

# Lumenera's Industrial USB 3.0 Lt16059H Cameras Selected as Imaging Solution to Monitor Traffic Violations



## Background: Cameras for ITS Applications

The right camera can make or break an Intelligent Traffic System (ITS) application. Too much noise, inaccurate timing, and insufficient sensitivity can all adversely impact the data quality and reliability of an Intelligent Traffic System. The selection of imaging equipment must be done under careful consideration of a wide range of characteristics to ensure accurate data is received for applications such as Red Light Enforcement, Automated Tolling, and Automated Speed Enforcement.

To successfully perform in the domain of ITS, the camera and its output must be versatile, enforceable, reliable, and easy to operate. These were the characteristics that a large ITS solutions vendor was looking for when they approached Lumenera to create a custom imaging solution for monitoring traffic.



## Highlights

- ITS vendor was looking for versatile, enforceable, reliable and easy-to-use imaging solution to monitor traffic violations
- Lumenera's Lt16059H was selected for its high resolution, dynamic range, accuracy, and stability needed to monitor 4 to 5 lanes of traffic with one camera
- Lumenera was able to provide a solution that matched the vendor's unique requirements, such as an auto calibration algorithm, software triggering for minimalistic installation, and pre-processing capabilities within the cameras to produce clear, and enforceable images



## Versatility

The camera selected for any ITS application must be able to perform in a wide range of environments and lighting conditions, from standard day/night operation to more challenging weather such as snow, rain, and fog. The combination of changing weather and varying light must be matched by a camera with excellent dynamic range.

This measurement is typically given in decibels and is the ratio between the number of electrons that can fill one pixel and the number of average noise electrons that are present. The higher a camera's dynamic range, the larger the differences between bright and dark the camera can interpret in a single frame. This should not be confused with the Quantum Efficiency (QE) of the camera, which is equally important in low light detection. QE is the percentage of photons that make it to the camera's sensor that are converted into electrons. The higher a camera's QE, the more sensitive it is to light.



## Enforceability

For an ITS solution to be viable, it must be enforceable under the regulation of the local jurisdiction. For instance, in some US states, a red light violation must be accompanied with dated and time stamped images of the violation as well as video footage of the incident. To achieve these results, the ITS vendor needed to move away from their consumer-level DSLR to something with a more deterministic triggering mechanism and reduce the 250 ms latency that they were experiencing.

They also required a camera with high enough resolution to image multiple lanes of traffic while maintaining a clear shot of the licence plates in order to perform Automated Number Plate Recognition. These high resolution images needed to be free of blurring or smearing, a common symptom of images captured by rolling shutter cameras when vehicles travel at a high rate of speed, as seen in the above photo. This was accomplished using the Lt16059HC with a high resolution image sensor and an electronic global shutter, where each pixel is exposed at the exact same time.



*Jacques Henri Latrigue's photo of a race car taken in 1912 demonstrates the skew generated by a rolling shutter on a fast moving object.*

## Reliability

After experiencing failures subsequent to as little as 100,000 shutter actuations with their DSLRs, the vendor required a more robust solution. Using a consumer product for an industrial application will void the manufacturer's warranty; therefore industrial grade cameras are essential for ITS applications. Furthermore, Industrial cameras typically have electronic shutters, which are far less susceptible to failure since there are no moving mechanical parts. They are also designed for continuous usage to better reflect the application's intended operation and have warranties that are applicable to this end.





## Ease of Use

Having a camera that can be integrated into an ITS application and function with minimal configuration is ideal. Utilizing a standard interface that is plug and play, such as USB 3.0, allows rapid deployment of the application with little effort. The camera's drivers, API and SDK should also be intuitive and robust to permit stable integration with the application's operating system.

The ITS vendor required a camera with minimal physical impact on the area surrounding the installation. The camera and any additional equipment needed to be encompassed in a single enclosure.

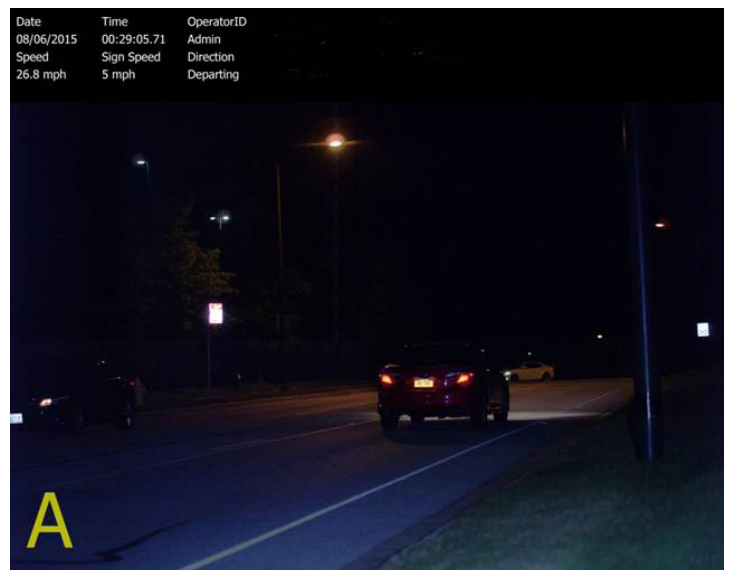
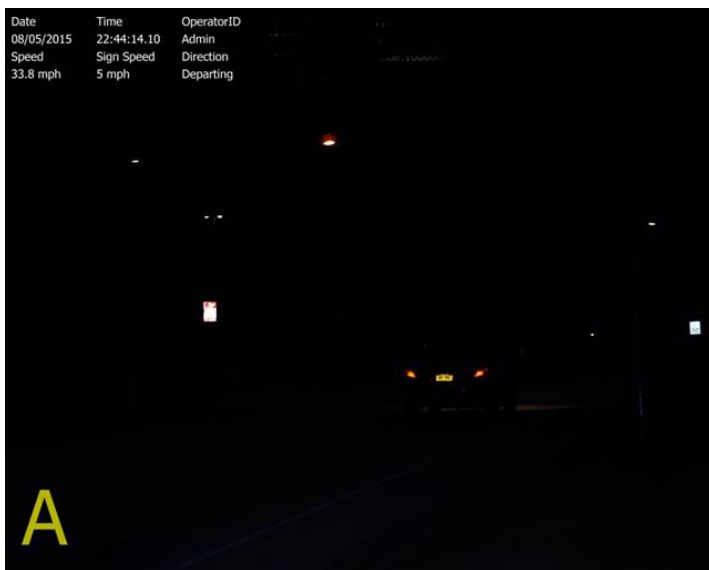


## The Right Fit

For this particular application, Lumenera's Lt16059H was selected for its 16 megapixel resolution (4864 pixels wide x 3232 pixels high), which allowed the ITS vendor to simultaneously monitor 4 to 5 lanes of traffic with one camera.

The Lt16059H is equipped with a 35mm OnSemi KAI-16070 CCD sensor with an electronic global shutter to help reduce smearing and blurring. The larger pixel size ( $7.4 \times 7.4 \mu\text{m}$ ), makes it ideal for low light conditions. The full well capacity of each pixel is roughly 33,700 electrons. Coupled with an industry-leading low read noise of 15.5 electrons, this camera has an excellent dynamic range of almost 67dB.

The Lt16059H is able to capture an incredible amount of detail in scenes with high variations in lighting to produce images that are fully enforceable as traffic violations. This level of enforceability is possible since the image processing is happening within the camera itself and is not post-processed by additional software.



*Pre-processing the images inside the camera brings out information that would otherwise be lost while remaining enforceable images for evidence purposes. (Left Photo: Before pre-processing, Right Photo: After pre-processing)*



## Continued: The Right Fit

Lumenera's team of engineers also collaborated with the ITS vendor's software group to devise an auto calibration algorithm, which enabled the camera to take multiple sample images every 5 minutes to tweak its exposure, iris, and gain values under varying weather and lighting conditions. This process ensured the camera was using optimum settings for capturing accurate and enforceable images, all while remaining capable of receiving a trigger to capture a violation. It also allowed for a reduction of latency of roughly 5 to 7 ms, compared to the previous DSLR camera, providing deterministic and repeatable results.

The Lt16059H is also capable of software triggering via a video feed for a minimalistic installation approach. The camera can self-trigger via software based rules, reducing the necessity of a ground loop or other external triggering mechanisms. It also retains the ability to be triggered via a near-zero latency (in the order of microseconds) opto-isolated GPIO if pre-existing infrastructure exists, such as a RADAR or LIDAR detector. Both these triggering mechanisms are much faster than DSLR cameras and are extremely deterministic to ensure that the vehicle will be located in the correct position of the frame when the camera is triggered.

Another key element to the selection of the Lt16059H camera for the ITS vendor's application was the camera's Canon EF lens mount. The Lt16059H includes a fully integrated Canon EF lens controller, which offers flexibility via remote control with no external cabling required. This enabled the vendor to automatically and remotely control the iris and focus of the lens via the API. Locking GPIO and USB 3.0 connectors ensure a reliable connection with the host computing platform for installations prone to shock and/or vibrations.

Backed by an industry-leading 4 year warranty, Lumenera's Lt16059H was selected by an ITS vendor as the best imaging solution for their application because of its versatility, accuracy, reliability, and ease of use.

### Lt16059H Product Highlights

- Canon EF lens mount with fully integrated controller for auto focus/iris supported by our API, increases accuracy and flexibility for remote applications
- High quality ON Semiconductor KAI-16070 CCD sensor provides excellent dynamic range and low smear
- Quad tap design for fastest possible frame rates (12 fps at full resolution)
- Fanless body, small footprint and lower power requirements
- Global electronic shutter that captures high quality, high-speed images with zero blur
- Zero loss 256 MB RAM frame buffer for reliable image delivery in demanding situations
- Full streaming uncompressed video and still image captures easily controlled through stable and reliable USB 3.0 device drivers

