



SightLine

APPLICATIONS

EAN-Performance and Latency

PN: EAN-Performance and Latency

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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 use the Performance Graph features to measure processing time and latency on the 1500-OEM and 3000-OEM boards. The performance monitoring graphs are useful for identifying problem areas and analyzing system performance.

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-RTSP](#): Describes how to use various commercial off-the-shelf media players and VMS (Video Management System) software to stream video from the RTSP server running on 1500-OEM or 3000-OEM systems.

[EAN-Decoder](#): Describes how to configure the 3000-OEM as a video decoder.

[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

The Performance Graphs feature requires version 2.22.xx and higher.

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

2 System Performance

2.1 Processing

Processing on the SLA boards is divided into two categories:

- Analyze: Registration, stabilization, tracking, and detection and other non-display processing.
- Render: Enhancement, blending, rotation, digital zoom, overlays, encoding, and other display processing.



3000-OEM:

- 1080p/60 video can be processed and streamed with encoder + KLV configurations.
- 1080p/30 video can be processed and streamed with any processing function configuration and maintain full frame rate. Single video stream case.
- A 1080p/30 + 720p/30 second channel can be processed and streamed with any processing function configuration while maintaining full frame rate, e.g., in a dual video stream use case.

2.4 Glass-to-Glass Latency Values - General Expectations

Example system configurations for glass-to-glass latency are shown in the tables below.

Table 1: 1500-OEM Glass-to-Glass Latency

Software Release	Camera	Input Format	Output Format	Encoder/ Display	Latency
2.24.7.39064	Analog	NTSC	Analog NTSC	tv-small	130
2.24.7.39064	Analog	NTSC	480p	H.264	145
2.24.7.39064	Analog	NTSC	480p	RTP H.264	150
2.25.4.43906	Hitachi	720p	480p	H.264	170
*2.25.4.43906	Hitachi	720p	720p/15fps	H.264	200

Note on latency for 720p in/out: The 1500-OEM cannot maintain 30fps with 720p input. See frame rate notes above.

Table 2: 3000-OEM Glass-to-Glass Latency

Software Release	Camera	Input Format	Output Format	Encoder/ Display	Latency
2.24.7.39064	Analog	NTSC	NTSC	tv-small	145
2.24.7.39064	Analog	NTSC	480p	H.264	145
2.24.7.39064	Bench HD-SDI	720p	720p	H.264	145
2.24.7.39064	Bench HD-SDI	1080p	1080p	H.264	210
2.24.7.39064	Bench HD-SDI	1080p	1080p	RTP H.264	210

Table 3: 3000-OEM Glass-to-Glass Latency with HDMI Monitor

Software Release	Camera	Input Format	Output Format	Display	Latency
2.25.1.42458	Bench HD-SDI	1080p 30	1080p 60	HDMI	190
2.25.6.44688	Bench HD-SDI	1080p 30	1080p 30	HDMI	230
2.25.6.44688	Bench HD-SDI	1080p 25	1080p 25	HDMI	245
2.25.6.44688	Bench HD-SDI	720p 50	720p 50	HDMI	180
2.25.6.44688	Bench HD-SDI	720p 60	720p 60	HDMI	160



3 Performance Optimization

It is important to run a consistent frame rate. For SLA-hardware, providing gimbal feedback at a regular rate, not occasionally skipping a frame will improve control loops. Motion in output video with inconsistent frame rate tends to look erratic e.g., 15 Hz can look better than 23 Hz.

3.1 Optimizing Performance

Use the performance graphs to monitor telemetry rate, display frame rate, processor load and process tree. If the telemetry and/or display rate is at an in-between rate, i.e., 21 Hz, and the processor has a high load, improvements to the system performance can be made by changing parameters and setting frame steps.

3.1.1 Video Compression

1500 OEM: Video compression takes significant DSP processor time. Using lower resolution, frame step and a faster codec will reduce this impact. MPEG4 uses less processor time than H.264 with low impact to bitrate and quality. MJPEG uses even less processor time, but at the expense of higher bitrate.

3000-OEM: Video compression does not significantly impact processor load.

3.1.2 Image Rotation, Zoom, Rotation Stabilization

Enabling image rotation, zoom or rotation stabilization increases the render time. If these features are not being used, turn them off.

3.1.3 Video Enhancement

Video Enhancement increases render time. Turn it off if it is not being used.

3.1.4 Detection

Detection uses more downsample, smaller search area, and frame step to reduce processor time. This will impact detection sensitivity.

3.1.5 Multiple Displays

Multiple display impacts processor load and latency. Turn off unused outputs, e.g., network + analog » network only.

3.2 Frame Step

Frame step is set up in the *Acquisition Settings* tab. The render and display frame step are set up in the *Compression* tab.



3.2.1 Capture Frame Step

From the main menu, got to *Configure » Acquisition Settings*. Setting *Frame Step* to a value less than 1 throws away frames as they are captured. Analyze and render will not process the discarded frames. This is most useful for a smooth display frame rate.

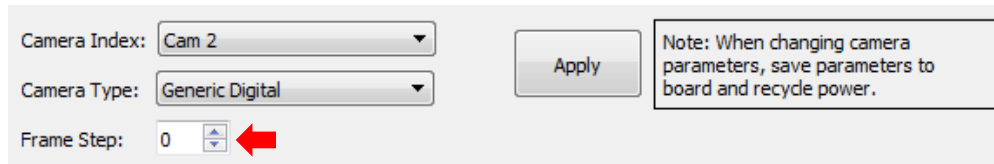


Figure 2: Capture Frame Step

3.2.2 Render and Display Frame Step

Render and display frame step are set in the *Compression* tab. Setting the frame step to value less than 1 skips frame rendering and display. Analyze still processes all frames, but some frames are not rendered or displayed. This is most useful when using full rate telemetry for control and still being able to save processing cycles.



Figure 3: Render and Display Frame Step

3.2.3 Frame Step Optimization (SLA systems for gimbal control)

If the camera is 60Hz, set the capture frame step to 2.

 *In some setups, it may be possible to run at 60Hz with the 3000-OEM.*

If the system is not able to output full frame rate telemetry, increase the render and display frame step to 30 Hz telemetry to get a smooth display frame rate.

3.2.4 Frame Step Optimization (SLE systems for display)

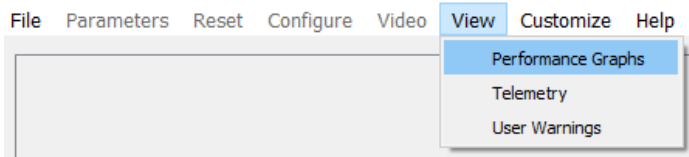
Increase the capture frame step as necessary to get a smooth display frame rate.



4 Using Performance Graphs

4.1 Configuring Panel Plus

1. Connect to the board using the Panel Plus application. See the [1500-OEM Startup Guide](#) or the [EAN-Startup Guide 3000-OEM](#) for connection instructions.
2. From the main menu in Panel Plus, go to *View » Performance Graphs*. A separate window opens that displays the performance monitoring areas (see [Figure 4](#)).



3. To enable/start system monitoring, check the following boxes at the top of the window:
 - *Enable System Status*: Shows the processor loads and frame rates at the bottom left.
 - *CPU Timing*: Displays process timing for major functions.
 - *Detailed CPU Timing*: Displays process timing for low level functions.
 - *Show High Low*: Displays the minimum and maximum in the Load Plot.

4.2 Performance Monitoring Areas

The *Performance Graphs* window ([Figure 4](#)) displays four performance monitoring areas:

- *Process*: Displays CPU execution time broken down by function and latency type.
- *Time Data*: Displays a graph of the process functions, matched by color.
- *Loads*: Displays processor load, temperature and frame rate.
- *Load Plot*: Displays a graph of the Loads information.

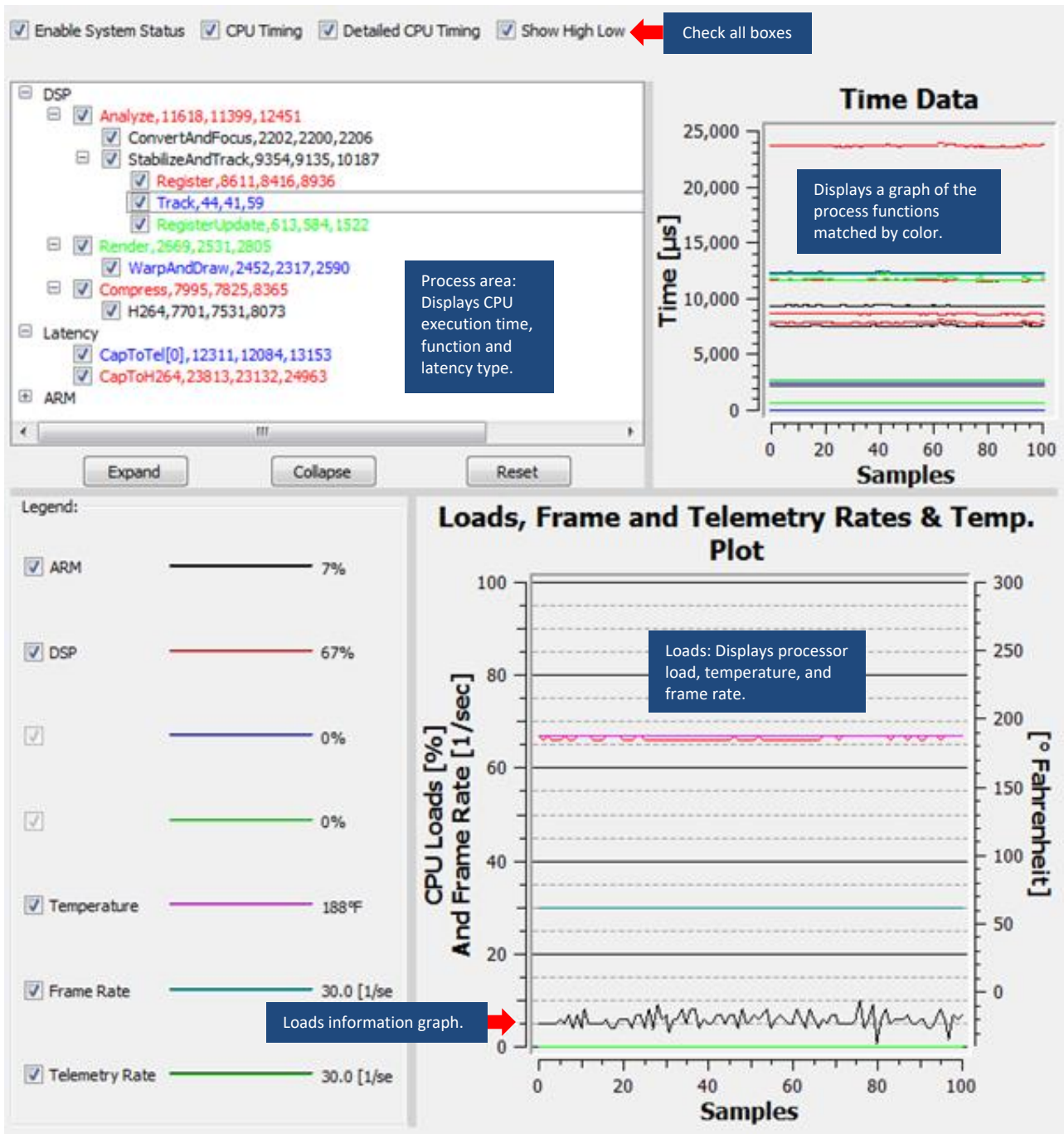


Figure 4: Performance Graphs



4.3 Process Area

All the timings show the average, minimum, and maximum execution time or latency in microseconds. Labels and can be expanded by clicking on the + sign. The data for each is collected and updated every few seconds.

The list order of the process areas (analyze, compress, render, etc.) may vary depending on when the monitor begins to poll the CPU.

Click Reset to clear out stale categories as setting are changed.

4.3.1 Example Process Tree (1500-OEM)

DSP: Displays Ave, Min, and Max time to run each processing function each frame.

↳ Analyze (register, track, etc., average 3.243 ms)

↳ Compress (encoding h.264, average 17.664 ms)

↳ Render (enhance, rotate, draw graphics, etc., average 4.860 ms)

ARM: In most cases the ARM processor is not the limiting factor in system performance.

Latency: Internal time between capture frame completion and video or telemetry output.

↳ CapToTel: Time from capture to sending telemetry to network or serial (average 4.266 ms)

↳ CapToH264: Time from capture to putting H.264 video on the network (average 27.874 ms)

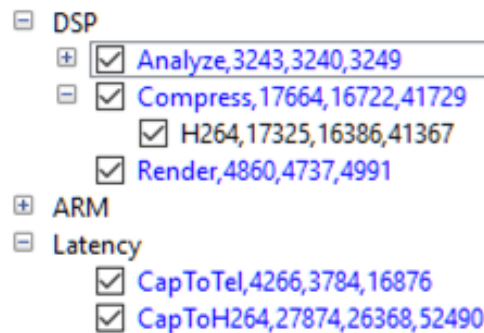


Figure 5: 1500-OEM Example Process Tree

When a system is running at full frame rate (typically 30 fps), CapToTel will be close to the analyze time in the DSP tree and CapTo H264 will be close to the sum of Analyze, Render, and Compress in the DSP tree. When a system is running below full frame rate, the latencies will be higher due to frame buffering.

Additional communications and processing steps add small amounts of latency. These values will not add up exactly to the latencies shown.



4.3.2 Example Process Tree (3000-OEM)

The 3000 has multiple DSPs and up to two simultaneous video chains. It also has a dedicated hardware encoder which contributes to latency, but not to DSP processor load for video compression.

DSP: Helper DSP when DSP1/2 are enabled, primary DSP for low power mode.

DSP1: Video processing routines for the first camera.

DSP2: Video processing routines for the second camera.

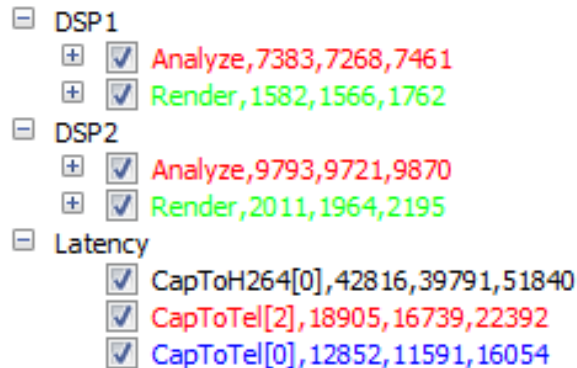


Figure 6: 3000-OEM Example Process Tree

DSP1: Cam 0 Ave, Min, and Max time in (us) to run each processing function each frame.

↳ Analyze (register, track, etc., average 7.383 ms)

↳ Render (enhance, rotate, draw graphics, etc., average 1.582 ms)

DSP2: Cam 2 Ave, Min, and Max time (us) to run each processing function each frame.

↳ Analyze (register, track, etc., average 9.793 ms)

↳ Render (enhance, rotate, draw graphics, etc., average 2.011 ms)

Latency: Internal time between capture frame completion and video or telemetry output.

↳ **CapToH264[0]:** Network 0 time from capture to putting H.264 video on the network (average 42.816 ms)

↳ **CapToTel[2]:** Cam 2 time from capture to sending telemetry on the network (average 18.905 ms)

↳ **CapToTel[0]:** Cam 0 time from capture to sending telemetry on the network (average 12.825 ms)



5 Measuring Decoder Latency with Performance Graph

The 3000-OEM can be configured to be used as a decoder as described in [EAN-Decoder](#). The decoder is supported in software version 2.25.xx and higher.


Follow the steps in [EAN-Decoder](#) to configure the 3000-OEM to support the IP camera input using Panel Plus software. Configure the 3000-OEM to either receive video from a Network Source or from the MicroSD card.

Once the decoder starts receiving video the Performance Graph can be used to measure the latency involved in decoding frames. See the [Performance Monitoring Areas](#) section for Performance Graph monitoring. A sample performance graph when the 3000-OEM is configured as a decoder is shown in [Figure 7](#).

In this example, camera 0 is configured as a decoder that receives a 1280x720 video over the network from another 3000-OEM.

CapToDecoded time is the time difference between receiving a compressed frame of video and when the decoder returns with an uncompressed frame.

CapToTel is the time difference between receiving a compressed frame of video and sending telemetry data to the network or serial port.

 *The CapToTel time starts as soon as the uncompressed frame is received. This includes the time to decode the frame.*

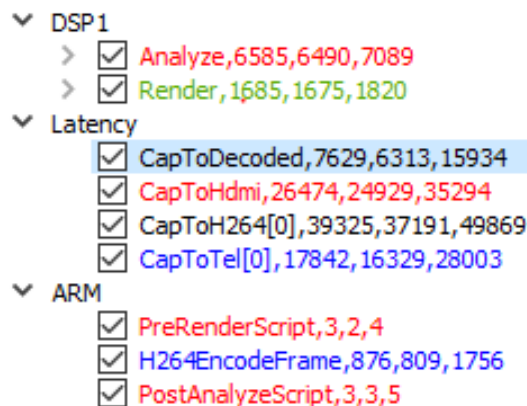


Figure 7: Performance Graph for Decoder



6 Measuring System Latency

This section describes different methods to setup and perform latency tests using an oscilloscope and online digital clocks. Two examples of digital clocks are available at [Flash Clocks](#) and [Java Script Clock](#).

A connection to the video processing board using the Panel Plus application is required. See the [1500-OEM Startup Guide](#) or the [EAN-Startup Guide 3000-OEM](#) for connection instructions.

6.1 Oscilloscope Latency Test


Follow the steps below to measure end-to-end latency using an oscilloscope and blinking LED configuration. Correct measurement requires a blinking LED with blinking interval ~ 1 sec.

1. Connect the LED light green cable to CH1 ground on the oscilloscope. Connect black/brown LED light cable to the probe.
2. Power on the oscilloscope and LED light.
3. Tape the LED light close to the camera lens.
4. Position the Panel Plus display to center on the LED. Press the *Autoset* button on the oscilloscope. The display should show a pulse on CH1 after a few seconds. The pulse should remain in the same location on the oscilloscope display. If the display is not showing the pulse, use the CH1 menu and make sure the following parameters are correct:
 - Trig on downslope
 - X10 on probe (check the probe)
 - Normal trigger mode
 - DC Coupling for channels (looks better)
5. Tape the sensor to the monitor. Position the Panel Plus display to center on the taped sensor. Plug in the 5.7 V power. Connect CH2 ground to one side of the sensor resistor and the CH2 probe to the other side of the resistor.
6. Locate the CH2 pulse with the oscilloscope. If it is at the top of the oscilloscope display, the pulse is too large. Select CH2 and use the *Position* knob and CH2 position to move CH2 into view and show a good pulse.
7. Go to the *Trig* menu. Set the following settings:
 - Slop: Falling
 - Trig Mode: Normal
 - Source: CH1Move the horizontal trigger line anywhere on the CH1 pulse. Move the pulses to the left using the round knob on the oscilloscope.
8. Measure the difference between the two pulses. Press the *Cursor* button on the oscilloscope, and then moving the cursor of CH1 to the start of edge transition (falling edge) of the CH1 pulse. Move the cursor of CH2 to the start of edge transition (falling edge) of the CH2 pulse. Type should be *Time*.
9. Use the *Acquire* button and select *Average*. Average is set to 16 by default.
10. Use the cursor button and place the falling edge of the cursor to the midpoint of the start of the edge transition of CH2. The falling edge should change slowly at first. Wait until the curve is formed before reading the delta. This gives the average, versus a range (the CH2 pulse edge changes) from the previous step.



6.2 Online Millisecond Clock Latency Test

1. Use any online digital clock available on the web.
2. Stream network video and decode with Panel Plus.
3. Overlap the millisecond clock on the web page with Panel Plus.
4. Use the Snipping Tool and create a screen capture.
5. Subtract the two numbers to obtain the latency measurement, e.g., $707 - 540 = 167$ ms.

 *End-to-End Glass latency value depends on several factors other than the SLA firmware and SLA Decoder. Windows OS version, display monitor latency, network configuration, and refresh rate also affect latency.*

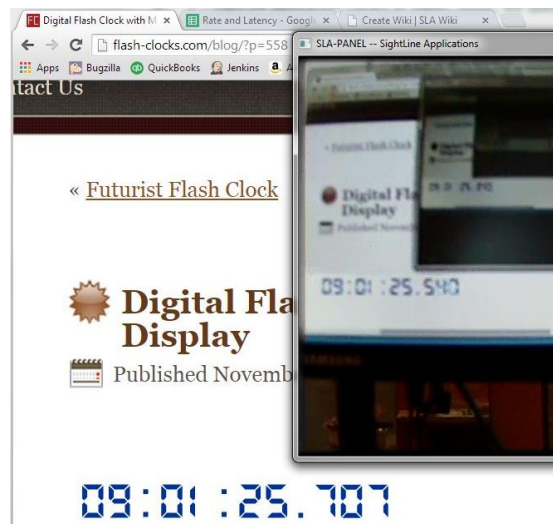


Figure 8: Panel Plus Online Digital Clock Overlap

6.3 RTSP Latency Measurement

See [EAN-RTSP](#) for more information on how configure the VLC application to stream video from the RTSP server running on 1500-OEM or 3000-OEM systems.

1. Use any online digital clock available on the web.
2. Point the camera to the millisecond clock on the web page.
3. Open the VLC application.
4. Go *Tools » Preferences » Input / Codecs » Default caching policy*. In the drop menu select *Lowest latency*.
5. Stream VLC using RTSP. Go to *Media » Open Network Stream*. In the URL field enter the IP address of the SLA board: e.g., `rtsp:\
192.168.1.145\`
6. Use VLC to start streaming the clock. The clock screen should appear twice in VLC.
7. Use the Snipping Tool and create a screen capture.
8. Subtract the two numbers to obtain the latency measurement, e.g., $707 - 540 = 167$ ms.



7 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](#).