OPTICOM

Voice Quality Testing

Audio Quality Testing

Video Quality Testing

Data Quality Testing

OPTICOM Product Line:	
Voice Quality Testing	
PSQM	ITU-T P.861
PESQ	ITU-T P.862
3SQM	ITU-T P.563
ECHO	
Audio Quality Testing	
PEAQ	ITU-T BS.1387
Video Quality Testing	
PEVQ	
Network Quality Testing	
VQmon	

PEVQ™ Analyzer
Perceptual Video Quality-of-Experience Measurement

The new **PEVQ Analyzer** evaluates the quality of multimedia (QCIF, CIF, VGA), SD and HD video formats based on perceptual video quality-of-experience measurement, reliably and objectively. The system allows for synchronous SD and HD play-out and recording over a range of interfaces (HD-SDI, DVI) and comes with a high-performance, front accessible array of hard disk drives.

Perceptual Evaluation of Video Quality (PEVQ) is an accurate, reliable and fast video quality measurement technology, developed by OPTICOM. It provides mean opinion score (MOS) analysis of the video quality degradation occurring through a network, e.g. in mobile and IP-based networks. PEVQ can be ideally applied to test video telephony, video conferencing, video streaming, and IPTV applications.

PEVQ is a full-reference, end-to-end measurement based on signal analysis: The degraded video signal output from a network is analyzed by comparison to the undistorted original reference video signal on a perceptual basis. Based on the approach to model the human visual system, PEVQ can detect anomalies in the video signal and quantify them by a multitude of key performance indicators (KPIs). With PEVQ one can analyze the video quality based on a human visual model, thus representing the true image quality as perceived by subjects, for example paying subscribers. Its value proposition is obvious: equipment manufacturers, network operators and service providers

can analyze QoE issues and optimize next generation networks and thus avoid customer's dissatisfaction, which otherwise might lead to complains or churn.

OPTICOM, the leading provider of signal based perceptual measurement technology for voice, audio and video, offers its new easy to use PEVQ testing technology in combination with its proven audio quality analysis techniques **PESQ** (Perceptual Evaluation of Speech Quality) and **PEAQ** (Perceptual Evaluation of Audio Quality). The combination with these state-of-the-art test algorithms allows for audio-visual quality analysis and thus provides useful means for lip-sync artefact measurement.

Users can choose among the PEXQ software suite for Windows™ and the PEVQ Analyzer. PEVQ is also available as an OEM solution and has been adopted by a range of leading industry partners (see www.pevq.org for further information on third parties' product availability).

PEVQ is based on the earlier PVQM technology developed by KPN Research and new developments of OPTICOM. The PEVQ analyzer is produced in cooperation with DVC Germany (www.digitalvideo.de).

PEVQ has been verified by the Video Quality Experts Group in 2008 and is going to be proposed for International Standardization.

**NEW:
VQEG approved for standardization**

Key Features:

- Accurate, reliable and fast objective analysis of perceived video quality

- Full reference based end-to-end quality analysis

- Outputs MOS score that correlates well with subjective MOS

- Additional KPIs for detailed analysis

- Measurement of multimedia (QCIF, CIF, VGA), SD and HD video quality

- Applications: IPTV, streaming video, 3G, video telephony

- Performance verified and recommended for standardization by the Video Quality Experts Group (www.vqeg.org) 2008

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Comfortable Graphical User Interface

The PEVQ Analyzer desktop combines PEXQ (1), OPTICOM's unified graphical user interface providing a Quad-KPI set for voice, audio, video and data analysis, and QuickClip (2) (powered by Drastic Technologies) for comfortable play-out and record. The PEXQ view window (3) allows for visual frame-by-frame overlay comparison of original, degraded (test) signal and PEVQ internal error patterns.

Split View Overlay

The PEXQ split screen feature of the viewer window allows for a 1:1 comparison of the degraded (test) video with the original reference by horizontal and/or vertical split of the overlay. This display feature is ideally suited for codec developers and cause analysis, as sliding through the image may visualize even slight deviations from the original (left half of the image). In this HD IPTV example, bit errors were inserted during the IP transport (visible in the right half of the image).
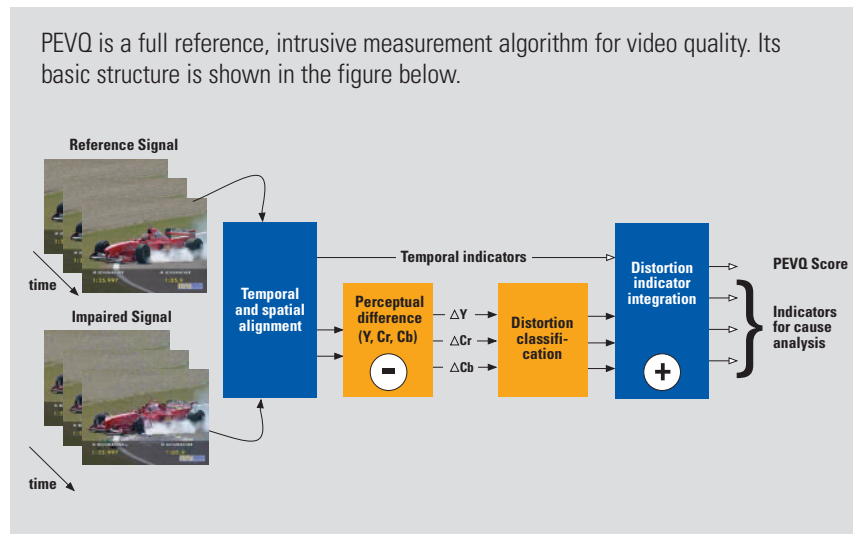
Principle

The algorithm can be divided up into four separate blocks. The first block – pre-processing stage – is responsible for the spatial and temporal alignment of the reference and the impaired signal. This process ensures that only corresponding frames are compared to each other.

The second block calculates the perceptual difference of the aligned signals. Perceptual means that only those differences are taken into account which are actually perceived by a human viewer. Furthermore the activity of the motion in the reference signal provides another indicator representing the temporal information. This indicator is important as it takes into account that in frame series with low activity the perception of details is much higher than in frame series with quick motion.

The third block in the figure classifies the previously calculated indicators and detects certain types of distortions.

Finally, in the fourth block all the appropriate indicators according to the detected distortions are aggregated, forming the final result - the mean opinion score (MOS). The MOS value describes the video quality on a

PEVQ is a full reference, intrusive measurement algorithm for video quality. Its basic structure is shown in the figure below.

range from 1 for very bad quality, to 5 for excellent quality. Besides the final quality score additional indicators are provided at the output of the algorithm for further cause analysis.

This approach to video quality estimation includes the effects of both packet level impairments (loss, jitter) and signal related impairments such as blockiness, jerkiness, blur and distortions caused by coding processes.

Future releases will be further optimized in computational performance and prediction accuracy for high definition video.

OPTICOM's PEVQ is one of the two top-ranked models in the 2008 Video Quality Experts Group (VQEG) multimedia evaluation and approved for standardization.

Human Visual Model View
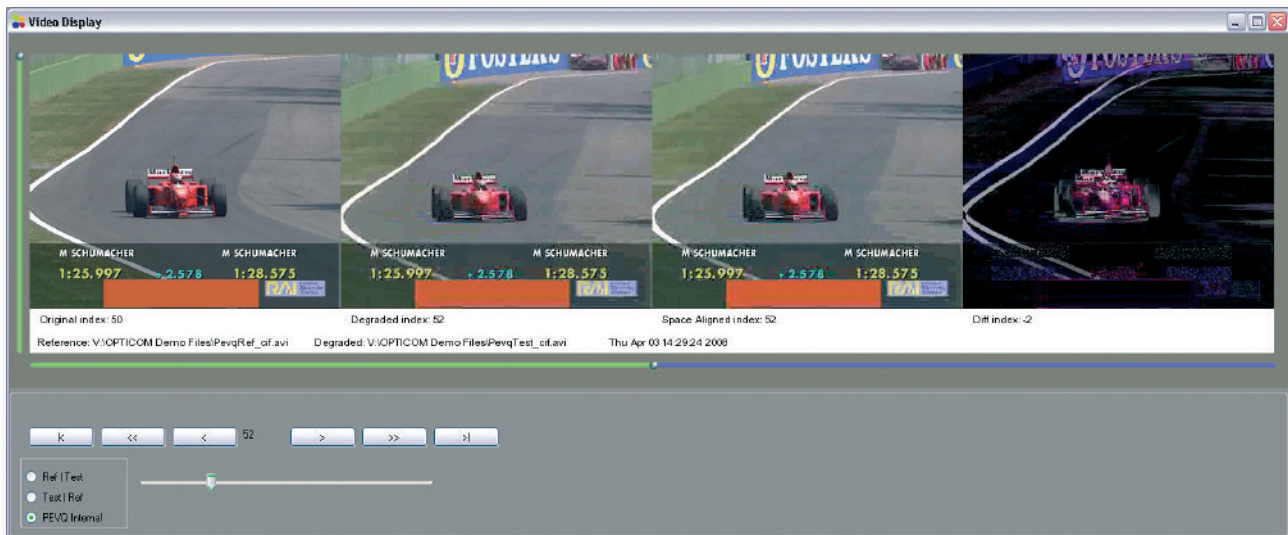
The internal PEVQ views expose an insight to the human visual model at work. From left to right:

1) Frame of the original reference sequence

2) Corresponding frame of the degraded (test) signal

3) Degraded signal after temporal and spatial alignment

4) Difference error pattern according to PEVQ's human visual model, this perceptible error forms the basis for the MOS calculation.

In the example shown, it can be noted that the degraded signal contained a lower frame rate than the original, which leads to temporal and spatial alignment artefacts that may contribute to the error pattern for the particular frame analyzed. (This example was pictured intentionally for illustration purposes).

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Clip Recorder/Player

The PEVQ Analyzer employs the QuickClipXO clip-recorder toolset (powered by Drastic Technologies) for comfortable system configuration, play-out and record control. A variety of common SD (625/50 or 525/60) and HD (720p, 1080i, 1080p) format settings are supported.

Comprehensive Numerical and Graphical KPI Set

Detailed graphical output for PEVQ: The 'Summary' window (top) includes information on the analyzed reference and test video files like frame rate, duration and pixel resolution. On the right the overall PEVQ MOS is depicted in a coloured bar graph that turns from red (bad quality) to green (good quality). The lower window allows for more detailed cause analysis based on a number of state-of-the-art KPIs, including PSNR. The radar chart to the right presents a multidimensional error indicator, including temporal, luminance and chrominance information along with indicators for blur, jerkiness and blockiness.

Output

PEVQ MOS
The PEVQ MOS value lies within a range from 1 (bad) to 5 (excellent). The PEVQ MOS is based on a multitude of perceptually motivated parameters.

Distortion indicators
For a more detailed analysis the perceptual level of distortion in the luminance, chrominance and temporal domain are provided.

Delay
The min, max and mean delay of each frame of the test signal related to the reference signal, as well as delay vs. time.

Brightness
The brightness of the reference and degraded signal.

Contrast
The contrast of the distorted and the reference sequence.

PSNR
To allow for a coarse analysis of distortions in different domains the PSNR is provided for the Y, Cb and Cr components separately.

Jerkiness
describes the smoothness of a video playback which is often impaired by down-sampling, coding processes and perturbed transmissions.

Blur
is a distortion characterized by reduced sharpness of contour edges and spatial detail.

Blockiness
is often the result of a low bit rate coding that uses a block matching algorithm for the motion estimation and a coarse quantization for the image blocks.

Frame Skips and Freezes
are temporal artefacts occurring in video transmissions caused by e.g. overloaded networks.

Effective Frame Rate
Down-sampling of a video signal on a frame by frame basis often results in loss of information which often leads to the degradation of the video signal. The effective frame rate is an indicator quantifying the severeness of such a process.

### Temporal Activity and Spatial Complexity
Temporal activity and spatial complexity indicators quantify the amount of activity/movement and spatial detail in the video content. These indicators are derived from ITU-T recommendation P.910.
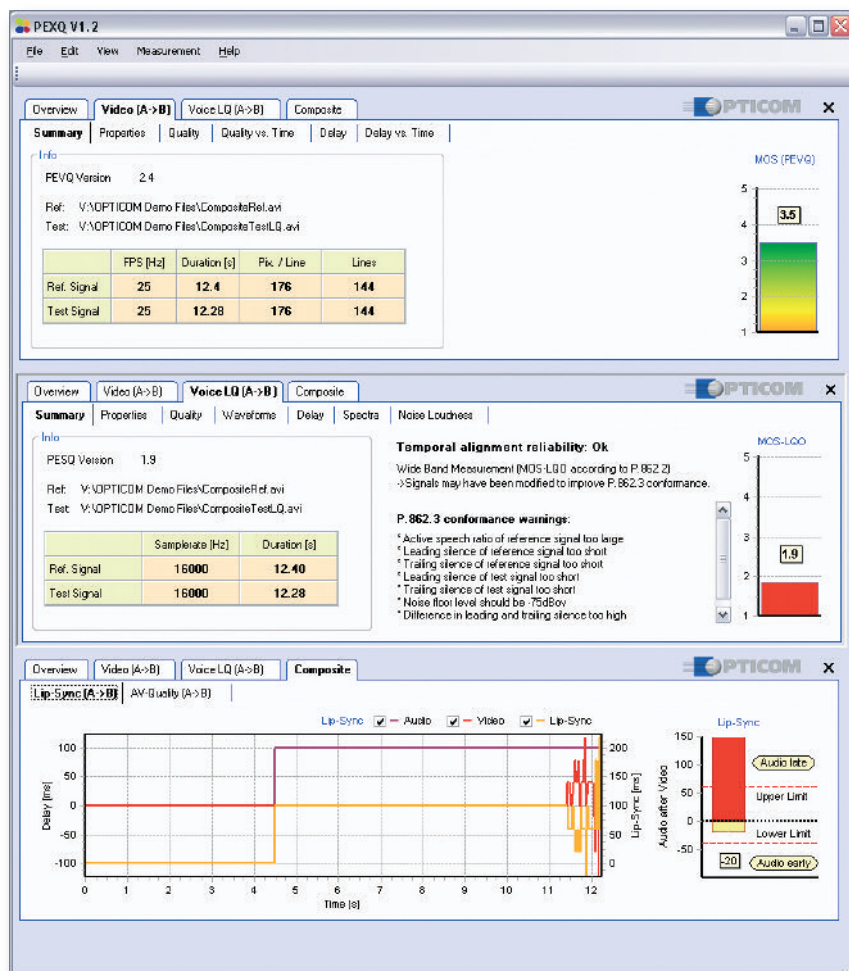
New in PEXQ: The composite result view for audio-visual quality analysis reporting the video MOS (PEVQ) (upper frame) and the audio MOS (PESQ) (middle frame). The combination of perceptual video and audio quality measures allows for detailed lip-sync analysis based on time-variant delay analysis (lower frame).

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Superior Accuracy

In the course of International Standardization of video quality metrics, in 2007 and 2008 the Video Quality Experts Group (www.vqeg.org) conducted a huge test series of 41 validation tests run across twelve different labs in Europe, USA and Asia. OPTICOM's PEVQ showed superior performance and is going to be proposed for standardization. Most importantly, PEVQ could also significantly outperform PSNR, a commonly used industry metrics for objective video quality estimation.
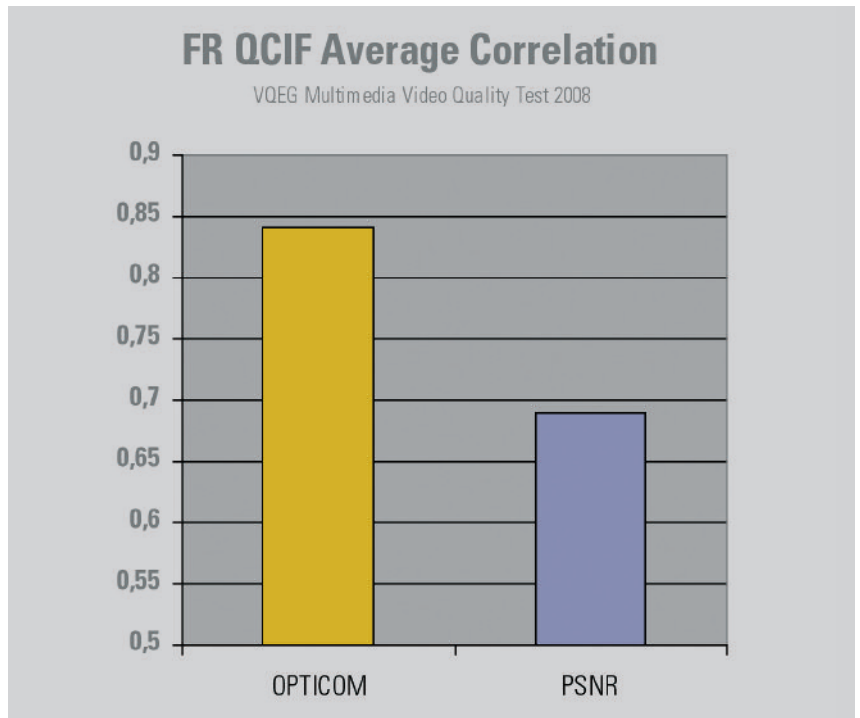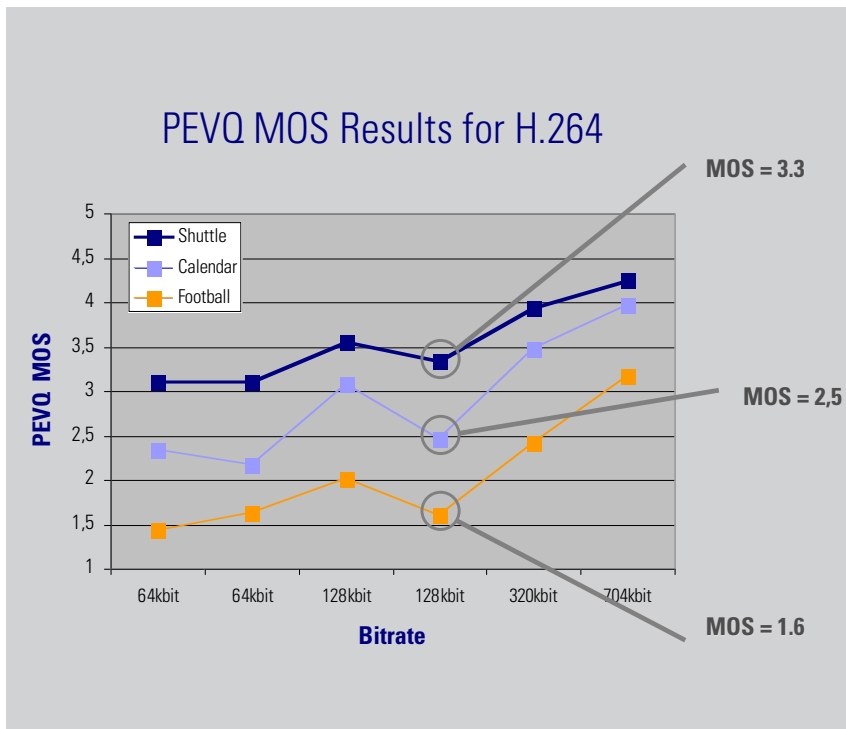

Subjective Validation

The accuracy of PEVQ has been trained on a huge number of human visual test databases. The photo shows OPTICOM's subjective test setup which is in line with ITU-T Rec. P.910 and further adaptations developed by VQEG for the multimedia test series.

Product Differentiator

PEVQ MOS Results for H.264

The image quality of advanced video codecs, like H.264, does very much depend on the content material and in particular at lower bitrates significant performance deviations can be observed for various programme material. In the diagram one and same H.264 encoding was applied to three test sequences of differing, individual complexity. As a result, the measured MOS scores vary between 3,3 and 1,6, a significant content depending difference which outlines why NGNs carrying IPTV and multimedia services need to be analyzed by true perceptual signal analysis like PEVQ. An example that clearly shows why packet-loss analysis based E-model estimates simply can't tackle this level of performance issue.

Application to IPTV and IMS Architectures
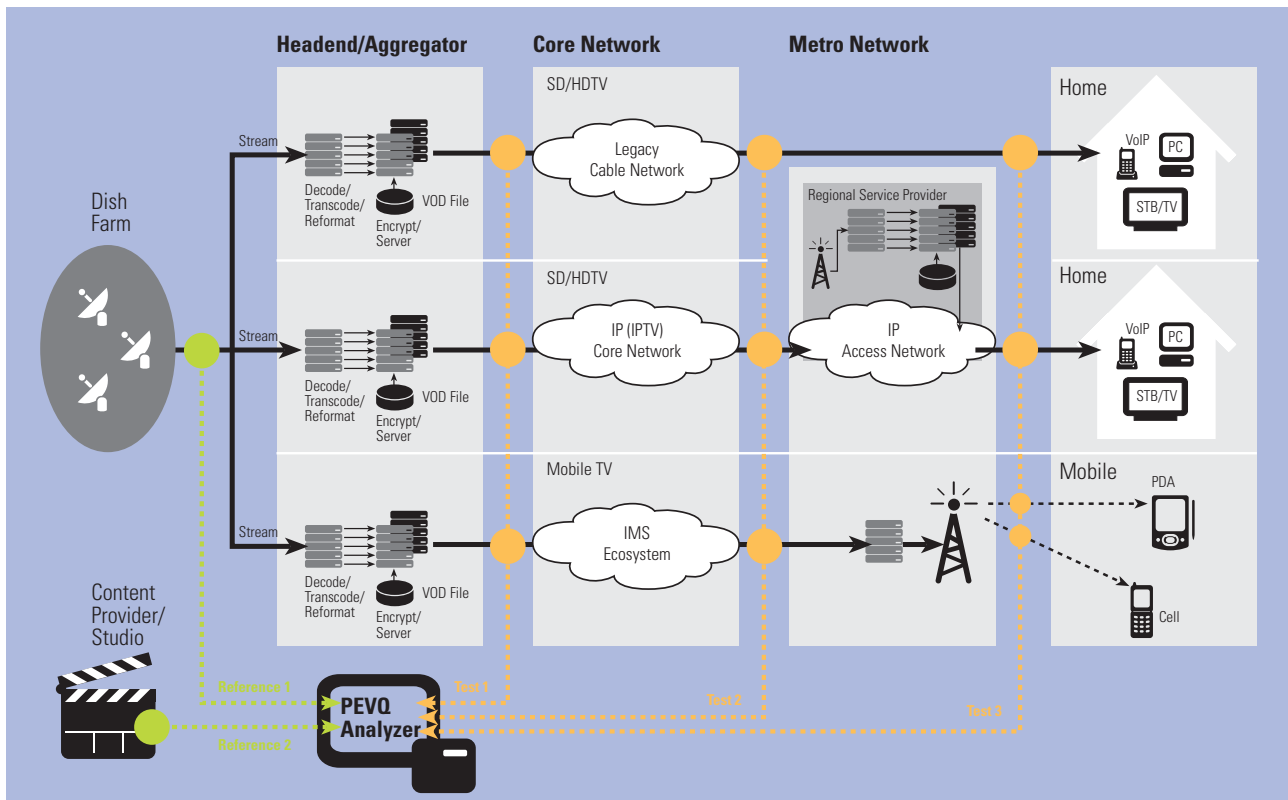
PEVQ is a full reference video quality measure that compares the original signal from the satellite downlink (reference1) or a stored reference from the studio (reference2) with the test signal, degraded by transmission artefacts. Test Signals can be acquired e.g. after transcoding at the headend (test1), at the edge of the core (test2) or the metro (test3) network, i.e. at the subscriber broadband tools (STB or Mobile TV). The application to network segments represents a very useful toolset for service assurance and SLA compliance testing.

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Specifications

PEVQ - Perceptual Evaluation of Video Quality

Functionality

- Perceptual Evaluation of Video Quality-PEVQ, with mapping to MOS scale (1 bad, … 5 excellent quality)
- Analysis of multimedia, SD and HD video formats

Input

- Raw YUV, AVI Files with RGB24, YUV444, YUV422 or YUV420 data, any frame rate from 2,5 up to 60 fps
- Video test sequences of 6 to 20 seconds duration

Ordering Information

PVQ-101-000-D
- PEVQ Analyzer, Desktop Version (DVC Boxxster)
- Single channel SD/HD SDI Interface for capturing video (uncompressed reference video play-out OR test record)
- Available with internal SATA-2-Storage 480 GB, 720 GB or 1200 GB (others on request)

PVQ-102-000-R
- PEVQ Analyzer, Rack-mountable Version (DVC Cliprecorder AVX2)
- Dual channel SD/HD SDI Interface for capturing video (uncompressed reference video play-out AND test record)

PVQ-00X-XXX-S
- PEVQ Analyzer, Software-only Version (for upgrade of existing DVC Boxxster/Cliprecorder systems)

Optional available on request:
- Rack-mountable 1U breakout box incl. SD/HD SDI I/O and analog/digital audio
- SD/HD SDI to DVI converter
- System flight-case (wheeled)

NOTE:
The PEVQ Analyzer comes with pre-configured system installation, system documentation, hard disk array as specified, break-out cables for analog video and analog/digital audio (Stereo), USB keyboard and mouse. The system does NOT include a monitor as shown on the first page.

About OPTICOM

OPTICOM GmbH is the leading vendor for voice, audio and video quality measurement technology and OEM products for mobile and IP based network testing. With PSQM, PESQ, PEAQ and P.563, the pioneers in perceptual quality testing have been providing by now four international world-class standards for voice and audio quality measurement since the foundation of OPTICOM as a spin-off from Fraunhofer's MP3 development team in 1995.

After the great success with PESQ - the International Standard for voice quality testing, the experts from Germany now also source PEVQ, the new industry standard to measure a perceptual video quality KPI for streaming, conferencing and messaging applications.

PEXQ, the next level of Perceptual Quality Measurement, is the ideal 'all-in-one' test suite for developers, manufacturers and operators, while the 'X' just symbolizes the ongoing evolution of perceptual QoE metrics: Based on PESQ, PEAQ, PEVQ and PEDQ the software provides the most comprehensive standards-based MOS-KPI set to score voice, audio/visual and data quality as experienced by subscribers. OPTICOM's proven OEM technology can be found in most state-of-the-art products of leading T&M vendors, see also www.opticom.de/company/customers-licensing.html.

OPTICOM GmbH is a privately held company located in Erlangen, Germany.

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