EMI Measurement Automation Systems: Not All Equal

DENNIS HANDLON
Hewlett-Packard Company, Santa Rosa, CA*

Not everyone needs the same level of automation in EMI measurement equipment.

Introduction

The end result of an electromagnetic interference (EMI) measurement process is a report. How the data is acquired to place in the report can range from total manual interaction, with the receiver recording measurement results on a form, to full automation, including report generation.

This article will explore the different types and levels of automation for EMI measurements and report generation.

Built-in Automation

Today's receivers and EMC analyzers have a wide range of built-in measurement automation. The simplest form is to have a measurement performed at a particular point in the measured frequency range. More complex built-in automation can measure multiple signals over a specified frequency range, store the results and generate a report.

There are significant advantages to using built-in automation features. Peak, quasi-peak and average measurements are performed in the same manner each time. The process does not change, so there are consistent measurement results with a reduced likelihood of operator error. For example, when a marker is placed on a signal and the "measure at marker" is pressed, the built-in routine "repeaks" the marker, zooms in on the signal, moves the peak to the reference level and performs peak, quasi-peak and average amplitude measurement results.

These results are displayed in frequency and amplitude format corrected for transducer and cable loss and amplifier gain (Figure 1). This same process is used each time a measurement is made.

A secondary benefit for using built-in automation is increased speed. There are fewer key presses and less operator interaction.

More sophisticated built-in automation can store the measurement results along with regulatory agency limit lines and correction factors. These measurement results can be printed out in a report with text and graphics (Figure 2).

Transferring Measurement Results

One of the shortcomings of built-in automation is the inability to easily transfer the measurement results to a PC. External software is required along with an interface bus. There are several software packages available that will allow the user to move the results to a PC for archival storage and report generation.

The simplest software is one that captures the display and stores it in a file for export to word processors. The file format can be one of several types. Examples are .tif, .gif, and pcx. Screen capture is very useful during the development phase of a product. The user can capture displays of measurement results for comparison later (Figure 3). The user can also perform EMI measurements on prototypes, capture the results and use them for future diagnostics and troubleshooting. The captured screen gives a graphical representation of the hot spot frequencies of prototypes.

Data capture and report generation programs have become very advanced. These programs can not only capture the display in a graphics format, they can capture correction factors, instrument setting, signal lists stored in the

Continued on page 218

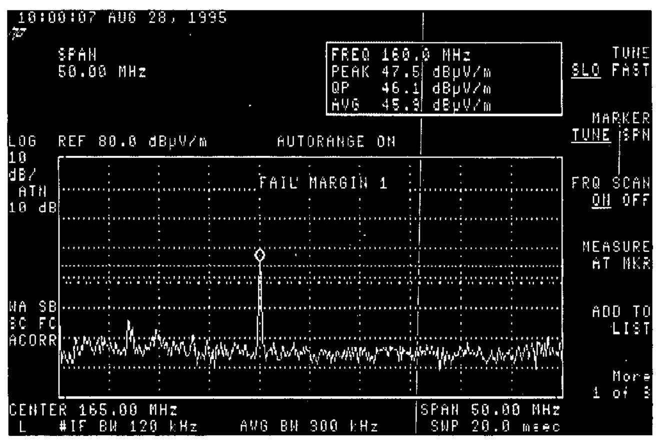

Figure 1. *Measurement Results Display.*

*See advertisement on page 11

receiver or EMC analyzer, limit lines and trace data in amplitude frequency pairs for importation into spreadsheets (Figure 4).

PC-Based Automation

So far, we have been discussing built-in automation and methods to capture the measurement results into a PC. The next step is to have the EMI measurement automation software reside in the PC.

With automation in the PC, the receiver or spectrum analyzer is not required to have a high level of built-in automation. The measurement routines are part of the PC-based software instead of the receiver or spectrum analyzer.

PC-based EMI measurement software packages have a wide range of capabilities. The simplest form of EMI package sets up the receiver parameters (start and stop frequency, reference level and bandwidths), takes a sweep, and captures the trace data. After the trace data has been placed in an array of amplitude frequency pairs corrections for transducers, cables and amplifiers are added and the resultant is displayed along with agency limit lines (Figure 5). The total number of points placed in the array is based on the total number of points the receiver or analyzer has across the display. This is a serious deficiency. For example, if a display has four hundred points across the screen and the frequency span is 30 MHz to 200 MHz then the resolution is 430 kHz.

More complete software packages

Edit item memory size = 404 Total memory = 1024

ACME COMPUTER COMPANY

Radiated Emissions report

Mark 17 Compiler System
Serial Number 618A88102

Test Engineer: Samuel Sharp
Extension: 1452

Test date: January 13, 1996
Regulator requirement: EH55822 class A

Test results:
The product failed radiated emissions at the frequencies shown in the attached list.

Figure 2. *Typical Report Header.*

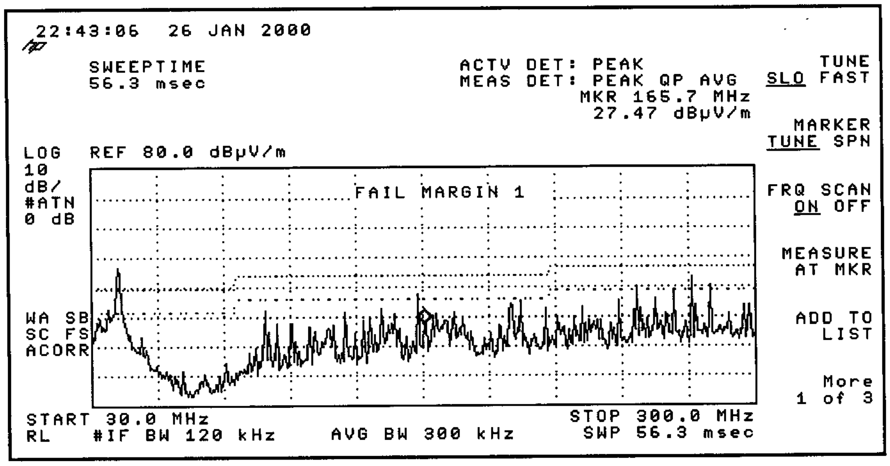

Figure 3. *Typical Screen Capture Display.*

will divide the span into frequency bands and concatenate the results to give much greater resolution.

Operator Interaction with Software

The type of software described above requires interaction by the operator. Once the trace data has been collected and placed in an array, the operator decides which signals should be marked for further investigation, or the operator can choose to mark all signals that meet the predetermined criteria. For example, the signals of interest are above the limit line or margin, or meets the criteria of peak excursion.

Once the signals have been marked, the operator can choose to tune and listen to the signal to determine if it is an ambient (local TV or radio station) source. If not, the operator can choose to perform a quasi-peak or average measurement.

The end result is to have a list of signals, compared to limit lines, which can be added to a report. Report generation is usually part of the software. It is less desirable to have to open up a word processor and develop a report

Continued on page 223

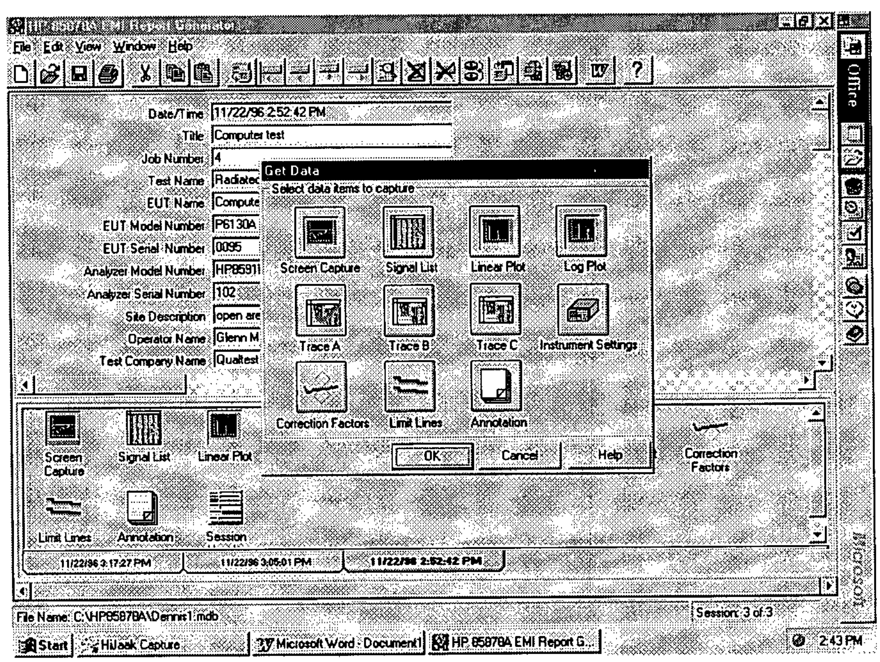

Figure 4. *Display of Choices Which Can Be Captured.*

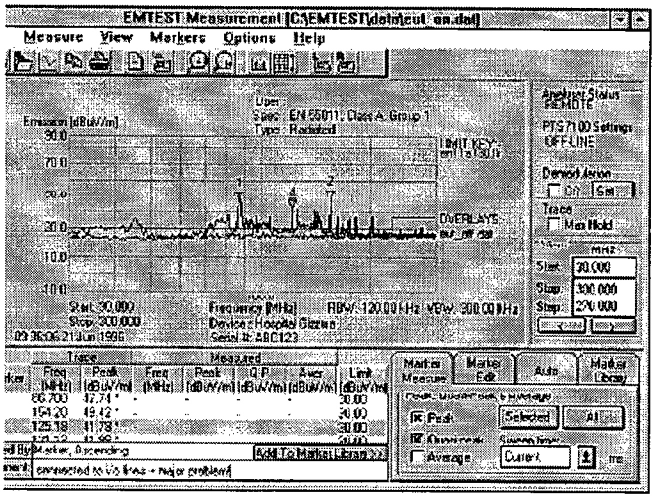

Figure 5. PC-Based EMI Test Results.

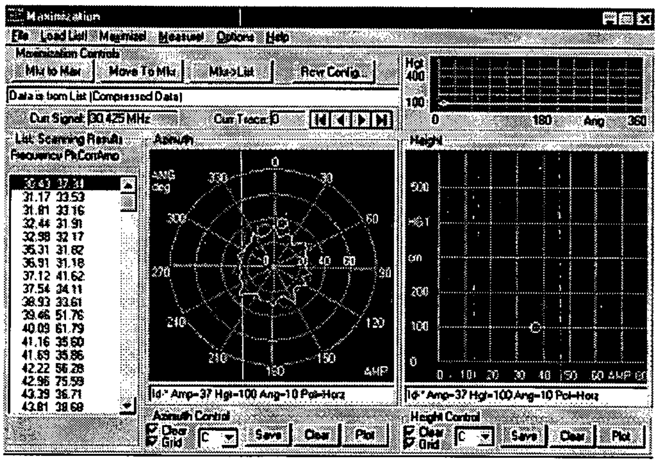

Figure 6. Results of an Automated Maximization Routine.

than to have available templates that the results can be dropped into.

Fully Automated EMI Measurement Software

So far, we have talked about control of the receiver or analyzer with PC-based software. The next step is to control antenna towers, equipment turntables and switch drivers. High-end EMI measurement software packages automate the entire process. Once the software has been set up to meet the unique needs of the measurement process, there need not be any intervention by the operator.

The key differentiation for this type of software is that it is aimed at full compliance measurements which require maximization of signals by rotating the equipment turntable and raising and lowering the antenna (Figure 6). These maximization routines can be very complicated.

The measurement process is as follows: signals that meet the criteria are placed in a list and compared to a list of ambient signals. Once the signals are sorted, the table is rotated and the antenna is raised to find the signal maximum. At that point, quasi-peak measurements are made and the results are compared to limits. After all the signals have been maximized and measured, a report is generated.

MIL-STD EMI measurements software requires additional routines to deal with broadband and narrowband signals. Table 1 compares the relative costs of increasingly sophisticated equipment.

SOFTWARE TYPE	APPROXIMATE PRICE
Screen Capture	Free from web
Data Capture/Report Generation	Less than $ 1,000
Interactive precompliance software	Less than $ 3,500
Fully automated compliance software	Less than $ 10,000

Table 1. Software Types.

Summary

A wide range of automation levels have been described. Not everyone needs the same level. For those who wish to evaluate the EMI performance of a new design without the burden of understanding the intricacies of EMI measurements, built-in automation may be the answer. The built-in automation takes care of correction factors, bandwidths and the settings required to make an accurate measurement.

Documenting and archiving the results can be easily accomplished using one of the screen capture and report generation software packages available.

The next step is to move to PC-based software. It is common to see a quality assurance department set aside an area where designers can have their designs evaluated and a report generated. A dedicated PC and analyzer, along with software and a step-by-step process, is available to designers for product evaluation.

Finally, for those companies that perform their own full-compliance testing, the high-end software with tower and turntable control along with maximization routines is appropriate. The main focus of large companies is throughput and accuracy. The higher the measurement accuracy, the lower the measurement uncertainty. With lower measurement uncertainty, the smaller the margin has to be and the less likelihood of repairing products that do pass emissions testing.

DENNIS HANDLON, currently the product manager for EMI products at Hewlett Packard Company, has been involved with EMI measurements for the past nine years. After receiving his BSEE, Dennis joined HP in 1968. He held various engineering positions in R&D and manufacturing while attending Stanford in the MSEE program before transferring to their marketing program in 1985. He assumed responsibility for marketing and product definition of EMI measurement solutions in 1989. Dennis has published several papers on EMI measurement applications. (707) 577-3747.