TV Test Receiver Family EFA

for analog and digital (DVB-C) TV signals

- Simple, user-friendly operation
- Modular design – easy retrofitting of options
- Support of all important TV standards
- Standard test receivers
- High-end test receivers
- High-end demodulators
- Comprehensive measurement and monitoring functions
- Areas of application: production, monitoring, research and development
- NICAM demodulator/ decoder option
- MPEG2 decoder option
- IEC/IEEE-bus and RS-232 interface

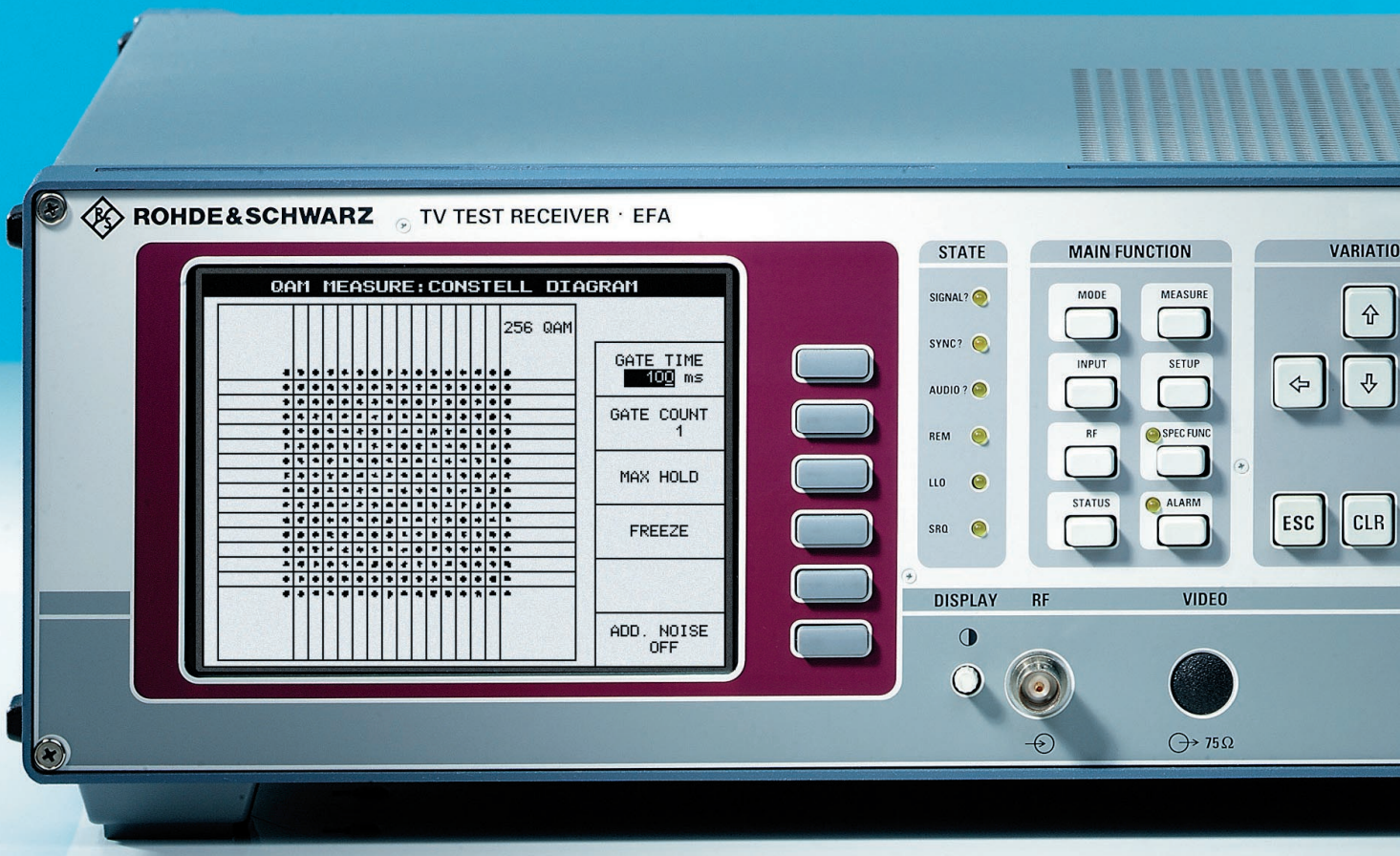
ROHDE&SCHWARZ

Three EFA models – analog or digital

Standard test receivers
- Model 12: standard B/G, optionally DVB-C
- Model 20: DVB-C
- Model 72: standard M/N
- Model 78: standard D/K or I, optionally DVB-C

High-end test receivers
- Model 23 incl. option EFA-B3: DVB-C
- Model 33 incl. option EFA-B3: standard B/G, optionally DVB-C
- Model 83 incl. option EFA-B3: standard M/N
- Model 89 incl. option EFA-B3: standard D/K or I, optionally DVB-C

High-end demodulators
- Model 23: standard DVB-C, optionally preselection
- Model 33: standard B/G, optionally DVB-C + preselection
- Model 83: standard M/N, optionally preselection
- Model 89: standard D/K or I, optionally DVB-C + preselection



The TV Test Receiver and Demodulator Family EFA is an instrument generation offering 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.

Wide choice of models

The TV Test Receiver Family 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.

There are standard and high-end models available. The high-end models have an even better signal-to-noise ratio than the standard models and offer excellent intermodulation characteristics. This, coupled with minimum inherent frequency response, guarantees extremely accurate measurements.

The approach described in the following is to help you find the right EFA model for your application:

First, a choice has to be made between the standard and the high-end version. Same as with the other criteria, this choice depends on the application. If the application mainly concerns 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, which guarantee extremely low measurement uncertainty without preselection.

The last selection criterion is the TV standard used, and whether it is analog or digital. EFA test receivers can be configured for digital signals to the DVB-C standard and for virtually all analog TV standards. A wide range of options including a NICAM demodulator (option EFA-B2) and an MPEG2 decoder (option EFA-B4) rounds off the 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 catered for by the QAM demodulator option for DVB-C (EFA-B1), which adds complete digital measurement functionality to the analog models.

family concept

Applications

- Monitoring of TV transmitters, transposers and cable head-ends
- Production of modulators and transmitters (calibration and test)
- Research and development
- Service
- Coverage measurements for terrestrial and cable signals
- Acceptance tests and commissioning
- Measurement of noise margin of QAM signals
- Monitoring of MPEG2 signals

Characteristics

All EFA models

- Simple, user-friendly operation
- Modular design – easy retrofitting of options
- General measurement functions for
  – RF input level
  – carrier frequency
- Alarm messages for measurement functions
- IEC/IEEE-bus and RS-232 interface

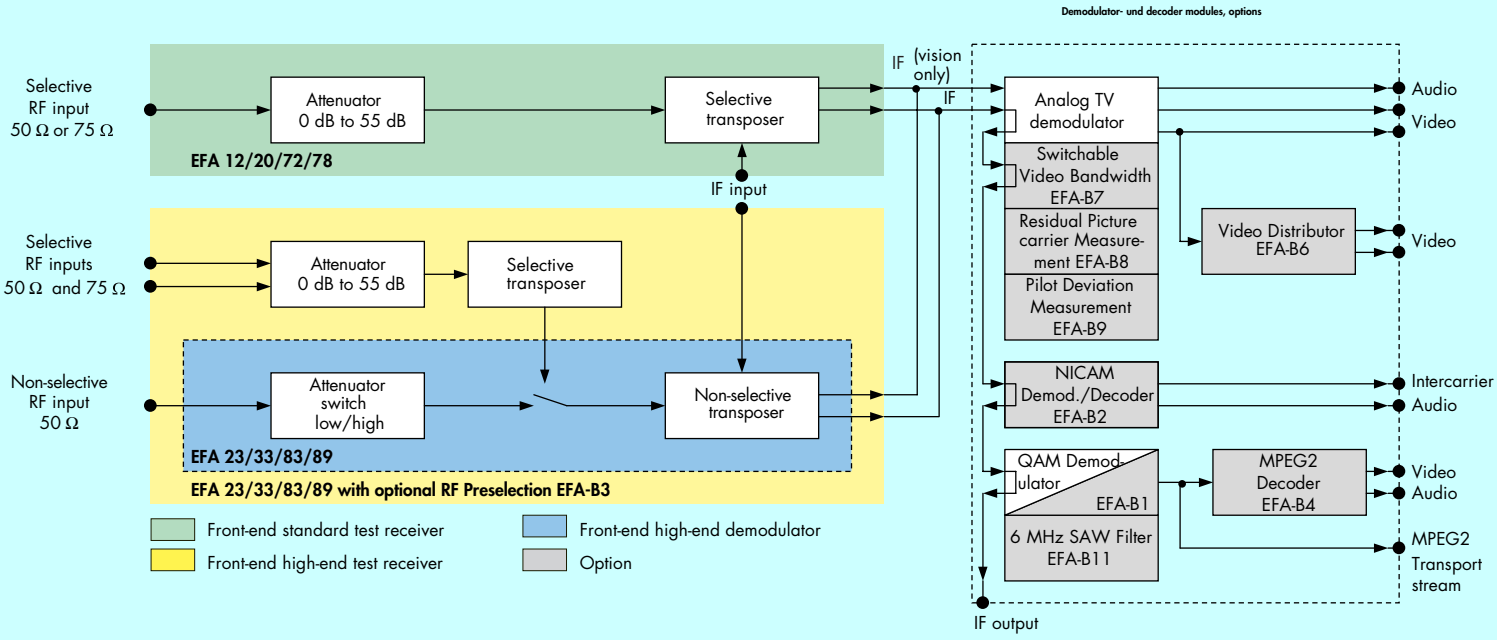
Analog TV demodulator

- Available TV standards: B/G, D/K, I, M/N
- Standard-conforming and flat group delay
- Stereo/dual-sound method A2 (IRT)
- Demodulation using intercarrier method
- Balanced audio outputs
- Switchable deemphasis
- Measurement functions for
  – vision/sound carrier spacing (level and frequency)
  – FM sound carrier and pilot deviation

NICAM demodulator (option 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

Fig. 1: Block diagram of TV Test Receiver Family EFA



QAM demodulator

- Demodulation of digital DVB-C signals
- 4QAM to 256QAM selectable
- User-selectable symbol rate
- Bit error ratio measurement
- Constellation diagram with automatic analysis of transmission parameters
- Integrated noise generator for measurement of noise margin
- Selectable IF filters of 8 MHz (standard) and 6 MHz (option EFA-B11) bandwidth
- Self-adapting equalizer for in-depth signal analysis in transmission channel:
  – echo measurement
  – amplitude and phase response

MPEG2 decoder (option EFA-B4)

- Video and audio output
- Realtime analysis to ETR 290
- Error report

Options

The **Video Distributor Option (EFA-B6)** adds further video outputs to high-end models 23, 33, 83 and 89. Depending on the selected demodulator mode, signals from the MPEG 2 decoder or from the analog TV demodulator are applied to the video outputs. With this option, two decoupled video outputs are provided both at the front and the rear of the unit. Moreover, the option adds an output on the front and the rear for the quadrature signal of the sync demodulator in the Nyquist demodulator mode.

The **Switchable Video Bandwidth Option (EFA-B7)** allows switchover of the video bandwidth to 6 MHz for TV standard B/G. This enables high-precision frequency response measurements up to 5.5 MHz on TV transmitters and modulators where the sound carrier can be switched off.

The **Residual Picture Carrier Measurement Option (EFA-B8)** makes it possible to measure the modulation depth of AM TV signals. The result can be indicated as residual carrier or modulation depth.

The **Pilot Deviation Measurement Option (EFA-B9)** provides FM peak deviation measurement in addition to FM average deviation measurement of the pilot tone. In this way, the amplitude modulation depth of the pilot tone can be determined.

family concept

Table of available EFA models and options

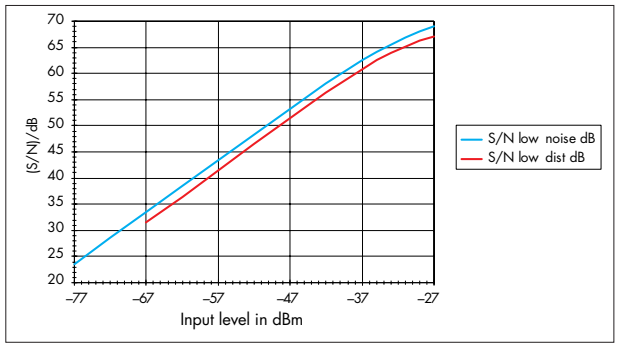
		Standard test receivers				High-end test receivers				High-end demodulators				
	Models ⇨	20	12	72	78	23	33	83	89	23	33	83	89	Required slots
Option	Standard ⇨	DVB-C	B/G	M/N	D/K or I	DVB-C	B/G	M/N	D/K or I	DVB-C	B/G	M/N	D/K or I	
EFA-B1	QAM Demodulator	✔	●	–	●	✔	●	–	●	✔	●	–	●	1
EFA-B2	NICAM Demodulator/ Decoder	–	●	–	●	–	●	–	●	–	●	–	●	1
EFA-B3	RF Preselection	–	–	–	–	◆	◆	◆	◆	●	●	●	●	1
EFA-B4	MPEG2 Decoder	●	● [1]	–	● [1]	●	–	–	–	●	● [1]	–	● [1]	1
EFA-B6	Video Distributor	–	–	–	–	● [3]	●	●	●	● [3]	●	●	●	0
EFA-B7	Switchable Video Bandwidth	–	●	–	–	–	●	–	–	–	●	–	–	1
EFA-B8	Residual Picture Carrier Measurement	–	●	●	●	–	●	●	●	–	●	●	●	0
EFA-B9	Pilot Deviation Measurement	–	● [2]	–	● [2]	–	● [2]	–	● [2]	–	● [2]	–	● [2]	0
EFA-B11	6 MHz SAW Filter	●	● [1]	–	● [1]	●	● [1]	–	● [1]	●	● [1]	–	● [1]	0

Each basic unit offers three free slots to take up options.
✔ Included in basic unit ◆ To be ordered with basic unit ● Available – Not available
[1] Can be retrofitted if option EFA-B1 is built in.
[2] Included in basic unit for EFA models manufactured after June 1999.
[3] Can be retrofitted if option EFA-B4 is built in.

Modular design

With its modular design, the compact TV Test Receiver EFA (three height units) is made for easy upgrading and high versatility. Each basic unit offers three slots for options requiring a separate slot, and further options can be added.

Fig. 2: Typical characteristic of weighted S/N ratio of high-end test receiver (analog TV) with 0 dB input attenuation



Complete documentation at a keystroke

Via the integrated printer interface of EFA, the screen contents can be printed out at a keystroke. The screen contents can also be output in the form of a PCX file to a PC or laptop via a null-modem cable. A large number of results can thus be archived conveniently.

Intermodulation and signal-to-noise ratio

These are the two parameters that mainly determine the quality of a TV test receiver. Settings with optimized intermodulation and S/N ratio are available to match the receiving conditions.

Fig. 2 shows the typical characteristic of the weighted video S/N ratio of the high-end version as a function of the receive level at various optimized settings. Signals below –67 dBm can be received in the low noise mode.

EFA rear view

Models 12, 33, 72, 78, 83, 89

Monitoring function

EFA provides high-precision demodulated baseband signals (vision and sound) for reproduction or measurements for the various applications (TV transmitters, cable headends, coverage measurements, R&D). At the same time, all relevant RF parameters are measured at high speed and represented in a logically arranged way. (Fig. 3a and 3b). User-configurable alarm messages enable unattended monitoring of receive 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 perfectly meets the requirements of these types of measurement and, featuring low measurement uncertainty, enables optimum alignment as well as permanent quality control of the transmitter.

NYQU FM MEASURE

SET RF	CHANNEL	ATTEN : 0 dB	STANDARD
48.250 MHz	2	65.7 dBuV	B/G

VISION CARRIER:

LEVEL	65.7	dBuV
SET RF	48.250000	MHz
MEASURED RF	48.250000	MHz
CONTROLLED RF	48.250000	MHz
VIDEO LEVEL	100	%
RPC	10.9	%

SOUND CARRIER:

VISION/SOUND1 CARRIER RATIO	12.9	dB
VISION/SOUND2 CARRIER RATIO	20.1	dB
INTERCARRIER1 FREQUENCY	5.5000	MHz
INTERCARRIER2 FREQUENCY	5.7420	MHz
FM DEVIATION SOUND1	31.1	kHz
FM DEVIATION SOUND2	31.2	kHz
FM DEVIATION PILOT AVERAGE	2.54	kHz
PILOT FREQUENCY	54.688	kHz
PILOT	STEREO	

Fig. 3a:
MEASURE menu of Nyquist demodulator FM sound mode with residual picture carrier measurement (RPC, option EFA-B8)

NYQU NICAM MEASURE

SET RF	CHANNEL	ATTEN : 0 dB	STANDARD
48.250 MHz	2	65.7 dBuV	B/G

VISION CARRIER:

	LEVEL	65.7	dBuV
	SET RF	48.250000	MHz
	MEASURED RF	48.250000	MHz
	CONTROLLED RF	48.250000	MHz
	VIDEO LEVEL	100	%
SOUND CARRIER:			
FM:	VISION/SOUND CARR RATIO	12.9	dB
	INTERCARRIER FREQUENCY	5.5000	MHz
	DEVIATION SOUND	31.1	kHz
NICAM:	VISION/SOUND CARR RATIO	20.0	dB
	EYE-HEIGHT	90	%
	BER	0.0E-9	(1000/1000)
	DATA JITTER	2	Hz
	DATA	OK	
	FRAME	OK	
	MODE	STEREO	
	RESERVE FLAG	1	
	HEADROOM	OK	

Fig. 3b:
MEASURE menu of Nyquist demodulator NICAM sound mode

Applications – DVB-C test receivers (digital TV)

Models 20, 23 and option EFA-B1

Bit error ratio measurement
During normal receive operation, EFA continuously calculates the raw bit error ratio. This is the bit error ratio prior to any error correction. EFA automatically adapts the integration rate to the measured bit error ratio. The BER is calculated by forming a sliding average of the last error events (up to 1000) to yield the actual measurement value. The great advantage of this method is the immediate response to changes of BER, producing a "live" measured value, as it were. The relationship between the BER and the S/N ratio (SNR) is illustrated by Fig. 4 for 4QAM, 16QAM, 64QAM and 256QAM.

Monitoring by means of alarm register
EFA checks the input level (LV), synchronization (SY), bit error ratio (BE) and MPEG data errors (DE) of the QAM signal at the rate of one second. All alarm messages are stored in the alarm register together with the date and time. Up to 1000 entries can be stored (Fig. 5). The messages can be summarized at a keystroke (STATISTICS), providing the user with an overview of down times.

Constellation diagram with excellent performance features
A new concept for the extremely fast processing of digital signals has for the first time been implemented in the digital Test Receiver EFA. Up to 1.4×10^6 I/Q values can be processed per second. With this new technique, even extremely rare error events can be reliably detected by means of the constellation diagram

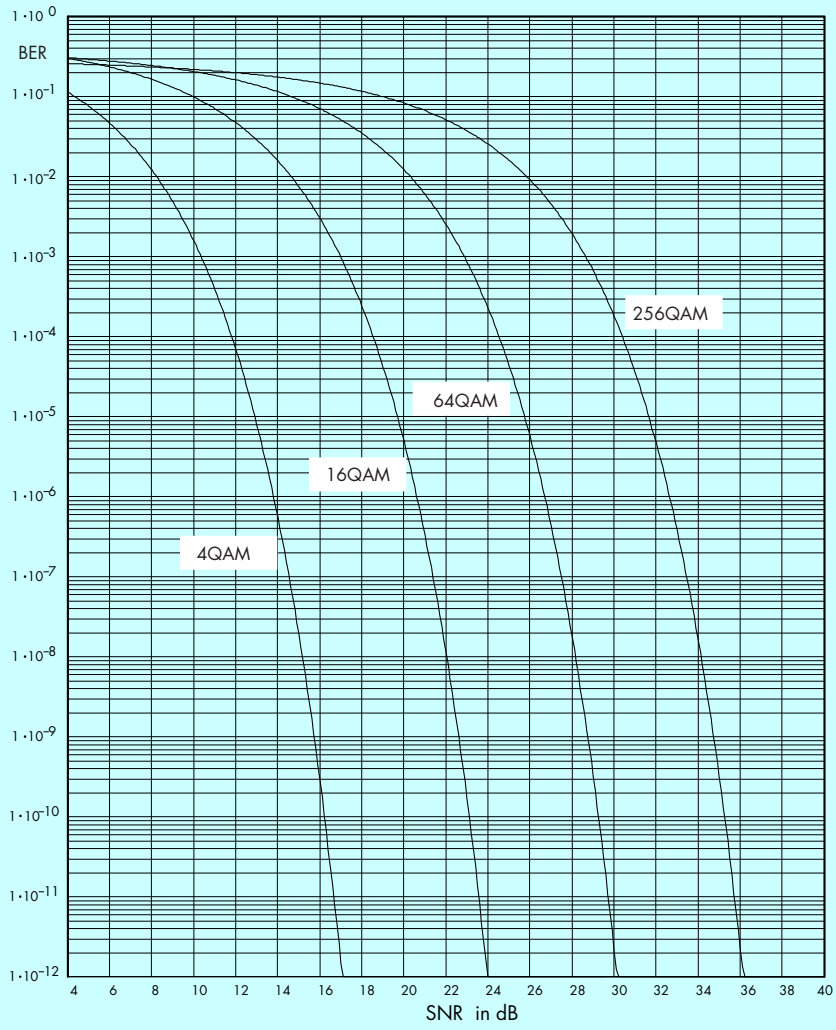


Fig 4:
Bit error ratio (BER) as a function of signal-to-noise ratio (SNR)

DVB Digital Video Broadcasting

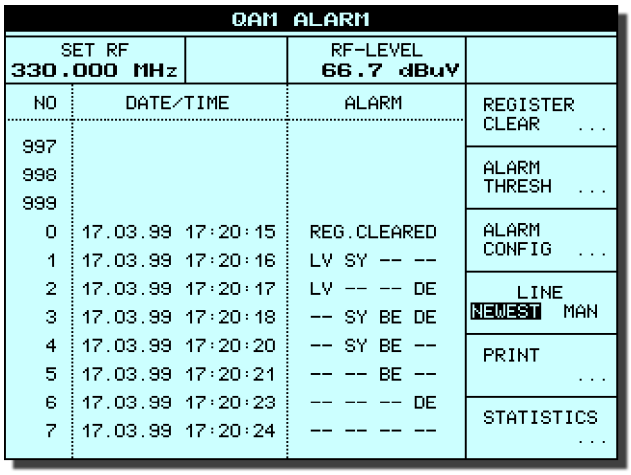


Fig. 5:
ALARM menu of QAM demodulator mode

(Fig. 6a and 6b). This technique yields the large number of measured values required for a detailed mathematical and statistical analysis of frequency distribution in the PARAMETER calculation.

Digital precision

The fully digital receiver concept ensures reliable demodulation of all QAM orders up to 256QAM. The low measurement uncertainty of EFA results in virtually error-free signal processing far below the quasi-error-free (q.e.f.) threshold also for this application. In addition, the symbol rate is continuously adjustable within the specified range.

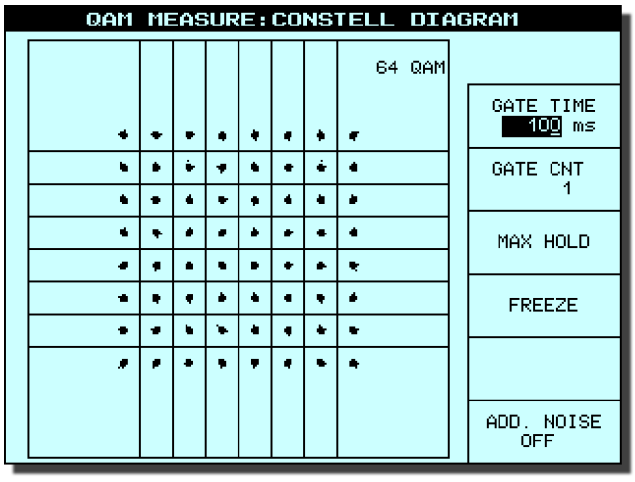


Fig. 6a:
Constellation diagram of errored QAM signal (overloading of power amplifier). Here, the number of simultaneously shown I/Q results is too small (1.4 x 10^5): the error essentially remains concealed

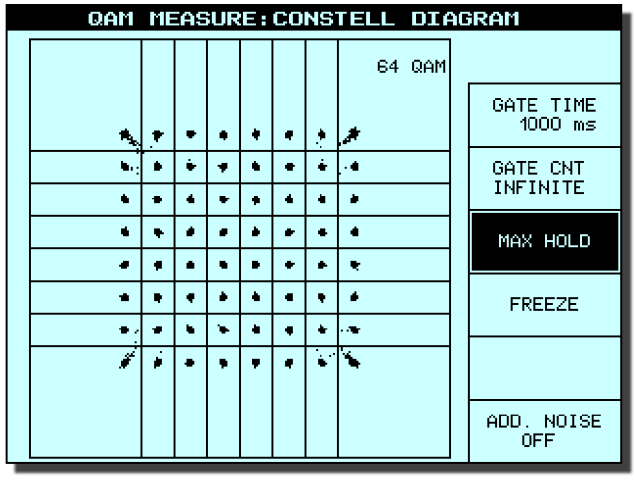


Fig. 6b:
Constellation diagram of same signal as in Fig. 6a, but with 5 x 10^8 I/Q results shown simultaneously. The error resulting from the power amplifier is reliably detected in the MAX HOLD mode

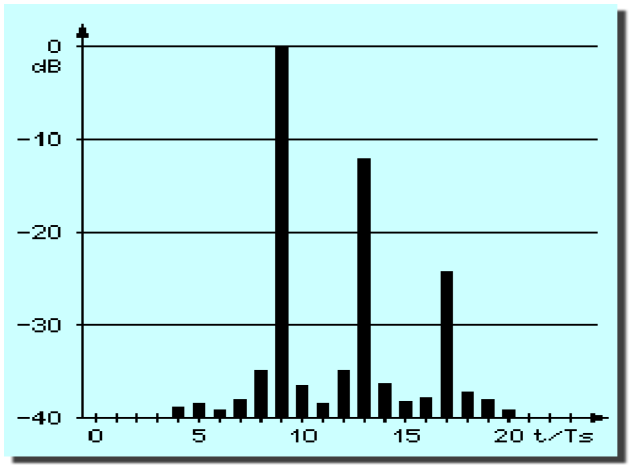


Fig. 7a:
ECHO PATTERN display: echo and multipath reception. The central coefficient is clearly discernible (here: at position 9). The pre-echos are shown left of the central coefficient, the post-echos right of it (here: two post-echos with an attenuation of 12 dB (position 13) and 24 dB (position 17))

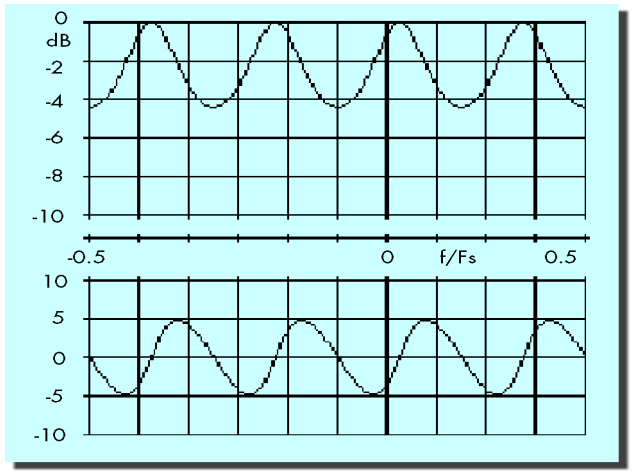


Fig. 7b:
SPECTRUM display: amplitude and phase frequency response in dB and ° of the same signal as shown in Fig. 7a. The displayed ripple results from the two echos

Spectrum measurement and echo display

The test receiver features a SPECTRUM and an ECHO PATTERN function. Both functions rely on the instrument's capability of adjusting itself to the actual receive conditions by means of the integrated, self-adapting equalizer. The equalizer coefficients are evaluated by the integrated DSP (Fig. 7a and 7b).

General QAM signals

Featuring high versatility, the digital Test Receiver EFA can be used not only for special DVB-C measurements but also for the analysis of general QAM signals. No special synchronization words are needed for synchronization of the signal, nor for constellation diagrams, parameter calculation or spectrum and echo measurements. The digital Test Receiver EFA thus provides high-precision measurements for all applications in QAM analysis (Fig. 7c).

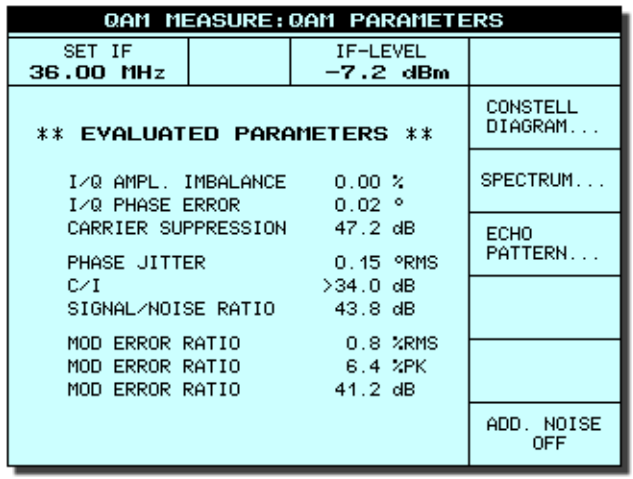


Fig. 7c:
QAM PARAMETERS display: measurement of all significant QAM parameters, including carrier suppression

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 colour subcarrier (f_{SB}) and a sound carrier (f_{SC}). Modulation is chosen such that the vision carrier is lowered by 6 dB, the colour 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. 8a shows the signals involved and the reference level at the RF.

Out-of-channel distortion

The effect of signals outside the receive channel is described by the 3rd-order intercept point (IP3). For the EFA family, this parameter is specified based on 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 unwanted frequencies are chosen to be within the bandwidth of the RF preselection but outside the bandwidth of the 1st IF filter. The effect of out-of-channel interference on the receiver is thus reliably determined.

It is assumed that each of the three signals has a level P = –33 dBm. The level of the intermodulation product ΔIM 1 MHz relative to the wanted carrier is measured (see Fig. 8b, measurement at the RF).The 3rd-order intercept point is

$$IP_3 / dBm = P / dBm + \frac{\Delta IM / dB}{2} + 3$$

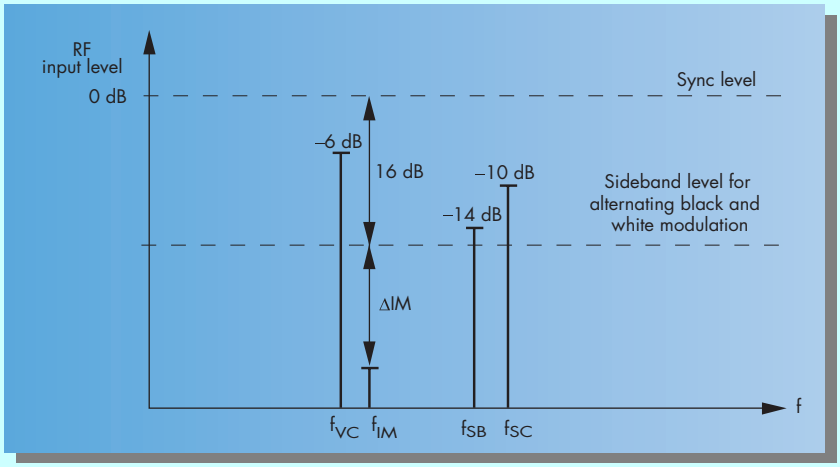


Fig. 8a: Example of in-channel distortion

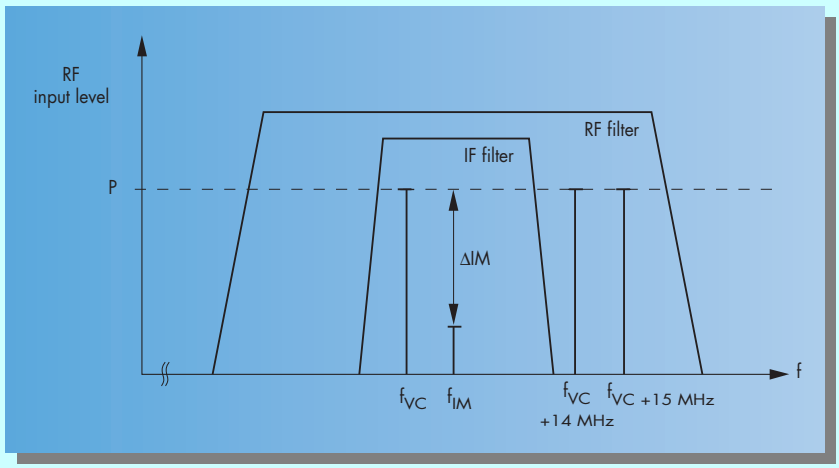


Fig. 8b: Example of out-of-channel distortion

Specifications – Analog TV

Model-specific characteristics

	Standard test receivers Models 12/72/78	**High-end test receivers** Models 33/83/89 with option EFA-B3 (RF Preselection)	**High-end demodulators** Models 33/83/89
RF input	selective	selective	non-selective
Connector	50 Ω or 75 Ω, BNC or N female, on front or rear panel (see configuration sheet)	50 Ω, N female, on rear panel 75 Ω, BNC female, on rear panel	50 Ω, N female, on 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	≥19 dB in channel at 50 Ω connector ≥16 dB in channel at 75 Ω connector	≥30 dB
Frequency range (vision carrier)	45 to 860 MHz for models 12, 78 50 to 888 MHz for model 72	5 to 1000 MHz	45 to 1000 MHz for models 33, 89 50 to 1000 MHz for model 83
Level range[1]	without preamplifier: –67 to 13 dBm with preamplifier: –77 to –47 dBm	low noise: –77 to 21 dBm[2] normal: –67 to 21 dBm[2] low distortion: –67 to 21 dBm[2]	–41 to 21 dBm
Image frequency rejection	VHF: ≥70 dB[3] ; UHF: ≥50 dB[3]	100 dB[4]	
IF rejection		100 dB[4]	
Local oscillator			
Resolution	1 Hz	1 Hz	1 Hz
Frequency error	≤$2x10^{-6}$	≤$2x10^{-6}$	≤$2x10^{-6}$
Phase noise[5]	≥50 dB	≥58 dB	≥62 dB [6]
Video demodulation characteristics			
Noise voltage, ref. to b/w transition	P_{RF}≥–33 dBm, 0 dB input attenuation	P_{RF}=–33 dBm, 0 dB input attenuation	P_{RF}≥–1 dBm
S/N_{rms} unweighted			≥60 dB typ. 63 dB
S/N_{rms} weighted to CCIR Rec. 567	low noise: ≥60 dB typ. 64 dB[7] low distortion: ≥57 dB typ. 59 dB[7]	low noise: ≥64 dB typ. 66 dB normal: ≥63 dB typ. 65 dB low distortion: ≥62 dB typ. 64 dB	≥67 dB typ. 70 dB
$Signal/hum_{peak}$	≥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 colour 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
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 (TV standards B/G, D/K, I)			≤3%
12.5T pulse amplitude error (TV standard M/N)			≤5%
Chrominance/luminance gain			≤3%
Chrominance/luminance delay			
With constant group delay	≤20 ns	≤15 ns	≤12 ns
With group delay dep. on TV std.	≤20 ns	≤20 ns	≤20 ns
Tilt, 10/75% modulation			
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	≤1%	≤1%	≤1%
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, referred to b/w transition; see Fig. 8a	low noise: ≥52 dB typ. 56 dB[7] low distortion: ≥62 dB typ. 66 dB[7]	low noise: ≥52 dB typ. 56 dB normal: ≥57 dB typ. 61 dB low distortion: ≥62 dB typ. 66 dB	≥55 dB
3rd-order intercept point; 0 dB attenuation, see Fig. 8b	low noise: ≥–10 dB low distortion: ≥–5 dB	normal: ≥10 dBm low distortion: ≥14 dBm	

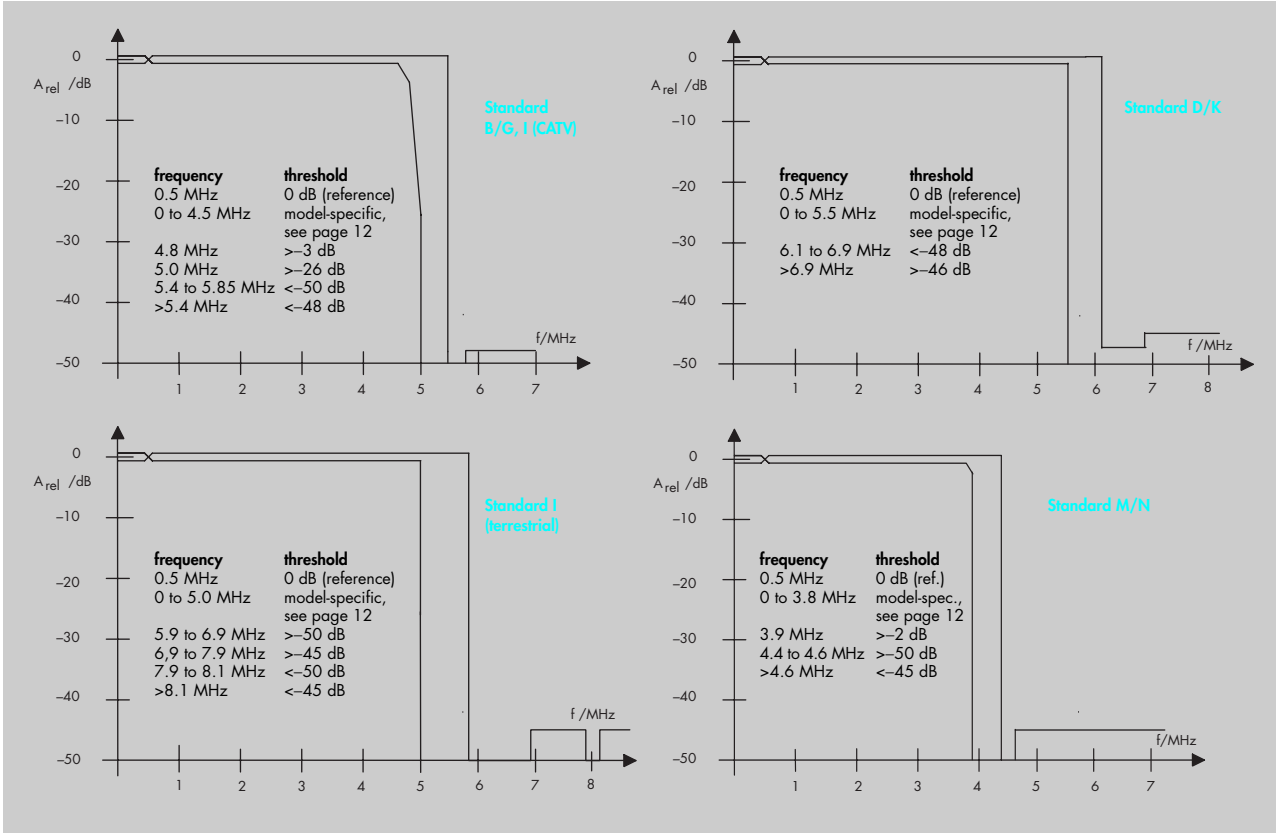
1) Levels are rms values referred to sync pulse
2) In receive frequency range 5 MHz to 15 MHz: –41 dBm to 21 dBm
3) Image frequency of vision carrier
4) Applies to both frequency conversions
5) FM S/N ratio measured at IF output, referred to ±30 kHz frequency deviation and 500 Hz modulation frequency, deemphasis 50 µs, measured to DIN45405, weighted to CCIR468-3
6) In frequency range 45 MHz to 900 MHz of models 33 and 89; in range 50 MHz to 890 MHz of model 83
7) Valid for instruments manufactured after June 99

Characteristics common to all models

IF input	50 Ω, BNC female, on rear panel
Vision carrier frequency	
TV standards B/G, I, D/K	38.9 MHz
TV standard M/N	45.75 MHz
Return loss in channel	≥30 dB
Level range *)	–13 to 4 dBm
Crosstalk attenuation, RF/IF input	≥75 dB
IF output	50 Ω, BNC female, on rear panel
Return loss in channel	≥20 dB
Vision carrier level*), regulated	–7 dBm
Input for external zero reference	75 Ω, BNC female, on 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, M/N	≥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
M/N	≥45 dB

*) Levels are rms values referred to sync pulse

Tolerance masks of EFA for total amplitude characteristic (RF, IF, VF)



Video outputs	75 Ω, BNC female, front panel and 75 Ω, BNC female, rear 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, selectable	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, referred 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)

Group delay depending on TV standard

Frequency/MHz	B/G							D/K					I	K1	M
	General	Sweden	Norway	Denmark	Australia	General/2 (reduced to 50%)	New Zealand	CCIR Report 308	OIRT TK-III-830	OIRT GOST 20532-75	GOST 20532-83	CSFR	SABC TVT 12.2		FCC
	Group delay/ns														
0.10	0	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 ±Δ
0.50		0 ±Δ	0 ±Δ							–10 ±Δ	–8 ±Δ		0 ±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	0 ±Δ
1.50		0 ±Δ	0 ±Δ							–70 ±Δ			0 ±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	0 ±Δ
2.25		0 ±Δ	0 ±Δ				–60 ±Δ						0 ±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	25 ±Δ
3.50		0 ±Δ			0 ±Δ								0 ±Δ	0 ±Δ	
3.58		0 ±Δ											0 ±Δ	0 ±Δ	170 ±20
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	293 ±40
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				

High-end demodulator: Δ = 12 ns
High-end test receiver: Δ = 15 ns
Standard test receiver: Δ = 20 ns

Audio demodulation characteristics, TV standards B/G, D/K, I

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, selectable	
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 inaccuracy, f_{mod} 500 Hz	≤0.2 dB
Amplitude frequency response, 40 Hz to 15 kHz, referred to 500 Hz	≤ ±0.3 dB
Deemphasis	50 µs, switchable
Distortion at ±50 kHz frequency deviation, deemphasis on	≤0.5%
S/N ratio (intercarrier method)	
referred to ±30 kHz frequency deviation and 500 Hz modulation frequency, measured to DIN45405, weighted to CCIR468-3; 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 referred to ±30 kHz frequency deviation and 500 Hz modulation frequency, deemphasis on	≥40 dB
Channel crosstalk, 40 Hz to 15 kHz referred to ±30 kHz frequency deviation, deemphasis on, measured with ±30 kHz spurious FM	≥74 dB

Audio demodulation characteristics, TV standard M/N

Demodulation	intercarrier method
Intercarrier input/output	configuration as input or output by means of internal jumpers; configured as output on delivery
Connector	50 Ω, BNC female, on rear panel
Return loss, 4.4 MHz to 4.6 MHz	≥20 dB
Intercarrier output level, vision/sound power ratio 10 dB	–7 dBm ±3 dB
Intercarrier input level range	–13 dBm to –1 dBm
Main channel output (mono)	Lemo Triax female on rear panel: balanced, Z=600 Ω on front panel: unbalanced, Z=600 Ω
Audio level, selectable	
Reference frequency deviation	±25 kHz
Setting range	0 to +6 dBm
Resolution of level control	0.1 dB
Level inaccuracy, f_{mod} 500 Hz	≤0.2 dB
Amplitude frequency response, 30 Hz to 15 kHz, referred to 500 Hz	≤±0.3 dB
Deemphasis	75 µs, switchable
Distortion, at ±25 kHz frequency deviation, f_{mod} = 30 Hz to 15 kHz	≤0.1%
S/N ratio (intercarrier method)	
referred to ±25 kHz frequency deviation and 500 Hz modulation frequency, measured to DIN45405, weighted to CCIR468-3	
Vision modulation: all-black picture	≥55 dB
Vision modulation: test pattern	≥48 dB
Vision modulation: sinewave, 0 to 4 MHz, 10 to 75% modulation	≥46 dB
Composite output (BTSC/MTS)	BNC female, on rear panel: unbalanced, Z=75 Ω
Output level	10 mV/kHz FM deviation
Level inaccuracy	≤0.2 dB
Frequency response, referred to 25 kHz	
Amplitude frequency response, 30 Hz to 47 kHz	≤±0.05 dB
Amplitude frequency response, 47 kHz to 120 kHz	≤±0.5 dB
Phase frequency response, 30 Hz to 47 kHz	≤±0.5°
Distortion, ±25 kHz frequency deviation	
f_{mod} 30 Hz to 15 kHz	≤0.1%
f_{mod} 15 kHz to 50 kHz	≤0.5%

NICAM demodulator – option 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 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, on 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, on rear panel
NICAM-728 clock input		75 Ω, TTL, BNC female, on rear panel
QPSK I output		BNC female, on rear panel
Output impedance		100 Ω
Permissible load		≥1 kΩ //≤1 nF
Level		0.8 V pp
QPSK Q output		BNC female, on 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, on rear panel
NICAM-728 data output		75 Ω, TTL, BNC female, on rear panel
NICAM-728 clock output		75 Ω, TTL, BNC female, on rear panel
Audio output, balanced		Lemo Triax female, pair of connectors, on 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, on 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 SUB-D, TTL, on 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, referred to full-scale level)		
unweighted		≥80 dB
weighted (CCIR 468-3)		≥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

Video distributor– option EFA-B6

Video outputs	2 x BNC female, on front panel; 2 x BNC female, on rear panel
Impedance	75 Ω
Return loss (0 to 6 MHz)	≥26 dB
Level inaccuracy	≤2%
DC offset of video signal, Nyquist demodulator mode, with zero carrier	0 V ±20 mV
MPEG2 decoder mode, black level	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)	
Outputs	BNC female, on front and rear panel
Impedance	75 Ω
Return loss (0 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 video bandwidth – option EFA-B7

for video bandwidth switchover to 6 MHz for TV standard B/G

	Standard test receivers	High-end test receivers	High-end demodulators
Amplitude frequency response	reference: 0.5 MHz	reference: 0.5 MHz	reference: 0.5 MHz
DC 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			
DC to 5.5 MHz	≤20 ns	≤15 ns	≤12 ns
With group delay depending on TV standard	see table on page 14	see table on page 14	see table on page 14
Additional ripple through SAW filter	≤15 ns	≤15 ns	≤15 ns

Test parameters, analog TV

	Measurement range	Resolution	Accuracy
Vision carrier power or voltage in µV/mV, dBµV, dBmV, dBm, dBpW, 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	50 to 150 %	1%	≤2%
Vision carrier frequency	frequency range depending on EFA model	20 Hz	≤$2x10^{-6}$
Vision/sound carrier 1 level ratio			
TV standards B/G, D/K, I	–23 dB to –7 dB	0.1 dB	≤2 dB
M/N	–20 dB to –4 dB	0.1 dB	≤2 dB
Vision/sound carrier 2 level ratio			
TV standards B/G, D/K	–30 dB to –14 dB	0.1 dB	≤2 dB
Vision/sound carrier 1 frequency spacing			
TV standards B/G, D/K, I, M/N	nominal IC frequency ± 50 kHz	100 Hz	≤200 Hz [1]
Vision/sound carrier 2 frequency spacing			
TV standards B/G, D/K	nominal IC frequency ± 50 kHz	100 Hz	≤200 Hz [1]
FM sound carrier deviation	0 to 80 kHz	100 Hz	≤3% ±200 Hz [2]
FM pilot carrier deviation (average)			
TV standards B/G, D/K	1 to 5 kHz	10 Hz	≤5%
M/N	1 to 10 kHz	10 Hz	≤5%
FM pilot carrier deviation (peak value) [3]	1 to 10 kHz	10 Hz	≤5%
Pilot frequency	pilot frequency ± 300 Hz	2 Hz	≤2 Hz
Residual AM [4]	0 to 30 %	0.1%	0.5%
Additional test parameters with option EFA-B2			
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%	≤2x(100 / displayed value) % [5]
BER	$0x10^{-9}$ to $<1*10^{-5}$	$0.2x10^{-exponent}$	–
	$1x10^{-5}$ to $1*10^{-2}$	$0.1x10^{-exponent}$	–
Clock or data jitter	0 Hz to 50 Hz	1 Hz	≤20% ± 2 Hz [6]

[1] With unmodulated sound carrier
[2] Without vision modulation
[3] With option EFA-B9
[4] With option EFA-B8
[5] Reference: 100%; vision modulation: all-black picture
[6] Valid for jitter frequency 50 Hz to 60 Hz; 3 dB bandwidth: 10 Hz to 120 Hz

Alarm messages

Vision carrier level, RF offset, TV synchronization, vision/sound carrier level ratios, vision/sound carrier frequency spacings, FM pilot deviation, max. FM deviations, min. FM deviations

Additional alarm messages with option EFA-B2

Vision/NICAM sound carrier power ratio, NICAM intercarrier level, eye height, BER, data jitter; loss of: NICAM data/NICAM clock, frame sync, headroom

Specifications – digital TV

Model-specific characteristics

	DVB-C standard test receiver, models 20 or 12, or model 78 with EFA-B1	DVB-C high-end test receiver, model 23 with option EFA-B3 (RF Preselection)	DVB-C high-end demodulator, model 23
RF input	selective	selective	non-selective
Connector	50 Ω or 75 Ω, BNC or N female, on front or rear panel (see configuration sheet)	50 Ω, N female, on rear panel 75 Ω, BNC female, on rear panel	50 Ω, N female, on rear panel
Return loss	≥14 dB in channel with 50 Ω connector and input attenuation ≥10dB ≥12 dB in channel with 75 Ω connector and input attenuation ≥10 dB	≥19 dB in channel at 50 Ω connector ≥16 dB in channel at 75 Ω connector	≥ 30 dB
Frequency range	48 MHz to 862 MHz	5 MHz to 1000 MHz	45 MHz to 1000 MHz
Level range[1]	without preamplifier: –67 to 13 dBm with preamplifier: –70 to –47 dBm	low noise: –70 to 17 dBm[2] normal: –67 to 17 dBm[2] low distortion: –67 to 17 dBm[2]	–44 dBm to 17 dBm
Image frequency rejection	VHF: ≥ 70 dB[3] UHF: ≥ 50 dB[3]	100 dB[4]	
IF rejection		100 dB[4]	
Local oscillator			
Resolution	1 Hz	1 Hz	1 Hz
Frequency error	≤$2x10^{-6}$	≤$2x10^{-6}$	≤$2x10^{-6}$
QAM demodulator characteristics			
Inherent MER, inherent SNR	for typical characteristics see diagram 1 on page 19	for typical characteristics see diagram 2 on page 19	for typical characteristics see diagrams 3 and 4 on page 20

[1] Levels are rms values
[2] In receive frequency range 5 MHz to 15 MHz: –47 dBm to 21 dBm
[3] Image frequency of carrier
[4] Applies to both frequency conversions

Characteristics common to all models

IF input	50 Ω, BNC female, on rear panel, 36 MHz
Return loss in channel	≥30 dB
Level range[1]	–27 dBm to –7 dBm
IF output	50 Ω, BNC female, on rear panel, 36 MHz
Return loss in channel	≥20 dB
Level[1], regulated	–14 dBm
QAM demodulator characteristics	
Modulation type	4, 16, 32, 64, 128, 256QAM
Roll-off factor	0.13; 0.15; 0.20; 0.25; 0.30; selectable
Insertion loss	≤1:5 dB (64QAM)
Symbol rate	1.5 to 6.995 MSPS
Equalizer	self-adapting
I/Q inversion	automatic or manual
Reed-Solomon decoder	204, 188, 8; selectable
Bit error ratio measurement range	$1x10^{-3}$ to $0.1x10^{-9}$
Interleaving	convolutional interleaver (Forney), L = 12
Energy dispersal	to DVB specification
Internal noise generator (on/off) C/N ratio Setting, filters	12 dB to 62 dB in steps of 0.1 dB automatic conversion and correct setting of C/N ratio if optional filters are fitted (eg 6 MHz, option EFA-B11)
Sync information on	symbol clock, carrier recovery, equalizer, MPEG2 frame
MPEG TS parallel output	to LVDS standard (188, 204 bytes); parallel MPEG transport stream
MPEG TS ASI output	serial MPEG transport stream (ASI); 75 Ω
SER DATA output	serial data stream ahead of Reed-Solomon decoder; 75 Ω
SER CLK output	clock output for SER DATA; 75 Ω
Alarm messages	level, BER, synchronization, transmission errors
Storage	with date and time, up to 1000 lines

[1] Levels are rms values

Test parameters for 64QAM	Range	Resolution	Accuracy
Level	–60 dBm to +10 dBm	0.1 dB	≤±3 dB, typ. ±1 dB
MER (modulation error ratio)	24 dB to 30 dB 30 dB to 35 dB 35 dB to 40 dB	0.1 dB 0.1 dB 0.1 dB	≤±0.3 dB ≤±0.7 dB ≤±1.5 dB
SNR (signal-to-noise ratio)	24 dB to 30 dB 30 dB to 35 dB 35 dB to 40 dB	0.1 dB 0.1 dB 0.1 dB	≤±0.4 dB ≤±0.8 dB ≤±1.8 dB
Carrier suppression	25 dB to 40 dB 40 dB to 50 dB 50 dB to 60 dB	0.1 dB 0.1 dB 0.1 dB	≤±1 dB ≤±1.5 dB ≤±3 dB
I/Q amplitude imbalance	0 to 5%	0.01%	≤±0.02%
I/Q phase error	0 to 5°	0.01°	≤±0.02°
Frequency offset	+/– 100 kHz	1 kHz	≤± 3 kHz
BER (bit error ratio)	$2x10^{-4}$ to $1x10^{-3}$ $0x10^{-9}$ to $2x10^{-4}$	$0.1x10^{-exponent}$ $0.1x10^{-exponent}$	– –
Symbol rate (auto search mode)	1.5 to 6.99 Msymb/s	0.001 Msymb/s	≤±0.003 Msymb/s

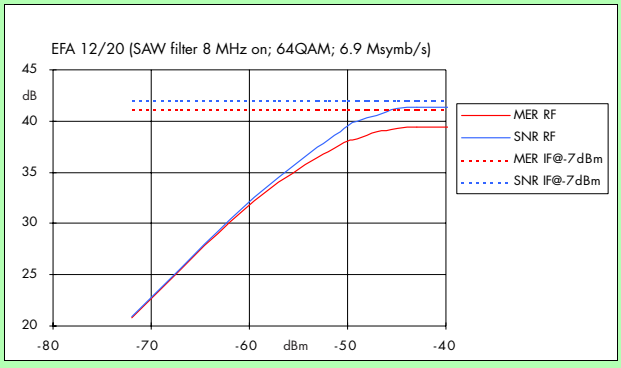


Diagram 1:
Typical MER and SNR characteristics as a function of input level for EFA 20, as well as EFA 12, 78 with option EFA-B1 (attenuator setting 0 dB; SAW on; f_{in} = 370 MHz; 64QAM; 6.9 Msymb/s)

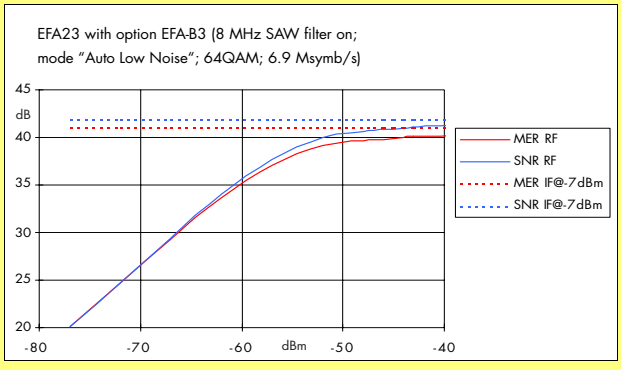


Diagram 2:
Typical MER and SNR characteristics as a function of input level for EFA 23 with option EFA-B3 (attenuator setting 0 dB; SAW on; f_{in} = 370 MHz; 64QAM; 6.9 Msymb/s)

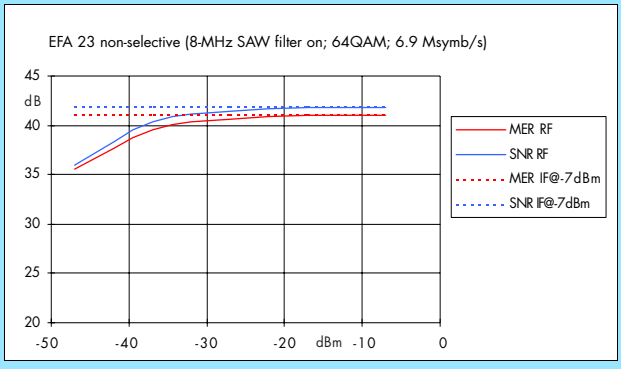


Diagram 3:
Typical MER and SNR characteristics as a function of input level for EFA 23 (SAW on; f_{in} = 370 MHz; 64QAM; 6.9 Msymb/s)

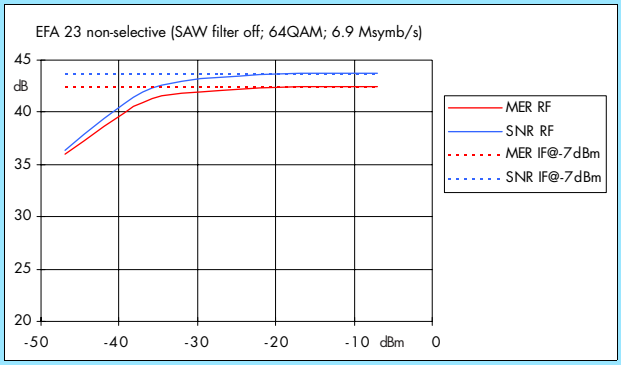


Diagram 4:
Typical MER and SNR characteristics as a function of input level for EFA 23 (SAW off; f_{in} = 370 MHz; 64QAM; 6.9 Msymb/s)

Option EFA-B4

Realtime measurement functions: simultaneous monitoring of all signals in transport stream.
Realtime measurement functions according to test specifications for DVB systems (ETR290): priorities 1, 2 and 3

Input signals	
Transport stream	to ISO/IEC 1-13818
Data rate of transport stream	up to 54 Mbit/s
Length of data packets	188/204 bytes
Signal input	
Asynchronous serial MPEG2 transport stream, 270 Mbit/s (TS ASI)	BNC connector on rear panel, 200 mV pp to 1 V pp, 75 Ω
Signal outputs	
Video	
CCVS (PAL, SECAM, NTSC)	BNC connector on rear panel, 1 V pp± 1%, 75 Ω
Video serial digital (ITU-R 601), 270 Mbit/s	BNC connector on rear panel, 800 mV pp, 75 Ω
Audio	
Connectors	Lemo-Triax female, in pairs; on front panel: unbalanced, on rear panel: balanced, floating
Impedance	<25 Ω
Signals	mono, left/right, sound 1/sound 2
Level (full scale)	+6 dBm ± 0.2 dB into 600 Ω
Frequency response (40 Hz to 15 kHz)	±0.5 dB relative to 1 kHz
S/N ratio	>70 dB, unweighted
THD	>70 dB

General data

Display	monochrome LCD (320 x 240) with backlighting
Interfaces	IEC625-2/IEEE488 bus, RS-232, printer (Centronics)
Electromagnetic compatibility	to EN50081-1, EN50082-2 (EU EMC directive)
Immunity to RFI	10 V/m
Ambient conditions	
Temperature range	to IEC68-2-1/-2
Rated temperature range	+5 °C to +45 °C
Operating temperature range	0 °C to +50 °C
Storage temperature range	–40 °C to +70 °C
Climatic conditions	+25°C/+40°C cyclical at 95% rel. humidity, to IEC68-2-30
Mechanical resistance	
Sinewave vibration	5 Hz to 150 Hz, max. 2 g at 55 Hz, max. 0.5 g from 55 Hz to 150 Hz, to IEC68-2-6, IEC1010-1 and MIL-T-28800D, class 5
Random vibration	10 Hz to 300 Hz, 1.2 g (rms)
Shock	40 g shock spectrum to MIL-STD-810D and MIL_T-28800D, class 3 and 5
Safety	to EN61010-1, IEC1010-1, UL3111-1, CSA-C22.2 No. 1010.1
Power supply	100 V to 120 V / 220 V to 240 V +10%/–15% (automatic voltage selection), 50 Hz to 60 Hz
Dimensions (WxHxD)	435 mm x 147 mm x 460 mm
Weight	approx. 12 kg, depending on options

Ordering information

TV Standard Test Receiver *)	
Standard B/G, stereo/dual sound IF 38.9 MHz, RF 45 MHz to 860 MHz, IEC/IEEE bus	2067.3004.12
Standard M/N IF 45.75 MHz, RF 50 MHz to 888 MHz, IEC/IEEE bus	2067.3004.72
Standard D/K, stereo/dual sound or standard I, mono IF 38.9 MHz, RF 45 MHz to 860 MHz, IEC/IEEE bus	2067.3004.78

DVB-C Standard Test Receiver *) 4/16/32/64/128/256QAM Output MPEG data stream, constellation diagram IF 36 MHz, RF 48 MHz to 862 MHz, IEC/IEEE bus	2067.3004.20
DVB-C High-End Demodulator *) 4/16/32/64/128/256QAM Output MPEG data stream, constellation diagram IF 36 MHz, RF 45 MHz to 1000 MHz, IEC/IEEE bus	2067.3004.23

TV High-End Demodulator *) Standard B/G, stereo/dual sound IF 38.9 MHz, RF 45 MHz to 1000 MHz, IEC/IEEE bus	2067.3004.33
Standard M/N IF 45.75 MHz, RF 50 MHz to 1000 MHz, IEC/IEEE bus	2067.3004.83
Standard D/K, stereo/dual sound or standard I, mono IF 38.9 MHz, RF 45 MHz to 1000 MHz, IEC/IEEE bus	2067.3004.89

Accessories supplied
Lemo Triax adapter to XLR (stereo), power cable, operating manual

Options

QAM Demodulator (for analog TV units)	EFA-B1	2067.3604.02
NICAM Demodulator Standard B/G	EFA-B2	2067.3610.02
NICAM Demodulator Standard I	EFA-B2	2067.3610.04
RF Preselection (for high-end TV demodulator)	EFA-B3	2067.3627.02
MPEG2 Decoder	EFA-B4	2067.3633.02
Video Distributor	EFA-B6	2067.3656.02
Switchable Video Bandwidth	EFA-B7	2067.3710.02
Residual Picture Carrier Measurement	EFA-B8	2067.3727.02
Pilot Deviation Measurement	EFA-B9	2067.3733.02
6 MHz SAW Filter (for DVB-C units)	EFA-B11	2067.3691.00

Recommended extras

Calibration Kit	EFA-CAL	1032.3999.19
19" Adapter	ZZA-931	0396.9465.00
Lemo Triax connector (mono) with connecting cable		2067.7451.00
Service manual	ERST.2	2068.0950.24

*) **Note:** please fill in configuration sheet (available from your local representative) so that your test receiver / demodulator can be tailored to your requirements.

Fax Reply (TV Test Receiver Family EFA)

❑ **Please send me an offer**
(configuration sheet is enclosed)

❑ **Please send me a configuration sheet**

❑ **I would like a demo**

❑ **Please call me**

❑ **I would like to receive your free-of-charge CD-ROM catalogs**

Others: _____

_____

_____

Name: _____

Company/Department: _____

Position: _____

Address: _____

_____

_____

Country: _____

Telephone: _____

Fax: _____

E-mail: _____

Printed in Germany 0499/0799 (U we)

ROHDE&SCHWARZ

ROHDE&SCHWARZ GmbH & Co. KG · Mühldorfstraße 15 · D-81671 München · P.O.B. 801469 · D-81614 München · Telephone +4989 4129-0
Internet: http://www.rsd.de · CustomerSupport: Tel. +491805124242, Fax +4989 4129-3777, E-mail: CustomerSupport@rsd.rsd.de