"Out-of-service Testing" Application Notes

Overview

Test and Measurement is not confined to manufacturing or Quality control applications. It is also an important part of broadcast installation (studio and OB) to ensure that everything is correct. Especially important in an environment of constant change.

In any broadcast environment, whether it is in a studio or outside broadcast truck, there are a number of aspects that need to be checked and monitored to ensure that all possible equipment interconnection (point to point) possibilities are correct for use.

For example this can include ensuring that data connections to and from a router are correctly timed and contain the same information, audio levels, audio channel assignment and metadata.

The PHABRIX Sx hand held range and the PHABRIX Rx rack mount range provide all of the instruments required to ensure that the broadcast installation is setup and running correctly.

The PHABRIX Rx range allows multiple instruments, across multiple analyser channels, to be displayed on screen at the same time. This makes the Rx ideal for live environments as all aspects of the multiple signals to be viewed and monitored simultaneously.

Both the PHABRIX Sx and Rx ranges provide generator, analysis and monitoring to allow closed loop testing of any video, audio and metadata processing equipment that might be present in the broadcast chain. Known test signals can be injected at any point in the installation and checked at any point in the installation.

The Picture monitor can display timecode, safe area and closed caption information of the selected signal

The waveform display allows the levels of the video content to be viewed for the selected signal
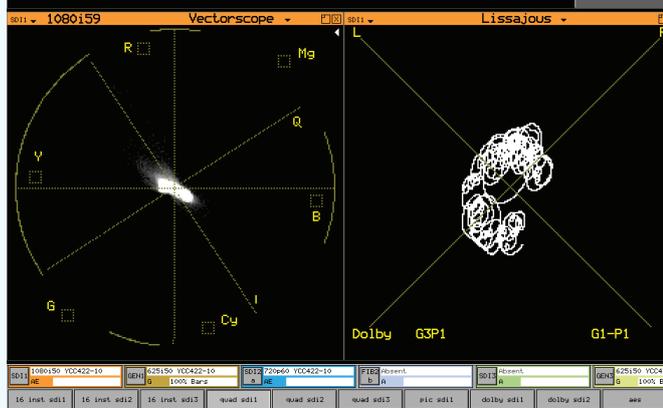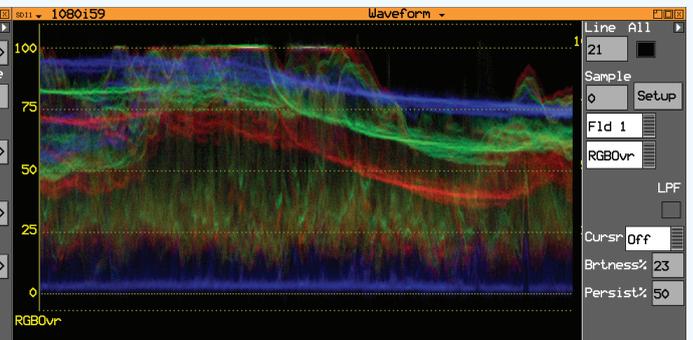
The vectorscope allows the colour saturation and cast of the signal to be viewed

The lissajous display allows the phase relationship between the audio channels to be monitored

Display presets can be recalled to focus on any aspects of the testing using any analyser or generator instruments

The Meter display allows level measurement of PCM and decoded Dolby Audio as well as audio mix down

Infrastructure Quality

The quality of cables, connectors, patch panels, etc will have an effect on the quality of the SDI signal. If the signal is degraded or damage then errors will occur.

The SxE hand held device or the Rx rasteriser with Eye modules allow the signal (physical layer) to be analysed. This allows the Eye waveform to be quality checked and allows Jitter measurement of the signal to be check to ensure that it is within specified limits and therefore not going to cause data errors.

Any measurements which do not meet specified level of are immediately indicated in red whilst valid parameters are displayed in white.
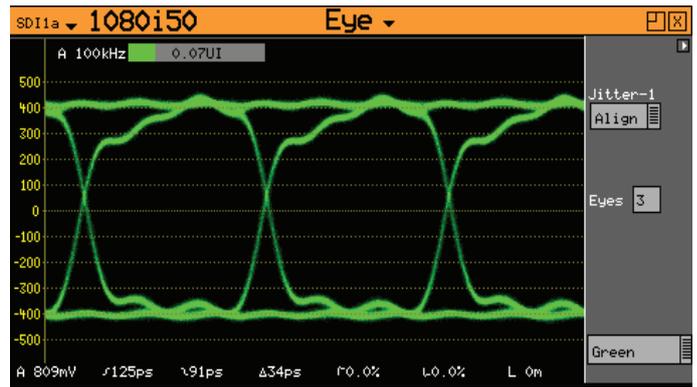
If all equipment within the installation generate signals with the correct waveform shape and with jitter within specified limits, there should be not data corruption.

Studio Reference Timing Checks

The Input Timing window allows the timing of SDI input signals to be measured with respect to the external reference (Studio reference).

All equipment in the signal path needs to be setup to ensure that all signals/feeds are correctly co-timed to each other and to avoid large propagation delays through the equipment chain.

In nearly all installation, routers are used to provide point-to-point connection flexibility in a dynamically environment. It is therefore important to ensure that the propagation delay through all equipment is taken into account. This can be done by checking equipment output timing with respect to a common reference point (typically studio reference).
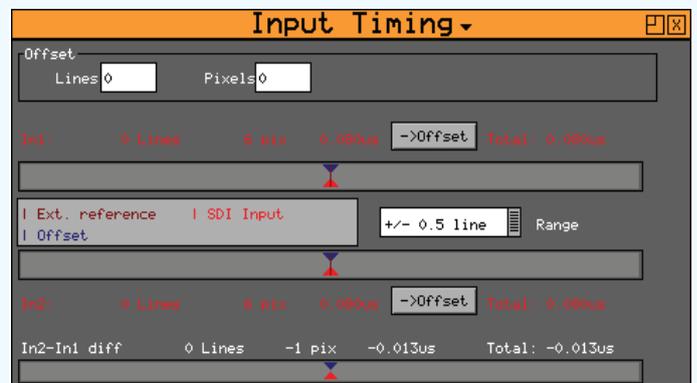
If all inputs to the router are aligned correctly then things are unlikely to go wrong when different point to point connections are made.

AV Delay Checks

Although SDI feeds hold both video and audio data, it does not mean that the video and audio are correctly co-timed. The AV delay can be significant, especially where feeds are encoded.

There is a potential that any active processing equipment can introduce and AV Delay, but compensation for this may only be possible as a system solution not on a unit by unit basis. So understanding the probable accumulated AV Delay is a priority.

The AV Delay Test Pattern and Tone provided by the Generator module allow the AV Delay to be checked.

The frame difference between the AV Delay Test pattern and audio tone provided by the Generator module can be checked using the Frame Grab system.

The AV delay check relies on the constant movement of the Clapper board on the AV Delay Test pattern and how far it has moved from the centre of the test pattern with respect to the audio tone.
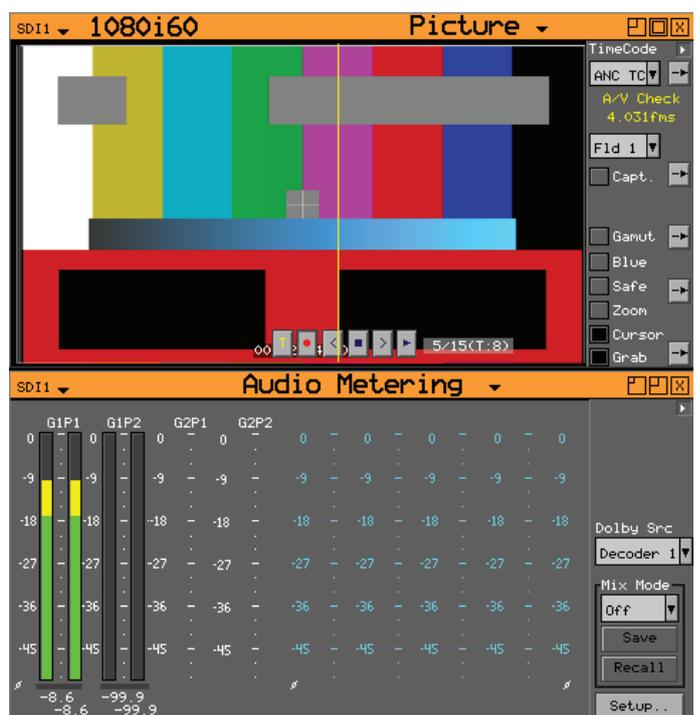
Picture construction and content

The Picture monitor allows the program to be viewed as a thumbnail or at native size. It can display program timecode, safe area and closed caption information.

Program ancillary timecode can be displayed on the picture in different positions and sizes as required.

Up to 4 different safe areas can be displayed at the same time to ensure that the action and open captions stay within 4:3, 14:9 and 16:9 constraints.

608, 708, WST, OP42 or OP47 closed caption present in the program and can be displayed to ensure correct content and accuracy.

The Rx range can also indicate Gamut issues.
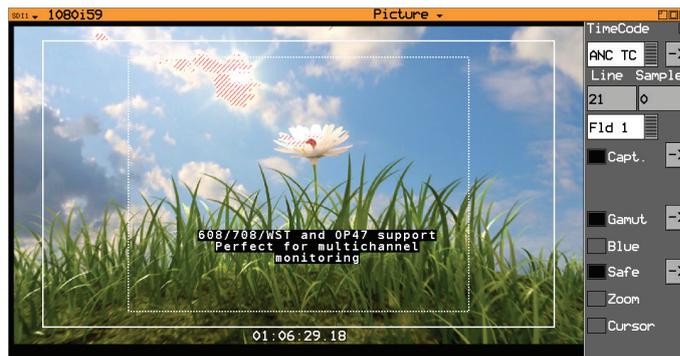
All equipment on the critical path (ie that contribute the the installation's output (for example a program or feed) must not damage or adversely affect the required video, audio and metadata.

Video levels

The Waveform monitor allows the quality and levels of the video image content to be checked. Typically the waveform is used to check that the luminance of the image is not saturated or clipped.

The vertical scale can be in percent, mV, decimal or hexadecimal selectable using the Setup menu.

The RGB parade mode and the RGB overlay mode can be used to check the image balance to ensure that cameras are matched.

The maximum luminance level or colour saturation of any of the primary colours is indicated on the graticule and cursors can be used to measure the actual levels.

Individual video line selection can be made which can be useful view the levels on specific lines.
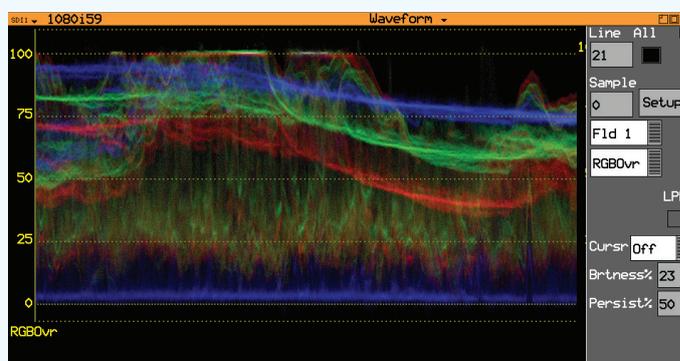
If the levels of all possible sources are correct then the installation's output will always be correct regardless of which source is being output.

Colour saturation and cast

The vectorscope allows the colour saturation and cast of the program to be viewed. In setup the vectorscope is used to check that 100% or 75% colour bars are correct. The maximum colour saturation of any of the primary colours is indicated on the graticule.

In general use, the centre point on the vectorscope indicates that there is no colour cast in the image. The cast is effectively the colour of light that appears on white or grey objects that appears as an offset.

The position of the vector mass on the display indicates the main colour of the image. Zoom allows the centre point to be viewed to see any colour cast.

Individual video line selection can be made which can be useful to view the colour of the image on specific lines.
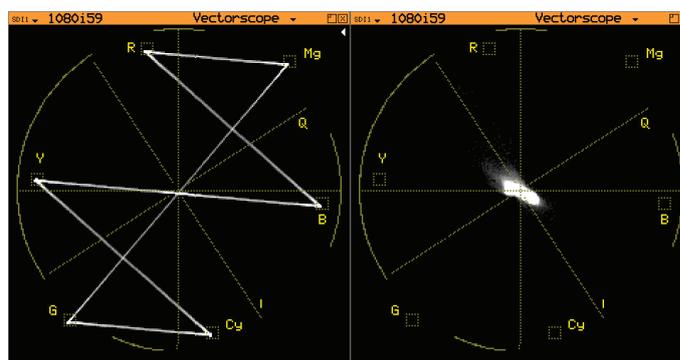
If the colour accuracy of all possible sources are correct then the installation's output will always be correct regardless of which source is being output.

Video Data Integrity and Status

The Video Status menu displays details about the integrity of the SDI data.

Any detected errors are shown in red text giving an immediate indication and can be logged.

Continuous CRC and EDH error detection is performed on the SDI data stream.

Active Picture CRC (cyclic redundancy check) data.

EDH (error detection handling) data displayed for 625i and 525i video.
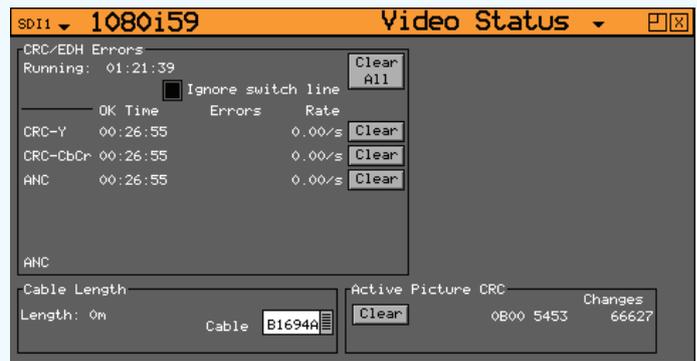
All equipment on the critical path must not damage or adversely affect the integrity or structure of the video.

Audio channel levels and assignment

The Audio Meters display up 16 embedded audio channels made up from audio pairs from the SDI input, Dolby E metadata or Dolby Decoder module (option).

The peak level indicators and audio level meters show the level of all of the program audio channels. Audio phase meters show the phase relationship between each stereo pair. Instantaneous numeric values of audio level are also provided.

Meter scale selection and meter ballistics can be set to studio normal practice.

The Mix Mode function allows selected channels to be assigned to the left and right channels of the Audio Monitoring output when "Analyser" - "Downmix" is selected.

The Mix Mode drop down menu allows User defined or predefined (5.1A, 5.1B, 7.1A or 7.1B defined in the System - Surround Channel Setup) to be used to monitor and hear specific audio channels.
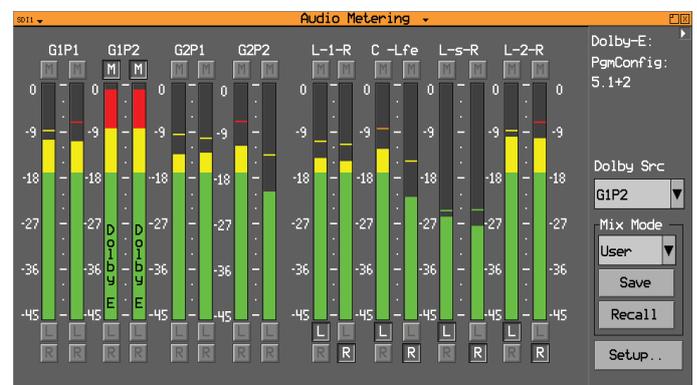
Audio channel phase relationship

The Lissajous display shows the relationship between the stereo audio channels.

If the display is mostly in the vertical centre then the audio channels are in phase (mono).

If the display is mostly to the right then the audio channels are out of phase in favour of the right.

If the display is mostly to the left then the audio channels are out of phase in favour of the left.
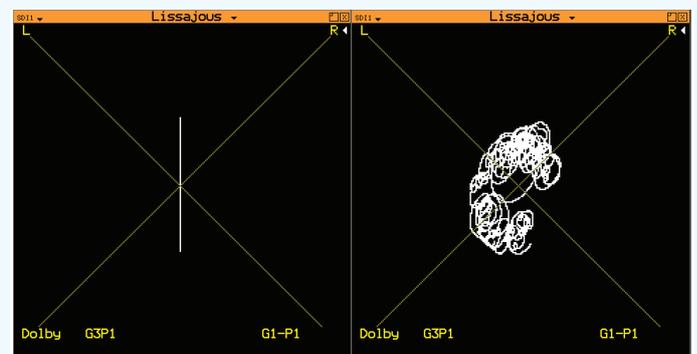
Audio Data Integrity and Status

The Audio Status menu shows the type of audio data on each channel. This can be PCM, Dolby E, Dolby D or Dolby D+. The Channel Status for the selected audio channel is displayed in decoded form as well as a hexadecimal dump of the bytes.
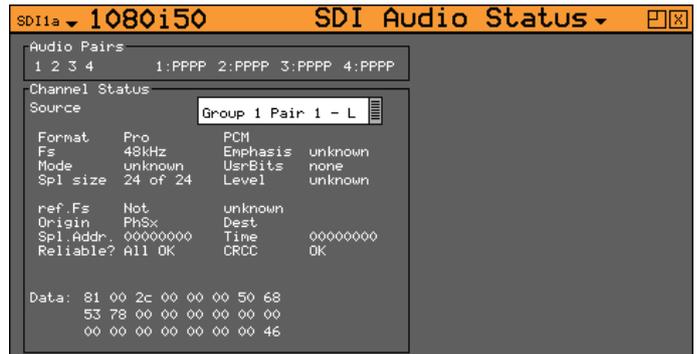
All equipment on the critical path must not damage or adversely affect the integrity or structure of the audio.

Dolby E Packet Timing

The Dolby E packet length is consistent and if the packet position it too early the header information be be damage by signal switching and if the position is too late then the packet may be cropped by the start of the next video frame.

The Dolby Metadata window (Dolby Metadata Analysis option) allows display of the Dolby metadata present in the selected audio stream.

This window also allows the correct timing of the Dolby E packets within the SDI signal to be checked at all stages in a broadcast chain.

Checks can be made to see that the Dolby E has been created correctly and transferred transparently through the broadcast chain unaffected by routers / switchers, satellite links, etc.
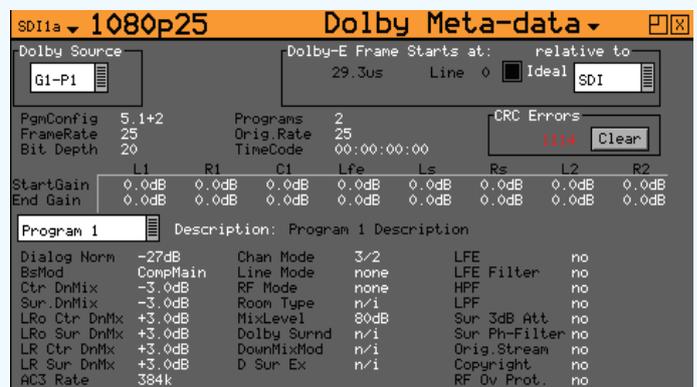
All equipment on the critical path must not damage or adversely affect the integrity or timing of the Dolby audio. Damaged Dolby E packets can result in full scale (0dB) audio being output.

Audio Quality

Probably one of the best measuring devices for actual audio quality is the human ear as it can detect subtle changes and artefacts (for example clicks, noise or hum) that otherwise may go unnoticed.

The Rx range of products provides broadcast audio quality analogue output to allow the quality of the selected audio pair to be heard. The Rx2000 provides broadcast quality speakers to allow the audio pair to be checked in the bay.

With the Dolby Decoder option installed, the Rx range can decode Dolby encoded audio to its base channels so that the quality of the individual audio channels can be checked at point of transmission (for example via a satellite feed back to the studio or before a program is sent to the transmitter).
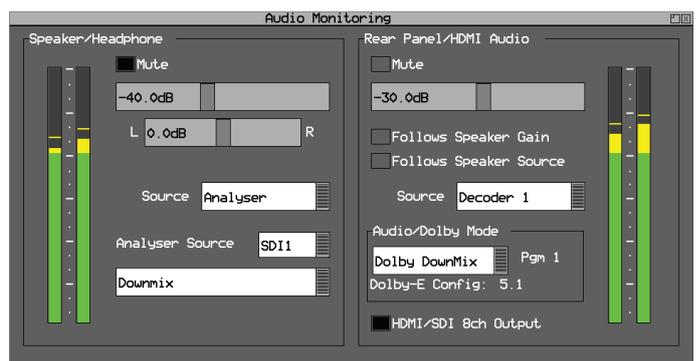
Test Equipment Integration

Traditionally test equipment has been considered as separate from the installation and only brought in at equipment installation or when something has gone wrong.

The PHABRIX Rx range of rasterisers is becoming a common permanent part of studio and OB installations as if can provide both add-hock test and measurement as well as on-going system monitoring and logging.

When integrated as part of a router, the Rx can introduce reference test patterns, audio tones and metadata that can be routed to any other piece of equipment and simultaneously analyse the equipment's output to check for dependencies.

In this typical installation an Rx 2000 with two analyser / generator modules installed is providing simultaneous HD and SD test signal generation and analysis to ensure that both SD and HD system paths are correct at setup and during live program transmission.

In large or remote installations the test equipment and the equipment under test may be a long way away from the operator or technician so the ability to remotely diagnose issues can save time an money.

The PHABRIX Sx range of hand held instruments and the PHABRIX Rx range of rasterisers can be controlled via a web browser that accesses the built-in web server.

Clicking on the virtual buttons of the web browser view works exactly like the instrument that you are connected to.

Being able to intuitively control the test equipment remotely, including changing test patterns, analysing specific waveforms, checking data and viewing error logs as well as having a graphical view of the equipment is a significant advantage.

Being able to remotely check input timing can identify locking reference issues and mistiming between video sources. When there are audio problems, having access to the audio levels and data. If there are intermittent issues, then being able to remotely setup different event triggers and logging the events to see if there was any effect can identify an errors.

The "HDMI" link on the virtual Rx 2000 front panel displays a copy of the HDMI output in the browser window.

Clicking on the position where a menu box appears on the browser HDMI display will control the corresponding menu on the actual Rx HDMI menu allowing up to 16 instruments to be displayed simultaneously.
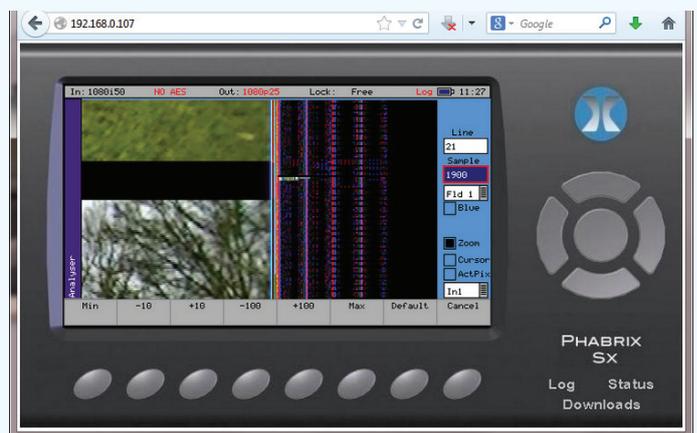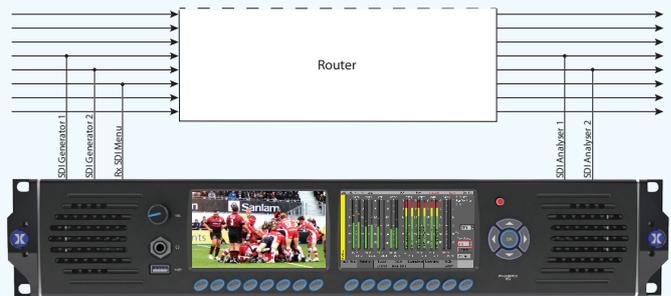
Virtual Sx displaying Picture instrument

Virtual Rx 2000 front panel.