



NATIONAL INSTRUMENTS ISC-178x Monochrome or Color Smart Camera User Guide

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NATIONAL INSTRUMENTS ISC-178x Monochrome or Color Smart Camera



Product Information

The ISC-178x is a monochrome/color smart camera that requires a 24 VDC power source for operation. It is designed for indoor use only and must not be used at altitudes exceeding 2000 meters. To maintain IP67 conformity, all unused connectors on the ISC-178x must be capped, and the IP lens cover must be screwed firmly into place.

The device has built-in safety protection, but misuse or damage can compromise its safety. It is essential to follow the safety guidelines provided in the user manual. The device must be kept away from live circuits, and equipment covers or shields must not be removed unless qualified to do so. Signal wires connected to the device can be hazardous even when the equipment is turned off. It is essential to disconnect all field power before removing covers or shields.

The device must not be modified or installed with unauthorized parts to avoid introducing additional hazards. It must be cleaned with a soft, non-metallic brush and free from contaminants before returning it to service. Signal connections must be insulated for the maximum voltage for which the device is rated, and maximum ratings for the device must not be exceeded.

The product has been tested and complies with regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications.

Product Usage Instructions

1. Inspect the system for damage on receipt and notify National Instruments if there are any damages.
2. Ensure that the AC input to the external power supply is disconnected before plugging in or unplugging any connector.
3. Ground the unit to minimize the possibility of static electricity damage.

4. Configure the hardware according to the figures provided in the user manual.
5. Ensure that all unused connectors on the device are capped, and the IP lens cover is screwed firmly into place to maintain IP67 conformity.
6. Clean the device and accessories by brushing off light dust with a soft, non-metallic brush. Remove other contaminants with a stiff, non-metallic brush. The unit must be completely dry and free from contaminants before returning it to service.
7. Insulate signal connections for the maximum voltage for which the device is rated. Remove power from signal lines before connection to or disconnection from the device.

GETTING STARTED GUIDE

ISC-178x

Monochrome/Color Smart Camera

The ISC-178x are high-performance smart cameras powered by a 1.58 GHz dual-core Intel Celeron processor. The combination of the onboard processor with a CMOS image sensor provides an easily distributed all-in-one system.

In addition to high-performance image acquisition and processing, you can use built-in digital I/O and industrial communication options for dynamic, real-time communication and integration with industrial automation devices including programmable logic controllers (PLCs), human machine interfaces (HMIs), robotics, sensors, and industrial machinery.

Safety Guidelines

- **Caution** Observe all instructions and cautions in the user documentation. Using the ISC-178x in a manner not specified can damage the model and compromise the built-in safety protection. Return damaged models to NI for repair.
- **Caution** The case of the ISC-178x can become hot and should not be touched while operating. Always allow hot surfaces to cool before touching the ISC-178x.
- **Caution** The ISC-178x must be mounted to a support using the provided mounting holes before operating. Refer to the ISC-178x User Manual for mounting information.
- **Caution** There are no serviceable parts inside the ISC-178x.
- **Caution** The ISC-178x can only be powered using a 24 VDC power source.
- **Caution** Do not use at altitudes exceeding 2000 meters.
- **Caution** To maintain IP67 conformity, all unused connectors on the ISC-178x must be capped and the IP lens cover must be screwed firmly into place.
- **Caution** For indoor use only.

Safety Information

Caution The following paragraphs contain important safety information you must follow when installing and operating the device.

Do not operate the device in a manner not specified in the documentation. Misuse of the device may result in a hazard and may compromise the safety protection built into the device. If the device is damaged, turn it off and do not use it until service-trained personnel can check its safety. If necessary, return the device to National Instruments for repair.

Keep away from live circuits. Do not remove equipment covers or shields unless you are trained to do so. If signal wires are connected to the device, hazardous voltages can exist even when the equipment is turned off. To avoid

a shock hazard, do not perform procedures involving cover or shield removal unless you are qualified to do so. Disconnect all field power prior to removing covers or shields.

Because of the danger of introducing additional hazards, do not install unauthorized parts or modify the device. Use the device only with the chassis, modules, accessories, and cables specified in the installation instructions. All covers and filler panels must be installed while operating the device.

This is a Pollution Degree 2 device. Do not operate the device in an explosive atmosphere or where flammable gases or fumes may be present. Operate the device only at or below the pollution degree stated in the specifications. Pollution consists of any foreign matter—solid, liquid, or gas—that may reduce dielectric strength or surface resistivity. The following is a description of pollution degrees.

- **Pollution Degree 1**—No pollution or only dry, nonconductive pollution occurs. The pollution has no effect.
- **Pollution Degree 2**—Normally only nonconductive pollution occurs. Occasionally, nonconductive pollution becomes conductive because of condensation.
- **Pollution Degree 3**—Conductive pollution or dry, nonconductive pollution occurs. Nonconductive pollution becomes conductive because of condensation.

Clean the device and accessories by brushing off light dust with a soft, nonmetallic brush. Remove other contaminants with a stiff, nonmetallic brush. The unit must be completely dry and free from contaminants before returning it to service.

You must insulate signal connections for the maximum voltage for which the device is rated. Do not exceed the maximum ratings for the device. Remove power from signal lines before connection to or disconnection from the device.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. These requirements and limits provide reasonable protection against harmful interference when the product is operated in the intended operational electromagnetic environment.

This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any changes or modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

What You Need to Get Started

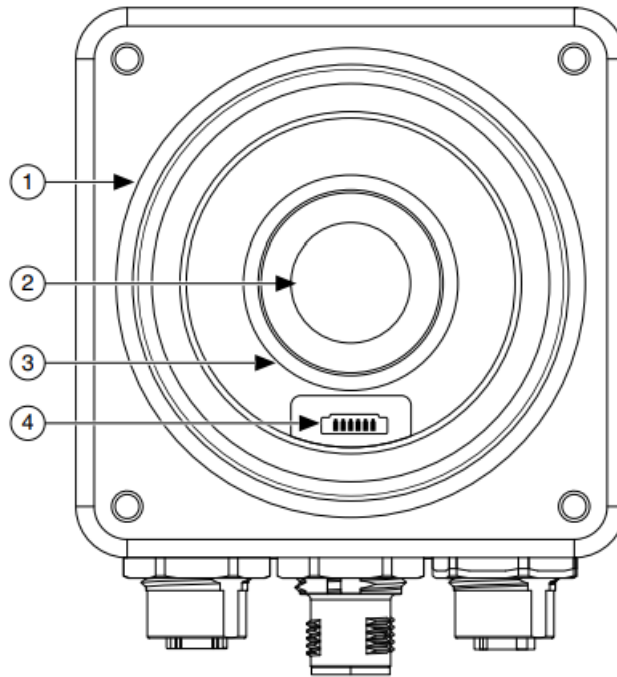
You need the following hardware components to get started with the ISC-178x Smart Camera.

- ISC-178x Smart Camera
- ISC-178x Smart Camera lens
- Starter Kit for ISC-178x Smart Cameras, NI part number 785830-02
 - X-Code M12 to RJ45 Network Cable, 5 m, NI part number 145230A-05
 - A-Code M12 to A-Code M12 Power and I/O Cable, 3 m, NI part number 145232A-03
 - M12 to VGA/USB Splitter Cable, 1 m, NI part number 782022-01
 - Power and I/O Accessory for ISC-178x Smart Camera, NI part number 145227A-01
 - Power Supply, PS-10, 100 VAC to 240 VAC, 24 VDC, 5A, NI part number 782698-01
 - Note Refer to the user manual on ni.com/manuals for more information about accessories for the ISC-

Configuring the Hardware

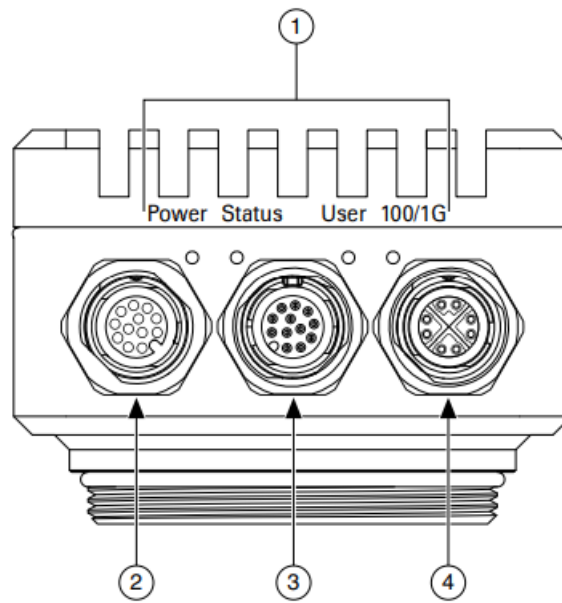
- Remove the ISC-178x from the package and inspect the system for damage. Notify National Instruments if the system appears damaged in any way. Do not use a damaged system.
- Ensure that the AC input to the external power supply is disconnected before plugging in or unplugging any connector. Ground the unit to minimize the possibility of static electricity damage.
- Refer to the following figures while configuring the hardware.

Figure 1. ISC-178x Front



1. Lens cover mount
2. Image sensor
3. C-mount lens mount
4. Varioptic liquid lens connector

Figure 2. ISC-178x Connectors



1. LED indicators
2. Power and I/O connector
3. VGA and USB connector
4. Network connector

Connector Pinout

ISC-178x Power and I/O Connector Pinout

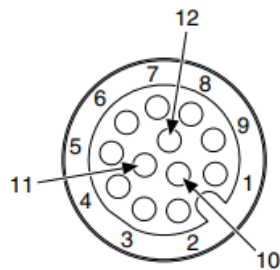


Table 1. ISC-178x Power and I/O Connector Signal Descriptions

Pin	Signal	Description
1	C OUT	Common reference (negative) for isolated outputs
2	Analog Out	Analog reference output for lighting controller
3	Iso Out 2+	General-purpose isolated output (positive)
4	V	System power voltage (24 VDC $\pm$ 10%)
5	Iso In 0	General-purpose isolated input
6	C IN	Common reference (positive or negative) for isolated inputs
7	Iso In 2	General-purpose isolated input
8	Iso In 3	(NI Linux Real-Time) Reserved for safe mode (Windows) General-purpose isolated input
9	Iso In 1	General-purpose isolated input
10	Iso Out 0+	General-purpose isolated output (positive)
11	C	System power and analog reference common
12	Iso Out 1+	General-purpose isolated output (positive)

The following NI power and I/O cables are available for the ISC-178x.

Table 2. Power and I/O Cables

Cables	Length	Part Number
A-Code M12 to A-Code M12 Power and I/O Cable	3 m	145232-03
A-Code M12 to Pigtail Power and I/O Cable	3 m	145233-03

Connection

Connecting the Power Supply

Complete the following steps to supply power to the ISC-178x.

1. Verify the power source is turned off.
2. Connect and secure the M12 connector of the power supply cable to the Power and I/O connector on the smart camera.
3. If necessary, connect the power supply cable to the power supply.
4. Turn on the external power source.

When power is first applied to the ISC-178x, the Power and Status LEDs flash red once while internal systems power up. The Power LED lights green when power is wired correctly.

Related Information

LED Indications on page 13

Connecting to the Power and I/O Accessory for ISC-178x Smart Cameras

Complete the following steps to connect the ISC-178x to the Power and I/O Accessory for ISC-178x Smart Cameras. Refer to the Power and I/O Accessory for ISC-178x Smart Cameras User Manual for more information.

1. Verify the power source is turned off.
2. Connect and secure the M12 connector of the terminal block cable to the Power and I/O connector on the smart camera.
3. Connect and secure the other end of the terminal block cable to the terminal block.
4. Connect any additional I/O signals necessary for your application to the appropriate signal on the cable or terminal block.
5. Connect the power supply to the 24 V IN connector on the Power and I/O accessory.
6. If necessary, connect the power supply cable to the power supply.
7. Turn on the external power source.

Related Information

LED Indications on page 13

Connecting a Lens

1. Connect the lens to the ISC-178x housing and screw it in firmly.
2. Slide the lens cover over the lens and screw it into the ISC-178x housing until it is firmly in place. The lens cover must be in place for IP67 conformity.

Connecting a Varioptic Liquid Lens

The ISC-178x supports the following models of Varioptic liquid lenses.

- Caspian C-39N0-160-I2C
- Caspian C-39N0-250-I2C

Complete the following steps to connect a Varioptic liquid lens to the ISC-178x.

1. Disconnect the power from the ISC-178x.
2. If the lens cover is connected, unscrew the lens cover from the ISC-178x.
3. If a plug is covering the liquid lens connector inside the lens housing, use non-conductive tweezers to remove the plug.
4. Connect the lens to the ISC-178x and screw it in firmly.
5. The Varioptic liquid lens has two cables. Wrap the cable with the 6-pin connector tightly around the liquid lens housing.
6. Tuck the 3-pin connector and its branched wire into the folds of the longer cable. The 3-pin connector is not used.
7. Use non-conductive tweezers to plug the 6-pin connector of the Varioptic liquid lens into the liquid lens connector on the ISC-178x. Once the connector is in place, use the tweezers to press firmly on either side of the wires to ensure a good connection.
8. Slide the lens cover over the lens and screw it into the ISC-178x housing until it is firmly in place. The lens cover must be in place for IP67 conformity.

9. Reconnect the power to the ISC-178x.

When the ISC-178x powers on with a compatible liquid lens connected, the lens will be detected and the Lens Present attribute will indicate that a compatible lens is present. You can adjust the focal point by using the Lens Focal Position Raw attribute.

Configuring the ISC-178x for NI Linux Real- Time

The real-time version of the ISC-178x ships preloaded with NI Linux Real-Time. Connecting to the Development Computer

The ISC-178x can connect to the development computer directly or through a network.

Connecting Directly to the Development Computer

What to Use

- ISC-178x Smart Camera
- Development computer
- M12 to RJ45 Ethernet cable, NI part number 145230-05

What to Do

Complete the following steps to connect the device directly to the development computer.

1. Verify the development computer is powered on.
2. Connect the M12 end of the Ethernet cable to the network connector on the ISC-178x.
3. Connect the RJ45 end of the Ethernet cable to an Ethernet port on the development computer.
4. Verify the 100/1G LED on the smart camera is on or blinking.

Connecting to the Development Computer Over a Network

What to Use

- ISC-178x Smart Camera
- Development computer
- Ethernet switch or other network device
- Ethernet cable (one of the following):
 - M12 to RJ45 Ethernet cable, NI part number 145230-05
 - M12 to M12 Ethernet cable, NI part number 145231-05

What to Do

Complete the following steps to connect the device to the development computer over a network.

Note The Ethernet switch or network device must be on the same subnet as the development computer to connect over a network.

1. Verify the development computer is powered on and connected to the network.
2. Connect one end of an M12 Ethernet cable to the network connector on the ISC-178x.
3. Connect the free end of the Ethernet cable to an Ethernet switch or network device.
4. Verify the 100/1G LED on the smart camera is on or blinking.

The device negotiates an IP address when connected to a network with a DHCP server or comparable network device.

Using Vision Builder AI with the ISC-178x

Complete the following steps to use Vision Builder for Automated Inspection (Vision Builder AI) with the ISC-178x:

1. Install Vision Builder AI 2015 f2 or later on the development computer. A development license for Vision Builder AI is included with the purchase of an ISC-178x. Vision Builder AI can be installed from the included DVD or downloaded from ni.com/download.
2. Refer to the How to Configure NI Vision Builder AI Remote Targets section in the Vision Builder for Automated Inspection: Configuration Help. When using Vision Builder AI, it is not necessary to install the NI-IMAQdx driver..

Installing NI-IMAQdx

Before using the ISC-178x in environments other than Vision Builder AI, install the necessary drivers onto the device and the Windows development machine. Complete the following steps to install and configure NI-IMAQdx:

1. Install NI-IMAQdx 16.2 or later onto the Windows development machine connected to the ISC-178x. NI-IMAQdx is included on the NI Vision Acquisition Software DVD. You can also download NI Vision Acquisition Software from ni.com/support.
2. Run NI MAX.
3. Expand the Remote Systems list in the configuration tree.
4. Select the ISC-178x in the list. By default, MAX lists devices by the model number followed by the serial number, such as NI-ISC-178x-XXXXXXXXX.
5. Configure the network settings for the ISC-178x. Refer to the Remote Systems Help in MAX. Select Help»Help Topics»Remote Systems for instructions about configuring network settings.
6. Install a recommended software set. If you would like to install custom software instead of a recommended software set, proceed to the next step.
 - **a)** Expand the ISC-178x under Remote Systems.
 - **b)** Click the Software item below the ISC-178x in the configuration tree.
 - **c)** Click Add/Remove Software on the MAX toolbar to launch the LabVIEW Real-Time Software Wizard.
 - **d)** Enter admin as the username and leave the password field blank.
 - **e)** Select Vision Software under the version of LabVIEW Real-Time you are using.
 - **f)** Click Next.
 - **g)** Select any additional add-ons you would like to install to the ISC-178x.
 - **h)** Click Next. Review the list of software to install.
 - **i)** Click Next to begin downloading the software to the ISC-178x. When MAX finishes downloading the software, the ISC-178x restarts.
 - **j)** Click Finish.
7. Install custom software. You do not need to install custom software if you installed a recommended software set.
 - **a)** Expand the ISC-178x under Remote Systems.
 - **b)** Click the Software item below the ISC-178x in the configuration tree.
 - **c)** Click Add/Remove Software on the NI MAX toolbar to launch the LabVIEW Real-Time Software Wizard.

- **d)** Enter admin as the username and leave the password field blank.
- **e)** Choose Custom software installation and click Next to proceed with a custom installation.
- **f)** Select NI-IMAQdx, and any additional software you would like to install on the ISC-178x.
- **g)** Click Next. Review the list of software to install.
- **h)** Click Next to begin downloading the software to the ISC-178x. When NI MAX finishes downloading the software, the ISC-178x restarts.

Configuring the ISC-178x for Windows

The ISC-178x ships pre-loaded with the NI-supported Windows 10 distribution. Other versions and distributions of Windows are not supported. Complete this section if you are using the Windows version of the ISC-178x.

Connecting the ISC-178x to a Network

What to Use

- ISC-178x Smart Camera
- M12 to RJ45 Ethernet cable (5 m), NI part number 145230-05
- Ethernet switch or other network device

What to Do

Complete the following steps to connect the device to a network.

1. Connect the M12 end of the Ethernet cable to the network connector on the ISC-178x.
2. Connect the RJ45 end of the cable to an Ethernet switch or other network device.
3. Verify the 100/1G LED on the smart camera is on or blinking.

Note By default, the operating system automatically attempts to connect to the network using DHCP. If it is unable to initiate a DHCP connection, it connects to the network with a link-local IP address (169.254.x.x).

Installing NI-IMAQdx Driver Software

Before using the ISC-178x, install other National Instruments software, such as application development environments, and then install the drivers onto the device.

If you have an external USB DVD drive, you can use the external DVD drive to install the NI-IMAQdx from the NI Vision Acquisition Software DVD shipped with the device. Otherwise, complete the following steps to download and install NI-IMAQdx.

What to Use

- ISC-178x Smart Camera
- M12 to VGA/USB splitter cable (1 m), NI part number 782022-01
- USB hub
- USB keyboard
- USB mouse
- Monitor

What to Do

Complete the following steps to install NI-IMAQdx driver software.

1. Connect the M12 splitter cable to the VGA and USB connector on the ISC-178x.
2. Connect the USB hub to the USB port on the M12 splitter cable.
3. Connect the keyboard and mouse to the USB hub.
4. Connect a monitor to the VGA port on the M12 splitter cable.
5. Using the web browser on the ISC-178x, navigate to ni.com/drivers.
6. In the Drivers search field, search for NI Vision Acquisition Software.
7. Download the latest version of NI Vision Acquisition Software from the search results.
8. Run the downloaded installer and ensure that NI Vision Acquisition Software is selected for installation. Some features of the NI Vision Acquisition Software installer are not available on the ISC-178x.

Troubleshooting

The following sections provide instructions for troubleshooting the ISC-178x.

The ISC-178x Does Not Appear Under Devices and Interfaces in MAX

Install the driver software on the ISC-178x.

Related Information

Installing NI-IMAQdx on page 9

(NI Linux Real-Time) The ISC-178x Does Not Appear Under Remote Systems in MAX

- The ISC-178x may not be powered. Verify that there is power to the device and that both the ISC-178x and the development computer are properly connected to the network. The Power LED should be lit green, the Status LED should be lit orange or green, and the 100/1G LED should flash green when refreshing the list of devices in MAX.
- Ensure you are connecting to the ISC-178x from a Windows development computer with NI-IMAQdx installed.
- The ISC-178x may have been configured on another network and then moved to the current network. Reconfigure the ISC-178x for the current network.
Note Connect a monitor and keyboard to the ISC-178x and press <Enter> to view the current configuration settings of the device.
- Another device on the network is using the IP address assigned to the ISC-178x. This can happen when two devices have the same static IP, when a static IP is in the range of the IP address available for DHCP use on your network, or the DHCP assigns the same IP address to another device. Either remove or reconfigure the other device, or reconfigure the ISC-178x to use a different IP address.
- The cable you are using may be inappropriate for the speed of your network, causing network communication dropout. While 1,000 Mbps communication over short cable lengths can be achieved with the CAT5 cable commonly used for 10 and 100 Mbps, CAT5e and CAT6 cables are more reliable and recommended for 1,000 Mbps links. The ISC-178x has the ability to perform auto-crossover, allowing the use of straight or crossover Ethernet cables, independent of the connection configuration.
- The ISC-178x is configured to acquire an IP address from a DHCP server, but no DHCP server is available. By default, the target will automatically attempt to connect to the network using DHCP. If the target is unable to initiate a DHCP connection, the target connects to the network with a link-local IP address (169.254.x.x).
- You may be experiencing firewall issues. If you are having difficulty detecting the system and setting up the ISC-178x on your network, you must configure the firewall to open the TCP/UDP ports used by the ISC-178x and the host machine. Refer to the following table for more information about TCP/UDP ports.

Table 3. TCP/UDP Ports Used by the ISC-178x

Port	Type	Details
3580	TCP/UDP	Reserved as nati-svrloc (NATI-ServiceLocator). Used by MAX to locate remote targets.
7749	TCP	Used for remote image display (not reserved).
7750	TCP	Used for NI-IMAQdx remote configuration (not reserved).
3363	TCP/UDP	Reserved as nati-vi-server (NATI VI Server). Used by Vision Builder AI to configure a remote target.

If your firewall is controlled remotely or you are unsure about configuring the firewall, contact your network administrator.

(NI Linux Real-Time) No Software Is Installed

MAX reports that no software is installed. Install application and driver software on the ISC-178x.

Related Information

Installing NI-IMAQdx on page 9

(Windows) Cannot Reach the Maximum Frame Rate in MAX or Other 32-bit Application Acquiring images using a 32-bit application, including MAX, introduces additional processing overhead due to the image transfer from the underlying 64-bit process to the 32-bit process.

This additional overhead could result in a lower acquisition frame rate than expected.

You can verify this by monitoring the Lost Buffer Count attribute. If the lost buffer count is increasing, the additional overhead is reducing your frame rate.

1. Select the Camera Attributes tab.
2. Navigate to View Options»All Attributes in the tree tool bar.
3. Expand the Status Information category to view the Lost Buffer Count attribute.

Note National Instruments recommends calling the NI-IMAQdx API from a native 64-bit application, such as LabVIEW 64-bit or Vision Builder AI 64-bit. This will eliminate overhead and you will be able to acquire images at the maximum frame rate reported by the Acquisition Frame Rate Limit attribute.

Related Information

Installing NI-IMAQdx on page 9

LED Indications

The ISC-178x indicates specific error conditions by flashing the Power, Status, and User LEDs.

Power LED	Status LED	User LED	Indication
Off	Off	Off	The ISC-178x does not have power.
Red	Red	Red	The ISC-178x is powered, but is not responding.
Red	—	Orange	Initialization error.
Orange	—	Orange/Red blink	Temperature limit exceeded.
Orange	Orange/Red blink	Orange	System firmware initializing.
Orange	Orange/Red blink	Green	System firmware initialization completed.
Green	Orange/Red blink	Off	Sensor driver not loaded. Possible reasons: • Operating system loading • ISC-178x is booted in safe mode (NI Linux Real-Time only) • NI-IMAQdx Smart Camera Support is not installed

Power LED	Status LED	User LED	Indication
Green	Orange	User defined (default is Off)	The ISC-178x is ready to use. The sensor driver is idle.
Green	Green	User defined (default is Off)	The ISC-178x is ready to use. The sensor driver is in use.

Related Information

Connecting the Power Supply on page 6

Connecting to the Power and I/O Accessory for ISC-178x Smart Cameras on page 6

Where to Go Next

The following documents and resources contain information you may find helpful as you use the ISC-178x in an application. Refer to the National Instruments Product Manuals Library at ni.com/manuals for the most recent versions of product documentation.

- Power and I/O Accessory for ISC-178x Smart Cameras User Manual—Contains installation and operation instructions for the Power and I/O Accessory for ISC-178x Smart Cameras.
- ISC-178x User Manual—Contains detailed electrical and mechanical information about the ISC-178x.
- ISC-1780 Specifications—Contains detailed specifications for the ISC-1780.
- ISC-1781 Specifications—Contains detailed specifications for the ISC-1781.
- ISC-1782 Specifications—Contains detailed specifications for the ISC-1782.
- ISC-1783 Specifications—Contains detailed specifications for the ISC-1783.

Worldwide Support and Services

The NI website is your complete resource for technical support. At ni.com/support, you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

Visit ni.com/services for information about the services NI offers.

Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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Documents / Resources

	NATIONAL INSTRUMENTS ISC-178x Monochrome or Color Smart Camera [pdf] User Guide ISC-1782, ISC-178x, Monochrome or Color Smart Camera, ISC-178x Monochrome or Color Smart Camera, Color Smart Camera, Smart Camera, Camera
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References

- [NI Engineer Ambitiously - NI](#)
- [NI Engineer Ambitiously - NI](#)
- [NI Driver Downloads - NI](#)
- [NI Trade Compliance - NI](#)
- [NI Product Documentation - NI](#)
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- [NI Support - NI](#)
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