Test of Wireless Access Point
802.11a Wireless LAN

To FCC 47 CFR Part 15.407 & IC RSS-210

Test Report Serial No.: TUVR32-A3 REV A

TEST REPORT

FROM

Test of Wireless Access Point AP70 802.11a

To FCC 47 CFR Part 15.407 & IC RSS-210

Test Report Serial No.: TUVR32-A3 REV A

This report supersedes NONE

Manufacturer: Aruba Wireless Networks
180 Great Oaks Blvd
San Jose
California, 95119 USA

Copy No: pdf

Issue date: 1st October '04

This Test Report is Issued Under the Authority

of

MiCOM Labs, Inc.

UKAS (United Kingdom Accreditation Service) Testing Laboratory No. 2016

2106

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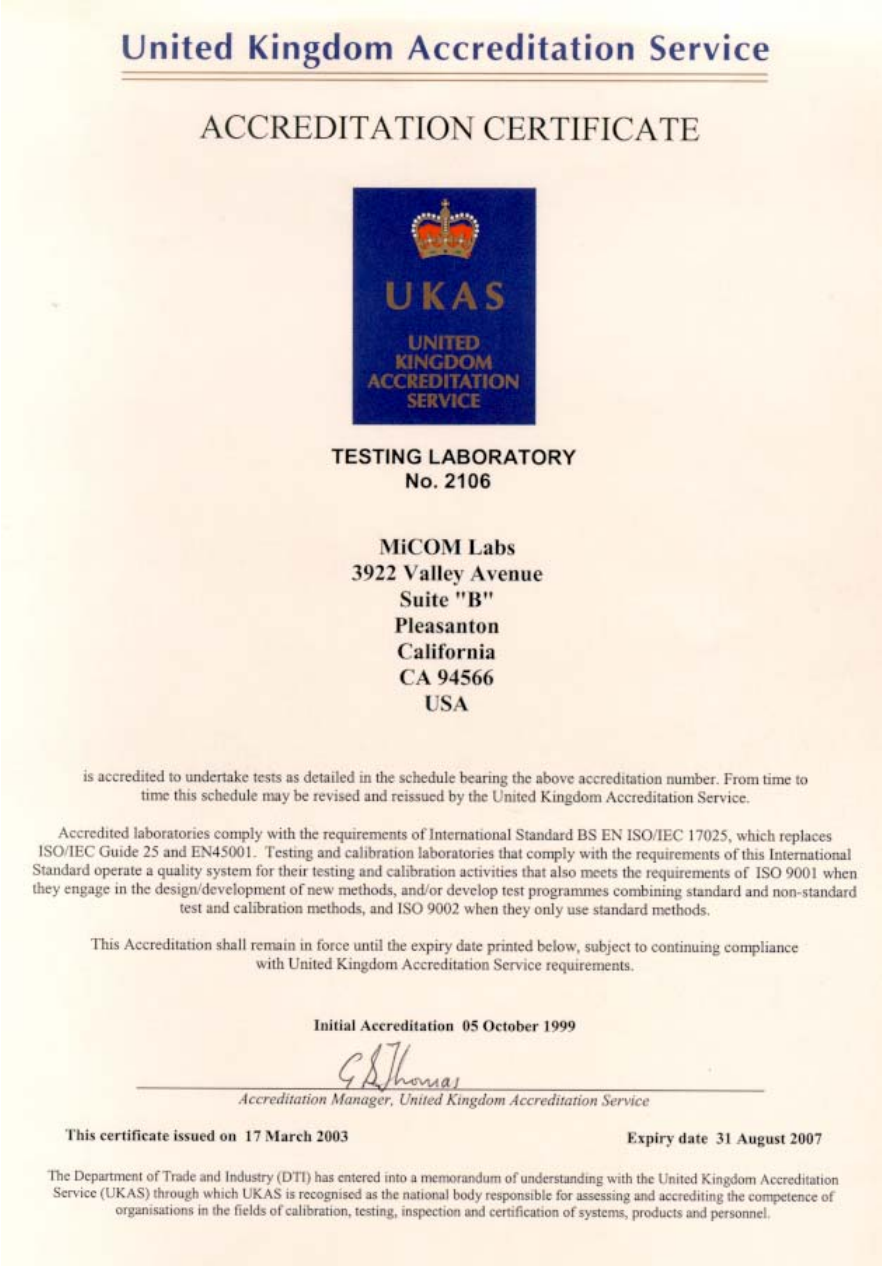
ACCREDITATION & LISTINGS

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the United Kingdom Accreditation Service (UKAS) www.ukas.org test laboratory number 2106. MiCOM Labs test schedule is available at the following URL;

http://www.ukas.org/testing/lab_detail.asp?lab_id=875&location_id=&vMenuOption=3 .



United Kingdom Accreditation Service

ACCREDITATION CERTIFICATE

UKAS
UNITED KINGDOM ACCREDITATION SERVICE

TESTING LABORATORY
No. 2106

MiCOM Labs
3922 Valley Avenue
Suite "B"
Pleasanton
California
CA 94566
USA

is accredited to undertake tests as detailed in the schedule bearing the above accreditation number. From time to time this schedule may be revised and reissued by the United Kingdom Accreditation Service.

Accredited laboratories comply with the requirements of International Standard BS EN ISO/IEC 17025, which replaces ISO/IEC Guide 25 and EN45001. Testing and calibration laboratories that comply with the requirements of this International Standard operate a quality system for their testing and calibration activities that also meets the requirements of ISO 9001 when they engage in the design/development of new methods, and/or develop test programmes combining standard and non-standard test and calibration methods, and ISO 9002 when they only use standard methods.

This Accreditation shall remain in force until the expiry date printed below, subject to continuing compliance with United Kingdom Accreditation Service requirements.

Initial Accreditation 05 October 1999

G S Thomas
Accreditation Manager, United Kingdom Accreditation Service

This certificate issued on 17 March 2003 Expiry date 31 August 2007

The Department of Trade and Industry (DTI) has entered into a memorandum of understanding with the United Kingdom Accreditation Service (UKAS) through which UKAS is recognised as the national body responsible for assessing and accrediting the competence of organisations in the fields of calibration, testing, inspection and certification of systems, products and personnel.

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 #: 4143

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	21st September '04	
Final Draft	27th September '04	
Rev A	1st October '04	

1. TEST RESULT CERTIFICATE

Manufacturer Name:	Aruba Wireless Networks 180 Great Oaks Blvd San Jose California, 95119 USA	Tested By:	MiCOM Labs, Inc. 3922 Valley Avenue Suite 'B' Pleasanton California 94566, USA Tel: (+1) 925 462 0304
EUT Description:	Product Description		
Model:	AP70 S/N's: 3732		
Date(s) Tested:	22nd Aug.-19th Sept. '04		

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.407 & IC RSS-210	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 the test methods used have been recorded and are kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

UKAS TESTING
2106

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Parts 15.407	2001	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 5 Nov. 2001	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	ANSI C63.4	2000	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9KHz to 40GHz
(iv)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(v)	M 3003 Addition 1	Edit 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vi)	LAB34	August 2002	Edition 1. The expression of uncertainty in EMC Testing
(vii)	ETSI TR 100 028	ETSI TR 100 028	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(viii)	FCC Public Notice – DA 02-2138	2002	Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices
(ix)	UKAS LAB 1	Edition 4 May 2004	Reference to Accreditation for Laboratories.
(x)	DTI URN 98/997	1998	Conditions for the use of National Accreditation Marks by UKAS and UKAS Accredited Organisations.

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, Normative Reference (iii).

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, Normative Reference (v).

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Purpose:	To test the Wireless Access Point AP70 802.11a to FCC and Industry Canada regulations
Applicant:	TUV Rheinland of North America 1279 Quarry Lane, Suite A Pleasanton California, 95566 USA
Manufacturer:	Aruba Wireless Networks 180 Great Oaks Blvd San Jose California, 95119 USA
Laboratory performing the tests:	MiCOM Labs, Inc. 3922 Valley Avenue, Suite "B" Pleasanton, California 94566 USA
Test report reference number:	TUVR32-A3 REV A
Date EUT received:	21st August '04
Standard(s) applied:	FCC 47 CFR Part 15.407 & IC RSS-210
Dates of test (from - to):	22nd Aug.-19th Sept. '04
No of Units Tested:	One
Equipment Category:	Wireless Access Point
Type of Equipment:	802.11a/b/g Wireless LAN
Location for use:	Internal use only
Number of Independent Transmitters:	2
Full Frequency Range(s):	5.150-5.350GHz
Modulation:	Per 802.11 - OFDM
Client Declared Nominal Output Power:	802.11a: +16dBm (40mW)
Transmit/Receive Operation:	Simplex
Rated Input Voltage and Current:	AC/DC Converter 115VAC / 5VDC (DC current rating 2.5A) Option: POE (Power Over Ethernet)
Temperature Range:	0 - 40ºC
ITU Emission Designator:	802.11a: 27M5D7D (54MBit/s)
Microprocessor(s):	IDT 79RC32H434
Clock/Oscillator(s):	33.33MHz, 25MHz, 24MHz
Frequency Stability:	±20ppm
Primary Function:	To initiate and receive Data Transmission, Telemetry, Telecommand, Voice

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

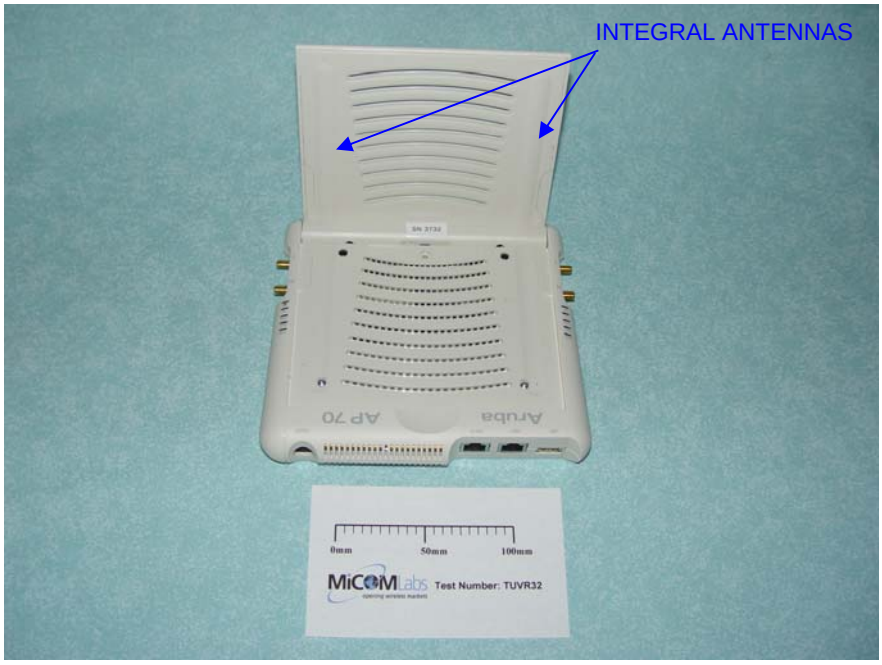
NAME	MODEL No.	SERIAL No.	TYPE	TEST PROGRAM
AP70	AP70	3732	Manufactured	Emissions (radiated and conducted) and RF Testing
CUI (PSU)	A1-15S05	DTS050300U	Manufactured	Emissions (radiated and conducted) and RF Testing

3.3. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Integral Antenna (5GHz)	7.7 (max)	TYCO	151351-1	N/A
Omni-Directional Dipole (5GHz)	5.5	Cushcraft	S5153WBPX	N/A
Directional Patch (5GHz)	14	Cushcraft	S51514WP	N/A

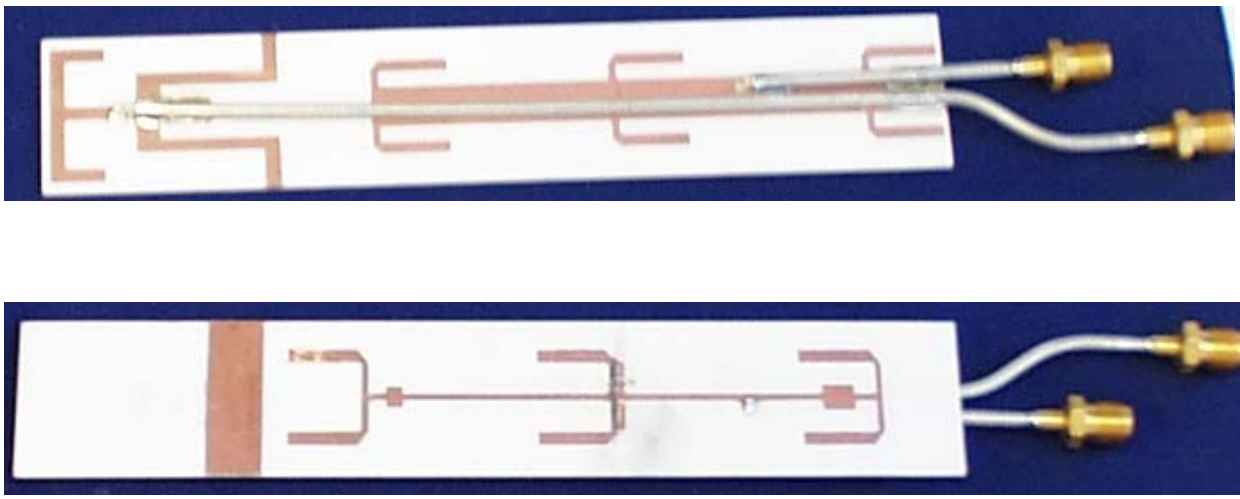
3.4. Wireless Access Point AP70 802.11a

AP70 Access Point



AP70 Access Point – Open Top Identifying Integral Antennas

1).. 5GHz Omni-Directional
2).. 5GHz Directional Patch
3).. 2.4GHz Omni-Directional
4).. 2.4GHz Wide Angle Directional



2.4 and 5GHz Integral Antenna Structure

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. Ethernet 10/100BT unscreened
2. Ethernet 10/100BT unscreened
3. USB (Universal Serial Bus)
4. DC power
5. 2 x 2.4GHz RPSMA Connector
6. 2 x 5GHz RPSMA Connector

3.6. Test Configurations

Matrix of test configurations

Operational Mode (802.11)	Operating Channel	Frequencies (MHz)	Maximum Data Rates (MBit/s)	Data Rate(s) Selected for Test Purposes (Mbit/s)	
				Conducted	Radiated
a	36, 52, 64	5,180 5,260 5,320	54	54	54

Frequency 5,180MHz is the lowest frequency of operation within the 5,150-5,250MHz frequency band.

Frequency 5,260MHz is the lowest frequency of operation within the 5,250-5,350MHz frequency band.

Frequency 5,320MHz is the highest frequency of operation within the 5,250-5,350MHz frequency band.

Only worst case plots are provided for each test parameter are identified within this report. Plots not included are held on file by the test laboratory and available upon request with client permission.

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. At the release of this test report FCC rules clearly state that only integral antennas are permissible within this frequency band. The rules however will shortly be amended to include external antennas. To accommodate this change external antennas were submitted for testing, see Section 5.1.8.1 Radiated Emissions Above 1GHz.

   The manufacturer clearly understands that until this rule is adopted only integral antennas are permitted.

3.9. Subcontracted Testing

Radiated emission testing 30MHz-1GHz (Section 5.1.8.2 within this report) was subcontracted to the following test facility;

Sanmina-SCI
Homologation Services
EMI Test Laboratory
2305 Mission College Blvd.
Santa Clara, California 95054
USA

Sanmina-SCI, NVLAP (National Voluntary Laboratory Accreditation Program) Lab Code 100411-0 are ISO/IEC 17025 accredited for emission testing 30MHz-1GHz.

4. TEST SUMMARY

List of Measurements

The following table represent the list of measurements required under the **FCC CFR47 Part 15.407** and **Industry Canada RSS-210**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.407(a) **6.2.2 (q1)**	26dB and 99% Emission BW	Emission bandwidth measurement	Conducted	Complies	5.1.1
15.407(a) **6.2.2 (q1)**	Peak Transmit Power	Peak Power Measurement	Conducted	Complies	5.1.2
15.407(a) **6.2.2 (q1)**	Peak Power Spectral Density	PPSD	Conducted	Complies	5.1.3
15.407(a) **(6)**	Peak Excursion Ratio	<13dB in any 1MHz bandwidth	Conducted	Complies	5.1.4
15.407(g) **15.31** **6.2.2 (q1)(iv)(e)**	Frequency Stability	Limits: contained within band of operation at all times.	Manufacturer declaration	Complies	5.1.5
15.407(f) **6.2.2 (q1)(iv)(g)**	Radio Frequency Radiation Exposure	Exposure to radio frequency energy levels, Maximum Permissible Exposure (MPE)	Calculation	Complies	5.1.6
15.407(b)(1), **(2),(3)** **6.2.2 (q1)(ii)**	Conducted Spurious Emissions	Spurious emissions above 1GHz (1-40GHz) including band edge	Conducted	Complies	5.1.7

Section(s)	Test Items	Description	Condition	Result	Test Report Section
5.205(a) / 15.209(a) **6.3**	Radiated Emissions Transmitter Radiated Spurious Emissions Radiated Emissions	Restricted Bands Emissions above 1GHz Emissions <1GHz (30M-1GHz)	Radiated (includes collocation of transmitters)	Complies	5.1.8 *5.1.8.1* *5.1.8.2*
15.407(c)	Discontinuation of Transmission	Discontinue transmission in case of either absence of information to transmit or operational failure	Conducted	Complies	5.1.9
15.207 **6.6**	AC Wireline Conducted Emissions 150kHz–30MHz	Conducted Emissions	Conducted	Complies	5.1.10

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 highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

5.1. Device Characteristics

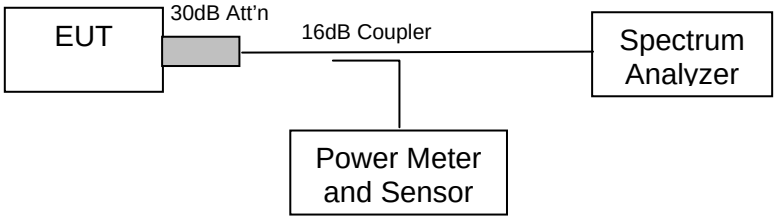
5.1.1. 26dB and 99% Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)
Industry Canada RSS-210 §5.9.1

Test Procedure
The bandwidth at 26dB and 99% is measured with a spectrum analyser connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate centre frequency. Using a 6dB resolution bandwidth filter setting the spectrum analyzer was set to the following for both 26dB BW and 99% BW measurements;

RBW=300KHz, VBW=1MHz, Span=75MHz, Sweep = 5mS

Test Measurement Set up



Measurement set up for26dB/99% Bandwidth test

Measurement Results for 6dB and 99% Operational Bandwidth(s)

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

Power Setting – Maximum Level 4 (set through Aruba system interface)

TABLE OF RESULTS – **802.11a 54Mbit/s**

Centre Frequency (MHz)	26dB Bandwidth (MHz)	26dB Plot #	99% BW (MHz)	99% BW Plots
5,180	27.3547	ON FILE	18.1864	ON FILE
5,260	27.5411	TUVR32-A3-01	18.1864	TUVR32-A3-02
5,320	27.3547	ON FILE	18.1864	ON FILE

Specification

Limits

§15.407 (a) For the following frequency band the peak transmit power over the following range of operation shall not exceed the lesser of;

(1) 5,150-5,250MHz of 50mW (+17dBm) or 4dBm + 10Log10 B, where B is the 26dB BW in MHz
(2) 5,250-5,350GHz of 250mW (+24dBm) or 11dBm + 10Log10 B, where B is the 26dB BW in MHz

RSS-210 §6.2.2 (q1)(i-iii)

(i) 5,150-5,250MHz (indoor use only) - The maximum equivalent isotropically radiated power (EIRP) shall not exceed 200mW or 10 + 10 Log_{10} B dBm, whichever power is less. B is the 99%* power bandwidth in MHz.

(ii) 5,250-5,350MHz The maximum transmitter power shall not exceed 250mW or 11 + 10 Log_{10} B, dBm, whichever power is less. The maximum EIRP shall not exceed 1.0 watt or 17 + 10Log10 B dBm, whichever power is less. B is the 99%* power bandwidth in MHz.

*Note: Section 6.2.2 (q1) (iv) (b) permits the use of a 26dB bandwidth as alternative

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	± 2.81dB

Traceability

METHOD	TEST EQUIPMENT USED
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0156, 0193, K-CBL 08, Coupler, 0070, 0116

5.1.2. Peak Output Power

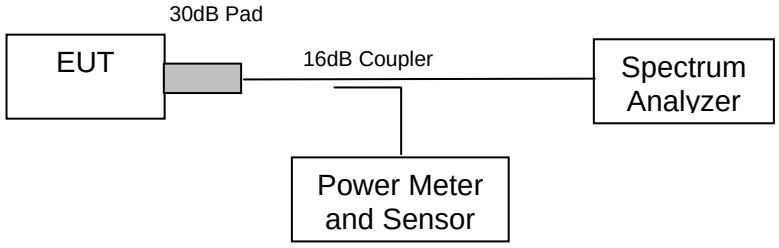
FCC, Part 15 Subpart C §15.247(b)
Industry Canada RSS-210 §6.2.2(o)(b)

Test Procedure

The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure peak power. The resolution filter bandwidth was set to 6dB, peak detector selected and the analyzer built-in power function was used to measure peak power. Average power was also measured utilizing the analyzers average power detector.

Spectrum analyzer settings: RBW=1MHz, VBW=3MHz, Span=75MHz, Sweep = 20mS

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

Measurement Results for Peak Output Power

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

Power Setting – Maximum Level 4 (set through Aruba system interface)

TABLE OF RESULTS – **802.11a 54Mbit/s**

Centre Frequency (MHz)	26dB Bandwidth (MHz)	Peak Power (dBm)	Ave. Power (dBm)	Peak Power Plot #
5,180	27.3547	+16.59	+9.60	ON FILE
5,260	27.5411	+16.62	+9.63	ON FILE
5,320	27.3547	+16.86	+9.96	TUVR32-A3-03

Supply Voltage Variation

The supply voltage was varied between 97.75VAC and 132.25VAC. The system operated as intended at either extreme with no change in the above measurement bandwidths.

Power Limits

Maximum Power Calculation

FCC Power Limits

Frequency Band (MHz)	FCC Limit shall not exceed the lesser of	Maximum Observed 26dB Bandwidth (MHz)	Power Limit
5,150-5,250	50mW (+17dBm) or 4dBm + $10Log_{10}$ B	27.3547	**50mW (+17dBm)**
5,250-5,350	250mW (+24dBm) or 11dBm + $10Log_{10}$ B	27.5411	**250mW (+24dBm)**

Industry Canada Power Limits

Frequency Band (MHz)	Industry Canada Limit (the lesser of)	Maximum Observed 99% Bandwidth (MHz)	Power Limit (dBm)
5,150-5,250	200mW (+23dBm) or 10dBm + $10Log_{10}$ B	18.1864	10dBm + $10Log_{10}$ B = **+22.6**
5,250-5,350	1W (+30dBm) or 17dBm + $10Log_{10}$ B	18.1864	17dBm + $10Log_{10}$ B = **+29.6**

Antenna Gain - Maximum Permissible Power Level

If transmitting antennas of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Antenna Type	Gain (dBi)	Antenna Gain >6dBi (dB)	Max. Allowable Peak Power (dBm)			
			5,180MHz		5,260/5,320MHz	
			FCC	IC	FCC	IC
Internal (5GHz)	7.7	1.7	**+15.3**	**+20.9**	**+22.3**	**+27.9**
Omni-Directional (5GHz)	5.5	0.0	**+17.0**	**+22.6**	**+24.0**	**+29.6**
Directional Patch (5GHz)	14	8.0	**+9.0**	**+14.6**	**+16.0**	**+21.6**

Specification

Limits

§15.407 (a) 1 -3 For the following frequency band the peak transmit power over the following range of operation shall not exceed the lesser of;

(1) 5,150-5,250MHz of 50mW (+17dBm) or 4dBm + 10Log10 B, where B is the 26dB BW in MHz
(2) 5,250-5,350GHz of 250mW (+24dBm) or 11dBm + 10Log10 B, where B is the 26dB BW in MHz

RSS-210 §6.2.2 (q1)(i-iii)

(i) 5,150-5,250MHz (indoor use only) - The maximum equivalent isotropically radiated power (EIRP) shall not exceed 200mW or 10 + 10 Log_{10} B dBm, whichever power is less. B is the 99%* power bandwidth in MHz.

(ii) 5,250-5,350MHz The maximum transmitter power shall not exceed 250mW or 11 + 10 Log_{10} B, dBm, whichever power is less. The maximum EIRP shall not exceed 1.0 watt or 17 + 10Log10 B dBm, whichever power is less. B is the 99%* power bandwidth in MHz.

*Note: Section 6.2.2 (q1) (iv) (b) permits the use of a 26dB bandwidth as alternative

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33dB

Traceability

METHOD	TEST EQUIPMENT USED
Measurements were made per work instruction WI-01 ‘Measuring RF Output Power’	0156, 0193, K-CBL 08, Coupler, 0070, 0116

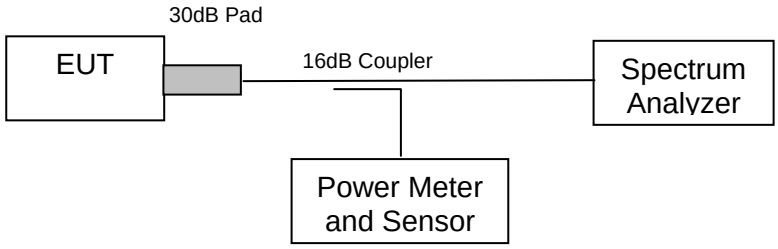
5.1.3. Peak Power Spectral Density

FCC, Part 15 Subpart C §15.407(a)
Industry Canada RSS-210 §6.2.2(o)(b)

Test Procedure
This is an antenna conducted measurement using a spectrum analyzer. The transmitter output is connected to a spectrum analyser in sample detector mode. Section 2.1 Normative References, reference (viii) was used in order to prove compliance, see method 2 for testing Peak Power Spectral Density. The Peak Power Spectral Density is the highest level found across the emission in any 1MHz reference bandwidth.

The spectrum analyzer settings were as follows:
RBW= 1MHz, VBW=3MHz, Span 50MHz and 5mS Sweep Time
Sample Detection, Power Average with 100 samples, 6dB Resolution BW Filter

Test Measurement Set up



Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

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

Power Setting – Maximum Level 4 (set through Aruba system interface)

TABLE OF RESULTS – **802.11a 54Mbit/s**

Centre Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
5,180	5,176.14	-5.22	ON FILE
5,260	5,258.65	-5.93	ON FILE
5,320	5,323.56	-4.80	TUVR32-A3-04

Antenna Gain - Maximum Permissible Peak Power Spectral Density

If transmitting antennas of directional gain greater than 6dBi are used the Peak Power Spectral Density of the intentional radiator shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Antenna Type	Gain (dBi)	Antenna Gain >6dBi (dB)	Max. PPSD (dBm)
Internal (5GHz)	7.7	1.7	+2.3
Omni-Directional (5GHz)	5.5	0	+11.0
Directional Patch (5GHz)	14	8.0	+3.0

Specification

Peak Power Spectral Density Limits

§15.407 (a) Peak Power Spectral Density shall not exceed the following limits for the frequency bands of interest;

(i) 5,150-5,250MHz - +4dBm
(ii) 5,250-5,350MHz - +11dBm

RSS-210 §**6.2.2(q)** , the Peak Power Spectral Density shall not exceed the following for each frequency band

(iii) 5,150-5,250MHz, +10dBm in any 1MHz band
(iv) 5,250-5,350MHz, +11dBm in any 1MHz band

Laboratory Measurement Uncertainty Spectral Density

Measurement uncertainty	±1.33dB

Traceability

METHOD	TEST EQUIPMENT USED
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0156, 0193, K-CBL 08, Coupler, 0070, 0116

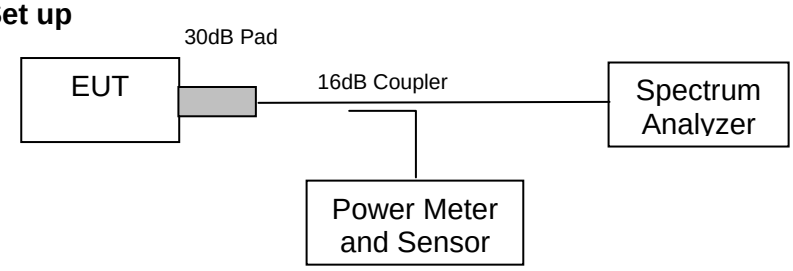
5.1.4. Peak Excursion Ratio

FCC, Part 15 Subpart C §15.407(a)(6)

Test Procedure
This is an antenna conducted measurement using a spectrum analyzer. The transmitter output is connected to a spectrum analyser in peak hold operational mode. Method 1 in Reference (viii) was used in order to prove compliance. The Peak Excursion Ratio is the difference in amplitude (dB) between the two traces.

The spectrum analyzer setting was as follows:
RBW= 1MHz, VBW=3MHz, Span 36.5MHz and 200mS Sweep Time, 6dB Resolution BW

Test Measurement Set up



Measurement set up for Peak Excursion Ratio

Measurement Results for Peak Excursion Ratio

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

Power Setting – Maximum Level 4 (set through Aruba system interface)

TABLE OF RESULTS – **802.11a 54Mbit/s**

Centre Frequency (MHz)	Peak Excursion Ratio (dB)	Plot #
5,180	1.39	ON FILE
5,260	1.89	TUVR32-A3-05
5,320	1.67	ON FILE

Specification

Limits

§15.407 (a)(6) The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified in this paragraph) shall not exceed 13dB across any 1MHz bandwidth or the emission bandwidth whichever is less

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	± 2.81dB

Traceability

METHOD	TEST EQUIPMENT USED
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0156, 0193, K-CBL 08, Coupler, 0070, 0116

5.1.5. Frequency Stability

FCC, Part 15 Subpart C §15.407(g)
Industry Canada RSS-210 §6.2.2 (q1)(iv)(e)

Test Procedure

The manufacturer of the equipment is responsible for ensuring that the frequency stability is such that emissions are always maintained within the band of operation under all conditions.

Manufacturer Declaration

The frequency stability of the reference oscillator sets the frequency stability of the RF transceiver signals. Therefore all of the RF signals should have ±20ppm stability.
This stability accounts for room temp tolerance of the crystal oscillator circuit, frequency variation across temperature, and crystal ageing.

Worst case:
5.150GHz – ±20ppm/103KHz

±20ppm at 5.150GHz translates to a maximum frequency shift of ±103KHz. As the edge of the channels are at least one MHz from either of the band edges, ±103KHz is more than sufficient to guarantee that the intentional emission will remain in the band over the entire operating range of the radio.

5.1.6. Radio Frequency Radiation Exposure

FCC, Part 15 Subpart C §15.407(f)
Industry Canada RSS-210 §14

Calculations for Maximum Permissible Exposure Levels

Given

$E = \sqrt{(30 * P * G)} / d$

and

$S = E^2 / 3770$

where
E = field strength in volts/meter
P = power in watts
G = numeric antenna gain
d = distance in meters
S = power density in milliwatts / square centimeter

Combining and rearranging the terms to express the distance as a function of the variables, yields:

$d = \sqrt{(30 * P * G)} / (3770 * S)$

Rearrange to milliwatts and centimeters

P(mw) = P(watts) / 1000

d(cm) = d(m) * 100

yields
$d = 100 * \sqrt{(30 * (P / 1000) * G)} / (3770 * S)$

$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in centimetres
P = Power in mW
G = Numeric Antenna Gain
S = Power Density in centimetres^2

Substituting the logarithmic form of power and gain using:

P(mW) = 10 ^ (P(dBm)/10) and

G(numeric) = 10 ^ (G(dBi) /10)

Yields:

d = 0.282 * 10 ^ ((P + G / 20) √ S

where

d = MPE distance in centimetres
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW / centimetres^2 (Limit S = 1mW / cm^2 from §1.310 Table 1)

Maximum output power observed from power measurements: **+16.86dBm**
Maximum Declared Antenna Gain: **14.0dBi**

Power Density Limit (mW / cm^2)	Maximum Measured Output Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)
1	+16.86	14	**10**

Specification

Maximum Permissible Exposure Limits

§1.1093, §2.1091, §2.1093 U-NII devices are subject to the radio frequency radiation exposure requirements within the above paragraphs as appropriate. All equipment shall be considered to operate in a "general population/controlled" environment".

Limit S = 1mW / cm2 from 1.310 Table 1

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

RSS-210 §**14** Before equipment certification is granted, the procedures of RSS-102 must be followed concerning exposure of humans to RF fields.

5.1.7. Conducted Spurious Emissions

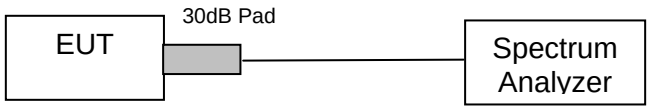
FCC, Part 15 Subpart C §15.407(b)
Industry Canada RSS-210 §6.2.2 (o)(e1)

Test Procedure

Undesirable emissions are measured with a spectrum analyzer connected directly to the antenna terminal. Measurements on any frequency or frequencies over 1GHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1GHz were performed using a minimum resolution bandwidth of 1MHz. When measuring the emission limits, the nominal carrier frequency was adjusted as close to the upper and lower band edge as the equipment software permitted.

The spectrum analyzer is set to:
RBW=1MHz, VBW=3MHz, Span=4MHz, Sweep = 10mS

Test Measurement Set up



Undesirable emission measurement test configuration

Measurement Results of Conducted Spurious Emissions

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

Power Setting – Maximum Level 4 (set through Aruba system interface)

Band-Edge Results

TABLE OF RESULTS – **802.11a 54Mbit/s**

Centre Frequency (MHz)	Band edge Frequency (MHz)	EIRP Limit dBm/MHz	Amplitude @ Band edge dBm/MHz	Plot #	Margin (dB)
5,180	5,150	-27.0	-34.89	TUVR32-A3-06	-7.89
5,260	Reference	-27.0	-38.90	ON FILE	-11.90
5,320	5,350	-27.0	-35.91	TUVR32-A3-07	-8.91

Spurious Emissions (above 1GHz)

Conducted spurious emissions (above 1GHz) are provided indicated by the following matrix. Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the band-edge measurements provided below are drawn on each plot.

Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	EIRP Limit (dBm/MHz)	Plot #	Margin (dB)
802.11a – Channel 36 (5,180MHz), 54MBit/s					
30	4,000	-36.54	-27.0	ON FILE	-9.54
4,000	5,150	-34.74	-27.0	ON FILE	-7.74
5,350	7,000	-45.57	-27.0	ON FILE	-18.57
7,000	13,200	-43.57	-27.0	ON FILE	-16.57
13,200	27,000	-42.40	-27.0	ON FILE	-15.40
27,000	31,000	-45.23	-27.0	ON FILE	-18.23
31,000	40,000	-35.40	-27.0	ON FILE	-8.40
802.11a – Channel 52 (5,260MHz), 54MBit/s					
30	4,000	-36.45	-27.0	ON FILE	-9.45
4,000	5,150	-37.49	-27.0	ON FILE	-10.49
5,350	7,000	-42.90	-27.0	ON FILE	-15.90
7,000	13,200	-43.40	-27.0	ON FILE	-16.40
13,200	27,000	-41.73	-27.0	ON FILE	-14.73
27,000	31,000	-45.73	-27.0	ON FILE	-18.73
31,000	40,000	-35.90	-27.0	ON FILE	-8.90
802.11a – Channel 64 (5,320MHz), 54MBit/s					
30	4,000	-36.96	-27.0	TUVR32-A3-08	-9.96
4,000	5,150	-36.57	-27.0	TUVR32-A3-09	-9.57
5,350	7,000	-30.90	-27.0	TUVR32-A3-10	-3.90
7,000	13,200	-42.90	-27.0	TUVR32-A3-11	-15.90
13,200	27,000	-42.73	-27.0	TUVR32-A3-12	-15.73
27,000	31,000	-45.73	-27.0	TUVR32-A3-13	-18.73
31,000	40,000	-36.73	-27.0	TUVR32-A3-14	-9.73

Specification

Specifically in-line with **15.407 (b) (1)** and **(b)(2)**. All emissions outside of the 5,150-5,350MHz band did not exceed an EIRP of -27dBm/MHz.

Data plots for band-edge requirements are available in Section 8 'Graphical Results'.

§**6.2.2 (o)(e1):** In any 100KHz bandwidth outside the operating frequency bands, either at least 20dB below the in-band spectral density, or shall not exceed the levels specified in Table 3, whichever is less stringent.

Measurement Uncertainty Conducted Spurious Emissions

Measurement uncertainty	±2.37dB

Traceability

METHOD	TEST EQUIPMENT USED
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0156, 0193, K-CBL 08, Coupler, 0070, 0116, 0088

5.1.8. Radiated Emissions

5.1.8.1. Transmitter Radiated Spurious Emissions (above 1GHz)

FCC, Part 15 Subpart C §15.407(b)
Industry Canada RSS-210 §6.3

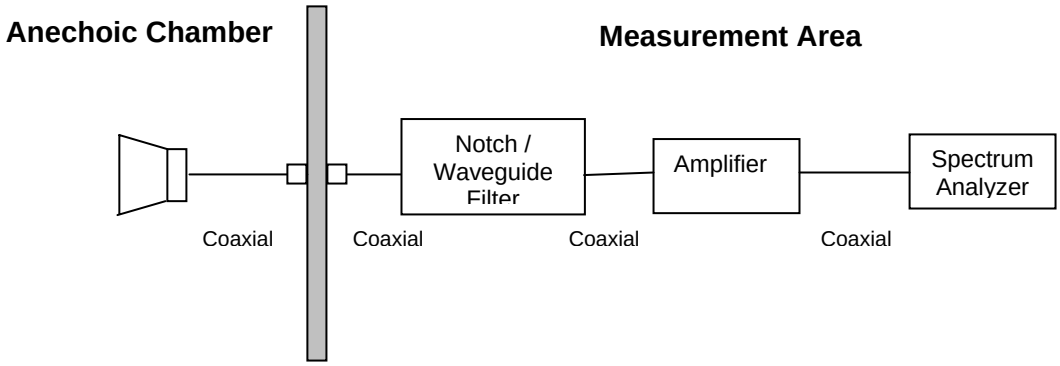
Test Procedure

Preliminary radiated emissions above 1GHz are 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. Depending on the frequency band spanned a notch filter or waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1GHz were performed using a minimum resolution bandwidth of 1MHz.

Collocated transmitters were exercised in all test cases.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

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

FS = R + AF + CORR - FO

where:

FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

For example:
Given 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 Transmitter Radiated Spurious Emissions 1GHz - 26GHz

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

Results
Power Setting – Maximum Level 4 (set through Aruba system interface), all test cases

Antenna Types: 2.4GHz and 5GHz **INTEGRAL ANTENNAS** (4.2dBi & 7.7dBi)

TABLE OF RESULTS – 802.11a + 802.11b/g (worst case for 802.11b or 802.11g reported)

Low Band 5GHz (5,150MHz-5,350MHz)

CHANNELS 1 & 36

Freq. MHz	Polarity H/V	Raw Reading dBμV/m	Correction Factor dB	Corrected Field Strength dBμV/m	Limit dBμV/m	Margin dB
4823.6	V	44.69	1.86	46.55	54.00	-7.45
10358.	H	42.12	10.06	52.18	54.00	-1.82
10359.	H	38.20	10.06	48.26	54.00	-5.74
10364.	V	38.00	10.26	48.26	54.00	-5.74
12969.	V	38.01	9.61	47.62	54.00	-6.38
15856.	H	39.10	9.61	48.71	54.00	-5.29

CHANNELS 6 & 52

Freq. MHz	Polarity H/V	Raw Reading dBμV/m	Correction Factor dB	Corrected Field Strength dBμV/m	Limit dBμV/m	Margin dB
4871.74	V	44.58	1.86	46.44	54.00	-7.56
4871.74	H	47.14	2.06	49.20	54.00	-4.60
7460.00	H	40.20	6.36	46.56	54.00	-7.44
10521.7	V	39.80	11.43	51.23	54.00	-2.77
10527.0	V	40.30	11.43	51.73	54.00	-2.27
15690.0	H	38.40	10.01	48.41	54.00	-5.59

CHANNELS 11 & 64

Freq. MHz	Polarity H/V	Raw Reading dBμV/m	Correction Factor dB	Corrected Field Strength dBμV/m	Limit dBμV/m	Margin dB
4919.83	V	45.92	1.86	47.78	54.00	-6.22
4919.83	H	37.88	2.06	39.94	54.00	-14.06
10630.9	V	39.60	11.43	51.03	54.00	-2.97
10651.0	V	42.02	11.43	53.45	54.00	-0.55

Results

Antenna Types: 2.4GHz and 5GHz **HIGH GAIN DIRECTIONAL PATCH** (11.5dBi & 14.0dBi)

TABLE OF RESULTS – 802.11a + 802.11b/g (worst case for 802.11b or 802.11g reported)

Low Band 5GHz (5,150MHz-5,350MHz)

CHANNELS 1 & 36

Freq. MHz	Polarity H/V	Raw Reading dBµV/m	Correction Factor dB	Corrected Field Strength dBµV/m	Limit dBµV/m	Margin dB
1036.07	H	44.88	-10.36	34.52	54.00	-19.48
1192.38	V	42.06	-10.46	31.60	54.00	-22.40
1877.75	H	46.24	-4.02	42.22	54.00	-11.78
1877.75	V	44.30	-4.02	40.08	54.00	-13.92
10364.00	V	42.10	10.26	52.36	54.00	-1.64
13485.00	H	29.00	9.41	38.41	54.00	-15.59

(-ve correction factor indicates gain)

CHANNELS 6 & 52

Freq. MHz	Polarity H/V	Raw Reading dBµV/m	Correction Factor dB	Corrected Field Strength dBµV/m	Limit dBµV/m	Margin dB
1192.38	V	42.56	-10.46	32.10	54.00	-21.90
2298.38	H	42.80	-2.42	40.38	54.00	-13.62
1877.75	V	45.06	-4.22	40.84	54.00	-13.16
1889.77	H	41.26	-4.02	37.24	54.00	-16.76
10143.00	H	39.12	11.86	50.98	54.00	-3.02
10527.00	V	41.32	11.43	52.75	54.00	-1.25
10536.00	V	42.02	11.43	53.45	54.00	-0.55

(-ve correction factor indicates gain)

CHANNELS 11 & 64

Freq. MHz	Polarity H/V	Raw Reading dBµV/m	Correction Factor dB	Corrected Field Strength dBµV/m	Limit dBµV/m	Margin dB
1877.75	H	48.34	-4.02	44.32	54.00	-9.68
1877.75	V	43.03	-4.22	38.81	54.00	-15.19
2298.59	H	46.85	-2.42	44.43	54.00	-9.57
5004.00	V	40.68	1.86	42.54	54.00	-11.46
10642.0	V	41.01	11.43	52.44	54.00	-1.56
15401.0	V	34.00	11.25	45.25	54.00	-8.75

(-ve correction factor indicates gain)

Results

Antenna Types: 2.4GHz and 5GHz **OMNI DIRECTIONAL** (6.0dBi & 5.5dBi)

TABLE OF RESULTS – 802.11a + 802.11b/g (worst case for 802.11b or 802.11g reported)

Low Band 5GHz (5,150MHz-5,350MHz)

CHANNELS 1 & 36

Freq. MHz	Polarity H/V	Raw Reading dBμV/m	Correction Factor dB	Corrected Field Strength dBμV/m	Limit dBμV/m	Margin dB
1192.38	V	41.80	-10.46	31.34	54.00	-22.66
1384.76	H	38.28	-8.46	29.82	54.00	-24.18
1589.17	H	39.04	-6.22	32.82	54.00	-21.18
2286.57	V	41.54	-2.42	39.12	54.00	-14.88
10364.00	V	41.03	10.26	51.29	54.00	-2.71
10373.00	V	41.08	10.26	51.34	54.00	-2.66

(-ve correction factor indicates gain)

CHANNELS 6 & 52

Freq. MHz	Polarity H/V	Raw Reading dBμV/m	Correction Factor dB	Corrected Field Strength dBμV/m	Limit dBμV/m	Margin dB
1192.38	H	40.06	-10.36	29.70	54.00	-24.30
1276.55	H	38.28	-8.46	29.82	54.00	-24.18
2298.59	V	40.38	-2.42	37.96	54.00	-16.04
10527.00	V	41.05	11.43	52.48	54.00	-1.52

(-ve correction factor indicates gain)

CHANNELS 11 & 64

Freq. MHz	Polarity H/V	Raw Reading dBμV/m	Correction Factor dB	Corrected Field Strength dBμV/m	Limit dBμV/m	Margin dB
1192.38	H	40.38	-10.36	30.02	54.00	-23.98
2298.59	V	44.50	-2.42	42.08	54.00	-11.92
8179.00	H	38.15	5.92	44.07	54.00	-9.93
10785.00	V	41.10	10.23	51.33	54.00	-2.67

(-ve correction factor indicates gain)

Radiated Band-Edge Results – Restricted Bands

Equipment was operated on the frequency channel closest to the restricted band in each case.

TABLE OF RESULTS – **802.11b 11Mbit/s**

Centre Frequency (MHz)	Restricted Band Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)
5,180	5,150	49.2	54.00	-4.8
5,320	5,350	48.1	54.00	-5.9

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 1000MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000MHz, 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.

Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Measurement Uncertainty Radiated Emissions

Measurement uncertainty (dB)	+5.6/ -4.5

Traceability

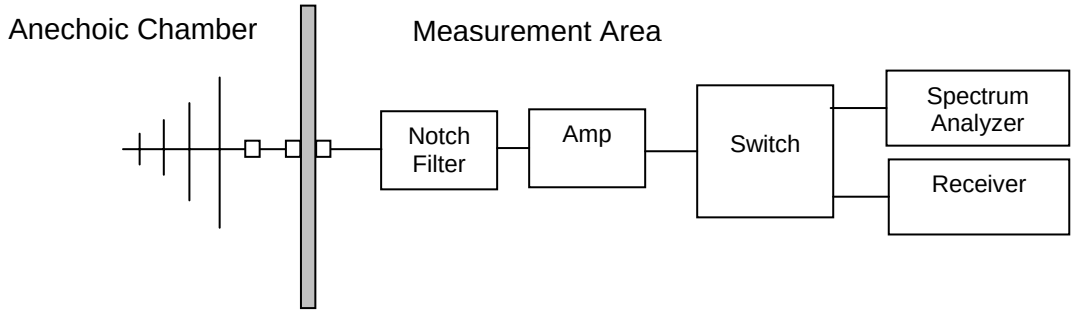
METHOD	TEST EQUIPMENT USED
Measurements were made per work instruction WI-EMC-07 "Measurement of Radiated Emissions"	0156, 0193, K-CBL 08, K-CBL 10, 0088, ANT1-18, ANT4, ANT5, Filter 2.4GHz Notch, Filter 5GHz Notch, W/Guide Filter 12.75-17GHz, W/Guide Filter 17-26.5GHz

5.1.8.2. Radiated Spurious Emissions (30M-1GHz)

FCC, Part 15 Subpart C §15.407(b)(5)/ §15.209
Industry Canada RSS-210 §6.2.2(o)(e1)

Test Procedure
Testing 30M-1GHz was subcontracted to the company identified in Section 3.9 Subcontracted Testing. Preliminary radiated emissions are 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 120kHz. 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 (30MHz – 1GHz)

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

Radio parameters.
Both transmitters 2.4GHz and 5GHz were operational
Antenna Types: 2.4GHz and 5GHz Omni directional antennas connected
Power Setting – Maximum Level 4 (set through Aruba system interface)

LAN and WAN data cables both carried traffic
RJ11 connected and generating noise

TABLE OF RESULTS - POWER OVER ETHERNET

Freq. MHz	Peak dBuV/m	QP dBuV/m	QP Lmt dBuV/m	QP Margin dB	Angle deg	Hgt cm	Pol	Total Correction Factor
30.94207	21.60	17.39	30.00	-12.61	354	101	Vert	-14.57
32.05312	27.47	23.91	30.00	-6.09	270	104	Vert	-15.35
250.0291	38.55	35.81	37.00	-1.19	250	397	Horz	-17.99
266.2992	31.61	25.94	37.00	-11.06	345	102	Vert	-17.19
500.0520	39.27	36.54	37.00	-0.46	136	203	Horz	-11.49
750.0877	32.98	31.01	37.00	-5.99	137	102	Horz	-5.78

TABLE OF RESULTS - AC/DC POWER CONVERTER

Freq. MHz	Peak dBuV/m	QP dBuV/m	QP Lmt dBuV/m	QP Margin dB	Angle deg	Hgt cm	Pol	Total Correction Factor
78.36462	20.38	14.59	30.00	-15.41	48	281	Vert	-25.09
79.98328	21.32	16.36	30.00	-13.64	62	219	Vert	-25.07
250.0278	32.54	31.50	37.00	-5.50	243	103	Vert	-17.99
266.6428	32.45	27.23	37.00	-9.77	346	101	Vert	-17.11
500.0593	35.71	35.09	37.00	-1.91	134	200	Horz	-11.49
668.3296	30.29	23.88	37.00	-13.12	4	394	Vert	-7.09

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 1000MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000MHz, 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.

Frequency (MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Measurement Uncertainty Radiated Emissions

Measurement uncertainty (dB)	+5.6/ -4.5

Traceability

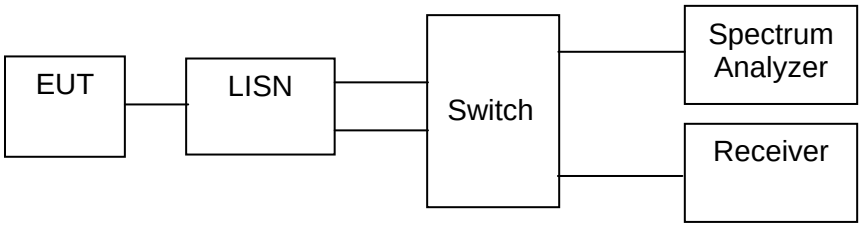
METHOD	TEST EQUIPMENT USED
Measurements were made per work instruction WI-EMC-07	HP 8546A E MI Receiver, HP8546A EMI Receiver (RF Filter Section), HP 9 KHz – 1 GHz Ant. Preamplifier, EMCO Biconilog (Imm/ Em),

5.1.9. AC Wireline Conducted Emissions (150KHz – 30MHz)

FCC, Part 15 Subpart C §15.407(b)/15.207
Industry Canada RSS-210 §6.6(b), §7.4

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 9KHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test Measurement Set up



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

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

Power Setting – Maximum Level 4 (set through Aruba system interface)

TABLE OF RESULTS – AC/DC CONVERTER

Frequency (MHz)	Average (dBµV)	Average Limit (dBµV)	QP Voltage (dBµV)	Margin (dB)	Phase
0.24600	40.551	51.89	--	-11.34	L
12.7460	35.417	50.00	--	-14.58	N
12.7940	36.935	50.00	--	-13.07	N
13.2820	35.561	50.00	--	-14.44	N
13.8260	37.011	50.00	--	-12.99	N
14.0740	35.582	50.00	--	-14.42	N

Emission plots are provided in Section 8, Graphical Results

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 150KHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μΩ 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.

6.6(b) On any frequency or frequencies within the band of 0.15-30 MHz, the measured RF voltage (CISPR meter) shall not exceed 250μV, 48dBμV (across 50 ohms)

Transmitters marketed for use only in a commercial, industrial or business environment and not intended for use in homes are permitted a limit of 1000 μV (60dBμV, 0.45 - 1.705 MHz) and 3000 μV (69.5dBμV, 1.705 - 30 MHz).

§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

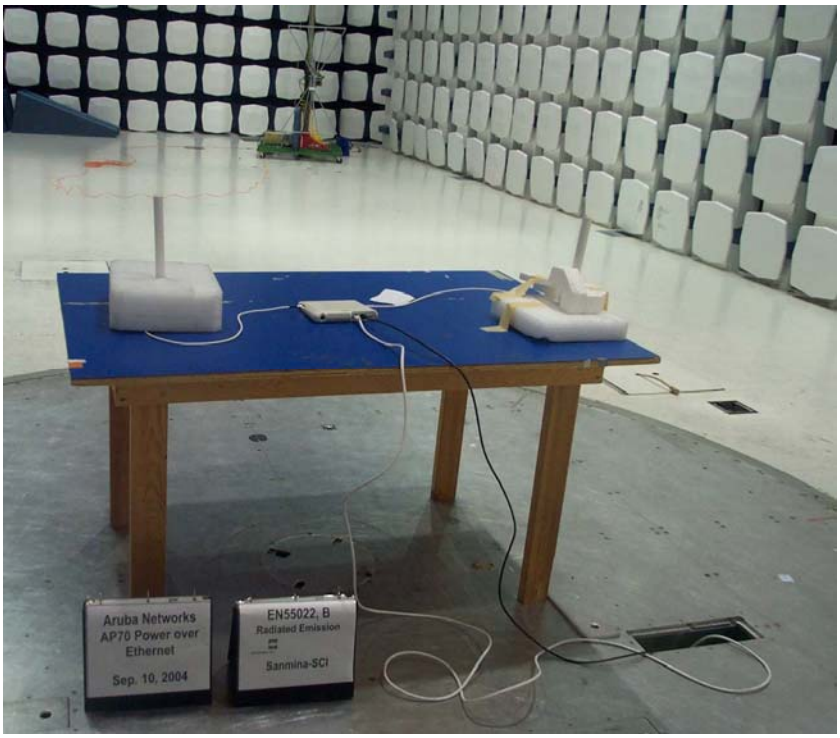
Measurement uncertainty	±2.64dB

Traceability

METHOD	TEST EQUIPMENT USED
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0156, 0193, 0190, 15F50B001, 15F0B002

6. TEST SET-UP PHOTOGRAPHS

6.1. Radiated Emissions (30MHz-1GHz)

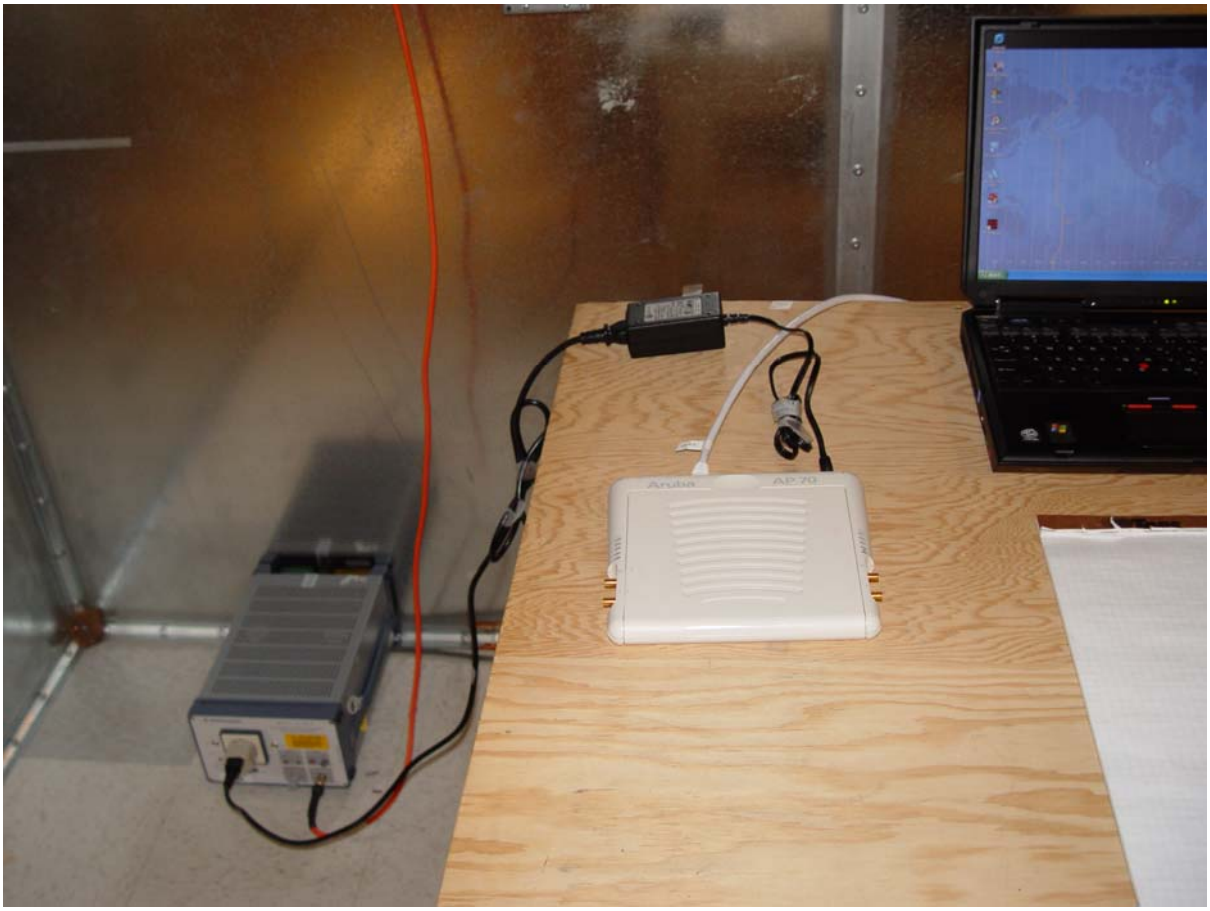


Power Over Ethernet (POE)

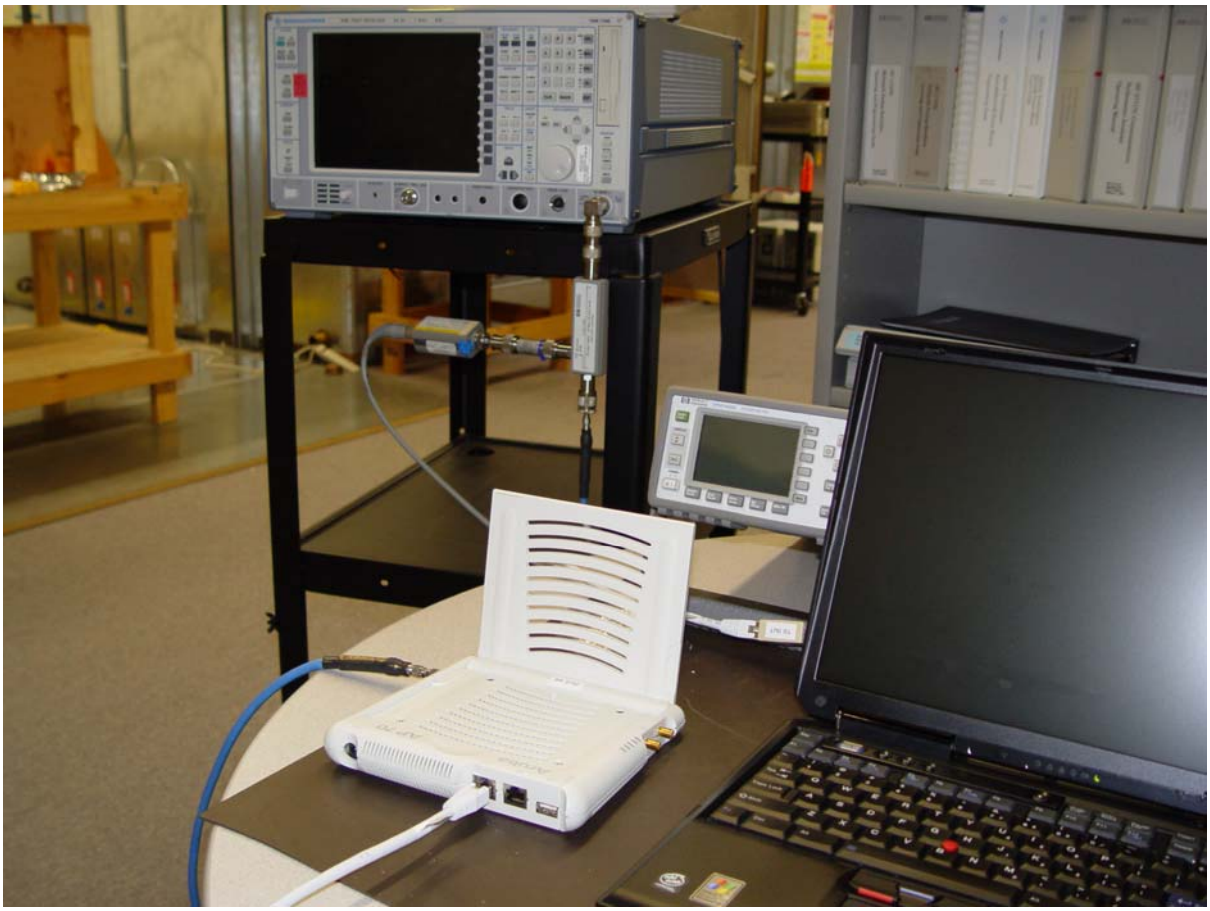
AC/DC Converter

6.2. Spurious Emissions >1GHz

6.3. Conducted Emissions (150KHz - 30MHz)



6.4. General Measurement Test Set-Up



7. TEST EQUIPMENT DETAILS

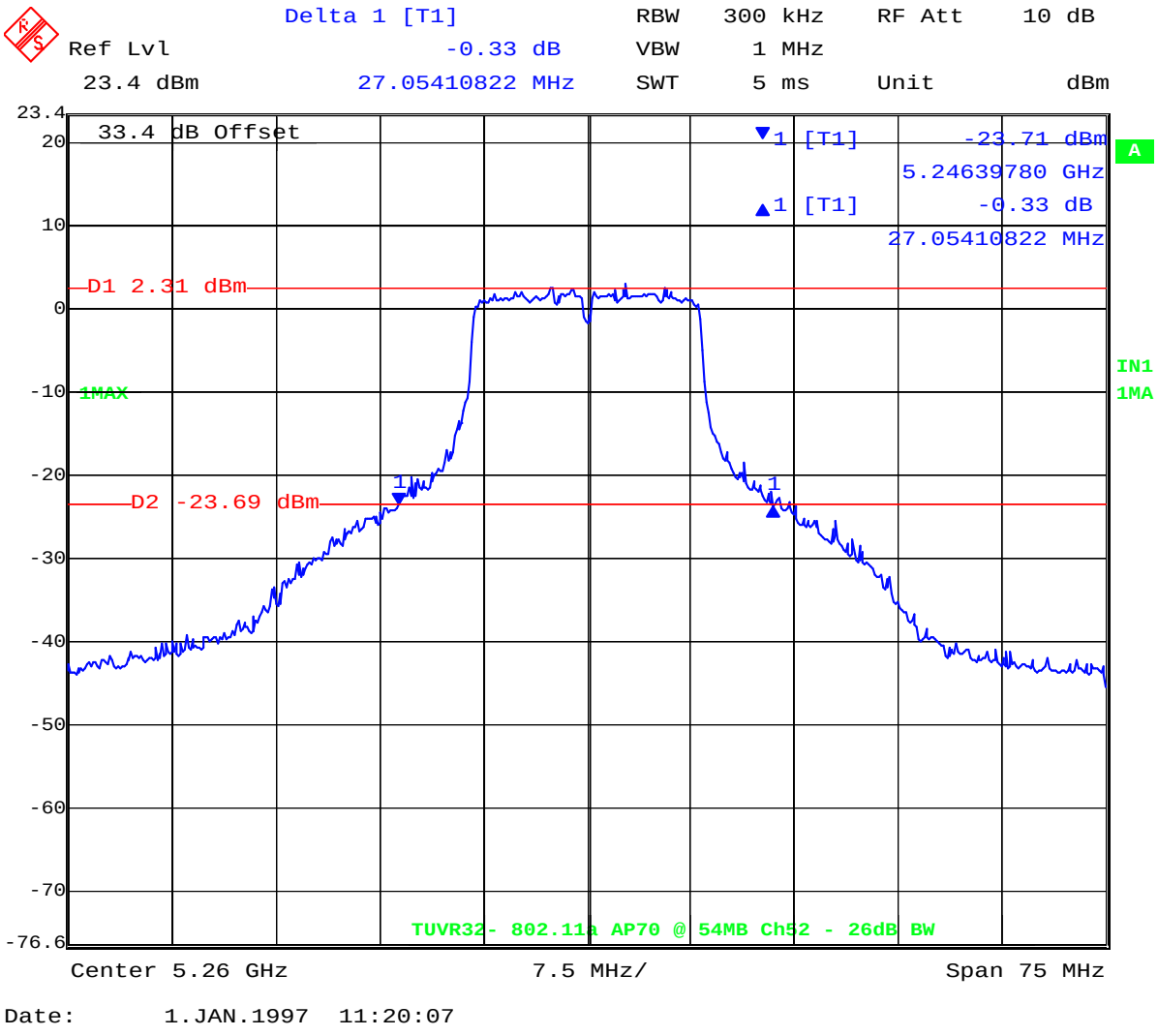
Asset #	Instrument	Manufacturer	Part #	Calibration Due Date	Serial #
0156	Barometer /Thermometer	Control Co.	4196	12 Aug '05	E2844
K-CBL 08	SMA Cable	Megaphase	Sucoflex 104	18 Jun '05	Unknown
K-CBL 10	SMA Cable	Megaphase	Sucoflex 104	18 Jun '05	Unknown
K-CBL 11	SMA Cable	Megaphase	Sucoflex 104	18 Jun '05	Unknown
K-CBL 12	SMA Cable	Megaphase	Sucoflex 104	18 Jun '05	Unknown
15F50B001	BNC Cable	Megaphase	Unknown	18 Jun '05	Unknown
15F50B002	BNC Cable	Megaphase	Unknown	18 Jun '05	Unknown
10F50B003	BNC Cable	Megaphase	Unknown	18 Jun '05	Unknown
15F50N001	N-Type Cable	Megaphase	Unknown	18 Jun '05	Unknown
5F50N001	N-Type Cable	Megaphase	Unknown	18 Jun '05	Unknown
3F50N002	N-Type Cable	Megaphase	Unknown	18 Jun '05	Unknown
ANT 1	Antenna (30M-2GHz)	Schaffner and Chase	CBLG140A	Not Applicable	1195
ANT1-18	Horn Antenna	The Electro-Mechanics Company	3115	12 Aug '05	9205-3882
0213	20-300MHz Antenna	Schwarzbeck	VHBB 9124	6 Apr '05	9124/0257
0250	230MHz-1GHz Antenna	Schwarzbeck	VUSLP9111	6 Apr '05	186
ANT4	18GHz-26.5GHz	Millimeter Products	261K	30 Apr '05	595
ANT5	26.5GHz-40GHz	Millimeter Products	261A	30 Apr '05	599
0193	EMI Receiver	Rhode & Schwartz	ESI 7	16 Mar '05	838496/007
0088	Spectrum Analyzer	Hewlett Packard	8564E	15 May '05	
0190	LISN	Rhode & Schwartz	ESH3Z5	3 Apr '05	836679/006
0070	Power Meter	Hewlett Packard	437B	13 May '05	3125U13554
0116	Power Sensor	Hewlett Packard	R8485A	16 Mar '05	3318A19694
Coupler	Coupler	Hewlett Packard	86205A	N/A	1623
3dB Att'n	3dB N-Type Attenuator	ARRA	N9444-30	N/A	--
30dB Att'n	30dB N-Type Attenuator	NARDA	32319	N/A	--
Filter	2.4GHz Notch	Micro-Tronics	--	N/A	--
W/guide Filter	12.75-17GHz	CMT	--	--	--
W/guide Filter	17-26.5GHz	HP	--	--	--

8. GRAPHICAL RESULTS

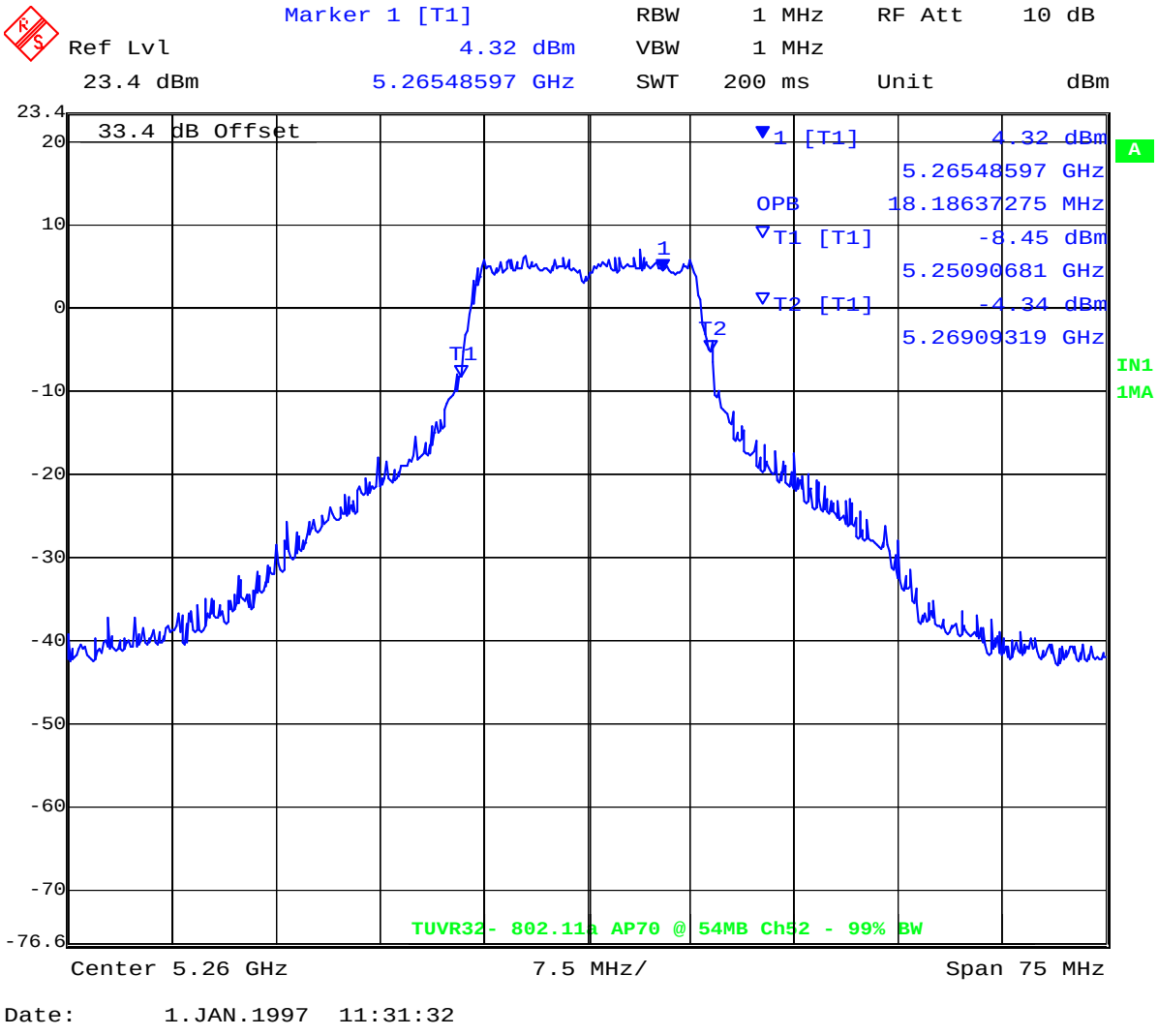
This report contains the following plots as referenced in the test results, Section 5 of this report.

2.4GHz 802.11b/g	
Parameter	**Plot No.**
Section 5.1.1 26dB Bandwidth (5,260MHz)	TUVR32-A3-01
Section 5.1.1 99% Bandwidth (5,260MHz)	TUVR32-A3-02
Section 5.1.2 Peak Output Power (5,320MHz)	TUVR32-A3-03
Section 5.1.3 Peak Power Spectral Density (5,320MHz MHz)	TUVR32-A3-04
Section 5.1.4 Peak Excursion Ratio (5,260MHz)	TUVR32-A3-05
Section 5.1.7	
Band Edge - 5,180MHz	TUVR32-A3-06
- 5,320MHz	TUVR32-A3-07
1-40GHz conducted spurious emissions	
30MHz – 4,000MHz	TUVR32-A3-08
4,000 – 5,1500MHz	TUVR32-A3-09
5,350 – 7,000MHz	TUVR32-A3-10
7,000 – 13,200MHz	TUVR32-A3-11
13,200 – 27,000MHz	TUVR32-A3-12
27,000 – 31,000MHz	TUVR32-A3-13
31,000 – 40,000MHz	TUVR32-A3-14
Section 5.1.6 Radiated Emissions	
5.1.6.1 Transmitter Radiated Spurious Emissions 1-40GHz	
1,000-7,000MHz Horizontal	TUVR32-A3-15
1,000-7,000MHz Vertical	TUVR32-A3-16
7,000-12,750MHz Vertical	TUVR32-A3-17
7,000-12,750MHz Horizontal	TUVR32-A3-18
12,750 – 18,000MHz Horizontal	TUVR32-A3-19
12,750 – 18,000MHz Vertical	TUVR32-A3-20
18,000 – 26,500MHz Horizontal + Vertical	TUVR32-A3-21
26,500 - 40,000MHz Horizontal + Vertical	TUVR32-A3-22
5.1.6.2 Radiated Spurious Emissions 30M-1GHz (POE)	TUVR32-A3-23
Radiated Spurious Emissions 30M-1GHz (AC/DC Converter)	TUVR32-A3-24
Section 5.1.7 AC Wireline Conducted Emissions	
- Line L1	TUVR32-A3-25
- Line N	TUVR32-A3-26

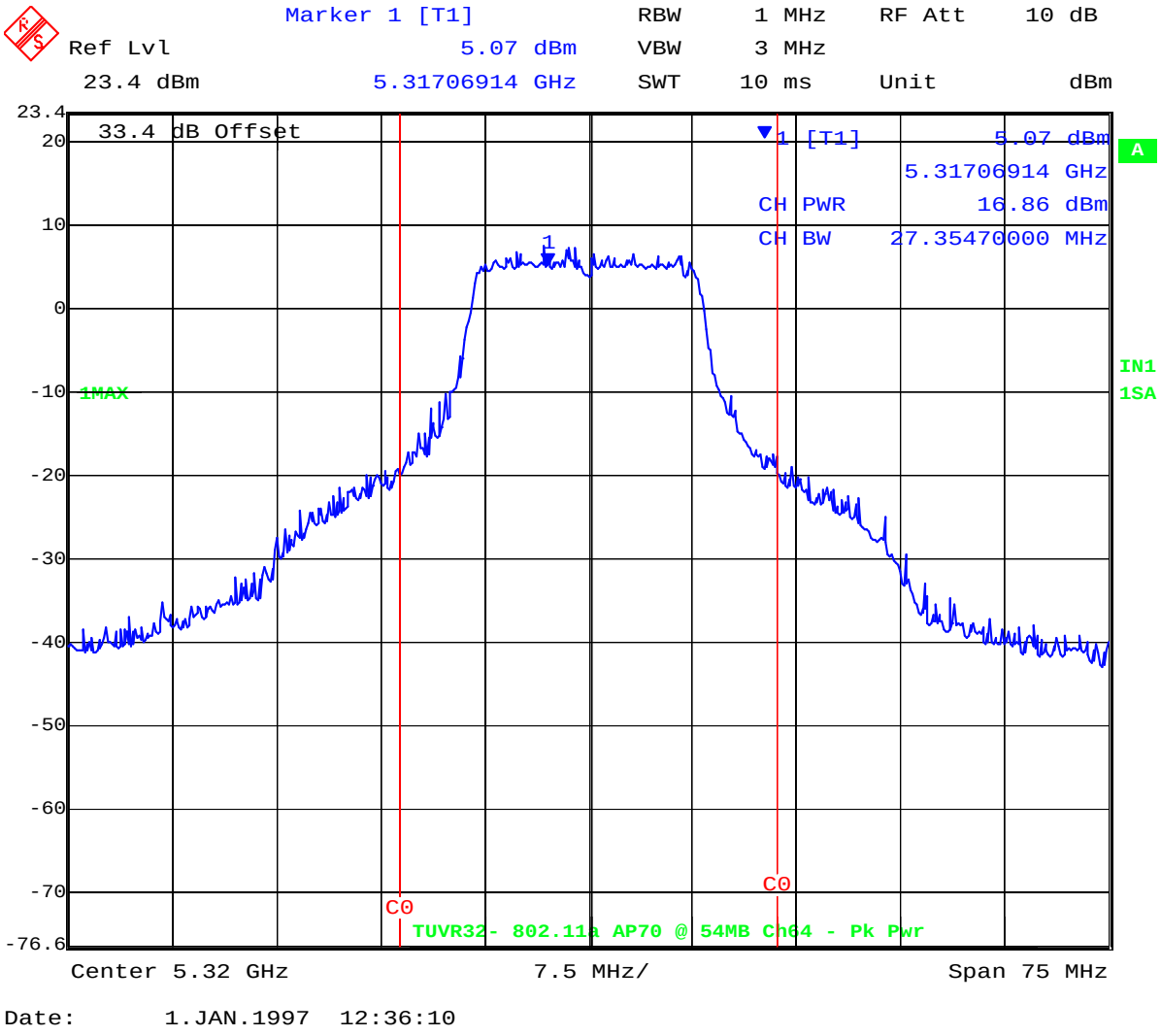
26dB Bandwidth (5,260MHz) - TUVR32-A3-01



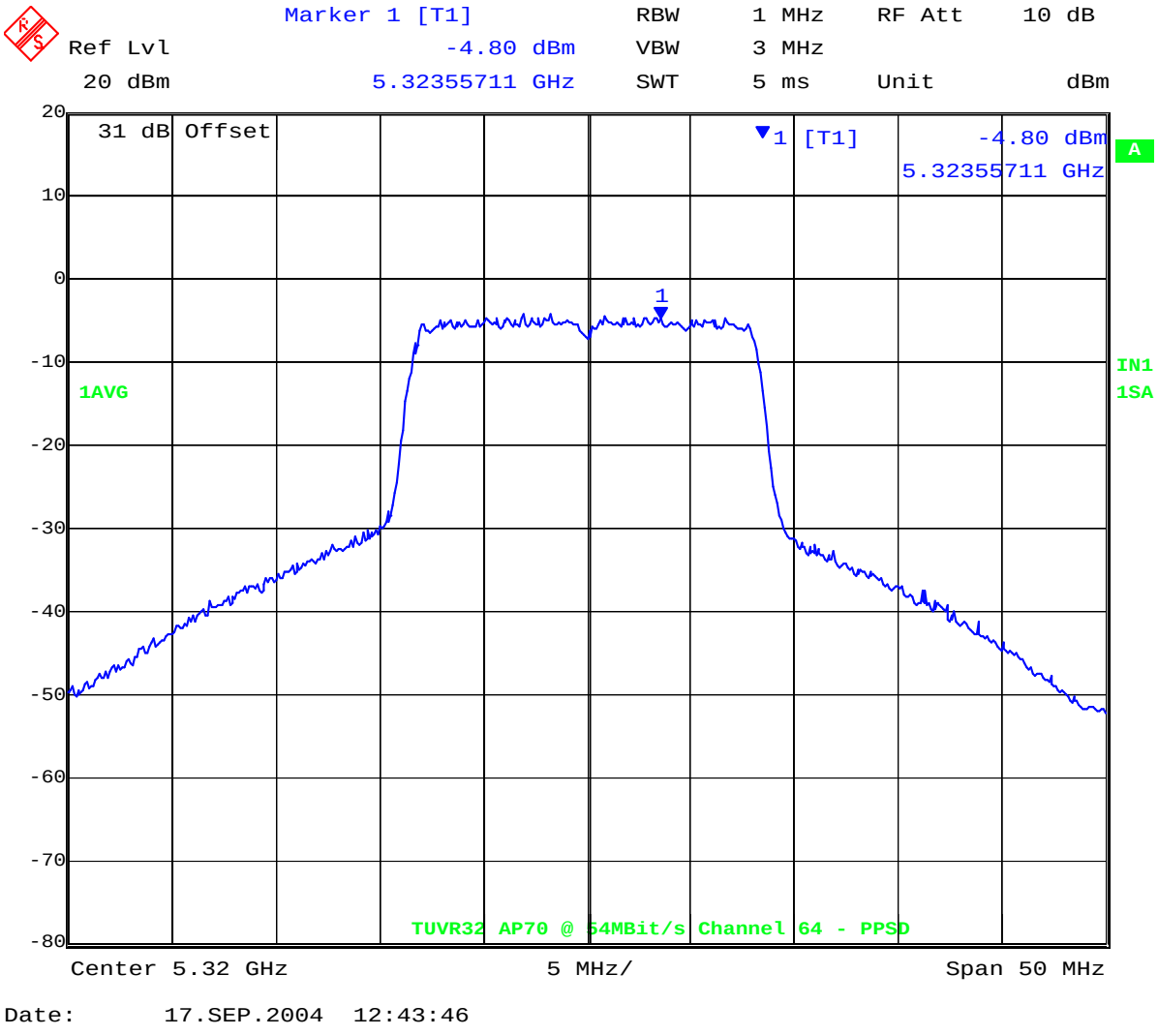
99% Bandwidth (5,260MHz) - TUVR32-A3-02



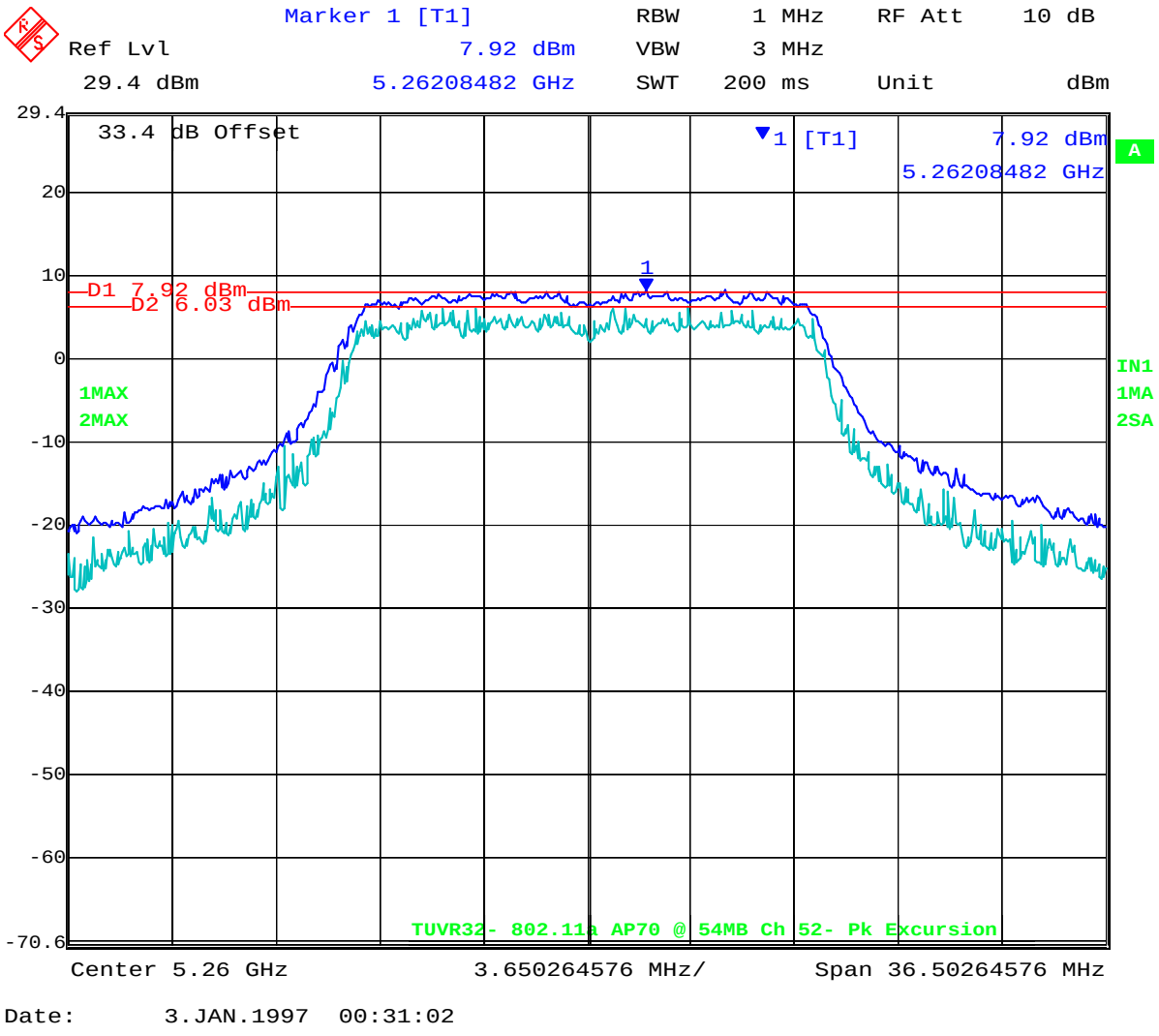
Peak Output Power (5,320MHz) - TUVR32-A3-03



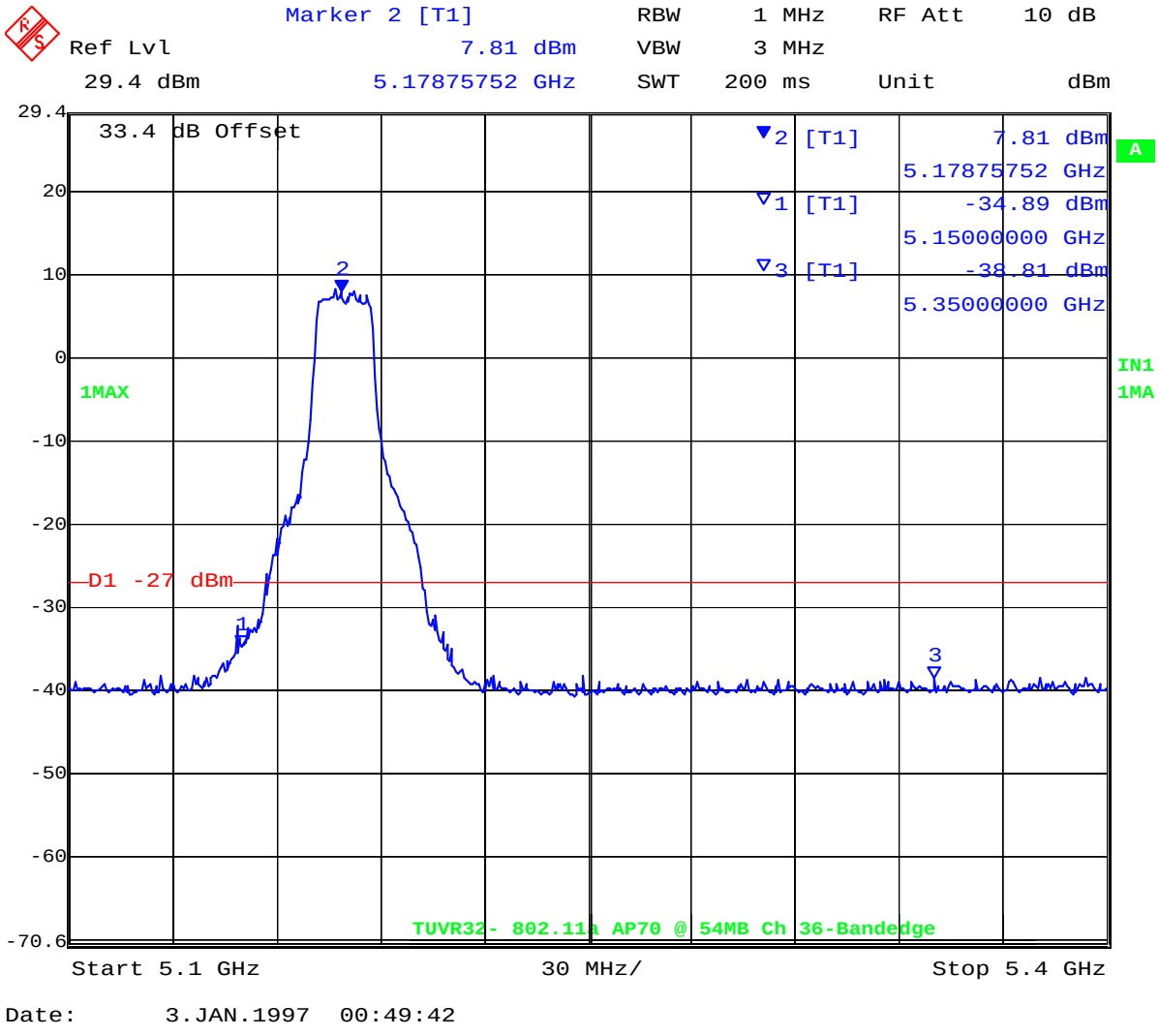
Peak Power Spectral Density (5,320MHz) - TUVR32-A3-04



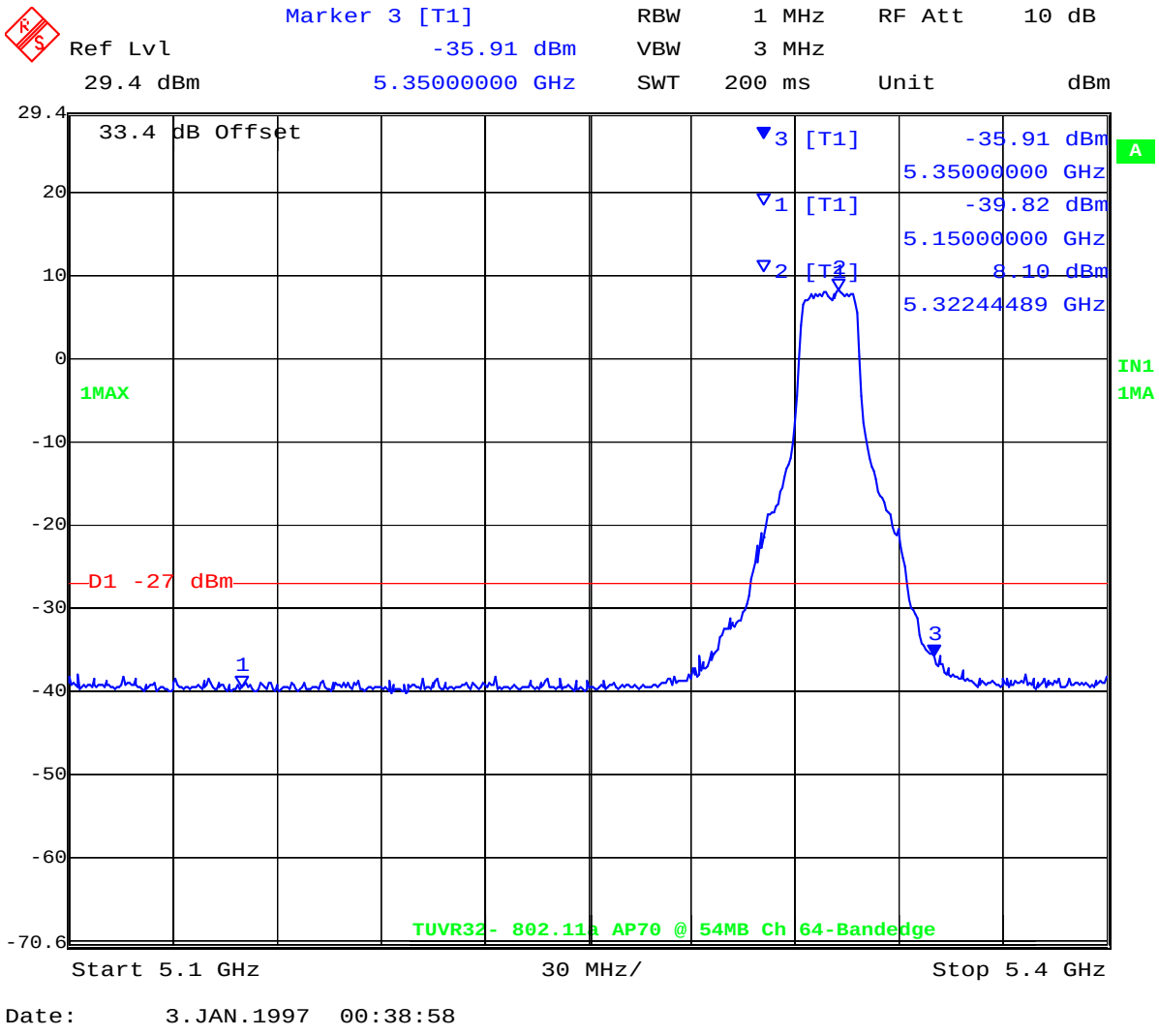
Peak Excursion Ratio, (5,260MHz) - TUVR32-A3-05



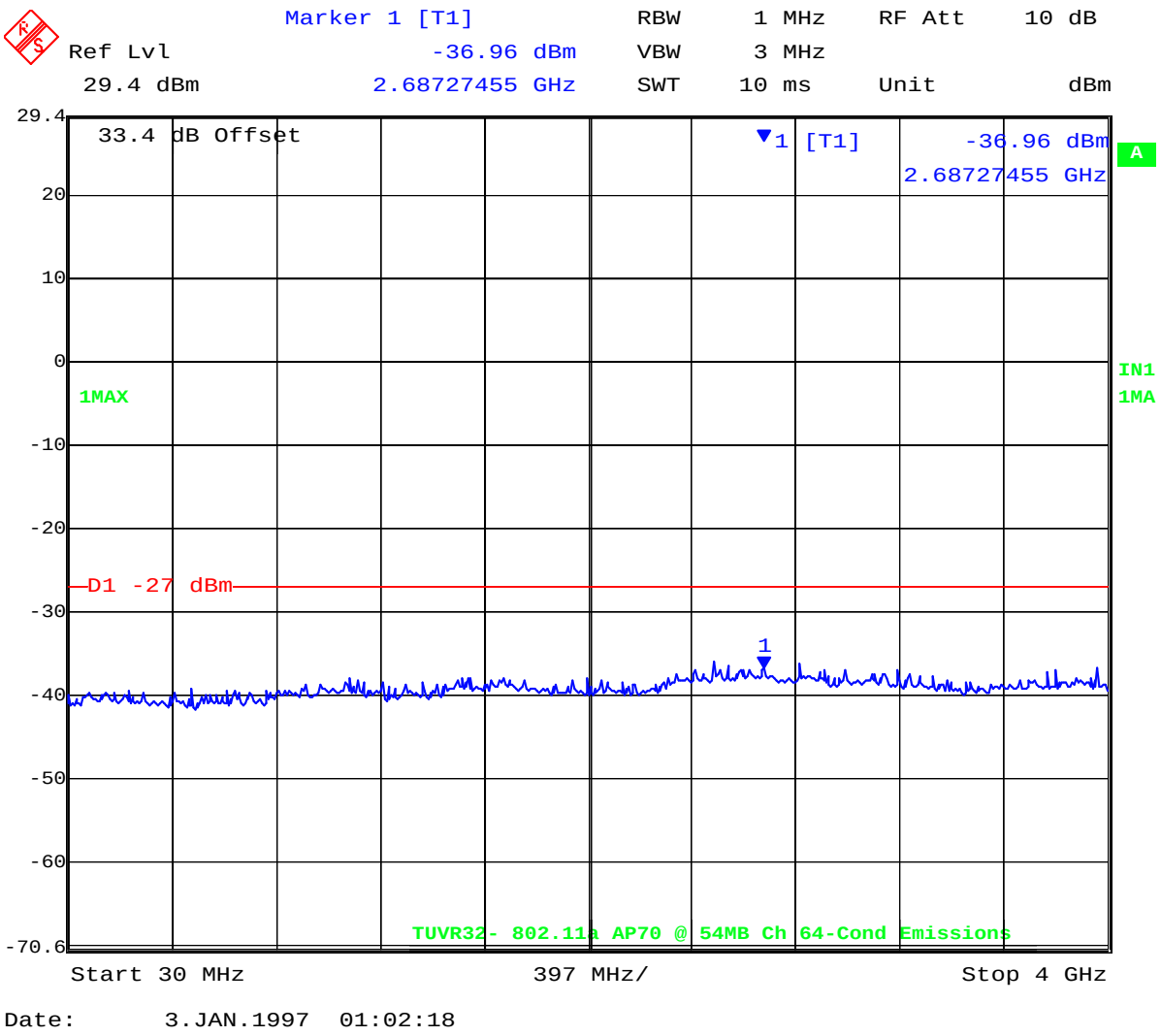
Conducted Spurious Emissions, Lower Band Edge 5,150MHz - TUVR32-A3-06



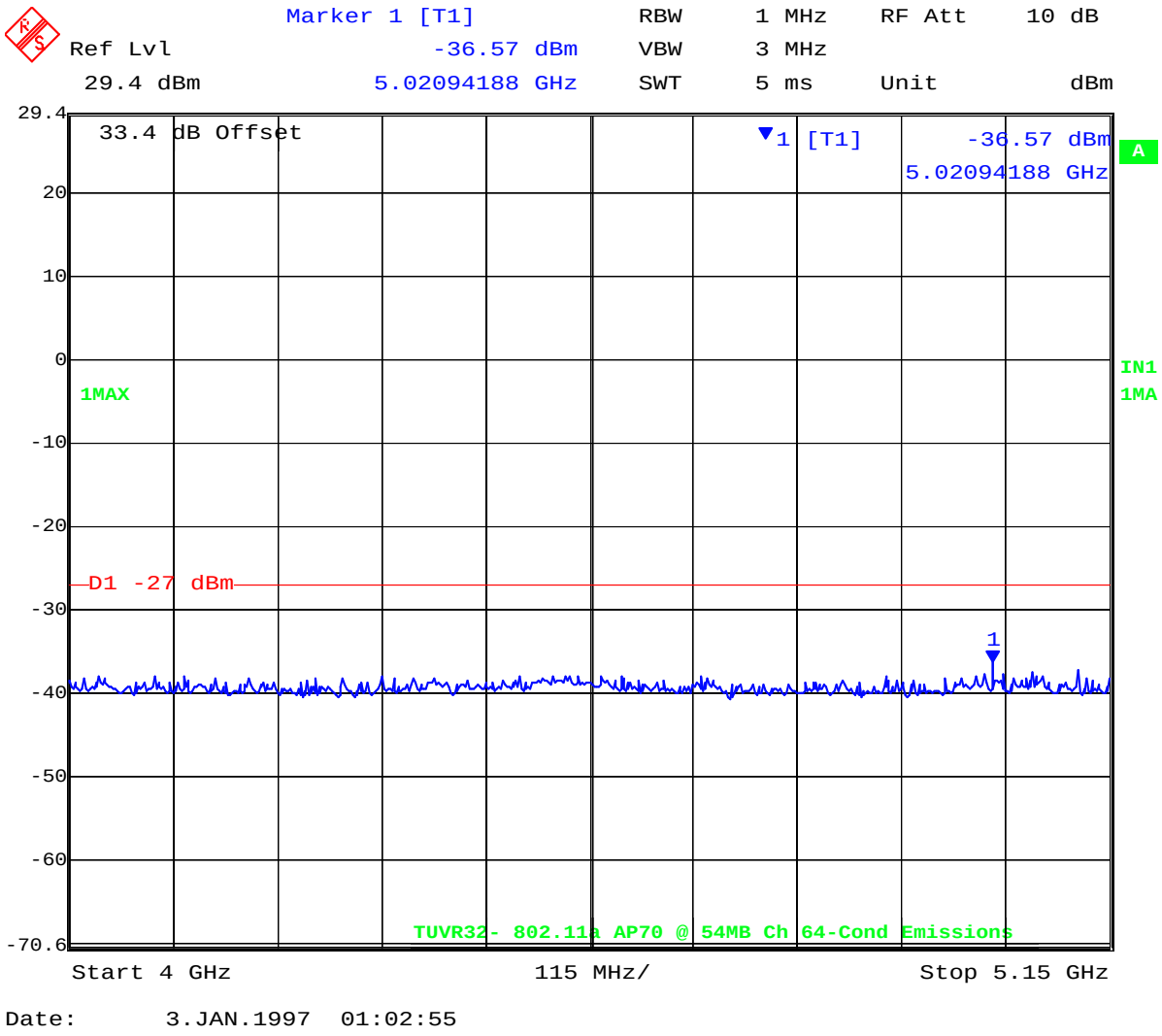
Conducted Spurious Emissions, Upper Band Edge 5,350MHz - TUVR32-A3-07



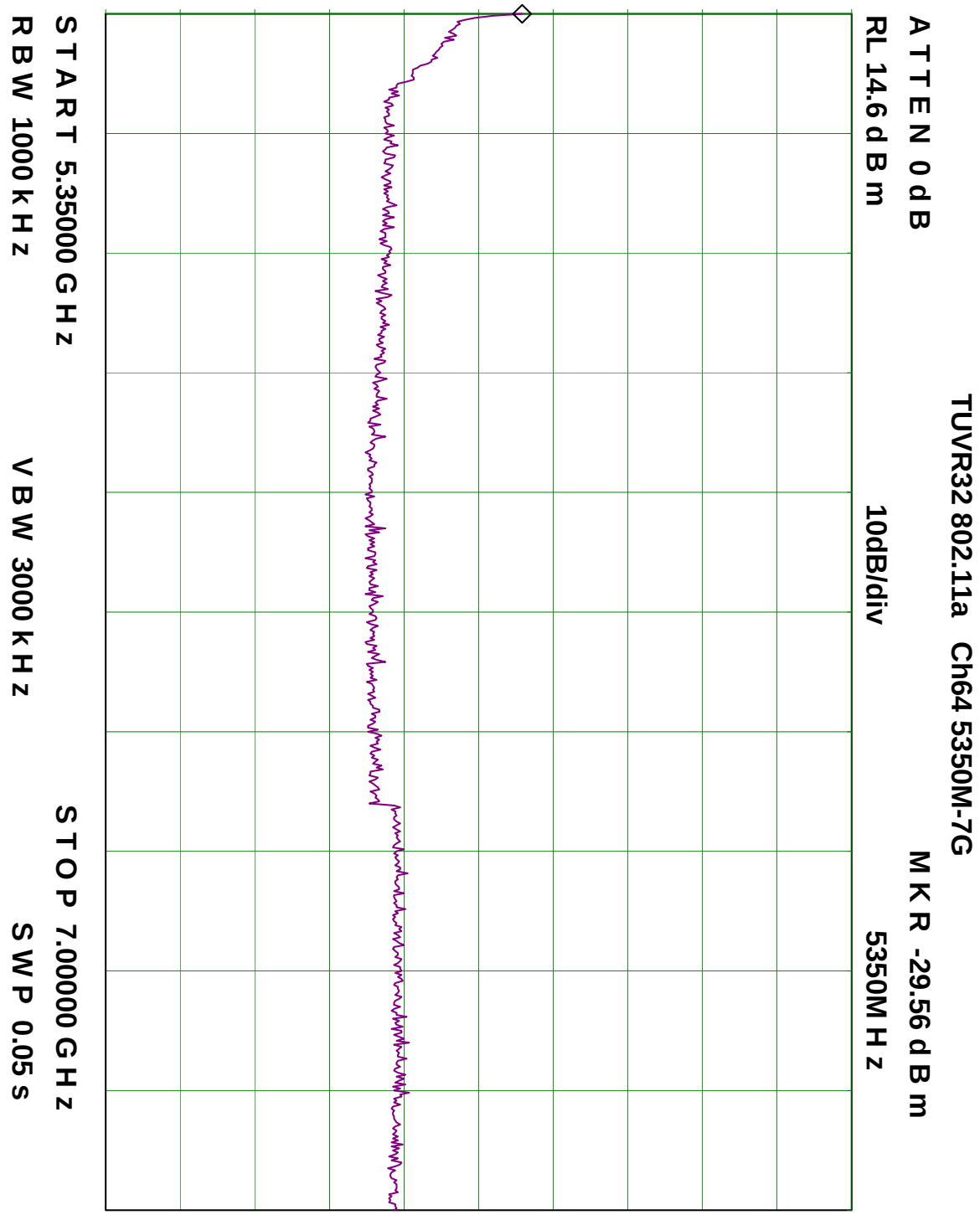
Conducted Spurious Emissions CH64 (5,320MHz), (1-40GHz) 30MHz-4,000MHz - TUVR32-A3-08



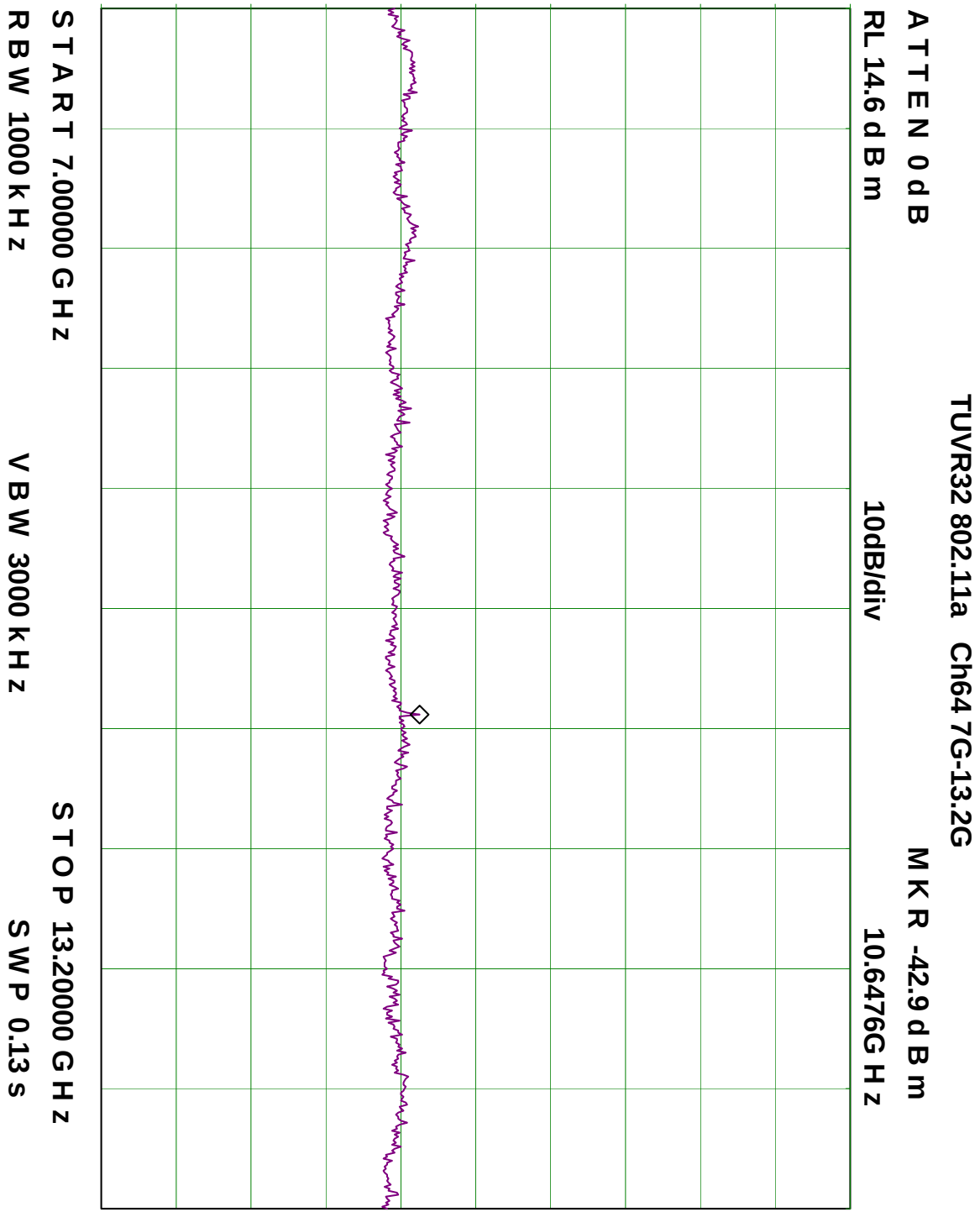
Conducted Spurious Emissions CH64 (5,320MHz), (1-40GHz) 4,000– 5,150MHz TUVR32-A3-09



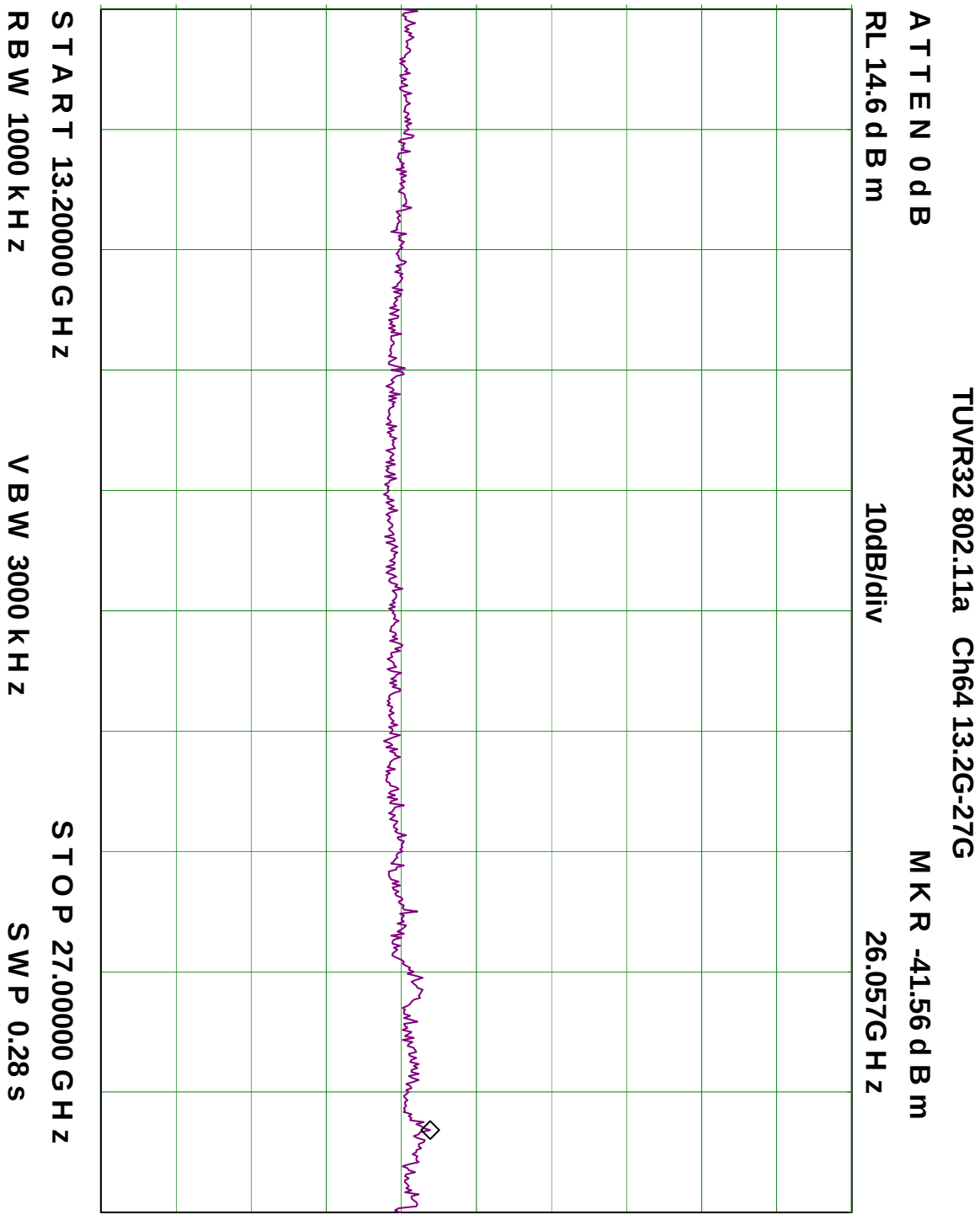
Conducted Spurious Emissions CH64 (5,320MHz), (1-40GHz) 5.350-7GHz
TUVR32-A3-10



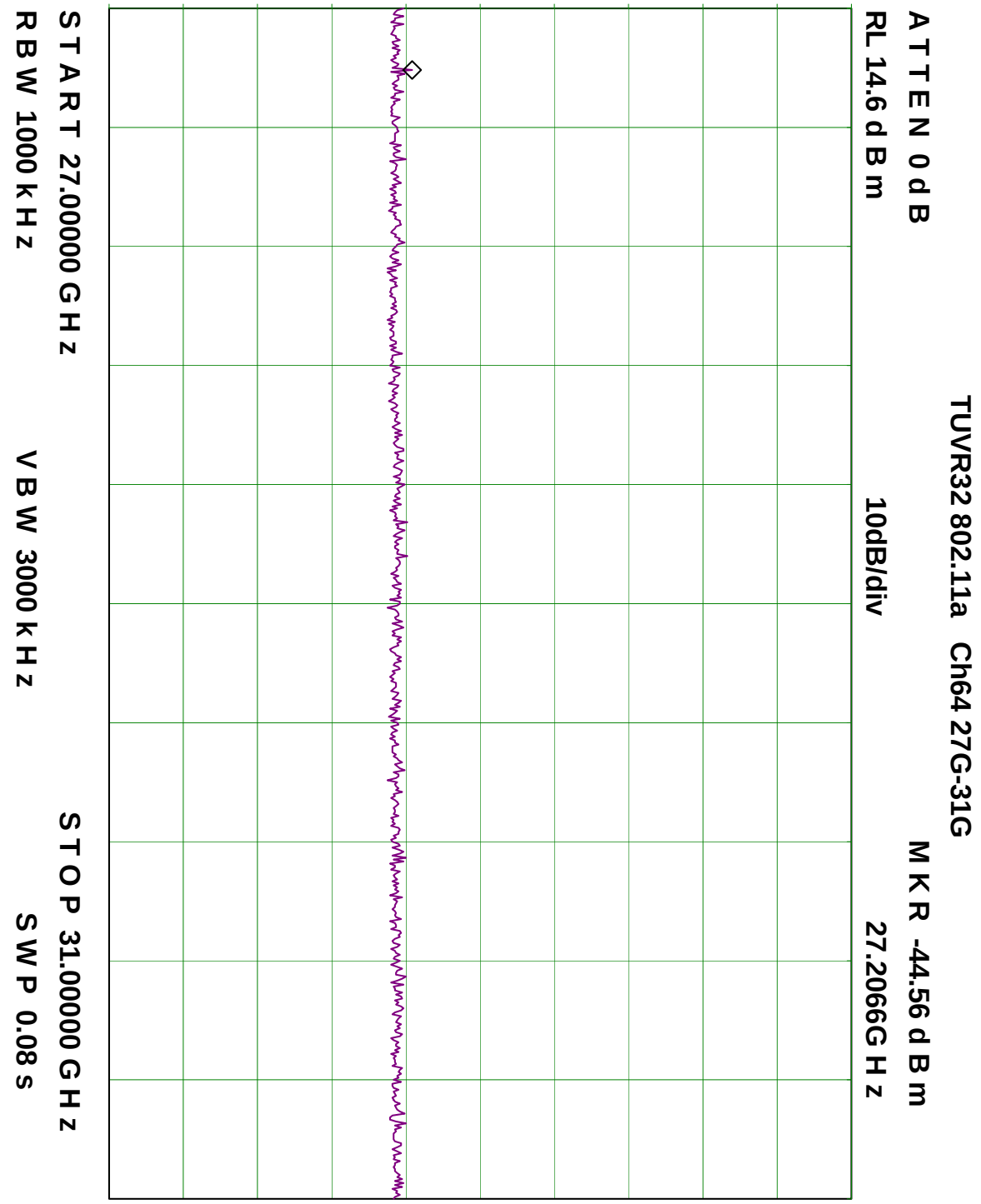
Conducted Spurious Emissions CH64 (5,320MHz), (1-40GHz) 7-13.2GHz
TUVR32-A3-11



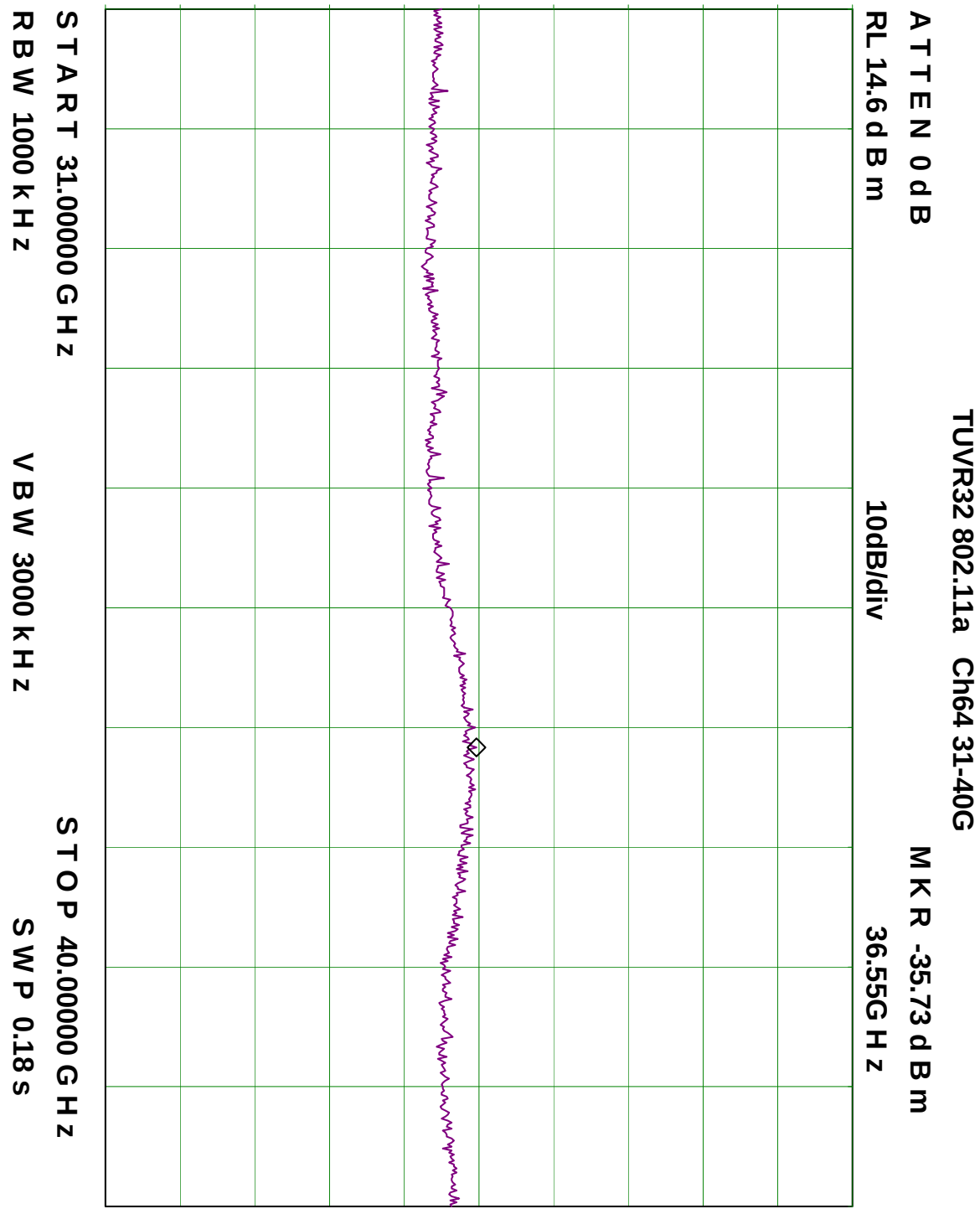
Conducted Spurious Emissions CH64 (5,320MHz), (1-40GHz) 13.2-27GHz
TUVR32-A3-12



Conducted Spurious Emissions CH64 (5,320MHz), (1-40GHz) 27-31GHz
TUVR32-A3-13

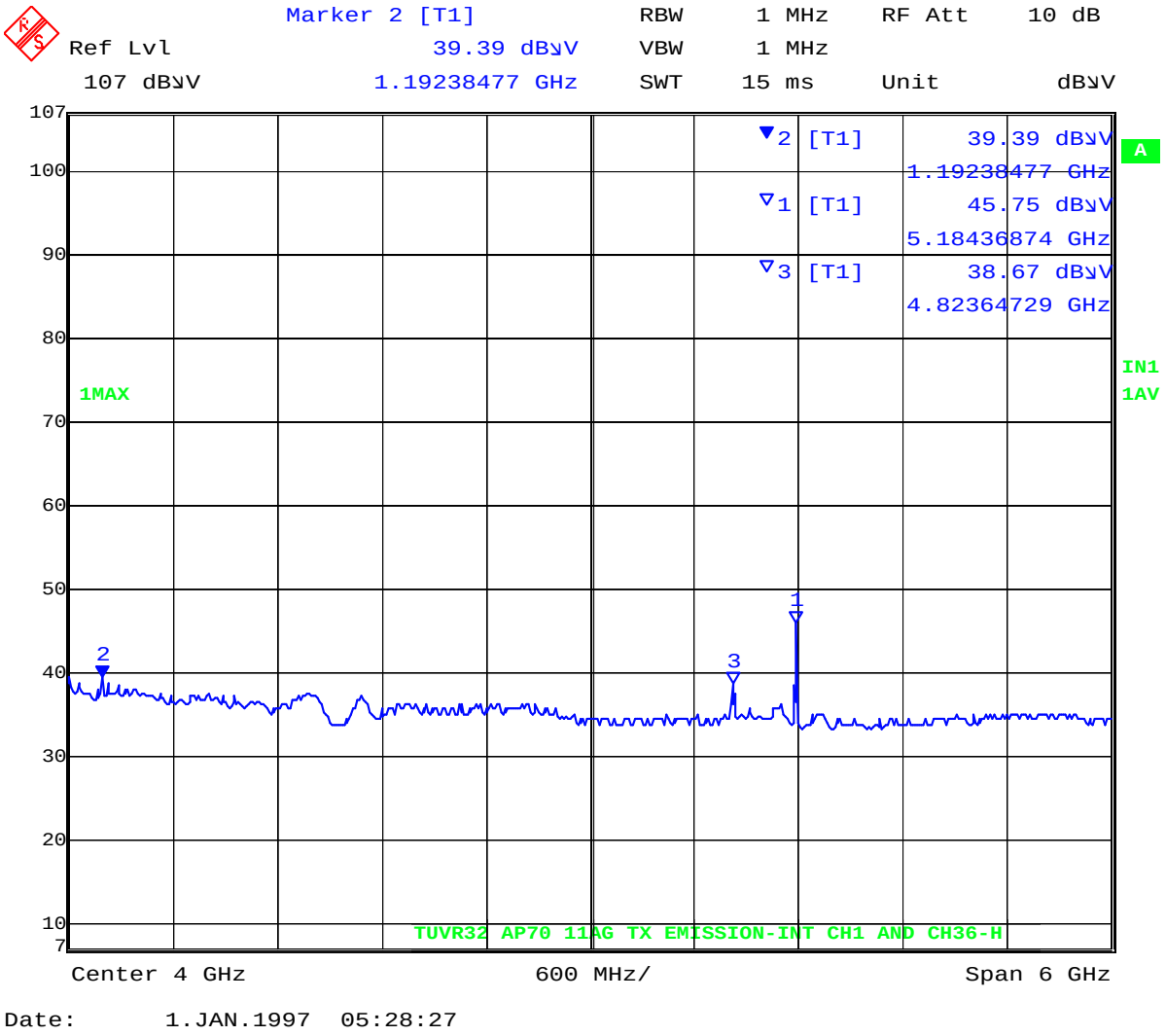


Conducted Spurious Emissions CH64 (5,320MHz), (1-40GHz) 31-40GHz
TUVR32-A3-14

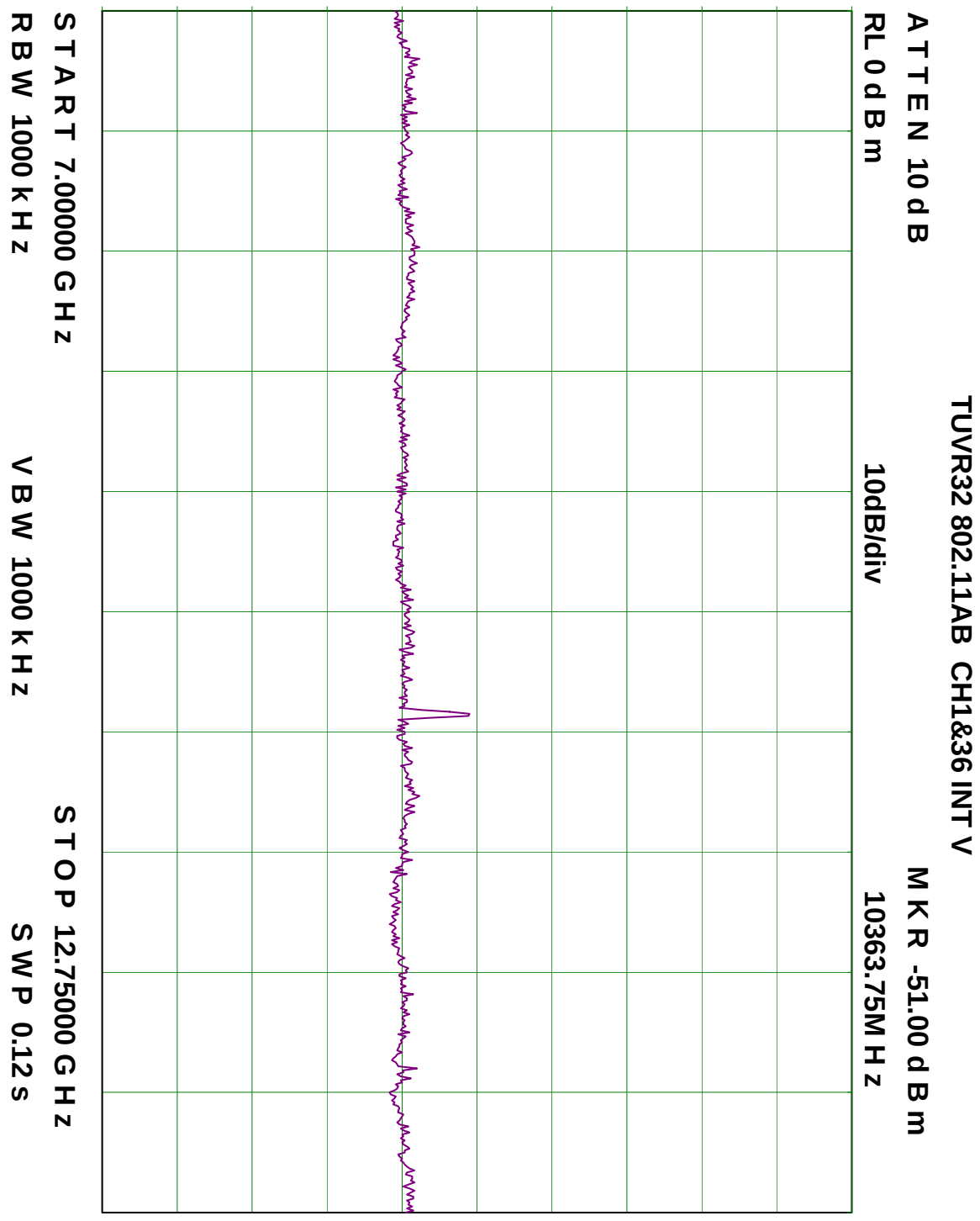


Transmitter Radiated Spurious Emissions, Internal Antenna - 802.11a/g
CH1&36 HORIZONTAL (1-6GHz) - TUVR32-A3-15

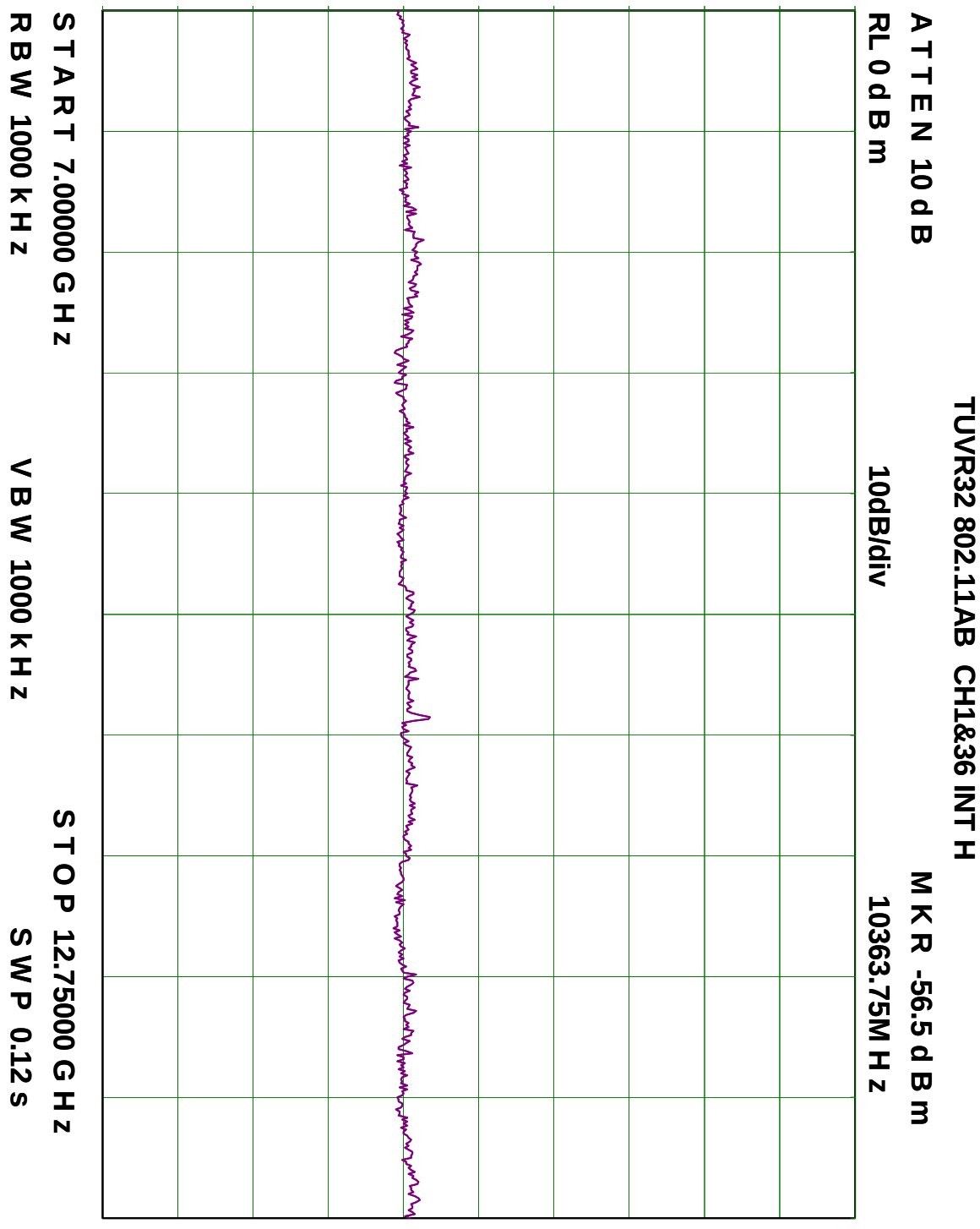
Transmitter Radiated Spurious Emissions Internal Antenna - 802.11a/g CH1&36 VERTICAL (1-6GHz) - TUVR32-A3-16



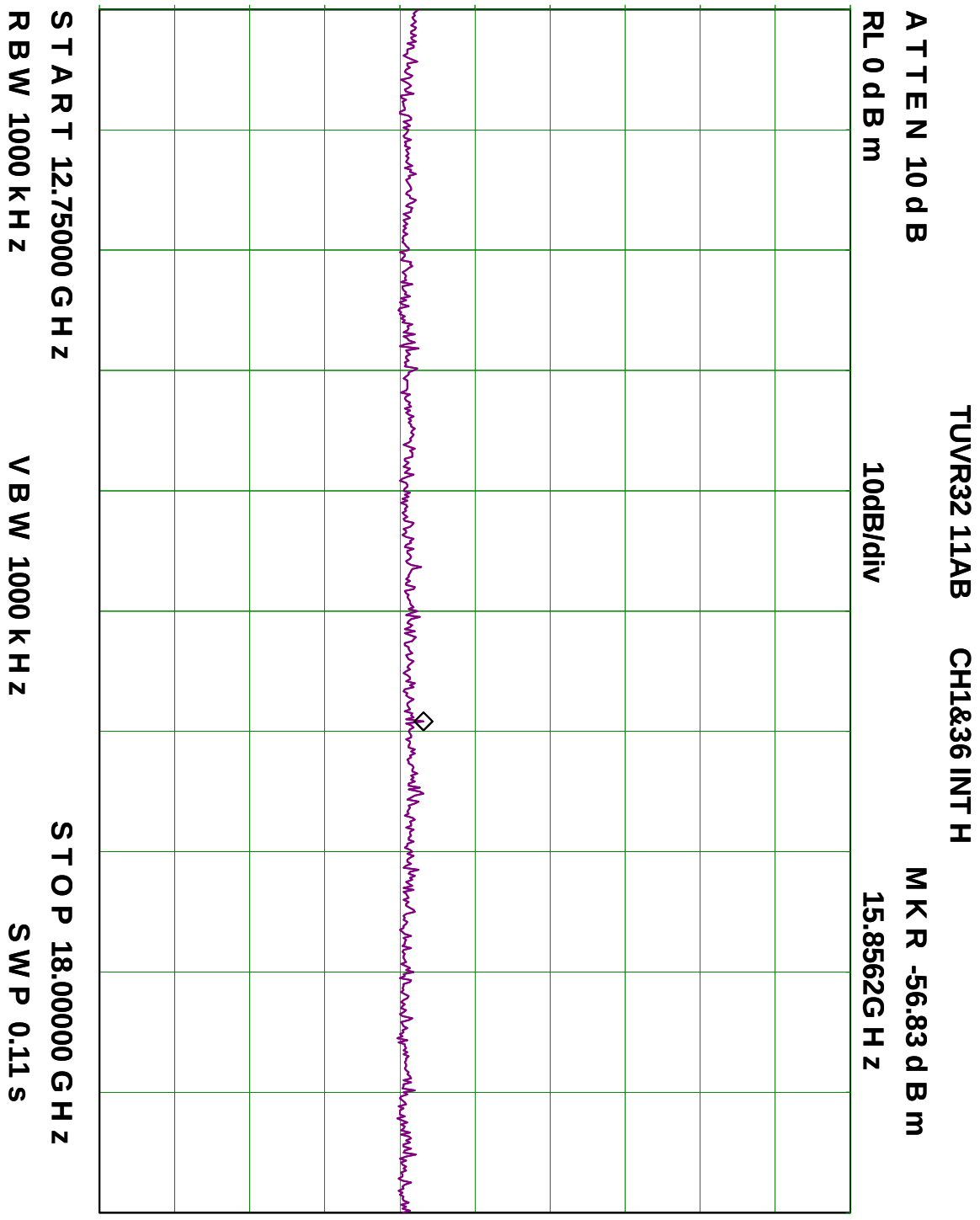
Transmitter Radiated Spurious Emissions Internal Antenna - 802.11a/b CH1&36 VERTICAL (7-12.75GHz) TUVR32-A3-17



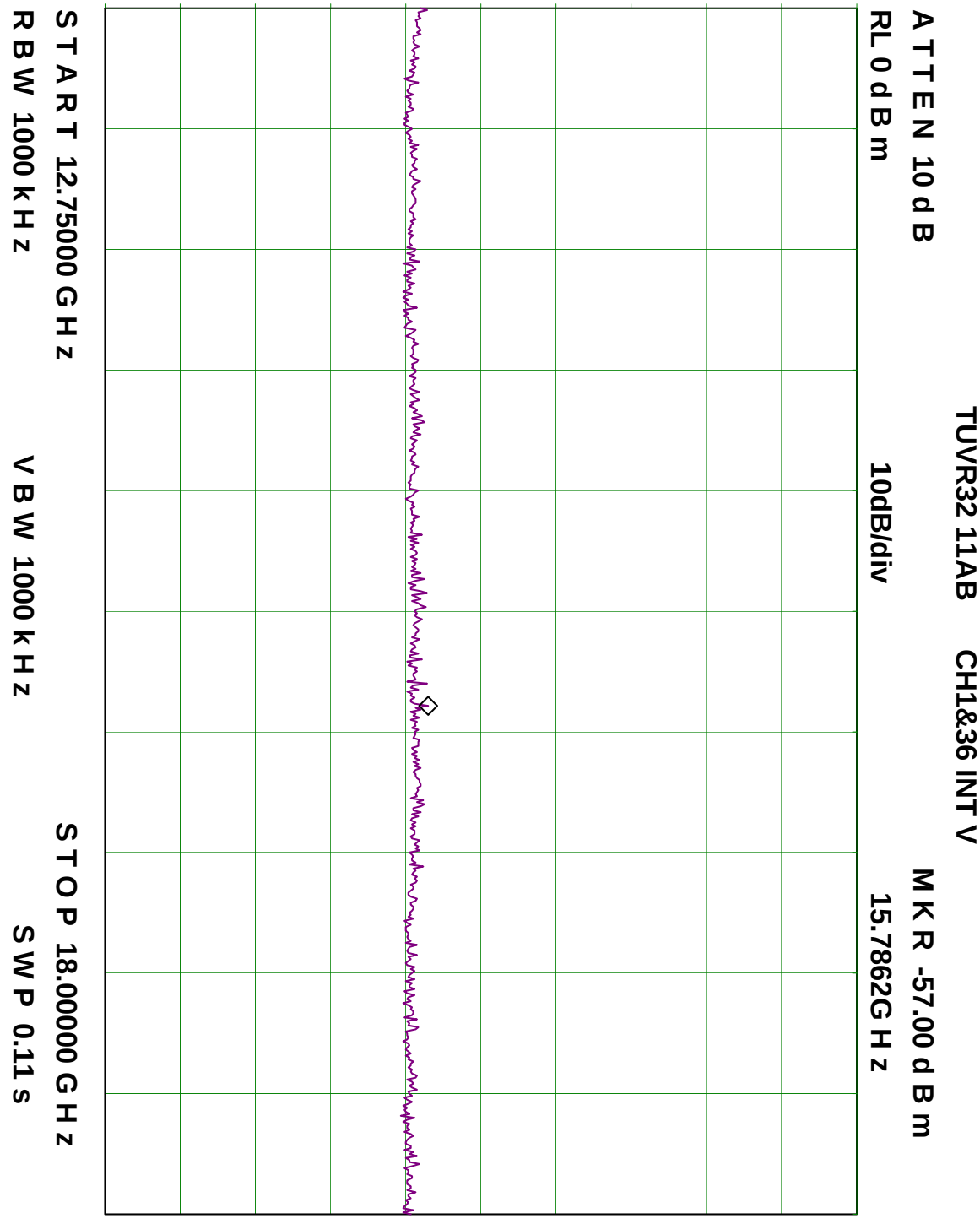
Transmitter Radiated Spurious Emissions Internal Antenna - 802.11a/b CH1&36 HORIZONTAL (7-12.75GHz) - TUVR32-A3-18



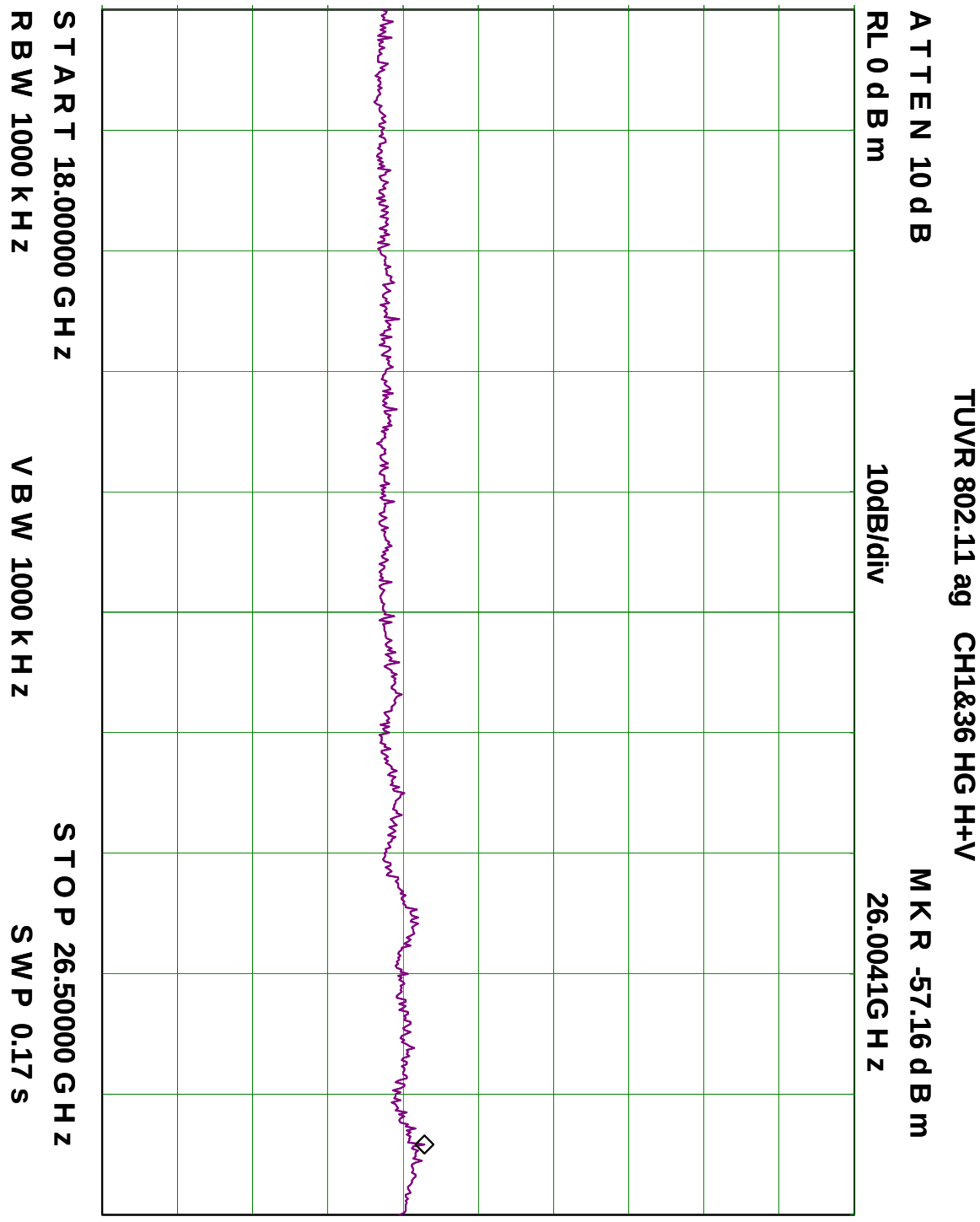
Transmitter Radiated Spurious Emissions Internal Antenna - 802.11a/b CH1&36 HORIZONTAL (12.75-18GHz) - TUVR32-A3-19



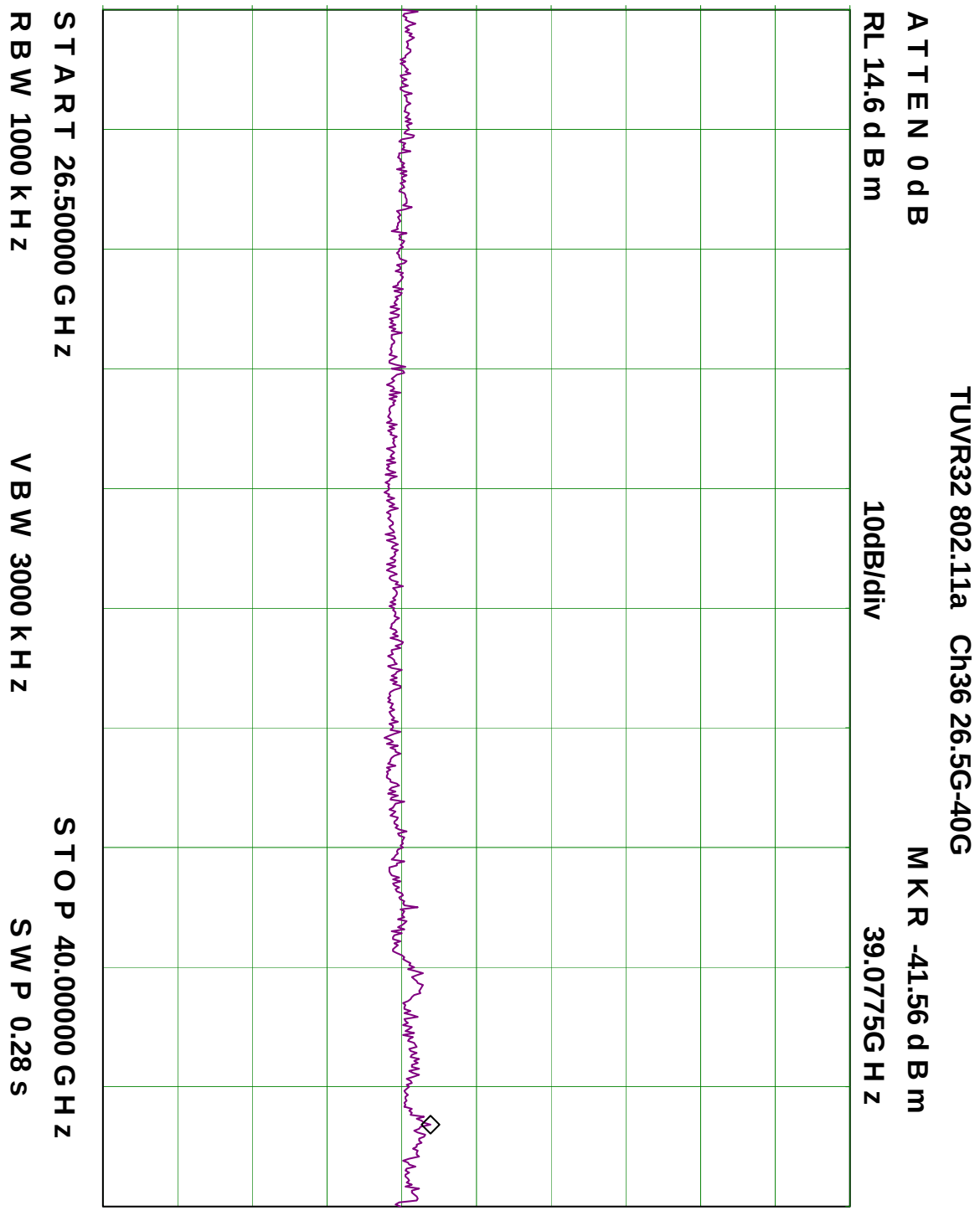
Transmitter Radiated Spurious Emissions Internal Antenna - 802.11a/b CH1&36 VERTICAL (12.75-18GHz) - TUVR32-A3-20



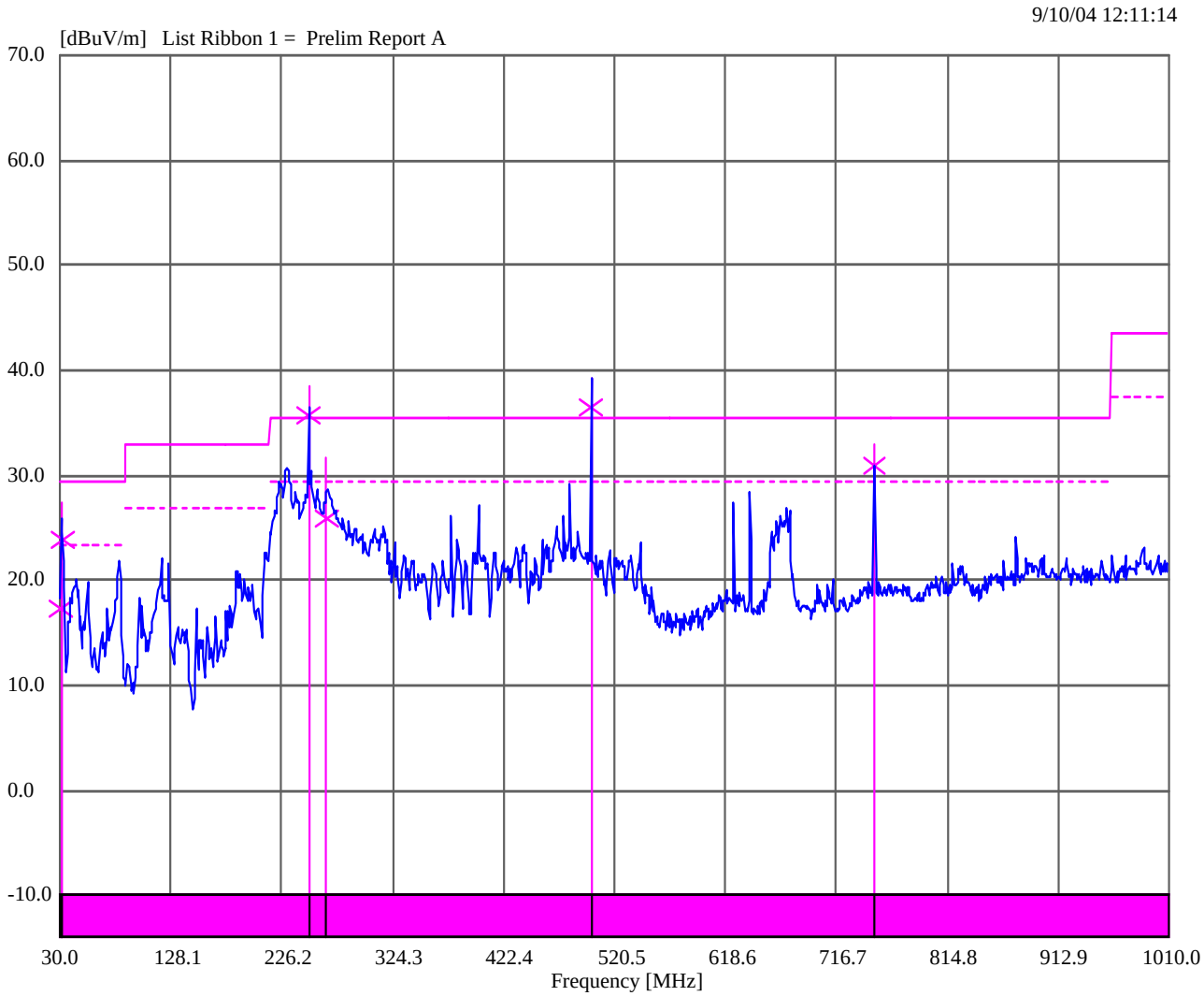
Transmitter Radiated Spurious Emissions Internal Antenna - 802.11a/g CH1&36 HORIZONTAL + VERTICAL (18-26.5GHz) - TUVR32-A3-21



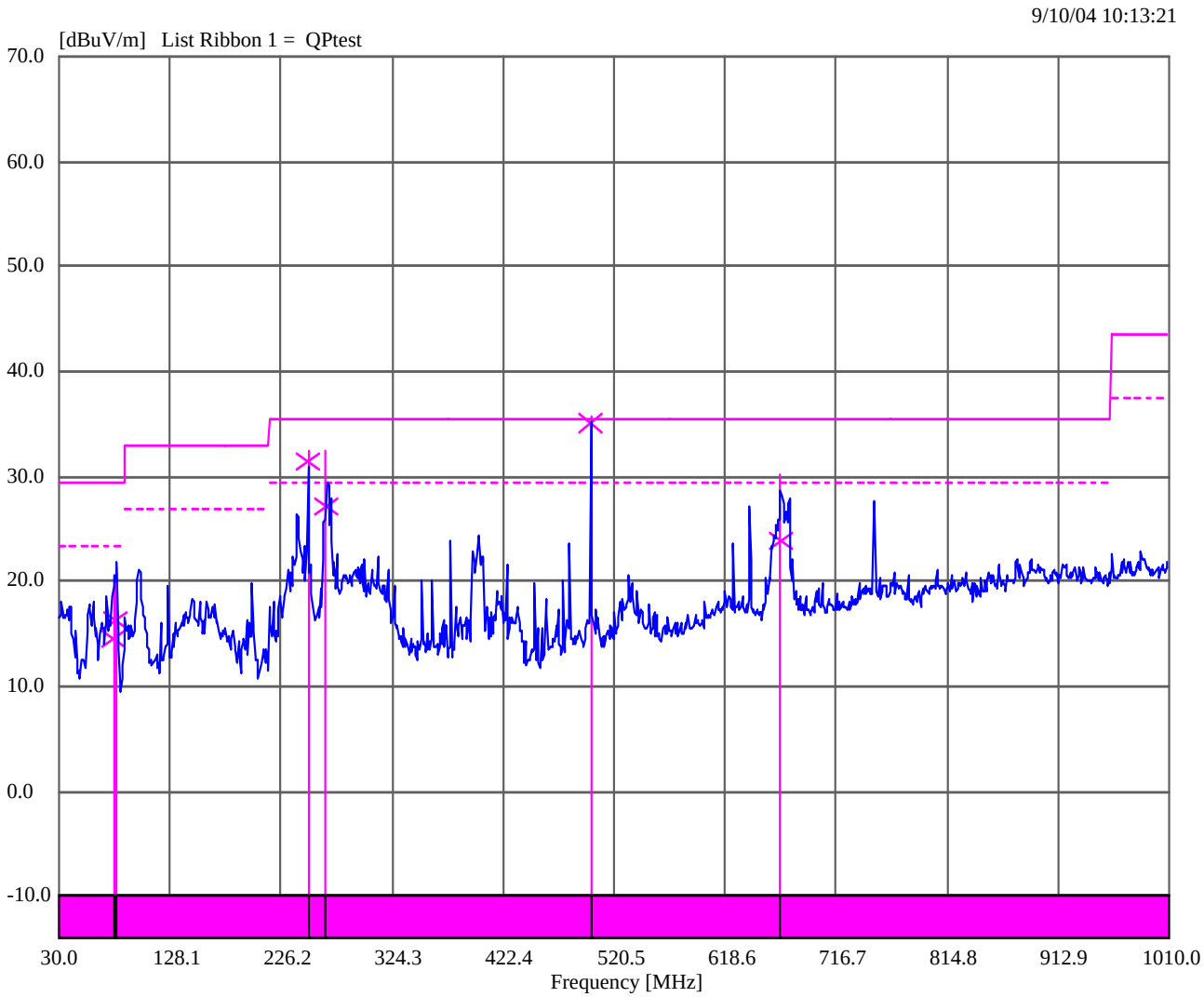
Transmitter Radiated Spurious Emissions Internal Antenna - 802.11a/g CH1&36 HORIZONTAL + VERTICAL (26.5-40GHz) - TUVR32-A3-22



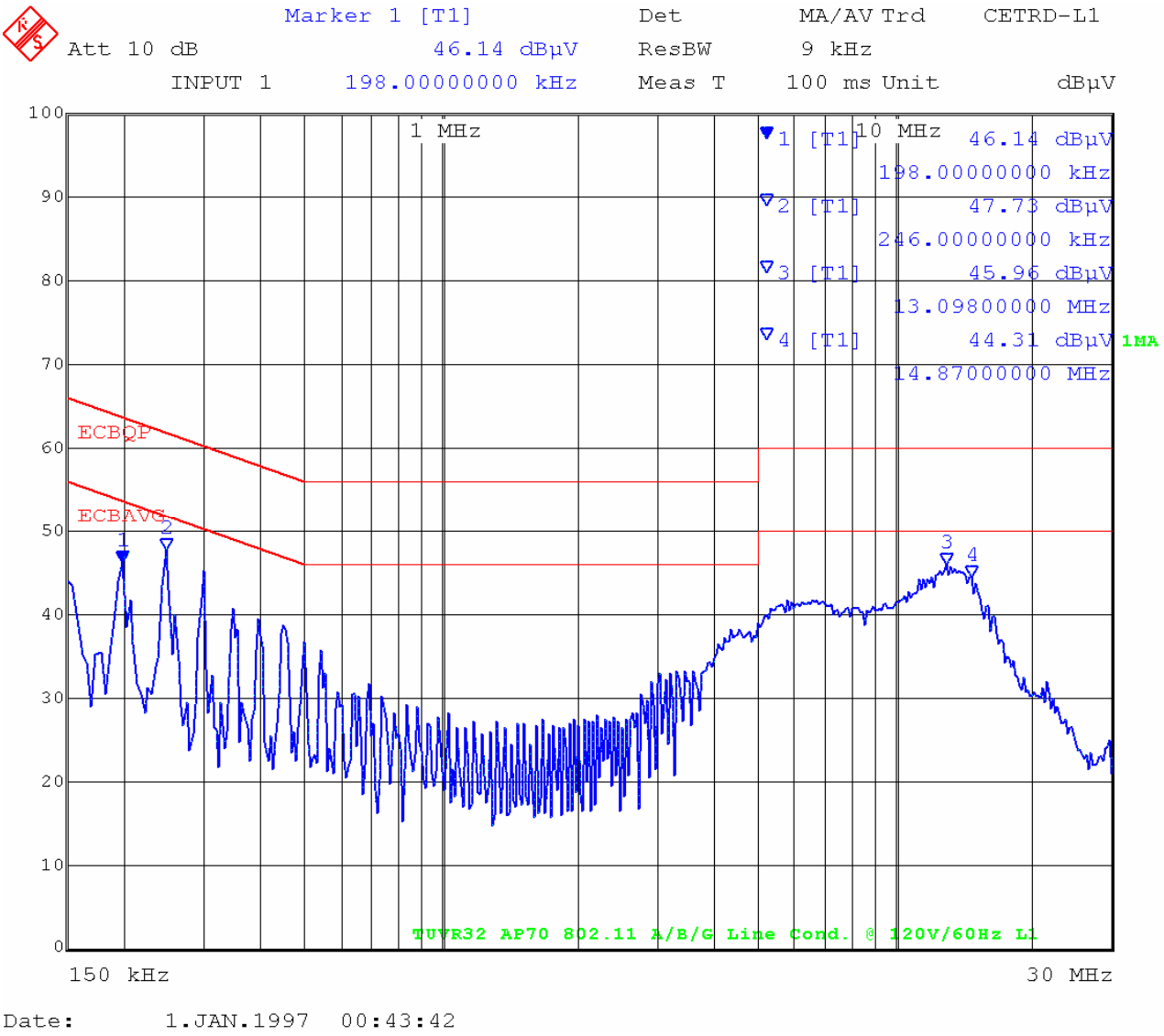
Spurious Emissions (Power Over Ethernet) 30M-1GHz-TUVR32-A3-23



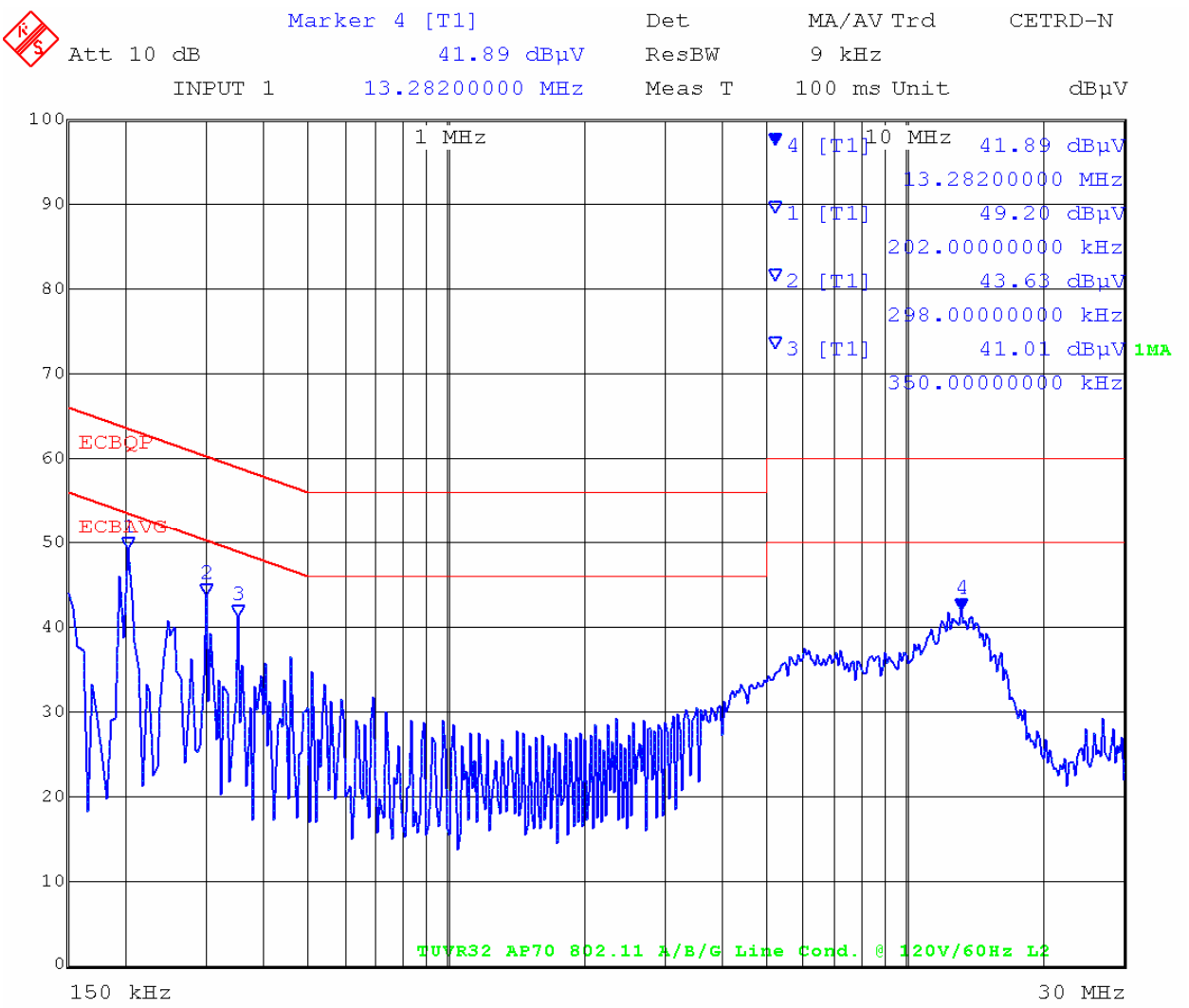
Spurious Emissions (AC/DC Converter) 30M-1GHz - TUVR32-A3-24



AC Wireline Conducted Emissions (Live Line) - TUVR32-A3-25



AC Wireline Conducted Emissions (Neutral Line) - TUVR32-A3-26



Date: 1.JAN.1997 00:51:43

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