SightLine APPLICATIONS

EAN-Lens Focus Control

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Alerts

The following notifications are used throughout the document to help identify important safety and setup information to the user:

⚠ **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 how to configure SightLine video processing boards for controlling motorized lenses using built in lens drivers. The Panel Plus application is used to configure the SightLine hardware communications to the connected lens. Once configured, the lens can be zoomed in and out manually, or the auto-focus feature can be used to drive the lens.

Before starting this procedure, the SightLine hardware should be connected to one of the supported motorized lenses through a serial port or directly through a SightLine camera adapter board.

This process may also helpful as a reference for creating customized lens controller software. See the Focus Metrics section for more information.

1.1 Additional Support Documentation

Additional Engineering Application Notes (EANs) can be found on the Documentation page of the SightLine Applications website.

The Panel Plus User Guide provides a complete overview of settings and dialog windows located in the Help menu of the Panel Plus application.

The Interface Command and Control (IDD) describes the native communications protocol used by the SightLine Applications product line. The IDD is also available as a PDF download on the Documentation page under Software Support Documentation.

1.2 SightLine Software Requirements

ⓘ **IMPORTANT:** The Panel Plus software version should match the firmware version running on the board. Firmware and Panel Plus software versions are available on the Software Download page.

1.3 Application Bit Requirements

The functions described in this EAN require Application Bits (app bits) purchased from SightLine. App bits 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 Sales.

Table 1: Application Bits Requirement Table

Function	Initial Software Release	Required Application Bit(s) v7 License
Focus Telemetry	2.21.xx	Focus Telemetry 0x0000 1000

2 Supported Lens Types and Serial Ports

The SightLine software integrates command and control for a set of known lenses or cameras with integrated lens. This assumes that the lens is connected to a known serial port (e.g., Tamron SC001 can be connected to Serial Port 1 on 1500-OEM). This serial port will automatically be configured to the correct baud rate using the **SetLensParameters (0x6e)** command.

Table 2: Supported Lens Types and Serial Ports

Device	Serial Port		
	1500-OEM	3000-OEM	4000-OEM
Tamron IR Lens (SC001*)	1	NA	NA
VISCA (Sony Block compatible)[1]	2	2 or 3	2 or 6
Hitachi (DI-SC120R compatible)	2	2 or 3	2 or 6

*The Tamron SC001 lens must initially be configured with the Tamron FZ Drive GUI to default to 115.2 kBaud.

2.1 Serial Port Configuration

Serial ports used for lens and camera control should be configured as *Port Not Used* through the Serial Port Settings Dialog in Panel Plus (main menu » Configure » Serial Ports). Lens control is enabled using the Lens tab described below

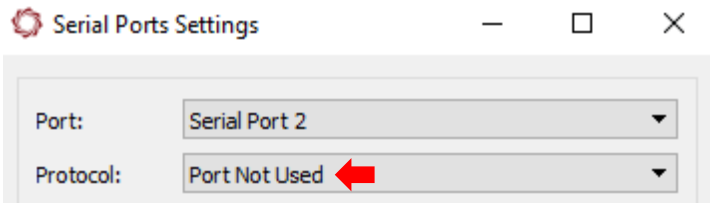


Figure 1: Configure Serial Port as Port Not Used

2.2 Custom Lens Drivers

If developing custom lens driver many of the same principles described below are still valid but will require alternative configurations for serial communications.

3 Configure Lens

3.1 SightLine Lens Control and Serial Passthrough

Presently lens control and serial passthrough features are mutually exclusive and should be used independently of each other. Serial passthrough is often used to send commands from 3rd party software to a camera or lens or other device on the serial port. For example, the lens manufactures' control UI could be used to directly drive the lens where the commands originate on a PC are sent over Ethernet to the SightLine OEM and then passed through to the serial port.

There is an option to set Protocol to Port Not Used for ports being configured for lens control, see Serial Port Summary above.

[1] Also compatible with Tamron MP1010M Compact Block, KZ33G and KZ10G

3.2 Connect to Target Hardware

The process outlined below assumes that all hardware is correctly and safely connected. See the associated startup EANs for additional connection information.

1. Apply power to SightLine hardware.
2. Start Panel Plus on the host PC.
3. From the *Connect* tab, click the *Refresh List* button to get a list of boards on the network.
4. Use the dropdown menu and click on the appropriate board to select it.
5. Click the Disconnected (click to connect) button. Once the connection is successful, the button changes to *Connected*.

See the Troubleshooting section in the startup EANs for recommendations on correcting connection issues.

3.3 Serial Port Configuration

Serial ports used for lens and camera control (above) should be configured as *Port Not Used* through the Serial Port Settings Dialog in Panel Plus (main menu » *Configure* » *Serial Ports*).

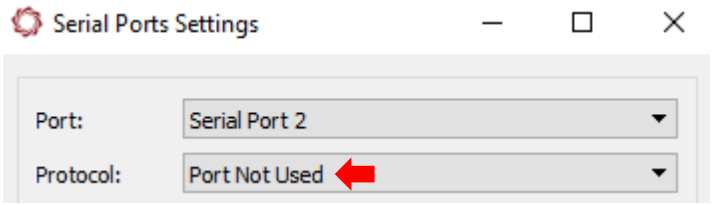
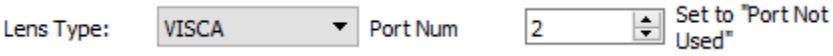


Figure 2: Configure Serial Port as Port Not Used

3.4 Select Lens Type and Serial Port Number

1. Click on the *Lens* tab.
2. Set the *Lens Type*.
3. Set the Serial *Port Num* based on the Serial Port Summary (above).

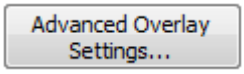


4. From the Panel Plus main menu, go to *Parameters » Save to board.*
5. Go to *Reset » Board*. After resetting the board, the SightLine hardware will initialize the Serial Port for lens communication.

Additional controls on this tab should now be available to control the lens.

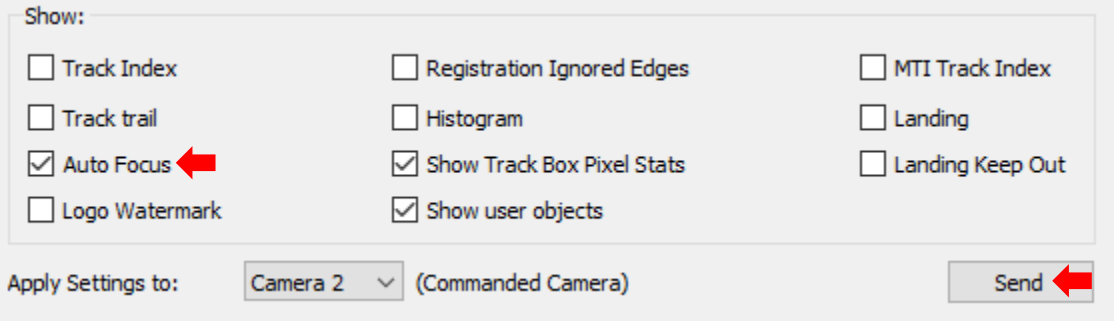
4 Enable Focus Overlays

1. Click on the *Overlays* tab.
2. Click *Advanced Overlay Settings*.



3. Click the *Auto Focus* checkbox and click *Send*.

   Verity that the Commanded Camera is set to the correct camera. This camera will display the autofocus overlays.



   In the main video display window, the region size (green box), AF metric, and the moving average overlays are shown in Figure 6. The moving average is displayed as a less noisy version of the focus metric for better readability.

5 Focus Control

Far Focus farther away.

Near Focus closer.

Position Drive to a known location.

Curr Current encoder position.

Speed Focus change speed.

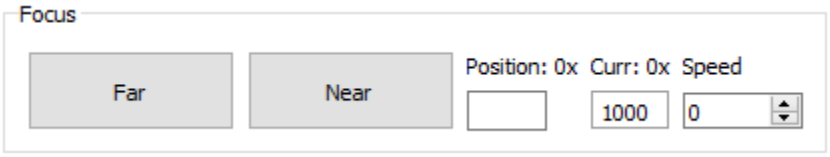


Figure 3: Focus Control

6 Auto Focus Control

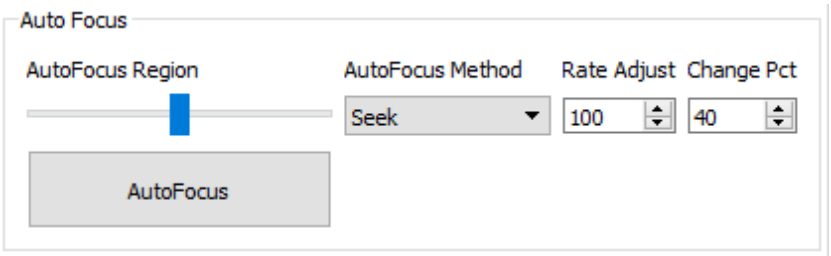


Figure 4: Auto Focus Control

AutoFocus Region	This is the centered size (0% to 100%) of the current view to be used in the focus metric calculation. In most cases it is preferable not to include objects at the edge of the view in the focus metric calculation. The size of this region is indicated with a green box when the focus metric overlay is enabled.
Change Pct	When using *Seek* in *AutoFocus Method*, this value (0 to 100) is the percentage of change in the focus metric that is considered significant enough to indicate that the focus metric is going in the right (or wrong) direction.
AutoFocus Method - Seek	Searches near current focus. Start by moving the focus in the far direction until the focus metric changes more than the value set in *Change Pct*. • **If the focus metric is increasing:** Keep moving in this direction until the focus metric starts to decrease by the value set in Change Pct, e.g., moving up the hill then down the hill. • **If the focus metric is decreasing:** Change directions until the focus metric increases and then decreases by the value set in Change Pct.
AutoFocus Method - Scan	Start by moving the focus to the far focus limit. Scan the full range to the near focus limit. Look for the peak focus metric over the entire range. This method may be problematic due to defocused imagery at the limits of the focus travel being noisy. Depending on the focus metric chosen, this noise can produce high metric values.
Rate Adjust	Denotes how fast the focus moves when seeking (0 to 255). *The focus rate may need to be slowed down using a lower value to get fine enough sampling of focus metrics to determine the peak metric.*
AutoFocus	Click to run the auto focus feature.

7 Zoom Control

Narrow	Zooms in.
Wide	Zooms out.
Track Focus	Stops when focus metric reaches peak threshold.
Zoom Position	Drives lens to a specific encoder position.
Curr	Current position of lens encoder.
Zoom Speed	Denotes the rate at which the lens encoder moves.

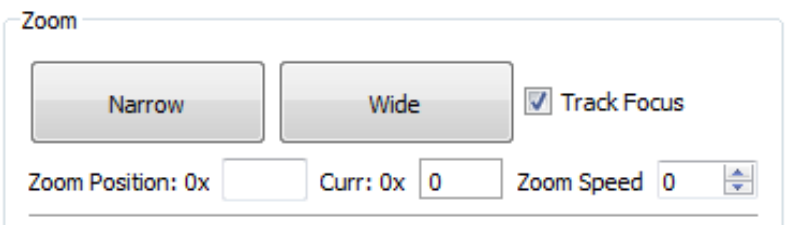


Figure 5: Zoom Control

8 Working with Focus Metrics

8.1 Adjusting Focus Parameters

In the *Lens* tab use the slider control in the *Auto Focus* dialog window to control the region size. The region size (shown in the green box in Figure 6) is the percent of the screen used to calculate the focus metric. Adjusting this helps ignore objects at the edge of the screen that have a different focus position that negatively affects the focus metric of an object of interest at the center of the screen.

AF Metric: The actual focus metric returned by the hardware.

Mov Avg: The moving average is a running average calculated by the software to provide a less noisy estimate of the focus metric.

The moving average is only intended to make the current focus metric easier to read on the overlay.

See Enable Focus Overlays for steps to enable the overlays shown below

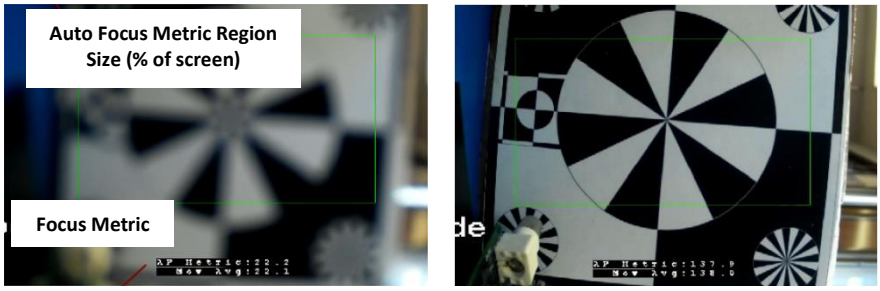


Figure 6: Focus Metrics Overlay in Panel Plus

1. To enable focus metric telemetry so the focus metric is output in the telemetry stream:
   a. Click on the *Tracking* tab.
   b. Click *Show Telemetry*.
   c. Click the *Auto Focus and Brightness* checkbox.
   d. Set *Send Telemetry Every [N] Frames* to *1*.
      - To configure or change the *Auto Focus* metrics:
      - *Configure* » *System Value*.
      - *System Value = 3: FOCUS_METRIC*
      - *FOCUS_METRIC Value0* options:
      - *Value0* = 3: *Variance of Laplacian*
      - *Value0* = 4: *Variance of Sobel*
      - *Value0* = 5: *Variance of Brenner*
      - *Value0* = 6: *Variance of Sobel8*
      - *Value0* = 7: *Variance of Brenner8*
2. See the next section for more information on *FOCUS_METRIC* filter options.

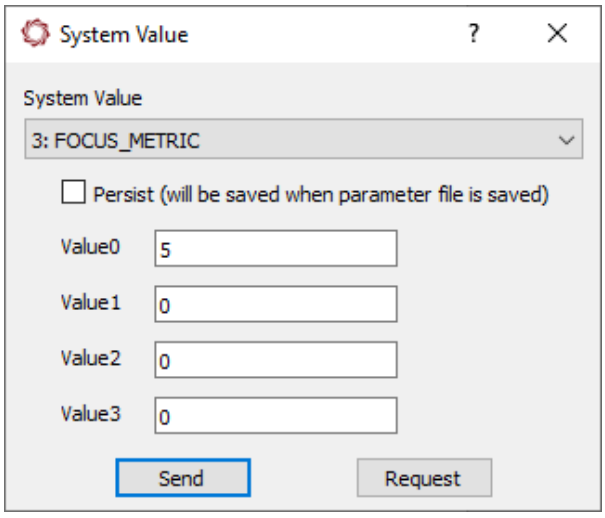


Figure 7: System Value

9 Focus Metrics

The software can report image statistics for creating a custom camera lens control driver. The focus metric reported is based on one of three calculations done over the full image or a specified image sub-region:

- The variance of the Laplacian filtered image (3). A good description is located at pyimagesearch.com. This filter looks for transition edges. It can have less of a peak than the other two measures, especially for noisy sensors such as an uncooled LWIR.
- The variance of the Sobel filtered image (4). This filter looks for vertical and horizontal edges.
- The variance of the Brenner filtered image (5, default) This filter also looks for vertical and horizontal edges but is somewhat more sensitive to diagonal edges and may be somewhat more sensitive to noise. This is the default and recommended focus metric.
- The variance of the Sobel8 filtered image (6). This filter is the same as Sobel, but the metric and image variance are scaled up by 8 bits (256) for 16-bit images.
- The variance of the Brenner8 filtered image (7). This filter is the same as Brenner, but the metric and image variance are scaled up by 8 bits (256) for 16-bit images.

Searching for the best focus generally requires some combination of sweeping to avoid finding a local maximum and gradient searching.

9.1 Focus Associated SightLine Protocol Commands

See the IDD for the associated SightLine Protocol Commands:

- Set the focus search region size: **Set Lens Parameters (0x6E**) and **Current Lens Params (0x6F).**
- Set the Focus Metric algorithm: **Set System Value (0x92).**
- Show auto focus metrics and region of interest (ROI): **Set Overlay Mode (0x06).**
- Enable Focus Stats (0x55) focus measurement: **Set Coordinate Reporting Mode (0x0B).**
- Focus metrics, mean, and variance for each camera index: **Focus Stats (0x55).**

Related commands:

The following two commands can be used to directly control the lens position, or interpreted by a custom lens control driver running onboard which in turn drives a custom lens:

- **Set Lens Mode (0x6C)**
- **Current Lens Status (0x6D)**

10 Example Code

SightLine has provided an example for creating a custom lens control driver as part of the LUA scripts examples. Onboard automated lens control provides faster feedback for driving the lens to a position.

The LUA lens control example code implements a full example of an autofocus algorithm. The integrator only needs to implement the focus/zoom control protocols to get a basic autofocus algorithm functioning

Example protocols for Sony (VISCA) and Hitachi are included as an example. Implementing the lens control protocol in LUA will additionally allow focus and zoom control using the controls in *Lens* tab of Panel Plus.

Some specific focus commands are required to successfully implement autofocus. The same commands are necessary for zoom if using the focus/zoom controls in Panel Plus.

- **Focus Slew**: Starts moving focus near (or far) at a specified rate. Automatically report focus position. Autofocus requires correlating focus position with focus metric.

  It is beneficial to report the lens focus position once per frame to allow the fastest autofocus operation.

- **Focus Stop**: Stops moving focus when in slew focus mode. Reports current position when stopped.

The *sonyctrl_internal.lua* script implements the full set of focus/zoom commands that are necessary for full lens control. SightLine recommends using this as a guide for implementation.

11 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 Documentation page of the SightLine Applications website.