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On Radio Spectrum Measurements With The ESVB Rohde & Schwarz Test Receiver

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Abstract – The learning process need good examples in order to be efficient. This paper present two experiments, useful in didactical process of Radio communication laboratory, based on the R&S ESVB radio test receiver. Starting from the R&S scan.exe software we developed a LabView based software application in order to control and communicate with the ESVB equipment.

Keywords: **telecommunications, radio spectrum scanning, Test Receiver, remote control, LabView application.**

1. INTRODUCTION

With the 2004-year our department has a set of Rohde & Schwarz equipments, mainly for radio-communication tests and measurements, composed of ESVB-22 test receiver, a signal generator and a digital radio tester.

In this work we present the results accumulated in testing the ESVB-22 radio test receiver equipment in order to better understand the specific measurements functions and to develop new software that match the specific behaviour of a fine radio instrument in the radio communication laboratory.

The work describes first the main features of the used equipment, including the remote and the manual operation, wiring with external devices and other specific functions, as in section 2. Next, in the section 3, two applications are presented, concerning the radio spectrum scanning and the retrieving and storing of generated data. The explanations include the basic hardware configuration, the software configuration reflected in logical diagrams and parameters set-up. Section 4 presents the measurements results. Finally, Section 5 presents the conclusions of the considered experiments, which polarize our future work.

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2. DESCRIPTION OF THE EQUIPMENT

R&S ESVB-22 Test Receiver features the bandwidths and signal weighting facilities required for terrestrial digital video (DVB-T) as well as for audio broadcasting (DAB). In conjunction with its high measurement rate it can be used in mobile and stationary coverage measurements. Also, it is suitable for measuring signal and interfering field strengths; it includes all functions of EMI (electromagnetic interference) Test Receiver.

The few main features that outline the ESVB are [1]:

- Precision field-strength measurements using test antennas, providing high measurement accuracy with typical error of 0.5 dB.
- Radio frequency range 20MHz to 2050 MHz.
- RMS and average detector for all test bandwidths.
- Manual operation or control by internal processor or external computer.
- Automatic overload detection.
- Average, RMS, peak and quasi-peak detectors operating in parallel.
- RF attenuator, switcheable in 10 dB steps in the range 0dB to 120 dB

The ESVB is equipped with a steep-sided 1,5 MHz channel filter (SAW type) for use in DAB networks. For DVB-T applications it is fitted with an 8 MHz IF filter (SAW) of high selectivity for adjacent-channel operation. The test receiver is including also an I/Q test demodulator with a bandwidth of 0.75 MHz (DAB) and 4 MHz (DVB-T).

All these hardware is powered by an internal powerful processor system, which consists of [1]:

- Macros for automatic and semiautomatic test runs.
- Automatic level calibration.
- Automatic consideration of frequency-dependent transducer factors.
- Full programmability of all internal functions via IEC/IEE bus.

- High-speed measurement with external triggering.

In order to make further signal evaluation and for driving or feeding additional devices, the ESVB [illegible] [1]:

- Coding and supply socket (ANTENNA CODE) for active antennas and for coding of transducer factor.
- 74.7 MHz IF output for connecting a spectrum analyzer.
- 10.7 MHz IF output for evaluating the IF signal e.g. with an oscilloscope.
- Controlled in phase and quadrature signal output for evaluating signals of any modulation.
- Envelope detector output (VIDEO OUTPUT) for evaluating the rectified IF signal e. g. with an oscilloscope
- User interface with:
  - 6 TTL ports for controlling external devices
  - Input for external trigger signals
  - Outputs for analog display voltage with and without meter simulation
  - RS-232 interface for firmware updates by reprogramming the built-in flash EPROMs by means of an IBM-compatible PC
  - Parallel interface (PRINTER INTERFACE) for connecting a printer
- IEC/IEE-..s i..terfa.e.
- Connector for MF2-compatible keyboard for text entry.
- Output for internal oven-controlled crystal reference frequency (10 MHz).
- Battery input for independent powering

3. THE EXPERIMENT APPLICATIONS SETUP

In our work we considered two different software applications. The first one, ROHDE & SCHWARZ SCAN.EXE, is a software application made under QuickBasic. The second one is made under LabView environment and we developed this software application.

In order to setup the two experiments, we have made an IEEE 488.2 serial link between PC and ESVB and a RF coaxial cable link between ESVB and test antenna.

The basic hardware structure of the experiment is shown in the Figure 1.

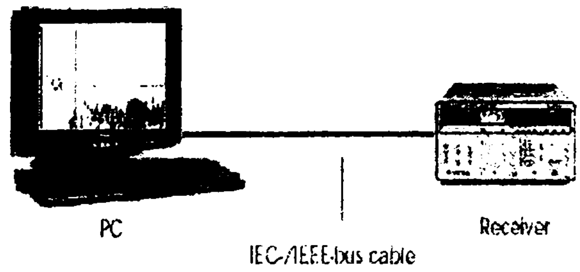

Figure 1 – IEEE 488.2 serial link used in both applications

With this configuration all data obtained with the Test Receiver is transferred along an HP serial cable to a computer. Via this bus almost all instrument settings can be effectuated, measurements triggered and test results read in by the PC.

Basically, both software applications have the same logical structure, shown in the Figure 2.

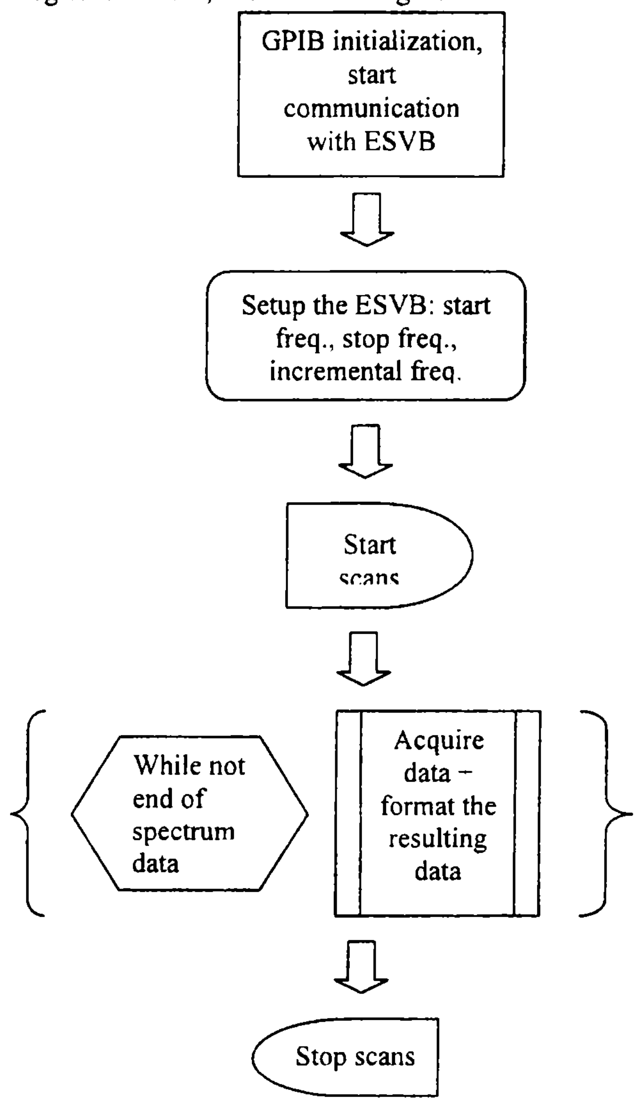

Figure 2. The common logical structure

The LABVIEW based application follow the same logical structure. In this application there is no representation of the scanned spectrum. The resulting data is only provided for further processing, it is not formatted.

In the Figure 3 are shown the elements of the LabView application, which represent the main program.

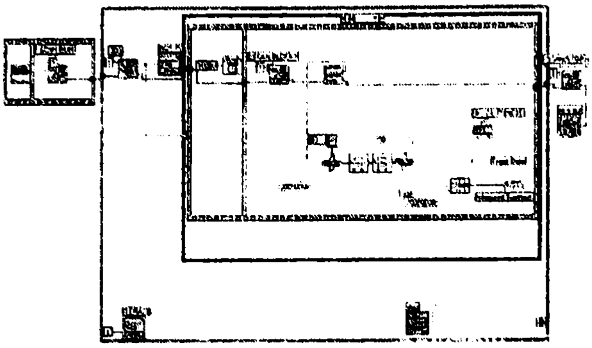

Figure 3 – The main program of the LabView application

There are also two subroutines, which are appealed by the main program. They are represented in Figure 4.

Figure 4 – The structure of the LabView application

The GPIB serial interface is initialised in subroutine in Figure 5. This subroutine also initialises the starting parameters of ESVB, and the "SRQ" (service request) of the GPIB, which is needed in asynchronous transfer between ESVB and PC along IEEE serial bus.

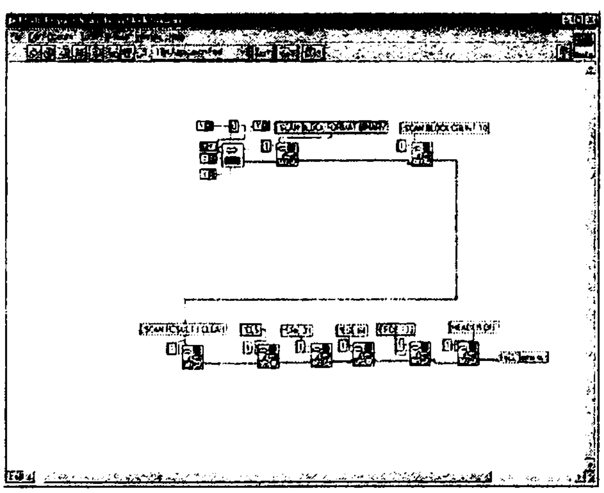

Figure 5 – The initialisation subroutine.

In order to further process the final obtained data, this must be concatenated, and then transformed from binary to ASCII. We present in Figure 6 the responsible subroutine with this job of concatenation. Finally, the concatenated data is converted into ASCII string (in the main program), and it can be further processed (not implemented).

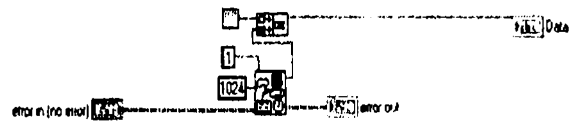

Figure 6 – The concatenation (reading long data) subroutine.

4. RESULTS OF THE MEASUREMENTS

The QuickBasic application SCAN.EXE generates two outputs: one is a graphic representation and the other is an ASCII file. We present in the figures 7 and 8 the two outputs, the graphic and the file, respective.

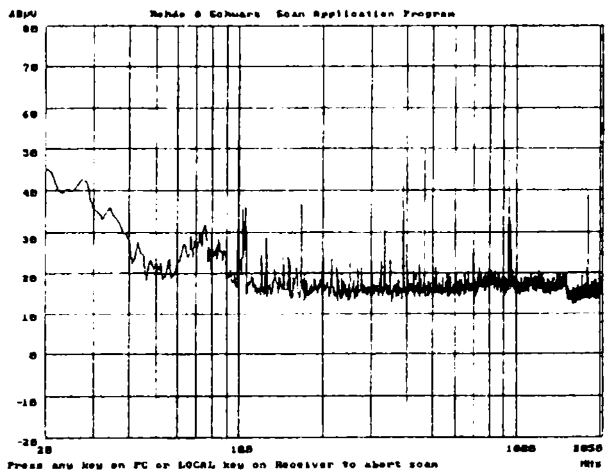

Figure 7 – The 20MHz ... 2050MHz graphical representation of scanned radio spectrum

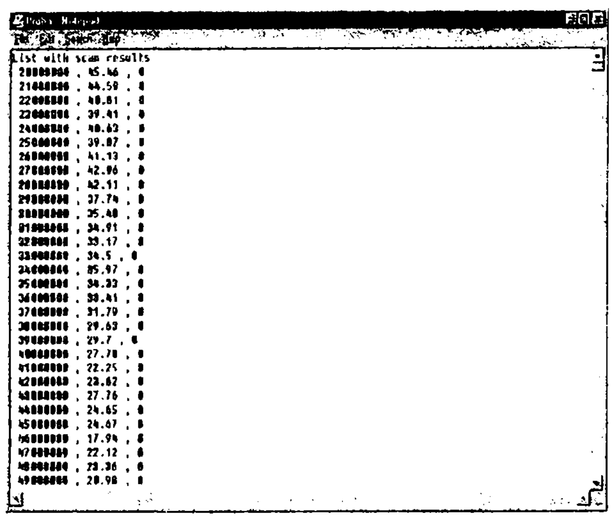

Figure 8 – Partial results from the ASCII representation of scanned radio spectrum, stored into a file.

File lines consist of data records made up by the following parts:

- First column: *Frequency* in Hz;
- Second column: *Level* in dB with 0.01dB resolution;

- Third column: *Status word*, which is 0 for error free.

5. CONCLUSIONS

The test receiver is a complex and powerful tool that combines the highest test requirements with fully remote controlled features. We presented in this paper a software tool developed by us in the LabView environment for educational purpose, and a ROHDE & SCHWARZ tool developed under QuickBasic. Both applications are running, they are obtaining the data from the receiver, and only the Rohde&Schwarz application is, for now, capable of writing files or drawing graphics. Thus, the next step of the work is to solve the data interpretation aspect and to add more and complex options in the remote mode functioning of R&S ESVB Test Receiver. The results are useful in our effort of understanding the measurements functions and to develop new software algorithms for other complex radio-communication and radio-measurement applications, for educational and telecommunications market targets.

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