

Cellular Handset Testing - The Latest Evolution Step

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Cellular radio testing has evolved dramatically since the initial introduction of the original analog cellular systems. Integrated test sets in the 1980s revolutionised testing by providing a "one box" solution for speedy diagnosis, repair and fault recording. This approach, which in its time was so innovative, is fast becoming past history however.

Today's radio workshops have to respond to the demands for high integrity, rapid and thorough testing along with the documentation required. This has triggered the change in test strategy. It is instructive first to trace the evolution of cellular radio testing to understand this latest evolutionary step more fully.

The Early Days of Cellular Testing

In the early 1980s a new generation of microprocessor controlled integrated radio test sets appeared on the market. Early pioneers of this "all in one" technology were IFR of Wichita, Kansas and Marconi Instruments of the UK. Both companies approached the design and implementation of radio testers from a similar standpoint. The design engineers involved in creating the product specifications "Lived the Test". By working alongside repair teams in their workshops the designers of these early test sets were able to gain a deep understanding of the tasks and to come up with a radical solutions through this first hand knowledge.

When AMPS appeared in the USA, and TACS and NMT were introduced in Europe and other territories, these early radio test sets changed and evolved to incorporate cellular radio testing facilities.

Digital Cellular

Digital Cellular forced the next evolutionary step of the radio test set in the early 1990s. In Europe, the introduction of GSM initiated new integrated digital test sets, initially for the 800 MHz band but latterly covering the new 1800 MHz and 1900 MHz bands.

Digital AMPS (IS 136) in the USA required new test and measurement techniques. The introduction of digital cellular did not dramatically alter the overall approach to testing however. More complex tests had to be made, and the testers became more sophisticated. Autotest routines and GPIB programs that automated test procedures, resulted in the de-skilling of tasks and faster testing but fundamentally the approach was similar.

What has Changed?

IFR's engineers have been "Living the Test" in customer's workshops on a continuing basis ever since the early days. During this time they have seen the cellular phone evolve from a large and cumbersome box in the trunk of an automobile to a tiny pocket sized device.

Inevitably, the repair workshop has changed too. Long gone are the days when discreet components can be changed to repair a mobile. Integration has resulted in fewer and fewer components. However, testing still has to be carried out in order to ensure that a mobile functions

correctly and that full serviceability is maintained. There are both commercial and technical drivers for this. The major manufacturers have invested vast sums in promoting their specific brands. Protection of brand integrity through advanced design before manufacture, and comprehensive test after manufacture, is essential.

Not only is testing essential but cost drivers dictate that workshop throughput must be increased to maintain revenue. Reducing testing time reduces cost, but other cost savings through cost reduction of capital equipment are also required. In the emerging economies, it has also been recognised that there is not a large pool of skilled labor - so testing must be simplified and automated.

Further study of the market place has shown that due to the dramatic rise of GSM mobiles the management of test has changed. The recent milestone of 100 million GSM mobiles brings this point into sharp focus. As a result there are now a small number of hub workshops which receive repairs from the point of sale outlets rather than numerous local workshops which were characteristic of the business only a few years ago.

All these factors, and many others, have caused today's design engineers to take a radical approach to the design of test and measurement instrumentation. Rather than just concentrating on the test equipment in isolation the entire repair process from receipt of a mobile at the front desk to final shipping was studied in great detail.

Typical Repair Process

Figure 1 traces the path of a mobile from the front desk onwards. At the front desk, the mobile is first booked into the repair system and customer details are entered on a computer, along with the serial number of the mobile. Previous test and repair history is retrieved from a database.

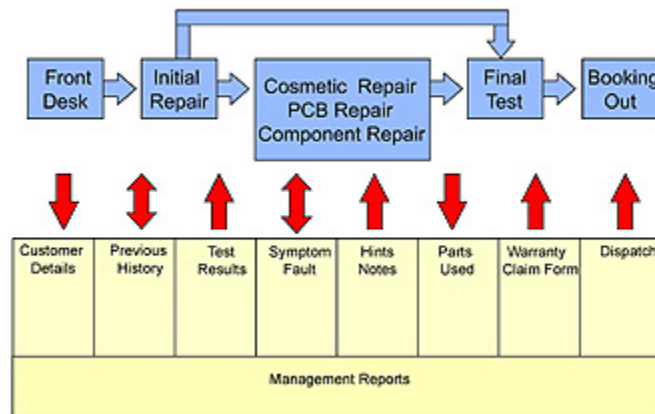


Figure 1. A typical repair process for a mobile. Actions from receipt at the front desk to final dispatch are shown along with documentation.

Following this initial procedure, the mobile is routed to the workshop where the tests are conducted to evaluate the reported fault. "No fault found" can be a common occurrence - network faults or poor coverage can cause users to blame the mobile. A rapid but thorough test is essential to ensure that the fault is not in the mobile - thus protecting the manufacturer's or service provider's brand identity and reputation referred to earlier.

The repair process, which is triggered as a result of these initial tests, is then carried out. Repairs can range from pure cosmetic repair (where no fault is found) to PCB, module or component repair. At various stages along the process the symptoms and faults are recorded on a work sheet and hints or notes retrieved from a computer to speed up the process. When spare parts are used they are also recorded on a computer, for record purposes and to generate warranty claim forms. After final test and authentication, the mobile is booked out and despatch documentation is raised.

By "Living the Test" the designer gains a full understanding of the process and gains an insight into the real requirements of a repair workshop and the quality demands placed on it. Analysis reveals that test only makes up 30% of handling time, the remainder of the time is spent on other processes. When interviewed, the objectives of the majority of workshop managers were summarized as:

- Quality and Performance must be maintained
- Cost reduction is required
- Ease and simplicity of operation is essential
- Systems must be flexible
- Customized solutions are needed

PhoneTest - Today's Response

Having researched and analyzed workshop manager's requirements the conclusion reached was that a total package solution is required, not just an automated tester and some software.

One industry response from IFR is a software suite called PhoneTest, which not only provides documentation, hints, warranty claim forms and access to databases, but also controls a new PC programmable GSM tester. The tester, known as a Test Head (model 2935) is housed in a case with no manual controls - all control is through an RS-232 socket connected to the workshop PC running the PhoneTest software and other software packages as required.



Figure 2. IFR's Dual Band GSM test set, combined with the PhoneTest software suite, provides a total workshop solution for mobile testing repair and documentation.

2935 GSM Test Head and Software

All the elements to test the transmit and receive parts of a GSM mobile are incorporated in the compact Test Head. Frequency coverage includes GSM (880 to 915 MHz and 925 to 960 MHz)

DCS (1710 to 1785 MHz and 1805 to 1880 MHz) and PCS (1850 to 1910 MHz and 1930 to 1990 MHz).

A digital signal generator, power meter and modulation analyzer, along with other test functions, are incorporated in the Test Head. Table 1 lists the key measurement capabilities of the tester. The PhoneTest Windows software is used to set up, control and display the measurements that are made. Customized solutions are simply set up and a manual mode can be initiated for detailed test and analysis.

The PhoneTest software is easy to use being based on familiar PC Windows software. Operation is further simplified by offering the software in local language variants. As well as English, the software is currently supplied with options for French, German and two versions of Chinese - traditional and simplified.

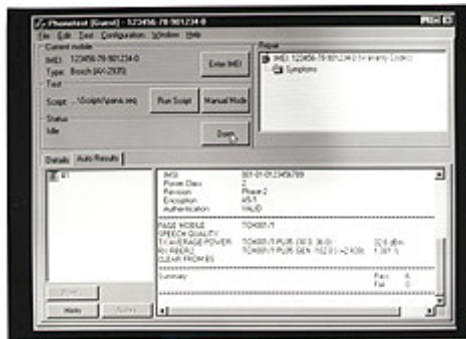


Figure 3. Example of PhoneTest Windows screen which shows test results and pass fail information.

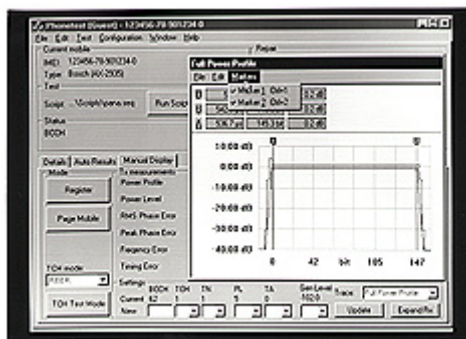


Figure 4. Graphical readout of a GSM mobile. Actual results are shown against programmed PASS/FAIL limit lines

Workshop Management Software

A range of "workshop management" software packages is available to use with the PhoneTest Test Head to automate the active workshop process. The repair package provides the capability for quickly and efficiently generating repair and fault information to accompany the repair. Fault symptoms, defects, repair codes and details of parts used can be entered and added to the warranty claims forms or saved to be recalled later.

A test area management software package provides facilities for archiving and retrieval of test results, repair histories, workshop throughput and performance analysis. This software is

invaluable for reducing time-consuming clerical tasks that divert skilled technicians from their primary functions. Repair hints are available on-line through the PC. Increased efficiency, failure modes historical records and more consistent report of failures are the major benefits.

An optional software package uses ODBC-32 (Open Database Communication) drivers for interfacing to an existing or new Management Information System. An example may be recording job information - for example; a customer's reported problem, name, etc. from the front desk entry procedure right through to the technician carrying out the repair. Many service centers will already be running their own database for accounting purposes and may want to link in the terminal test and repair data.

An additional software package provides a programming interface for customized Windows and NT applications. A DLL interface is available for Visual C/BASIC programming and a VXI Plug and Play driver is available for development environments such as LabWindows.

Automatic test procedures are increasingly demanded by users, Go/No Go automated test sequences are required for fast and efficient checks. More comprehensive tests such as registration, call placement and full parametric tests for transmission and receiver verification need to be carried out with PASS/FAIL indication on completion. The results need to be viewed on the screen to show the tests performed and their results compared against the programmed limits. Manual tests are also needed in order to carry out more detailed investigations.

Conclusion

The test and measurement industry has again responded to both hardware and software demands associated with mobile testing. By "living the test" designers can provide an easy to use fully automated package at an economical price. This ensures that operators of today's cellular radio systems can continue to offer efficient and economical service.

Table 1

<p>Capabilities of the PhoneTest test head, model 2935.</p> <p>Transmitter</p> <ul style="list-style-type: none">- Power- Power Profile to 45 dB (ramps, full, useful part)- Frequency- Phase, RMS and Peak- Timing Advance <p>Receiver</p> <ul style="list-style-type: none">- BER I and II- RBER Ib and II- FEr- RX Lev- RXQual
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Protocol

- Registration
- Page Mobile
- Place Call
- Cleardown
- Handoff
- Dual Band handoff