



ADEPT

MULTI FORMAT WAVEFORM MONITOR OPERATOR'S HANDBOOK



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Hamlet Video International Limited

Maple House 11 Corinium Business Centre Raans Road Amersham Bucks HP6 6FB England

Main Line: +44 (0)1494 729 728 Fax Line: +44 (0)1494 723 237 Free phone (UK) 0500 625 525

E-mail: sales@hamlet.co.uk Web site: www.hamlet.co.uk

Hamlet Video International USA service center , Tecads Inc, 23 Del Padre St, Foothill Ranch, CA 92610,

U.S.A. Tel: +1 (949) 597 1053, Fax: +1 (949) 597 1094. Toll Free Tel number: (866) 4 HAMLET

E-mail: service@hamlet.us.com Web site: www.hamlet.us.com

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List of available options

SD SDI Video Input

Provides an SDI video input option. It has an equalised loop output and an audio de embedder.

DV Video Input

Provides a DV (firewire) video input option with audio decoder.

SD SDI and VGA Output

Used as an alternative to the standard analog output card, replaces the composite and component video outputs with SDI video and de-interlaced VGA video outputs.

GENERAL INFORMATION

WARRANTY

This product is manufactured by Hamlet Video International Ltd and is warranted to be free from defects in components and factory workmanship under normal use and service for a period of one year from the date of purchase.

FREE EXTENDED WARRANTY

The warranty period can be extended to two years by registering the instrument on the Hamlet web site

<http://www.hamlet.co.uk/serv.html>

TERMS AND CONDITIONS

During the warranty period, Hamlet Video International Ltd will undertake to repair or at its option, replace this product at no charge to its owner when failing to perform as specified, provided the unit is returned shipping prepaid, to the factory or authorised service facility.

No other warranty is expressed or implied. Warranty shall not be applicable and be void when this product is subjected to:

1. Repair work or alteration by persons other than those authorised by Hamlet Video International Ltd in such a manner as to injure the performance, stability, reliability or safety of this product.
2. Misuse, negligence, accident, act of God, war or civil insurrection.
3. Connection, installation, adjustment or use otherwise than in accordance with the instructions in this manual.

Hamlet Video International Ltd reserves the right to alter specifications without notice. This warranty does not affect the statutory rights of the UK customer.

GENERAL INFORMATION

SAFETY COMPLIANCE

This product is manufactured and tested to comply with **BS EN 61010-1 : 1993**
Safety requirements for electrical equipment for measurement, control and laboratory use.



EMC COMPLIANCE

We: Hamlet Video International Limited
Maple House, 11 Corinium Business Centre, Raans Road
Amersham, Bucks, HP6 6FB, England.

Declare under our sole responsibility that the product **HAMLET ADEPT** to which this declaration relates is in conformity with the following standards:

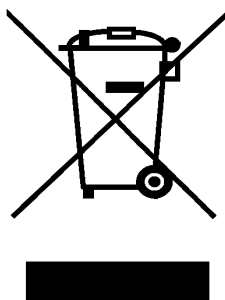
EN50081-1 Generic emissions standard for light industrial applications.

EN50082-1 Generic immunity standard for light industrial applications.

Following the provisions of EU EMC directives 89/336/EEC and 92/31/EEC.

NOTE. During the EMC certification of this product, shielded cables were used.
We recommend that they be used in operation.

PRODUCT DISPOSAL INSTRUCTIONS



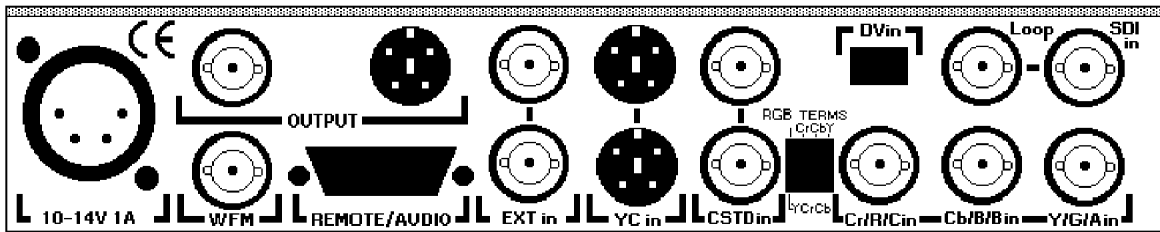
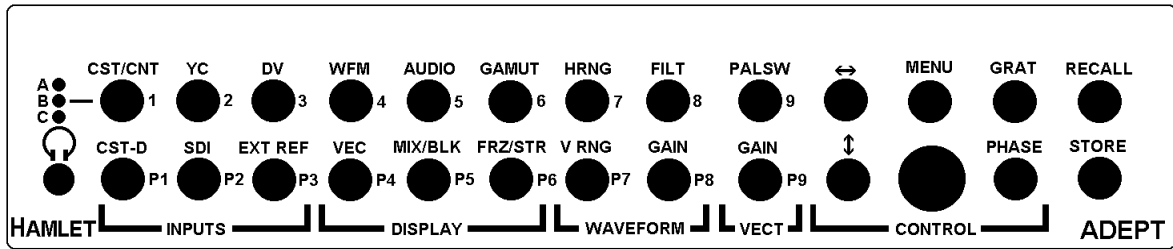
The symbol shown above and on the Hamlet Adept means the product is classed as Electrical or Electronic Equipment and should not be disposed with other commercial waste at the end of its working life.

The Waste of Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) has been put in place to recycle products using best available recovery and recycling techniques to minimise the impact on the environment, treat any hazardous substances and avoid the increasing landfill.

Product disposal instructions for business users.

Business users should contact their Hamlet Adept supplier to arrange for its return to Hamlet, who will safely dispose of it and ensure that this Hamlet Adept is not mixed with other commercial waste for disposal.

FRONT AND REAR PANELS



GENERAL INFORMATION

OVERVIEW

The Hamlet Adept is a 1U high, half width 19" rack mounted waveform and vector monitor and test pattern generator, designed to analyse video and audio signals in a wide variety of formats. There is an output of broadcast quality analog composite video, and a second output of component (YCrCb or RGB) or YC video, with the waveforms burnt into the picture. There is a third, monochrome waveform output, which can be used when the main outputs are used for the test patterns. An option card replaces the first two analog outputs with an SDI output and a de-interlaced VGA output.

The base unit has inputs for one composite, one component (YCrCb or RGB) and one YC video signal. The component input can be re configured as three additional composite inputs. There is also an stereo analog audio balanced input, which drives an on-screen audio bar graph amplitude and phase display and can be monitored via the front panel phone jack.

Option cards provide the following additional inputs (all can be fitted simultaneously):

SDI video with audio de-embedder.

DV video with audio decoder.

AES stereo audio.

Three different display sizes are selectable and the positions can be adjusted in the menu. An option card allows the background picture to be reduced to half size so that a picture monitor (or LCD panel) can show the picture, waveforms, vectors and audio on one screen. The unit employs nine bit digital processing throughout, ensuring absolute accuracy. Proprietary digital signal processing produces displays with the 'look' of analog signals.

Remote control software allows all functions to be controlled from a personal computer.

GENERAL INFORMATION

INSTALLATION

UNPACKING

The Hamlet Adept is shipped from the factory in a specially constructed packing case. Exercise caution when unpacking the unit to prevent damage to the case finish. Examine the unit carefully for damage, which may have occurred during shipment

MOUNTING INSTRUCTIONS

The unit can be fitted in a standard 19 inch equipment rack with the optional rack mount kit, where it occupies 1U of height. The unit itself generates little heat and does not need forced ventilation, but heat generated from adjacent units should not cause the case temperature to rise above 50 deg.C.

POWER REQUIREMENTS

The Hamlet Adept should be powered from the supplied adaptor fed from a 100V to 240V AC supply, or a regulated supply of 12VDC at 2 amps rating.

SIGNAL AND CONTROL CONNECTIONS

Input and output cable connections are all made to sockets on the rear panel. To utilise all the Hamlet Adept functions, all the inputs, outputs, and external reference (video or syncs) should be wired.

CHECKOUT FOR INITIAL USE

After installation as above, switch on the Hamlet Adept and operate each control in turn, verifying correct response as described in the operating instructions.

PREVENTATIVE MAINTENANCE

The Hamlet Adept should be visually inspected, cleaned and the calibration checked every one year of operation.

OPERATING INSTRUCTIONS

GETTING STARTED

1. Connect a 100 - 240VAC supply to the adaptor. Don't plug into the Adept yet.
2. Connect a composite video feed to the rear lower CSTD in bnc.
3. Connect a 75 ohm term to the rear upper CSTD in bnc.
4. Connect a composite picture monitor to the rear OUTPUT bnc.
5. Connect the supplied power adaptor to the rear 12V input socket. Hold down the front panel CST-D button for at least one second. This starts the Adept in a pre-programmed state, see fig 4. When the unit is subsequently turned on, it will remember the panel settings used previously.

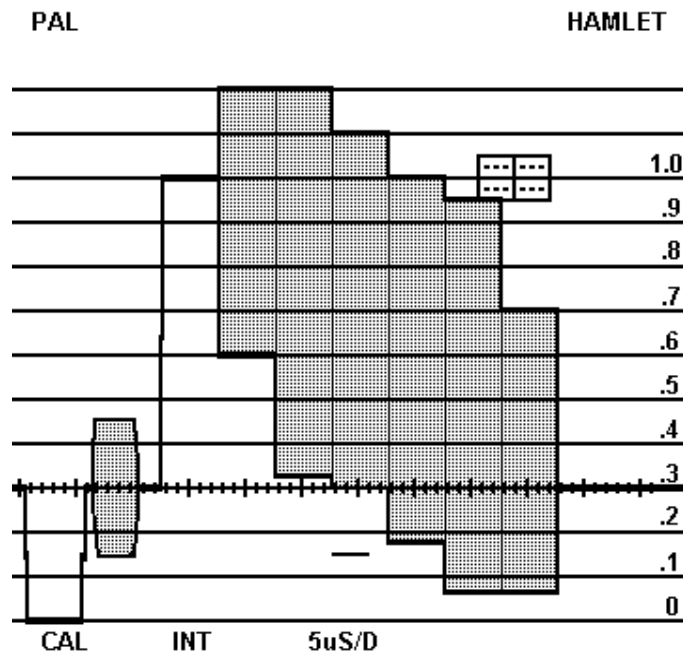
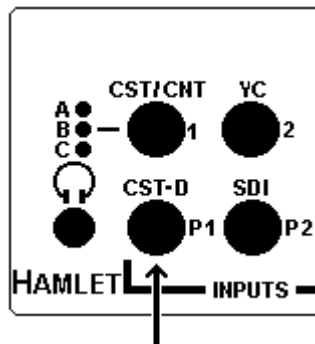


Fig 4

OPERATING INSTRUCTIONS

Most functions can be selected using the front panel keys, which are illuminated to show which function is selected. The keys are colour coded for operational clarity:

1. INPUT keys are blue.
2. Non-standard keys (EXT-REF, GAMUT, FRZ/STO, RECALL, STORE) are red.
3. All other keys are green.

Additional functions are selected from the on - screen menu.

The video standard is displayed in the top right of the main display (PAL,NTSC).

An area of the screen below the waveforms is reserved for displaying information on unit settings (status) and menu selections.

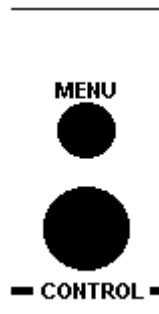


Fig 5

Menu Operation

To show the menu, press the front panel MENU key and navigate by turning the CONTROL knob to highlight the required function. Press menu to toggle through the options.

To exit from the menu, use the CONTROL knob to highlight EXIT and then press the MENU button.

TYPICAL STATUS DISPLAY

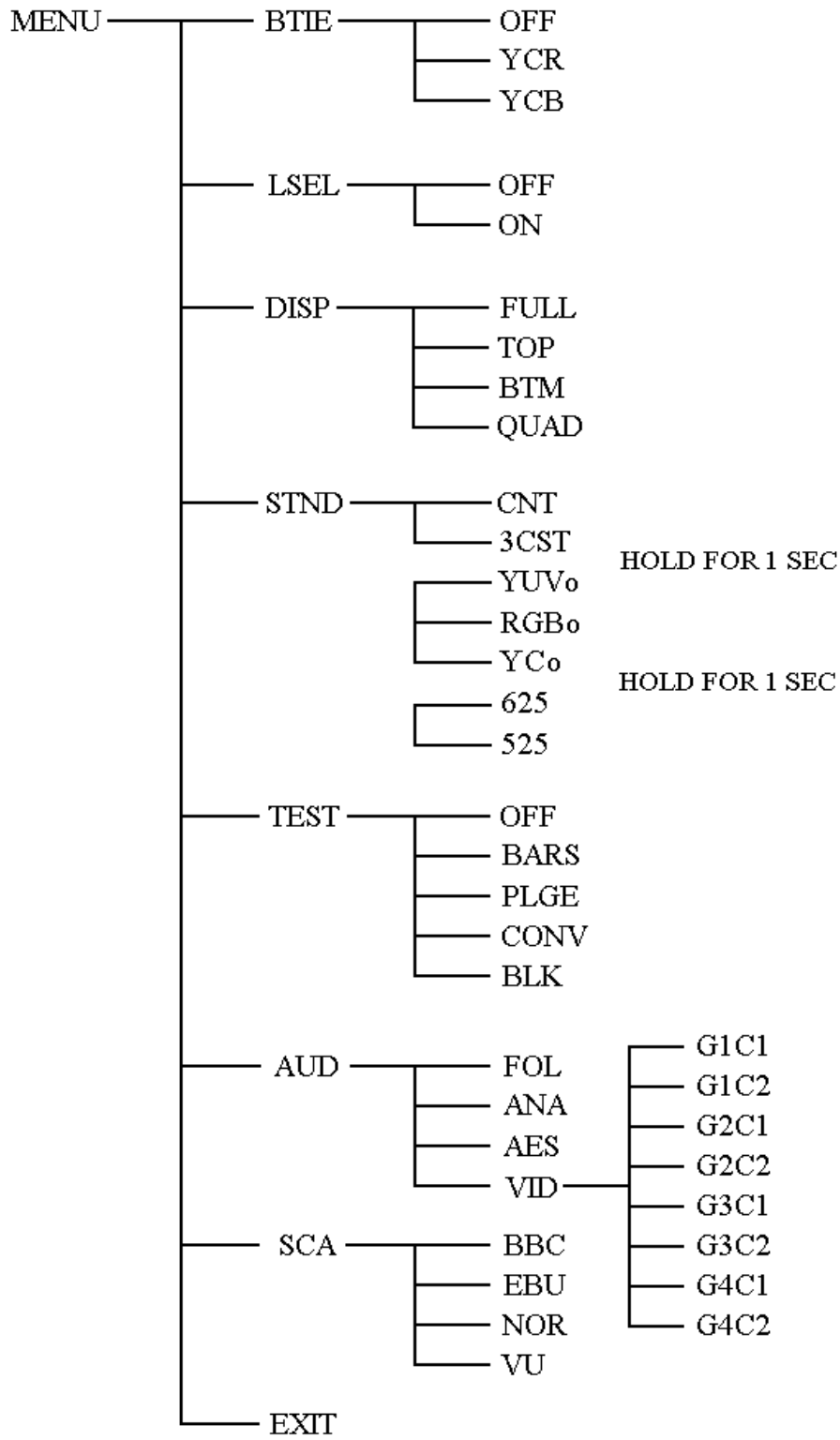


TYPICAL MENU DISPLAY

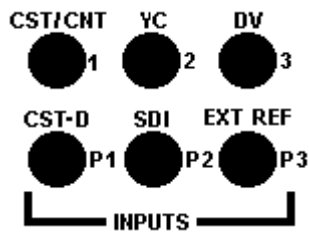


Fig 6

OPERATING INSTRUCTIONS
MENU TREE



OPERATING INSTRUCTIONS - INPUTS



Video Source Selection

The adept has dedicated inputs for composite (CSTD) and YC (YC) with corresponding loop inputs, which need terminating for correct levels. There are three other inputs, selected by the CST/CNT key, which can be configured in the menu as component (YCrCb or RGB) or three composite (A,B,C). Termination is selected by the switch on the rear panel.

If the SDI option board is fitted, this additional input can be selected by the SDI key. There is an equalised looped output from the sdi input.

If a DV (firewire) option board is fitted, this additional input can be selected by the DV key.

Sync Reference Source Selection

The reference signal can be derived from the signal being used (int) or from an analog reference of video or sync (ext) applied to the rear EXT in bnc with loop input.

To select which is to be used press the EXT REF key. This has three options, INTERNAL, EXTERNAL and HFT(hands free timing) which alternates between internal and external every second to facilitate synchronising two sources.

Video Output Format Selection

The standard Adept has analog outputs of composite and YC. There is a jumper on the output board to reconfigure the YC output as component (YCrCb or RGB) in conjunction with the STND menu.

The output board can be replaced with a digital board which outputs in SDI and de-interlaced SVGA formats.

There is an additional output BNC of waveforms only (no background picture).

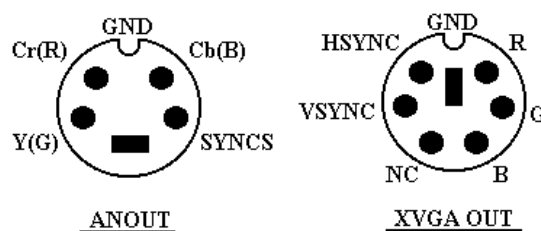
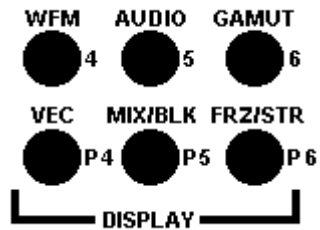


Fig 7

OPERATING INSTRUCTIONS - DISPLAY



Waveforms

Press the WFM key to display a full size waveform display of 512 x 512.

Vectors

Press the VEC key to display a full size vector display of 512 x 512. Selecting both WFM and VEC gives a full size superimposed display.

Dual Display

Menu DISP allows selection of half size waveform and vector displays side by side at the top or bottom of screen. If the scaler option board is fitted, Menu DISP - QUAD gives half size waveform and vectors together with half size background picture and audio.

Audio

The AUDIO key selects the on-screen audio bar graphs showing stereo levels and phase. The scale can be set in the SCA menu and source can be set in the AUD menu.

Display Mixed or on Black

Pressing the MIX/BLK key toggles between:

Display cut into picture.

Display mixed with picture.

Display on black.

Gamut errors

Pressing the front panel GAMUT key enables the gamut alarm. Out of gamut picture levels trigger the external GPI output and areas of the picture which are out of gamut are highlighted with a crosshatch pattern.

Persistence

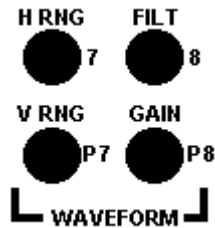
Pressing the FRZ/STO key toggles between:

Display persistence of one frame.

Display frozen.

Display builds up - writing with no erasure.

OPERATING INSTRUCTIONS - WAVEFORMS



Video Timebase Ranges

The full range of timebases are only available in the full size waveform mode.

The H RNG timebase key toggles between Hmag, H, 2H and 3H Parade ranges.

The V RNG timebase key toggles between Vmag, V and 2V ranges.

Line Select mode is set in menu and the line number is selected by turning the CONTROL knob. The current mode/line number is displayed on the status bar.

Video Filters

Pressing the FILT button toggles between:

Flat

Low pass filter with IRE characteristic.

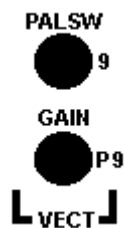
Chroma pass filter with bandpass characteristic. In YC mode shows the C component.

Chroma pass is not valid in Component, SDI or DV modes.

Video Gain

Pressing the GAIN button toggles between calibrated gain (x1) and magnified (x3).

OPERATING INSTRUCTIONS - VECTORS



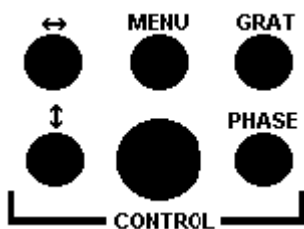
Pal Switch

The PALSW key switches between 6 vector and 12 vector display in PAL composite or YC modes by defeating the Pal switch action.

Vector Gain

Pressing the GAIN button toggles between calibrated gain (100%) calibrated gain (75%) and magnified (x3). The current setting of vector gain is displayed in the Status Area.

OPERATING INSTRUCTIONS - CONTROL



Horizontal and vertical shift

The CONTROL knob can be horizontal or vertical shift by pressing the appropriate key.

Menu

Pressing the menu key switches the CONTROL knob to menu mode. See pages 10 & 11.

Graticule Brightness

The GRAT key switches the CONTROL knob to graticule brightness mode.

Vector Phase

The PHASE key switches the CONTROL knob to vector phase mode (>360deg).

OPERATING INSTRUCTIONS - PANEL MEMORY



To store and recall user settings

When the unit is switched off the current setting are stored, then recalled when the unit is switched on again. In addition, nine sets of front panel settings can be stored for later recall.

To store settings, when the unit is set up as required, press the STORE key on the front panel then press a key 1...9 to store the settings at that location.

To recall the settings, press the RECALL key on the front panel followed by the required location number 1...9. The stores can all be loaded with the default boot up values by holding down the front panel SDI button for at least one second.

Factory Preset Panel Settings

To recall the settings, press the RECALL key on the front panel followed by the required location number P1...P9.

P1 = Full size waveform.

P4 = Filter Parade

P7 = Gamut on picture

P2 = Full size vector

P5 = Line Select

P8 = Quad split display (option)

P3 = Dual waveform/vector

P6 = Bowtie from Cnt

P9 = Colour bars output

OPERATING INSTRUCTIONS - EXTRAS

To start the unit in a known state

Powering on the unit normally will recall the settings previously used, but if previous settings were non-standard, a standard mode can be established to allow faster use. With a composite video signal applied to the CST D BNC, hold down the CST D front panel button for more than one second. It will then be in the following mode:

| | | | |
|--------------|---------|--------------|---------|
| INPUT: | CST D | TIMEBASE: | H |
| REF: | INT | FILTER: | FLAT |
| DISPLAY: | EXP WFM | WFM GAIN: | X1 |
| AUDIO BARS: | ON | PAL SWITCH: | OFF |
| AUDIO SCALE: | PPM | VECTOR GAIN: | 100% |
| MIX-BLK: | OFF | CONTROL: | H SHIFT |
| GAMUT: | OFF | BOWTIE: | OFF |
| FREEZE: | OFF | TEST GEN: | OFF |
| PERSIST: | OFF | | |

Bowtie

This display is selected setting the unit to expand waveform mode and H range. Press MENU and select BTIE to enable. The MENU key then toggles between Bowtie (Y-Cr), Bowtie (Y-Cb) and Bowtie OFF. The current state is displayed in the status area.

Test Signal Generator

Press the MENU key and rotate the CONTROL knob to select TEST. Pressing the MENU key then steps through the available outputs of Colour bars, Pluge, Convergence and Black. These are available in all the above output formats, including SDI and SVGA.

The dedicated waveform bnc continues to show the input waveforms, so the Adept can be used to feed test signals into a system and analyse the results, all in the one unit.

Menu Standard

Pressing MENU STND allows selection of the following:

| | |
|------------|--|
| CNT-3CST | Input component or three extra composite. |
| YUV-RGB-YC | Analog output YCrCb, RGB or YC. |
| 625-525 | Test generator and no-input standard 625 or 525. |

To step between the three sub menus, hold the MENU key down for one second.

OPERATING INSTRUCTIONS - AUDIO

To select the audio bars

Press the front panel AUDIO key.

To select audio scales

Press MENU and turn the CONTROL knob to select SCA. Press MENU to toggle between the audio scales available.

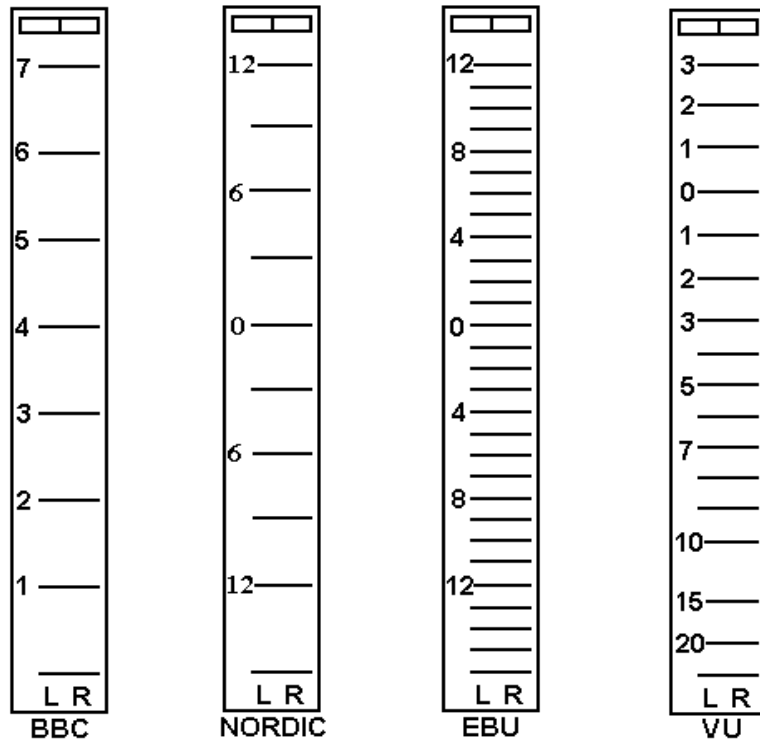


Fig 8

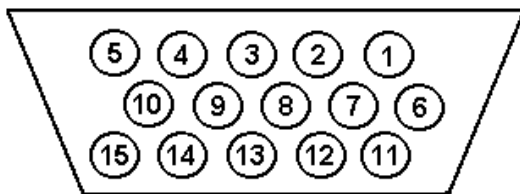
To select the audio source

Press MENU and turn the CONTROL knob to select AUD. Press MENU to toggle between the audio inputs. The audio source will follow the video by selecting FOL.

Audio Output

The selected audio can be monitored through the front panel headphone jack socket and a balanced output is available from the rear D socket.

PINOUT OF AUDIO CONNECTOR



- | | | |
|---------------|----------------|------------------|
| 1 = GND | 6 = RIGHT 1 in | 11 = LEFT 1 out |
| 2 = RS232 in | 7 = RIGHT 2 in | 12 = LEFT 2 out |
| 3 = GPI out | 8 = AES 1 in | 13 = RIGHT 1 out |
| 4 = LEFT 1 in | 9 = AES 2 in | 14 = RIGHT 2 out |
| 5 = LEFT 2 in | 10 = n/c | 15 = n/c |

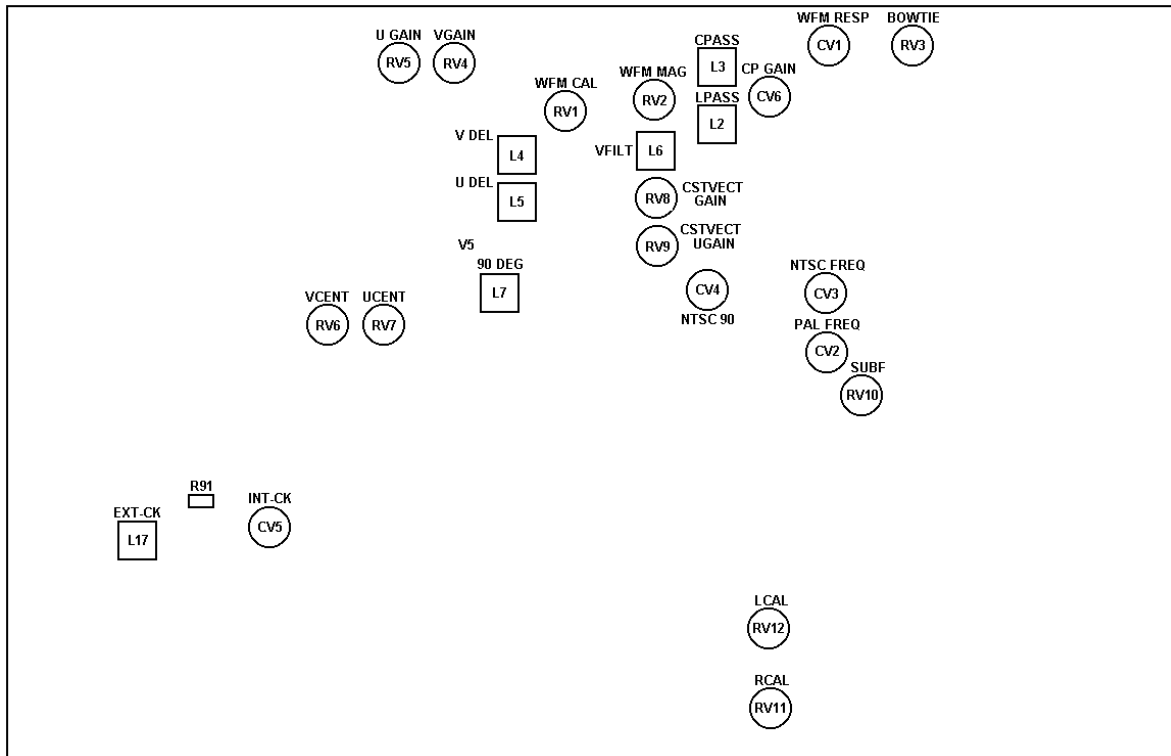
Fig 9

CALIBRATION AND TEST

The unit is calibrated and tested before leaving the factory and should not normally require adjustment. Do not attempt adjustment without an accurate video source.

Main Board

Adjustments (Fig 10)



With a PAL 100% bars composite input to the CST D input, adjust L17 for 2.0V on R91. Switch to the test pattern and adjust L17 for the same output line frequency by locking the picture monitor to the CST-D feed..

Adjust RV1 for a 1V p/p waveform (white bar to sync tip).

Adjust CV1 for green bar touching black level and an overall height of 0.83V.

Press the waveform GAIN button and set RV2 for syncs of 1.0V p/p. Press again to cancel.

Press the FILT button and adjust L2 for minimum chroma on the waveform steps.

Press the FILT button again and adjust L3 for maximum chroma, then adjust CV6 for 0.885V p/p chroma display. Press again to return to normal.

With a 625 Bowtie YCrCb component input, select BTIE in the menu and adjust RV3 for minimum height in the centre of the bowtie. Cancel BTIE.

CALIBRATION AND TEST

With a 625 100% colour bar YCrCb component input, select vector mode and adjust centring controls RV6 and RV7.

Adjust gains controls RV4 and RV5 to put the vectors in their appropriate boxes.

With a PAL 100% bars composite input to the CST D input adjust CV2 so the display is at its most anticlockwise position. Press the EXT REF button twice and turn RV10 fully anticlockwise then back off until the display regains lock immediately. Turn a further 10 degrees clockwise. Press EXT REF to cancel.

With PALSW selected, adjust L7 together with the phase control to superimpose the two sets of six vectors. De-select the PALSW.

Adjust RV8 and RV9 to fit the vectors in their boxes, then adjust L6 for straight lines between the vectors. Re trim RV8 and RV9 if needed.

Trim L4 and/or L5 for thinnest burst ears (no looping).

Switch the generator to NTSC 75% colour bars and trim CV3 if needed for vector lock.

Press the vector GAIN button to select 75% and turn the front panel phase control for horizontal burst, then adjust CV4 to put the vectors in their boxes. Return to PAL operation.

Connect an audio tone generator to the rear D socket, set for 1KHz at 0dbm (775mV rms). Press AUDIO to display the audio bars and adjust RV11 and RV12 to line up the audio bars to 0db on the required scale.

Option Boards

ADEPTDAC option board

With a 625 100% colour bar SD|I input applied, in parade mode, adjust as follows:

Adjust RV701 for 1.0V p/p luminance plus syncs.

Adjust RV702 for 0.7V p/p Cb component.

Adjust RV703 for 0.7V p/p Cr component.

ADEPTAOU option board

With the colour bar test pattern selected, adjust RV501 for 1V composite output and RV502 for 1V YC output.

ADEPTSDI, ADEPTDV and ADEPTSCA option boards

These are totally digital boards and have no adjustments.

REMOTE CONTROL

To Remote Control the Unit via the RS232 serial interface. Data is sent on a 2 wire implementation of RS-232 i.e. Rx and Gnd. Data type is 8 bits, no parity, 1 stop bit. The baud rate is 9.6Kb. All commands consist of a single byte and are equivalent to pressing a key on the panel.

List of Key commands

| Key | Byte value(decimal) |
|--------------------|---------------------|
| CNT/CST | 240 |
| CST-D | 232 |
| YC | 216 |
| SDI | 184 |
| DV | 120 |
| EXT REF | 241 |
| WFM | 233 |
| VEC | 217 |
| AUDIO | 185 |
| MIX/BLK | 121 |
| GAMUT | 242 |
| STO/FRZ | 234 |
| H-RNG | 218 |
| V-RNG | 186 |
| FILT | 122 |
| WFM-MAG | 243 |
| PALSW | 235 |
| VEC-MAG | 219 |
| H-SHIFT | 187 |
| V_SHIFT | 123 |
| MENU | 244 |
| GRAT | 236 |
| PHASE | 220 |
| RECALL | 188 |
| STORE | 124 |
| SHIFT ONE STEP CW | 1 |
| SHIFT ONE STEP ACW | 2 |

TECHNICAL SPECIFICATION

INPUTS

| | |
|-----------------------|---|
| Composite input | BNC connector with loop through output. Return loss better than 40dB. Zin of 22k. Max dc +/- 3 volts. |
| Component input | 3 x BNC connectors. Return loss better than 40dB. Zin of 22k or 75R. Max dc +/- 3 volts. YCrCb, RGB or 3 x CST. |
| Serial digital input | BNC connector. Input impedance 75 ohms. Max d.c. +/- 10V. SMPTE 259M, ITU-R BT.601/656 serial component. 800mV pp +/-10% auto equalised up to 300 metres. |
| Serial digital output | BNC connector. Output impedance 75 ohms. Equalised version of the serial digital input. |
| DV input | 4 pin firewire IEEE1394 input. |
| External ref input | BNC connector with loop through output. Return loss better than 40dB. Zin of 22k. Max dc +/- 3 volts. |

OUTPUTS

| | |
|------------------------|---|
| Composite output | BNC connector. 1V to 75 ohms. |
| Component output | 4 pin mini-din connector. 1V to 75 ohms. YC, YCrCb or RGB. |
| Waveform output | BNC connector. 1V mono video to 75 ohms. |
| Serial digital outputs | BNC connector. 800mV to 75 ohms. |
| XVGA output | 6 pin mini-din connector. Analog 0.7V R,G,B and H and V sync. |

AUDIO

| | |
|---------------|---|
| Analog input | Stereo balanced input. Zin of 22K. |
| Digital input | AES/EBU @ 48KHz, 44.1KHz or 32KHz. Zin of 200R. |
| Analog output | Stereo balanced output at line level. |

REMOTE CONTROL

GPI gamut output and RS232 remote control 8bits, no parity, 1 stop bit.
Pin 1 = Ground Pin 2 = RS232 input. Pin 3 = GPI (closure to ground).

POWER

10 to 14V D.C. to 4 pin XLR. Pin 1 = ground, pin 4 = +12V @ 2A max.

ENVIRONMENT

Indoor use, 5 to 45 deg.C. ambient to 2,000m.
Max humidity 80% to 31 deg.C decreasing to 50% at 40 deg.C.
Overvoltage category 2. Pollution degree 1.
Weight (all options) 1.25Kg net.

TECHNICAL SPECIFICATION

DISPLAY AREAS

| | |
|-----------------------|---------------------------------------|
| Waveform cutout boxes | 38uS x 512 lines or 19uS x 256 lines. |
| Text cutout box | 38uS x 16 lines at bottom of frame. |
| Audio cutout boxes | 3.6uS x 512 lines at right of frame. |

WAVEFORM MONITOR

| | |
|-------------|--|
| Resolution | 9 bit processing. Display resolution 512 x 512. |
| Response | +/- 1% from 50Hz to 5.5MHz. Low Pass is -3db @ 1.5MHz, -60db @ 6.75MHz. |
| Sensitivity | 1 volt encoded video reads 1 volt on screen. Mag is x 3.33. |
| Timebase | Hmag, H, 2H & 3H. Vmag, V, 2V & Line select. |

VECTOR MONITOR

| | |
|-------|--|
| Video | Traditional component or composite (option) display. Component accuracy 0.2%. Bandwidth 3.375MHz . Composite accuracy 1%. Bandwidth 1.0MHz . |
|-------|--|

AUDIO MONITOR

| | |
|-----------------|--|
| Accuracy | Better than 0.1db over full scale range. |
| Characteristics | BBC Type 2, Nordic, VU and EBU. |

EXTERNAL CONNECTIONS

2 x 75 ohm BNCs for the analog composite input and loop output.

3 x 75 ohm BNCs for the analog component or 3 x cst inputs.

2 x 4 pin mini-din sockets for the analog YC input and loop output.

75 ohm bnc for the SDI inputs (SMPTE 259M).

75 ohm bnc for re-equalised SDI output.

4 pin DV socket for the firewire IEEE1394 input.

2 x 75 ohm BNCs for external reference input and loop output.

Analog output

75 ohm bnc for display composite analog video output.

4 pin mini-din socket for analog YC or YCrCb or RGB video outputs.

Digital output option

75 ohm bnc for display SDI output (SMPTE 259M).

6 pin mini-din socket for analog de-interlaced SVGA output.

15 pin High density D socket for audio input and output, GPI and RS232.

4 pin XLR plug for 12V DC power.

ANALOG BASICS

COMPONENT COLOUR

The colour picture can be distributed in two forms, whether in 625 or 525 line standards:

RGB

This is the basic signal produced by a camera etc and fed to a colour CRT. It consists of three primary signals, **Red**, **Green** and **Blue**. By convention, black level is at 0mV and peak brightness is at + 700mV.

YCrCb

As the human eye can see less resolution with colours, the video can be modified to take advantage of this to reduce the amount of information needed. The picture is separated into monochrome and colour components. The monochrome Y signal is formed from:

$Y = (0.3 \times \text{Red}) + (0.59 \times \text{Green}) + (0.11 \times \text{Blue})$ approximately.

This signal has black level at 0mV and maximum white level at + 700mV.

The colour components are two colour difference signals:

$Cr = (R - Y)$ and $Cb = (B - Y)$

These are weighted to give maximum values of +/- 350mV and are bandwidth restricted to half that of the Y component.

PAL

Fig 11 shows an encoded 100% colour bar signal. The two colour components of Cr and Cb are used to amplitude modulate a 4.43361875Mhz carrier signal. The two carriers are arranged to be 90 degrees apart before they are combined with the Y luminance signal, so that they can be decoded separately. The PAL system is designed to minimise hue errors by phase reversing the Cr axis on alternate lines (**Phase Alternate Line**). This reversal is copied by the decoder, so that the hue error will now alternate in phase. By combining the chrominance from two adjacent lines, the error is thus cancelled out.

NTSC

Fig 12 shows an encoded SMPTE (75%) colour bar signal. The two colour components of Cr and Cb are used to amplitude modulate a 3.579545Mhz carrier signal, but they are first modified into I and Q signals to reduce the overall maximum chrominance level when combined.

PAL BASICS

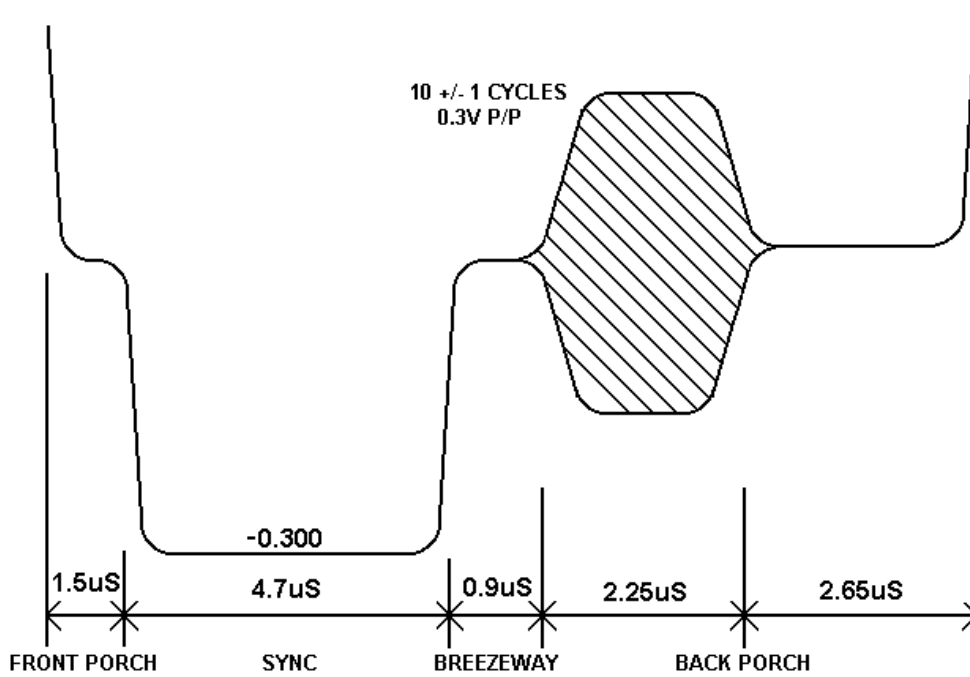
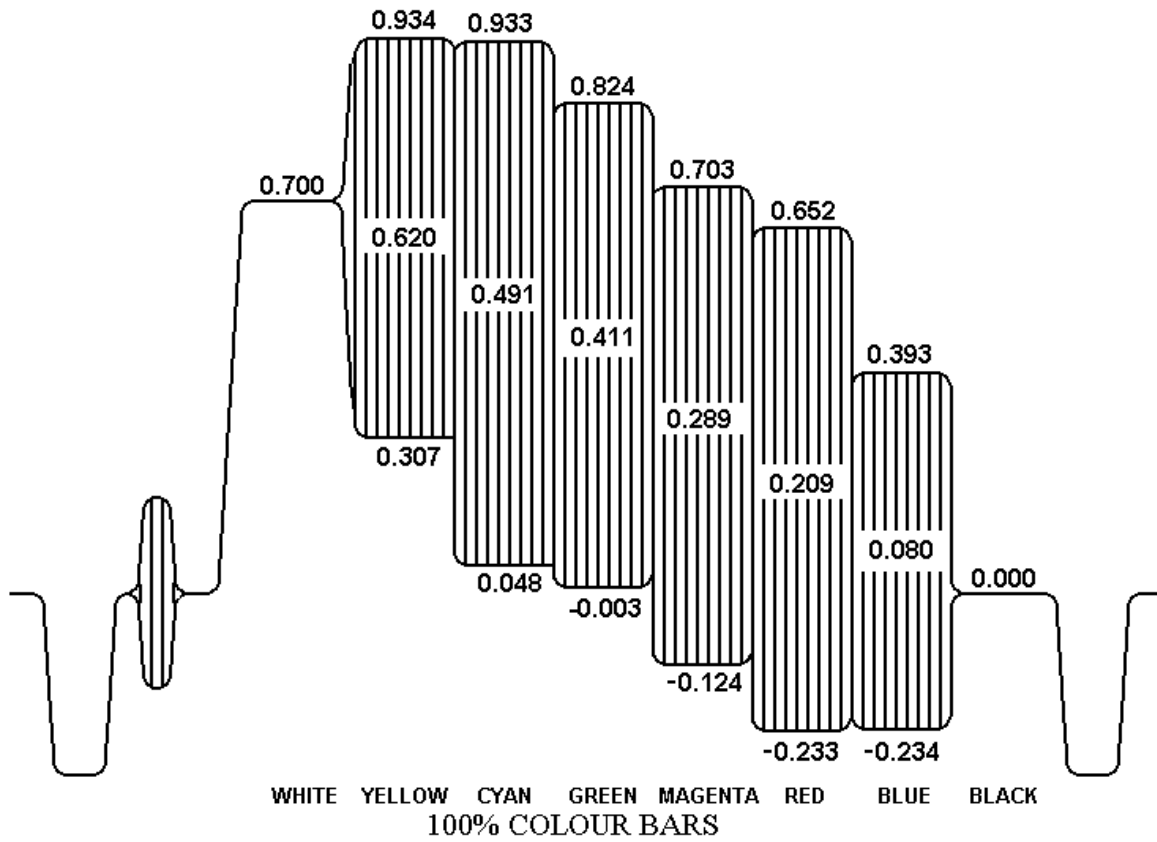


Fig 11.

NTSC BASICS

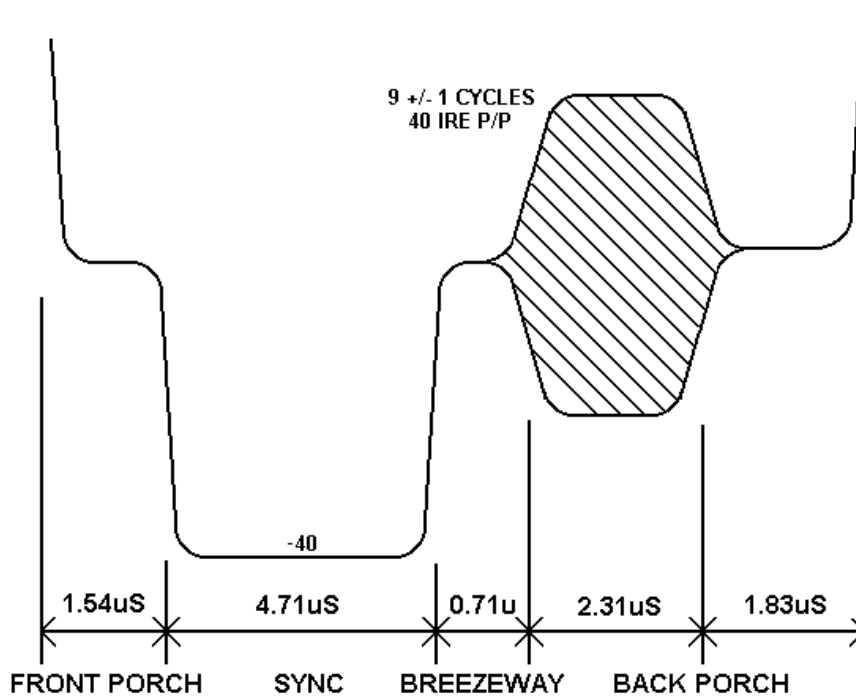
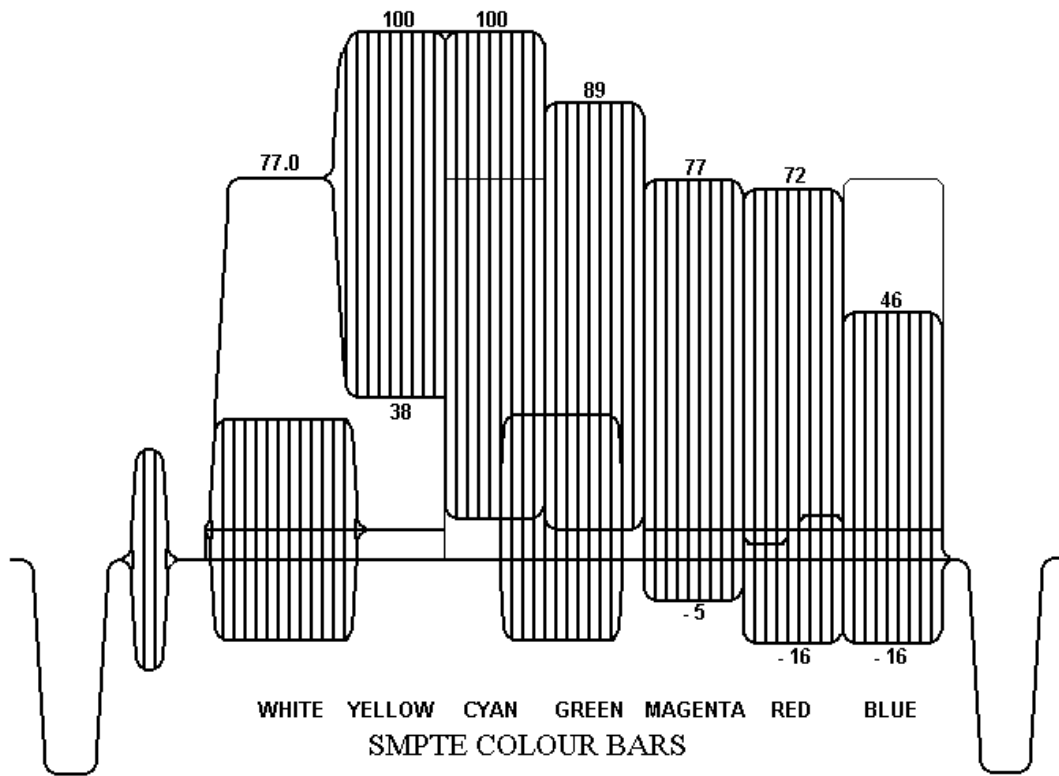


Fig 12.

SC-H RELATIONSHIP

PAL appears, at first sight, to be a four field system: field 1 being identical to field 5, and field 3 having the opposite pal switch phase. However, if a switch or edit is made between two video sources which are in the same pal sequence only, a small horizontal picture shift will often be noticed, this is due to the relationship between subcarrier and line frequencies. In order to avoid chroma patterning on monochrome receivers the PAL subcarrier frequency was chosen to have a 90 degree offset per television line, with 25Hz added on so that any remaining patterning would run through the picture:

$$F(\text{pal}) = (283.75 \times 15.625\text{KHz}) + 25\text{Hz} = 4.43361875\text{MHz}$$

The drawback of this is that after one PAL frame of four fields the subcarrier will have executed exactly 354689.50 cycles, so it will be 180 degrees shifted from its original phase at the same sync point. Hence the subcarrier to horizontal sync (SC-H) phase will only repeat every EIGHT fields.

A similar problem also exists in NTSC, except that it is a four field system rather than eight field.

$$F(\text{ntsc}) = (227.5 \times 15.73426373\text{KHz}) = 3.579545\text{MHz}$$

After one NTSC frame of two fields, the subcarrier will have executed exactly 119437.50 cycles, so it will then be exactly 180 degrees shifted from its original phase at the same sync point hence the sc-h phase will only repeat every FOUR fields.

If a video edit or switch is made without regard to the above field sequence, there is a 50/50 chance of picking the wrong eight field match. This will cause an SC-H phase jump producing a picture shift of half a cycle of subcarrier. Whilst this may be acceptable if cutting to a different shot, in animation or tag-editing the shift would be very noticeable. To produce reliable match frame edits it is therefore necessary to identify the correct field sequence. In addition, if due to misalignment, the SC-H phase was displaced from the ideal by 90 degrees, the field relationship would be uncertain.

Both these problems can be addressed by having an instrument which displays the subcarrier phase to horizontal sync phasing. Zero SC-H phase has been defined as a positive zero-crossing of subcarrier at the vertical sync point on field 1.

Systems can now be adjusted in the exactly correct SC-H phase to avoid uncertainty when near to the 90 degree point. A video signal in the exactly wrong eight-field sequence would show up as an 180 degree SC-H phase error.

SERIAL DIGITAL BASICS

625 and 525 digital component video is produced by applying a 4:2:2 sampling structure to the analog signal. This process is defined by a sub-set of international standards ITU-R BT.601 and BT.656. (these were formerly known as CCIR-601 and CCIR-656. The label 'CCIR601' is commonly applied to digital video coded in this manner.)

The luminance (Y) component is sampled at 13.5 MHz, and the colour difference components (U and V) are both sampled at 6.75 MHz. With 10 bit quantisation, this results in a data stream of 10 bit words at a clock frequency of 27 MHz. If the signal source uses 8 bit quantisation, 10 bit data is used with the two least significant bits of each sample code set to binary zero. This is to maintain the same data rate.

The quantizing levels employed in the analog to digital conversion are set to give 66.4mV headroom above peak white and 51.1mV below black. Coded U and V signals have 50mV above and below their normal maximum and minimum excursions.

The synchronisation pulses are discarded in the coding process, and are replaced by Timing Reference Signals (TRS) which are inserted into the data stream to serve the same purpose. Two TRS's are used to synchronise the data stream, EAV (End of Active Video) and SAV (Start of Active Video). These are placed at the beginning and end of the horizontal video blanking period. see fig 13.

Each TRS consists of 4 words:

- 1) 3ff hex i.e. all '1's
- 2) 000 hex i.e. all '0's
- 3) 000 hex i.e. all '0's
- 4) XYZ, which determines the type of TRS pulse:

XYZ:

Bit 9: always '1'

Bit 8: 0 = frame 1 1 = frame 2

Bit 7: 0 = normal 1 = field blanking

Bit 6: 0 = SAV 1 = EAV

Bit 5: Bits used for Hamming correction.

Bit 4: Bits used for Hamming correction.

Bit 3: Bits used for Hamming correction.

Bit 2: Bits used for Hamming correction.

Bit 1: Always '0'

Bit 0: Always '0'

SERIAL DIGITAL BASICS

The period between EAV and SAV is not used by normal video and is available for other purposes e.g.: error checking, timecodes or embedded audio.

Illegal Values: The values 0 and 3FF hex are used solely by TRS pulses (EAV and SAV) they must not appear anywhere in the active video area.

Out of Gamut: Values apart from the illegal values which should not be used.

Luminance is defined as being between peak white, 700mV, 3AC, hex and black, 0mV, 040 hex.

Chroma is defined as being between max positive, 350mV, 3C0, hex and max negative, -350mV, 040 hex.

The values above and below these are termed "out of gamut".

The data is serialised using an NRZ (None Return to Zero) code to produce a 270 Mb/s signal. This coding method removes any low frequency component and is insensitive to polarity. The data has to be scrambled first to avoid the possible transmission of all '0's. This data is output at 800mV p-p to normal 75 ohm video coaxial cable.

Due to the high frequencies, the cable losses are quite high, typically 10dB per 100 metres at 270 MHz. To allow acceptable cable lengths, automatic cable equalisers are used at the receiver which usually allow up to 300 metres of cable to be used. It is important that standard cable is used, otherwise the equaliser will not compensate correctly.

Suitable cable is: PSF 2/3 BELDEN 8281 F&G 1.0/6.6

DIGITAL ERROR DETECTION OVERVIEW

In order to check if the digital video signal has been received correctly a Cyclic Redundancy Check (CRC) can be made on each frame in the generating equipment, this four digit number is then placed in a 'packet' and put in the EAV-SAV space of one line of each field.

At the receiving equipment the incoming video field also has a Cyclic Redundancy Check number calculated, this value is then compared with the 4 digit number sent in the packet. If the two numbers are not identical an error has occurred between transmission and reception of the signal.

SERIAL DIGITAL BASICS

This type of error detection is known as Error Detection and Handling or EDH and is defined by SMPTE RP165. In practice two check sums are sent per frame, one for the active video period and one for the full frame. A typical packet consists of:

The Header: (000, 3FF, 3FF) This always precedes an EDH packet.

Data ID: (1F4)

Block Number: (200)

Data Count: This contains the number of words that follow.

Active picture CRC: 3 words

Full-field CRC: 3 words

Error flags: 3 words

Reserved: 7 words

Check Sum: This is used to test for transmission errors.

Note, all values in Hex.

EMBEDDED AUDIO OVERVIEW

The period between the EAV and SAV markers can be used to send embedded digital audio signals. This is known as SMPTE 272M. Up to 16 separate audio signals may be sent in a single video channel. These are organised as four GROUPS of four signals, the four signals are often two stereo pairs. Typically only one group will be used, giving two stereo pairs of audio. The audio data is digitised in the sending equipment to 20 bits of resolution, usually at a 48 KHz sample rate. Often only 16 bits are used in practice. The digitised data is arranged in packets which are placed in the EAV-SAV space.

A typical packet consists of:

The Header: (000, 3FF, 3FF) This always precedes an audio packet.

Data ID: This contains the Audio Group number.

Block Number: AES blocks have 192 'frames' of audio data

Data Count: This contains the number of words that follow.

Audio Sample:

Audio Sample:

Audio Sample:

Audio Sample:

Check Sum: This is used to test for transmission errors.

Each audio sample consists of a sample of all four audio signals,
eg: Channel 1 left, Channel 1 right, Channel 2 left, Channel 2 right.

Each signal requires 3 words to hold all 20 bits data, thus each audio sample has 12 words in it. Typically 3 or 4 audio samples are sent in each EAV-SAV period.

As with the video signal, words which consist of all '1's or all '0's are not allowed.

SERIAL DIGITAL BASICS

EAV and SAV

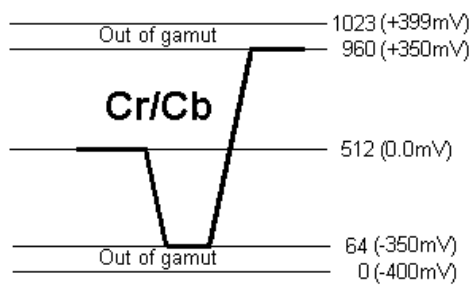
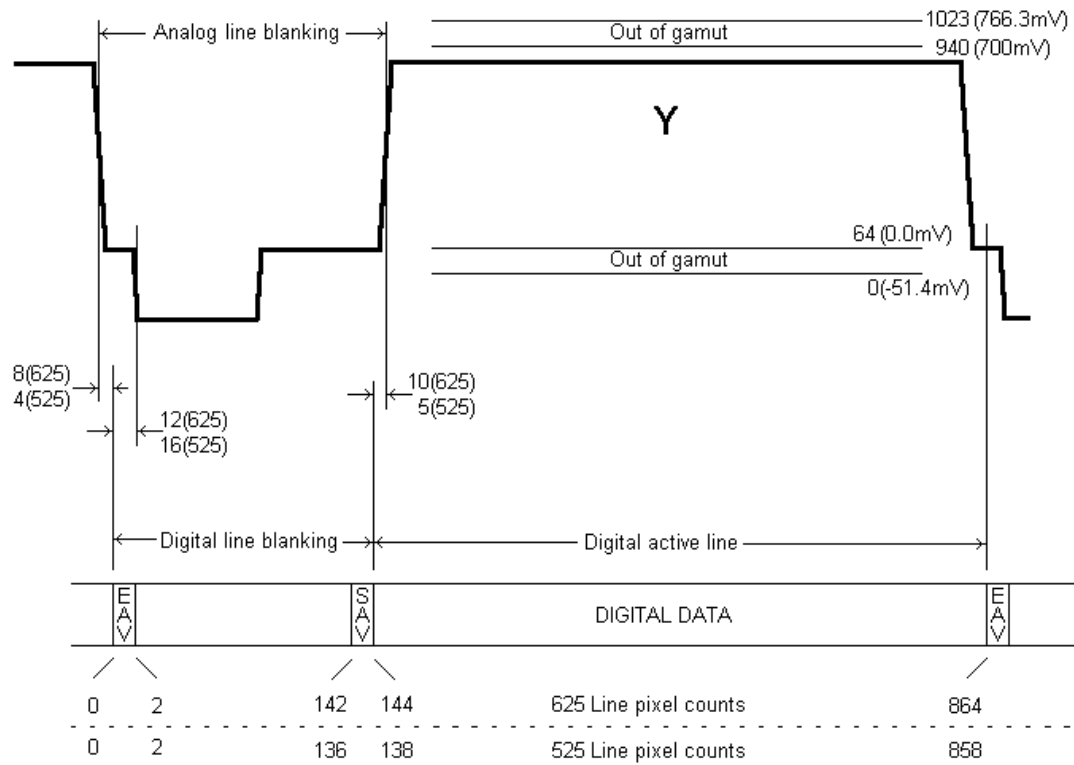


Fig 13 .

SERIAL DIGITAL BASICS

SD SDI Field Blanking – 625

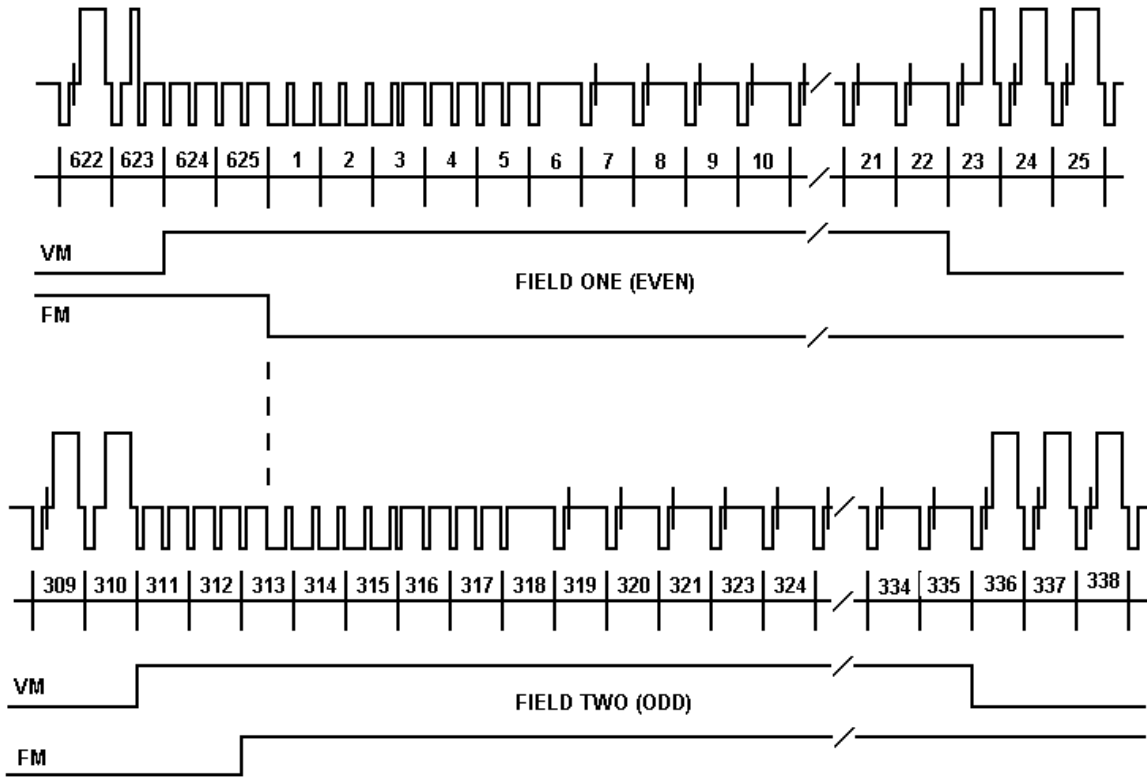


Fig 14 .

SERIAL DIGITAL BASICS

SD SDI Field Blanking – 525

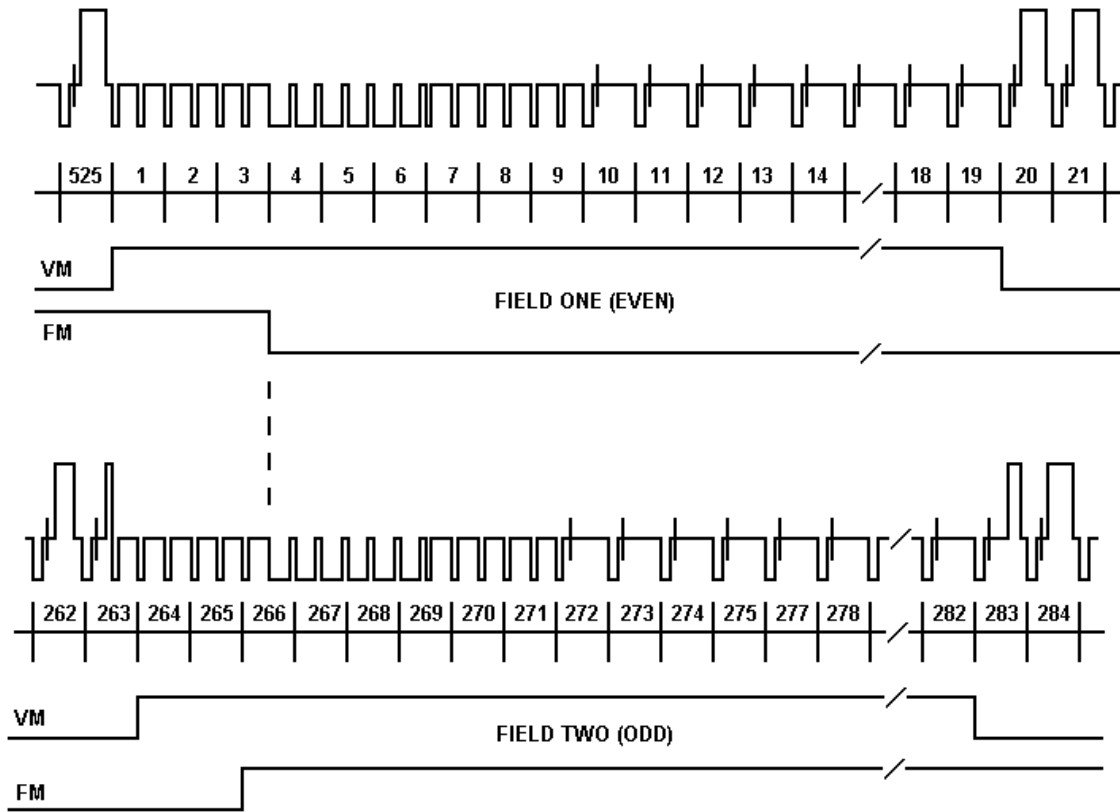


Fig 15 .

USEFUL WEBSITES

| | | |
|---------------------|--|--|
| HAMLET | www.hamlet.co.uk | |
| HAMLET (USA) | www.hamlet.us.com | |
| SMPTE | www.smpte.org | Society of Motion Picture Television Engineers |
| DIN | www.din.de | German Standards Institute |
| EBU | www.ebu.ch | European Broadcasting Union |
| AES | www.aes.org | Audio Engineering Society |
| ITU | www.itu.int | International Telecommunication Union |

CONTACT DETAILS AND CUSTOMER SUPPORT

For any form of assistance in maintaining your Adept, please contact:

Hamlet Video International Limited
Maple House 11 Corinium Business Centre Raans Road Amersham Bucks HP6 6FB
England
Main Line: +44 (0)1494 729 728
Fax Line: +44 (0)1494 723 237
Free phone (UK) 0500 625 525
E-mail: sales@hamlet.co.uk Web site: www.hamlet.co.uk

Hamlet Video International USA service center , Tecads Inc, 23 Del Padre St, Foothill Ranch, CA 92610, U.S.A.
Tel: +1 (949) 597 1053,
Fax: +1 (949) 597 1094.
Toll Free Tel number: (866) 4 HAMLET
E-mail: service@hamlet.us.com Web site: www.hamlet.us.com

In correspondence concerning this instrument, please quote the serial number, which you will find printed on the label at the back of the unit.