# Application Note

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## Testing mobiles faster with the 2935

by Peter Jennings

In the GSM repair field, there is an ever-present need to improve efficiency. This is not just so as to improve the turn-around of mobiles, but also to be able to maximize the return on capital equipment. One way in which efficiency can be improved is to minimize the time taken in testing a mobile phone.

There are three ways in which the user of an Aeroflex 2935 GSM test set can achieve faster test times, with no degradation in test accuracy:

1. Use test scripts that have been optimized for speed.

2. Use the new High Speed Test option, 02.

3. Use both.

This Application Note concentrates on the first of these. It provides simple guidelines on how best to optimize test sequences for speed. It shows typical time savings that can be made by following the guidelines, and also the additional improvements that can be made through using the High Speed Test option, 02.

## Guidelines for speed-optimized scripts

The guidelines for increasing test speed do not involve changing the accuracy (and hence the validity) of the test; they simply involve re-ordering the sequence.

### 1. Minimizing the effect of changing RF generator level

Changes to the 2935's RF generator level have a delaying effect on the results of some tests, proportional to the magnitude of the level change. The implications of this are:

(a) If testing the mobile over a range of RF generator levels, then minimize the size of each level change. This can be done by increasing (or decreasing) the level progressively, as opposed to arbitrarily jumping from a low level to a high one and back again.

(b) Assuming that the effective running of the script is unaffected, a change in RF generator level should be followed by setup statements or protocol changes, rather than parametric tests. In particular, if using the High Speed Test option, then RxLEV and RxQUAL tests should be left as long as possible after a change of generator level.

The following segments from 'standard' and speed-optimized ('HS') scripts illustrate the latter point:

```
:
Set_RF_Gen_Level -80.0
:
Page_Mobile 1 1
Set_MS_Power Highest
Test_Speech_Quality
Set_TCH_Mode RBER
Set_RF_Gen_Level_By_Class -104.0 -102.0
Measure_Power
Measure_Power_Profile
Measure_Timing
Measure_Tx_Freq
Measure_RMS_Phase
Measure_Peak_Phase
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
Measure_Rx_RBER2
Set_RF_Gen_Level -80.0
Measure_RxLev
Set_MS_Power  9
Set_TCH_Mode TalkBack
:
```

**'Standard'**

'Measure_RxLev' called immediately after RF Gen Level change. Test has to wait for hardware to settle.

```
:
Set_RF_Gen_Level -80.0
:
Page_Mobile 1 1
Set_MS_Power Highest
Test_Speech_Quality
Set_TCH_Mode RBER
Measure_RxLev
Set_RF_Gen_Level_By_Class -104.0 -102.0
Measure_Power
Measure_Power_Profile
Measure_Timing
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
Measure_Rx_RBER2
Set_RF_Gen_Level -80.0
Set_TCH_Mode TalkBack
:
```

**'HS'**

'Measure_RxLev' called long after RF Gen Level change. Hardware already settled, so result available immediately.

### 2. Minimizing the effect of changing test settings

Non-optimized scripts, including the standard ones that have traditionally been included with PhoneTest (e.g. 'GSM 900+1800 Brief test.seq'), tend to be structured as a simple sequence of tests, repeated several times over as the traffic channel changes. Clearly, it would be preferable to start the next sequence of tests using the settings that were inherited at the end of the previous sequence. For example, if the mobile's power level is progressively decreased during the first test sequence, then it should be progressively increased during the next sequence, and so-on, with the sequences alternating:

```
:
Place_Call 1 1
Clear_From_MS
Page_Mobile 1 1
Set_MS_Power Highest
:
Measure_Power
Measure_Power_Profile
Measure_Timing
Measure_Tx_Freq
Measure_RMS_Phase
Measure_Peak_Phase
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
:
HandOff 63 1
Set_MS_Power Highest
:
Measure_Power
Measure_Power_Profile
Measure_Tx_Freq
Measure_RMS_Phase
Measure_Peak_Phase
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
:
HandOff 124 1
Set_MS_Power Highest
:
Measure_Power
Measure_Power_Profile
Measure_Tx_Freq
Measure_RMS_Phase
Measure_Peak_Phase
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
:
```

**'Standard'**

Tests on each traffic channel carried out in the same order. In this code there is a total of nine settings of mobile power, with two relatively long delays as it changes all the way from “Lowest” to “Highest”.

```
:
Place_Call 1 1
Clear_From_MS
Page_Mobile 1 1
Set_MS_Power Highest
:
Measure_Power
Measure_Power_Profile
Measure_Timing
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
:
HandOff 63 1
:
Measure_Power
Set_MS_Power Middle
Measure_Power
Set_MS_Power Highest
Measure_Power
Measure_Power_Profile
Measure_RMS_Phase
Measure_Peak_Phase
:


HandOff 124 1
:
Measure_Power
Measure_Power_Profile
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
:
```

**'HS'**

Tests on one traffic channel mirror the order that they were done on the preceding channel. In this code there are only seven settings of mobile power, with each change reflecting only half of the mobile's range.

Note that, although tests are carried out in a slightly different order, the coverage is identical.

PhoneTest V2.2-onwards includes, for continuity, the traditional scripts such as 'GSM 900+1800 Brief test.seq' and, in addition, an 'HS' version of the 'Brief' and 'Comprehensive' scripts that have been speed-optimized using the guidelines above. The very simple nature of the 'Call + RF test' and 'Call Processing only' scripts means that no significant gain can be made from an 'HS' version.

## Savings in test time

The savings in test time that can be gained through script optimization and using the High Speed Test option, depends upon the nature of the test sequence being run. To indicate the typical spread, the table below lists the savings made on the four test categories supplied as standard with PhoneTest:

| | | *Time saved by using:* | |
|---|---|---|---|
| | | 'HS' script, *Opt 2 disabled* | 'HS' script, *Opt 2 enabled* |
| **'Brief'** | Single band | 5 sec (6%) | 22 sec (27%) |
| | Dual band | 11 sec (8%) | 40 sec (29%) |
| **'Comprehensive'** | Single band | 8 sec (6%) | 30 sec (21%) |
| | Dual band | 8 sec (3%) | 51 sec (20%) |
| **'Call + RF test'** | Single band | N/A | 4 sec (8%) |
| | Dual band | N/A | 8 sec (11%) |
| **'Call Processing only'** | N/A | N/A | N/A |

As an example of optimizing a custom script, one large 2935 user has developed a final test script for use with Nokia mobiles. The savings that could be made on that test were:

| | | *Time saved by using:* | |
|---|---|---|---|
| | | 'HS' script, *Opt 2 disabled* | 'HS' script, *Opt 2 enabled* |
| **'Typical Nokia Final Test'** | Dual band | 5 sec (6%) | 25 sec (27%) |
| | Tri band | 11 sec (10%) | 39 sec (34%) |

## Reducing burst counts

Although the above tests were all carried out on a "like-for-like" basis, with no change to any test parameters, we have also investigated the effect of reducing the number of bursts used by certain tests, and have found that further time savings can be made with minimal effect on accuracy.

By modifying the following setup statements at the start of the scripts such that:

Set_RmsPhase_Bursts 20 becomes:
Set_RmsPhase_Bursts 2

Set_PeakPhase_Bursts 20 becomes:
Set_PeakPhase_Bursts 4

Set_TxFreq_Bursts 20 becomes:
Set_TxFreq_Bursts 6

a further reduction in test time can be gained. See right-hand column below:

| | | *Time saved by using:* | | |
|---|---|---|---|---|
| | | 'HS' script, *Opt 2 disabled* | 'HS' script, *Opt 2 enabled* | 'HS', Optim Bursts, *Opt 2 enabled* |
| **'Brief'** | Single band | 5 sec (6%) | 22 sec (27%) | 29 sec (35%) |
| | Dual band | 11 sec (8%) | 40 sec (29%) | 55 sec (40%) |
| **'Comprehensive'** | Single band | 8 sec (6%) | 30 sec (21%) | 38 sec (27%) |
| | Dual band | 8 sec (3%) | 51 sec (20%) | 67 sec (27%) |
| **'Typical Nokia Final Test'** | Dual band | 5 sec (6%) | 25 sec (30%) | 30 sec (36%) |
| | Tri band | 11 sec (9%) | 39 sec (30%) | 46 sec (36%) |

Note: All the above tests include a number of factors that are beyond the control of the test set, i.e. the time taken for a mobile to register, for the user to answer a call, close a call, and conduct a speech quality test. The percentage gains shown above include the following allowances for these activities:

- 'Brief', 'Comprehensive', 'Call + RF Test', 'Call Processing only': 30 sec.
- 'Typical Nokia Final Test' (dual band): 25 sec.
- 'Typical Nokia Final Test' (tri band): 40 sec.

All tests, both "Normal" and "HS" were run using a 38400 Baud rate between the PC and the 2935 Test head.

## 'HS' dual band script

All the standard and 'HS' PhoneTest scripts are supplied with PhoneTest, the latest version of which can be found in the 2935 downloads section at www.aeroflex.com. So that they correctly reflect the tests in the standard version, the supplied 'HS' do not include any burst count reduction. To summarize all the points in this application note, here is the full listing of the 'HS Optim bursts' version of the standard GSM 900+1800 Brief test.seq:

```
Print_Header
Set_RF_Gen_Level -80.0
Reset
System_Type GSM900/1800
Set_BCCH_Arfcn 62
Set_MS_Power  9
Set_MS_Timing 0
Set_Authentication_Check ON
Set_IMSI_Attach Allowed
Set_Registration_TimeOut 30
Set_Protocol_TimeOut 20
Set_TxPower_Limits HIGH -2.0 2.0
Set_TxPower_Limits NORMAL -3.0 3.0
Set_TxPower_Limits MID -4.0 4.0
Set_TxPower_Limits LOW -5.0 5.0
Set_TxTiming_limit 1.000000
Set_TxFreq_Limit 0.100000
Set_RMSPhase_Limit 5.000000
Set_PeakPhase_Limit 20.000000
Set_TxFreq_Bursts 6
Set_RmsPhase_Bursts 2
Set_PeakPhase_Bursts 4
Set_TxMeasure_Mode Average
Set_RxLev_Limits 4 6
Set_RxQual_Limit 4
Set_RxBER1_Samples 45500
Set_Ber1_Limit 0.410000
Set_RxBER2_Samples 8200
Set_Ber2_Limit 2.439000
Set_RxRBER1b_Samples 33000
Set_RBer1b_Limit 0.410000
Set_RxRBER2_Samples 8200
Set_RBer2_Limit 2.439000
Set_RxFer_Samples 500
Set_Fer_Limit 0.200000
Set_TCH_Mode TalkBack

Registration
Place_Call 62 1
Clear_From_MS
Page_Mobile 1 1
Set_MS_Power Highest
Test_Speech_Quality
Set_TCH_Mode RBER
Measure_RxLev
Set_RF_Gen_Level_By_Class -104.0 -102.0
Measure_Power
Measure_Power_Profile
Measure_Timing
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
Measure_Rx_RBER2
Set_RF_Gen_Level -80.0
Set_TCH_Mode TalkBack

HandOff 63 1
Set_TCH_Mode RBER
Measure_RxLev
Set_RF_Gen_Level_By_Class -104.0 -102.0
Measure_Power
Set_MS_Power Middle
Measure_Power
Set_MS_Power Highest
Measure_Power
Measure_Power_Profile
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Measure_Rx_RBER2
Set_RF_Gen_Level -80.0
Set_TCH_Mode TalkBack

HandOff 124 1
Set_TCH_Mode RBER
Measure_RxLev
Set_RF_Gen_Level_By_Class -104.0 -102.0
Measure_Power
Measure_Power_Profile
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
Measure_Rx_RBER2
Set_RF_Gen_Level -80.0
Set_TCH_Mode TalkBack

HandOff 512 1
Set_BCCH_Arfcn 699
Set_TCH_Mode RBER
Measure_RxLev
Set_RF_Gen_Level_By_Class -104.0 -102.0
Set_MS_Power Lowest
Measure_Power
Set_MS_Power Middle
Measure_Power
Set_MS_Power Highest
Measure_Power
Measure_Power_Profile
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Measure_Rx_RBER2
Set_RF_Gen_Level -80.0
Set_TCH_Mode TalkBack

HandOff 699 1
Set_TCH_Mode RBER
Measure_RxLev
Set_RF_Gen_Level_By_Class -104.0 -102.0
Measure_Power
Measure_Power_Profile
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Set_MS_Power Middle
Measure_Power
Set_MS_Power Lowest
Measure_Power
Measure_Rx_RBER2
Set_RF_Gen_Level -80.0
Set_TCH_Mode TalkBack

HandOff 885 1
Set_TCH_Mode RBER
Measure_RxLev
Set_RF_Gen_Level_By_Class -104.0 -102.0
Measure_Power
Set_MS_Power Middle
Measure_Power
Set_MS_Power Highest
Measure_Power
Measure_Power_Profile
Measure_RMS_Phase
Measure_Peak_Phase
Measure_Tx_Freq
Measure_Rx_RBER2
Set_RF_Gen_Level -80.0
Set_TCH_Mode TalkBack

Clear_From_BS
Print_Summary
```


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