VG-5
Video Frame Grabber
PCI Version

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Communications Regulations

FCC Statement

This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in Part 15 of FCC rules. See instructions if interference to radio or television reception is suspected.

Radio and Television Interference

The equipment described in this manual generates, uses, and can radiate radio frequency energy. If it is not installed and used properly, it may cause interference with radio and television reception. This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in Part 15 of FCC rules. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

You can determine whether your computer system is causing interference by turning it off. If the interference stops, it was probably caused by the computer or one of the peripheral devices.

If your computer does cause interference to radio or television reception, try to correct the interference by using one or more of the following measures:

Turn the television or radio antenna until the interference stops.

Move the computer to one side or the other of the television or radio.

Move the computer farther away from the television or radio.

Plug the computer into an outlet that is on a different circuit from the television or radio.

If necessary, consult Scion or an experienced radio/television technician for additional suggestions. You may find the following booklet helpful: *Interference Handbook* (stock number 004-000-00493-1). This booklet, prepared by the Federal Communications Commission, is available from the U.S. Government Printing Office, Washington, DC 20402.

Changes or modifications to this product not authorized by Scion Corporation could void the FCC Certification and negate your authority to operate the product.

Getting Started

Introduction

The VG-5 frame grabber that you have just received is a high-quality instrument suitable for use in a variety of scientific and industrial imaging applications such as video microscopy, gel documentation, autoradiography, and automatic process inspection. The primary function of the VG-5 is to capture video frames from standard RS-170 (or CCIR) video sources such as CCD cameras. It can also output images as standard video. The VG-5 is supplied with Scion Image, a version of the popular image acquisition and analysis software package, NIH Image, developed at the National Institutes of Health. Scion Image is a slightly extended version of NIH Image that supports the PCI version of the VG-5 as well as other Scion imaging boards. The VG-5 also comes with PhotoShop modules for use with other software packages that support the PhotoShop interface.

Please take a few moments to read through this manual before you begin using your VG-5 as it should answer some of the questions that you may have concerning your new frame grabber. Please contact us at Scion Corporation should you encounter difficulty at any time, or if you have any questions.

Contents

You have received in addition to your VG-5 frame grabber: a CD-ROM, and an installation sheet. You may also have received a cable to connect a video source to the frame grabber board. All cables are optional.

The CD-ROM contains a short Read Me file, this manual, the driver file for the frame grabber, a compressed archive containing the Scion Image application program along with complete documentation. Should any items be missing, please contact Scion Corporation so that we can rush you the missing items.

System Requirements

The VG-5 can be installed in any Macintosh with a PCI slot. This includes all currently shipping PCI Macintoshes – the Power Macintosh 7200, 7500, 8500, and 9500.

Any standard RS-170 (or CCIR) video source can be used with the VG-5. The RS-170 (CCIR) standard is a specification for monochrome video signals. The AG-5 board does not come standard with a cable. An optional cable can be purchased from Scion Corporation. The VG-5 cannot be directly connected to a color (NTSC or PAL) video signal. The color information in a color video signal will produce an unacceptable interference pattern in captured frames. The VG-5 can, however, be connected to RGB video sources using the optional RGB cable. When connected to an RGB source, the VG-5 can capture frames from each of the individual color signals and can capture three-pass color images.

The VG-5 is designed for use primarily with RS-170 (or CCIR) CCD cameras and RGB output CCD cameras. The VG-5 does not perform time-base correction on the incoming video signal. This means that the VG-5 may have sync difficulties with some consumer quality VCR's and camcorders that exhibit large time-base errors.

Installation

VG-5 Circuit Board

Installing the VG-5 in your Macintosh is an easy process that should only take a couple of minutes. The first step is to remove the cover from your Macintosh. If a PCI card retainer is present, swing it aside so that the PCI slots are accessible. If you are unsure of the proper method for removing the cover from your particular Macintosh, consult your Macintosh user's manual. Once the PCI slots are exposed, select the PCI slot that you wish to use and, if necessary, remove the cover from the opening in the rear of the Macintosh case that corresponds to the slot.

At this point, make sure that you have discharged all static electricity from your body. A good way to discharge static electricity is to touch the Macintosh power supply. Remove the VG-5 frame grabber from its static shielding bag. Holding the VG-5 by its top edge, align the rear edge of the circuit board with the card guide, if present, corresponding to the selected slot. At the same time, align the VG-5's connector bracket with the slot opening. When the circuit board is aligned, carefully lower the VG-5 into the slot until the edge connector on the bottom of the board rests against the Macintosh PCI connector. Check to insure that the board and the connector are appropriately aligned. Then press firmly on the top edge on the circuit board until the board mates with the connector. If excessive force is required to mate the connectors, remove the VG-5 from the Macintosh and try again. Once the VG-5 is inserted in the PCI slot, replace the PCI card retainer, if present, then replace the cover of your Macintosh.

Cables

If you bought the Single Source cable then insert the nine pin connector of the cable into the nine pin connector of the VG-5. When the connectors are mated, tighten the two screws on the single source cable connector. Connect the BNC end of the single source cable labeled VIN to your camera. Connect the BNC end labelled VOUT to your video printer or external monitor. If you are using the RGB cable, it connects to the VG-5 in the same manner as the single source cable. Connect the nine pin connector to the nine pin connector of the VG-5. The other end (or ends) of the cable connects to your video source. If you have a video source with a non-standard connector, please contact Scion for assistance.

Scion Image Software

To install the Scion Image software package, insert the Scion CD-ROM and double slick the Scion Image folder. To decompress the archive, double click on the archive icon and follow the directions. The archive will decompress into a Scion Image folder containing the program as well as documentation, sample macros, and convolution kernels.

There are four Adobe PDF documents describing the Scion Image package. ‘NIH Image Manual’ is the user's manual for the standard version of NIH Image. 'NIH Image Engineering' is a brief introduction to some of the technical aspects of imaging. 'Inside NIH Image' describes some of the structure of the standard Image program and discusses ways to modify it for custom applications. All of these documents apply to Scion Image as well. The final document, ‘Mods to NIH Image’ describes the extensions to the standard Image that are available in Scion Image and how to use them.

Using the VG-5

Introduction

Once the VG-5 circuit board has been installed, the supplied single source cable connected to the VG-5 and your camera, and the Scion Image archive copied to your hard disk and decompressed, you are ready to begin using your VG-5. This section will describe some of the capturing capabilities of the VG-5 and Scion Image – such as normal grayscale capturing, frame averaging, grabbing frame sequences, color capturing, using the external trigger, and outputing images.

Once the Scion Image software has been started, by double clicking on the program icon, the Scion Image menus and windows will be presented. The commands that deal with the VG-5 and image capturing, such as basic grayscale capturing, frame averaging, capture of frame sequences, and color capturing, are contained in the 'Special' menu and the 'Stacks' menu.

Grayscale Capturing

When the 'Start Capturing' command, under the 'Special' menu, is selected, the program will continuously capture and display video frames. The display rate on all current Macintosh models is 30 frames per second. On some Macintoshes, it may be necessary to move the cursor out of the image window to achieve the maximum display rate. You may stop the continuous capture process at any time by either choosing the menu command again (which has changed to 'Stop Capturing') or by clicking in the 'Camera' window with any of the tools except the magnifying glass or the grabber. Once the capturing process has stopped, the captured frame is available for analysis or saving to disk.

The 'Video Control' dialog box, also under the 'Special' menu, allows you to change various parameters of capture. The 'Offset' and 'Gain' fields allow you to adjust the range of digitization of the VG-5's analog to digital converter. 'Use External Trigger' enables the VG-5's external trigger capability. 'Separate Sync' should be enabled when the VG-5 is connected to an RGB video source using the optional four source cable. It instructs the VG-5 to look for video sync information on the sync channel of the four source cable. The 'Channel' radio buttons select which of the VG-5's four video sources is to be digitized. The 'Video Pass Through' option will enable real-time video on the VG-5's video output. This is useful when observing or focusing on an external TV monitor.

Frame Averaging

The 'Average Frames' command is useful for reducing random video noise. This command is also found under the 'Special' menu. The number of frames to average can be specified, though if more than 128 frames are specified, there is a possibility of overflow in the arithmetic buffer. Frames can also be integrated (summed) using this command with the results scaled to the range 0 to 255.

The 'Integrate on-chip' allows the use of integrating cameras. The specified number of frames will be integrated on the imaging sensor of the camera and the resultant image will then be captured by the VG-5. Currently supported integrating cameras are the Cohu 491X series and the Dage CCD-72. An optional cable, CAB-DAGE-LG3, will be required for

connecting the LG-3 to the integration input of the Dage Camera. The Cohu adapter, CAB-COHU-ADP will adapt the Dage cable for the Cohu 491X.

Sequence Capture

The 'Make Movie' command is found under the 'Stacks' menu. It is used for capturing sequences of frames. Before the command is invoked, a region of interest must be drawn in the 'Camera' window using the rectangular selection tool. When the command is invoked, a dialog box will appear. This box will request the number of frames in the sequence and the time interval between frames in the sequence. When both values have been specified, the software will instruct the VG-5 to capture the specified number of frames at the specified time interval. After the command has completed, the sequence will be presented on-screen as a stack of frames. The PCI version of the VG-5 is capable of sequence capture at 30 frames per second.

Color Capture

The 'Capture Color' command, under the 'Stacks' menu, will capture a three-pass 24 bit color image using the VG-5. To capture color, you must have the optional four source cable connected to an RGB video source and the 'Separate Sync' box checked in the 'Video Control' dialog box. When the command is selected the software will capture three separate frames using the VG-5. The first frame will be captured from the red video signal, the second frame from the green video signal, and the third frame from the blue video signal.

After the 'Capture Color' command has completed, there will be a three slice stack on the screen and an 8 bit indexed color image. This stack will contain the three color slices – red, green, and blue. The 8 bit indexed color image represents the captured 24 bit color image. The 8 bit color look-up table used to display the 8 bit indexed image may be selected using the 'RGB to 8-bit Color' command.

External Triggering

The VG-5 has an external trigger capability that allows the synchronization of frame capture to external events. The external trigger feature is enabled in the 'Video Control' dialog box as discussed above. When this feature is enabled, the VG-5 will wait for a trigger event on its external trigger input before capturing a frame. A trigger event is defined as a falling TTL edge (that is, a transition from 5 volts to 0 volts). The trigger input is pin 9 of the 9 pin video connector. Once the trigger event has occurred, this input must be brought back to 5 volts before another trigger event can be recognized.

Outputting Images with the VG-5

At any time, when using the Scion Image software, an image window may be sent to the VG-5 for outputting by choosing the 'Print Video' command under the 'Special' menu. Choosing this command causes the image in the window to be copied to the VG-5's frame buffer, at which point the image will be converted into an RS-170 (CCIR) video signal. An error message will be displayed if the selected image is greater than 640 x 480 (768 x 512) pixels, the maximum size of an image that can be output with the VG-5. If the VG-5 is connected to the print enable input of a compatible video printer, using one of the optional cables, the 'Print Video' command will cause the video printer to print.

The 'Print Video' command can be used to output a selected region of interest (ROI), instead of the entire image window. If a region of interest is selected, using the ROI tool, only the region of interest will be output by the VG-5. Note that an error will be generated, and an error message displayed, if the selected region of interest is larger than 640 x 480 (768 x 512) pixels, the maximum image size that the VG-5 can handle.

When a selected region of interest is smaller than 640 x 480 (768 x 512) pixels, or for that matter the entire image is smaller than 640 x 480 (768 x 512), the outputted image will be centered in the RS-170 (CCIR) video field. When the outputted image does not fill the entire video field, there will be a border around the image. This border will be set to Scion Image's current background color. The background color may be adjusted by changing the color of the eraser tool.

Architectural Description

Overview

The hardware architecture of the VG-5 is designed to provide advanced features and maximum flexibility, combined with a simple programming interface. Such features include separate multiplexors for video information and for sync information, 8 bit digital to analog converters for controlling the range of digitization, and input and output look-up tables.

The programming interface of the VG-5 consists of six Control Registers and one Status Register. The Control Registers, Status Register, and the frame buffers are available to the programmer at all times, even during digitization. Hence software can be transferring one frame from the VG-5 to system memory at the same time that a new frame is being digitized.

The sections that follow describe in detail the various components of the VG-5. These are the video and sync multiplexors, the analog to digital converter, the input look-up table, the frame buffers, the output look-up table, the digital to analog converter, and the Control and Status Registers. The Programming Information section of this manual will present details of controlling the VG-5 and taking advantage of all the VG-5's features.

Video and Sync Multiplexors

The VG-5 accepts up to four video sources via its 9 pin D shell connector. The individual sources are terminated with 75 Ohm resistors upon entering the board. After termination the video signals are routed to two separate four to one multiplexors. The first multiplexor determines which of the video signals will be digitized, while the second multiplexor determines from which of the video signals the necessary video sync information will be obtained. The source selections for digitization and sync are determined by bits in Control Register 3.

Allowing the sync information to be selected from any source provides for capturing flexibility using a simple standard cable assembly. Grayscale video can be captured from any source by selecting the same source for both digitizing and sync information. Color cameras can be connected to the VG-5 using either a separate sync or a sync on green format with the same cabling. Additionally, the VG-5 can be easily integrated into systems that are driven by one or more external sync signals.

Analog to Digital Converter

The selected video signal is next DC restored by clamping the video sync tips to 0 volts and then amplified by a factor of three. The video signal is then fed into the analog to digital flash converter. The flash converter converts the incoming video signal into an 8 bit digital value. The analog to digital converter has two analog inputs – top of range and bottom of range – that specify the limits of digitization. If the incoming signal is greater than or equal to the top of range voltage, it will receive a digital value of 255; conversely, an input less than or equal to the bottom of range voltage will receive a digital value of 0.

The top of range and bottom of range voltages are set by two digital to analog converters. These converters have a resolution of 8 bits and are specified by Control Register 4 and

Control Register 5, respectively. Each range voltage can be set from 0 volts to 4 volts. The variability of the range of digitization of the analog to digital converter allows the VG-5 to be adjusted to differing input signals by changing the range voltages. For example, if the input signal is low, the range voltages can be lowered to brighten up the captured image. Similarly, if the video signal has poor contrast, the range voltages can be squeezed closer together to increase the contrast in the captured image. Thus control of the range of digitization provides an analog offset and gain capability.

Input Look-up Table

Once the video signal is digitized, the digital data is immediately passed through an input look-up table. The look-up table affords an opportunity to perform some processing on the digitized image such as image inversion and histogram equalization. The input look-up table consists of a memory array which maps each of the 256 possible pixel values to a new value (also one of 256).

The primary purpose of the input look-up table is to invert the pixel values so as to make the incoming image compatible with the Macintosh. The video is digitized by the analog to digital converter with white receiving a digital value of 255 and black receiving a value of 0. The Macintosh, however, interprets grayscale values in the opposite manner with black as 255 and white as 0. Hence the look-up table inverts each pixel (subtracts it from 255) to convert it to the Macintosh representation.

Frame Buffers

After the data has passed through the input look-up table it stored in one of the VG-5's onboard frame buffers. The frame buffers are configured as arrays of 512 rows of 1024 bytes. As each line of video contains only 640 (768 for CCIR) pixels, each one byte, each row of the frame buffer will contain video data padded at the end with 384 (256) bytes of unused data. Similarly, the last 32 (0) rows of each frame buffer will be unused.

The frame buffers can be addressed through one of two PCI addresses, corresponding to two separate base address registers in PCI configuration space. Address Space 0 contains a single logical frame buffer into which either of the physical frame buffers may be mapped. Control Register 6 determines which physical frame buffer will be accessed in Address Space 0. The same register also determines which buffer will be used to store a captured frame. Address Space 1 contains both of the frame buffers. It is recommended that all frame buffer operations take place through Address Space 1, as memory caching can be enabled for this space. Enabling caching to a PCI address space in a Power Macintosh will enable PCI burst transactions to that address space, speeding up all frame buffer operations.

Output Look-up Table

The video output data comes either from one of the frame buffers or the input look-up table. Before being converted into an analog signal, the data is passed through an output look-up table. The look-up table consists of a memory array which maps each of the 256 possible pixel values to a new value (also one of 256).

The purpose of the output look-up table is to invert the pixel values back to their original representation. That is, white will become 255, and black 0 again. The ouput look-up table can, of course, be used for other image modification purposes.

Analog to Digital Converter

Once the pixel data stream has passed through the output look-up table, it comes to the digital to analog converter, where it is converted back into a video signal. Pixel values of 0 are converted to the video black level and pixel values of 255 are converted to the video white level. The sync information for the video output is derived from the video input source; thus it is necessary to have a video source connected to obtain video output.

Control and Status Registers

The VG-5 has six Control Registers and one Status Register. As the names imply, the Control Registers set the parameters for frame capture while the Status Register reports the results of capture and also properties of the video signal. Each of the registers is eight bits wide. The Control Registers are write only; the Status Register is read only.

Control Register 1 controls the capture process. It contains bits for enabling capture, for setting which field is to be digitized first, for switching between field capture mode and frame capture mode, and for enabling the external trigger feature. Control Register 2 provides bits for enabling the video output and the video pass through mode (where the video output is derived directly from the digitized data stream). Control Register 3 specifies which of the video sources is to be digitized and which of the sources is to be used for sync information. Control Register 6 is used to specify which of the VG-5's two frame buffers is used for capturing or video output.

Control Registers 4 and 5 set the two digital to analog converters on the VG-5. The DAC which determines the top of range voltage for digitization is set by Control Register 4. The DAC which determines the bottom of range voltage for digitization is set by Control Register 5.

The VG-5's Status Register contains a bit which reports when frame capture has been completed. It also contains two bits which represent timing characteristics of the video sync signal. One bit tells when the video signal is in a vertical sync period. The other bit reports whether the video signal is currently transmitting the even or odd video field.

Programming Information

Introduction

The VG-5 is designed to be easy to program. This section sets forth the details of the VG-5's programming interface and hardware interfacing– it's name registry classification, address spaces, register descriptions, and I/O connections. The material presented here should be sufficient to enable an experienced Macintosh programmer to utilize the VG-5 in a custom application.

Programming the VG-5 to capture a video frame is essentially a 7 step process:

1) Find the VG-5 using the supplied library routine
2) Load the input look-up table
3) Set the top and bottom voltages for the digitization range
4) Set the Grab bit in Control Register 1
5) Wait for the Done bit in the Status Register to come on
6) Clear the Grab bit
7) Read out the video data from the frame buffer.

Note that for simple applications, it is not necessary to set all parameters, such as selecting the video and sync channels, as the Control Registers all default to zero on power-up.

For those who need additional guidance in programming with the VG-5, the supplied source code for the Scion Image application software provides a wealth of example code for controlling the VG-5. The source code is written in Pascal using the Metrowerks CodeWarrior development environment. Below is a short list of instructive functions and the files they reside in:

LookForFrameGrabbers:	Init.p
SetupFGPort:	Init.p
ResetScionVG5:	Utilities.p
GetFrame:	Camera.p
CaptureAndDisplayFrame:	Camera.p

There are other routines in these files that perform more specialized functions with the VG-5; a few hours examining the code should prove helpful in learning how to program the VG-5.

On the VG-5 diskette is a C library, ScionLib, which contains a routine that will find the VG-5 in a PCI Macintosh, and return the base addresses for the two address spaces. The routine has the form

```
LookForPCIFrameGrabbers(short model, long* base0, long* base1, long* buffers,
                        long* revision).
```

The routine should be passed 2 as the model parameter (this specifies searching for an VG-5), and will pass the base addresses for the two address spaces and the number of buffers and the board revision level in the other parameters. The routine will return true if a board is found, false otherwise. The routine also enables memory space accesses to the VG-5 and enables memory caching to Address Space 1.

Name Registry Classification

Upon startup a PCI Power Macintosh will create a Name Registry entry for the VG-5. This entry will have a name property value of 'pci11ff,2'. The VG-5 can be located in the Macintosh by searching for a registry entry with this name property. However, this information is not necessary to work with the VG-5 as the library routine discussed above will take care of locating the board.

Address Spaces

Let us denote the base addresses for the address spaces base0 and base1. Address Space 1 of the VG-5 contains the frame buffers, while Address space 0 contains an alias of the selected frame buffer, the input look-up table, the output look-up table, the Control Registers, and the Status Register.

The frame buffers are arrayed in Address Space 1 at 512 Kb intervals. The two buffers will be at addresses

base1	Buffer 0
base1 + $80000	Buffer 1.

The selected frame buffer, as determined by Control Register 6, will also appear in address space 0 at address base0. The frame buffers appear as pixel maps of width 640 (768) bytes, height 480 (512) lines, and row length 1024 bytes.

The input look-up table appears at address base0 + $80000. The LUT uses only byte lane 0, hence the 256 bytes of the look-up table are addressed at

base0 + 80000
base0 + 80004
base0 + 80008
.
.
.
base0 + 8003fc.

The lowest address corresponds to the lowest digitization value; i. e. address base0 + 80000 maps $00 (black) pixels, while base0 + 8003fc maps $ff (white) pixels.

The input look-up table appears at address base0 + $e0000. The LUT uses only byte lane 0, hence the 256 bytes of the look-up table are addressed at

base0 + e0000
base0 + e0004
base0 + e0008
.
.
.
base0 + e003fc.

The lowest address corresponds to the lowest digitization value; i. e. address base0 + 80000 maps $00 (white) pixels, while base0 + 8003fc maps $ff (black) pixels.

The Control Registers are eight bit wide write-only registers at the following addresses:

CR1: base0 + c0000
CR2: base0 + c0004
CR3: base0 + c0008
CR4: base0 + c000c
CR5: base0 + c0010
CR6: base0 + c0014

The Status Register is an eight bit wide read-only register located at address base0 + c0000.

Control and Status Registers

The format of Control Register 1, from most significant bit to least significant bit, is as follows:

CR1_7:	Grab Enable
CR1_6:	Single Field Select
CR1_5:	Starting Field Select
CR1_4:	Trigger Enable
CR1_3:	Auxiliary Output 0
CR1_2:	Auxiliary Output 0 Mode
CR1_1:	
CR1_0:	

When Grab Enable is set, the VG-5 will capture the next incoming video frame. Note that this bit must be reset by software before any additional frames can be captured. It acts as a trigger for a single frame capture. Capture begins at the trailing edge of vertical sync. When Starting Field Select is set, frame capture will begin with the odd field; when it is clear, frame capture will begin with the even field. When Single Field Select is set, only one field will be captured — that specified by the Starting Field Select bit. Single fields are captured into the frame buffers as if they were a component of an entire frame; that is, they will load into every other line of the buffer leaving the remaining lines unaltered. When Trigger Enable is set, the VG-5 will wait for a trigger event on the external trigger pin of the video connector before capturing a frame. A trigger event is defined as a falling TTL edge. Auxiliary Output 0 is available for custom use. Auxiliary Output 0 Mode determines the operation of the auxiliary output. When the mode is high, the output is TTL, when the mode is low, the output is an open drain which is pulled low by setting the output high.

The format of Control Register 2, from most significant bit to least significant bit, is as follows:

CR2_7:	Video Enable
CR2_6:	Video Pass Through Enable
CR2_5:	
CR2_4:	
CR2_3:	Auxiliary Output 1
CR2_2:	Auxiliary Output 1 Mode
CR2_1:	
CR2_0:	

When the Video Enable bit is clear, the video signal will be forced to the blanking level at

all times. When this bit is set, the video output is enabled. Video Pass Through Enable determines the source of the output video. When clear, the contents of one of the frame buffers are output. When set, the constant digitized video stream is output. Auxiliary Output 1 is available for custom use. Auxiliary Output 1 Mode determines the operation of the auxiliary output. When the mode is high, the output is TTL, when the mode is low, the output is an open drain which is pulled low by setting the output high.

The format of Control Register 3, from most significant bit to least significant bit, is as follows:

CR3_7:	Sync Select MSB
CR3_6:	Sync Select LSB
CR3_5:	Source Select MSB
CR3_4:	Source Select LSB
CR3_3:	
CR3_2:	
CR3_1:	
CR3_0:	

The Source Select bits determine which of the four video sources will be selected for capturing, while the Sync Select bits determine which of the four video sources will be used for sync information. In most cases the same source will be selected for both fields.

Control Registers 4 and 5 control the two digital to analog converters on the board. They accept an integer in the range 0 to 255. The functions of each converter and its voltage range are as follows:

CR4:	Top of Digitization:	0 to 4 volts
CR5:	Bottom of Digitization:	0 to 4 volts

In each case the lower voltage corresponds to register value $00, while the higher voltage corresponds to register value $ff. When setting the digitization range, note that the sync tips of the incoming video are clamped to 0 volts and that the video is amplified by a factor of 3. Also, for proper operation, the top of digitization voltage must be higher than the bottom of digitization voltage.

The format of Control Register 6, from most significant bit to least significant bit, is as follows:

CR6_7:	
CR6_6:	
CR6_5:	
CR6_4:	Output Buffer Select
CR6_3:	
CR6_2:	
CR6_1:	
CR6_0:	Input Buffer Select

The Output Buffer Select bit determines which of the two frame buffers will be used for video output. When clear, frame buffer 0 will be used, else frame buffer 1 will be used. The Input Buffer Selct bit determines which buffer will be used for capturing. It is clear for buffer 0 and set for buffer 1. This bit also determines which buffer will be aliased into address space 0.

The format of the Status Register, from most significant bit to least significant bit, is as follows:

SR_7:	Grab Done
SR_6:	50 Hz
SR_5:	Vertical Sync
SR_4:	Field Status
SR_3:	
SR_2:	
SR_1:	
SR_0:	

The Grab Done bit indicates that a capture has been completed. This bit will be cleared when the Grab Enable bit in Control Register 1 is reset. The 50 Hz bit indicates that the VG-5 is a 50 Hz board, compatible with CCIR video. If this bit is cleared, then the board is intended for 60 Hz RS-170 video. The Vertical Sync bit will be clear during the vertical sync period of the selected video sync source and set otherwise. The Field Status bit will be set during the odd field of the selected video sync source and clear during the even field.

Connector Pin Assignments

There ìs one external connector on the VG-5. This connector is a standard female DB-9 connector. It contains signal lines for the four video sources as well as the external trigger. The pin-out is

Pin 1:	Video Source 3
Pin 2:	Auxiliary Output 0
Pin 3:	Video Source 2
Pin 4:	Auxiliary Ouput 1
Pin 5:	Video Source 1
Pin 6:	Video Output
Pin 7:	Video Source 0
Pin 8:	Ground
Pin 9:	External Trigger.

Questions and Answers

Q: Why do I see a cross-hatched interference pattern in the captured image?

A: You are probably trying to capture images from a color (NTSC or PAL) camera. The VG-5 is designed to capture images from an RS-170 (or CCIR) video source. RS-170 (CCIR) is grayscale video. Color video has color information modulated on the grayscale portion of the video signal. This color information causes the distortion pattern in the captured image.

Q: I am trying to do a color capture in Image. I have an RGB camera connected to the VG-5 with the four source cable, but I seem to be having difficulty getting the VG-5 to sync to the camera. What could be causing this?

A: You need to have the 'Separate Sync' box selected in the 'Video Control' dialog box. This dialog box is found under the 'Special' menu. Separate sync tells the VG-5 to look for sync information on the sync signal of the four source cable.

Q: How can I capture grayscale images from an RGB camera?

A: There are two methods for capturing grayscale images from an RGB camera. The first is to simply capture from the green signal (source 2 in the 'Video Control' dialog box). The green signal contains the majority of the grayscale information of a color image. The second method is use Image's 'Capture Color' command. After the three color slices are captured, choose the 'RGB to 8 bit Color' command with the existing palette option selected. If you were currently working with a grayscale look-up table, then the resulting image will be the correct grayscale image.

Optional Cables

The VG-5 comes with a Cab-SS-VG5 single source cable suitable for connecting to a grayscale video camera. It also has an output connection for a video printer or other video peripheral. A number of additional cables are available for connecting to other sorts of cameras and devices:

Cab-RGB-VG5 – This cable, terminated in five BNC connectors, can be used to connect the VG-5 to four separate grayscale video sources. It may also be used to connect to RGB video sources with separate connections for red, green, blue, and sync. A video output connection is also supplied.

Cab-SVHS-Adp – This adapts any BNC terminated cable to an SVHS connector.

Cab-SST-VG5 – This cable is similar to the supplied single source cable but, in addition, has a BNC connector for the VG-5's external trigger input.

Cab-Int-VG5 – This cable is a single source cable with additional connections for the integration input of the Dage CCD-72 camera and for the print enable input of a video printer.

Cab-Cohu-Adp – This adapts the Dage integration cable for Cohu 491X cameras.

Optional cables are available direct from Scion. We can also manufacture custom cables for use with video sources with non-standard connectors.

Software Support

Please note that these packages support the NuBus version of the LG-3. PCI support is forthcoming. Please check with Scion for the latest LG-3 PCI support list.

IPLab Spectrum-VG5

IPLab Spectrum-VG5 software provides scientific imaging, visualization, analysis, image acquisition and laboratory automation in a single package. This version of IPLab controls all features of Scion's VG-5 frame grabber. Users can do real time image sequence acquisition and frame averaging, and control external devices through the digital I/O and analog outputs on the board, all coordinated with image capture. Applications include microscopy, low-light imaging, bio-medicine, and others. Signal Analytics provides specific solutions based on this board for low-cost fluorescence imaging applications, including ion ratio imaging and fluorescence in situ hybridization. With IPLab you can: automatically analyze particles; perform FFTs, image enhancement, densitometry and morphometry; acquire, deconvolve, and display 3-D serial sections; control lab equipment such as motorized stages and filter wheels. You can also use IPLab as a development environment for new algorithms by adding your own code written in C or Pascal. Custom software development is also available from Signal Analytics.

Signal Analytics Corporation
440 Maple Ave. East
Suite 201
Vienna, VA 22180
(703) 281-3277

NIH Image

NIH Image is a public domain image processing and analysis program for the Macintosh. It can acquire, display, edit, enhance, analyze, print, and animate images. It reads and writes TIFF, PICT, PICS, and MacPaint files, providing compatibility with many other applications, including programs for scanning, processing, editing, publishing, and analyzing images. It supports may standard image processing functions, including contrast enhancement, density profiling, smoothing, sharpening, edge detection, median filtering, and spatial convolution with user defined kernels up to 63x63. NIH Image also incorporates a Pascal-like macro programming language, providing the ability to automate complex, and frequently repetitive, processing tasks.

National Technical Information Service
5382 Port Royal Rd.
Springfield, VA 22161
(703) 487-4650

Ultimage

Ultimage is a powerful image processing and analysis tool that takes full advantage of the graphic capabilities and user interface of the Macintosh II. It offers a complete library of image processing functions that can be used for a large variety of applications. The program can process images acquired from scanners, cameras, microscopes, and other acquisition systems. Several images of different formats can be displayed and manipulated

simultaneously, using either the 256 gray levels or the color capabilities of the Macintosh. The main features of Ultimage include image enhancement, thresholding, zooming, contour detection, histogram manipulation, palette modification, 3D display, and arithmetic and logic operations. A set of advanced functions is also available for scientific and professional image processing such as morphology analysis, pattern recognition and classification, frequency domain analysis, and linear and non-linear filtering.

GTFS, Inc. (West Coast)
2455 Bennet Valley Rd. #100C
Santa Rosa, CA 95404
(707) 579-1733

Engineering Technology Center (East Coast)
240 Oral School Rd. Suite 105
Mystic, CT 06355
(800) 959-3011

Video VI

The Video VI package supports video data acquisition and image manipulation in the LabVIEW environment for the Macintosh. LabVIEW is the graphic and object oriented instrumentation software from National Instruments. The Video VI package is a cost effective alternative for building systems that require image acquisition, analysis, and documentation in process control environments. There are currently over 20 VI's (Virtual Instruments) in the Video VI package. These include VI's for capturing images with the Scion VG-5, reading and writing TIFF files, displaying images, moving and scaling images, and thresholding.

GTFS, Inc.
2455 Bennet Valley Rd. #100C
Santa Rosa, CA 95404
(707) 579-1733

Specifications

Imaging

Digitizing Speed: 1/30 (1/25) second
Pixel Depth: 8 bits
Image Resolution: 640 x 480 (768 x 512) pixels
Pixel Aspect Ratio: 1 to 1

Capturing

Capture Mode: field or frame
Initial Field: even or odd

Memory

Frame Buffer: (2) 512 Kb
Input Look-up Tables: 1
Output Look-up Tables: 1

Video Inputs

Video Input Level: 1 volt peak to peak
Video Signal Type: RS-170 (CCIR) or similar
Input Sources: 4, AC coupled
Video Gain Factor: 3
Digitizing Range, Bottom: 0 to 4 volts
Digitizing Range, Top: 0 to 4 volts

Video Output

Video Output Level: 1.0 volts peak to peak
Video Signal Type: RS-170 (CCIR)
Adjustment Range: 0.5 to 1.5 volts
Output Resistance: 75 ohms

I/O

Digital Outputs: 2 TTL level or open drain

Connectors

Video Connector: 9 pin D shell

General

Installation: 1 PCI slot
Operating Conditions : 0 to 70° C
Power: 7.5 watts typical

Warranty and Support

Limited Warranty

Scion Corporation ("Scion") warrants this VG-5 against defects in materials and workmanship for a period of one (1) year from the date of original purchase. If you discover a defect, Scion will, at its option, repair, replace, or refund the purchase price of this VG-5 to you, provided you return it during the warranty period, with transportation charges prepaid, to Scion. Each VG-5 returned for warranty service must bear a Return Materials Authorization number, which may be obtained from Scion, on the outside of the shipping box.

This warranty does not apply if the product has been damaged by accident, misuse, or misapplication; if the product has been modified without the written permission of Scion; or if the VG-5 serial number has been removed or defaced.

THE WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHERS, WHETHER ORAL OR WRITTEN, EXPRESS OR IMPLIED. SCION SPECIFICALLY DISCLAIMS ANY AND ALL IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NO SCION DEALER, AGENT, OR EMPLOYEE IS AUTHORIZED TO MAKE ANY MODIFICATION, EXTENSION, OR ADDITION TO THIS WARRANTY.

Scion is not responsible for special, incidental, or consequential damages resulting from any breach of warranty, or under any other legal theory, including but not limited to lost profits, downtime, goodwill, and damage to or replacement of equipment and property.

Some states do not allow the exclusion or limitation of incidental or consequential damages or exclusions of implied warranties, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

Money-Back Guarantee

You may return your VG-5 to Scion Corporation, within 30 days of the date of invoice, for a full refund of the purchase price. All returns must be in as new condition and be returned with all supplied accessories in the original shipping box. All returns must bear a Return Materials Authorization number, which may be obtained from Scion, on the outside of the shipping box.

If payment has already been made at the time you return your VG-5, a cash refund will be made within 30 days of Scion's receipt of the VG-5. If payment has not been made at the time Scion receives your VG-5, a credit memo will be issued against the outstanding invoice within 15 days of Scion's receipt of the VG-5.

Service Information

Should you determine that your VG-5 requires service, it should be returned directly to Scion Corporation for repair. Before returning your VG-5, call Scion for a Return Materials Authorization number. This number should be printed on the outside of the

shipping carton. Carefully pack the VG-5 in its original shipping materials and include a short note describing the problem. You are responsible for all shipping costs to Scion and for insuring the returned unit. Scion will commit its best efforts to repairing your unit within 5 days of receipt of the unit at our factory.

If your VG-5 is under warranty, it will be repaired or replaced at no charge. Scion will pay for shipping your VG-5 back to you by ground transportation. You may, at your cost, request faster transportation. If your VG-5 is not under warranty, there will be a minimum repair charge of $150. If the repair cost is greater than $150, you will be called to approve the necessary work. You must provide, in advance, appropriate payment information (e.g., approved purchase order, credit card number) for non-warranty repair work.