# R&S®ETL TV Analyzer

## The universal reference for the analysis of TV, mobile TV and sound broadcasting signals

Broadcasting
Test & Measurement

Product Brochure | 05.01

ROHDE&SCHWARZ

# R&S®ETL TV Analyzer At a glance

The R&S®ETL TV analyzer stands for all-in-one. The R&S®ETL combines the functionality of a TV and FM (radio) signal analyzer, a video and MPEG TS analyzer and a spectrum analyzer in a single instrument. The R&S®ETL also contains generators to create analog video signals, audio signals and MPEG-2 transport streams.

The R&S®ETL's innovative instrument concept facilitates the flexible integration of demodulators for analog and digital TV standards as well as sound broadcasting. All of the demodulators work in realtime; fast signal processing allows comprehensive, extremely accurate measurements.

Its wide range of functions and flexible configuration make the R&S®ETL TV analyzer the universal reference for the analysis of TV signals – for TV and cable network operators, transmitter manufacturers, service technicians and regulatory authorities.

The R&S®ETL TV analyzer has primarily been designed to provide reproducible, high-quality analysis of TV and sound broadcasting signals such as are needed at the transmitter site, at the cable headend or for quality assurance during production.

The R&S®ETL is ideal for both stationary and portable use. The compact, rugged housing makes outdoor use possible, e.g. for coverage measurements within a terrestrial TV or sound broadcasting transmitter network.

## Key facts

- Frequency range from 500 kHz to 3 GHz
- TV, FM (radio), video, audio, MPEG-2 transport stream and spectrum analysis in a single box
- FPGA and chip-based realtime demodulators for analog TV, DVB-T, DVB-T2, DVB-H, ATSC/8VSB, ATSC Mobile DTV, ISDB-$T_{(B)}$, J.83/A/C, DVB-C, J.83/B, DTMB, T-DMB/DAB and FM (radio)
- Baseband outputs
- Preselection with additional 75 Ω RF input
- Video signal generator
- Audio signal generator
- MPEG-2 transport stream generator/recorder
- Support of power sensors
- DC input and rechargeable Li-ion battery

## Main applications

**Acceptance testing, maintenance and servicing of TV, mobile TV, DAB and FM transmitters**

- Precise analysis of the signal quality at the transmitter output
- Measurements to optimize transmitter operating parameters
- Measurement of spurious emissions
- Detection of faults
- Documentation of signal parameters
- Remote maintenance via IP networks with the Remote Desktop function

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**Quality assurance during the production of modulators and TV, DAB and FM transmitters**

- Reproducible analysis of the signal quality of modulators and transmitters

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**Optimization of TV, mobile TV, DAB and FM transmitter networks**

- Measurement of receive levels and signal quality at the reception site
- Checking and optimization of digital single-frequency networks (SFN)
- Systematic determination of receive quality in the transmission area (coverage measurement)

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# R&S®ETL TV Analyzer

# Benefits and key features

### All-in-one solution

- All required measurement equipment in a compact instrument
- Short learning curve due to uniform operating concept
- Fast and comprehensive signal analysis
- Simplified documentation of measurement results
- Excellent price/performance ratio

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### FPGA-based realtime demodulators

- Simple implementation of new standards with firmware updates
- Easy integration of multiple standards in a single instrument
- Seamless signal analysis through realtime demodulation
- Analysis and provision of baseband signals (video, audio, ETI, MPEG-2 TS)

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### Comprehensive analysis of analog TV signals

- Ideal for the transition from analog to digital TV
- Overview of the most important parameters
- Measurements for evaluating modulator quality at the transmitter or cable headend
- TV picture for fast visual inspection of transmission links

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### Comprehensive analysis of digital TV and mobile TV signals

- Overview of the most important parameters
- Spurious emissions quickly detected with integrated spectrum analyzer
- Constellation diagram with high processing speed for detecting short-duration interferers
- Measurements for optimizing transmitters and modulators

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### Analysis functions for second-generation TV standards – DVB-T2, ATSC MDTV

- DVB-T2, realtime signal analysis
- Wide-ranging analysis functions
- Prepared for multi-PLP and MISO
- ATSC MDTV realtime signal analysis
- Analysis of signaling parameters and services
- Measurements to optimize single-frequency networks

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### Precise analysis of digital single-frequency networks (SFN)

- High-precision display of channel impulse response
- Simple identification of echoes using tabular lists and marker functions
- Extended time domain for faraway post-echoes
- Efficient measurement of frequency drifts within an SFN

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### High-performance analysis of FM (radio) and audio signals

- Analysis of RF and MPX signals at the transmitter or in the field
- High-quality SNR measurement with high SNR frontend
- Integrated audio analysis

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### MPEG-2 transport stream analysis

- Checking of input and output signals at the transmitter or cable headend
- Analysis in line with ETSI TR 101290, priorities 1 to 3
- Table interpreter and in-depth analysis
- Data broadcast analysis including ESG
- Software and hardware decoder for MPEG-2 and H.264

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### Measurements for cable TV networks

- CSO, CTB and C/N
- Frequency response measurement
- Ingress measurement to detect interferers

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### Automatic measurements and documentation

- R&S®TxCheck measurement software for DVB-T, DVB-T2, DVB-H, ATSC/8VSB, ISDB-$T_{(B)}$, J.83/A/B/C and FM (radio)
- R&S®TPCHECK transposer measurement software for DVB-T and DVB-H
- R&S®TVSCAN measurement software for measuring cable TV systems and DVB-T/DVB-T2 transmissions
- Long-term documentation of measured values for DTV, DAB and FM (radio)

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### Integration of spectrum measurements in TV and sound broadcasting signal analysis

- Full-featured spectrum analyzer
- Measurement of transmission channel power, adjacent channel power and harmonics
- Crest factor
- Built-in tracking generator for measuring filters and amplifiers
- Transducer tables and antenna factors taken into account

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### Precise power measurement

- Support of R&S®NRP-Zxx power sensors

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### Flexible option concept

- Modules for easy upgrading by user
- Interfaces for enhanced functionality

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### Reference signals for transmitters and modulators

- MPEG TS generator and recorder
- Analog TV video generator
- Audio generator

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### Ideal for portable use

- High-contrast, daylight-compatible display
- Rugged housing with edge protection
- DC power supply and replaceable, rechargeable battery for use in vehicles and the field
- Compact design and low weight with wide range of functions

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# Acceptance testing, maintenance and servicing of TV, mobile TV, DAB and FM transmitters

The quality of transmitter networks depends on the optimal and error-free operation of each individual transmitter. The R&S®ETL TV analyzer offers a range of functions to maintain the high quality of the network during acceptance testing, maintenance and servicing of transmitters. The same holds true for cable TV networks and their modulators used in cable headends.

**Precise analysis of the signal quality at the transmitter output**

The R&S®ETL's high-quality RF frontend and subsequent digital signal processing help ensure accurate, close-tolerance measurement results. A contributing factor is the R&S®ETL system performance, with a video signal-to-noise ratio of > 60 dB (analog TV) and an intrinsic MER of > 40 dB (digital TV), providing enough margin for measurements with relatively low inherent error. The precision of the R&S®ETL can be increased by using an internal temperature-compensated oscillator or external power sensors supported by the R&S®ETL.

**Measurements to optimize transmitter operating parameters**

The R&S®ETL measurement functions are not limited to a few key parameters. The TV analyzer also provides other measurements that help the user optimally set up the operating parameters, such as frequency spectrum, modulation parameters and output power.

**Measurement of spurious emissions**

Spurious emissions at the transmitter or cable headend must be measured to make sure adjacent channels are not adversely affected. One of the main advantages of the R&S®ETL is the built-in spectrum analyzer functionality that makes it possible to measure shoulder attenuation, adjacent channel power and harmonics without additional measurement equipment.

**Detection of faults**

The very difficult task of finding sporadic faults is easy with the R&S®ETL. Fast realtime signal processing captures even sporadic interference. The measurement log option is especially useful. Important parameters are logged even over longer time periods. Deviations from nominal values are clearly shown.

**Documentation of signal parameters**

The R&S®ETL offers various options for documenting signal parameters. It only takes seconds to create and save screenshots, either internally or to an external storage medium. These tasks can be conveniently accomplished with the R&S®TxCheck measurement software. The software automatically measures DVB-T, DVB-T2, DVB-H, ATSC/8VSB, ISDB-$T_{(B)}$, DVB-C, J.83/B/C and FM (radio) signals, evaluates the results and documents them in a report.

**Remote maintenance via IP networks with the Remote Desktop function**

A service technician is not always available at the transmitter site to quickly analyze the cause of faults. In this case, the R&S®ETL can be controlled remotely via a LAN interface. The Remote Desktop function allows specialists to carry out all measurements from a remote location, such as a central service center, as if they were on site.

# Quality assurance during the production of modulators and TV, DAB and FM transmitters

The quality level of modulators and transmitters must be maintained on the production line, even when transmission standards frequently change. Numerous demodulators and measurement functions for various standards can be installed on the compact R&S®ETL TV analyzer multistandard platform. Users can quickly switch between these functions, either manually or via the remote control interface which provides the appropriate remote commands for all available standards. The R&S®ETL can be easily integrated into automatic measurement systems.

**Reproducible analysis of the signal quality of modulators and transmitters**

It is only possible to reliably determine fluctuations in the production quality when the quality is regularly checked under reproducible conditions.

This is one of the strong points of the R&S®ETL. Combining the measurement functions of several instruments in a single instrument ensures that measurements are always made with matching settings. All instrument settings can be saved and reloaded at any point in time.

The user can define PASS/FAIL limits for almost every measurement parameter. This makes it easier to evaluate the production quality and create test logs.

Parameter list with user-definable limits.

| Pass | Limit < | Results (HP) | < Limit | Unit |
|---|---|---|---|---|
| Level | -60.0 | -26.7 | 10.0 | dBm |
| Constellation | | 64 QAM NH / normal | | |
| MER (rms) | 24.0 | 44.5 | ----- | dB |

# Optimization of TV, mobile TV, DAB and FM transmitter networks

**Measurement of receive levels and signal quality at the reception site**

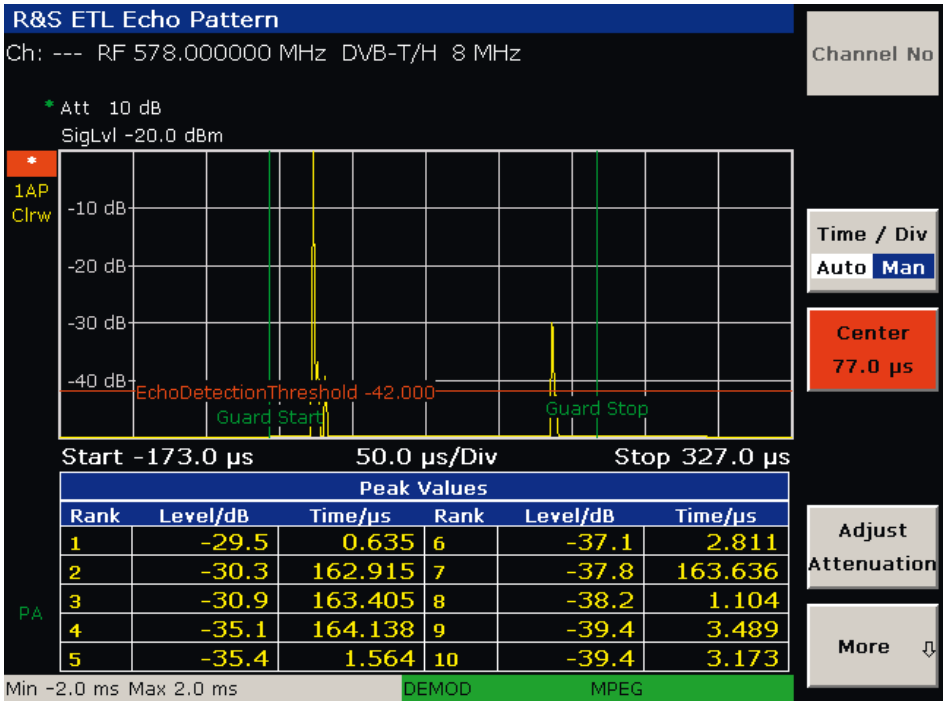
When a new broadcast transmitter network is put into operation, it is especially important that the quality of the transmitter coverage fulfills the network planning specifications. While the main criterion for analog transmitter networks is a sufficiently high receive level, digital transmitter networks have even more criteria that must be taken into account.

For field measurements, the R&S®ETL can be equipped with an internal preselection to improve receive dynamics and input sensitivity. As a result, the R&S®ETL is perfectly able to analyze all relevant signal parameters in the field.

**Checking and optimization of digital single-frequency networks (SFN)**

All over the world, digital networks are replacing analog networks. Most digital networks are operated as single-frequency networks in order to achieve high coverage quality. The R&S®ETL's high-precision SFN measurements provide network operators with all the tools they need to check and optimize SFN networks.

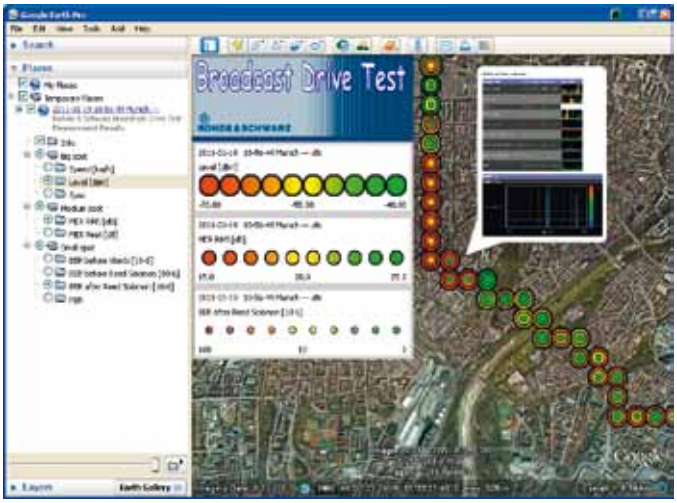
Echo pattern of a DVB-T, DVB-H single-frequnecy network.



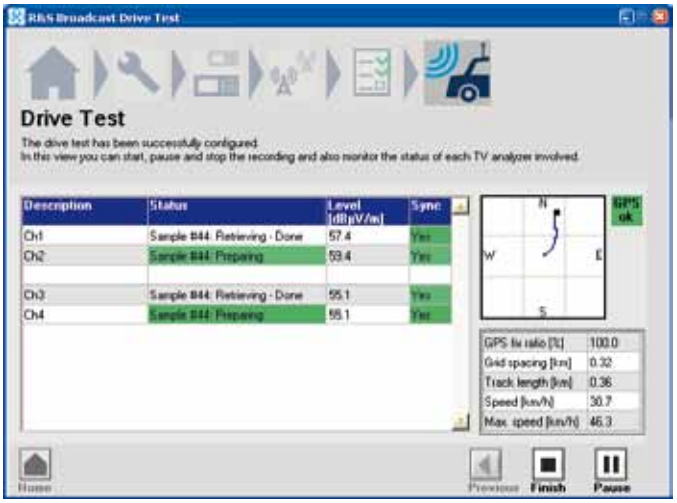
**Systematic determination of receive quality in the transmission area (coverage measurement)**
Test vehicles are often used when measuring the receive quality of the transmission area. While they are systematically driven over the entire coverage area, important signal parameters and their location are measured and logged. The R&S®BCDRIVE for drive tests software provides a solution that makes it possible to capture and record the signal quality while driving and export it for viewing the record on a map.

For the most common digital standards, the R&S®ETL can be integrated into the R&S®BCDRIVE drive test system to help find problematic receive locations and determine the cause of reduced signal quality.

Presentation and analysis of measurement results in the map view.




Status messages at a glance during a drive test.



# All-in-one solution

**All required measurement equipment in a compact instrument**

The R&S®ETL TV analyzer can perform measurements that used to require several separate measuring instruments. The R&S®ETL combines the functionality of a TV test receiver, a spectrum analyzer, an MPEG TS analyzer and other instruments providing users with all the tools they need in a single, compact instrument.

**Short learning curve due to uniform operating concept**

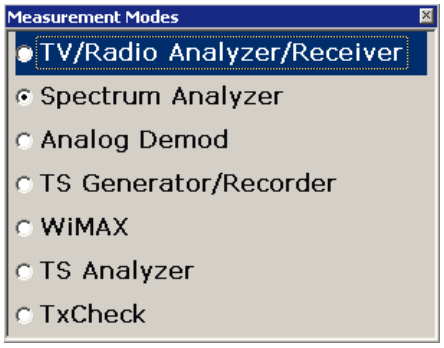
Integrating several T&M instruments into one makes operation considerably easier. Similar functions have similar user prompts. The uniform operating concept means that the learning curve for the R&S®ETL is very short and the risk of operator error is reduced.

**Fast and comprehensive signal analysis**

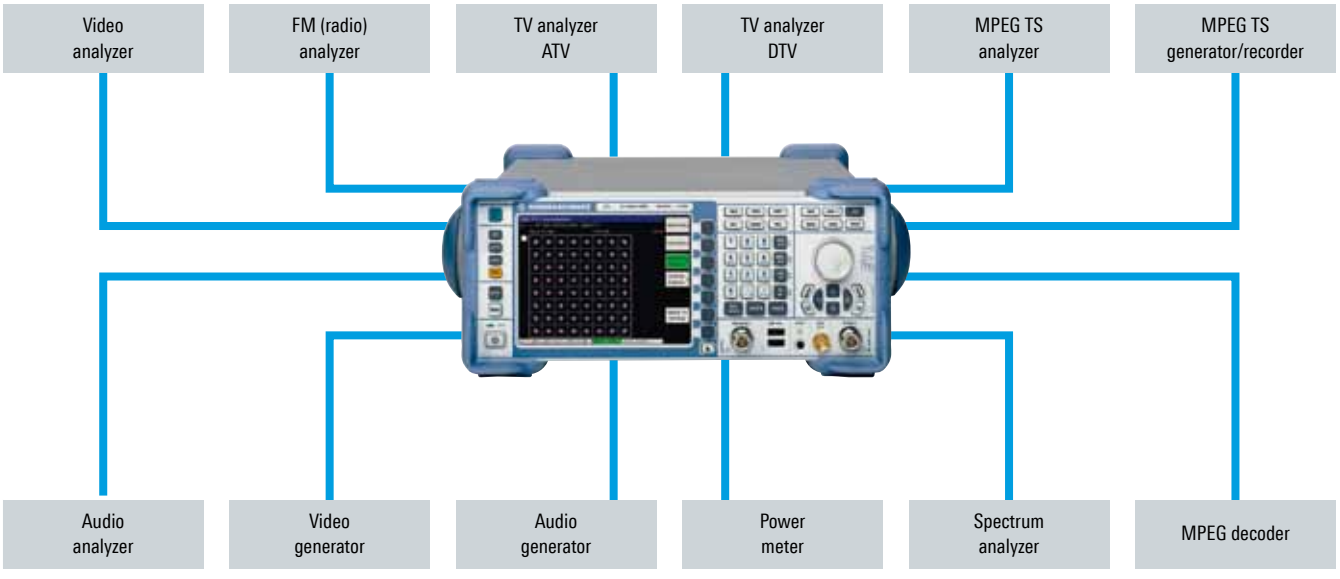
When an error occurs in a transmitter network, quick action is required. The R&S®ETL's comprehensive signal analysis functions allow users to quickly find the cause of errors – without any additional T&M equipment.

The R&S®ETL also helps save time when performing everyday, routine tasks because it is fast and easy to switch between the various T&M functions; no changes need to be made to instrument settings or test setup.

Menu for selecting the measurement mode.




## All-in-one solution



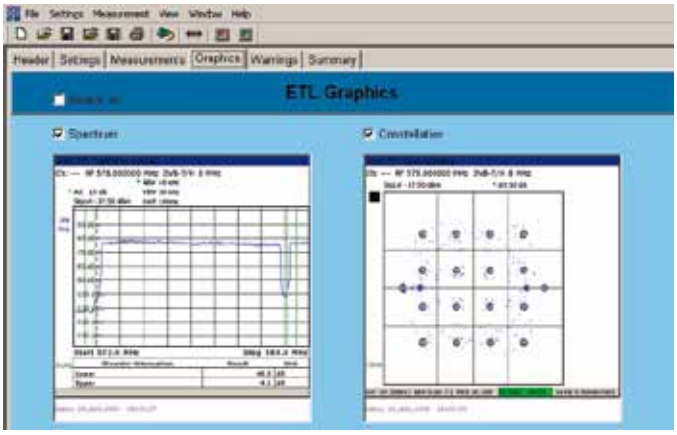
**Simplified documentation of measurement results**
When several T&M instruments are used to collect data, various data formats, storage media or remote commands are usually needed to document the results in a report.

The all-in-one concept of the R&S®ETL makes documentation of measurement results easier because it is based on a ccess to common storage media, uniform operation and standardized remote commands.

This is illustrated by the R&S®TxCheck measurement software, which runs on the TV analyzer itself. R&S®TxCheck automatically executes the measurements the user wants, and documents the measurement results and traces in a common report.

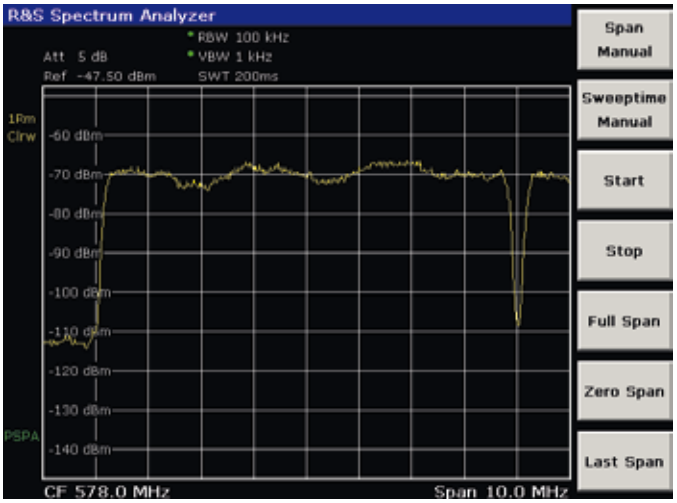
**Excellent price/performance ratio**
In addition to shortening the learning curve and making everyday work more efficient, the R&S®ETL's all-in-one concept also yields an excellent price/performance ratio. Combining several T&M functions on one hardware platform drastically lowers purchase costs. Another cost-saving benefit of the all-in-one concept is the significant reduction in effort necessary for regular calibration.

R&S®TxCheck automatic measurement tool.




Span menu in TV analyzer mode ...


... and in spectrum analyzer mode.



# FPGA-based real-time demodulators

The central component in a TV analyzer is the demodulator. The demodulator determines which analyses in what quality can be carried out. Chip-based demodulators do not usually offer the required quality nor do they have the interfaces required for professional T&M applications. That's why Rohde & Schwarz uses its own FPGA-based demodulators in the R&S®ETL.

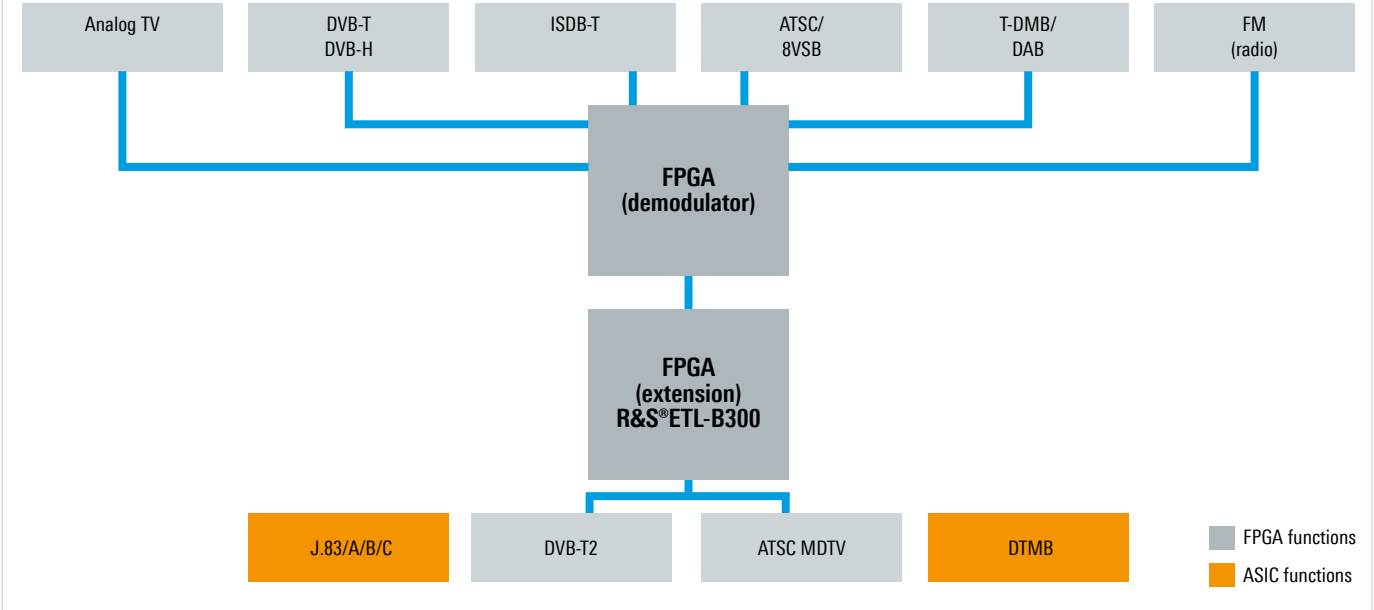
**Simple implementation of new standards with firmware updates**

In addition to quality, another advantage of FPGA-based demodulators is that they make it easy to implement new transmission standards. Usually, only a firmware update and an installation key are required. This provides a high degree of investment protection and flexibility.

**Easy integration of multiple standards in a single instrument**

It is not unusual for transmitter network operators in the same coverage area to broadcast different standards, often from the same site. Today, analog TV can be found adjacent to digital TV, and analog sound broadcasting adjacent to digital audio broadcasting. The R&S®ETL is an ideal, cost-effective solution for transmitter measurements. The FPGA-based demodulators in the R&S®ETL allow multiple TV and sound broadcasting standards to be easily integrated, which eliminates the need for investing in several instruments. The R&S®ETL hardware can also be updated to add other standards to cover future requirements.

**R&S®ETL multistandard platform**



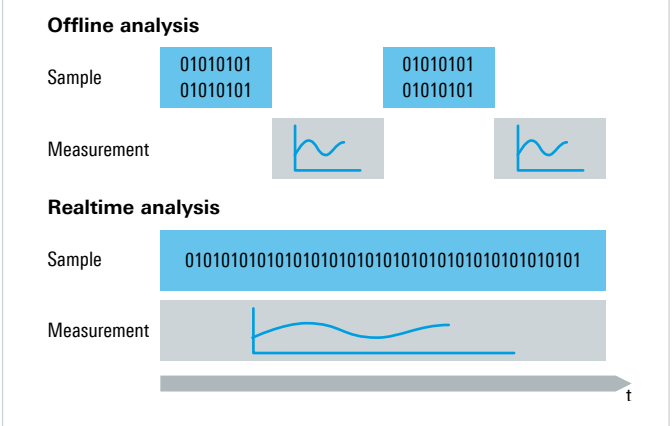
### Seamless signal analysis through realtime demodulation

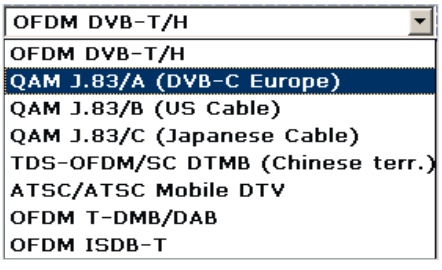
One of the basic principles of the R&S®ETL TV analyzer is realtime demodulation for practically seamless signal analysis to detect even sporadic interference.

### Analysis and provision of baseband signals (video, audio, ETI, MPEG-2 TS)

Realtime demodulators are important for seamless signal analysis. They also allow analysis of baseband signals such as video, audio and those from a digital transport stream. Baseband signals can be analyzed internally with the R&S®ETL or externally with additional instruments. The R&S®ETL has numerous interfaces where the demodulated signals are made.

**Comparision between offline and realtime analysis**



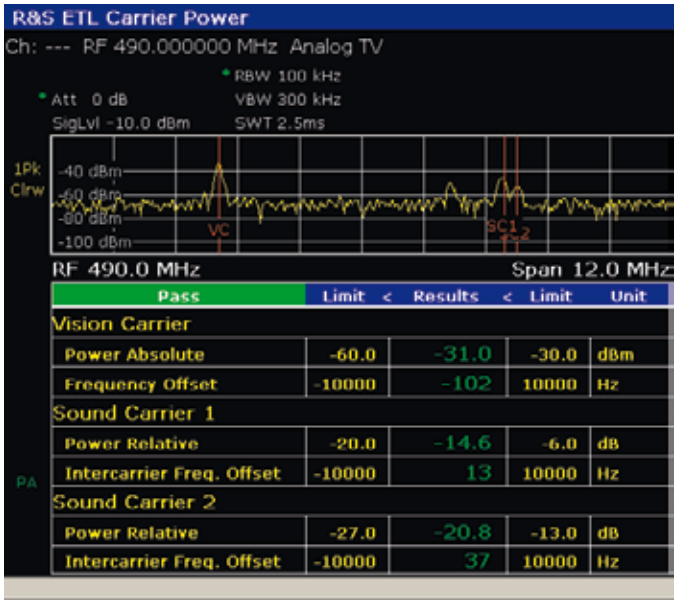




Menu for selecting digital standards.


Menu for selecting analog TV standards.

# Comprehensive analysis of analog TV signals

Analog TV carrier measurement.




Analog TV picture.


The R&S®ETL standard version comes with a range of elementary measurements for analyzing analog TV signals. The video analyzer functionality needed at the transmitter site or at the cable headend can be added to the R&S®ETL.

**Ideal for the transition from analog to digital TV**

Digitization of terrestrial transmitter networks and cable TV networks is progressing swiftly. Usually, the transition from analog to digital TV is a step-by-step process over a longer period of time.

The R&S®ETL is the ideal solution for those who need a professional analyzer for digital TV signals and still must ensure the quality of analog transmissions during the transition period.

**Overview of the most important parameters**

The basic version of the R&S®ETL comes with a carrier measurement facility, a video line oscilloscope and measurements for modulation depth and residual carrier. The measurement results are clearly presented, providing the user with a quick overview of the key parameters.

**Measurements for evaluating modulator quality at the transmitter or cable headend**

There are stringent signal quality requirements directly at the transmitter or cable headend. To help ensure the required quality, other parameters need to be checked during commissioning or regular servicing.

The R&S®ETL optionally offers video analyzer functionality (R&S®ETL-K202) to measure and optimize the quality of exciters and their precorrection.

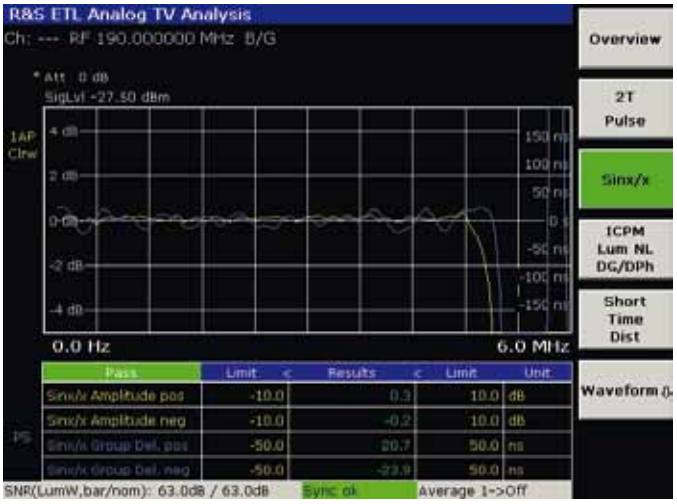
**TV picture for fast visual inspection of transmission links**

A picture is worth a thousand words or a series of signal parameters. For experienced users, a quick look at the transmitted TV picture is the first way to quickly check if a transmission link is working.

A decoder can be added to the R&S®ETL to display a TV picture on the instrument's display.

Video test line with measurement parameters.

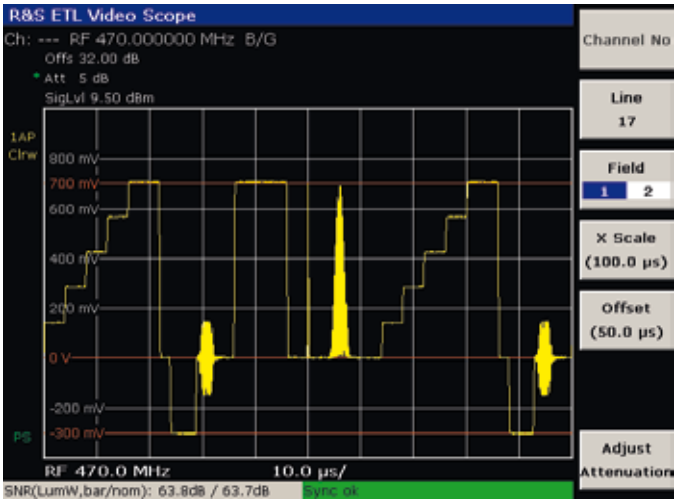

Amplitude and group delay measurement.



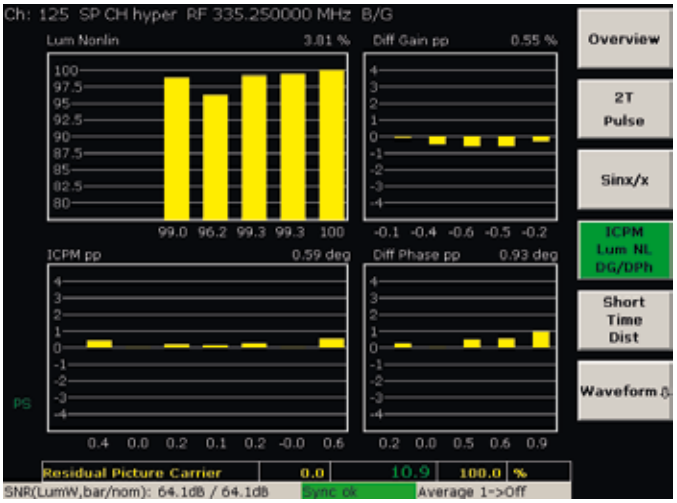

Overview of video test line parameters (part 1).


Overview of video test line parameters (part 2).


Video line oscilloscope.




ICPM measurement.



# Comprehensive analysis of digital TV and mobile TV signals

Digitization has made the production of multimedia content much easier – from recording to postprocessing and archiving. Highly efficient digital transmission methods are used to bring such produced content to the receiver, ideally with no loss in quality. A range of parameters needs to be taken into account.

**Overview of the most important parameters**

The R&S®ETL TV analyzer provides users with a compact list that gives a quick overview of the key parameters. Only the parameters relevant to the selected standard are displayed. Predefined limits for almost every parameter also help personnel with little training evaluate the signal quality.

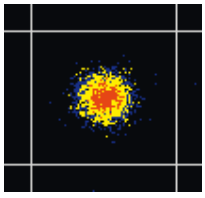
Essential parameters are permanently displayed in a footer, even after changing to another measurement. These parameters include the level, MER, bit error rate and the status fields for synchronizing to the carrier signal or the digital transport stream. As a result, users do not have to continually switch between the various measurement screens, and alignment is easier.

**Spurious emissions quickly detected with integrated spectrum analyzer**

For digitally modulated transmissions, it is vital to ensure that adjacent channels are not adversely affected by spurious emissions. A transmitter operator must always observe certain standard-specific criteria. Typical criteria are, for example, defined shoulder attenuation within specified frequency ranges, output-power-dependent spectrum masks and level differences defined for specific frequencies.

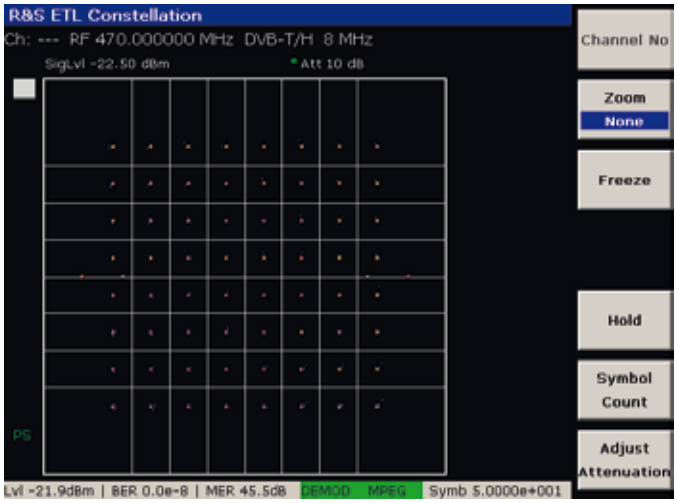
The R&S®ETL provides a choice between standard-compliant predefined measurements and the flexible use of the integrated spectrum analyzer.

The most important parameters at a glance (DVB-T, DVB-H).

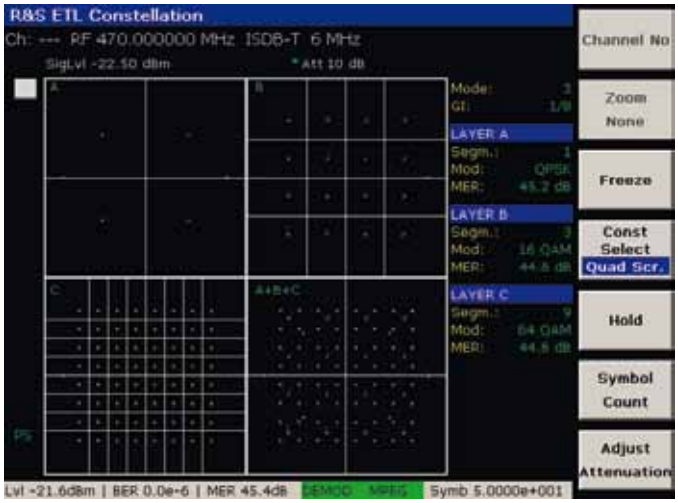



Constellation point with color display of frequency distribution of individual symbols.

Constellation diagram of a DVB-T, DVB-H signal.




Constellation diagram of an ISDB-T signal.



**Constellation diagram with high processing speed for detecting short-duration interferers**

The display of the constellation diagram is an elementary measurement for digital modulation. If the constellation diagram has been accurately created in realtime, it can be used by an experienced user to determine a number of error sources for poor signal quality.

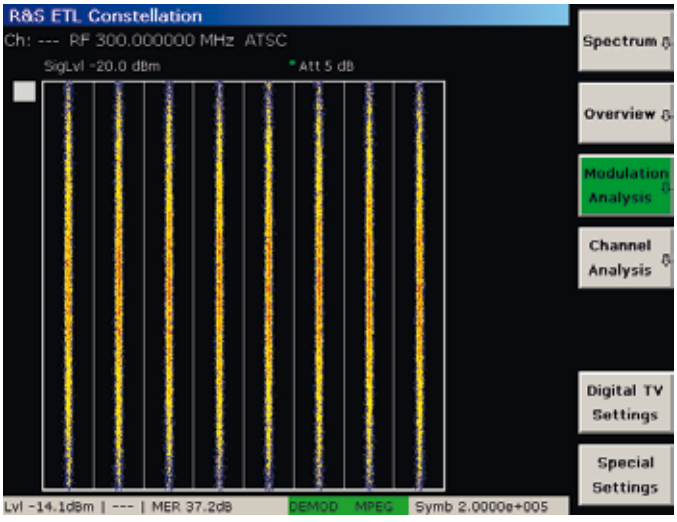
The high processing speed of the R&S®ETL makes this possible. Several million symbols per second are processed and displayed; even sporadic interference can be reliably detected. Plus, color-coding shows the distribution of symbols within their decision fields, allowing users to quickly find problems such as excessive phase or amplitude noise or other errors.

**Measurements for optimizing transmitters and modulators**

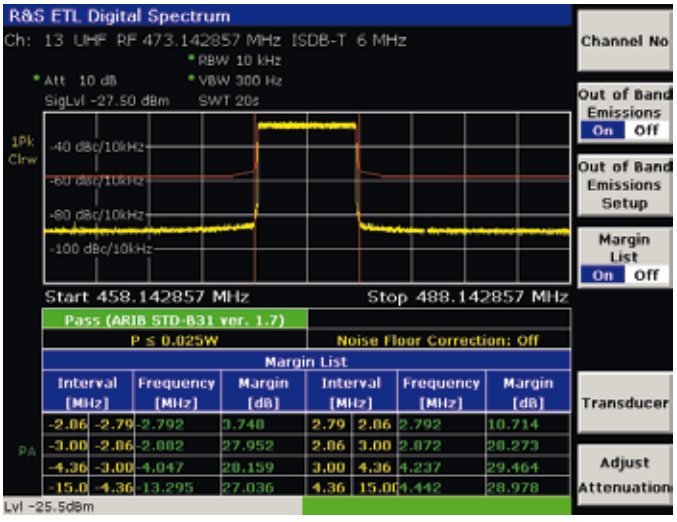
In addition to the the constellation diagram, which gives users a first idea of how to optimize the transmitter or modulator at the cable headend, the R&S®ETL provides other measurements that help achieve optimum signal quality. Measurements to determine the amplitude characteristic, phase response and group delay in the transmission channel help determine whether the channel filtering and the pre-correction on the transmitter have been correctly set and are functioning.

The R&S®ETL has a unique measurement function especially for modulators that work according to the orthogonal frequency division multiplex (OFDM) multicarrier method. This measurement shows any existing I/Q imbalance or I/Q phase error for each carrier. A convenient zoom function to view each carrier's MER values and a measurement to detect a central residual carrier round out the R&S®ETL TV analyzer's capability to detect the quality of digital modulators in all its details.

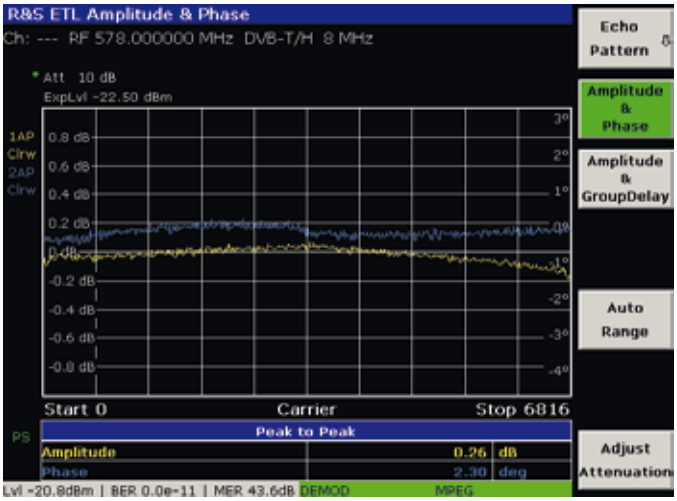
Constellation diagram of an ATSC/8VSB signal.



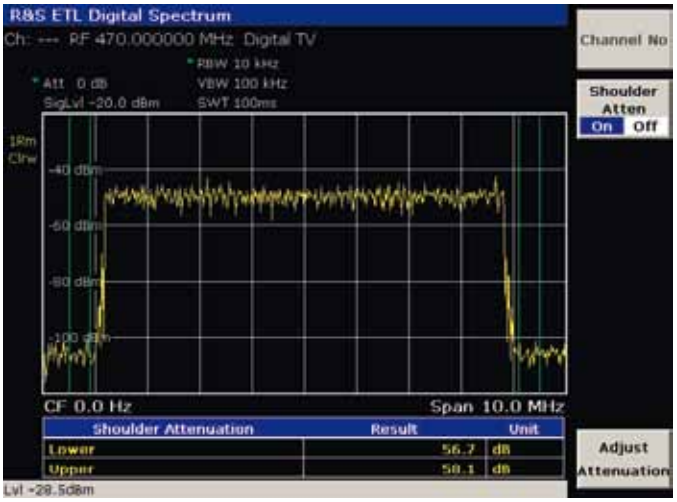

Checking spurious emissions with spectrum mask.




Amplitude and phase in the useful channel.




Shoulder attenuation measurement in line with ETSI TR 101290.



# Analysis functions for second-generation TV standards – DVB-T2, ATSC MDTV

TV transmissions in HD quality or in 3D require higher bandwidths, even in terrestrial broadcasting. But the DVB-T broadcast standard is gradually approaching its limits with regard to bandwidth. The solution to this problem is DVB-T2. Improved error protection and new transmission modes such as 256QAM, 32K FFT, rotated constellation, multi-PLP and MISO make it possible to take the transmission bandwidth to its theoretical limits. A TV analyzer such as the R&S®ETL with its new DVB-T2 options must meet high requirements – for example, the ability to support all transmission modes as well as to provide reliable and exact information on the quality of all relevant signal parameters. The R&S®ETL, equipped with its DVB-T2 options, meets both requirements.

### DVB-T2 realtime signal analysis

- Demodulation of a selected physical layer pipe (PLP) and output at the ASI output
- Decoding and representation of L1 pre- and post-signaling parameters
- Detection of short-duration interference signals

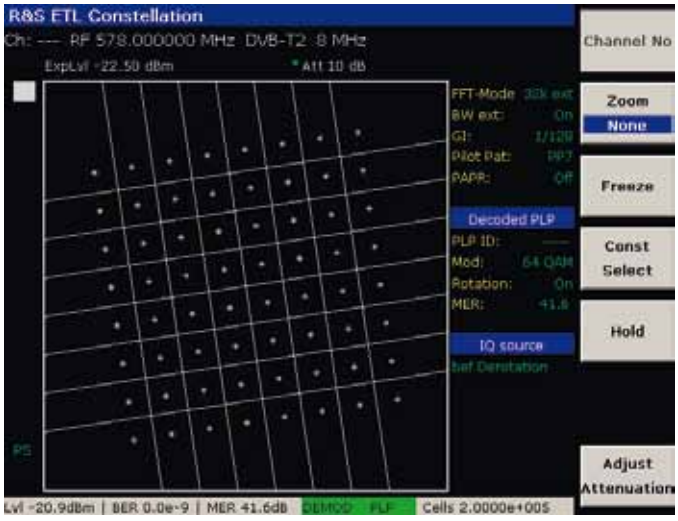
### Wide-ranging analysis functions

- Reliable assessment of the quality of DVB-T2 signals
- Comprehensive information on the transmission parameters and PLP currently selected
- Detailed constellation analysis for detecting errors in modulators

### Prepared for multi-PLP and MISO

- Prepared for full, future support of multi-PLP and MISO transmission modes

Constellation diagram of a DVB-T2 signal.




Overview with PLP data in detail.

| L1-pre signalling | | | | |
|---|---|---|---|---|
| Bandwidth Extension | Off | (Off) | S1 (binary) | 000 |
| Guard Interval | 1/32 | (1/32) | S2 (binary) | 1010 |
| Pilot Pattern | PP4 | (PP4) | System ID (hex) | 0x0 |
| Transmission System | SISO | (SISO) | Cell ID (hex) | 0x0 |
| Data Symbols/Frame | 59 | (59) | Network ID (hex) | 0x0 |
| L1-post Constellation | QPSK | (QPSK) | Frames/Superframe | 2 |
| L1-post Size | 750 | (750) | Tx ID Availability (hex) | 0x0 |
| L1-post Extension | Off | (Off) | L1-post Info Size | 318 |
| L1 Repetition | Off | (Off) | Regeneration Flag | 0 |
| L1-post Code Rate | 1/2 | | Frequencies | 1 |
| L1-post FEC Type | Short | | RF Index | 0 |
| PAPR | None | | CRC32 (hex) | 0xCDEE31D1 |
| Stream Type | TS only | | Reserved (hex) | 0x0 |
| T2 Version | 1.1.1 | | | |

L1 pre-signaling information.

| | Pass | Limit < | Results | < Limit | Unit |
|---|---|---|---|---|---|
| | Level | -60.0 | -10.6 | 10.0 | dBm |
| | Sideband | | normal | | |
| | FFT Mode | | 32k | | |
| | Guard Interval | | 1/32 | | |
| | Carrier Freq Offset | -30000.0 | 635.2 | 30000.0 | Hz |
| | Bit Rate Offset | -100.0 | 1.3 | 100.0 | ppm |
| | MER (L1,rms) | 24.0 | 46.6 | ----- | dB |
| | PLP Data (Decoded PLP ID 6) | | | | |
| | MER (PLP,rms) | 24.0 | 45.3 | ----- | dB |
| | BER before LDPC | | 0.7e-9(60%/1e10) | 1.0e-2 | |
| | LDPC Iterations | | 4.7 | | |
| | BER before BCH | | 0.0e-9(40%/1e10) | 1.0e-10 | |
| | TS Packet Error Ratio | | 0.0e-6(26%/1e7) | 1.0e-10 | |

Lvl -10.6dBm | BER 0.0e-9 | MER 45.3dB DEMOD PLP:6

ATSC mobile digital television (ATSC MDTV) – also known as ATSC M/H (mobile/handheld) – represents a further development of the ATSC/8VSB digital terrestrial TV standard for TV reception on mobile devices such as smartphones and multimedia players. ATSC MDTV contains improvements for stable reception on moving devices and also enables the setup of single-frequency networks (SFN). The R&S®ETL analyzes the RF signal quality of an ATSC MDTV signal and also offers extensive functions for analyzing signaling parameters, the ATSC M/H frame structure and the services it carries.

**ATSC MDTV realtime signal analysis**

- Demodulation of an ATSC MDTV signal
- Decoding of a selected parade
- Detection of short-duration interference signals

**Analysis of signaling parameters and services**

- Analysis and display of transmission parameter channel (TPC)
- Analysis and display of fast information channel (FIC)
- Display of dynamic occupancy of ATSC M/H subframes
- Overview of services

**Measurements to optimize single-frequency networks**

- Display of channel impulse response
- Display of frequency deviations within SFNs

Analysis of the Transmission Parameter Chanel (TPC)


Anzeige der dynamischen Belegung von ATSC-M/H Subframes

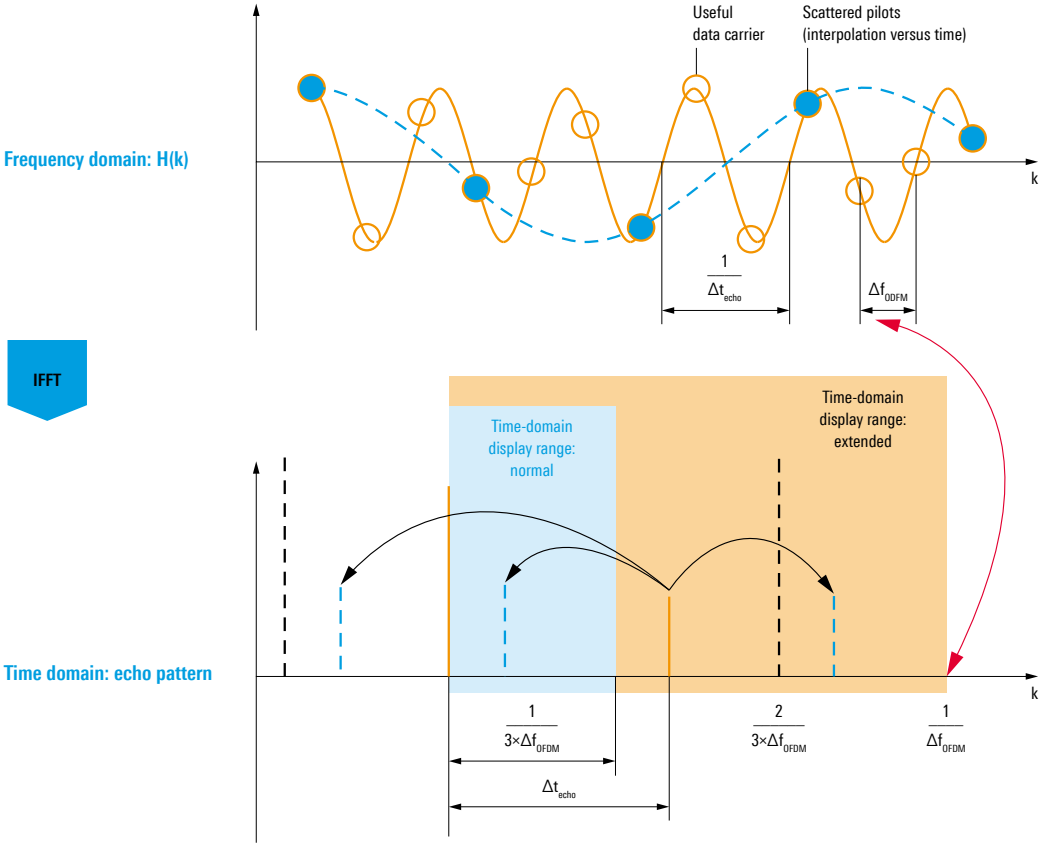
# Precise analysis of digital single-frequency networks (SFN)

Transmitters that broadcast a standard based on the OFDM method, such as DVB-T, DVB-H, DVB-T2, ISDB-$T_{(B)}$, T-DMB/DAB, DTMB and the extended single carrier standard ATSC MDTV can be combined and operated as a single-frequency network (SFN). For interference-free operation, certain criteria need to be optimized, observed and regularly monitored. These criteria are the transmitter frequency, the level and the delay at the transmitter and in the reception area. The R&S®ETL TV analyzer comes with a range of high-precision measurements that help to optimally set up and operate a transmitter SFN.

**High-precision display of channel impulse response**

When it comes to optimizing and monitoring an SFN, the main function of the R&S®ETL is to accurately measure the channel impulse response and display it in a clear and understandable manner. The delays in an SFN have to be set so that all the receivable transmitters at a reception site are within a guard interval. Any transmitter outside the guard interval would act as an interferer. The R&S®ETL uses green lines to show the beginning and end of a guard interval, making it easy to evaluate the timing characteristics. Impulses are measured and displayed to an accuracy of < 20 ns. A high-resolution zoom function is provided to evaluate impulses that are temporally close together.

## DTV extended time domain



A special feature of the R&S®ETL is the positioning of the FFT window. To help ensure stable synchronization to the transmitter signal, especially for field measurements, the R&S®ETL tries to place all impulses above an echo detection threshold so that they are equidistant within the guard interval. For some applications, the echo detection threshold is dependent on the system optimization method selected by the user.

**Simple identification of echoes using tabular lists and marker functions**

If several transmitters are interconnected to form an SFN, and if there is also a large number of reflected transmitter signals at an inner-city reception site, it can be difficult to interpret a channel impulse response. To make evaluation easier, the R&S®ETL lists the ten most important echoes in a table. The list can be sorted according to receive level or delay time for a better overview. The measurement unit for the graphic and the table can be set to km, miles or µs.

The measured levels are usually displayed relative to the main pulse, but sometimes this is not what the user wants. The levels can also be displayed as absolute values, which is especially helpful for coverage measurements in the field.

The R&S®ETL also has a marker function for easy echo identification. With the marker function, the receive level and delay of each echo can be precisely measured.

**Extended time domain for faraway post-echoes**

Normally, all impulses should be within the guard interval. The display of the channel impulse response serves to check if this is the case. But sometimes the maximum time domain that can be displayed is not sufficient to correctly display signals reflected over long distances or received due to overshoot. Therefore, impulses that lie outside the normal measurement range might be interpreted as leading impulses instead of lagging impulses. The measurement range has been expanded by a factor of three to prevent this from happening.

**Efficient measurement of frequency drifts within an SFN**

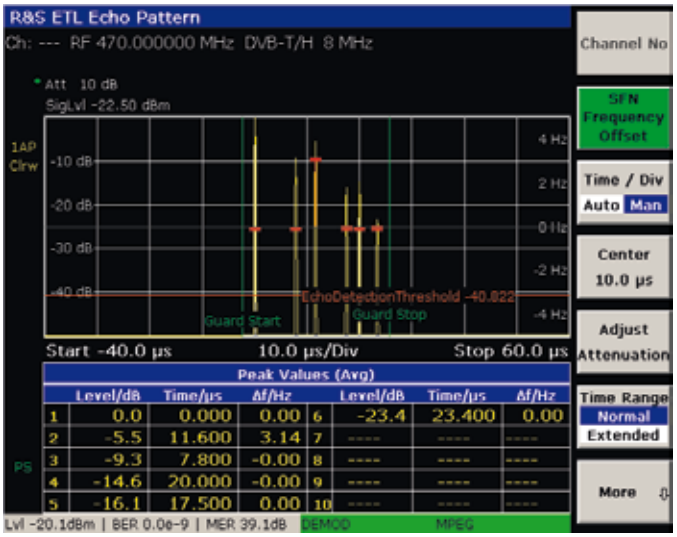
For optimum operation, all transmitters in a single-frequency network must transmit at exactly the same frequency. An incorrect reference frequency at the transmitter site or an incorrectly set transmitter frequency can violate this SFN condition. To help ensure that each SFN transmitter operates at the same transmitter frequency, the transmitter frequency at each site must be precisely measured. The measurement tolerance has to be < 1 Hz.

The R&S®ETL's patented SFN frequency offset measurement provides a highly accurate, efficient method of determining the frequency drift of all SFN transmitters based on a single measurement made at a central location within the network. All frequency drifts are referenced to the frequency of the main pulse. The advantage of this is that no external reference signal is needed. The accuracy of this measurement is an unprecedented 0.03 Hz.

Red markers on the impulses in the channel impulse response display show the determined frequency drifts.

DVB-T, DVB-H channel impulse response with markers.


Channel impulse response
with SFN frequency offset-measurement (red lines).



# High-performance analysis of FM (radio) and audio signals

Digitization does not stop at sound broadcasting. But in contrast to terrestrial TV, it moves at a slower pace. This is due to the fact that high-quality FM (radio) is very widespread. Today, existing FM transmitters are maintained and new FM transmitters are being installed. The R&S®ETL FM options provide all key measurements needed for everyday transmitter and field work, including integrated analysis functions for audio signals.

**Analysis of RF and MPX signals at the transmitter or in the field**

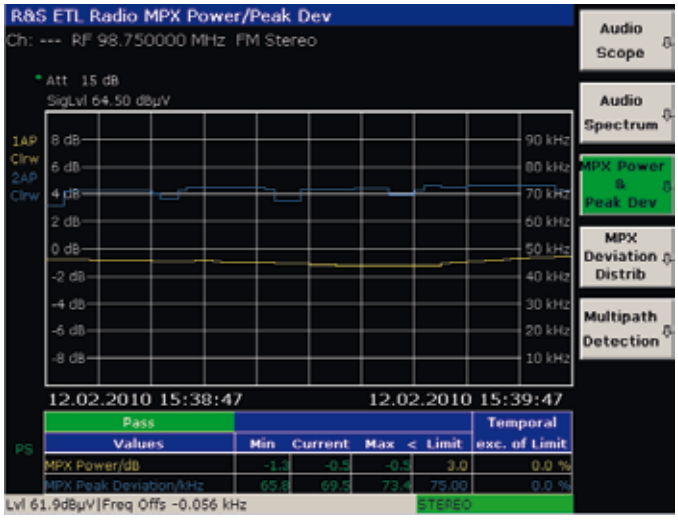
An overview shows all the values that provide information about key modulation parameters, including the receive level, center frequency and frequency deviations in the audio signal as well as additional information about the pilot tone and carriers. The audio spectrum display provides a graphical overview of the demodulated FM (radio) signal. Presets make it easier to select specific sections of the spectrum. Special attention was paid to measurements of the MPX power and the frequency deviation of the entire MPX signal.

FM (radio) overview.

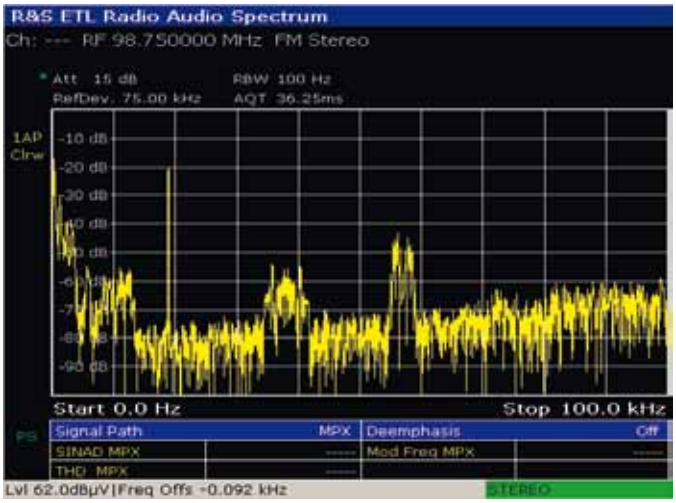
| Pass | Limit < | Results | < Limit | Unit |
|---|---|---|---|---|
| Level | -47.0 | -46.3 | 20.0 | dBm |
| Carrier Freq Offset | -0.500 | -0.325 | 0.500 | kHz |
| AM Depth | | 0.97 | 1.00 | % |
| MPX Deviation | | 73.044 | 75.000 | kHz |
| L Deviation | | ----- | 67.500 | kHz |
| R Deviation | | ----- | 67.500 | kHz |
| M Deviation | | 64.887 | 67.500 | kHz |
| S Deviation | | 27.432 | 67.500 | kHz |
| Pilot Deviation | 6.000 | 7.430 | 7.500 | kHz |
| Pilot Freq Offset | -2.00 | -0.32 | 2.00 | Hz |
| Pilot Phase | -3.0 | 0.5 | 3.0 | ° |
| RDS Deviation | 1.500 | 2.500 | 7.500 | kHz |
| RDS Freq Offset | -2.00 | -0.98 | 2.00 | Hz |
| RDS Phase | 87.0 | 90.4 | 93.0 | ° |

Lvl -46.3dBm |Freq Offs -0.325 kHz |MPX Dev 73.044 kHz STEREO

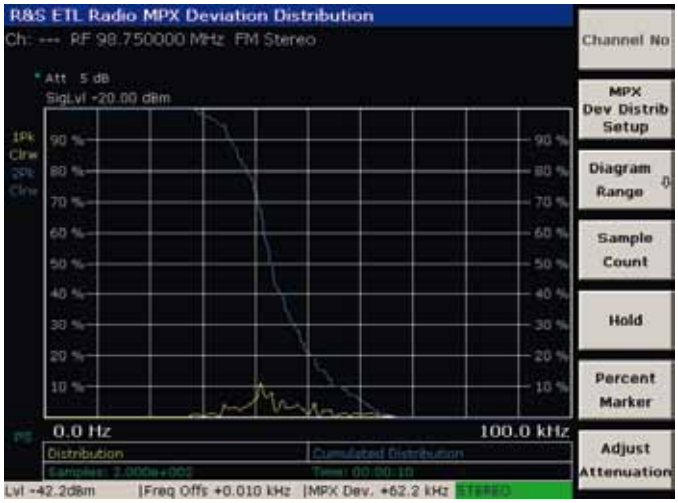
MPX power and peak deviation over 60 s.




FM (radio) audio spectrum.




MPX deviation and MPX deviation distribution.



These values must be precisely adhered to, so that adjacent programs are not adversely affected. In line with ITU-R SM.1268-1, the MPX power is integrated over 60 seconds and displayed in a histogram, together with the peak deviation. Both the current and the accumulated frequency deviation of an MPX signal can be precisely displayed to help ensure optimum transmitter modulation. An audio scope function and the display of essential RDS information rounds out the range of FM (radio) analysis functions.

### High-quality SNR measurement with high SNR frontend

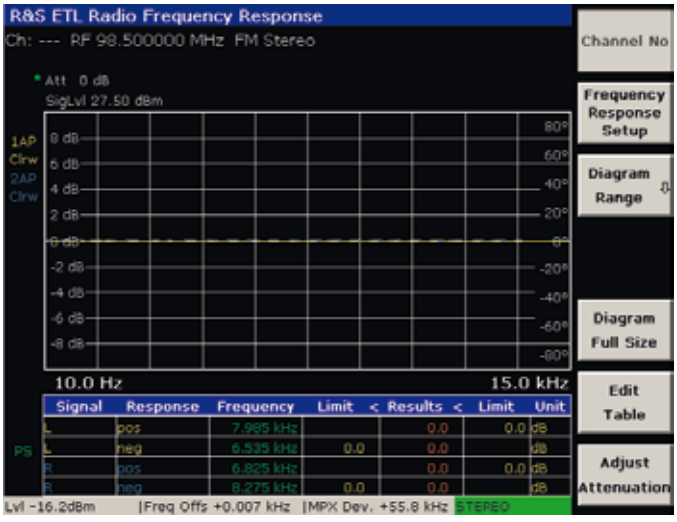
An additional RF frontend, which operates in the 75 MHz to 110 MHz frequency range, can be added to the R&S®ETL for SNR measurements at the transmitter. The measurement range of the SNR measurement is increased to an outstanding ≥ 80 dB (weighted, q-peak). With this frontend the R&S®ETL offers sufficient margin to reliably verify that the SNR meets the high requirements of prevailing standard specifications.

### Integrated audio analysis

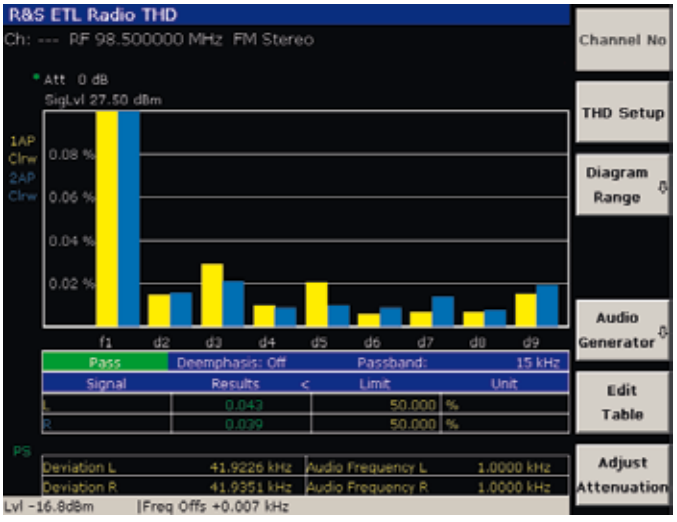
The audio quality of an FM transmission is not only determined by parameters such as MPX power, deviation and SNR. To completely check the quality of an FM modulator, its linear and nonlinear characteristics must also be measured. Audio analysis after demodulation is the best way to measure these characteristics.

Using the FM (radio) audio analysis/generator option, the R&S®ETL analyzes the audio frequency response, the total harmonic distortion, intermodulation products using two-tone measurements, and the crosstalk between two audio channels. If the integrated R&S®ETL audio generator is used to feed in the audio signals at the transmitter, the measurements can be made with matching settings for user-selectable audio frequencies and levels. This saves time and reduces the risk of incorrectly executing measurements.

Audio frequency response measurement.




Total harmonic distortion (THD) measurement.




RDS basic information.


SNR measurement.

# MPEG-2 transport stream analysis

In digital television (DTV), pictures, sound and additional information are transmitted as a digital MPEG-2 transport stream. The MPEG-2 transport stream's complex structure must conform to defined rules so that it can be properly processed by the receiver. A range of MPEG options can be added to the R&S®ETL to analyze the structure of MPEG-2 transport streams in addition to the RF quality of DTV signals.

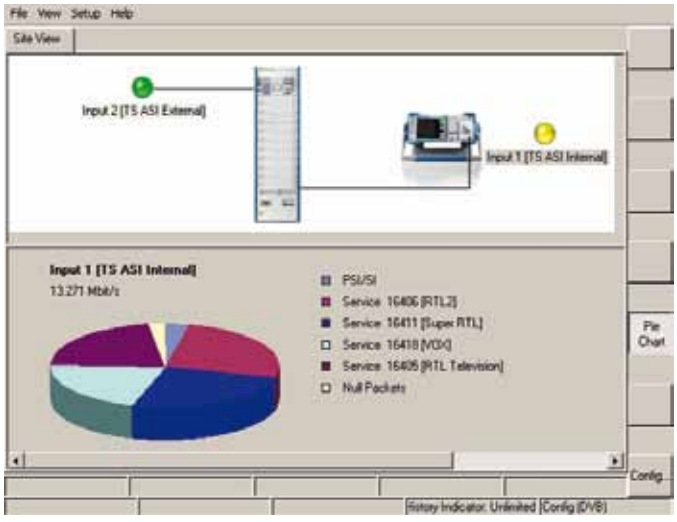
**Checking of input and output signals at the transmitter or cable headend**

The R&S®ETL can check both the incoming and outgoing MPEG-2 transport stream at the transmitter or cable head-end. The central R&S®ETL-B280 MPEG processing board has an internal and an external transport stream input. Users can quickly determine whether the fed-in signal or the modulator is the source of errors.

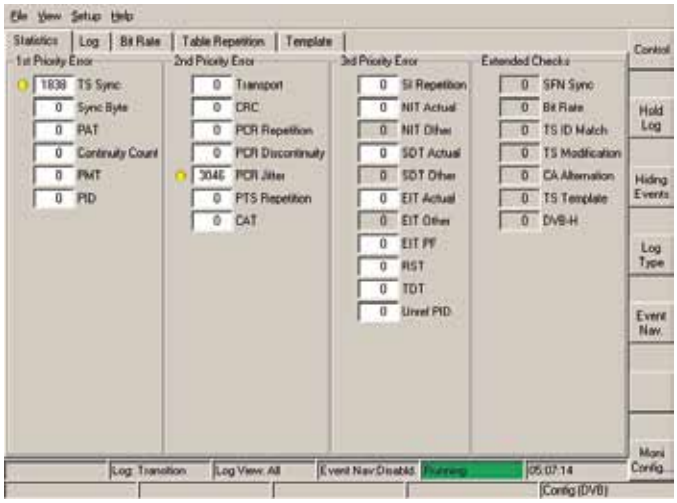
**Analysis in line with ETSI TR 101290, priorities 1 to 3**

The R&S®ETL-K282 MPEG analysis/monitoring software option provides basic MPEG-2 transport stream analysis functions. The software shows a clear overview of the underlying structure of the transport stream (TS) that is to be analyzed. Individual TS elements can be quickly and easily selected for more in-depth examination. The software analyzes conditions in accordance with DVB test specification TR 101290, which classifies errors into priority levels 1, 2 and 3. The same applies to the ATSC, SCTE and ISDB-$T_{(B)}$ standards, which are also covered. In addition to the parameters of priority levels 1 to 3, the software also measures the repetition rates for the individual information tables (e.g. PAT, PMT) as well as the transfer rates for the individual services, and checks whether they comply with the defined limits. Each of these parameters can also be monitored separately. If an error occurs, the software enters a message into the instrument's internally-saved report and outputs the message via the R&S®ETL's LAN interface.

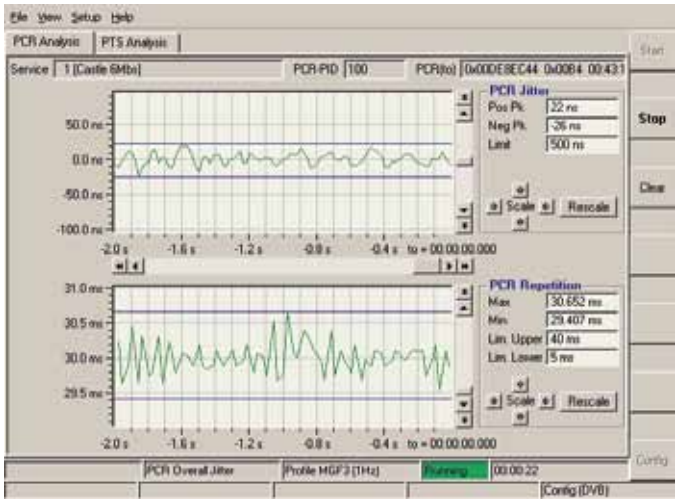
Parallel monitoring of two MPEG-2 transport streams.




MPEG analysis in line with ETSI TR 101290.




Tracking down PCR jitter.



The R&S®ETL-K285 TS template monitoring software option provides a convenient, simple solution for comparing the selected signal to a previously selected reference transport stream. The state of the analyzed transport stream can be quickly determined. The reference TS is known as the golden transport stream. The software compares the data and table structures, user-specific tables, program names, and much more. Unlike conventional MPEG analysis, it also detects differences that would normally go unnoticed. For example, a change in the arrangement of programs in the transport stream would not necessarily generate an error message as long as the data itself is consistent.

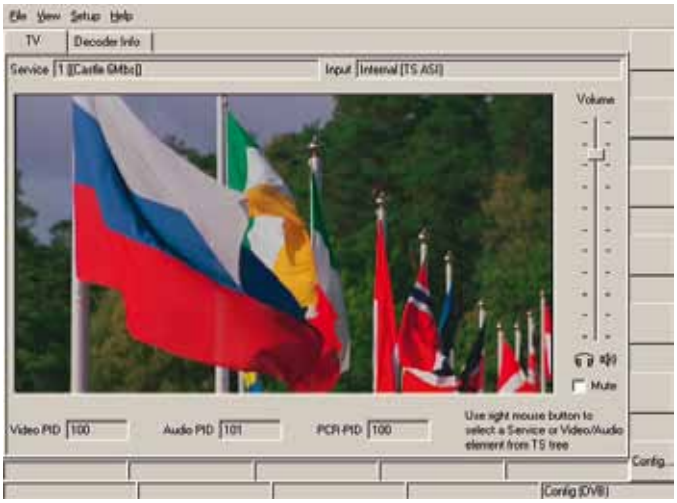
**Table interpreter and in-depth analysis**

For more comprehensive analysis, the R&S®ETL-K283 in-depth analysis software option provides further information about the bits and bytes in the individual TS elements. The table interpreter provides a clear, easily readable overview of the table contents, making it easier to identify faulty references between the various tables, for example. The in-depth analysis option graphically indicates whether this auxiliary information is received regularly within the applicable limits (repetition) and whether the temporal spacing is constant (e.g. PCR jitter). Tolerance violations can make it impossible for decoders in receivers and set-top boxes to output video and audio. Such problems can also disrupt lip synchronicity.

**Data broadcast analysis including ESG**

The R&S®ETL-K284 data broadcast analysis software option can be used for analyzing data services and DVB-H content. The protocol structures and individual components of selected data packets are presented in clearly structured tree views. The interpreter presents the data in plain text, e.g. individual lines of teletext. Of course, the option also allows a detailed look at the raw data. Operators can document individual data rates to prove their guaranteed data transfer rates for individual data services.

TV display with hardware decoder.



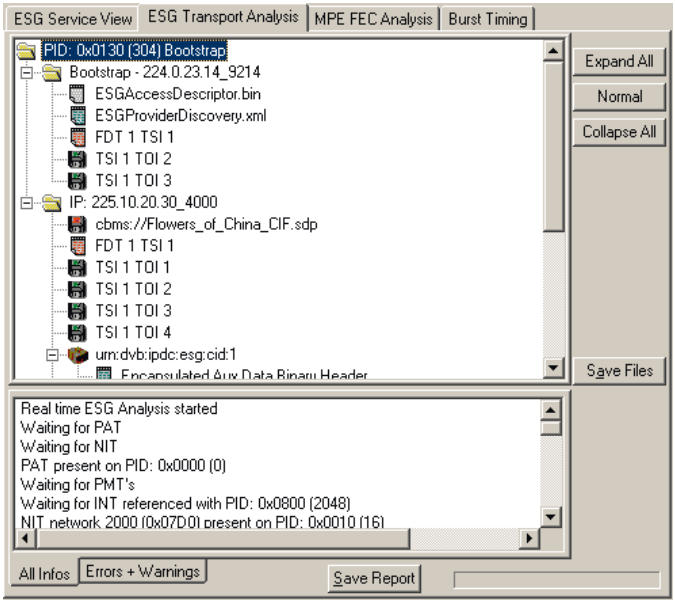

For DVB-H, the R&S®ETL-K284 option offers a number of additional analysis functions. For example, all details of the electronic service guide (ESG) are analyzed for structural errors, and the structure is displayed. In the MPE FEC Analysis view, numerous parameters provide information about the transmission quality and bandwidth. To supplement the DVB-H analysis functions, the burst timing is also displayed. This view graphically presents the measured timing conditions for the TV programs that are transmitted using time slicing.

**Software and hardware decoder for MPEG-2 and H.264**

A software-based media player is available for displaying unencrypted TV pictures on the R&S®ETL's screen. Programs selected via the ESG are reproduced in SD resolution. For reproducing programs in HD quality on an external monitor, the R&S®ETL-B281 video and audio hardware decoder can be added to the MPEG processing board. The HDMI interface of the R&S®ETL-B280 option provides a connection on the instrument's rear panel for an HD-ready display. The picture is output in SD quality via the base unit's video output (CCVS) and the audio signals are output via two audio outputs.

Encrypted programs can be decrypted using the hardware decoder in conjunction with a suitable CA module and Smart Card. The MPEG processing board includes a DVB common interface for this purpose.

Structure of an electronic service guide (ESG).



# Measurements for cable TV networks

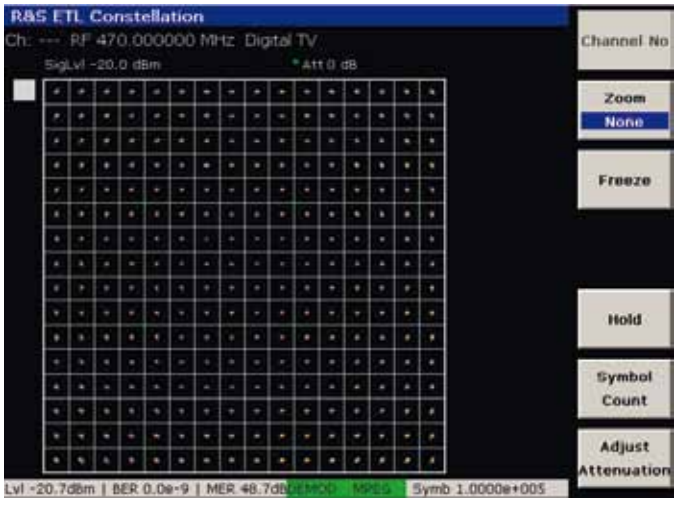
Even though digitization in cable TV networks is rapidly progressing, many programs are still transmitted in both analog and digital channels, very often together with FM (radio). The R&S®ETL offers the appropriate demodulators and specific measurements needed to reliably determine the signal quality of cable TV and FM (radio) signals. The R&S®ETL-B203 RF preselector is recommended for maximum performance when measuring cable TV systems. The R&S®ETL can measure the performance capacity in a cable network today, helping ensure the needed performance for tomorrow's new, highly efficient transmission standards.

In addition to these measurements, comprehensive analysis functions make it possible to quickly and reliably identify problems that can occur when transmitting a "mixture" of digital and analog signals.

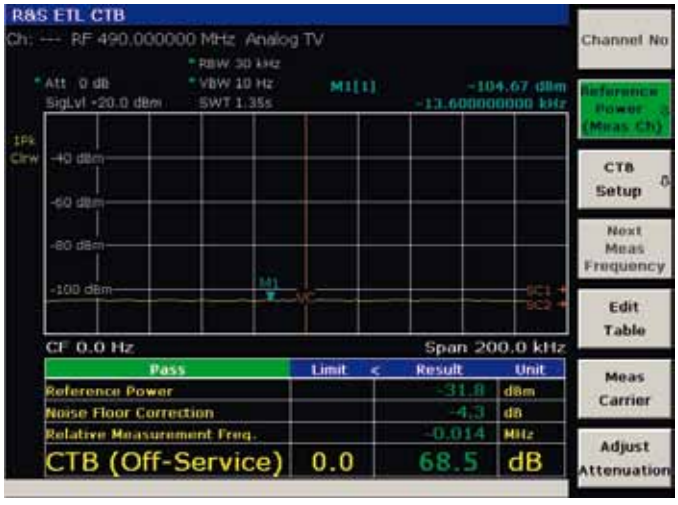
### CSO, CTB and C/N

Line amplifiers that are not perfectly linear cause unavoidable intermodulation products, which reduces the S/N ratio. Second and third order intermodulation products are especially crucial for analog TV channels, because they can lead to a visible reduction in the picture quality. The R&S®ETL TV analyzer provides composite second order (CSO), composite triple beat (CTB) and carrier to noise (C/N) measurements to detect and quantify intermodulation products.

Constellation diagram of a DVB-C signal.




Composite triple beat (CTB) measurement.




Composite second order (CSO) measurement.


Carrier to noise (C/N) measurement.

### Frequency response measurement

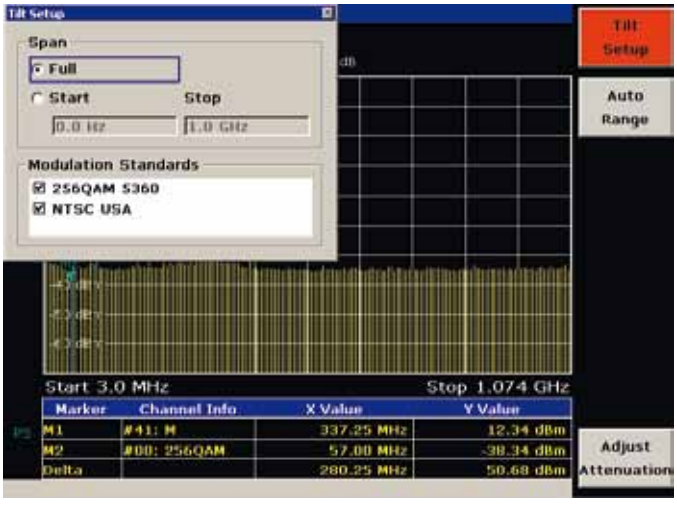
To keep the interfering intermodulation products in a cable system to a minimum, but still ensure a sufficient minimum signal level over the system's entire frequency range, the levels defined for the analog, digital and FM (radio) channels must be precisely adhered to. The TILT measurement provides a quick overview of the levels. The TILT measurement is based on a previously selected channel table and can be carried out for all or just for certain modulation standards. Markers make it easier to read the individual level values in the previously created graphic. Level differences between two selected channels are easy to measure, making it possible to determine the frequency response of a cable system.

### Ingress measurement to detect interferers

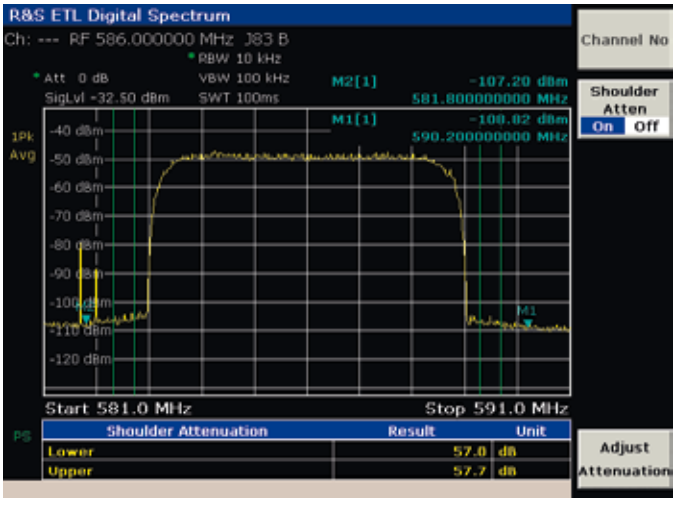
For interference-free operation of a cable TV network, it is important to prevent ingress signals which could adversely affect the signal quality of the individual channels. Ingress prevention is gaining in importance because terrestrial data services are entering the VHF/UHF frequency range, occupying former analog TV channels.

Rohde&Schwarz has developed a special process to detect ingress signals and integrated it into the R&S®ETL. The ingress (f) measurement provides a simple way to see interfering signals that are superimposed on a useful digital signal. These interfering signals are typically difficult to recognize in the frequency spectrum and the constellation diagram. MER(f) can also be selected as the display mode. MER is well known from the analysis of OFDM-based TV standards, where it has long been used to detect interferers.

TILT measurement in a cable TV system.




Frequency spectrum of a J.83/B-signal with interferer.




Ingress (f), frequency spectrum of an interfering signal that is superimposed on the useful signal.


MER (f) of a J.83/B-signal with superimposed interfering.

# Automatic measurements and documentation

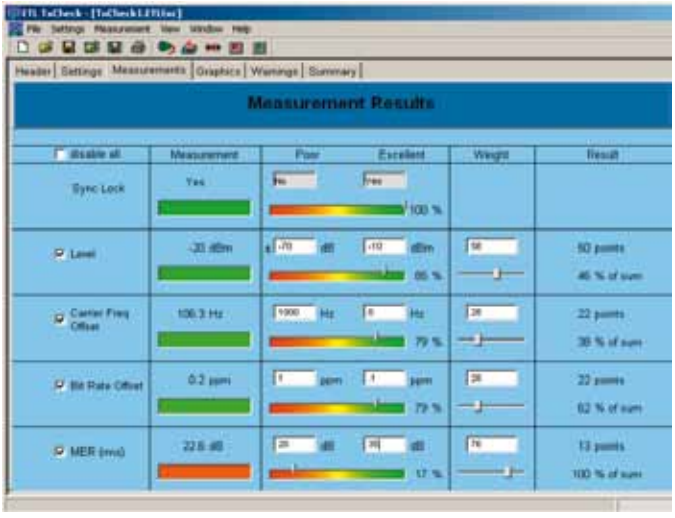
A technician's everyday tasks include measuring, evaluating and documenting the quality of the transmitted signals at the transmitter, transposer and cable headend. The R&S®ETL's all-in-one concept provides the ideal prerequisites for time-saving and effective solutions.

**R&S®TxCheck measurement software for DVB-T, DVB-T2, DVB-H, ATSC/8VSB, ISDB-T$_{(B)}$, J.83/A/B/C and FM (radio)**

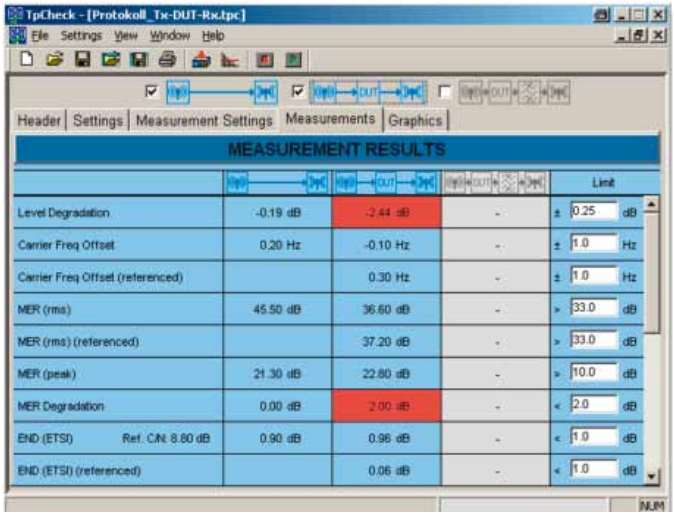
The R&S®ETL always comes with the R&S®TxCheck measurement software, which has been designed for the DVB-T, DVB-T2, DVB-H, ATSC/8VSB, ISDB-T$_{(B)}$, J.83/A/B/C and FM (radio) standards. The basis for automatic measurements is a measurement profile where the required measurements are defined. Limits and weightings can be entered for each parameter in the profile, for both individual and overall evaluation. The profiles can be adjusted to specific applications and transmitted from R&S®ETL to R&S®ETL. After a measurement profile has been selected, all R&S®ETL measurements can be automatically and reproducibly executed by simply pressing the start button. Color bars show the quality evaluation for each parameter and the overall result, allowing users to evaluate the quality at a glance, without having to go into detail.

The results, together with measurement graphics and general information about the DUT, are entered in report. The created reports can be saved on the R&S®ETL or to an external storage medium.

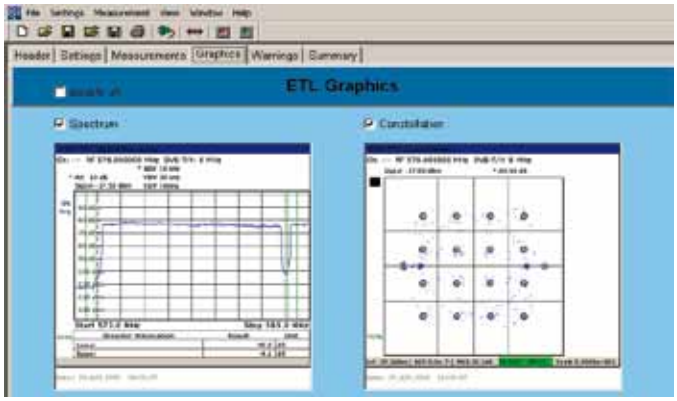
Parameter and result list of R&S®TxCHECK.



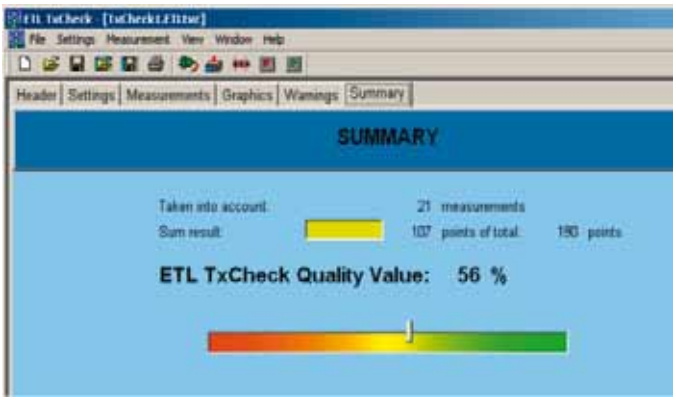

Parameter and result list of R&S®TPCHECK.




Measurement graphics in R&S®TxCHECK.



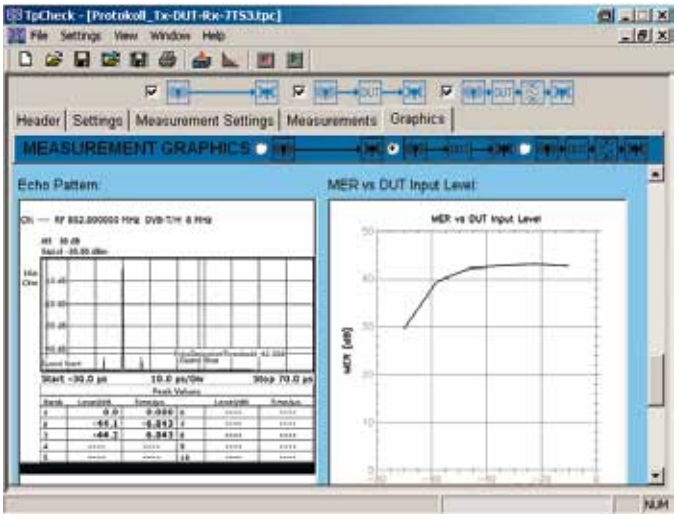

Signal quality at a glance.



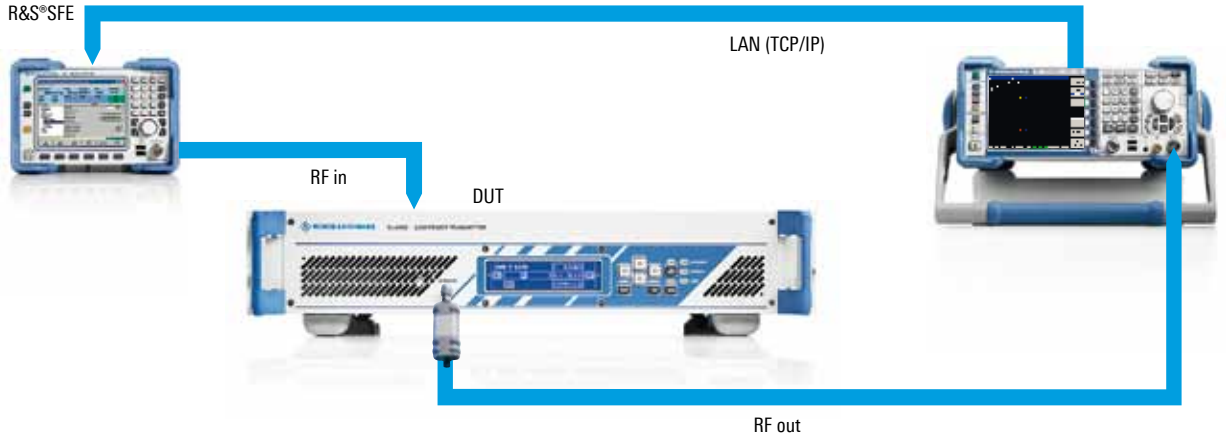
### R&S®TPCHECK transposer measurement software for DVB-T and DVB-H

Similar to R&S®TxCheck, the R&S®TPCHECK transposer measurement software is used to measure, evaluate and document TV signals. R&S®TPCHECK has been specially designed for measurements on transposers. Again, a measurement profile that can be changed by the user is the basis for automatic measurements. The measurements can be executed in three optional steps. The signal quality can be measured at the input and output of the transposer and also after a mask filter. R&S®TPCHECK can help determine how well the measured transposer converts the input signal. A specific sequence of measurements, which runs automatically, additionally shows how the transposer behaves when the input levels vary or when the GPS connection is faulty. For reproducible results, a high-quality, defined signal source, such as the R&S®SFE broadcast tester, is recommended. The R&S®ETL integrates the R&S®SFE into the automatic measurements. The R&S®SFE is remotely controlled by the R&S®ETL via LAN.

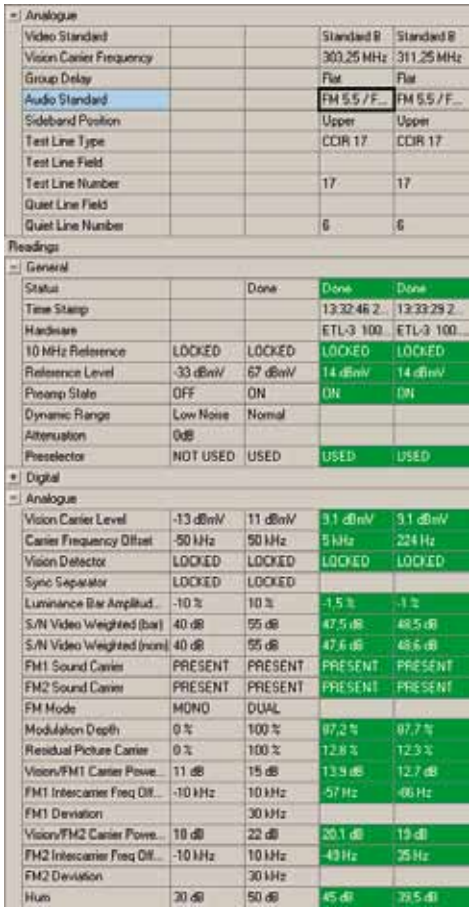
Measurement graphics in R&S®TPCHECK.




## Transposer check with the R&S®SFE

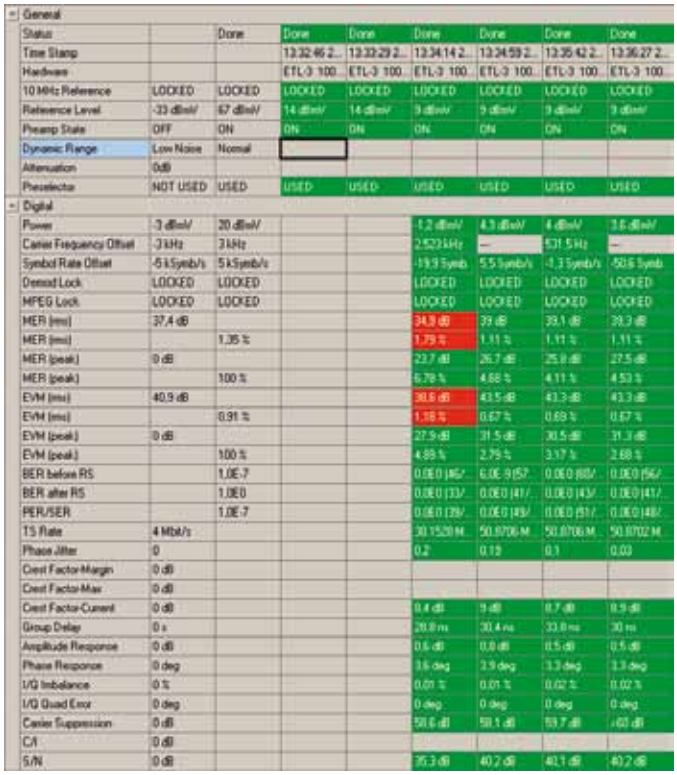


Result table for analog cable TV channels.



| | | | | |
|---|---|---|---|---|
| Analogue | | | | |
| Video Standard | | | Standard B | Standard B |
| Vision Carrier Frequency | | | 303.25 MHz | 311.25 MHz |
| Group Delay | | | Flat | Flat |
| Audio Standard | | | FM 5.5 / F... | FM 5.5 / F... |
| Sideband Position | | | Upper | Upper |
| Test Line Type | | | CCIR 17 | CCIR 17 |
| Test Line Field | | | | |
| Test Line Number | | | 17 | 17 |
| Quiet Line Field | | | | |
| Quiet Line Number | | | 6 | 6 |
| Readings | | | | |
| General | | | | |
| Status | | Done | Done | Done |
| Time Stamp | | | 13:32:46 2... | 13:33:29 2... |
| Hardware | | | ETL-3 100... | ETL-3 100... |
| 10 MHz Reference | LOCKED | LOCKED | LOCKED | LOCKED |
| Reference Level | -33 dBmV | 67 dBmV | 14 dBmV | 14 dBmV |
| Preamp State | OFF | ON | ON | ON |
| Dynamic Range | Low Noise | Normal | | |
| Attenuation | 0dB | | | |
| Preselector | NOT USED | USED | USED | USED |
| Digital | | | | |
| Analogue | | | | |
| Vision Carrier Level | -13 dBmV | 11 dBmV | 3.1 dBmV | 3.1 dBmV |
| Carrier Frequency Offset | -50 kHz | 50 kHz | 5 kHz | 224 Hz |
| Vision Detector | LOCKED | LOCKED | LOCKED | LOCKED |
| Sync Separator | LOCKED | LOCKED | | |
| Luminance Bar Amplitud... | -10 % | 10 % | -1.5 % | -1 % |
| S/N Video Weighted (bar) | 40 dB | 55 dB | 47.5 dB | 48.5 dB |
| S/N Video Weighted (nom) | 40 dB | 55 dB | 47.6 dB | 48.6 dB |
| FM1 Sound Carrier | PRESENT | PRESENT | PRESENT | PRESENT |
| FM2 Sound Carrier | PRESENT | PRESENT | PRESENT | PRESENT |
| FM Mode | MONO | DUAL | | |
| Modulation Depth | 0 % | 100 % | 97.2 % | 97.7 % |
| Residual Picture Carrier | 0 % | 100 % | 12.8 % | 12.3 % |
| Vision/FM1 Carrier Powe... | 11 dB | 15 dB | 13.9 dB | 12.7 dB |
| FM1 Intercarrier Freq Dif... | -10 kHz | 10 kHz | -57 Hz | -66 Hz |
| FM1 Deviation | | 30 kHz | | |
| Vision/FM2 Carrier Powe... | 10 dB | 22 dB | 20.1 dB | 19 dB |
| FM2 Intercarrier Freq Dif... | -10 kHz | 10 kHz | -43 Hz | 35 Hz |
| FM2 Deviation | | 30 kHz | | |
| Hum | 30 dB | 50 dB | 45 dB | 39.5 dB |

Result table for digital cable TV channels.



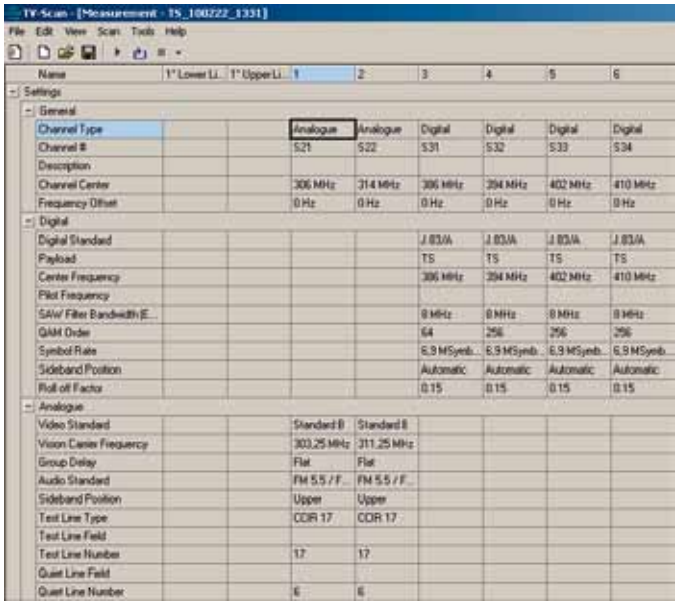
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| General | | | | | | | | | |
| Status | | Done | Done | Done | Done | Done | Done | Done | Done |
| Time Stamp | | | 13:32:46 2... | 13:33:29 2... | 13:34:14 2... | 13:34:59 2... | 13:35:42 2... | 13:36:27 2... | |
| Hardware | | | ETL-3 100... | ETL-3 100... | ETL-3 100... | ETL-3 100... | ETL-3 100... | ETL-3 100... | |
| 10 MHz Reference | LOCKED | LOCKED | LOCKED | LOCKED | LOCKED | LOCKED | LOCKED | LOCKED | |
| Reference Level | -33 dBmV | 67 dBmV | 14 dBmV | 14 dBmV | 9 dBmV | 9 dBmV | 9 dBmV | 9 dBmV | |
| Preamp State | OFF | ON | ON | ON | ON | ON | ON | ON | |
| Dynamic Range | Low Noise | Normal | | | | | | | |
| Attenuation | 0dB | | | | | | | | |
| Preselector | NOT USED | USED | USED | USED | USED | USED | USED | USED | |
| Digital | | | | | | | | | |
| Power | -3 dBmV | 20 dBmV | | | 5.2 dBmV | 4.3 dBmV | 4 dBmV | 3.6 dBmV | |
| Carrier Frequency Offset | -3 kHz | 3 kHz | | | 2.523 kHz | --- | 531.5 Hz | --- | |
| Symbol Rate Offset | -5 kSymb/s | 5 kSymb/s | | | -19.9 Symb... | 5.5 Symb/s | -1.3 Symb/s | -50.6 Symb... | |
| Demod Lock | LOCKED | LOCKED | | | LOCKED | LOCKED | LOCKED | LOCKED | |
| MPEG Lock | LOCKED | LOCKED | | | LOCKED | LOCKED | LOCKED | LOCKED | |
| MER (min) | 37.4 dB | | | | 34.9 dB | 39 dB | 39.1 dB | 39.3 dB | |
| MER (min) | | 1.35 % | | | 1.79 % | 1.11 % | 1.11 % | 1.11 % | |
| MER (peak) | 0 dB | | | | 23.7 dB | 26.7 dB | 25.8 dB | 27.5 dB | |
| MER (peak) | | 100 % | | | 6.78 % | 4.68 % | 4.11 % | 4.53 % | |
| EVM (rms) | 40.9 dB | | | | 38.6 dB | 43.5 dB | 43.3 dB | 43.3 dB | |
| EVM (rms) | | 0.91 % | | | 1.18 % | 0.67 % | 0.69 % | 0.67 % | |
| EVM (peak) | 0 dB | | | | 27.9 dB | 31.5 dB | 30.5 dB | 31.3 dB | |
| EVM (peak) | | 100 % | | | 4.89 % | 2.79 % | 3.17 % | 2.68 % | |
| BER before RS | | 1.0E-7 | | | 0.0E0 [4E/... | 6.0E-9 [5E/... | 0.0E0 [6E/... | 0.0E0 [5E/... | |
| BER after RS | | 1.0E0 | | | 0.0E0 [3J/... | 0.0E0 [4I/... | 0.0E0 [4J/... | 0.0E0 [4I/... | |
| PER/USER | | 1.0E-7 | | | 0.0E0 [3N/... | 0.0E0 [4N/... | 0.0E0 [5I/... | 0.0E0 [4E/... | |
| TS Rate | 4 Mbit/s | | | | 30.1520 M... | 50.8706 M... | 50.8706 M... | 50.8702 M... | |
| Phase Jitter | 0 | | | | 0.2 | 0.19 | 0.1 | 0.03 | |
| Crest Factor Margin | 0 dB | | | | | | | | |
| Crest Factor Max | 0 dB | | | | | | | | |
| Crest Factor Current | 0 dB | | | | 9.4 dB | 9 dB | 8.7 dB | 8.9 dB | |
| Group Delay | 0 s | | | | 28.8 ns | 30.4 ns | 33.8 ns | 30 ns | |
| Amplitude Response | 0 dB | | | | 0.6 dB | 0.8 dB | 0.5 dB | 0.5 dB | |
| Phase Response | 0 deg | | | | 3.6 deg | 3.9 deg | 3.3 deg | 3.3 deg | |
| I/Q Imbalance | 0 % | | | | 0.01 % | 0.01 % | 0.02 % | 0.02 % | |
| I/Q Quad Error | 0 deg | | | | 0 deg | 0 deg | 0 deg | 0 deg | |
| Carrier Suppression | 0 dB | | | | 50.6 dB | 50.1 dB | 49.7 dB | 49.5 dB | |
| C/I | 0 dB | | | | | | | | |
| S/N | 0 dB | | | | 35.3 dB | 40.2 dB | 40.1 dB | 40.2 dB | |

**R&S®TVSCAN measurement software for measuring cable TV systems and DVB-T/DVB-T2 transmissions**

It is not unusual for today's cable TV systems to have well over one hundred occupied channels. Numerous terrestrial channels are also on air.. The channels can be analog TV channels as well as DVB-C, J.83/B/C, DVB-T and DVB-T2 digital channels. It would be very time-consuming and expensive to manually measure these channels separately and record the results. These tasks can be accomplished automatically, effectively, quickly and easily with R&S®TVSCAN.

The basis for automatic measurement are the user-defined channel tables and measurement profiles. In the channel tables, all parameters can be predefined so that the R&S®ETL is correctly set for each channel. In addition to frequency, offset, QAM order and test lines, for example, the definition also includes guidelines for using the preselection and the preamplifier. Measurements are made in accordance with a selected, user-specific measurement profile. The parameters that are to be measured and their tolerance limits are defined here. After the measurement, all the values are shown in a matrix. Measurement values outside the specified tolerances are highlighted in color. At a later point in time, the measurements can be exactly repeated and saved in the same result file. The individual data records make measurement comparisons simple.

User-definable channel table in R&S®TVSCAN.

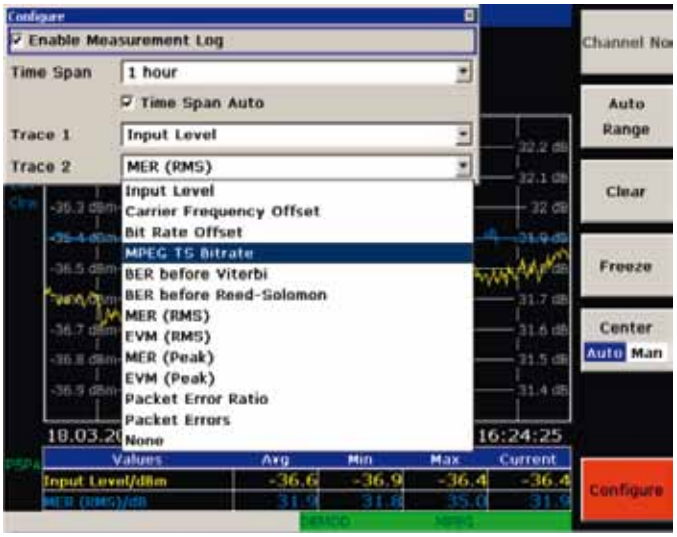


| Name | 1* Lower Li... | 1* Upper Li... | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| Settings | | | | | | | | |
| General | | | | | | | | |
| Channel Type | | | Analogue | Analogue | Digital | Digital | Digital | Digital |
| Channel # | | | S21 | S22 | S31 | S32 | S33 | S34 |
| Description | | | | | | | | |
| Channel Center | | | 306 MHz | 314 MHz | 386 MHz | 394 MHz | 402 MHz | 410 MHz |
| Frequency Offset | | | 0 Hz | 0 Hz | 0 Hz | 0 Hz | 0 Hz | 0 Hz |
| Digital | | | | | | | | |
| Digital Standard | | | | | J.83/A | J.83/A | J.83/A | J.83/A |
| Payload | | | | | TS | TS | TS | TS |
| Center Frequency | | | | | 386 MHz | 394 MHz | 402 MHz | 410 MHz |
| Pilot Frequency | | | | | | | | |
| SAW Filter Bandwidth [E... | | | | | 8 MHz | 8 MHz | 8 MHz | 8 MHz |
| QAM Order | | | | | 64 | 256 | 256 | 256 |
| Symbol Rate | | | | | 6.9 MSymb... | 6.9 MSymb... | 6.9 MSymb... | 6.9 MSymb... |
| Sideband Position | | | | | Automatic | Automatic | Automatic | Automatic |
| Roll off Factor | | | | | 0.15 | 0.15 | 0.15 | 0.15 |
| Analogue | | | | | | | | |
| Video Standard | | | Standard B | Standard B | | | | |
| Vision Carrier Frequency | | | 303.25 MHz | 311.25 MHz | | | | |
| Group Delay | | | Flat | Flat | | | | |
| Audio Standard | | | FM 5.5 / F... | FM 5.5 / F... | | | | |
| Sideband Position | | | Upper | Upper | | | | |
| Test Line Type | | | CCIR 17 | CCIR 17 | | | | |
| Test Line Field | | | | | | | | |
| Test Line Number | | | 17 | 17 | | | | |
| Quiet Line Field | | | | | | | | |
| Quiet Line Number | | | 6 | 6 | | | | |

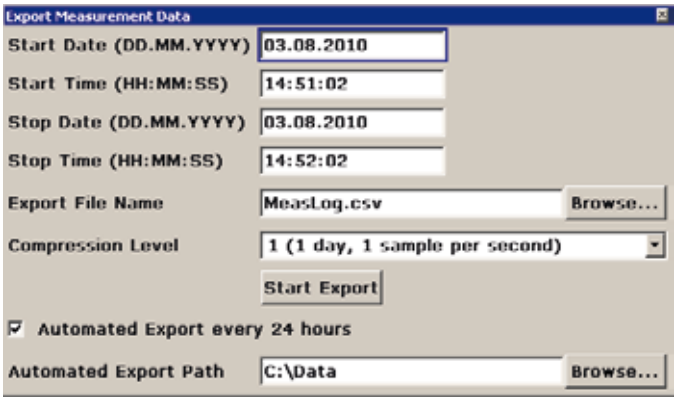
**Long-term documentation of measured values for DTV, DAB and FM (radio))**

The R&S®ETL-K208 measurement log option is ideal for long-term documentation of measured values, e.g. for a 24-hour test. This option is also the first choice for detecting sporadic errors. After it has been activated, the measurement log works in the background and saves essential parameters permanently in a database. During a measurement, the values for two selected parameters and a specified time domain can be graphically displayed. All parameters that are not displayed continue to be recorded. The same graphic can later be used to analyze a specific time domain. An export function for the CSV format is provided for external analysis or recording.

Configuration of the measurement log function.




Measurement log export function.



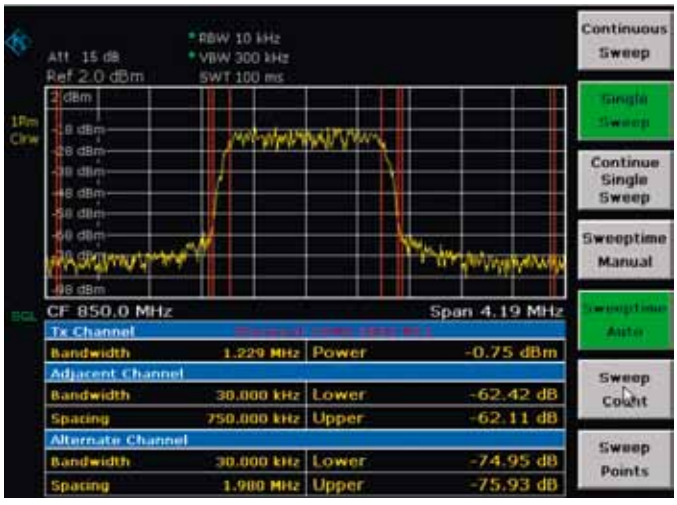
# Integration of spectrum measurements in TV and sound broadcasting signal analysis

At a transmitter, at a cable headend and in the field, a spectrum analyzer is always necessary because it is a universal T&M instrument which can be used to check a series of influences and conditions that could adversely affect signal transmission. The R&S®ETL eliminates the need for a separate spectrum analyzer and test receiver. The R&S®ETL includes a complete spectrum analyzer that can be operated directly from the TV Analyzer/Receiver mode or all or just for certain measurements. Efficient integration of a spectrum and TV analyzer in a single instrument saves time. There is no need to connect and disconnect between two T&M instruments. Automatic measurements can be made and documentation is easier.

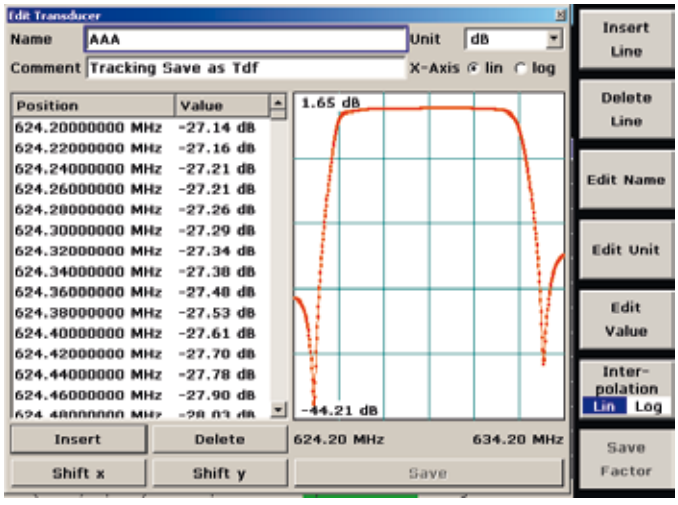
**Full-featured spectrum analyzer**

The R&S®ETL can operate as a full-featured spectrum analyzer. Up to four markers, including noise, phase noise and delta markers, are available in this operating mode. Various resolution and display bandwidths, as well as detectors, can be flexibly set. In addition to the normal spectrum display, other measurements that are of great interest to network providers are offered.

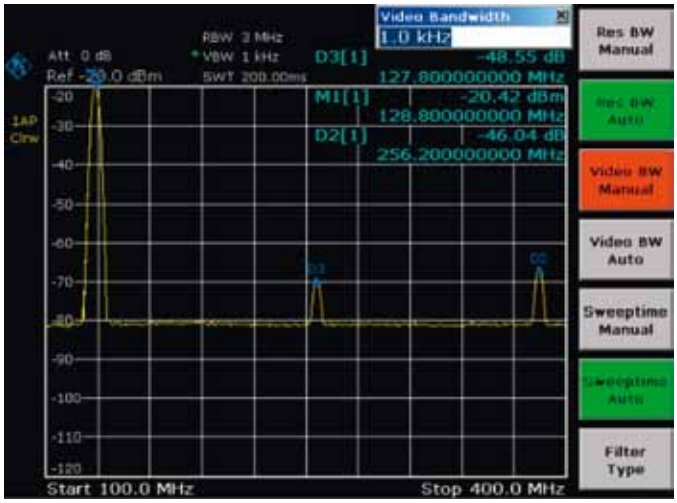
Adjacent channel power (ACP) measurement.




Transducer editor.




Harmonics measurement.




Complementary cumulative distribution function (CCDF) measurement.

### Measurement of transmission channel power, adjacent channel power and harmonics

It is of fundamental importance that TV signals be broadcast at a defined power, while affecting adjacent channels as little as possible. The R&S®ETL provides measurements for determining the channel power, the power in adjacent channels, and harmonics. The settings can be predefined by the user and saved for repetitive use.

### Crest factor

For digital transmission standards, the output power is deliberately limited in order to operate transmitters and modulators in an energy-efficient manner. The crest factor is a measure of how the output power is limited. The crest factor can be measured and displayed in both the spectrum and TV analyzer modes. An advantage of the TV analyzer mode is that all the needed settings are predefined according to a specific standard.

### Built-in tracking generator for measuring filters and amplifiers

The R&S®ETL comes with a tracking generator as standard. The output power of the tracking generator can be set between –20 dBm and 0 dBm in 1 dB steps. The tracking generator can be used to quickly check filters and amplifiers and determine their transfer function, without the need for a separate signal source.

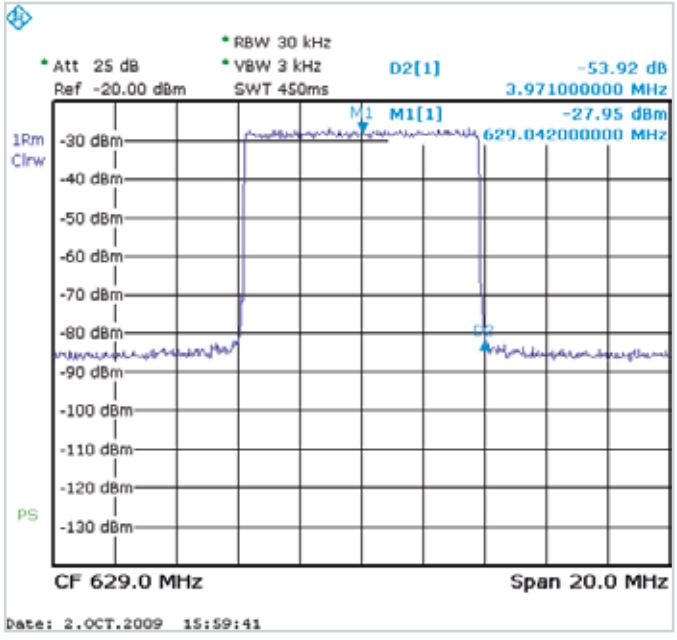
### Transducer tables and antenna factors taken into account

Transducer tables can be used to correct measured values. For example, frequency-dependent attenuation and amplifier characteristics are taken into account during measurements. This function is very useful for coverage measurements in the field. Frequency-dependent antenna factors for test antennas can be conveniently entered and converted to field strength values using the measured input levels.

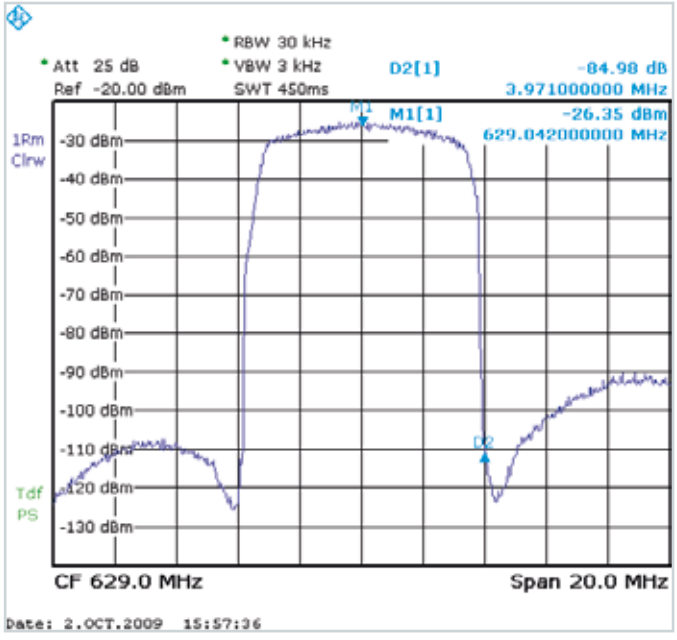
The output spectrum of a terrestrial transmitter usually has defined limits. Adherence to these limits can normally only be tested with a high-end spectrum analyzer that has a sufficiently high dynamic range. As a rule, such spectrum analyzers are too large, too heavy and do not have the TV-specific functions required for field use. The R&S®ETL is the ideal compromise.

Using the convenient copy function, a channel filter's passband characteristic, which was recorded by the R&S®ETL and its integrated tracking generator, can be easily and reliably transferred to a transducer function which is taken into account in the transmitter's measured output spectrum. Values that would be outside the dynamic range of the R&S®ETL can be checked in this way.

Frequency spectrum without transducer function.




Frequency spectrum with transducer function.



# Precise power measurement

At both the transmitter output and the output of a cable modulator, the output power must always be within defined limits in order to run at the optimum operating point, achieve the highest efficiency or fulfill regulatory requirements. In addition to the integrated spectrum analyzer capabilities, each demodulator also has a precise power measurement which integrates all the fractions of power in the useful channel. In the TV analyzer mode, the measured channel power is either displayed in the overview or in the bottom line of the screen. The measuring accuracy is < 1 dB (typ. < 0.5 dB).

**Support of R&S®NRP-Zxx power sensors**

When even more accuracy is needed for power measurements, the R&S®ETL supports the use of R&S®NRP-Zxx power sensors. The R&S®NRP-Z3 or R&S®NRP-Z4 USB adapter can be used to connect the sensors to one of the two USB ports on the front panel of the R&S®ETL.

R&S®NRP-Z55 power sensor.

Information line with displayed signal level.


Display of signal level in overview with limit monitoring.

| Pass | Limit | < | Results (HP) | < | Limit | Unit |
|---|---|---|---|---|---|---|
| Level | -60.0 | | -26.7 | | 10.0 | dBm |
| Constellation | | | 64 QAM NH / normal | | | |
| MER (rms) | 24.0 | | 44.5 | | ----- | dB |

# Flexible option concept

The R&S®ETL's flexible option concept means the instrument can be ideally configured to the required tasks – at any time, not only on delivery. Most of the demodulators and measurement functions are easy-to-install software options that the user can simply activate.

**Modules for easy upgrading by user**

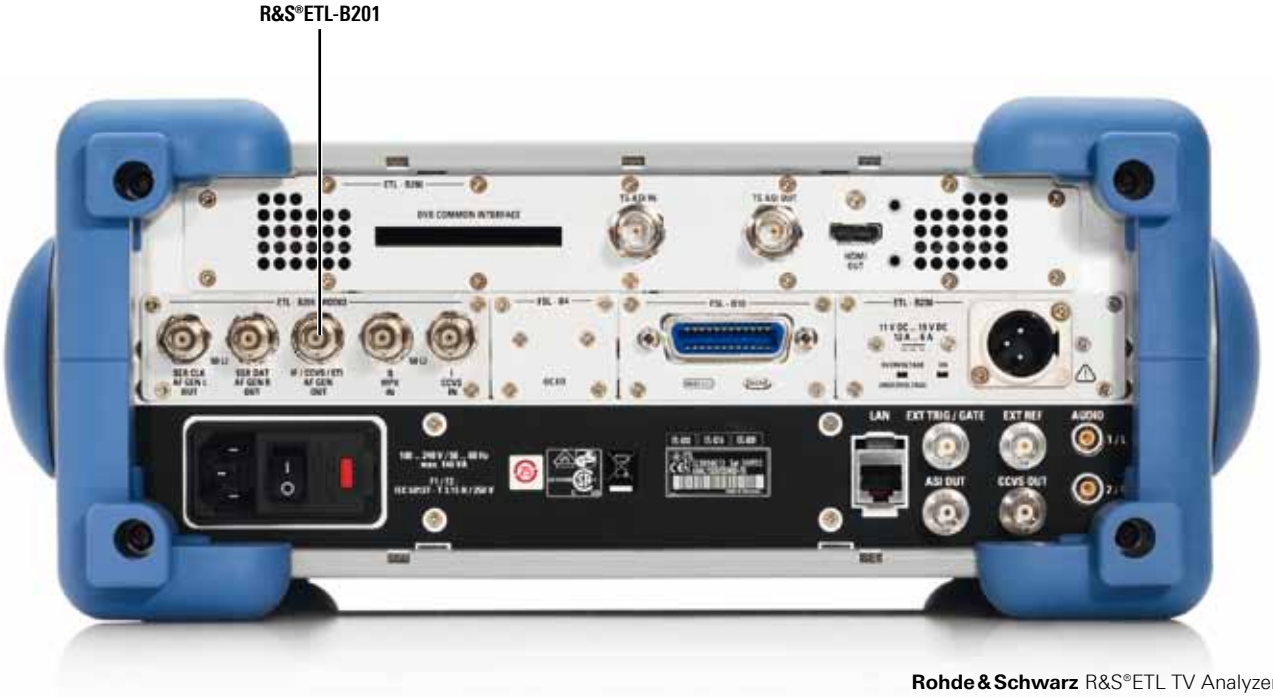
A series of enhancements can be conveniently integrated as modules. A number of plug-in slots, which can be variably configured, are provided on the rear of the R&S®ETL. Users can install these enhancements themselves, which means that the TV analyzer is always available. For example, the R&S®ETL can be enhanced by adding a temperature-stabilized crystal oscillator or a DC power input and rechargeable battery. Various interface options are also available.

**Interfaces for enhanced functionality**

The R&S®ETL comes with numerous interfaces as standard. More interfaces can be added for certain applications. The required interface only takes minutes to install, for example a GPIB interface to connect to older measurement systems or to directly connect Rohde&Schwarz power sensors.

The R&S®ETL-B201 ATV, DTV, FM universal interface was specially developed for measurements on transmitters and modulators. This interface module significantly expands the functionality of the R&S®ETL. I/Q inputs are provided for most digital TV transmission standards so that, for example, RF ASICs or exciters with I/Q outputs can be directly connected and measured. Or, in conjunction with the R&S®SFU broadcast test system, a precise bit error rate measurement can be carried out via the serial clock (SER CLK) and serial data (SER DAT) digital outputs. A CCVS input and an MPX input make i t possible to directly feed in video and MPX signals so that the signals fed into a transmitter can be directly analyzed.

The R&S®ETL-B201 universal interface is also needed to use the integrated signal generator. For both analog TV and FM (radio), the interface module offers variable, configurable, signal outputs for stimulation of analog transmitter input stages and modulators.



# Reference signals for transmitters and modulators

Often, high-quality reference signals are needed to reproducibly check and accurately measure the transmission characteristics or simply test the functionality of transmitters and modulators. The need for a separate signal generator has now been eliminated. Remaining true to the all-in-one motto, the R&S®ETL again offers the ideal solution, with integrated analog and digital signal generators.

Measurements are more convenient, efficient and error-free because the R&S®ETL always delivers the right input signal for the current measurement.

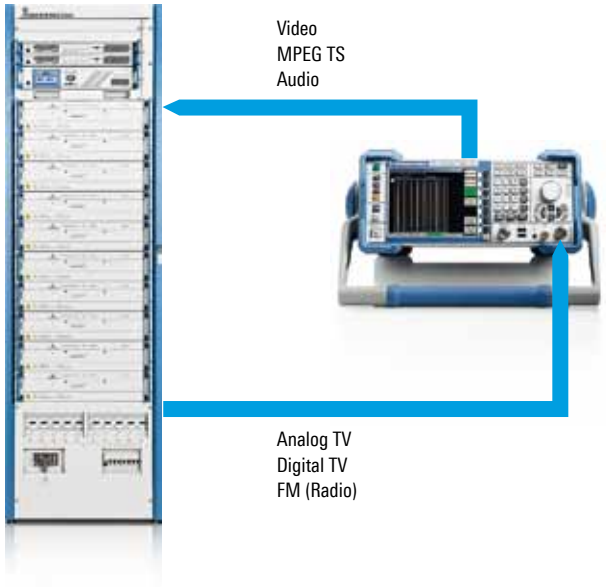
**MPEG TS generator and recorder**

Generators for both analog TV and digital TV can be added to the R&S®ETL. The R&S®ETL-K280 option allows digital transport streams for DVB, ATSC or ISDB-$T_{(B)}$ to be output at the ASI output of the MPEG processing board (R&S®ETL-B280). An SDTV stream library for DVB and ATSC is included as standard. Other stream libraries can be added as options.

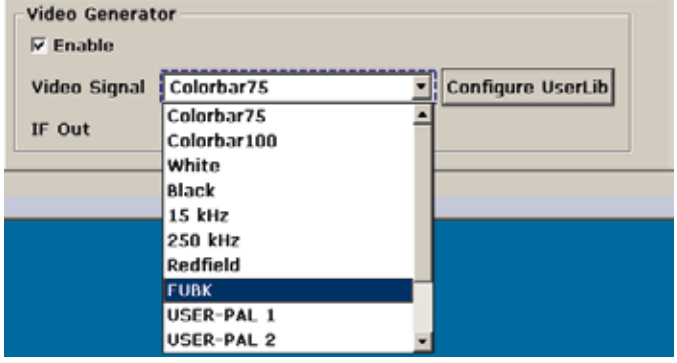
The R&S®ETL-K280 option lets users play and output predefined transport streams and also record their own streams on the R&S®ETL's hard disk – either transport streams delivered by the active demodulator or streams that were added via the external ASI input.

The recorder function is especially helpful when errors occur in the transport stream. The transport stream can be recorded for documentation purposes and evaluated later. The optional TS analyzer integrated into the R&S®ETL can be used for evaluation. The TS generator output only has to be connected to the external ASI input. An ideal solution for maintenance and service.

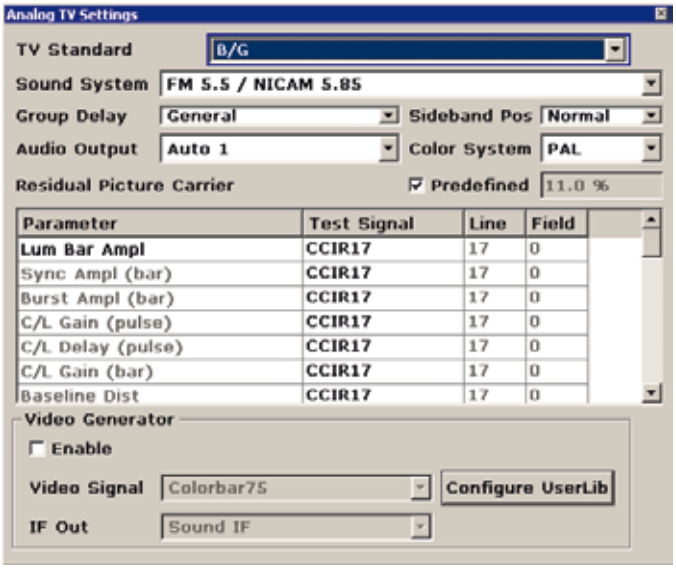
**R&S®ETL with transmitter**




Settings of analog video signals for the video generator.




Settings for analog TV and video test line analysis.



### Analog TV video generator

The R&S®ETL-K203 software option adds the functionality of a video generator to the R&S®ETL. The video generator provides predefined test signals with embedded video test lines in accordance with CCIR, NTC or FCC.

The R&S®ETL-K202 video analysis option is adapted to the video test lines in the test signals – for all analog TV standards offered in the R&S®ETL. The close interaction between test signals and signal analysis makes it easy to evaluate analog video signals, without time-consuming presets.

The generated video signal is available at the CCVS output of the base unit. Using the R&S®ETL-B201 universal interface module, the demodulated analog TV signal can also be output.

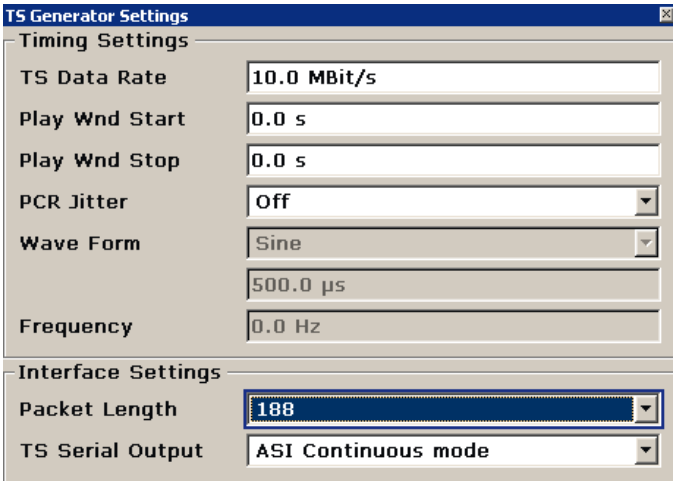
### Audio generator

The R&S®ETL-K111 FM (radio) audio analysis/generator option is the first choice for audio measurements of FM (radio) transmitters or modulators.

In conjunction with the R&S®ETL-B201 universal interface module, users have an audio generator tailored to the measurements needed for audio analysis. The generator delivers single-tone and two-tone signals in the frequency range from 1 Hz to 100 kHz via both the analog interfaces and the digital interface, in accordance with the AES/EBU standard. The audio generator also outputs stereo signals via the digital interface.

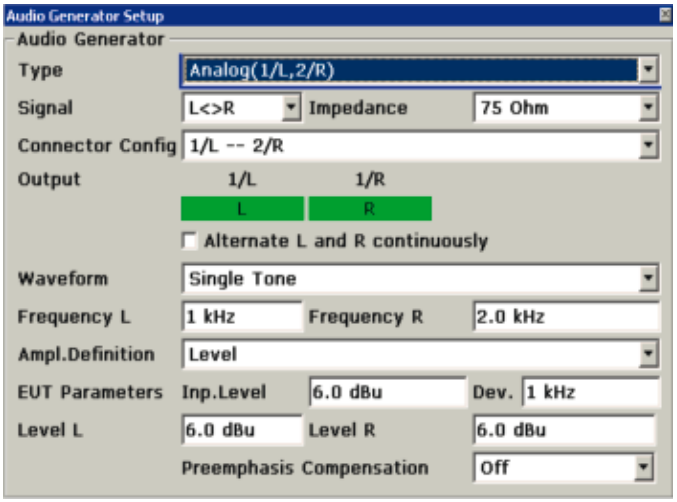
Transport stream generator.


Transport stream generator settings.




Transport stream recorder.


Audio generator settings.



# Ideal for portable use

The R&S®ETL TV analyzer is a T&M instrument with an unprecedented range of functions. The versatile R&S®ETL is used in a correspondingly wide variety of applications – at the transmitter, at a cable headend, in vehicles and in the field. The R&S®ETL was therefore designed to meet the requirements for portable use.

**High-contrast, daylight-compatible display**
All measured values and traces are clearly displayed on the high-contrast, daylight-compatible display. The color display can be switched to black-and-white for maximum contrast in extreme situations.

**Rugged housing with edge protection**
Portable instruments are not always handled with care, which is why the R&S®ETL has a sturdy handle and edge protection on the corners. These features and the rugged housing make the R&S®ETL well protected against major mechanical damage.

**DC power supply and replaceable, rechargeable battery for use in vehicles and the field**

The TV analyzer is usually connected to AC voltage. But there are situations where mains-independent operation is required. For example, for coverage measurements at locations that are difficult to reach, or measurements made from a test vehicle. The R&S®ETL also offers solutions for these situations.

A slot is provided on the rear of the R&S®ETL for a rechargeable Li-ion battery, which makes it possible to operate the analyzer for more than one hour without AC connection. Via a DC interface, the battery can be recharged in the instrument and the R&S®ETL can be connected to the vehicle's 12 V on-board system. There are practically no limits to the everyday use of the R&S®ETL.

**Compact design and low weight with wide range of functions**

For everyday measurements, the compact, lightweight R&S®ETL is a welcome companion for all technicians. The R&S®ETL redefines the meaning of all-in-one, offering a range of functions that could previously only be covered by a number of separate measuring instruments. This combination of a wide range of functions and a compact, light-weight design is unique among TV analyzers in this power class.

Mobile coverage measurements in the field.

The R&S®ETL in the carrying bag.

# Instrument configurations

| Recommendations |  | | | |  | | |  | | |  |  | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Application | Installation, maintenance and servicing of transmitters | | | | Installation, maintenance, service of cable headend | | | Coverage measurements | | | Installation, maintenance, service of transposer | MPEG analysis of local remultiplexer at transmitter site | Function |
| | Analog TV | Digital TV | DAB | FM (radio) | Analog TV | Digital TV | FM (radio) | Digital TV | DAB | FM (radio) | Digital TV | Digital TV | |
| R&S®ETL | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | base unit |
| R&S®ETL-B203 | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | RF preselector |
| R&S®ETL-B110 | | | | ✓ | | | | | | | | | high SNR FM frontend |
| R&S®ETL-K... | | ✓ | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | digital TV standard |
| R&S®ETL-B210 | | | | | | ✓ | | | | | | | demodulator for digital cable TV |
| R&S®ETL-K110 | | | | ✓ | | | ✓ | | | ✓ | | | FM demodulator |
| R&S®ETL-K111 | | | | ✓ | | | ✓ | | | | | | FM audio analysis/ generator |
| R&S®ETL-K2x1 | | | | | | | | ✓ | ✓ | | ✓ | | SFN frequency offset |
| R&S®ETL-K202 | ✓ | | | | ✓ | | | | | | | | video analysis |
| R&S®ETL-K203 | ✓ | | | | ✓ | | | | | | | | video generator |
| R&S®ETL-K208 | | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | | measurement log |
| R&S®ETL-B201 | ✓ | | ✓ | ✓ | ✓ | | ✓ | | ✓ | | | | ATV, DTV, ETI, FM universal interface |
| R&S®ETL-B280 | ✓ | ✓ | | | ✓ | ✓ | | | | | | ✓ | MPEG processing board |
| R&S®ETL-B281 | ✓ | ✓ | | | ✓ | ✓ | | | | | | ✓ | live picture, digital TV and analog TV |
| R&S®ETL-K281 | | ✓ | | | | ✓ | | | | | | ✓ | HDTV, Dolby, HE-AAC |
| R&S®ETL-K282 | | ✓ | | | | ✓ | | | | | | ✓ | MPEG analysis/ monitoring |
| R&S®ETL-K283 | | ✓ | | | | ✓ | | | | | | ✓ | in-depth analysis |
| R&S®ETL-K284 | | | | | | | | | | | | ✓ | data broadcast analysis |
| R&S®ETL-K285 | | | | | | | | | | | | ✓ | TS template monitoring |
| R&S®ETL-K280 | | ✓ | | | | ✓ | | ✓ | | | | ✓ | TS generator/ recorder |
| R&S ETL-B230 | | | | | | | | ✓ | ✓ | ✓ | ✓ | | DC power supply |
| R&S®ETL-B235 | | | | | | | | ✓ | | | ✓ | | Li-ion battery pack |
| R&S®NRP-Zxx | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | | power sensor |
| Measurement software | | R&S®TxCheck | | | R&S® TVSCAN | | | R&S® BCDRIVE | | | R&S®TPCHECK | | automatic measurements and documentation |

# Specifications in brief

| Data | | |
|---|---|---|
| Frequency range | FM (radio) | 500 kHz to 3 GHz<br>75 MHz to 110 MHz |
| Displayed average noise level (DANL) | 50 MHz to 3 GHz, preamplifier OFF<br>500 MHz, preamplifier ON, preselector ON<br>3 GHz, preamplifier ON, preselector ON | ≤ –140 dBm (1 Hz)<br>typ. –166 dBm (1 Hz)<br>typ. –161 dBm (1 Hz) |
| Level | quasi-error-free for digital standards depending on transmission modes<br>T-DMB/DAB with R&S®ETL-B203 preselector, preamplifier ON | –90 dBm to +10 dBm<br><br>–92 dBm |
| Inherent modulation error ratio (MER) | signal level ≥ –30 dBm, f ≤ 1.3 GHz<br>DTMB | ≥ 40 dB, typ. 46 dB<br>≥ 34 dB |
| Video S/N | analog TV mode | ≥ 60 dB |
| **General data** | | |
| Dimensions | W x H x D with handle | 409 mm × 158 mm × 465 mm<br>(16.1 in x 6.2 in x 18.3 in) |
| Weight | without options | < 9 kg<br>(< 19.8 lb) |

**For data sheet, see PD 5213.7748.22 and www.rohde-schwarz.com**

# Ordering information

| Designation | Type | Order No. |
|---|---|---|
| TV Analyzer, 500 kHz to 3 GHz, with tracking generator | R&S®ETL | 2112.0004.13 |
| **Accessories supplied** | | |
| Power cable, quick start guide and CD-ROM (with operating manual) | | |

# Options

| Designation | Type | Order No. | Retrofittable | Remarks |
|---|---|---|---|---|
| High SNR FM Frontend | R&S®ETL-B110 | 2112.0233.02 | yes (service) | not with R&S®ETL-B210, R&S®ETL-B215, R&S®ETL-B216 or R&S®ETL-B300 |
| DTV, ATV, FM Universal Interface (same slot as R&S®FSL-B5) | R&S®ETL-B201 | 2112.0304.03 | yes | SER-DAT out, SER-CLK out, I in, Q in, IF out/ETI out, CCVS out, SOUND IF out, AF GEN L out, AF GEN R out, AF GEN out, MPX in, CCVS in |
| RF Preselector | R&S®ETL-B203 | 2112.0327.02 | yes (service) | |
| 80 Gbyte Hard Disk | R&S®ETL-B209 | 2112.0291.02 | yes (service) | only for R&S®ETL with serial number ≥ 100500; included in R&S®ETL with serial number ≥ 101500 |
| Digital Demodulator for Single Carrier | R&S®ETL-B210 | 2112.0104.02 | yes (service) | |
| Digital Demodulator for DTMB | R&S®ETL-B215 | 2112.0156.02 | yes (service) | |
| Digital Demodulator for Single Carrier and DTMB | R&S®ETL-B216 | 2112.0162.02 | yes (service) | |
| DC Power Supply, 11 V to 19 V | R&S®ETL-B230 | 2112.0256.02 | yes | |
| Li-Ion Battery Pack, 10 Ah, with Battery Charger | R&S®ETL-B235 | 2112.0262.02 | yes | requires R&S®ETL-B230 (same slot as R&S®ETL-B280) |
| MPEG Processing Board | R&S®ETL-B280 | 2112.0362.02 | yes (service) | only for R&S®ETL with serial number > 100500 (same slot as R&S®ETL-B235) |
| Video and Audio Hardware Decoder | R&S®ETL-B281 | 2112.0356.02 | yes (service) | requires R&S®ETL-B280 |
| FPGA Extension Board | R&S®ETL-B300 | 2112.0385.02 | yes (service) | not with R&S®ETL-B110, R&S®ETL-B210, R&S®ETL-B215 or R&S®ETL-B216 |
| Mounting Kit for R&S®ETL-B300 | R&S®ETL-U300 | 2112.0379.02 | yes (service) | only for R&S®ETL with serial number < 102000 |
| OCXO Reference Frequency | R&S®FSL-B4 | 1300.6008.02 | yes | |
| Additional Interfaces | R&S®FSL-B5 | 1300.6108.02 | yes | video out, IF out, noise source control, AUX port, R&S®NRP-Zxx power sensor (same slot as R&S®ETL-B201) |
| Narrow Resolution Filters | R&S®FSL-B7 | 1300.5601.02 | yes (service) | |
| GPIB Interface | R&S®FSL-B10 | 1300.6208.02 | yes | |
| **Firmware/software** | | | | |
| FM (radio) Firmware | R&S®ETL-K110 | 2112.0410.02 | | R&S®ETL-B110 for SNR recommended |
| FM (radio) Audio Analysis/Generator | R&S®ETL-K111 | 2112.0427.02 | | requires R&S®ETL-K110 and R&S®ETL-B201 mod. 03 |
| Analog TV Video Analysis | R&S®ETL-K202 | 2112.0433.02 | | |
| Analog Multistandard TV Video Generator | R&S®ETL-K203 | 2112.0440.02 | | |
| Measurement Log | R&S®ETL-K208 | 2112.0579.02 | | requires at least one digital TV standard or R&S®ETL-K110 |
| DVB-C Firmware | R&S®ETL-K210 | 2112.0404.02 | | requires R&S®ETL-B210 or R&S®ETL-B216 |
| J.83/B Firmware | R&S®ETL-K213 | 2112.0504.02 | | requires R&S®ETL-B210 or R&S®ETL-B216 |
| ATSC/8VSB Firmware | R&S®ETL-K220 | 2112.0456.02 | | |
| ATSC/8VSB SFN Frequency Offset | R&S®ETL-K221 | 2112.0462.02 | | requires R&S®ETL-K220 |
| DVB-T, DVB-H Firmware | R&S®ETL-K240 | 2112.0556.02 | | |
| DVB-T, DVB-H SFN Frequency Offset | R&S®ETL-K241 | 2112.0562.02 | | requires R&S®ETL-K240 |

| Designation | Type | Order No. | Retrofittable | Remarks |
|---|---|---|---|---|
| T-DMB/DAB Firmware | R&S®ETL-K250 | 2112.0533.02 | | |
| T-DMB/DAB SFN Frequency Offset | R&S®ETL-K251 | 2112.0540.02 | | requires R&S®ETL-K250 |
| ISDB-T Firmware | R&S®ETL-K260 | 2112.0485.02 | | |
| ISDB-T SFN Frequency Offset | R&S®ETL-K261 | 2112.0491.02 | | requires R&S®ETL-K260 |
| MPEG TS Generator/Recorder | R&S®ETL-K280 | 2112.0591.02 | | requires R&S®ETL-B209 (included in R&S®ETL with serial number ≥ 101500) and R&S®ETL-B280 |
| HDTV and Dolby Upgrade | R&S®ETL-K281 | 2112.0604.02 | | requires R&S®ETL-B281 |
| MPEG Analysis/Monitoring | R&S®ETL-K282 | 2112.0610.02 | | requires R&S®ETL-B280 |
| In-Depth Analysis | R&S®ETL-K283 | 2112.0627.02 | | requires R&S®ETL-K282 |
| Data Broadcast Analysis | R&S®ETL-K284 | 2112.0633.02 | | requires R&S®ETL-K282 |
| TS Template Monitoring | R&S®ETL-K285 | 2112.0640.02 | | requires R&S®ETL-K282 |
| DVB-T2 Firmware | R&S®ETL-K340 | 2112.0527.02 | | requires R&S®ETL-B300 |
| ATSC MDTV, ATSC/8VSB Firmware | R&S®ETL-K320 | 2115.1553.02 | | requires R&S®ETL-B300 |
| ATSC MDTV, ATSC/8VSB SFN Freqency Offset | R&S®ETL-K321 | 2115.1560.02 | | requires R&S®ETL-K320 |
| ATSC MDTV Upgrade | R&S ETL-K322 | 2115.1576.02 | | requires R&S®ETL-K220 and R&S®ETL-B300 |
| AM/FM/φM Measurement Demodulator | R&S®FSL-K7 | 1301.9246.02 | | |
| Power Sensor Support | R&S®FSL-K9 | 1301.9530.02 | | requires R&S®FSL-B5 |
| WiMAX™ IEEE 802.16 OFDM/OFDMA Application Firmware | R&S®FSL-K93 | 1302.0736.02 | | see separate specifications |
| **Software tools** | | | | |
| Automatic TV Channel Scan Software | R&S®TVSCAN | 2115.1660.02 | | for more information, see brochure PD 5214.5484.12 |
| Broadcast Drive Test Software | R&S BCDRIVE | 2115.1360.02 | | for more information, see brochure PD 5214.xxxx.12 |
| Automatic Transposer Measurement Software | R&S®TPCHECK | 2115.0585.02 | | for more information, see brochure PD 5214.5478.11 (available from July 2011) |
| **Transport stream libraries for the R&S®ETL-K280 MPEG TS generator/recorder** | | | | |
| HDTV Sequences | R&S®DV-HDTV | 2085.7650.02 | | requires R&S®ETL-K280 |
| H.264 Stream Library | R&S®DV-H264 | 2085.9052.02 | | requires R&S®ETL-K280 |
| DVB-H Stream Library | R&S®DV-DVBH | 2085.8704.02 | | requires R&S®ETL-K280 |
| Test Card M Sequences | R&S®DV-TCM | 2085.7708.02 | | requires R&S®ETL-K280 |
| Japanese ISDB-T Transport Stream Library | R&S®DV-ISDBT | 2085.9146.02 | | requires R&S®ETL-K280 |
| Brazilian ISDB-T Transport Streams | R&S®SFU-K224 | 2110.4777.02 | | requires R&S®ETL-K280 |
| Advanced Stream Combiner, dongle for USB interface | R&S®DV-ASC | 2085.8804.03 | | |

# Recommended extras

| Designation | Type | Order No. |
|---|---|---|
| Documentation of R&S®ETL Calibration Values | R&S®ETL-DCV | 2082.0490.31 |
| 19“ Rackmount Adapter | R&S®ZZA-S334 | 1109.4487.00 |
| Lemo Triax connector (mono) with connecting cable (open) | | 2067.7451.00 |
| Soft Carrying Bag | R&S®FSL-Z3 | 1300.5401.00 |
| Protective Hard Cover | R&S®EVS-Z6 | 5201.7760.00 |
| Matching Pad 75 Ω, L section | R&S®RAM | 0358.5414.02 |
| Matching Pad 75 Ω, series resistor 25 Ω | R&S®RAZ | 0358.5714.02 |
| Matching Pad 75 Ω, L section, N to BNC | R&S®FSH-Z38 | 1300.7740.02 |
| SWR Bridge 5 MHz to 3 GHz | R&S®ZRB2 | 0373.9017.52 |
| SWR Bridge 40 kHz to 4 GHz, 50 Ω | R&S®ZRC | 1039.9492.52 |
| SWR Bridge 40 kHz to 2.5 GHz, 75 Ω | R&S®ZRC | 1039.9492.72 |
| Mouse with USB Interface, optical | R&S®PSL-Z10 | 1157.7060.03 |
| Keyboard with USB Interface (US assignment) | R&S®PSL-Z2 | 1157.6870.04 |
| Spare F Adapter, female/female | R&S®FSHTV-Z61 | 2111.7111.02 |

# Power sensors supported by R&S®FSL-K9

| Designation | Type | Order No. |
|---|---|---|
| USB Adapter (active) (required for using power sensors with the R&S®ETL if the R&S®FSL-B5 option is not installed) | R&S®NRP-Z3 | 1146.7005.02 |
| USB Adapter (passive) (required for using power sensors with the R&S®ETL if the R&S®FSL-B5 option is not installed) | R&S®NRP-Z4 | 1146.8001.02 |
| Universal Power Sensor, 10 MHz to 8 GHz, 200 mW | R&S®NRP-Z11 | 1138.3004.02 |
| Universal Power Sensor 10 MHz to 18 GHz, 200 mW | R&S®NRP-Z21 | 1137.6000.02 |
| Universal Power Sensor, 10 MHz to 18 GHz, 2 W | R&S®NRP-Z22 | 1137.7506.02 |
| Universal Power Sensor, 10 MHz to 18 GHz, 15 W | R&S®NRP-Z23 | 1137.8002.02 |
| Universal Power Sensor, 10 MHz to 18 GHz, 30 W | R&S®NRP-Z24 | 1137.8502.02 |
| Universal Power Sensor, 9 kHz to 6 GHz, 200 mW | R&S®NRP-Z91 | 1168.8004.02 |
| Thermal Power Sensor, 0 Hz to 18 GHz, 100 mW | R&S®NRP-Z51 | 1138.0005.02 |
| Thermal Power Sensor, 0 Hz to 40 GHz, 100 mW | R&S®NRP-Z55 | 1138.2008.02 |
| Wideband Power Sensor, 50 MHz to 18 GHz, 100 mW | R&S®NRP-Z81 | 1137.9009.02 |

# Service options

| Designation | Type | Order No. |
|---|---|---|
| Two-Year Calibration Service | R&S®CO2ETL | please contact your local Rohde&Schwarz sales partner |
| Three-Year Calibration Service | R&S®CO3ETL | |
| Five-Year Calibration Service | R&S®CO5ETL | |
| One-Year Repair Service following the warranty period | R&S®RO2ETL | |
| Two-Year Repair Service following the warranty period | R&S®RO3ETL | |
| Four-Year Repair Service following the warranty period | R&S®RO5ETL | |

# From pre-sale to service. At your doorstep.

The Rohde&Schwarz network in over 70 countries ensures optimum on-site support by highly qualified experts. The user risks are reduced to a minimum at all stages of the project:

- Solution finding/purchase
- Technical start-up/application development/integration
- Training
- Operation/calibration/repair

## Service you can rely on

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

### 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

Certified Quality System
ISO 9001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