R&S®DVQ Digital Video Quality Analyzer

Always in the picture about picture quality

- ◆ Realtime measurement
- ◆ No reference signal required
- ◆ SSCQE scaling of quality levels
- ◆ Monitoring of picture freeze, picture loss and sound loss
- ◆ Program decoding
- ◆ Integrated MPEG-2 decoder
- ◆ Histogram representation of quality levels
- ◆ Recording of quality profile (long-term)
- ◆ Internal event and error report and statistics

ROHDE&SCHWARZ

With the R&S®DVQ Digital Video Quality Analyzer, the assessment of picture quality according to subjective criteria becomes an objective realtime measurement method. Picture quality is assessed from artefacts produced by digital compression. The method is based on the analysis of video data and can thus also be used where no reference video material is available. To this end, the optional PC software Quality Explorer™ is available, allowing complete display and analysis of all coding data as well as convenient remote control of the R&S®DVQ and display of the recorded quality data.

The increasing use of digital, data-compressed TV signals calls for monitoring and assessment of the picture quality. Picture quality assessment is very strongly influenced by the subjective perception of the human eye.

The R&S®DVQ is a tool that ideally satisfies both requirements. It determines the picture quality in relation to digital compression and evaluates the results according to the subjective criteria of visual perception.

In the year 2000 Rohde & Schwarz won an EMMY Award for R&S® DVQ in the category "Pioneering development of equipment to provide objective measurement of perceptible picture quality in digital television systems"

Characteristics

The method adopted for determining the quality is based on the analysis of DCT-coded video data applied to the R&S®DVQ in a MPEG-2 transport stream. The additional SDI input also allows evaluation of decompressed video data.

Another important feature is quality analysis being performed in realtime so that any potential quality degradation can immediately be recognized and remedied. Moreover, this method allows long-term recording, monitoring and evaluation of picture quality.

The unique combination of realtime capability and independence from a reference signal make the R&S®DVQ an indispensable tool in the quality assessment of digital, DCT-coded video sequences.

Representation of quality levels

The intermediate values determined by video data analysis are differentiated according to luminance (Y) and chrominance (Cb and Cr) (R&S®DVQL-U). In a further automatic processing step the quality values are assessed according to the subjective masking effects produced by high temporal and/or spatial activities of the picture. The result of analysis is a reproducible quality level (R&S®DVQL-W) from "excellent" (100) to "bad" (0) on a SSCQE scale (see box) that is optimally adapted to the subjective picture perception.

The four parameters obtained can be read out in the following display modes:

◆ Bargraph (see front view of the R&S®DVQ)
◆ Numeric display
◆ Long-term profile (screenshot 1)
◆ Histogram (screenshot 2)

For long-term recording of the quality levels, a time between five seconds and five hours can be selected.
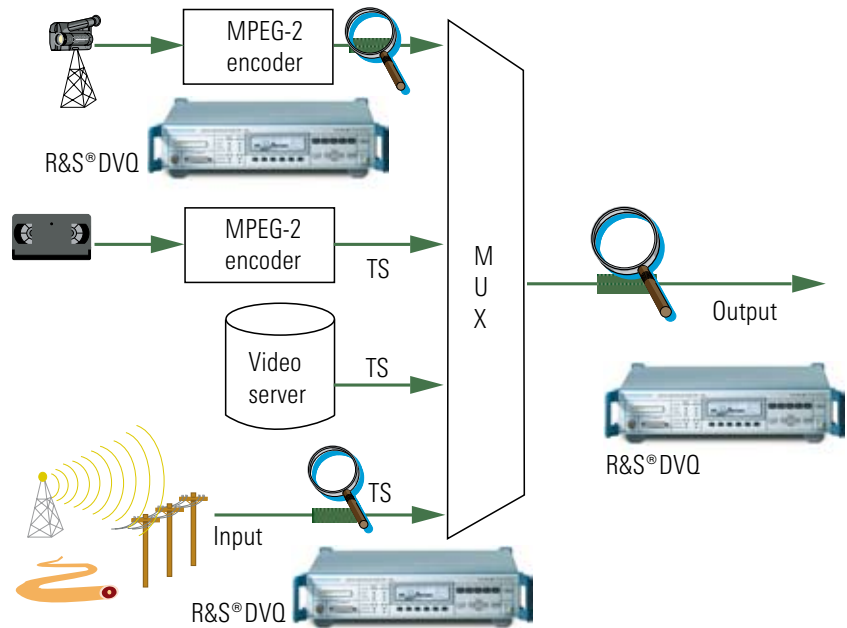
Playout center

Recording of broadcasting failures

The R&S®DVQ also detects and signals failures such as picture freeze, picture and sound loss (left and right separately) as well as failure to reach a defined minimum picture quality. All these events are continuously recorded in realtime in a report (screenshot 4) stating time, duration, program concerned, etc. Representation of the report can optionally be filtered according to the type of event. In this way any type of interference can exactly be reproduced and analyzed at a later date.

In addition to the report, events are also recorded according to the type of event with error seconds of the failures. Moreover there is an overview of all programs contained in a transport stream and of their current status regarding failures and picture quality.
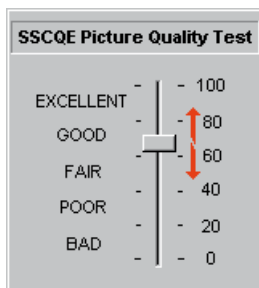
Quality scale for comparative (DSCQS) and absolute (SSCQE) subjective assessment of picture sequences

To make subjective quality ratings comparable, ITU (International Telecommunication Union) has specified two main test methods: the DSCQS (double stimulus continuous quality scale) method is exclusively used for comparative quality assessments. The SSCQE (single stimulus continuous quality evaluation) method is based on a single observation of the sequence to be assessed.

During the presentation the test person moves a slider on a scale from 0 (bad) to 100 (excellent) according to his/her subjective impression of picture quality. This method can be used when no original sequence is available as a reference and corresponds better to the real-life situation of the TV viewer who cannot see the picture recorded in the studio and to the measurement method implemented in R&S®DVQ.

Decoder

In addition to the analysis unit, the R&S®DVQ also has a built-in decoder for audio and video data in the format Main-profile @ MainLevel and 4:2:2 Profile @ MainLevel. The program being analyzed is decoded and can simultaneously be viewed on a connected video monitor (CCVS or ITU-R 601 or SMPTE259M formats). The audio signals are available at the connectors both in analog and digital form (AES/EBU).

Alarm outputs

Altogether 12 relay outputs which can be allocated to one or several (ORed) events are fitted as standard. The switching mode (active when open or closed) can be set separately for each relay. In addition to the data interfaces, floating switching contacts are thus available for external signalling of failures and quality degradations.

Scan mode for several programs

An MPEG-2 transport stream usually contains several programs made up of video and audio data streams. For automatic monitoring of all programs, a scan mode is provided in the R&S®DVQ allowing all or selected programs to be successively analyzed for picture quality and interference over a selectable period of time. The threshold values for the detection of picture freeze, picture and
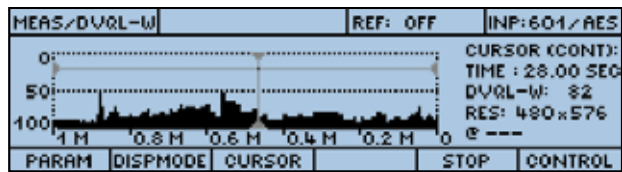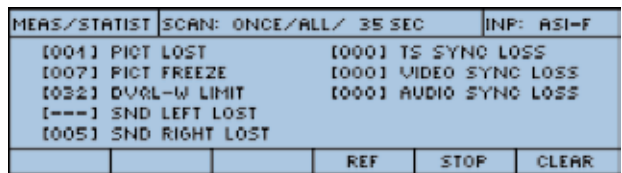
Long-term profile
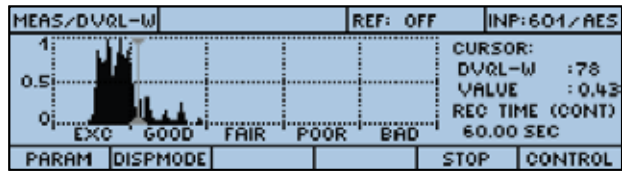
*Histogram*
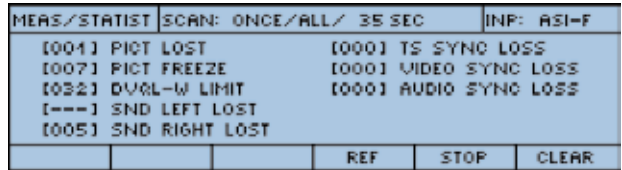
Error statistics

Time-related repor

sound loss as well as the minimum value for picture quality can be set separately for each program in the scan mode. Plus, the user can select – for each of these tests and separately for each program – after how many scans with consecutive errors a given error is to be recorded and processed. Thanks to these two setting facilities, monitoring can be optimally adapted to the specific characteristics of each program transmitted.

Comparative measurements

For comparative quality measurements the quality analysis can simultaneously be carried out on two different signals.

Quality analysis is carried out completely independently for each signal and the final result is formed from the differences found. There is no pixel comparison of two video data sources in this mode either. The reference signal as an uncompressed SDI video stream (in line with ITU-R 601/656 or SMPTE259M) or as a transport stream (ASI, SPI, or SMPTE310M with R&S®DVQ-B3 option) is applied to the R&S®DVQ input that is not occupied by the signal to be analyzed. The R&S®DVQ automatically detects and compensates for any delay of up to ±5 s between the reference and the test signal.
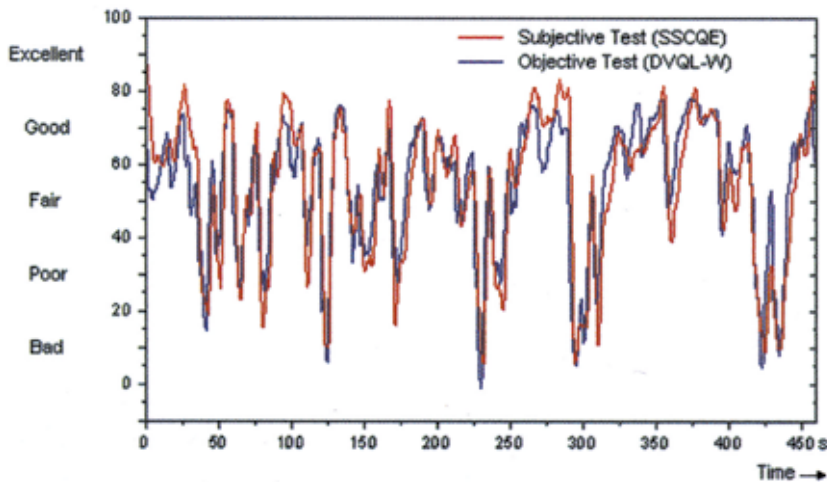
Comparison of objective test results (R&S®DVQL-W) and subjective quality assessments (SSCQE) for 480 s sample sequence

Operation

The R&S®DVQ can be controlled manually via the keypad with fast-access keys for the main menus and softkeys for the submenus. The displayed contents of the clearly arranged LCD is inserted into the decoded picture at the video output. With a recorder connected the quality ratings can be logged together with the associated picture contents.

Remote control

The R&S®DVQ features full remote-control capability via the RS-232-C or Ethernet interface using the same commands in SCPI language. When using the Ethernet interface, the TCP/IP and SNMP protocols are available.

The R&S®DVQ has a built-in 32 Mbit memory for transport stream data. Depending on the data rate of the video stream, the memory is sufficient for storing a video data sequence of approx. five to ten seconds. The sequence can be read out for in-depth analysis via one of the remote-control interfaces using for instance the Quality Explorer™ (see data sheet PD 0757.5450).

*Clearly visible blocking effects on digitally coded TV picture and – by comparison –
picture without blocking*

Applications

The unique combination of realtime capability and independence from a reference signal opens up a wide field of applications for the R&S®DVQ. Long-term recording and evaluation allows quality assessment that is closer to reality than that of short standardized test sequences.

Quality monitoring in distribution networks

The R&S®DVQ allows the picture quality to be monitored during program transmission and in realtime. Degradations in quality and failures can be recognized at an early stage so that remedial measures can be taken in time. Since the analysis method employed does not require any reference signals, the R&S®DVQ is suitable for use wherever MPEG-2-coded video data are transmitted or received.

The R&S®DVQ can be used to document the picture quality versus time at the gateway between two different networks. This could for instance be used as an evidence for the contractual performance of services.
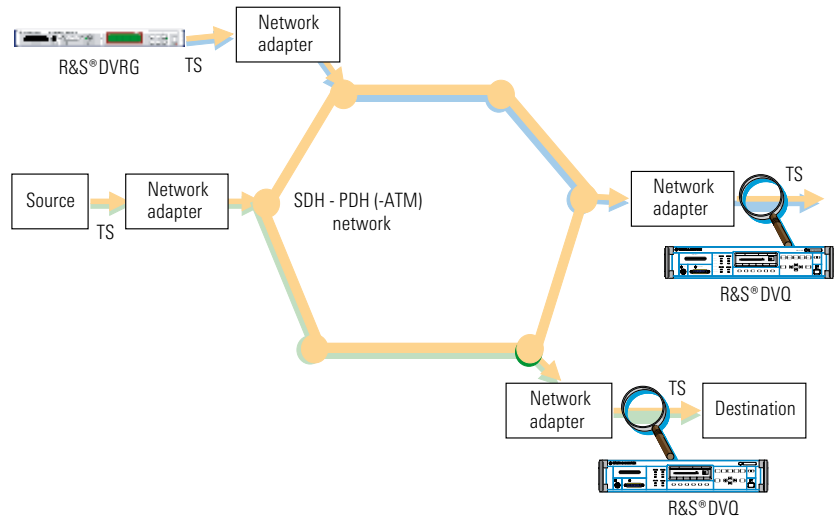
The network compatibility of the R&S®DVQ ensures optimum integration into monitoring systems.

The R&S®DVQ in conjunction with the R&S®DVRG DTV Recorder Generator (see data sheet PD 0758.1006) and, optionally, the R&S®DVM100 forms a complete monitoring system with recording capability even for very rare disturbances. The relay outputs of the R&S®DVQ and the R&S®DVM100 are connected with the trigger input of the R&S®DVRG, whose elaborate trigger characteristics make it possible to record a transport stream section of arbitrary length before and after an error event for subsequent detailed analysis.
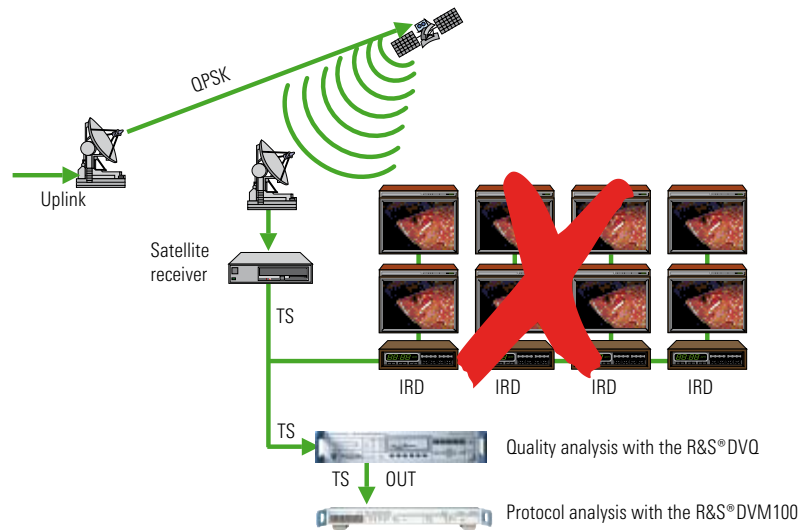
Program quality assessment

Again it is a benefit that the measurement method is based on the analysis of video data and does not need reference pictures. Instead of lengthy observations carried out by a test person, unknown program material can automatically be checked for its picture quality.

Development as well as evaluation and setting of operational hardware

In the following application examples comparative quality measurement is mainly used since the changes in picture quality are of significance.

The R&S®DVQ provides fast and automated evaluation of encoder algorithms and multiplex methods. The advantage here is that the evaluation is made according to subjective aspects under real conditions of use and with real program material.

Furthermore the R&S®DVQ provides the means of optimizing the operational settings so that transmission can be as efficient and with as little resources as possible (low data rate), whilst maintaining the required minimum quality.

Testing of set-top boxes

The effects of the receiver and internal processing on picture quality can conveniently be determined with the aid of the R&S®DVQ.

To this end, the MPEG-2 transport stream is tapped at the common interface of the set-top box using a suitable adapter (R&S®SFQ-Z17). The artefacts in the test signal produced by coding can be excluded from analysis when using the reference mode.

Thanks to its two remote-control interfaces the R&S®DVQ can ideally be integrated into automatic production environments and systems.

Network monitoring

R&S®DVRG — TS — Network adapter

Source — TS — Network adapter — SDH - PDH (-ATM) network — Network adapter — TS

R&S®DVQ

Network adapter — TS — Destination

R&S®DVQ

Satellite uplink

QPSK

Uplink

Satellite receiver — TS

IRD   IRD   IRD   IRD

TS — Quality analysis with the R&S®DVQ

TS   OUT

Protocol analysis with the R&S®DVM100

Error analyses with R&S®DVRG and realtime analyzers

DUT — Transport Stream MPEG-2

R&S®DVM100

R&S®DVQ

TRIG — TS ▲ OUT — TS — R&S®DVRG

IN — IN

R&S®Quality Explorer™   Video ES Analysis

Options

R&S®DV-B310 SMPTE310M Interface
This option is a serial interface to SMPTE310M standard for ATSC. It replaces the TS/ASI input on the R&S®DVQ's front panel.

R&S®DVQ-B1 software Quality Explorer™
The optional software package is installed on an external Pentium II PC and connected to the R&S®DVQ via the serial or Ethernet interface. It allows in-depth display, analysis and decoding of the coded video data in MPEG-2 format down to bit and byte level.

The following display modes are possible:

◆ Header and extension data at sequence, group and picture level
◆ Information at picture, slice and macro block level
◆ Type, DC value and motion vectors per macro block
◆ Macro block statistics and decoding of each individual macro block
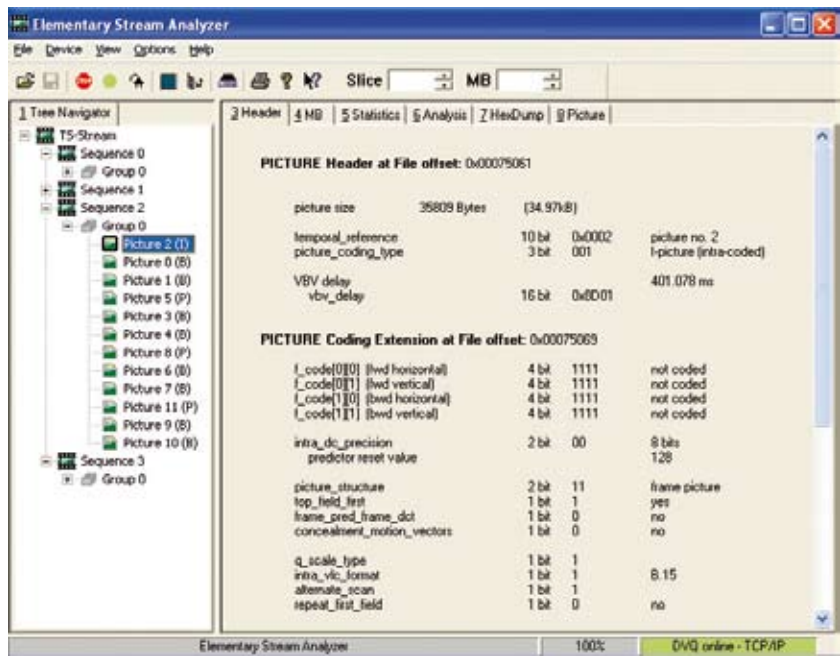
Clear display of header information with Elementary Stream Analyzer, shown here by the picture header
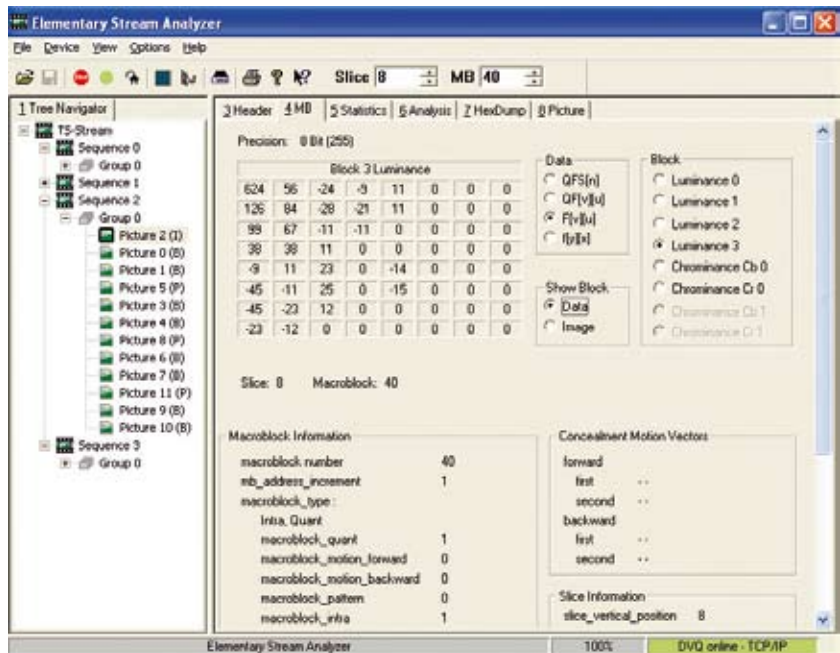
Comprehensive display of all macroblock data satisfies any information requirement

Software Quality Monitor™

This is a free-of-charge extra for the R&S®DVQ which allows remote control of the unit and reading of measured values (temporal and spatial activities, data rate, R&S®DVQL-W quality values) from an external Windows-operated PC. The R&S®DVQ is connected to the PC via serial or Ethernet interface. Measured values can be continuously stored in a data memory and graphically displayed using a compatible interchange format (CSV).
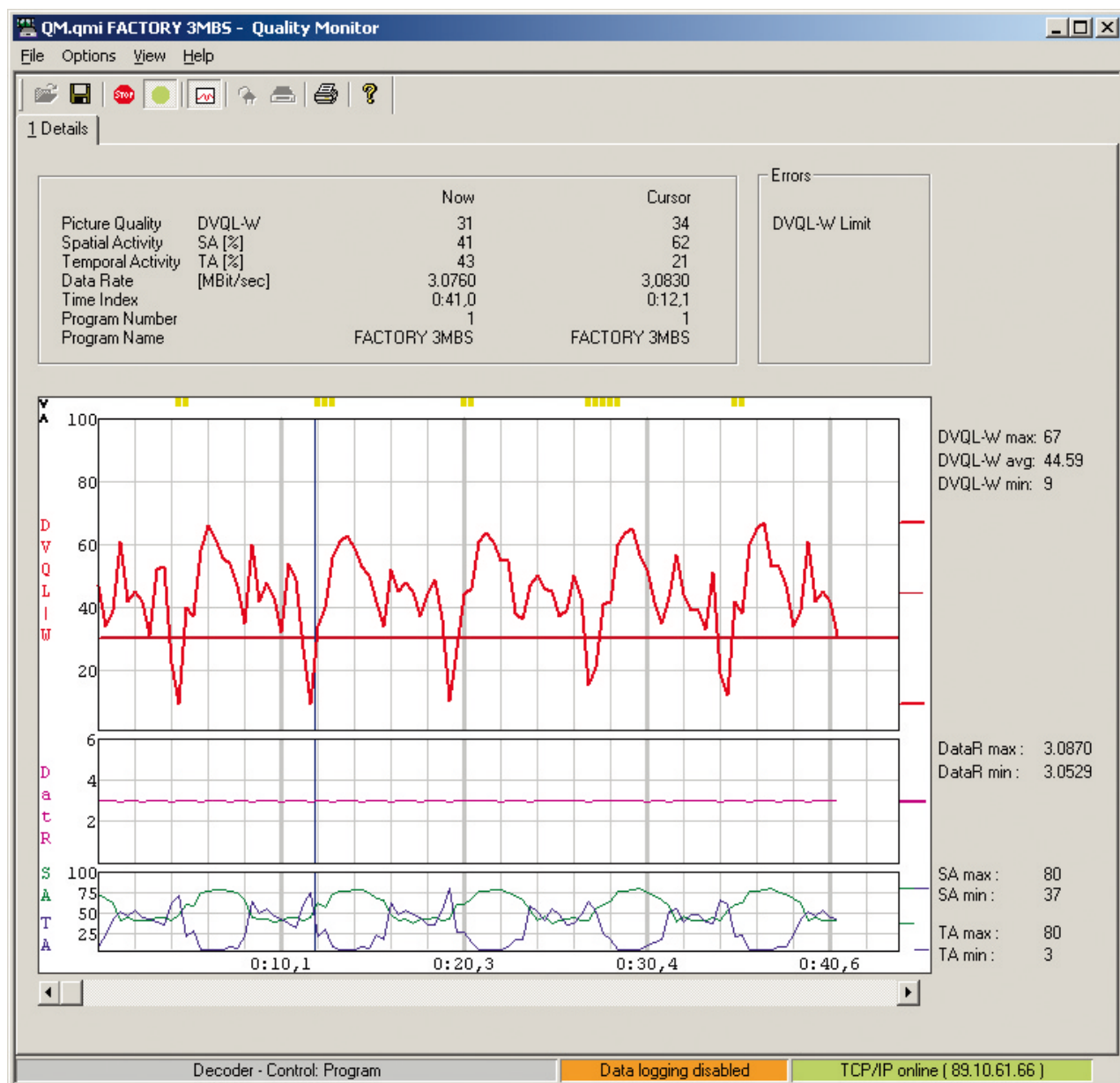
Quality Monitor for realtime logging and graphical display of quality levels determined by the R&S®DVQ

Specifications

Signal inputs	
MPEG-2 transport stream	to ISO/IEC 13818-1
Length of data packets	188/204/208 byte
Synchronous parallel (SPI-LVDS, to DVB-A010)	25-pin connector on front panel 100 mV to 2 V (Vpp), 100 Ω
Data rate	up to 80 Mbit/s
Asynchronous serial 270 Mbit/s (ASI, to DVB-A010)	BNC connector on front and rear panel 200 mV to 1 V (Vpp), 75 Ω
Data rate	up to 72 Mbit/s
Synchronous serial (SSI, to SMPTE310M)	BNC connector on front panel with R&S®DV-B310 option
Data rate	19.392658 Mbit/s, ±500 Hz
Video serial digital 270 Mbit/s (SDI, to ITU-R 601/656 or SMPTE259M)	BNC connector on rear panel in line with SMPTE259M
Audio serial digital (AES/EBU)	LEMO Triax connectors on rear panel 400 mV to 12 V (V pp), 110 Ω
Integrated MPEG-2 decoder	
Supported formats:	
Video	MPEG-2 422P@ML
	MPEG-2 MP@ML
	MPEG-2 SP@ML
Audio	MPEG-1 layer I or II
	MPEG-2 layer I or II
	Dolby AC-3 (stereo downmix)
Signal outputs	
MPEG-2 transport stream	to ISO/IEC 13818-1
Asynchronous serial	BNC connector on rear panel
270 Mbit/s (ASI, to DVB-A010)	looped through from input
Video CCVS (PAL, SECAM, NTSC, MPEG-2 transport stream)	BNC connector on rear panel 1 V ±1 % (V pp), 75 Ω
C/L gain	±2 % (measured on 20T signal)
C/L delay	±30 ns (measured on 20T signal)
Return loss (0 Hz to 6 MHz)	34 dB
Frequency response (typical values, measured with multiburst signal)	
0 Hz to 3 MHz	+2 %/−2 %
<4 MHz	+2 %/−5 %
<5 MHz	+2 %/−15 %
Video serial digital 270 Mbit/s (SDI, to ITU-R 601/656 or SMPTE259M	BNC connector on rear panel 800 mV (V pp), 75 W
Audio	unbalanced, not floating
Level (full scale)	6/9/12/15 dBu ±0.5 dB
Frequency response (60 Hz to 15 kHz)	±0.5 dB relative to 1 kHz, into 600 Ω
S/N ratio	>70 dB, unweighted
THD	>70 dB
Audio left, audio right	LEMO Triax connectors on rear panel <50 Ω
Audio serial digital (AES/EBU)	LEMO Triax connectors on rear panel 4 V (Vpp), 110 Ω

Operation

Manual control	front-panel keys with LCD, output of test results on LCD as well as text inserted in video output signal
Remote control	via RS-232-C interface or Ethernet (network)
Interfaces	
Serial interface	9-pin D-sub connector on rear panel RS-232-C, 9600 baud to 115 000, remote control, SCPI commands

Parallel interface	25-pin D-sub connector on rear panel printer output
Network	RJ-45 connector on rear panel Ethernet, 10BaseT, 10 Mbit/s remote control, system integration
Protocols	TCP/IP, SNMP
Relay outputs	15-pin VGA connector on rear panel
Number	12 with any allocation to events, ORed in case of allocation to several events
Active state	separately selectable (open or closed)

Test parameters

Events	sound loss left sound loss right picture loss picture freeze quality below (user-selectable) threshold
Recording	
Statistics	error seconds of events according to type display selectable according to type
Report	listing of events according to time optional filtering according to type display per entry: time, duration, PID, type
Video data analysis	temporal activity spatial activity digital video quality level, unweighted (R&S®DVQL-U), separately for luminance and chrominance (Y, Cb, Cr) digital video quality level, weighted (R&S®DVQL-W) total level corresponding to subjective assessment
Display	
Current values	bargraph numeric values
Recorded values	time profile histogram
Time frame for recording	5/10/30 s, 1/5/10/30 min, 1/2/5 h single-shot or continuous
Reference measurement	
Delay	±5 s, automatically detected

General data

Rated temperature range	+5 °C to +40 °C
Operating temperature range	0 °C to +45 °C
Storage temperature range	–40 °C to +70 °C
Mechanical resistance	
Vibration, sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, max. 0.5 g in range 55 Hz to 150 Hz, in line with IEC 68-2-6, IEC 1010-1 and MIL-T-28800D class 5
Vibration, random	10 Hz to 300 Hz, acceleration 1.2 g (rms)
Shock	40 g shock spectrum, in line with MIL-STD-810D and MIL-T-28800 D class 3 and 5
Climatic resistance	95% rel. humidity, cyclic test at +25 °C/+40 °C, in line with IEC 68-2-30
Electromagnetic compatibility	in line with EN 50081-2 and 50082-2 (EMC directive of EU)
Power supply	100 V to 240 V ±10 %, 50 Hz to 60 Hz ±5 %
Power consumption	20 W (without options)
Electrical safety	in line with EN 61010-1
Dimensions (W × H × D)	427 mm × 88 mm × 450 mm 16.81 in × 3.46 in × 17.72 in
Weight	5.7 kg (without options) 12.57 lb

Ordering information

Designation	Type	Order No.
Digital Video Quality Analyzer	R&S®DVQ	2079.6003.03
Accessories supplied	power cable, operating manual, audio adapter (LEMO Triax to XLR), modem bypass cable	
Options		
Quality Explorer™ Software	R&S®DVQ-B1	2079.7151.02
Quality Monitor™ Software	available free of charge at www.rohde-schwarz.com	
SMPTE310 Input	R&S®DV-B310	2085.7543.02
Calibration Data Documentation	R&S®DVQ-DCV	2082.0490.20
Recommended extras		
Common Interface Adapter TSout	R&S®SFQ-Z17	2081.9364.02
19" Rack Adapter (2 height units) for installation with handles (rackmount without handles on request)	R&S®ZZA-211	1096.3260.00
Service Manual		2079.7951.24

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More information at
www.rohde-schwarz.com
(search term: R&S®DVQ)

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