Canon® EF Lens Control

Using a high-quality lens is a necessity in any vision application. With the LC-2 Canon® EF lens controller, controlling the lens doesn't require a specific camera to be connected. The ISSI Canon® EF lens controller allows you to operate an EF lens on any camera of your choice.

The ISSI Canon® EF lens controller is designed to operate Canon® EF, EF-S and L series IS auto focus lenses as well as Sigma® and Tamron® EF lenses. The lens controller makes it possible to operate these lenses on non-Canon® cameras.

Rather than give the camera automatic control of focus and aperture, the LC-2 gives that control to the operator. Its Ethernet connection makes communication simple and also allows it to be operated over long distances or via a network connection. The LC-2 control can also be written into existing software for both Windows and Linux via API commands.

ISSI’s Canon EF lens controller can be tailored to fit custom applications for control of Canon, Sigma and Tamron lenses.

Why Lens Control?

Machine vision cameras don’t have great options for remote control lenses. To use an SLR lens on a non-SLR camera meant sacrificing control. With the LC-2 lens control system, you can use any Canon EF lens on a machine vision camera.

- Remotely control Canon®, Sigma® and Tamron® EF/EF-S auto focus (AF) lenses
- Use Canon® EF/EF-S, Sigma® EF and Tamron® EF auto focus (AF) lenses on non-Canon® cameras
- Accurate and repeatable control of Focus, and aperture
- Image stabilization control
- Auto-detection of attached lens and F-number stops with included lens adapter
- 10/100Mbps Ethernet interface
- Multiple controllers can be connected and simultaneously controlled over a network
- Easy to use software interface and TCP/IP API commands for Windows and Linux
- Unlimited programmable preset capability to easily store and recall saved positions on the lens

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Control Box

The control box (LC-2) is used to power and control the attached lens. The control box mounts to a camera using a slotted bracket or adapter. The control box features screw and lock connections for lens adapter and power and an Ethernet port for communication. Its small size allows it to be mounted directly to a camera or within an enclosure. The control box is compatible with all lens adapters.

Lens Adapters

In order to work with a lens directly, a lens adapter is needed to pass communication to the control box. ISSI supplies a variety of lens adapters for the most common camera mounts.

For infinity focus with EF lenses, a flange focal distance of 44.0 mm must be maintained. Flange focal distance is the distance from the lens mounting flange to the sensor image plane. 2D CAD drawings show the overall thickness of each adapter ("B"). Camera datasheets will specify "A" in their mechanical drawings.
Lens Adapter Models

Standard lens mounts are available for the adapters. For cameras with non-standard mounts, customization of the lens adapter is available at an added cost. If the flange focal distance does not equal 44.0 mm with the lens adapter and camera, a separate adapter will be needed or a custom lens adapter will need to be constructed.

**EF-c Lens Adapter (LC-2A-C)**
A popular mount for lower resolution image sensors, the c-mount is a 25 mm threaded optics mount. The front side of the adapter features an EF adapter ring to lock the lens in place and pins to make contact with the pads on the lens. The back side is a male c-mount threaded screw mount which threads directly into a camera lens mount.

**EF-M42x1 Lens Adapter (LC-2A-M42)**
A popular mount for medium to high resolution image sensors, the M42-mount is a 42 mm threaded optics mount. The front side of the adapter features an EF adapter ring to lock the lens in place and pins to make contact with the pads on the lens. The back side is a male M42x1.0 metric threaded screw mount which threads directly into a camera lens mount.

**EF-M42x0.75 Lens Adapter (LC-2A-T)**
The “T” mount is a common lens mount for astronomy cameras and other optical assemblies. The front side of the adapter features an EF adapter ring to lock the lens in place and pins to make contact with the pads on the lens. The back side is a male M42x0.75 metric threaded screw mount which threads directly into a camera lens mount. Also available in short 18mm thickness (LC-2A-T18).

**EF-M58x0.75 Lens Adapter (LC-2A-M58-75)**
The M58 adapter is used on cameras with large format, high-resolution imaging sensors. The front side of the adapter features an EF adapter ring to lock the lens in place and pins to make contact with the pads on the lens. The back side is a male M58x0.75 metric threaded screw mount which threads directly into a camera lens mount.
EF-M42x0.75 Lens Adapter (LC-2A-T18)

The “T” mount is a common lens mount for astronomy cameras and other optical assemblies. This thinner T-mount adapter is 18mm thick, used for applications involving filter wheels in front of the image sensor. The front side of the adapter features an EF adapter ring to lock the lens in place and pins to make contact with the pads on the lens. The back side is a male M42x0.75 metric threaded screw mount which threads directly into a camera lens mount.

EF-M42x0.75 Lens Adapter (LC-2A-WX)

Made specifically to fit Photron mini series fast cameras. The front side of the adapter features an EF adapter ring to lock the lens in place and pins to make contact with the pads on the lens. The back side is a male M42x0.75 metric threaded screw mount which threads directly into a camera lens mount.

Custom Solutions Available

If one of our standard solutions is not compatible with your camera or setup, we can customize a solution that will work. Our full machine shop and electronics lab can tailor a solution to meet your needs.
Compatibility

In addition to the Canon® EF/EF-S product line, the Canon® Lens controller is also compatible with most Sigma® and Tamron® EF lenses. This includes the standard and high-end versions of each lens model but does not include older models with STM motors which are discontinued. The list of tested lenses is kept updated on the ISSI website.

Precision Motors

The lens controller is recommended for use with precision EF lenses. Each manufacturer has their own name for the internal lens motors.

- Canon: USM (Ultra Sonic Motor)
- Sigma: HSM (Hyper Sonic Motor)
- Tamron: USD (Ultrasonic Silent Drive)

These lenses offer the best focus motor quality with fast, quiet and ultra-precise encoders.

Image Stabilization

Shaking causes frame to frame jitter and image blurring. Lens based image stabilization uses floating elements with electromagnets in the lens which move independent of the lens body to reduce blurring caused by unwanted shaking of the lens. For situations where longer exposures are needed or in low-light, image stabilization is advantageous.

- Canon: IS (Image Stabilization)
- Sigma: OS (Optical Stabilization)
- Tamron: VC (Vibration Compensation)

Image stabilization can be controlled via the lens controller as a simple ON/OFF feature.
Camera and Lens Selector

The vision application will determine the type of camera and size of the sensor that will be needed. Once that determination is made, the appropriate lenses and lens adapter need to be determined. The lenses used with the ISSI LC-2 lens controller are designed for digital single-lens reflex cameras (DSLR) used in general and professional photography. There are two common sensor formats for Canon and Sigma cameras: APS-C or Full Frame. Full Frame sensors are equivalent in size to 35mm film (36mm x 24mm) and are typically found in higher-end DSLR cameras. APS-C sensors are cropped to reduce the cost and size of camera bodies. These sensors are cropped from a standard Full Frame format to a 24mm x 16mm (Canon) format.

Third-party cameras used with the lens controller have sensors of varying sizes so selecting the right adapter and lens for your application is critical to image quality in terms of sensor cropping and lens distortions. The APS-C and Full Format sizes can be used as a guide to compare to your camera sensor size when selecting a lens and lens adapter.

**APS-C Format Lenses**
- Canon: EF-S
- Sigma: DC
- Tamron: Di-II

**Full Frame Lenses**
- Canon: EF
- Sigma: DG
- Tamron: Di

Full frame lenses are generally more expensive than those designed for APS-C sensors will provide full use of the larger, full frame size image sensors without lens distortions.
Lens Adapter Selector

Each camera will have its own lens mount or may have a few options for type of lens mount. ISSI lens adapters include most of the common lens mounts available on machine vision CCD and CMOS cameras. The size of the image sensor will determine which lens mount should be used. A lens mount should be selected as to avoid lens distortion or sensor cropping.

<table>
<thead>
<tr>
<th>Lens Adapter</th>
<th>Maximum Sensor Size Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC-2A-C</td>
<td>4/3”</td>
</tr>
<tr>
<td>LC-2A-M42</td>
<td>Full Frame</td>
</tr>
<tr>
<td>LC-2A-T</td>
<td>Full Frame</td>
</tr>
<tr>
<td>LC-2A-T18</td>
<td>Full Frame</td>
</tr>
<tr>
<td>LC-2A-M58-75</td>
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</tr>
</tbody>
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Repeatability

The precision of the lens encoder is a big part of the repeatability of the motor positions on the lens. Higher quality lenses will have more precise encoders, allowing better focus repeatability. Repeatability of focus position is very important in vision applications. Removing the human element from focusing dramatically increases the repeatability. The LC-2 can deliver better than 98% focus accuracy for most EF lenses.

Lenses experience drift in the focus motor position. This causes the encoder position associated with a particular focus point to change. This is not an effect of the controller, but the lens encoder itself.
Sample Lens Performance Data

**Canon EF 400mm f/5.6L USM Lens**

Focus lens. Save focus position. Reboot LC-2 and recall saved focus position. Focus position vs. iteration is displayed.

- Standard Deviation: **0.71%**
- Accuracy: **99.96%**

![Canon Focus Repeatability](image)

**Sigma 150-600mm f/5-6.3 DG OS HSM Lens**

Focus lens. Save focus position. Reboot LC-2 and recall saved focus position. Image sharpness vs. iteration is displayed.

- Standard Deviation: **0.83%**
- Accuracy: **99.17%**

![Sigma Focus Repeatability](image)
**Aperture Repeatability**

Aperture positions are determined from the lens and f/stops calculated in the software.

Aperture accuracy is better than **98%**.
Available with the lens controller are API commands for Windows and Linux. The API commands are based on UDP protocol and the 1339/UDP port is used for communication. These allow the lens controller to be integrated into existing software for existing imaging systems. For integrators of the controller, this is the preferred method of control and communication with the controller where it serves as a component in a larger system.