

Analyzers R&S®FSP/FSU/FSQ

Easy replacement of HP 856x and HP 859x spectrum analyzers in T&M systems

Anyone who has ever developed a certified T&M system knows the problem:

What can be done once the instruments get older and spare parts are no longer available? With older controllers, a modern, PC-based solution is usually the answer. But when it comes to T&M instruments, e.g. the HP 856x or HP 859x family of spectrum analyzers,

there are no successors with a compatible remote control command set. Yet

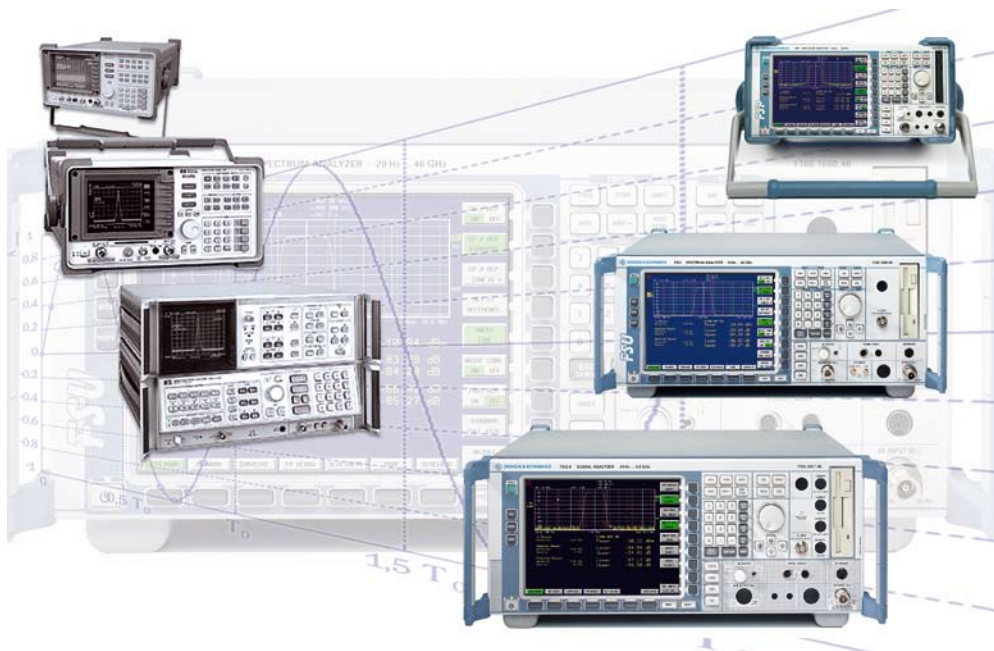
without these, you cannot avoid expensive modifications and renewed certification of the control programs. A solution is found in the Rohde & Schwarz spectrum and signal analyzers of the

R&S®FSP, R&S®FSU and R&S®FSQ

families (FIG), which provide an

expanded command set compatible

with the HP 856x and HP 859x.



With its comprehensive portfolio of spectrum analyzers and outstanding command compatibility, Rohde & Schwarz in many cases can offer a technically and economically attractive solution when replacing older HP 856x and HP 859x analyzers.

History of the IEC/IEEE bus command sets

In the 1980s, when the GPIB interface was first implemented in T&M instruments for remote control, the command set was often limited to converting the front panel key codes into combinations of letters and digits – and this was of course completely dependent on the instrument and manufacturer.

In the next stage of development, the key codes were replaced by simple abbreviations of the settings to be changed, e.g. CF for center frequency. The use of delimiters was optional; lowercase and uppercase letters made commands distinct. Characters such as = and / were permitted as part of the com-

mand. The result was combinations such as the following for setting a center frequency of 3 GHz, a span of 2 MHz, marker to next peak, and blank trace C: [CF3GZSP2MZKSKKSK](#)

The HP 8566A and HP 8568A spectrum analyzers came on the market during this period. The HP 8566B and HP 8568B successor generation expanded the number of characters per command word. The blank space was introduced to separate commands and data, and the semicolon to separate individual commands. The uppercase/lowercase distinction was dropped. Thus, the command sequence for the setting described above became [CF 3GZ;SP 2MZ;MKPK NH;BLANK TRC](#)

This convention was also used in later instrument families such as the HP 8560 E through HP 8565 E, plus the HP 8590 E and HP 8594 E. In contrast, the use of combined commands in accordance with the IEEE 488.2 standard was reserved for the next generation of instruments such as the Spectrum Analyzer R&S®FSA from Rohde & Schwarz. The command sequence then became: `FREQUENCY:CENTER 3GHZ; :SPAN 2MHZ; :MARKER NEXT_PEAK; :TRACE3 BLANK`

Although the rules for command structure were now defined, the commands themselves were nevertheless arbitrarily created by the instrument manufacturers. This did not change until the introduction of the SCPI standard (standard commands for programmable instruments). Since then, modern analyzers such as the R&S®FSP, R&S®FSU and R&S®FSQ accept command sequences such as the following: `SENS:FREQ:CENT 3GHZ;SPAN 2MHZ;:CALC:MARK:MAX;:DISP:WIND:TRAC:STAT OFF`

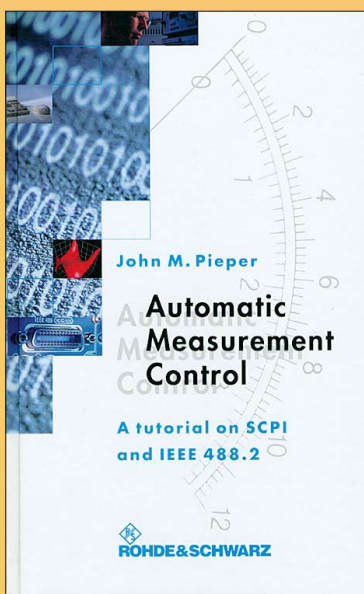
Instruments of this generation have thus reduced the problem of interchangeability to a minimum. However, the situation is quite different if these instruments need to be compatible with those of the earlier generations.

What does command-compatible mean?

Command-compatible does not merely mean being able to understand the commands of another instrument. Compatibility also means that the same command sequences yield the same results as with the original. Simply duplicating the command recognition of the original is not sufficient. Rather, an entire series of other conditions must be met:

- ◆ The available commands must be sufficient for the planned applications.
- ◆ The default setting is the starting point for every remote control program and therefore must match the original instrument.

- ◆ The response to the query for instrument ID and firmware version must match the original so that recognition of the instrument model will be successful in the control program.
- ◆ The output format for queries must match the original, because the memory depth of control programs is often tailored to the responses of the original instrument.
- ◆ It must be possible to duplicate the responses of the status reporting system (service requests) as exactly as possible, including the response time and the assignment of the status registers.
- ◆ The interdependencies of the instrument settings must match the original, because they are the basis for obtaining the same results from the same command sequences.
- ◆ The response times of the original are the upper limit for command processing in order not to exceed the timeout values predefined in the control program.



Related book

To eliminate the problem of incompatible command sets from different manufacturers and instruments, the major T&M instrument manufacturers established a standard command language in the early 1990s. This language is based on the data formats and protocols found in the IEEE 488.2 standard. Since that time, the “Standard Commands for Programmable Instruments” (SCPI) have significantly simplified the development and maintenance of T&M applications both with respect to programming and system design when using components from different manufacturers.

To find out more about SCPI, refer to the book titled “Automatic Measurement Control” from Rohde & Schwarz. It provides a detailed description plus numerous examples of the principles and use of the language. You can obtain a copy for a nominal fee from any Rohde & Schwarz representative.

- The objective in the development of compatible command sets in the Rohde & Schwarz analyzers was to make the behaviour so close to the original that no type of control program would notice any difference.

How compatible are the Rohde & Schwarz analyzers?

The R&S®FSP, R&S®FSU and R&S®FSQ analyzers from Rohde & Schwarz are presumably the only analyzers that can reliably recognize both the commands of the earlier HP 8566 A/HP 8568 A families as well as the newer HP 8566 B/HP 8568 B, HP 856xE and HP 859xE families.

Limitations in delimiters between commands and data were eliminated by expanding the command recognition algorithms. Thus, commands such as the following are recognized without any problem:

CF3GZSP2MZKSKKSK

For data queries, the output formats are identical to the original. This is true both for individual values as well as for entire traces. The fact that small differences in the output format and in the number of test points between the HP 8566 B, HP 856xE and HP 859xE were accounted for is just as standard as support for a wide range of units.

When an HP 85xx emulation is selected, the default settings for the selected instrument are automatically activated. This includes frequency range, reference level and input coupling as well as the number of test points and the IEC/IEEE bus addresses.

The more than 200 commands cover everything from default settings and numerous marker and trace functions up to save and recall. Options such as tracking generators and audio demodu-

lators are also supported. Firmware version queries are answered with original data; the response character sequence following an ID query can be selected by the user.

A special challenge was to reduce the hierarchical SCPI status register structure to a register with a maximum of seven events. The primary task was to determine all conditions under which a new measurement is started and then under which the end of sweep is reported by a service request.

The significance of the setting interdependencies is especially made clear by the delta marker example. Switching on this marker when noise measurement is active – depending on the emulated instrument type – either causes noise measurement to be deactivated or phase noise measurement to be activated. Therefore, each command was thoroughly analyzed for dependencies and differences between the instrument models, and the response time during emulation was taken into account.

Summary

The R&S®FSP, R&S®FSU and R&S®FSQ are the only analyzers that support not only the command set of the HP 8566 B und HP 8568 B but also the commands and syntax of the earlier HP 8566 A models and the modern HP 856xE and HP 859xE models. The compatible command sets are already included in the base unit; they do not interfere with any installed software option.

The more than 200 supported commands contain not only instrument-specific default settings but also special features in command processing, status administration and response formatting.

With its comprehensive portfolio of spectrum analyzers and available com-

mand compatibility, Rohde & Schwarz in many cases can offer a technically and economically attractive solution when replacing older HP 856x and HP 859x analyzers. The Rohde & Schwarz instruments have already withstood the test of numerous implementations. The number of applications is constantly increasing as more and more commands are added.

Ottmar Steffke

Additional articles on the R&S®FSP/FSU/FSQ are found on pages 16, 18, 27 and 30.

More information and data sheets at www.rohde-schwarz.com
(search term: type designation)

