

Test Report

Processing gain Measurement

for
PADB6.81 printer dongle

Report Reference: 4_TROY_0101_BTT_FCCa



TTI-P-G 178/99

Test Laboratory:

7 layers AG
Borsigstrasse. 11
D-40880 Ratingen
Germany

Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the testing laboratory

Administrative Data:**Testing Laboratory**

Company Name: 7 layers AG

Address: Borsigstrasse 11
40880 Ratingen
Germany

Laboratory accreditation no: DAR – Registration no. TTI-P-G 178/99

Responsible for accreditation scope: Dipl.-Ing. Bernhard Retka
Dipl.-Ing. Marco Kullik

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Project Data

Responsible for test and report: Dipl.-Ing. Arndt Stöcker

Date of Report: 2001 October 2nd

Applicant Data:

Company Name: Troy Wireless and Connectivity

Address: 1692 Browning
Irvine, CA 92606
USA

Contact Person: Mr. Jorge Flores-Guido

Summary of test result

The device fulfils the requirements of FCC part 15, 247(g), processing gain.

Responsible for Accreditation Scope: _____ Responsible for testing and Test Report: _____

Introduction

This report describes the results of the processing gain measurement test using the FCC CW jamming margin method.

Requirement

Hybrid systems that employ a combination of both direct sequence and frequency hopping modulation techniques shall achieve a processing gain of at least 17 dB from the combined techniques.

Measurement method

De-spreading is accomplished by correlating the received bit stream with the bit pattern of the access code. Then with the value of the correlator output will be decided if the access code is valid or not.

That means if the access code is not valid a "bit error" occurs for the Bluetooth device.

For this reason, the ratio of invalid access codes (IACR) is used instead of the BER, in CW jamming margin method.

Another reason to use this criterion is the fact, that the Bluetooth technology uses the access code to find the correct sampling point. That means if the access code cannot be found, all other bits in the transmission cannot be sampled successfully.

In this case the Packet Error Rate (PER), which is similar to the Access Code Error Rate, was used. As limit a PER of 0.1% was chosen.

The test was performed in the Bluetooth test mode loop back.

System losses

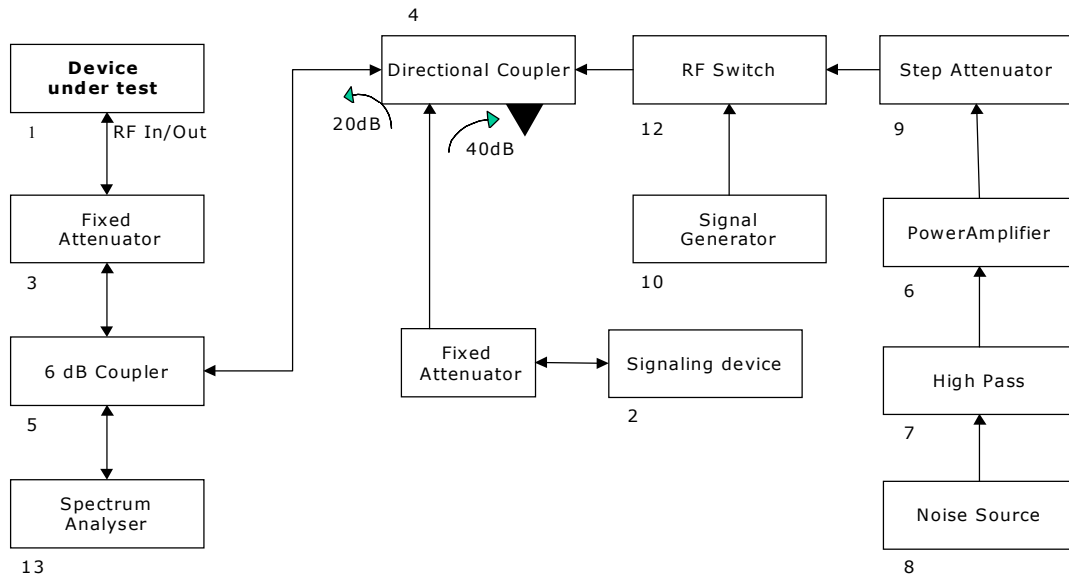
In the formula for calculation of the processing gain the term 'system losses' appear. In Bluetooth, there are two major causes for the system loss:

1. The non-optimal sampling time. The CW jamming method assumes that the optimal sampling time has been determined before. In fact it will be determined via the access code. If a Packet is not accepted (PER) the access code is not valid.
2. Losses due to attenuation in the RF part.

Although this two points produce a system loss (L_{sys}) which will be much greater than 2 dB, we calculated with this value, because this is the maximum that will be accepted by FCC.

Measurement Set-up

To measure the PER, the following test set-up was used:



Measurement set-up

Note: detailed information for the equipment please see in the test equipment list

For setting up the connection and measuring the PER, the Bluetooth tester CMU200 was used. The measurement was performed at the RF input (temporary antenna connector) of the device under test.

The level of the wanted signal was set for all single measurements to **-50 dBm**.

Measurement Results

S/N Measurement

The measurement for S/N was performed by adding noise to the wanted signal. The noise level was adjusted until the PER reached 0.1% (noise level: -71,3 dBm).

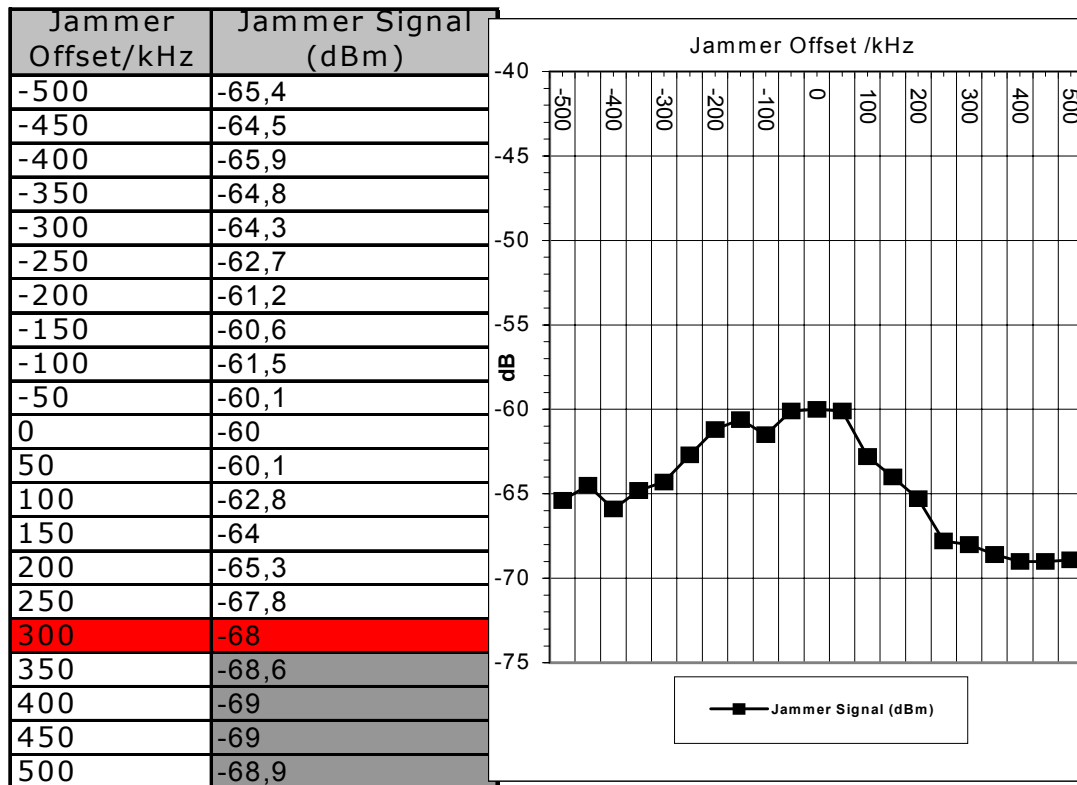
With this measurement configuration, the S/N ratio was **21.3 dB**

Jammer/Signal Measurement (JSR)

The jammer signal was stepped in 50 kHz steps over the receiving channel.

For every step the jammer level was adjusted until the PER was 0.1 %. The ratio between wanted signal power and the jammer power at the RF input of the device is the required Jammer to Signal ratio.

With this measurement configuration the JSR has the following results:



Disregarding the marked data points (-350, -400, -450, 500 kHz) the worst data point is at 300 kHz offset with a JSR value of **-18 dB**.

Processing gain calculation

With these values we calculated the processing gain:

$S/N = 21.3 \text{ dB}$

$M_j = \text{JSR} = -18 \text{ dB}$

$L_{\text{sys}} = \text{system loss} = 2 \text{ dB}$

$$G_p = S/N + M_j + L_{\text{sys}} = 21.3 - 18.0 + 2.0 = 5.3 \text{ dB}$$

The processing gain for the DSS is 5.3 dB.

The processing gain for FHSS part is calculated as:

$$10 * \log 32 = 15 \text{ dB} \text{ (32 hopping channels in hybrid mode)}$$

This means for the total processing gain of the hybrid system:

$$15 \text{ dB} + 5.3 \text{ dB} = 20.3 \text{ dB}$$

This is above the minimum value of 17 dB stated in FCC rules.

The device passes the requirement of this clause.

Test equipment

no	Single Devices	Type	Serial No	Manufacturer
1	Device under test	PADB6.81	00710035	Troy
2	Universal Radio Communication Tester	CMU200	837728/030	Rohde & Schwarz
3	Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz
3	Attenuator, 3 dB	N		Weinschel
4	Attenuator, 3 dB	SMA		Weinschel
5	Directional coupler 20dB			
6	Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel
7	Broadband Amplifier 45MHz-27GHz	JS4-00102600-42-	619368	Miteq
8	High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
9	Noise Emitter	CNE III	99/016	York
10	RF Step Attenuator	RSP	833695/001	Rohde & Schwarz
11	Laptop	2626	55-3211P 99/09	IBM
12	Laptop	Omnibook XE2	TW95004702	HP
13	Manual Switch	-	-	7 layers
14	Manual Switch	-	-	7 layers
15	EMI Analyzer	ESI 26	830482/004	Rohde & Schwarz