Application Note

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Performing RF measurements in mobile phones using the 1207 Inductive Probe

boosting wireless efficiency

Performing RF measurements in mobile phones using the 1207 Inductive Probe

In mobile phone service and repair, the performance of wireless devices can easily be checked using one of Willtek's test sets for mobile phones. Once a deviation from the specified performance has been found, a more detailed fault analysis should indicate the source of the error. This application note shows how the Willtek 1207 Inductive Probe supports fault diagnostics on component level, and proposes ways to optimise repetitive fault analysis processes.

While searching for the source of an error on a modern, highly integrated printed circuit board in mobile phones, there often is a problem with finding a suitable test point. Most of the latest designs no longer have any contact for measurements at the synthesizers. These components, however, emit an electromagnetic field. This field can be used to test the functionality of the component, e.g. test for the correct frequency and for harmonics.

The Willtek 1207 Inductive Probe helps in measuring the frequencies and the frequency spectrum by picking up the magnetic component of the field emitted by the device under test. The 1207 Inductive Probe is an accessory to the 9102 Handheld Spectrum Analyzer, similar to the Willtek 1205 RF Probe 20 dB, as both are probes supporting the frequency range of the 9100 Handheld Spectrum Analyzer Series. The 1207, however, enables contactless measurements.

Connecting the probe

The 1207 Inductive Probe picks up the signal over the air and provides it to the RF In port of the Willtek 9102 Handheld Spectrum Analyzer via an N-type connector. Low signals are amplified within the 1207, so a power source is needed. The 9102 provides the supply voltage via its Multi Port; the 1207 Inductive Probe comes with the appropriate plugs for both the RF In port and the Multi Port.

Figure 1: Connectors

Overall test set-up

The 1207 Inductive Probe, in conjunction with the 9102 Handheld Spectrum Analyzer, is designed for fault finding. In combination with a power supply and either a Willtek 4200 Series Mobile Service Tester or a Willtek 4400 Series Mobile Phone Tester, this is the perfect fit for analysing faulty mobile phones. Figure 2 shows a typical test set-up for the application in mobile phone service.

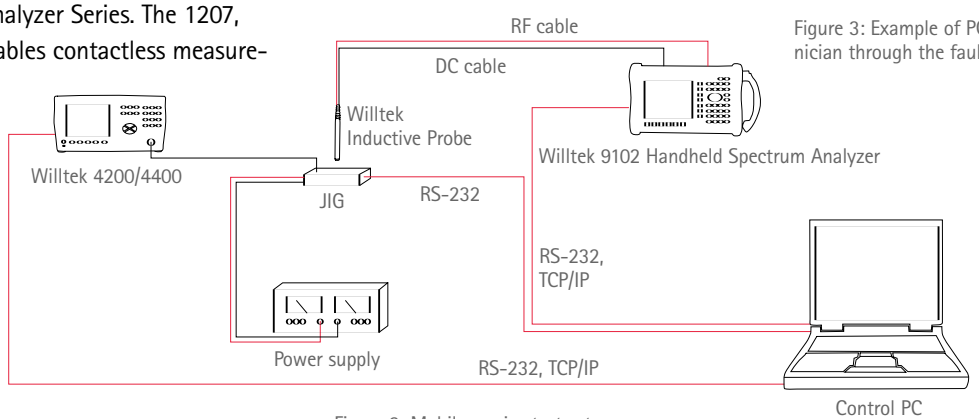

Figure 2: Mobile service test set-up

Ideally the following equipment is used:

- Willtek 9102 Handheld Spectrum Analyzer
- Willtek 1207 Inductive Probe
- Willtek 4200 Series Mobile Service Tester or 4400 Series Mobile Phone Tester
- Mobile phone under test
- Its power supply
- Manufacturer-specific service software
- For faster and comparable measurements, a software tool for remote control of the 9102 and either the 4200 or the 4400

Figure 3 shows an example of softwar designed to control the 9102 and guide the user through the fault analysis. It controls the 9102 and displays instructions for the service technician. In addition the expected signal is displayed to compare with the actual screen on the 9102.

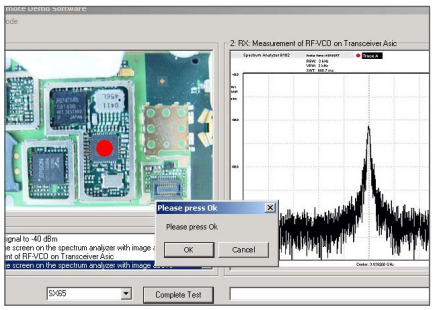

Figure 3: Example of PC software guiding the technician through the fault analysis

Example of receiver measurement

All measurements depend on the type of mobile phone. For almost all measurement types the mobile phone should be in service mode. In this mode the mobile does not switch between receiving and transmitting. This ensures stable measurement values. For receiver measurements, a GSM signal generator is necessary; the 4200 and 4400 series instruments both provide this function.

The mobile phone under test should be set to receiving mode. In this mode the antenna switch of the phone is set to receive. The signal generator is set to generate a signal on a defined channel. Typically, in each frequency band to be tested, the highest channel number is chosen; for example, channel 124 is used in the GSM 900 band. This way, the highest internal modulation frequencies are used, which typically cause most of the RF problems.

Figures 4a and 4b show the settings for the 4200 and the 4400 generator mode, respectively. The output power level has to be adjusted for best measurements results.

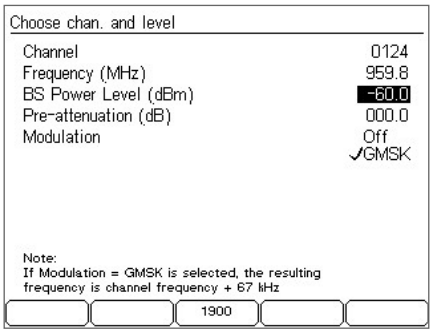

Figure 4a: 4200 generator mode

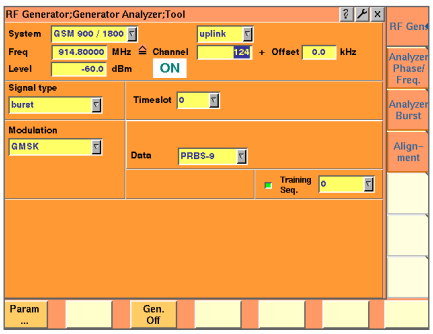

Figure 4b: 4400 generator mode

With this signal the receiver path can be measured. The 9102 is then set to the expected frequencies and settings are adjusted so that the signal is optimally displayed. When using the remote control software shown in Figure 3, the service technician just needs to hold the 1207 Inductive Probe in the indicated position and compare the displayed measurement on the 9102 with the example shown in the remote control software.

Figure 5 shows an example measurement on the screen of the 9102. Using software which guides through the fault analysis, the user compares this measurement result with the displayed trace in the remote control software (see Figure 4). The service technician proceeds with measurements at other positions until a faulty signal has been found.

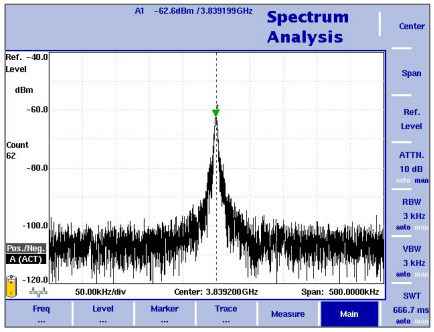

Figure 5: Example of measurement result with the 9102 Handheld Spectrum Analyzer

Example of transmitter measurement

The sequence of transceiver measurements is quite similar to that of the receiver measurements. The main difference is that for the transmitter measurement no signal source is needed. The mobile phone under test must be set to continuous transmit mode on a defined channel. For this mode the same channel numbers as for the receiver measurements could be selected.

Figure 6 shows the application in mobile phone service. With these measurements the synthesizers for the receiver and transmitter can be checked, no matter if they are integrated into larger chips.

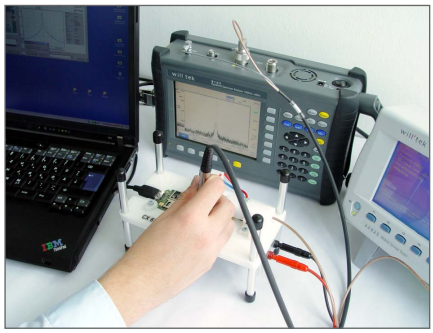

Figure 6: Application

Cross-functional measurements

The 1207 is an extremely useful tool when testing RF boards. Intermodulation frequencies produced by FPGAs, for example, can be detected and measured. Figure 7 shows the clock frequency of 100 MHz and the subharmonic frequency of 16.667 MHz. In addition, other subharmonics and mixing products are shown. All these measurements can be done without physical contact to the FPGA. Measurements of this kind may not be possible without the 1207.

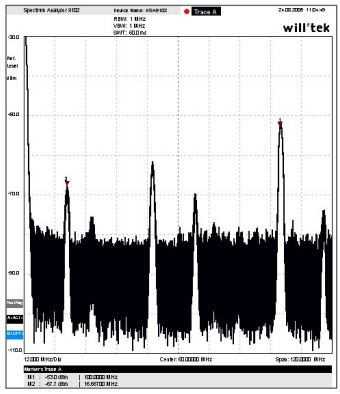

Figure 7: Subharmonics and mixing products of a 100 MHz reference frequency

Restrictions

The 1207 Inductive Probe is not designed for measurements of the absolute power. The distance, the position and direction of the probe strongly influence the power level measured. The results at various frequencies can be compared, however, so the 1207 can be a suitable tool for relative power measurements.

Ordering information

Willtek 9102 Handheld Spectrum Analyzer Bench Edition	M 100 412
Willtek 9102 Handheld Spectrum Analyzer Tracking Edition	M 248 801
Willtek 9102 Handheld Spectrum Analyzer VSWR/DTF Edition	M 248 802
Willtek 9102 Handheld Spectrum Analyzer Field Edition	M 248 806
Willtek 1207 Inductive Probe	M 248 971

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