Murraypro

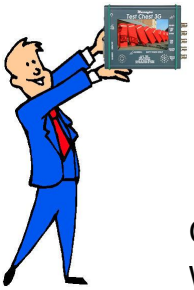
Test Chest

+

EYE~POD

Operational Manual

Issue: 1V0



Test Chest
Manual 1V0

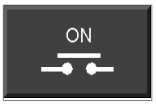
Congratulations on the purchase of your ***Murraypro Test Chest***

We are certain you will find this to be an extremely quick to use, and powerful diagnostic Tool. It will become a truly indispensable item in your daily work on the Bench, or whilst away elsewhere investigating problems under battery power.

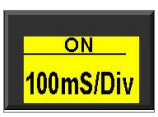
Test Chest is an impressive Product, so let's spend a few moments together getting to know it, and exploring it's features. In fact of course, most of the major features are immediately obvious as they are menu selected, but other rather more subtle features may be a key press or two away. Users who wish to get the most out of the ***Test Chest*** are recommended to familiarise themselves with the contents of this Manual, and the Unit itself, before attempting serious operational use of the instrument in the Field. We offer a short demo Video showing many features:- http://www.murraypro.com/testchest3g.htm

Introduction:

Test Chest is controlled by means of a touch sensitive LCD panel and only a gentle touching action will be required to achieve the desired action. The LCD's surface must ***NEVER*** be activated by a stylus such as a capped ball-pen, or, worse still, a hard point such as an uncapped pen or a screwdriver! Such activity is highly likely to cause scratch-damage to the LCD's front panel; physical damage of this sort is specifically excluded from warranty cover, and LCD replacements due to this cause will be chargeable.



Ensure that the 'Battery Off/Norm' switch, situated on the left end panel, is in the 'Norm' position, and 'Power up' is initiated by just lightly tapping the LCD panel anywhere, with the flesh of a finger. Next, 'confirm' this 'power-up?' command with a light tap on the Switch Icon itself within 4 seconds. Major functions are then selected and initiated by tapping the required menu function from the 'Home Menu' page, which is presented immediately after the ***Test Chest*** power-up confirmation. In a number of instances, **T**est **S**ignal **G**eneration and the **W**ave-**F**orm display mode, for example, selection of the required output Test Signal or WFM display mode, will require a subsequent selection process, via a sub-menu. This direct switching process is highly intuitive, and extremely quick to implement. There is no place on ***Test Chest*** for assignable 'Hot Keys' or anything of that nature. Often use of such key functions are very difficult to track, as the required 'next' function's position changes as each new menu page is presented!

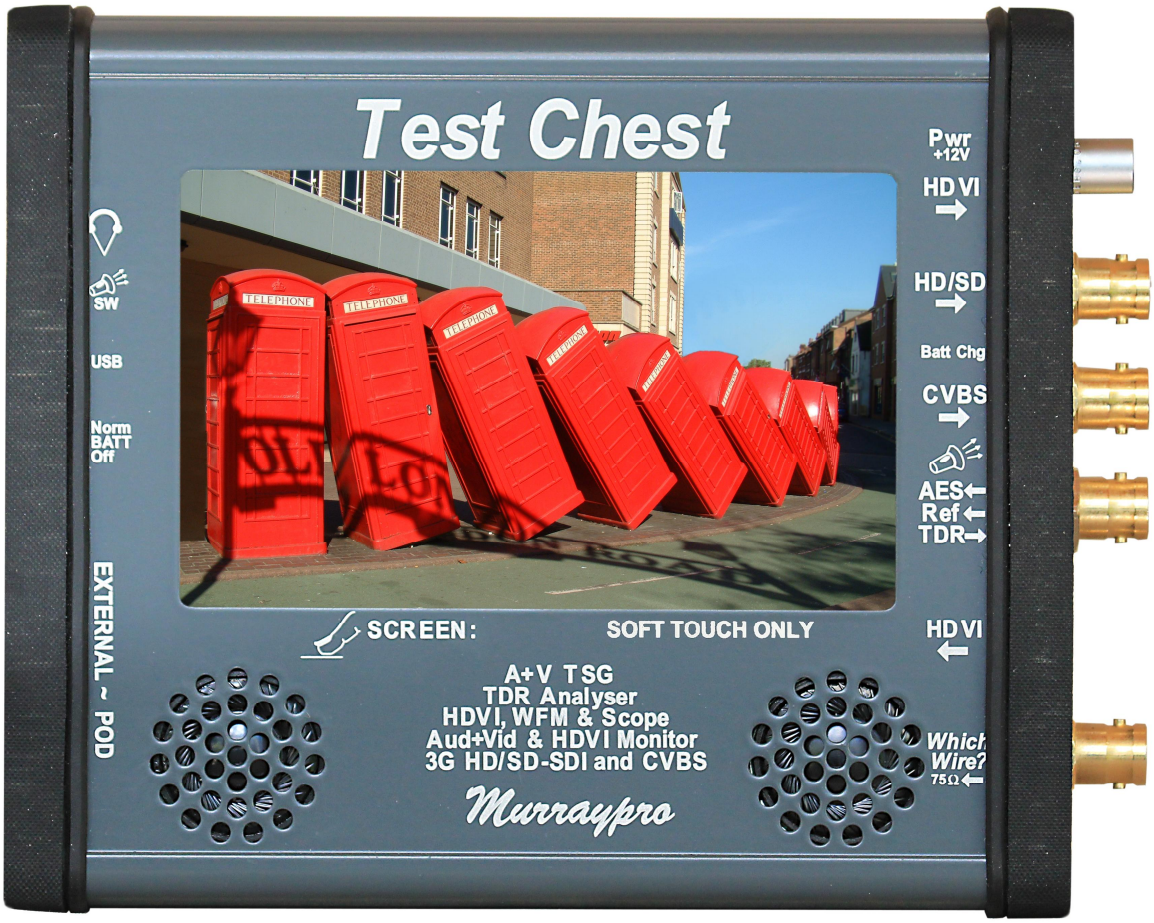


Users should be aware that some Menu options, although subtle, will substantially alter the mode of operation. As may be appreciated from the ***Test Chest***'s "Video Generation" flow chart, selecting 'Clapper Board' for example, will bypass most other Video selections; whilst selecting 'OUT~LOOP' bypasses the local TSG, forcing the output to be a reclocked & equalised 'LOOP' of the input signal..... naturally, this can only occur *if a signal is actually present at the input!*

Selection of one of these powerful modes, whilst quite normal, could have a high nuisance value' if unintentional, and so the ***TC*** will helpfully flag up such an activation with a cautionary yellow coloured icon, or legend.

The cluster of 4 BNCs on the right side of the front panel carry Video input and outputs. Unbalanced AES and External sync is input on BNC2, whilst the TDR cable-test also shares this Port.

Balanced stereo audio input and output, together with the balanced AES OP, are carried by the D-25F connector on the left panel which couples with the "Audio~POD" breakout adapter. The 3.5mm Headphone Jack is located here too.



Test Chest: Front.

Power considerations.

Test Chest is powered when portable, from an internal 3000mAH 7V2 Lithium Polymer battery pack. We have achieved nearly 5 hours endurance with a freshly charged battery in tests, so realistically Users could anticipate in excess of three hours operation. Power drain will be dependent to some extent upon LCD back light

brightness, the mode used, and the Clock rate of the TV Standard.

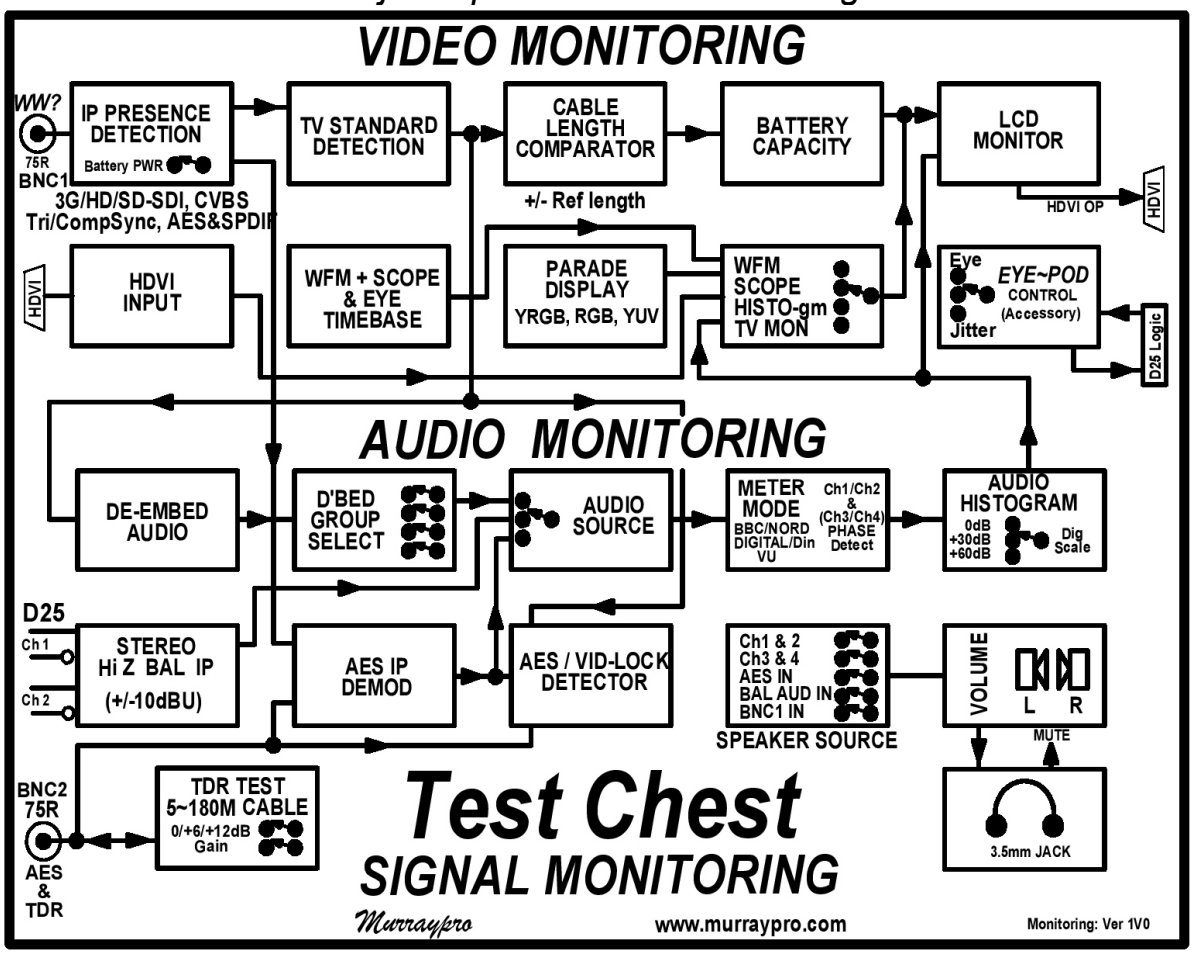
Test Chest is unusual in that *it has two quite distinct modes of operation,* and these are totally different, and separate, from any battery charging considerations:-

a) In ***Which-Wire?*** mode, *the unit will detect an input signal on BNC1, and power up automatically,* displaying the signal as soon as it is detected. NO action being required from the User, other to plug the unknown source into BNC1.

In "***W-W?***" mode, ***TC*** will automatically power down a moment or two after the input signal is removed from BNC1. 'Touching' the LCD panel will end the "***W-W?***" mode, and manual 'power down' will be required to restore ***"W-W?"*** mode.

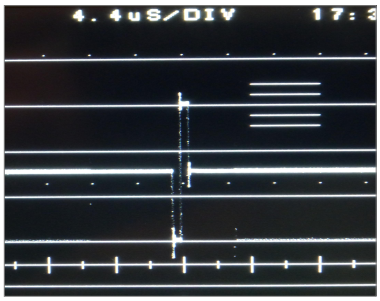
b) In the ***Generation*** and ***Measuremen***t modes, it will be necessary to turn the Unit **ON** manually. This is achieved gently tapping the LCD panel, and *CONFIRMING* your 'power on' request by tapping the *Switch ICON* presented in the bottom-right of the LCD. In these modes, the Test Chest is 'powered down' by briefly tapping the YELLOW switch icon on the menu home page.

Test Chest *provides essentially 9 functions, which are described more fully later, but these are at present, perhaps, best initially considered under 3 major separate function headings:-*



1) *Which-Wire?*

Which-Wire? is an exceptionally powerful investigative tool in which ***Test Chest*** emulates our earlier *Murraypro* ***'Which-Wire?'*** Unit, and it is *not even* necessary to 'manually' power the Unit up for operation in this mode. As soon as a signal is applied to the ***'Which-Wire?'*** input ***Test Chest*** automatically awakens, determines it's signal format, automatically selecting the optimum manner to display the detected signal, whether it be TV monitor, WFM, or as an audio histogram. Additionally if a TV signal is detected, it identifies the source's TV Standard as 3G-SDI, HD-SDI, SD-SDI, CVBS, together with it's Frame Rate, which is reported on a Banner at the top of the 16:9 LCD screen.



"W-W?" capability includes 'Tri-Level' and 'Colour Black' Sync detection. Either sync signal is displayed in the WFM's 'H Expand' mode.

"W-W?" capability on BNC1 includes the detection of UNBALANCED AES and SPDIF sources. When present, the LCD display automatically selects *AES* mode on the 'Audio Monitoring' page.

"W-W?" detection mode has been extended to now include **H**igh **D**efinition **V**ideo **I**nterface sources which are applied to the connector twixt BNC1 & 2. When detected, HDVI images @ TV related scan rates will be displayed, sources on other standards will be detected, but may not be coherently presented.

Users should connect their 'mystery IP signal' to the lowest BNC connector, BNC1, designated "***WW?"*** at the bottom right of the front panel. This connector always terminates the input with 75Ω, so it is never necessary to provide a separate external termination. The fundamental feature of ***Which-Wire?*** Mode is that CVBS, SDI and AES signals enter the Unit *via the same connector. It is* never necessary to double guess what signal may be present on a given cable, as the ***Test Chest*** will automatically switch to the appropriate Digital, Analogue, AES or Tri-level/Composite sync mode, as required to correctly display the detected input which now includes HDVI signals with TV related image formats.

It is vital to appreciate that ***"Which-Wire?"*** mode can ***ONLY*** be initiated with the ***Test Chest*** un-powered, it cannot function when the ***Test Chest*** is already powered up as it will *already* be in a 'manually' selected operating mode!

Following a 'manual' power-up, the main menu is presented from which the User selects 'TV', WFM' or 'Audio' mode as required. ~ Let us assume 'TV' mode is manually selected, so applying a TV signal to the ***"W-W?"*** input will indeed display an immediate picture, and in fact this will be even faster than from quiescent, as the Unit is already powered, BUT it can't *identify* Tri-level sync, *or* AES audio for example, nor display these in any meaningful manner in *TV Monitor* mode, as this doesn't offer any 'WFM display' or AES measurement capability!

This powerful ***"Which-Wire?"*** auto-detection feature is an important and vital difference pioneered by Murraypro which completely separates ***Test Chest*** from any other product. Other testers will require Users to consecutively, and tediously, offer an unknown signal to the separate SDI, CVBS and AES inputs in turn; if indeed they actually possess any analogue capability at all*!* Consider for a moment, just *how* does one investigate and resolve a Station Reference Pulse problem without any analogue capability?

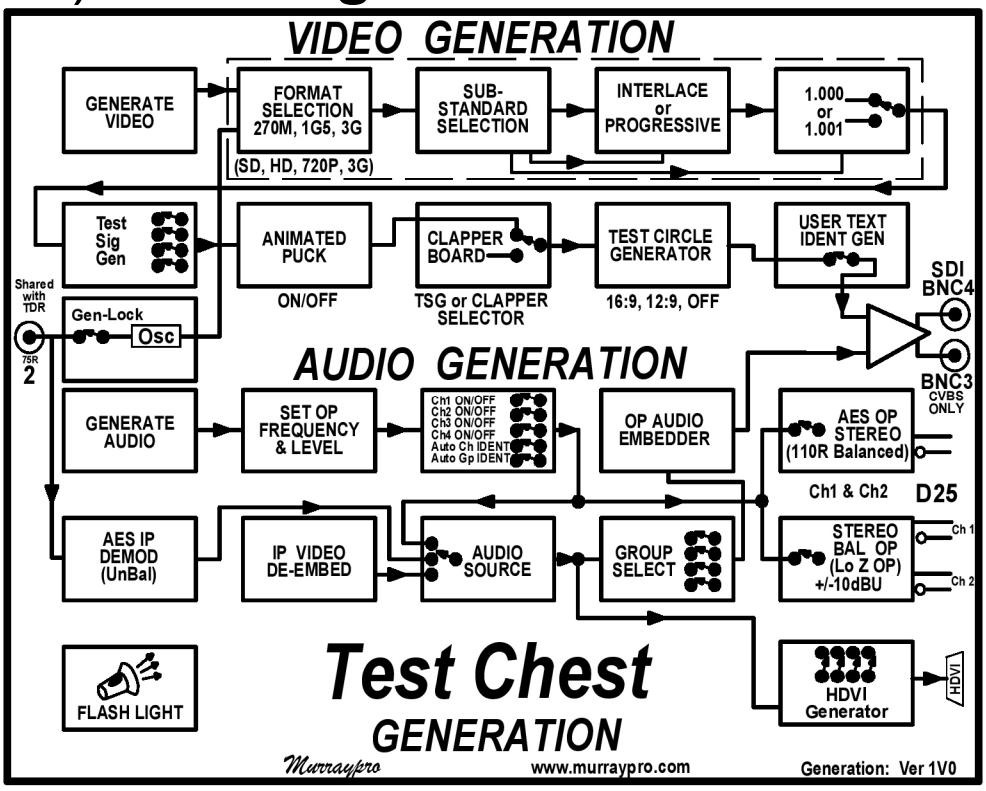
AES inputs in "Which-Wire?" mode.

Be aware that ***Test Chest***'s highly impressive capability of detecting and identifying "AES" signals fed in via BNC1, <u>*ONLY*</u> applies when the Unit is in ***"Which-Wire?"*** mode, having powered itself up automatically.

It most certainly does <u>*NOT*</u> apply when the Unit has been manually powered, or if the ***"W-W?"*** mode has been manually over ridden with a subsequent 'touch' command. Under these powered conditions it is necessary to apply the unbalanced AES source directly to BNC 2, the normal AES IP port, and which is labeled as such.

Under all 'powered' modes use of BNC 2 as the AES input port is mandatory. AES signals manually presented to the "Video" port BNC1, will NOT be recognised.

2a) ***Test Signal Generation ~ Video***



TSG.

SD 270 MB	1080 I/P 1.5G	720P 1.5G	1080P 3G

The ***Test Chest*** contains a powerful, high quality, 10 bit TSG that is suitable for testing TV equipment. The TV video format, categorized by 'Clock rate' is selected first (1080 @ 3G, 1080

or 720 @ 1.5G, or SD @ 270MB), followed by the required Frame rate (24, 25, 30, 50 or 60Hz), and on 60Hz related standards, subsequent sub-selection between 1.000 & 1.001 rates. On non-progressive only standards, interlace may be selected. Support for Level B Dual Link at 3G is provided.

Menu selection of the different Test signals is easy and intuitive, with the Generator providing parallel SDI and CVBS outputs of the selected Test Signal on SD.

Tri-level sync generation.

The CVBS video output can of course only be valid whilst the ***Test Chest*** is generating at 'Standard Definition' on 525 or 625 Standards, and is muted on HD. However on all high definition standards BNC 3 will output Tri-level syncs, and this changeover is completely automatic and transparent.

Tri-level syncs may be looped from BNC 3 round to BNC 2, and then used as an external reference for the **W**ave **F**orm **M**onitor; this will particularly useful when ***Test Chest*** is used to measure 'Latency' through digital equipment.

HDVI Signal generation.

Test Chest contains two HDVI ports using industry standard connectors and suitable for use with commercially available, or pre-installed HDMI cables; one each for input and output and both are independently available whilst the system is powered. A digital DVI OP is available via a proprietary passive HDMI/DVI adapter.

These signals are primarily intended for use in Television based Engineering applications, rather than 'Multi-Media' entertainment environments. So although industry standard connectors are used for convenience, the generation and display capability is pitched towards confirmation of function with SD and HD Professional TV related display standards, and a non-exhaustive list of the generally TV related Graphics standards that can be coherently displayed is tabulated in the Specification section.

HDVI signals generated by ***Test Chest*** may be selected from either a dedicated TSG or the LCD panel's screen, and in either case the OP standard is 800x640. Either source may be used as a convenient HDVI stream for quickly checking connectivity or system function, and neither are intended for detailed system analysis purposes although elements of '681 are supported.

Unlike some other Generators producing a PC/Graphics output, the signals produced by ***Test Chest's*** separate Graphics TSG do not stray from 'legal values'.

If required, ***Test Chest*** can generate a separate SPDIF compatible audio output too from the AES OP stream, via the Audio-POD's integral BAL/UN matching transformer.

Input looping ~ 'Processing Amplifier' mode.

SDI Equalisation and reclocking:

Using the Home Menu it is practical to "LOOP" external SDI signals through the Unit and benefit from the internal equalisation and re-clocking facility. Note that the menu flags this unusual setting with *yellow* text.

CVBS looping:

Test Chest will also loop CVBS inputs. CVBS will be ac coupled to remove any

possible dc off–set on the input, and then clamped to remove dc changes due to variations with **A**verage **P**icture **L**evel.

Text Ident:

A locally generated identification text string may be inserted into the output video, a particularly useful feature when identifying long lines. The Character Generator's non-volatile memory is pre-loaded with “TEST-CHEST” when shipped; however it is very easily reprogrammed to individual requirements by using the Text menu provided, an operation familiar to all mobile phone Users.

External video Reference:

TC may be Gen-locked (Slaved) to an external video Reference, this allows the output signal to be ‘timed’ to a Vision Mixer, for example. The external reference is applied as either a Composite video, Composite or Tri-Level sync to BNC2. Selection between modes is via menu icon. Be aware that Mixed or Composite sync is only appropriate for SD, and that HD standards require Tri-level syncs.

Genlock operation is initiated via the main menu's “Gear” icon, which leads to the Set-Up sub-menu page. The TSG output will be maintained locked within ½TV line of the Reference, enabling fully synchronous operation with digital equipment employing 2H digital synchronisers.

Backlight:

Once the TSG mode has been set up, one may wish to reduce the LCD's back light drive to a lower brightness. Using the 'Set Up' menu the brilliance may be reduced, or switched to 'LCD DIM' mode to conserve battery power.

Auto/Manual Power Management:

Under certain circumstances it may be desired to set the ***Test Chest*** to generate a test signal for a prolonged period, perhaps whilst tests are performed elsewhere.

If no icon 'activation' is detected for 10 minutes, in ‘Auto off’ mode the Unit will automatically shut down to conserve battery power.

This time-out may be defeated by selecting 'Always ON' in the main menu. Be aware however that when running on battery power, the Unit will continue to operate until the battery’s *low voltage cut off logic activates*. No Li-Po battery distress will occur, but the Unit will not be capable of further battery powered operation until the battery is recharged.

Murraypro recommend that the battery is recharged as soon as possible.

Test Chest may be used, and will continue to operate normally whilst it's battery is being recharged. Charge completion is indicated by the extinguishing of the yellow LED twixt BNC 3 & 4.

It is not necessary to remove the low voltage lead when charging is completed, and ***Test Chest*** may be safely run for protracted periods with the ‘charge/external power’ lead connected.

2b) *Test Signal Generation~Audio*

Test Chest generates audio in 3 different formats simultaneously:-

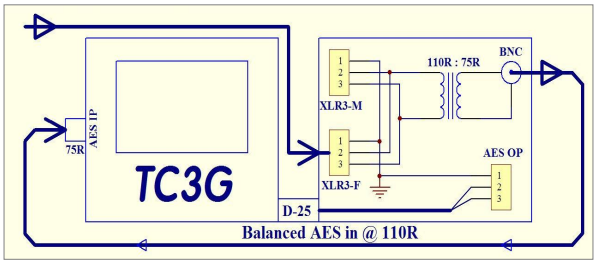
1) Embedded Audio is inserted in Group 1 by default, but Group 2, 3 or 4 may be manually selected for instead. Each channel 1~4 within the selected Group may be enabled or muted as required, with on-screen mapping to track and display the current set up.
   Audio modulation may be muted to 'Digital Silence'. This does not affect the digital house-keeping data, which is always generated.

2) **AES output stream**. This is enabled by default and runs in parallel with and uses the same source as Embedded Audio, via the 'Generate Audio' page. Channels 1 or 2 may be enabled, or muted as required.
   The Unit's dual channel AES output is presented on the D-25F connector as an 110Ω balanced 48KHz AES encoded stream. This output port is automatically coupled through to the Audio-POD when it is connected; and it is accessed via the AES OP XLR3-M.
   For **Un-Balanced** 75Ω AES operation, the balanced OP should be first routed to the BAL/UN (110Ω:75Ω) transformer on the Audio-POD, and then extended to the load from the POD's unbalanced AES 75Ω BNC as usual.

3) **Balanced dual channel analogue audio**. Enable this mode which runs in parallel with, and uses the same source as Embedded Audio, via the 'Generate Audio' page and, as with the Embedded Audio, Channels 1 or 2 may be enabled, or muted, as required.
   The Unit's dual channel Analogue output is also presented on the D-25F connector, and these low impedance balanced output ports are also conveniently coupled through to the Audio-POD, where it is accessed via the Analogue OP's dual XLR3-Ms.

AES Matching with the Audio POD: Generation & Monitoring

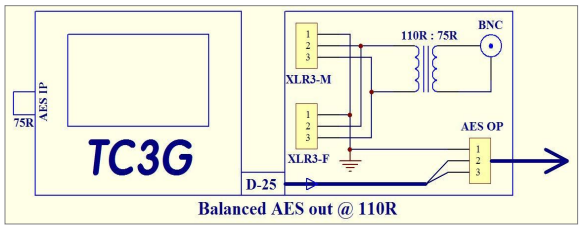
AES: Unbalanced IP @ 75 Ω.
Very easy, just couple the coax cable to BNC2 Test Chest's main AES input.



AES: Balanced IN on XLR3-M @ 110Ω.
Couple IP cable XLR3-M to the POD's Transformer XLR3-F, and loop a short BNC~BNC coax round to ***TC****'s* BNC2.

AES: Balanced OP @ 110RΩ.
Very easy! Just connect your XLR3-F cable to the POD's AES OP.

AES: Unbalanced OP @ 75Ω.



Use an XLR~XLR 'double ender', couple the POD's XLR3-M AES OP *back* into the POD's transformer, and then plug your coax cable into the POD's 75Ω BNC.

Output amplitude considerations:

The Embedded and AES digital audio bit-streams may be operated over a much greater encoded amplitude range than that of the balanced analogue audio, where practical considerations confines ***Test Chest***'s limits to about +/-10dBU.

Do not confuse the encoded audio amplitude data with the actual amplitude of the AES bit stream which remains unaltered, at around RS422 levels; normally around 3~4 V PP.

Digital outputs may be adjusted in 1dB steps from 0dBFS down to -80dBFS. This low output amplitude is useful for testing the digital microphone inputs of a Mixer realistically. Whilst the overall envelope of the AES signal will remain at the standard RS422 level at all times, digital microphones usually emulate their analogue partners' low OP level, generating an AES output with a similar low digital *modulation* amplitude.

Analogue amplitude:

The analogue audio channel is aligned such that a level of "-18dBFS" will

produce a balanced analogue OP of 0.775VRMS = 0dBU, this is about 10dB below the maximum OP. Users are reminded that the maximum balanced analogue output, which does embrace the normal +8dBU peak programme level, is headroom-limited by the internal battery voltage to about +10dBU.

Murraypro recommend using an external 60dB XLR/XLR attenuator if it is desired to simulate 'Mic level' and similar low level analogue signals.

Audio Sources:

1) The internal audio oscillator offers menu selected spot frequencies, and amplitudes.
2) An External AES input may be selected. Be aware that, although a 48KHz source may easily be monitored and metered, it will not be practical to use it as an Embedded source, unless the 48KHz input Word Clock is synchronous with the output Video signal.
3) External Embedded Audio may be selected that has been extracted from the signal applied to BNC1, the ***"Which-Wire?"*** input. Be aware that, as above, unless the 48KHz input Word Clock is synchronous with the output Video signal, it will not be possible to use it as an Embedded source.
4) **TC3G** offers a very powerful Utility in the "Audio Measurement" menu, which indicates whether an external AES input signal is synchronous with a video reference that is applied via the ***WW?*** Operation is described under the following "AES/Video Lock Confirmation" passage.
5) A unique pulsed 'Tone PIP' identification can be added by **TC3G** to each audio channel within a selected Group. This enables downstream monitoring points to correctly, and unambiguously, identify each channel individually.

600Ω Audio loading:

Output loading: ***Test Chest*** follows current audio line driving practice, sending from a current limited, balanced, low impedance source.

Test Chest follows Broadcast equipment's input convention, by presenting a balanced load with a high impedance comfortably in excess of 10KΩ.

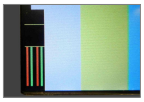
600Ω loads are *very* unusual with current audio practice, and the significant loading of the XLR3-M balanced output by a 600Ω termination will cause a reduction in the output amplitude of perhaps a couple of dB, by potential divider action.

The outputs are current limited, and no damage will occur due to short circuits or indeed 600Ω loading.

3) *A&V Monitoring*

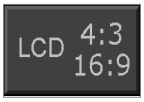
TV Monitor:

TC3G incorporates a TV Monitor function with 800 x 480 pixel resolution which automatically displays images in any supported Format.



Mini-Histogram:
Tapping the lower left side of the TV monitor display will toggle the burnt-in Histogram ON/OFF. See later text for more information.

Aspect Ratio:



TC3G defaults to a 16:9 aspect ratio, but 4:3 images may be viewed in their native format using the '16:9/4:3' menu option on the “Spanner” Setup icon page for manual adjustment of Aspect Ratio.
This is ***Test Chest’***s only non-automatic mode!

Measurement:

The TV **W**ave-**F**orm **M**onitor and **Vectorscope** function accepts SDI & CVBS sources, automatically switching as required. Video signals from either may be displayed as either standard video signals with H or V Timebases; or in H Parade mode, where the colour information is sequentially switched between either the YRGB, RGB, YUV channels, or in Vector format. To ease channel identification, the Parade display sequentially adopts the colour of the signal being instantaneously presented.

WFM display may re-positioned on the LCD by simply touching the trace, and *dragging* it to the desired position with a fingertip.

In the Composite video display mode, the WFM's HF response extends up to well beyond 6MHz.

HDVI

Display:

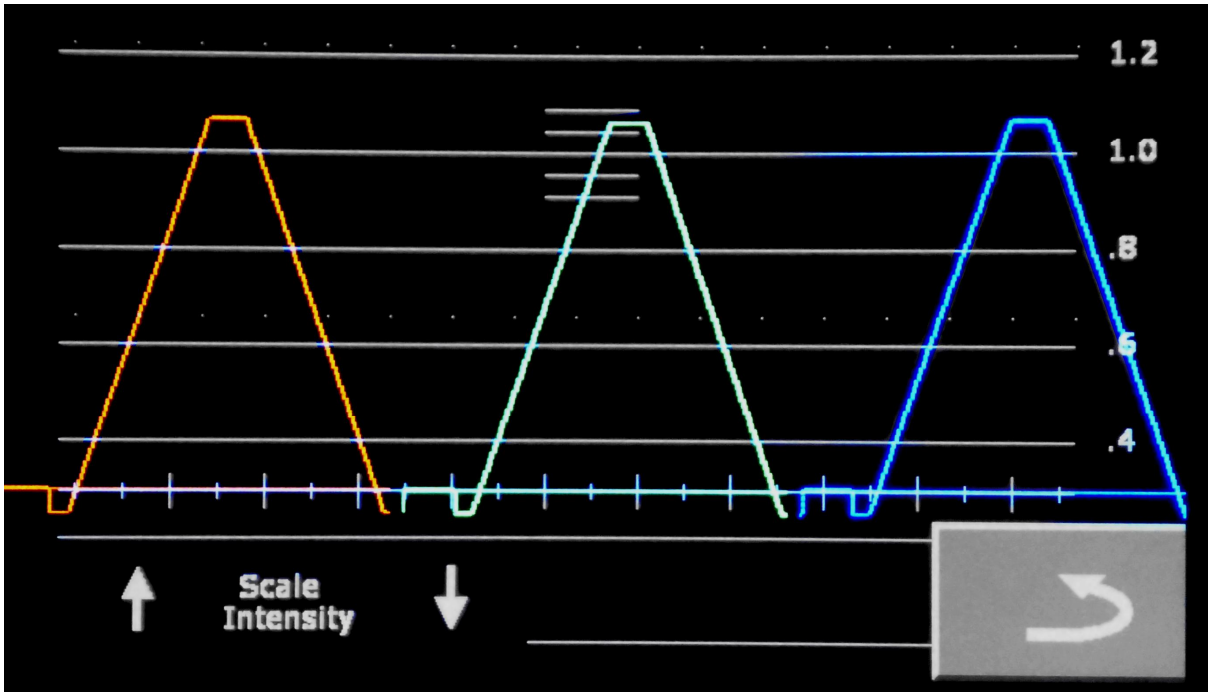
Test Chest’s HDVI input port is designed to accept ‘TV display’ (SD~>3G) formats adhering to ‘681, and whilst the port will accept signals on other graphics standards, they may not be coherently displayed.

Use of industry-standard connectors enables PC Display, Graphic cabling, and associated interfaces to be swiftly checked out. This useful feature should be regarded as an additional integral facility, significantly expanding "Test Chest's" existing capability, rather than as a substitute for a dedicated Graphics Test Set.

WFM & Vectorscope:

HDVI waveforms may be examined either on the Vectorscope or displayed as a signal in WFM or Parade mode.

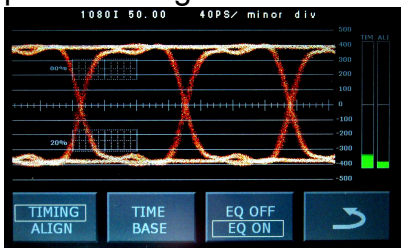
The Y channel display scaling adheres to Broadcast SMPTE standards, and sources that do not conform with these are easily spotted. Excursions below black level and above 100% are caused by coding with of out of range values, as the out of gamut signal generated by this low cost HDMI generator demonstrates well!



This HDVI input signal contains out of Gamut values!

Touch-Shift:

Using the LCD's touch panel, waveforms may be 'dragged' in both the X & Y planes to align the trace with the graticule, to facilitate measurements.



The WFM display may, in SDI mode only, be synchronised to an External Reference. This Reference signal which may be either Tri-Level or Colour Black, is applied via BNC2. BNC2 has a 75Ω impedance and is also used for the dedicated AES input and as the TDR port.

The WFM Vertical sweep display may be expanded to reveal further detail during the active frame period.

Swiping fully across the whole width of the LCD screen in one continuous action will increase both position in the Frame/Field, and the *rate* of shift. An on-screen counter displays the delay in 'TV Lines' between the WFM's vertical trigger point, and the start of the displayed period.

With PAL/NTSC CVBS sources, unlike the WFM, the Vectorscope displays only 'Active Line Time' chrominance information, and the colour Burst is therefore suppressed.

When confirming optimum White or Black 'Balance' on a Camera etc, the display gain may be increased, using the icon on the Vectorscope menu page.

"EYE" and Jitter:

This feature is supported by the Test Chest's ***EYE~POD*** accessory, which provides the EYE and Jitter measurement capability, which is accessed via the WFM

menu. Eye monitoring and making measurements do require this module, and are not supported unless this is present.

Instructions for the use of *EYE~POD* are presented in the rear section of this manual.

Audio Measurements:

The **TC3G** provides two independent type of audio level measurement, “Histogram” and “Numeric”, and generally both forms are available simultaneously.

The histogram display is highly dynamic and primarily intended for use when measuring programme audio amplitude, but is suitable for steady state tones too.

The numeric display, which appears on the top 'banner' field, is heavily damped, and is only intended for use with steady-state tones.

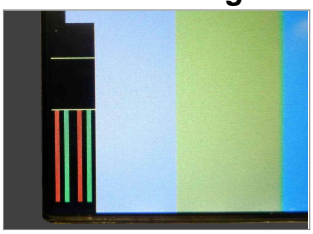
Using the Test Chest’s 75Ω ***WW?*** input port, Audio Monitor mode provides accurate audio level monitoring of embedded audio signals via the Audio menu. Embedded audio levels for the selected Group are presented in histogram format, as 4 columns on the LCD screen, and it is immediately possible to unambiguously differentiate between an AES reference level at -20FS and an EBU reference at -18FS, when using either measurement facility.

The histogram display offers menu selection between the quaisi-peak~semi-logrithimic scaling of **BBC PPM**, **Nordic, DIN & Digital scales** or the more transient **VU Scaling + ballistics** which offer additional sub-selection for operation with different Reference levels.

The usual BBC PPM scale sensitivity (-18dBFS = PPM”4”) may be preset via the audio menu so that either the ITU or SMPTE (-20dBFS) Operational Reference levels are 'normalised' to read PPM = “4”, making the subsequent evaluation of SMPTE programme audio level considerably easier.

The histogram's “Digital” scale has 1dB graticule gradations covering levels from 0dBFS down to -29dBFS, with icon selection of additional switched gain blocks of +30 and +60dB. This additional gain allows AES & Embedded level measurements down to around -90dBFS.

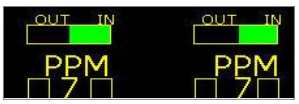
In-vision Histogram:



TC3G provides a neat in-vision histogram feature which may be displayed whilst in the 'TV Monitor' mode. Useful for confirmation that audio is being satisfactorily received, especially when output from the loudspeakers is muted. According to the type of the source, the histogram display may be stereo or 4 channel.

This is a simplified display, bearing graticule points at -18 and -10dBFS (=0dBU & +8dBU analogue) and emulates the full scale histogram scaling selectable via the Audio Monitoring menu. The burnt in mini-display is enabled or disabled by tapping the lower left region of the TV monitor's image where the histogram would be/is presented.

Audio Phase:



Test Chest includes Audio Phase error detection for each of the Ch1/Ch2 and Ch3/Ch4 pairs of the selected Group. With embedded audio both channel pairs are presented; whilst with balanced analogue input only the single stereo pair can be monitored. Either detector will instantly "RED" flag a phase inversion of one channel, with respect to

the other; and whilst the effect is instantly recognisable with steady state test tones, it could take a moment or two before an error is apparent on Programme Audio due to the varied nature of the real-world signals encountered. On a normal Programme, with correctly phased stereo, one would anticipate only an occasional, and momentary, "RED" flag; whilst in the presence of a phase inverted channel, one might anticipate a near continuous "RED" flag.

TC3G digitally compares the amplitude of “M” & “S” channels derived from each stereo pair. With true stereo (not necessarily true with ‘electronic’ music), almost without exception the amplitude of the “S” channel will seldom exceed that of the “M” channel, and then only on peaks, *except* in the presence of a phase error. “S > M” will, after integration, therefore be flagged as an error.

Prolonged illumination of the red “PHASE” flag will leave little doubt that a serious audio phasing problem exists, requiring immediate remedial action.

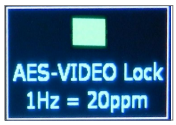
AES Audio:

Using the Selector on the Audio Monitor sub-menu, a 48KHz *unbalanced* AES stream input on the 75 R BNC3, may be selected for monitoring.
Essentially, the same options as for Embedded Audio are available.

Balanced AES IP:

Balanced AES sources should be first routed, to the BAL/UN (110Ω:75Ω) transformer on the Audio-POD, and then extended onwards, using a short BNC~BNC cable to BNC 2, in the usual way.

AES/Video: Lock Confirmation



Test Chest includes a very useful Utility to confirm that the 48KHz Word Clock of the AES input signal on BNC2, is synchronous with the chosen Video Reference signal, fed in this case via BNC 1.
To use this feature, the AES INPUT mode should first be selected on the 'Monitor Audio' sub-menu. The Reference Video, with which synchronism is being checked, is applied to the ***'Which-Wire?'*** input via BNC1.

When synchronous, the ‘lock’ flag should be a solid green. Should these signals be asynchronous, the "AES LOCK" flag on the audio monitor page will change state to red and will pulse at the 'beat' frequency, referring to their difference at 48KHz.
Flash rate of 1Hz equates to a difference error of approximately 20 parts per million.

Audio Monitoring

Loudspeakers:

Be aware that when monitoring AES or Embedded sources, overall system gain is controlled by the switched +30 and +60dB preset gain icons, with the loudspeaker volume level being controlled with the up/down icons on the main menu.

Using the Audio sub-menu the front panel loudspeaker may select between 'Ch1 + Ch2' or 'Ch3 + Ch4' pairs for each of the 4 audio groups. Stereo audio for each channel pair 1&2 through to 15&16, may therefore be monitored on the conveniently mounted front panel stereo speakers; or on Headphones when they are jacked into the side-panel mounted 3.5mm socket.

When jacked, the headphones automatically mute the modestly dimensioned loudspeakers, and furnish significantly enhanced audio quality.

********** !!! CAUTION !!! **********

Headphone operation

*Users are cautioned to operate the **Test Chest**'s headphone port with restricted volume levels. Always advance the volume from an initial low setting.*

The headphone output has limited current drive and is voltage limited by design, but Murraypro has no control over User's choice of headphone.

Some high efficiency transducers, closely coupled to the ears, may be able to produce pressure levels that are hazardous to hearing.

External Display

Sometimes it may prove useful to be able to port the ***Test Chest's*** 800x480 display on to an external PC type monitor. This is easily achieved using the 19 pin HDVI output port at the top of the right side panel, active whenever ***Test Chest*** is powered.

Low latency display

Test Chest's image processing has been designed to provide acceptable quality images on the internal 800 x 480 pixel LCD, and is a subtle balance between conflicting 'interpolation', 'latency' and battery drain considerations. Our chosen solution shuns power hungry interpolation techniques involving multi-frame storage and digital multiplication, in favour of direct ratio-metric processing. This achieves an impressive through-put with a maximum LCD latency of around 1 field (with interlaced sources).

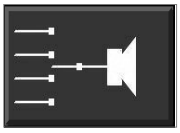
This is a neat solution for a battery powered Tester with a 5" panel, which makes no attempt to offer "Grade 1" images. A major improvement in both processing speed and power economy have resulted in excellent battery endurance too, and *ALL* this has been traded for only a modest increase in interpolation artefacts.

You may wish to ensure that the Power Management option on the main menu is set to "Always ON" rather than 'Auto Off', or the ***Test Chest*** will automatically de-power 10 minutes after your last key press!

Additional functions are present within the Test Chest, and these are discussed below:-

Audio Signal Tracer

The internal audio amplifier is also operational in WFM mode, and may be selected via this three step operation:-
1) On the Home Menu, select the Input = ***"W-W?"*** option.
2) On the Home Menu, select the "Audio Monitor" option.
3) Tap the diagrammatic "switch" icon on the lower-left of the LCD screen until "W-W? BNC" is declared at the end of the top banner text.



Note that although, normally ***Test Chest*** automatically pre-routes the audio associated with the selected *video source* to the *audio monitor*; the "switch" icon on the "Audio Monitor" page permits manual over-ride, to give total flexibility. This might be particularly useful when comparing an SDI embedded audio against it's balanced analogue counterpart.

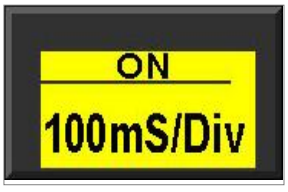
When the audio monitoring amplifier is switched to ***"W-W?"*** input (BNC 1), this feature becomes a really useful tool for audio investigation and signal tracing. Audio volume level is controlled by the Home Menu "up" and "down" selection.

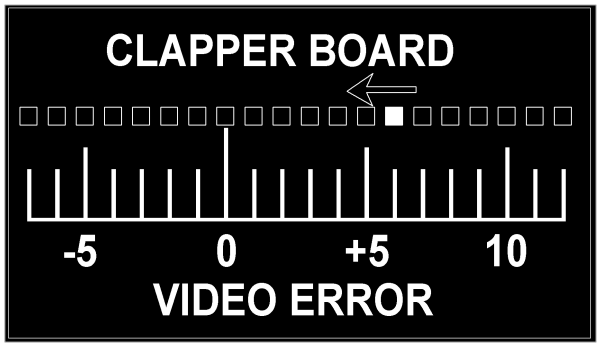
Clapper Board

'Clapper Board' is a proprietary Test Signal that is designed to show Audio/Video delay inequalities that a TV signal may have incurred, usually due to external Video processing, and which has not been accompanied with the complementary audio delay. It is not designed to correct an error, simply to demonstrate that one is present, and which requires remedial action.

"Simplicity" is the word, and all that is required at a remote Monitoring Point is a picture Monitor with low Latency, and a Loudspeaker.

The picture shows a diagrammatic, functional representation of the Clapper



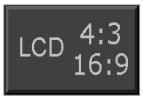


Board signal as generated, for feeding to a Remote Location. The 'Puck' is represented by the white dot which travels rhythmically across the screen from right to left; and at 'time zero' a white flash is generated together with a brief pulse of audio tone. The Clapper Bd's 'Puck' speed is calibrated so that each major graticule division represents 100mS of time.

Whilst 'Time zero', Flash and tone pulse are co-incident when generated; subsequent (particularly) video processing incurred during progress along the Link, may result in a delay in-equality experienced by the Audio and Video components. An error of several Frames of differential delay is entirely possible, with a disastrous effect on “Lip Sync”, an effect that will be painfully obvious to all downstream Viewers.

At the Receive Point, the Observer simply judges precisely *where* the tone blip actually occurs, with respect to the instantaneous position of the travelling 'Puck'. It may help to estimate the error more accurately, if the screen zone *outside* the area of interest is simply masked off temporarily with both the Listener's hands, to leave a 'trackable slot' that is centred where the tone interruption occurs.

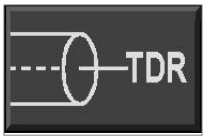
LCD Aspect Ratio



Users may wish to optimise the Aspect Ratio of the internal LCD panel in order to display Heritage 4:3 pictures correctly.

The ***Test Chest's*** LCD aspect ratio is toggled using the Aspect Ratio option on the “Set Up” menu, accessed via the 'Spanner' icon. Note that this feature is only operational when the LCD is displaying a TV Picture, thus ensuring that the menu pages are always completely visible.

Cable Fault Detection (TDR)



Test Chest offers **T**ime **D**omain **R**eflectrometry utility for the identification, and location, of cable problems. The TDR launches a fast pulse from a precision 75Ω source impedance, into the near end of the problem network which is connected to the TDR port, BNC 2.

With a correctly terminated cable, all the launch energy will be absorbed by the terminating load at the far end of the cable; however, should that load not perfectly match the network's 75Ω impedance, a percentage of the launch energy will be reflected back from the far end of the cable, and is directly dependent upon the magnitude of the error, very similar to a RADAR return. It is this reflected energy which ***Test Chest*** detects and displays on the LCD's display.

The TDR launches fast 16 nS pulses, and longer cables will have higher losses, and so absorb more energy, thereby producing lower amplitude reflections. You may wish to ponder the fact that with all cables, energy reflected from the *far* end of any cable will have travelled *twice* that distance *before* being detected.

Users may choose to obtain improved performance and so resolve smaller TDR artefacts by increasing the display gain, but the noise floor is compromised.

The X axis (Time-Base) of the display is calibrated in Metres for Belden 1694 (5~180M). An *unterminated* cable shows a *positive* reflection, whilst a short circuit shows as a *negative* reflection, with *distance* to anomaly indicated on the X scale.

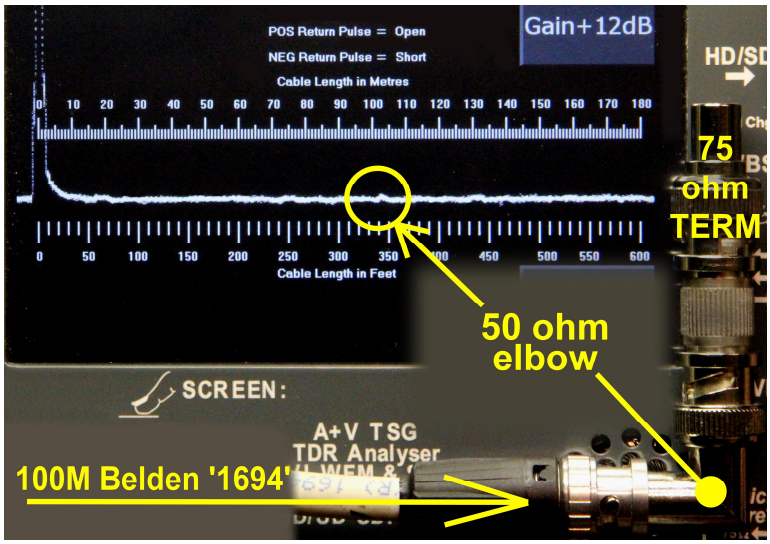
The velocity ratio of this cable (0.82), is similar to that of other quality coaxial cables, and the distances indicated may be used, with only a small nominal error, as a direct guide with many other cables types.

In a 75Ω system ***Test Chest*** was very easily able to differentiate between a correctly terminated system, and one which is:-

a) Open circuit (unterminated).
b) Incorrectly terminated in 110Ω.
c) Incorrectly terminated in 50Ω.
d) Double terminated with 2 separate 75Ω loads.
e) Correctly terminated, but containing an unterminated “stub”.

Tests demonstrate that a stub only 50mm long, T-Piece'd in, 10M before the end of 110M of correctly terminated Belden 1694 is clearly detectable.

It is unlikely however that, unless significant, mechanical deformation due to cable compression would be readily detectable.



This annotated photo shows ***Test Chest***’s 16nS TDR pulse probing a 100M high quality coaxial cable and revealing an obvious glitch.

This photo, taken following a Client demonstration, shows that this glitch is due to the presence of a 50Ω BNC elbow immediately before precision 75Ω termination.

Remember, all this reflected pulse energy has actually traversed 200M of cable!

‘SDI Event’ logging

Test Chest incorporates an ‘HD/SD-SDI’ Error logging Utility which is accessed from the main menu, through the ‘*Set Up’* menu (Gear icon).

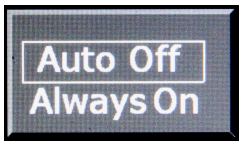
After initiation through the ‘*Start Log’* icon, 8 parameters are continuously monitored for error codes which, when detected, are logged against the internal RTC. The Logger has been designed to operate independently of external time references, and it is *NOT* necessary for the input video signal meta-stream to contain VITC data, however an option to select VITC time for logging is envisaged.

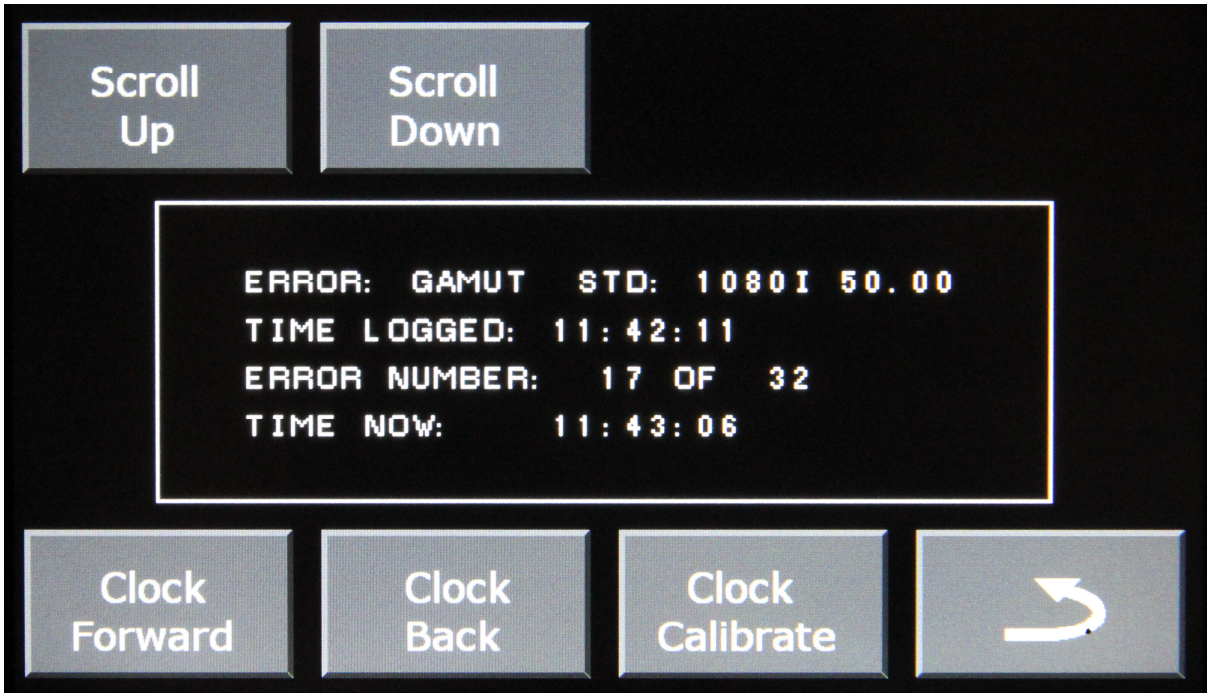
A running count of the total number of errors that has been detected in each of the 8 monitored ‘error’ fields is presented for information.

Logging:

Note that once initiated, the Error Logging continues in the background, even if an operation on another menu page is selected.

When Logging is in progress ***Test Chest*** forces the power timer into "*Always ON*" mode. Else, with "*Auto Off*" mode enabled powering down occurs 10 minutes after the last icon-touch, and this might just prove to be very annoying!





The '*Auto Off*' default power setting is automatically re-instated when the logging activity terminates.

Operation under battery power is time limited, and the internal battery's endurance will be determined by age, condition, state of charge, and the Clock speed of input signal being monitored. Nominal figures for guidance below:-

	SD-SDI	HD-SDI	3G-SDI
Battery current	720mA	800mA	900mA
Nominal endurance	4H	3.75H	3.3H

Mains powered operation is recommended for lengthy logging operations!

The non-volatile memory stores the *first* 100 logged events, with up to 230 occurrences of each type counted, and when present indication of counter overflow.

Error flags are generated when any of the conditions below occur:-

1 Timing Reference Signals: SAV & EAV protocol error detected.
2 Ancillary Data (various): CRC invalid
3a CRC-AP: Check Sum failure for the **SD only** 'Active Picture' area.
3b CRC-Y: Luminance Check Sum error **HD only**.
4a CRC-FF: Check sum failure for the **SD only** 'Full Frame' period
4b CRC-C: Chrominance Check sum failure **HD only.**
5 Line: Declares that 'encoded line number' declared in HANC is incorrect.
6 Lock: Confirms SDI receiver 'unlocked' in the presence of valid SDI source.
7 Illegal: Confirmation that value '000' or 'FFF' has been detected.
8 Gamut: Y/C Colour Space LPF'd values exceed -1% or +103% system limit.

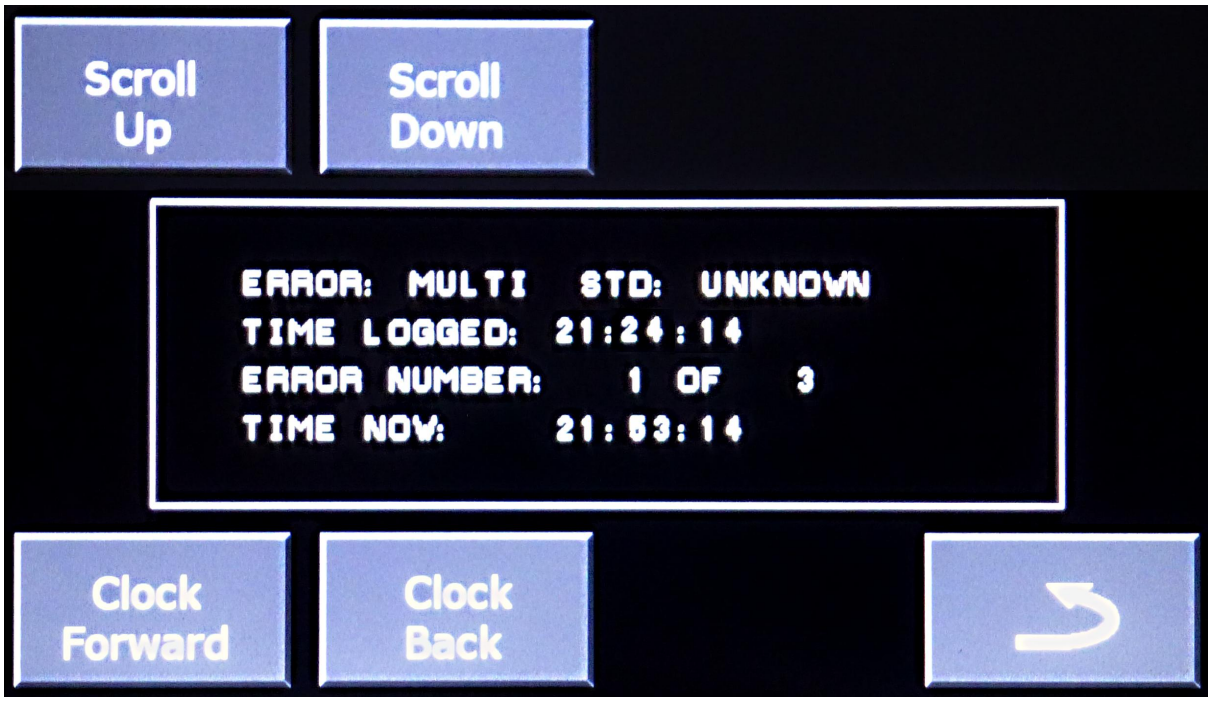
Read Log:

Selecting the *Read Log* icon immediately stops the current Logging operation and switches to the Stored events page, where intuitive icons speed Users to the stored Event of interest.

The first 100 events are stored in the memory, thereafter writing ceases. However the 8 respective Event counters will continue to increment independently up to 230, when over range is indicated.

The internal memory is accessible via the USB Port, and the stored event Log will be downloadable to a PC for subsequent investigation, using a software Suite that is currently in development.

Reselecting "*START LOG*" will flush the storage memory and the Event counters, which recommence from zero.



VITC Reader

Test Chest contains a Reader which decodes VITC (SDI only) on BNC1 and displays the decoded time, preceded with a "V", in the banner on the LCD.

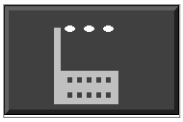
Configuration Memory

Test Chest contains memory which stores 10 User-configurations. These are held in non-volatile ROM, and may be recalled to over-ride the default 'Last used' configuration which is automatically loaded at manually initiated power-up. Write/Read operations here are intuitive too, and further instructions are not given.

Reset

From time to time occasions may arise where a User might wish to "soft" reset all ***Test Chest*** variable options to their "nominal" settings. This option is selected via the 'Set Up" icon on the Home Menu.

***********CAUTION***************************************



Be aware that this immediately pre-loads default median values, but 'Master Oscillator frequency', 'Analogue audio ADC off-set', and 'SDI Calibrate' parameters will be reloaded with individual values established during their factory alignment

We have supplied the alignment instructions later in this manual to optimise Master Oscillator frequency, and the ADC off-set, if these are required.

SDI Calibrate

A really useful utility is ***Test Chest's*** cable comparator which provides the ability to quickly compare different cable lengths.

After selection of *cable type*, *length* and *TV clock frequency,* a composite performance parameter is stored for your chosen 'reference' cable via the 'Set Up" (Gear) icon (**SDI Cal**). The performance of any cable subsequently plugged to BNC 1 is compared against this stored reference, and a declaration as to whether more or less SDI equalisation is required to 'normalize' the cable in use is instantly presented on the LCD's banner.

By way of example, we will choose *100M* of Belden *1694A* cable and *1.5GHz Clock (1080i 50Hz)* as our *"Reference*", and then store this loss value.

Having defined our *Reference's* parameters, take one end of your Reference cable to the ***Test Chest*** SDI output on BNC4, and loop the far end of the cable round to BNC1. *Store* this value by tapping the "Set SDI Cable loss" icon in the Set-up menu.

The SDI Cal's *"Reference*" value may be reset for a different cable Type/Length/Clock at any time, simply by initiating the 'SDI CAL' command.

The losses associated with a longer length of cable (for the same *system-clock & cable type*) will clearly be higher with longer cables, and lower with shorter cables. The difference between previously stored *"Reference*" loss variable, and loss associated with the current input signal, will be declared on the banner at the top of the LCD panel as 'Hi loss' = Longer than Reference; or 'Lo loss' = Shorter than Ref.

Nota Bene:

Note that "Hi loss" does NOT necessarily infer that your current cable is faulty, only that it is requiring more SDI equalisation than your reference cable!

Pressing the Factory RESET icon in the set-up menu will automatically restore the *Reference* value for 100M of Belden 1694A cable @ 1.5GHz.

Choosing a 'longish' length of cable (as above) for your reference can be useful (especially at 3GHz!), as it can offer timely warning that the 'Digital Cliff' could be approaching, something much less likely with significantly shorter cables.

Battery, Switch & Charger

Li-Po battery pack, and charging

Test Chest uses an internal battery comprising 2x Lithium Polymer cells connected in series. When fully charged, Users may anticipate a minimum of 2 hours endurance. By reducing the LCD backlight drive, a function on the main menu, a useful extension in battery powered operation is achievable.

Be aware that generally logic devices' power consumption increase with system clock speed, and that HD operation at 3GHz clock frequencies can consume 25% more power than SD operation at 270MB. This has a measurable influence on endurance when on operating under battery power.

Battery packs are fitted with connectors but are not operationally 'swappable'. They are however considered 'field replaceable', so please contact Murraypro for information concerning the supply of replacement battery packs.

The battery pack is charged automatically as soon as low voltage external power is applied, via the 2 pin Lemo connector. An intelligent charger monitors the cells' voltage, charge current and temperature throughout the charge cycle, thereby ensuring that the battery recharges as quickly as practical, consistent with the Manufacturer's specification.

The internal battery charger monitors a number of parameters, as above, and will prevent overcharge, no matter how long the external power is connected.

From "flat", expect the ***Test Chest*** battery to be fully recharged in 2~3 hours. Note that manufacturers suggest that the performance of a new pack will improve after a few charge/discharge 'conditioning' cycles.

The "Battery Charging" status is flagged by the illumination of the yellow LED between BNC 3 & 4. The LED extinguishes when the charge process is complete.

The battery is protected against "deep discharge" damage by a special low voltage detector which powers down the ***Test Chest*** when the cells have discharged to their minimum safe level. Prior to that time the battery voltage histogram at the top of the LCD panel will give warning that only a limited period remains before automatically shutting down.

The 3V6 Lithium Polymer cells fitted in the battery have a capacity of 3000mAH, and are anticipated to have a service life in excess of 500 charge/discharge cycles.

Murraypro supply a +12V regulated supply that is capable of *operating* ***Test Chest*** *whilst* it recharges the battery. An external power source between +12V and +15V dc, and capable of sourcing of 1.25A via the 2 pin Lemo connector, should be suitable. The 'red dot' on the connector, adjacent to pin 1, identifies the +Ve input.

During the charge cycle, it is usual for the cells to become gently warm, and a rise of 10 - 15^{o}C is entirely normal. The internal monitoring of cell parameters provides a high measure of protection against overcharge.

Standby mode

Users will be aware that with all re-chargeable batteries there is a degree of "self-discharge" (virtually negligible in the case of Li-Po), and there is also a tiny ***"Which-Wire?"*** quiescent current drain too which reduces the level of stored charge with time. This drain is small, and even after 6 months 'standby' well over 50% of the charge should remain.

If ***Test Chest*** has been stored for several months Murraypro recommend that the battery is given a “topping up” charge before use.

Battery “off” switch

Test Chest is fitted with a ‘battery disable’ switch which is mounted on the left end panel adjacent to the D-25 connector.

This switch is usually in the “Norm” position, and the Unit will then be ready for instant service.

If storage is envisaged for any significant period, or the screen may be ‘touched’ whilst in short term storage, then it is recommended that the switch is set to the “BATT Off” position. This disables most of the internal load, but power to the Logger’s **R**eal **T**ime **C**lock will be maintained.

Software Version installed.

Test Chest contains four re-programmable devices, ‘PC’, ‘WPM’, ‘TSG’ & ‘PM’.

First select the ‘Setup Menu’, and the unique ID Code of the main PCB is reported at the top of this screen.

Select ‘About’, then the installed software suite for each device will be reported at the top of the screen.

Information regarding the latest software revision available is reported on the ***Test Chest*** web site at:- ***http://www.murraypro.com/testchest.htm***

Flashlight

By activating the press switch on the left end panel, ***TC3G*** provides a beam of white LED light, from the lens on the right panel to illuminate those dark and inaccessible areas which seem to be liberally positioned throughout the Broadcast TV environment. Cable colours and numbers are brilliantly illuminated in an instant, removing ambiguity caused by poor lighting.

CAUTION! The high efficiency White LED in the flashlight is extremely bright. ***NEVER stare directly into the light, or DAMAGE to EYES could occur.***

Frequently Asked Questions

Sometimes a different 'angle' may help resolve an issue, and we have a number of FAQ presented for perusal at:-

http://www.murraypro.com/testchest_faq.htm

Although great care has been taken to ensure that the information given in our documentation is as accurate as possible, errors can occur.....

Should you identify, what you believe to be an error, or perhaps a ***Test Chest*** operation that you feel requires revision, or a new instruction, please email your suggestion to us at:-

E: ***tech@***murraypro.com *.....and we thank you for your interest*

Test Chest: Specification

The Specification of the ***Test Chest*** is subject to a process of continuous review and development, and will be subject to revision. Hardware upgrades require return to the Works for installation, and will be announced from time to time. Information relating to the latest Software Suite is given on the Murraypro Web Site:- http://www.murraypro.com

INPUTs: BNC1: "WW?" 75Ω 1% terminating.
BNC2: External sync IP.
BNC2: AES& SPDIF @ 75Ω.
HDVI: 19 pin PC graphics IP port

OUTPUTs: BNC2: TDR port.
BNC3: CVBS (SD Only), 1 Volt into 75Ω load.
Tri-Level (HD only) 600mV into 75Ω load.
BNC4: SDI, 800 mV into load of 75Ω..
HDVI: 19 pin PC @ 800x480 graphics OP port
Headphone: Stereo 3.5mm Jack, 30Ω.

Which-Wire?

Power on; Auto-power up upon signal detection.
Sources: Automatic 3G/1.5G/270M-SDI & CVBS ~ displayed in TV mode,
Composite/Tri-level sync ~ displayed in WFM mode,
AES/SPDIF digital audio ~ Histogram display + de-embed speakers,
HDVI ~ graphics display mode,
Standards: Auto-detection of IP.
Aspect: Setup selectable to 16:9 (default) or 4:3 aspect ratio.
Legend: On-screen text field declaring detected Video+Standard.

Test Signal Generator

Test Signals: 100%, 75% & SMPTE Colour Bars, White field, Red Field, Black Field,
2T Augmented Pulse & Bar, Multiburst, Grill, PLUGE, Bow-Tie.
5 Step Staircase+Chroma, Sawtooth & Chroma, Pathological Test.
Luminance ON/OFF
Chroma ON/OFF
Puck ON/OFF
Circle 16:9/4:3/OFF
Clapper Bd ON/Normal
IDENT User programmable burnt-in character: ON/OFF.

SDI	Generated with 10 Bit precision.
CVBS	Generated to with 8 Bit equivalent precision, 0.5'DP & 0.5%DG..
A+V Sync	Clapper Board, proprietary Test Signal.

Video Generate & Monitor

1080p @ 50, 59.94, 60Hz. Level A (3G)
1080p @ 50, 59.94, 60Hz. Level B (3G)
1080ps @ 23.98, 24, 25, 29.97, 30Hz (1.5G)
1080i @ 23.98, 24, 25, 29.97, 30, 50, 59.94, 60 Hz (1.5G)
720p @ 50, 59.94, 60Hz (1.5G)
625i @ 50 Hz PAL + SD-SDI (270M)
525i @59.94 Hz NTSC + SD-SDI (270M)
HDVI TX @ 800x600
HDVI RX @ TV related scan standards.

Genlock: External IP on 75Ω BNC2.
CVBS Video, Composite sync, Tristate video.
Lock tolerance <0.5 TV line

Internal Audio Generation

Osc: 125, 250, 500Hz, 1K, 2K, 4K, 8KHz;
Amplitude: 0dBFS ~ -79dBFS in 1dB steps
Analogue OP: Dual, balanced low impedance drive, limits +/-10dBU nominal.
Embedding: Ch1, 2, 3, 4 Individually mutable, routed to Group 1, 2, 3 or 4.
Channel Ident: Ch1 ~ 4 of selected Group have unique Tone-Pip identification.
All Ch Ident: Each of 16 channels identified sequentially
AES: 110Ω ac coupled, balanced line.
OP Mute: Independent for Embedded, AES and Analogue channels

Waveform Monitor

Input Video: Uses "WW?" 75 Ω input, BNC1.
Video level measurement with SDI source ± 0.1dB
Video level measurement with CVBS source ± 0.3dB
HDVI; Uses HDVI IP port
TimeBase: 2H, H, H mag, 2V, V, V mag (with line count of trigger/display delay)
Shift: X shift, Y shift.
Parade: YRGB, RGB, YP_rP_b, available on SDI & CVBS inputs.
Traces appropriately coloured for identification.
Response: Analogue WFM: 25Hz-6MHz, +0.5dB, -3dB @ 10MHz.

HDVI

Input: Non-exhaustive list of coherent images include~
480i@60Hz H:720**420p**@60HzH:720
720p@60HzH:1280**720p**@50HzH:1280
1080i@60HzH:1920**1080p**@60HzH:1920
576i@50HzH:720**576p**@50HzH:720
1080i@50HzH:1920**1080p**@50HzH:1920
1080p@24HzH:1920**720p**@50HzH:1280 3D TB

1080p@24HzH:1920 3D SH**1080p**@24HzH:1920 3D TB
720p@60HzH:1280 3D SH**720p**@60HzH:1280 3D FP
720p@50HzH:1280 3D SH**720p**@50HzH:1280 3D TB
(SH = Side/Side HalfTB = Top & BottomFP = Frame Packing)
HDCP# EDID# or CEC# are not specifically supported.
Output: Either 'LCD-Panel' display, or HDVI TSGen.

Cable Fault

Range: 0-180M TDR Cable fault indicator @ 75Ω iterative impedance
Pulse: 16nS & 32nS width.
Detects: Open circuit, High impedance, Correct, Low impedance, Short circuit.

Audio Measurement

IP signal: De-embed Group *1, 2, 3, 4 from the SDI input signal.
Unbalanced AES: 48/96/192KHz, on 75Ω BNC3.
Balanced Analogue, stereo.
Group: Menu selectable *1, 2, 3, 4
Pairs: *A1&A2, through A15&A16.
Level Meter Histogram: PPM (BBC/Nordic/Digital) or VU ballistics & scaling.
Numeric readout: 'Slugged' ballistics with dB resolution for 'Tone'.
Analogue: -10dBU ~ +10dBU range, nominal.
-1dB @ 30Hz & 20KHz
-3dB @ 12Hz & 30KHz
Digital: -90dBFS ~ 0dBFS
AES/Video 48KHz Lock confirmation *GREEN*: 20ppm error = 1Hz Flagged *RED*.
Audio Phase Detection of "*S = +3dB>M*" error, flagged Red.
AES Utility: 110<~>75Ω Bal/Un-Bal bi-directional conversion via Audio-POD.
(= default pre-loads. All measurement tolerances are nominal, typical values.)*

Audio Monitoring

IP selection: De-embedded, AES, Bal Analogue, BNC IP
'Speakers: Internal stereo speakers mounted on the front panel.
2x 80mW drive. <250Hz - 5KHz response.
'Phones: Jacking in mutes internal speakers.
Current limited drive to 30Ω transducers.
30Hz ~ 20KHz, -1dB

Character Generator

Generator: 15 ASCII characters per line
Storage: Non-volatile RAM.

Configuration Memory

Store & Recall 10 User set configurations.

VITC

When present, VITC is read and displayed on TV Monitor's banner.

Electrical

Battery: Internal, pluggable, customised 3000mAH Lithium Polymer battery
Endurance: >3+ Hours Test Chest only @ 3G.
DC Input 2 pin male, mates with:- Lemo: HGG-0B-302-CLRP (Red dot = +Ve)
PSU: External 15W 3 pin IEC-320 mains PSU, permits battery charging & simultaneous (non-time limited) mains operation.
Charging: 3 Hour nom from flat. Ext 12V @ 1.25A.
Float charge: Automatic cut-off, Unit may be left connected continuously.
External dc: 12V-16V dc external power for full function.
LVC: Automatic “deep discharge” low voltage cut off.
LCD: 5””, 800 x 480 pixel, 110 x 65mm, 16:9 Aspect ratio,
Touch screen command entry, NO keyboard or 'Hot Keys'.
300mCD/M2, Contrast: 450, Viewing: X 140’, Y 130’.

FlashLight: High efficiency white LED. ***Caution: Do NOT flash into eyes.***

Physical

Robust alloy case.
Test Chest Unit: 1KG nom
Size: X:180mm, Y:140mm, Z:35mm nom.
Test Chest + Audio-POD 1.5KG nom
Size: X:280mm, Y:140mm, Z:35mm nom.
Test Chest Unit + POD & PSU in Carry case 2KG nom.
Size: X:290mm, Y:250mm, Z:95mm nom.

Current Firmware

PC:1V0 WPM:1V0 TSG1V1 PM: 1V0 Nov 2015
Reported at:- *http://www.murraypro.com/testchest.htm*

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EYE~POD

‘POD’ accessory to display ‘EYE’ & ‘Jitter’ characteristics.
False colour Eye display for clarity.
SD, 1G5-HD and 3G-HD
View 'RAW' or 'Equalised' stream.
WFM display 3, 10 & 30 Eye
Dual (but separate) histograms for Alignment & Timing Jitter modes.
Equalised & Reclocked Utility SDI throughput, for external equipment.
Controlled via Test Chest 800 x 480 Px Touch Panel.
Couples to TC3G via D-25 connector.
Size: 75 x 140 x 35mm nom.

(Provisional Spec)
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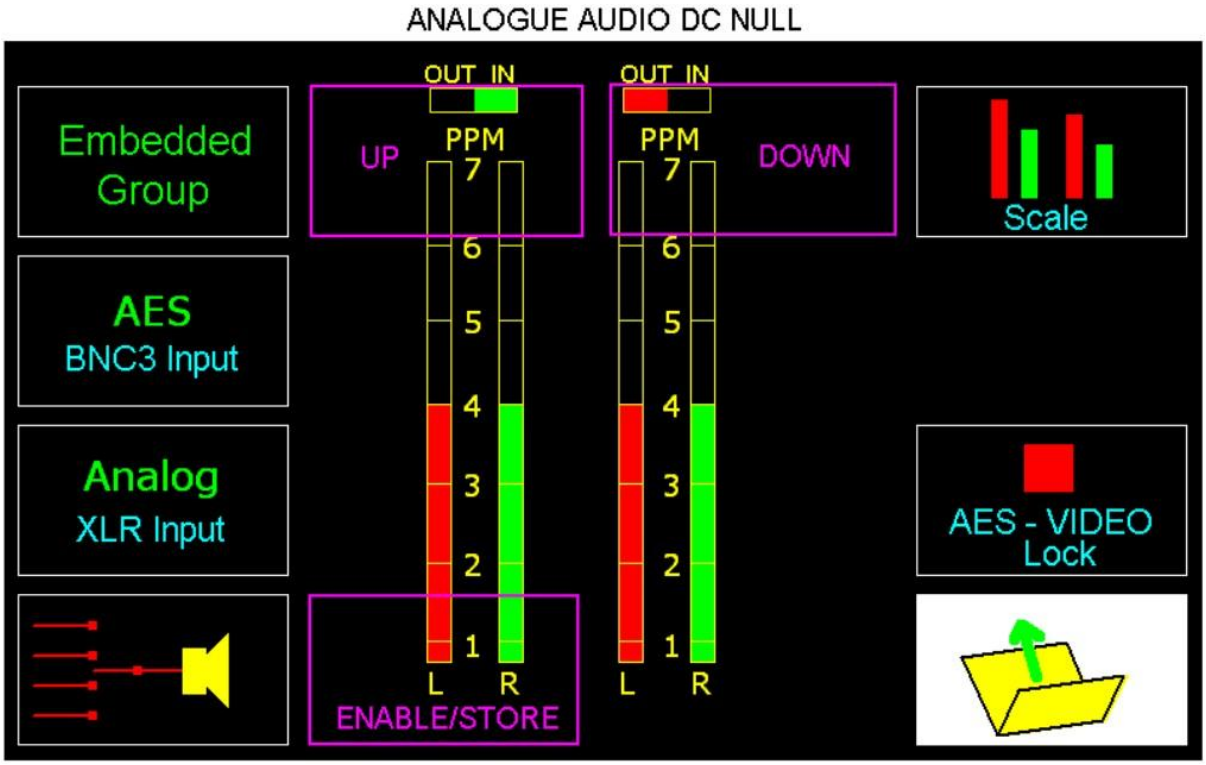
Alignment:

Test Chest is supplied pre-aligned and fully tested. Under normal circumstances the adjustments below are not required, however following any unauthorised "Tweeking", including an unintentional 'Factory Reset' command, the following procedures may be invoked to correct off-sets that may have been unintentionally introduced.

Audio ADC offset:

This may be required if the analogue histogram display shows residual low amplitude noise with no Balanced input present.

Be aware that the "Mauve Icons" shown below are ***NOT*** *actually displayed*, it only their *relative position*, and *functions*, that are important here:-



1) Select "Analogue XLR IP" on the Audio Measurement page. Ensure the Audio-Pod is not connected, and select "VU" mode on the audio histogram, and that the histogram is displaying low level pseudo-noise.
2) Briefly touch the LCD in the boxed area indicated as "Enable/Store" to initialise the setup menu. A numeric count, indicating the ADC's offset value will be presented at the top of the screen.
3) Briefly tap the position of the "UP" box and observe whether the displayed histogram 'noise' increases, or decreases.
4) Continue to tap the "UP" ***or*** "DOWN" box until the error is just removed. Note this on-screen ADC offset reading.
5) Continue to tap the same box, until the histogram error re-appears. Note this on-screen ADC reading too and subtract the smaller value from the larger value. A difference of 8 to 10 is typical.
6) Divide this value by two (to produce a value of perhaps 4 or 5), and tap the "DOWN" or "UP" box as appropriate, to centre the offset. ***STORE*** this value with a single tap of "Enable/Store" which enters this value, and clears the setup mode.

Master 27MHz: Accuracy

All the ***Test Chest****'s* generated outputs are referred to the internal 27MHz oscillator, (unless it is gen-locked to an external Reference IP) so it is important that its own frequency is as accurate as possible.

Broadcast SPGs for PAL use usually have highly accurate oven controlled high stability reference oscillators which are capable of maintaining an accuracy in the region of ± 1 Hz @ 4433618 .75Hz. Professional SPGs used entirely with digital Systems generate pulses that should have a similar level of accuracy. A Composite sync, or 'Colour Black' OP of this SPG (see below) are normally easily obtainable.

GPS timing is significantly more precise, as that system is directly locked to Atomic Clocks. However, their 1Hz OP, whilst likely to be more accurate, may be less convenient to use.

If using a GPS 1 Hz reference, it will be found beneficial to trigger the oscilloscope's timebase using the "Triggered" mode, rather than the "Auto" mode. A digital oscilloscope is recommended for use with GPS references, as the 1 Hz refresh rate will result in a very dim trace when using an analogue 'scope (see below).

27MHz Oscillator adjust.

This oscillator is adjusted using the "Setup" menu (Gear Icon), selected from the Home page.

1) Set ***Test Chest*** to generate a standard definition 625 100% Colour Bar. This is important as ***TC*** mutes the Composite Video output when generating HD signals.
2) Prior to any adjustment you must have access to Composite sync generated by an SPG of high stability, or a GPS receiver which produces a 1 Hz pulse output.
3) Either of these References may be used to externally trigger an oscilloscope displaying the CVBS output from ***TC***'s BNC 4.
4) Adjust the oscilloscope's timebase so that a 2H display of SD 625 Colour Bar waveform is presented. At this stage the display will be asynchronous, and so drift slowly across the screen.
5) Tap "VCO UP" or "VCO DOWN" icons as appropriate to reduce the speed of horizontal drift to the minimum practical.
6) When satisfied, tap the "SET VCO" icon to store this setting.

EYE~POD

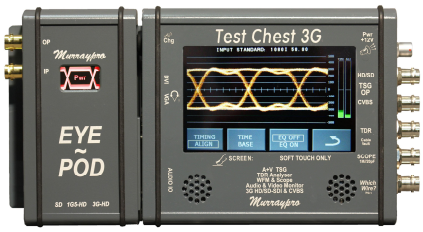
This section of the Manual is equally applicable to our earlier *"*Test Chest 3G*",* although this text will only refer to the current *"****Test Chest****"* model.

EYE~POD is available as an accessory for use with ***Test Chest***, and is not supplied as part of the basic unit. Current ***TC*** units are supplied fitted with the hardware interface and software required for *EYE~POD* operation, but any pre-existing ***TC3G*** Unit may be upgraded for *EYE~POD* operation by Murraypro at

modest cost. There is no question of 'existing inventory obsolescence' when using TC3G with the *EYE~POD* module.

In use, the *EYE~POD* module simply replaces the AUDIO-POD on its mounting plate, and when coupled using the keyed slide and toggle locking mechanism of the mounting plate, is then operated with the ***TC*** as if it were the AUDIO-POD. DC power and logic control is automatically coupled to the *EYE~POD* accessory by means of the D-25.

The *EYE~POD* module has its own dedicated BNC input connector, this is provided to enable precise input matching for optimum performance with SDI signals up to, and including 3G.



After the module is activated, a fully equalised and re-clocked utility output of the *EYE~POD's* input signal is available on the adjacent BNC.

When the module is activated, the 'Eye' icon on the Pod's front panel will illuminate, however it functions only as an indicator and is not an operational control.

When activated, the *EYE~POD* draws power requirement via the D-25 interface connector directly from the ***TC***, and under mains power the ***TC*** will support the *EYE~POD* module indefinitely. However when running under internal power, the ***TC***'s normal duration of around 3 hours with a fully charged battery will be significantly reduced.

The *EYE~POD* module is offered as an *accessory*, and may be used with *<u>any</u>* ***Test Chest*** or ***Test Chest 3G*** that has been upgraded and fitted with appropriate software. *EYE~POD* modules are *<u>not</u>* dedicated for use with any particular unit, so a single Inventory Asset could service several ***Test Chests***.

Operation:

When coupled to ***Test Chest*** the *EYE~POD* module will draw power and illuminate the front icon ONLY when the Eye feature is actually enabled. Under all other conditions, even when mated, the Eye module is completely quiescent.

The *EYE~POD* features are a sub-set of the WFM menu structure of ***TC***, which is accessed and activated using the main LCD touch screen in the usual way.

The software required to operate the *EYE~POD* is included with later ***TC3G*** units, but can be retro-fitted to existing earlier ***TC3G*** inventory, if absent.

After selection of the WFM icon in the main menu, the "Eye" & "Jitter" icons will be apparent in the top-right sub-menu. Selection of either the "Eye" or "Jitter" icon will automatically power up the *EYE~POD* module if fitted, or display a message warning that the module is absent if it has not been detected. If the module is present, and has a valid SDI input, the selected display will be presented on the ***TC***'s LCD panel.

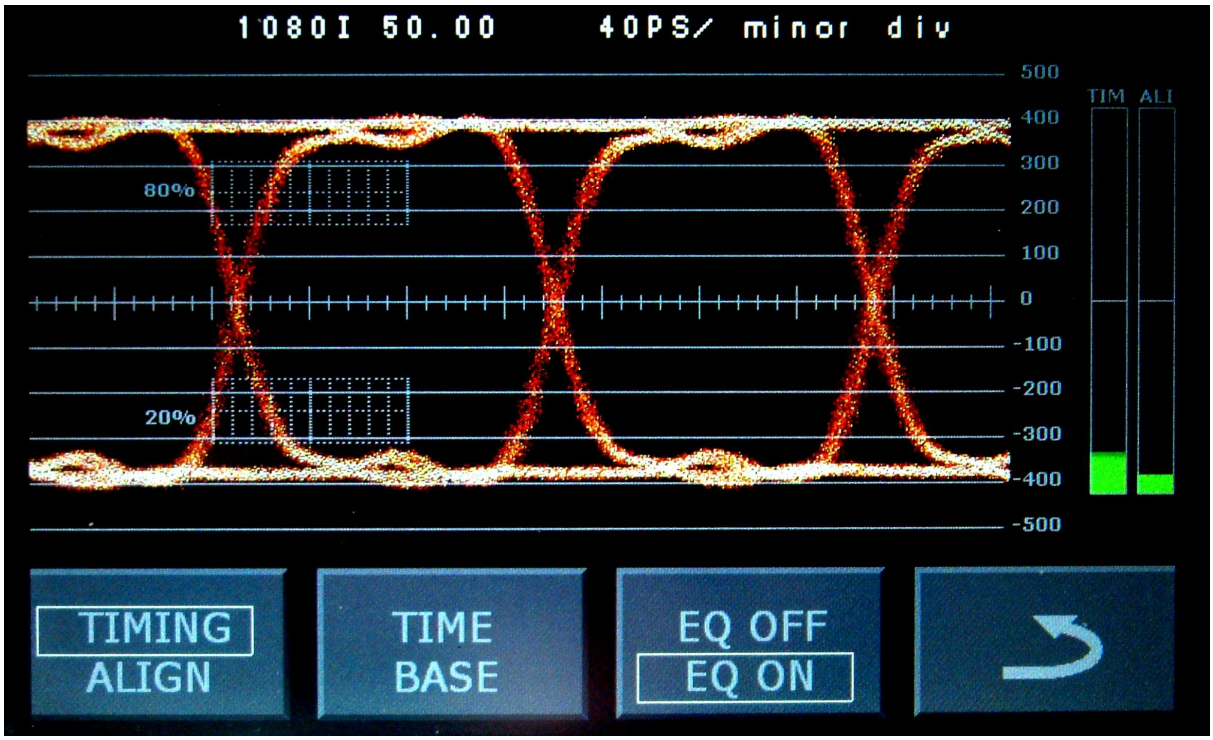
Prolonged selection of the *EYE~POD* mode, even if the *EYE~POD* module is declared as "NOT FOUND", will not result in any harm to the **TC/TC3G**.

Selection of the accessory's "Eye" mode will present a triple-function display showing Eye and a dual histogram feature.

The histogram display shows simultaneous Timing and Alignment jitter parameters. SMPTE/ITU specify the bandwidths and roll off characteristics required to display these two jitter parameters correctly, and these parameters will vary with the input TV standard. These parameters are automatically selected by the Test Chest, and no manual selection is required.

The histograms' 50% point represents the specification jitter limit for the standard in use, and excursions above this limit will be flagged in red.

Measurement of Waveform Rise Time



The Main Eye display graticule has two boxes with a number of fine subdivisions which assist with rise time measurements, this is shown above with a 1080i input signal displayed.

The display timebase is shown on the banner at the top of the LCD panel (40pS/minor division in the photo above), and the positive or negative going excursion is positioned by means of the LCD's 'touch-shift' so that the leading edge of the measured transition is at the centre of either the lower (or upper) sub-division box, as appropriate (in this example, the 20% point of the positive going transition has been aligned with the start of the timing graticule), and the timing difference to the 80% point is read off directly in 'subdivision units', which are then converted using the time value declared on the banner (Risetime = 3 div @ 40pS/div = 120pS).

Users should be aware that rise/fall time measurements of SDI signals are specified to be taken at 20% and 80% points, unlike conventional pulse rise time measurements which are normally taken at the 10% and 90% points of the overall amplitude excursion.

These timing measurements are facilitated by the finer subdivisions within the boxes on the Eye graticule.

Considerations for the display of 'Timing Jitter'

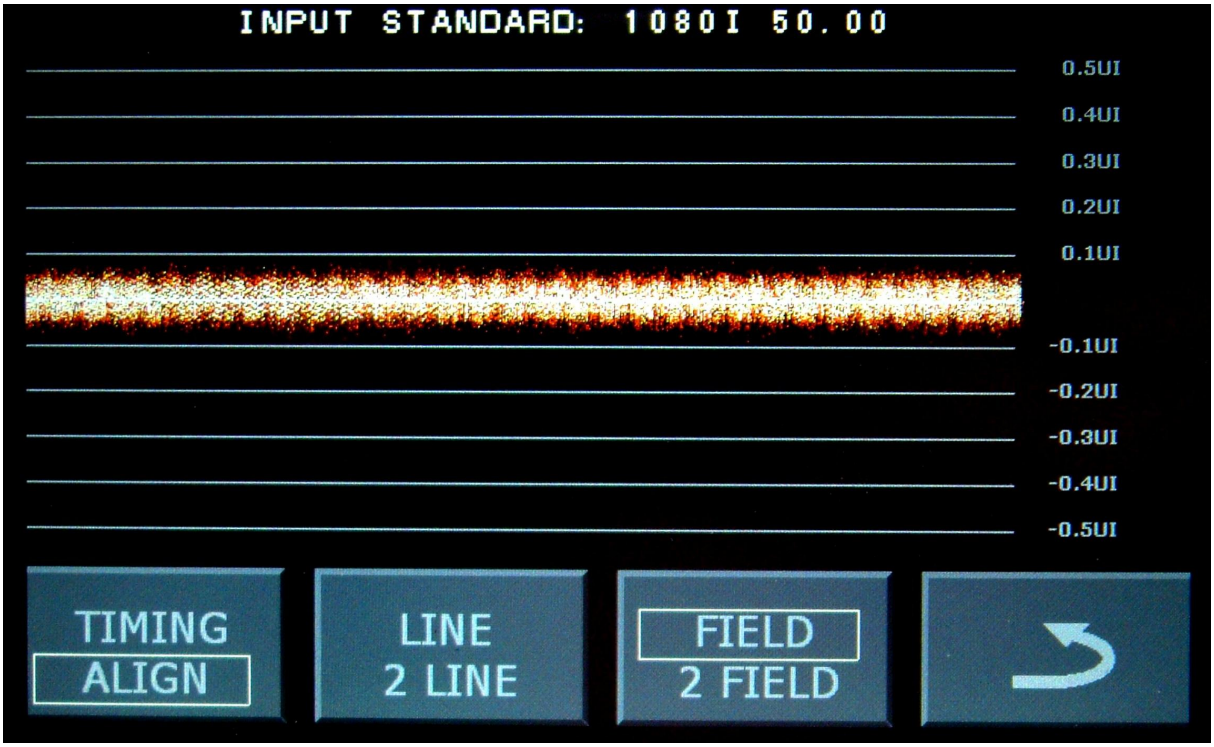
Be aware that, unlike with some other Eye display units, when the "Timing Jitter" mode is selected, with *EYE~POD* the ***TC***'s Eye waveform will be presented with the display timebase using that mode too.

This will result, with respect to the perceived horizontal jitter, in a significantly noisier display than that obtained using the alternative 'Alignment' parameters. However this is quite inevitable if the *Eye-POD's* display is to *correctly include* these lower frequency jitter components that are implicit with these longer time constants. The visually less pleasing presentation in "Timing" does not imply any EYE~POD circuit malfunction, and indeed some competitive Eye products actually disguise/mask the display of this larger phase jitter through use of 'inappropriate' damping, creating (only) the *illusion* of a subjectively much cleaner display!

Unless the 'Timing jitter' excursions, as presented on the histogram, significantly exceed the system's jitter limit, thereby activating the histogram's red warning flag, jittery SDI signals of this magnitude should be easily tracked by the local oscillators of normal broadcast equipment.

Users should be aware too that on 3G standards this Specification for Timing Jitter is very wide indeed, due to the very real technical difficulties associated with transporting signals of this bandwidth down coaxial cable using BNC connectors, and subjectively very jittery Eye displays can/will result, although these are accomodated within the System's specification and will usually be satisfactory tracked by the receiving equipment.

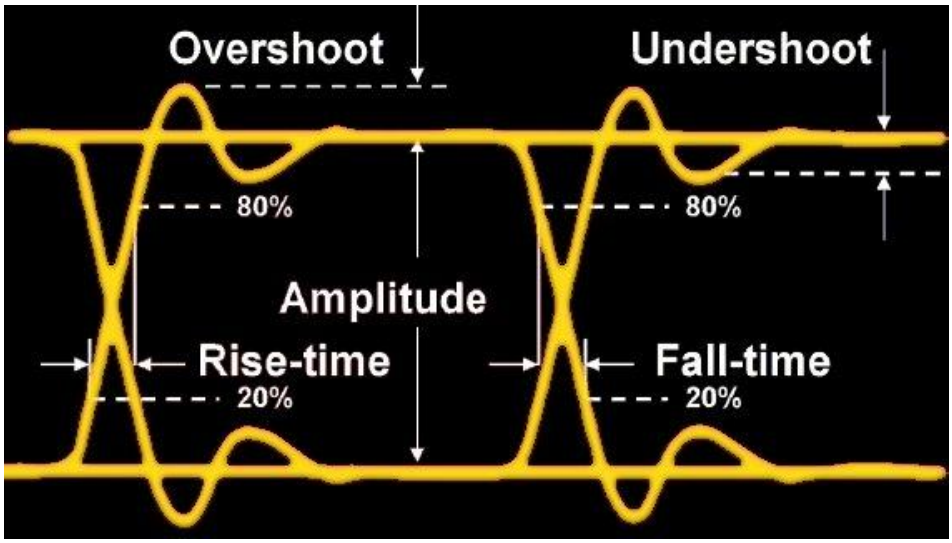
The venerable BNC connectors were originally designed in the 1940s, and were never intended for microwave frequency use at 75Ω.



Jitter measurement filtering

The SMPTE/ITU Standard of the signal source is detected by the EYE~POD + TC, and this will determine the tracking characteristics of the PLL/oscillator used for the detection, measurement and display of associated 'Jitter' parameters. These 'Standards dependent' parameters are automatically preloaded and will be used for measurements, there is *no requirement* for manual preselection.

System Specification & Measurement



System specified limits:

Standards:	SD	SMPTE 259M }	Amplitude 800mV +/- 10%
	HD	SMPTE 292M }	Overshoot < 10%
	3G	SMPTE 424 }	Undershoot < 10%

Jitter:	Timing HPF	10Hz on SD / HD / 3G	
	Alignment HPF	SD	1KHz
		HD	100KHz
		3G	100KHz
	Alignment Jitter	All Std	< 0.2UI
	Timing Jitter	SD	< 0.2UI
		HD	< 1.0UI
		3G	< 2.0UI

'LF Drift' is not a measured parameter, and is excluded by the HPF.

Slew rate:	SD	1.5nS max (0.4nS min)	Difference 0.5nS maximum
	HD	270pS max	Difference 100pS maximum
	3G	135pS max	Difference 50pS maximum

Certification
Test Chest

This is a Class A Product
and is not intended for use
in Domestic Environments

Product is CE compliant.

Declaration: The Equipment meets the requirements of EMC Directive 2004/108/EEC for Electro Magnetic Compatibility, and Low Voltage Directive 2006/95/EEC for Product Safety.

EMC Directive:

EN61326-1:2006
EMC requirements for electrical equipment used for measurement.*(A)*

Electromagnetic emissions:

EN55011/A2: 2002 Radiated & Conducted emissions, Class A.
EN61000-3:2006 Harmonic current emissions. (Not applicable)
EN61000-3-3/2005 Voltage fluctuation and Flicker.

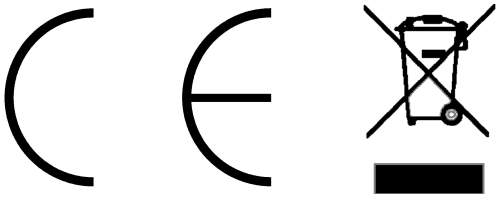
Electromagnetic Immunity:

EN61000-4-2:2001 Electrostatic discharge *(B)*
EN61000-4-3:2006 RF Radiated Electromagnetic Field *(B)*
EN61000-4-4:2004 Electrical Fast Transient *(B)*
EN61000-4-5:2006 Surges
EN61000-4-6:2007 RF Conducted Electro Magnetic Field *(B)*
EN61000-4-11:2004 Mains dips and interruptions.

Low Voltage Directive

EN61010-1:2001 Mains supply connector *(C)*
Pollution Degree 2

(A) Correctly shielded leads are required to meet Conformance
(B) Performance may be degraded, but Operator intervention should not be required during recovery.
(c) Mains powered: Class 2 insulation, Indoor use only, in conditions of non-condensing humidity.



Signed:

September 2009

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