Service monitors

The central tool in a technician's arsenal has to be selected for reliability and durability. Modularity and software upgrades are keys to functionality for a variety of procedures.

By the MRT staff

Service monitors are essential to wireless communications for two basic reasons: to maintain equipment in compliance with its licensed operating limits and to troubleshoot problems when they occur. Radio system components that incorporate digital technology, integrated-circuit technology and surface-mount components have required increasing sophistication in service equipment.

The need for portable test sets that can double as bench units and field units has resulted in a combination and miniaturization of devices that are necessary for maintenance and troubleshooting. Modularity and software upgrades are important keys to realizing this functionality.

The FCC has established tolerances for two-way communications, particularly related to transmitters. The operating frequency must be accurate and stable, power output and modulation levels must be regulated and spurious radiation must be suppressed.

The system operator has necessary business-related tolerances as well. Communications must be reliable, intelligible and free from interference for receivers as well as transmitters.

Basic requirements for test equipment to ensure compliance with technical regulations include a frequency counter or meter to assure that the transmitter is set on the assigned frequency. This aids tuning, checks frequency stability and avoids drift beyond the established percentage for the assigned frequency. A modulation meter determines that modulation is also within prescribed percentages and allows the system owner to improve coverage and reliability by letting the transmitter deviate to the maximum limit on the modulation peaks.

Power output meters are also useful in allowing transmitters to attain, but not exceed, their maximum limit; however, this is not as critical an issue with FCC-approved OEM equipment, which limits power by design. The power output meter is necessary in matching the transmitter to the antenna system.

A signal generator is generally needed for receiver alignment. Other necessary technical tools include volt-ohm meters (VOM), digital voltmeter and oscilloscopes. In recent years test equipment manufacturers have incorporated most of these elements into a single, portable unit suitable for both field and bench work: the service monitor.

Service monitors have become the central instruments for testing and analyzing

Technician using a test set for cellular analog and digital testing. In addition to hand units, cell sites can be standardized within a cellular system. *Photo courtesy of Hewlett-Packard.*

Technician using a test set to check a public safety mobile. Software options allow retrieval of trunking parameters programmed into a mobile unit. *Photo courtesy of Hewlett-Packard.*

two-way equipment. They are not cheap, and technicians rightfully expect numerous years of reliability and durability from the investment. The types and locations of service for which the unit will be used should be considered when selecting an instrument, particularly if field work in inclement locations is involved. Constant use (or abuse) can lead to breakdowns that limit the work load and usefulness of the technician. Some monitors withstand continuous use; some need frequent repairs.

The primary functions of service monitors include radio-frequency (RF) measurement, RF power measurement, measurement of the deviations of speech and tone-coded squelch, frequency measurement of tone-coded squelch, and signal-to-noise and distortion (SINAD) measurement to check receiver sensitivity. Most monitors have a multimode code synthesizer that can generate all continuous-tone controlled squelch system (CTCSS) tones, paging tones, and digital code squelch signals. A signal generator, used in conjunction with an oscilloscope, is used in troubleshooting components. The spectrum analyzer, often offered as a system option, displays a window of the RF spectrum to allow checking for spurious outputs from transmitters and to analyze intermodulation interference.

There are well over 30 different manufacturers and suppliers of service monitor

equipment. (For a complete list, see *MRT's* Buyers' Guide, December 1997.)

As a specific illustration of how equipment modularity and the ability to upgrade functions with software is offered by manufacturers, we have elected a workhorse monitor well-known to two-way technicians, the Hewlett-Packard 8920A RF communications test set.

First introduced in 1991, that service monitor was designed to perform more complete radio tests with less effort, to provide more reliable test results and to deliver a broader range of test capability in a smaller package. Its stored test routines allowed for replicable testing, before and after repair. Transmitter testing included measurement of frequency and power and simultaneous displays of deviation and audio frequency measurements. A radio's distortion, dc level current drain or SINAD could be measured and displayed. Both analog and digital readouts were made available for audio frequency, distortion, dc level and current drain. For receiver testing, measurements were provided for SINAD, distortion, audio frequency and ac voltage (audio power). Duplex radio testing included

displays of transmitter frequency or frequency error and RF power output.

The great contribution to technicians' workload of this and similar systems was automation. Automatic test routines were made available to speed up work, and provision was made for technicians to write their own routines with elementary software. In the case of the HP monitor, it runs on a built-in IBASIC computer.

The current version of the HP monitor combines 22 instruments into a portable package, applicable for land mobile, cellular and other communications systems operating in ranges as high as 1GHz. Using single-key procedures for transmitter, receiver or duplex tests, the monitor displays measured results on a single screen as either digital measurements or analog bar charts.

All settings can be saved in nonvolatile save-recall registers or on a SRAM card. Most service monitors now make a provision for hard-copy printout and an interface with a laptop or desktop computer, allowing technicians to have extensive record-keeping of service.

Available as an option, a signaling encoder and decoder can be added for all

common formats: tone sequential, digital paging, DTMF, trunking and cellular.

Software options extend the usefulness of the current generation of monitors. Options allow testing of trunked radio systems, checking links and even allowing retrieval of trunking parameters programmed into a mobile unit. Similar test sets perform these functions specifically for analog cellular, PCS and CDMA base stations and mobile stations, GSM900 and other systems. Software options increasingly reduce the time required to optimize the performance of a cell site and standardize test methodologies so that all sites are optimized to the same standards.

Experienced technicians have noted, however, that the available equipment is not a complete solution to troubleshooting and maintenance requirements. Even though test routines are available, the technician must know how to use the equipment and apply troubleshooting techniques. Procedures followed are dictated by the equipment available and by experience. A review of procedures after a job is complet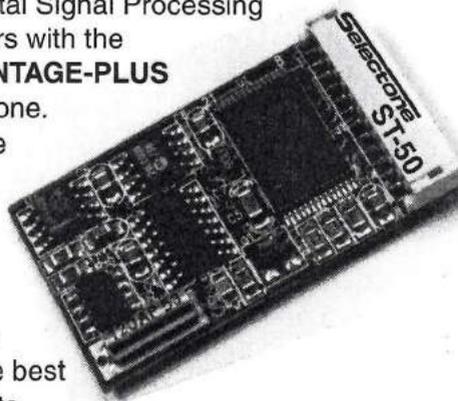ed can make the job go a lot faster.