HAMLET®

EXCELLENCE IN VISION

MS9000A/B

3G, HD, SD & CST WAVEFORM, VECTOR, AUDIO AND PICTURE MONITORING WITH EYE PATTERN AND SIGNAL GENERATION

OPERATOR'S HANDBOOK

V1.4A onwards

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IN CORRESPONDENCE CONCERNING THIS INSTRUMENT
PLEASE QUOTE THE SERIAL NUMBER PRINTED ON THE
LABEL AT THE SIDE OF THE UNIT

VERSIONS

A

Full specification unit.

The "A" version can be best remembered as ADVANCED and used typically more for the Engineering regions. The "A" has full factory software loaded and is provided with a 4 year Warranty

B

Reduced specification unit.

The "B" version can be best remembered as BASIC and used more for the Production regions.

The "B" unit has reduced functionality and therefore does not include Quad/Tiled display, Gamut, Cursors, Download, Logging and is supplied with a 1 year warranty which is extendable to 2 years - if the product is registered on the Hamlet website warranty page. (see page 5)

"B" units can be upgraded to "A" retrospectively

CONTENTS

FIGURES

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.

Monitorscope 9000 “A”, Digiscope 9000 “A” and Microflex units are covered by “Absolute Care” warranty – providing 4 year cover (subject to warranty registration)

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.

CE

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 MS9000** to which this declaration relates is in conformity with the following standards:

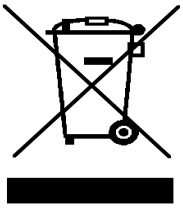
EN50081-1 Generic emissions standard for light industrial applications.
EN50082-1 Generic immunity standard for light industrial applications.

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

B2B COMPLIANCE REG NO.
WEE/GJ0146QT



The symbol shown above and on the Hamlet MS9000 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 Producer Registration Number above, WEE/GJ0146QT proves that Hamlet are formally registered with a legally approved Compliance Scheme. The Scheme we are registered with is called "B2B Compliance". B2B Compliance takes on the legal responsibilities of the reporting on, and the collection and treatment of, all WEEE that Hamlet Video International Limited is obliged for - and ensures that the appropriate recycling targets are met on this WEEE

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 in the EU should contact their Hamlet MS9000 supplier to arrange for its return to Hamlet head office in the UK, who will safely dispose of it and ensure that this Hamlet MS9000 is not mixed with other commercial waste for disposal.

OVERVIEW

The Hamlet MS9000 is a 3U high, half rack width 3G, HD, SD and Composite capable waveform and picture monitor, with vectors and embedded/AES audio monitoring and optional HD-SD test pattern generator and/or 3G,HD,SD EYE pattern functionality - supports 3G level A and level B mapping

Option 1: HD/SD
accepts all major HD (high definition) and SD (standard definition) SDI (serial digital video) standards.

Option 2: SD/CST
accepts Serial Digital video in 625 and 525 line standards and Composite video in PAL and NTSC standards.

Option 3: HD/SD + TSG
accepts all major HD (high definition) and SD (standard definition) SDI (serial digital video) standards. Includes HD and SD Test Signal Generator output

Option 4: HD/SD + EYE
accepts all major HD (high definition) and SD (standard definition) SDI (serial digital video) standards. Includes EYE Pattern display with Jitter

Option 5: 3G/HD/SD
accepts all major 3G and HD (high definition) and SD (standard definition) SDI (serial digital video) standards

Option 6: 3G/HD/SD + EYE
accepts all major 3G and HD (high definition) and SD (standard definition) SDI (serial digital video) standards. Includes EYE Pattern display with Jitter

The MS9000 displays the waveforms on its internal high quality 6.5” XVGA 1024 x 768 high contrast TFT liquid crystal display. The output option allows the use of an external analogue or digital monitor, via a DVI-I socket.

All the standard displays are produced, including H and V Mag, Line Select, Component Parade, Filter Parade and Bowtie. Proprietary patented digital signal processing produces displays with the look of a CRT but without the problems of scan burn, EHT difficulties etc. The very low power consumption also allows it to be used in the field from an external 12V supply.

There are also displays of four channels of audio and a vector audio phase display. The unit contains a high specification audio de-embedder, which displays on the audio bar graphs and outputs analog stereo audio to a front panel mounted headphone jack.

The serial digital signal itself is analysed to give on-screen readouts of the various digital parameter errors and signal strength in the top of screen status bar.

Measurement cursors are provided to allow amplitude and timing differences to be measured between two points on the waveform display and to provide vector phase and amplitude on the vector display.

The full screen picture mode allows the MS9000 to act as a high quality picture monitor.

Remote control software allows all functions to be controlled from a personal computer and for waveforms to be downloaded to a computer for display and storage.

CASE VIEW

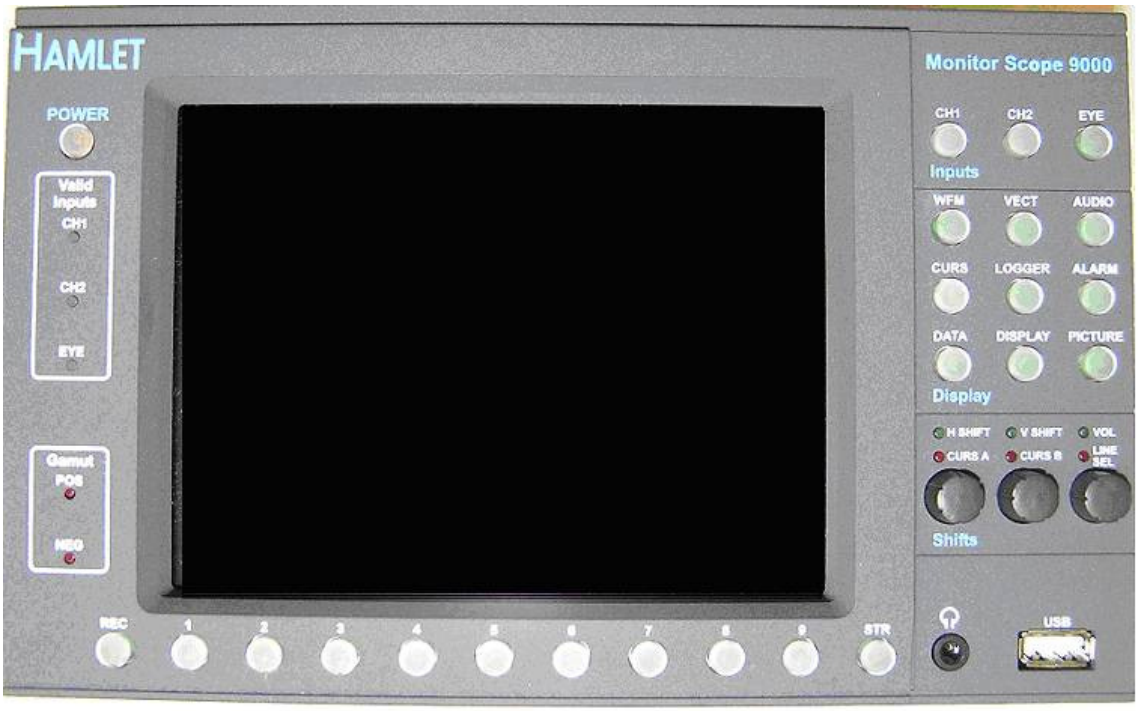


Fig 1

GETTING STARTED

UNPACKING

The Hamlet MS9000 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, if severely handled.

POWER REQUIREMENTS

The Hamlet MS9000 should be powered from the supplied adaptor, or a regulated supply of 12VDC of at least 2 Amps rating, to the 4 pin XLR power socket.

SIGNAL AND CONTROL CONNECTIONS

The 3G/HD/SD/CST input connection is made to the centre BNC socket, which is internally terminated at 75 ohms.

The left BNC provides either an equalised output of the input feed, or subject to module fitted user selected Test Signal, whilst the right BNC allows an external timing reference or AES audio signal to be input.

Output option

An external digital or analogue XVGA monitor can be connected to the DVI-I sockets. The standard is XVGA 1024x768 @ 60Hz.

PREVENTATIVE MAINTENANCE

The Hamlet MS9000 should be visually inspected and cleaned every one year of operation.

CAUTION. The display screen is made from polycarbonate, which may soften if cleaned with some organic solvents. Do not allow water to get inside the equipment case.

The internal clock battery will need replacing every 5 years approximately with a CR2032 type.

GETTING STARTED

1. Connect the supplied 12V power adaptor output to the rear XLR socket.

2. Apply AC mains (100 - 250VAC) to the power adaptor.

3. Connect an appropriate video feed to the CH1 option centre BNC.

4. Press the front panel PWR key. The software versions will be displayed for the first two seconds.

5. The MS9000 remembers all the setting when it was previously used. If the icon menu is not visible, it may be in picture mode. Press the WFM key to cancel this.

6. Press the DATA key, then press the menu key pointing to the FAC icon for two seconds to restore factory defaults. This will show a waveform display in 1H timebase range.

TYPICAL STATUS DISPLAY

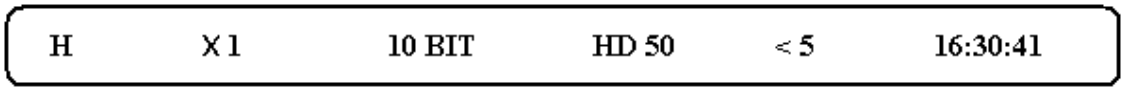


Fig 2

H is the time base range.

X1 is the vertical gain.

10BIT shows the number of active bits per pixel.

HD50 is the television standard.

<5 is an indication of SDI cable attenuation in dB.

The internal real time clock displays on the right of the status screen and has a battery backup for at least 5 years. It will also display any VITC timecode on the input signal.

All MS9000 functions are controlled from a simple menu structure.

OPERATING INSTRUCTIONS

FRONT PANEL

Control keys allow direct access to all the major functions, with sub functions controlled by a simple menu system.

VALID Blue Led's indicate which input/s has a valid signal present.
Nb. "EYE" validity light illuminates when EYE module is present.

INPUTS

CH1 Selects the Channel 1 input option when fitted.

CH2 Selects the Channel 2 input option when fitted.

EYE Selects the Eye Pattern input option.

WFM Selects waveform monitor mode.

VECT Selects vector monitor mode.

AUDIO Selects audio monitor mode.

CURSOR Selects measurement cursor mode.

LOGGER Selects error logger mode and real time clock setting.

ALARM Selects which errors are logged or cause an audible alarm.

DATA Selects data and sundry functions (inc Test Signal Generator - GEN).

DISPLAY Selects the display options.

PICTURE Selects picture monitor mode.

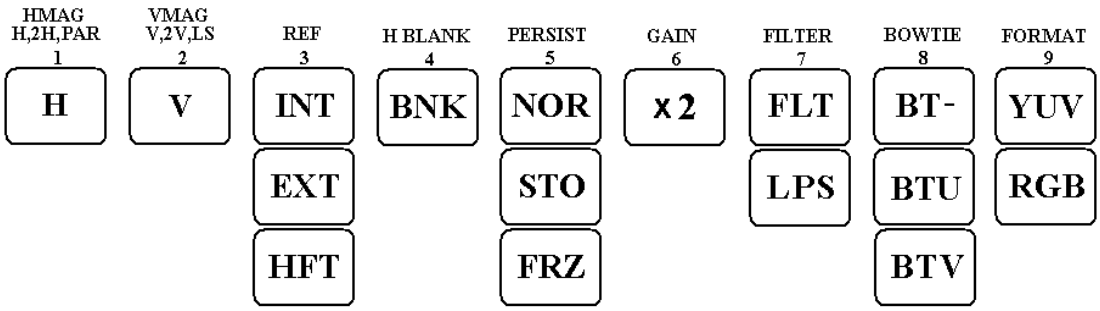
GAMUT ERRORS

POS Lights if the low pass filtered Y signal is high by 3% or more.

NEG Lights if the low pass filtered Y signal is low by 1% or more.

OPERATING INSTRUCTIONS

WAVEFORM MENU



1 **H** — Selects horizontal timebase ranges of H, 2H, Parade and Hmag.
In HD Hmag range, the graticule major divisions are 200nSec apart.

2 **V** — Selects horizontal timebase ranges of V, 2V, Vmag and Line Select.
The front panel LINE SEL control selects the line number.

3 **INT**
- INT Selects internal sync reference from the input video.
- EXT Selects the EXT-REF bnc as the sync reference.
- HFT Hands Free Timing™ automatically switches the display between internal and external syncs, so easily showing timing errors.

4 **BNK** — Blanks out the horizontal blanking area (TRS, audio, aux data etc).

5 **NOR**
- NOR Selects the display persistance to the normal frame rate.
- STO Selects the display persistance to infinite.
- FRZ Freezes the display.

6 **x2** — Toggles the video gain between x1 and x2 values.

7 **FLT**
- FLT Selects Flat video filter.
- LPS Selects Low Pass video filter.

8 **BT-**
- BT- Selects Bowtie OFF.
- BTU Selects Bowtie Y-U.
- BTV Selects Bowtie Y-V.

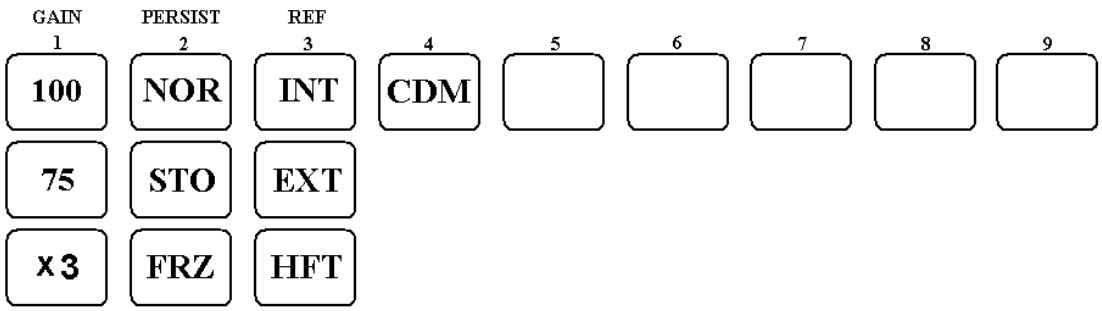
9 **YUV**
- YUV Selects YUV waveform display in 3H timebase range.
- RGB Selects RGB waveform display in 3H timebase range.

The waveform display can be moved horizontally and vertically using the front panel H SHIFT and V SHIFT controls.

Fig 3

OPERATING INSTRUCTIONS

VECTOR MENU



1 **100**

100 Sets the vectorscope gain for 100% vectors.
75 Sets the vectorscope gain for 75% vectors.
x3 Sets the vectorscope gain to 3 times the 100 setting.

2 **NOR**

NOR Selects the display persistance to the normal frame rate.
STO Selects the display persistance to infinite.
FRZ Freezes the display.

3 **INT**

INT Selects internal sync reference from the input video.
EXT Selects the EXT-REF bnc as the sync reference.
HFT Hands Free Timing™ automatically switches the display between internal and external syncs, so easily showing timing errors.

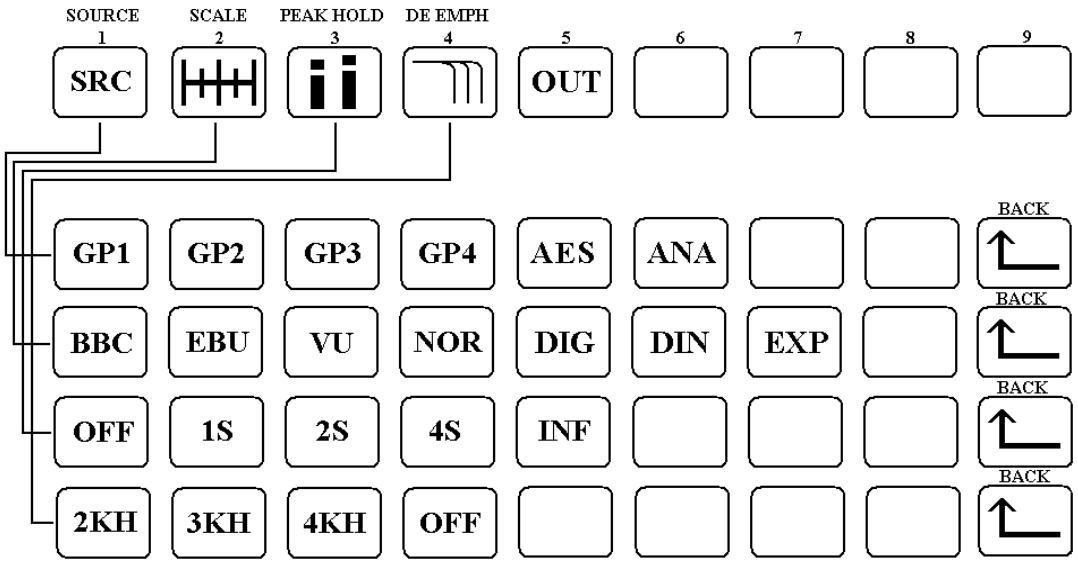
4 **CDM**

Selects Chroma Du Monde graticule and gain.

Fig 4

OPERATING INSTRUCTIONS

AUDIO MENU



1 **SRC**

- GP1 Selects embedded audio Group 1.
- GP2 Selects embedded audio Group 2.
- GP3 Selects embedded audio Group 3.
- GP4 Selects embedded audio Group 4.
- AES Selects AES audio input.
- ANA Selects analogue audio (option).
- ↑ Up one level in the menu.

2

- BBC Selects BBC Type II audio scale.
- EBU Selects EBU audio scale.
- VU Selects VU audio scale.
- NOR Selects NORDIC audio scale.
- DIG Selects DIGITAL audio scale.
- DIN Selects DIN audio scale.
- EXP Selects expanded DIN scale.
- ↑ Up one level in the menu.

See following page.

3

- OFF Selects audio bars peak hold to off.
- 1S Selects 1 second audio bars peak hold time.
- 2S Selects 2 seconds audio bars peak hold time.
- 4S Selects 4 seconds audio bars peak hold time.
- INF Selects infinite audio bars peak hold time.
- ↑ Up one level in the menu.

4

- 2KH Selects 2KHz de emphasis.
- 3KH Selects 3KHz de emphasis.
- 4KH Selects 4 KHz de emphasis.
- OFF Selects de emphasis to off.
- ↑ Up one level in the menu.

5 **OUT**

Selects the audio output and phase display source. The selection is displayed in the top status bar:

CH:1&2 CH:3&4 CH:1 MONO CH:2 MONO CH:3 MONO CH:4 MONO

Fig 5

OPERATING INSTRUCTIONS

AUDIO SCALES

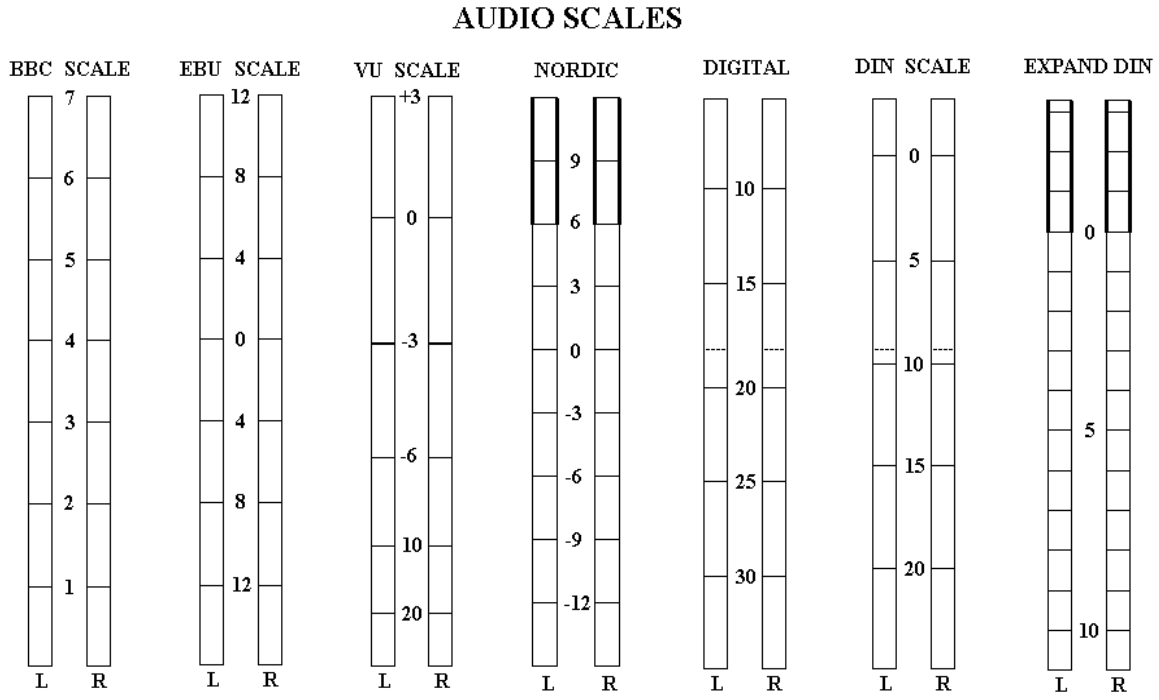
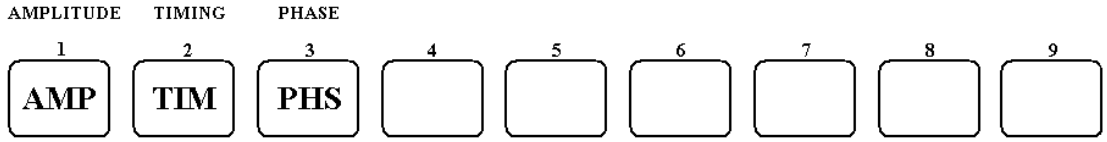


Fig 6

OPERATING INSTRUCTIONS

CURSOR MENU



1 **AMP** The amplitude corresponding to each cursor in mV, is displayed in the status area, along with the difference between the two values.

2 **TIM** The time corresponding to each cursor is displayed in the status area, along with the difference between the two values.

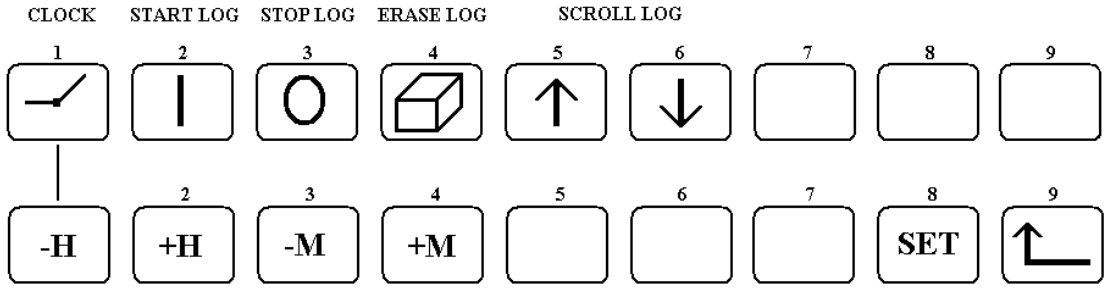
3 **PHS** The intersection of the cursors represents a phase amplitude measured from the centre and a phase angle value. The phase angle is taken as 0 degrees at the 9 o'clock position. The phase magnitude and angle at the intersection is displayed in the status area.

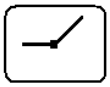
The cursor positions are moved using the front panel CURS A and CURS B controls. The third control moves both cursors together.

Fig 7

OPERATING INSTRUCTIONS

LOGGER MENU



1 

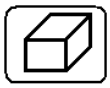
- −H Moves clock Hours back.
- +H Moves clock Hours forwards.
- −M Moves clock Minutes back.
- +M Moves clock Minutes forwards.
- SET Stores the new time setting.
- Up one level in the menu.

2 

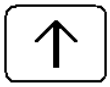
Starts the logger. Stores the time of occurrence, the video standard and type of all errors that have been enabled in the top level Alarms menu.
All logged errors have a number starting at 1 and going up to a maximum of 980.

3 

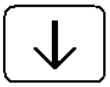
Stops the logger.

4 

Erases all logged errors.

5 

Scrolls up the list of logged errors displayed on the top status bar.
Says "End of Log" when at the top of the list.

6 

Scrolls down the list of logged errors displayed on the top status bar.

The log can be downloaded to a computer via the USB port. See the Remote Control section for more details.

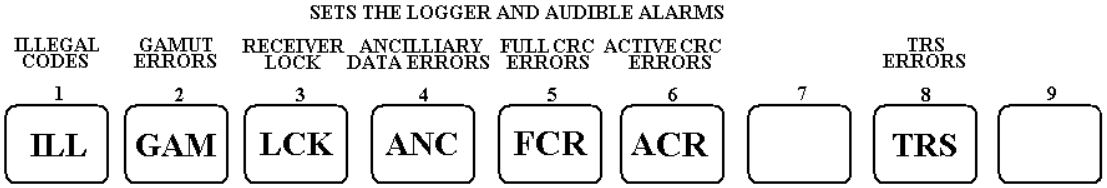
Fig 8

OPERATING INSTRUCTION

ALARM MENU

These alarms can be set individually. When set and an error of that type occurs, they will have the following effects:
If the logger is running the error will be logged
If the logger is not running the error count will be displayed in the top status bar in Data mode and an audible warning will sound.

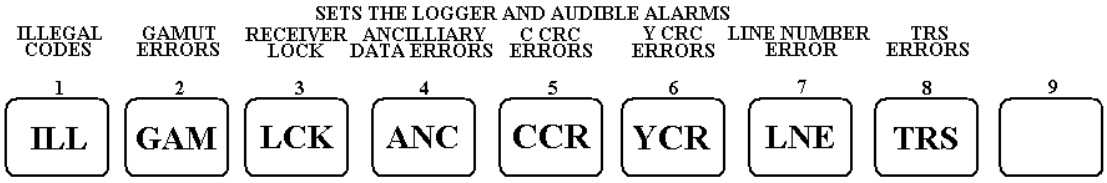
With SD Video Input



ILL Detects illegal values in the incoming video data stream.
GAM Detects out of gamut values in the incoming video data stream (+3%, -1%)
LCK Indicates the unit is not locked to the incoming video.
ANC Detects illegal values in the ancillary data packets in the the video data stream.
FCR Detects errors in the Full Field CRC of the incoming video data stream.
ACR Detects errors in the Active Picture Area CRC of the incoming video data stream.
TRS Detects errors in the EAV and SAV values in the incomming video data stream.

Fig 9a

With HD Video Input

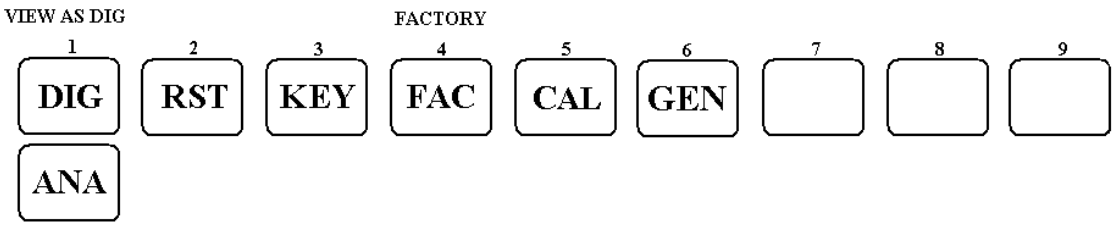


ILL Detects illegal values in the incoming video data stream.
GAM Detects out of gamut values in the incoming video data stream (+3%, -1%)
LCK Indicates the unit is not locked to the incoming video.
ANC Detects illegal values in the ancillary data packets in the the video data stream.
CCR Detects errors in the Chroma CRC of the incoming video data stream.
YCR Detects errors in the Luma CRC of the incoming video data stream.
LNE Detects line numbering errors in the incoming video data stream.
TRS Detects errors in the EAV and SAV values in the incomming video data stream.

Fig 9b

OPERATING INSTRUCTIONS

DATA MENU



1 **DIG**

DIG This is the totally digital display mode.
ANA This allows an analog representation of the digital input, complete with analog syncs.

2 **RST** Resets all the error counters.

3 **KEY** Causes an audible "beep" when any key is pressed.

4 **FAC** Resets the unit to a standard default "Factory Setting".

5 **CAL** Calibrates the cable level display. Using a cable clone, switch in attenuation and click on the matching icon:

0DB -5 -10 -15 -20 -25

Then click on the SET icon to store the settings.

6 **GEN** Controls the Option 3 test pattern generator.

Fig 10

GENERATOR MODULE

This option provides all the features of Option 1 with the addition of a high specification test signal generator for standard and high definition signals. The control menu is accessed by selecting DATA then GEN in the top menu. The output state is described in the top Status line.

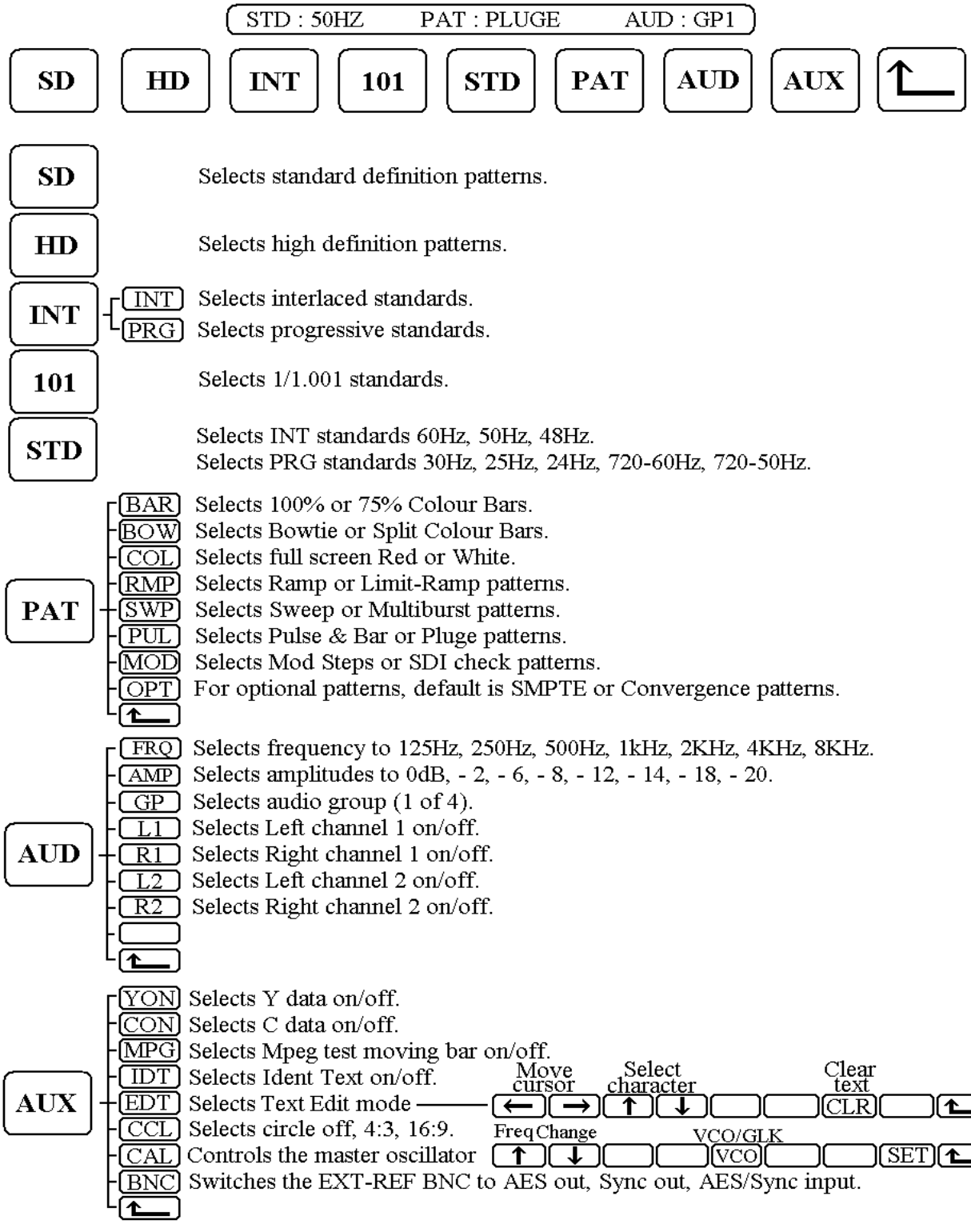


Fig11

FEATURES

VIDEO
The video Y and C components can be individually disabled from both outputs.

EMBEDDED AUDIO
Audio tone, with seven frequencies and eight amplitudes, can be embedded into any of the four groups, with individual channel control.

AES AUDIO
Audio tone, as above, can be output in AES format to the EXT BNC.

MPEG TEST
A moving black bar can be added to any pattern to check for stuck frames and MPEG coding errors.

IDENT TEXT
16 of 64 text characters can be superimposed on the selected pattern. To enter new characters or edit an existing ident caption, go to the GEN - AUX - EDT menu. The cursor can be moved to any 1 of 16 positions using the left/right arrows. The character over the cursor can be selected using the up/down arrows, Selecting from 0-9, A-Z, ( ) ! & @ # . + - thus all character spaces can be set. The CLR key sets all characters to a white space.

CIRCLE
A white circle can be added to any pattern in 4:3 or 16:9 aspect ratios.

MASTER OSCILLATOR
The generator clock free running frequency can be calibrated using the menu, in 5ppm steps. Alternatively, it can Genlock to the external reference input.

EXT-REF BNC
This has four functions, selectable in the AUX menu.
1. AES audio input.
2. Analogue external reference input.
3. AES audio output.
4. Analogue black and syncs output.

All settings are stored when the unit is switched off.

STANDARDS SUPPORTED

SMPTE 259

STANDARD	FRAME RATE		CLOCK
711 x 487 (525)	59.94	2:1 I	13.5MHz
702 x 575 (625)	50	2:1 I	13.5MHz

SMPTE 274M

STANDARD	FRAME RATE		CLOCK
1920 x 1080	60	2:1 I	74.25MHz.
1920 x 1080	59.94	2:1 I	74.25MHz/1001
1920 x 1080	50	2:1 I	74.25MHz
1920 x 1080	30	1:1 P	74.25MHz
1920 x 1080	29.97	1:1 P	74.25MHz/1001
1920 x 1080	25	1:1 P	74.25MHz
1920 x 1080	24	1:1 P	74.25MHz
1920 x 1080	23.98	1:1 P	74.25MHz/1001
1920 x 1080	30	S.F.	74.25MHz
1920 x 1080	29.97	S.F.	74.25MHz/1001
1920 x 1080	25	S.F.	74.25MHz
1920 x 1080	24	S.F.	74.25MHz
1920 x 1080	23.98	S.F.	74.25MHz/1001

SMPTE 296M

STANDARD	FRAME RATE		CLOCK
1280 x 720	60	1:1 P	74.25MHz
1280 x 720	59.94	1:1 P	74.25MHz/1001
1280 x 720	50	1:1 P	74.25MHz

PATTERNS

100% BARS
100% full colour bars.
Digital levels are Yblack =64, Ywhite = 940, Cr and Cb are 512 +/- 448 max.

75% BARS
White as 100% bars. Colours reduced to 75% level.

SPLIT
Top half of screen is 100% colour bars, bottom half is full red.

BOWTIE
Y channel is 500KHz. Cr,Cb channels are 502KHz phase adjusted so equal to Y in mid line. Suitable monitoring equipment, e.g. the Hamlet LCDScope 292WVA, produce (Y-Cr) and (Y-Cb) displays to accurately check system gains and timings, with the traditional bowtie displays.
Y Waveform is 438 bits (350mV) p/p centred on 502 bits (350mV).
C Waveform is 448 bits (350mV) p/p centred on 512 bits (350mV).
Timing markers at +/-5nSec and at every 20nSec.

SWEEP
SD sweeps from 500KHz to 5MHz over the line period, with markers at 1,2,3,4,5 MHz.
HD sweeps from 1MHz to 30MHz over the line period, with markers at 5,10,15,20,25 MHz.
Waveform is 600bits (480mV) p/p centred on 502 bits (350mV).

PLUGE
Grey scale block for colour monitor gain tracking adjustment and grey/superblack stripes for brightness setting.
Block is 940 bits (700mV), 502 bits (350mV), 239 bits (140mV).
Stripes are at 64 +/- 18bits (+/- 14mV).

MULTI
525 SD is a white bar at 765 bits (560mV) followed by six frequency bursts at 500KHz, 1.25MHz, 2MHz, 3MHz, 3.58MHz, 4.2MHz at 526 bits (370mV) p/p centred on 502 bits (350mV).

625 SD is a white bar at 765 bits (560mV) followed by six frequency bursts at 500KHz, 1MHz, 2MHz, 3MHz, 4MHz, 5MHz at 526 bits (370mV) p/p centred on 502 bits (350mV).

HD is a white bar at 765 bits (560mV) followed by five frequency bursts at 5MHz, 10MHz, 15MHz, 20MHz and 25MHz at 526 bits (370mV) p/p centred on 502 bits (350mV).

PULSE+BR
2T luma pulse at 940 bits (700mV), 10T chroma pulse at 502 bits (350mV), bar at 940 bits (700mV).

PATTERNS

MOD STPS
5-step ascending staircase, equal steps of 175 bits (140mV) each.
Added chroma of Cr at 638 bits and Cb at 652 bits.

WHITE
Plain full white screen.
Y waveform 940 bits (700mV), Cr is 512 bits, Cb is 512 bits.

RED
Plain full red screen.
Y waveform is 250 bits (149mV), Cr is 960 bits, Cb is 409 bits.

CONVERGE
Crosshatch pattern for colour monitor convergence adjustment.

DIG CHK
Top half of the screen is the equaliser test and contains several examples of 19 "0"s followed by 2 "1"s per frame.
Bottom half of the screen is the phase locked loop test and contains several examples of 20 "0"s followed by one "1" per frame.

RAMP
Y waveform is an ascending ramp, running from 64 bits (0mV) to 940 bits (700mV).
Cr and Cb waveforms are ascending ramps, running from 64 (-350mV) to 960 (+350mV)

LIM RAMP
Y waveform is an ascending ramp, running from 1 bit (50 mV below black) to 1022 bits (66 mV above peak white).

TECHNICAL SPECIFICATION

OUTPUTS

SD Serial digital	BNC connector. Output impedance 75 ohms. SMPTE 259M, ITU-R BT.601/656 serial component. 800mV pp
HD Serial digital	BNC connector, output impedance 75 ohms. SMPTE 292, serial component. 800mV pp

Full 10 bit pattern generation.

3G/HD/SD EYE OPTION MODULE

These modules (Option 4 & 6) provide all the features of the Option 1 module, with the addition of operation at 3G standards and an EYE pattern display in SD, HD and 3G standards. Please read the following in conjunction with the operation manual of the main instrument.

Compatibility

This option is designed to operate in the Hamlet MS9000, DS9000, Flexiscope and Microflex.

Overview

This module allows the display of waveforms, vectors and picture for all SMPTE serial digital video standards from standard definition (525 & 625) up to 3G (1080P50/60). It will also show an EYE pattern display in all these standards. There is a high specification audio de-embedder and an AES receiver, allowing audio bar graph displays of four channels of audio (two from AES) and a vector audio phase display. There is a stereo headphone monitor output jack from a stereo high quality 1-bit DAC.

The serial digital signal itself is analysed to give on-screen readouts of the EDH/CRC word, various digital parameter errors and signal strength in the top of screen status bar.

Measurement cursors are provided to allow amplitude and timing differences to be measured between two points on the waveform display and to provide vector phase and amplitude on the vector display.

Remote control software allows all functions to be controlled from a personal computer and for waveforms to be downloaded to the computer for display and storage.

SMPTE 425M mapping.

The option supports 3G level A and level B mapping.

Level A is the standard single channel 3G interface and the input standard is displayed in the status bar at the top of the screen as HD50P**A**, HD60P**A** (or #HD60P**A** for 1/1.001).

Level B is two channels of HD video and the standards suffix is changed to **B**.
The menu allows selection either channel.

EYE pattern operation in an MS9000 or DS9000

The module can be fitted into the CH1 or CH2 positions. Select the relevant channel using the front panel buttons and then press the EYE button on the front panel INPUT section. The module is controlled by on-screen menu.

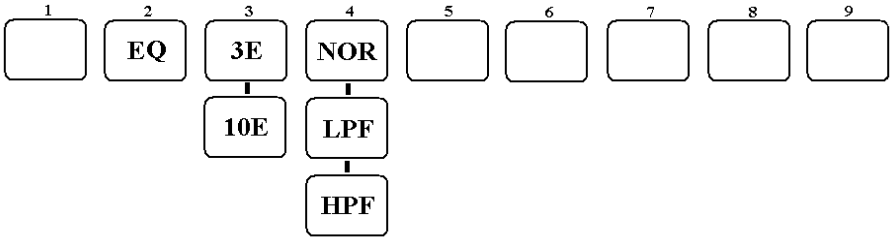
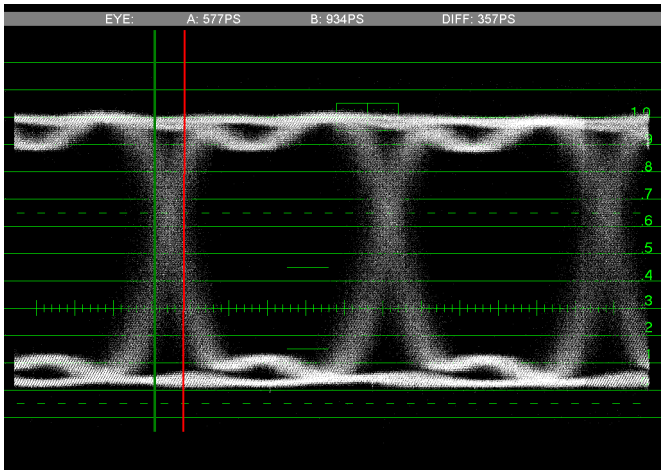


Fig 12

Key 2 enables or disables the input equaliser, the icon is coloured blue when enabled.
Key 3 selects a display of 3 eyes or 10 eyes.
Key 4 selects the frequency response of the clock recovery circuit. The loop-bandwidth is normally 1/1000 of the input clock frequency. This is doubled in HPF or halved in LPF, to help identify the frequency of any jitter present.

Cursor measurements

Press the front panel CURSOR key, then select TIM (key2) in the menu.



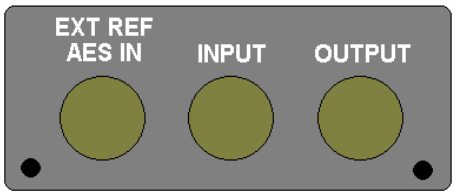
The front panel CURSOR A and CURSOR B controls allow precise timing measurements to be made on the EYE pattern.

Module specification

SD/HD/3G digital input.
BNC connector. Input impedance 75 ohms. Max d.c. +/- 10V.
SMPTE 259M serial digital at 800mV p/p. Auto equalised up to 250 m of cable at 270Mb/s.
SMPTE 292M serial digital at 800mV p/p. Auto equalised up to 230 m of cable at 1.485Gb/s.
SMPTE 424M serial digital at 800mV p/p. Auto equalised up to 170 m of cable at 2.970Gb/s.

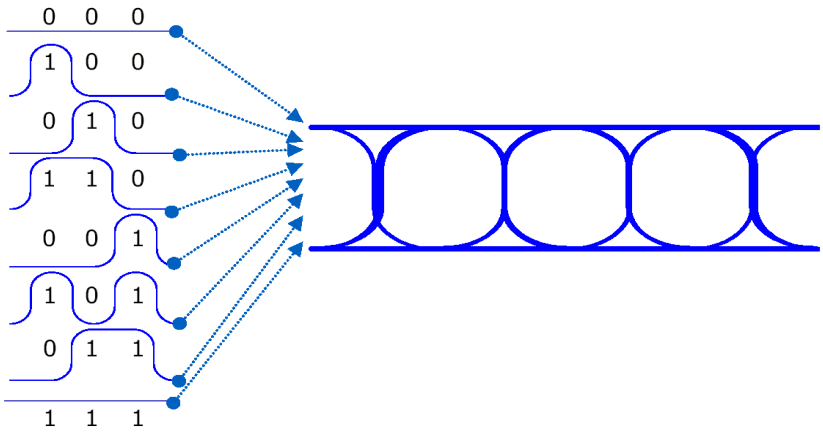
SD/HD digital output.
BNC connector. Output impedance 75 ohms. Equalised version of the serial digital input.

Ext-ref / AES input.
BNC connector. Input impedance 75 ohms. Max dc +/- 3 volts.
Video 0.5 to 2.0V p/p.
Digital Audio min 150mV p/p, max 3V p/p conforming to S/PDIF,
AES3, IEC60958 or EIAJ CP1201.



Eye Measurement Basics

Eye diagrams are a very successful way of quickly and intuitively assessing the quality of a digital signal. A properly constructed eye should contain every possible bit sequence from simple 101's and 010's, through to isolated ones after long runs of consecutive zeros and other problem sequences that often show up weaknesses present in system design.

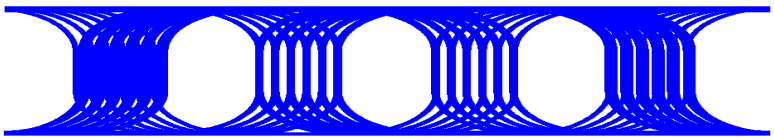


Overlaying of bit sequences to form and eye diagram.

Eye diagrams show parametric information about the signal – effects deriving from physics such as system bandwidth health etc. It will not show protocol or logical problems – if a logic 1 is healthy on the eye, this does not reveal the fact that the system meant to send a zero. However, if the physics of the system mean that a logic one becomes so distorted while passing through the system that the receiver at the far end mistakes it for a zero, this should be shown in a good eye diagram. Common ways of characterizing an eye are to measure the rise times, fall times, jitter at the middle of the crossing point of the eye, the overshoot present and many other numerical descriptions of eye behaviour in order to compare devices being measured.

Jitter

As there is no separate clock available, the display has to trigger from recovered clock. Circuits used for recovering clock typically have a loop bandwidth, or filtering function, that removes from the clock signal some of the jitter that was present on the data signal. Depending upon the measurement being made, this can be helpful or hurtful, but needs to be understood. Narrow loop bandwidth clock recovery tends to give a rock solid clock trigger signal as the reference, and any jitter, or movement of edges with time, in the data eye diagram that is present will be displayed. This is a useful absolute measure but might not properly represent the jitter seen by a real system if the receiver uses clock recovery to track some of the jitter out.

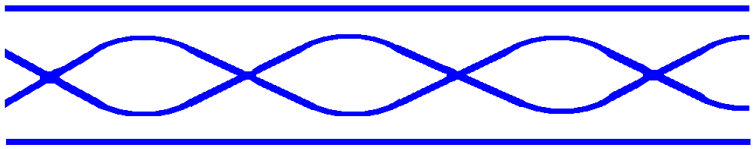


Clock recovered from the data signal using a narrow loop bandwidth clock recovery scheme.

Wide bandwidth clock recovery tends to let more of the jitter that was present on the data signal through on to the clock. This can mean that as the data jitters by moving edges in one direction, then the other; the recovered clock tracks it, and the resulting eye appears to have very little jitter present on it. This tracking function is the way many system receivers work to reduce the jitter passed on through the system.

Conditions can also conspire to create the opposite effect, where the delay between data signal and trigger signal is such that when the data edges are moving to their furthest extent in one direction, the recovered clock signal being triggered from it is moving to its furthest extent in the other, and the resulting eye shows as much as twice the jitter that was present on the data signal.

Equalisation
Long cable runs attenuate the higher frequency components in the serial data stream, effectively closing the eye. Although modern equalisers can compensate for this, there is still a limit, typically only 100 metres or so at 2.970Gb/s.



Closing eye due to high frequency attenuation.

Signal Specifications

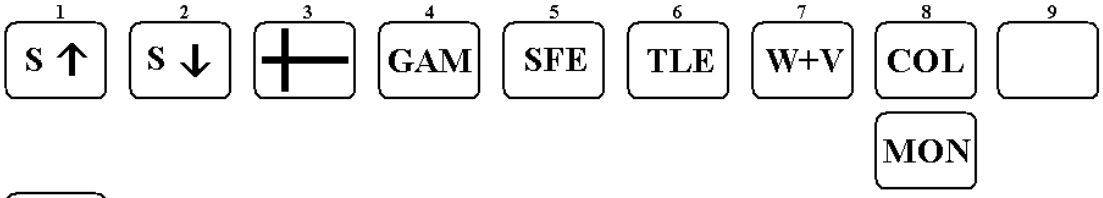
SMPTE 259M
Amplitude 800mv +/- 10%
Rise and fall times between 0.4nS and 1.5nS. The difference should be less than 0.5nS.
Data rate is 270MHz
Cycle width is 1UI = 3.7nS
Jitter allowed is 0.2UI = 0.74nS

SMPTE 292M
Amplitude 800mv +/- 10%
Rise and fall times no greater than 0.27nS . The difference should be less than 0.1nS.
Data rate is 1485MHz
Cycle width is 1UI = 0.673nS
Jitter allowed is 1.0UI = 0.673nS

SMPTE 424M
Amplitude 800mv +/- 10%
Rise and fall times no greater than 0.27nS . The difference should be less than 0.1nS.
Data rate is 2970MHz
Cycle width is 1UI = 0.337nS
Jitter allowed is 2.0UI = 0.673nS

OPERATING INSTRUCTIONS

DISPLAY MENU



1 **S ↑** Increases the scale brightness.

2 **S ↓** Decreases the scale brightness.

3 Picture H/V delay to show blanking areas.

4 **GAM** This mode shows R,G and B traces superimposed, with a 1H timebase, and low pass filtering. There are gamut limit lines at +3% and -1%.

5 **SFE** Selects the safe area display to:
OFF 16:9 14:9 4:3
When selected, the unit switches to picture mode.

6 **TLE** Selects TILE mode, which shows waveform, vector, audio and picture in four display quadrants. The individual main menu keys control each quadrant. Line Select and Gains don't operate in this mode.

7 **W+V** Allows a TILE display, but with the audio and picture areas blanked.

8 **COL** COL Allows the waveform parade display to be in colour.
MON Allows the waveform parade display to be in monochrome.

Fig 13

PICTURE MODE

Pressing the PICTURE key gives a full screen picture. Repeated pressing toggles between 16:9 and 4:3 aspect ratios. Press any other main menu key to exit.

REMOTE CONTROL

To control the unit via a USB interface.

Installation of Software

Install the software supplied on the CD-ROM on to a PC. The program should auto-start. If not, click on the program:

setup.exe

When it is installed connect the MS9000 to the PC's USB port by the supplied USB A to USB A cable.

Switch on the MS9000.
The first time, the PC will ask for the location of the drivers.
Using the browser display, select the path as Program Files\MS9000 and press OK.
This will load the drivers. Remove the CD-ROM and store safely.

Start the MS9000 utility program from the PC Start menu…MS9000
Or by double clicking on the program icon located in the folder:

Program Files/MS9000/MS9000_rem.exe

Operation of Software

Get a Log This button downloads the error logs from the MS9000.

Print Log this button will send the log to your printer.

Erase log will clear the logger memory in the MS9000.
Note that the logger memory is automatically cleared when the logger is started.

1 Frame button will download the current display of the MS9000.

Continuous will download the display from the MS9000 constantly until
The **Stop** button is pressed.

Files button opens a window for saving and recalling downloaded displays.

To store a downloaded display enter a file name for the display in the box provided
Then press the **Store** button.

To recall a stored display use the Select Folder and Select File boxes to find a display file then press the **Display** button.

Pressing the **Cancel** button returns to the normal window.

Clear button clears both the log and display areas.

Exit closes the utility.

ADDITIONAL FUNCTIONS

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, factory set mode can be established to allow faster use.

Press the data key, then the Factory settings Icon [FAC].

Factory mode can also be loaded at boot up. With the unit turned off, hold down the front panel REC key and switch on. Continue holding the key down for at least 5 seconds.

To store and recall user settings
8 sets of front panel setting can be stored for later recall.

To Store Settings: Press the front panel STR button, then a menu 1 - 8 key.

To Recall the settings: Press the front panel RCL button, then a menu 1 - 8 key.

Power Source

The Hamlet MS9000 can be powered from the supplied adaptor, providing 12V @ 2 amps regulated, or from the optional external battery pack.

TECHNICAL SPECIFICATION

INPUTS WITH SDI-CST MODULE

INPUT	BNC connector. Input impedance 75 ohms. Max d.c. +/- 10V. SMPTE 259M serial digital at 800mV p/p. Auto equalised up to 350 metres of cable at 270mb/s. PAL or NTSC composite video 0.5 to 2.0V p/p.
SDI output.	BNC connector. Output impedance 75 ohms. Equalised version of the serial digital input.
Ext-ref / AES input.	BNC connector. Input impedance 75 ohms. Max dc +/- 3 volts. Video 0.5 to 2.0V p/p. Digital Audio min 150mV p/p, max 3V p/p conforming to S/PDIF, AES3, IEC60958 or EIAJ CP1201.

INPUTS WITH HD-SD MODULE

SD/HD digital input.	BNC connector. Input impedance 75 ohms. Max d.c. +/- 10V. SMPTE 259M serial digital at 800mV p/p. SMPTE 292M high definition serial digital at 800mV p/p. Auto equalised up to 350 metres of cable at 270mb/s. Auto equalised up to 140 metres of cable at 1.485Gb/s.
SD/HD digital output.	BNC connector. Output impedance 75 ohms. Equalised version of the serial digital input.
Ext-ref / AES input.	BNC connector. Input impedance 75 ohms. Max dc +/- 3 volts. Video 0.5 to 2.0V p/p. Digital Audio min 150mV p/p, max 3V p/p conforming to S/PDIF, AES3, IEC60958 or EIAJ CP1201.

OUTPUT OPTION

XVGA	DVI-I socket with analogue and digital signals.

AUDIO MONITORING OUTPUT

3.5mm stereo jack socket.

REMOTE CONTROL

USB

TECHNICAL SPECIFICATION

POWER
10 to 13V d.c. to 4 pin XLR socket. 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 3Kg.

DISPLAY AREAS

Display	129.0mm x 96.8mm viewing area.
Resolution	1024 pixels wide x 768 pixels high.

WAVEFORM MONITOR

Response	Flat is +/- 1% 50Hz to 5.5MHz (30.0MHz in HD modes). Low Pass is -3db @ 1.5MHz, -60db @ 6.75MHz.
Timebase	H, 2H and Hmag (x5). V, 2V and Vmag. Line select is any line from the frame. Parade is YCrCb left to right.

VECTOR MONITOR

Video	Traditional component display. Accuracy 0.2%. B/width 3.4MHz (15MHz in HD modes).
Audio	Stereo phase display of CH1 or CH2 audio pair. Phase accuracy 2 deg.

AUDIO MONITOR

Accuracy	Better than 0.1db over full scale range.
Characteristics	BBC, EBU, VU, NORDIC, DIGITAL, DIN and EXPANDED DIN.

TROUBLE SHOOTING

Unit appears dead:
Check that the 12V supply adaptor is plugged into the unit and that this is plugged into an operational mains supply, or the external battery pack is fresh. Ensure the front panel power switch is illuminated.

No video displayed:
If there is no video signal connected to the selected input, the screen will display the message "No Signal".
Check that "validity" lights are illuminated on the front panel for the selected channel

Unusual display:
The unit may be set to a non-standard mode. Reset the unit as follows.
Press the DATA key, then the Factory settings Icon [FCT]. See Page 33

Displays not locked:
May be in external reference mode. Press the menu EXT REF key to cancel. This may need pressing twice to step through the HFT mode.

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 15.

Each TRS consists of 4 words:
1) 3ff hex ie all '1's
2) 000 hex ie all '0's
3) 000 hex ie 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 eg: 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 equalises 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.

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:

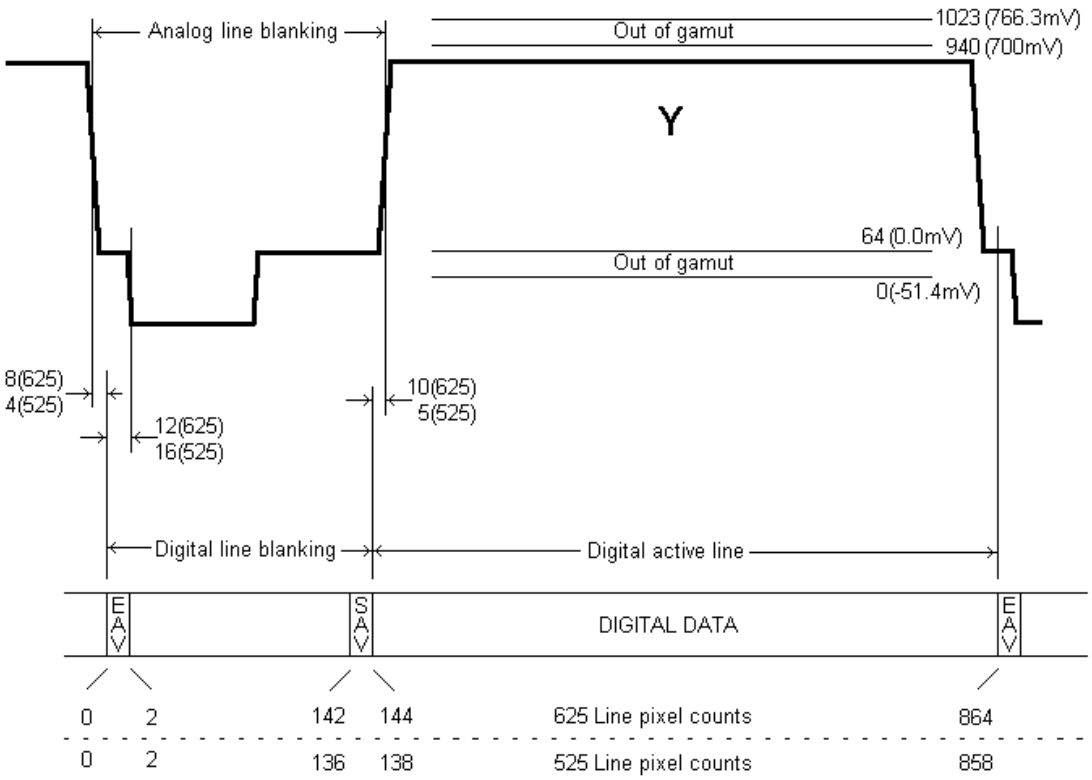
The Header:	(000, 3FF, 3FF) This always precedes an EDH packet.
Data ID:	(1F4)
Block Number:	(200)
Data Count:	This contains the number of words that follow.
Active picture crc:	3 words
Full-field crc	3 words
Error flags:	3 words
Reserved:	7 words
Check Sum:	This is used to test for transmission errors.

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.


Analog line blanking
Out of gamut
1023 (766.3mV)
940 (700mV)
Y
64 (0.0mV)
Out of gamut
0(-51.4mV)
8(625)
4(525)
12(625)
16(525)
10(625)
5(525)
Digital line blanking
Digital active line
EAV
SAV
DIGITAL DATA
EAV
0
2
142
144
625 Line pixel counts
864
0
2
136
138
525 Line pixel counts
858

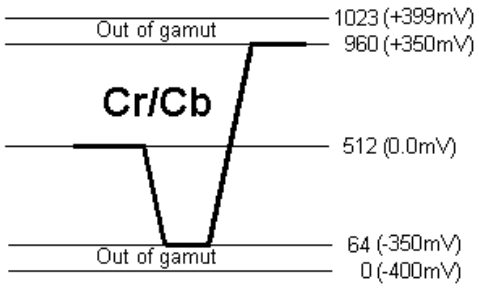

Out of gamut
1023 (+399mV)
960 (+350mV)
Cr/Cb
512 (0.0mV)
64 (-350mV)
Out of gamut
0 (-400mV)

Fig 14

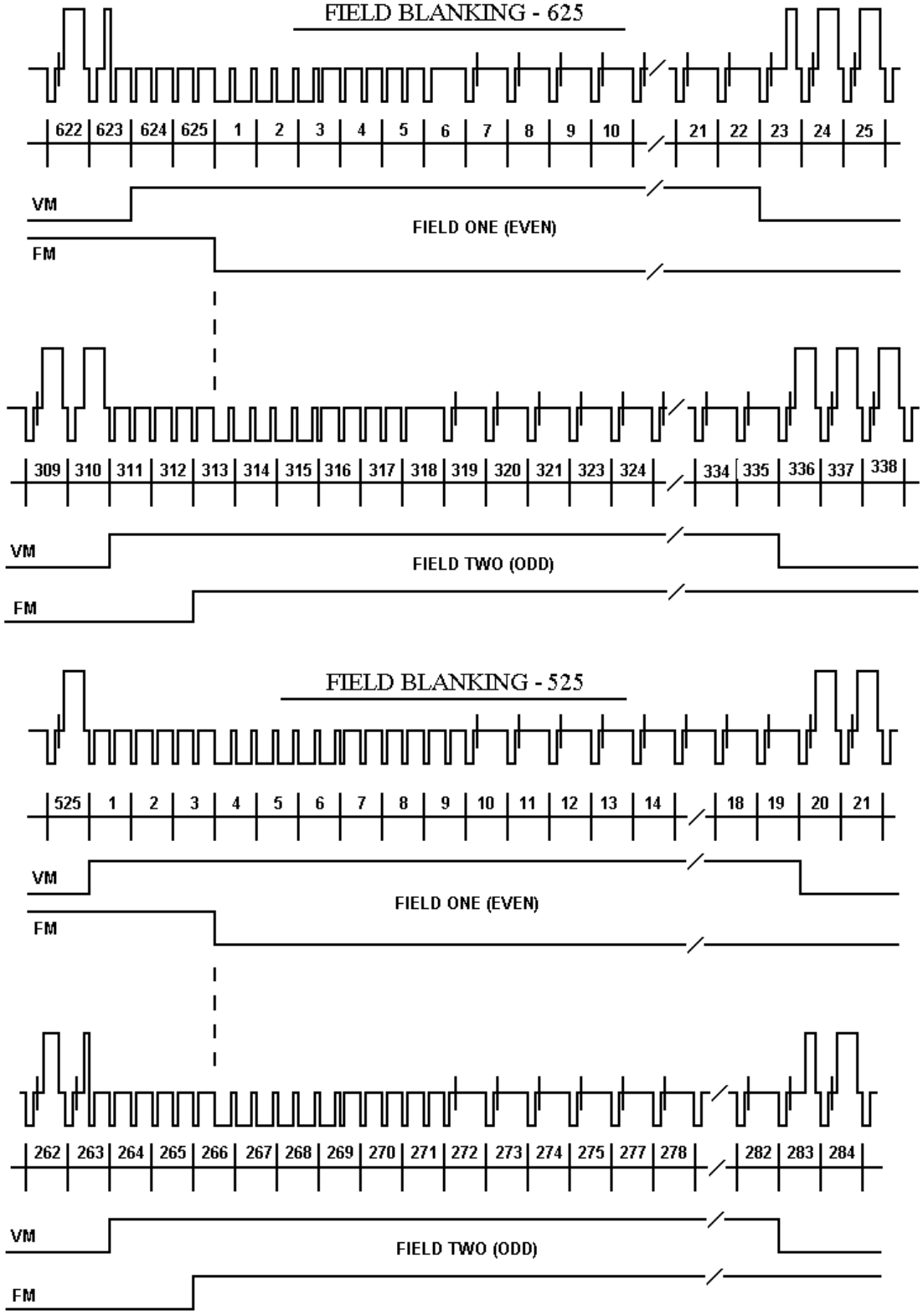

FIELD BLANKING - 625
622 623 624 625 1 2 3 4 5 6 7 8 9 10 21 22 23 24 25
VM
FIELD ONE (EVEN)
FM
309 310 311 312 313 314 315 316 317 318 319 320 321 323 324 334 335 336 337 338
VM
FIELD TWO (ODD)
FM
FIELD BLANKING - 525
525 1 2 3 4 5 6 7 8 9 10 11 12 13 14 18 19 20 21
VM
FIELD ONE (EVEN)
FM
262 263 264 265 266 267 268 269 270 271 272 273 274 275 277 278 282 283 284
VM
FIELD TWO (ODD)
FM

Fig 15/16

HD SERIAL DIGITAL BASICS

BIT SERIAL DIGITAL INTERFACE DEFINED BY SMPTE 292M.

HDTV digital component video is produced by applying a 4:2:2 sampling structure to the analog signal. The luminance component (Y) is sampled at 74.25 MHz, the colour difference components U & V) are both sampled at 37.125 MHz.

The Y stream is quantised to 10 bits resolution and Timing Reference Signals (TRS) are added at the beginning and end of the horizontal video blanking period.

The U & V streams are also quantised to 10 bits and then interleaved to give a C stream at 74.25 MHz. TRS are added at the beginning and end of the horizontal video blanking period.

The 74.25MHz Y and C streams are then interleaved to produce a single stream at 148.5MHz. This data is then scrambled and serialised using a None Return to Zero (NRZ) code to produce a 1.485 GHz signal.

The TRS at the end of the horizontal blanking period is called Start of Active Video (SAV) it consists of 4 words:

1) 3FF hex ie all '1;s
2) 000 hex ie all '0's
3) 000 hex ie all '0's
4) XYZ, which determines the type of TRS pulse, consisting of:

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

The TRS at the beginning of the horizontal blanking period is called End of Active Video (EAV) it consists of 8 words: The first 4 are the same as for SAV, followed by 2 words containing the current line number and 2 words containing a Cyclic Redundancy Check (CRC) for all the preceding words in the line. The period between EAV and SAV is not used by normal video and may be used for embedded audio or timecode data.

ILLEGAL VALUES

The values 000 and 3FF hex are used solely by TRS pulses (EAV & SAV) they must not appear anywhere in the active video area.

SAMPLE STRUCTURE

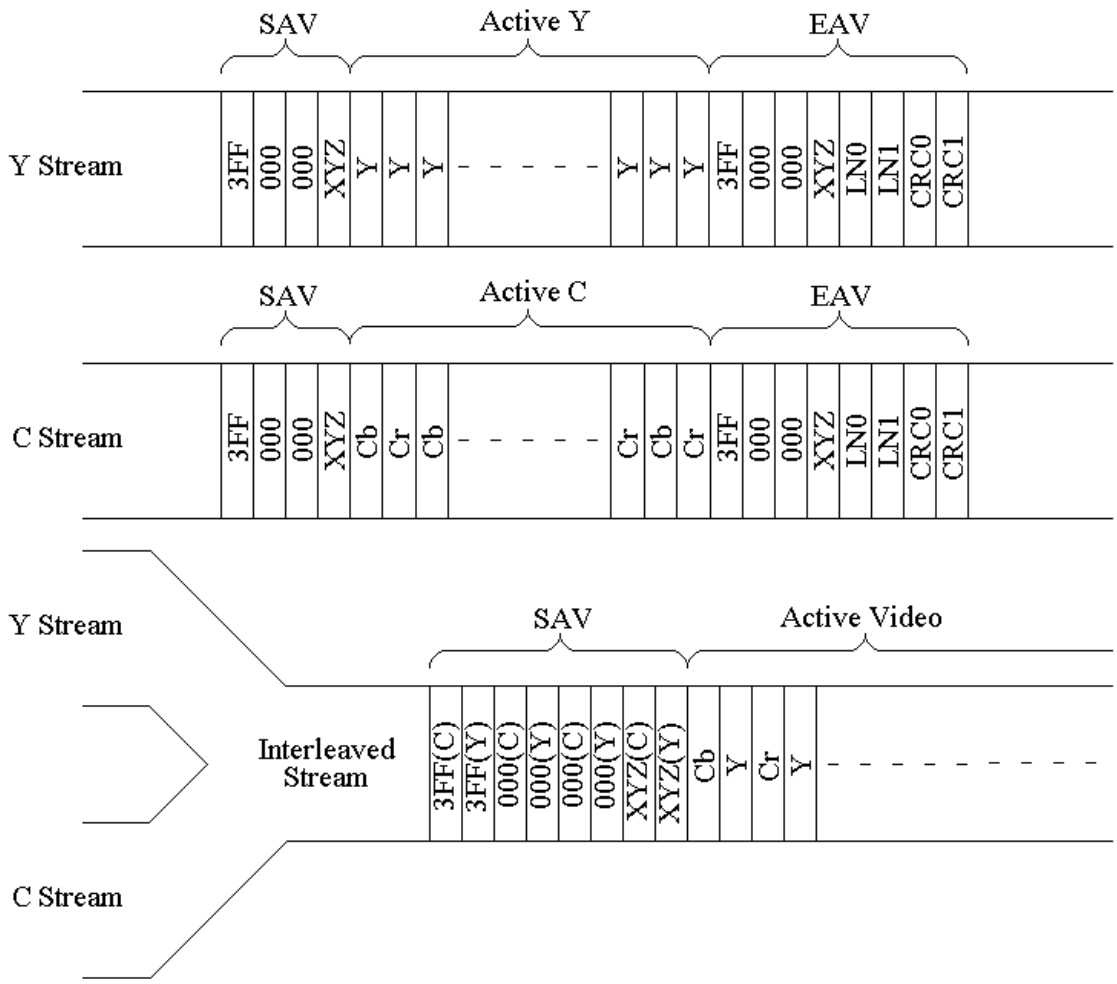


Fig 17

PARALLEL DIGITAL INTERFACES

Several parallel video Standards can be used with the above serial interface. These are defined in SMPTE 274M for 1920 x 1080 scanning and SMPTE 296M for 1280 x 720 scanning.

SMPTE 274M
Several sub-standards for this are defined:

1920 x 1080/60/2:1
1920 samples/active line 1080 active line/frame 30PsF segmented format.
74.25 MHz Sample frequency 2200 total samples/line 1125 total lines/frame

1920 x 1080/59.94/2:1
1920 samples/active line 1080 active line/frame 29.97PsF segmented format.
74.176 MHz Sample frequency 2200 total samples/line 1125 total lines/frame
This standard gives an exact frame rate compatibility with NTSC.

1920 x 1080/50/2:1
1920 samples/active line 1080 active line/frame 25PsF segmented format.
74.25 MHz Sample frequency 2640 total samples/line 1125 total lines/frame

1920 x 1080/30/1:1
1920 samples/active line 1080 active line/frame 30 Hz Progressive scan.
74.25 MHz Sample frequency 2200 total samples/line 1125 total lines/frame

1920 x 1080/29.97/1:1
1920 samples/active line 1080 active line/frame 29.97 Hz Progressive scan.
74.176 MHz Sample frequency 2200 total samples/line 1125 total lines/frame
This standard gives an exact frame rate compatibility with NTSC.

1920 x 1080/25/1:1
1920 samples/active line 1080 active line/frame 25 Hz Progressive scan.
74.25 MHz Sample frequency 2640 total samples/line 1125 total lines/frame

1920 x 1080/24/1:1
1920 samples/active line 1080 active line/frame 24 Hz Progressive scan.
74.25 MHz Sample frequency 2750 total samples/line 1125 total lines/frame

1920 x 1080/24sf
1920 samples/active line 1080 activelines/frame 24 Hz segmented frame
74.25 MHz sample frequency 2750 total samples/line 1125 total lines/frame

1920 x 1080/23.98/1:1
1920 samples/active line 1080 active line/frame 23.98 Hz Progressive scan.
74.176 MHz Sample frequency 2750 total samples/line 1125 total lines/frame

HD SERIAL DIGITAL BASICS

SMPTE 296M
Several substandards for this are defined:

1280 x 720/60/1:1
1280 samples/active line 720 active line/frame 60 Hz Progressive scan.
74.25 MHz Sample frequency 1650 total samples/line 750 total lines/frame

1280 x 720/59.94/1:1
1280 samples/active line 720 active line/frame 59.94 Hz Progressive scan.
74.176 MHz Sample frequency 1650 total samples/line 750 total lines/frame

1280 x 720/50/1:1
1280 samples/active line 720 active line/frame 50 Hz Progressive scan.
74.25 MHz Sample frequency 1980 total samples/line 750 total lines/frame

EMBEDDED AUDIO

The period between EAV and SAV can be used to send embedded digital audio signals. This is defined in SMPTE 299M. 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 quantised in the sending equipment to 24 bits of resolution, usually at 48 KHz sample rate in AES/EBU format. The digitised data is arranged in packets which are placed in the EAV-SAV space.

A packet consists of:

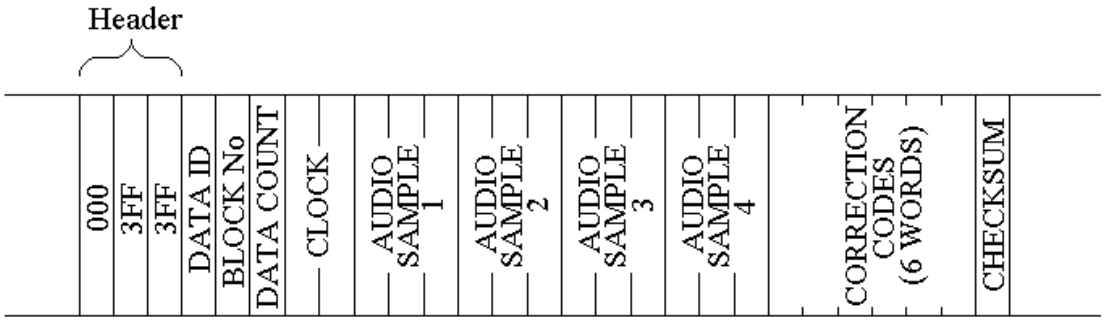


Fig 18

HD SERIAL DIGITAL BASICS

The Header: (000, 3FF, 3FF)

Data ID: This contains the Audio group number.

Data block number: AES frames have 192 samples of audio data

Data Count: This contains the number of words that follow, always 218 hex

Clock: 2 words containing the number of video clocks that have elapsed between the first word of EAV and the time the audio sample was made, it is used by the receiving equipment to reconstruct the audio signal with the correct phase delay.

Audio Sample 1: Consists of four words

Audio Sample 2: Consists of four words

Audio Sample 3: Consists of four words

Audio Sample 4: Consists of four words

Error Correction Codes
Consist of six words used by the receiving equipment to detect or correct errors in the 24 words from the header to the last word of audio sample 4 inclusive.

Check Sum This is the sum of all previous words in the packet except the header words.
Each audio packet contains a sample of all four audio signals
eg: Channel 1 left, Channel 1 right, Channel 2 left and Channel 2 right.
Each audio signal requires 3 words to hold all 24 bits, thus each audio packet has 12 words of audio data.
Typically one or two packets are sent in each EAV-SAV period.
These audio data packets are placed in the Chroma data stream only.

Audio Control Packets.
The audio control packet structure is similar to the audio data packet.
Data in the packet includes the audio sample rate eg 48 KHz,
the number of active channels out of the possible 4,
the delay information between Channel 1 audio and Channel 2
and delay information between Channel 3 audio and Channel 4.
Audio control packets are placed in the Luminance Stream, this is sent once per frame in the second line after the switching point.

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

COMPOSITE 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, **R**ed, **G**reen and **B**lue. 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 x Red) + (0.59 x Green) + (0.11 x Blue) approximately.
This signal has black level at 0mV and maximum white level at + 700mV.

The colour components are two colour difference signals:

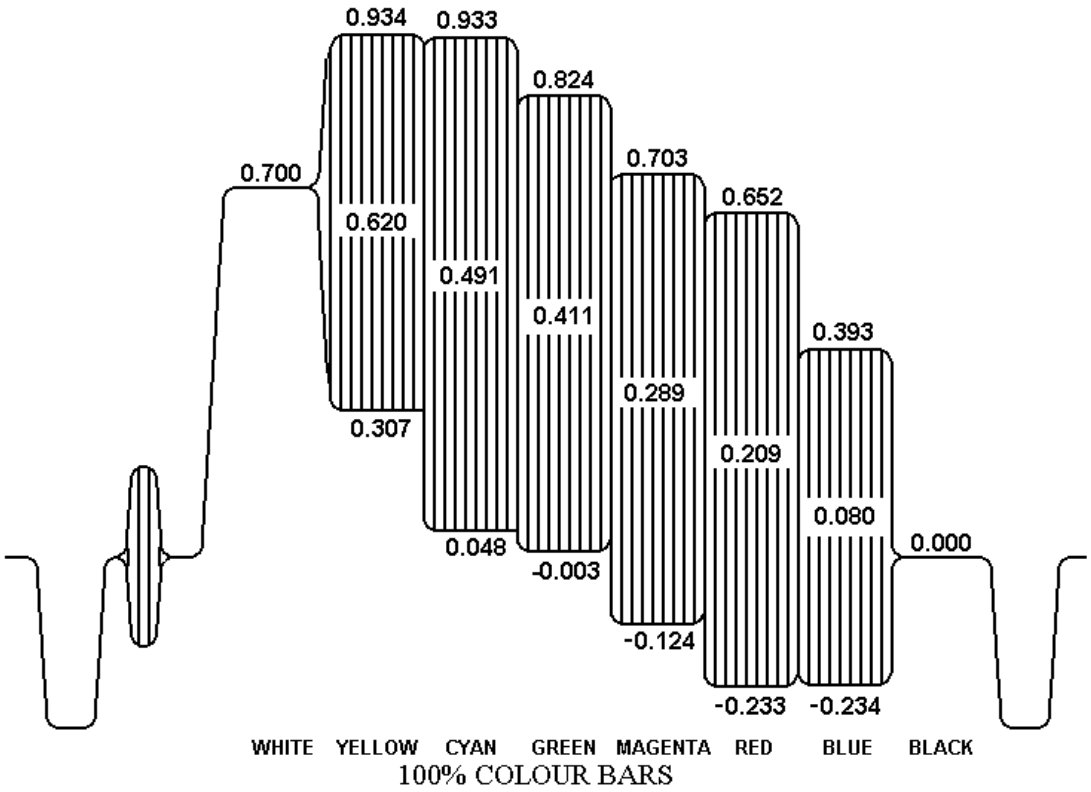
Cr = (R-Y) and Cb = (B-Y)
These are weighted to give maximum values of +/- 350mV and are bandwidth restricted to half that of the Y component.

PAL

Fig 18 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 (**P**hase **A**lternate **L**ine). 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 19 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.



100% COLOUR BARS

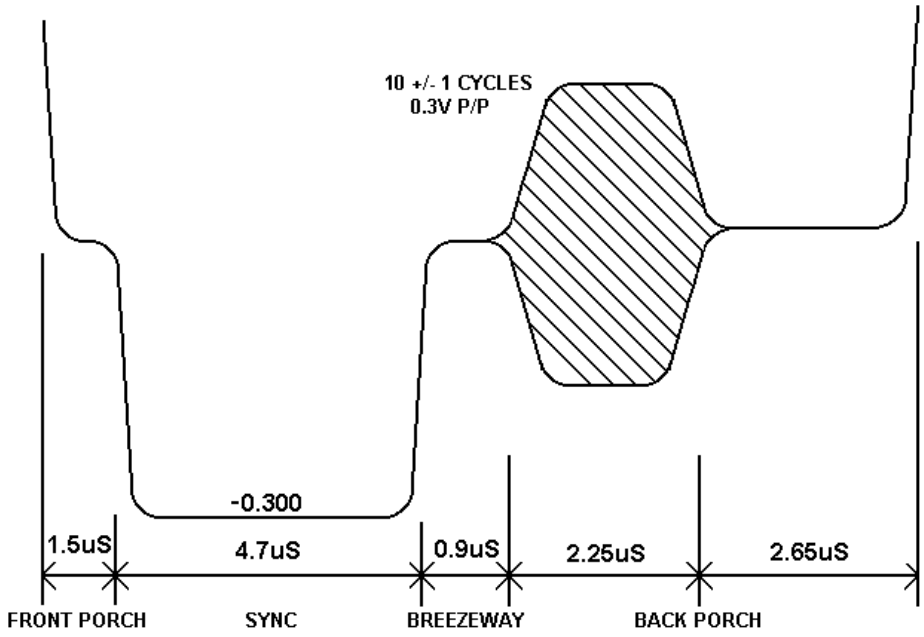
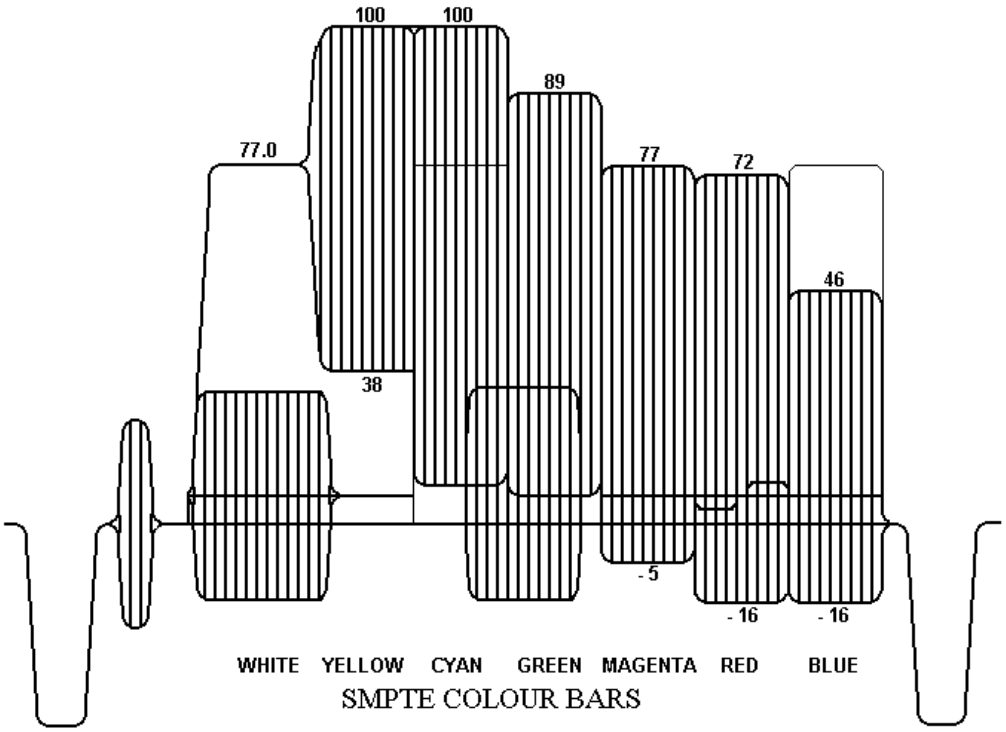


Fig 19



SMPTE COLOUR BARS

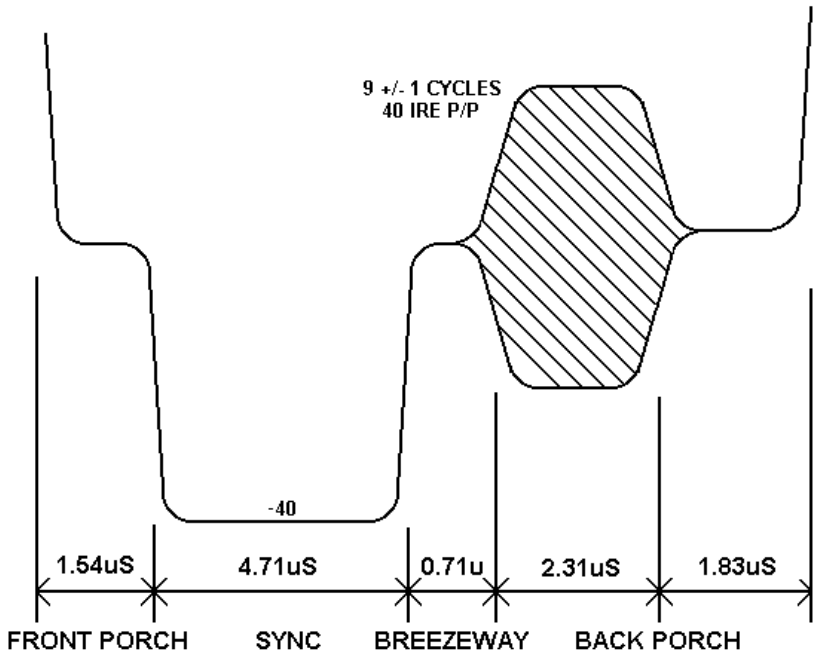


Fig 20

USEFUL WEBSITES

MS9000	www.monitorscope.tv	
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 Hamlet MS9000, please contact:

Corporate Head Office
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: service@hamlet.co.uk Web site: www.hamlet.co.uk

Hamlet USA
Sencore, Inc.
3200 W Sencore Drive, Sioux Falls SD 57107, U.S.A.
Phone: (605) 339-0100
Fax: (605) 339-7032
Toll Free: 1-800-SENCORE (736-2673)
Toll Free: 1-866-4-HAMLET (426-538)
Email: service@sencore.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.

INTERNAL BATTERY FITTED

The Batteries and Accumulators (Placing on the Market) Regulations 2008 implement in the UK the Internal Market provisions of the European Parliament and Council Directive on Batteries and Accumulators and Waste Batteries and Accumulators 2006/66/EC.

In accordance with Regulation 7 of these regulations, information is provided on the battery specification and on its ready removal.

ACCESS
To access the battery, undo the four posidriv screws on the rear of the case and slide off the case rear box section. The battery is then immediately accessible and can be removed from the battery socket by hand, without any tools.

The battery type is CR2032 Lithium coin cell.