will'tek

Series

Willtek 4100

Mobile Phone Tester

GSM 900 ■ E-GSM ■ GSM 1800 (PCN) ■ GSM 1900 (PCS)
Dual band GSM 900+1800 ■ GSM 900+1900
Multiband GSM 900+1800+1900

User Guide

Manual Version: 0312-341-A

Designations such as utility names, company names and trade names are not specially indicated in this manual, as they are all widely known. Such names may, however, be the property of companies or other such bodies.

This manual is subject to change at any time without notice. Errors and omissions excepted.

Manual layout and text: Redaktion Interpreta, Munich, Germany

Contents

Chapter 3: AUTOTEST

Chapter 4: FAULT FIND

Chapter 5: Additional Features

Chapter 6: APPENDIX

1

GETTING STARTED

Preface

Thank you for choosing a model in the Willtek 4100 series. The equipment will give you valuable assistance in functional testing and troubleshooting on GSM mobile phones.

Model	Frequency band	Network	
Willtek 4107 Willtek 4107L Willtek 4107S	0,9/1,8/1,9 GHz	GSM 900/1800/1900 E-GSM GSM 900+1800 GSM 900+1900 GSM 900+1800+1900	Single band Single band Dual band Dual band Multiband

Willtek 4107S   The Willtek 4107S offers a number of additional features compared with the Willtek 4107 (see chapter 5 for details). The S version can be identified by the type label and the model name in the start menu.

Willtek 4107L   Special inexpensive model only available bundled with other products (eg 4192 GSM Phone Checker software). The same range of functions as the Willtek 4107, except that FAULT FIND mode is not available. This model can, however, be remotely controlled (see chapter 5). Please contact our Sales department for details.

■ **Operating modes**

AUTOTEST   Fast and accurate full testing of a mobile phone with an overall assessment of *PASSED* (mobile phone OK) or *FAILED* (mobile phone defective). Largely automatic testing requiring no system expertise on the part of the user.

FAULT FIND   Operating mode for error location on defective mobile phones (not available for Willtek 4107L). Selective performance of individual tests. Displays measurements for assessment by experienced users.

This User Guide is applicable to all models in the Willtek 4100 series. The generic name 4100 is used whenever the Guide refers to features which are not specific to a particular model.

Do you speak English? The testers have a display which can show text either in English or in some other language. This Guide assumes that you have selected English, in which case the illustrations and instructions will match up with what you see on your tester's display.

If some other language is selected, the Guide and the display no longer match up. In that case either translate what the Guide says into the other language or switch the language to English for a short period (see also page 2-3).

Important instructions

Proper operation

AC power	Permissible line voltage: 100 V through 240 V (AC voltage; 47 Hz through 63 Hz). The power supply unit automatically adapts to the line voltage.
Use for intended purpose only	Use your Willtek 4100 only for its intended purpose for function testing and repairs on the radio telephones of a GSM mobile radio system.
Ambient conditions	Store and operate your Willtek 4100 only in a dry and dust-free environment. Operate your Willtek 4100 only in the permissible temperature range of 15 °C through 35 °C. Observe the permissible storage temperatures (see Appendix: Technical data).
Breakable display	Do not press down on the display.
Air circulation	Keep the air vents free of obstruction.
Electromagnetic compatibility	The device emits RF radiation. For this reason, do not operate it in EMC-sensitive environments if this might result in danger (e.g. when traveling in automobiles or during flights). The EMC and Safety directives to which the device conforms are listed in the Declaration of EU Conformity (see Chapter 6).
Do not open	Do not make technical modifications to the device or its accessories. Do not open the device. There are no parts inside it which require maintenance or disposal. Do not open the device, otherwise you will lose your claim to warranty.
Original accessories only	Use original accessories only.
No solvents	Do not use agents which contain solvents to clean the equipment casing.

Handling Avoid the following during operation and storage:
- strong direct sunlight
- vibrations, heavy impacts
- ingress of liquids or small objects into the device
- bending of the RF adapter cable
- contamination of the electrical contacts

After unpacking

● Do not throw the packaging of your Willtek 4100 away. It will make shipment easier if you want to have your model upgraded later (see also page 6-25).

● Check that the delivery is complete:

Standard items supplied

M 101 2XX	1 x Willtek 4100
M 860 188	1 x Test SIM, plug-in format
M 295 012	1 x Getting Started manual
M 897 055	1 x CD with User Guide in PDF format
M 860 105	1 x Power supply unit with power cord and connecting cable
M 860 409	1 x RF adapter cable

Options/extra accessories For a list of useful options and extra accessories refer to Chapter 6.

● Check that the unit is undamaged:

⚠ Do not attempt to operate a WIlltek 4100 if there is obvious damage to the device, the power supply unit or the accessories. Retain the packaging and contact the office who supplied the equipment.

Key functions

The cursor keys have two functions:

● selecting menu items

● when entering numbers/letters: moving to the required location

F1 F2 F3 Softkeys: The current function of a key is assigned by the currently visible menu. If no such assignment has been made, the softkey is irrelevant.
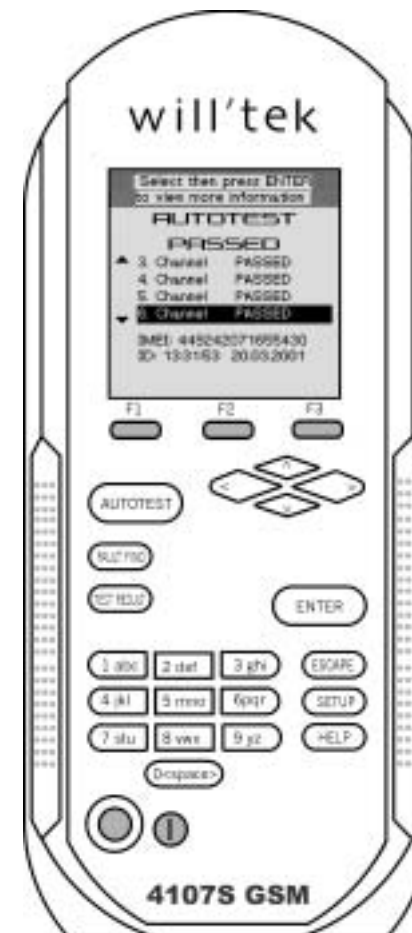
AUTOTEST | Switches to AUTOTEST mode (quick test of mobile phones)

FAULT FIND | Switches to FAULT FIND mode (troubleshooting – not available for Willtek 4107L)

TEST RESULTS | Displays a list of AUTOTEST logs you have stored (e.g. if you want to print a certain log)

ENTER | The ENTER key has three functions:
- confirming input
- opening a submenu
- launching a program

1abc ... 9 yz | The number-and-letter keys have the following functions:
- entering the numbers 1 through 9 (e.g. phone numbers)
- entering the letters A through Z (e.g. comments)

0 space | Enters the digit 0 or a space

ESCAPE | The ESCAPE key has two functions:
- returning to the next menu up
- aborting the current test

SETUP | Calls the setup menu (for basic parameter settings such as language and contrast)

HELP | Calls up brief explanations of the currently visible menu

On/off button

Initial startup

All you need to do to start up your Willtek 4100 the first time round is connect it to the power via the accompanying power supply unit.
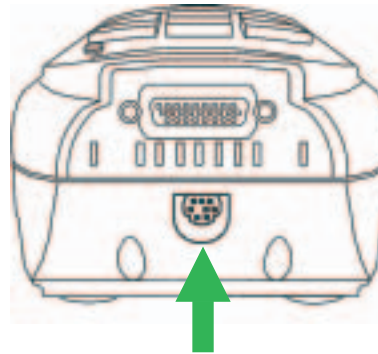
Attach power supply unit here

■ **Attaching the power supply unit**

1⃞ Plug the 8-pin connector coming from the power supply unit into the matching socket on your Willtek 4100.

⚠ When plugging the connector into the socket, be sure to observe the mechanical coding on the socket and the connector. If these do not match, the connector will not fit into the socket. Do not use force! Use only the original power supply unit.

2⃞ Connect the power supply unit to the wall power outlet.
3⃞ Press the on/off button to switch your Willtek 4100 on.

■ **Start menu**

Immediately after being switched on, the Willtek 4100 briefly displays an initialization menu (in this period among other things the operability of the device is checked).

The tester is fitted with a maintenance-free fan in order to keep the semiconductor components cool. The level of noise produced by the fan is normal.

Once you see the start menu (picture on left), the device is ready for use.

Start menu of the Willtek 4107S.

The first time you start up the device, you should at this point press the ⎣SETUP⎦ key to adapt the basic configuration of your Willtek 4100 to match your specific requirements (see Chapter 2).

2

SETUP

Basic settings

```
┌──────────────────────────┐
│▓Select then press ENTER▓│ ⇦
│                          │
│ SETUP                    │
│ Adjust contrast          │
│ Language                 │
│ Printer                  │
│ Date and time            │
│ User definitions         │
│ Serial port              │
│ Sound                    │
│ ▓Self check▓             │
│                          │
└──────────────────────────┘
```
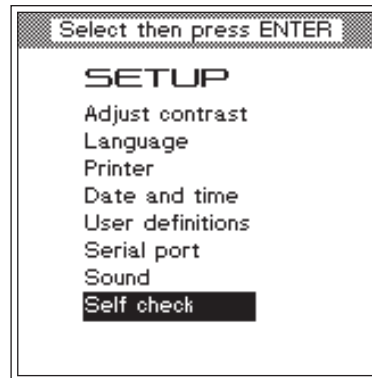
SETUP

As a rule, the basic settings need only be configured once during initial startup. A powerful capacitor ensures that the settings and the stored test result are preserved when your Willtek 4100 is off.

☞ The tester should be on for about 4 hours at least every 14 days (for capacitor charging) to ensure that no data is lost.

Contrast

```
┌──────────────────────────┐
│▓Press ESCAPE when ready▓│ ⇦
│                          │
│    ADJUST                │
│    CONTRAST              │
│                          │
│ Brighter: Press Cursor key  < │
│                          │
│ Darker:  Press Cursor key  > │
│                          │
│ ┌──────────────────────┐ │
│ │████████████          │ │
│ └──────────────────────┘ │
└──────────────────────────┘
```
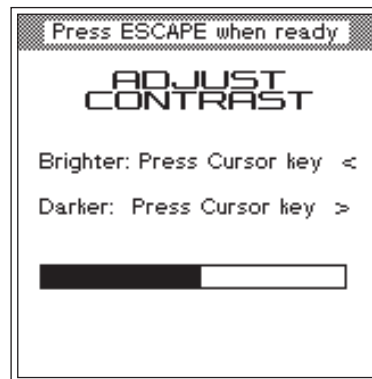
SETUP + *Adjust contrast* + ENTER

To adjust the readability of the display to the ambient conditions.

1. Using the cursor keys, alter the contrast to produce optimum readability from the normal viewing angle.
2. Return with ESCAPE .

Language

```
Select then press ENTER
```

```
LANGUAGE
√English
Deutsch
Italiano
Francais
```

⇐

SETUP + *Language* + ENTER

To select the language in which the display shows text.

① Select one of the languages offered using the cursor keys.

② Confirm your selection with ENTER .

③ Return with ESCAPE .

☞ The languages currently offered are English, German, Italian and French. Other languages are being prepared, and these will be made available in the form of a firmware update (see page 6-26).

Printer

```
┌─────────────────────────────┐
│  Select then press ENTER    │
│                             │
│       PRINTER               │
│                             │
│  Printer or Printer Compatible │
│    ✓ ASCII                  │
│      EPSON                  │
│      HP                     │
│      CANON                  │
│                             │
│  Lines per page       60    │
│  Free lines at top     0    │
│                             │
│                  ┌───────┐  │
│                  │ PRINT │  │
│                  └───────┘  │
└─────────────────────────────┘
```

Press the (PRINT) *key to print a test page using the current settings (see also page 6-6).*

Example of page length
Lines per page = 59
Free lines at top = 9
Nine lines will remain blank at the top of the page. This means that a total of 50 lines will be available on each page for the test results (59 - 9). Whether these will fill the entire page or not depends to a large extent on the font settings on the printer, since the Willtek 4100 just outputs the characters.

The way in which the characters appear on the paper (font, size, line feeds) is determined by the printer on the basis of the settings made on the printer. This means that you can only change the appearance of the test results by changing the printer's settings.

⬅

SETUP + *Printer* + ENTER

To select a printer for outputting test results.

1 Using the cursor keys, select the manufacturer of your printer (*EPSON* or *HP*). Printers from other manufacturers can also be used, provided that they have an HP or Epson emulation available. Select *ASCII* if your printer is neither Epson nor HP-compatible.

☞ All printers which do *not* require the use of a driver under DOS can be used directly. More recent Windows printers are therefore generally unsuitable. Printers of this type can, however, be used to print exported test logs from the PC (see page 6-16).

2 Confirm your selection with ENTER .

Setting the page length
The value you specify for *Lines per page* determines the number of printed lines per page (including blank lines at the top of the page) when you print test results. Once this number of lines is reached on the printout, the tester issues a form feed. The specification you make for *Free lines at top* sets the number of blank lines at the top of the page (if, for instance you want to avoid overwriting a letter header).

1 Move to the entry fields with the cursor keys, enter the required value and confirm every entry with ENTER .

2 Return with ESCAPE .

☞ For information on connecting a printer to your Willtek 4100 and on printing test results, refer to page 6-5.

Date and time

```
┌─────────────────────────┐
│        Select           │
│                         │
│ DATE AND TIME           │
│                         │
│ Type value + ENTER      │
│  Time:   14:27:46       │
│                         │
│  Date:   19.02.97       │
│                         │
│ Change Format with ENTER│
│       √DD.MM.YY         │
│        MM/DD/YY         │
│                         │
└─────────────────────────┘
```
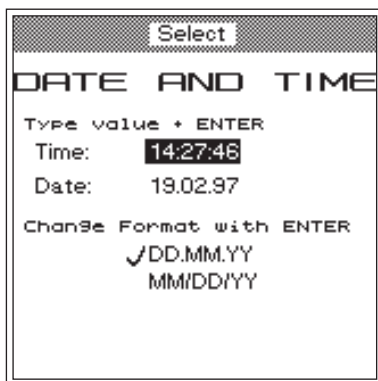
Changes to the date format are reflected by swapping of the first two values in the "Date" line.

Each time you confirm a setting you can either go on to configure another setting or press ESCAPE *to quit the menu.*

SETUP + *Date and time* + ENTER

To set the date and time (shown on the start menu and printed on test results).

Date format

1 Using the cursor keys, select the date format you require (shown at the bottom of the display):
DD/MM/YY = day/month/year
MM/DD/YY = month/day/year

2 Confirm your selection with ENTER.

Time

1 Using the cursor keys, select the "*Time*" line.

2 Enter the current time in 24-hour format (comparable to entering a 6-digit number on a pocket calculator).
Example: 10:32
Input: 103200

3 Confirm your input with ENTER.

Date

1 Using the cursor keys, select the "*Date*" line.

2 Enter the current date in the selected date format (comparable to entering a 6-digit number on a pocket calculator).
Example: June 14, 1997
Input: 140697 or 061497

3 Confirm your input with ENTER.

Return with ESCAPE.

Header

Select

USER DEFINITIONS

Set cursor then type char.
Press ENTER when ready.

User name:
USER NAME

Company:
USER COMPANY

Example 1 abc
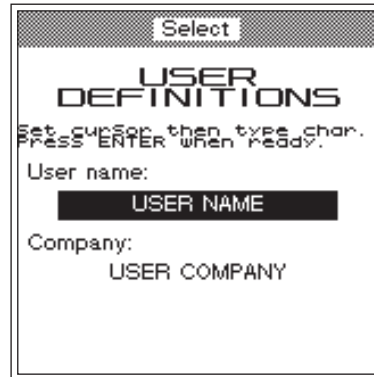
Repeated pressing of the 1 abc
*key causes the following charac-
ters to be entered at the cursor po-
sition:*

1st press = **A**
2nd press = **B**
3rd press = **C**
4th press = **1**
5th press = A
6th press = B
    etc.

SETUP + *User definitions* + ENTER

To enter the text that you want to appear in the header on printed tested reports (e.g. user/company).

① Using the cursor keys, select the required input line.
② Enter text letter by letter (digits are also acceptable) using the keys on the numeric keypad. Repeated pressing of a number key first displays all the letters assigned to that key and then the digit:
 – Automatic text entry: Avoid pauses between selecting characters. If you pause for more than approx. 1 second between selecting two characters, the character currently visible is used and the cursor moves to the next entry position.
 – Corrections: Use the left or right cursor key to position onto the incorrect character and then overwrite the character.
 – Use the 0 space key to enter spaces.
③ Confirm your input with ENTER .
④ Using the cursor keys, move to the second input line and enter text – or return with ESCAPE .

PC interface

```
┌─────────────────────────────┐
│  Select then press ENTER     │
│                              │
│     SERIAL  PORT             │
│                              │
│  Baudrate:      4800         │
│                 9600         │
│                 19200        │
│               √38400         │
│                              │
│  RXTX lines:  √Normal        │
│               Crossed        │
│                              │
└─────────────────────────────┘
```

⬅
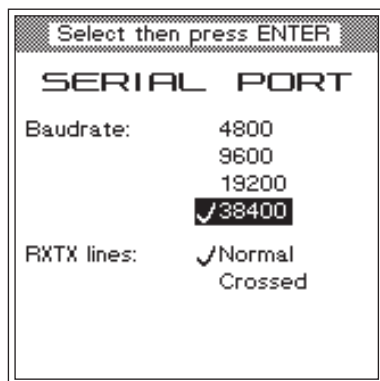
`SETUP` + *Serial port* + `ENTER`

To set the baud rate (bit/s) for serial data communication between PC and Willtek 4100, and to select the type of communication line.

1 Using the cursor keys, select the required baud rate. The higher the baud rate, the shorter the transmission time. On older PCs it may be necessary to select one of the lower rates to ensure error-free data transmission. Further data communication parameters are permanently set (in the background) to:

8 data bits – no parity – 1 stop bit

2 Confirm your selection with `ENTER`.

3 If you are using one of the original cables for serial data communications (extra accessories: Serial adapter cable or Universal adapter cable), please select the entry *Normal* under *RXTX lines* using the cursor keys. If you are using other cables (e.g. extension cables), lines RXD and TXD can be crossed (Pin 2 and Pin 3, see also page 6-3). In this case, please select *Crossed*.

4 Confirm your selection with `ENTER`.

5 Return with `ESCAPE`.

☞ The values set for the serial interface (COM port) on the PC must be the same as those set on the Willtek 4100. If the PC also asks you about the (transmission) protocol, the (transmission) protocol, select "NONE". For instructions on setting the baud rate of the serial interfaces (RS-232-C) and the other parameters on your PC, refer to the manual for your operating system (DOS, Windows 3.xx, Windows 95).

Why data communication?
Setting up a data communication link between a PC and your Willtek 4100 is not difficult, but it can be really useful! For example, you are able to download the latest firmware versions from the Internet, and feed them into your Willtek 4100, or selectively upload user-specific AUTOTESTs and limit values that are geared to specific models of mobile phone. Willtek also has the right software for your data communication requirements (some of which are optionally available).

```
┌─────────────────────────────┐
│ ▓Select then press ENTER▓   │
│                             │
│   SERIAL  PORT              │
│                             │
│ Baudrate:      4800         │
│                9600         │
│                19200        │
│              ✓█38400█       │
│                             │
│ RXTX lines:  ✓Normal        │
│               Crossed       │
│                             │
│ Protocol:    ✓X-ON / X-OFF  │
│               RTS / CTS     │
└─────────────────────────────┘
```
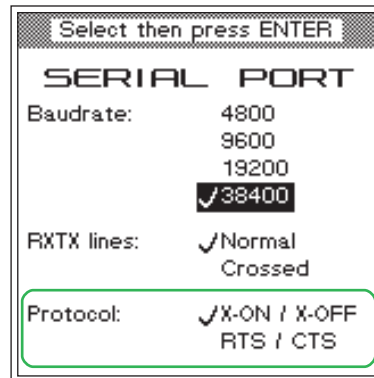
■ **Choose the protocol**

When a tester is under remote control, the transfer protocol ensures error free transfer of data between the PC and the tester (handshaking). You can choose between one software protocol and one hardware protocol (Willtek 4107S only).

X-ON / X-OFF   Choose this software protocol if the RTS and CTS lines are missing in the cable connecting the PC and the tester (see also page 6-3).

RTS / CTS   If you are using a fully-wired cable (original Willtek accessories), you should choose this fast hardware protocol in preference to the slower software protocol.

☞ On the PC, the same protocol must be set for the serial interface (COM port) used as for the Willtek 4107S.

The protocol you set only takes effect when the tester is under remote control and does not interfere with data transfer using other protocols (e.g. when loading a firmware update).

Sound

```
┌─────────────────────────────────┐
│▓Select then press ENTER▓         │
│                                 │
│         SOUND                   │
│                                 │
│      Disable sounds             │
│     ┌──────────┐                │
│     │✓None     │                │
│     └──────────┘                │
│       On Autotest               │
│       All sounds                │
│                                 │
│                                 │
└─────────────────────────────────┘
```

⟵

[SETUP] + *Sound* + [ENTER]

Enable or disable the sounds used by the Willtek 4100 to signal special operating status (e.g. when a key is pressed, when an error occurs or when the device is ready).

1 Using the cursor keys, select the required setting.

None   Sounds are always active.
On Autotest   Sounds are deactivated during an AUTOTEST.
All Sounds   Sounds are always deactivated.

2 Confirm your selection with [ENTER]

Self check

```
Select then press ENTER

SELF  CHECK
System Info

Printer Test
Keyboard Test
Display Test
Internal Test
```
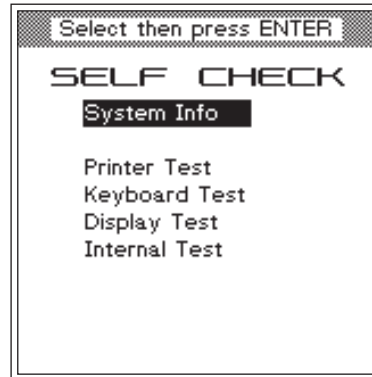
⇦ [SETUP] + *Self check* + [ENTER]

The Willtek 4100 checks its hardware modules and indicates whether they are working correctly. It also displays information on the version status of individual modules.

Accessing the menus

Once you see the *SELF CHECK* menu on the display, access to the submenus always follows the same pattern:

1. Use the cursor keys to select the menu you require.
2. Confirm your selection with [ENTER]. The display then shows the menu you have selected. On some menus you can then use softkeys to start self checks.
3. Return with [ESCAPE].

System information

```
SYSTEM INFORMATION
Serial number :        1234567
Model :                  4106S

Version :                  1.30
from :  Nov 21 1997 11:03:49

MCU Serial number : 1234567
HF Serial number :       12005
HW Revision   :         0, 1, 2


                        PRINT
```
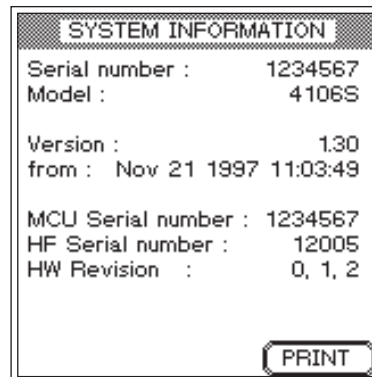
⇦ [SETUP] + *Self check* + [ENTER] + *System info* + [ENTER]

The *SYSTEM INFORMATION* menu shows the following information:
– the serial number of the tester
– the model number
– the firmware version number
– the date and time of the creation of the firmware at Willtek
– details relating to the hardware level of the device

☞ **Please have the information on this menu ready when contacting Willtek for product support (Press (PRINT) to start printing the menu).**

Printer test

```
Press PRINT or ESCAPE

PRINTER  TEST

Printer Test
12345678901234567890
ABCDEFGHIJabcdefghij

You should see the 3 lines
above on the printout.

                    PRINT
```

⟸ `SETUP` + *Self check* + `ENTER` + *Printer test* + `ENTER`

To test the printer.

1. Attach your Willtek 4100 (26-pin socket) to the printer, typically using the Universal adapter cable (extra accessory).

2. Press `PRINT` to start the printer test.

● If your printer outputs the three lines shown on the left, test results will also be printed correctly.

● Please refer to page 6-5 if the printer does not respond or responds incorrectly.

3. Return with `ESCAPE`.
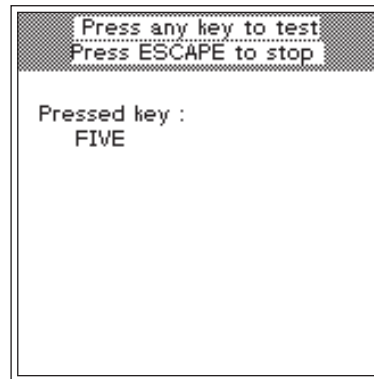
Keyboard test

`SETUP` + *Self check* + `ENTER` + *Keyboard test* + `ENTER`

To test the keypad.

When you call this menu, the keyboard test starts automatically.

1️⃣ Press all the keys on your Willtek 4100 in succession.

● If the display reports the designation of the key you press, the key is OK. Numbers are written out (e.g. *FIVE*).

● If the display does not acknowledge a keypress, the key is defective (e.g. corroded contacts following ingress of liquid). In this case consult your sales partner.

2️⃣ Return with `ESCAPE`.
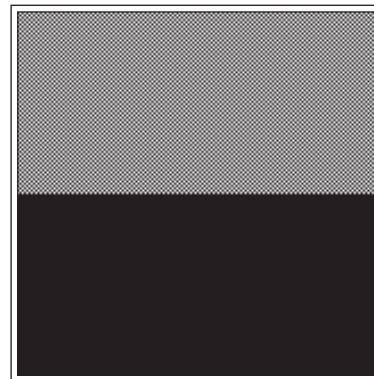
Display test

`SETUP` + *Self check* + `ENTER` + *Display test* + `ENTER`

To test the liquid crystal display.

When you call this menu, the display test starts automatically.

● The display is divided into two areas which alternate between white, gray and black. These areas should show no obvious dots or stripes.

● If, for instance, you can see black dots or stripes in a white area, the display is faulty. In this case, consult your local Willtek sales office or authorized Distributor.

Return with `ESCAPE`.

2-12

Internal test

```
┌─────────────────────────────┐
│▓▓▓▓▓▓▓ Internal test ▓▓▓▓▓▓▓▓│
│ GSM loop :          PASS    │
│ DCS1800 loop :      FAIL    │
│ 3 Volt :            PASS    │
│ 5 Volt :            PASS    │
│ Vcc :               PASS    │
│ -18 Volt :          FAIL    │
│ +15 Volt :          PASS    │
│ +4.9 Volt :         PASS    │
│ -10 Volt :          PASS    │
│ +5 Volt Loop :      PASS    │
│ +5 Volt IQ :        PASS    │
│ Synth.Synchr.:      PASS    │
│                             │
│                             │
│ ┌──────┐          ┌───────┐ │
│ │ CONT.│          │ONESHOT│ │
│ └──────┘          └───────┘ │
└─────────────────────────────┘
```

⟸

`SETUP` + *Self check* + `ENTER` + *Internal test* + `ENTER`

To run an internal test on important modules and supply voltages.

1   Press the (ONESHOT) softkey to start a single test run or (CONT.) to start continuous testing (press (STOP) to abort). *PASS* indicates that a test has been passed, *FAIL* reports an error. With continuous testing, the number of tests carried out and the total number of errors detected are also reported.

●   Errors reported by tests may also be due to external factors (such as major glitches in the line voltage). In such cases repeat the test. If the errors recur, consult your sales partner.

2   Return with `ESCAPE`. Use (STOP) to abort continuous testing first.

2-13

Preparing the tests

Preparations are identical for the tests in AUTOTEST and FAULT FIND modes. They involve only two steps:

● insertion of the test SIM in the test unit,

● connection of the test unit to your Willtek 4100.

Installing the test SIM

Make sure that you insert the test SIM in the mobile phone before carrying out an AUTOTEST. This is because during the test, the Willtek 4100 will attempt to perform measurements which are not generally permitted by original SIMs. The test SIM is not absolutely necessary for FAULT FIND mode, although it is useful.

1 Make sure the mobile phone is switched off.

⚠ Observe the equipment manufacturer's handling instructions.

2 Replace the original SIM with the test SIM. Plug-in SIMs are usually hidden behind a small flap that you see when you take out the battery.

Do not forget to remove the test SIM before returning an intact mobile phone. With the test SIM in the phone, the customer will no longer be able to check into a radio network; so even though the phone is intact, it will be of no use to the customer.

■ **Background information: SIM**

The Subscriber Identity Module (SIM) contains the subscriber identity code and is an exchangeable component of any mobile phone. If there is no SIM, it is not possible to set up a connection (except for emergency calls). Some mobiles use smartcard-style SIMs (full size), while others use the plug-in format.

A full-size SIM (top) and a plug-in SIM.

⚠ Please note that the SIM card has an embedded chip and the contacts to this can become damaged with repeated flexing or a very large number of insertions and removals from a mobile phone.

Attaching the test unit

A WIlltek 4100 supports three methods of attaching a mobile phone for testing:

- wireless connection via antenna (extra accessory).
- connection via the Universal Antenna Coupler (extra accessory).
- Cable-based connection via RF adapter cable and an RF adapter which matches the phone (extra accessory).

Connection via antenna

■ Points in favor

- Very quick to set up.
- Any GSM mobile phone can be tested.
- The entire RF signal path of the phone is tested (antenna included).
- No RF adapter required.

■ Points to note

- Some tests call for clearly defined conditions (accurately known RF input level at the radio's antenna input). With a wireless connection, these particular test values cannot be correctly measured (refer also to page 3-17).
- In order to keep RF signal attenuation in the space between the devices to within reasonable bounds, the distance between the tester and the mobile phone must not exceed 50 cm.
- Make sure that no conductive objects are lying between the tester and the mobile phone (screening effect). The two devices must not be placed on a conductive surface.
- Nearby base stations of a GSM mobile radio network may cause the test results to be distorted.

max. approx. 50 cm

Wireless connection of the test unit via antenna. The orientation of the two antennas to each other is of no particular significance.

2-16

● The radio is likely to get registered into a public mobile radio network (unintentionally). Additional measures must be taken at the start of a test run to ensure that this does not happen.

■ **Connection**

Select the correct antenna for the mobile radio system (extra accessory, see also page 6-38) which matches the mobile phone frequency range and secure it to the TNC connection of your Willtek 4100 by tightening the coupling ring.

☞ Do not use the wrong antenna, as this will falsify the results of the test. The antenna for GSM 900/E-GSM mobile phones has an overall length of around 165 mm (6.5") and has two yellow rings at the end. The antenna for GSM 1800/1900 mobile phones is around 229 mm (9") in length and no rings at all.
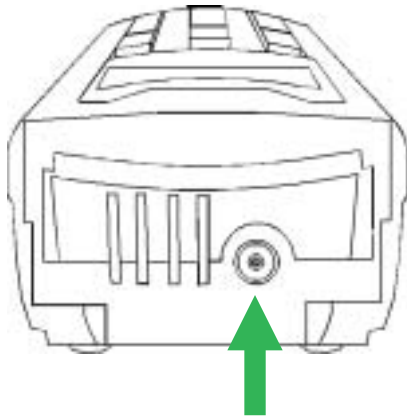
TNC connection
on Willtek 4100

Connection via the Universal Antenna Coupler

The important feature with the Universal Antenna Coupler is that mobile phones of the same type are always placed in exactly the same position in the clamp.

■ Points in favor

The Universal Antenna Coupler is suitable for all radio systems (GSM, PCN, PCS). It combines most of the benefits of wireless connection via antenna with those of cable-based connection. The more precisely defined test conditions mean that measurements and tests which were too inaccurate with the simple antenna connection method are more reliable (refer also to page 3-17).

■ Points to note

The Universal Antenna Coupler can also react to changes in the environmental conditions (such as the proximity of a hand). Precision measurements can therefore still only be performed with a cable-based connection. RF interference from nearby base stations can also create problems.

■ Connection

Connect the Universal Antenna Coupler to the Willtek 4100 with the RF adapter cable supplied.

Release the jaws of the clamp by pressing small button and insert the mobile phone in such a way that its display points to the Willtek logo and the housing touches the bottom restraint (see the figure lefthand). Press the jaws of the clamp together firmly.

☞ Make sure that mobile phones of one type are always mounted in exactly the same position. Only in this way can constant test conditions and appropriate test results be guaranteed. If you select an automatic start for an AUTOTEST, you must observe any special instructions for the test which may appear (e.g. fully extend the antenna or check size of battery pack).

Cable-based connection

■ Points in favor

● RF adapter with cable coupling guarantees a set of defined testing conditions. That means that all tests produce results which can be correctly evaluated against specifications.

● As all the tests are suitable for evaluation, the *PASS/FAIL* evaluation is more broadly based than with wireless connection.

● It is not possible for the test unit to (unintentionally) register in a public mobile radio network.

● There is no chance of interference from nearby GSM base stations.

■ Points to note

● Test preparation takes longer.

● Only mobile phones which have an RF connection socket can be tested with this method.

● Defects in the mobile phone's antenna circuit are not detected.

■ Connection

Select the RF adapter (extra accessory) which matches the mobile phone (see also page 6-40). First securely attach the RF adapter cable (1.5 m) to the TNC connection on the Willtek 4100 and to the RF adapter. Then attach the mobile phone to the RF adapter. Use original equipment only (otherwise you may risk false readings).

⚠ When attaching the RF adapter, take great care with the alignment of the contacts. Do not use force. If an adapter does not fit properly, you may have chosen the wrong one.
Make sure that there is good contact on all plug-in connections (loose contacts lead to errors in test results).

Cable-based connection of the test unit is the ideal choice for precision measurements.

3

AUTOTEST

Overview

An AUTOTEST performs a series of different measurements largely automatically. By comparing its measurements with stored target values, the Willtek 4100 detects faults in the mobile phone. The tolerances allowed with respect to the target values are used to decide *PASS* or *FAIL* of each measurement.

At the end of the AUTOTEST, an overall evaluation of *PASSED* or *FAILED* is derived from the evaluations of the individual tests.

AUTOTEST **PASSED**   The mobile phone is within the tolerances, and is in full working order. There is no need for further measurements in FAULT FIND mode.

AUTOTEST **FAILED**   The mobile phone is outside the tolerances. The test unit is defective. Further measurements in FAULT FIND mode can be used to identify the cause of the fault (not available for Willtek 4107L).

Testing without stress
A group of test parameters can be assigned to any model of mobile phone and then stored. Once the parameters have been stored for a given model, these preparatory steps are no longer required if a further test is carried out on the same model. The AUTOTEST can be started immediately. In these cases, the two steps of preparing and running an AUTOTEST are totally separate. The advantage is that the two tasks can be carried out at different times and by people with different levels of expertise.

■ The influence of the user

Depending on the model, each Willtek 4100 incorporates at least one standard AUTOTEST as supplied from the factory. In addition, it is possible to read in user-defined AUTOTESTs. The user of a Willtek 4100 cannot change the installed AUTOTEST program, but can change the **test parameters** (selection of channels, compensation of RF pre-attenuation etc.). This allows local GSM channel conflicts and model-specific RF measurement errors to be eliminated. The AUTOTEST thus provides a reliable evaluation of the mobile phone being tested.

Using the programming option "Utility Software" the user can create user-defined AUTOTESTs, including number, sequence or evaluation of the tests.

Running an AUTOTEST

An AUTOTEST is always started in the same way: First call the *MS TYPE* menu, then select the entry which best matches the test unit.

⬅️

```
 Select then press ENTER 

   MS  TYPE
▲ BLUE MOBILE
  GREEN MOBILE
  GSM MOBILE
  MOBILE BIG
  MOBILE SMALL
  MOD-3941 CABLE
  PCN MOBILE ANT-
▼ PCS MOB-COUPLER
                    CONFIG
```
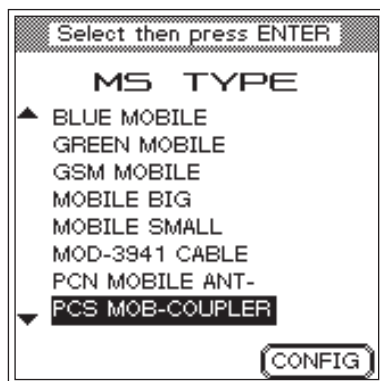
The more accurately an entry in the list characterizes a model, the less risk there is of making an error. The softkey has no significance when starting AUTOTESTs (if it is pressed by accident, you can return to the MS TYPE menu by pressing ESCAPE *).*

Be very careful to select the entry which matches the test unit exactly. It is possible that there are a number of entries for a single model. This can occur, for instance, if the test unit is to be connected via the Universal Antenna Coupler and different battery packs are available for this model. Since the thickness of the battery pack has a considerable influence on the measurements, it is quite common for there to be a number of different entries for a model in a case of this type.

▮ AUTOTEST ▮

1️⃣ With the cursor keys, select from the list exactly the model you want to test (for details on adding a model to the list, refer to page 3-13ff). A Willtek 4100 can store up to 100 records of this type.
Fast search function: pressing a number key repeatedly immediately places the cursor on the first entries which start with the letters assigned to the key (for instance, 7 stu places the cursor alternately on the first entry beginning with S, T or U).

2️⃣ Switch off the mobile phone and install the test SIM (refer to page 2-14). If the name of the model as shown in the list already indicates the type of connection, then connect the test unit as indicated (refer to page 2-16).

⚠️ AUTOTEST only returns correct results if the appropriate connection is used (antenna, coupler or cable).

3️⃣ Start AUTOTEST by pressing ENTER, switch on the mobile phone and wait until the display on the mobile phone shows the receiving signal strength or the ID of the test network (11 or 00101). Now follow the instructions on the display of the Willtek 4100. If the required connection type has not been clear up to now, it should be indicated at this point at the latest.

A Standard AUTOTEST is carried out as follows

```
                    ┌──────────────┐
                    │    Start     │
                    └──────┬───────┘
                           │
                    ┌──────┴───────┐
                    │ 1st Input break│
                    │  (MS CALL)    │
                    └──────┬───────┘
                           │
                    ┌──────┴───────┐
                    │ 2nd Input break│
                    │  (RELEASE)    │
                    └──────┬───────┘
                           │
                    ┌──────┴───────┐
                    │ 3rd Input break│
                    │  (BS CALL)    │
                    └──────┬───────┘
                           │
                    ┌──────┴───────┐
                    │ 4th Input break│
                    │ (Speech test) │
                    └──────┬───────┘
                           │
                    ┌──────┴───────┐
                    │    Result    │
                    └──────────────┘
```

```
  ┌─ AUTOTEST ─┐
  │ ACTIVE     │
  │            │
  │            │
  │ PLEASE WAIT│
  └────────────┘
```
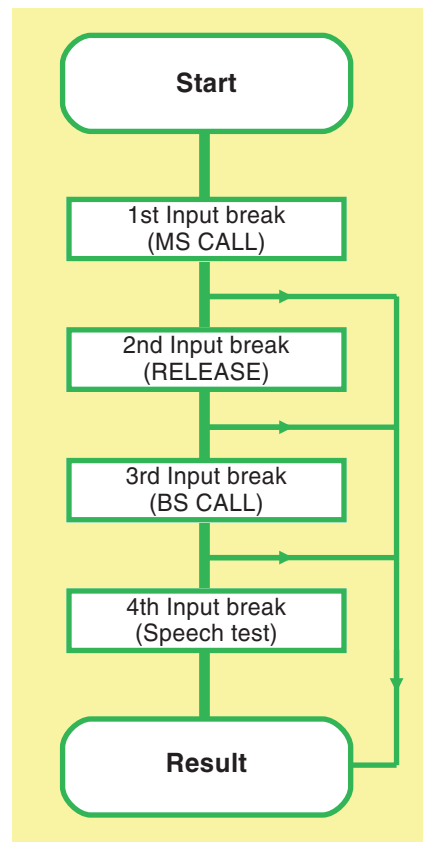
The following description applies exclusively to the standard AUTOTEST, as this is the only test for which a binding and pre-specified format exists. User-defined AUTOTESTs are the sole responsibility of the programmers who created them. They may resemble the standard AUTOTEST in many ways, or differ quite considerably.

■ Be prepared for input breaks

A standard AUTOTEST will be interrupted some times by breaks in processing, during which the Willtek 4100 prompts you on its display to perform a certain action. The device waits as long as is necessary for you to respond (no time limit). The message *ACTIVE* displayed on the screen means that your Willtek 4100 is busy with the AUTOTEST and is not expecting an input from you.

■ When an AUTOTEST aborts

If you are quick with your inputs, a standard AUTOTEST takes around 1 minute. If the message *AUTOTEST FAILED* appears much earlier than this, it is likely that a serious error has occurred which is preventing further messages from being issued. An error of this nature (e.g. during connection setup) will result in the AUTOTEST aborting.

You can find out precisely which error led to the AUTOTEST aborting by using the tester's error analysis routine (see page 3-8).

If an AUTOTEST aborts with a message that there is not enough main memory left, you will need to delete some or all of the stored AUTOTESTs before running another test (see page 3-12).

Press ESCAPE to cancel an AUTOTEST you have started.

■ **The input breaks of a Standard AUTOTEST**

1st input During connection setup (MS CALL), the tester prompts you to dial a number on the mobile phone.

```
┌─ AUTOTEST ─┐
MS  CALL

Dial 1234567890 and press
SEND at the mobile phone
```

☞ Do not start to dial before the display on the mobile phone shows either the receiving signal strength or the ID of the test network (`11` or `00101`).

● Dial `1234567890` on the mobile phone (note the order!) and then press the button with function "Send". The AUTOTEST now continues.

☞ Dial the number correctly. If you miss any numbers or enter them in the wrong order, the result of the test will be *FAILED*!

2nd input Provided the AUTOTEST was not aborted owing to a problem on the mobile telephone, another break occurs just before the test to see whether a connection has been set up correctly (hang up on mobile phone).

```
┌─ AUTOTEST ─┐
RELEASE

Press the END button on
Mobile
```

● Press the button with function "Disconnect" on the mobile phone (usually a button with a symbol of a "hung-up" receiver). The AUTOTEST continues.

3rd input Provided the AUTOTEST was not aborted owing to a problem on the mobile telephone, the tester – having again set up a connection (this time BS CALL) – now prompts you to take the call (incoming call from tester).

```
┌─ AUTOTEST ─┐
BS  CALL

If mobile phone rings,
press CALL key.
```

● When the mobile phone rings and/or displays an optical signal, press the button labeled CALL (usually the same as the key function "Call"). The AUTOTEST continues.

```
       ┌─ AUTOTEST ─┐
       │             │
       │  AF  LOOP   │
       │             │
       │             │
       │ Talk for some seconds. │
       │ Do you hear the echo ? │
       │    Press softkey       │
       │             │
       └─────────────┘

   ┌──────────┐      ┌──────────┐
   │    NO    │      │   YES    │
   └──────────┘      └──────────┘
```

4th input Provided the AUTOTEST was not aborted owing to a problem on the mobile phone, the routine stops for the last time at the speech test. This test does not produce a positive result unless all the AF/RF components in the mobile phone's send and receive paths are in full working order.

Say a single word into the mouthpiece of the phone. If you hear a good quality echo after approx. 1 second, press the (YES) softkey on the tester. If you do not hear anything or if the echo is distorted, press (NO). When you have pressed one of the two softkeys, the AUTOTEST proceeds without interruption to the end of the routine, where it displays the test results.

■ **Lifting a tester block**

In exceptional cases, defective mobile phones can result in the tester no longer responding in the course of an AUTOTEST. Should this happen, press [ESCAPE] to cancel the test (a delay of up to 30 s is possible before anything happens). If this does not lift the block, switch off the tester briefly) and restart AUTOTEST.

Results of the AUTOTEST

☞ ***AUTOTEST PASSED?***
Do not forget to restore the original SIM before returning the mobile phone to the customer. Otherwise the customer will be unable to use the phone and you will not be able to continue testing...

At the end of an AUTOTEST, the tester outputs a *PASS/FAIL* assessment for each voice channel tested and the resultant overall assessment of *PASSED* or *FAILED*. At the same time, the AUTOTEST log will be stored in the tester under the ID number shown.

AUTOTEST PASSED

The mobile phone is within the permitted tolerances on all tested channels. The tester has detected no faults. The mobile phone malfunction of which the customer has complained is not attributable to a technical defect in the device.

It is highly likely that the malfunction is due to user error or to bad reception (dead spots). Try to obtain a more detailed description of the problem from the customer.

```
┌─────────────────────────────┐
│ Select then press ENTER     │
│ to view more information    │
│        AUTOTEST             │
│        PASSED               │
│ ▲ 3. Channel      PASSED    │
│   4. Channel      PASSED    │
│   5. Channel      PASSED    │
│ ▼ 6. Channel      PASSED    │
│                             │
│ IMEI: 449242071655430       │
│ ID: 13:31:53  20.03.2001    │
│ (DELETE)(REPEAT)(PRINT)     │
└─────────────────────────────┘
```

■ **What to do if you are in doubt**

If in doubt, repeat the AUTOTEST on other channels, check that you prepared the test correctly, or switch to FAULT FIND mode to check whether the phone is only just within the allowed tolerances in a number of places (FAULT FIND not available for Willtek 4107L).

■ **Softkey functions**

☞ ***Evaluate later***
Each log is automatically given its own ID number (time, date). You can use this ID in conjunction with TEST RESULTS *to find a log at a later point in time, and then print it out (see also page 3-12).*

DELETE   Deletes the log of the AUTOTEST you have just run, then returns you to the *MS TYPE* menu.

REPEAT   Repeats the AUTOTEST you have just run.

PRINT   Prints a log of the most recent AUTOTEST (see page 6-5 for general notes on printing).

Return to the *MS TYPE* menu with ESCAPE.

AUTOTEST FAILED

FAILED means that the mobile phone is outside the permitted tolerances on at least one of the tested channels.

■ Fault analysis

1. Use the cursor keys to select one of up to 15 possible *FAIL* entries.

2. ENTER activates the first level of detail display. The tester here shows the number of the defective channel. The text also gives the assessments of all measurements which are outside the permitted tolerances.

Special case: The detail display of the 15th *FAIL* entry *Following Channels* shows an asterisk in place of the channel number (only possible with user-defined AUTOTESTs). This occurs when more than 14 changes of channel are performed during an AUTOTEST. The detail display for *Following Channels* then groups together all the errors identified as of the 14th channel change. In this event, please refer to the test log to assign the errors to the channel numbers.

```
Select then press ENTER
to view more information
        AUTOTEST

        FAILED
▲ 3. Channel    FAILED
  4. Channel    FAILED
  5. Channel    FAILED
▼ 6. Channel    FAILED

  IMEI: 449242071655430
  ID: 13:22:36  20.03.2001

( DELETE ) ( REPEAT ) ( PRINT )
```

ENTER ⬇ ⬆ ESCAPE

```
FAILURES ON
CHANNEL  45
      Actual Band:
      GSM 900 band
RMS phase too high.
Peak phase too high.
Freq. error outside limits.
AF loop (FR) failed.
Burst length too long.
AF loop (EFR) failed.
Freq. error outside limits.
RMS phase too high.
```

ESCAPE ⬅

ENTER ➡

```
        DETAIL
Actual Band:
GSM 900 band
Failed Channel : 45

Freq. error outside limits.

High limit:        20 Hz

MEASURED:         -41 Hz

Low limit:        -20 Hz
```

First level of detail display   *Second level of detail display*

3-8

3   If you need more information, select more detail with the cursor keys.

4   ENTER activates the second level of detail display. The tester now shows the measurements on which the selected assessment is based (including the tolerance band limits).

5   ESCAPE returns you to the next menu level up.

Sample AUTOTEST log (excerpt)

```
Willtek 4100 Mobile Tester      Overall Test Result : FAILED
  AUTOTEST: GSM Standard   (GSM / E-GSM)
  Test ID : 09:58:42  17.04.97
  Mobile connection via : CABLE

  IMSI : 001011234567890      IMEI : 490125513271390
  MS Power Class : 4 (33 dBm)  Revision level : Phase 1
  Extended freq. : NO          SMS : YES   A5 : 1

  Pre attenuation : 1.5 dB
  RF output -60.0 dBm
  Broadcast channel 63
  Traffic channel 3
  Power level 9                          (25dBm)

Call from Mobile        PASS
  Dialled number        PASS    1234567890   (1234567890)
Mobile release          PASS
  Broadcast channel 63
  Traffic channel 27
  Power level 5                          (33dBm)

Call from Basestation   PASS
  Power Time template   PASS
  TX power              PASS       35.1 dBm  (29.0 - 37.0 dBm)
  RMS phase             PASS       3.63 deg  (0.00 - 8.50 deg)
  Peak phase            PASS       9.68 deg  (0.00 - 23.50 deg)
  Freq. error           PASS         12 Hz   (-140 - 140 Hz)
  Burst length          PASS        559 us   ( 543 - 563 us)
  RX level              FAIL  *      63       (  45 - 55)
  RX quality            PASS          0       (   0 - 0)
  RF output -80.0 dBm
  Power level 9                          (25dBm)
  Power Time template   PASS
  TX power              PASS       26.9 dBm  (20.0 - 30.0 dBm)
  RMS phase             PASS       2.52 deg  (0.00 - 8.50 deg)
  Peak phase            PASS       7.76 deg  (0.00 - 23.50 deg)
  Freq. error           PASS        -12 Hz   (-140 - 140 Hz)
  RX level              FAIL  *      42       (  25 - 35)
  RX quality            PASS          0       (   0 - 0)
  RF output -96.0 dBm
  BER                   PASS       0.00 %    (0.00 - 0.30 %)
  RF output -102.0 dBm
  BER                   PASS       0.00 %    (0.00 - 2.44 %)
  RF output -80.0 dBm
  Power level 14                         (15dBm)
Traffic channel 123
  TX power              PASS       18.0 dBm  (10.0 - 20.0 dBm)
  RMS phase             PASS       2.58 deg  (0.00 - 8.50 deg)
  Peak phase            PASS       8.70 deg  (0.00 - 23.50 deg)
```

Evaluating stored AUTOTESTs

```
┌─────────────────────────────┐
│ Select then press ENTER     │
│                             │
│ TEST  RESULTS               │
│ ▲  12  15:02:03  19.03.2001 │
│    13  15:02:30  19.03.2001 │
│    14  15:07:28  19.03.2001 │
│    15  15:48:42  19.03.2001 │
│    16  16:01:58  19.03.2001 │
│    17  16:02:41  19.03.2001 │
│    18  16:03:23  19.03.2001 │
│ ▼  19  16:09:22  19.03.2001 │
│ (DELETE)(DEL.ALL)( PRINT )  │
└─────────────────────────────┘
```

⇦   ▐ TEST RESULTS ▌

Provided you do not delete it the moment you have finished running the AUTOTEST, a log will be stored in your Willtek 4100 each time an AUTOTEST is run. The tester automatically uses the date and time the AUTOTEST was started as a means of identification (ID). This ID appears at the bottom of each AUTOTEST, and will help you locate a specific log at a later point in time.

■ Selecting a stored log

1 Press TEST RESULTS to display a list of AUTOTEST logs you have stored.

2 Use the cursor keys to select the ID (AUTOTEST) you are looking for. A scroll arrow in the left-hand margin indicates that there are more IDs outside the visible area of the window. The ← and → cursor keys place the cursor bar at the top and bottom of the list respectively.

```
┌─────────────────────────────┐
│      ▐ TEST RESULTS ▌       │
│ Test result:         FAILED │
│ Test ID:  16:09:22 19.03.2001│
│ AUTOTEST:           GSM900  │
│ MS TYPE:         2630 MODEL │
│ Network:               900  │
│ IMEI:        449242071655430│
│ IMSI:        001011234567890│
│ Connection:          CABLE  │
│                             │
│                             │
│ (DELETE)( DETAIL )( PRINT ) │
└─────────────────────────────┘
```

⇦   ▐ TEST RESULTS ▌ + Select ID + ▐ ENTER ▌

3 Press ENTER to display a profile of the chosen AUTOTEST log with its significant data. If this is the log you are looking for, you can now either delete it or print it out. Select ESCAPE to return to the list.

4 Select AUTOTEST or FAULT FIND to return to the mode you require.

■ **Softkey functions**

(DELETE)   Deletes the AUTOTEST log currently selected (after a confirmation prompt).

(DEL.ALL)   Deletes all stored AUTOTEST logs (after a confirmation prompt).

(DETAIL)   Displays the results of the selected AUTOTEST as described on pages 3-7 and 3-8 (including access to the detail display). ESCAPE returns you to the *TEST RESULTS* menu.

(PRINT)   Prints the complete log of the AUTOTEST currently selected (see page 6-5 for general notes about printing).
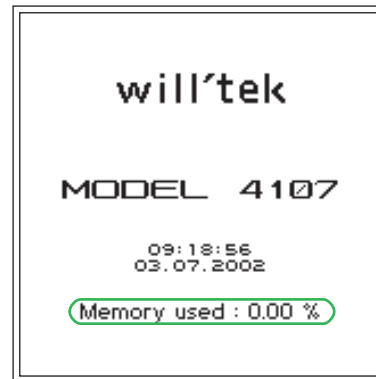
■ **Available capacity for storing AUTOTESTs**

There is space in the memory for approx. 300 standard AUTOTEST logs. The actual number might be considerably more or less than this in the case of user-defined AUTOTESTs, which can vary in size.

When the memory is full, an error message is issued the next time you attempt to run an AUTOTEST, or while an AUTOTEST is in progress. If this happens, you will need to free some capacity by deleting one or more stored logs.

```
will'tek



MODEL  4107


09:18:56
03.07.2002

( Memory used : 0.00 % )
```

■ **Downloading logs to a PC**

If you want to avoid losing any logs, or intend to archive logs for statistical evaluation at a later date, it is worthwhile transferring saved logs to a PC (see page 6-16).

Entering test parameters

Correct test parameters are of key importance: On the one hand, they prepare a model-specific AUTOTEST in such a way that it can subsequently be started at the touch of a button. On the other hand, the test parameters can control an AUTOTEST in such a way that the test results do not give errors from either model-specific features or from local GSM channel conflicts.

Select then press ENTER

MS TYPE

▲ BLUE MOBILE
   GREEN MOBILE
   GSM MOBILE
   MOBILE BIG
   MOBILE SMALL
   MOD-3941 CABLE
   PCN MOBILE ANT-
▼ **PCS MOB-COUPLER**

(DELETE) (INSERT) (MODIFY)

(DELETE) *deletes the marked record from the list.*
(INSERT) *allows you to create a new record.*
(MODIFY) *allows you to edit the marked record.*

⟸
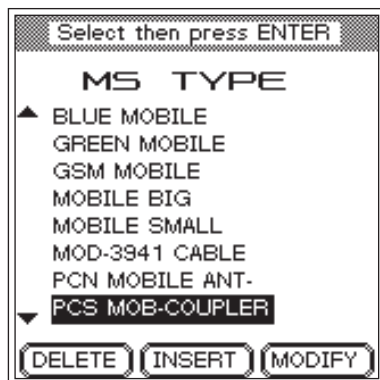
(AUTOTEST) + (CONFIG)

☞   The *MS TYPE* menu only shows entries for which test parameter records have been created.

Entry of the test parameters involves only a few steps, described on the following pages:

● **Assigning a name to the record**
● **Selecting the radio system and the connection type**
● **Selecting the required AUTOTEST**
● **Entering the channel numbers and the compensation values for RF pre-attenuation**

As usual, the (ESCAPE) key returns you to the previous menu while you are entering the test parameters.

☞   Please note that the test parameters are valid only for the type of mobile phone for which they were entered. Models which vary only in their construction (for example a different battery pack) may need a new set of test parameters to be created. This is particularly true for wireless connections with the Universal Antenna Coupler.

1. Assigning a name to a record

```
 ┌─────────────────────────────┐
 │░░░Press NEXT if ready░░░│
 │ Assign Name:                │
 │ ┌─────────────────────────┐ │
 │ │    BLUE MOBILE          │ │
 │ └─────────────────────────┘ │
 │ User advice:                │
 │    PULL ANTENNA-            │
 │    INSERT TESTSIM-          │
 │    SWITCH ON                │
 │                             │
 │               ┌────────┐    │
 │               │  NEXT  │    │
 │               └────────┘    │
 └─────────────────────────────┘
```

⇦

[AUTOTEST] + (CONFIG) + (INSERT)

All the test parameters are stored in a single record, which should be provided with a meaningful name (the type of mobile phone for which the parameters are valid). The name subsequently appears in alphabetical order in the *MS TYPE* menu where it serves to directly start model-specific AUTOTESTs.

In addition, you can enter a longer text which is subsequently displayed immediately before the AUTOTEST is started (for instance user information or advice which is important for correct execution of the test).

One line is available for the name of the record (shown at the top) and up to four lines are available for user information (shown at the bottom).

If other persons subsequently run AUTOTESTs, you should always provide detailed information. Unclear or incomplete information can lead to an inappropriate AUTOTEST being started. If, for instance, the connection type is not clear without additional information, you should indicate the correct connection type, and it is best to do this in the record name.

It should be noted that battery packs of different thicknesses for mobile phones can affect the results. Depending on the model, these can cause considerable fluctuations in the measurements if the Universal Antenna Coupler is used.

1 Use the cursor keys to select the required input line.
2 Enter the text letter by letter (digits are also allowed) using the keys of the numeric keypad. Automatic text entry also applies here (refer to page 2-6).
3 Press [ENTER] to confirm the text you have entered.
4 Use the cursor keys to move to the next input line and enter text or proceed by pressing (NEXT).

2. Selecting the radio system

```
┌──────────────────────────────┐
│▓▓▓ Press NEXT if ready ▓▓▓▓│
│ BLUE MOBILE                  │
│ Assign system:               │
│ ┃✓ 900                    ┃│
│    1800 (PCN)                │
│    1900 (PCS)                │
│    900 / 1800                │
│    900 / 1900                │
│    900 / 1800 / 1900         │
│ Assign connection:           │
│  ✓ CABLE                     │
│    ANTENNA                   │
│    COUPLER        ┌─NEXT─┐   │
└──────────────────────────────┘
```
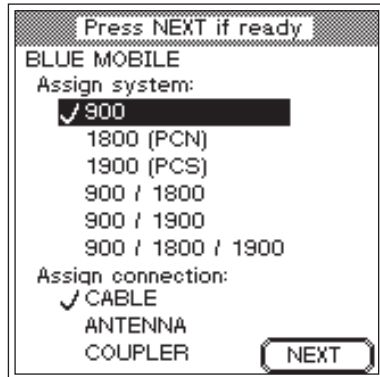
⟸　[AUTOTEST] + (CONFIG) + (INSERT) + (NEXT)

Select the radio system used by the mobile phone.

1️⃣　Use the cursor keys to select the required system.
2️⃣　Press [ENTER] to confirm your selection.

3. Selecting the connection type

```
┌──────────────────────────────┐
│▓▓▓ Press NEXT if ready ▓▓▓▓│
│ BLUE MOBILE                  │
│ Assign system:               │
│ ┃✓ 900                    ┃│
│    1800 (PCN)                │
│    1900 (PCS)                │
│    900 / 1800                │
│    900 / 1900                │
│    900 / 1800 / 1900         │
│ Assign connection:           │
│  ✓ CABLE                     │
│    ANTENNA                   │
│    COUPLER        ┌─NEXT─┐   │
└──────────────────────────────┘
```

⟸　[AUTOTEST] + (CONFIG) + (INSERT) + (NEXT)

Select the type of connection to be used when the
mobile phone is subsequently tested. Refer to page
2-16ff for information on choosing the right connection.

1️⃣　Use the cursor keys to select the required connection.
2️⃣　Press [ENTER] to confirm your selection.
3️⃣　Press (NEXT) to proceed.

3-15

4. Selecting the AUTOTEST

```
  Press NEXT if ready
BLUE MOBILE
900
CABLE

Assign Autotest:
900 Standard
GSM900



              [ NEXT ]
```

At the bottom of this menu only those AUTOTESTs are listed which match the test parameters listed at the top of the display.
A Willtek 4107, for example, has at least six AUTOTESTs stored (one standard AUTOTEST for each radio system). Since, however, the "radio system" parameter for the test is in this case 900, the standard AUTOTESTS for the other radio systems do not appear in the list. In our example, however, a further (user-defined) AUTOTEST has passed the filter.

[AUTOTEST] + [CONFIG] + [INSERT] + 2 x [NEXT]

The top part of this menu shows a summary of the test parameters already set. This is important because the bottom part of the menu does not simply list all the AUTOTESTs stored in your Willtek 4100, but rather lists only those which match the parameters for the *radio system* and the *connection*. These two test parameters filter out the matching AUTOTESTs from those which are stored. The following section provides information on the standard AUTOTESTs available ex works. You will have to find the information on the tests and measurements performed by a user-defined AUTOTEST yourself.

1 Use the cursor keys to select the required AUTOTEST which will then be started when the mobile phone is tested.

2 Press [NEXT] to proceed.

■ At least one AUTOTEST

If the list does not display the AUTOTEST you are expecting, you should first check the two test parameters. The standard AUTOTESTs available ex works (one for each radio system) permit all three possible variants for the *connection* test parameter. For this reason, the list always shows at least the standard AUTOTEST which matches the radio system test parameter (e.g. *GSM Standard*). The word *Standard* always follows the radio system in the names of standard AUTOTESTs.

Background: AUTOTEST

Any Willtek 4100 can store and run two variants of an
AUTOTEST:

- Standard AUTOTESTs (installed at the factory)
- User-defined AUTOTESTs (using the Utility Software option)

■ Standard AUTOTESTs

To make the correct choice in selecting AUTOTESTs,
you need to know what tests and measurements are
carried out during the routine. The table below provides
information on all the standard AUTOTESTs
(depending on the radio system). Please note the effect
of the connection type.

	Applies only for standard AUTOTESTs		
Test/measurement	**Wireless**		**Cable**
	Antenna	**Coupler**	
1 RF output power		✓	✓
2 Bit error ratio (BER)			✓
3 Frame erasure ratio (FER)			✓
4 Phase error (RMS/peak)	✓	✓	✓
5 Frequency error	✓	✓	✓
6 RX level		✓	✓
7 RX quality			✓
8 Power-time template		✓	✓
9 IMSI/IMEI	✓	✓	✓
10 Antenna	✓	✓	
11 Keypad	✓	✓	✓
12 Call to/from mobile phone	✓	✓	✓
13 Connection release	✓	✓	✓
14 Audio loopback	✓	✓	✓

Depending on the connection type, certain tests are not
carried out, either because they are not possible (antenna
test for a cable-based connection) or because the result
would be unreliable due to external influences.

PASS or FAIL

With standard AUTOTESTs, correct FAIL evaluation requires the GSM limits to be increased by the measurement tolerances caused by physical phenomena. This method is in common practice and means that a mobile phone which lies just outside the GSM limits will be passed. At the same time, it is not possible for a fully functional mobile phone to be failed.

In all standard AUTOTESTs, *PASS/FAIL* evaluation of the test results is based on the limits prescribed by ETSI (European Telecommunications Standards Institute) in its official "GSM Recommendations". If, however, measurement tolerances are disregarded, it is possible that a mobile phone which lies just inside the limits may be failed incorrectly. To prevent this from happening, standard AUTOTESTs use slightly larger tolerance windows (GSM limits + measurement tolerance) during evaluation.

Measurement	Added Measurement Tolerances	
	GSM900/E-GSM	GSM1800/1900
RF Level	±2.0 dB	±2.0 dB
Peak Vector	±1.5 °	±2.5 °
RMS Vector	±1.5 °	±2.5 °
Frequency offset	±25 Hz	±50 Hz
Burst length	±0 μs	±0 μs
RX Sens	±2.0 dB	±2.0 dB

User-defined AUTOTESTs can allow for design-specific features of mobile phones and thus make highly reliable PASS/FAIL decisions.

■ **User-defined AUTOTESTs**

The Utility Software (option `897 110`) allows you to create user-defined AUTOTESTs and load them into the Willtek 4100 (see the User Guide for the 4100 Utility Software). Here you can modify the limits governing *PASS/FAIL* evaluation and the number and order of individual measurements. So-called "question boxes" allow queries or instructions to be directed at the user at any time during the execution of the test. The user must then react to the question box (by pressing a softkey) before the AUTOTEST continues.

A Willtek 4100 is able to store up to 20 user-defined AUTOTESTs.

5. Channel selection

```
┌─────────────────────────────────┐
│░░░░░░░ Press OK if ready ░░░░░░░░│
│                                 │
│ BLUE MOBILE                     │
│ 900                             │
│ CABLE                           │
│ 900 Standard                    │
│                                 │
│ Assign pre attenuation (db):    │
│          CHAN    RX     TX      │
│ BCCH     0063   003.0  003.2    │
│ TCH A    0003   004.0  002.9    │
│ TCH B    0027   003.0  003.6    │
│ TCH C    0123   004.0 ▉002.4▉   │
│                    ┌──────┐     │
│                    │  OK  │     │
│                    └──────┘     │
└─────────────────────────────────┘
```

⬅
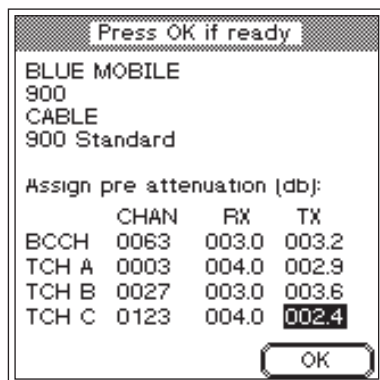
[AUTOTEST] + (CONFIG) + (INSERT) + 3 x (NEXT)

In this menu, you enter the numbers of the channels which your Willtek 4100 will subsequently use to test the mobile phone. One signaling channel (BCCH) and three voice channels (TCH) are tested.

1️⃣ Use the cursor keys to select the line you require in the *CHAN* column (*BCCH, TCH A, TCH B*, or *TCH C*).

2️⃣ Enter the channel number. Make sure that you do not enter the same channel number twice.

Permissible channel numbers (BCCH and TCH)	
GSM	0001 through 0124
E-GSM	0000 and 0975 through 1023
GSM-R	0955 through 0974
GSM 1800 (PCN)	0512 through 0885 (even numbers only)
GSM 1900 (PCS)	0512 through 0810 (odd numbers only)

Low – Middle – High
To ensure that frequency-depen-dent defects are not hidden, it is advisable to choose three TCH numbers which are evenly spread out across the frequency band.

Multiband only
If, when selecting the radio system, you have already selected a multiband system (dual or triple band), the above menu will be shown two or three times for the entries for each of the bands. (NEXT) *takes you to the next band. When you reach the last band, press the* (OK) *softkey to confirm all the entries you have made and pass the parameters to the tester.*

3️⃣ Press [ENTER] to confirm your input. Invalid channel numbers are detected and rejected.

4️⃣ Select the next channel and repeat the procedure. Do not leave the menu when you have finished, since the compensation values still have to be entered.

☞ **BCCH channel number:** to avoid malfunctions (particularly with wireless connection), do not use the signaling channels of nearby base stations.

6. Entering compensation values

```
┌─────────────────────────────────┐
│░░░░░░░░░Press OK if ready░░░░░░░░│
│                                 │
│BLUE MOBILE                      │
│900                              │
│CABLE                            │
│900 Standard                     │
│                                 │
│Assign pre attenuation [db]:     │
│                                 │
│          CHAN    RX     TX       │
│BCCH      0063   003.0  003.2     │
│TCH A     0003   004.0  002.9     │
│TCH B     0027   003.0  003.6     │
│TCH C     0123   004.0 │002.4│    │
│                    ┌─────────┐   │
│                    │   OK    │   │
│                    └─────────┘   │
└─────────────────────────────────┘
```

Are you using original Willtek accessories for a cable-based connection? Then you can simply accept the factory settings for the compensation values.

If the cursor is in one of the columns RX or TX, the value at the current cursor position can be copied to all the fields below that field using (COPY). The (COPY) key only appears if this method of rapidly entering identical values is feasible.

⚠ *Incorrect compensation values (which deviate from the actual attenuation values) distort those test results which are based on the value for the RF signal level.*

⇦ `[AUTOTEST]` + `(CONFIG)` + `(INSERT)` + 3 x `(NEXT)`

The last parameters you need to enter are the values used to compensate for RF signal attenuation. To allow correct RF level measurements at different frequencies, this pre-attenuation can be compensated for separately on the RX and TX signal paths for each channel (refer to the section on "Background" for details).

1⃞ Use the cursor keys to move to the required input field (*RX* or *TX*).

2⃞ Use the number keys to enter the overall attenuation of the RF signal in decibels. When you start entering a value, the softkey (OK) is assigned the new function (DP) (for entering a decimal point).

3⃞ Press `[ENTER]` to confirm your entry or use the (COPY) key.

4⃞ Select the next field and repeat the procedure

5⃞ Press (OK) to finish entering the test parameters. The record is saved under the specified name. The *MS TYPE* menu then appears in the display. Now you can create another record for a different model of mobile phone.

Background: signal attenuation

If a test unit is connected to the Willtek 4100, the connection (cable, RF adapter or linear distance between the antennas) will attenuate the RF signal. This means that the mobile phone receives a signal that is reduced by this attenuation, and the tester is unable to measure the phone's actual output power. False readings such as these can be avoided by mathematically compensating for signal attenuation, provided the attenuation value is known.

■ **Effect of the connection type**

Universal Antenna Coupler The test conditions can be calculated to a sufficient degree of accuracy to allow a meaningful compensation. However, since the attenuation of signals to and from the mobile and the coupler (signal attenuation) is frequency-dependent, you must take the receive and transmit paths into account. This is because GSM radio systems transmit and receive in different frequency bands (refer also to page 6-2). The signal attenuation values can therefore fluctuate considerably between the transmit and receive directions. Compensation allows you to take account of this by entering separate values for the RX and TX paths.

The RF signal paths RX and TX always refer to the mobile phone (rather than the tester):

RX   Receive path of the mobile phone (corresponds to the transmit path of the tester).

TX   Transmit path of the mobile phone (corresponds to the receive path of the tester).

Cable Compensation is set to an optimum value for cable-based connection. This type of connection is not frequency-dependent, so that it is not necessary to distinguish between the receive and send paths of the RF signal (RX/TX). The same compensation value is valid for both paths.

Antenna Compensation is meaningless for a simple antenna connection. External influences have such a wide effect on RF signal attenuation that compensation does not improve the accuracy of measurements.

The Universal Antenna Coupler can be used with other test equipment and also for analog phones.

Precautions are necessary to avoid interference, and the test equipment needs to have an RF power offset facility of at least 15 dB for displayed values to be valid after correction.

Deviations of up to 20 dB
Measurements performed in the Willtek laboratories have shown that the coupling attenuation of the Universal Antenna Coupler depends to a large degree on the model of the mobile phone (deviations of up to 20 dB). Battery packs of different thicknesses and the degree to which the antenna is extended have a significant effect on the coupling attenuation value. For this reason, it is impossible to provide a compensation value which is valid for all types of phones, battery and antenna combinations.

Determining compensation values

Since simple antenna connection is of no relevance here, we only need to consider compensation values for the remaining two connection types. If you are using a cable-based connection, it is very simple to determine the compensation values.

■ Cable-based connection

In this case, it is sufficient to enter a fixed compensation value in the RX and TX entry fields:

1.5   applies for GSM/E-GSM
2.0   applies for PCN (DCS1800)/PCS (DCS1900)

Values are identical for the RX and TX signal paths, since a cable-based connection is not frequency-dependent. Please note that these values only apply if you are using Willtek original accessories (cable, RF adapter).

■ Universal Antenna Coupler

Fortunately, you do not need an RF signal generator and monitoring decoder to derive the compensation values for the coupler. In practice, a Willtek 4100 and a correctly functioning mobile phone are sufficient for the job.

1. Secure the mobile phone in the clamp on the Universal Antenna Coupler.
2. Create a record for the mobile phone with appropriate test parameters. For the connection method, select *COUPLER*, choose the standard AUTOTEST listed and enter the value 0 in all the entry fields for the RX and TX compensation values.
3. Start an AUTOTEST using the record you have just created and then print the test log. If *FAIL* comments appear, this is due to the 0 dB compensation values and should be disregarded.

3-22

Measurements

```
        Traffic channel 3
        Power level 9                                      (25dBm)

        Call from Mobile        PASS
        Dialled number          PASS      1234567890       (1234567890)
        Power Time template     PASS
A1 ──── TX power                PASS        22.1 dBm       (20.0 - 30.0 dBm)
        RMS phase               PASS        3.63 deg       (0.00 - 7.50 deg)
        Peak phase              PASS        9.68 deg       (0.00 - 22.50 deg)
        Freq. error             PASS          12 Hz        (-115 - 115 Hz)
        Burst length            PASS         559 us        ( 543 - 563 us)
A2 ──── RX level                PASS          26           (  25 - 35)
        RX quality              PASS           0           (   0 - 0)
        Mobile release          PASS
        Broadcast channel 63
        Traffic channel 27
        Power level 5                                      (33dBm)

        Call from Basestation   PASS
        RF output -80.0 dBm
        Power Time template     PASS
B1 ──── TX power                PASS        29.4 dBm       (28.0 - 38.0 dBm)
        RMS phase               PASS        3.63 deg       (0.00 - 7.50 deg)
        Peak phase              PASS        9.68 deg       (0.00 - 22.50 deg)
        Freq. error             PASS          12 Hz        (-115 - 115 Hz)
        Burst length            PASS         559 us        ( 543 - 563 us)
B2 ──── RX level                PASS          25           (  25 - 35)
        RX quality              PASS           0           (   0 - 0)
        RF output -96.0 dBm
        BER                     PASS        0.00 %         (0.00 - 0.30 %)
        RF output -102.0 dBm
        BER                     PASS        0.00 %         (0.00 - 1.50 %)
        FER                     PASS        0.08 %         (0.00 - 0.10 %)
        RF output -80.0 dBm
        Power level 14                                     (15dBm)
        Traffic channel 123
C1 ──── TX power                PASS        12.6 dBm       (10.0 - 20.0 dBm)
        RMS phase               PASS        2.58 deg       (0.00 - 7.50 deg)
        Peak phase              PASS        8.70 deg       (0.00 - 22.50 deg)
        Freq. error             PASS         -52 Hz        (-115 - 115 Hz)
        AF loop                 PASS
C2 ──── RX level                PASS          27           (  25 - 35)
        Basestation release     PASS
```

*Depending on the radio system and the type of connection, it is possible that the log will differ from the example shown on the right (GSM). The only important values are the **TX power** and **RX level** lines which appear in the log once for each traffic channel.*
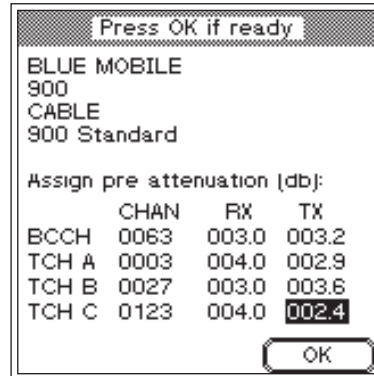
```
┌─────────────────────────┐
│░░░Press OK if ready░░░░░░│
├─────────────────────────┤
│ BLUE MOBILE             │
│ 900                     │
│ CABLE                   │
│ 900 Standard            │
│                         │
│ Assign pre attenuation [db]: │
│                         │
│          CHAN   RX    TX │
│ BCCH    0063  003.0 003.2│
│ TCH A   0003  004.0 002.9│
│ TCH B   0027  003.0 003.6│
│ TCH C   0123  004.0 [002.4]│
│                         │
│            ( OK )        │
└─────────────────────────┘
```

④ In your log, identify the six lines marked in the extract from the sample log shown above and make a note of the measurements (e.g. A1 = 22.1) and the corresponding TCH channel number.

⑤ Use the difference table below to derive the compensation values. Replace the values A1 through C2 with the relevant measurements. The table is structured in the same way as the menu in which you enter the compensation values. All you have to do is to enter the results in the corresponding fields.
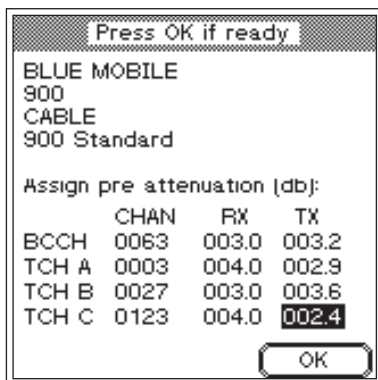
	CHAN	RX	TX	
		GSM/PCN/PCS	GSM 900 only	PCN/PCS
BCCH				
TCH A		30 – A2	25 – A1	12 – A1
TCH B		30 – B2	33 – B1	20 – B1
TCH C		30 – C2	15 – C1	2 – C1

```
  ┌─────────────────────────────┐
  │░░░░░Press OK if ready░░░░░░░│
  │ BLUE MOBILE                 │
  │ 900                         │
  │ CABLE                       │
  │ 900 Standard                │
  │                             │
  │ Assign pre attenuation [db]:│
  │                             │
  │         CHAN   RX    TX     │
  │ BCCH    0063  003.0 003.2   │
  │ TCH A   0003  004.0 002.9   │
  │ TCH B   0027  003.0 003.6   │
  │ TCH C   0123  004.0 ┌─────┐ │
  │                     │002.4│ │
  │                     └─────┘ │
  │              ┌─────────┐    │
  │              │   OK    │    │
  │              └─────────┘    │
  └─────────────────────────────┘
```

For the BCCH signaling channel, you should use the values of the nearest TCH channel (this approximation is permissible since no RF measurements are carried out on the BCCH channel).

6 In the *MS TYPE* menu, select the appropriate record for the mobile phone and correct the compensation values there. Then save the record by pressing (OK).

⇐   [AUTOTEST] + (CONFIG) + (MODIFY) + 3 x (NEXT)

Copying records

The "4X00 Data Exchange" program allows you to copy all MS TYPE records and AUTOTESTs to a different Willtek 4100 (see also page 6-14). Alternatively, you can save a copy of the records on your PC's hard disk, so that you can revert to this backup in the event of data loss.

⚠ During the copy operation, all MS TYPE records and AUTOTESTs on the target tester will be overwritten!

4X00 Data Exchange (de4X00.exe) is provided on the accompanying CD. The current version is available on the Internet:

http://www.willtek.com

4

FAULT FIND

Overview
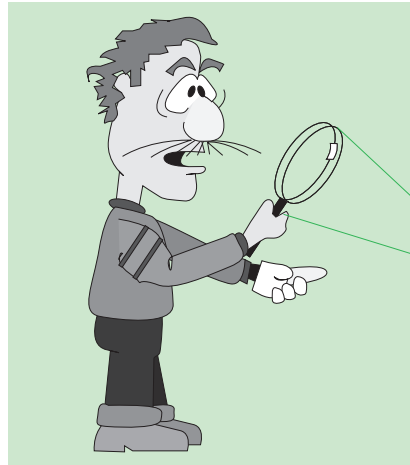
In FAULT FIND mode a Willtek 4100 shows its sophisticated test capability; but correct interpretation of the test results and measurements does demand a certain amount of expertise with GSM and measurement techniques.

In FAULT FIND mode you have access to all the tests that a Willtek 4100 is capable of performing. This includes those tests which are run automatically in AUTOTEST mode. You can also add further tests, and numerically displayed measurements help you to selectively identify important quality parameters of a mobile phone.

The mode for experts

In FAULT FIND mode as opposed to AUTOTEST mode there is no automatic *PASSED/FAILED* evaluation of the test results. That means that FAULT FIND tests are more suitable for experts who want to pinpoint the source of faults on the basis of individual test results and measurements.

☞ The FAULT FIND mode is not available for the Willtek 4107L model.

Accessing FAULT FIND mode

Regardless of which menu is currently open, pressing the ⌑FAULT FIND⌑ key calls up the first menu of the FAULT FIND mode (provided that the tester is passive and is not maintaining a connection to a mobile phone). Which menu is the first depends on which model in the Willtek 4100 series you have (see below).

Willtek 4107   Willtek 4107S

```
┌──────────────────────┐    ┌──────────────────────┐
│ Select then press ENTER│   │ Select then press ENTER│
│                        │   │                        │
│  SYSTEM               │    │  SELECT  MODE         │
│  SELECT               │    │                        │
│                        │   │                        │
│ ┌────────────┐         │   │    ✓FAULT FIND        │
│ │✓900        │         │   │   ┌──────────┐        │
│ └────────────┘         │   │   │ ASYNCHRON│        │
│   1800 (PCN)           │   │   └──────────┘        │
│   1900 (PCS)           │   │                        │
│   900 / 1800           │   │                        │
│   900 / 1900           │   │                        │
│   900 / 1800 / 1900    │   │                        │
│                        │   │                        │
└──────────────────────┘    └──────────────────────┘
```
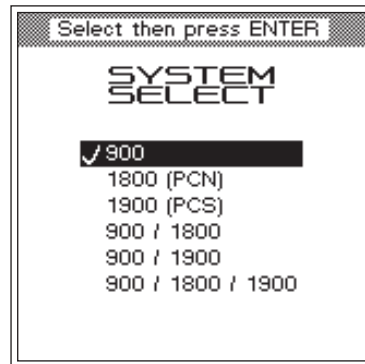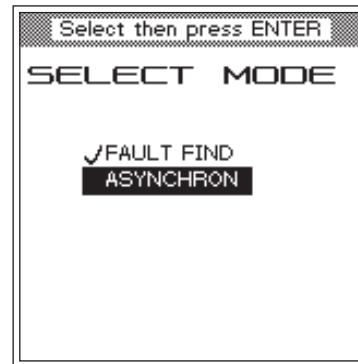
■ **Access with the Willtek 4107S**

In the Willtek 4107S only, the additional *SELECT MODE* menu is used to access FAULT FIND mode:

Use the cursor keys to select the entry *FAULT FIND* and confirm your selection with ⌑ENTER⌑.

ASYNCHRON: see Chapter 5

FAULT FIND test preparation

Test preparation in FAULT FIND mode involves a maximum of five actions:

● selecting the radio system

● selecting channels/RF power

● compensating for signal attenuation

● installing the test SIM (only if necessary)

● Connecting the mobile phone

```
┌─────────────────────────────┐
│ Select then press ENTER ▓   │
│                             │
│      SYSTEM                 │
│      SELECT                 │
│                             │
│  ┌─────────────────────┐    │
│  │ √ 900               │    │
│  └─────────────────────┘    │
│    1800 (PCN)               │
│    1900 (PCS)               │
│    900 / 1800               │
│    900 / 1900               │
│    900 / 1800 / 1900        │
│                             │
└─────────────────────────────┘
```
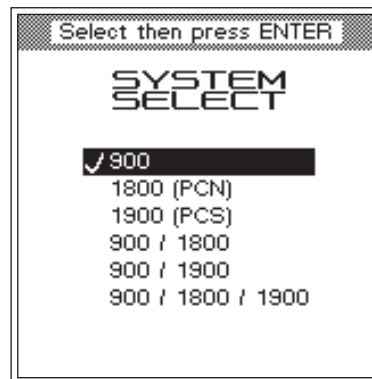
⇦ Any menu + [FAULT FIND]

Selecting the radio system

Willtek 4107 and WAVETEK 4107S are able to carry out tests on mobile phones using different GSM radio systems. Therefore, for these models only, test preparation starts with the selection of the radio system.

1️⃣ Position the cursor on the radio network to which the mobile phone belongs. The menu lists the generic radio network names, the radio systems. The actual names of the radio networks vary from country to country and generally have nothing at all to do with the generic names.

2️⃣ Press [ENTER] to confirm your selection. When you do so, the *FAULT FIND* menu for selecting the test channels and the RF power is opened.

```
╔═══════════════════════════════╗
║░░░░░░░░░░░ FAULT FIND ░░░░░░░░░║
║                               ║
║ BCCH channel            0063  ║
║ TCH channel             0027  ║
║ BS Power Level (dBm)   │-080│ ║
║ MS Power Level 25dBm     09   ║
║                               ║
║ Pre attenuation (dB) RX  01.5 ║
║ Pre attenuation (dB) TX  01.5 ║
║                               ║
║ Before starting:              ║
║ Insert test SIM.              ║
║                               ║
║                               ║
║ (MS CALL)          (BS CALL)  ║
╚═══════════════════════════════╝
```

FAULT FIND menu when testing single-band mobile phones.

```
╔═══════════════════════════════╗
║░░░░░░░░░░░ FAULT FIND ░░░░░░░░░║
║                               ║
║ BCCH channel            0063  ║
║ TCH channel             0528  ║
║ BS Power Level (dBm)    -080  ║
║ GSM 900 band                  ║
║ MS Power Level 25dBm   │ 09 │ ║
║ Pre attenuation (dB) RX  01.5 ║
║ Pre attenuation (dB) TX  01.5 ║
║                               ║
║ GSM 1800/1900 band            ║
║ MS Power Level 24dBm     03   ║
║ Pre attenuation (dB) RX  02.0 ║
║ Pre attenuation (dB) TX  02.0 ║
║ (MS CALL)          (BS CALL)  ║
╚═══════════════════════════════╝
```

FAULT FIND menu when testing dual-band mobile phones.

■ **Special considerations for dual-band systems**

When single-band mobile phones are being tested, the Willtek 4107(S) also displays the *FAULT FIND* menu in the form shown on the left. The meanings of the fields there are described on the following pages.
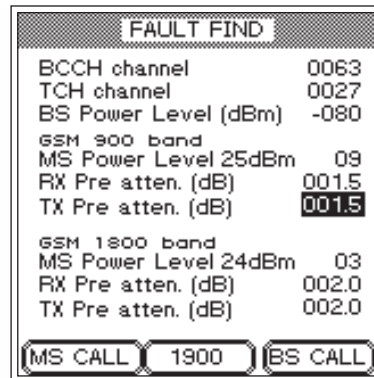
When dual-band mobile phones are being tested, the *FAULT FIND* menu requires the same entries as for single-band systems, with the exception that certain entries need to be made twice, once for each band (see below).

☞ In the descriptions as of this page, the dual-band systems will no longer be mentioned separately, since all the descriptions also apply fully to these systems.

Separate entry fields for each band

As soon as a dual-band system (GSM 900+1800 or GSM 900+1900) has been set in the Willtek 4107(S), the *FAULT FIND* menu assumes the form shown on the bottom left of this page. The *MS Power Level* and *Pre attenuation (RX/TX)* fields are available separately for each band. In the case of *MS Power Level*, this has the advantage that both transmission branches of the mobile phone (900 MHz and 1800/1900 MHz) can be tested independently (for instance one band at power level 9 and the other at level 3).

The separate entry fields for *Pre attenuation*, on the other hand, benefit the measuring precision. Since pre-attenuation (and hence the associated compensation) is frequency-dependent, compensation values which have been matched to each frequency band are of benefit. Please refer to pages 3-20 and 4-9 for more details on pre-attenuation and compensation values.

```
          FAULT FIND
  BCCH channel            0063
  TCH channel             0027
  BS Power Level (dBm)   -080
  GSM 900 band
  MS Power Level 25dBm     09
  RX Pre atten. (dB)     001.5
  TX Pre atten. (dB)     001.5

  GSM 1800 band
  MS Power Level 24dBm     03
  RX Pre atten. (dB)     002.0
  TX Pre atten. (dB)     002.0

  [MS CALL][  1900  ][BS CALL]
```

FAULT FIND menu when testing
multiband mobile phones.

■ Special features of multiband systems

If when selecting the radio system you have chosen a multiband system (GSM 900+1800+1900) the *FAULT FIND* menu first shows the input fields for the lower and middle bands. In a similar way to the menu for the dual-band systems you can first enter the required values for *MS Power Level* and *Pre atten. (RX,TX)* for each band (see page 4-). Then press (1900) to call the menu for the upper band and enter the required values for *MS Power Level* and *Pre atten. (RX,TX)*. The (900/1800) softkey takes you back to the input menu for the lower and middle band.

■ Testing multiband mobile phones

It is basically possible to test a multiband mobile phone on one band after another by simply setting the appropriate radio system on the tester and testing each one individually (see page 4-4). However, it is better to select the appropriate multiband and thus avoid having to keep going back to the *SYSTEM SELECT* menu. But because of the double assignment of channel numbers in the 1800 and 1900 bands you must bear the following in mind:

● It is not possible to change channels between the 900 and 1900 bands or between the 1800 and 1900 bands.

● If the mobile phone does not switch automatically from band to band, this must be done manually.

● To switch the tester from 900/1800 to 1900 you must:

1 Terminate the connection.
2 Switch band using (900/1800) or (1900).
3 Allow the mobile phone to register with the new band.
4 Establish a new connection and continue the test.

☞ The following pages will not mention multiband systems explicitly again, since all information without exception applies to these systems as well.

BCCH and TCH?

BCCH (Broadcast Control Channel): This is the channel via which the base station and the mobile phone exchange fundamental connection data such as the current location of the mobile phone and the network ID.

TCH (Traffic Channel): Channel carrying voice and data traffic.
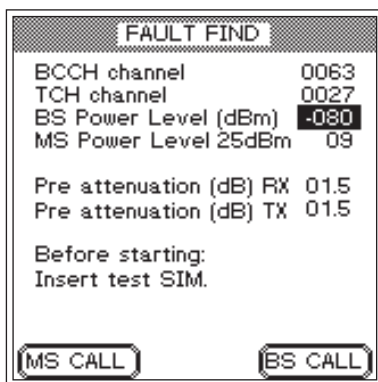
Selecting channels/RF power

This stage in the test preparation phase applies to any Willtek 4100. Here you select:

- the channel on which signaling between tester and mobile phone is to take place (BCCH)

- the channel on which voice traffic between tester and mobile phone is to take place (TCH)

- the RF transmit power of the tester (BS Power Level)

- the RF transmit power of the mobile phone following connection setup (MS Power Level)

```
         FAULT FIND
BCCH channel              0063
TCH channel               0027
BS Power Level (dBm)     -080
MS Power Level 25dBm       09

Pre attenuation (dB) RX  01.5
Pre attenuation (dB) TX  01.5

Before starting:
Insert test SIM.


 MS CALL              BS CALL
```

Any menu + [FAULT FIND]

■ Entering channel numbers

1. Use the cursor keys to select the *BCCH channel* line.
2. Enter the number of the channel which is to be used for signaling.
3. Press [ENTER] to confirm your input.
4. Use the cursor keys to select the *TCH channel* line.
5. Enter the number of the channel which is to be used for voice traffic.
6. Press [ENTER] to confirm your input.

☞ *Invalid input*
causes the message INPUT ERROR to be displayed along with a list of acceptable values.

Permissible channel numbers (BCCH and TCH)	
GSM	0001 through 0124
E-GSM	0000 and 0975 through 1023
GSM-R	0955 through 0974
GSM 1800 (PCN)	0512 through 0885 (even numbers only)
GSM 1900 (PCS)	0512 through 0810 (odd numbers only)

☞ ***Invalid input***
Invalid input causes the message INPUT ERROR to be displayed along with a list of acceptable values.

■ Setting the RF power

1. Use the cursor keys to select the *BS Power Level* line.
2. Enter a value for the RF transmit power (in dBm) at which the Willtek 4100 is to send signals to the mobile phone.

☞ It is best to specify the maximum value to ensure that there are no complications with check-in attempts. You can always change the power again to some other value later.

RF transmit power of tester	
GSM 900/E-GSM	−117 dBm through −45 dBm
GSM 1800 + 1900	−117 dBm through −45 dBm
Observe the specified level range (see chapter 6, Technical data).	

The minus sign is added automatically.

3. Press [ENTER] to confirm your input.
4. Use the cursor keys to select the *MS Power Level* line.
5. Enter the power level (corresponding to an RF transmit power value) at which the mobile phone is to send signals to the Willtek 4100 (see table below).

☞ On handportables (not car phones) the RF output power is limited to a maximum of 33 dBm. Bear this in mind when selecting the power level.

6. Press [ENTER] to confirm your input.

Permissible power levels and corresponding RF power in dBm																							
Power level	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	29	30	31
GSM 900/E-GSM	43	41	39	37	35	33	31	29	27	25	23	21	19	17	15	13	11	9	7	5	–	–	–
GSM 1800 (PCN)	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2	0	–	–	–	–	36	34	32
GSM 1900 (PCS)	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2	0	res	res	res	res	res	33	32

```
                    FAULT FIND
        BCCH channel            0063
        TCH channel             0027
        BS Power Level (dBm)   -080
        MS Power Level 25dBm     09

        Pre attenuation (dB) RX 01.5
        Pre attenuation (dB) TX 01.5

        Before starting:
        Insert test SIM.


        (MS CALL)              (BS CALL)
```

Each radio system has its own permitted compensation value which comes into force automatically the moment you select the system.

☞ *Any compensation configured in FAULT FIND mode has **no** bearing on the readings in AUTOTEST mode. Separately defined compensation values for individual models of mobile phones apply in AUTOTEST mode.*

Compensating for signal attenuation

You will find details on compensating for signal attenuation on page 3-23ff. The information given there for AUTOTESTs also applies to FAULT FIND mode with the following exceptions:

● Only one input field (lines *Pre attenuation*) is available for each of the compensation values (RX and TX).

● The compensation values apply to both the TCH and the BCCH channels (this is valid because no measurements are performed for the BCCH channel).

☞ FAULT FIND mode provides the option of assigning other channel numbers to the TCH channel after the connection has been established. For this reason, when evaluating RF values (e.g. *MS Pwr* and *Rx Level*), make sure that the TCH channel number that is selected, is the one for which the compensation values apply. This restriction does not apply for cable-based connections, which are not frequency-dependent.

■ Compensation values

In the case of a cable-based connection, it is sufficient to specify a fixed compensation value which you enter in the RX and TX entry fields.

1.5   for GSM/E-GSM
2.0   for GSM1800 (PCN)/GSM1900 (PCS)

Values are identical for the RX and TX signal paths, since a cable-based connection is not frequency-dependent. Please note that these values only apply if you are using Willtek original accessories (cable, RF adapter). If this is not the case, or if you are using a wireless connection, other compensation values apply, which have to be determined on an individual basis.

Installing the test SIM

See page 2-14 for installation instructions.

It is not absolutely necessary to insert the test SIM for FAULT FIND mode. Apart from the bit/frame error rate measurements, all tests can also be carried out with the original SIM. There is, however, one important reason for installing the test SIM. With the test SIM installed, the mobile phone forgets all its information about its usual home network and instead considers the GSM network simulated by the tester to be its home network. The advantage of this is that as a rule no problems will be encountered when registering the mobile phone into the test network (see also page 4-13).

☞   Switch the SIMs back over again once testing of the mobile phone has finished!

Connecting the mobile phone

For notes on connection, see page 2-16.

The correct connection type depends on the tests and measurements you want to perform. Cable-based connection provides the greatest testing depth, but requires suitable RF adapters.

☞   Please note that connections using the Universal Antenna Coupler and in particular antenna connections result in RF measurements which are subject to a degree of uncertainty. The table on page 3-17 provides information on the tests and measurements which are affected.

This is what is tested

In FAULT FIND mode you can test the following functions and quality-determining parameters of a mobile phone:

Function	
Registration	**Test 1.0**
Outgoing call from mobile phone (connection setup)	**Test 2.0**
Incoming call (mobile phone)	**Test 3.0**
Response to TCH change	**Test 4.1**
Response to RF power change (tester)	**Test 4.2**
Response to power level change (mobile phone)	**Test 4.3**
Hang-up on mobile phone	**Test 4.4**
Hang-up on tester	**Test 4.5**
Correct transmission of IMEI/IMSI	**Test 6.0**
Correct interpretation of power class	**Test 6.0**
Mobile phone keypad	**Test 2.0**
Acoustic speech test (audio loopback)	**Test 7.0**
Broadcast cell (display text messages)	**Test 8.0**
Parameters	
Mobile phone transmit power	**Test 4.0**
Phase error (RMS and peak)	**Test 4.0**
Frequency error	**Test 4.0**
RX level	**Test 4.0**
RX quality	**Test 4.0**
Power-time template	**Test 4.0**
Bit/frame error rate	**Test 5.0**

Test 1.0: Network identification and registration
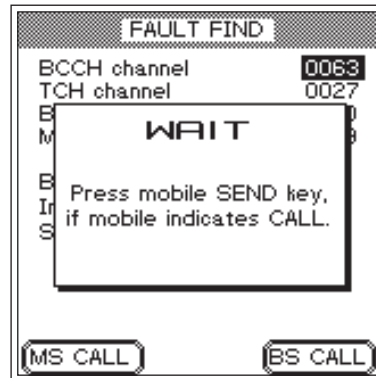
Tester display after (BS CALL) has been pressed.

Selecting the test network

Depending on the type of mobile phone and how it is configured, widely differing actions are required to select the network. It may be that you first have to call functions like "Network selection" and "New search" manually. However you go about it, once the network has been found, the mobile must display the ID of the test network, which is as follows:

MCC:001 MNC:01

The mobile phone may show the ID in a slightly different format (e.g. 1 1 or 00101). The important point is that you do not make the mistake of selecting a public network.

Registering the mobile phone on the GSM radio network simulated by the Willtek 4100 is a fundamental test. If this initial test fails, there is something seriously wrong, and none of the other tests can be performed.

■ Preconditions for testing

● Test preparation completed (see page 4-4) and Willtek 4100 ready for use (*FAULT FIND* menu on display)?

● Mobile phone switched off? If it is on, switch it off now.

■ Test 1.0 step by step

1️⃣ Switch the mobile phone on and (if asked to) enter the PIN (PIN of test SIM = 0000).

2️⃣ It may now be necessary to select the test network, but only on a mobile phone with its original SIM (see the text on the left).

3️⃣ Press the (BS CALL) softkey on the Willtek 4100 (the tester calls the mobile phone and displays a *WAIT* menu) and observe how the mobile phone responds.

■ Test 1.0 result

☺ The mobile phone reports the incoming call visually or audibly. It can only do so if it has correctly identified the test network and registered. Now go on to Test 3.0, step 2, or press ESCAPE to go back to the *FAULT FIND* menu.

☹ There is no visual or audible calling signal. This should not be treated as a fault until all the solutions described in the next section have failed to result in registration. After each failed registration attempt, press ESCAPE to return to the *FAULT FIND* menu.

Problems with registration

Even with an intact mobile phone, there is one problem which may arise – with an original SIM – when you attempt to register onto the test network:

● The mobile phone checks into a public network instead of the test network. This is typically likely to happen under the following conditions:

   – wireless connection between test unit and tester
   – signal from Willtek 4100 competing with strong base stations.

Problem solving

Take the following steps and repeat them after each registration attempt (Test 1.0).

[1] Check that the RF output level of the tester is set to the maximum value.

[2] If the check-in attempt fails with the original SIM, switch off the mobile phone and install the test SIM (see also page 2-14).

[3] If the attempt fails with wireless connection, try again using the cable-based connection via the RF adapter.

Location update?

When you switch on a mobile phone which is fitted with its original SIM, it immediately searches for receivable GSM base stations. Every base station identifies itself with a typical LAC (Location Area Code).

The LAC of the last base station used is stored on the SIM. If the phone again detects the last station it used (by comparing the LACs), it registers automatically. If this is not possible, e.g. after a change of location, a location update is performed. Here the mobile phone checks which base station on the home network it can receive best (home network: the GSM network that was activated on the SIM when the phone was purchased).

The phone stores the LAC of this base station on the SIM and at the same time registers into the home network. The phone acts in the same way if the test SIM is mounted, except that in this case the home network is held to be the GSM radio network simulated by the tester.

Test 2.0: MS CALL connection setup

Test 2.0 checks whether the mobile phone is able to set up a telephone connection to the Willtek 4100. Once the connection has been established, many other functions and parameters of the mobile phone can be checked.
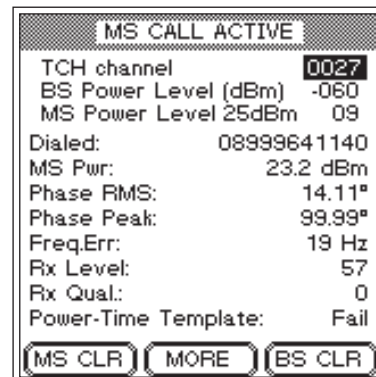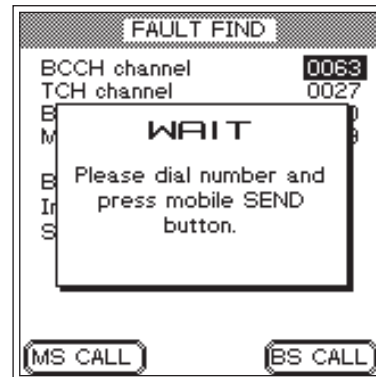
■ Preconditions for testing

● The phone has previously passed Test 1.0 and identified the radio network simulated by the tester.

● There is no existing telephone connection between the phone and the tester (if there is one, release it using Test 4.4 or 4.5).

■ Test 2.0 step by step

⬚1 Press the (MS CALL) softkey on the Willtek 4100 (the tester waits for a call from the mobile phone and displays a *WAIT* menu). The display shows a prompt for action (see picture).

⬚2 Enter any number (up to 20 digits) on the mobile phone. Include all the numbers from 0 through 9 so that you can read these later on the tester's display and identify any defective number keys.

⬚3 On the mobile phone, press the key with the "Send" function to initiate connection setup.

■ Test 2.0 result

☺ Connection setup was successful; the tester's display now shows the **MS CALL ACTIVE** menu (in subsequent tests, **MS** reminds you that connection setup was initiated by MS CALL). Go on to Test 4.0.

☹ Connection setup has failed; the tester's display continues to show the *WAIT* menu. The mobile phone failed the test. Press ESCAPE to return to the *FAULT FIND* menu.

Test 3.0: BS CALL connection setup

Test 3.0 checks whether the mobile phone is able to handle an incoming connection request from the Willtek 4100. Once the connection has been established, many other functions and parameters of the mobile phone can be checked.

■ Preconditions for testing

● The phone has previously passed Test 1.0 and identified the radio network simulated by the tester.

● There is no existing telephone connection between the phone and the tester (if there is one, release it using Test 4.4 or 4.5).
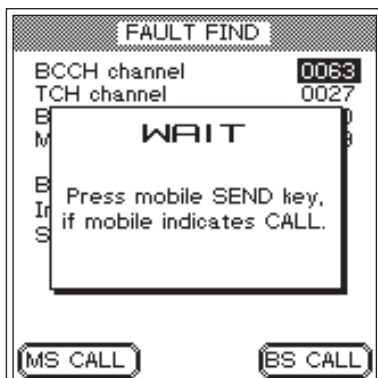
■ Test 3.0 step by step

[1] Press the (BS CALL) softkey on the Willtek 4100 (the tester call the mobile phone and displays a *WAIT* menu).

[2] In response to a visual and/or audible calling signal on the mobile phone, press the "Send" on the mobile phone to answer the call.

■ Test 3.0 result

☺ Connection setup was successful; the tester's display now shows the **BS CALL ACTIVE** menu (in subsequent tests, **BS** reminds you that connection setup was initiated by BS CALL). Go on to Test 4.0.

☹ Connection setup has failed; the tester's display continues to show the *WAIT* menu. The mobile phone failed the test. Press [ESCAPE] to return to the *FAULT FIND* menu.

Test 4.0: Messages and measurements

```
┌─────────────────────────────┐
│▓▓▓▓▓ MS CALL ACTIVE ▓▓▓▓▓│
│ TCH channel          ▌0027▐ │
│ BS Power Level (dBm)  -060  │
│ MS Power Level 25dBm   09   │
│ ┌─────────────────────────┐ │
│ │Dialed:       08999641140│ │
│ │MS Pwr:         23.2 dBm │ │
│ │Phase RMS:        14.11° │ │
│ │Phase Peak:       99.99° │ │
│ │Freq.Err:         19 Hz  │ │
│ │Rx Level:           57   │ │
│ │Rx Qual.:            0   │ │
│ │Power-Time Template: Fail│ │
│ └─────────────────────────┘ │
│ (MS CLR)( MORE )(BS CLR)    │
└─────────────────────────────┘
```

Precision measurements
Always take into account the measuring tolerances of the tester (see chapter 6, Technical data) when evaluating any of the measurements.

On successful connection setup the display shows messages and quality-determining measurements directly on the *CALL ACTIVE* menu. The indications always apply to the test conditions described in the first three lines of the menu. The effect of modifying test conditions (see Tests 4.1 through 4.3) can be seen immediately.

☞　Please note that any RF level measurements are only correct if the signal attenuation has been correctly compensated (see also page 4-9).

■ Preconditions for testing

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

■ Test 4.0, interpreting the indications

Dialed　Number dialed on the mobile phone in the course of Test 2.0 (MS CALL) (nothing is shown if the connection was set up with BS CALL).

☺　The value is the same as the number that was dialed.

☹　If the value is different (digits missing or the same digit repeated several times in succession), there is something wrong with the numeric keypad (oxidized contacts, key bounce).

MS Pwr　RF transmit power of the mobile phone.

☺　The value matches the currently applicable power level of the mobile phone (target value shown on the *MS Power Level* line). Allowable deviations from the target value are indicated in the table (as per GSM standard).

☹ The value is outside the permitted tolerances. This can lead to connection breakdown (value too low) or to interference with other subscribers (value too high). In the event of connection breakdown, press and hold down ⎡BS CLR⎤ until you hear the acknowledgment signal (this takes you back to the *FAULT FIND* menu).

Example

The tester reports a value of 23.2 dBm for MS Pwr. The MS Power Level line shows you the target value (here 25 dBm) and the associated power level (09). According to the table, on power level 9 the test unit is allowed to transmit at 25 dBm ±3 dB. That means that the measured value is within the permitted tolerances.

Power level/RF power/permissible tolerances								
GSM/E-GSM			**GSM 1800 (PCN)**			**GSM 1900 (PCS)**		
0	43 dBm	±2 dB	29	36 dBm	±2 dB	29	res.	–
1	41 dBm	±3 dB	30	34 dBm	±3 dB	30	33 dBm	±2 dB
2	39 dBm	±3 dB	31	32 dBm	±3 dB	31	32 dBm	±3 dB
3	37 dBm	±3 dB	**0**	30 dBm	±3 dB	**0**	30 dBm	±3 dB
4	35 dBm	±3 dB	1	28 dBm	±3 dB	1	28 dBm	±3 dB
5	33 dBm	±3 dB	2	26 dBm	±3 dB	2	26 dBm	±3 dB
6	31 dBm	±3 dB	**3**	24 dBm	±3 dB	**3**	24 dBm	±3 dB
7	29 dBm	±3 dB	4	22 dBm	±3 dB	4	22 dBm	±3 dB
8	27 dBm	±3 dB	5	20 dBm	±3 dB	5	20 dBm	±3 dB
9	25 dBm	±3 dB	6	18 dBm	±3 dB	6	18 dBm	±3 dB
10	23 dBm	±3 dB	7	16 dBm	±3 dB	7	16 dBm	±3 dB
11	21 dBm	±3 dB	8	14 dBm	±3 dB	8	14 dBm	±3 dB
12	19 dBm	±3 dB	9	12 dBm	±4 dB	9	12 dBm	±4 dB
13	17 dBm	±3 dB	10	10 dBm	±4 dB	10	10 dBm	±4 dB
14	15 dBm	±3 dB	11	8 dBm	±4 dB	11	8 dBm	±4 dB
15	13 dBm	±3 dB	12	6 dBm	±4 dB	12	6 dBm	±4 dB
16	11 dBm	±5 dB	13	4 dBm	±4 dB	13	4 dBm	±4 dB
17	9 dBm	±5 dB	14	2 dBm	±5 dB	14	2 dBm	±5 dB
18	7 dBm	±5 dB	15	0 dBm	±5 dB	15	0 dBm	±5 dB
19	5 dBm	±5 dB	–	–	–	–	–	–

☞ **Highlighted values:** When the power level corresponds to the power class of the mobile phone, then the tolerances shall be ±2.0 dB.

Phase RMS, Peak Phase error in GSM burst signal (RMS value left, peak value right). The phase error is a quality indicator for correct adjustment of the modulator.

☺ The phase error is not outside the following limits (GSM standard, irrespective of radio system):
RMS: $\leq 5°$
Peak: $\leq 20°$

☹ The value is over the limits. Typical symptoms: problems with connection setup, problems with maintaining a connection, distortion of the voice signal.

Freq. Err Frequency error of mobile phone RF carrier signal compared to target value.

Permitted frequency error (GSM standard)		
GSM/E-GSM	GSM 1800 (PCN)	GSM 1900 (PCS)
$\leq \pm 90$ Hz	$\leq \pm 180$ Hz	$\leq \pm 180$ Hz

☺ Frequency error is within limits.

☹ Excessive frequency error may lead to interference with other subscribers on adjacent channels or exhibit the same symptoms as an unacceptable phase error.

RX Level Measure of the RF level at which the mobile phone receives the signal from the base station (here the tester). Mobile phones measure the RF receive level at regular intervals and report the measurement to the base station in the form of a code number (0 through 63). The higher the RF level measured, the higher the code number.

It is advisable to check the *Rx Level* code number for a variety of *BS Power Level* settings (high, medium and low value).

```
╔═══════════════════════════════╗
║░░░░░░░ MS CALL ACTIVE ░░░░░░░░░║
║  TCH channel            [0027]║
║  BS Power Level (dBm)   [-060]║
║  MS Power Level 25dBm     09  ║
║  Dialed:          08999641140 ║
║  MS Pwr:             23.2 dBm ║
║  Phase RMS:            14.11° ║
║  Phase Peak:           99.99° ║
║  Freq.Err:             19 Hz  ║
║  Rx Level:             [ 57]  ║
║  Rx Qual.:               0    ║
║  Power-Time Template:   Fail  ║
║ (MS CLR)  ( MORE )  (BS CLR)  ║
╚═══════════════════════════════╝
```
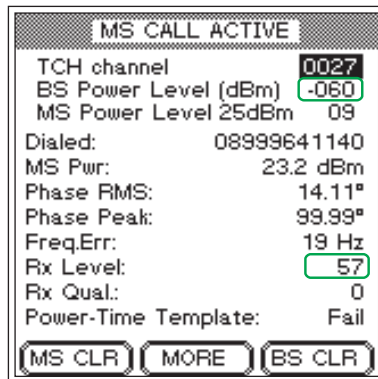
The reported Rx level must match the BS power level.

Equivalent code numbers/RF receive levels (dBm)					
0	< −110	22	−89 to −88	44	−67 to −66
1	−110 to −109	23	−88 to −87	45	−66 to −65
2	−109 to −108	24	−87 to −86	46	−65 to −64
3	−108 to −107	25	−86 to −85	47	−64 to −63
4	−107 to −106	26	−85 to −84	48	−63 to −62
5	−106 to −105	27	−84 to −83	49	−62 to −61
6	−105 to −104	28	−83 to −82	50	−61 to −60
7	−104 to −103	29	−82 to −81	51	−60 to −59
8	−103 to −102	30	−81 to −80	52	−59 to −58
9	−102 to −101	31	−80 to −79	53	−58 to −57
10	−101 to −100	32	−79 to −78	54	−57 to −56
11	−100 to −99	33	−78 to −77	55	−56 to −55
12	−99 to −98	34	−77 to −76	56	−55 to −54
13	−98 to −97	35	−76 to −75	57	−54 to −53
14	−97 to −96	36	−75 to −74	58	−53 to −52
15	−96 to −95	37	−74 to −73	59	−52 to −51
16	−95 to −94	38	−73 to −72	60	−51 to −50
17	−94 to −93	39	−72 to −71	61	−50 to −49
18	−93 to −92	40	−71 to −70	62	−49 to −48
19	−92 to −91	41	−70 to −69	63	> −48
20	−91 to −90	42	−69 to −68	−	−
21	−90 to −89	43	−68 to −67	−	−

☺ Under the GSM standard, the code number shown in the *Rx Level* field should match the RF output level set on the tester (value on *BS Power Level* line – see table for conversion).

☹ The RF receive level derived from the *Rx Level* code number deviates by an unacceptable amount from the target value (*BS Power Level*).

Rx Qual Measure of transmission quality at the current RF receive level. Mobile phones check the bit error rate (BER) of the decoded data at regular intervals and report the measurement to the base station in the form of a code digit (0 through 7). The higher the BER, the higher the code digit.

Equivalent code digits/BERs*			
0	< 0.2 %	1	0.2 % to 0.4 %
2	0.4 % to 0.8 %	3	0.8 % to 1.6 %
4	1.6 % to 3.2 %	5	3.2 % to 6.4 %
6	6.4 % to 12.8 %	7	> 12.8 %
*) BER measured by the mobile phone. Not to be confused with the tester's BER measurement.			

☺ At an RF receive level of −102 dBm the BER reported by the mobile phone must be < 2.44 % (equivalent code digit: 4).

☹ The BER is over the permitted limit. (The greater the overshoot, the greater the resulting distortion of the voice signal. For acoustic confimation run Test 7.0.)

4-20

Power-Time Template Under the GSM standard, the profile of the GSM burst signal over time must fit into a "template" which allocates defined tolerances zones to the signal pattern. A Willtek 4100 checks that the burst does not overshoot the tolerance limits at any point in the template and reports the result as *Pass* or *Fail*.

Pass The burst profile is acceptable.

Fail The burst goes outside the tolerance limits at one or more points. Typical symptom: interference with calls running on the same RF channel but in different timeslots.

Willtek 4107S only: Three symbols indicate the locations where the tolerance zones were exceeded. These symbols (the Burst Edge Failure Indication) can appear on their own or in combination with the other symbols.
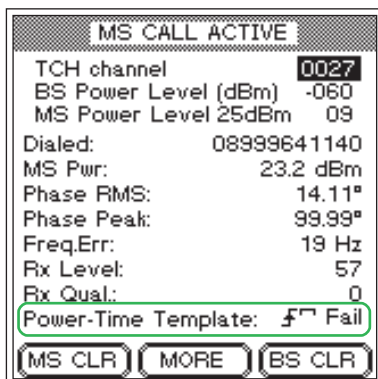
Willtek 4107S only: Symbols indicate the locations where the tolerance zones were exceeded.
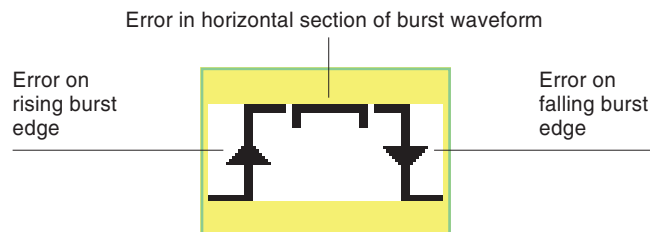
The following diagram illustrates the zones of the power-time template.

Test 4.1: Changing the voice channel

```
┌─────────────────────────────────┐
│▓▓▓▓▓▓▓▓ MS CALL ACTIVE ▓▓▓▓▓▓▓▓│
│ (TCH channel          ▐0027▌)   │
│  BS Power Level (dBm)    -060   │
│  MS Power Level 25dBm     09    │
│ Dialed:           08999641140   │
│ MS Pwr:              23.2 dBm   │
│ Phase RMS:            14.11°    │
│ Phase Peak:          99.99°    │
│ Freq.Err:             19 Hz    │
│ Rx Level:                57    │
│ Rx Qual.:                 0    │
│ Power-Time Template:    Fail   │
│ ┌────────┐┌──────┐┌────────┐  │
│ │ MS CLR ││ MORE ││ BS CLR │  │
│ └────────┘└──────┘└────────┘  │
└─────────────────────────────────┘
```

Multiband mobile phones:

It is not possible to switch talk channels directly between the 900/1800 and 1900 bands. The reason for this is that the channel numbes are assigned twice (see also pae 4-6).

While a telephone connection is in place, a mobile phone must be able to switch to another voice channel (TCH) allocated by the base station (in our case the Willtek 4100).

■ **Preconditions for testing**

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

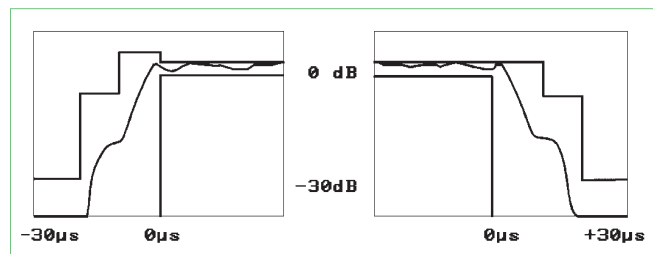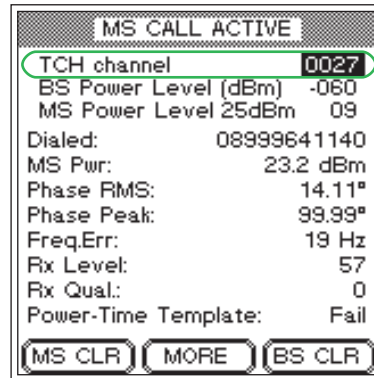● The *BS CALL ACTIVE* or *MS CALL ACTIVE* menu must be visible (to get back to this menu from lower-level menus press ENTER).

■ **Test 4.1 step by step**

1. Use the cursor keys to select the *TCH channel* line.
2. Enter another valid channel number:

Permissible channel numbers (BCCH and TCH)	
GSM	0001 through 0124
E-GSM	0000 and 0975 through 1023
GSM-R	0955 through 0974
GSM 1800 (PCN)	0512 through 0885 (even numbers only)
GSM 1900 (PCS)	0512 through 0810 (odd numbers only)

3. Press ENTER to confirm your input.

■ **Test 4.1 result**

☺ The connection is maintained, the *CALL ACTIVE* menu continues to show acceptable measurements. Repeat the test with a different channel number or run the next test.

☹ The connection breaks down. The tester's display stops showing measurements. The mobile phone has failed the test. Press and hold down BS CLR until you hear the acknowledgment signal (back to the *FAULT FIND* menu).

Test 4.2: Reducing the RF power (from the tester)

```
┌─────────────────────────────┐
│░░░░░░ BS CALL ACTIVE ░░░░░░░│
│ TCH channel          [0027] │
│ BS Power Level (dBm)   -060 │
│  MS Power Level 25dBm    09 │
│ Dialed:                     │
│ MS Pwr:             23.8 dBm │
│ Phase RMS:            10.82° │
│ Phase Peak:           26.94° │
│ Freq.Err:             13 Hz  │
│ Rx Level:                57  │
│ Rx Qual.:                 0  │
│ Power-Time Template:   Fail  │
│ [MS CLR] [ MORE ] [BS CLR]  │
└─────────────────────────────┘
```
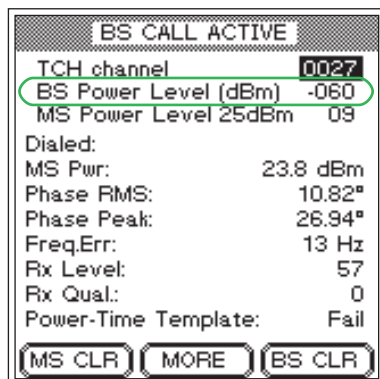
This test simulates harsh reality: the farther you are from the base station, the lower the RF received level by your mobile phone. As required by the GSM specification, a mobile phone should be able to maintain a connection without malfunctioning at a receive level at least as low as about –102 dBm (portables) or –104 dBm (car phones).

■ **Preconditions for testing**

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

● The *BS CALL ACTIVE* or *MS CALL ACTIVE* menu must be visible (to get back to this menu from lower-level menus press ESCAPE).

■ **Test 4.2 step by step**

1 Use the cursor keys to select the *BS Power Level* line.
2 Enter the tester's RF transmit level. According to the GSM standard this should be:
–102 dBm for handportables
–104 dBm for car phones
3 Press ENTER to confirm your input.

■ **Test 4.2 result**

☺ The connection is maintained, the *CALL ACTIVE* menu continues to show acceptable measurements. Repeat the test with a lower RF level or run the next test.

☹ The connection breaks down. The tester's display stops showing measurements. The RF sensitivity of the mobile phone is insufficient. Press and hold down (BS CLR) until you hear the acknowledgment signal (back to the *FAULT FIND* menu). Restart the test (at a higher level, e.g. –90 dBm) and gradually determine the exact value of the RF level at which the connection breaks down.

Test 4.3: Changing power levels

```
┌─────────────────────────────┐
│     BS CALL ACTIVE          │
│  TCH channel          0027  │
│  BS Power Level (dBm)  -060 │
│  MS Power Level 25dBm   09  │
│  Dialed:                    │
│  MS Pwr:         23.8 dBm   │
│  Phase RMS:        10.82°   │
│  Phase Peak:       26.94°   │
│  Freq.Err:         13 Hz    │
│  Rx Level:            57     │
│  Rx Qual.:             0     │
│  Power-Time Template:  Fail │
│  ┌──────┐ ┌──────┐ ┌──────┐ │
│  │MS CLR│ │ MORE │ │BS CLR│ │
│  └──────┘ └──────┘ └──────┘ │
└─────────────────────────────┘
```

Changes in the MS power level should have an immediate impact on the MS Pwr measurement.

While a telephone connection is in place, a mobile phone must be able to switch to another power level allocated to it by the base station (in our case the tester). This helps save battery power when approaching a base station and ensure that the connection is maintained when moving away from a base station.

■ Preconditions for testing

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

● The *BS CALL ACTIVE* or *MS CALL ACTIVE* menu must be visible (to get back to this menu from lower-level menus press ESCAPE).
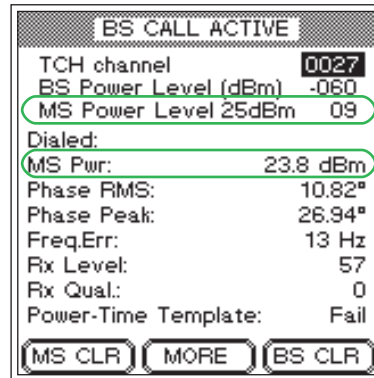
☞ This test will only have correct and precise results when the tester and the mobile phone are connected by cable.

■ Test 4.3 step by step

1 Use the cursor keys to select the *MS Power Level* line.
2 Enter a different power level.
3 Press ENTER to confirm your input.

■ Test 4.3 result

☺ The connection is maintained, the *MS Pwr* measurement matches the selected power level on the *MS Power Level* line. Repeat the test with other power levels or run the next test.

☹ The connection breaks down or the *MS Pwr* measurement is outside the permitted tolerances (see the table on page 4-17). Press and hold down BS CLR until you hear the acknowledgment signal (back to the *FAULT FIND* menu). The mobile phone has failed the test.

Test 4.4: Clear down on the mobile phone

```
┌─────────────────────────────────┐
│░░░░░ MS CALL ACTIVE ░░░░░░░│
│ TCH channel          [0027] │
│ BS Power Level (dBm)  -060  │
│ M┌──────────────────┐ 0     │
│ Dia│      WAIT      │ 0     │
│ MS │                │ m     │
│ Ph │  Press mobile RELEASE │ 8°  │
│ Ph │       button.  │ 8°  │
│ Fr │                │ z    │
│ Rx └──────────────────┘ 7    │
│ Rx Qual..            0      │
│ Power-Time Template:  Fail  │
│ (MS CLR)  (MORE )  (BS CLR) │
└─────────────────────────────────┘
```
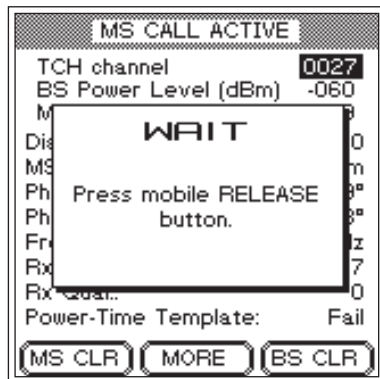
(MS CLR) makes the tester prompt you to press the "Release" button on the mobile phone.

☞ *If this is the last test on the phone and you have installed the test SIM, please do not forget to remove the test SIM once the test is over!*

A telephone connection can be released by either party, either from the mobile phone or from the base station. This test determines whether the connection is released correctly if release is initiated from the mobile phone.

■ Preconditions for testing

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

● The *BS CALL ACTIVE* or *MS CALL ACTIVE* menu must be visible (to get back to this menu from lower-level menus press ⌈ESCAPE⌋).

■ Test 4.4 step by step

1. Press the (MS CLR) softkey. If this softkey is not shown: press (MORE).

2. Press the key which has the "Release" function on the mobile.

3. Observe the tester's display.

■ Test 4.4 result

☺ Following correct connection release, the Willtek 4100 shows the *FAULT FIND* menu again. You can now start setting up a new connection with (MS CALL) or (BS CALL) or go back to the *SYSTEM SELECT* menu by pressing ⌈ESCAPE⌋.

☹ Error releasing connection, e.g. because the "Release" key on the mobile phone is defective. Press and hold down (BS CLR) until you hear the acknowledgment signal (back to the *FAULT FIND* menu), or switch the device off for a short while. The mobile phone has failed the test.

Test 4.5: Clear down on the tester

```
┌─────────────────────────────┐
│▓▓▓▓▓ MS CALL ACTIVE ▓▓▓▓▓▓▓│
│ TCH channel            0027 │
│ BS Power Level (dBm)   -060 │
│ M┌─────────────────────┐    │
│ Di│      WAIT           │  0 │
│ MS│                     │  m │
│ Ph│                     │  ° │
│ Ph│ Release in progress │  ° │
│ Fr│                     │  z │
│ Rx│                     │  7 │
│ Rx└─────────────────────┘  0 │
│ Power-Time Template:   Fail │
│ ┌────────┐┌──────┐┌───────┐ │
│ │ MS CLR ││ MORE ││ BS CLR│ │
│ └────────┘└──────┘└───────┘ │
└─────────────────────────────┘
```

If connection cleardown with (BS CLR) *is completed correctly, the display shows the WAIT information box for only about 4 s.*

☞ *If this is the last test on the phone and you have installed the test SIM, please do not forget to remove the test SIM once the test is over!*

A telephone connection can be released by either party, either from the mobile phone or from the base station. This test determines whether the connection is released correctly if release is initiated from the tester.

■ Preconditions for testing

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

● The *BS CALL ACTIVE* or *MS CALL ACTIVE* menu must be visible (to get back to this menu from lower-level menus press (ESCAPE)).
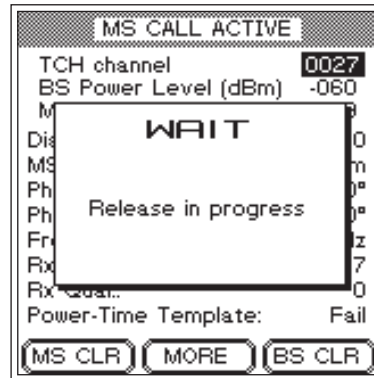
■ Test 4.5 step by step

1. Press the (BS CLR) softkey. If this softkey is not shown: press (MORE).

2. Observe the tester's display.

■ Test 4.5 result

☺ Following correct connection release (duration: max. about 5 seconds), the Willtek 4100 shows the *FAULT FIND* menu again. You can now start setting up a new connection with (MS CALL) or (BS CALL) or go back to the *SYSTEM SELECT* menu by pressing (ESCAPE).

☹ Error releasing connection. If the tester is still showing the *WAIT* menu after about 20 seconds, switch the device off for a short while. The mobile phone has failed the test.

Test 5.0: Measuring the bit and frame error rate

```
┌─────────────────────────────┐
│      BER / FER              │
│                             │
│ BS Power Level (dBm)  -102  │
│                             │
│   BER:        0.10%         │
│                             │
│   FER:        0.03%         │
│                             │
│                             │
│                             │
└─────────────────────────────┘
```

The bit and frame error rate is a measure of the mobile phone's RF sensitivity.

☞ *This test can only be guaranteed to work if the mobile phone is fitted with the test SIM.*

The bit and frame error rate is a measure of the RF sensitivity of a mobile phone. Even at a low RF receive level, mobile phones should continue to offer acceptable voice transmission quality (low BER/FER values).

■ Preconditions for testing

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

● This test cannot be guaranteed to run unless the test SIM has been installed in the mobile phone (for installation see page 2-14).

● The *BS CALL ACTIVE* or *MS CALL ACTIVE* menu must be visible (to get back to this menu from lower-level menus press ESCAPE).
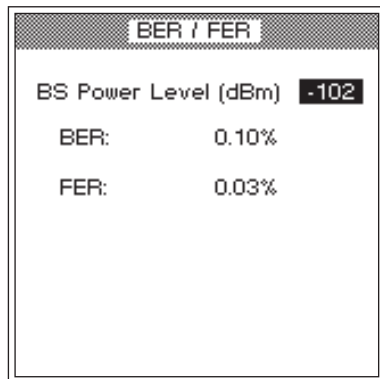
■ Test 5.0 step by step

1. Press the BER softkey. If this softkey is not shown: press MORE .

2. Enter the tester's RF transmit level in the *BS Power Level* field (a delayed reaction from the tester when you start entering the value is normal as a number of signal bursts need to be measured to calculate the error performance). The GSM standard recommends three level settings for this test:
   −100 dBm (all GSM mobile phones)
   −104 dBm for car phones (P > 2 W).
   −102 dBm for handportables (P ≤ 2 W).
   Start with −100 dBm.

3. Press ENTER to confirm your input.

4. The tester's display now shows measurements for BER (bit error rate) and FER (frame error rate). Check that the values are below the permitted limits (the FER value is significant only if the RF transmit level is set to −102 dBm).

Depending on what RF transmit level is set, the following limits apply under the GSM standard:

Permissible limits for BER/FER			
RF level	Phone	BER	FER
−100 dBm	all	0.00 %	−
−104 dBm	P > 2 W	< 2.44 %	−
−102 dBm	P ≤ 2 W	< 2.44 %	0.10 %

5 Enter the second RF transmit level in the *BS Power Level* field, confirm your entry with ENTER and check the measurements.

6 Terminate the test with ESCAPE.

■ Test 5.0 result

☺ The limits are not exceeded.

☹ The limits are exceeded. Typical symptom: the customer complains of poor speech quality or poor data connection when using a modem.

Test 6.0: Checking mobile phone identification

```
┌─────────────────────────────┐
│      ▓▓▓▓ MS Info ▓▓▓▓       │
│  IMSI:      001011234567890  │
│  IMEI:   448896-20-146068-0  │
│  MS Pwr class:               │
│  Rev. Level:        Phase 2  │
│  Ext.Freq.:              NO  │
│  SMS:                   YES  │
│  EFR:                   YES  │
│  A5 Support:              3  │
│ ┌─────────────────────────┐ │
│ │Multiband:     900,1800  │ │
│ │Ext. Protocol:       NO  │ │
│ │MS Pwr class 1:  4 33 dBm│ │
│ │MS Pwr class 2:  1 30 dBm│ │
│ └─────────────────────────┘ │
└─────────────────────────────┘
```

The characteristic information highlighted in the lower part of the display is only shown if the test unit is a dual-band mobile phone. If you are testing a multiband mobile phone, the menu displays a softkey which you can use to call up the identification data of the 1900 band.

The identification data is a mobile phone's "ID card". It provides information about the test unit which is useful for interpreting measurements (Test 4.0) or for general classification purposes (e.g. E-GSM mobile phone or not?).

■ Preconditions for testing

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

● The *BS CALL ACTIVE* or *MS CALL ACTIVE* menu must be visible (to get back to this menu from lower-level menus press ESCAPE).

■ Test 6.0 step by step

1. Press the MS INFO softkey. If this softkey is not shown: press MORE.

2. Check the identification data which is reported (see "Test 6.0 results").

3. Press the ESCAPE key to return to the *CALL ACTIVE* menu and run some other tests there.

■ Test 6.0 results

IMSI International Mobile Subscriber Identity gives important subscriber data which is stored in the SIM. The IMSI displayed comes from the SIM which is currently installed in the mobile phone. The IMSI comprises the following data:

xxx xx xxxxxxxxxx

└─── Subscriber number within the net
└─── Code of home network
└─── Code of home country
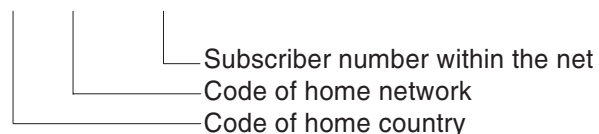
The IMSI of the test SIM is: `001 01 1234567890`

IMEI   International Mobile Equipment Identity is the device identity of the mobile phone. The IMEI comprises the serial number, the manufacturer, the country of manufacture and a code identifying the country in which the mobile phone has been granted type approval.

MS Pwr class RF power class of the mobile phone (code digit and absolute value for the maximum RF power in dBm; This is not displayed when testing dual-band telephones – see below).

RF power classes					
Code digit	1	2	3	4	5
GSM 900/E-GSM	43 dBm	39 dBm	37 dBm	33 dBm	29 dBm
GSM1800 (PCN)	30 dBm	24 dBm	36 dBm	–	–
GSM1900 (PCS)	30 dBm	24 dBm	33 dBm	–	–

Rev. Level   Indicates the GSM revision level of the mobile phone's hardware and software. According to the GSM specification the value should be *Phase 1* or *Phase 2*.

Ext. Freq.   Indicates whether the mobile phone supports the extended channel range (E-GSM): *YES* or *NO*.

SMS   Indicates whether the mobile phone supports the GSM Short Message Service (SMS). *YES* or *NO*.

EFR   Indicates whether the mobile phone supports Enhanced Full Rate mode (improved voice quality): *YES* or *NO* (mobile telephone only supports Full Rate mode).

A5 Support   Code number of the A5 algorithm, stored in the mobile phone.
For data protection reasons, speech and all traffic data are encrypted before transmission and decrypted again at the receiving end. The code number is an integer between 1 and 7.

Dual-band mobile phone only

Multiband   Indicates which frequency ranges the mobile phone supports: *900* or *900E* and *1800* or *1900*.

Ext. Protocol   Indicates the status of the extension bit:
NO = 0, *YES* = 1.

MS Pwr class 1   Power class of the mobile phone for GSM/E-GSM.

MS Pwr class 2   Power class of the mobile phone for GSM 1800/1900.

Test 7.0: Speech testing

```
┌─────────────────────────────┐
│░░░░░░░░░ AUDIO TEST ░░░░░░░░░│
│ ┌─────────────────────────┐ │
│ │BS Power Level (dBm) ▋-060▋│ │
│ │Speech mode          FR  │ │
│ │                   ✓EFR  │ │
│ │                         │ │
│ │   Speak a test message  │ │
│ │       into handset.     │ │
│ │  Wait 1 second for echo.│ │
│ │      Press ESCAPE       │ │
│ │  to terminate Audio Test.│ │
│ └─────────────────────────┘ │
│                             │
└─────────────────────────────┘
```

The speech mode EFR is only displayed if the mobile phone supports this mode (improved voice quality in the event of poor reception).

In speech testing the test signal runs through the entire transmission path from the mobile phone's mouthpiece to the base station (tester) and back to the mobile phone's earpiece. That means that the test is positive only if all the RF and audio signal paths in the mobile phone are intact. You can run this test as an initial function check or for selective testing of the AF signal paths.

■ **Preconditions for testing**

● There must be a valid telephone connection between the mobile phone and the tester, set up in Test 2.0 or 3.0.

● The *BS CALL ACTIVE* or *MS CALL ACTIVE* menu must be visible (to get back to this menu from lower-level menus press ESCAPE).

■ **Test 7.0 step by step**

1 Press the SPEECH softkey (which calls the menu shown on the top left of this page). If this softkey is not shown: press MORE.

2 Enter the BS power level of the tester in the *BS Power Level* field (recommended initial value: –60 dBm).

3 If the voice codec of the mobile phone being tested supports Enhanced Full Rate (*EFR*) mode, this is displayed in addition to the standard Full Rate (*FR*) mode. Only if this is the case is it possible to select the required mode with the cursor keys and confirm your choice with ENTER.

4 Speak a word into the mobile phone's mouthpiece.

5 After a delay of about a second you should hear the word in the mobile phone's earpiece (echo loop).

6 Repeat the speech test as many times as you like. Reduce the *BS power level* of the tester each time. You can also switch between EFR and FR modes during testing.

7   Press the ⌐ESCAPE⌐ key to return to the *CALL ACTIVE* menu and run some other tests there.

    ■ **Test 7.0 result**

☺   Down to approx. –96 dBm, the echo should not be distorted, irrespective of whether EFR or FR mode is selected. At levels below this (approx. –102 dBm), distortions can first be heard in FR mode and if the level is further reduced, distortions will also be heard in EFR mode.

☹   No echo is heard or the echo is distorted at levels significantly above –96 dBm. If the mobile phone does not exhibit any other errors, the fault may be caused by defective audio signal processing (defective microphone or loudspeaker etc.).
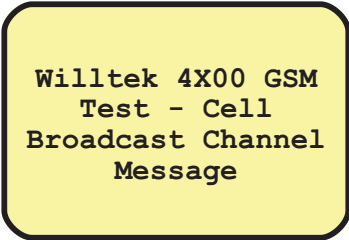
Test 8.0: Cell Broadcast test

In Test 8.0, the Willtek 4100 sends a text message to the mobile phone. If the phone's decoder is in working order, the received text is displayed.

Cell Broadcast?

The Cell Broadcast service is not to be confused with the SMS (Short Message Service). SMS enables individually addressed messages to be sent across the TCH.

Cell Broadcast transmits public information (e.g. traffic reports or match results) on a cell's BCCH. However, the fact that a mobile phone is able to decode SMS texts (see test 6.0) does not automatically mean that it will also support the Cell Broadcast service.

Message Identifier Page = 0

```
Willtek 4X00 GSM
   Test - Cell
Broadcast Channel
    Message
```

■ Preconditions for testing

● The Cell Broadcast test can only be run on test units capable of receiving messages such as these. Unfortunately, a standard procedure for ascertaining this state does not exist. If you cannot find any menu items on your mobile phone entitled Cell Broadcast or Broadcast Call, it is highly likely that the device does not support the service.

● If you succeed in finding an appropriate menu item, switch on the Cell Broadcast function on your mobile phone (if the "page" is to be defined under which messages arrive: Message Identifier Page = 0).

● Switch off your mobile phone.

● Carry out the usual test preparations (see page 4-4). Your choice of TCH channel number is of no significance. Make sure that the Willtek 4100 is displaying the *FAULT FIND* menu (this means that the tester is already broadcasting on the BCCH).

■ Test 8.0 step by step

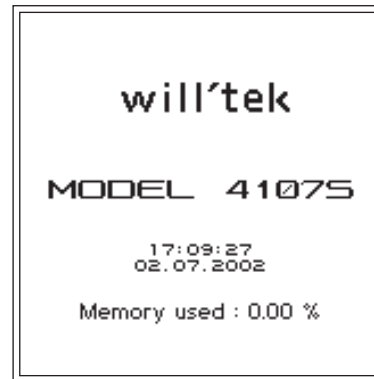1 Switch on your mobile phone and look at the display.

■ Test 8.0 result

☺ The text on the left appears on the phone the moment it connects to the service (the appearance of the text may differ from model to model).

☹ The text does not appear at all or is distorted.

5

Additional Features

Introduction

☞ This chapter only has any relevance for you if you possess a Willtek 4107S. In case of a Willtek 4107L the only available additional feature is Remote Control (see page 5-8).

A Willtek 4107S has all the same characteristics as the corresponding standard model, but also provides a number of additional features.

```
will'tek

MODEL  4107S

17:09:27
02.07.2002

Memory used : 0.00 %
```

■ **Additional features**

● Asynchronous Mode: The tester evaluates the signals sent by a GSM telephone in test mode. In Asynchronous Mode, the tester indicates together with other data, information on the RF signal bursts.

● Detailed display of where the power-time template has been violated.

● Emission of an unmodulated or defined, modulated carrier signal.

● Remote Control of the tester using SCPI commands over the RS-232-C interface (making settings on the tester and querying test results).

Asynchronous Mode

Any GSM mobile phone can be set to "test mode". How this is achieved and what features are available on a mobile phone in test mode vary from manufacturer to manufacturer. It is therefore not possible to provide generally valid instructions in this document.

Once a mobile phone has been set to test mode, it will generally no longer react to normal signals. This means that settings have to be carried out on the mobile phone itself (either manually or under Remote Control). In Asynchronous Mode, the Willtek 4107S and the mobile phone do not exchange signals. Instead, the tester is permanently set to receive and is able to evaluate the RF signals from the mobile phone.

Preparation and starting

Select then press ENTER

SELECT MODE

✓FAULT FIND
ASYNCHRON
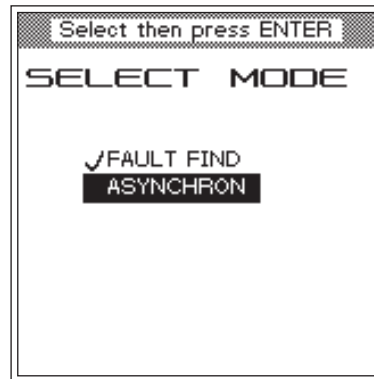
1. Connect the mobile phone to the tester and set it to test mode according to the manufacturer's instructions.
2. Set the required test parameters (e.g. channel number, power level) on the mobile phone according to the manufacturer's instructions.
3. Press [FAULT FIND] on the Willtek 4107S, use the cursor keys to select a radio system which matches the mobile phone and confirm your selection with [ENTER].
4. Choose *ASYNCHRON* from the *SELECT MODE* menu and confirm your choice with [ENTER]. You will now see the test menu.

Choose chan.,then START
Channel   0027
Pre attenuation (dB)   001.5

MS Pwr: dBm
Phase RMS: ▫
Phase Peak: ▫
Freq.Err: Hz
Power-Time Template:
Burst Length: us
Burst Type:

(RF Gen.) (1900) (START)

The (1900) softkey only appears if you have selected a multiband radio system.

[FAULT FIND] + *ASYNCHRON* + [ENTER]

5. Enter the channel number you set on the mobile phone in the *Channel* input field and confirm your entry with [ENTER]. You do not have to distinguish between TCH and BCCH as the channel number is only used to tune the receiver in the Willtek 4107S.
6. Choose (START) to start measuring in Asynchronous Mode. The tester will now measure continuously, updating every 2.5 seconds until you choose [ESCAPE]. The channel number cannot be changed during measurement.

☞ Test mode must be terminated on the mobile phone after the measurements have been completed or before FAULT FIND mode or RF Gen. is called, for example.

■ **Changing bands on multiband devices**

If you want to change between the 900/1800 and 1900 bands when testing a multiband phone, proceed as follows:

1 Terminate the current measurement (e.g. in the 900/1800 band) by pressing ESCAPE .

2 Terminate test mode on the mobile phone.

3 Switch the tester to the new band (e.g. the 1900 band) using the softkey.

4 Set the mobile phone to test mode again and set the new band.

5 Set the new channel number on the mobile phone and on the tester and press START to continue the measurement.

Emission of a carrier signal

It may be appropriate to feed a defined carrier signal into the mobile phone for test and adjustment purposes. This function is available if you press RF Gen. . As soon as the menu shown on the left appears, the Willtek 4107S sends a carrier signal defined by the values entered in the menu. You can toggle between the values On and Off for Modulation by selecting the field with the cursor keys and then pressing ENTER .

```
╔══════════════════════════════╗
║  Choose chan. and level       ║
╟──────────────────────────────╢
║ Channel                  0027 ║
║ BS Power Level (dBm)     -080 ║
║ Pre attenuation (dB)    001.5 ║
║ Modulation                 On ║
║                               ║
║                               ║
║                               ║
║         ┌─────────┐           ║
║         │  1900   │           ║
║         └─────────┘           ║
╚══════════════════════════════╝
```

When Modulation is set to *On*, the frequency of the carrier signal is offset by +67.7 kHz (relative to the current channel frequency). This corresponds to a digital modulation signal in the form 111111...

Press ESCAPE to deactivate emission of the carrier signal.
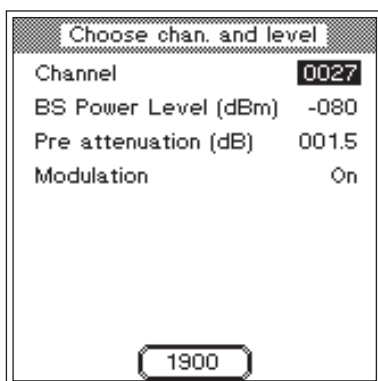
Test results in Asynchronous Mode

The Willtek 4107S displays the following measurements and messages in Asynchronous Mode:

MS Pwr RF transmit power of the mobile phone.

Phase RMS Phase errors of the GSM burst signal (average value).

Phase Peak Phase errors of the GSM burst signal (peak value).

Freq.Err Frequency error of the RF carrier signal.

Power-Time Template Assessment of whether the GSM burst signal lies within the tolerance zones of the template.

Pass Burst profile is error free.

Fail Burst profile exceeds the tolerance limits at one or more locations. Three symbols indicate the locations where the tolerance zones were exceeded. These symbols (the Burst Edge Failure Indication) can appear on their own or in combination with the other symbols.

```
Choose chan.,then START
Channel                    0027
Pre attenuation (dB)       01.5

MS Pwr:                29.0 dBm
Phase RMS:               2.27°
Phase Peak:             24.27°
Freq.Err:               -86 Hz
Power-Time Template:  ⌐ Fail
Burst Length:           555 us
Burst Type:           Burst + T
```
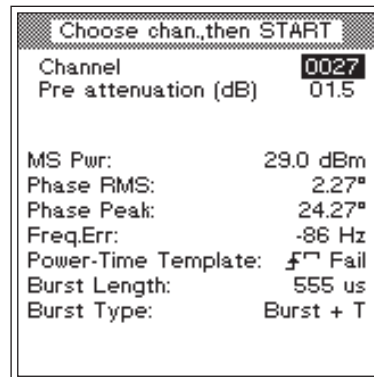
Error in horizontal section of burst waveform

Error on rising burst edge
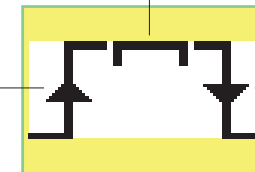
Error on falling burst edge

The following diagram illustrates the zones of the power-time template.

5-6
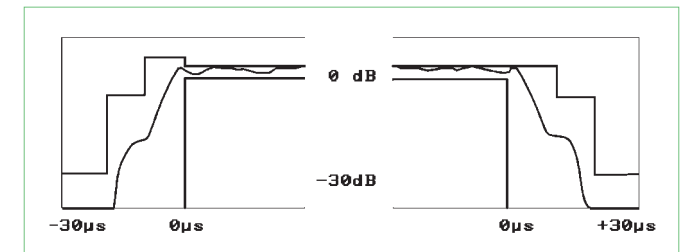
Burst Length	Length of the GSM burst.
Burst Type	Detailed information on the characteristics of the GSM burst. The tester derives this information by comparing the received bursts with stored reference patterns. The following messages may appear, depending on the result:
Burst + T	Burst with training sequence.
Cont.	The mobile phone transmits a continuous GMSK modulated RF signal rather than bursts.
—-	No detailed information available on the signal.

Remote Control

Willtek 4107S and Willtek 4107L can be controlled remotely via the RS-232-C serial interface (remote mode). The sections below describe the SCPI (Standard Commands for Programmable Instruments, pronounced *skipi*) commands required to do this. SCPI is a command language for communication between measuring instruments and control computers.

Preparation
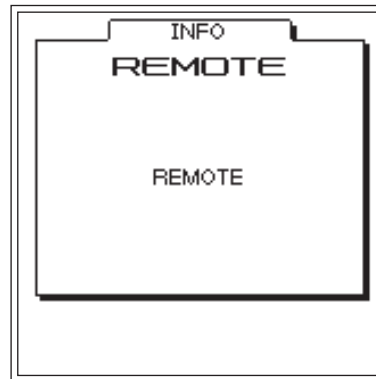
① Connect the 26-pole socket on the tester to a free COM port on the control computer (PC). Suitable cables are available as accessories in the form of the Universal adapter cable (384 877) or the Serial adapter cable (384 875).

② From the *SERIAL PORT* menu of the tester, select the baud rate, protocol and line type to match the settings for the COM port (see also page 2-7).

③ On the control computer, start the software used for writing or executing the control program (e.g. Visual Basic, C, Pascal). For initial trials, it is also possible to issue SCPI commands directly using a terminal program (e.g. HyperTerminal under Windows 95).

■ **Starting remote mode**

The tester automatically switches to remote mode when a SCPI command is received (the information text *REMOTE* appears on the display). If no further command is received within 3 seconds, when GSM signaling is deactivated, the tester automatically switches back to local mode.

Special characters in SCPI

Colon **:**　A colon precedes all SCPI commands. A colon at the start of a command line, i.e. before the first command, is optional.

Semicolon **;**　The semicolon is used to separate complete commands to be issued together.

Terminator ↵　Termination character (e.g. CR), marks the end of the SCPI command or command sequence.

SCPI syntax

The definition of the SCPI command sets use a number of text symbols which have a special meaning:

Angle brackets **< >**　Angle brackets contain placeholders for which current values are to be substituted.

Square brackets **[ ]**　Optional commands are enclosed in square brackets.

Abbreviations

Keywords can be written out in full or abbreviated. Uppercase and lowercase characters are not distinguished. No blanks are permitted within a keyword. Abbreviations are indicated by bold type in this manual (e.g. **CONF**igure).

Command indicators

All SCPI commands can be preceded by a colon, although this is not always the case. Every colon within a command causes a further branch down the command hierarchy.

Example:　**CONF**igure**:GSM:BS:TCH:ARFC**n 120↵
Semicolons (;) separate a number of commands in the same line. Commands are executed from left to right.

Example:　**RFG**enerator**:GSM:LEV**el?**;:SYST**em**:ERR**or?↵

Composite commands

Commands from one command set can be joined together and written in a single line, separated by semicolons. Composite commands are executed from left to right.

Composite command: **SYST:DATE** 1997,10,13;**TIME** 15,0,0↵
means the same as: **SYST:DATE** 1997,10,13↵
SYST:TIME 15,0,0↵

DATE and **TIME** are commands from the same level. This approach is therefore permitted.

Parameters

Three types of parameters are permitted. The command and the parameter must always be separated by a **blank**:

■ Text
Strings which can also contain numeric characters.

Example: **AUT:MSTY:STAR**? "Standard GSM"

■ Numeric
Numeric parameters (integer, floating point, exponent) can be specified together with a unit. Measurements and return values from parameters are passed in exponential form by default.

Example: Setting:
`RFGenerator:GSM:LEVel -60.5dBm`
Query:
`RFGenerator:GSM:LEVel?`

Return value in dBm: -6.05e1

■ Boolean

The "labels" OFF and ON are permitted. The values 0 or 1 are returned for queries. Every parameter has a maximum value, a minimum value and a factory-set value. These three values can be set by specifying 'MAX', 'MIN' or 'DEF' in place of a numeric value.

Example: `RFG:GSM:LEVel MIN`

Queries

Result formats

Measurements are output in exponential format. The formats of other queries correspond to the value concerned.

Query

Queries are indicated by appending a question mark to the end of the command. Certain commands are only permitted with a question mark. Any exceptions are described. Responses to queries are always terminated with a CR+LF pair (↵) .

Example: Measure burst length
`MEAS:RFTR:LENG?`

Example: `SYST:TIME?;*ESR?`
Response e.g.: 17,40,55↵4↵
The system time is 17:40:55 and the event status of the tester is 4.

Settings and queries

If queries are combined in a single line with commands which make settings for a parameter, the response to the query will depend on any changes made to the parameter.

Example: Composite command
RFG:GSM:LEV?**;LEV** –80**;LEV**?
Response: -6.0e1↵-8.0e1↵

Multiple measurement

If a multiple measurement is started, the return values for the measurements (responses) are separated by semicolons.

Compatibility

Two ways of identifying the various radio systems are permitted within a SCPI command:
GSM or GSM900
PCN or GSM1800
PCS or GSM1900

Example: **RFG:GSM:LEV? = RFG:GSM900:LEV?**

SCPI command sets

The SCPI commands fall into the following command sets:

MEASure   Start single and multiple measurements.

RFGenerator   Set output power of the RF generator.

CONFigure   Set all system-related parameters (GSM, PCS, PCN).

CALL   Start all signaling routines.

STATus   Query internal statuses.

SYSTem   Set all device-related parameters (interfaces, system time, user details etc.).

AUTotest   Start AUTOTESTs and query results.

CALibration   Start calibration prior to TX measurements.

The quick reference section at the end of this chapter gives a concise overview of all the SCPI instructions sorted by instruction sets.

Overview SCPI commands

MEASure command set

Transmitter measurement completed

■ Single measurement

Command: **MEAS**ure:**RFTR**ansmit:**GRO**up:**ALL**?

Parameters: None

Response: <PPEak>,<PRMS>,<FREQuency>,<LENGth>,<POWer>
PPEak: Peak phase error in degrees
PRMS: RMS phase error in degrees
FREQuency: Frequency error in Hz
LENGth: Burst length in μs
POWer: Power in dBm

Comment: Query only

■ Single measurement with assessment

Command: **MEAS**ure:**RFTR**ansmit:**GRO**up:**ALL:LIM**it:**FAIL**?

Parameters: <PPEak limu>,<PPEak liml>,
<PRMS limu>,<PRMS liml>,
<FREQuency limu>,<FREQuency liml>,
<LENGth limu>,<LENGth liml>,
<POWer limu>,<POWer liml>
limu: Upper limit
liml: Lower limit

Response: <PPEak Pass/Fail>,
<PRMS Pass/Fail>,
<FREQuency Pass/Fail>,
<LENGth Pass/Fail>,
<POWer Pass/Fail>
0 = PASS   1 = FAIL

Comment: Query only

■ **Multiple measurement**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:GRO**up**:ALL**?

Parameters: <n>   Number of measurements (up to 10)

Response: <PPEak measurement 1>,<PRMS measurement 1>,
            <FREQuency measurement 1>,<LENGth measurement 1>,
            <POWer measurement 1>;...<PPEak measurement n>,
            <PRMS measurement n>,<FREQuency measurement n>,
            <LENGth measurement n>,<POWer measurement n>

Comment: Query only

■ **Multiple measurement - average**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:GRO**up**:ALL:MAV**erage?

Parameters: <n>   Number of measurements (up to 10)

Response: <PPEak average>,
            <PRMS average>,
            <FREQuency average>,
            <LENGth average>,
            <POWer average>

Comment: Query only

■ **Multiple measurement with assessment**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:GRO**up**:ALL:LIM**it**:FAIL**?

Parameters: <n>,
            <PPEak limu>,<PPEak liml>,
            <PRMS limu>,<PRMS liml>,
            <FREQuency limu>,<FREQuency liml>,
            <LENGth limu>,<LENGth liml>,
            <POWer limu>,<POWer liml>
            n: Number of measurements (up to 10)
            limu: Upper limit
            liml: Lower limit

Response: <PPEak Pass/Fail 1>,<PRMS Pass/Fail 1>,
            <FREQuency Pass/Fail 1>,<LENGth Pass/Fail 1>,
            <POWer Pass/Fail 1>;...<PPEak Pass/Fail n>,
            <PRMS Pass/Fail n>,<FREQuency Pass/Fail n>,
            <LENGth Pass/Fail n>,<POWer Pass/Fail n>
            0 = PASS   1 = FAIL

Comment: Query only

■ **Multiple measurement with assessment - average**

Command: **MEAS**ure:**ARR**ay:**RFTR**ansmit:**GRO**up:**ALL**:**MAV**erage
            :**LIM**it:**FAIL**?

Parameters: <n>   Number of measurements (up to 10)
             <PPEak limu>,<PPEak liml>,
             <PRMS limu>,<PRMS liml>,
             <FREQuency limu>,<FREQuency liml>,
             <LENGth limu>,<LENGth liml>,
             <POWer limu>,<POWer liml>
             limu: Upper limit
             liml: Lower limit

Response: <PPEak Pass/Fail>,
             <PRMS Pass/Fail>,
             <FREQuency Pass/Fail>,
             <LENGth Pass/Fail>,
             <POWer Pass/Fail>
             0 = PASS   1 = FAIL

Comment: Query only

Frequency errors

■ **Single measurement**

Command: **MEAS**ure:**RFTR**ansmit:**FREQ**uency?

Parameters: None

Response: Frequency error in Hz

Comment: Query only

■ **Single measurement with assessment**

Command: **MEAS**ure:**RFTR**ansmit:**FREQ**uency:**LIM**it:**FAIL**?

Parameters: <limu>,<liml>
limu: Upper limit in Hz
liml: Lower limit in Hz

Response: <Pass/Fail>   0 = PASS   1 = FAIL

Comment: Query only

■ **Query unit**

Command: **MEAS**ure:**RFTR**ansmit:**FREQ**uency:**UNIT**?

Parameters: None

Response: Hz

Comment: Query only

■ **Multiple measurement**

Command: **MEAS**ure:**ARR**ay:**RFTR**ansmit:**FREQ**uency?

Parameters: <n>   Number of measurements (up to 10)

Response: <measurement 1>;<measurement 2>...<measurement n>

Comment: Query only

■ **Multiple measurement - average**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:FREQ**uency**:MAV**erage?

Parameters: <n>   Number of measurements (up to 10)

Response: Average value in Hz

Comment: Query only

■ **Multiple measurement with assessment**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:FREQ**uency**:LIM**it**:FAIL**?

Parameters: <n>,<limu>,<liml>
n: Number of measurements (up to 10)
limu: Upper limit in Hz
liml: Lower limit in Hz

Response: <Pass/Fail 1>;<Pass/Fail 2>...<Pass/Fail n>
0 = PASS   1 = FAIL

Comment: Query only

■ **Multiple measurement with assessment - average**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:FREQ**uency**:MAV**erage
:LIMit**:FAIL**?

Parameters: <n>,<limu>;<liml>
n: Number of measurements (up to 10)
limu: Upper limit in Hz
liml: Lower limit in Hz

Response: <Pass/Fail>   0 = PASS   1 = FAIL

Comment: Query only

Peak phase error

■ Single measurement

Command: **MEAS**ure:**RFTR**ansmit:**PPE**ak?

Parameters: None

Response: Peak phase error in degrees

Comment: Query only

■ Single measurement with assessment

Command: **MEAS**ure:**RFTR**ansmit:**PPE**ak:**LIM**it:**FAIL**?

Parameters: <limu>,<liml>
limu: Upper limit in degrees
liml: Lower limit in degrees

Response: <Pass/Fail>   0 = PASS   1 = FAIL

Comment: Query only

■ Query unit

Command: **MEAS**ure:**RFTR**ansmit:**PPE**ak:**UNIT**?

Parameters: None

Response: deg

Comment: Query only

■ Multiple measurement

Command: **MEAS**ure:**ARR**ay:**RFTR**ansmit:**PPE**ak?

Parameters: <n>   Number of measurements (up to 10)

Response: <measurement 1>;<measurement 2>...<measurement n>

Comment: Query only

■ **Multiple measurement - average**

Command: **MEAS**ure:**ARR**ay:**RFTR**ansmit:**PPE**ak:**MAV**erage?

Parameters: <n>　Number of measurements (up to 10)

Response: Average value in degrees

Comment: Query only

■ **Multiple measurement with assessment**

Command: **MEAS**ure:**ARR**ay:**RFTR**ansmit:**PPE**ak:**LIM**it:**FAIL**?

Parameters: <n>,<limu>,<liml>
　　　　　n:　　Number of measurements (up to 10)
　　　　　limu: Upper limit in degrees
　　　　　liml: Lower limit in degrees

Response: <Pass/Fail 1>;<Pass/Fail 2>...<Pass/Fail n>
　　　　　0 = PASS　　1 = FAIL

Comment: Query only

■ **Multiple measurement with assessment - average**

Command: **MEAS**ure:**ARR**ay:**RFTR**ansmit:**PPE**ak:**MAV**erage
　　　　　:**LIM**it:**FAIL**?

Parameters: <n>,<limu>,<liml>
　　　　　n:　　Number of measurements (up to 10)
　　　　　limu: Upper limit in degrees
　　　　　liml: Lower limit in degrees

Response: <Pass/Fail>　　0 = PASS　　1 = FAIL

Comment: Query only

5-21

RMS phase errors

■ Single measurement

Command:	**MEAS**ure:**RFTR**ansmit:**PRMS**?
Parameters:	None
Response:	RMS phase error in degrees
Comment:	Query only

■ Single measurement with assessment

Command:	**MEAS**ure:**RFTR**ansmit:**PRMS**:**LIM**it:**FAIL**?
Parameters:	<limu>,<liml>
	limu: Upper limit in degrees
	liml: Lower limit in degrees
Response:	<Pass/Fail> 0 = PASS 1 = FAIL
Comment:	Query only

■ Query unit

Command:	**MEAS**ure:**RFTR**ansmit:**PRMS**:**UNIT**?
Parameters:	None
Response:	deg
Comment:	Query only

■ Multiple measurement

Command:	**MEAS**ure:**ARR**ay:**RFTR**ansmit:**PRMS**?
Parameters:	<n> Number of measurements (up to 10)
Response:	<measurement 1>;<measurement 2>...<measurement n>
Comment:	Query only

■ **Multiple measurement - average**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:PRMS:MAV**erage?

Parameters: \<n\>   Number of measurements (up to 10)

Response: Average value in degrees

Comment: Query only

■ **Multiple measurement with assessment**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:PRMS:LIM**it**:FAIL**?

Parameters: \<n\>,\<limu\>,\<liml\>
n: Number of measurements (up to 10)
limu: Upper limit in degrees
liml: Lower limit in degrees

Response: \<Pass/Fail 1\>;\<Pass/Fail 2\>...\<Pass/Fail n\>
0 = PASS   1 = FAIL

Comment: Query only

■ **Multiple measurement with assessment - average**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:PRMS:MAV**erage
:LIMit**:FAIL**?

Parameters: \<n\>,\<limu\>,\<liml\>
n: Number of measurements (up to 10)
limu: Upper limit in degrees
liml: Lower limit in degrees

Response: \<Pass/Fail\>   0 = PASS   1 = FAIL

Comment: Query only

Transmit power

■ Single measurement

Command: **MEAS**ure:**RFTR**ansmit:**POW**er?

Parameters: None

Response: TX power in dBm

Comment: Query only

■ Single measurement with assessment

Command: **MEAS**ure:**RFTR**ansmit:**POW**er:**LIM**it:**FAIL**?

Parameters: <limu>,<liml>
limu: Upper limit in dBm
liml: Lower limit in dBm

Response: <Pass/Fail>   0 = PASS   1 = FAIL

Comment: Query only

■ Query unit

Command: **MEAS**ure:**RFTR**ansmit:**POW**er:**UNIT**?

Parameters: None

Response: dBm

Comment: Query only

■ Multiple measurement

Command: **MEAS**ure:**ARR**ay:**RFTR**ansmit:**POW**er?

Parameters: <n>   Number of measurements (up to 10)

Response: <measurement 1>;<measurement 2>...<measurement n>

Comment: Query only

■ Multiple measurement - average

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:POW**er**:MAV**erage?

Parameters: <n>   Number of measurements (up to 10)

Response: Average value in dBm

Comment: Query only

■ Multiple measurement with assessment

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:POW**er**:LIM**it**:FAIL**?

Parameters: <n>,<limu>,<liml>
n: Number of measurements (up to 10)
limu: Upper limit in dBm
liml: Lower limit in dBm

Response: <Pass/Fail 1>;<Pass/Fail 2>...<Pass/Fail n>
0 = PASS   1 = FAIL

Comment: Query only

■ Multiple measurement with assessment - average

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:POW**er**:MAV**erage
:LIMit**:FAIL**?

Parameters: <n>,<limu>,<liml>
n: Number of measurements (up to 10)
limu: Upper limit in dBm
liml: Lower limit in dBm

Response: <Pass/Fail>   0 = PASS   1 = FAIL

Comment: Query only

Burst length

■ Single measurement

Command: `MEASure:RFTRansmit:LENGth?`
Parameters: None
Response: Burst length in μs
Comment: Query only

■ Single measurement with assessment

Command: `MEASure:RFTRansmit:LENGth:LIMit:FAIL?`
Parameters: <limu>,<liml>
limu: Upper limit in μs
liml: Lower limit in μs
Response: <Pass/Fail>   0 = PASS   1 = FAIL
Comment: Query only

■ Query unit

Command: `MEASure:RFTRansmit:LENGth:UNIT?`
Parameters: None
Response: us
Comment: Query only

■ Multiple measurement

Command: `MEASure:ARRay:RFTRansmit:LENGth?`
Parameters: <n>   Number of measurements (up to 10)
Response: <measurement 1>;<measurement 2>...<measurement n>
Comment: Query only

■ **Multiple measurement - average**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:LENG**th**:MAV**erage?

Parameters: \<n>   Number of measurements (up to 10)

Response: Average value in μs

Comment: Query only

■ **Multiple measurement with assessment**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:LENG**th**:LIM**it**:FAIL**?

Parameters: \<n>,\<limu>,\<liml>
n: Number of measurements (up to 10)
limu: Upper limit in μs
liml: Lower limit in μs

Response: \<Pass/Fail 1>;\<Pass/Fail 2>...\<Pass/Fail n>
0 = PASS   1 = FAIL

Comment: Query only

■ **Multiple measurement with assessment - average**

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:LENG**th**:MAV**erage
:LIMit**:FAIL**?

Parameters: \<n>,\<limu>,\<liml>
n: Number of measurements (up to 10)
limu: Upper limit in μs
liml: Lower limit in μs

Response: \<Pass/Fail>   0 = PASS   1 = FAIL

Comment: Query only

Power/Time template

■ Single measurement

Command: **MEAS**ure**:RFTR**ansmit**:TEMP**late?

Parameters: None

Response: <Pass/Fail overall>,
             <Pass/Fail rising edge>,
             <Pass/Fail mid range>,
             <Pass/Fail falling edge>,
             0 = PASS   1 = FAIL

             <Async. Burst Information>
             0 = No information
             1 = Burst with training sequence
             2 = Burst without training sequence
             3 = Continuous output

Comment: Query only

■ Multiple measurement

Command: **MEAS**ure**:ARR**ay**:RFTR**ansmit**:TEMP**late?

Parameters: <n>   Number of measurements (up to 10)

Response: <Pass/Fail 1 overall>,
             <Pass/Fail 1 rising edge>,
             <Pass/Fail 1 mid-range>,
             <Pass/Fail 1 falling edge>,
             <Async. Burst Information>**;**

             ...
             <Pass/Fail n overall>,
             <Pass/Fail n rising edge>,
             <Pass/Fail n mid-range>,
             <Pass/Fail n falling edge>,
             <Async. Burst Information>
             0 = PASS   1 = FAIL
             Async. Burst Information: see single measurement

Comment: Query only

BER

■ **Single measurement**

Command: **MEAS**ure:**RFR**eceive:**RBER:C2**?

Parameters: None

Response: Bit Error Ratio in %

Comment: Query only

■ **Single measurement with assessment**

Command: **MEAS**ure:**RFR**eceive:**RBER:C2:LIM**it:**FAIL**?

Parameters: <limu>,<liml>
limu: Upper limit in %
liml: Lower limit in %

Response: <Pass/Fail>   0 = PASS   1 = FAIL

Comment: Query only

■ **Query unit**

Command: **MEAS**ure:**RFR**eceive:**RBER:C2:UNIT**?

Parameters: None

Response: %

Comment: Query only

■ **Multiple measurement**

Command: **MEAS**ure:**ARR**ay:**RFR**eceive:**RBER:C2**?

Parameters: <n>   Number of measurements (up to 10)

Response: <measurement 1>;<measurement 2>...<measurement n>

Comment: Query only

■ **Multiple measurement with assessment**

Command: **MEAS**ure:**ARR**ay:**RFR**eceive:**RBER:C2:LIM**it:**FAIL**?

Parameters: <n>,<limu>,<liml>
n: Number of measurements (up to 10)
limu: Upper limit in %
liml: Lower limit in %

Response: <Pass/Fail 1>;<Pass/Fail 2>...<Pass/Fail n>
0 = PASS   1 = FAIL

Comment: Query only

FER

■ Single measurement

Command: **MEAS**ure:**RFR**eceive:**RBER**:**FER**?

Parameters: None

Response: Frame Erasure Ratio in %

Comment: Query only

■ Single measurement with assessment

Command: **MEAS**ure:**RFR**eceive:**RBER**:**FER**:**LIM**it:**FAIL**?

Parameters: <limu>,<liml>
limu: Upper limit in %
liml: Lower limit in %

Response: <Pass/Fail>   0 = PASS   1 = FAIL

Comment: Query only

■ Query unit

Command: **MEAS**ure:**RFR**eceive:**RBER**:**FER**:**UNIT**?

Parameters: None

Response: %

Comment: Query only

■ Multiple measurement

Command: **MEAS**ure:**ARR**ay:**RFR**eceive:**RBER**:**FER**?

Parameters: <n>   Number of measurements (up to 10)

Response: <measurement 1>;<measurement 2>...<measurement n>

Comment: Query only

■ **Multiple measurement with assessment**

Command: **MEAS**ure:**ARR**ay:**RFR**eceive:**RBER:FER:LIM**it:**FAIL**?

Parameters: <n>,<limu>,<liml>
        n: Number of measurements (up to 10)
        limu: Upper limit in %
        liml: Lower limit in %

Response: <Pass/Fail 1>;<Pass/Fail 2>...<Pass/Fail n>
        0 = PASS   1 = FAIL

Comment: Query only

RFGenerator command set

■ Set RF output level

Command: **RFG**enerator:**GSM**:**LEV**el
            RFGenerator:**PCN**:**LEV**el
            RFGenerator:**PCS**:**LEV**el

Parameters: <Value>
            GSM 900   −45 dBm through −117 dBm
            GSM 1800   −50 dBm through −117 dBm
            GSM 1900   −50 dBm through −117 dBm

Comment: With query

■ Activate/deactivate modulation

Command: **RFG**enerator:**GSM**:**MOD**ulation:**STAT**e
            RFGenerator:**PCN**:**MOD**ulation:**STAT**e
            RFGenerator:**PCS**:**MOD**ulation:**STAT**e

Parameters: ON | OFF
            ON   Activate modulation (the tester constantly
                    transmits the bit sequence 11111 ...).
            OFF   Deactivate modulation.

Comment: With query

CONFigure command set

Sets all test parameters. All these settings directly affect the CALL command set.

■ **Configure system**

Command: **CONF**igure:**CSYS**tem

Parameters: GSM | PCN | PCS | GSM,PCN | GSM,PCS

Comment: With query

If you prefer to use the modern system names for the parameters, then the following command applies:

Command: **CONF**igure:**SYST**em

Parameters: GSM900 | GSM1800 | GSM1900 | GSM900,GSM1800 | GSM900,GSM1900

Comment: With query. The query returns one of the following values:

1 = GSM 900   3 = GSM 900+1800   5 = GSM 900+1900
2 = GSM 1800   4 = GSM 1900

☞ An example of the use of the SCPI commands for testing dual-band telephones can be found on page 5-53.

■ **Configure BCCH**

Command: **CONF**igure:**GSM:BS:CCH:ARFC**n
CONFigure:**PCN:BS:CCH:ARFC**n
CONFigure:**PCS:BS:CCH:ARFC**n

Parameters: <Channel number>
GSM: $1...124_{dec}$,
E-GSM: $0...124_{dec}$ and $975...1023_{dec}$,
PCN: $512...885_{dec}$
Use only even channel numbers!

PCS: $512...810_{dec}$
Use only odd channel numbers!

Comment: With query

■ **Configure TCH**

Command: **CONF**igure**:GSM:BS:TCH:ARFC**n
CONFigure**:PCN:BS:TCH:ARFC**n
CONFigure**:PCS:BS:TCH:ARFC**n

Parameters: <Channel number>
GSM:　　1...124$_{dec}$,
E-GSM:　0...124$_{dec}$ and 975...1023$_{dec}$,
PCN:　　512...885$_{dec}$
Use only even channel numbers!

PCS:　　512...810$_{dec}$
Use only odd channel numbers!

Comment: With query

■ **Activate/deactivate Asynchronous Mode**

Command: **CONF**igure**:GSM:BS:ABUR**st**:STAT**e
CONFigure**:PCN:BS:ABUR**st**:STAT**e
CONFigure**:PCS:BS:ABUR**st**:STAT**e

Parameters: ON | FPOWER | OFF

ON　　　　The tester switches to Asynchronous Mode. All the measurements from the MEASure command set permitted in this operating mode can then be called.

FPOWER　The tester switches to Asynchronous Mode. Only the RF power measurement is then permitted. The advantage of this mode is that the measurement duration is approximately halved compared with ON.

OFF　　　The tester switches from Asynchronous Mode back to normal operating mode.

Comment: With query

5-35

■ **Asynchronous Mode (auto-synchronization)**

Command: `CONFigure:GSM:BS:ABURst:ASEarch:STATe`
`CONFigure:PCN:BS:ABURst:ASEarch:STATe`
`CONFigure:PCS:BS:ABURst:ASEarch:STATe`

Parameters: ON | OFF

ON   In Asynchronous Mode, the tester regularly carries out synchronization on the basis of recognized bursts (<Time> parameter, see page 5-36). Depending on the stability of the mobile phone, this allows drift problems to be eliminated at an early stage.

OFF   In Asynchronous Mode, the tester carries out synchronization only once on the basis of the first recognized burst.

Comment: With query

■ **Asynchronous Mode (time)**

Command: `CONFigure:GSM:BS:ABURst:ASEarch:TIME`
`CONFigure:PCN:BS:ABURst:ASEarch:TIME`
`CONFigure:PCS:BS:ABURst:ASEarch:TIME`

Parameters: <Time>

Time: Interval (1 s through 300 s) at which automatic synchronization is carried out in Asynchronous Mode.

Comment: With query

■ **Configure power level (BCCH)**

Command: `CONFigure:GSM:MS:CCH:PLEVel`
`CONFigure:PCN:MS:CCH:PLEVel`
`CONFigure:PCS:MS:CCH:PLEVel`

Parameters: <Power Level>

GSM: $0...19_{dec}$
PCN: $0...15_{dec}$, $29_{dec}...31_{dec}$
PCS: $0...15_{dec}$, 30_{dec}, 31_{dec}

Comment: With query

■ **Configure power level (TCH)**

Command: **CONF**igure**:GSM:MS:TCH:PLEV**el
CONFigure**:PCN:MS:TCH:PLEV**el
CONFigure**:PCS:MS:TCH:PLEV**el

Parameters: <Power level>
GSM: $0...19_{dec}$
PCN: $0...15_{dec}$, $29_{dec}...31_{dec}$
PCS: $0...15_{dec}$, 30_{dec}, 31_{dec}

Comment: With query

■ **Configure audio loopback**

Speech mode = FR (Full Rate)

Command: **CONF**igure**:GSM:AUD**io**:LOOP**back
CONFigure**:PCN:AUD**io**:LOOP**back
CONFigure**:PCS:AUD**io**:LOOP**back

Speech mode = EFR (Enhanced Full Rate)
CONFigure**:GSM:AUD**io**:EFR**ate**:LOOP**back
CONFigure**:PCN:AUD**io**:EFR**ate**:LOOP**back
CONFigure**:PCS:AUD**io**:EFR**ate**:LOOP**back

Parameters: ON | OFF
Comment: With query

■ **Set number of samples for BER measurement**

Command: **CONF**igure**:GSM:BER:ERR**or**:COUN**t
CONFigure**:PCN:BER:ERR**or**:COUN**t
CONFigure**:PCS:BER:ERR**or**:COUN**t

Parameters: <Value>   Number of samples ($500...100000_{dec}$).
Comment: With query

■ **Set number of samples for FER measurement**

Command: **CONF**igure**:GSM:BER:FER**asure**:COUN**t
CONFigure**:PCN:BER:FER**asure**:COUN**t
CONFigure**:PCS:BER:FER**asure**:COUN**t

Parameters: <Value>   Number of samples ($500...100000_{dec}$).
Comment: With query

■ **Set pre-attenuation (depending on system)**

Command: **CONF**igure**:GSM:PATT**enuation**:LEV**el
CONFigure**:PCN:PATT**enuation**:LEV**el
CONFigure**:PCS:PATT**enuation**:LEV**el

Parameters: <RX>, <TX>
RX: RX pre-attenuation   (–50.0 dB...+50.0 dB)
TX: TX pre-attenuation   (–50.0 dB...+50.0 dB)

Comment: With query. Any system-independent pre-attenuation
set with the **SYST**em command will overwrite
system-dependent pre-attenuation values.

CALL command set

This command set allows you to query information on the mobile phone (MS). The information depends on the signaling status. This means, for instance, that a connection must already have been established.

■ Establish connection (MS)

Command: `CALL:MSORiginate`
Parameters: None
Comment: No query

■ Clear connection (MS)

Command: `CALL:MSRelease`
Parameters: None
Comment: No query

■ Establish connection (tester)

Command: `CALL:BSORiginate`
Parameters: None
Comment: No query

■ Clear connection (tester)

Command: `CALL:BSRelease`
Parameters: None
Comment: No query

■ Read RX level

Command: `CALL:MSINfo:RXLevel?`
Response: <Value>   0...63
Comment: Query only

■ Read RX quality

Command: **CALL:MSIN**fo:**RXQ**ual?

Response: <Value>   0...7

Comment: Query only

■ Read number

Command: **CALL:MSIN**fo:**NUMB**er?

Response: <Number>

Comment: Query only

■ Read IMSI

Command: **CALL:MSIN**fo:**IMSI**?

Response: 15-digit decimal integer

Comment: Query only

■ Read IMEI

Command: **CALL:MSIN**fo:**IMEI**?

Response: 15-digit decimal integer

Comment: Query only

■ Read MS power class

Command: **CALL:MSIN**fo:**MSCL**ass?

Response: <Value>   1...5

Comment: Query only

■ Read revision level

Command: **CALL:MSIN**fo:**RLEV**el?

Response: <Value>
            0 = Phase 1
            1 = Phase 2

Comment: Query only

■ Query SMS support

Command: `CALL:MSINfo:SMS?`

Response: <Value>   1 = Yes   0 = No

Comment: Query only

■ Query E-GSM support

Command: `CALL:MSINfo:EFRequency?`

Response: <Value>   1 = Yes   0 = No

Comment: Query only

■ Query A5 algorithm

Command: `CALL:MSINfo:A5?`

Response: <Value>   0...7

                  1 = A5/1
                  2 = A5/2
                  4 = A5/3

Comment: Query only

■ Classmark 3: Query status

Command: `CALL:MSINfo:CM3?`

Response: <Value>

                  0 = Classmark 3 information is not available
                  1 = Classmark 3 information is available

Comment: Query only

■ Extension bit: Query status

Command: `CALL:MSINfo:EBIT?`

Response: <Value>

                  0 = No
                  1 = Yes

Comment: Query only

■ **Multiband: Query status**

Command: **CALL:MSIN**fo**:MBAN**d?

Response: <Value>
0 = Not a multiband unit
5 = GSM900 + GSM1800
6 = E-GSM900 + GSM1800

Comment: Query only

■ **Query MS Power Class (E)-GSM 900**

Command: **CALL:MSIN**fo**:ARC1**?

Response: <Value>   1...5

Comment: Query only

■ **Query MS Power Class GSM 1800/1900**

Command: **CALL:MSIN**fo**:ARC2**?

Response: <Value>   1...5

Comment: Query only

STATus command set

This command set provides information on the current status of the tester.

The quick reference section at the end of this chapter provides information on the status registers (in the STATus section).

■ Query register operation

Command: **STAT**us**:OPER**ation[**:EVEN**t]?

Response: <Value>   0...32768

Comment: Query only

■ Query register signaling

Command: **STAT**us**:OPER**ation**:SIGN**alling[**:EVEN**t]?

Response: <Value>   0...255

Comment: Query only

■ Query QUEStionable register

Command: **STAT**us**:QUES**tionable[**:EVEN**t]?

Response: <Value>   0...32768

Comment: Query only

SYSTem command set

The SYSTem command set allows you to make device settings and query the current error status.

■ Switch tester to local mode

Command: **SYST**em:**COMM**unicate:**LOC**al

Parameters: None

Comment: No query

■ Set system date

Command: **SYST**em:**DATE**

Parameters: <Year>,<Month>,<Day>
Year: 4-digit year specification (1997...2049)
Month: 1...12
Day: 1...31

Comment: With query

■ Set system time

Command: **SYST**em:**TIME**

Parameters: <Hour>,<Minute>,<Second>
Hour: 0...23
Minute: 0...59
Second: 0...59

Comment: With query

■ Define pre-attenuation

Command: **SYST**em:**SETT**ings:**PATT**enuation:**LEV**el

Parameters: <RX>,<TX>
RX: RX pre-attenuation (–50.0 dB...+50.0 dB)
TX: TX pre-attenuation (–50.0 dB...+50.0 dB)

Comment: With query

■ **Activate/deactivate timeout**

Command: **SYST**em:**COMM**unicate:**SER**ial:**TIM**eout:**STAT**e

Parameters: ON | OFF

Comment: With query
An active timeout prevents the tester from being
permanently blocked if a mobile phone does not react
as expected (because of a fault). The effect of a
timeout can be compared to pressing the ESCAPE
button: the current test (command) is aborted and the
subsequent SCPI command is executed. It is useful if
the subsequent command provides information on the
progress of the previous test (test executed completely
or aborted due to a timeout; see the example).
A timeout affects the following tests/commands:
– Activate/deactivate Asynchronous Mode
– MS connection setup
– BS connection setup (tester)
– BER measurement

Example:

SYST:COMM:SER:TIM 30	Set timeout to 30 s
SYST:COMM:SER:TIM:STAT ON	Activate timeout
CALL:BS	BS connection setup. If this test causes the tester to be blocked, it is aborted after 30 seconds and the next command is executed.
STAT:OPER:SIGN?	Query signaling register (bit 6 = Call Active): 1 = Connection established successfully; 0 = No connection.

The status of bit 9 in the questionable status register
shows whether a timeout has occurred (see
page 5-57). This bit is set as soon as an operation is
cancelled by a timeout (remote control) or using
ESCAPE (manually).

■ **Set timeout duration**

Command: **SYST**em**:COMM**unicate**:SER**ial**:TIM**eout

Parameters: <Value>
            Value: Duration of timeout in seconds (1 s through
                       100000 s).

Comment: With query

■ **Read error queue - code and text**

Command: **SYST**em**:ERR**or[**:NEXT**]?

Response: <Value>,<String>
            Value: Error code (see table)
            String: Error message in plain text
                       e.g. -350,"Queue overflow"

Comment: Query only

■ **Read error queue - code only**

Command: **SYST**em**:ERR**or**:CODE**[**:NEXT**]?

Response: <Value>   Error code (see table)

Comment: Query only

■ **Read error queue - all codes**

Command: **SYST**em**:ERR**or**:CODE:ALL**?

Response: <Value 1>;<Value 2>...<Value n>
           Error code (see table)

Comment: Query only

■ **Query number of errors in error queue**

Command: **SYST**em**:ERR**or**:COUN**t?

Response: <Value>   Number of error messages, currently
                         stored in error queue.

Comment: Query only

Error queue messages

Code	Message	Meaning
0	No error	No error codes in queue
Command errors		
-100	Command error	General command error
-101	Invalid character	Invalid character
-102	Syntax error	Invalid command or data type
-103	Invalid separator	Invalid separator
-104	Data type error	Invalid data type
-108	Parameter not allowed	Too many parameters received
-109	Missing parameter	Too few parameters received
-112	Program mnemonic too long	Command name is longer than 12 characters
-113	Undefined header	Command name not defined
Program execution errors		
-200	Execution error	General execution error
-225	Out of memory	Insufficient memory to carry out command
-233	Invalid version	Command not supported in this version
-240	Hardware error	Command cannot be executed due to hardware problem
Device errors		
-300	Device-specific error	General device-specific error
-311	Memory error	Error in system memory (e.g. incorrect checksum)
-315	Configuration memory lost	Tables in EEPROM of RF stage are errored
-330	Self-test failed	Self-test failed
-340	Calibration failed	Calibration failed
-350	Queue overflow	Dummy code if no more space is available in the queue for the actual error code
-360	Communication error	Error during communication over the serial port
Query error		
-400	Query error	General query error

CALibration command set

This command set contains only the one command: CALibration. If this command is issued befor TX measurements are carried out, it calibrates a tester in such a way that the highest possible accuracy is achieved during measurement. Calibration should be carried out more regularly while the tester is warming up than after it has reached operating temperature. Calibration takes approximately 6...10 seconds.

■ **Start calibration prior to TX measurements**

Command: **CAL**ibration[**:ALL**]

Parameters: None

Comment: No query.

General commands

■ Clear status register

The *CLS command resets the status report system.
The following actions are carried out:

– Status byte is reset.
– Event status register is reset.
– Operation status register is reset.
– Signaling register is reset.
– Questionable status register is reset.
– Event/error queue is flushed.

Command: ***CLS**
Parameters: None
Comment: No query.

■ Set event status register mask

This command defines the mask for calculating the
sum bits in the status byte. The event status register
(ESR) is ANDed with the mask before the value of the
sum bit is calculated from the result.

Command: ***ESE**
Parameters: <Value>   0...255
Comment: With query

■ Read event status register

Command: ***ESR**?
Parameters: None
Response: <Value>   0...255
Comment: Query only

■ Read device ID

Command:	***IDN**?
Parameters:	None
Response:	\<Manufacturer\>,\<Model\>,\<Serial number\>,\<Version number\>
	e.g. Willtek,4107S,00123456,1.22
Comment:	Query only

■ Execute reset

The tester is restarted. The status report system is cleared and signaling is switched off.

Command:	***RST**
Parameters:	None
Comment:	No query

During a reset operation, the tester does not react to received commands for a brief period. Since the duration of this pause depends on the firmware, fixed wait times before the next command is executed are not recommended. It is better to couple the *RST command with a quick query (e.g. *RST;*IDN?). The query is then always executed immediately after the reset. Any subsequent command thus reliably reaches the tester.

■ Read status byte

Command:	***STB**?
Parameters:	None
Response:	\<Value\> 0...255
Comment:	Query only

■ **Perform self-test**

Command: ***TST**?

Parameters: None

Response: <Pass/Fail 1>,<Pass/Fail 2>...<Pass/Fail 13>
0 = PASS   1 = FAIL

1	Sum bit	8	+15 V
2	GSM loop	9	+4.9 V
3	GSM 1800-Loop	10	−10 V
4	+3 V	11	+5 V loop
5	+5 V	12	+5 V IQ
6	V$_{CC}$	13	+Synth. Sync.
7	−18 V		

Comment: Query only

Sample program

Single-band mobilte phone

Command (abbreviated)	Response (tester)	Comment
*CLS		;Clear status report
CONF:CSYS GSM		;Select GSM system
CONF:GSM:BS:CCH:ARFC 63		;Channel 63 is CCH
CONF:GSM:BS:TCH:ARFC 27		;Channel 27 is TCH
CONF:GSM:MS:CCH:PLEV 9		;MS transmits on CCH with power level 9
CONF:GSM:MS:TCH:PLEV 9		;MS transmits on TCH with power level 9
SYST:SETT:PATT:LEV 1.5,1.5		;Preattenuation for TX/RX: 1.5 dB
RFG:GSM:LEV -60		;Output level of 4100S: –60 dBm
CALL:MSOR		;Establish connection from MS
CALL:MSIN:IMSI?	001011234567890	;Read IMSI
CALL:MSIN:IMEI?	445200516624260	;Read IMEI
CALL:MSIN:NUMB?	1234567890	;Read number dialed
MEAS:ARR:RFTR:GRO:ALL:MAV? 10	...6.79e+00,2.42e+00,-1e+00	;transmit measurements, 10x, average
MEAS:RFTR:TEMP?	0,0,0,0,0	;Power-time template = PASS!
RFG:GSM:LEV -102		;Output level: –102 dBm
CONF:GSM:BER:ERR:COUN 4000		;Number of samples for BER measurement
MEAS:RFR:RBER:C2:LIM:FAIL? 2.44,0	0	;BER = PASS!
RFG:GSM:LEV -80		;Output level: –80dBm
CONF:GSM:BS:TCH:ARFC 120		;TCH = 120
CONF:GSM:MS:TCH:PLEV 5		;MS power level = 5
MEAS:RFTR:POW?	3.27e+01	;Power measurement
MEAS:RFTR:POW:UNIT?	dBm	;Read unit
CALL:BSR		;Hang up from 4100S
SYST:ERR:COUN?	0	;Error queue: no errors
SYST:COMM:LOC		;Switch 4100S to local mode
		;END

Dual-band mobile phone

Command (abbreviated)	Response (tester)	Comment
*CLS		;Clear status report
CONF:SYST GSM900,GSM1800		;Select GSM900/1800 system
CONF:GSM900:BS:CCH:ARFC 63		;GSM900 Channel 63 is CCH
CONF:GSM1800:BS:TCH:ARFC 698		;GSM1800 Channel 698 is TCH
CONF:GSM900:MS:CCH:PLEV 9		;MS transmits on CCH GSM900 with power level 9
CONF:GSM1800:MS:TCH:PLEV 5		;MS transmits on GSM1800 TCH with power level 5
CONF:GSM900:MS:TCH:PLEV 10		;MS transmits on GSM900 TCH with power level 10
CONF:GSM900:PATT:LEV 1.5,1.5		;GSM900 preattenuation for TX/RX: 1.5 dB
CONF:GSM1800:PATT:LEV 2.0,2.0		;GSM1800 preattenuation for TX/RX: 2.0 dB
RFG:GSM900:LEV -60		;GSM900 output level of 4107S: –60 dBm
RFG:GSM1800:LEV -60		;GSM1800 output level of 4107S: –60 dBm
CALL:MSOR		;Establish connection from MS
CALL:MSIN:IMSI?	001011234567890	;Read IMSI
CALL:MSIN:IMEI?	445200516624260	;Read IMEI
CALL:MSIN:NUMB?	1234567890	;Read number dialed
MEAS:RFTR:POW?	2.10e+01	;Single power measurement
MEAS:RFTR:TEMP?	0,0,0,0,0	;Power-time template = PASS!
RFG:GSM1800:LEV -102		;GSM1800, TCH output level: –102 dBm
CONF:GSM1800:BER:ERR:COUN 4000		;GSM 1800, number of samples for BER measure.
MEAS:RFR:RBER:C2:LIM:FAIL? 2.44,0	0	;BER = PASS!
RFG:GSM1800:LEV -80		;GSM1800, TCH output level: –80dBm
CONF:GSM900:BS:TCH:ARFC 120		;GSM900, TCH = 120
CONF:GSM900:MS:TCH:PLEV 5		;MS power level = 5
MEAS:RFTR:FREQ?	2.3e+01	;Single frequency error measurement
MEAS:RFTR:FREQ:UNIT?	Hz	;Read unit
CALL:BSR		;Hang up from 4107S
SYST:ERR:COUN?	0	;Error queue: no errors
SYST:COMM:LOC		;Switch 4107S to local mode
		;END

Quick reference

Convention **{ }**   If a command sequence include braces, these enclose the name of a table. The required entry must be taken from the table indicated.

						MEASure
Query unit	**MEAS**ure	{meas. val.}	{unit}	?		
Single measurement	**MEAS**ure	{meas. val.}	{stats}	?		
Single measurement with limit assessment (Pass/Fail)	**MEAS**ure	{meas. val.}	{stats}	{limit}		
Multiple measurement	**MEAS**ure	:**ARR**ay	{meas. val.}	{stats}	?	<number>
Multiple measurement with limit assessment (Pass/Fail)	**MEAS**ure	:**ARR**ay	{meas. val.}	{stats}	{arraylimit}	
Table: **{meas. val.}** for MEASure						
Transmit measurements						
Measurement of all values	:**RFTR**ansmit		:**GRO**up		:**ALL**	
Peak phase error	:**RFTR**ansmit		:**PPE**ak			
RMS phase error	:**RFTR**ansmit		:**PRMS**			
Frequency error	:**RFTR**ansmit		:**FREQ**uency			
Burst length	:**RFTR**ansmit		:**LENG**th			
RF power (peak power)	:**RFTR**ansmit		:**POW**er			
Power-time template	:**RFTR**ansmit		:**TEMP**late			
Receive measurements						
Class II: RBER II (residual mode)	:**RFR**eceive		:**RBER**		:**C2**	
FER (residual mode)	:**RFR**eceive		:**RBER**		:**FER**	
Table: **{unit}** for MEASure						
Query unit set	:**UNIT**	?				
Table: **{stats}** for MEASure						
Return current measurement	done automatically					
Return average value	:**MAV**erage					
Table: **{limit}** for MEASure						
Pass/fail query with new values for upper <limu> and lower <liml> limits (for this measurement only)	:**LIM**it	:**FAIL**	?	<limu>,<liml>		
Table: **{arraylimit}** for MEASure						
Pass/fail query with new values for upper <limu> and lower <liml> limits (for this measurement only)	:**LIM**it	:**FAIL**	?	<number of measurements>,<limu>,<liml>		

						RFGenerator
Query output level	**RFG**enerator	{System}	:**LEV**el	?		
Set output level	**RFG**enerator	{System}	:**LEV**el	<Value>		
GMSK modulation on (sequence of 1s)	**RFG**enerator	{System}	:**MOD**ulation	:**STAT**e	ON	
GMSK modulation off	**RFG**enerator	{System}	:**MOD**ulation	:**STAT**e	OFF	
Query modulation status	**RFG**enerator	{System}	:**MOD**ulation	:**STAT**e	?	
Table: **{System}** for RFGenerator						
GSM / E-GSM	:**GSM**					
GSM 1800 (PCN)	:**PCN**					
GSM 1900 (PCS)	:**PCS**					

						CONFigure
Which system is activated?	**CONF**igure	:**CSYS**tem	?			
Activate GSM system	**CONF**igure	:**CSYS**tem	GSM			
Activate PCN system	**CONF**igure	:**CSYS**tem	PCN			
Activate PCS system	**CONF**igure	:**CSYS**tem	PCS			
Activate GSM+PCN system	**CONF**igure	:**CSYS**tem	GSM,PCN			
Activate GSM+PCS system	**CONF**igure	:**CSYS**tem	GSM,PCS			
Which system is activated?	**CONF**igure	:**SYST**em	?		The **SYST** command acts in the same way as the **CSYS** command. The only difference lies in the names of the various radio systems	
Activate GSM900 system	**CONF**igure	:**SYST**em	GSM900			
Activate GSM1800 system	**CONF**igure	:**SYST**em	GSM1800			
Activate GSM1900 system	**CONF**igure	:**SYST**em	GSM1900			
Activate GSM900+1800 system	**CONF**igure	:**SYST**em	GSM900,GSM1800			
Activate GSM900+1900 system	**CONF**igure	:**SYST**em	GSM900,GSM1900			
Query CCH number	**CONF**igure	{System}	:**BS**	:**CCH**	:**ARFC**n	?
Set CCH number	**CONF**igure	{System}	:**BS**	:**CCH**	:**ARFC**n	<Value>
Query TCH number	**CONF**igure	{System}	:**BS**	:**TCH**	:**ARFC**n	?
Set TCH number	**CONF**igure	{System}	:**BS**	:**TCH**	:**ARFC**n	<Value>
Query TCH power level	**CONF**igure	{System}	:**MS**	:**TCH**	:**PLEV**el	?
Set TCH power level	**CONF**igure	{System}	:**MS**	:**TCH**	:**PLEV**el	<Value>
Asynchronous Mode on	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**STAT**e	ON
Asynchronous Mode on (Fast Power)	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**STAT**e	FPOWER
Asynchronous Mode off	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**STAT**e	OFF
Query Asynchronous Mode	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**STAT**e	?
Async. Mode auto-synchronization on	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**ASE**arch	:**STAT**e	ON
Async. Mode auto-synchronization off	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**ASE**arch	:**STAT**e	OFF
Async. Mode auto-synchronization status	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**ASE**arch	:**STAT**e	?
Set Async. Mode auto-synchronization time	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**ASE**arch	:**TIME**	<Value>

Async. Mode auto-synchronization status	**CONF**igure	{System}	:**BS**	:**ABUR**st	:**ASE**arch	:**TIME**	?
Query CCH power level	**CONF**igure	{System}	:**MS**	:**CCH**	:**PLEV**el	?
Set CCH power level	**CONF**igure	{System}	:**MS**	:**CCH**	:**PLEV**el	<Value>
Set RX/TX preattenuation	**CONF**igure	{System}	:**PATT**enuation		:**LEV**el	<RX value>,<TX val.>
Query RX/TX preattenuation	**CONF**igure	{System}	:**PATT**enuation		:**LEV**el	?
Query audio loopback setting	**CONF**igure	{System}	:**AUD**io	[:**EFR**ate]	:**LOOP**back	?
Audio loopback on	**CONF**igure	{System}	:**AUD**io	[:**EFR**ate]	:**LOOP**back	ON
Audio loopback off	**CONF**igure	{System}	:**AUD**io	[:**EFR**ate]	:**LOOP**back	OFF
Query number of frames for BER	**CONF**igure	{System}	:**BER**	:**ERR**or	:**COUN**t	?
Set number of frames for BER	**CONF**igure	{System}	:**BER**	:**ERR**or	:**COUN**t	<Value>
Query number of frames for FER	**CONF**igure	{System}	:**BER**	:**FER**rasure	:**COUN**t	?
Set number of frames for FER	**CONF**igure	{System}	:**BER**	:**FER**rasure	:**COUN**t	<Value>

Table: **{System}** for CONFigure	
GSM / E-GSM	:**GSM**
GSM 1800 (PCN)	:**PCN**
GSM 1900 (PCS)	:**PCS**

				CALL
Establish connection from the tester	**CALL**	:**BSOR**iginate		
Clear connection from the tester	**CALL**	:**BREL**ease		
Establish connection from MS	**CALL**	:**MSOR**iginate		
Clear connection from MS	**CALL**	:**MREL**ease		
RX level, measured by MS	**CALL**	:**MSIN**fo	:**RXL**evel	?
RX qual., measured by MS	**CALL**	:**MSIN**fo	:**RXQ**ual	?
Telephone number, only when connection established by MS	**CALL**	:**MSIN**fo	:**NUMB**er	?
Read IMSI	**CALL**	:**MSIN**fo	:**IMSI**	?
Read IMEI	**CALL**	:**MSIN**fo	:**IMEI**	?
Read mobile power class	**CALL**	:**MSIN**fo	:**MSCL**ass	?
Query phase 1 or phase 2 support	**CALL**	:**MSIN**fo	:**RLEV**el	?
Query SMS support	**CALL**	:**MSIN**fo	:**SMS**	?
Query support for extended frequency range	**CALL**	:**MSIN**fo	:**EFR**equency	?
Query A5 algorithms used	**CALL**	:**MSIN**fo	:**A5**	?
Classmark 3: Query status	**CALL**	:**MSIN**fo	:**CM3**	?
Extension bit: Query status	**CALL**	:**MSIN**fo	:**EBIT**	?
Multiband: Query status	**CALL**	:**MSIN**fo	:**MBAN**d	?
Query MS Power Class 1 (multiband)	**CALL**	:**MSIN**fo	:**ARC1**	?
Query MS Power Class 2 (multiband)	**CALL**	:**MSIN**fo	:**ARC2**	?

					STATus
Read operation status register	**STAT**us	**:OPER**ation	[**:EVEN**t]	?	
Read signaling status register	**STAT**us	**:OPER**ation	**:SIGN**alling	[**:EVEN**t]	?
Read questionable status register	**STAT**us	**:QUES**tionable	[**:EVEN**t]	?	
Meaning of the register bits					
Operation status register					
0	CALibrating: The tester has performed calibration				
1-3	reserved				
4	MEASuring: The tester has performed a measurement				
5-7	reserved				
8	Composite signaling status register				
9-12	reserved				
13	INSTrument Summary Bit: Indicates that an operational status has been set				
14	PROGram running: The tester has run an Autorun program				
15	This bit is always set to 0				
Signaling status register					
0	Idle: The tester is in idle mode, signaling is deactivated				
1-5	reserved				
6	Call Active: The tester is currently in call mode				
7	Closed Loop: The tester has switched the MS to test mode (BER or AFLOOP)				
Questionable status register					
0-4	reserved				
5	FREQuency: Synthesizer is not in a steady state				
6-7	reserved				
8	CALibration: Error occurred during calibration				
9	This bit is set in the event of a remote timeout or if the operation is aborted manually with [ESCAPE]				
10-12	reserved				
13	INSTrument Summary Bit: Indicates that a QUEStionable status has been set				
14	Command Warning: Invalid command was not executed				
15	This bit is always set to 0				

					SYSTem
Read error message from error queue (code + text)	**SYST**em	**:ERR**or	[**:NEXT**]	?	
Query number of error messages in error queue	**SYST**em	**:ERR**or	**:COUN**t	?	
Read error message from error queue (code only)	**SYST**em	**:ERR**or	**:CODE**	[**:NEXT**]	?

Read entire error queue (code only)	**SYST**em	**:ERR**or	**:CODE**	**:ALL**	?
Switch from remote to local	**SYST**em	**:COMM**unicate	**:LOC**al		
Activate timeout	**SYST**em	**:COMM**unicate	**:SER**ial	**:TIM**eout	**:STAT**e	ON
Deactivate timeout	**SYST**em	**:COMM**unicate	**:SER**ial	**:TIM**eout	**:STAT**e	OFF
Query timeout status	**SYST**em	**:COMM**unicate	**:SER**ial	**:TIM**eout	**:STAT**e	?
Set timeout duration (in seconds)	**SYST**em	**:COMM**unicate	**:SER**ial	**:TIM**eout	<second>
Query timeout duration status	**SYST**em	**:COMM**unicate	**:SER**ial	**:TIM**eout	?
Set system date	**SYST**em	**:DATE**	<year>,<month>,<day>		
Query system date	**SYST**em	**:DATE**	?		
Set system time	**SYST**em	**:TIME**	<hour>,<minute>,<second>		
Query system time	**SYST**em	**:TIME**	?		
Set RX/TX preattenuation	**SYST**em	**:SETT**ings	**:PATT**enuation	**:LEV**el	<RX value>, <TX value>
Query RX/TX preattenuation	**SYST**em	**:SETT**ings	**:PATT**enuation	**:LEV**el	?

		CALibration
Start calibration prior to TX measurements	**CAL**ibration	[**:ALL**]

	General commands
Clear status register	***CLS**
Set event status register mask for deriving sum bit in status byte	***ESE**
Query mask	***ESE**
Read event status register (see below)	***ESR**
Read device ID	***IDN**
Execute reset	***RST**
Read status byte (see below)	***STB**
Perform self-test	***TST**
Event status register: Meaning of the register bits	
0 Operation Complete: Set when all queued commands have been executed	
1 reserved	
2 Query Error: Set when a query error has occurred (Error code = –400 through –499)	
3 Device Dependent Error: Set when a device-specific error has occurred (Error code = –300 through –399)	
4 Execution Error: Set when an execution error has occurred (Error code = –200 through –299)	
5 Command Error: Set when a command error has occurred (Error code = –100 through –199)	
6 reserved	
7 Power On: Set when the tester is powered up	

Status byte: Meaning of the bits	
0-1	reserved
2	Error Queue: Errors have been stored in the error queue
3	Composite questionable status register
4	reserved
5	Composite event status register
6	reserved
7	Composite operation status register

6
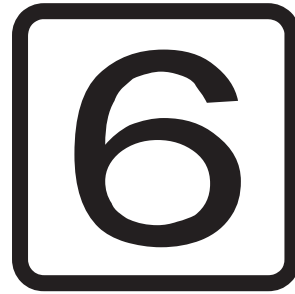
APPENDIX

Technical data

RF generator

Frequency spectrum   921 to   960 MHz (GSM 900, E-GSM, GSM-R)
1805 to 1880 MHz (GSM 1800)
1930 to 1990 MHz (GSM 1900)

Generator output level

4107 model   GSM 900:   −45 to −110 dBm (< 1.5 dB)

GSM 1800/1900:   −50 to −110 dBm (< 1.5 dB)

4107S model   GSM 900:   −45 to −110 dBm (< 1.0 dB)

GSM 1800/1900:   −50 to −110 dBm (< 1.0 dB)

Generator frequency error   1 ppm

TX measurement

Frequency spectrum   876 to   915 MHz (GSM 900, E-GSM, GSM-R)
1710 to 1785 MHz (GSM 1800)
1850 to 1910 MHz (GSM 1900)

Frequency error measurement[1]   within 5 kHz offset from carrier
GSM 900:   < 25 Hz
GSM 1800/1900:   < 50 Hz

RF power measurement (burst)   +39 to −20 dBm (< 1.5 dB) usable up to +45 dBm

Phase error measurement[1]   within measurement range 1.5 to 20° rms
GSM 900:   < 1.5° rms
GSM 1800/1900:   < 2.5° rms (< 2.0° rms 4107S model)
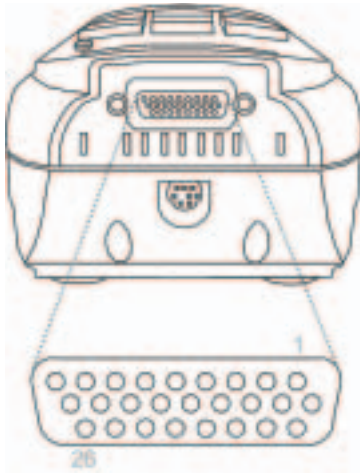
[1]) Average of 10 measurements

General data

Size   250 mm x 110 mm x 95 mm

Weight   1.5 kg

Permitted storage temperature   −30 °C to +50 °C

Working temperature   +15 °C to +35 °C
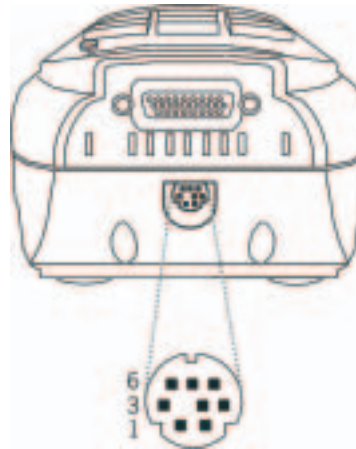
Interfaces

HD sub-26 socket

The HD sub-26 socket acts as both an RS-232-C port (PC) and a Centronics port (printer).

Position and pin layout of the HD sub-26 socket

Pin allocation of the HD sub-26 socket			
Pin (socket)	Allocation	Pin (cable)	
1	DCD	1	R S 2 3 2 C
2	RXD	2	
3	TXD	3	
4	DTR	4	
8	GND	5	
5	DSR	6	
6	RTS	7	
7	CTS	8	
8,26	GND	19 – 29, 33	C e n t r o n i c s
9	Strobe	1	
10	Select Input	36	
11	Reset	31	
12	–	–	
13	Ack	10	
14	Busy	11	
15	Paper End	12	
16	Select	13	
17	Fault	32	
18	D0	2	
19	D1	3	
20	D2	4	
21	D3	5	
22	D4	6	
23	D5	7	
24	D6	8	
25	D7	9	

Pin (cable): pin allocation on the plug-in connectors of the attached cable

Mini-DIN socket

The 8-pin mini-DIN socket is used to attach the accompanying power supply unit. The design of the connector and the socket ensures that polarity reversal is not possible.

⚠ When plugging the connector into the socket, be sure to observe the mechanical coding on the socket and the connector. If these do not match, the connector will not fit into the socket. Do not use force! Use only the original power supply unit.

Pin allocation on the mini-DIN socket	
Pin (socket)	Allocation
1,2,3,4	+5.5 V
5,6,7,8	GND (floating)

Position and pin layout of the mini-DIN socket

TNC socket

The TCN socket can optionally be used to attach an antenna (extra accessory) or the supplied RF adapter cable (standard accessory) (both with TNC connector).

☞ Always fasten the TNC connector's coupling ring securely by hand to ensure perfect contact. Otherwise measurements may not be reproducible and reliable.

Make sure that the contact surfaces of the TNC plug-in connector are kept clean (to ensure secure contact).

Position of the TNC socket

Printing

● AUTOTEST logs (detailed listing of all measurements taken with planned and actual values), see also page 3-7.

● The current configuration of your Willtek 4100 (serial number, firmware version, etc.), see also page 2-10.

■ **Printer requirements**

● Any model of printer is usable unless the printer works under DOS but needs no DOS driver. If AUTOTEST logs containing graphics (e.g. company logos) you will require an Epson or HP (Hewlett Packard) printer, or one which understands the graphics command sets of these two makes. Please consult your printer's manual for more details.

● Standard Centronics interface (36-pin socket on printer).

● Option of setting a monospace font (e.g. `Courier`, where all characters have the same width). Please consult your printer's manual for more details here.
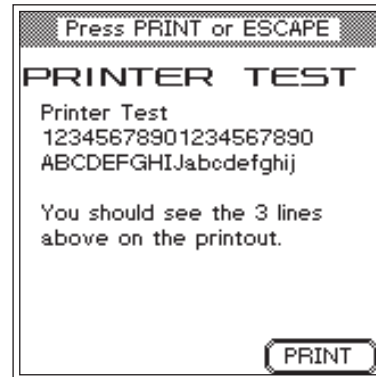
■ **Connecting a printer**

① Switch off both your Willtek 4100 and the printer.

② Connect the 26-pin plug of the Willtek 4100 with the 36-pin Centronics socket on your printer. If necessary, you can use extra accessories, such as the "Universal adapter cable" (`384 877`) or "Centronics adapter cable" (`384 876`). Other extensions available on the market are also acceptable, provided the overall length of a cable does not exceed approx. 5 meters (see page 6-3 for pin layout).

■ **Testing the printer**

This test tells you whether your Willtek 4100 is able to communicate with the printer.

```
Press PRINT or ESCAPE

PRINTER  TEST

Printer Test
12345678901234567890
ABCDEFGHIJabcdefghij

You should see the 3 lines
above on the printout.

                    PRINT
```

⇐

SETUP + *Self check* + ENTER + *Printer test* + ENTER

① Switch on your Willtek 4100 and the printer. Make sure that the printer is ready to start printing (enough paper, online/ready message or lamp).

② Call the *PRINTER TEST* menu on the tester. Press PRINT to start testing.

③ If the three test lines appear on the printout, data communications between the two devices are generally functioning correctly. If you encounter problems when printing AUTOTEST logs later on (missing graphics, formatting errors), the next section provides a few tips on troubleshooting.

④ Back with ESCAPE .

■ **Troubleshooting**

Printer does not respond Complete failure is generally the result of the printer being connected incorrectly or the use of an unsuitable printer. Driver problems – as often experienced with PCs – can be excluded, as the tester outputs pure ASCII data (during the printer test).

– If you are using an extension cable, repeat the printer test, this time without an extension.
– Make sure that all cables are firmly plugged into their respective sockets.
– Check that the printer is functioning correctly by connecting it to a PC and then printing something from an installed word processing program (remember to set the right printer driver on the PC first).
– The printer is a Windows printer which (unlike a DOS printer) is unable to interpret the pure ASCII data. If no DOS printer is available, first export the test logs to a PC (see page 6-16) and then print them to a Windows printer from the PC.

Bad characters   If the printer's output is garbled, select *ASCII* in the tester's *PRINTER* menu.

Bad formatting   AUTOTEST logs are formatted in such a way that e.g. all *PASS/FAIL* readings are listed in clearly arranged lines one beneath the other. For this to happen, however, a monospace font such as `Courier` must be set on your printer. If your printer is set to a proportional font, the above formatting will not work. Please consult your printer's manual for information on how to switch fonts.
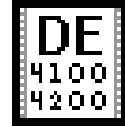

Correct formatting with a monospace font

```
Call from Basestation        PASS
   Power Time template       PASS
   TX power                  PASS
```

Incorrect formatting with a proportional font

Call from Basestation   PASS
  Power Time template   PASS
  TX power   PASS

Data transfer between the tester and the PC

de4x00.exe

The Windows software "4X00 Data Exchange" offers you an easy way of transfering data between your Willtek 4100(S) and a PC:

● **Firmware update:** Load your tester with new firmware which you have downloaded from the Willtek web site, for instance (see also page 6-26).

● **MS TYPE list:** Copy test specifications for mobile phones from one tester to any number of other testers (including user-defined AUTOTESTs). This saves the time-consuming entry of identical test specifications on the target devices.

● **Test logs:** Export the AUTOTEST logs saved in the tester to a PC, for instance to back up the data or for statistical evaluation of the test logs.

● **AUTOTEST:** Import of all user-defined AUTOTESTs created using the 4100 utility software (optional) and made available on the Internet, for instance.

■ **Where can I get the software?**

www.willtek.com   4X00 Data Exchange (de4X00.exe) is provided on the accompanying CD. The current version is available on the Internet.

Installing the software

Save the file de4X00.exe in any directory on your PC's hard disk. No setup procedure is required. The first time it is started, the program creates an INI file in the installation directory. This file is relevant when exporting test logs in Excel format (see page 6-18).
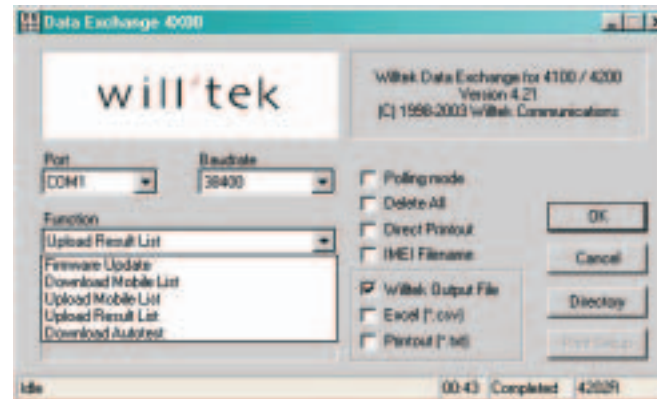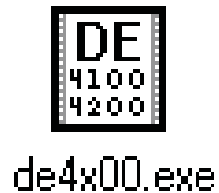
Preparation

No matter what type of data transfer you are planning, the necessary preparations are always the same.

1 Switch off the PC and your tester.

2 Connect the 26-pole connector on the tester to a free COM port on the PC (COM1... COM255). Suitable cables can be found in the additional accessories in the form of the universal adapter cable (384 877) or the serial adapter cable (384 875).

3 Switch on the PC and the tester. On the tester, call up the *SERIAL PORT* menu.

SETUP + *Serial port* + ENTER

4 Choose a baud rate (see also page 2-7).

5 Start the 4X00 Data Exchange on your PC by double clicking on `de4x00.exe`.
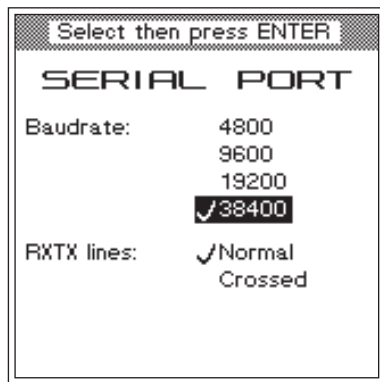
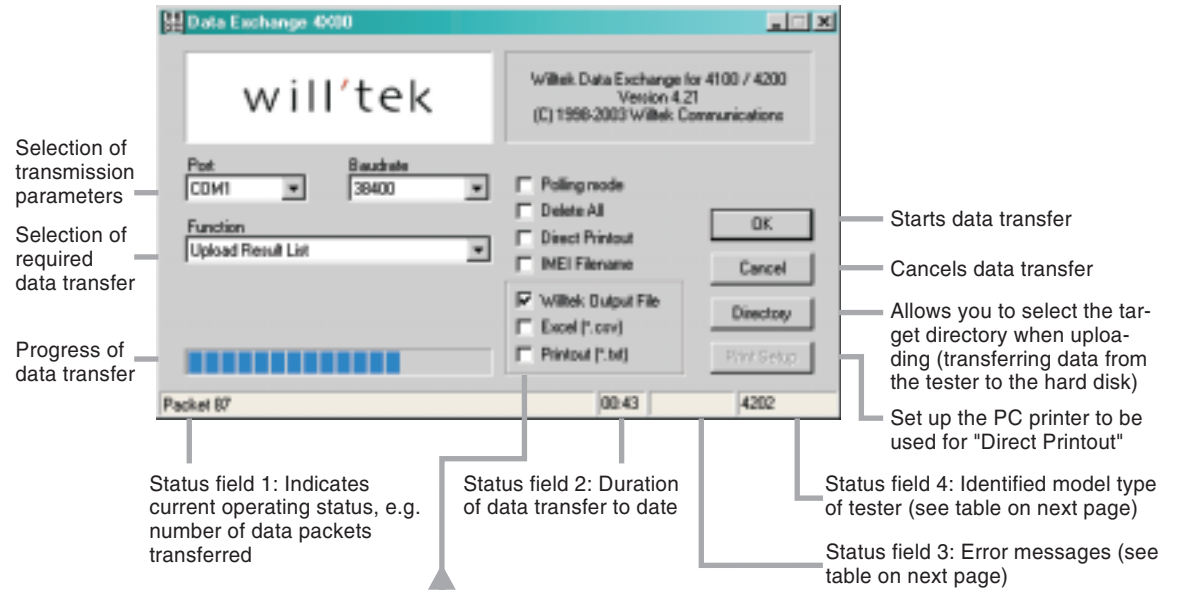6 Select the COM port used and the baud rate previously set on the tester with the **Port** and **Baudrate** menus.

This completes the preparations. You can now perform one of the types of data transfer between the tester and the PC as described below.

6-9

The Program window

Selection of
transmission
parameters

Selection of
required
data transfer

Progress of
data transfer

Starts data transfer

Cancels data transfer

Allows you to select the tar-
get directory when uploa-
ding (transferring data from
the tester to the hard disk)

Set up the PC printer to be
used for "Direct Printout"

Status field 1: Indicates
current operating status, e.g.
number of data packets
transferred

Status field 2: Duration
of data transfer to date

Status field 4: Identified model type
of tester (see table on next page)

Status field 3: Error messages (see
table on next page)

Options for Function = Upload Result List	Polling mode	Export individual test logs (Willtek 4200 only).
	Delete All	Once test logs have been exported (see page 6-16), all test logs are automatically deleted on the tester.
	Direct Printout	Print out test logs on the PC printer (see page 6-16 to find out how to set up the printer with [Print Setup]).
	IMEI Filename	All text logs are merged on export into a container file (box not checked) or are exported individually, in which case the IMEI of each log determines the file name used. Details: see page 6-17.
	Willtek Output File Excel (*.csv) Printout (*.txt)	Selection of output files which are created when exporting test logs. In most cases the output in Excel and/or Printout format (both are text files) is sufficient. For special evaluations the original raw data can be stored in addition (more from page 6-18 on).

■ No data transfer?

If no data is transferred between the tester and the PC, the message `Timeout` appears in status field 4 after approximately 2 seconds. In this event, you should check the following:

– Is the tester connected to the correct COM port?
– Are the cables seated properly?
– Is the same baud rate set at the tester and in the 4X00 Data Exchange program?
– Are the `RXTX lines` and `Protocol` settings correct on the tester? If you are using original cables, choose the settings `Normal` and `X-ON / X-OFF`.
– Is the baud rate too high for the PC interface (only with older PCs)?

☞ If data transfer fails, switch off your Willtek 4100 briefly before trying again in order to ensure stable operating conditions.

■ Error messages

Status field 3	
Aborted	Data transfer canceled by user
Timeout	Tester is not reacting to requests from the program
Completed	Data transfer completed successfully
Out of sync	Aborted because sender and receiver are out of synchronization
Unknown	Aborted for unknown reason
NACK	Sender requests retransmission of an acknowledgement (Non Acknowledge)
CRC Error	Aborted due to invalid checksum
Status field 4	
4XXX	Identified model type of tester
Timeout	No response from the tester
Unknown	Unknown model

Performing a firmware update
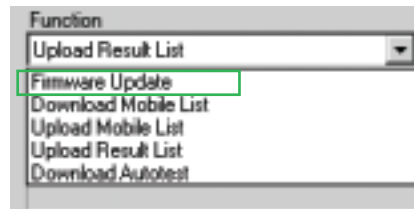
1. Completed the preparations (see page 6-9)? Then choose **Firmware Update** from the **Function** list box in 4X00 Data Exchange.
2. Confirm the settings by clicking the [OK] button.
3. After you click [OK], Windows displays the standard file open dialog box. Since you want to perform a firmware update, the file type *.BIN has already been entered in the appropriate field.
4. Double clicking on the BIN file starts the load process. If an error occurs, please refer to page 6-11.

*Standard dialog box for opening the firmware file *.BIN under Windows 95/98 (shown here in German). If the file (msw_0211.bin in the example) is not shown immediately, you must first open the right folder as described in your Windows documentation.*
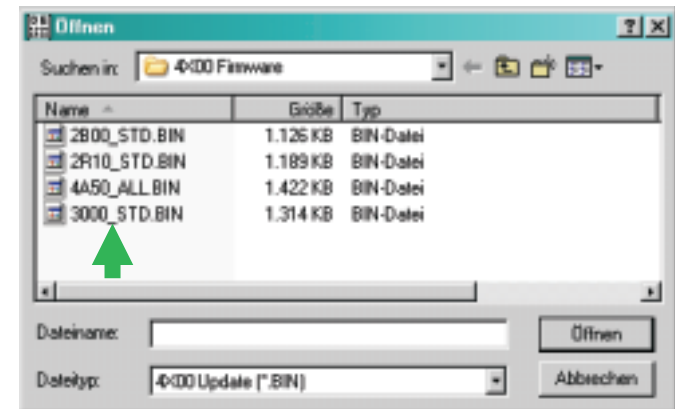
5. As soon as data transfer is complete, the Willtek 4100 restarts automatically.
6. On the tester, call up the menu *SYSTEM INFORMATION*. If the new firmware version is shown there, the update has been successful.

■ **Abortion during an update**

If data transfer is aborted when performing a firmware update (e.g. because the tester was switched off), the exact time at which the operation was aborted determines the subsequent reaction.

● If the update is aborted early, the SETUP settings and any stored test logs are lost, but otherwise the tester starts as usual (with the previous version of the firmware).

● If the update is aborted late, the tester will only display a prompt to start a download. In this event, restart the load procedure from the PC by double clicking on the firmware file.

Copying MS TYPE records

Function
Upload Result List

Firmware Update
Download Mobile List
Upload Mobile List
Upload Result List
Download Autotest
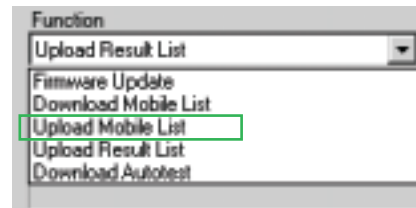
☞ *The file name of the MS TYPE record depends on the device, as it always indicates the MCU serial number of the tester from which the MS TYPE list comes in order to allow unique identification (see also page 2-10). The file name extension is always AUT.*

If you wish to transfer a long list of MS TYPE records including user-defined AUTOTESTs from one tester to another, you must first export the MS TYPE list. The resulting AUT file can then be transferred by floppy, email or Internet. The recipients then import the file into the target unit.

■ **Exporting an MS TYPE list to PC**

1 Completed the preparations (see page 6-9)? Then choose *Upload Mobile List* from the *Function* list box in in 4X00 Data Exchange.

2 Click [Directory] and select the hard disk directory you want.

3 Confirm your settings by clicking on [OK] in 4X00 Data Exchange.

4 After you have clicked on [OK], the MS TYPE records start to be uploaded from the tester to the PC. This can be seen by the message *REMOTE* on the display of the Willtek 4100 and by the *Packet* counter in status field 1 of the program. If an error occurs, please refer to page 6-11.

You can, for instance, now send the record to the recipient by email. The recipient in turn uses the 4X00 Data Exchange software to import the record from the PC to their Willtek 4100.

⚠ When you export an MS TYPE list, any existing MS TYPE list already stored in the target directory will be overwritten without any confirmation. You can avoid this by renaming the existing file or by moving it to a different directory.
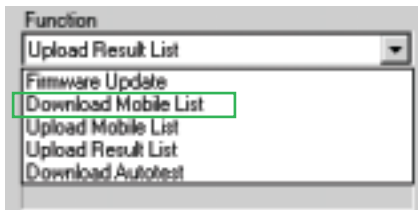
■ Importing an MS TYPE list from the PC

1. Completed the preparations on the target unit (see page 6-9)? Then choose *Download Mobile List* from the *Function* list box in in 4X00 Data Exchange.

2. Confirm your settings by clicking on [OK] in 4X00 Data Exchange.

3. After you click [OK], Windows displays the standard file open dialog box (see also page 6-12). Since you want to load an MS TYPE list, the file type *.AUT has already been entered in the appropriate field. In this dialog box, open the directory containing the AUT file you wish to import.

   ⚠ When you import an MS TYPE list, all existing MS TYPE lists and user-defined AUTOTESTs are deleted from the target unit. This data can be backed up if you export the MS TYPE list from the target unit beforehand.

4. Double clicking on the AUT file starts the load process. If an error occurs, please refer to page 6-11.

5. As soon as the data transfer is complete, the newly imported MS TYPE records, including the user-defined AUTOTESTs are ready to use immediately.

Exporting test logs
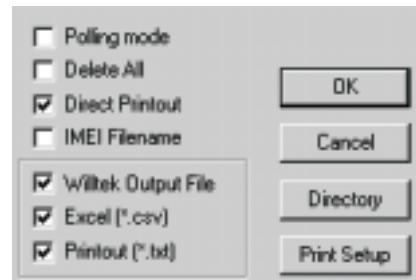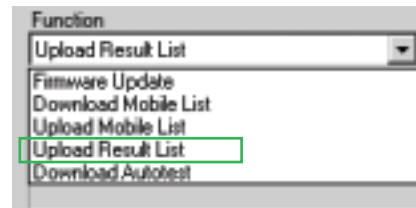
Test logs stored in the memory of a Willtek 4100 during an AUTOTEST can be exported to a PC where they can be archived or statistically evaluated, for instance.

1️⃣ Completed the preparations (see page 6-9)? Then choose *Upload Result List* from the *Function* list box in 4X00 Data Exchange.

2️⃣ Select the required export options using the mouse pointer by checking the ☐ box as required. The export options are described below.

3️⃣ Click [Directory] and select the hard disk directory you want.

4️⃣ Confirm your settings by clicking on [OK] in 4X00 Data Exchange.

5️⃣ After you have clicked on [OK], the test logs start to be uploaded from the tester to the PC. This can be seen by the message *REMOTE* on the display of the Willtek 4100 and by the *Packet* counter in status field 1 of the program. If an error occurs, please refer to page 6-11.

■ **Export options**

Polling mode   Not available for Willtek 4100 (Willtek 4200 only).

Delete All   **With** ✓: After export to a PC, all test logs on the tester are automatically deleted (to increase the available memory space).
Without ✓: The logs are retained on the tester.

Direct Printout   **With** ✓: Functions identically to `Printout (*.txt)`, but the TXT file (test results) is also output on the PC or network printer. Set up the printer with [Print Setup].
Without ✓: No printout.

IMEI Filename

This export option has a dual effect: It extracts all text logs from the Willtek Output File and affects the way in which file names are assigned automatically on export.

Willtek Output File
A Willtek Output File (ALL file, see also page 6-18) contains the raw data of all exported test logs. All other export files are therefore simply derived from the ALL file. If the ALL file is divided into individual test logs (using an export option IMEI Filename), the same number of RES files are created as there are logs in the ALL file.

These RES files, too, still contain raw data that is difficult to interpret. Only once the Data Exchange program has expanded the raw data using INI files (formatting, text), the more comprehensible TXT and CSV files are created from the ALL file or the RES files (see page 6-18).

With ✓: All test logs in the Willtek Output File (ALL file) are extracted automatically and saved as separate files with the suffix **RES** (Result). The RES files still contain raw data. Thus, it is advisable to select the export option Excel or Printout (or both) in addition. This also produces separate test logs, but they are saved in TXT and/or CSV file format, which is more easily interpreted.

Names are assigned to RES, TXT and CSV files automatically, according to the following pattern:

IMEI_HHMMSS_DDMMYYYY

IMEI	IMEI number of the tested mobile phone (see page 4-30).
HHMMSS	The time the test took place: Hour-Minute-Seconds.
DDMMYY	The time the test took place: Day-Month-Year.

Without ✓: No RES files are extracted from the ALL file. Since the export files (ALL, TXT, CSV) are now containers for several test logs, names are assigned according to the following pattern:

AAA_BBBB

Example of name assignment
143_153.ALL: File will contain all logs which were stored in the tester between 23 May (143rd day of the current year) and 2 June.

143_0952.ALL: File will contain all logs which were stored in the tester on 23 May. The most recent (final) log to enter the file is the one stored in the tester at 9.52 in the morning.

AAA	Day counter (1 through 365): The day on which the oldest AUTOTEST log was stored in the tester.
BBBB	Day counter (1 through 0365): The day on which the most recent AUTOTEST log was stored in the tester,
	or (if all logs are stored on the same day)the time of day at which the most recent AUTOTEST log was stored in the tester.

`Willtek Output File`   **With ✓**: Test logs are exported in the form of an ALL file (see also page 6-17). This is a text file with unprocessed raw data (for an example, see page 6-20). The ALL file is a container which holds all test logs that were saved in the tester at the time of export.
Without ✓: The ALL file is not created.

`Excel (*.csv)`   **With ✓**: Test logs are exported in the form of a CSV text file formatted for import into a spreadsheet program (separator: semicolon). The identifiers (see page 6-28) are expanded to include plain-text explanations on the basis of the `DE4X00.INI` file (see page 6-8) (identifier A15 is expanded to include MS Power Level, for instance). Page 6-20 shows the appearance of such a CSV file.

Tip: `DE4X00.INI` *can be loaded in standard ASCII text editors, where it can be edited and saved. Thus, if terms such as MS Power Level are translated, the explanations will appear in the local language.*

The [Excel column] and [Excel row] sections in the file `DE4X00.INI` determine how the CSV file is prepared for viewing in Excel (definition of the column titles and the way in which the rows are presented for each test result). Only when these specifications have been made will the tabular representation of the data be clear. The following extract from a table of this type illustrates how the column and row definitions in the INI file shown on the left) affect the appearance of the Excel spreadsheet.

[Excel column]

	1	2	3	4	5	6	7		39
				Time	Date	Result	MSTYPE name	...	Printout
A01	Test name	Demotest	02:36:19	12.05.03	Fail	Mobile XYZ		
A02	Mobile inf...	00101123...						
A03	Tester inf...	4107						
...								
A42	Question...	Pull antenna...			Pass			O.K.

4 Time
5 Date
6 Result
7 MSTYPE name
8 Autotest name
...
38 Question ID
39 Printout

[Excel row]
A01;Test name;4,5,6:PASS:FAIL,7,8,9,10:Cable:Antenna:Coupler,11:Standard:User
A02;Mobile information;12,13,14,15::Phase 1:Phase 2,16:No:Yes,17:No:Yes,18
A03;Tester information;19,20,21,22
A10;Call from mobile;6:PASS:FAIL
...
A42;Question box;38,6:PASS:FAIL,39

`Excel (*.csv)`   **Without** ✓: The CSV file is not created.

`Printout (*.txt)`   **With** ✓: Text logs are exported in the same form that they would have if they were printed to paper (simulated printout). The resulting export file is a text file (TXT). Any text editors or word processing programs can be used to view the simulated printout.

Without ✓: The TXT file is not created.

■ **Examples of exported test logs**

The following examples show two identical records exported once as an ALL file (top) and once as a CSV file (bottom). The file `DE4X00.INI` (see page 6-8) modifies the ALL file in such a way that it can be represented clearly and understandably under Excel. If a record contains several test logs, A01 always indicates the start of the next log.

```
A01;02:36:19,05.10.98,1,AA GSM STANDARD,GSM 900 Standard,1,0,0
A03;Willtek 4107S,212044,USER NAME,USER COMPANY,3a00
A23;A,B,63,15.0,13.0
A23;A,T,3,15.0,13.0
A23;B,T,45,15.0,13.0
A23;C,T,123,15.0,13.0
A21;-80.0
A22;63
A16;1,3
A15;0,9
A10;1
```

```
;;;Time;Date;Result;MSTYPE name;Autotest name;Tested network;
Connection;Test;IMSI;IMEI;MS class;MS Revision;Extended frequency;
Short message capability;A5 ciphering support;Tester model;Serial
number;User name;User company;Level;TCH;TX Pre attenuation (dB);RF
level;Broadcast no;Channel ID;Channel type;Channel no;RX pre att
(dB);TX pre att (dB);Dialed digits;Reference digits;Measured;Low
limit;High limit;Question ID;Printout;
A01;Test name;;02:36:19;05.10.98;FAIL;AA GSM STANDARD;GSM 900
Standard;1;Cable;Standard;
A03;Tester information;;;;;;;;;;;;;;;;;Willtek 4107S;212044;USER
NAME;USER COMPANY;3a00;
A23;Pre att by MSType;;;;;;;;;;;;;;;;;;;;;;;;;A;B;63;15,0;13,0;
A23;Pre att by MSType;;;;;;;;;;;;;;;;;;;;;;;;;A;T;3;15,0;13,0;
A23;Pre att by MSType;;;;;;;;;;;;;;;;;;;;;;;;;B;T;45;15,0;13,0;
A23;Pre att by MSType;;;;;;;;;;;;;;;;;;;;;;;;;C;T;123;15,0;13,0;
A21;RF output level (dBm);;;;;;;;;;;;;;;;;;;;;;;-80,0;
A22;Broadcast channel;;;;;;;;;;;;;;;;;;;;;;;63;
A16;Traffic channel;;;;FAIL;;;;;;;;;;;;;;;3;
A15;MS power level;;;;PASS;;;;;;;;;;;;;;;9;
A10;Call from mobile;;;;FAIL;
```

Importing AUTOTESTs
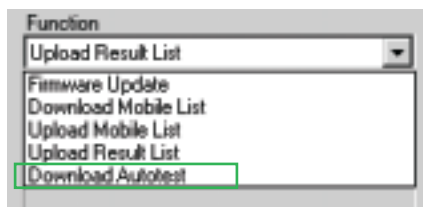
The 4100 utility software (optional) allows you to simply create user-defined AUTOTESTs and to save them as DLD files (Down Load Data). This means that if, for instance, a telephone vendor makes a file of this type available to you on the Internet, you will be able to import it into your Willtek 4100.

1 Have you made all the preparations (see page 6-9)? Then choose **Download Autotest** from the **Function** drop-down list in 4X00 Data Exchange.

2 When you click [OK], the standard Windows file open dialog box appears (see also page 6-12). Since you want to import an AUTOTEST, the file type *.DLD has already been entered in the appropriate field. In the dialog box, open the directory containing the DLD file you want to import.

3 Double-click on the DLD file to open a window with a list of all the user-defined AUTOTESTs stored on your tester.
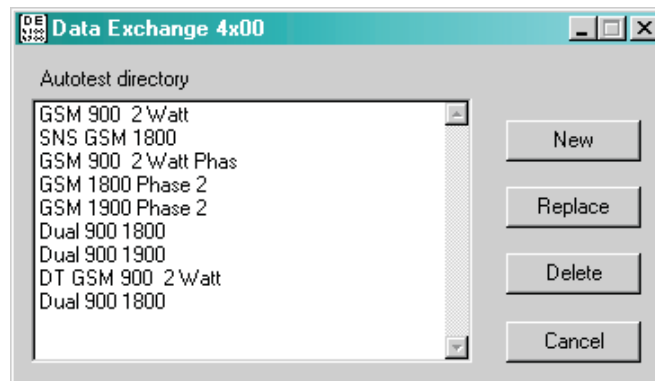
4 If you want to insert the new test, click on [New]. If you want to overwrite an existing test, click on the name of the test you want to overwrite and then click on [Replace]. Click on [Delete] to cancel the presently marked AUTOTEST, and with [Cancel] you close the window without performing any action.

6-21

The fact that the AUTOTEST is being downloaded from the PC to the tester can be seen by the message *REMOTE* on the display of the Willtek 4100 and by the *Packet* counter in status field 1 of the program. In the event of an error, refer to page 6-11.

Command line parameters

Syntax:

The 4x00 Data Exchange program recognizes command line parameters that trigger the required action automatically when the program is started.

`de4x00.exe –Fn –Cn –Bn –P"path \ file name" –Mxn`

Example*: The program should update the firmware of a Willtek 4100 automatically and should use the COM1 port and a transfer rate of 38400 baud. The corresponding program call is:*

`de4x00.exe –F0 –C1 –B38400`
`–P"C:\Update\V400.bin"`

–Fn	Function (n = 0 to 4)	
	–F0	Firmware Update
	–F1	Download Mobile List
	–F2	Upload Mobile List
	–F3	Upload Result List
	–F4	Download Autotest
–Cn	Port (n = 1 to 255)	
	–Cn	COMn
–Bn	Baudrate (n = 4800 to 38400)	
	–B4800	4800 Baud
	–B9600	9600 Baud
	–B19200	19200 Baud
	–B38400	38400 Baud
–P"Path or file name" Entry depends on the selected function		
	Firmware Update	File name of the update
	Download Mobile List	File name of the mobile list
	Upload Mobile List	Target folder of the mobile list
	Upload Result List	Target folder of the result list
	Download Autotest	File name of the AUTOTEST
–Mxn	Upload Result modes (x = P,D,E,T, I or W) (n = 0 or 1)	
	–MP0	Polling mode off (Willtek 4200 only)
	–MP1	Polling mode on (Willtek 4200 only)
	–MD0	Delete All off
	–MD1	Delete All on
	–ME0	Excel file off
	–ME1	Excel file on
	–MT0	Printout file off
	–MT1	Printout file on
	–MI0	IMEI filename off
	–MI1	IMEI filename on
	–MW0	Willtek Output File off
	–MW1	Willtek Output File on

■ **General notes**

– Invalid paramters are ignored.
– If a parameter is missing, the program will assume the most recently used value.
– If no function (*-Fn*) is declared, the required function has to be selected manually after starting the program.
– If the *Firmware Update*, *Download Mobile List* or *Download Autotest* functions are called up without the parameter *-P*, the program expects a file name to be selected/entered manually after starting.
– Once the program has been executed, the program is closed automatically.
– The program logs command line actions in the file `de4x00.log`.

Upgrading your model

Information for on-site upgrade

☞ *If you opt for a rapid, on-site upgrade, we will need the following information:*

1. *The model designation of your tester (e.g.4107).*
2. *The serial number and (if shown), the MCU version number of your tester (see page 2-10).*

You will receive from us a complete upgrade package (software) including upgrade instructions and the latest User Guide.

For details of prices please contact your nearest Willtek office or Distributor.

For various models in the Willtek 4100 series Willtek offers an upgrade to the next model. This allows you to respond to changing requirements.

■ **On-site upgrade or service centre?**

You can perform all upgrades yourself (short downtime). To clarify details, please contact the nearest sales office or the Company from which you obtained your Willtek 4100 (central contact addresses are shown on the back cover and on the Willtek Web site on the Internet under http://www.willtek.com).

Available upgrades			
from	⇨	to	Order no.
WAVETEK 4103**	⇨	Willtek 4107	897 121
WAVETEK 4104**	⇨	Willtek 4107	897 121
WAVETEK 4105**	⇨	Willtek 4107	897 121
WAVETEK 4106**	⇨	Willtek 4107	897 123
WAVETEK 4107**	⇨	Willtek 4107S*	897 122
ACTERNA 4107**/Willtek 4107	⇨	Willtek 4107S*	897 122
Willtek 4107L	⇨	Willtek 4107	call
Willtek 4107L	⇨	Willtek 4107S	call
WAVETEK 4103S**	⇨	Willtek 4107S	897 121
WAVETEK 4104S**	⇨	Willtek 4107S	897 121
WAVETEK 4105S**	⇨	Willtek 4107S	897 121
WAVETEK 4106S**	⇨	Willtek 4107S	897 123

*) Factory upgrade also available. Advantage: the device will be recalibrated free of charge and will then achieve the greater precision of the original Willtek 4107S.

**) Model no longer in production.

Updating the firmware

Updating the firmware will erase all SETUP settings and all the test logs stored in the tester (for details on backing up test logs, see page 6-16). The MS TYPE list and all AUTOTESTs are retained.

To a large extent, it is the firmware which is responsible for determining the performance characteristics of your Willtek 4100. Willtek continually maintains this software, providing new versions at intervals free of charge. Making use of these firmware updates provides you with new or optimized features.

■ **This is how to get your update package**

● **Internet:** If you have access to the Internet, you can download the latest firmware from Willtek's Web site (from the download area) to your PC. From there, you can upload it to your tester. The address of our Web site is:

http://www.willtek.com

The files of the update package are all stored in a self-extracting file with the name:

```
4100XXXX.EXE
```

ID of firmware version

● **Direct sales:** Contact the sales office from whom you obtained your Willtek 4100. In order to identify the firmware currently installed in your tester, it is a good idea to have the information which is displayed in the SYSTEM INFORMATION menu at the ready (see page 2-10).

6-26

■ To update you will need these

● A PC with Windows 95/98 or later.

● An update package.

● A connecting cable between the PC and your Willtek 4100. Suitable cables are available as extra accessories, namely the Universal adapter cable (384 877) or the Serial adapter cable (384 875).

● A free COM port on the PC (serial interface).

■ Contents of the update package

You can unpack the update package to any directory on you hard disk. You can also subsequently move the files to other directories.

A firmware update comprises a number of files. The most important are as follows:

● **DE4X00.EXE**   Windows program (4X00 Data Exchange) responsible for uploading the firmware files from the PC to your Willtek 4100. The program is also used for exchanging user data (test logs, MS TYPE list) between the PC and the tester.

● **XXXX.BIN**   Firmware file valid for any model of the Willtek 4100 series (the correct model is detected automatically when the update is carried out).

● **README.TXT**   Text file with accompanying information. This may include the latest installation notes which differ from those listed in the manual.

■ Performing the update

Refer to the information as of page 6-12 for details on performing a firmware update with the Windows 4X00 Data Exchange program.

The code used in log listings

Read from top to bottom, a log reflects exactly the chronological sequence of events in an AUTOTEST. Each log begins with the identifier A01. In "ALL" files, this identifier marks the beginning of a new log.

The tables below show the meaning of each identifier, along with its associated data (the data in the same line).

General information = A01

Field type	Example	Information
Identifier	A01;	
Test ID (time)	10:14:42	Time of test start
Test ID (date)	07.03.97	Date of test start
Overall Test Result	0	0=PASS, 1=FAIL
MS TYPE Name	BLUE MOBILE	Name from MS TYPE list
AUTOTEST Name	GSM STANDARD	Name of the performed test
Tested network	1	1=GSM900 2=GSM1800 3=GSM900+1800 4=GSM1900 5=GSM900+1900 7=GSM900+1800+1900
Connection	0	0=Cable, 1=Antenna 2=Coupler
Test type	0	0=Standard 1=User

Mobile information = A02

Identifier	A02;	
IMSI	001011234567890	Subscriber id
IMEI	490402810032110	Mobile id
MS class	4	Power class of mobile
MS revision	1	1=Phase 1, 2=Phase 2
Extended frequency	0	0=No, 1=Yes
Short message capability	0	0=No, 1=Yes
A5 cyphering support	1	0 to 7 1=A5/1, 2=A5/2, 4=A5/3

Identifier	A02;	
Classmark 3 info	1	0=Classmark 3 not available 1=Classmark 3 available
Extension Bit status*	0	0=No, 1=Yes
Multiband info*	5	0=single band mobile 5=GSM900+1800 6=E-GSM900+1800
MS Pwr class 1*	4	valid for (E-)GSM900
MS Pwr class 2*	1	valid for GSM1800
MS Pwr class 1900*	3	valid for GSM1900 (Tri-band only)
EFR Speech mode	1	0=Only FR available 1=EFR available
*) Only if Classmark 3 is available		

Tester information = A03

☞ *The identifiers are not always numbered sequentially: any gaps you may find are intentional.*

Identifier	A03;	
Tester model	4106	Model
Tester serial number	120025	Serial number
User name	MILLER	
User company	Willtek	
Firmware version	2.10	

Call from mobile = A10

Identifier	A10;	
Result	0	0=PASS, 1=FAIL

Call from base station = A11

Identifier	A11;	
Result	1	0=PASS 1=FAIL

Release from mobile = A12

Identifier	A12;	
Result	0	0=PASS 1=FAIL

Release from base station = A13

Identifier	A13;	
Result	0	0=PASS 1=FAIL

MS power level = A15

Identifier	A15;	
Result	0	0=PASS, 1=FAIL
Level	5	Power level
A FAIL result stands for a failed MS power level change signaling sequence. A PASS result means a setting or a correct signaling sequence.		

Traffic channel = A16

Identifier	A16;	
Result	0	0=PASS, 1=FAIL
TCH	27	Traffic channel
A FAIL result stands for a failed handover signaling sequence. A PASS result means a setting or a correct signaling sequence.		

Pre-att. defined by AUTOTEST = A20

Identifier	A20;	
RX value	1.5	Dimension dB
TX value	1.5	Dimension dB

410x RF output level = A21

Identifier	A21;	
Value	–60.0	Dimension dBm

Broadcast channel = A22

Identifier	A22;	
Value	63	

Pre-att. defined by MS TYPE = A23

Identifier	A23;	
Channel ID	A	A, B, C, D, E, F, G, H or I
Channel type	T	T=Traffic channel B=Broadcast channel
Channel	63	
RX value	1.5	Dimension dB
TX value	1.5	Dimension dB

Dialled number = A30

Identifier	A30;	
Result	0	0=PASS, 1=FAIL
Dialled digits	123456789	Transmitted from mobile
Reference digits	123456789	

Power/Time Template = A31

Identifier	A31;	
Total result	0	0=PASS, 1=FAIL
Models 4107S only		
Total result	0	0=PASS, 1=FAIL
Rising edge res.	0	0=PASS, 1=FAIL
Middle area res.	0	0=PASS, 1=FAIL
Falling edge res.	0	0=PASS, 1=FAIL
Burst information (answer 1 to 3 in asynchronous mode only)	1	0=No information 1=With training sequ. 2=All other GMSK bursts 3=Contin. GMSK signal

TX power = A32

Identifier	A32;	
Result	0	0=PASS, 1=FAIL
Measured	34.0	Dimension dBm
Low limit	29.0	Dimension dBm
High limit	37.0	Dimension dBm

RMS phase = A33

Identifier	A33;	
Result	0	0=PASS, 1=FAIL
Measured	2.77	Dimension degrees
Low limit	0.00	Dimension degrees
High limit	8.50	Dimension degrees

Peak phase = A34

Identifier	A34;	
Result	0	0=PASS, 1=FAIL
Measured	9.33	Dimension degrees
Low limit	0.00	Dimension degrees
High limit	22.50	Dimension degrees

Frequency error = A35

Identifier	A35;	
Result	0	0=PASS, 1=FAIL
Measured	37	Dimension Hz
Negative limit	−115	Dimension Hz
Positive limit	115	Dimension Hz

Burst length = A36

Identifier	A36;	
Result	0	0=PASS, 1=FAIL
Measured	559	Dimension μs
Low limit	543	Dimension μs
High limit	563	Dimension μs

RX level = A37

Identifier	A37;	
Result	0	0=PASS, 1=FAIL
Measured	52	
Low limit	46	
High limit	54	

RX quality = A38

Identifier	A38;	
Result	0	0=PASS, 1=FAIL
Measured	0	
Low limit	0	
High limit	1	

BER = A39

Identifier	A39;	
Result	0	0=PASS, 1=FAIL
Measured	0.20	Dimension %
Low limit	0.00	Dimension %
High limit	1.50	Dimension %

AF loop = A40

Identifier	A40;	
Result	0	0=PASS, 1=FAIL
Speech mode	1	0=FR, 1=EFR

FER = A41

Identifier	A41;	
Result	0	0=PASS, 1=FAIL
Measured	0.20	Dimension %
Low limit	0.00	Dimension %
High limit	1.50	Dimension %

Quest. box def. in AUTOTEST = A42

Identifier	A42;	
Question Identifier	1	
Result	0	0=PASS, 1=FAIL
Printout	BATTERY	

Input box defined in AUTOTEST = A43

Identifier	A43;	
Input Identifier	4	
User input	123456789	e.g. UUT serial number

User break = A50

Identifier	A50;	
Fail flag	1	Signals with (BREAK) disrupted connection

Troubleshooting

Basic settings lost ▪ To store the basic settings, the 4100 series of testers use a powerful capacitor, not a battery. If a tester is left switched off for more than about 14 days, the energy reserves may drain away. The tester must be switched on in order to load the capacitor. Simply supplying power via the power supply unit whilst the tester is switched off is not sufficient. To restore lost settings, see chapter 2.

Display is blank ▪ Contrast correctly set?
▪ Supply voltage present?

Mobile phone does not recognize tester ▪ Test SIM correctly mounted?
▪ Battery in mobile phone OK?
▪ Correct radio system (GSM/PCN/PCS)?
▪ Tester's RF output level set to maximum value (*BS Power Level*)?
▪ In the case of a wireless connection: is the distance between the tester and the mobile phone less than approx. 50 cm?
▪ In the case of a cable-based connection: are you using the correct RF adapter and is this installed correctly?

Print problems ▪ See page 6-6.

SETUP + *Self check* + ENTER + *System info* + ENTER

Please have the information on this menu ready when contacting Willtek for product support (Press PRINT to start printing the menu).

Tests not reproducible
- Test channels (BCCH and TCH) are being used by nearby base stations?
- Battery in mobile phone OK?
- In the case of a wireless connection: are there any metallic objects lying between the tester and the mobile phone?
- In the case of Universal Antenna Coupler: are there any nearby base stations on same channels as test frequencies? Is the mobile phone fitting snugly in the cradle/clamp?

Willtek 4100 Timeline

The chronological timeline tells you what modifications have been made to the firmware (FW) and the User Guide. After a firmware update the timeline helps you to find out quickly about all major changes (see code).

FW	Manual Version	Code C = Correction I = Important Note N = New Feature M = Modified Comment		See Chapter
1.10	9706-110-A	-	First edition of the manual	–
1.22	9711-122-A	N	Automatic text entry for input lines like in the USER DEFINITIONS menu	2
		N	Possibilty to enable or disable sounds	2
		N	Connection via the new accessory universal antenna coupler	2
		N	Automatic start for AUTOTESTs via MS TYPE menu	3
		N	Copying records of MS TYPE incl. AUTOTEST to another tester	3
		N	BER/FER measurement now with direct entry of power level	4
		N	New identifier A41 and A42 for log listings	6
		N	Compensation values for pre-attenuation separated in RX/TX	4
		N	Compensation values for pre-attenuation with channel relationship (MS TYPE only)	3
		N	Up to 20 user-defined AUTOTESTs selectable in menu	3
		N	$\rightarrow$ and $\leftarrow$ jumps to the end and the top of numerical sorted test results list	3
		N	Question boxes in user-defined AUTOTESTs	3
		C	Sporadic blocking of internal calibration after starting an AUTOTEST	–
		C	DELETE immediately after an AUTOTEST deletes the false test result	3
		C	Menu MS Info shows false results for Rev. Level and A5 Support	4
1.23	9711-122-A	C	Bug fixes	–
2.00	9712-200-A	M	Chapter 5 describes all features of the 4100S series	5
		N	4100S series only: in FAULT FIND mode detailed diagnostic of power/time template	4
		N	4100S series only: asynchronous test mode for mobiles	5
		N	4100S series only: remote control with SCPI commands	5
		I	Additional information about upgrade possibilities	6
		C	Bug fixes	–
		N	Free windows software "4100 Result Loader" available on Willtek's web site	6
	9801-200-A	I	SIM card damage warning	2
		C	Calculation of compensation values (pre-attenuation) now separated in GSM/PCN/PCS	3
	9802-200-B	N	RF generator in Asynchronous Mode available	5
2.10 ▼	9805-210-A	N	Setup PRINTER screen with entry fields for lines per page and top free lines	2
		N	New SCPI commands for fast measurements in Asynchron. Mode (e.g. FPOWER)	5

FW	Manual Version	Code	C = Correction I = Important Note N = New Feature M = Modified	See Chapter
			Comment	
2.10	9805-210-A	N	New Axx identifiers A43 (input box) and A50 (user break)	6
		M	Identifier A03 additionally signals the firmware version of the 4100(S) model	6
2.11	9808-211-A	C	Bug fixes (model 4105 only)	–
3.00	9810-300-A	N	Test of dual-band mobiles with new 4107(S) model	3/4
		M	Additional information about dual-band mobiles in the MS Info menu	4
		N	Two ways of identifying radio systems within SCPI commands (eg PCN or GSM1800)	5
		N	Additional SCPI command for setting pre-attenuation depending on radio system	5
		N	Additional SCPI commands (queries) for dual-band tests	5
		N	Data transfer between the tester and the PC with Windows Data Exchange program	6
		M	Data Exchange description replaces section "Downloading AUTOTEST logs to a PC"	6
		M	Changements at identifiers A01, A02 and A23	6
	9905-300-B	M	Description of enhanced Data Exchange program	6
3.10	9906-310-A	N	Pre-attenuation input range extended to ±50 dB	–
		C	Bug fixes	–
	9907-310-B	M	Description reduced to models 4105, 4107*light*, 4107 and 4107S	all
3.11	9908-311-A	C	Bug fixes	–
3.12	0003-320-A	M	Description reduced to models 4107 and 4107S	all
		C	Bug fixes	–
		M	The year date can now be entered as a 4-digit number	–
		N	GSM-R frequency range added (channel number 955 through 974)	3/4
3.20	0003-320-A	N	Questionable Status Register: bit 9 indicates remote timeout and [ESCAPE] abort	5
		I	Cell Broadcast: message identifier will be sent on page = 0	4
		N	(REPEAT) added to AUTOTEST result screen	3
		N	Audio loopback test now with Full Rate (FR) and Enhanced Full Rate mode (EFR)	4/5
		N	(COPY) simplifies identical entries for pre-attenuation at MS TYPE configuration	3
		N	Speech mode EFR added at identifier A40	6
		C	Bug fixes	–
		I	Printout: Notes for usability of DOS and Windows printers	2/6
	0004-320-A	I	Crossreference from timeout description to bit 9 of the Questionable Status Register	5
		C	Bug fixes (operating manual only)	all
3.21	0005-321-A	C	EFR/FR switching works now with all types of mobiles trouble-free	–
3.22	0010-322-A	C	Bug fix related to internal HW/SW	–
3.30 ▼	0106-330-A	N	The test set now supports multiband radio systems (GSM900+1800+1900)	4
		M	Start of an AUTOTEST from now on only via menu MS TYPE	3
		N	Capacity of the display to show AUTOTEST results enlarged to 15 channels	3

FW	Manual Version	Code	C = Correction I = Important Note N = New Feature M = Modified	See Chapter
			Comment	
3.30	0106-330-A	C	Bug fixes	–
		N	Detailed result display of stored AUTOTESTs	3
	0107-330-A	M	Minor changements in the manual only	–
	0109-330-A	M	SIM adapter from plug-in to full-size format no longer part of the standard items	1/6
	0202-330-A	N	New RF Shield II available	6
3.31	0207-331-A	M	Renaming of the brand from Acterna to Willtek	all
3.32	0210-332-A	C	Bug fixes	–
3.33	0211-333-A	C	Corrected the allocation of channel numbers in Autotest Results	3
	0304-333-A	M	Description of new Data Exchange software version 4.00	6
		N	Product range extended with model Willtek 4107L	1
		I	Declaration of EU Conformity moved to new Getting Started manual	6
3.40	0312-341-A	N	4x00 Data Exchange (4.20): full COM-port support and direct printout feature	6
		N	4x00 Data Exchange (4.21): new export option Willtek output file	6
		M	4x00 Data Exchange (4.21): modified file extensions for Excel/Printout output files	6
		N	4x00 Data Exchange (4.21): new button to delete a selected AUTOTEST	6
		C	Bug fixes	–
		M	RF Shield III available and new power supply 860 105	–
3.41		C	Bug fixes	–

Accessories and options

■ Standard accessories

Order number	Description
M 860 188	Test SIM, plug-in format
M 860 105	Power supply unit with power cord and connecting cable for Willtek 4100
M 860 409	RF adapter cable (1.5 m) *Purpose: connecting cable between any RF adapter (extra accessory) and a Willtek 4100*
M 295 012	Getting Started manual
M 897 055	CD with User Guide in PDF format

■ Extra accessories

Order number	Description
M 860 XXX	RF adapters for different mobile phones (see page 6-40)
M 248 330	Universal Antenna Coupler (see page 2-18)
M 248 340	RF Shield III (TNC-TNC) *Purpose: Shielded box which isolates the Universal Antenna Coupler from external electromagnetic disturbances.*
M 248 399	RF Shield package (248 330 + 248 340)
M 860 261	Antenna, 900 MHz
M 860 262	Antenna, 1.8/1.9 GHz *Purpose: wireless testing of mobile phones*
M 384 876	Centronics adapter cable (2.5 m). *Purpose: attaching a printer with a Centronics interface to a Willtek 4100*
M 384 875	Serial adapter cable (D-Sub 9; 2.5 m) *Purpose: attaching a PC with an RS-232-C port to a Willtek 4100*
M 384 877	Universal adapter cable (RS-232-C/Centronics) *Purpose: attaching a Willtek 4100 to the serial port of a PC and to a printer (parallel port)*
M 860 252	Carrying case
M 860 251	Shoulder bag

■ Options

M 897 110   Utility Software plus User Guide
             Purpose: menu-driven creation of user-defined
             AUTOTESTs with individual selection of the range of
             testing of the limits for PASS/FAIL assessment

M 897 12X   Upgrade to Willtek 4107 model (see page 6-25)

M 897 12X   Upgrade to Willtek 4107S model (see page 6-25)

RF adapters

Owing to the great number of different mobile phones, RF adapters are required to perform cable-based testing. These adapters join the mobile phone's RF connection to the RF adapter cable attached to the tester. For precise measurements Willtek strongly recommend to use an RF adapter.

⚠ Mobile-specific RF adapter cables are available from the mobile's manufacturer or from Willtek. Please contact your local Willtek representative for available adapters.

However, should the RF adapter for your mobile not be at hands, the air connection with the Universal Antenna Coupler (extra accessory) offers a simple-to-use alternative for quick tests (see chapter 2). In conjunction with the RF Shield III (extra accessory) precise measurements can be achieved without interference. For reproducible test results Willtek strongly recommend to use the RF Shield III.

Overview GSM threshold values

This User Guide contains various references to the permissible threshold values for mobile telephones (according to the GSM standard specification). These values are summarized in tabular form below.

Power classes

RF power classes					
Code digit	**1**	**2**	**3**	**4**	**5**
GSM/E-GSM	43 dBm	39 dBm	37 dBm	33 dBm	29 dBm
PCN/GSM1800	30 dBm	24 dBm	36 dBm	–	–
PCS/GSM1900	30 dBm	24 dBm	33 dBm	–	–

Power level/RF power

Highlighted values: When the power level corresponds to the power class of the mobile phone, then the tolerances shall be ±2.0 dB.

Power level/RF power/permissible tolerances								
GSM/E-GSM			**GSM 1800 (PCN)**			**PCS (GSM 1900)**		
0	43 dBm	±2 dB	29	36 dBm	±2 dB	29	res.	–
1	41 dBm	±3 dB	30	34 dBm	±3 dB	30	33 dBm	±2 dB
2	39 dBm	±3 dB	31	32 dBm	±3 dB	31	32 dBm	±3 dB
3	37 dBm	±3 dB	**0**	30 dBm	±3 dB	**0**	30 dBm	±3 dB
4	35 dBm	±3 dB	1	28 dBm	±3 dB	1	28 dBm	±3 dB
5	33 dBm	±3 dB	2	26 dBm	±3 dB	2	26 dBm	±3 dB
6	31 dBm	±3 dB	**3**	24 dBm	±3 dB	**3**	24 dBm	±3 dB
7	29 dBm	±3 dB	4	22 dBm	±3 dB	4	22 dBm	±3 dB
8	27 dBm	±3 dB	5	20 dBm	±3 dB	5	20 dBm	±3 dB
9	25 dBm	±3 dB	6	18 dBm	±3 dB	6	18 dBm	±3 dB
10	23 dBm	±3 dB	7	16 dBm	±3 dB	7	16 dBm	±3 dB
11	21 dBm	±3 dB	8	14 dBm	±3 dB	8	14 dBm	±3 dB
12	19 dBm	±3 dB	9	12 dBm	±4 dB	9	12 dBm	±4 dB
13	17 dBm	±3 dB	10	10 dBm	±4 dB	10	10 dBm	±4 dB
14	15 dBm	±3 dB	11	8 dBm	±4 dB	11	8 dBm	±4 dB
15	13 dBm	±3 dB	12	6 dBm	±4 dB	12	6 dBm	±4 dB
16	11 dBm	±5 dB	13	4 dBm	±4 dB	13	4 dBm	±4 dB
17	9 dBm	±5 dB	14	2 dBm	±5 dB	14	2 dBm	±5 dB
18	7 dBm	±5 dB	15	0 dBm	±5 dB	15	0 dBm	±5 dB
19	5 dBm	±5 dB	–	–	–	–	–	–

Rx Level

Equivalent code numbers/RF receive levels (dBm)					
0	< −110	22	−89 to −88	44	−67 to −66
1	−110 to −109	23	−88 to −87	45	−66 to −65
2	−109 to −108	24	−87 to −86	46	−65 to −64
3	−108 to −107	25	−86 to −85	47	−64 to −63
4	−107 to −106	26	−85 to −84	48	−63 to −62
5	−106 to −105	27	−84 to −83	49	−62 to −61
6	−105 to −104	28	−83 to −82	50	−61 to −60
7	−104 to −103	29	−82 to −81	51	−60 to −59
8	−103 to −102	30	−81 to −80	52	−59 to −58
9	−102 to −101	31	−80 to −79	53	−58 to −57
10	−101 to −100	32	−79 to −78	54	−57 to −56
11	−100 to −99	33	−78 to −77	55	−56 to −55
12	−99 to −98	34	−77 to −76	56	−55 to −54
13	−98 to −97	35	−76 to −75	57	−54 to −53
14	−97 to −96	36	−75 to −74	58	−53 to −52
15	−96 to −95	37	−74 to −73	59	−52 to −51
16	−95 to −94	38	−73 to −72	60	−51 to −50
17	−94 to −93	39	−72 to −71	61	−50 to −49
18	−93 to −92	40	−71 to −70	62	−49 to −48
19	−92 to −91	41	−70 to −69	63	> −48
20	−91 to −90	42	−69 to −68	−	−
21	−90 to −89	43	−68 to −67	−	−

Rx Qual(ity)

Equivalent code digits/BERs*			
0	< 0,2 %	1	0.2 % to 0,4 %
2	0.4 % to 0,8 %	3	0.8 % to 1,6 %
4	1.6 % to 3,2 %	5	3.2 % to 6,4 %
6	6.4 % to 12,8 %	7	> 12.8 %

*) BER, measured by the mobile phone. Not to be confused with the tester's BER measurement.

BER/FER

Permissible limits for BER/FER			
RF level	**Phone**	**BER**	**FER**
−100 dBm	all	0.00 %	–
−104 dBm	P > 2 W	< 2.44 %	–
−102 dBm	P ≤ 2 W	< 2.44 %	0.10 %

Channel numbers

Permissible channel numbers (BCCH and TCH)	
GSM	0001 through 0124
E-GSM	0000 and 0975 through 1023
GSM-R	0955 through 0974
GSM 1800	0512 through 0885 (even numbers only*)
GSM 1900	0512 through 0810 (odd numbers only*)
*) Characteristic of the tester	

Frequency error

Permissible frequency error		
GSM/E-GSM	**GSM 1800 (PCN)**	**GSM 1900 (PCS)**
≤ ±90 Hz	≤ ±180 Hz	≤ ±180 Hz