



**Configuration Manager Software User's Guide
for the
ECS-320A
Embeddable Camera Electronics System**

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1 Introduction

This guide has been written to help the user become acquainted with the Configuration Manager Software (v2.11) and to some extent the Embeddable Camera Electronics System hardware.

An overview of the system configuration and communications is provided along with software installation instructions. This guide also provides detailed information on using the Configuration Manager software to operate the ECS-320A hardware during system setup/production.

This document has been written with the assumption that the user is knowledgeable about Microsoft Windows OS based applications and the general characteristics of infrared cameras and systems.

2 System Requirements

2.1 Operating System

Although the Configuration Manager software will function on various Microsoft Windows platforms it has been designed and tested with Windows XP. The GUI screens and controls have also been tuned for a screen size of 1024 x 768 using the 'small fonts' selection.

Using this OS with the proper screen settings will provide the user with optimum performance and ease of use. Use of this software with Windows 95/98/Me will not be supported by Lumitron.

2.2 Frame Grabber Configuration

The Configuration Manager supports the use of the Arvoo Picasso LVDS frame grabber board but it is not recommended since it is being phased out.

To achieve better performance and a higher level of compatibility with this software it is recommended that a National Instruments (NI) NI-1422 LVDS frame grabber be installed.

Since Lumitron can not distribute the required application extensions, it will be necessary to install the NI software that is shipped with the frame grabber card. Follow the vendor's installation instructions. Once the NI software has been installed it will be necessary to perform some extra tasks to ready the Configuration Manager for use with the frame grabber.

Step 1: Locate the following files in the install directory of the Configuration Manager software.

LG2_240.icd (320x240 Camera Configuration File)

LG2_256.icd (320x256 Camera Configuration File)

LTron_240.iid (320x240 Camera Interface File)

LTron_256.iid (320x256 Camera Interface File)

Step 2: Copy or Move these files into the 'Data' directory of the NI software installation. The default install directory will be "C:\Program Files\National Instruments\NI-IMAQ\Data". This is where other manufacturer standard camera files are located.

Step 3: Next open (run) the NI Measurement and Automation Explorer application.

Step 4: In the Configuration window browse down to the "My System\Devices and Interfaces\IMAQ PCI-1422". Then on the file menu select the 'Open Interface'. Browse to the "LTron_240.iid" file and open it.

Step 5: Go to the file menu again and select 'Open Camera'. Browse to the "LG2_240.icd" and open it.

Step 6: Go to the 'Tools\IMAQ\Max number of buffers' menu and set that value to 300.

Step 7: Close the application.

The above steps can also be done with the 320x256 versions of the files as well. The NI will now be ready to use with the Configuration Manager Software.

3 Communications

Connection to the camera electronics is accomplished via a serial port connection. The desired port on the host side can be configured through the "Communications – COM Port..." menu command.

3.1 Setup

No configuration of the COM port is required on the computer side of the connection. All of the settings - baud rate, data size, parity, and stop bits are configured by the software automatically.

Once the physical connection is made and the Configuration Manager software is started; the COM port is configured and then polled to determine connection type. If no connection is detected the software remains/reverts to terminal mode (paragraph 3.2), else once the camera has booted and is operational (with no errors) the software switches to PC Master Mode (paragraph 3.3).

Note: It is best to start the Configuration Manager software *before* the camera has been powered on or *after* it has completed the boot process.

3.2 Terminal Mode

This is the default communication mode when no connection with the camera is detected. In this mode the software goes into a 'listening' mode waiting for the camera to begin its boot process. During the boot process the camera will output strings to notify the user of current status. This data is viewed on the Bootloader Terminal Output window (paragraph 7.3). Once the camera has completed the boot cycle and started normal operation the communication mode will automatically convert over to PC Master Mode.

Note: At any point during normal operation, if the camera is no longer detected, the software will revert back to Terminal Mode. To return to PC Master Mode, select the Debug Tab-View window and click on the 'Camera Re-Connect' button.

3.3 PC Master Mode

This mode will be used to control the camera during normal operation. While in PC Master Mode commands can be sent to control various camera functions, change settings, and update status. Peripheral and FPGA register values can also be inspected/modified using the Debug Tab-View controls. While in this mode, the embedded camera application is always polling the serial port for user commands from the host. The camera can not initiate commands to the host.

PC Master is a packet driven protocol developed by Motorola to assist in the development and debugging of DSP based hardware by monitoring the embedded application in real time. It is included as part of the Software Developers Kit for the DSP56800 family of DSP's. Using this protocol gives the application developer the ability to send user commands, directly read and write to DSP data memory, and directly read and write to DSP peripheral registers. For more information about this protocol see Lumitron document 700-00000040.

4 Configuration Manager Software Description

The Configuration Manager Software application is used in the production/manufacturing process to configure the camera for end-user operation. The configuration setup consists of loading the desired embedded application, FPGA configuration file, video and overlay palettes, assembly serial numbers and types, operational mode data, and NUC mode data.

Along with the miscellaneous settings, several file paths can be stored to the file (using the Save or Save As command) in the Configuration Manager Software. These are the paths to the embedded application file, Xilinx FPGA configuration files, video palette files, and overlay palette files.

After the camera has been configured for normal operation the software provides the functionality to perform local calibrations, automatic and manual defective pixel identification, calibration upload and download, and saving NUC coefficients to a file on the host system. These features require either an Arvoo Picasso LVDS or National Instruments NI-1422 LVDS Framegrabber.

The user will be able to save all of the settings used in the configuration process in a file that can be used as a template for subsequent cameras or as an archive of the hardware's original setup.

5 Menu Items

5.1 File Menu

5.1.1 New

Command opens a new Configuration Manager File (*.pfg) window with a default name and values.

5.1.2 Open...

Command opens an existing Configuration Manager file, via the standard Windows file dialog, with stored file paths to embedded application and palettes.

5.1.3 Close

Command closes the currently active Configuration Manager file. User will be asked to save changes to the file if any have been made.

5.1.4 Save

Command saves the currently active Configuration Manager file.

5.1.5 Save As...

Command saves the currently active Configuration Manager file to the user specified name/path via the standard Windows file dialog.

5.1.6 Print...

Command prints the current state of the camera to any connected printer. This feature has not been fully implemented.

5.1.7 Print Setup...

Command opens the Windows standard printer setup dialog to allow for printer and printer properties selection.

5.1.8 MRU Files

This area of the menu contains a list of the most recently used (MRU) Configuration Manager files. The user can directly open one of these files by selecting it on the menu.

5.1.9 Exit

This command exits the application and closes any opened files. The user will have a chance to save any modified files before exiting.

5.2 View Menu

5.2.1 Toolbar

Shows or hides the icon based toolbar just below the menu items.

5.2.2 Status Bar

Shows or hides the status bar at the bottom of the main window frame.

5.3 Window Menu

Although the Configuration Software was developed using a multiple documents interface (MDI), it is not recommended to operate the camera in this fashion. Difficulty connecting to the camera when switching between files can occur. The MDI was used to incorporate other features not available with a single document interface.

5.3.1 Cascade

Cascades all open windows (documents).

5.3.2 Tile

Tiles all open windows within the main frame.

5.3.3 Active Windows

Shows a list of all open windows (documents) and places a check by the active (top-most) file. Other windows can be selected using this menu.

5.4 Communications Menu

5.4.1 COM Port...

Displays a dialog for configuration of the Operational Manager to use either COM1 or COM2 for serial communications.

5.4.2 Enable Framegrabber

Enables the framegrabber check feature. If checked, the application will perform a check on boot to verify that a framegrabber is installed and configured for use. If not checked, then the application will not attempt any hardware check.

Note: When changing the state of the menu item, it will be necessary to restart the application.

5.4.3 Enter PIN...

Brings up a dialog, allowing advanced configuration users to supply a PIN to the camera electronics. Providing a valid PIN will unlock certain memory areas in the camera that have extra write protection. Protected memory locations store settings that if are set to improper values can prevent the camera from operating. Various controls (write/update) within the application dialogs will be disabled to reflect the status of the memory being locked.

5.4.4 Enable Embedded Deserializer

Enables the deserializer check feature. If checked, the application will perform a check on boot to verify that the embedded deserializer is installed and configured for use. If not checked, then the application will not attempt any hardware check. The deserializer is only used for a specific application and customer. Communications is performed through the parallel port. The majority of systems will not need this functionality.

Note: When changing the state of the menu item, it will be necessary to restart the application.

5.5 Help Menu

5.5.1 About ConfigMgr...

Menu item opens a dialog that displays the current version of the Configuration Manager.

5.5.2 ConfigMgr Help...

Menu item opens a help window for the application.

6 Status Pane

The status pane is located at the bottom of the application frame and contains several items that give the user an indication to the camera's current status.

Messages are displayed in the leftmost portion of the bar. Typically it will display 'Ready'. If a communication error occurs a message will appear here with the corresponding error number. Download status of the Xilinx configuration files and palette files are also displayed in this location.

The status panes are located on the right portion of the bar and are similar to that shown in Figure 1.

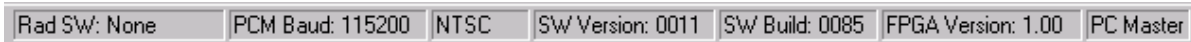


Figure 1: Status Bar Panes

6.1 Radiometric Software

The first pane (leftmost) indicates the OEM provider of camera embedded radiometric software routines, if any.

6.2 PC Master Baud Rate

The second pane indicates the detected PC Master baud rate. The camera has a fixed baud rate that is configured by this software or will default to 115K baud. This rate is set shortly after execution has transferred from the bootloader to the embedded application.

6.3 Video Format

The next pane contains the configured video format of camera electronics. Typically this will be NTSC, PAL or NONE for digital only applications.

6.4 Camera Software Version

The fourth pane will show the current loaded embedded software version. Typically major changes (look/feel/functionality) to the embedded code will result in version increments.

6.5 Camera Software Build

The fifth pane will show the current loaded embedded software build. Increments in software builds can occur without the version changing. Typically minor changes to the embedded code will result in build increments.

6.6 Xilinx FPGA Configuration File Version

The sixth pane contains the Xilinx configuration file version stored in the serial flash.

6.7 Connection Type

The last pane indicates the serial communications mode as Terminal or PC Master.

7 File Load Tab-View

The controls in the file load tab view dialog (shown in Figure 2) allow the user to update/load the embedded application, FPGA configuration file(s), and video palettes.

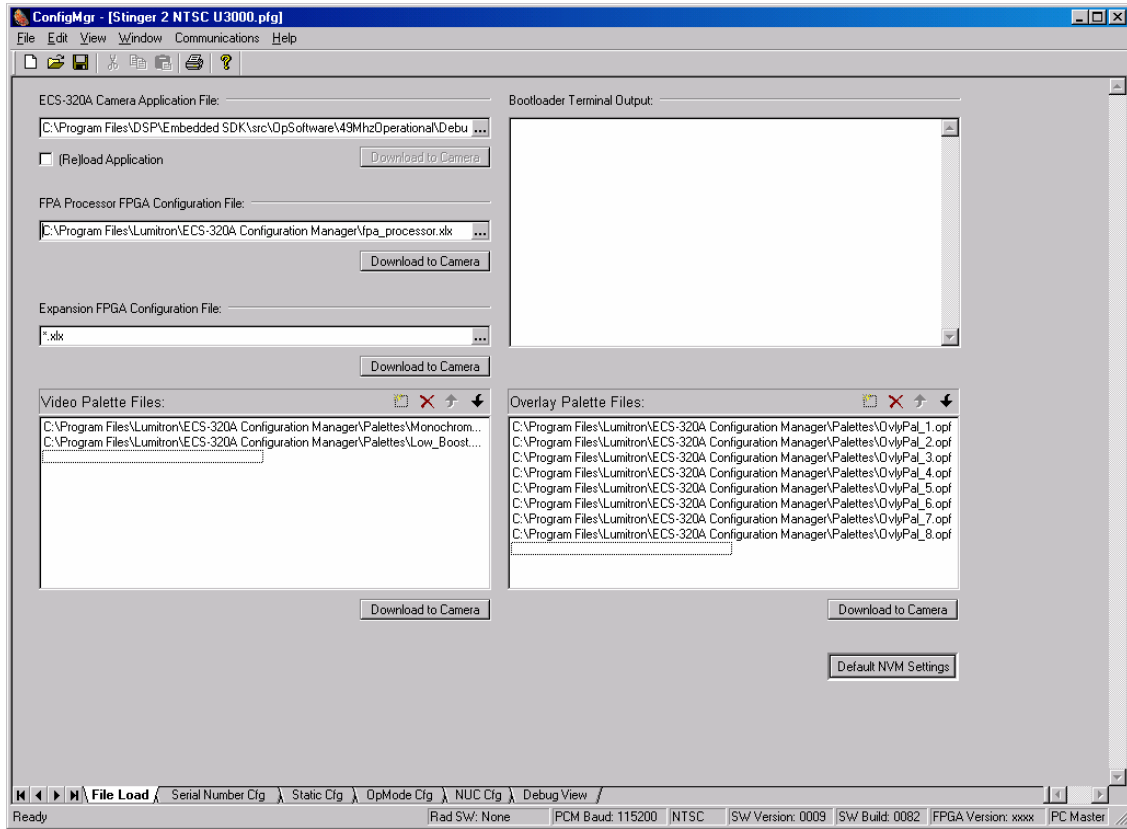


Figure 2: Main Tab-View Dialog

7.1 Camera Application File

The Configuration Manager software provides a method for updating the embedded application. The first step would be to select the file (*.elf.S extension) to be downloaded. This control is shown in Figure 3.

The camera embedded application file, obtained from Lumitron, is an output file from the “Metrowerks CodeWarrior for Motorola DSP56800” development environment. Once the desired file has been selected the user can check the “(Re)Load Application” check-box. This tells the Configuration Manager to load the file locally and then wait for the download trigger. The download is initiated with a power cycle of the camera electronics (make sure the communication mode reverts back to or already is ‘Terminal’ before applying power to camera).

Once the Configuration Manager recognizes the bootloader is awaiting a download, the transfer will begin. Status of the transfer process is displayed in the bootloader output window (Figure 4).

The automatic “Download to Camera” button is disabled and has not been implemented.

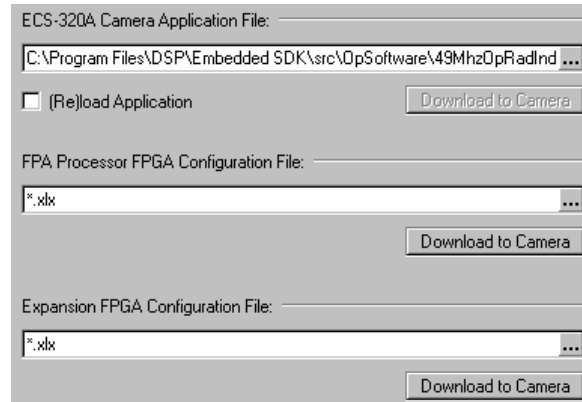


Figure 3: Application and FPGA File Controls

7.2 Xilinx Configuration File(s)

The FPA Processor Xilinx FPGA configuration file can be upgraded using the Configuration Manager Software. Using the file browser control (Figure 3), locate the desired file. Then click the “Download to Camera” button. Since this download uses the embedded application instead of the bootloader, the download status is displayed on the far left of the status pane.

Currently the expansion FPGA configuration file is not used, although the upgrade capability is functional.

7.3 Bootloader Terminal Output

When the embedded application resets (power cycle) the code execution begins with a small application in the DSP boot flash. This executable outputs start up status information as well as serving as the download application for the main executable. This output is shown in the bootloader terminal output window shown below (Figure 4).

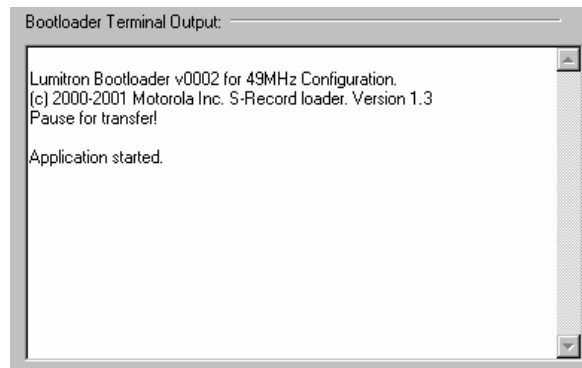


Figure 4: Bootloader Terminal Output Window

If no output is displayed in this window during reset confirm that the proper COM port has been selected for the Configuration Manager (paragraph 5.4).

7.4 Video Palette Files

The embedded application has storage for up to 16 video palettes. The palettes can be loaded via the controls shown below in Figure 5.

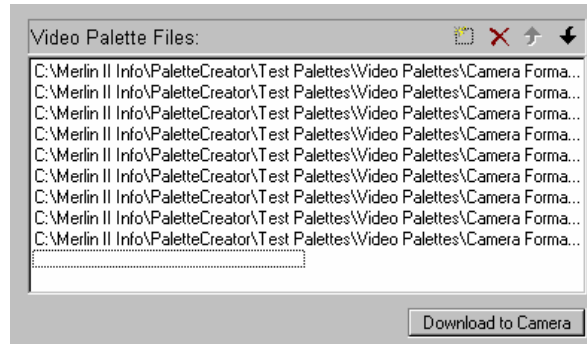






Figure 5: Video Palette Update Controls

To select a file locally click on the  icon or double click on the next open line. A control will appear to the right of the open line. Click on that icon to open a standard file dialog and browse to the desired file. Select “Open” and the filename (full path) will be placed in the window.

As the desired files are loaded locally into the video palette file window, the user can adjust the index or position of the files. Using the move up () or move down () controls, the palette file's position can be modified. This position will directly correlate to the video palette selection on the main tab-view dialog (of the OpMgr Main Tab View Dialog). A file can also be deleted from the list using the  control.

Click on the “Download to Camera” button once all the files have been loaded into the palette control window. This will download all of the palettes to serial flash. The status of the download will be displayed in the far left portion of the status pane.

Note: All palettes are loaded in a single pass; therefore it is not possible to append a single palette to camera storage.

7.5 Overlay Palette Files

The embedded application has storage for up to 8 overlay palettes. The palettes can be loaded via the controls shown below in Figure 6.

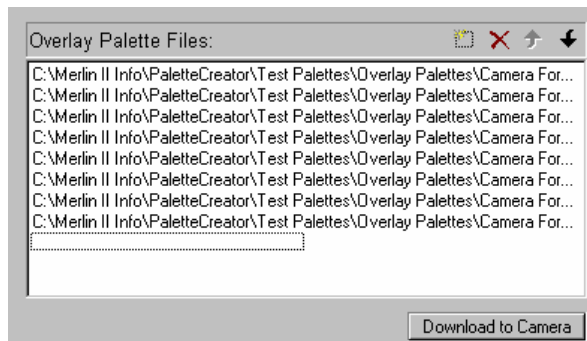


Figure 6: Overlay Palette Update Controls

The loading process is identical to that listed for video palettes; refer to paragraph 7.4 for information on loading palettes.

8 Serial Number Configuration Tab-View

The controls in the serial number configuration tab view dialog (shown in Figure 7) are used to store production information about the camera to DSP data flash. This information can be retrieved during operation for use by the embedded application or remotely by the host application.

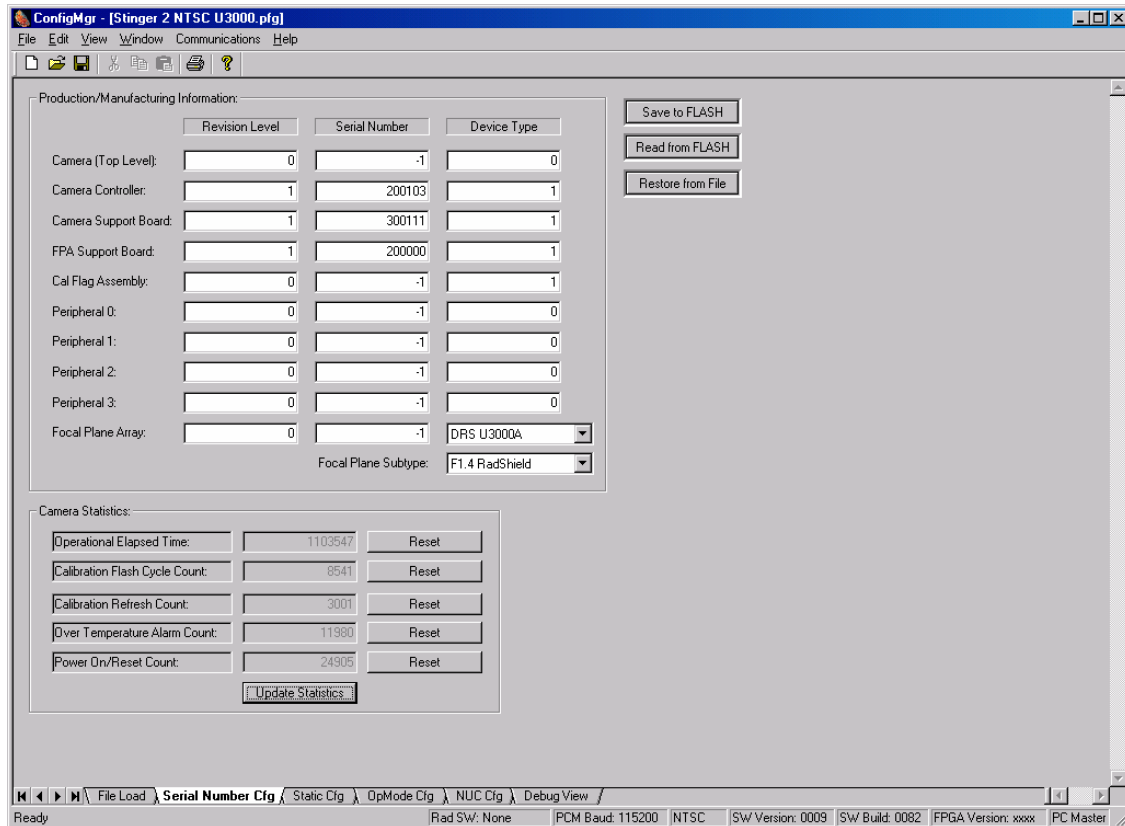


Figure 7: Serial Number Configuration Tab-View Dialog

8.1 Production/Manufacturing Information

The array of edit fields shown in Figure 8, are interface controls used to store/retrieve camera production information. Each assembly that is incorporated into the final product will have a revision, serial number, and type identifier.

The first column stores a numerical representation of the assembly revision (0 – rev A, 1 – rev B, etc.).

The second column contains the assembly serial number. Typically all of the sub-assemblies will be serialized by Lumitron. The camera top-level serial number may or may not be provided depending upon the level of the product shipped.

The last column contains a device specific type identifier. These codes are used primarily for manufacturing information but also can be used by either the embedded or host application for configuration purposes. For example the calibration flag assembly device type lets the software know if the flag is an ambient only, heated only or a dual temperature style.

Production/Manufacturing Information			
	Revision Level	Serial Number	Device Type
Camera (Top Level):	<input type="text" value="0"/>	<input type="text" value="-1"/>	<input type="text" value="0"/>
Camera Controller:	<input type="text" value="1"/>	<input type="text" value="200103"/>	<input type="text" value="1"/>
Camera Support Board:	<input type="text" value="1"/>	<input type="text" value="300111"/>	<input type="text" value="1"/>
FPA Support Board:	<input type="text" value="1"/>	<input type="text" value="200000"/>	<input type="text" value="1"/>
Cal Flag Assembly:	<input type="text" value="0"/>	<input type="text" value="-1"/>	<input type="text" value="1"/>
Peripheral 0:	<input type="text" value="0"/>	<input type="text" value="-1"/>	<input type="text" value="0"/>
Peripheral 1:	<input type="text" value="0"/>	<input type="text" value="-1"/>	<input type="text" value="0"/>
Peripheral 2:	<input type="text" value="0"/>	<input type="text" value="-1"/>	<input type="text" value="0"/>
Peripheral 3:	<input type="text" value="0"/>	<input type="text" value="-1"/>	<input type="text" value="0"/>
Focal Plane Array:	<input type="text" value="0"/>	<input type="text" value="-1"/>	<input type="text" value="DRS U3000A"/>
		Focal Plane Subtype:	<input type="text" value="F1.4 RadShield"/>

Figure 8: Production and Manufacturing Information Setting Controls

When saved, the production information is stored in the camera controller DSP data flash at a base address of 0x2000. These values are not to be modified by unauthorized users as it may affect embedded application operation and/or decisions concerning repair and upgrade. See paragraph 8.3 for information on reading and storing the values to the camera.

8.2 Camera Statistics

The fields, shown below in Figure 9, display various camera statistic values. The values are automatically incremented by the embedded application during normal operation as each event occurs. This information can be used by the factory/OEM for maintenance or upgrade purposes. The data is located in non-volatile memory on the real time clock.

Camera Statistics		
Operational Elapsed Time:	<input type="text" value="0"/>	<input type="button" value="Reset"/>
Calibration Flash Cycle Count:	<input type="text" value="0"/>	<input type="button" value="Reset"/>
Calibration Refresh Count:	<input type="text" value="0"/>	<input type="button" value="Reset"/>
Over Temperature Alarm Count:	<input type="text" value="0"/>	<input type="button" value="Reset"/>
Power On/Reset Count:	<input type="text" value="0"/>	<input type="button" value="Reset"/>
<input type="button" value="Update Statistics"/>		

Figure 9: Camera Statistics Controls

During the initial detection of PC Master the data is read and output to the GUI a single time. To refresh the values click on the 'Update Statistics' button.

The values can be reset to zero by clicking on the corresponding 'Reset' button.

8.3 Flash/File Controls

The buttons shown below in Figure 10 are used to save and retrieve the production/manufacturing data. To understand the relationship of the three buttons it is necessary to understand the way the data is handled.

Initially the data is read from an existing file (*.pfg) and is copied to a local data structure that is displayed on the GUI. Manually modifying the values on the GUI, restoring from the file, or reading from camera flash only changes the values in the local copy.



Figure 10: Flash and File Controls

Clicking on the 'Read from FLASH' button reads the settings from the camera and stores them in the local copy. To save those values to a local file it is necessary to perform a 'File Save' or 'File Save As...' as described in paragraph 5.1.

Clicking on the 'Restore from File' button updates the GUI with the data from the open file.

Once the user has updated the fields to the desired value, they can be saved in the camera by clicking on the 'Save to FLASH' button.

9 Static Configuration Tab-View

The controls in the static configuration tab view dialog (shown in Figure 11) are used to configure the static camera electronics settings. These values are read once by the embedded application on boot and subsequently used to set up corresponding camera registers during normal operation.

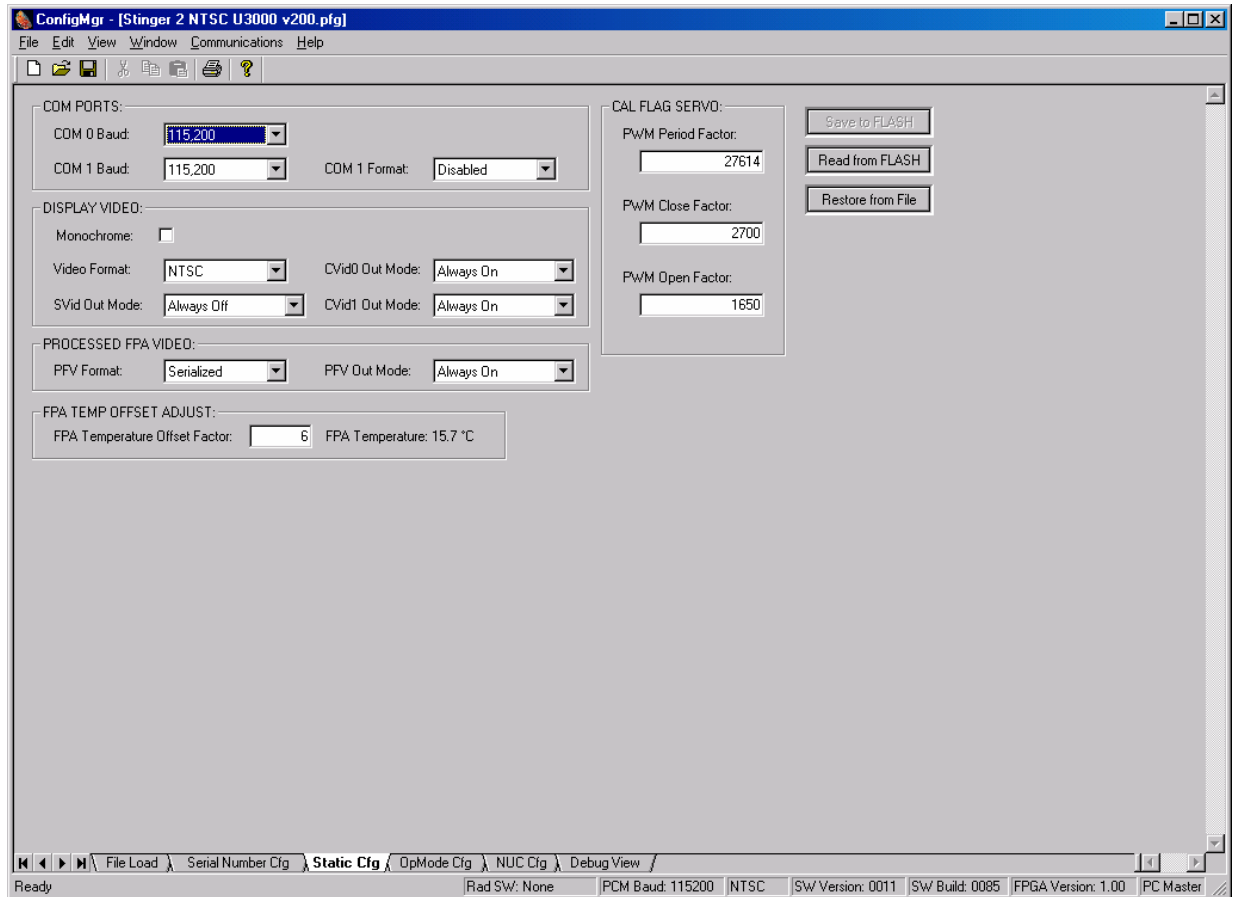


Figure 11: Static Configuration Tab-View Dialog

The camera settings in this dialog when saved to the camera are placed in DSP data flash. During the camera boot sequence the settings are read and used by the embedded camera application to configure the hardware.

9.1 COM Ports Configuration

The controls shown below in Figure 13 are used to configure each of the available serial communications ports.



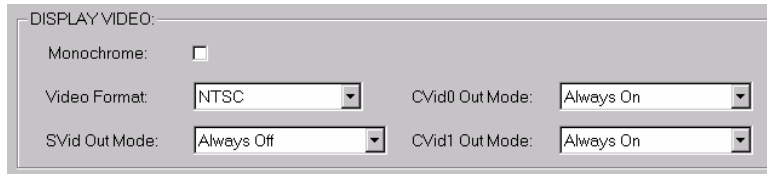
Figure 12: Camera COM Port Setting Controls

Each of the available ports needs to have a format and a baud rate setting. COM 0 is reserved for use by PC Master.

The camera will always boot (via boot flash) with COM 0 set for 115K baud. Once it enters the main application it will be restored to the user defined settings.

9.2 Display Video Configuration

The controls shown below in Figure 13 are used to configure the camera's available analog display video formats.



DISPLAY VIDEO:

Monochrome:

Video Format: CVid0 Out Mode:

SVid Out Mode: CVid1 Out Mode:

Figure 13: Camera Display Video Setting Controls

The display video format can be NTSC, PAL, or disabled for digital output only modes. Select the monochrome check box for black and white only output.

9.3 Processed FPA Video Configuration

The controls shown below in Figure 14 are used to configure the digital output port of the camera.



PROCESSED FPA VIDEO:

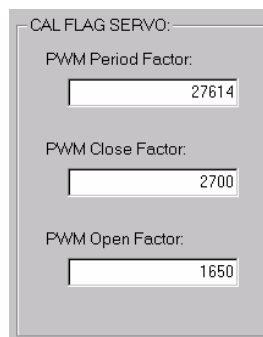
PFV Format: PFV Out Mode:

Figure 14: Camera Processed FPA Video Setting Controls

The digital port format can be set to parallel, serialized, or disabled (for display video output only applications).

9.4 Calibration Flag Servo Configuration

The edit fields shown in Figure 15 are used to configure the calibration flag servo for use during normal operation.



CAL FLAG SERVO:

PWM Period Factor:

PWM Close Factor:

PWM Open Factor:

Figure 15: Camera Calibration Flag Setting Controls

The PWM period factor sets the DSP modulus value which determines the period. The period is computed from this value and the DSP bus clock.

The close factor sets the duty cycle of the PWM needed to close the servo (calibration flag in sensor FOV).

The open factor sets the duty cycle of the PWM needed to open the servo (calibration flag in sensor not in FOV).

For further information on the PWM refer to the Motorola DSP56F80X User's Manual (DSP56F801-7UM/D – Rev 3.0).

9.5 FPA Temperature Offset Adjust Configuration

The edit field shown in Figure 16 can be used to adjust for error in the DSP ADC module when computing the FPA temperature.

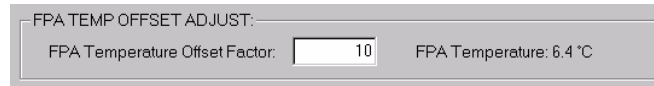


Figure 16: Camera FPA Temperature Offset Adjust Setting Control

The offset value factor is shifted up three bits to match the DSP ADC offset register and once applied is subtracted from the ADC channel read back results.

9.6 Flash/File Controls

The buttons shown below in Figure 17 are used to save and retrieve the static configuration data.

Initially the data is read from an existing file (*.pfg) and is copied to a local data structure that is displayed on the GUI. Manually modifying the values on the GUI, restoring from the file, or reading from camera flash only changes the values in the local copy.



Figure 17: Flash and File Controls

Clicking on the 'Read from FLASH' button reads the settings from the camera and stores them in the local copy. To save those values to a local file it is necessary to perform a 'File Save' or 'File Save As...' as described in paragraph 5.1.

Clicking on the 'Restore from File' button updates the GUI with the data from the open file.

Once the user has updated the fields to the desired value, they can be saved in the camera by clicking on the 'Save to FLASH' button.

10 OpMode Configuration Tab-View

The controls in the operational mode tab view dialog (shown in Figure 18) are used to configure up to 16 different operational modes that the camera could use during operation. At least one operational mode will need to be defined for the camera to function properly.

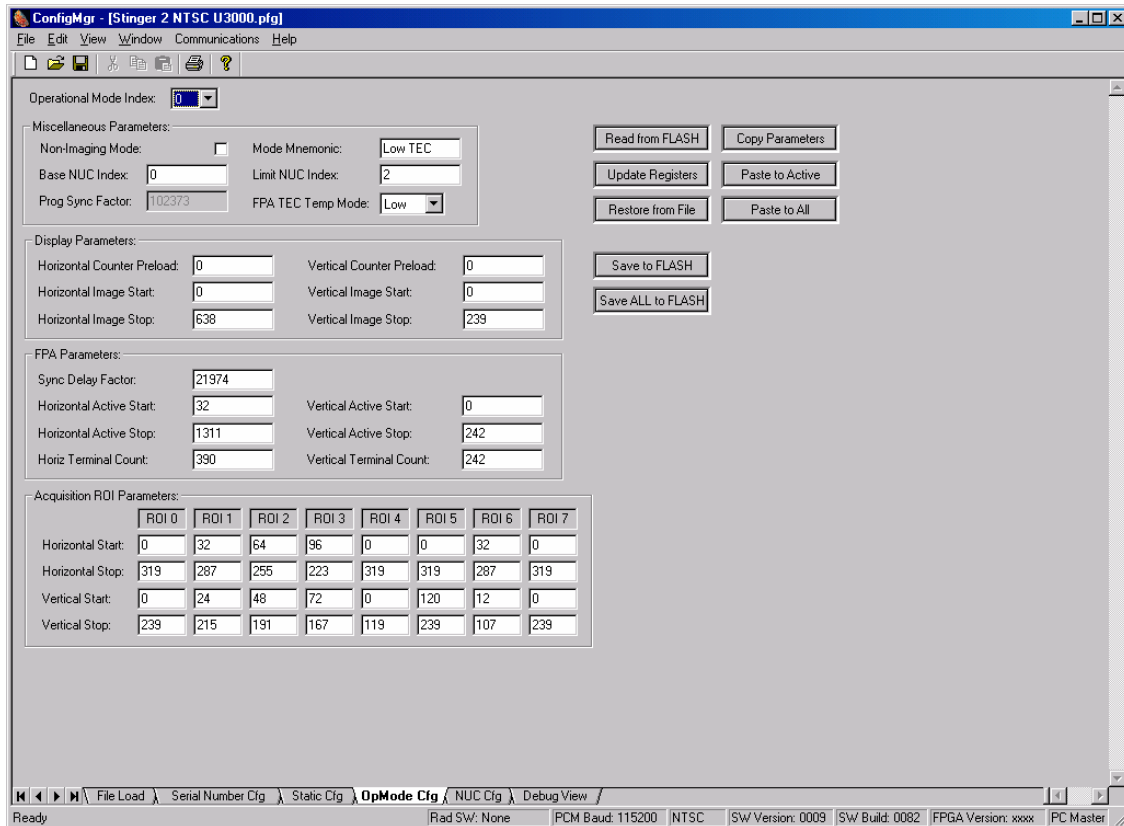


Figure 18: OpMode Configuration Tab-View Dialog

10.1 Miscellaneous Parameters Configuration

The controls shown in Figure 19 below are used to configure an operational mode. An operational mode informs the embedded application which NUC indexes are valid, display and FPA image start/stop registers, the region of interest windows for automatic gain control, and mode identifier. Settings in this dialog are stored in the serial data flash (1 page per mode) on the camera controller. Space has been allocated for up to 16 operational modes.

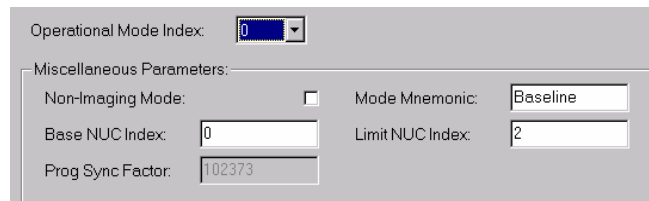


Figure 19: NUC Index Setting Controls

The user will first need to set the 'Operational Mode Index' to the desired value. There will be a set of defaults applied to all the GUI controls, which can be modified as needed. Changing this index does not change the active operational mode of the connected camera.

If the mode will be used in a digital output only application then check the 'Non-Imaging Mode' check box.

A name (mnemonic 1 – 8 characters) needs to be supplied for every mode saved to the camera. The mode mnemonic will be retrieved remotely for identification and/or displayed on the analog display output when symbology is properly enabled.

The base and limit NUC index fields determine the valid NUC indexes that the operational mode can use during normal operation. The NUC index is used by the operational mode to point the camera to a set of coefficients and FPA setup parameters. The embedded application has storage for 64 different NUC tables but the actual value is limited by the amount of NUC flash memory. Currently the camera supports only 12 sets of coefficients for a 320 x 256 array. In the example shown in the figure above, operational mode 0 is configured to switch between NUC tables 0, 1, and 2. If operational mode index 1 was to be created it would be configured to start with NUC index 3.

The 'Prog Sync Factor' field is fixed by the reference clock rate and is for information only.

10.2 Display Parameters Configuration

The edit fields shown in Figure 20 are used to configure the display timing registers.

Display Parameters:			
Horizontal Counter Preload:	<input type="text" value="0"/>	Vertical Counter Preload:	<input type="text" value="0"/>
Horizontal Image Start:	<input type="text" value="0"/>	Vertical Image Start:	<input type="text" value="0"/>
Horizontal Image Stop:	<input type="text" value="638"/>	Vertical Image Stop:	<input type="text" value="239"/>

Figure 20: Camera Display Configuration Setting Controls

The 'Horizontal Counter Preload' value is preloaded into the display horizontal counter upon each received master sync pulse. The display horizontal counter increments at 4 times the FPA pixel clock rate and controls the horizontal display phase with respect to an external sync.

The 'Horizontal Image Start' value controls the horizontal starting position of the display active image region (i.e. FPA Video).

The 'Horizontal Image Stop' value controls the horizontal stop (end) position of the display active image region.

The 'Vertical Counter Preload' value is preloaded into the display vertical counter upon each received master sync pulse. The display vertical counter increments at the FPA line rate and controls the vertical display phase with respect to an external sync.

The 'Vertical Image Start' value controls the vertical starting position of the display active image region.

The 'Vertical Image Stop' value controls the vertical stop (end) position of the display active image region.

10.3 FPA Parameters Configuration

The edit fields shown in Figure 21 are used to configure the FPA acquisition timing registers.

FPA Parameters:			
Sync Delay Factor:	<input type="text" value="21974"/>	Vertical Active Start:	<input type="text" value="0"/>
Horizontal Active Start:	<input type="text" value="32"/>	Vertical Active Stop:	<input type="text" value="240"/>
Horizontal Active Stop:	<input type="text" value="1311"/>	Vertical Terminal Count:	<input type="text" value="240"/>
Horiz Terminal Count:	<input type="text" value="390"/>		

Figure 21: FPA Configuration Setting Controls

The 'Sync Delay Factor' value controls the delay from the display vertical sync signal to the FPA sync signal in NTSC or PAL Modes (Electronic Bore sight) and the delay from the master sync signal to the FPA sync signal in non-imaging mode.

The 'Horizontal Active Start' value controls the horizontal starting position of the internal FPA horizontal active signal.

The 'Horizontal Active Stop' value controls the horizontal stop (end) position of the internal FPA horizontal active signal.

The 'Horizontal Terminal Count' value controls the FPA horizontal line rate.

The 'Vertical Active Start' value controls the vertical starting position of the internal FPA vertical active signal.

The 'Vertical Active Stop' value controls the vertical stop (end) position of the internal FPA vertical active signal.

The 'Vertical Terminal Count' value controls the end of FPA vertical timing.

10.4 Acquisition ROI Parameter Configuration

The edit fields below in Figure 22 are used to configure multiple regions of interest zones for an operational mode. Each mode can have up to eight different regions of interest with the only exception being that ROI 0 is reserved for full frame only.

Acquisition ROI Parameters:								
	ROI 0	ROI 1	ROI 2	ROI 3	ROI 4	ROI 5	ROI 6	ROI 7
Horizontal Start:	0	32	64	96	0	0	32	32
Horizontal Stop:	319	287	255	223	319	319	287	287
Vertical Start:	0	24	48	72	0	120	12	132
Vertical Stop:	239	215	191	167	119	239	107	227

Figure 22: Acquisition Region of Interest Setting Controls

The 'Horizontal Start' value controls the horizontal starting position of the image/histo-grab memory ROI.

The 'Horizontal Stop' value controls the horizontal stop (end) position of the image/histo-grab memory ROI.

The 'Vertical Start' value controls the vertical starting position of the image/histo-grab memory ROI.

The 'Vertical Stop' value controls the vertical stop (end) position of the image/histo-grab memory ROI.

10.5 Flash/File Controls

The buttons shown below in Figure 23 are used to save, copy, paste and retrieve the operational mode data.

Initially the data is read from an existing file (*.pfg) and is copied to an array of local data structures representing an array of operational modes. The active mode index determines the values to be displayed on the GUI.

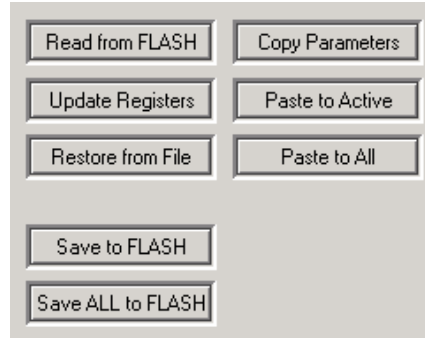


Figure 23: Flash and File Controls

Since there is a capability to have multiple operational modes, there has been additional control over manipulating the modes.

Clicking on the 'Read from FLASH' button reads the settings from the camera and stores them in the local copy. To save those values to a local file it is necessary to perform a 'File Save' or 'File Save As...' as described in paragraph 5.1.

Clicking on the 'Update Registers' button updates several camera registers with values from this dialog. This will provide a means for the user to determine if the settings as configured provide the proper operation before storing the data to flash memory.

Clicking on the 'Restore from File' button updates the GUI with the data from the open file for the active index.

Once the user has updated the fields to the desired value, it can be saved to the camera by clicking on the 'Save to FLASH' button. This will save the GUI active mode to the associated index table. To save all modes to the camera then click on the 'Save ALL to FLASH'.

Clicking on the 'Copy Parameters' button saves the values of the active GUI index to a buffer. From there, the data can be pasted into a different mode index ('Paste to Active') by changing the operational mode. The data can also be pasted into every other mode by using the 'Paste to All' button.

11 NUC Configuration Tab-View

The controls in the NUC configuration tab view (shown in Figure 24) provide a means of adjusting FPA settings to desired levels before performing calibrations. If the host computer has a National Instruments NI-1422 LVDS framegrabber installed, then digital data can also be monitored to assist with the FPA setup.

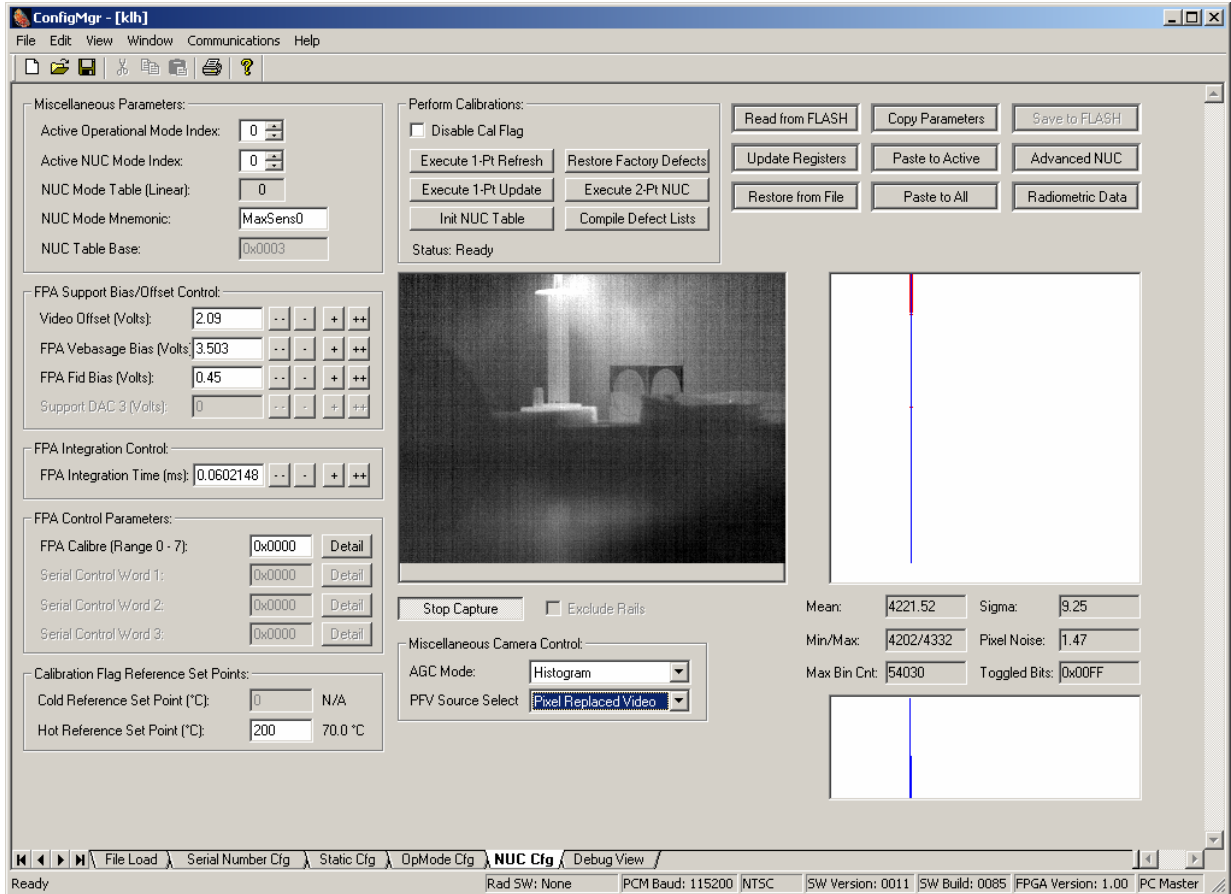


Figure 24: NUC Configuration Tab-View Dialog

11.1 Miscellaneous NUC Configuration

The miscellaneous NUC table controls are shown in Figure 25.

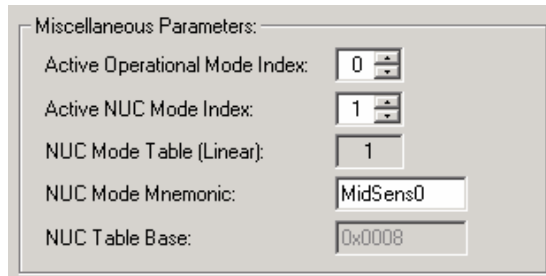


Figure 25: NUC Index and Miscellaneous Controls

The top control is labeled 'Active Operational Mode Index' and is used to set the operational mode of the camera (if attached) or the file. When changing this value the software will validate the new index on the camera or in the file before actually updating the controls. The control will not increment to an operational mode that has not been programmed into the camera (paragraph 10.5) or saved in the local file.

The 'Active NUC Mode Index' control shown in Figure 25 is used to set the desired NUC mode index within the active operational mode. When changing this value the software will validate the new index on the camera or in the file before actually updating the controls. If the data stored in camera flash has not been programmed then the GUI will update its controls to file defaults. This provides the user with a starting point in mode creation. Note it may be necessary to click on the 'Update Registers' button to set the camera to a known state after switching NUC tables.

The 'NUC Mode Table (Linear)' text field represents the linear index of the current NUC mode.

Each configured NUC mode should have a name associated with the table. The mnemonic will be stored along with the mode data and can be retrieved by the host or embedded application during normal operation.

The 'NUC Table Base' field displays the register value that represents the most significant bits of an address in NUC flash memory. This address is a pointer (to the base of the first block within the flash device) for the desired NUC coefficient set.

The FPA TEC selection box sets the desired temperature level of the internal cooler to its low or high setting.

11.2 FPA DAC Bias Configuration

FPA DAC bias setting controls are shown in Figure 26 below.

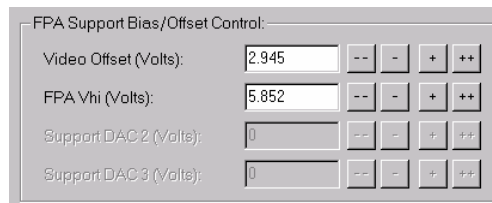


Figure 26: FPA DAC Bias Setting Controls

The Configuration Manager software will identify the camera FPA type and then enable and name the available bias controls. Each bias is controlled through a register value that has a resolution of 0 – 255. These values are converted to a voltage for the user interface.

Clicking on the single increment '+' or decrement '-' button adjusts the register value by 1. The updated voltage value will be displayed in the edit field.

Clicking on the double increment '++' or decrement '--' button adjusts the register value by 10. The updated voltage value will be displayed in the edit field.

11.3 FPA Integration Configuration

The integration setting control is shown in Figure 27.

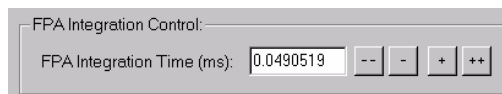


Figure 27: FPA Integration Time Setting Controls

The Configuration Manager software will identify the camera FPA type and then select the proper conversion for the integration time. The integration time is displayed in milliseconds and is limited by the conversion equation for the specific FPA.

Clicking on the single increment '+' or decrement '-' button adjusts the register value by 1. The updated time value will be displayed in the edit field.

Clicking on the double increment '++' or decrement '--' button adjusts the register value by 10. The updated time value will be displayed in the edit field.

11.4 FPA Serial Control Word Configuration

FPA serial control parameters can be modified using the controls shown in Figure 28.

FPA Control Parameters:		
Serial Control Word 0:	0x00C1	Detail
Serial Control Word 1:	0x1A40	Detail
Serial Control Word 2:	0x7FFF	Detail
Serial Control Word 3:	0x0000	Detail

Figure 28: FPA Serial Control Word Setting Controls

The control words are made up of bit fields that represent various internal FPA settings. These values are serially loaded to the FPA during normal operation.

Depending upon the FPA type these controls may not be enabled, indicating either a fixed setting or an absent setting. If the control is enabled then it can be modified to adjust camera FPA behavior.

The value can be entered directly into the edit field or by using the 'Detail' button to bring up a dialog with detailed settings such as the one shown in Figure 29.

Serial Control Word 1 Detail	
Value:	0x0000
Detector Bias:	0
FPA Current:	0
FPA Power:	0
FPA Gain:	0
<input type="button" value="Cancel"/> <input type="button" value="OK"/>	

Figure 29: Serial Control Word Detail Dialog

11.5 Calibration Flag Reference Configuration

The controls for setting the calibration flag reference are shown in Figure 30.

Calibration Flag Reference Set Points:		
Cold Reference Set Point (°C):	0	N/A
Hot Reference Set Point (°C):	180	61.2 °C

Figure 30: Calibration Flag Reference Setting Controls

If a calibration flag is installed in a camera it will be one of three types: ambient only, heated only, and dual temperature.

If the type is ambient only, both edit fields will be disabled. If the type is heated only, just the hot reference field will be enabled.

The value that goes into the edit field represents a register value applied to the corresponding DAC; which has a range of 0 – 255.

In the case when the calibration flag type contains a TEC, a resulting temperature will be shown next to the entered value. Otherwise a “N/A” will be displayed.

11.6 Calibration Controls

Controls for performing calibrations are shown in Figure 31. The defective pixel detection, 1-point, and 2-point calibrations are performed using a series of commands/messages between the host and the connected camera. These buttons are not enabled if no connection exists.

The calibration buttons are also not enabled if the current GUI settings do not match the camera register settings. This prevents a calibration being performed with invalid settings, which would be saved to the camera prior to the execution of the calibration.

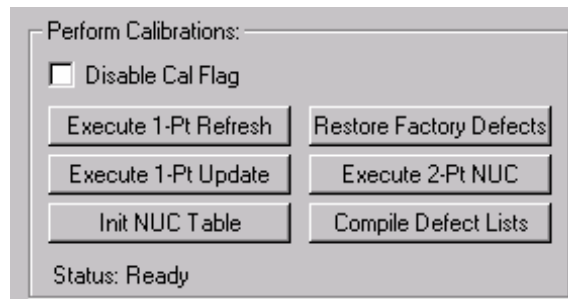


Figure 31: Calibration Controls

The ‘Disable Cal Flag’ check box, when selected, informs the embedded application to execute the calibration with an external flag. The user will be responsible for placing the reference in the camera field of view at the proper time.

Click on the ‘Execute 1-Pt Refresh’ to initiate a one point refresh calibration. The resulting coefficients are stored in volatile memory and are dependent upon the active NUC table.

Click on the ‘Execute 1-Pt Update’ to initiate a one point update calibration. This calibration assumes a two point data set is already in flash and will update the offset coefficients only.

Click on the ‘Restore Factory Defects’ button to initiate a NUC table reset. The routine will completely erase the NUC flash area and then write ‘0x0000’ into the gain terms to identify bad pixels as defined by the camera’s factory defect table for the active NUC. This ‘0x0000’ term will be ignored during the two point calibration but will be used as a trigger for the bad pixel replacement algorithm. Subsequent two point calibrations will not reset any previously detected bad pixels, it can only add to them.

Click on the ‘Execute 2-Pt NUC’ to initiate a two point calibration process. These coefficients will be stored in the NUC flash memory at the desired index. Defective pixels from the existing NUC (if any) will be saved before the flash area is erased and then re-inserted to the new coefficient set.

Click on the ‘Init NUC Table’ to completely erase all coefficients in the active NUC’s table. This includes erasing the locations where bad pixels have been identified.

Click on the ‘Compile Defect Lists’ to call a routine on the camera that builds a defective pixel list for all existing NUC tables. During this process each NUC will be inspected for defective pixels and a list will be saved in camera flash. It is this table that is used when restoring a NUC to the factory defect state (see above). Since this function inspects existing NUC tables it is best to completely configure the camera with all necessary calibrations prior to executing this command.

The ‘Status:’ text line provides a GUI interface of the current process state.

11.7 Miscellaneous Camera Controls

Two miscellaneous camera controls are shown in Figure 32.



Figure 32: Miscellaneous Camera Controls

These two controls are provided to assist with frame grabber data acquisition. The 'AGC Mode' selection control is used to set the automatic gain algorithm that the embedded application uses to process analog display video.

The 'PFV Source Select' control sets the format of the output of the digital port. Typically the user would select digital FPA video prior to performing a calibration and pixel replaced video afterwards.

11.8 Digital Port Grab Display Controls

Controls for initiating and viewing frame grab data is shown in Figure 33.

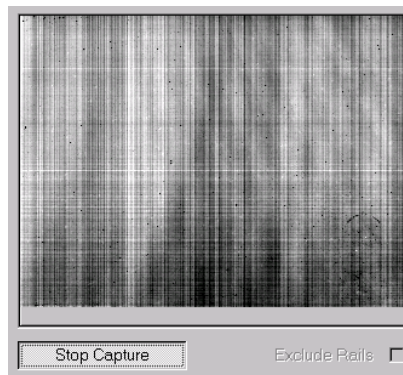


Figure 33: Frame Grabber Controls

The data display window is sized for a 320 x 256 array. If the actual FPA size is 320 x 240, there will be a blank area at the bottom of the window as shown above. The video data that gets displayed goes through a simple linear AGC routine for the purposes of efficiency.

Click on the 'Start Capture' button to begin a capture and click it again to stop the process.

Note: The controls will not be enabled if a frame grabber is not present or if there was an error detecting/initializing the hardware.

11.9 Digital Port Statistics Controls

The area used for displaying information about the digital data stream is shown in Figure 34.

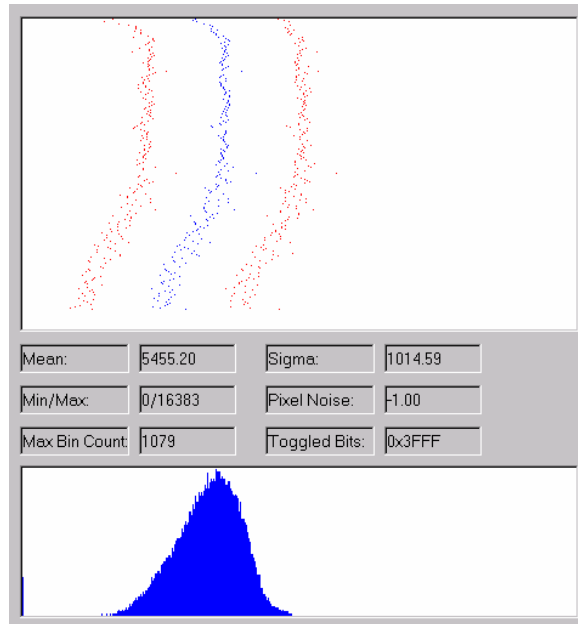


Figure 34: Digital Data Statistics

Digital port data while being captured is also processed for statistical analysis. This data can assist in the characterization of the camera FPA and for setting up calibrations.

The top window displays a row by row average of the pixel data with noise. The blue dot represents the row average pixel value from 0 – 16383. The red dots on either side represent the (\pm) three sigma point of that row's pixel values.

The edit fields, between the two display windows, are statistics based on the entire frame. The pixel noise is computed on a 32 frame summation (frames are not in sequence). A value of -1 for pixel noise indicates that not enough frames have been processed to display the results.

The bottom window displays a histogram of a frame of pixel values. The horizontal axes of the window represent bins from 0 to 16383. The height of the window is scaled to the maximum bin value which is reported in the 'Max Bin Count' field.

11.10 Flash, File, and Advanced Configuration Controls

The buttons shown below in Figure 35 are used to save, copy, paste and retrieve NUC mode data.

Initially the data is read from an existing file (*.pfg) and is copied to an array of local data structures representing an array of NUC modes. The GUI active mode index determines the values to be displayed in the dialog.

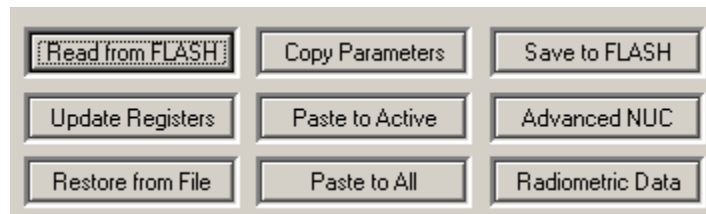


Figure 35: Flash and File Controls

Clicking on the 'Read from FLASH' button reads the current settings from the camera and stores them to the local copy. To save those values to a local file it is necessary to perform a 'File Save' or 'File Save As...' as described in paragraph 5.1.

Clicking on the 'Restore from File' button updates the GUI with the data from the open file for the active index.

Clicking on the 'Copy Parameters' button saves the values of the active GUI index to a buffer. From there, the data can be pasted into a different mode index ('Paste to Active') by changing the NUC mode. The data can also be pasted into every other mode by using the 'Paste to All' button.

A control not previously included in other dialogs is the 'Update Registers' button. This button updates all the registers in the camera that are associated with this dialog. Doing this will also enable the appropriate calibration buttons. This ensures that the GUI settings, that the user sees, are the same as what the camera is currently operating. Only during a calibration are the GUI settings stored to serial data flash for permanent storage.

Clicking on the 'Save to FLASH' button will update the NUC table parameters for the active NUC table. This control is enabled through the 'Enter PIN...' menu item. It is not to be used unless the user is certain that the NUC parameters must be modified independently of a calibration. Saving settings that do not match the coefficients will more than likely render the active NUC table useless. This control is to be used with caution.

Clicking on the 'Advanced NUC' button initiates a dialog for a more advanced method of detecting defective pixels and calibration (see paragraph 13).

Clicking on the 'Radiometric Data' button initiates a dialog for entering OEM radiometric parameters (see paragraph 14).

12 Debug Tab-View

The controls in the debug tab view dialog (shown in Figure 36) provide the user access to various settings, registers, and memory for the purpose of debugging. Peripheral and FPGA registers may be read and/or modified to verify operation. It is recommended that no changes be made if the user is unsure of the result or device being affected.

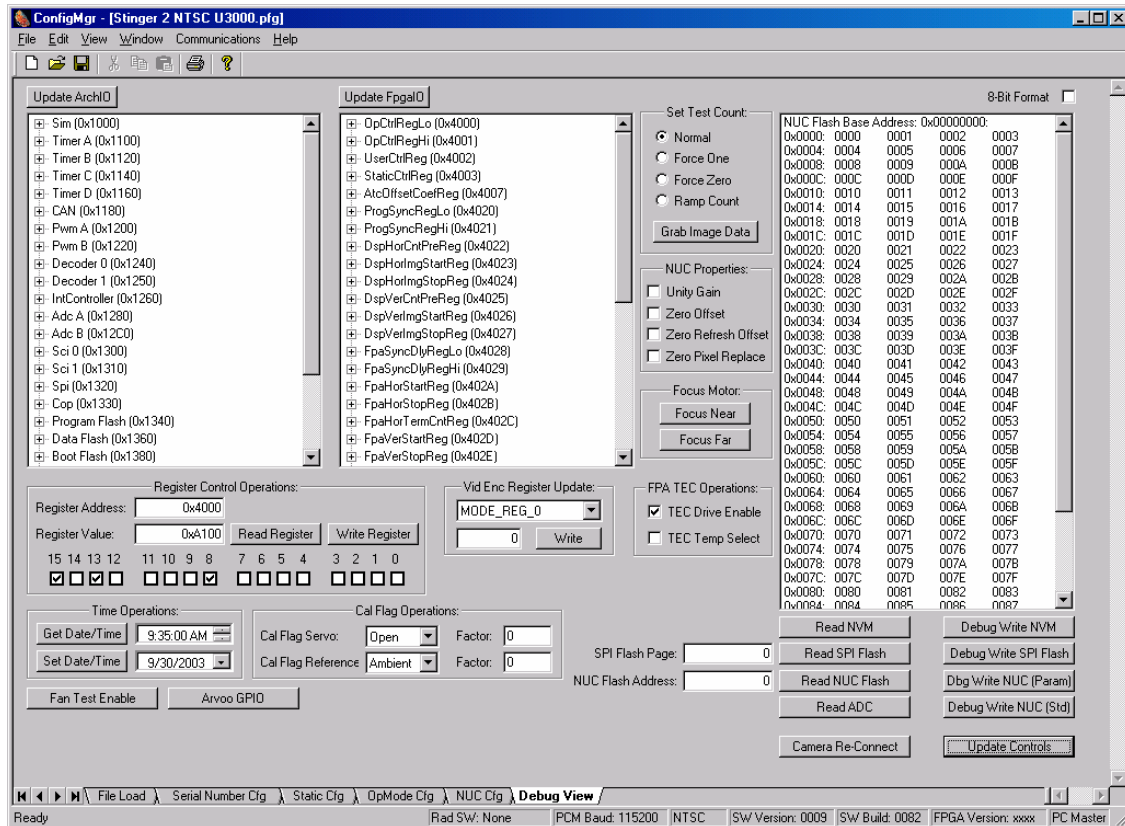


Figure 36: Debug Tab-View Dialog

12.1 DSP Peripheral I/O Registers

The DSP peripheral register control window is shown below in Figure 37. This window gives the user access to the value of each of the peripherals built into the DSP architecture.

By clicking on the “Update ArchIO” button, a read of the entire memory mapped region is performed and the results can be viewed with the tree list control. The tree list shows each peripheral base register address. Typically a peripheral has multiple registers that are used to define its operation. Click on the “+” next to the peripheral to expand the tree list and view sub-registers.

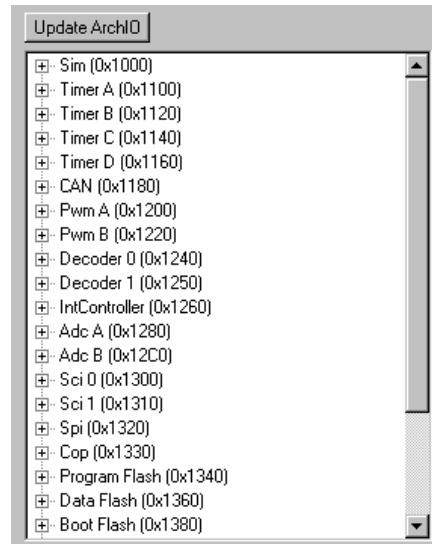


Figure 37: DSP Peripheral I/O Register Control

Specific information about register contents can be found in the Motorola DSP56F80X User's Manual (DSP56F801-7UM/D).

12.2 Xilinx FPGA I/O Registers

The Xilinx FPGA register control window is shown below in Figure 38. This window gives the user access to read each of the registers in the FPGA map.

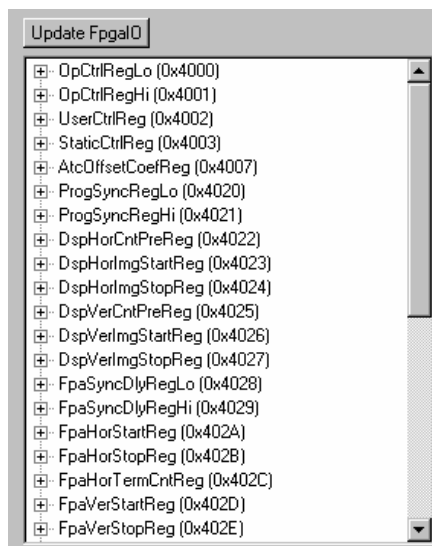


Figure 38: Xilinx FPGA I/O Register Control

Click on the "Update FpgaIO" button to refresh the state of each of the registers in the map. The tree list control displays each of the register mnemonic and memory mapped address. Click on the "+" to expand the list tree and reveal the current register value. Double clicking on the register mnemonic will place the address in the single register control window (paragraph .12.3) along with the current value.

Specific register information may be obtained from Lunitron.

12.3 Register Control

The register control group provides the user with read/write access to both the DSP peripheral and Xilinx FPGA registers. Actually even valid memory locations in DSP data memory space can be accessed as well.

Register Control Operations:

Register Address:

Register Value:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 39: Register Control

To read data at a specific location: (a) enter the address in hexadecimal form (0xXXXX) (b) and then click the “Read Register” button. The updated value will be shown in hexadecimal form in the value edit field, and the appropriate bits will be set in the check boxes below.

To write a value to a specific location: (a) enter the address in hexadecimal form (0xXXXX), (b) enter the desired output value (directly or with bit check boxes), (c) then click the “Write Register” button.

Note: Care should be taken to update known addresses only, since DSP data memory is also accessible, stack and variable values are not protected.

12.4 Memory View Window/Controls

The memory view control group shown below in Figure 40, provides a mechanism to read various memory locations on the electronics. These memory locations are all peripheral to the actual DSP.

Data read back is displayed in the window in 16-bit form. A check box is provided to display the data in 8-bit form if required.

Each of the buttons on the left hand column read a different peripheral memory. The first is the “Read NVM” button. When pressed this control will read the 96 bytes of RAM located on the serial data real time clock/non-volatile memory chip.

When the “Read SPI Flash” button is pressed an entire serial flash page (264 bytes) is displayed. The desired serial flash page can be entered in the edit box to the left of the read button. Valid values are 0 – 4095.

The reading of the flash associated with the NUC coefficients is done by pressing the “Read NUC Flash” button. This will read 160 words of data from the user supplied address at the left of the button. The base address will appear at the top of the display window with the offset listed in the left-hand column. Since the flash part is a 16-bit device the 8-bit checkbox will be ignored.

The last button at the bottom left of the group will read the ADC results registers when pressed. The ADC results registers contain the current count value. These values are scaled by shifting the values down 3 bits. The resulting voltage can be computed by using the equation:

$$Volts = V_{Ref} \times \frac{ADC_{value}}{4095}; V_{Ref} = 2.8V$$

The buttons located in the right hand column call routines that write values to specific locations in the associated memory. Use of these buttons will over-write existing settings or values currently being used by the camera.

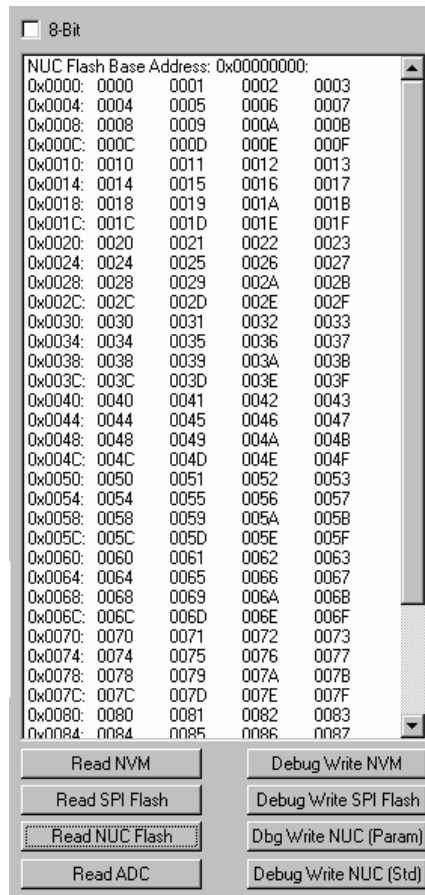


Figure 40: Miscellaneous Memory View Controls

Press on the “Debug Write NVM” button to output a ramp test pattern to the non-volatile RAM.

A click of the “Debug Write SPI Flash” button outputs a ramp test pattern to serial flash at page 1536.

Press on the “Dbg Write NUC (Param)” button to initiate a command that outputs a ramp test pattern in the NUC flash parameter blocks (0 – 7).

Press on the “Debug Write NUC (Std)” button to initiate a command that outputs a ramp test pattern in the NUC flash standard blocks (10 – 14).

12.5 Test Count

The test count controls shown in Figure 41, are used to manipulate the hardware test pattern generator.

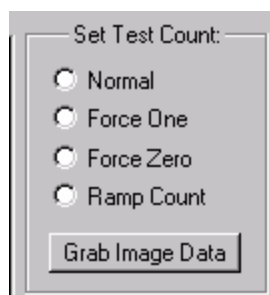


Figure 41: Test Count Control

Select 'Normal' for standard operation (no pattern); 'Ramp Count' to generate a repeating 0 – 0x3FFF ramp pattern; 'Force Zero' to have every pixel set to 0; and 'Force One' to have every pixel set to 0x2000.

Press on the "Grab Image Data" to grab and display the first three rows of pixel data in the memory view control window.

12.6 Time Set

The time operations controls shown in Figure 42 below, can be used to set and retrieve the camera time.

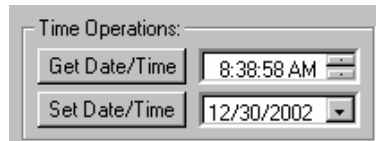


Figure 42: Time & Date Controls

Press on the "Get Date/Time" button to perform a read of the camera time.

To set the camera time:

- Click on the hour, minute, second, or AM/PM portion of the edit control.
- Click the up/down spinner to set to desired value.
- Click on the date control to show calendar dialog.
- Click on the desired day/date.
- Click on the "Set Date/Time" button.

12.7 Focus Motor Control

The focus motor operations buttons shown in Figure 43, initiate a command to focus either near or far.

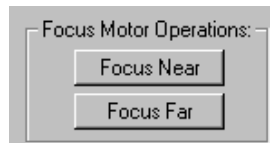


Figure 43: Focus Motor Controls

12.8 FPA TEC Control

The FPA TEC control group is shown below in Figure 44. These controls operate the TEC control.

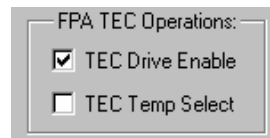


Figure 44: FPA TEC Drive Controls

Select the TEC Drive Enable to "turn on" the control circuitry.

Select the TEC Temp Select to set to the "high" temperature otherwise it will operate at the "low" temperature point.

12.9 NUC Table Properties

The NUC table coefficient property controls are shown below in Figure 45. These settings are use to apply or disable different portions of the NUC coefficients.

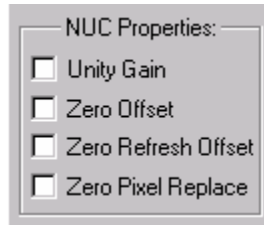


Figure 45: NUC Processor Controls

Enabling the 'Unity Gain' checkbox will set the gain coefficient for each pixel to a value of 1.

Enabling the 'Zero Offset' checkbox will set each pixel's offset coefficient to 0.

Enabling the 'Zero Refresh Offset' checkbox will set each pixel's refresh offset coefficient to 0.

Enabling the 'Zero Pixel Replace' checkbox will bypass the pixel replacement algorithm and allow the bad pixels to be viewed.

12.10 Calibration Flag Control

The servo control group is shown below in Figure 46. These controls are valid for the single temperature calibration flag.



Figure 46: Calibration Flag Controls

The top combo-box control can be used to open and close the servo, assuming that it is present and configured properly.

To bottom combo-box control sets the temperature of the calibration flag to ambient or the programmed "hot" temperature.

12.11 Video Encoder Register Control

The video encoder register control group is shown below in Figure 47. These controls give the user the ability to modify the video encoder registers for debug purposes.

Please refer to documentation about the Analog Devices ADV7170/7171 digital video encoder for information about register mnemonics and modes of operation.

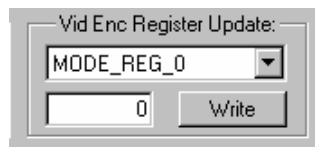


Figure 47: Video Encoder Register Controls

Using the combo-box control select the desired register to modify. Then enter the value to be written to that register. Finally press on the "Write" button to execute the command.

13 Advanced NUC

The advanced NUC (pixel defect replacement) dialog in Figure 48; can be used to identify defective pixels automatically, during a calibration, or by manual selection. An installed framegrabber is required for this process.

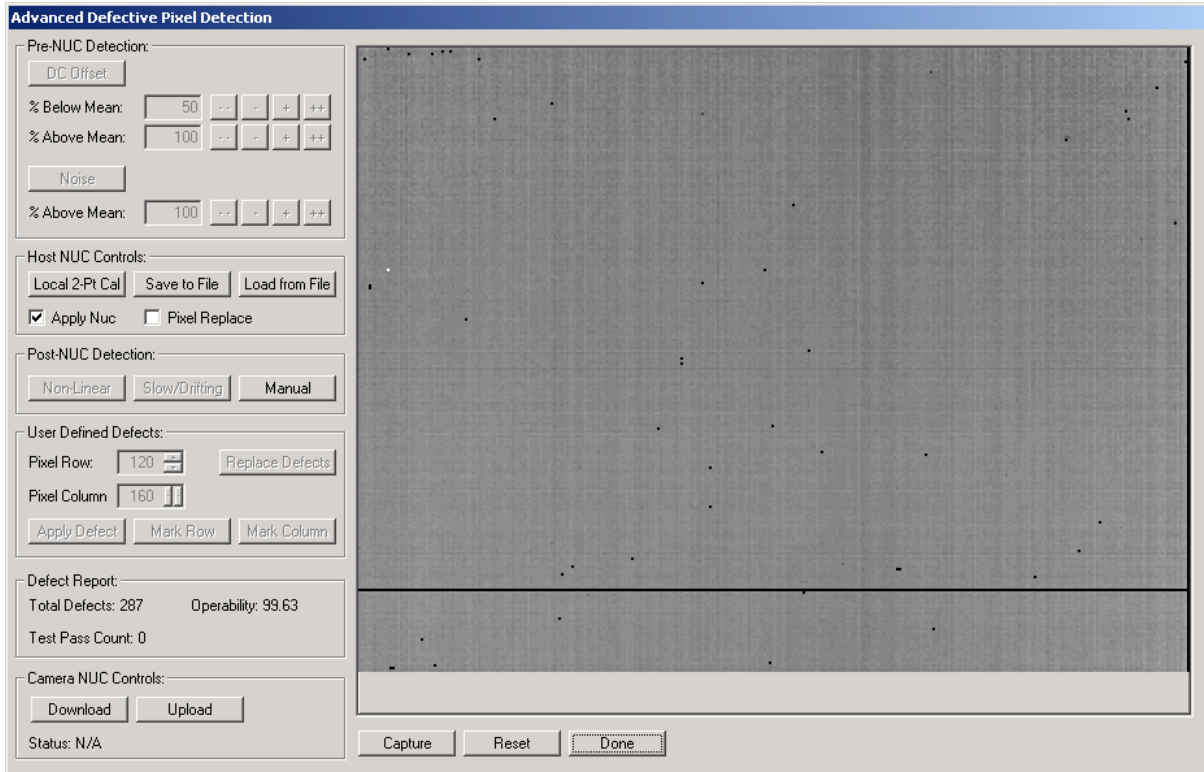


Figure 48: Advanced Defective Pixel Replacement Dialog

The 'Capture' button begins a digital video grab where the data is used for defect identification, display video, and/or manual defective pixel removal.

Clicking on the 'Reset' button resets all buffers (detected defects) and local calibration coefficients.

Clicking on the 'Done' button closes the dialog without further action.

13.1 Pre-NUC Detection Controls

The controls used to detect bad pixels before performing a two point calibration are shown below in Figure 49.

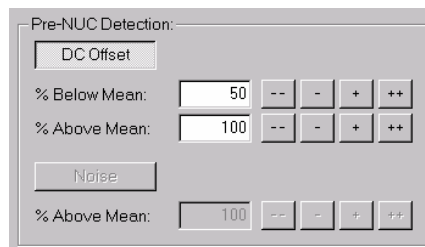


Figure 49: Pre-NUC Defect Detection Controls

The pre-NUC detection controls work in conjunction with the capture process to acquire, compare, and identify defective pixels based on DC offset and/or noise.

To detect pixels outside of desired DC offset range click on the 'DC Offset' button. Next, adjust the percent above and below mean levels to determine limits. The single increment '+' or decrement '-' buttons adjust the setting by 1 percent. The double increment '++' or decrement '--' buttons adjust the setting by 10 percent. Changes to the settings will reset defects previously identified by this test and start over. The defective pixel will be displayed in the capture window in a black/white format.

The equation used to compute the threshold for below the mean:

$$Threshold_{Low} = FrameMean \times (1 - GUIValue / 100)$$

The equation used to compute the threshold for above the mean:

$$Threshold_{High} = FrameMean \times (1 + GUIValue / 100)$$

Click on the 'Noise' button to detect pixels above a desired noise threshold. Noise data is collected over a 32 frame summation and will take longer to compute results. The increment controls operate the same as those listed above for the DC offset test.

13.2 Host NUC Controls

The host NUC controls shown below in Figure 50, are used for creating/saving/loading non-uniformity coefficients.

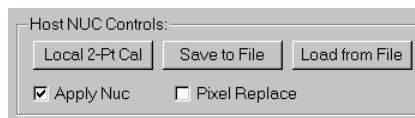


Figure 50: Host NUC Controls

To begin the process of performing a two point calibration click on the 'Local 2-Pt Cal' button. The calibration will use external references only and will incorporate any defects computed in the pre-NUC detection process. As part of the calibration process defective pixels will go through the pixel replace algorithm to compute a replacement pixel.

Note: If the application is being used in conjunction with a National Instruments 1422 framegrabber an additional dialog will appear. This dialog will permit the user to change the number of frames used in the calibration acquisition process. Initially the default will be 32 with additional choices of 64, 128, and 256 frames.

Once completed, the user can click on the 'Capture' button to preview the results. The 'Apply Nuc' checkbox is automatically set and the coefficients will be applied to the incoming digital data. Initially the preview data will show defective pixels as off or black. Enable the 'Pixel Replace' checkbox to have the defective pixels replaced.

The two point calibration data can be saved to a file on the host computer in a simple binary file format. To save the file click on the 'Save to File' button and provide a filename in the Windows File Dialog. The data is saved as raw floating point values - a gain term followed by an offset term for each pixel (4 byte floats).

Clicking on the 'Load from File' button will open a Windows File Dialog that can be used to load an existing NUC data file.

With this file capability, accompanied by the camera NUC upload/download functions (paragraph 13.6), it is possible to manipulate NUC coefficient sets for just about any application.

13.3 Post-NUC Detection Controls

Post-NUC defective pixel detection controls are shown in Figure 51.

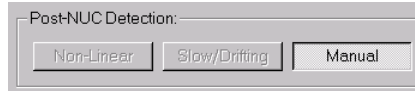


Figure 51: Post-NUC Defect Detection Controls

Currently the only implemented post NUC defective pixel removal tool is manual mode.

Clicking on the 'Manual' button will change the cursor to a cross hair and allow the user to begin selection of pixels to be added as defects. See paragraph 13.4 for more detailed information about the user defined defect selection process.

13.4 User Defined Defect Controls

Controls used in the selection of user defined defects are shown in Figure 52.

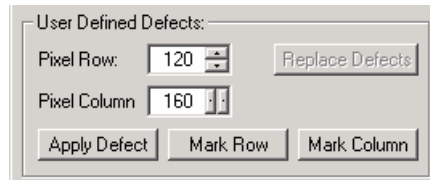


Figure 52: User Defined Defective Pixel Controls

Once the manual defect mode has been enabled (paragraph 13.3); the cursor will change to a cross hair. Also a flashing pixel (identifying the currently selected pixel) will appear on the preview window. Since the flashing pixel control is embedded in the preview process it is recommended to enable capture mode during manual pixel removal.

Position the cross hair over the desired pixel to be removed and left click the mouse. This will set the flashing cursor to that pixel and update the row and column values. To zoom to a larger image, making the selection process easier, right click on the mouse to toggle the zoom state. The zoom will attempt to center the window around the location of the cursor when it was right clicked. The user can also move the pixel cursor via the 'Pixel Row' and 'Pixel Column' edit controls.

Once the desired pixel has been identified click on the 'Apply Defect'. This will mark the pixel as bad for later replacement. Also the button name will change to 'Undo Defect' giving the user an opportunity to undo the last pixel. If the 'Apply Defect' button is not enabled, it means that the current pixel location has already been identified as defective.

The user can also define an entire row or column as 'bad' by clicking on the corresponding button. Note: there is no way to undo this change in the defect list.

Once the user has made the necessary changes then the 'Manual' button can be deselected ending the process. At this point the 'Replace Defect(s)' button will enable. Clicking on this button will execute a routine to recomputed replacement pixel values for all defective pixels. This is done to ensure that replacement index values that previously were pointing to valid pixels before manual replacement are updated along with the newly added defects.

Finally the NUC data can be saved locally or uploaded to the camera as desired.

13.5 Defect Report Window

The defect report window is shown in Figure 53.

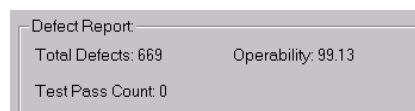


Figure 53: Defective Pixel Report

During the defective pixel detection process the number of bad pixels and operability is displayed in the 'Defect Report' area. If defects are being detected using the pre-NUC tests, the number of passes/checks is also displayed.

The operability represents the percent of valid pixels to the entire array.

13.6 Camera NUC Controls

Camera NUC transfer controls are shown in Figure 54.

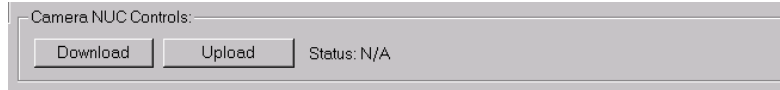


Figure 54: Camera NUC Up/Download Controls

The camera NUC controls are made up of three parts; download, upload and status of current operation.

The user can click the 'Download' button to initiate a transfer of NUC coefficients for the NUC table that corresponds to the index set in the NUC Configuration tab-view. This process takes a minute or so to complete so the status text line indicates the progress. The data that is requested is actually stored in NUC flash which is not accessible to the host. So the data is first copied to utility memory and then read in small chunks until complete. The area in utility memory for temporary storage is not large enough for both the gain and offset terms; therefore, the gain terms are downloaded separately from the offset terms. Also the data is being received in formatted for the camera hardware (16 bit). As the data is being downloaded it is converted to 4-byte floats for use by the host software. When the download is complete it can be manipulated just as a locally computed calibration table. The downloaded coefficients can not be merged with pre-NUC defects, but manual defects may be added to the data.

After creating, loading, or modifying a downloaded NUC table - it can be saved to camera flash. It is a good idea to save the table to a local file before beginning an upload. Click on the 'Upload' button to initiate an upload of the current NUC coefficients. Again this is a two part process that will upload the gain terms first followed by the offset terms. The local data will be converted from floating point to 16-bit values. The flash will also be erased before the actual upload occurs so make sure the NUC index is properly set.

14 Radiometric Parameter Data

Radiometric parameter data entry is OEM specific and beyond the scope of this document.