PROFIX
MDD 3000
Multi-Standard
Digital Decoder

Operator's Manual

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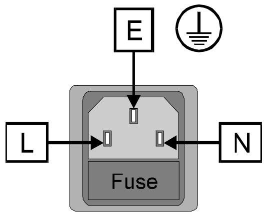
Safety Warnings

Always ensure that the unit is properly earthed and power connections correctly made.

This equipment shall be supplied from a power system providing a **PROTECTIVE EARTH** connection and having a neutral connection which can be reliably identified.

The power terminals of the IEC mains input connector on the rear panel are identified as shown below:



E = Protective Earth Conductor

N = Neutral Conductor

L = Live Conductor

Power cable supplied for countries other than the USA

The equipment is normally shipped with a power cable with a standard IEC moulded free socket on one end and a standard IEC moulded plug on the other. If you are required to remove the moulded mains supply plug, dispose of the plug immediately in a safe manner. The colour code for the lead is as follows:

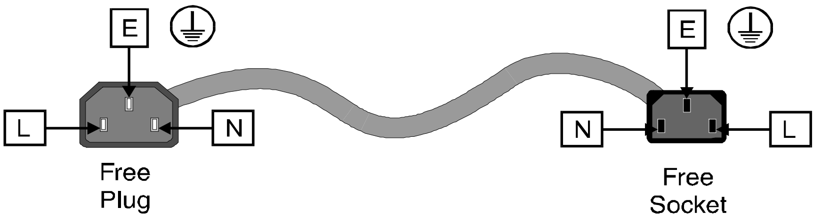
GREEN/YELLOW lead connected to E (Protective Earth Conductor)
BLUE lead connected to N (Neutral Conductor)
BROWN lead connected to L (Live Conductor)

Power cable supplied for the USA

The equipment is shipped with a power cord with a standard IEC moulded free socket on one end and a standard 3-pin plug on the other. If you are required to remove the moulded mains supply plug, dispose of the plug immediately in a safe manner. The colour code for the lead is as follows:

GREEN lead connected to E (Protective Earth Conductor)
WHITE lead connected to N (Neutral Conductor)
BLACK lead connected to L (Live Conductor)

The terminals of the IEC mains supply lead are identified as shown opposite:



Note that for equipment that is not fitted with a mains power switch, to comply with BS60950 Clauses 1.7.2 and 2.6.9, the power outlet supplying power to the unit should be close to the unit and easily accessible.

⚠ Warnings ⚠

Voltages within this unit can be lethal under certain circumstances. Where power is required to be connected to the unit during servicing great care must be taken to avoid contact with these voltages.

Maintenance should only be carried out by suitably qualified personnel.

EMC Standards

This unit conforms to the following standards:

Electromagnetic Compatibility-Generic Immunity Standard BS EN 50082-1:1992

The European Standard EN 50082-1:1992 has the status of a British Standard and is related to European Council Directive 89/336/EEC dated 3rd May 1989.

Electromagnetic Compatibility-Generic Emission Standard BS EN 50081-1:1992

The European Standard EN 50081-1:1992 has the status of a British Standard and is related to European Council Directive 89/336/EEC dated 3rd May 1989.

Safety Standards

This unit conforms to EN60065:1992 as ammended by ammendment A1(May 1993) and ammendment A2(March 1994). Specification for safety of technology equipment, including electrical business equipment.

EMC Performance of Cables and Connectors

Snell & Wilcox products are designed to meet or exceed the requirements of the appropriate European EMC standards. In order to achieve this performance in real installations it is essential to use cables and connectors with good EMC characteristics.

All signal connections (including remote control connections) shall be made with screened cables terminated in connectors having a metal shell. The cable screen shall have a large-area contact with the metal shell.

COAXIAL CABLES

Coaxial cables connections (particularly serial digital video connections) shall be made with high-quality double-screened coaxial cables such as Belden 8281 or BBC type PSF1/2M.

D-TYPE CONNECTORS

D-type connectors shall have metal shells making good RF contact with the cable screen. Connectors having "dimples" which improve the contact between the plug and socket shells, are recommended.

Packing List

The unit is supplied in a dedicated packing carton provided by the manufacturer and should not be accepted if delivered in inferior or unauthorised materials. Carefully unpack the carton and check for any shipping damage or shortages.

Any shortages or damage should be reported to the supplier immediately.

Enclosures:

- PROFIX MDD 3000
- Power cable
- Operator's Handbook

Table of Contents

SECTION

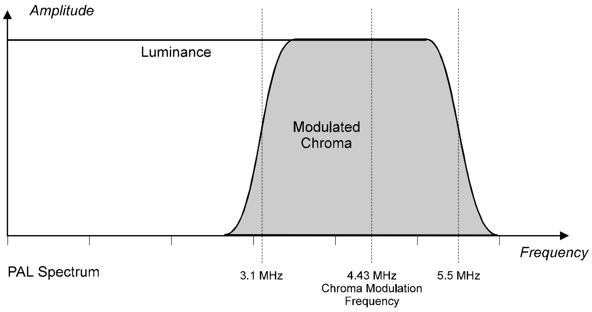
Manual Revision Record

Date	Version No.	Issue No.	Change	Comments
250797	1	1		First Issue

Description

The MDD3000 is a Multi-Standard broadcast quality digital decoder and noise reducer. Incorporating an adaptive field based digital comb filter, the MDD is capable of generating very high quality digital component output from an analogue composite source. The module utilises techniques derived from work pioneered by the BBC Research department, and ensures exceptional stability, excellent subcarrier rejection and repeatable results.

Decoding of a composite signal is carried out by separating the luminance and chrominance signals and then decoding the chrominance. The problem is that the signal actually consists of a 5MHz luminance signal with a modulated chrominance signal of 2MHz bandwidth superimposed at 4.43MHz. A simple decoder just filters the chrominance away from the luminance but this leaves remnants of the chrominance on the luminance and vice versa.



The relationship between the subcarrier and the line frequency reveals another approach to separating these two signals. The composite video signal which has horizontal, vertical and temporal components produces a complex energy spectrum of interleaving luminance and chrominance sidebands. In the luminance the peaks appear at multiples of the line frequency, and the chrominance peaks interleave with these due to the PAL quarter line offset in the subcarrier frequency with respect to the line frequency.

Thus it is possible to separate chrominance from luminance with a filter that has nulls at frequencies close to the multiple of the line frequency. This technique is called COMB FILTERING.

By careful product design it is possible to arrange for the filter to operate over several lines in a number of fields. This produces excellent results on static images and only slight degradation on a moving image.

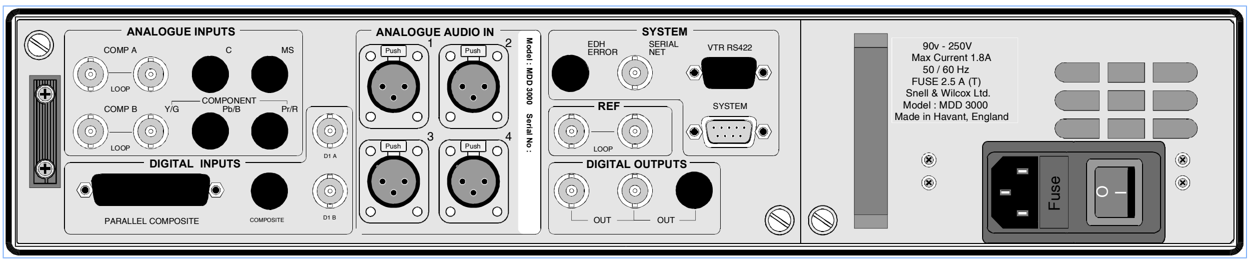
One of two analogue composite video signals can be selected for decoding to 10 bit digital 4:2:2 CCIR 656 format. In order to extract the best performance the relevant mathematical relationship between the colour sub-carrier frequency and the horizontal line frequency should be maintained.
The MDD3000 includes a sophisticated frame synchroniser. The synchroniser operates in the digital component domain and is capable of genlocking to either an analogue studio 'black-and-burst' reference or the currently-selected input.
Noise reduction techniques are applied, in 4:2:2 domain to minimise any undesirable artefacts. The noise-reduction process has a number of distinct filters. Each filter is 'tuned' to remove a specific type of noise.
The filters available consist of a median filter designed to remove impulse or 'salt and pepper' noise. This filter can be changed to suit the type of video material as well as the user's noise reduction requirements. Alternatively the user may set the type of filtering required and delegate the noise reduction level to an automatic mode which can adaptively change the noise reduction threshold at a pixel-by-pixel level.
A recursive noise filter is used to remove electronically generated or random noise. The filter has been designed using state-of-art algorithms to provide up to 12 dB noise reduction. Automatic threshold control is achieved by measurement of the noise floor level. A manual bias adjustment allows the user to have fine control over the automatic threshold level for applications which require precise control over the noise reduction level.
For picture sources which have been band limited the MDD3000 contains a sophisticated detail Enhancer. The enhancer works to 'sharpen' detail in the picture without causing ringing. The level of enhancement can be subjectively selected by the user to suit the bandwidth of the material.

Once the video has been noise reduced it is passed to the last processing stage which inserts up to 4 channels of digitised audio into the CCIR 656 data stream. The audio insertion process is synchroniser delay aware, such that the resulting audio-visual CCIR 656 data stream is correctly co-timed.

Behind the hinged front panel is a status display and menu control system. The system's functionality can be controlled from the 4-button and display system present on the upper-most card in the system. Alternatively the units can be controlled from a RollCall compliant active front-panel system. The processor cards are housed in a 2U 19 inch rack which also contains the switched mode power supply, axial cooling fan and connectors.

Features

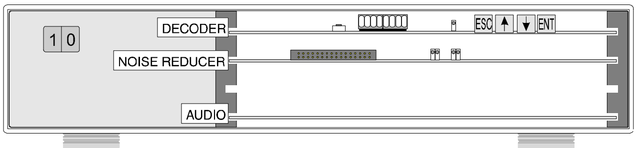
- 10-bit processing throughout the system.
- Adaptive Field Comb Filtering.
- Full frame synchroniser with H&V offset control. The synchroniser is capable of locking to either the analogue studio reference signal or the currently-selected input (digital or analogue).
- Variable aperture 9-point median filter with a pixel-by-pixel automatic threshold calculation mode. This filter is best suited to the removal of impulse or 'salt and pepper' noise.
- Automatic aperture selection effectively configures each filter optimally for film\video inputs.
- Recursive filter with unique filter biasing and motion adaption algorithms, producing high-levels of noise reduction while substantially suppressing motion artefacts, normally associated with recursive filtering.
- Sophisticated spatial detail enhancer.
- Audio processing and embedding by conditioning and conversion of analogue audio channels into Digital format. The digital audio is inserted into the CCIR 656 stream in channel positions 1, 2, 3 and 4 respectively, depending on the AES group selected. The digital audio insertion process is synchroniser-aware and is tied to the audio delay flag.
- EDH extraction on serial digital input.
- Full remote control facility using Snell & Wilcox proprietary serial BNC system 'RollCall'
- Internal test pattern generation.



Installation

The MDD3000 is supplied in a dedicated carton provided by the manufacturer and should not be accepted if delivered in inferior or unauthorised material. Carefully unpack the unit and check for any shipping damage or shortages. If you encounter any problems please report them to the supplier immediately.

IMPORTANT NOTE : In case of complaint the packing material should be retained for inspection by the carrier.



The unit is designed for mounting in a 2U high slot in a 19" racking system.

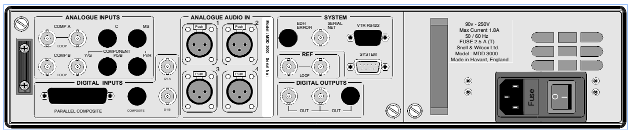
The chassis is equipped with a pair of mounting ears attached to the side plates. Suitable screws should be inserted through the holes in these flanges to secure the chassis to the racking system. Ensure that the rack is correctly configured to accept the 2U unit with chassis runners positioned to support the unit.

Under no circumstances should the unit be hung from its rack ears alone as this will result in irreparable damage to the case.

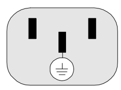
Whilst mounting the unit please try to ensure that there is adequate air flow to the rear of the unit.
If an MDD3000 is to be mounted in a rack together with convection cooled equipment, e.g. Analogue distribution amplifiers ensure that it is not located above or interspersed with these units. The equipment should be operated in an environment having a temperature between 0^{o}C and +40^{o}C and a relative humidity of less than non-condensing.

The front panel is opened by pulling the two catches forwards. We have found that the easiest way of doing this is with your thumbs ! The internal hinge mechanism has been designed so that the panel can hinge forwards and to the left to leave unrestricted access to the boards.

Electrical Connection



The power supply accepts AC mains in the range 90 to 250 Volts AC @ 50Hz to 60Hz and will auto switch to these standards. The main power connection, located at the rear of the unit, is made via a fused IEC320 inlet socket (fuse 2.5 AT, Max Current 1.8A) with the middle pin as earth conductor. This electrical connection should be located as close to the unit as possible to facilitate easy isolation.



Earth Connection

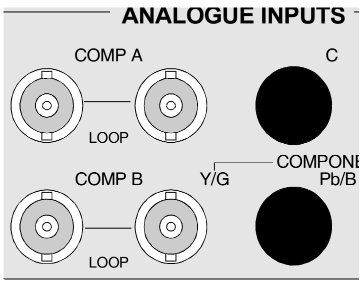
Power Switch

The unit has two ON / OFF switches. One is located behind the front panel, the other on the rear of the unit. Both need to be in the ON position for the unit to function.

Signal Connections

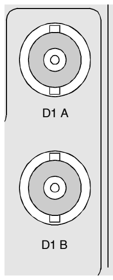
All external signal connections are made to the rear panel.

Composite Analogue Inputs



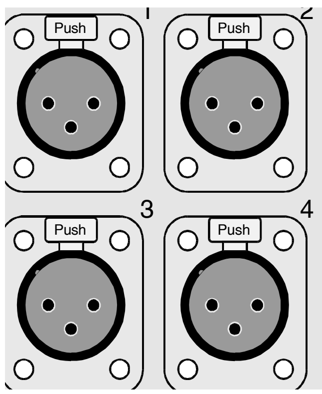
The rear panel supports these inputs which are labelled as COMP A and COMP B with loop through indication. Nominal input level for analogue video is 1V peak to peak and a 75-ohm termination must be fitted if the loop through facility is not used.

Digital Inputs



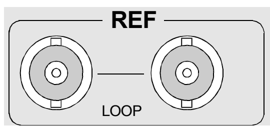
The BNC connectors labelled D1 A and D1 B accept serial digital component signals via BNC connectors.

Analogue Audio Inputs



These inputs require locking XLR connectors. To remove the connector the release tab must be pushed in.

Reference Input

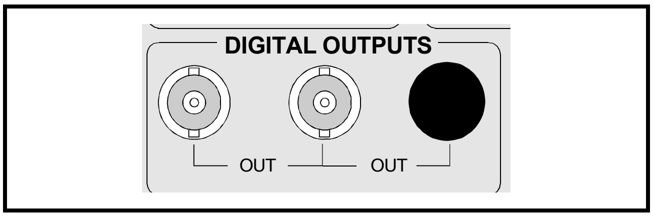


The reference accepts analogue video with a nominal input level of 1V peak to peak. A 75-ohm termination must be fitted if the loop through facility is not used.

Digital Outputs

These are the serial digital outputs from the unit via BNC connectors. They are component digital outputs, both of which can be used simultaneously.

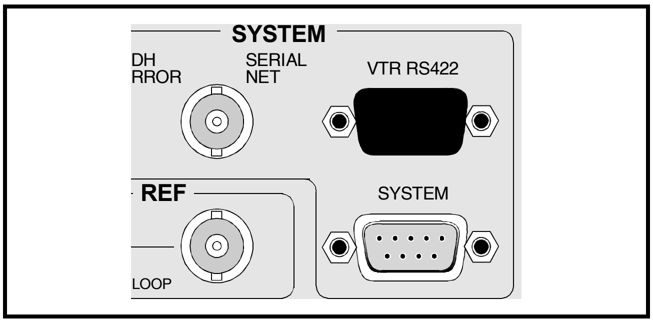
Note
To aid compliance with EMC/RFI regulations, we recommend the use of high quality co-axial cable type BBCPSF1/2 or equivalent.



Remote Control

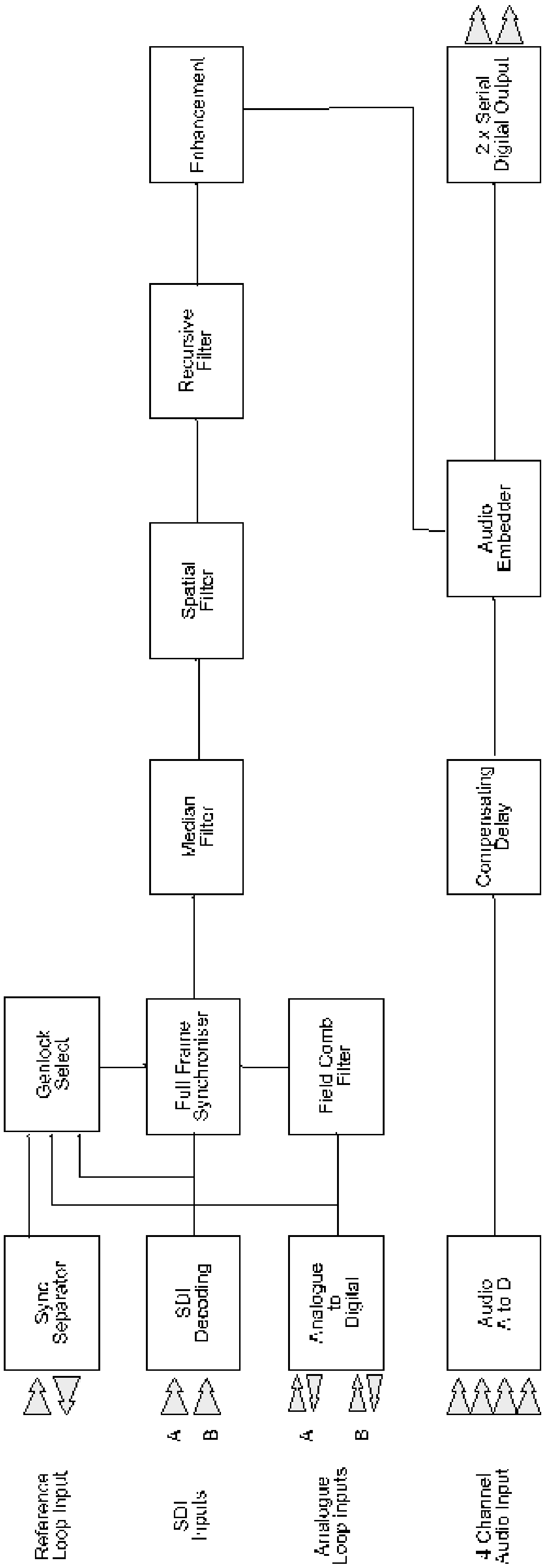
Interface to the "RollCall" communications network is via the single REMOTE BNC connector labelled Serial Net. Connections should be made by means of a `T' piece (Zo=75 Ohms) to a 75 Ohm cable system with both extremities terminated in 75 Ohms.

Under no circumstances should the "RollCall" network be directly connected to any other communications network such as a computer "Ethernet" system.



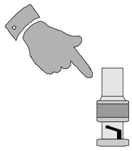
Block Diagram

Simple Block Diagram



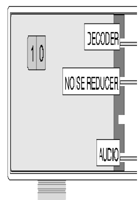
Getting Started

Connect up the unit so that there is a Analogue Composite video signal applied to input A. REMEMBER to fit a termination if the video loop through is not used. Either one of the 2 serial outputs can be used from the same channel. A reference signal may be connected if required.

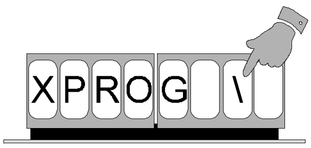


The front panel is opened by using the two black catches at either end of the panel. We have found the best way of opening the panel is to use your thumbs to release the catches and then ease the panel sufficiently forward to take hold of it. Carefully hinge the assembly forward.

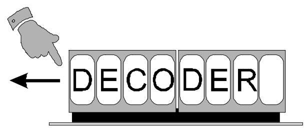
Turn the unit on. It should be audible that the fan has started. If the unit does not power up check the switch on the rear panel.



The display will indicate that the Xilinx devices are being configured. The bar at the end of the message will rotate during this process.



A scrolling message will then display the units name and the configuration status.

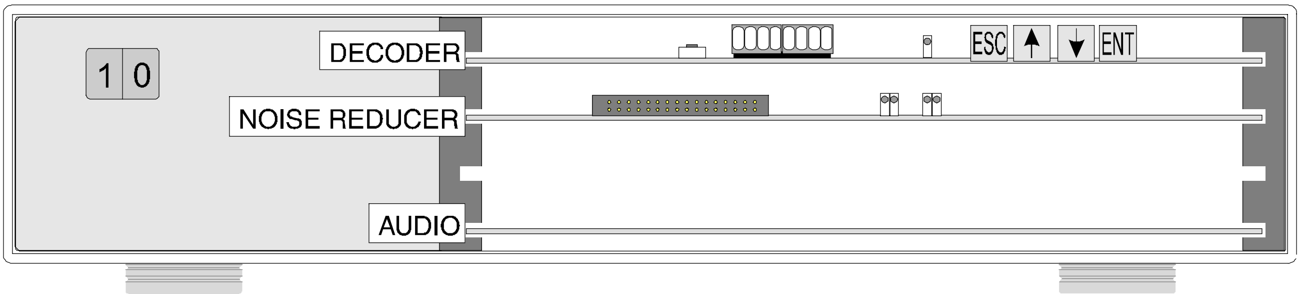


The initialisation sequence is now complete and the output should be the decoded input.

Factory Configuration

Auto standards mode
Adaptive Comb Mode
Composite Input A
All VITS lines enabled
Unit Address 2OH

Card Edge Functions



Decoder Card

The upper card is the decoder. The LED will illuminate if there is a loss of syncs on the analogue input

Noise Reducer

The right hand pair of LED's indicate the condition of CPU A. The GREEN LED flashes when the CPU is in normal operation. The RED LED will illuminate if an internal error occurs.

Similarly the left hand pair of LED's indicate the condition of CPU B.

If for any reason the menu system should hang the CPU can be restarted with the CPU RESET switch.

Audio

There are no indicators or switches on this card.

Decoder Operation

There are two modes of YC separation using different combing architectures. Each mode has been optimised for different applications.

Adaptive mode (Default)

This mode uses a field comb to separate Y & C. Traditional comb failure artefacts are suppressed by a tailored algorithm. This mode should be used if failure artefacts become obtrusive or if minimum chroma smear on shot changes is required.

Normal mode

This mode uses a non-adaptive field comb to separate the Y & C. This mode gives the best possible YC separation giving a high Luminance bandwidth and significantly reduced cross colour. However, some comb failure artefacts will be noticed on saturated vertical transitions.

Colour Filter

Another important option in the menu system is the COLOUR FILTER. By altering the response of the chrominance filter, prior to remodulation and subtraction from the composite input, the effective area of the spectrum that is combed can be controlled.

On static scenes luminance and chrominance will be separated by the comb structure. However, with movement the comb will fail and the luminance resolution will be degraded. Therefore a wider chroma bandwidth will produce slightly lower luminance resolution with moving scenes. In general the filter choice will depend upon the type of material that is being decoded.

This is shown in the table below.

Filter	***Movement***
WIDE	Little
MEDIUM	Medium (default)
NARROW	Fast moving

There are 2 further modes of operation for the decoder set in the Dec Mode menu option.

Decode (Default)

This mode decodes the video using the selected comb mode.

Comp

In this mode the video is *not* decoded and the output is digitised composite. This mode is particularly useful for preserving the quality of monochrome inputs.

Adaptive Vertical Filter

An adaptive vertical filter has been included which cancels out small chroma phase errors thus suppressing Hannover bars.

The filter also offers a further reduction in cross colour and reduced chroma smearing on vertical transitions. The adaption algorithm can be switched on or off from the "VERT ADP" option in the menu.

The operation will generally depend upon the type of material being decoded. Some guidelines as to which settings should be used are given below,

On

Filter will adapt to vertical transitions. This is optimised for the sharpest pictures.
This has the maximum vertical resolution & Hannover bar suppression

Off

Picture content has a lot of high frequency diagonal luminance
e.g. Small graphics, captions, scrolling titles, chequered patterning etc.

Noise Reducer Operation

Recursive Filter

Recursive filters reduce noise by temporally averaging successive pictures. Utilising delays of exactly one picture or frame, noise can be reduced in stationary areas without loss of spatial (horizontal and vertical) resolution. Although temporal recursive filters offer considerable levels of noise reduction, sophisticated control logic is required to ensure that picture detail is preserved at higher noise settings.

In particular, analysis of the noise floor level is necessary to set movement thresholds at levels which are just above the noise floor. At optimum settings this allows maximum noise reduction and simultaneously maximum sensitivity to movement.

Auto Threshold Bias

In auto threshold mode the noise detection algorithm may be given a subjective bias to give more or less noise reduction. Modification of the bias should not be necessary under normal circumstances.

Y And C Recursive levels

These settings change the amount of noise reduction for luminance (Y) and chrominance (C) by limiting the maximum level of noise reduction. The actual level of noise setting is dynamically adjusted on a pixel-by-pixel basis with regard to the noise setting for the same pixel in the previous frame. Other factors such as movement contribute to the current pixel setting. This mechanism ensures that the optimum level of noise reduction is applied to each pixel.

Threshold

This sets the threshold for the motion detector. The lowest level of 0 gives the greatest sensitivity to motion, but allows more noise to break through, while 15 gives the greatest noise reduction but can lead to excessive filtering of low-level textures. When this is set to auto the threshold is dynamically set to an appropriate value for the current input noise level.

Median Filter

Median filters can be effective at removing impulse noise. They operate by rank filtering pixels from an odd number of aperture points yielding the median value. The aperture set may utilise the surrounding pixels from the same field or more usually some combination of pixels from current and adjacent fields or frames.

When a pixel is judged to be in error it is replaced by the median value of the aperture set. Pixels judged not to be in error remain unaltered. The algorithm is therefore quite specific about the areas of the picture which are filtered.

An algorithm utilises both spatial and temporal gradient information to determine if the suspect pixel has impulse noise characteristics.

Level and Noise Correction

Two settings are provided for the median filter. The low setting provides modest filtering. The high level is biased towards removal of higher levels of noise. The noise correction setting can be used to set the rejection level of false alarms.

Spatial Filter

Spatial filtering typically involves filtering using an aperture which is comprised of adjacent pixels from the same field period. Spatial median filters can be effective at suppressing impulse noise originating from film dust or small drop outs. However they are also effective as Gaussian noise reduction filters.

Y And C Spatial Levels

The spatial filter operates by median filtering a small kernel of adjacent pixels and then comparing the median filtered pixel level with the current pixel. The spatial filter has three level settings which are used to vary the comparison threshold and effectively set the balance between the level of noise suppression and detail preservation. Typically used in conjunction with other temporal based filters such as the recursive filter, spatial noise reduction can increase the overall noise reduction level.

Enhancer

The enhancer uses a combination of linear and non-linear processes to generate edge correction and peaking correction signals. The use of non-linear processing ensures that high levels of correction are possible without introducing edge distortion such as overshoots and ringing normally associated with traditional frequency boosting techniques.

Three settings of enhancement are provided for both luminance and chrominance. Coring controls can be used for noisy inputs to prevent enhancement of low level noise. Three settings are provided for both luminance and chrominance signals.

Synchroniser Operation

Introduction

Incorporated onto the noise reduction card is a full frame synchroniser which allows the selected input to be referenced to a signal of the same line standard.

The menu system allows the synchroniser to be switched such that the genlock mode is on or off.

Genlock Off

When the genlock is forced into the off state the output video will *not be locked* to the input or the reference video signal.

This is sometimes referred to as “free-running”. If the input and output were to be viewed on an oscilloscope the two traces would be seen to be moving one past the other.

Genlock On

This mode forces the output to be locked to another video signal of the same line standard.

Usually Genlock On will force the output to be locked to the signal that is connected to the reference input.

However, if the reference signal is invalid, or of a different line standard than that of the input, the synchroniser will lock the output to the input.

The status display will always indicate the mode of operation for the synchroniser.

Reference Format

The reference signal should be a normal composite video signal of either PAL I or NTSC formats. The burst information has no effect on the operation of the synchroniser.

The nominal input level is 1 volt peak to peak.

If the loop-through facility is not required the signal should be terminated here by using a 75 Ohm BNC terminator.

Summary of Operating Modes

Input	Reference	Genlock Mode	Output (locked to)
PAL	not connected	Off	Free-running
PAL	not connected	On	Input
PAL	PAL	Off	Free-running
PAL	PAL	On	Reference
PAL	NTSC	Off	Free-running
PAL	NTSC	On	Input
NTSC	not connected	Off	Free-running
NTSC	not connected	On	Input
NTSC	PAL	Off	Free-running
NTSC	PAL	On	Input
NTSC	NTSC	Off	Free-running
NTSC	NTSC	On	Reference
625 SDI	not connected	Off	Free-running
625 SDI	not connected	On	Input
625 SDI	PAL	Off	Free-running
625 SDI	PAL	On	Reference
625 SDI	NTSC	Off	Free-running
625 SDI	NTSC	On	Input
525 SDI	not connected	Off	Free-running
525 SDI	not connected	On	Input
525 SDI	PAL	Off	Free-running
525 SDI	PAL	On	Input
525 SDI	NTSC	Off	Free-running
525 SDI	NTSC	On	Reference

Genlock Offsets

Provision has been made to allow the horizontal and vertical timing of the output to be varied in relation to the “referenced” signal, whether it be the input or the reference.

These features are available in the Genlock menu option.

Audio Features

Introduction

The audio processing card of the MDD 3000 accepts 4 differential analogue inputs for digitisation. These are then delayed to co-time them with the video before being embedded into the output data stream.

Input Stage Levels

The analogue input stage (prior to analogue to digital conversion) was designed to have +24dB headroom. This is larger than is usual within the audio industry to accommodate variations between different countries. However, typical audio levels are normally:

+8dBu for broadcast applications
+4dBu for studio applications

Therefore the nominal headroom is specified between +16 dB and +20dB for these input levels.

Gain Range

The on-board analogue gain control has a range between +31.5 dB and -95.5 dB/mute to cater for levels which are different from the nominal level of +4dBu. However, increasing the gain of the analogue multipliers will reduce the overall headroom.

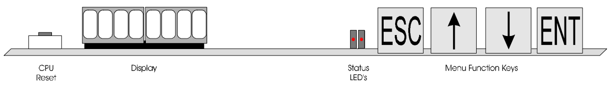
For example if the input level is +4dBu and a gain of +10dB is set on the multiplier then the overall headroom will have dropped to only +10dB.

Test Tones

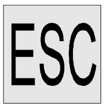
An on-board digital test-tone generator is provided for alignment and is fixed at +4dBu. Note that this tone is applied in the digital domain and therefore can be used to align your monitoring and audio digital to analogue conversion equipment.

Menu System

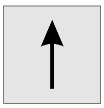
The MDD3000 has an interactive user interface which is accessed by opening the front panel. This interface consists of a high contrast 8 character display and a bank of four push button switches located on the Decoder card.



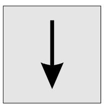
Long messages are scrolled across the display so that more information can be displayed.



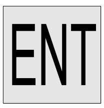
Cancels the current action and reverts to the previous level.



Steps to the next menu level or causes a relevant value to increase.



Steps to the previous menu level or causes a relevant value to decrease.



Branches to a sub-menu or causes a parameter to be accepted with a transition to the previous menu level.

Operation

The decoder configuration can be programmed via the control buttons adjacent to the display. These buttons give access to a number of menus which have been arranged so that progressively selecting the relevant item on any given menu will eventually lead to the parameter requiring modification.

Some of the parameter modifications take effect immediately allowing the change to be previewed before accepting it by pressing the [ENT] button. Pressing the [ESC] Button will cancel the change and move the menu up one level.

Once the decoder has been configured the menu should be returned to the top level by pressing [ESC] [ESC] [ESC]. In this way any status or error messages can be scrolled across the display.

Input =	COMP A / COMP B SDI - A / SDI - B / None
GLK =	Off / Input / Ref / ---

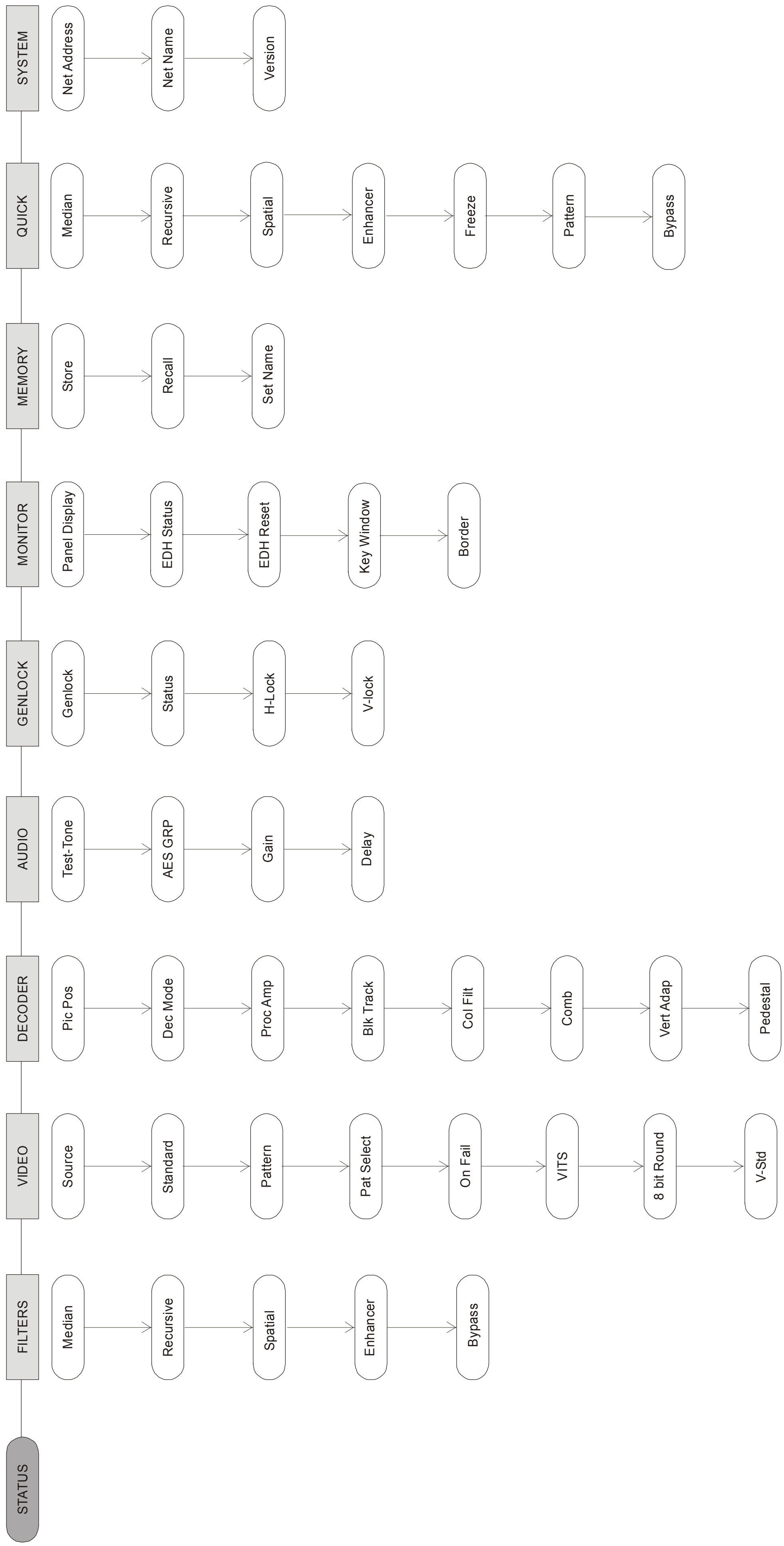
Error Messages

No composite signal.	Missing input or wrong input selected
Wrong Input standard.	Unrecognised input standard or incorrect standard for selected output
Black Level Invalid.	Signal level outside the Automatic Black tracking window - Unable to track.

Default Settings

The menu system is factory configured so that each option has a default setting, which are listed with the description of each menu item. The Factory defaults can be recalled at any time from the FACTORY option in the RECALL menu.

Any change made to the menu set up will be automatically stored in DEFAULTS options after the unit has been left idle for more than 3 minutes. These defaults will then be loaded the next time the unit is powered up. The FACTORY settings can be recalled from the STORE menu at any time.


STATUS
FILTERS
Median
Recursive
Spatial
Enhancer
Bypass
VIDEO
Source
Standard
Pattern
Pat Select
On Fail
VITS
8 bit Round
V-Std
DECODER
Pic Pos
Dec Mode
Proc Amp
Blk Track
Col Filt
Comb
Vert Adap
Pedestal
AUDIO
Test-Tone
AES GRP
Gain
Delay
GENLOCK
Genlock
Status
H-Lock
V-lock
MONITOR
Panel Display
EDH Status
EDH Reset
Key Window
Border
MEMORY
Store
Recall
Set Name
QUICK
Median
Recursive
Spatial
Enhancer
Freeze
Pattern
Bypass
SYSTEM
Net Address
Net Name
Version

Menu Top Level

STATUS	Input = COMP A / COMP B SDI - A / SDI - B / None GLK = Off / Input / Ref / ---
FILTERS	This menu level controls the operation and configuration of the filters.
VIDEO	This menu level controls the main video parameters
DECODER	This menu level controls operation of the decoder card. This menu level is only active for composite video sources
AUDIO	This menu level controls the audio card features.
GENLOCK	This menu level controls the operation and configuration of the synchroniser.
MONITOR	This menu level displays EDH status and controls then split screen mode.
MEMORY	This menu level allows the unit's configuration to be stored and recalled
QUICK	. The quick menu allows fast access to the main features of the MDD 3000.
SYSTEM	This menu level allows adjustment of the remote control facilities

Filters

This menu level controls the operation and configuration of the filters.
For more detailed information about the filters see the operation section and the appendix.

Median

Median	Switches the Median filter On or Off
Level	Level Min/Max
Noise Correction	Level Auto/Min/Max

Recursive

Recursive	Switches the Recursive filter On or Off
Luma	Luma level Auto/Off/Min/Med/Max
Chroma	Chroma level Auto/Off/Min/Med/Max/X-Colour
Threshold	Threshold Auto / 0 - 15
Bias	Bias adjusts auto threshold motion sensitivity. * *Range :* -3 to +3

Spatial

Spatial	Switches the Spatial Filter On or Off
Luminance	Luminance Auto/Off/Min/Med/Max
Chrominance	Chroinance Auto/Off/Mini/Med/Max

Enhancer

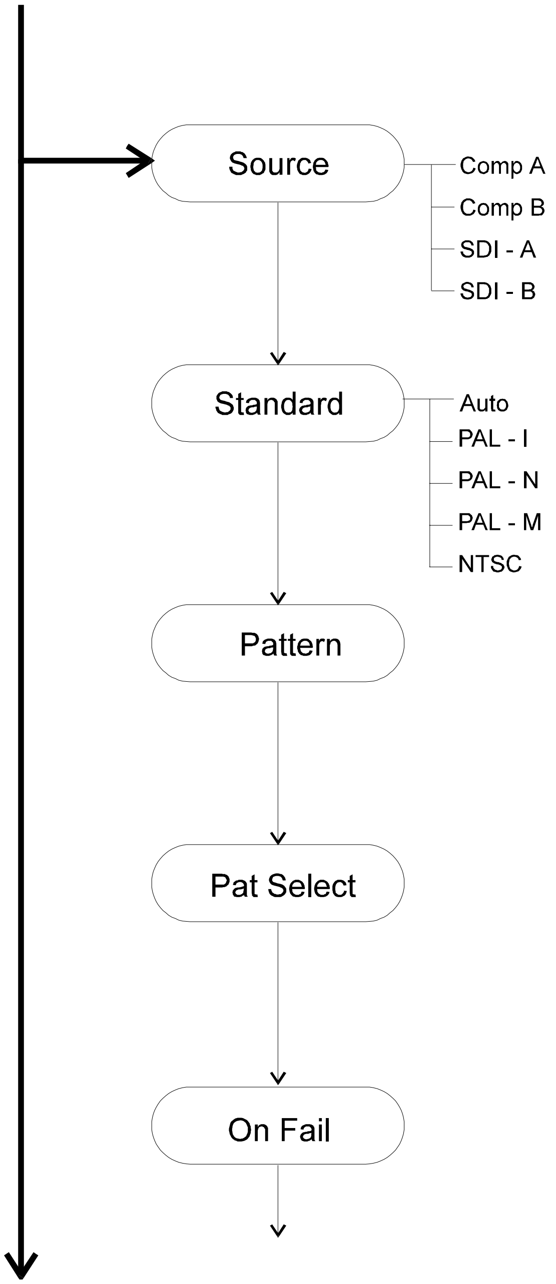
Enhancer	Switches the Enhancer On or Off
Luma	Luma Auto/Off/Min/Med/Max
Chroma	Chroma Auto/Off/Min/Med/Max
Coring	Selectes the Luma or Chroma coring level
– Luma	Luma Off/Min/Med/Max
– Chroma	Chroma Off/Min/Med/Max

Bypass

Enables Filter Bypass Mode

Video

This menu level controls the main video parameters.



Selects the unit’s input
Composite A & B are decoded by the upper card.
D1 A & B are input directly into the second card.

Sets the operational standard.
When the Composite input is selected the options available are PAL-I / PAL-N / PAL-M / NTSC / Auto

When the SDI input is selected the options available are 525 / 625 / Auto

This switches the test pattern mode on and off.

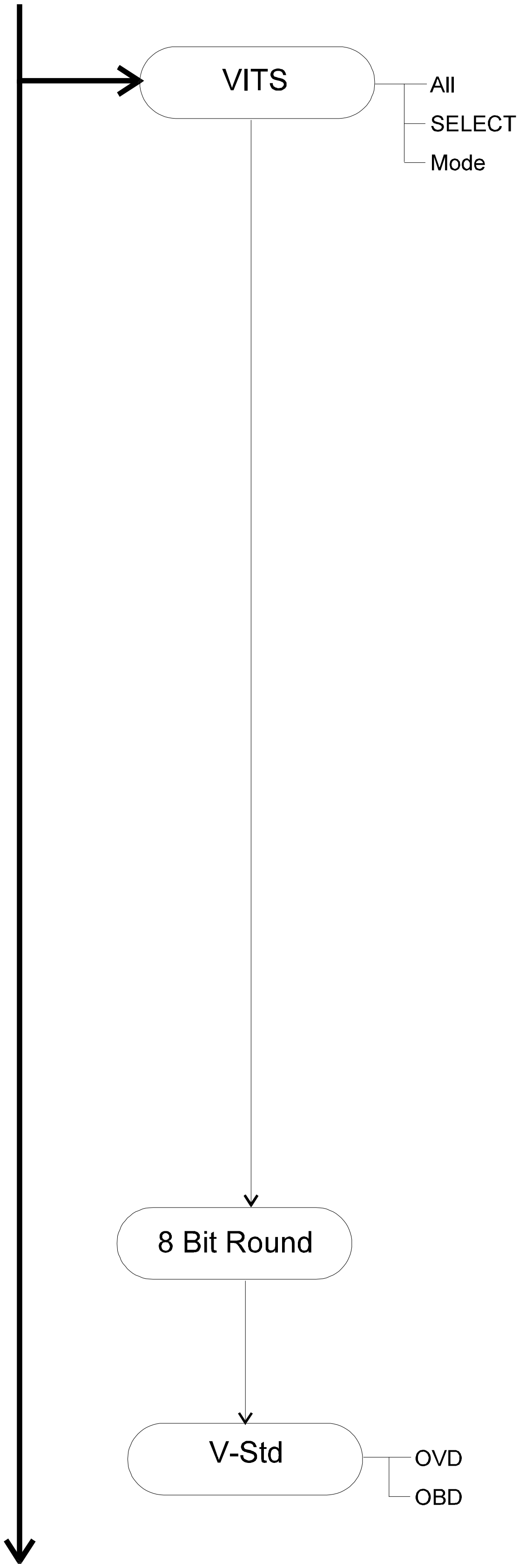
States: Off Pass Input
On Test Pattern On

This selects the test pattern.
Options are as follows:-
Black / EBU Bars / Y Ramp /
UV Ramp / Y Sweep / UV Sweep
Bowtie / Full Bars

This sets the default mode for the unit when the input signal fails. Options are as follows:-
Video
Black / EBU Bars / Y Ramp /
UV Ramp / Y Sweep / UV Sweep
Bowtie / Full Bars

Video

(continued)



Controls VITS blanking

ALL: All ON Force all VITS lines to be passed
All OFF Force all VITS lines to be blanked
User Cfg Permit mixed selection

SELECT - Individual ON/OFF control of VITS lines

MODE (Composite inputs only) :
States Decoded Pass decoded luma
Composite Pass sampled composite as luma

VITS lines in 525 and 625 line standards which may be processed by the MDD3000.

625

Field1	Field 2
	318
6	319
7	320
8	321
9	322
10	323
11	324
12	325
13	326
14	327
15	328
16	329
17	330
18	331
19	332
20	333
21	334
22	335

525

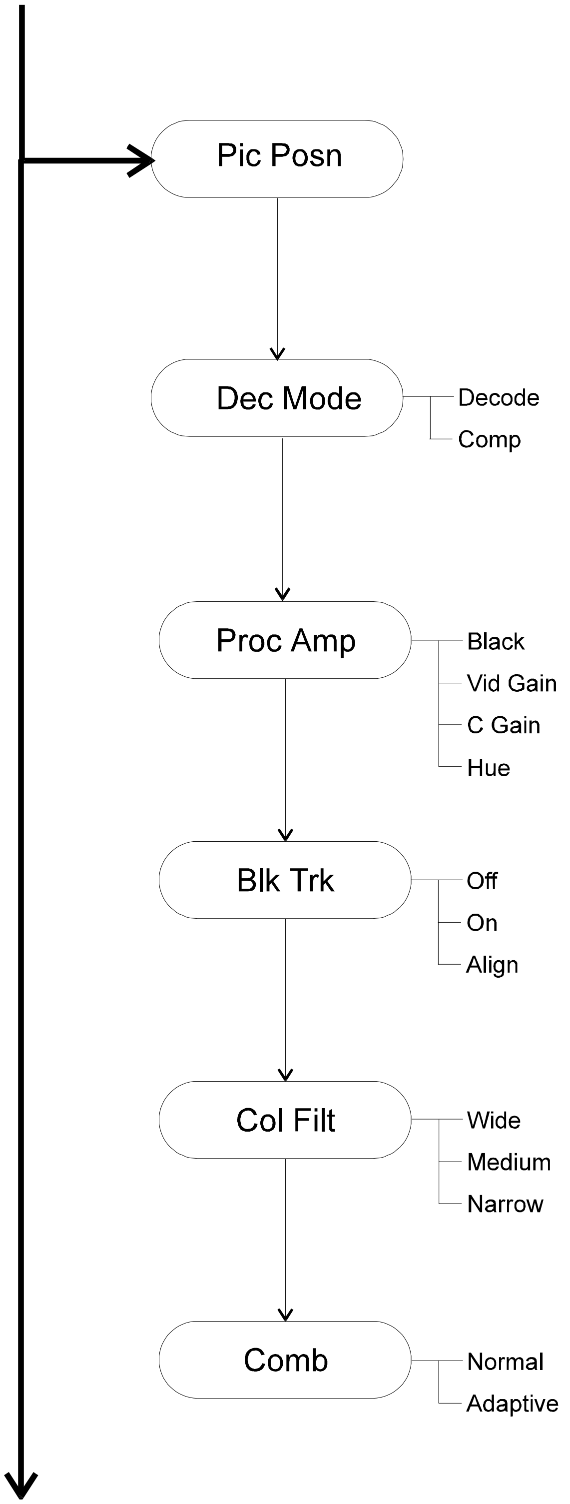
Field 1	Field 2
10	272
11	273
12	274
13	275
14	276
15	277
16	278
17	279
18	280
19	281
20	282

This switches the 8 bit rounding mode on and off.
States: Off Pass Input
On Round to 8 bits

Selects the style of the V flag embedded in the TRS code groups. 525 line standards only.
States : OVD Optional Video Data (1-9 / 264-272)
OBD Optional Blanking Data (1-19 / 264-282)

Decoder

This menu level controls operation of the decoder card. This menu level is only active for composite video sources.



Allows delay adjustment of output video in relation to the TRS codes.
±599.4 nsec adjustable in 7.4 nsec steps, the default setting is 0 nsec.

Decoder Mode

Decode - the output is decoded
Comp - the output is non-decoded digitised composite.

Black sets the offset of the ADC (-20 mV to +20 mV)

Vid Gain sets the gain of the ADC. (-3.00 dB to +3.00 dB)

C Gain sets the chroma gain. (-6.00 dB to +6.00 dB)

Hue adjusts the NTSC hue (-179.5 to 180 degrees)

Black Track controls the Automatic Black stabilisation

States :	Off	No stabilisation
	Align	Used for card alignment
	On	Auto black stabilised

Colour Filter selects the filter type used to filter the chrominance prior to it being re-modulated for subtraction from the composite.

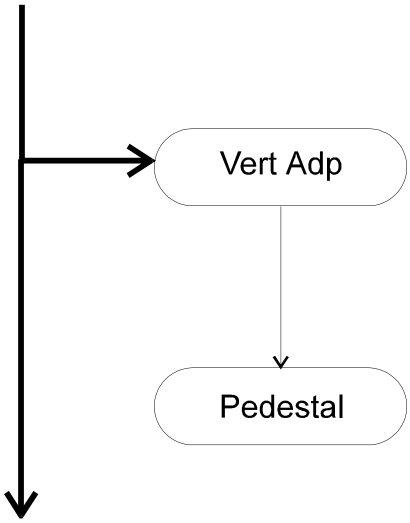
Wide	filtering with a wide bandwidth
Medium	filtering with a medium bandwidth
Narrow	filtering with a narrow bandwidth

Comb selects the style of Field Combing and adaptive algorithms

Adaptive	Adaptive comb
Normal	Non-Adaptive comb

Decoder

(continued)



Vert Adap controls the Adaptive algorithm for the vertical filter.

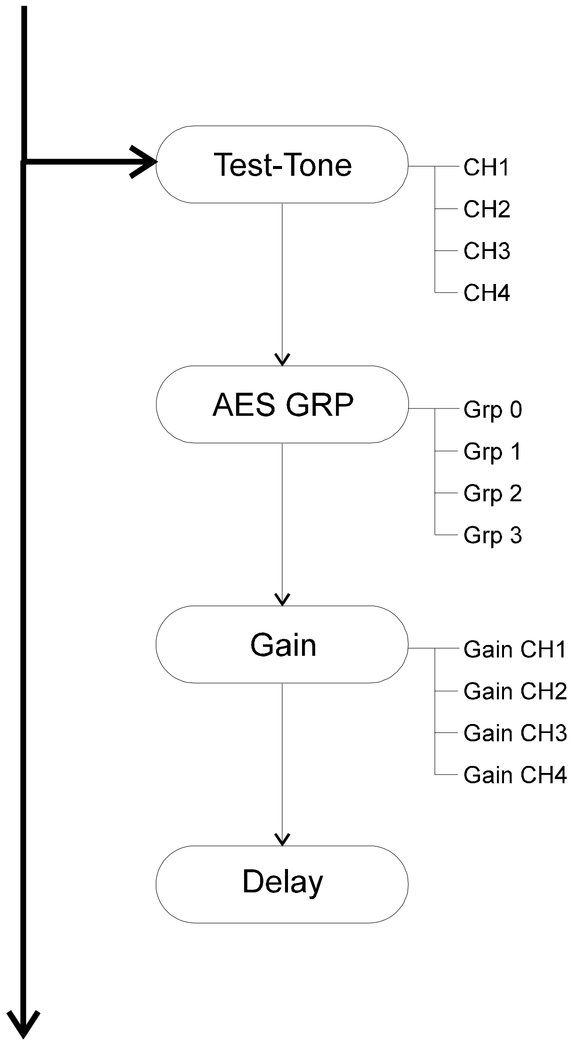
States :	On	Adaptive filtering
	Off	Vertical filtering i.e.. No Adaption

Determines whether the input pedestal is removed or passed.

States :	On	Input has a pedestal
	Off	No pedestal on input

Audio

This menu level controls the audio card features.



Enables the test tone on each channel.
States: On Test Tone Enabled
Off Test Tone Disabled

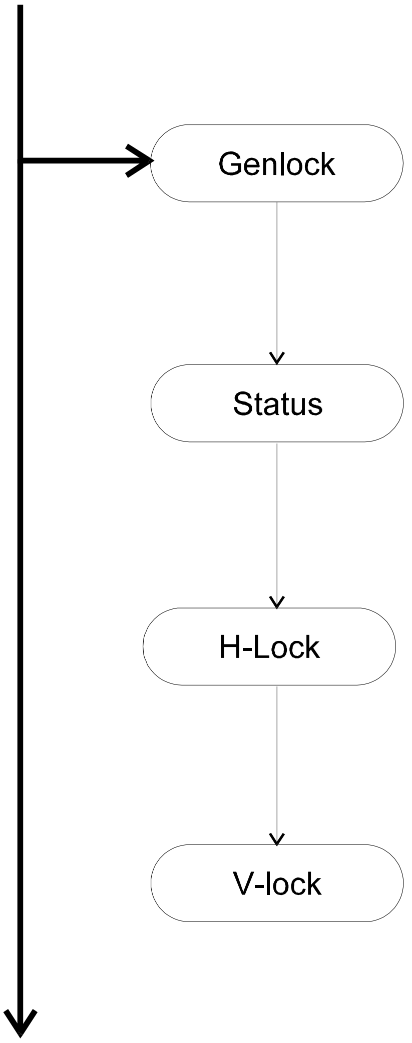
Selects the AES group for embedded audio.

Alters the output gain of each channel.
Range : Mute, -95.5 dB to +31.5 dB
in 0.5 dB steps.

Changes the audio delay .
Range : -1 to 10 fields
in 0.25 field steps

Genlock

This menu level controls the operation and configuration of the synchroniser.



Selects the genlock source.

States : Off — Output free runs
On — Locks to a valid reference. If the reference is not present or invalid then the genlock source is the input

Returns the Genlock status,

--- — Unable to Genlock
Off — Output free running
Input — Output locked to input
Ref — Output locked to reference

Allows adjustment of the horizontal output phase in relation to the genlock source

Range : 0 - 63455ns (525 line standards)
(in steps of 37 ns)
0 - 63899ns (625 line standards)
(in steps of 37 ns)

Allows adjustment of the vertical output phase in relation to the genlock source

Range : 0 - 524 lines (525 line standards)
0 - 624 lines (625 line standards)

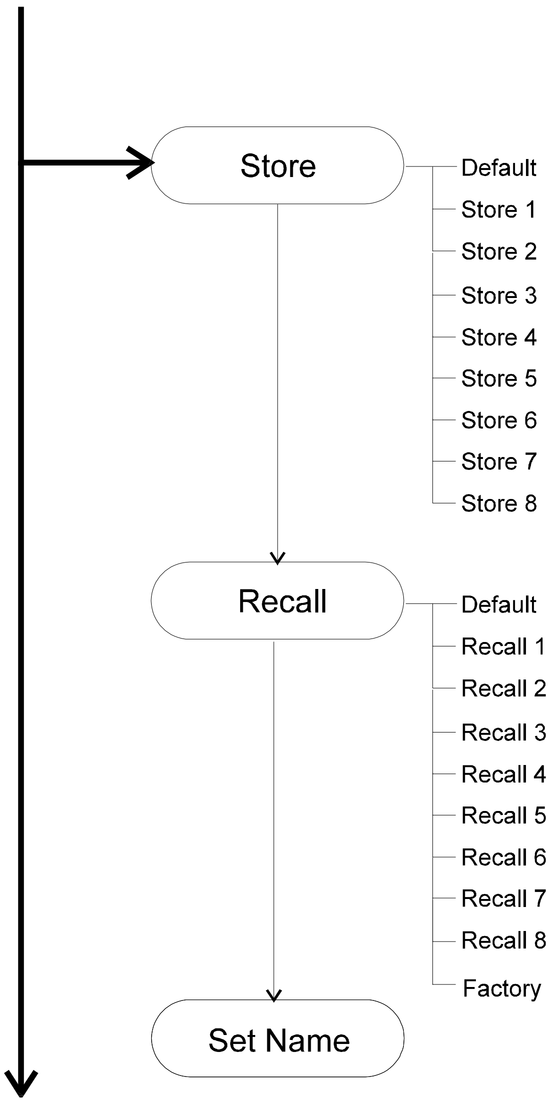
Monitor

This menu level displays the EDH status and controls the split screen mode.

Menu	Options	Description
Panel Display	Normal Recursive Median Spatial Enhancer EDH Check Network Auto Loop	This option selects the status message displayed on the Decoder card edge LED display
EDH Status		Reports in “real time” any EDH errors. *States :* None No EDH present OK EDH present with no errors Errors EDH present with errors
EDH Reset	AP Reset FF Reset Reset Both	Reset EDH Counters
Key Window	Window Select Invert	Selects Key Window shape Off/H-Split/V-Split/Box Change Active Area of Key Window
Border	Off Black White	Selects the colour of the border around the Key Win.

Memory

This menu level allows the unit's configuration to be stored.



Stores the unit's configuration.

The configuration stored in Default is restored on power-up.

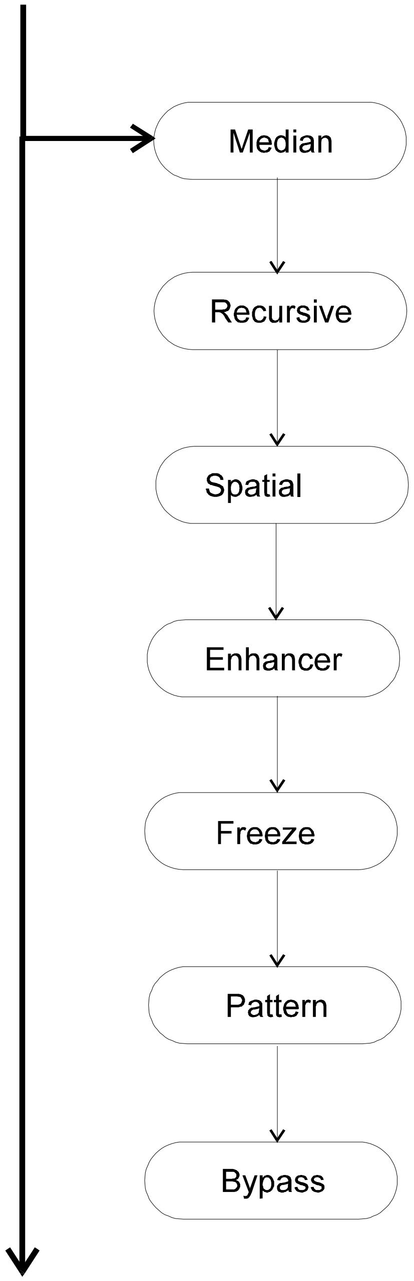
Recall previously stored configuration.

Select name for memory when Store Memory is used.

Quick

The quick menu allows fast access to the main features of the MDD 3000.

All quick menu options work with the last filter configuration.



Controls the operation of the median filter
States: Off / On

Controls the operation of the recursive filter
States: Off / On

Controls the operation of the Spatial filter
States: Off / On

Controls the operation of the Enhancer
States: Off / On

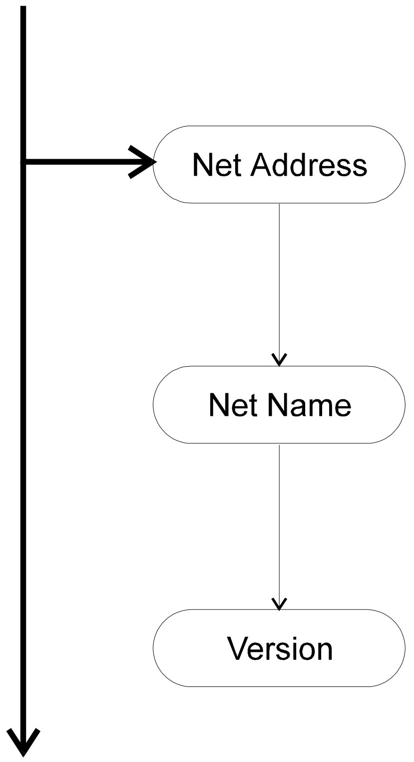
Performs a clean frame Freeze
States: Off / On

Controls the operation of Test Patterns
States: Off / On

Turns Bypass mode on and off
States: Off / On

System

This menu level allows adjustment of the remote control facilities.



Sets the remote control network address
Range : 20\h to FF\h in steps of 1

Sets the network name for the card.
Range : ASCII character sequence. (See below)
The "UP" and "DOWN" arrow keys sequence through the character set. The "ENTER" key accepts the current letter and moves on to the next character space

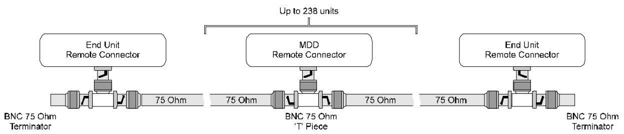
Returns the software version number.

	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	[	\		]	^
_	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~

Remote Control

The MDD has provision to be remotely controlled via the serial BNC network - S&W Roll Call.

Interface to the "Roll Call" communications network is via the single BNC connector. Connections should be made by means of a ‘T’ piece (Zo=75 Ohms) to a 75 Ohm cable system as shown below. It should be noted that both extremities of the cable system must be terminated in 75 Ohms and the maximum number of units limited to 240 on one single cable run.



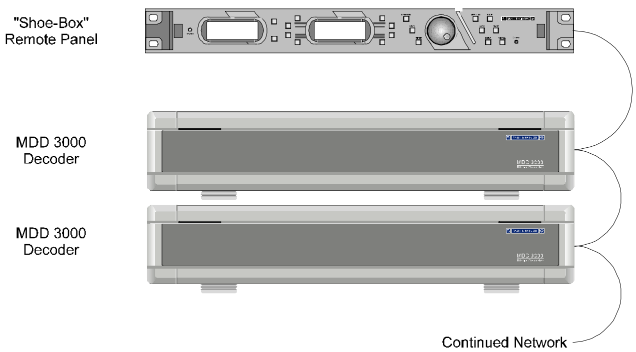
The communications network is a specially designed remote control network system and many more units can be accommodated by using a "Network Bridge". Remote control can come from either a dedicated front panel or "shoe-box" or a standard IBM compatible PC. Full protocol documentation and more detailed information is available on request from the supplier.

An RS 422 interface is available via the 9-pin female D type connector. Further information about this port is available on request.

Basic RollCall Operation

All the features from the menu system are available remotely with the same options structure. This maintains compatibility and facilitates easy operation for users familiar with the unit.

The most common MDD remote configuration is shown below where many decoders are connected to the network for remote control by one remote panel or "shoe-box".



Typical Set-up

The network address for each unit is set via the menu system option "NETWORK". The default address is 20hex. When installing a network it is recommended that a table similar to the one at the end of the manual be kept up-to-date to allow fast and accurate allocation of new unit addresses.

Parameter changes are reflected both locally and remotely. For example, if the output is changed to a test pattern by a remote unit then any further access from the card edge to the PATTERNS option will indicate this change. Similarly, if the card edge changes a parameter then this will be reflected on the display panel of the remote unit.

For more detailed information about the operation of the remote panel or PC software please consult their relevant manuals.

Specifications

Signal Inputs

Composite Video	2 analogue balanced loop-through
Digital Component	2 serial digital inputs to SMPTE 259M - C
Composite Reference Video	1 analogue balanced loop-through.
Analogue Audio	4 Balanced line audio inputs (XLR style)

Signal Outputs

Digital Component	2 Serial Digital to SMPTE 259M - C Embedded AES audio in channel positions 1, 2, 3, 4.

Main Processing

Digital Processing	Full 10 bit processing throughout.
Field comb	Symmetric multi-standard adaptive field comb.
EDH Detection and Checking	Digital Component inputs only
Frame Synchroniser	Full frame synchroniser capable of genlocking either to reference or selected analogue or digital input
Median Filtering	Non variable 5-point aperture. Separate Y and C level controls
Spatial Filtering	5-point Spatial Median Separate Y and C level controls
Recursive Filtering	Motion adaptive with motion/noise biasing option Separate Y, C controls inc. noise floor measurement. Noise reduction range: 0 - 12 dB.
Enhancement	Variable detail enhancement Separate Y and C level controls Separate Y and C Coring controls
EDH Insertion	EDH packet insertion
Test Patterns	Multiple 10 bit Test patterns

Controls

Input Select	SDI-A or SDI-B COMP-A , COMP-B,
Format Select	525 or 625 digital component line standards, AUTO PAL-I, PAL-N, PAL-M, NTSC
Video Gain	±3 dB
Chroma Gain	±6 dB
Black Level	±20 mV
Colour Filters	Wide / medium / narrow
NTSC / PAL-M Pedestal	Remove / pass
NTSC Hue	±180°
Synchroniser	Genlock : Input / Reference / OFF Horizontal offset: 1 line adjustable in 37ns steps Vertical offset: 0 - 624 (625 standards) 0 - 524 (525 standards)
Median Filter	Filter ON / OFF Y-median: Min/Max C-median: Min/Max Noise correction: Auto/Min/Max
Spatial Filter	Filter ON / OFF Y: Auto/Off/Min/Med/Max C: Auto/Off/Min/Med/Max

Recursive Filter	Filter ON / OFF Y: Auto/Off/Min/Med/Max C: Auto/Off/Min/Med/Max/Cross Colour Bias: -3 - +3 Threshold: AUTO, 0 - 15
Enhancement	Filter ON / OFF Y: Auto/Off/Min/Med/Max C: Auto/Off/Min/Med/Max Y Coring: Off/Min/Med/Max C Coring: Off/Min/Med/Max
VBIS	525 OVD and OBD options for SDI Blanking Individual line controls or Group control for blanking / passing of VBIS lines. 625 composite standard : 6 to 22 & 319 to 335 525 composite standard: 9 to 20 & 271 to 282

Video Performance

Standards	525 or 625 digital component line standards PAL-I, PAL-N, PAL-M, NTSC
Video ADC Sampling	10 bits at 27 MHz
Video Data Paths	Full 10 bit, selectable 8 bit rounded output
Hannover Bar Suppression	YES
BLO Operating Range	±100 Hz
Analogue Input Return Loss	Better than 40 dB at 4.43 MHz
Digital Input Return Loss	Better than 17 dB at 270 MHz
Digital Output Return Loss	Better than 17 dB at 270 MHz

Audio Performance

Audio ADC Sampling	18 bits at 48 kHz, 64 times oversampled
Input Impedance	10k Ohm, electronically balanced
Input Dynamic Range	106 dB
Headroom	Adjustable, nominally +12dBu
Frequency Range	20Hz - 20kHz ±1dB.
THD	Less than 0.015% @ 1kHz
Signal to Noise Ratio	Better than -100 dB, 20Hz - 20kHz
Phase Difference	Less than 1 degree between channels @ 1kHz
Cross Talk	Less than 75 dB @ 15kHz
Channel Level Difference	Less than 0.5 dB

Communications

RollCall™ BNC	Proprietary Snell & Wilcox interface. Multi-drop via BNC network.

Power

Input Voltage Range	90 V to 250 V 50/60 Hz
Consumption	1.8 A maximum
Mains Fuse Rating	2.5 A (T)

Mechanical

Cooling	Filtered Axial fan
Case Type	2RU Rack Mounting
Dimensions	483 mm x 495 mm x 88.6 mm (w,d,h)

Company policy is one of continuous product improvement. Specification is subject to change without notice

Appendix 1-Using the Filters

Median Filtering

Median filters operate by rank ordering a set of points selected from a median aperture. The outer points end up at the extremes of the list with the median value in the middle. Hence median filters always sort from an odd number of points. The median aperture used in the MDD3000 performs a sorting operation from 5-points.

They are effective at suppressing impulse noise originating from film dust or ‘sparkles’ prevalent in pictures received via satellite sources.

The median filter in the MDD3000 has two settings of noise suppression. The low setting operates by identifying spatial gradients around the suspect pixels and replacing them with the median if there are uniform spatial gradients. This type of selective algorithm can achieve a high level of noise suppression on small drop outs and will only filter damaged areas of the picture.

High levels of noise can appear as drop outs and cause the median filter to unnecessarily filter areas of the picture which are not damaged. The algorithm in the MDD3000 is tuned to reject noise by adapting its algorithm to the level of noise in the picture. This can be set manually or left in the automatic position whereby the noise level is automatically measured and fed to the median algorithm.

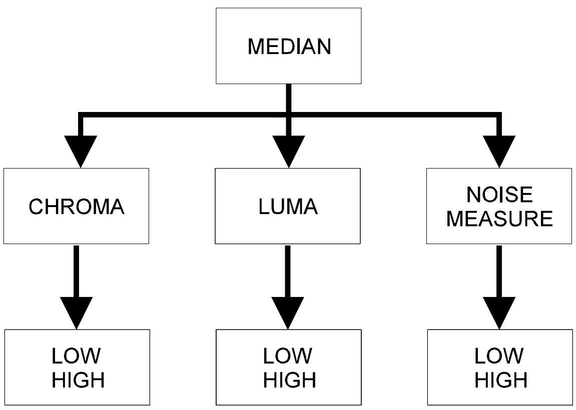
In the high setting, the median filter will operate over the whole image. Although this does achieve higher levels of impulse noise suppression, high frequency luminance textures will be filtered and some details may be lost.

The median filter operates in both luminance and chrominance with independent control for each.

Operation

Details on how the relevant menu section works including adjustable features with range & units.

Control parameters for the recursive filter can be found under the MEDIAN menu as shown below:



The MEDIAN filter has separate controls for luminance and chrominance noise reduction levels.

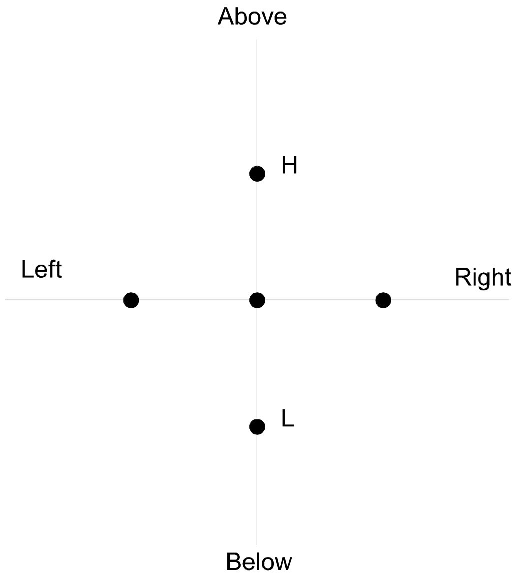
Spatial Filtering

Spatial filtering typically involves filtering using an aperture which comprises adjacent pixels from the same field period. Typically linear filters have been used for noise reduction formed from a weighted average of adjacent pixels. Usually non-adaptive in nature they reduce noise by averaging contributions across several pixels. In plain areas, the degree of noise reduction is proportional to the sum of the square of the weighted contributions. In general a larger aperture will allow a higher level of noise reduction.

Typical levels of noise reduction for equally weighted contributions are shown in the table below:

Aperture Size	Noise power dB
3	-4.7
5	-6.9

A major disadvantage of this approach is that high frequency picture detail is also filtered and this leads to a softening of the picture on edges and on textures.



Spatial Aperture comprising adjacent points on the same line and on adjacent lines above and below the central pixel.

The spatial filter in the MDD3000 utilises a median filter based on an aperture of 5 pixels shown above.

Median filters operate by rank ordering a set of points selected from a median aperture. The outer points end up at the extremes of the list with the median value in the middle.

Although median filters can be effective at suppressing impulse they are also effective as gaussian noise reduction filters.

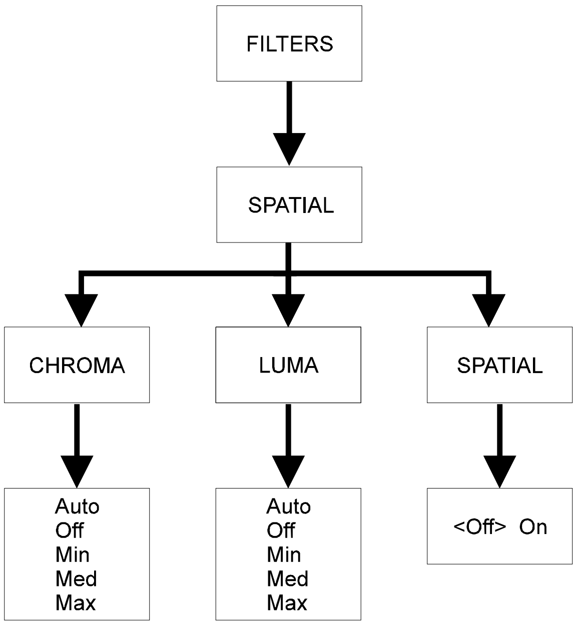
The spatial filter operates by resolving the spatial median and then verifying if this is of similar value to the current pixel. By varying the comparison threshold, the spatial filter can be tuned to reject noise but still preserve picture transitions and textures.

The spatial filter is controlled by two settings which vary the comparison threshold and effectively set the balance between the level of noise suppression and detail preservation.

Spatial Filtering cont.

Operation

Control parameters for the recursive filter can be found under the SPATIAL menu as shown below:



The SPATIAL filter has separate controls for luminance and chrominance noise reduction levels.

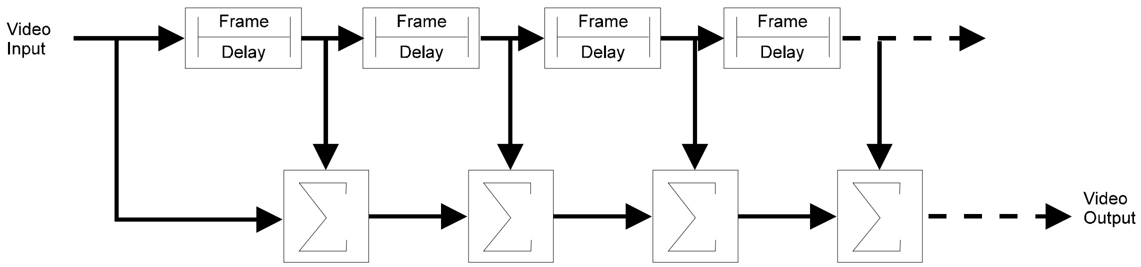
Examples for use

The spatial filter is complementary to the temporal noise filters (such as recursive, de-enhancement and decoder matching) and should be used in conjunction to achieve greater levels of noise suppression.

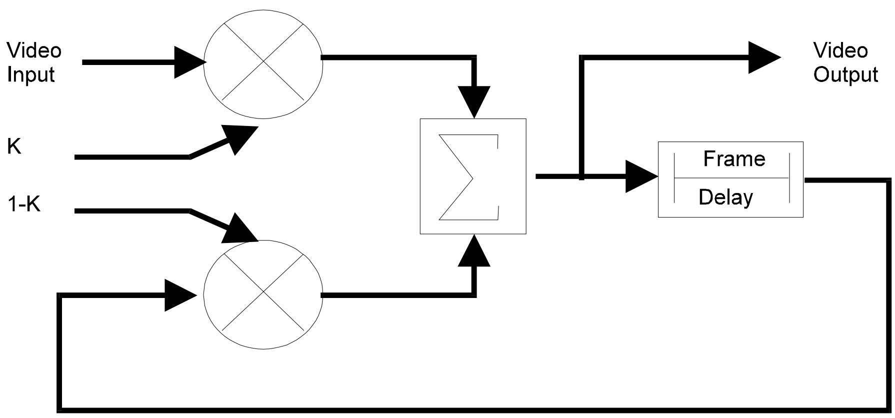
Recursive Filtering

Noise can be reduced in video signals without impairing spatial (horizontal and vertical) resolution by using the fact that in stationary pictures the only difference between successive frames is caused by the noise itself. Thus temporal averaging of successive video frames will produce a degree of noise reduction of the picture since the noise contribution is random with zero mean. The overall effect of this is a temporal low pass filter.

There are two ways of implementing such a low pass filter. Firstly the signal may be passed through a series of delay elements, each of length one picture period, and the output signals summed together as shown below:



This type of noise reducer is typically known as a transversal noise reducer. The level of noise reduction that can be obtained from this type of arrangement is directly determined by the number of temporal or picture contributions. Unfortunately, a large number of picture contributions are required to achieve a useful level of noise reduction. Another consequence of this arrangement is that it introduces a substantial processing delay. An alternative filter arrangement is shown below:



The structure of this filter is basically a two input cross-fader between the video input and previous output delayed by one frame. The cross-fade value, K is determined by factors such as the degree of noise reduction required and the level of picture difference detected between current input and frame delayed output. Hence if the K value is very small then the contribution to the output will predominantly be from the previous output and not from the current input. On a static scene following a shot change the picture output will be formed entirely from the input (K=1) since there will be a large picture difference between scenes. On the next frame however, K will be reduced to the optimum value of 1/2 and some noise reduction will be accrued from the combination of current input and previous output. On the following frame the value of K will be further adjusted to the optimum value of 1/3 and so forth for additional frames until K reaches the lowest corresponding to the ultimate level of noise reduction required.

Recursive Filtering cont.

If current input is denoted as input (n) , subsequent input frames are described as input (n+1), input (n+2) etc..

OP1 (scene change) = input (n)

OP2 (scene change + 1 frame) = 1/2 * input (n+1) + 1/2* OP1

Which can be rewritten as:

OP2 (scene change + 1 frame) = 1/2 * input (n+1) + 1/2 * input (n)

OP3 (scene change + 2 frames) = 1/3 * input (n+2) + 2/3 * OP2

Which can be rewritten as:

OP3 (scene change + 2 frames) = 1/3 * input (n+2) + 2/3 *(1/2 * input (n+1) + 1/2 * input (n))

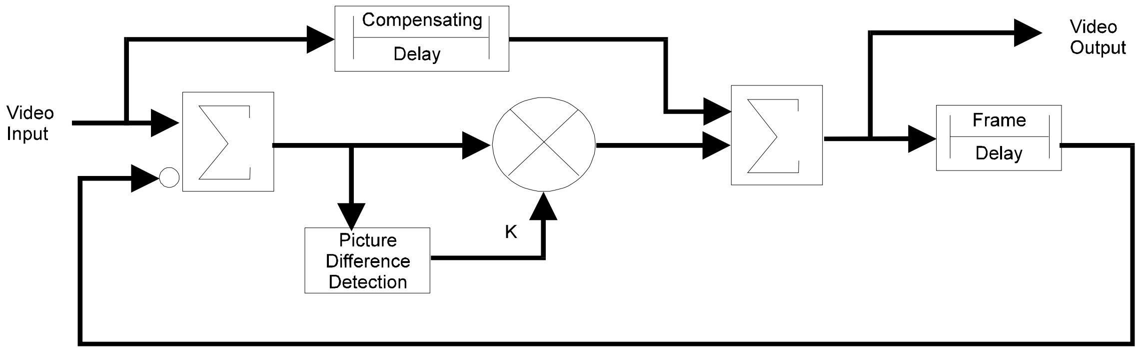
Which can be rewritten as:

OP3 (scene change + 2 frames) = 1/3 * input (n+2) + 1/3 * input (n+1) + 1/3 * input (n)

and so on for further inputs..

Each output is built up from contributions of previous inputs in a controlled manner to provide optimum noise reduction as quickly as possible. The advantages of such an arrangement are that much higher levels of noise reduction can be obtained than the transversal arrangement with virtually no delay. In the limiting case an infinite amount of noise reduction can be applied to a stationary picture with picture contributions backwards into infinity. In reality the level of noise reduction will be continuously modulated by picture differences such as shot changes or motion. Sophisticated control of K is vital to the correct operation of a recursive noise reducer.

Without some form of motion detection, the impulse response of the recursive filter would be that of a decaying exponential sampled at the picture frequency, and the effect on moving pictures is very like that of a long persistence display tube with a time constant of 1/K picture periods. Its effect on motion would be to cause unacceptable smearing of the current picture with contributions of previous pictures. Therefore a sophisticated movement detector is used to disable contributions from previous pictures when there is a difference between the previous output and the current input. The structure of the recursive filter can be re-arranged as shown below:



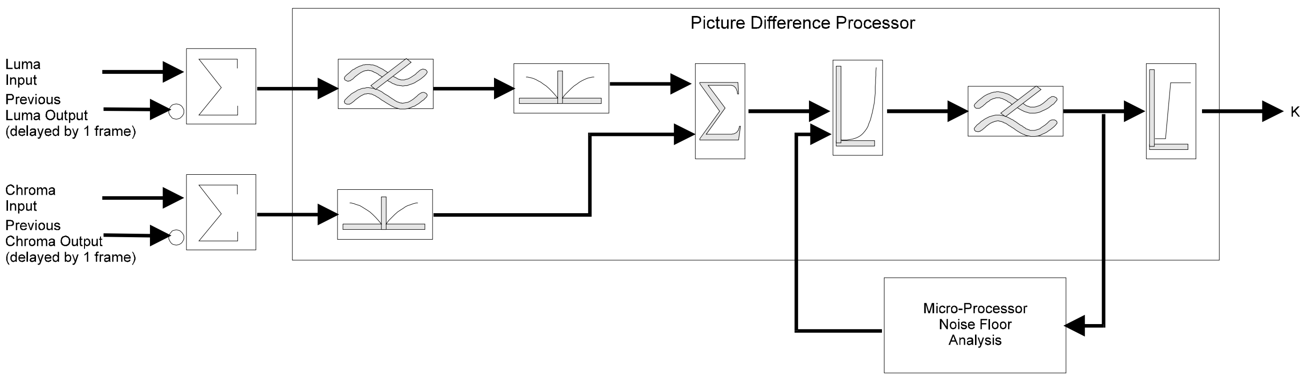
This arrangement removes one of the multipliers at the expense of a second adder and has the added benefit of providing a picture difference signal which is used in the picture difference processor to generate the cross-fade value K.

Recursive Filtering cont.

Noise Floor Measurement

Accurate noise floor measurement is required to set the threshold above which picture differences are perceived as motion. Luminance and chrominance picture differences are processed using a combination of full-wave rectifiers, linear filters and non-linear mapping tables to generate the control value K which determines the amount of noise reduction which can be applied on a pixel-by-pixel basis. Luminance differences are low pass filtered before being rectified and summed with the rectified chrominance difference signal. Subsequent non-linear mapping tables are used to amplify the combined picture differences. Finally a 2D spatial filter is used which has contributions from adjacent pixels and lines. The overall effect of the rectifier and spatial filter is to form the mean modulus of the picture difference signal. This is similar to measuring the r.m.s. value of the difference signal but is computationally easier and in the absence of motion is a good representation of the r.m.s .value of the noise (which forms the only contribution to the picture differences).

A side chain is used to integrate the processed differences and a software algorithm evaluates the noise floor based on a large history of previous picture difference measurements. Integrated picture differences will have a minimum value when there is no motion. The noise floor measurement produces a control value which determines the sensitivity of the motion detector (shown as a non-linear transfer function below).

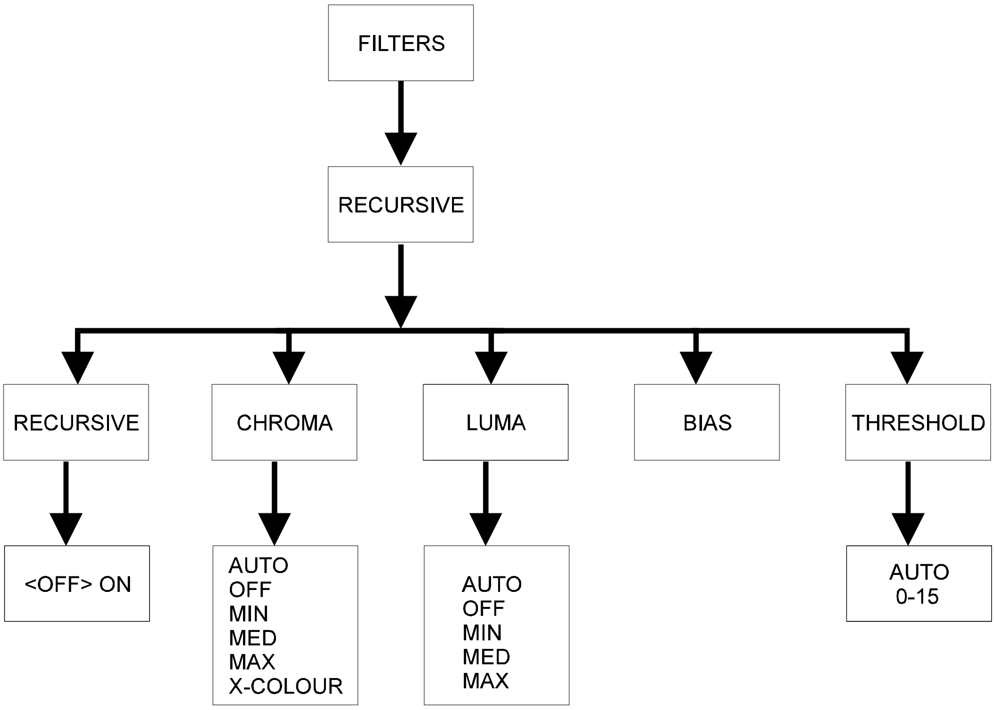


The control parameter for this function can be configured manually through the THRESHOLD adjustment or normally it can be left in the AUTO setting in which case the microprocessor will automatically control the sensitivity.

Recursive Filtering cont.

Operation

Control parameters for the recursive filter can be found under the RECURSIVE menu as shown below:



The recursive filter has separate controls for luminance and chrominance noise reduction levels. The levels represent the maximum noise reduction that can be obtained and can be roughly equated to 4dB, 8dB and 12dB for the min, med and max settings respectively. The default AUTO setting sets the noise reduction level to the MED position.

X-COLOUR (Cross Colour)

The cross-colour setting in the chrominance level menu allows greater attenuation of cross-colour by defeating the chrominance motion adaption control. Whilst this is capable of considerably attenuating cross-colour the sensitivity of the motion detector to moving chrominance will be reduced with the consequent possibility of chrominance smearing.

Threshold setting

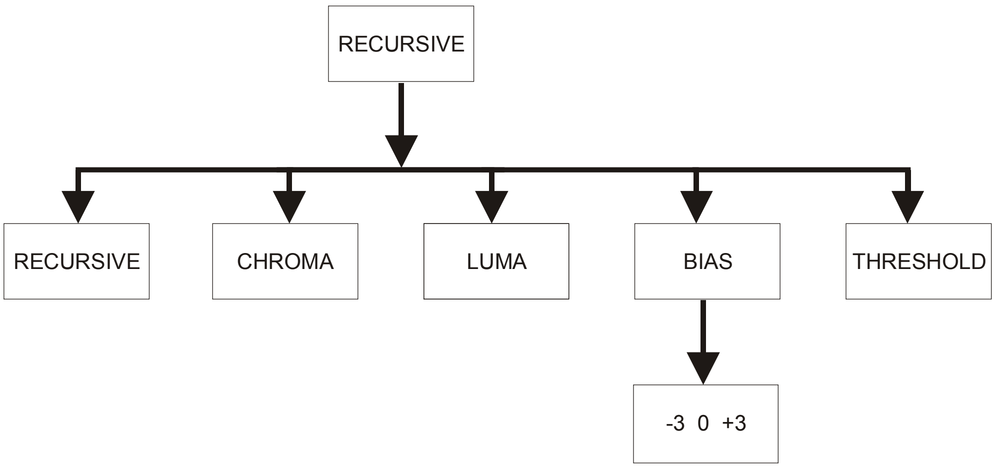
The recursive noise reducer has a threshold setting which determines the sensitivity of the noise reducer to picture differences. In the AUTO position (default) the sensitivity of the picture difference detector is set at a level which is appropriate for the amount of measured noise. The overall effect is that the closed loop system will attempt to provide the desired level of noise reduction whilst maintaining maximum sensitivity to picture differences caused by motion. Traditionally, noise reducers have offered manual configuration of the threshold setting to allow adjustment over a range around the correct operating point and the same facility has been provided in this design for that purpose.

Recursive Filtering cont.

Bias setting

An alternative mechanism for modifying the level of noise reduction is to use the bias function to introduce a small offset value to the threshold calculations of the noise floor detector. The THRESHOLD setting can then be left in AUTO position and the bias control can still be used to increase or decrease the amount of noise reduction applied to the picture. The behaviour of the bias function is as follows:

- -3 Less Noise Reduction
- 0 Default setting
- +3 More noise reduction



Examples for use

Recursive noise reduction is a powerful method of reducing electronically generated or white noise in video or film sources. Additionally it can be effective in reducing the level of film grain and to some extent film weave.

A typical range of settings may be described by the following table:

Noise Reduction Setting	Luminance Level	Chrominance Level	Bias	Threshold Setting
Low	Min	Min	0 (Default)	AUTO
Low-Medium	Min	Min	+3	AUTO
Medium	Min	Med	0 (Default)	AUTO
Medium-High	Med	Med	+3	AUTO
High	Med	Max	0 (Default)	AUTO
High-Maximum	Med	Max	+3	AUTO
Maximum	Max	X-Colour	Not relevant	15

Note the bias setting is an offset to the AUTOmatic noise floor measurement and is only effective when the microprocessor is controlling the closed loop system. Setting the threshold manually effectively opens the loop therefore the bias adjustment setting no longer has any effect.

Enhancer

INTRODUCTION

During the process of video recording or transmission, pictures can lose sharpness as high frequency components of the picture are lost or reduced resulting in soft or blurred edges.
The aim of the enhancer is to restore the perceived sharpness of an image by adding a correction signal derived from information from the incoming signal to sharpen edges and boost peaks but in a way that does not produce unnaturally sharp pictures or excessive unwanted artefacts.

The enhancer correction signal uses a combination of linear and non-linear methods. The linear and non-linear enhancement signals are calculated separately and combined to provide the final correction signal which is then summed with the incoming signal.

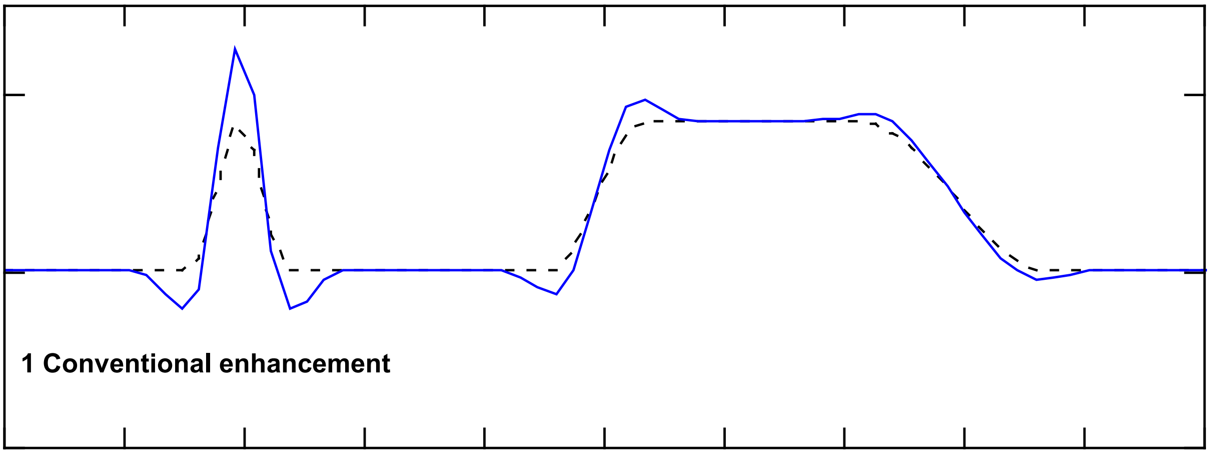
Non-linear enhancement is able to enhance images without the large increase in overshoots and ringing that are associated with linear enhancement methods.
The non-linear correction signal consists of a peak enhancement signal and an edge enhancement signal. The type of non-linear enhancement is determined by analysis of the incoming signal and has a pixel by pixel response to provide the optimum blend of peaking and edge correction.

Although the benefits of linear enhancement methods are limited, linear enhancement is more successful at dealing with low amplitude detail and texture in pictures.

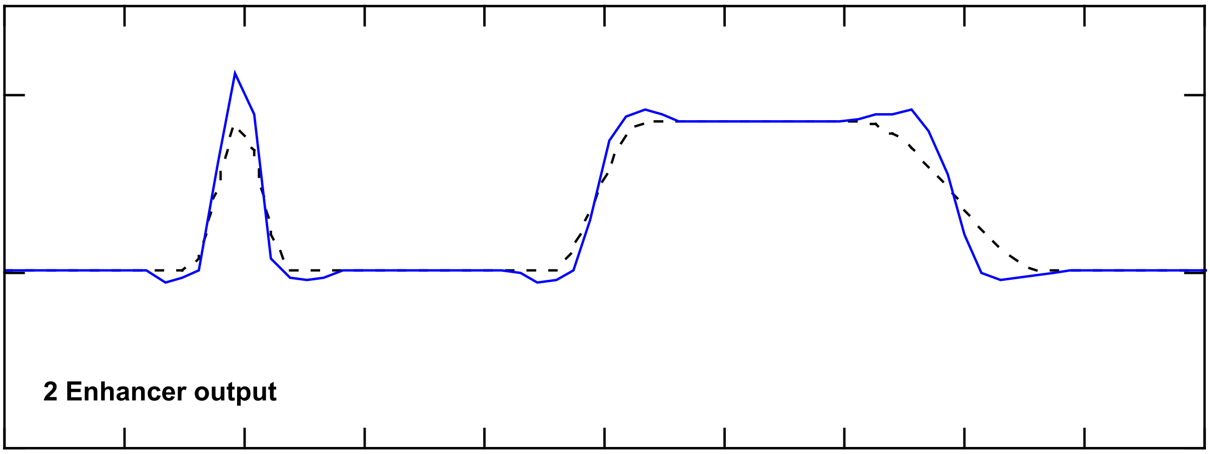
The enhancer uses a combination of both methods to provide an optimum correction signal which produces minimal ringing and overshoots.
The control of enhancement levels together with the adjustable coring make the enhancer a very powerful tool for improving picture quality.

ENHANCEMENT

As mentioned previously the aim of the enhancer is to sharpen edges and boost peaks with minimal ringing and overshoots. An example of this effect is shown below.



The first diagram shows the output of a conventional enhancer showing large undershoots and overshoots. The solid line represents the enhanced signal and the dotted line shows the input signal.



The second diagram shows the output of the enhancer. The solid line shows the enhanced signal and the dotted line shows the input signal. The rise and fall time of the edges has been reduced i.e. the edges are sharper without changing the position of the edge. The peak has been boosted which will also add to the appearance of a sharper picture.

The enhancer uses two different types of filtering in order to optimise the type and level of enhancement. The two filters used are a broad bandpass filter and an adaptive filter.

The broad bandpass filter produces the highest enhancement levels at 3.375 MHz for luminance whereas the adaptive filter has the highest levels of enhancement over a broader range of frequencies.

The table below shows the filter settings used for the various levels of luminance enhancement:

Enhance Level	Filter Type
minimum	broad bandpass
medium	broad bandpass
maximum	adaptive

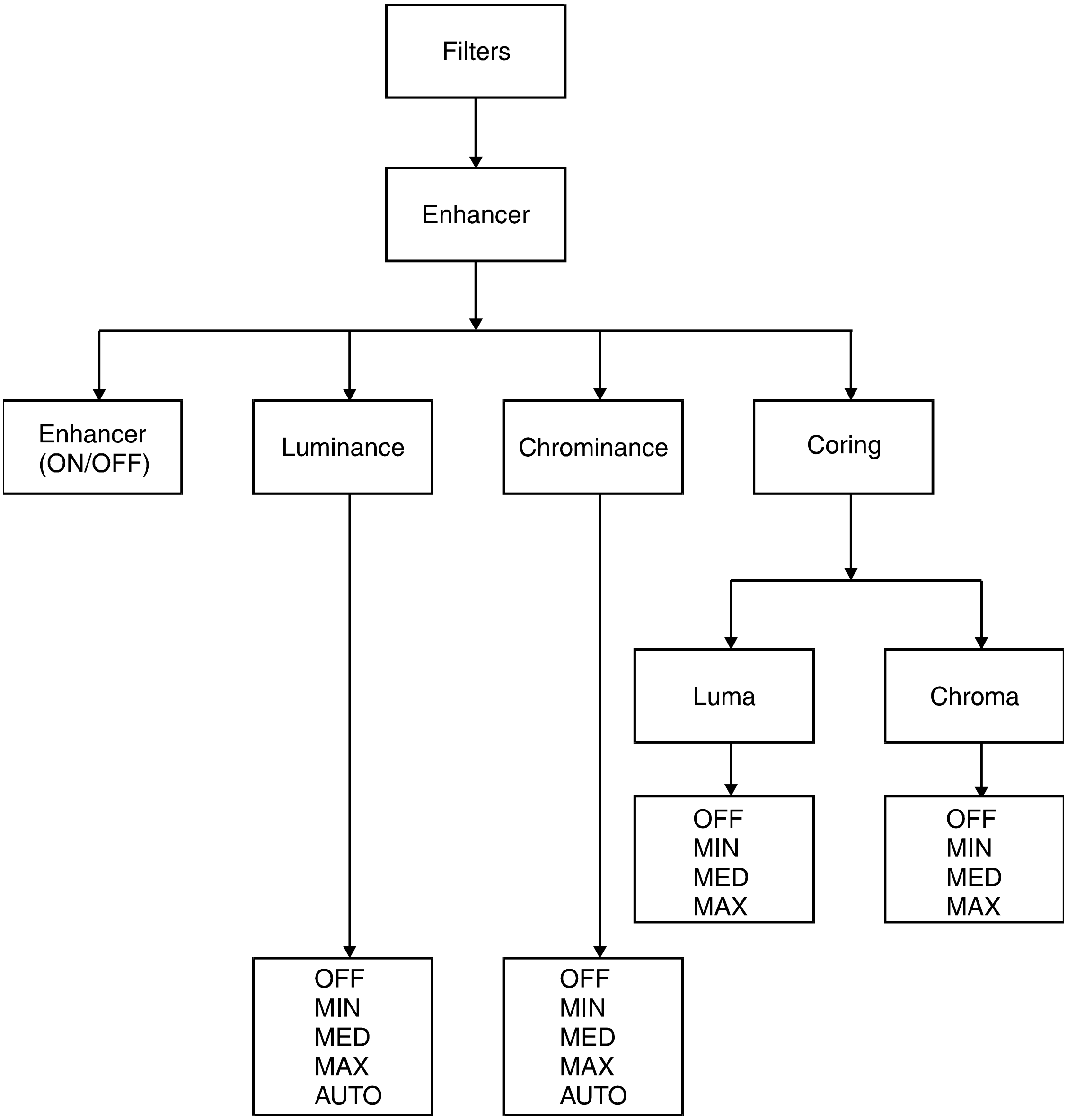
CORING

The aim of coring is to reduce or prevent the enhancement of noise in the picture using information from the incoming signal.
The coring function uses an adjustable threshold window which can be adjusted for different levels of noise in the incoming signal.
The enhancer has adjustable coring levels which can be altered depending on the quality of input pictures; the higher the coring level the less noise is enhanced.

OPERATION

Using The Enhancer

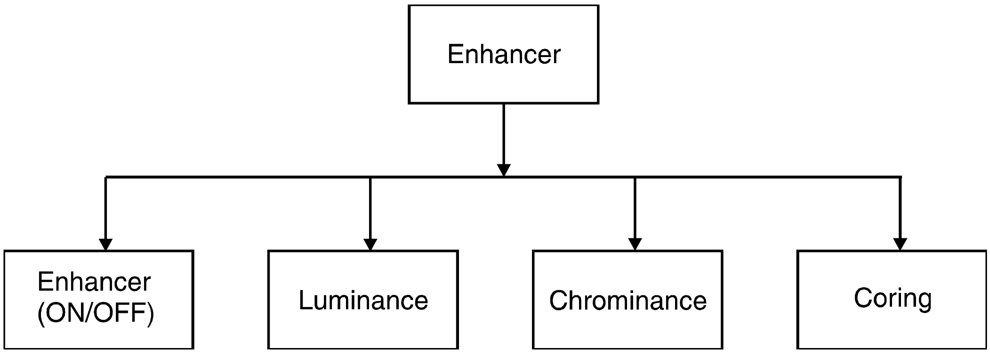
The enhancer control parameters can be found under the ENHANCER menu as shown below:



The factory default settings for the enhancer are as follows:

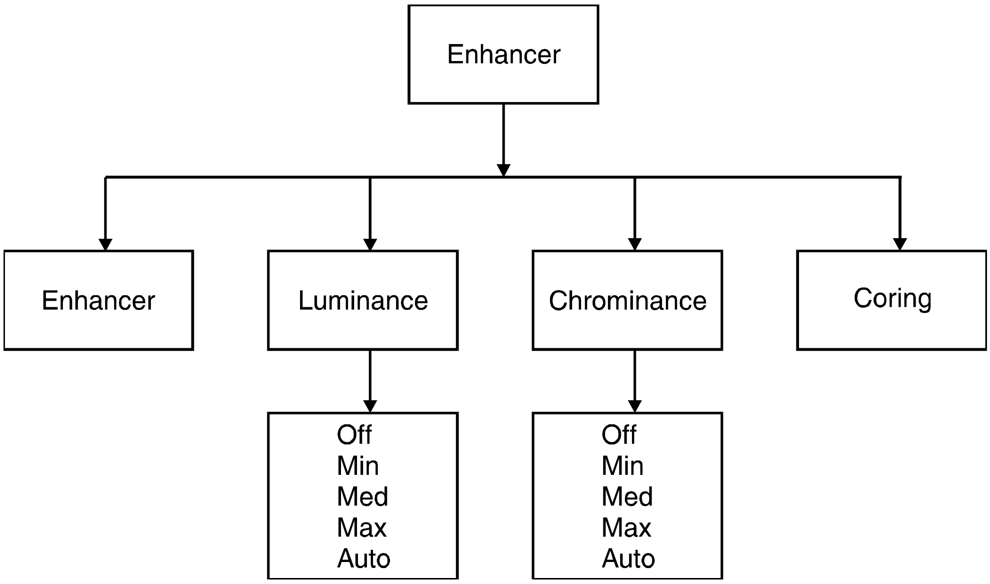
ENHANCER		OFF
LUMINANCE		Medium Enhance
CHROMINANCE		Medium Enhance
CORING	LUMA	OFF
CORING	CHROMA	OFF

The enhancer can be switched on by selecting the enhancer setting under the enhancer menu as shown below which toggles the enhancer on and off.



Adjusting Enhancement Settings

The enhancer filter has separate controls for luminance and chrominance enhancement. The luminance and chrominance enhancement controls are shown below:

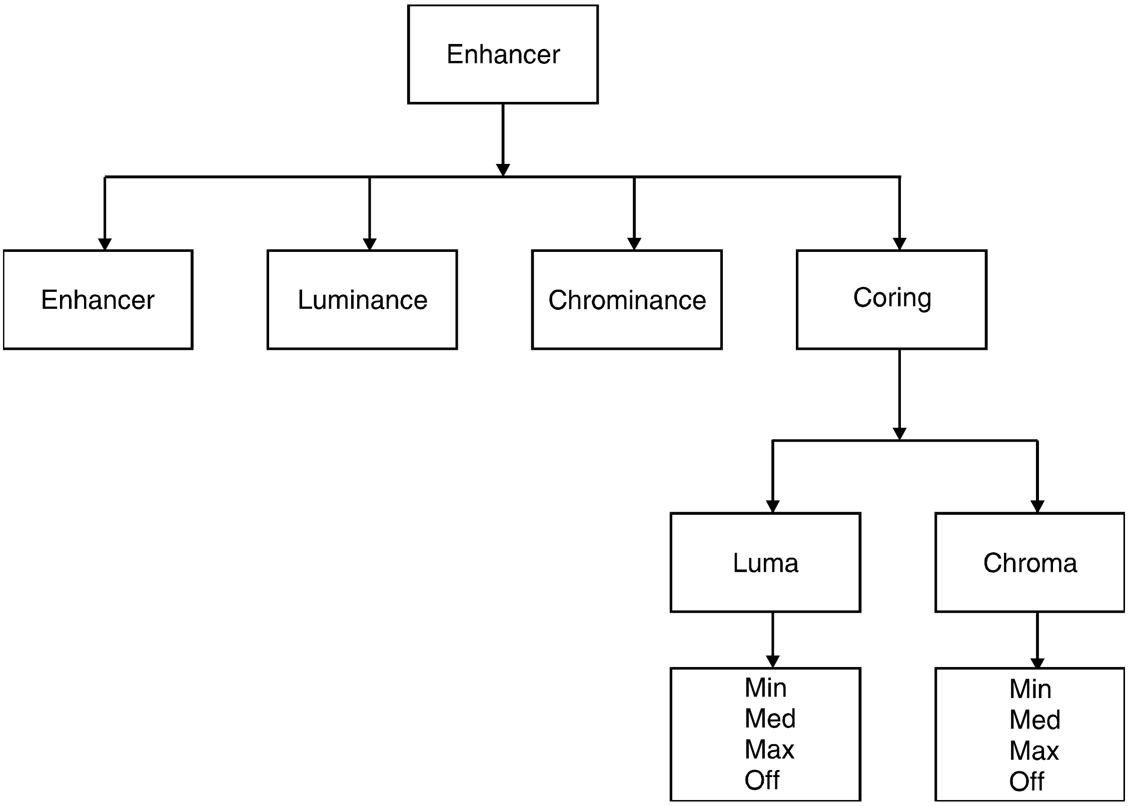


The enhance settings range from maximum softness to maximum enhancement. It is possible to enhance just luminance or just chrominance by selecting the OFF option on either. Setting both Luminance and Chrominance to OFF has the same effect as switching the enhance off.

The auto settings for luminance and chrominance enhancement selects the automatic enhancement control. If this option is not installed then this option corresponds to medium enhancement.

Adjusting The Coring Level

The enhancer has separate coring controls for luminance and chrominance.
The coring level controls for the enhancer are shown below:



Coring controls

Coring can be used to control the effects of noise for the enhance settings for luminance and chrominance.

In the off position, which is also the default, no coring is applied. For very noisy input pictures a high level of coring is recommended.

Examples For Use

Minimum enhance	designed for pictures that are fairly soft, for example film originated pictures
Medium enhance	the recommended setting for the majority of pictures
Maximum enhance	ideal for extremely soft archived material, multi-generation film copies and semi-professional sources

Other Information

It is important that the enhancement levels used match the type of pictures being enhanced for the best results. Pictures will suffer from artefacts such as overshoots if the enhancement level is set too high.
The main indication that the enhancement level is set too high is the effect of noticeable outlining around objects.
With the coring switched off very small detail is enhanced which with some sharp pictures can lead to unnatural effects on some textures. This can be solved by reducing the enhancement level.
The easiest way to check the level of enhancement is with coring switched off.

If the input pictures contain a high level of noise, coring may be necessary, otherwise the noise will be enhanced and the result will be poor.
Enhancing noise is an unfortunate consequence of the enhancement process and coring allows this problem to be dealt with but at the expense of low amplitude detail and texture. As a result coring should not be used unless necessary. Setting the coring level too high can result in 'cartoon-like' results as small amplitude detail and texture is lost.

Appendix 2

Error Messages Summary

Message NO COMPOSITE SIGNAL

Meaning Missing input or wrong input selected

Action *Check rear panel connections are made to the correct channel and the selected input, either A or B is correctly defined in the menu*

Message WRONG INPUT STANDARD

Meaning Unrecognised input standard or incorrect standard for selected output

Action *Check that the input is of a known standard. From the menu system ensure that the"TV MODE" option is correctly set for this input standard or AUTO is selected.*

Message INPUT BLACK LEVEL INVALID

Meaning Signal black level outside the Automatic Gain control window Unable to track.

Action *Check that a termination is fitted if the video loop through is not used. Check the input black level.*

Network Address Table

It is recommended that the following table be kept up-to-date with the units and their addresses.

Example entries,

Network Address	Product Name	Network Name Card / Slot	Rack Position	Notes
16	MDD500	Main	R3 / 20	Main feed
20	MDD500	Upper	R3 / 20	Aux feed

Network Address	Product Name	Network Name Card / Slot	Rack Position	Notes