CETECOM ICT Services GmbH

Radio Satellite Communication
Untertürkheimer Straße 6-10 . D-66117 Saarbrücken Telephon: +49 (0)681 598-0 Telefax: -9075

Recognized by the
Federal Communications Commission
Anechoic chamber registration no.: 90462 (FCC)
Anechoic chamber registration no.: 3463 (IC)
TCB ID: DE 0001

Accredited by the
German Accreditation Council
DAR–Registration Number
TTI–P–G 081/94-D0

Independent ETSI
compliance test house

Accredited Bluetooth™ Test Facility (BQTF)

Test Report No.: 2-3606-01-01/04
FCC Part 15.247 / CANADA RSS-210
WDI 100
FCC ID: R4T-WDI100
IC: 5082A-WDI100

CETECOM – ICT Services GmbH
Untertürkheimerstr. 6-10
66117 Saarbrücken, Germany

Telephone: + 49 (0) 681 / 598-0
Fax: + 49 (0) 681 / 589-9075

BLUETOOTH is a trademark owned by Bluetooth SIG, Inc. and licensed to CETECOM

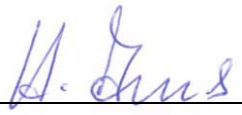
Table of Contents

1 General Information

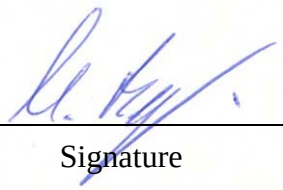
1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

Test Laboratory Manager:

2004-06-07	RSC8414	H. Ames	
Date	Section	Name	Signature

Technical Responsibility for Area of Testing:

2004-06-07	RSC8411	M.Berg	
Date	Section	Name	Signature

1.2 Testing Laboratory

CETECOM ICT Services GmbH
Untertürkheimer Straße 6 - 10
66117 Saarbrücken
Germany
Telephone : + 49 681 598 - 0
Telefax : + 49 681 598 - 9075
E-mail : info@ict.cetecom.de
Internet : www.cetecom-ict.de

Accredited testing laboratory
The Test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025.
DAR-registration number : TTI-P-G 081/94-D0
Accredited Bluetooth™ Test Facility (BQTF)
BLUETOOTH is a trademark owned by Bluetooth SIG, Inc. and licensed to CETECOM

1.3 Details of Applicant

Name : ABB Stotz-Kontakt GmbH
Street : Eppelheimer Strasse 82
City : D-69123 Heidelberg
Country : Germany
Telephone : +49(0)6221 701 1287
Telefax : +49(0)6221 701 1344
Contact : Mr. Alexander Bock
Telephone : +49(0) 6221 701 1287
E-mail : Alexander.bock@de.abb.com

1.4 Application Details

Date of receipt of application : 2004-05-04
Date of receipt of test item : 2004-05-04
Date of test : 2004-05-04 to 2004-05-06

1.5 Test Item

Type of equipment	:	**FHSS Transceiver**
Type designation	:	**WDI 100**
Manufacturer	:	ABB Stotz-Kontakt GmbH
Street	:	Eppelheimer Strasse 82
City	:	D-69123 Heidelberg
Country	:	Germany
Serial number	:	
FCC – ID	:	R4T-WDI100
IC	:	5082A-WDI100
Hardware	:	
Software	:	
Additional information	**:**	
Frequency	:	2400– 2483.5 MHz ISM-band
Type of modulation	:	1M00FXD / 77M0FXD (FHSS) (2402 – 2478)
Number of channels	:	77
Antenna	:	External patch antennas
Power supply	:	24V DC or via 110VAC external power supply
Output power	:	EIRP: 3.05 mW (worst case); conducted : 1.57 mW
Field strength	:	max. 98.1 dBµV/m in 3m
Occupied bandwidth	:	991.983 kHz
Transmitter spurious	:	335 µV/m in 3m ; conducted : -29.9 dBm
Receiver spurious	.	371.5 dBµV/m in 3m
Temperature range	:	-20°C - +50°C

DECLARATION OF COMPLIANCE: I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above-mentioned Industry Canada standard(s); and that the equipment identified in this application has been subjected to all the applicable test conditions specified in the Industry Canada standards and all of the requirements of the standard have been met.

Signature: _____

Date: 2004-06-01 **Michael Berg ; Test management**
NAME AND TITLE (Please print or type):

1.6 Test Specifications:

FCC Part 15 §15.247 (August 2003)
CANADA RSS-210 (Issue 5)

2 Technical Test

2.1 Summary of Test Results

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 25 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform with specifications ANSI C63.2-1987 clause 15 and ANSI C63.4-1992 clause 4.1.5. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63-4-1992 clause 4.2.

Antennas are conform with ANSI C63.2-1996 item 15.

150 kHz - 30 MHz: Quasi Peak measurement, 9kHz Bandwidth, passive loop antenna.

30 MHz - 200 MHz: Quasi Peak measurement, 120KHz Bandwidth, biconical antenna

200MHz - 1GHz: Quasi Peak measurement, 120KHz Bandwidth, log periodic antenna

1GHz: Average, RBW 1MHz, VBW 10 MHz, waveguide horn

All measurements are done in accordance with the Filing and Measurement Guidelimes for Frequency Hopping Spread Spectrum Systems DA 00-705 .

The product fullfills also the requirements for CANADA RSS-210

No deviations from the technical specification(s) were ascertained in the course of the tests performed.

Final verdict : PASS

2.2 Test Report

TEST REPORT

Test Report No. : 2-3606-01-01/04

TEST REPORT REFERENCE

LIST OF MEASUREMENTS

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Antenna Gain

The antenna gain of the complete system is calculated by the difference of conducted power of the module and the radiated power in EIRP.

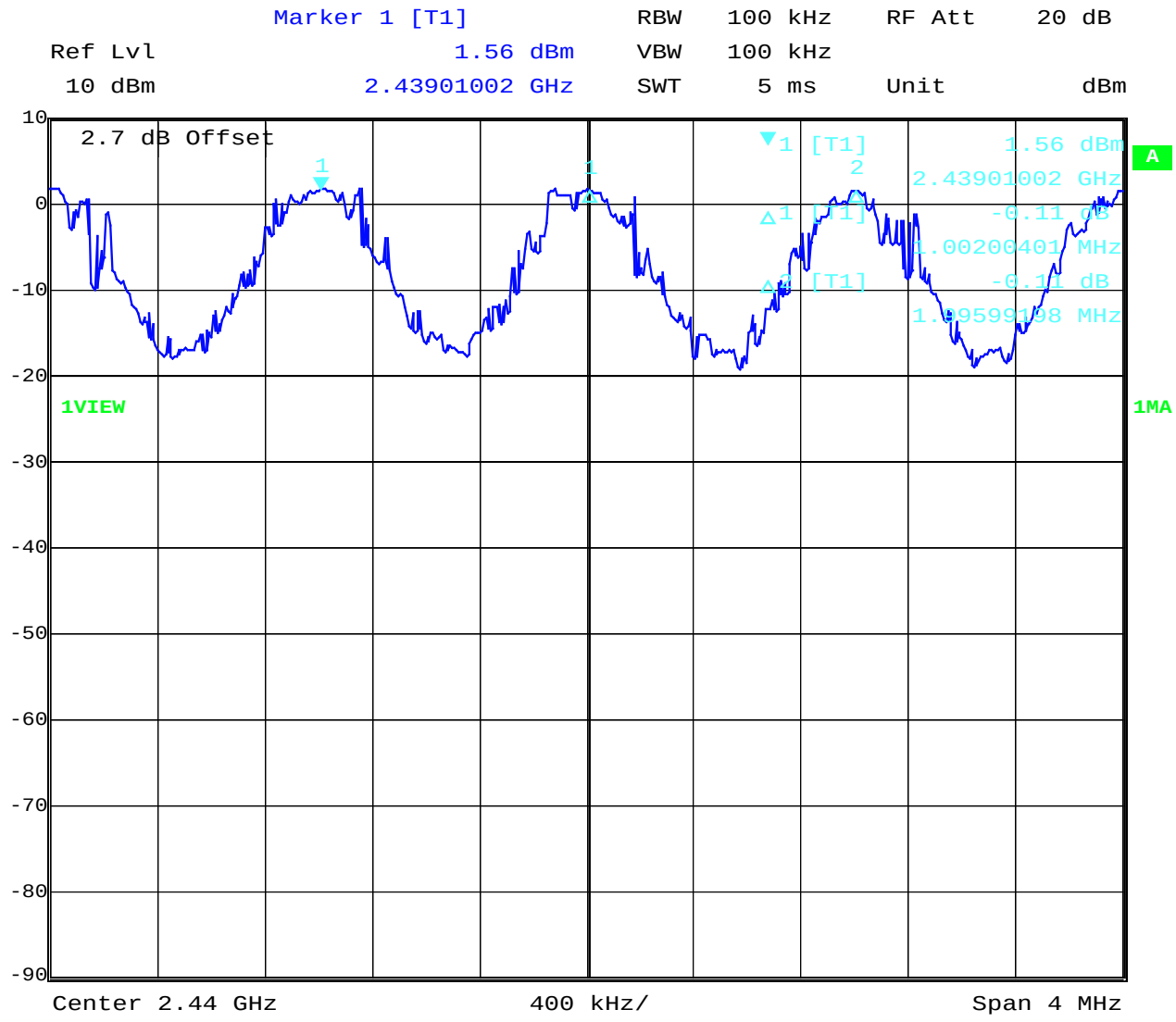
	low channel	mid channel	high channel
Conducted power	**+1.96 dBm**	**+1.52 dBm**	**+0.56 dBm**
Radiated power	**+4.85 dBm**	**+4.58 dBm**	**+3.46 dBm**
Gain including cable loss	**+2.89 dBi**	**+3.06 dBi**	**+2.90 dBi**

The system itself has two coax connectors (SMA). We measured the system with a 2m coax cable with about 2.5 dB loss at 2.4 GHz. This loss is included in the calculated antenna gain.

Excluding the cable loss the antenna gain is between 5 and 6 dBi.

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Carrier frequency separation §15.247(a1)



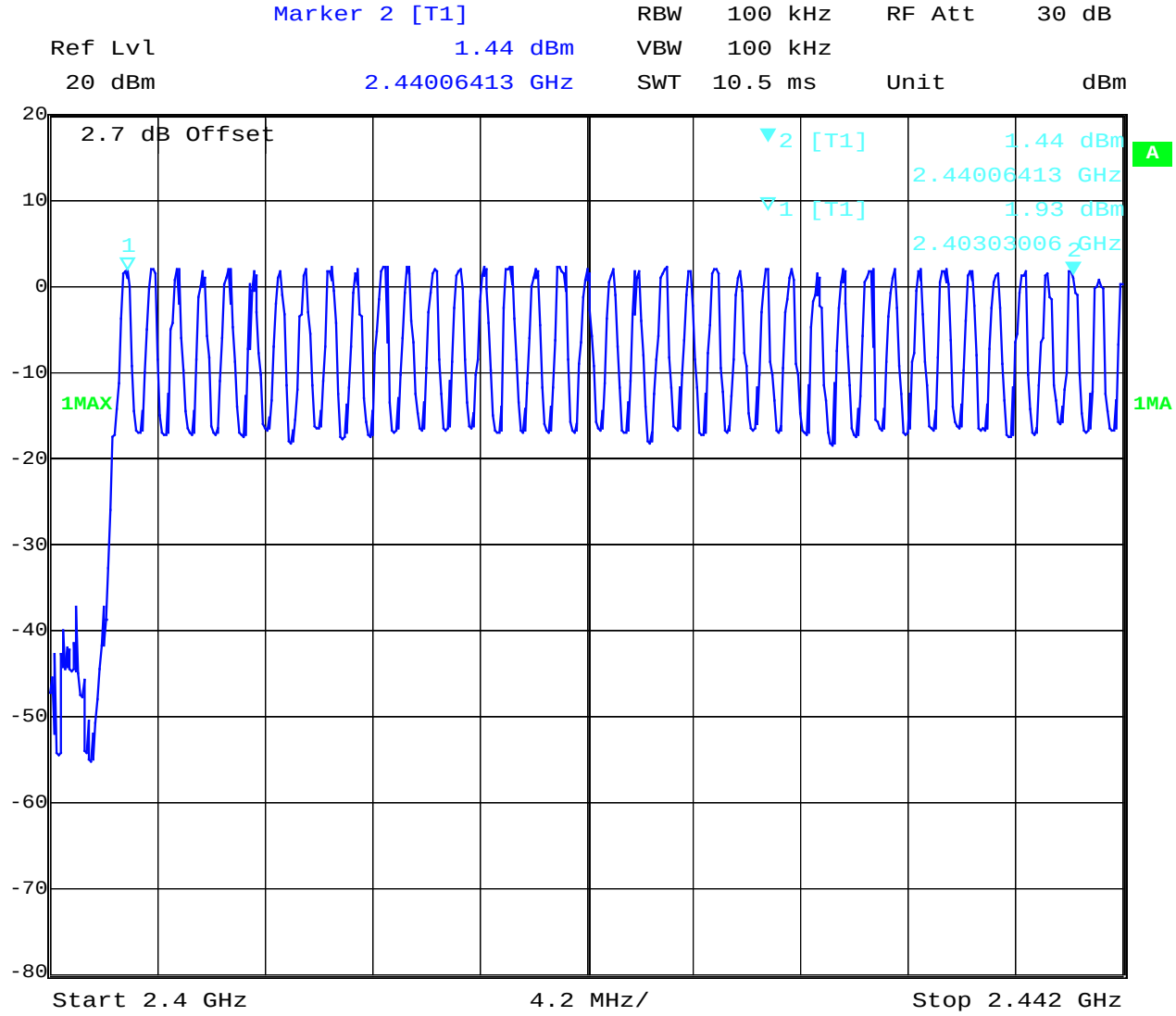
Channel separation is ~ 1 MHz

Limit: minimum 25 kHz or the 20 dB Bandwidth of the hopping system

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Number of hopping channels **§15.247(a1)**
Channel 1 - 40



Date: 5.MAY.2004 11:49:00

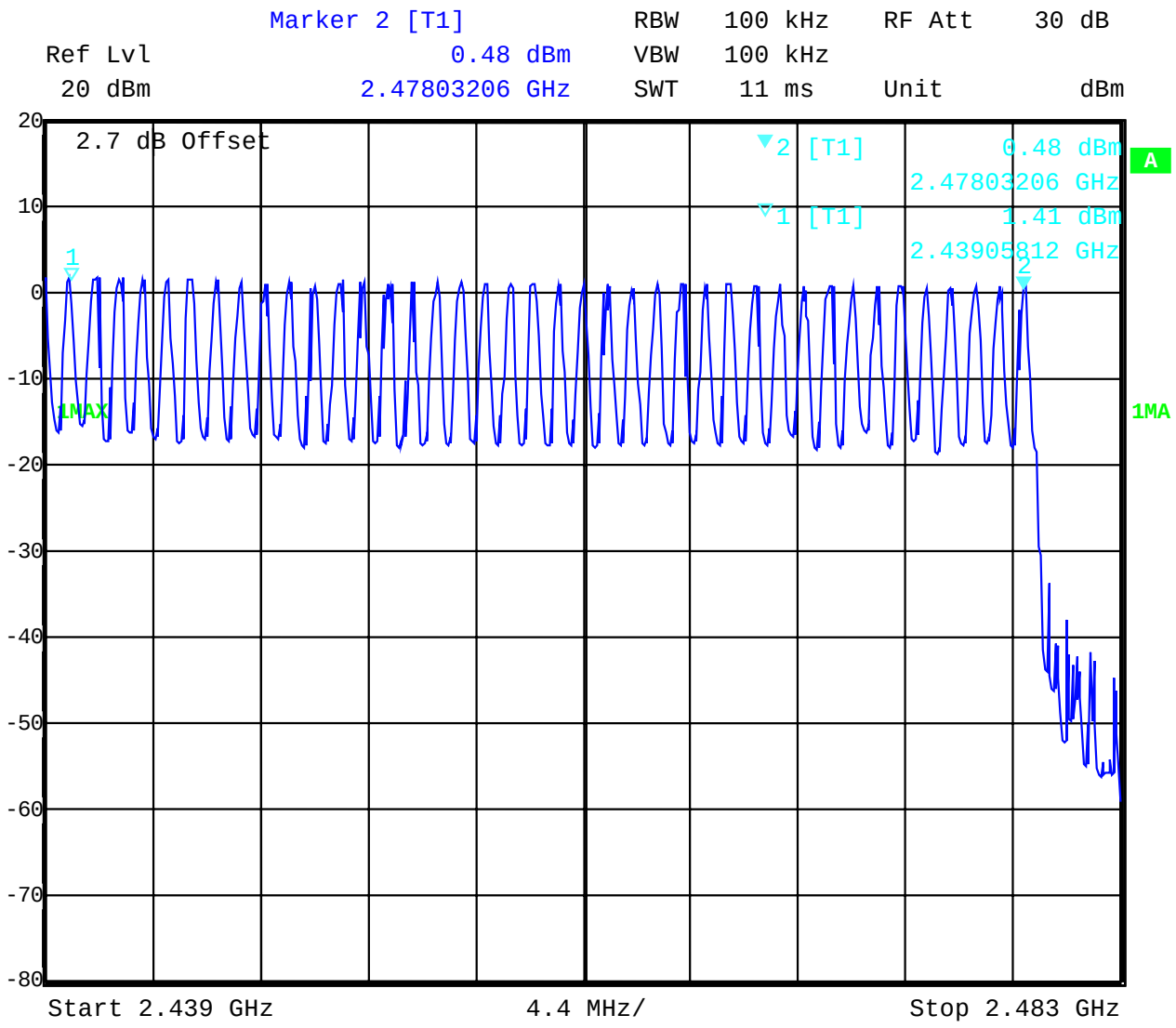
The number of hopping channels is 78.

Limit: at least 15 non-overlapping channels

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Number of hopping channels
Channel 38 - 77 **§15.247(a1)**



Date: 5.MAY.2004 11:50:29

The number of hopping channels is 77.

Limit: at least 15 non-overlapping channels

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

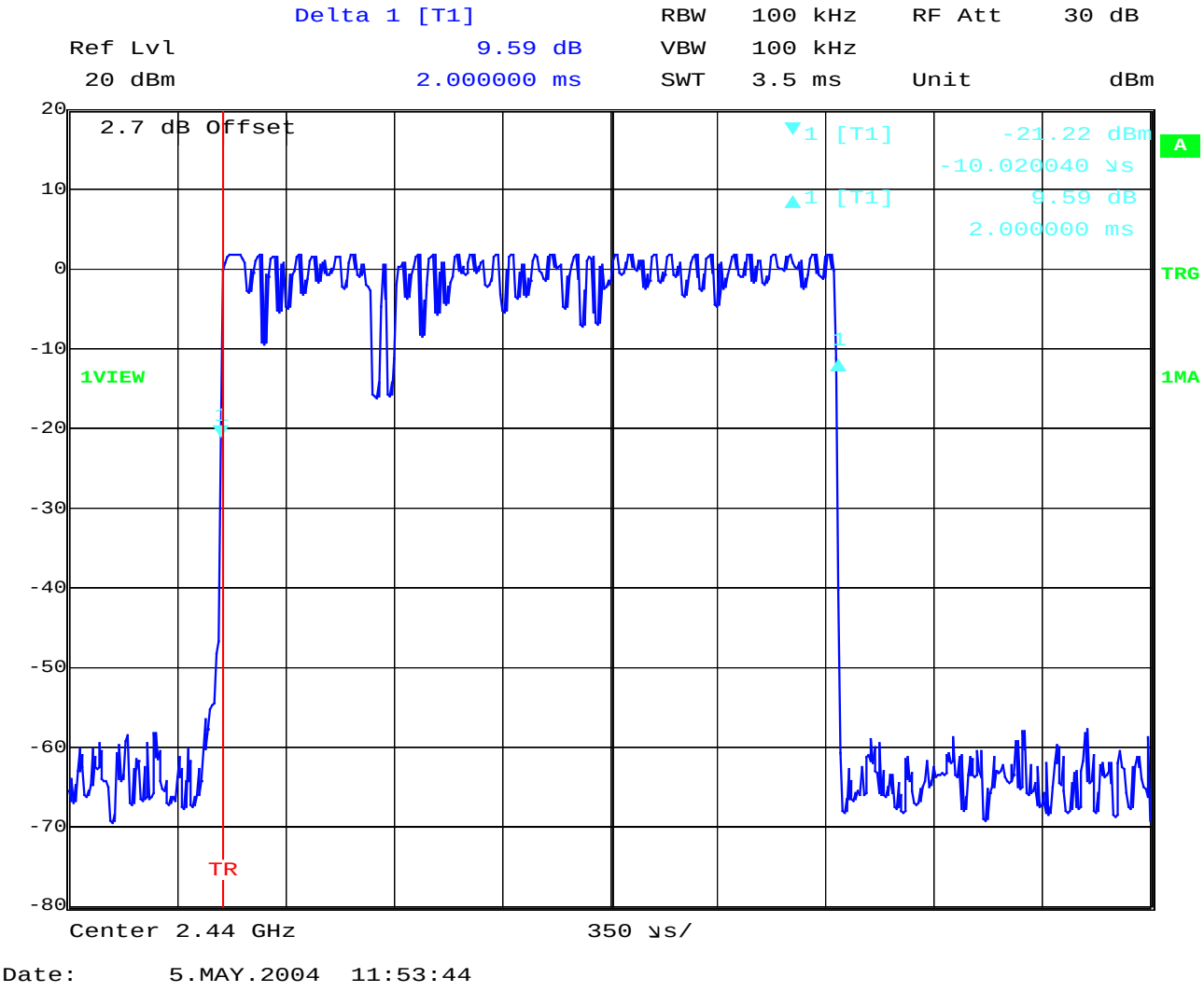
Time of occupancy (dwell time) §15.247(a1 iii)

For FHSS devives:

The dwell time for this device is calculated with the following datas.

2.048 ms On-time, 77 channels, packet every 157.7 ms => TX On-time 0.4 s within 30.8 s

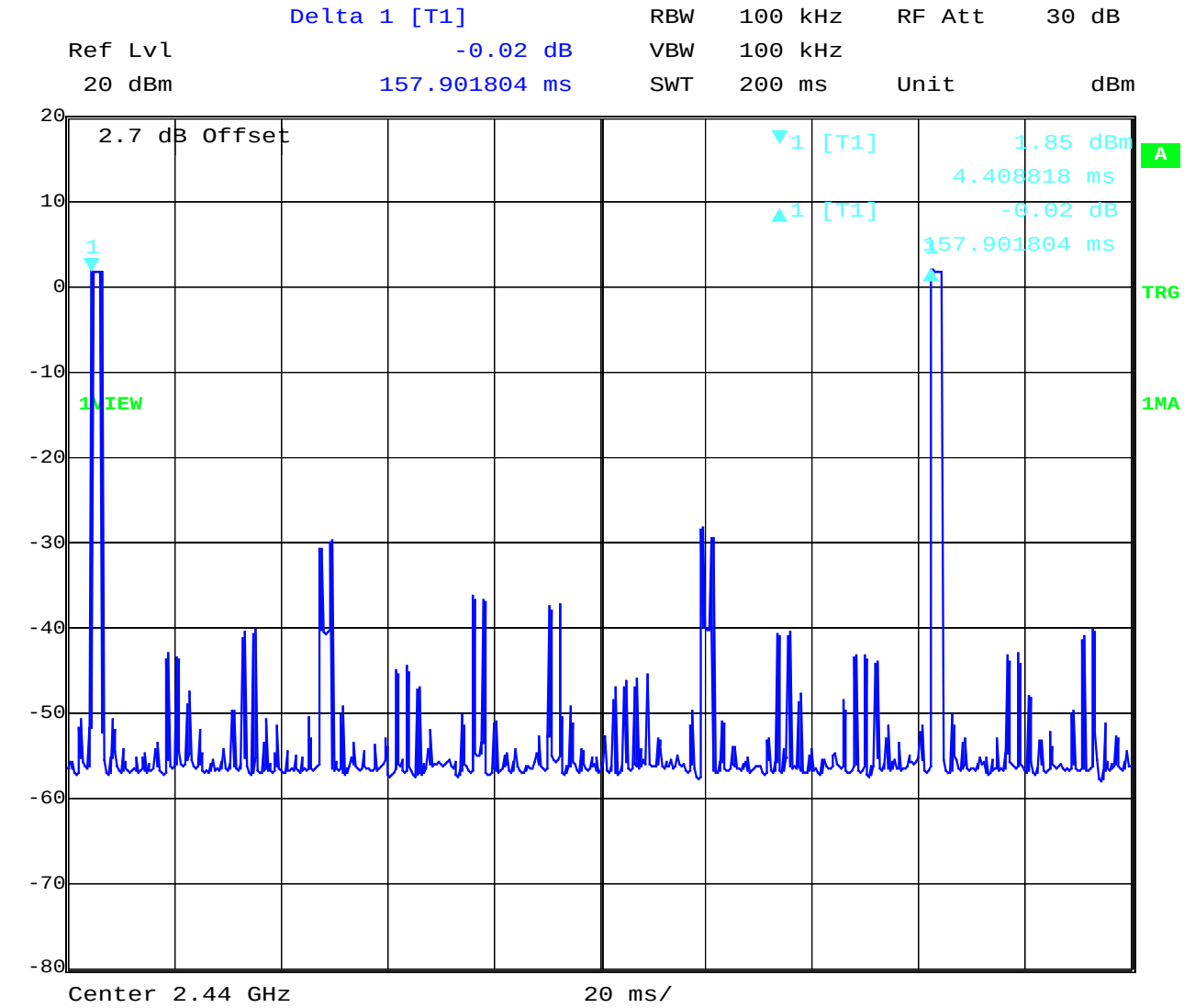
here on-time per channel 2.048 ms.



REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

here packet every 157.7 ms

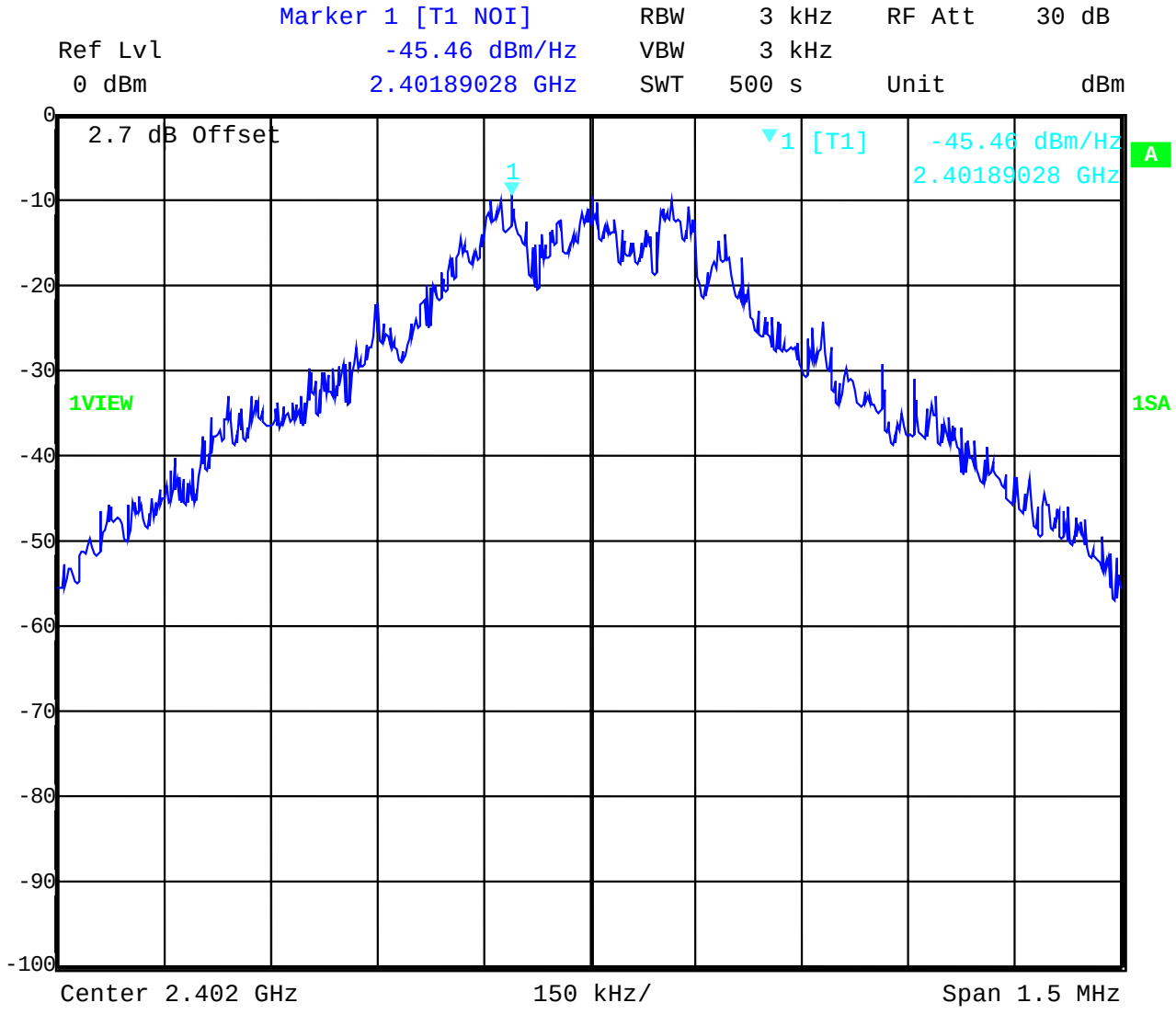


Date: 5.MAY.2004 13:29:03

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Power Spectral density §15.247(d)
Low channel

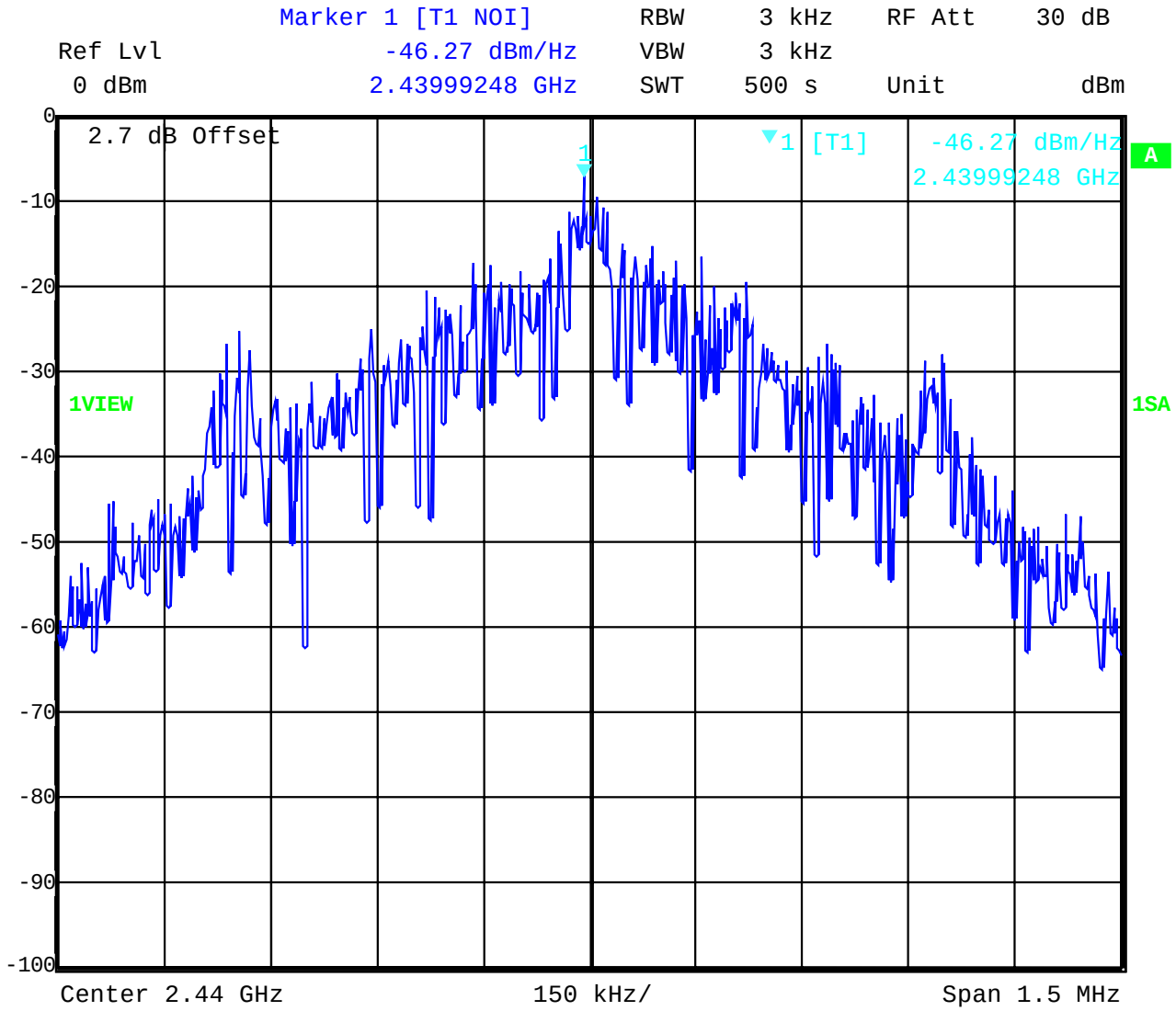


Power density : -45.46 dBm/Hz = -10.66 dBm / 3 KHz

Correction factor from dBm/Hz to dBm/3KHz is +34.8 dB

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%
Power Spectral density §15.247(d)
Middle channel

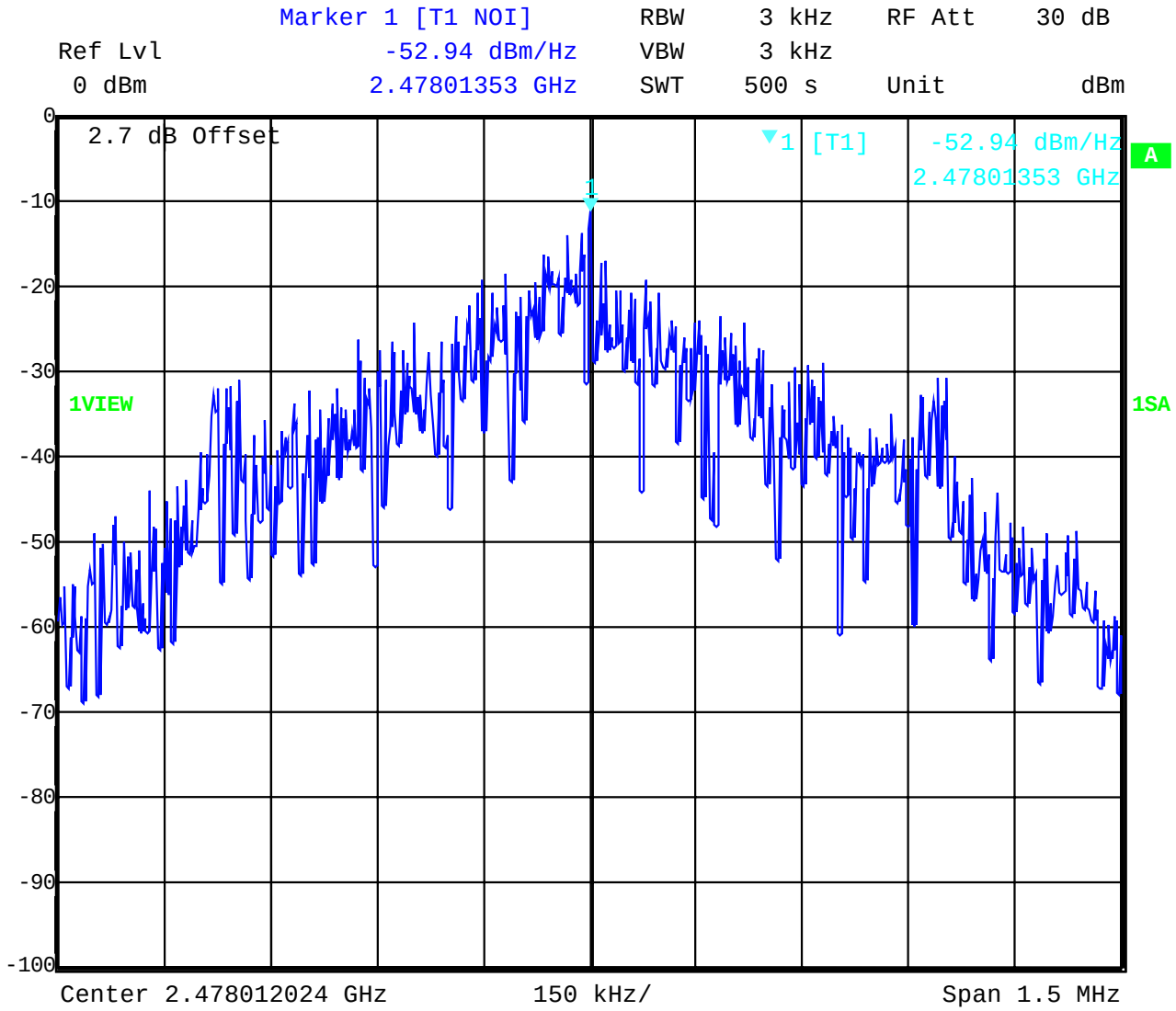


Power density : -46.27 dBm/Hz = -11.47 dBm / 3 KHz

Correction factor from dBm/Hz to dBm/3KHz is +34.8 dB

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%
Power Spectral density §15.247(d)
High channel



Power density : -52.94 dBm/Hz = -18.14 dBm / 3 KHz

Correction factor from dBm/Hz to dBm/3KHz is +34.8 dB

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Spectrum Bandwidth of a FHSS System §15.247(a1)
20 dB bandwidth

TEST CONDITIONS		20 dB BANDWIDTH (kHz)		
Frequency (MHz)		2402	2441	2479
T_{nom}(23)°C	V_{nom}(24.0)V	661.322	991.983	985.972
Measurement uncertainty		±1kHz		

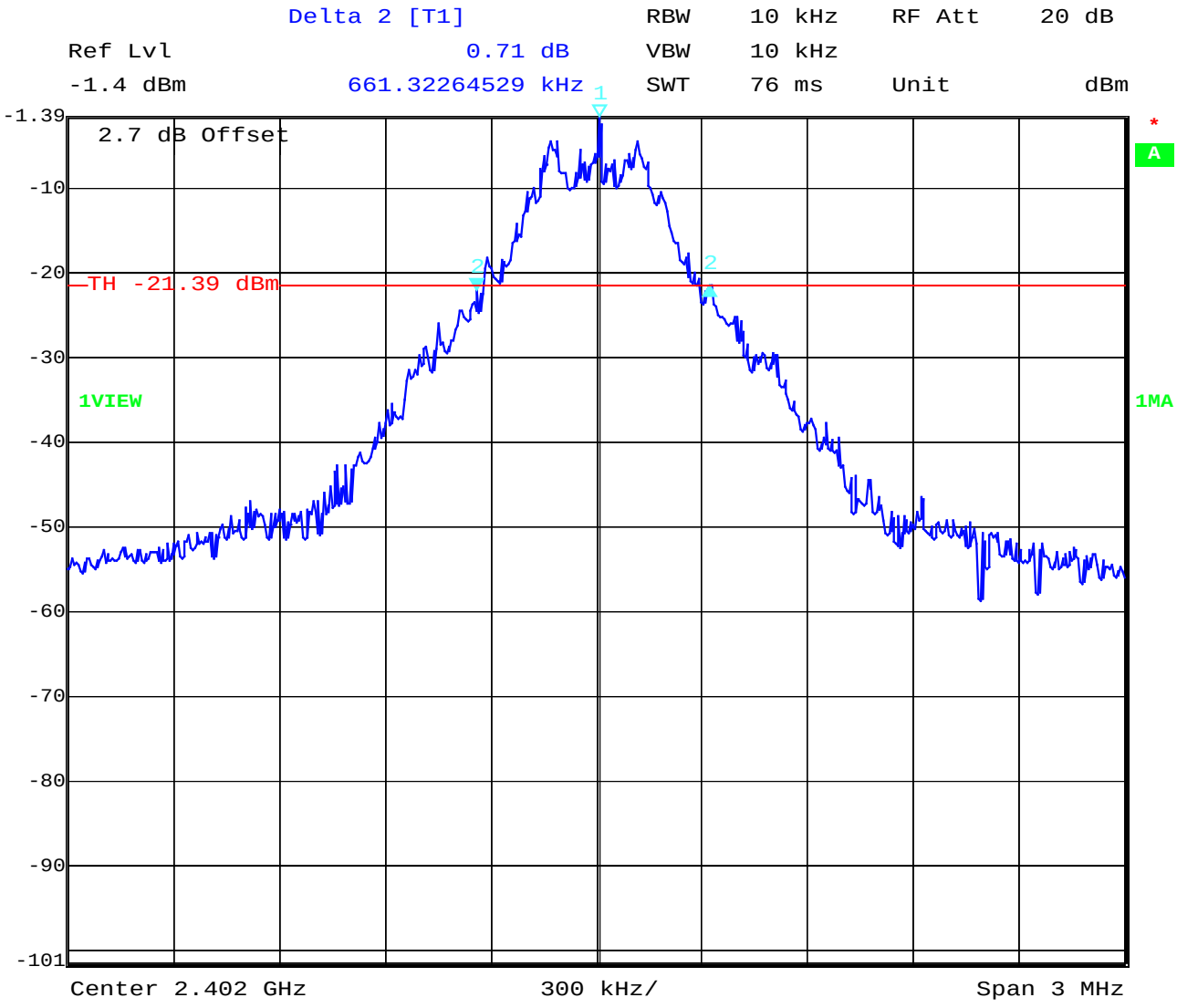
RBW / VBW as provided in the „Measurement Guidelines“ (DA 00-705, March 30, 2000)
RBW: 10 kHz / VBW 10 kHz

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Spectrum Bandwith of a FHSS System **§15.247(a1)**
20 dB bandwidth

Low Channel

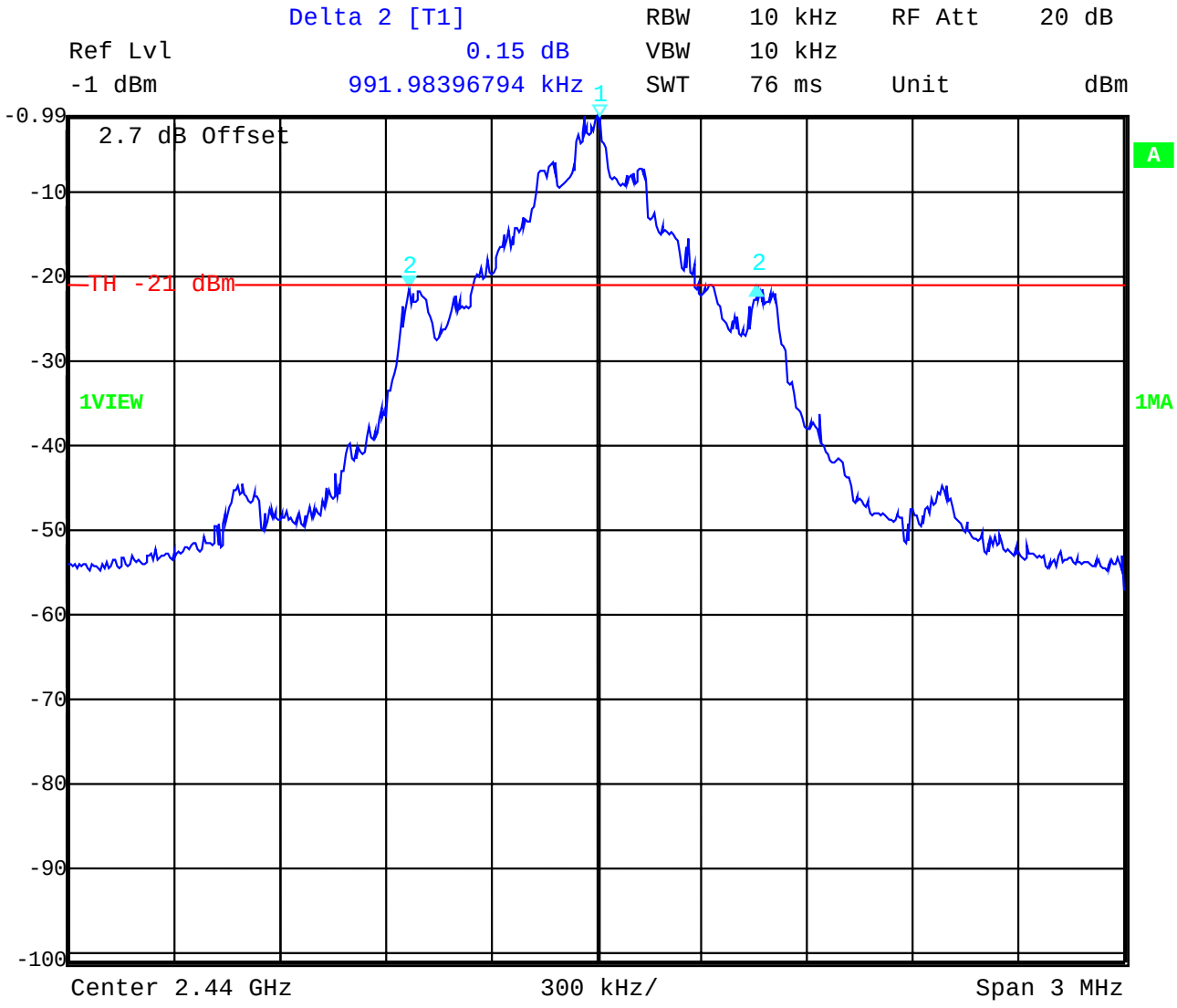


REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Spectrum Bandwith of a FHSS System **§15.247(a1)**
20 dB bandwidth

Mid Channel

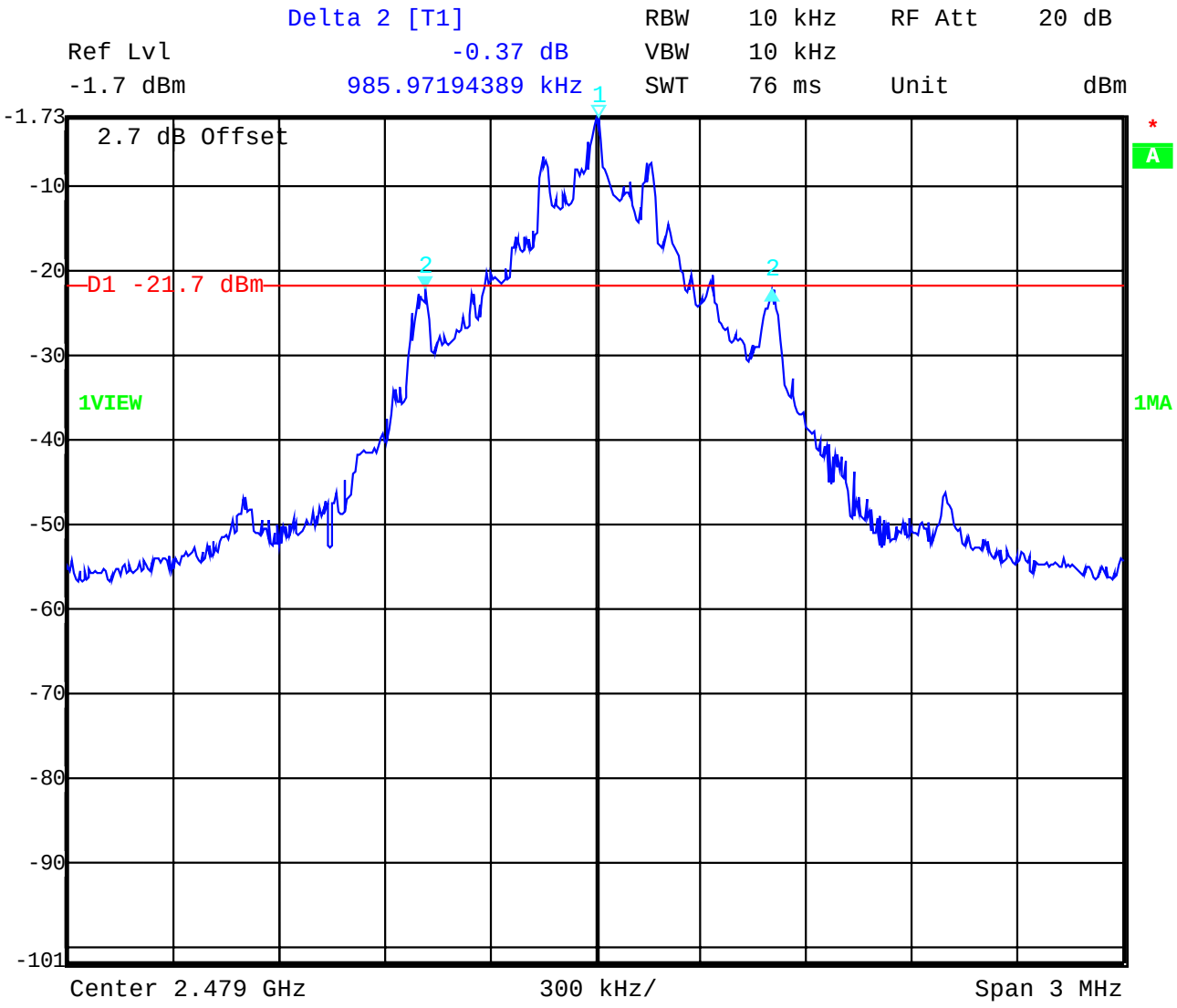


REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Spectrum Bandwith of a FHSS System **§15.247(a1)**
20 dB bandwidth

High Channel



REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

MAXIMUM PEAK OUTPUT POWER SUBCLAUSE § 15.247 (b) (1)
(conducted)

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER			
Frequency (MHz)			2402	2441	2479
T_{nom}(22.7)°C	V_{nom}(24.0)V	PK	+1.96 dBm	+1.52 dBm	+0.56 dBm
			1.57 mW	1.42 mW	1.14 mW
De facto EIRP (Peak) (Antenna gain)			3.05 mW +4.85 dBm (+2.89 dBi)	2.45 mW +4.58 dBm (+3.06 dBi)	2.88 mW +3.46 dBm (+2.90dBi)
Measurement uncertainty			±3dB		

RBW / VBW : 3 MHz

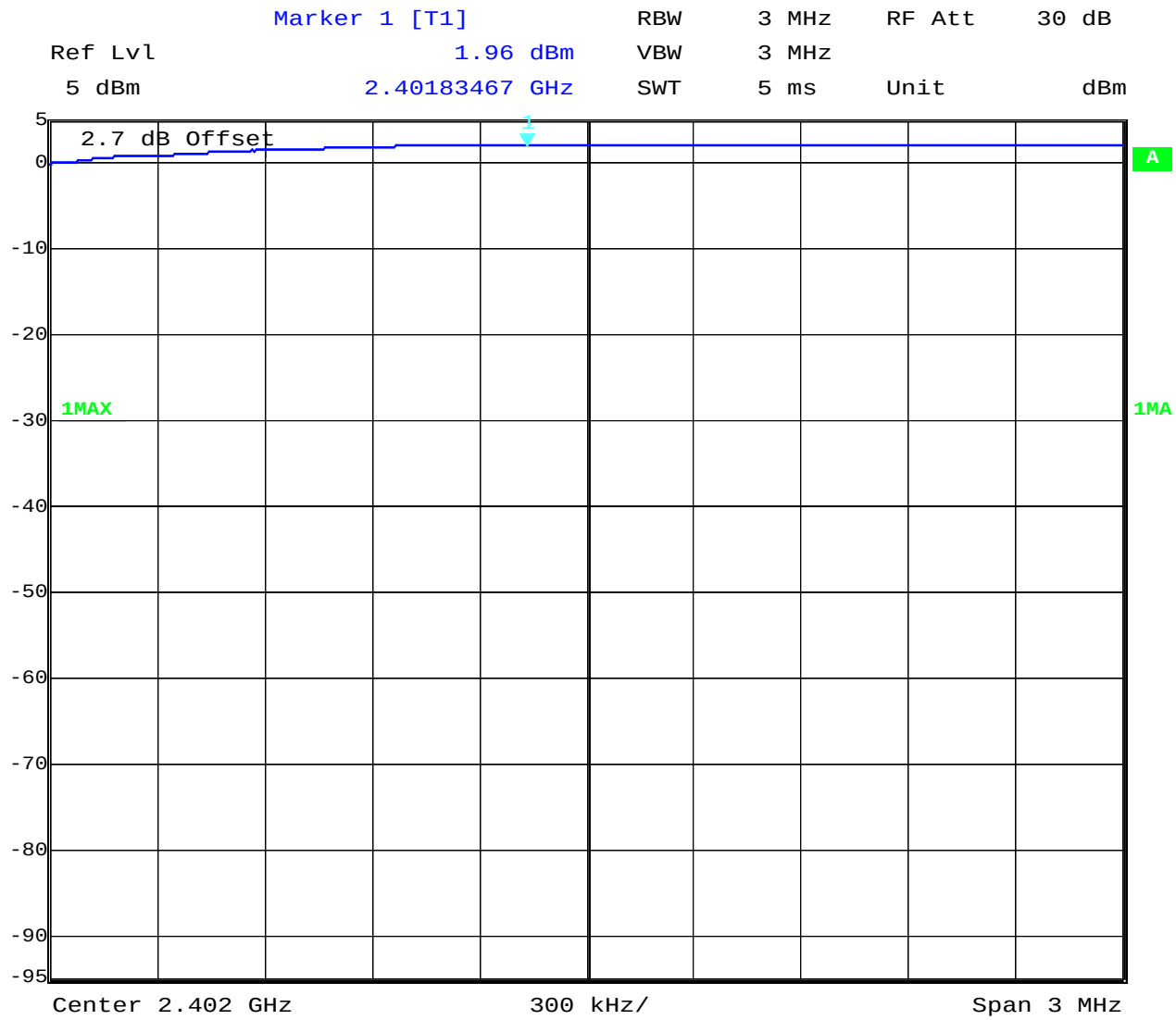
LIMIT SUBCLAUSE § 15.247 (b) (1)

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

MAXIMUM PEAK OUTPUT POWER **SUBCLAUSE § 15.247 (b) (1)**
(conducted)
Low Channel



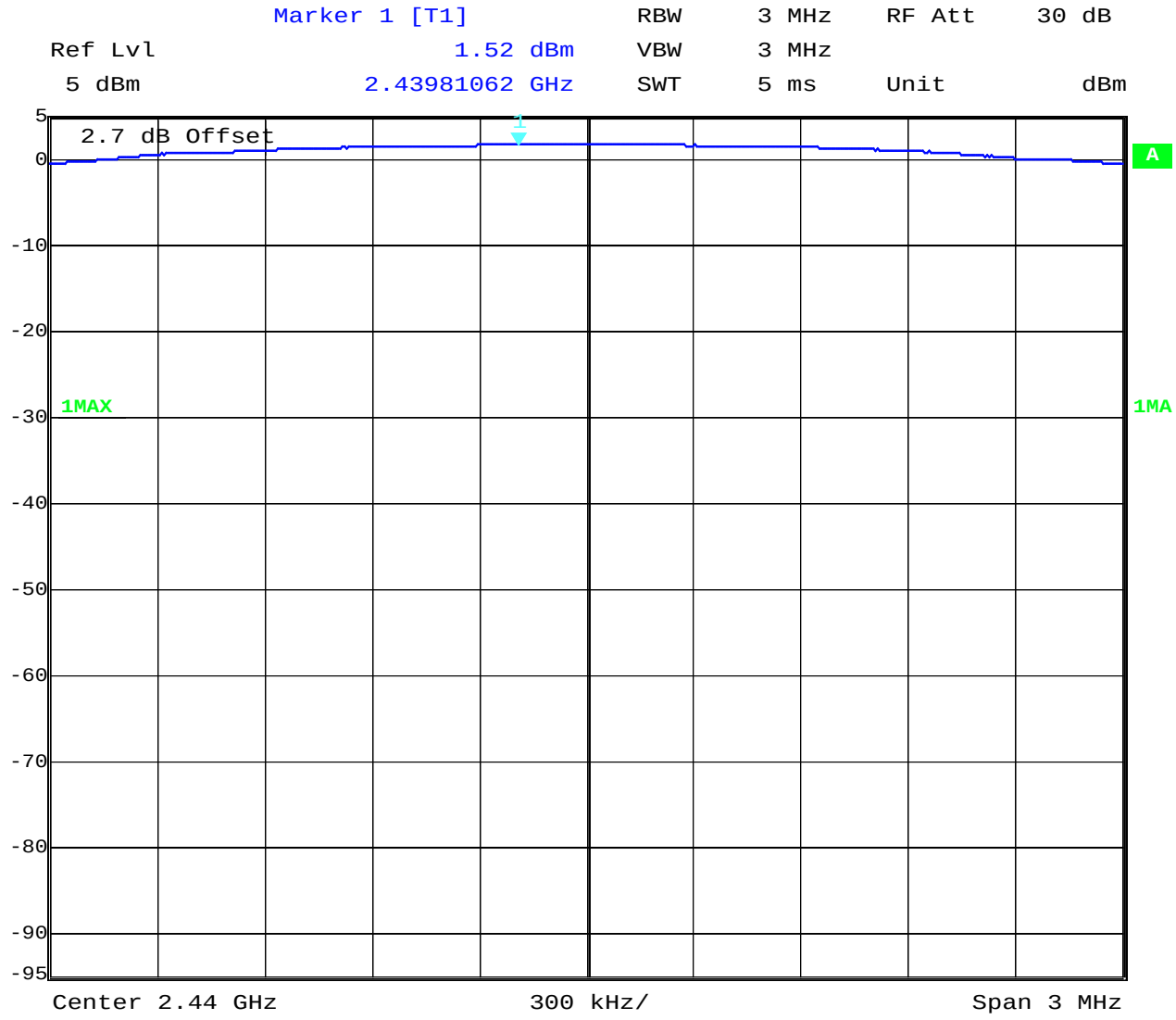
LIMIT **SUBCLAUSE § 15.247 (b) (1)**

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

MAXIMUM PEAK OUTPUT POWER **SUBCLAUSE § 15.247 (b) (1)**
(conducted)
Mid Channel



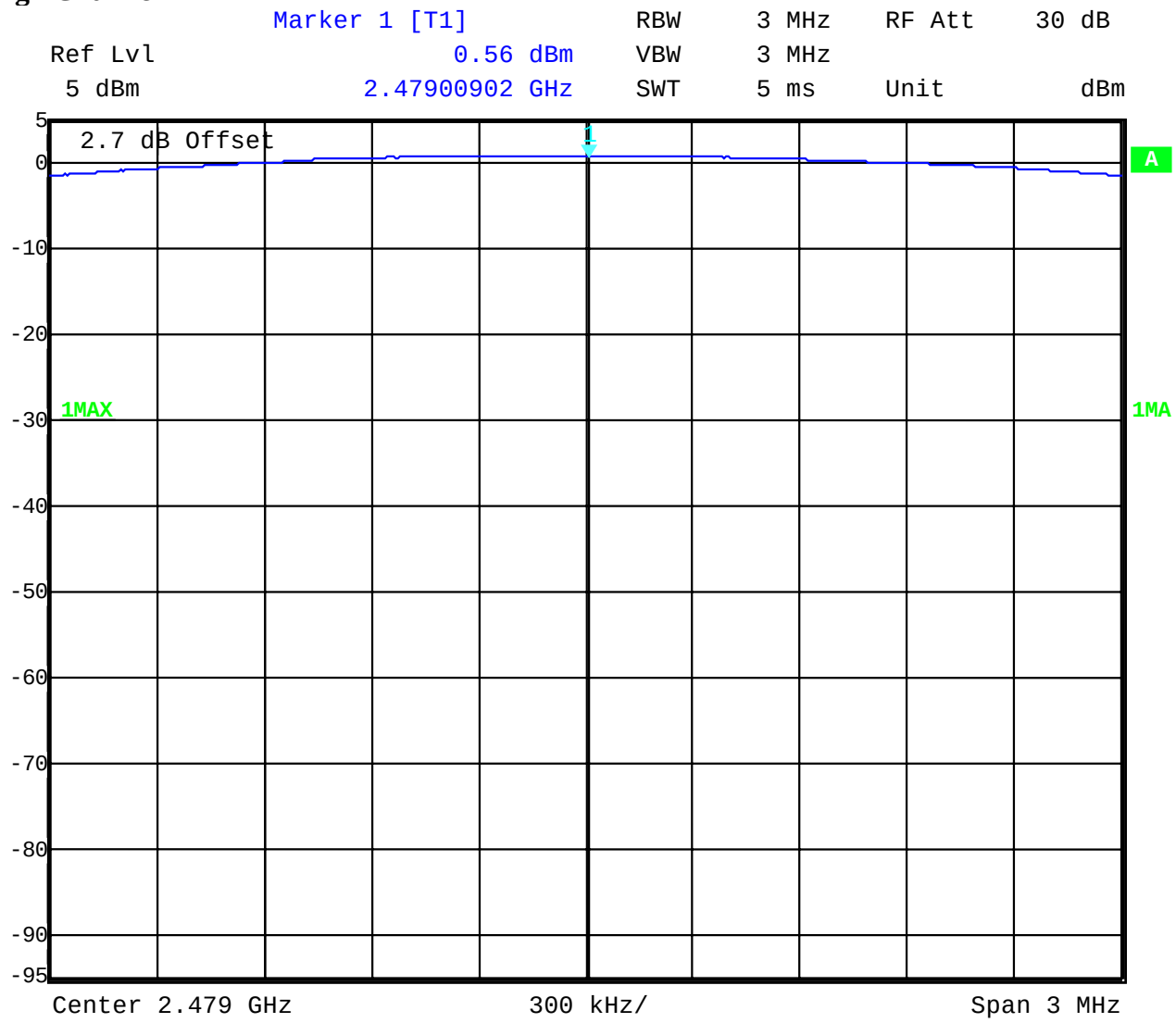
LIMIT **SUBCLAUSE § 15.247 (b) (1)**

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

MAXIMUM PEAK OUTPUT POWER **SUBCLAUSE § 15.247 (b) (1)**
(conducted)
High Channel



LIMIT **SUBCLAUSE § 15.247 (b) (1)**

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

MAXIMUM PEAK OUTPUT POWER SUBCLAUSE § 15.247 (b) (1)
(RADIATED)

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER EIRP (mW)		
Frequency (MHz)		2402	2441	2479
T_{nom}(22.7)°C	V_{nom}(24.0)V	3.05 mW	2.87 mW	1.14 mW
Measurement uncertainty		±3dB		

RBW/VBW : 3 MHz

Measured at a distance of 3m

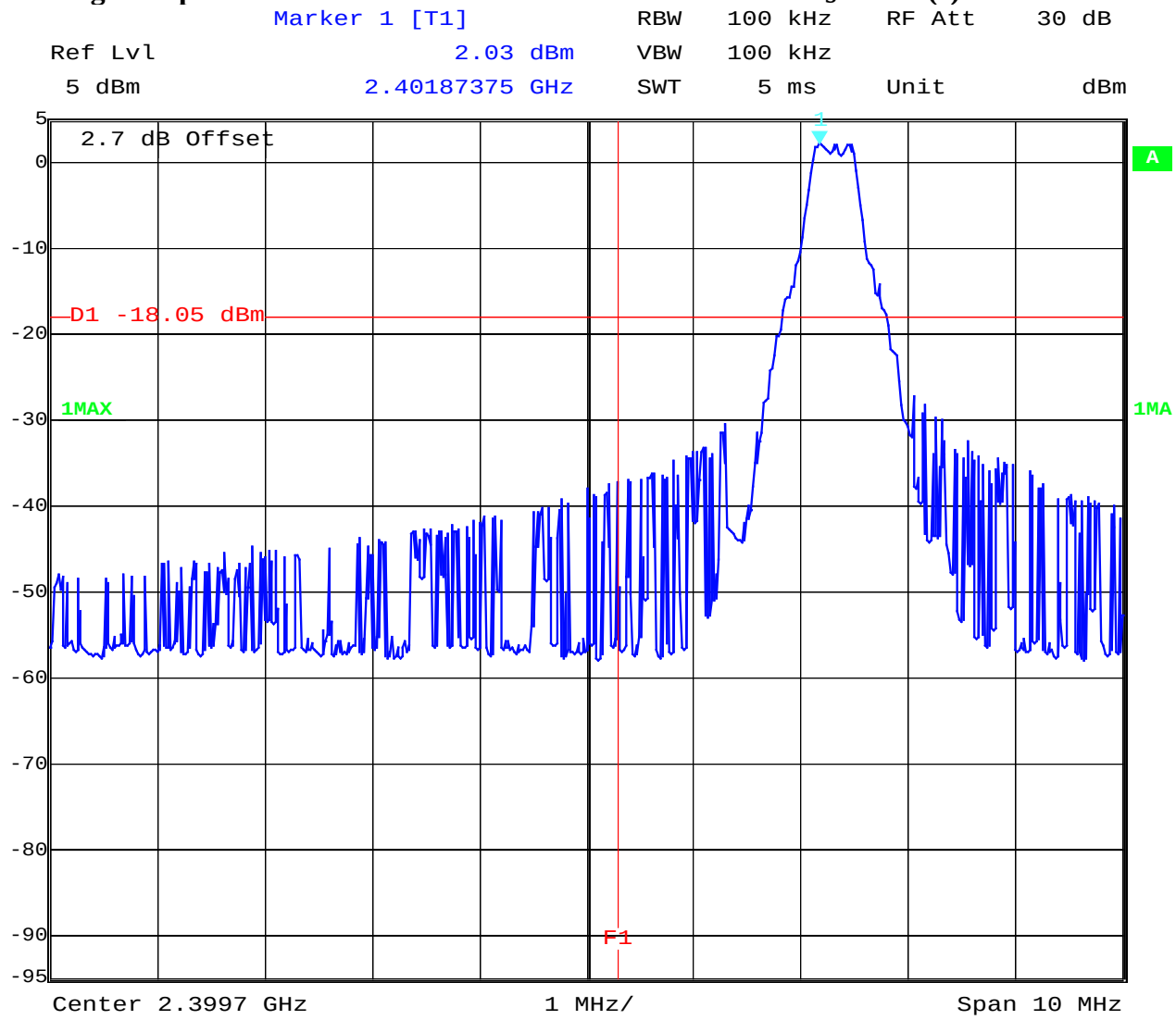
LIMIT SUBCLAUSE § 15.247 (b) (1)

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance of conducted emissions **§15.247 (c)**



Low frequency section (hopping off)

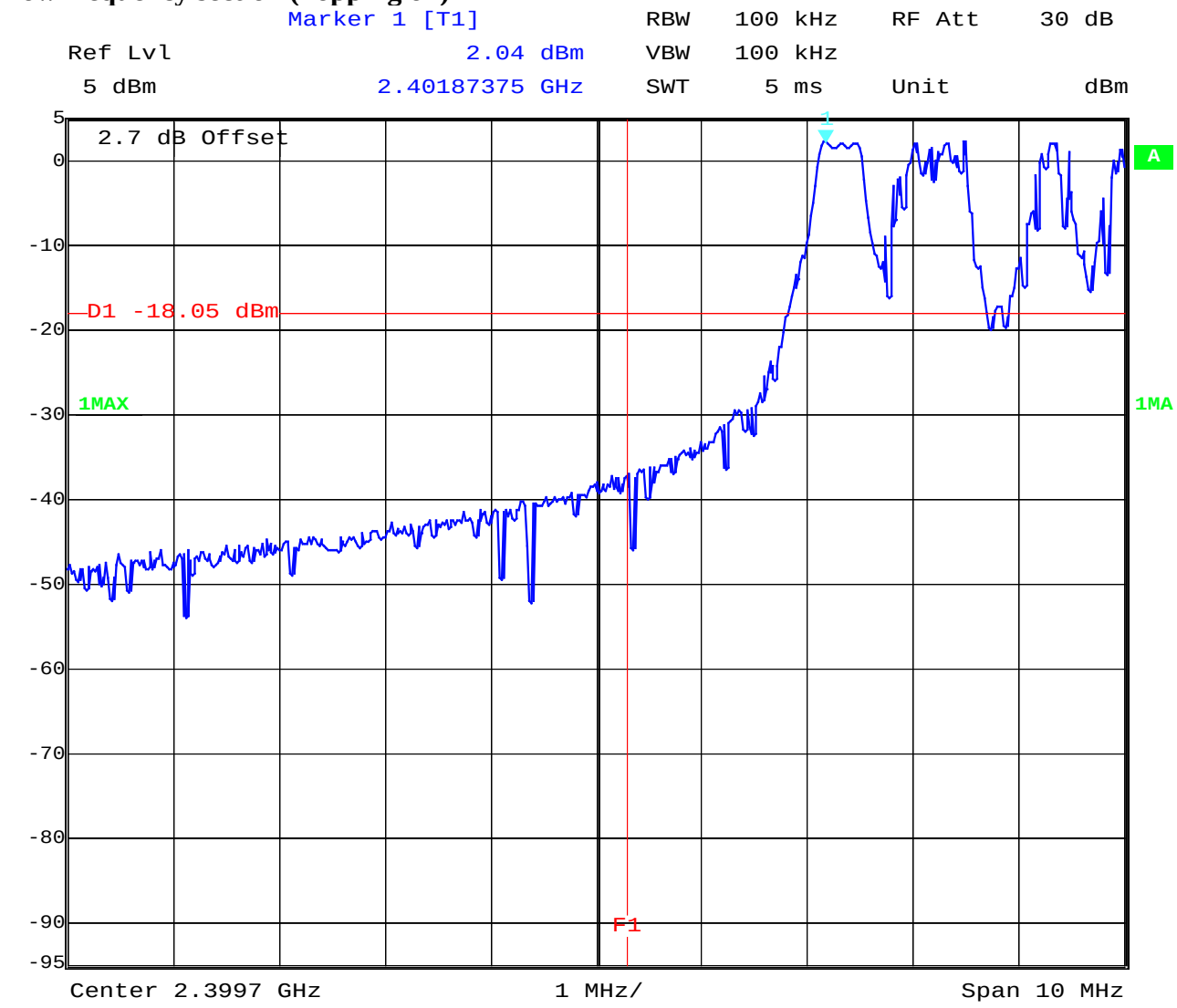
Limit: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance of conducted emissions §15.247 (c)

Low frequency section (hopping on)



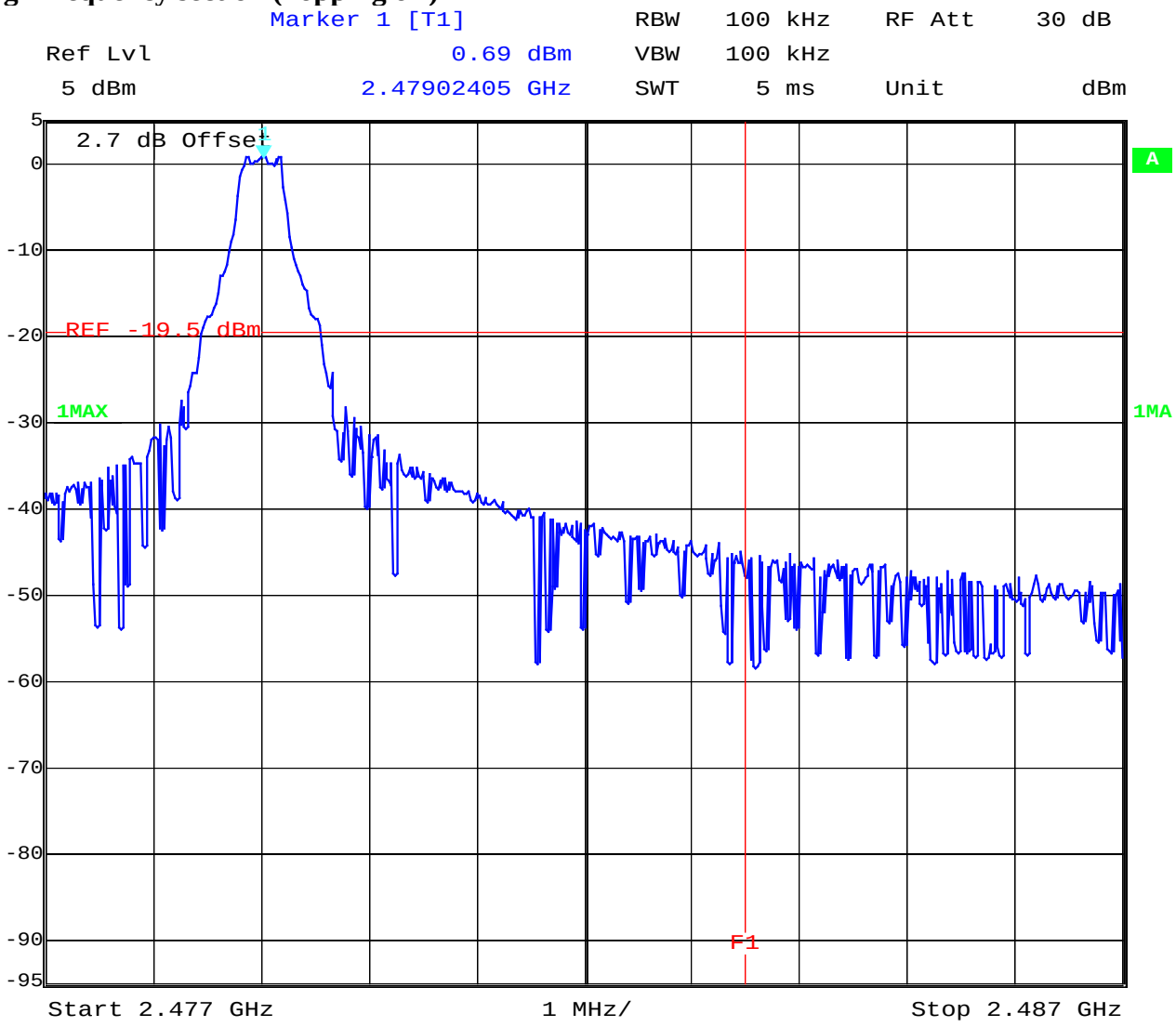
Limit: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance of conducted emissions §15.247 (c)

high frequency section (hopping off)



Date: 5.MAY.2004 14:39:01

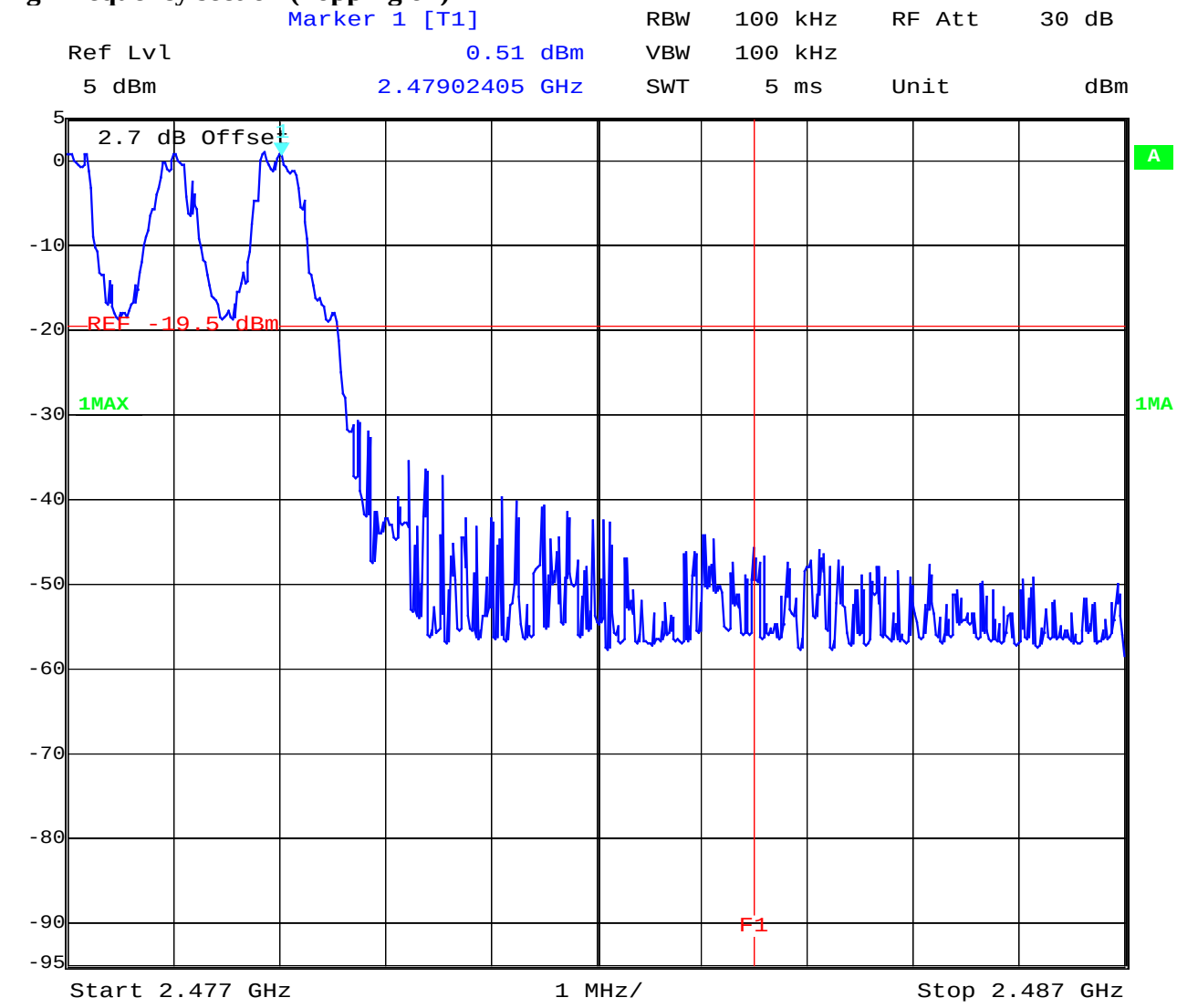
Limit: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance of conducted emissions §15.247 (c)

high frequency section (hopping on)



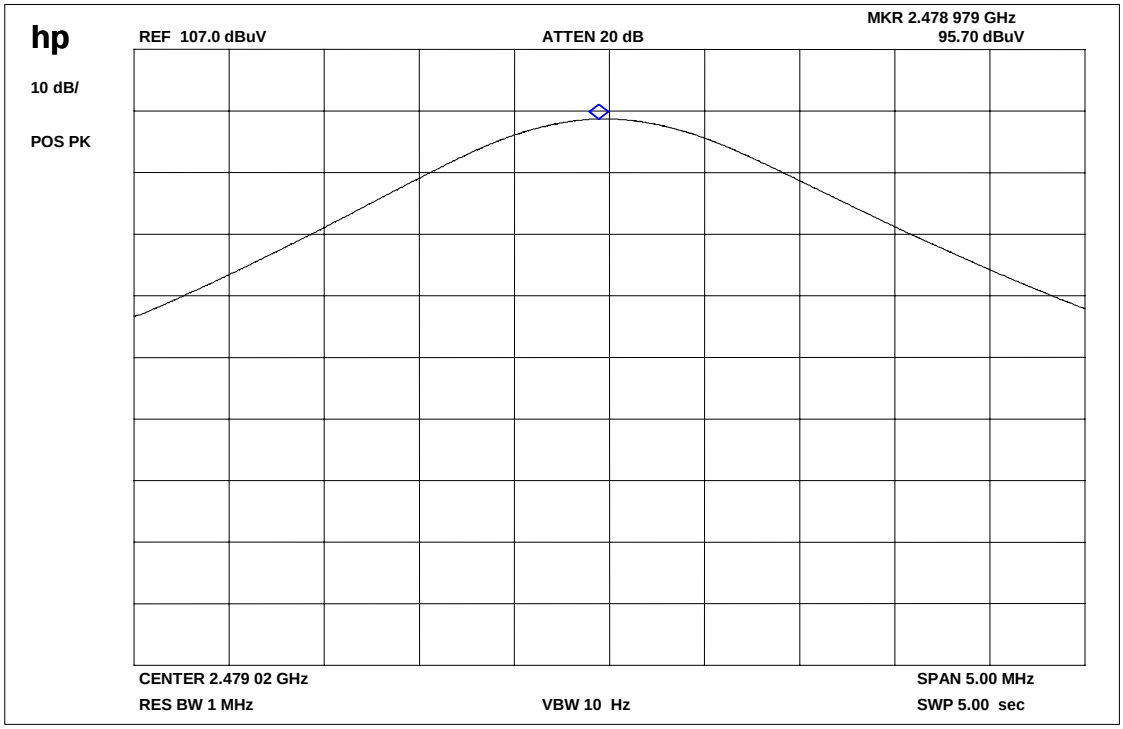
Date: 5.MAY.2004 14:38:13

Limit: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance radiated
Max field strength in 3m distance
(single frequency, AV)

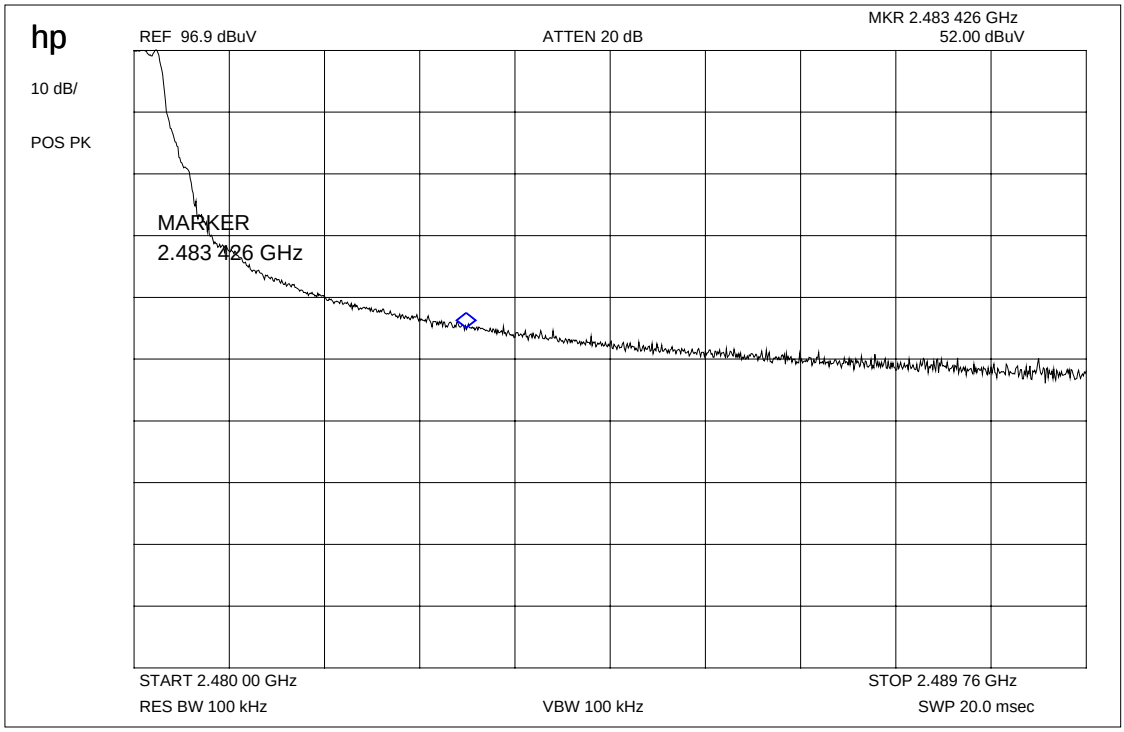


Frequency	Meter reading	Cable loss	Antenna factor	Results
2479 MHz	95.7	1.4	-0.7	96.4 dBµV/m

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance radiated
Marker-Delta Method (single carrier)



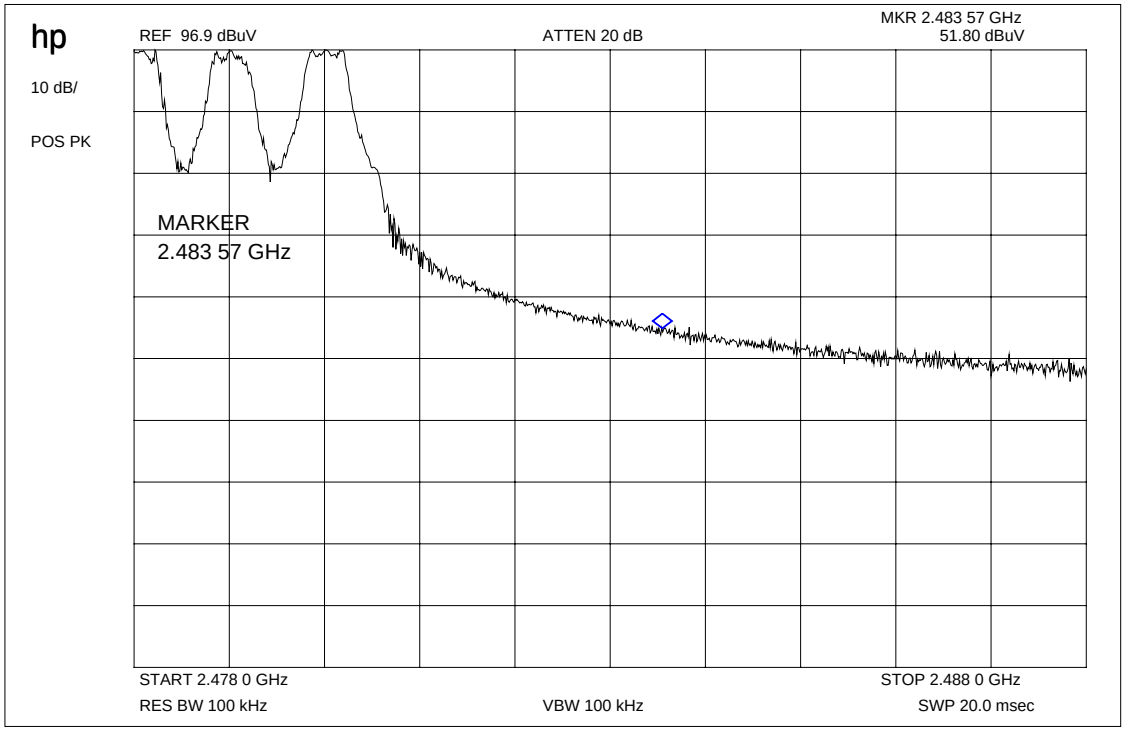
Marker-Delta-Value : 44.9 dB
This measurement was made to show that the behavior of the system is conform to

FCC 15.205 (restricted bands)

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance radiated
Marker-Delta Method (hopping mode)



Marker-Delta-Value : 45.1 dB

This measurement was made to show that the behavior of the system is conform to FCC 15.205 (restricted bands)

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance of radiated emissions §15.205

Radiated field strength

The field strength was measured with an EMI measuring receiver and 1 MHz RBW / VBW for peak and with 1MHz RBW / 10Hz VBW for average at a distance of 3m.

high channel	setup	measured value (3m)	correction factor (3m)	calculated value (3m)
Max. peak value	1 MHz RBW 1 MHz VBW	97.4 dBµV/m	+0.7	98.1 dBµV/m
Max. average value	1 MHz RBW 10 Hz VBW	95.7 dBµV/m	+0.7	96.4 dBµV/m
Delta value	Peak 100 kHz RBW/VBW	44.9 dB (single carrier) 45.1 dB (hopping mode)	-	-
Value at band edge	limit 54 dBµV/m			51.5 dBµV/m (single carrier) 51.3 dBµV/m (hopping mode)
Statement:				Complies

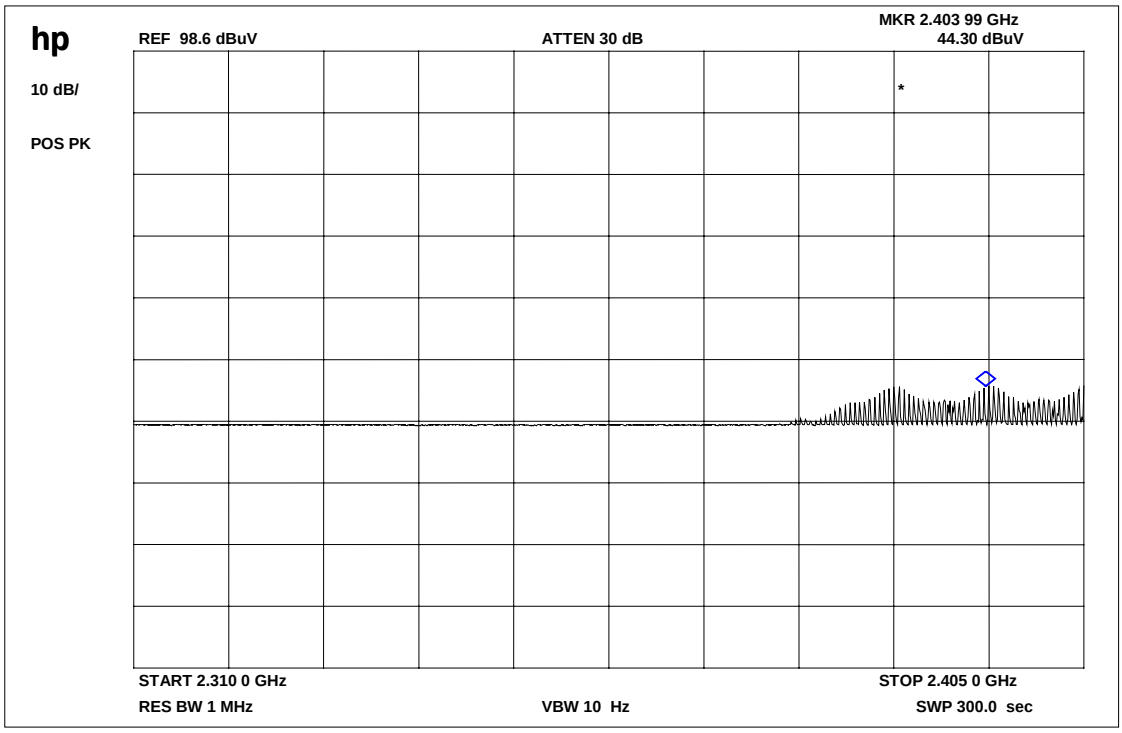
The product complies with the limit of the restricted bands.

Delta marker plots see above pages

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

Band-edge compliance radiated (average)
Restricted band 2310 – 2390 MHz



REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS- Conducted (Transmitter) **§ 15.247 (c) (1)**

EMISSION LIMITATIONS					
f (MHz)		**amplitude of emission (dBm)**	**limit max. allowed emmision power**	**actual attenuation below frequency of operation (dB)**	**results**
2402		+1.96	30 dBm	-	Operating frequency
4309		-63.0	-20 dBc (-18.04 dBm)	64.96	complies
6469		-57.3		59.26	complies
9018		-30.1		32.06	complies
2441		+1.52	30 dBm	-	Operating frequency
4308		-62.8	-20 dBc (-18.48 dBm)	64.32	complies
6463		-56.7		58.22	complies
9018		-30.1		31.62	complies
2480		+0.56	30 dBm		Operating frequency
4309		-62.9	-20 dBc (-19.44 dBm)	63.46	complies
6463		-56.8		57.36	complies
9018		-29.9		30.46	complies
Measurement uncertainty		± 3dB			

RBW : 100 kHz VBW: 100 MHz
For emissions that fall into restricted bands you find the radiated emissions later in the report.

LIMITS **SUBCLAUSE § 15.247 (c)**

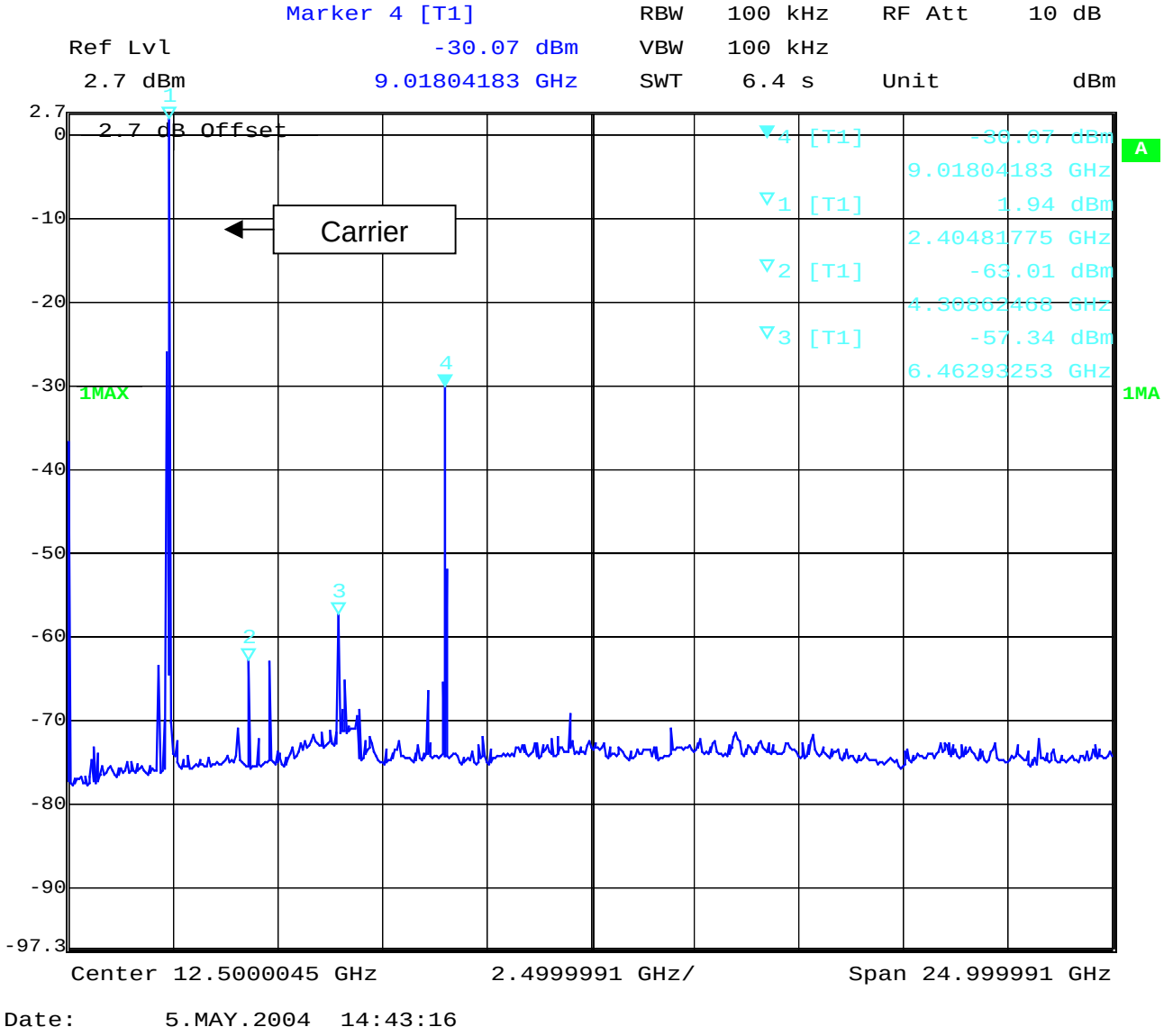
In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS- Conducted (Transmitter) § 15.247 (c) (1)

Low Channel : 9 kHz - 25 GHz

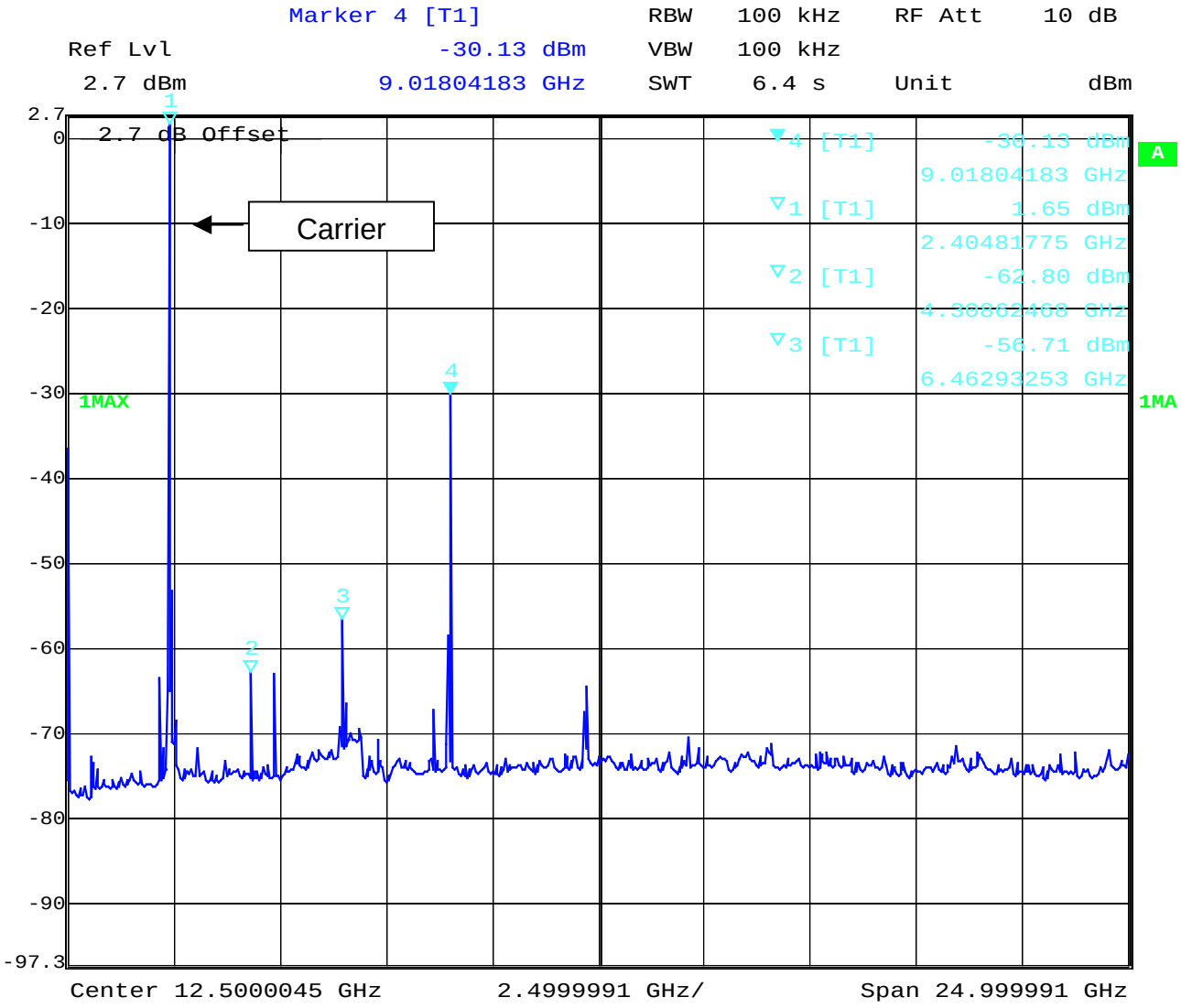


RBW:100 kHz / VBW: 100 kHz

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS- Conducted (Transmitter) § 15.247 (c) (1)
Mid Channel : 9 kHz – 25 GHz



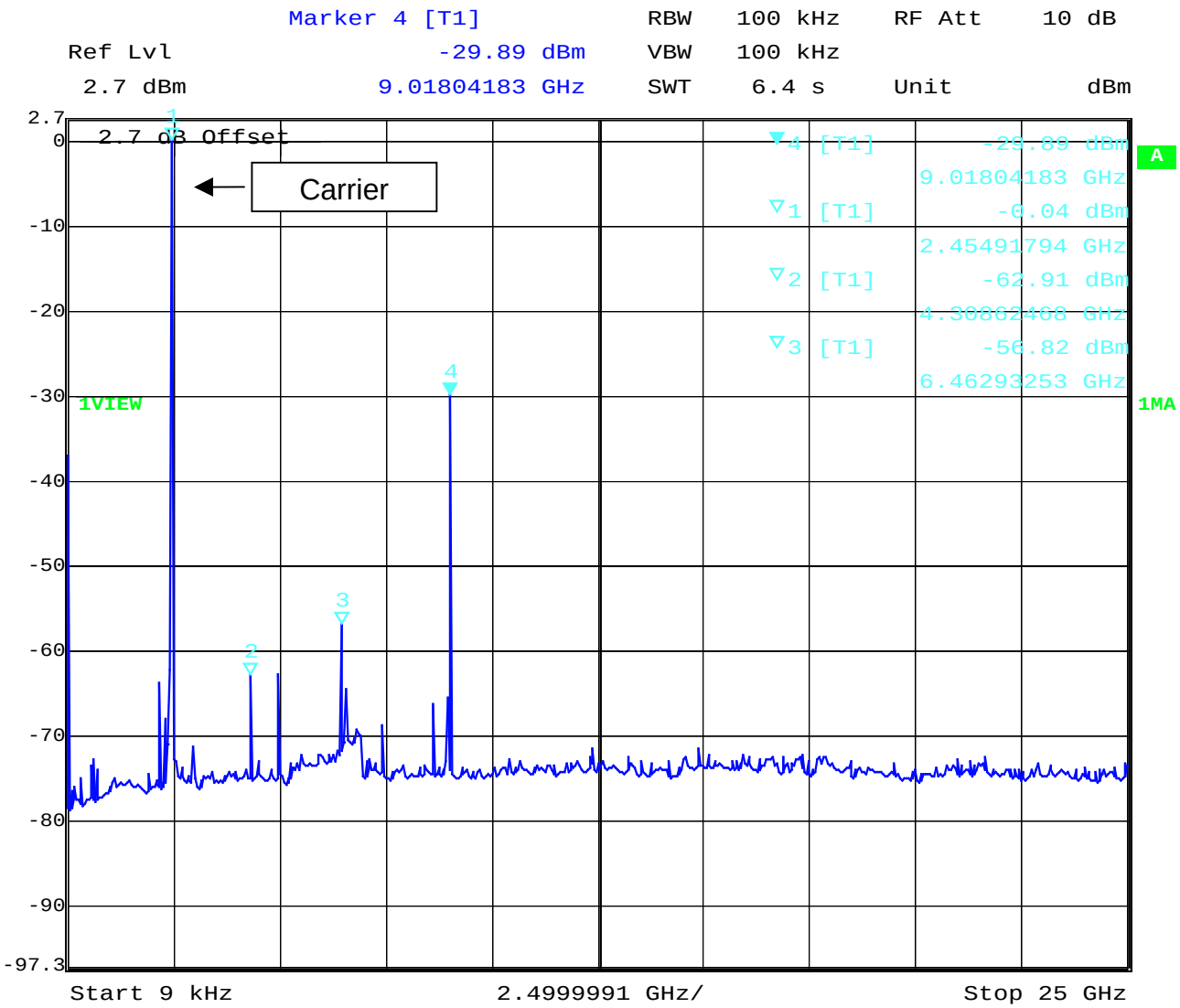
RBW:100 kHz / VBW: 100 kHz

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS- Conducted (Transmitter) § 15.247 (c) (1)

High Channel : 9kHz – 25 GHz



Date: 5.MAY.2004 14:41:43

RBW:100 kHz / VBW: 100 kHz

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24, 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

SPURIOUS RADIATED EMISSION § 15.247 (c) (1)

SPURIOUS EMISSIONS LEVEL (µV/m)								
2402 MHz			2441 MHz			2479 MHz		
f (MHz)	Detector	Level (µV/m)	f (MHz)	Detector	Level (µV/m)	f (MHz)	Detector	Level (µV/m)
4804	PK	134.9	4882	PK	266.1	4960	PK	104.7
7206	PK	371.5	7323	PK	89.1	7437	AV	465.4
8606	PK	285.1	8543	PK	346.7	8770	PK	323.6
9020	AV	335.0	9020	AV	320.4			
12 to 25 GHz no traceable signal found								
Measurement uncertainty			±3 dB					

f < 1 GHz : RBW/VBW: 100 kHz f ≥ 1GHz : RBW/VBW: 1 MHz

LIMITS SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Limits SUBCLAUSE § 15.209

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
30 - 88	100 (40 dBµV/m)	3
88 - 216	150 (43.5 dBµV/m)	3
216 - 960	200 (46 dBµV/m)	3
above 960	500 (54 dBµV/m)	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

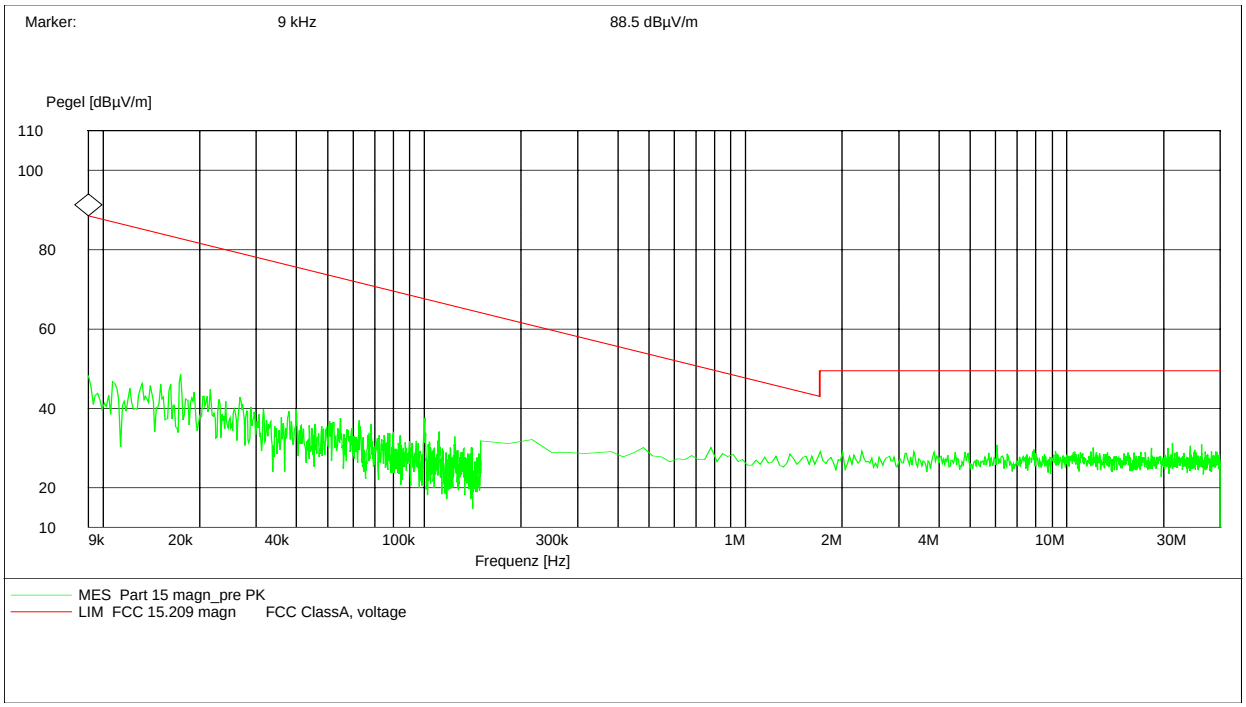
Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS **SUBCLAUSE § 15.247 (c) (1)**
(valid for all channels)

9 kHz –30 MHz

Part 15.209 Magnetics

EUT: WDI 100
Manufacturer: ABB Stotz-Kontakt
Operating Condition: Transmitting, hopping
Test Site: Cetecom, Room 6
Operator: Ames
Test Specification: 15.209
Comment: pass
Start of Test:

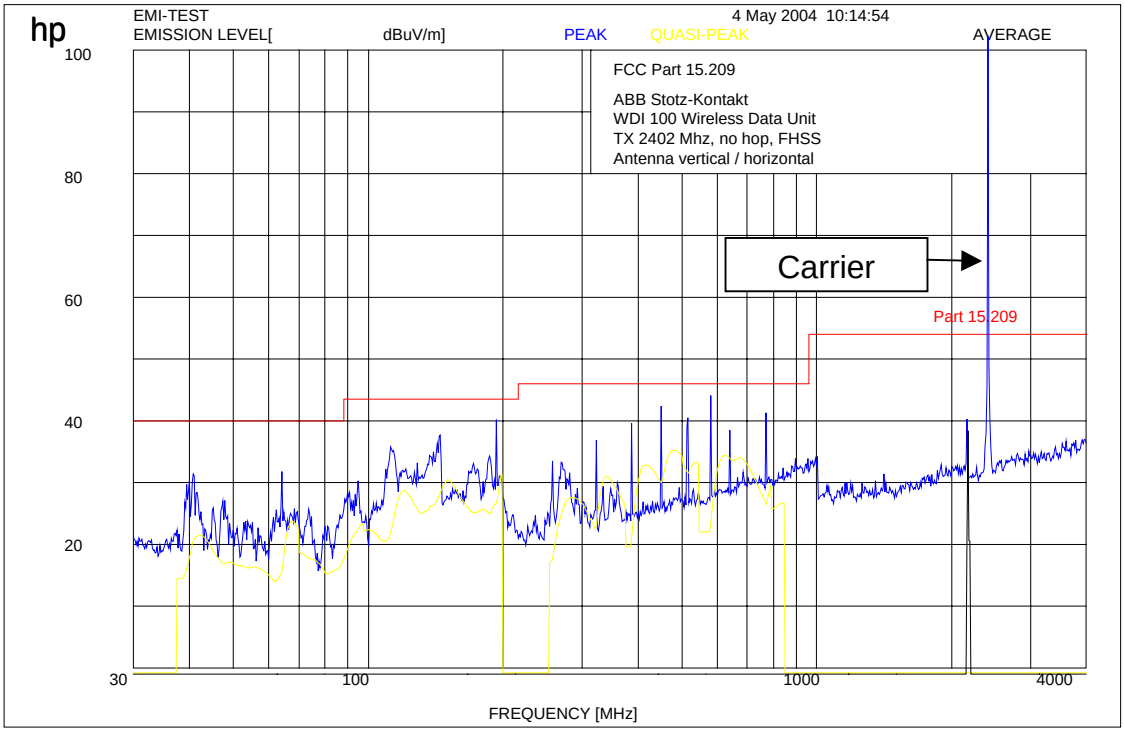


REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS SUBCLAUSE § 15.247 (c) (1)

2402 MHz - 4 GHz



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

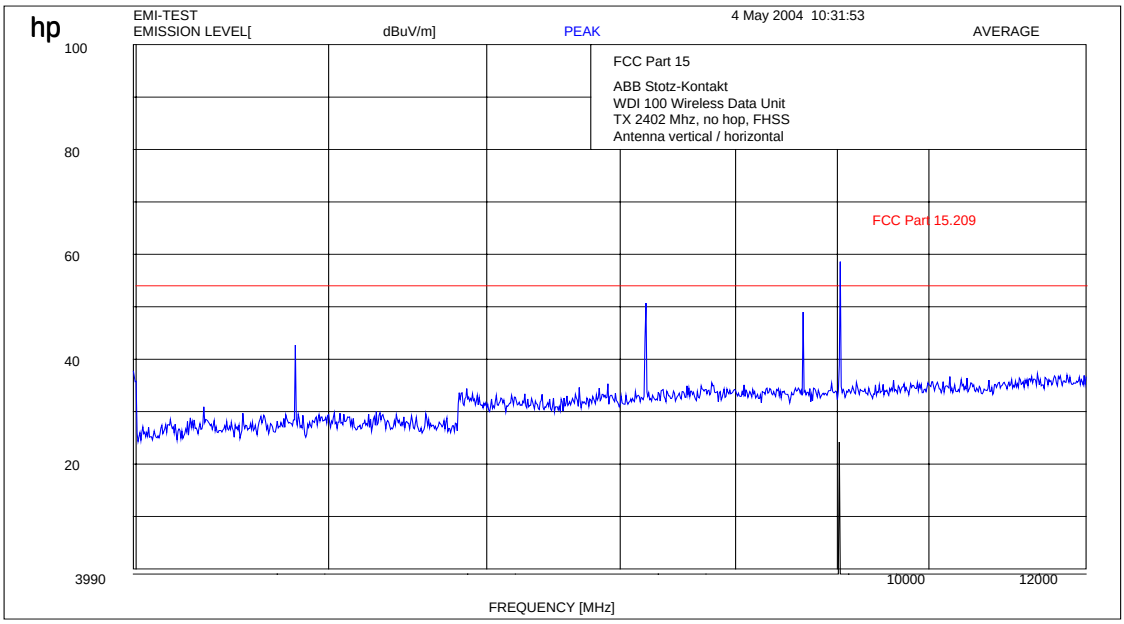
LIMITS SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS **SUBCLAUSE § 15.247 (c) (1)**
2402 MHz - 12 GHz



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

The frequency 9.02 GHz was remeasured manually. The value is 50.5 dBµV/m AV at 3m.

LIMITS **SUBCLAUSE § 15.247 (c)**

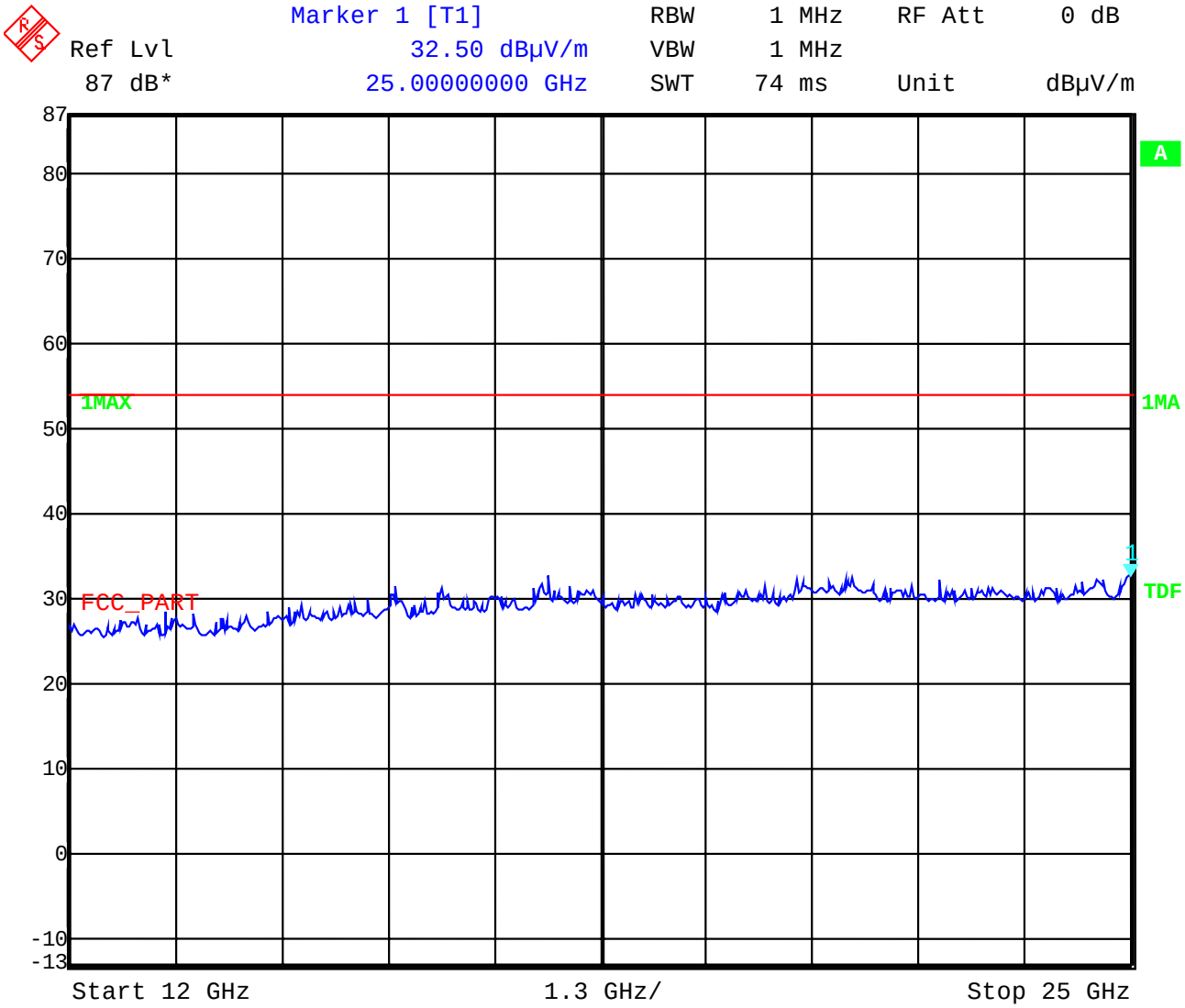
In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS SUBCLAUSE § 15.247 (c) (1)

2402 MHz



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

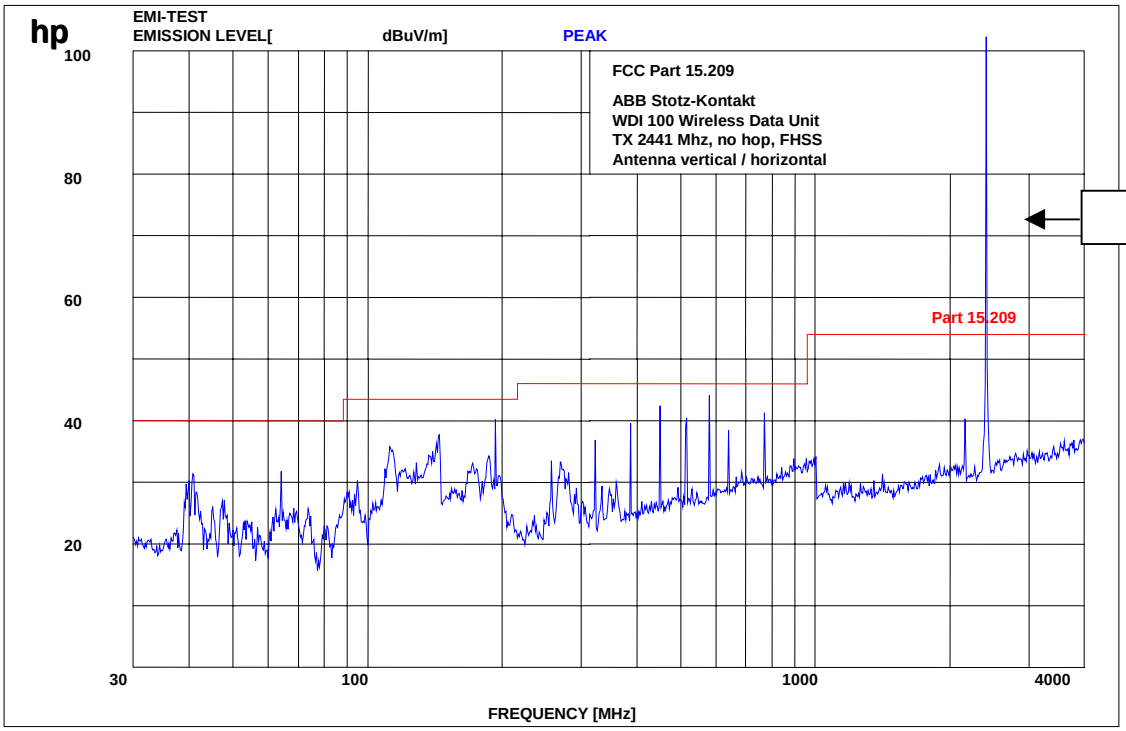
LIMITS SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS SUBCLAUSE § 15.247 (c) (1)
2441 MHz -4 GHz



f < 1 GHz : RBW/VBW: 100 kHz f ≥ 1GHz : RBW/VBW: 1 MHz

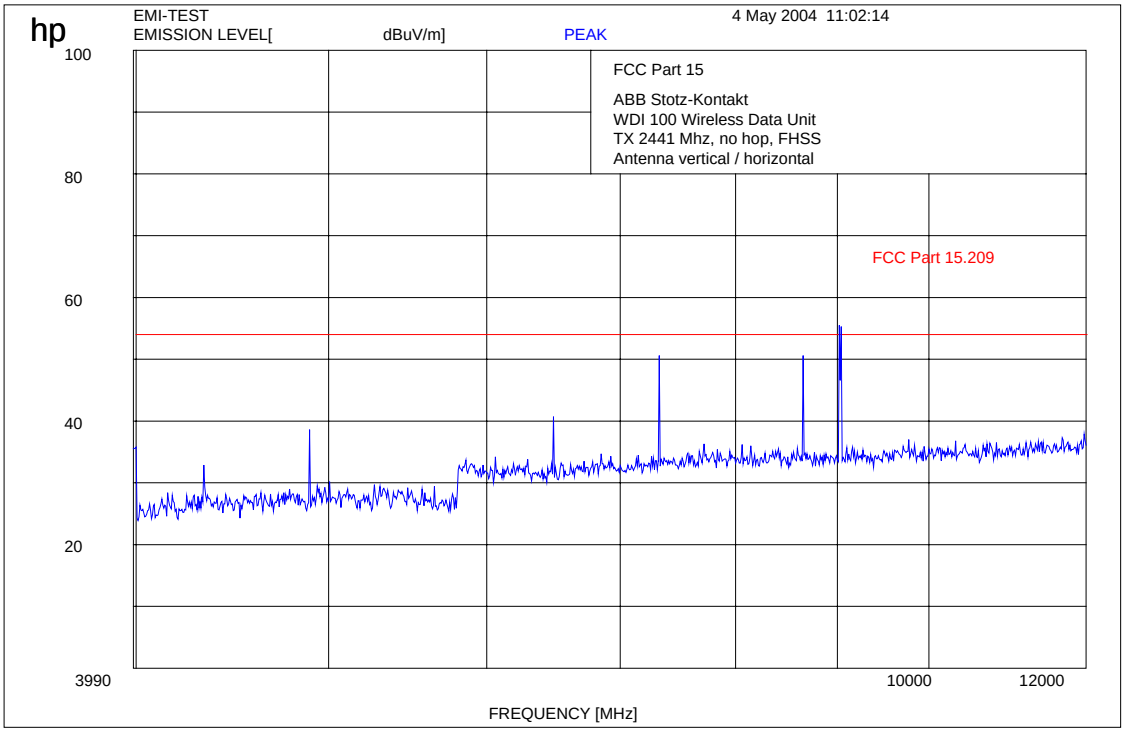
LIMITS SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS SUBCLAUSE § 15.247 (c) (1)
2441 MHz - 12 GHz



f < 1 GHz : RBW/VBW: 100 kHz f ≥ 1GHz : RBW/VBW: 1 MHz

LIMITS SUBCLAUSE § 15.247 (c)

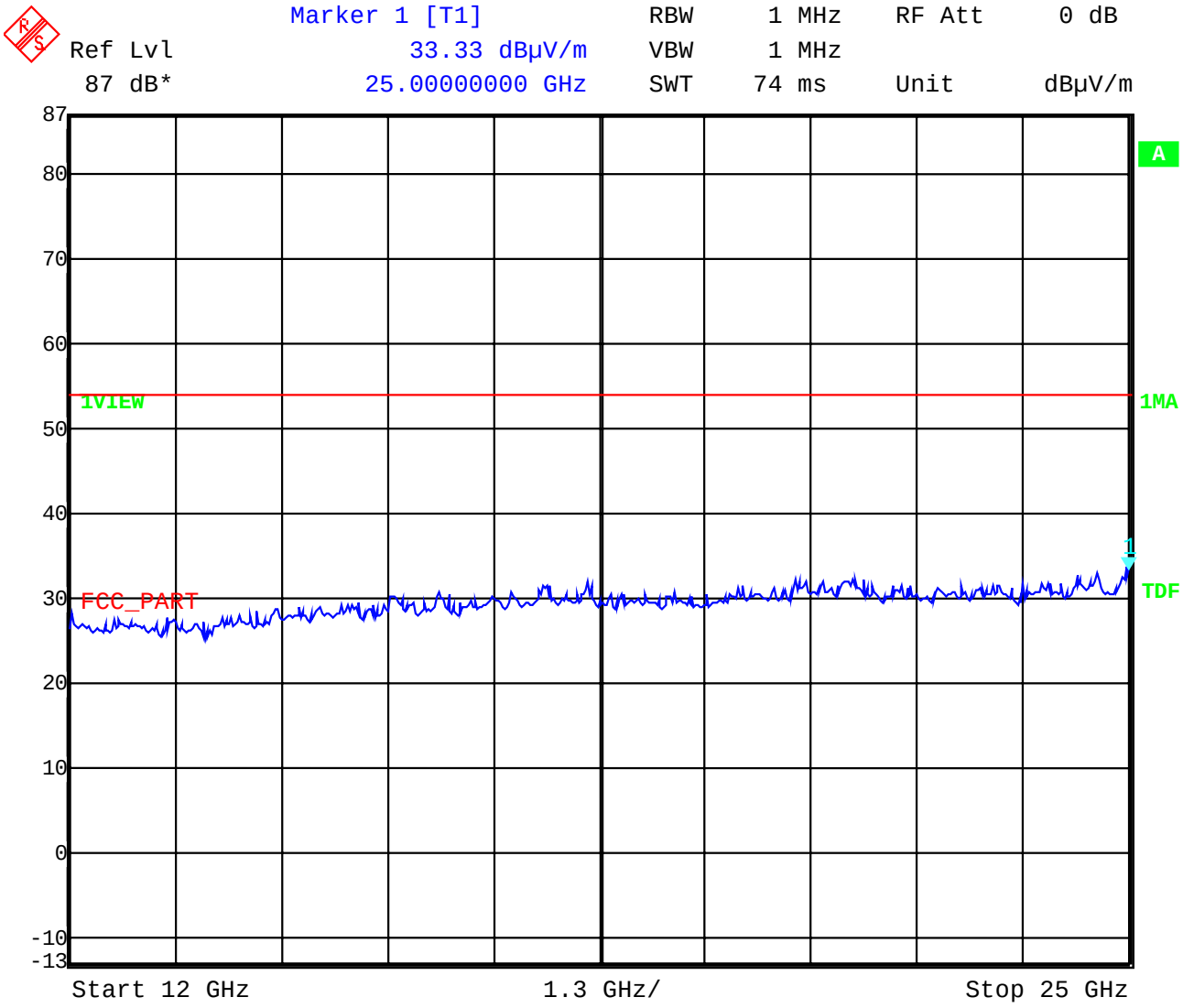
In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS SUBCLAUSE § 15.247 (c) (1)

2441 MHz - 25 GHz



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

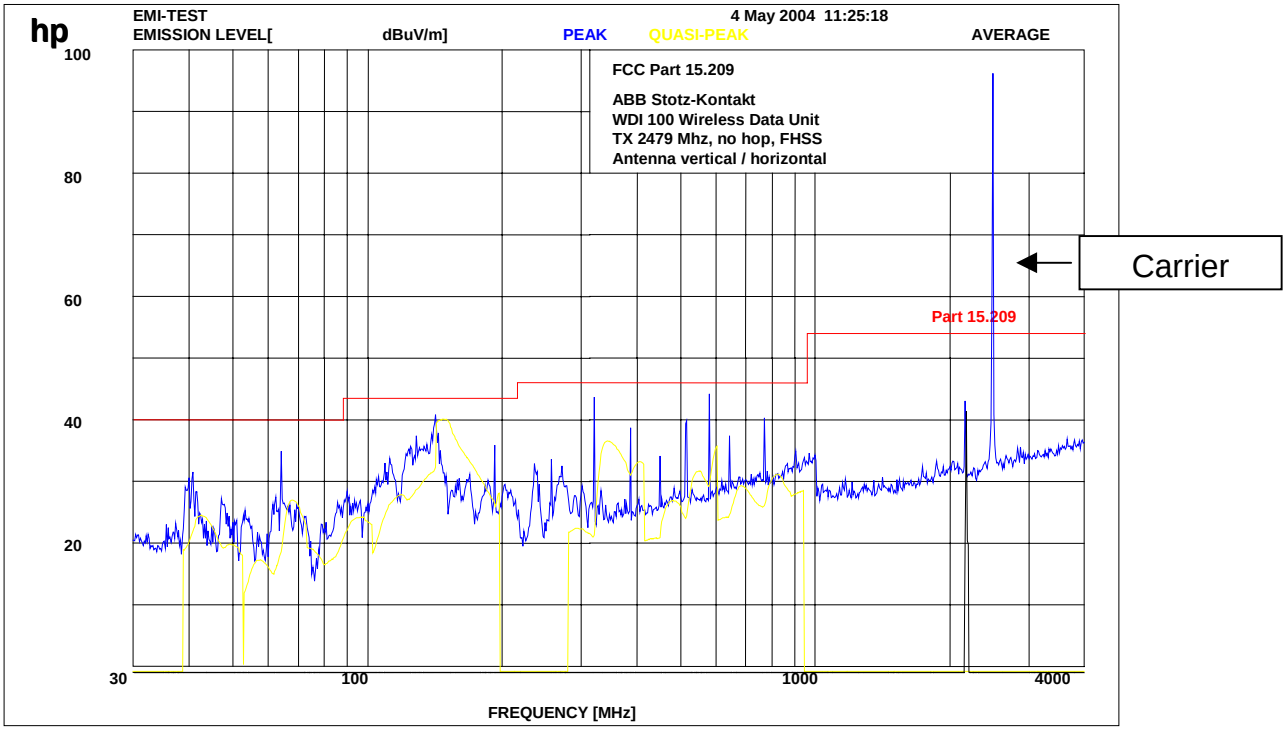
LIMITS SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS **SUBCLAUSE § 15.247 (c) (1)**
2479 MHz – 4 GHz



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

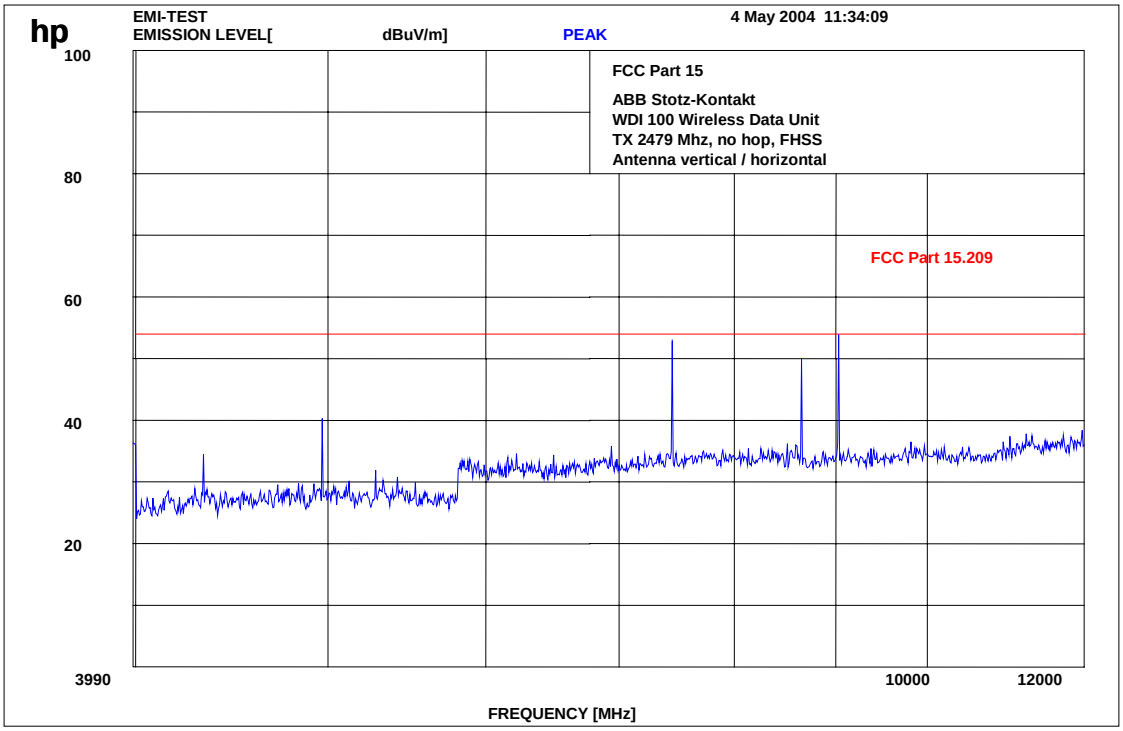
LIMITS **SUBCLAUSE § 15.247 (c)**

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS **SUBCLAUSE § 15.247 (c) (1)**
2479 MHz – 12 GHz



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

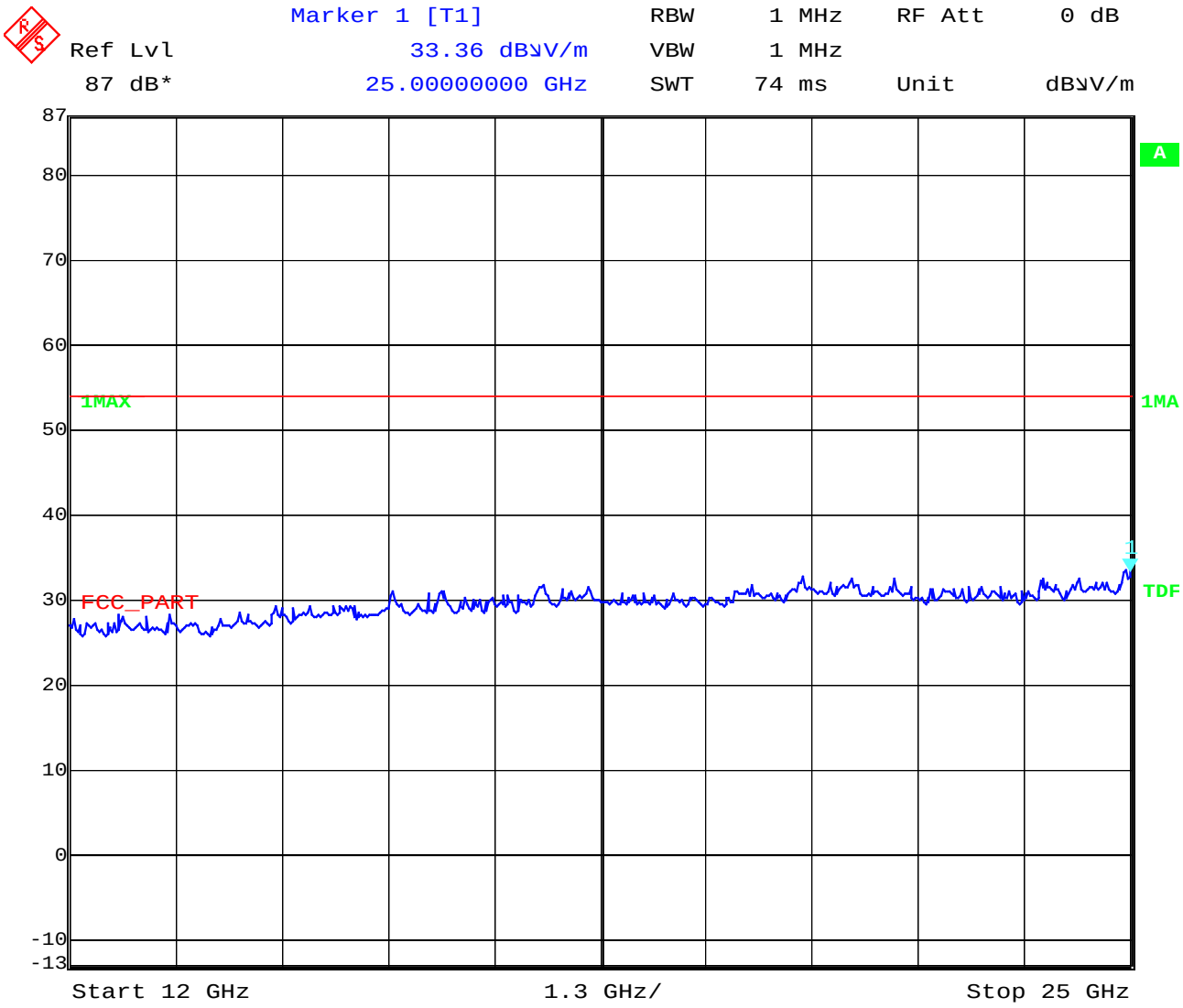
LIMITS **SUBCLAUSE § 15.247 (c)**

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS SUBCLAUSE § 15.247 (c) (1)
2479 MHz –25 GHz



Date: 27.OCT.2003 10:48:13

f < 1 GHz : RBW/VBW: 100 kHz f ≥ 1GHz : RBW/VBW: 1 MHz

LIMITS SUBCLAUSE § 15.247 (c)

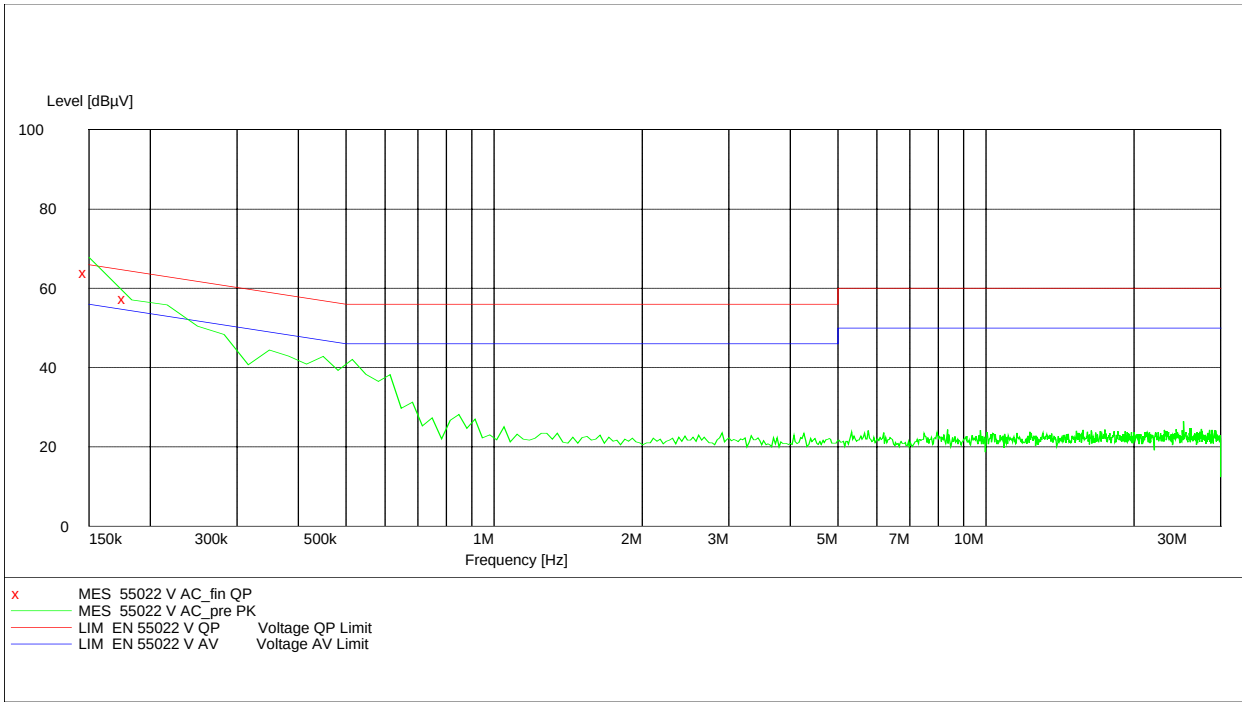
In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

AC-conducted

EUT: WDI 100
Manufacturer: ABB Stotz-Kontakt
Operating Condition: Transmitting, hopping
Test Site: Room 006 (Shielded chamber)
Operator: Ames
Test Specification: CISPR22, 110V AC
Comment: pass
Start of Test:



MEASUREMENT RESULT: "CISPR22 AC_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.150000	64.00	11.8	66	2.0	L1	GND
0.180000	57.40	11.4	65	7.1	L1	GND

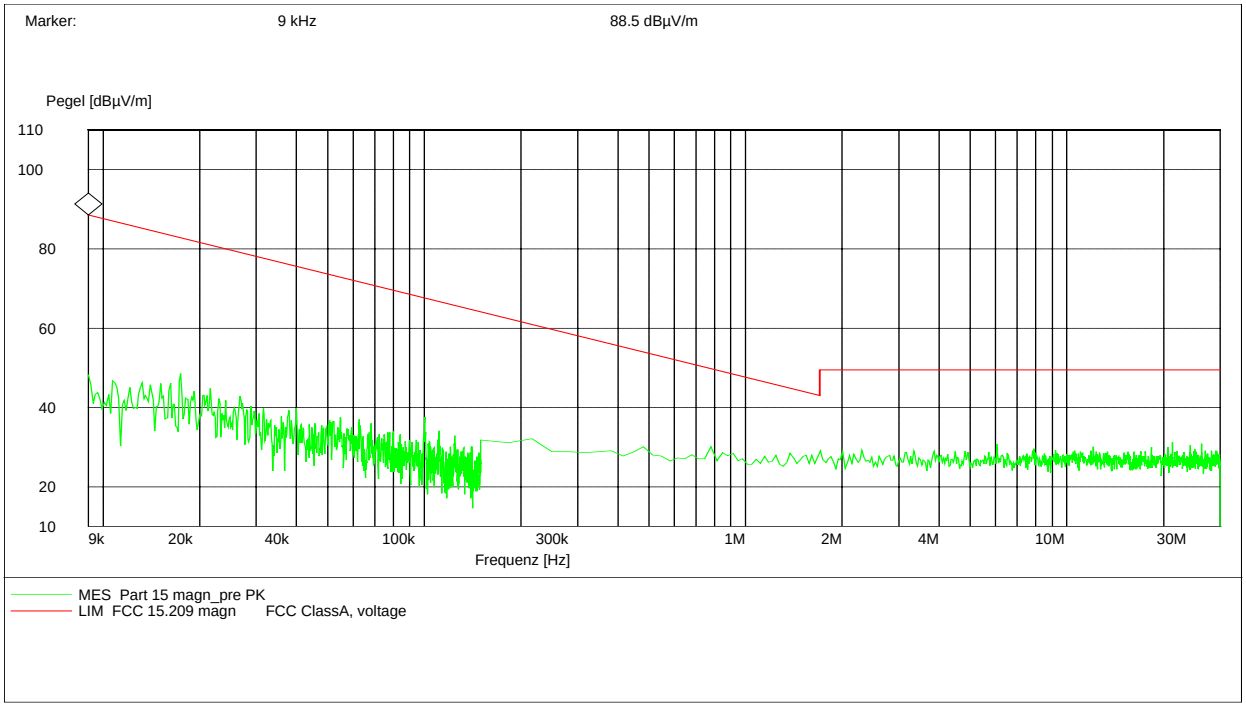
REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS (Receiver) SUBCLAUSE § 15.109
9 kHz –30 MHz

Part 15.209 Magnetics

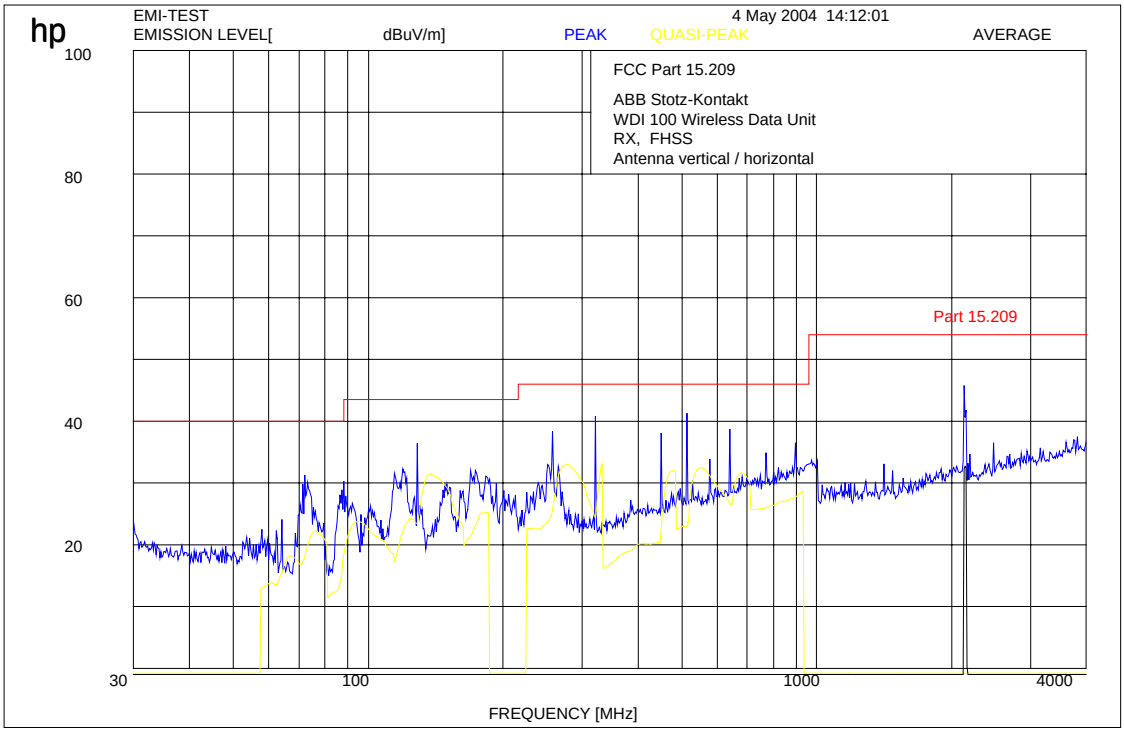
EUT: WDI 100
Manufacturer: ABB Stotz-Kontakt
Operating Condition: Receiving
Test Site: Cetecom, Room 6
Operator: Ames
Test Specification: 15.209
Comment: pass
Start of Test:



REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS (Receiver) SUBCLAUSE § 15.109



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

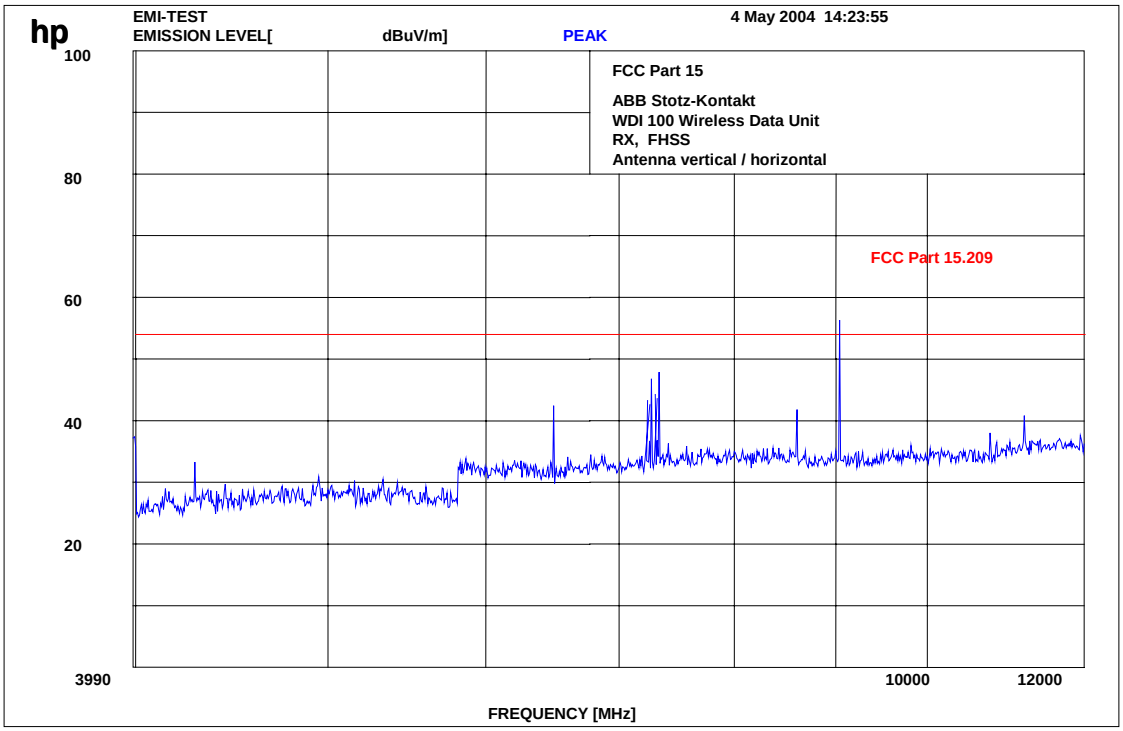
Limits **SUBCLAUSE § 15.109**

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
30 - 88	100 (40 dBµV/m)	3
88 - 216	150 (43.5 dBµV/m)	3
216 - 960	200 (46 dBµV/m)	3
above 960	500 (54 dBµV/m)	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS (Receiver) SUBCLAUSE § 15.109



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

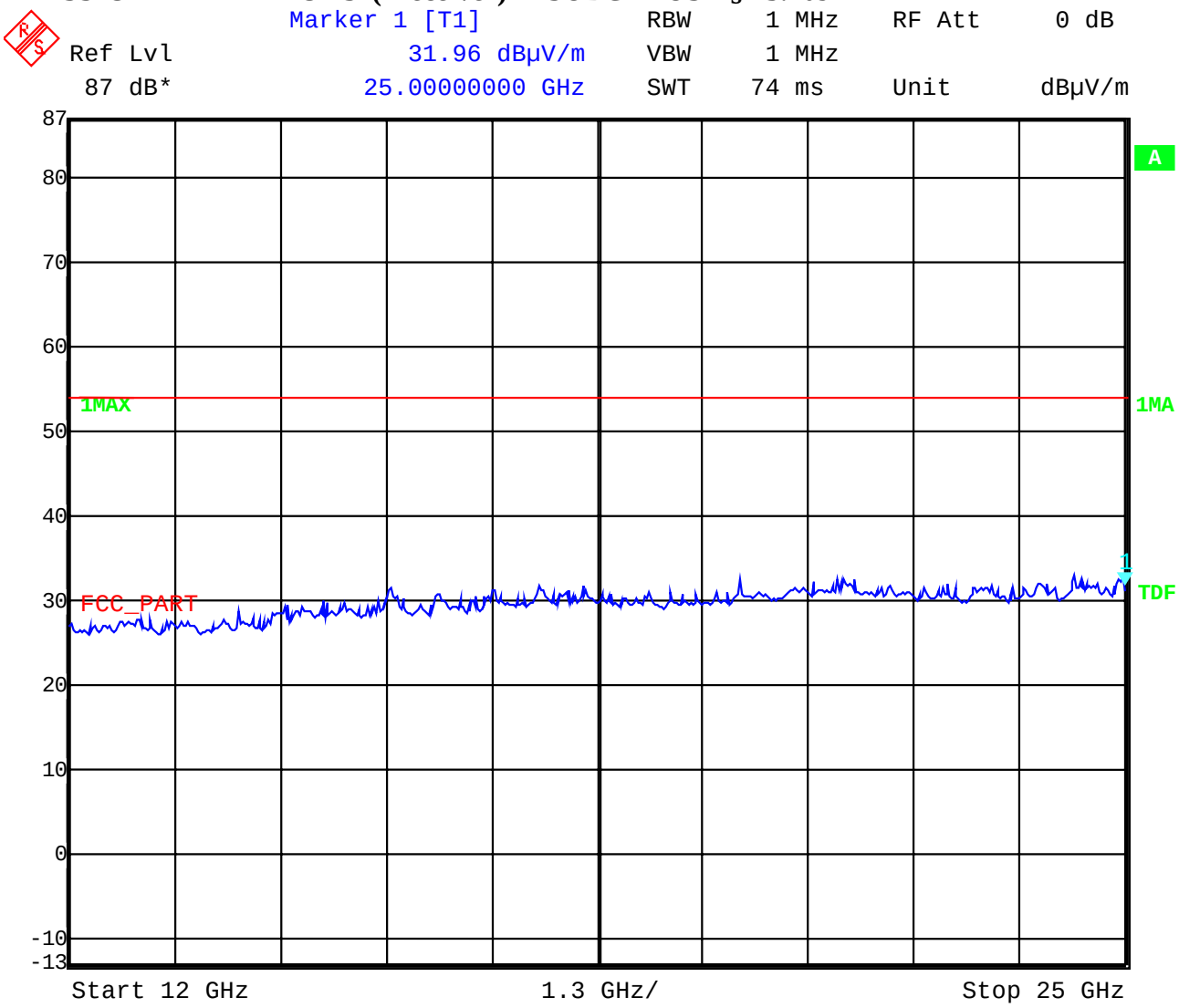
Limits **SUBCLAUSE § 15.109**

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
30 - 88	100 (40 dBµV/m)	3
88 - 216	150 (43.5 dBµV/m)	3
216 - 960	200 (46 dBµV/m)	3
above 960	500 (54 dBµV/m)	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

EMISSION LIMITATIONS (Receiver) SUBCLAUSE § 15.109



f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**

Limits **SUBCLAUSE § 15.109**

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
30 - 88	100 (40 dBµV/m)	3
88 - 216	150 (43.5 dBµV/m)	3
216 - 960	200 (46 dBµV/m)	3
above 960	500 (54 dBµV/m)	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

Equipment under test : WDI 100
Ambient temperature : 22.7°C
Relative humidity : 34%

RECEIVER SPURIOUS RADIATION **§ 15.109**
Radiated

SPURIOUS EMISSIONS LEVEL (µV/m)								
CH 1 / 2 / 3								
f (MHz)	Detector	Level (µV/m)	f (MHz)	Detector	Level (µV/m)	f (MHz)	Detector	Level (µV/m)
7280	AV	257.0						
9020	AV	371.5						
Measurement uncertainty			±3 dB					

f < 1 GHz : RBW/VBW: 100 kHz **f ≥ 1GHz : RBW/VBW: 1 MHz**
see above plots

Measurement distance see table

Limits **SUBCLAUSE § 15.109**

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
30 - 88	100 (40 dBµV/m)	3
88 - 216	150 (43.5 dBµV/m)	3
216 - 960	200 (46 dBµV/m)	3
above 960	500 (54 dBµV/m)	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)
17 – 24; 64

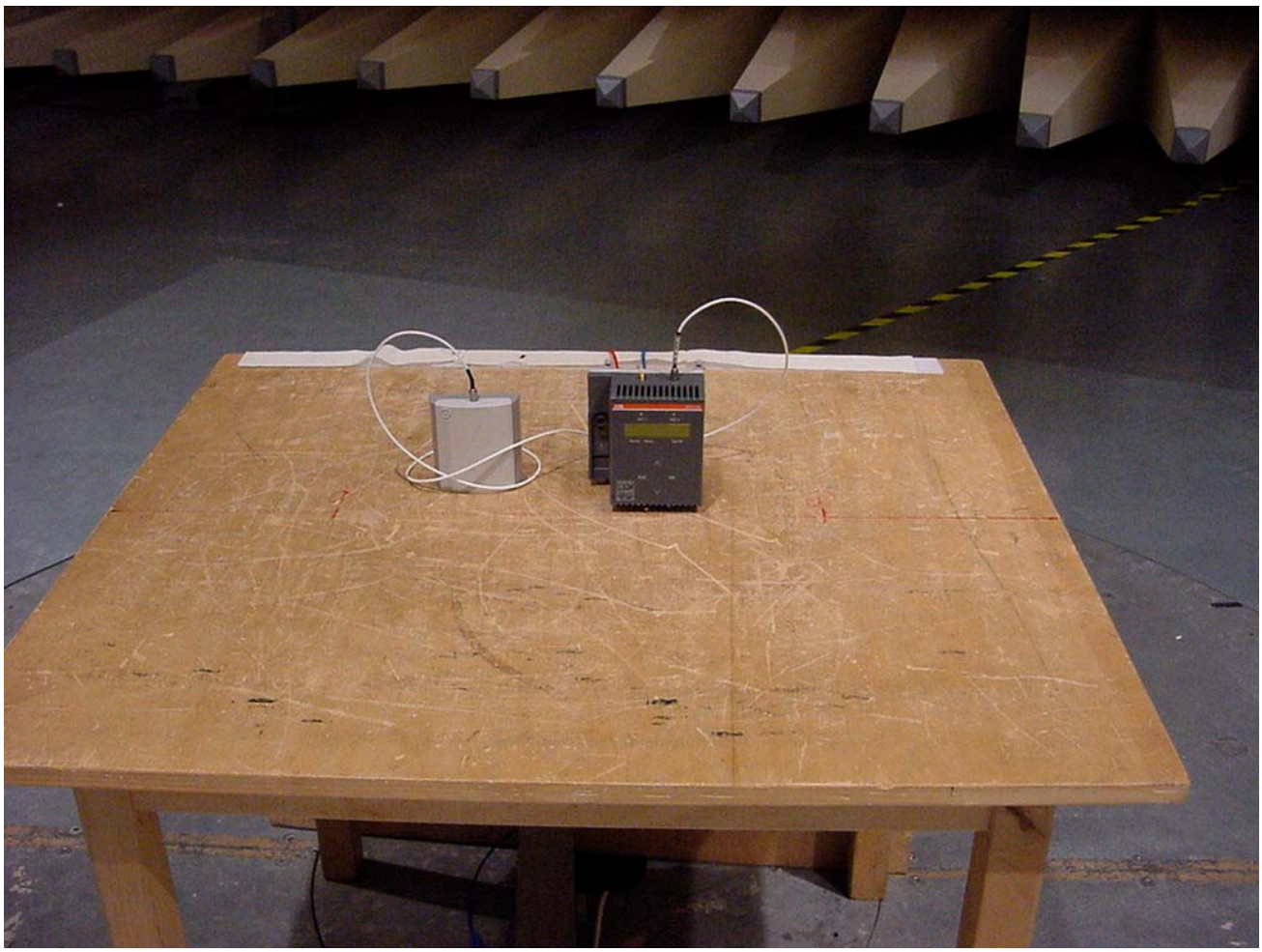
TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

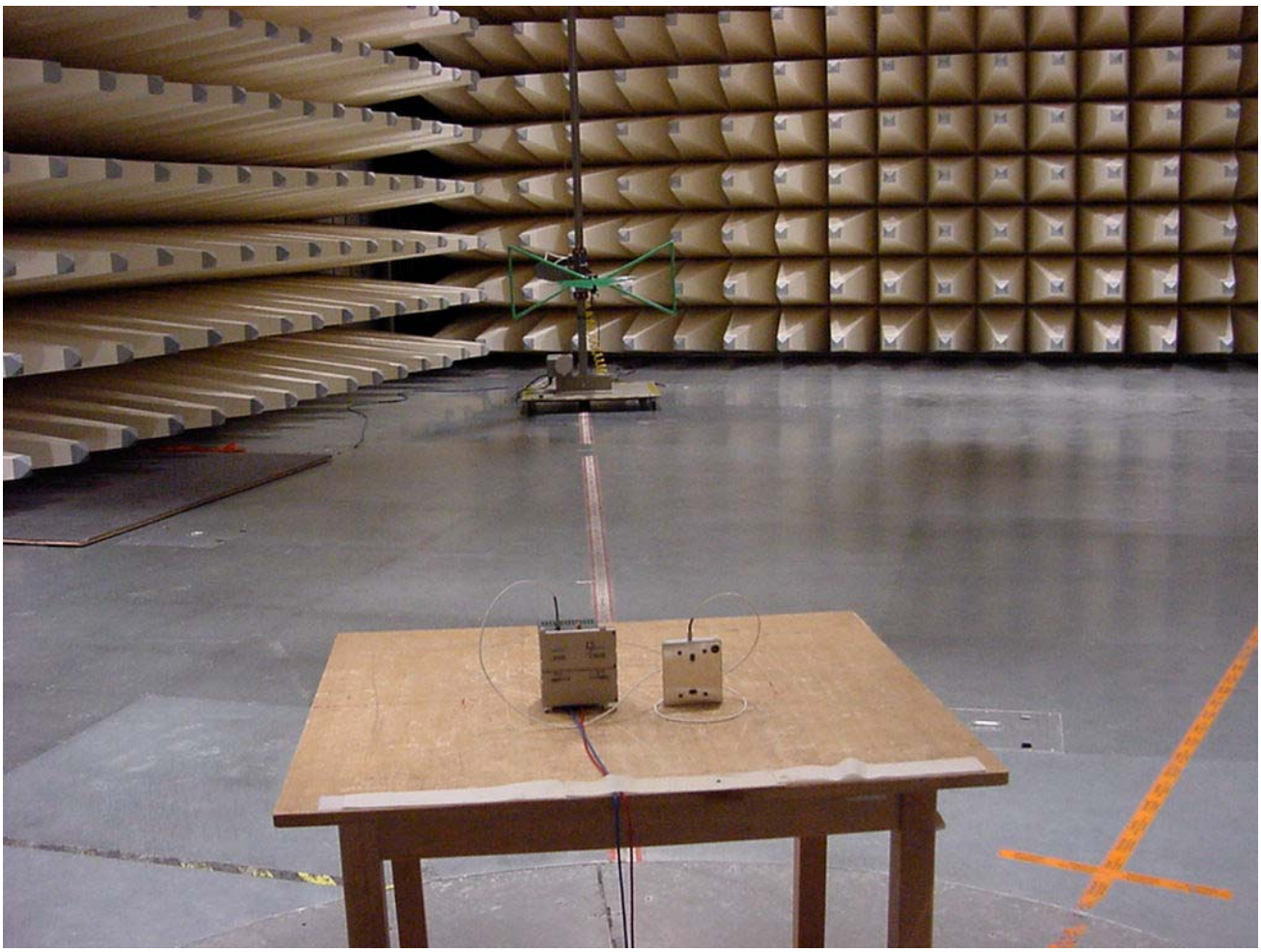
No	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Spectrum Analyzer	8566 A	Hewlett-Packard	1925A00257
02	Analyzer Display	8566 A	Hewlett-Packard	1925A00860
03	Oscilloscope	7633	Tektronix	230054
04	Radio Analyzer	CMTA 54	Rohde & Schwarz	894 043/010
05	System Power Supply	6038 A	Hewlett-Packard	2848A07027
06	Signal Generator	8111 A	Hewlett-Packard	2215G00867
07	Signal Generator	8662 A	Hewlett-Packard	2224A01012
08	Funktionsgenerator	AFGU	Rohde & Schwarz	862 480/032
09	Regeltrenntrafo	MPL	Erfi	91350
10	Netznachbildung	NNLA 8120	Schwarzbeck	8120331
11	Relais-Matrix	PSU	Rohde & Schwarz	893 285/020
12	Power-Meter	436 A	Hewlett-Packard	2101A12378
13	Power-Sensor	8484 A	Hewlett-Packard	2237A10156
14	Power-Sensor	8482 A	Hewlett-Packard	2237A00616
15	Modulationsmeter	9008	Racal-Dana	2647
16	Frequenzzähler	5340 A	Hewlett-Packard	1532A03899
17	Absorber Schirmkabine	---	MWB	87400/002
18	Spectrum Analyzer	85660 B	Hewlett-Packard	2747A05306
19	Analyzer Display	85662 A	Hewlett-Packard	2816A16541
20	Quasi Peak Adapter	85650 A	Hewlett-Packard	2811A01131
21	RF-Preselector	85685 A	Hewlett-Packard	2833A00768
22	Biconical Antenne	3104	Emco	3758
23	Log. Per. Antenne	3146	Emco	2130
24	Double Ridge Horn	3115	Emco	3088
25	EMI-Testreceiver	ESAI	Rohde & Schwarz	863 180/013
26	EMI-Analyzer-Display	ESAI-D	Rohde & Schwarz	862 771/008
27	Biconical Antenne	HK 116	Rohde & Schwarz	888 945/013
28	Log. Per. Antenne	HL 223	Rohde & Schwarz	825 584/002
29	Relais-Switch-Unit	RSU	Rohde & Schwarz	375 339/002
30	Highpass	HM985955	FSY Microwave	001
31	Amplifier	P42-GA29	Tron-Tech	B 23602
32	Absorber Schirmkabine		Frankonia	
33	Steuerrechner	PSM 7	Rohde & Schwarz	834 621/004
34	EMI Test Reciever	ESMI	Rohde & Schwarz	827 063/010
35	EMI Test Receiver	Display	Rohde & Schwarz	829 808/010

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
36	Controler	HD 100	Deisel	100/322/93
37	Relais Matrix	PSN	Rohde & Schwarz	829 065/003
38	Control Unit	GB 016 A2	Rohde & Schwarz	344 122/008
39	Relais Switch Unit	RSU	Rohde & Schwarz	316 790/001
40	Power Supply	6032A	Hewlett Packard	2846A04063
41	Spektrum Monitor	EZM	Rohde & Schwarz	883 720/006
42	Meßempfänger	ESH 3	Rohde & Schwarz	890 174/002
43	Meßempfänger	ESVP	Rohde & Schwarz	891 752/005
44	Biconi Ant. 20-300MHz	HK 116	Rohde & Schwarz	833 162/011
45	Logper Ant. 0.3-1 GHz	HL 223	Rohde & Schwarz	832 914/010
46	Amplifier 0.1-4 GHz	AFS4	Miteq Inc.	206461
47	Logper Ant. 1-18 GHz	HL 024 A2	Rohde & Schwarz	342 662/002
48	Polarisationsnetzwerk	HL 024 Z1	Rohde & Schwarz	341 570/002
49	Double Ridge G Horn Antenne 1-26.5 GHz	3115	EMCO	9107-3696
50	Microw. Sys. Amplifier 0.5- 26.5 GHz	8317A	Hewlett Packard	3123A00105
51	Audio Analyzer	UPD	Rohde & Schwarz	1030.7500.04
52	Steuerrechner	PSM 7	Rohde & Schwarz	883 086/026
53	DC V-Netzwerk	ESH3-Z6	Rohde & Schwarz	861 406/005
54	DC V-Netzwerk	ESH3-Z6	Rohde & Schwarz	893 689/012
55	AC 2 Phasen V-Netzwerk	ESH3-Z5	Rohde & Schwarz	861 189/014
56	AC 2 Phasen V-Netzwerk	ESH3-Z5	Rohde & Schwarz	894 981/019
57	AC-3 Phasen V-Netzwerk	ESH2-Z5	Rohde & Schwarz	882 394/007
58	Stromversorgung	6032A	Rohde & Schwarz	2933A05441
59	HF-Test Empfänger	ESVP.52	Rohde & Schwarz	881 487/021
60	Spectrum Monitor	EZM	Rohde & Schwarz	883 086/026
61	HF-Test Empfänger	ESH3	Rohde & Schwarz	881 515/002
62	Relais Matrix	PSU	Rohde & Schwarz	882 943/029
63	Relais Matrix	PSU	Rohde & Schwarz	828 628/007
64	Spectrum Analyzer	FSIQ 26	Rohde & Schwarz	119.6001.27
65	Spectrum Analyzer	HP 8565E	Hewlett Packard	3473A00773
66				

Test setup
Radiated Emissions

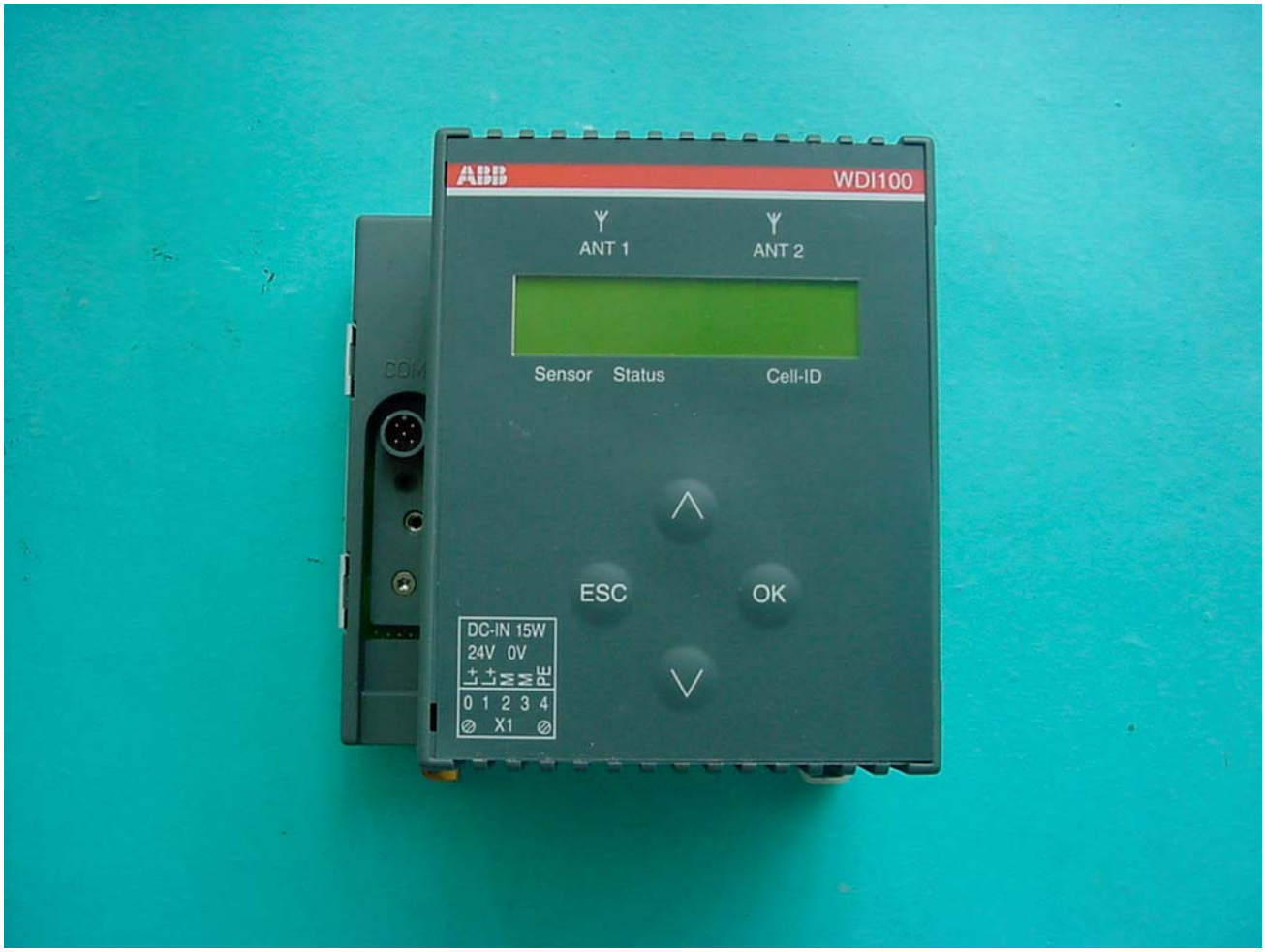


PHOTOGRAPH OF THE EQUIPMENT

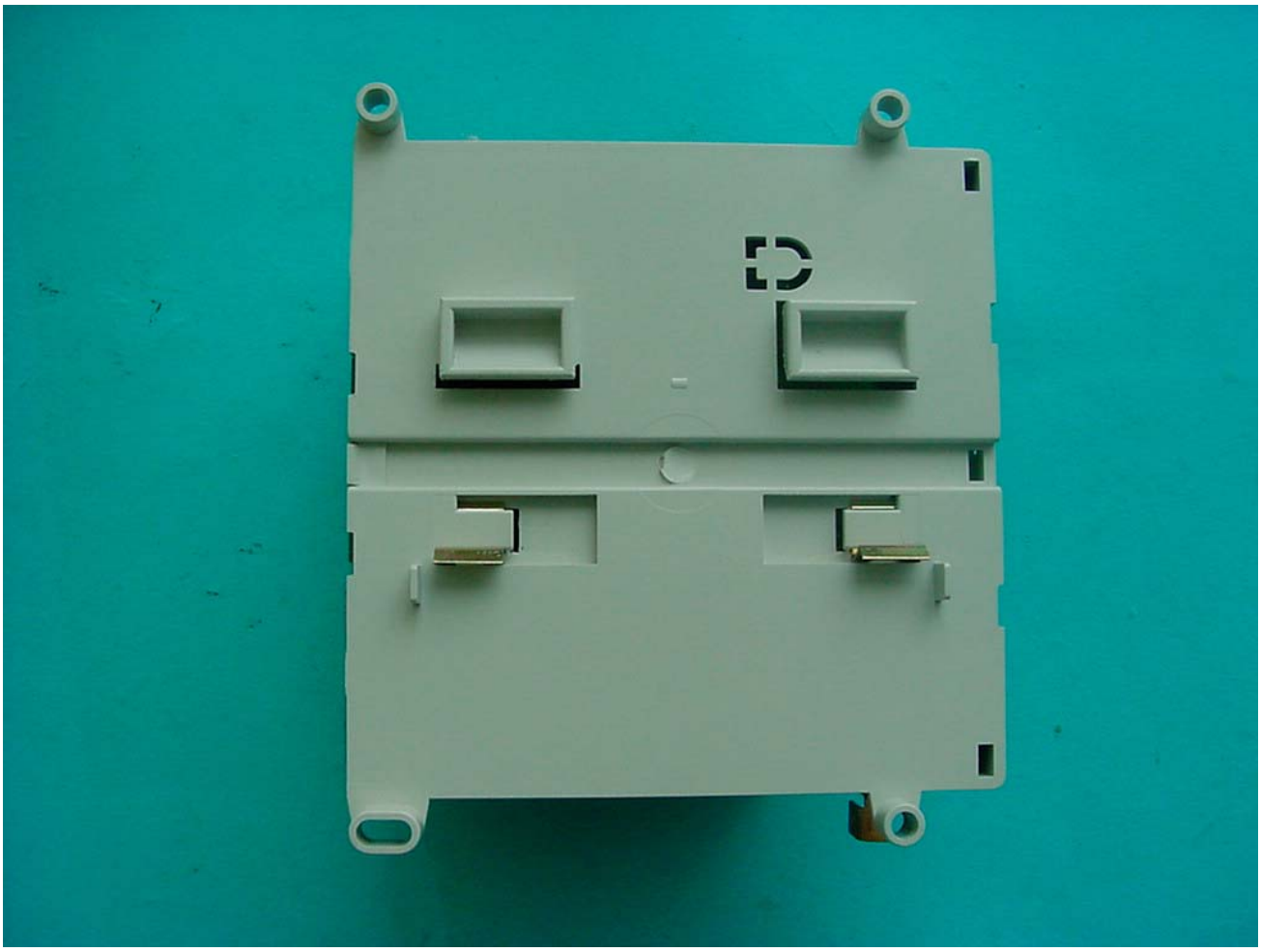


PHOTOGRAPH OF THE EQUIPMENT

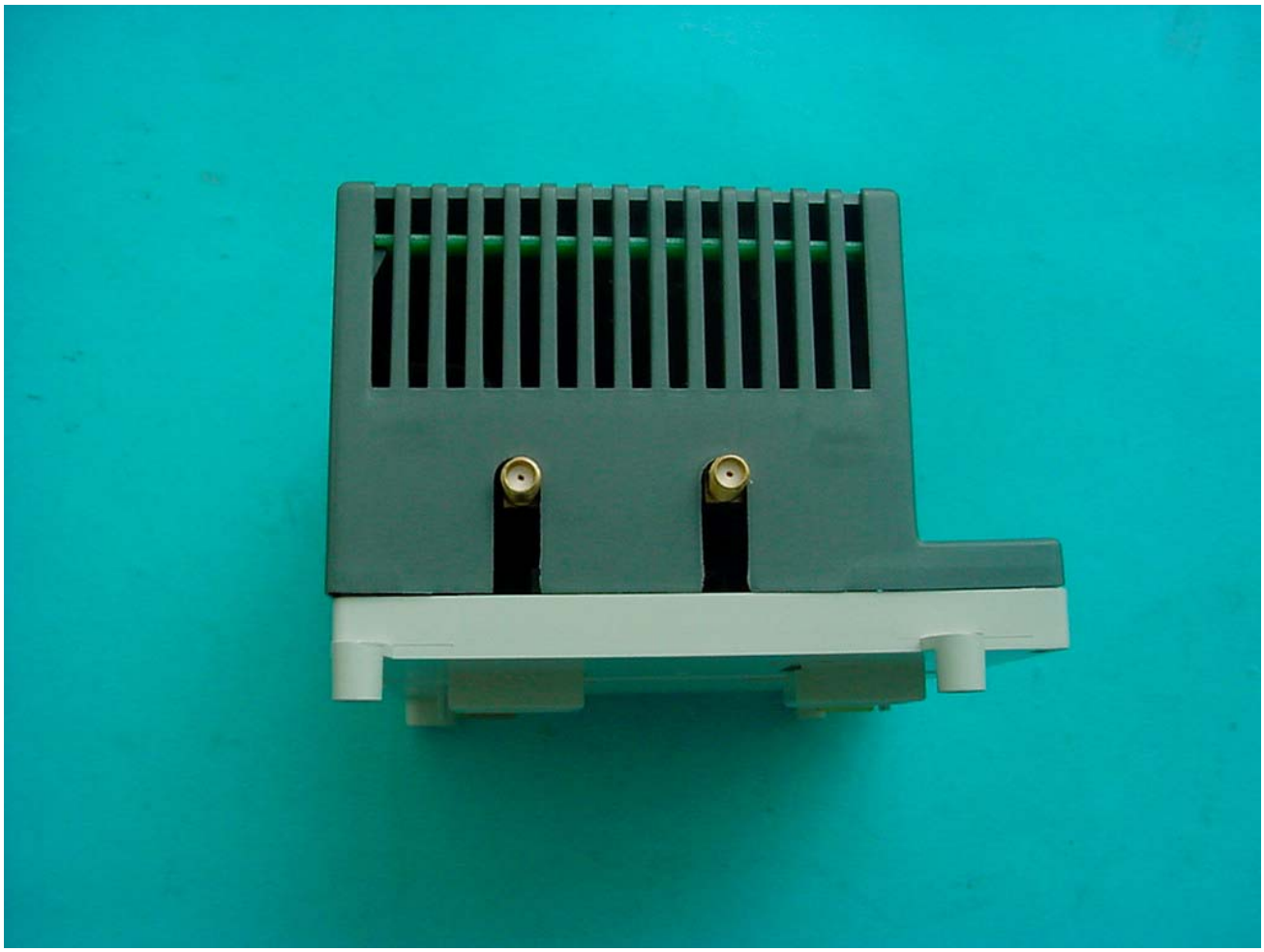
PHOTOGRAPH OF THE EQUIPMENT



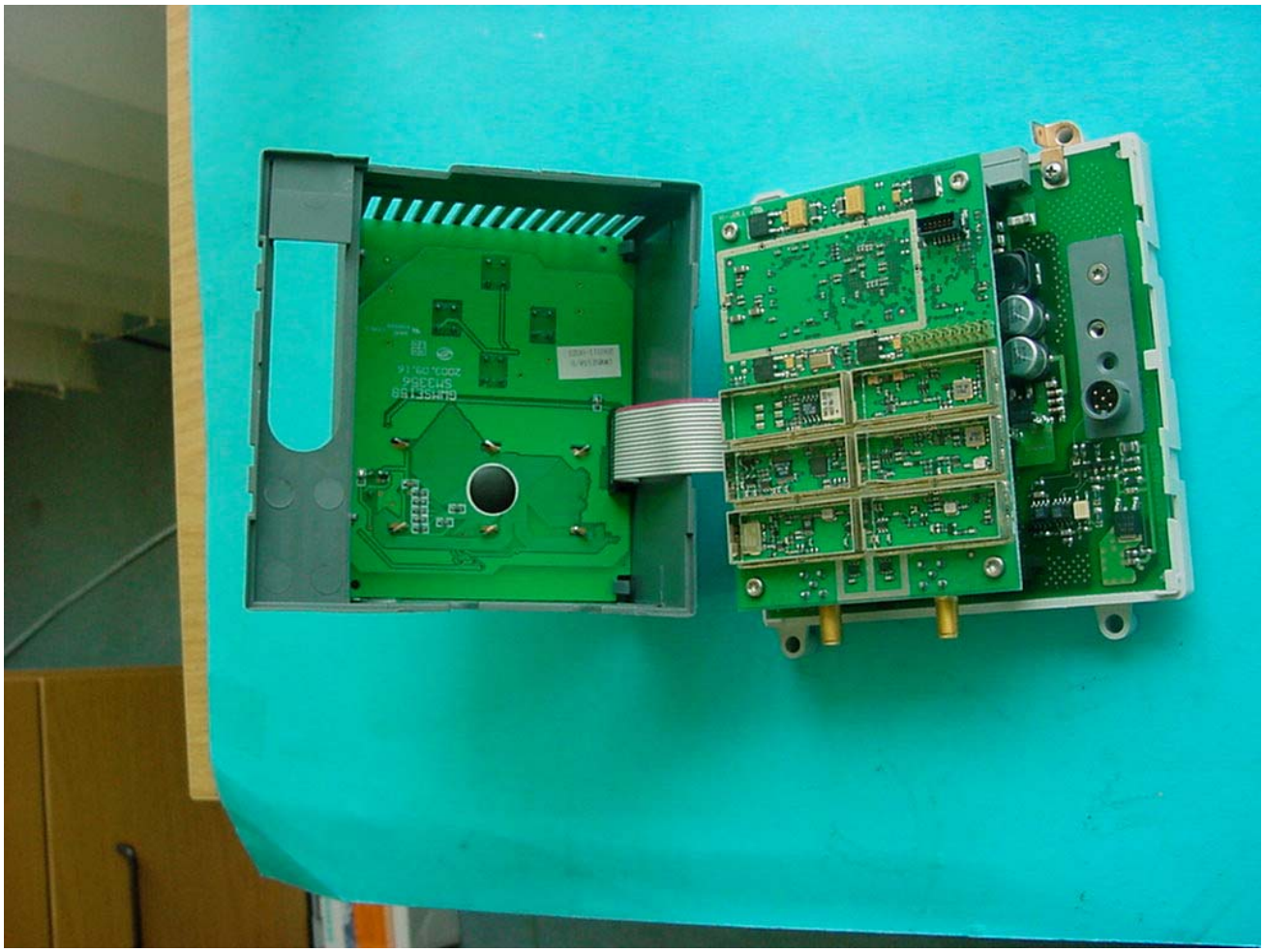
PHOTOGRAPH OF THE EQUIPMENT



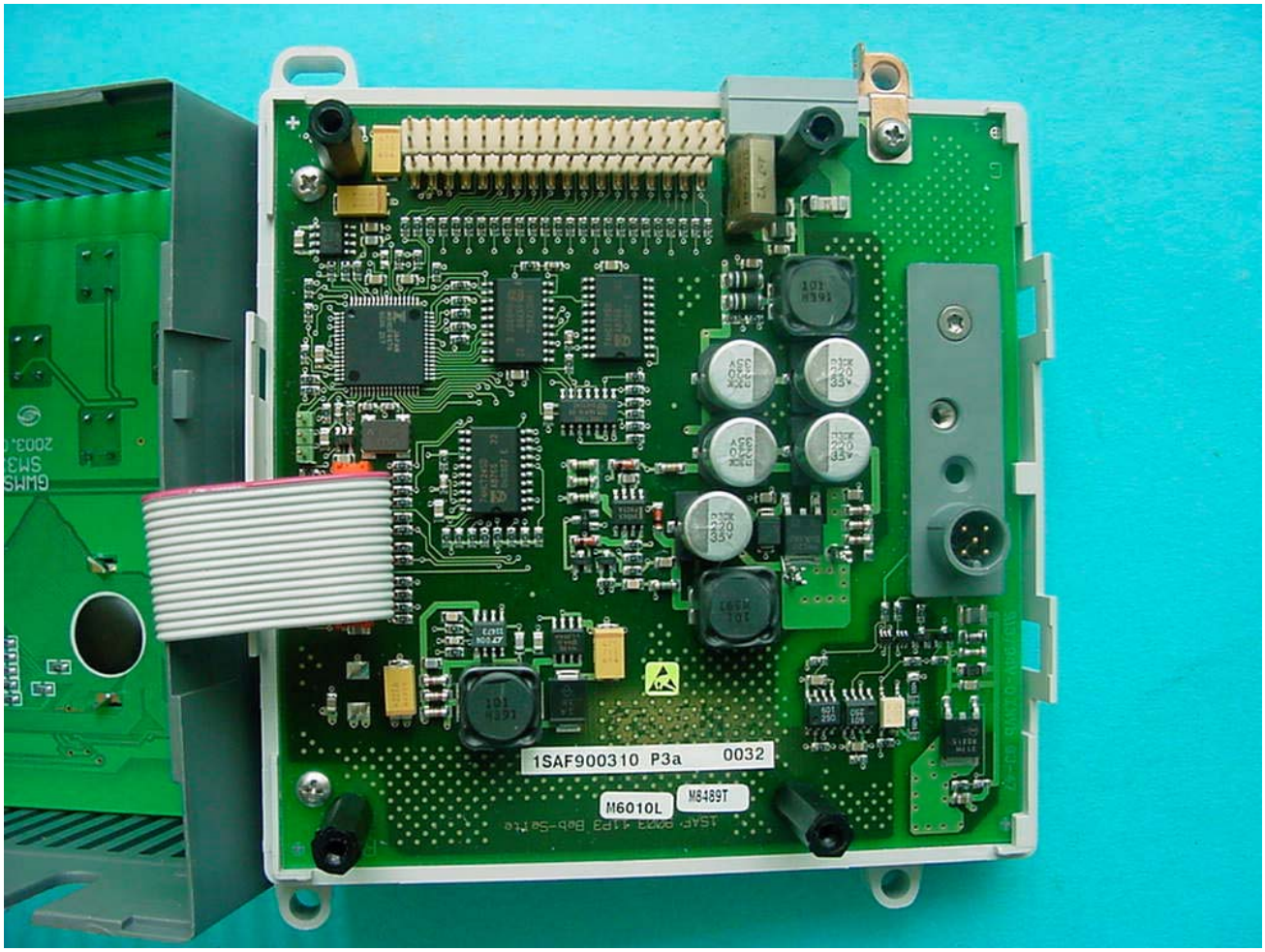
PHOTOGRAPH OF THE EQUIPMENT



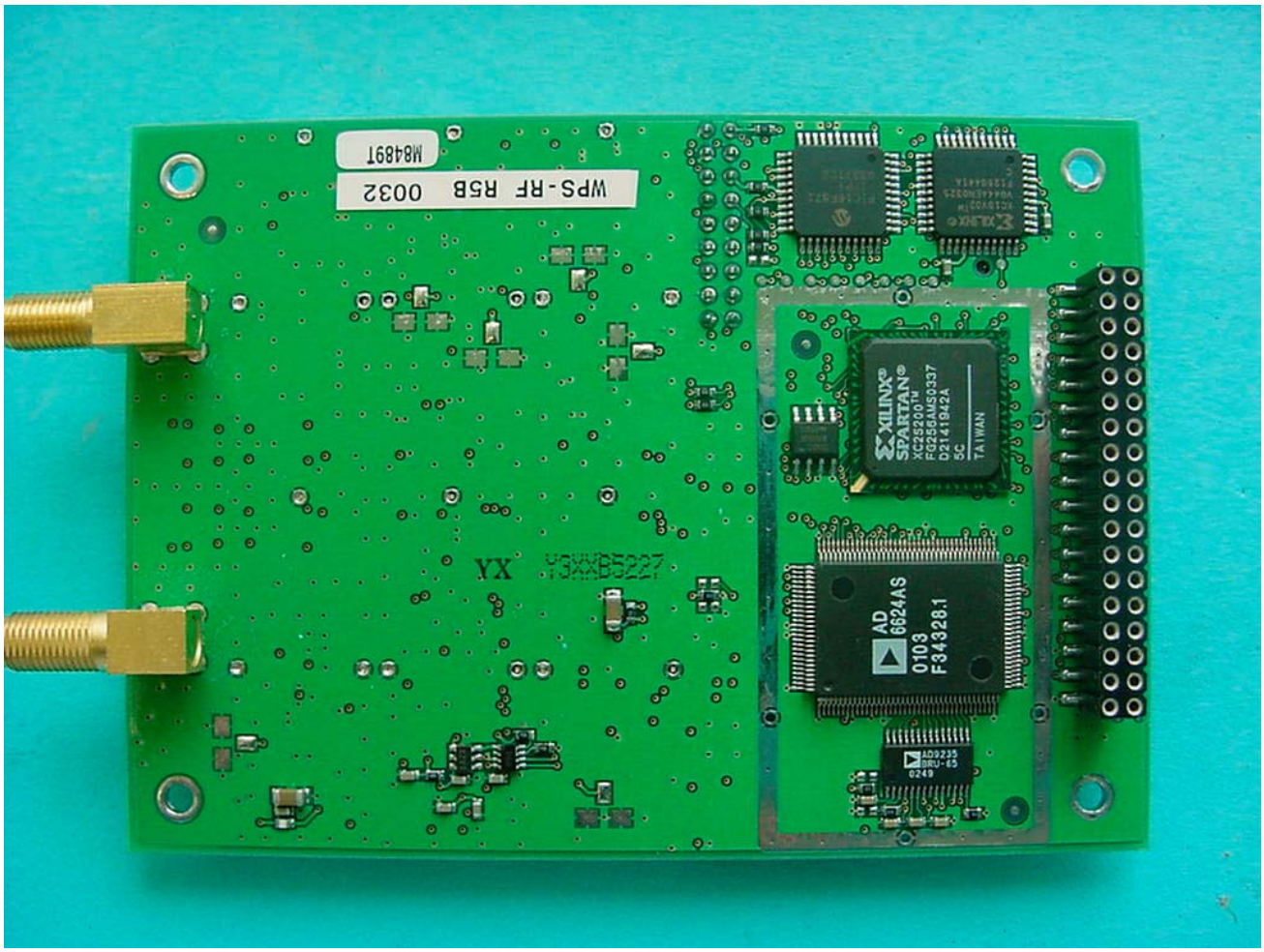
PHOTOGRAPH OF THE EQUIPMENT



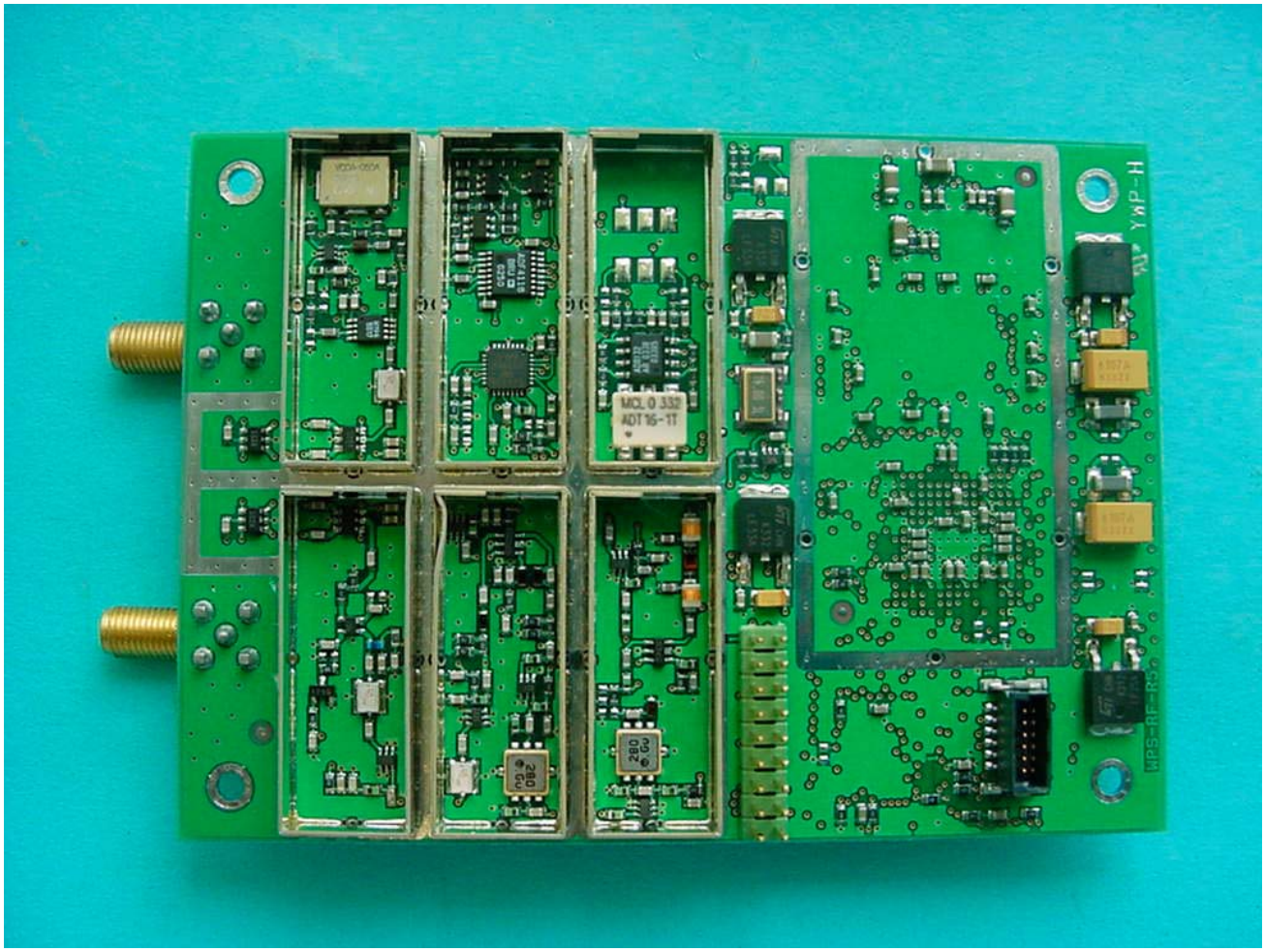
PHOTOGRAPH OF THE EQUIPMENT



PHOTOGRAPH OF THE EQUIPMENT



PHOTOGRAPH OF THE EQUIPMENT



PHOTOGRAPH OF THE EQUIPMENT

Antenna