

# Application Note

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## Diversity Receiver Testing with the 6413A



The Aeroflex 6413A is designed to test Duplex and Simplex Node B's as standard. With the addition of an external attenuator, it is possible to test the performance of a Node B's diversity receiver.

## Prerequisites

46891/958 - Aeroflex 6413A - Testing of UMTS Node B's. Describes how to set up and configure the 6413A to perform tests on a Node B in general.

## The Problem

Receiver diversity requires the use of two antennas for the receive signal. This presents the Node B with an increase in signal to noise ratio of about 3 dB due to correlation in signal power, but not in noise power. Therefore, assuming the received signal power on each antenna is the same, the apparent sensitivity would increase by about 3 dB.

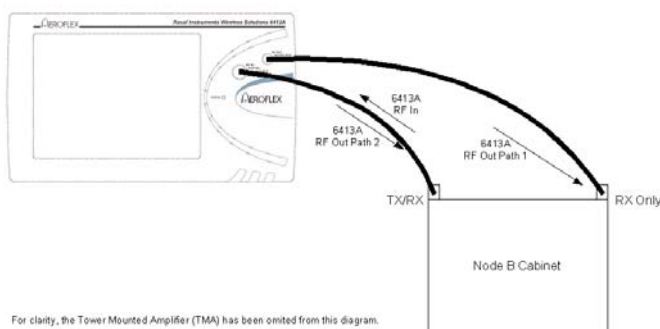
Receive diversity operation is normally catered for by configuring one antenna port for the Transmit and Receive (Duplex) signals and the other for receive only.

The 6413A in its standard configuration is designed to perform BER measurements on a Node B with either a Duplex RF connection (antenna interface) or a Simplex (split RX and TX paths) antenna interface.

The 6413A is a high performance field tester. In order to minimize measurement uncertainty there are no switches in the RF path of the unit. As such, during "simplex" operation of the unit there is RF power transmitted simultaneously from the both the RF OUT (simplex) port and the main RF IN/OUT (Duplex) port.

To test the Node B's main receiver, the RF IN/OUT port of the 6413A is connected to the Node B's duplexer and the full suite of transmitter and receiver measurements can be carried out. Similarly, if there is no duplexer present the RF OUT can be connected to the receiver under test (i.e. either the main receiver or the diversity receiver) and the RF IN/OUT port to the transmitter. Again, a full suite of transmitter and receiver measurements can be made.

However, if the user wishes to test the diversity receiver and still make a connection to the transmitter via the duplexer, additional care needs to be taken to avoid erroneous results. The reason for this is that the RF IN/OUT port always has an output RF signal present so the following signal paths exist:



In the worst case, the two receivers sum the two input signals with no losses with the result that the Node B sees an apparent input power 3 dB higher than the level output by the 6413A. This in turn means that the measured absolute sensitivity level of the diversi-

ty receiver can be up to 3 dB lower than the actual performance.

What this test configuration will give is a measure of the Node B's absolute sensitivity with diversity enabled. However, for maintenance it is more useful to be able to measure the receivers independently so that any degradation in performance can be detected and appropriate action taken. Fortunately, inserting an external attenuator between the 6413A and the Node B's duplexer allows the diversity receiver's sensitivity to be correctly measured. A 20 dB attenuator will reduce the maximum potential error caused by the second signal path from 3 dB to 0.04 dB

The following sections explain the correct test configuration for making receiver measurements on Node Bs:

1. Receiver Sensitivity of duplex port only
2. Receiver Sensitivity of diversity port only
3. Receiver Sensitivity of Node B using full Receiver Diversity
4. Receiver Sensitivity of either receiver where no duplexer is present or is bypassed (simplex operation)

The first two configurations are the most appropriate for normal installation/commissioning and preventive maintenance of Node Bs on site.

## The Solutions

### 1. MEASURING RECEIVER SENSITIVITY OF THE DUPLEX PORT ONLY

In general, this test mode is the standard configuration for Receiver testing on any Node B configured in Duplex mode. The system setup would be similar to that shown below:

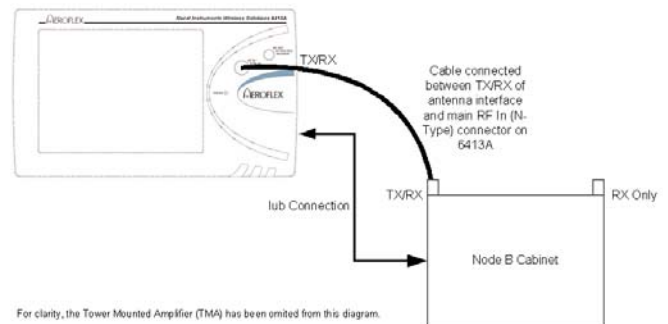


Figure 1: Shows RF and lub Connections. Duplex Port Sensitivity

## Test Method

The test method assumes that the user is able to generally configure the 6413A and the Node B to allow the 6413A to audit the Node B and enter "Link Established" mode.

1. Configure the 6413A to test in "Duplex" mode via the main menu à options screen.
2. Connect the 6413A main N-Type RF In/Duplex port to the TX/RX (Duplex) port of the antenna interface of the Node B (which may be direct on the cabinet, or on a Tower Mounted Amplifier (TMA)).

- Do not connect the 6413A RF Out port to the Node B's RX Only port. Leave this disconnected.
- Assuming the Node B has already been "Audited" the user will now be able to perform a Receiver Test such as Reference Sensitivity or Absolute Reference Sensitivity from the Receiver Tests menu.

## 2. MEASURING RECEIVER SENSITIVITY OF THE DIVERSITY PORT ONLY

The test mode below is used to test the Reference Sensitivity of the Diversity Port only and along with the first test (above) are the most common and useful tests to perform.

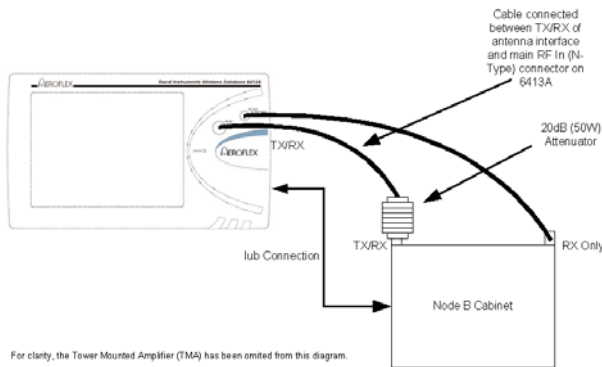


Figure 2: Shows RF and Iub Connections. Diversity Port Sensitivity

### Test Method

The test method assumes that the user is able to generally configure the 6413A and the Node B to allow the 6413A to audit the Node B and enter "Link Established" mode.

- Configure the 6413A to test in "Duplex" mode via the Main menu à options screen.
- Connect the 6413A main N-Type RF In/Duplex port to the 20 dB attenuator, and then the attenuator to the TX/RX (Duplex) port of the antenna interface of the Node B (which may be direct on the cabinet, or on a Tower Mounted Amplifier (TMA)).
- Connect the 6413A RF Out port to the Node B's RX Only port (which may be direct on the cabinet, or on a Tower Mounted Amplifier (TMA)).
- Assuming the Node B has already been "Audited" the user will now be able to perform a Receiver Test such as Reference Sensitivity or Absolute Reference Sensitivity from the Receiver Tests menu.

## 3. MEASURING RECEIVER SENSITIVITY OF NODE B USING FULL RECEIVER DIVERSITY

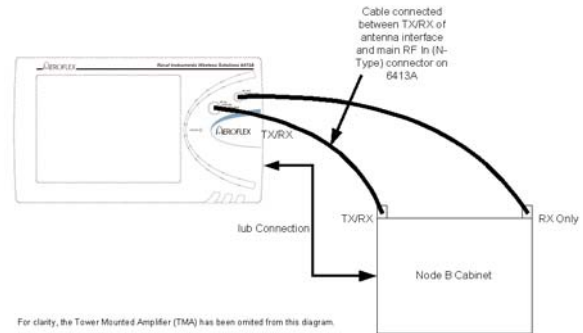


Figure 3: Shows RF and Iub Connections. Full Receiver Diversity

Note: The typical RF OUT (TNC) power level is greater than the Duplex (N-type) power level by +1.3 dB +/-0.8 dB at 1710-2200 MHz or by +1.0 dB +/-0.5 dB at 800-960 MHz.

### Test Method

The test method assumes that the user is able to generally configure the 6413A and the Node B to allow the 6413A to audit the Node B and enter "Link Established" mode.

- Configure the 6413A to test in "Duplex" mode via the Main Menu à Options screen.
- Connect the 6413A main N-Type RF In/Duplex port to the TX/RX (Duplex) port of the antenna interface of the Node B (which may be direct on the cabinet, or on a Tower Mounted Amplifier (TMA)).
- Connect the 6413A RF Out port to the Node B's RX Only port (which may be direct on the cabinet, or on a Tower Mounted Amplifier (TMA)).
- Assuming the Node B has already been "Audited" the user will now be able to perform a Receiver Test such as Reference Sensitivity or Absolute Reference Sensitivity from the Receiver Tests menu.

**4. RECEIVER SENSITIVITY OF EITHER RECEIVER WHERE NO DUPLEXER IS PRESENT OR IS BYPASSED (SIMPLEX OPERATION).**

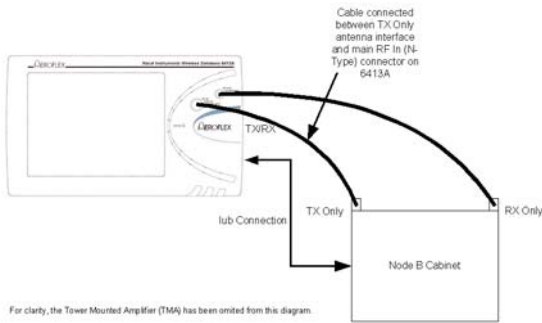


Figure 4: Shows RF and Iub Connections. Simplex Operation

**Test Method**

The test method assumes that the user is able to generally configure the 6413A and the Node B to allow the 6413A to Audit the Node B and enter "Link Established" mode.

1. Configure the 6413A to test in "Simplex" mode via the Main Menu à Options screen.
2. Connect the 6413A main N-Type RF In/Duplex port to the TX/RX (Duplex) port of the antenna interface of the Node B (which may be direct on the cabinet, or on a Tower Mounted Amplifier (TMA)).
3. Connect the 6413A RF Out port to the Node B's RX Only port (which may be direct on the cabinet, or on a Tower Mounted Amplifier (TMA)).
4. Assuming the Node B has already been "Audited" the user will now be able to perform a Receiver Test such as Reference Sensitivity, or Absolute Reference Sensitivity from the Receiver Tests menu.

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