

Processing gain Measurement

The Processing Gain measurement is based on FCC guidelines on measurements for Direct Sequence Spread Spectrum Systems. The procedure adopted is based on CW Jamming margin method.

The system under test is a Digital Spread Spectrum Cordless telephone including Hand set and base station. 960 Kbps PN sequence modulo 2 added with the digitized audio modulates the RF carrier using Differential BPSK modulation to generate Spread spectrum signal with a null to null bandwidth of ± 960 K Hz.

Test setup for the measurement is as shown in the Fig ##. One of the duplex paths is jammed by the CW Jammer at any time to enable selective measurement of the BER of the Handset and base station. Personal computer with a test program is employed to establish the link between the Base station and Hand set as well as compute / display the results of the measurement.

The DCT has a special *Built In Test* mode to measure bit errors in the channel. The result is stored in a set of registers of the Base band ASIC which are accessed by a PC for dynamic computation of the BER and display. The system tolerates errors up to 1 in 1000 bits (without sacrificing the intelligibility of the audio) which determines the sensitivity of the system corresponding to S/N₀ of 8 dB.

Procedure:

Step 1 : Measure the signal Level S taking in to account the Cable losses, combiner / attenuator losses

Step2: Establish normal Duplex communication link between Hand set and base station in Channel # 1 using the test software.

Step3 : Feed The CW Jamming signal at the Center frequency of the channel (F_0)

Step4 : Increase amplitude of the Jamming signal while monitoring BER on the PC screen such that the BER is $\leq 1 \times 10^{-3}$. This is recorded for computing Jammer level J

Step 5: Increment the Signal Generator in Steps of 50 kHz and repeat step 4

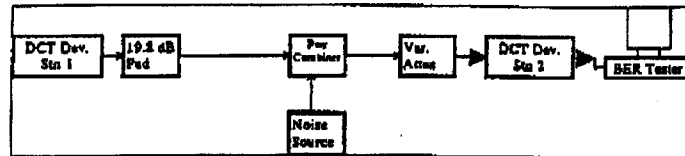
The Processing gain is computed using the equations listed below.

The measurement is repeated at LOW MID and HIGH end of the operating band for both Hand set and Base station.

Implementation losses of the system are limited to 2 dB Max as permitted by the FCC guidelines.

Process Gain Measurement

Handset (C45) Gen 2.2.3 radio Date 3rd Apr 06



$$G_p = (S/N)_o - M - L_{sys}$$

(S/N)_o= Signal to Noise Ratio reqd @ BER of 1e-3=6.0 dB for DPSK

M= Jamming Margin (JM) in dB

L_{sys}= system implementation Losses= 2dB

Channel 1 (803.8MHz)

S = Signal Power - Attn - Comb loss - Cable loss

= -4.4 - 19.8 - 3.6 - 0.55

-28.35 dB

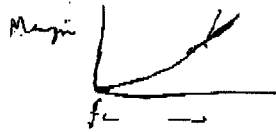
J = Sig Gen C/PLV(N) - cal factor - Comb Loss

= N - 0.3 - 3.6 dB

Jammer Freq (MHz)	Signal dBc	Lvl CW Noise N dB	MJ J/S dB	Proc Gain dB
803.6	-28.35	-15.4	9.05	19.05
803.65	-28.35	-15.7	8.75	18.75
803.7	-28.35	-15.8	4.65	14.65
803.75	-28.35	-20.1	4.35	14.35
803.8	-28.35	-19.3	5.15	15.15
803.85	-28.35	-21.8	2.65	12.65
803.9	-28.35	-21.5	2.95	12.95
803.95	-28.35	-19.5	4.95	14.95
904	-28.35	-22	2.45	12.45
904.05	-28.35	-19.1	11.35	21.35
904.1	-28.35	-19.8	4.85	14.85
904.15	-28.35	-12.3	12.25	22.25
904.2	-28.35	15.4	40.85	50.85
904.25	-28.35	-19.8	10.85	20.85
904.3	-28.35	-19	11.45	21.45
904.35	-28.35	-11.1	19.35	29.35
904.4	-28.35	-7	17.45	27.45
904.45	-28.35	-4.5	19.55	29.55
904.5	-28.35	-3	22.45	32.45
904.55	-28.35	-1	23.45	33.45

↑
S

↑
[N - 0.3 - 3.6] - S



$$S = \text{Signal Power} - \text{Attn} - \text{Comb loss} - \text{Cable loss}$$

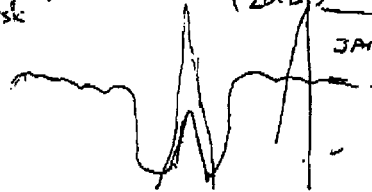
↑ ↑ ↑ ↑
 L.M.H. fixed fixed fixed
 (measured) (19.8 dB) (3.6 dB) (0.55 dB)

$$J = \text{Sig Gen} - \text{Cal factor} - \text{Comb loss}$$

↑ ↑ ↑
 changing fixed fixed
 (0.3) (3.6 dB)

$$G_p = (S/N)_0 + M_j + L_{sys}$$

↑ ↑ ↑
 fixed J/S fixed
 (8 dB for) (2 dB)
 DBPSK JAMMING MARGIN



Channel 11 (915.6MHz)

S= Signal Power - Attn-Comb loss-cable Loss

=-4.53-18.8-3.6-0.55

=-26.48 dB

J= Sig Gen O/P Lvl(N)-cal factor-Comb Loss

=N -0.3-3.6 dB

Jammer Freq.(MHz)	Signal Lvl dB	CW Noise N dB	MJ J/N dB	Proc.Gain dB
915.6	-26.48	-15.1	9.48	19.48
915.65	-26.48	-14.8	9.78	19.78
915.7	-26.48	-20.4	4.18	14.18
915.75	-26.48	-20.2	4.38	14.38
915.8	-26.48	-19.5	5.08	15.08
915.85	-26.48	-21.3	3.38	13.38
915.9	-26.48	-21.9	2.68	12.68
915.95	-26.48	-19.8	4.78	14.78
916	-26.48	-22.3	1.98	11.98
916.05	-26.48	-15.5	11.08	21.08
916.1	-26.48	-19.5	5.08	15.08
916.15	-26.48	-12.1	12.48	22.48
916.2	-26.48	-18.9	7.88	17.88
916.25	-26.48	-13.7	10.88	20.88
916.3	-26.48	-15.1	11.48	21.48
916.35	-26.48	-10.9	13.78	23.78
916.4	-26.48	-6.3	18.38	28.38
916.45	-26.48	-4.2	20.38	30.38
916.5	-26.48	-2	22.88	32.88
916.55	-26.48	-1	23.88	33.88

Channel 20(926.4 MHz)

S= Signal Power - Attn-Comb loss-cable Loss

=-4.7-18.8-3.6-0.5

=-26.55 dB

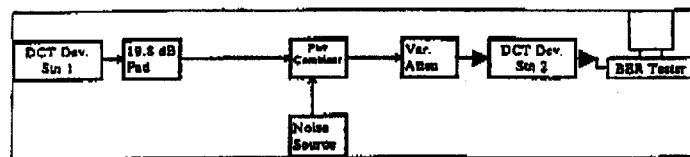
J= Sig Gen O/P Lvl(N)-cal factor-Comb Loss

=N -0.3-3.6 dB

Jammer Freq.(MHz)	Signal Lvl dB	CW Noise N dB	MJ J/N dB	Proc.Gain dB
926.4	-26.55	-15	9.75	19.75
926.45	-26.55	-15	9.75	19.75
926.5	-26.55	-19.7	5.05	15.05
926.55	-26.55	-20.7	4.05	14.05
926.6	-26.55	-19	5.75	15.75
926.65	-26.55	-20.8	3.85	13.85
926.7	-26.55	-21.8	2.85	12.85
926.75	-26.55	-19.6	3.95	13.95
926.8	-26.55	-21.8	2.85	12.85
926.85	-26.55	-19.3	5.15	15.15
926.9	-26.55	-19.5	2.85	12.85
926.95	-26.55	-12	11.25	21.25
927	-26.55	-16.8	5.25	15.25
927.05	-26.55	-15	12.75	22.75
927.1	-26.55	-13	9.25	19.25
927.15	-26.55	-13.6	9.75	19.75
927.2	-26.55	-12.1	11.75	21.75
927.25	-26.55	-7.3	11.15	21.15
927.3	-26.55	-4	12.85	22.85
927.35	-26.55	-2	17.45	27.45

Process Gain Measurement

Base Station (C85) Gen 2.2.3 radio Date: 3rd Apr 96



$$G_p = (S/N)_{\text{avg}} - M - L_{\text{sys}}$$

(S/N)_{avg} = Signal to Noise Ratio reqd @ BER of 1e-3 to 6.0 dB for DQPSK

M = Jamming Margin (JM) in dB

L_{sys} = system implementation Losses in dB

Channel 1 (803.6MHz)

S = Signal Power - Attn-Comb loss-cable Loss

= -2.7 - 19.8 - 3.6 - 0.55

= -26.65 dB

J = Sig Gen O/P Lvl (N)-cable factor-Comb Loss

= N - 0.3 - 3.6 dB

Jammer Freq. (MHz)	Signal Lvl dB	CW Noise N dB	M J/S dB	Proc. Gain dB
903.6	-26.65	-13.8	11.95	21.95
903.68	-26.65	-13.8	11.95	21.95
903.7	-26.65	-21.5	4.35	14.25
903.75	-26.65	-21	4.75	14.75
903.8	-26.65	-19.4	6.35	18.35
903.85	-26.65	-21.4	4.35	14.35
903.9	-26.65	-20.8	5.15	18.15
903.95	-26.65	-20.3	5.45	18.45
904	-26.65	-20.7	5.05	18.05
904.05	-26.65	-19	12.75	22.75
904.1	-26.65	-18.5	7.25	17.25
904.15	-26.65	-11.5	13.65	23.65
904.2	-26.65	-16.9	8.55	18.55
904.25	-26.65	-15.1	10.55	20.55
904.3	-26.65	-12.9	12.65	22.65
904.35	-26.65	-11.3	14.45	24.45
904.4	-26.65	-7	18.75	28.75
904.45	-26.65	-4.4	21.35	31.35
904.5	-26.65	-1.5	24.25	34.25
904.55	-26.65	-1	24.75	34.75

Channel 11 (915.6MHz)

S= Signal Power - Attn-Comb loss-cable Loss

=-2.7-19.8-3.6-0.5

=-26.65 dB

J= Sig Gen O/P Lvl(N)-csl factor-Comb Loss

=N -0.3-3.6 dB

Jammer Freq.(MHz)	Signal dB	LW Noise N dB	M/ J/S dB	Proc.Gain dB
926.4	-26.65	-13.7	9.08	18.06
926.45	-26.65	-13.6	9.18	19.18
926.5	-26.65	-13.2	9.88	13.53
926.55	-26.65	-10.7	2.06	12.09
926.6	-26.65	-20	2.75	12.75
926.65	-26.65	-20.2	2.85	12.66
926.7	-26.65	-20.4	2.98	12.38
926.75	-26.65	-20.3	3.48	12.46
926.8	-26.65	-21.8	0.85	10.98
926.85	-26.65	-12.8	4.05	14.05
926.9	-26.65	-16.7	10.85	20.85
926.95	-26.65	-11.9	6.75	16.75
927	-26.65	-17	7.95	17.95
927.05	-26.65	-14.6	10.48	20.48
927.1	-26.65	-12.3	11.75	21.75
927.15	-26.65	-11	16.75	26.75
927.2	-26.65	-6	18.15	28.15
927.25	-26.65	-4.6	21.38	31.38
927.3	-26.65	-1.4	21.75	31.75
927.35	-26.65	-1	22.75	32.75

Channel 20(926.4 MHz)

S= Signal Power - Attn-Comb loss-cable Loss

=-2.7-19.8-3.6-0.55

=-26.65 dB

J= Sig Gen O/P Lvl(N)-cn factor-Comb Loss

=N -0.3-3.6 dB

Jammer Freq.(MHz)	Signal dB	LW Noise N dB	M/ J/S dB	Proc.Gain dB
926.4	-26.65	-12	10.75	20.75
926.45	-26.65	-13.2	9.48	19.48
926.5	-26.65	-17.3	6.48	16.48
926.55	-26.65	-19	5.75	13.75
926.6	-26.65	-18.3	4.48	14.48
926.65	-26.65	-20	2.75	12.75
926.7	-26.65	-18.8	3.85	13.85
926.75	-26.65	-18.5	4.25	14.25
926.8	-26.65	-19.3	3.28	13.25
926.85	-26.65	-11.4	11.35	21.35
926.9	-26.65	-18.5	6.25	16.25
926.95	-26.65	-10	32.75	42.75
927	-26.65	-18.1	7.65	17.65
927.05	-26.65	-13.3	9.45	19.45
927.1	-26.65	-11	11.75	21.75
927.15	-26.65	-7.5	14.85	24.85
927.2	-26.65	-5	17.75	27.75
927.25	-26.65	-4	18.75	28.75
927.3	-26.65	-0.5	22.28	32.28
927.35	-26.65	0	22.75	32.75