Processing Gain Measurement Method

The following method is specified by the FCC to measure processing gain. The details are in FCC document 15.247 (e)(1). This involves transmitting a Continuous Wave (CW) jammer in the RF passband of the system and measuring the Jammer to Signal Ratio (JSR) required to achieve a certain BER (normally 10-3). The choice of the actual value of the BER is left up to the tester. The jammer is stepped in 50 kHz increments across the entire passband and in each case the JSR to achieve the desired BER is measured. The Jammer to Signal Ratio (JSR) is measured at the RF input of the system under test. The lowest 20 percent of the JSR data (in dB) is discarded. The processing gain can then be calculated as follows:

$Gp = (S/N)_{theory} + (J/S)_{measured} + L_{system\ loss}$

where GP is the processing gain (dB), S is signal power (dBm), N is signal noise (dBm), J is
jammer power (dBm), and Lsystem is the system implementation losses (dB). Note that the FCC
does not allow values for Lsystem greater than 2 dB.

Processing Gain Measurement Test Setup

The test set up is shown in Figure below. The base station and handset are configured to measure
the BER using the utility program *FCC3v3.exe*. The BER test results are displayed on the monitor. The strength of the received signal entering at the receiving antenna port of the UUT is derived from the signal strength of the transmitting unit.

General Procedure

1. Measure the output power of the base station and handset units in LOW power modes. Determine attenuation and signal losses in the path to calculate the received signal strength arriving at the base station antenna port.
2. Connect the serial interface of the base station and handset to the serial ports of a PC.
3. Connect the base station and handset through the attenuator, signal combiner, and other
components using 50 SMA connectors and cables as shown in Figure below. In this way, the
BER test set up establishes a link through wired connections.

4. Using the Test Utility software, select the channel 10, low power mode, and corresponding LNA attenuation for the base station and handset units.
5. On the **BER Test** window, click on the “Start S7 HS Master” button. The link is established and the BER results are displayed on the monitor.
6. Turn on the very low power jamming signal from the signal generator.
7. Increase jamming signal power until the BER increases to 10–3. This signal power is recorded for computing received jammer power level *J*.
8. Increment the jamming signal frequency in steps of 50 kHz and repeat step 7. Determine the minimum jammer signal power required to achieve a BER of 10–3. Calculate the processing gain.
Table B-1 provides the parameters used for the test setup. Table B-2 presents test measurement results taken at the base station. The desired BER was set to 10–3.
For Differential Binary Phase-Shift Keying (DBPSK) systems at 10–3 BER, the required SNR is 8.0
dB. Using the results above and the data in Table B-3, the processing gain is calculated to be 10.54 dB. The measured result for a processing gain of 10.54 dB is close to the actual processing gain due to a 12-chip spreading code of 10 log10 (12) = 10.8 dB

Table B-1. Test Setup Parameters

Parameter	**Signal Level**	**Notes**
Handset Tx power	-1.9 dBm	@ 50 SMA-antenna port
Base station LNA gain	0 dB	
Test system losses (signal)	-61.6 dB	-51 dB (channel atten.), -1.6 dB cable loss -9 dB combiner/ splitter
Received signal	-63.5 dBm	@ splitter output
Test system losses (jammer) up to the front end input	-15.4 dB	-6 dB (attenuator), -6 dB (signal combiner), -3.4 dB (cable+splitter)

Table B-2 Test results

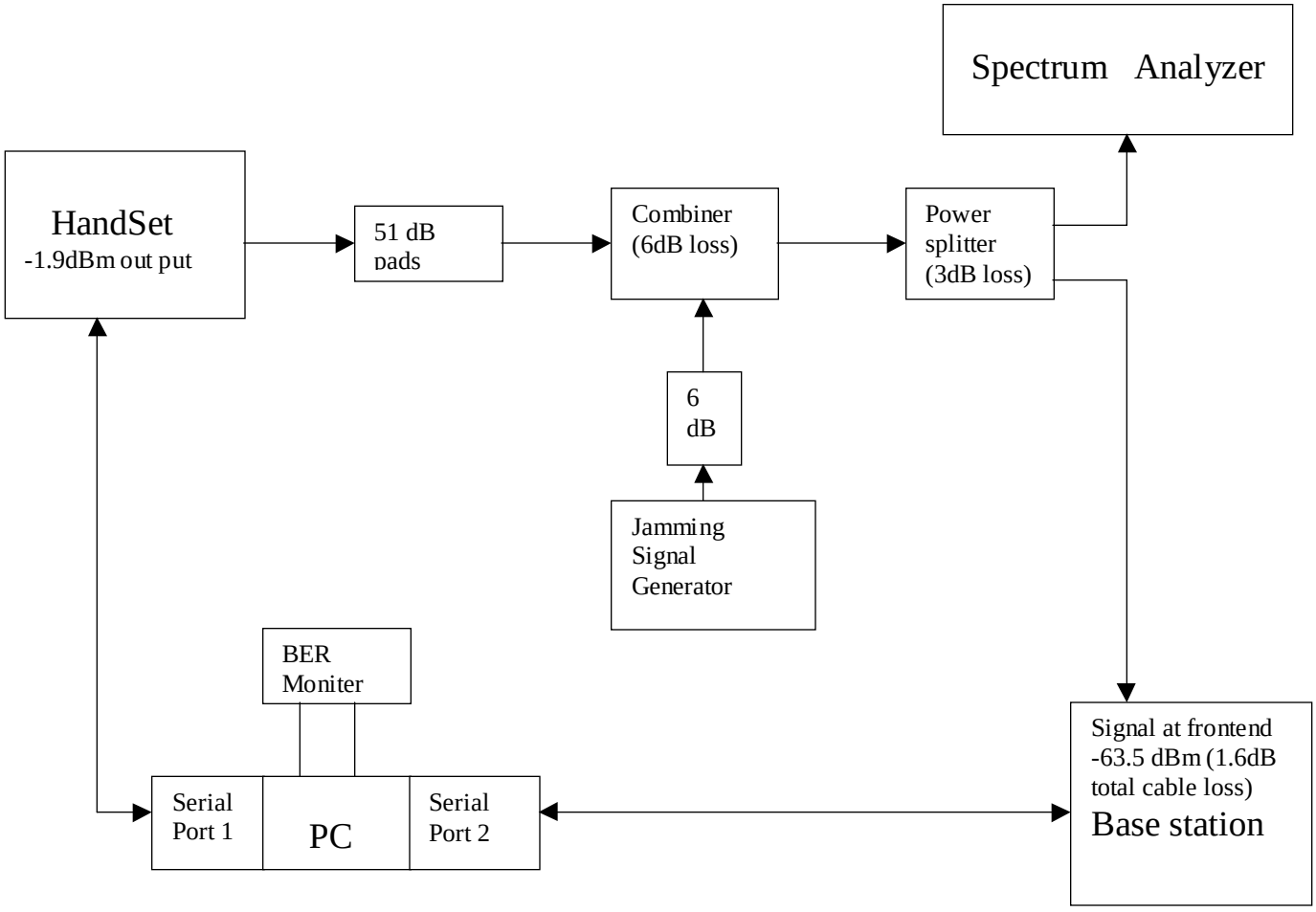
			Jammer loss:	15.4	(dB)
Freq. Start:	913.6	(MHz)	SNRo:	8	(dB)
Freq. Stop:	915.2	(MHz)	Lsys:	2	(dB)
			Signal Level:	-63.5	(dB)

Processing gain after discarding 20% lowest points: 10.54 dB

Frequency (MHz)	Jammer Level from Sweeper(dB)	Corrected Jammer Level (dBm)	SNRo (dB)	Lsys (dB)	Signal Level (dBm)	Gp (dB)
913.6	-40.4	-55.8	8	2	-63.5	17.7
913.65	-42.4	-57.8	8	2	-63.5	15.7
913.7	-41.3	-56.7	8	2	-63.5	16.8
913.75	-44.2	-59.6	8	2	-63.5	13.9
913.8	-45.1	-60.5	8	2	-63.5	13
913.85	-44.68	-60.08	8	2	-63.5	13.42
913.9	-47.18	-62.58	8	2	-63.5	10.92
913.95	-49.42	-64.82	8	2	-63.5	8.68
914	-46.94	-62.34	8	2	-63.5	11.16
914.05	-47.74	-63.14	8	2	-63.5	10.36
914.1	-47.562	-62.962	8	2	-63.5	10.538
914.15	-48.46	-63.86	8	2	-63.5	9.64
914.2	-43.9	-59.3	8	2	-63.5	14.2
914.25	-47.2	-62.6	8	2	-63.5	10.9
914.3	-47.4	-62.8	8	2	-63.5	10.7
914.35	-44.1	-59.5	8	2	-63.5	14
914.4	-29.82	-45.22	8	2	-63.5	28.28
914.45	-37.82	-53.22	8	2	-63.5	20.28
914.5	-45.66	-61.06	8	2	-63.5	12.44
914.55	-47.56	-62.96	8	2	-63.5	10.54
914.6	-43.1	-58.5	8	2	-63.5	15
914.65	-47.44	-62.84	8	2	-63.5	10.66
914.7	-48.06	-63.46	8	2	-63.5	10.04
914.75	-47.56	-62.96	8	2	-63.5	10.54
914.8	-46.36	-61.76	8	2	-63.5	11.74
914.85	-48.26	-63.66	8	2	-63.5	9.84
914.9	-48.14	-63.54	8	2	-63.5	9.96
914.95	-45.26	-60.66	8	2	-63.5	12.84
915	-44.86	-60.26	8	2	-63.5	13.24
915.05	-41.96	-57.36	8	2	-63.5	16.14
915.1	-43.64	-59.04	8	2	-63.5	14.46
915.15	-41.4	-56.8	8	2	-63.5	16.7
915.2	-42.5	-57.9	8	2	-63.5	15.6

Table B-3

Parameter	Relative Power difference (dB)
SNR required for 1x 10^{-3} BER	8
System loss	2
J/S ratio at 80% point	0.54
FCC processing gain at 80% point (@914.75MHz	10.54
FCC processing gain limit	>=10



BER Test setup for Processing Gain measurement