OmniTek

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Advanced Measurement Technology

OTR 1001

Advanced Waveform Rasterizer, Signal Generator, Stereo 3D Monitor, Picture Quality Analyzer

3Gb/s • Dual-Link • HD • SD • 1RU chassis

Introducing the OTR 1001

The OmniTek OTR 1001 offers a unique combination of high-precision video and audio analysis tools, picture quality analysis suite and comprehensive full-motion signal generator system. The OTR 1001 is compatible with all single and dual-link SDI formats at 270Mb/s, 1.5Gb/s, and 3Gb/s. The system also contains an optional physical layer analysis package, providing jitter measurements and the industry's first production eye diagram display for 3Gb/s signals.

System Overview

The OTR 1001 is supplied in an industry-standard 1RU rackmount enclosure. A full control panel is provided on the front of the chassis, and the system may also be controlled using an external mouse and keyboard in conjunction with the easy-to-use graphical user interface. The basic system provides two SDI inputs and two SDI outputs, plus a reference analog sync input loop-through (bi-level or tri-level) and an analog RGB/YPbPr component monitoring output. There is a headphone socket for audio monitoring on the front.

The user interface graphics display is output via a DVI-I port on the rear, capable of driving an external monitor at up to 1920 x 1200 pixels resolution. Other system interfaces include dual gigabit ethernet ports, multiple USB sockets, LTC timecode input, GPI/Os, and an RS-422 serial interface.

The capabilities of the system are defined by a range of performance options, to allow users to configure the system to meet their exact needs. Most of these options are enabled via a software download. Users can "try-before-buy" using timed option licences. The physical layer analysis package and digital audio I/O interfaces are additional hardware plug-in circuit cards.

The OTR 1001 user interface contains a unique flexible display manager, which allows the user to configure the screen displays to best suit their needs. Each window tile can be positioned and sized individually, and the complete layout stored as a preset. The OTR 1001 can also be controlled remotely, either via the ethernet network connection (which supports SNMP and a simple browser interface) or a remote control panel connected to the RS-422 serial interface.

Signal Analysis Functions

Input Signal Status

Input signals are checked for errors and the presence of various types of metadata. Checks include SDI formatting, TRS and CRC/EDH validity; Picture freeze/ mono/black detect; SMPTE 352M "payload ID" display; AFD, Video Index, and WSS aspect ratio controls; VITC, LTC, and ATC timecode monitoring; Range and gamut checks in RGB & YCbCr colour spaces; and EIA-608, 708, teletext and OP47 subtitle display.

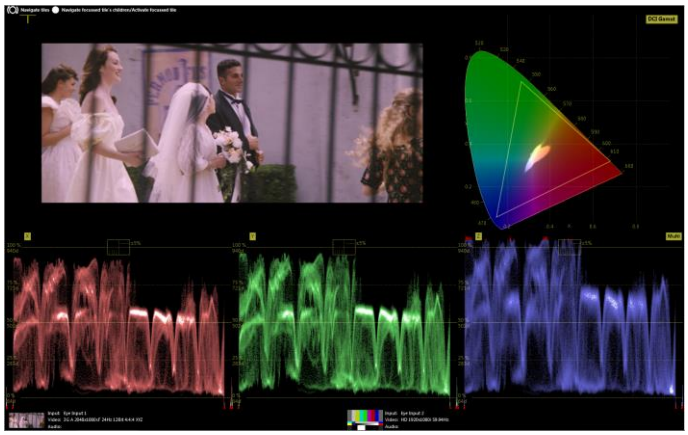
Picture Monitor

The OTR 1001 includes a high quality full frame-rate picture monitor display, which can be configured to show either the active picture or the entire raster with horizontal and vertical "pulse-cross" modes. Gamut and range errors can be highlighted on the picture, and there is a unique *zoom view* mode for high magnification of a user-selectable area of the picture.

Waveform Displays

The OTR 1001 contains OmniTek's award-winning high resolution, user-adjustable waveform displays in YCbCr, RGB, Composite, and XYZ colour spaces. Multi-line, single-line, two-line, and frame-scan modes are available, and the colour components may be displayed as a horizontal parade, overlay, or vertical stack. There is fully functional H & V magnification, plus our unique *region of interest* control. There are also timebase and amplitude cursors.

The internal signal processing is performed to 12-bit precision, to maximize waveform accuracy. Arbitrary combinations of colour components may be displayed simultaneously and each may be individually colour-coded. Gain, gamma, and persistence controls are available.



Digital cinema monitoring: 2k x 1080 images in 12-bit XYZ color space, with real-time CIE display and waveforms

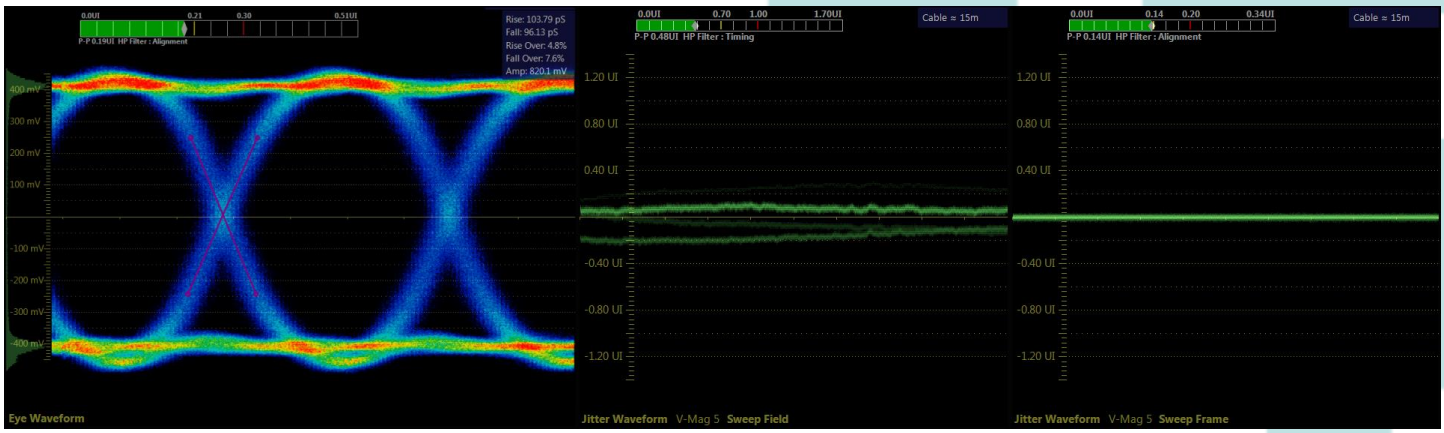
Colour Analysis Functions

The OTR 1001 provides up to four separate colour monitoring and analysis displays, to support users working in broadcast, QC, post-production, or digital cinema environments. There is a high resolution *vectorscope* with 75% and 100% graticules, including region-of-interest, zoom, gain control, and luma-level masking modes. The system also provides a colour *gamut indicator* display, which gives a real-time indication of the percentage of pixels which are outside gamut in any of the monitored colour spaces (for example as specified in EBU Recommendation 103).

For post-production users, the **VIEW_XR_DCI** software option provides *histogram* displays in RGB, YCbCr, XYZ, and Composite colour spaces, and the real-time *CIE colour chart* display provides a unique method for showing which source pixels fall inside or outside the colour gamut of a range of different display types and formats.

Physical Layer Analysis

The **EYE** option on the OTR 1001 system provides a full range of physical layer analysis tools for the SDI inputs. An additional hardware plug-in card is required, available in SD-only, SD/HD, and SD/HD/3G versions.



3Gb/s Eye diagram with auto amplitude & rise-time calculation plus jitter displays with Timing and Alignment filtering

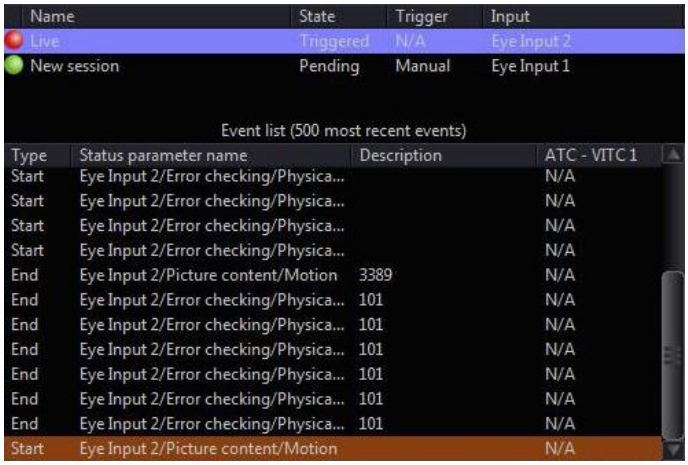
The **EYE** option provides accurate, automatic measurement of the amplitude of the incoming SDI signal, the bitstream rise and fall times, the overshoot/ undershoot level, and the calibrated input cable length. The option also gives a detailed analysis of the bitstream jitter characteristic over various frequency bands, including the SMPTE recommendation timing and alignment filters.

Two display windows are available with the **EYE** option: Firstly the Eye Diagram display itself, showing the waveform of the input SDI bitstream calculated with an input bandwidth in excess of 10GHz. 2, 4, and 8-Eye displays are available, in both equalised and non-equalised modes. Secondly a Jitter Waveform display is available, showing the jitter amplitude with respect to time using a range of different horizontal timebases.

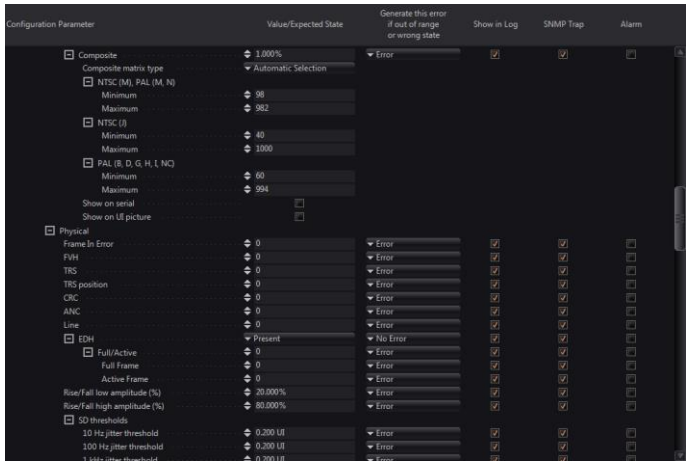
Logging, Alarms, & Closed Caption Decoding

Comprehensive error detection and logging is a standard feature on the OTR 1001. All the video, audio, and metadata parameters monitored by the system can be saved to an XML log file, with time-stamping from input timecode or the system internal clock. Multiple simultaneous event logging processes are allowed. In addition, events may be configured to trigger alarms or SNMP network traps. Thresholds and timeouts for each monitored parameter are fully adjustable in the configuration menus.

The OTR 1001 supports a full closed caption decoder as standard. This is compatible with “Line 21” analog captions plus EIA/CEA 608-B and 708-B digital caption data. There is also an Enhanced Teletext subtitle decoder supporting specification level 1.5, including support for “OP-47" digital ancillary teletext. Decoded captions may be overlaid on the picture display, and the caption data (raw or decoded) is logged in XML files.



Event log Window



Main configuration menu for setting log parameters

Dual Simultaneous Channels

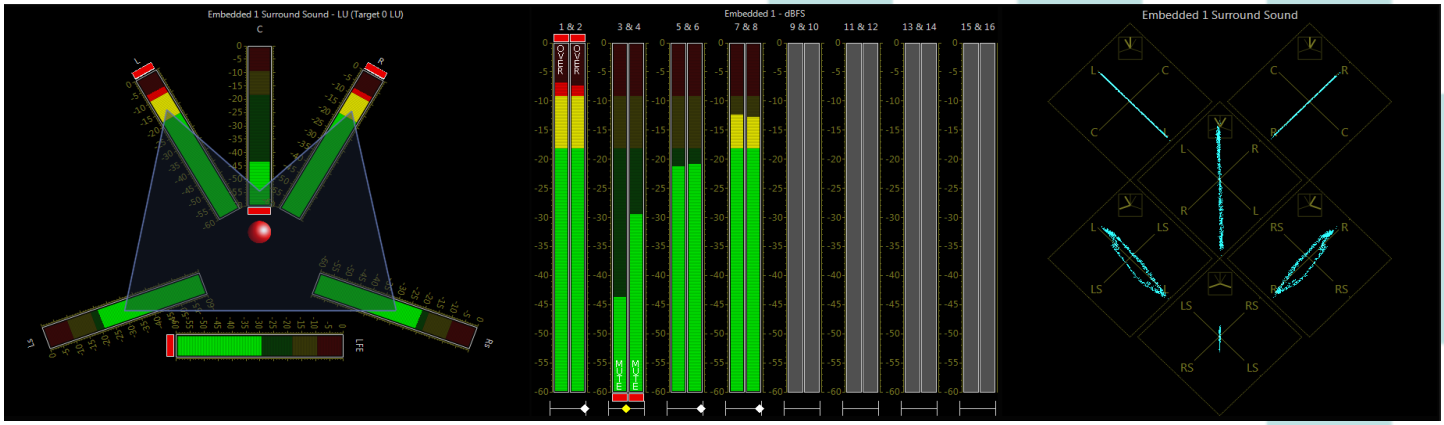
When equipped with the **VIEW_2** option, the OTR 1001 can simultaneously monitor two independent SDI inputs.

The full range of analysis functions are provided for each input, and the two inputs may be in different formats (SD, HD single-link or 3Gb/s type A).

Audio Monitoring Functions

The OTR 1001 provides a comprehensive range of audio monitoring functions. The basic **AUDIO** option supports 16 channels of PCM embedded audio input.

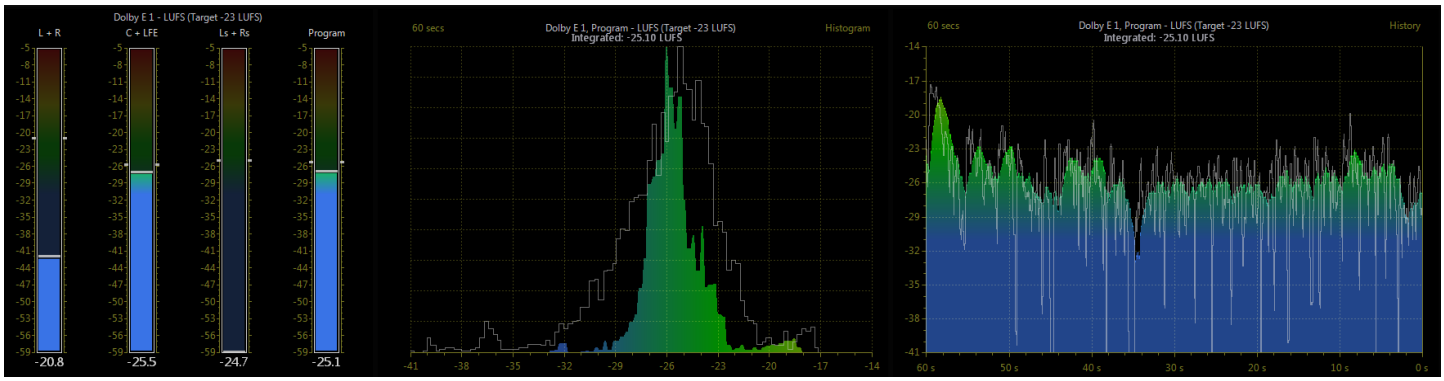
It also provides detailed channel status, a wide range of PPM meter ballistics and graticules, surround-sound display, and Lissajous figures.



Surround Sound PPM view, 16-channel embedded PPMs and Surround Sound Lissajous

The **AUDIO_LOUD** option includes a detailed loudness monitoring package, based on ITU-R BS.1770 with adjustable timing windows and gating factors as described in EBU recommended practice 128.

A range of dedicated displays for loudness are provided, including long-term histograms and time-history graphs with logging features.



Loudness PPMs, histogram and history displays

Options **AUDIO_DOLBY_D** and **AUDIO_DOLBY_E** provide full decoding of compressed audio inputs, including detailed metadata analysis and display (guard band timing etc.). A decoded analog stereo pair is available at the headphone/line-out socket.

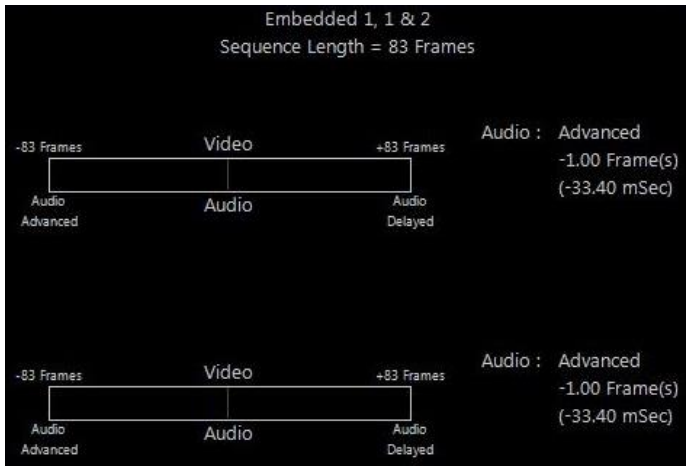
The **AUDIO_AES** option is a separate hardware card providing 16 channels of digital audio I/O. Digital input signals are routed to the various analysis displays, and the digital outputs may be selected from the Dolby decoder options or PCM embedded audio input.

In-Service Audio/Video Delay Measurement

Lip-Sync measurements typically either use a dedicated test sequence, the details of which are known very precisely, or involve watermarking the video digitally. Both methods have drawbacks.

Where the OTR 1001 includes the **AV_ISD** software option, neither a test sequence nor a watermark are required. Instead the OTR 1001 takes all the information it needs to determine the A/V delay from whatever video is currently being processed. An accuracy of approximately 20µs is achieved.

The **AV_ISD** option also allows you to determine the Loop Delay applied to the audio and video streams as the video is transmitted through one or more items of equipment.

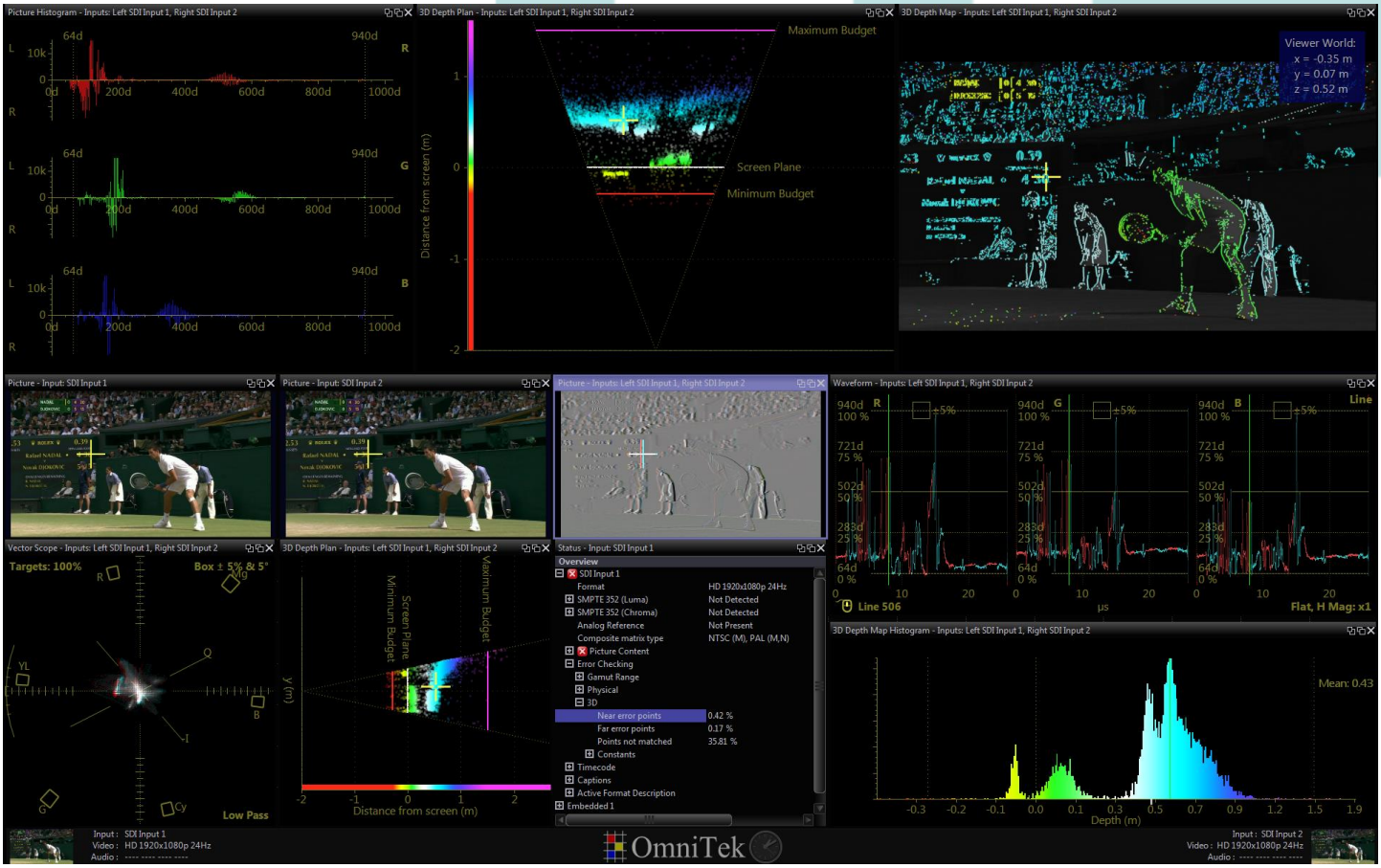


Audio/video delay measurement tile

Stereo 3D Support

When equipped with the **VIEW_3D** and the **VIEW_2** options, the OTR 1001 is able to analyse Stereo 3D (S3D) video i.e. video that uses the principles of stereoscopic vision to project 3D images. Displays are offered to show disparities between the left- and right-eye images; to see how these disparities relate to the specified Depth Budget and to check for colour matching between the left and right images.

The OTR 1001 also offers displays that show the 3D depths perceived by the viewer. Another feature of the OTR 1001's 3D support is that all the displays are linked such that the crosshair cursor is in the equivalent position on each display and the information you see as you move from display to display is about the same point in the image.



3D display options including: (top row) Pixel histogram (difference mode); Depth Plan from above; Depth Map; (middle row) Difference image; '3D' Waveform; (bottom row) '3D' Vectorscope; Depth Plan from the side; Depth Histogram

Disparity Assessment

The OTR 1001 offers both a *Difference* image and an *Anaglyph* image from which the disparities between the left- and right-eye images can be judged. The disparities are also used to produce a *3D Depth Map* in which pixels that are closer than the Budget minimum are coloured red, those which are further than the Budget maximum are coloured violet and a colour ramp is used between. A *3D Depth Histogram* shows how much of the scene falls outside your chosen Depth Budget. The Depth Budget can be expressed either in terms of distances perceived by the viewer or in terms of disparities expressed in pixels or as a percentage of the screen width.

Depth Analysis

Armed with the screen size and the distance of the viewer from the screen, the OTR 1001 is able to calculate the XYZ coordinates at which the viewer will perceive each object in the image to be. These coordinates are then used to create novel '*Depth Plans*' that present a 'theatre' view of the objects from above or from the side.

The *Depth Histogram* can also be configured to show its results in terms of these depths rather than disparities. If required, 'what if' tests of how the perceived depths will vary for users watching on different screen sizes can be run by entering the different screen sizes and viewer distances.

Colour Matching

Colour differences can be seen in two special Picture displays: a *Checkerboard* display comprising alternate squares from the two eyes; and an *Alternating* display that switches between the two eyes at a selection of switch rates. In addition, the *waveform*, *vectorscope* and *pixel histogram* views have an optional 3D mode in which the analyses from the left- and right-eye images are displayed together. The waveform display shows alternating segments from the left- and right-eye image traces. In the vectorscope, the traces are simply superimposed. The pixel histogram offers a choice of displays: one in which the separate traces are superimposed; and an another in which a histogram is shown of the differences between the images.

Picture Quality & Audio Quality Analysis

In today's multi-media digital broadcast environment, a wide variety of compression techniques are used in the attempt to maximise the payload capacity of the chosen transmission path. Picture Quality and Audio Quality assessment of the resulting broadcast video are essential to ensure that the best use is made of the available channel bandwidth.

Traditional measures such as Peak Signal-to-Noise Ratio and Total Harmonic Distortion have some value but are often at variance with the results of subjective tests which have the drawback of being expensive and time-consuming to conduct. What is needed for both assessments are measures that are both suitable for continuous monitoring and reflect human perception.

The new **PQA** software option for the OTR 1001 provides full-reference picture quality analysis, with all the tools necessary for R&D laboratories, broadcasters and transmission engineers to make deterministic measurements that take account of factors such as luma level and location near to edges in assessing picture quality. It also supports remote control using SNMP with user-configurable alarms.

The main features of the system include:

Flexible Signal Processing Architecture

- Compare either two live video inputs in real-time, or
- Compare two stored video sequences, or
- Compare one live input against a stored sequence
- Automatic delay compensation
- Full remote control using SNMP

Picture & Audio Quality Measurements

- Real-time Luma & Chroma PSNR calculations
- Edge-compensated picture difference analysis
- Macroblock artifact detection with edge compensation
- Average picture level of both test and reference signals
- User-configurable combined quality assessment

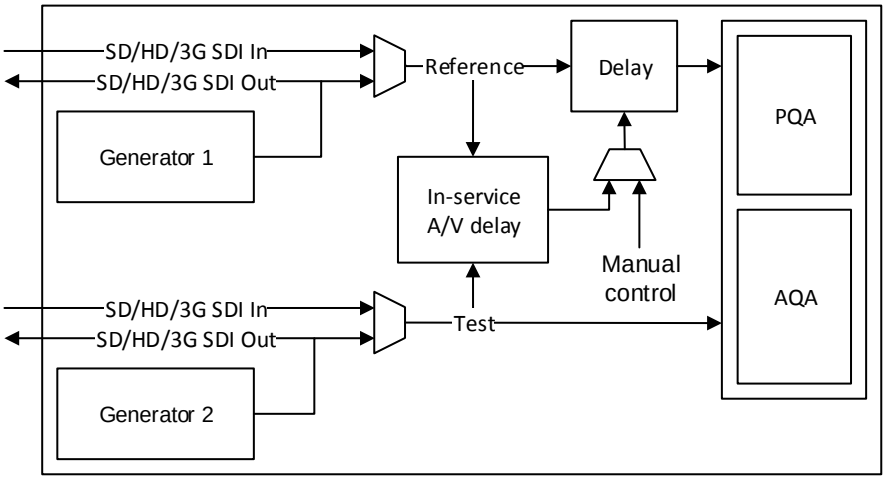
Comprehensive Result Analysis

- Graphical presentation of all quality measurements
- User-selectable error trigger thresholds
- Data time-stamped and stored in XML files
- Comparison of results from different tests

R&D engineers can use it to evaluate the relative performance of different image compression codecs. Broadcasters can use it in remote monitoring of picture quality, with alarms fed to station automation software. Transmission engineers can use it to measure end-to-end quality degradation over an entire process path.

Displays include difference images of various types, graphs of the various quality measurements over time and a set of meters with red-green 'traffic lights' to give immediate feedback on the quality of the video against the user-defined error criteria. The results are also reported alongside SDI signal integrity data in a Status display that also includes Audio Quality Analysis (AQA) data, determined in accordance with ITU-R BS.1387.

Existing 'Classic' PQA SNMP scripts are backwards compatible with this new option.



System overview showing how live inputs and stored sequences are compared to assess Picture Quality, Audio Quality and In-Service A/V Delay

Input Capture Functions

The standard OTR 1001 system can freeze & capture both the user interface display and also video frames from the SDI inputs. With the **CAP_MOTION** option, full-motion sequences of frames may be captured directly into system memory for subsequent analysis. Sequence duration limits are the same as for the **GEN_MOTION** option.

There is also a **CAP_ADVANCED** option, to enable users to capture frames or sequences as full-raster RVF files with all blanking and ancillary data.

Note that to play out any captured images or sequences, the appropriate generator option must also be installed.