
Radiomonitoring with Test Receivers ESN/ESVN

Application Note 1EPAN13E

Subject to change

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Products:

Test Receivers of Series ESxN



ROHDE & SCHWARZ

Introduction

The constantly increasing number of telecommunication services and subscribers is putting more and more pressure on the availability of already scarce frequencies. Authorities responsible for monitoring and regulating the radio traffic are confronted with more and more complex problems relating to radiomonitoring and frequency management.

The problem

Without exact data - a prerequisite for monitoring existing installations and planning new services - it is impossible to solve the problem. It is essential to use the proper measurement equipment.

This Application Note deals with the following measurements:

- Measuring various signal parameters at defined frequencies.
- Monitoring emissions for compliance with specified limits for field strength, modulation depth/index, frequency deviation and offset.

The solution

The design and performance of Test Receivers ESN/ESVN make them ideal for radiomonitoring measurements. The operating mode *Measurement on Frequency Lists* (FIG 1) is a versatile and powerful mode for use in conjunction with computer-controlled systems. It is particularly suited to the requirements of radiomonitoring. The versatile setting capabilities are designed to tackle "real world" measurements and draw on R&S's wide experience in this field.

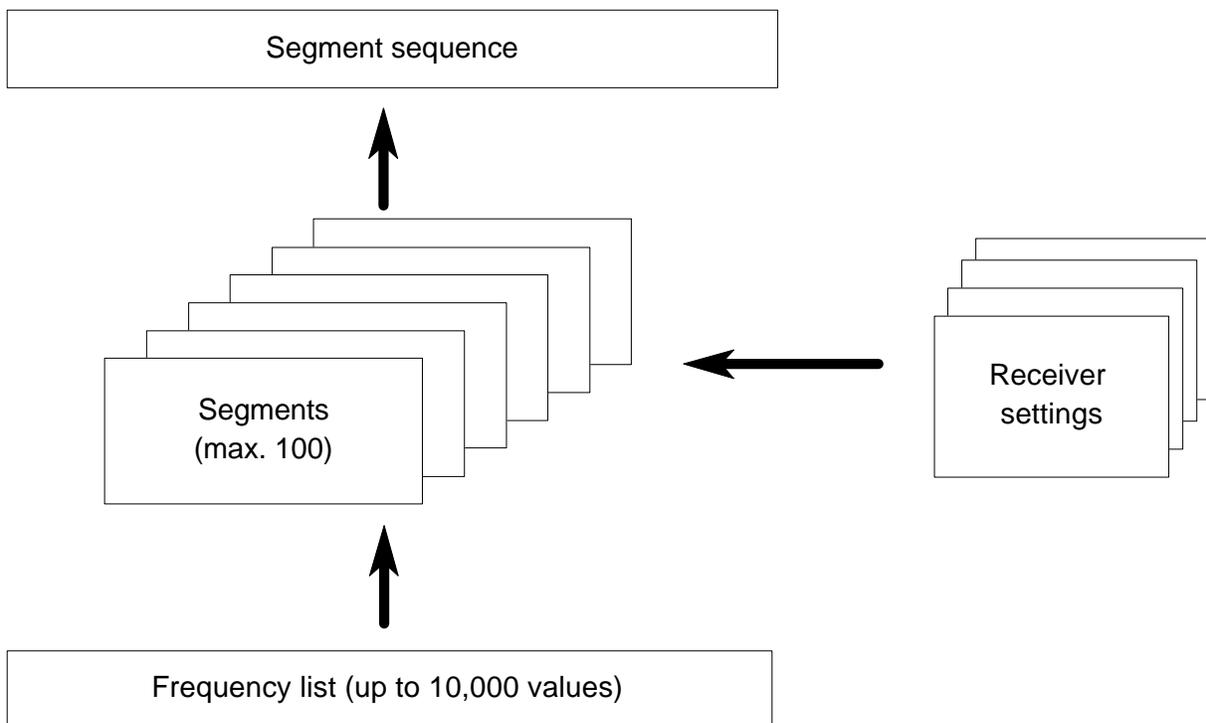


FIG 1: Configuration of operating mode *Measurement on Frequency Lists*

The *Measurement on Frequency Lists* mode has the following outstanding features:

- Up to 10,000 discrete frequencies are stored in the ESN/ESVN in any order.
- The list can be partitioned to give up to 100 segments.
- Segments are arranged in a sequence.
- One of 20 receiver setups may be assigned to each segment.
- The signal parameters to be measured are user-selectable for each segment.
- Modulation parameters and frequency offset are only determined when a level threshold is exceeded.
- The user may chose one of three modes:
 1. measured values are buffered in a 64-Kbyte memory and read out in one block,
 2. measured values are output onto the IEC/IEEE bus after each measurement,
 3. measured values are compared with threshold values and, if required, an alarm is activated.
- The short measurement and setting time gives a high frequency-band scanning rate.
- If a threshold is exceeded, an alarm signal sent to the control computer simplifies signal detection.
- In the Alert mode the programmed sequences are executed independently by the receiver. Only when an alarm is triggered does the controller take over. Minimizing data transfer in this way is particularly attractive for detached systems.
- Readout or reprogramming of a complete frequency list with up to 10,000 values and segment definitions is possible in about 1 s.
- Automatic activation via a user port with programmable waiting times makes it possible to carry out complex measurements with several antennas (FIG 2).

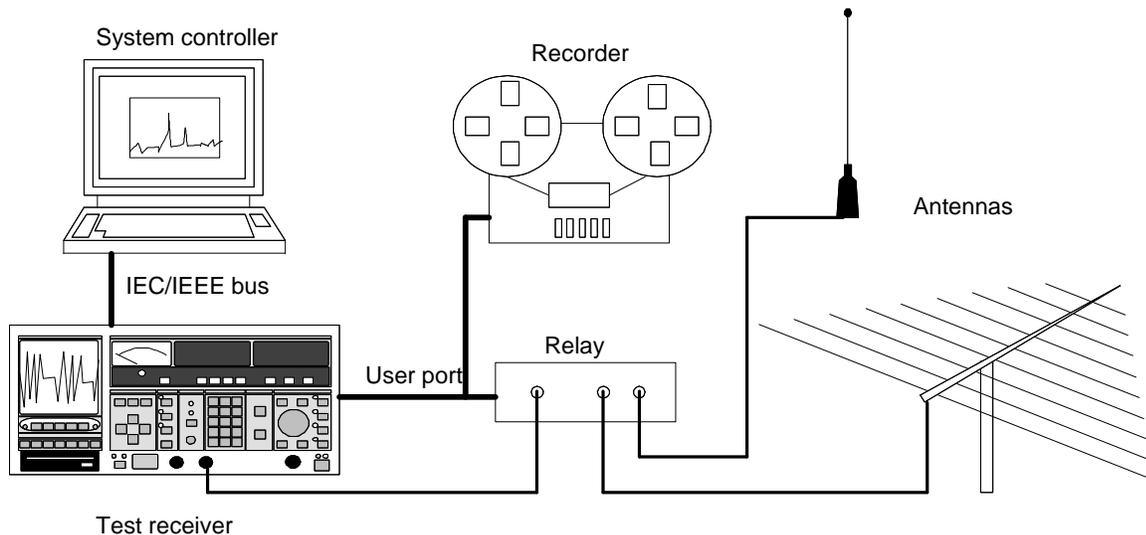


FIG 2: Test setup

Program samples

1. ESN.EXE (Windows program)

1.1 Purpose of the Program

- The application software carries out measurements in the Frequency List mode using a Test Receiver ESN or ESVN.
- Predefined frequency lists can be downloaded to the receiver.
- A built-in editor is used to generate new lists and modify existing ones.
- Test results are displayed in graphical form.
- Several windows with different lists may be opened simultaneously.
- Diagrams may be printed out.

1.2 System Requirements

Hardware:

Windows-compatible PC and an IEC/IEEE-bus card from National Instruments, eg PCII-2A or GPIB-AT.

Software:

MS Windows version 3.1 or higher. Windows drivers for the IEC/IEEE-bus card must be installed.

1.3 Installation

Use the supplied setup program (eg insert floppy in drive A: select File - Run in the program manager and enter A:SETUP).

1.5 Operation

Menu item: File

<i>New</i>	An empty frequency list is displayed.
<i>Open</i>	A frequency list file is selected and loaded into the computer.
<i>Close</i>	A frequency list is closed. If the list was modified, the user is asked whether the modified list should be stored.
<i>Print</i>	The current diagram is output on the standard Windows printer.
<i>Print Preview</i>	The diagram is viewed before printout.
<i>Print Setup</i>	The printer is selected and the printout configured (portrait or landscape).
<i>Exit</i>	The application is quit. Modified frequency lists can be stored beforehand.

Setup copies the program data into the directory selected by the user. Then an R&S group is installed in the program manager which includes the programs ESN.EXE and INFO.TXT. INFO.TXT comprises brief instructions in English. A double click on the icon starts the Windows editor containing the brief instructions.

1.4 Starting the Program

The application program is started by a double-click on the ESN icon.

First an empty frequency list with default settings is displayed. It is easiest to use one of the supplied lists. To do this, select File - Open in the menu list or click on the icon at the very left of the toolbar. A dialog box which is used to select frequency lists is displayed. Frequency lists are identified by the file extension *.LST.

Another possibility for users is to create their own lists. The appropriate editor can be found under the menu item Parameter - Frequency.

When the program is started, a frequency list file may be defined as command line parameter. In this case the file is opened immediately, the frequencies are loaded into the receiver and the measurement is started. To enter the command line parameter, select the program icon for ESN.EXE using the program manager. The command line may then be supplemented by the command line parameter under File - Properties. If C:\ESN\ESN.EXE GSM.LST is entered, for instance, file GSM.LST, which must be in the working directory, is loaded and executed when the program is started.

Menu item: View

Toolbar The bar with the icons which are clicked on to perform an action can be turned on or off.

Status Bar The status line can be turned on and off.

Menu item: Parameter

Grid Diagram settings are entered in a dialog box.

IEC-Bus The IEC/IEEE-bus address of the receiver is set. It is stored in the APL.INI file.

Time A measurement time of between 100 μ s and 32 ms can be set.

Frequency With this menu item the built-in frequency list editor is accessed. Each frequency can be individually modified or deleted. By entering a start frequency, stop frequency and step width, lists with a constant step width are generated or inserted in already existing lists.

Menu item: Measure

Measurement With this single item the actual measurement is started. If the list in question has not yet been loaded into the receiver, the loading procedure is carried out first, then the scan is started. The measurement can be interrupted any time by deactivating this menu item. The receiver icon in the toolbar has the same function as this menu item.

Menu item: Window

New Window The current frequency list is duplicated.

Cascade Open windows are arranged in a cascaded form.

Tile Open windows are arranged next to each other.

Arrange Icons Windows displayed as icons are arranged.

Menu item: Help

About ESN The program version is displayed.

1.6 INFO.TXT

The setup program installs the INFO.TXT file in the application-program directory.

Contents of the INFO.TXT file:

ESN/ESVN Frequency List Application for Windows

The purpose of this program is to show how Test Receiver ESN or ESVN carries out level measurements using a frequency list.

This program requires a National Instruments IEEE card with Windows DLL installed on the PC.

The Test Receiver needs Firmware Version 1.07 or later.

The program presents the user with an empty frequency list. To start a measurement, it is necessary to edit a list or to open a file with a predefined frequency list.

This demo comes with some predefined lists. They may be loaded and used at once.

Select Parameter - Frequency to create a new list.

You may also edit a frequency list file with your own text editor.

This file has to have a special format:

- It is a plain ASCII file.
- The first line indicates the size of the frequency list.
- The second line and the third line give the start frequency and the stop frequency of the grid.
- Any other lines form the frequency list.
- It is not necessary to have the frequencies in ascending order. They are scanned as they occur in the list.

Example:

```
6
88000000
89000000
88000000
88200000
88400000
88600000
88800000
89000000
```

This is a list of 6 frequencies. The grid starts at 88 MHz and stops at 89 MHz.

The maximum number of frequencies which can be handled by the ESN or ESVN is 10,000.

The Minimum Level and Maximum Level of the grid are set with Parameter - Grid.

The Measurement may be started and stopped with Measure - Measurement or with the receiver icon in the tool bar.

The frequency list is downloaded to the receiver, when the measurement is started for the first time. This may take up to a minute with very long lists. Progress is shown by the status bar.

It is possible to open multiple frequency lists. When switching between them, a measurement in progress is stopped automatically before a new measurement is started.

The selected list is then downloaded again because the receiver can handle only one list at a time.

After the first download, the PC obtains a binary image of the internal receiver data. This means that it is possible to swap between several lists very quickly, because any subsequent download uses binary format.

The binary download takes about 1 to 5 seconds - depending on your PC and IEEE card.

In fact it is possible to divide the list into several segments. So the ESN is able to scan different frequency ranges without a new download. This feature, however, is not used with this application.

The APL.INI file is placed automatically in the Windows directory. It contains the IEEE address of the ESN.

Receiver settings such as IF bandwidth and RF attenuation may be checked manually before starting the measurement. The default measurement time is 0.1 ms.

2. LIST.BAS (QuickBASIC)

2.1 Purpose of the Program

With the aid of a frequency list file, measurements are carried out in the frequency list modes talker/listener or controller. The supplied LIST.BAS source file makes it clear how these operating modes are programmed. Conversion to other languages, eg C, is easy because of the similar language interface to the IEC/IEEE-bus function library.

2.2 System Requirements

The program can be run on IBM PCs or IBM-compatible equipment, eg process controllers of the PSA family with VGA graphics card. The controller must be equipped with an IEC/IEEE-bus interface (R&S PS-B4, National Instruments PCIIA or other compatible interface).

Item	R&S Designation
Second IEC/IEEE-bus Interface	PS-B4
IEC/IEEE-bus Driver	PS-K2
QuickBASIC	PS-K1

The MS-DOS operating system must be installed on the computer and the IEC/IEEE-bus driver GPIB.COM loaded.

2.3 Starting the Program

The compiled program – SCAN.EXE – is started by simply entering the program name and pressing the enter key.

The source text – SCAN.BAS – can be edited, recompiled and restarted with the aid of a QuickBASIC development environment.

2.4 Execution

When the program is started, a frequency list file is created. In dialog mode the user enters start frequency, stop frequency and step width (Select values so that not more than 10,000 frequency values are obtained). The file format corresponds to that of the described Windows program.

Frequencies are loaded into the receiver and a measurement is carried out.

Two different modes may be used: In the talker/listener mode – SCAN:MODE LIST – measured values are displayed as points joined by line segments. In the controller mode – SCAN:MODE CLIST – the first ten values are output as text when the measured value buffer in the control computer is full.

2.5 Functions Provided

Command line parameter:

- `/?` outputs a help text listing all possible command line parameters.
- `/ad n` *n* defines the IEC/IEEE-bus address of the receiver. The standard address is 23.
- `/cf file` *file* is the name of the frequency list file - possibly with path - from which the frequencies programmed into the receiver are read. The file format has been described above. If this parameter is not specified, the user is prompted to enter values.
- `/f file` *file* is the name of the file - possibly with path - in which all measured values from the receiver are stored as a table.
- `/cic` Measurement carried out in the controller mode. The talker/listener function is the default setting.
- `/lin` The diagram is displayed using a linear frequency axis. The default setting is a logarithmic frequency axis.

3. LISTCPLX.BAS (QuickBASIC)

3.1 Purpose of the Program

With this program too, measurements are carried out in the frequency list mode. In addition to the signal levels, parameters such as frequency deviation, modulation depth/index, frequency offset and phase deviation are measured. Measured values are always displayed in plain text.

3.2 Program Description

The structure of this program is similar to that of LIST.BAS. The main difference is the evaluation of data read from the signal generator, since different data formats are used for measuring several signal parameters or pure signal levels.

The measurement configuration, ie segmenting, selection of level thresholds and definition of signal parameters to be measured, is carried out in the program within the *PrepareSegments* subprogram.

4. ALERT.BAS (QuickBASIC)

4.1 Purpose of the Program

A frequent task to be carried out in this field is the monitoring of thresholds of various signal parameters.

When the ESN is in the Alert mode, one or more signal parameters are monitored automatically. Once started, measurement and evaluation are carried out in the receiver and the controller need not be involved.

4.2 Execution

The frequency list is generated as described for the programs above and loaded into the receiver. The measurement which is then started is carried out automatically until the trigger condition is met, ie set thresholds are exceeded or not reached, depending on the configuration.

After this the receiver carries out frequency offset measurement and corrects the input frequency accordingly. Since special function 06, AFC, is switched on, this procedure is carried out automatically.

By pressing a key on the controller, the receiver continues scanning at the current frequency.

Segments, threshold values and the signal parameter to be measured are configured in the program within the *PrepareSegments* subprogram.

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