



ABB MEASUREMENT & ANALYTICS | 2107012MNAA

I/O Interface application guide

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Additional information

Additional free publications for the device are available for download at www.abb.com/totalflow.

Table 0-1: Related documentation

Documents	Document number
XIO user manual	2106424
XIO interface application guide	2107011
XSeries ^{G5} user manual	2106026
RMC user manual	2105552
TFIO module user manual	2101226

1 I/O Interface application

This document describes the I/O Interface application and provides basic steps for initial application configuration and verification of communication with attached TFIO modules. The document also provides detailed parameter and function description for the application screens in PCCU (version 7.68 or later).

The I/O Interface is supported by all Totalflow devices with TFIO interfaces (I/O bus): RMC-100, XSeriesG5, XIO, etc. The document indicates when content is applicable only to certain product(s) in the Totalflow product family.

1.1 Overview

Also referred to as I/O system, the I/O Interface application manages the communication between Totalflow devices and TFIO modules. TFIO connections are supported by remote controllers (RMC-100, XRC), flow computers (XFC), and extendible I/O devices (XIO). It supports the following scenarios:

- Configuration and communication management of TFIO modules directly attached to the device. These are local TFIOs that connect directly to a device's electronic board or TFIO connectors. The I/O Interface application is added on the device and runs locally.
- Configuration and communication management of TFIO modules attached to a remote device such as the XIO. This scenario can manage modules connected to an XIO from a remote controller. The I/O Interface application must still be added and initially configured on the XIO, but it is also available on the controller for further configuration and management. Applications on the RMC drive the module inputs and outputs as if they were connected directly. This scenario requires successful RMC-XIO communication and the export of the I/O Interface application to the RMC.

1.2 Available application options

The application gives several options through screens that provide parameters and functions for module configuration, detection, provisioning, and monitoring.

TFIO module screens display when the TFIO interface on the device is enabled. They display as follows:

- XSeriesG5 devices and XIOs automatically display a TFIO module screen for their single TFIO interface. The TFIO interface is enabled by default and remains enabled always. The user is not able to disable the interface.
- RMC-100 displays two sets of TFIO module screens for each of the two supported TFIO interfaces (TFIO-A and TFIO-B). The screens display only when the corresponding interface is enabled. On the RMC-100, the user can disable or enable the TFIO interfaces. TFIO-A is enabled by default from the factory. TFIO-B is disabled.

The following is a list of the I/O Interface application screens and what you can do in each of them. For more details, see the specific topic for each screen in the Reference information section.

Options for global module management:

- **TFIO Bus Enable** (RMC-100 only): Displays only when a TFIO interface or port is disabled. Enable a TFIO interface if planning to connect modules to that interface.
- **TFIO Module Setup** (default screen when the TFIO interface is enabled): Configure global module discovery and state parameters and configure per-module configuration/calibration restore mode. For details see [7.1 I/O Interface: TFIO Module Setup](#).
- **TFIO Modules List**: View inventory or summary of detected modules and their current operational state. For details see [7.2 I/O Interface: TFIO Module List](#).
- **TFIO Modules State**: Provision or decommission any detected module through module state control. Depending on field needs, place modules online or offline. For details see [7.3 I/O Interface: TFIO Module State](#).
- **TFIO Module Info**: Determine hardware and software part numbers and revisions per detected module. This information may be required for part replacement or troubleshooting. For details see [7.4 I/O Interface: TFIO Module Info](#).
- **TFIO Statistics**: Monitor performance, data traffic and alarms. For details see [7.4 I/O Interface: TFIO Module Info](#) [7.5 I/O Interface: TFIO Statistics](#).
- **Fail Safe Watchdog** (XIO only): Enable monitoring of XIO-remote controller communication to control module outputs fail-safe states. This is a safeguard that allows the XIO to drive the outputs to a pre-configured fail-safe state, in the event the RMC is no longer able to communicate and control the outputs remotely. For details see [7.6 I/O Interface: Fail Safe Watchdog](#).

Options for module-level management:

- **Advanced:** Management and monitoring options per module. Options vary depending on the type of module. For example, for modules with outputs, per channel configuration of watchdog and output fail-safe states is available. Click **Help** on each screen for module-specific information.
- **Module-type specific screens:** Monitor or reset the current state and other parameter values. For example, for outputs, view current state or reset last state for each output on the selected module. Click **Help** on each screen for module-specific information.

2 Startup procedures

Startup procedures describe initial installation and commissioning procedures when connecting TFIO modules to Totalflow devices. These procedures describe how to verify module detection and quickly determine if communication with the modules is successful. The I/O Interface provides default configuration values for module operation. See section [3 Additional configuration Procedures](#) to change defaults to meet field requirements.



IMPORTANT NOTES: Determine if your location requires powering off equipment before making any connections. TFIO modules are hot pluggable and can connect to devices without having to turn power off on the devices, but you may still be required to power them off if your location requires it.

It is assumed that the TFIO module terminal connectors are correctly wired. Connectors can be removed for wiring and re-inserted back into the module before or after the module is connected to the device. Follow your field guidelines for correct wiring and connection sequence.

2.1 Enable the TFIO Interface (RMC-100 only)

The RMC-100 provides the ability to enable or disable either of its two TFIO interfaces or ports. TFIO-A is enabled by default. TFIO-B is disabled by default.

This procedure describes how to enable a TFIO interface or bus. It enables the RMC TFIO-B as an example. The procedure assumes the I/O Interface is already added on the RMC. It is applicable only to I/O Interface instances which the RMC-100 uses to control directly-connected TFIO modules. This does not apply to I/O Interface instances exported from remote XIOs.

Note that the I/O Interface application name displayed on the RMC-100 navigation tree is I/O System.

This procedure applies to the RMC-100 only. If you are configuring the I/O Interface for an XSeriesG5 device or an XIO, skip this procedure and go to section [2.2 Add I/O Interface on devices with directly-connected TFIO modules](#).

To enable the TFIO interface:

1. On the navigation tree, locate the I/O System application instance used to control directly-connected TFIO modules.
2. Expand **I/O System**, then select **TFIO-B Modules**. The TFIO Bus Enable screen displays.
3. Select **Enabled** from the TFIO-B Bus drop-down list.
4. Click **Send**.
5. On the navigation tree, select **TFIO-B Modules** again. The TFIO Module setup displays. All other TFIO Module screens become available.
6. Configure as necessary.

2.2 Add I/O Interface on devices with directly-connected TFIO modules

All devices that connect to TFIO modules directly must have the I/O Interface application instantiated and enabled.

Add the I/O Interface application if it is not already in the device factory default configuration. If the I/O Interface is already available, skip this procedure. These steps apply to all devices supporting TFIO connections.

To add the I/O Interface on devices:

1. Connect to the device with PCCU in Entry mode.
2. On the navigation tree, select the Station ID. The Station Setup displays.
3. Select the **Application/License Management** tab.

4. Click **Add App**.
5. Select **I/O Interface XSeries** from the Application to add drop-down list.
6. Click **OK**. The I/O Interface displays in the application table, ready to be activated.
7. Click **Send**. The I/O Interface is added to the application table. It displays available in the navigation tree. If the navigation tree does not display it, click **Close** to disconnect from the device and Click **Entry** to reconnect.
8. If the I/O Interface is on the XIO, complete steps in section **Export the I/O Interface application (XIO only)**.
9. If the I/O Interface is configured on remote controllers or flow computers for control of directly connected TFIOs, proceed to the section [2.4 Connect the TFIO module to the device](#).

2.3 Export the I/O Interface application (XIO only)

Export the I/O Interface application when it is configured on the XIO. I/O Interface export provides the remote controller with the ability to control the modules remotely.

On the XIO:

1. On the **Application/License management** tab, locate the I/O Interface in the application table.
2. Select the checkbox under the Exported column.
3. Click **Send**.
4. Proceed to the section **Connect the TFIO module to the device**.

2.4 Connect the TFIO module to the device

Devices dedicate a communication address number for communication with each attached TFIO module. When multiple TFIO modules are attached, each should have a unique address. The device detects the address number and assigns that number for operation.

Before connecting the module, configure a different address number for each TFIO. The device must be able to display the detected module with the address selected on the module. All modules have address 0 selected by default. The address number range on the module is 0-7. Note that, the I/O interface screens list the addresses as 00-07.

Configure address on the TFIO module:

1. Position a small flat screwdriver on the address selector slot on the face of the TFIO module.
2. Rotate the address selector to the desired address number. Make sure the selector arrow points to the address number.

Connect module(s) when the device is powered off:

1. If required, or when in hazardous locations, power off the device and remove wired connectors from the TFIO module.
2. Connect the TFIO module(s) to the device.
3. Re-insert wired connectors on the module(s).
4. If the device's power was turned off, re-apply power.
5. Observe module LEDs. The LEDs may turn on briefly, but then turn off. They remain off until the module is set to Online state.
6. Proceed to verify module detection.

Connect modules when device is on (hot insert):

1. Connect the TFIO Module(s) to the device.
2. Re-insert wired connectors on the module(s).
3. Observe module LEDs. The LEDs may turn on briefly, but then turn off. They remain off until the module is set to Online state
4. Proceed to verify module detection.

2.5 Verify TFIO module detection

After module connection, verify that the device detects the newly connected TFIO module(s). View detected modules on the TFIO Module State screen which provides quick visual confirmation of the number of modules, their addresses, and current state.

When verifying on the RMC-100, verify detection in the correct TFIO interface. The RMC-100 supports two TFIO interfaces (TFIO-A and TFIO-B). If connecting modules to both interfaces, verify that all modules are detected in each interface.

To verify module detection:

1. If the device was off for insertion, reconnect with the device on PCCU.

2. On the navigation tree, expand the **I/O Interface**. Then expand **TFIO Modules**. On the RMC-100, expand each of the TFIO interfaces if both are used.
3. Select the **TFIO Module State** tab.
4. Verify that the device detects the correct number and type of module(s).
5. If you are missing module(s):
 - a. Check the module address selector to determine the address assigned.
 - b. Adjust the selector to make sure the address is unique and not assigned to another module. See section [6.5 Module address change](#) for additional details.
 - c. Reset the TFIO module(s).
 - d. Click **Re-read**.
 - e. Verify that the previously missing modules are detected and that they show in the address selected.
6. Proceed to configure the TFIO modules next.

2.6 Configure global TFIO parameters

Global configuration parameters apply to all detected modules. These parameters define how the device controls TFIO LEDs, discovery start module state, scan interval, etc. Determine if the default values meet your field requirements. Change values as necessary.

For an RMC-100 with both TFIO-A and TFIO-B enabled, configure parameters for each set in their corresponding TFIO Module Setup screens.

Control module LEDs and configure the scan interval:

1. Select the **TFIO Module Setup** tab.
2. Select the **LED Enable** drop-down list to enable or disable LEDs on modules. This controls if the LEDs are turned on or left off.
3. Type the desired scan interval to define how often the device polls the TFIO modules for I/O values.

Set up the Discovery Start Default State and Save Committed Module State. These two parameters affect the module states after the device is power cycled. If the device must be powered off for module removal or insertion, the module states are determined by these parameters. The states may be different if removal or replacement is performed with the device powered on. See section [6 Service and maintenance](#).

To configure:

1. Select the start state from the **Discovery start default state** drop-down list. Available options are: Online and Available. Note that if set to Available, a module that was online prior to restart, will display as Available if the Save Committed State is set to No. The module will need to be set back to Online to resume operation.
2. Select **Yes** from the **Save committed module state** drop-down (recommended). This parameter configures the device to remember the attached devices and their states before a power cycle.

2.7 Configure module configuration/calibration restore

For each detected module type, configure if the device keeps the module's configuration and calibration data for use on a replacement module. Note that the setting applies to all detected modules for each type. When you set the preferred option for a module type, it applies to all the modules in that group.

Using an existing module's configuration and calibration data on the replacing module saves time and configuration effort. The replacement module can start operating as soon as it is online.

If you remove a module you plan to insert a replacement for, do not delete the module. Deleting the module deletes the configuration and calibration data even if the automatic restore is set to Yes. If the replacement is not immediate, leave the module in Offline state until ready to insert the new module.

To configure the configuration and calibration usage:

1. Select the **TFIO Module Setup** tab.
2. For each module type, select the drop-down list in the value column.
3. Select **Yes** to keep the configuration and calibration data.
4. Select **No** if not restoring the configuration and calibration data.



IMPORTANT NOTE: When you have elected not to restore the configuration and calibration data, you must remember to calibrate and configure the replacement module soon after installation. The device does not display a warning or reminder to do so.

5. Proceed to activate the TFIO modules next.

2.8 Activate TFIO modules

To activate the module for communication:

1. Select the **TFIO Module State** tab. The connected module displays the status: Available. This indicates that the XIO has detected the TFIO module in its communication bus, but the module is not yet ready for use.
2. Set the TFIO module to **Online** to enable the TFIO module for communication.
3. Click **Send**. The State of the TFIO module displays: Online. Refresh the screen to see the state field change to green (click **Re-read**). For color to show, clear the **Show editable fields** at the bottom of the screen.
4. When installing the module on an XIO, proceed to clear the fail-safe alarm in the next procedure.
5. When installing the module on remote controllers or flow computers, proceed to Configure global TFIO parameters.
6. On the navigation tree, verify that the activated module displays under **I/O Interface>TFIO Modules> ONLINE**. The navigation tree classifies and displays online and available modules.
7. If TFIO modules are attached to an XIO, proceed to section [2.9 Clear fail-safe watchdog alarm after first-time TFIO installation \(XIO only\)](#).
8. If the TFIO modules are attached to a remote controller or flow computer, proceed to [3 Additional configuration Procedures](#).

2.9 Clear fail-safe watchdog alarm after first-time TFIO installation (XIO only)

The XIO supports a watchdog function to define module output fail-safe states in case of XIO-remote controller communication failure. The watchdog function is enabled for all modules from the factory. The watchdog is in an alarm state if:

- The I/O Interface on the XIO is not exported to the RMC
- The XIO-RMC connection has not been established or has failed
- The XIO needs a reset. The alarm may display during the first-time installation of the modules.

This procedure clears the alarm after a module is first connected to the XIO and is set to Online state. It assumes the alarm is not due to connection failure and that the I/O Interface application has already been exported to the RMC.

The 3rd and 4th SYS STATUS LEDs on the XIO blink intermittently to indicate the alarm state.

This procedure assumes the fail-safe watchdog configuration is the default.

To clear watchdog alarm:

1. Select the **Fail Safe Watchdog** tab.
2. Locate the Watchdog State value and verify the state.
3. If in Alarm state, select: Now in the **Recovery Manually** drop-down list and then click **Send**.
4. Verify that the alarm clears. The watchdog state displays: Normal (green). The 3rd and 4th SYS STATUS LEDs quit blinking and remain on.
5. Proceed to [3 Additional configuration Procedures](#) if needed.

3 Additional configuration Procedures

3.1 Enable the watchdog feature for device-TFIO module communication (RMC-100, XFC/XRC)

This procedure applies to remote controllers and flow computers with attached TFIO modules.

To enable the watchdog feature for the communication between the electronic board and directly attached TFIO modules:

1. On the navigation tree, expand **I/O Interface>TFIO Modules**, then **ONLINE**.
2. Select the desired module. For example, **TFIO DIDO I:00** (Combo DI/DO I module).
3. Select **Advanced**. The Watchdog screen displays.
4. Type a value in milliseconds in the Timeout/Counter field. Since the TFIO modules are polled once a second, this should be something greater than a second. Three seconds is recommended which would be 3000 milliseconds. The Timeout can be in 100 millisecond intervals.
5. Enable the Watchdog feature for the DOs that will use this feature by selecting **Enabled** in the Disabled / Enabled cells.
6. Click **Send**.
7. Click **Re-read** or select **Monitor**. Observe the value displayed to the right of the Timeout cell. This is the time in milliseconds it took the device electronic board to poll the TFIO modules.

3.2 Enable the watchdog feature for device-XIO communication (XIO)

The procedures in this section apply to the XIO with attached TFIO modules. The watchdog function in the XIO monitors the XIO-RMC communication and drives the module outputs to fail-safe states when communication fails.

Enable the watchdog feature for all outputs or for each output independently (module-level). In the XIOs, the watchdog mode is enabled on the Fail-safe watchdog tab. Specific output settings are configured on the Watchdog tab for the specific module.

3.2.1 Enable All (XIO)

When the watchdog is enabled for all outputs on a module, configuration change of the watchdog per output is not available. If you need independent control of each output, see section [3.2.2 Enable module-level fail-safe watchdog \(XIO\)](#) below.

To enable the watchdog for all module outputs:

1. Select the **Fail Safe Watchdog** tab.
2. Select **Enable All** from the Enable fail safe watchdog drop-down list.
3. On the navigation tree, expand **TFIO Modules**, then **ONLINE**. This displays all detected modules that are ready to communicate (set to Online state).
4. Expand the desired module, then select **Advanced**. The **Watchdog** tab displays.
5. Type a value in milliseconds in the Timeout/Counter field. Since the TFIO modules are polled once a second, this should be something greater than a second. Three seconds is recommended which would be 3000 milliseconds. The Timeout can be in 100 millisecond intervals.
6. Select the fail-safe state for each output (open or closed).
7. Click **Send**.

3.2.2 Enable module-level fail-safe watchdog (XIO)

The fail-safe watchdog is enabled for all outputs on a module by default. To enable the watchdog and fail-safe state per specific module outputs or channels:

1. Select the **Fail Safe Watchdog** tab.
2. Select **Module Control** from the Enable fail safe watchdog drop-down list.
3. On the navigation tree, expand **TFIO Modules**, then **Online**. This displays all detected modules that are ready to communicate.
4. Expand the desired module, then select **Advanced**. The Watchdog tab displays. The global fail-safe control field should display: Module Control.
5. Type a value in milliseconds in the Timeout/Counter field. Since the TFIO modules are polled once a second, this should be something greater than a second. Three seconds is recommended which would be 3000 milliseconds. The Timeout can be in 100 millisecond intervals.
6. Enable the watchdog function and select the fail-safe state for each channel (output) as required. The fail-state value depends on the type of equipment connected to the output and the safety requirements for operation. Select the appropriate option for your requirements.
7. Click **Send**.

4 Module operation

This section includes procedures performed after initial installation of the module(s) is complete. It assumes that the TFIO module is online and has been able to communicate successfully with the device.

The XIO-RMC connections scenario assumes that the RMC is successfully communicating with the TFIO module: The I/O Interface is visible from the RMC, reflecting module health and state in real-time, and you are able to make configuration changes or trigger actions from the RMC.

4.1 Configure applications driving the modules

Control application configuration details depend on the type of application or operations driving the modules. Application-specific configuration details are beyond the scope of this document. Refer to the documentation for each application or click **Help** from application screens.

In general, configure based on connections scenarios:

- Device-TFIO module communication: Applications run on the device and control directly-connected TFIO modules. The device can be an RMC-100, XSeriesG5 device or an XIO. The XIO supports a small subset of the Totalflow application suite, such as Operations, PID Controller,

Trend System, etc. These applications, when configured on the XIO, have local access and control of the TFIO modules.

- Device-XIO TFIO module communication: Applications run on the controller (RMC-100) and control TFIO modules connected to an XIO. From the RMC perspective, the modules are controlled as if they were directly connected.

4.2 Global and module-level operation

The I/O Interface supports global (all modules) or module-level operation. Once modules are installed and configured:

- Perform monitoring for all modules on the **TFIO Module State** or **TFIO Statistics** screens. These screens provide information for all modules and comprehensive module activity.
- Perform module-level monitoring or management on the module-specific screens available for each module.

4.3 Monitor TFIO module state

The TFIO Module State screen provides the most complete view of all modules installed and their state. Per-module state control is available. Use this screen to monitor module health and to manage replacement or removal of modules.

Also use the TFIO Module State screen to monitor module state after device restarts. After the device is power cycled, the states of the modules depend on the configuration of the Discovery Start Default State and the Save Committed Module State parameters. See section [2.6 Configure global TFIO parameters](#).

Obtain quick visual information for all detected module states:

1. Select the **TFIO Modules State** tab.
2. Verify that all modules are detected and accounted for.
3. Verify module states. Module state changes that are not manually triggered may indicate module failure.
4. Keep this view updated after module service events to make sure it always reflects module health and count accurately. See section [6.15 Service and maintenance](#).

4.4 Monitor TFIO module performance or events

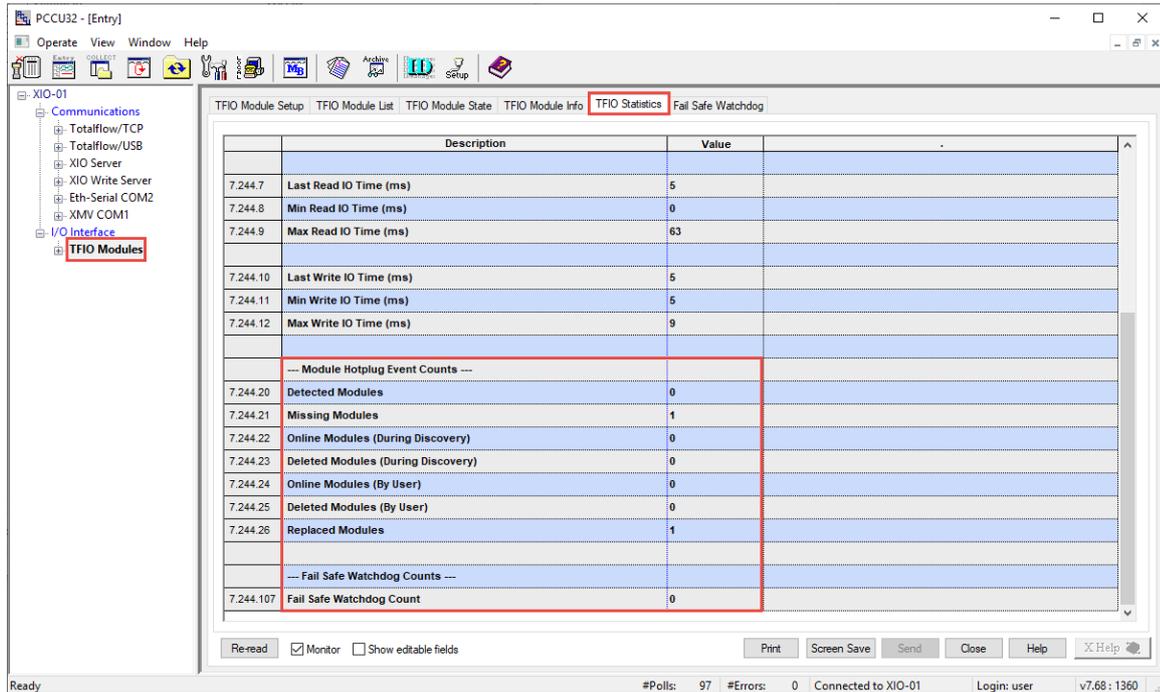
The TFIO Statistics screen displays information to verify module communication activity, service events, or watchdog events. Statistics help support troubleshooting.

The screen supports statistic reset. Reset when monitoring values for troubleshooting purposes or to monitor during a time interval. To trigger the reset, select **Yes** from the **Reset Statistics** drop-down list, then click **Send**.

To monitor module activity or events:

1. Select the **TFIO Statistics** tab.
2. To monitor module scan and communication timing activity:
 - a. Locate the scan counts and statistic screen section.
 - b. Monitor the values to determine if there are unusual delays or minimum activity. The I/O reads and writes are executed at high priority (high priority threads in the device). They are less likely to be affected by CPU utilization, but low timing performance such as high delays may indicate an overloaded system.
3. To monitor module service events:
 - a. Locate the **Module Hotplug events counts** section on the screen.
 - b. Monitor the tracked values displayed. Missing modules may be an indication of module failure. Refer to troubleshooting section. If the Replaced modules field displays any number, it indicates that new modules have been inserted to replace failed or old ones. These events should reflect and record service activity.
4. To monitor watchdog events (XIO only):
 - a. Locate the Fail Safe Watchdog counts section on the screen.
 - b. Monitor the watchdog count. An excessive amount of watchdog events in a short period of time may indicate faulty XIO-RMC connection, poor network port performance, excessive network load (possible from malicious denial of service attacks on the network port), an overly restrictive Ethernet interface rate limit, etc.

Figure 4-1: Monitor TFIO Module Hotplug and watchdog event counts (TFIO Statistics)



4.5 Monitor TFIO module events in the System log

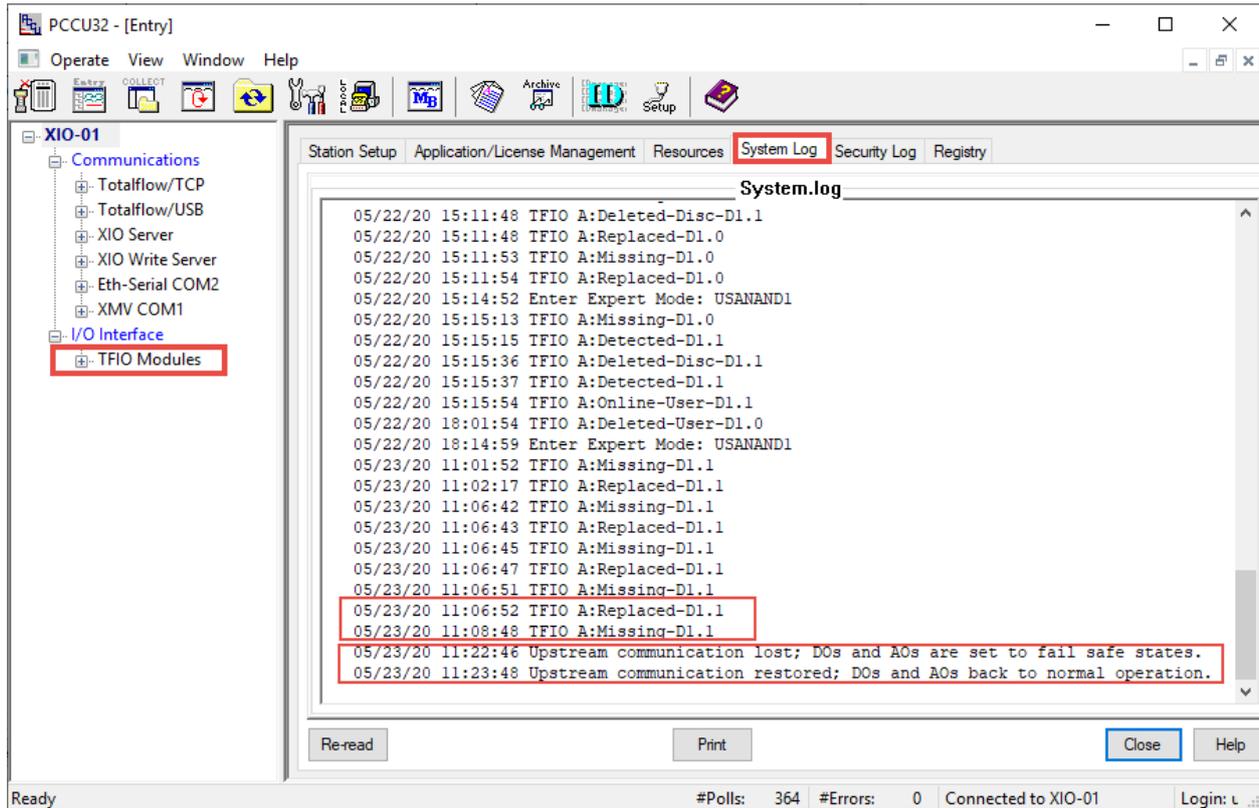
TFIO module events are logged in the device’s system log. These logs provide additional event information and more precise event details.

This procedure applies to devices that have directly-connected TFIO modules. The system log of a controller using the TFIO modules connected to an XIO does not record remote TFIO module events.

To review logged events:

1. On the navigation tree, select the Station ID.
2. Select the **System Log** tab.
3. Locate logged TFIO module related events. Logs may reflect service activity involving the modules, errors or communication failure. For example, in the figure below, service-related events due to module replacement are recorded as missing and replaced modules. Loss and restoration of XIO-RMC communication is recorded as Upstream communication loss and Upstream communication restored events.

Figure 4-2: Monitor TFIO Module events from the System Log screen



4.6 Management of remote TFIO modules (RMC only)

Remote controllers, such as the RMC-100, can manage and drive TFIO modules connected to XIOs. The I/O Interface in the XIO becomes visible from the RMC when the application is exported. The XIO I/O Interface displays in the RMC navigation tree under the XIO Interface application.

This procedure assumes that the XIO Interface is already successfully running on the RMC, the I/O Interface is exported to the RMC, and that XIO-RMC communication is successfully established and healthy. For additional information select the link to the XIO Interface application guide listed in [Additional information](#).

To access the XIO I/O Interface from the RMC:

1. On the navigation tree, expand the **XIO Interface** for the desired XIO.
2. Select **I/O Interface**. The TFIO Module Setup tab displays. Note that all the I/O Interface tabs displayed in the XIO are also available on the RMC.
3. Monitor or configure the modules as necessary.

i **IMPORTANT NOTE:** The fail-safe watchdog tab displayed on the RMC has a subset of the full parameter list on the XIO. The watchdog screen on the RMC allows the configuration of the watchdog mode and timeout as well as taking module outputs out of their fail-safe states. For a more complete parameter list, see the TFIO **Fail Safe Watchdog** tab on the XIO.

5 Troubleshooting

When a TFIO module fails and the device can no longer communicate with it, the module state is Offline. The TFIO Modules State screen provides a comprehensive view of all the modules and their states and is very useful to monitor module health.

The procedures included in this section describe what to do in case of failure or alarm conditions.

5.1 Troubleshoot using the watchdog alarm (XIO)

The watchdog monitors XIO-RMC communication. When this communication breaks, the watchdog raises an alarm. This is also indicated on the XIO by the intermittent blinking of the 3rd and 4th SYS

STATUS LEDs. If you are not in proximity and are unable to visually detect this condition, verify the watchdog alarm state on the XIO.

The watchdog state can only be monitored on the XIO. The RMC does not display this alarm as the watchdog is an XIO-only function and applies only locally to the XIO.

To monitor the watchdog state on the XIO:

1. Select the **Fail Safe Watchdog** tab.
2. Under Current Status, check the Watchdog State. If it displays Alarm, the device has detected XIO-RMC communication failure.
3. If the watchdog recovery is set to Manual, select **Now** from the **Recover Manually** drop-down list to try to clear the alarm.
4. If the alarm does not clear after attempting manual recovery, proceed to determine the cause of communication failure.

Verify that the XIO I/O Interface is exported:

1. Select the Station ID.
2. Select the **Application /License Management** tab.
3. Verify that the **I/O Interface Exported** checkbox is selected.
4. If the I/O Interface is not exported, select the export checkbox and then click **Send**.
5. Go back to the **Fail Safe Watchdog** tab. If the watchdog recovery is set to Manual, the watchdog state still displays Alarm.
6. Select **Now** from the **Recover Manually** drop-down list to try to clear the alarm.
7. If the alarm clears, then the cause of the watchdog alarm was an un-exported I/O Interface.
8. If the alarm persists, verify communication on the RMC side next.

Verify communication from the RMC:

1. On the RMC navigation tree, expand the XIO Interface corresponding to the XIO of interest.
2. Verify that the I/O Interface displays on the navigation tree. The XIO I/O Interface should display if it was set to export at the XIO.
3. Select **XIO Interface**.
4. Click **Re-read** to refresh the screen.
5. Verify the Connection Status indicator color.
6. If the connection status indicator is red, verify that **Scan Enabled** is selected.
7. If scan is not enabled, select and then click **Send**.
8. Verify if the connection status indicator changes to green.
9. If a red connection status persists, on both devices check that:
 - a. Ethernet interfaces are enabled.
 - b. Ethernet IP configurations are intact.
 - c. Ethernet IP configurations have not been lost if configured for DHCP.
 - d. The local field router providing IP configuration when DHCP is used is in working condition. If the router fails, the XIO and RMC lose their IP configuration and cannot communicate.
 - e. Physical Ethernet connections are intact. Cable damage or a loose connector can cause intermittent error or failure.
10. If unable to resolve a persistent connection failure, contact technical support.

5.2 Recover from watchdog alarm state (XIO)

If the recovery is set to auto, recovery is automatic. Skip this procedure.

If the fail-safe watchdog alarm is set to manual recovery, then resetting the alarm and restoring the module outputs to normal operation requires manual intervention. This is done once XIO-RMC communication resumes. The watchdog remains in alarm state and the outputs in their fail-safe state until this procedure is performed.



IMPORTANT NOTE: While the watchdog is in alarm state, users or control applications cannot set or operate TFIO module outputs. If the recovery is set to manual, resolve the alarm as soon as the RMC-XIO communication is restored to minimize disruption of output operation.

To manually recover from an alarm state:

1. Ensure XIO-RMC communication has resumed.
2. Select the **Fail Safe Watchdog** tab.
3. Select **Now** from the Recover Manually drop-down list to trigger the recovery.
4. Click **Send**.

5. Verify that the watchdog alarm state returns to Normal. The outputs also return to normal operation and begin to respond again to the driving applications as programmed.
6. If the alarm fails to clear, troubleshoot the XIO-RMC connection.

6 Service and maintenance

Service activities involve removal and replacement of TIFO modules.

Module removal may require powering off the device. Determine requirements per location designation. Follow guidelines required for hazardous locations.

At sites where powering off the device is not necessary, you can remove and replace modules while the device is on. Hot-pluggable events are recorded in the system log. View the system log as necessary to determine removal, insertion or detection of modules and their time stamp.



IMPORTANT NOTE: Remove the module's electronic board from the module enclosure when replacing or removing modules. The connection bus remains intact and other modules do not experience disruption. In newer module models, use release clips to remove the board. When pressed, these clips ease the extraction of the board.

6.1 Determine hardware and software versions on detected TFIO modules

There are several generations of TFIO modules. They are distinguished by part number revisions and software versions. For module replacement, ordering or troubleshooting, it may be necessary to determine the hardware part number or embedded software running in the modules.

To determine hardware and software in the module:

1. Select the **TFIO Module Info** tab.
2. Locate the module type under hardware part numbers or software versions.
3. Locate the specific module.
4. Take note of part numbers or versions.
5. Provide this information to sales or tech support personnel as necessary.

6.2 Remove a TFIO module permanently

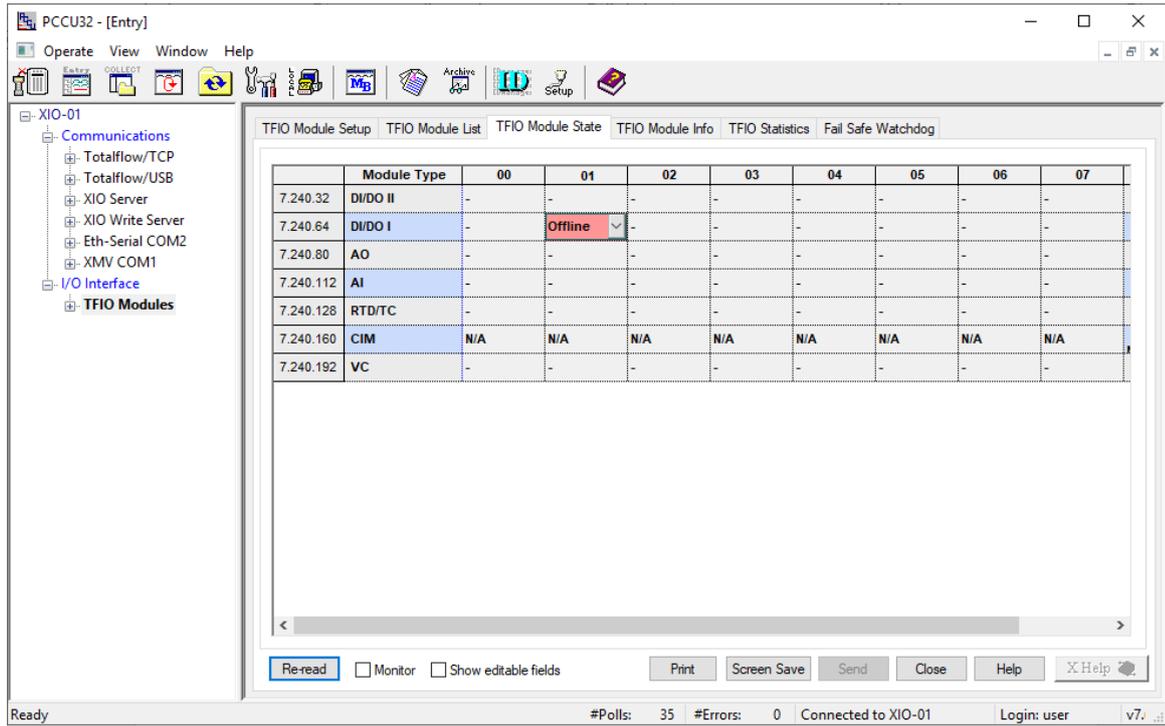
This procedure describes the removal of a module from the XIO. The behavior of the XIO during and after the module removal depends on whether the module is removed while the XIO is powered off or on, the state of the module prior to removal, and the configuration of the module.

If the module is new and has not yet been placed in Online state (the module is still in the Available state), the device deletes the module automatically after module removal. This procedure describes the removal of a module that is Online.

To remove a module while the XIO is powered:

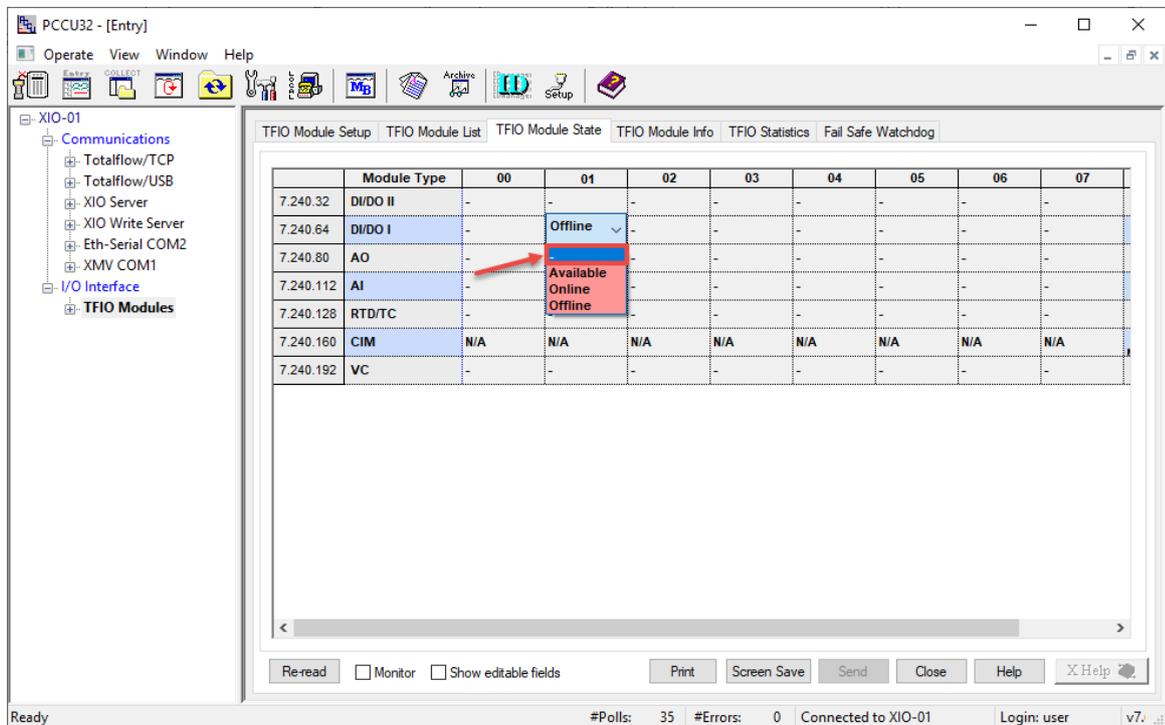
1. Remove the TFIO module board from the module enclosure.
2. Select **TFIO Module State**.
3. Monitor the state of the removed module. It should display Offline. Click **Re-read** to refresh screen if necessary.

Figure 6-1: Removed TFIO module state (Offline)



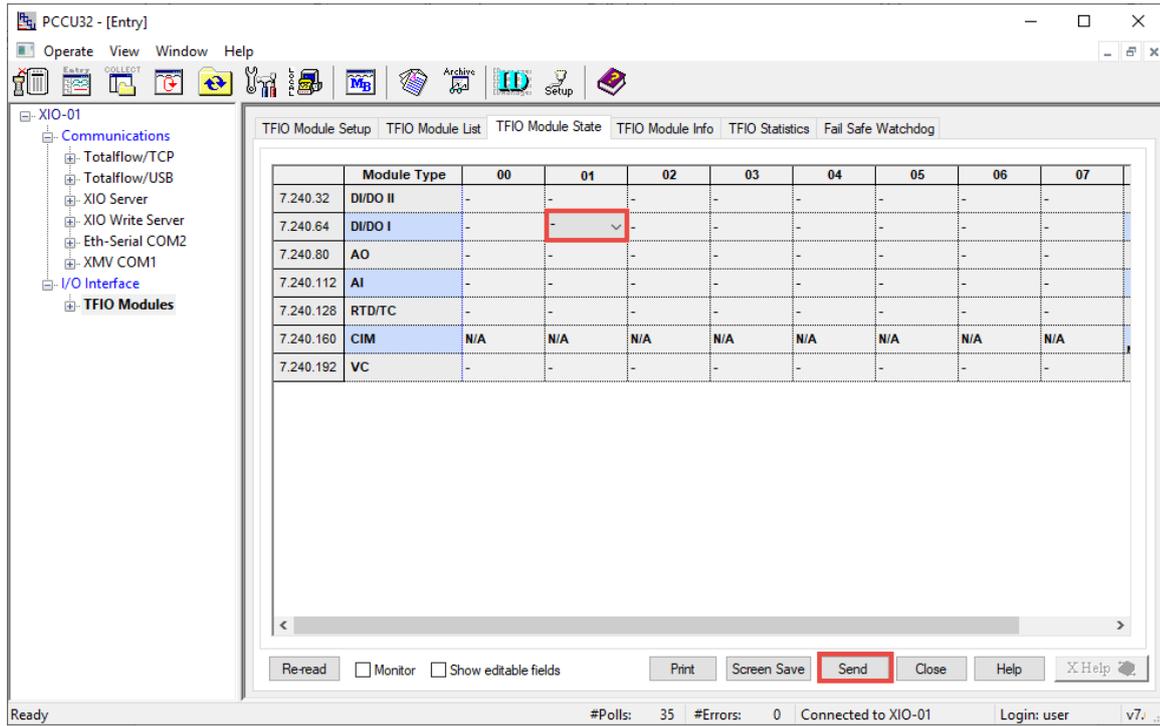
4. If the module is removed permanently and will not be replaced by another module, delete it. Note that if you delete the module, the configuration and calibration data of the module is also deleted. If you later decide to insert a module to replace the failed one, you will need to configure and calibrate the module after insertion.
 - a. Select the dash "-" from the drop-down list in the module's channel.

Figure 6-2: Delete TFIO module



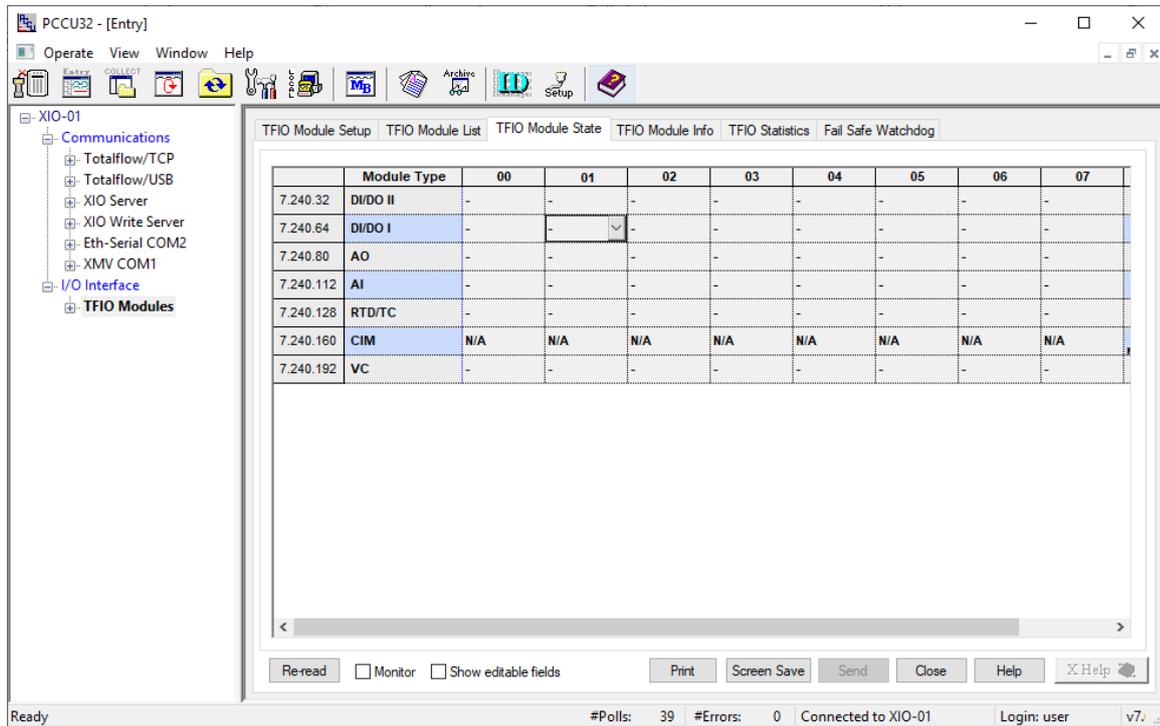
- b. Click **Send**.

Figure 6-3: Select deleted TFIO module state



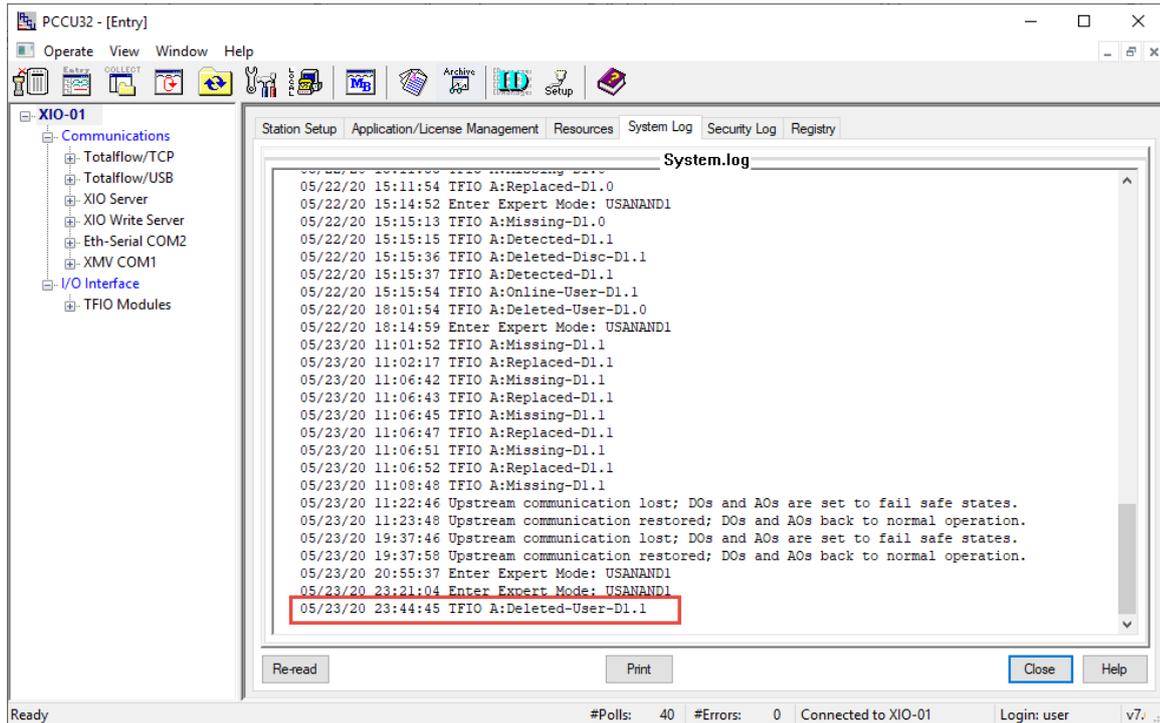
5. Verify that the module state does not display anymore.

Figure 6-4: Permanently deleted TFIO module state



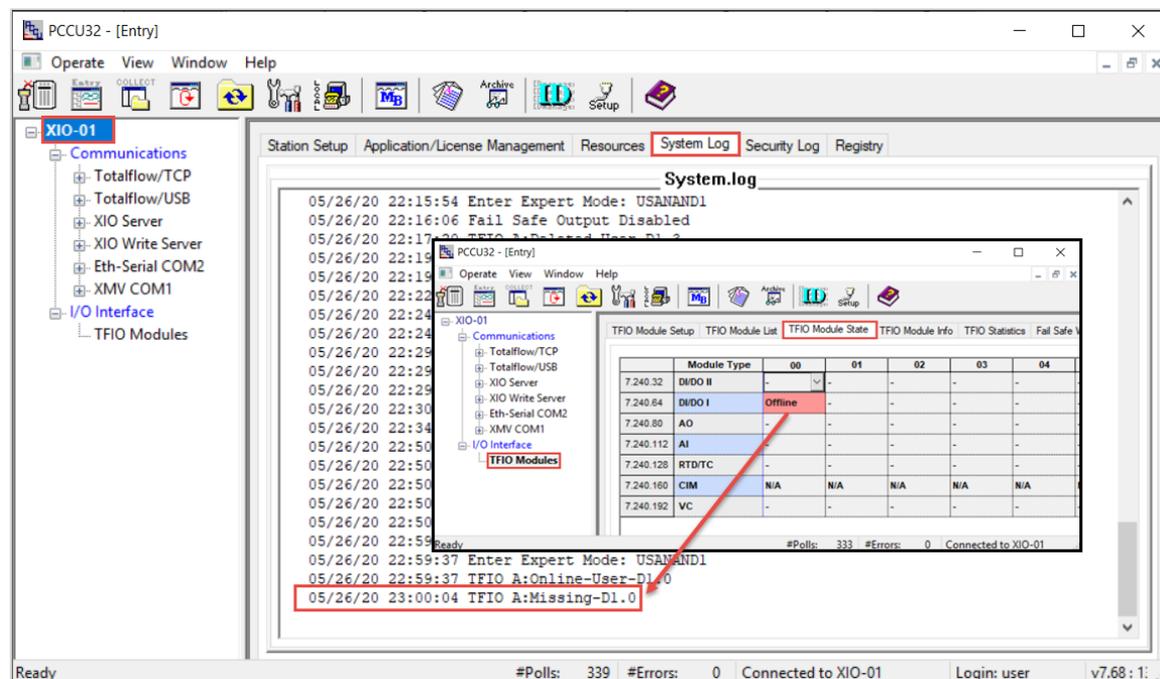
6. Select the **Station ID** and then the **System Log** tab. Note that the device logs the module delete event. The log indicates that the module was deleted by the user.

Figure 6-5: Deleted module event in System Log



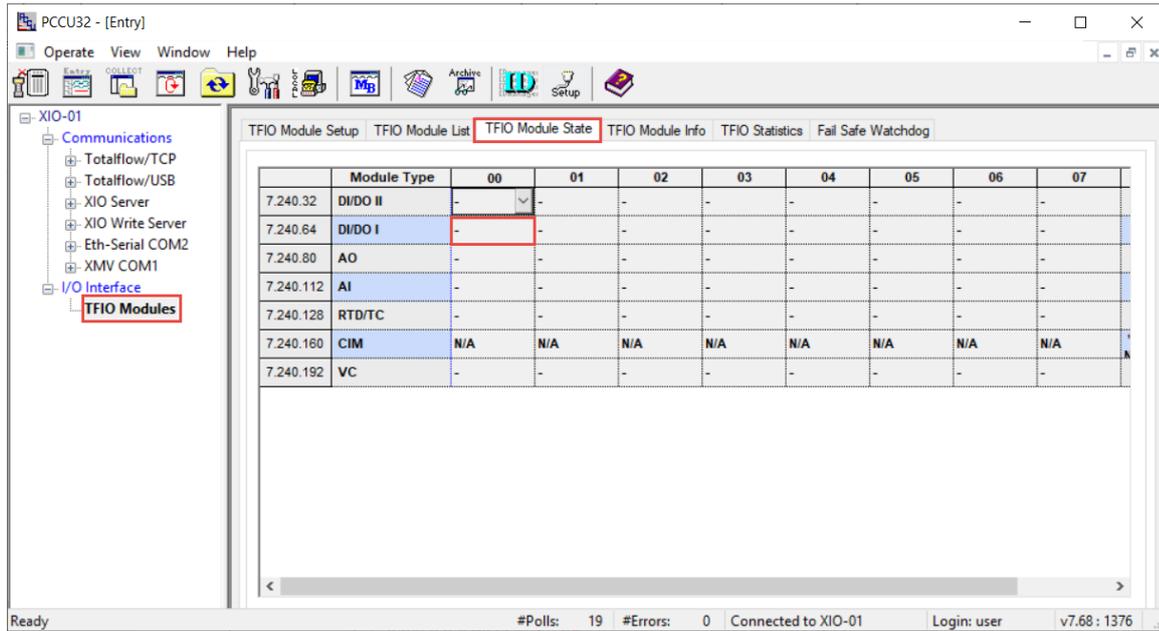
If you do not delete the removed module, the TFIO Module State screen continues to show the Offline state even if the module is no longer present (see insert view in figure below). The device does report the module as missing in the System log (see System Log tab message below) but does not remove it from the screen until the XIO is power cycled and if the "Save Committed Module State" is set to: No.

Figure 6-6: Removed (missing) module displayed state



The figure below shows the deleted state after the XIO is power cycled. The module is permanently removed and no longer remembered.

Figure 6-7: Deleted (non-existent) module state after XIO is power cycled



6.3 Replace a TFIO module (hot swap)

Replace existing modules when they fail or to upgrade with newer module models. If the configuration and calibration data restore option was enabled for the module, the device uses that data for the new module. There is no need to calibrate or reconfigure the replacement module, but the replacement module must be of the same type. For example, if the existing module is a DI/DO Module, the replacement module should also be a DIO/DO Module.



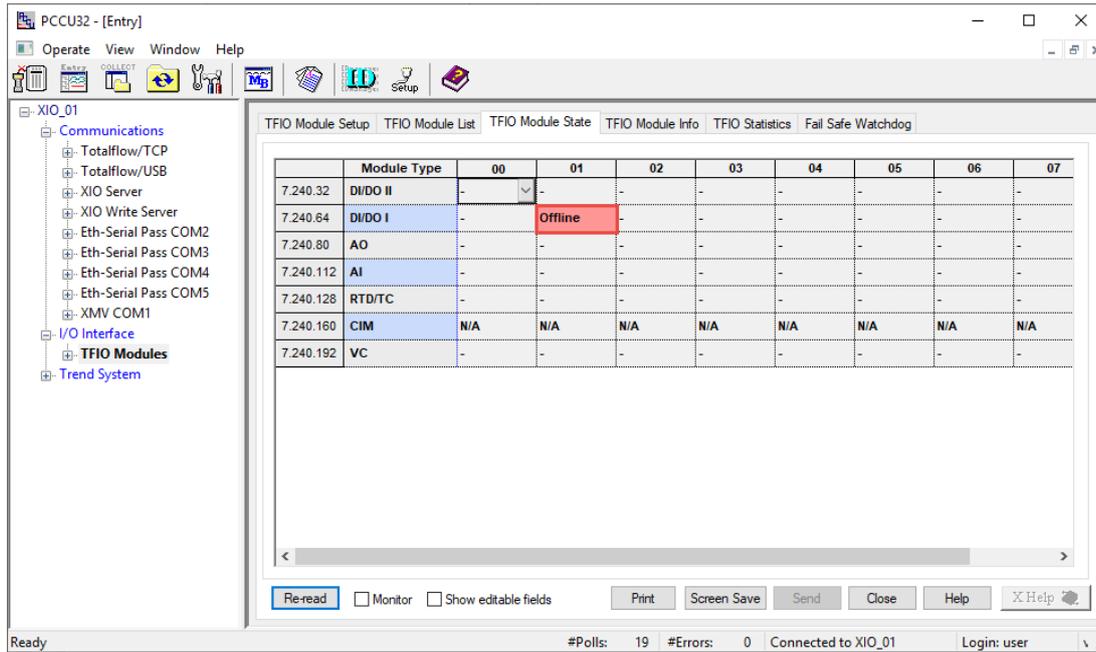
IMPORTANT NOTE: The new module should also be set for the same address prior to insertion to be considered a hot swap. If either the type or address of the new module is not the same as the existing one, it is not considered as a hot swap. The device will consider it a new installation

Do not delete the removed module. If you delete it, the calibration and configuration data is lost, and you will need to configure the replacement module from scratch and calibrate it after insertion.

To replace a module (while the device is powered on):

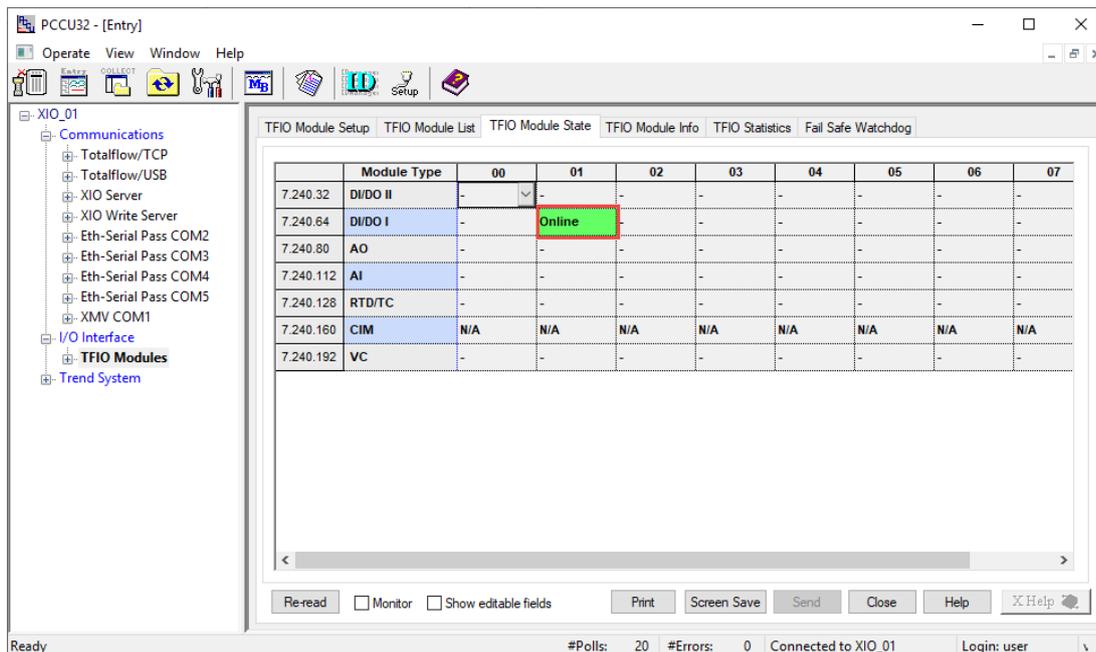
1. Select **TFIO Module State**.
2. Locate the module to replace on the module's address number. If the module has failed completely, the state may already be Offline. Take note of the address.
3. On the replacement module, before you insert it, set the address:
 - a. Position a small flat screwdriver on the address selector slot on the face of the TFIO module.
 - b. Rotate the address selector to the desired address number (it must be the same as the address of the old module). Make sure the selector arrow points to the address correctly.
4. Remove the failed TFIO module. If the module state was online, the state changes to offline.

Figure 6-8: Removed module state



5. Insert the replacement TFIO module.
6. Click **Re-read** to refresh the screen. Verify that the module state display online. In hot swaps, the module state automatically changes to Online. The module is ready for use.

Figure 6-9: Replacement module state (hot swap)



6.4 Reset a module

TFIO modules can be reset while connected to the device. The device responds based on the module state prior to the reset:

- If the module state is Online, it changes to Offline during the reset, then changes back to Online after the module completes restart.
- If the module state is Available, it displays "-" (dash for undetected state) during the reset, then changes back to Available after the module completes restart.

Reset TFIO modules if needed:

1. Monitor the reset on the TFIO Module State tab.
2. Locate the TFIO module to reset.

3. Insert the tip of a paper clip into the module reset button and press for a few seconds. The module reset LED turns on briefly.
4. If the module was Online before reset, verify that it returns to Online.
5. If the module was Available before reset, verify that it returns to Available. Set to Online if needed or leave as Available.

6.5 Module address change

It may be necessary to change the address of a TFIO module after it has been connected to the device.

If the number of modules displayed on the TFIO Module State screen does not match the number of modules connected, or the same address displays states for more than one module, there are address duplicates. This can happen if the modules were inserted with their default addresses (all modules addresses are 0, the factory default) or if unique addresses were not set.

Change the address of the modules if you desire a different address or if there are duplicate addresses.

If you change the address on a TFIO module, remove the module and plug it back in, or press the reset button (recommended). The following procedures reset the modules while connected to the device, as recommended.



IMPORTANT NOTE: The register numbers associated with the module change when the module address is changed. For example, a DI/DO module at address 03 has different registers than the DI/DO module at address 04. Plan any address change carefully if the module is already in service. Registers change may require reconfiguration of applications driving the module I/Os.

Module addresses are labeled from 0-7 on the module face. The addresses are listed as 00-07 on the I/O screens.

6.5.1 Change the address of a single module

To change the address on a connected module (device powered on):

1. Locate the module that needs the address change.
2. With a small flat screwdriver, rotate the selector to the desired module address.
3. Insert the tip of a paper clip into the module reset button and press for a few seconds. The module reset LED turns on briefly.
4. Observe the module state. It changes to Offline at the old address and Available at the new address.

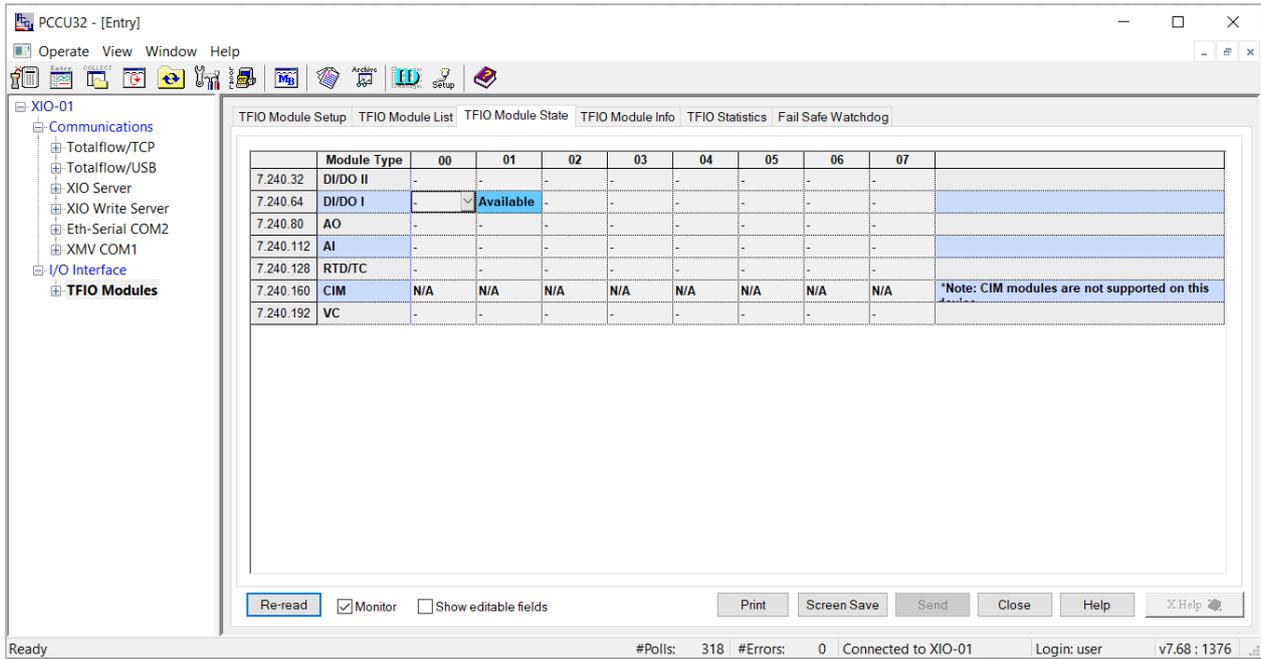
Figure 6-10: Module state on address change

	Module Type	00	01	02	03	04	05	06	07
7.240.32	DI/DO II	-	-	-	-	-	-	-	-
7.240.64	DI/DO I	Offline	Available	-	-	-	-	-	-
7.240.80	AO	-	-	-	-	-	-	-	-
7.240.112	AI	-	-	-	-	-	-	-	-
7.240.128	RTD/TC	-	-	-	-	-	-	-	-
7.240.160	CIM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7.240.192	VC	-	-	-	-	-	-	-	-

5. Clear the state of the module from the old address:
 - a. Select the old address and select the dash "-" from the drop-down list.
 - b. Click **Send**.

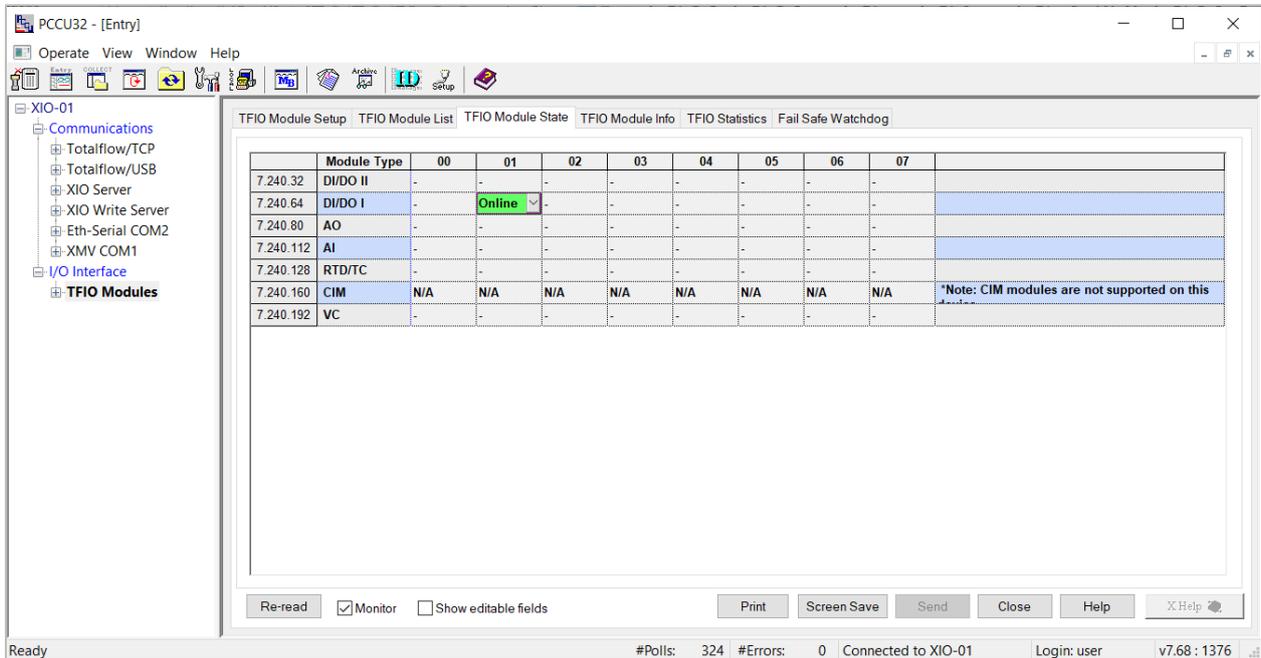
c. Verify that the old address does not display the module state.

Figure 6-11: Default module state on new address



6. Activate the module in the new address if needed:
 - a. Select the new address and select **Online** from the drop-down list.
 - b. Click **Send**.
 - c. Click **Re-read**.
 - d. Verify that the state of the module is Online.

Figure 6-12: Set the module on new address to Online



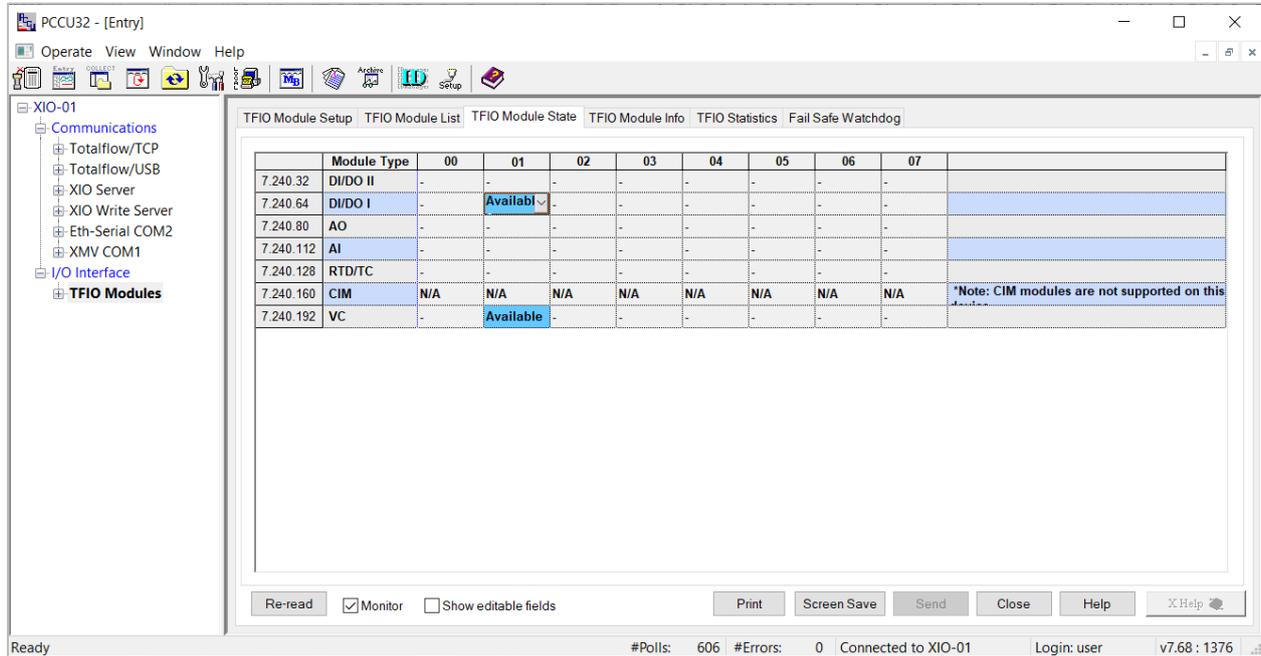
6.5.2 Change the duplicate address of a module

This procedure describes how to change the address of a module to resolve a duplicate addresses situation.

The device responds to duplicate addresses based on the module type.

- If two modules of the same type have the same address, the device detects the first one that responds, which is typically the module connected closest to the device (bus). The other module does not display.
- If two modules of a different type have the same address, the device detects both and displays them as Available on the same address. See the figure below.

Figure 6-13: Duplicate addresses for two different modules

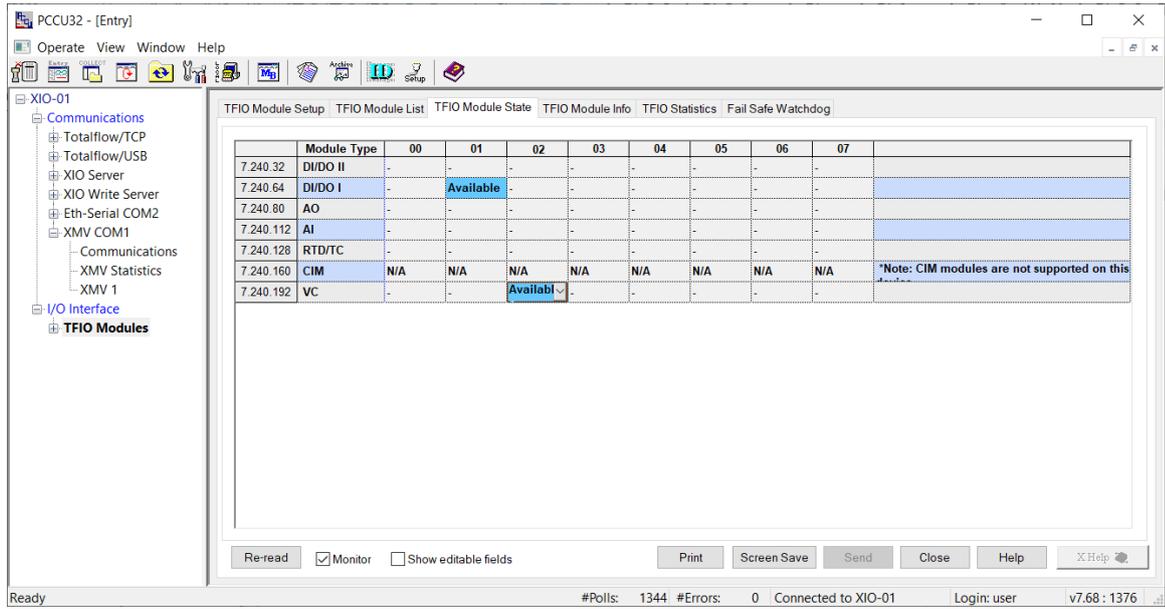


Change the address on one of the modules and reset the module. When the module restarts, the state shows in the correct address as Available.

To change the duplicate address on a connected module (device powered on):

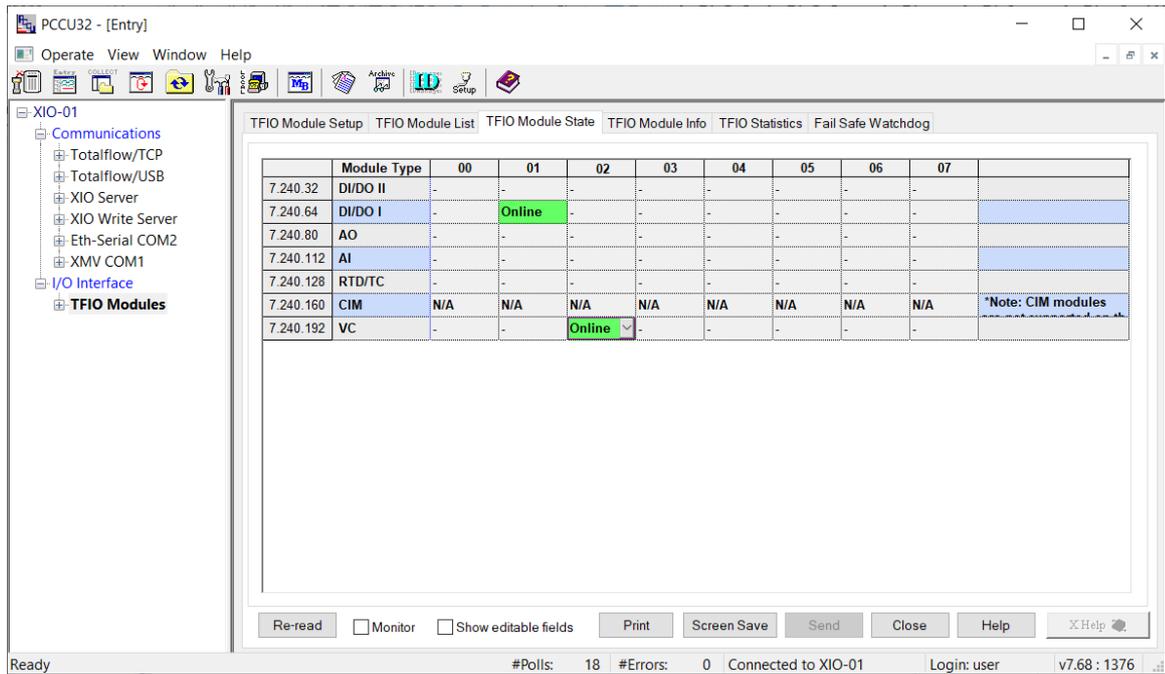
1. Select the **TFIO module state** tab to monitor the state changes during reset and after the module restarts.
2. Locate the module that needs the address change.
3. With a small flat screwdriver, rotate the address selector to the desired module address. Take note of the address selected. The module state displays at this address when the module restarts.
4. Insert the tip of a paper clip into the module reset button and press for a few seconds. The module reset LED turns on briefly. If the state of the module displayed in the wrong address, it clears during reset.
5. Observe the new address for the corresponding module type and verify that the state displays Available. This indicates that the module has been detected and assigned to the new address.

Figure 6-14: Change duplicate address on module – new address



6. Change the state of both modules to Online as needed.

Figure 6-15: Set modules to Online after address correction



7 Reference information

The reference information sections include PCCU screen-specific descriptions and parameters. The sections focus on the main screens for the I/O Interface. They provide options for global configuration of all TFIO modules attached to the bus. Additional information on module-type-specific screens is available in the PCCU help files. Click **Help** from the screen of interest to display related topic.

The sections indicate when screens are applicable only to certain product(s).

7.1 I/O Interface: TFIO Module Setup

7.1.1 Overview

The TFIO Module Setup screen provides configuration options for TFIO modules attached to devices:

- The XSeriesG5 devices and the XIOs display a TFIO setup screen for their single TFIO interface. The TFIO interface is enabled by default.
- The RMC-100 displays a TFIO setup screen for each of the two supported TFIO interfaces (TFIO-A and TFIO-B). On the RMC-100, the user can disable or enable the TFIO interfaces. TFIO-A is enabled by default from the factory. TFIO-B is disabled. The TFIO module setup screen displays only when its corresponding interface is enabled.

Some module setup options in this screen apply to all modules, others can be enabled or disabled per module type.

It is recommended to configure the modules on the TFIO Module Setup screen before they are online and ready for operation since they affect how the device manages the state of modules when the device is power-cycled, or when modules are removed or replaced.

7.1.2 Understanding key global module parameters

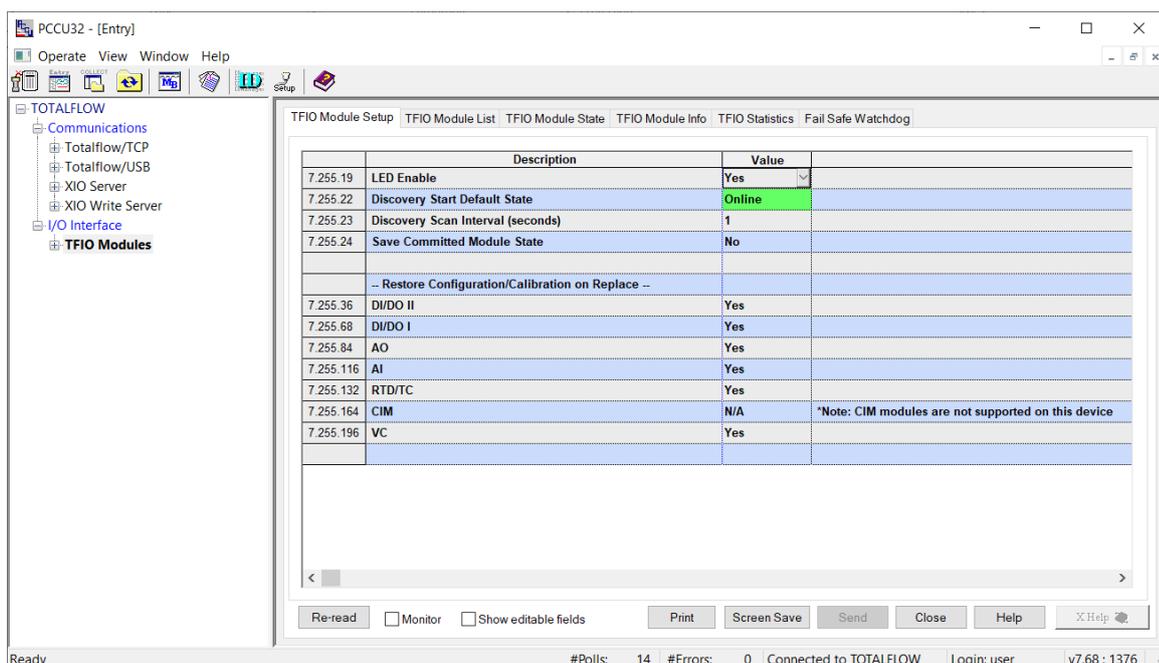
Module parameter setup determines device behavior during module hot-swap events, permanent removal, and module discovery after power reset. Please consider device setup to avoid losing calibration or configuration if the device is powered-cycled. If modules are deleted, their calibration and configuration data is also deleted.

7.1.2.1 Discovery Start Default State

This function defines the state the device will place a module in upon discovery during startup. The default mode is either Online or Available.

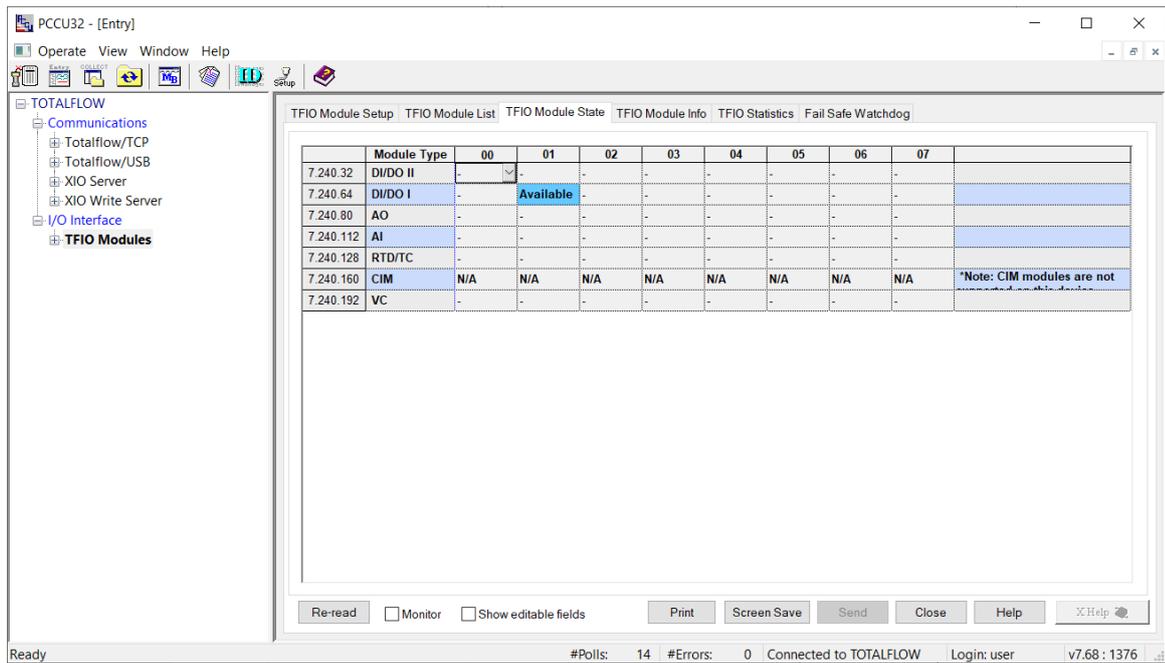
For example, you can configure the device to place newly installed modules in the Online state after the device is power-cycled. The figure below shows this configuration: The Discovery Start Default State set to Online.

Figure 7-1: Discovery Start Default State configuration



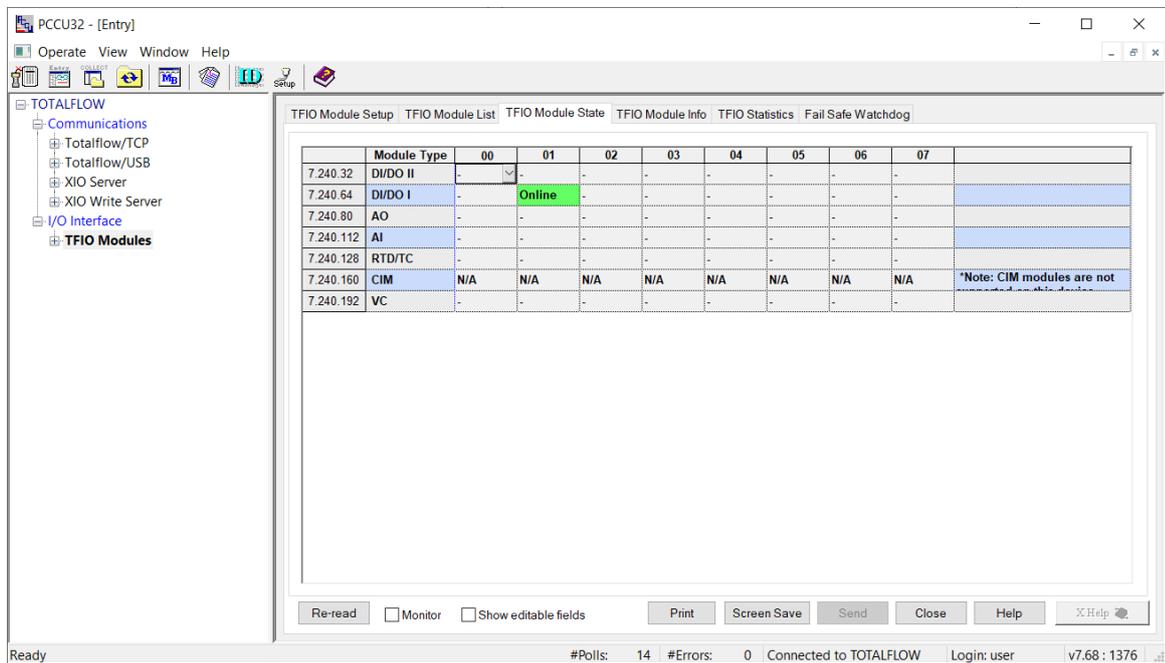
When a new module is installed, the device sets it to the Available state.

Figure 7-2: Default module state for new modules (Available)



After the device is power-cycled, the module state displays Online. The device has automatically changed the module from Available to Online as defined.

Figure 7-3: New module state when Discovery Start Default State is set to Online

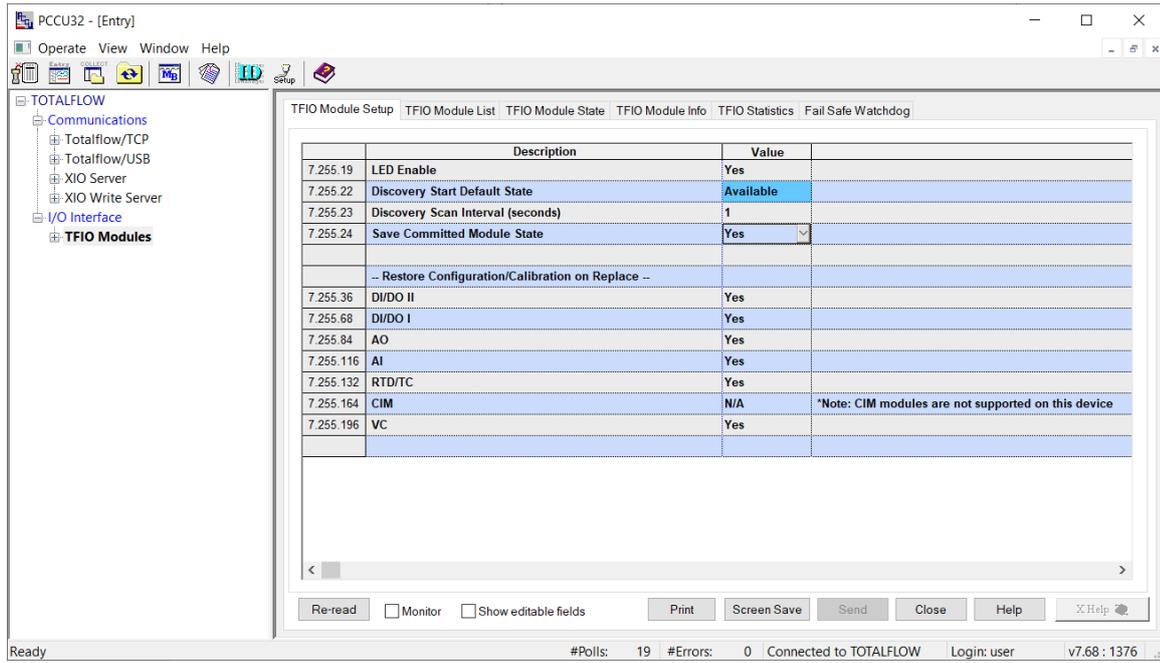


7.1.2.2 Save Committed State

This function determines if the device remembers the attached modules and their states between power cycles. Enabling this function lets the device handle module changes automatically.

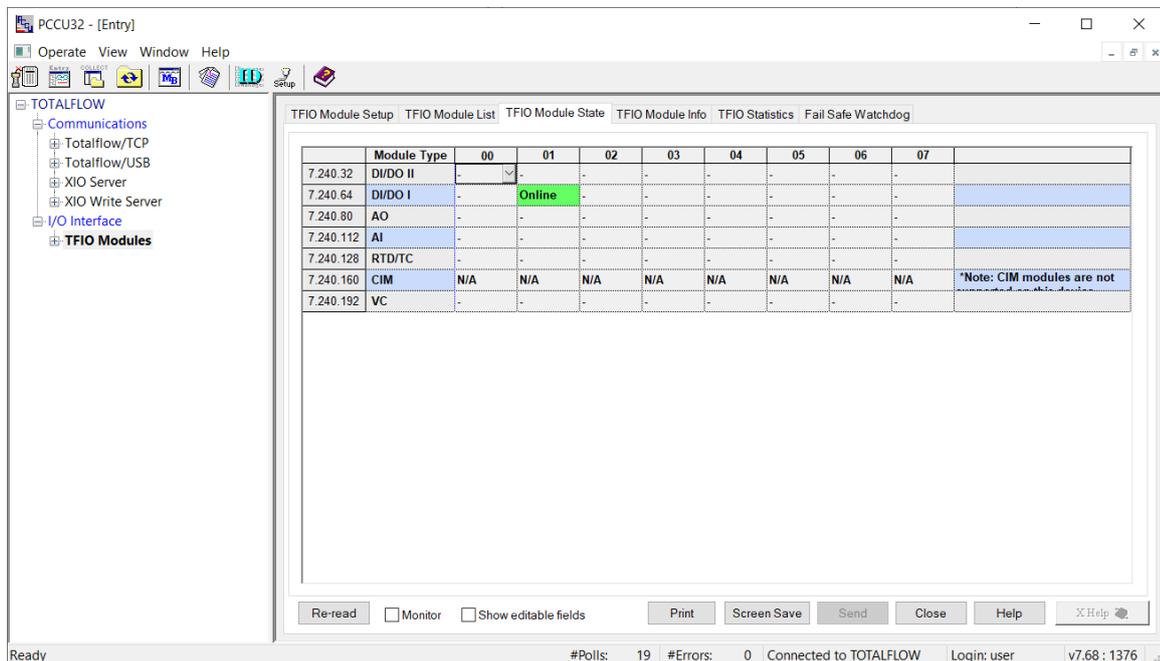
For example, the figure below shows the Discovery Start Default State set to Available, and the Save Committed State set to Yes. This configuration sets the device to keep modules in the Available state upon restart, but it also sets the device to remember the state of the modules prior to power cycle. The state of the module is restored regardless of what the Discovery Start Default Parameter is set to.

Figure 7-4: Save Committed Module State configuration



The figure below shows the state of a module after power-cycling the device. This module was in the Online state prior to the device restart. Even though the Discovery Start Default State was set to Available, the device remembered that the module was Online and keeps that state.

Figure 7-5: Module state after device power cycle



7.1.1.3 Restore Calibration and configuration on replacement

Enable this function to preserve calibration and configuration data for use during module replacement. With this feature, the device does not delete old module data when it is removed. It uses the data on the replacement module to avoid having to reconfigure and calibrate the new module. This function applies and can be enabled independently per module groups of the same type.

7.1.3 Parameter description

The table below provides descriptions for module setup parameters.

Table 7-1: I/O Interface - TFIO Module Setup screen parameters

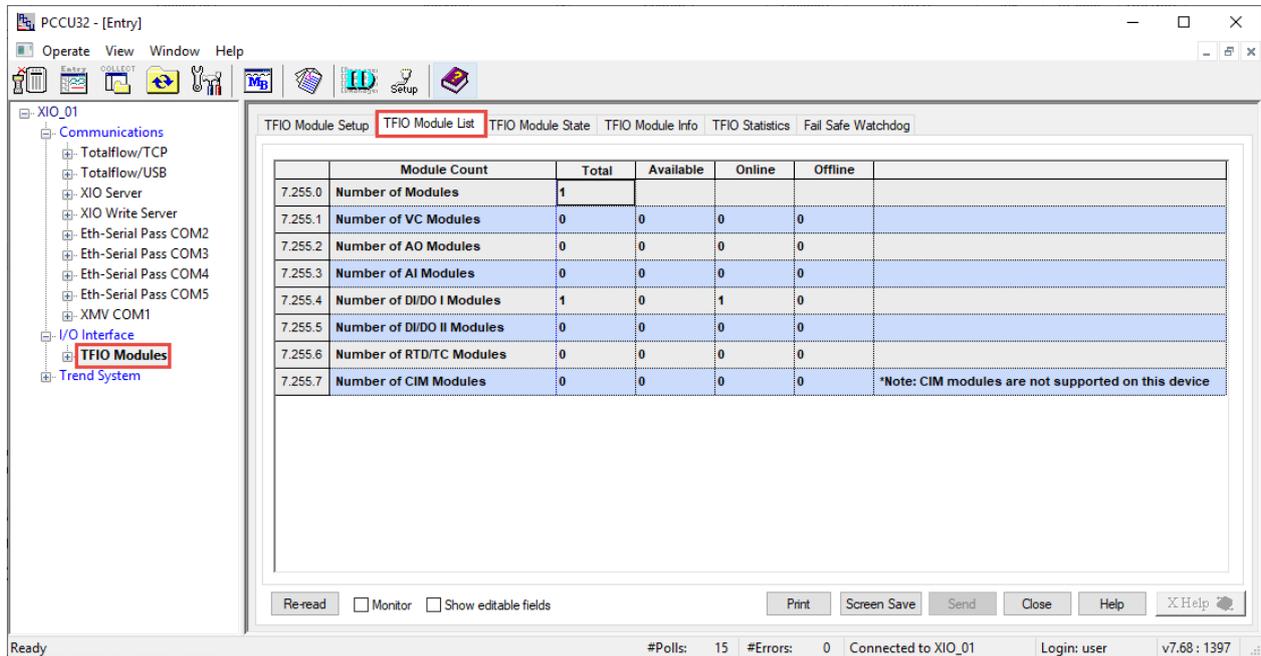
Parameter/Function	Description	Value
LED Enable	Turns TFIO LEDs on	Select option from the drop-down list: <ul style="list-style-type: none"> – Yes (default): Turn the TFIO LEDs on. LEDs are indicators of activity and are useful when troubleshooting. – No: Keep the TFIO LEDs off.
Discovery Start Default State	State on discovery at startup for new modules added since the last shutdown	Select option from the drop-down list: <ul style="list-style-type: none"> – Available: The TFIO Module is detected on the bus, but it is new and not executing read or write operations yet. To activate the module, change the module state to Online. – Online (Default): The TFIO Module is detected, and ready to start read-write operations (transmit and receive data)
Discovery Scan Interval (seconds)	Amount of time between scans	User-defined. Type the preferred value. Lower numbers mean more frequent scans. 1 (default)
Save Committed Module State	Function which saves module state between power cycles	Select option from the drop-down list: <ul style="list-style-type: none"> – Yes: The device remembers every module that was connected before power shutdown. It can determine if modules are missing when power restarts. – No (default): The device does not remember which modules were connected before power shutdown. It does not know if a module has been removed and it will not display it with Offline state on restart.
Restore Configuration/Calibration on Replace	Function to enable the use of an existing TFIO module's configuration and calibration files on a replacement module. Applicable when field-replacing an existing module with another module of the same type. When enabled, you do not have to calibrate or configure the new module.	Select option from the drop-down list for each module type: <ul style="list-style-type: none"> – Yes: Automatically restores the configuration and calibration files for the specific module type on the new module. – No: Does not automatically restore the configuration and calibration files on the new module.
DI/DO II	Combo Digital Input/Output Module type II	Yes (default)
DI/DO I	Combo Digital Input/Output Module Type I	Yes (default)
AO	Analog Output Module	Yes (default)
AI	Analog Input Module	Yes (default)
RTD/TC	RTD/Thermocouple Input Module	Yes (default)
CIM	Communication Interface Module	Yes (default)
VC	Valve Control Module	Yes (default)
Bus Enable	(Applicable only to devices with multiple TFIO interfaces such as the RMC-100) Function to activate the device's TFIO interface.	Select an option from the drop-down list: <ul style="list-style-type: none"> – Enabled: The I/O system application communicates with the TFIO modules (scan/transmit are enabled). – Disabled: No communication takes place between the I/O system and the TFIO modules (scan/transmit are disabled).

Parameter/Function	Description	Value
TFIO-A Bus or TFIO-B Bus	Specifies the corresponding TFIO interface the TFIO Module Setup screen displays for.	<p>Note: Disabling the TFIO interface does not remove power from the attached TFIO modules. The TFIO modules remain on until they are disconnected from the interface or the device is powered off. Take necessary precautions when removing or attaching TFIO modules in hazardous locations. Powering off the device may be required.</p> <p>TFIO Module Setup screens display for each interface only when they are enabled.</p> <p>TFIO-A is enabled by default. TFIO-B is disabled by default. To display the TFIO-B Module Setup screen, you must first enable it. Exit the TFIO-A Setup screen:</p> <ul style="list-style-type: none"> - On the navigation tree, select TFIO-B Modules to display the TFIO Bus Enable screen. - Select Enabled from the drop-down list and then click Send.

7.2 I/O Interface: TFIO Module List

The TFIO Module List screen provides the count and state of the TFIO modules attached to the device. The information on this screen is read-only. The device updates the counts as it detects the module types and the number.

Figure 7-6: TFIO Module List



7.2.1 Parameter description

The table below provides descriptions for the TFIO Module List parameters.

Table 7-2: I/O Interface - TFIO Module List screen parameters

Parameter/Function	Description	Value
Total	Total detected module count per device and per module type	(Read-only) Total valid ranges: Per TFIO Interface (number of modules): 0 (default) to 22 Per module type: 0 (default) to 8
Available	Number of modules per type in the Available state	(Read-only) Valid range per module type: 0 to 8
Online	Number of modules per type in the Online state	(Read-only) Valid range per module type: 0 to 8
Offline	Number of modules per type in the Offline state	(Read-only) Valid range per module type: 0 to 8
Module Count	Detected types/Description	
Number of Modules	All detected modules types	
Number of VC Modules	Number of TFIO Valve Control Modules	
Number of AO Modules	Number of TFIO Analog Output Modules	
Number of AI Modules	Number of TFIO Analog Input Modules	
Number of DI/DO I Modules	Number of TFIO Combo Digital I/O Modules - Type I	
Number of DI/DO II Modules	Number of TFIO Combo Digital I/O Modules - Type II	
Number of RTD/TC Modules	Number of TFIO RTD and Thermocouple Input Modules	
Number of CIM Modules	Number of TFIO Communication Interface Modules (CIM)	

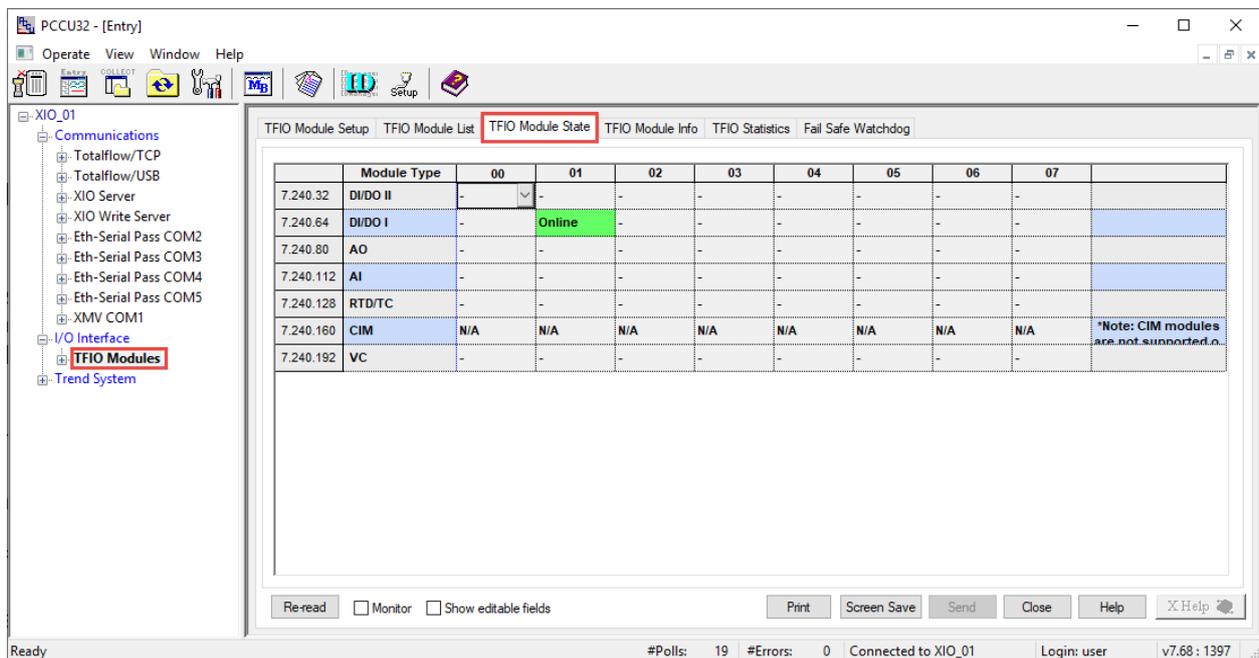
Parameter/Function	Description	Value
	Note: The CIM are not supported by the RMC-100 or the XIO. See the RMC-100 and XIO User Manuals for more information and configuration options to expand serial port capacity.	

7.3 I/O Interface: TFIO Module State

7.3.1 Overview

The TFIO Module State screen provides the ability to view or configure the state of each module per module type. To configure each module, select the module's number and assign or change the desired state.

Figure 7-7: TFIO Module State



The module states may be affected by power-cycling the device, module configuration, and manual intervention by the user (removal or replacement). The following are valid state transitions:

- Available to Online: Can be manually performed by the user after installing the module for the first time or by the device upon discovery at startup (if the device is configured to set modules online upon discovery at startup).
- Online to Offline: The device automatically places a module offline when the module is removed. User cannot change from Online to Offline state.
- Offline to deleted: Can be manually performed by the user after module removal or by the device upon discovery at startup (if the device is not configured to save committed state).

7.3.2 Parameter description

The table below provides descriptions for the TFIO Module State parameters.

Table 7-3: I/O Interface - TFIO Module State screen parameters

Parameter/Function	Description	Value
Module address Number	Detected bus address number given by the address selector on the front of the TFIO Module. The selector is a rotary knob. Use small flat screwdriver to rotate the knob to assign the desired address. The address numbers available are: 00 to 07 (Maximum of 8 channels per type)	Select an option from the drop-down list for each module in each type: <ul style="list-style-type: none"> - "-" [dash]: Deleted or otherwise unavailable. There is no data available for a module at this address. - Available: The TFIO module is detected on the bus, but it is new

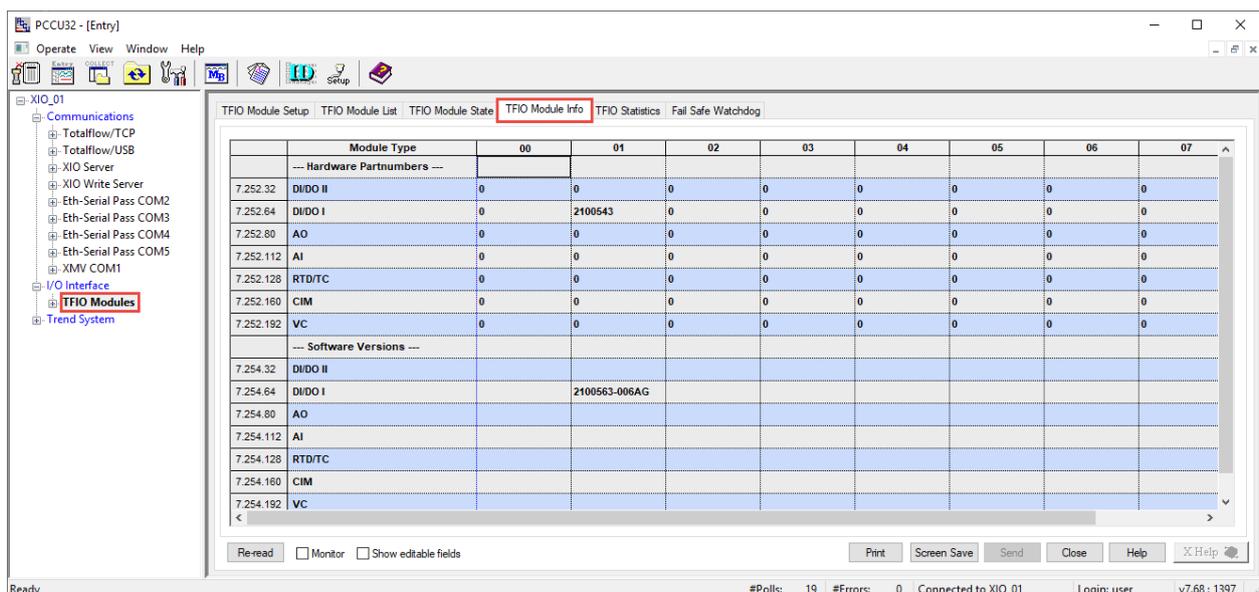
Parameter/Function	Description	Value
	If the address is changed while the TFIO is connected and powered on, the TFIO module must be reset.	<p>and not performing read or write operations yet. To activate, change the module state to Online.</p> <ul style="list-style-type: none"> – Online: The TFIO module is detected, available for use and ready to start read-write operations (transmit and receive data). – Offline: The module was previously Online and is no longer available. Can be removed by changing the state to “-[dash].
Module Type	Specific TFIO module name/description	
DI/DO II	Combo Digital Input/Output Modules type II	
DI/DO I	Combo Digital Input/Output Modules type I	
AO	Analog Output Modules	
AI	Analog Input Modules	
RTD/TC	RTD/Thermocouple Input Modules	
CIM	Communication Interface Modules	
VC	Valve Control Modules	

7.4 I/O Interface: TFIO Module Info

7.4.1 Overview

The TFIO Module Info screen provides part number information for each detected module. This information is read-only and is automatically displayed when modules are physically connected and detected. The part numbers help identify different generations of modules which may be combined in field installations. ABB support or sales personnel may request part numbers for service, part replacement or troubleshooting.

Figure 7-8: TFIO Module Info





IMPORTANT NOTE: Module addresses are labeled from 0-7 on the module face. The addresses are listed as 00-07 on the I/O screens.

7.4.2 Parameter description

The table below provides descriptions for the TFIO Module Info parameters.

Table 7-4: I/O Interface - TFIO Module Info screen parameters

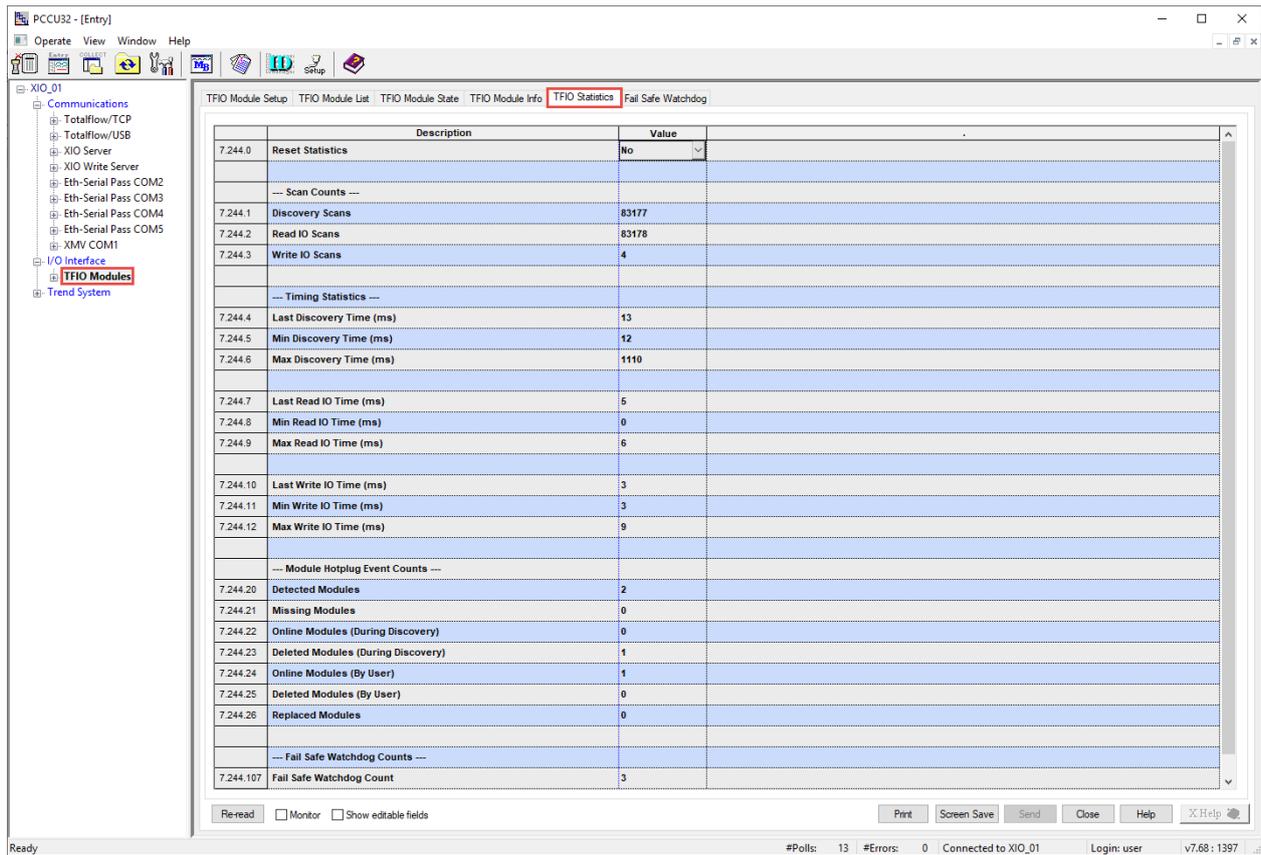
Parameter/Function	Description	Value
Module Address	Bus address The hardware and software versions of the detected modules show under the address number detected from the module.	The address numbers available are: 00 to 07 (For a maximum of 8 addresses per module type)
Hardware Part Numbers	Part number per detected module. The part number may include revision number.	(Read-only) The part number has the following format: <Totalflow part number>-<revision number> For example, the AO module hardware part number is 2100415, where: Totalflow part number per module type: 2100415. Revision number: may specify a variation or model, depending on the module generation. In the AO example no revision is included.
Software Version	Version number of the embedded software running (stored) in the module. The software version may include a revision number.	(Read-only) The part number has the following format: <Totalflow part number>- <revision number> For example, the AO module software part number is 2100715-005AF, where: Totalflow part number per module type is: 2100715 Revision number specifying software build: 005AF
Module Type	Specific TFIO module name/description	
DI/DO II	Combo Digital Input/Output Module type II	
DI/DO I	Combo Digital Input/Output Module type I	
AO	Analog Output Module	
AI	Analog Input Module	
RTD/TC	RTD/Thermocouple Input Module	
CIM	Communication Interface Module	
VC	Valve Control Module	

7.5 I/O Interface: TFIO Statistics

7.5.1 Overview

The TFIO Module Statistics screen provides a view of the statistical values for TFIO Module parameters. The screen displays read-only values updated automatically. Use statistics when troubleshooting or analyzing device-TFIO module communication performance.

Figure 7-9: TFIO Statistics



7.5.2 Parameter description

The following table describes the TFIO module statistical parameters or metrics the XIO keeps track of.

Table 7-5: I/O Interface – TFIO Statistics

Parameter/Function	Description	Value
Reset Statistics	Function to reset the statistical parameter values or metrics kept for the TFIO modules	Select an option from the drop-down list: <ul style="list-style-type: none"> – Yes - Device resets the statistical parameter values – No (default) - Device keeps accumulating statistical values as applicable
Scan Counts		
Discovery Scans	The number of system bus discovery scans since the last system power-up. Use this information to troubleshoot problems related to TFIO module detection.	Value range: 0 to 4294967295
Read IO Scans	The accumulated number of polls that read data from connected TFIO modules since the last system power-up	Value range: 0 to 4294967295
Write IO Scans	The accumulated number of polls that write data to connected TFIO modules since the last system power-up	Value range: 0 to 4294967295
Timing Statistics		
Last Discovery Time (ms)	The duration of the last discovery scan in milliseconds	Value range: 0 to 4294967295
Min Discovery Time (ms)	The minimum duration of a discovery scan since the last reset or power-up	Value range: 0 to 4294967295
Max Discovery Time	The maximum duration of a discovery scan	Value range: 0 to 4294967295

Parameter/Function	Description	Value
(ms)	since the last reset or power-up	
Last Read IO Time (ms)	The duration of the last I/O read scan since the last reset or power-up	Value range: 0 to 4294967295
Min Read IO Time (ms)	The minimum duration of a read poll during the last I/O read scan since the last reset or power-up	Value range: 0 to 4294967295
Max Read IO Time (ms)	The maximum duration of a read poll during the last I/O read scan since the last reset or power-up	Value range: 0 to 4294967295
Last Write IO Time (ms)	The duration of the last I/O write scan since the last reset or power-up	Value range: 0 to 4294967295
Min Write IO Time (ms)	The minimum duration of an I/O write scan since the last reset or power-up	Value range: 0 to 4294967295
Max Write IO Time (ms)	The maximum duration of an I/O write scan since the last reset or power-up	Value range: 0 to 4294967295
Module Hotplug Event Counts		
Detected Modules	The number of detected modules on the TFIO bus	Value range: 0 to 4294967295
Missing Modules	The number of modules missing from the TFIO bus. Note: This includes modules removed during a hot swap replacement.	Value range: 0 to 4294967295
Online Modules (During Discovery)	The number of detected online modules on the TFIO bus	Value range: 0 to 4294967295
Deleted Modules (During Discovery)	The number of deleted modules on the TFIO bus	Value range: 0 to 4294967295
Online Modules (by User)	The number of modules set to Online state by the user from the TFIO Module State tab	Value range: 0 to 4294967295
Deleted Modules (By User)	The number of modules deleted by the user from the TFIO Module State tab	Value range: 0 to 4294967295
Replaced Modules	The number of modules that have replaced existing modules (in a hot swap)	Value range: 0 to 4294967295
Fail Safe Watchdog Counts		
Fail Safe Watchdog Count	The number of times the XIO detects a loss of connection with the RMC that exceeds the timeout value. This count is kept only when the watchdog is enabled. See sections 3.1 Enable the watchdog feature for device-TFIO module communication (RMC-100, XFC/XRC) and 3.2 Enable the watchdog feature for device-XIO communication (XIO) for details.	Value range: 0 to 4294967295

7.6 I/O Interface: Fail Safe Watchdog

7.6.1 Overview

The Fail Safe Watchdog screen provides the ability to configure, monitor, and manage the fail-safe watchdog function supported by the XIOs.

The fail-safe watchdog is a mechanism that allows the XIOs to monitor the health of the connection with a remote controller and manage the state of all the attached TFIO module outputs in response to the connection condition. The screen provides quick visual indication of the state of the connection. In the captures below the watchdog state show the Normal and Alarm condition. Normal state indicates XIO-remote controller communication is OK. Alarm state indicates communication failure.

Figure 7-10: XIO Fail Safe Watchdog – Normal state

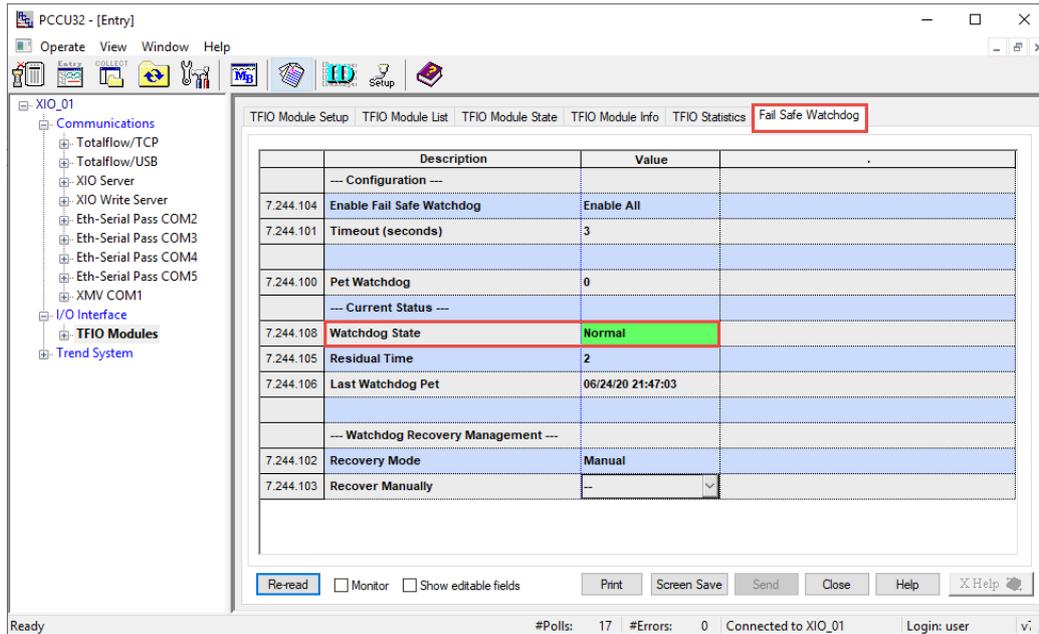
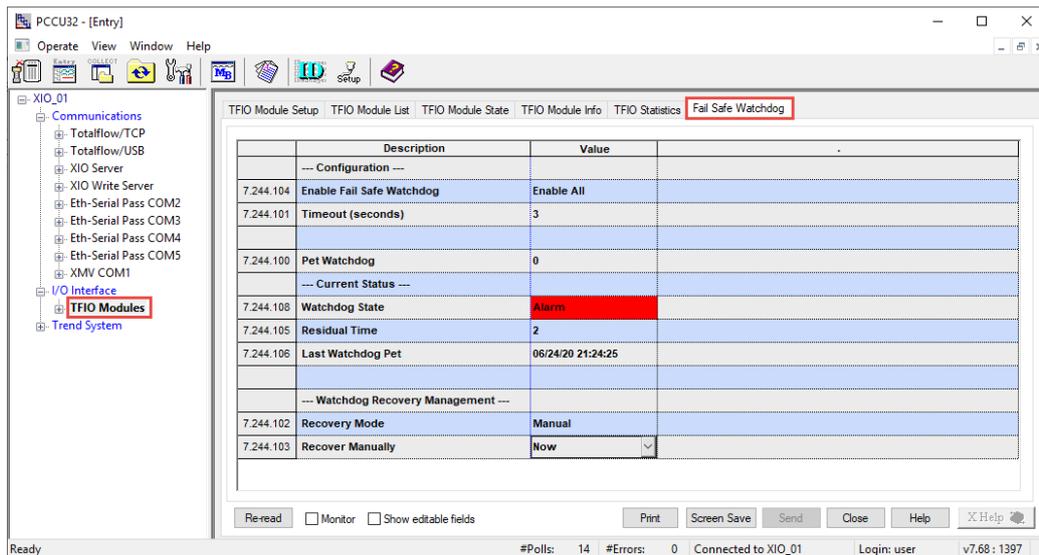


Figure 7-11: XIO Fail Safe Watchdog – Alarm state



Configuring the fail-safe watchdog requires the following:

- The XIO Interface application is running on the remote controller connected with the XIO. The XIO Interface handles the communication with the XIO on the controller's side and must be active before the watchdog function can work properly. See the XIO Interface Application Guide for configuration details.
- The I/O Interface application on the XIO is set to export. The I/O Interface must be visible from the controller.

7.6.2 Principle of operation

The purpose of the watchdog is to monitor the connection with the host controller. If this connection fails, the TFIO module outputs (AO, DO) are set to a known, expected value for safe field conditions. This may mean closing or opening a valve or setting some other state that is appropriate for the system until the communication with the host controller is restored.

When the watchdog is enabled, the XIO monitors whether communication from the host controller takes place at a pre-determined time interval. Consistent reception of communication from the controller within the expected time interval indicates that the connection is healthy. When the communication from the controller fails to arrive at the expected time, this indicates errors or loss of connection.

The mechanism for the host controller to notify the XIO watchdog that it is connected, is for the XIO Interface application to send control messages (writes) to an XIO register at a specified time interval. This register is referred to as the "pet watchdog" register. The XIO monitors the update of this register to verify that the writes take place periodically within the expected time (the controller must "pet" the watchdog as expected). Failure of the pet watchdog register to update sets the watchdog state to alarm.



IMPORTANT NOTE: The condition for network link status is only relevant to the XIO and it is not needed for the TFIO modules attached directly to the host controller (RMC). If the network connection is lost from the controller's standpoint, it is still considered the master controller and should still operate its outputs according to its programming. The XIO however, functions as a slave system and, in the absence of the control messages from the host controller, will set the outputs to the pre-configured fail-safe states.

7.6.3 Output fail-safe state configuration

For AOs, the fail-safe value is the same as the initial value. The initial value is defined in the calibration entry mode for AOs and is readable on the module's Advanced tabs.

For DOs, the fail state is configurable on the module's Advanced tabs.

7.6.4 Parameter description

The following table describes the configuration options and functions available to set up the XIO watchdog function.

Table 7-6: I/O Interface – Fail Safe Watchdog screen parameters

Parameter/Function	Description	Value
Configuration		
Enable Fail Safe Watchdog	Function that provides several options to configure the mode of operation of the Fail Safe Watchdog	Select an option from the drop-down list: <ul style="list-style-type: none"> – Enable All (default): Globally enable all modules to react to loss of communications with the remote host controller. – Module Control: Allows module-level configuration of host controller communications monitoring. You can select which channels on the module go to fail-safe output levels when communication is lost. – Disable All: Globally disable all modules from reacting to loss of host controller communications.
Timeout (seconds)	Duration between writes to the pet watchdog register before the XIO determines it has lost communications with the host controller	User-defined. Type a value from 0 to 65
Pet watchdog	Value of the pet watchdog register that the XIO monitors to determine if the connection to the host controller is healthy. The pet watchdog register is to be written to periodically to prevent the fail-safe output from being driven by the XIO. Note: When connecting the XIO to an ABB controller such as the RMC-100, this register is written to automatically by the XIO Interface application when the I/O application is exported. When connecting the XIO to a third-party controller, the	(Write-only) A value of 1 indicates the host controller's write to the pet register is successful. The write triggers an action to signal that the connection with the host controller is healthy. When the XIO does not detect a write, it starts to decrement the residual time register. If the residual time register value reaches 0, and no write is detected, the XIO drives outputs to the fail-safe state.

Parameter/Function	Description	Value
	controller must write a 1 to this register. The configuration of a third-party controller is beyond the scope of this topic. For reference, the pet watchdog XIO register address is 7.244.100.	
Current Status		
Watchdog State	Displays the current condition of the fail-safe watchdog monitoring system	(Read-only) The state displays one of the following: <ul style="list-style-type: none"> – Normal: The XIO-controller network connection is established and communication between the two devices is successful – Alarm: The XIO-controller connection has failed, or the I/O Interface is not exported to the controller. Note: When in alarm state, neither control applications nor users can set the value of module outputs. – Disabled: The Fail Safe Watchdog is disabled (set to: Disable All). No monitoring of the XIO-controller connection is taking place).
Residual Time	Remaining time before outputs are driven to the fail-safe state unless the watchdog is pet	(Read-only) 0 - (Timeout-1)
Last Watchdog Pet	Time since the last watchdog pet from the host controller	(Read-only) Date/Time
Watchdog Recovery Management		
Recovery Mode	Method for taking the TFIO module outputs out of fail-safe states	Select from the drop-down list: <ul style="list-style-type: none"> – Manual: TFIO module outputs stay in their fail-safe state even after the XIO-Controller connection is restored. Use the Recover Manually command below to take the outputs out of fail-safe state. – Auto: The XIO automatically takes the TFIO module outputs out of their fail-safe states after the XIO-controller connection is restored.
Recover Manually	Applicable to Manual Recovery Mode only. Function that takes the TFIO module outputs out of fail-safe mode	Perform manual recovery from the drop-down list: Select Now , then click Send .

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