

Radio test report

99828931 – rev 1.0

based on:

- FCC Part 15 Subpart C, section 15.247 (10-1-05 Edition);
- FCC Part 15 Subpart B, section 15.109 (10-1-05 Edition);
- RSS-210, Issue 6 (Sept. 2005 edition);
- RSS-Gen, Issue 1 (Sept. 2005 edition).

Complete Class 2 Bluetooth Module
Taiyo Yuden
EYTFXCS

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This report comprises of five modules. The total number of pages is: 32

Main module

1 Introduction

This report contains the result of tests performed by:

Telefication B.V.
Edisonstraat 12a
6902 PK Zevenaar
The Netherlands

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:1999. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie). The contents of this test report, if reproduced, shall be copied in full, unless special consent in writing for reproduction in part is granted by Telefication. Copyright of this test report is reserved to Telefication.

Ordering party:

Company name : Taiyo Yuden Co., Ltd.
Address : 5607-2 Nakamuroda-machi
Zipcode : 370-3347
City/town : Takasaki-shi Gunma
Country : Japan
Date of order : 28 November 2006

2 Product

A sample of the following product was submitted for testing:

| | |
|---------------------|-------------------------------------|
| Product description | : Complete Class 2 Bluetooth Module |
| Manufacturer | : Taiyo-Yuden Co., Ltd. |
| Trade mark | : Taiyo Yuden |
| Type designation | : EYTFXCS |
| FCC ID | : RYYEYTFXCS |
| IC ID | : 4389B-EYTFXCS |
| Hardware version | : -- |
| Serial number | : -- |
| Software release | : -- |

3 Test schedule

Tests are carried out in accordance with the specification detailed in chapter 7 “Summary” of this report.

Tests are carried out at the following location:

- Telefication, Zevenaar

The samples of the product were received on:

- 1 December 2006

Tests are carried out from:

- 5 December to 20 December 2006

4 Product documentation

For production of this report the following product documentation has been used:

| Description: | Date: | Identification: |
|------------------------------|------------|------------------------|
| Operating manual for testing | -- | Taiyo Yuden Co., Ltd. |
| Electrical diagram | 28-11-2006 | Doc. no. HD-MC-BO61151 |

The above-mentioned documentation will be filed at Telefication for a period of 10 years following the issue of this test report.

5 Observations and comments

For the purpose of testing a software test tool named BlueSuite™ V1.10 for CSR's BlueCore™ Bluetooth® wireless technology chips has been used.

The test sample used for the transmitter tests was provided with a temporary SMA antenna connector.

For all transmitter tests the RF power settings ("Power Int.") by means of this tool were according to the following table:

| GFSK | $\pi/4$ DQPSK | 8DPSK |
|------|---------------|-------|
| 54 | 95 | 95 |

All tests were performed with frequency hopping disabled and with the packet configuration according to the following table:

| | GFSK | | $\pi/4$ DQPSK | | 8DPSK | |
|-----|-------------|-------------|---------------|-------------|-------------|-------------|
| | Packet type | Packet size | Packet type | Packet size | Packet type | Packet size |
| DH5 | 15 | 339 | 30 | 679 | 31 | 1021 |

The test sample used for the receiver tests was provided with the (original) integral antenna.

Initially an appointment has been made for final measurements of unwanted emissions 30 - 1000 MHz on the Open Area Test Site of TNO EPS in Niekerk

TNO Electronic Products & Services (EPS) B.V
Smidshornerweg 18
9822 TL Niekerk
The Netherlands

FCC listed : 90828
Industry Canada : IC3501A-1

Exploratory measurements (section 3.8) revealed that these final measurements are unnecessary.

6 Modifications to the sample

No modifications were made to the sample.

7 Summary

The product is intended for use in the following application area(s):

INTENTIONAL RADIATOR OPERATING IN THE FREQUENCY BAND 2400 - 2483.5 MHz

The sample was tested according to the following specification(s):

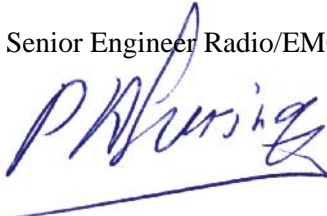
FCC Part 15 Subpart C, section 15.247 (10-1-05 Edition);
FCC Part 15 Subpart B, section 15.109 (10-1-05 Edition);
RSS-210, Issue 6 (Sept. 2005 edition);
RSS-Gen, Issue 1 (Sept. 2005 edition).

8 Conclusions


The samples of the product showed **NO NON-COMPLIANCES** to the specification stated in chapter 7 of this report.

The results of the tests as stated in this report, are exclusively applicable to the product items as identified in this test report. Telefication does not accept any responsibility for the results stated in this test report, with respect to the properties of product items not involved in these tests.


All tests are performed by:

name : ing. P.A. Suringa
function : Senior Engineer Radio/EMC
signature : 

Review of test report by:

name : ing. S.J. van Spijker
function : Test Engineer
signature : 

The above conclusions have been verified by the following signatory:

Date : 11 January 2007
name : J.P. van de Poll
function : Co-ordinator Test Group
signature : 

Test results module

1 General information

1.1 Equipment information

| | |
|---------------------------|----------------------------|
| Type of equipment | Class 2 Bluetooth module |
| Bluetooth specification | V2.0 + EDR |
| Rated conducted RF power | 1.5 dBm |
| Operating frequency range | 2402 - 2480 MHz |
| Modulation types | GFSK, $\pi/4$ DQPSK, 8DPSK |
| Duty cycle | 79.2 % (during testing) |
| ITU designation | 946KF1D, 1M24G1D, 1M27G1D |
| Antenna type | Integral |
| Antenna gain | 2 dBi |

1.2 Tested channels

| | | | |
|-----------------|-----------|------------|------------|
| | Channel 2 | Channel 41 | Channel 80 |
| Frequency (MHz) | 2402 | 2441 | 2480 |

2 Summary of test data

| NAME OF TEST | PARA. NO. | Limit | MEAS. | RESULT |
|---|--------------------|--|--------------------------------------|----------|
| 20 dB bandwidth | 15.247(a)(1) | -- | 1263 kHz | Complies |
| Channel separation | 15.247(a)(1) | $\geq 2/3 * 20$ dB BW | 1010 kHz | Complies |
| Number of channels | 15.247(a)(1)(iii) | > 15 | 79 | Complies |
| Average time of occupancy | 15.247(a)(1) (iii) | 0.4 sec. | 0.397 sec. | Complies |
| Occupied bandwidth (99%) | -- | -- | 1230 kHz | -- |
| Maximum Peak Power Output | 15.247(b)(1)&(4) | 27 dBm E.I.R.P. | -0.5 dBm E.I.R.P. | Complies |
| Peak Power Spectral Density | 15.247(e) | 8 dBm/3 kHz | -- | N/A |
| Spurious Emissions Tx (Conducted) | 15.247(d) | > 20 dB below fundamental | ≥ 57 dB below fundamental | Complies |
| Spurious Emissions Rx (Radiated) | 15.109 | 54 dB μ V/m(av) | 45.5 dB μ V/m(pk) | Complies |
| Restricted band emissions (Radiated) | 15.205(a) | 54 dB μ V/m(av) 74 dB μ V/m(pk) | 45.5 dB μ V/m(pk) | Complies |

3 Emission tests

3.1 20 dB bandwidth

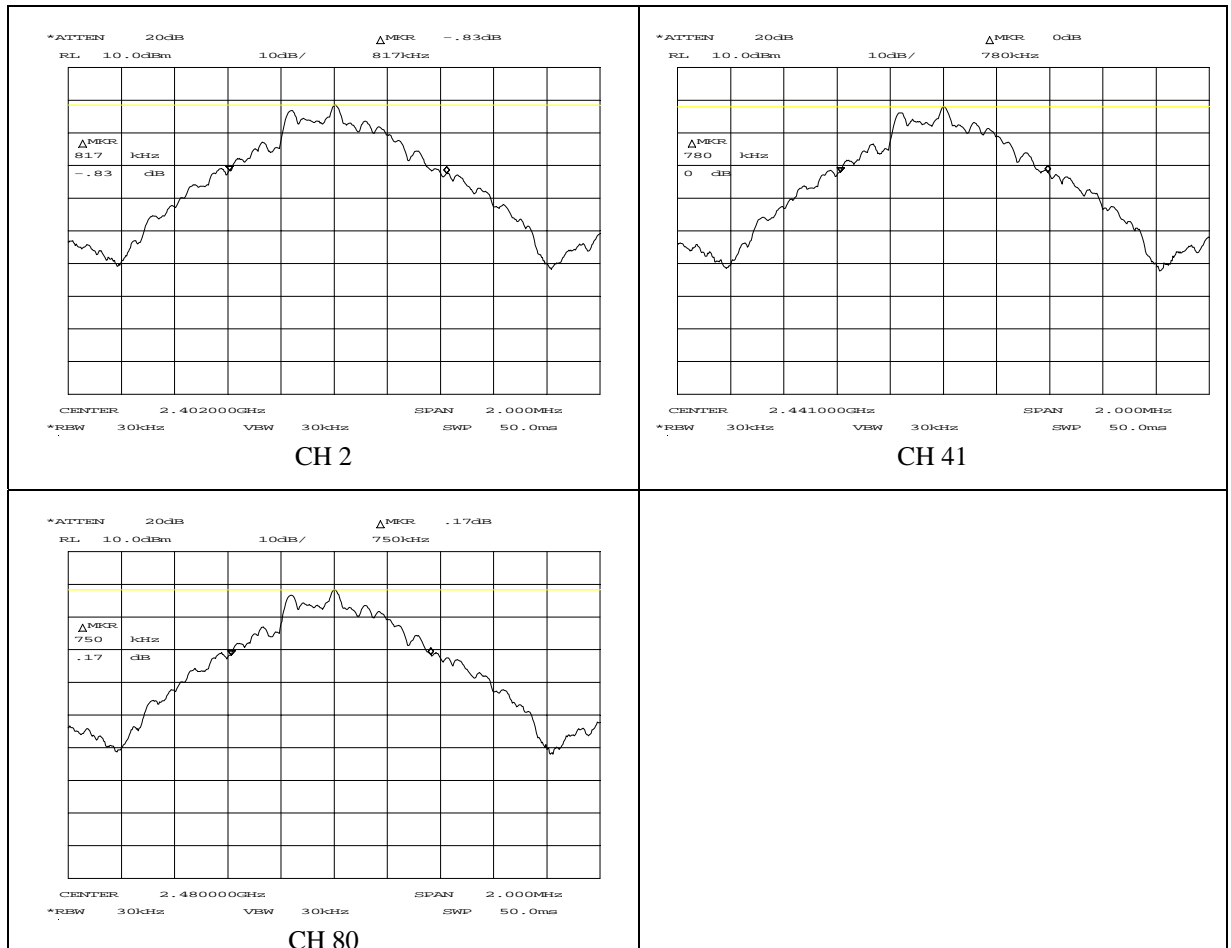
Compliance standard : FCC part 15, subpart C, section 15.247 (a)(1)
Method of test : Public Notice DA 00-705

Ambient temperature : 20 °C
Relative humidity : 42 %

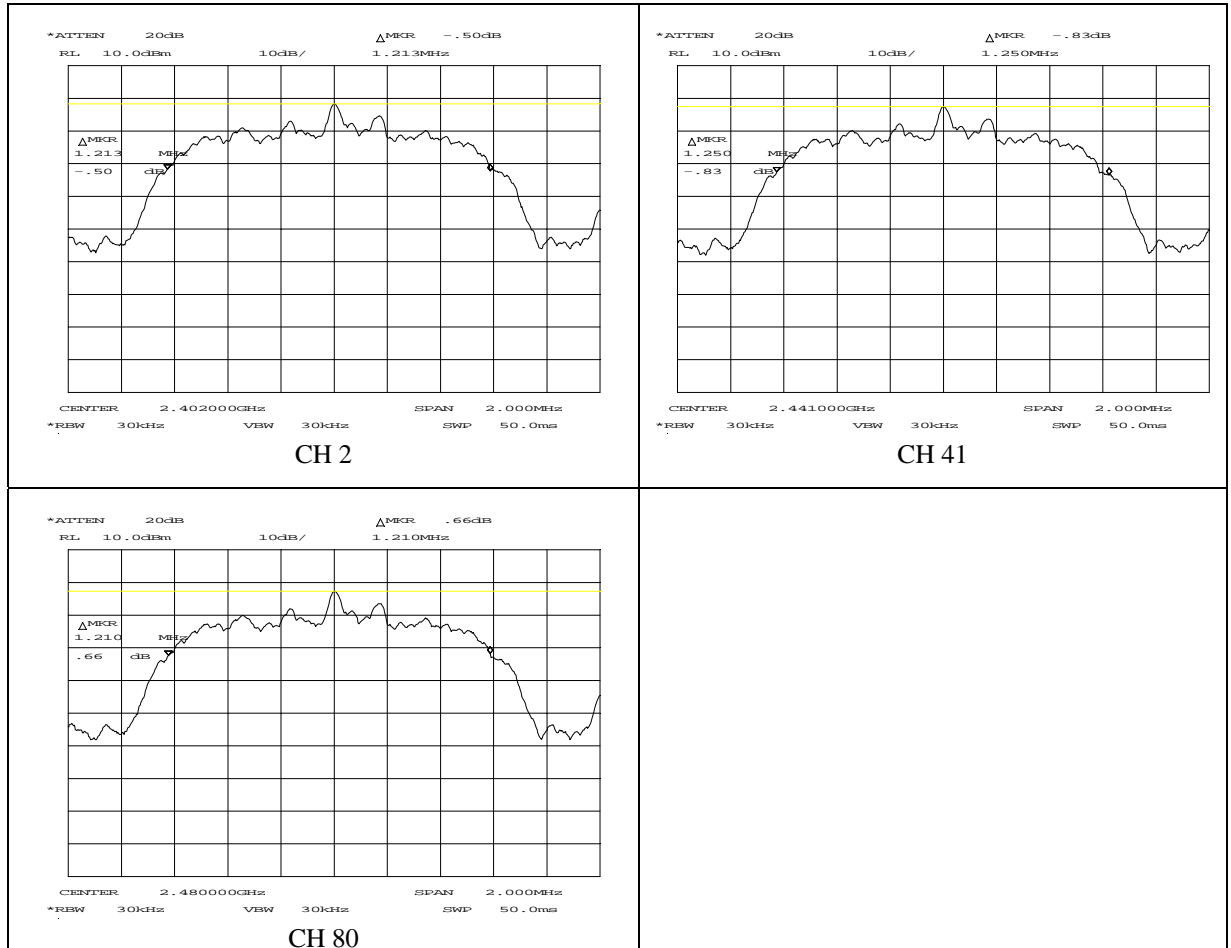
Test results :

| Modulation | Channel 2 | Channel 41 | Channel 80 |
|---------------|-----------|------------|------------|
| GFSK | 817 kHz | 780 kHz | 750 kHz |
| $\pi/4$ DQPSK | 1213 kHz | 1250 kHz | 1210 kHz |
| 8DPSK | 1260 kHz | 1260 kHz | 1263 kHz |

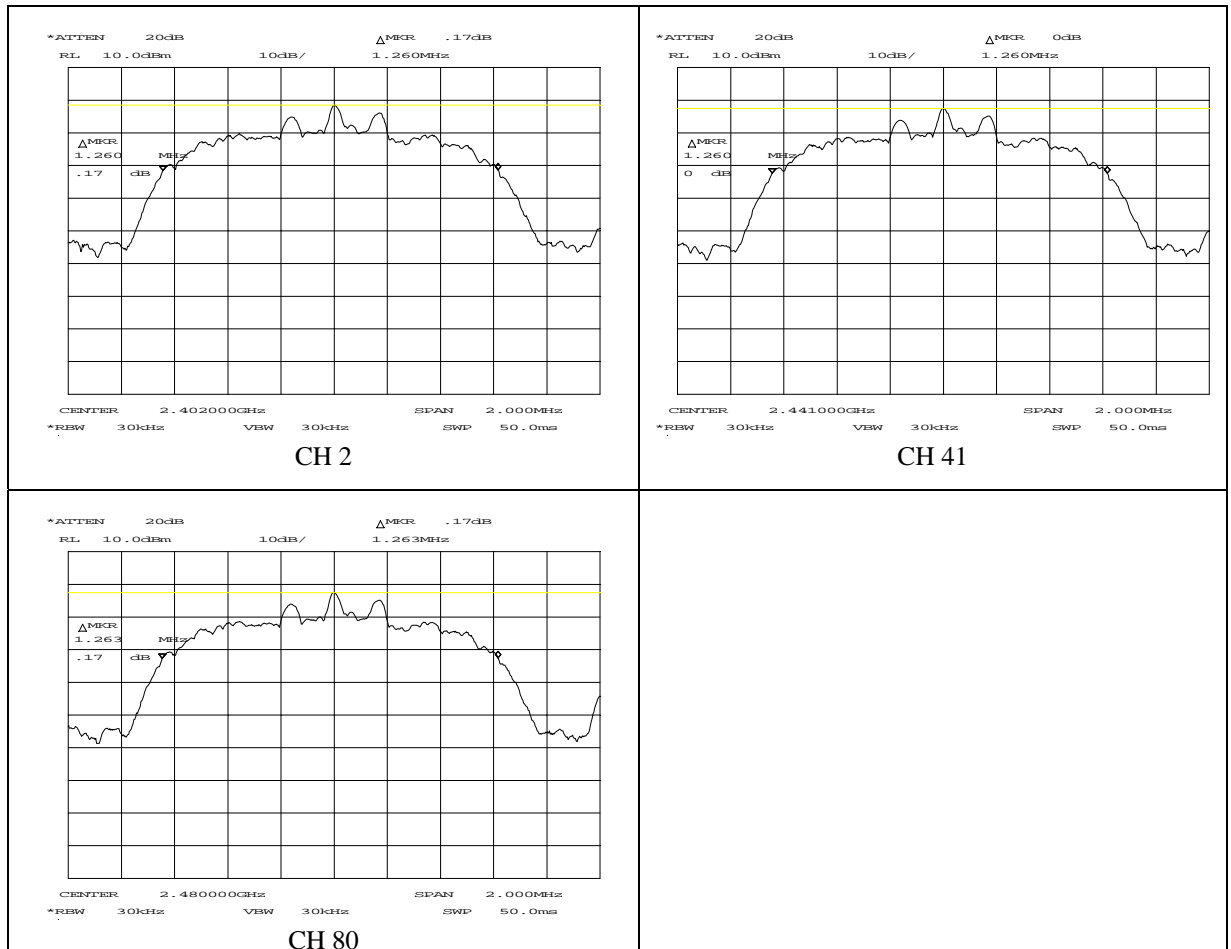
GFSK plots



$\pi/4$ DQPSK plots



8DPSK plots



Measurement uncertainty: + 23/- 23 kHz

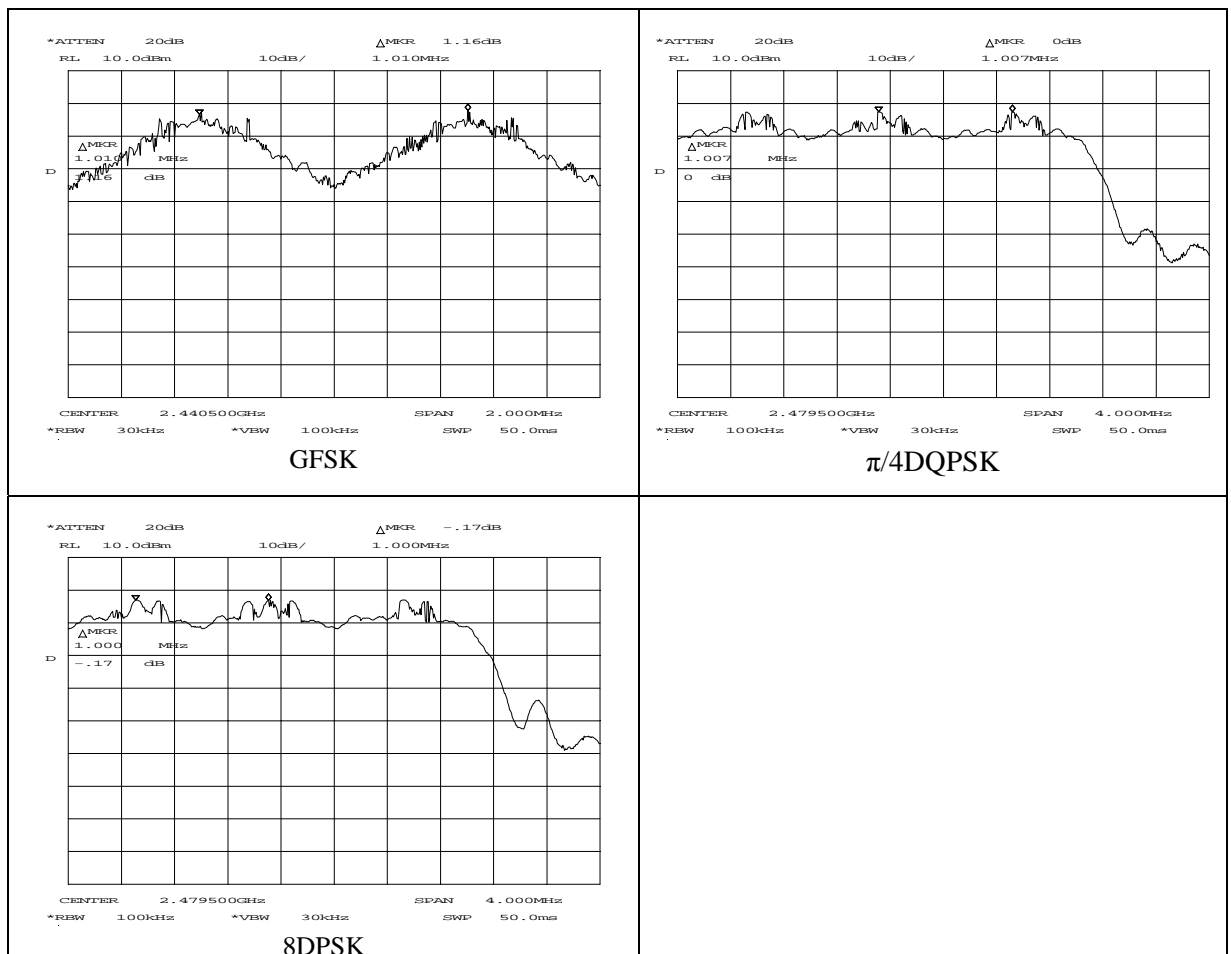
3.2 Channel separation

Compliance standard : FCC part 15, subpart C, section 15.247 (a)(1)
 Method of test : Public Notice DA 00-705
 Ambient temperature : 20 °C
 Relative humidity : 42 %

Test results :

| Modulation | Separation |
|---------------|------------|
| GFSK | 1010 kHz |
| $\pi/4$ DQPSK | 1007 kHz |
| 8DPSK | 1000 MHz |

Plots



Measurement uncertainty: + 46/- 46 kHz

3.4 Occupied bandwidth (99%)

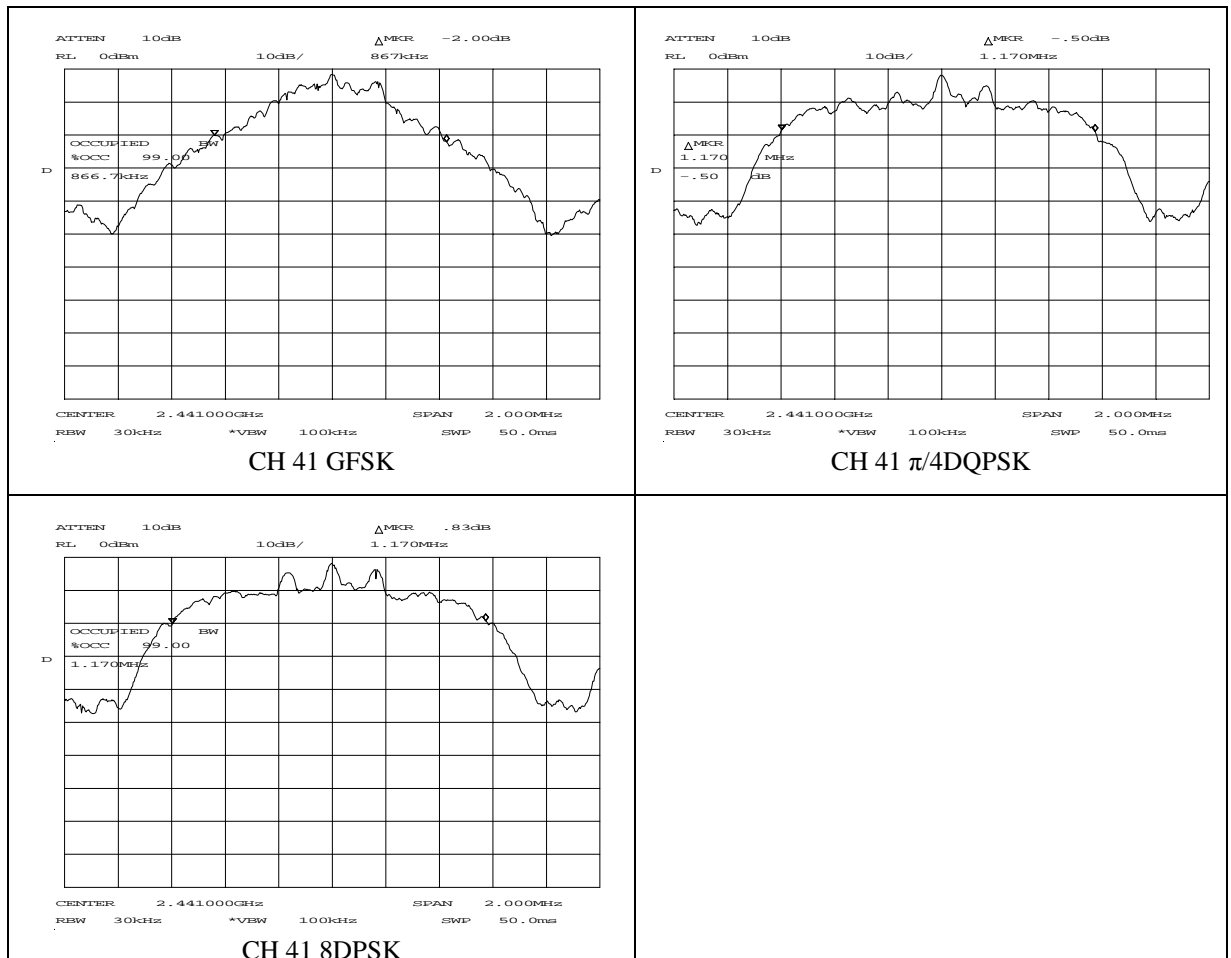
Compliance standard : RSS-Gen section 4.4
Method of test : RSS-Gen section 4.4

Ambient temperature : 20 °C
Relative humidity : 42 %

Test results :

| | | |
|-----------|---------------|----------|
| GFSK | $\pi/4$ DQPSK | 8DPSK |
| 866.7 kHz | 1170 kHz | 1170 kHz |

GFSK plots



Measurement uncertainty: + 23/- 23 kHz

3.5 Peak power output

Compliance standard : FCC part 15, subpart C, section 15.247 (b)(1)
Method of test : Public Notice DA 00-705 (conducted test)

Ambient temperature : 20 °C
Relative humidity : 42 %

Test results :

For 2 dBi antenna gain

| Modulation | Channel 2 | Channel 41 | Channel 80 |
|---------------|-------------------|-------------------|-------------------|
| GFSK | 0.6 dBm e.i.r.p. | 0.8 dBm e.i.r.p. | 0.8 dBm e.i.r.p. |
| $\pi/4$ DQPSK | -0.2 dBm e.i.r.p. | -0.3 dBm e.i.r.p. | -0.7 dBm e.i.r.p. |
| 8DPSK | -0.2 dBm e.i.r.p. | -0.3 dBm e.i.r.p. | -0.6 dBm e.i.r.p. |

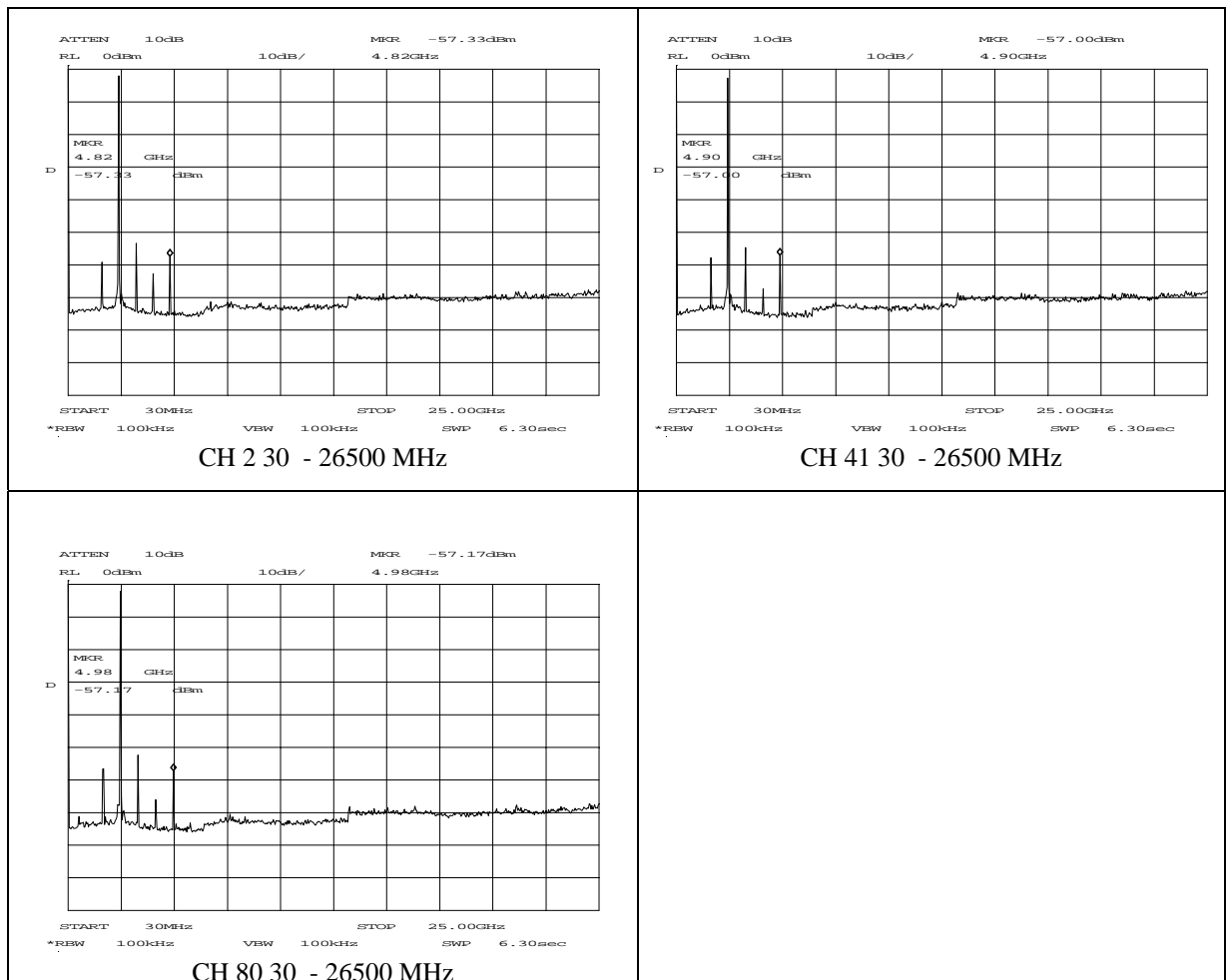
Measurement uncertainty: + 1.6/ -1.9 dB

3.6 Field strength of Tx unwanted emissions - conducted

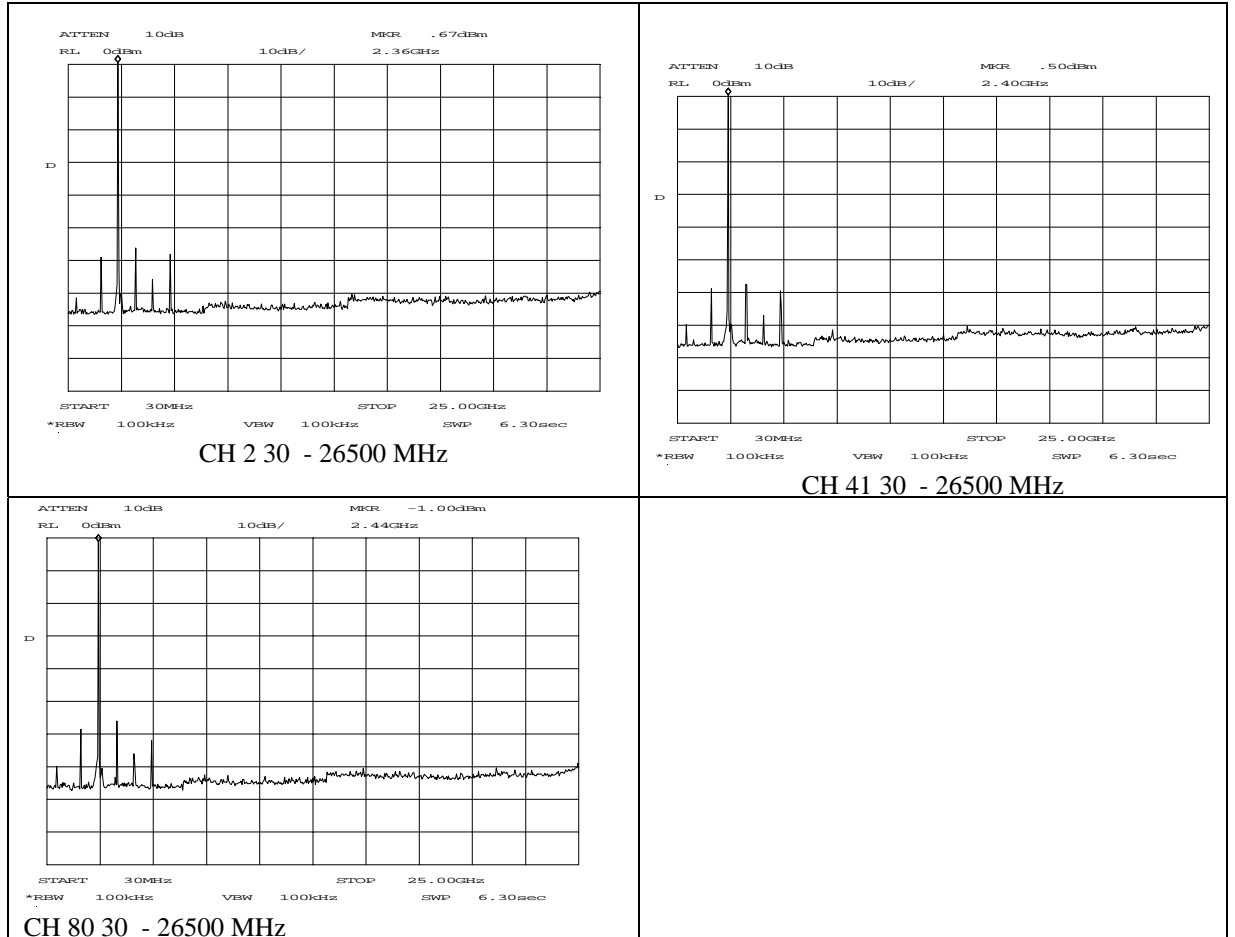
Compliance standard : FCC part 15, subpart C, section 15.247(d)
 Method of test : KDB publication number 558074
 Ambient temperature : 20 °C
 Relative humidity : 42 %

Test results :

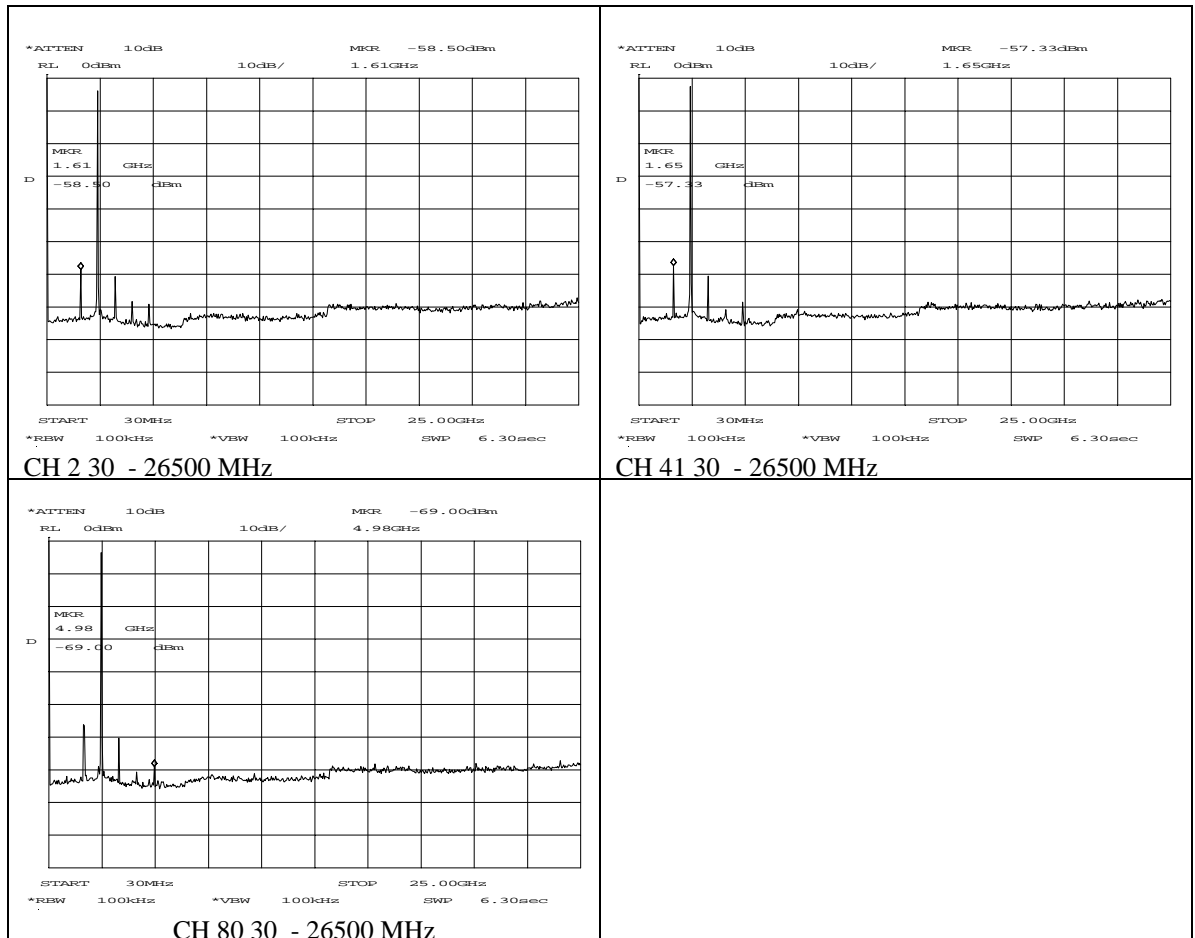
GFSK



Π/4 DQPSK



8DPSK



Measurement uncertainty: 0.03 – 2 GHz: +1.7 / -1.9 dB
> 2 GHz: +2.4 / -2.7 dB

3.7 Field strength of unwanted emissions in restricted bands

Compliance standard : FCC part 15, subpart C, section 15.205(a)
 Method of test : FCC Public Notice DA 00-705
 Ambient temperature : 20 °C
 Relative humidity : 42 %

| Frequency (MHz) | Peak value (dBμV/m) | Remark |
|-----------------|---------------------------|---------------------------------------|
| 1600 | $-49.7 + 95.2 = 45.5$ | Relates to ch 2 ($\pi/4$ DQPSK) |
| 1626.3 | $-52.5 + 95.2 = 42.7$ | Relates to ch 41 (8DPSK) |
| 4003 | $-2.1 - 50 + 95.2 = 43.1$ | Relates to ch 2 (GFSK) |
| 4068 | $-4.6 - 66 + 95.2 = 24.6$ | Relates to ch 41(GFSK) |
| 4134 | $-6.9 - 66 + 95.2 = 22.3$ | Relates to ch 80 (GFSK) |
| 4804 | $-57.3 + 2 + 95.2 = 39.9$ | 2 nd harm. of ch 2 (GFSK) |
| 4882 | $-57.0 + 2 + 95.2 = 40.2$ | 2 nd harm. of ch 41 (GFSK) |
| 4960 | $-57.2 + 2 + 95.2 = 40.0$ | 2 nd harm. of ch 80 (GFSK) |

Measurement uncertainty: +4.5 dB / -6.0 dB

Note 1: values stated in the table above are worst case for all three types of modulation.

Note 2: as the peak values are below the average limit, there was no need to perform average detector measurements.

3.8 Average time of occupancy *

| | |
|---|--|
| Hops per second (Bluetooth specification) | 1600 |
| Time of occupancy on any channel | 1/1600 sec. |
| Frequency retention time in one 31.6 sec. period on any channel | $(\text{time slot length} \times \text{hop rate} / \text{no. of hopping channels}) \times 31.6 \text{ sec}$ $(5 \times 625 \mu\text{sec} \times 1600 \times 1/5 \times 1/\text{sec} / 79) \times 31.6 \text{ sec} = 0.4 \text{ sec.}$ |

* DM5/DH5 packet size for Tx; DM1/DH1 packet size for Rx

Limit values:

| | |
|--------------------------|---|
| Frequency retention time | $\leq 0.4 \text{ sec. in one } 31.6 \text{ sec. period } (79 \times .4 \text{ sec.})$ |
|--------------------------|---|

Test equipment:

| | |
|-------------------------------------|------|
| Test equipment used: (Item numbers) | n.a. |
|-------------------------------------|------|

3.9 Field strength of Rx unwanted emissions - radiated

Compliance standard : FCC part 15, subpart B, section 15.109
RSS-Gen, section 6, table 1

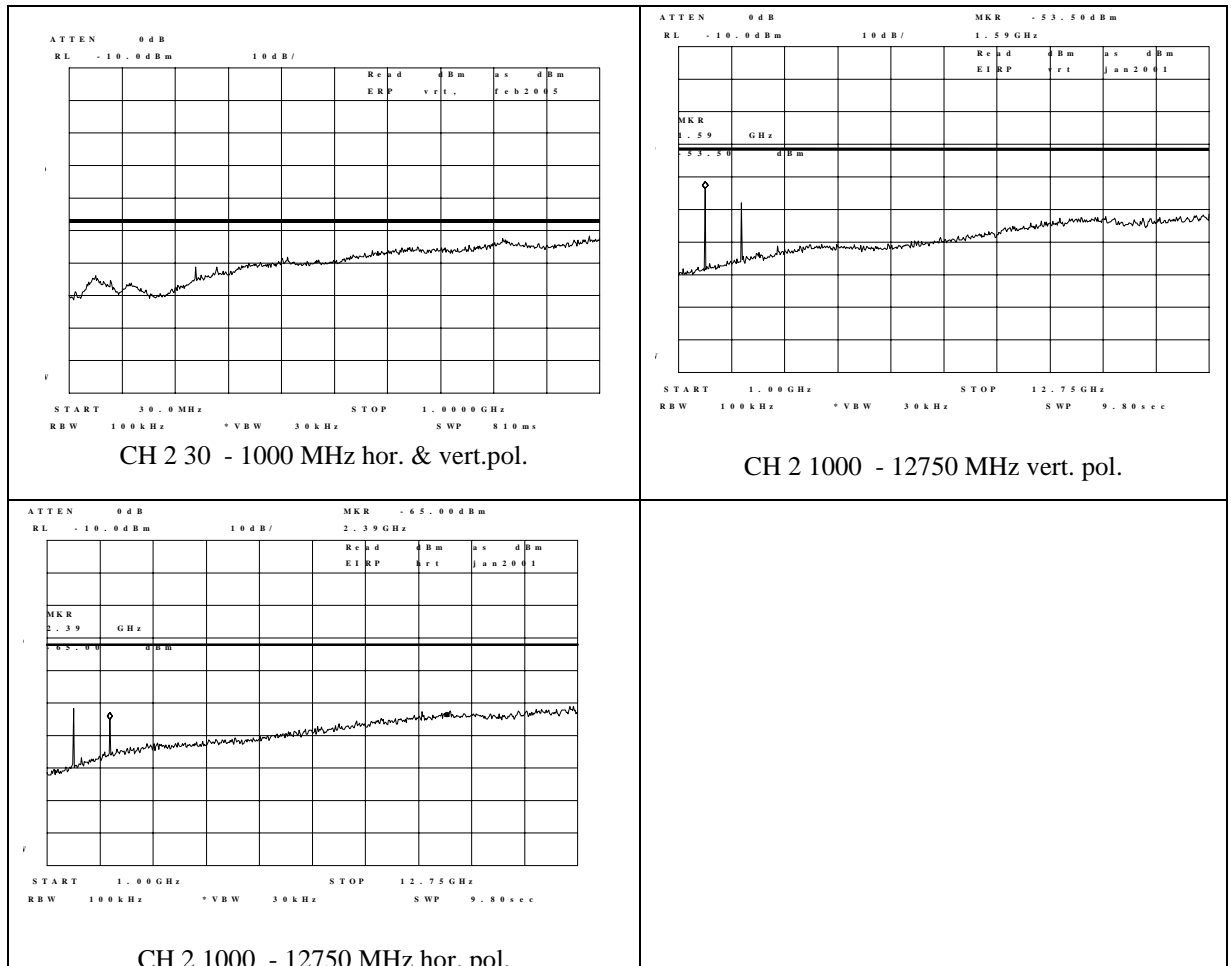
Method of test : FCC Public Notice DA 00-705
FCC part 15, subpart A, sections 15.31(f)(1), 15.31(m), 15.33, 15.35.

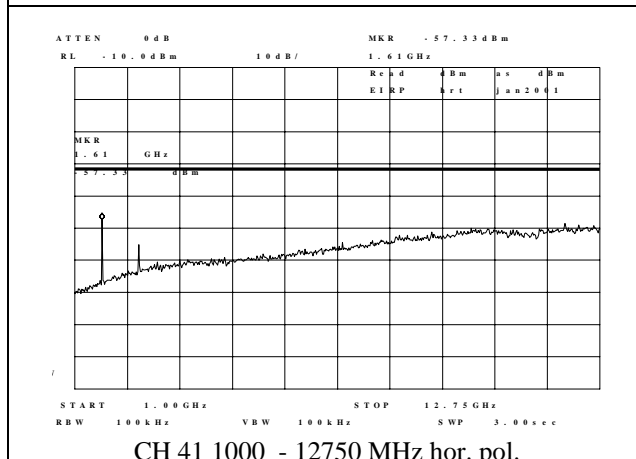
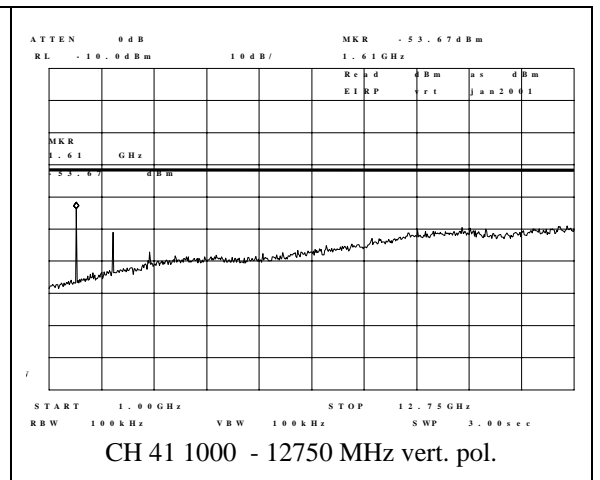
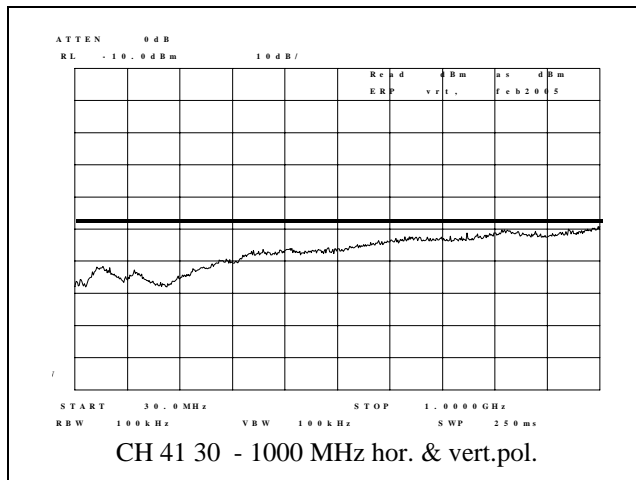
Ambient temperature : 20 °C

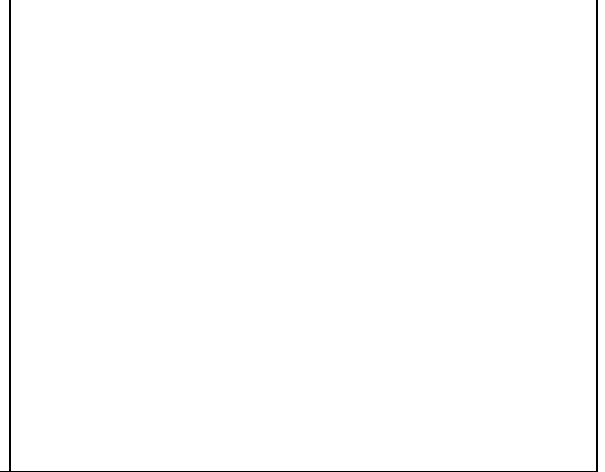
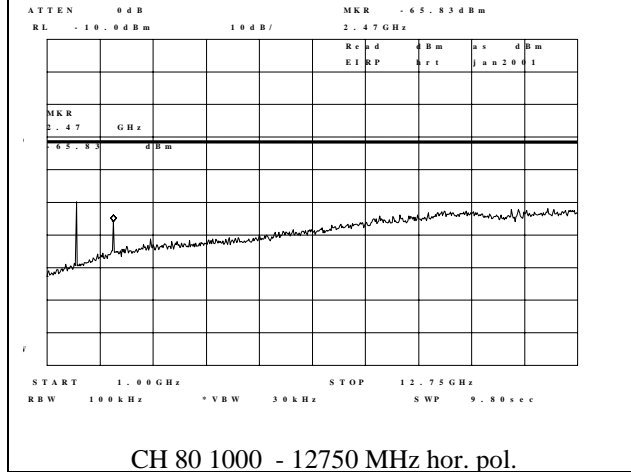
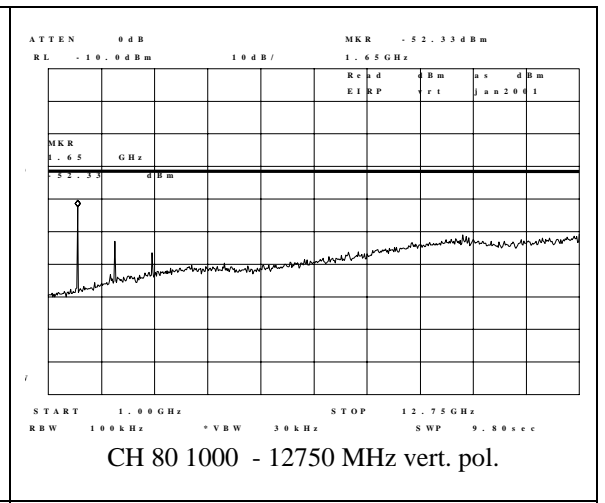
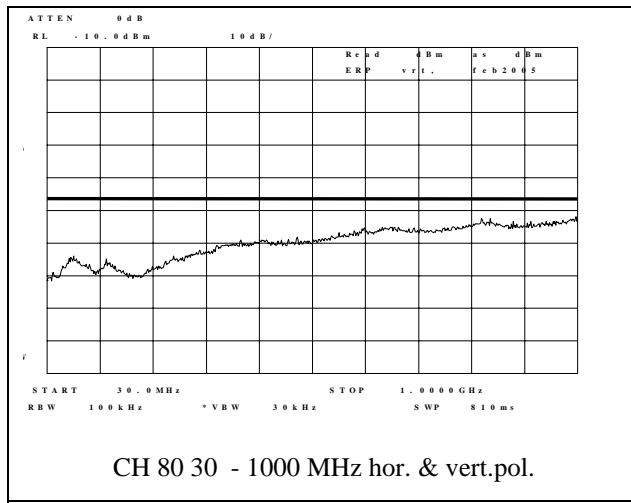
Relative humidity : 42 %

Test results :

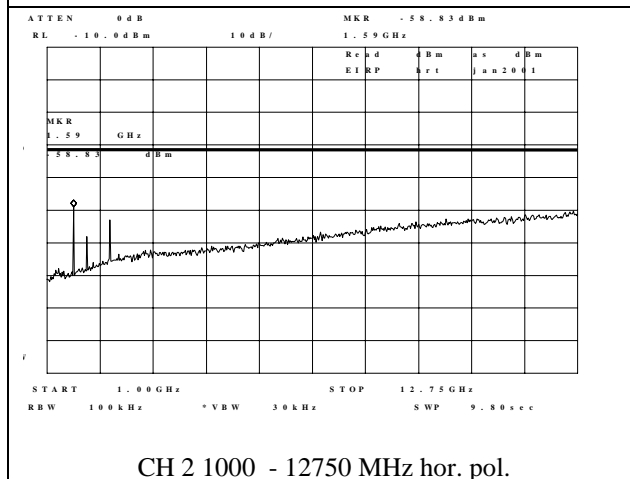
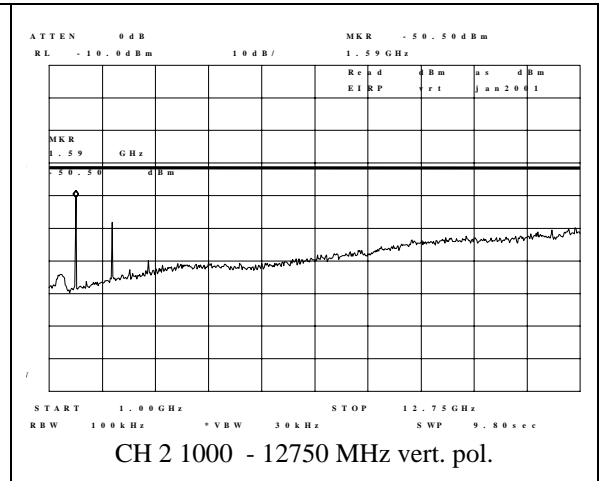
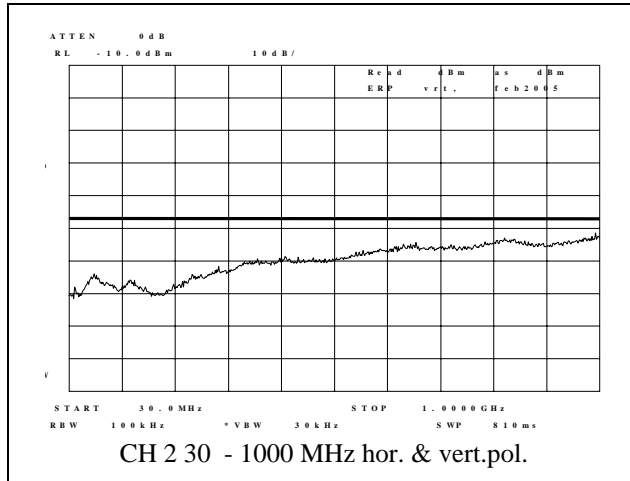
GESK

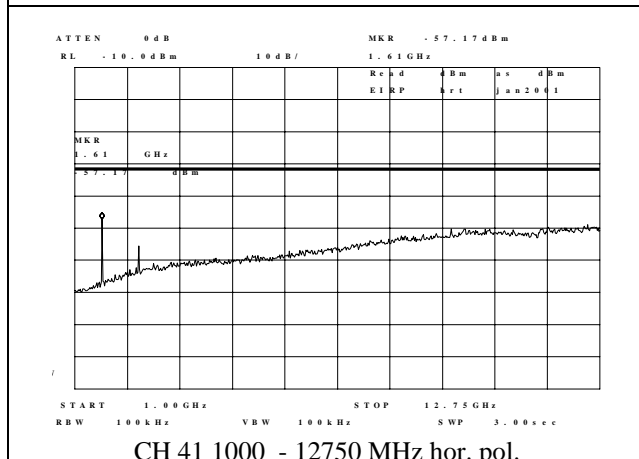
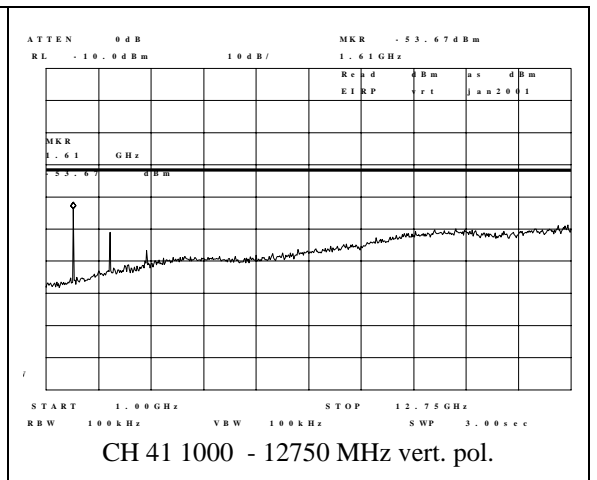
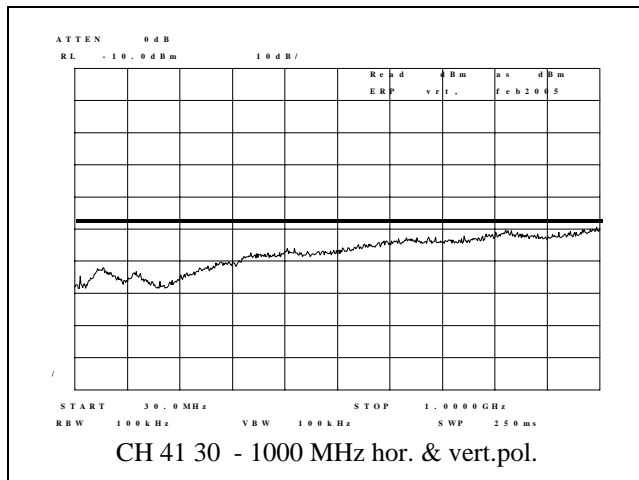


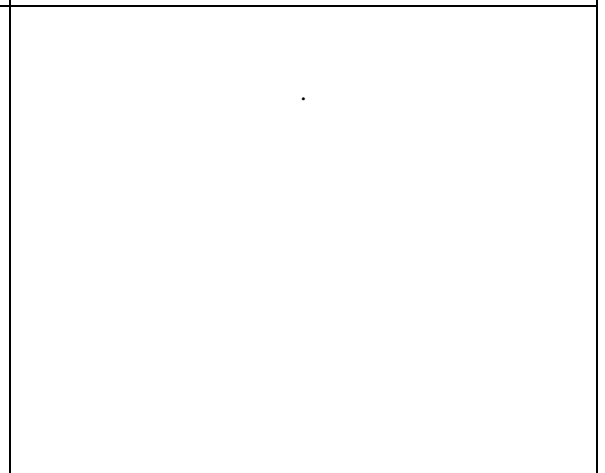
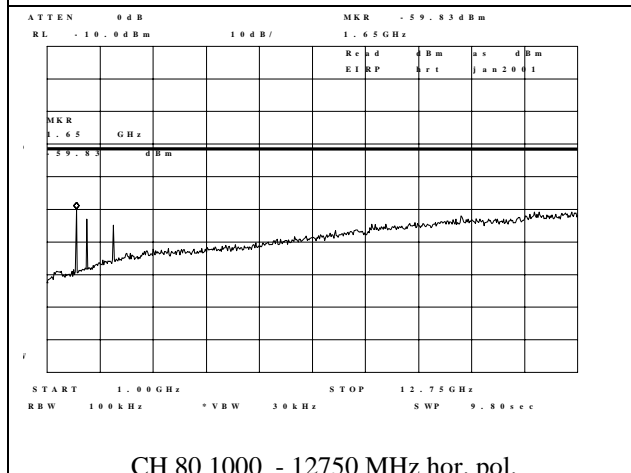
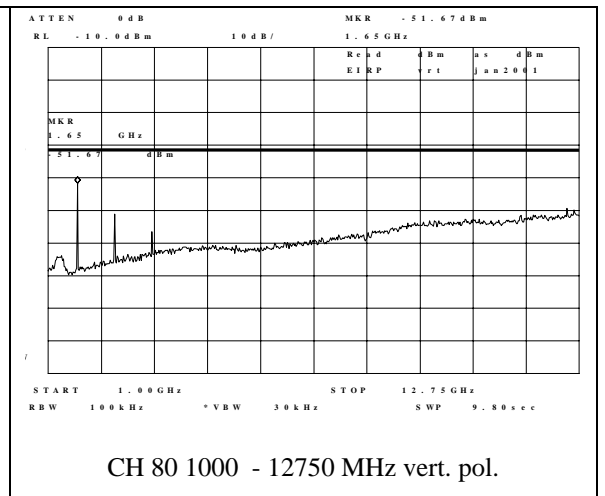
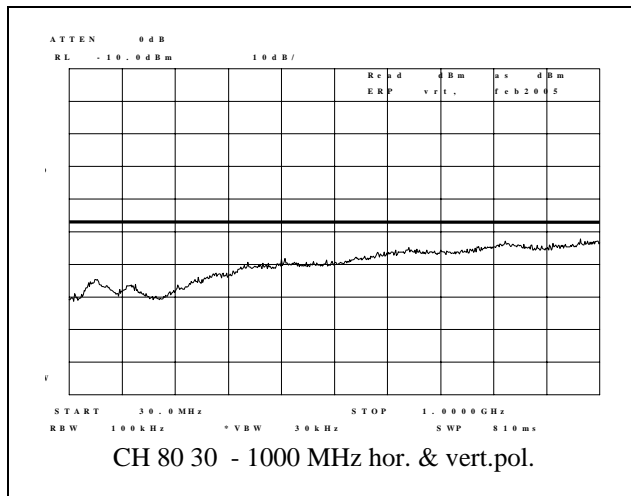




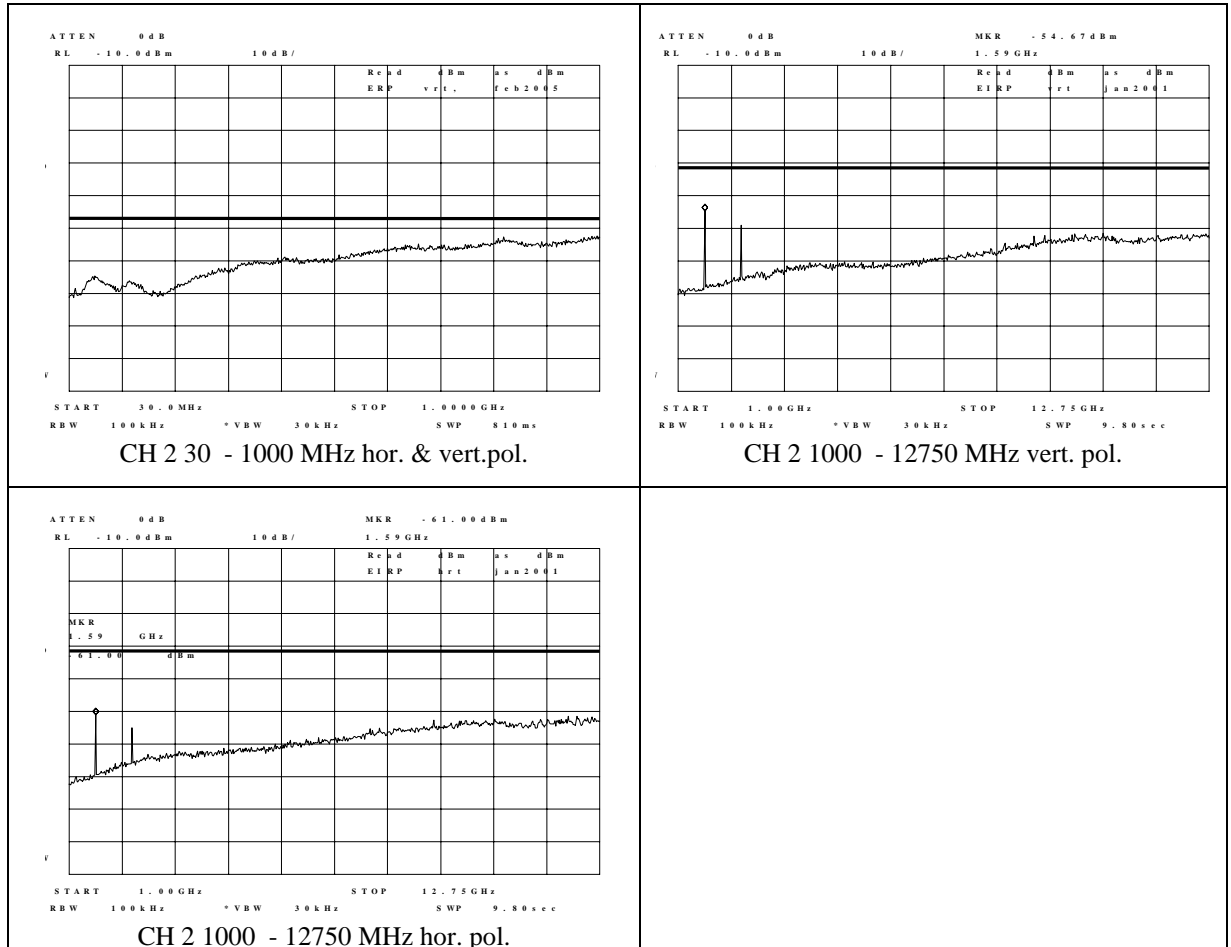
11/4QPSK

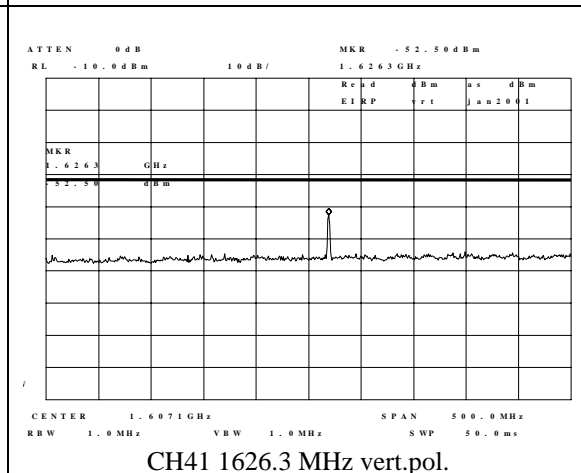
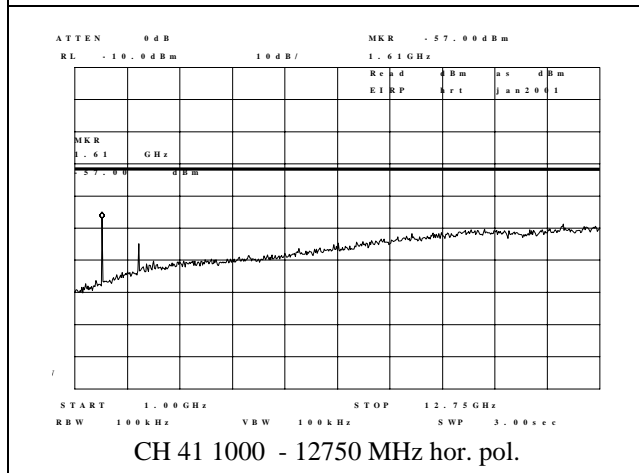
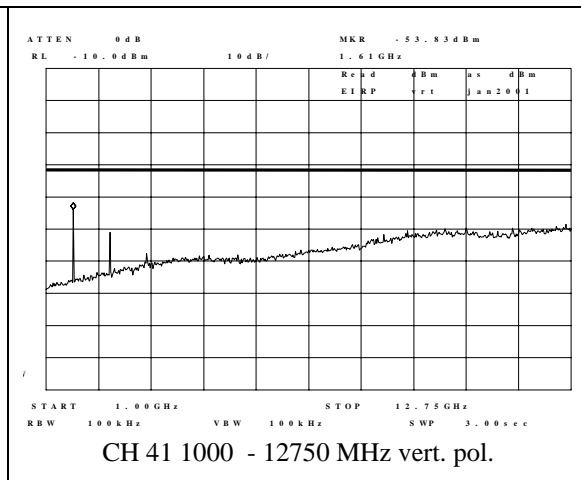
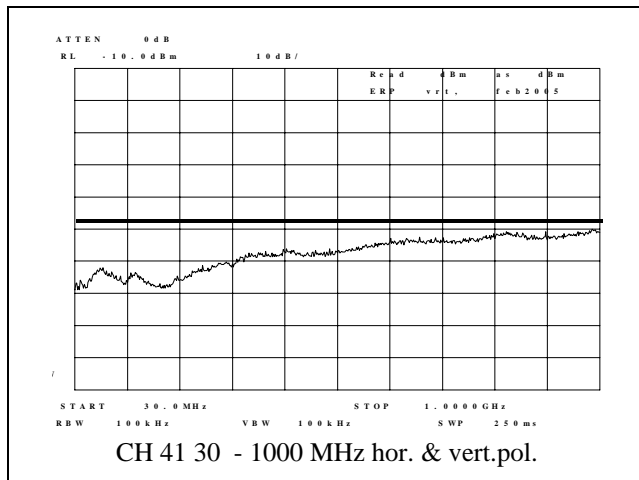


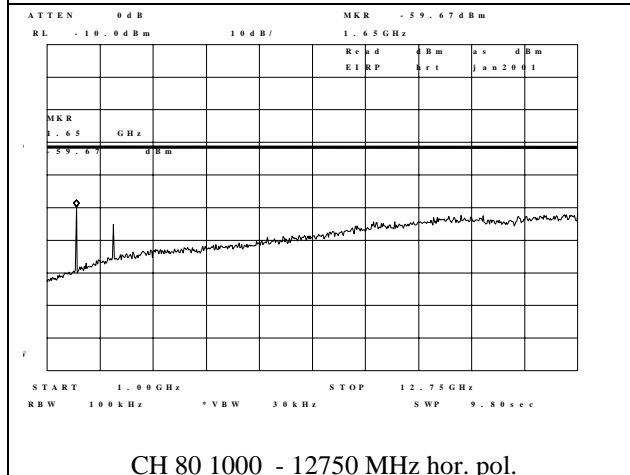
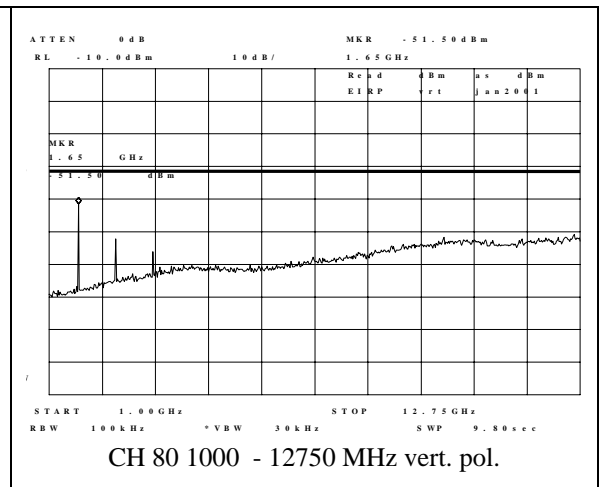
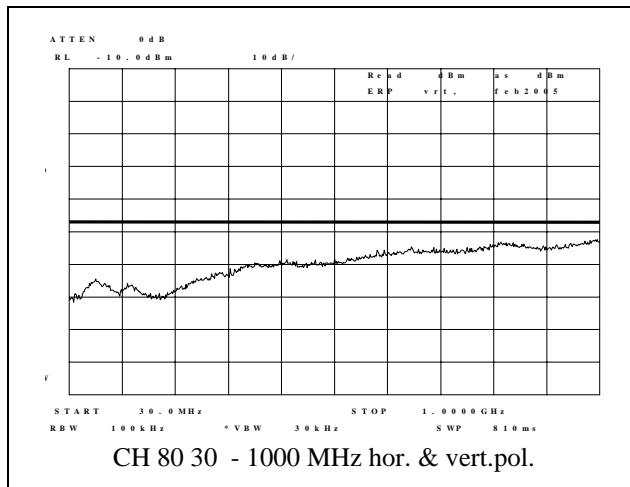




8DPSK







Note 1: plots in this section show limits, which result from conversion using:

$$P_{dBm\ e.i.r.p.} = E_{dB\mu V/m} - 95.2\ dB$$

Note 2: above 1 GHz a measuring distance of 1 m was used.

Measurement uncertainty: $\leq 1\ GHz: +2.6/-3.3\ dB$
 $> 1\ GHz: +4.5/-6.1\ dB$

Used test equipment module

| Description | Telef. ID | Manufacturer | Model | Used at par. |
|---------------------------------|-----------|-----------------|-----------|-----------------------------------|
| Spectrum Analyzer | TE 00481 | Hewlett Packard | HP8563E | 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.9 |
| Power meter | TE 00489 | Hewlett Packard | 437B | 3.5 |
| Power sensor | TE 00355 | Hewlett Packard | 8481A | 3.5 |
| Attenuator | TE 00403 | Hewlett Packard | 8491A | 3.5 |
| RF Pre-amplifier up to 1000 MHz | TE 00098 | Rohde & Schwarz | ESV-Z3 | 3.9 |
| RF Pre-amplifier 1 - 26.5 GHz | TE 00093 | Hewlett Packard | HP8449B | 3.9 |
| Biconilog antenna | TE 00700 | Emco | 3143 | 3.9 |
| Horn Antenna 1 - 18 GHz | TE 00532 | Emco | 3115 | 3.9 |
| Anechoic Chamber | TE 01064 | Euroshield | RFD-F-100 | 3.9 |
| Antenna tower | -- | HD | AS 620p | 3.9 |
| Turntable | -- | HD | DS 412 | 3.9 |
| Turntable controller | -- | HD | HD 050 | 3.9 |

Cross reference table

| Transmitter | |
|------------------------------------|--|
| IC RSS-210 Issue 6, Annex 8 | FCC 47 CFR Ch. 1 part 15, subpart C (10-1-05 Edition) |
| A8.1 (1) | -- |
| A8.1 (2) | section 15.247 (a) (1) |
| A8.1 (4) | section 15.247 (a) (1) (iii) |
| A8.4 (2) | section 15.247 (b) (1) |
| A8.4 (6) | section 15.247 (b) (4) |
| A8.5 | section 15.247 (d) |
| Receiver | |
| IC RSS-Gen Issue 1 | FCC 47 CFR Ch. 1 part 15, subpart B (10-1-05 Edition) |
| Section 6, table 1 | section 15.109 |
| Section 4.4 | -- |

Revision history

| REVISION | DATE | REMARKS |
|----------|-----------------|--|
| 1.0 | 10 January 2007 | Section 2 "Summary of test data": number of channels added Section 3.3 "Number of channels" added Section 3.8: calculation result 0.397 changed into 0.4 |