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### Rev History

<table>
<thead>
<tr>
<th>Revision Number</th>
<th>Release Date</th>
<th>Description</th>
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<tr>
<td>A</td>
<td>3/26/2012</td>
<td>Initial Release Use with Firmware older than V01.00.0080</td>
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<tr>
<td>B</td>
<td>5/26/2012</td>
<td>Added Lens Calibration Tab and Custom Pixel Map Tab Use with Firmware V01.00.0080</td>
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<tr>
<td>C</td>
<td>12/4/2012</td>
<td>Updated Screen Shots, Improved upload/download tools, Modified Manual AGC explanation Use with Firmware older than V01.00.0080</td>
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<tr>
<td>D</td>
<td>7/16/2013</td>
<td>New Features added: ICE, symbology, colorization.</td>
</tr>
<tr>
<td>E</td>
<td>06/09/2014</td>
<td>Prepared for Public Release</td>
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Camera Link® is a registered trademark of the Automated Imaging Association.
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## Acronyms and Abbreviations

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<th>Abbreviation</th>
<th>Description</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>Celsius</td>
<td>mm</td>
<td>millimeter</td>
</tr>
<tr>
<td>°F</td>
<td>Fahrenheit</td>
<td>ms</td>
<td>milliseconds</td>
</tr>
<tr>
<td>AGC</td>
<td>automatic gain control</td>
<td>MSB</td>
<td>Most Significant Bit</td>
</tr>
<tr>
<td>BPR</td>
<td>bad pixel replacement</td>
<td>MTU</td>
<td>Maximum Transfer Unit</td>
</tr>
<tr>
<td>CCA</td>
<td>circuit card assembly</td>
<td>MWIR</td>
<td>Mid-wave infrared</td>
</tr>
<tr>
<td>CL</td>
<td>center line</td>
<td>NETD</td>
<td>noise equivalent temperature difference</td>
</tr>
<tr>
<td>COMM</td>
<td>communication</td>
<td>NTSC</td>
<td>National Television System Committee</td>
</tr>
<tr>
<td>CSC</td>
<td>Computer Software Component</td>
<td>NUC</td>
<td>non-uniformity correction</td>
</tr>
<tr>
<td>CSCI</td>
<td>Computer Software Configuration Item</td>
<td>NVTHERM</td>
<td>Night Vision Thermal Analysis Tool</td>
</tr>
<tr>
<td>CSU</td>
<td>Computer Software Unit</td>
<td>OEM</td>
<td>original equipment manufacturer</td>
</tr>
<tr>
<td>dB</td>
<td>decibels</td>
<td>OLA</td>
<td>Optical Lens Adapter</td>
</tr>
<tr>
<td>DSP</td>
<td>digital signal processor</td>
<td>P</td>
<td>probability</td>
</tr>
<tr>
<td>ESD</td>
<td>electrostatic discharge</td>
<td>POL</td>
<td>polarity</td>
</tr>
<tr>
<td>E-Zoom</td>
<td>electronic zoom</td>
<td>psi</td>
<td>pound per square inch</td>
</tr>
<tr>
<td>FOV</td>
<td>field of view</td>
<td>Rev</td>
<td>revision</td>
</tr>
<tr>
<td>FPA</td>
<td>Focal Plane Array</td>
<td>ROI</td>
<td>region of interest</td>
</tr>
<tr>
<td>ft</td>
<td>feet</td>
<td>SC</td>
<td>split configuration</td>
</tr>
<tr>
<td>G</td>
<td>gravitational force</td>
<td>SWIR</td>
<td>Short-wave infrared</td>
</tr>
<tr>
<td>g</td>
<td>gram</td>
<td>TBD</td>
<td>To Be Determined</td>
</tr>
<tr>
<td>GUI</td>
<td>graphical user interface</td>
<td>TCR</td>
<td>Temperature coefficient of resistance</td>
</tr>
<tr>
<td>H</td>
<td>height</td>
<td>TIM</td>
<td>Thermal Imaging Module</td>
</tr>
<tr>
<td>HFOV</td>
<td>horizontal field of view</td>
<td>UART</td>
<td>Universal Asynchronous Receiver Transmitter</td>
</tr>
<tr>
<td>I/O</td>
<td>input/output</td>
<td>UAV</td>
<td>unmanned aerial vehicle</td>
</tr>
<tr>
<td>ICD</td>
<td>Interface Control Document</td>
<td>UFPA</td>
<td>Un-cooled Focal Plane Array</td>
</tr>
<tr>
<td>ICE</td>
<td>Image Contrast Enhancement</td>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>ID</td>
<td>identification</td>
<td>V</td>
<td>Vertical or Voltage</td>
</tr>
<tr>
<td>IR</td>
<td>infrared</td>
<td>VDC</td>
<td>volts direct current</td>
</tr>
<tr>
<td>IRS</td>
<td>Interface Requirements Specification</td>
<td>VGA</td>
<td>video graphics array</td>
</tr>
<tr>
<td>km</td>
<td>kilometer</td>
<td>VOx</td>
<td>Vanadium Oxide</td>
</tr>
<tr>
<td>LR</td>
<td>lower right</td>
<td>W</td>
<td>width or Watt</td>
</tr>
<tr>
<td>LWIR</td>
<td>long-wave infrared</td>
<td>μm</td>
<td>micron (micrometer)</td>
</tr>
</tbody>
</table>
REFERENCE DOCUMENTS

The following documents form part of this specification. In the event of a conflict between documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

Document No: 1012820 Tamarisk®_320 Electrical Interface Control Document
Document No: 1012819 Tamarisk®_320 Software Interface Control Document
Document No: 1003727 Tamarisk®_320 Mechanical Interface Control Document
SAFETY INSTRUCTIONS

NOTIFICATIONS: CAUTION, WARNING AND NOTE

The following is a list of notifications and their accompanying symbol that may be found through this document to alert the reader to potential risks and to minimize the potential for personal injury and or damage to the product. When a notification is present, it is important that the user review and understand all statements related to the notification before proceeding. If questions arise, please contact your authorized dealer or DRS Technologies.

Notifications are preceded by a symbol and followed by highlighted text. Three types of notifications are typically used and are defined below:

CAUTION

A caution is a procedure, practice, or condition that, if not strictly followed, may result in personal injury or damage to the equipment that may impede product performance.

WARNING

A warning is intended to alert the user to the presence of potentially harmful circumstances and provide precautionary guidance for mitigating risk of personal injury and or damage to the product.

NOTE

A note is a statement that clarifies or is used to emphasize important information.

1. Read all instructions
2. Keep these instructions for future reference.
3. Follow all instructions
4. Heed all warnings.
5. Do not submerge this apparatus in liquid of any kind.
6. Clean per recommended instructions using dry non-abrasive cloth.
7. Do not install near any sources of intense heat such as radiators, furnaces, stoves or other apparatus that regularly produce excessive heat.
8. Refer all servicing to qualified service personnel.
1 Introduction

The Camera Control Software provides an easy to use, graphical interface which allows the user to fully evaluate the camera’s functions and features. This user guide describes the installation requirements, installation procedure, and provides details on how to use the Camera Control Software to configure the camera, display status information, and perform image processing.

NOTE

This guide is based on version 1.8 or later of the DRS Camera Control Software.

1.1 Supported Cameras

This User Guide explains the operation of with the Camera Control Software version 1.8 or later. This version supports the following cameras:

1. Tamarisk® 640
2. Tamarisk® 320
3. Zafiro™ 640
4. UC640

1.2 System Requirements

To install and run the Camera Control Software, ensure the host PC supports the following:

1. Operating System: Microsoft Windows7 (64-bit/32-bit), or Windows XP (64-bit/32-bit) with SP3
2. CPU: 1GHz or faster
3. Memory: 512MB of RAM (1GB recommended) and 500 MB of available hard-disk space
4. CD/DVD-ROM drive
5. USB 2.0 port, USB 3.0 port, or a serial port
6. Display: 1024×768 resolution or above
7. Adobe PDF reader – for viewing the help files
8. The following are optional
9. Analog frame grabber which supports Microsoft’s DirectShow API
10. Camera Link frame grabber which supports Microsoft’s DirectShow API
1.3 LENS CALIBRATION REQUIREMENTS

The following hardware is needed to calibrate the camera successfully:

1. Pass Key to enable the Lens Calibration tab
2. A Tamarisk® 320 with lens focused at infinity running:
   a. FPGA RTL ver: V01.00.0080 or newer
   b. CPU SW ver: X1.P1.01.13.13 or newer -OR- X1.Px.00.xx.xx
3. A USB cable or RS232 cable and power
4. One or two thermally stable black bodies. Ideally, the calibration process uses a controllable black body, but any thermally stable and uniform body is acceptable. The black body must completely fill the field of view with a uniform scene. DRS recommends the following black body manufactures and models:
   a. Santa Barbara Infrared, Inc.
      www.sbir.com
      Model: Infinity black body and controller
   b. CI Systems
      www.ci-systems.com
      Model: sR-800

Note: Tamarisk Precision series cameras do not support the custom lens calibration and hence the custom lens calibration tab will not be displayed when connected to a Tamarisk Precision camera module
2 HARDWARE SETUP

2.1 HARDWARE CONFIGURATION

In this section, three different configurations for viewing your camera’s output video will be presented, including solutions for both analog and digital video. Although the physical interface may vary from camera to camera, the schema outlined below will remain valid for the products listed in section 1.1 above.

Table 1, presents three different approaches for viewing your camera’s output video as well as the recommended hardware to support that given approach. An illustration is provided to document each connection and demonstrate what the given set-up may look like.

Table 1. Hardware Configuration Set-up Overview

<table>
<thead>
<tr>
<th>Display Configuration</th>
<th>Required Hardware</th>
<th>Illustration</th>
</tr>
</thead>
</table>
| Analog video to an external monitor   | Laptop
  Analog Display
  USB to USB mini cable
  Camera Module
  Camera Interface Cable
  Camera break out box
  Coax cable                           | ![Analog Video Setup Illustration](image1.png)                                 |
| Analog video displayed on the PC      | Laptop
  USB to analog frame grabber
  USB to USB mini cable
  Camera Module
  Camera Interface Cable
  Camera break out box
  Coax cable                           | ![Analog PC Setup Illustration](image2.png)                                   |
| Camera Link (digital) video displayed on the PC | Laptop
  Camera Link frame grabber
  Camera Link cable
  USB to USB mini cable
  Camera Module
  Camera Interface Cable
  Camera break out box                 | ![Camera Link PC Setup Illustration](image3.png)                              |

2.1.1 Connecting to an Analog Monitor

The simplest way to evaluate the camera is to configure the hardware as shown in Figure 1. The user simply needs to apply power and connect the RS-170 cable to an analog monitor. For some
cameras, a USB cable may be used to provide both power and control. The user will immediately see video displayed on the analog monitor. To manipulate or change the camera settings a serial communication link (serial RS232 or USB) is required. The camera may be control through issuing serial commands via the serial link or by using the Camera Control Software described herein.

![Diagram of a camera setup](image)

Figure 1. Analog Video Displayed on an Analog Monitor

### 2.1.2 Connecting to an Analog Frame Grabber

Alternatively, an analog video-to-USB frame grabber (as shown in Figure 2) may be used to display the camera’s output video. In this case, the RS-170 feed from the camera or interface box is connected to an analog video-to-USB frame grabber. To display the video on screen please follow the instructions that came with your analog-to-USB frame grabber.

The frame grabber allows the user to capture video or images and analyze or view them later.

![Diagram of a camera setup](image)

Figure 2. Analog Video Displayed on a PC, via Analog Frame Grabber

### 2.1.3 Connecting to a Camera Link Frame Grabber

This method provides the highest quality image for display. Figure 3, illustrates the set-up for viewing digital video (14-bit or 8-bit) using CameraLink®.

Simply connect the CameraLink®
cable to the PC’s CameraLink® frame grabber card on one end and to the CameraLink® connector on the interface box. Besides capturing digital video and images, Camera Link adapters provide a host of control features such as data capture rates and video compression formats. Please follow the instructions that came with your CameraLink® capture card to display the image on screen. A list of compatible frame grabbers is available and can be found in your Tamarisk® Product Documentation Package.

Figure 3. Digital Video Displayed on a Digital Display via Digital Frame Grabber
3 SOFTWARE INSTALLATION

Check with your authorized dealer or directly with DRS Technologies to get the latest version of the Tamarisk® 320 Camera Control Software.

3.1 LAUNCHING THE CAMERA CONTROL SOFTWARE INSTALLER

Follow the instructions below to install the Camera Control Software GUI on your PC or laptop.

Insert the flash media into your PC. Refer to Figure 4.

Figure 4. Flash Media Install

Using Windows Explorer, select the drive corresponding to the media was just inserted. Look for the file name: DRS Camera Control Software Setup. Refer to Figure 5.

Figure 5. CD or Flash Media Install
Initiate the installation process by selecting (double mouse click) DRS Camera Control Software Setup icon; Refer to Figure 6.

Figure 6. CD or Flash Media Install

3.2 INSTALL CAMERA CONTROL SOFTWARE

Once the user double clicks the DRS Camera Control Software Setup icon, the image shown in Figure 7 appears. If the Install Wizard detects that an older version of the Camera Control Software is installed, the user will be asked if he wants to install a new version. It is highly recommended to exit setup and uninstall the previous version prior to installing the new version. At any point prior to clicking the “Install” button; the user can cancel the installation by clicking the “Cancel” button.

Figure 7. Welcome to the InstallShield Wizard

Software License Agreement: The Software License Agreement screen is shown in Figure 8. Once the agreement is read the terms accepted, the user selects “I accept the terms in the license agreement”. The user can print the agreement by selecting the “Print” button.
LGPL License: The LGPL License Agreement is shown in Figure 9. Once you have read the agreement and accept the terms, select “I accept the terms in the license agreement”. The user can print the agreement by selecting the “Print” button.

Destination Folder: The default installation directory is shown in Figure 10. The user can change the installation directory by clicking on the “Change” button. Select next to confirm installation destination.
Setup Type: Figure 11 shows the Setup Type screen. The user can select between a “Complete” (recommended) or “Custom” install, then select Next.
Ready to Install the Program: The InstallShield Wizard has enough user information to complete the installation. At this point the user can cancel the installation. Once the “Install” button is pressed, the Wizard will make sure the system meets the minimum installation requirements and complete the installation. The Ready to Install the Program screen is shown in Figure 12.

![Figure 12. Ready to Install the Program](image)

Installing DRS Camera Control Software: The InstallShield Wizard status shows the changes that are made during the installation; a progress bar also is provided. A command prompt window may briefly appear; this is a normal part of the installation. Figure 13 shows the Installing DRS Camera Control Software screen.

![Figure 13. Installing DRS Camera Control Software](image)

Within approximately three minutes the InstallShield Wizard Completed screen appears. The installation is now complete. Select Finish. By default the DRS Camera Control Software will not
immediately start when the “Finish” button is pressed. The user can select the “Launch DRS Camera Control Software” checkbox and upon selecting “Finish” and the DRS Camera Control Software will start. Figure 14 shows the InstallShield Wizard Complete screen.

![Figure 14. InstallShield Wizard Completed](image)

Once the installation is complete the user will notice that an icon was added to the desktop and a DRS Technologies folder is added to the programs list.
4 SET-UP AND OPERATION

4.1 GETTING STARTED
Make sure your camera is connected and powered up. Refer to the user manual for your specific camera to ensure the proper power-up procedure is followed.

Connect the USB or RS232 serial cable to the proper port on your PC or laptop. If connecting to the camera via USB for the first time, drivers will need to be installed. You can skip obtaining the drivers from windows update since these drivers were installed on the PC as part of “Launching the Camera Control Software Installer” on page 8.

4.2 STARTING THE CAMERA CONTROL SOFTWARE
Once your device is properly connected and powered, start the Camera Control Software by clicking on the icon (refer to Figure 15).

![Figure 15. DRS Control Software Icon](image)

The software will automatically search for and connect to any supported and attached camera(s) (refer to Figure 16).

![Figure 16. DRS Control Software Icon](image)

While the system is searching you may press the ESC key to manually add a camera.

If the key ESC is pressed or no device is found, the No Attached Devices Found dialog box is displayed (refer to Figure 17). Check to verify that the device drivers have been installed. Go to Control Panel, select programs and features and look for FTDI Driver Install Package. If drivers are present then follow the steps below to manually connect the camera. If drivers are not found, then install drivers from the media used when installing the software.

Click Manually Add Device to open the Add Devices dialog box (refer to Figure 18).
Select the camera from the pull-down menu or select “Auto Detect Device.” Additionally, the user may select the COM port and Baud rate. The default baud rate for connecting through USB is 921600. The default baud rate for connecting through a RS232 serial interface is 57600. Figure 18 illustrates the configuration needed to connect to the camera via the RS232 interface; The COM port used is PC dependent. Click “Add Device” to connect to the selected camera.
5 Camera Control Software Operation

In this section the operation of the Camera Control Software GUI is explained by stepping through the various tabs and providing an explanation of features and functions.

The Camera Control Software is capable of supporting multiple cameras within the same application. A new camera tab, identified by the camera’s serial number (see Figure 19) is displayed for each additional camera. This feature is available only when using a USB cable (and not a USB-to-serial RS232 cable) to communicate with your camera. For example, to configure and control three Tamarisk® 320 cameras, connect each camera (via USB) from the camera’s break out box to the PC as shown in Table 1. Hardware Configuration Set-up Overview. Open the Camera Control Software. The software will display three separate camera tabs; each tab is uniquely identified by the camera’s serial number.

Additionally, multiple instances of the Camera Control Software may be opened at a time by launching multiple Camera Control Software applications and manually connecting your cameras as desired.

For non precision series camera modules, there are ten tabs available to assist you in communicating with and controlling your connected Tamarisk® 320 cameras. For precision series camera modules, there are 9 tabs available to assist you in communicating with and controlling your connected Tamarisk® 320 cameras. They are:

1. Information
2. Settings
3. Video Output Select
4. Colorization
5. Radiometric Settings
6. AGC/ICE
7. Pan and Zoom
8. Lens Calibration
9. Pixel Map
10. Utilities
11. Help

Additionally, there are two functions that may be present on the Camera Control Software window, namely, Search for New Connected Devices and Show Live Video. See section 5.10 for details.
5.1 INFORMATION TAB

Once a supported camera is located the “Information” tab is displayed (refer to Figure 19).

Table 2 provides an overview of the features and functions that are available on the Information tab.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Number</td>
<td>Displays the DRS Technologies part number. For a detailed description of the part number refer to the Tamarisk® 320 user guide or data sheet</td>
</tr>
<tr>
<td>Serial Number</td>
<td>Displays the serial number. This is a unique number which is used to track the camera through the manufacturing process</td>
</tr>
<tr>
<td>Rel</td>
<td>Displays the Firmware version that is loaded and running in the camera. The Firmware is upgradable – See the utilities tab for details</td>
</tr>
<tr>
<td>RTL Rel</td>
<td>Displays the FPGA code revision. The FPGA code is upgradable – See the utilities tab for details</td>
</tr>
<tr>
<td>Connected</td>
<td>The two types of connections are RS-232 and USB</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>When connected via USB the baud rate is fixed at 921600. When connected via RS-232 the default baud rate is 57600. Refer to the Software Interface Control Manual for details on how to change the default baud rate.</td>
</tr>
</tbody>
</table>

5.2 SETTINGS

Figure 20 illustrates the Settings tab. This tab has been organized into 5 task panes, Calibration, Image Orientation, Polarity, Shutter, and Symbology, to help the user configure the camera. To change a setting, hover over the setting of interest and select with your mouse or pointer device. The
selected command is immediately applied to the camera and the results will appear on the output video. Note, the settings are not saved until you select the Save Settings tab at the bottom of the window. Once Save Settings has been selected, all indicated settings will be saved to the cameras non-volatile memory; this may take a few seconds. When the camera is powered cycled the settings are retained.

Figure 20 illustrates the settings tab for non-precision series (left) and precision series (right) camera modules. The difference between the non-precision and precision series cameras is within the Symboloby task plan and is described in Table 3.

NOTE

To save settings, select the Save Settings tab at the bottom of the window. This may take a few seconds and will store all selected settings to non-volatile memory.

Table 3 provides an overview of the features and functions available on the Settings tab.

<table>
<thead>
<tr>
<th>Task Pane</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration</td>
<td>1-Point Calibration</td>
<td>Performs calibration / non-uniformity correction (NUC) – shutter is used</td>
</tr>
<tr>
<td>Calibration</td>
<td>1-Point (No Shutter)</td>
<td>Performs NUC through the lens – shutter is not used</td>
</tr>
<tr>
<td><strong>Automatic Calibration</strong></td>
<td><strong>Period (in minutes)</strong></td>
<td>Sets time between calibrations</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td><strong>Set Period</strong></td>
<td>Sets new calibration period (default is 5 minutes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Setting the “Autocal Enabled” button to “0” turns auto calibration off.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Please note that for RTL Rel version 01.00.0080 or older,</strong> <strong>Autocal must be enabled for lens calibration to work.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Click “Save Settings” to save changes to the camera’s non-volatile memory</td>
</tr>
<tr>
<td><strong>Calibration Status</strong></td>
<td><strong>Provides the current calibration status</strong></td>
<td>The camera will periodically update the calibration status. This is especially important if the user has disabled the automatic calibration by clicking “Autocal Enabled.”</td>
</tr>
<tr>
<td><strong>Image Orientation</strong></td>
<td><strong>Normal</strong></td>
<td>Normal display mode</td>
</tr>
<tr>
<td></td>
<td><strong>Flip Vertically</strong></td>
<td>Flips the image from top to bottom</td>
</tr>
<tr>
<td></td>
<td><strong>Flip Horizontally</strong></td>
<td>Flips the image from left to right</td>
</tr>
<tr>
<td></td>
<td><strong>Flip Vertically/ Horizontally</strong></td>
<td>Flips the image from top to bottom and left to right</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Click “Save Settings” to save changes to the camera’s non-volatile memory</td>
</tr>
<tr>
<td><strong>Shutter</strong></td>
<td><strong>Shutter Open</strong></td>
<td>Opens shutter</td>
</tr>
<tr>
<td></td>
<td><strong>Shutter Closed</strong></td>
<td>Closes shutter</td>
</tr>
<tr>
<td><strong>Polarity</strong></td>
<td><strong>White Hot</strong></td>
<td>Hot pixels are shown as white and cold pixels are shown as black</td>
</tr>
<tr>
<td></td>
<td><strong>Black Hot</strong></td>
<td>Hot pixels are shown as black and cold pixels are shown as white</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Click “Save Settings” to save changes to the camera’s non-volatile memory</td>
</tr>
<tr>
<td><strong>Symbology</strong> (non-precision camera modules)</td>
<td><strong>Enable on-screen indicators</strong></td>
<td>Enables/disables zoom, 1-pt calibration, and polarity indicators. The 1-pt calibration indicator also requires the 1-pt indicator display time to be set greater than 0 to be enabled.</td>
</tr>
<tr>
<td></td>
<td><strong>Enable DRS logo</strong></td>
<td>Enables/disables the DRS logo.</td>
</tr>
<tr>
<td></td>
<td><strong>Start-up screen duration</strong></td>
<td>Sets the time in seconds that the DRS splash screen is displayed on camera power-up.</td>
</tr>
<tr>
<td></td>
<td><strong>1-pt indicator display time</strong></td>
<td>Sets the time in seconds that the 1-pt calibration indicator will be shown prior to a shutter event.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Changes on the Symbology task pane are automatically saved to the camera’s non-volatile memory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sets the time in seconds that the DRS splash screen is displayed on camera power-up.</td>
</tr>
<tr>
<td></td>
<td><strong>Start-up screen duration</strong></td>
<td>Allows the user to select and upload a 320x240 pixels, 8-bit/pixel bitmap file. Please refer to the software ICD for the ability to upload more than one splash screen.</td>
</tr>
<tr>
<td><strong>Symbology</strong> (precision camera modules)</td>
<td><strong>Upload Splash (Start-up) screen</strong></td>
<td></td>
</tr>
</tbody>
</table>
5.2.1  **Calibration (One-Point Calibration) Non-Uniformity Correction**

To optimize a thermal scene, the processor software performs NUC or 1-Point calibration of the video images through internal calculations. To provide the best possible image, a non-uniformity correction is performed based on information provided by factory calibration, user-commanded 1-point calibrations, and bad pixel replacement (BPR) algorithms. Initiating a NUC activates a one-point single-temperature correction sequence that will reset the level offset of each pixel to improve overall image uniformity and contrast.

A NUC is performed automatically at start up, per the AutoCal setting and when the FPA temperature transitions into another temperature zone – these zones are static with a corresponding set of offsets determined as part of the factory calibration process. The operator can also initiate a NUC at anytime and has the option of selecting “1-Point Calibration” or “1-Point (No Shutter)” from the camera software control GUI.

**“1-Point Calibration” (shutter closed)**

Calibration is performed with the shutter closed preventing scene IR energy being received by the detector. With the shutter closed, the sensor sees a uniform temperature when performing the NUC. The shutter will momentarily close while calibration is performed.

**“1-Point (No Shutter)” (Shutter open, “Through-the-lens”)**

Shutterless calibration is use for optimal image performance by removing unwanted optical noise. This calibration is a, “through-the-lens,” one-point calibration. In this case, a uniform temperature object must be placed in front of the lens while the one-point calibration is performed.

5.2.2  **Automatic Calibration (One-Point Calibration)**

The camera is programmed at the factory to automatically perform a 1-point on power-up, when the FPA temperature transitions across predefined temperature zones, and every 5 minutes (per the default automatic calibration time setting). The user can disable the automatic calibration timer by entering a 0 in the automatic calibration field.

5.2.3  **Image Orientation**

The image can be displayed in four operator-selectable orientations as shown below:
5.2.4 Polarity

Polarity switches the displayed image from White Hot to Black Hot polarity (refer to Figure 25 and Figure 26). White Hot polarity is set as factory default. Reversing the image polarity can improve the apparent detail in some scenes, especially in the presence of bright ambient lighting around the display screen. In general, there is no correct polarity setting but a matter of operator preference.

5.2.5 Symbology – Non-Precision Series

By selecting the *Enable on-screen indicators* check box, the camera will display symbology for the current polarity, 1-point indicator time (if a value of greater than 0 is entered) and the current electronic zoom value. These three symbology indications are displayed at the top of the screen as shown below:
During a 1-point event the camera’s shutter closes and the video output is temporarily frozen. The 1-point indication is used in instances when the user desires advanced notice of an imminent 1-point. The user may want to postpone an event until after the 1-point is complete. For maximum flexibility, the 1-point indication time is adjustable by the user.

The user may also, independently, enable or disable the DRS logo. The DRS logo symbology is displayed in the lower right-hand corner of the screen.

Additionally, the user may adjust the time interval for displaying the start-up screen between power-up and the output of live video. A value of “0” disables the start-up screen.

When displaying 14-bit digital video, symbology is not displayed. Refer to Figure 28 for more details.

### 5.2.6 Symbology – Precision Series

By selecting the *Upload Splash (Start-up) Screen* button, a file selection screen is presented to the user. The user can select a 320x240 pixel, 8-bit/pixel image. By default there are no splash screens loaded in the camera module. The start-up screen duration is configurable by selecting the + and – buttons. The time increments are displayed in seconds and to disable the start-up screen select 0 seconds.

### 5.3 VIDEO

Figure 29 illustrates the Video tab. The *Video* tab comprised of two task panes, *Analog Video* and *Digital Video*. Factory default settings are *Analog Video* Enabled and *Digital Video* Camera Link enabled. *Analog Video* and *Parallel Digital Video* are mutually exclusive. To save changes to the video output, the user must click on *Save Settings* before moving to another tab or closing the Camera Control Software application.
5.3.1 Video Overview

A high level explanation of the camera video output selections is helpful. Figure 28 is a simplified block diagram of the video chain.

Figure 28: Video Block Diagram

On the left side of the block diagram, the detector (or FPA) output feeds into the rate adaptation, Non Uniformity Correction, Bad Pixel Replacement, and Zoom block. The output of this block is a 14-bit corrected image.

The zoom block can perform up to a 4X digital zoom and also allows the user to perform a digital pan and tilt. The Zoom block feeds into the Frame buffer block.

The frame buffer block performs the white-hot, black-hot and allows the user to change the image orientation. The 14-bit output of the Frame buffer block feeds into the AGC block and to a Radiometric Look Up Table (RLUT).

The AGC block allows the user to select several different AGC modes. The AGC block also converts the 14-bit video to 8-bit digital video. The output of the AGC block feeds into the Color and Symbology block.

The output of the RLUT or a bypass table can be selected. This output is used in combination with the output of the AGC block in the Color and Symbology block.

The Color block provides radiometric colorization to the video stream. The user has the ability to select the color pallet.

The Symbology block allows the user to display camera information on-screen. The output of the Symbology block feeds into the YUV Superframe block. It is also converted to gray scale before
being input to a digital to analog converter (DAC) where the digital data is converted into RS-170 analog video. The RS-170 video is not colorized.

The YUV superframe block provides video with twice the data per frame. Each video frame will contain YUV color video together with either 14 bit grey scale or 16 bit radiometric data. For more details, please refer to the YUV superframe mode in sections 3.1 LVDS INTERFACE and 3.2 PARALLEL DIGITAL VIDEO INTERFACE of document 1012820 Tamarisk®320 Electrical Interface Control Document.

For non-precision series camera modules, the Digital Video task pane allows the user to enable the camera link output. If the Enable 24 bit RGB Map check-box is selected, the camera link video will be colorized. The user can also enable parallel digital video; if parallel digital video is enabled, the analog video will be disabled. The parallel digital video and analog video selections are mutually exclusive. The user can also select 14-bit (pre AGC), or 8-bit (post AGC) video. If the YUV superframe check-box is selected, camera link and/or parallel digital video shall output superframe formatted video.

For precision series camera modules, the Digital Video task pane drop down menu allows the user to select 14-bit (pre AGC), 8-bit (post AGC), 24-bit RGB/post symbology, and YUV superframe digital data.

![Image](image_url)

**Figure 29. Video Tab**

Table 4 provides an overview of the features and functions that are available on the Video tab.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Video Output Select</td>
<td>Enable Camera Link</td>
<td>Enables/disables the Camera Link Output</td>
</tr>
<tr>
<td></td>
<td>Enable Parallel Digital</td>
<td>Enables/disables the parallel digital video output</td>
</tr>
</tbody>
</table>
### Analog Video

With feature board, the camera can output RS-170/NTSC (or PAL)-compatible analog video. The output is 1 volt peak-to-peak when properly terminated.

### Digital Video

The camera can output a Camera Link digital video signal both with the feature board and without. Parallel digital video output is available only in the base configuration. When superframe is disabled, the frame format is always formatted as 320 columns by 240 rows of progressive scan (4:3).

<table>
<thead>
<tr>
<th>Analog Video Select</th>
<th>Video</th>
<th>(Note: Parallel digital video cannot be enabled while analog video is enabled)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Changes are automatically saved to the camera’s non-volatile memory</td>
</tr>
<tr>
<td>NTSC</td>
<td></td>
<td>Sets analog video output to the National Television System Committee standard</td>
</tr>
<tr>
<td>PAL-M</td>
<td></td>
<td>Sets analog video output to the Phase Alternating Line (M)</td>
</tr>
<tr>
<td>PAL-N</td>
<td></td>
<td>Sets analog video output to the Phase Alternating Line (N) standard</td>
</tr>
<tr>
<td>PAL-B,D,G,H,I,N2</td>
<td></td>
<td>Sets analog video output to the Phase Alternating Line (B,D,G,H,I,N) standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Changes are automatically saved to the camera’s non-volatile memory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital Video</th>
<th>Video</th>
<th>(Note: Parallel digital video cannot be enabled while analog video is enabled)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Changes are automatically saved to the camera’s non-volatile memory</td>
</tr>
<tr>
<td>8 bit grey scale</td>
<td></td>
<td>Sets the Camera Link and parallel digital video output to display 8 bits</td>
</tr>
<tr>
<td>14 bit grey scale</td>
<td></td>
<td>Sets the Camera Link and parallel digital video output to display 14 bits</td>
</tr>
<tr>
<td>RGB color (CameraLink) / Grey scale symbology (PDVO)</td>
<td></td>
<td>Sets Camera Link to display 24 bit RGB color with symbology and parallel digital video output to display grey scale with symbology</td>
</tr>
<tr>
<td>Superframe (YUV, 14bit grey scale)</td>
<td></td>
<td>Sets the Camera Link and parallel digital video output to display both YUV and 14 bit pre AGC data</td>
</tr>
<tr>
<td>Superframe (YUV, 16bit radiometric)</td>
<td></td>
<td>Sets Camera Link and parallel digital video output to display both YUV and 16 bit, radiometric, per pixel temperature data.</td>
</tr>
</tbody>
</table>
5.4 COLORIZATION

Figure 30, illustrates the Colorization tab. The user is presented with 8-bit to 24-bit colorization pallet mappings. By selecting the Enable 24 bit RGB Map, the user may select any one of eleven different pallets. The results are immediately applied to the output video. To save the settings, the user must select Save Settings button before moving to another tab or closing the Camera Control Software application.

![Figure 30. 8-Bit Colorization Tab](image)

5.5 RADIOMETRIC SETTINGS

Figure 31 illustrates the Radiometric Settings tab. This window includes three task panes, Indicators, Region of Interest, and ICE™-O-Therm to help the user configure the Tamarisk Precision series camera. To change a setting, hover over the setting of interest and select with your mouse or pointer device. The selected command is immediately applied to the camera and the results will appear on the output video. Note, the settings are not saved until you select the Save Settings tab at the bottom of the window. Once Save Settings has been selected, all indicated settings will be saved to the cameras non-volatile memory; this may take a few seconds. When the camera is powered cycled the settings are retained.

The DRS Tamarisk Precision Series camera modules are radiometrically calibrated cameras. Please refer to the Tamarisk 320 Precision Series Data Sheet for details such as operation temperature, scene dynamic range, and temperature accuracies. The Tamarisk Precision Series cores include the following features:

a. Radiometric scene colorization with 6 pre-defined color pallets.
b. User definable symbology overlay.

c. Text string display (TTY) capability.

d. User defined region of interest

e. User defined \textit{ICE}^{TM} - \textit{O-Therm}

Most of the features can be customized by the DRS Custom Control GUI (v1.8.xx or later).

![Figure 31. Radiometric Settings Tab](image)

Table 5 provides an overview of the features and functions that are available on the \textit{Radiometric Settings} tab.
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators</td>
<td>None</td>
<td>Turns off all radiometric indicators including the spotmeter, temperature readout, and color reference bar. The camera must be power cycled for this change to take effect.</td>
</tr>
<tr>
<td>Display Spotmeter and Temperature Readout</td>
<td></td>
<td>Displays the spotmeter indicated by the green rectangle. The default location of the spotmeter is in the center of the screen. The camera must be power cycled for this change to take effect. The temperature readout is also displayed. Its default location is in the lower right hand corner of the video. In addition to displaying the spotmeter and the temperature readout, the color reference bar is displayed with a triangle pointer indicating the temperature color associated with temperature readout. The color reference bar’s default location is the right hand side of the screen.</td>
</tr>
<tr>
<td>Display Spotmeter, Temp Readout, and Color Reference Bar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Units</td>
<td>The Temp Readout will be displayed in Celsius or Fahrenheit.</td>
<td></td>
</tr>
<tr>
<td>Spotmeter Size</td>
<td>Change the size of the spotmeter. Default is 8 pixels. The camera must be power cycled for this change to take effect.</td>
<td></td>
</tr>
<tr>
<td>Region of Interest</td>
<td>Length of side in Each Pixel</td>
<td>Allows the user to define the size (in pixels) for a region of interest. The region of interest is not displayed on the screen</td>
</tr>
<tr>
<td>Refer to Figure 33.</td>
<td>Statistics</td>
<td>The mean, standard deviation, maximum (and pixel location) and minimum (and pixel location) temperature value is provided for the region of interest. The temperature value provided is the measured temperature + Global Correction + Environmental Thermal Settings</td>
</tr>
<tr>
<td></td>
<td>Image Detail Adjust</td>
<td>Full radiometric color: True Radiometric Color Image Medium detail: Choose this mode to sacrifice some temperature color fidelity for scene detail. High detail: This mode has maximum scene detail.</td>
</tr>
<tr>
<td></td>
<td>Color Palette</td>
<td>Selects the desired color palette. If the color reference bar is enabled, the appropriate color</td>
</tr>
</tbody>
</table>
| **ICE™-O-Therm** | **Gain Mode** | **reference bar will be drawn on video**
| | | In high gain mode, the radiometric accuracy is the greater of +/- 5°C or +/- 10%.
| | | In low gain mode, the radiometric accuracy is the greater of +/- 20°C or +/- 20%.
| | | The camera will automatically switch between the high gain setting and the low gain setting depending on the scene (saturation and temperature conditions). Please see section 3.11 Auto gain control in Tamarisk®320 Software Interface Control Document for more details
| **Temperature Ranging** | **Auto:** Automatically spans the color over the entire scene. But as the dynamic range of the scene changes, so does the color. The color reference bar also automatically scales
| | | **Fixed:** Allows the user to image a specific scene and the color will cover this scene. As the scene changes, the color span stays fixed. The color bar also remains fixed.
| | | **Manual Span:** Allows the user to specify specific temperatures or temperature ranges. Must use the Advanced Radiometric Settings tab to set the manual span. If the color is changed, the pre defined color bar will not be displayed.
| | | The Apply Temperature Range Setting must be selected to actually apply one of the above settings. In order for the setting to be saved between power cycles, select the Save Settings button
| **Advanced Radiometric Settings** | This button will open another window with more advanced controls. See

Selecting the Advanced Radiometric Settings tab opens the advanced window shown in Figure 32. This window includes two task panes, *Isometric Color and Temperature Settings* and *Temperature Correction*. The user can manually select the color and temperatures which will be displayed within the camera module output. This setting is also applied to the color reference bar (if one of the default color palettes are used).
Table 6 provides an overview of the features and functions that are available on the Advanced Radiometric Settings tab.
## Table 6 – Advanced Radiometric Settings

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isometric Color and Temperature Settings</td>
<td>Auto, Fixed, Manual</td>
<td>These radio buttons allow the selection of the temperature ranging mode without having to go back to the basic Radiometric Settings tab. However, the Temperature Ranging task pane on the basic Radiometric Settings tab must be used to specify the minimum and maximum temperature values for fixed temperature ranging mode. Auto: Automatically spans the color over the entire scene. But as the dynamic range of the scene changes, so does the color. The color reference bar also automatically scales. Fixed: Allows the user to image a specific scene and the color will cover this scene. As the scene changes, the color span stays fixed. The color bar also remains fixed. Manual Span: Allows the user to specify specific temperatures or temperature ranges. Must use the Advanced Radiometric Settings tab to set the manual span. If the color is changed, the predefined color bar will not be displayed. The Apply Temperature Range Setting must be selected to actually apply one of the above settings. In order for the setting to be saved between power cycles, select the Save Setttings button.</td>
</tr>
<tr>
<td>Read Isometric Color and Temperature Settings</td>
<td>Enable</td>
<td>When selected, enables/disables one of 8 color segments. Enable radiometric color for pixels greater than or equal to the temperature (°C) of the enabled segment and less than the temperature of the segment above.</td>
</tr>
<tr>
<td></td>
<td>Temp</td>
<td>The temperature which will be assigned to the selected color. The temperature (°C) at which the segment’s specified color will be applied. Use the LEFT CTRL key with UP/DOWN arrows to increment/decrement by 1°C. Use the RIGHT CTRL key with UP/DOWN arrows to increment/decrement by 0.125°C.</td>
</tr>
<tr>
<td></td>
<td>Hue, Sat</td>
<td>In the HSV color space, the hue and saturation to apply to a pixel of this segment’s temperature. The hue and saturation of pixels at temperatures in between segments will be linearly interpolated between the hue and saturation specified by those segments.</td>
</tr>
</tbody>
</table>
## 5.5.1 Temperature Indicators

Figure 33 illustrates a colorized radiometric image. In the very center of the image is a small square is overlaid on to the video image when the spot meter is enabled. On the left hand side of the image is the color reference bar. The small triangular pointer indicates the average temperature within the spot meter; in this case the auto temperature ranging was used and hence the triangular pointer represents the average temperature of the pixels defined within the spot meter box as compared to the maximum and minimum temperature of the overall scene. At the bottom right is the average temperature of the spot meter (displayed in Fahrenheit).

The spot meter is defined as a M x N temperature measurement zone where M represents the number of pixels in the horizontal direction and N represents the number of pixels in the vertical direction. The valid values of M and N are 1 to 240. The camera control software always forces the spot meter to be centered around the center of the image; the user cannot move the spot meter off center. But this can be done via the manual command mode. See the Tamarisk Software ICD for details on how to move the spot meter within the image.

When the color reference bar is enabled, a small triangular indicator will move up and down alongside the selected color palette. The color referenced by this indicator should match the
“averaged” color value of the spot meter. The triangular indicator will work correctly only when the camera is in Auto Min/Max or Manual Min/Max auto ranging modes.

When the temperature readout is enabled, the average temperature inside the temperature measurement zone will be displayed at the bottom left corner of the display output (by default). The foreground and background color can be changed via the manual command mode; see the Tamarisk Software ICD for details.

The camera control software will configure the camera module to automatically apply the temperature correction values to the ROI temperatures. If used, the Global Correction is applied to all pixel values and temperature values. If used, the Environmental Thermal Settings are only applied to the ROI and spot meter. Via the manual command mode the user can force the camera module only apply the Environmental Thermal Settings to either the ROI and/or the spot meter; see the Tamarisk Software ICD for details.

![Figure 33. Radiometric Indicators](image)

5.5.2 Region of Interest

A region of interest (ROI) within the camera’s field of view (FOV) can be defined by the user. The ROI is not overlaid onto the video image. The intent of the ROI is to allow real time processing of image data for a pre defined part of the image. The ROI is defined as a M x N temperature measurement zone where M represents the number of pixels in the horizontal direction and N represents the number of pixels in the vertical direction. The valid values of M are 1 to 320 and the valid values for N are 1 to 240. If there are more than 1 minimum and/or maximum temperature pixels within the ROI, the camera will return the 1st minimum and/or maximum location of the pixels, starting from the top left corner of the ROI, going across, and then going down.

The maximum, minimum, standard deviation, and average temperatures (along with the maximum and minimum temperature pixel location) are available to the user within 0.5 seconds after the Get ROI Statistics command is received by the camera. In the case where multiple pixels within the ROI have the same maximum or minimum value, the first pixel (going from left to right and top to bottom) will be listed as the maximum or minimum location. Although not supported by the camera control software, the user could redefine the ROI and collect the ROI...
statistics at a rate of approximately once per second; this will allow the user to support multiple ROIs.

The camera control software will configure the camera module to automatically apply the temperature correction values to the ROI temperatures. If used, the Global Correction is applied to all pixel values and temperature values. If used, the Environmental Thermal Settings are only applied to the ROI and spot meter. Via the manual command mode the user can force the camera module to apply the Environmental Thermal Settings to either the ROI and/or the spot meter; see the Tamarisk Software ICD for details.

5.5.3 **ICE-o-Therms™**

The Tamarisk Precision Series is able to uniquely combine Image Contrast Enhancement (ICE™) and a customizable ICEo-Therm™ feature. ICE-o-Therms™ allow the user to display color based upon the temperature of the object and apply ICE™ for added scene clarity. Figure 34 shows that the ICE™-o-Therm is set to display color for temperatures above 150°F. In Mode 1, Full Radiometric Color assigns color profiles to the scene without image enhancements. With the addition of ICE™ Low Strength in Mode 2 the edges of the image are emphasized and provide additional contrast. The ICE™ High Strength Mode 3 provides the highest level of detail enhancement. In all modes of operation, the temperature data provided by the camera remains accurate.

![Figure 34. ICEo-Therm™](image)

5.5.4 **Gain Mode**

The Tamarisk Precision Series has three modes of operations for scene temperature dynamic range control: high gain mode, low gain mode, and auto gain mode.

In high gain mode, the scene pixels which are higher than approximately 80C will start to saturate. This mode gives the best contrast and details for subjects below the high gain mode saturation temperature. There will be no gray scale or color differences in the camera’s image among pixels that are higher than the high gain mode saturation temperature.

In Low Gain Mode, the scene pixels which are higher than approximately 550C will start to saturate. This mode can reveal the details on subjects up to the low gain mode saturation temperature. Compared to high gain mode, the contrast is less and the reported temperature is typically a few degrees lower.

In Auto Gain mode, the camera will switch between the high gain mode and the low gain mode automatically based on scene contents. Each time the gain mode changes, a 1-point is automatically performed.
The camera module supports (and the camera control software supports via the Manual Command Mode) two sub-modes of the Auto Gain mode for high gain to low gain switching. Auto Gain mode switch can be saturation based or temperature based.

In saturation based mode, the camera will switch from high gain to low gain when the hottest pixel(s) within a defined number of scene pixels saturates (at or above the highest calibrated temperature in high gain mode).

In temperature based mode, the camera will switch from high gain to low gain when the hottest pixel(s) within a defined number of scene pixels exceeds a predefined temperature that is lower than the maximum calibrated high gain temperature.

The low gain to high gain switching in Auto Gain mode is always temperature based. The camera will switch from low gain to high gain when the hottest pixel(s) within a defined number of scene pixels falls below a predefined temperature.

5.5.5 **Isometric Color and Temperature Settings**

By default the camera will output 8-bit gray scale images. To enable the color radiometric video, the user must go to the Video Output Settings tab and within the Digital Video section, click on the drop down box and select RGB Color. Next, click on the Radiometric Settings tab and within the ICE™-o-Therm section, click on the Color Palette drop down and choose from one of 6 color palettes. If a Color Palette is not selected, an RGB gray scale color palette is used.

Via the Advanced Radiometric Settings tab, two temperature ranging modes are available when using the pre-programmed color pallets. The two modes (auto and manual) are configured as follows:

1. In auto ranging mode, camera automatically spread the 8 defined colors in the selected color pallet linearly across the min/max temperatures in the camera’s FOV. In this mode, same object may appear in a different color when the scene min/max temperatures are changing. All objects in the scene will be colorized in this mode if the full-color scheme is selected. In other color schemes, the lowest temperature objects may appear in black.

2. In manual ranging mode, user defines the min/max temperatures for the selected color pallet. In this mode, objects below the min temperature will be presented in gray scale and objects at or above the max temperature will be colorized to the top color of the pallet. If the user would like to represent a maximum temperature as a gray scale value, the 8th color range must be disabled. Based on the 8 defined colors, the same object within the min/max temperature range should always be colorized with the same color.

Via the Advanced Radiometric Settings tab, a custom pallet is configurable. The color reference bar is only defined for the default color pallets. If a custom color pallet is defined, the color reference bar will not be displayed in the image. The User can control the hue (H) and saturation (S) values of each segment while cameras sets the value (V) in different color modes mentioned below:

1. Temperature controls for each segment has 1/8 degrees C resolution.

2. The camera module firmware processes color from the top color control segment (8) to the bottom color control segment (1), the temperature settings should be defined from the highest temperature at segment 8 to the lowest temperature at segment 1.
3. If the temperature settings from segment 1 to segment 8 are not monotonically increasing, unpredictable scene colorization may occur.

4. If the color segment is enabled, scene pixels of the exact temperature as the temperature setting in that segment will be set to the color defined for that segment.

5. If the color segment is disabled, scene pixels of temperatures between this segment and the next higher segment will be output in gray scale.

6. If color segment 8 is disabled, scene pixels of temperatures greater than or equal to the highest temperature setting will be presented in gray scale.

7. If color segment 8 is enabled, scene pixels of temperatures greater than or equal to the highest temperature setting will be set to the same color defined in segment 8.

8. Scene pixels below segment 1’s temperature setting are presented in their normal 24-bit gray scale output from the AGC/ICE processing.

9. Scene pixels of temperatures in between two temperature segments are linearly interpolated between the HSV settings between the two segments according to the temperature differences.

5.5.6 Global Temperature Correction

A global gain and offset correction for both high and low gain are available via the Advanced Radiometric Settings tab. As the name implies the global gain and offset correction is applied to all temperatures reported by the camera module; this includes the per pixel temperature data within the superframe.

The gain adjustment is a 16-bit unsigned integer representing a value between 0 and 2. That is, the LSB = 1/32768. So the gain value of 1.0 is 32768 or 0x8000, which is the default value. The Offset adjustment is a 10-bit signed integer representing a value between -512 to +511 degrees C. LSB = 1C. The default value is 0.

Essentially the Global Correction is a formula of the form y = mx+b where y is the corrected temperature, x is the current temperature, m is the gain, and b is the offset. To accurately determine the correct gain and offset values for either high or low gain setting, the user should use the spot meter to collect multiple black body temperature settings (both below and above the camera’s ambient temperature). At each black body setting, determine the difference between the spot meter temperature and the black body temperature. Now calculate a gain and offset value.

Following is a worked example.

<table>
<thead>
<tr>
<th>Black Body Temp (C/K)</th>
<th>Spot Meter reported Temp (C/K)</th>
<th>Delta Temperature (C/K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35/308</td>
<td>32/305</td>
<td>3</td>
</tr>
<tr>
<td>50/323</td>
<td>45/318</td>
<td>5</td>
</tr>
<tr>
<td>60/333</td>
<td>55/328</td>
<td>5</td>
</tr>
</tbody>
</table>
Next, calculate the best fit (trendline) line which cut through the black body temperatures and is extrapolated to 0K (-273°C). Figure 35 illustrates the best fit line.

The line equation that results from the best fit line with an equation of \( y = 1.08979x - 24.144527 \).

![Figure 35: Best Fit Line](image)

The Tamarisk camera module has a gain value of 0.0 to 1.999. To calculate the gain, use the equation, gain = 32768*m = 32768*1.08979 = 35710. The user would enter 1.08979 into the Gain setting within the camera control software. The user would enter a value of 35710 or 0x8B7E directly into the Gain register via the manual command mode.

The Tamarisk camera module has a offset value from -256 to 255. To calculate the offset, use the equation, offset = 512+b+0.5 = 488. (Note that if b is a positive value, the offset will simply be set to b+0.5).

The following steps should be taken prior to collecting temperature data for global temperature correction:

1. The camera should be set to either High Gain mode or Low Gain mode.
2. Gain and Offset values for the Gain mode of interest should be reset to 1.0 and 0 respectively.

### 5.5.7 Environmental Thermal Settings

The enivironmental settings are automatically applied to the spot meeter and ROI temperature values. The camera module actually has one set of parameters for the spot meter and another set of parameters for the ROI. The camera control software applies the same values to both sets. The enivironmental settings are not applied to the per pixel temperature data within the superframe.

The following emissivity control parameters which can be set by the user with real-time:
1. Average emissivity of the object (0 to 1.0).
2. Background temperature: The value is implemented as a Kelvin value but for consistency the camera control software requires the temperature to be entered in celcius. Hence the default value of 0K will show up as -273C.
3. Atmospheric transmission (0 to 1.0)
4. Atmospheric temperature: The value is implemented as a Kelvin value but for consistency the camera control software requires the temperature to be entered in celcius. Hence the default value of 0K will show up as -273C.
5. Transmission of external window (0 to 1.0).
6. Temperature of external window: The value is implemented as a Kelvin value but for consistency the camera control software requires the temperature to be entered in celcius. Hence the default value of 0K will show up as -273C.

5.6 AGC/ICE

Figure 36 illustrates the Automatic Gain Control (AGC) tab. This window includes three task panes, Gain/Level Control, Gain/Level Bias and Temporal Noise Reduction. The factory default setting is AGC enabled. When enabling Image Contrast Enhancement (ICE) for the first time, the default setting is ICE Strength 3. Additional user selectable settings are also available.

NOTE

The utility of AGC, (automatic or manual) is highly dependent upon the scene content Operators are encouraged to experiment with various scenes, alternately enabling, disabling, and varying the controls to develop a familiarity with this feature.
Table 8, provides an overview of the features and functions that are available on the AGC tab.

Table 8 – AGC Overview

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain/ Level Control</td>
<td>Automatic AGC</td>
<td>Enables AGC mode</td>
</tr>
<tr>
<td></td>
<td>Freeze</td>
<td>Turns off/freeze AGC at its current level</td>
</tr>
<tr>
<td></td>
<td>Manual</td>
<td>Operator adjustment</td>
</tr>
<tr>
<td></td>
<td>Image Contrast Enhancement</td>
<td>Turns on ICE and enables the adjustment of the ICE Strength (Range = 0 - 7)</td>
</tr>
<tr>
<td>Gain/Level Bias</td>
<td>Gain</td>
<td>Displays current Gain (Range = 0 - 4095)</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>Displays current Level (Range = 0 - 4095)</td>
</tr>
<tr>
<td>Temporal Noise Reduction</td>
<td>State</td>
<td>On – Enables, Off – Disables (default)</td>
</tr>
</tbody>
</table>

5.6.1 Gain and Level Control

Adjusting the gain and level, may improve how the detected energy is displayed on a video monitor. By adjusting the gain and level, an operator can control image output intensity and contrast. There are four Gain/Level Control modes to select from as noted in Table 8.
5.6.2 **Automatic AGC Mode**

Automatically adjusts the gain and level of the entire scene, in real-time, providing an image with optimum average contrast and brightness. AGC limits the adjustment range when enabled but allows the operator to fine tune by adjusting the gain and level bias. *Automatic AGC* enabled is the factory default setting. This setting can be disabled by selecting one of the other gain control modes such as *Manual AGC, Freeze AGC or Image Contrast Enhancement*.

5.6.3 **Manual Gain and Level**

This mode is used to enhance specific objects or areas in the scene. This mode is not recommended for overall global adjustment but to quickly discriminate targets from background. Gain and level can be lowered for very bright objects to reduce pixel saturation, maintain image detail and increase dark objects to improve their visibility. This is a variable setting from 0 – 4095 counts. The default is set to 2048 counts, the midpoint of the full dynamic range.

In Manual Mode, a three-piece linear transformation is used to convert a 12-bit input image to an 8-bit output image. These transfer functions are defined by three lines with $y = mx + b$ format.

The three-piece transfer function is defined by $X_0$ and $X_1$ boundaries (see Figure 32). These boundaries are determined using the following equations and controlled by adjusting the Manual Gain and Level sliders in the Camera Control Software:

$$X_0 = \text{Manual Level} - \text{floor}((4095 - \text{Manual Gain}) / 2)$$

$$X_1 = 1 + \text{Manual Level} + \text{floor}((4095 - \text{Manual Gain} + 1) / 2)$$

This effectively sets the Manual Level to the center point of the central-piece of the 3-piece transfer function. This Manual Level value can be any value from 0-4095 (212, 12-bits of values). The Manual Gain value then determines the span or how far the central-piece of the 3-piece transfer function spreads apart. At the same time, it also determines the “slope” of the central-piece; hence it is also referred to as the Gain of the image.

---

**NOTE**

Care should be taken when using Manual Mode AGC so that the output video is not saturated solid black or solid white. This often occurs when the majority of the scene histogram falls outside the span defined by $X_0$ and $X_1$, see Figure 37: Manual Gain and Level. If this occurs, adjust the Manual Gain and Level to re-center the histogram.
5.6.4 **Freeze AGC**

As the name implies, *Freeze AGC* locks or freezes the current gain and level settings for a particular scene preventing AGC from making adjustments; however, logarithmic equalization continues to be applied to the scene information. This is useful when one wants to establish a background scene, possibly discriminating certain objects in the scene and does not want the displayed image characteristics of the object or background to change when there is a dramatic change in the thermal signature of objects entering or exiting the scene. In such a case, if AGC mode were enabled, the camera would automatically adjust the scene gain and level to accommodate the new object and potentially affect the displayed image characteristics and/or wash-out other objects of interest.
5.6.5 **Image Contrast Enhancement - ICE**

Unlike *Automatic AGC* mode (which makes global image adjustments via the Gain and Level controls), *Image Contrast Enhancement* independently adjusts the gain and level settings for different “localized” areas of the image based on spacial frequency and an object’s individual brightness and contrast; it functions in real-time. Figure 38 and Figure 39 illustrate the differences in the thermal image with and without *Image Contrast Enhancement*.

![Figure 38. Automatic AGC Mode w/o Image Contrast Enhancement](image1)

![Figure 39. Image w/ High Contrast Enhancement](image2)

ICE can be tuned for lower contrast or higher contrast scenes by adjusting the ICE strength slider. Lower contrast scenes typically include indoor or bland outdoor environments where the scene temperature variance is minimal. Higher contrast scenes typically include outdoor environments or thermal scenes with significant thermal variations. The degree of contrast enhancement may be adjusted by moving the slider between 0 and 7.

5.6.6 **Temporal Noise Reduction**

Tamarisk camera modules with code X1.Px.00.02.40 or newer include support for the temporal noise reduction (TNR) filter. The TNR filter algorithm performs frame to frame analysis on the noise characteristic of all pixels. Temporal noise (due to row bounce or flickering pixels) is significantly suppressed without causing image delay or blurring. The end result is a higher signal-to-noise ratio, and enhanced detection capabilities.

The noise reduction is applied to the 14-bit NUC data and hence when the TNR filter is enabled, the user will not only see a better image but the temperature data will also be more consistent (frame-to-frame).

To be backward compatible with older systems the TNR filter is disabled by default. For the best imaging and radiometric results it is recommended to enable the TNR filter.
5.7 PAN AND ZOOM

Figure 40 illustrates the Pan and Zoom tab. This feature enables the user to define a region of interest (ROI) using a combination of the Zoom and Pan functions. Once a region has been defined, the user may reposition the ROI using the up, down, left, and right arrow keys or selecting the ROI box and moving it with a mouse/pointer device. The user also has the option to perform an electronic zoom between 1x and 4x. See Figure 40.

Table 9 provides an overview of the features and functions that are available on the Pan and Zoom tab.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pan and Zoom</td>
<td>Pan and Zoom Area</td>
<td>To change the region of interest, hold down the right mouse button and draw a new region of interest on the gray area. To move the current region of interest, hold down the left mouse button and drag.</td>
</tr>
<tr>
<td></td>
<td>Arrows</td>
<td>The up, down, right, and left arrows can be used to move the region of interest</td>
</tr>
<tr>
<td></td>
<td>E-Zoom</td>
<td>The e-zoom value can be set using the plus and minus buttons or by moving the slider to the desired value.</td>
</tr>
<tr>
<td></td>
<td>Presets</td>
<td>The 1x, 2x, 3x, and 4x buttons will move the e-zoom to the corresponding zoom positions.</td>
</tr>
</tbody>
</table>
5.8 LENS CALIBRATION

All Tamarisk® 320 camera cores are calibrated as stand alone units prior to leaving the factory to ensure product specifications are met. This includes all lensed and no-lens versions commonly referred to as thermal imaging modules or TIMs. TIMs start as fully assembled cameras and are calibrated with a specified lens. After calibration, the lens is removed and the unit is ready for shipment.

However, as cores are often just one component of an integrated systems, the factory calibration may not always prove to be the most optimal. Therefore the Lens Calibration Utility has been designed to enable integrators to compensate for nonuniform conditions that may have been introduced when embedding the Tamarisk® 320 camera core into a system or when installing a new lens or any other process that may have altered the isothermal nature of the camera core.

Please refer to section 3.1 (Lens Calibration Requirements) for a list of recommended equipment and software version requirements.

5.8.1 Lens Calibration – Theory of Operation

During the calibration process, the camera stares at two uniform scenes of different temperature; the response of each pixel is automatically captured, tabulated and saved to one of 5 user selected memory locations known as Tables. Using this pixel data, individual gain and offset values for each pixel are calculated resulting in a matrix or table of correction coefficients for the entire pixel array. When applied, these correction coefficients compensate for the non-uniformities of the system and pixel behavior characterized for the given set of conditions under which the calibration was performed. When performed with an optical assembly between the focal plane array and the uniform scenes, these coefficients will “calibrate out” the non-uniformity of the the optical design.

Additionally, the Lens Calibration utility permits the upload/download of calibration tables; this is very useful when configuring multiple cameras with the same configuration as the data may be stored on an external PC and uploaded to each camera during its build/configuration cycle.

Other useful applications include: In the case of an optical zoom lens, the user may want to calibrate the zoom lens at different zoom settings and store the data for future use. Or, the user may calibrate the camera under different environmental conditions (hot, cold, mild temperatures) and save this data to one of the 5 tables and then call on the table as needed.

5.8.2 Lens Calibration - Getting Started

In this section a step-by-step procedure for accessing the Lens Calibration Utility.

1. To install the latest version of the Camera Control Software including the Lens Calibration utility please follow instructions outlined in section 3.2.

2. Clicking the Lens Calibration tab for the first time, the user is prompted to enter a pass key. To obtain a pass key, please contract your DRS representative. Figure 41 illustrates the pass key screen. The hash number is used to generate a unique pass key. The computer and pass key are tied together. The pass key is a 25 character alpha numeric string which is typed or pasted into the text box.
3. After entering a valid pass key, select Verify Key. Once the pass key is verified, the Lens Calibration tab (shown in Figure 43) is displayed. If the pass key is invalid, a pop up message provides a warning and the user is returned to the Verify Key screen.

5.8.3 **Lens Calibration - Setup**

This section provides a step-by-step procedure and recommended conditions for performing lens calibration.

4. **Set-up.** Figure 42 illustrates the hardware setup to perform a custom calibration. Connect the serial data cable (USB or RS232) and power the camera. Please allow the camera to sit for 30 minutes to stabilize its temperature before beginning the calibration process.

5. Place the camera at the appropriate distance from the black body/thermal scene such that the entire field of view is flooded with the uniform thermal scene, but not so close as to affect the thermal equilibrium of the camera. The recommended calibration temperature set points are:

- Cold set point -10°C below camera ambient temperature
- Hot set point +10°C above camera ambient temperature

The exact temperature is not critical. For best results a black body should be used but any thermally uniform scene is acceptable.
NOTE

For best results, please allow the camera to reach steady state operating temperature before starting the custom calibration process - it is recommended that the camera sit in a powered-on state for at least 30 mins prior to starting.

Figure 42. Lens Calibration Setup

5.8.4 Lens Calibration: Start

6. In Figure 43, the user is prompted to start the custom lens calibration process, See START button at the bottom of the Custom Lens Calibration task pane. One of the 5 custom tables may be selected. In this example, Table 1 is occupied with existing data (note, this is not the factory calibration settings. Factory calibration data is stored elsewhere and will always be available to return the camera to its original factory calibration settings). The user may select or the Return to Factory Calibration Settings from the pull-down menu located in the Calibration Selection task pane.

Figure 43. Lens Calibration Tab
5.8.5  **Lens Calibration - Selecting a Table to Store your Data**

7. Next, select the location to store your calibration. During the calibration process, lens “correction coefficients” are calculated and saved to the camera, via one of the 5 tables.

Tables that have been previously populated are labeled “Occupied;” tables that have not been used are labeled “Empty.” The user can save the correction coefficients to any of the five tables. Selecting an occupied table will overwrite the table with new correction coefficients.

Factory calibration coefficients are permanently stored in the camera. To restore factory default settings go to the *Calibration Selection* task pane found on the *Lens Calibration* tab, see Figure 44, and select *Return to Factory Calibration Settings* found in the *Calibration Selection* pull-down menu.

![Figure 44: Table Selection](image)

8. Once the table is selected, the first step in the 2-point lens characterization is to capture the uniform cold target data. The recommended temperature of the cold target is approximately 10°C below the ambient temperature (or 12°C if the ambient temperature is 22°C). The exact temperature is not critical; the temperature delta between the cold and hot target should be approximately 20°C. Click *Cold Target Ready* button, as shown in Figure 45.

![NOTE](image)

Once the cold target data is captured, the user has 180 seconds to begin capturing the hot target data. If the 180 second timer expires the lens calibration process must be started over again.
The Camera Control Software application will send setup information to the camera and command it to start collecting cold target data. Several frames are integrated together to reduce noise and provide an average pixel response for each pixel in the FPA. The cold data collection takes a few seconds; once complete, the user is prompted to capture the hot data.

9. The next step is to capture data from a uniform “hot” thermal scene. The recommended temperature for the hot target is approximately +10°C above ambient temperature. The exact temperature is not critical; the temperature difference between the cold and hot target should be approximately 20°C.

When the screen changes to Continue – Hot Target is Ready, flood the camera field of view with the “hot” scene. Once the FOV is flooded, click Continue – Hot Target is Ready button as shown in Figure 46.
The application will send setup information to the camera and command it to start collecting hot target data. Several frames are integrated together to reduce noise and provide an average pixel response for each pixel in the focal plane array for the second point of the two-point calibration. The hot data collection takes a few seconds. Following the hot target data collection, the application will calculate the gain correction factors for each pixel as shown in Figure 47.
10. Once the calculations are complete, the lens calibration settings are immediately applied to the camera video output. The user is prompted to use or discard the settings by answering “Yes” or “No,” see Figure 48. If the user selects yes, the lens settings are saved in non-volatile memory; power cycling the camera is not required.

Figure 48: Save Settings

The Lens Calibration procedure is now complete and the application returns to the Lens Calibration tab, see Figure 49. Notice, Table 2 is now occupied and in use as indicated by the pull-down menu in the Calibration Selection task pane.

Figure 49: Lens Calibration
5.8.6 **Lens Calibration - Table Upload/Download Procedure**

Using the upload/download feature the user may easily move calibration data to and from the camera. This feature is useful if building multiple cameras with the same configuration. Lens calibration performed on one camera may be stored to an external PC and uploaded to multiple cameras.

1. To download, select an occupied table followed by Download to PC.

   The user is prompted to save the file to the PC, see Figure 50. In the example shown, Table 2 was selected. The downloaded file is named Table_2. The saved file will have an extension of .nuc. The .nuc table contains both the gain and offset data, file size for the Tamarisk® 320 is typically 600Kbytes.

![Figure 50: Download to PC](image)

2. To upload table data to the camera, select any one of the 5 tables to receive the data. If data is written to an occupied table, the uploaded data will overwrite the current data. In this example, Table 3 is selected. Upon selecting Upload to Camera, the user is prompted to select a file. See Figure 50.

   Once the upload is complete the data is saved to the selected table, Table 3, in this case, now indicates it is occupied. See Figure 51.
5.8.7 **Lens Calibration - Calibration Selection**

*Calibration Selection* (shown in Figure 52) allows the user to select one of the occupied tables for use or to *Restore Factory Calibration Settings*. To enable a specific calibration table, simply highlight one of the options in the pull-down menu found in the *Calibration Selection* task pane. Upon selection, the table is immediately applied to the camera and saved to non-volatile memory and will remain persistent through power cycles until it is changed.

![Figure 51: Table 3 Occupied](image1)

![Figure 52: Calibration Selection](image2)
5.9 PIXEL MAP

The Custom Pixel Map allows the user to mark and substitute pixels, rows, and columns. A keyboard with a number pad is required to mark the pixels. Figure 53 illustrates the Custom Pixel Map Tab. The hot keys are defined at the top. The hot keys allow the user to quickly maneuver around the screen and mark and unmark pixels. The user also can mark/unmark pixel, column, and row by using the defined buttons. The user can upload and download the Custom Pixel Map; this is useful if the user wants to use an offline program or algorithm to mark pixels and then upload the Custom map back to the PC.

To manually mark pixels, columns, and rows, the Custom Pixel Map must be selected as the active windows application.

The Pixel Map Utility allows the user to mark/unmark pixels, rows, and columns and to upload/download custom pixel maps via several user controls. The Pixel Map utility window is divided into three task panes as shown in Figure 53. In this section, a reference table is first presented followed by an explanation of each of the three task panes found in Pixel Map tab.

![Figure 53: Pixel Map](image)

Table 10: Pixel Map Utility Features provides an outline of the features/functions of the Pixel Map Utility. A keypad is required to enter hotkeys. Even if a keyboard does not have a number keypad, the keypad functionality is typically provided as part of a function “Fn” key.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toggle Cursor On/Off</td>
<td>* hotkey</td>
<td>Toggles the cursor on and off. The cursor shows the current location and which pixel, row, or column will be replaced.</td>
</tr>
<tr>
<td>Function</td>
<td>Hotkey</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cursor Color Change</td>
<td>/ hotkey</td>
<td>Toggles the color of the cursor between white and black. This helps the user see the cursor when looking at a hot or cold scene.</td>
</tr>
<tr>
<td>Mark Pixel</td>
<td>+ hotkey</td>
<td>Marks the current pixel for substitution</td>
</tr>
<tr>
<td>Unmark Pixel</td>
<td>- hotkey</td>
<td>Unmark the current pixel for substitution</td>
</tr>
<tr>
<td>Step Size Change</td>
<td>5 hotkey</td>
<td>Toggles the step size between 1 and 5 pixels for each arrow key that is pressed. This helps move the cursor to a position quickly. The user can moves in steps of 5 and when in the correct region, switch to moving the cursor in steps of 1.</td>
</tr>
<tr>
<td>Mark</td>
<td>Pixel, Column or Row</td>
<td>Allows the user to mark the pixel, column or row associated with the cursor</td>
</tr>
<tr>
<td>Unmark</td>
<td>Pixel, Column, or Row</td>
<td>Allows the user to unmark a pixel, column, or row associated with the cursor</td>
</tr>
<tr>
<td>Clear</td>
<td>Clear the custom pixel map</td>
<td>Allows the user to clear the custom pixel map. Once the user selects clear, all marked pixels, rows, or columns are cleared. The original factor pixel map is still retained and unchanged. Clearing is immediately applied to the camera but not saved between power cycles</td>
</tr>
<tr>
<td>Save to Flash</td>
<td>Save custom pixel map to non-volatile memory</td>
<td>Allows the user to save a custom pixel map to non-volatile memory. To use the original factory pixel map, the user must perform a Clear and Save to Flash.</td>
</tr>
<tr>
<td>Upload to Camera</td>
<td>Upload a pixel map from a PC to the camera</td>
<td>Allows the user to upload a custom pixel map from the PC to the camera. This is useful if generating a custom pixel map offline.</td>
</tr>
<tr>
<td>Download to PC</td>
<td>Download a custom pixel map from the camera to the PC</td>
<td>Allows the user to download the custom pixel map from the camera to the PC.</td>
</tr>
</tbody>
</table>

5.9.1 Pixel Map – Hot Key Definitions

Figure 53 illustrates the Pixel Map tab. Hot keys are detailed in the Hot Key Definitions task pane at the top portion of the window. Hot keys allow the user to quickly maneuver around the screen to mark/unmark pixels. A keyboard with a number pad is required to mark pixels.

5.9.2 Pixel Map – Mark Unmark

Pixels, columns and rows may be marked/unmarked using the defined buttons located in the Mark and Unmark task panes. Selecting Mark and Unmark saves the results to temporary flash memory. To keep the markings press Save.

NOTE

The factory pixel map is permanently retained/used in/by the camera. The customer pixel map is an additional map which is overlaid on the factory pixel.
map. To return back to the default factory pixel map, press the Clear and Save to Flash.

5.9.3   **Pixel Map – Table Upload/Download**

The Camera Control Software allows the user to upload or download a custom pixel map. This feature is useful if a pixel substitution algorithm is run off line. The user can capture a digital image via the Camera Link interface, calculate the custom pixel map, and upload the custom pixel map to the camera. To upload or download, select the Upload to Camera or Download to PC button and follow the windows prompts.

If downloading a custom pixel map, the user is prompted to save the file to PC. The saved file has an extension of .cpm. The .cpm table contains only the pixel substitution data and has a file size of 19.2Kbytes.

\[
\frac{320 \text{ bits}}{\text{row}} \times \frac{240 \text{ rows}}{\text{frame}} \times \frac{\text{characters}}{4\text{bits}} = \frac{19200 \text{ characters}}{\text{frame}}
\]

Hence each row contains exactly 80 characters and each character represents 4 pixels; for a total of 320 pixels per row.

5.10   **UTILITIES**

The Utilities tab provides several functions as indicated by the task panes seen in Figure 54, namely, Firmware Upgrade, Camera Communication, and Customer Camera Info. The option to Restore Factory Settings is also made available through the Utilities tab.
5.10.1 Firmware

Updating/upgrading the camera’s firmware: simply click on Select File in the Firmware Upgrade task pane. Choose the appropriate version of DRS supplied Firmware. The firmware file name should look similar to the following:

Tamarisk 320 CPU - X1.P1.01.13.13 FPGA - 01.00.0080.zip

CAUTION

Only unaltered files provided by DRS are approved for upload. Use of any file to the contrary may render the camera inoperable and void the camera warranty. The user should not attempt to modify the file name or the contents of DRS provided firmware, so doing may invalidate/corrupt the file. During the firmware upgrade, the user should not power cycle the camera.

Once the firmware upgrade is complete, the user must power cycle the camera for the upload to take effect. During the firmware upgrade, the user should not power cycle the camera. After the firmware is uploaded and the camera has been power cycled, select “Search for New Connected Devices” in the lower left hand corner of the Camera Control Software window and verify that the firmware was correctly upgraded. On the Information tab, the CPU code version is displayed as “Rel:” and the FPGA code version is displayed as “RTL Rel:”

While the upgrade is underway, a green progress bar is displayed (as shown in Figure 55). Once completed, the user will see a pop-up message indicating that the upgrade is complete. If the upgrade fails for any reason, an error message is displayed at the top of the Camera Control Software screen.

Figure 55: Firmware Upgrade
5.10.2 Camera Communications

Under the Camera Communications section, a Manual Command Mode is provided. Clicking Manual Command Mode will open a command line window for direct communication with the camera (as shown in Figure 56).

![Figure 56. Camera Communications](image)

**CAUTION**

Manual Command Mode requires advanced knowledge of the camera's registers; improperly writing commands to the camera may result in camera malfunction. The user is encouraged to review the camera's Interface Control Document before using Manual Command Mode.

The Manual Command Mode requires advanced knowledge and should be used only after reviewing the camera’s Interface Control Document.

Selecting **Load Sequence File** will open up your PCs file manager. The user may select a file/script/sequence to be loaded. A sequence file is a sequence of manual commands where each line of the command file contains only one command. Please refer to Tamarisk® 640 Software Interface Control Document for more information.

<Command><Parameter upper byte><Parameter lower byte><Additional Parameters>

5.10.3 Camera Info

The Camera Info button allows the user to save (and read back) up to 252 ASCII characters. The characters are stored in non-volatile memory and hence they are retained across power cycles.
The Camera Info feature allows users to add their own unique camera identification or serial number. Figure 57 illustrates the Camera Info screen. To change the characters, simply edit the text and select update to save the characters to non-volatile memory. In this example Custom Camera Info Field is saved in non-volatile memory.

![Camera Info Screen](image)

Figure 57: Camera Info

5.10.4 Reset to Factory Defaults

*Restore Factory Settings* returns all camera settings back to their factory defaults. This feature is sometimes useful if the user would like to return the camera to a known state. To restore reset to factory defaults, select *Restore Factory Settings* at the bottom of the *Utilities* window.

![Triangle Note](image)

**NOTE**

Restoring factory settings will return all camera settings, including non-volatile parameters and custom lens calibration settings, if applicable, to their factory default values. Any marked pixels, rows, columns saved to the camera (i.e. overlaid on top of the factory pixel map) will remain, i.e. will not be affected by the *Restore to Factory Settings* command.

5.10.5 Help

To view the help file, select the *Help* tab. This will open up a pdf version of the Camera Control Software User Manual in a separate window. See Figure 58 below:
5.10.6 **Show Live Video**

If a frame capture device which supports Microsoft’s DirectShow AP is plugged into the PC (prior to launching the Camera Control Software Icon and starting the application), the user may select *Show Live Video* located in the bottom right corner of the Camera Control Software window to display live video.

5.10.7 **Search for New Connected Devices**

At any time, the user may select the Search for New Connected Devices button located in the bottom left corner of the Camera Control Software window. This will close the current window, search for connected devices, and display the information tab for the first device and a separate Serial Number tab across the top of the Camera Control Software window for all devices found.
6 UNINSTALLING THE SOFTWARE

There are multiple methods for uninstalling the DSR Camera Control Software.

1. Running the Install Shield Wizard and selecting “Remove”
2. Running the uninstall utility
3. Using Microsoft’s uninstall utility through the Program and Features control panel.

In this section all three approaches are reviewed.

6.1 REMOVING THE SOFTWARE USING THE INSTALL UTILITY

The DRS Camera Control Software may be removed by launching the DRS Camera Control Software InstallShield Wizard; Refer to Figure 59. Since the DRS Camera Control Software is already installed, the user has the option to “Modify”, “Repair”, or “Remove”. Select the Remove button, select Next and follow the final on-screen menu to completely remove the program. When finished, a notification is displayed to confirm the uninstall operation has been completed.

![InstallShield Wizard (Uninstall)](Image)

Figure 59. InstallShield Wizard (Uninstall)

6.2 UNINSTALLING THE SOFTWARE USING THE UNINSTALL PROMPT

During the installation process, the InstallShield Wizard creates a DRS Technologies folder within the Start Programs menu. To uninstall the DRS Camera Control Software, perform the following:

1. From the Start menu, select All Programs
2. Open the DRS Technologies folder
3. Select Uninstall DSR Camera Control Software icon
Once the icon is selected, the window shown Figure 60 will appear. Click “Yes” to continue the uninstall procedure. When finished, a notification is displayed to confirm the uninstall operation has been completed.

![Figure 60. DRS Camera Control Software Uninstall](image)

6.3 UNINSTALLING THE SOFTWARE VIA CONTROL PANEL

Microsoft Windows has a built in uninstall mechanism. To uninstall the DRS Camera Control Software, perform the following:

1. From the Start menu, select Control Panel
2. In Large or Small icon view, click Programs and Features. If you're using Category view, under "Programs", click Uninstall a program
3. Select the DRS Camera Control Software and click Uninstall. Alternatively, right-click the program and select Uninstall

Once the icon is selected, the window shown in Figure 61 will appear. Click on Yes to continue the uninstall procedure. When complete a notification window will tell you that the uninstall was completed.

![Figure 61. Control Panel Uninstall](image)
## 7 Troubleshooting

In this section troubleshooting guides are presented to aid the user in diagnosing potential problems.

### 7.1 No Attached Devices Found

If the DRS Camera Control Software does not detect a camera, the “No attached devices found!” window appears - see Figure 62. Symptoms and solutions for remedying this issue are outlined below.

---

**Symptom: An audible shutter click is not heard when the camera is powered:**

- Verify that the camera interface cable is inserted correctly into both the 30-pin electrical interface on the back of the camera as well as the 30-pin connector on the break out box. The connectors are keyed such that they can only be inserted one way.

- If your set-up uses USB for camera communication and power, verify that the mini-USB to USB cable is properly connected to their respective ports on the break out box and on the PC.

- If your set-up uses RS232 for camera communication then an auxiliary power supply is required. Be sure the external DC power supply is connected to the camera’s break out box and that the supply is turned on. Verify that the serial RS232 cable is properly connected between the camera’s break out box and the PC.

- Verify that the communication cable (ie.USB) is not damaged.
- If using a DC power supply to power the camera, verify that the power supply is on and supplying the correct voltage and is capable of sourcing enough current.

- **Symptom:** A continual audible shutter click is heard when the camera is powered. This commonly occurs when the supply current drops below the minimum operating requirement. Refer to the Tamarisk® 320 Electrical ICD for specifications. Check for the following:

  - Voltage drop or marginal supply current:

    - Verify supply voltage and current capabilities of the power source. If batteries are being used it may be necessary to exchange them for new ones.

    - Excessively long USB cables may cause a voltage drop in the cable which results in a temporary power cycle of the PC’s USB port; this behavior is typically seen as the camera’s shutter closes.

    - If connecting the camera to a hub, it is recommended to limit the number of USB devices connected to the hub. The user may also want to power the hub from an external power supply.

    - If connecting the camera directly to the PC, it is recommended to limit the number of USB devices connected to the PC. Too many USB devices may overload the PC’s USB ports.

- **Symptom:** A single audible shutter click is heard when the camera is powered via the USB cable but the Camera Control Software does not detect the camera. Check the following:

  - Open Windows Device Manager and verify that the camera hardware is detected and installed properly. A yellow exclamation mark indicates a problem. Figure 63 shows the camera is not installed properly.

![Windows Device Manager](image.png)

**Figure 63 Windows Device Manager**
- Verify that the yellow exclamation mark belongs to the camera and not some other device. While looking at the Windows Device Manager, unplug the camera’s USB cable. If (after the screen updates) the yellow exclamation mark disappears from the list, the camera hardware is not detected or installed properly. Confirm hardware configuration, refer to Table 1. Hardware Configuration Set-up Overview.

- **Symptom:** Windows Device Manager shows the camera is not detected or installed properly. **Check the following:**

  - Verify/update installed drivers. From the Windows Device Manager, Right-click the device with the yellow exclamation mark. In the popup menu select Update Driver Software. Then follow the instructions on screen. If you know where the drivers are located you may select the “Browse my computer for driver software” option. The other option is allow Windows to search the web for updated drivers. If allowing Windows to search make sure the PC is connected to the web.

  - If you are using a USB-to-serial port adapter, follow the manufactures procedure to verify the serial port is properly configured.

- **Symptom:** After the Windows Device Manager searches for drivers, the drivers cannot be found or would not install properly. **Check the following:**

  - Sometimes a conflict will occur during the installation process and the drivers will not load properly. Run the Camera Control Software installer again, the software will automatically attempt to install/re-install the drivers.

  - Follow the on screen menu. When the InstallShield Wizard displays the “Modify, repair, or remove the program” menu, select Modify. The Custom Setup screen in Figure 64 will appear. It indicates the USB drivers were not installed during the initial installation process. Select the USB Drivers pull down and ensure this feature will be installed to the local hard drive option is selected. Select Next to continue the installation
The installer will load the drivers and the hardware will be detected and installed correctly.

- **Symptom:** The installer was re-run and the drivers were installed on the local hard drive but the camera is not detected and a yellow exclamation mark appears in the Windows Device Manager window. Check the following:
  
  - Sometimes a conflict will occur during the installation process and the hardware is not properly detected. If connecting via USB, try disconnecting and reconnecting the USB cable. If connecting via a serial interface, try power cycling the camera. If this does not work, restart your computer.

- **Symptom:** The camera is powered and the Windows Device Manager shows that the hardware is detected and installed properly but the Camera Control Software does not detect the camera. Check the following:
  
  - Close all Camera Control Software windows. Re-launch the software by double-clicking the DRS Camera Control Software icon. If the camera is still not discovered, proceed to next step.
  
  - Ensure that only one instance of the Camera Control Software is running. Windows will allow multiple instances of the Camera Control Software but the first instance is tied to the first serial port/camera detected.
  
  - If using a serial RS232 cable:
    
    - Make sure the serial port is properly connected to the camera and make sure that the pin out is correct; refer to the Electrical Interface Control Document for pin out details.
- If using a serial RS232 cable, ensure that other applications running on the PC are not using the serial port. Shut down any other applications that may be using the serial port.

- If connecting via USB cable, when the Camera Control Software displays the menu shown in Figure 62, select “Try Search Again”. Sometimes the camera itself is not fully initialized when the Camera Control Software is first run.

**Symptom:** The camera is powered and the Windows Device Manager shows that the hardware is detected and installed properly but the Camera Control Software does not start or immediately closes. Check the Following:

- The Camera Control Software is built upon Microsoft’s .net framework. In order for the Camera Control Software to operate correctly, the .net framework (version 4.0) must be installed on the PC. To check if the .net framework is installed, perform the following steps.

- Open Windows Explorer and go to the following directory:

  \%windir\%\Microsoft.NET\Framework\%

  Where "\%windir\%" represents "Windows" directory present in the system drive where Windows is installed in your system e.g. C:\Windows\%

- Within the Framework folder, ensure that the v4.0 directory is present (as shown in Figure 65). If it’s not present, re-run the Camera Control Software Installer or download the Framework from the following link:

Symptom: The camera is connected via USB-to-serial port adapter, the Windows Device Manager shows that the serial port is detected and installed properly, and the serial port pin out is correct but the Camera Control Software will not automatically connect to the camera. Check the following:

- If Figure 62 is displayed, the user can manually connect to the camera by selecting “Manually Add Device”. The user will then see the window show in Figure 66.

The user can now manually select the Device Type, the Communication Type, and Communications Settings.

- Select the Tamarisk®320 device type.
- Select RS232 Serial or USB as the Communications Type
- To set the COM port the user needs to open Windows Device Manager and determine the port number. If the COM port is not listed in the Communications Settings window, the user should select “custom” and then enter the COM port. The COM port number must be in the format of COMX where X = any number from 1 – 99. For example if the Window’s device manager reports that the USB-to-serial cable is COM18, the user must select “custom” and then type COM18 into the port number. The user also must select the correct baud rate for RS232 (57600 is factory default) or 921600 as the baud rate for USB.
NOTE

Adding Devices: The USB-to-serial cables are uniquely identified by the USB driver but the Camera Control Software does not always recognize these as camera interfaces; hence the user must manually connect to the camera. In addition the Camera Control Software will only allow one (1) manual connection at a time. If the user has manually connected to a second camera, the first camera connection is lost and the second camera is connected.

7.2 NO VIDEO OR POOR VIDEO FROM THE CAMERA

The DRS Camera Control Software will display video data taken from a frame capture device which supports Microsoft’s DirectShow API. If no video or poor video is seen, review the following symptoms and solutions:

- No video data is displayed, check the following:
  - Verify that a video cable is connected between the camera and the video display device.
  - Verify that the camera and the video display device are powered and operational.
  - Use a different video source to verify that the video cable and video display device are functioning correctly.
  - Verify the bits per pixel and ensure that the frame grabber or video display is configured correctly. Having the wrong pixel mapping will give strange video effects. Typically the frame grabber hardware will include software which allows the user to configure the frame grabber.
  - If using a USB port frame grabber, make sure you use a USB 2.0 (or greater) USB port.
  - The frame grabber device driver must be installed. This device driver is provided by the frame grabber manufacturer. The DSR Camera Control Software uses the DirectShow interface of the manufacturer's device driver to display video.
  - Make sure that the cameras’ shutter is not closed or that the lens is not block from seeing thermal energy. When the camera is first powered on, you should hear the shutter “click” indicating both power to the camera and that a 1-pt NUC has been performed. Refer to the Tamarisk®320 User Manual for more details.
  - Make sure your video display device supports the cameras' output. For analog display devices, make sure the device can supports the RS-170 protocol and supports the camera’s resolution.
☐ Make sure the camera is set to the proper video output mode. The camera supports NTSC, several PAL modes and 8-bit and 14-bit digital video. Refer to section 5.2.

- **Symptom:** The frame grabber is installed and operating correctly but the video quality is very poor. Check the following:
  
  ☐ Make sure the camera is not zoomed out too far. Some cameras support a very narrow field of view and when an image is viewed close up the image will look very poor.
  
  ☐ Verify the operating range of the camera as well as the scene temperature is within specified limits. The image may look poor because the camera is operating out of its designed operating or scene temperature range.

### 7.3 CUSTOM LENS CALIBRATION AND CUSTOM PIXEL MAP TABS ARE NON FUNCTIONAL

- The Custom Lens Calibration and Custom Pixel Map tabs are non-functional but the other tabs are functional
  
  ☐ The Custom Lens Calibration and Custom Pixel Map tabs are only enabled for cameras that have FPGA firmware version 01.00.0076 or higher.

### 7.4 CUSTOM LENS CALIBRATED CAMERA HAS POOR VIDEO

☐ Focus on an object far in the distance. Do not focus the camera on the uniform black body.

☐ Ensure that the uniform black body is truly uniform and stable before beginning the custom lens calibration

☐ Ensure that the custom lens calibration option is enabled by selecting the correct calibration table.

☐ Power cycle the camera to ensure that the calibration settings are applied

☐ The dynamic range may be too small or too large. Adjust the temperature of the black bodies to ensure adequate dynamic range over the scene temperature desired.

☐ Ensure that air conditioning or air is not blowing on the camera or the black body during the Custom Lens Calibration process. The air movement can cause thermal gradients which will show up as gain or offset errors and cause poor image uniformity. For best results the test environment should be thermally static.
Ensure that the custom lens and lens mount are tightly coupled to the TIM. For best results the TIM, lens mount, and lens should be isothermal.

Do not rely on the analog video output to determine the video quality. If the image is extremely uniform the AGC will cause the image to look like it has more noise. To properly evaluate the image quality, the user should look at the pre AGC, Camera Link video data. The user should plot the histogram of the output image while looking at a uniform black body. Figure 67 shows the same camera (with a custom lens) while looking at the same black body. The histogram on the left is with the custom lens calibration disabled. The histogram on the right is with the custom lens calibration enabled. Notice that the pixel distribution on the right is much tighter (which is expected and desired). But while looking at the analog output image (while looking at the same black body), the image with the custom lens calibration looks worse; this is because the AGC is trying to apply gain correction over a narrow (uniform) scene.

Figure 67: Pre AGC Camera Link Output
DRS RSTA, Inc.

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### Table 11

<table>
<thead>
<tr>
<th>Item</th>
<th>File Name</th>
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<td>1.</td>
<td>LibUsbDotNet USB Driver:</td>
<td><a href="http://fsf.org">http://fsf.org</a></td>
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<tr>
<td>2.</td>
<td>FTDI USB Driver:</td>
<td><a href="http://www.ftdichip.com">http://www.ftdichip.com</a></td>
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