

## How to add a new mobile phone model in UMTS/EDGE/GSM Phone Checker



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The coupling loss between the device under test (DUT) and the test instrument plays a key role for correct measurements in all technologies. The coupling characteristic varies from phone model to phone model, and there are thousands of mobile phone models in the market, each one of them supporting one or several technologies and frequency bands. The UMTS/EDGE/GSM Phone Checker is delivered with information about a lot of mobile phone types, in particular the pre-attenuation values which serve for corrected power level measurements in receive and transmit direction. This information is called characterisation in the context of this application note.

For obvious reasons, UMTS/EDGE/GSM Phone Checker cannot cover characterisation of all models being or becoming available. Therefore this application note explains how to characterise a new mobile phone model in UMTS/EDGE/GSM Phone Checker. This way the user will be able to add a new mobile phone model, thus allowing the user to keep his mobile database up to date in the most effective way.

Furthermore, when the user updates UMTS/EDGE/GSM Phone Checker with the latest version, the mobile phone models that have already been characterised by the user will be automatically saved in the UMTS/EDGE/GSM Phone Checker's mobile phone database.

**Note:** This applies to UMTS/EDGE/GSM Phone Checker version 3.10 and onwards.

The remainder of this document is divided into three main sections:

- The first section explains how to find out whether or not the DUT is in the mobile phone database and therefore if it needs to be characterised.
- The second section explains how to determine the correct pre-attenuation (coupling loss) values with the 3100 and the UMTS/EDGE/GSM Phone Checker software.
- The last section explains how to add a new mobile phone model to the UMTS/EDGE/GSM Phone Checker database.

## When does a mobile phone model need to be characterised?

When testing a mobile phone with 3100 and the UMTS/EDGE/GSM Phone Checker, the software will first try to identify the mobile phone model reading its TAC<sup>1)</sup> code when the mobile registers in the 3100 network. If this code is included in the database of the UMTS/EDGE/GSM Phone Checker, the phone itself may be in the database under a different TAC. Otherwise you can either work with some standard (default) values or feed the database with pre-attenuation data.

This is how to proceed in detail: If the TAC code the mobile has reported is not contained in the mobile database, the Assign TAC menu appears.

This menu offers a list of models as shown in Figure 1. You can check whether the model is already saved under another

TAC code, and select it from the list. If this is the case you have to select the appropriate mobile phone model and click on the ASSIGN button.

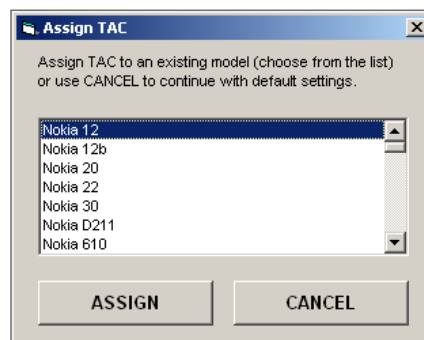


Figure 1: Selecting a phone when the phone's TAC is not in the database

If the mobile phone model is not in the list offered in the drop down menu, you should click on the CANCEL button. Then, another window will appear that offers the possibility either to continue testing your mobile phone using default RX/TX attenuation values or to cancel the test process.

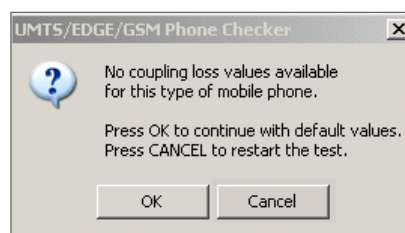


Figure 2: Test with the default values question window

If you click on the OK button, your mobile phone will be tested as an "unknown mobile". This means that the software will use default values for the RX/TX pre-attenuation. The default pre-attenuation values used are indicated in the test report printout and in the test

<sup>1)</sup> The TAC (Type Approval Code) number consists of the first six digits of the so-called IMEI. This number is unique for a specific model. It is assigned at the time of the mobile phone type approval. For the most popular mobile phones that are produced in big volumes several TAC numbers can be allocated to a single model.

report that is automatically saved after every test under C:\Program files\Willtek\UMTS\GSM Phone Checker\RESULTS in the format shown below.

```
TEST ENVIRONMENT:

Mobile connected via:
Willtek Antenna Coupler
(4916)

Pre-attenuation RX,TX:
15 dB, 15 dB
```

If the real coupling loss between the mobile and the tester is not equal to the default value applied you will get wrong results in the TX and RX power measurements. This may cause a mobile phone that is working perfectly to fail the test and vice versa.

For this reason it is recommended to test the mobile phones after they have been characterised (and are therefore available) in the database of UMTS/EDGE/GSM Phone Checker. The section below explains how to characterise a new mobile phone and add it to the database in UMTS/EDGE/GSM Phone Checker.

Mobile phones are characterised with UMTS/EDGE/GSM Phone Checker in two steps:

- Determine the correct pre-attenuation values for the DUT, for all the frequency bands supported by the DUT.
- Add the DUT to the database of UMTS/EDGE/GSM Phone Checker.

## Determining the DUT-specific pre-attenuation with UMTS/EDGE/GSM Phone Checker

If you do not have the pre-attenuation values of the type of phone under test, you can derive the values by performing measurement on a phone of a type which is known to work within specifications or for which the accuracy is well-known. The measurement should be taken in both the receive and transmit bands at different frequencies to take any frequency-dependent variations of the pre-attenuation into account. Determination of the attenuation factors is a prerequisite for adding this information into the database of the UMTS/EDGE/GSM Phone Checker, which is described in the last section of this application note.

In order to add a new mobile phone model in UMTS/EDGE/GSM Phone Checker you need the following items:

- Test instrument 3100 Mobile Fault Finder with UMTS/EDGE/GSM Phone Checker software installed on a PC, a USB, serial (RS-232) or GPIB cable connection and a test USIM.
- Willtek 4916 Antenna Coupler, with or without Willtek shielding box (the use of the shield box is strongly recommended to avoid external interferences).
- "Golden" unit of the mobile phone model you want to add.

A "golden" unit is a mobile phone with known transmit and receive power as well as other RF characteristics. Ideally, this means that it has been calibrated so that its nominal output power level equals the values indicated in the 3GPP specifications according to mobile power class.

In WCDMA the nominal maximum output power depends on the mobile power class, the most common power classes are 4 (21 dBm maximum output power) and 3 (24 dBm maximum output power).

The instructions below explain how to retrieve the correct WCDMA and GSM pre-attenuation values from an "unknown" mobile phone model.

1. Identify your mobile phone's TAC code and model name
  - a. The TAC code consists of the first six digits of the IMEI code. This code is printed on a label located under the phone battery or displayed on the mobile display after dialing \*#06#.
  - b. The model name is the name given to the phone, this is the name that will appear in UMTS/EDGE/GSM Phone Checker as an information for the user, like "Testing Model X".
2. Determine the RX/TX pre-attenuation values for the mobile phone model for each frequency band the mobile phone works with. Two values (one for the receiving side RX and one for the transmit direction TX) are needed for each frequency band. The correct RX/TX pre-attenuation values for the mobile phone can be derived by testing the mobile phone in the coupler position that is closest to the mobile phone antenna<sup>2)</sup>, usually position number 3 in case the Willtek 4916 Antenna Coupler is used. The test should be performed with the default coupling values, i.e. as an unknown phone.

<sup>2)</sup> Depending on the mobile phone type its antenna may be placed differently.

The example below shows how to retrieve these values from an exemplary unknown mobile phone.

WCDMA transmitter (uplink) pre-attenuation calculation: If you select the option to test the DUT with default values for an "unknown" mobile phone, you will get a result similar to the one in the picture below.

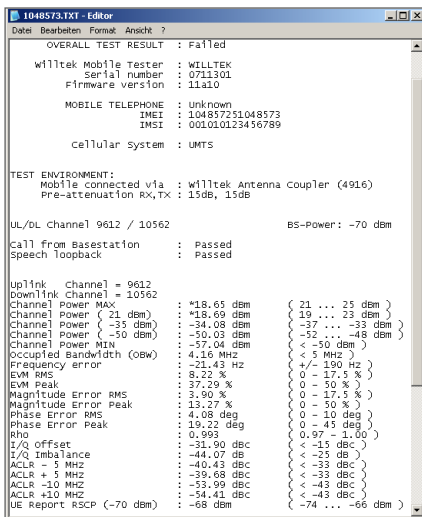


Figure 3: Exemplary WCDMA measurement result for an "unknown" mobile

Figure 3 shows an exemplary UMTS result file for a non-characterised ("unknown") mobile phone model. From this result we can derive the correct pre-attenuation values to be used as shown in the following example. Here, a pre-attenuation value of 15 dB (indicated in the test report) for the unknown mobile phone and the transmitted receive characteristics provided by the golden mobile (known TX/RX power) is taken into account.

**Example:** Calculation of the TX pre-attenuation values for the WCDMA band

TX pre-attenuation for WCDMA = known power (max power<sup>3)</sup>) - measured channel power + default pre-attenuation

Taking the result for the lowest channel number in WCDMA, this means:

TX pre-attenuation for WCDMA low channel = target power - measured channel power + default pre-attenuation;

TX pre-attenuation for WCDMA low channel = 21 dBm - 18.65 dBm + 15 dB = 17.35 dB;

**TX pre-attenuation for WCDMA low channel = 17.35 dB;**

For the WCDMA mid and high bands the same test process must be repeated by changing the channel number to mid and high channels.

TX pre-attenuation for WCDMA mid channel = target power - measured channel power + default pre-attenuation;

TX pre-attenuation for WCDMA mid channel = 21 dBm - 20.67 dBm + 15 dB = 15.33 dB;

**TX pre-attenuation for WCDMA mid channel = 15.33 dB;**

TX pre-attenuation for WCDMA high channel = target power - measured channel power + default pre-attenuation;

TX pre-attenuation for WCDMA high channel = 21 dBm - 20.83 dBm + 15 dB = 15.17 dB;

**TX pre-attenuation for WCDMA high channel = 15.17 dB;**

RX pre-attenuation for WCDMA has to be calculated in the same way but using the RSCP measurement as a reference:

RX pre-attenuation for WCDMA = known power (RSCP) - measured RSCP + default pre-attenuation

The pre-attenuation values for the GSM bands can be derived in the same way as for UMTS. This way, the required pre-attenuation values for all bands supported by the DUT can be obtained.

**GSM bands pre-attenuation calculation:** The pre-attenuation (coupling loss) values are derived using the same procedure.

The pictures below show the measurement results obtained with the same mobile phone in the GSM 900 and 1800 bands. The procedure to follow in order to calculate the correct pre-attenuation values is the same as for the UMTS/WCDMA bands. However, the default pre-attenuation values that have to be taken into account differ from the values used for the WCDMA bands.

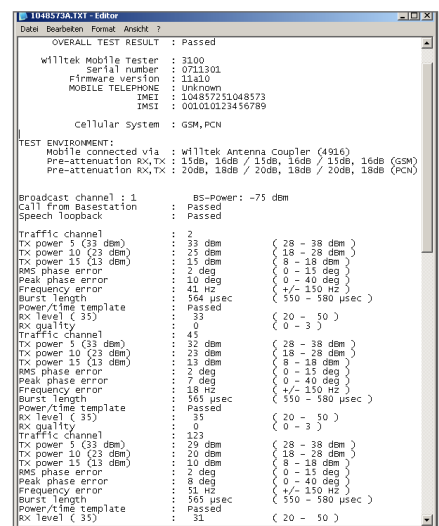


Figure 4: Exemplary GSM 900 measurement result for an "unknown" mobile

<sup>3</sup> Depends on mobile phone power class (WCDMA class 4: 21dBm, WCDMA class 3: 24 dBm) and on the DUT.

**Example:** Calculation of the TX/RX pre-attenuation values for the GSM 900 bands

TX pre-attenuation for GSM 900 = known power - measured TX power + default pre-attenuation

TX pre-attenuation for GSM 900 low channel = known power - measured TX power + default pre-attenuation;

TX pre-attenuation for GSM 900 low channel = 33 dBm - 33 dBm + 16 dB = 16 dB

TX pre-attenuation for GSM 900 low channel = 23 dBm - 25 dBm + 16 dB = 14 dB

TX pre-attenuation for GSM 900 low channel = 13 dBm - 15 dBm + 16 dB = 14 dB

**TX pre-attenuation for GSM 900 low channel = 14 dB;**

TX pre-attenuation for GSM 900 mid channel = known power - measured TX power + default pre-attenuation;

TX pre-attenuation for GSM 900 mid channel = 33 dBm - 32 dBm + 16 dB = 17 dB

TX pre-attenuation for GSM 900 mid channel = 23 dBm - 23 dBm + 16 dB = 16 dB

TX pre-attenuation for GSM 900 mid channel = 13 dBm - 13 dBm + 16 dB = 16 dB

**TX pre-attenuation for GSM 900 mid channel = 16 dB;**

TX pre-attenuation for GSM 900 high channel = known power - measured TX power + default pre-attenuation;

TX pre-attenuation for GSM 900 high channel = 33 dBm - 29 dBm + 16 dB = 20 dB

TX pre-attenuation for GSM 900 high channel = 23 dBm - 20 dBm + 16 dB = 19 dB

TX pre-attenuation for GSM 900 high channel = 13 dBm - 10 dBm + 16 dB = 19 dB

**TX pre-attenuation for GSM 900 high channel = 19 dB;**

RX pre-attenuation for GSM 900 = known power - measured RX power + default pre-attenuation

RX pre-attenuation for GSM 900 low channel = known power - measured RX power + default pre-attenuation;

RX pre-attenuation for GSM 900 low channel = 35 - 33 + 15 dB;

**RX pre-attenuation for GSM 900 low channel = 17 dB;**

RX pre-attenuation for GSM 900 mid channel = known power - measured RX power + default pre-attenuation;

RX pre-attenuation for GSM 900 mid channel = 35 - 35 + 15 dB;

**RX pre-attenuation for GSM 900 mid channel = 15 dB;**

RX pre-attenuation for GSM 900 high channel = known power - measured RX power + default pre-attenuation;

RX pre-attenuation for GSM 900 high channel = 35 - 31 + 15 dB;

**RX pre-attenuation for GSM 900 high channel = 19 dB;**

For GSM 1800 the process to follow is identical to the one with GSM 900.

Please note that the pre-attenuation values calculated are only valid for the coupler position that has been selected by the user. If the test is performed in another coupler position the coupling loss will change and the pre-attenuation values will not be correct anymore.

In the example, the pre-attenuation values of the mobile phone are summarised in Table 1.

When testing the same mobile several times the measurement results will slightly differ, therefore it is recommended to repeat this test procedure several times and average the results in order to obtain pre-attenuation characterisation values that are as precise as possible.

Model name	Mobile example
TAC number	104857
4916 coupler position	3
WCDMA low channel TX/RX pre-attenuation (channel numbers 9612 and 10562)	17.35 dB => 17.4 dB <sup>4)</sup> /13 dB
WCDMA mid channel TX/RX pre-attenuation (channel numbers 9750 and 10700)	15.33 dB => 15.3 dB <sup>4)</sup> /16 dB
WCDMA high channel TX/RX pre-attenuation (channel numbers 9888 and 0838)	15.17 dB => 15.2 dB <sup>4)</sup> /12 dB
GSM 900 Low channel TX/RX pre-attenuation	14 dB/17 dB
GSM 900 Mid channel TX/RX pre-attenuation	16 dB/15 dB
GSM 900 High channel TX/RX pre-attenuation	19 dB/19 dB
GSM 1800 Low channel TX/RX pre-attenuation	21 dB/20 dB
GSM 1800 Mid channel TX/RX pre-attenuation	19 dB/16 dB
GSM 1800 High channel TX/RX pre-attenuation	20 dB/20 dB

Table 1: Calculated pre-attenuation values for exemplary mobile phone

**Note:** EDGE technology works on the same frequency bands as GSM. For this reason the pre-attenuation values characterised for GSM bands are applied to EDGE as well.

### Adding a new mobile phone model in UMTS/EDGE/GSM Phone Checker

Once the correct pre-attenuation values have been calculated, the new model is added in the UMTS/EDGE/GSM Phone Checker as described below:

1. Open the TAC6USR.DAT<sup>5)</sup> file that you will find in the C:\Program files\Willtek\UMTSGSM Phone Checker directory.

Add a line with the following structure:

**[TAC number], [Model Name]**

In our example this would be:

**104857, Mobile example**

Save and close the TAC6USR.DAT file.

2. Save a picture of the mobile phone in a .bmp file under C:\Program files\Willtek\UMTSGSM Phone Checker\pictures with the name Modelname.bmp and a size of 165 x 205 pixels (W x H). For the mobile phone in the example the file name xxx.bmp is used.
3. Open the MPUSER.DAT<sup>6)</sup> file in the C:\Program files\Willtek\UMTSGSM Phone Checker directory. Add the pre-attenuation values and the coupler position into the file. For the exemplary mobile phone the data in the MPUSER.DAT will have to be filled in as shown in Figure 5.

```
[Mobile example]
Bands = 900,1800,WCDMA
Audio = 1
UserInstruct =
NormalPic = XXX.BMP
SpecialPic =
Comment =
DataModes =
(4916)
Position = 3
RX900 = 17,15,19
TX900 = 14,16,19
RX1800 = 20,16,20
TX1800 = 21,19,20
DLWCDMA= 13,16,13
ULWCDMA= 17.4,15.3,15.2
```

Figure 5: Pre-attenuation data for exemplary mobile phone to be saved in MPUSER.DAT

<sup>4)</sup> Rounded value

<sup>5)</sup> From version 3.10 of the UMTS/EDGE/GSM Phone Checker; for lower software versions please use TAC6ROW.DAT instead.

In general, for other mobile phone types which have to be characterised, the format used for the MPUSER.DAT is described in Figure 6.

Once these three steps have been performed, save and close the files TAC6.DAT and MPUSER.DAT and restart UMTS/EDGE/GSM Phone Checker. The next time that a mobile phone of the newly characterised type is tested, its picture will appear on the screen and the calculated attenuation values will be used.

[Nokia 6680]	Model Name
Bands = 900,1800,1900,E900,WCDMA	Supported Bands
Audio = 1	Speech loopback required (1= yes, 0=no)
UserInstruct =	User instruction in English
NormalPic = N6680a.BMP	Phone Picture
SpecialPic = N6680.bmp	-
Comment =	-
DataModes = EDGE,GPRS	-
(4916)	Coupling values for Ant. Coupler 4916 are below
Position = 3	Position in the Antenna coupler 4916 to be selected.
RXE900 = 19.5,19.5,19.5	RX Coupling loss values for EGSM900 band with 4916
TXE900 = 13.4,13.4,13.4	TX Coupling loss values for EGSM900 band with 4916
RX900 = 19.5,21,21.3	RX Coupling loss values for GSM900 band with 4916
TX900 = 15.5,15.1,15.9	TX Coupling loss values for GSM900 band with 4916
RX1800 = 18.9,27.1,16.4	RX Coupling loss values for GSM1800 band with 4916
TX1800 = 18.0,26.5,25.7	TX Coupling loss values for GSM1800 band with 4916
RX1900 = 20,21.1,21.6	RX Coupling loss values for GSM1900 band with 4916
TX1900 = 28,19.5,19.1	TX Coupling loss values for GSM1900 band with 4916
DLWCDMA= 14.8,16.3,15.3	RX Coupling loss values for WCDMA band with 4916
ULWCDMA= 12,11.8,12.3	TX Coupling loss values for WCDMA band with 4916
(4916SB3)	Coupling values for Ant. Coupler 4916 and shield box III (SB3)
Position = 1	Position in the Antenna coupler 4916+ SB3 to be selected.
RXE900 = 27,27,27	RX Coupling loss values for EGSM900 band with 4916+SB3
TXE900 = 21.8,21.8,21.8	TX Coupling loss values for EGSM900 band with 4916+SB3
RX900 = 27,27,6,28	RX Coupling loss values for GSM900 band with 4916+SB3
TX900 = 19,19.2,20.1	TX Coupling loss values for GSM900 band with 4916+SB3
RX1800 = 23.5,25.8,22.6	RX Coupling loss values for GSM1800 band with 4916+SB3
TX1800 = 28.3,35.8,24.4	TX Coupling loss values for GSM1800 band with 4916+SB3
RX1900 = 27.3,27.4,26	RX Coupling loss values for GSM1900 band with 4916+SB3
TX1900 = 24.8,23.2,29.4	TX Coupling loss values for GSM1900 band with 4916+SB3
DLWCDMA= 14.8,16.3,15.3	RX Coupling loss values for WCDMA band with 4916+SB3
ULWCDMA= 12,11.8,12.3	TX Coupling loss values for WCDMA band with 4916+SB3

Figure 6: Format of the pre-attenuation data for mobile characterisation

<sup>6)</sup> From version 3.10 of the UMTS/EDGE/GSM Phone Checker; for lower software versions please use MPROW.DAT instead.

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