

Products: R&S® UPL, R&S® UPV, R&S® SML

FM Stereo Tuner Measurements

with Audio Analyzers R&S® UPV or R&S® UPL and
Signal Generator R&S® SML with R&S® SML-B5 option

Application Note RAC-0502-0012

This Application Note presents a program called FMTunerMeas, which combines FM tuner measurements to form automatically running sequences in line with DIN EN60315-4. It is an extension of Application Note 1GA43 and can be used with the Audio Analyzer R&S UPV.



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1 Overview

More and more modern mobile phones and PDAs come integrated with FM chipsets. To analyze the quality of RF FM tuners, a large number of measurements have to be performed. This Application Note presents a program, FMTunerMeas, which combines automatic FM tuner measurement sequences in line with DIN EN60315-4. It is an extension of Application Note 1GA43 and can be used with the Audio Analyzer R&S UPV.

The program FMTunerMeas is included. Run FMTunerMeas to perform measurements via GPIB remote control or to simulate the test sequences without any hardware connected. The report with measurement graphics and the test results are generated automatically in the appropriate folders in the user's computer.

2 Stereo Frequency Modulation Theory

In FM, the amplitude of the information signal is used to vary the carrier frequency, while the frequency of the information signal determines the rate at which the carrier frequency changes. For a transmitter with linear modulation characteristics, the frequency deviation of the carrier is directly proportional to the amplitude of the applied modulating signal. The frequency deviation is defined as follows:

$$\delta = k_f * E_M$$

where k_f (= frequency deviation/V) is the frequency sensitivity of the FM modulator and δ is the peak frequency deviation.

Mathematical analysis of FM

$$E_{fm}(t) = E_c \sin(2\pi f_c t + m_f \sin 2\pi f_m t)$$

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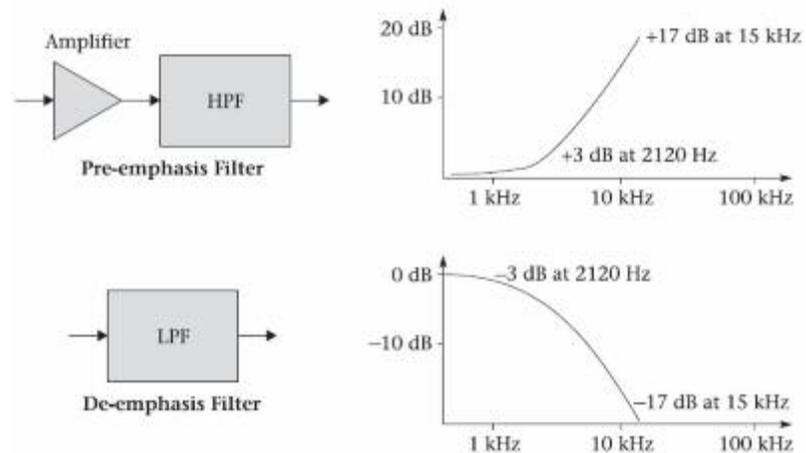
where E_c is the peak amplitude of the carrier frequency, f_c and f_m represent the carrier and modulating frequencies, and m_f is the index of modulation.

$$m_f = \frac{\delta}{f_M} \quad \text{where } f_M \text{ is the rated maximum system deviation.}$$

Pre-emphasis and de-emphasis

In normal speech and music, the spectral amplitude of the signal drops at higher frequencies.

This behavior can be used to improve the signal-to-noise ratio of the FM transmission. In the transmitter the higher signal frequency amplitudes are amplified. Due to the typically lower amplitudes at higher frequencies, this can be done without violating the rated maximum system deviation (RMSD). On the receiver side, this frequency-dependent amplification is compensated by a lowpass with exactly the same time constant used in the transmitter. This lowpass reduces the noise in the receiver but produces an overall flat frequency response for the desired signal, due to the pre-emphasis in the transmitter.

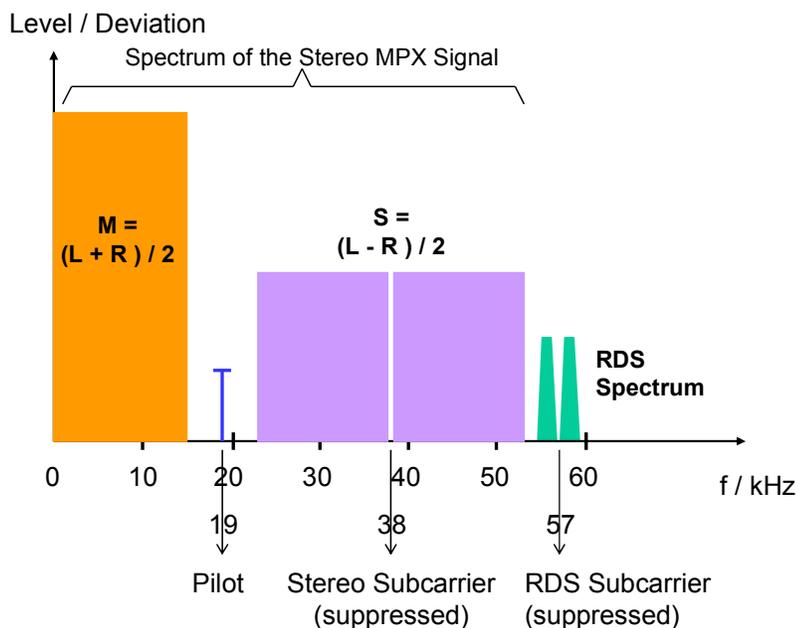
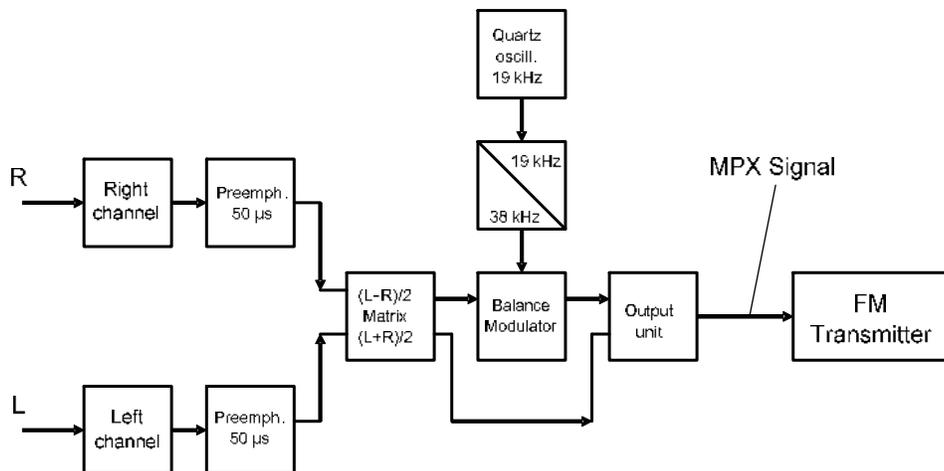


FM Stereo

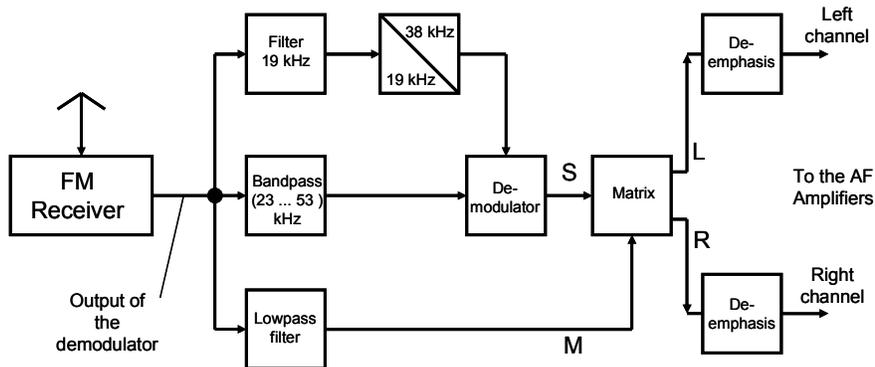
FM Stereo Transmitter block diagram

The left and right sources of information are first pre-emphasized and then fed to adder circuits. The output of one adder is the sum of the two signals ($L + R$), and the output of the other adder is the difference of the two signals ($L - R$). The $L - R$ signal is applied to a balanced modulator driven with a 38 kHz signal. The output of the balanced modulator is a DSBSC AM signal centered at 38 kHz.

FM Stereo Tuner Measurements



FM Stereo Receiver block diagram



3 Hardware and Software Requirements

PC hardware requirements

- CPU: Pentium III 800 MHz or better
- RAM: 128 MB or more
- Monitor: VGA color monitor
- IEC/IEEE bus: NI-compatible IEC/IEEE bus interface

PC software requirements

- Microsoft 32-bit operating system (Windows 2000/XP)
- GPIB driver installed
- CVI runtime engine
- VISA runtime version 2.5 or later
- For a document report, Microsoft Word 2000 or later must be installed

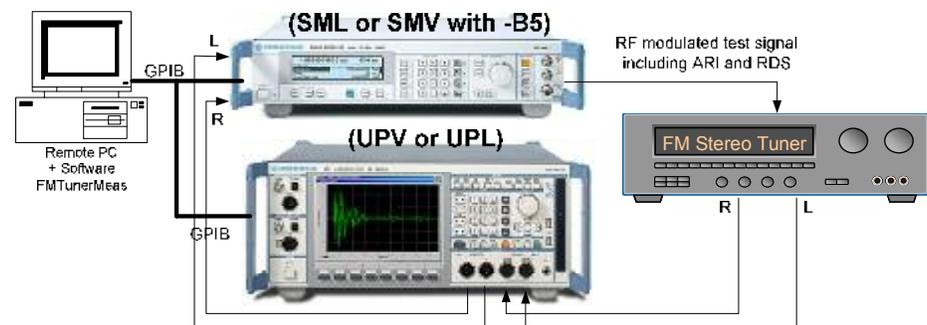
4 Connecting the Computer and the Instrument

The instrument connection is set up via an IEC/IEEE bus primary address. Make sure that each instrument has a unique GPIB address.

Connect the RF output of the R&S SML to the unbalanced antenna input of the tuner. Since the R&S SML has an output impedance of 50 ohm, the generator has to be matched to the tuner. Usually the coaxial 75 ohm antenna input is used. We recommend using the Matching Pad R&S RAM, which can be ordered under 358.5414.02.

If the receiver to be measured is only equipped with a balanced input, an adequate balun with an impedance of 240 ohm or 300 ohm must be connected in between the R&S SML's 50 ohm output the receiver balance input.

Make sure that measurements are performed with adequate grounding, e.g. to eliminate hum pick-up. Since tuners are normally not grounded and their outputs are floating, the inputs of the R&S UPV / R&S UPL should be grounded, provided a ground connection is not established via the antenna connected to the R&S SML.



5 Installing the Software

1. Extract the ZIP file, *FMTunerMeas_demo.zip*, available for free download from the R&S website.
2. Start *SETUP.EXE* to install the program.
Program files are copied to a directory of your choice during installation.
3. Complete the registration form to receive a registration key.

Welcome to FMTUNERMEAS_DEMO v1.00
You are using an unregistered version of FMTUNERMEAS_DEMO. This version has full functionality and no expiration date. As we are continuously improving the program, we depend on your comments and experience with FMTUNERMEAS_DEMO. Therefore, we kindly ask you to register FMTUNERMEAS_DEMO. Registration is free of charge and doesn't obligate you or your company.

To register
1. Fill out the registration form below.
2. Click 'Copy Registration Form to Clipboard'.
3. Open your mail client and paste the clipboard into the email message field with 'Ctrl-V'. Then send the registration form to RAC.ap@rohde-schwarz.com
You will receive an email from Rohde & Schwarz with your registration key.

Name *
* The registration key is derived from your name. All other fields may be filled out optionally.
Please help us by also providing these few details.

Company Dep.
Street City United States
Telephone
Email
Comments

Copy Registration Form to Clipboard

Once you receive your registration key
1. Enter your User Name and Registration Key.
2. Click 'Continue'.
FMTUNERMEAS_DEMO will start immediately. This registration form will no longer appear at program start.

User Name mike cheong
Key Code **Start**

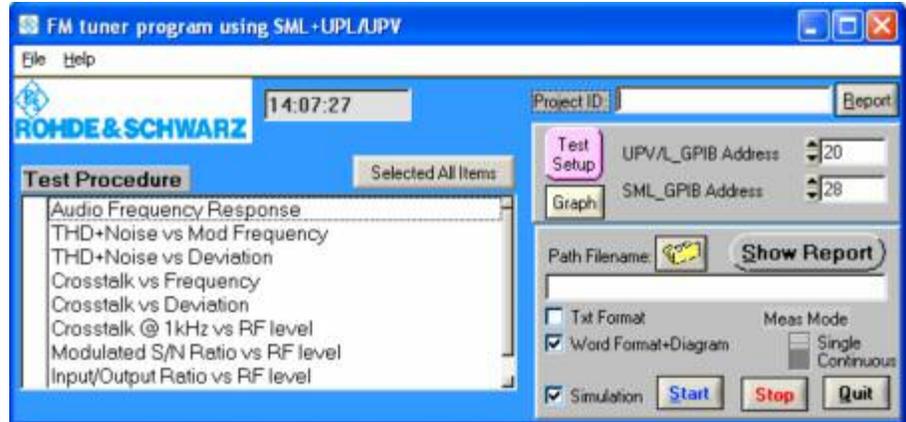
4. Enter the key code in the registration form and click "Start".
The main window for *FMTunerMeas_demo* appears.
5. Once the program has been registered, the registration form will not appear the next time you run *FMTunerMeas_demo*.

NOTE: If *FMTunerMeas_demo* has not been registered, you can still start the program by clicking the "Start" button.

6 Operating FMTunerMeas_demo Software

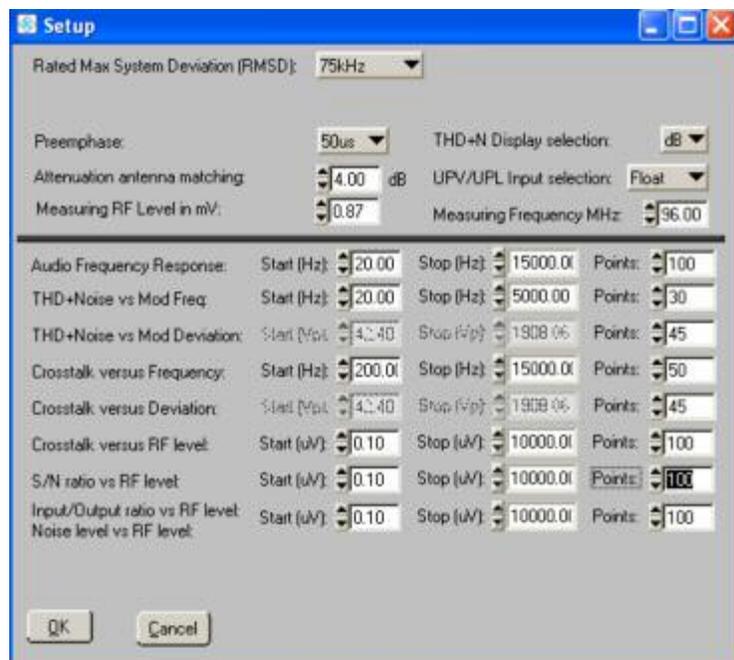
Getting started:

1. Start FMTunerMeas_demo.EXE



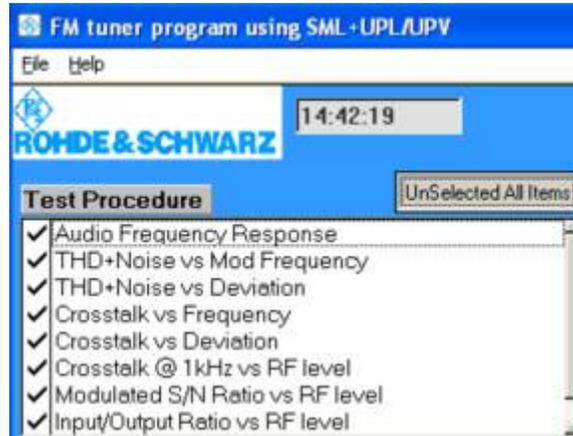
2. Connection and instrument control setup

Before you can use this software for connecting the instrument, you must configure the program to match your setup (e.g. GPIB connection), and then click the “Test Setup” button for your test configuration as follows:



3. Run the test

Before you run the test program, you should select the test procedures you want or click the “Selected All Items” button to select all the test procedures.



You also can click the “Report” button  to include the information that you want to add to your report files.



4. Run the simulation test

You can execute this software without connecting any instruments. In order to do that, you have to enable the Simulation check box.



Note: In order to run this software properly, please close the Tuner.BAS or any other BASIC program running in the R&S UPL. If MS Word is not installed in the controller PC, you can enable "Txt Format" and disable "Word format + Diagram". If you want a Word printout format with picture results, MS Word 2000 or a later version needs to be installed in the controller PC.

7 Literature

Audio Analyzer R&S UPL Operating Manual

Audio Analyzer R&S UPV Operating Manual

Signal Generator R&S SML Operating Manual

1GA43_0E **Tilman Betz**, Measurements on RF radio tuners with Audio Analyzer R&S UPL and Signal Generator R&S SML with option -B5.

1GA24_1E **Klaus Schiffner, Marco Brusati**, Measurements on Tuners using the Audio Analyzer R&S UPL or UPD and Signal Generator R&S SMT.

1EC 60315-4: 1997 Methods of measurement on radio receivers for various classes of emission – part 4: Receivers for frequency modulated sound broadcasting emissions.

NI-VISA™ User Manual, National Instruments, available for free download: <http://www.ni.com/visa>

8 Additional Information

For additional information or further suggestions, please contact your nearest Rohde & Schwarz office or rac.ap@rohde-schwarz.com.

9 Ordering Information

Audio Analyzer		
R&S UPL		1078.2008.06
R&S UPV		1146.2003.02
Signal Generator		
R&S SML01	9 kHz to 1.1 GHz	1090.3000.11
R&S SML02	9 kHz to 2.2 GHz	1090.3000.12
R&S SML03	9 kHz to 3.3 GHz	1090.3000.13
R&S SMV03	9 kHz to 3.3 GHz	1147.7509.13
R&S SML-B5	Stereo/RDS Coder (option)	1147.8805.02
Accessory		
R&S RAM	Matching Pad 50/75 Ohm	0358.5414.02



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