will'tek

Wiltek 4300

Mobile Service Tester

Testing CDMA Phones with the 4910/4916 Universal Antenna Coupler

Characterizing the path loss between CDMA mobiles and the Willtek 4910/4916 Antenna Coupler

The mobile RF adaptor has always been one of the weak links in the testing process for repair depots and stores. These adaptors can be expensive, hard to get and have a limited lifetime. Each model of phone requires its own unique adaptor and some may not even have an RF test port to connect to. To simplify the testing process, Willtek is offering an RF coupled solution for testing mobile phones; the solution consists of the Willtek 4910 Universal Antenna Coupler or 4916 Antenna Coupler with the Willtek 4924 RF Shield Box. It is important to note that testing using a coupled connection will not offer the accuracy that a direct connection allows. However, the ability to identify good and bad phones should be realised.

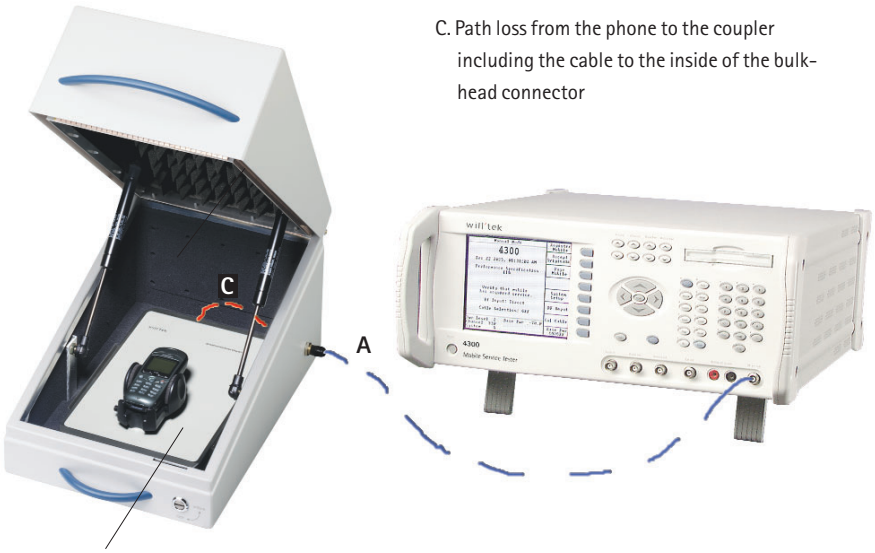
Since every mobile phone has its own unique form factor and RF characteristics, a profile of each model type must be
created. The CDMA mobile phone characterisation is obtained by performing max power and frame error rate measurements. In order to improve the accuracy of the characterisation, several samples of each mobile phone model should be characterised and the results averaged.

Characterisation can be carried out in manual mode or can also be automated. Both methods are described below.

4920 RF Shield Box

A. Path loss from the tester to the 4924 RF Shield Box and including the bulkhead connector

C. Path loss from the phone to the coupler including the cable to the inside of the bulkhead connector



4910/4916 Antenna Coupler

Figure 1 - Coupled connection

Manual characterisation

No direct RF connection to mobile

If the mobile you are characterising has no antenna connector, the following section explains how to characterise a mobile without using a direct RF connection.
The reverse path loss (base RX) is obtained as follows:

1. Set the base power to –70 dBm.
2. Set up the CDMA control channel to settings applicable to the mobile that is being character ised.
3. Connect the mobile in the RF-coupled configuration (see Figure 1).
4. Close the RF Shield Box.
5. Register, then page the mobile in loopback service option 2 or 9.
6. Perform a handoff to the traffic channel you want to characterise.
7. Set power control to "All Up". This will rail the phone at its maximum power.
8. Log the maximum power as "RX Coupled".
9. Perform the following path loss formula to find the total RX path loss:
   Total Base RX Path Loss = (Expected level – Rx coupled) + Path Loss A

Example: Let expected maximum power = 23.5 dBm, RX coupled measurement = 14 dBm and path loss "A" = 1 dB. Then the total RX path loss would be 10.5 dB = (23.5 dBm – 14 dBm) + 1 dB.

The forward (base TX) path loss can be determined similarly:

1. Register, then page the mobile in loopback service option 2 or 9.
2. Perform a handoff to the traffic channel you want to characterise.
3. Go to the "Receiver Tests" screen.
4. On the following steps, allow a few seconds for settling.
5. Lower the base power in one dB steps until you begin to see frame errors. Be sure to allow a few seconds between each step for settling.
6. Lower the base power in 0.1 dB steps until you get > 0.5% FER.
7. Log the base power that caused the > 0.5% FER as "TX coupled".
8. Release the call.
9. Perform the following path loss formula to find the total TX path loss:
   Total Base TX Path Loss = (Expected level – TXcoupled) + Path Loss A

Example: Let expected base power = –105 dBm, RX coupled measurement = –90 dBm and path loss "A" = 1 dB. Then the total TX path loss would be 16 dBm = (–105 dBm – (–90 dBm)) + 1 dB

4920 RF Shield Box

A. Path loss from the tester to the 4924 RF Shield Box and including the bulkhead connector

B. Path loss of the mobile RF test cable

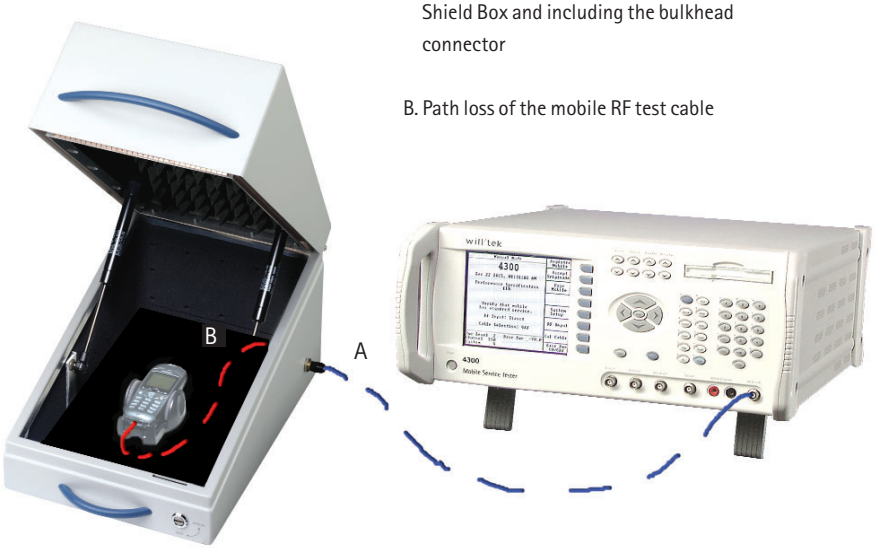


Figure 2 - RF cable connection

Mobiles with a direct RF connection

These are relative measurements to be used to compare results from a direct RF connection to a coupled RF connection for both the RX and TX paths.

The path loss for "A" and "B" in Figures 1 and 2 must be known prior to performing this characterisation. A path loss of 0.1 dB can be assumed for the bulkhead connector on the RF Shield Box for the cellular band (800 MHz) and 0.2 dB for the PCS band (1900 MHz).

The reverse path loss (base RX) is found as follows:

1. Set the base power to –70 dBm.
2. Set up the CDMA control channel to settings applicable to the mobile that is being characterised.
3. Connect the mobile with the direct RF cable connection (see Figure 2).
4. Close the RF Shield Box.
5. Register, then page the mobile in loopback service option 2 or 9.
6. Perform a handoff to the traffic channel you want to characterise.
7. Set power control to "All Up". This will rail the phone at its maximum power level.
8. Log the maximum power as "RX direct".
9. Release the call.
10. Connect the mobile in the RF-coupled configuration (see Figure 1).
11. Repeat steps 4 through 7.
12. Log the maximum power as "RX coupled".
13. Perform the following path loss formula to find the total RX path loss:
    Total Base RX Path Loss = (RX direct – RX coupled) + Path Loss A – Path Loss B

Similarly, the forward (base TX) path loss can be determined with the following procedure:

1. Connect the mobile with the direct RF cable connection (see Figure 2).
2. Close the RF Shield Box.
3. Register, then page the mobile in loopback service option 2 or 9.
4. Perform a handoff to the traffic channel you want to characterise.
5. Go to the "Receiver Tests" screen.
6. On the following steps, allow a few seconds for setting.
7. Lower the base power in one dB steps until you begin to see frame errors. Be sure to allow a few seconds between each step for setting.
8. Lower the base power in 0.1 dB steps until you get > 0.5% FER.
9. Log the base power level that caused the > 0.5% FER as "TX direct".
10. Release the call.
11. Connect the mobile in the RF coupled configuration (see Figure 1).
12. Repeat steps 2 through 11.
13. Log the base power as "TX coupled".
14. Perform the following path loss formula to find the total TX path loss:
    Total Base TX Path Loss = (TX coupled – TX direct) + Path Loss A – Path Loss B

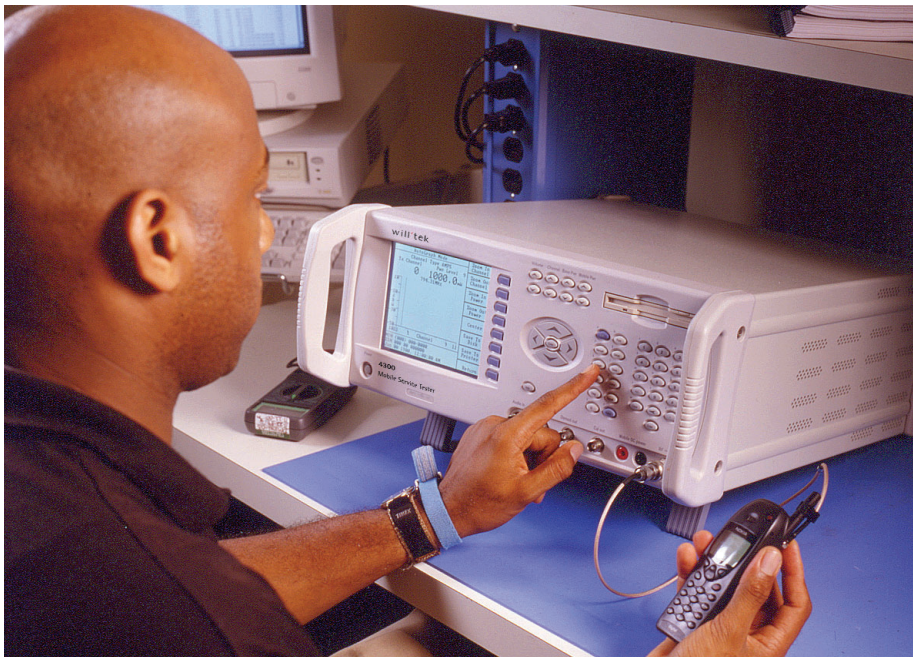
Automatic characterization sequences for the Willtek 4302 and 4303 Mobile Service Testers

There are two automated test sequences available that will perform the measurements noted in the Manual Characteri-
sation section of this document for up to five chan-nels. The files containing these test sequences can be found in the download section of Willtek's web pages on the Internet (www.willtek.com). The sequen-ces are applicable also to the 3600D with the CDMA option.

- cpl_cell.prg – Characterises channels in the cellular band.
- cpl_pcs.prg – Characterises channels in the PCS band.

The sequences do not set up the control channel information. The tester must be manually set to the proper control channel, band and SID prior to run-ning the sequence. After the automated sequence has completed, press "Display Test Results" to display base RX and TX path loss for the channels measured. Here is an example of typical results:

PCS Chan.	TX Loss	RX Loss
150	12.1	10.2
575	12.8	10.6
875	13.4	11.5
1075	15.1	13.2



Customizing the automated sequences

The sequences can be edited with any text editor such as Notepad or Word. At the top of the sequence there are global parameters that can be edited to customise the sequence; see figure 3.

Test channels

The sequences can be edited to character-
ise the channels you want. The default traffic chan-nels are 100, 283, 384, 691 and 777 in Cellular and 150, 225, 575, 825 and 1075 in PCS. Enter a "0" in place of the channel to skip one or more channels. The example below will characterise the mobile on channels 100, 283, 384 and 691 only.

```
DefineGlobal  CDMA_Traf1    100
DefineGlobal  CDMA_Traf2    283
DefineGlobal  CDMA_Traf3    384
DefineGlobal  CDMA_Traf4    691
DefineGlobal  CDMA_Traf5    0
```

Initial Power Levels For Looped FER Measurement

During the FER portion of the of the sequence, the starting power can be modified to a level that is close to the failure point in order speed up the process. However, it is important that the level is high enough that the first few FER measurements in the loop for each channel pass. If the level is set too low the first measurement may be taken below the failure point we are trying to identify.

DefineGlobal Init_FER_Base_Dir –98 – defines the starting power for the FER loop measurement during the direct connection (see Figure 1).

DefineGlobal Init_FER_Base_Cpl –72 – defines the starting power for the FER loop measurement during the coupled connection (see Figure 2).

DefineGlobal Cable_A 1.0 – Input path loss for cable "A" (see Figure 1).

DefineGlobal Cable_B 0.5 – Input path loss for cable "B" (see Figure 1).

In order to get the total path loss for the TX and RX paths, the program puts the loss value for cable "A" and cable "B" along with the result from each channel through the formulas below:
Total TX Path Loss =
TX value + Path Loss A – Path Loss B
Total RX Path Loss =
RX value + Path Loss A – Path Loss B

Note: The path loss for "A" and "B" in Figures 1 and 2 must be known prior to performing this characterization.

```
#Program Name
        prog:str1 "Cpl_Cell.prg"
#Program Revision
        prog:str2 "Rev: 2.2 - Date: 05/16/02"
        delay         2
        prog:str1 ""
        prog:str2 ""

#   This program is used for finding the RX and TX loss of a mobile using the antenna
coupler.
#   Setting any CDMA_Traf(1-5) to "0" will cause the program to skip that channel.
        DefineGlobal CDMA_Traf1 100
        DefineGlobal CDMA_Traf2 283
        DefineGlobal CDMA_Traf3 384
        DefineGlobal CDMA_Traf4 691
        DefineGlobal CDMA_Traf5 777

#   Level to start FER loop during direct RF connection step.
        DefineGlobal              Init_FER_Base_Dir –98

#   Level to start FER loop during direct RF connection step.
        DefineGlobal              Init_FER_Base_Cpl –84

#   Modify Path loss by adding the path loss for cable "A". (cable from tester to bulk-
    head connector outside box)
        DefineGlobal Cable_A  0

#   Modify Path loss by subtracting the path loss for cable "B". (cable from mobile to
bulkhead connector inside box)
        DefineGlobal Cable_B  0
```

Figure 3 - Customisable section of test sequence

Willtek Communications GmbH
85737 Ismaning
Germany
Tel: +49 (0) 89 99 641-0
Fax: +49 (0) 89 996 41-440
info@willtek.com

Willtek Communications Inc.
Indianapolis
USA
Tel: +1 317 595 2021
Fax: +1 866 willtek
willtek.us@willtek.com

Willtek Communications Ltd.
Chessington
United Kingdom
Tel: +44 (0) 20 8408 5720
Fax: +44 (0) 20 8397 6286
willtek.uk@willtek.com

4300/AN700/0404/EN