

Programming EMI Test Receivers

Application Note

Products:

- | R&S® ESU
- | R&S® ESCI
- | R&S® ESPI
- | R&S® ESL

This application note discusses several basic methods for reading and displaying measurement results from EMI test receivers.

The included free programming example is small and easily comprehended, so that users can quickly learn how to program test receivers.

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1 Introduction

Rohde & Schwarz offers two different software packages for measuring electromagnetic compatibility (EMC) automatically:

- R&S® EMC32 measurement software, an advanced and powerful tool for controlling and monitoring Rohde & Schwarz electromagnetic interference (EMI) test receivers, spectrum analyzers and EMC test systems.
- R&S® ES-SCAN EMI software, a cost-effective and user-friendly software solution developed specifically for EMI diagnostic testing during development.

EMC test measurements in particular require very individualized solutions, which is why EMI test receivers are frequently controlled with proprietary software. A major requirement for this software is that it must sample a specific frequency range (frequency scan) and transmit the measured levels to the controlling computer. The included example program should give an entry in programming this type of software.

The Virtual Instrument Software Architecture from National Instruments (NI-VISA) and the VME eXtensions for Instrumentation Plug&Play Instrument Driver (VXIplug&play) were used for remote control of the EMI test receiver. The application was written in Visual C# using Microsoft Visual Studio 2008 and the Microsoft Chart Controls for Microsoft .NET Framework 3.5 to allow graphical output of test results.

2 Technical Summary

To carry out a frequency scan, certain parameters, such as start and stop frequency as well as bandwidth and measurement duration, are defined and programmed into the test receiver. During the actual scan, the measured level values are transferred to the controlling computer, assigned to the corresponding frequencies and displayed in the diagram as trace. The peak search function is then used to calculate and display the highest level values.

3 Scan Measurement Example

3.1 Software Functions

The example program makes it easy to configure and start an EMI measurement. The following functions are supported:

- Compatibility with four different test instrument families:
 - R&S® ESU EMI test receiver
 - R&S® ESCI EMI test receiver
 - R&S® ESPI test receiver
 - R&S® ESL EMI test receiver
- Different configuration options:
 - Detector type
 - Number of peaks/subranges
- Result output in two different layouts:
 - Diagram area
 - Peak value list

3.2 Requirements

3.2.1 Hardware Requirements

Note the system requirements for the individual products required to run the example program, as listed under "Software Requirements". Additionally required are 20 MByte of free disk space and a color monitor with an SVGA resolution of 1024 x 768 pixels or higher.

3.2.2 Software Requirements

To open and run the example program, you will need Microsoft Visual Studio 2008 or later, as well as .NET Framework Version 3.5. NI-VISA Run-Time 4.6.2 or later must be installed in order to control the EMI test receiver remotely via the local area network (LAN) or a general purpose interface bus (GPIB). If the instrument is to be remotely controlled via the GPIB interface, an appropriate GPIB driver must additionally be installed on the computer. The appropriate VXIplug&play instrument driver for the test instrument families being used is also required.

Refer to the table below for more detailed information.

Requirements		
Software Requirements		
Instrument Model	VXIplug&play Instrument Driver	Version
R&S®ESU EMI Test Receiver	VXIplug&play Instrument Driver for R&S®ESCI, R&S®ESPI and R&S®ESU	4.40.1 or higher
R&S®ESCI EMI Test Receiver		
R&S®ESPI Test Receiver		
R&S®ESL EMI Test Receiver	RSSpecAn VXIplug&play Instrument Driver for R&S®ESL	1.10.2 or higher

3.2.3 Instrument Requirements

Requirements	
Instrument Requirements	
Instrument Model	Firmware
R&S®ESU EMI Test Receiver	4.43 SP3 or higher
R&S®ESCI EMI Test Receiver	4.42 SP1 or higher
R&S®ESPI Test Receiver	
R&S®ESL EMI Test Receiver	1.82 SP3 or higher

Current firmware versions are available at <http://www.rohde-schwarz.com>.

3.3 Download, Unpack and Start

You can download the example program from <http://www.rohde-schwarz.com/appnote/1MA185>. Unpack the ZIP file and extract the solution (SLN) file, which you can then open using Microsoft Visual Studio 2008 or a later version. To compile and run the application, in the development environment click "Debug > Start Debugging" (on the menu bar), or press the [F5] key. Please note that this is a 32 bit application.

3.4 Performing an EMI Measurement

The following window opens when the application launches:

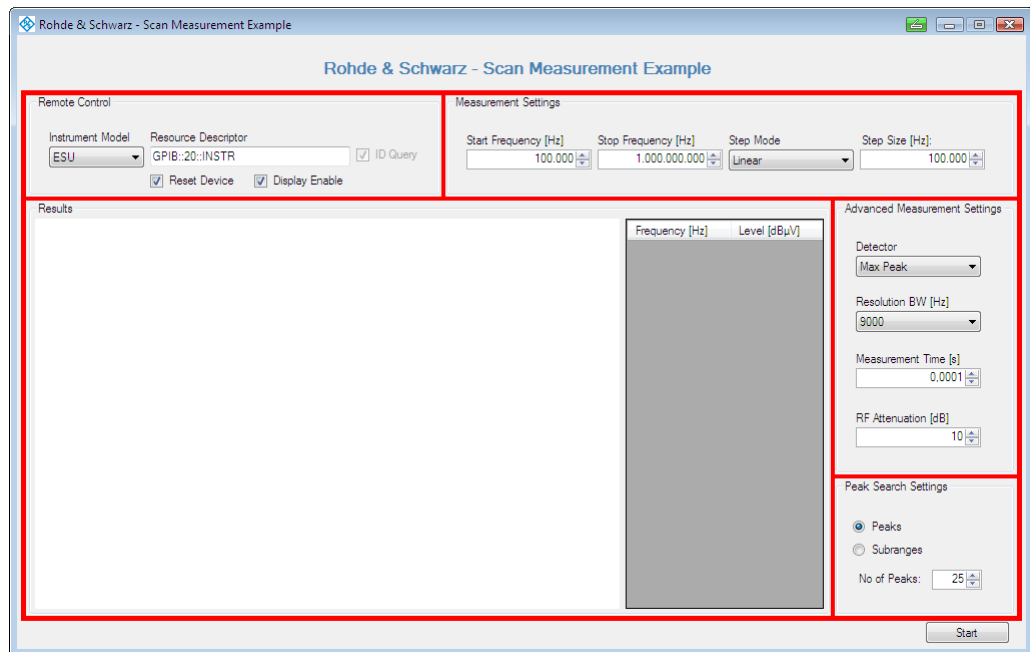


Figure 1: Start window for an example application.

The various configuration areas, outlined in red in Figure 1, are described in more detail below.

3.4.1 Remote Control

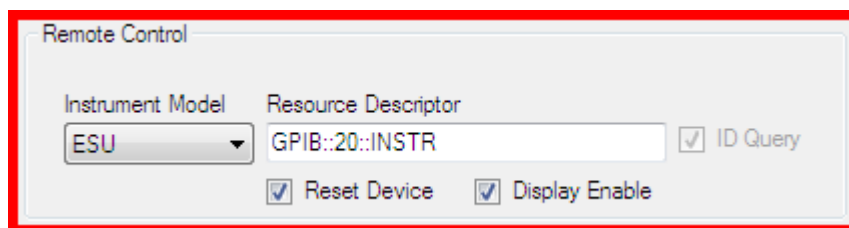


Figure 2: Measurement instrument remote control settings.

Instrument Model

Use this menu to define the type of instrument. The correct instrument driver is loaded at the start of the measurement. The application supports the following EMI test receivers:

- R&S® ESU EMI test receiver
- R&S® ESCI EMI test receiver
- R&S® ESPI test receiver
- R&S® ESL EMI test receiver

VISA Resource Descriptor

Use this field to configure the interface and address of the test instrument to be used. The instrument addresses are defined as shown below. Optional parameters are enclosed in square brackets ([]).

Remote Control		
VISA Resource Descriptor		
Interface	Keyword	Grammar
Serial	ASRL	ASRL[::INSTR]
GPIOB	GPIOB	GPIOB[Board]::PrimaryAddress[::SecondaryAddress][::INSTR]
RSIB	RSIB	RSIB::RemoteHost::INSTR
VXI-11	TCPIP	TCPIP::RemoteHost::INSTR

ID Query:

Use the "ID Query" field to allow the instrument driver to verify that the instrument being initialized is supported by the driver. This field, which is enabled by default, is not available to users during configuration, because it is used primarily for development purposes.

Reset Device:

Use the "Reset Device" field to reset the test instrument to its default status during initialization. It is recommended that a "preset" be performed before every measurement to prevent any invalid configurations.

Display Enable:

Use the "Display Enable" field, which is enabled by default, to define whether the test instrument screen should be activated or deactivated when the instrument is being controlled remotely. If the display is to be deactivated during remote control, uncheck the field to disable it.

3.4.2 Measurement Settings

Figure 3: Configuring the measurement.

Start Frequency / Stop Frequency:

Use the two fields "Start Frequency" and "Stop Frequency" to configure the frequency range within the measurement is to be performed. "Start Frequency" defines the start of the frequency range and "Stop Frequency" the end of the range.

Important: The start frequency must be greater than the stop frequency!

Step Mode / Step Size:

Use the "Step Mode" and "Step Size" fields to define a linear or logarithmic frequency change and the increments of the change. The following table provides additional information.

Measurement Settings	
Step Mode and Step Size	
Step Mode	Description
Linear Frequency Change	The frequency is changed in the increments defined in the "Step Size" field; Steps can be between 1 Hz and the maximum EMI test receiver frequency
Logarithmic Frequency Change	The frequency is changed at a % of the current frequency; Values of 0.1 % to 100 % at increments of 1/2/3/5 are possible (i. e.: 0.1 %, 0.2 %, 0.3 %, 0.5 %, 1.0 % etc.)

3.4.3 Advanced Measurement Settings

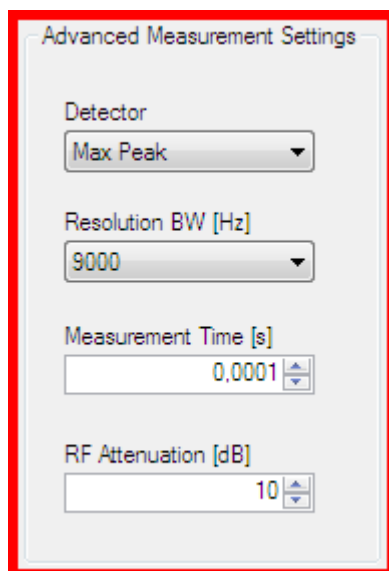


Figure 4: Advanced measurement settings.

Detector:

One of six available detectors can be selected for weighting the receive signal. By default, the "Max Peak" detector is enabled.

Refer to the table below for more detailed information.

Advanced Measurement Settings	
Detector	
Type	Description
Max Peak	Yields the largest sample values of the levels measured during the set measurement time
Min Peak	Yields the smallest sample values of the levels measured during the set measurement time
Quasi Peak	Yields the maximum detected value weighted to CISPR 16
Average	Yields the average level of the samples measured during the set measurement time
CISPR ¹ Average	Defines the weighted average value in accordance with CISPR 16-1-1
RMS ²	Yields the RMS level of the samples measured; the integration time corresponds to the set measurement time
CISPR ¹ RMS ²	Defines the weighted average value in accordance with CISPR 16-1-1

¹ CISPR: Comité International Spécial des Perturbations Radioélectriques

² RMS: Root Mean Square

Resolution BW:

Use this field to select the resolution bandwidth for the EMI test receiver. The following bandwidths are available: 200 Hz, 9 kHz, 120 kHz and 1 MHz. A Gaussian bandfilter (EMI 6 dB) is assumed at a bandwidth of 6 dB.

Measurement Time:

Use this field to define the measurement period during which the EMI test receiver observes the input signal and, based on the selected detector, generates the measurement results. Values from 100 μ s to 100 s are possible. Please note that the measurement period must be at least 1 ms for the "Quasi Peak" detector.

RF Attenuation:

Use this field to define the attenuation for the reference input circuit. The increment is 5 dB, and the range is from 0 dB to 75 dB. The default is 10 dB.

3.4.4 Peak Search Settings

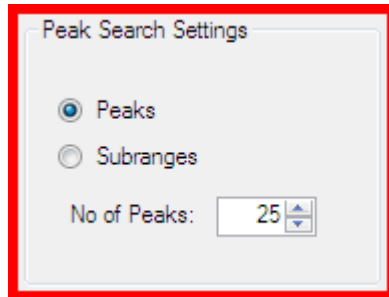


Figure 5: Peak search settings.

Peaks / Subranges:

Use the "Peaks" and "Subranges" radio buttons to select the search method used to find existing maximum values within a given measurement. The following table provides additional information.

Peak Search Settings	
Peaks and Subranges	
Method	Description
Peaks	A defined number of the peak values relative to the limit line are identified, regardless of their distribution over the frequency spectrum
Subranges	A subrange maximum is formed; i. e., the interference spectrum is studied based only on the frequencies having the highest interference level within a frequency subrange

Number of Peaks:

Use this field, which is located under the radio buttons, to define the number of peaks or subranges. The range for the number of peaks lies between 1 and 500, while the range for the number of subranges is between 1 and 50.

3.4.5 Results

After the measurement is configured, click the "Start" button to run the test. A message is displayed indicating that the measurement is running.

As soon as the measurement is complete, the test results are displayed in both a diagram and a table (see Figure 6).

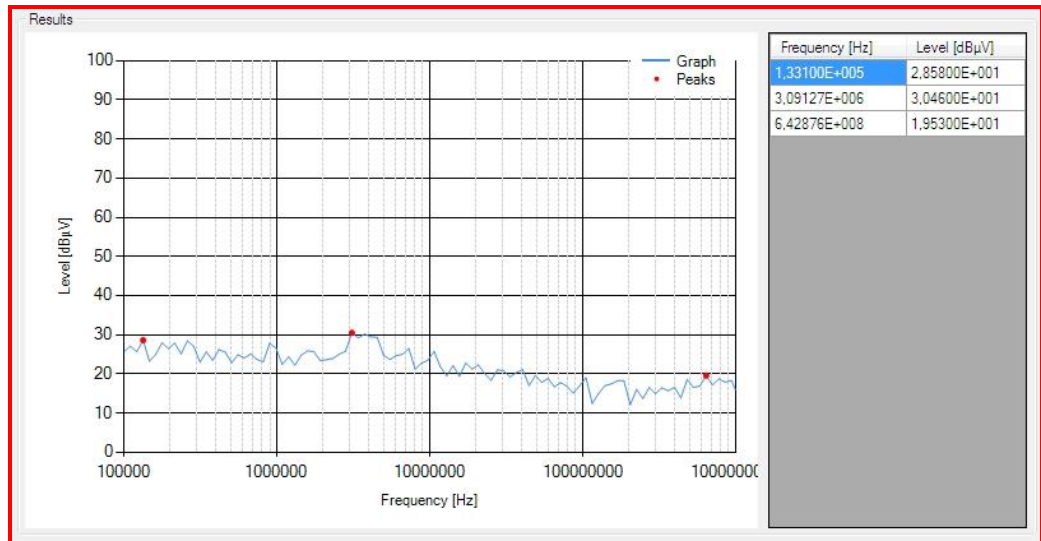


Figure 6: Displaying the test results in two formats.

The diagram area is made up of a test graph (blue) and the peak values (red). The table located to the right of the "Results" section shows all identified peaks, with the frequency and the associated level.

3.5 Program Architecture

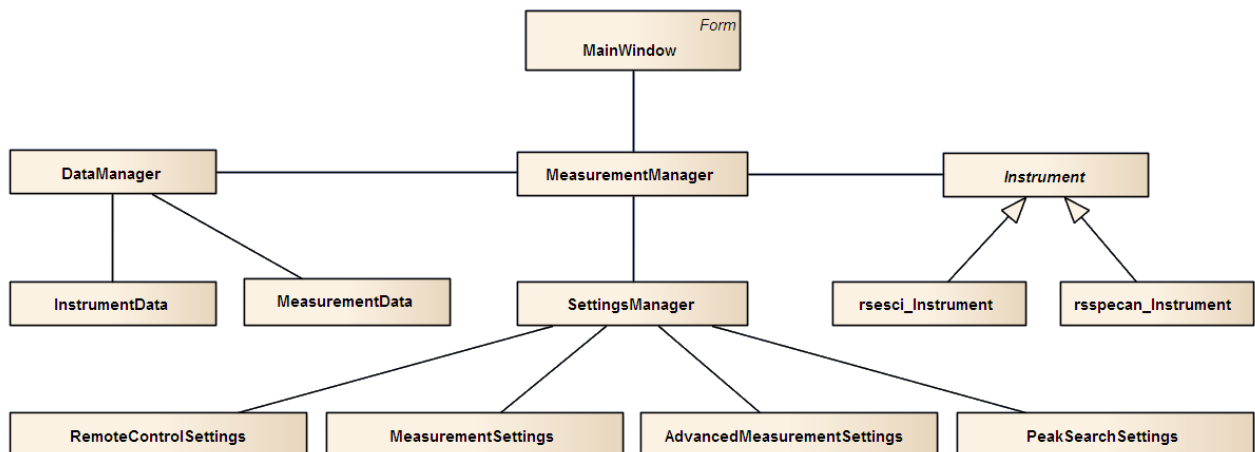


Figure 7: Simplified class diagram for the example application.

The graphic above shows a simplified class diagram, based on the Unified Modeling Language (UML) and generated using SparxSystems® Enterprise Architect. It shows the structure of the example program.

The "MainWindow" class defines the user interface for the application. The core of the program is the "MeasurementManager", which is responsible for the complete execution of the test routine. This class, together with the "SettingsManager", defines the various settings, loads the appropriate driver, configures the test receiver, performs the EMI measurement and returns the measurement results to the "DataManager". One special aspect of the example program is that it can support four different instruments from different test instrument families, using two different instrument drivers. These drivers are loaded at the start of the test routine based on the settings made by the user. The abstract class "Instrument" provides an interface that is used by the "MeasurementManager" to access the instruments in a consistent manner, and independently of the instrument drivers. Access to the various drivers and their methods is via the inherited classes "rsspecan_Instrument" and "rsesci_Instrument". The responsibility of the individual classes to the compatible test instruments is shown in the table below.

Program Architecture				
Responsibilities of the individual classes				
Class	R&S®ESU	R&S®ESCI	R&S®ESPI	R&S®ESL
rsesci_Instrument	X	X	X	
rsspecan_Instrument				X

4 Appendix

4.1 References

- [1] [Remote Control of Rohde & Schwarz Instruments](#)
- [2] [R&S®ESU Operating Manual](#), Manual, December 2009
- [3] [R&S®ESCI3, ESCI7 Operating Manual](#), Manual, August 2009
- [4] [R&S®ESPI Operating Manual](#), Manual, March 2010
- [5] [R&S®ESL Operating Manual](#), Manual, October 2009

4.2 Additional Information

Please direct your comments and suggestions regarding this application note to TM-Applications@rohde-schwarz.com

4.3 Ordering Information

Ordering Information		
EMI Test Receiver		
Model	Designation	Order No.
R&S®ESU EMI Test Receiver	R&S®ESU EMI Test Receiver 20 Hz to 8 GHz	1302.6005.08
	R&S®ESU EMI Test Receiver 20 Hz to 26.5 GHz	1302.6005.26
	R&S®ESU EMI Test Receiver 20 Hz to 40 GHz	1302.6005.40
R&S®ESCI EMI Test Receiver	R&S®ESCI3 EMI Test Receiver 9 kHz to 3 GHz	1166.5950.03
	R&S®ESCI7 EMI Test Receiver 9 kHz to 7 GHz	1166.5950.07
R&S®ESPI Test Receiver	R&S®ESPI3 Test Receiver 9 kHz to 3 GHz	1164.6407.03
	R&S®ESPI7 Test Receiver 9 kHz to 7 GHz	1164.6407.07
R&S®ESL EMI Test Receiver	R&S®ESL3 EMI Test Receiver 9 kHz to 3 GHz	1300.5001.03
	R&S®ESL6 EMI Test Receiver 9 kHz to 6 GHz	1300.5001.06

Note: Available options are not listed in detail.
Please contact your local Rohde & Schwarz sales office for further assistance.

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system



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