Electronic Keying in Logix5000 Control Systems

Keying is a feature that reduces the possibility that you use the wrong device in a control system. The wrong device can be the following:

- A replacement device for one that is already in use.
- A device that is installed during the initial system installation.

The wrong device does not support the same functionality as the device intended for use in the system. When the wrong device is used, unexpected system behavior can occur.

Types of Keying

Traditionally, mechanical keying was used to prevent using the wrong device in the system by preventing the installation of the device. For example, mechanical keying prevented the wrong I/O module from being installed in a chassis or onto a DIN rail.

In Logix5000™ control systems, Electronic Keying also helps prevent using the wrong device in the system.

Electronic Keying lets you verify that communication occurs only with an installed device that matches the expected device type and revision.
Electronic Keying automatically compares the expected device, as defined in your RSLogix 5000™ or Logix Designer project, to the installed device. If keying fails, the controller does not establish a connection to the device and a fault occurs on the device. You can configure the project such that a fault also occurs on the controller when keying fails.

**IMPORTANT** Electronic Keying functions the same with all Logix5000 control and Integrated Architecture® systems.

For example, Compatible Module functions the same in a 1756 ControlLogix® control system as in a CompactLogix™ 5370 control system.

Electronic Keying is an open standard that meets ODVA, Inc. requirements for devices to be ODVA/Common Industrial Protocol (CIP) certified.

For each device in the project, the user-selected keying option determines if, and how, an Electronic Keying check is performed. Three options are available:

- Compatible Module
- Disable Keying
- Exact Match

Carefully consider the benefits and implications of each keying option when selecting between them. For some device types, fewer options are available.

Electronic Keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a device, the following attributes are considered.

**Table 1 - Keying Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor</td>
<td>The device manufacturer, for example, Rockwell Automation/Allen-Bradley.</td>
</tr>
<tr>
<td>Device Type</td>
<td>The general type of the product, for example, communication adapter, AC drive or digital I/O module.</td>
</tr>
<tr>
<td>Product Code</td>
<td>The specific type of the product. The Product Code maps to a catalog number. The Product Code differentiates the product from other products of the same Device Type under the indicated Vendor. For example, if the Vendor is Allen-Bradley and the Device Type is Digital I/O, the Product Code can indicate 1756-IB16D.</td>
</tr>
<tr>
<td>Major Revision</td>
<td>A number that represents the functional capabilities of a device. Typically, a Major Revision is backwards compatible with a lower Major Revision.</td>
</tr>
</tbody>
</table>
On the Module Properties dialog box for the device, you can find the following:

- Revision information of the defined device on the General tab
- Revision information of the installed device on the Module Info tab

**IMPORTANT** Changing Electronic Keying parameters online interrupts connections to the device and any devices that are connected through the device. Connections from other controllers can also be broken.

If an I/O connection to a device is interrupted, the result can be a loss of data.
Compatible Module indicates that the device determines whether to accept or reject communication. Various device families, communication adapters, and device types implement the compatibility check differently based on the family capabilities and on prior knowledge of compatible products. Release notes for individual devices indicate the specific compatibility details.

Compatible Module is the default setting. Compatible Module lets the installed device accept the key of the device that is defined in the project when the installed device can emulate the defined device. The exact level of emulation that is required is product and revision specific.

With Compatible Module, you can typically replace a device of a certain Major Revision with another device that has the following characteristics:

- Same catalog number
- Same or higher Major Revision
- Minor Revision as follows:
  - If the Major Revision is the same, the Minor Revision must be the same or higher.
  - If the Major Revision is higher, the Minor Revision can be any number.

For example, with Compatible Module, you can replace a ControlLogix digital input module, catalog number 1756-IB16D, revision 3.005, with a ControlLogix digital input module, catalog number 1756-IB16D, revision 3.005 or higher.

In some cases, with Compatible Module, you can use a replacement device that is another catalog number than the original. The device determines if the replacement device can be used. For example, you can replace a ControlLogix communication module, catalog number 1756-EN2T with a ControlLogix communication module, catalog number 1756-EN3TR.
When a device is created, the device developers can consider the features of past revisions, and of similar devices, to implement capabilities that emulate these past revisions and similar devices.

We recommend that you configure your project to use the lowest revision of the device that has the feature set that you expect to use in the system. This practice helps you avoid a case where a device rejects the keying request because it is an earlier revision than the device defined in the project.

**EXAMPLE**

In this example, *Compatible Module prevents communication.*

The project configuration is for a ControlLogix digital input module, catalog number 1756-IB16D, revision 3.003, with Compatible Module specified. The device in the chassis is a ControlLogix digital input module, catalog number 1756-IB16D, revision 3.002.

In this case, communication is prevented because the revision of the device in the chassis is lower than expected and can be incompatible with revision 3.003. For more information, see the Connection and Module Info tabs on the Module Properties dialog box.

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**Project Configuration**

Vendor = Allen-Bradley  
Device Type = Digital I/O  
Catalog Number = 1756-IB16D  
Major Revision = 3  
Minor Revision = 003

**Device**

Vendor = Allen-Bradley  
Device Type = Digital I/O  
Catalog Number = 1756-IB16D  
Major Revision = 3  
Minor Revision = 002

Communication is prevented.
Electronic Keying in Logix5000 Control Systems

In rare cases, the project defines a device to use Compatible Module as described in this section and the installed device is a newer revision but the connection is rejected. Typically, the installed device rejects the connection because a significant hardware or firmware change prevents that device from emulating the device that is defined in the project.

Release notes for individual devices indicate the specific compatibility details.

**EXAMPLE**

In this example, **Compatible Module lets communication occur:**

The project configuration is for a ControlLogix digital input module, catalog number 1756-IB16D, revision 2.001, with Compatible Module specified. The device in the chassis is a ControlLogix digital input module, catalog number 1756-IB16D, revision 3.002.

In this case, communication occurs. The major revision of the device in the chassis is higher than expected and the device is compatible with the prior major revision.

**IMPORTANT**

Changing Electronic Keying parameters online interrupts connections to the device and any devices that are connected through the device. Connections from other controllers can also be broken.

If an I/O connection to a device is interrupted, the result can be a loss of data.
Disable Keying

Disable Keying indicates that the keying attributes are not considered when attempting to communicate with a device. Other attributes, such as data size and format, are considered and must be acceptable before communication is established.

With Disable Keying, communication can occur with a device other than the type specified in the project with unpredictable results. Unpredictable results can include unwanted and unexpected system behavior.

ATTENTION: Be extremely cautious when using Disable Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss.

We strongly recommend that you do not use Disable Keying.

If you use Disable Keying, you must take full responsibility for understanding whether the device being used can fulfill the functional requirements of the application.

EXAMPLE

In this example, Disable Keying lets communication occur:

The project configuration is for a ControlLogix digital input module, catalog number 1756-IA16, revision 2.001, with Disable Keying specified. The device in the chassis is a ControlLogix digital input module, catalog number 1756-IB16, revision 3.002. In this case, communication occurs because the digital module types share common data formats.

**Project Configuration**
- Vendor = Allen-Bradley
- Device Type = Digital I/O
- Catalog Number = 1756-IA16
- Major Revision = 2
- Minor Revision = 001

**Device**
- Vendor = Allen-Bradley
- Device Type = Digital I/O
- Catalog Number = 1756-IB16
- Major Revision = 3
- Minor Revision = 002

In this example, the project configuration is for a digital input module that uses AC signals. The device in the chassis is a digital input module that uses DC signals. Because the Disable Keying option is used, the system does not recognize the device mismatch. The system does not indicate that the incorrect installation has occurred. In this example, system damage or personal injury can occur.

IMPORTANT

Changing Electronic Keying parameters online interrupts connections to the device and any devices that are connected through the device. Connections from other controllers can also be broken.

If an I/O connection to a device is interrupted, the result can be a loss of data.
Exact Match

Exact Match indicates that all keying attributes of the device that is defined in the project must match the attributes of the installed device to establish communication.

If any attribute does not match precisely, communication with the device does not occur.

Use Exact Match when you need the system to verify that the device revision in use is exactly as specified in the project. This requirement is typically found in highly regulated industries. Exact Match is also necessary to enable Automatic Firmware Update for the device via the Firmware Supervisor feature from a Logix5000 controller.

**EXAMPLE**

In this example, **Exact Match prevents communication**.

The project configuration is for a ControlLogix digital input module, catalog number 1756-IB16D, revision 3.001, with Exact Match specified. The device in the chassis is a ControlLogix digital input module, catalog number 1756-IB16D, revision 3.002.

In this case, communication is prevented because the revision of the device in the chassis does not match the project configuration. For more information, see the Connection and Module Info tabs on the Module Properties dialog box.

**IMPORTANT**

Changing Electronic Keying parameters online interrupts connections to the device and any devices that are connected through the device. Connections from other controllers can also be broken.

If an I/O connection to a device is interrupted, the result can be a loss of data.
Connection Fault Indication

There are hardware and project fault indicators in Logix5000 control systems. Not all indicators apply to all control systems. For example, CompactLogix 5370 controllers do not have a Scrolling Status Display.

We recommend that you use multiple methods to monitor for the existence of faults that are related to Electronic Keying. The following can indicate that a fault condition exists:

- **Controller Status Display** - Fault information, for example, a fault code, scrolls across the controller display.

  ![Logix5575](image)

  **IMPORTANT** The information that scrolls across the controller display varies by system conditions. For example, multiple faults can exist simultaneously, and the information scrolling across the display does not provide complete information about each fault.

For more information on fault codes, see the online help or the Logix5000 Controllers Major, Minor, and I/O Faults Programming Manual, publication [1756-PM014](#).
• **Module and Project Status Indicators** - If the project is configured so that a fault occurs on the controller when a connection fails while in Run mode, the following occurs:

  - The controller OK status indicator flashes red.

  ![Logix5575](image)

  - If the controller has an I/O status indicator, it flashes green and the OK status indicator flashes red.

  ![Controller Mode Icon](image)

  - In the project, the controller mode icon lists **Faulted** and is solid red. Also, the Controller Fault indicator flashes red.

  ![Controller Properties Dialog Box](image)

  - **Major Faults Tab** - The Major Faults tab on the Controller Properties dialog box describes the fault.
• **I/O Configuration Folder in Controller Organizer** - A warning symbol appears on the device.

![I/O Configuration Folder](image1)

**IMPORTANT** The warning symbol appears if any fault occurs, not only faults that are related to Electronic Keying.

If you see the warning symbol, we recommend that you use the Connection tab on the Module Properties dialog box to determine the fault type.

• **Connection Tab** - The Connection tab on the Module Properties dialog box displays a module fault code and description.

![Connection Tab](image2)

• **Module Info Tab** - The Module Info tab on the Module Properties dialog box indicates a Module Identity mismatch and provides identification information about the device.

![Module Info Tab](image3)
• **Module Input Tag** - Fault members are set (to true) automatically in Module Input Tags when a connection is not established for any reason.

The names, and existence, of fault members in the input tags vary by device.

• **Get System Value (GSV) Instruction** - You can use a GSV instruction to monitor the status of a device. In this case, you monitor the **FaultCode** and **FaultInfo** attributes.

For more information on using GSV instructions, see the online help or the Logix5000 Controllers Information and Status Programming Manual, publication **1756-PM015**.