

Analog and digital audio broadcast signals with the R&S®SMx family of generators

Various audio broadcasting standards, GPS reception with navigation, and Bluetooth® interface: Leading-edge mobile radio equipment and car radios boast a wide range of features. As a result, manufacturers must perform ever more complex tests and therefore require generators that are able to provide all the usual standards in a single box, thereby simplifying system tests.

Rohde & Schwarz signal generators for almost all requirements

Analog audio broadcasting continues to be an attractive choice since it offers the best network coverage worldwide. Even these days, it is hard to imagine a radio receiver without analog reception. Still, there is no stopping the transition from analog to digital standards in sound broadcasting. The world of digital broadcasting has become quite diverse: Just consider the various broadcast standards and system providers such as XM Satellite Radio™ or SIRIUS Satellite Radio™ – both operating the satellite digital audio radio services (SDARS) in North America. The providers not only define broadcast technology, they also deliver content. Technical broadcast standards – e.g. digital audio broadcasting (DAB) and HD Radio™ – only define the broadcast technology, while content is delivered by independent providers.

End-user hardware is just as multifaceted. Car radio manufacturers, for instance, integrate different broadcast standards into their devices or offer different radio configurations depending on the target market. This immensely increases test requirements; manufacturers need measurement equipment that ensures simple and trouble-free system tests using a minimum of devices. Here it is important to have signal generators that are easy to operate and – in a single box – provide all necessary test signals in the very best quality.

With its R&S®SMx signal generators, Rohde & Schwarz offers a comprehensive generator portfolio to meet almost any requirement. New options enable the R&S®SMx family of signal generators to generate test signals for all important audio broadcast systems/standards (FIG 1, left):

- HD Radio™
- SDARS with XM Satellite Radio™ and SIRIUS Satellite Radio™
- DAB
- FM stereo and RDS/RBDS

Generators for all important standards: digital and audio broadcasting, mobile TV and mobile radio

R&S®SMU 200A vector signal generator		XM Satellite Radio™ SIRIUS Satellite Radio™		R&S®SFU broadcast test system						
R&S®SMJ 100A vector signal generator		HD Radio™ DAB		R&S®SFE broadcast tester						
R&S®SMBV100A vector signal generator		FM stereo RDS / RBDS		R&S®SFE100 test transmitter						
LTE	3GPP	GSM	WLAN	Bluetooth®	GPS	All ATV	ATSC	ISDB-T	T-DMB	(CMMB)

FIG 1 Rohde & Schwarz is the only manufacturer in the world to offer a portfolio of generators that covers all major standards: from analog and digital audio broadcasting to mobile TV and mobile radio.

Options for the established R&S®SMU200A and R&S®SMJ100A generators are already available or are currently being certified by the radio operators; the options for the newcomer, the R&S®SMBV100A, will follow soon.

FM stereo with the versatile R&S®SMX-K57 option

The basic operating principle of the FM stereo option is shown in FIG 2. All important parameters/data can be adjusted, making it possible to test the analog radio receiver to the limit. Audio data is either generated by an internal AF generator or fed in via the S/P DIF input. In addition, it is possible to read in audio files in WAV format and use them as an audio source. This makes it convenient for the user to choose music or audio contents on the PC and then generate an FM broadcast signal later on using the generators.

A special feature of the FM stereo option is the wide range of possibilities it offers for generating RDS/RBDS signals. This is where the R&S®SMx generators with their intuitive user interface really show their strength. All the usual parameters can be entered via the menus. FIG 3 shows group type 0 as an example. The RDS standard defines 16 different message formats, which are designated as group type 0 to 15. Due to its flexibility, the option even makes it possible to enter open data application (ODA) and traffic message channel (TMC) data. FIG 4 shows the input dialog for ODA in group type 8.

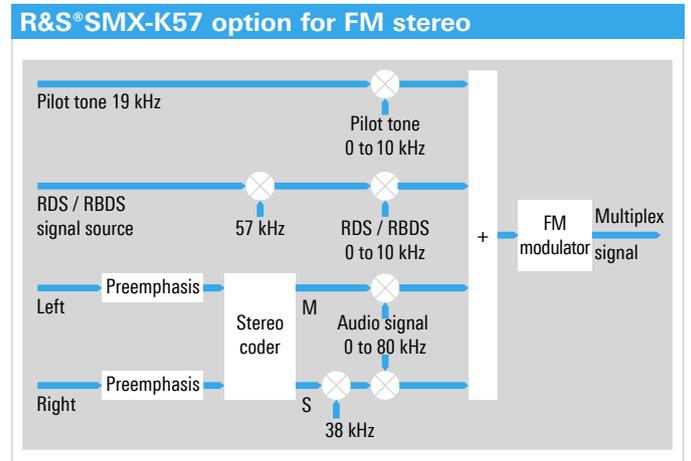


FIG 2 The principle behind the R&S®SMU-K57 FM stereo option.

DAB / T-DMB – using the R&S®SMX-K53 option for music and data services via VHF FM

DAB has become an established standard for broadcasting digital terrestrial audio broadcast programs and covers many European countries. In addition to audio data, DAB can also transmit auxiliary services and information as desired. Based on OFDM technology, the standard achieves a net data rate of 1.824 kbit/s at a bandwidth of 1.536 MHz. The programs are logically grouped to form services and ensembles.

No.	Block 2	Block 3	Block 4	No.	Block 2	Block 3	Block 4
0	01	1122	5434	16			
1	02	4343	FF2A	17			
2	1E	5CC4	AD10	18			
3	1F	0345	30A8	19			
4				20			

Group	Type	Transmit Time	State	Do Conf.	
0	Type 0	A	40%	On	On
1	Type 1	A	10%	On	Off
2	Type 2	A	15%	On	Off
3	Type 3	A	0%	Off	Off
4	Type 4	A	15%	On	Off
5	Type 5	A	0%	Off	Off
6	Type 6	A	0%	Off	Off
7	Type 7	A	0%	Off	Off
8	Type 8	A	0%	Off	Off
9	Type 9	A	0%	Off	Off

FIG 4 FM stereo: user mode for entering useful data for group type 8 / ODA.

FIG 3 FM stereo: dialogs for setting the RDS/RBDS parameters using group type 0 as an example.

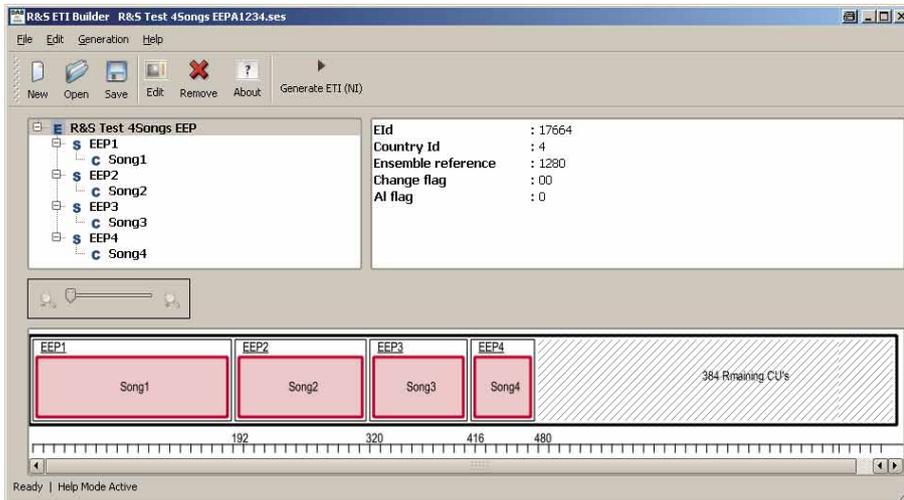


FIG 5 The ETI builder’s main window, which shows an ensemble with four services. The upper left window shows the ensemble’s tree structure; information about the ensemble can be found to the right. The lower window shows the position of the individual services (with different error protection) in the payload area of the DAB frame, just as they are to be transmitted later.

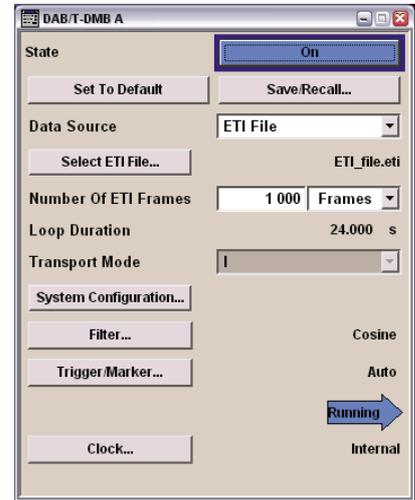


FIG 6 DAB: main dialog box of the R&S®SMU-K53 option.

The interface between the broadcasters and the broadcast network is described by the ensemble transport interface (ETI). The R&S®SMX-K53 DAB/T-DMB option uses the ETI as its input data format and transmits the included streams as DAB signal. In doing so, it supports all standard-defined transport modes and error protection methods. FIG 6 shows the main menu in which the ETI file is selected. Provided the format is valid, information such as the transport mode detected from the ETI frames and the duration of the selected frames is displayed.

In order to generate ETI data streams, Rohde&Schwarz offers the ETI builder software free of charge (FIG 5). This software makes it possible to convert music files into ETI streams, which can then be played by the R&S®SMx generators.

HD Radio™ – digital radio in parallel to analog AM and FM radio broadcasting

HD Radio™, also known as in-band on-channel (IBOC), was developed by the iBiquity corporation and is primarily being used in the United States. This method uses the same frequency bands as analog AM/FM broadcasting and can – unlike DAB – be operated in parallel as a hybrid variation. FIG 7 illustrates this for the FM frequency band. In hybrid mode, the OFDM-modulated HD Radio™ signal is additionally broadcast to the left and right of the analog FM signal.

The R&S®SMx generators have already been certified for HD Radio™ by iBiquity. The R&S®SMX-K352 option encompasses the complete set of AM and FM test vectors for all test categories, i.e. functional, bit error rate (BER) test pattern, analog only, non-IBOC, and production.

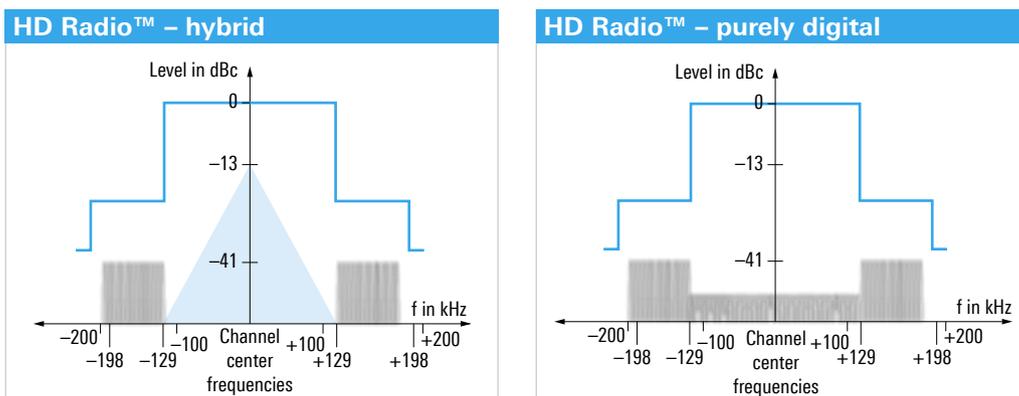
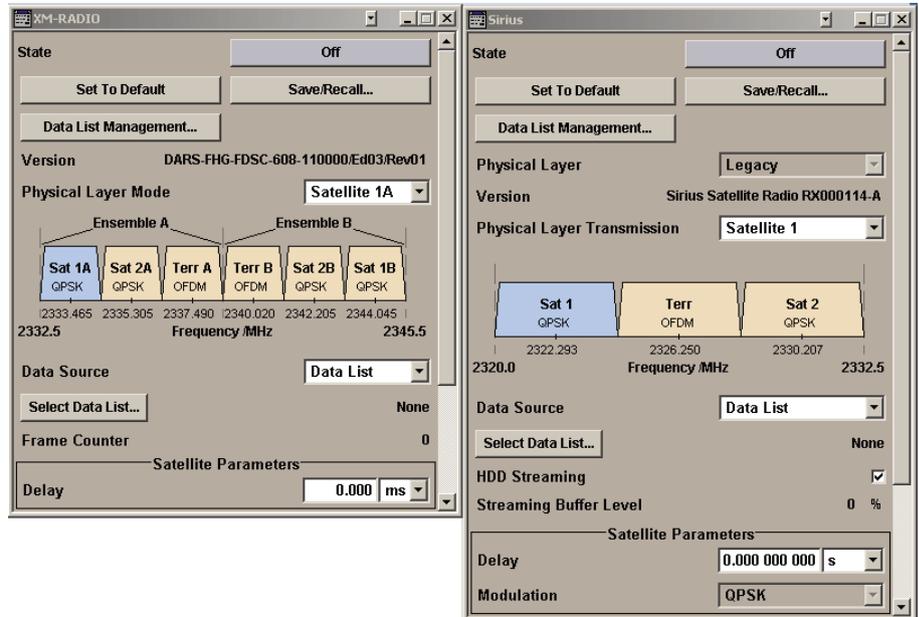


FIG 7 HD Radio™: FM frequency band as a hybrid (left) and as a purely digital system.

FIG 8 Main dialog box for SIRIUS Satellite Radio™ and XM Satellite Radio™.



XM Satellite Radio™ and SIRIUS Satellite Radio™ with the R&S®SMX-K56 and R&S®SMX-K58 realtime options

The two most important SDARS systems are XM Satellite Radio™ and SIRIUS Satellite Radio™. These two providers merged in 2008. SDARS systems broadcast a QPSK-modulated signal over satellites and a COFDM-modulated signal over terrestrial repeaters. This broadcast technology provides good reception in both thinly populated and in metropolitan areas. The assigned frequency bands are in the 2.3 GHz range.

For XM Satellite Radio™, the frequency band is divided into two subbands referred to as ensembles. Each ensemble includes two QPSK-modulated satellite carriers and one COFDM-modulated terrestrial carrier. Currently both ensembles transmit the same content. In the future, it will also be possible to transmit different content. The frequency band of SIRIUS Satellite Radio™ is divided into two QPSK-modulated satellite carriers and one COFDM-modulated terrestrial carrier. The complete frequency band of both SDARS systems is 12.5 MHz wide.

The R&S®SMx generators were type-tested by the system provider and validated for XM Satellite Radio™ and SIRIUS Satellite Radio™, which means that they generate standard-conforming signals (FIG 8). The generators' powerful baseband provides safety of investment because it makes them well-equipped for any future expansions by the system providers. As the first in their class, the R&S®SMx generators offer dynamic reloading of the modulation data directly from the internal hard drive. The data length is only limited by the size of the internal hard drive.

Summary

With its range of signal generators, Rohde&Schwarz covers all relevant standards and frequency ranges. The R&S®SMx generators are specialists for almost every mobile radio standards as well as for GPS simulation and – as described here – now also support the most important analog and digital audio broadcasting standards – all in one box. Two options round off the wide range of functions of the R&S®SMx family: the AWGN (additive white Gaussian noise) generator for artificially interfering with the useful signal and the fading simulator for simulating multipath propagation.

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In addition to the solutions described, Rohde&Schwarz offers other products that are able to generate signals for some of the analog and digital broadcasting standards specified above. The R&S®SMB100A supports FM stereo/RDS, the R&S®AFQ100A supports XM Satellite Radio™, and the R&S®SFx family of generators is able to support FM stereo/RDS, DAB, and HD Radio™. Further information can be found on the Rohde&Schwarz homepage.