

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 Nieuwerkerk

TNO Electronic Products & Services (EPS) B.V
Smidshornerweg 18
9822 TL Nieuwerkerk
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 :



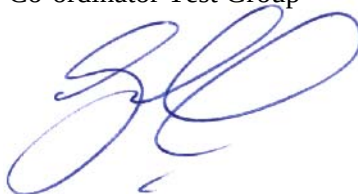
The above conclusions have been verified by the following signatory:

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)	$\geq 2/3 \cdot 20$ 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

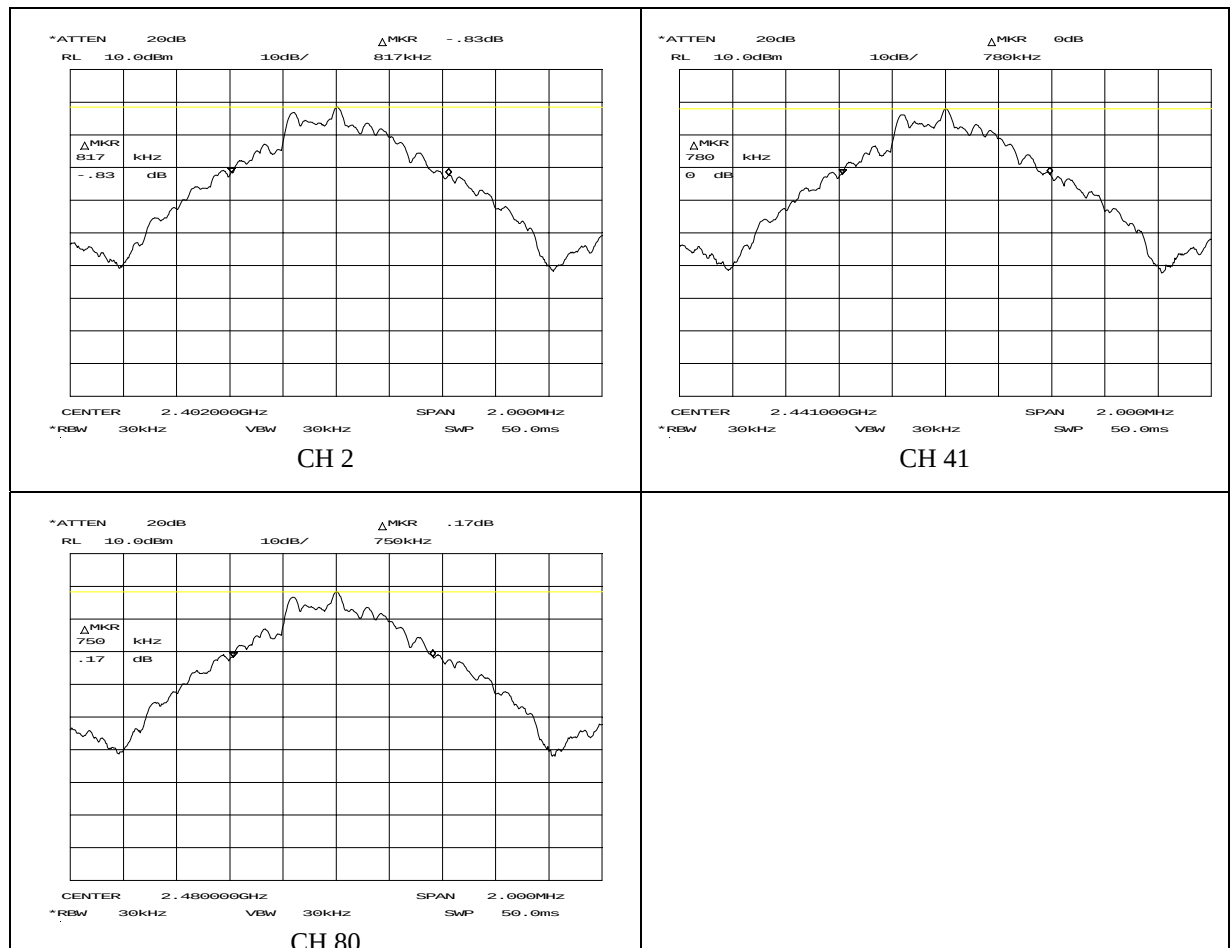
Compliance standard : FCC part 15, subpart C, section 15.247 (a)(1)
Method of test : Public Notice DA 00-705

Ambient temperature : 20 °C
Relative humidity : 42 %

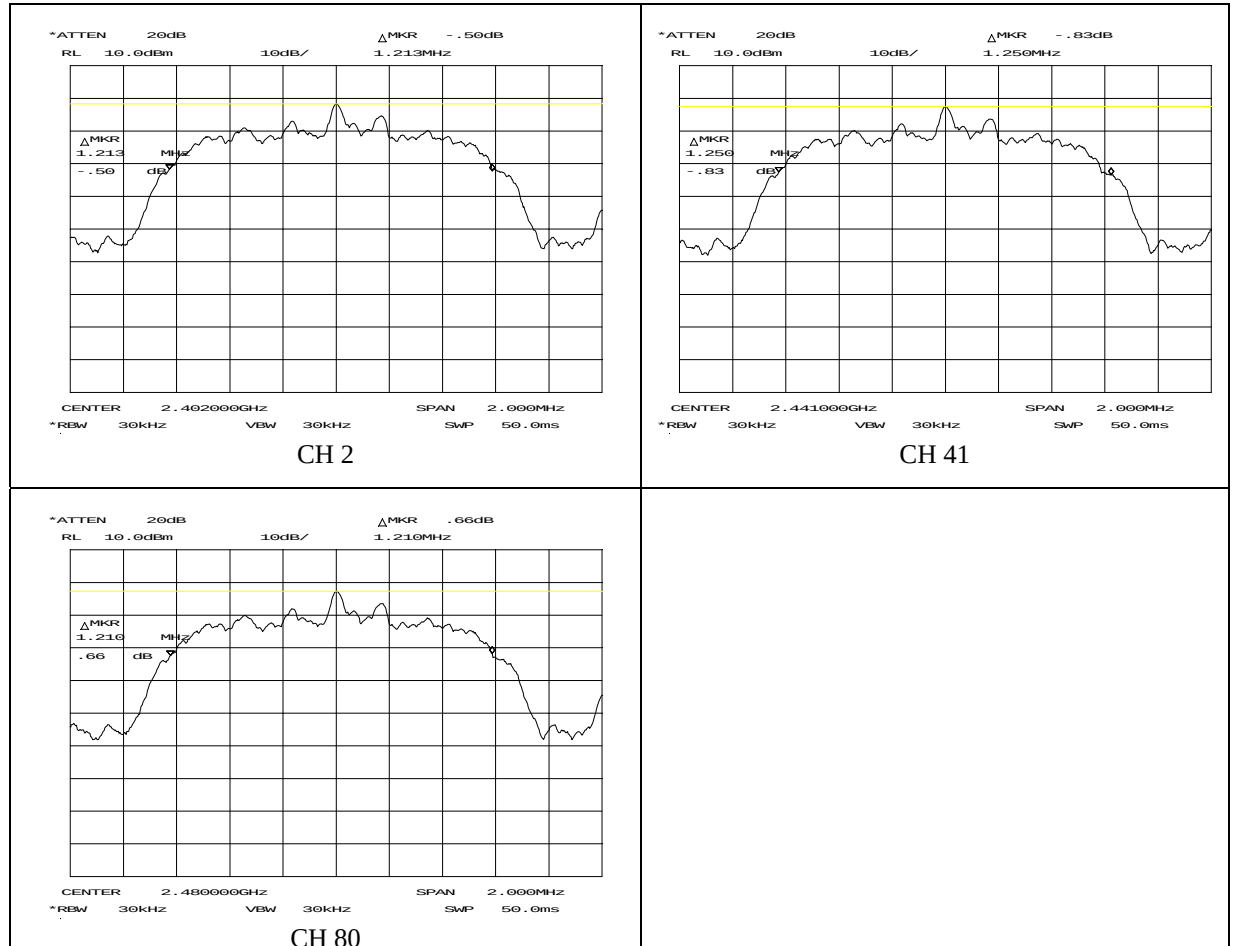
Test results :

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

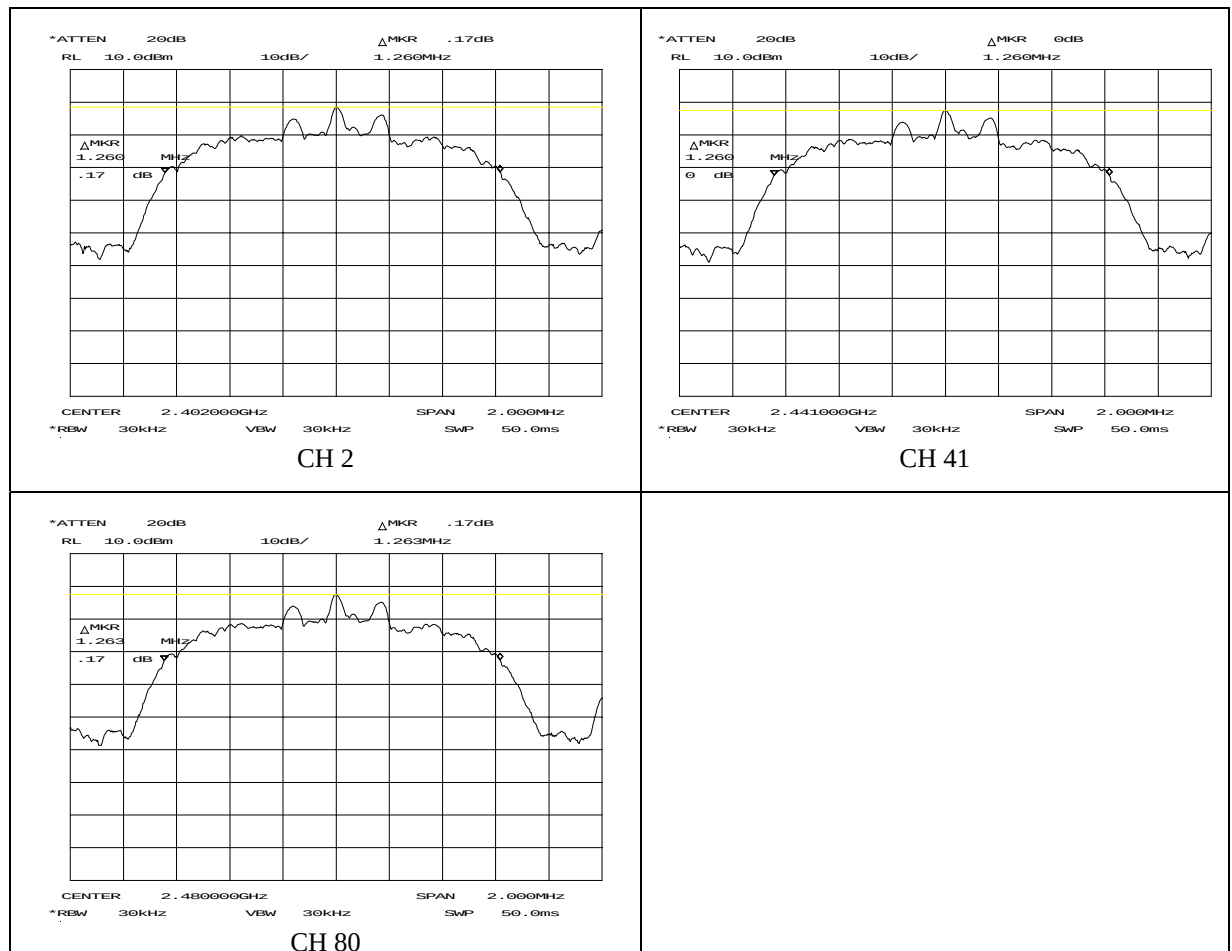
GFSK plots



$\pi/4$ DQPSK plots



8DPSK plots



Measurement uncertainty: + 23/- 23 kHz

3.2 Channel separation

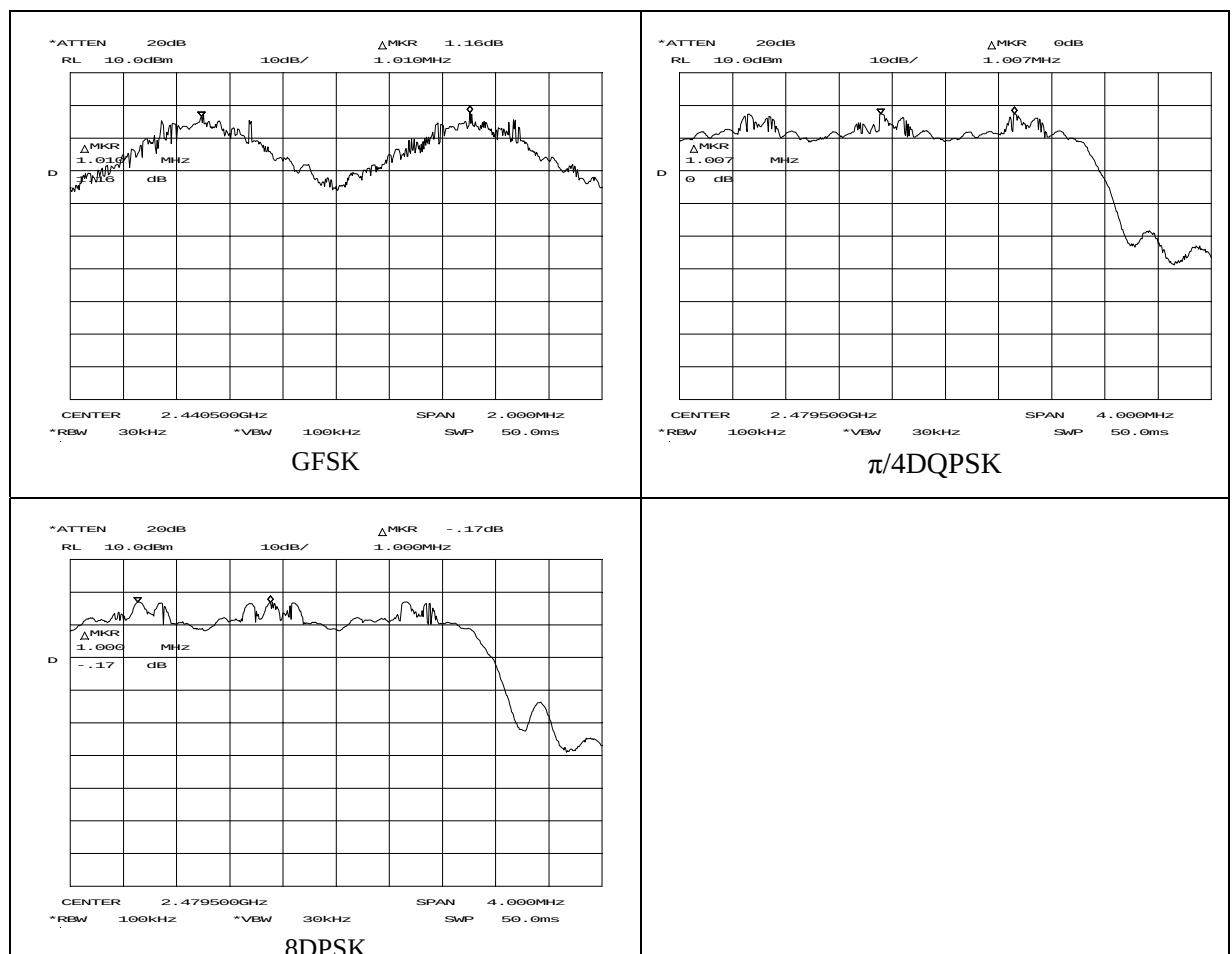
Compliance standard : FCC part 15, subpart C, section 15.247 (a)(1)
Method of test : Public Notice DA 00-705

Ambient temperature : 20 °C
Relative humidity : 42 %

Test results :

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

Plots

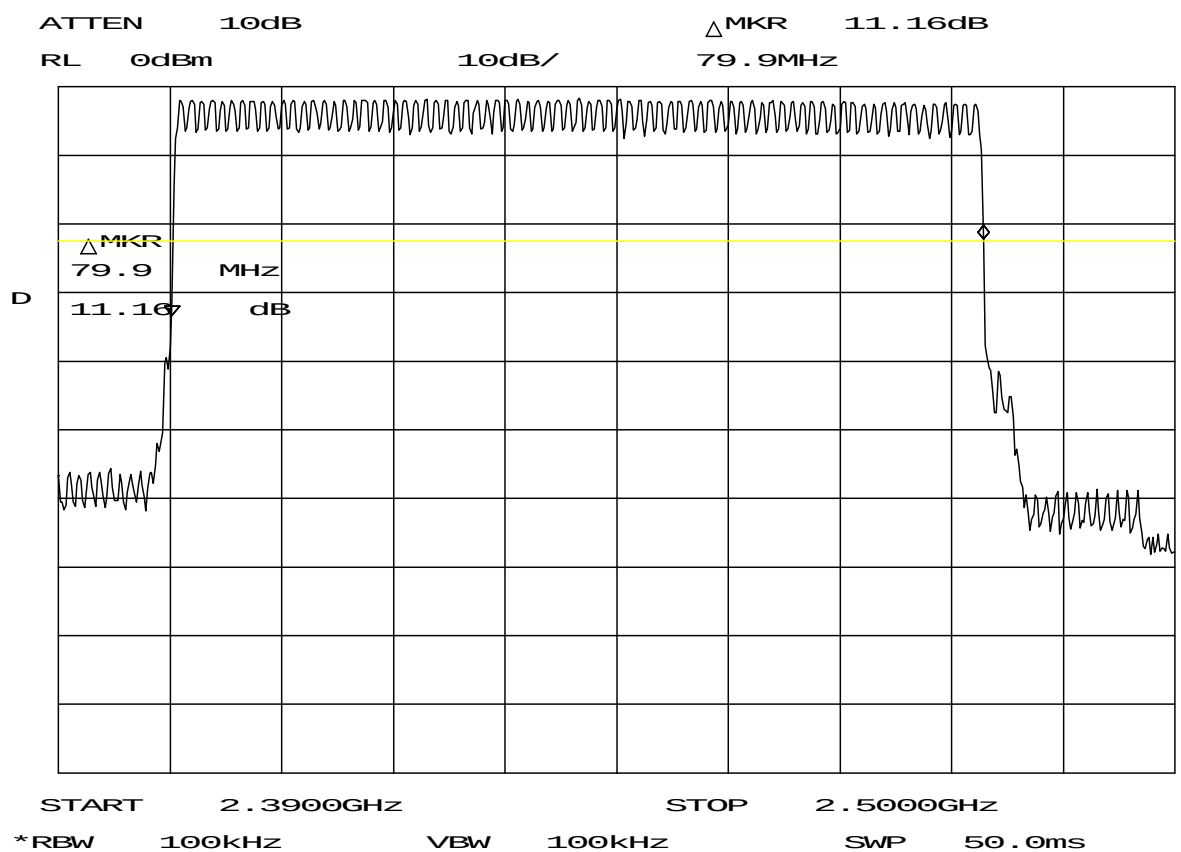


Measurement uncertainty: + 46/- 46 kHz

3.3 Number of channels

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

Ambient temperature : 20 °C
Relative humidity : 42 %



From the plot above it can be seen that 79 channels are contained in the frequency band 2400 – 2483.5 MHz.

3.4 Occupied bandwidth (99%)

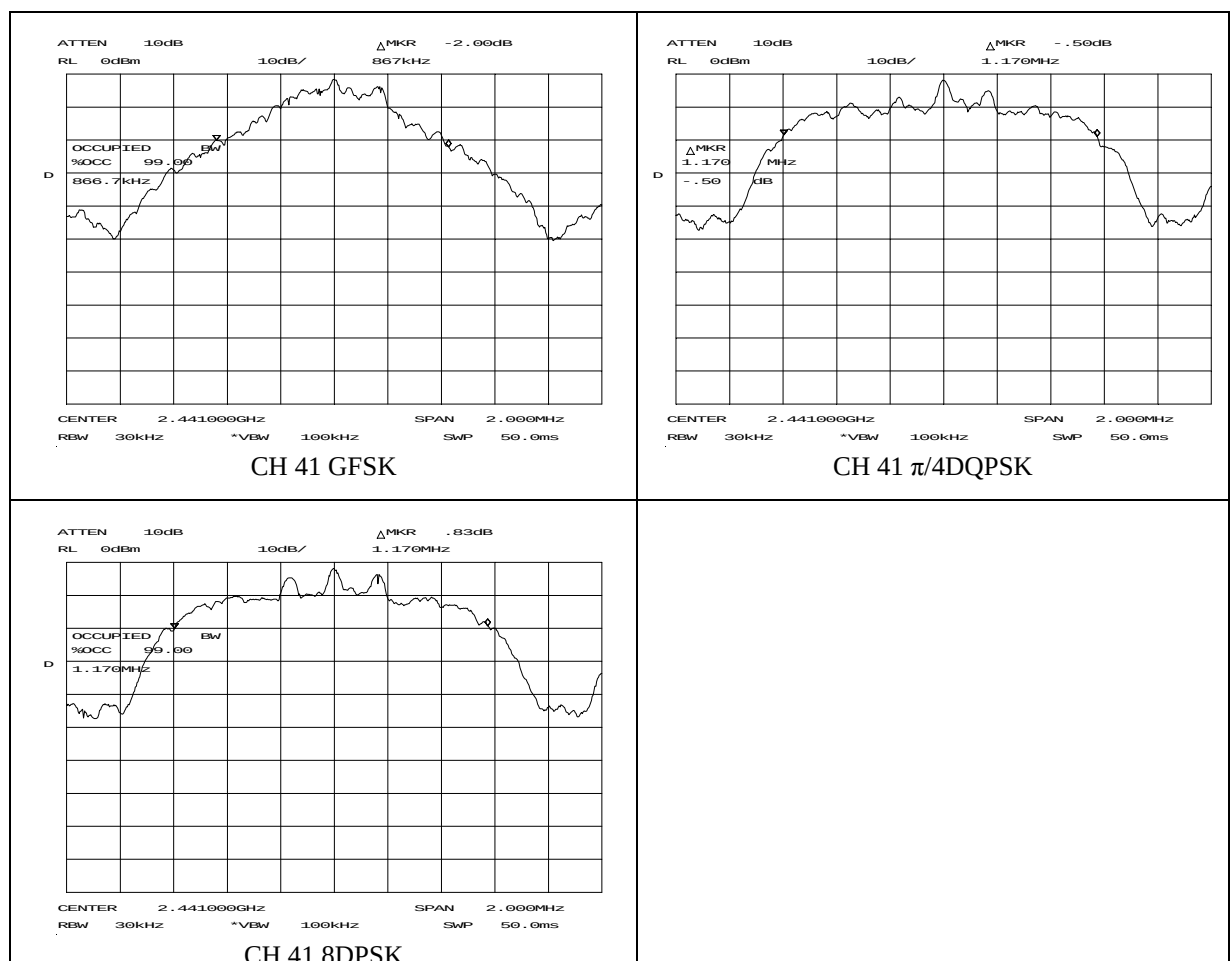
Compliance standard : RSS-Gen section 4.4
Method of test : RSS-Gen section 4.4

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.

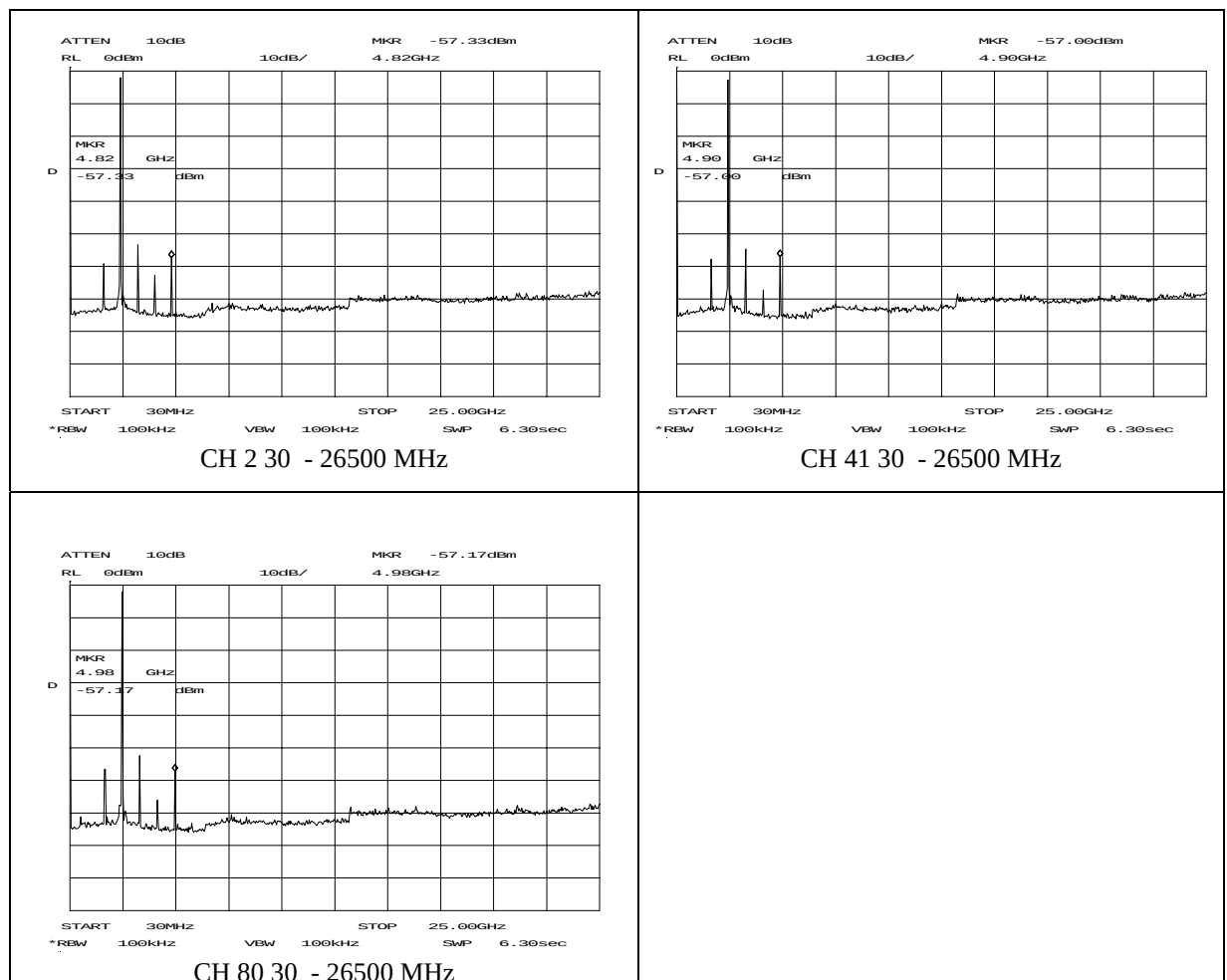
Measurement uncertainty: + 1.6/ -1.9 dB

3.6 Field strength of Tx unwanted emissions - conducted

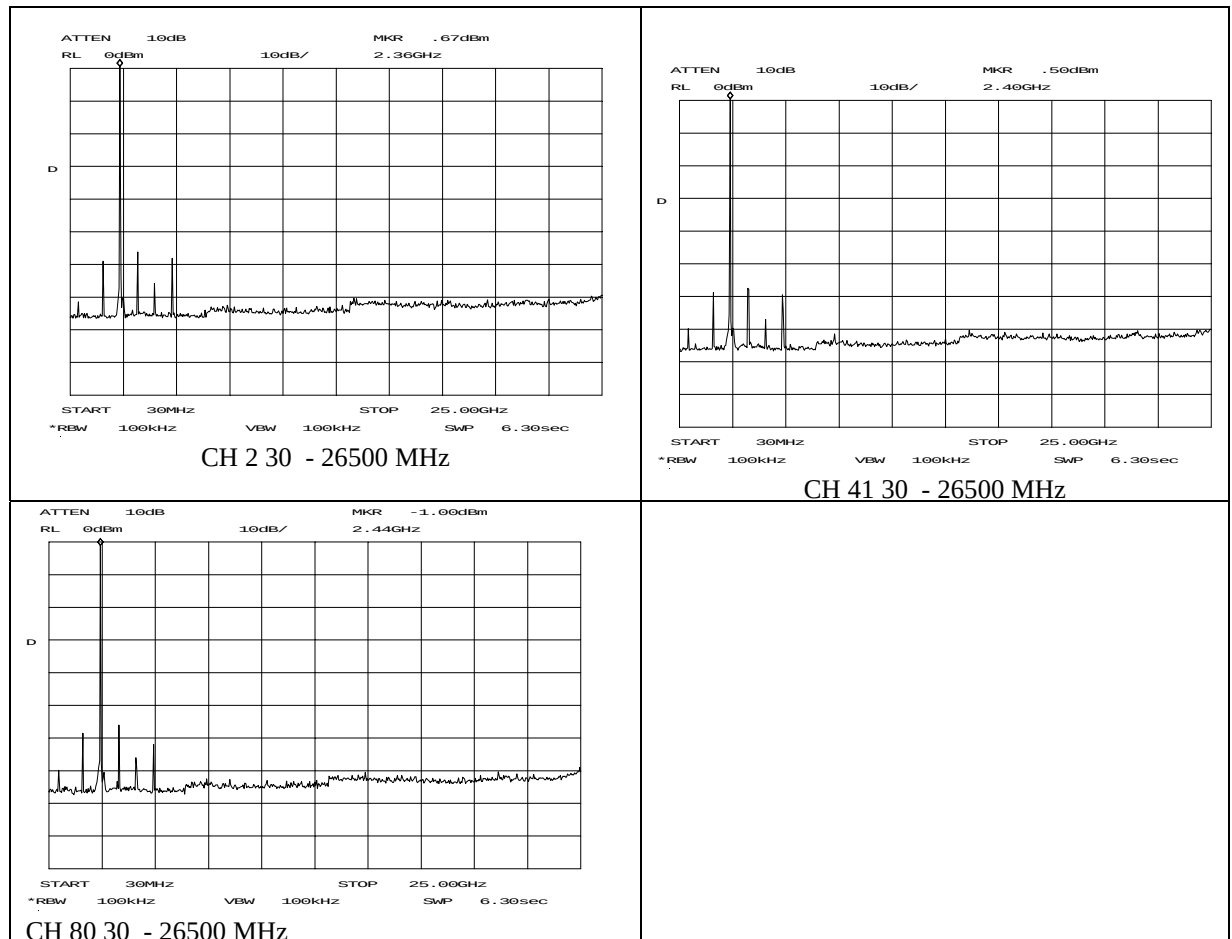
Compliance standard : FCC part 15, subpart C, section 15.247(d)
Method of test : KDB publication number 558074
Ambient temperature : 20 °C
Relative humidity : 42 %

Test results :

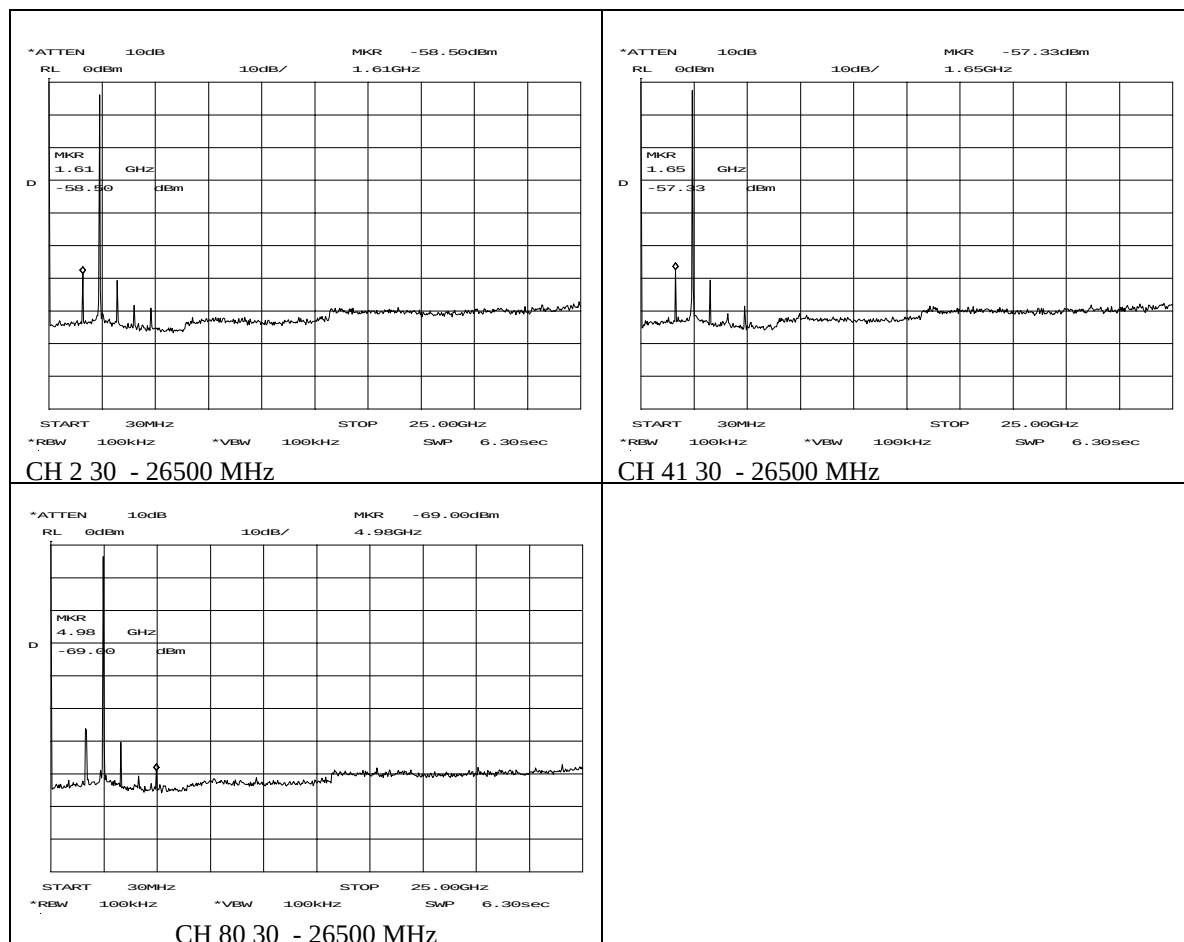
GESK



$\Pi/4$ 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	$\leq 0.4 \text{ sec. in one 31.6 sec. period (79} \times .4 \text{ sec.)}$
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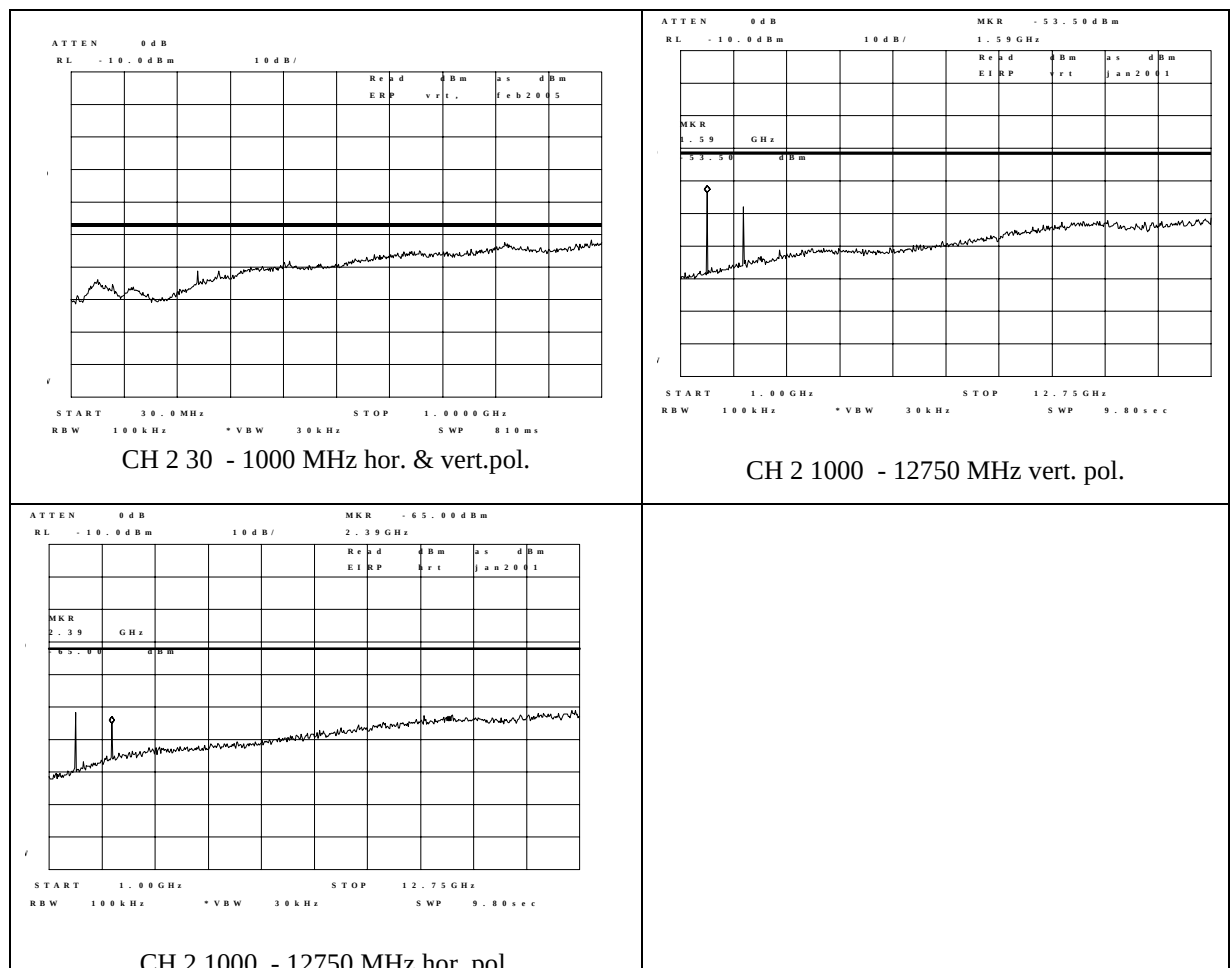
Test equipment:

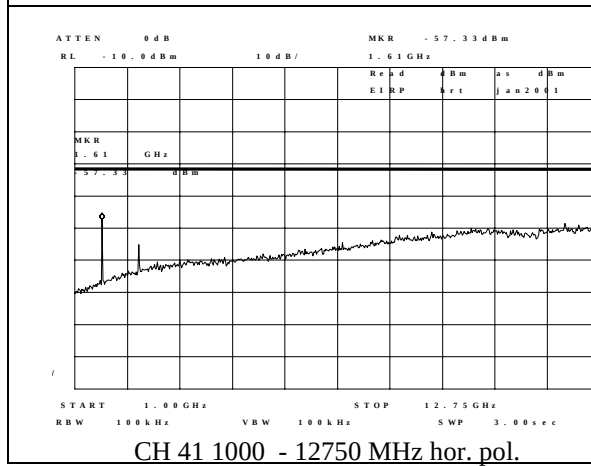
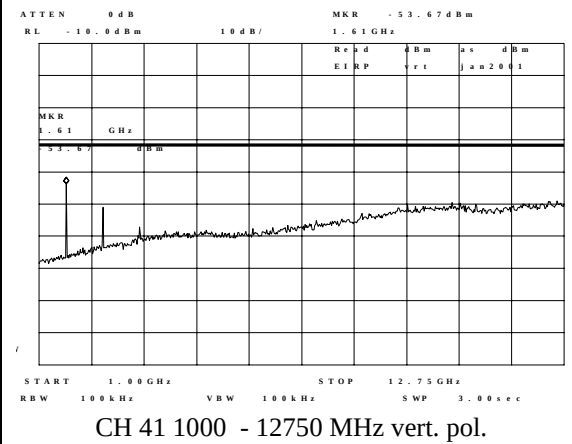
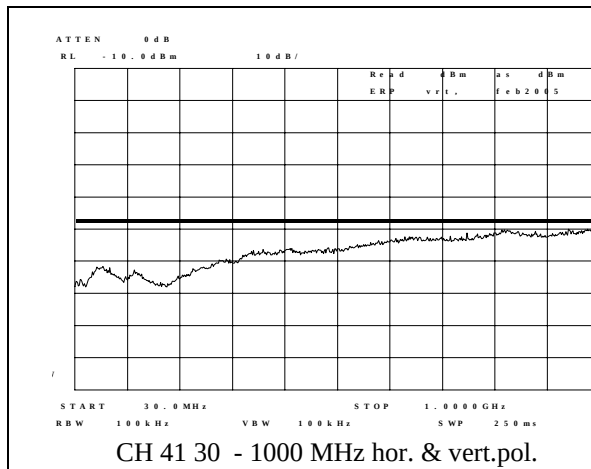
Test equipment used: (Item numbers)	n.a.
-------------------------------------	------

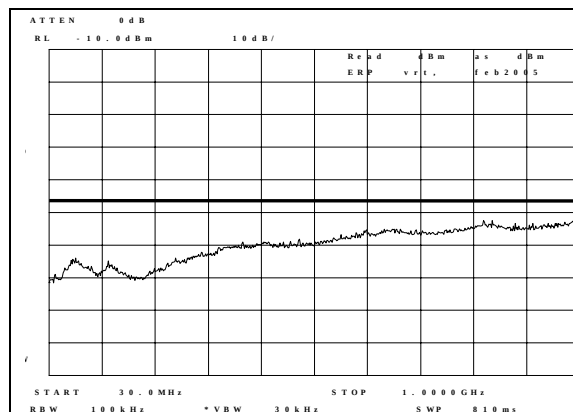
3.9 Field strength of Rx unwanted emissions - radiated

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 :

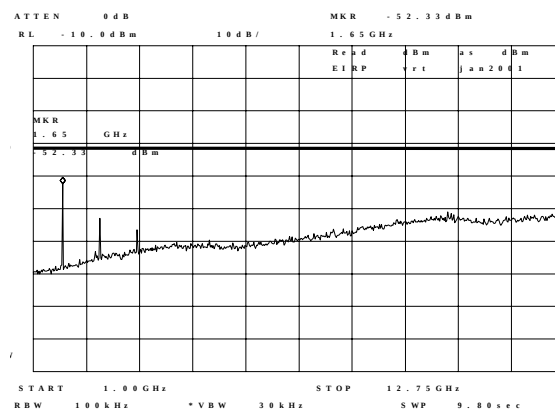
GESK



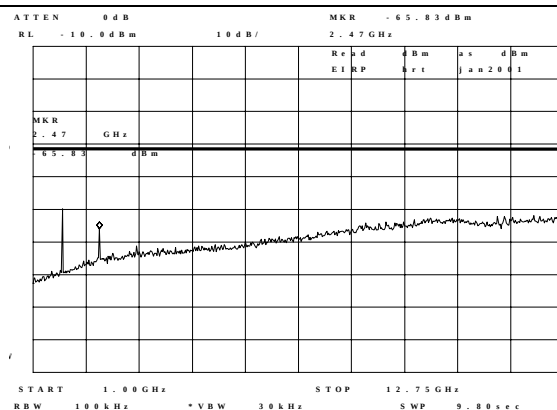




CH 80 30 - 1000 MHz hor. & vert. pol.

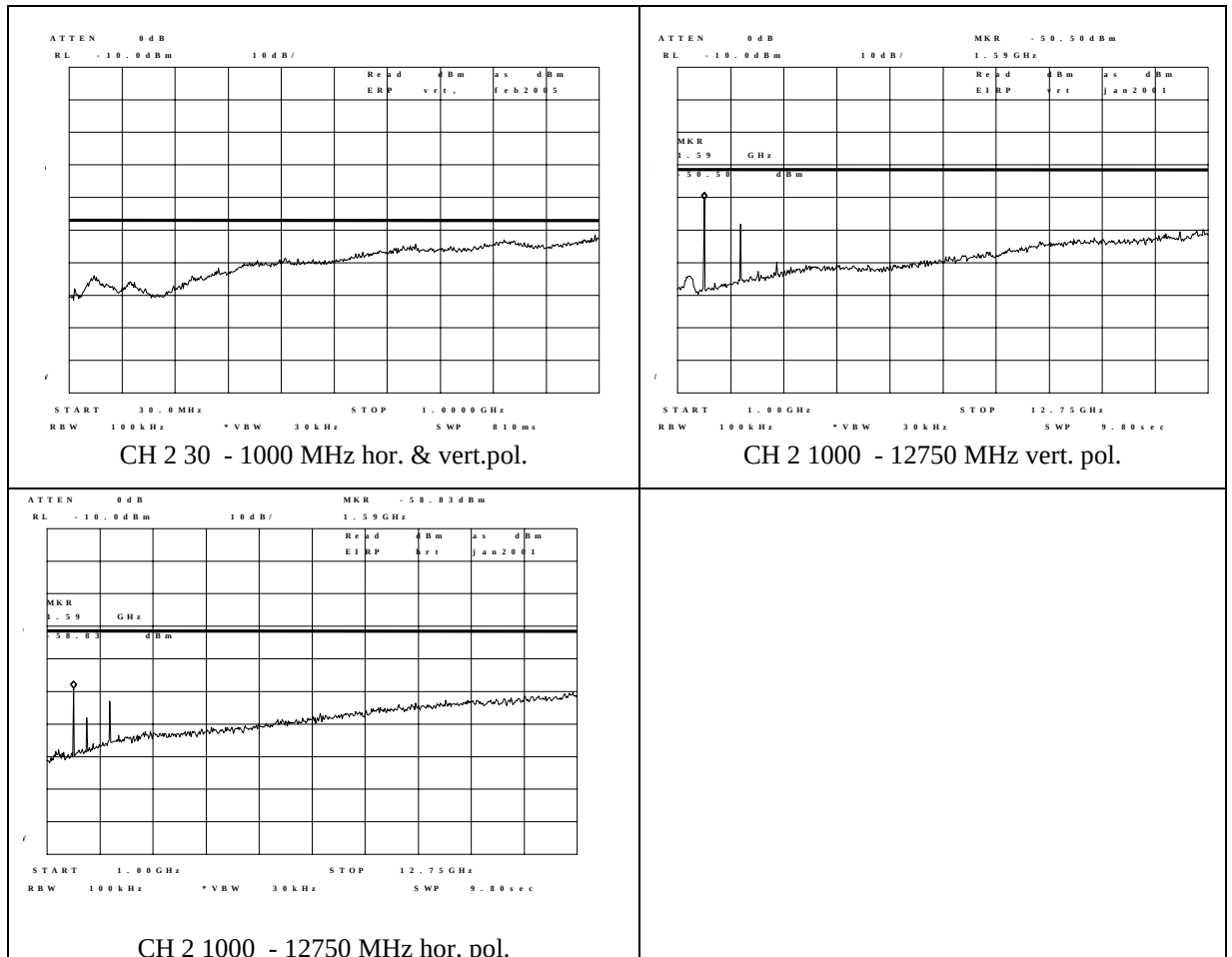


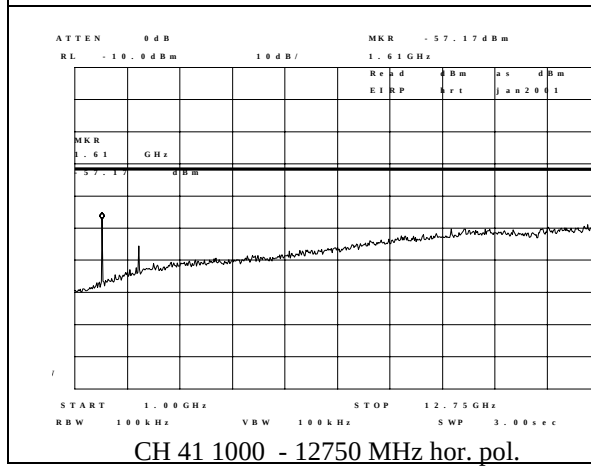
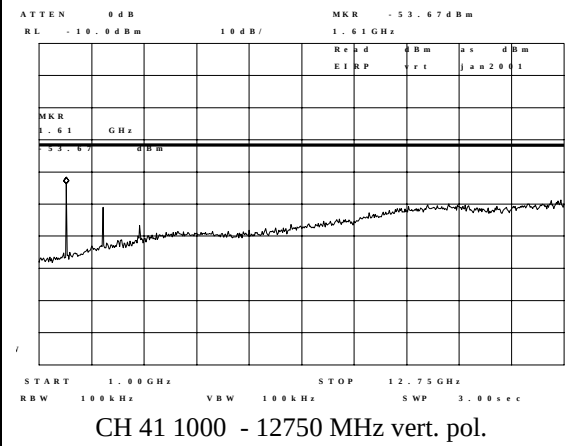
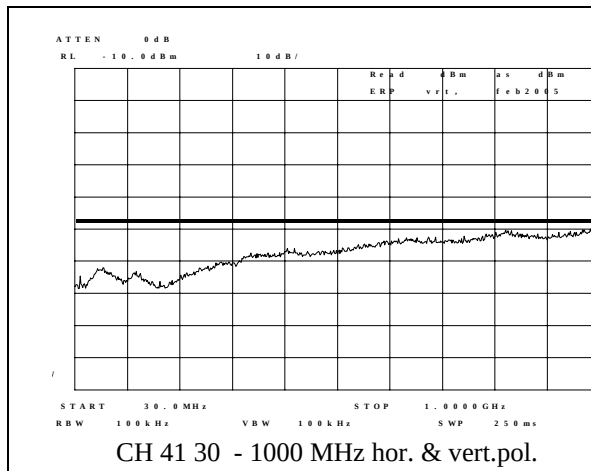
CH 80 1000 - 12750 MHz vert. pol.

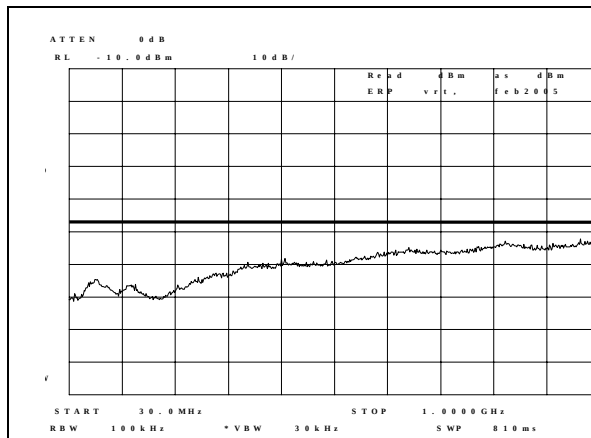


CH 80 1000 - 12750 MHz hor. pol.

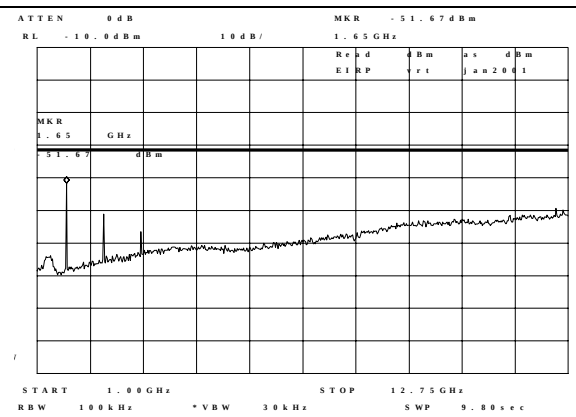
II/4DQPSK



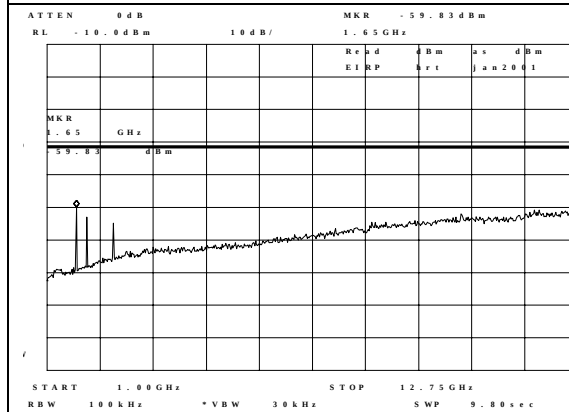




CH 80 30 - 1000 MHz hor. & vert.pol.

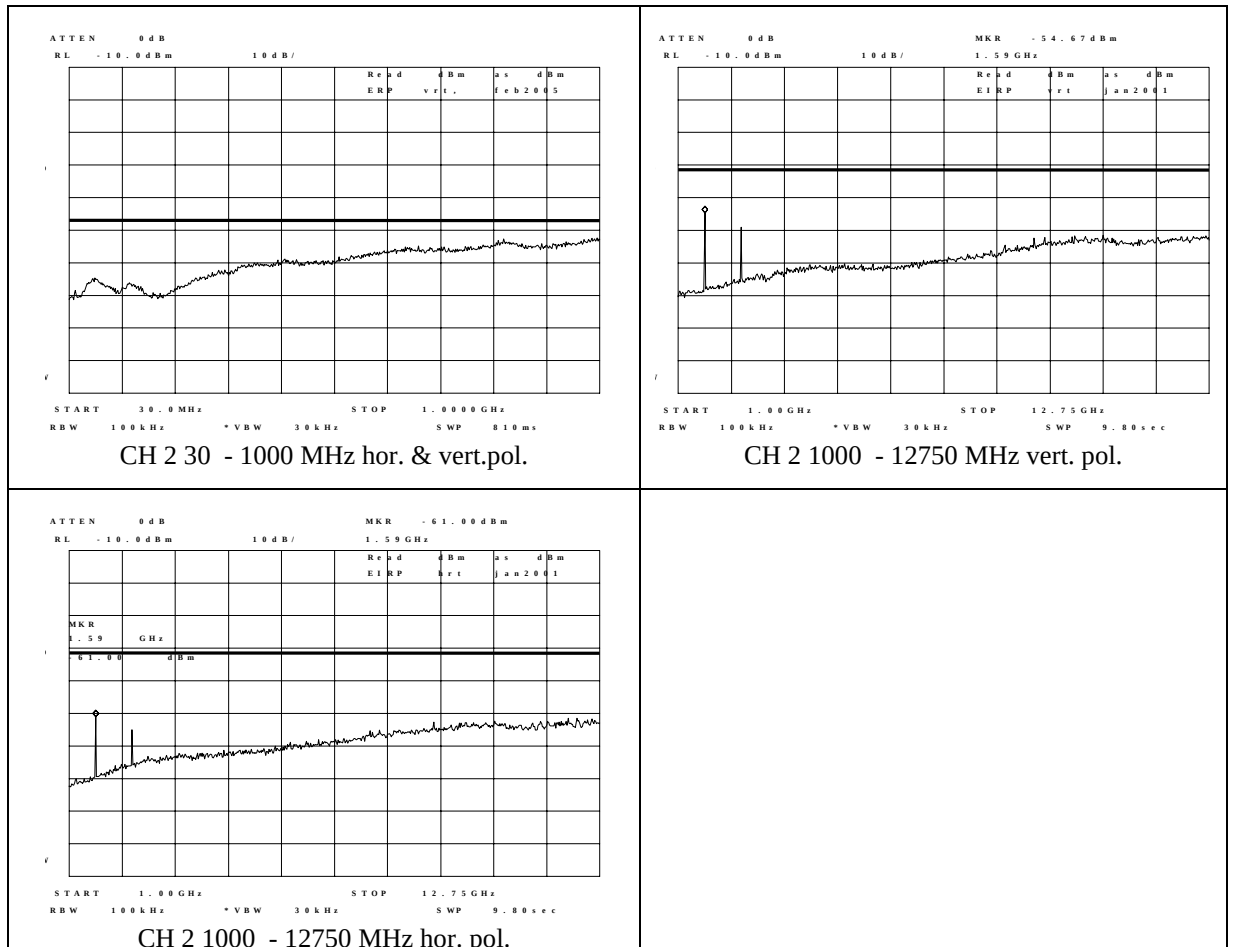


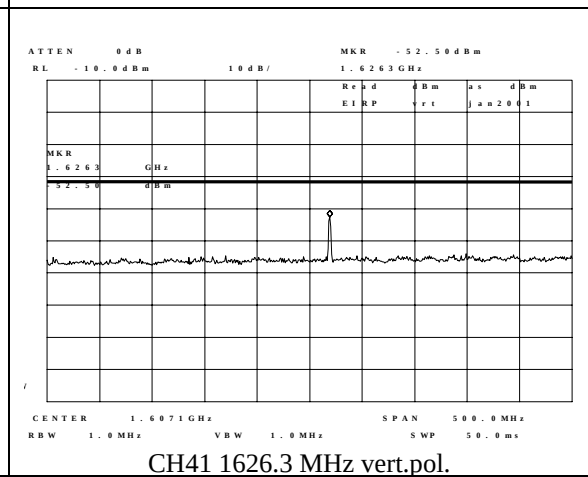
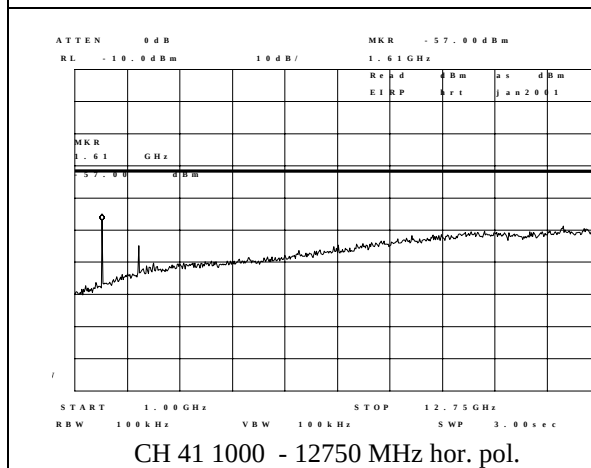
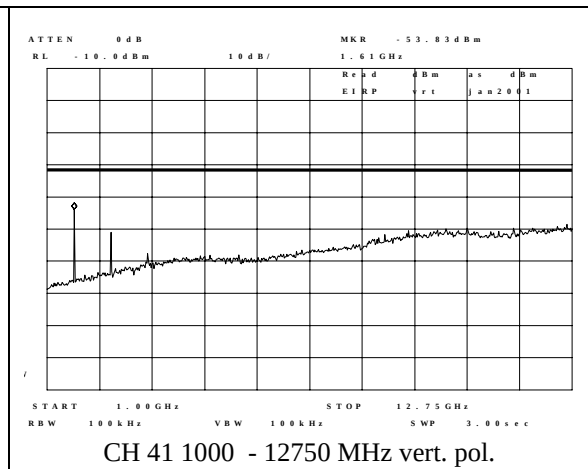
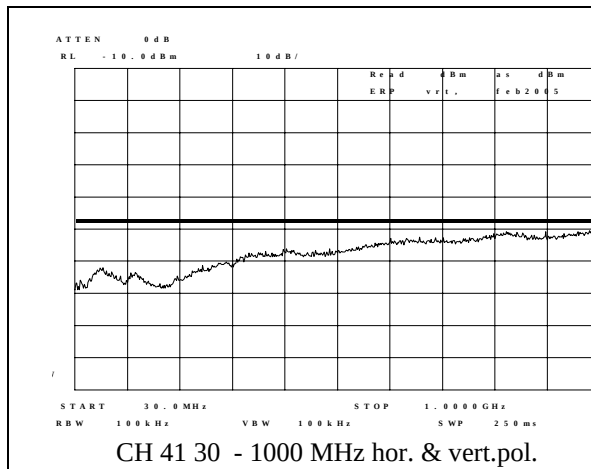
CH 80 1000 - 12750 MHz vert. pol.

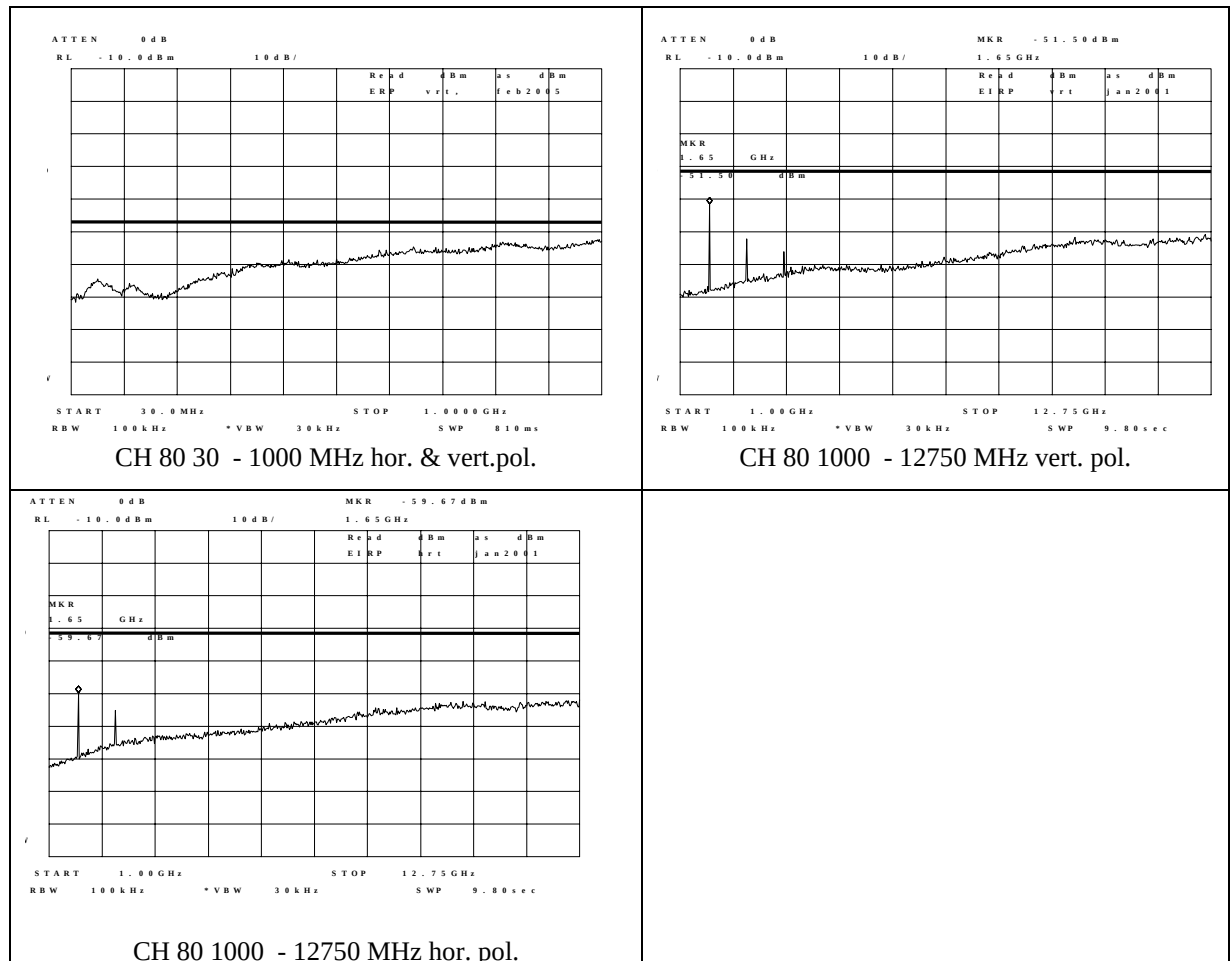


CH 80 1000 - 12750 MHz hor. pol.

8DPSK







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

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

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

Measurement uncertainty: $\leq 1\text{ GHz}$: +2.6/-3.3 dB
 $> 1\text{ GHz}$: +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