

EMC TEST REPORT


Report No. : EME-031174
Model No. : ZyAIR B-500
Issued Date : Nov. 12, 2003

Applicant : ZyXEL Communications Corporation
No. 6, Innovation Rd. II, Science-Based Industrial Park,
Hsin-Chu, Taiwan

Test By : Intertek Testing Services Taiwan Ltd.
No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,
Shiang-Shan District, Hsinchu City, Taiwan

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Project Engineer



Jerry Liu

Reviewed By



Elton Chen

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Summary of Tests**Wireless LAN Access Point-Model: ZyAIR B-500
FCC ID: I88B500**

Test	Reference	Results
Minimum 6dB Bandwidth test	15.247(a)(2)	Complies
Maximum Output Power test	15.247(b)	Complies
Radiated Spurious Emission test	15.205, 15.209	Complies
Power Spectrum Density test	15.247(d)	Complies
Power Line Conducted Emission test	15.207	Complies

1. General information

1.1 Identification of the EUT

Applicant	: ZyXEL Communications Corp.
Product	: Wireless LAN Access Point
Model No.	: ZyAIR B-500
FCC ID.	: I88B500
Frequency Range	: 2412MHz to 2462MHz
Channel Number	: 11
Frequency of Each Channel	: 2412MHz, 2417MHz, 2422MHz, 2427MHz, 2432MHz, 2437MHz, 2442MHz, 2447MHz, 2452MHz, 2457MHz, 2462MHz
Type of Modulation	: CCK (11Mps, 5.5Mbps), DQPSK (2Mbps), DBPSK (1Mbps)
Power Supply	: 120Vac, 60Hz to 9Vac adapter (MW41-0901000A)
Power Cord	: N/A
Sample Received	: Oct. 16, 2003
Test Date(s)	: Oct. 22, 2003 to Oct. 28, 2003

A FCC DoC report has been generated for the client.

1.2 Additional information about the EUT

The EUT is a Wireless LAN Access Point which embedded web-based configurator and SNMP network management enables remote configuration and management.

It offers highly secured wireless connectivity to wired network with IEEE 802.1x, WEP data encryption and MAC address filtering.

We verified the models, 401310 and B-500 are identical to ZyAIR B-500 (EUT), and the difference model number for difference brand serves as marketing purpose.

For more detail features, please refer to User's manual as file name "Installation guide.pdf"

1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Gain : 1.8dBi

Antenna Type : Dipole antenna

Connector Type : Male

1.4 Peripherals equipment

Peripherals	Manufacturer	Product No.	Serial No.	FCC ID
Notebook 1	DELL	PP01L	CN-06P83-48643-33V-0112	5ZXMUL-36273-FB-E
Notebook 2	Twinhead	P79T	H0905483	FCC DoC Approved
2.4GHz Wireless Cardbus Adapter	D-Link	DWL-650+	BN1F133001013	KA2DWLG650PLUSB1

Data Cable: RJ-45 cable 10 meter × 1

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Section § 15.205 、 §15.207 、 §15.209 、 §15.247 and ANSI C63.4/2001.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

During conducted emission test, the EUT was operated in normal mode, communicating with a WLAN card, while in other test, it works in the status of continuously transmitting.

After verifying the maximum output power, we found the maximum output power was occurred at 11Mbps data rate. The final test was executed under this condition and recorded in this report individually.

2.3 Test equipment

Equipment	Brand	Frequency range	Model No.	Series No.	Last Cal.Date
EMI Test Receiver	Rohde & Schwarz	9kHz~2.75GHz	ESCS 30	825788/014	Feb. 18, 2003
EMI Test Receiver	Rohde & Schwarz	20Hz~26.5GHz	ESMI	825428/005	June 10, 2003
Spectrum Analyzer	Rohde & Schwarz	9kHz~30GHz	FSP 30	100137	July 10, 2003
Horn Antenna	EMCO	1GHz~18GHz	3115	9906-5890	Sep. 19, 2002
Horn Antenna	SCHWARZBECK	14GHz~40GHz	BBHA 9170	159	June 21, 2003
Bilog Antenna	SCHWARZBECK	25MHz~1.7GHz	VULB 9160	3133	Feb. 21, 2003
Turn Table	HDGmbH	N/A	DS 420S	420/669/01	N/A
Antenna Tower	HDGmbH	N/A	MA 240	240/573	N/A
Microwave Amplifier	Agilent	2GHz~26.5GHz	8348A	3111A00567	Dec. 20, 2002
Crystal Detector	Agilent	10MHz~18GHz	8472B	MY42240243	N/A
Signal Generator	Rohde & Schwarz	20MHz~27GHz	SMR27	100036	Aug. 15, 2003
Two Channel Digital Storage Oscilloscope	Tektronix	N/A	TDS1012	C031679	Aug. 16, 2003

Note:

1. The calibration interval of the above instruments is 12 months.

3. Minimum 6dB Bandwidth test

3.1 Operating environment

Temperature: 24 °C
Relative Humidity: 55 %
Atmospheric Pressure 1023 hPa

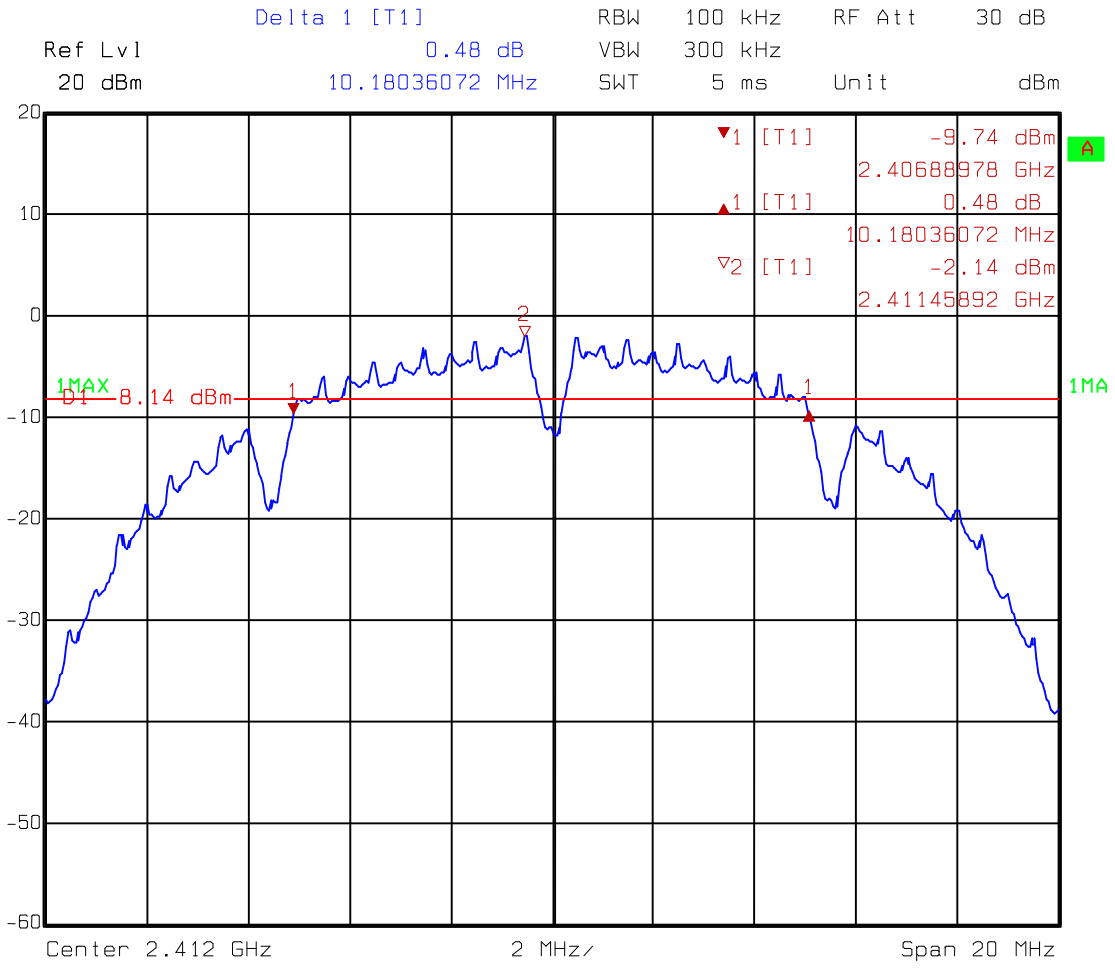
3.2 Test setup & procedure

The minimum 6dB bandwidth per FCC §15.247(a)(2) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 100kHz, the video bandwidth set at 300kHz, and the SPAN>>RBW. The test was performed at 3 channels (lowest, middle and highest channel). The minimum 6-dB modulation bandwidth is in the following Table.

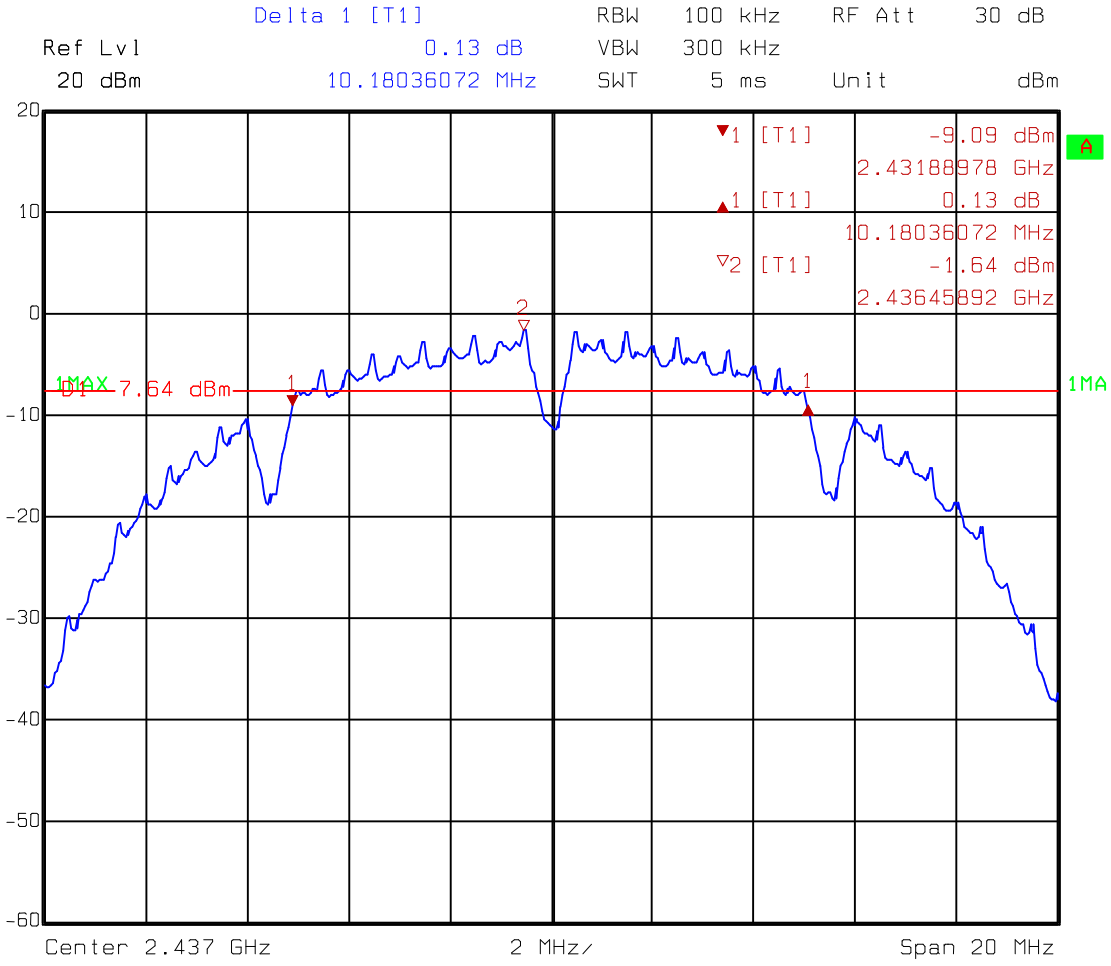
3.3 Measured data of Minimum 6dB Bandwidth test results

Channel	Frequency (MHz)	Bandwidth (MHz)	Limit
Low	2412	10.180	> 500kHz
Middle	2437	10.180	> 500kHz
High	2462	10.180	> 500kHz

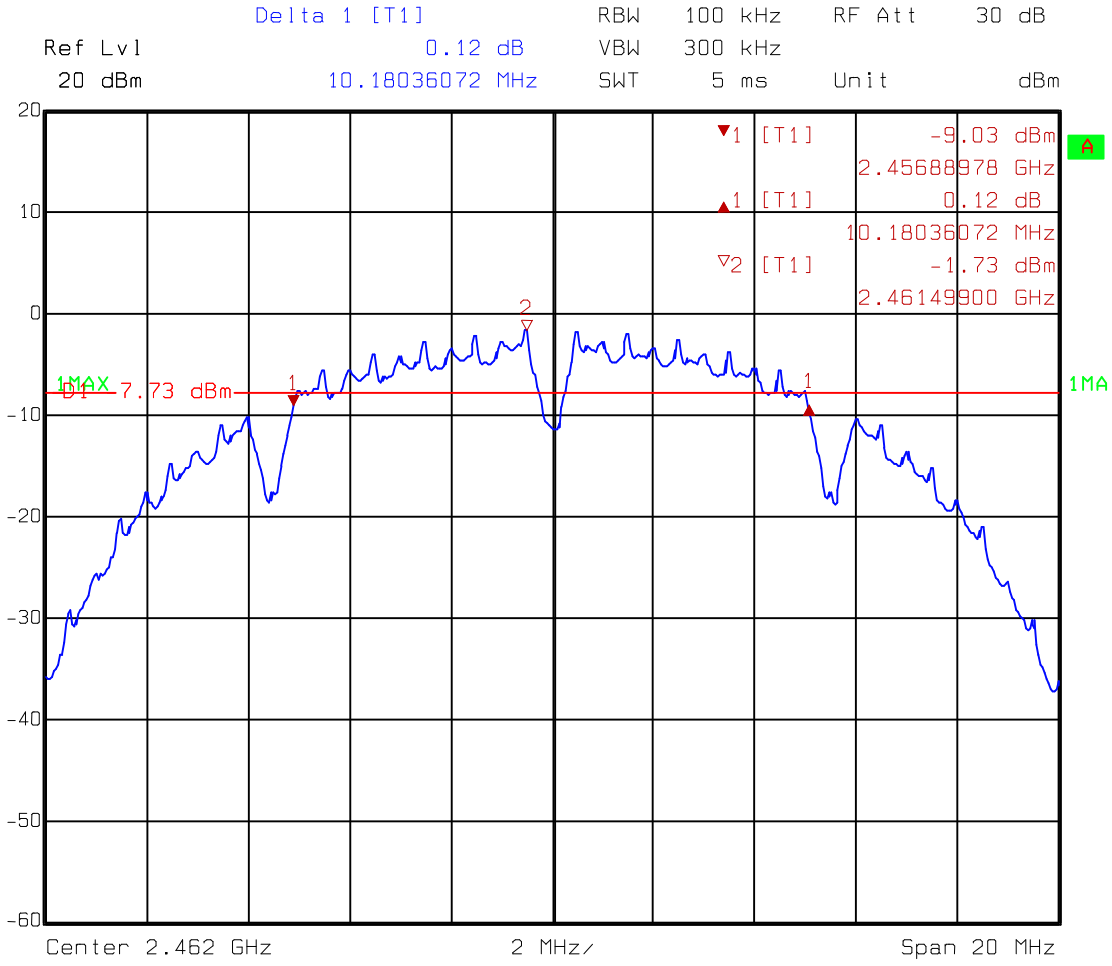
Please see the plot below.



Comment A: 6dB bandwidth at low channel (EC365) Att=6dB CB=3.13dB
Date: 24.OCT.2003 15:40:24



Comment A: 6dB bandwidth at middle channel (EC365) Att=6dB CB=3.13dB
Date: 24.OCT.2003 15:48:55



Comment A: 6dB bandwidth at high channel (EC365) Att=6dB CB=3.13dB
Date: 24.OCT.2003 15:51:55

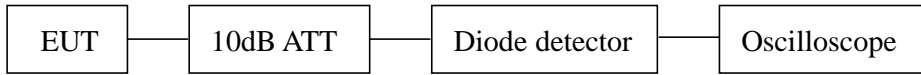
4. Maximum Output Power test

4.1 Operating environment

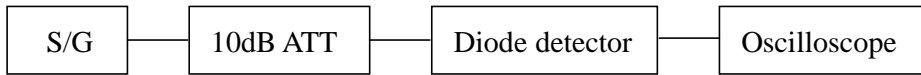
Temperature: 22 °C
 Relative Humidity: 60 %
 Atmospheric Pressure 1023 hPa

4.2 Test setup & procedure

A:



B:



1. The output of the transmitter via a 10 dB attenuator and coupled to a diode detector.
2. The output of the diode detector connected to the vertical channel of and oscilloscope. The observed trace of the oscilloscope shall be recorded as “A”.
3. The transmitter replaced by a signal generator. The output frequency of the signal made equal to the center of the frequency range occupied by the transmitter and unmodulated.
4. The output of the signal generator raised to reach the peak of trace “A” named X.
5. The signal generator output level X (dBm) is the transmitter peak output power.

4.3 Measured data of Maximum Output Power test results

Channel	Frequency (MHz)	Reading (dBm)	Output Power		Limit (W)
			(dBm)	(mW)	
Lowest	2412	19.03	19.03	79.98	1
Middle	2437	19.93	19.93	98.40	1
Highest	2462	20.03	20.03	100.69	1

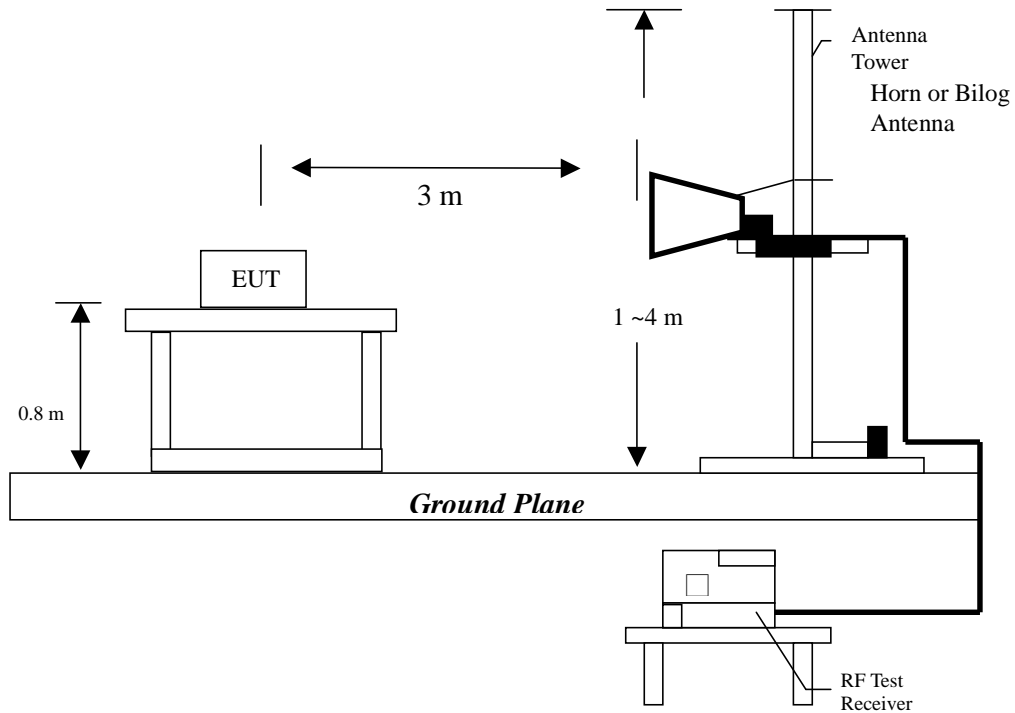
5. Radiated Emission test

5.1 Operating environment

Temperature:	25	°C	(10-40°C)
Relative Humidity:	55	%	(10-90%)
Atmospheric Pressure	1023	hPa	(860-1060hPa)

5.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.



Radiated emissions were investigated cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1MHz RBW/VBW) recorded also on the report.

The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

The EUT configuration please refer to the “Spurious set-up photo.pdf”.

5.3 Emission limits

The spurious Emission shall test through the 10th harmonic. 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).

Frequency (MHz)	Limits (dB μ V/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Uncertainty was calculated in accordance with NAMAS NIS 81.

Expanded uncertainty (k=2) of radiated emission measurement is ± 4.98 dB.

Expanded uncertainty (k=2) of conducted emission measurement is ± 2.02 dB.

5.4 Radiated spurious emission test data

5.4.1 Measurement results: frequencies equal to or less than 1 GHz

EUT : ZyAIR B-500
Worst Case Condition : Tx at low channel

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polariz. (H/V)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV)	Limit @ 3 m (dBuV)	Margin (dB)	Antenna high (cm)	Turn Table angle (degree)
132.99000	QP	V	13.34	13.59	26.93	43.50	-16.57	100	352
166.24000	QP	V	14.92	12.88	27.80	43.50	-15.70	100	303
498.74000	QP	V	18.61	16.18	34.79	46.00	-11.21	100	360
532.00000	QP	V	19.15	16.94	36.09	46.00	-9.91	100	52
664.99000	QP	V	21.72	16.88	38.60	46.00	-7.40	100	264
797.99000	QP	V	23.49	7.00	30.49	46.00	-15.51	265	265
99.74000	QP	H	10.44	19.83	30.27	43.50	-13.23	400	81
132.99000	QP	H	13.34	17.75	31.09	43.50	-12.41	209	270
166.25000	QP	H	14.92	14.68	29.60	43.50	-13.90	225	112
644.40000	QP	H	21.32	11.18	32.50	46.00	-13.50	128	53
797.90000	QP	H	23.49	9.96	33.45	46.00	-12.55	111	163
930.00000	QP	H	25.46	7.90	33.36	46.00	-12.64	189	0

Remark:

1. Corrected Level = Reading Level + Correction Factor
2. Correction Factor = Antenna Factor + Cable Loss

5.4.2 Measurement results: frequency above 1GHz

The radiated spurious emissions at

Frequency(MHz)	Margin
3216	-3.87

are less than uncertainty. This is within the stated measurement uncertainty, this may affect compliance determined in other test arrangements.

EUT : ZyAIR B-500
Test Condition : Tx at low channel

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polariz. (H/V)	Preamp (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV)	Limit @ 3 m (dBuV)	Margin (dB)	Antenna high (cm)	Turn Table angle (degree)
3216	PK	V	32.81	33.642	52.718	53.55	74	-20.45	112	145
3216	AV	V	32.81	33.642	49.298	50.13	54	-3.87	112	145
7236	PK	V	34.17	39.966	48.554	54.35	74	-19.65	120	234
7236	AV	V	34.17	39.966	39.934	45.73	54	-8.27	120	234
3216	PK	H	32.81	33.642	48.088	48.92	74	-25.08	162	204
3216	AV	H	32.81	33.642	42.228	43.06	54	-10.94	162	204
7236	PK	H	34.17	39.966	44.624	50.42	74	-23.58	122	192
7236	AV	H	34.17	39.966	35.024	40.82	54	-13.18	122	192

Remark:

1. Corrected Level = Reading Level + Correction Factor – Preamp
2. Correction Factor = Antenna Factor + Cable Loss
3. The frequency measured ranges from 1GHz to 25GHz. The data value listed above which is higher than the noise floor, the others please refer to noise floor level.

For PK:
1GHz-3GHz: 20dBuV
3GHz-14GHz: 27dBuV
14GHz-26.5GHz: 39dBuV

For AV:
1GHz-3GHz: 10dBuV
3GHz-14GHz: 16dBuV
14GHz-26.5GHz: 28dBuV

The radiated spurious emissions at

Frequency(MHz)	Margin
3249	-4.76

are less than uncertainty. This is within the stated measurement uncertainty, this may affect compliance determined in other test arrangements.

EUT : ZyAIR B-500
Test Condition : Tx at middle channel

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polariz. (H/V)	Preamp (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV)	Limit @ 3 m (dBuV)	Margin (dB)	Antenna high (cm)	Turn Table angle (degree)
3249	PK	V	32.81	33.642	51.978	52.81	74	-21.19	151	155
3249	AV	V	32.81	33.642	48.408	49.24	54	-4.76	151	155
7311	PK	V	34.17	39.966	50.264	56.06	74	-17.94	129	228
7311	AV	V	34.17	39.966	41.994	47.79	54	-6.21	129	228

Remark:

1. Corrected Level = Reading Level + Correction Factor – Preamp
2. Correction Factor = Antenna Factor + Cable Loss
3. The frequency measured ranges from 1GHz to 25GHz. The data value listed above which is higher than the noise floor, the others please refer to noise floor level.

For PK:

1GHz-3GHz: 20dBuV
3GHz-14GHz: 27dBuV
14GHz-26.5GHz: 39dBuV

For AV:

1GHz-3GHz: 10dBuV
3GHz-14GHz: 16dBuV
14GHz-26.5GHz: 28dBuV

The radiated spurious emissions at

Frequency(MHz)	Margin
3282	-2.62

are less than uncertainty. This is within the stated measurement uncertainty, this may affect compliance determined in other test arrangements.

EUT : ZyAIR B-500
Test Condition : Tx at high channel

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polariz. (H/V)	Preamplifier (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV)	Limit @ 3 m (dBuV)	Margin (dB)	Antenna high (cm)	Turn Table angle (degree)
3282	PK	V	32.81	33.642	50.548	51.38	74	-22.62	151	149
3282	AV	V	32.81	33.642	50.548	51.38	54	-2.62	151	149
7386	PK	V	34.17	39.966	50.034	55.83	74	-18.17	138	229
7386	AV	V	34.17	39.966	42.514	48.31	54	-5.69	128	229

Remark:

1. Corrected Level = Reading Level + Correction Factor – Preamp
2. Correction Factor = Antenna Factor + Cable Loss
3. The frequency measured ranges from 1GHz to 25GHz. The data value listed above which is higher than the noise floor, the others please refer to noise floor level.

For PK:

1GHz-3GHz: 20dBuV
3GHz-14GHz: 27dBuV
14GHz-26.5GHz: 39dBuV

For AV:

1GHz-3GHz: 10dBuV
3GHz-14GHz: 16dBuV
14GHz-26.5GHz: 28dBuV

6. Power Spectrum Density test

6.1 Operating environment

Temperature: 24 °C
Relative Humidity: 55 %
Atmospheric Pressure 1023 hPa

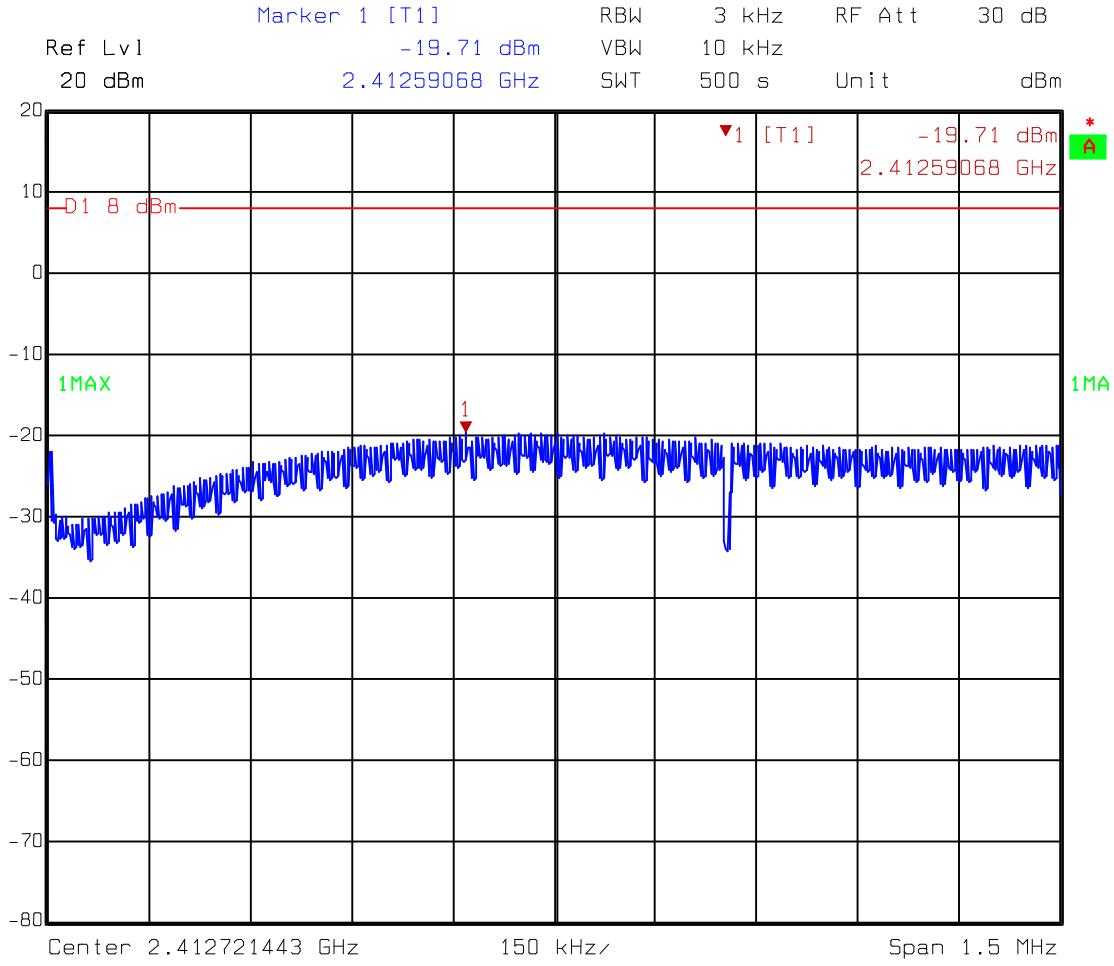
6.2 Test setup & procedure

The power spectrum density per FCC §15.247(d) was measured from the antenna port of the EUT using a 50ohm spectrum analyzer with the resolution bandwidth set at 3kHz, the video bandwidth set at 10kHz, a span of 1.5 MHz, and the sweep time set at 500 seconds. Power Density was read directly and cable loss (3.13dB)/external attenuator (6dB) correction was added to the reading to obtain power at the EUT antenna terminals. The test was performed at 3 channels (lowest, middle and highest channel). The Power Spectral Density measured result is in the following table.

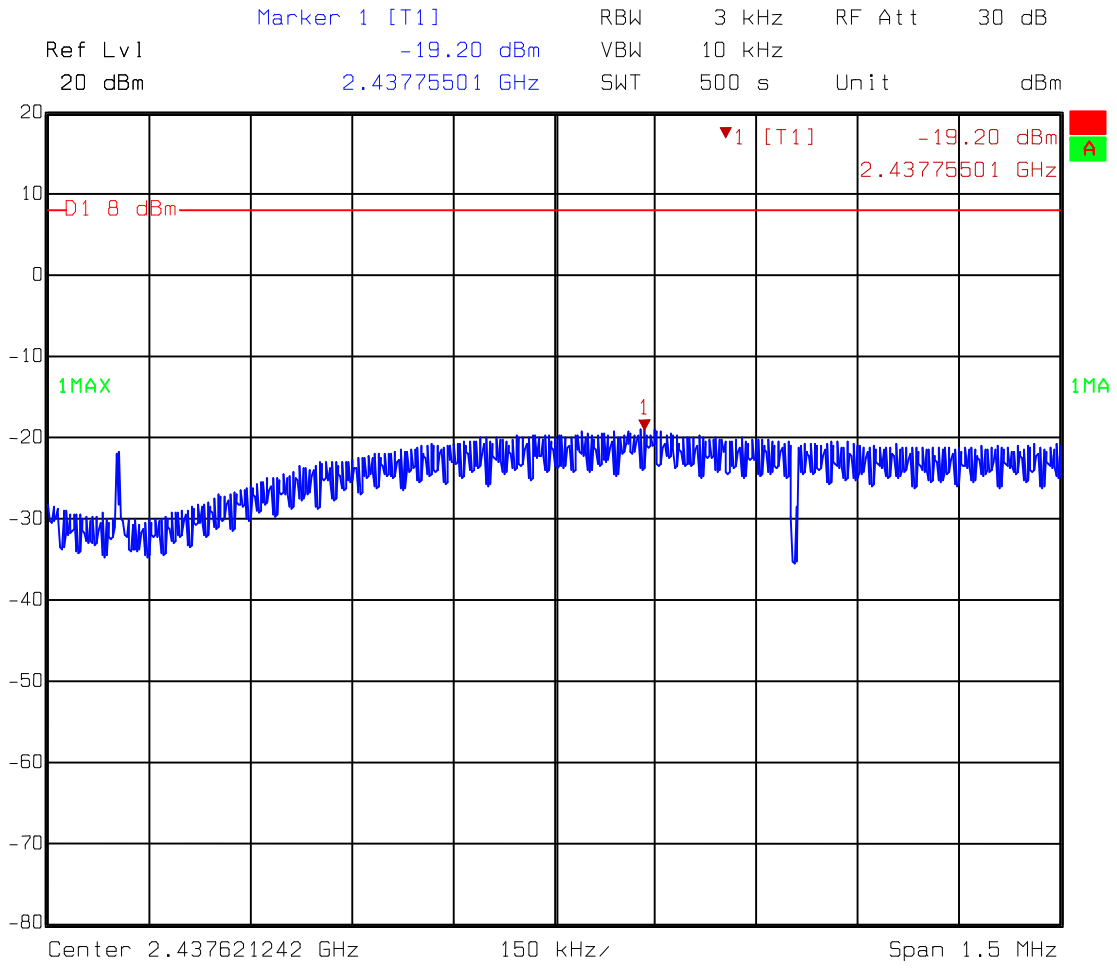
6.3 Measured data of Power Spectrum Density test results

Channel	Frequency (MHz)	Measured level (dBm)	Limit (dBm)
Low	2412.590	-10.58	8
Middle	2437.755	-10.07	8
High	2462.827	-10.35	8

Please see the plot below.



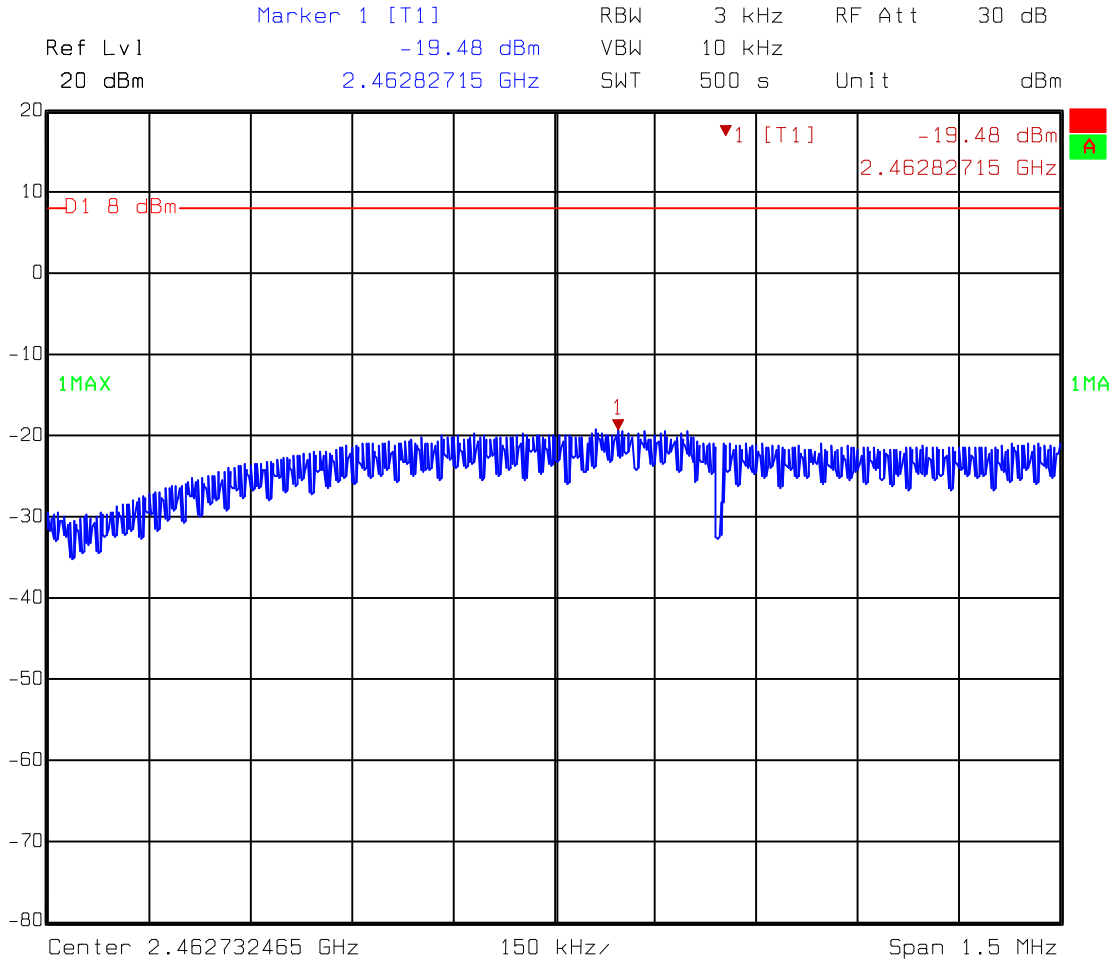
Comment A: Power spectrum density at low channel
 ATT=6dB CL=3.13dB
 Date: 24.OCT.2003 15:58:18



Comment A: Power spectrum density at middle channel

ATT=6dB CL=3.13dB

Date: 24.OCT.2003 16:01:01



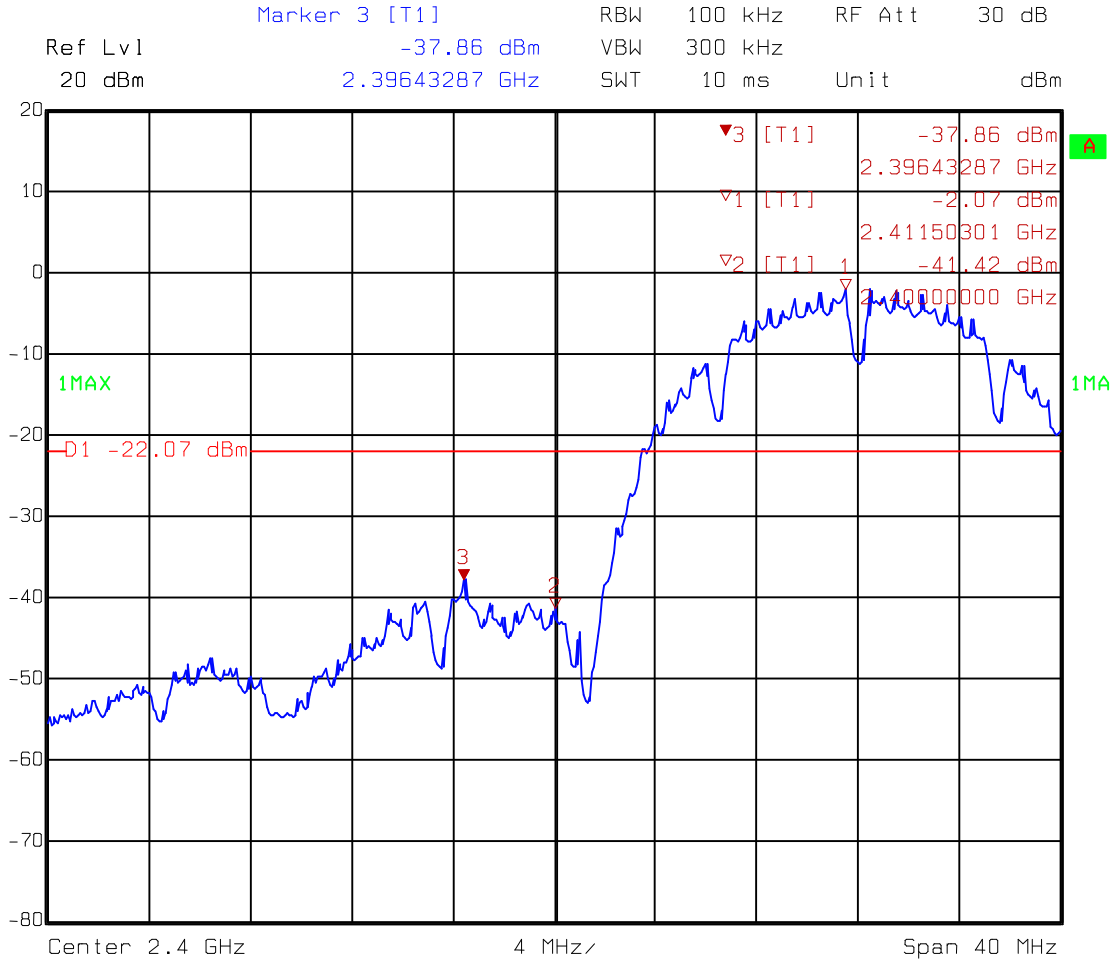
Comment A: Power spectrum density at high channel
 ATT=6dB CL=3.13dB
 Date: 24.OCT.2003 15:55:37

7. Emission on the band edge §FCC 15.247(C)

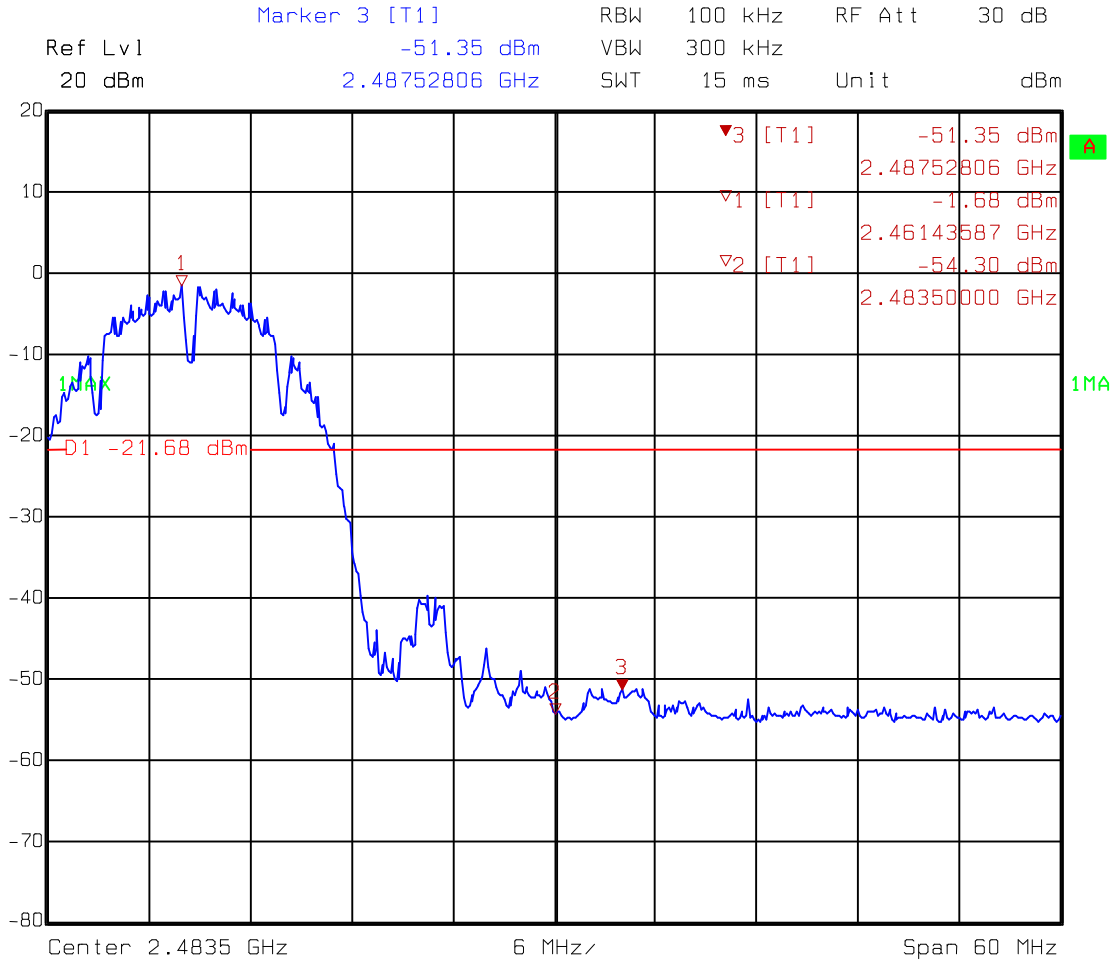
In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Please see the plot below.

7.1 Band-edge (Conducted method)



Comment A: Band-edge at low channel Att=6dB CB=3.13dB
Date: 24.OCT.2003 16:08:13



Comment A: Band-edge at high channel Att=6dB CB=3.13dB
Date: 24.OCT.2003 16:15:14

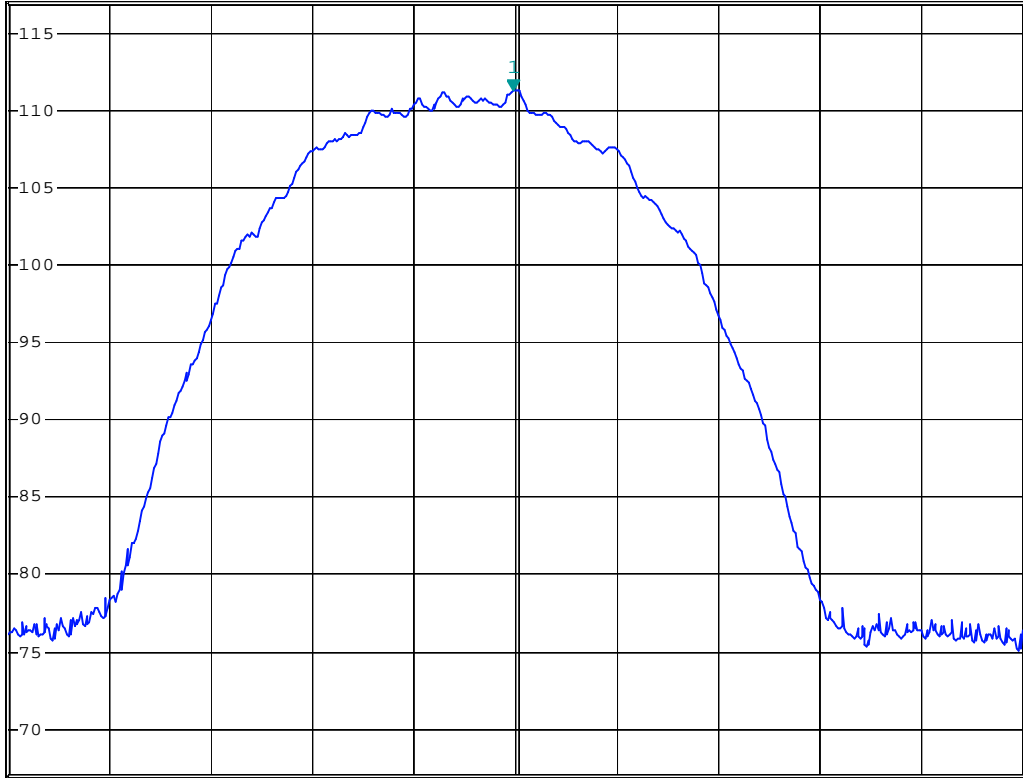
7.2 Band-edge (Radiated method)



CENTER FREQUENCY
 2.413325 GHz
 Ref 117 dB μ V *Att 20 dB

*RBW 1 MHz Marker 1 [T1]
 *VBW 1 MHz 111.32 dB μ V
 SWT 2.5 ms 2.413265000 GHz

1 PK
 MAXH

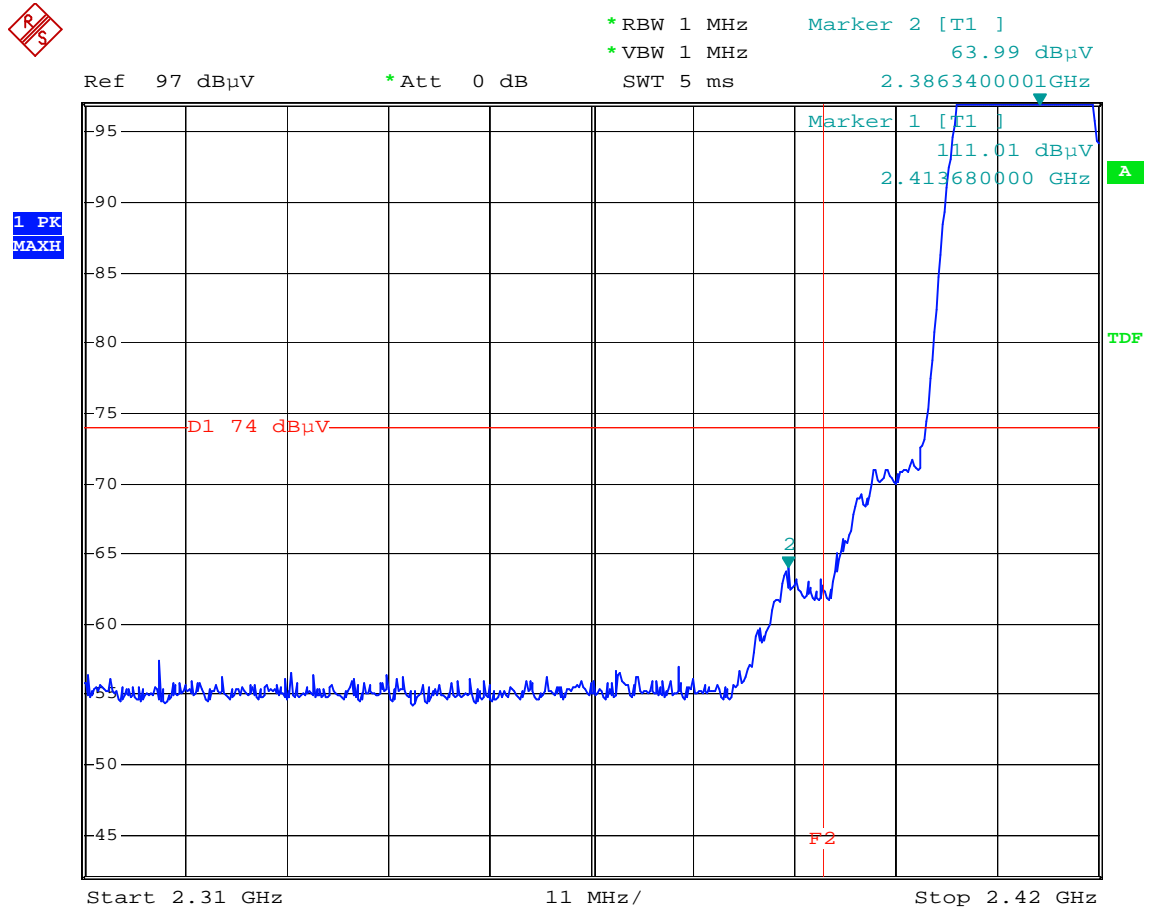


Center 2.413325 GHz 3 MHz/ Span 30 MHz

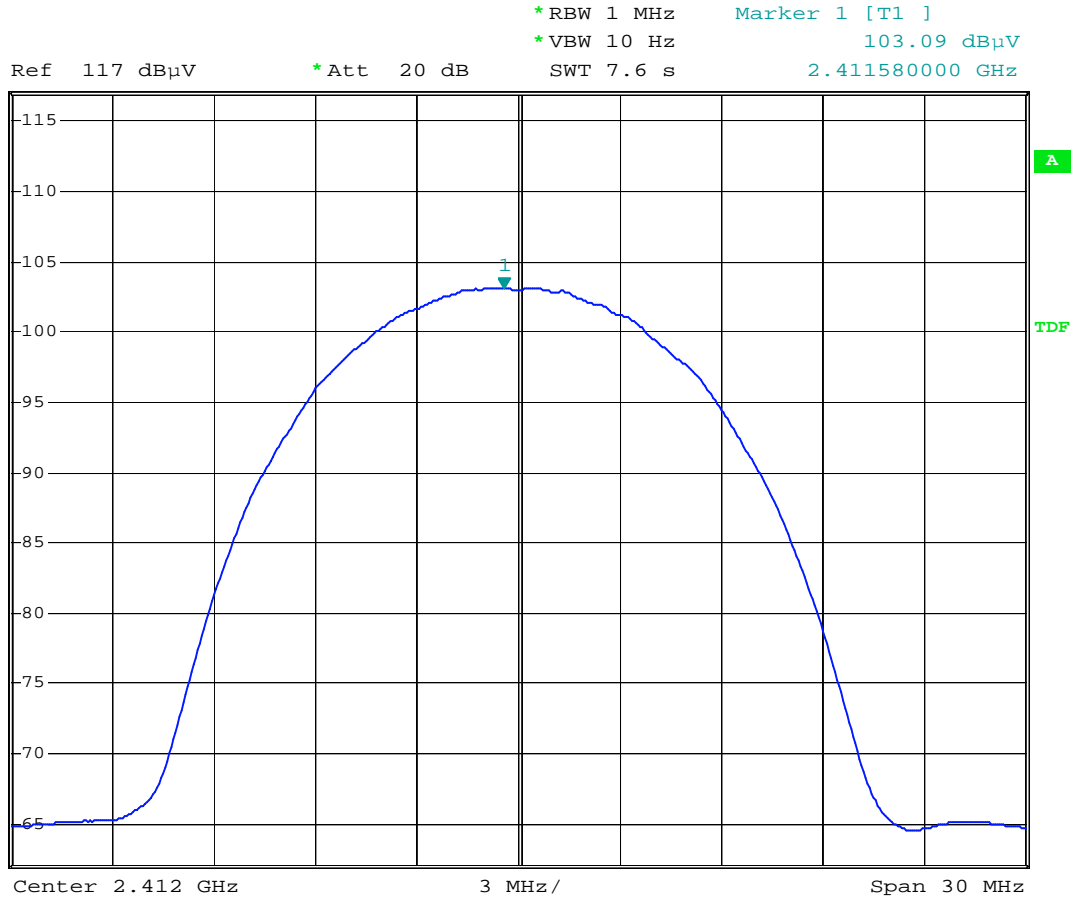
Comment A: Band-edge test at low channel EN B

Fundamental(PK)

Date: 12.NOV.2003 09:02:04

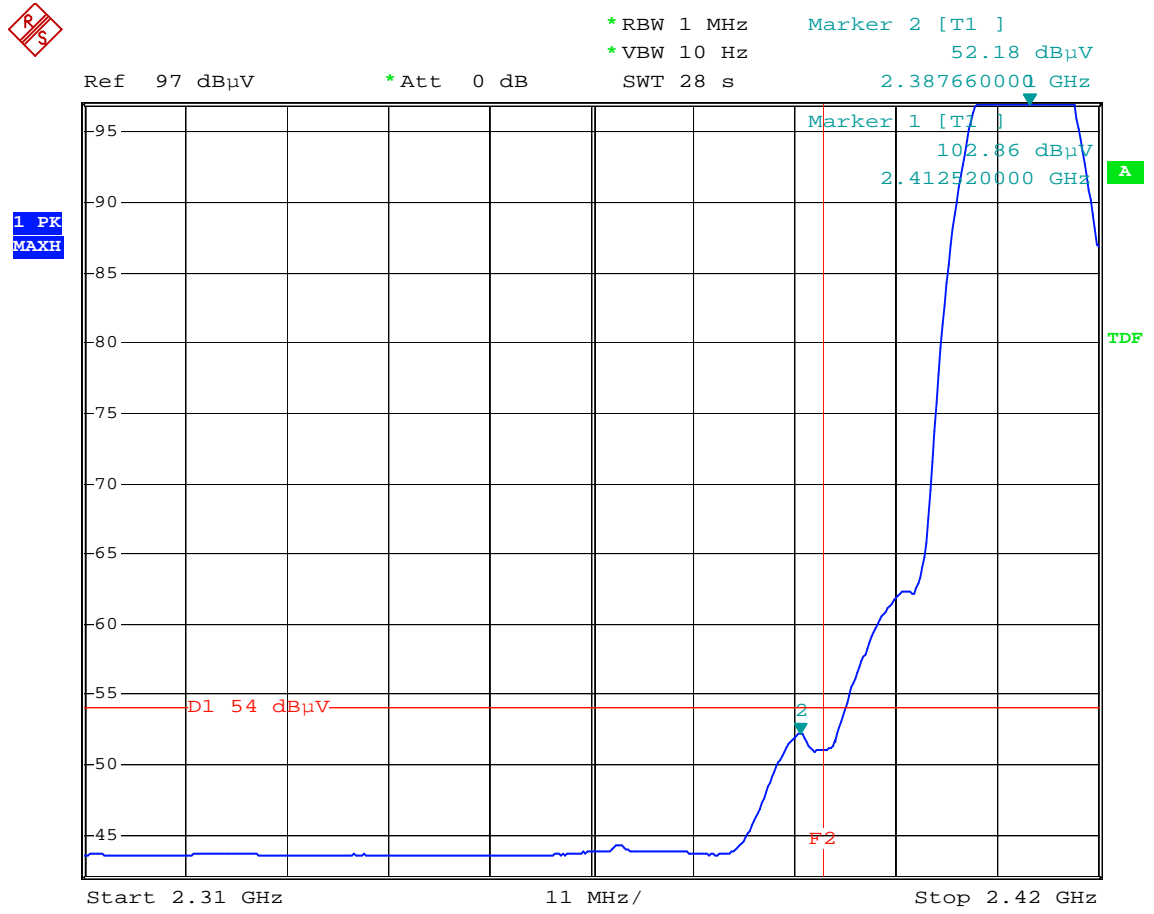


Comment A: Band-edge test at low channelEN B
 Peak detector F2=2390MHz
 Date: 12.NOV.2003 09:18:45

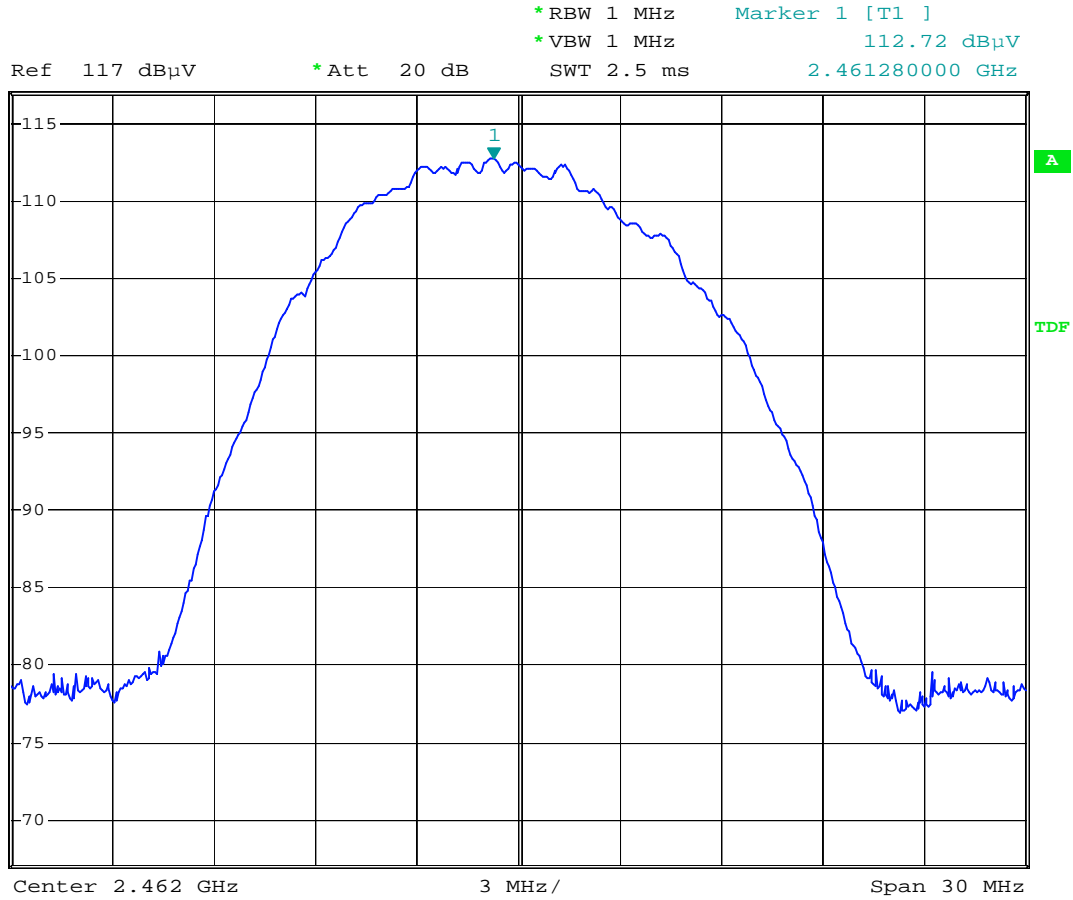


Comment A: Band-edge test at low channel EN B
Fundamental (AV)

Date: 12.NOV.2003 09:05:15

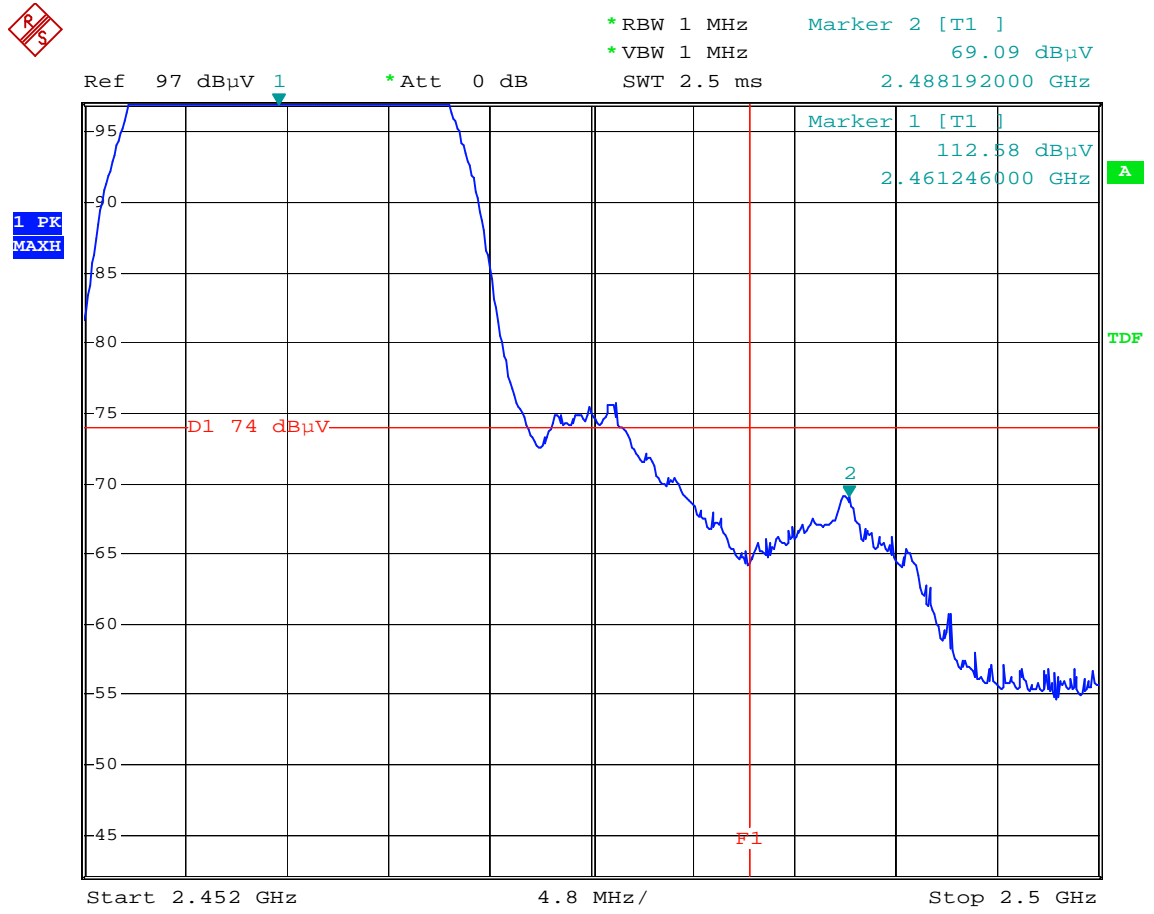


Comment A: Band-edge test at low channel EN B
 Average detector F2=2390MHz
 Date: 12.NOV.2003 09:21:18

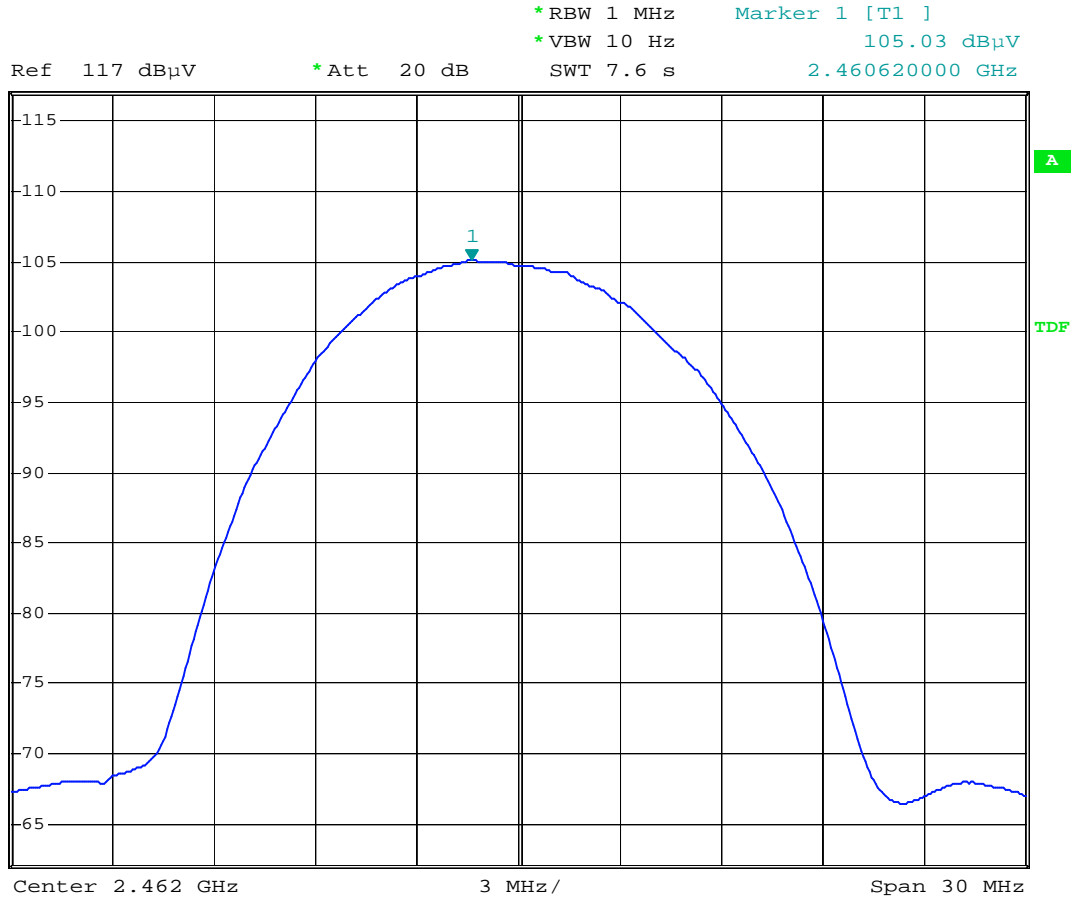


Comment A: Band-edge test at high channel N B
Fundamental (PK)

Date: 12.NOV.2003 09:30:00

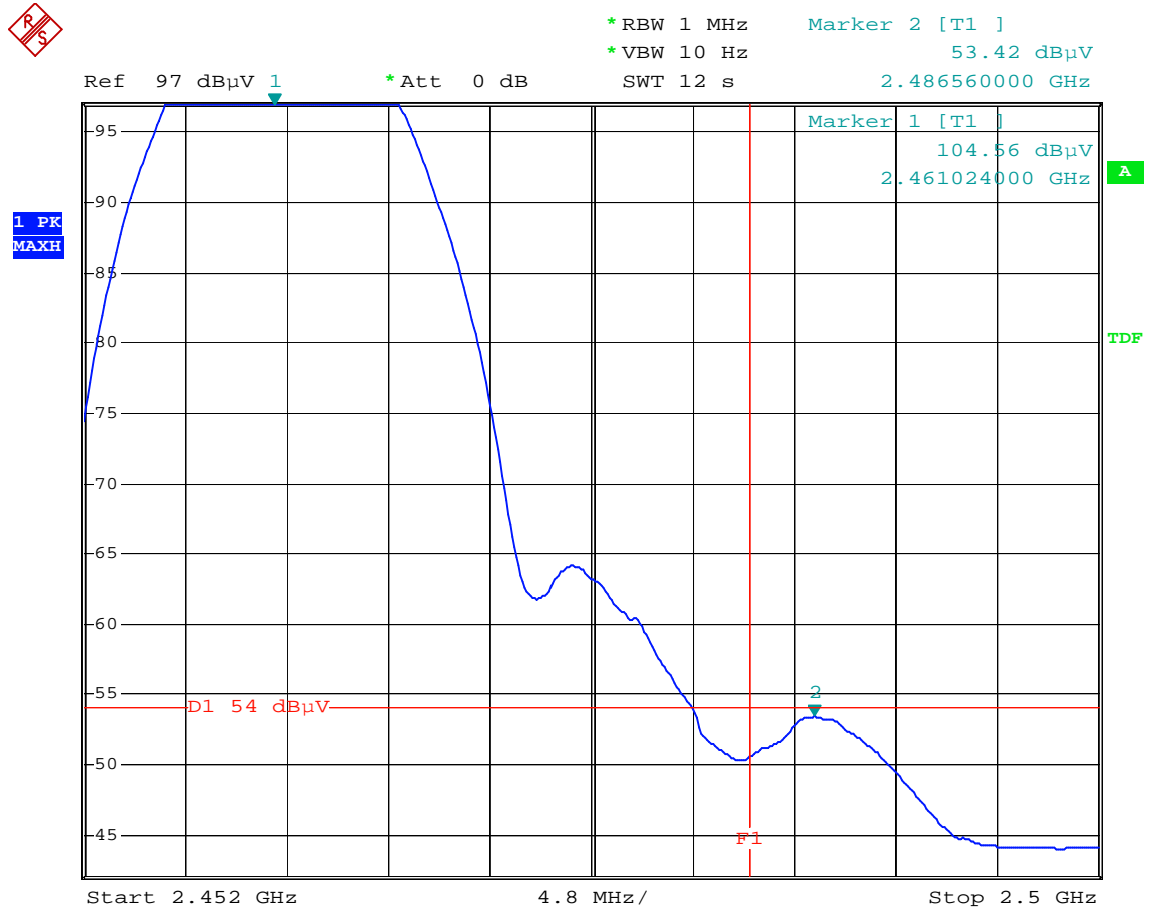


Comment A: Band-edge test at high channel N B
 Peak detector F1=2483.5MHz
 Date: 12.NOV.2003 09:35:58



Comment A: Band-edge test at high channel N B
Fundamental (AV)

Date: 12.NOV.2003 09:32:29



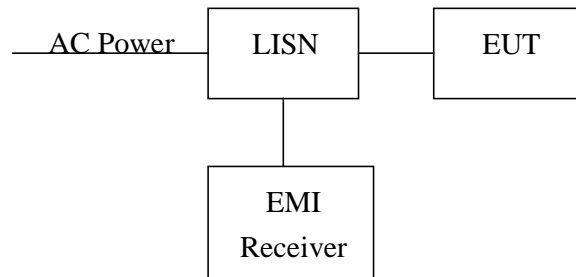
Comment A: Band-edge test at high channel N B
 Average detector F1=2483.5MHz
 Date: 12.NOV.2003 09:54:20

8. Power Line Conducted Emission test §FCC 15.207

8.1 Operating environment

Temperature:	24	°C	(10-40°C)
Relative Humidity:	55	%	(10-90%)
Atmospheric Pressure	1023	hPa	(860-1061hPa)

8.2 Test setup & procedure



The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50 ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4/1992 on conducted measurement. The AC power conducted emissions was investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz. (15.207 paragraph)

The EUT configuration please refer to the “Conducted set-up photo.pdf”.

Please see the plot below.

Emission Limit

Freq. (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56*	56 – 46*
0.50~5.00	56	46
5.00~30.0	60	50

*Decreases with the logarithm of the frequency.

8.3 Power Line Conducted Emission test data

(1) Line

EUT : ZyAIR B-500
Test Condition : Normal mode

Freq. (MHz)	Reading (dB μ V) QP	Limit (dB μ V) QP	Reading (dB μ V) AV	Limit (dB μ V) AV	Margin (dB)	
					QP	AV
2.02200	24.0	56.00	20.7	46.00	-32.00	-25.30
2.07800	21.7	56.00	14.9	46.00	-34.30	-31.10
2.48600	25.9	56.00	22.6	46.00	-30.10	-23.40
2.71800	25.8	56.00	21.9	46.00	-30.20	-24.10
2.77400	20.9	56.00	15.9	46.00	-35.10	-30.10
23.12600	32.3	60.00	30.1	50.00	-27.70	-19.90

(2) Neutral

EUT : ZyAIR B-500
Test Condition : Normal mode

Freq. (MHz)	Reading (dB μ V) QP	Limit (dB μ V) QP	Reading (dB μ V) AV	Limit (dB μ V) AV	Margin (dB)	
					QP	AV
1.79800	27.1	56.00	25.6	46.00	-28.90	-20.40
1.97400	27.6	56.00	26.3	46.00	-28.40	-19.70
2.26200	27.1	56.00	25.9	46.00	-28.90	-20.10
2.49400	27.6	56.00	25.9	46.00	-28.40	-20.10
2.72600	26.4	56.00	24.4	46.00	-29.60	-21.60
19.71000	29.2	60.00	26.4	50.00	-30.80	-23.60

Remark:

1. The reading value included cable loss and LISN factor.
2. Uncertainty was calculated in accordance with NAMAS NIS 81.
Expanded uncertainty (k=2) of conducted emission measurement is ± 2.6 dB.

Intertek Testing Services RF VOLTAGE

EUT: ZyAIR B-500
 Manuf: ZyXEL
 Op Cond: LISN-L
 Operator: Jerry
 Test Spec: FCC 15 Class B
 Comment: RCV:EC303 AMN:EC320
 120V 60Hz 24'c 56%RH Normal operation
 Date: 22. Oct 03 11:40

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp
150k	30M	8k	9k	PK	20ms AUTO	LN OFF

Final Measurement: x QP / + AV
 Meas Time: 1 s

