NRS500

Noise Reducer

Operator's Manual

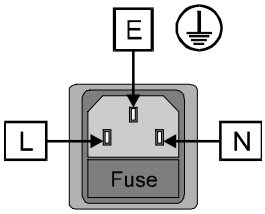
Snell & Wilcox Ltd, Durford Mill, Petersfield, Hampshire, GU31 5AZ, United Kingdom.
Tel: +44(0) 1730 821188. Fax: +44(0) 1730 821199.

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:

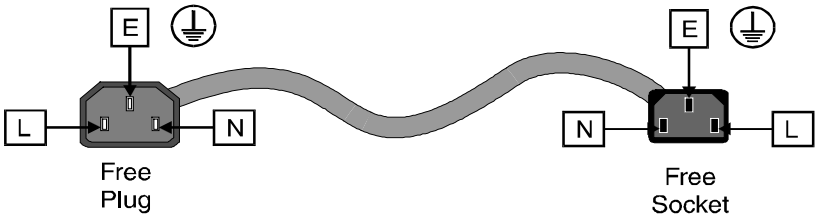
GREEN/YELLOW lead connected to E (Protective Earth Conductor)
BLUE lead connected to N (Neutral Conductor)
BROWN lead connected to L (Live Conductor)

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:

- NRS500 Unit
- Power cable
- Operator’s Manual

Product Type

This manual is for use the following product variants

NRS500-1	NRS500 noise reducer. Digital component input. Digital component output.
NRS500-D	NRS500 noise reducer with digital decoder. Digital component input. Analogue Composite input. Digital component output.

When shipped this product is fitted with software version 1.42 .

Table of Contents

Manual Revision Record

Date	Version No.	Issue No.	Change	Comments
100298	1	1	First Issue	Software Version 1.42
020398	1	2	Page 2.2 Input and output data	New section 2 issued

Description

The NRS500 is a high performance noise reducer which operates in the component 4:2:2 domain.

The NRS500 contains a wide range of digital filters optimised to selectively attenuate or remove a wide range of picture impairments. For example, a 3-Dimensional median filter is typically used to remove impulse noise such as video drop-outs or film dirt. By ensuring that is is highly selective in its operation, small drop-outs can be removed whilst textures and other details remain unaffected.

Similarly, temporal recursive filters are widely used to reduce random noise and film grain. Operating on a pixel-by-pixel basis, they are capable of providing a high level of noise reduction. However, at scene changes or in revealed/concealed areas the level of noise reduction diminishes. To counteract this, the NRS500 has a unique transversal filter which operates in conjunction with the recursive filter to provide noise reduction in these instances.

Film scratches are detected using a sophisticated algorithm which accumulates statistical information over several fields. This is used to generate a key signal which controls a filter which has been optimised for the removal of film scratches.

Each stage of noise reduction has been tailored to reduce picture artefacts and disturbances. By combining sophisticated adaptive algorithms with the power of the video analysis each filter can be precisely controlled, maximising it's performance whilst minimising artefacts usually encountered with other noise reduction systems.

As well as reducing noise, for picture sources which have been band limited the NRS500 contains a sophisticated detail enhancer. The enhancer works to 'sharpen' detail in the picture without introducing ringing or overshoots normally associated with enhancers. The level of enhancement can be subjectively selected by the user to suit the bandwidth of the material and coring facilities ensure that low level noise is not enhanced.

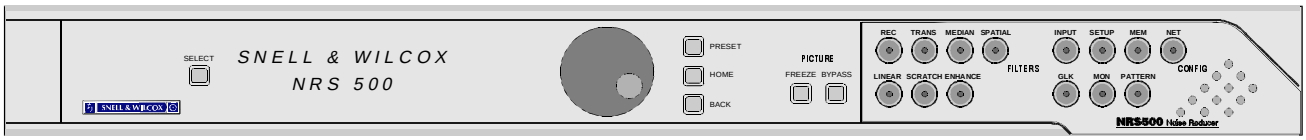
Residual subcarrier and cross effects can also cause a compressor similar problems; hence the NRS500 contains an adaptive field based digital comb filter capable of providing excellent luma/chroma separation. The design utilises techniques derived from work pioneered by the BBC Research department, and ensures exceptional stability, excellent subcarrier rejection and repeatable results.

The NRS500 also has a number of other features including test pattern generation, SMPTE-259M-C digital component inputs, an integral synchroniser capable of genlocking to either an analogue studio reference or the currently-selected input and unique picture splitting facilities.

The system's functionality can be controlled from the active front panel. Alternatively the units can be controlled remotely from a RollCall "shoebox" remote control unit or PC.

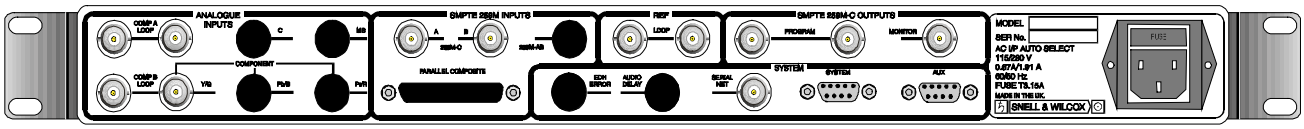
The processor cards are housed in a 1RU, 19-inch rack which also contains the automatic switched mode power supply, axial cooling fan and connectors.

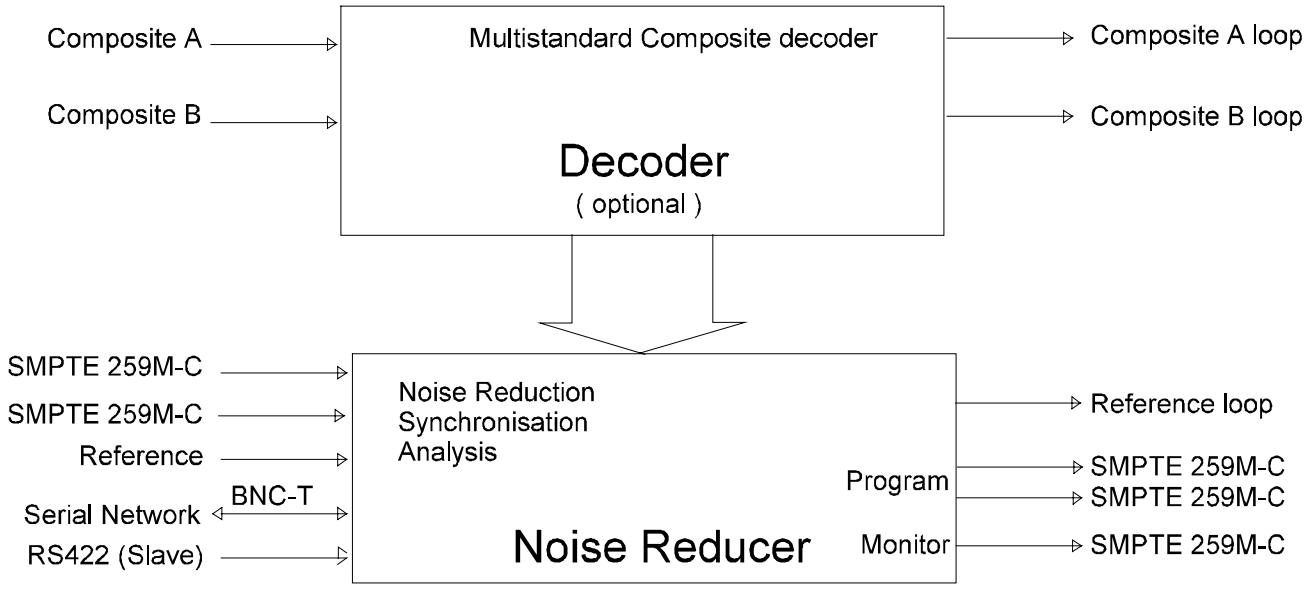
Features



- Minimum 10 bit processing throughout the system.
- Adaptive Field Comb Filtering and proc. amp facilities (with optional decoder).
- 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).
- Seven Filters
  - Recursive filter
    Unique filter biasing and motion adaption algorithms.
  - Semi-transversal filter
    Enhances Recursive filter performance.
    Increases Overall noise reduction.
  - Median filter
    Selective median filtering only filters suspect pixels.
  - Spatial Filter
    Spatial median filter for improved noise reduction.
  - Linear filters
    A suite of linear filters : Brickwall & Gaussian Low-pass/High-pass.
  - Scratch Filter
    Vertical scratch filter.
  - Enhancer
    Sophisticated spatial detail enhancer utilising non-linear and linear processing.
- EDH extraction and status check
- Full remote control facility using Snell & Wilcox proprietary serial BNC system ‘RollCall’
- Internal test pattern generation

I/O & Interconnection





Composite inputs are decoded using an adaptive field-based comb-decoder and passed down the backplane to the pre-processor card as separated luminance and multiplexed U/V. Up to two composite loop through inputs can be applied simultaneously to the unit with switch selection between them on the decoder.

In addition to composite inputs, up to two serial digital component (SMPTE259M-C) inputs can be applied directly to the pre-processor. Source switching between digital inputs is accomplished on the pre-processor card.

An analogue loop-through reference may also be applied to the pre-processor card if the output is required to be synchronised to a station reference. External communication is via a serial network (described more fully later) connection to the pre-processor card. Internal communication is facilitated by a conventional CPU bus link (address/data, ALE, WR, RD) between the three cards.

Filtered data sent from the pre-processor is formatted and the video output is then serialised into a 270Mbit/sec output as per SMPTE 259M-C.

Noise Reducer Overview

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.

Semi Transversal

The semi-transversal filter is a uniquely patented design which operates in conjunction with the recursive filter to increase its effectiveness. Quite unlike traditional transversal filters it operates by selecting the most appropriate outputs from a chain of picture stores at the output of the recursive filter.

An algorithm is used to determine which of the stores contains the highest level of noise-reduced picture. The overall effect is to increase the amount of noise reduction in a typical picture. For example, moving objects cause the recursive filter to turn off at the edge of the moving object. This leads to a recurrence of noise which takes a number of frames to reduce to the defined user level. The semi-transversal filter is able to monitor the recurrence of noise and delay the output of the recursive filter up to a maximum of three frames. Operating on a pixel-by-pixel basis, the overall level of noise reduction in a typical picture is maintained at a more uniform level and is less dependent on movement.

As the semi-transversal filter complements the recursive filter, it cannot be utilised without the recursive filter. Effective at all recursive filter settings its operation can be seen as a reduction in the level of revealed noise trail following moving objects.

The semi-transversal filter operates in a fully automatic mode - there are no user adjustments required.

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.

Median level

Six settings are provided for the median filter level control. The low setting provides modest filtering and has high rejection of false alarms caused by picture movement and texture etc..The medium and high settings are biased increasingly towards removal of larger drop-outs and dirt but consequently may have a higher false alarm rate resulting in a general softening of the picture.

Spatial Filter

Spatial filtering typically involves filtering using an aperture which comprises 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 and transversal filters, spatial noise reduction can increase the overall noise reduction level.

Linear Filters

A suite of linear filters allows fine control of the horizontal bandwidth of the luminance signal.

Brickwall low-pass filters ranging from 2.5MHz to 4.2MHz provide good band-limiting facilities for MPEG encoders which use half resolution processing. These filters also provide variable peaking or boosting at each of the selected cut-off frequencies. The overall perception of picture sharpness can be raised by boosting prior to brickwall filtering. In addition to the above filters there is a set of extra low pass filters where greater band-limiting is required. These filters have a cut-off ranging from 2.4MHz to 0.9MHz.

The ten sets of Gaussian low-pass filters gently attenuate high frequencies and can be used to correct material which has previously been boosted or enhanced as well as reducing high frequency noise.

Similarly, five sets of Gaussian high-pass filters provide variable correction of high-frequency luminance which may have been attenuated from faulty distribution links or analogue VTR processes.

Scratch Filter

This filter has been designed to detect and repair vertical scratches, of variable contrast, and length, be they black, white or both, while maintaining picture quality where there are no scratches. To maximise the benefit obtained from this filter, a suite of filter strengths has been provided.

Enhancer

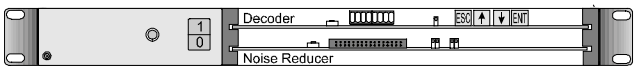
The enhancer uses a combination of linear and non-linear processes to generate edge correction and peaking correction signals. The use of non-linear processing ensures that high levels of correction are possible without introducing edge distortion such as overshoots and ringing normally associated with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

Installation

The NRS500 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 1RU slot in a 19" racking system.

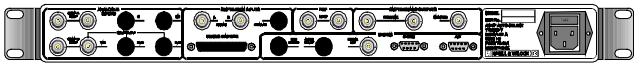
The chassis is equipped with a pair of mounting ears attached to the side plates. Suitable screws should be inserted through the holes in these flanges to secure the chassis to the racking system. Ensure that the rack is correctly configured to accept the 1U unit with chassis runners positioned to support 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.

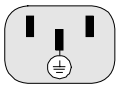
Whilst mounting the unit please try to ensure that there is adequate air flow to the rear of the unit.
If a NRS500 is to be mounted in a rack together with convection cooled equipment, e.g. Analogue distribution amplifiers ensure that it is not located above or interspersed with these units. The equipment should be operated in an environment having a temperature between 0°C and +30°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 downwards 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

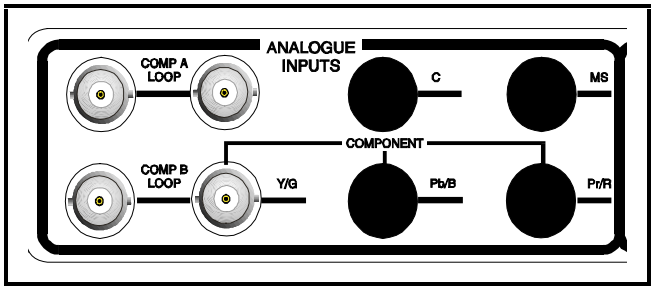
The unit has two ON / OFF switches. One is located behind the front panel, the other on the rear of the unit. Both need to be in the ON position for the unit to function.

Signal Connections

All external signal connections are made via the rear panel.

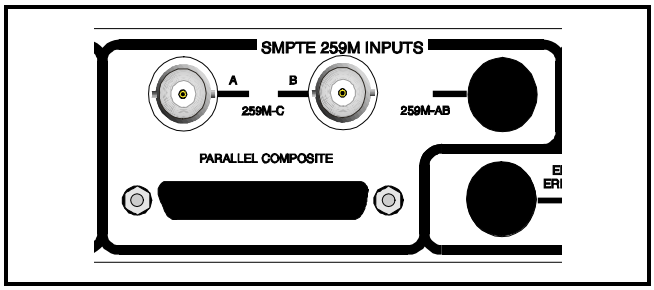
Composite Analogue Inputs

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.



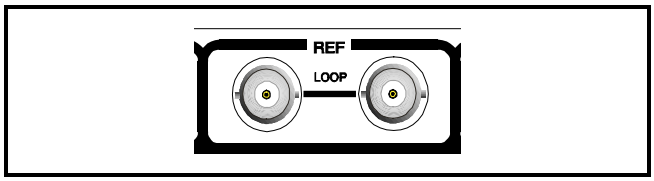
Digital Inputs

The BNC connectors labelled 259M-C A and B accept digital component signals. These inputs can be selected from the menu by choosing the SDI-A or SDI-B option.
Not that this interface is in accordance with SMPTE 259M-C ITU recommendation BT.656-3



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

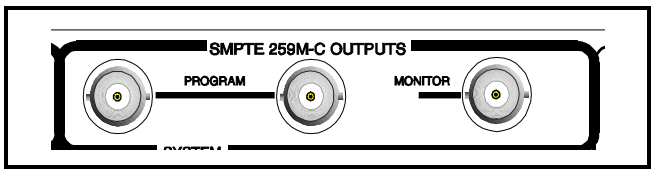
These are the SDI outputs from the unit via BNC connectors. They are component digital outputs, all of which can be used simultaneously.
The interface is in accordance with SMPTE 259M-C ITU recommendation BT.656-3

The Program output carries processed video.

The monitor output carries processed video, and if selected, the on screen display.

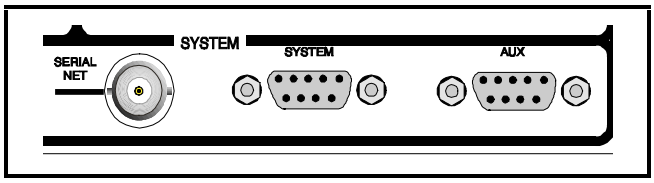
*Note that Error Detection and Handling (EDH) is only implemented on the **program** output.*

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



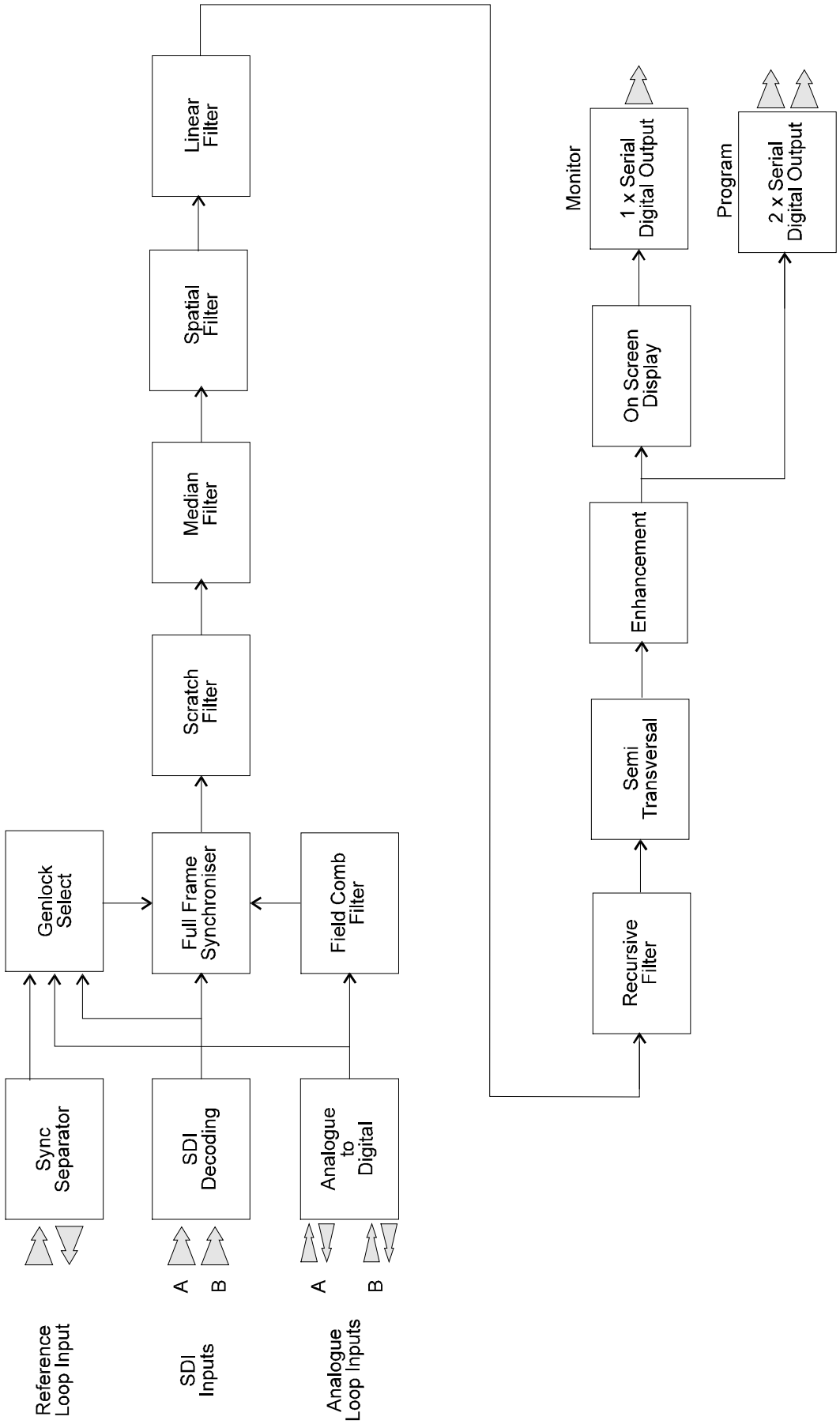
Remote Control

Interface to the "RollCall" communications network is via the single 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.



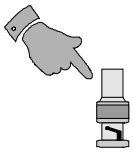
Under no circumstances should the "RollCall" network be directly connected to any other communications network such as a computer "Ethernet" system.

Block Diagram



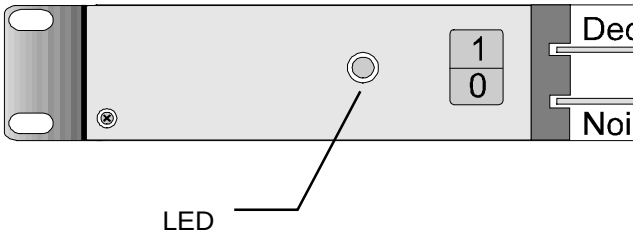
Getting Started

Connect up the unit so that there is an Analogue Composite video signal applied to the composite input or a Serial Digital video signal applied to the SMPTE259M-C serial input. For Composite inputs REMEMBER to fit a termination if the video loop through is not used. Either one of the 2 serial outputs can be used. 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.

Turn the unit on. The green LED to the left of the ON/OFF switch should be illuminated, and the fan should be audible.

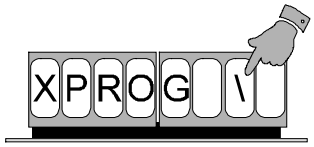


The front panel display will indicate that the unit is powering up and that the Xilinx and CPU devices are being configured.

SNELL & WILCOX
NRS-500
Booting Xilinx..

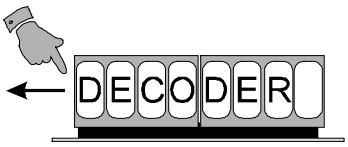
SNELL & WILCOX
NRS-500
Booting....

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

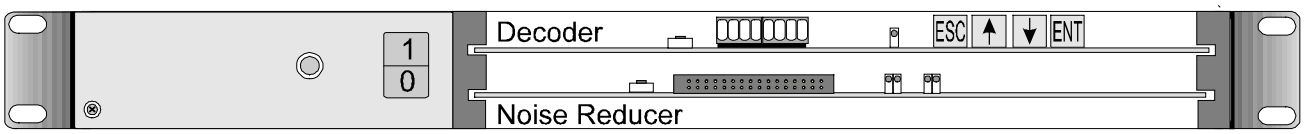


A scrolling message will then display the unit's name and the configuration status.

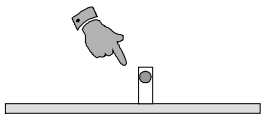
The initialisation sequence is now complete and the output should be the decoded input.



Card Edge Functions

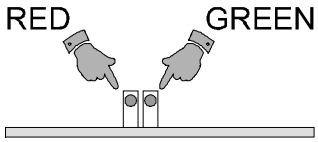


Decoder Card

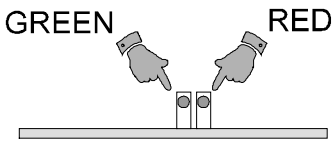


The upper card is the decoder. The LED will illuminate if there is a loss of syncs on the analogue input

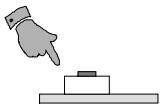
Noise Reducer



The right hand pair of LEDs indicate the condition of CPU A. The GREEN LED flashes when the CPU is in normal operation. The RED LED illuminates on power-up and if an internal error occurs.



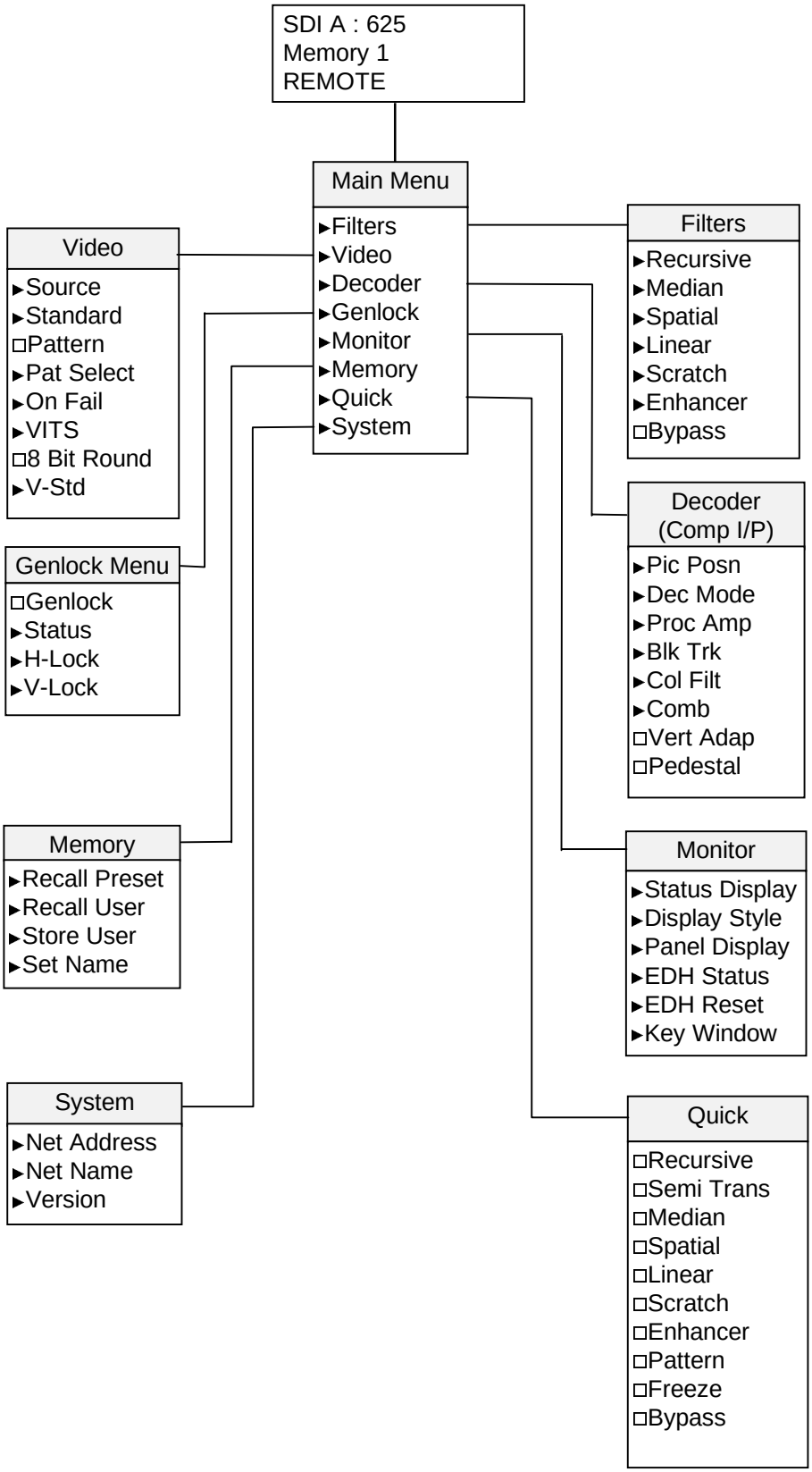
Similarly the left hand pair of LEDs indicate the condition of CPU B.



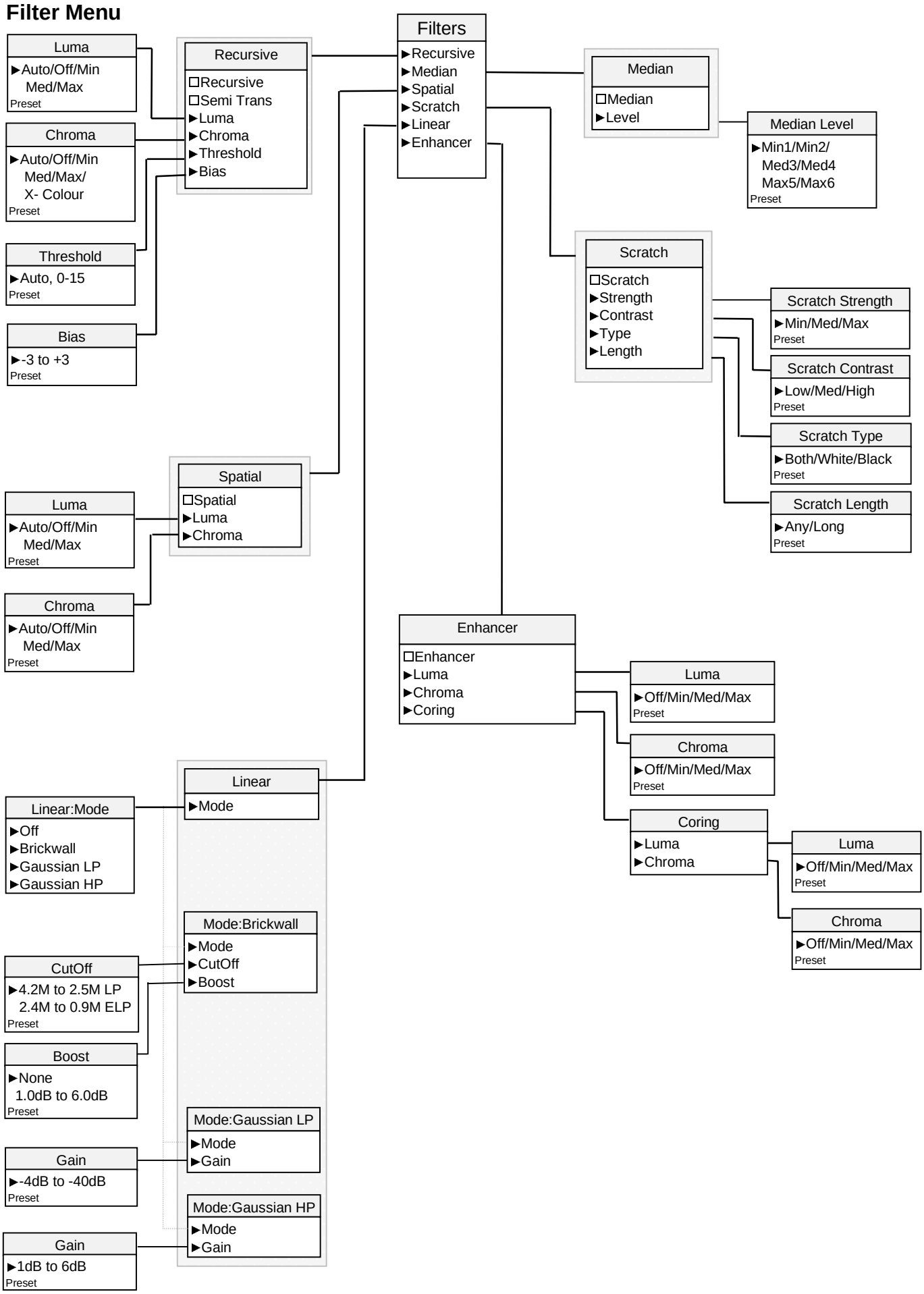
If for any reason the menu system should hang the CPU can be restarted with the CPU RESET switch.

Menu System

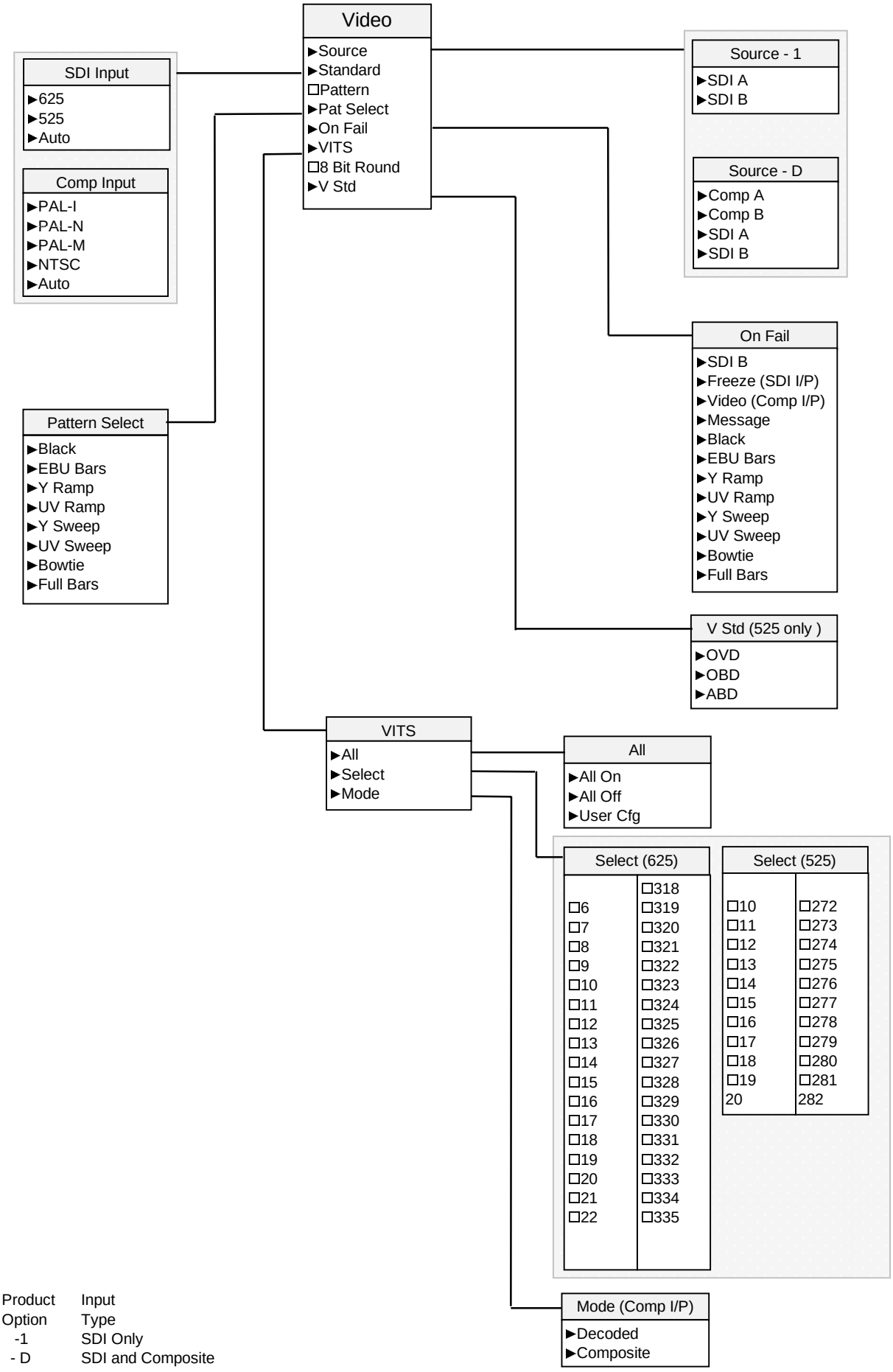
Normal Panel Display and Top Level Menu Structure



Filter Menu

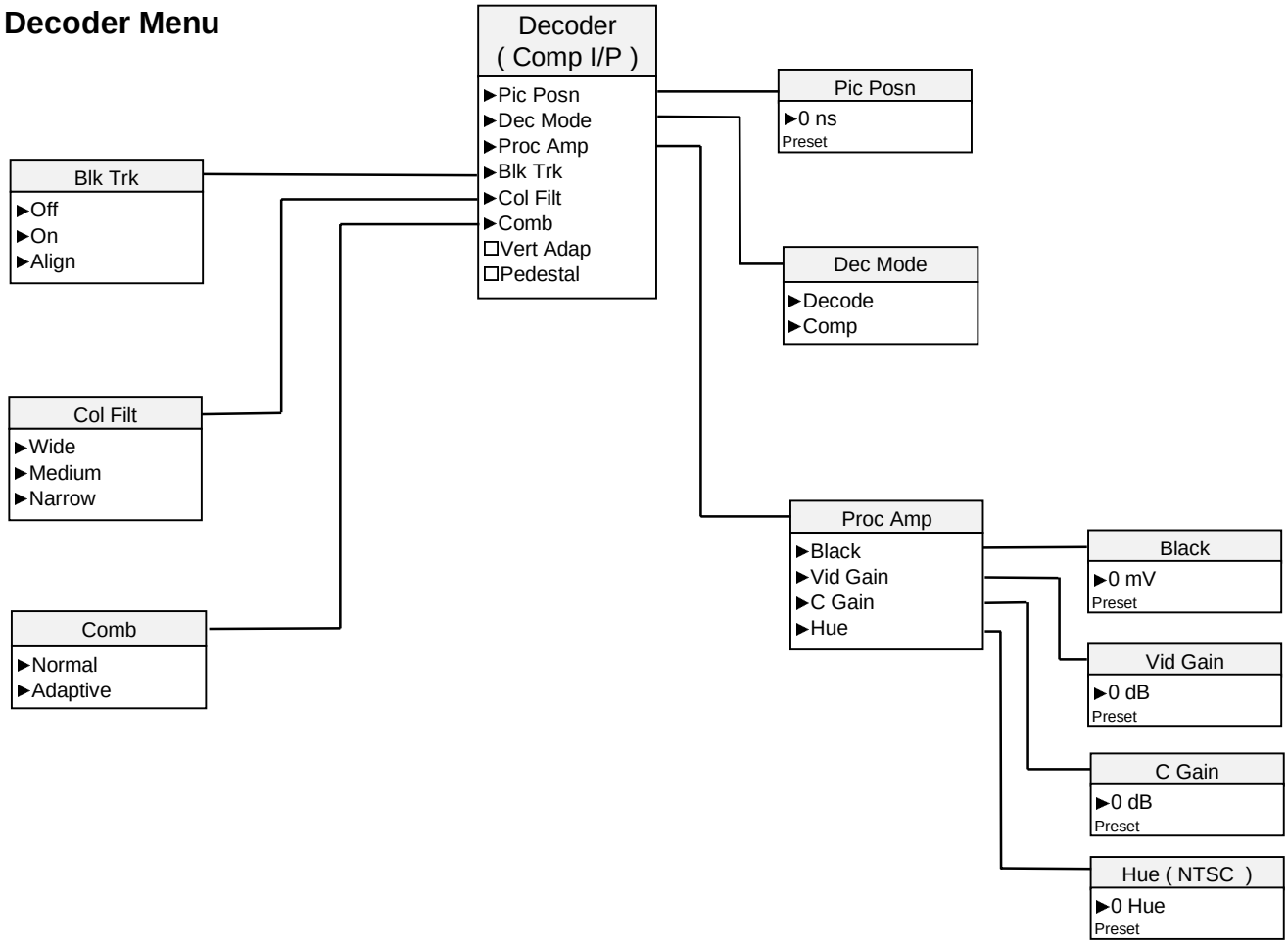

Filters
▶Recursive
▶Median
▶Spatial
▶Scratch
▶Linear
▶Enhancer
Recursive
☐Recursive
☐Semi Trans
▶Luma
▶Chroma
▶Threshold
▶Bias
Luma
▶Auto/Off/Min Med/Max
Preset
Chroma
▶Auto/Off/Min Med/Max/ X- Colour
Preset
Threshold
▶Auto, 0-15
Preset
Bias
▶-3 to +3
Preset
Median
☐Median
▶Level
Median Level
▶Min1/Min2/ Med3/Med4 Max5/Max6
Preset
Scratch
☐Scratch
▶Strength
▶Contrast
▶Type
▶Length
Scratch Strength
▶Min/Med/Max
Preset
Scratch Contrast
▶Low/Med/High
Preset
Scratch Type
▶Both/White/Black
Preset
Scratch Length
▶Any/Long
Preset
Spatial
☐Spatial
▶Luma
▶Chroma
Luma
▶Auto/Off/Min Med/Max
Preset
Chroma
▶Auto/Off/Min Med/Max
Preset
Enhancer
☐Enhancer
▶Luma
▶Chroma
▶Coring
Luma
▶Off/Min/Med/Max
Preset
Chroma
▶Off/Min/Med/Max
Preset
Coring
▶Luma
▶Chroma
Luma
▶Off/Min/Med/Max
Preset
Chroma
▶Off/Min/Med/Max
Preset
Linear
▶Mode
Linear:Mode
▶Off
▶Brickwall
▶Gaussian LP
▶Gaussian HP
Mode:Brickwall
▶Mode
▶CutOff
▶Boost
CutOff
▶4.2M to 2.5M LP 2.4M to 0.9M ELP
Preset
Boost
▶None 1.0dB to 6.0dB
Preset
Mode:Gaussian LP
▶Mode
▶Gain
Gain
▶-4dB to -40dB
Preset
Mode:Gaussian HP
▶Mode
▶Gain
Gain
▶1dB to 6dB
Preset

Video Menu



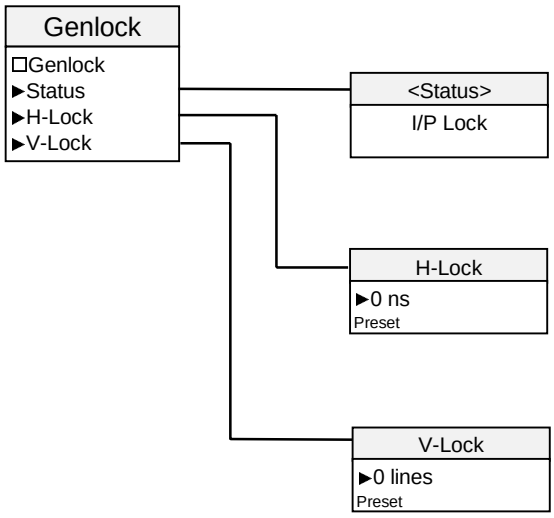
Product Option	Input Type
-1	SDI Only
- D	SDI and Composite

Decoder Menu

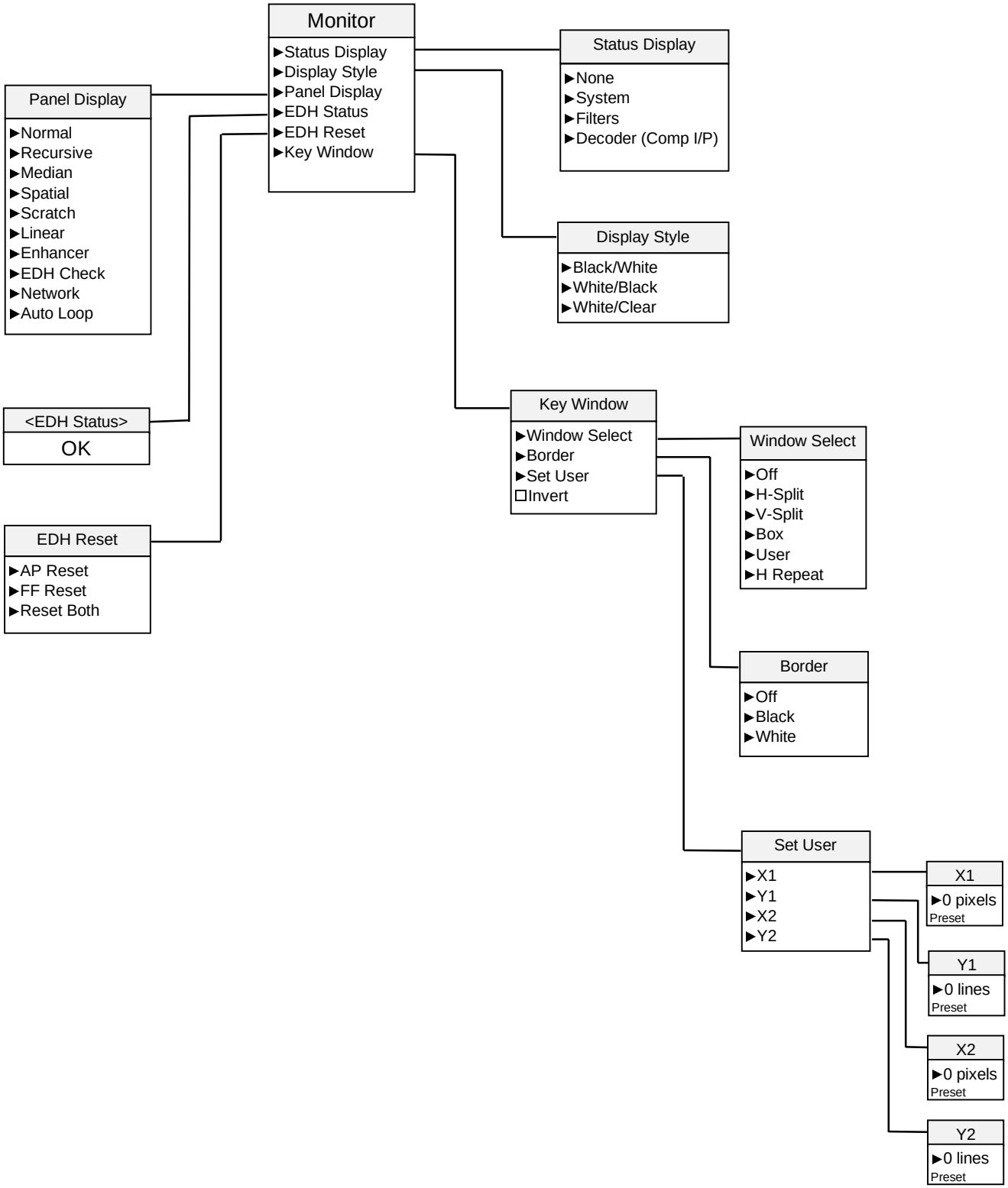


Note: The decoder sub-menu is only available if the optional decoder card is fitted and a composite video input is selected.

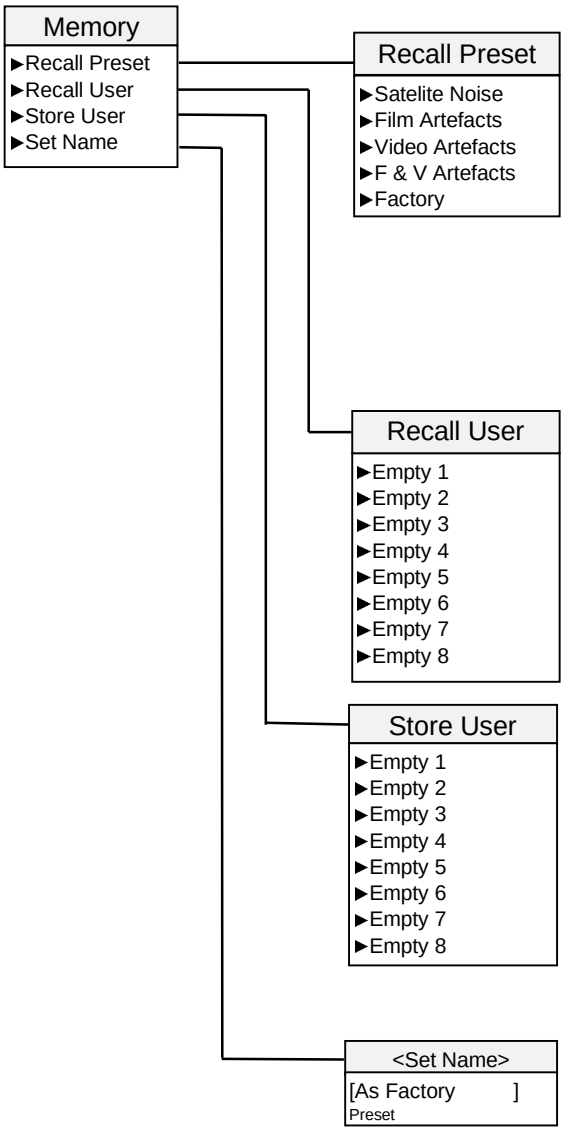
Genlock Menu



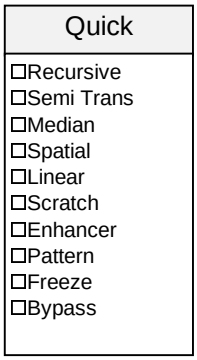
Monitor Menu



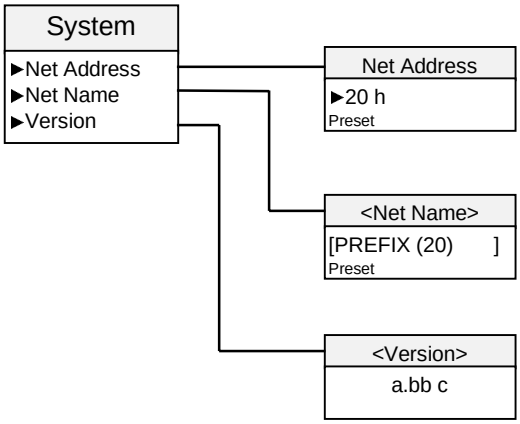
Memory Menu



Quick Menu



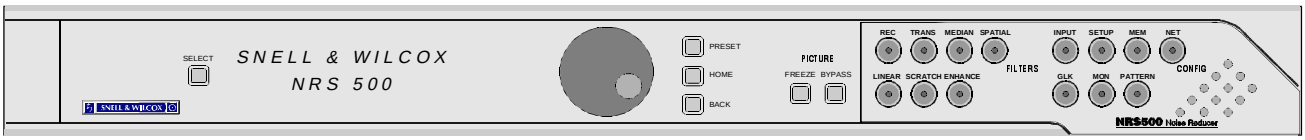
System Menu



Character set for <Net Name> and <Memory Name>

	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	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	{	|	}	~

Operation



All operational parameters and selections are made using a system of menus as shown in the previous section. A guide to controlling the NRS500 and what the operational parameters and selections do can be found in this section.

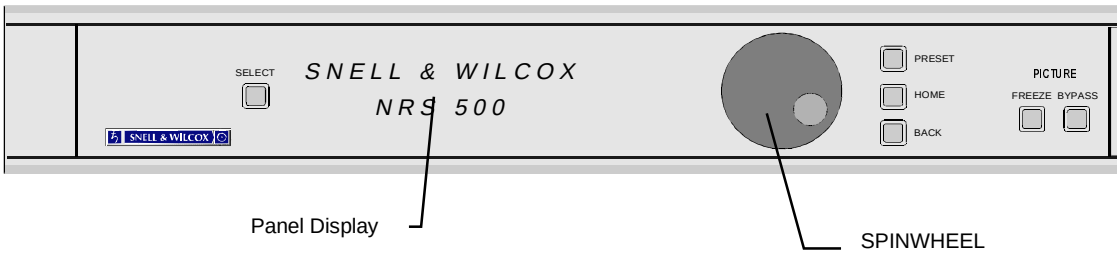
The NRS500 may be controlled by a number of different means:-

- Local front control panel,
- Remote “Shoe Box”
- Computer Interface
- Card Edge Control

When using a Remote “Shoe Box” or the computer interface, communication is via a wired network system called RollCall™. Several units may be controlled using this system. Further details can be found in section 7 and the “Shoe Box” operation manual.

If the NRS500 is fitted with a decoder card (top slot) the unit may be controlled by using the interface fitted to this card. This interactive user interface consists of a high contrast 8 character display and a bank of four push button switches, both of which are accessed by opening the front panel. Further details of this method of control can be found at the end of this section.

Front Panel Control



Menus are selected by using the spinwheel and the SELECT button. The two arrows to the right of the panel display indicate that more items are available, to view these use the spinwheel to scroll the display. The bottom line of the front panel is used to display unit status and warning messages.

The spinwheel can also be used to adjust parameters such as the Horizontal Genlock Offset.

SELECT Use this button to select a menu item, select a parameter or turn a feature on.

PRESET Use this button to choose the factory preset for the chosen parameter

HOME Return the menu to the NORMAL panel display

PREV Go Back up the menu structure one level

Panel Lock

A facility exists where the front panel can be locked out. This may be useful where accidental depression of one of the control buttons could occur or where the unit will be under remote control. To enter this mode press SELECT + HOME together. A status message, “PANEL LOCKED” , will be displayed on the front panel. To unlock the front panel press SELECT + HOME together again.

Picture

Button	Press
FREEZE	On / Off
BYPASS	On / Off

FREEZE

This performs a full frame picture freeze at the input to the NRS500. The freeze button has a status LED, when this is illuminated Freeze is ON, when the LED is extinguised Freeze is OFF. A status message, “FREEZE” , will be displayed on the front panel.

BYPASS

This button is used to turn the signal processing ON and OFF. When Bypass is turned ON all the filters are effectively turned OFF. This allows for a whole picture comparison of pre-processed against unprocessed without using the key window facility. When Bypass is on the green status LED in the button flashes. A status message , “BYPASS” , will be displayed on the front panel.

Filters

The set of seven 'FILTERS' buttons on the front panel can be used to access and control the filters.

Button	Press	Press and Hold
REC	On / Off	Goto Recursive filter menu
TRANS	On / Off	Goto Recursive filter menu
MEDIAN	On / Off	Goto Median filter menu
SPATIAL	On / Off	Goto Spatial filter menu
LINEAR	On / Off	Goto Linear filter menu
SCRATCH	On / Off	Goto Scratch filter menu
ENHANCE	On / Off	Goto Enhancer filter menu

Each of the filter push buttons has a green LED indicator. When the LED is illuminated the Filter is ON, when the LED is extinguished the Filter is OFF.

CONFIG

The set of seven 'CONFIG' buttons on the front panel can be used to access and control the set up and configuration of the unit.

Button	Press	Press and Hold
INPUT	Goto *Video-Source* menu	No Action
SETUP	Goto *Video* menu	Goto *Decoder* menu (Comp I/P)
MEM	Goto *Memory-Recall User* menu	Goto *Memory-Recall Presets* menu
NET	Goto *System* menu	Goto *System-Net Name* menu
GLK	*Genlock* ON/OFF	Goto *Genlock* menu
MON	On Screen *Status Display* ON/OFF	Goto *Monitor-Status Display* menu
PATTERN	Pattern ON/OFF	Goto *Video-Pat Select* menu

The GLK, MON and PATTERN buttons have a green LED indicator. When the LED is illuminated the feature is ON, when the LED is extinguished the feature is OFF. If the GLK button is flashing it means that there is a Genlock error. For further information see the paragraph on Genlock in the following section.

The INPUT and NET buttons have a red LED indicator. If these LEDs flash it means there is an input signal or network error. For further information see the following section.

Filter Menu

Filters
- ►Recursive
- ►Median
- ►Spatial
- ►Scratch
- ►Linear
- ►Enhancer

This section provides a brief overview of the filter controls. For a more detailed and in depth explanation please see Appendix 1.

Recursive

Recursive
- ►Recursive
- ►Semi Trans
- ►Luma
- ►Chroma
- ►Threshold
- ►Bias

This is the top level Recursive Filter menu.

To go directly to this menu PRESS and HOLD the REC button on the front panel.

The Recursive filter can be turned ON/OFF directly from the front panel by pressing the REC button.

The Semi Transversal Filter can be turned ON/OFF directly from the front panel by pressing the TRANS button. Note : The Semi Transversal filter can only be turned ON/OFF if the Recursive filter is ON

Recursive Luma Level

Default Off

Recursive Luma Level

Range Off/Min/Med/Max
Preset Min

Recursive Chroma Level

Range Off/Min/Med/Max/X-Color
Preset Min

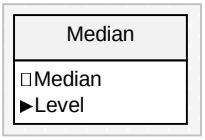
Recursive Threshold

Range Auto, 0-15
Preset Auto

Recursive Bias

Range -3 ... 0 ... +3
Preset 0

Median



This is the top level Median Filter menu.

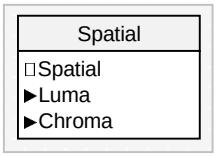
To go directly to this menu PRESS and HOLD the MEDIAN button on the front panel.

The Median filter can be turned ON/OFF directly from the front panel by pressing the MEDIAN button.

Median Level

Range Min1/Min2/Med3/Med4/Max5/Max6
Preset Min1

Spatial



This is the top level Spatial Filter menu.

To go directly to this menu PRESS and HOLD the SPATIAL button on the front panel.

The Spatial filter can be turned ON/OFF directly from the front panel by pressing the SPATIAL button.

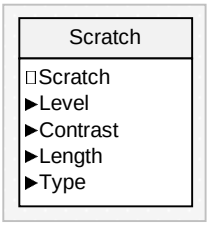
Spatial Luma Level

Range Off/Min/Med/Max
Preset Min

Spatial Chroma Level

Range Off/Min/Med/Max
Preset Min

Scratch



This is the top level Scratch Filter menu.

To go directly to this menu PRESS and HOLD the SCRATCH button on the front panel.

The Scratch filter can be turned ON/OFF directly from the front panel by pressing the SCRATCH button.

Scratch Strength

Range Min/Med/Max
Preset Min

Scratch Contrast

Range Low/Med/High
Preset High

Scratch Type

Range Both/White/Black
Preset Both

Scratch Length

Range Any/Long
Preset Long

Linear

Linear
►Mode

This is the top level Linear Filter menu when the filter is turned OFF.

Mode:Brickwall
►Mode ►CutOff ►Boost

Mode:Gaussian LP
►Mode ►Gain

Mode:Gaussian HP
►Mode ►Gain

If the Linear filter is turned on in one of the three operating modes the top level Linear Filter menu will show the different options available for that operating mode.

To go directly to this menu PRESS and HOLD the LINEAR button on the front panel.

The Linear filter can be turned ON/OFF directly from the front panel by pressing the LINEAR button.

Linear : Mode

Linear:Mode
►Off ►Brickwall ►Gaussian LP ►Gaussian HP

The default operating mode is Brickwall

Linear : Brickwall CutOff

The Brickwall filter has two sets of low pass filters. The first set of Low Pass (LP) has a variable boost available. The second set of Extra Low Pass (ELP) filters has a fixed level of boost.

Low Pass (LP)

Range 4.2 MHz to 2.5 MHz
Step 0.1 MHz
Boost Variable, 1dB to 6dB

Extra Low Pass (ELP)

Range 2.4 MHz to 0.9 MHz
Step 0.3 MHz
Boost Fixed

Preset Low Pass 4.2 Mhz

Linear : Brickwall Boost

Range 1dB , 2dB , 3dB , 4.5dB , 6dB
Preset None

Variable Boost is only available with the Low Pass Brickwall filters.

Linear : Gaussian LP Gain

Range -4dB to -40dB
Step -4dB
Preset -4dB

Linear : Gaussian HP Gain

Range 1dB , 2dB , 3dB , 4.5dB , 6dB
Preset 1dB

Enhancer

Enhancer
□Enhancer ►Luma ►Chroma ►Coring

This is the top level Enhancer Filter menu when the filter is turned OFF.

To go directly to this menu PRESS and HOLD the ENHANCE button on the front panel.

The Enhancer filter can be turned ON/OFF directly from the front panel by pressing the ENHANCE button.

Enhancer Luma Level

Range Off/Min/Med/Max
Preset Min

Enhancer Chroma Level

Range Off/Min/Med/Max
Preset Min

Enhancer Luma Coring

Range Off/Min/Med/Max
Preset Min

Enhancer Chroma Coring

Range Off/Min/Med/Max
Preset Min

Video Menu

Video
►Source ►Standard □Pattern ►Pat Select ►On Fail ►VITS □8 Bit Round ►V Std

If the optional decoder is not fitted this menu can be entered directly from the front panel. To do this PRESS and HOLD the SETUP button on the front panel.

The video menu allows configuration and control of the Input, Video Standard, Test Patterns, On Fail and VITS processing.

Source

To go directly to this menu PRESS the INPUT button on the front panel.

This selects the video input, and the menu displays the available sources. If the optional decoder card is fitted (-D) then four options are available:-

Comp A
Comp B
SDI A
SDI B

Default Comp A

If the optional decoder card is not fitted then only two options are available:-

SDI A
SDI B

Default SDI A

Standard

The NRS500 has the ability to automatically detect the video standard of the selected source. In most cases this will prove to be a satisfactory method. However the standard can be manually selected if required. The available options are:-

Decoder Card fitted (-D)

PAL-I / PAL-N / PAL-M / NTSC / Auto

Decoder Card not fitted (-1)

625 / 525 / Auto

Default Auto

V-Std

When a 525 serial digital component input is selected it is possible to select three different modes of operation.

Note: Lines 10-20/273-282 are collectively treated as VITS lines and as such can be individually blanked or passed. Although the following description assumes that all VITS lines have been selected to be passed through the unit, individual VITS lines may be blanked or passed as required. The following V-Std setting determines which of the VITS lines may be filtered.

SMPT125M permits the optional use of lines 10-19 and 273-282 as video. This is reflected in the data stream by changing the width of the embedded vertical blanking period. If the optional lines are used to carry video information then the vertical blanking period is reduced as shown below:

OVD Optional Video Data
Lines 1-9/264-272

Lines 1-9/264-272 are digitally blanked within the unit and lines 10-19/273-282 are treated as video and *will* be affected by any of the filters which are active within the unit.

If the optional lines are *not* used to carry video information then the vertical blanking period is increased as shown below:

OBD Optional Blanking Data
Lines 1-19/264-282

In this case, lines 1-19/264-283 will not be filtered within the unit and any VITS or embedded information will be passed.

In order to preserve closed caption information which may be transmitted on lines 20 or 21 an additional setting has been provided which affects these lines only:

ABD Additional Blanking Data
Lines 1-21/264-282

This setting behaves in the same way as OBD with the exception that lines 20 and 21 will *not* be filtered by any of the filters within the unit.

The embedded vertical flag conforms to the SMPTE125 OBD standard (lines 10-19/273-282).

Default OVD

Pattern

The internal test patterns can be enabled by selecting this option.

The test pattern can be turned ON and OFF directly from the front panel by pressing the PATTERN button on the front panel.

Pat Select

The test pattern displayed can be selected in the *Pat Select* menu.

To go directly to this menu PRESS and HOLD the PATTERN button on the front panel.

The available test patterns are:-

Black / EBU Bars / Y Ramp / UV Ramp /
Y Sweep / UV Sweep / Bowtie / Full Bars

Default EBU Bars

On Fail

When an input loss occurs it is possible to configure the NRS500 to operate in a predetermined mode dependent on which input is selected.

Composite Input Selected

SDI B / Video / Message / Black / EBU Bars / Y Ramp / UV Ramp / Y Sweep / UV Sweep / Bowtie / Full Bars

Default Message

SDI Input Selected

SDI B / Freeze / Message / Black / EBU Bars / Y Ramp / UV Ramp / Y Sweep / UV Sweep / Bowtie / Full Bars

Default Message

As soon as a valid input is detected the On Fail condition is released and the source is passed through the unit again.

On Fail : SDI B

When an input loss is detected this option displays a frozen image of the signal on SDI B. This option could be used to display a station logo or other static message. If SDI B is selected as the source this option performs an On Fail Freeze.

On Fail : Freeze (SDI inputs only)

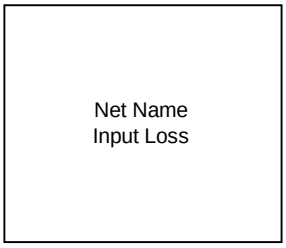
When an input loss is detected the picture is frozen.

On Fail : Video (Comp inputs only)

When an input loss is detected the ‘failed’ source is fed to the ouput.

On Fail : Message

When an input loss is detected, a black test pattern is generated. This is sent to the PROGRAM output. A message is displayed on the MONITOR output as shown below.



On Fail : Test Pattern

Any of the available test patterns can be selected should an input loss occur.

When the NRS500 detects that the input has recovered the On-Fail condition reverts back to the selected video source.

Vertical Interval Test Signal Processing (VITS)

The NRS500 provides for comprehensive VITS processing. The following options are available:-

All On	Pass all VITS lines
All Off	Blank All VITS lines
User Cfg	Selectively Blank VITS lines
Default	All On

When the *User Cfg* option is chosen the VITS lines to be blanked are picked in the *Select* sub-menu. The appropriate VITS lines for 525 line and 625 line standards are displayed. Individual lines can then be selected. For example if only line 10 is to be blanked the simplest method is to select the *All On* mode and then select line 10 in the *Select* sub-menu.

VITS Mode

If the source is composite then a further option is available. The VITS lines may be processed as decoded or composite.

Decoded	Pass as decoded luma
Composite	Pass sampled composite as luma, chroma blanked
Default	Composite

8 Bit Rounding

A facility exists to round the processed video to 8 bits. This is only done at the ouput stage of the NRS500, so signal processing is maintained at 10 bits or higher until the output stage. Use of this facility may be preferable as some systems truncate the video to 8 bits. Rounding to 8 bits upstream of such systems may improve the quality of the picture. The default status is 8 bit rounding OFF.

Decoder Menu

Decoder
►Pic Posn
►Dec Mode
►Proc Amp
►Blk Trk
►Col Filt
►Comb
□Vert Adap
□Pedestal

This menu is only available if the optional decoder is fitted, and a composite input is selected.

If a Composite input is selected it is possible to go directly to this menu.To do this PRESS the SETUP button on the front panel.

Pic Posn

This allows delay adjustment of output video in relation to the TRS codes

Range	± 1835.2 nsec
Step	7.4 nsec steps
Preset	0 nsec

Dec Mode

This specifies whether the input is colour or mono

Decode	Colour input will be decoded
Comp	Output is non-decoded digitised composite to preserve quality
Default	Decode

Decode

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.

Proc Amp

Vid Gain - this sets the sensitivity of the ADC. ie. Gain

Range	-3.00 dB to +3.00 dB
Step	0.2 dB steps
Preset	0 dB

C Gain - this sets the chroma gain

Range	-6.00 dB to +6.00 dB
Step	0.05 dB
Preset	0 dB

Black - this sets the offset of the ADC ie. Black level

Range	-20 mV to +20 mV
Step	0.2 mV
Preset	0 mV

Hue - this allows adjustment of the NTSC hue control

Range	-180° to +180°
Step	0.5°
Preset	0°

Black Track

This disables or enables the Automatic Black stabilisation

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

Colour Filter

This selects the type of filter 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
Default	Medium

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 chrominance 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

Comb

This selects the style of Combing and adaptive algorithms

Adaptive	Adaptive Field comb
Normal	Non-Adaptive Field comb
Default	Adaptive

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

Adaptive mode

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 chrominance smear on shot changes is required.

Normal mode

This mode uses a non-adaptive field comb to separate 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.

Vert Adap

This disables or enables the Adaptive algorithm for the vertical filter.

On	Adaptive filtering
Off	Vertical filtering, ie. No Adaption
Default	Off

Hannover bars and small chroma phase errors are suppressed by averaging across adjacent lines. An adaptive vertical filter has been included which cancels out small chrominance phase errors thus suppressing Hannover bars.

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

Vert Adap (cont)

On

The filter will adapt to vertical transitions. This is optimised for the sharpest pictures. Normal chroma transistions are unaffected in this mode. This has the maximum vertical resolution.

Off

In this mode some reduction of cross colour can be achived in addition to suppression of Hannover bars. However this will be at the expense of softening all vertical colour transitions.

This mode should be used where the picture content has a lot of high frequency diagonal luminance. e.g. Small graphics, captions, scrolling titles, chequered patterning etc.

Pedestal

This determines whether the input pedestal is removed or passed

Ped On	The input has a pedestal
Ped Off	The input has no pedestal
Default	Ped On

Genlock Menu

Genlock
□Genlock ►Status ►H-Lock ►V-Lock

To go directly to this menu PRESS and HOLD the GLK button on the front panel.

Genlock can be turned ON/OFF directly from the front panel by pressing the GLK button.

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 (Default)

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. This mode of operation needs to be used if the source video signal has embedded audio in the ancilliary data space.

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.

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. This facility is useful when the output needs to be in sync with other units such as in a studio system. This will allow clean switching between multiple sources which may have different phase relationships.

H-Lock

This changes the Horizontal Genlock Offset

525 line standards
- Range 0ns to 63455ns
- Step 37ns
- Preset 0 lines

625 line standards
- Range 0ns to 63899ns
- Step 37ns
- Preset 0ns

V-Lock

This changes the Vertical Genlock Offset

525 line standards
- Range 0 lines to 524 lines
- Step 1 line steps
- Preset 0 lines

625 line standards
- Range 0 lines to 624 lines
- Step 1 line
- Preset 0 lines

Genlock Status

This displays the current Genlock status

---	Unable to Genlock. Check the reference signal is valid or that the input is valid.
Off	Genlock Off
Input	Genlocked to input if a valid reference input is not present.
Ref	Genlocked to reference input

Status information about Genlock is also indicated by the status LED on the Genlock button and on the front panel LED display.

Using the Synchroniser

The NRS500 contains a frame-synchroniser which is essentially just a variable delay which has a little in excess of 1 frame capacity. The purpose of the variable delay is to allow each unit to provide an output picture which is cotimed with other units in a studio system. Normally this is achieved by applying a studio reference signal to each unit in the studio and the variable delay automatically adjusts the output so it is horizontally and vertically phased-up with the studio reference.

The purpose is to allow clean switching between multiple sources which may have different phase relationships.

Another advantage of a synchroniser is that the stability of the output clock is directly related to the quality of the reference signal. This is fundamental as the output video rate must be phase locked to the reference video signal. In some cases this is also important as it guarantees output clock stability even if the input disappears or is noisy.

The penalty of using a synchroniser is that the input and output sides of the synchroniser are running at different clock rates and sooner or later the synchroniser will be forced to repeat or drop a video frame. A complete frame must be dropped to avoid interlace errors. This is fundamental and will almost certainly be undetectable.

If no reference is applied then the unit will automatically phase lock to the input as long as Genlock ON is selected. In this case there will be no necessity to repeat or drop a video frame and the output of each unit will be a fixed minimum delay relative to the input.

With Genlock OFF the frame synchroniser will once again be running with different clock rates on each side and therefore will either repeat or drop a frame as necessary. The output clock stability will be very high because the read side XTAL will be set to the nominally correct freqency but will not be phase locked.

Genlock Warnings

If there is a Genlock error the GREEN status LED in the Genlock button will flash.

REF	Reference is wrong standard. Check that the input standard is set correctly, and that the reference is the correct standard.

This is displayed on the bottom line of the front panel display at the right hand side.

Summary of Genlock Operating Modes

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

Note: Whenever the Genlock mode is OFF the output is always free-running.

Monitor Menu

Monitor
►Status Display
►Display Style
►Panel Display
►EDH Status
►EDH Reset
►Key Window
►Border

To go directly to this menu PRESS and HOLD the MON button on the front panel.

The On Screen Status Display can be turned ON/OFF directly from the front panel by pressing the MON button.

Status Display

None / System / Filters / Decoder (Comp I/P)

Default None

The *Status Display* provides an on screen status display of the NRS500 settings and configuration. The status display information is sent to the MONITOR output only. The style of this display can be selected in the *Display Style* sub-menu.

Display Style

Black/White	Black text on white background
White/Black	White text on black background
White/Clear	White text on clear background (picture)

Default Black/White

Panel Display

Normal / Recursive / Median / Spatial / Linear / Scratch / Enhancer / EDH Check / Network / Auto Loop

Default Normal

The panel display can be controlled using the front panel buttons as well as the menu structure.

PRESET+PREV	Panel display auto loop
PRESET	Next display page
PREV	Previous display page
HOME	Normal panel display

Panel Display (cont)

The *Panel Display* sub-menu provides a facility to display the NRS500 settings and configuration on the LED display on the front panel. Filter configuration information or unit status information can be displayed, optionally the display can be set to automatically scroll through all the status and configuration information.

When the front panel LED is showing the status display the menu control buttons can also be used to select which status information is displayed. Use the PRESET or PREV buttons to scroll through the different status and configuration information. To set the panel display into automatic scroll mode simply press PREV and PRESET together. To turn off the automatic scroll simply press PREV and PRESET together again.

EDH Status

The NRS500 performs automatic checking of the SDI bitstream. The *EDH Status* menu indicates the current status of the EDH checking. The messages displayed are:-

None	EDH not present
OK	EDH present no errors
Errors	EDH is present with errors
Off	EDH checking turned off

This display is constantly updated, and reflects the current EDH status. To view the Active Picture and Full Field Error Second counts use the *Panel Display* or *Status Display*. The EDH error second count can be reset in the *EDH Reset* sub-menu. When the H-Split key window is selected EDH checking is turned off.

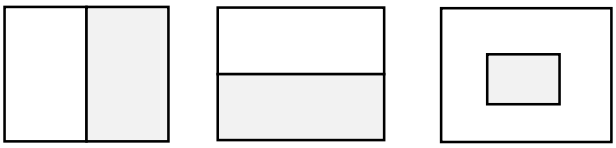
EDH Reset

AP Reset	Reset Active Picture Error Seconds
FF Reset	Reset Full Field Error Seconds
Reset Both	Reset AP and FF Error Seconds

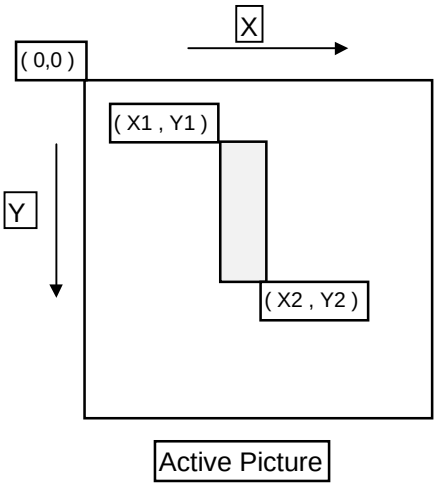
Key Window

A powerful facility exists in the NRS500 to control which areas of the picture are processed. This can be found in the *Key Window* sub-menu. The key window can be set up as a basic split or a user definable area. The options available are:-

H-Split V-Split Box

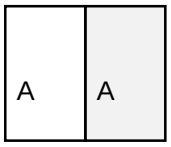


User



The user defined key window could be used to apply processing to a specific area of the picture. The coordinates are set in the *Set User* sub-menu. The coordinate pairs are specified as top-left and bottom right, (X1,Y1) and (X2,Y2). The range of values for X is 0 to 719 pixels . The range of values for Y is 0 to 285 lines in 625 line standards and 0 to 242 lines in 525 line standards.

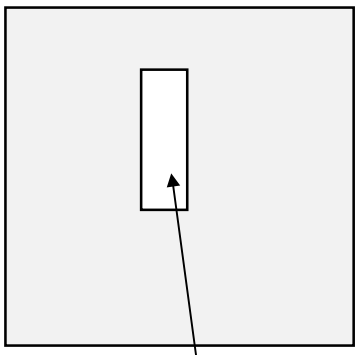
H-Repeat



H-Repeat performs a horizontal repeat so that the left half of the picture is repeated on the right half of the picture.

When key window is selected the signal processing is applied to the shaded area. It is possible to invert the sense of the key window so that processing is applied to the other part of the picture instead.

With the user definable key window a particular area of the picture could be excluded as shown below.



Area to be excluded from processing selected by user defined key window and Key window invert

The Key Window can be highlighted by selecting a *Border* to be displayed around the key window.

Please note that when the key window is chosen it is applied to both the PROGRAM and MONITOR outputs. Hence the processing is applied to the PROGRAM and MONITOR outputs. The Border is only visible on the MONITOR output.

Memory Menu

Memory
►Recall Preset
►Recall User
►Store User
►Set Name

This menu allows unit configuration and settings to be stored and recalled.

In the *Store User* sub-menu there are eight initially empty memory slots. To recall one of the user defined memories use the *Recall User* sub-menu. *Set Name* allows the name of the user memories to be selected by the user.

There are a set of pre-defined memory settings for specific applications and these can be found in the *Recall Preset* sub-menu.

Current Operating Conditions

When the panel display shows the 'normal' status page the current memory name is displayed on the second line. If any setting is different to that memory either "(Modified)" or "(Mod)" will be added to the end of the name to show that the current configuration is a modified version of that store.

The current settings, including the network name and address, are maintained in a special store that is recalled when the NRS500 is powered on. Ten seconds after any setting is changed it is written to this store so that if the unit is subsequently powered off then on again its configuration will not be lost.

Store User

The eight user defined memories store all the NRS500 configuration settings such as filters, decoder parameters and video configuration. The only exceptions to this are the Network Address and Name, these are only changed and stored under the *Sytem* menu.

Using the memory.

1. Set up NRS500 with the desired settings such as
   SDI A, VITS All On
   Recursive On
   Median On

2. Use the *Set Name* sub-menu, and select the name for the memory. You could adopt a simple numbering system, use a channel name or a generic setting such as film or sports.

3. Store the memory. To do this enter the *Store User* sub-menu and choose which memory slot is to be used. Press SELECT when the desired slot has been chosen.

Recall User

The eight user defined memories can be recalled by using the *Recall* sub-menu. Simply choose the desired memory and press the SELECT button. When a user defined memory is recalled, ALL parameters and configuration information including the source are set as per the memory.

Recall Preset

This sub-menu contains a set of pre-defined memory settings for specific applications. These settings provide a guide for the filters which are appropriate for particular types of noise. The actual settings for each filter should be evaluated depending on the material being processed. When these memories are recalled only the Filter configuration and control parameters are recalled. So if the source is composite A, recalling the Film Artefact preset memory will not change the decoder or video set up, only the filters will be changed.

The Preset memories are:-

Satelite Noise
Film Artefacts
Video Artefacts
F & V Artefacts
Factory

The final entry in the *Recall Preset* sub-menu is a Factory setting. This can be used to return all configuration and control parameters to the default state when the unit was shipped. Note that the Net address and Net Name are reset when you do a Recall Factory.

Set Name

To change the characters in the memory name, the SELECT button is used to move the cursor along one character to the right. The SPINWHEEL is used to change the character. The available characters are shown in the menu structure.
When the desired memory name has been entered press the SELECT button until the cursor is at the end of the text entry field. Pressing the SELECT button once more will return to the Memory menu.

PRE-DEFINED MEMORIES - General Settings

	Application	Recursive	Semi Transversal	Median	Spatial	Linear	Scratch	Enhancer
1	Satelite Noise	Y - Med C - Med Threshold - Auto Bias - 0	On	Level - Med 3	Off	Mode : Off	Off	Off
2	Film Artefacts	Y - Min C - Med Threshold - Auto Bias - 0	On	Level - Med 4	Y - Min C - Med	Mode : Off	Strength - Med Contrast - Low+Med Length - Long Type - Both	Mode : Enhance Y - Min C - Min Y Core - Min C Core - Min
3	Video Artefact	Y - Med C - X colour Threshold - Auto Bias - 0	On	Level - Med 3	Y - Min C - Max	Mode : Off	Off	Off
4	Film & Video Artefacts	Y - Med C - X Colour Threshold - Auto Bias - 0	On	Level - Max 5	Y - Med C - Max	Mode : Brickwall Cutoff - 3.2MHz Boost - 0dB	Strength - Med Contrast - Low+Med Length - Long Type - Both	Off

PRE-DEFINED MEMORIES - Factory Settings

	Application	Recursive	Semi Transversal	Median	Spatial	Linear	Scratch	Enhancer
11	Factory	Off	Off	Off	Off	Off	Off	Off

Note : This also resets all other control and configuration parameters to their default setting.

Quick Menu

Quick
□Recursive □Semi Trans □Median □Spatial □Linear □Scratch □Enhancer □Pattern □Freeze □Bypass

The *Quick* menu provides a fast way to turn key features of the unit On and Off. This facility will probably be of more benefit when using the 'Shoe Box' interface. When using the local front panel all the features in the *Quick* menu are accessible by single button presses on the front panel.

System Menu

System
►Net Address ►Net Name ►Version

To go directly to this menu press the NET button on the front panel.

The *Net Address* can be accessed directly from the front panel. To do this PRESS and HOLD the NET button.

The system menu allows configuration of the RollCall network address and name. The address can be changed in the *Net Address* sub-menu. The default is 20h, the network address is displayed in hexadecimal format. The *Net Name* could be changed to something meaningful such as a channel name or rack unit and location. The Net Name is set in the same way that the memory name is set.

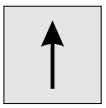
If the On-fail condition is selected as Message, the Net Name is displayed on the MONITOR output.

The software *version* number can also be recalled in this menu.

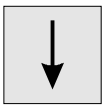
Operation from Decoder Card Edge

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.

The NRS500 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.

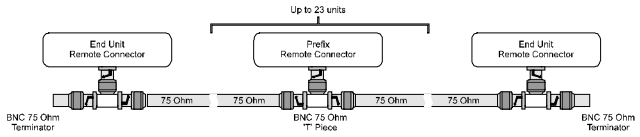
Pressing [↑] and [↓] simultaneously recalls the preset option for a menu entry.

Once the NRS500 has been configured the menu should be returned to the top level by pressing [ESC] as required. In this way any status or error messages can be scrolled across the display.

Remote Control

The NRS500 has provision to be remotely controlled via the serial BNC network - S&W Roll Call.

Interface to the RollCall™ 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 25 on one single cable run.



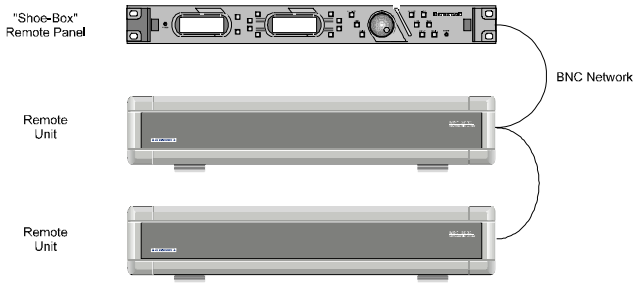
The communications network is a specially designed remote control network system and many more units can be accommodated by using a "Network Bridge". Remote control can come from either a dedicated front panel or "shoe-box" or a standard IBM compatible PC. Full protocol documentation and more detailed 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 NRS500 remote configuration is shown below where several compression pre-processors 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.

Network Configuration

If a number of Snell & Wilcox products are to be connected to a RollCall™ network each needs to be assigned a unique identification number. This *Network Address* is a number between 1 and 255 (usually shown in hex as 0x01 to 0xff). Addresses in the range 0x01 to 0x1f are reserved for network bridging and gateways so each NRS500 must have a unique address between 0x20 and 0xff.

The best way to configure a network is to draw up a table of units and allocate an address and name to each. Each unit should then be set up before connecting to the network or while the other devices on the network are powered off.

Alternatively advantage can be taken of the automatic network address selection facility of the NRS500. Whenever a NRS500 is powered on it checks that its network address is not already being used by another device. If the address is being used it will search for the next available value and will configure itself to use this new address.

When a new NRS500 is delivered to a customer it will have the factory default network address of 0x20 and network name “NRS500 (20)”. If this unit is added to a network that already contains a device with address 0x20 the new unit will pick the next free address, say for example 0x34. In this case the unit’s network name will also be updated to “NRS500 (34)”. The name can now be changed to something more meaningful.

If a large number of new NRS500s are to be formed into a network they will all start with address 0x20, but the second unit to be powered on will find that 0x20 is in use by the first and so will set its address to 0x21. The third unit powered on will find both 0x20 and 0x21 in use so will select 0x22 and so on until all units have configured themselves. A remote control device on the network will show units named “NRS500 (20)”, “NRS500 (21)”, “NRS500 (22)” etc. Knowing the order power was applied will allow each unit to be identified and more meaningful name, such as “OB Feed 1” or “Rack 1, Unit 3” to be set. Once a unit’s address is correctly configured it will not change unless it is powered off and then attached to a new network that already has a unit with the same address.

If you wish to configure a network automatically it is important to realise that each time a NRS500 checks a prospective network address it takes a second. This means that when configuring a network of 20 devices, each NRS500 should be allowed at least 20 seconds to pick a network address before another unit is powered on. A more accurate method is to wait for each new NRS500 to be shown on a remote control device such as a *Shoebox* or a PC before powering on the next one.

***Note** : It is not recommended to connect more than 25 NRS500s or other RollCall™ devices on a single section of coax network. If a larger system is required sections of up to 25 units should be built with at least one Shoebox each. The sections can then be linked with 9-way ribbon cable linking the Shoeboxes’ “Network” connectors. The sections will all be regarded as one network so any of the units can be controlled by any of the Shoeboxes. The total number of units that can be connected in this way is limited, by the number of unique addresses, that is, up to about 200.*

Specifications

Signal Inputs:

Composite A Loop	Analogue loop-through input 1V pk-pk 75 Ohm impedance
Input Return Loss	Better than 40 dB at 4.43 MHz
Composite B Loop	Analogue loop-through input 1V pk-pk 75 Ohm impedance
Input Return Loss	Better than 40 dB at 4.43 MHz
SMPTE 259M Inputs	SMPTE 259M - C A input SMPTE 259M - C B input
Input Return Loss	Better than 17 dB at 270 MHz
Reference Loop	Analogue loop-through input 1V pk-pk 75 Ohm impedance

Signal Outputs:

SMPTE 259M-C Outputs	2 off Program Outputs 1 off Monitor Output
Output Return Loss	Better than 17 dB at 270 MHz

Communications

Serial Net RollCall™ BNC	Proprietary Snell & Wilcox interface multi-drop via BNC-T network
System Communication	9 pin D-Type RS422 Slave
AUX	9 pin D-Type RS422 Master

Power

Input Voltage Range	90 V to 250 V 50/60 Hz 1.2 A
Consumption	100 VA maximum
Mains Fuse Rating	2.5 A (T)

Mechanical

Temperature Range	0 to 30° C operating
Cooling	Filtered Axial fan. Front to rear air flow
Case Type	1RU Rack Mounting
Dimensions	1RU - 483mm x 535mm x 45 mm (w,d,h)

Digital Decoder (optional)

Digital Processing	Minimum 10 bit processing throughout.
ADC Conversion	Analogue composite input is sampled using 10 bit ADC twice oversampled and digitally filtered/decimated
Luminance/Chrominance Separation	Symmetric multi-standard adaptive field comb. Dual 312H PAL-I, PAL-N Dual 263H NTSC, PAL-M
Composite Formats	AUTO, PAL-I, PAL-N, PAL-M, NTSC
BLO operating range	±100 Hz
Video gain	±3 dB, 0.1dB steps
Chroma gain	±6 dB, 0.05dB step
Black level	±20 mV, 2mV step Manual or Automatic tracking
Colour filters	Wide/medium/narrow
NTSC / PAL-M pedestal	On - Input has a pedestal Off - Input does not have a pedestal
NTSC hue	±180°, 1° step
Picture Position	±600nsec
Decode Mode	Enable or disable Y/C separation
Comb Mode	Non adaptive/Adaptive (default)
Vertical Adaption	Chrominance Hannover bars suppression On - Adaptive vertical filter (default) Off - Non adaptive vertical filter
VITS	Individual line controls or Group control for blanking/passing of VITS lines. 625 composite standard: 6 to 22 & 318 to 335 525 composite standard: 9 to 20 & 271 to 282

Pre-Processor

Recursive Filter	Motion Adaptive asymmetric temporal (frame) recursive filter. Three set levels with maximum noise reduction of up to 12dB. Bias adjustment ±3 allows fine control in approximately 1dB steps. Filter ON/OFF Y: AUTO, Off, Min, Med, Max C: AUTO, Off, Min, Med, Max Bias: -3 - +3 Threshold (Noise floor): AUTO, 1 - 15
Semi-Transversal Filter	Operates on recursive filter output. Reduces absolute levels of noise trails in static revealed/concealed areas e.g. after scene changes up to 4.7dB. Can only be switched on when recursive filter is selected. Filter ON/OFF
Median Filter	Adaptive spatial/temporal median filter. Filter ON/OFF Level: Min 1, Min 2, Med 3, Med 4, Max 5, Max 6
Spatial Filter	Spatial 2D median filter. Filter ON/OFF Y: Off, Min, Med, Max C: Off, Min, Med, Max
Linear Filter	18 sets of linear 15 tap low pass brickwall digital filters. 6 sets of linear 15 tap extra low pass brickwall digital filters. 6 sets of peaking value for each cut-off frequency. 10 sets of Gaussian low pass filters (no peaking). 5 sets of Gaussian high pass filters.
Brickwall Low Pass Cut Off:	Full Bandwidth, 4.2 - 2.5MHz (-6dB) in 0.1 MHz steps
Brickwall Extra Low Pass Cut Off	2.4 - 0.9MHz (-6dB) in 0.3 MHz steps (no boost)
Boost:	None, 1dB, 2dB, 3dB, 4.5dB, 6dB
Gaussian Low Pass:	-4dB to -40dB in 4dB step
Gaussian High Pass:	1dB, 2dB, 3dB, 4.5dB, 6dB
Scratch Filter	Filters, of different strengths, for Vertical scratches, of variable contrast, type and length. Filter ON/OFF Strength: Min, Med, Max Contrast: Low, Med, High Length: Any, Long Type: Both, Black, White
Enhancer	Spatial 2D enhancer utilising separately derived non-linear and linear edge detection and compression. Luma: Off, Min, Med, Max Chroma: Off, Min, Med, Max Luma Coring: Off, Min, Med, Max Chroma Coring: Off, Min, Med, Max

Synchroniser	Genlock: Input/Reference/OFF Status: I/P lock, Ref. Lock Horizontal offset: 0 - 1H (in 37ns steps) Vertical offset: 0 - 624H (625 standards) 0 - 524H (525 standards)
VITS	All On, All Off, Select individual lines Individual line controls or Group control for blanking/passing of VBIS lines 625 Standard 6-22/319-335 525 Standard 9-20/272 -280
Embedded V flag Style (525 line only)	OVD Optional Video Data (1-9/264-272) Lines 1-9/264-272 not filtered OBD Optional Blanking Data (1-19/264-282) Lines 1-19/264-282 not filtered ABD Additional Blanking Data (20/21) Lines 1-21/264-282 not filtered (V flag as OBD)
8 Bit Rounding	10 bit to 8 bit rounding using truncation error feedback.
EDH	Input error detection and handling Status: None, OK, Errors AP/FF Individual or linked reset. EDH insertion on two PROGRAM outputs.
Key Window	Allows split screen facilities to monitor effect of digital filtering applied to the key area only.
Select:	Off, H-Split, V-Split, Box, User, H-Repeat
User:	User Defined Key window co-ordinates X1, Y1, X2, Y2
Invert:	Inversion of selected key window.
Border	Selects the border shade around the key window. Off, Black, White
Pattern	Internal Test Patterns. Black/EBU Bars/Y Ramp/UV Ramp/Y Sweep/UV Sweep/Bowtie/Full Bars
On Fail	This sets the default mode for the unit when the input signal fails. SDI B / Video (Comp I/P) / Freeze (SDI I/P) / Message / Any of the test patterns.
Panel Display	RollCall™ shoebox panel display information: Normal, Recursive, Median, Spatial, Linear, Enhancer, EDH Check, Network, Auto Loop
On Screen Display	On screen status display using Monitor output None, System, Filters, Decoder
Memory	
Store:	User defined memory Slots 1-8
Recall User:	User defined memories 1-8
Recall Preset:	Recall preset memories or Factory set up
Set name:	Set Memory Name (user defined) 1-8, 10 characters ASCII character set.

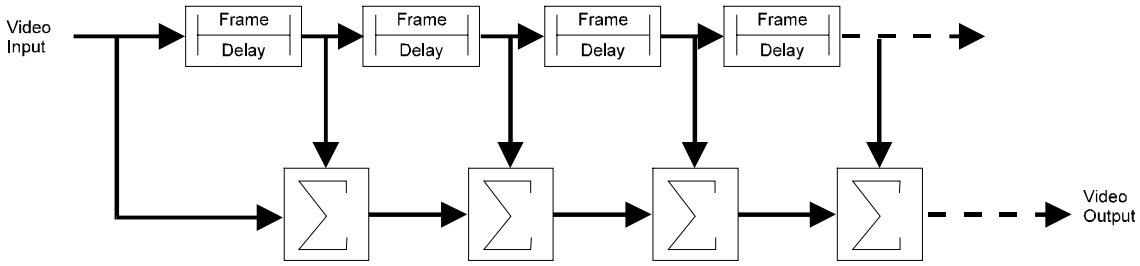
Company policy is one of continuous product improvement. Specification is subject to change without notice.

Appendix 1-Using the Filters

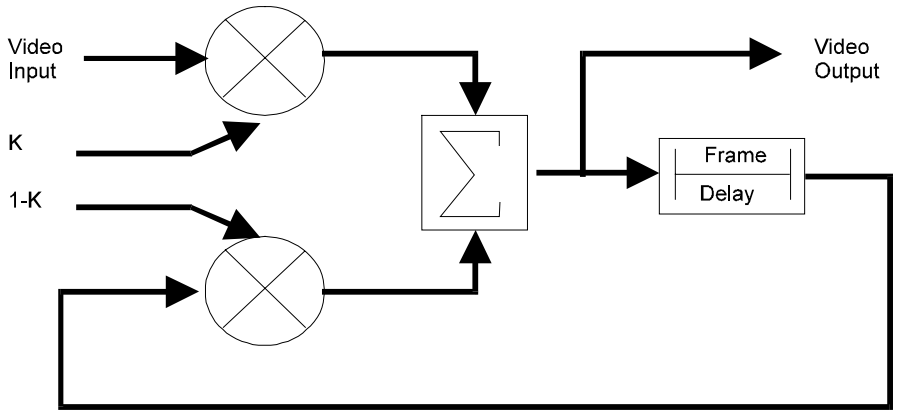
Recursive Filtering

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))

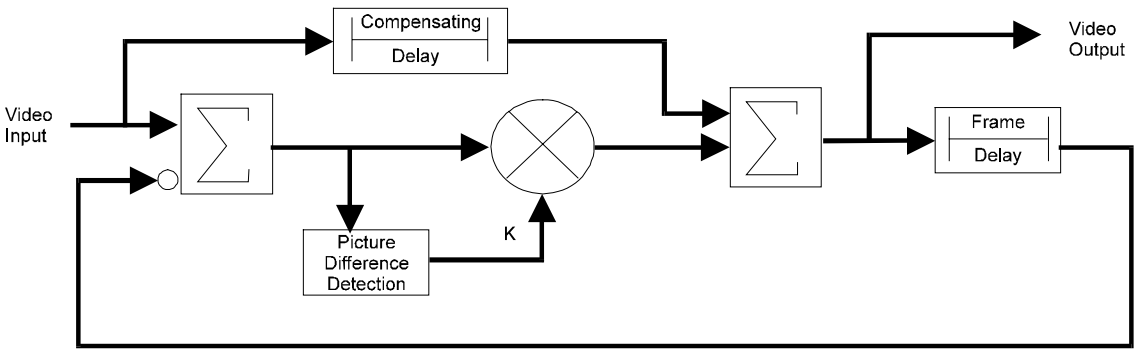
Which can be rewritten as:

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:



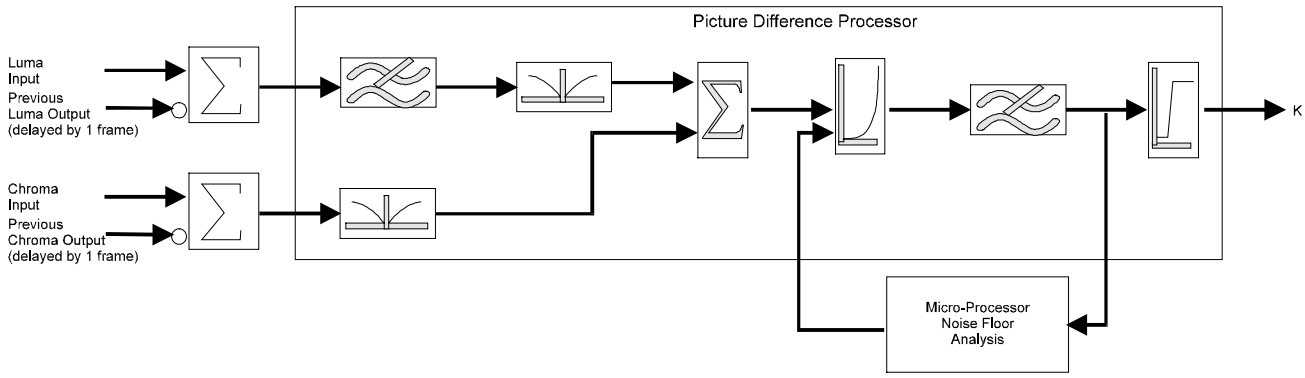
This arrangement removes one of the multipliers at the expense of a second adder and has the added benefit of providing a picture difference signal which is used in the picture difference processor to generate the cross-fade value K.

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.

Semi-Transversal

The semi-transversal filter operates in conjunction with the recursive filter to increase its effectiveness. Quite unlike the traditional transversal filters described in the preceding section it operates by selecting the most appropriate output from a chain of picture stores at the output of the recursive filter.

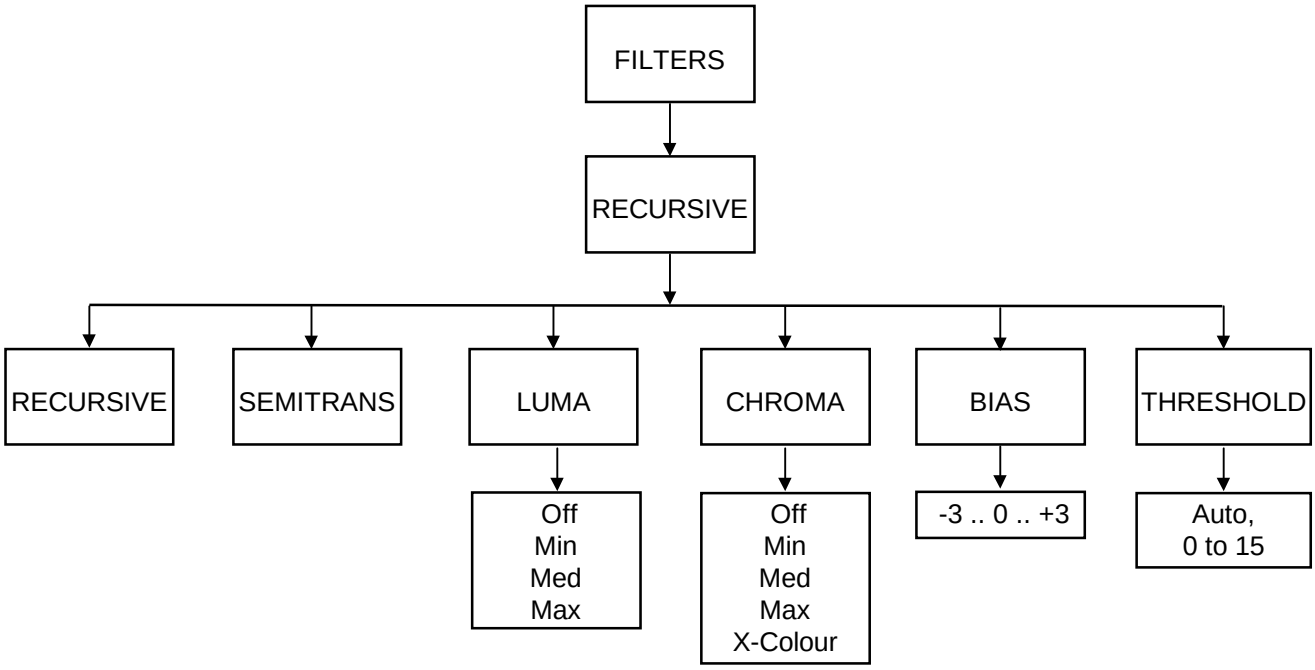
An algorithm is used to determine which of the stores contains the highest level of noise reduced picture. The overall effect is to increase the amount of noise reduction in a typical picture. For example, moving objects cause the recursive filter to turn off at the edge of the moving object. This leads to a recurrence of noise which takes a number of frames to reduce to the defined user level. The semi-transversal filter is able to monitor the recurrence of noise and delay the output of the recursive filter up to a maximum of three frames. Operating on a pixel-by-pixel basis, the overall level of noise reduction in a typical picture is maintained at a more uniform level and is less dependent on movement. As the semi-transversal filter complements the recursive filter, it cannot be used without the recursive filter. Effective at all recursive filter settings its operation can be seen as a reduction in the level of revealed noise trail following moving objects.

The semi-transversal filter operates in a fully automatic mode - there are no user adjustments required.

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

The cross-colour setting in the chroma 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

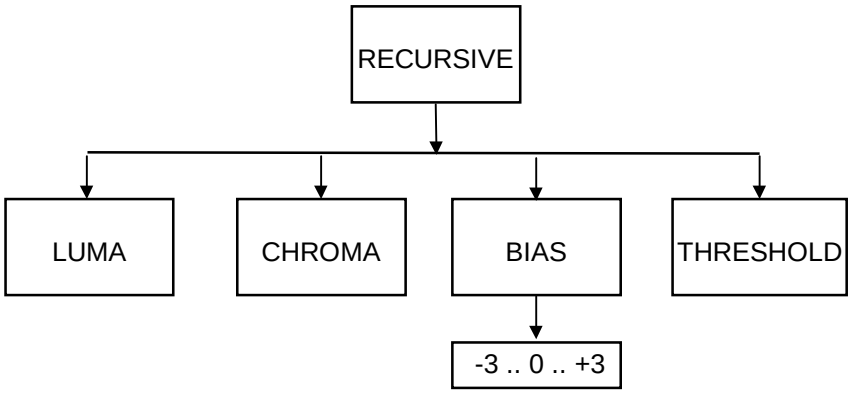
The recursive noise reducer has a threshold setting which determines the sensitivity of the noise reducer to picture differences. In the AUTO position (default) the sensitivity of the picture difference detector is set at a level which is appropriate for the amount of measured noise. The overall effect 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.

Median Filtering

Introduction

Median filters operate by rank ordering a set of points selected from an 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 filter used in The NRS500 operates on the five most appropriate points selected from a 9-point aperture.

Median filters are effective at suppressing impulse noise which tends to end up at the extremes of the sorted list. Moving textures would also be distorted by the median filter if the filter were applied universally. Hence an algorithm is used to evaluate spatial and temporal gradients in the vicinity of the suspect pixel to determine if it has the characteristics of impulse noise. This serves the dual purpose of rejecting false alarms caused by moving textures and noisy sources.

The median filter has six settings which control both the strength and aperture set.

Min 1. This setting is used to conceal small drop-outs and sparkle which have a high contrast. It utilises information from adjacent lines only and is very selective.

Min 2. This setting is also used for small drop-outs and sparkle but is also effective for film dust and lower contrast drop-outs. It utilises information from adjacent lines only and is quite selective.

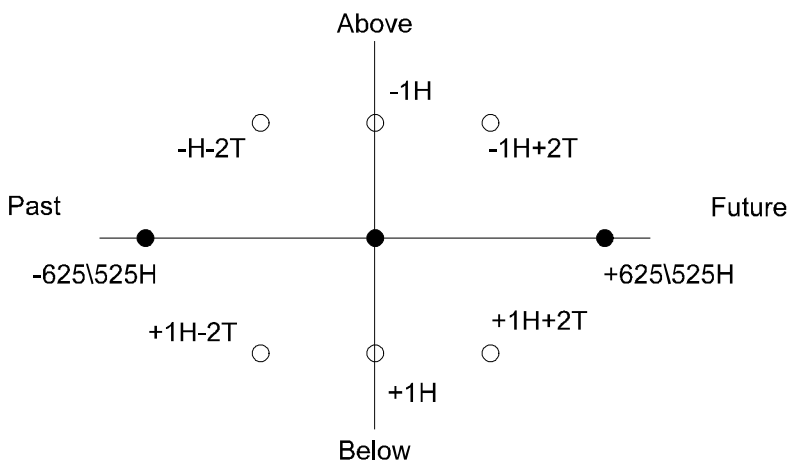
Med 3. This setting should be used for low contrast drop-outs and dust\small dirt. It utilises information from adjacent lines only and is quite selective.

Med 4. This setting is more effective at concealing small\medium dirt. It utilises information from both the current frame and adjacent frames.

Med 5. This setting is used to conceal medium dirt. It utilises information from both the current frame and adjacent frames.

Med 6. This setting provides the highest level of concealment for medium\large dirt. It utilises information from both the current frame and adjacent frames.

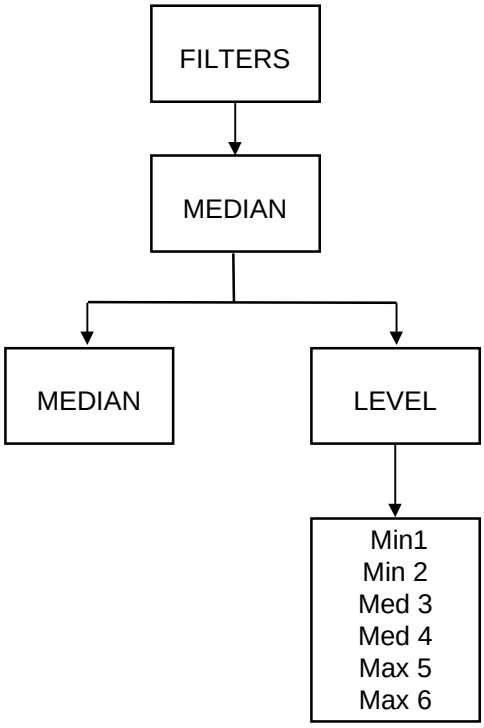
Median Filter Aperture



A subset of the points shown in the above aperture may be used in the median filter depending on the strength selected. In addition to the points shown in the aperture drawing above, horizontally adjacent pixels are used in the gradient analysis. The result of the gradient analysis determines whether or not the suspect pixel is replaced by the result of the median.

Operation

Control parameters for the median filter can be found under the MEDIAN menu as shown below.



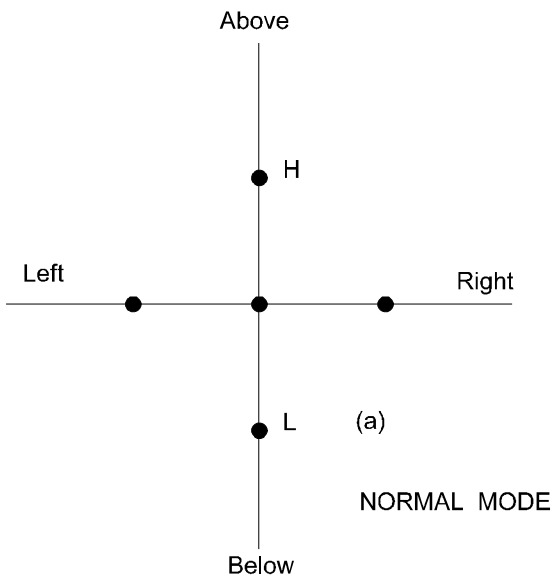
Spatial Filtering

Spatial filtering typically involves 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
7	-8.4

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 NRS500 uses 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.

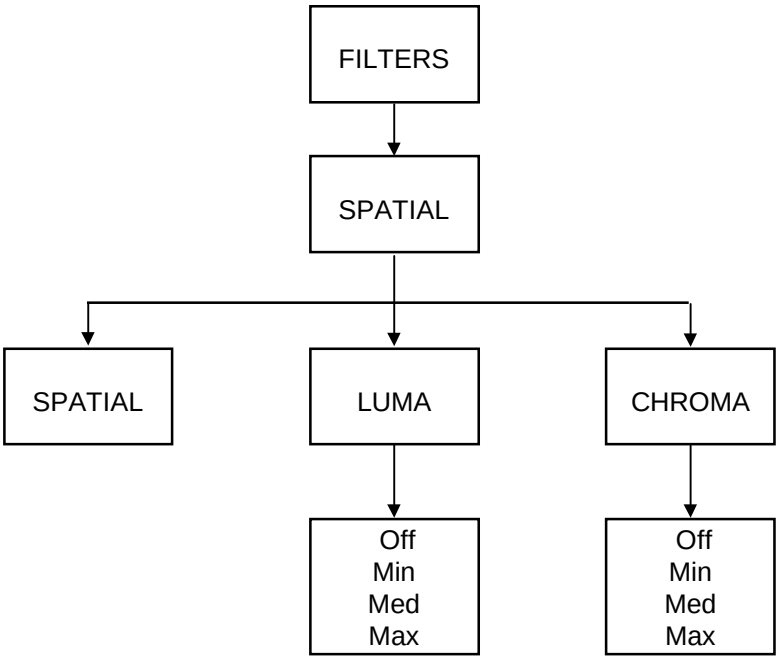
The spatial filter operates by resolving the spatial median and then verifying if this is of similar value to the current pixel. By varying the comparison threshold, the spatial filter can be tuned to reject noise but still preserve picture transitions and textures.

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 the recursive filter, and should be used in conjunction to achieve greater levels of noise suppression.

Linear Filters

Introduction

There are three types of linear filter which are available:

1. Brickwall Low Pass Filter with optional Boost
2. Gaussian Low Pass Filter.
3. Gaussian High Pass Filter.

The function of these filters is to perform various levels of noise reduction or compensation on the luminance component of the video signal.
The requirement to filter the luminance component can be desirable since its high bandwidth means that it is susceptible to high frequency noise. Also as the human eye is more susceptible to the luminance signal (as it is this signal which controls picture contrast) filtering of the signal can be extremely important.

Brickwall Filter

This filter is employed to reduce noise resident in the high frequency region of the luminance spectrum.

The filter has two ranges : Low Pass and Extra Low Pass.

Low Pass.

There are 18 user selectable cut-off frequencies (specified at -6dB) ranging from 4.2 MHz down to 2.5 MHz in 0.1 MHz steps. The stopband performance is -34 dB or better with no boost.

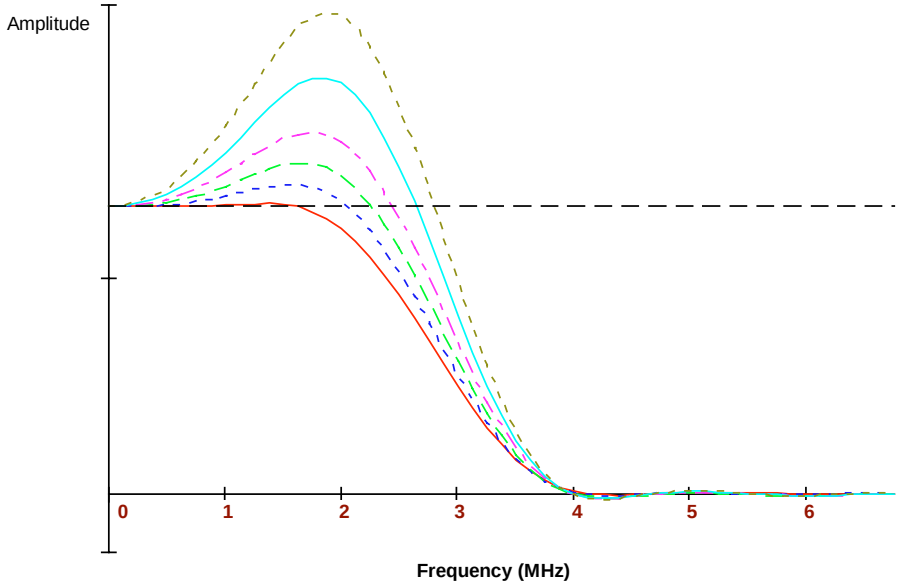
In addition to the selectable cut-off frequencies the user can also select a given boost at each cut-off:
0dB (no boost), 1dB, 2dB, 3dB, 4.5dB, 6dB.

The boost value selected is the amount of gain applied to the filter response at the chosen cut-off frequency.
The selectable boost facility is incorporated to allow the user to increase the perception of sharpness in the picture by boosting the contrast. The sharpness of a picture can sometimes be significantly reduced by filtering the high luminance frequencies so the inclusion of the extra boost helps to restore some of the sharpness to the picture. A boost of 6dB will result in the cut-off frequency being increased by up to 0.4 MHz.
The actual amount of boost selected will be a trade-off between cut-off and picture sharpness.

Extra Low Pass.

There are 6 user selectable cut-off frequencies (specified at -6dB) ranging from 2.4 MHz down to 0.9 MHz in 0.3 MHz steps. These filters can be used where the luminance component of the video signal needs to be significantly reduced in bandwidth. This set of filters would only normally be used in exceptional circumstances.

Linear Filters - cont.



2.8 MHz Brickwall Filter with available boosts

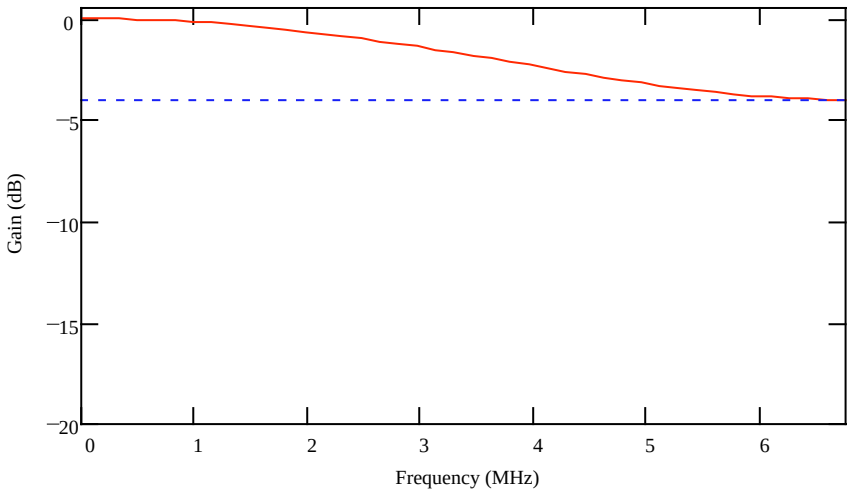
Linear Filters - cont.

Gaussian Filter

This filter is employed for both noise reduction and compensation purposes. The filter has two user selectable modes both of which are mutually exclusive: *low-pass* and *high-pass*.

Gaussian Low Pass

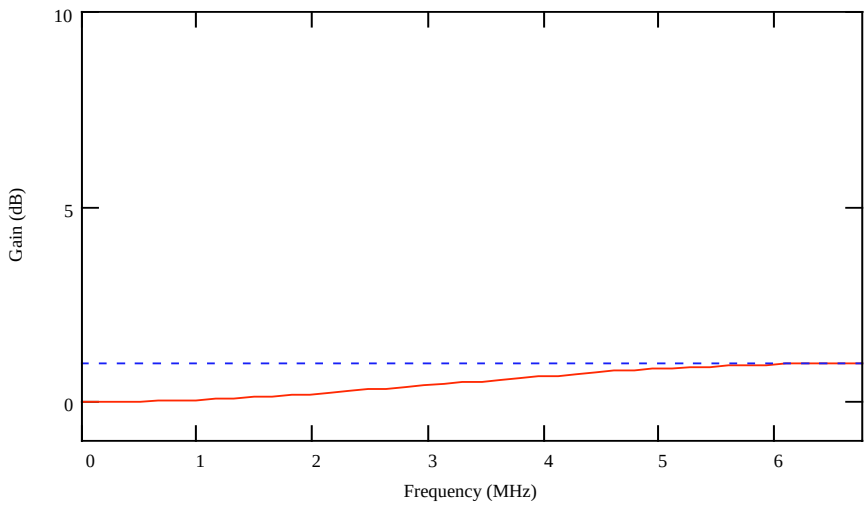
The *low-pass* filter mode is employed to noise reduce with less severity than the brickwall filter and/or to compensate for any irregularities in the luminance signal such as inherent high frequency gain.
This mode has 10 user selectable levels at 6.75 MHz ranging from -4dB to -40dB in -4dB steps.



Gaussian Low Pass Filter with -4dB Gain

Gaussian High Pass

The *high-pass* filter mode is employed to compensate for high frequency attenuation in the luminance spectrum. This high frequency attenuation may be mainly caused by stray capacitances inherent throughout the cables of an installation. This mode has 5 user selectable levels at 6.75 MHz: 1dB, 2dB, 3dB, 4.5dB, 6dB.



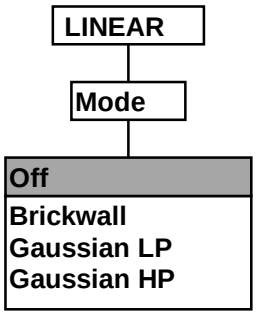
Gaussian High Pass Filter with 1 dB Gain

Linear Filters - cont.

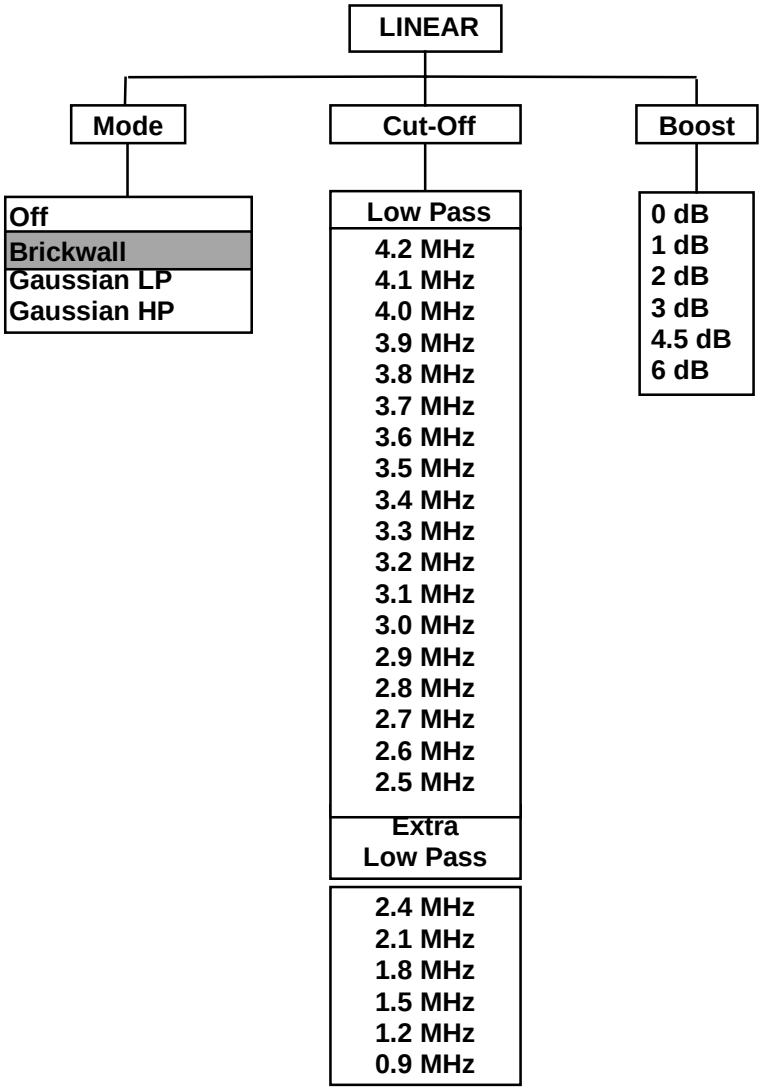
Operation

The linear filter control parameters can be found in the **FILTERS** menu under **LINEAR**.
The control features available to the user depend on the filter mode selected.
The options available for each mode are as follows:

Mode - Off (Full Bandwith)

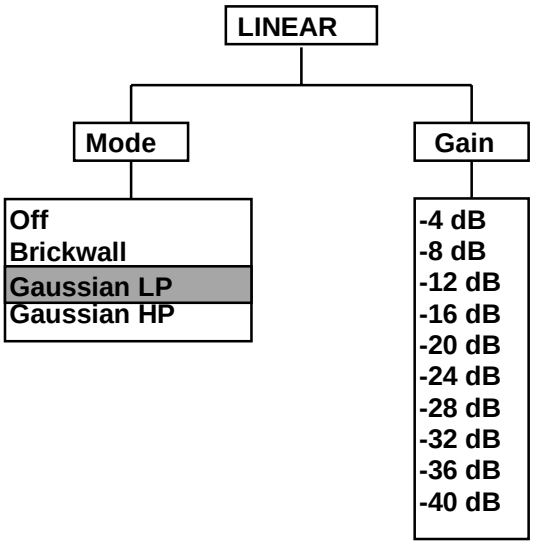


Mode - Brickwall

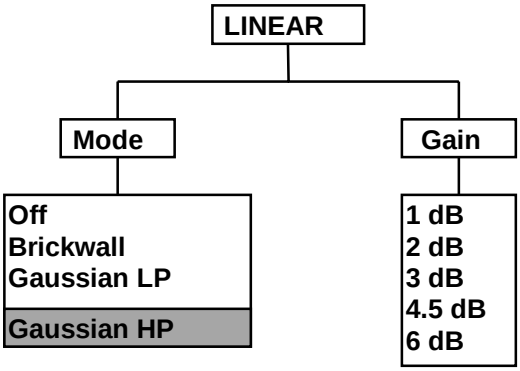


Linear Filters - cont.

Mode - Gaussian Low Pass



Mode - Gaussian High Pass



The factory default setting for the linear filter is **Off (Full Bandwidth).**

The factory default settings for each filter type are as follows:

Brickwall	**4.2 MHz** (**0 dB Boost**)
Gaussian LP	**-4 dB**
Gaussian HP	**1 dB**

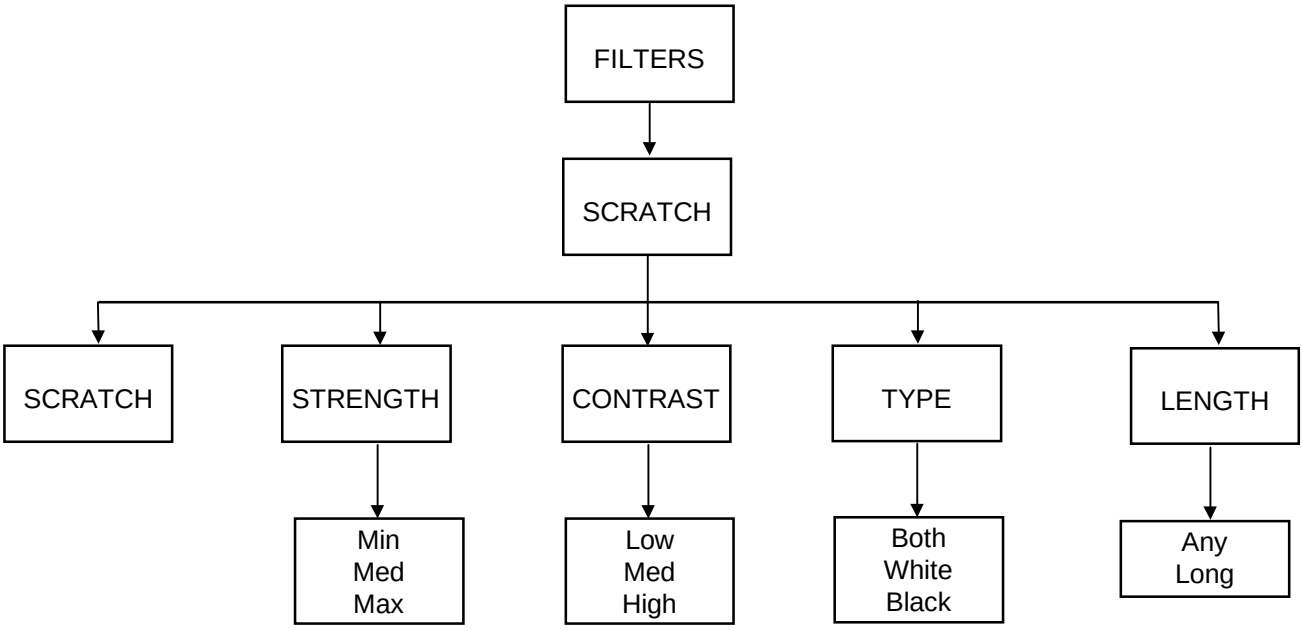
Scratch Filter

Introduction

This filter has been designed to detect and repair vertical scratches, of variable contrast and length, be they black, white or both, while maintaining picture quality where there are no scratches. To maximise the benefit obtained from this filter, a suite of filter strengths has been provided.

Operation

Control parameters for the scratch filter can be found under the SCRATCH menu as shown below:



Scratch Filter - On/Off

For unscratched material, it makes sense to turn the scratch filter off.

In order to remove scratches, it is necessary to enable the scratch filter.

Strength

There are three *Filter Strengths* available, and they are denoted as *Min*, *Med* and *Max*.

By increasing the strength of the filter, the potential for detecting and removing more scratches is improved. While the probability of false alarms is small, increasing the filter strength increases the probability of false alarms. Thus, when choosing the filter strength for a certain piece of footage, the smallest filter strength that is sufficient to cope with its scratches should be chosen, thus minimising the number of unrepaired scratches as well as false alarms, while maintaining maximum picture quality.

Contrast

There are three settings for *Scratch Contrast* available, and they are denoted as *Low*, *Med* and *High*.

Depending on the footage in question, the scratches may be low, medium or high contrast. Selecting the most appropriate *Scratch Contrast* option results in the maximum number of detected scratches, the minimum number of undetected scratches and the minimum number of false alarms, while keeping picture quality to its maximum.

Type

With most pieces of footage, the scratches appear to be white or black. With footage that has been processed both as positives and negatives, there may be both white and black scratches present.

Where there is only one type of scratch (i.e. white or black), the *Type* option should be set to W*hite* or *Black*, as appropriate. This will aid in reducing the number of false alarms, and thus result in improved picture quality.

Where there are white and black scratches, the *Type* option should be set to *Both*.

Length

As well as being of different strength, type and contrast, scratches will also be of different lengths.

Where one is only concerned with repairing long scratches (whose length is the majority of the height of the screen), the *Length* option should be set to *Long*. This will result in the minimum number of false alarms, while keeping picture quality to its maximum.

When concerned with short scratches, or scratches of any length, the *Length* option should be set to *Any.*

Enhancer

Enhancement

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.

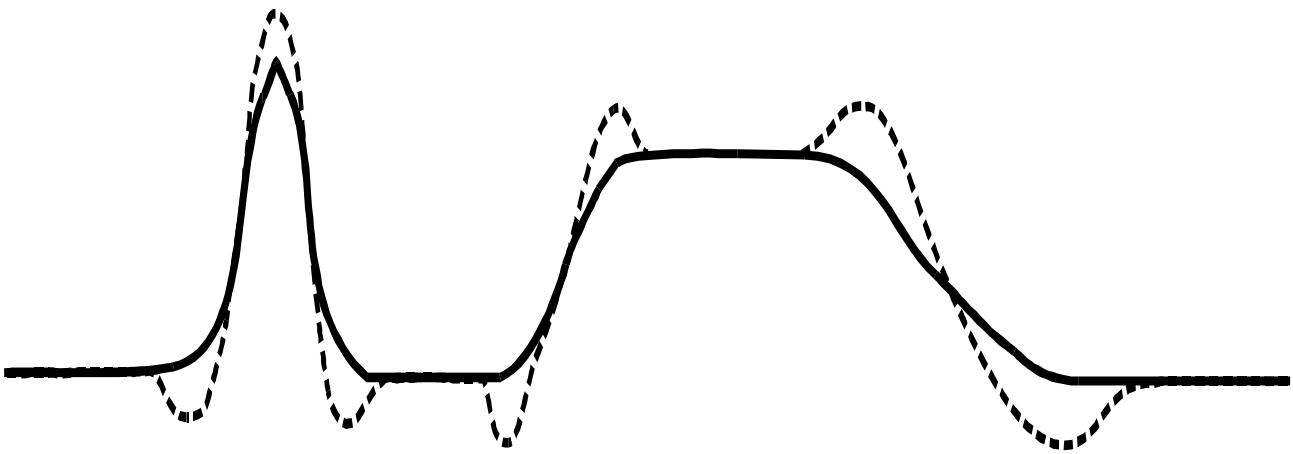
Non-linear enhancement is able to enhance images without the large increase in overshoots and ringing that are associated with linear enhancement methods.
The non-linear correction signal consists of a peak enhancement signal and an edge enhancement signal. The type of non-linear enhancement is determined 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.

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

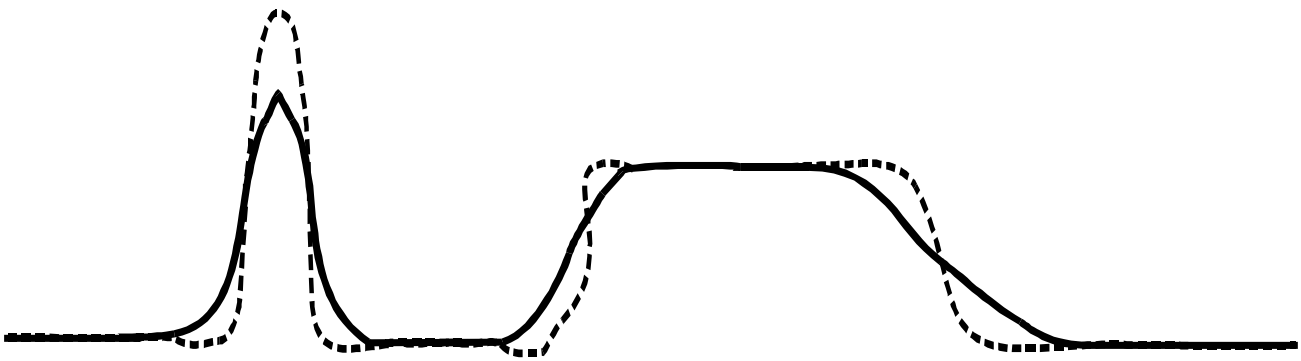
Conventional enhancement



Enhancer cont.

The figure below 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.

Enhancer output



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

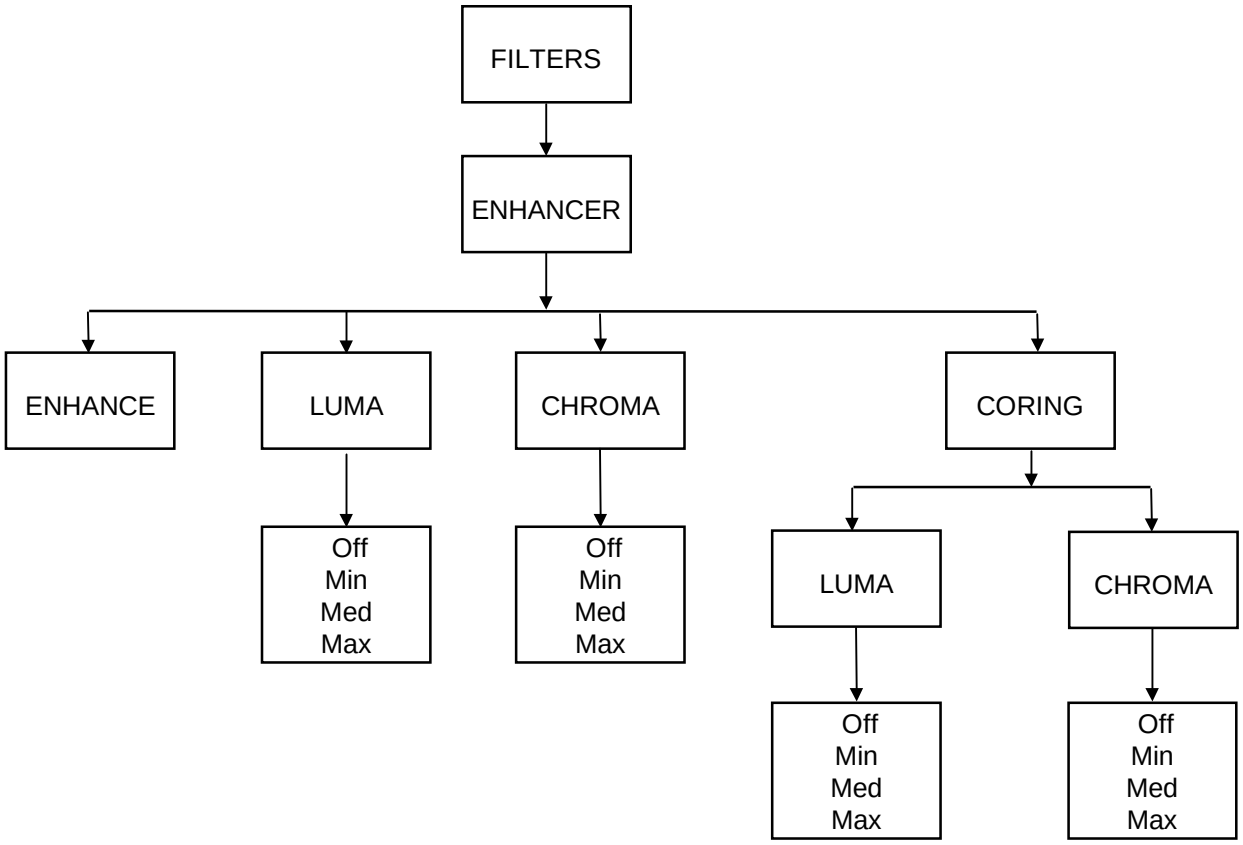
Coring

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.

Enhancer cont.

Using The Enhancer

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



Adjusting Enhancement Settings

The enhancer filter has separate controls for luminance and chrominance enhancement. The luminance and chrominance enhancement controls are shown in the above diagram.

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 Enhancer off.

Adjusting The Coring Level

The enhancer has separate coring controls for luminance and chrominance. The coring controls are shown in the above diagram.

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.

Enhancer cont.

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 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 certain 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

Status and Warning Messages Summary

A number of different messages are displayed on the front panel NORMAL display or on the 'ShoeBox' status display. In addition status information can be found in different parts of the menu structure and from the front panel buttons.

Source Status

The top line of the NORMAL panel display is used to identify the source selected and the status.

The source is identified as follows

SDI A	Serial Digital Interface Input A
SDI B	Serial Digital Interface Input B
Comp A	Composite Input A
Comp B	Composite Input B

The status messages are

No I/P	A valid video input has not been detected at the selected source. Please check that the correct source has been selected and that a valid source has been connected to the unit.
Wrong Std	The video standard of the selected source does not match the selected source standard for the unit. Check that the selected standard is correct. Check that the source is valid. This error should not occur if the standard is set to Auto.
525	525 line SDI source signal
625	625 line SDI source signal
PAL-I	PAL-I composite video signal
PAL-N	PAL-N composite video signal
PAL-M	PAL-M composite video signal
NTSC	NTSC composite video signal

If there is an input error the RED status LED in the INPUT button will flash.

Genlock Status Menu

---	Unable to Genlock. Check the reference signal is valid or that the input is valid.
Off	Genlock Off
Input	Genlocked to input if a valid reference input is not present.
Ref	Genlocked to reference input

If there is a Genlock error the GREEN status LED in the Genlock button will flash.

EDH Status Menu

None	EDH not present
OK	EDH present no errors
Errors	EDH is present with errors
Off	EDH Turned Off

Status Messages

These are displayed on the bottom line of the display at the left hand side.

Message	Meaning
PATTERN	Test pattern is turned ON
REMOTE	The unit is being accessed from a remote RollCall™ unit
FREEZE	Picture Freeze is turned ON
PANEL LOCKED	Front panel lock is ON
BYPASS MODE	Filters are turned OFF

If more than one of these messages is valid then the display automatically loops round.

Warning Messages

These are displayed on the bottom line of the display at the right hand side.

REF	Reference is wrong standard. Check that the input standard is set correctly, and that the reference is the correct standard.
NET	Network error. Check that the RollCall™ network is properly connected and terminated. This may occur briefly when a new unit is added to the network.
EDH	EDH errors on SDI input. Check upstream SDI equipment and cabling for errors or damage.

The above messages relate to causes which may indicate a problem with a connection to the unit such as the input, reference or the network.

XIL	Hardware error
XLB	Hardware error
VID	Video error
SYS	Internal network error
BUF	Internal comms error

The above messages relate to unit warnings which may occur briefly in normal operations, for example when the unit is reconfigured. If these messages persistently occur please contact Snell & Wilcox for assistance.

Appendix 3

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