Test Report

Processing gain Measurement

for
Digianswer Bluetooth™ Protocol Analyser

Report Reference: 4_DIGI_0300_BT_FCC_n

Applicant:

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Summary of test result

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

Responsible for Accreditation Scope: _____ Resposible for Test Report: _____

Introduction

This report describes the results of the processing gain measurement for the PCMCIA Card Type BTPCM101 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 to 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 losses

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

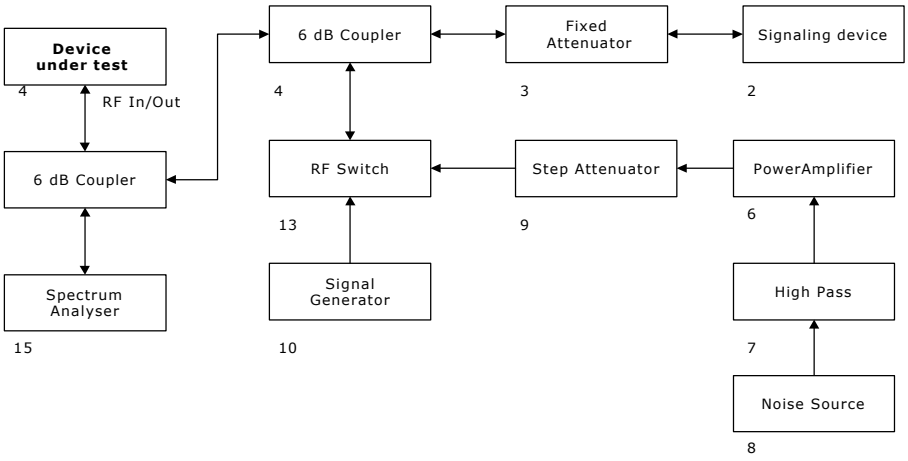
1. The non optimal sampling time. The CW jamming method assumes that the optimal sampling time as determined before, in fact, as described above, it will be determined via the access code.

2. Losses 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: detailed information for the equipment please see in the test equipment list

To set-up the connection and measure the IACR special debug program was used. It is installed on the laptop and communicates with the PCMCIA card via the RS 232 serial port.

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%, this means that 51 access codes are not valid.

The level of the wanted signal was set for all single measurements to –42 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%.
Due to the fact that a measured noise level depends essentially of the characteristic of the measurement filter. If you measure at the RF input of the card, the relevant filter will be the analyser filter, which has a gaussian characteristic. This characteristic is completely different from the internal IF filter.
For this reason the signal/noise ratio was measured behind the IF filter (worst case).

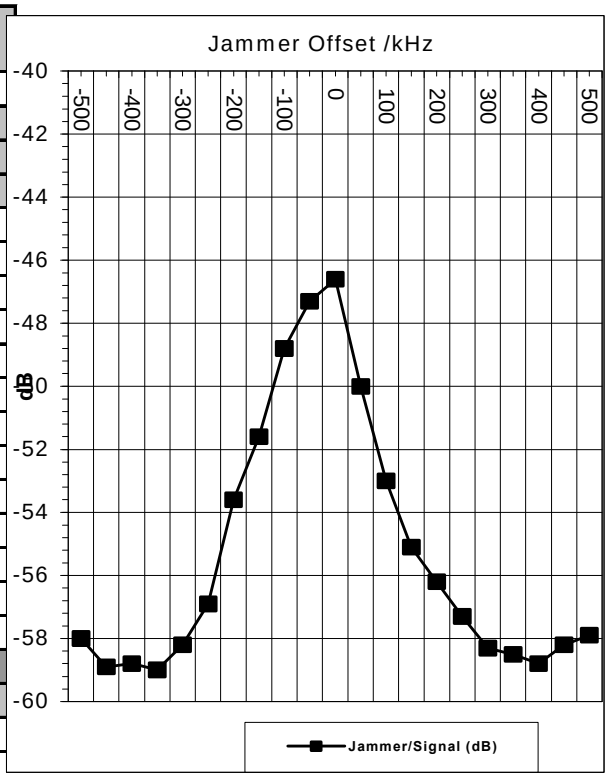
With this measurement configuration the S/N ratio was 18.0 dB

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:

Jammer Offset/kHz	Jammer/Signal (dB)
-500	-58
-450	-58,9
-400	-58,8
-350	-59
-300	-58,2
-250	-56,9
-200	-53,6
-150	-51,6
-100	-48,8
-50	-47,3
0	-46,6
50	-50
100	-53
150	-55,1
200	-56,2
250	-57,3
300	-58,3
350	**-58,5**
400	-58,8
450	-58,2
500	-57,9



Disregarding the marked data points (-450, -400, -350, 400 kHz) the worst data point is at 350 kHz with a value of –58,5 dB.

Processing gain calculation

With these values we calculated the processing gain:
Mj = JSR

Gp = S/N + Mj + Lsys = 18.0 – 16.5 + 2.0 = 3.5 dB

The processing gain for the DSS is 2.5 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 + 3.5 dB = 18.5 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 protocol analyser	DGABTPA101	0050CD010048	Digianswer
2	Digianswer PC-card	BTPCM100	0050CD12A07F	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	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