# Test Report

# Processing gain Measurement

## for
## PADB6.81 printer dongle

Report Reference: 4_TROY_0101_BTT_FCCa

Deutscher
Akkreditierungs
Rat
DAR

**TTI-P-G 178/99**

**Test Laboratory:**
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Note:
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# Administrative Data:

## Testing Laboratory

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| Report Template Version: | 1.2 |

## Project Data

| | |
|---|---|
| Responsible for test and report: | Dipl.-Ing. Arndt Stöcker |
| Date of Report: | 2001 October 2nd |

## Applicant Data:

| | |
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| Company Name: | Troy Wireless and Connectivity |
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## <u>Summary of test result</u>

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

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## 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:

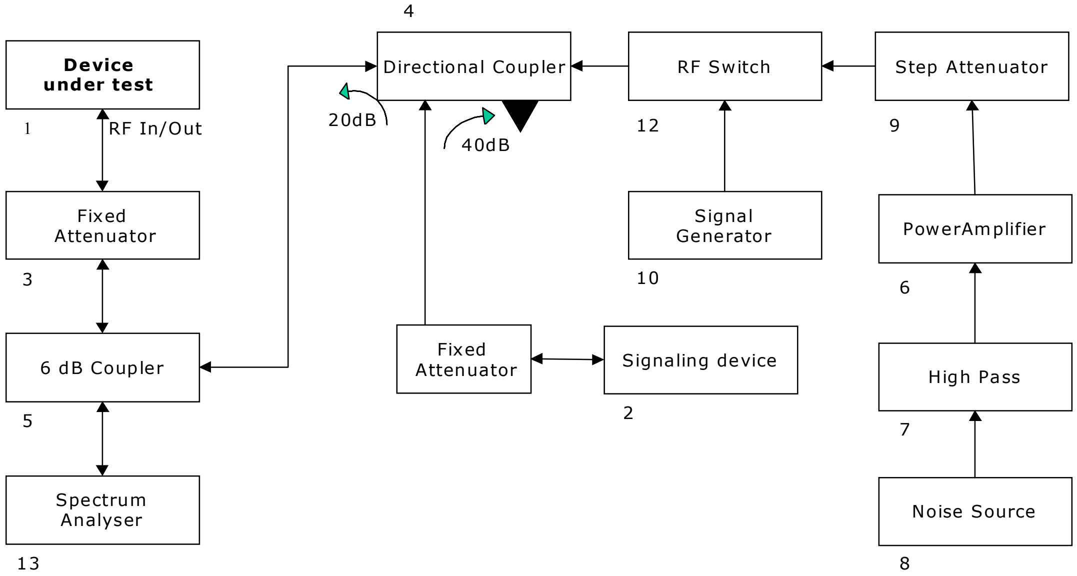
1. The non-optimal sampling time. The CW jamming method assumes that the optimal sampling time has been determined before. In fact it will be determined via the access code. If a Packet is not accepted (PER) the access code is not valid.

2. Losses due to attenuation in the RF part.

Although this two points produce a system loss (Lsys) 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

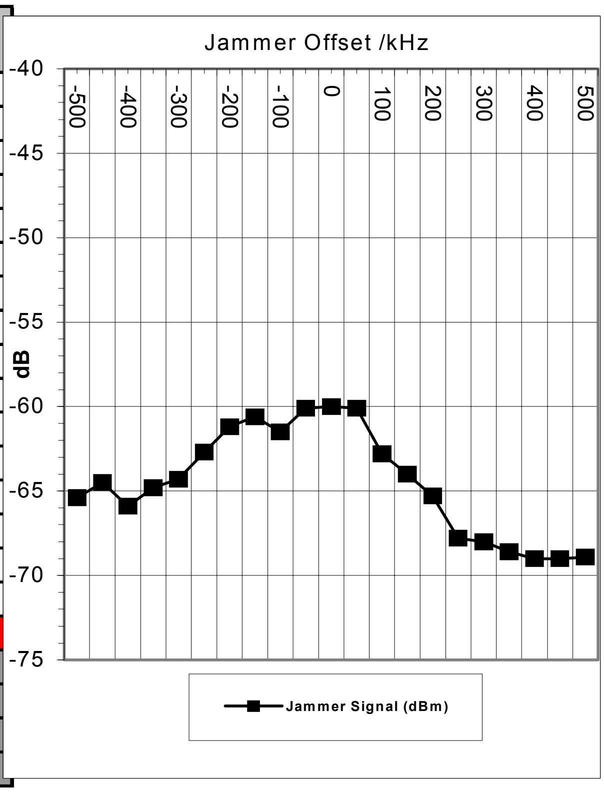
## Jammer/Signal Measurement (JSR)

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:

| Jammer Offset/kHz | Jammer Signal (dBm) |
|---|---|
| -500 | -65,4 |
| -450 | -64,5 |
| -400 | -65,9 |
| -350 | -64,8 |
| -300 | -64,3 |
| -250 | -62,7 |
| -200 | -61,2 |
| -150 | -60,6 |
| -100 | -61,5 |
| -50 | -60,1 |
| 0 | -60 |
| 50 | -60,1 |
| 100 | -62,8 |
| 150 | -64 |
| 200 | -65,3 |
| 250 | -67,8 |
| 300 | -68 |
| 350 | -68,6 |
| 400 | -69 |
| 450 | -69 |
| 500 | -68,9 |




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 dB
Mj = JSR =-18 dB
Lsys = system loss = 2 dB

Gp = S/N + Mj + Lsys = 21.3 – 18.0 + 2.0 = 5.3 dB

The processing gain for the DSS is 5.3 dB.

The processing gain for FHSS part is calculated as:

10 * log 32 = 15 dB (32 hopping channels in hybrid mode)

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

15 dB + 5.3 dB = 20.3 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 coupler20dB | | | |
| 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 |