PIXEL VS 5200 VIDEO SYNCHRONIZER OPERATOR AND INSTALLATION MANUAL

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PIXEL VS 5200 BACKGROUND

General

The Pixel Instruments Corp. VS 5200 is a format transcoding universal video synchronizer which utilizes state of the art digital video signal processing to provide high performance video frame synchronization and time base correction, along with simultaneous format conversion. The VS 5200 was designed to provide television facilities with a means to integrate existing analog production equipment with new digital production equipment during the transition to all digital production and broadcasting.

In keeping with the desire to provide an interface between analog and digital, it was also kept in mind that any purchase of transitional equipment should not be obsoleted once the transition to an all digital facility is accomplished. Toward that purpose, the VS 5200 is designed to function equally well in an all digital environment.

Features

The VS 5200 provides the following features:

- 10 bit analog video frame synchronizer
- 10 bit analog video time base corrector with auto select
- Transcoding from any selected input to all output formats simultaneously
- Digital proc amp with user settings stored and recalled for each input
- Genlock timing settings stored and recalled separately for each input
- Wide range output timing
- Serial digital I/O (SMPTE 259M)
- Analog composite I/O
- Analog component (Beta) I/O
- Analog Y/C (SVHS) I/O
- Field/Frame Freeze
- Patented digital signal processing
- Small size, low power, low weight
- Two synchronizers in a 1RU case

Warranty

STANDARD EQUIPMENT WARRANTY

Pixel Instruments Corp. Warrants that the goods sold under this contract will be free from defects in material and workmanship for a period of 1 year from the date of shipment from Pixel's factory to the customer. This warranty is limited to the repair and replacement of parts and the necessary labor and services required to repair the goods, or in Pixel's sole option, the replacement of the product with a like product. IT IS EXPRESSLY AGREED THAT THIS WARRANTY WILL BE IN LIEU OF ALL OTHER WARRANTIES INCLUDING WARRANTIES OF FITNESS AND MERCHANTABILITY.

SPECIFICATIONS

The VS 5200 achieves the following performance specifications:

Video Inputs (selectable)

Serial Digital (BNC)	SMPTE 259M-C Auto Equalized to 300 meters
Composite Analog (BNC)	1 volt p-p, 75Ω internal termination
Component Analog (3xBNC)	Y: 1 volt p-p, 75Ω internal termination R-Y, B-Y: 700 mV p-p, 75Ω internal termination (Beta levels)
Y/C (SVHS) (4 pin mini DIN)	Y: 1 volt p-p, 75Ω internal termination C (subcarrier): 286 mV p-p (burst) NTSC 75Ω internal termination 300 mV p-p (burst) PAL 75Ω internal termination

Genlock Reference Input

Composite Analog (BNC)	1 volt p-p, 75Ω internal termination. Black Burst preferred. Any stable signal i.e. color bars may be used at slightly diminished timing specifications. **Genlock must be connected!**

Remote Control I/O

RS-422 (telephone handset)	RS-422 interface to Pixel RC 5200 remote control.

Video Outputs (simultaneous)

Serial Digital (BNC)	SMPTE 259M-C
Composite Analog (BNC)	1 volt p-p, 75Ω source termination
Component Analog (3xBNC)	Y: 1 volt p-p, 75Ω source termination R-Y, B-Y: 700 mV p-p, 75Ω source termination (Beta levels)
Y/C (SVHS) (4 pin mini DIN)	Y: 1 volt p-p, 75Ω source termination C (subcarrier): 286 mV p-p (burst) NTSC 75Ω source termination 300 mV p-p (burst) PAL 75Ω source termination

DDO Pulse Output

TTL DDO (BNC)	TTL Level, 75Ω source terminated pulse whose positive duration matches the video delay. The pulse is always present with a maximum duty cycle of 50% and a minimum length of 5 µS.

PERFORMANCE

Signal to Noise (Weighted luminance)

SDI In, Composite Out	> 76 dB*
Composite In, Composite Out (Synch mode)	> 63 dB*
Composite In, Composite Out (TBC mode)	> 65 dB*
Component In, Composite Out	> 66 dB*
Y/C In, Composite Out	> 65 dB*

* *Note: S/N for SDI, Component and Y/C outputs exceed the specifications for Composite Output*

Luminance Frequency Response

Sync Mode: ± 0.1 dB 0-5.0 MHZ, -.05 dB @ 5.8 MHZ
TBC mode: ± 0.2 dB 0-2.5 MHZ*

Differential Gain (Sync or TBC mode) < 1.0%

Differential Phase (Sync or TBC mode) < 0.7°

K Factor, 2T	(synch mode)	< 0.5%
	(TBC mode)*	< 2%

* *Note:* K Factor in Y/C TBC mode is equal to synchronizer mode.

Output Timing

H Phase	-6 to +13 µ seconds
V Phase	-2H to +1H
Subcarrier Phase	360° (proper SC/H must be maintained)
Residual Jitter (Synch mode)	< 1 nS p-p
Residual Jitter (TBC mode)	< 10 nS p-p
Serial Output Jitter	Meets SMPTE 259M per EG 33-1998 (.2UI)
Chroma	0.5°
Chroma Phase Error (TBC mode)	2°

Processing Amplifier Controls

Video Gain	± 3 dB
Black Level (Pedestal/Setup)	± 100 mV (14 IRE)
Chroma Gain	± 3 dB
Hue (NTSC only)	± 22°
Unity Set	Returns Proc Amp value to factory set unity

Displays and Indicators

Input Present	LED on indicates input present
Reference Locked	LED on indicates lock
Freeze (field/frame)	2x LED on indicates field or frame freeze
TBC On/Off (manual mode)	LED on indicates TBC on
TBC On/Off (auto mode)	LED on indicates auto enabled, LCD notation indicates TBC on
Mode / Proc Amp setting	LCD display indicates mode or proc setting

Power

AC Input	110-240 VAC, 50/60 Hz
DC Input	Special Order for 12, 24, 28 or 48 volts
Consumption (single channel)	30 Watts (max.) for AC Input
(dual channel)	50 Watts (max.) for AC Input

Mechanical

Width	19" (48.3cm) Standard Rack
Height	1.75" (4.5 cm) 1RU
Depth	20" (50.8 cm) from rack mount to power cord radius. Dimension is sufficient to allow use of right angle BNC connectors. Add sufficient room for cable radius if straight BNC's are used.

Environmental

Storage Temperature	-55°C to +75°C
Operating Temperature	0°C to +45°C. Free air circulation must be provided on sides, top, bottom and back of case.
Humidity	10-90%, non condensing

Patents

The VS 5200 is protected by U.S. Patents 4,305,091; 4,313,135; 4,803,547; 4,816,830; 5,202,761; 5,459,524; 5,486,869; 5,550,594; 5,754,250 and others applied for as well as foreign counterparts.

Specification subject to change without notice. All trademarks cited are the property of their respective holders.

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INSTALLATION AND SETUP

SAFETY SUMMARY

Power Source

The standard product is intended to operate from a power source of either 100-125 volts rms AC or 220-240 volts rms AC at either 50 or 60 Hz, between supply conductors and with no more than 250 volts rms from any power supply conductor to any other power or signal conductor or ground. The VS 5200 is designed with a protective ground connection by way of the grounding conductor in the power cord and maintaining this connection is essential for safe operation! When servicing the unit, it is always necessary to use an isolated AC power source, such as by use of an isolation transformer, in order to ensure that service personnel are not accidentally exposed to voltages which can cause shock in the event of inadvertently touching one of the power circuits and ground. For products supplied with optional D.C. power source capability, please consult the material provided with the option.

Ground the VS 5200

The VS 5200 is grounded through the grounding conductor of the power module power cord. To avoid electrical shock in the event of failure of power supply conductor insulation, or otherwise, always power the unit from a properly wired receptacle with function ground connection. Do not ever defeat the ground connection by cutting the ground lead off of the power cord!

Use the Proper Fuse

To avoid fire hazard, use only the correct fuse type and rating. Pixel products use user replaceable slow blow fuses which are overrated to prevent nuisance blowing with clean power sources. In addition, Pixel products use an internal fast blow fuse to protect against major shorts and failures of the power supply module.

In the event the customer is forced to use the product in areas where fuse blowing is caused by power spikes and/or brown outs, a slightly larger user replaceable slow blow fuse may be incorporated as described in the POWER section below, however the internal fast blow fuse must never be replaced with a larger rated or slow blow type.

Repeated blowing of the user replaceable fuse, or blowing of the internal fuse are indications of trouble and this problem should be referred to a qualified service technician for resolution and repair.

Do Not Operate in Explosive Atmospheres

Remember that, while extremely rare, electronic components can fail quite catastrophically shooting sparks and flames for several feet. The VS 5200 is not designed to be used in Explosive Atmospheres such as near or in aircraft or automotive fueling facilities, grain storage or grinding facilities, or any other installation location where a spark or ignition caused by the failure of an internal or external component could cause an explosion or fire.

Do Not Operate Without Covers

The VS 5200 must be operated with the covers in place in order to provide proper cooling to avoid heat related failure of the internal components. In addition the covers act as a shield to prevent inadvertent contact with dangerous voltages, thus the covers must be in place at all times.

Maintain Adequate Ventilation

Which each VS 5200 board only dissipates 20 watts of power, without adequate ventilation this amount of heat can quickly become a fire hazard, igniting plastic cabling or other flammable materials. To prevent fire hazard it is necessary to ensure that the unit has adequate natural convection ventilation, and that the fans and vent openings are unblocked. The ambient temperature of all parts of the case of the VS 5200 must be maintained to a maximum temperature of 45° C.

Refer Service to Qualified Technicians

All servicing of the VS 5200, and especially that inside the unit, should be referred to qualified service technicians who hold adequate and necessary training, licenses and certificates as required in the user's facility.

Do Not Service Alone

As with any product which utilizes voltages which can render an electric shock, do not perform internal servicing or adjustment of this product unless another person capable of rendering Cardiopulmonary resuscitation (CPR) and other shock related first aid is present.

Maintain The Safety Worthiness of The Product

When making repairs or modifications to the VS 5200, always replace parts with the same voltage, current and temperature ratings as specified in the parts list. Note that repairs with unapproved parts or any modifications from factory design will void the warranty.

MECHANICAL

Rack Mounting

The VS 5200 should be bolted into a standard 19" rack with the supplied rack ears. An optional rack slide kit is available for those who wish the convenience. The single channel VS 5200 has a single fan mounted in the rear panel, and the dual channel version has both the rear panel fan as well as two side fans mounted near the front of the unit. When installing the unit, ensure that fans and ventilation holes are not blocked by cables or other outside items. Note that it is normal for the rack slides to partially cover the side vent holes.

Ventilation

In addition to the fans and vent holes, the VS 5200 needs air circulation on the sides, top, bottom and back of the unit. Do not stack the VS 5200 on top of or under other heat generating equipment as the added heat load can not be tolerated. You may stack dual VS 5200's on one another, however it is necessary that the all three fans in each case be open to ambient air without additional restriction. The ambient temperature of all parts of the case of the VS 5200 must be maintained to a maximum temperature of 45° C.

In dusty or high vibration environments such as remote trucks or aircraft, please periodically inspect the fans to ensure that they remain operating and unobstructed. Vacuum any dust from the fan blades and ventilation openings.

POWER

AC Input

The VS 5200 is supplied standard with an auto ranging AC power supply which can automatically accept input voltages in all common world standards. It is important that the incoming power be free from excessive spikes or brown out events as these can seriously shorten the life of the supply, or can lead to blowing of the internal fuse. Please verify that the input AC power is within the range of 100 to 240 Volts AC at 50/60 Hz and then connect the VS 5200 to a properly fused and grounded AC receptacle with the power cord supplied.
NOTE THAT THE GROUND CONNECTION IN THE SUPPLIED POWER CORD IS FOR SAFETY - DO NOT DEFEAT THIS GROUND CONNECTION!

DC Input

The VS 5200 can be configured with DC inputs of 12, 24, 28 or 48 volts for various mobile and aircraft operations. Please consult the literature supplied for the custom supply for installation details.

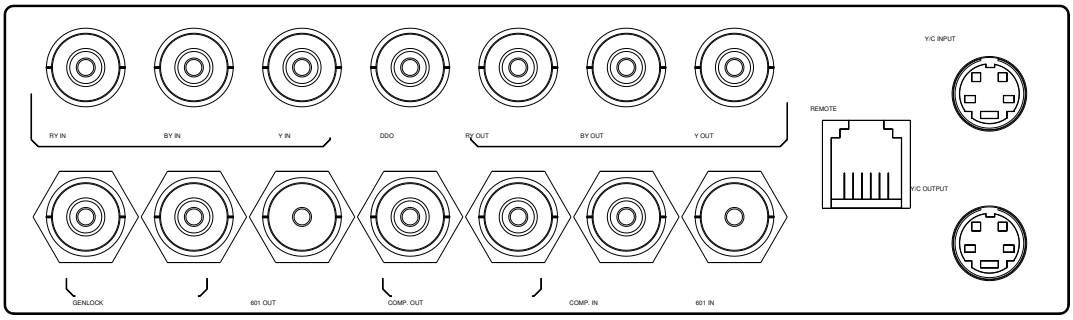
Fuse

The VS 5200 has a main fuse located in the power connector. In addition, the power supply module has an internal fuse. If either fuse blows, please replace with the same type as the blown fuse. The main fuse in the power connector is a slow blow type which is adequately sized for normal AC power connections which are not subject to brown out connections. The supplied fuse may be replaced with a fuse which is ½ amp larger in the event local power brown outs cause unwanted fuse failure. Consistent failure of this fuse indicate a problem with either the unit or the AC power supply, and fuse replacement with an even larger size will result in risk of damage to the unit or possibly even fire!

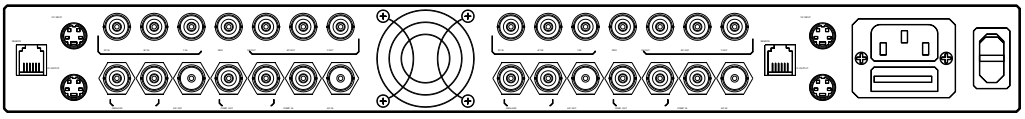
Please note that the power supply module internal fuse normally only blows in the event of serious internal failure. If this fuse blows, disconnect the power output cable from the VS 5200 main board before turning on AC power after replacing this fuse, then verify that the output DC voltages are correct. If all output DC voltages are correct disconnect AC power and reconnect the power output cable to the main board. This procedure will prevent possible (further) damage to the main board in the event of a power supply regulation failure.

NOTE THAT THE FUSES SUPPLIED IN THE VS 5200 ARE FOR SAFETY - DO NOT DEFEAT THESE FUSES WITH JUMPERS OR SUBSTANTIALLY LARGER FUSES!

CONNECTING THE UNIT



PIXEL VS 5200 REAR PANEL CONNECTIONS



PIXEL DUAL VS 5200 REAR PANEL CONNECTIONS

Video Inputs

VIDEO - The VS 5200 has four video inputs, Serial (BNC), Composite (BNC), Component (3 BNCs) and Y/C (mini DIN). Connect the unit to the appropriate video source using appropriate Coaxial cables with good quality BNC or DIN connectors. These inputs are all internally terminated in 75Ω. Unused video inputs may be left unconnected.

Any or all of these inputs may be connected simultaneously, although only one will be used at a time depending on the input mode selected. Note that the Component (YUV) input is factory adjusted to be optimized for Beta input levels. MII levels may be used without internal adjustment,

however the chroma gain will need to be adjusted to achieve the proper output level, depending on the output being used. Consult factory for optimization with MII levels.

Please note in particular that the Serial Digital Input is extremely sensitive to impedance mismatches and less than perfect coaxial cable connections. It is recommended that low loss precision 75Ω cable and connectors be used for this connection. Cheaper non precision 75Ω cable with 75Ω or 50Ω connectors may be utilized for the other analog video connections. Note that 75Ω and 50Ω connectors are fairly easy to identify from the amount of insulation around the center conductor. 75Ω connectors normally have no insulation, or very thin insulation around the center conductor whereas 50Ω connectors have thick insulation around the center conductor. Always use 75Ω connectors for the serial digital connections.

GENLOCK **A Genlock signal must be connected!** The genlock connector is a high impedance looping connector. Connect either genlock BNC of the unit to the appropriate black burst video reference source using appropriate 75Ω Coaxial cables with good quality BNC connectors. The end of the video reference must always be terminated. If the looping input is unused it must be terminated with a customer supplied termination. If black burst video is not available for a reference, any static color video signal (such as color bars) may be utilized as the reference with a slight decrease in output jitter specifications. The slight decrease is due to D.C. tilt and small amounts of cross coupling of the non black burst reference as compared to black burst which has no D.C. tilt or high frequency components to cross couple.

Remember that the stability of the VS 5200 output is directly related to the stability of the reference signal, especially as it relates to the jitter specification. Consequently it is important to use a reference source which has excellent stability and low sideband noise. Some cheaper signal generators use low cost low performance digital oscillator crystals which exhibit a considerable amount of phase noise which can be reflected in the chroma subcarrier or serial digital outputs.

Video Outputs

The VS 5200 has four video outputs, Serial (BNC), Composite (BNC), Component (3 BNCs) and Y/C (mini DIN). Connect the unit to the appropriate video source using appropriate Coaxial cables with good quality BNC or DIN connectors. Please note in particular that the Serial output is extremely sensitive to impedance mismatches and less than perfect coaxial cable connections. It is recommended that low loss precision 75Ω cable and connectors be used for this connection. Historically 50Ω connectors have been used for analog video connections, however these connectors will not work well with serial digital connections. Cheaper non precision 75Ω cable with 75Ω or 50Ω connectors may be utilized for the other analog video connections. Note that 75Ω and 50Ω connectors are fairly easy to identify from the amount of insulation around the center conductor. 75Ω connectors normally have no insulation, or very thin insulation around the center conductor whereas 50Ω connectors have thick insulation around the center conductor. Always use 75Ω connectors for the serial digital connections.

Note that the output signal jitter is directly related to the genlock reference stability. If black burst video is not available for a reference, any static color video signal (such as color bars) may be utilized as the reference with a slight decrease in output jitter specifications due to D.C. tilt and small amounts of cross coupling of the non black burst reference as compared to black burst which has no D.C. tilt or high frequency components to cross couple.

Remember that the stability of the VS 5200 output is directly related to the stability of the reference signal, especially as it relates to the jitter specification. Consequently it is important to use a reference source which has excellent stability and low sideband noise. Some cheaper signal generators use low cost low performance digital oscillator crystals which exhibit a considerable amount of phase noise which can be reflected in the chroma subcarrier or serial digital outputs.

DDO (Digital Delay Output) Pulse

The DDO output is a TTL delay tracking pulse used to drive a companion audio synchronizer such as the Pixel AD 2100, AD 3000 or AD 3100 in order to maintain proper lip sync in television systems. Maintaining proper lip sync is essential in television systems because even slight amounts of lip sync error, even amounts so small that they are not conciously noticed by the viewer, can cause the television program to not be as enjoyable as it would be if the lip sync were properly maintained. The reason lip sync errors have a negative effect on the viewer's enjoyment of television programming is believed to be the result of subconcious stress which these errors cause. In nature the viewer is used to hearing sound coincident with the associated visual activity, or in instances where the viewer is removed some distance from the visual activity the sound is slightly delayed. In television systems, the video is often delayed which caused uncorrected audio to arrive earlier than the vision, which is totally unnatural. This unnatural relationship between vision and sound is believed to create unconcious stress which the viewer then relates to the television program. Commercial advertizers often complain about lip sync errors which in turn causes the television broadcaster to have to make financial compensation to the advertizer in the form of refunds or extra commercial insertions.

The signal is available on the DDO BNC and is a TTL Level, 75Ω source terminated pulse whose positive duration matches the video delay. The pulse is always present with a maximum duty cycle of 50% and a minimum length of 5 µS. Ordinary non precision 75Ω video cable may be used to connect this pulse to the audio synchronizer. When the DDO output is terminated in 75Ω the pulse amplitude is approximately 2 volts p-p, and may be passed through most video DA's, routers and patch panels. If the pulse amplitude is too high, it may be padded to a lower level as all Pixel audio synchronizers will operate with a .5 volt p-p DDO pulse.

Note that the VS 5200, like any video frame synchronizer device, can make instant delay changes of over 1 frame (40 ms in PAL) whenever the video memory either fills, requiring a frame to be dropped, or empties, requiring a frame to be repeated. When these instant delay changes occur, the DDO pulse jumps accordingly, and the audio synchronizer is required to quickly track the delay change in order to maintain proper lip sync. Often, in broadcasting applications, these instant delay changes occur at the times when commercials are airing since it is at that time that video is switched from one source to another.

The user should keep in mind that it is necessary for the companion audio synchronizer to make the corresponding delay change within a few seconds. For example, in order that a 40 ms delay change be completed in 2 seconds, a 2% rate of change in delay is needed. This rate of change can cause audio artifacts such as popping, clicking, harmonic distortion or pitch errors. For that reason, selection of a proper audio synchronizer is very important.

Timing the VS 5200

The VS 5200 allows timing adjustment of the output video relative to the genlock reference signal. The analog signal outputs are always in time with each other. Any timing adjustment will move all three outputs by the same amount. Due to delays in analog filtering, the Serial Digital 4:2:2 tends to lead the other outputs. Serial Digital leading analog outputs is desirable because delays associated with serial digital input processing in downstream units tend to further delay the digital signal to bring it close to the analog outputs. Virtually all serial digital devices also include about 10 μS of automatic timing capability. Note that the timing adjustments may be stored in nonvolatile memory and that each input mode has its own timing adjustment memory. See the description of the nonvolatile memory below for more details.

The VS 5200 has timing controls for shifting output timing relative to genlock by lines, pixels and by sub-pixels. These adjustment modes are selected by pressing the Vertical, Horizontal Coarse and Horizontal Fine buttons on the front panel which turning the adjustment knob. During timing adjustment the display shows relative timing numbers to indicate the amount of timing shift.

Once the VS 5200 is installed, it may be timed into the system. Apply color bars or another appropriate test signal to one of the inputs and select that input with the mode control. Monitor the desired output at the system timing point.

Adjust the front panel V phase control to set the vertical timing to compensate for any vertical timing errors of the system. Adjustment is achieved by holding the V phase button and turning the control knob. Vertical timing may be adjusted in 1H steps from 2 H advanced to 1H delayed. H timing is adjusted using the coarse H phase button. The coarse phase adjustment range is 6 µS delayed to 13 µS advanced. If the composite or Y/C output is being timed, next adjust the fine H phase to properly set the output signal **burst** phase to the desired system phase.The fine H phase only achieves around a ± 30° phase adjustment and attempts at further adjustment beyond the end of this range will result in a 1 click step in coarse H phase. Note that proper SC/H phase is always maintained, so that as output burst phase is adjusted with the fine H phase control, the horizontal sync phase is also adjusted to maintain 0° SC/H phase.

It is possible, but not desirable, to adjust SC/H phase in order to achieve a phase adjustment of burst (i.e. a traditional burst phase adjustment) independent of H phase. Note that if it is necessary to adjust SC/H phase it is because the system into which the VS 5200 is being timed does not have correct 0° SC/H phase. Thus if the VS 5200 SC/H phase is adjusted, the output analog composite video signal will be made incorrect. SC/H phase (burst phase) is adjusted by simultaneously pressing and holding both the Vertical and Horizontal Coarse buttons while turning the adjustment knob.

NONVOLATILE MEMORY The timing settings for each mode of operation can be stored in a nonvolatile memory so that if power is turned off the unit will return to the last stored setting. Note that there is a separate Proc Amp memory for each mode - that is for each input which is selected. Consequently it is possible to set different timing settings for each mode, store those settings, and they will be immediately recalled when returning to that mode at a later time. This is useful where the VS 5200 is to be timed separately at different points in the system, depending on which input mode is being used. For example, the VS 5200 can be timed into a serial digital switcher when the serial digital input mode is selected, and can be timed differently into an analog composite

switcher when the analog composite input mode is selected. The different timing settings will be recalled automatically when each mode is selected by the operator.

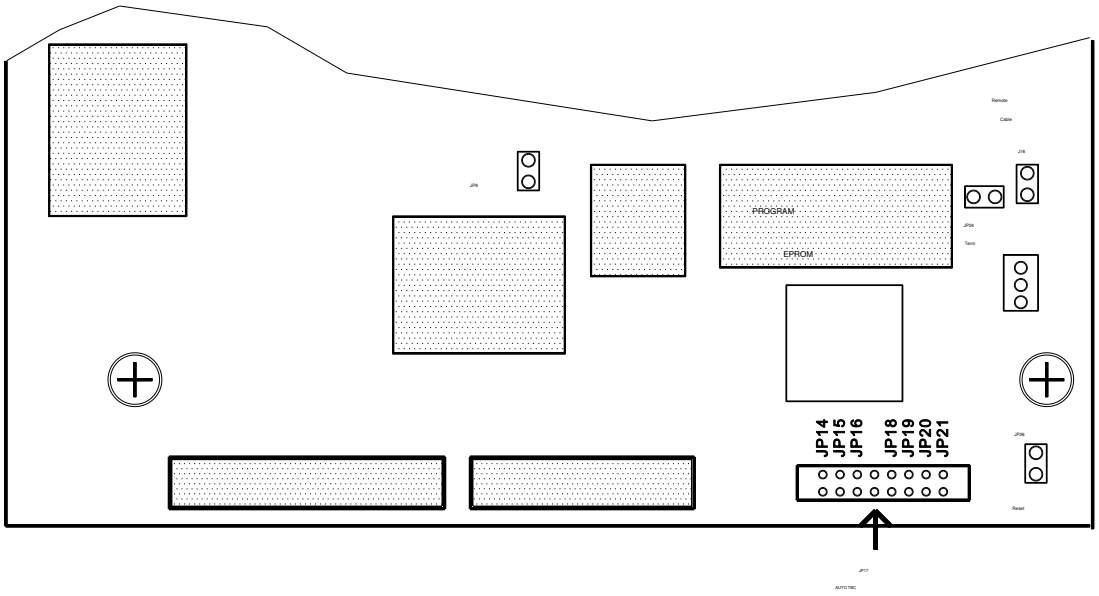
NOTE THAT SETTINGS ARE NOT AUTOMATICALLY STORED AS THEY ARE BEING ADJUSTED BY THE OPERATOR, NOR WILL THEY BE AUTOMATICALLY SAVED WHEN POWER IS LOST. If the operator makes an adjustment of a timing function, and the unit is subsequently turned off, the unit will return to the previously stored settings, rather than the newer (unstored) settings. This allows the operator to make temporary adjustments without affecting the previously stored settings. Also note that in initial setup, timing must be adjusted and stored separately for each input mode, even if the settings are the same.

In order for a timing setting to be stored, the Unity Preset button or the Mode\Enter button must be pushed after the desired timing setting is made. Whenever the Unity Preset button or the Mode\Enter button is pushed **ALL** of the then current timing and proc amp settings are stored, thus when adjusting for a new input signal or operating mode the operator may adjust all of the proc amp and timing functions followed by pressing the unity button in order to store all settings. Note that after making a timing adjustment, if the Mode\Enter button is pushed the settings will be stored, but the mode will also change to the next operating mode, thus it is usually preferred to press the Unity Preset button to store changes.

Internal Installation Adjustments

When installing the VS 5200, there are two internal jumpers which may need to be set. As you face the VS 5200 from the front, the jumpers are located in the near right corner of the PC board. See the drawing below for detailed location.

VS 5200 JUMPER LOCATIONS



AUTO TBC MODE

Jumper JP17 is used to select either Auto TBC (jumper installed) or Manual TBC (jumper out). In both modes, the TBC is always off when the front panel TBC button is pushed causing the TBC LED to be off.

In the Manual TBC mode, the TBC only comes on when the front panel button is pushed causing the TBC LED to be on. There is no interaction between TBC on/off and the need for TBC operation.

In the Auto TBC mode, the TBC will come on if the front panel TBC button is pushed causing the TBC LED to be on, and the input circuitry senses time base error. In the auto mode, when the TBC is turned on the front panel LCD display will display "TBC".

REMOTE CONTROL

Please note that the VS 5200 main board has jumpers which must be properly set in order for the remote to function. In addition, the cable from the remote to the VS 5200 main board must be properly wired as the two wire interface is polarity sensitive, and a 4 wire connector is used. Note that while a standard telephone handset connector is used for remote connections, the VS 5200 does not use the standard pairs (two inner and two outer) used by the telephone company. This wiring is chosen as protection - in case somebody connects a telephone circuit to the VS 5200 or the RC 5200, hopefully the voltage on the telephone circuit will not destroy the RS 422 receiver IC.

Jumper JP24 (termination) and JP22 (signaling method) must be set for proper remote control operation. Power must be cycled after changing any jumper.

Jumper JP15 is installed it allows the front panel to operate in parallel with the remote control, and when removed the front panel is disabled. Power must be cycled after changing any jumper.

JP16 - Short, enable front panel display (normal operation). Open disable front panel display. This option is sometimes used with remote operation. Power must be cycled after changing any jumper.

There are two communication port associated with the micro controller. J16 (not to be confused with JP16) is the port for connecting the remote control unit. JP23 is an RS-232 port provided for factory service a computer. JP22 selects which port is active. For normal operation, there is a jumper between pins 1 and 2 on JP22. Power must be cycled after changing any jumper.

Unless several VS-5200 synchronizers are to be daisy-chained on a single RS-422 cable, the termination resistor should be enabled by jumpering JP24. When several units are daisy-chained the unit is the last unit in a chain should have Jumper JP 24 is installed, terminating the RS 422 line with 100Ω.

There is a status light, D10, near the array of option jumpers. It indicates activity on the remote control link. D10 changes state each time a valid message is received from the remote.

JP17 Open force TBC to manual mode. Jumpered enables Auto-TBC function. Power must be cycled after changing any jumper.

JP18 - Option Jumper 4, Remote control address select, jumpered 3D primary, open 3D secondary. See further explanation under Remote Control section. Power must be cycled after changing any jumper.

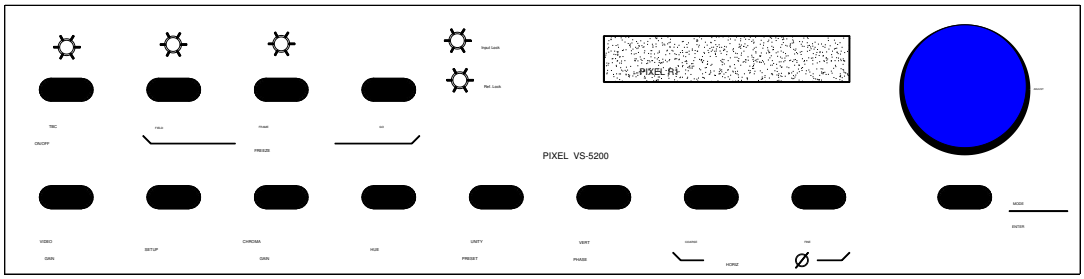
Many of these function do not take effect until the microprocessor has been reset either by cycling the power or by a momentary short on pin 1 to pin 2 on JP26.

3

VS 5200 OPERATION

FRONT PANEL CONTROLS AND INDICATORS

The VS 5200 has 13 push buttons, 5 function LEDs, one Alphanumeric Display and one adjustment knob. The function of each will be described below.



VS 5200 FRONT PANEL

Front Panel Indicators

The front panel has 5 function LEDs and one Alphanumeric Display.

TBC The LED located above the TBC ON/OFF button indicates that the TBC is on or off in the manual TBC mode, or that the auto TBC function is enabled or disabled in the auto TBC mode.

FIELD The LED located above the Field Freeze button indicates that field freeze is enabled and that the stored field is being output from the VS 5200.

FRAME The LED located above the Frame Freeze button indicates that field freeze is enabled and that the stored field is being output from the VS 5200.

INPUT LOCK The Input Lock LED indicates that the VS 5200 is receiving and locked to the video signal selected for the current operating mode.

REF LOCK The Reference Lock LED indicates that the VS 5200 is receiving a genlock reference signal.

ALPHANUMERIC DISPLAY The Alphanumeric Display indicates the mode of operation and in auto TBC mode whether the TBC is currently turned on. When adjusting proc amp functions, the display indicates the function being adjusted and the current relative setting value.

Function Pushbuttons

MODE\ENTER BUTTON This button is used to select the input signal to be synchronized by the VS 5200. In addition, this button operates as an enter button to store proc amp settings in the non volatile memory. On power on, the VS 5200 will come up in the same mode of operation which it was in when it was last powered down. Pressing this button will cycle through the four modes in sequence and will display the mode selected in the Alphanumeric Display. The modes are: Composite Video In (CMPST); Y/C or S VHS (SVHS); Component (YUV); and Serial Digital Input (D422).

TBC ON/OFF BUTTON This button turns the TBC on and off in the manual TBC mode, or enables and disables the automatic TBC function in auto TBC mode. TBC which stands for **T**ime **B**ase **C**orrection is a circuit which is used to remove instability from the color and/or luminance portion of an incoming composite or Y/C video signal. Typically such instability is associated with video signals which are provided by video tape recorders, but may also be associated with video signals from other sources such as remote signals from aircraft and trucks. Time Base Error, if uncorrected, will cause horizontal jitter or color streaking of the video signal. Whenever video signals having Time Base Error are received by the VS 5200, it is necessary that the TBC circuit be enabled.

The selection of whether manual TBC or auto TBC mode is operational is determined by internal jumper JP-17. When JP-17 is installed autol TBC mode is selected, and when JP-17 is removed manual TBC mode is selected. Note that power must be cycled after any jumper is changed.

In manual TBC mode, the operator selects TBC operation as needed by pressing the TBC button so that the green LED indicator above the button is lit. This mode should be selected whenever the input is known to be from a source having Time Base Error, or whenever the input video signal is very noisy. In the presence of a noisy input video signal with or without Time Base Error, the detector which looks for such errors can be fooled by the noise, causing unwanted switching in or out of TBC operation.

In auto TBC mode, the operator selects to enable or disable auto TBC by pressing the TBC button. The green LED indicator above the TBC button turns on indicating that auto TBC is enabled, and turns off indicating that auto TBC is disabled. When auto TBC is enabled, if the VS 5200 senses the presence of Time Base Error the TBC will be automatically engaged, and the front panel Alphanumeric Display will display the operating mode followed by the letters “tbc”.

FREEZE MODES

FIELD This button causes a frame freeze and accompanying output of a field of that frame. Repeated pressing of this button toggles between fields. Note that you can also select frame freeze by pressing the frame button after you have captured a frame using the field freeze button.

FRAME This button causes a frame freeze and accompanying output of that frame of video. Note that you can also select field freeze by pressing the field button after you have captured a frame using the frame freeze button.

GO This button releases field or frame freeze and returns the VS 5200 to normal operation. Once released, the previously stored frame is lost and can not be recalled.

Note that in the freeze mode the timing and proc amp controls may be adjusted but the adjustments will not take effect until the freeze is released.

Proc Amp (Processing Amplifier) Pushbuttons

GENERAL The Proc Amp functions operate on the input video signal so that an incoming signal which is incorrect may be adjusted to correct levels before further processing. Note that if a correct level video signal is intentionally adjusted to incorrect levels that serious distortion of the video signal may occur. For example if input gain is adjusted too high, clipping of the video signal will occur.

VIDEO GAIN This button is used to adjust the overall video gain of the video which is input to the VS 5200. This function is intended to compensate for an incoming video signal which is too low or too high in amplitude. Adjustment of video gain is accomplished by pushing and holding the video gain button while turning the Adjustment knob clockwise to increase video gain or counterclockwise to decrease video gain. When making adjustment, the front panel Alphanumeric Display shows relative gain setting numbers with 100 corresponding to the factory preset unity level. Note that the D.C. clamp and chroma decoder for the composite and Y/C inputs are located downstream of the gain control, and large amounts of misadjustment will cause these circuits to malfunction. For example, if video gain is turned too low, the chroma decoder will lose lock and chroma streaking or breakup will occur.

SETUP This button is used to adjust the overall video setup, also called pedestal and black level, of the video which is input to the VS 5200. This function is intended to compensate for an incoming video signal which is too low or too high in setup. Adjustment of video gain is accomplished by pushing and holding the setup button while turning the Adjustment knob clockwise to increase video setup or counterclockwise to decrease video setup. When making adjustment, the front panel Alphanumeric Display shows relative gain setting numbers with 0 corresponding to the factory preset unity level

CHROMA GAIN This button is used to adjust the overall chroma gain of the chroma portion of the video which is input to the VS 5200. This function is intended to compensate for an incoming video signal with chroma that is too low or too high in amplitude. Adjustment of chroma gain is accomplished by pushing and holding the chroma gain button while turning the Adjustment knob clockwise to increase chroma gain or counterclockwise to decrease chroma gain. Note that for

composite and Y/C input modes, chroma gain operates by adjusting subcarrier amplitude, and for serial digital and component inputs the chroma gain operates by adjusting RY and BY amplitude. When making adjustment, the front panel Alphanumeric Display shows relative gain setting numbers with 100 corresponding to the factory preset unity level

HUE (NTSC) This button is used to adjust the hue (or tint) of the chroma portion of the video which is input to the VS 5200. This function is intended to compensate for an incoming video signal with chroma which does not have the proper tint. Adjustment of hue is accomplished by pushing and holding the hue button while turning the Adjustment Knob clockwise to increase phase or counterclockwise to decrease phase. Note that for composite and Y/C input modes, chroma gain operates by adjusting subcarrier phase in a traditional tint adjustment fashion, and for serial digital and component inputs the HUE operates by adjusting RY amplitude relative to the BY amplitude, thus providing some measure of tint change. When making adjustment, the front panel Alphanumeric Display shows relative gain setting numbers with 0 corresponding to the factory preset unity level

HUE (PAL) Since in PAL systems there is no provision for hue adjustment, this button is used to provide some similar functions. With composite and Y/C inputs, the HUE adjustment adjusts the rotation of the chroma subcarrier, which is useful for correcting PAL signals which have passed through improperly adjusted equipment. This is frequently a problem with computer based equipment where the PAL encoder is designed by computer based engineers who do not fully understand PAL specifications. **NOTE that if HUE is misadjusted that the serial digital (4:2:2) output will display a double set of PAL vectors (four sets) on a vector display. Note also that this will not be apparent on the other outputs or on many serial digital monitors since the PAL system cancels the error, just as it is supposed to do!** Proper adjustment of HUE with a composite or Y/C input is to minimize the double vector while observing the serial digital output on a vector display. If in doubt, simply reset HUE to 0 using the unity preset button.

In the serial digital input and component input modes, the relative gain of the RY amplitude is adjusted relative to the BY amplitude. Adjustment of hue is accomplished by pushing and holding the hue button while turning the Adjustment Knob clockwise to increase BY amplitude.. When making adjustment, the front panel Alphanumeric Display shows relative gain setting numbers with 0 corresponding to the factory preset unity level

UNITY PRESET This button provides a quick return of any of the Proc Amp functions to the unity level. To return any of Video Gain, Setup, Chroma Gain, or Hue to unity, push and hold that button simultaneously with the unity preset button.

NONVOLATILE MEMORY The proc amp settings (and genlock timing) for each mode of operation can be stored in a nonvolatile memory so that if power is turned off the unit will return to the last stored setting. Note that there is a separate Proc Amp memory for each mode - that is - for each input which is selected. Consequently it is possible to set different Proc Amp settings (and genlock timing) for each mode, store those settings, and they will be immediately recalled when returning to that mode at a later time.

NOTE THAT SETTINGS ARE NOT AUTOMATICALLY STORED AS THEY ARE BEING ADJUSTED BY THE OPERATOR, NOR WILL THEY BE AUTOMATICALLY SAVED WHEN POWER IS LOST. If the operator makes an adjustment of a proc amp function, and the unit is subsequently turned off, the unit will return to the previously stored settings, rather

than the newer settings. This allows the operator to make temporary adjustments without affecting the previously stored settings.

In order for a proc amp setting to be stored, the Unity Preset button or the Mode\Enter button must be pushed after the desired proc amp setting is made. Whenever the Unity Preset button or the Mode\Enter button is pushed **ALL** of the then current proc amp settings (and genlock settings) are stored, thus when adjusting for a new input signal the operator may adjust all of the proc amp functions followed by pressing the unity button in order to store all settings. Note that after making a proc amp adjustment, if the Mode\Enter button is pushed the settings will be stored, but the mode will also change to the next operating mode, thus it is usually preferred to press the Unity Preset button to store proc amp changes.

PROC AMP ADJUSTMENT IN FREEZE Note that in the freeze mode the timing and proc amp controls may be adjusted but the adjustments will not take effect until the freeze is released.

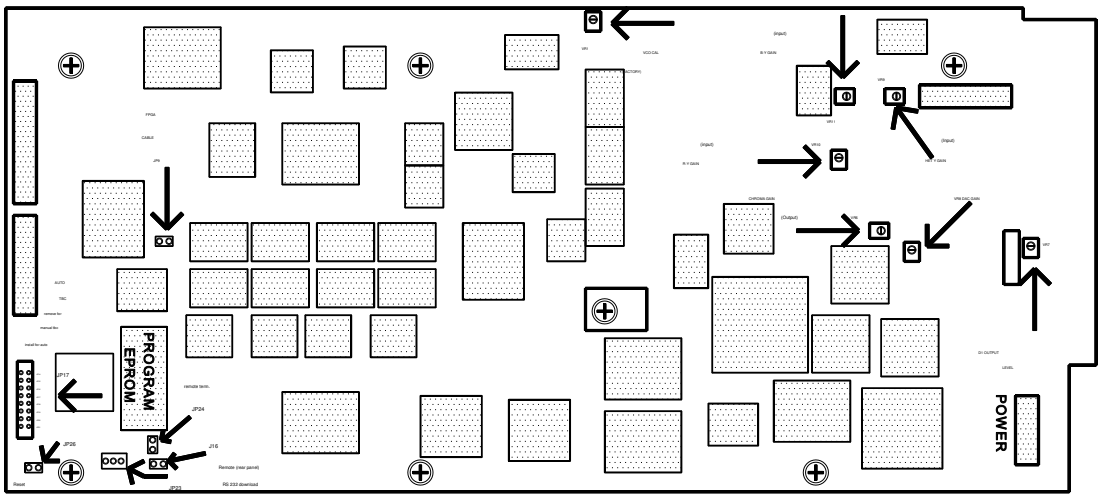
Timing Adjustments

While the Coarse and Fine Horizontal Phase, and the Vertical Phase push buttons are located on the front panel, these are only used in installing the VS 5200, and once the unit is installed these functions are not normally readjusted. Please refer to the installation section of this manual for instructions on the use of these buttons.

NONVOLATILE MEMORY The genlock timing settings for each mode of operation can be stored in a nonvolatile memory so that if power is turned off the unit will return to the last stored setting. Note that there is a separate timing memory for each mode - that is - for each input which is selected. Consequently it is possible to set different timing settings for each mode, store those settings, and they will be immediately recalled when returning to that mode at a later time. Also note that if it is desired to maintain the same timing settings for each mode that they will have to be stored separately for each.

4

VS 5200 INTERNAL JUMPERS AND ADJUSTMENTS



VS 5200 ADJUSTMENT AND JUMPER LOCATIONS

INTERNAL ADJUSTMENTS AND CALIBRATION

VS 5200 Calibration Procedure

Field calibration is not normally required. The procedure is provided herein for reference only. These calibrations do not interact, however it is necessary to calibrate the inputs before using them as the reference input for adjusting output levels. Calibrate VR3 before using the serial digital input, VR9 before using the analog composite input with the TBC on and VR10 & VR11 before using the Y/RY/BY component input.

Otherwise, the calibration may be performed in any order. Calibration is to be performed with a known good input signal, with the input proc amp set to the unity levels. All adjustments are to be made after the unit has been operating for 10 minutes.

It is suggested that a calibrated serial digital input signal be used for calibrating the outputs, as this leads to the most accurate performance. If a serial digital input signal is not available, then a calibrated analog composite input signal is preferred. Color bars is suitable for all adjustments.

Note that of all the pots, the only one which has enough range to prevent the unit from operating is VR3. All other pots may be turned from one end of their range to the other and will not prevent a signal from being passed by the VS 5200.

VR1 calibration of the VCO error voltage. Used to set the error voltage at pin 1 of U2A to the middle of the lock range with a stable analog composite input signal. Typically, this has no effect on any performance except pseudo lock in shuttle mode. Set VR1 so that the voltage at U2A pin 1 is +2 volts with a stable analog composite input.

VR3 Serial (D1) Input lock calibration. This is the most critical adjustment on the board. This pot is used to center the PLL frequency on the serial digital input receiver. Select the serial input (422) mode.

Use a stable serial input with color bars or other static test signal. Monitor the loop error voltage at the junction of 62 and C36 with an oscilloscope. Watch any of the video outputs with a picture monitor. Turn VR3 in the direction which decreases the error voltage. Keep decreasing the error voltage until the PLL loses lock as seen on the picture monitor. Turn VR3 the other way to increase the error until lock is achieved. Slowly turn VR3 to decrease the error voltage until lock is lost, noting the error voltage at the instant before lock is lost. Set VR3 to give an error voltage which is 250 mV above the voltage where lock is lost.

Note that the point where lock is lost is dependent on temperature, thus it is necessary to run the VS 5200 for 10 minutes or more with the cover on, then remove the cover and quickly make the adjustment before the circuitry has time to cool down. Some adjustment away from the 250 mV point may be necessary to compensate for high temperature operation.

VR6 Chroma (subcarrier) output level calibration. This adjusts the level of subcarrier on the composite and Y/C outputs. Be sure that the input video signal is correct before adjusting this pot, and adjust for proper subcarrier level on the analog composite output. It is common to have a 1% difference between composite and Y/C levels due to component tolerances. This is well within all Y/C specifications.

VR7 Serial output level calibration. This adjusts the amplitude of the serial digital (D1) output signal. Connect a serial digital waveform monitor (such as a Tektronix 601i) to the serial digital output and adjust VR7 for proper amplitude. Note that the amplitude may be increased if it is intended to drive long cable runs with the output. Typically, this output level has little or no effect on the ability of downstream equipment to receive and lock to the serial digital output.

VR8 D-A gain calibration. This adjusts the amplitude of the Y, R-Y and B-Y outputs from the triple D-A convertor. Note that this adjustment affects all three signals simultaneously. Also note that the Y output is used for composite, Y/C and component outputs, so that adjusting this

adjustment will affect all three. With a known good input signal, use this adjustment to set the analog composite output Y to the proper level.

VR9 Heterodyne Y Gain. This adjusts the input Y gain for the analog composite input. With a stable analog composite input signal selected, note the Y level of any of the outputs. Force the TBC on and adjust VR9 to match the Y level which the TBC off. This adjustment does not affect the Y/C input's Y level.

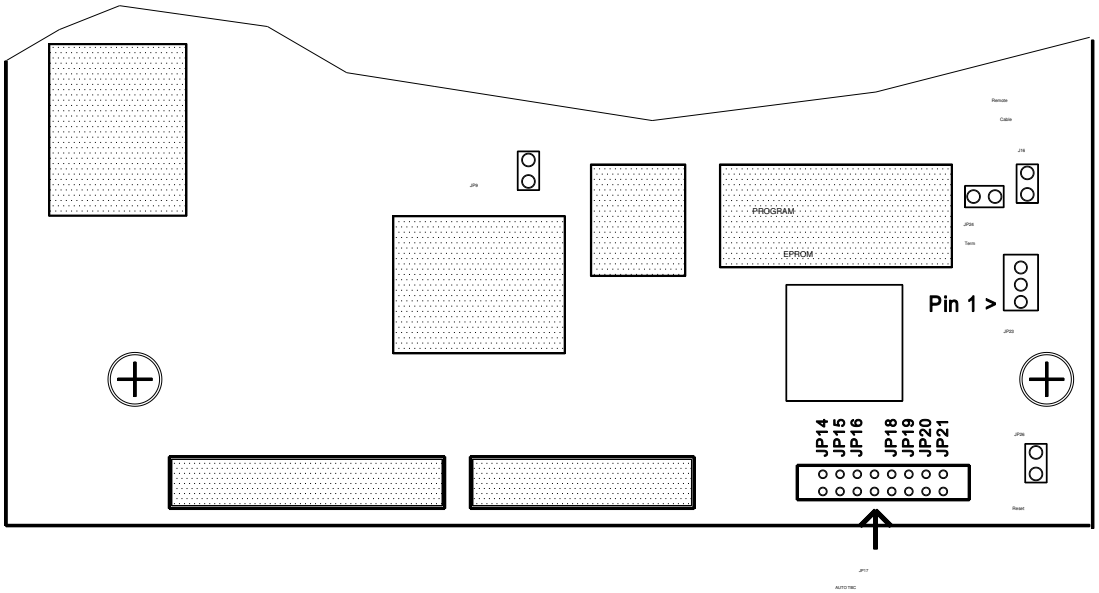
VR10 RY input gain. This adjusts the gain of the R-Y input signal so that the VS 5200 has unity gain from input to output. With an oscilloscope, measure the R-Y input level at pin 3 of U31, or alternatively using a BNC T, at the R-Y input connector. Connect the R-Y output via a thru termination to the oscilloscope and adjust VR10 so that the output R-Y level is the same as the input R-Y level. This adjustment can also be used to make up for system level errors. For example if the input R-Y level is low or high, this adjustment can be set to compensate for the incorrect level.

VR11 BY input gain. This is adjusted the same as the R-Y adjustment VR 10 for the B-Y channel.

Internal Jumpers

The VS 5200 has an array of eight option jumpers with the following functions:

VS 5200 INTERNAL JUMPERS



JP14 - Option Jumper 0, Test chroma portion of modulated ramp to composite output

JP15 - Option Jumper 1, Test chroma portion of color bars to composite output

JP16 - Option Jumper 2, Open: disable front panel display

JP17 - Option Jumper 3, Jumpered: enable Auto-TBC function

JP18 - Option Jumper 4, Remote control address select, jumpered 3D primary, open 3D secondary

JP19 - Option Jumper 5, Jumpered: setup unit for FPGA download (be sure JP22 is jumpered 2 to 3)

JP20 - Option Jumper 6, Momentarily jumper to reload FPGAs

JP21 - Option Jumper 7, Leave open to disable Option jumpers 0 and 1

JP22 - Serial Communications select, Jumper pins 1-2 for the rear panel RS422 port, pins 2-3 for the internal RS232 port (JP23).

JP23 - RS 232 Serial Communications Port, For test purposes. Pin 1 is data transmitted from the VS5200, Pin 2 is data received by the VS5200, Pin 3 is singal ground. Requires JP22 to be jumpered from pins 2-3 to operate. For connection with standard 9 pin "D" RS232 serial port connectors, JP22 pin 1 is wired to pin 2 of the "D" connector, JP22 pin 2 is wired to pin 3 of the "D" connector and JP22 pin 3 is wired to pin 5 of the "D" connector.

Many of these function do not take effect until the microprocessor has been reset either by cycling the power or by shorting pin 1 to pin 2 on JP26.

There is a status light, D10, near the array of option jumpers. It indicates activity on the remote control link. D10 changes state each time a valid message is received from the remote.

5

VS 5200 THEORY OF OPERATION

OVERVIEW

The VS 5200 is a universal video synchronizer with TBC. It accepts composite, Y/C and component analog inputs plus 270 Mb serial digital inputs (SDI). It outputs all of these formats in simultaneously. All of the analog outputs are timed to one another. The serial digital output is slightly advanced form the analog outputs due to the delay in the analog output filtering. Also serial digital input processing on the receiving device usually needs more input processing time.

The genlock circuit controls the output timing. All of the outputs remain timed to one another as the output H phase and V phase is varied. The range of control is a little more than plus and minus 7 m s for horizontal adjustment and 2 lines advance and 1 line delay for vertical timing.20

The VS 5200 has several very useful features such as digital clamping of the analog input for hum rejection and bounce rejection, a very reliable TBC mode detect and auto select circuit, digital control of video gain, chroma gain, hue and setup, and hot switch and freeze functions. Infinite gain digital clamping is also used for the chroma circuit to eliminate R-Y and B-Y black balance pots and eliminate aging and thermal drift that are usually associated with circuits similar to this in other products.

There are field and frame mode freeze functions that can be alternated after a freeze is captured. The hot switch is always field freeze because motion on the input cannot be predicted. There is an analog input gain stage that is digitally controlled, to keep very high level inputs from clipping at the ADC and to boost low inputs so they are the correct level at the ADC.

Calibration pots are minimized throughout the design and replaced with 1% tolerance resistors everywhere. This is to minimize setup and calibration requirements in the factory and in the field. All inputs and outputs are tested and verified to be within 1% of unity gain.

VIDEO INPUT PROCESSING

Analog Luminance

Composite video, component video and Y/C inputs have separate and equal input stages. The luminance portions of these input buffers drive a analog input selector that drives the input analog gain control. The analog gain control is restricted to a little more than +3 dB range of control. The output of the gain control is used to drive the luminance filter, the sync stripper and the chrominance selector for heterodyne TBC operation.

The luminance filter module that has approximately 0.05dB ripple tolerance to 5.5 MHZ. The output of the luminance filter is coupled to a clamp stage and ADC driver. The ADC is driven with inverted video into the inverted input of the 10 bit ADC. The use of inverted drive is to achieve the best differential gain and differential phase specification. Note that the driver is a high performance low power operational amplifier that is operated from +5 volts. The inverted output puts the sync tip more positive at 3.1 volts where any potential non linearity is away from the active video level.

The heterodyne portion of the luminance processing uses a filter module and amplifier. The filter passes 2.5 MHZ but eliminates signals 3.58 MHZ and above so they do not interfere with the chrominance that is processed through the chrominance path.

Digital Gain and Digital Clamp

The analog gain control voltage is determined by the micro processor that receives control signals inputs from the front panel or remote control and processes them to the correct offset for unity gain and downloads to the clamp chip. The digital gain level is converted to analog by a 12 bit DAC which also converts the Luminance, R-Y and B-Y clamp levels and burst PLL control to analog levels. These clamp, PLL and gain control analog levels are multiplexed in time during a horizontal line. These control signals are sampled and held on holding caps. High input impedance low power buffers drive the various control points.

There are several advantages of digital clamping. The first is it as always accurate with no calibration required. There can be no variation because the digitized video is compared to the digital value that back porch should be. The second is all samples are equally weighted in the digital clamp while the back porch sample in analog clamp circuits is weighted toward the end of the sample gate due to RC effects. This makes the digital clamp less susceptible to noise on the video input. The third advantage is the digital clamp gain can be adapted to noise on the input to minimize clamp streaking as input noise increases.

Analog Chrominance

JP 4 is the board input for the S-VHS Y and C signals. The Y input on pin 4 is amplified and buffered and the output of the buffer drives the Chroma selector. Pins 2 and 15 are selected for Composite mode and pin 7 is selected for S-VHS mode. The output of the selector is buffered to produce a positive and negative going chrominance signal to the input of the bandpass filter T1.

T1 is loaded as a 3.58 MHZ bandpass filter for the NTSC version of the VS 5200 and is loaded with a 4.43 MHZ filter for the PAL version. The output of T1 is buffered to drives the differential inputs of the chroma demodulators. The outputs of the demodulators are filtered to pass up to 1.5 MHZ but reject 3.58 (4.43) MHZ and 7.16 (8.86) MHZ components. There is a very deep trap at 7.16(8.86) MHZ because the demodulator produces a lot of high energy transients at 2 FSC. Buffers drive the R-Y and B-Y ADCs with a filtered, clamped and timed signals.

Chroma Clamp

The chroma clamp is part digital and part analog. The clamp error detection is digital to eliminate subcarrier feed through balancing adjustments and drift errors. The digitized and time multiplexed R-Y and B-Y signals are sent to a digital clamp error detection. Long term infinite integration for both the R-Y and B-Y signals is performed along with Y clamping and burst phase error detection. The digital error signals are time multiplexed across each horizontal line and converted to an analog signal by a 12 bit DAC. The output of the DAC is a current representing the digital error signal. This error current signal is converted to a voltage and multiplexed to sample and hold gates. 1000pF hold capacitors store the respective signals at the inputs of the buffer amplifiers which hold the sample error signal until the next sample time which is 1 H later. The R-Y and B-Y clamp error correction signal at the outputs feed the error integrator. The output of the integrator is the DC value that is required to offset the output of the R-Y driver and the B-Y driver to the correct DC level at the ADCs. The signals will be offset to match the point where color black will produce a code of 10-0000-0000 from the ADCs.

Burst PLL

The burst phase locked loop (PLL) consist of a digital phase error detector along with clamp circuits and analog integrator and the subcarrier divider. The phase error is detected by subtracting the demodulated R-Y vector to a HUE value that is loaded into a register by the microprocessor. A digital accumulator is used to integrate all of the samples within the burst window. If the R-Y vector is clamped properly and servoed to the correct hue, some of the samples will be slightly negative and some will be slightly positive depending on noise at burst time. A 12 bit unweighted average is taken of these samples and offset to the center range of the 12 bit DAC. The output of the DAC is sampled with the sample held by a hold circuit. The held and buffered phase error sample is integrated and the integrated error drives the frequency of the VCXO Y3 which produces a 4 FSC output. The 4 FSC clock input is divided by 4 and provides 90 degree shifted outputs to the R-Y and B-Y demodulators.

ADCs

There are three 10 bit ADCs (analog to digital converter) for digitizing component and composite inputs. The luminance and composite ADC oversamples and digitizes the input at 27 MHZ.. The Y signals from the component input or the Y/C input presents the same amplitude and DC levels to the ADC as the composite input. Therefore, the signal to noise and all other specifications are approximately the same. The video signal is inverted and input to the ADC, to give the best performance in DP and DG. The typical performance is 0.6% DG and 0.4% DP. The input signal is 3.13 volts at sync tip, 2.54 volts at back porch and 1.4 volts at 100 % white. The clip points are 3.25 v and 0.92 v. The voltage references to the ADCs is created by a precision voltage reference

source and buffer. The use of oversampling, in conjunction with digital interpolation to convert the 27 MHZ oversampled video to 13.5 MHZ sampled video provides analog signal performance which in many ways exceeds that which would be achieved with simple 13.5 MHZ sampling.

The R-Y ADC and the B-Y ADC operate the same. The R-Y and B-Y signals are not inverted at the ADC inputs. The outputs of the ADCs are multiplexed at 6.75 MHZ with 74 nS for the R-Y signal and 74 nS for the B-Y signal. The OE/ input to the ADCs are used to tri-state the outputs of the ADCs alternately to accomplish the multiplexing. During D1 mode, both ADCs are tri-stated and the digital input is turned on to place the R-Y and B-Y signals from the D1 input on the CRY-BY bus.

The output of the CRY-BY bus goes to the digital clamp chip on to and the memory write mux chip.

The output of the luminance/composite ADC goes to a 55 tap digital filter that accepts an input signal at 27 MHZ and filters and interpolates the signal to 5.75 MHZ. Passband response is within 0.02 dB. Rejection at 6.75 MHZ is filtered to 36dB or more. This technique is used to achieve high performance analog to digital conversion as well as precise filtering by using a high frequency anti-aliasing filter in the analog section that has very little ripple and very little group delay in the pass-band to 6 MHZ or more while a precise digital filter is used to reduce the signal above the Nyquist frequency of 6.75 MHZ for D1 levels and clock rates in the system and on the serial digital output

TBC and Synchronizer PLL

Composite sync is stripped from the input video by a sync stripper IC. The H sync output is used for time base correction. An FPGA with a program to control H and V lock in all modes including all composite inputs with or without TBC turned on as well as with the Serial Digital Input is used for memory write control.

MODE SELECTION

The video input selector receives mode instructions from the microprocessor after the initial turn on configuration. The serial data input selection instruction from the micro causes the selector to select a video input and change the PLL mode and clock source. When the TBC mode is selected the unit configures itself for TBC mode and selects an LC oscillator U1 as the clock source. In the synchronizer mode the VCXO (Y1) is selected. If SDI mode is selected, both oscillators are turned off and the D1 clock is enabled.

PHASE LOCKED LOOP (PLL)

A ramp and sample technique is used for detecting phase errors on the input signal because it is very accurate. Accuracy of error detection is necessary to achieving very low PLL jitter. The ramp is formed from the Write Control Logic that is clocked from the same clock that is digitizing the video and writing to the memories. A pulse is made from the incoming sync to sample the ramp. The error signal from the ramp sample is integrated and used to control the frequency of a voltage control crystal oscillator (VCXO) or a wide range LC oscillator. The LC oscillator is selected for TBC mode and the VCXO is selected for stable inputs. TBC mode can be selected or not selected for composite, Y/C or component inputs. The combination of a good sync

stripper, ramp and sample error detector, and good crosstalk immunity in the error integrator and LC oscillator gives the PLL excellent stability of less than 10ns p-p on a clean input. Noise on the input will cause an increase in the jitter because the PLL will tend to follow the sync from the sync stripper.

The sync stripper chip has a built in low pass filter to minimize sync jitter caused by noisy inputs and a good clamp circuit to minimize jitter due to APL changes or DC bounce. The sync also is stripped at the 50% level to minimize jitter. The 50% threshold is created in the sync stripper by sampling sync tip and back porch voltages and dividing them equally. In order to prevent latch up, a coarse sync tip separator is used to generate the sync tip and back porch sample pulses.

The H sync from the sync stripper is AC coupled to the input of the sync window gate and the sample pulse generator. The sync window gate allows sync leading edges to pass if they are in a narrow acceptance gate but rejects edges from dropouts or other noise that may cross the 50% sync threshold level. The window is widened for initial capture of the input sync and recapture during skew errors from VTRs in TBC mode. The leading edge of the output pulse is used to create the sync sample pulse. The sample pulse is approximately 3 ms. Its width is not critical because the leading edge is used to stop the charging current of a linear ramp and create the error sample at that time. The sample pulse width only determines the width of the flat spot on the ramp and the transfer duration.

The ramp is sampled at the flat spot which represents the instantaneous sync position error. This error is integrated and used to bring the internal oscillator in phase with the stripped sync. The integration time constant is chosen as a compromise between fast time base correction to follow the slightest input error and noise immunity so that the servo does not try to follow the noise modulation on the stripped sync..

The output of the integrator drives both the LC oscillator for TBC correction and the VCXO (Y1) for stable inputs. Only one of these oscillators receives power at any one time.

DIGITAL CIRCUITRY

Memories

The memory consist of 8ea. UPD42280 memory chips, the 1 H hysteresis memories and the input and output mux chips. These memories are one field FIFO memories with a write clock, write clock enable and write reset on one side and read clock, read clock enable and read reset on the other. Write data and clocks are asynchronous permitting the memory to be used for time base correction (TBC) and synchronization. The memories are reset at the top of each field independently for the write and read sides. Only one field is written at one time but both fields are read simultaneously but only one of the fields is output enabled. This is so that hot switch can be used with a FIFO memory. When a lock error is detected on one of the fields the logic determines that the other field should be read until a good field of video is written over the bad field. This causes a temporary freeze on the good field until the new source is stable for a minimum of two fields.

Composite video or luminance may be written into the Y memories. Only component R-Y and B-

Y is written into the C memories. The output mux latches the Y and C data from the memories and multiplexes it out at a 27 MHZ CCIR-601 rate..

Video Decoding and Processing

The TMC22153 is a complex multipurpose chip. It receives a digitized composite signal in composite mode with TBC off and Y/R-Y/B-Y multiplexed component signals in all other modes. It is a three line adaptive comb filter for separating luminance and chrominance, a chrominance demodulator, and a processing amplifier for all input modes. It passes component modes without demodulation but allows processing. The TMC22153 provides control of video or luminance gain, however, luminance gain is performed in the analog stage so that signal to the ADC is at the right level. This prevents clipping when the input is too high or unnecessary noise caused by digitally amplifying a signal that is too small to be properly quantized by the ADC. The chrominance gain is always performed in the TMC22153 with either composite or component inputs. Also the setup is always performed in this chip. The input signal is always clamped to the proper back porch level by the digital clamp circuit so adjustable setup has to be performed later in the processing chain. In order to provide a legal CCIR-601 output, the setup is removed from NTSC signals in the input section of the TMC22153. The setup control is adjusted for the correct black value in the chip. The 7.5 IRE setup is added to the Y signal in the analog output to produce a correct analog NTSC output while the SDI output has no setup.

The TMC22153 is loaded with the unity gain parameters for each mode by the microprocessor and the values for the proc amp settings for each mode are stored separately for each mode whenever the mode setting is changed or the UNITY button is pressed. The settings are stored in a non volatile flash memory and are loaded again on power on or return to that mode and proc amp settings..

The TMC22153 has multiple output modes so it can provided separated luminance at 13.5 MHZ on the Y parallel. bus, multiplexed R-Y and B-Y at 13.5 MHZ on the C parallel bus and simultaneous multiplexed Y, R-Y and B-Y at 27 MHZ on the D1 mux bus.

Genlock

The VS 5200 uses digital genlock to lock to the black burst reference signal. The genlock reference signal is buffered and filtered The chip receives the reference signal on pin 34. It is digitized internally and the digitized signal is used to lock a 27 MHZ synthesized clock to the burst of the reference signal. It also produces a H sync signal (pin 12) and a V sync signal (pin 13). A genlock valid signal goes high to indicate the chip is locked to the incoming reference signal. There is a digital output (CVBS) that defines the timing signal. The CVBS data carries the H, V and subcarrier lock data and is modified by the genlock chip. The microprocessor uses a serial load through programming input to modify the internal registers and embed a new vertical position in the CVBS word. **Note that a proper genlock signal must always be connected**!

The H phase, subcarrier phase and new vertical (phase) position is received in on the genlock bus at CVBS input pins of the digital encoder. There are four vertical position lines with two lines of advance and one of delay . The microprocessor controls the horizontal phase and subcarrier phase through the A/D port. The fine H phase controls the subcarrier and H phase in .4 degree increments over a 90 degree range. All of these registers are loaded on power up from the microprocessor to restore the last saved value of coarse H phase, fine H phase, and V position.

Encoder, Analog Out

The encoder produces an encoded chroma output from the R-Y and B-Y multiplexed input. The encoder also produces composite sync and burst that is locked to the modified CVBS data. SCH phase is controllable but is set to 0 SCH by the micro processor. The encoder up interpolates the digital luma and chroma signals to 27 MHZ clocking rates before the internal DACs. This reduces the output filter requirements, improves filter ripple, group delay and reduces filter cost and size. The chroma output signal with burst is filtered and the output chroma drives the C portion of the Y/C connector and adds chroma to the luma and sync signal to make the composite video output signal.

The digital Y signal drives the component output mux chip. The Y and C signals are properly timed at the this point, however, the R-Y and B-Y up interpolation filters are clocked at 6.75 MHZ on their inputs while the luminance up interpolator filter is clocked at 13.5 MHZ. These filters have 26 clocks of delay so the R-Y and B-Y up interpolators create 26 high speed clocks of delay more than the luma up interpolator. This delay difference is corrected by delaying the 10 bit Y signal by 26 clocks. The up interpolation filters are used to reduce the analog reconstruction filter requirements as well as minimize sine x/x equalization requirements. They drive the triple 10 bit DAC. This DAC is very small and power efficient but it is accurate to 1/4 LSB at 10 bits. It produces an accurate Y, R-Y and B-Y output. A DAC output gain calibration pot is provided for accurate luminance output with a serial digital input signal. The R-Y and B-Y outputs will track to within 1% accuracy.

The luminance output from the D1 input has no sync added. Therefore, the composite sync from the digital encoder is amplified and added to the Y output from the DAC. This combined Y and composite sync signal is clamped at a very slow rate to restore the DC value. The luminance output drives the reconstruction and sine x/x equalization filter. The filtered output is amplified and slightly peaked and then drives the Y/C connector, the Y/R-Y/B-Y connector. Luminance and sync are added to the chroma signal in the composite driver which drives the two composite video BNC connectors CX3 and CX4.

Serial Digital Output

The multiplexed digital signal is multiplexed as B-Y, Y, R-Y, Y etc. at 27 MHZ. It comes from the video decoder chip in this form. An FPGA that blanks any present SAV and EAV codes and adds proper codes that match the analog output signal with its H and V offsets from the reference signal. This is essential because of the field freeze and hot switch capabilities of the VS 5200.

Audio Delay (DDO) Output

There is a audio delay output to control audio delay correction devices such as the Pixel AD 3100 audio synchronizer. This signal has a high period which represents the delay of the video passing through the synchronizer.

Micro Controller

The microprocessor is a simple 8-bit processor which coordinates and distributes control information among the various subsystems of the synchronizer. It is specifically responsible for:

- Accepting operator input from the front panel and taking the appropriate action
- Formatting status information to the display on the front panel.
- Accepting operator input from the remote control unit
- Loading the FPGA devices on power up from programs stored in flash memory
- Saving operating parameters into flash memory and restoring them on power up
- Accepting hardware options from the array of option jumpers on the board
- Configuring certain programmable parts on the board, such as the comb filter, the genlock chip and the chroma encoder.

Remote Control and Serial Communications

There are two serial communications ports associated with the micro controller. J16 is the RS422 port for connecting the remote control unit. JP23 is the RS232 port for maintenance and troubleshooting via the on board micro. One or the other of these connections is selected via JP22. For normal operation, there is a jumper between pins 1 and 2 on JP22 which enables the rear panel remote control port. Unless several VS-5200 synchronizers are to be daisy-chained on a single RS-422 cable, the termination resistor should be enabled by jumpering JP24. Note that the connector from the rear panel remote can be connected to JP22 in the event the user wishes to utilize RS232 remote communications rather than RS-422 which is supplied as shipped.

Flash File Download

JP23 is an RS-232 port provided for convenience in transferring FPGA programs from a computer allowing updated firmware to be installed in the field. To download, you must have a computer, preferably running Windows ‘95 and the terminal emulation program TTY.

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VS 5200 BOARD DIMENSIONS, CONNECTIONS AND POWER WIRING

POWER REQUIREMENTS

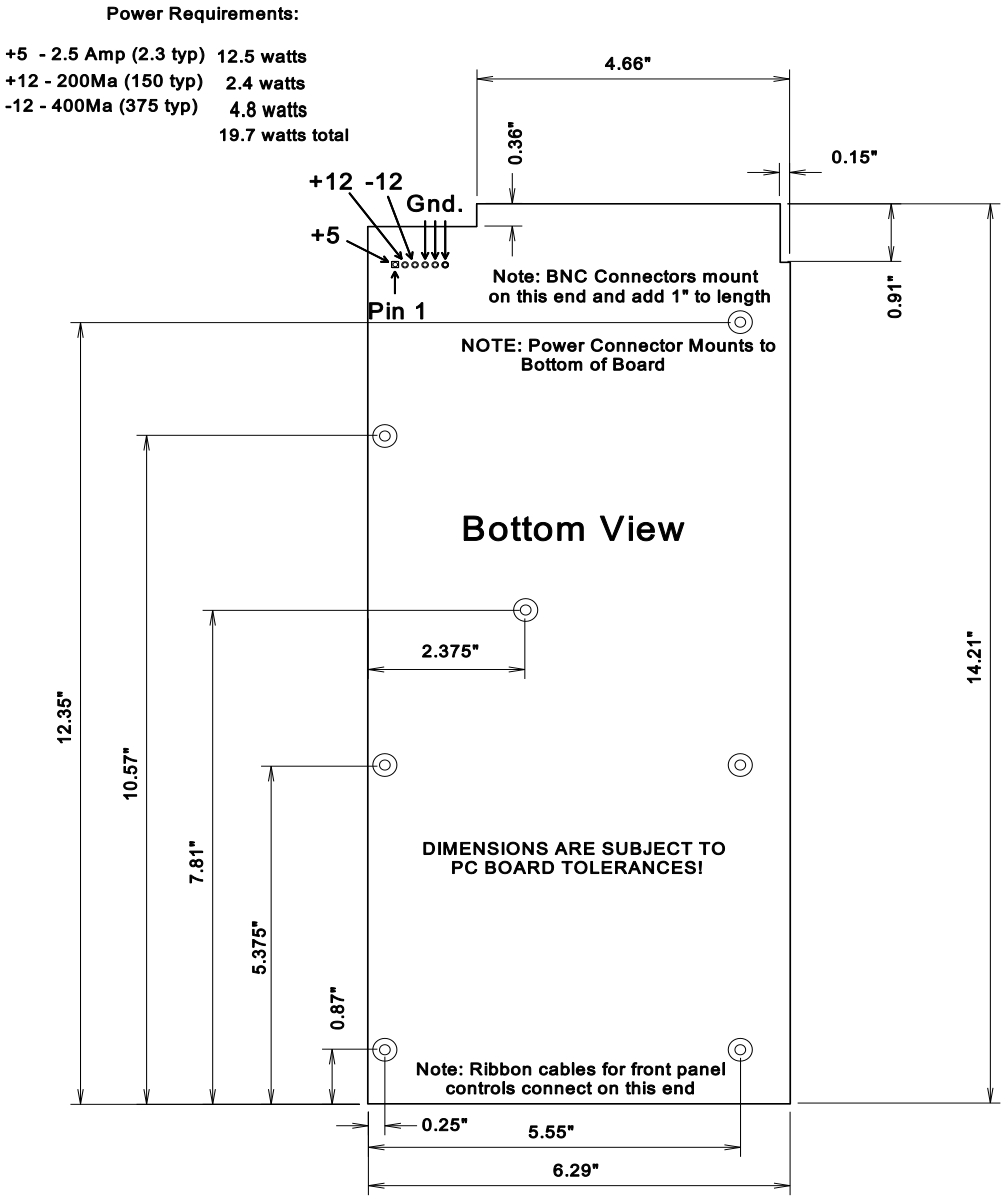
The VS 5200 main board uses the following D.C. power inputs at its power connector located on the bottom of the board:

+ 5 volts @ 2.5 Amp max	(2.3 A typical)	2.5 watts
+12 volts @ 200 Ma max	(150 Ma typical)	2.4 watts
-12 volts @ 400 Ma max	(375 Ma typical)	4.8 watts
		19.7 watts total

A 20 watt or larger D.C.. to D.C. convertor may be utilized to provide power from mobile and aircraft systems. Be sure to properly size the convertor to include any power needed for cooling fans and other accessories.

BOARD DIMENSIONS

Due to the small size of the VS 5200 main board, many customers desire to build custom enclosures for the VS 5200, or to add the board to existing equipment. The drawing given below shows a bottom view of the PC board and dimensions which, along with the PC board itself, will allow the user to construct custom enclosures or provide mounting hardware inside existing equipment.



As with all high speed digital equipment the user constructing a custom enclosure should remember to provide adequate shielding from electrostatic and electromagnetic radiation as the VS 5200 both generates and is sensitive to such interference. In addition, a minimal amount of ventilation is necessary in order to remove approximately 20 watts of heat from the board. Normally a small 3" muffin fan will be adequate for such cooling. Smaller fans may be utilized providing testing of the individual components in the board is performed to ensure that none of the ICs exceeds a case temperature of 45° C.

VS 5200 MAIN PC BOARD CONNECTOR IDENTIFICATION

The following is a listing of signal connections on the VS 5200 main board and a brief description of their signals:

*** PC REAR EDGE BNC CONNECTORS**
 # TO REAR PANEL CONNECTIONS

TYPE	REF	PINS	SHEET/NAME	PINS/FUNCTION
*BNC	CX1	BNC	1 SERIAL DIG. IN	1 D1 IN (right pc conn. from rear) 2 GND 3 GND 4 GND
*BNC	CX2	BNC	1 COMPOSITE IN	1 COMP IN (#2 pc conn. from rear) 2 GND 3 GND 4 GND
*BNC	CX3	BNC	8 COMPOSITE OUT	1 SIGNAL (#3 pc conn. from rear) 2 GND 3 GND 4 GND
*BNC	CX4	BNC	8 COMPOSITE OUT	1 SIGNAL (#4 Pc conn. from rear) 2 GND 3 GND 4 GND
*BNC	CX5	BNC	8 SERIAL OUT	1 SIGNAL (#5 pc conn. from rear) 2 GND 3 GND 4 GND

#RJ8	J16	2	10	Remote	1 RS232 2 RS232
*BNC	J19	BNC	7	Genlock in	1 Signal (#6 Pc Conn. From Rear) 2 GND 3 GND 4 GND
*BNC	J20	BNC	7	Genlock in	1 Signal (Left Pc Conn. From Rear) 2 GND (By Notch in Board) 3 GND 4 GND
#BNC	JP2	2	1	Comp'nt Y	1 Y IN 2 GND
#BNC	JP3	4	2	RY-BY IN	1 RY IN 2 GND 3 GND 4 BY IN
#BNC	JP4	4	1	SVHS IN	1 Y IN 2 GND 3 GND 4 C IN
	JP5	20	10	Front Panel Alphanumeric Display	
#BNC	JP10	4	8	Y/C OUT	1 Y OUT 2 GND 3 GND 4 C OUT
#BNC	JP11	6	9	Comp'nt out	1 Y OUT 2 GND 3 RY OUT 4 GND 5 BY OUT 6 GND
#BNC	JP25	2	8	Delay out	1 Delay 2 GND
	JP27	6	3	POWER	1 +5 2 +12 3 -12 4 GND 5 GND 6 GND

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TROUBLESHOOTING

IDENTIFYING THE PROBLEM

The quickest way of solving any problem is to ensure that it is well understood. Quite often problems which appear to be present in a particular piece of equipment are actually just the manifestation of a failure elsewhere. First verify that the VS5200 is properly installed and is being properly operated.

Video Problems

Before attempting to identify a problem with the VS 5200, first verify that what is observed is actually a problem located in the unit. If the failure is a noise or distortion type effect, cable around the unit to verify that the problem does not exist in either the source video or the test and monitoring equipment. **Note that a proper genlock signal must always be connected!**

Once it has been firmly established that the problem resides in the VS 5200, and before removing the cover on the unit, the next step is to verify that the unit has not been inadvertently misadjusted, thereby causing the problem. As an example, if the video gain is turned down to accommodate an incoming video signal which is too high because it was not terminated, the gain must be returned to normal before a correctly terminated video signal is used. Without returning the gain to normal, the unit will appear to malfunction by outputting low video levels, or even by losing chroma lock.

Since there are four selectable inputs and four simultaneous outputs provided on the VS 5200, the first step is to identify which of the inputs and outputs are affected by the problem, and which are not. Stepping through the mode control will allow checking the inputs and connecting an appropriate waveform monitor and picture monitor to each of the outputs will allow this determination.

The VS 5200 is separated into input and output sections which share common memory and initialization, but for the most part are otherwise totally unrelated. By freezing the video signal and observing whether or not the problem freezes, it can sometimes be determined whether the problem is located in the input or the output circuitry.

In summary:

1 Remove the VS 5200 from the video circuit to verify that the problem is not with the source or monitoring equipment. Verify proper installation and use of the VS5200.

2 Check to see which of the four inputs are affected by the problem.

2a Check to see if the input problem is affected by the TBC on/off.

2b Check to see if it is a chroma or luma (or both) problem by turning the chroma gain all the way down.

3 Check to see which of the four outputs are affected by the problem.

4 Freeze the video to see if the problem freezes to establish whether the problem is input or output circuit related.

Once these tests are performed, hopefully the problem can be located to a particular input or output video circuit. Consult the Pixel VS 5200 Service Manual or contact factory for further information.

REPAIRS

The cabling and through hold components, despite being very small, can be easily replaced in the field by skilled technicians who have a professional soldering station and small tools available.

Replacement of surface mount components, and especially the ICS, requires special hot air removal, cleaning and soldering equipment, as well as a lot of skill. The traces, pads and vias used in modern surface mount printed circuit boards are extremely small and can be easily damaged by standard soldering equipment. If you do not already have the equipment and skill to replace surface mount components, do not attempt replacement as it is highly likely that damage to the surface and internal pads, vias and traces will occur. Such damage can be impossible to repair resulting in irreparable damage to the printed circuit board and possibly even destruction of the unit!

Educating one in proper surface mount repair techniques is beyond the scope of this manual. If you discover the need to replace a surface mount component, please return the unit to the factory or authorized service location

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RC-5200 REMOTE CONTROL

REMOTE OPERATIONS GUIDE

General

The RC-5200 enables control of up to 12 VS-5200 synchronizers from a central, remote location. All functions of the VS-5200, including gain, black level, and timing can be controlled from the RC-5200. For the more commonly used functions, the RC-5200 has individual buttons for selecting that function. For the less used functions, there is a menu tree from which to select functions.

Establishing Remote Communications

Before the RC-5200 can control a synchronizer, communications must first be established. Press the numbered unit select button on the right side of the RC-5200 control panel to initiate communication with the appropriate unit. If communications are established, the display will change to show the unit number and status (freeze state, TBC state and input mode) of the selected unit. Otherwise, a not found message will be displayed briefly, followed by the unit idle message. Please note that the VS 5200 main board has jumpers which must be properly set in order for the remote to function. In addition, the cable from the remote to the VS 5200 main board must be properly wired as the two wire interface is polarity sensitive, and a 4 wire connector is used. Note that while a standard telephone handset connector is used for remote connections, the VS 5200 does not use the standard pairs (two inner and two outer) used by the telephone company. This wiring is chosen as protection - in case somebody connects a telephone circuit to the VS 5200 or the RC 5200, hopefully the voltage on the telephone circuit will not destroy the RS 422 receiver IC.

Remote Adjustment of Video Parameters

Once communications have been established, the video parameters of the VS-5200 can be adjusted by pressing the appropriate selection button and then rotating the adjustment knob. When a selection button is pressed, the display will show the current value for that adjustment, and will

update as the adjustment is changed. At the same time, the local display on the VS-5200 will also show the new setting much as if the adjustment had been made at the local control panel. Pressing the same selection button again will return the unit to the status display screen

Note that when adjusting the horizontal phase, the first press of the H button selects the coarse horizontal adjustment, a second press selects the fine adjustment and a third press returns to the status display screen.

Note also that pressing the Hue button will select Hue for adjustment on modulated inputs (Composite and SVHS) and will select differential chroma gain for adjustment on component inputs.

Remote Freezing/Unfreezing the Output

There are two buttons used to freeze/unfreeze the output of the synchronizer. The left hand button is a Freeze/Go button (marked FRAME on some units). The right hand button is a Field/Frame mode selection button (marked FIELD on some units). Pressing the Field/Frame mode button toggles the freeze mode state and will momentarily display either a Field Mode message or a Frame Mode message. If the synchronizer is operating normally, pressing the Freeze/Go button will freeze the image in the currently selected freeze mode. Pressing the Freeze/Go button again will restore the unit to normal operation. Pressing the Field/Frame button while the synchronizer output is frozen will toggle the synchronizer output between field mode and frame mode freezes.

Whenever the output of the synchronizer is frozen, there will be an "F" in front of the unit number on the RC-5200 display. A capital "F" indicates a frame mode freeze. A lower case "f" indicates a field mode freeze.

Using the Remote Menu System

The menu system is accessed by pressing the Menu button. When Menu is pressed, the first item of the Main Menu is displayed. Menu items may be scrolled into view by turning the adjustment knob. The function of the currently displayed menu item is activated by pressing the Menu button again. Menu items and their associated functions are shown in the following table.

Function

Main Menu

TBC
Display the TBC menu

Select Composite
Select the Composite input on the VS-5200

Select YUV
Select the YUV Component input on the VS-5200

Select D422

Select the Digital 4:2:2 input on the VS-5200

Select Y/C
Select the Y/C (SVHS) input on the VS-5200

Unity
Display the Unity menu

Adjust SCH
Allow SCH adjustment of the attached VS-5200

TBC Menu

TBC Force On
Forces all modulated signals to be treated as if they have time base errors

TBC Auto
Allows the unit to auto select TBC if there are time base errors

TBC Force Off
Disables the TBC function of the synchronizer

Unity Menu

Unity Gain
Set Gain Adjustment to Unity

Unity Chroma
Set Chroma Adjustment to Unity

Unity Diff/Hue
Set Diff/Hue Adjustment to Unity

Unity Setup
Set Setup Adjustment to Nominal

Unity H
Set H Adjustment to Nominal

Unity V
Set V Adjustment to Nominal

Other Remote Options

When the display shows the unit number and input mode of the synchronizer, or the unit idle message, the knob is not selected for adjustment of any parameter and may be used to turn off the display. To turn off the display, rotate the knob 15 or more clicks counterclockwise. To turn it back on, rotate the knob 1 or more clicks clockwise.

There are a few options which may be selected by jumpers on the circuit board. J2 is the option jumper header. These functions are highlighted in the following table.

J2 Pins

	Jumpered Function	Open Function
1-2	Single Wire Communication	Six Wire Communication
3-4	Spare	Spare
5-6	Channel Idle Mode	Channel Stick Mode
7-8	Knob Idle Mode	Knob Stick Mode
9-10	Spare	Spare

In Single Wire Communication, the RC-5200 looks to find all 12 units connected to port #1 (right most port as seen from the rear). the other five ports are not functional.

In Six Wire Communication, the RC-5200 expects to find no more than 2 remote units on each of the six ports. In this mode, a remote unit setup as hardware address #1 (the primary address) would be selected by pressing button "1" if the unit were connected to port #1, button "2" if on port #2, and so on. If the remote unit were setup as hardware address #2, then pressing button "7" would connect to it if it is on port #1. Button "12" would have to be pressed to connect to address #2 on port #6.

In Channel Idle Mode, the remote will disconnect from the selected synchronizer after a minute or so of no activity at the controls. In Channel Stick Mode, the remote will stay connected to the last selected unit.

In Knob Idle Mode, the remote will return to the status screen a minute or so after the last adjustment. This prevents inadvertent operation of the knob from making unintended adjustments to the remote synchronizer. In Knob Stick Mode, the RC-5200 will leave the last selected adjustment active until it is manually deselected.

FIGURES AND TABLES

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