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# NI ELVIS III

# Features

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## NI ELVIS III 2.2.1 Manual

The NI Educational Laboratory Virtual Instrumentation Suite III (NI ELVIS™ III) is an engineering laboratory solution for project-based learning.

It combines a suite of commonly used lab instruments, flexible analog and digital I/Os, and a high-performance embedded controller. Its open software architecture supports a wide range of experimental exploration, allowing students to quickly learn concepts through turnkey applications and basic programming APIs, or drill down to low-level programming of the embedded processor and FPGA. The removable prototyping board can be replaced with a wide selection of domain-specific application boards which include teaching resources to cover courses in electrical engineering, mechanical engineering and other departments.

The NI ELVIS III manual contains concepts, step-by-step instructions, and reference information about using the NI ELVIS III. The NI ELVIS III manual does not include reference information for the LabVIEW ELVIS III Toolkit VIs. Find the VI reference information in the [LabVIEW ELVIS III Toolkit Help](#).

### Top Tasks

What do you want to do?	Where to go
Set up the NI ELVIS III in your lab.	<a href="#">Getting Started</a>
Use the instruments on the NI ELVIS III.	<a href="#">Launching the Soft Front Panels</a>
Get started with programming the NI ELVIS III.	<a href="#">Creating an NI ELVIS III Application</a>

## NI ELVIS III 2.2 New Features

Refer to the list below to learn what's new in NI ELVIS III 2.2.

### Streaming Data from Multisim Live

You can now [stream data from Multisim Live to Measurements Live](#) to compare your theoretical circuit design with real-world measurements.

## Simulating the Instruments

[Simulating the instruments](#) helps you learn to use the instruments before connecting to a real NI ELVIS III device. Go directly to [measurementslive.ni.com](http://measurementslive.ni.com) and click **DEVICE SIMULATION** to simulate the following two pairs of instruments:

- Oscilloscope & Function and Arbitrary Waveform Generator
- Variable Power Supply & Digital Multimeter

## Improvements to Soft Front Panels

Measurements Live adds the following improvements to the Data Logger and Digital I/O Soft Front Panels:

- You can now plug a USB in the NI ELVIS III and configure the [log settings](#) of the Data Logger to log a large amount of data to the USB.
- The Digital I/O provides two [new modes](#) for you to control how to write values to the lines.
  - Pattern (Auto) mode
  - Pattern (Manual) mode

## New Python Examples

You can now [program the NI ELVIS III with Python](#) by using the following additional examples:

- Analog Input N Samples
- Analog Output N Samples
- Analog Input Continuous
- Analog Output Continuous

## About the NI ELVIS III

This section provides an overview of the NI ELVIS III, its ecosystem and possible uses in various academic disciplines, and related documents that help you successfully use the NI ELVIS III.

[Hardware Overview](#)

[Software Overview](#)

[Teaching with NI ELVIS III](#)

## Hardware Overview

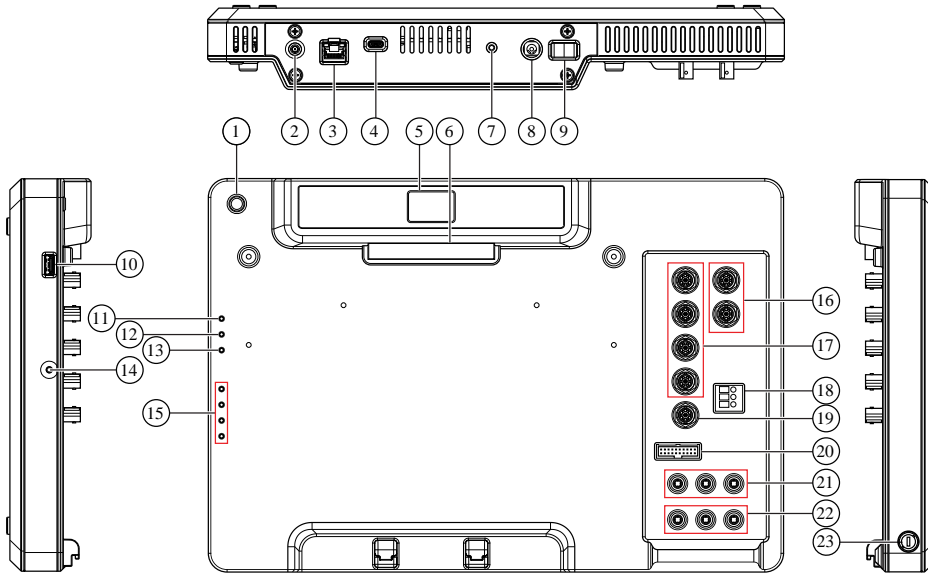
The NI ELVIS III provides convenient connectivity and functionality in the form of a high density direct connection to the application board for the control I/O, industry standard connectors for the instrumentation I/O, and standard communication ports for controlling the NI ELVIS III.

### Key Features

- Engineering lab workstation that can be controlled through USB, Ethernet, or Wi-Fi
- Complete suite of laboratory instruments:
  - Oscilloscope
  - Function and Arbitrary Waveform Generator
  - Digital Multimeter
  - Variable Power Supplies
  - Logic Analyzer and Pattern Generator
  - Current-Voltage Analyzer
  - Bode Analyzer
- Flexible I/O for control and measurement functionality:
  - Analog Input
  - Analog Output
  - Digital Input/Output
  - Fixed Power Supplies
- High performance RIO controller:
  - Supports LabVIEW RT and LabVIEW FPGA programming
- Modular application board:
  - Default application board for prototyping experiments

- Numerous domain-specific application boards available

Figure 1. NI ELVIS III Workstation

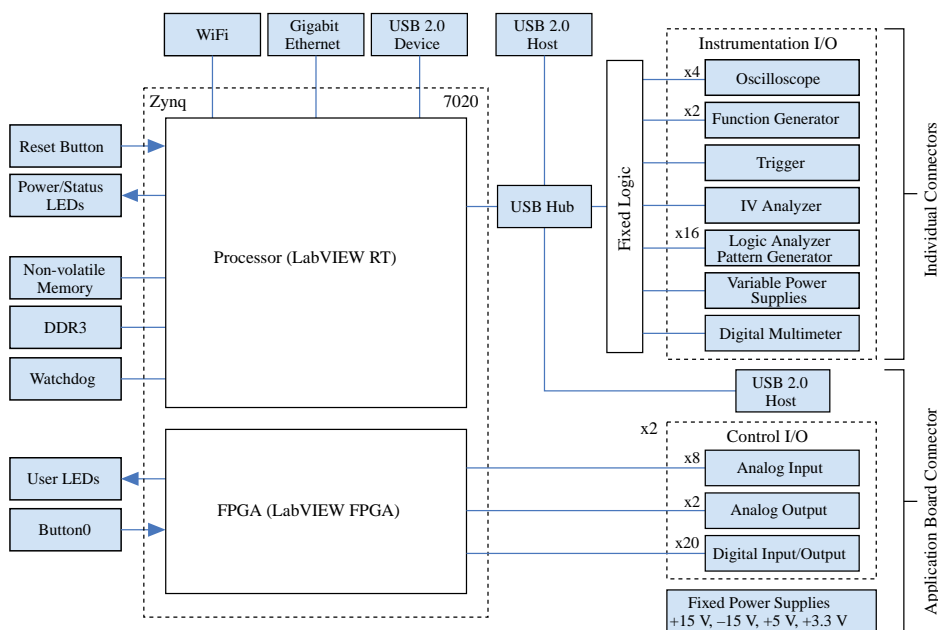


1. Application board power button/LED
2. Wi-Fi antenna connector (Wi-Fi models only)
3. Ethernet port
4. USB device port
5. OLED display
6. Application board connector
7. Reset button
8. Power supply connector
9. Workstation power switch
10. USB host port
11. Workstation power LED
12. Status LED
13. Wi-Fi LED (Wi-Fi models only)
14. User programmable button (Button 0)
15. User programmable LEDs
16. Function Generator BNC connectors

17. Oscilloscope BNC connectors
18. IV Analyzer screw terminal
19. Trigger BNC connector
20. Logic Analyzer/Pattern Generator 20-pin connector
21. Variable Power Supplies banana jacks
22. Digital Multimeter banana jacks
23. Digital Multimeter Fuse

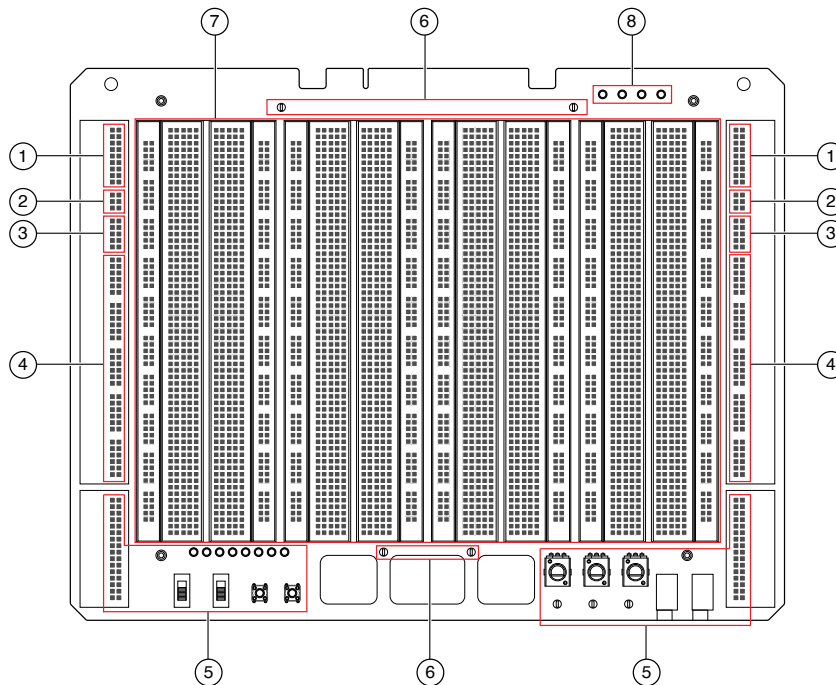
The hardware architecture of the NI ELVIS III is based on an FPGA and an RT processor that are programmatically accessible by the user. The user can control a variety of analog and digital I/O lines exposed via the application board, and the instrumentation I/O via dedicated connectors.

Figure 2. NI ELVIS III Hardware Architecture



The NI ELVIS III Prototyping Board is connected to the device by default and provides easy access to the available I/O via breadboard connectors, as well as additional user peripherals commonly used in the laboratory.

Figure 3. NI ELVIS III Prototyping Board



1. Analog Input
2. Analog Output
3. Fixed User Power Supplies
4. Digital I/O
5. User Peripherals
6. Digital Ground
7. Central Build Area (breadboard)
8. Fixed User Power Supplies LEDs

## Software Overview

The NI ELVIS III offers a variety of software options for accessing and controlling the hardware.

- The instruments can be accessed interactively with **Soft Front Panels** (SFPs), which you can launch from the [Measurements Live](#) application in your browser.
- The instrumentation I/O and control I/O can both be programmatically accessed from a LabVIEW RT application running on the embedded processor.



- The control I/O can also be programmatically accessed from a LabVIEW FPGA application running on the embedded FPGA, offering very low-level access to the I/O.

Most application boards are shipped with additional software, commonly in the form of LabVIEW VIs or turnkey applications. You can also exchange data with other applications, such as Multisim Live.

The NI ELVIS III Software Bundle includes the main software you need to access and control the hardware, including the SFPs, the LabVIEW ELVIS III Toolkit, Multisim Live, and Multisim. The software bundle also includes the LabVIEW FPGA Module, which provides the FPGA VIs and functions that you use to create custom FPGA applications.

## Soft Front Panels

Use the Soft Front Panels (SFPs) to quickly access and control the instruments on the NI ELVIS III without programming. You can use the following SFPs with the NI ELVIS III:

- Oscilloscope
- Function and Arbitrary Waveform Generator (FGen/Arb)
- Digital Multimeter (DMM)
- Variable Power Supply (VPS)
- Logic Analyzer and Pattern Generator (Logic)
- Current-Voltage Analyzer (IV Analyzer)
- Bode Analyzer

Use the following SFPs to access and control the RIO instruments built with the Control I/O:

- Data Logger
- Data Generator (Data Gen)
- Digital I/O

Use the LabVIEW ELVIS III Toolkit to create and deploy applications on the NI ELVIS III. The LabVIEW ELVIS III Toolkit provides NI ELVIS III-specific support for LabVIEW RT and LabVIEW FPGA applications. Most applications can be implemented

using the LabVIEW Real-Time Module and the LabVIEW ELVIS III Toolkit. Advanced applications that require low-level access to the control I/O can use the LabVIEW FPGA Module to create custom I/O peripherals, handle high-performance inline processing, and more. The LabVIEW ELVIS III Toolkit contains the following components:

- **Academic I/O VIs**—Provide programmatic support for the instrument I/O, control I/O, and integrated devices on the NI ELVIS III such as the user programmable LEDs and button. Use the Academic I/O VIs with the Real-Time Module to create custom applications.
- **Templates, sample projects, and example VIs**—Templates demonstrate useful design patterns and serve as starting points for your applications. Sample projects demonstrate working applications based on the templates. Example VIs demonstrate other common application types and programming techniques. You can customize these templates, sample projects, and examples VIs according to the needs of your application.

## Multisim Live

[Multisim Live](#) provides a web-based schematic capture and simulation experience. You can complete the following tasks with Multisim Live:

- Test the behavior of a circuit.
- Demonstrate the application of a design.
- Illustrate concepts.
- Perform and share interactive simulations in web browsers on your computer or mobile device.
- Embed simulatable Multisim Live designs directly into courseware pages.

## Multisim

This is the desktop version of Multisim, which provides a full schematic capture and simulation experience. You can complete the following tasks with Multisim:

- Test the behavior of a circuit.

- Demonstrate the application of a design.
- Illustrate concepts.
- Export designs to Ultiboard to layout circuit boards for rapid prototyping.

## Data Import and Export

You can share data between the above platforms by using the NI ELVIS III data import and export features. Refer to [Data Import and Export](#) for more information about the data file formats that these platforms support.

## C and Python Programming Examples

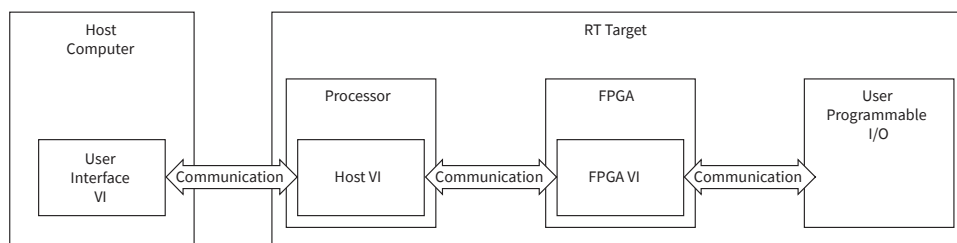
NI ELVIS III provides C and Python programming examples on [GitHub](#).

- [Python Support](#)—Program the NI ELVIS III for project-based learning with Python.
- [C Support](#)—Configure the Eclipse development environment and debug or run C example projects on the NI ELVIS III with Eclipse.

## The LabVIEW RIO Architecture

The NI ELVIS III is based on the LabVIEW RIO architecture, which incorporates the LabVIEW Real-Time (RT) system, a user programmable FPGA, and user programmable I/O.

The following diagram illustrates the physical layout of the RIO architecture of the NI ELVIS III:



## LabVIEW Real-Time System

A LabVIEW Real-Time system consists of software and hardware components. The software components include LabVIEW, the RT engine, and the LabVIEW projects

and VIs that you create. The hardware components of a RT system include a host computer and an RT target such as the NI ELVIS III.

For the NI ELVIS III, the RT system includes the following four components:

- **Host computer**—The host computer is a computer with LabVIEW, the LabVIEW Real-Time Module, and the LabVIEW ELVIS III Toolkit installed on which you develop the VIs for the RT system. After developing the RT system VIs, you can download and run the VIs on RT targets. The host computer can run user interface VIs that communicate with VIs running on the NI ELVIS III to provide a user interface.
- **LabVIEW**—You develop VIs with LabVIEW on the host computer. The Real-Time Module extends the capabilities of LabVIEW with additional tools for creating, debugging, and deploying deterministic VIs. The LabVIEW ELVIS III Toolkit provides NI ELVIS III-specific support for LabVIEW RT applications.
- **RT Run-Time engine**—The RT run-time engine is a version of LabVIEW that runs on the NI ELVIS III. The RT run-time engine runs the host VIs you download to the NI ELVIS III.
- **RT target**—The RT target is your NI ELVIS III. The NI ELVIS III is a networked hardware platform with an embedded processor and a Real-Time operating system that runs the RT engine. You can use a separate host computer to communicate with VIs on the NI ELVIS III through USB, Ethernet, or Wi-Fi (Wi-Fi models only).

## User Programmable FPGAs

You can use the FPGA, which is the core of the LabVIEW RIO architecture, to offload critical or intensive tasks from the processor. The FPGA also provides reliable, deterministic execution with extremely high throughput.

You can use the FPGA VIs and functions provided by the LabVIEW FPGA Module to program the embedded FPGA within the RIO architecture of the NI ELVIS III. You can program with the NI ELVIS III using FPGA personalities that consist of predefined FPGA bitfiles. The LabVIEW ELVIS III Toolkit provides a default FPGA personality.

Refer to [NI ELVIS III Shipping Personality Reference](#) for more information. You can create a custom FPGA personality by creating and compiling an FPGA VI.

## User Programmable I/O

The user programmable I/O, also known as control I/O, consists of three levels of programming that you can access on the NI ELVIS III. Refer to [Programming the Control I/O](#) for the three levels of programming.

### Related information:

- [Real-Time System Components](#)
- [Building and Deploying a Stand-Alone Real-Time Application](#)
- [Introduction to FPGA Applications and Projects](#)
- [Introduction to FPGA Hardware Concepts](#)

## Data Import and Export

You can share data between the Soft Front Panels (SFPs) and other NI platforms, such as Multisim, Multisim Live, and LabVIEW. For example, you can import the simulated data from Multisim to the Oscilloscope, and compare the simulated data with the measured data, or export the measured data from the Oscilloscope to LabVIEW to filter and process the data.

The following table lists the types of files that you can import from other NI platforms to the SFPs:

SFP	LabVIEW	Multisim	Multisim Live
Oscilloscope	TDMS file that contains analog waveform data	CSV	CSV
FGen/Arb	TDMS file that contains analog waveform data	CSV	CSV
Logic	TDMS file that contains digital waveform data	None	None
Bode Analyzer	None	CSV	CSV

The following table lists the types of files that you can export from the SFPs to other NI platforms:

SFP	LabVIEW	Multisim	Multisim Live
Oscilloscope	TDMS	CSV	CSV
Logic	TDMS	None	None
Bode Analyzer	None	CSV	CSV
IV Analyzer	None	CSV	CSV

Refer to each instrument's help in the [Using the Instruments](#) section for more information about the file formats that each instrument supports.

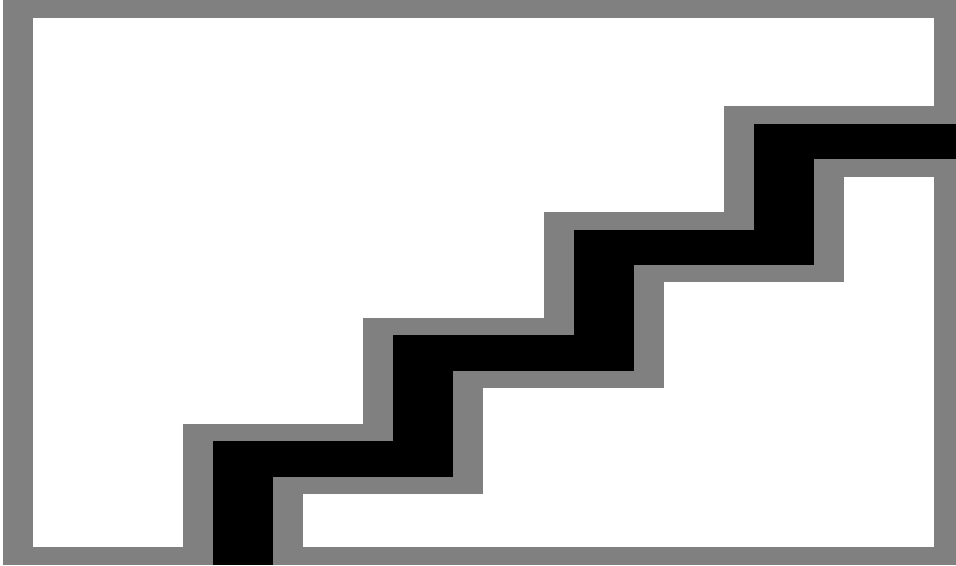
Refer to [.csv file format](#) for more information about the data structure of the CSV file exported from Multisim and Multisim Live. The CSV files you export from the SFPs have the same data structure as that of Multisim and Multisim Live.

## Teaching with NI ELVIS III

NI ELVIS III is used in hands-on laboratories for analog electronics, mechatronics, power electronics, measurements, instrumentation, digital communications, digital electronics, controls, and more.

The NI ELVIS III has numerous interchangeable application boards and parts kits available, which have lab manuals that you can find at [ni.com/teach/elvis-iii](http://ni.com/teach/elvis-iii). These labs allow students to explore theory in the physical laboratory with a safe, in-depth experience. They allow students to apply the theory they learn in class through simulation, experimentation, and open-ended activities. By relating concepts and activities to real-world applications, the labs also encourage complex analysis and increased engagement.

The labs are available in both a Word Document version and an online interactive version. When developing curriculum, instructors can use the labs as they are or modify them to suit their needs. Instructors can request access to restricted content, which includes answer keys and complete LabVIEW code that cannot be viewed by students.



Instructors can also customize the webpage containing his or her courseware by embedding the [Measurements Live](#) toolbar on that webpage. For more information, refer to [Embedding Measurements Live in Your Courseware](#).

To learn more about the different application boards, refer to [Using the Application Boards](#) or [NI ELVIS Application Directory](#).

To learn more about NI's teaching resources, visit [ni.com/teach](http://ni.com/teach).

## Guide for Lab Administrators

Lab administrators set up and maintain the software and hardware in labs. Lab administrators can also make advanced configurations to manage the NI ELVIS III devices and satisfy their customized needs.

If you are a lab administrator and a first-time user of the NI ELVIS III, go through the following steps to get started.

1. [Set up the NI ELVIS III devices](#) in the lab.
2. [Set up the host computers](#) in the lab.
3. **Optional:** Make advanced configurations to better manage the NI ELVIS III devices in the lab.

For example, you can set up a local server to allow for communication between devices and increase Internet security. Use the following table to decide which advanced configurations you want to make:

What you want to do	Where to go
<ul style="list-style-type: none"> <li>▪ Deliver device IDs to the students to allow for remote device connection and gather device information for better management.</li> <li>▪ Better control the usage of lab devices and secure the device connection and lab data.</li> </ul>	<a href="#">Setting up a Custom Signaling Server</a>
<ul style="list-style-type: none"> <li>▪ Change the lease time of a device ID.</li> <li>▪ Customize the signaling server.</li> </ul>	<a href="#">Customizing the connection between the NI ELVIS III and Measurements Live</a>
Set up your own Session Traversal Utilities for NAT (STUN) server, which has higher Internet security than public STUN servers.	<a href="#">Setting up STUN Server</a>



**Note** A device ID is a pairing code that builds the connection between the NI ELVIS III device and Measurements Live.

## Troubleshooting

This section covers common pitfalls and recommended solutions when using the NI ELVIS III.

If an issue persists after you complete a troubleshooting procedure, contact NI technical support or visit [ni.com/support](http://ni.com/support).

- [Flashing Status LED](#)—Refer to this topic to understand each state of the Status LED.
- [Set Up and Troubleshoot](#)—Refer to this page if you fail to connect to the device or launch the Soft Front Panel from Measurements Live.

### Flashing Status LED

Below is an explanation of each state of the NI ELVIS III Status LED and recommended solutions:



Number of Flashes every Few Seconds	Explanation	Solution
1	The NI ELVIS III is unconfigured.	<a href="#">Configure the device.</a>
2	The NI ELVIS III has detected an error in its software. This usually occurs when an attempt to upgrade the software is interrupted.	<a href="#">Reinstall software on the device.</a>
3	The NI ELVIS III is in safe mode.	Refer to the <b>Measurement &amp; Automation Explorer Help</b> for information about safe mode.
4	The software has crashed twice without rebooting or cycling power between crashes. This usually occurs when the NI ELVIS III runs out of memory.	<ol style="list-style-type: none"> <li>1. Review your Real-Time VI.</li> <li>2. Check the memory usage.</li> <li>3. Modify the VI as necessary to solve the memory usage issue.</li> </ol>
Continuously flashing or solid	The NI ELVIS III has detected an unrecoverable error.	Contact NI by visiting <a href="https://ni.com/support">ni.com/support</a> .

## Contacting Support

Find technical support and services from online resources on ni.com.

- [ni.com/support](https://ni.com/support) — Visit this website for software drivers and updates, a searchable KnowledgeBase, product manuals, troubleshooting instructions, and so on.
- [NI ELVIS Discussion Forums](#) — Visit the discussion forums to search FAQs, ask for help, or contribute to the community of NI ELVIS III users.