



# Annex to Test Report 4\_Digi\_0101\_BT\_FCCa

## Processing gain Measurement

for

Digianswer Mini PCI Card  
BTMPC100

### **Test Laboratory:**

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#### 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

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## **Introduction**

This report describes the results of the processing gain measurement for the Digianswer Bluetooth Mini PCI Card BTMPC100 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.

## **Modification of measurement method**

Despreading 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 in CW jamming margin method the ratio of invalid access codes (IACR) is used instead of the BER.

Another reason to use this criteria 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.

## **System loss**

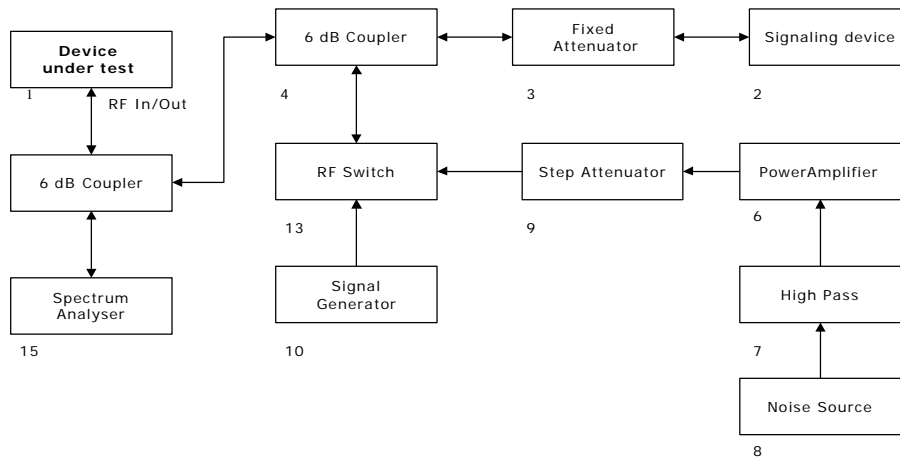
In the formula to calculate the processing gain appears the term system loss. In Bluetooth there are two major causes for the system loss:

1. The non optimal sampling time. The CW jamming method assumes that the optimal sampling time as determined before, in fact, as described above, will be determined via the access code.
2. Loss due to attenuation in the RF part.

Although this two points produce a system loss 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 IACR the following test set-up was used:



### *Measurement set-up*

*Note: For detailed information about the equipment please see test equipment list*

To set up the connection a special test program was used. It is installed on the laptop and controls the Digianswer Mini PCI Card.

In the result the number of invalid access codes for a packet of 255 transmissions is given. For this test 200 packets (51000 bursts) were measured. For the selected IACR of 0.1% it means that 51 access codes are not valid.

The level of the wanted signal was set for all single measurements to  $-39.1$  dBm.

## Measurement Results

### S/N Measurement

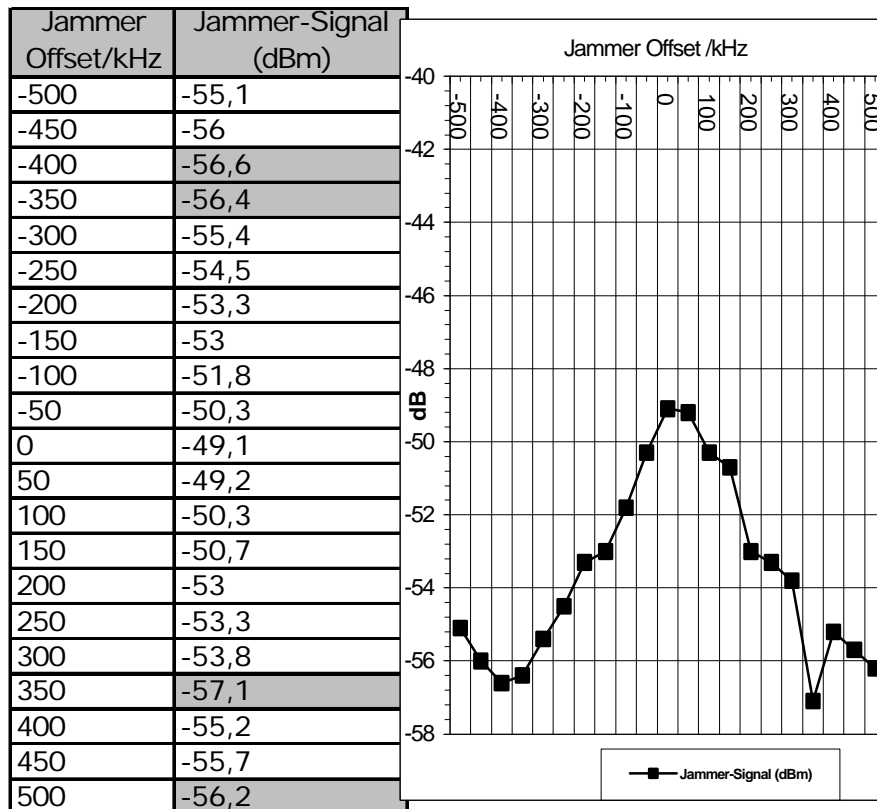
The measurement for S/N was performed by adding noise to the wanted signal. The noise level was adjusted until the IACR reached 0.1%.

With this measurement configuration the S/N ratio was 18.1 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 IACR 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 (-400, -350, 350, 500 kHz) the worst data point is at -450 kHz (Jammer-signal -56 dBm) with a Jammer / Signal value of -16.9 dB.

### Processing gain calculation

With these values the processing gain for the DSS part of the system is calculated to:

$$M_j = \text{JSR}$$

$$G_p = S/N + M_j + L_{\text{sys}} = 18.1 - 16.9 + 2.0 = \mathbf{3.2 \text{ dB}}$$

The processing gain for FHSS part is calculated as:

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

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

$$15 \text{ dB} + 3.2 \text{ dB} = \mathbf{18.2 \text{ dB}}$$

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	Digianswer Mini PCI Card	BTMPC100	0050CD0E001C	Digianswer
2	Digianswer USB Dongle	BTUSB 100	-	Digianswer
3	Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz
3	Attenuator, 20dB RCC_	Model 2	BD8827	Weinschel
4	Broadband Resist. Power Divider N	1506A / 93459	LM390	Weinschel
5	Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel
6	Broadband Amplifier 45MHz-27GHz	JS4-00102600-42-	619368	Miteq
7	High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
8	Noise Emitter	CNE III	99/016	York
9	RF Step Attenuator	RSP	833695/001	Rohde & Schwarz
11	Laptop Toshiba Satellite Pro 4600	PS460L-02HZ3	Y0012421J	Toshiba
12	Laptop	Omnibook XE2	TW02117302	Hewlett Packard
13	Manual Switch	-	-	7 layers
14	Manual Switch	-	-	7 layers
15	EMI Analyzer	ESI 26	830482/004	Rohde & Schwarz