Test signal not test pattern?

Paul Nicholls
Sales and marketing manager
PHABRIX Limited

PHABRIX LTD

Test and measurement has moved on from the traditional method of pointing a camera at a printed card and measuring the response. The new world of T&M is much more complex – a mix of technologies with many more compatibility issues, standards, colour spaces and formats to deal with. The new formats also tend to be less forgiving. The world of SD was relatively simple, but now with HD and 3G networks becoming the norm, the test engineer has to be well versed in identifying which standard is on test as much as the signal integrity as it goes through the broadcast chain.

Formats

Let's stop for a moment to consider all those new SMPTE formats. SD was a cinch. With HD, dual link and 3G Level A and B and support for different colour spaces 4:2:2 YUV, 4:4:4 RGB, 4:4:4 YUV, at 10/12 bit you have the possibility of over 350 formats to choose from.

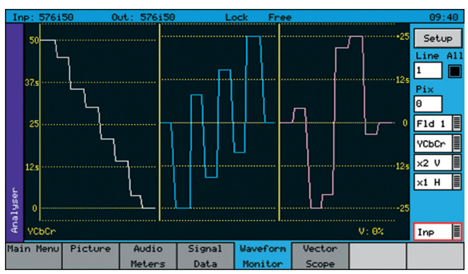
Generation

So where to begin? Which test pattern, which test signal, should you be using?

Let's assume you have a good generator and an analyser on hand capable of generating and recognising all the various colour spaces, formats and bit depths you may come across.

Next you need a known source, a SMPTE compliant source and preferably one with the ability to identify your signal from all the others in front of you. Once you have a known good source to check against on the generation side it gets a whole lot easier.

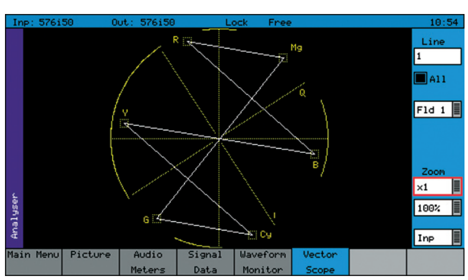
Let's start with 100% colour bars, the staple of the broadcast engineer. 100% bars has a familiarity which settles most engineers - they instinctively know what to expect. Some might argue that SMPTE 219, also known as the ARIB test chart, enables you to see chroma swaps instantaneously as well



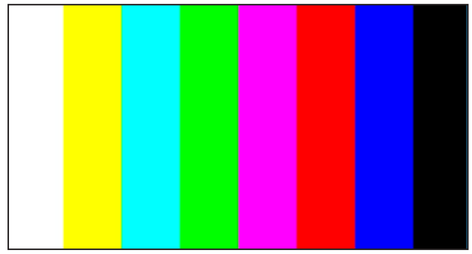
PHABRIX SxA Waveform display

as 100% bars and ramps. However, most engineers would agree that 100% bars is their first choice, they supply an easily recognised waveform response of a video signal to time, plotting the 'overall' characteristics of a video signal.

Typically using bars analysed on a waveform monitor



PHABRIX SxA Vector scope display



100% colour bars

is a method used when calibrating cameras. Where there is a wave form monitor there is usually a vector scope supplementing the waveform response with that of chrominance. Both tools are aids to broadcasters in the analysis of pattern response.

In with the new

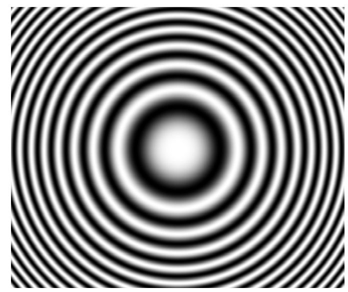
Whereas the colour bars is an excellent visual check, several new test patterns have moved out of the R&D manufacturers domain and into the instruments now hand carried by broadcast engineers and are fast becoming as familiar as bars.

For example, moving from CRT displays to LCD has required a new emphasis on testing for 'banding' and colour casts so luma and chroma ramp patterns designed to stress the response of the screen are an important check before accepting an expensive new monitor.

Modern monitors not only support 4:3 and 16:9 aspect ratios but also zoom and wide screen so geometry checking is important. Whether manifest as a selection of circles or a 'safe area' pattern, a simple check can be invaluable between formats.

Moving zone plates provide a very useful 'dynamic' pattern for testing a range of video processing equipment as well as LCD displays. Spatial and temporal control of the so called 'moving zone plate' is particularly useful for testing up/down converters, image scalers and applications which compress signals.

Aspect ratio processing too can be tested using the horizontal and vertical controls.



'Look into my eyes' the moving zone plate

Frequency sweep testing using the zone plate is particularly useful. By feeding in the signal generated, the output of the device can be looped back into a waveform monitor to determine the usable bandwidth of the system.

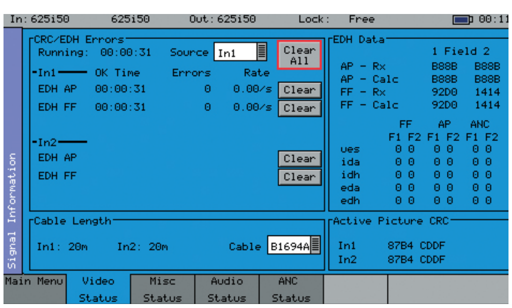
So for the moment I have described a set of very visual patterns designed to be generated and visually checked at the receiving end, but are we really seeing the 'whole' picture?

Moving from test pattern to test signal

The reality is that whilst the video content may appear good, the signal level may be low such that the addition of a few more metres of cable could result in the whole transmission collapsing. Digital television equipment has become very good at recovering a poor signal but the engineer needs to know the 'quality' of the signal. If there is little headroom then factors such as temperature or interference could cause failure.

Testing for transmission errors is a major advancement in broadcast T&M equipment. Most broadcast engineers will have an awareness of EDH (Error detection and handing) and CRC (cyclic redundancy check sum). Faulty equipment, bad joints or excessive cable lengths can dramatically affect the number of errors recorded. If audio is carried on the digital signal then bit errors are more noticeable than visual errors. In identifying these errors in combination with a known pattern the engineer has a very quick check of the system.

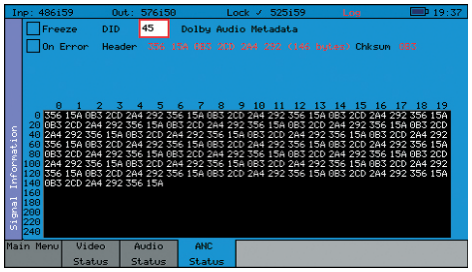
Whilst the HD/3G line based CRC checking system proves the integrity of inter-equipment connections, unlike EDH it doesn't provide proof of the transparency of a particular piece of equipment to the video signal being processed. In order to provide an indication of video transparency PHABRIX has uniquely added a video frame content CRC capability to its Sx range of instruments.



EDH and CRC checks Sx range

Payload identifiers

With all the new formats that have been introduced, and the list is growing, SMPTE has added payload identifiers to assist engineers in understanding the type of signal they are looking at. Every little helps as they say and SMPTE 352 payload is a requirement for use in 3G products to identify the source. A quick check that this is present can avoid endless wasted hours.



Pathological pattern

Signal identifiers in the signal are also present in DID displays which can identify the multitude of signal data present, another check.

Eye and jitter

Engineers have recently been introduced to eye and jitter measurements as a verification of signal integrity.

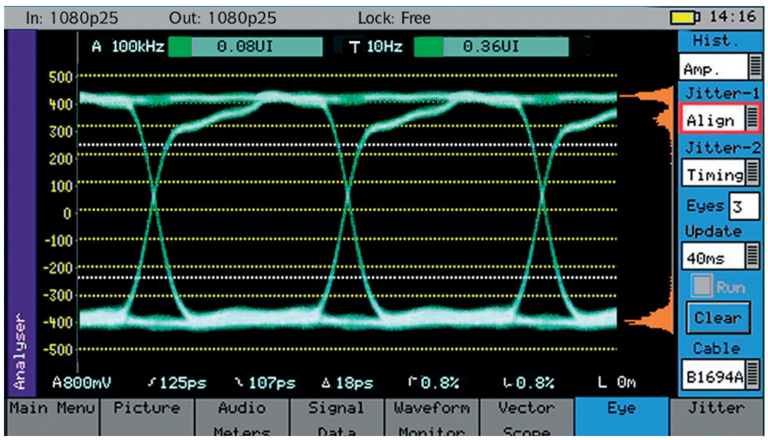
Here 100% colour bars are used as part of the SMPTE requirement for testing source quality.

SMPTE specify the important eye parameters and some instruments are capable of automatically measuring these parameters. Such instruments are invaluable – by ensuring that installed equipment adheres to these standards the integrity of a system can be maintained.

The SMPTE eye specifications state that the rise/fall time for SD should be no greater than 1.50ns and no less than 0.4ns and should not differ by more than 0.5ns. HD should be no greater than 270ps and not differ by more than 100ps with 3Gb/s no greater than 135ps and differ by not more than 50ps.

Jitter

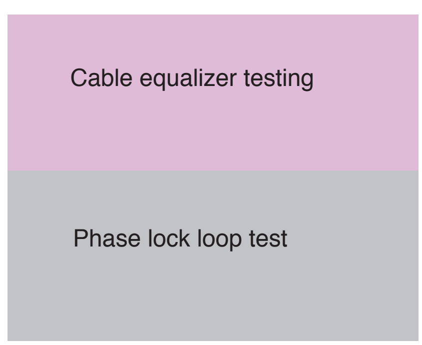
Jitter measurement indications are also an important aid in signal integrity.



PHABRIX SxE Eye and Jitter with automatic measurements at SD-SDI, HD-SDI, 3G-SDI

Take for example the SMPTE specifications for 3Gb/s. The timing jitter should be <=2UI above 10 Hz and alignment Jitter <=0.3UI above 100kHz. Having the familiar 'thermometer' indicators on an instrument will quickly identify if you are in range (green) close to specification (amber) and red when the specification is incorrect.

In testing performance over cable length a pathological



Pathological pattern

pattern can be useful. This provides equaliser and phase locked loop 'stress' testing of a connection and will quickly show the performance of a cable within a facility or OB situation.

Logging

Just because it works for a second doesn't mean it will work for the next two hours.

As T&M moves forward there is a need to capture relevant test data and analyze it offline. Indeed some of the most up to date equipment including hand held instruments can be easily accessed from web browsers so that the engineer can interrogate the equipment at any time to see the data being logged in situ. The equipment can in some cases be controlled remotely so an engineer can select a test pattern or signal and then switch to the logging screen to see the response even if the generator/analyzer is many miles away, or even a different country.

The future

Interestingly there does appear a growth area for dedicated T&M equipment that has been designed for field use. By this I mean the ability for an engineer to use a focussed set of tools be it generation, analysis or logging.

As the broadcast environment becomes increasingly varied then the possibility for failure becomes more acute and with fewer engineers around, keeping this precious resource fully tooled up with the best equipment to apply their knowledge is definitely a sound investment.

www.phabrix.com
Tel: 01635 276 302

PHABRIX®
broadcast excellence