E5515C Fading Solution Application Guide for

E6703 W-CDMA/HSDPA Lab Application
E6702 cdma2000 Lab Application
E6706 1xEV-DO Lab Application
E6701/E6704 GSM/GPRS/EGPRS Lab Application
E6785 Fast Switching Lab Application

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Agilent Technologies
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Product Description

The Agilent E5515C Fading Solution (referred to as “fader” throughout this document) provides a complete solution for performing faded signal tests on cdma2000, 1xEV-DO, W-CDMA/HSDPA and GSM/GPRS/EGPRS mobile devices by integrating the base station emulation and measurement capability of the 8960 Wireless Communications Test Set (referred to as the “test set” throughout this document) with the digitally generated channel impairments generated by the N5115B Baseband Studio for Fading software (referred to as “fading software” throughout this document).

The primary components of the fader are a test set and a PC with a PCI fader circuit board and fading software.

The test set includes a hardware option that supports a digital interface to the PC for baseband signal data transfer between the devices.
Figure 1. 8960 Fading Test Setup

**Baseband Studio for Fading Software**

The GPIB (General Purpose Interface Bus) allows the fading software running on the PC to configure a number of settings on the test set when you want a faded signal.

When a faded signal from the test set is requested, the forward (or downlink) digital baseband signal from the test set is diverted to a PC equipped with the Baseband Studio PCI card via the test set’s rear panel Digital Bus connector. The fading software, in conjunction with the PCI card, digitally integrates fading patterns and AWGN with the baseband signal.
Product Description

The Digital Bus is an 80-pin bi-directional data interface. This bus is used to route the test set’s digitized baseband I/Q in the outgoing direction to the PC, and then route the incoming faded digital I/Q signal returning from the PC.

The Digital Bus is available only on test sets equipped with E5515C Option 004 Digital Bus. See www.agilent.com/find/8960upgrades for more information on upgrading your test set to include option 004.

Figure 2. Test Set Rear Panel with Digital Bus

NOTE
For GSM/GPRS/EGPRS Lab Application, hardware connections require Option 003 (Flexible Radio Link) and Option 004 (Digital Bus) be present to make the baseband I/Q available to an external fader. Flexible Radio Link is used to generate the baseband downlink signal and the Digital Bus is used to route the baseband data to an external fader.

Hardware and Software Checklist

Below is a checklist of all hardware and software components and connections required for the test set and the PC:

NOTE
Refer to the Baseband Studio for Fading Online Documentation for detailed setup instructions. (see “Related Documentation” on page 91).
Test Set hardware and software

- E5515C Wireless Communications Test Set with
  - E5515C Option 004 Digital Bus.
  - E5515C Option 003 Flexible Radio Link.
  - E5515C Option 002 RF Source 2 (Needed only for GSM/GRPS/EGPRS fading test).
- Running one of these Test or Lab Applications:
  - E1962 cdma2000 Test Application with the required feature option.
  - E6702 cdma2000 Lab Application.
  - E1966 1xEV-DO Test Application with the required feature option.
  - E6706 1xEV-DO Lab Application.
  - E6703 W-CDMA/HSDPA Lab Application.
  - E1987 Fast Switching Test Application with the required feature option.
  - E6785 Fast Switching Lab Application.
  - E6701/E6704 GSM/GPRS/EGPRS Lab Application.

**NOTE**
The Special High Data Rate hardware required to support the E6703T/U, E6702T and E6706T/U Special Lab Applications may not meet the E6703, E6702 and E6706 measurement parametric specifications, and has a maximum operating temperature specification of 35° C.
Older test sets may require additional hardware upgrades to enable fading for W-CDMA/HSDPA. See www.agilent.com/find/8960upgrades for more information.

PC hardware and software

- You must have a Baseband Studio PCI card installed in your PC, along with the Baseband Studio for Fading software and relevant software options, and the software license file. For details, see the Installation section of the N5115B Baseband Studio for Fading Online Documentation. This document is accessible through the Help menu in the fading software.
- GPIB interface hardware and software drivers
  (Agilent 82357A USB/GPIB Interface recommended, see www.agilent.com/find/gpib).

Cables

- Digital Bus cable (included with the N5101A).
- GP-IB cable (Agilent 82357A USB/GPIB Interface recommended).
Product Description

- RF cable.

How is a Faded Signal Generated?

The Baseband Studio for Fading software running on the PC generates fading patterns and AWGN on the forward channel. RF power levels, including AWGN, are controlled by this software.

The fader software is designed to control the following test set functions via GPIB:

- Selecting the test set’s Open Loop ALC (Automatic Level Control) mode.
- Configuring the baseband signal path switches to route digital I/Q to and from the Digital Bus.
- Setting up a fading headroom value (see “Impairments Backoff” on page 75).
- Compensation for time delay through the external (Digital Bus) path.
- Setting the test set’s AWGN generator to OFF.

---

**NOTE**

When the test set is configured to generate a faded signal, the test set’s internal AWGN generator is automatically turned off to allow the AWGN to be added by the external fading software. The resulting RF signal from the test set has fading applied to the forward (downlink) channel only, with no fading applied to AWGN.

---

Test sets equipped with option 004 have the capability to re-route the digital baseband signal. Using GPIB commands and front panel controls, the test set can be configured to route the baseband IQ digital data to the rear panel Digital Bus interface, where it is converted to a format compatible with the PCI card on the PC (see “The Digital Bus Connection” on page 81).

The Baseband Studio for Fading software running on the PC mathematically integrates fading patterns with the baseband signal depending on the fading pattern you’ve selected and the AWGN setting. The faded digital IQ data is sent back to the test set on the Digital Bus, where it is converted back to the data format used by the test set.

The digitally faded data is then sent to the test set’s analog IQ circuit and provides the forward channel modulation source for the RF output.

The fading software controls the test set’s internal baseband signal path switching when the fader is turned on. See Figure 3. on page 9
What Fading Patterns are Available?

Standard test patterns are available in the software and can be modified if necessary.

- 1xEV-DO Mobile Station: 3GPP2 TSG-C C.S0032-A (2005-12) Table 6.4.1 and C.S0033-A Table 8.4.1.1 (Configurations 1-5).
- W-CDMA Mobile Station: 3GPP TS 34.121 V5.2.0 (2003-12) Release 5 Annex D.2.2 (Cases 1-6, Birth-Death and Moving Propagation).
- GSM/GPRS/EGPRS Mobile Station: 3GPP TS 45.005 V7.4.0 (2006-02) Annex C.3.

Additional information is available in the Baseband Studio for Fading Online Documentation.
Operating Overview

This section provides the fundamental operating information for the E5515C Fading Solution (fader).

For reference information about the N5115B Baseband Studio for Fading (fading software) controls, refer to the Baseband Studio for Fading Online Documentation.

For reference information about the E5515C controls, refer to the 8960 online reference guides: http://wireless.agilent.com/rfcomms/refdocs/.
Configuring the Fader System

Before you configure the fader system, the PC must have the N5101A PCI card, software drivers, and fading software license file installed in the PC. See “Hardware and Software Checklist” on page 6.

(For hardware and software installation instructions, refer to the N5101A Baseband Studio PCI Card Installation Guide shipped with the PCI card.)

In the fader software Welcome screen there is a System Configuration dialog that is used to setup and test the GPIB and the PCI card interfaces. This dialog gives you access to the System Configuration Add Wizard (wizard), which helps you set up and verify communication with the fader hardware in your system.

**IMPORTANT**  Make sure the test set’s power is on and a cdma2000, 1xEV-DO, W-CDMA/HSDPA or GSM/GPRS/EGPRS lab application is selected before you configure the fader system.

1. Start the Baseband Studio for Fading software. From the Start, Programs menu, select:

   ![Agilent Baseband Studio](image)
   ![Agilent Baseband Studio for Fading](image)
   ![Fader](image)

   When you start up the fading software, a Welcome screen appears, which allows you access to the System Configuration dialog.

2. Select New Hardware Configuration from the Baseband Studio software Welcome screen:
3. Unless you plan to identify a new hardware configuration next time you start up the fading software, it is recommended that you select the “Don’t show this dialog at startup” checkbox. The System Configuration dialog can always be accessed from the Tools menu.

4. Click OK.
Using the System Configuration Add Wizard

1. If a valid system configuration has already been specified and is listed in the System Configuration dialog box, skip ahead to “Selecting and Testing the System Configuration” on page 20. Otherwise, click on Run System Configuration Wizard button to run the System Configuration Wizard.

2. Select E5515C Single Channel, Click Next >.

3. Select N5101A PCI card + E5515C mainframe, Click Next >.
Operating Overview

4. If there is no applicable or previously saved hardware configurations for you to use, select <New> to
configure a new system.

5. A list of the N5101A PCI cards that have been detected on your PC is displayed. Select a PCI card and Click Next >.
Operating Overview

NOTE If you have more than one card installed in your PC, you can click the Toggle LED button to toggle a yellow LED visible from the PC's rear panel. This verifies that the digital bus cable is connected to the PCI card you are selecting.

6. Select GPIB in the “Enter a new 8960 Mainframe” dialog.
The 8960 does not support LAN instrument control. The PC must be configured with GPIB hardware and the required drivers. For easy connectivity with good performance, Agilent Technologies recommends the Agilent 82357A USB/GPIB Interface. See www.agilent.com/find/gpib.

7. Configure the GPIB interface between the test set and PC by selecting the Board Index and Primary Address for your GPIB interface, then Click Next >. During this step, you can:

a. verify the Board Index field matches the GPIB interface name, which is assigned when you run the GPIB driver configuration.

b. verify the test set’s GPIB address matches the Primary Address field. You can find out the test set’s GPIB address by pressing the SYSTEM CONFIG key.
Operating Overview

8. In step 6 of the System Configuration Wizard, the software automatically runs a test of the GPIB I/O connection and reports the result.

9. Click Next > if the “E5515C mainframe connected” message appears. Click < Back if the connection fails, and correct the GPIB configuration.

10. Enter a name for the system you have just set up. (Any combination of characters and numbers is permissible).
11. Click Finish to return to the System Configuration utility.
Selecting and Testing the System Configuration

1. Select the Hardware item in the left tree view, the details of the current hardware configuration are displayed on the right.

   The example below shows the E5515C (referred to as the Source Type) configured with a GPIB primary address of 14 and an N5101A PCI card assigned to fader channel 1.

   ![System Configuration](image)

   **NOTE**

   Other Baseband Studio products have the capability for 2-channel fading. Configurations that use the test set as a signal source are currently limited to single channel operation.

2. You can click the Run Self-Tests button to run I/O tests for the selected hardware resource in the list, or you can click the Test I/O Connections button to check the basic I/O connections to the devices. The fading software checks the digital bus loopback for the digital bus (LVDS) external cable.

3. Click OK.

   The system you have just configured now appears in the Channel Resource box.
Faded Test Example Procedures

The following examples detail how to perform faded tests on wireless devices as defined by the 3GPP and 3GPP2 test specifications, using the E5515C Fading Solution.

- “Testing a cdma2000 Mobile Station with a Faded Channel” on page 22
- “Testing a W-CDMA UE with a Faded Channel” on page 35
- “Testing an 1xEV-DO Access Terminal with a Faded Channel” on page 47
- “Testing a GSM Mobile Station with a Faded Channel” on page 62
Faded Test Example Procedures

Testing a cdma2000 Mobile Station with a Faded Channel

This procedure outlines the steps required to perform test 3.4.2 Demodulation of Forward Fundamental Channel in Multipath Fading Channel, as outlined in test standard 3GPP2 C.S0011 C.

3.4.2 Demodulation of Forward Fundamental Channel in Multipath Fading Channel

This test shall be performed on the Forward Fundamental Channel with Radio Configuration 1 or 2, if the Forward Fundamental Channel with Radio Configuration 1 or 2 is supported by the mobile station.

3.4.2.1 Definition

The performance of the demodulation of Forward Traffic Channel in multipath fading channel is determined by the frame error rate (FER) or the error rate in each frame category. The FER is calculated for each individual data rate. The following table summarizes the fading tests to be performed:

<table>
<thead>
<tr>
<th>Case</th>
<th>Radio Configuration</th>
<th>Channel Simulator Configuration Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1 (9 km/h, 2 paths)</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3 (30 km/h, 1 path)</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>4 (100 km/h, 3 paths)</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1 (9 km/h, 2 paths)</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3 (30 km/h, 1 path)</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>4 (100 km/h, 3 paths)</td>
</tr>
</tbody>
</table>

Cases 1 and 4 test the demodulation performance for the 9 km/h, two-path case by checking the full rate FER. Cases 2 and 5 test the demodulation performance for the 30 km/h, single-path case by checking the FER at all four possible data rates. Cases 3 and 6 test the demodulation performance and the rate determination for the 100 km/h, three-path case by checking the FER and the error rate in each frame category.

Tip:

This table gives the fading profiles for each of six test Cases.

Each test Case in this table defines a Radio Configuration/Channel Simulator Configuration pair. The Channel Simulator Configuration Number, not the test case, defines the fading profile used for each test case.
3.4.2.2 Method of Measurement

To perform step 1 of section 3.4.2.2, connect and configure the test set and fading software as described in “Operating Overview” on page 10. Then connect the mobile station to the test set’s front panel RF IN/OUT port (or the RF OUT ONLY port, see “Output Power” on page 83).

Before beginning testing, be sure that any necessary calibrations have been performed. See “Calibration” on page 78.

1. Connect the base station and an AWGN generator to the mobile station antenna connector as shown in Figure 6.5.1-1.

2. For each band class that the mobile station supports, configure the mobile station to operate in that band class and perform steps 3 through 5.

3. If the mobile station supports demodulation of Radio Configurations 1 or 2, set up a call using Fundamental Channel Test Mode 1 or 2 (see 1.2).

4. Set the test parameters for each test as specified in Tables A.2.2.1-1 through A.2.2.1-9.

5. Count, at the base station, the number of frames transmitted and the number of good frames received at the mobile station. For Cases 3 and 5, count, at the base station, the number of frames received in each category at the mobile station.

To perform steps 2 through 5 from section 3.4.2.2 follow the instructions in the and boxes that follow.
Faded Test Example Procedures

1. Connect the base station and an AWGN generator to the mobile station antenna connector as shown in Figure 6.5.1-1.

2. For each band class that the mobile station supports, configure the mobile station to operate in that band class and perform steps 3 through 5.

3. If the mobile station supports demodulation of Radio Configurations 1 or 2, set up a call using Fundamental Channel Test Mode 1 or 2 (see 1.3).

4. Set the test parameters for each test as specified in Tables A.2.2.1-1 through A.2.2.1-9.

5. Count, at the base station, the number of frames transmitted and the number of good frames received at the mobile station. For Cases 3 and 6, count, at the base station, the number of frames received in each category at the mobile station.

**On the Test Set:**
No operation required.

**On the PC:**
No operation required.
1. Connect the base station and an AWGN generator to the mobile station antenna connector as shown in Figure 6.5.1-1.

2. For each band class that the mobile station supports, configure the mobile station to operate in that band class and perform steps 3 through 5.

3. If the mobile station supports demodulation of Radio Configurations 1 or 2, set up a call using Fundamental Channel Test Mode 1 or 2 (see 1.2).

4. Set the test parameters for each test as specified in Tables A.2.3.1-1 through A.2.3.1-9.

5. Count, at the base station, the number of frames transmitted and the number of good frames received at the mobile station. For Cases 3 and 5, count, at the base station, the number of frames received in each category at the mobile station.

**On the Test Set:**

1. Set up Cell Parameters (System ID, Network ID). (Press the CALL SETUP hardkey, then press the left side More key to display the 2 of X menu. Press the F2 Cell Info, then F2 Cell Parameters keys).

2. Select Service Option 2 (SO2) for Radio Config 1 (Fwd1, Rvs1). (Press the CALL SETUP hardkey, then press the F12 FCH Service Option Setup key to set up the Service Option).

3. Set up the call to use Radio Config 1 (Fwd1, Rvs1). (Press the CALL SETUP key, then press the F11 Radio Config key.)
Faded Test Example Procedures

**On the PC:**

1. Enter the mobile station’s Cell Band.
2. Enter the mobile station’s RF Channel number.
3. Enter the Cell Power (-55 dBm is usually sufficient power to set up a call).
4. Clear the Impairments Enabled checkbox if it is selected. This disables fading while a call is attempted.
5. Click the Fader On button. This action causes the fading software to download the settings from steps 1-4 to the test set.

Turning the fader on also configures the test set for fading, which disables certain settings and requires that some settings not be changed. See “Critical Fading Solution Settings” on page 73.

![Diagram showing steps 1, 2, 3, 4, and 5 of the process.](image)
1. Turn on the mobile station and verify that the Mobile Station Information screen (press the Call Setup key) is updated, indicating that the mobile station has registered.

2. Press the Originate Call key.

3. Verify that the call status field indicates that the call is connected.

---

**IMPORTANT** While a call is connected, you must not select Fader Off, or the call will drop (selecting Fader Off causes a momentary loss of the signal from the test set). If you want to enable/disable fading during a call, select/clear the Impairments Enabled checkbox, do not select Fader Off.
Faded Test Example Procedures

1. Connect the base station and an AWGN generator to the mobile station antenna connector as shown in Figure 6.5.1-1.

2. For each band class that the mobile station supports, configure the mobile station to operate in that band class and perform steps 3 through 5.

3. If the mobile station supports demodulation of Radio Configurations 1 or 2, set up a call using Fundamental Channel Test Mode 1 or 2 (see 1.3).

4. Set the test parameters for each test as specified in Tables A.2.2.1-1 through A.2.2.1-9.

5. Count, at the base station, the number of frames transmitted and the number of good frames received at the mobile station. For Cases 3 and 6, count at the base station, the number of frames received in each category at the mobile station.

Table A.2.2.1-1. Test Parameters for Forward Fundamental Channel Radio Configuration 1 in Fading Channel (Case 1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{0r}/I_{0c}$</td>
<td>dB</td>
<td>8</td>
<td>-7</td>
<td></td>
</tr>
<tr>
<td>Pilot $E_b/N_0$</td>
<td>dB</td>
<td>(1):-16.1</td>
<td>(1):-13.5</td>
<td>(1):-11.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2):-16.1</td>
<td>(2):-13.5</td>
<td>(2):-11.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3):-16.0</td>
<td>(3):-16.0</td>
<td>(3):-15.2</td>
</tr>
<tr>
<td>$I_{0c}$</td>
<td>dBm/1.23 MHz</td>
<td>-63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Rate</td>
<td>bps</td>
<td>9600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic $E_b/N_0$</td>
<td>dB</td>
<td>Not Directly Settable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Simulator Configuration</td>
<td></td>
<td>(1): BCS and 11; (2): BC0, 2, 3, 7, 9, 10 and 12; (3): BC 1, 4, 6 and 8.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tip:**
To calculate Cell Power ($I_{0c}$), add the ratio of Cell Power/AWGN ($I_{0r}/I_{0c}$) with AWGN ($I_{0c}$).

For example, if $I_{0r}/I_{0c}$ is 8 dB and $I_{0c}$ is -63 dBm/1.23 MHz, Cell Power is -65+8 = -55 dBm/1.23 MHz.

Table 6.4.1.3-1. Standard Channel Simulator Configurations

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Channel Simulator Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Speed [km/h]</td>
<td>1</td>
</tr>
<tr>
<td>Band Class 0, 2, 3, 5, 7, 9, 10, 11, and 12</td>
<td>8</td>
</tr>
<tr>
<td>Band Class 1, 4, 6 and 8</td>
<td>8</td>
</tr>
<tr>
<td>Number of Paths</td>
<td>2</td>
</tr>
<tr>
<td>Path 2 Power (Relative to Path 1) [dB]</td>
<td>0</td>
</tr>
<tr>
<td>Path 3 Power (Relative to Path 1) [dB]</td>
<td>N/A</td>
</tr>
<tr>
<td>Delay from Path 1 to Input [μs]</td>
<td>0</td>
</tr>
<tr>
<td>Delay from Path 2 to Input [μs]</td>
<td>2</td>
</tr>
<tr>
<td>Delay from Path 3 to Input [μs]</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Tip:**
Unless you need to modify a standard fading profile (User Defined Path Config), all you need to do is select the correct Channel Simulator Configuration.

Baseband Studio software sets up all of the correct parameters including number of paths, delays, and Doppler shifts.
On the PC:
1. Select the Impairments Enabled checkbox.
2. Enter -55 in the Cell Power field (See Tip above).
3. Select the AWGN Enabled checkbox.
4. Enter -63 dBm in the In Band Noise Power field.

Note that the Carrier to Noise Ratio (C/N) is automatically calculated and matches I_{or}/I_{oc} in the table above.

5. Click the Standard Path Config button and select the cdma2000 Mobile Station fading configuration Case 1.

6. Click Apply Needed
Faded Test Example Procedures

**On the Test Set:**

1. Press the **LOCAL** key to enable front panel operation.
2. Display the Generator Information screen. (Press the **CALL SETUP** key, then press the More key on the left side of the display and select **F3** Generator Info key from the 2 of 3 menu).
3. Select the Code Channel Parameters menu. (Press the **F2** Code Channel Parameters key).
4. Set the Cell 1 F-Pilot Level and Cell 1 F-FCH/Traffic Level parameters as shown.

<table>
<thead>
<tr>
<th>Code Channel Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell 1 PN Offset</td>
<td>12</td>
</tr>
<tr>
<td>Cell 1 F-Pilot Level</td>
<td>-7.00 dB</td>
</tr>
<tr>
<td>Cell 1 F-Sync Level</td>
<td>-16.00 dB</td>
</tr>
<tr>
<td>Cell 1 F-Paging Level</td>
<td>-12.00 dB</td>
</tr>
<tr>
<td>Cell 1 F-FCH/Traffic Level</td>
<td>-16.10 dB</td>
</tr>
<tr>
<td>Cell 1 F-FCH/Traffic Nalsh Code</td>
<td>10</td>
</tr>
<tr>
<td>Cell 1 F-SCH Level</td>
<td>-15.60 dB</td>
</tr>
</tbody>
</table>

5. Display the Call Setup screen (press the **CALL SETUP** key).
6. Set the Traffic Data Rate field to **Full (9600 bps)** on the right 2 of 3 menu. (Press the More key on the right side of the display and select **F12** Traffic Data Rate from the 2 of 4 menu).
1. Select the Frame Error Rate measurement. (Press the Measurement Selection key).

2. (Optional) Select single trigger mode by selecting the Frame Error Rate Setup menu (press the F1 Frame Error Rate Setup key) and selecting Single in the Trigger Arm field.

On the Test Set:

1. Select the Frame Error Rate measurement. (Press the Measurement Selection key).

2. (Optional) Select single trigger mode by selecting the Frame Error Rate Setup menu (press the F1 Frame Error Rate Setup key) and selecting Single in the Trigger Arm field.

If you select single trigger mode, press the START SINGLE key to count frame errors.
3.4.2.3 Minimum Standard

The actual power measurement uncertainty shall be less than or equal to 0.2 dB (see 5.6.2) with the minimum test duration meeting the requirements specified in Table 6.6.2-1. Test durations must be sufficient to meet confidence level requirements.

A minimum confidence level of 95% shall be obtained for the following FER requirements (see 6.6).

Case 1:

The actual $P_0/K_0$ used in each test shall be within ±0.5 dB of the value indicated in Tables A.2.2.1-1 and A.2.2.1-2.

The FER for each test at 9600 bps shall not exceed the piece-wise linear FER curve specified by the points in Tables A.2.2.2-1 through A.2.2.2-3.

### Table 6.6.2-1. Minimum Test Duration Requirements

<table>
<thead>
<tr>
<th>Band Class</th>
<th>Channel Simulator Configuration</th>
<th>1</th>
<th>3</th>
<th>4</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 and 11</td>
<td>seconds frames frames frames</td>
<td>50</td>
<td>2500</td>
<td>30</td>
<td>1500</td>
</tr>
<tr>
<td>0, 2, 3, 7, 9, 10 and 12</td>
<td>seconds frames frames frames</td>
<td>30</td>
<td>1500</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td>1, 4, 5 and 8</td>
<td>seconds frames frames frames</td>
<td>10</td>
<td>500</td>
<td>7</td>
<td>350</td>
</tr>
</tbody>
</table>

**Tip:**

The Minimum Frame Count ensures that the FER test runs for a sufficient length of time to allow fading statistics to average out (mean power standard deviation must be less than 0.2 dB).

**On the Test Set:**

1. Select the Frame Error Rate Setup. (Press the F1 Frame Error Rate Setup key).
2. Enter the Minimum Frame Count.

<table>
<thead>
<tr>
<th>Frame Error Rate Setup</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence Level</td>
<td>95.00 %</td>
</tr>
<tr>
<td>FER Requirement</td>
<td>1.00 %</td>
</tr>
<tr>
<td>Minimum Frame Count</td>
<td>1500</td>
</tr>
<tr>
<td>Maximum Frame Count</td>
<td>10000</td>
</tr>
<tr>
<td>F-FCCH/Traffic Level</td>
<td>-15.60 dB</td>
</tr>
<tr>
<td>Trigger Arm</td>
<td>Continuous</td>
</tr>
<tr>
<td>Measurement Timeout</td>
<td>Off</td>
</tr>
</tbody>
</table>
The actual power measurement uncertainty shall be less than or equal to 0.2 dB (see 5.6.2) with the minimum test duration meeting the requirements specified in Table 6.6.2-1. Test durations must be sufficient to meet confidence level requirements.

A minimum confidence level of 95% shall be obtained for the following FER requirements (see 6.6).

Case 1:
1. The actual $E_b/N_0$ used in each test shall be within ±0.5 dB of the value indicated in Tables A.2.2.1.1 and A.2.2.2.1-2.
2. The FER for each test at 9600 bps shall not exceed the piece-wise linear FER curve specified by the points in Tables A.2.2.2.1 through A.2.2.2.3.

Table A.2.2.2-1. Minimum Standards for Fundamental Channel Performance in Fading

<table>
<thead>
<tr>
<th>Traffic $E_b/N_0$ [dB]</th>
<th>Band Classes 0, 2, 3, 5, 7, 9, 10, 11 and 12</th>
<th>Band Classes 1, 4, 6 and 8</th>
<th>FER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.9</td>
</tr>
</tbody>
</table>

Minimum Standard
On the Test Set:

1. Select the Frame Error Rate Setup. (Press the F1 Frame Error Rate Setup softkey).
2. Enter the FER Requirement (4.00% if table specifies 0.04).
3. Press START SINGLE and check the Pass/Fail indication.
Testing a W-CDMA UE with a Faded Channel

This section outlines the steps required to perform 3GPP TS 34.121 7.3 Demodulation of DCH in Multi-path Fading Propagation Conditions using the E5515C Fading Solution.

7.3 Demodulation of DCH in Multi-path Fading Propagation Conditions

The following excerpt from 3GPP TS 34.121 states the definition and purpose of the tests in 7.3.

<table>
<thead>
<tr>
<th>7.3</th>
<th>Demodulation of DCH in Multi-path Fading Propagation conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.3.1</td>
<td>Single Link Performance</td>
</tr>
<tr>
<td>7.3.1.1</td>
<td>Definition and applicability</td>
</tr>
<tr>
<td></td>
<td>The receive characteristics of the Dedicated Channel (DCH) in different multi-path fading environments are determined by the Block Error Rate (BLER) values. BLER is measured for each of the individual data rates specified for the DFCH. DCH is mapped into the Dedicated Physical Channel (DPCH). The UE shall be tested only according to the data rate, supported. The data-rate corresponding requirements shall apply to the UE.</td>
</tr>
<tr>
<td>7.3.1.3</td>
<td>Test purpose</td>
</tr>
<tr>
<td></td>
<td>To verify the ability of the receiver to receive a predefined test signal, representing a multi-path fading propagation channel for the wanted and for the co-channel signals from serving and adjacent cells, with a BLER not exceeding a specified value.</td>
</tr>
</tbody>
</table>

The subsequent sections of 7.3 testing are shown in the following pages, followed by instructions for performing the test steps using the fading software (on the PC) and the test set's front panel.
Faded Test Example Procedures

To perform step 1 of section 7.3.1.4.1, connect and configure the test set and fading software as described in “Operating Overview” on page 10. Then connect the UE (mobile phone or other wireless device) to the test set’s front panel RF IN/OUT port (or the RF OUT ONLY port, see “Output Power” on page 83).

<table>
<thead>
<tr>
<th>7.3.1.4</th>
<th>Method of test</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.3.1.4.1</td>
<td>Initial conditions</td>
</tr>
<tr>
<td></td>
<td>Test environment: normal; see clauses G.2.1 and G.2.2.</td>
</tr>
<tr>
<td></td>
<td>Frequencies to be tested: mid range; see clause G.2.4.</td>
</tr>
</tbody>
</table>

1. Connect the SS, multi-path fading simulator and an AWGN noise source to the UE antenna connector as shown in figure A.10.

2. Set up a call according to the Generic call setup procedure.

3. Set the test parameters for test 1-20 as specified table 7.3.1.11, table 7.3.1.13, table 7.3.1.15, table 7.3.1.17 and table 7.3.1.19.

4. Enter the UE into loopback test mode and start the loopback test.

5. Setup fading simulators as fading condition case 1, case 2, case 3 and case 6, which are described in table D.2.2.1.

<table>
<thead>
<tr>
<th>7.3.1.4.2</th>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Measure BLER of DCH.</td>
<td></td>
</tr>
</tbody>
</table>

Before beginning testing, be sure that any necessary calibrations have been performed. See “Calibration” on page 78.
To perform steps 2 through 5 from section 7.3.1.4.1 follow the instructions in the [ ] and [ ] boxes that follow.

7.3.1.4  Method of test

7.3.1.4.1  Initial conditions

Test environment: normal, see clauses G.2.1 and G.2.2.

Frequencies to be tested: mid range; see clause G.2.4.

1. Connect the SS, multi-path fading simulator and an AWGN noise source to the UE antennas connector as shown in figure A.10.

2. Set up a call according to the Generic call setup procedure.

3. Set the test parameters for test 1-20 as specified table 7.3.1.11, table 7.3.1.13, table 7.3.1.15, table 7.3.1.17 and table 7.3.1.19.

4. Enter the UE into loopback test mode and start the loopback test.

5. Setup fading simulators as fading condition case 1, case 2, case 3 and case 6, which are described in table D.2.2.1.

7.3.1.4.2  Procedures

1. Measure BLER of DCH.

7.3.1.5  Test requirements

For the parameters specified in tables 7.3.1.11, 7.3.1.13, 7.3.1.15, 7.3.1.17 and 7.3.1.19 the average downlink $E_{DPCH} \ P/C$ power ratio shall be below the specified value for the BLER shown in tables 7.3.1.12, 7.3.1.14, 7.3.1.16, 7.3.1.18 and 7.3.1.20. These requirements are applicable for TFCS size 16.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_{DPCH} / E_{C}$</td>
<td>9,6</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$I_{OC}$</td>
<td>-60</td>
<td></td>
<td></td>
<td></td>
<td>dBm / 3.84 MHz</td>
</tr>
<tr>
<td>Information Data rate</td>
<td>12,2</td>
<td>64</td>
<td>144</td>
<td>384</td>
<td>kbps</td>
</tr>
</tbody>
</table>

On the Test Set:

1. Set the Call Control and Call Parameters as required for your UE to be able to camp to the test set (press the CALL SETUP hardkey, then press the left and right More keys to move through the various menus).

Do not power the UE on at this time.
**Faded Test Example Procedures**

**On the PC:**

1. Clear the Impairments Enabled checkbox if it is selected. This disables fading while a call is attempted.

2. Click the Fader On button (it may take a few seconds for this action to complete).

NOTE: Turning the fader on configures the test set for fading, which disables certain test set settings and requires that some settings not be changed. See “Critical Fading Solution Settings” on page 73.
On the Test Set:

1. Set Channel Type (F8) to 12.2k RMC (7.3.1 Test 1 requires a 12.2k RMC connection).

<table>
<thead>
<tr>
<th>Channel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.2k RMC</td>
</tr>
<tr>
<td>64k RMC</td>
</tr>
<tr>
<td>144k RMC</td>
</tr>
<tr>
<td>394k RMC</td>
</tr>
<tr>
<td>33k No Coding RNC</td>
</tr>
<tr>
<td>12.2k UL / 64k DL AN RNC</td>
</tr>
</tbody>
</table>

2. To configure the test set properly for the Block Error Ratio measurement required for this test, select RB Test Mode Setup (F6 on the Call Control 3 of 4 menu). Set Uplink DTCH RMC CRC Presence to Used for Data, and UE Loopback Type to Type 2.

<table>
<thead>
<tr>
<th>RB Test Mode Settings</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB Test Mode RRC State Setting</td>
<td>CELL_DCH</td>
</tr>
<tr>
<td>Uplink DTCH RMC CRC Presence</td>
<td>Used for Data</td>
</tr>
<tr>
<td>Uplink Dummy DCCH Data</td>
<td>Off</td>
</tr>
<tr>
<td>UE Loopback Type</td>
<td>Type 2</td>
</tr>
</tbody>
</table>

3. Turn on the UE and verify that the UE Information screen (on the Call Setup Screen) is updated, indicating that the UE has camped.

4. Select Originate Call (F3 on the Call Control 1 of 4 menu).

5. Verify that the call status field indicates that the call is connected.

IMPORTANT: While a call is connected, you must not select Fader Off, or the call will drop (selecting Fader Off causes a momentary loss of the signal from the test set). If you want to enable/disable fading during a call, select/clear the Impairments Enabled checkbox, do not select Fader Off.
Faded Test Example Procedures

To configure the power and noise levels of the faded channel as required for 7.3.1 Test 1, follow the instructions in the  and  boxes on the following pages.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase reference</td>
<td>P-CPICH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{dp}/I_{dc}$</td>
<td>9.6</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$I_{dc}$</td>
<td>-50</td>
<td></td>
<td></td>
<td></td>
<td>dBm / 3,84 MHz</td>
</tr>
<tr>
<td>Information Data Rate</td>
<td>12.2</td>
<td>64</td>
<td>142</td>
<td>384</td>
<td>kbps</td>
</tr>
</tbody>
</table>

Table 7.3.1.12: DCH requirements in multi-path fading propagation conditions (Case 1)

<table>
<thead>
<tr>
<th>Test Number</th>
<th>$\frac{DPCH - P_e}{I_{dp}}$</th>
<th>BLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-14.9 dB</td>
<td>$10^{-2}$</td>
</tr>
<tr>
<td>2</td>
<td>-13.8 dB</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>-9.9 dB</td>
<td>$10^{-2}$</td>
</tr>
<tr>
<td>3</td>
<td>-10.5 dB</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>-8.7 dB</td>
<td>$10^{-2}$</td>
</tr>
<tr>
<td>4</td>
<td>-8.2 dB</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td></td>
<td>-2.1 dB</td>
<td>$10^{-2}$</td>
</tr>
</tbody>
</table>
On the PC:

1. Select the Impairments Enabled checkbox.

2. Select the AWGN Enabled checkbox.

3. Set In Band Noise Power (N) ($I_{oc}$) to -60.00 dBm.

4. Under AWGN Functions, select Set C/N with constraints.
   a. Set Carrier to Noise Ratio (C/N) ($\frac{I_{or}}{I_{oc}}$) to 9.6 dB.
   b. Select the button next to $N$, to hold $N$ constant when setting C/N.
   c. Select OK.

Note that the Cell Power (C) and Carrier to Noise Ratio (C/N) fields are then updated accordingly.
5. Click the **Standard Path Config** button and select the **W-CDMA Mobile Station fading configuration Case 1**.

6. Click **Apply Needed** (it may take a few seconds for this action to complete). Clicking **Apply Needed** transfers the settings for parameters such as **Cell Power** and **External AWGN** to the test set.
1. Display the Generator Information screen. (Press the CALL SETUP key, then press the More key on the left side of the display and select the F3 Generator Info key from the 2 of 4 menu).

2. Select Connected DL Channel Levels (F4).

3. Set Cell 1 Connected DPCH Level (DPCH_Ec/Io) to -14.9 dB.

4. Select Close Menu (F6).

---

<table>
<thead>
<tr>
<th>Connected Downlink Channel Levels</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell 1 Connected CPICH Level</td>
<td>-3.30 dB</td>
</tr>
<tr>
<td>Cell 1 Connected P-CCPCH/SCH Level</td>
<td>-5.35 dB</td>
</tr>
<tr>
<td>Cell 1 Connected SC-CCPCH Level</td>
<td>Off</td>
</tr>
<tr>
<td>Cell 1 Connected PICH Level</td>
<td>-8.33 dB</td>
</tr>
<tr>
<td><strong>Cell 1 Connected DPCH Level</strong></td>
<td><strong>-14.90 dB</strong></td>
</tr>
<tr>
<td>Cell 2 CPICH Level</td>
<td>-3.30 dB</td>
</tr>
<tr>
<td>Cell 2 P-CCPCH/SCH Level</td>
<td>-5.35 dB</td>
</tr>
<tr>
<td>Cell 2 DPCH Level</td>
<td>-10.30 dB</td>
</tr>
</tbody>
</table>
Faded Test Example Procedures

To perform step 1 of section 7.3.1.4.2, follow the instructions in the gray box below.

3. Set the test parameters for test 1-20 as specified table 73.1.11, table 73.1.13, table 73.1.15, table 73.1.17 and table 73.1.19.

4. Enter the UE into loopback test mode and start the loopback test.

5. Setup fading simulators as fading condition case 1, case 2, case 3 and case 6, which are described in table D.2.2.1.

7.3.1.4.2 Procedures

1. Measure BLER of DCH.

On the Test Set:

1. Initiate the Block Error Ratio measurement.

(Press the Measurement Selection key, scroll down and select Block Error Ratio.)

<table>
<thead>
<tr>
<th>Loc</th>
<th>Measurement Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRACH Transmit On/Off Power</td>
<td></td>
</tr>
<tr>
<td>Phase Discontinuity</td>
<td></td>
</tr>
<tr>
<td><strong>Block Error Ratio</strong></td>
<td></td>
</tr>
<tr>
<td>Dynamic Power Analysis</td>
<td></td>
</tr>
<tr>
<td>PRACH Preamble Analysis</td>
<td></td>
</tr>
</tbody>
</table>

2. Select Block Error Setup (F1)

a. Set Trigger Arm to Single.

b. Set Number of blocks to test to at least 8200 (34.121 Table F.6.1.6.2 specifies the minimum test time as 164 s for a 3km/h fading profile, which corresponds to 8200 20 ms blocks.)

<table>
<thead>
<tr>
<th>Block Error Ratio Setup</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of blocks to test</td>
<td>8200</td>
</tr>
<tr>
<td>Trigger Arm</td>
<td>Single</td>
</tr>
<tr>
<td>Measurement Timeout</td>
<td>Off</td>
</tr>
<tr>
<td>Uplink DTCH RNC CRC Presence</td>
<td>Used for Data</td>
</tr>
<tr>
<td>UE Loopback Type</td>
<td>Type 2</td>
</tr>
</tbody>
</table>

3. Press the **START SINGLE** key to start the BLER measurement.

Note: With Number of blocks to test set to 8200, it takes ~2.5 minutes for the BLER results to be displayed.
Faded Test Example Procedures

Compare your measured BLER result with the test requirements of section 7.3.1.5.

7.3.1.5 Test requirements

For the parameters specified in tables 7.3.1.11, 7.3.1.13, 7.3.1.15, 7.3.1.17 and 7.3.1.19 the average downlink $\frac{DPCH_E}{I_c}$ power ratio shall be below the specified value for the BLER shown in tables 7.3.1.12, 7.3.1.14, 7.3.1.16, 7.3.1.18 and 7.3.1.20. These requirements are applicable for TFCs size 16.

Table 7.3.1.11: DCH parameters in multi-path fading propagation conditions (Case 1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase reference</td>
<td>P-CPICH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{dp}/I_{dc}$</td>
<td>9.6</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$I_{dc}$</td>
<td>-60</td>
<td></td>
<td></td>
<td></td>
<td>dBm / 3.84 MHz</td>
</tr>
<tr>
<td>Information Data Rate</td>
<td>12.2</td>
<td>64</td>
<td>144</td>
<td>384</td>
<td>kbps</td>
</tr>
</tbody>
</table>

Table 7.3.1.12: DCH requirements in multi-path fading propagation conditions (Case 1)

<table>
<thead>
<tr>
<th>Test Number</th>
<th>$\frac{DPCH_E}{I_c}$</th>
<th>BLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-14.9 dB</td>
<td>$10^{-2}$</td>
</tr>
<tr>
<td>2</td>
<td>-13.8 dB</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>3</td>
<td>-9.9 dB</td>
<td>$10^{-2}$</td>
</tr>
</tbody>
</table>

On the Test Set:

1. Verify that the Block Error Ratio result is less than $10^{-2}$ (1%).

<table>
<thead>
<tr>
<th>BLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block Error Ratio</td>
</tr>
<tr>
<td>0.23 %</td>
</tr>
<tr>
<td>Block Error Count: 19</td>
</tr>
<tr>
<td>Blocks Tested: 8200</td>
</tr>
<tr>
<td>Uplink Missing Blocks: 0</td>
</tr>
</tbody>
</table>

8200 / 8200 Single
Faded Test Example Procedures

To perform Tests 2 through 20 in section 7.3.1.4.1, follow the directions in the gray boxes below.

**On the PC:**
1. Clear the Impairments Enabled checkbox. (It is recommended that you perform call processing operations, such as changing RMCs, without channel impairments, to ensure that the UE is able to receive and properly decode the signaling from the test set).
2. Click Apply Needed.

**On the Test Set:**
1. Perform a Transport Channel Reconfiguration to the required RMC (Press the CALL SETUP key, select Handoffs (F5), then Transport Chan Reconfig (F2). Set Handoff RB Test Mode RAB. Select Execute Handoff (F5). Ensure that the call status is still Connected.)
2. Set Cell 1 Connected DPCH Level as required.

**On the PC:**
1. Select the Impairments Enabled checkbox.
2. Set the Carrier to Noise Ratio (C/N) as needed using the Set C/N with constraints dialog box.
3. Select the required Standard Path Config.
4. Click Apply Needed.

**On the Test Set:**
1. Set the Number of Blocks to Test as needed.
2. Press the START SINGLE key. Wait for BLER results to be displayed.
Testing an 1xEV-DO Access Terminal with a Faded Channel

This section outlines the steps required to perform 3GPP2 C.S0033 3.1.1.2.2 Demodulation of Forward Traffic Channel in Multipath Fading Channel using the E5515C Fading Solution.

3.1.1.2.2 Demodulation of Forward Traffic Channel in Multipath Fading Channel

The following excerpt from 3GPP2 C.S0033 states the definition of the tests in 3.1.1.2.2 and the standard channel simulator configurations as defined in 11.4.1.1.

<table>
<thead>
<tr>
<th>Case</th>
<th>Channel Simulator Configuration Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Tip: Each test Case of 3.1.1.2.2 requires a standard Channel Simulator Configuration which defines the fading profile. For details, see the excerpted table on next page.

Case 1 tests the demodulation performance for the 8 km/h, two-path case by checking the PER at the 38.4 kbps and 76.8 kbps data rates.

Case 2 tests the demodulation performance for the 3 km/h, single-path case by checking the PER at the 38.4 kbps and 76.8 kbps data rates.

Case 3 tests the demodulation performance for the 30 km/h, single-path case by checking the PER at the 38.4 kbps and 76.8 kbps data rates.

Case 4 tests the demodulation performance for the 100 km/h, three-path case by checking the PER at the 38.4 kbps and 76.8 kbps data rates.

Refer to 11.4.1.1 for the standard channel simulator configurations.

(see next page)
Faded Test Example Procedures

Standard Channel Simulator Configurations

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Channel Simulator Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Vehicle Speed [km/h]</td>
<td>8</td>
</tr>
<tr>
<td>Band Classes 0, 2, 3, 7, 9, 10, and 12</td>
<td></td>
</tr>
<tr>
<td>Band Classes 1, 4, 6, and 8</td>
<td>8</td>
</tr>
<tr>
<td>Band Class 5 and 11</td>
<td>15</td>
</tr>
<tr>
<td>Number of Paths</td>
<td>2</td>
</tr>
<tr>
<td>Path 2 Power (Relative to Path 1) [dB]</td>
<td>0</td>
</tr>
<tr>
<td>Path 3 Power (Relative to Path 1) [dB]</td>
<td>N/A</td>
</tr>
<tr>
<td>Delay from Path 1 to Input [μs]</td>
<td>0</td>
</tr>
<tr>
<td>Delay from Path 2 to Input [μs]</td>
<td>2</td>
</tr>
<tr>
<td>Delay from Path 3 to Input [μs]</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The subsequent sections of 3.1.1.2.2 testing are shown in the following pages, followed by instructions for performing the test steps using the fading software on the PC and the test set’s front panel.
To perform step 1 of section 3.1.1.2.2.2, connect and configure the test set and fading software as described in “Operating Overview” on page 10. Then connect the 1xEV-DO access terminal to the test set’s front panel RF IN/OUT port (or the RF OUT ONLY port, see “Output Power” on page 83).

3.1.1.2.2.2 Method of Measurement

1. Connect the sector, the channel simulator and an AWGN generator to the access terminal antenna connector as shown in Figure 11.5.1-1.

**Equipment Setup:**

Before beginning testing, be sure that any necessary calibrations have been performed. See “Calibration” on page 78.
Faded Test Example Procedures

To perform steps 2 and 3 from section 3.1.1.2.2.2, follow the instructions in the and boxes that follow.

2. Set the access network equipment’s forward packet activity to 100%. Set the access network equipment’s Control Channel data rate to 38.4 kbps.

3. Set the SetManagementSameChannelParameters attribute fields of the Default Route Update Protocol to the values specified below:

<table>
<thead>
<tr>
<th>Field</th>
<th>Value (Hex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PilotDrop</td>
<td>0x1c(-14 dB)</td>
</tr>
</tbody>
</table>

On the Test Set:

1. You do not need to make any setting for Forward packet activity because it is fixed to 100% in the test set.

2. Set the Control Channel Data Rate to 38.4 kbps. (Press the CALL SETUP hardkey, then press the left side More key to display the 2 of 3 menu. Press the F2 (Access Network Info), then the F2 (Cell Parameters) key. Use the knob and DATA ENTRY keys to set the control channel data rate.

3. Set the Pilot Drop (F5) to 28. (The pilot drop threshold used by the AT is -0.5 dB times the pilot drop value sent by the test set.)

Tip: Do not power the Access Terminal on at this time.
To perform step 4 from section 3.1.1.2.2.2 follow the instructions in the [ ] and [ ] boxes that follow.

4. Set up a Test Application session. Open a connection and configure the Test Application FTAP so that the Forward Traffic Channel rate corresponds to the rate of the test only.

5. Once the connection is established, set the test parameters for Test 1 as specified in Table 3.1.1.2.2.2-1.

**On the Test Set:**

1. Set the parameters as required for your AT to camp to the test set such as Cell Power, Cell Band, Channel, etc. (Press the CALL SETUP hardkey, then set the parameters from Call Parms and Call Control menus. Press the left and right More keys to move through the various menus if required.)

2. Set Test Application Protocol to FTAP. (Select Application Config (F10), make sure Session Application Type is Test Application and then set the Test Application Protocol to FTAP.)
On the PC:

1. Enter the AT’s Cell Band.
2. Enter the AT’s RF Channel number.
3. Enter the Cell Power (-55 dBm is usually sufficient power to set up a call).
4. Clear the Impairments Enabled checkbox if it is selected. This disables fading while a call is attempted.
5. Click the Fader On button (it may take a few seconds for this action to complete). This action causes the fading software to download the settings from steps 1-4 to the test set.

NOTE: Turning the fader on also configures the test set for fading, which disables certain settings and requires that some settings not be changed. See “Critical Fading Solution Settings” on page 73.
On the Test Set:

1. Turn on the AT and wait for it to open a session. (NOTE: A session can only be originated from the AT. The test set can not open a session.)

2. Verify that the AT Information screen (on the Call Setup Screen) is updated, indicating that the UE has camped. The Active Cell status field indicates that a session is open.

3. Press the F3 (Start Data Connection on Call Control 1 of 3) to page the AT.

4. Verify that the Active Cell status field indicates that a data connection is established.

IMPORTANT While a call is connected, you must not select Fader Off, or the call will drop (selecting Fader Off causes a momentary loss of the signal from the test set). If you want to enable/disable fading during a call, select/clear the Impairments Enabled checkbox, do not select Fader Off.
Faded Test Example Procedures

To perform step 5 from section 3.1.1.2.2.2 follow the instructions in the and boxes that follow. (PCS band is used in this example.)

5. Once the connection is established, set the test parameters for Test 1 as specified in Table 3.1.1.2.2.2-1.

6. From the number of packets transmitted and the number of bad packets received calculate the PER for this test.

Table 3.1.1.2.2.2-1. Test Parameters for FTC Demod in Fading Channel

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{OR} / I_{OC}$</td>
<td>dB</td>
<td>(1): -6.0</td>
<td>(1): -4.2</td>
<td>(1): -3.3</td>
</tr>
<tr>
<td>$I_{OC}$</td>
<td>dBm/1.23 MHz</td>
<td>(1): -49</td>
<td>(1): -50.8</td>
<td>(1): -51.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2): -47.6</td>
<td>(2): -49.2</td>
<td>(2): -50.4</td>
</tr>
<tr>
<td>Data Rate</td>
<td>kbps</td>
<td></td>
<td>38.4</td>
<td></td>
</tr>
<tr>
<td>$\frac{E_c}{I_0}$</td>
<td>dB</td>
<td>(1): -6.97</td>
<td>(1): -5.60</td>
<td>(1): -4.97</td>
</tr>
</tbody>
</table>

(1): Band Classes 0, 2, 3, 5, 7, 9, 10, 11 and 12
(2): Band Classes 1, 4, 6, and 8

Note: The Traffic $E_b/N_t$ and Pilot $E_c/I_0$ values are calculated from the parameters set in the table. They are not settable parameter themselves.
On the PC:

1. Select the Impairments Enabled checkbox.
2. Select the AWGN Enabled checkbox.
3. Set In Band Noise Power (N) \( (I_{oc}) \) to -47.6 dBm.
4. Under AWGN Functions, select Set C/N with constraints.
   (Set Carrier to Noise Ratio \( (C/N) \) \( (I_{or}/I_{oc}) \) to -7.4 dB. Select the button next to N, to hold N constant when setting C/N. Select OK.)

Note that the Cell Power \( (C) \) and Carrier to Noise Ratio \( (C/N) \) fields are then updated accordingly.
5. Click the **Standard Path Config** button and select the 1xEV-DO fading configuration Case 1.

Tips:
Unless you need to modify a standard fading profile (User Defined Path Config), all you need to do is to select the correct Channel Simulator Configuration. Baseband Studio software sets up all of the correct parameters including number of paths, delays, and Doppler shifts as specified by standard. The standard channel simulator configurations are excepted on page 48.

6. Click **Apply Needed** (it may take a few seconds for this action to complete). Clicking **Apply Needed** transfers the settings for parameters such as **Cell Power** and **External AWGN** to the test set.
On the Test Set:

1. Press the **LOCAL** key to enable front panel operation.

2. Set **FTAP Rate** to 38.4 Kbps for Test 1. (Press the **CALL SETUP** hardkey, then Press the **F11** (**FTAP Rate**) key from Call Parms 1 of 3 menu).
Faded Test Example Procedures

To perform step 6 from section 3.1.1.2.2.2 follow the instructions in the \( \square \) and \( \square \) boxes that follow.

5. Once the connection is established, set the test parameters for Test 1 as specified in Table 3.1.1.2.2.2-1.

6. From the number of packets transmitted and the number of bad packets received calculate the PER for this test.

\( \square \) On the Test Set:

1. Initiate the Packet Error Rate measurement.

   (Press the Measurement Selection key, scroll down and select Packet Error Rate.)

2. Select Packet Error Setup (F1). Set the measurement parameters as required for the Test 1. See the following pages for details.
To perform the Test 1 as the following test requirements, follow the instructions in the gray box.

3.1.1.2.2.3 Minimum Standard

The actual power uncertainty due to fading shall be less than or equal to 0.2 dB (see 14.2) with the minimum test duration meeting the requirements specified in Table 12.2-1. Test durations must be sufficient to meet confidence level requirements.

A minimum confidence level of 95% shall be obtained for the following PER requirements (see Section 12).

Case 1:
The actual $E_b/N_t$ used in each test shall be within ±0.5 dB of the value indicated in Table 3.1.1.2.2.2-1 and Table 3.1.1.2.2.2-2.

The PER for each test shall not exceed the piece-wise linear PER curve specified by the points in Table 3.1.1.2.2.3-1.

### Table 12.2-1. Minimum Test Duration Requirements

<table>
<thead>
<tr>
<th>Band Class</th>
<th>Channel Simulator Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>seconds</td>
</tr>
<tr>
<td>5 and 11</td>
<td>50</td>
</tr>
<tr>
<td>0, 2, 3, 7, 9, 10 and 12</td>
<td>30</td>
</tr>
<tr>
<td>1, 4, 6 and 8</td>
<td>10</td>
</tr>
</tbody>
</table>

One slot corresponds to 1.66... ms.

**Tip:**
The Test Duration Requirements ensures that the PER test runs for a sufficient length of time to allow fading statistics to average out (mean power standard deviation must be less than 0.2 dB).
### Table 3.1.1.2.2.3-1. Minimum Standards for Forward Traffic Channel Performance in Fading Channel (Case 1)

<table>
<thead>
<tr>
<th>Rate</th>
<th>$E_b/N_t$ [dB]</th>
<th>PER</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.4 kbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1): 6.84</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>(2): 5.29</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1): 7.29</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(2): 6.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1): 8.85</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(2): 7.47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1): 9.59</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>(2): 8.51</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1): 10.3</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(2): 9.01</td>
<td></td>
</tr>
</tbody>
</table>
To perform Tests 2 through 24 as specified in section 3.1.1.2.2.2, repeat the procedures above and set the parameters properly.
Faded Test Example Procedures

Testing a GSM Mobile Station with a Faded Channel

This procedure outlines the steps required to perform test 14.2.1 Reference sensitivity - TCH/FS in the 3GPP standard TS 51.010-1.

14.2.1 Reference sensitivity - TCH/FS

The following excerpt from 3GPP TS 51.010 states the definition and conformance requirement of the tests in 14.2.1.

<table>
<thead>
<tr>
<th>14.2</th>
<th>Reference sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2.1</td>
<td>Reference sensitivity - TCH/FS</td>
</tr>
</tbody>
</table>

14.2.1.1 Definition

The reference sensitivity is the signal level at the MS receiver input at which a certain BER and FER must be achieved.

For E-GSM 900 MS this test is only performed in the P-GSM band.

14.2.1.2 Conformance requirement

1. At reference sensitivity level, the TCH/FS FER shall meet the reference sensitivity performance of table 1 in 3GPP TS 05.05 subclause 6.2.
2. At reference sensitivity level, the TCH/FS class I RBER shall meet the reference sensitivity performance of table 1 in 3GPP TS 05.05 subclause 6.2.
3. At reference sensitivity level, the TCH/FS class II RBER shall meet the reference sensitivity, performance of table 1 in 3GPP TS 05.05 subclause 6.2.
4. At reference sensitivity level, the TCH/FS class II RBER shall meet the reference sensitivity, performance of table 1 in GSM under extreme conditions; 3GPP TS 05.05 subclause 6.2 and annex D subclauses D.2.1 and D.2.2.

Tip:

1. The reference sensitivity level for each band is defined in the 3GPP standard TS 05.05 subclause 6.2. In this example, -102dBm is used as the reference sensitivity level for GSM900.
2. 3GPP TS05.05 annex D subclauses D.2.1 and D.2.2 specifies the environmental (Temperature and voltage) requirements for the mobile station.
14.2.1.4 Method of test

Before the test, be sure that any necessary calibrations have been performed. See “Calibration” on page 78.

A call is set up according to the generic call set up procedure on a TCH-FS with an ARFCN in the Mid ARFCN range for GSM 400, GSM 700, T-GSM 810, GSM 850, DCS 1800 and PCS 1900 and ARFCN 70 for GSM 900.

**NOTE:** For GSM 900 ARFCN 70 is tested since this is the 73rd harmonic of the 13 MHz clock normally used internally in a MS.

The SS transmits Standard Test Signal C1 on the traffic channel.

The SS commands the MS to create traffic channelloop back signalling erased frames.

To prepare for the initial conditions in 14.2.1.4.1, connect and configure the test set and fading software as described in “Operating Overview” on page 10. Then connect the mobile phone to the test set’s front panel RF IN/OUT port (or the RF OUT ONLY port, see “Output Power” on page 83).

Follow the instructions in the following pages to operate either on the test set or on the PC.
On the Test Set:

1. Set the Operating Mode to Active Cell (GSM) (press the **CALL SETUP** hardkey, then press **F1** in the Control 1 of X).

2. Setup the Cell Info (**F6** in Control 1 of X) if needed.

3. Set the BCH Parameters to proper values (**F7** on the right side Call Parms).

4. Setup the TCH Parameters as required (**F8** on the right side Call Parms). For example, for PGSM, setup the following parameters:
   1. Set the Traffic Band to PGSM.
   2. Set the Traffic Channel to 70.
   3. Set the MS Tx Level to 30.

4. Set the Downlink Traffic Power to the reference sensitivity level. To achieve this, press Downlink Traffic Power (**F7**), set the Power Reduction Level One (PRL One) to a value that will make the Traffic Channel Downlink Power of the required slot to -102dBm.

5. Set the Channel Mode to FS. Press Channel Mode Setup (**F11** in TCH Parms 1 of X), then press **F7** to enter the Channel Mode Configuration menu, set the Logical Speech Channel to FS.

6. Set the Mobile Loopback to Type A. Go to TCH Parms 2 of X, press Internal Test Loops (**F9**), continue to press Mobile Loopback (**F9**) and set it to Type A.

---

<table>
<thead>
<tr>
<th>Burst:</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>dBm:</td>
<td>-102.06</td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Timeslot</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing Advance</td>
<td>0</td>
</tr>
<tr>
<td>Traffic Band</td>
<td>PGSM</td>
</tr>
<tr>
<td>Traffic Channel</td>
<td>70</td>
</tr>
<tr>
<td>MS TX Level</td>
<td>30</td>
</tr>
<tr>
<td>Channel Mode Setup</td>
<td>Frequency Hopping</td>
</tr>
<tr>
<td>Return</td>
<td>Return</td>
</tr>
<tr>
<td>2 of 3</td>
<td></td>
</tr>
</tbody>
</table>
On the Test Set (Continued):

1. Set the faded channel to TCH. To achieve this, go to 4 of X in Control, then press Digital Bus Info (F1), set the Faded Channel to Traffic.

Do not power the UE on at this time.

On the PC:

1. Click the Upload Settings button to upload the settings like Frequency, Cell Power etc, from the test set.
2. Clear the Impairments Enabled checkbox if it is selected. This disables fading while a call is attempted.
3. Click the Fader On button (it may take a few seconds for this action to complete).

NOTE: Turning the fader on configures the test set for fading, which disables certain test set settings and requires that some settings not be changed. See “Critical Fading Solution Settings” on page 73.
Faded Test Example Procedures

1. Turn on the mobile station and verify that the Mobile Station Information screen (press the Call Setup key) is updated, indicating that the mobile station has registered.

2. Press the Originate Call key.

3. Verify that the call status field indicates that the call is connected.
14.2.1.4.2 Procedure

a) The fading function is set to TUhigh.

b) The SS sets the amplitude of the wanted signal to reference sensitivity level ( ).

c) The SS compares the data of the signal that it sends to the MS with the signal which is looped back from the receiver after demodulation and decoding, and checks the frame erasure indication.

d) The SS determines the number of residual bit error events for the bits of class II, by examining sequences of at least the minimum number of samples of consecutive bits of class II. Bits are taken only from those frames not signalled as erased.

On the PC:

1. To perform the step a) in the procedure, check the Impairments Enabled and set the Standard Path Config to GSM_EDGE/TUx 6 Tap(2).

Note: TUhigh is related to different MS speeds depending on the operating band. Refer to 3GPP TS 51.010 table 3.2 for the term representative for different bands.

Edit the Speed to the required value for your band. For example, for PGSM, edit the Speed to 50km/h for each path.

2. The signal amplitude in step b) has been set in the step 4) in page 64.

3. Click Apply Needed to enable the fading function to the test.
14.2.1.5 Test requirements

The error rates measured for different channels and under the different propagation conditions, under any combination of normal and extreme test voltages and ambient temperatures, shall not exceed the test limit error rate values given in table 14-5 or 14-6.

<table>
<thead>
<tr>
<th>Channels</th>
<th>Propagation conditions T(\mathrm{U})high</th>
<th>Propagation conditions RA</th>
<th>Propagation conditions HT</th>
<th>Static conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test limit error rate %</td>
<td>Minimum No. of samples</td>
<td>Test limit error rate %</td>
<td>Minimum No. of samples</td>
</tr>
<tr>
<td>TCH/FS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FER class I(\text{b}) (RBER)</td>
<td>6.742(\times)(\alpha)</td>
<td>8960</td>
<td>0.42(\times)(\alpha)</td>
<td>1000 000</td>
</tr>
<tr>
<td>FER class II(\text{b}) (REER)</td>
<td>8.333</td>
<td>120 000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where \(\alpha\) is a parameter which can range from 1 to 1.6. The value of \(\alpha\) for a RBER test on TCH/FS class I\(\text{b}\) bits under particular measurement conditions shall be the same as that determined in the FER test on TCH/FS under the same conditions.
Faded Test Example Procedures

1. Initiate the GSM Bit Error measurement (Press the Measurement Selection softkey and select the GSM Bit Error).

2. Set the following measurement parameters as specified in the 14.2.1.5 Test requirements. To achieve this, select the Bit Error Setup. (Press F1 Bit Error Setup softkey)
   1) Set the Number of bits to test to 130000.
   2) Set the Measurement Type to Residual Type II.
   3) Set the Trigger Arm to Single.
   4) Press START SINGLE, wait for the measurement results for both Bit Error and Frame error rate (FER).

<table>
<thead>
<tr>
<th>BER Setup</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of bits to test</td>
<td>130000</td>
</tr>
<tr>
<td>Measurement Type</td>
<td>Residual Type II</td>
</tr>
<tr>
<td>Signaling Loopback Control</td>
<td>On</td>
</tr>
<tr>
<td>Close Loop Signaling Delay</td>
<td>300.0 ms</td>
</tr>
<tr>
<td>Loopback Delay</td>
<td>Auto</td>
</tr>
<tr>
<td>Measurement Unit</td>
<td>%</td>
</tr>
<tr>
<td>Trigger Arm</td>
<td>Single</td>
</tr>
<tr>
<td>Measurement Timeout</td>
<td>Off</td>
</tr>
</tbody>
</table>

4) Bit Error: 3.47%  
   FER: 0.95%  
   Loopback Delay: 4.00  
   Measurement Type: Residual Type II  
   Rx Level: 5.00 (-106 to -105 dBm)  
   Rx Qual: 4.00 (1.5 to 3.2 % BER)
Faded Test Example Procedures

e) The SS determines the number of residual bit error events for the bits of the class 1b, by examining sequences of at least the minimum number of samples of consecutive bits of class 1b. Bits are only taken from those frames not signalled as erased.

f) The SS also determines the frame erasure events by examining sequences of at least the minimum number of samples of consecutive frames and assuming a frame is received successfully, if it is not signalled as erased.

g) Steps a) to d) are repeated under extreme test conditions.

h) Steps a) to g) are repeated for TCH/FS with ARFCNs in the Low ARFCN range for GSM 400, GSM 700, T-GSM 810, GSM 850, DCS 1800 and PCS 1900 and ARFCN 5 for GSM 900 and the High ARFCN range.

NOTE: For GSM 900 ARFCN 5 is tested since this is the 72nd harmonic of the 13 MHz clock normally used internally in a MS.

i) Steps b) to d) are repeated with the SS fading function set in turn to RA and HT.

j) Steps b) to g) are repeated, with the SS fading function set to static and the MS is commanded by the SS into hopping mode using the hopping sequence defined in clause 6.

The amplitude of the wanted signal is set according to step b). All the other time slots, except the active ones, are set to 20 dB above reference sensitivity level. This implicitly tests adjacent time slot rejection.
To perform the step e) through f), follow the directions in the gray boxes below.

**On the Test Set:**

1. In the Bit Error Setup menu
   1) Set the **Number of bits** to the required value.
   2) Set the **Measurement Type** to **Residual Type Ib**.
2. Press **START SINGLE** softkey, wait for the measurement results for both Bit Error and Frame error rate (FER).

To perform step h), follow the directions below.

**On the PC:**

1. Disconnect the mobile with the test set.
2. Set the Frequency to the low or high ARFCN as the standard required.
3. Clear the Impairments Enabled checkbox to disable the impairments.
4. Power on the mobile and wait for the status area to be Connected.
5. Check the Impairments Enabled checkbox to enable the impairment

To perform step i), follow the directions below.

**On the Test Set:**

1. Initiate the GSM Bit Error measurements and set the measurement parameters as required.
2. Press **START SINGLE** softkey, wait for the measurement results for both Bit Error and Frame error rate (FER).

**On the PC:**

1. Set the fading profile by first clicking the Standard Path Config button and choose a proper profile, change the Speed to the required value manually if necessary.
2. Click Apply Needed.
Faded Test Example Procedures

**On the Test Set:**

1. Initiate the GSM Bit Error measurements and set the measurement parameters as required.

2. Press **START SINGLE** softkey, wait for the measurement results for both Bit Error and Frame error rate (FER).
Fader System Requirements

This section provides background operating information and theory of operation for the E5515C Fading Solution (fader).

Critical Fading Solution Settings

Because the fader integrates a PC software application with hardware residing on both the PC and the test set, the fader must function as a test system. During fading, the PC functions as the system controller, sending GPIB commands to the test set.

After the PC has remotely configured the test set for fading, critical settings must not be overridden by manual test set via front panel operation.

Critical settings on the test set

The following settings are set automatically by the Baseband Studio software via GPIB when the fader is turned on. If these settings are changed using the test set's front panel controls, the test set does not generate an accurate faded signal.

When the fader is on, the following settings must be preserved:

- AWGN = Off. If AWGN is desired, it must be enabled using the fading software. If enabled, AWGN appears in the Ext AWGN Power fields.
- Bbio Control Digital Bus Path mode = Tx Out + Tx In.
Fader System Requirements

- The Bbio Control ALC mode must be Open Loop.

In addition, the test set’s Operating Mode must remain set to “Active Cell”. This setting is not controlled by the Baseband Studio software.

Critical settings on the Baseband Studio for Fading software

The only critical setting on the fader software is the Fader On/Fader Off buttons. Once the fader is turned on, it should not be turned off until the call is ended.

**DO NOT CHANGE THIS SETTING DURING A CALL!**

Turning the fader off causes a momentary loss of the signal from the test set and the call to drop. To enable/disable fading during a call select/clear the Impairments Enabled checkbox.
Power Level Control During Fading
This section, “Power Level Control During Fading”, provides background information pertaining to the fader’s power level control. It helps you understand the fader’s output signal generation and some of the limitations that can cause the overrange error to be displayed.

When the fader is turned on, the test set’s signal level is controlled differently than when the fader is turned off. Even though all of the necessary configuration changes to the test set are made automatically by the fader software via GPIB, in some cases it may be useful to understand how power levels are affected when the fader is turned on.

Level Accuracy
Normally, the test set uses an automatic level control (ALC) loop to compare detected power with a reference level and feed back the difference to the RF modulator to correct any error.

During faded signal tests, however, the test set’s ALC loop must be open (disabled). This is because the test set’s ALC loop would interpret the effects of fading as signal level error. If the ALC loop were not opened, the faded signal would be distorted since the ALC bandwidth is much wider than the relatively narrow bandwidth of typical fading patterns.

When the ALC loop is open, you must perform a calibration routine to provide output level accuracy. This calibration procedure, called “Open Loop ALC”, covers the range of frequencies generated by the test set. See “Calibration” on page 78.

Modulation Backoff
Wideband modulation produces inherently high peak-to-average magnitude levels. This is referred to as the modulation’s crest factor. Because of the modulation’s crest factor, Baseband Studio software must scale down the digital I/Q signal power to avoid exceeding the full scale (DAC) range. This provides headroom for signal peaks that result from the modulation type.

Modulation Back Off (MBO) is the parameter that Baseband Studio software receives from the test set for the purpose of scaling down digital I/Q signal for the effects of the particular modulation type’s crest factor.

For example, when the cdma2000 lab application is running and the System Type is IS-2000, MBO is 18 dB.

Figure 4. Modulation Backoff for System Type cdma2000

<table>
<thead>
<tr>
<th>Baseband Studio Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseband Studio Status:</td>
</tr>
<tr>
<td>Modulation Backoff:</td>
</tr>
<tr>
<td>Modulation Bandwidth:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current</th>
<th>Desired</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.01 dB</td>
<td>16.01 dB</td>
</tr>
</tbody>
</table>

Impairments Backoff
Depending on the type of fading, further down-scaling is required. This is referred to as Impairments Backoff (IBO).

Based on the fading profile, the fader software calculates IBO. The fader software scales down the unfaded baseband signal by this factor and then multiplies the resulting signal with the complex fading vector.
Fader System Requirements

For example, the standard fading configuration for cdma2000 mobile station test Case 1 would result in an IBO of 16.01 dB.

**Figure 5. IBO for a 2-Path Rayleigh Fading Profile with 6.5 Hz of Doppler Spread**

<table>
<thead>
<tr>
<th>Baseband Studio Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseband Studio Status: Impairments On</td>
</tr>
<tr>
<td>Nodulation Backoff: 18.00 dB</td>
</tr>
<tr>
<td>Nodulation Bandwidth: 1.28 Hz</td>
</tr>
<tr>
<td>Impairments Backoff: Current Desired</td>
</tr>
<tr>
<td>16.01 dB 15.01 dB</td>
</tr>
</tbody>
</table>

**Output Power Limits**

After fading has been applied to the baseband signal, the test set receives the scaled down baseband signal and must then scale the signal up in power to compensate for both backoffs, MBO and IBO. Whether or not the test set has the output power range required depends on the amount of backoff associated with the fading profile selected and the requested power level.

If an RF Power level is requested that exceeds the test set's maximum output power limit, the IBO value cannot be applied without overranging the test set's full scale value. In this case, the test set transmits the highest power level possible considering the IBO required to return the baseband signal to full range while maintaining the requested Eb/Nt ratio. The following error message indicates that an over range occurred.

On the Baseband Studio Summary screen above, the Desired Impairments Backoff value indicates the IBO associated with the requested RF Power level. The Current IBO value indicates the value associated with the current maximum power level attainable.

The difference between the Desired (actual) Impairments Backoff value and the Current (maximum obtainable) Impairments Backoff is displayed. The difference between the Current and Desired Impairments Backoff reflects the difference between the Current and Desired RF output power. These values are reported in the Generated Power Level Information screen.
### Generated Power Level Information

<table>
<thead>
<tr>
<th></th>
<th>Current Level</th>
<th>Desired Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell 1 Power (dBm/1.23 MHz):</td>
<td>-26.74</td>
<td>-25.74</td>
</tr>
<tr>
<td>Cell 2 Power (dBm/1.23 MHz):</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>AUGH Power (dBm/1.23 MHz):</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Ext AUGH Power (dBm/1.23 MHz):</td>
<td>-34.74</td>
<td>-33.74</td>
</tr>
<tr>
<td><strong>Total RF Power (dBm/1.23 MHz):</strong></td>
<td><strong>-26.10</strong></td>
<td><strong>-25.10</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Channel</th>
<th>Cell 1</th>
<th>Cell 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PN Offset: 12</td>
<td>PN Offset: 36</td>
</tr>
<tr>
<td></td>
<td>Level (dB):</td>
<td>Walsh Code:</td>
</tr>
<tr>
<td>F-Pilot</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>F-Syn</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>F-Pag</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>F-DCCH</td>
<td>1 180</td>
<td>1 180</td>
</tr>
<tr>
<td>F-SCH</td>
<td>1 208</td>
<td>1 208</td>
</tr>
</tbody>
</table>

**Warning:** Impairments backoff (IBD) over range due to settings made under external software control
Fader System Requirements

Calibration

ALC Open Loop Calibration

In addition to the same calibrations required for non-fader operation, there is one additional calibration routine required for accurate faded signals. It is called ALC Open Loop Calibration.

When the fader is on, the test set's ALC (Automatic Level Control) loop is disabled. The ALC loop normally measures output power, continually applying correction values to the output level through a feedback loop. If allowed to operate in the closed loop mode, level changes introduced by signal fading would essentially be canceled out.

The method used to obtain calibrated output levels on faded signals is called “Open Loop ALC”. In this mode, the ALC path is opened and corrections applied to the output signal level are obtained from calibration tables in the test set’s memory. These tables are built during the ALC Open Loop Calibration. ALC open loop calibration values provide level correction across the complete frequency range of the test set.

The Open Loop ALC calibration routine must be run initially before performing faded tests. The test set should be allowed to warm up at least a two hours for the internal temperatures to stabilize. After the initial calibration, Open Loop ALC should be run about every six months or when the test set’s internal temperature changes more the +/- 5 degrees C from the temperature during the last calibration. A temperature sensor inside the test set detects when +/- 5 degrees C of temperature drift has occurred and displays a message on the front panel.

Open Loop ALC is accessed through the Digital Bus Info field (left 3 of 4 Call Control menu). The entire process takes about two minutes. Call processing is disabled during this time.
I/Q Calibration

When fading is applied to the baseband signal, signal levels can momentarily drop to levels far below the average level. This drop in signal level is referred to as a deep fade, and can result in levels that approach the minimum power level the test set is capable of generating.

The test set’s lower power limit is determined by carrier leakage and residual broadband noise. Residual noise is always present, but carrier leakage caused by DC offsets in the analog baseband I/Q circuitry can be calibrated out by running the IQ calibration routine. This ensures that the range of power levels generated by the test set extends to the lowest possible levels.

I/Q calibration, like Open Loop ALC, should be performed initially after the test set is fully warmed up and again if the operating temperature has drifted more than 5 degrees C since the last I/Q calibration.

The Cal. first IQ Modulator procedure is accessed through the System Config, Service field (right 2 of 2 Utilities menu). This calibration process takes about 10 minutes. Call processing is disabled while the calibration is in progress.
Fader System Requirements

NOTE
Performing Cal. second IQ Modulator is not necessary for faded signals. It applies to the test set’s second RF source which is not faded.
The Digital Bus Connection

The digital bus carries digital baseband signals between the N5101A PCI card installed in the PC and the test set’s rear panel digital bus interface.

Digital Bus path control in the test set

A test set equipped with option 004 includes a rear panel with an 80-pin connector labeled Digital Bus and a BBIO (Baseband Input/Output) circuit board that provides the necessary baseband I/Q signal path switching.

The correct path switching mode is automatically set by the fader software when fading is turned on or off. In addition to the path switching modes used for faded and non-faded operation, there are two path switching modes that are provided for diagnostic purposes. Before changing any Digital Bus Path settings, see “Critical Fading Solution Settings” on page 73.

The Digital Bus Path menu consists of the following settings:

- Internal - For normal non-faded operation. Routes the test set’s digital I/Q signal to the analog I/Q circuitry. See Figure 6. “Digital Bus Path Control = Internal”.
- TX Out + TX In - For normal faded operation. Sends digital I/Q data from the test set to a PC via the Digital Bus output and routes the Digital Bus data input from a PC to the test set’s analog I/Q circuitry. See Figure 7. “Digital Bus Path Control = TX Out + TX In”.
- Diag Loopback - Used for testing path switching internal to the test set. Transmitted digital I/Q data bits are routed back to the digital I/Q receiver. No data is sent to/from the Digital Bus.
- Ext Loopback - Used for testing external (N5101A PCI card) hardware. Routes the data input from the PC to the Digital Bus back to the PC via the Digital bus output. This is used when the “Run Self Tests for Selected Item button is selected from the System Configuration window (see “Configuring the Fader System” on page 11).
- TX Output Only - Reserved for future use.
- TX Out + I Data - Reserved for future use.
- TX Out + Q Data - Reserved for future use.
Fader System Requirements

Figure 6. Digital Bus Path Control = Internal

![Digital Bus Path Control Diagram (Internal)](image1)

Figure 7. Digital Bus Path Control = TX Out + TX In

![Digital Bus Path Control Diagram (TX Out + TX In)](image2)
Output Power

The RF Out Only connector, available on test sets with two RF ports, provides a higher output power than the RF In/Out. By externally duplexing the RF input and output, you can take advantage of the higher output power available at the RF Out Only connector. This results in approximately 8 dB of increased cell power and 3 dB of increased AWGN power.

See the following data sheets for CDMA and W-CDMA output power specifications:

- Agilent E6702B cdma2000/IS-95/AMPS Mobile Lab Application Data Sheet
- Agilent E6703B W-CDMA Lab Application Data Sheet
- Agilent E6701F GSM/GPRS Lab Application and E6704A EGPRS Lab Application Technical Overview
Fader System Requirements

Figure 9. RF Setup using RF Out Only Port
GSM/GPRS/EGPRS Operating Considerations

The GSM/GPRS/EGPRS Lab Application supports fading functionality in the following operating modes: Active Cell, GSM BCH, GPRS BCH, EGPRS BCH, GSM BCH + TCH, GPRS BCH+ PDTCH, EGPRS BCH + PDTCH, GPRS BCH + TCH + PDTCH and EGPRS BCH + TCH + PDTCH.

W-CDMA/HSDPA Transmitter Measurement Considerations

Some of the test set's transmitter measurements do not provide valid results while on a faded channel. To perform these transmitter measurements, you must end the connection between the test set and UE, click on Fader Off on the fading software, then re-establish the connection and perform the desired transmitter tests with the fader off.

The table below indicates which transmitter measurements are available while fading is on.

Table 1. W-CDMA/HSDPA Transmitter Measurement Availability on Faded Channel

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Available on Faded Channel?</th>
<th>Requirements</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjacent Channel Leakage Ratio</td>
<td>Yes</td>
<td>Trigger Source must be set to Immediate or External.</td>
<td></td>
</tr>
<tr>
<td>Audio Analyzer</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio Generator</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change of TFC</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Power</td>
<td>Yes</td>
<td>Trigger Source must be set to Immediate or RF Rise.</td>
<td></td>
</tr>
<tr>
<td>Code Domain</td>
<td>Yes</td>
<td>Trigger Source must be set to Immediate or External.</td>
<td>Timing Error measurement result is not available when Trigger Source is set to Immediate.</td>
</tr>
<tr>
<td>Data Throughput Monitor</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Power Analysis</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast Device Tune</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Stability</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inner Loop Power</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ Tuning</td>
<td>Yes</td>
<td>Trigger Source must be set to Immediate or External.</td>
<td>Timing Error measurement result is not available when Trigger Source is set to Immediate.</td>
</tr>
<tr>
<td>Occupied Bandwidth</td>
<td>Yes</td>
<td>Trigger Source must be set to Immediate or External.</td>
<td></td>
</tr>
<tr>
<td>Out-of-Synch Handling of Output Power</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fader System Requirements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Available on Faded Channel?</th>
<th>Requirements</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase Discontinuity</td>
<td>Yes</td>
<td>Trigger Source must be set to External.</td>
<td></td>
</tr>
<tr>
<td>PRACH Preamble Analysis</td>
<td>Yes</td>
<td>Trigger Source must be set to External or RF Rise.</td>
<td>Timing Error measurement result is not available when Trigger Source is set to RF Rise.</td>
</tr>
<tr>
<td>PRACH Transmit On/Off Power</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spectrum Emission Mask</td>
<td>Yes</td>
<td>Trigger Source must be set to Immediate or External.</td>
<td></td>
</tr>
<tr>
<td>Spectrum Monitor</td>
<td>Yes</td>
<td>Trigger Source must be set to Immediate, RF Rise, or External.</td>
<td></td>
</tr>
<tr>
<td>Swept Audio</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal Power</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TX Dynamic Power</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waveform Quality</td>
<td>Yes</td>
<td>Trigger Source must be set to Immediate or External.</td>
<td>Time Error measurement result is not available when Trigger Source is set to Immediate.</td>
</tr>
</tbody>
</table>

Table 1. W-CDMA/HSDPA Transmitter Measurement Availability on Faded Channel
Position Location

The E5515C with option 004 installed for the fader is not compatible with the R1431A and E5515C H16 gpsOne calibration.

If the E5515C has been calibrated for gpsOne with either:

- Local service center R1431A or
- a new purchase with E5515C option H16

the calibration data uncertainty is degraded from +/-17 nS to +/-30 nS.

The gpsOne testing itself is not affected by fader options. Only the certainty of the gpsOne data is degraded. If you determine that the uncertainties are acceptable, gpsOne testing is still valid. Agilent, however, does not specify or support gpsOne operation on instruments that have E5515C option 004 installed.

R1431 re-calibration of the E5515C with E5515C option 004 is not supported.
Fader System Requirements

GPIB Configuration

The fading software controls some test set functions via GPIB. When using the fading software System Configuration Add Wizard you are prompted for a Board Index, Primary Address, and Secondary Address. The correct values for these fields depends upon your GPIB driver configuration (for Board Index) and the test set’s SYSTEM CONFIGURATION screen (for Primary Address).

**NOTE**

The 8960 does not support LAN instrument control. The PC must be configured with GPIB hardware and the required drivers. For easy connectivity with good performance Agilent Technologies recommends the Agilent 82357A USB/GPIB Interface. See www.agilent.com/find/gpib.

When using the Agilent 82357A, you can determine the Board Index by clicking the “IO” icon on the Windows task bar, and selecting Run IO Config. In the Agilent IO Libraries Configuration dialog the VISA (Interface) Name contains the Board Index number.

---

**Board Index=0**
Troubleshooting

The E5515C Fading Solution (fader) integrates signal processing hardware in a PC with the E5515C test set’s signal generator. Most of the problems associated with fader operation involve setting incompatibility that results when Baseband Studio for Fading software (fading software) control of the test set is overridden.

Refer to the “Critical Fading Solution Settings” on page 73 for a description of settings that must be preserved during faded signal testing.

Known Issues

**Call processing errors resulting from turning the fader on or off during a call.**

The procedures given in the “Faded Test Example Procedures” on page 21 provide a step-by-step example of fader operation.

During these procedures, the fader is always turned on before a call is made. Once a call is connected, the fader must remain on.

**DO NOT CHANGE THIS SETTING DURING A CALL!**

Turning the fader off causes a momentary loss of the signal from the test set and the call to drop. If you would like to disable fading during a call, clear the Impairments Enabled checkbox and click the Apply Needed button.

**Loss of synchronization during handoffs.**

Handoffs, such as RF channel and PN offset hard handoffs, can cause frame clock synchronization problems between the test set and the Baseband Studio for Fading software. It is recommended that performing handoffs be avoided while the fader is on.

**Some W-CDMA/HSDPA Transmitter Measurements Not Available in Faded Configuration**

Some of the test set’s transmitter measurements do not provide valid results while on a faded channel. See “W-CDMA/HSDPA Transmitter Measurement Considerations” on page 85 for more information.
Troubleshooting

Other Considerations

- It is recommended that you perform call processing operations (such as establishing a call and changing RMCs) without channel impairments, to ensure that the UE is able to receive and properly decode the signaling from the test set.

Error Messages

The following test set error messages can occur during fader operation:

**NOTE** Refer to the online Help for fading software error messages that appear on the PC.

**Table 2. Test Set Error Messages**

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Cause</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation rejected; Setting is currently under external control</td>
<td>This error is displayed when an attempt is made to set something on the front panel of the test set that is settable from the fading software. Examples are Cell Power, Cell Band, and Channel settings.</td>
<td>Perform these operations using the controls on the PC's fading software.</td>
</tr>
<tr>
<td>Warning: Impairments backoff (IBO) over range due to settings made under external software control</td>
<td>The test set does not have sufficient power range to generate the power level requested.</td>
<td>Reduce the RF Power level or AWGN using the PC’s fading software settings.</td>
</tr>
</tbody>
</table>

Checking Fader Hardware Connectivity

There are several diagnostic routines that can be run to check fader system connectivity.

The diagnostic routines and conditions for running them are listed in **Table 3.**

**Table 3. Fader Connectivity Diagnostics**

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>Typically run when...</th>
<th>Runs From the...</th>
<th>Automated?</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCI Card Connectivity 1</td>
<td>Adding a new system configuration (using System Configuration Add Wizard)</td>
<td>Baseband Studio System Configuration Menu</td>
<td>Yes</td>
<td>Button label is “Run Self Tests for Selected Item”</td>
</tr>
<tr>
<td>PCI Card Connectivity 2</td>
<td>PCI Card Connectivity #1 fails</td>
<td>Baseband Studio System Configuration Menu</td>
<td>Partially</td>
<td>You are prompted to install loopback fixture.</td>
</tr>
</tbody>
</table>
Verification of the Communication Test Set is first installed.

You are prompted to install loopback fixture and configure the test set to analyze transmitted signal on internal spectrum monitor.

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>Typically run when...</th>
<th>Runs From the...</th>
<th>Automated?</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verification of the Communication Test Set</td>
<td>Option 504 (Baseband IO board and rear panel) is first installed.</td>
<td>Test Set</td>
<td>No</td>
<td>You are prompted to install loopback fixture and configure the test set to analyze transmitted signal on internal spectrum monitor</td>
</tr>
<tr>
<td>PCI Connectivity 3</td>
<td></td>
<td>Baseband Studio</td>
<td>Yes</td>
<td>Future enhancement that will fully test path from PCI card through test set switching paths and back to PCI card.</td>
</tr>
</tbody>
</table>

**Related Documentation**

- **N5101A Baseband Studio PCI Card Installation Guide**: Provides instructions on how to set up a PC and the test set to run fading software. This document (P/N N5101-90001) is available in pdf format from www.agilent.com.

- **Baseband Studio for Fading Online Documentation**: Provides reference information describing controls in the fading software. This help utility is accessible through the Help menu in the fading software.