Drive
Milpitas, California 94035
USA

Product Function: Wireless Voice and Data Communication

Copy No: pdf **Issue Date:** 18th March 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

A2LA 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	Directorate General of Telecommunications (DGT) Bureau of Standards, Metrology and Inspection (BSMI)	I I	

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	18th February 2009	Initial Release

1. TEST RESULT CERTIFICATE

Manufacturer:	Proxim Wireless Corporation 1561 Buckeye Drive Milpitas, California 94035 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Wireless Voice and Data Communication	Telephone:	+1 925 462 0304
Model:	Tsunami MP.16 3650 3650-B00-AM0 (Base Station) 3650-S00-AM0 (Subscriber) 3650-S00-AM1 (Subscriber)	Fax:	+1 925 462 0306
S/N:	08UT18760058		
Test Date(s):	18th Dec '08 - 3rd Feb '09	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC Part 90 Subpart Z	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 Proxim Wireless Corp. Tsunami MP.16 3650 to FCC Part 90 Subpart Z regulations.		
Applicant:	Proxim Wireless Corporation 1561 Buckeye Drive Milpitas, California 94035 USA		
Manufacturer:	As Applicant		
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA		
Test report reference number:	PROX16-A2 Rev A		
Date EUT received:	18th December 2008		
Dates of test (from - to):	18th Dec '08 - 3rd Feb '09		
Standard(s) applied:	FCC Part 90 Subpart Z		
No of Units Tested:	1		
Type of Equipment:	3,650 MHz WiMAX Device		
Manufacturers Trade Name:	Tsunami		
Model:	MP.16 3650		
Product Variants:	Base Station – External Antenna Subscriber Station – External Antenna Base/Subscriber Station – Integral Antenna		
Location for use:	Outdoor use only		
Declared Frequency Range(s):	Transmit: 3,650 – 3,675 MHz, Receiver: 3,650 – 3,675 MHz		
Type of Modulation:	BPSK, QPSK, 16QAM, 64QAM		
Operational Bandwidths:	3.5 MHz, 7 MHz		
Declared Maximum Output Power:	+21 dBm		
ITU Emission Designator:	Modulation	3.5 MHz	7 MHz
	BPSK, QPSK, 16QAM, 64QAM	3M2W7D	6M4W7D
Transmit/Receive Operation:	Time Division Duplex (TDD)		
Rated Input Voltage and Current:	POE: 115Vac 60Hz / +48 Vdc 1.0 A		
Operating Temperature Range:	Client declared: -40ºC to +60ºC		
Clock/Oscillator(s):	25 MHz, 32 MHz, 33 MHz		
Equipment Dimensions:	10.5” X 10.5” X 3.25”		
Weight:	5.3 lbs		
Primary function of equipment:	Wireless Voice and Data Communication		

3.2. Scope of Test Program

The scope of the test program was to test the As Applicant Proxim Wireless Corp. Tsunami MP.16 3650 for compliance against;-

FCC 47 CFR Part 90, Subpart Z regulatory requirements.

The Tsunami MP-16 has two operational bandwidths 3.5 and 7 MHz and employs four modulation schemes BPSK, QPSK, 16QAM, 64QAM in the frequency range 3650 to 3700 MHz. Per Part 90 SubPart Z, 90.1319 the Tsunami MP-16 "equipment incorporating a restricted contention based protocol may operate in and shall only tune over, the lower 25 MHz of this frequency band".

As the Tsunami MP.16 incorporates a restricted contention based protocol the frequency range is limited to 3650 to 3675 MHz

Product Variants
There are three Tsunami MP.16 3650 product variants;

1. 3650-B00-AM0 - Base station with type-N Connector for external antennas
2. 3650-S00-AM0 - Subscriber with type-N Connector for external antennas
3. 3650-S00-AM1 - Subscriber with integrated 18dBi antenna.

All three devices use the same radio, same main board, same enclosure and same PoE. The subscriber units main board is depopulated from the co-processor (see Operational description) and for 3650-S00-AM1 (Subscriber with integrated 18dBi antenna) the metal cover on the enclosure is replaced with integrated antenna - 18dBi antenna gain in plastic housing.

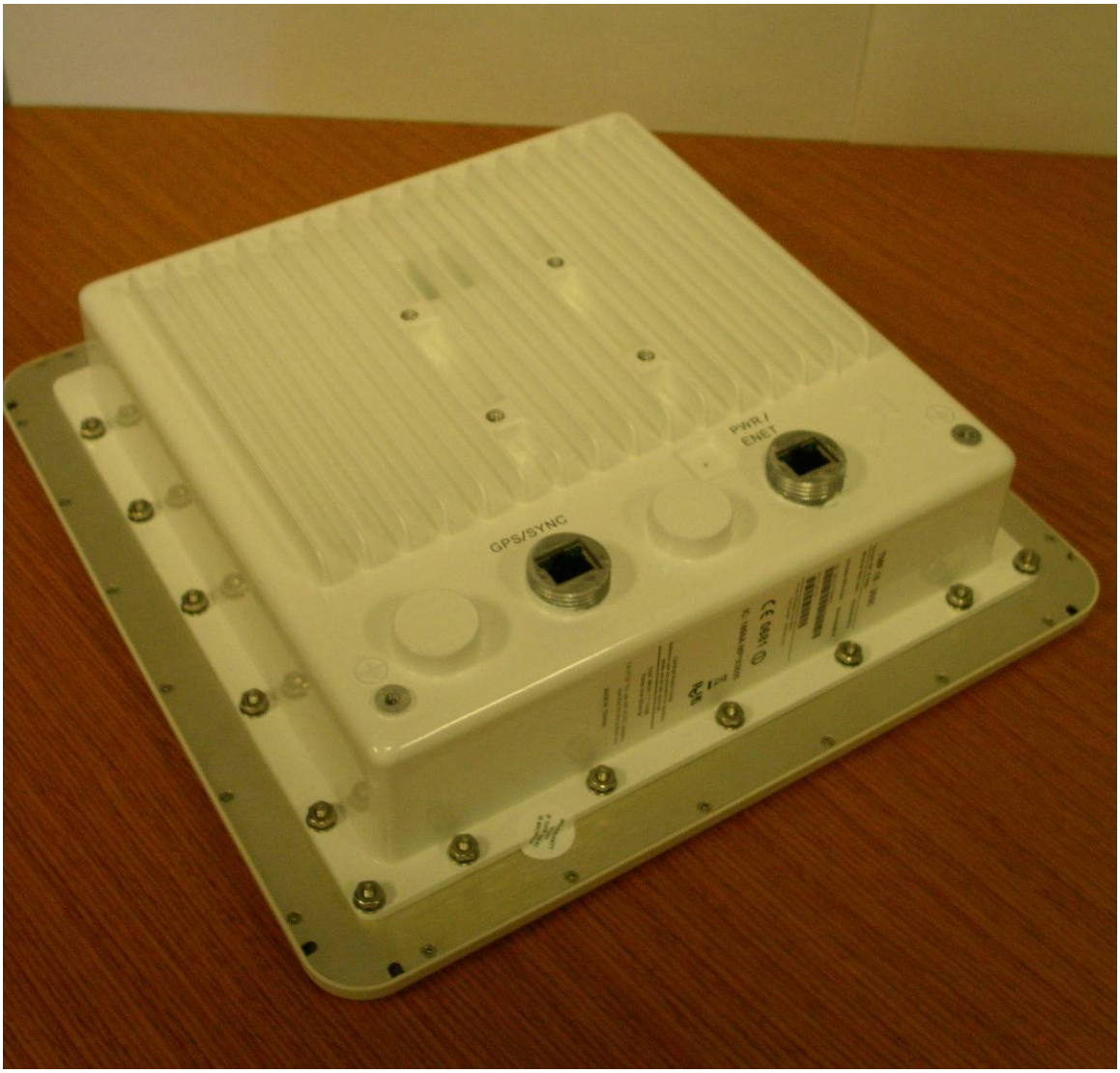
The Base station and Subscriber are preset by the firmware during the manufacturing process of each unit - base can function as base or subscriber, the Subscriber has only Subscriber functionality.

As a result of the above a single test program covered both the Base and Subscriber Station scenarios.

Proxim Wireless Corp. Tsunami MP.16 3650 Base and Subscriber Station

Proxim Wireless Corp. Tsunami MP.16 3650 Base and Subscriber Station

Proxim Wireless Corp. Tsunami MP.16 3650 Subscriber Station only
Integral Antenna



Proxim Wireless Corp. Tsunami MP.16 3650 POE ac Adapter PW130

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

EUT/ Support	Manufacturer	Equipment Description (Including Brand Name)	Model No.	Serial No.
EUT	Proxim Wireless	Tsunami MP.16 3650 (configured as Base Station)	3650-B00-AM0	08UT18760058
EUT	ITE POE Adapter 100-250Vac 50-60Hz 48Vdc, 420mA	DC Power Injector for Power Over Ethernet (POE) 115Vac 60 Hz/ 48Vdc	PW130	--
Support	Proxim Wireless	Tsunami MP.16 3650 (configured as Subscriber Station)	3650-S00-AM0	N/A
Support	ITE POE Adapter 100-250Vac 50-60Hz 48Vdc, 420mA	DC Power Injector for Power Over Ethernet (POE) 115Vac 60 Hz/ 48Vdc	PW130	--
Support	IBM Laptop	Computer	2896-72U	FX-05793 -4/03

3.4. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Dipole	8.0	Proxim Wireless	3336-A00-360	--
Panel Sector 60°	17	Proxim Wireless	3338-A00-060	--
Panel Sector 90°	14	Proxim Wireless	3338-A00-090	--
Panel Sector 120°	13	Proxim Wireless	3338-A00-120	--
Panel Sector 18°	18	Proxim Wireless	3338-A00-018	--

No antennas were submitted for test purposes

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. 10/100 BT Ethernet
2. Serial port
3. RF Port 3650 MHz

3.6. Test Configurations

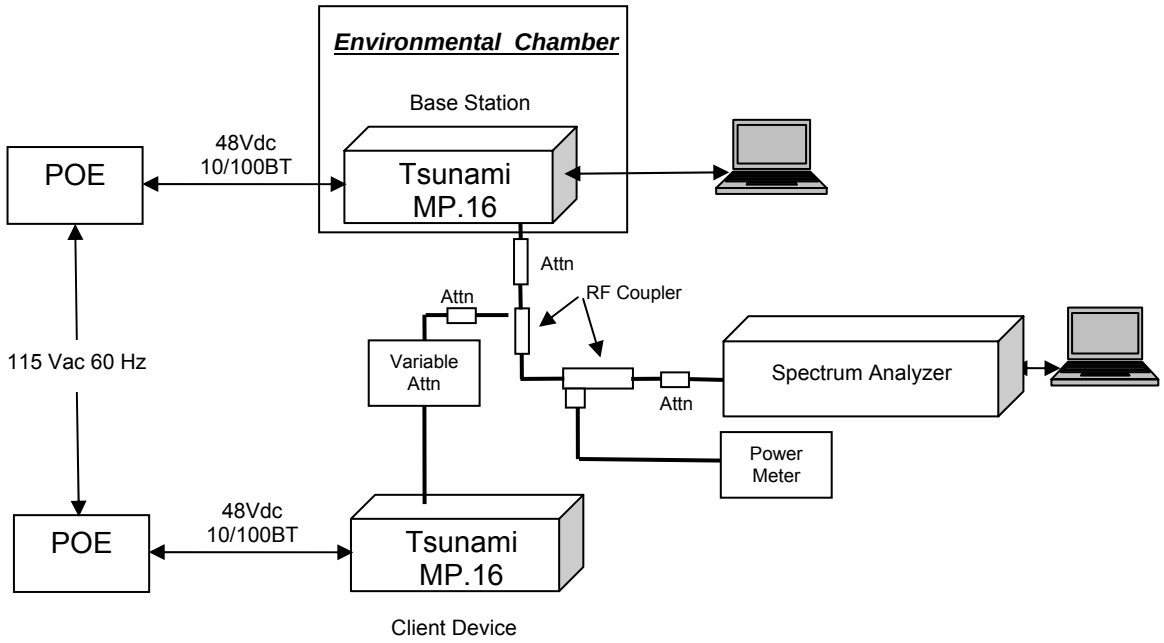
Matrix of test configurations

Parameter	Operational Mode	Test Conditions	Bandwidths (MHz)
99% Occupied BW	Modulated - BPSK QPSK, 16QAM, 64QAM	Ambient, 48Vdc (POE)	3.5, 7
Output power			
Peak Power Spectral Density			
Frequency Stability	Modulated - BPSK	Temperature and Voltage Variations (48, 43.2, 52.8 Vdc)	3.5
Conducted Spurious Emissions	Modulated - BPSK	Ambient	3.5
Radiated Spurious Emissions	Modulated - BPSK	Ambient 115 Vac 60 Hz	3.5
AC Wireline Emissions	Modulated - BPSK	Ambient 115 Vac 60 Hz	3.5

BW (MHz)	Modulation		
	BPSK, QPSK, 16QAM, 64QAM		
	Low (MHz)	Mid (MHz)	High (MHz)
3.5	3652.50	3662.50	3672.00
7	3654.25	3660.50	3670.75

Test Set-Up

As there was no test software available to exercise the Access Point the EUT was associated with a client to provide sufficient duty cycle (48%) irrespective of modulation. Data transfer was initiated between the access point to the client.



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	99% Occupied Bandwidth	Bandwidth measurement(s)	Conducted	Complies	5.1.1
2.1046; 90.1321 (a)	EIRP Rated Power	Modulated Output Power	Conducted	Complies	5.1.2
2.1046; 90.1321 (a)	Peak EIRP Power Density	Maximum Spectral Density	Conducted	Complies	5.1.3
Subpart C 90.1217	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Radiated	Complies	5.1.4
2.1055(a)(1)	Frequency Stability	Includes temperature and voltage variations	Conducted	Complies	5.1.5
2.1051; 90.1323	Conducted Spurious Emissions at Antenna Port	Emissions from the antenna port	Conducted	Complies	5.1.6
2.1053; 90.1323 ANSI/TIA-603	Radiated Spurious Emissions	Spurious emissions	Radiated	Complies	5.1.7
15.207	AC Wireline Conducted	Emissions 150 kHz–30 MHz	Conducted	Complies	5.1.8

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, Subpart Z; 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 ON.

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 of 30 kHz.

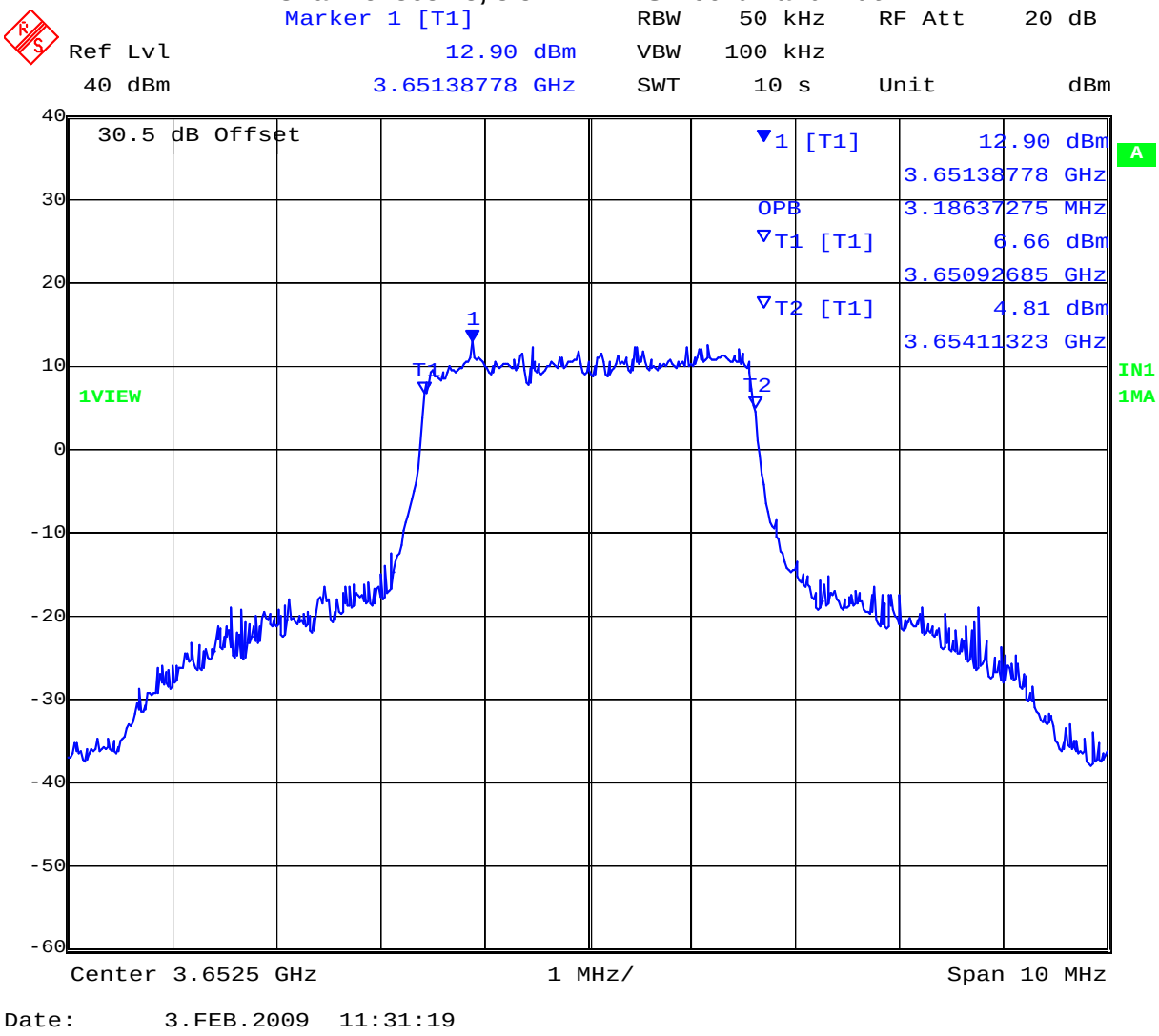
Test Set-up is shown in Section 3.6 Test Configuration

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

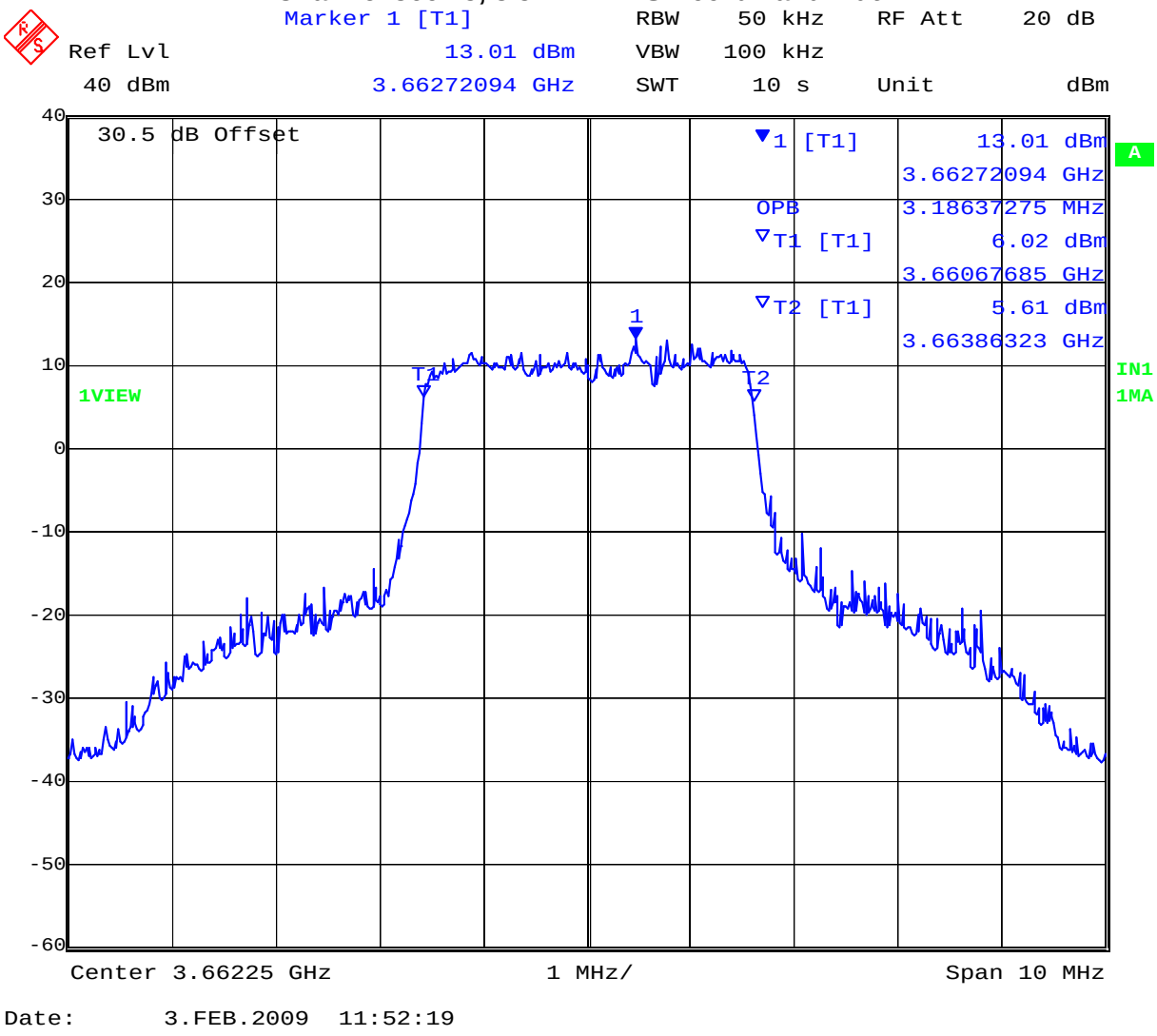
BPSK Modulation

Modulation	Bandwidth (MHz)	Center Frequency (MHz)	99% Bandwidth (MHz)
BPSK	3.5	3652.50	3.186
		3662.50	3.186
		3672.00	3.186
	7	3654.25	6.403
		3660.50	6.403
		3670.75	6.373

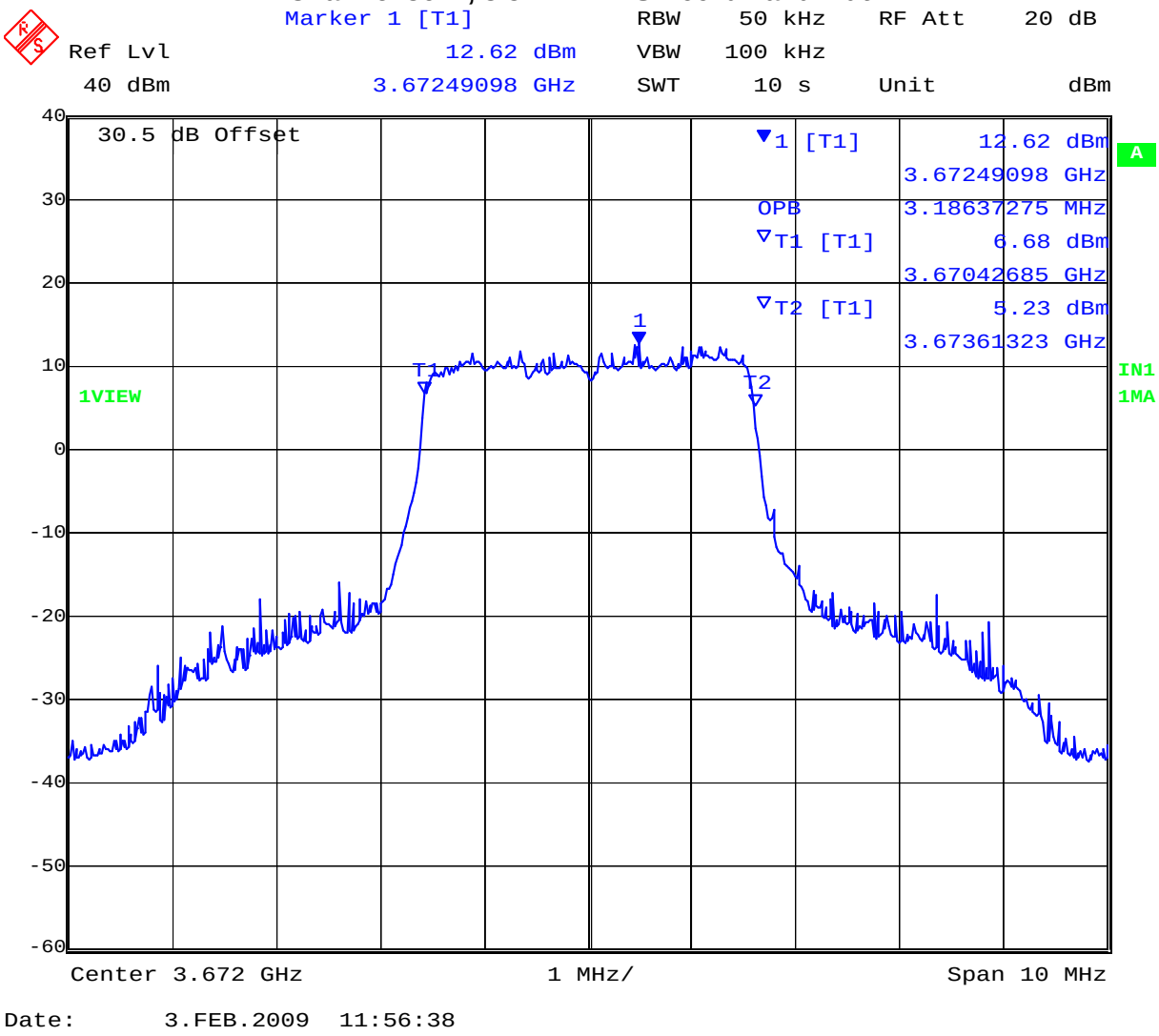
Channel 3652.5, 3.5 MHz BPSK 99% Bandwidth



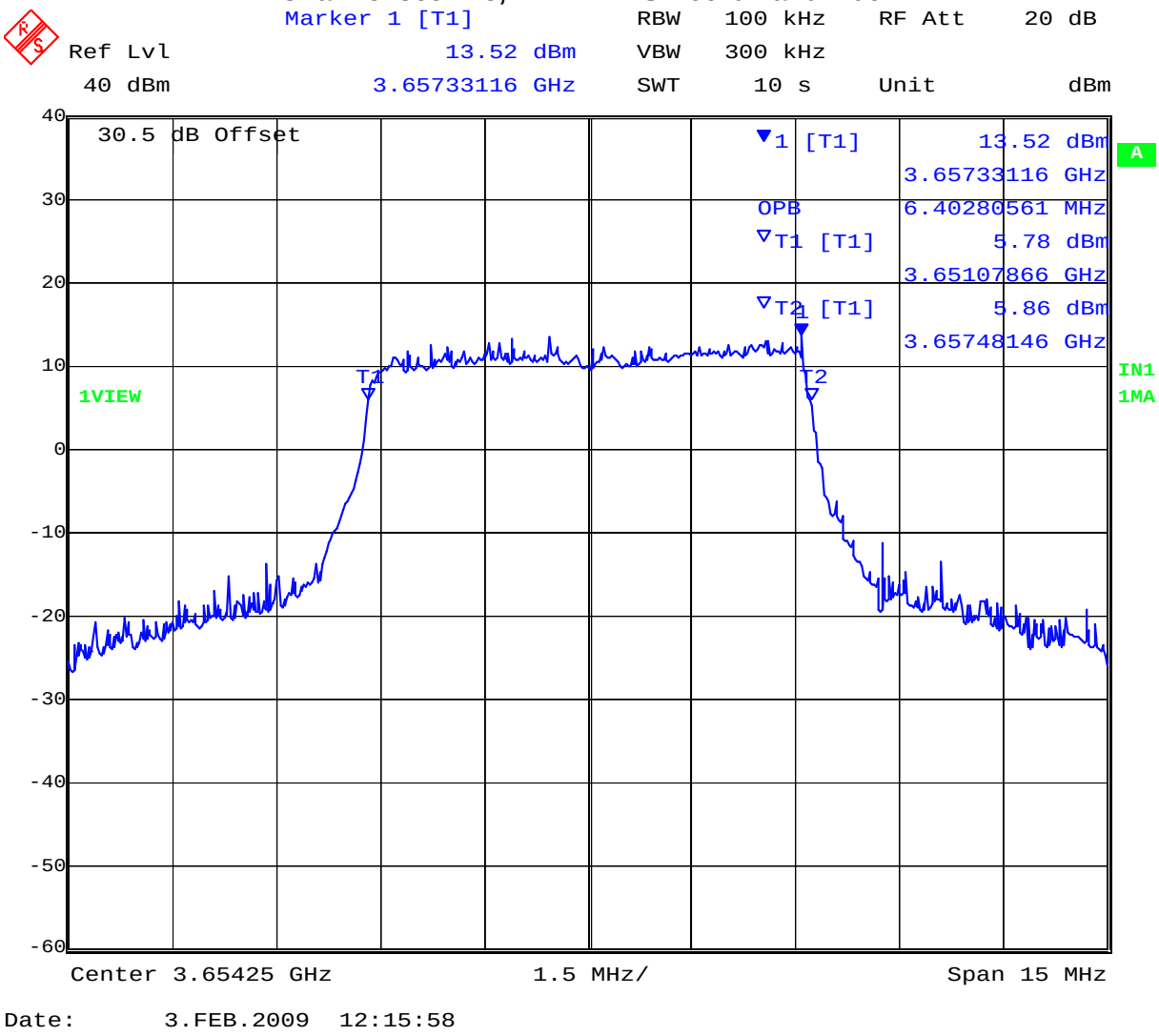
Channel 3662.5, 3.5 MHz BPSK 99% Bandwidth



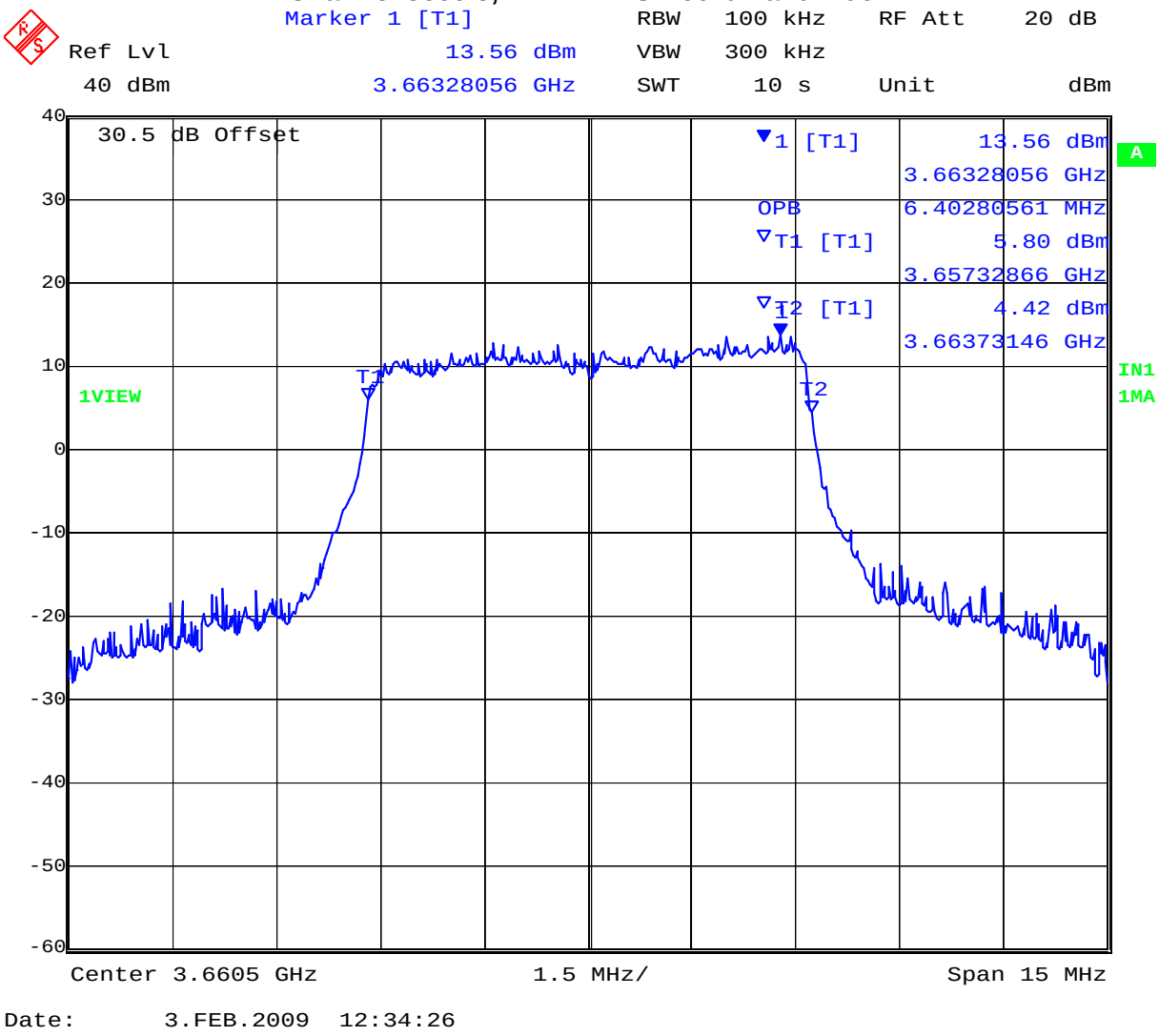
Channel 3672, 3.5 MHz BPSK 99% Bandwidth



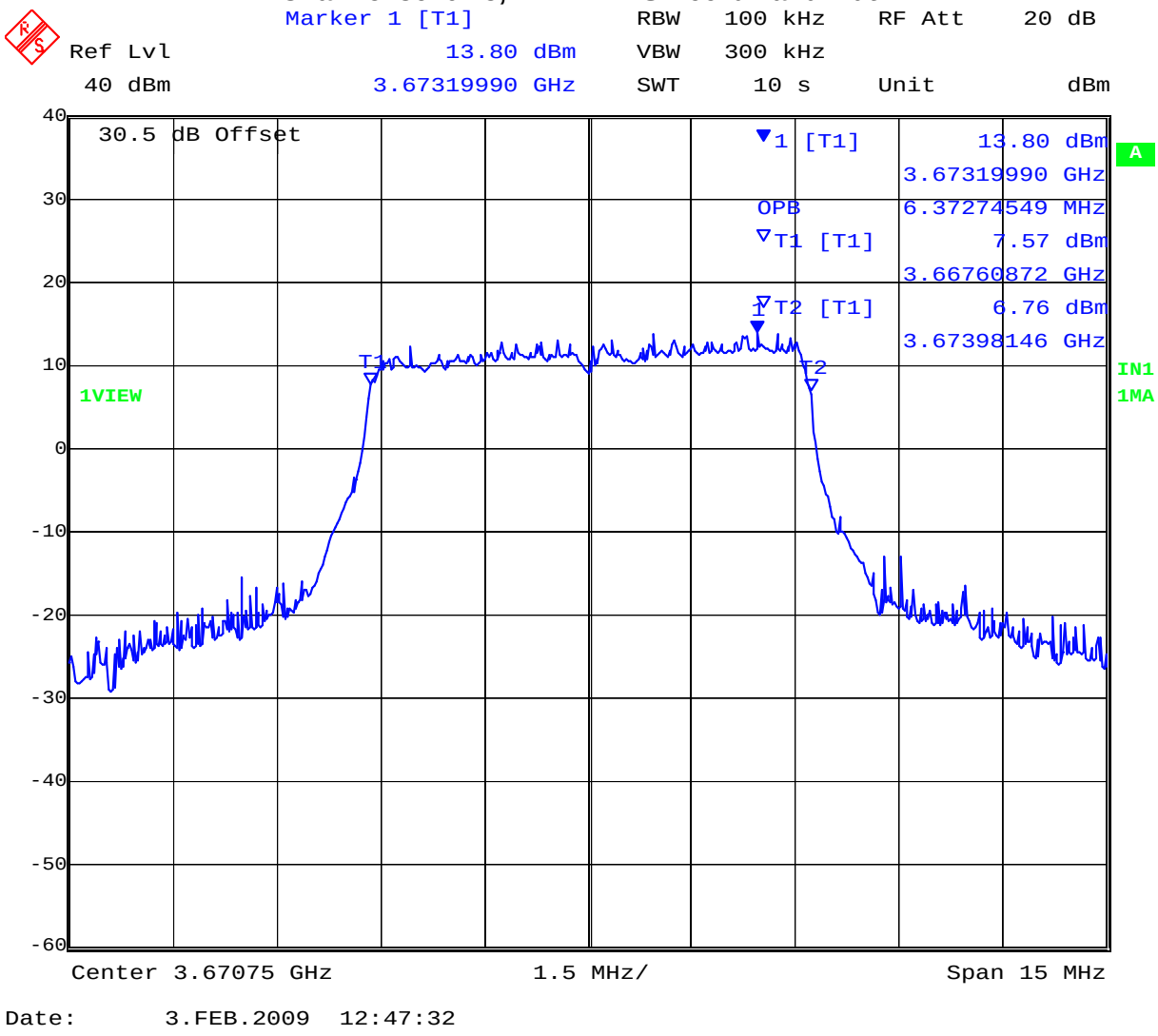
Channel 3654.25, 7 MHz BPSK 99% Bandwidth



Channel 3660.5, 7 MHz BPSK 99% Bandwidth



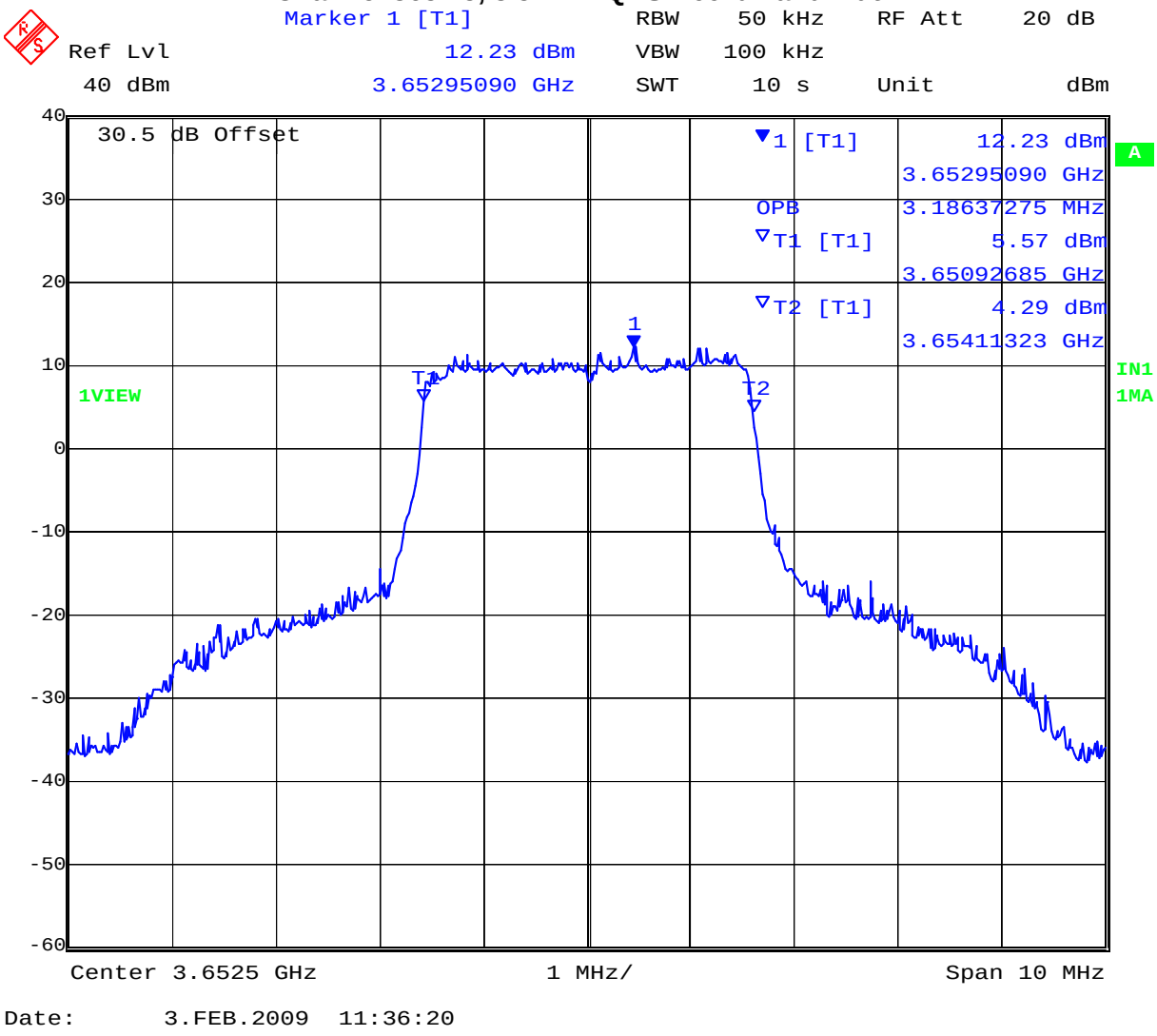
Channel 3670.75, 7 MHz BPSK 99% Bandwidth



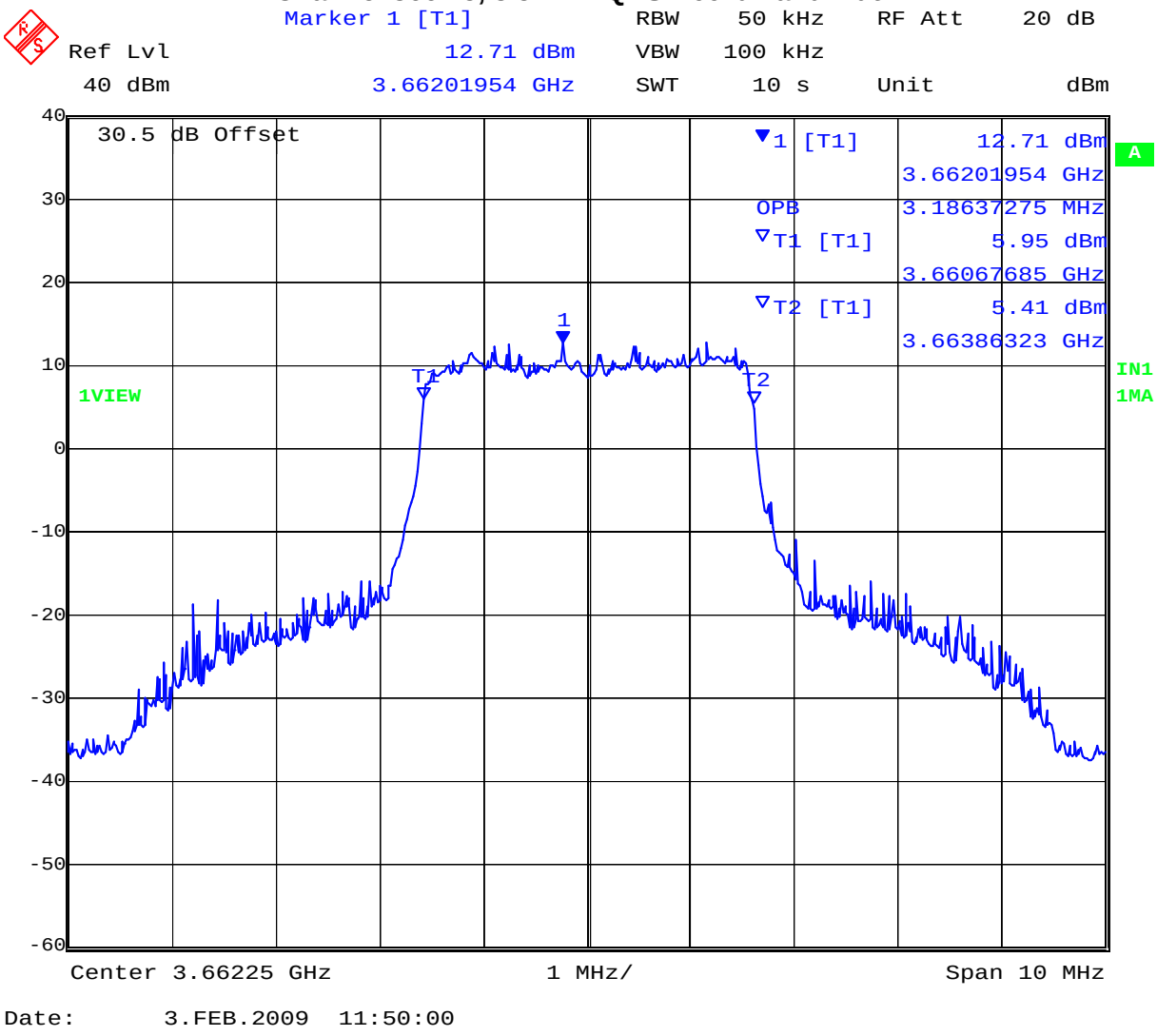
QPSK Modulation

Modulation	Bandwidth (MHz)	Center Frequency (MHz)	99% Bandwidth (MHz)
QPSK	3.5	3652.5	3.186
		3662.5	3.186
		3672	3.186
	7	3654.25	6.403
		3660.5	6.403
		3670.75	6.403

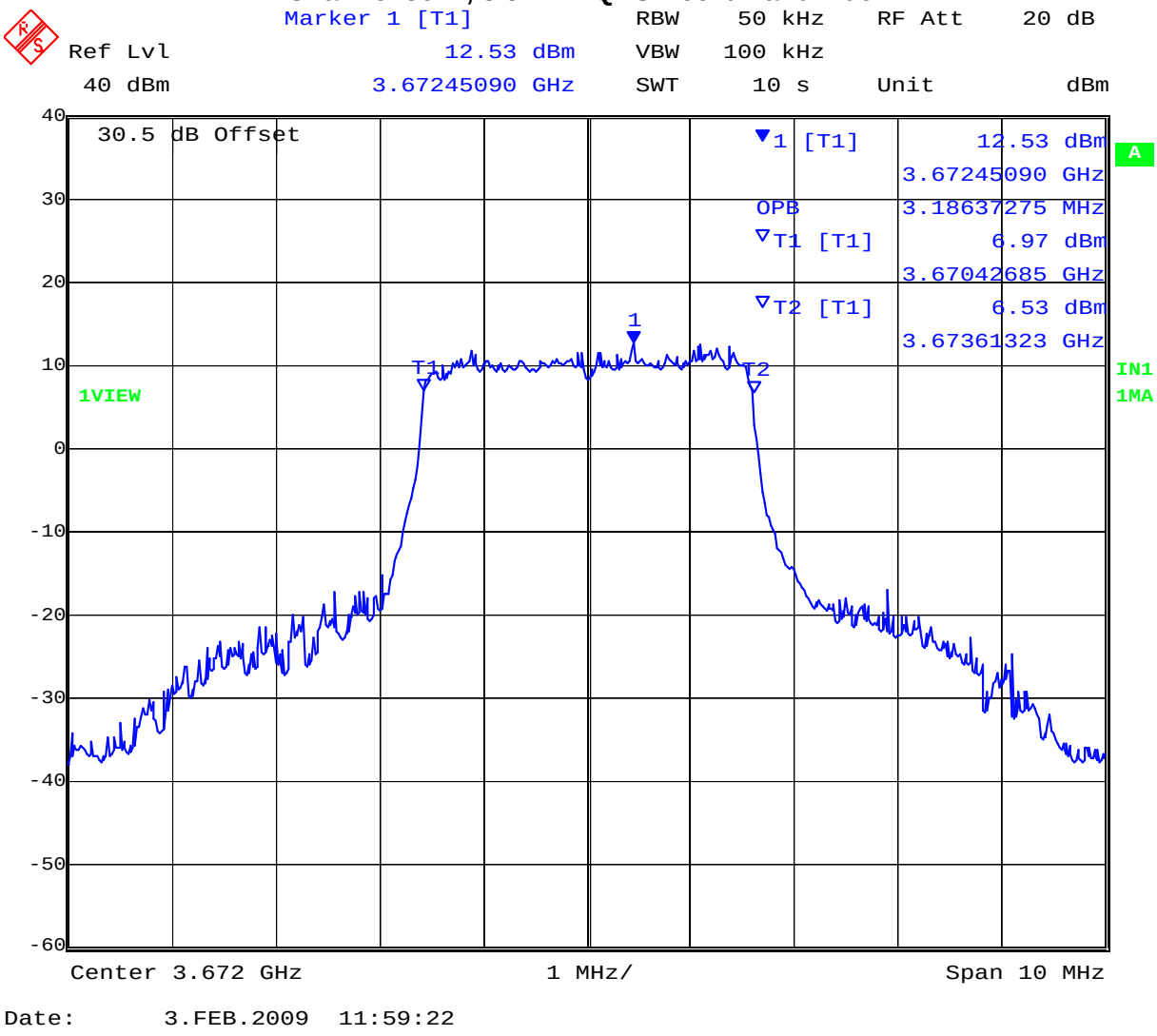
Channel 3652.5, 3.5 MHz QPSK 99% Bandwidth



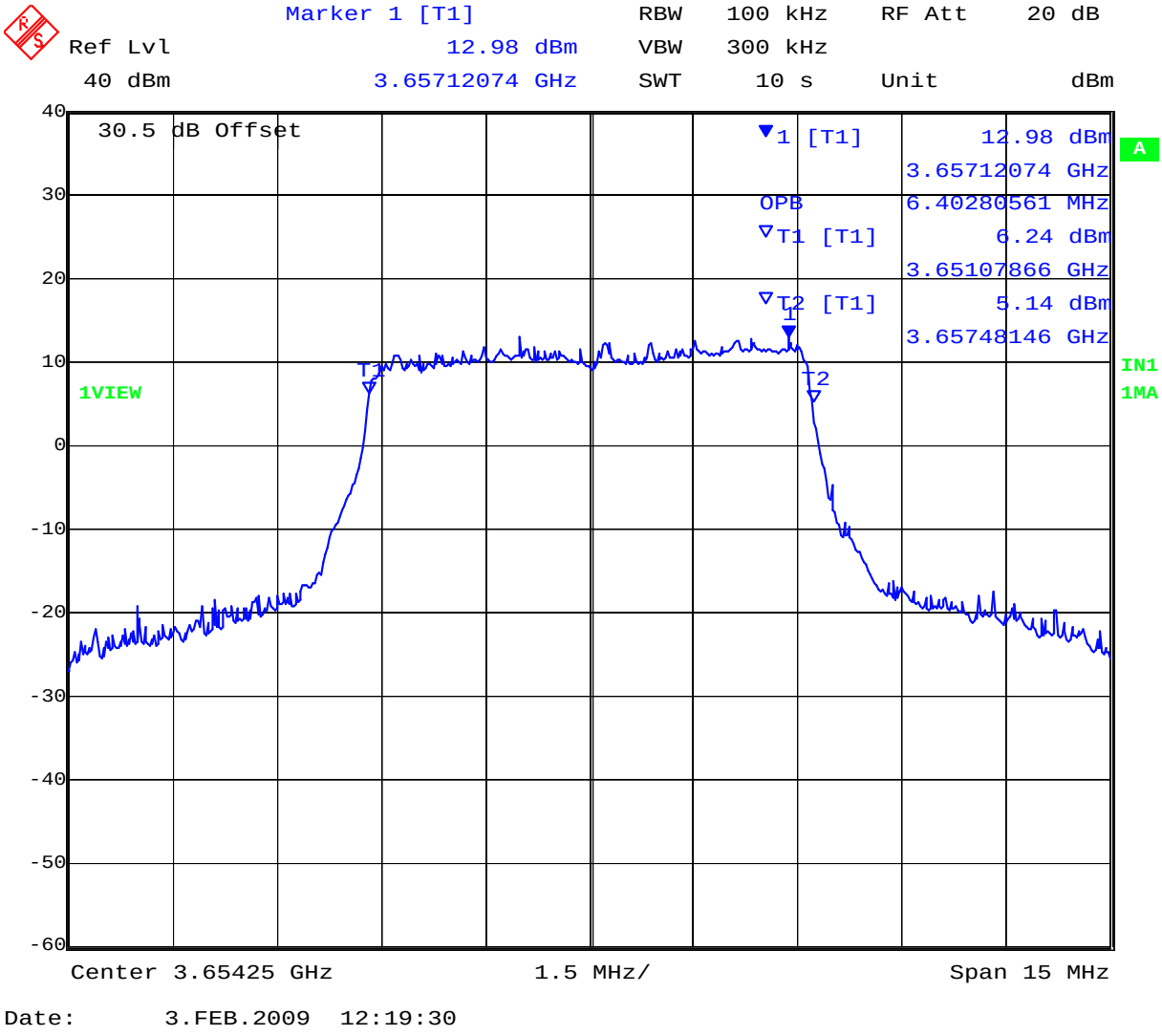
Channel 3662.5, 3.5 MHz QPSK 99% Bandwidth



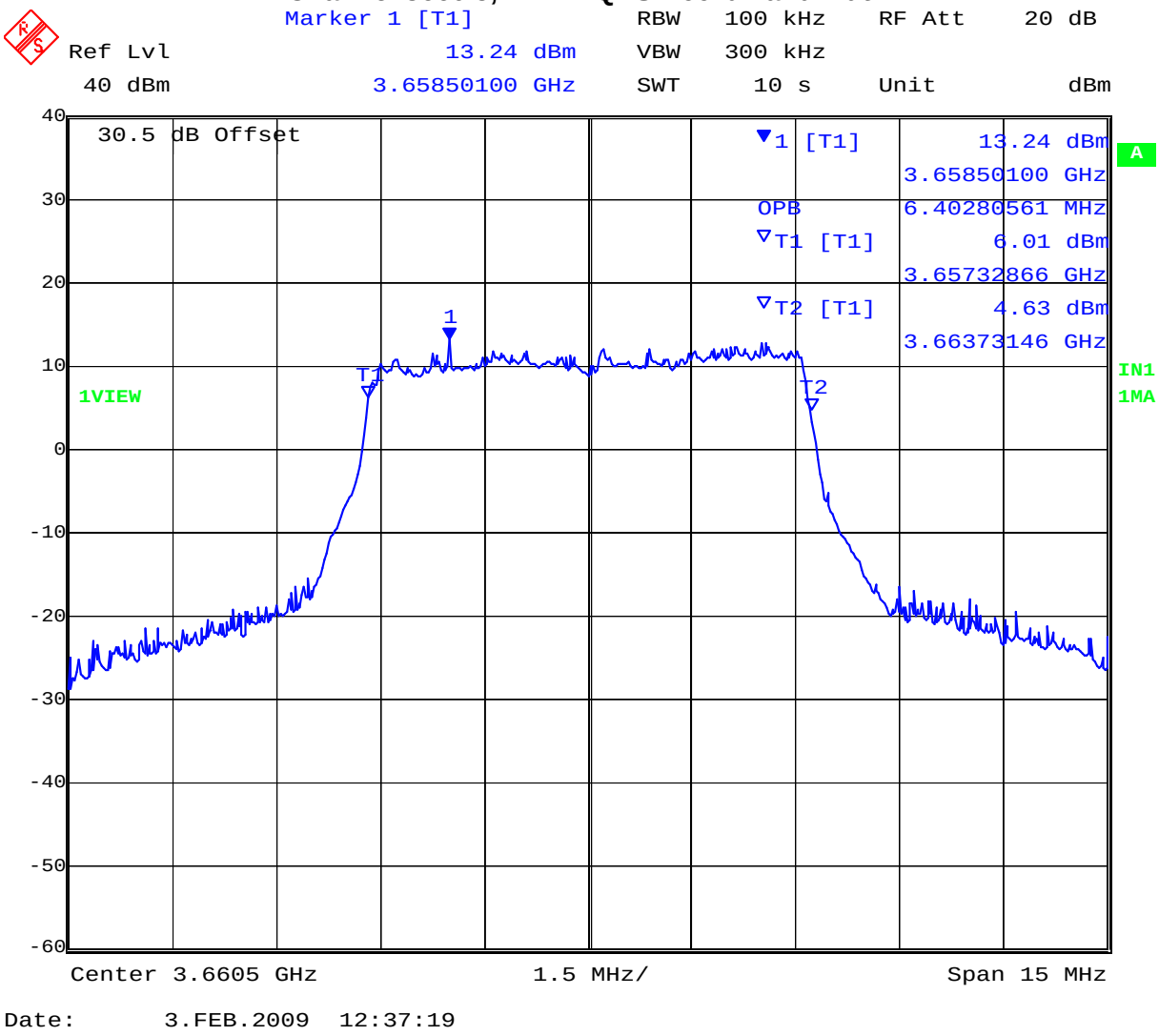
Channel 3672, 3.5 MHz QPSK 99% Bandwidth



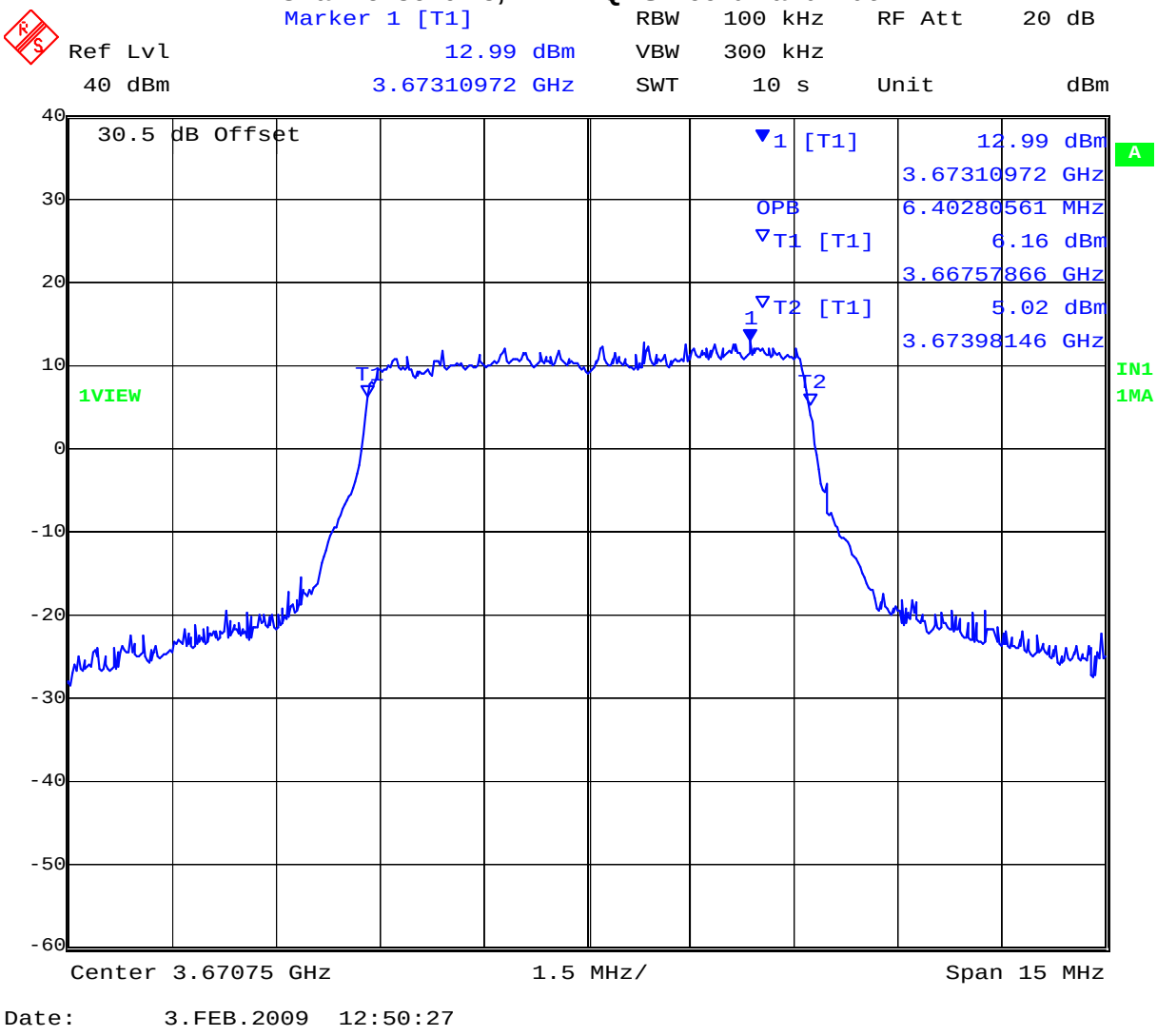
Channel 3654.25, 7 MHz QPSK 99% Bandwidth



Channel 3660.5, 7 MHz QPSK 99% Bandwidth



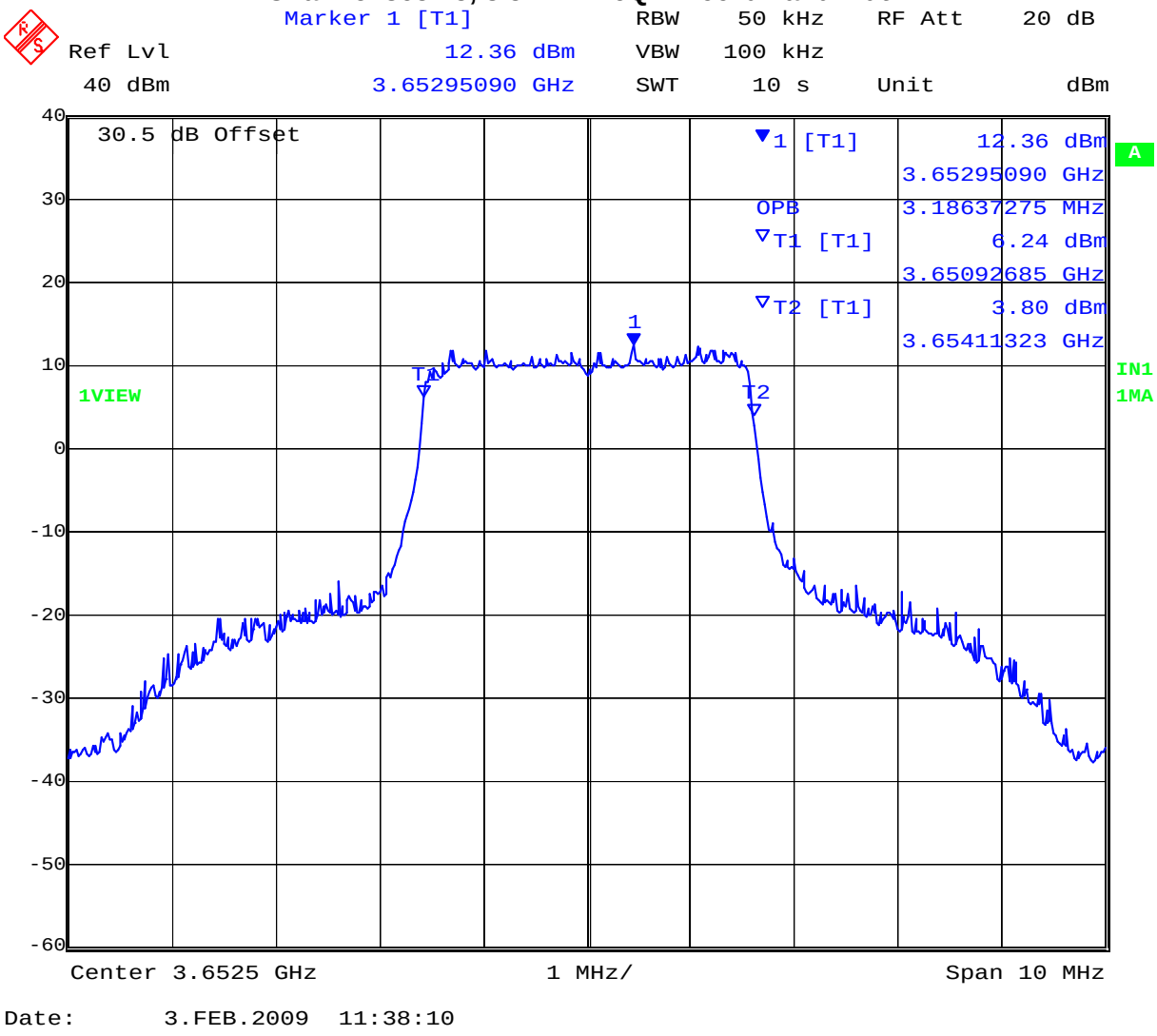
Channel 3670.75, 7 MHz QPSK 99% Bandwidth



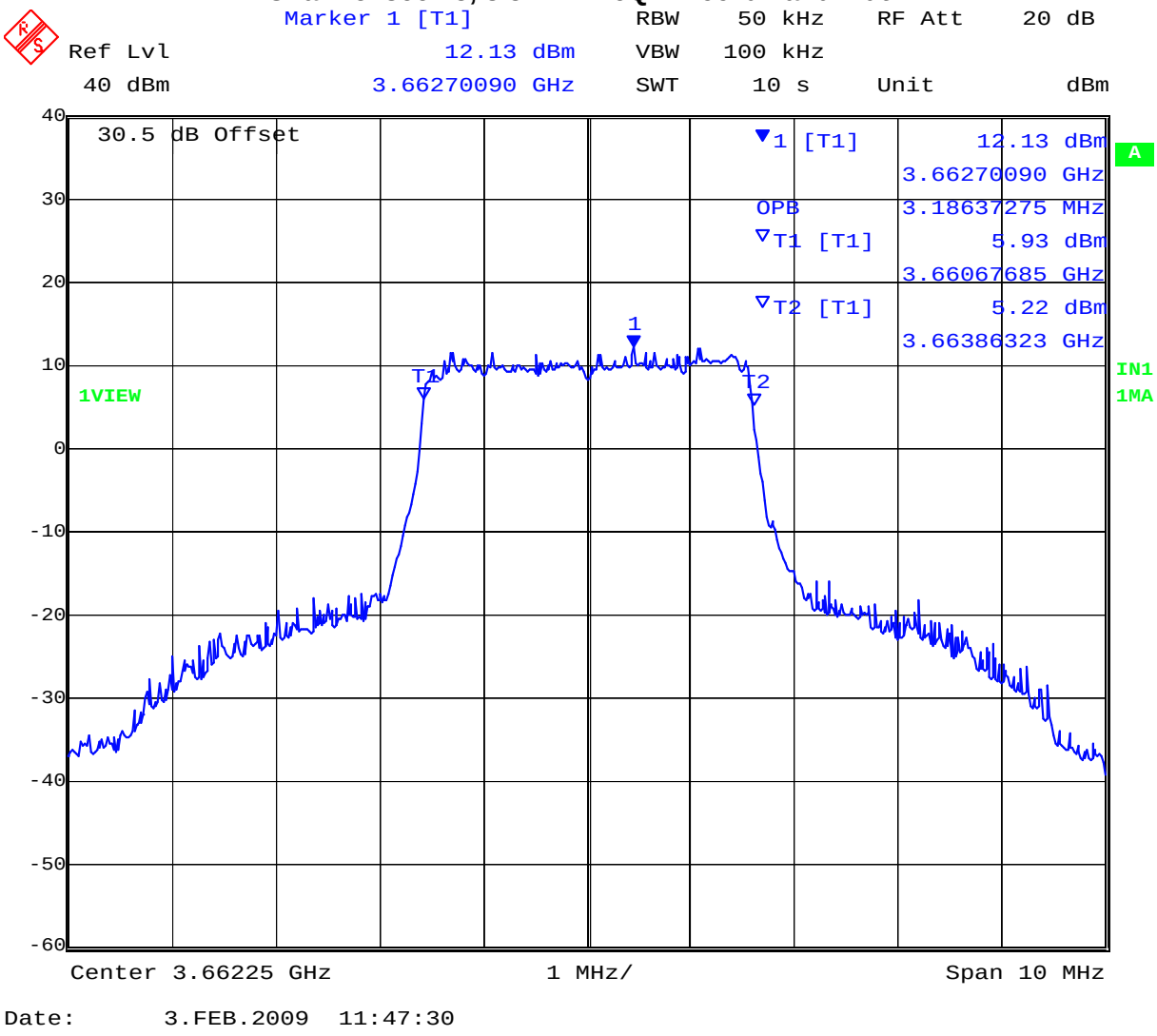
16QAM Modulation

Modulation	Bandwidth (MHz)	Center Frequency (MHz)	99% Bandwidth (MHz)
16QAM	3.5	3652.5	3.186
		3662.5	3.186
		3672	3.186
	7	3654.25	6.343
		3660.5	6.343
		3670.75	6.373

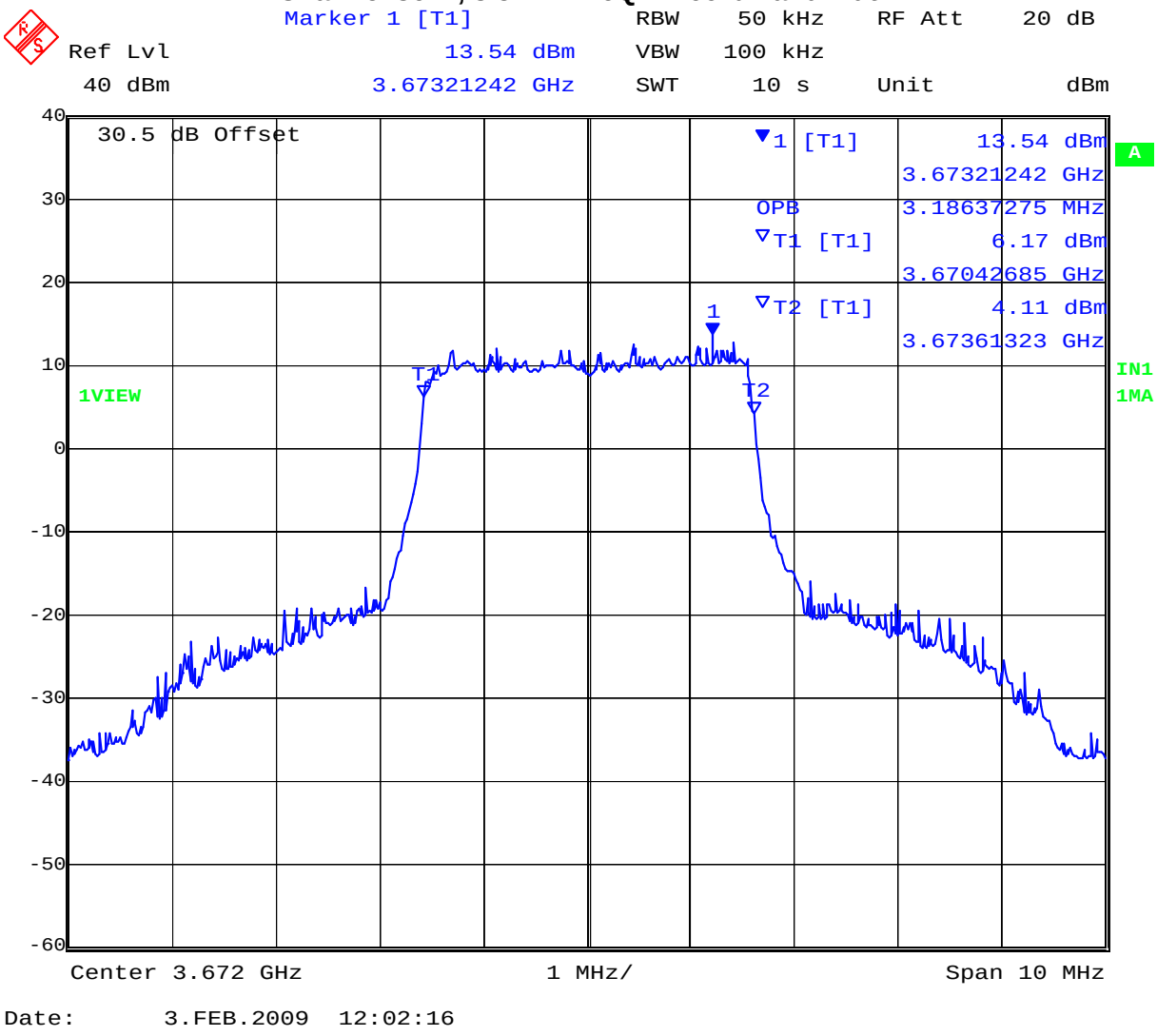
Channel 3652.5, 3.5 MHz 16QAM 99% Bandwidth



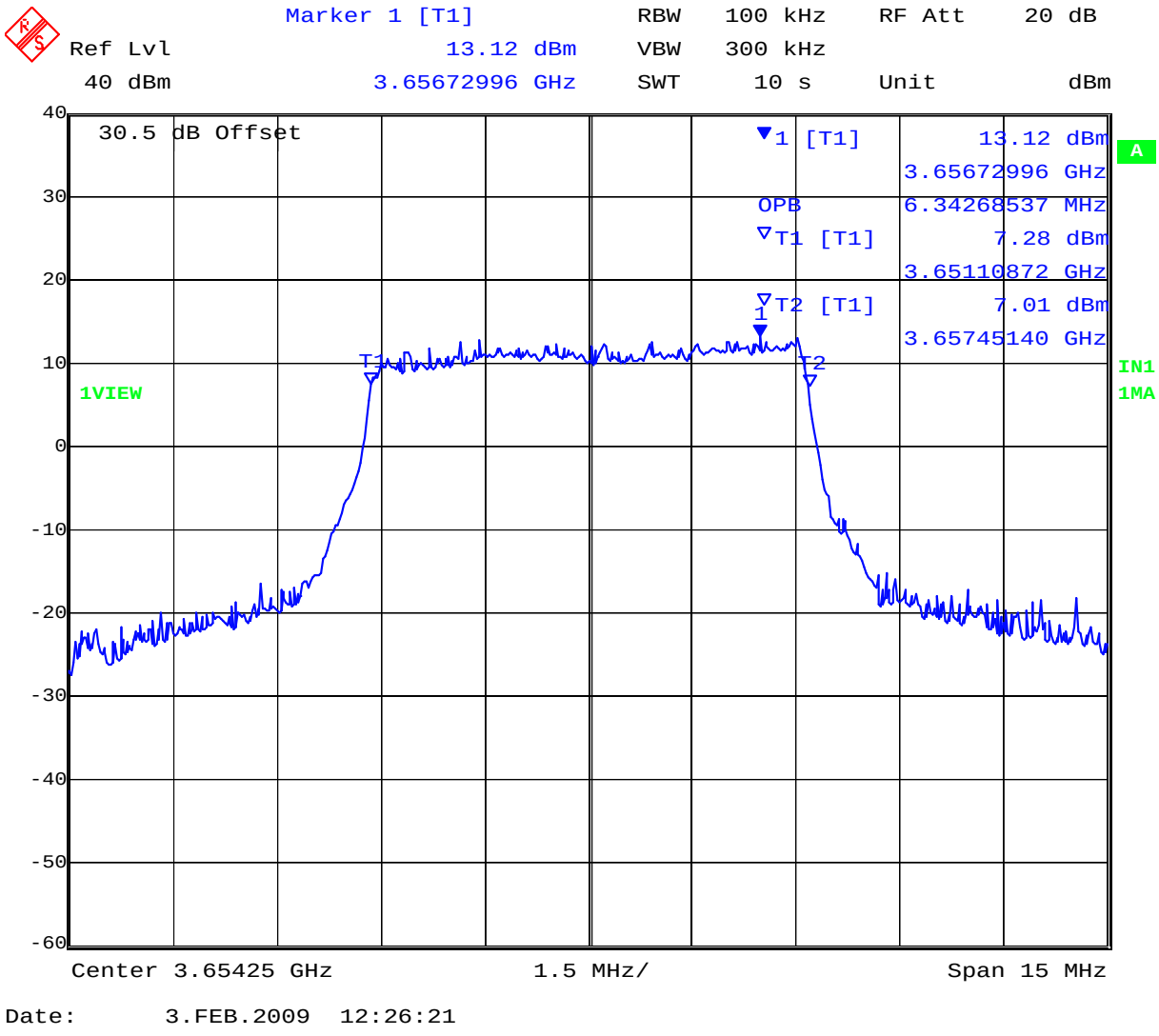
Channel 3662.5, 3.5 MHz 16QAM 99% Bandwidth



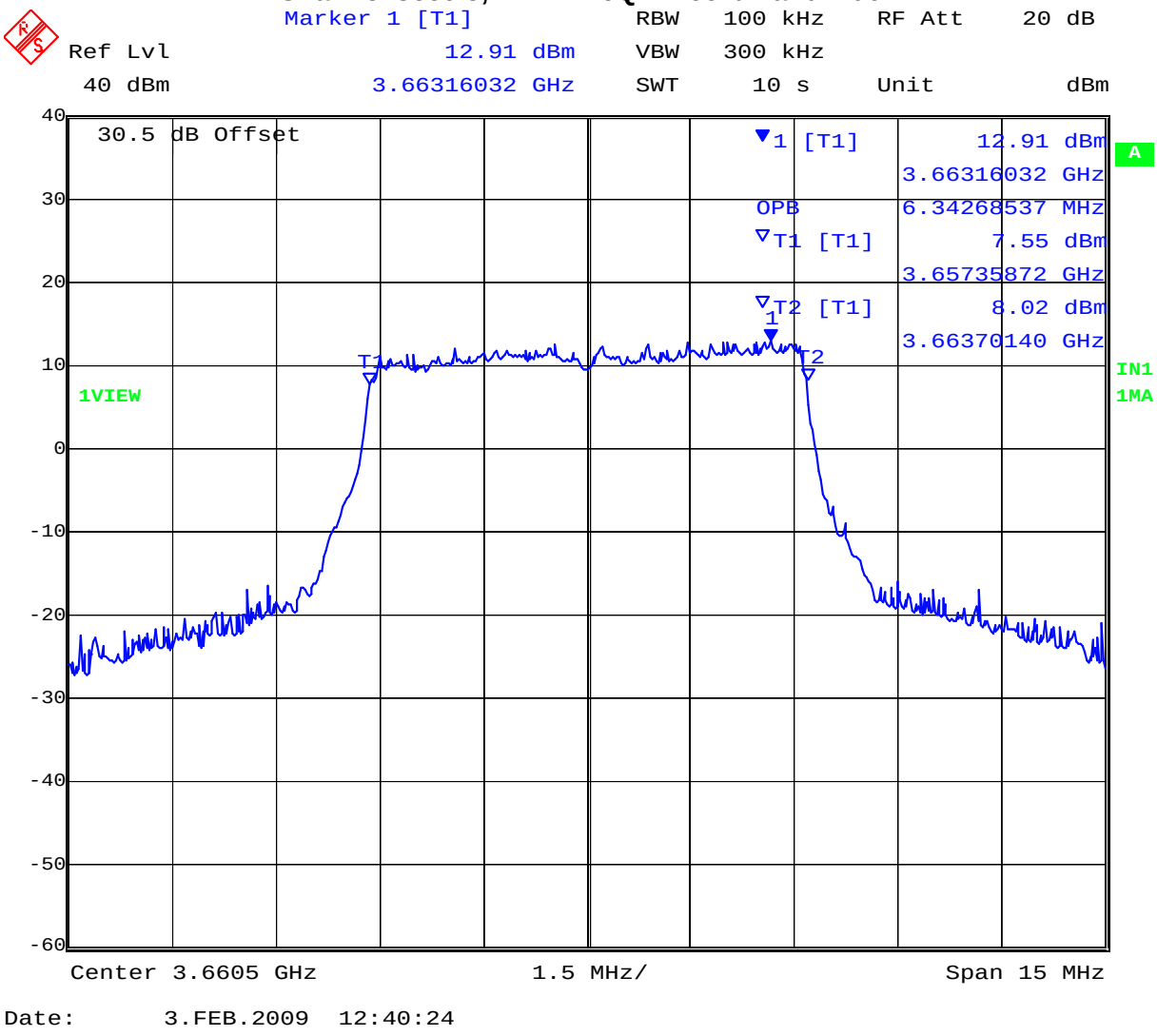
Channel 3672, 3.5 MHz 16QAM 99% Bandwidth



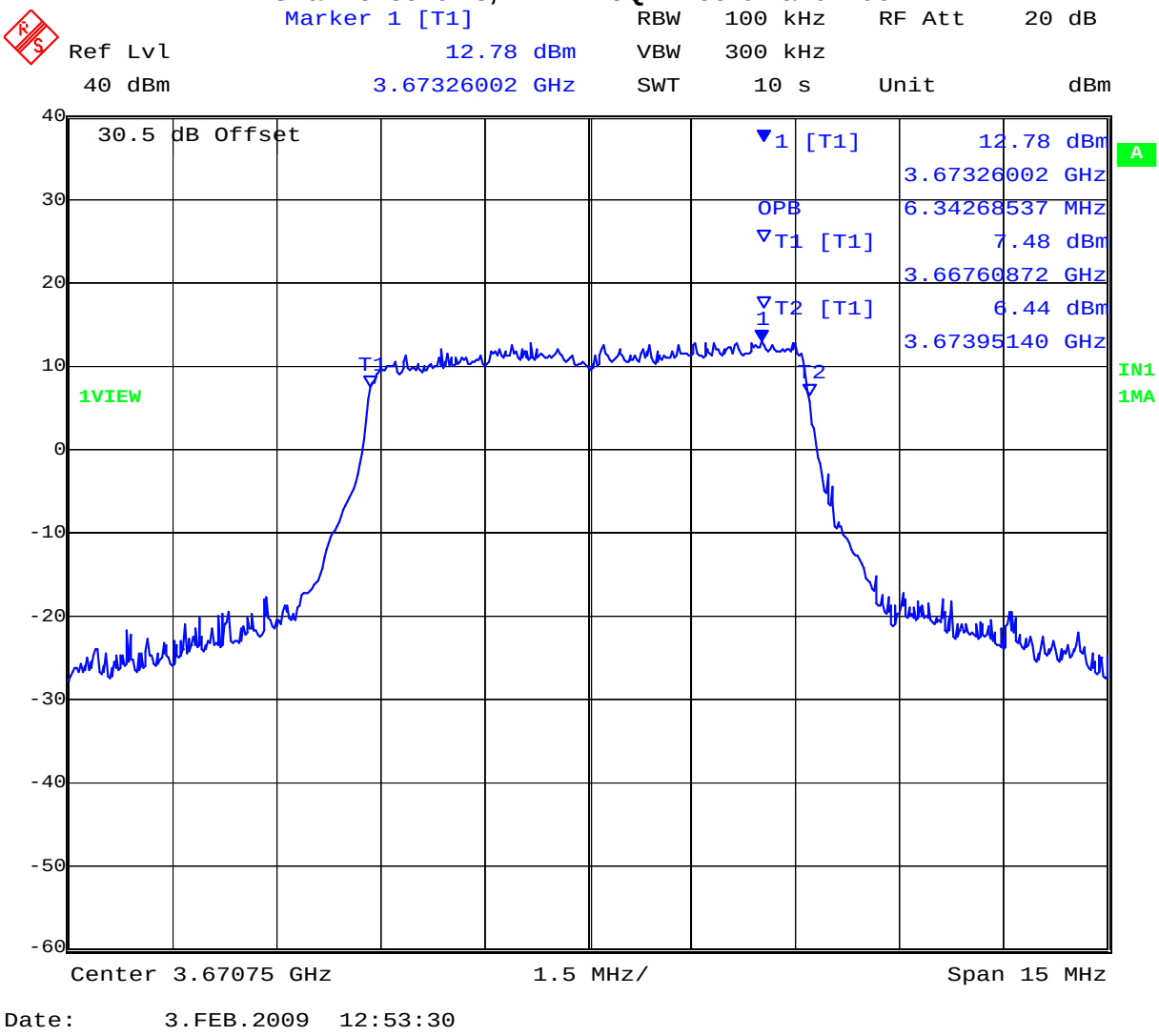
Channel 3654.25, 7 MHz 16QAM 99% Bandwidth



Channel 3660.5, 7 MHz 16QAM 99% Bandwidth



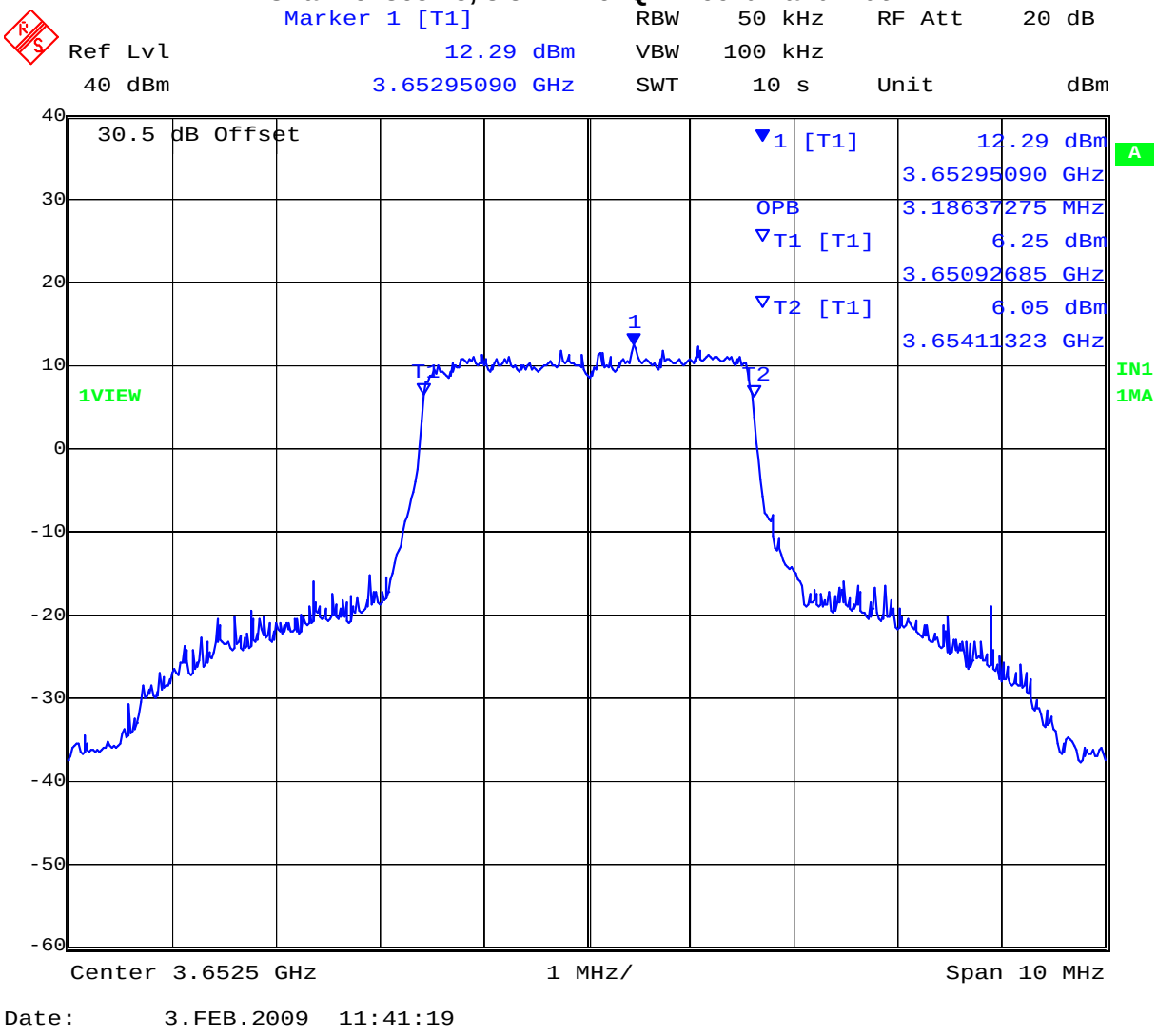
Channel 3670.75, 7 MHz 16QAM 99% Bandwidth



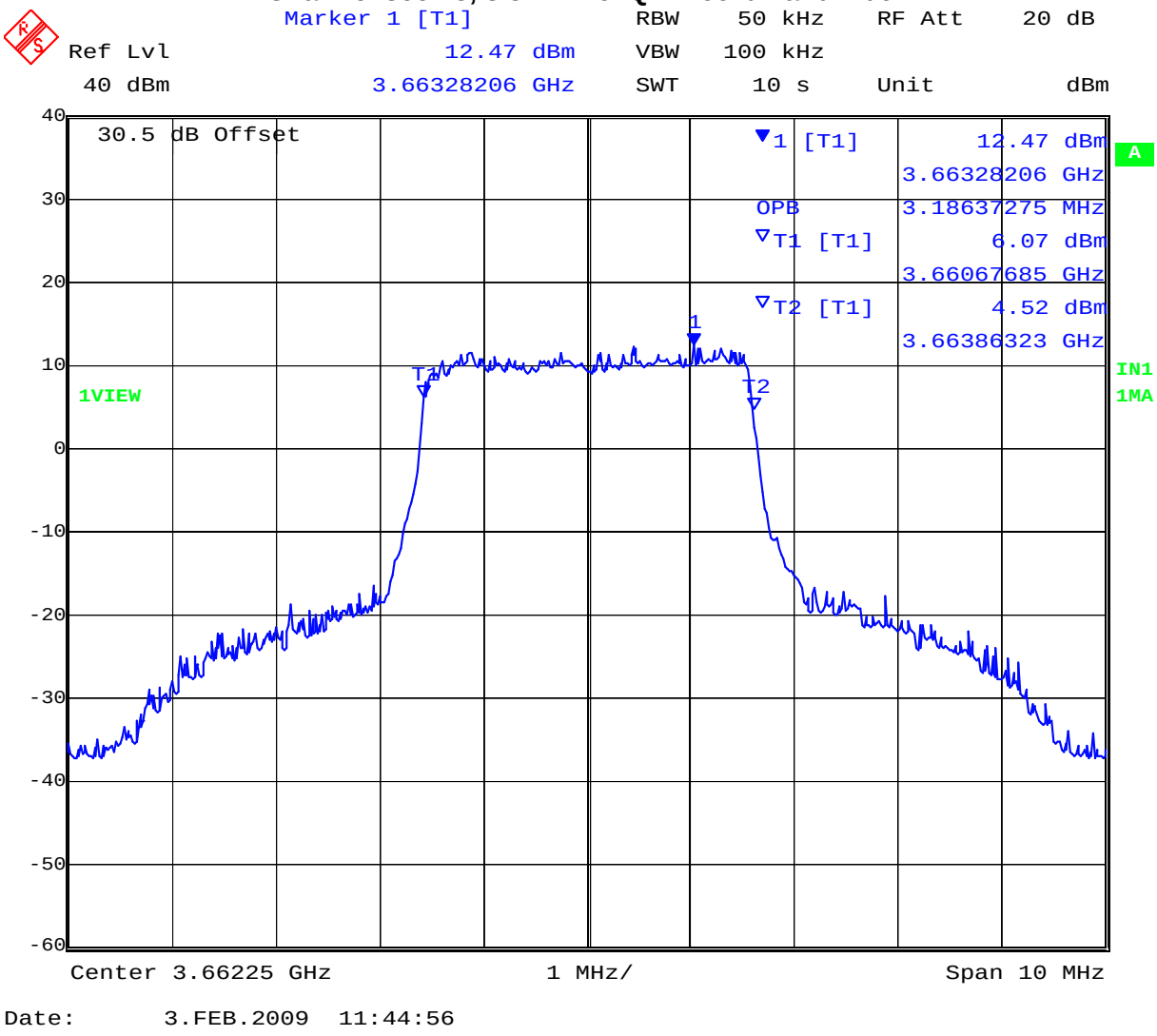
64QAM Modulation

Modulation	Bandwidth (MHz)	Center Frequency (MHz)	99% Bandwidth (MHz)
64QAM	3.5	3652.5	3.186
		3662.5	3.186
		3672	3.186
	7	3654.25	6.373
		3660.5	6.343
		3670.75	6.373

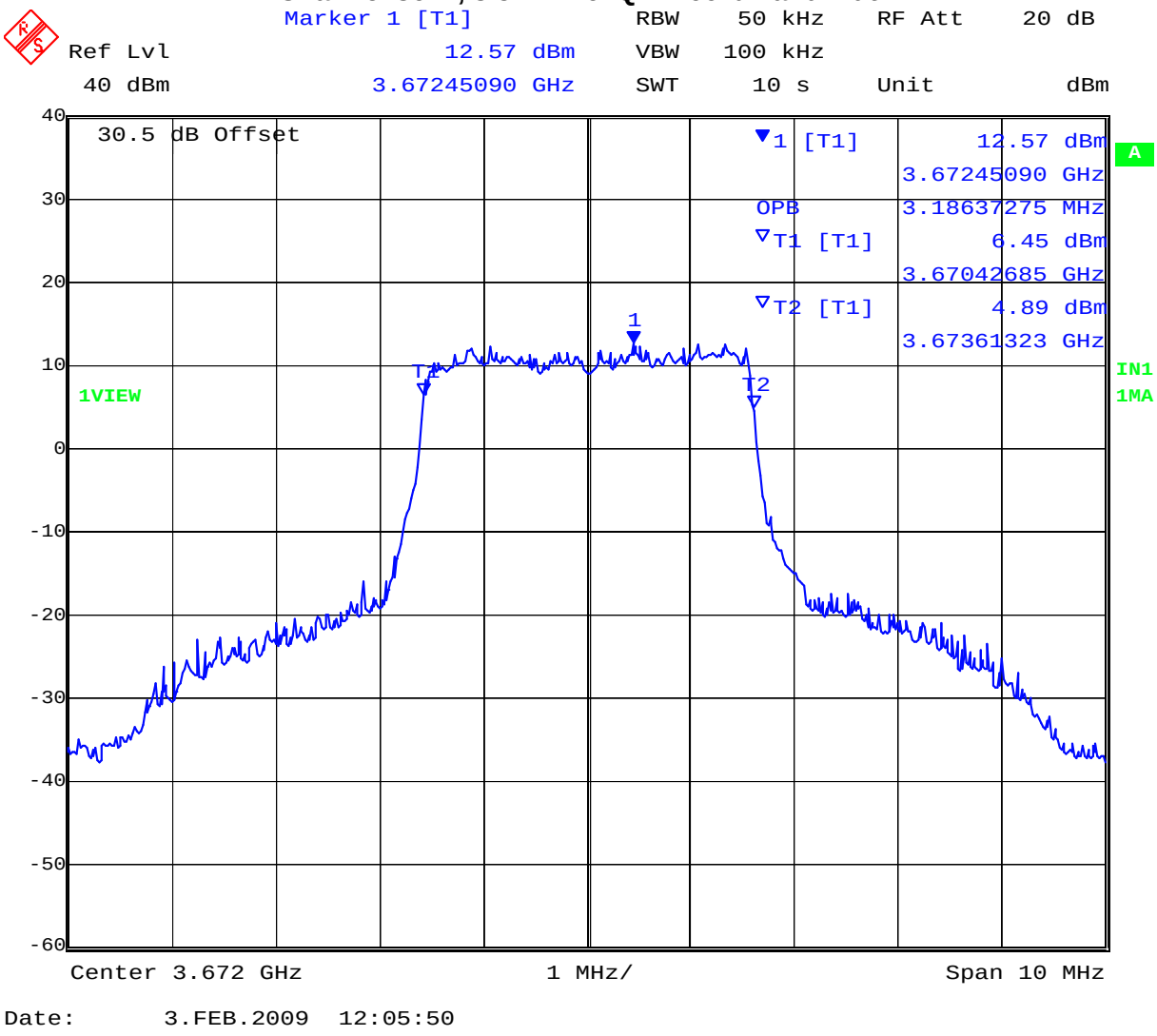
Channel 3652.5, 3.5 MHz 64QAM 99% Bandwidth



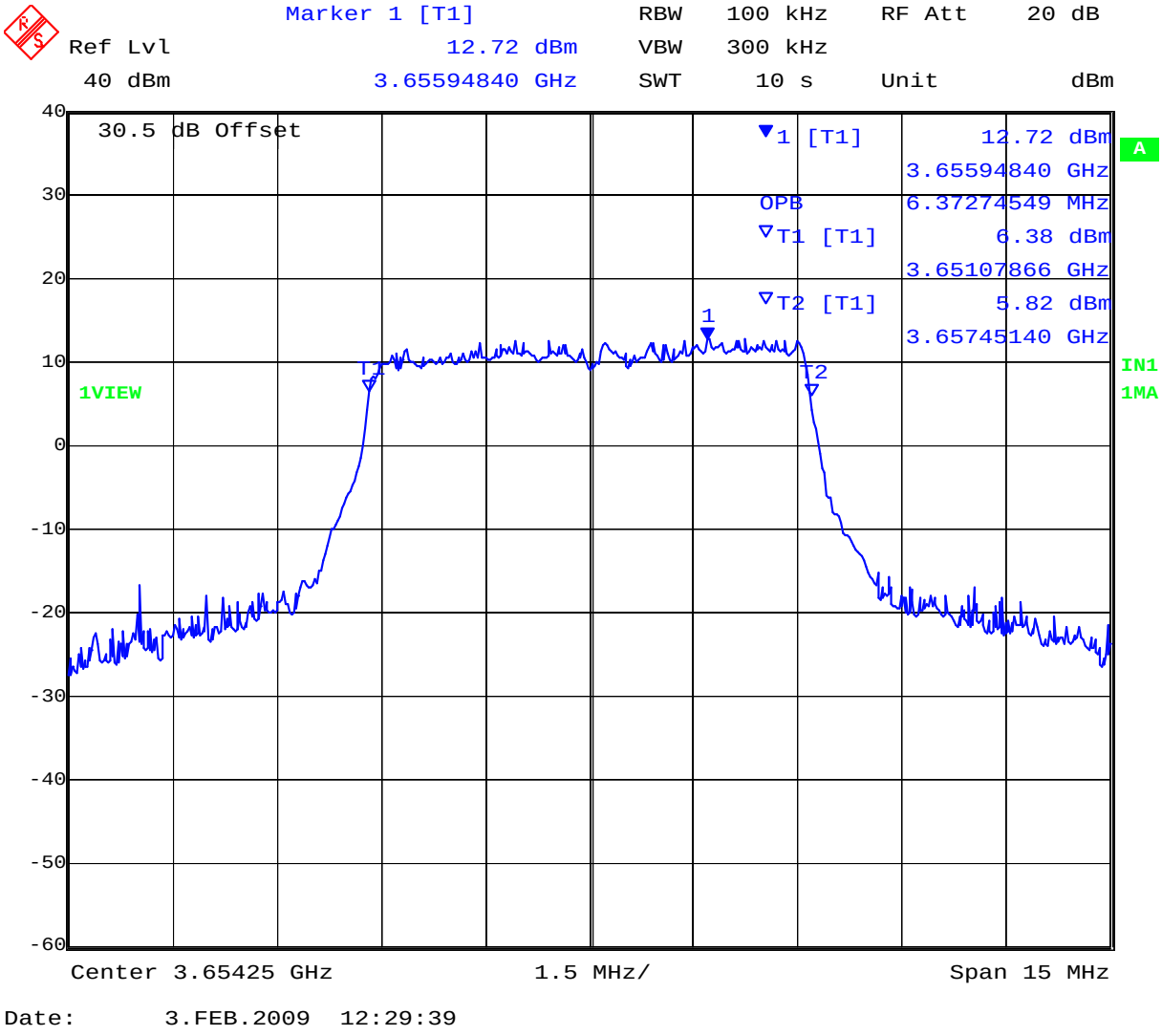
Channel 3662.5, 3.5 MHz 64QAM 99% Bandwidth



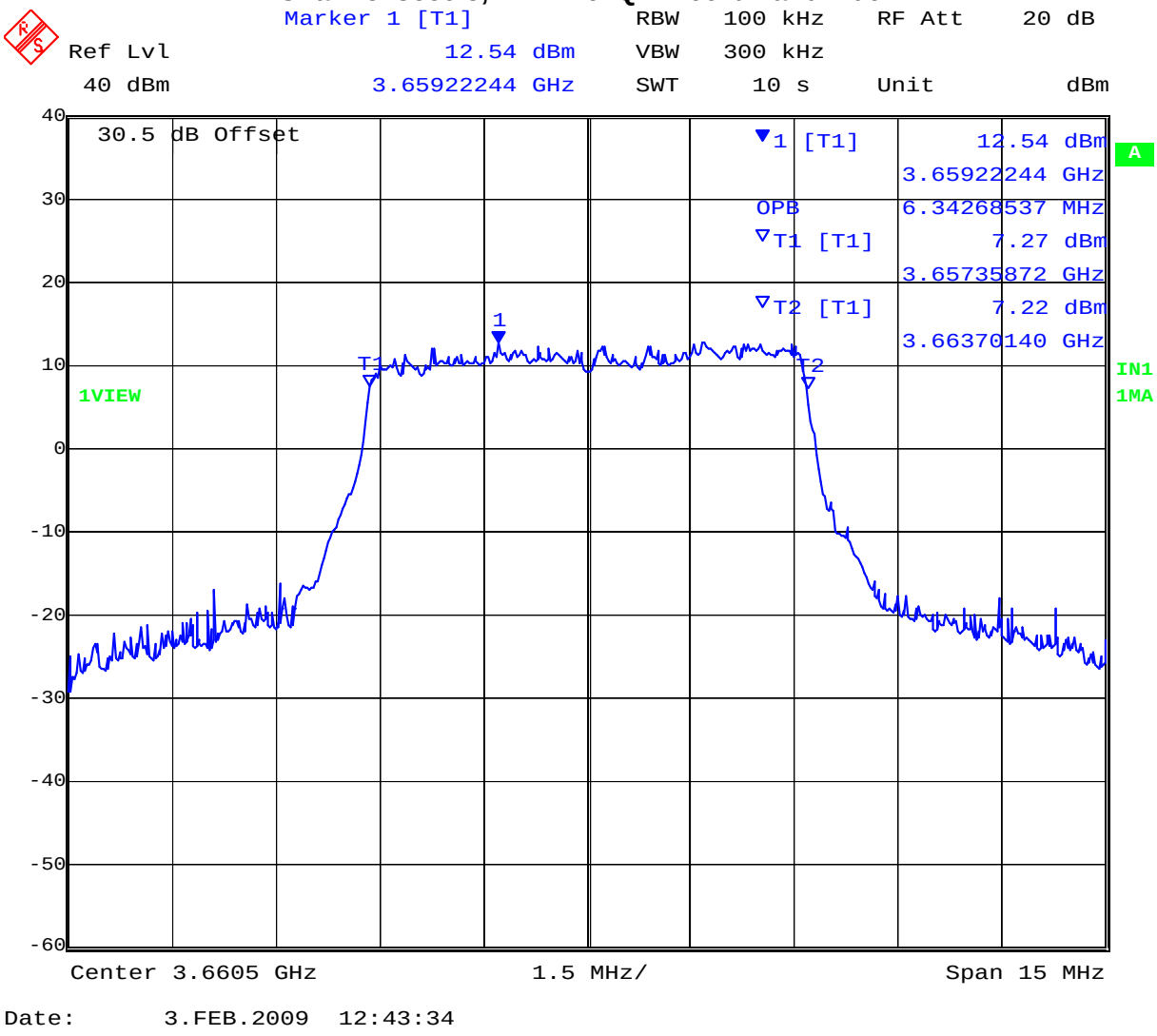
Channel 3672, 3.5 MHz 64QAM 99% Bandwidth



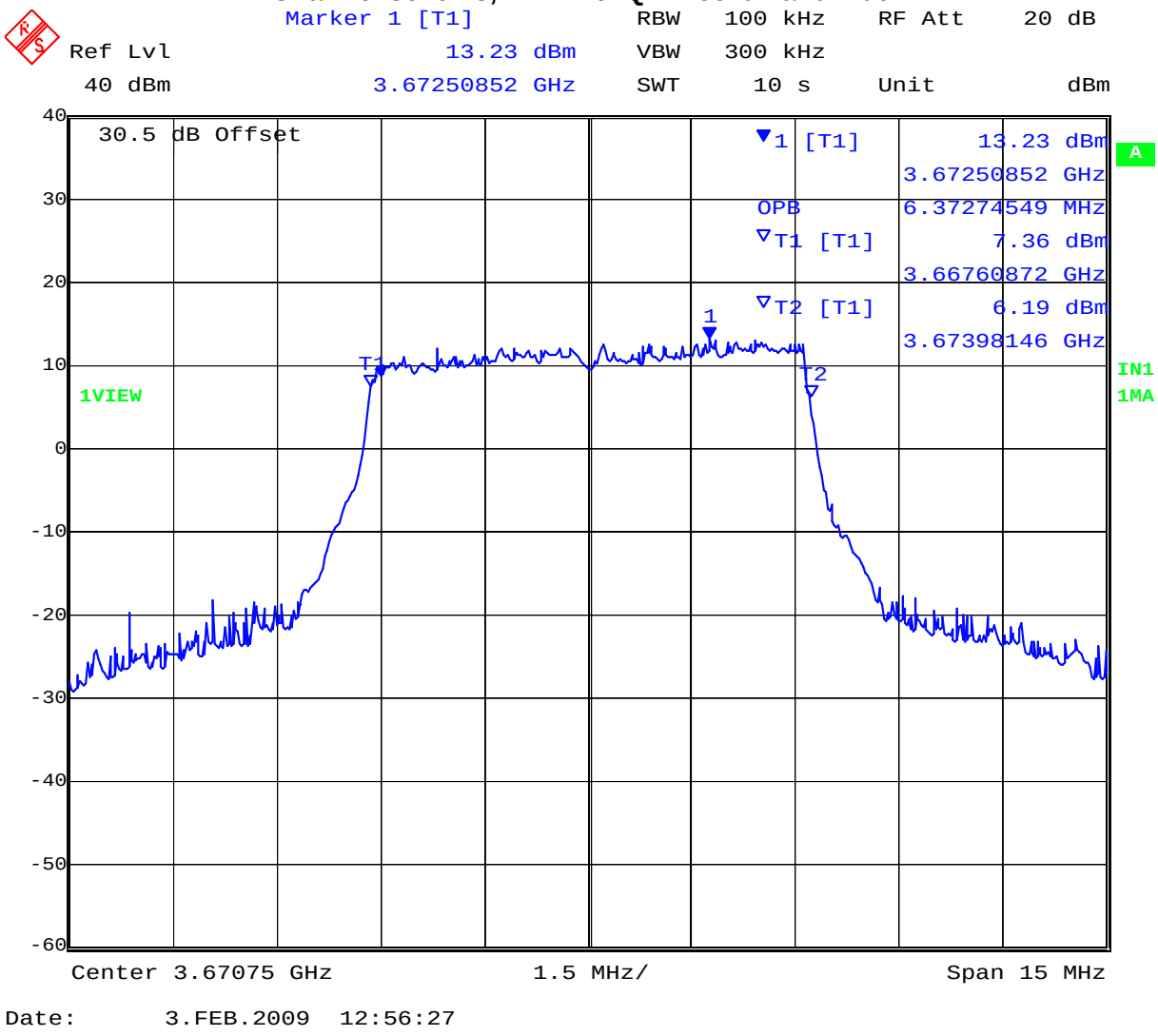
Channel 3654.25, 7 MHz 64QAM 99% Bandwidth



Channel 3660.5, 7 MHz 64QAM 99% Bandwidth



Channel 3670.75, 7 MHz 64QAM 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. Peak Output Power

FCC 47 CFR Part 90, Subpart Z; §90.1321(a)
The following power limits apply to the 3650 – 3675 MHz band.

Base and fixed stations are limited to 25W/25 MHz equivalent isotropically radiated power (EIRP). In any event the peak EIRP power density shall not exceed 1 Watt (+30 dBm) in any one Megahertz slice of spectrum.

Power Limit 3.5 MHz Channel Spacing = +35.4 dBm
Power Limit 7 MHz Channel Spacing = +38.4 dBm

Test Procedure
Average power measurements were measured with the use of an average power head. The system highest power setting was selected with modulation ON.

Test Set-up is shown in Section 3.6 Test Configuration

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

MAXIMUM OUTPUT POWER V'S ANTENNA GAIN

Power Limit 3.5 MHz Channel Spacing V's Antenna Gain

Antenna Type	Gain (dBi)	EIRP Limit (+dBm)	Maximum Permissible Conducted Power (+dBm)
Dipole	8	35.4	+27.4
Panel Sector 60°	17		+18.4
Panel Sector 90°	14		+21.4
Panel Sector 120°	13		+22.4
Panel Sector 18°	18		+17.4

Power Limit 7 MHz Channel Spacing V's Antenna Gain

Antenna Type	Gain (dBi)	EIRP Limit (+dBm)	Maximum Permissible Conducted Power (+dBm)
Dipole	8	38.4	+30.4
Panel Sector 60°	17		+21.4
Panel Sector 90°	14		+24.4
Panel Sector 120°	13		+25.4
Panel Sector 18°	18		+20.4

BPSK Modulation – Antenna Gain

Modulation	Bandwidth (MHz)	Center Frequency (MHz)	Conducted Peak Power (dBm)	EIRP Limit (dBm)
BPSK	3.5	3652.5	+19.20	+35.4
		3662.5	+20.06	+35.4
		3672	+18.58	+35.4
	7	3654.25	+19.20	+38.4
		3660.5	+19.22	+38.4
		3670.75	+18.74	+38.4

QPSK Modulation

Modulation	Bandwidth (MHz)	Center Frequency (MHz)	Conducted Peak Power (dBm)	EIRP Limit (dBm)
QPSK	3.5	3652.5	+19.11	+35.4
		3662.5	+19.26	+35.4
		3672	+18.79	+35.4
	7	3654.25	+19.24	+38.4
		3660.5	+19.01	+38.4
		3670.75	+18.79	+38.4

16QAM Modulation

Modulation	Bandwidth (MHz)	Center Frequency (MHz)	Conducted Peak Power (dBm)	EIRP Limit (dBm)
16QAM	3.5	3652.5	+19.10	+35.4
		3662.5	+19.50	+35.4
		3672	+18.72	+35.4
	7	3654.25	+19.13	+38.4
		3660.5	+19.11	+38.4
		3670.75	+19.60	+38.4

64QAM Modulation

Modulation	Bandwidth (MHz)	Center Frequency (MHz)	Conducted Peak Power (dBm)	EIRP Limit (dBm)
64QAM	3.5	3652.5	+19.13	+35.4
		3662.5	+18.82	+35.4
		3672	+18.56	+35.4
	7	3654.25	+19.13	+38.4
		3660.5	+19.21	+38.4
		3670.75	+18.70	+38.4

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. Power Spectral Density

FCC 47 CFR Part 90, Subpart Z; §90.1321(a)

The following power limits apply to the 3650 – 3675 MHz band.

Base and fixed stations are limited to 25W/25 MHz equivalent isotropically radiated power (EIRP). In any event the peak EIRP power density shall not exceed 1 Watt (+30 dBm) in any one Megahertz slice of spectrum.

Power Limit 3.5 MHz Channel Spacing = +35.4 dBm
Power Limit 7 MHz Channel Spacing = +38.4 dBm

Test Procedure
The test methodology used for this measurement was determined to provide the highest possible power density readings.

Power spectral density measurements were performed via the spectrum analyzer and plots were recorded. The system highest power setting was selected and modulation was ON.

Test Set-up is shown in Section 3.6 Test Configuration

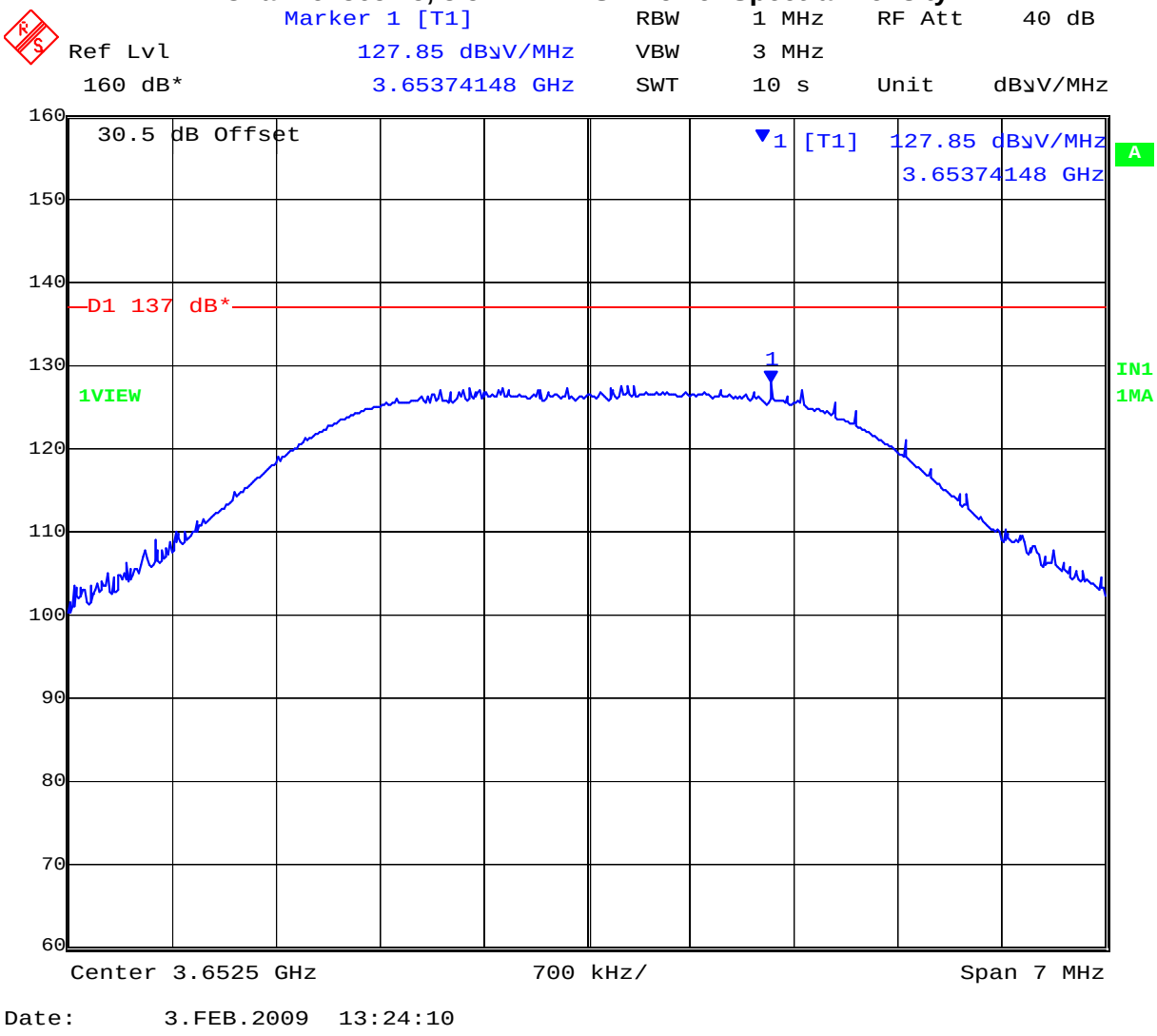
Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

BPSK Modulation

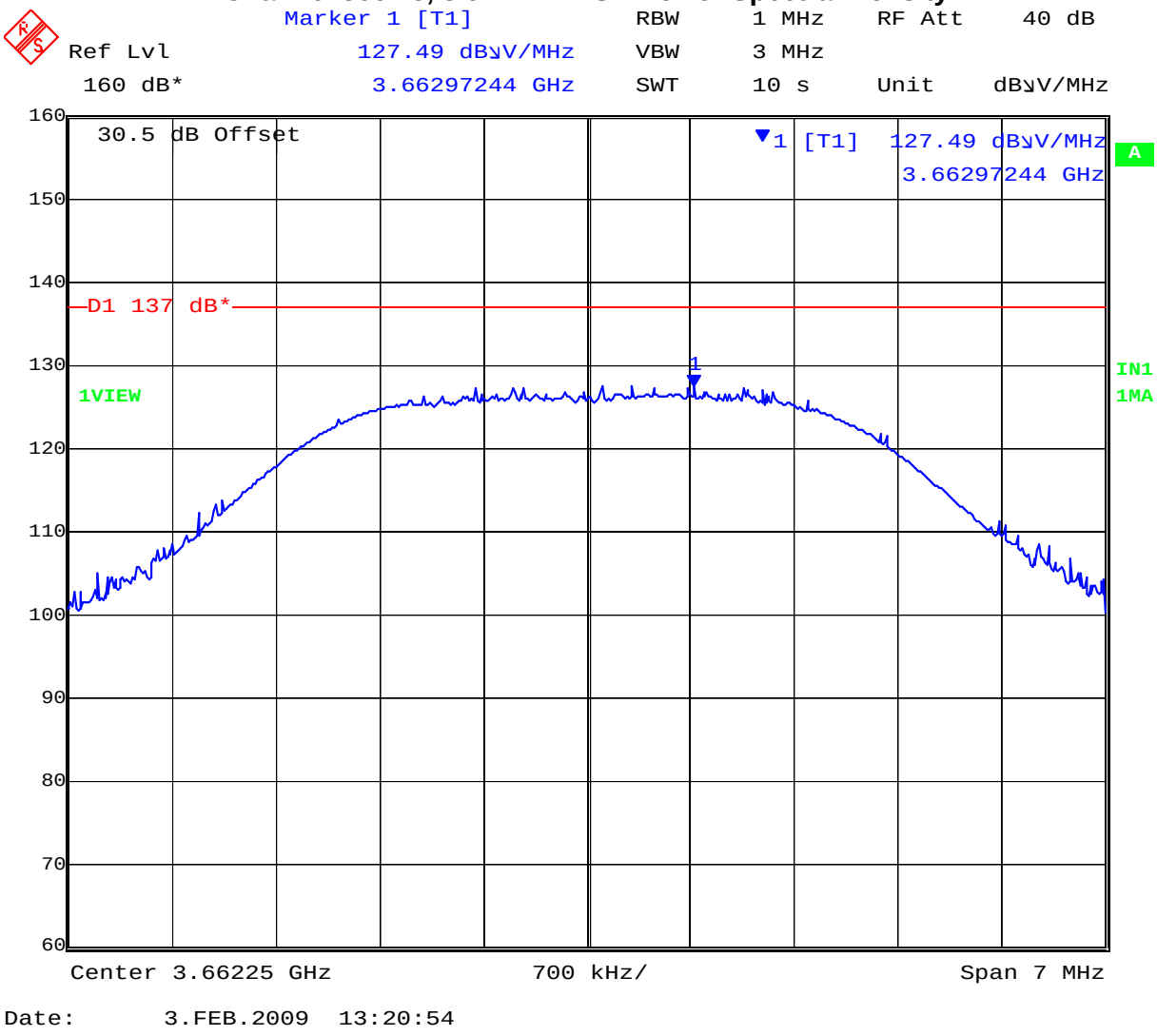
Modulation	Bandwidth (MHz)	Center Frequency (MHz)	Frequency of Emission (MHz)	PPSD (dBm/MHz)	Limit (dBm)	Margin (dB)
BPSK	3.5	3652.5	3653.74148	20.85	+30.0	-9.15
		3662.5	3662.97244	20.49		-9.51
		3672	3672.91884	20.85		-9.15
	7	3654.25	3656.42435	19.25		-10.75
		3660.5	3662.57415	19.76		-10.24
		3670.75	3672.10271	19.52		-10.48

NOTE: dBm/MHz = dBµV/MHz - 107

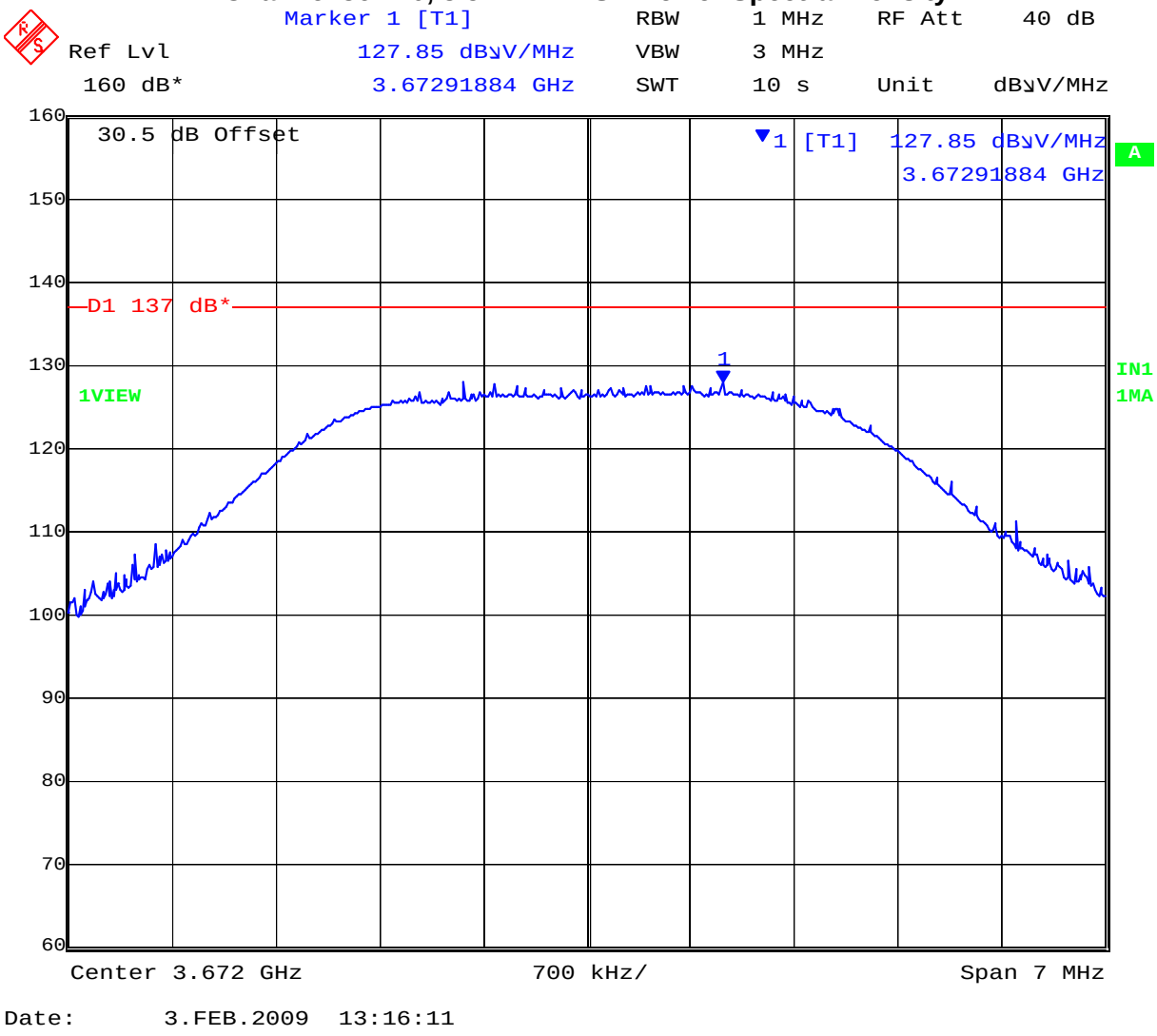
Channel 3652.5, 3.5 MHz BPSK Power Spectral Density



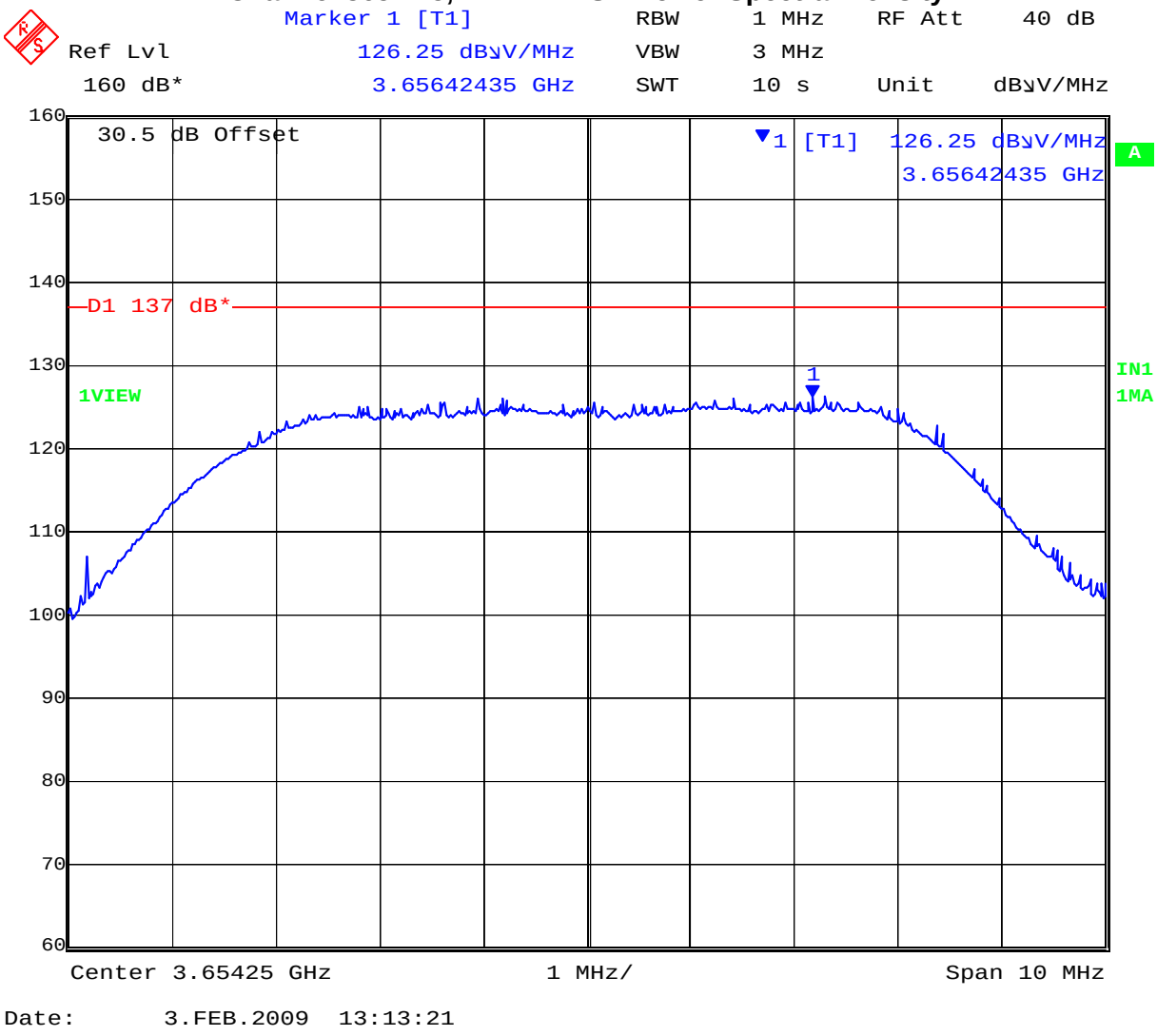
Channel 3662.5, 3.5 MHz BPSK Power Spectral Density



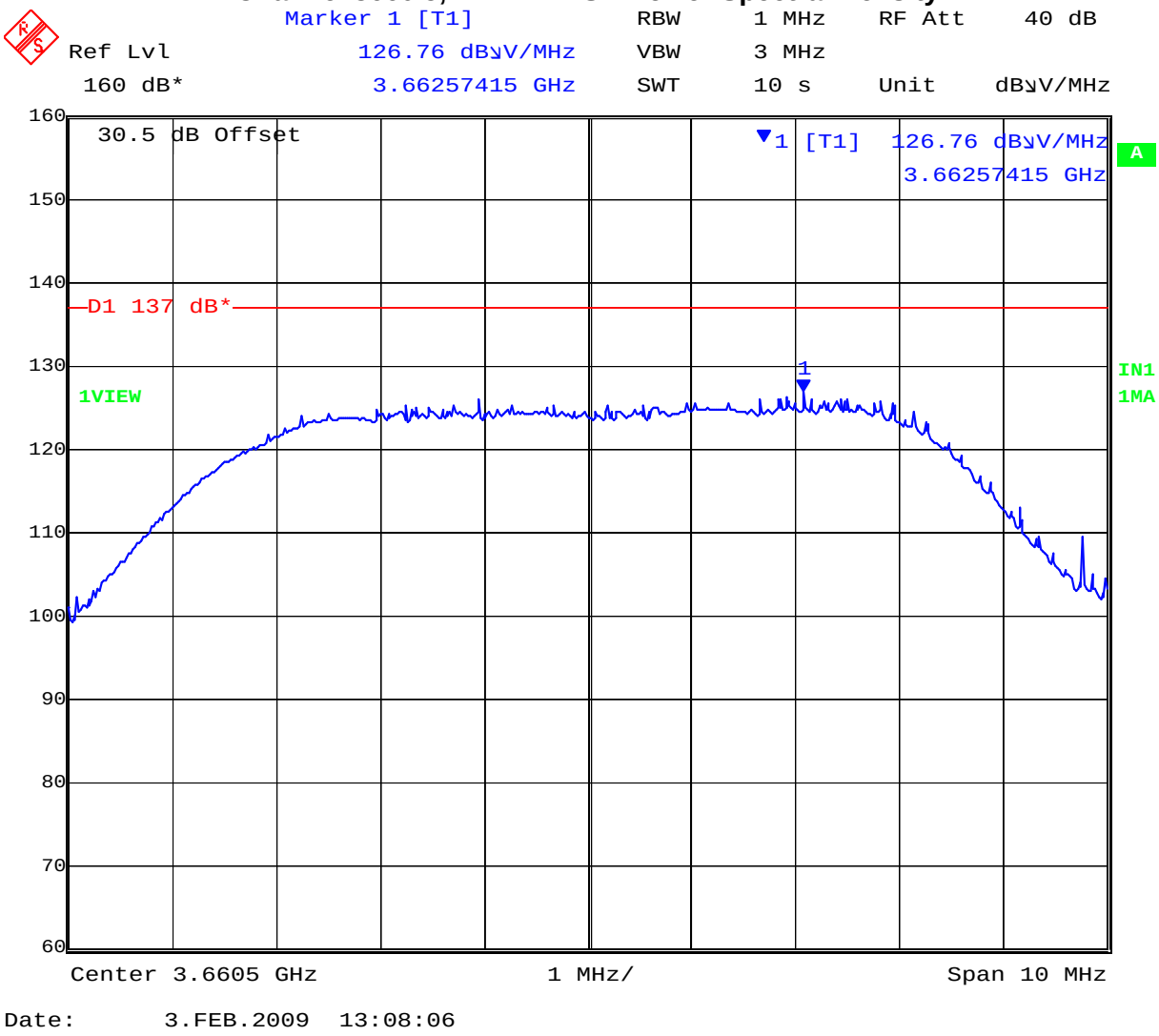
Channel 3672.0, 3.5 MHz BPSK Power Spectral Density



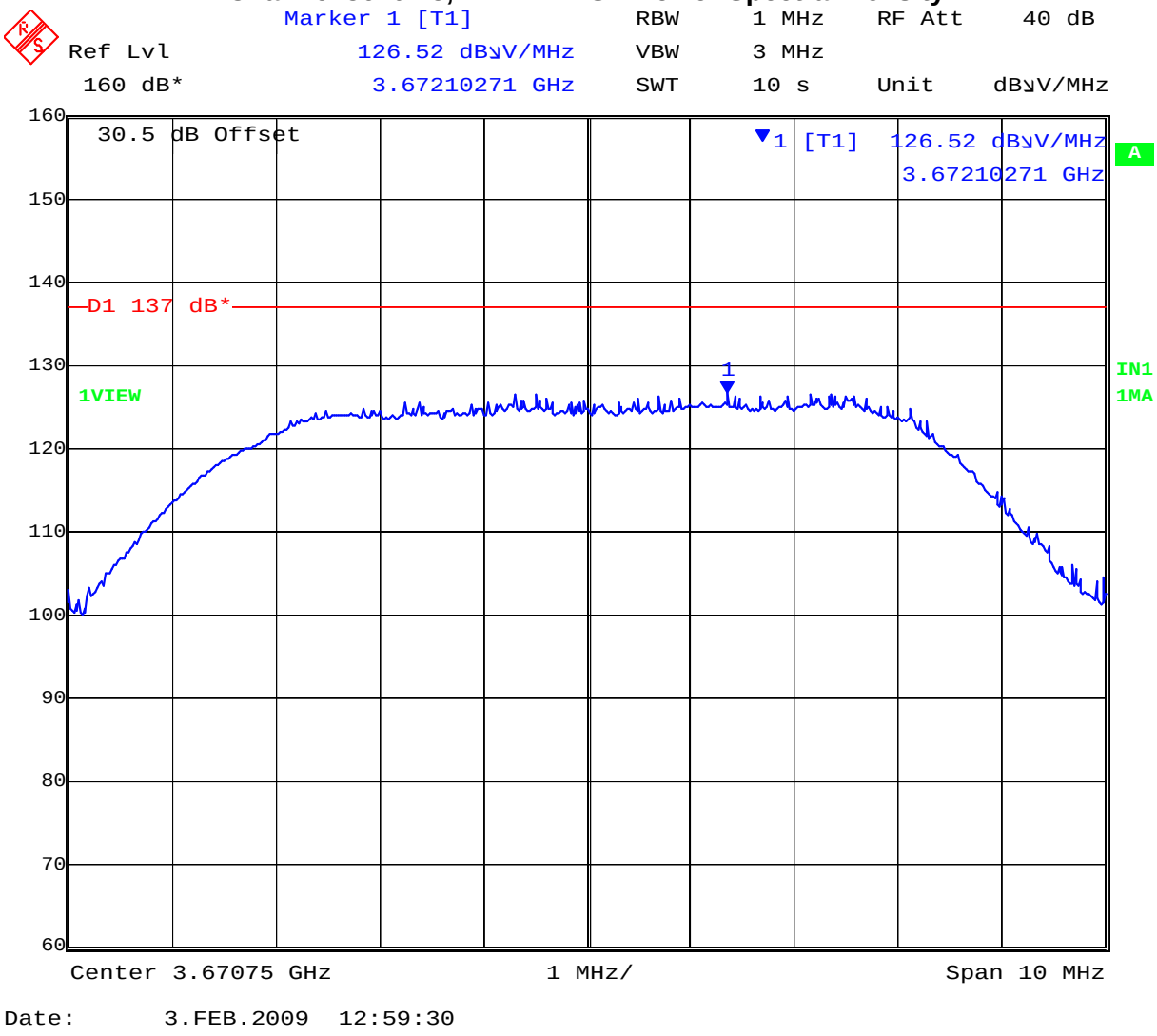
Channel 3654.25, 7 MHz BPSK Power Spectral Density



Channel 3660.5, 7 MHz BPSK Power Spectral Density



Channel 3670.75, 7 MHz BPSK Power Spectral Density



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.

5.1.4. 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 Proxim 3650 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 7 MHz bandwidth (higher power level).

where the two transmitters are operating simultaneously in the same band. The Peak Power in mW is calculated by taking the maximum allowable conducted power in each band and multiplying by 2.

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 Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm^2 Limit(cm)	Minimum Separation Distance (cm)
3650	18	63.1	+20.4	109.6	23.5	23.5

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 = 5mW / 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

5.1.5. 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 modulated operational mode as the transmitter could not operate Continuous Wave (CW). Further there was no carrier breakthrough available to provide a measurement point. Frequency error was measured using the 6 dB points on the spectrum mask and center frequency calculated as Marker 1 + ½ Delta Marker 1.

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.

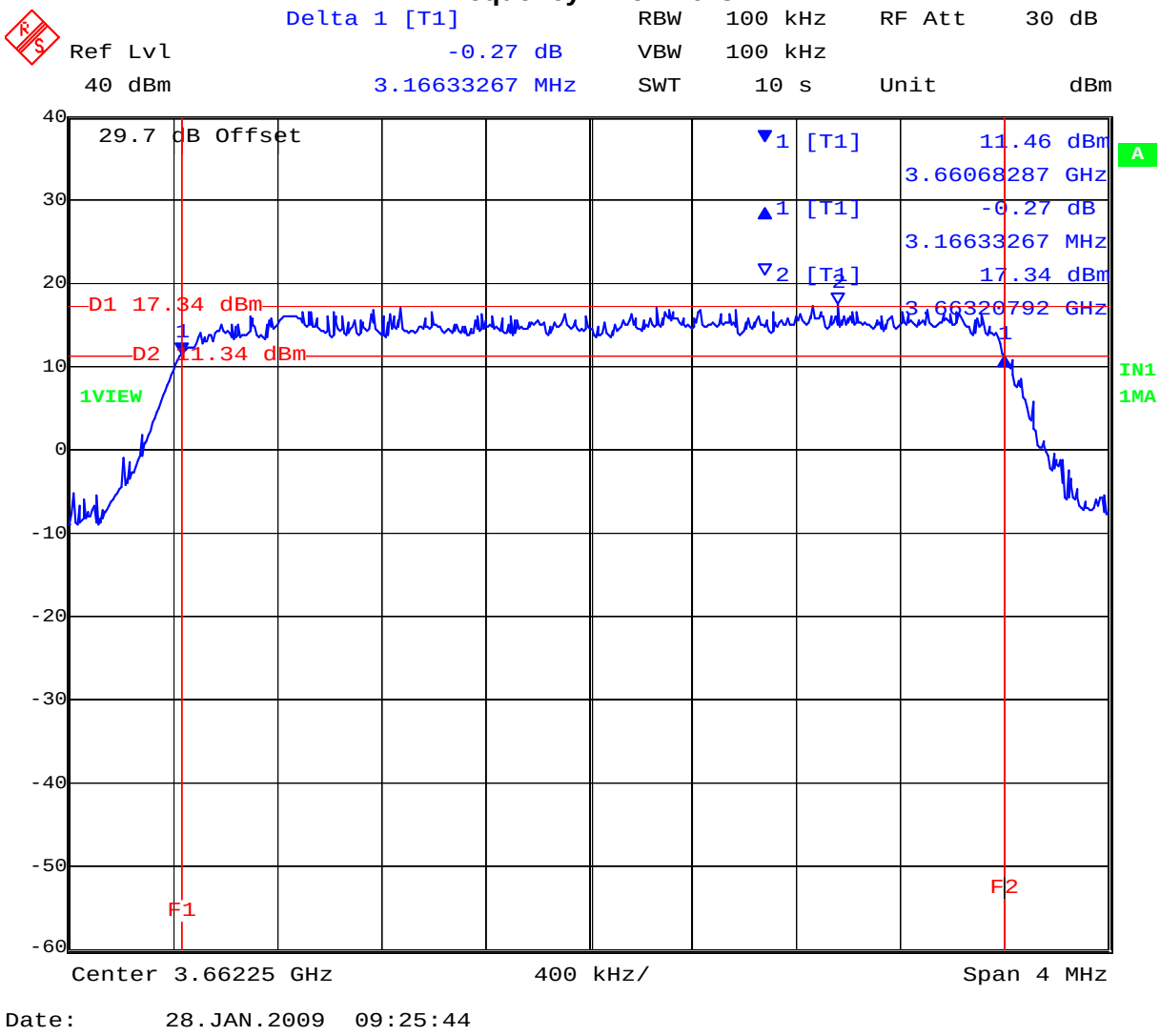
Test Set-up is shown in Section 3.6 Test Configuration

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

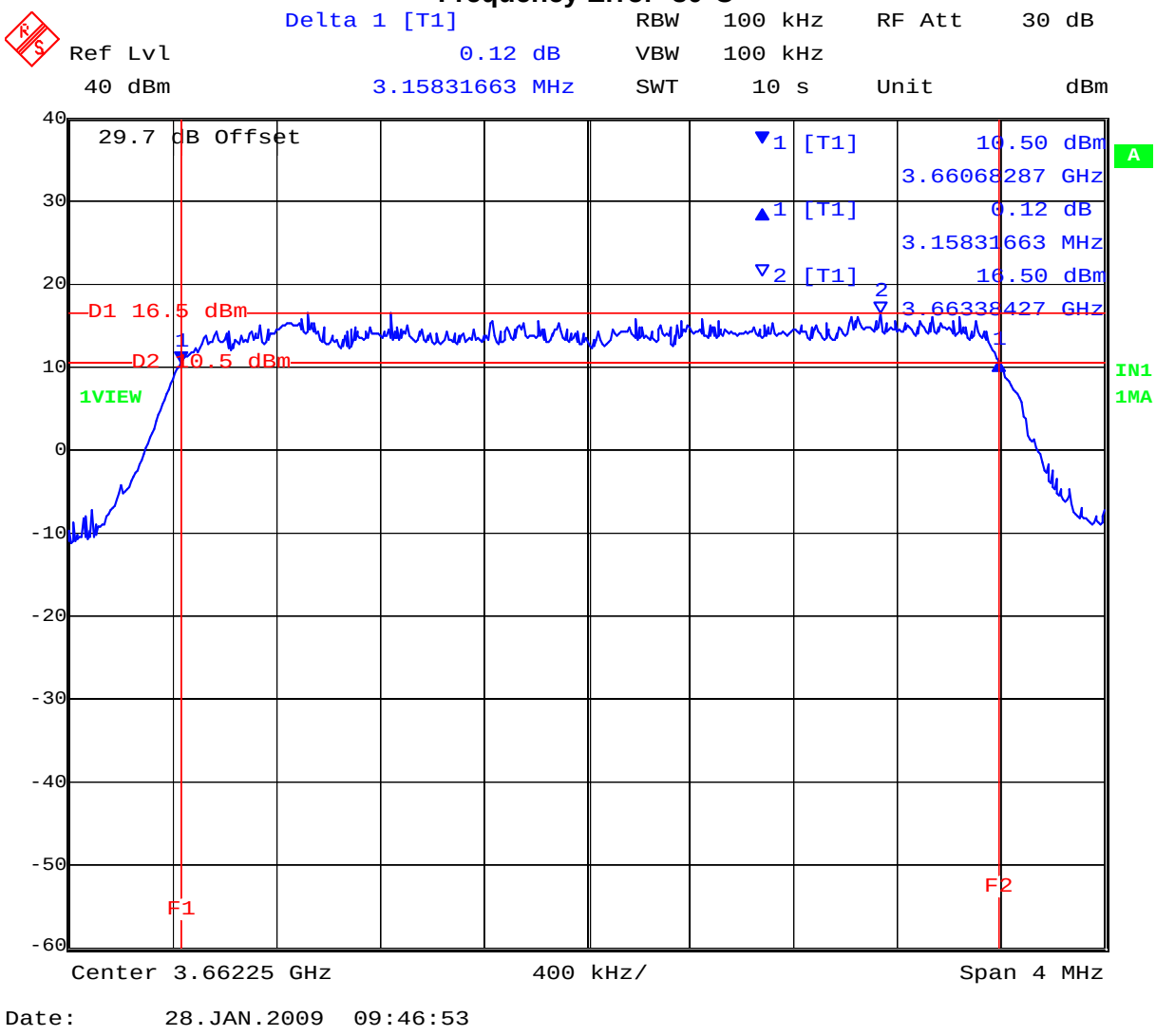
TABLE OF RESULTS Frequency Stability – Channel Measured 3662.25 MHz

Voltage	Temp. (°C)	Marker 1 (MHz)	Δ Marker 1 (MHz)	Center Frequency (MHz)	Delta (kHz)	ppm
48 Vdc	-40	3660.6829	3.1663	3662.2660	+16.036	+4.379
	-30	3660.6829	3.1583	3662.2620	+12.028	+3.284
	-20	3660.6989	3.1423	3662.2700	+20.042	+5.473
	-10	3660.6829	3.1663	3662.2660	+16.036	+4.379
	+0	3660.6829	3.1583	3662.2620	+12.028	+3.284
	+10	3660.6829	3.1743	3662.2700	+20.044	+5.473
	+20	3660.6829	3.1663	3662.2660	+16.036	+4.379
52.8Vdc	+20	3660.6829	3.1663	3662.2660	+16.036	+4.379
43.2Vdc	+20	3660.6829	3.1663	3662.2660	+16.036	+4.379
48 Vdc	+30	3660.6829	3.1583	3662.2620	+12.028	+3.284
	+40	3660.6668	3.1824	3662.2580	+8.012	+2.188
	+50	3660.6749	3.1663	3662.2580	+8.016	+2.189
	+60	3660.6829	3.1583	3662.2620	+12.028	+3.284
Maximum Frequency Drift with respect to the nominal frequency		+8.012kHz / +20.042kHz +2.188ppm / +5.473ppm				

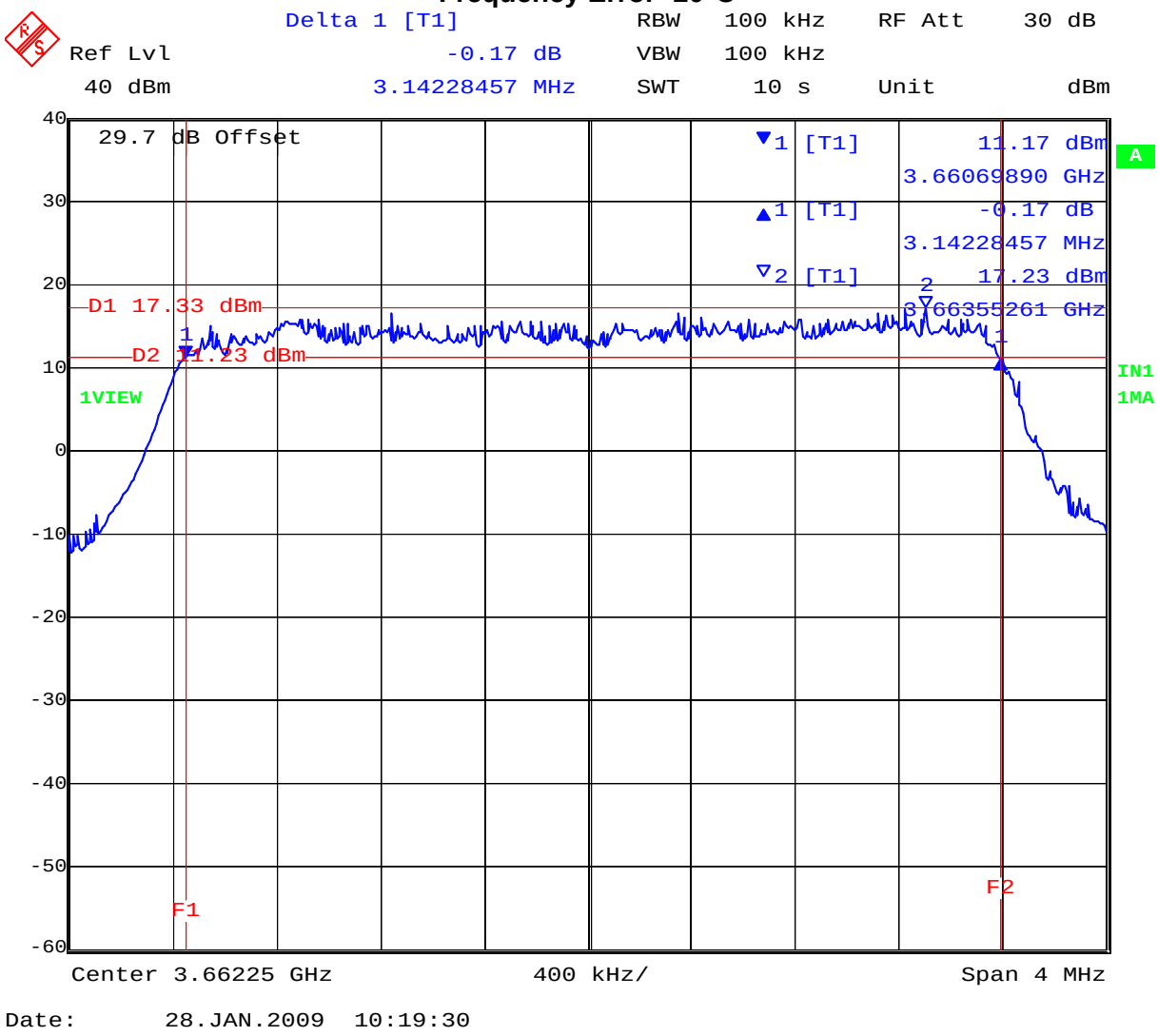
Frequency Error -40°C



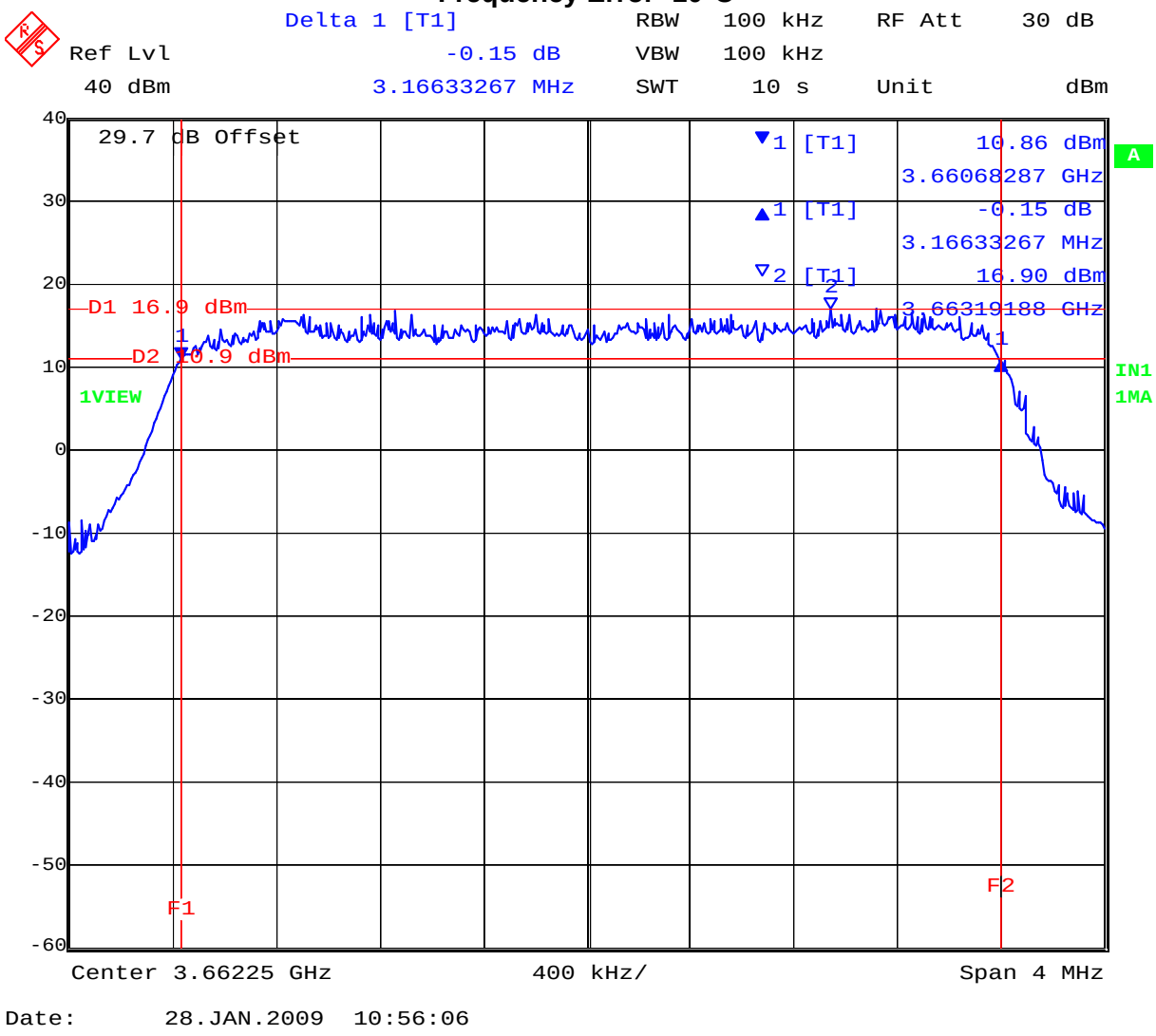
Frequency Error -30°C



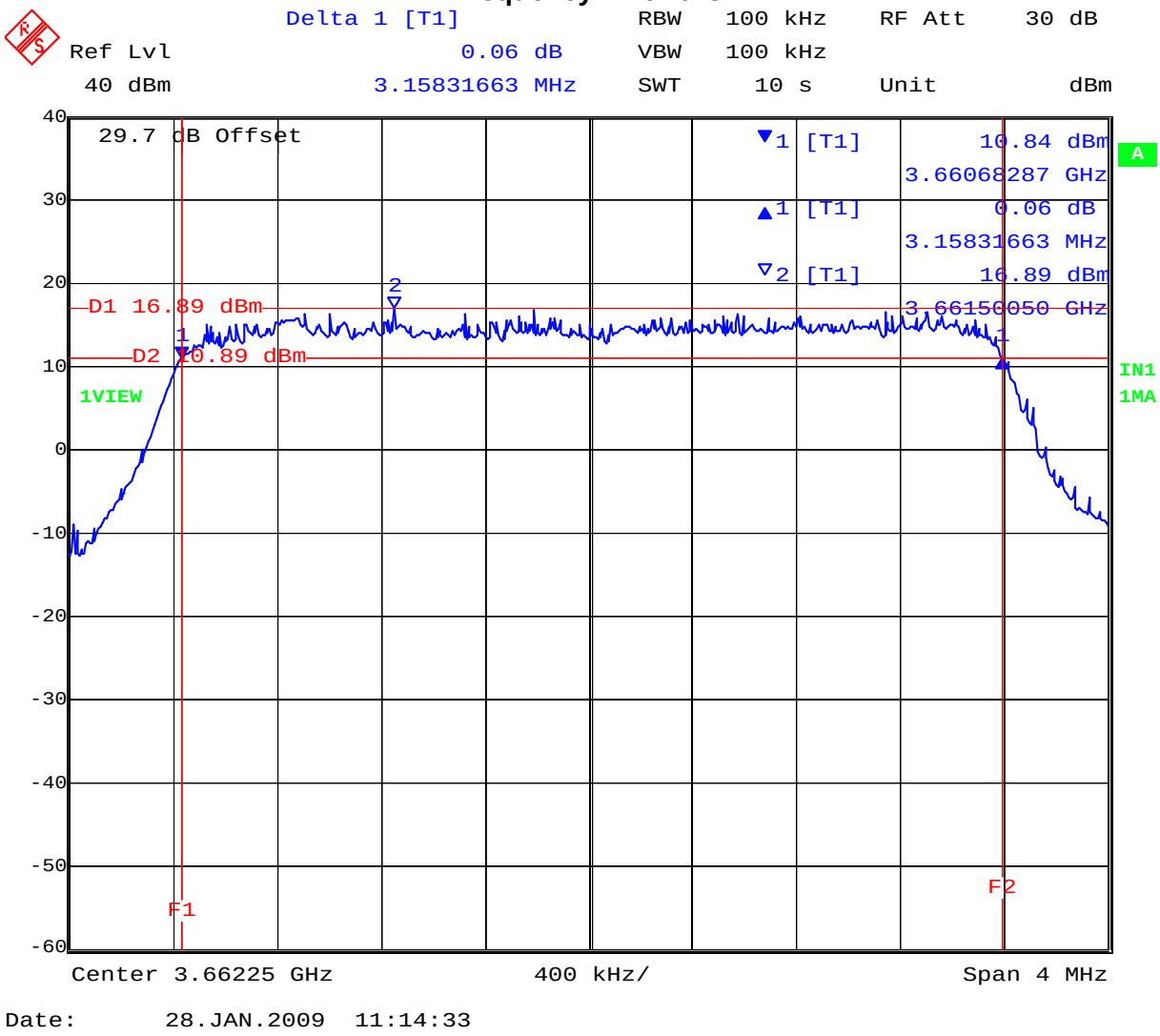
Frequency Error -20°C



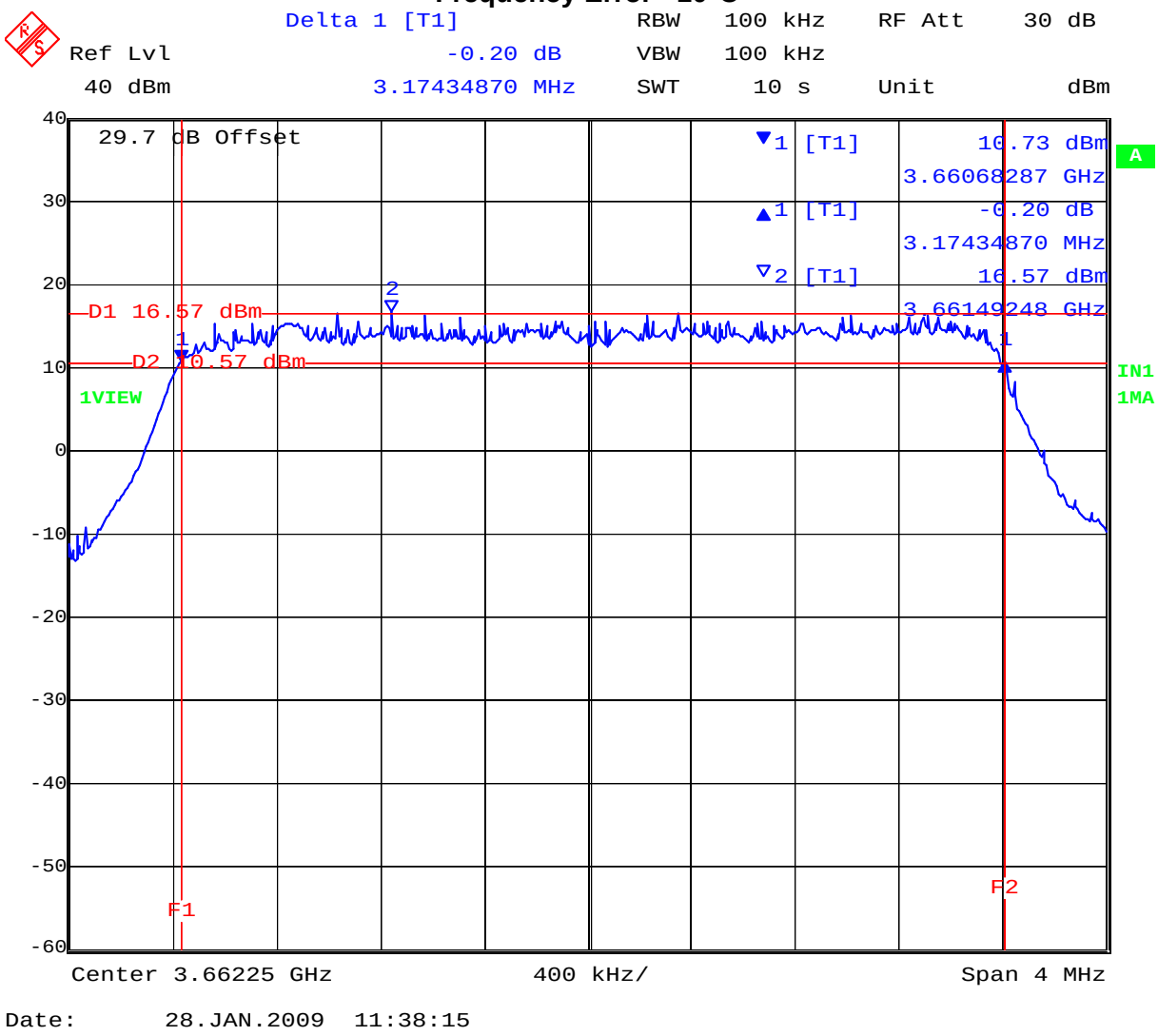
Frequency Error -10°C



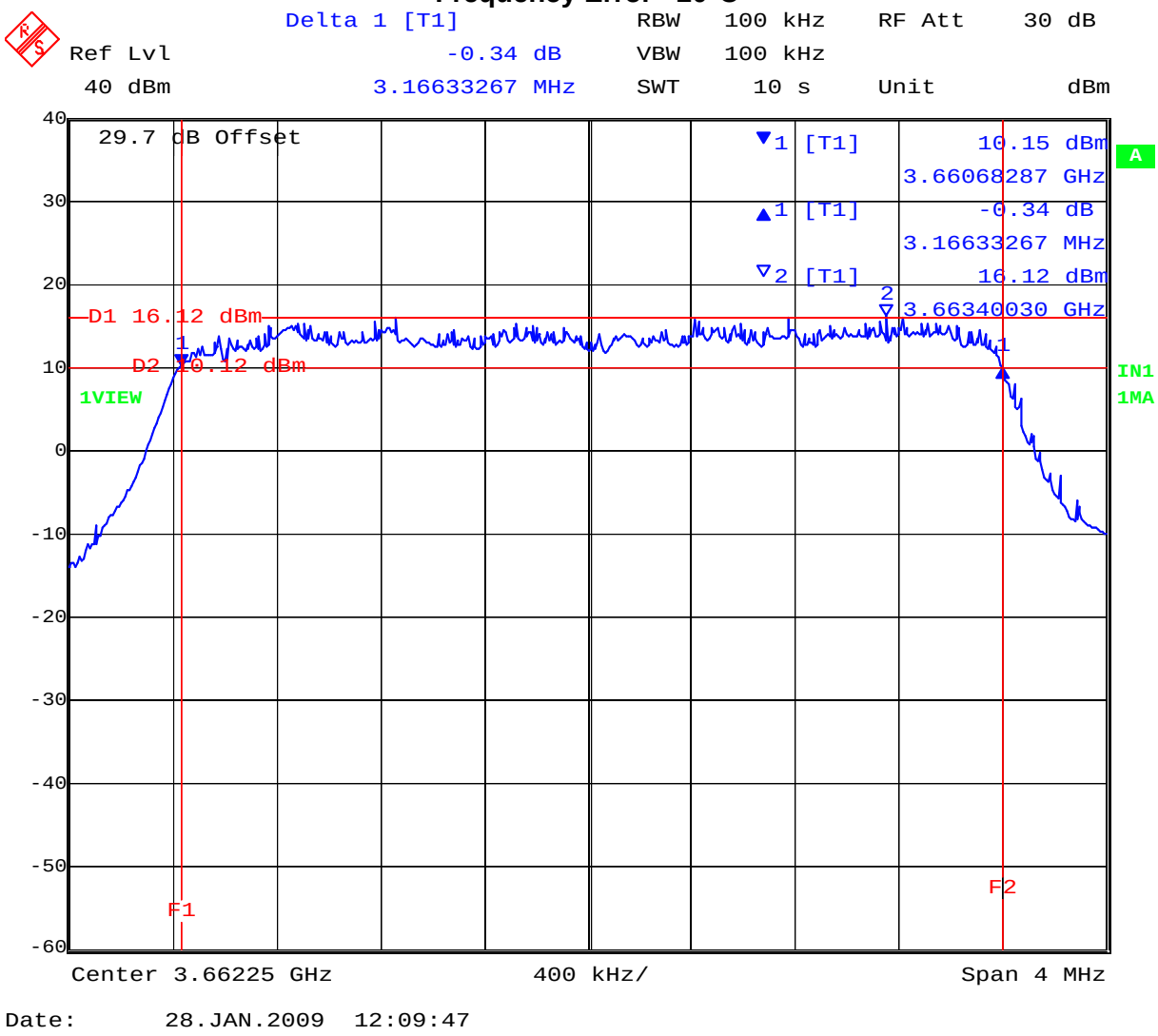
Frequency Error 0°C



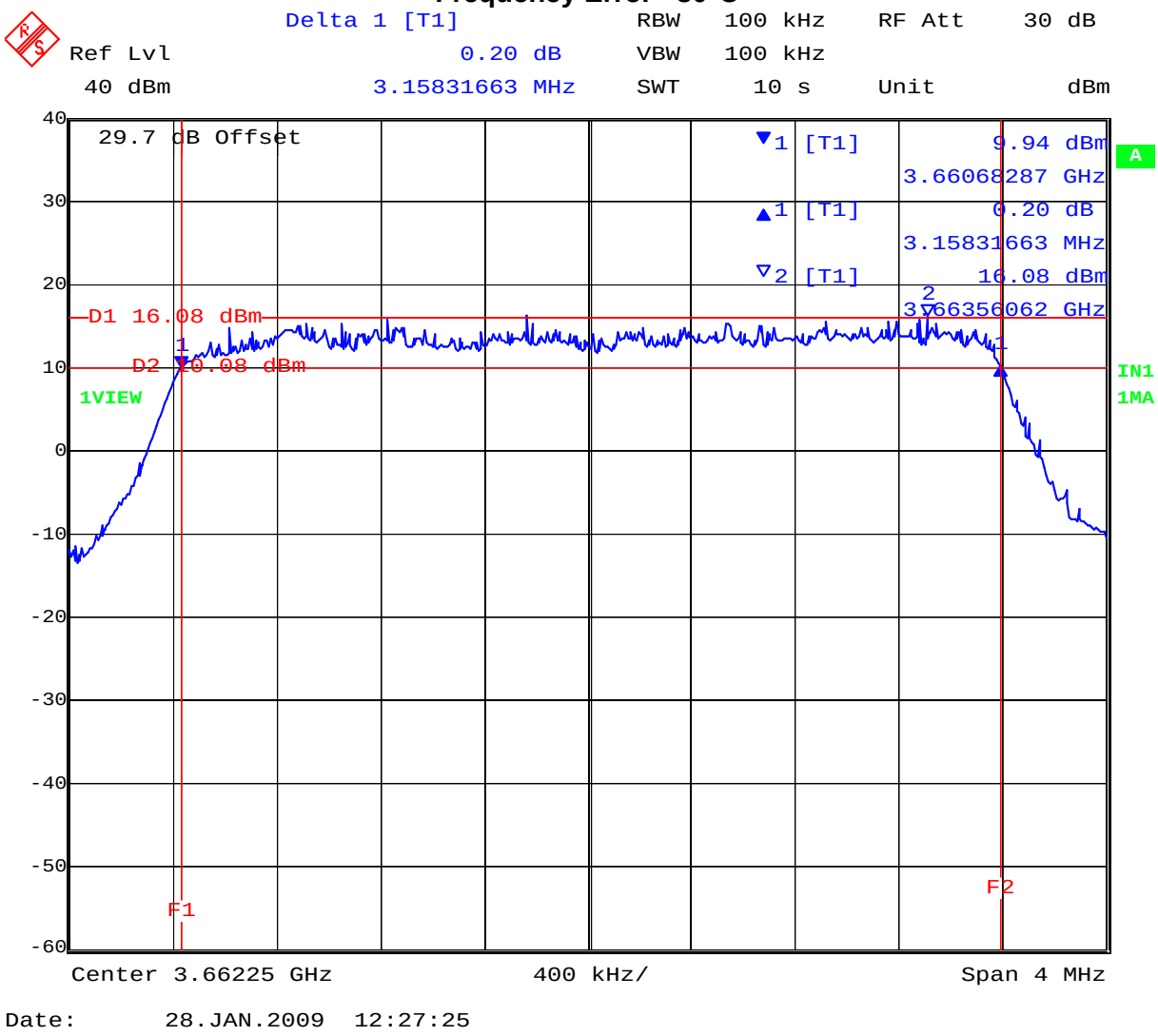
Frequency Error +10°C



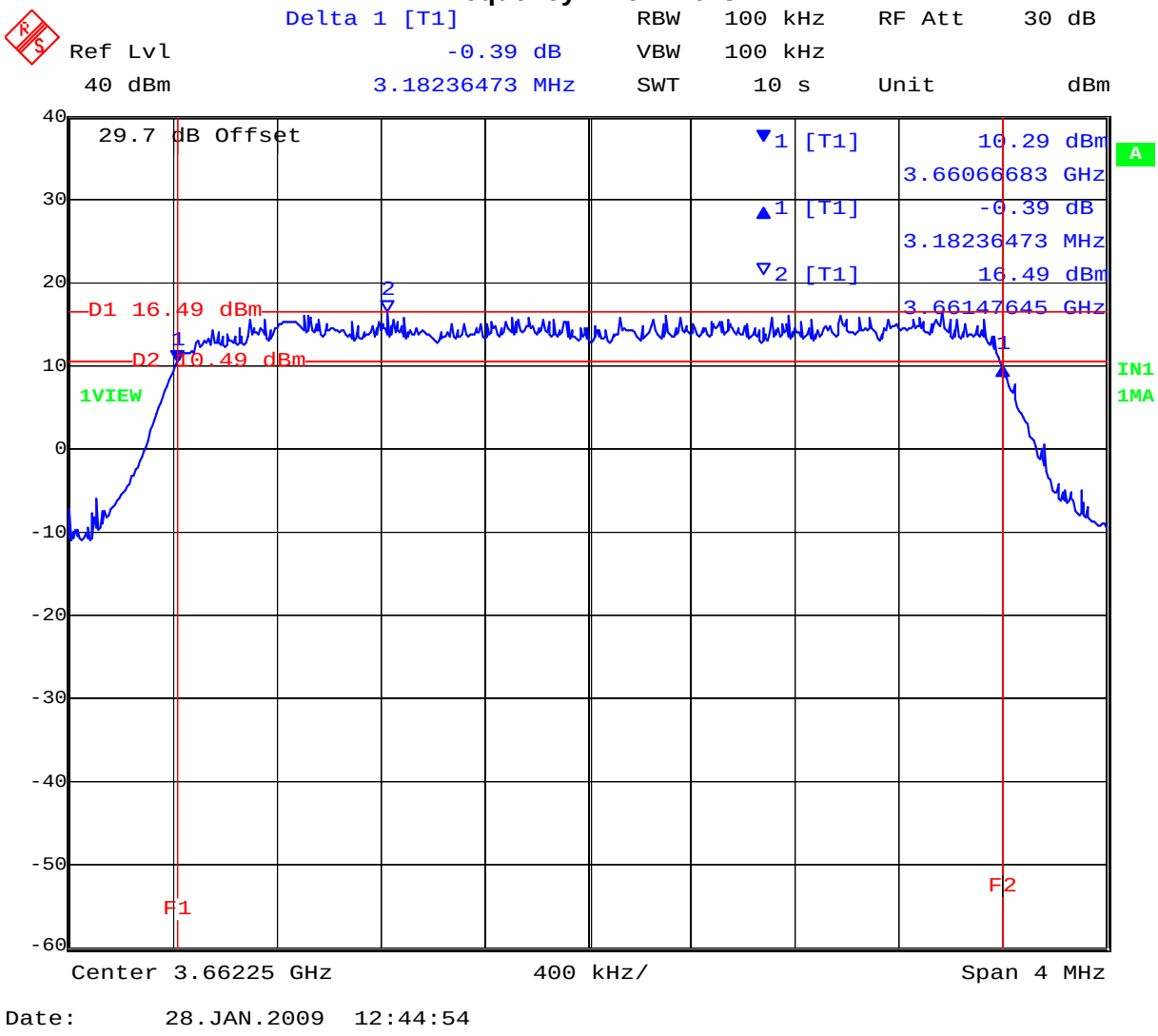
Frequency Error +20°C



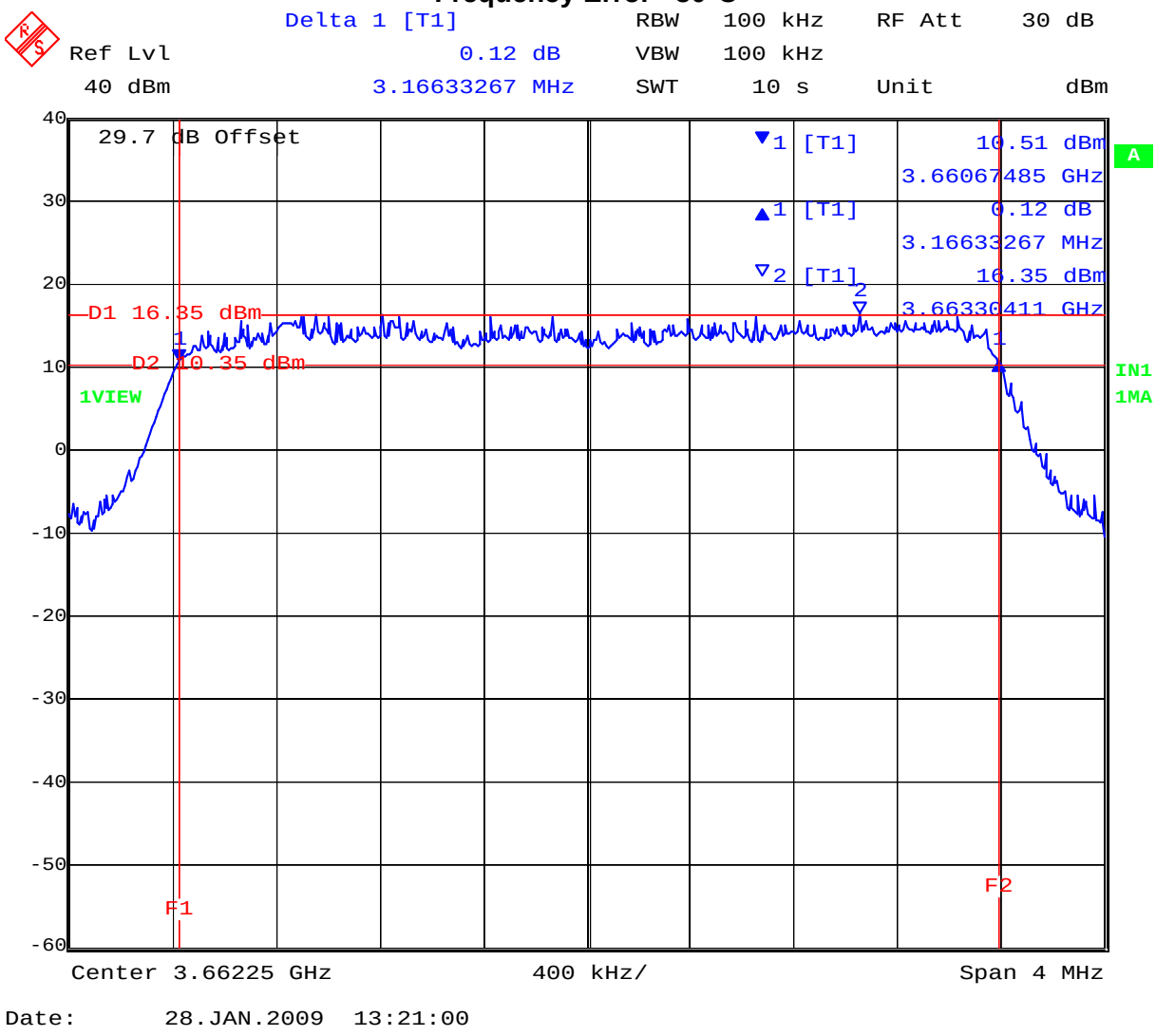
Frequency Error +30°C



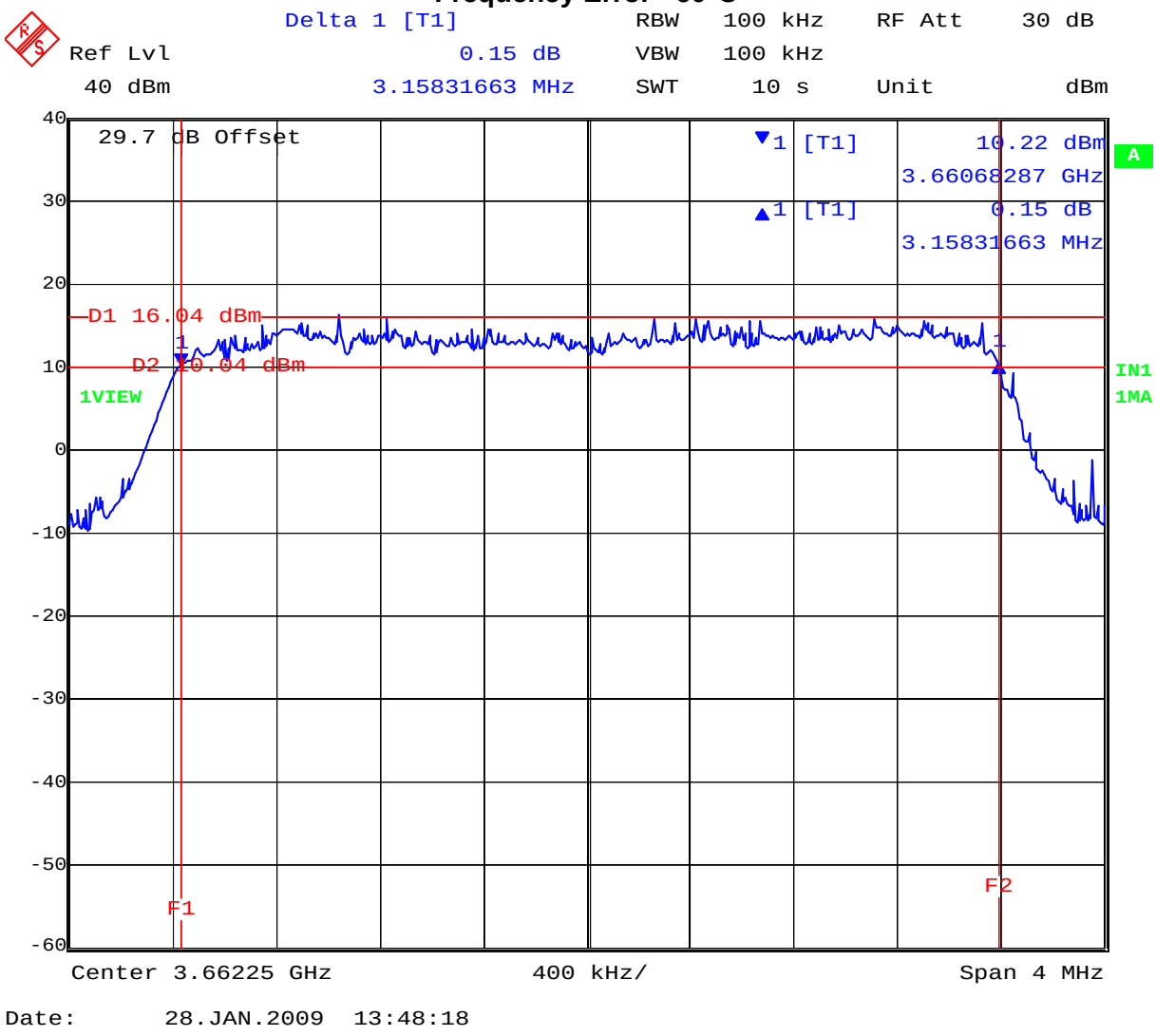
Frequency Error +40°C



Frequency Error +50°C



Frequency Error +60°C



Manufacturers Specification for Frequency Stability

As no apparent frequency stability limits were provided the manufacturer's specification was used ±20 ppm.

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.

5.1.6. Spurious Emissions at Antenna Terminals

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

5.1.6.1. Transmitter Conducted Spurious Emissions (30 M- 40 GHz)

Test Procedure
Transmitter conducted spurious emissions were measured for BPSK modulation state only. Measurement were made while EUT was operating in a modulated transmit mode of operation, at the appropriate center frequency. Conducted spurious emissions were measured to 40 GHz in a peak hold mode.

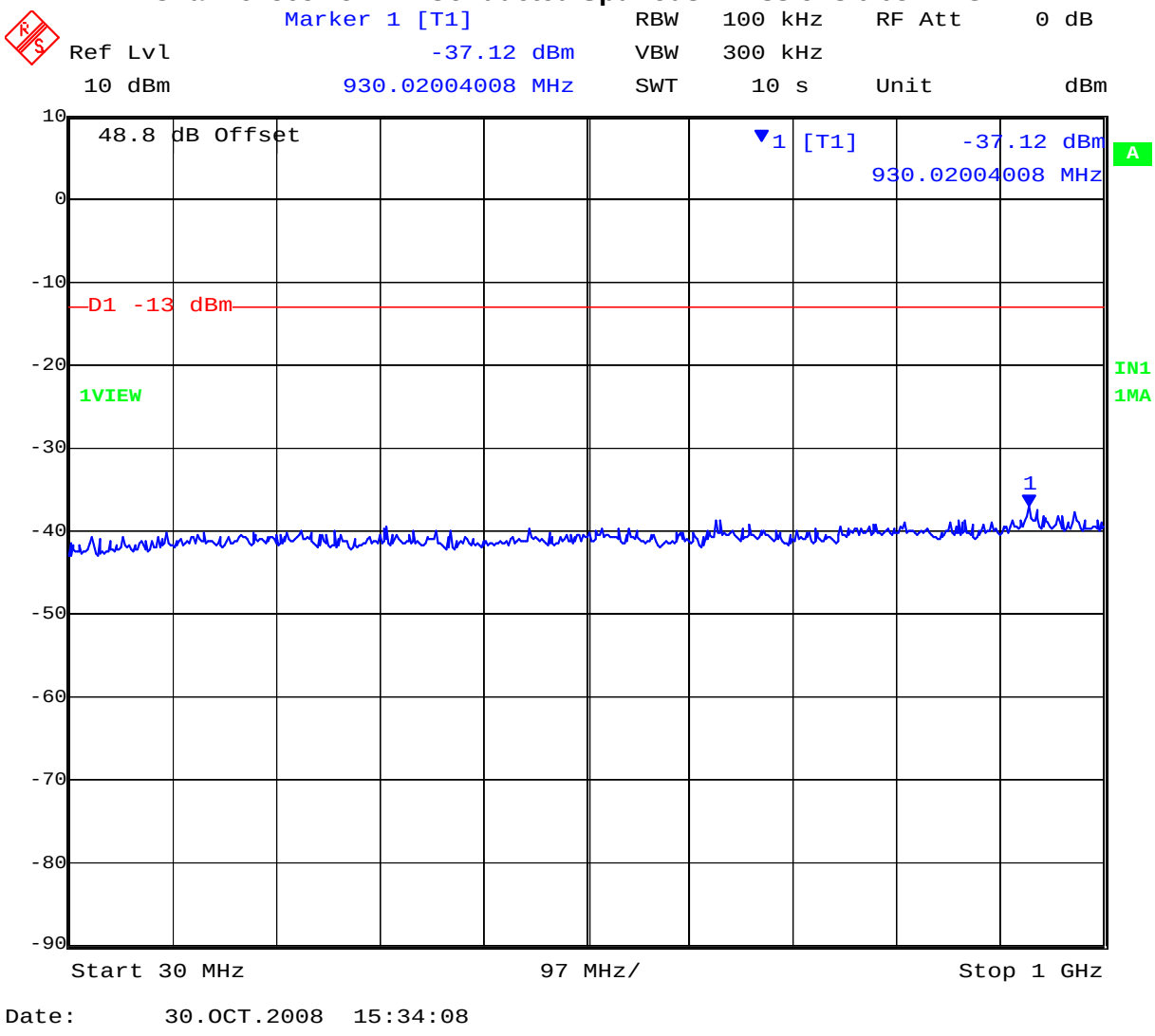
Test Set-up is shown in Section 3.6 Test Configuration

Limit
For operation in the 3650 – 3700 band the power of any emission outside the frequency band of operation shall be attenuated below the transmitter power (P) within the licensed band of operation, measured in Watts, by at least 43 + 10*Log (P) = -13dBm.

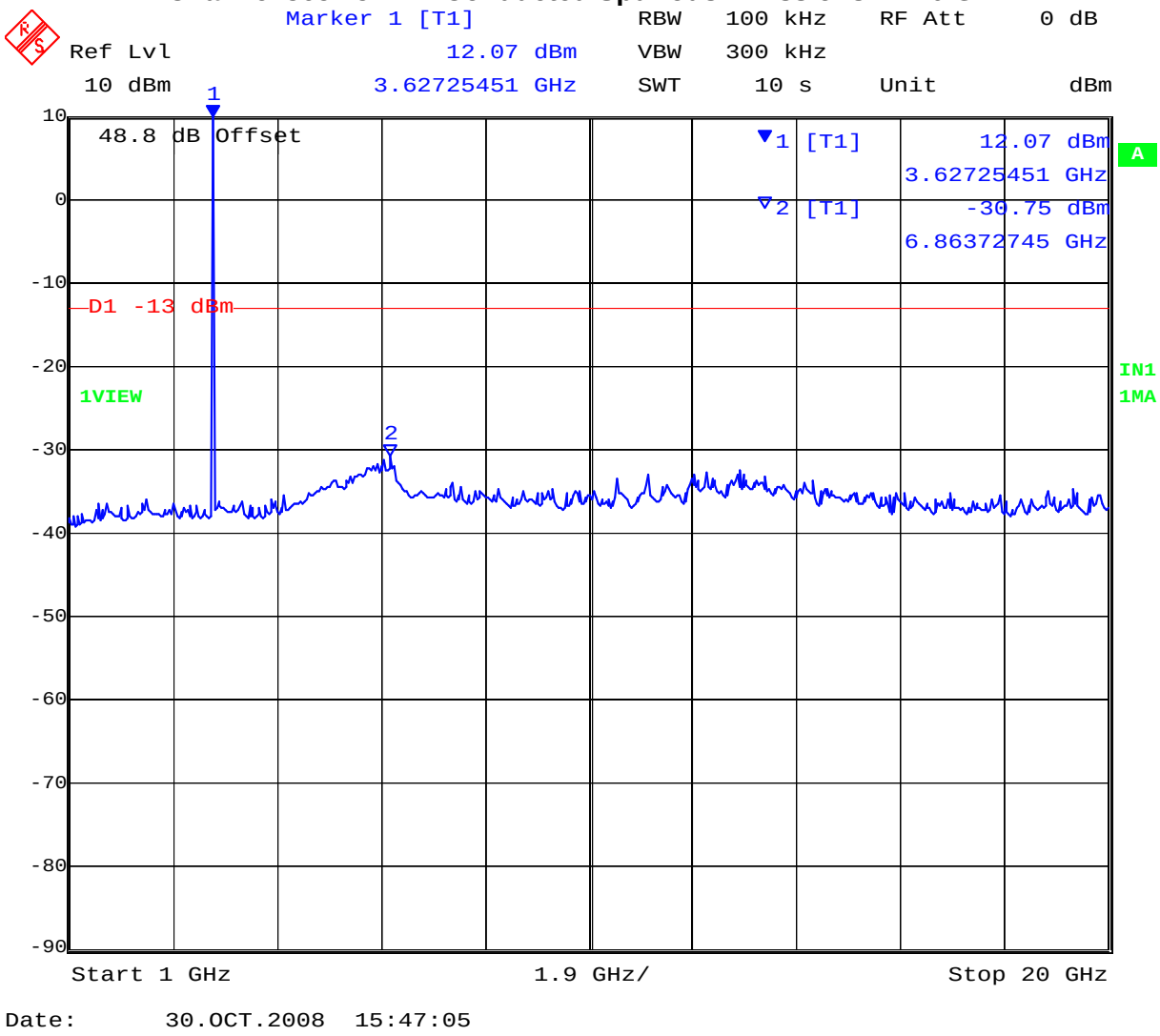
Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
3652.5	30	1,000	-37.12	-13.0	-24.12
	1,000	20,000	-30.75		-17.75
	20,000	40,000	-21.53		-8.53

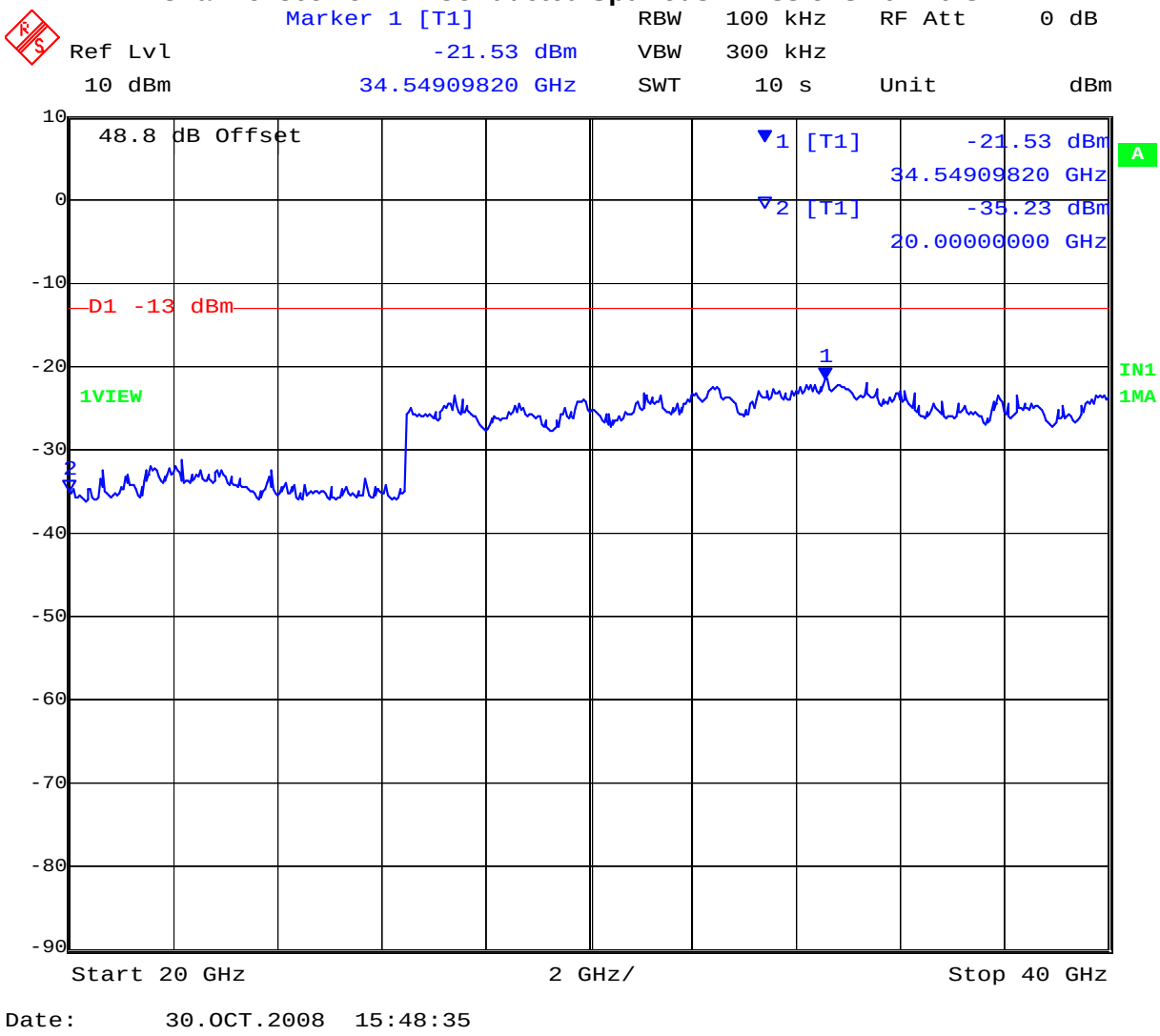
Channel 3652.5 MHz Conducted Spurious Emissions 0.03 – 1 GHz



Channel 3652.5 MHz Conducted Spurious Emissions 1 - 20 GHz

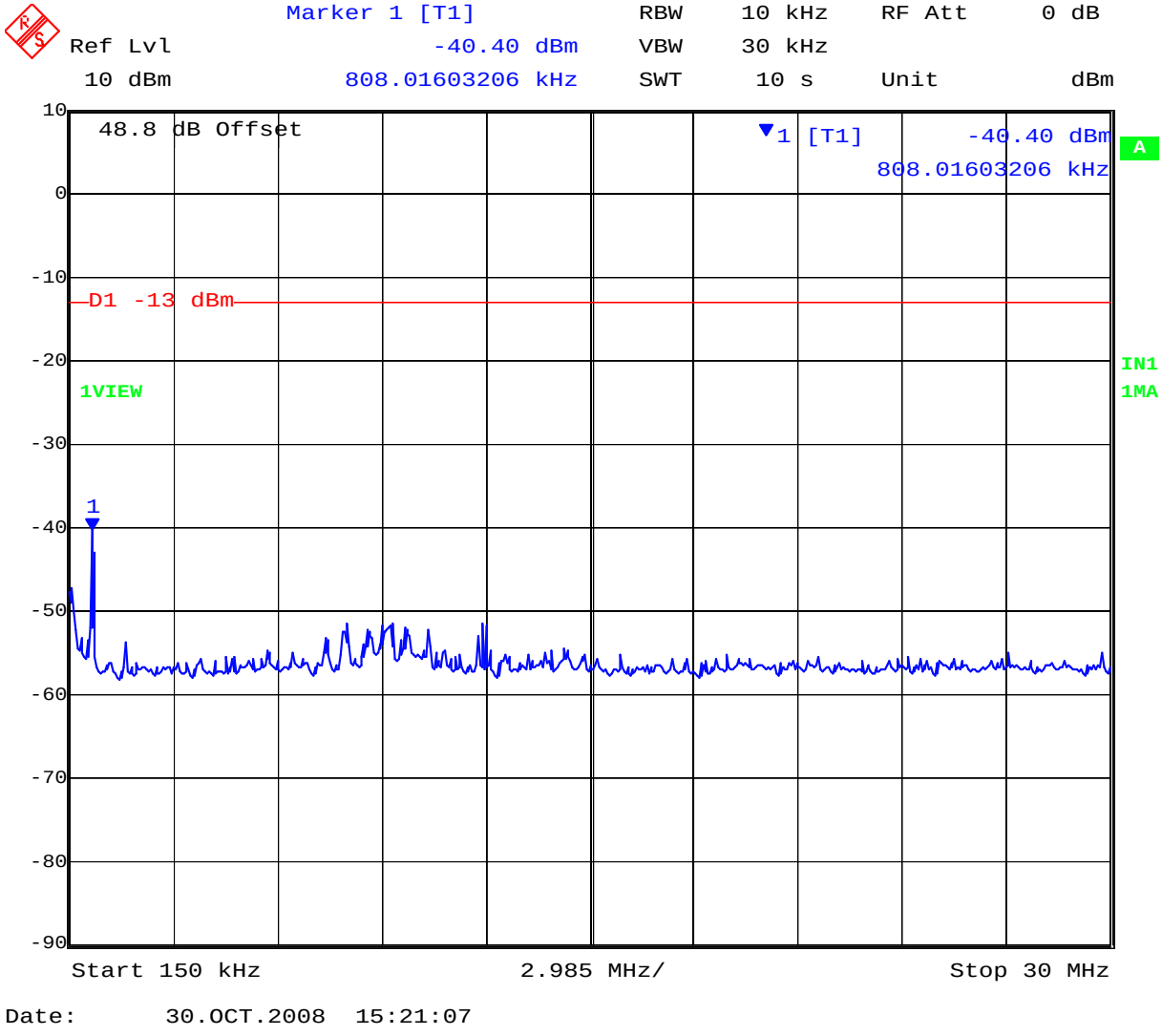


Channel 3652.5 MHz Conducted Spurious Emissions 20 - 40 GHz

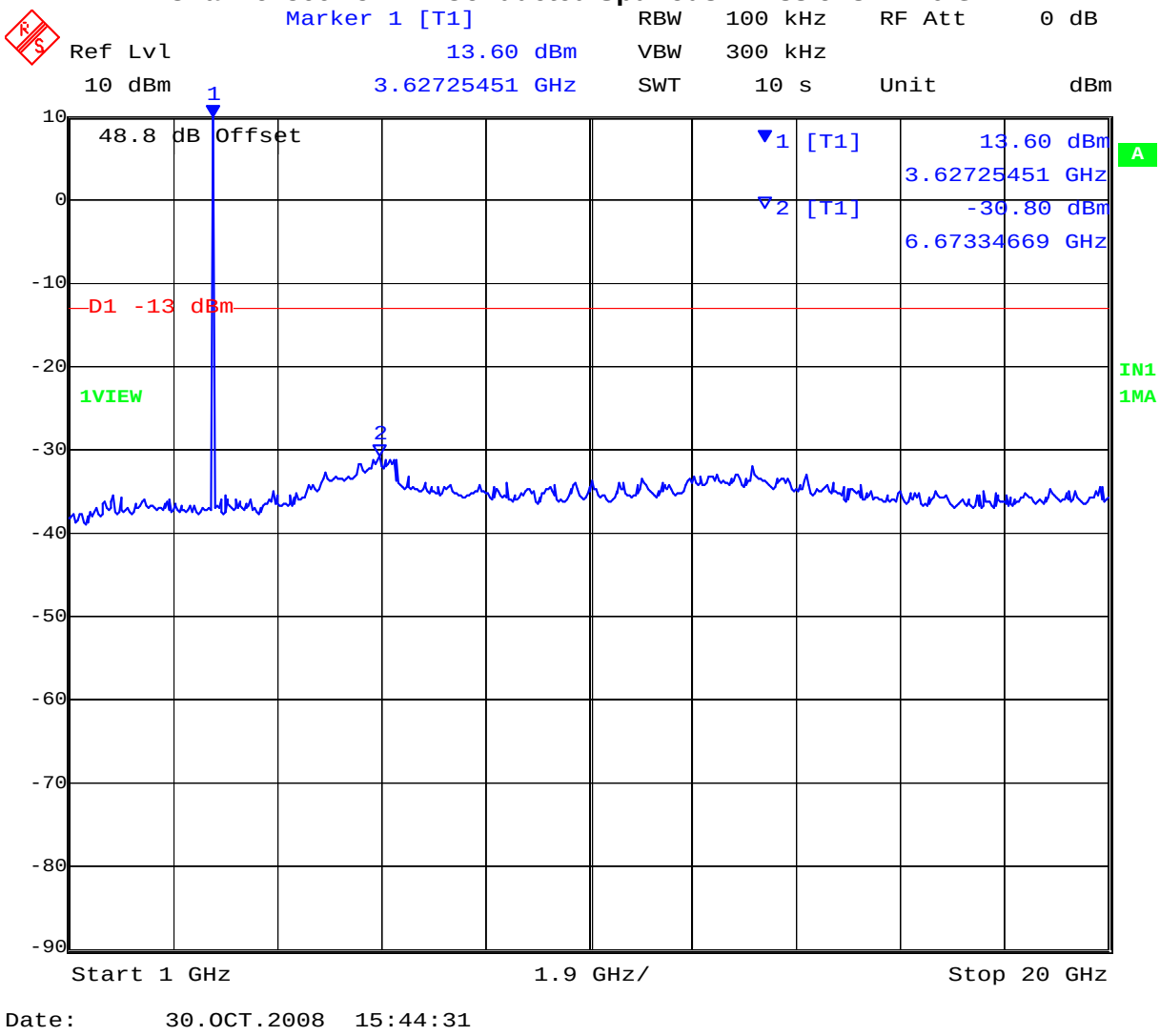


Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
3662.5	30	1,000	-40.40	-13.0	-27.40
	1,000	20,000	-30.80		-17.80
	20,000	40,000	-21.81		-8.81

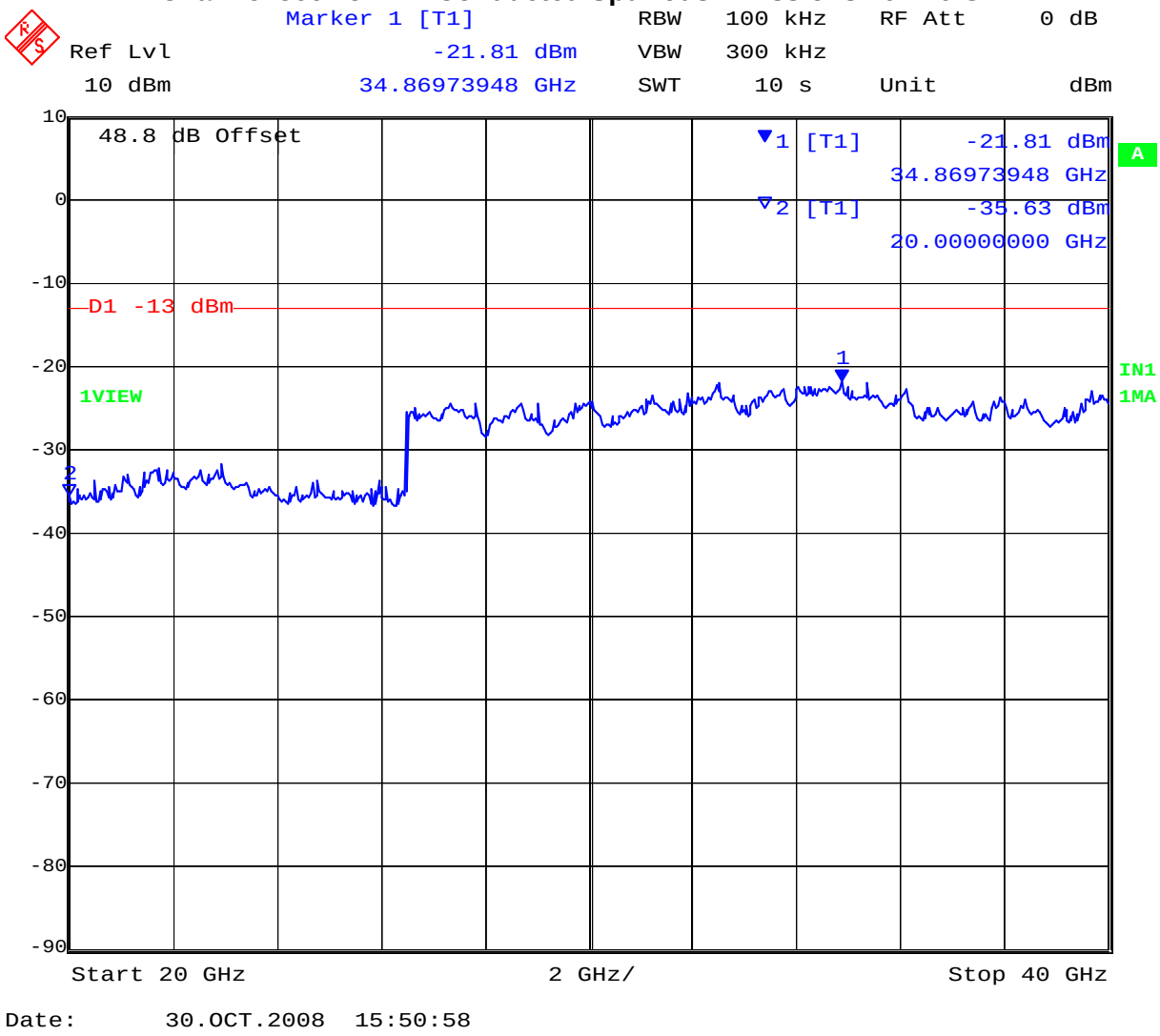
Channel 3662.5 MHz Conducted Spurious Emissions 0.03 – 1 GHz



Channel 3662.5 MHz Conducted Spurious Emissions 1 - 20 GHz

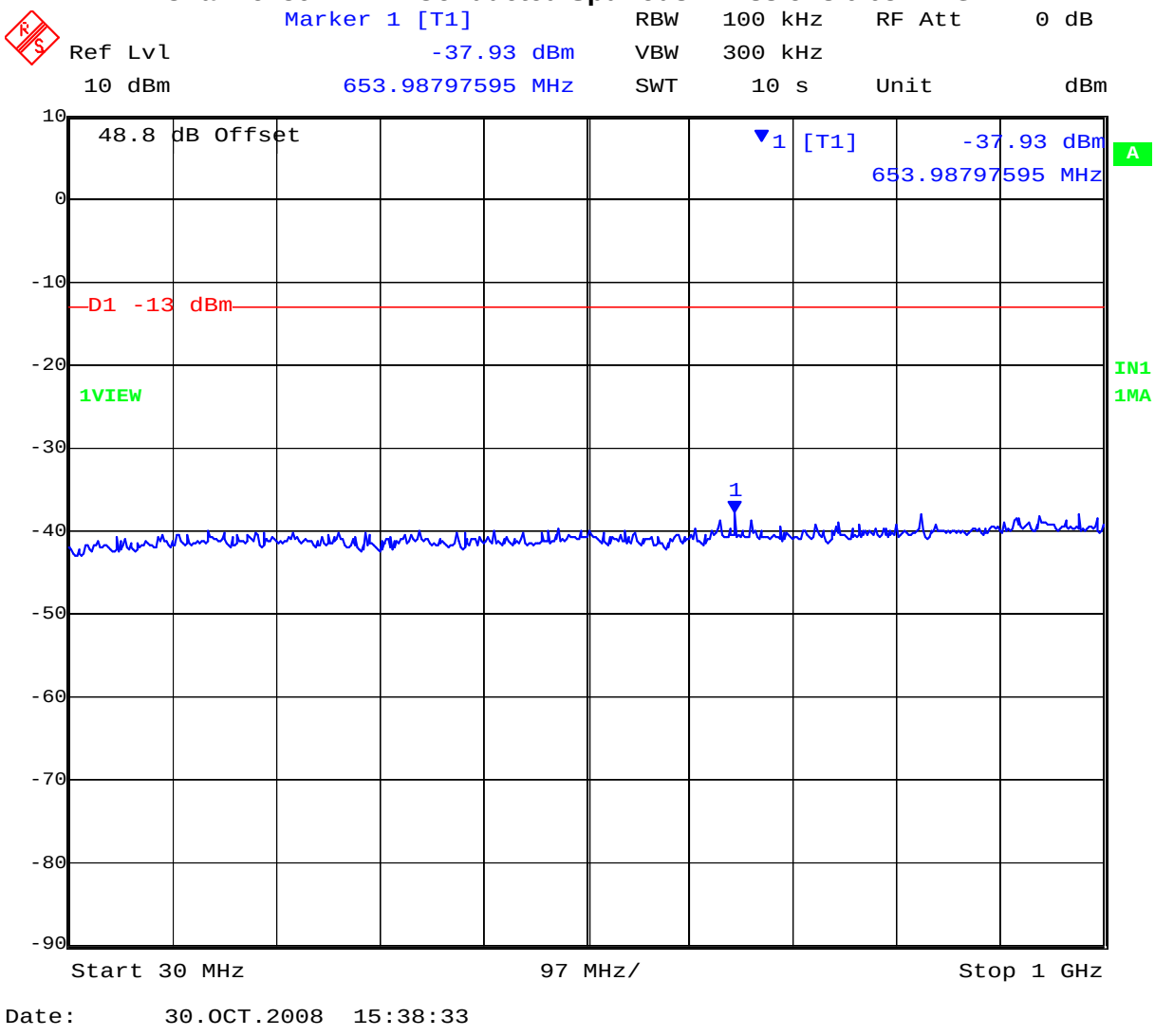


Channel 3662.5 MHz Conducted Spurious Emissions 20 - 40 GHz

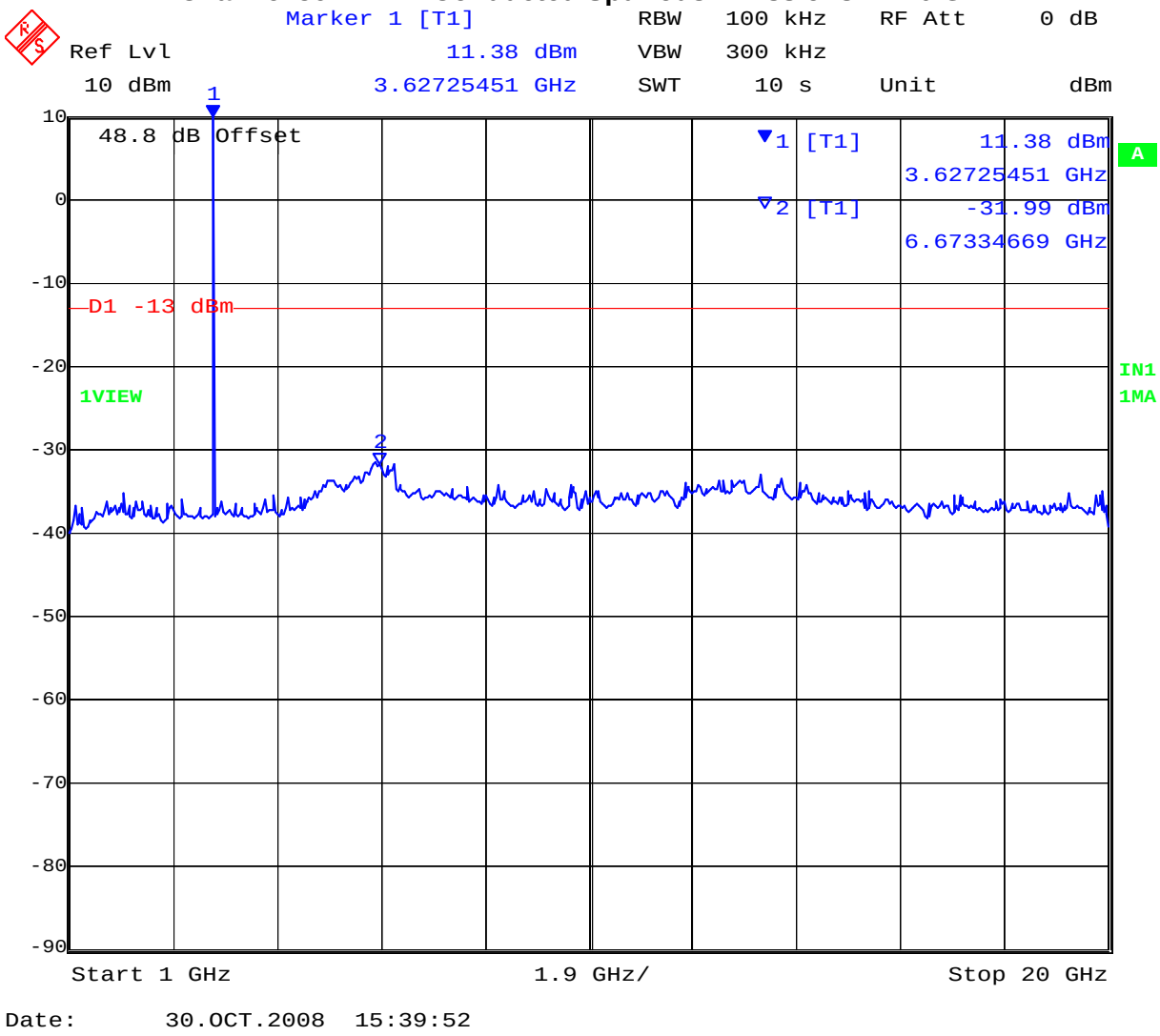


Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
3672.0	30	1,000	-37.93	-13.0	-24.93
	1,000	20,000	-31.99		-18.99
	20,000	40,000	-22.17		-9.17

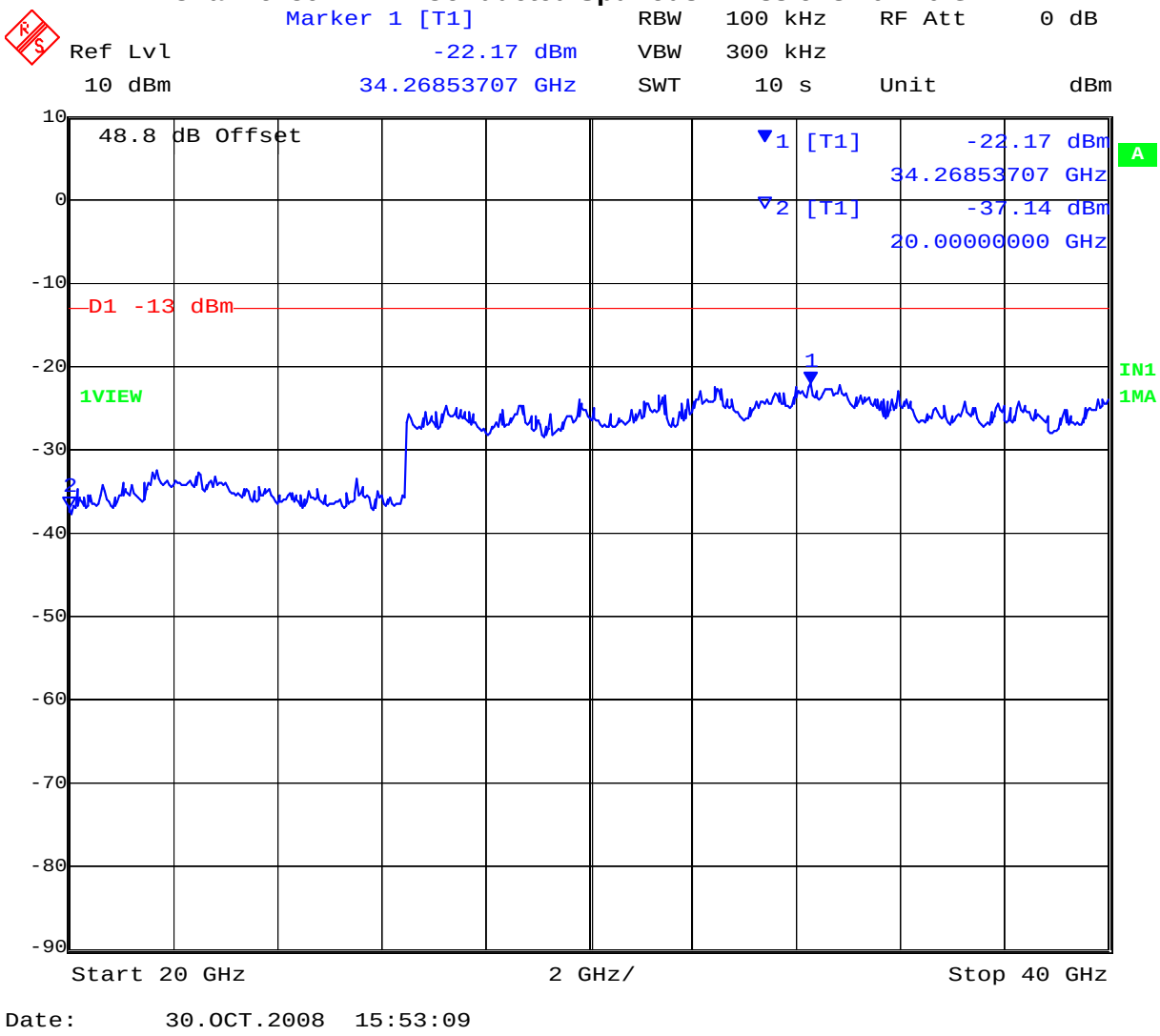
Channel 3672 MHz Conducted Spurious Emissions 0.03 – 1 GHz



Channel 3672 MHz Conducted Spurious Emissions 1 - 20 GHz



Channel 3672 MHz Conducted Spurious Emissions 20 - 40 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

5.1.7. Radiated Spurious Emissions

5.1.7.1. 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 a modulated transmit 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.

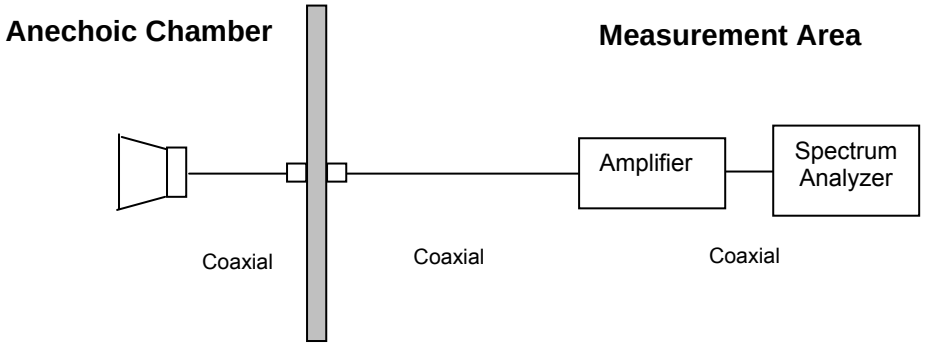
As no antennae were required for testing purposes and only BPSK 3.5 MHz bandwidth was tested to prove compliance.

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.

Limit
For operation in the 3650 – 3700 band the power of any emission outside the frequency band of operation shall be attenuated below the transmitter power (P) within the licensed band of operation, measured in Watts, by at least 43 + 10*Log (P) = -13dBm.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Radio parameters

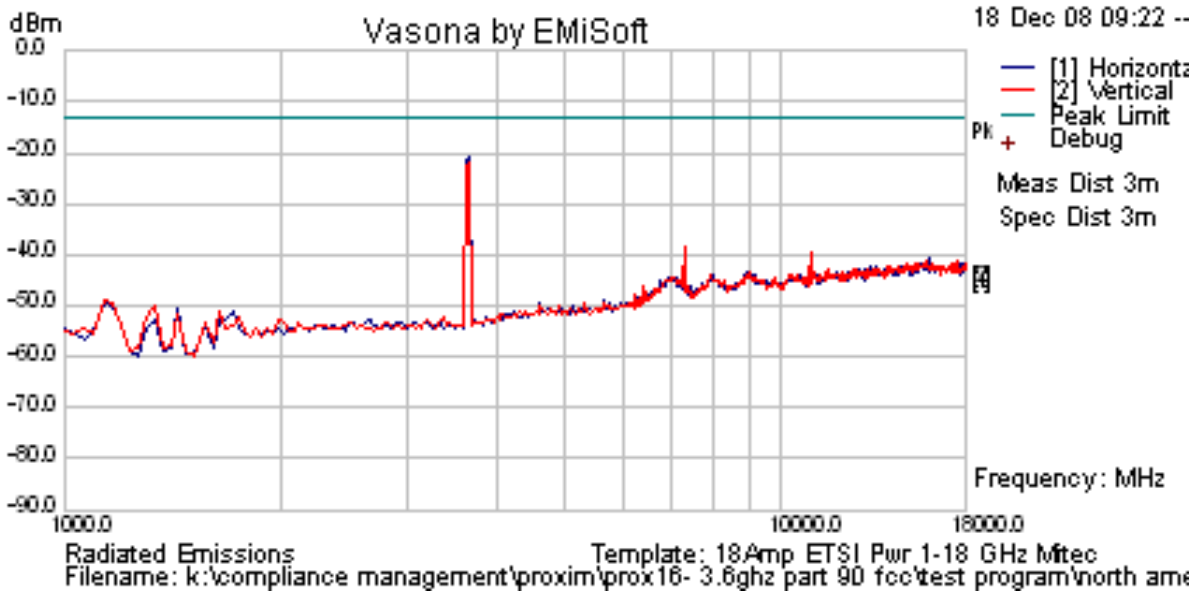
Antenna port terminated in a 50 ohm load.
Radio transmitter set to maximum power.

3.5 MHz BPSK Maximum Power, Channel 3652.5 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS				
Freq. (MHz)	Pol.	Raw (dBuV)	Res BW (KHz)	Pwr @ Antenna (dBm)	Ant. Gain (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)

No emissions found within 6 dB of the limit. Emission breaking the limit is the carrier

BPSK 3.5 MHz Bandwidth Channel Frequency 3652.5 MHz Results



Radio parameters

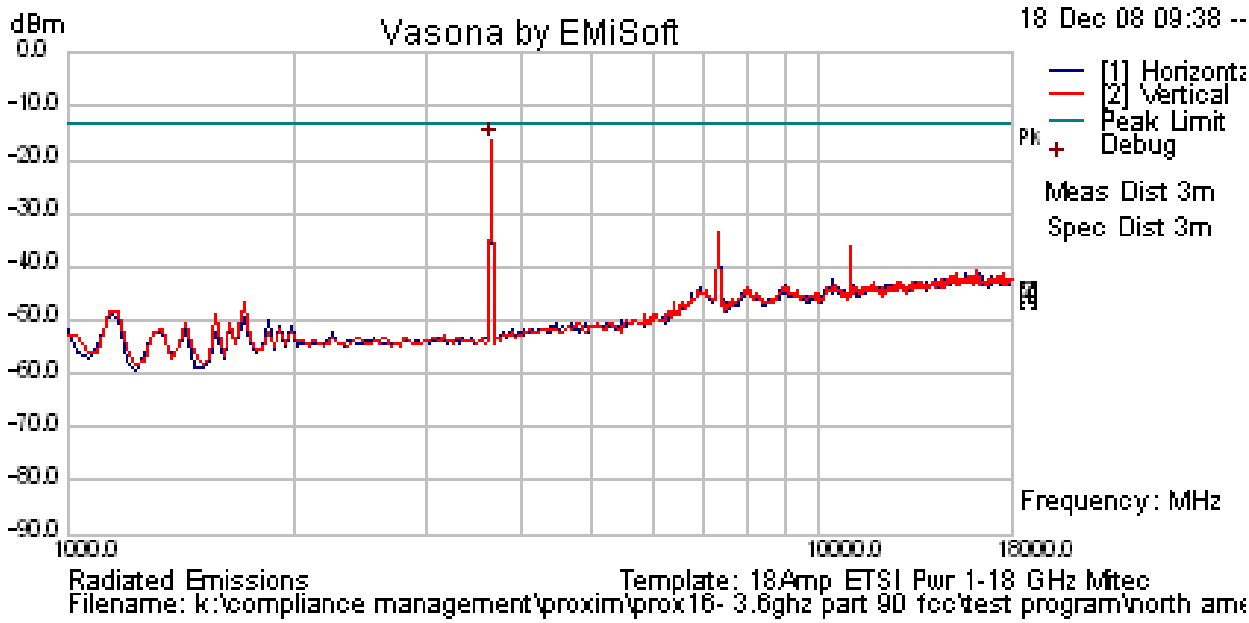
Antenna port terminated in a 50 ohm load.
Radio transmitter set to maximum power.

3.5 MHz BPSK Maximum Power, Channel 3662.5 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS				
Freq. (MHz)	Pol.	Raw (dBuV)	Res BW (KHz)	Pwr @ Antenna (dBm)	Ant. Gain (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)

No emissions found within 6 dB of the limit. Emission breaking the limit is the carrier

BPSK 3.5 MHz Bandwidth Channel Frequency 3662.5 MHz Results



Radio parameters

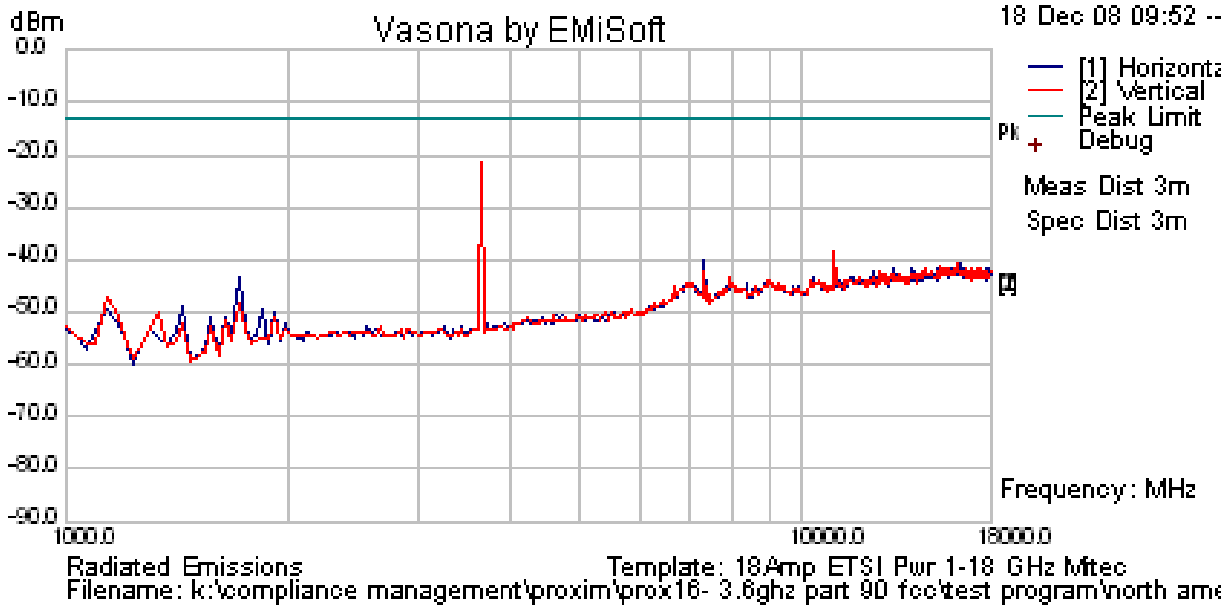
Antenna port terminated in a 50 ohm load.
Radio transmitter set to maximum power.

3.5 MHz BPSK Maximum Power, Channel 3672.0 MHz

INITIAL INVESTIGATION				SUBSTITUTION RESULTS				
Freq. (MHz)	Pol.	Raw (dBuV)	Res BW (KHz)	Pwr @ Antenna (dBm)	Ant. Gain (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)

No emissions found within 6 dB of the limit. Emission breaking the limit is the carrier

BPSK 3.5 MHz Bandwidth Channel Frequency 3672.0 MHz Results



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.

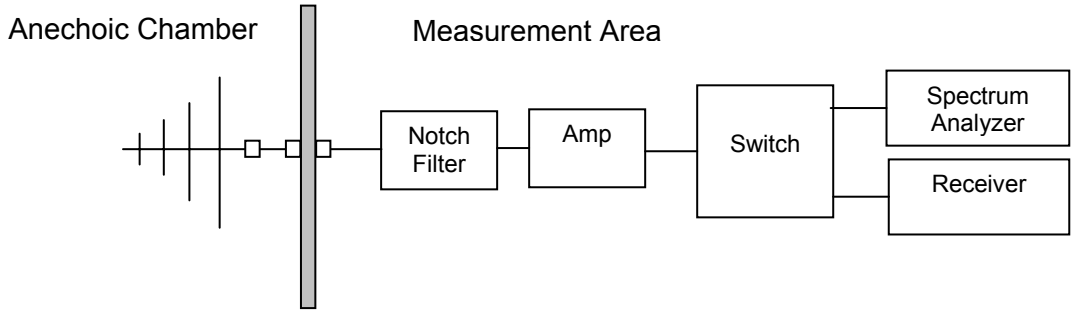
5.1.7.2. Transmitter Radiated Spurious Emissions (30M-1 GHz)

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 10-meter distance on every azimuth in both horizontal and vertical polarity. The emissions are 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.

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: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

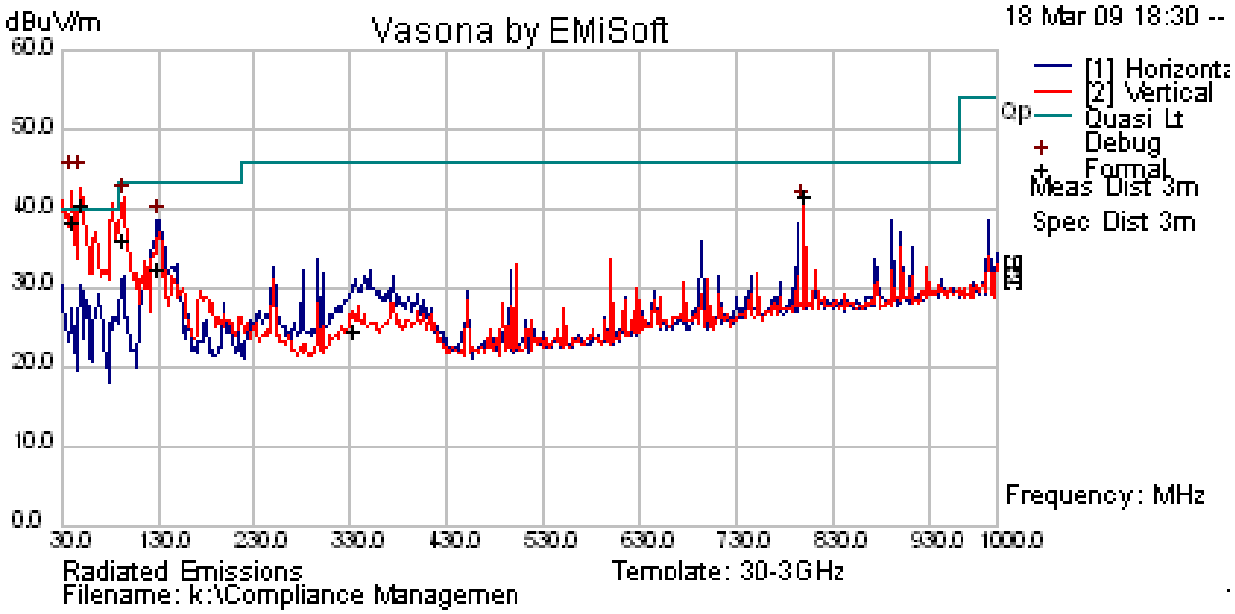
Radio parameters.

3.5 MHz BW
Modulation: BPSK
Full Power: +21dBm

TABLE OF RESULTS

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB
50.567	66.60	3.73	-30.46	39.87	Quasi Max	V	98	321	40.0	-0.13
42.841	60.49	3.61	-25.49	38.61	Quasi Max	V	100	185	40.0	-1.39
93.152	66.75	4.10	-32.84	38.01	Quasi Max	V	107	218	43.5	-5.49
129.499	56.73	4.37	-27.94	33.16	Quasi Max	H	231	152	43.5	-10.34
799.989	56.69	7.18	-21.24	42.63	Quasi Max	V	147	198	46.0	-3.37
332.949	49.19	5.35	-28.44	26.10	Quasi Max	H	108	263	46.0	-19.90

Radiated Spurious Emissions 30 MHz to 1 GHz



The above plot depicts peak emissions only. Further investigation was required to find the six maximum quasi-peak emission values reported in the above table.

Specification

Limits

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

§15.209 (a) Limit Matrix

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

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, 0158, 0134, 0304, 0311, 0315, 0310, 0312

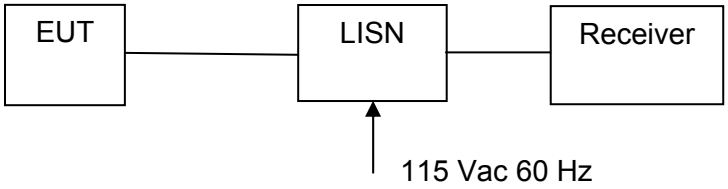
5.1.8. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

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: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

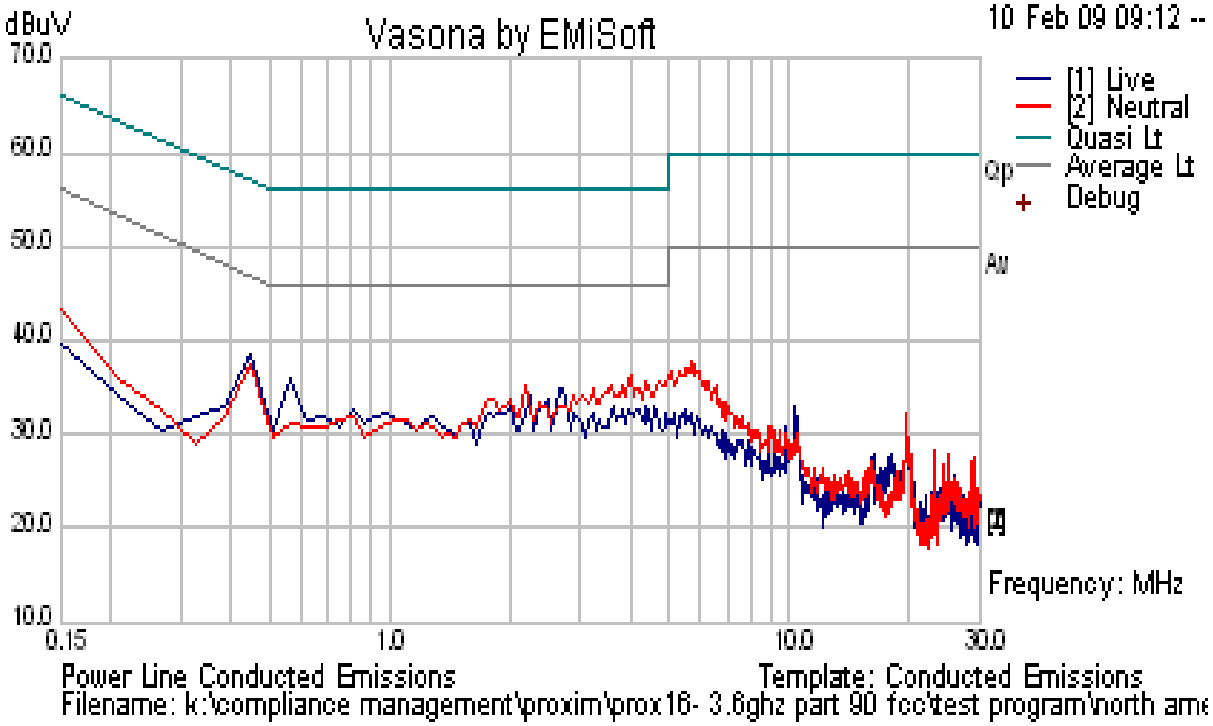
Radio parameters.

Power: Full power +21 dBm
Transmitter Port: Terminated in 50 Ohm load
Variant: Base Station

TABLE OF RESULTS

Freq (MHz)	Line	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)
0.462	L	38.62	32.11	56.66	-24.56	22.38	46.66	-24.28
19.649	N	32.65	23.92	60	-36.08	15.57	50	-34.43
23.129	N	29.78	27.78	60	-32.22	24.67	50	-25.33
14.762	N	37.45	--	60	--	--	50	--
11.251	L	33.11	--	60	--	--	50	--
0.561	L	35.41	--	56	--	--	46	--

AC Wireline Conducted Emissions (150 kHz – 30 MHz)



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

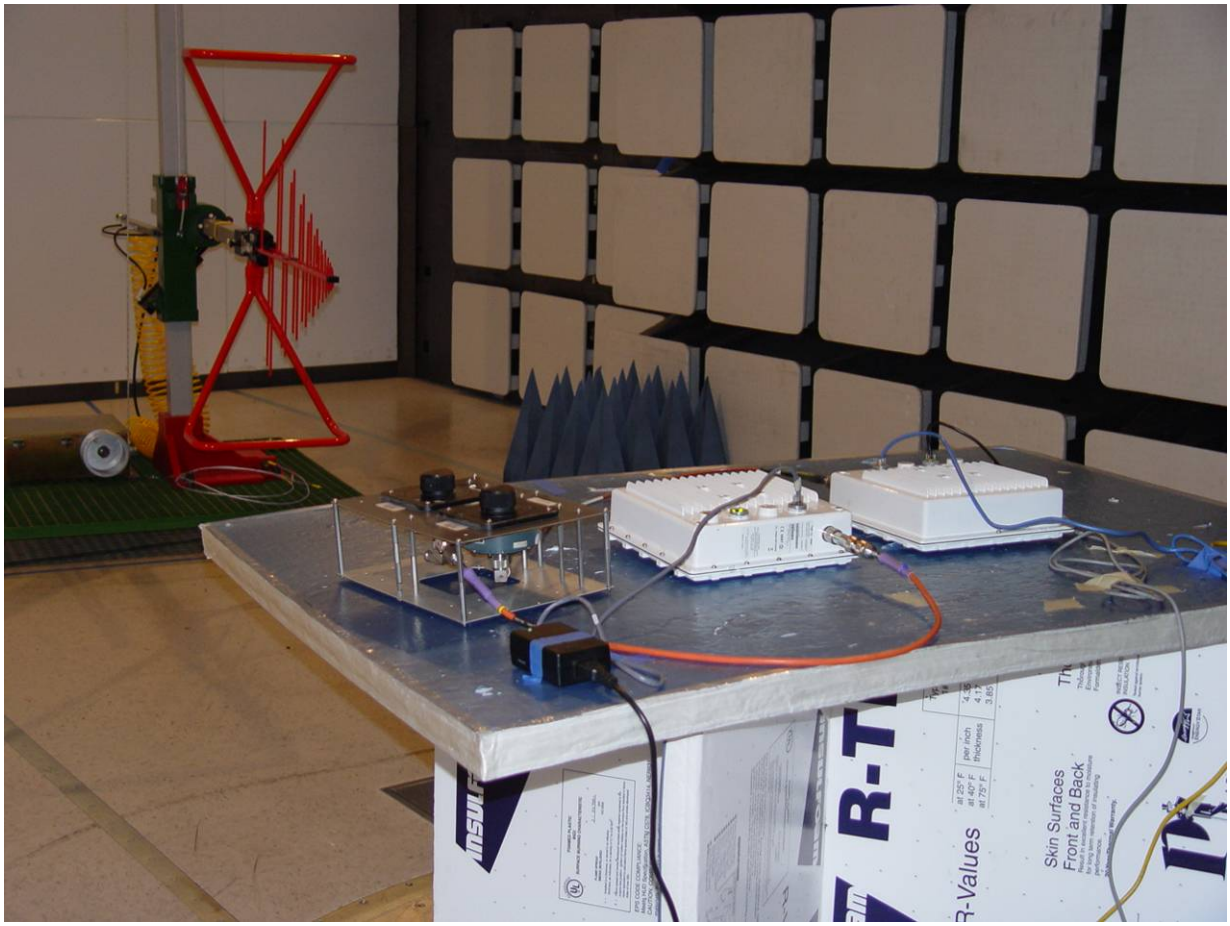
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

6. TEST SET-UP PHOTOGRAPHS

6.1. General Measurement Test Set-Up

6.2. Radiated Spurious Emissions below 1GHz

Base + Subscriber Station

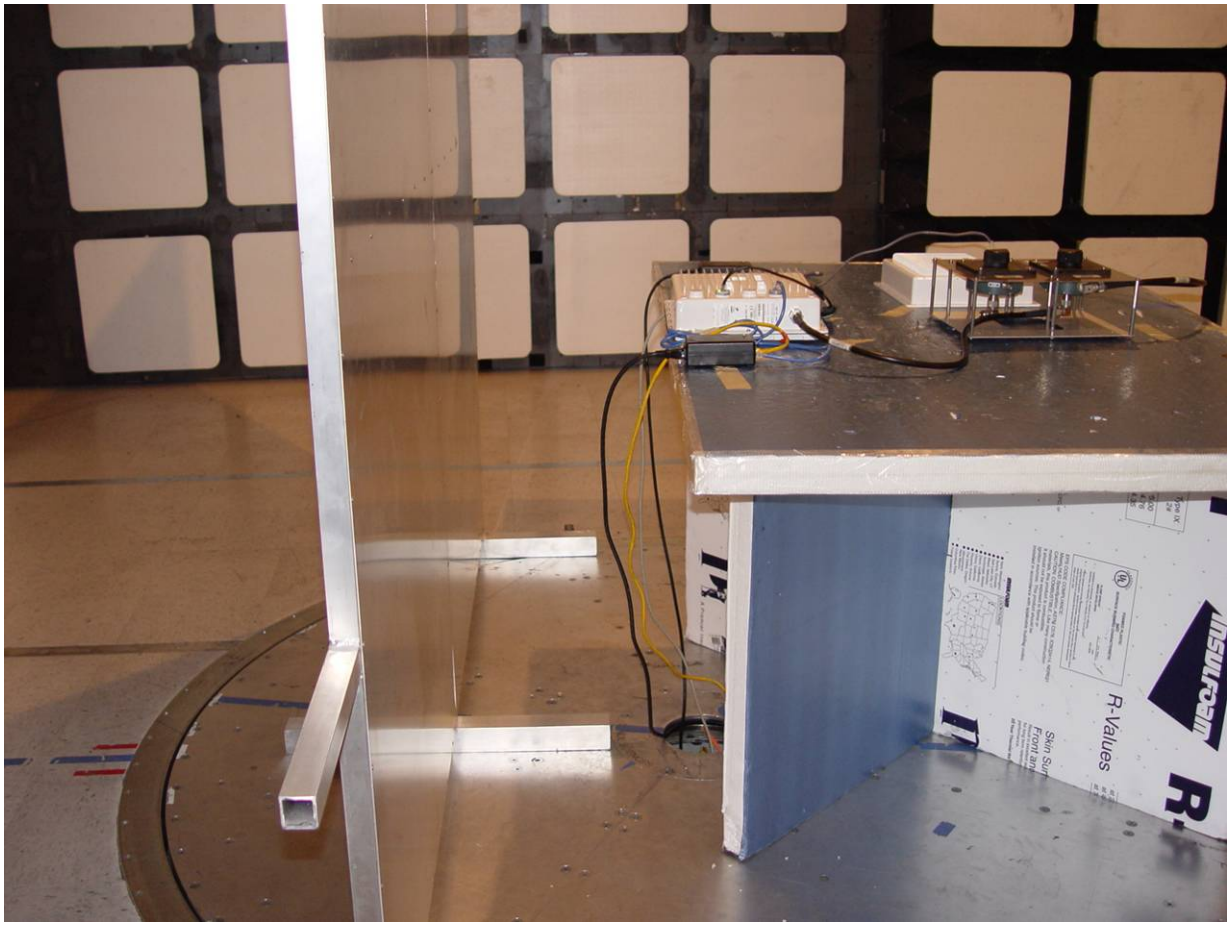


6.3. Radiated Spurious Emissions above 1GHz

Base + Subscriber Station

6.4. Conducted Emissions (150 kHz - 30 MHz)

Base Station



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

440 Boulder Court, Suite 200
Pleasanton, CA 94566, USA
Tel: 1.925.462.0304
Fax: 1.925.462.0306
www.micomlabs.com