Version 06.00

August 2010

R&S®EFA Test Receiver
DVB-C – B/G Analog TV – D/K or I Analog TV

Comprehensive analysis/demodulation/monitoring of digital and analog TV signals in a single unit

- *discontinued* Standard test receiver
- High-end test receiver
- High-end demodulator
- Multistandard digital and analog platform for terrestrial and CATV applications
- Application areas: production, monitoring, coverage, service, research and development
- Comprehensive measurement and monitoring functions
- Modular design — easy retrofitting of options
- MPEG-2 analyzer/decoder option for SDTV
- IEC/IEEE-bus and RS-232-C interface
- Simple, user-friendly operation

ROHDE&SCHWARZ

The R&S®EFA Family

The TV Test Receiver and Demodulator Family R&S®EFA offers outstanding performance features and excellent transmission characteristics. The instruments provide high-precision reception and demodulation of vestigial sideband AM signals (analog TV signals) as well as quadrature amplitude modulated DVB signals. They measure a comprehensive range of transmission parameters and are therefore ideal for measurement and monitoring applications in cable networks, TV transmitter stations and development labs.

The complete R&S®EFA family at a glance

Standard test receivers *discontinued*

- Model 60: digital TV, DVB-C
- Model 12: analog TV, standard B/G
- Model 78: analog TV, standard D/K or I

High-end test receivers

- Model 63 incl. option R&S®EFA-B3: digital TV, DVB-C
- Model 33 incl. option R&S®EFA-B3: analog TV, standard B/G
- Model 89 incl. option R&S®EFA-B3: analog TV, standard D/K or I

High-end demodulators

- Model 63: digital TV, DVB-C
- Model 33: analog TV, standard B/G
- Model 89: analog TV, standard D/K or I

This data sheet

Standard test receiver *discontinued*

- Model 40: digital TV, DVB-T

High-end test receiver

- Model 43 incl. option R&S®EFA-B3: digital TV, DVB-T

High-end demodulator

- Model 43: digital TV, DVB-T

Data sheet No. PD 5213.6835.32

Standard test receivers *discontinued*

- Model 50: digital TV, ATSC/8VSB
- Model 70: digital TV, ITU-T J.83/B
- Model 90: analog TV, standard M/N

High-end test receivers

- Model 53 incl. option R&S®EFA-B3: digital TV, ATSC/8VSB
- Model 73 incl. option R&S®EFA-B3: digital TV, ITU-T J.83/B
- Model 93 incl. option R&S®EFA-B3: analog TV, standard M/N

High-end demodulators

- Model 53: digital TV, ATSC/8VSB
- Model 73: digital TV, ITU-T J.83/B
- Model 93: analog TV, standard M/N

Data sheet No. PD 5214.4836.32

Wide variety of models

The TV Test Receiver Family R&S®EFA from Rohde & Schwarz is a versatile and high-performance TV test receiver and demodulator platform, which can be optimally configured for any application, whether digital or analog.

Two frontends are available:

standard selective *discontinued*
high-end selective
high-end non-selective

The high-end models have a better signal-to-noise ratio than the standard models and offer excellent intermodulation characteristics. This, coupled with minimum inherent frequency response, ensures extremely accurate measurements.

The family concept described in the following will help you to find the right R&S®EFA model for your application:

- If the application mainly involves measurements in cable networks or on terrestrial signals, a receiver model that selects the channel to be measured is the appropriate choice; adjacent-channel signals, which impair measurement results, are filtered out by high suppression;
- Measurements on modulators or TV transmitters, where only one TV signal is involved, are performed with one of the demodulator models with the high-end non-selective frontend, which ensures extremely low measurement uncertainty without preselection

The last selection criterion is the TV standard used, and whether it is analog or digital:

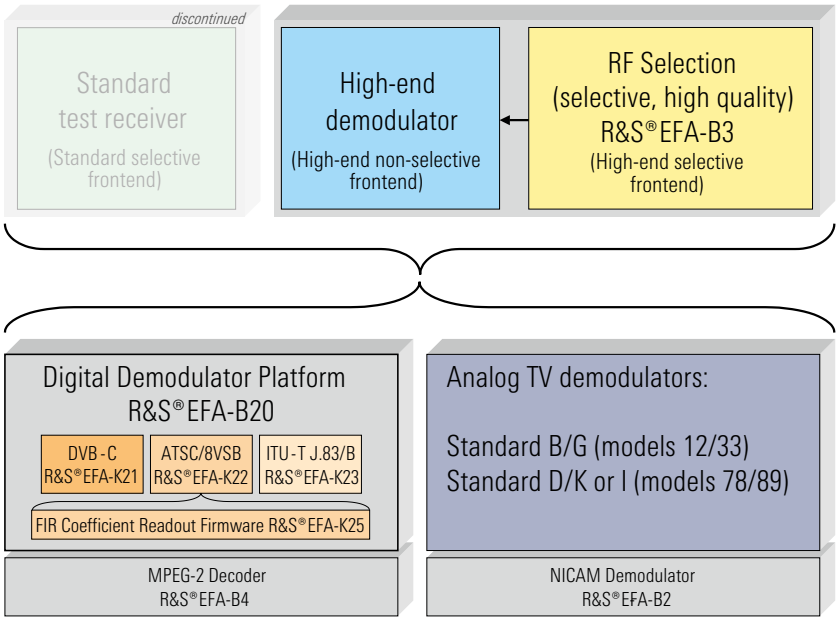
- The R&S®EFA test receivers can be configured for digital signals to the DVB-C, ATSC/8VSB, ITU-T J.83/B (R&S®EFA-B20) or DVB-T (R&S®EFA-B10) standard and for virtually all analog TV standards. For ATSC/8VSB and ITU-T J.83/B, refer to data sheet PD 5214.4836.32; for DVB-T refer to data sheet PD 5213.6835.32. A wide range of options including a NICAM demodulator (option R&S®EFA-B2) and an MPEG-2 decoder (option R&S®EFA-B4) complete the R&S®EFA product line.
- Operation involving a mix of analog and digital channels is becoming more widespread especially in cable networks; this kind of operation is handled by the QAM demodulator option for

  DVB-C (R&S®EFA-B20 + R&S®EFA-K21) or ITU-T J.83/B (R&S®EFA-B20 + R&S®EFA-K23)

  which adds complete digital measurement functionality to the analog models.
- It is even possible to update to digital terrestrial applications in accordance with the ATSC/8VSB standard using the

  ATSC/8VSB demodulator option (R&S®EFA-B20 + R&S®EFA-K22)

The R&S®EFA model selection concept



The R&S®EFA Family

Common to all models

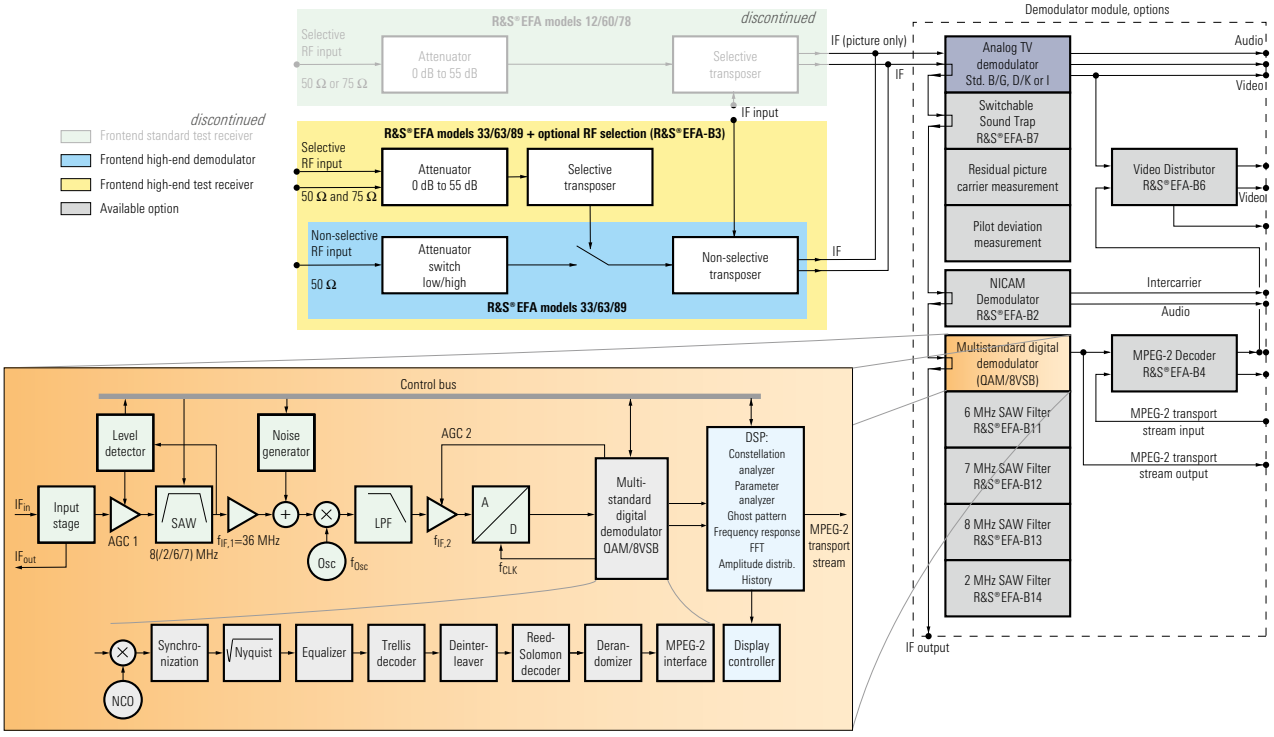
- In-depth measurement capabilities
- Simple, user-friendly operation
- Modular design — easy retrofitting of options
- Alarm messages for measurement functions, internal storage
- Seven alarm-triggered relays for switching external devices
- IEC/IEEE-bus and RS-232-C interface

discontinued

Standard test receiver (R&S®EFA models 12/60/78)
- Selective receiver
- Typical use in the field where adjacent channels need to be filtered
- High-end synthesizer with low phase noise
- Excellent price/performance ratio

High-end demodulator (R&S®EFA models 33/63/89)
- Wideband input (non-selective receiver), tunable
- Typically used for transmitter testing
- Outstanding SNR, excellent intermodulation characteristics
- High-end synthesizer with extremely low phase noise

High-end test receiver (R&S®EFA models 33/63/89 + option R&S®EFA-B3)
- Outstanding SNR and improved intermodulation characteristics
- Rejection of image frequency and IF
- Two additional selective RF inputs (50 Ω and 75 Ω)
- Extended frequency range from 4.5 MHz to 1000 MHz



Block diagram of the TV Test Receiver R&S®EFA

Digital options

MPEG-2 decoder (option R&S®EFA-B4)
- MPEG-2 syntax analysis in accordance with DVB standard ETSI TR 101290
- SDTV decoding, 625L or 525L supported, SDI output, PAL / SECAM / NTSC video out
- Error report

6 MHz SAW filter (option R&S®EFA-B11)
- Adjacent-channel rejection
- Meets US requirements

7 MHz SAW filter (option R&S®EFA-B12)
- Adjacent-channel rejection
- Meets Cable Australian requirements

R&S®EFA — realtime signal analysis of DVB-C signals

The R&S®EFA's powerful digital signal processing provides fast and thorough analysis of the received DVB-C signal. Analysis is performed simultaneously with, but independently of, demodulation and decoding. The MPEG-2 transport stream is permanently available for decoding as well as for video and audio reproduction.

Due to its realtime analysis capability, the high number of measured values necessary for the complex calculation and display processes are made available for subsequent mathematical/statistical processing in an extremely short and as yet unequalled time. Because of its high-speed data acquisition, the TV Test Receiver R&S®EFA is the ideal choice, not only for R & D but also for production environments where short measurement cycles are essential.

8 MHz SAW filter (option R&S®EFA-B13)
- Adjacent-channel rejection
- Meets European and US standards, recommended for spectrum measurements

2 MHz SAW filter (option R&S®EFA-B14)
- Adjacent-channel rejection
- Meets channel return requirements (in cable applications)

OFDM demodulator (option R&S®EFA-B10)
- Retrofit of analog instruments
- Support of DVB-T
- Included in basic R&S®EFA 43 models
- MPEG-2 transport stream output (serial and parallel)

SFN frequency offset measurement (option R&S®EFA-K10)
- Unique measurement feature
- Indication of frequency offset of each SFN transmitter
- Measurement range from –5 Hz to +5 Hz
- High precision, typ. <0.3 Hz

Digital demodulator platform (option R&S®EFA-B20)
- Retrofit of analog instruments
- Multistandard demodulator platform supporting DVB-C demodulation (with R&S®EFA-K21), ATSC/8VSB demodulation (with R&S®EFA-K22), ITU-T J.83/B demodulation (with R&S®EFA-K23)
- Included in basic R&S®EFA 53/63/73 models
- MPEG-2 transport stream output (serial or parallel)
- General measurement functions for
  - RF input level
  - carrier frequency offset
  - bit rate offset
  - BER (before and after Reed-Solomon)

DVB-C firmware (option R&S®EFA-K21)
- Analysis, demodulation and monitoring of DVB-C signals in accordance with ETS 300 429 standard
- Included in basic R&S®EFA 63 models

ATSC/8VSB firmware (option R&S®EFA-K22)
- Analysis, demodulation and monitoring of ATSC/8VSB signals in accordance with ATSC Doc. A/53
- Included in basic R&S®EFA 53 models
- Additional SMPTE310M MPEG-2 transport stream output

ITU-T J.83/B firmware (option R&S®EFA-K23)
- Analysis, demodulation and monitoring of American digital cable signals in accordance with ITU-T J.83/B standard
- Included in basic R&S®EFA 73 models

FIR coefficient readout firmware (option R&S®EFA-K25)
- Calculation of FIR filter coefficients for linear precorrection of digital signals
- Only available for the ATSC/8VSB models

The R&S®EFA Family

Analog options

NICAM demodulator (option R&S®EFA-B2)

- Demodulation and decoding of signals to NICAM-728 standard
- I and Q signal output
- Switchable deemphasis
- Balanced audio outputs
- Measurement parameters: bit error ratio, eye height, clock and data jitter

Video distributor (option R&S®EFA-B6)

- 2 video outputs on front panel
- 2 video outputs on rear panel
- 1 additional Q output on front panel

Switchable sound trap (option R&S®EFA-B7)

- Only available for standard B/G (R&S®EFA models 33)
- Allows video bandwidth switchover to 6 MHz

M/N NTSC/BTSC demodulator (option R&S®EFA-B30)

(Cannot be combined with standard B/G, D/K or I.)

Available R&S®EFA models and options

discontinued

			Standard test receivers			High-end demodulators			High-end test receivers			
		Models →	12	60	78	33	63	89	33	63	89	Slot needed
Option	Designation	Order No.	B/G	DVB-C	D/K or I	B/G	DVB-C	D/K or I	B/G	DVB-C	D/K or I	
R&S®EFA-B2	NICAM Demodulator (Standard B/G or D/K)	2067.3610.02	❍	–	❍	❍	–	❍	❍	–	❍	1
R&S®EFA-B2	NICAM Demodulator (Standard I)	2067.3610.04	–	–	❍	–	–	❍	–	–	❍	1
R&S®EFA-B3	RF Selection	2067.3627.02	–	–	–	❍	❍	❍	◆	◆	◆	1
R&S®EFA-B4	MPEG-2 Decoder	2067.3633.02	❍ 1)	❍	❍ 1)	❍ 1) 8)	❍	❍ 1) 8)	–	❍	–	1
R&S®EFA-B6	Video Distributor	2067.3656.02	–	–	–	❍	❍ 4)	❍	❍	❍ 4)	❍	0
R&S®EFA-B7	Switchable Sound Trap (Standard B/G)	2067.3710.02	❍	–	–	❍	–	–	❍	–	–	1
R&S®EFA-B11	6 MHz SAW Filter	2067.3691.00	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	0
R&S®EFA-B12	7 MHz SAW Filter	2067.3591.00	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	❍ 1) 3) 9)	0
R&S®EFA-B13	8 MHz SAW Filter	2067.3579.02	❍ 3) 7)	–	❍ 3) 7)	❍ 3) 7)	–	❍ 3) 7)	❍ 3) 7)	–	❍ 3) 7)	0 3) 7)
R&S®EFA-B13	8 MHz SAW Filter	2067.3579.03	❍ 3) 10)	❍ 3)	❍ 3) 10)	❍ 3) 10)	❍ 3) 10)	❍ 10) 3)	❍ 3) 10)	❍ 3) 9)	❍ 3) 9) 10)	0
R&S®EFA-B14	2 MHz SAW Filter	2067.2562.00	❍ 3) 10)	❍ 3)	❍ 3) 10)	❍ 3) 10)	❍ 3) 10)	❍ 3) 10)	❍ 3) 10)	❍ 3)	❍ 3) 10)	0
R&S®EFA-B10	OFDM Demodulator	2067.3740.02	❍ 6)	–	❍ 6)	❍ 6)	–	❍ 6)	❍ 6)	–	❍ 6)	1
R&S®EFA-B20	Digital Demodulator Platform	2067.3585.02	❍ 2) 6)	✔	❍ 2) 6)	❍ 2) 6)	✔	❍ 2) 6)	❍ 2) 6)	✔	❍ 2) 6)	1
R&S®EFA-K10	SFN Frequency Offset Measurement	2067.9454.02	❍ 7)	–	❍ 7)	❍ 7)	–	❍ 7)	❍ 7)	–	❍ 7)	0
R&S®EFA-K21	DVB-C / J.83/A,C (QAM) Firmware	2067.4000.02	❍ 10)	✔	❍ 10)	❍ 10)	✔	❍ 10)	❍ 10)	✔	❍ 10)	0
R&S®EFA-K22	ATSC/8VSB Firmware	2067.4017.02	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	0
R&S®EFA-K23	J.83/B Firmware	2067.4023.02	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	❍ 10)	0
R&S®EFA-K25	FIR Coefficient Readout Firmware	2067.4046.02	❍ 5)	❍ 5)	❍ 5)	❍ 5)	❍ 5)	❍ 5)	❍ 5)	❍ 5)	❍ 5)	0
R&S®ZZT-314	Carrying Bag for 19" units, 3 HU	1001.0523.00	❍	❍	❍	❍	❍	❍	❍	❍	❍	0

Each base unit has three free slots to take up options.

✔ included in base unit ◆ must be ordered with base unit ❍ available – not applicable

1) Can be retrofitted if option R&S®EFA-B10 or R&S®EFA-B20 is built in.
2) Must be ordered with min. one firmware option (R&S®EFA-K21 or R&S®EFA-K22 or R&S®EFA-K23).
3) Max. 3 SAW filters.
4) Requires R&S®EFA-B4.
5) Can be retrofitted if options R&S®EFA-B20 and R&S®EFA-K22 are built in.
6) Only R&S®EFA-B10 or -B20 possible (same slot needed).
7) Can be retrofitted if option R&S®EFA-B10 is built in.
8) Cannot be retrofitted if option R&S®EFA-B3 is built in.
9) R&S®EFA models 60/63 or R&S®EFA-B20: R&S®EFA-B11 and R&S®EFA-B12 cannot be retrofitted in parallel.
10) Can be retrofitted if option R&S®EFA-B20 is built in.

DVB-C

R&S®EFA models 63 — all measurement functions for DVB-C digital CATV standard

Besides digital terrestrial TV and digital video broadcasting over satellite, digital cable TV still represents an alternative for many consumers worldwide. Additionally, cable technology provides a return channel within the same physical layer (coax cable), allowing the consumer to send back information to the cable headend for versatile applications (full Internet access, video-on-demand and more). Data communications and TV networks have never been so close!

Characteristics

Fully compatible with the DVB-C standard (EN 300 429), the R&S®EFA 63 model receive, demodulate, decode and analyze all orders of QAM (quadrature amplitude modulated) signals. All key parameters for demodulating the received signal can be automatically or manually selected:

- 4, 16, 32, 64, 128 or 256 QAM
- Variable symbol rate for special modulator tests and lab analysis (1 Msymbol/s to 6.999 Msymbol/s)
- Reed-Solomon error correction
- Optional SAW filter bandwidths: 6 MHz, 7 MHz, 8 MHz and 2 MHz
- Input of any IF frequency with the aid of the R&S®EFA-B3 option: frequency range continuously tunable from 5 MHz to 1000 MHz
- Special function: invert spectrum
- Bit error ratio measurement (before and after Reed-Solomon decoder)
- Integrated noise generator for measurement of noise margin

Features

The test receiver features a wide range of innovative measurement functions, allowing comprehensive, in-depth signal analysis. In addition to measuring general parameters (Fig. 1) such as bit error ratio (BER), more thorough analysis includes:

- I/Q constellation diagrams (Fig. 2) with user-selectable number of symbols to be displayed, range: 1 to 999 999 999 symbols
- Histogram I (Fig. 3) and Q (Fig. 4) with user-selectable number of symbols to be displayed, range: 1 to 999 999 999 symbols
- I/Q parameters, modulation error ratio (MER), error vector magnitude (EVM), phase jitter and signal-to-noise ratio (Fig. 5)
- Frequency spectrum (Fig. 6)
- Complex channel transmission function (Fig. 7)
- Phase jitter and amplitude jitter spectra (Fig. 8)
- Received echo signals (Fig. 9)
- Linearity analysis from amplitude distribution histogram and CCDF referenced to the RF signal (Figs. 10 and 11)
- Eye monitoring (Fig. 12)
- History function: long-term monitoring of transmission parameters (Fig. 13)
- Monitoring window (Fig. 14)
- Easy configuration of alarm relays (Fig. 15)
- Permanent MPEG-2 transport stream demodulation (independent of the selected measurement task)
- Integrated noise generator

Any failures and degradations are immediately visible in the constellation diagram. Effects of interest can be located more precisely by varying the number of symbols represented. The integrated spectral analysis function enables easy examination of the signal type and its spectrum.

DVB-C

Fig. 1: Measurement menu

All parameters for the demodulated DVB-C channel are displayed on a single screen and can be checked at a glance:

- Level of the input signal
- Two BERs (bit error ratio) — before and after Reed-Solomon decoder — provide a fast quality overview of the demodulated signal
- Demodulated symbol rate
- Symbol rate offset
- Packet errors

Hint: When required, the internal noise generator can be activated to perform END (equivalent noise degradation) or noise margin measurements based on the BER measurement.

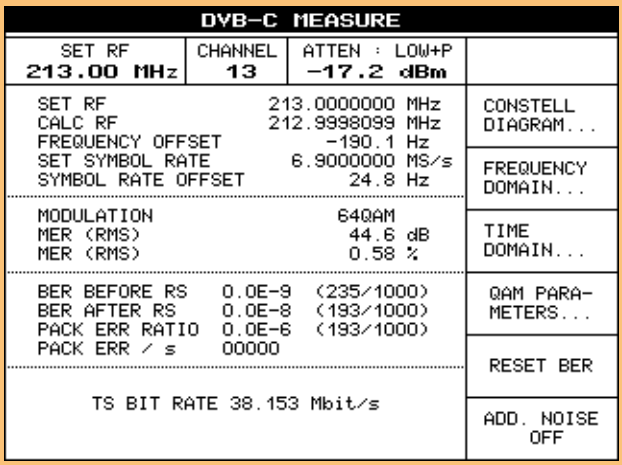


Fig. 2: Constellation diagram

The constellation diagram is always the best way to represent digital modulation. It is also the best visual tool for interpreting measurement results such as I/Q amplitude imbalance or carrier suppression. For in-depth analysis, adjustment of the displayed number of symbols is possible (10 000 symbols are shown in this example).

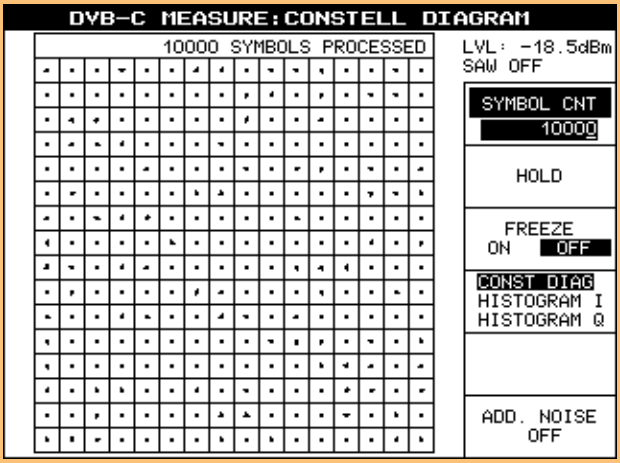
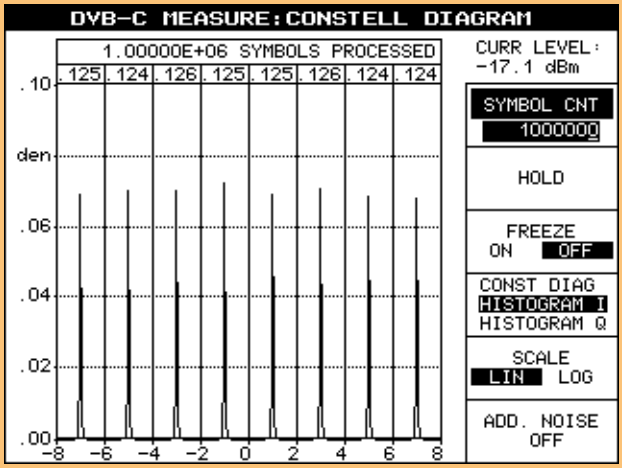


Fig. 3: Histogram I

Histogram I represents the distribution of the quadrature amplitude modulated (QAM) signal on the X axis (I for inphase), and can be expressed on a linear or logarithmic scale.
It allows an estimate of the interferer's origin (interferer, Gaussian noise, etc).
Linear scaling is used in this plot.



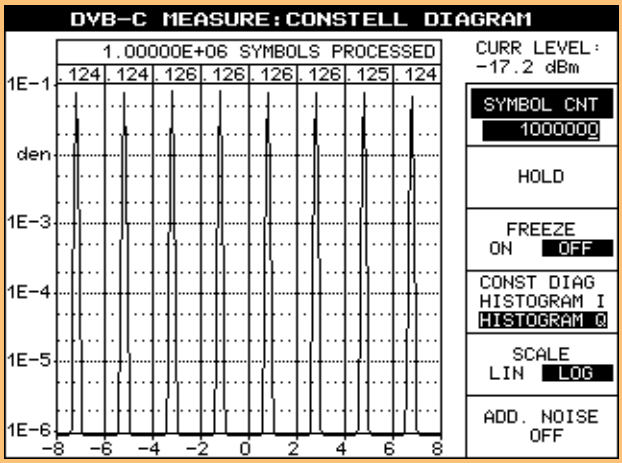


Fig. 4: Histogram Q

Same representation as Fig. 15 — but referring to the distribution of the Q component projected on the X axis (Q for quadrature).

Logarithmic scaling is used in this plot.

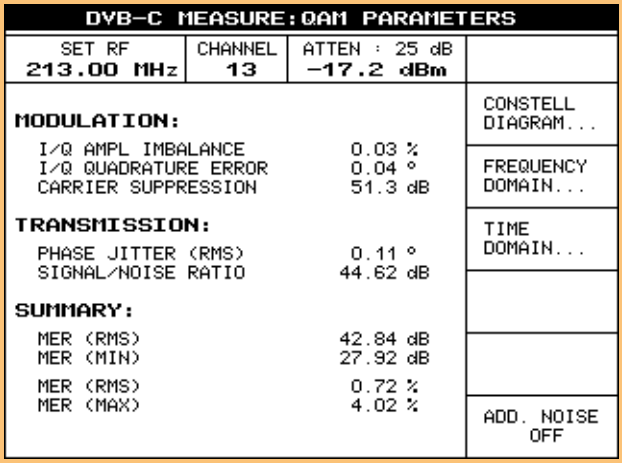


Fig. 5: QAM parameters

All QAM parameters are calculated from the constellation diagram:

- I/Q amplitude imbalance
- I/Q phase error
- Carrier suppression
- Phase jitter
- Signal-to-noise ratio
- MER (modulation error ratio), RMS and Min
- EVM (error vector magnitude), RMS and Max

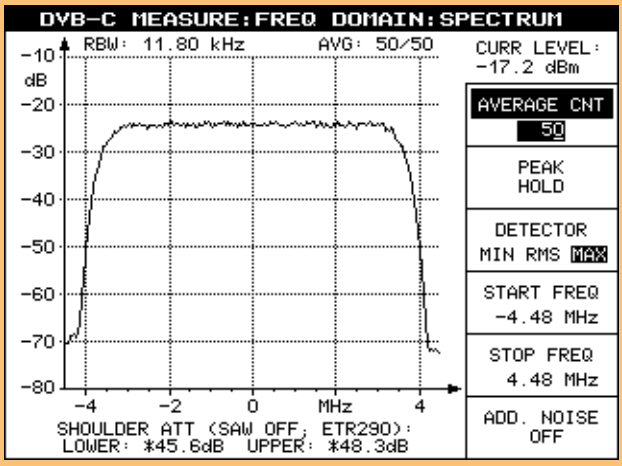


Fig. 6: Spectrum analysis

Owing to this measurement, a separate spectrum analyzer is not required anymore, e.g. for measuring the shoulder attenuation. Basic spectrum analyzer functions are provided. For example, the start/stop frequency (or center/span) and several detection and averaging modes can be selected.

Fig. 7: Amplitude and phase frequency response
The coefficients of the equalizer are used to display the amplitude and phase frequency response (shown here), the group delay (not shown here) and the polar plot representation. The polar plot representation — which is the complex representation of amplitude and phase — may help to interpret very short echoes that are difficult to visualize on the echo pattern display.

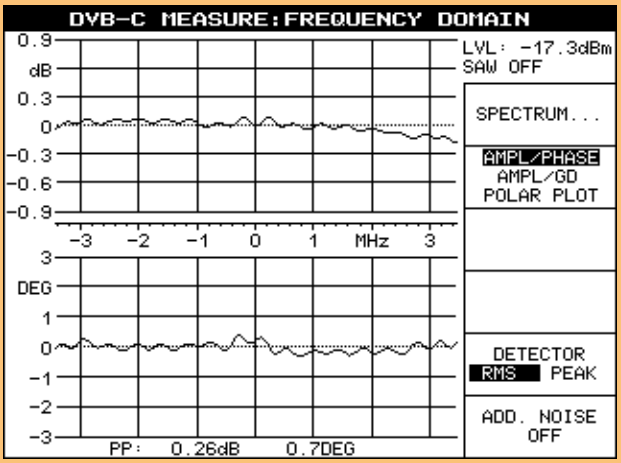


Fig. 8: Phase jitter and amplitude jitter spectrum
The R&S EFA's QAM function for measuring the phase jitter and amplitude jitter spectra makes it possible to analyze and monitor the quality of the various mixer oscillators and amplifier loops of a transmitter. Jitter analysis can easily be performed during normal operation without switching off the carrier modulation.

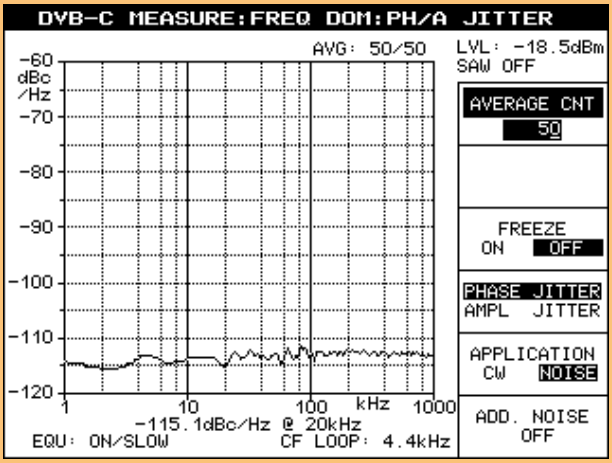
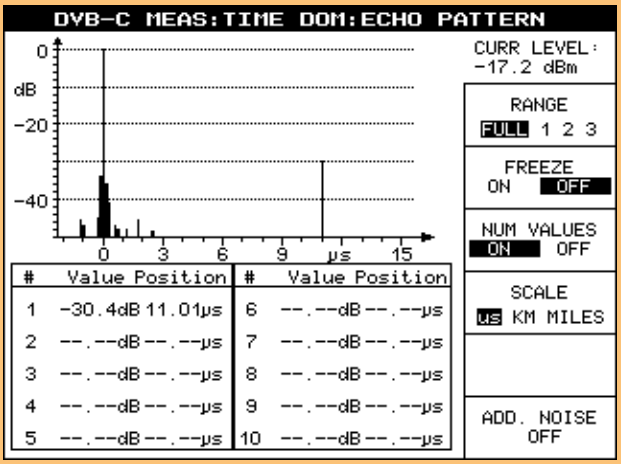


Fig. 9: Echo pattern
The echo pattern measurement allows the main QAM signal (0 dB relative), echoes and pre-echoes to be visualized and measured (numeric values).
The units of the X axis and of the numeric values can be changed from µs to km or even miles, depending on the application.



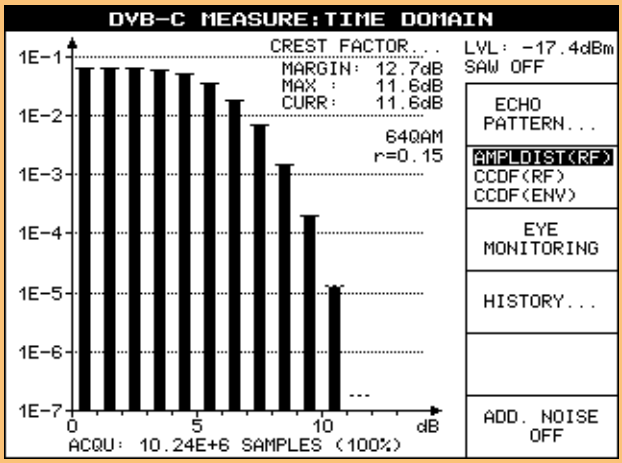


Fig. 10: Amplitude distribution

The measurement function for displaying the amplitude distribution or the CCDF (complementary cumulative distribution function) is used to detect nonlinear distortion.

The frequency distribution of the QAM signal is divided into several 1 dB windows to determine the amplitude distribution. Information on the crest factor is obtained from the frequency distribution and displayed in the upper right-hand corner of the graph.

The reference values are marked by short horizontal lines.

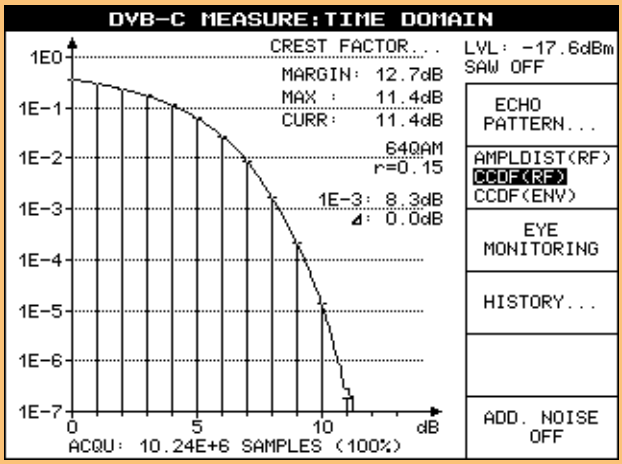


Fig. 11: Complementary cumulative distribution function (CCDF)

In contrast to the amplitude distribution, each trace point indicates how often a certain voltage level is attained or exceeded.

The ideal frequencies are displayed as short horizontal lines at 1 dB intervals (reference values) so that the amplitude distribution of the applied signal can be compared with that of an ideal QAM signal. Any deviation from the ideal distribution is then identified by the deviations of the column heights and the value of the crest factor, for example due to clipping in the modulator output stage.

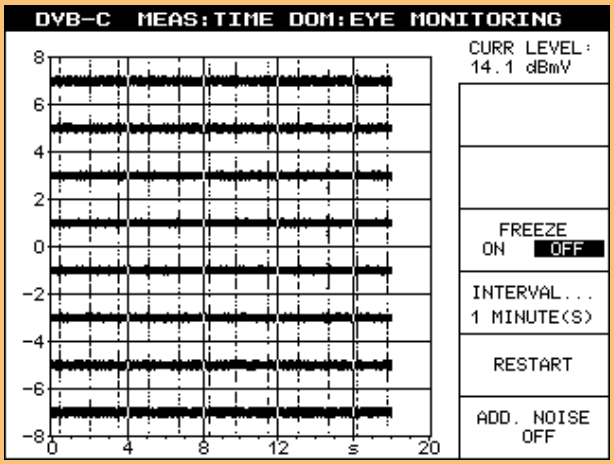


Fig. 12: Eye monitoring

Digitally modulated signals are usually presented in a constellation diagram. This diagram has the disadvantage that it cannot provide sufficient information on the temporal behavior of interference.

The unique eye monitoring shows I and Q components versus time. With eye monitoring, 100 % of the symbols are captured and displayed. Thus, in the case of impulsive interferers or long-term effect, all undesired signals are captured and displayed.

Fig. 13: History function

This measurement is just what is required for long-term monitoring of modulators in cable headends.

The key parameters (level, synchronization information, MER/dB, MER/%, EVM/%, BER before and after Reed-Solomon decoder, synchronization and MPEG-2 transport stream data error) are, therefore, displayed in graphical form. This mode can also display all values numerically (average, max, min, current). BER and level measurements run continuously and are independent of other measurements. The user can configure a monitoring interval from 60 seconds (shown here) to 1000 days.

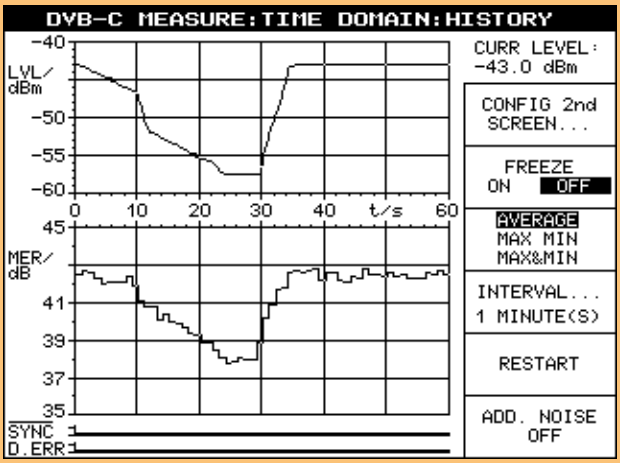


Fig. 14: Monitoring/Alarm register

The R&S® EFA checks the input level (LV), QAM synchronization (SY), modulation error ratio (ME), error vector magnitude (EV), bit error ratio before Reed-Solomon decoder (BR) and MPEG-2 data errors (DE) of the DVB-C signal once per second.

All alarm messages are stored in the alarm register together with the date and time.

Up to 1000 entries can be stored.

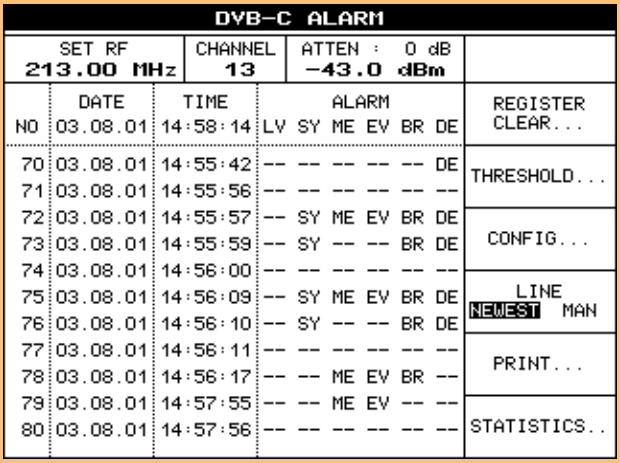
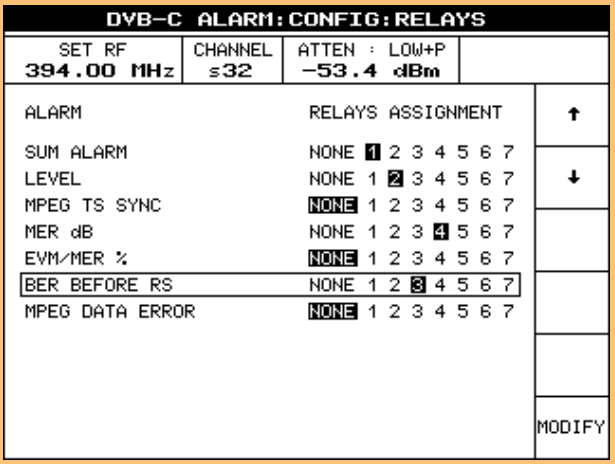


Fig. 15: Configuration of alarm relays

Alarms can be signaled via seven integrated relays. An assignment table is available for configuring the alarm relays.



Typical applications

R&S® EFA for production of modulators
The R&S® EFA's analysis capabilities permit in-depth testing of the cable modulator's performance due to the outstanding MER/EVM dynamic range, amplitude distribution measurement and spectrum analysis. Another feature is the Equalizer ON/FREEZE/OFF function, which is mandatory during the alignment phase of modulators. Finally, the high accuracy and repeatability of the measurements makes the R&S® EFA ideally suited for the production of QAM modulators.

Cable headend monitoring
The capability of the R&S® EFA to handle multichannel reception with the spectrum measurement and the history functions (graphical measurement representation versus time) permits the instrument to monitor cable headends. In addition, an alarm is triggered if one of the selected parameters exceeds the set threshold (all thresholds can be individually configured). Incident level, QAM synchronization, MER (modulation error ratio), EVM (error vector magnitude), BER before Reed-Solomon decoder and MPEG-2 transport stream data error can be checked in realtime independently of other measurements and decoding. If an error occurs, a 1000-line register is available for recording the date, time and description of the event.

R&S® EFA in research and development laboratories
Owing to the high-quality frontend design, the dynamic range of the modulation error ratio measurement (MER dynamic range better than 41 dB) allows the instrument to be used as a reference demodulator in research and development laboratories.

R&S® EFA as a multistandard digital and analog platform
Since the analog standards B/G, D/K and I are still used in cable networks, and cable operators need a future-proof solution for their short- and long-term investment, the digital DVB-C demodulator option can be implemented in the analog units. It covers all application areas from R & D to cable headend measurements. Furthermore, to protect your investment, the instrument can be updated by means of options to demodulate and analyze the ITU-T J.83/B cable standard as well as the digital terrestrial standards ATSC/8VSB and DVB-T. These unique features make the new R&S® EFA family members *THE* measurement devices for the present and the future.

Summary of measurements required for the various DVB-C applications

DVB-C application	Level	BER	I/Q parameters	SNR	Phase jitter	Phase jitter and amplitude jitter spectra	MER/EVM	Eye monitoring	Constellation diagram Histograms	Frequency spectrum	Amplitude (f) – phase (f) – group delay (f)	Amplitude distribution – CCDF	Echo pattern	History	Alarm	Statistics
Production of modulators	✔	✔	✔	✔	✔	✔	!	✔	✔	✔	✔	✔				
Cable headend monitoring	✔	✔					✔	!	✔	✔			✔	!	✔	✔
Research and development	✔	✔	✔	✔	✔	✔	✔	✔	!	✔	✔	✔	✔	✔		
Service	✔	✔	✔				✔	!	!	✔				✔	✔	✔

! most important measurement ✔ required measurement

Analog TV

R&S®EFA models 33/89 — analog TV test receivers

Since the analog terrestrial standards B/G, D/K and I are still commonly in use, and broadcasters need a future-proof solution for their short- and long-term investment, Rohde & Schwarz provides a high-end measurement device that can cover all application areas from R & D to field measurements. This R&S®EFA model was created to offer the best performance and the most useful features to test standard B/G, D/K and I transmitters under optimal conditions.

To further protect your investment, the instrument can be updated by means of options to demodulate and analyze the digital CATV standards DVB-C (option R&S®EFA-K21) and ITU-T J.83/B (option R&S®EFA-K23) as well as the digital terrestrial standards ATSC/8VSB (option R&S®EFA-K22) and DVB-T (option R&S®EFA-B10). These unique features make the R&S®EFA models *THE* measurement devices for the present and the future!

Characteristics of the analog R&S®EFA models 33/89

Fully compatible with analog standards, the analog R&S®EFA models receive and demodulate most analog TV standards (B/G, D/K and I). All key parameters for demodulating the received signal can be automatically or manually selected:

- Switchable group delay correction
- Switchable synchronous detector (5 different modes)
- Demodulation using intercarrier method
- Balanced audio outputs
- Measurement functions for
  - vision/sound carrier spacing (level and frequency)
  - FM sound carrier and pilot deviation
  - Residual picture carrier (RPC) or video modulation depth
- Input of any IF frequency with the aid of the R&S®EFA-B3 option: frequency range continuously tunable from 5 MHz to 1000 MHz

Features

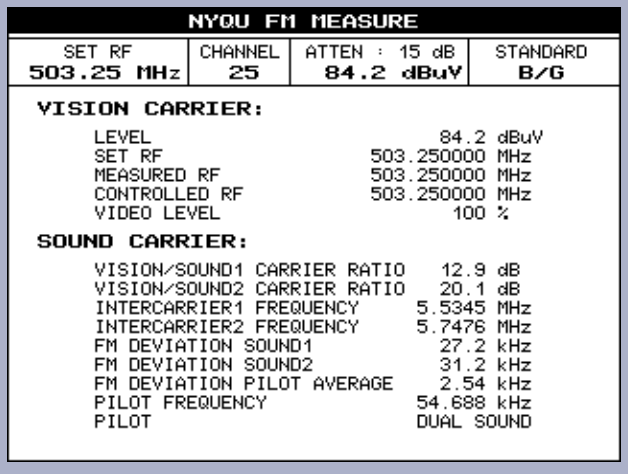
The analog R&S®EFA models provide high-precision demodulated baseband signals (vision and sound) for measurements in various applications (TV transmitters, cable headends, coverage measurements, R & D). At the same time, all relevant RF parameters are monitored at high speed and represented in a logical manner (Fig. 16). User-configurable alarm messages permit unattended monitoring of the received signals as well as switchover to alternative links in the event of a failure.

The high-end demodulator version is used for on-site measurements on TV transmitters. This version offers particularly low-distortion demodulation of the broadcast signal. It is perfectly suited for these types of measurements; its low measurement uncertainty permits optimal alignment as well as permanent quality control of transmitters.

Fig. 16: Measurement window

All parameters for the demodulated standard B/G TV channel are displayed on a single screen and can be checked at a glance:

- Vision carrier level
- Video modulation depth
- Sound intercarrier measurements
- Vision/sound level ratio
- Sound 1 & 2 FM deviation
- Pilot decoding



Specification of intermodulation

In-channel distortion

In-channel distortion is determined by means of a modulated TV signal with a vision carrier (f_{VC}), a color subcarrier (f_{SB}) and a sound carrier (f_{SC}). Modulation is selected such that the vision carrier is lowered by 6 dB, the color subcarrier by 14 dB and the sound carrier by 10 dB relative to the sync pulse level. The level of the intermodulation product is measured at the video output relative to the black-to-white transition of the video signal. Fig. 17 shows the signals involved and the reference level at the RF.

Out-of-channel distortion

The effect of signals outside the received channel is described by the 3rd order intercept point (TOI). For the R&S®EFA family, this parameter is specified on the basis of a three-tone measurement with the following signals: a wanted carrier at the receive frequency f_{VC} and two unwanted carriers 14 MHz and 15 MHz above the receive frequency.

The selected unwanted frequencies are within the bandwidth of the RF selection but outside the bandwidth of the first IF filter. The effect of out-of-channel interference on the receiver can thus reliably be determined. It is assumed that each of the three signals has the same RF input level P. The level of the intermodulation product ΔIM 1 MHz relative to the wanted carrier is measured (see Fig. 18, measurement at the RF). The 3rd order intercept point is as follows:

$$TOI/dBm = P/dBm + \frac{\Delta IM/dB}{2} + 3$$

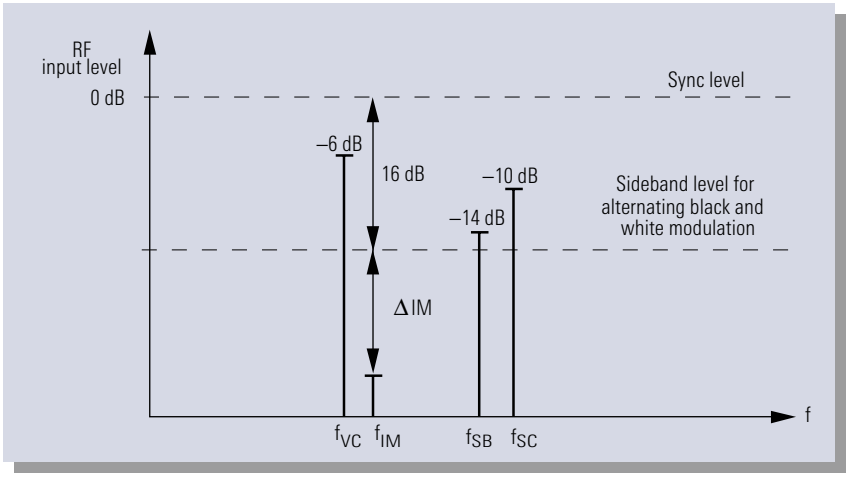


Fig. 17

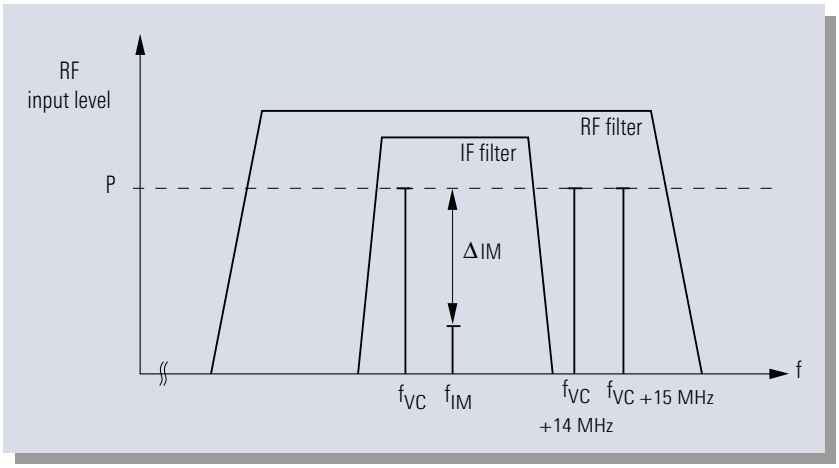


Fig. 18

Specifications

DVB-C characteristics (specific to R&S®EFA models 63 or options R&S®EFA-B20 + R&S®EFA-K21)

	Standard test receiver *discontinued*	High-end test receiver with option R&S®EFA-B3	High-end demodulator	
RF input	selective	selective[1]	non-selective	
Connector	50 Ω or 75 Ω, BNC or N female, front or rear panel	50 Ω, N female, rear panel and 75 Ω, BNC female, rear panel	50 Ω, N female, rear panel	
Return loss	≥14 dB in channel with 50 Ω connector and input attenuation ≥10 dB ≥12 dB in channel with 75 Ω connector and input attenuation ≥10 dB	≥17 dB (typ. >20 dB) in channel with 50 Ω connector ≥14 dB (typ. >17 dB) in channel with 75 Ω connector	≥30 dB	
Frequency range[2]	48 MHz to 862 MHz	4.5 MHz[3] to 1000 MHz	45 MHz to 1000 MHz	
Level range[4]	–55 dBm to +20 dBm (low distorsion, preamplifier off) –59 dBm to +20 dBm (low noise, preamplifier off) –64 dBm to +13 dBm (low noise, preamplifier on)	–63 dBm to +20 dBm[5] (normal) –62 dBm to +20 dBm[5] (low distorsion) –65 dBm to +16 dBm[5] (low noise)	–50 dBm to +20 dBm	
Noise figure	typ. 12 dB (low noise) typ. 7 dB (low noise, preamplifier on)	typ. 7 dB (low noise)[6] typ. 9 dB (normal)[6] typ. 11 dB (low distortion)[6]		
Image frequency rejection	≥70 dB (VHF) and ≥50 dB (UHF)	100 dB		
IF rejection		100 dB		
Local oscillator				
Resolution	1 Hz	1 Hz	1 Hz	
Frequency error	≤2×10^{-6}	≤2×10^{-6}	≤2×10^{-6}	
Phase noise[7]	≥50 dB	≥58 dB	≥62 dB[8]	
SSB phase noise (RF = 860 MHz)	≤–82 dBc/Hz, typ. ≤–86 dBc/Hz at 1 kHz ≤–93 dBc/Hz, typ. ≤–98 dBc/Hz at 20 kHz	≤–93 dBc/Hz, typ. ≤–98 dBc/Hz at 1 kHz ≤–98 dBc/Hz, typ. ≤–102 dBc/Hz at 20 kHz	≤–100 dBc/Hz, typ. ≤–104 dBc/Hz at 1 kHz ≤–105 dBc/Hz, typ. ≤–110 dBc/Hz at 20 kHz	
System performance			equalizer on	equalizer off
MER	≥40 dB[9]	≥41 dB[10]	≥42 dB[11]	typ. ≥40 dB
EVM	≤0.66 %[9]	≤0.59 %[10]	≤0.52 %[11]	≤ ≤0.65 %
SNR	≥42 dB[9]	≥43 dB[10]	≥44 dB[11]	typ. ≥40 dB

1) The selective RF inputs of the high-end TV test receiver (with option R&S®EFA-B3) are additional to the non-selective RF input of the high-end demodulator. For specifications involving the non-selective RF input, see the high-end demodulator column.
2) Center frequency.
3) For frequencies <10 MHz: group delay tilt increases up to 200 ns, amplitude tilt increases up to typ. 0.7 dB pp, minimum input level: –30 dBm, SAW filter ON.
4) For quasi error-free MPEG-2 transport stream, 256 QAM.
5) At low input frequencies such as 4.57 MHz: additional tilt (typ. 0.7 dB pp), minimum input level: –30 dBm, SAW filter ON.
6) RF >47.15 MHz.
7) FM S/N ratio measured at IF output, referenced to ±30 kHz frequency deviation and 500 Hz modulation frequency, deemphasis 50 µs, measured to DIN45405, weighted to ITU-R468-3.
8) In frequency range 45 MHz to 900 MHz.
9) Signal power > –40 dBm.
10) Signal power > –43 dBm.
11) Signal power > –30 dBm.

DVB-C characteristics (continued)

IF input Return loss Center frequency Level range	50 Ω, BNC female, rear panel ≥20 dB in channel 36 MHz –30 dBm to –5 dBm		
IF output Return loss Center frequency Level, regulated **10 MHz reference input** Level range **10 MHz reference output** Level	50 Ω, BNC female, rear panel ≥20 dB in channel 36 MHz –17 dBm 50 Ω, BNC female, rear panel –20 dBm to +16 dBm 50 Ω, BNC female, rear panel typ. +11 dBm		
MPEG-2 TS parallel output	LVDS (188 bytes/204 bytes)		
MPEG-2 TS ASI output Symbol rate Bandwidth (SAW filter) Channel correction Modulation mode	serial MPEG-2 transport stream (ASI); 75 Ω 1 Msymbol/s to 6.999 Msymbol/s 2 MHz, 7 MHz, 6 MHz, 8 MHz or SAW filter OFF self-adapting equalizer, equalizer freeze, equalizer off 4/16/32/64/128/256 QAM		
Measurements	signal power carrier frequency offset symbol rate offset MPEG-2 TS bit rate BER (bit error ratio) before and after Reed-Solomon decoder packet error ratio (J.83/A,C)	packet errors /s (J.83/A,C) segment error ratio (J.83/B) segment errors /s (J.83/B) EVM (error vector magnitude) MER (modulation error ratio) SNR (signal/noise ratio)	phase jitter I/Q amplitude imbalance I/Q quadrature error carrier suppression crest factor shoulder attenuation in accordance with ETSI TR 101290
Graphic displays	constellation diagram histogram I/Q frequency spectrum amplitude frequency response phase frequency response	phase jitter spectrum amplitude jitter spectrum group delay frequency response polar plot echo pattern	amplitude distribution (RF) CCDF (RF) CCDF (ENV) eye monitoring history
Alarm messages	signal power, MPEG-2 synchronization, EVM, MER, BER before Reed-Solomon decoder, MPEG-2 data error		
Storage	alarm message with date and time, up to 1000 messages		
Memory for instrument setup storage	0 to 4		

Test parameters	**Range**	**Resolution**	**Error**
Signal power	corresponding to level range	0.1 dB	<3 dB, typ. <1 dB
MER dB (modulation error ratio in dB)	18 dB to 30 dB 30 dB to 35 dB	0.1 dB 0.1 dB	≤0.8 dB ≤1.0 dB
MER % (modulation error ratio in %)	1.9 % to 3.2 % 3.2 % to 12.5 %	0.01 % 0.01 %	≤12 % of actual value ≤10 % of actual value
EVM (error vector magnitude)	1.17 % to 2.07 % 2.07 % to 8.3 %	0.01 % 0.01 %	≤12 % of actual value ≤10 % of actual value
SNR (signal/noise ratio)	18 dB to 30 dB 30 dB to 35 dB	0.1 dB 0.1 dB	≤0.5 dB ≤0.8 dB
I/Q amplitude imbalance	0.00 % to 5.00 %	0.01%	≤0.03 dB
I/Q quadrature error	0.00 ° to 5.00 °	0.01°	≤0.03 °
Carrier suppression	25 dB to 45 dB 45 dB to 60 dB	0.1 dB 0.1 dB	≤1 dB ≤3 dB
Carrier frequency offset 10 MHz reference, internal 10 MHz reference, external	 ±100 kHz[1)] ±100 kHz[1)]	 0.1 Hz 0.1 Hz	 ≤280 Hz + 2 ppm × RF ≤1 Hz
Symbol rate offset 10 MHz reference, internal 10 MHz reference, external	 ±1000 Hz ±1000 Hz	 0.1 Hz 0.1 Hz	 <7 Hz ≤0.5 Hz
MPEG-2 TS bit rate	up to 51.600 Mbit/s	1 kbit/s	<1 kbit/s
BER before Reed-Solomon	1.0×10^{-3} to 0.1×10^{-15}	$0.1 \times 10^{-\text{exponent}}$	–
BER after Reed-Solomon	1.0×10^{-5} to 0.1×10^{-14}	$0.1 \times 10^{-\text{exponent}}$	–

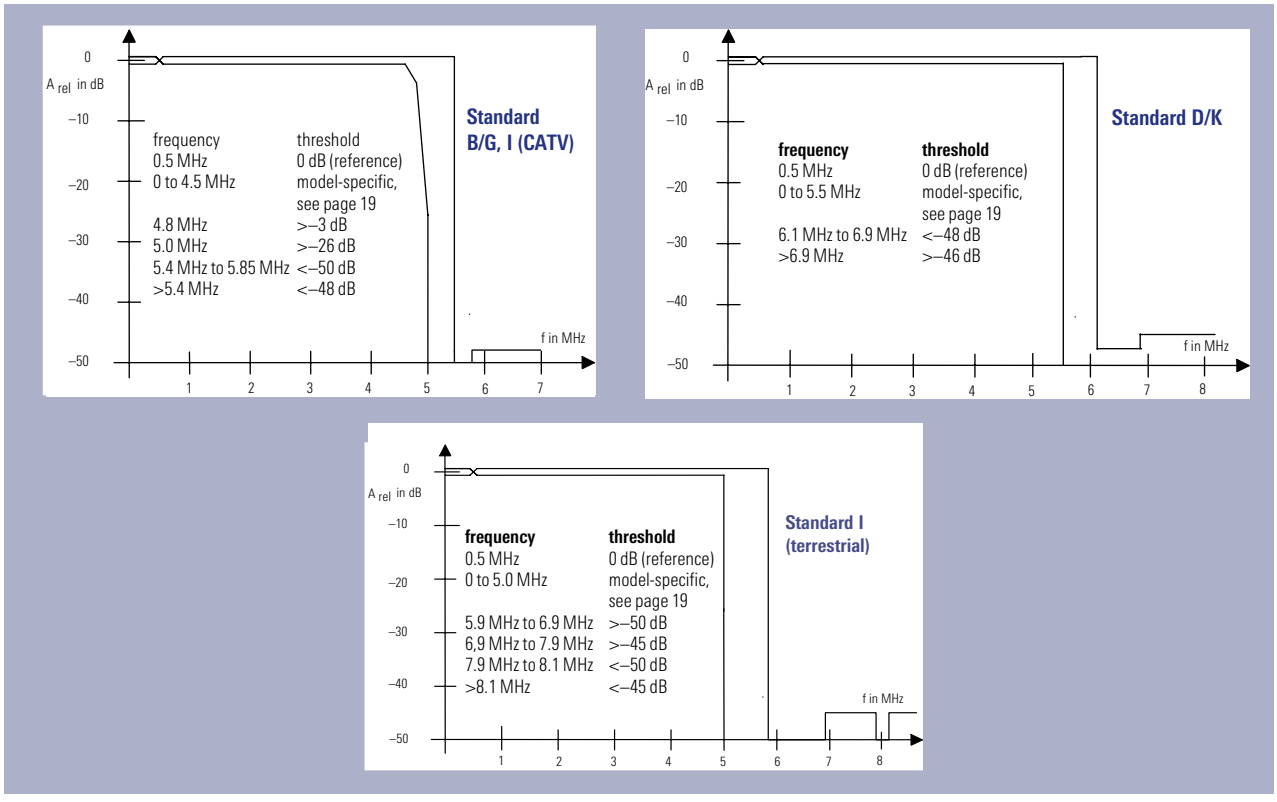
[1)] For symbol rate ≥ 5 Msymbol/s.

Specifications

Analog TV, model-specific characteristics

	Standard test receivers *discontinued* models 12/78	High-end test receivers models 33/89	High-end demodulators models 33/89
RF input	selective	selective	non-selective
Connector	50 Ω or 75 Ω, BNC or N female, front or rear panel	50 Ω, N female, rear panel and 75 Ω, BNC female, rear panel	50 Ω, N female, rear panel
Return loss	≥14 dB in channel with 50 Ω connector and input attenuation ≥10 dB ≥12 dB in channel with 75 Ω connector and input attenuation ≥10 dB	≥17 dB (typ. >20 dB) in channel with 50 Ω connector ≥14 dB (typ. >17 dB) in channel with 75 Ω connector	≥30 dB
Frequency range (vision carrier)	48 MHz to 860 MHz	5 MHz [1] to 1000 MHz	45 MHz to 1000 MHz
Level range[2]	–67 dBm to +13 dBm (normal) –77 dBm to –47 dBm (with preamplifier)	–67 dBm to +21 dBm [3] (normal) –67 dBm to +21 dBm [3] (low distortion) –77 dBm to +21 dBm [3] (low noise)	–41 dBm to +21 dBm
Image frequency rejection	VHF: ≥70 dB[4] UHF: ≥50 dB[4]	100 dB[5]	
IF rejection		100 dB[5]	
Local oscillator			
Resolution	1 Hz	1 Hz	1 Hz
Frequency error	$\leq 2 \times 10^{-6}$	$\leq 2 \times 10^{-6}$	$\leq 2 \times 10^{-6}$
Phase noise[6]	≥50 dB	≥58 dB	≥62 dB[7]

1) For frequencies <10 MHz: group delay tilt increases up to 200 ns, amplitude tilt increases up to typ. 0.7 dB pp, minimum input level: –30 dBm, SAW filter ON; upper sideband.
2) Levels are rms values referenced to sync pulse.
3) In receive frequency range 5MHz to 15 MHz: –41 dBm to 21 dBm.
4) Image frequency of vision carrier.
5) Applies to both frequency conversions.
6) FM S/N ratio measured at IF output, referencSed to ±30 kHz frequency deviation and 500 Hz modulation frequency, deemphasis 50 µs, measured to DIN45405, weighted to ITU-R468-3.
7) In receive frequency range 45 MHz to 900 MHz.



Tolerance masks of the R&S® EFA for total amplitude characteristic (RF, IF, VF)

Analog TV, model-specific characteristics (continued)

Video demodulation characteristics	Standard test receivers *discontinued* Models 12/78	**High-end test receivers** Models 33/89	**High-end demodulators** Models 33/89
Noise voltage, ref. to b/w transition	$P_{RF} \geq -30$ dBm, 0 dB input attenuation	$P_{RF} = -33$ dBm, 0 dB input attenuation	$P_{RF} \geq -1$ dBm
S/N_{rms} unweighted			≥60 dB, typ. 63 dB
S/N_{rms} weighted to ITU-R Rec. 567	≥60 dB, typ. 64 dB (low noise)	≥64 dB, typ. 66 dB (low noise) ≥63 dB, typ. 65 dB (normal)	≥67 dB, typ. 70 dB
	≥57 dB, typ. 59 dB (low distortion)	≥62 dB, ,typ. 64 dB (low distortion)	
$Signal/hum_{peak}$	≥52 dB	≥52 dB	≥52 dB
Linear distortion			
Amplitude frequency response	reference: 0.5 MHz	reference: 0.5 MHz	reference: 0.5 MHz
DC to color subcarrier	≤0.5 dB	≤0.35 dB	≤0.25 dB
Additional ripple through SAW filter	≤0.1 dB	≤0.1 dB	≤0.1 dB
Group delay response	reference: 0.1 MHz	reference: 0.1 MHz	reference: 0.1 MHz
With constant group delay	≤20 ns	≤15 ns	≤12 ns
With group delay dep. on TV std.	see group-delay table	see group-delay table	see group-delay table
Additional ripple through SAW filter	≤10 ns	≤10 ns	≤10 ns

Frequency/MHz	B/G							D/K					I	K1
	General	Sweden	Norway	Denmark	Australia	General/2 (reduced to 50 %)	New Zealand	ITU-R Report 308	OIRT TK-III-830	OIRT GOST 20532-75	GOST 20532-83	CSFR	SABC TVT 12.2	
	Group delay/ns													
0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.25	–5 ±Δ	0 ±Δ	0 ±Δ	–5 ±Δ		–2.5 ±Δ		–5 ±Δ		–5 ±Δ			0 ±Δ	0 ±Δ
0.50		0 ±Δ	0 ±Δ							–10 ±Δ	–8 ±Δ		0 ±Δ	0 ±Δ
1.00	–53 ±Δ	0 ±Δ	0 ±Δ	–53 ±Δ	–30 ±Δ	–26.5 ±Δ		–53 ±Δ	–40 ±Δ	–40 ±Δ	–40 ±Δ	–40 ±Δ	0 ±Δ	0 ±Δ
1.50		0 ±Δ	0 ±Δ							–70 ±Δ			0 ±Δ	0 ±Δ
2.00	–90 ±Δ	0 ±Δ	0 ±Δ	–75 ±Δ	–60 ±Δ	–45 ±Δ		–87 ±Δ	–75 ±Δ	–80 ±Δ	–85 ±Δ	–85 ±Δ	0 ±Δ	0 ±Δ
2.25		0 ±Δ	0 ±Δ				–60 ±Δ						0 ±Δ	0 ±Δ
3.00	–75 ±Δ	0 ±Δ	0 ±Δ	–75 ±Δ	–40 ±Δ	–37.5 ±Δ	–60 ±Δ	–85 ±Δ	–90 ±Δ	–80 ±Δ	–92 ±Δ	–90 ±Δ	0 ±Δ	0 ±Δ
3.50		0 ±Δ			0 ±Δ								0 ±Δ	0 ±Δ
3.58		0 ±Δ											0 ±Δ	0 ±Δ
3.60		0 ±Δ	20 ±Δ										0 ±Δ	0 ±Δ
3.75	0 ±Δ					0 ±Δ	0 ±Δ						0 ±Δ	0 ±Δ
3.80				0 ±Δ									0 ±Δ	0 ±Δ
4.00			50 ±20					–50 ±20	–70 ±20	–40 ±20	–60 ±20	–60 ±20	0 ±Δ	0 ±Δ
4.43	170 ±20	175 ±20	170 ±20	170 ±20	170 ±20	85 ±20	170 ±20	0 ±20		0 ±20	–25 ±20	–25 ±20	40 ±20	15 ±20
4.70											0 ±20	0 ±20		
4.80	400 ±40	400 ±40	350 ±40	400 ±40	260 ±40	200 ±40	400 ±40						100 ±40	
5.00								90 ±20	0 ±20	80 ±20		70 ±20		90 ±20
5.50									90 ±20		260 ±40			

Group delay depending on TV standard

High-end demodulator: $\Delta = 12$ ns
High-end test receiver: $\Delta = 15$ ns
Standard test receiver: $\Delta = 20$ ns

Specifications

Analog TV, model-specific characteristics (continued)

Video demodulation characteristics (continued)	Standard test receivers *discontinued* models 12/78	**High-end test receivers** models 33/89	**High-end demodulators** models 33/89
Transient response			
2T pulse k factor	≤1 %	≤1 %, typ. 0.6 %	≤1 %, typ. 0.6 %
2T pulse amplitude error			≤2 %, typ. 1 %
20T pulse amplitude error			≤3 % (TV standards B/G, D/K, I)
12.5T pulse amplitude error			≤5 % (TV standard M/N)
Chrominance/luminance gain			≤3 %
Chrominance/luminance delay	≤20 ns (with constant group delay)	≤15 ns (with constant group delay)	≤12 ns (with constant group delay)
	≤20 ns (with group delay dep. on TV std.)	≤20 ns (with group delay dep. on TV std.)	≤20 ns (with group delay dep. on TV std.)
Tilt, 10/75 % modulation	≤1 % (15 kHz squarew. signal, T_{rise} 200 ns)	≤1 % (15 kHz squarew. signal, T_{rise} 200 ns)	≤1 % (0.25 Hz squarew. signal, T_{rise} 2 µs) ≤1 % (50 Hz squarew. signal, T_{rise} 2 µs) ≤1 % (15 kHz squarew. signal, T_{rise} 200 ns)
Nonlinear distortion			
Luminance nonlinearity	≤2 %, typ. 0.3 %	≤2 %, typ. 0.3 %	≤2 %, typ. 0.4 %
Differential gain	≤2 %, typ. 0.3 %	≤2 %, typ. 0.3 %	≤2 %, typ. 0.4 %
Differential phase	≤1 °, typ. 0.4 °	≤1 °, typ. 0.4 °	≤1 °, typ. 0.5 °
Intermodulation in channel, referenced to b/w transition	≥52 dB, typ. 56 dB (low noise) ≥62 dB, typ. 66 dB (low distortion)	≥57 dB, typ. 61 dB (normal) ≥52 dB, typ. 56 dB (low noise) ≥62 dB, typ. 66 dB (low distortion)	≥55 dB
3rd order intercept point; 0 dB attenuation (see also page 15)	≥0 dBm (low noise) ≥5 dBm (low distortion)	≥10 dBm (normal) ≥14 dBm (low distortion)	

Characteristics common to all analog models

IF input		50 Ω, BNC female, rear panel
Vision carrier frequency		
TV standards B/G, I, D/K		38.9 MHz
Return loss in channel		≥30 dB
Level range[1]		–13 dBm to 4 dBm
Crosstalk attenuation, RF/IF input		≥75 dB
IF output		50 Ω, BNC female, rear panel
Return loss in channel		≥20 dB
Vision carrier level[1], regulated		–7 dBm
Input for external zero reference		75 Ω, BNC female, rear panel
Control voltage		>1 V
Delay of carrier blanking relative to control pulse		<3 µs
Video selectivity		
In-channel sound carrier suppression		
TV standard	B/G, I	≥50 dB
	D/K	≥48 dB
Adjacent-channel vision carrier suppression		
TV standard	B/G, I (CATV)	≥50 dB
	I (terrestrial)	≥48 dB
	D/K	≥46 dB

[1] Levels are rms values referenced to sync pulse.

Characteristics common to all analog models (continued)

Video outputs	75 Ω, BNC female, front panel and 75 Ω, BNC female, real panel
Return loss (0 to 6 MHz)	≥26 dB
Decoupling of outputs Level variation at terminated output with other output short-circuited or open	≤1 %
Video level, adjustable	1 V pp ±3 dB
Level inaccuracy	≤2 %
Resolution of level control	10 mV
DC offset with carrier clamped to zero level	0 V ±20 mV
Quadrature signal output of sync demodulator	75 Ω, BNC female, on rear panel
Return loss (0 to 6 MHz)	≥20 dB
Gain difference, referenced to nominal video output level	≤0.5 dB
Synchronous demodulation	
Phase error of switching carrier	≤1 °
Vision carrier phase control	continuous, sampled (switchable)
Time constant of PLL for keyed phase control	normal, slow (switchable)
Time constant of PLL for continuous phase control	fast, normal, slow (switchable)
Sound demodulation	intercarrier method
Audio outputs	Lemo Triax female, in pairs rear panel: balanced, Z <35 Ω front panel: unbalanced, Z <10 Ω
Output signal	M1/L and M2/R
Permissible load	≥300 Ω // ≤5000 pF
Audio level, adjustable	
Reference frequency deviation	±30 kHz or ±50 kHz, selectable
Setting range for ±30 kHz reference frequency deviation	–3 dBm to +10 dBm
Setting range for ±50 kHz reference frequency deviation	+2 dBm to +10 dBm
Resolution of level control	0.1 dB
Level accuracy, f_{mod} 500 Hz	≤0.2 dB
Amplitude frequency response, 40 Hz to 15 kHz, referenced to 500 Hz	≤ ±0.3 dB
Deemphasis	50 µs, can be switched off
Distortion at ±50 kHz frequency deviation, deemphasis on	≤0.5 %
S/N ratio (intercarrier method)	
Referenced to ±30 kHz frequency deviation and 500 Hz modulation frequency, measured to DIN45405, weighted to ITU-R468-3; the channel not being measured is without signal	
Vision modulation: all-black picture	≥55 dB
Vision modulation: test pattern	≥48 dB
Vision modulation: sinewave, 10 % to 75 % modulation	≥46 dB
Vision modulation: sinewave, 242 kHz ±15 kHz, 10 % to 75% modulation	≥42 dB
Stereo crosstalk, 40 Hz to 15 kHz Referenced to ±30 kHz frequency deviation and 500 Hz modulation frequency, deemphasis on	≥40 dB
Channel crosstalk, 40 Hz to 15 kHz Referenced to ±30 kHz frequency deviation, deemphasis on, measured with ±30 kHz spurious FM	≥74 dB
Alarm message Vision carrier level, RF offset, TV synchronization, vision/FM sound carrier level ratios, vision/FM sound carrier frequency spacings, FM pilot deviation, max. FM deviations, min. FM deviations	

Test parameters, analog TV

	Measurement range	Resolution	Error
Vision carrier power or voltage in µV/mV, dBµV, dBmV, dBm, dBµW, dBpW			
Standard test receivers	–77 dBm to 13 dBm	0.1 dB	≤3 dB
High-end test receivers	–77 dBm to 21 dBm	0.1 dB	≤3 dB
High-end demodulators	–41 dBm to 21 dBm	0.1 dB	≤2 dB
Video level (CVS0)	50 % to 150 %	1 %	≤2 %

Specifications

Test parameters, analog TV (continued)

	Measurement range	Resolution	Error
Vision carrier frequency	frequency range depending on R&S®EFA model	20 Hz	≤2 ×10^{-6}
Vision/FM sound carrier 1 level ratio	–23 dB to –7 dB	0.1 dB	≤2 dB
Vision/FM sound carrier 2 level ratio	–30 dB to –14 dB	0.1 dB	≤2 dB
Vision/FM sound carrier 1 frequency spacing	nominal IC frequency ±50 kHz	100 Hz	≤200 Hz [1]
Vision/FM sound carrier 2 frequency spacing	nominal IC frequency ±50 kHz	100 Hz	≤200 Hz [1]
FM sound carrier deviation	0 kHz to 80 kHz	100 Hz	≤3 % ±200 Hz [2]
FM pilot carrier deviation (average)	1 kHz to 5 kHz	10 Hz	≤5 %
FM pilot carrier deviation (peak value)	1 kHz to 10 kHz	10 Hz	≤5 %
Pilot frequency	pilot frequency ±300 Hz	2 Hz	≤2 Hz
Residual AM	0 % to 30 %	0.1 %	0.5 %
Modulation depth of vision carrier	70 % to 100 %	0.1 %	0.5 %

[1] With unmodulated sound carrier.
[2] Without vision modulation.

Options

NICAM Demodulator R&S®EFA-B2

Standard		NICAM-728
NICAM IF carrier frequency	standard B/G	33.05 MHz
	standard I	32.348 MHz
Vision/NICAM carrier level ratio		15 dB to 31 dB
FM sound carrier suppression		≥40 dB
Frequency response deviation from standard curve up to 182 kHz		≤1 dB
Group delay up to 120 kHz		≤150 ns
Group delay up to 182 kHz		≤200 ns
NICAM intercarrier input		50 Ω, BNC female, rear panel
NICAM carrier frequency	standard B/G	5.85 MHz
	standard I	6.552 MHz
Return loss		≥20 dB
Level range		–22 dBm to –5 dBm
NICAM-728 data input		75 Ω, TTL, BNC female, rear panel
NICAM-728 clock input		75 Ω, TTL, BNC female, rear panel
QPSK I output		BNC female, rear panel
Output impedance		100 Ω
Permissible load		≥1 kΩ //≤1 nF
Level		0.8 V pp
QPSK Q output		BNC female, rear panel
Output impedance		100 Ω
Permissible load		≥1 kΩ // ≤1 nF
Level		0.8 V pp
Clock/2 output		75 Ω, TTL, BNC female, rear panel
NICAM-728 data output		75 Ω, TTL, BNC female, rear panel
NICAM-728 clock output		75 Ω, TTL, BNC female, rear panel
Audio output, balanced		Lemo Triax female, pair of connectors, rear panel
Output impedance		<35 Ω
Permissible load		≥300 Ω // ≤5 nF
Level at 600 Ω, f_{mod} = 400 Hz		0 dBm ±0.2 dB

Audio output, unbalanced		Lemo Triax female, pair of connectors, front panel
Output impedance		<35 Ω
Permissible load		≥300 Ω // ≤5 nF
Level at 600 Ω, f_{mod} = 400 Hz		0 dBm
NICAM additional information		25-contact D-SUB, TTL, rear panel
Permissible load		≥1 kΩ // ≤100 pF
– Control bits		C0 to C4
– Additional data		A0 to A10
– Frame sync		
– Additional data sync		
– Bit errors		parity bit evaluation
Audio demodulation characteristics		
Frequency response:	30 Hz to 14.7 kHz	≤0.2 dB
	14.7 kHz to 15 kHz	≤0.3 dB
Phase difference between channels (stereo)		≤3 °
Distortion		≤0.15%
Crosstalk		≤–80 dB
S/N ratio (empty channel, referenced to full-scale level)		
Unweighted		≥80 dB
Weighted (ITU-R468-3)		≥80 dB
Aliasing products:	30 Hz to 14.7 kHz	≤–55 dB
	14.7 kHz to 15 kHz	≤–35 dB
Other spurious lines (referred to full-scale level)		≤–50 dB
Additional alarm messages		
Vision/NICAM sound carrier power ratio, NICAM intercarrier level, eye height, BER, data jitter; loss of: NICAM data/NICAM clock, frame sync, headroom		

Additional test parameters

	Measurement range	Resolution	Error
Vision/NICAM carrier level ratio	13 dB to 34 dB	0.1 dB	≤1.5 dB
Level (intercarrier input)	–24 dBm to –3 dBm	0.1 dB	≤1.5 dB
Eye height	10 % to 100 %	1 %	≤2 × (100 / displayed value) % [1]
BER	0×10^{-9} to $<1 \times 10^{-5}$	$0.2 \times 10^{-exponent}$	–
	1×10^{-5} to 1×10^{-2}	$0.1 \times 10^{-exponent}$	–
Clock or data jitter	0 Hz to 50 Hz	1 Hz	≤20 % ±2 Hz [2]

[1] Reference: 100 %; vision modulation: all-black picture.

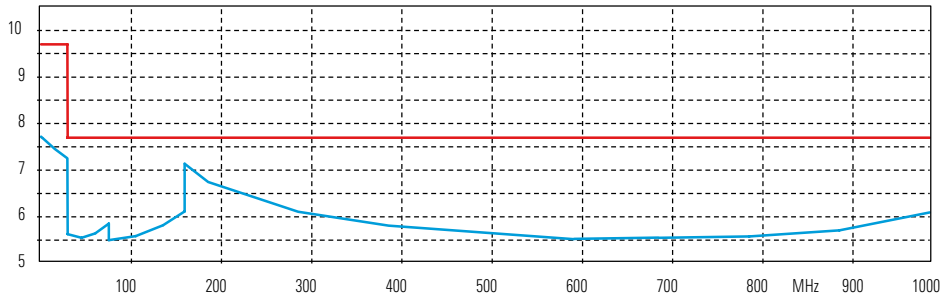
[2] Valid for jitter frequency 50 Hz to 60 Hz; 3 dB bandwidth: 10 Hz to 120 Hz.

RF Selection R&S®EFA-B3

RF selection for the High-End Demodulator Models R&S®EFA 63/33/89. Two selective RF inputs with 50 Ω and 75 Ω impedance are available on the rear panel in addition to the non-selective RF input of the high-end demodulator. Demodulation of variable IFs up to 50 MHz via the selective RF inputs.

IF inputs	selective
Connectors	50 Ω, N female, rear panel and 75 Ω, BNC female, rear panel
Return loss	17 dB (typ. >20 dB) in channel with 50 Ω connector 14 dB (typ. >17 dB) in channel with 75 Ω connector
Frequency range	4.5 MHz to 1000 MHz
Level range	see high-end test receiver column of relevant demodulator mode
System performance	
Noise figure	typ. 7 dB (low noise) typ. 9 dB (normal) typ. 11 dB (low distortion)
Image frequency rejection	100 dB
IF rejection	100 dB

[1] For frequencies <10 MHz: group delay tilt increases up to 200 ns, amplitude tilt increases up to typ. 0.7 dB pp, minimum input level: –30 dBm, SAW filter ON.



Noise figure (low noise mode)

MPEG-2 Decoder R&S®EFA-B4

Simultaneous monitoring of all signals in transport stream. Realtime measurement functions in accordance with test specifications for DVB systems (ETSI TR 101290): priorities 1, 2 and 3.

System performance	
Transport stream	in accordance with to ISO/IEC 1-13818
Data rate of transport stream	up to 54 Mbit/s
Length of data packets	188/204 bytes, automatic switchover
External TS ASI input	BNC female, rear panel, 75 Ω
Asynchronous serial MPEG-2 transport stream	270 Mbit/s
Level	200 mV pp to 1 V pp
Video signal output (CCVS)	BNC female, rear panel, 75 Ω
Level	1 V pp ±1 %
DC offset (black level)	0 V
Video serial digital output (ITU-R601)	BNC female, rear panel, 75 Ω
Audio signal output	Lemo Triax connectors, in pairs; front panel: unbalanced, Z <10 Ω rear panel: balanced, floating, Z <25 Ω
Signals	left/right, sound 1/sound 2, mono
Level of balanced output at rear panel (full scale)	+6 dBm ±0.2 dB into 600 Ω
Frequency response (40 Hz to 15 kHz)	≤0.5 dB, referenced to 1 kHz
S/N ratio	>70 dB, unweighted
THD	>70 dB

Video Distributor R&S®EFA-B6

The video distributor option provides four decoupled video outputs (CCVS) for analog and digital TV. Option R&S®EFA-B4 is required for digital TV.

Video output	2 × BNC female front panel; 2 × BNC female rear panel
Impedance	75 Ω
Return loss (0 MHz to 6 MHz)	≥26 dB
Level accuracy	≤2 %
DC offset of video signal (MPEG-2 decoder mode, black level)	0 V
DC offset of video signal (analog TV mode, zero vision carrier)	0 V
Decoupling of outputs (level variation at terminated output when switching the other outputs between short circuit and open circuit)	≤1 %
Quadrature signal outputs (quadrature signal of sync demodulator in Nyquist demodulator mode)	BNC female, front and rear panel
Impedance	75 Ω
Return loss (0 MHz to 6 MHz)	≥20 dB
Decoupling of outputs (level variation at terminated output when switching the other outputs between short circuit and open circuit)	≤1 %

Switchable Sound Trap R&S®EFA-B7 (for video bandwidth switchover to 6 MHz for TV standard B/G)

	Standard test receivers *discontinued*	High-end test receivers	High-end demodulators
Amplitude frequency response	reference: 0.5 MHz	reference: 0.5 MHz	reference: 0.5 MHz
0 Hz to 5 MHz	≤0.5 dB	≤0.35 dB	≤0.25 dB
5 MHz to 5.5 MHz	≤0.7 dB	≤ 0.5 dB	≤ 0.45 dB
Additional ripple through SAW filter	≤0.1 dB	≤0.1 dB	≤0.1 dB
Group delay response	reference: 0.1 MHz	reference: 0.1 MHz	reference: 0.1 MHz
With constant group delay			
0 Hz to 5.5 MHz	≤20 ns	≤15 ns	≤12 ns
With group delay depending on TV standard	see table on page 19	see table on page 19	see table on page 19
Additional ripple through SAW filter	≤15 ns	≤15 ns	≤15 ns

OFDM Demodulator R&S®EFA-B10

Option.

6 MHz SAW Filter R&S®EFA-B11

This filter is recommended for rejection of adjacent channels in systems with 6 MHz channel spacing.

Ripple in band	0.4 dB pp
Rejection of adjacent channels	50 dB (>±3.8 MHz) 85 dB (>±6 MHz) with High Adj. Chan Power ON

7 MHz SAW Filter R&S®EFA-B12

This filter is recommended for rejection of adjacent channels in systems with 7 MHz channel spacing.

Ripple in band	0.7 dB pp
Rejection of adjacent channels	>55 dB (>±4.0 MHz) >90 dB (>±5.3 MHz) with High Adj. Chan Power ON

8 MHz SAW Filter R&S®EFA-B13 (model 02 for R&S®EFA-B10)

Ripple in band	0.8 dB pp
Rejection of adjacent channels	>55 dB (>±4.4 MHz) >90 dB (>5.3 MHz) with High Adj. Chan Power ON

8 MHz SAW Filter R&S®EFA-B13 (model 03 for R&S®EFA-B20)

This filter is recommended for shoulder attenuation measurement in accordance with FCC recommendation and for rejection of adjacent channels in systems with 8 MHz channel spacing.

Ripple in band	0.4 dB pp
Rejection of adjacent channels	50 dB (>±4.8 MHz) 90 dB (>±5.3 MHz) with High Adj. Chan Power ON

2 MHz SAW Filter R&S®EFA-B14

This filter is recommended for rejection of adjacent channels in systems with 2 MHz channel spacing.

Ripple in band	0.7 dB pp
Rejection of adjacent channels	45 dB (>±1.3 MHz)

Digital Demodulator Platform R&S®EFA-B20

Supports ATSC/8VSB demodulation (for specifications see ATSC/8VSB characteristics of the R&S®EFA models 50/53), ITU-T J.83/B demodulation (for specifications see ITU-T J.83/B characteristics of the R&S®EFA models 73) and DVB-C (ITU-T J.83/A,C) demodulation.

M/N NTSC/BTSC Demodulator R&S®EFA-B30

(Cannot be combined with standard B/G, D/K or I.)

General data

Display	monochrome LCD (320 × 240), backlit
Interfaces	IEC625-2/IEEE488 bus, RS-232-C, printer (Centronics)
Temperature range	to IEC68-2-1/-2
Climatic resistance	95 % rel. humidity, cyclic test at +25 °C/+40 °C, meets EN 60068-2-30
Operating temperature range	+5 °C to +45 °C
Permissible temperature range	0 °C to +50 °C
Power supply	100 V to 120 V/220 V to 240 V; +10 %/–15 % (autoranging), 50 Hz to 60 Hz
Power consumption	R&S®EFA models 12/60/78: 70 VA R&S®EFA models 33/63/89: 75 VA R&S®EFA models 33/63/89 + R&S®EFA-B3: 90 VA
Dimensions (W × H × D)	435 mm × 147 mm × 460 mm
Weight	approx. 12 kg, depending on options

Ordering information

DVB-C Test Demodulator, broadband[*)] 4/16/32/64/128/256 QAM, MPEG-2 data stream output, constellation diagram	R&S®EFA 63	2067.3004.63
TV Demodulator, Std. B/G, dual sound[*)] IF 38.9 MHz, RF 45 MHz to 1000 MHz, IEEE bus	R&S®EFA 33	2067.3004.33
TV Demodulator, Std. D/K or I (mono)[*)] IF 38.9 MHz, RF 45 MHz to 1000 MHz	R&S®EFA 89	2067.3004.89

Ordering information for instruments described in data sheet PD 5213.6835.32

DVB-T Test Demodulator[*)] Broadband, constellation diagram, MPEG-2 data stream output	R&S®EFA 43	2067.3004.43

Ordering information for instruments described in data sheet PD 5214.4836.32

ATSC/8VSB Test Demodulator[*)] Broadband, constellation diagram, MPEG-2 data stream output	R&S®EFA 53	2067.3004.53
ITU-T J.83/B Test Demodulator[*)] Broadband, constellation diagram, MPEG-2 data stream output	R&S®EFA 73	2067.3004.73
TV Demodulator, Std. M/N/NTSC/BTSC[*)] RF 45 MHz to 1000 MHz	R&S®EFA 93	2067.3004.93

[*)] Please fill in configuration sheet (available from your local representative or from the Rohde & Schwarz web site, search term EFA) so that your test receiver/demodulator can be tailored to your requirements.

Options

NICAM Demodulator for TV standard B/G, D/K	R&S®EFA-B2	2067.3610.02
NICAM Demodulator for TV standard I	R&S®EFA-B2	2067.3610.04
RF Selection for demodulators (models 33/43/53/63/73/89/93)	R&S®EFA-B3	2067.3627.02
MPEG-2 Decoder	R&S®EFA-B4	2067.3633.02
Video Distributor (four video outputs, only models 33/89/93)	R&S®EFA-B6	2067.3656.02
Switchable Sound Trap (for models 33)	R&S®EFA-B7	2067.3710.02
OFDM Demodulator	R&S®EFA-B10	2067.3740.02
6 MHz SAW Filter (for digital R&S®EFA models or R&S®EFA-B10, R&S®EFA-B20)	R&S®EFA-B11	2067.3691.00
7 MHz SAW Filter (for digital R&S®EFA models or R&S®EFA-B10, R&S®EFA-B20)	R&S®EFA-B12	2067.3556.02
8 MHz SAW Filter (for R&S®EFA 4x or R&S®EFA-B10)	R&S®EFA-B13	2067.3579.02
8 MHz SAW Filter (for R&S®EFA 5x/6x/7x or R&S®EFA-B20)	R&S®EFA-B13	2067.3579.03
2 MHz SAW Filter (for R&S®EFA 5x/6x/7x or R&S®EFA-B20)	R&S®EFA-B14	2067.3562.00
Digital Demodulator Platform	R&S®EFA-B20	2067.3585.02
M/N NTSC/BTSC Demodulator	R&S®EFA-B30	2067.4046.02

Firmware options

SFN Frequency Offset Measurement (for R&S®EFA 4x or R&S®EFA-B10)	R&S®EFA-K10	2067.9454.02
DVB-C /J.83/A,C (QAM) Firmware (for models 53/73 or option R&S®EFA-B20)	R&S®EFA-K21	2067.4000.02
ATSC/8VSB Firmware (for models 63/73 or option R&S®EFA-B20)	R&S®EFA-K22	2067.4017.02
J.83/B (QAM) Firmware (for models 53/63 or option R&S®EFA-B20)	R&S®EFA-K23	2067.4023.02
FIR Coefficient Readout Firmware (only for R&S®EFA 5x or R&S®EFA-B20 + R&S®EFA-K22)	R&S®EFA-K25	2067.4046.02

Recommended extras

Measurement Software R&S®EFA-SCAN (for all digital modules)	R&S®EFA-K1	2067.9202.02
R&S®EFA Calibration Values	R&S®EFA-DCV	2082.0490.09
R&S®EFA-B4 Calibration Values	R&S®EFA-DCV	2082.0490.15
19" Adapter	R&S®ZZA-93	0396.4892.00
Lemo Triax connector (mono) with connecting cable (open)		2067.7451.00
Service manual		2068.0950.24
Carrying Bag for 19" units, 3 HU, depth 460 mm	R&S®ZZT-314	1001.0523.00

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