



**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**

TEST - REPORT

FCC 15.247

**Test report no.:
U0M20304-4891-T-47b**

ELECTRONIC TECHNOLOGY SYSTEMS
DR. GENZ GMBH

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1.0 General Information

1.1. Notes

The purpose of conformity testing is to increase the probability of adherence to the essential requirements or conformity specifications, as appropriate.

The complexity of the technical specifications, however, means that full and thorough testing is impractical for both technical and economic reasons.

Futhermore, there is no guarantee that a test sample which has Passed all the relevant tests conforms to a specification.

Neither is there any guarantee that such a test sample will interwork with other genuinely open systems.

The existence of the tests nevertheless provides the confidence that the test sample possesses the qualities as maintained and that its performance generally conforms to representative cases of communications equipment.

The test results of this test report relate exclusively to the item tested as specified in 3.1.

The test report may only be reproduced or published in full.

Reproduction or publication of extractes from the report requires the prior written approval of the ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH.

1.2. Testing laboratory

1.2.1. Location

ELECTRONIC TECHNOLOGY SYSTEM DR. GENZ GMBH (ETS)

Storkower Straße 38c

D-15526 Reichenwalde b. Berlin

Germany

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1.2.2. Details of accreditation status

Accredited testing laboratory

Accredited by: Bundesamt für Post und Telekommunikation (BAPT)

DAR-registration number: TTI-P-G 126/96-30

Accredited Competent Body

Accredited by: Bundesamt für Post und Telekommunikation (BAPT)

DAR-registration number: BPT-ZE-026/96-00

FCC filed test laboratory Reg. No. 96970

A2LA Accredited Certification No.1983-01

Bluetooth Qualification Test Facility (BQTF)

Accredited by Bluetooth Qualification Review Board

Industry Canada filed test laboratory Reg. No. IC 3470



2.0 Summary of Tests

EUT: Dolphin 9500 with 802.11b Radio,

Model No.: D9500 -03

FCC ID: HD5950003

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	N/A
Radiated Emission from Digital Part	15.109	N/A
Radiated Emission from Receiver L.O.	15.109	pass
Antenna Requirement	15.203	Provided by applicant

Test Engineer: R.Schultze_____

Date: 06/13/2003

EMC Site Manager: Th. Dickten_____

Date: 06/13/2003

Registrationnumber : U0M20304-4891-T-47b

3.0 General Description

3.1. Product Description

A production version of the sample was received on June.04, 2003 in good condition.

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	Hand Held Products, Inc.
Trade Name & Model No.	Dolphin 9500 with 802.11b Radio, D9500 -03,
FCC Identifier	HD5950003
Use of Product	POS Terminal
Manufacturer & Model of Spread Spectrum Module	SyChip, Inc.
Type of Transmission	☒ Direct Sequence spread spectrum (DSSS), ☐ Frequency hopping spread spectrum (FHSS)
Rated RF Output (W)	0.05888
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. -0.9
Antenna Requirement FCC Part 15.203	The EUT uses an Antenna equipped with unique connector which can not be replaced by standard antenna jack or electrical connector, it is a permanently affixed internal antenna.

3.2. Related Submittal(s) Grants

None.

Registrationnumber : U0M20304-4891-T-47b

3.3. 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 internal antenna.

3.4. Test Facility

Measurements were made by ETS Dr. Genz GmbH

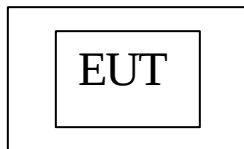
4.0 System Test Configuration

4.1. Support Equipment and description

None, the EUT was tested as a stand-alone device, no external power supply was used.

4.2. Block Diagram of Test Setup

The Equipment under test (EUT) is powered by an internal battery (Lithium ion 7.4V) and therefore tested with this power supply .



4.3. 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.

4.4. Software Exercise Program

The EUT exercise program (WLAN TestUtils) 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 unit was setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing (always fully charged battery).

4.5. Mode of Operation During Test

Transmitting modes: DSSS continuous wave

Receiving: Continuous RX ON

4.6. 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 HHP prior to compliance testing):

No modifications were made to the EUT by ETS Dr. Genz.

4.7. Additions, Deviations and Exclusions from Standards

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

4.8. Test environment

Temperature: 22 °C

Relative humidity content: 20 ... 75 %

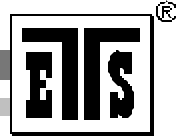
Air pressure: 86 ... 103 kPa

Details of power supply: Lithium ion battery 7.4 V

4.9. 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

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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

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5.0 Measurement Results

5.1. DSSS Systems

5.1.1. 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 -0.9 dBi declared by the manufacturer.

Because of the internal antenna only radiated measurements were performed.

The guidance on measurements for DSSS systems allows radiated tests to show compliance with the various conducted requirements of section 15.247 if antenna conducted test cannot be performed.

Because of the internal antenna of the EUT all measurements were performed radiated.

Test conditions $T_{nom}=22C$, $V_{nom}=7.40VDC$	Radiated Power highest power mode	
	Mode CW	
	[dBm]	[mW]
Frequency [MHz]		
2412	15.42	34.83
2437	16.44	44.05
2462	17.70	58.88
Measurement uncertainty	< 3 dB	

Test conditions $T_{nom}=22C$, $V_{nom}=7.40VDC$	Signal Field strength Tx highest power mode Mode CW [dB μ V/m]	
Frequency [MHz]		
2412	98.62	
2437	99.43	
2462	100.59	
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 .

5.1.2. 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 $T_{nom}=22C$, $V_{nom}=7.40VDC$	6 dB Bandwidth Mode CW [MHz]
Frequency [MHz]	
2412	11.00200
2437	10.40080
2462	11.00200
Measurement uncertainty	< 10 Hz

Test equipment used: 12 0011

See diagram Annex A

5.1.3. 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.

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 $T_{nom}=22^{\circ}\text{C}$, $V_{nom}=5.00\text{VDC}$	Power density
	Mode CW [dBm]
Frequency [MHz]	
2461.3046	4.34

Test equipment used: 12 0011

See diagram Annex B

5.1.4. 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: $100.59 \text{ dB}\mu\text{V/m} - 20 \text{ dB} = 80.59 \text{ dB}\mu\text{V/m}$

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: $100.59 \text{ dB}\mu\text{V/m}$

For frequencies above 1GHz (Average measurements).

Duty Cycle correction factor(dB) = $20 \log(r_{\text{FON}} \text{ in ms}/100\text{ms})$

Max. reading – 20 dB+duty cycle correction:

No duty cycle correction was added to the reading.

For mode DSSS CW: $100.59 \text{ dB}\mu\text{V/m} - 20 \text{ dB} = 80.59 \text{ dB}\mu\text{V/m}$

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

For Band edges measurements see Diagrams in Annex C.

5.1.5. 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: 54.0 dBμV/m

For frequencies above 1GHz (Peak measurements):

For mode DSSS CW: 54.0 dBμV/m +20 dB = 74 dBμV/m

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-amplifier /dB	Cable loss /dB	Corrected reading	Limit /dBμV/m	Margin
30 H		PK	20.56	0.1	13.6	0	0.76	34.92	40	-5.08
926.25 V		PK	57	0.1	22.7	-35.4	2.08	46.38	80.59	-34.21
2412 V		AV	99.19	1	29.35	-32.17	2.25	98.62		
2398 H		AV	48.96	1	29.35	-32.07	2.23	48.47	80.59	-32.12
2398 H		PK	56.62	1	29.35	-32.07	2.23	56.13	100.59	-44.46
2483.5 H		AV	22.49	1	29.35	-32.04	2.3	22.1	54	-31.9
2483.5 H		PK	35.69	1	29.35	-32.04	2.3	35.3	74	-38.7
4824 H		AV	38.14	1	35.4	-41.73	3.1	34.91	54	-19.09
4824 H		PK	56.62	1	35.4	-41.73	3.1	53.39	74	-20.61
7234 V		AV	38.57	1	39.3	-41.7	3.82	39.99	54	-14.01
7236 V		PK	50.7	1	39.3	-41.7	3.82	52.12	74	-21.88

DSSS CW Channel 6										
Frequency /MHz	Polarisation H/V	Detector	Reading /dBμV	Bandwidth /MHz	Antenna factor /dB	Pre-amplifier /dB	Cable loss /dB	Corrected reading	Limit /dBμV/m	Margin
31.02 H		PK	20.32	0.1	13.6	0	0.76	34.68	40	-5.32
964.73 H		PK	57.38	0.1	22.7	-35.4	2.08	46.76	54	-7.24
2437 V		AV	100	1	29.35	-32.17	2.25	99.43		
2483.5 H		PK	43.15	1	22.7	-35.4	2.08	32.53	80.59	-48.06
4873 H		AV	43.33	1	35.4	-41.73	3.1	40.1	54	-13.9
4874 H		PK	57.67	1	35.4	-41.73	3.1	54.44	74	-19.56
7312 V		AV	39.79	1	39.3	-41.7	3.82	41.21	54	-12.79
7303 H		PK	51.96	1	39.3	-41.7	3.82	53.38	74	-20.62

DSSS CW Channel 11										
Frequency /MHz	Polarisation H/V	Detector	Reading /dBμV	Bandwidth /MHz	Antenna factor /dB	Pre-amplifier /dB	Cable loss /dB	Corrected reading	Limit /dBμV/m	Margin
30.68	H	PK	20.08	0.1	13.6	0	0.76	34.44	40	-5.56
980.7	H	PK	57.66	0.1	22.7	-35.4	2.08	47.04	54	-6.96
2463	V	AV	101.16	1	29.35	-32.17	2.25	100.59		
2398	H	AV	21.99	1	29.35	-32.07	2.23	21.5	80.59	-59.09
2398	H	PK	46.09	1	29.35	-32.07	2.23	45.6	100.59	-54.99
2484	H	AV	33.18	1	29.35	-32.04	2.3	32.79	54	-21.21
2483.5	H	PK	39.8	1	29.35	-32.04	2.3	39.41	74	-34.59
4924	H	AV	44.77	1	35.4	-41.73	3.1	41.54	54	-12.46
4922	H	PK	59.43	1	35.4	-41.73	3.1	56.2	74	-17.8
7391	H	AV	44.2	1	39.3	-41.7	3.82	45.62	54	-8.38
7391	H	PK	54.78	1	39.3	-41.7	3.82	56.2	74	-17.8

From 7.4 GHz to 26.5 GHz no reading above the noise floor.

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

5.1.6. 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

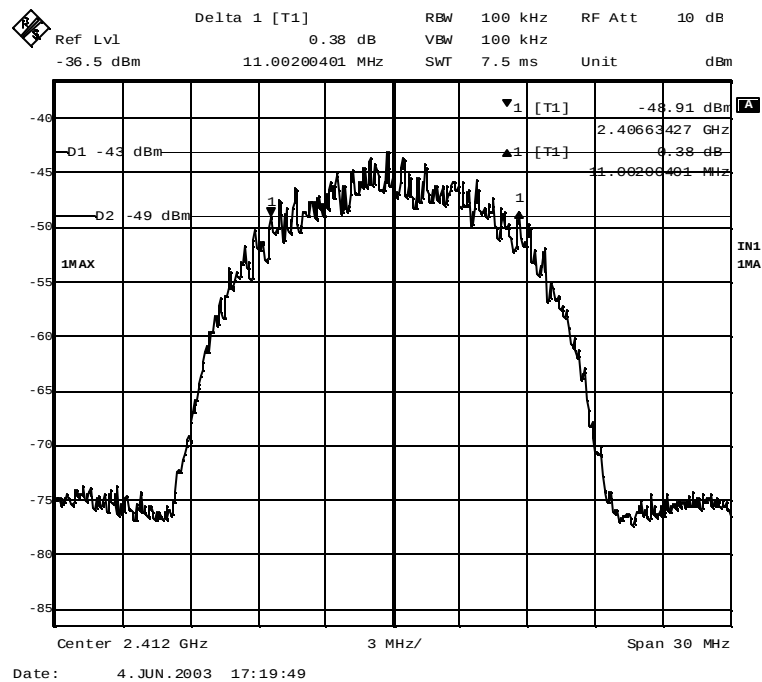
With the exercise program (WLAN TestUtils) used during the measurements the EUT was set in a receiving mode.

From 30 MHz to 26.5 GHz no emission above the noise floor were found.

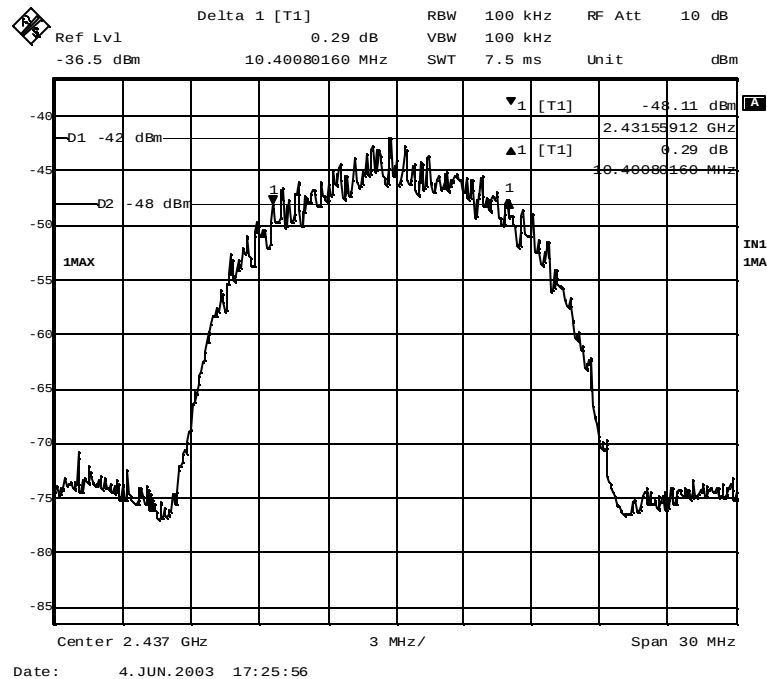
Test equipment used: 12 0011, 12 0005, 12 0006, 12 0007

Annex A Diagrams Minimum 6 dB Bandwidth

Mode DSSS CW, Channel 1

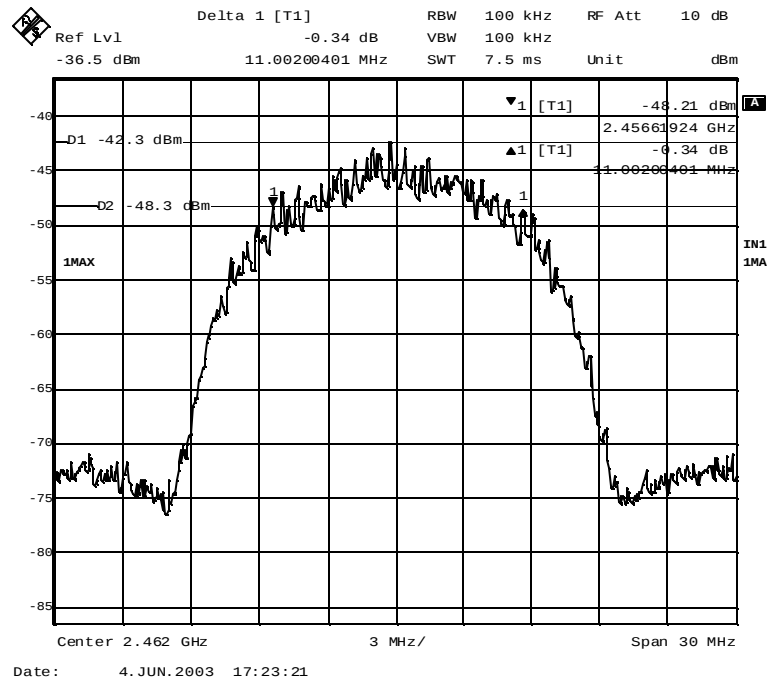


Mode DSSS CW, Channel 6



Registrationnumber : U0M20304-4891-T-47b

Mode DSSS CW, Channel 11

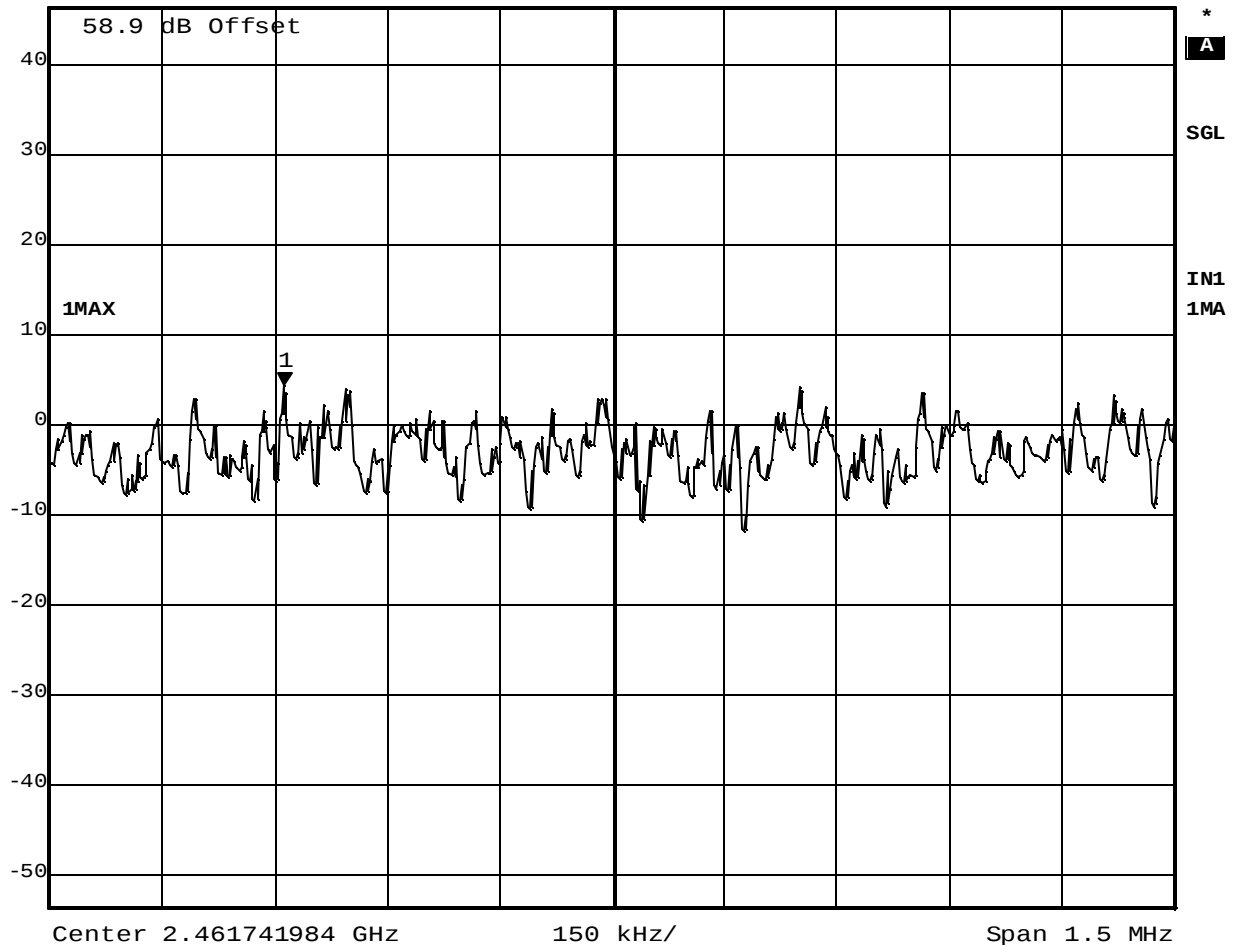


Registrationnumber : U0M20304-4891-T-47b

Annex B Diagram Maximum Power Density

Mode DSSS CW


 Marker 1 [T1] RBW 3 kHz RF Att 10 dB
 Ref Lvl 4.34 dBm VBW 100 kHz
 46.5 dBm 2.46130461 GHz SWT 500 s Unit dBm



Date: 5.JUN.2003 07:44:48

Registrationnumber : U0M20304-4891-T-47b



Annex C Diagrams Spurious emission Transceiver

See files Annex_C_47b_diagrams1.pdf, Annex_C_47b_diagrams1.pdf.

Annex D Picture external / internal / testsetup

See files Annex_D_47b_picture_external.pdf , Annex_D_47b_picture_internal.pdf ,
Annex_D_47b_picture_setup.pdf.