



# SightLine

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APPLICATIONS

## EAN-Infrared Temperature

PN: EAN-Infrared-Temperature

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 **CAUTION:** Alerts to a potential hazard that may result in personal injury, or an unsafe practice that causes damage to the equipment if not avoided.

 **IMPORTANT:** Identifies crucial information that is important to setup and configuration procedures.

 *Used to emphasize points or reminds the user of something. Supplementary information that aids in the use or understanding of the equipment or subject that is not critical to system use.*



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## 1 Overview

This document describes features surrounding infrared camera temperature measurements. SightLine -hardware products can be used to acquire and process 14 / 16-bit data from IR cameras. This allows calculation of statistics on the raw pixel count data, which can be used to provide metrics along with the compressed video output stream.

The autogain algorithm is configurable, allowing clipping of raw data to a specific digital range (and the corresponding temperatures). Standard or custom color lookup tables (LUT) can then be applied to highlight temperature regions. For more details on Autogain see the [Autogain Calculation Notes](#).

The FLIR Tau-2 LWIR Camera can be purchased with TLinear calibration. This allows the camera output data to be converted to temperature (linear conversion). Setup and configuration of this camera will be detailed. The DRS Tamarisk Superframe camera also supports raw temperature calibrated data output. This data is full 16 bits.

The 1500-OEM board allows snapshot exports of raw camera data. Raw 16-bit snapshot data from the camera can be saved in 16-bit PNG files. The process for saving these snapshots to the SD Card as well as extracting the data is detailed.

### 1.1 Associated Documents

[EAN-Startup Guide 1500-OEM](#): Describes steps for connecting, configuring, and testing the 1500-OEM video processing board on the 1500-AB accessory board.

[EAN-Startup Guide 3000-OEM](#): Describes steps for connecting, configuring, and testing the 3000-OEM video processing board on the 3000-IO interface board.

[EAN-Detection Modes](#): Provides information and guidelines on the parameters that primarily affect the detection modes.

[EAN-Digital-Video-Configuration](#): Describes how to configure the SLA- hardware for Digital Video input.

[EAN-FLIR Cameras](#): Setup and configuration information for the FLIR Tau and Quark LWIR cameras.

[EAN-File Recording](#): Describes how to record video or snap shots to either the onboard MicroSD card or to an external FTP drive.

[Interface Command and Control \(IDD\)](#): Describes the native communications protocol used by the SightLine Applications product line. The IDD is also available as a local download on the [Software Download](#) page.

Panel Plus User Guide: Provides descriptions of all the settings in the Panel Plus application. (Located in the Panel Plus application in the *Help* menu.)

### 1.2 SightLine Software Requirements

**ⓘ IMPORTANT:** The Panel Plus software version should match the firmware version running on the board.



### 1.3 Application Bit Requirements

The functions described in this EAN require Application Bits (app bits) purchased from SightLine. App bits reside on the hardware unit and are enabled with a license file provided by SightLine at initial unit purchase or during a license upgrade process. License files use a hardware ID that is applicable to a specific hardware serial number. For questions and upgrade support contact [SightLine Sales](#).

Table 1: Application Bits Requirement Table

Function	Minimum Software Version	Required Application Bit(s)
Enhance + High Depth + Temp	2.22.xx	Enhancement. 0x0080

## 2 Requirements

The FLIR Tau 2 or DRS Tamarisk Superframe camera are both compatible with SightLine hardware. FLIR Tau 2 cameras can be purchased with a factory calibrated TLinear mode. This is not available on a non-calibrated Tau 2.

Read the camera calibration overview in the FLIR *Advanced Radiometry App Note* document available at [www.flir.com](http://www.flir.com) before attempting to use this feature.

The infrared camera should support the following:

- Output of digital pixel data with full resolution (14 or 16 bits).
- Operating mode where output digital counts are linear with temperature. Normal detector counts are linear with photons, i.e., flux (not the same as temperature).

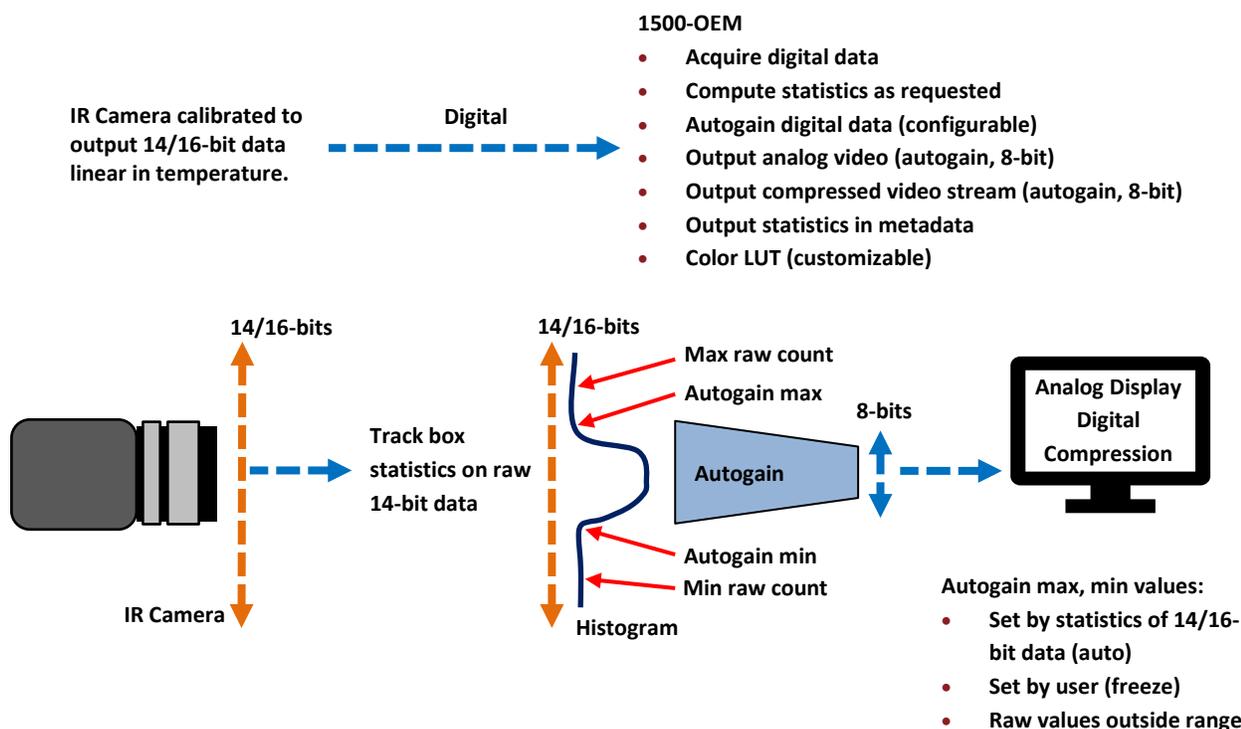


Figure 1: IR Temperature Measurement System



### 3 FLIR Tau 2 T Linear Camera Setup

#### 3.1 1500-OEM - Acquiring Tau 14-Bit Data

Open the Panel Plus application and connect to the 1500-OEM. See the document [EAN-Digital-Video-Configuration](#) for details of setting up a digital camera.

Digital camera setting: FLIR Tau 640 14-bit (or FLIR Tau 320 14-bit)

#### 3.2 FLIR T Linear Modes and Ranges

- FLIR TLinear supports low and high-resolution modes
- 14-bit digital output maximum counts = 16383
- Low resolution digital counts correspond to 0.4 Kelvin
- High resolution digital counts correspond to 0.04 Kelvin

*The Tau 2 camera has a gain mode setting of High, Low and Auto.*

- High gain mode (default) limits maximum temp to about 350°F
- Low gain mode allows for measuring higher temperature scenes
- Auto mode switches between the two modes at a programmable scene temperature. This is the preferred selection.

**Table 2: FLIR TLinear High/Low Resolution Temperature Ranges**

	Min °K	Max °K	Min °C	Max °C	Min °F	Max °F
Low Res (0.4)	0	6553	-273	6280	-459	11336
High Res (0.04)	0	655	-273	382	-459	719

#### 3.3 FLIR Tau 2 TLinear Configuration

The FLIR Tau-2 camera must be configured in 14-bit TLinear mode. This can be done using the USB dongle provided with the camera, or through the Serial Passthrough feature on the SLA board.

To use Serial Passthrough, setup Serial Port 2 using 57,600 baud. See the [EAN-Ethernet-and-Serial-Communication](#) document for details.

1. From the FLIR Camera Controller interface got to the Digital Video tab.
2. Select all the settings shown in [Figure 2](#).

*If the 14-bit TLinear options are not visible, the FLIR Tau 2 camera has not been factory calibrated.*

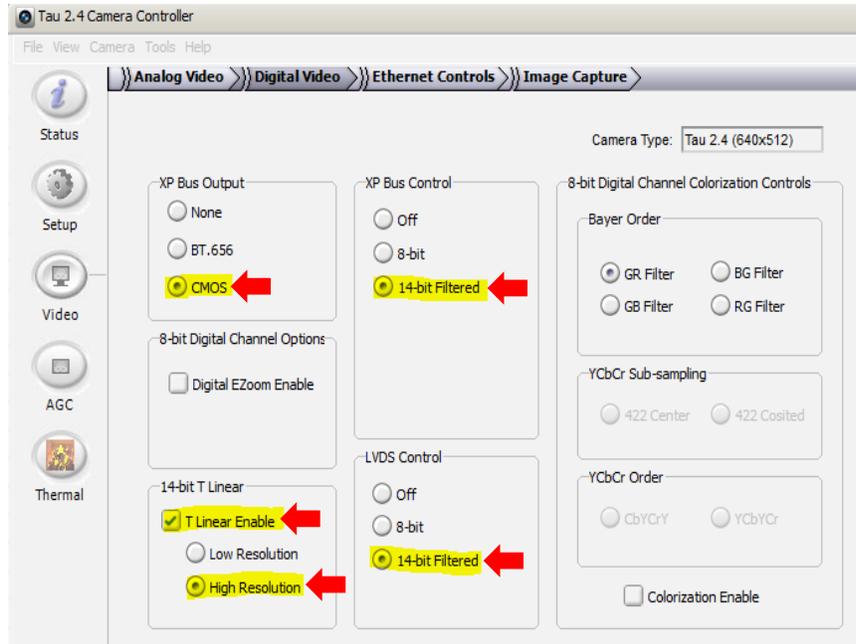


Figure 2: FLIR Camera Controller Interface - Digital Video Tab

3. From the Setup tab, set *Gain Mode* to *Auto*.
4. Click *Save Settings* to save the settings for subsequent restarts.

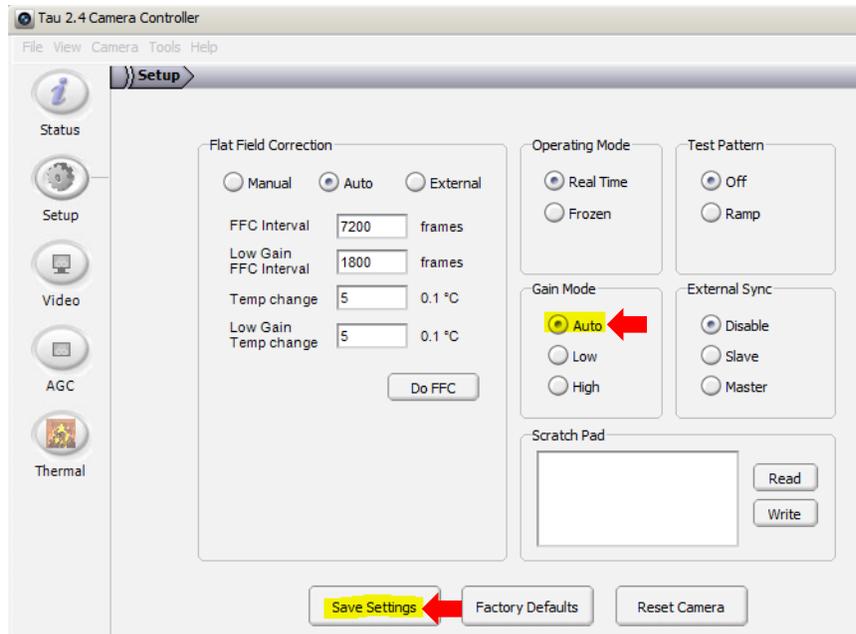


Figure 3: FLIR Camera Controller Interface - Setup Tab



## 4 DRS Tamarisk Precision Superframe Setup

The DRS Tamarisk Superframe is supported in firmware 2.22.15 and later. This has currently been tested on the 320 version of this camera (the 640 is not available).

From the main menu in Panel Plus, go to *Configure » Aquisition settings* and use the following settings shown in [Figure 4](#).

Camera Index: **Cam 2** ← Cam 0 or Cam 2

Camera Type: **Generic Digital** ←

Frame Step: **0**

**Apply**

Hit *Apply*, then *Save Parameters* and cycle power. Check for errors in menu [View >> User Warnings](#)

Generic Digital Settings (Applys to CameraType: Generic Digital Only)

AutoFill: [Dropdown]

Height: **240** ← Width: **320** ←

Vertical Front Porch: **0** Horizontal Front Porch: **320** ←

Resulting Flag Bits **0x80**

Bit Depth: **16** ←

Input:  Gray Scale  YUV color  G8 16bit in  Bayer  Laser  Interlaced  Byte Swap

Invert V-Sync Polarity  Invert H-Sync Polarity  UB0 Sync/Crop: **None**

Camera Init Code: **InitDRS** Options: [Text Box]

Big: Height **0** Width **0** Vertical Blanking **0** Horizontal Blanking **0**

Figure 4: DRS Tamarisk Precision Superframe Setup (3000-OEM shown)

### 4.1 DRS Superframe Modes and Ranges

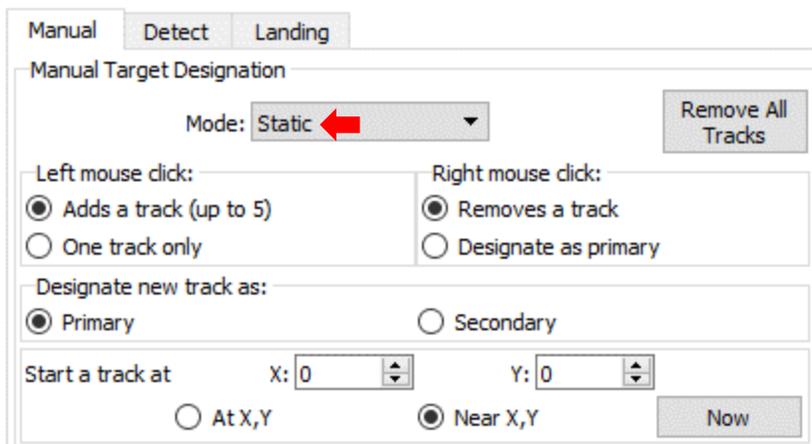
Data output is 16-bits (there are no programmable ranges). Each 16-bit pixel value represents Kelvin temperature as 11.5 fixed point binary. For Celsius, use 16-bit pixel value as the integer, divide by 32.0f, then subtract 273.15.



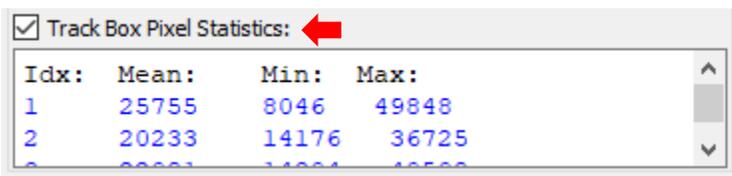
## 5 Measuring Temperature in Regions

Tracking provides mean, min, and max raw digital counts of up to five Region of Interests (ROI) within the image. ROI's can be specified through the Sightline Command and Control Protocol (SVP) Modify Track command (0x05) or by starting tracks with Panel Plus.

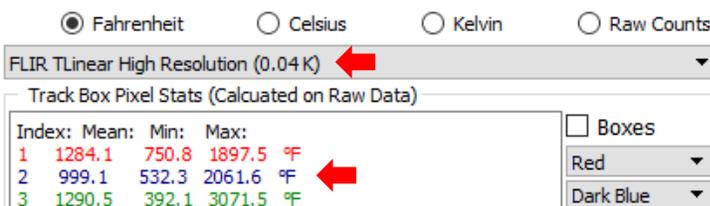
- In Panel Plus in the *Tracking » Manual* tab, set one of the following *Manual Target Designation* modes:
  - Static* for a non-moving location
  - Vehicle* for a moving track
  - Stationary* for a track that stays on a stationary object in the scene



- Click *Show Telemetry* then enable *Track Box Pixel Statistics*. This is needed before starting a track.



- Click the desired region on the image in Panel Plus to start a track.
- In the *Thermal* tab, set the camera type to show the *Mean*, *Min* and *Max* values for each track.



Statistics values are read through the SVP Tracking Box Pixel Stats command (0x78). They are provided if the current camera is a 14-bit digital imager, and the pixels stats output are enabled in the Set Coordinate Reporting Mode command (0x0B).

Conversion from raw digital counts can be done based on the configuration of the IR imager.



## 6 Color LUT Display of User Defined Temperature Regions

The Thermal tab also provides the ability to specify temperature ranges of interest. Freeze the Autogain algorithm to display the desired temperature range. Use the custom color LUT to highlight temperatures of interest.

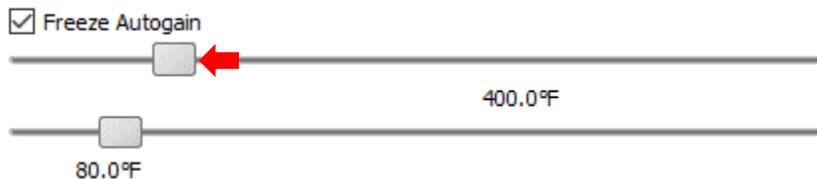
### 6.1 Autogain

Autogain is used to convert a wide range of digital counts to an 8-bit range for display or compression (0 - 255). The default autogain setting maps the current max and min digital counts to 255 and 0 respectively. The autogain range can be locked to a specific region using the Set Digital Camera Parameters command (0x70).

### 6.2 Defined Temperature Range Example

Range and autogain freeze:

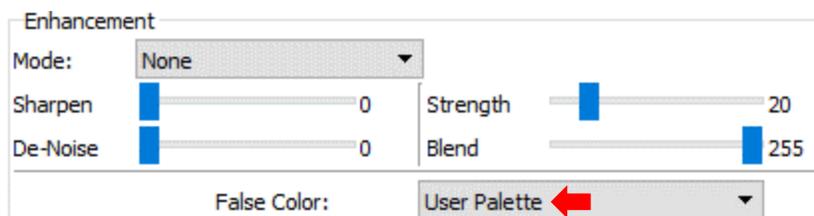
1. The FLIR TLinear camera should be in high resolution mode (0.04 °K/count).
2. Set min temperature of interest to 80°F (300°K = 7500 digital counts).
3. Set max temperature of interest to 400°F (478°K = 11,950 digital counts).
4. Use 0x70 command or the *Thermal* tab in Panel Plus to freeze the autogain at (7500,11950) counts.



- All temperatures below 80°F are then mapped to 0 (8-bit range)
- All temperatures above 400°F are then mapped to 255 (8-bit range)
- Each output count in between now corresponds to a 0.8°F change in temperature.
- Temperature to count conversion is  $(temp-80) * (255) / (320)$ .

Custom LUT setting 0 » 255 counts maps to RGB values (r,g,b):

1. From the Panel Plus *Video* tab, set *False Color* to *User Palette*.



2. Panel Plus main menu » *Configure* » *Edit User Palette*.
3. Initialize the LUT to an incrementing grayscale  $LUT[x] = (x,x,x)$ .
4. Map the range of human temperature (80°F - 100°F )  $LUT[1 - 16]$  to a color range.



5. Map the range of hot-wires (150°F - 200 °F) LUT[56 - 96] to a color range.
6. Map all values above 400°F to pure red by setting LUT[255] to (255,0,0).
7. Click *Send* to send the settings to the board.

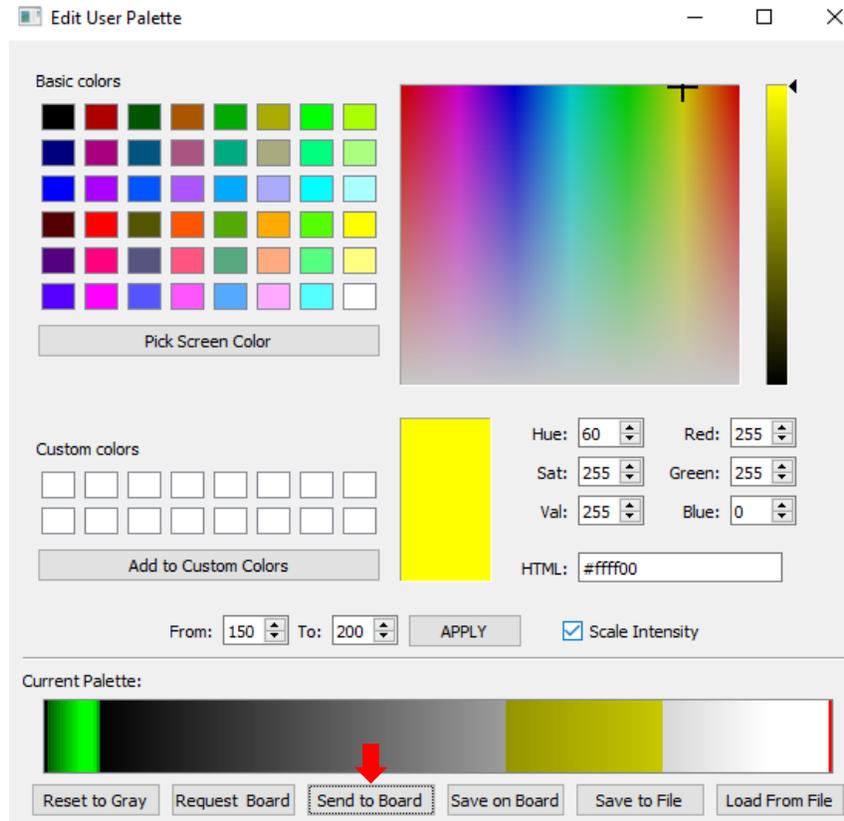


Figure 5: Setting Up a Defined Temperature Range

### 6.3 Auto Gain Calculations Notes

- The auto gain algorithm is used to convert 14-bit camera data into 8-bit data for display and compression. Grayscale data values range from 0 to 16383 (14-bits).
- Define the information content of the scene and scale this range of data into 8-bits (255 counts).
- Standard deviation and mean are suitable measures of information content and are easy to calculate.
- AGC currently uses a spread of 4 standard deviations and uses the mean as the center of the range, i.e., +/- 2.0 standard deviations about the mean.



## 6.4 Brightness and Contrast

Brightness and contrast can be adjusted in the *Video* tab of Panel Plus. These settings are used to adjust the spread and center of the region used for autogain. *Contrast* is used to scale the spread of the data. A higher contrast setting results in a smaller spread of data. *Brightness* is used to adjust the center of the region used for autogain.



Figure 6: Brightness and Contrast

## 7 Smoothing Filter

If the spread and center were to be calculated and then new values applied to every frame, the image would change levels very quickly and the video quality would degrade. Instead, the max and min values of the data range to be displayed are calculated, and then both are run through a smoothing filter with a time constant of  $\sim 1$  second. These smoothed values are then used to calculate the spread and center of the current AGC calculation.

 To freeze the autogain, or preset a specified max and min count, overwrite the filter output with a constant max and min value from the *Thermal* tab in Panel Plus.

## 8 16-Bit Grayscale PNG File Snapshot

It is possible to capture snapshots of the raw 16-bit camera data to the microSD Card inserted into the port on the SLA board. This will enable conversion of each pixel element of the snapshot into full resolution temperature data.

### 8.1 PNG File Features

- Lossless compression
- Support for 16-bit grayscale
- 16-bit grayscale PNG files can be displayed in most image viewer software
- Viewer software normally only displays the top 8-bits (most images appear black with faint imagery)
- Scenes on TLinear Tau around 100°F are  $\sim 8000$  counts. This gives an intensity of 32 out of 255 counts in the upper 8-bits.
- Support for RGB data
- Support for user chunks of binary data (this is where MISB metadata is stored)
- 16-bit PNG files can be imported into Matlab via `imread()` function



## 8.2 SLAPanel Snapshot Mode

This mode allows for the selection of a JPG or PNG output format. See the [EAN-File Recording](#) document for digital 14-bit camera data. PNG output selection will result in a 16-bit Grayscale PNG file. *Capture* must be selected as the image source. All other cameras (including 8-bit digital) will output and RGB PNG file. If *Display* is chosen as image source, the output will always be an RGB PNG file.

An example of decoding PNG 16-bit imagery is included in the SLADecoder installer.

Full source and libraries (open source) are provided as an example of how to decode the 16-bit PNG data and convert it to temperature. The code is provided to decode MISB lat/lon data that is tagged in each PNG file (this data must be provided to the 1500-OEM during acquisition).

## 8.3 SLADecodePng

- Visual Studio 2008 windows application. Easily ported to Linux. Includes libpng and zlib source (open source)
- Decodes and auto-scales PNG 16-bit data for display. Displays temperature data
- Extracts MISB klv metadata user chunk and decodes sensor latitude and longitude for display as an example
- Example 16-bit PNG taken from FLIR Tau 2 TLinear with MISB KLV is included
- Contains link where MISB KLV metadata spec can be downloaded

 For more information contact [Support](#) for a demonstration video of the decode process.

## 9 Questions and Additional Support

For questions and additional support, please contact [Technical Support](#). Additional support documentation and Engineering Application Notes (EANs) can be found on the Support pages of the SightLine Applications [website](#).