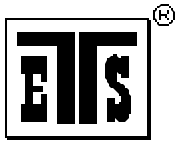

ELECTRONIC TECHNOLOGY SYSTEMS
DR. GENZ GMBH

COMPETENT BODY
DAR-REGISTRATION NUMBER: BPT-ZE-026/96-00

ACCREDITED TESTING LABORATORY
DAR-REGISTRATION NUMBER: TTI-P-G 126/96-30

ACCREDITED BY: BUNDESAMT FÜR POST UND TELEKOMMUNIKATION (BAPT)

TEST - REPORT

FCC 15.247

Test report no.:

U0M20303-4886-E-16

ELECTRONIC TECHNOLOGY SYSTEMS
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Table of Contents

1.0 Summary of Tests

Model: 802.11b VPN Accesspoint

Model No.: APL11-031 / SL-2511MP

FCC ID: QWU-031

TEST	REFERENCE	RESULTS
Max. Output power	15.247(b)	pass
6 dB Bandwidth	15.247(a)(2)	pass
Max. Power Density	15.247(d)	pass
Out of Band Antenna Conducted Emission	15.247(c)	pass
Out of Band Radiated Emission	15.247(c)	pass
Radiated Emission in Restricted Bands	15.35(b)(c)	pass
AC Conducted Emission	15.207	EMT Test report M30319A1
Radiated Emission from Digital Part	15.109	N/A
Radiated Emission from Receiver L.O.	15.109	N/A
Antenna Requirement	15.203	Provided by applicant

Test Engineer: R.Schultze_____ Date:09.04.2003

EMC Site Manager: Th. Dickten_____ Date: 09.04.2003

2.0 General Description

2.1. Product Description

A production version of the sample was received on Mar.18, 2003 in good condition.

The wireless LAN is accomplished by an 802.11b compliant Mini PCI radio card mounted on the main card. Inherent in the mini PCI are buffered data IO. Power to the Mini PCI connector is 3.3 VDC that is regulated from the 5 VDC from the external power supply. (110VAC/ 5VDC). The antenna is Dipole antenna, and the antenna connector type is TNC m with a screw thread, this makes the antenna connector unique, no standard TNC connector will fit this coupling. (Antenna requirement 15.203)
Under normal use condition, the user has to keep at least 20cm separation distance between radiator and the body of the user.
The other instruction, please have a look at the users manual.

DSSS Information
This device is Direct Sequence Spread Spectrum.

For all tests the transceiver was set to continuous wave (CW) mode.

Overview of EUT

Applicant	Sonicwall, Inc.
Trade Name & Model No.	10/100 Ethernet Firewall/VPN 1 U Rack Dual, APL11-031 / SL-2511MP
FCC Identifier	FCC ID: QWU-031
Use of Product	Wireless LAN Access point
Manufacturer & Model of Spread Spectrum Module	Sonicwall, Inc.
Type of Transmission	☒ Direct Sequence spreed spectrum (DSSS), ☐ Frequency hopping spreed spectrum (FHSS)
Rated RF Output (W)	0.262
Frequency Range (MHz)	☐ 902 MHz -- 928 MHz ☒ 2400 MHz – 2483.5 MHz ☐ 5725 MHz -- 5850 MHz
Operating Frequencies (MHz)	2412, 2437, 2462
Number of Channel(s)	11
Antenna(s) & Gain, dBi	max. 5.0
Antenna Requirement	The EUT uses an external antenna.

2.2. Related Submittal(s) Grants

None.

2.3. Test Methodology

RADIATION INTERFERENCE: The test procedure used was ANSI STANDARD C63.4-2000 using a spectrum analyzer. The bandwidth of the spectrum analyzer was 100 kHz with an appropriate sweep speed. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was the 100 kHz and the video bandwidth was 300 kHz. Measurements above 1 GHz the resolution bandwidth were 1MHz and the video bandwidth was 3MHz. The ambient temperature of the EUT was 23°C with a humidity of 40 %.

FORMULA OF CONVERSION FACTORS: The Field Strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBµV) to the antenna correction factor supplied by the antenna manufacturer. The antenna correction factors are stated in terms of dB.

Example:
Freq (MHz) METER READING + ACF + CABLE LOSS (to the receiver) = FS
20 dBµV + 10.36 dB + 6 dB = 36.36 dBµV/m @3m

ANSI STANDARD C63.4-2000 10.1.7 MEASUREMENT PROCEDURES: The EUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m (non metallic table). The EUT was placed in the center of the table. The table used for radiated measurements is capable of continuous rotation. The spectrum was scanned from 30 MHz to 10th harmonic of the fundamental.

Peak readings were taken in three (3) orthogonal planes and the highest readings.
When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes.

ANTENNA & GROUND:
This unit uses external antenna.

2.4. Test Facility

Measurements were made by ETS Dr. Genz.

3.0 System Test Configuration

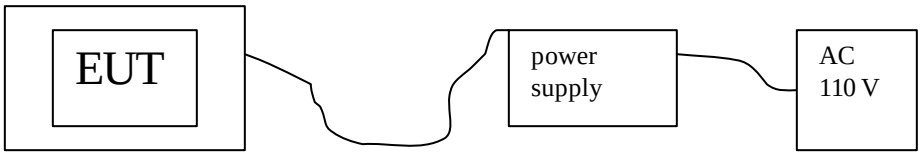
3.1. Support Equipment and description

None, the EUT was tested as a stand-alone device, an external power supply (DVE switching power supply, Model:DSA-0151D-05).

3.2. Block Diagram of Test Setup

powered by an external power supply and therefore tested with this power supply

The Equipment under test (EUT) is powered by an external power supply and therefore tested with this power supply .



3.3. Justification

All emissions measurements were performed according to the procedures in ANSI C63.4-2000. All other measurements were made in accordance with the procedures in Part 2 of CFR 47.
For emission testing, the equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst-case emissions. For radiated emission measurements, the EUT is attached to a cardboard box (if necessary) and placed on the wooden turntable. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). The EUT is wired to transmit full power. The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a preamplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three meters reading using inverse scaling with distance.

3.4. Software Exercise Program

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. For emissions testing, the units were setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing.

3.5. Mode of Operation During Test

Transmitting modes: DSSS continuous wave
Receiving: because of the nature of an access point there is no stand by or only receiving mode.

3.6. Modifications

The following modifications were installed during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by SonicWall, Inc prior to compliance testing):
No modifications were made to the EUT by ETS Dr. Genz.

3.7. Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusion have been made from standard.

3.8. Testen environment

Temperature:	23 °C
Relative humidity content:	20 … 75 %
Air pressure:	86 … 103 kPa
Details of power supply:	DVE switching power supply, Model:DSA-0151D-05, 100-240V AC/ 5VDC

3.9. Test equipment utilized

No.	Equipment	Type	Serial #	Manufacturer
12 0005	Antenna	HL025	100056	Rohde & Schwarz
12 0006	Antenna	HK116	100011	Rohde & Schwarz
12 0007	Antenna	HL223	100009	Rohde & Schwarz
12 0008	Antenna	HK116	100010	Rohde & Schwarz
12 0009	Antenna	HL025	100057	Rohde & Schwarz
12 0010	Antenna	HL223	100008	Rohde & Schwarz
12 0011	EMI Test receiver	ESI 26	831438/001	Rohde & Schwarz
12 0012	Signal generator	SML02	100114	Rohde & Schwarz
12 0013	DC Power Supply	3003B	H004689	Protek
12 0015	Power amplifier	150W1000	301793	Amplifier Research
12 0018	Notch filter	WRCD1747/1748-1.0/32-555	SN1	Wainwright
12 0019	Notch filter	WRCD1879.5/1880.5-1.0 32-5SS	SN2	Wainwright
12 0020	Notch filter	WRCB901.9/903.1-1.2/50-8SS	SN1	Wainwright
12 0024	EM Radiation Meter	EMR-20 BN2244/20	AE-0068	Wandel&Goltermann
12 0027	LISN Two Line -V-Network	ESH3-Z5	100002	Rohde & Schwarz
12 0028	EMI Test Receiver	ESHS10	838693/002	Rohde & Schwarz
12 0029	Pulse limiter	ESH3-Z2	836248/098	Rohde & Schwarz
12 0029	Pulse limiter	ESH3-Z2	836248/096	Rohde & Schwarz
12 0038	Transient 2000	TRA12191N	TRA2000-402	EMC-Partner
12 0039	Harmonics 1000	HAR1H01B	HAR1000-57	EMC-Partner
12 0043	Milli voltmeter	URV55	100059	Rohde & Schwarz
12 0044	Diode Power Sensor	NRV-Z6	100006	Rohde & Schwarz
12 0045	Insertion Unit	URV5-Z4	839313/020	Rohde & Schwarz
12 0047	Digital Multimeter	M3900		Suns
12 0048	Digital Multimeter	MY68	7875498	Suns
12 0049	AC-Voltmeter	TVT 321		Yamada

No.	Equipment	Type	Serial #	Manufacturer
12 0050	Audio Generator	TAG-101		Troneer
12 0052	Function Generator	7202 sweep	DGCE002	Dagatron
12 0054	ESD Mouse		ESD101-356	EMC-Partner
12 0056	Digital Multimeter	EC890G	7803446	Suns
12 0060	EMI Test receiver	ESVS10	832699/003	Rohde & Schwarz
12 0062	Universal Radio Communication Tester	CMU 200	837586/062	Rohde & Schwarz
12 0066	DC Power Supply	382203	N96031 489	Extech
12 0069	Climate chamber	VT 4010	282215	Vötsch Industrietechnik
12 0080	Bluetooth HF-Testsystem	TS8960	1000003	Rohde & Schwarz
12 0084	Multimeter	MY-64	9616635	Standard
12 0085	GG CMT54 Radio Comm.Tester	CMT54	873967/0103	Rohde & Schwarz
12 0151	Antenna	BBH 9120D	186	Schwarzbeck
12 0152	Antenna	UHAP-10dB	747	Schwarzbeck
12 0153	Antenna	VHAP	765	Schwarzbeck
12 0154	DC Power Supply	Model 1670	281-8543	BK Precision

4.0 Measurement Results

4.1. DSSS Systems

4.1.1. Maximum Peak Output Power

FCC Rule 15.247(b)

For antennas with gains of 6 dBi or less , maximum allowed transmitter output is 1 watt (+30dBm).
The gain of the antenna is 5dBi declared by the manufacturer.
The measurement was performed with a power meter, the antenna port of the EUT was directly connected to the power sensor.

Test conditions T_{nom}=22°C , V_{nom} =5.00VDC	Conducted Power highest power mode Mode CW [dBm]	[mW]
Frequency [MHz]		
2412	22.16	164.4
2437	22.63	183.2
2462	24.18	262.0
Measurement uncertainty	< 3 dB	

Test conditions T_{nom}=22°C , V_{nom} =5.00VDC	Signal Field strength Tx highest power mode Mode CW [dBµV/m]
Frequency [MHz]	
2411	103.59
2436	104.06
2461	105.61
Measurement uncertainty	< 3 dB

Test equipment used: 12 0011, 12 0005, 12 0043, 12 0045

The diagrams for the field strength measurements are included in Annex C .

4.1.2. Minimum 6 dB Bandwidth

FCC Rule 15.247(a)(2):

Analyzer RES BW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a MARKER was set 6 dB below to the left of the PEAK level and a DELTA MARKER was set to the same level to the right of the PEAK level.
The 6 dB bandwidth is the frequency between MARKER 1 and DELTA MARKER 1.
The minimum 6 dB bandwidth shall be at least 500 kHz.

For DSSS Systems Test conditions T_{nom}=22°C ,V_{nom} = 5.00VDC	6 dB Bandwidth Mode CW [MHz]
Frequency [MHz]	
2412	9.87
2437	9.82
2462	9.37
Measurement uncertainty	< 10 Hz

Test equipment used: 12 0011

See diagram Annex A

4.1.3. Maximum Power Density

FCC Rule: 15.247(d)

The spectrum analyzer RES BW was set to 3 kHz. The START and STOP frequencies were set to the band edges of the maximum output passband
For this measurement the Noise density function of the spectrum analyzer was used.
The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The Power density was measured using the procedure Guidance on Measurements for Direct Sequence Spread Spectrum Systems. "…Locate and zoom in on emission peak(s) within the passband. Set RBW=3kHz, VBW>RBW, sweep=(Span/3kHz)…..The peak level must be not greater then +8dBm. …."

Analyzer settings: RBW=3kHz, VBW=100kHz, Span=1.5MHz, Sweep time=500s

Test conditions T_{nom}=22°C ,V_{nom} = 5.00VDC	Power density Mode CW [dBm]
Frequency [MHz]	
2412	0.2

Test equipment used: 12 0011

See diagram Annex B

4.1.4. Out of Band Radiated Emissions

FCC Rule: 15.247(c)

For out of band emissions that are close to or that exceed the 20 dB attenuation requirement described in the specification, radiated measurements were performed at a 3 m separation distance to determine whether these emissions complied with the general radiated emission requirement. In addition a conducted test regarding the Guidance on Measurement of DSSS Systems was performed. For the measurement diagram see Annex C.

Limits:
For frequencies below 1GHz :
Max. reading – 20 dB
For mode DSSS CW: 105.61 dBµV/m- 20 dB= 85.61 dBµV/m

Guidance on Measurement of DSSS Systems:
"If the emission is pulsed, modify the unit for continuous operation , use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation

For frequencies above 1GHz (Peak measurements).
Limit=max. aver. reading-20dB +20dB(because Peak detector is used)

For mode DSSS CW: 105.61 dBµV/m

For frequencies above 1GHz (Average measurements).
Duty Cycle correction factor(dB) = 20 log (rfON in ms/100ms)
Max. reading – 20 dB+duty cycle correction:

No duty cycle correction was added to the reading.

For mode DSSS CW: 105.61 dBµV/m- 20 dB= 85.61 dBµV/m

Test equipment used: 12 0011, 12 0005, 12 0006, 12 0007

For Band edges measurements see Diagrams in Annex C.

4.1.5. Transmitter Radiated Emissions in Restricted Bands

FCC Rules: 15.247 (c), 15.205, 15.209, 15.35

Radiated emission measurements were performed from 30 MHz to 26000 MHz.
For radiated emission tests, the analyzer setting was as followings:

	RES BW	VID BW	
Frequency <1 GHz	100 kHz	100 kHz	(Peak measurements)
Frequency >1 GHz	1 MHz	1 MHz	(Peak measurements)
	1 MHz	1 MHz	(Average measurements)

Limits:
For frequencies below 1GHz:

Frequency of Emission (MHz)	Field Strength (microvolts/meter)	Field Strength (dBmicrovolts/meter)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

For frequencies above 1GHz (average measurements):
Guidance on Measurement of DSSS Systems:
"If the emission is pulsed, modify the unit for continuous operation, use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation."

No duty cycle correction was added to the reading.

For frequencies above 1GHz (average measurements):

For mode DSSS CW: 54.0dBµV/m

For frequencies above 1GHz (Peak measurements):

For mode DSSS CW: 54.0dBµV/m
Reading –20dB

See attached Table.
Measurement diagrams included in Annex C

DSSS CW Channel 1										
Frequency /MHz	Polarisation H/V	Detector	Reading /dBµV	Bandwidth /MHz	Antenna factor /dB	Pre-amlifier /dB	Cable loss /dB	Corrected reading	Limit /dBµV/m	Margin
30.68	V	PK	37.57	0.1	12.3	0	1.06	50.93	83.59	-32.66
988.77	V	PK	56.44	0.1	23	-35.4	2.08	46.12	54	-7.88
2412	V	AV	71.99	1	29.35	0	2.25	103.59		103.59
2390	V	PK	65.59	1	29.35	-32.07	2.23	65.1	74	-8.9
2390	V	AV	37.49	1	29.35	-32.07	2.23	37	54	-17
2483.5	V	PK	35.49	1	29.35	-32.04	2.3	35.1	74	-38.9
2483.5	V	AV	25.39	1	29.35	-32.04	2.3	25	54	-29
4824	V	PK	55.87	1	35.4	-41.73	3.1	52.64	74	-21.36
4824	V	AV	43.89	1	35.4	-41.73	3.1	40.66	54	-13.34
7238	V	PK	56.67	1	39.3	-41.7	3.82	58.09	74	-15.91
7238	V	AV	44.86	1	39.3	-41.7	3.82	46.28	54	-7.72
10188	V	PK	55.4	1	41.5	-43.5	4.48	57.88	103.59	-45.71
10188	V	AV	43.8	1	41.5	-43.5	4.48	46.28	83.59	-37.31

DSSS CW Channel 6										
Frequency /MHz	Polarisation H/V	Detector	Reading /dBµV	Bandwidth /MHz	Antenna factor /dB	Pre-amlifier /dB	Cable loss /dB	Corrected reading	Limit /dBµV/m	Margin
50.78	V	PK	28.42	0.1	12.3	0	1.06	41.78	84.06	-42.28
996.79	V	PK	55.45	0.1	23	-35.4	2.08	45.13	54	-8.87
2437	V	AV	72.46	1	29.35	0	2.25	104.06		
2390	V	PK	51.4	1	29.35	-32.07	2.25	50.93	74	-23.07
2390	V	AV	40.25	1	29.35	-32.07	2.23	39.76	54	-14.24
4200	V	PK	51.67	1	33.9	-41.5	2.93	47	74	-27
4200	V	AV	40.67	1	33.9	-41.5	2.93	36	54	-18
4874	V	PK	55.39	1	35.4	-41.73	3.1	52.16	74	-21.84
4874	V	AV	45.17	1	35.4	-41.73	3.1	41.94	54	-12.06
7312	V	PK	45.08	1	39.3	-41.7	3.82	46.5	74	-27.5
7312	V	AV	42.86	1	39.3	-41.7	3.82	44.28	54	-9.72
8248	V	PK	44.31	1	40.8	-43.6	3.99	45.5	74	-28.5
8248	V	AV	43.09	1	40.8	-43.6	3.99	44.28	54	-9.72
10317	V	PK	55.43	1	41.6	-42.56	4.58	59.05	104.06	-45.01
10317	V	AV	43.33	1	41.6	-42.56	4.58	46.95	84.06	-37.11

DSSS CW Channel 11										
Frequency /MHz	Polarisation H/V	Detector	Reading /dBµV	Bandwidth /MHz	Antenna factor /dB	Pre-amlifier /dB	Cable loss /dB	Corrected reading	Limit /dBµV/m	Margin
32.38	V	PK	32.96	0.1	12.3	0	1.06	46.32	85.61	-39.29
993.6	H	PK	54.82	0.1	23	-35.4	2.08	44.5	54	-9.5
2462	V	AV	74.01	1	29.35	0	2.25	105.61		
4200	V	PK	55.67	1	33.9	-41.5	2.93	51	74	-23
4200	V	AV	40.67	1	33.9	-41.5	2.93	36	54	-18
4924	V	PK	55.46	1	35.4	-41.73	3.1	52.23	74	-21.77
4924	H	AV	43.91	1	35.4	-41.73	3.1	40.68	54	-13.32
7384	V	PK	54.62	1	39.3	-41.7	3.82	56.04	74	-17.96
7384	V	AV	44.21	1	39.3	-41.7	3.82	45.63	54	-8.37
8345	V	PK	55.83	1	41.3	-43.7	4.07	57.5	74	-16.5
8345	V	AV	43.09	1	41.3	-43.7	4.07	44.76	54	-9.24
10437	V	PK	55.16	1	41.6	-42.73	4.69	58.72	104.06	-45.34
10437	V	AV	42.25	1	41.6	-42.73	4.69	45.81	84.06	-38.25

From 10.5 GHz to 26.5 GHz no reading above the noise floor.

Test equipment used: 12 0011, 12 0005, 12 0006, 12 0007

4.1.6. Radiated Emissions from Receiver Section of Transceiver

FCC Rule: 15.109

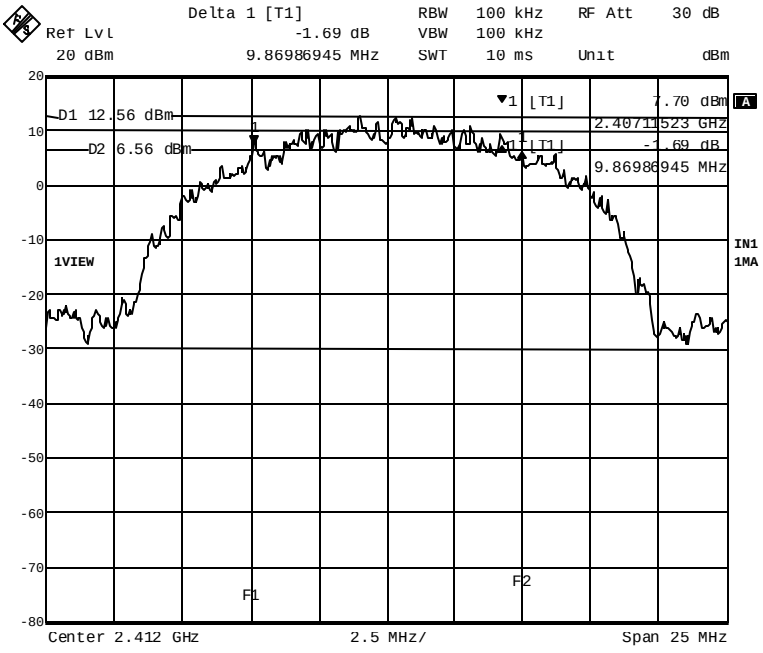
Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of Emission (MHz)	Field Strength (microvolts/meter)	Field Strength (dBmicrovolts/meter)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

Because of the nature of an access point there is no mode where the EUT is in a receive only or stand by mode.

Annex A Diagrams Minimum 6 dB Bandwidth

Mode DSSS CW, Channel 1



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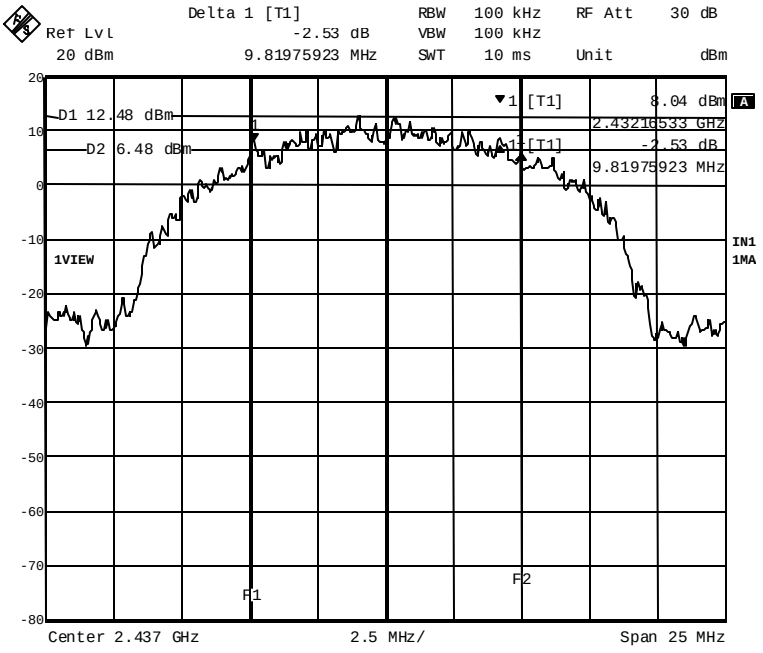
Date: 20.MAR.2003 15:11:22

Mode DSSS CW, Channel 6



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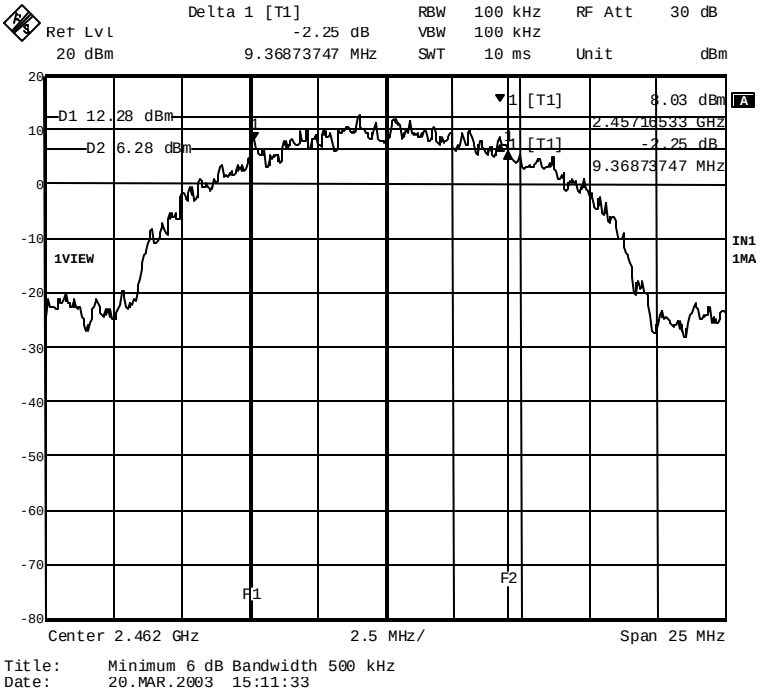
Date: 20.MAR.2003 15:09:21

Registrationnumber : U0M20303-4886-E-16

Mode DSSS CW, Channel 11

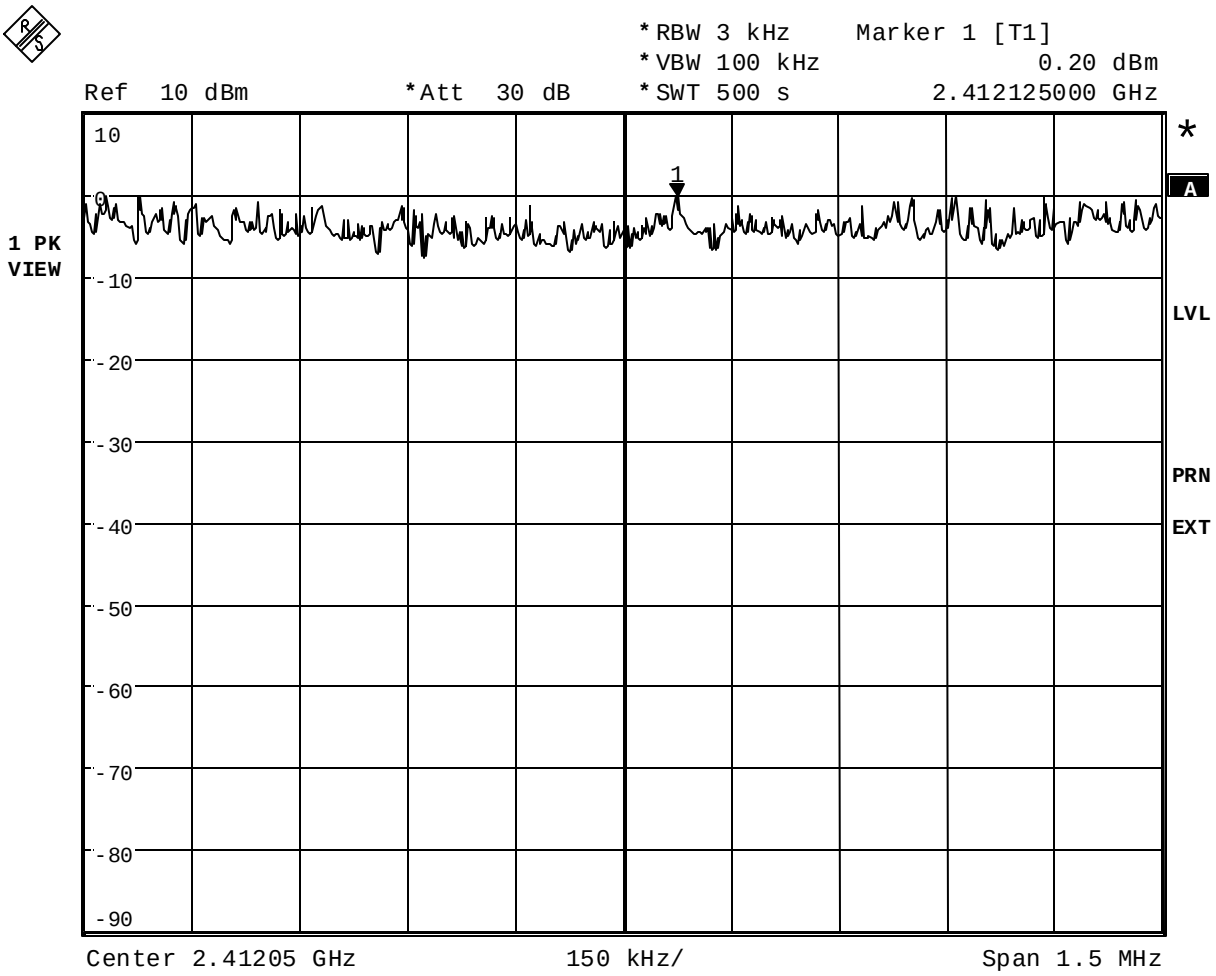


Title: Minimum 6 dB Bandwidth 500 kHz
Date: 20.MAR.2003 15:11:33

Registrationnumber : U0M20303-4886-E-16

Annex B Diagram Maximum Power Density

Mode DSSS CW



Date: 20.MAR.2003 12:20:26

Registrationnumber : U0M20303-4886-E-16

Annex C Diagrams Spurious emission Tranceiver