ControlLogix Compute Modules
Catalog Numbers 1756-CMS1B1, 1756-CMS1C1
Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

---

**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

**IMPORTANT** Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).
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Preface

This manual explains how to use ControlLogix® Compute modules in a ControlLogix 5570 or ControlLogix 5580 control system. You create custom application programs in the embedded operating system on the module.

Make sure that you are familiar with the following:

- Use of ControlLogix 5570 or ControlLogix 5580 controllers
- High-level language software development in a Windows 10 or Linux operating system (OS)

Summary of Changes

This revision of the publication includes new information about security settings on the embedded Linux OS on the 1756-CMS1C1 module. For more information, see Chapter 3, Linux Operating System Overview on page 37.

Terminology

The following terms and abbreviations are used throughout this manual. For definitions of terms that are not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication AG-7.1.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>Backplane</td>
<td>Refers to the electrical interface, or bus, to which modules connect when inserted into the chassis. The Compute module communicates with the controller through the ControlLogix backplane.</td>
</tr>
<tr>
<td>BPIE</td>
<td>Backplane Interface Engine</td>
</tr>
<tr>
<td></td>
<td>Accesses the device driver on the backplane.</td>
</tr>
<tr>
<td>BIOS</td>
<td>Basic Input Output System.</td>
</tr>
<tr>
<td></td>
<td>The BIOS firmware initializes the module at power-on, performs self-diagnostics, and loads the operating system.</td>
</tr>
<tr>
<td>CIP</td>
<td>Common Industrial Protocol.</td>
</tr>
<tr>
<td></td>
<td>The messaging protocol that is used for communications over the ControlLogix backplane.</td>
</tr>
<tr>
<td>Connection</td>
<td>A logical binding between two objects. A connection lets more efficient use of bandwidth occur because the message path is not included once the connection is established.</td>
</tr>
<tr>
<td>Consumer</td>
<td>A destination for data.</td>
</tr>
</tbody>
</table>
## Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ControlLogix Compute Modules Installation Instructions, publication 1756-IN072</td>
<td>Describes how to install ControlLogix Compute modules.</td>
</tr>
<tr>
<td>1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002</td>
<td>Provides specification information for ControlLogix I/O modules.</td>
</tr>
<tr>
<td>Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1</td>
<td>Provides general guidelines for installing a Rockwell Automation® industrial system.</td>
</tr>
</tbody>
</table>


To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLL</td>
<td>Dynamic Link Library</td>
</tr>
<tr>
<td>Library</td>
<td>Refers to the library file that contains the API functions. The library must be linked with the developer application code to create the final executable program.</td>
</tr>
<tr>
<td>Mutex</td>
<td>A system object that is used to provide mutually exclusive access to a resource.</td>
</tr>
<tr>
<td>Originator</td>
<td>A client that establishes a connection path to a target.</td>
</tr>
<tr>
<td>Producer</td>
<td>A source of data.</td>
</tr>
<tr>
<td>SDK</td>
<td>Software Development Kit. A collection of files necessary to develop an application</td>
</tr>
<tr>
<td>Target</td>
<td>The end node to which an originator establishes a connection.</td>
</tr>
<tr>
<td>Thread</td>
<td>Code that is executed within a process. A process can contain multiple threads.</td>
</tr>
</tbody>
</table>
Chapter 1

ControlLogix Compute Modules

This chapter describes the ControlLogix® Compute modules.

**Module Overview**

ControlLogix Compute modules are chassis-based modules that let you communicate directly with a ControlLogix 5570 or ControlLogix 5580 controller via the system backplane and over a network.

The modules offer an embedded operating system (OS) that lets you create custom applications. ControlLogix Compute modules come with an instance of one of the following on them:

- **Windows 10 IoT Enterprise LTSB 64 bit**
- **Linux 32 bit (Debian 8.9)**

**IMPORTANT** In the rest of this document, the following conventions are used:

- Embedded OS refers to both OS types
- Windows OS refers to the Windows 10 Long Term Service Baseline OS
- Linux OS refers to the Debian 8.9 32-bit OS

The embedded OS lets you perform tasks on the controller that are performed on an external workstation in other Logix 5000™ control systems. The presence of a ControlLogix Compute module in a ControlLogix chassis is similar to installing a personal computer in a ControlLogix chassis.
Catalog Number Explanation

ControlLogix Compute module catalog numbers indicate specific information about the module. All modules use the same format, that is, **1756-CMwxyz**, where the following apply:

- 1756 is the Bulletin number.
- CM = Compute Module
- \( w \) represents the Performance Level and CPU core type
- \( x \) represents the Solid State Drive (SSD) capacity
- \( y \) represents the embedded OS that is installed on the module
- \( z \) represents the application that is shipped on the module

Table 1 describes the variables in a ControlLogix Compute module catalog number.

**Table 1 - ControlLogix Compute Module Catalog Numbers**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Attribute</th>
<th>Possible Value</th>
</tr>
</thead>
</table>
| \( w \)  | Performance and core | • S = Standard performance (Dual core)  
           |           | • P = Performance (Quad core) |
| \( x \)  | SSD capacity     | • 1 = 32 GB  
           |           | • 2 = 64 GB |
| \( y \)  | Operating system  | • A = Windows 10 IoT Enterprise LTSB 32 bit  
           |           | • B = Windows 10 IoT Enterprise LTSB 64 bit  
           |           | • C = Linux 32 bit (Debian 8.9)  
           |           | • D = Linux 64 bit (Debian 8.9) |
| \( z \)  | Application that is shipped on the module | 1 = No application |

For example, these catalog numbers are described as follows:

- **1756-CMS1B1** - Compute module with standard performance (dual-core CPU), 32 GB SSD, and an embedded Windows 10 IoT Enterprise LTSB 64-bit OS.
  
  This module does not include a pre-loaded application.

- **1756-CMS1C1** - Compute module with standard performance (dual-core), 32 GB SSD, and an embedded Linux 32 bit (Debian 8.9) OS.
  
  This module does not include a pre-loaded application.
Module Components

Table 2 describes components available on ControlLogix Compute modules.

Table 2 - ControlLogix Compute Module Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of the following embedded OS:</td>
<td>Lets you install commercially-available software and/or create custom applications while using the backplane API.</td>
</tr>
<tr>
<td>- Windows OS</td>
<td></td>
</tr>
<tr>
<td>- Linux OS</td>
<td></td>
</tr>
<tr>
<td>Onboard memory</td>
<td>4 GB - RAM</td>
</tr>
<tr>
<td>Four-character display</td>
<td>Scrolls information about the module. For example, the characters INIT scroll across the display after a device driver starts successfully.</td>
</tr>
<tr>
<td>Status indicators</td>
<td>Show information about the module status and health. These indicators are user-defined and, therefore, unique to the application. That is, indicators USR1, USR2, and USR3.</td>
</tr>
</tbody>
</table>
| Reset button                     | Used with the embedded OS to perform one of the following:  
|                                  | - Orderly shutdown of the OS.  
|                                  | - Reset the OS.  
|                                  | - Start the OS.                                                             |
| DisplayPort                      | Connect to a monitor to use with the embedded OS.                          |
| USB 3.0 port                     | Connect peripherals to be used with the embedded OS.                       |
| Two 1 Gb Ethernet ports          | Used with the Ethernet protocol.                                           |
| Rotary switches                  | Application-specific.                                                      |
| Battery                          | Provides real time clock persistence when the module is not powered.        |

Figure 1 on page 12 shows the components that are visible on a ControlLogix Compute module.
Figure 1 - ControlLogix Compute Module Components

Front View

- Four-character Display
- Status Indicators
- Reset Button
- DisplayPort
- USB 3.0 Port

Back View

- Battery (inside plastic holder)

Side View

- Rotary Switches

Ethernet ports 1 and 2
- On modules that use a Windows OS, the top port is Ethernet 2, and the bottom port is Ethernet.
- On modules that use a Linux OS, the top port is eth0, and the bottom port is eth1.
Module Location

A ControlLogix Compute module can reside in the same chassis as the controller or in a chassis that is remote from the controller with which it communicates. That is, the module can reside in either of the following:

- Local Chassis
- Remote Chassis

Local Chassis

Figure 2 shows a ControlLogix 5580 control system that includes a ControlLogix Compute module.

Figure 2 - ControlLogix 5580 System with Compute Module
Remote Chassis

The ControlLogix Compute module can operate in a remote ControlLogix chassis. Figure 3 shows a control system with the Compute module in a remote chassis.

Figure 3 - Control Application with Compute Module in Remote Chassis
**Compute Module in a Redundancy System**

You can use a Compute module in a ControlLogix redundancy system. When you do, the requirements apply:

- The module must reside in a remote chassis. The module communicates with the ControlLogix controller over an EtherNet/IP network.

**IMPORTANT** The module cannot reside in the primary or secondary chassis.

- If the custom application that is used on the Compute module writes tags to the controller in a Redundancy system, the OCXcip_SetTagAccessConnSize function can be required. This case is uncommon, however.

For more information on the OCXcip_SetTagAccessConnSize function, see Chapter 5, *Backplane API Library Functions on page 53.*

**Figure 4 - ControlLogix Redundancy System with Compute Module in Remote Chassis**

Redundant Chassis Pair

![Diagram of a ControlLogix Redundancy System with Compute Module in Remote Chassis](image-url)

**Primary Chassis**

- ControlLogix Compute Module
- ControlLogix EtherNet/IP Adapter
- ControlLogix I/O Modules
- PanelView Plus 7 Terminal

**Secondary Chassis**

- Stratix 5400 Switch
- Point I/O EtherNet/IP Adapter
- Point I/O Modules
- Kinetix 5500 Drives
Status Indicators

The ControlLogix Compute module uses a 4-character display and status indicators to show the module state at any point in time.

For more information on how to use the 4-character display and the status indicators, see Appendix A, Program-controlled Status Indicators on page 119.

Connection Options

There are multiple ports on ControlLogix Compute modules that let you connect different device types. The available connection types include:

- DisplayPort
- USB 3.0 Port
- Ethernet Ports

DisplayPort

The DisplayPort interface lets you connect industrial monitors to the Compute module to use with the embedded OS. You can use the following industrial monitors with your Compute module:

- Super Video Graphics Array (SVGA) to HD 1080p
- High-Definition Multimedia Interface (HDMI)
- Video Graphics Array (VGA)
- Digital Visual Interface (DVI)
- DisplayPort
You must use a VESA-certified DisplayPort adapter to connect some industrial monitors to the module.

**TIP**
- We recommend that you connect a monitor to the DisplayPort before you power up the module.
- If you power up a module with the Linux OS before you connect a monitor, the monitor typically does not work. If this occurs, restart the Linux OS while leaving the monitor connected to the DisplayPort.
- You can restart the Linux OS via the reset button on the module or by cycling power to the module. If you use the reset button, the module does not turn off but the embedded OS performs a reset.
- For more information on the reset button, see page 22.

*Figure 5 - Connect a Cable to the DisplayPort*
You use the USB port to connect peripherals, for example, a wireless keyboard, to the module. The USB port supports the use of a USB hub. USB hubs let you connect more than one peripheral to the module via the USB port.

**TIP** We recommend the following:
- Connect peripherals to the USB port before you power up the module.
- Use wireless peripherals with the USB port to reduce the number of cables that are connected to the module.

**Figure 6 - Connect to the USB Port**

![USB Dongle Connection](image1)

![USB Cable Connection](image2)
Ethernet Ports

There are two Ethernet ports that let you connect the ControlLogix Compute modules to EtherNet/IP networks. The Ethernet ports can communicate on an EtherNet/IP network at a maximum network communication speed of 1 Gbps.

To connect the module to an EtherNet/IP network, connect an RJ45 cable to an embedded Ethernet port.

IMPORTANT  Keep in mind that while Compute modules can operate on EtherNet/IP networks, they are not EtherNet/IP devices.

You must install an application on the embedded OS that supports the EtherNet/IP protocol before you can use the module on the network.

This section assumes that an application is installed that supports communication on an EtherNet/IP network.

Figure 7 - Connect Ethernet Cable to Compute Module
Set the Network Internet Protocol (IP) Address

ControlLogix Compute module Ethernet ports require an IP address to support the Ethernet protocol. Out-of-the-box, the Ethernet ports are configured as follows:

<table>
<thead>
<tr>
<th>Embedded OS on the Module</th>
<th>Port Position</th>
<th>Port Default Name</th>
<th>IP Address</th>
<th>Mask(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows</td>
<td>Top Port</td>
<td>Ethernet 2</td>
<td>None - Ports are DHCP-enabled. You can use a DHCP server or other software tool to set the address and mask.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bottom Port</td>
<td>Ethernet</td>
<td>None - Ports are DHCP-enabled. You can use a DHCP server or other software tool to set the address and mask.</td>
<td></td>
</tr>
<tr>
<td>Linux</td>
<td>Top Port</td>
<td>eth0</td>
<td>192.168.1.250</td>
<td>255.255.255.0</td>
</tr>
<tr>
<td></td>
<td>Bottom Port</td>
<td>eth1</td>
<td>None - Port is DHCP-enabled. You can use a DHCP server or other software tool to set the address and mask.</td>
<td></td>
</tr>
</tbody>
</table>

(1) The mask is also known as a Network Mask or Subnet Mask.

Your use of the Ethernet ports is application-dependent. Consider the following:

- You can use any combination of ports, that is, port 1, port 2, or both ports.

**IMPORTANT** If you use both Ethernet ports, they must be connected to separate EtherNet/IP networks. Additionally, you must set IP addresses for the ports that use different subnets.

- You can use any IP address and mask values in your application.
- You can configure the IP address and mask to be static or dynamic.
  - If an IP address and mask are static, they remain assigned to a port after power is cycled to the module.
  - If an IP address and mask are dynamic, they are cleared from the port each time power is cycled to the module. A DHCP server must reassign values. Remember, the IP address and mask values that are assigned after a power cycle can differ from the ones that were used before a power cycle.

We recommend that you do set the IP addresses to be static.
Rotary Switches

There are rotary switches on the side of the module. Out-of-the-box, the switches are set to the 000 and are not used until module operation begins.

Figure 8 - ControlLogix Compute Module Rotary Switches

The rotary switches are application-dependent. You must install a custom application on the module that defines how to use them. You can use the switches to perform various functions as dictated by the custom application that is installed.

EXAMPLE

Your application can dictate that part of the module power-up sequence includes using the number set by the switches as the final three numbers in the port 1 IP address.

The rotary switches set the octet according to 100s, 10s, 1s from left to right. In this example, if you set the switches to 004, when the power-up sequence is complete the final octet in the port 1 IP address is 004.

Use a small screwdriver to turn the switches to the desired numbers.
Reset Button

Compute modules have a reset button behind the door on the front of the module.

Remember the following:

- The reset button functions like the power button on a computer and is only used with the embedded OS.

- You can only use the reset button when the Compute module is powered. That is, when the module resides in a powered ControlLogix chassis.

- We strongly recommend that you shut down the module before you remove power to avoid potential data loss and disk corruption.

You use a tool with a small head, for example, a small screwdriver, to press the reset button when the module is powered.
This table describes the actions that you can perform with the reset button and the result of taking each action.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press and release the button when the embedded OS is running.</td>
<td>Performs an orderly shutdown of the embedded OS. When the shutdown is complete, the OK status indicator is in a steady red state.</td>
</tr>
<tr>
<td>Press and release the button when the embedded OS is not running.</td>
<td>Starts the embedded OS.</td>
</tr>
<tr>
<td>Press and hold the button down for 6 seconds</td>
<td>Performs a reset of the embedded OS. When the reset is complete, the OK status indicator is in a steady red state.</td>
</tr>
</tbody>
</table>

**WARNING:** When you press the reset button while power is on, an electric arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

Examples of reasons that you use the reset button include:

- To perform an orderly shutdown of the embedded OS on the module before you remove the module from a powered chassis.

- To perform an orderly shutdown of the embedded OS on the module before you remove power to the chassis in which the module is installed.

- To reset the embedded OS after a module crashes.
Replacement Battery

Compute modules use a battery to maintain the real time clock on the module when there is no power that is applied to module. A battery is installed in the module when it ships.

You can replace the battery if necessary. The battery is a Panasonic Type BR1225A coin type lithium battery. Replacement batteries are commercially available.

**TIP** Battery life depends on how much time the module is not powered. When the module is installed in a powered ControlLogix chassis, the battery is not used. Thus, the life of the battery is greater.

The obvious indication that the battery must be replaced is that module does not maintain the correct time of day when the module is not powered.

Consider designing your application to check the system date on the module periodically, and, if the system date is incorrect, alert you that the battery must be replaced.

To replace the battery, complete these steps.

1. Pull the white plastic battery holder from the back of the module.

   If necessary, pull the holder out far enough to use a small screwdriver to pry out the battery. In this case, insert the screwdriver from the side of the battery that faces the module printed circuit board.

**IMPORTANT** There are metal guides that hold the battery holder in place. Do not attempt to remove the metal guides.
2. Remove the old battery from the holder.

3. Install a new battery into the holder.

   The side of the battery with words and numbers is installed in the side of 
   the holder with tabs to hold it in place.

4. Reinstall the battery holder in the back of the module.

   The narrower part of the holder is installed first into the metal guides.

   **IMPORTANT** Make sure that the battery is installed in an orientation so that the 
   side of the battery with words and numbers faces away from the 
   PCB.

5. Push the battery holder all the way into the back of the module.
Notes:
Chapter 2

Windows Operating System Overview

The Compute modules are highly user-configurable and, therefore, let you define how the module is used as uniquely as necessary to fit your custom application.

We recommend that when you customize the module for your application, you follow not only your company design guidelines but also general good engineering practices and behaviors.

For example, it is generally a good practice when you configure an embedded OS login to include a System Use notification message. The message can make a user aware of the conditions within which the module is used.

If you change the embedded Windows OS default security settings from the out-of-box conditions, you assume responsibility for any potential issues that arise as a result of the changes.

We recommend that you apply the same IT policies to the Compute module that your organization applies to an industrial personal computer (PC).
Connect Monitor and Peripherals Before Power-up

We recommend that before you apply power to the chassis within which the Compute module resides, you make all necessary module connections. For example, connect a monitor to the DisplayPort and peripherals to the USB 3.0 port before you apply power to the module.

Consider the following:

- We recommend that you connect a monitor to the DisplayPort before you power up the module.
- Because the module has only one USB 3.0 port, we recommend that you use a USB hub or keyboard/mouse combination so that you can use both with the module.

Security Settings

The embedded Windows OS on your Compute module is configured per the Microsoft Security Baseline for Windows 10 v1607 with three exceptions that are described at Inactivity Lock and Screen Saver Settings on page 30.


Remember the following as you read this section:

- The security setting descriptions provide information that is considered to be of particular importance regarding how you use your ControlLogix Compute module.

  However, the descriptions are not exhaustive descriptions. For complete descriptions, see the Microsoft Security Baseline referenced previously.

- If you change the embedded Windows OS default security settings from the out-of-box conditions, you assume responsibility for any potential issues that arise as a result of the changes.
Windows 10 OS Updates

The Compute module does not automatically update the Windows OS. You must manually perform OS updates.

We recommend that you update the Windows OS on your Compute module according to your organization's IT policies with regard to OS updates.

Using .NET Framework 3.5

If the application on your Compute module requires .NET Framework 3.5, you must enable the .NET Framework 3.5 feature in the Windows Features tool.

| IMPORTANT | To enable the .NET Framework 3.5 feature, the module requires access to an external network. |

Install Software Application From External Network

If you need to install software on the module from an external network, you can experience an issue during the installation process. That is, a dialog box can unexpectedly disappear.

The following is an example of how the issue can occur.

1. Access the remote network via an Ethernet port on the Compute module.
2. Browse to an executable file and double-click on it. The Open File - Security Warning dialog box appears.
3. Click Run. The User Account Control dialog box appears.
4. Click Yes. The Windows Security dialog box appears that requires you to enter your network credentials. When you click on the dialog box, it disappears.
5. Click ALT + tab and the Windows Security dialog box reappears. **TIP** This step is one method to get the dialog box to reappear. It is a potential workaround.
6. Enter your credentials and the installation process proceeds as expected.
Inactivity Lock and Screen Saver Settings

The Inactivity Lock and Screen Saver policies settings are the exceptions regarding the embedded Windows OS design differing from the Microsoft Security Baseline for Windows 10 v1607.

- In the Baseline, the policies are set so that a screen saver launches if no activity occurs for a specified period of time. Once the screen saver launches, the user enters the password to access the module.

- In the embedded Windows OS on the Compute module, a screen saver does not launch and the account is not locked, regardless of the length of time that no activity occurs on the OS.

The following changes were made to disable the inactivity lock and screen saver policies.

<table>
<thead>
<tr>
<th>Policy Path</th>
<th>Policy Name</th>
<th>Value in Embedded Windows OS on Compute Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Configuration\Windows Settings\Security Settings\Local Policies\Security Options</td>
<td>Interactive logon: Machine inactivity limit</td>
<td>0</td>
</tr>
<tr>
<td>User Configuration\Administrative Templates\Control Panel\Personalization</td>
<td>Password protect the screen saver</td>
<td>Not Configured</td>
</tr>
<tr>
<td>User Configuration\Administrative Templates\Control Panel\Personalization</td>
<td>Enable screen saver</td>
<td>Not Configured</td>
</tr>
</tbody>
</table>

For more information on the policies in the Microsoft Security Baseline for Windows 10 v1607, see the following:

- Interactive logon: Machine inactivity limit policy:

- Password protect the screen saver policy and Enable screen saver policy:
Password Settings

Password and account lockout settings are tied together because, if an account is locked, a password is required to unlock it. A password can help to establish and maintain a degree of security.

**IMPORTANT** The first time you power up a Compute module, there is no enabled account. You must configure a login ID and password. The module guides you through the process to create them.

After you implement a password, you can change it. However, you cannot recover the password if you forget or lose it.

If you cannot log in to your account on a Compute module because you do not know the password, you must return it to Rockwell Automation to be reimaged.

When a Compute module is reimaged, it returns to the out-of-box condition. As a result, all data that was previously on the module is lost.

Table 3 describes some of the password policies.

### Table 3 - ControlLogix Compute Module Password Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
</table>
| Password change      | The following apply::  
- You must change the password every 60 days.  
  When 60 days have expired, you are prompted to change the password the next time that you log in.  
- After you change the password, you cannot change it again for at least one day. |
| Minimum password length | The password must be a minimum of 14 characters in length.                  |
| Password complexity  | The password must include at least one of **each of the following:**  
  - Lower case letter  
  - Upper case letter  
  - Number  
  - Special character |
| Password reuse       | The password cannot be the same as the previous 24 passwords that were used on the module. |

Chapter 2  Windows Operating System Overview

Account Lockout Settings

To help maintain a degree of security, an account on a Compute module can be locked. Table 4 describes some of the account lockout policies.

Table 4 - ControlLogix Compute Module Account Lockout Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Password use to unlock account</td>
<td>An account is locked after 10 failed attempts to log in.</td>
</tr>
<tr>
<td>Access to a locked account</td>
<td>The following apply:</td>
</tr>
<tr>
<td></td>
<td>• Once an account is locked, you can attempt to log in to the account after 15 minutes.</td>
</tr>
<tr>
<td></td>
<td>• A system administrator can manually unlock the account for a general user before 15 minutes expire.</td>
</tr>
</tbody>
</table>


Network Settings

The Compute module has two Ethernet ports that let the module connect to an EtherNet/IP network. Table 5 describes some of the Network policies.

Table 5 - ControlLogix Compute Module Network Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local account access over network</td>
<td>Local accounts are denied permission to log on to the module over the network.</td>
</tr>
<tr>
<td>Windows Firewall</td>
<td>Windows Firewall policy that is managed by local policy.</td>
</tr>
</tbody>
</table>

For more information on the Microsoft Security Baseline for Windows 10 v1607 policies, see the following:

- Local account access over network policy - https://docs.microsoft.com/en-us/windows/device-security/security-policy-settings/deny-access-to-this-computer-from-the-network

Internet Explorer Settings

You can use Internet Explorer (IE) on your Compute module. Table 6 describes some of the IE policies.

Table 6 - ControlLogix Compute Module IE Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restrictions on using IE</td>
<td>Restrictions exist to account for unsafe ActiveX controls. The restrictions include:</td>
</tr>
<tr>
<td></td>
<td>• You cannot use IE to run outdated controls.</td>
</tr>
<tr>
<td></td>
<td>• You cannot use IE to run some controls that are not outdated.</td>
</tr>
<tr>
<td>Java configuration</td>
<td>Java is configured on the module to run with High Safety settings on the following:</td>
</tr>
<tr>
<td></td>
<td>• Trusted Sites Zone</td>
</tr>
<tr>
<td></td>
<td>• Intranet Zone</td>
</tr>
</tbody>
</table>


Removable Media Settings

You can use removable media with your Compute module. Table 7 lists removable media policies.

Table 7 - ControlLogix Compute Module Removable Media Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removable media use</td>
<td>Removable media that is connected to the module is read-only unless it is protected by Bit Locker.</td>
</tr>
<tr>
<td>Autoplay</td>
<td>Autoplay is disabled.</td>
</tr>
</tbody>
</table>

Driver Signature Enforcement

The embedded Windows OS on the Compute module is designed with the driver signature enforcement feature enabled. Therefore, you can only use signed drivers that are installed correctly.

If you install an unsigned driver or incorrectly install a signed driver, it does not work. The error is indicated in the Device Manager dialog box under A-B Virtual Backplane folder.

If you double-click the A-B Virtual Backplane folder that is shown, Device status section of the A-B Virtual Backplane Properties dialog box describes the presence of error code 52.

**IMPORTANT** To avoid this error, install signed drivers correctly. If you need to use a driver but only have an unsigned version of it, you must first obtain a signed version of that driver.
Implement a BIOS Password

To implement a BIOS password on a ControlLogix Compute module, complete these steps.

1. Verify that a keyboard is connected to the module via the USB port.

2. Apply power to the module, that is, turn on power to the chassis within which the module resides.

3. On the keyboard, press the F2 key.

4. In the BIOS, use the arrow keys on your keyboard to navigate to the Security menu.

5. On the Security menu, the following options are available:
   - Set Supervisor Password
   - Supervisor Password Hint String
   - Set User Password
   - User Hint String
   - Min. password length
   - Authenticate User on Boot [Disabled/Enabled]
   - HDD02 Password State
   - Set HDD02 User Password

6. If you want the login procedure to appear whenever the Compute module starts up in the future, enable the Authenticate User on Boot option.

7. Click F10 to Save and Exit or use your keyboard to navigate to the Exit menu and select Exit Saving Changes.

**IMPORTANT** After you implement a BIOS password, you can change it. However, you cannot recover the BIOS password if you forget or lose it.
Information on the Module Cannot Be Erased

Once you load data on a Compute module, it stays on the module permanently. You cannot simply delete the data from the module. In this case, the term data refers to an organization's intellectual property.

Due to how the Windows OS manages the hard drive memory on the Compute module, deletion of a file does not completely remove the data from the hard drive.

You can only delete information on a Compute module with a commercially-available data wiping/erasing tool in accordance with your organization's standards that renders the module permanently inoperable. You can also destroy the module itself to prevent access to the data.

Data Lost Due to OS Corruption Cannot Be Recovered

If the embedded OS becomes corrupted, the following apply:

- Any data that was on the module when the OS became corrupted is lost and cannot be recovered.

- You must return the module to Rockwell Automation, where it is reimaged or replaced.

  If Rockwell Automation can reimage the module, it is reimaged to its out-of-box condition.
Chapter 3

Linux Operating System Overview

This chapter describes the embedded Linux OS on a ControlLogix® Compute module.

Follow Design and Engineering Best Practices

The Compute modules are highly user-configurable and, therefore, let you define how the module is used as uniquely as necessary to fit your custom application.

We recommend that when you customize the module for your application, you follow not only your company design guidelines but also general good engineering practices and behaviors.

For example, it is generally a good practice when you configure an embedded OS login to include a System Use notification message. The message can make a user aware of the conditions within which the module is used.

If you change the embedded Linux OS default security settings from the out-of-box conditions, you assume responsibility for any potential issues that arise as a result of the changes.

We recommend that you apply the same IT policies to the Compute module that your organization applies to an industrial personal computer (PC).
**Connect Monitor and Peripherals Before Power-up**

We recommend that before you apply power to the chassis within which the Compute module resides, you make all necessary module connections. For example, connect a monitor to the DisplayPort and peripherals to the USB 3.0 port before you apply power to the module.

If you power up a module with the embedded Linux OS before you connect a monitor, the monitor typically does not work. In this case, restart the embedded Linux OS while leaving the monitor connected to the DisplayPort.

You can restart the OS via the reset button on the module or by cycling power to the module. If you use the reset button, the module does not turn off but the embedded OS performs a reset.

For more information on the reset button, see page 22.

**TIP** A Linux OS only uses command lines. You cannot use a mouse with a Linux OS so there is no reason to connect one to the module.

**Security Settings**

The embedded Linux OS on your Compute module is configured per the Center for Internet Security (CIS) Debian Linux 8 Benchmark Level 1 profile with exceptions that are described at page 42.

For detailed information on CIS Debian Linux 8 Benchmark Level 1 profile, hereafter listed as Benchmark, see https://www.cisecurity.org/cis-benchmarks.

Remember the following as you read this section:

- The security setting descriptions provide information that is considered to be of particular importance regarding how you use your ControlLogix Compute module.

  However, the descriptions are not exhaustive descriptions. For complete descriptions, see the Benchmark referenced previously.

- In some policy descriptions, there are references to section numbers and names in the Benchmark. The numbers and names are as of the Level 1 profile and can change in future Benchmark versions.

- If you change the embedded Linux OS default security settings from the out-of-box conditions, you assume responsibility for any potential issues that arise as a result of the changes.
Password Settings

Password and account lockout settings are tied together because, if an account is locked, a password is required to unlock it. A password can establish, and help to maintain, a degree of security on the module.

There is a login the first time that you power up a Compute module that uses the embedded Linux OS.

- User name is **root**.
- Password is **Rockwell**.

After you log in for the first time, you are prompted to change the password.

**IMPORTANT** After you implement a password, you can change it. However, you **cannot** recover the password if you forget or lose it.

If you cannot log in to your account on a Compute module because you do not know the password, you must return it to Rockwell Automation to be reimaged.

When a Compute module is reimaged, it returns to the out-of-box condition. As a result, all data that was previously on the module is lost.

Table 8 describes some of the password policies.

**Table 8 - ControlLogix Compute Module Password Policies**

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Password change** | The following apply:  
  - You must change the password every 90 days.  
    When 90 days have expired, you are to change the password the next time that you log in.  
    - After you change the password, you cannot change it again for at least 7 days. |
| **Minimum password length** | The password must be a minimum of 14 characters in length. |
| **Password complexity** | The password must include at least one of each of the following:  
  - Lower case letter  
  - Upper case letter  
  - Number  
  - Special character |
| **Password reuse** | The password cannot be the same as the previous 5 passwords that were used on the module. |

For more information on password policies in the Benchmark, see the following:

- Section 9.2, Configure PAM (Pluggable Authentication Modules)
- Section 10, User Accounts and Environment
Account Lockout Settings

To help maintain a degree of security, an account on a Compute module can be locked. Table 9 describes some of the account lockout policies.

Table 9 - ControlLogix Compute Module Account Lockout Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Password use to unlock account</td>
<td>An account is locked after 10 failed attempts to log in.</td>
</tr>
<tr>
<td>Access to a locked account</td>
<td>The following apply:</td>
</tr>
<tr>
<td></td>
<td>• Once an account is locked, you can attempt to log in to the account after</td>
</tr>
<tr>
<td></td>
<td>15 minutes.</td>
</tr>
<tr>
<td></td>
<td>• A system administrator can manually unlock the account for a general user</td>
</tr>
<tr>
<td></td>
<td>before 15 minutes expire.</td>
</tr>
</tbody>
</table>

Secure Shell Access Settings

Secure Shell Access (SSH) is a secure, encrypted login service that helps to protect the embedded Linux OS from login by unauthorized users who intend to access sensitive data from the system and perform harmful actions to the system.

The SSH service is disabled by default. To enable the SSH server, run this command as root: `update-rc.d ssh enable`.

If you must use SSH after it is enabled, you must start the service and configure IPTables to permit connections on the SSH port. For more information on IPTables, see IPTables Settings on page 41.

The `PermitRootLogin` parameter specifies if root users can use the SSH service to log in. By default, they cannot.

Table 10 describes some of the SSH policies.

Table 10 - ControlLogix Compute Module SSH Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSH Root Login</td>
<td>SSH Root Login is disabled. Only a system administrator can use it.</td>
</tr>
<tr>
<td>SSH Session Termination</td>
<td>If a user is logged into the module via the SSH Root Login, the session is terminated after 5 minutes without any activity.</td>
</tr>
</tbody>
</table>

For more information on SSH settings in the Benchmark, see Section 9.3, Configure SSH.
IPTables Settings

IPTables is configured by default to DROP all incoming packets except on the local host. If your application requires network access, IPTables must be configured correctly to support the ports and protocols that your application requires.

For more information, see the Debian8 Firewall documentation available at: https://wiki.debian.org/DebianFirewall.

User Account Access Settings

The `su` command lets you run commands or shell as another user. However, only users in the wheel group can execute the `su` command.

For more information on the `su` command in the Benchmark, see Section 9.5, Restrict Access to the su Command.

Access to Core Dumps Settings

A core dump is the memory of an executable program. That is, if the system crashes, the file provides information about the application conditions when the system crashed.

Core dumps are typically used to determine why a program aborted. We recommend that you restrict access to core dump files to privileged groups.

For more information on core dumps in the Benchmark, see Section 4.1, Restrict Core Dumps.

Prelink Settings

The Prelink feature changes binaries to improve start up time. This feature is disabled by default. Consequently, your application can take longer to start up.

We recommend that you do not enable Prelink unless an application explicitly requires it. Prelinking can increase the vulnerability of the system if a malicious user can compromise a common library.

For more information on the Prelink feature in the Benchmark, see Section 4.4, Disable Prelink.
Settings Not Implemented On the Module

Some settings in the CIS Debian Linux 8 Benchmark are not implemented in the embedded Linux OS.

Table 11 describes the settings that are not implemented on the embedded Linux OS in out-of-box condition.

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Time Protocol (NTP) configuration.</td>
<td>NTP lets system clocks across various systems synchronize via a highly accurate time source. This requires a knowledge of each NTP server in the system. NTP is disabled.</td>
</tr>
<tr>
<td>Specific systems that are granted or denied access to the module.</td>
<td>These files are used to help make sure that only authorized systems can access the module:</td>
</tr>
<tr>
<td></td>
<td>- The /etc/hosts.allow file specifies the IP addresses from which systems can access to the module.</td>
</tr>
<tr>
<td></td>
<td>- The /etc/hosts.deny file specifies the IP addresses from which systems are denied access to the module.</td>
</tr>
<tr>
<td></td>
<td>Neither file is not configured.</td>
</tr>
<tr>
<td>Warning banners as part of the login procedure.</td>
<td>Warning banners can be part of the login procedure.</td>
</tr>
<tr>
<td></td>
<td>They can help to prosecute unauthorized users who access the module with malicious intent and to hide detailed system information that unauthorized users attempting to inflict damage to the system. These files determine what warnings are displayed:</td>
</tr>
<tr>
<td></td>
<td>- The /etc/issue file defines the warning message that is displayed before you can log into the module.</td>
</tr>
<tr>
<td></td>
<td>- The /etc/motd file defines the warning message that is displayed after a successful login.</td>
</tr>
<tr>
<td></td>
<td>By default, the files are not set in the embedded Linux OS. We recommend that you add warning banners to your module's login procedure.</td>
</tr>
<tr>
<td>IPv6 support</td>
<td>The IPv6 settings are not configured because it is not supported in the embedded Linux OS.</td>
</tr>
<tr>
<td>Sends logs to a remote log host.</td>
<td>The rsyslog utility is used to send logs that it gathers to a remote log host running syslogd (8) or to receive messages from remote hosts. The rsyslog utility is not configured.</td>
</tr>
<tr>
<td>Rotating log files regularly.</td>
<td>The logrotate file can be configured to rotate log files that are created by the rsyslog utility to avoid filling up the system with logs or making log too large to manage. The logrotate uses the default configuration.</td>
</tr>
<tr>
<td>List of users and group permitted access via SSH</td>
<td>There is no list of users or groups that can access the embedded OS via SSH.</td>
</tr>
</tbody>
</table>

For more information on the policies in Table 11, see the following sections of the Benchmark. The section names and numbers are as of the Level 1 profile.

- NTP - Section 6.5, Configure Network Time Protocol (NTP)
- Systems Granted/Denied Access - As follows:
  - Section 7.4.2 Create /etc/hosts.allow
  - Section 7.4.4, Create /etc/hosts.deny
- Warning Banners - Section 11, Warning Banners
- Rotate log files via logrotate - Section 8.4, Configure logrotate
- rsyslog Utility - Section 8.2.5, Configure rsyslog to Send Logix to Remote Log Host
- User or group access via SSH - Section 9.3.13, Limit Access via SSH
Additional Considerations

The following apply to a Compute module that uses the embedded Linux OS:

- To run an application that accesses the backplane as a non-root user, the user that runs the application must be added to the ocxdevice group.

For example, if the user engineer must be added, run the following command: `usermod -a -G ocxdevice engineer`.

The change takes effect, the next time the user logs into the embedded OS.

Implement a BIOS Password

To implement a BIOS password on a ControlLogix Compute module, complete these steps.

1. Verify that a keyboard is connected to the module via the USB port.
2. Apply power to the module, that is, turn on power to the chassis within which the module resides.
3. On the keyboard, press the F2 key.
4. In the BIOS, use the arrow keys on your keyboard to navigate to the Security menu.
5. On the Security menu, the following options are available:
   - Set Supervisor Password
   - Supervisor Password Hint String
   - Set User Password
   - User Hint String
   - Min. password length
   - Authenticate User on Boot [Disabled/Enabled]
   - HDD02 Password State
   - Set HDD02 User Password
6. If you want the login procedure to appear whenever the Compute module starts up in the future, enable the Authenticate User on Boot option.
7. Click F10 to Save and Exit or use your keyboard to navigate to the Exit menu and select Exit Saving Changes.

IMPORTANT After you implement a BIOS password, you can change it. However, you cannot recover the BIOS password if you forget or lose it.
**Information on the Module Cannot Be Erased**

Once you load data on a Compute module, it stays on the module permanently. You cannot simply delete the data from the module. In this case, the term data refers to an organization's intellectual property.

Due to how the Linux OS manages the hard disk drive memory on the Compute module, deletion of a file does not completely remove the data from the hard disk drive.

You can only delete information on a Compute module with a commercially available data wiping/erasing tool in accordance with your organization's standards that renders the module permanently inoperable. You can also destroy the module itself to help prevent access to the data.

**Data Lost Due to OS Corruption Cannot Be Recovered**

If the embedded OS becomes corrupted, the following apply:

- Any data that was on the module when the OS became corrupted is lost and cannot be recovered.

- You must return the module to Rockwell Automation, where it is reimaged or replaced.

  If Rockwell Automation can reimage the module, it is reimaged to its out-of-box condition.
Chapter 4

Application Development

This chapter describes the ControlLogix® Compute module API, including how to use the API to develop applications the modules that use the Windows OS or Linux OS.

The Linux or Windows platform that is supplied with the ControlLogix Compute module already has the API shared libraries and device driver installed. The API functions are the same for Linux and Windows.

API Architecture

The API lets you access the ControlLogix backplane and special devices that the ControlLogix Compute module supports. The API consists of the following components:

- Backplane device driver
- Backplane interface engine
- Backplane interface API library

You must install the components on a system to run an application that is developed for the API.
The backplane device driver allocates device resources, directly manipulates hardware devices, and fields device interrupts. The BPIE accesses the device driver.

The BPIE is provided as a 32-bit or 64-bit DLL for the Windows OS or as a shared library for the Linux OS. The BPIE is not a standalone process; it requires a host application. This design lets the host application run in the same process space as the BPIE. The result is maximum performance.

Each module can only have one host application. The BPIE is automatically started when the host application accesses the host API.

Figure 9 shows the relationships between these components.

Figure 9 - API Architecture
CIP Messaging

The BPIE contains the functionality necessary to perform CIP™ messaging over the ControlLogix backplane. The BPIE implements the following CIP components and objects:

- Communications Device (CD)
- Unconnected message manager (UCMM)
- Message router object (MR)
- Connection manager object (CM)
- Transports
- Identity object
- ICP object
- Assembly object (with API access)

For more information about these components, refer to the CIP Specification available at the following: https://www.odva.org/

All connected data exchange between the application and the backplane occurs through the Assembly Object by using functions that are provided by the API.

The API functions let you complete the following:

- Register or unregister the object.
- Accept or deny Class 1 scheduled connection requests.
- Access scheduled connection data.
- Service unscheduled messages.
API Library
Already Installed

The ControlLogix Compute module API library files and device driver are already installed in the embedded OS when you receive the module. You must install only the user application.

You can install the ControlLogix Compute module SDK on a computer that is used to develop an application that uses the API. The SDK includes documentation, sample source code, header files, and API libraries.

Install the API Development Files (SDK)

For Windows SDK, to install the API development files and documentation, double-click the SDK installation file (56Comp_sdk_setup_vx_x_x.msi). Follow the prompts to select the installation path and complete the installation.

The Linux SDK is supplied as a compressed tar file. You extract the files to a suitable directory to install it.

You can download the SDK installation files at the Rockwell Automation Product Compatibility and Download Center available at:

https://compatibility.rockwellautomation.com/Pages/home.aspx

Remove the SDK

To remove the Windows SDK from the system, complete these steps.

1. From the Control Panel, click Programs and Features.
2. Select 56Comp Backplane SDK from the list.
3. Click Uninstall.
4. Follow the prompts to remove all components of the API.
Four-character Alphanumeric Display

The ControlLogix Compute module includes a 4-character alphanumeric display. Table 12 lists the messages that are displayed to indicate the system status.

Table 12 - Display Messages

<table>
<thead>
<tr>
<th>Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;blank&gt; or POST codes</td>
<td>Device driver has not yet been started (or application has written to the display)</td>
</tr>
<tr>
<td>INIT</td>
<td>Device driver has successfully started</td>
</tr>
<tr>
<td>OK</td>
<td>BPIE has successfully started</td>
</tr>
<tr>
<td>—</td>
<td>BPIE has stopped (host application has exited)</td>
</tr>
</tbody>
</table>

An application can use the OCXcip_SetDisplay function to display any desired 4-character message on the display.

API Library

The API library supports industry standard programming languages. The API library is supplied as a 32-bit or 64-bit DLL that is linked to the users application at runtime.

Calling Convention

You use the C programming language syntax to specify the API library functions. The standard Win32 stdcall calling convention is used for all API functions. This calling convention lets applications be developed in other standard programming languages and also to achieve compatibility between different C implementations.

The function names are exported from the DLL in undecorated format to simplify access from other programming languages.

Header Files

Two header files are provided in the SDK. These header files contain API function declarations, data structure definitions, and miscellaneous constant definitions. The header files are in standard C format.

**IMPORTANT** The header files include some functions that are not documented in this guide. These functions are deprecated and cannot be used. They remain in the API for legacy applications. The deprecated functions are listed below.
Deprecated Functions

These functions appear in the header files but are not documented in this publication:

- OCXcip_ClientOpen (not supported)
- OCXcip_SetEmbeddedEDSFile (not supported)
- OCXcip_SetUserLED (superseded by OCXcip_SetLED)
- OCXcip_GetUserLED (superseded by OCXcip_GetLED)
- OCXcip_SetLED3 (superseded by OCXcip_SetLED)
- OCXcip_GetLED3 (superseded by OCXcip_GetLED)
- OCXcip_RegisterFlashUpdateRtn (not supported)
- OCXcip_RegisterResetParamReqRtn (not supported)
- OCXcip_RegisterShutdownReqRtn (not supported)
- OCXcip_RegisterResetButtonRtn (not supported)
- OCXcip_GetTemperature (not supported)
- OCXcip_ReadSRAM (not supported)
- OCXcip_WriteSRAM (not supported)
- OCXcip_DataTableRead (superseded by OCXcip_AccessTagData)
- OCXcip_DataTableWrite (superseded by OCXcip_AccessTagData)
- OCXcip_InitTagDefTable, OCXcip_UninitTagDefTable, OCXcip_TagDefine, and OCXcip_TagUndefine (superseded by OCXcip_CreateTagDbHandle, OCXcip_BuildTagDb, etc.)
- OCXcip_DtTagRd and OCXcip_DtTagWr (superseded by OCXcip_AccessTagDataBase)
- OCXcip_ReadIdStatusDefine (superseded by OCXcip_GetDeviceIdStatus)
- OCXcip_PLC5GetIDHost (legacy, undocumented)
- OCXcip_ReadSectionPLC5 (legacy, undocumented)
- OCXcip_MLGXProtoTypedRead (legacy, undocumented)
- OCXcip_MLGXProtoTypedWrite (legacy, undocumented)
- OCXcip_MLGXReadModWrite (legacy, undocumented)
- OCXcip_MLGX14ProtoTypedRead (legacy, undocumented)
- OCXcip_MLGX14ProtoTypedWrite (legacy, undocumented)
- OCXcip_MLGX14ReadModWrite (legacy, undocumented)
- OCXcip_GetSerialConfig (not supported)
- OCXcip_SetSerialConfig (not supported)
Sample Code

Sample source files are supplied with the SDK to provide example applications.

Import Library

During development, the application must be linked with an import library that provides information about the functions that are contained within the DLL. An import library compatible with the Microsoft linker is provided.

**IMPORTANT** Importing a library only applies to modules that use the embedded Windows OS.

API Files

Table 13 lists the supplied API files that are required for development.

**Table 13 - API File Names**

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ocxbpapi.h</td>
<td>Main API include file</td>
</tr>
<tr>
<td>ocxtagdb.h</td>
<td>Include file for tag access function</td>
</tr>
<tr>
<td>ocxbpapi.lib</td>
<td>API Import library (Microsoft COFF format)</td>
</tr>
</tbody>
</table>

**IMPORTANT** API files are only required on modules that use the embedded Windows OS.
Host Application

Another process, called the host application, must host the BPIE. The host application has access to the entire range of API functions. Because it runs locally and in the same process space as the BPIE, it achieves the best performance possible.

The BPIE starts automatically when the host application calls the OCXcip_Open function.

Only one host application can run at any one time on a Compute module. However, the host API is thread safe, so that multi-threaded host applications can be developed.

Where necessary, the API functions acquire a critical section before accessing the BPIE. In this way, access to critical functions is serialized. If the critical section is in use by another thread, a thread is blocked until it is freed.
Chapter 5

Backplane API Library Functions

The Backplane API library functions are listed in Table 14. Details for each function are presented in subsequent sections.

Table 14 - Library Functions

<table>
<thead>
<tr>
<th>Category</th>
<th>Name</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initialization</td>
<td>OCXcip_Open</td>
<td>Starts the BPIE and initializes access to the API</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>OCXcip_OpenNB</td>
<td>Provides access to non-backplane functions</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>OCXcip_Close</td>
<td>Terminates access to the API</td>
<td>58</td>
</tr>
<tr>
<td>Object Registration</td>
<td>OCXcip_RegisterAssemblyObj</td>
<td>Registers all instances of the Assembly Object, and lets other devices in</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the CIP™ system to establish connections with the object. Callbacks are</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>used to handle connection and service requests.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OCXcip_UnregisterAssemblyObj</td>
<td>Unregisters all instances of the Assembly Object that had previously been</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>registered. Subsequent connection requests to the object are refused.</td>
<td></td>
</tr>
<tr>
<td>Callback Registration</td>
<td>OCXcip_RegisterFatalFaultRtn</td>
<td>Registers a fatal fault handler routine</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>OCXcip_RegisterResetRtn</td>
<td>Registers a reset request handler routine</td>
<td>61</td>
</tr>
<tr>
<td>Connected Data Transfer</td>
<td>OCXcip_WriteConnected</td>
<td>Writes data to a connection</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>OCXcip_ReadConnected</td>
<td>Reads data from a connection</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>OCXcip_ImmediateOutput</td>
<td>Transmits output data immediately</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>OCXcip_WaitForRxData</td>
<td>Blocks until new data is received on connection</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>OCXcip_WriteConnectedImmediate</td>
<td>Update and transmit output data immediately</td>
<td>65</td>
</tr>
</tbody>
</table>
## Chapter 5  Backplane API Library Functions

**Table 14 - Library Functions**

<table>
<thead>
<tr>
<th>Category</th>
<th>Name</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tag Access</td>
<td>OCXcip_AccessTagData</td>
<td>Read and write Logix controller tag data</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>OCXcip_AccessTagDataAbortable</td>
<td>Abortable version of OCXcip_AccessTagData</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>OCXcip_CreateTagDbHandle</td>
<td>Creates a tag database handle.</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>OCXcip_DeleteTagDbHandle</td>
<td>Deletes a tag database handle and releases all associated resources.</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SetTagDbOptions</td>
<td>Sets various tag database options.</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>OCXcip_BuildTagDb</td>
<td>Builds or rebuilds a tag database.</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>OCXcip_TestTagDbVer</td>
<td>Compare the current device program version with the device program version</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>read when the tag database was created.</td>
<td></td>
</tr>
<tr>
<td>Messaging</td>
<td>OCXcip_GetDeviceIdObject</td>
<td>Reads a device's identity object.</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetDeviceICPObject</td>
<td>Reads a device's ICP object</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetDeviceIdStatus</td>
<td>Read a device's status word.</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetExDevObject</td>
<td>Read a device's extended device object.</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetWCTime</td>
<td>Read the Wall Clock Time from a controller.</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SetWCTime</td>
<td>Set a controller's Wall Clock Time.</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetWCTimeUTC</td>
<td>Read a controller's Wall Clock Time in UTC.</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SetWCTimeUTC</td>
<td>Set a controller's Wall Clock Time in UTC.</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>OCXcip_PLC5TypedRead</td>
<td>Perform data typed reads from PLC-5®</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>OCXcip_PLC5TypedWrite</td>
<td>Perform data typed writes to PLC-5®</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>OCXcip_PLC5WordRangeWrite</td>
<td>Perform word writes to PLC-5®</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>OCXcip_PLC5WordRangeRead</td>
<td>Perform word reads from PLC-5®</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>OCXcip_PLC5ReadModWrite</td>
<td>Perform bit level writes to PLC-5®</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SLCProtTypedRead</td>
<td>Perform data typed reads from SLC™</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SLCProtTypedWrite</td>
<td>Perform data typed writes from SLC™</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SLCReadModWrite</td>
<td>Perform bit level writes to SLC</td>
<td>103</td>
</tr>
<tr>
<td>Category</td>
<td>Name</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>OCXcip_GetIdObject</td>
<td>Returns data from the module’s Identity Object</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SetIdObject</td>
<td>Lets the application to customize certain attributes of the identity object</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetActiveNodeTable</td>
<td>Returns the number of slots in the local rack and identifies the slots are occupied by active modules</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>OCXcip_MsgResponse</td>
<td>Send the response to a unscheduled message. This function must be called after returning OCX_CIP_DEFER_RESPONSE from the service_proc callback routine.</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetVersionInfo</td>
<td>Get the API, BPIE, and device driver version information</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SetLED</td>
<td>Set the state of the LED</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetLED</td>
<td>Get the state of the LED</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SetDisplay</td>
<td>Set the state of the display</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetDisplay</td>
<td>Get the currently displayed string</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetSwitchPosition</td>
<td>Get the state of the 3-position switch</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SetModuleStatus</td>
<td>Lets an application set the status of the module’s status LED indicator.</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>OCXcip_ErrorString</td>
<td>Returns a text error message associated with the error code ercode.</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>OCXcip_Sleep</td>
<td>Delays for approximately msdelay milliseconds.</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>OCXcip_CalculateCRC</td>
<td>Computes a 16-bit CRC for a range of data</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>OCXcip_SetModuleStatusWord</td>
<td>Lets an application set the 16-bit status attribute of the module’s Identity Object.</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>OCXcip_GetModuleStatusWord</td>
<td>Lets an application read the current value of the 16-bit status attribute of the module’s Identity Object.</td>
<td>113</td>
</tr>
<tr>
<td>Callback</td>
<td>connect_proc</td>
<td>Passes to the API in the OCXcip_RegisterAssemblyObj function and called when a Class 1 scheduled connection request is made for the registered object instance.</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>service_proc</td>
<td>Passes to the API in the OCXcip_RegisterAssemblyObj function and called when an unscheduled message is received for the registered object.</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td>fatalfault_proc</td>
<td>Passes to the API in the OCXcip_RegisterFatalFaultRtn function and called when the backplane device driver detects a fatal fault condition.</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>resetrequest_proc</td>
<td>Passes to the API in the OCXcip_RegisterResetReqRtn function and called if the backplane device driver receives a module reset request (Identity Object reset service).</td>
<td>118</td>
</tr>
</tbody>
</table>
Initialization Function

Category

This section describes the Initialization functions.

0CXcip_Open

Syntax

```c
int OCXcip_Open(OCXHANDLE *apiHandle);
```

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>apiHandle</td>
<td>Pointer to variable of type OCXHANDLE</td>
</tr>
</tbody>
</table>

Description

0CXcip_Open acquires access to the host API and sets apiHandle to a unique ID that the application uses in subsequent functions. This function must be called before any of the other API functions can be used.

**IMPORTANT:** Once the API has been opened, 0CXcip_Close must always be called before exiting the application.

Return Value

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>BPIE has started successfully and API access is granted</td>
</tr>
<tr>
<td>OCX_ERR_REOPEN</td>
<td>API is already open (host application can already be running)</td>
</tr>
<tr>
<td>OCX_ERR_NODEVICE</td>
<td>Backplane device driver could not be accessed</td>
</tr>
<tr>
<td>OCX_ERR_NODEVICE</td>
<td>is returned if the backplane device driver is not properly installed or has not been started.</td>
</tr>
<tr>
<td>OCX_ERR_MEMALLOC</td>
<td>Unable to allocate resources for BPIE</td>
</tr>
<tr>
<td>OCX_ERR_TIMEOUT</td>
<td>BPIE did not start</td>
</tr>
</tbody>
</table>

Example

```c
OCXHANDLE apiHandle;
if (OCXcip_Open(&apiHandle)!= OCX_SUCCESS)
{
    printf("Open failed!\n");
}
else
{
    printf("Open succeeded\n");
}
```

For more information, see 0CXcip_Close on page 58.
# OCXcip_OpenNB

## Syntax

```c
int OCXcip_OpenNB(OCXHANDLE *apiHandle);
```

## Parameters

- `apiHandle` Pointer to variable of type OCXHANDLE

## Description

OCXcip_OpenNB acquires access to the API and sets `apiHandle` to a unique ID that the application uses in subsequent functions. This function must be called before any of the other API functions can be used.

Most applications use OCXcip_Open instead of this function. This version of the open function gives access to a limited subset of API functions that are not related to the ControlLogix backplane. This can be useful in some situations if an application separate from the host application needs access to a device such as the alphanumeric display, for example.

An application must use either OCXcip_Open or OCXcip_OpenNB but never both.

The API functions that can be accessed after calling OCXcip_OpenNB are the following:

- OCXcip_Close
- OCXcip_GetDisplay
- OCXcip_GetIdObject
- OCXcip_GetLED
- OCXcip_GetModuleStatus
- OCXcip_GetSwitchPosition
- OCXcip_GetVersionInfo
- OCXcip_SetDisplay
- OCXcip_SetLED
- OCXcip_SetModuleStatus
- OCXcip_Sleep

**IMPORTANT:** Once the API has been opened, OCXcip_Close must always be called before exiting the application.

## Return Value

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>API has started successfully and API access is granted</td>
</tr>
<tr>
<td>OCX_ERR_REOPEN</td>
<td>API is already open (host application can already be running)</td>
</tr>
</tbody>
</table>

## Example

```c
OCXHANDLE apiHandle;
if (OCXcip_OpenNB(&apiHandle)!= OCX_SUCCESS)
{
   printf("Open failed\n");
}
else
{
   printf("Open succeeded\n");
}
```

For more information, see the following:

- [OCXcip_Open on page 56.](#)
- [OCXcip_Close on page 58.](#)
### OCXcip_Close

<table>
<thead>
<tr>
<th>Syntax</th>
<th>int</th>
<th>OCXcip_Close(OCXHANDLE apiHandle);</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>apiHandle</td>
<td>Handle returned by previous call to OCXcip_Open</td>
</tr>
<tr>
<td>Description</td>
<td>This function is used by an application to release control of the API. apiHandle must be a valid handle returned from OCXcip_Open.</td>
<td></td>
</tr>
<tr>
<td><strong>IMPORTANT</strong></td>
<td>Once the API has been opened, this function must always be called before exiting the application.</td>
<td></td>
</tr>
<tr>
<td>Return Value</td>
<td>OCX_SUCCESS</td>
<td>API was closed successfully</td>
</tr>
<tr>
<td></td>
<td>OCX_ERR_NOACCESS</td>
<td>apiHandle does not have access</td>
</tr>
<tr>
<td>Example</td>
<td>OCXHANDLE apiHandle;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OCXcip_Close(apiHandle);</td>
<td></td>
</tr>
</tbody>
</table>

For more information, see OCXcip_Open on page 56.
Object Registration
Function Category

This section describes the Object Registration functions.

**OCXcip_RegisterAssemblyObj**

This function is used by an application to register all instances of the Assembly Object with the API. The object must be registered before a connection can be established with it. The `apiHandle` must be a valid handle returned from `OCXcip_Open`.

**Parameters**

- **apiHandle**
  Handle returned by previous call to `OCXcip_Open`

- **objHandle**
  Pointer to variable of type `OCXHANDLE`. On successful return, this variable contains a value that identifies this object.

- **reg_param**
  Value that is passed back to the application as a parameter in the `connect_proc` and `service_proc` callback functions.

- **connect_proc**
  Pointer to callback function to handle connection requests

- **service_proc**
  Pointer to callback function to handle service requests

**Description**

- `apiHandle` must be a valid handle returned from `OCXcip_Open`.
- `reg_param` is a value that is passed back to the application as a parameter in the `connect_proc` and `service_proc` callback functions. The application can use this to store an index or pointer. It is not used by the API.
- `connect_proc` is a pointer to a callback function to handle connection requests to the registered object. This function is called by the backplane device driver when a Class 1 scheduled connection request for the object is received. It is also called when an established connection is closed.
- `service_proc` is a pointer to a callback function that handles service requests to the registered object. This function is called by the backplane device driver when an unscheduled message is received for the object.

**Return Value**

- **OCX_SUCCESS**
  Object was registered successfully

- **OCX_ERR_NOACCESS**
  apiHandle does not have access

- **OCX_ERR_BADPARAM**
  connect_proc or service_proc is NULL

- **OCX_ERR_ALREADY_REGISTERED**
  Object has already been registered

**Example**

```c
OCXHANDLE apiHandle;
OCXHANDLE objHandle;
MY_STRUCT mystruct;
int rc;

OCXCALLBACK MyConnectProc(OCXHANDLE, OCXCIPCONNSTRUC *);
OCXCALLBACK MyServiceProc(OCXHANDLE, OCXCIPSERVSTRUC *);

// Register all instances of the assembly object
rc = OCXcip_RegisterAssemblyObj(apiHandle, &objHandle, (DWORD)&mystruct, MyConnectProc, MyServiceProc);
if (rc != OCX_SUCCESS)
    printf("Unable to register assembly object\n");
```

For more information, see the following:

- **OCXcip_UnregisterAssemblyObj** on page 60
- **connect_proc** on page 114
- **service_proc** on page 116

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## OCXcip_UnregisterAssemblyObj

**Syntax**

```c
int OCXcip_UnregisterAssemblyObj( 
    OCXHANDLE apiHandle, 
    OCXHANDLE objHandle );
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>apiHandle</td>
<td>Handle returned by previous call to OCXcip_Open</td>
</tr>
<tr>
<td>objHandle</td>
<td>Handle for object to be unregistered</td>
</tr>
</tbody>
</table>

**Description**

This function is used by an application to unregister all instances of the Assembly Object with the API. Any current connections for the object specified by `objHandle` are terminated.

- `apiHandle` must be a valid handle returned from OCXcip_Open.
- `objHandle` must be a handle returned from OCXcip_RegisterAssemblyObj.

**Return Value**

- **OCX_SUCCESS**: Object was unregistered successfully
- **OCX_ERR_NOACCESS**: `apiHandle` does not have access
- **OCX_ERR_INVALID_OBJHANDLE**: `objHandle` is invalid

**Example**

```c
OCXHANDLE apiHandle;  
OCXHANDLE objHandle;  
// Unregister all instances of the object
OCXcip_UnregisterAssemblyObj(apiHandle, objHandle);
```

For more information, see [OCXcip_RegisterAssemblyObj on page 59](#).
Special Callback Registration

This section describes the Callback Registration functions.

**OCXcip_RegisterFatalFaultRtn**

### Syntax

```c
int OCXcip_RegisterFatalFaultRtn(
    OCXHANDLE apiHandle,
    OCXCALLBACK (*fatalfault_proc)( ) );
```

### Parameters

- **apiHandle**: Handle returned by previous call to OCXcip_Open
- **fatalfault_proc**: Pointer to fatal fault callback routine

### Description

This function is used by an application to register a fatal fault callback routine. Once registered, the backplane device driver calls `fatalfault_proc` if a fatal fault condition is detected. `apiHandle` must be a valid handle returned from OCXcip_Open. `fatalfault_proc` must be a pointer to a fatal fault callback function. A fatal fault condition results in the module being taken offline; i.e., all backplane communications halt. The application can register a fatal fault callback to perform recovery, safe-state, or diagnostic actions.

### Return Value

- **OCX_SUCCESS**: Routine was registered successfully
- **OCX_ERR_NOACCESS**: `apiHandle` does not have access

### Example

```c
OCXHANDLE apiHandle;
// Register a fatal fault handler
OCXcip_RegisterFatalFaultRtn(apiHandle, fatalfault_proc);
```

For more information, see [fatalfault_proc on page 117](#).

**OCXcip_RegisterResetReqRtn**

### Syntax

```c
int OCXcip_RegisterResetReqRtn(
    OCXHANDLE apiHandle,
    OCXCALLBACK (*resetrequest_proc)( ) );
```

### Parameters

- **apiHandle**: Handle returned by previous call to OCXcip_Open
- **resetrequest_proc**: Pointer to reset request callback routine

### Description

This function is used by an application to register a reset request callback routine. Once registered, the backplane device driver calls `resetrequest_proc` if a module reset request is received. `apiHandle` must be a valid handle returned from OCXcip_Open. `resetrequest_proc` must be a pointer to a reset request callback function. If the application does not register a reset request handler, receipt of a module reset request results in a software reset (i.e., reboot) of the module. The application can register a reset request callback to perform an orderly shutdown, reset special hardware, or to deny the reset request.

### Return Value

- **OCX_SUCCESS**: Routine was registered successfully
- **OCX_ERR_NOACCESS**: `apiHandle` does not have access

### Example

```c
OCXHANDLE apiHandle;
// Register a reset request handler
OCXcip_RegisterResetReqRtn(apiHandle, resetrequest_proc);
```

For more information, see [resetrequest_proc on page 118](#).
This section describes the Connected Data Transfer functions.

**OCXcip_Write Connected**

### Syntax

```c
int OCXcip_WriteConnected(
    OCXHANDLE apiHandle,
    OCXHANDLE connHandle,
    BYTE *dataBuf,
    WORD offset,
    WORD dataSize);
```

### Parameters

- **apiHandle** Handle returned by previous call to OCXcip_Open
- **connHandle** Handle of open connection
- **dataBuf** Pointer to data to be written
- **offset** Offset of byte to begin writing
- **dataSize** Number of bytes of data to write

### Description

This function is used by an application to update data being sent on the open connection specified by `connHandle`. `apiHandle` must be a valid handle returned from OCXcip_Open. `connHandle` must be a handle passed by the `connect_proc` callback function. `offset` is the offset into the connected data buffer to begin writing. `dataBuf` is a pointer to a buffer containing the data to be written. `dataSize` is the number of bytes of data to be written.

### Return Value

- **OCX_SUCCESS** Data was updated successfully
- **OCX_ERR_NOACCESS** `apiHandle` does not have access
- **OCX_ERR_BADPARAM** `connHandle` or `offset/dataSize` is invalid

### Example

```c
OCXHANDLE apiHandle;
OCXHANDLE connHandle;
BYTE buffer[128];
// Write 128 bytes to the connected data buffer
OCXcip_WriteConnected(apiHandle, connHandle, buffer, 0, 128);
```

For more information, see [OCXcip_ReadConnected on page 63](#).
OCXcip_ReadConnected

Syntax

```c
int OCXcip_ReadConnected(  
    OCXHANDLE apiHandle,  
    OCXHANDLE connHandle,  
    BYTE *dataBuf,  
    WORD offset,  
    WORD dataSize );
```

Parameters

- `apiHandle`: Handle returned by previous call to OCXcip_Open
- `connHandle`: Handle of open connection
- `dataBuf`: Pointer to buffer to receive data
- `offset`: Offset of byte to begin reading
- `dataSize`: Number of bytes to read

Description

This function is used by an application to read data being received on the open connection specified by `connHandle`. `apiHandle` must be a valid handle returned from OCXcip_Open. `connHandle` must be a handle passed by the `connect_proc` callback function. `offset` is the offset into the connected data buffer to begin reading. `dataBuf` is a pointer to a buffer to receive the data. `dataSize` is the number of bytes of data to be read.

When a connection has been established with a ControlLogix controller, the first 4 bytes of received data are processor status and are automatically set by the controller. The first byte of data appears at offset 4 in the receive data buffer.

Return Value

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>Data was read successfully</td>
</tr>
<tr>
<td>OCX_ERR_NOACCESS</td>
<td><code>apiHandle</code> does not have access</td>
</tr>
<tr>
<td>OCX_ERR_BADPARAM</td>
<td><code>connHandle</code> or offset/dataSize is invalid</td>
</tr>
</tbody>
</table>

Example

```c
OCXHANDLE apiHandle;
OCXHANDLE connHandle;
BYTE buffer[128];
// Read 128 bytes from the connected data buffer
OCXcip_ReadConnected(apiHandle, connHandle, buffer, 0, 128 );
```

For more information, see OCXcip_WriteConnected on page 62.
Chapter 5  Backplane API Library Functions

### OCXcip_ImmediateOutput

<table>
<thead>
<tr>
<th>Syntax</th>
<th>int</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCXcip_ImmediateOutput</td>
<td></td>
</tr>
<tr>
<td>OCXHANDLE apiHandle,</td>
<td></td>
</tr>
<tr>
<td>OCXHANDLE connHandle,</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>apiHandle</td>
<td>Handle returned by previous call to OCXcip_Open</td>
</tr>
<tr>
<td>connHandle</td>
<td>Handle of open connection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>This function causes the output data of an open connection to be queued for transmission immediately, rather than waiting for the next scheduled transmission (based on the RPI). It is equivalent to the ControlLogix IOT instruction. apiHandle must be a valid handle returned from OCXcip_Open. connHandle must be a handle passed by the connect_proc callback function.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Return Value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>Data was received</td>
</tr>
<tr>
<td>OCX_ERR_NOACCESS</td>
<td>apiHandle does not have access</td>
</tr>
<tr>
<td>OCX_ERR_BADPARAM</td>
<td>connHandle is invalid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Example</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OCXHANDLE apiHandle;</td>
<td></td>
</tr>
<tr>
<td>OCXHANDLE connHandle;</td>
<td></td>
</tr>
<tr>
<td>BYTE buffer[128];</td>
<td></td>
</tr>
<tr>
<td>// Update the output data and transmit now</td>
<td></td>
</tr>
<tr>
<td>OCXcip_WriteConnected(apiHandle, connHandle, buffer, 0, 128);</td>
<td></td>
</tr>
<tr>
<td>OCXcip_ImmediateOutput(apiHandle, connHandle);</td>
<td></td>
</tr>
</tbody>
</table>

For more information, see [OCXcip_Write Connected on page 62](#).

### OCXcip_WaitForRxData

<table>
<thead>
<tr>
<th>Syntax</th>
<th>int</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCXcip_WaitForRxData</td>
<td></td>
</tr>
<tr>
<td>OCXHANDLE apiHandle,</td>
<td></td>
</tr>
<tr>
<td>OCXHANDLE connHandle,</td>
<td></td>
</tr>
<tr>
<td>int timeout</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>apiHandle</td>
<td>Handle returned by previous call to OCXcip_Open</td>
</tr>
<tr>
<td>connHandle</td>
<td>Handle of open connection</td>
</tr>
<tr>
<td>timeout</td>
<td>Timeout in milliseconds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>This function blocks the calling thread until data is received on the open connection specified by connHandle. If the timeout expires before data is received, the function returns OCX_ERR_TIMEOUT. apiHandle must be a valid handle returned from OCXcip_Open. connHandle must be a handle passed by the connect_proc callback function.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Return Value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>Data was received</td>
</tr>
<tr>
<td>OCX_ERR_NOACCESS</td>
<td>apiHandle does not have access</td>
</tr>
<tr>
<td>OCX_ERR_BADPARAM</td>
<td>connHandle is invalid</td>
</tr>
<tr>
<td>OCX_ERR_TIMEOUT</td>
<td>The timeout expired before data was received</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Example</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OCXHANDLE apiHandle;</td>
<td></td>
</tr>
<tr>
<td>OCXHANDLE connHandle;</td>
<td></td>
</tr>
<tr>
<td>// Synchronize with the controller scan</td>
<td></td>
</tr>
<tr>
<td>OCXcip_WaitForRxData(apiHandle, connHandle, 1000);</td>
<td></td>
</tr>
</tbody>
</table>

For more information, see [OCXcip_ReadConnected on page 63](#).
### OCXcip_WriteConnectedImmediate

**Syntax**

```c
int OCXcip_WriteConnectedImmediate( 
    OCXHANDLE apiHandle, 
    OCXHANDLE connHandle, 
    BYTE *dataBuf, 
    WORD offset, 
    WORD dataSize );
```

**Parameters**

- `apiHandle`: Handle returned by previous call to OCXcip_Open
- `connHandle`: Handle of open connection
- `dataBuf`: Pointer to data to be written
- `offset`: Offset of byte to begin writing
- `dataSize`: Number of bytes of data to write

**Description**

This function is used by an application to update data being sent on the open connection specified by `connHandle`. This function differs from the OCXcip_WriteConnected function in that it bypasses the normal image-integrity mechanism and transmits the updated data immediately. This is faster and more efficient than OCXcip_WriteConnected, but it does not guarantee image integrity. `apiHandle` must be a valid handle returned from OCXcip_Open. `connHandle` must be a handle passed by the `connect_proc` callback function.

`offset` is the offset into the connected data buffer to begin writing. `dataBuf` is a pointer to a buffer containing the data to be written. `dataSize` is the number of bytes of data to be written.

This function must not be used in conjunction with OCXcip_WriteConnected. It is recommended that this function only be used to update the entire output image (i.e., no partial updates).

The OCXcip_WriteConnected function is the preferred method of updating output data. However, for applications that need a potentially faster method and do not need image integrity, this function can be a viable option.

**Return Value**

- `OCX_SUCCESS`: Data was updated successfully
- `OCX_ERR_NOACCESS`: `apiHandle` does not have access
- `OCX_ERR_BADPARAM`: `connHandle` or `offset/dataSize` is invalid

**Example**

```c
OCXHANDLE apiHandle;
OCXHANDLE connHandle;
BYTE buffer [128]:
// Write 128 bytes to the connected data buffer
OCXcip_WriteConnectedImmediate(apiHandle, connHandle, buffer, 0, 128 );
```

For more information, see [OCXcip_Write Connected](#) on page 62.
# Tag Access Functions

The API functions in this section can be used to access tag data within ControlLogix™ controllers. The prototypes for most of these functions and their associated data structure definitions can be found in the header file OCXTagDb.h.

The tag access functions that include ‘Db’ in the name are for use with a valid tag database. For more information, see OCXcip_BuidTagDb on page 71.

## OCXcip_AccessTagData

### Syntax

```c
int OCXcip_AccessTagData(
    OCXHANDLE handle,
    char * pPathStr,
    WORD rspTimeout,
    OCXCIPTAGACCESS * pTagAccArr,
    WORD numTagAcc
);
```

### Parameters

- **handle**: Handle returned by previous call to OCXcip_Open.
- **pPathStr**: Pointer to NULL terminated device path string (see Appendix A).
- **rspTimeout**: CIP response timeout in milliseconds.
- **pTagAccArr**: Pointer to array of pointers to tag access definitions.
- **numTagAcc**: Number of tag access definitions to process.

### Description

This function efficiently reads and/or writes a number of tags. As many operations as fit are combined in a single CIP packet. Multiple packets can be required to process all of the access requests.

- **pTagAccArr**: A pointer to an array of pointers to OCXCIPTAGACCESS structures. numTagAcc is the number of pointers in the array.
- **OCXCIPTAGACCESS** structure is described in the rest of this section.

### typedef struct tagOCXCIPTAGACCESS

```c
{
    char * tagName;  // tag name (symName[x,y,z].mbr.mbr[x].etc)
    WORD daType;     // Data type code
    WORD eleSize;    // Size of one data element
    WORD opType;     // Read/Write operation type
    WORD numEle;     // Number of elements to read or write
    void * data;     // Read/Write data pointer
    void * wrMask;   // Pointer to write bit mask data, NULL if none
    int result;      // Read/write operation result
} OCXCIPTAGACCESS;
```

- **tagName**: Pointer to tag name string (symName[x,y,z].mbr.mbr[x].etc). All array indices must be specified except the last set of brackets – if the last set is omitted, the indices are assumed to be zero.
- **daType**: Data type code (OCX_CIP_DINT, etc).
- **eleSize**: Size of a single data element (DINT = 4, BOOL = 1, etc).
- **opType**: OCX_CIP_TAG_READ_OP or OCX_CIP_TAG_WRITE_OP.
- **numEle**: Number of elements to read or write - must be 1 if not array.
- **data**: Pointer to read/write data buffer. Strings are expected to be in OCX_CIP_STRING82_TYPE format. The size of the data is assumed to be numEle * eleSize.
- **wrMask**: Write data mask. Set to NULL to execute a non-masked write. If a masked write is specified, numEle must be 1 and the total amount of write data must be 8 bytes or less. Only signed and unsigned integer types can be written with a masked write. Only data bits with corresponding set wrMask bits are written. If a wrMask is supplied, it is assumed to be the same size as the write data (eleSize * numEle).
- **result**: Read/write operation result (output). Set to OCX_SUCCESS if operation successful, else if failure. This value is not set if the function return value is other than OCX_SUCCESS or opType is OCX_CIP_TAG_NO_OP.

Full structure reads and writes are not permitted (with the exception of OCX_CIP_STRING82).
### Return Value

<table>
<thead>
<tr>
<th>OCX_SUCCESS</th>
<th>All of the access requests were processed (except those whose opTypes were set to OCX_CIP_TAG_NO_OP). Check the individual access result parameters for success/fail.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Else</td>
<td>An access error occurred. Individual access result parameters not set.</td>
</tr>
</tbody>
</table>

### Example

```c
OCXHANDLE apiHandle;
OCXCIPTAGACCESS ta1;
OCXCIPTAGACCESS ta2;
OCXCIPTAGACCESS * pTa[2];
INT32 wrVal;
INT16 rdVal;

int rc;
ta1.tagName = "dintArr[2]";
ta1.daType = OCX_CIP_DINT;
ta1.eleSize = 4;
ta1.opType = OCX_CIP_TAG_WRITE_OP;
ta1.numEle = 1;
ta1.data = (void *) &wrVal;
ta1.wrMask = NULL;
ta1.result = OCX_SUCCESS;
wrVal = 123456;
ta2.tagName = "intVal"
ta2.daType = OCX_CIP_INT;
ta2.eleSize = 2;
ta2.opType = OCX_CIP_TAG_READ_OP;
ta2.numEle = 1;
ta2.data = (void *) &rdVal;
ta2.wrMask = NULL;
ta2.result = OCX_SUCCESS;
pTa[0] = &ta1;
pTa[1] = &ta2;
rc = OCXcip_AccessTagData(Handle, "p:1,s:0", 2500, pTa, 2);
if ( OCX_SUCCESS != rc)
{
    printf("OCXcip_AccessTagData() error = %d\n", rc);
}
else
{
    if ( ta1.result != OCX_SUCCESS )
        printf("%s write error = %d\n", ta1.tagName, ta1.result);
    else
        printf("%s write successful\n", ta1.tagName);
    if ( ta2.result != OCX_SUCCESS )
        printf("%s read error = %d\n", ta2.tagName, ta2.result);
    else
        printf("%s = %d\n", ta2.tagName, rdVal);
}
```

For more information, see  [OCXcip_Open on page 56](#).
**OCXcip_AccessTagDataAbortable**

**Syntax**

```c
int OCXcip_AccessTagDataAbortable(
    OCXHANDLE handle,
    char * pPathStr,
    WORD rspTimeout,
    OCXCIPTAGACCESS * pTagAccArr,
    WORD numTagAcc,
    WORD * pAbortCode)
```

**Parameters**

- `pAbortCode`: Pointer to abort code. This lets the application pass a large number of tags and gracefully abort between accesses. Can be NULL. `*pAbort` can be OCX_ABORT_TAG_ACCESS_MINOR to abort between tag accesses or OCX_ABORT_TAG_ACCESS_MAJOR to abort between CIP packets.

**Description**

This function is similar to `OCXcip_AccessTagData()`, but provides an abort flag. See `OCXcip_AccessTagData()` for additional operational and parameter description.

For more information, see [OCXcip_AccessTagData on page 66](#).

**OCXcip_CreateTagDbHandle**

**Syntax**

```c
int OCXcip_CreateTagDbHandle(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    WORD devRspTimeout,
    OCXTAGDBHANDLE * pTagDbHandle);
```

**Parameters**

- `apiHandle`: Handle returned by previous call to `OCXcip_Open`.
- `pPathStr`: Pointer to device path string.
- `devRspTimeout`: Device unconnected message response timeout in milliseconds.
- `pTagDbHandle`: Pointer to `OCXTAGDBHANDLE` instance.

**Description**

`OCXcip_CreateTagDbHandle` creates a tag database and returns a handle to the new database if successful.

**IMPORTANT:** Once the handle has been created, `OCXcip_DeleteTagDbHandle` must be called when the tag database is no longer necessary. `OCXcip_Close()` deletes any tag database resources the application left open.

**Return Value**

- `OCX_SUCCESS`: Tag database handle successfully created
- `OCX_ERR_NOACCESS`: Invalid apiHandle
- `OCX_ERR_MEMALLOC`: Out of memory
- `OCX_ERR_*`: Other failure
For more information, see the following:

- [OCXcip_Open on page 56](#)
- [OCXcip_DeleteTagDbHandle on page 69](#)

# OCXcip_DeleteTagDbHandle

## Syntax

```c
int OCXcip_DeleteTagDbHandle(
    OCXHANDLE apiHandle,
    OCXTAGDBHANDLE tdbHandle);
```

## Parameters

- `apiHandle`: Handle returned by previous call to `OCXcip_Open`.
- `tdbHandle`: Handle created by previous call to `OCXcip_CreateTagDbHandle`.

## Description

This function is used by an application to delete a tag database handle. `tdbHandle` must be a valid handle previously created with `OCXcip_CreateTagDbHandle`.

**IMPORTANT:** Once the tag database handle has been created, this function must be called when the database is no longer needed.

## Return Value

- `OCX_SUCCESS`: Tag database handle successfully created
- `OCX_ERR_NOACCESS`: `apiHandle` or `tdbHandle` invalid
- `OCX_ERR_*`: Other failure

## Example

```c
OCXHANDLE hApi;
OCXTAGDBHANDLE hTagDb;
OCXcip_DeleteTagDbHandle(hApi, hTagDb);
```

For more information, see [OCXcip_CreateTagDbHandle on page 68](#).
Ocxip_SetTagDbOptions

Syntax

```c
int Ocxip_SetTagDbOptions(
    OCXHANDLE apiHandle,
    OCXTAGDBHANDLE tdbHandle,
    DWORD optFlags,
    WORD structAlign)
```

Parameters

- **apiHandle**: Handle returned by previous call to Ocxip_Open.
- **tdbHandle**: Handle created by previous call to Ocxip_CreateTagDbHandle.
- **optFlags**: Bit masked option flags field. Multiple options can be combined (with |).
  - **OCX_CIP_TAGDBOPT_NORM_STRINGS**: Normalized strings are stored as `<DATA><NULL>` (instead of `<LEN><DATA>). Ocxip_GetSymbolInfo() and Ocxip_GetStructMbrInfo() report strings as having a datatype of `OCX_CIP_TAGDB_DATATYPE_NORM_STRING`. The reported eleSize is the size of the string data buffer including space for the NULL term (`OCX_CIP_STRING82s have an eleSize of 83`). The reported hStruct is zero (not a struct). When accessing normalized strings (with Ocxip_AccessTagDataDb()), pass a dataType of `OCX_CIP_TAGDB_DATATYPE_NORM_STRING`.
  - **OCX_CIP_TAGDBOPT_NORM_BOOLS**: With this option, `OCX_CIP_BOOL` variables are treated as bytes. `OCX_CIP_BYTE`, `OCX_CIP_WORD`, `OCX_CIP_DWORD`, and `OCX_CIP_LWORD` types are converted to arrays of `OCX_CIP_BOOL`. A normalized `OCX_CIP_DWORD` is normalized to an array of 32 `OCX_CIP_BOOL` (that occupies 32 bytes) for example. When accessing arrays of BOOLs (with Ocxip_AccessTagDataDb()), any number of array elements can be specified -- masked and unmasked controller reads/writes are executed as required to complete the tag access. Some `OCX_CIP_BOOLs cannot be normalized. The FUNCTION_GENERATOR structure has `OCX_CIP_BOOLs that are aliased into an `OCX_CIP_DINT`. Because the DINT base member is not expanded into a BOOL array, the BOOL alias structure members cannot be normalized. A special (and rarely used) data type has been created to identify alias structure member `OCX_CIP_BOOLs that cannot be normalized: `OCX_CIP_TAGDB_DATATYPE_NORM_BITMASK`.
  - **OCX_CIP_TAGDBOPT_STRUCT_MBR_ORDER_NATIVE**: This option causes Ocxip_GetStructMbrInfo() to retrieve structure members in native order (lowest offset to highest) instead of alphabetical order. This is not a normalization option.
- **structAlign**: Ignored if no normalization options are used. If normalization is enabled, this can be 1, 2, 4, or 8 (4 = recommended). Structure members are aligned according to the minimum alignment requirement. That is, if structAlign is 4, `OCX_CIP_DINTs are aligned on 4 byte boundaries, but `OCX_CIP_INTs are aligned on 2 byte boundaries.

Return Values

- **OCX_SUCCESS**: Options set successfully
- **OCX_ERR_NOACCESS**: apiHandle or tdbHandle invalid
- **OCX_ERR_* code**: Other failure

Description

This function can be used to change options on the fly, but is intended to be called once immediately after `Ocxip_CreateTagDbHandle()`. All options are off by default.

Example

```c
OCXHANDLE hApi;
OCXTAGDBHANDLE hTagDb;
DWORD opts = OCX_CIP_TAGDBOPT_NORM_STRINGS | OCX_CIP_TAGDBOPT_NORM_BOOLS;
int rc;
rc = Ocxip_SetTagDbOptions(hApi, hTagDb, opts, 4);
if ( rc != OCX_SUCCESS )
{
    printf("Ocxip_SetTagDbOptions() error %d\n", rc);
}
else
{
    printf("Ocxip_SetTagDbOptions() success\n");
}
```

For more information, see the following:

- [Ocxip_GetSymbolInfo](#)
- [Ocxip_GetStructInfo](#)
- [Ocxip_GetStructMbrInfo](#)
- [Ocxip_AccessTagDataDb](#)
**OCXcip_BuildTagDb**

**Syntax**

```c
int OCXcip_BuildTagDb(
    OCXHANDLE apiHandle,
    OCXTAGDBHANDLE tdbHandle,
    WORD * numSymbols);
```

**Parameters**

- `apiHandle` Handle returned by previous call to OCXcip_Open.
- `tdbHandle` Handle created by previous call to OCXcip_CreateTagDbHandle.
- `numSymbols` Pointer to WORD value - set to the number of discovered symbols if success.

**Description**

This function is used to retrieve a tag database from the target device. If the database associated with `tdbHandle` was previously built, the existing database is deleted before the new one is built. This function communicates with the target device and may take a few milliseconds to a few tens of seconds to complete. `tdbHandle` must be a valid handle previously created with OCXcip_CreateTagDbHandle. If successful, `*numSymbols` is set to the number of symbols in the tag database.

**Return Value**

- **OCX_SUCCESS** Tag database build successful
- **OCX_ERR_NOACCESS** `apiHandle` or `tdbHandle` invalid
- **OCX_ERR_VERMISMATCH** The device program version changed during the build
- **OCX_CIP_INVALID_REQUEST** Target device response not valid or remote device not accessible
- **OCX_ERR_* code** Other failure

**Example**

```c
OCXHANDLE hApi;
OCXTAGDBHANDLE hTagDb;
WORD numSyms;
if ( OCXcip_BuildTagDb(hApi, hTagDb, &numSyms) != OCX_SUCCESS )
    printf("Error building tag database\n");
else
    printf("Tag database build success, numSyms=%d\n", numSyms);
```

For more information, see the following:

- **OCXcip_CreateTagDbHandle on page 68.**
- **OCXcip_DeleteTagDbHandle on page 69.**
- **OCXcip_TagTagDbVer on page 72.**
- **OCXcip_GetSymbolInfo on page 73.**
**OCXcip_TestTagDbVer**

| Syntax | int OCXcip_TestTagDbVer( 
| Parameters | OCXHANDLE apiHandle, 
| Description | OCXTAGDBHANDLE tdbHandle); |
| apiHandle | Handle returned by previous call to OCXcip_Open. |
| tdbHandle | Handle created by previous call to OCXcip_CreateTagDbHandle. |
| Return Value | This function reads the program version from the target device and compares it to the device program version read when the tag database was built. |
| OCX_SUCCESS | Tag database exists and program versions match |
| OCX_ERR_NOACCESS | apiHandle or tdbHandle invalid |
| OCX_ERR_OBJEMPTY | Tag database empty, call OCXcip_BuildTagDb to build |
| OCX_ERR_VERMISMATCH | Database version mismatch, call OCXcip_BuildTagDb to refresh |
| OCX_ERR_* code | Other failure |

**Example**

```c
OCXHANDLE hApi;
OCXTAGDBHANDLE hTagDb;
int rc;
rc = OCXcip_TestTagDbVer(hApi, hTagDb);
if ( rc != OCX_SUCCESS )
{
    if ( rc == OCX_ERR_OBJEMPTY || rc == OCX_ERR_VERMISMATCH )
    {
        rc = OCXcip_BuildTagDb(hApi, hTagDb);
    }
    if ( rc != OCX_SUCCESS )
    {
        printf("Tag database not valid\n");
    }
}
```

For more information, see [OCXcip_BuildTagDb on page 71.](#)
**OCXcip_GetSymbolInfo**

**Syntax**

```c
int OCXcip_GetSymbolInfo(
    OCXHANDLE apiHandle,
    OCXTAGDBHANDLE tdbHandle,
    WORD symId,
    OCXCIPTAGDBSYM * pSymInfo);
```

**Parameters**

- **apiHandle** Handle returned by previous call to OCXcip_Open.
- **tdbHandle** Handle created by previous call to OCXcip_CreateTagDbHandle.
- **symId** 0 through numSymbols-1.
- **pSymInfo** Pointer to symbol info variable – all members set if success:
  - name = NULL terminated symbol name
  - dataType = OCX_CIP_BOOL, OCX_CIP_INT, OCX_CIP_STRING82, etc.
  - hStruct = 0 if symbol is a base type, else if symbol is a structure
  - eleSize = size of single data element, is zero if the symbol is a structure and the structure is not accessible as a whole
  - xDim = 0 if no array dimension, else if symbol is array
  - yDim = 0 if no array dimension, else for Y dimension
  - zDim = 0 if no array dimension, else for Z dimension
  - fAttr = Bit masked attributes, where:
    - OCXCIPTAGDBSYM_ATTR_ALIAS – Symbol is an alias for another tag.

**Description**

This function gets symbol information from the tag database. A tag database must have been previously built with OCXcip_BindTagDb. This function does not access the device or verify the device program version.

**Return Value**

- **OCX_SUCCESS** Symbol information successfully retrieved
- **OCX_ERR_NOACCESS** apiHandle or tdbHandle invalid
- **OCX_ERR_BADPARAM** symId invalid
- **OCX_ERR_* code** Other failure

**Example**

```c
OCXHANDLE hApi;
OCXTAGDBHANDLE hTagDb;
OCXCIPTAGDBSYM symInfo;
WORD numSyms;
WORD symId;
int rc;
if ( OCXcip_BuildTagDb(hApi, hTagDb, &numSyms) == OCX_SUCCESS )
{
    for ( symId = 0; symId < numSyms; symId++ )
    {
        rc = OCXcip_GetSymbolInfo(hApi, hTagDb, symId, &symInfo);
        if ( rc == OCX_SUCCESS )
        {
            printf("Symbol name = [%s]\n", symInfo.name);
            printf(" type = %04X\n", symInfo.dataType);
            printf(" hStruct = %d\n", symInfo.hStruct);
            printf(" eleSize = %d\n", symInfo.eleSize);
            printf(" xDim = %d\n", symInfo.xDim);
            printf(" yDim = %d\n", symInfo.yDim);
            printf(" zDim = %d\n", symInfo.zDim);
        }
    }
}
```

For more information, see the following:

- **OCXcip_BindTagDb** on page 71.
- **OCXcip_TestTagDbVer** on page 72.
- **OCXcip_GetStructInfo** on page 74.
- **OCXcip_GetStructMbrInfo** on page 75.
OCXcip_GetStructInfo

Syntax

```c
int OCXcip_GetStructInfo(
    OCXHANDLE apiHandle,
    OCXTAGDBHANDLE tdbHandle,
    WORD hStruct,
    OCXCIPTAGDBSTRUCT * pStructInfo);
```

Parameters

- `apiHandle` Handle returned by previous call to OCXcip_Open.
- `tdbHandle` Handle created by previous call to OCXcip_CreateTagDbHandle.
- `hStruct` Nonzero structure handle from previous OCXcip_GetSymbolInfo or OCXcip_GetStructMbrInfo call.
- `pStructInfo` Pointer to structure info variable – all members set if success:
  - `name` = NULL terminated name string
  - `dataType` = Structure data type
  - `daSize` = Size of structure data in bytes, zero indicates the structure is not accessible as a whole
  - `ioType` = OCX_CIP_STRUCT_IOTYPE_NA: Structure is not accessible as a whole.
    - `OCX_CIP_STRUCT_IOTYPE_INPUT`: Structure is an input type and is read only when accessed as a whole.
    - `OCX_CIP_STRUCT_IOTYPE_OUTPUT`: Structure is an output type and is read only when accessed as a whole.
    - `OCX_CIP_STRUCT_IOTYPE_MEMORY`: Structure is memory type and is read only when accessed as a whole.
    - `OCX_CIP_STRUCT_IOTYPE_STRING`: Structure is a memory string and is read/write compatible.
  - `numMbr` = number of structure members

Description

This function gets structure information from the tag database. A tag database must have been previously built with OCXcip_BuildTagDb. This function does not access the device or verify the device program version.

Return Value

- `OCX_SUCCESS` Structure info successfully retrieved
- `OCX_ERR_NOACCESS` apiHandle or tdbHandle invalid
- `OCX_ERR_BADPARAM` hStruct invalid
- `OCX_ERR_*` code Other failure

Example

```c
OCXHANDLE hApi;  
OCXTAGDBHANDLE hTagDb;  
OCXIPTAGDBSYM symInfo;  
OCXIPTAGDBSTRUCT structInfo;  
WORD symId;  
int rc;  
rc = OCXcip_GetSymbolInfo(hApi, hTagDb, symId, &symInfo);  
if ( rc == OCX_SUCCESS && symInfo.hStruct != 0 )  
{  
    rc = OCXcip_GetStructInfo(hApi, hTagDb, symInfo.hStruct, &structInfo);  
    if ( rc == OCX_SUCCESS )  
    {  
        printf("Structure name = [\%s]\n", structInfo.name);  
        printf(" type = %04X\n", structInfo.dataType);  
        printf(" size = %d\n", structInfo.size);  
        printf(" numMbr = %d\n", structInfo.numMbr);  
    }  
}  
```

For more information, see the following:

- OCXcip_BuildTagDb on page 71.
- OCXcip_TextTagDbVer on page 72.
- OCXcip_GetSymbolInfo on page 73.
- OCXcip_GetStructMbrInfo on page 75.
OCXcip_GetStructMbrInfo

Syntax

```
int OCXcip_GetStructMbrInfo(
    OCXHANDLE apiHandle,
    OCXTAGDBHANDLE tdbHandle,
    WORD hStruct,
    WORD mbrId,
    OCXCIPTAGDBSTRUCTMBR * pStructMbrInfo);
```

Parameters

- **apiHandle**
  Handle returned by previous call to OCXcip_Open.

- **tdbHandle**
  Handle created by previous call to OCXcip_CreateTagDbHandle.

- **hStruct**
  Nonzero structure handle from previous OCXcip_GetSymbolInfo or OCXcip_GetStructMbrInfo call.

- **mbrId**
  Member identifier (0 thru numMbr-1).

- **pStructMbrInfo**
  Pointer to structure member info variable — all members set if success:
  - name = NULL terminated name string
  - daType = Structure member data type
  - hStruct = Zero if member is a base type, nonzero for structure
  - daOfs = Byte offset of member data in structure data block
  - bitId = Bit ID (0-7) if daType is OCX_CIP_BOOL and BOOL normalization is off, or daType is
    OCX_CIP_TAGDB_DATYPE_NORM_BITMASK
  - arrDim = Member array dimensions if array, 0 = not array
  - dispFmt = Recommended display format
  - fAttr = Bit masked attribute flags
    - OCXCIPTAGDBSTRUCTMBR_ATTR_ALIAS – Indicates member is an alias for (or within) another member.
    - baseMbrId = Alias base member ID (0-numMbr, if alias flag is set).

Description

This function gets structure member information from the tag database. A tag database must have been previously built with OCXcip_BuildTagDb. This function does not access the device or verify the device program version.

Return Value

- **OCX_SUCCESS**
  Structure member info successfully retrieved

- **OCX_ERR_NOACCESS**
  apiHandle or tdbHandle invalid

- **OCX_ERR_BADPARAM**
  hStruct or mbrId invalid

- **OCX_ERR_* code**
  Other failure

Example

```
OCXHANDLE  hApi;
OCXTAGDBHANDLE  hTagDb;
OCXCIPTAGDBSTRUCT  structInfo;
OCXCIPTAGDBSTRUCTMBR  structMbrInfo;
WORD  hStruct;
WORD  mbrId;
int rc;
rc = OCXcip_GetStructInfo(hApi, hTagDb, hStruct, &structInfo);
if ( rc == OCX_SUCCESS )
{
    for ( mbrId = 0; mbrId < structInfo.numMbr; mbrId++ )
    {
        rc = OCXcip_GetStructMbrInfo(hApi, hTagDb, hStruct, mbrId, &structMbrInfo);
        if ( rc == OCX_SUCCESS )
            printf("Successfully retrieved member info\n");
        else
            printf("Error %d getting member info\n", rc);
    }
}
```

For more information, see the following:

- OCXcip_BuildTagDb on page 71
- OCXcip_TestTagDbVer on page 72
- OCXcip_GetSymbolInfo on page 73
- OCXcip_GetStructInfo on page 74
### OCXcip_GetTagDbTagInfo

**Syntax**

```c
int OCXcip_GetTagDbTagInfo(
    OCXHANDLE apiHandle,  
    OCXTAGDBHANDLE tdbHandle,  
    char * tagName,  
    OCXCIPTAGINFO * tagInfo
);
```

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>apiHandle</td>
<td>Handle returned by previous call to OCXcip_Open.</td>
</tr>
<tr>
<td>tdbHandle</td>
<td>Handle created by previous call to OCXcip_CreateTagDbHandle.</td>
</tr>
<tr>
<td>tagName</td>
<td>Pointer NULL terminated tag name string.</td>
</tr>
<tr>
<td>tagInfo</td>
<td>Pointer to OCXCIPTAGINFO structure. All members set if success.</td>
</tr>
</tbody>
</table>

- `dataType` = Data type code.
- `hStruct` = Zero if member is a base type, nonzero for structure.
- `eleSize` = Data element size in bytes.
- `xDim` = X dimension – zero if not an array.
- `yDim` = Y dimension – zero if no Y dimension.
- `zDim` = Z dimension – zero if no Z dimension.
- `xIdx` = X index – zero if not array.
- `yIdx` = Y index – zero if not array.
- `zIdx` = Z index – zero if not array.
- `dispFmt` = Recommended display format.

**Description**

This function gets information regarding a fully qualified tag name (i.e. `symName[x,y,z].mbr[x].etc`). If `symName` or `mbr` specifies an array, unspecified indices are assumed to be zero. A tag database must have been previously built with OCXcip_BuildTagDb(). This function does not communicate with the target device or verify the device program version.

**Return Value**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>Success</td>
</tr>
<tr>
<td>OCX_ERR_*</td>
<td>Failure</td>
</tr>
</tbody>
</table>

**Example**

```c
OCXHANDLE hApi;
OCXTAGDBHANDLE hTagDb;
OCXCIPTAGINFO tagInfo;
int rc;
rc = OCXcip_GetTagDbTagInfo(hApi, hTagDb, "sym[1,2,3].mbr[0]", &tagInfo);
if (rc != OCX_SUCCESS)
    {
        printf("OCXcip_GetTagDbTagInfo() error %d\n", rc);
    }
else
    {
        printf("OCXcip_GetTagDbTagInfo() success\n");
    }
```

For more information, see [OCXcip_BuildTagDb on page 71](#).
### OCXcip_AccessTagDataDb

**Syntax**

```c
int OCXcip_AccessTagDataDb(
    OCXHANDLE apiHandle,
    OCXTAGDBHANDLE tdbHandle,
    OCXCPTAGDBACCESS ** pTagAccArr,
    WORD numTagAcc,
    WORD * pAbortCode)
```

**Parameters**

- **apiHandle**
  Handle returned by previous call to OCXcip_Open.
- **tdbHandle**
  Handle created by previous call to OCXcip_CreateTagDbHandle.
- **pTagAccArr**
  Pointer to array of pointers to tag access definitions.
  
  | tagName    | Pointer to tag name string (symName[x,y,z].mbr[x], etc). All array indices must be specified except the last set of brackets -- if the last set is omitted, the indices are assumed to be zero.
  |            | Data type code (OCX_CIP_DINT, etc).
  |            | Size of a single data element (DINT = 4, BOOL = 1, etc).
  | opType     | OCX_CIP_TAG_READ_OP or OCX_CIP_TAG_WRITE_OP.
  | numEle     | Number of elements to read or write - must be 1 if not array.
  | data       | Pointer to read/write data buffer. The size of the data is assumed to be numEle * eleSize.
  | wrMask      | Write data mask. Set to NULL to execute a non-masked write. If a masked write is specified, numEle must be 1 and the total amount of write data must be 8 bytes or less. Only signed and unsigned integer types can be written with a masked write. Only data bits with corresponding set wrMask bits are written. If a wrMask is supplied, it is assumed to be the same size as the write data (eleSize * numEle).
  | result      | Read/write operation result (output). Set to OCX_SUCCESS if operation successful, else if failure. This value is not set if the function return value is other than OCX_SUCCESS or opType is OCX_CIP_TAG_NO_OP.
- **numTagAcc**
  Number of tag access definitions to process.
- **pAbortCode**
  Pointer to abort code. This lets the application to pass a large number of tags and gracefully abort between accesses. Can be NULL. *pAbort can be OCX_ABORT_TAG_ACCESS_MINOR to abort between tag accesses or OCX_ABORT_TAG_ACCESS_MAJOR to abort between CIP packets.

**Description**

This function is similar to OCXcip_AccessTagData() but lets full structure reads and writes. See OCXcip_AccessTagData() (in the OCX API document) for additional operational and parameter description. See OCXcip_GetStructInfo() for more information on the structures are accessible as a whole.

For more information, see the following:

- [OCXcip_AccessTagData on page 66](#).
- [OCXcip_GetSymbolInfo on page 73](#).
- [OCXcip_GetStructInfo on page 74](#).
- [OCXcip_GetStructMbrInfo on page 75](#).
# OCXcip_SetTagAccessConnSize

## Syntax

```c
int OCXcip_SetTagAccessConnSize (OCXHANDLE apiHandle, int connSize)
```

## Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>apiHandle</td>
<td>Handle returned by previous call to OCXcip_Open.</td>
</tr>
<tr>
<td>connSize</td>
<td>Must be one of OCX_TAGACC_CONNSIZE_SM, OCX_TAGACC_CONNSIZE_MED, or OCX_TAGACC_CONNSIZE_LG.</td>
</tr>
</tbody>
</table>

## Description

This function allows the connection size used for tag access to be configured. A smaller connection size results in less loading on the controller and can eliminate any redundant chassis synchronization errors. By default, the API uses the largest connection size for highest performance. In order to select a smaller connection size, the application must call the OCXcip_SetTagAccessConnSize function once before accessing any controller tags.

There are three connection size options available:
- Small (OCX_TAGACC_CONNSIZE_SM)
- Medium (OCX_TAGACC_CONNSIZE_MED)
- Large (OCX_TAGACC_CONNSIZE_LG).

A larger connection size usually results in faster tag transfers, but can increase controller loading. Trial and error can be required to determine the optimal size for a given application and system configuration.

When writing tags to a controller in a redundant system, we recommended that the small connection size is used.

## Example

```c
rc = OCXcip_Open(&apiHandle);
if (rc != OCX_SUCCESS)
{
    fprintf(stderr, "ERROR: OCXcip_Open failed: %d\n", rc);
    return(rc);
}
rc = OCXcip_SetTagAccessConnSize(apiHandle, OCX_TAGACC_CONNSIZE_SM);
if (rc != OCX_SUCCESS)
{
    fprintf(stderr, "ERROR: OCXcip_SetTagAccessConnSize failed: %d\n", rc);
    return(rc);
}
```

For more information, see the following:

- [OCXcip_AccessTagData on page 66](#)
- [OCXcip_AccessTagDataDb on page 77](#)
# Messaging Functions

This section describes the Messaging functions.

## OCXcip_GetDeviceIdObject

### Syntax

```c
int OCXcip_GetDeviceIdObject(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    OCXCIPIDOBJ *idobject,
    WORD timeout
);
```

### Parameters

- **apiHandle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being read
- **idobject**: Pointer to structure receiving the Identity Object data
- **timeout**: Number of milliseconds to wait for the read to complete

### Description

OCXcip_GetDeviceIdObject retrieves the identity object from the device at the address specified in `pPathStr`. `apiHandle` must be a valid handle returned from OCXcip_Open.

`idobject` is a pointer to a structure of type `OCXCIPIDOBJ`. The members of this structure are updated with the module identity data.

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

The `OCXCIPIDOBJ` structure is defined below:

```c
typedef struct tagOCXCIPIDOBJ
{
    WORD VendorID; // Vendor ID number
    WORD DeviceType; // General product type
    WORD ProductCode; // Vendor-specific product identifier
    BYTE MajorRevision; // Major revision level
    BYTE MinorRevision; // Minor revision level
    DWORD SerialNo; // Module serial number
    BYTE Name[32]; // Text module name (null-terminated)
    BYTE Slot; // Not used
} OCXCIPIDOBJ;
```

### Return Value

- **OCX_SUCCESS**: Id object was retrieved successfully
- **OCX_ERR_NOACCESS**: `apiHandle` does not have access
- **OCX_ERR_MEMALLOC**: If not enough memory is available
- **OCX_ERR_BADPARAM**: If path was bad

### Example

```c
OCXHANDLE apiHandle;
OCXCIPIDOBJ idobject;
BYTE Path[]="p:1,s:0";
// Read Id Data from controller in slot 0
OCXcip_GetDeviceIdObject(apiHandle, &Path, &idobject, 5000);
printf("\r\n\rDevice Name: ");
printf((char *)idobject.Name);
printf("\r\rVendorID: %2X DeviceType: %d", idobject.VendorID, idobject.DeviceType);
printf("\r\ProdCode: %d SerialNum: %ld", idobject.ProductCode, idobject.SerialNo);
```
Chapter 5  Backplane API Library Functions

### OCXcip_GetDeviceICPObject

#### Syntax

```c
int OCXcip_GetDeviceICPObject(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    OCXCIPICPOBJ *icpobject
    WORD timeout );
```

#### Parameters

- **api Handle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being read
- **icpobject**: Pointer to structure receiving the ICP data
- **timeout**: Number of milliseconds to wait for the read to complete

#### Description

OCXcip_GetDeviceICPObject retrieves the ICP object from the module at the address specified in `pPathStr`. `apiHandle` must be a valid handle returned from OCXcip_Open. `icpobject` is a pointer to a structure of type OCXCIPICPOBJ. The members of this structure are updated with the ICP object data from the addressed module. The ICP object contains a variety of status and diagnostic information about the module's communications over the backplane and the chassis in which it resides.

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

The OCXCIPICPOBJ structure is defined below:

```c
typedef struct tagOCXCIPICPOBJ
{
    BYTE RxBadMulticastCrcCounter; // Number of multicast Rx CRC errors
    BYTE MulticastCrcErrorThreshold; // Threshold for entering fault state due to multicast CRC errors
    BYTE RxBadCrcCounter; // Number of CRC errors that occurred on Rx
    BYTE RxBusTimeoutCounter; // Number of Rx bus timeouts
    BYTE TxBadCrcCounter; // Number of CRC errors that occurred on Tx
    BYTE TxBusTimeoutCounter; // Number of Tx bus timeouts
    BYTE TxRetryLimit; // Number of times a Tx is retried if an error occurs
    BYTE Status; // ControlBus status
    WORD ModuleAddress; // Module's slot number
    BYTE RackMajorRev; // Chassis major revision
    BYTE RackMinorRev; // Chassis minor revision
    DWORD RackSerialNumber; // Chassis serial number
    WORD RackSize; // Chassis size (number of slots)
} OCXCIPICPOBJ;
```

#### Return Value

- **OCX_SUCCESS**: ICP object was retrieved successfully
- **OCX_ERR_NOACCESS**: `apiHandle` does not have access
- **OCX_ERR_MEMALLOC**: If not enough memory is available
- **OCX_ERR_BADPARAM**: If path was bad

#### Example

```c
OCXHANDLE apiHandle;
OCXCIPIDOBJ icpobject;
BYTE Path[]="p:1,s:0";
// Read ICP Data from controller in slot 0
OCXcip_GetDeviceICPObject(apiHandle, &Path, &icpobject, 5000);
printf("\n\rRack Size: %d SerialNum: %ld", icpobject.RackSize, icpobject.RackSerialNumber);
printf("\n\rRack Revision: %d.%d", icpobject.RackMajorRev, icpobject.RackMinorRev);
```
OCXcip_GetDeviceIdStatus

Syntax

```c
int OCXcip_GetDeviceIdStatus(
   OCXHANDLE apiHandle,
   BYTE *pPathStr,
   WORD *status,
   WORD timeout);
```

Parameters

- **apiHandle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being read
- **status**: Pointer to location receiving the Identity Object status word
- **timeout**: Number of milliseconds to wait for the read to complete

Description

OCXcip_GetDeviceIdStatus retrieves the identity object status word from the device at the address specified in pPathStr. `apiHandle` must be a valid handle returned from OCXcip_Open. `status` is a pointer to a WORD that receives the identity status word data. The following bit masks and bit defines can be used to decode the status word:

- `OCX_ID_STATUS_DEVICE_STATUS_MASK`
- `OCX_ID_STATUS_FLASHUPDATE` - Flash update in progress
- `OCX_ID_STATUS_FLASHBAD` - Flash is bad
- `OCX_ID_STATUS_FAULTED` - Faulted
- `OCX_ID_STATUS_RUN` - Run mode
- `OCX_ID_STATUS_PROGRAM` - Program mode
- `OCX_ID_STATUS_FAULT_STATUS_MASK`
- `OCX_ID_STATUS_RCV_MINOR_FAULT` - Recoverable minor fault
- `OCX_ID_STATUS_URCV_MINOR_FAULT` - Unrecoverable minor fault
- `OCX_ID_STATUS_RCV_MAJOR_FAULT` - Recoverable major fault
- `OCX_ID_STATUS_URCV_MAJOR_FAULT` - Unrecoverable major fault

The key and controller mode bits are S55x specific:

- `OCX_ID_STATUS_KEY_SWITCH_MASK` - Key switch position mask
- `OCX_ID_STATUS_KEY_RUN` - Keyswitch in run
- `OCX_ID_STATUS_KEY_PROGRAM` - Keyswitch in program
- `OCX_ID_STATUS_KEY_REMOTE` - Keyswitch in remote
- `OCX_ID_STATUS_CNTR_MODE_MASK` - Controller mode bit mask
- `OCX_ID_STATUS_MODE_CHANGING` - Controller is changing modes
- `OCX_ID_STATUS_DEBUG_MODE` - Debug mode if controller is in Run mode

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

Return Value

- **OCX_SUCCESS**: ID object was retrieved successfully
- **OCX_ERR_NOACCESS**: apiHandle does not have access
- **OCX_ERR_MEMALLOC**: If not enough memory is available
- **OCX_ERR_BADPARAM**: If path was bad
Example

```c
OCXHANDLE apiHandle;
WORD status;
BYTE Path[]="p:1,s:0";
// Read Id Status from controller in slot 0
OCXcip_GetDeviceIdStatus(apiHandle, &Path, &status, 5000);
printf("\n\r");
switch(Status & OCX_ID_STATUS_DEVICE_STATUS_MASK)
{
    case OCX_ID_STATUS_FLASHUPDATE: // Flash update in progress
        printf("Status: Flash Update in Progress\n");
        break;
    case OCX_ID_STATUS_FLASHBAD: // Flash is bad
        printf("Status: Flash is bad\n");
        break;
    case OCX_ID_STATUS_FAULTED: // Faulted
        printf("Status: Faulted\n");
        break;
    case OCX_ID_STATUS_RUN: // Run mode
        printf("Status: Run mode\n");
        break;
    case OCX_ID_STATUS_PROGRAM: // Program mode
        printf("Status: Program mode\n");
        break;
    default:
        printf("ERROR: Bad status mode\n");
        break;
}
printf("\n\r");
switch(Status & OCX_ID_STATUS_KEY_SWITCH_MASK)
{
    case OCX_ID_STATUS_KEY_RUN: // Key switch in run
        printf("Key switch position: Run\n");
        break;
    case OCX_ID_STATUS_KEY_PROGRAM: // Key switch in program
        printf("Key switch position: program\n");
        break;
    case OCX_ID_STATUS_KEY_REMOTE: // Key switch in remote
        printf("Key switch position: remote\n");
        break;
    default:
        printf("ERROR: Bad key position\n");
        break;
}
```
**OCXcip_GetExDevObject**

Syntax

```c
int OCXcip_GetExDevObject(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    OCXCIPEXDEVOBJ *exdevobject
    WORD timeout );
```

Parameters

- **api Handle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being read
- **exdevobject**: Pointer to structure receiving the extended device object data
- **timeout**: Number of milliseconds to wait for the read to complete

Description

OCXcip_GetExDevObject retrieves the Extended Device object from the module at the address specified in `pPathStr`. `apiHandle` must be a valid handle returned from OCXcip_Open.

`exdevobject` is a pointer to a structure of type OCXCIPEXDEVOBJ. The members of this structure are updated with the extended device object data from the addressed module.

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

The OCXCIPEXDEVOBJ structure is defined as follows:

```c
typedef struct tagOCXCIPEXDEVOBJ
{
    BYTE Name[64];
    BYTE Description[64];
    BYTE GeoLocation[64];
    WORD NumPorts;
    OCXCIPEXDEVPORTATTR PortList[8];
} OCXCIPEXDEVOBJ;
```

The OCXCIPEXDEVPORTATTR structure is defined as follows:

```c
typedef struct tagOCXCIPEXDEVPORTATTR
{
    WORD PortNum;
    WORD PortUse;
} OCXCIPEXDEVPORTATTR;
```

Return Value

- **OCX_SUCCESS**: ICP object was retrieved successfully
- **OCX_ERR_NOACCESS**: `apiHandle` does not have access
- **OCX_ERR_MEMALLOC**: If not enough memory is available
- **OCX_ERR_BADPARAM**: If path was bad
- **OCX_ERR_INVALID_REQUEST**: The device does not support the requested object

Example

```c
OCXHANDLE apiHandle;
OCXCIPEXDEVOBJ exdevobject;
BYTE Path[]="p:1,s:0";
// Read Extended Device object from controller in slot 0
OCXcip_GetExDevObject(apiHandle, &Path, &exdevobject, 5000);
printf("\nDevice Name: %s", exdevobject.Name);
printf("\nDescription: %s", exdevobject.Description);
```

```c
```
Chapter 5 Backplane API Library Functions

OCXcip_GetWCTime

Syntax

```c
int OCXcip_GetWCTime(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    OCXCIPWCT *pWCT,
    WORD timeout);
```

Parameters

- **apiHandle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being accessed
- **pWCT**: Pointer to OCXCIPWCT structure to be filled with Wall Clock Time data
- **timeout**: Number of milliseconds to wait for the device to respond

Description

OCXcip_GetWCTime retrieves information from the Wall Clock Time object in the specified device. The information is returned both in ‘raw’ format, and conventional time/date format.

- **apiHandle** must be a valid handle returned from OCXcip_Open.
- **pPathStr** must be a pointer to a string containing the path to a device that supports the Wall Clock Time object, such as a ControlLogix controller. For information on specifying paths, see Appendix B, Specify the Communication Path on page 121.
- **timeout** is used to specify the amount of time in milliseconds the application must wait for a response from the device.
- **pWCT** can point to a structure of type OCXCIPWCT, that on success is filled with the data read from the device. As a special case, **pWCT** can also be NULL.

If **pWCT** is NULL, then the system time is set with the local time returned from the WCT object. This is a convenient way to synchronize the system time with the controller time. (Note: The user account must have appropriate privileges to set the system time.)

The OCXCIPWCT structure is defined below:

```c
typedef struct tagOCXCIPWCT
{
    ULARGE_INTEGER CurrentValue;
    WORD TimeZone;
    ULARGE_INTEGER CSTOffset;
    WORD LocalTimeAdj;
    SYSTEMTIME SystemTime;
} OCXCIPWCT;
```

**CurrentValue** is the 64-bit Wall Clock Time counter value (adjusted for local time), that is the number of microseconds since 1/1/1972, 00:00 hours. This is the ‘raw’ Wall Clock Time as presented by the device.

**TimeZone** is obsolete and is no longer used. It is retained in the structure only for backwards compatibility and is not used.

**CSTOffset** is the positive offset in microseconds from the current system CST (Coordinated System Time). In a system that utilizes a CST Time Master, this value lets the Wall Clock Time be precisely synchronized among multiple devices that support CST and WCT.

**LocalTimeAdj** is obsolete and is no longer used. It is retained in the structure only for backwards compatibility and is not used.

**SystemTime** is a Win32 structure of type SYSTEMTIME. (Refer to the Microsoft Platform SDK documentation for more information.) The time and date returned in this structure is the local adjusted time on the device. The SYSTEMTIME structure is shown below:

```c
typedef struct _SYSTEMTIME {
    WORD wYear;
    WORD wMonth;
    WORD wDayOfWeek;
    WORD wDay;
    WORD wHour;
    WORD wMinute;
    WORD wSecond;
    WORD wMilliseconds;
} SYSTEMTIME, *PSYSTEMTIME;
```

Return Value

- **OCX_SUCCESS**: WCT information has been read successfully
- **OCX_ERR_NOACCESS**: apiHandle does not have access
- **OCX_ERR_MEMALLOC**: Not enough memory is available
- **OCX_ERR_BADPARAM**: An invalid parameter was passed
- **OCX_ERR_NODEVICE**: The device does not exist
- **OCX_CIP_INVALID_REQUEST**: The device does not support the WCT object
### Example

```c
OCXHANDLE apiHandle;
OCXCIPWCT Wct;
BYTE Path[]="p:i,s:0"; // controller in Slot 0
int rc;
rc = OCXcip_GetWCTime(apiHandle, Path, &Wct, 3000);
if (rc != OCX_SUCCESS)
{
    printf("\nOCXcip_GetWCTime failed: %d\r", rc);
}
else
{
    printf("\nWall Clock Time: %02d/%02d/%d %02d:%02d:%02d.%03d",
            Wct.SystemTime.wMonth, Wct.SystemTime.wDay,
            Wct.SystemTime.wYear, Wct.SystemTime.wHour,
            Wct.SystemTime.wMinute, Wct.SystemTime.wSecond,
            Wct.SystemTime.wMilliseconds);
}
```

For more information, see the following:

- [OCXcip_SetWCTime](#) on page 86.
- [OCXcip_GetWCTimeUTC](#) on page 88.
## OCXcip_SetWCTime

### Syntax

```c
int OCXcip_SetWCTime(  
    OCXHANDLE apiHandle,  
    BYTE *pPathStr,  
    OCXCIPWCT *pWCT,  
    WORD timeout );
```

### Parameters

- **apiHandle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being accessed
- **pWCT**: Pointer to OCXCIPWCT structure with Wall Clock Time data to set
- **timeout**: Number of milliseconds to wait for the device to respond

### Description

OCXcip_SetWCTime writes to the Wall Clock Time object in the specified device. This function lets the time be specified in two different ways: a specified date/time (Win32 SYSTEMTIME structure), or automatically set to the local system time. See the description of the `pWCT` parameter for more information.

 apiHandle must be a valid handle returned from OCXcip_Open.

 pPathStr must be a pointer to a string containing the path to a device that supports the Wall Clock Time object, such as a ControlLogix controller. For information on specifying paths, see Appendix B, Specify the Communication Path on page 121.

 timeout is used to specify the amount of time in milliseconds the application must wait for a response from the device.

 pWCT can point to a structure of type OCXCIPWCT, or can be NULL. If pWCT is NULL, the local system time is used (as returned by the Win32 function GetLocalTime()).

 The OCXCIPWCT structure is defined below:

```c
typedef struct tagOCXCIPWCT  
{  
    ULARGE_INTEGER CurrentValue;  
    WORD TimeZone;  
    ULARGE_INTEGER CSTOffset;  
    WORD LocalTimeAdj;  
    SYSTEMTIME SystemTime;  
} OCXCIPWCT;
```

CurrentValue is ignored by this function.

TimeZone is obsolete and is no longer used. It is retained in the structure only for backwards compatibility and is ignored by this function.

CSTOffset is ignored by this function.

LocalTimeAdj is obsolete and is no longer used. It is retained in the structure only for backwards compatibility and is ignored by this function.

SystemTime is a Win32 structure of type SYSTEMTIME. The SYSTEMTIME structure is shown below:

```c
typedef struct _SYSTEMTIME  
{  
    WORD wYear;  
    WORD wMonth;  
    WORD wDayOfWeek;  
    WORD wDay;  
    WORD wHour;  
    WORD wMinute;  
    WORD wSecond;  
    WORD wMilliseconds;  
} SYSTEMTIME, *PSYSTEMTIME;
```

The wDayOfWeek member is not used by the OCXcip_SetWCTime function.

### Return Value

- **OCX_SUCCESS**: WCT information has been set successfully
- **OCX_ERR_NOACCESS**: apiHandle does not have access
- **OCX_ERR_MEMALLOC**: Not enough memory is available
- **OCX_ERR_BADPARAM**: An invalid parameter was passed
- **OCX_ERR_NODEVICE**: The device does not exist
- **OCX_CIP_INVALID_REQUEST**: The device does not support the WCT object
Example 1

```c
OCXHANDLE apiHandle;
BYTE Path[]="p:1,s:0"; // controller in Slot 0
int rc;
// Set the controller time to the local system time
rc = OCXcip_SetWCTime(apiHandle, Path, NULL, 3000);
if (rc != OCX_SUCCESS)
{
    printf("\n\rOCXcip_SetWCTime failed: %d\n", rc);
}
```

Example 2

```c
OCXHANDLE apiHandle;
OCXCIWCT Wct;
BYTE Path[]="p:1,s:0"; // controller in Slot 0
int rc;
// Set the controller time to current GMT using SystemTime
GetSystemTime(&Wct.SystemTime);
rc = OCXcip_SetWCTime(apiHandle, Path, &Wct, 3000);
if (rc != OCX_SUCCESS)
{
    printf("\n\rOCXcip_SetWCTime failed: %d\n", rc);
}
```

For more information, see the following:
- [OCXcip_GetWCTime](#) on page 84.
- [OCXcip_SetWCTimeUTC](#) on page 90.
## OCXcip_GetWCTimeUTC

### Syntax

```c
int OCXcip_GetWCTime(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    OCXCIPWCT *pWCT,
    WORD timeout);
```

### Parameters

- `apiHandle`: Handle returned from OCXcip_Open call
- `pPathStr`: Path to device being accessed
- `pWCT`: Pointer to OCXCIPWCTUTC structure to be filled with Wall Clock Time data
- `timeout`: Number of milliseconds to wait for the device to respond

### Compatibility

This function is compatible only with Logix 5000 controllers with firmware revision 16 or later installed. Firmware revision 15 or earlier result in error OCX_CIP_INVALID_REQUEST. For previous firmware revisions, see OCXcip_SetWCTime.

### Description

OCXcip_GetWCTimeUTC retrieves information from the Wall Clock Time object in the specified device. The time returned is expressed as UTC time.

- `apiHandle` must be a valid handle returned from OCXcip_Open.
- `pPathStr` must be a pointer to a string containing the path to a device that supports the Wall Clock Time object, such as a ControlLogix controller. For information on specifying paths, see Appendix A.
- `timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.
- `pWCT` can point to a structure of type OCXCIPWCTUTC, that on success is filled with the data read from the device. As a special case, `pWCT` can also be NULL.

If `pWCT` is NULL, then the system time is set with the UTC time returned from the WCT object. This is a convenient way to synchronize the system time with the controller time. (IMPORTANT: The user account must have appropriate privileges to set the system time.)

The OCXCIPWCTUTC structure is defined below:

```c
typedef struct tagOCXCIPWCTUTC
{
    ULARGE_INTEGER CurrentUTCValue;
    char TimeZone[84];
    int DSToffset;
    int DSTEnable;
    SYSTEMTIME SystemTime;
} OCXCIPWCT;
```

- `TimeZone` is a null-terminated string that describes the time zone configured on the controller. It includes the adjustment in hours and minutes that is used to derive the local time value from UTC time. The `TimeZone` string is expressed in one of the following formats:
  - `GMT+hh:mm <location>`
  - `GMT-hh:mm <location>`

- `DSToffset` is the number of minutes (positive or negative) to be adjusted for Daylight Savings Time.
- `DSTEnable` indicates whether or not Daylight Savings Time is in effect (1 if DST is in effect, 0 if not).

`SystemTime` is a Win32 structure of type SYSTEMTIME. (For more information, see the Microsoft Platform SDK documentation.) The time and date returned in this structure is UTC time. The SYSTEMTIME structure is shown below:

```c
typedef struct _SYSTEMTIME {
    WORD wYear;
    WORD wMonth;
    WORD wDayOfWeek;
    WORD wDay;
    WORD wHour;
    WORD wMinute;
    WORD wSecond;
    WORD wMilliseconds;
} SYSTEMTIME, *PSYSTEMTIME;
```
### Return Value

<table>
<thead>
<tr>
<th>OCX_SUCCESS</th>
<th>WCT information has been read successfully</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_ERR_NOACCESS</td>
<td>apiHandle does not have access</td>
</tr>
<tr>
<td>OCX_ERR_MEMALLOC</td>
<td>Not enough memory is available</td>
</tr>
<tr>
<td>OCX_ERR_BADPARAM</td>
<td>An invalid parameter was passed</td>
</tr>
<tr>
<td>OCX_ERR_NODEVICE</td>
<td>The device does not exist</td>
</tr>
<tr>
<td>OCX_CIP_INVALID_REQUEST</td>
<td>The device does not support the WCT object</td>
</tr>
</tbody>
</table>

### Example

```c
OCXHANDLE apiHandle;
OCXCIPWCTUTC Wct;
BYTE Path[]="p:1,s:0"; // controller in Slot 0
int rc;
rc = OCXcip_GetWCTimeUTC(apiHandle, Path, &Wct, 3000);
if (rc != OCX_SUCCESS)
{
    printf("\n\rOCXcip_GetWCTimeUTC failed: %d\n\r", rc);
}
else
{
    printf("\nWall Clock Time: %02d/%02d/%d %02d:%02d:%02d.%03d",
            Wct.SystemTime.wMonth, Wct.SystemTime.wDay,
            Wct.SystemTime.wYear, Wct.SystemTime.wHour,
            Wct.SystemTime.wMinute, Wct.SystemTime.wSecond,
            Wct.SystemTime.wMilliseconds);
}
```

For more information, see the following:

- [OCXcip_GetWCTime on page 84](#)
- [OCXcip_SetWCTimeUTC on page 90](#)
### OCXcip_SetWCTimeUTC

**Syntax**

```c
int OCXcip_SetWCTimeUTC(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    OCXCIPWCTUTC *pWCT,
    WORD timeout);
```

**Parameters**

- **apiHandle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being accessed
- **pWCT**: Pointer to OCXCIPWCTUTC structure with Wall Clock Time data to set
- **timeout**: Number of milliseconds to wait for the device to respond

**Compatibility**

This function is compatible only with Logix 5000 controllers with firmware revision 16 or greater installed. Firmware revision 15 or earlier result in error OCX_CIP_INVALID_REQUEST. For previous firmware revisions, please refer to OCXcip_SetWCTime().

**Description**

OCXcip_SetWCTimeUTC writes to the Wall Clock Time object in the specified device. This function lets the time be specified in two different ways: a specific date and time expressed in UTC time (Win32 SYSTEMTIME structure), or automatically set to the 56Comp system time (expressed in UTC time). See the description of the pWCT parameter for more information.

- **apiHandle** must be a valid handle returned from OCXcip_Open.
- **pPathStr** must be a pointer to a string containing the path to a device that supports the Wall Clock Time object, such as a ControlLogix controller. For information on specifying paths, see Appendix A.
- **timeout** is used to specify the amount of time in milliseconds the application must wait for a response from the device.
- **pWCT** can point to a structure of type OCXCIPWCTUTC, or can be NULL. If **pWCT** is NULL, the 56Comp system time (UTC) is used (as returned by the Win32 function GetSystemTime()).

The OCXCIPWCTUTC structure is defined below:

```c
typedef struct tagOCXCIPWCTUTC {
    ULARGE_INTEGER CurrentUTCValue;
    char TimeZone[84];
    int DSTOffset;
    int DSTEnable;
    SYSTEMTIME SystemTime;
} OCXCIPWCTUTC;
```

- **CurrentUTCValue**, **TimeZone**, **DSTOffset**, and **DSTEnable** are ignored by this function.
- **SystemTime** is a Win32 structure of type SYSTEMTIME. The SYSTEMTIME structure is shown below:

```c
typedef struct _SYSTEMTIME {
    WORD wYear;
    WORD wMonth;
    WORD wDayOfWeek;
    WORD wDay;
    WORD wHour;
    WORD wMinute;
    WORD wSecond;
    WORD wMilliseconds;
} SYSTEMTIME, *PSYSTEMTIME;
```

- The **wDayOfWeek** member is not used by the OCXcip_SetWCTimeUTC function.

**Return Value**

- **OCX_SUCCESS**: WCT information has been set successfully
- **OCX_ERR_NOACCESS**: apiHandle does not have access
- **OCX_ERR_MEMALLOC**: Not enough memory is available
- **OCX_ERR_BADPARAM**: An invalid parameter was passed
- **OCX_ERR_NODEVICE**: The device does not exist
- **OCX_CIP_INVALID_REQUEST**: The device does not support the WCT object
Example 1

OCXHANDLE apiHandle;
BYTE Path[]="p:1,s:0"; // controller in Slot 0
int rc;
rc = OCXcip_SetWCTimeUTC(apiHandle, Path, NULL, 3000);
if (rc != OCX_SUCCESS)
{
    printf("\n\rOCXcip_SetWCTimeUTC failed: %d\n\r", rc);
}

Example 2

OCXHANDLE apiHandle;
OCXCIPWCTUTC Wct;
BYTE Path[]="p:1,s:0"; // controller in Slot 0
int rc;
// Set the controller time to current GMT using SystemTime
GetSystemTime(&Wct.SystemTime);
rc = OCXcip_SetWCTimeUTC(apiHandle, Path, &Wct, 3000);
if (rc != OCX_SUCCESS)
{
    printf("\n\rOCXcip_SetWCTimeUTC failed: %d\n\r", rc);
}

For more information, see the following:

- OCXcip_GetWCTime on page 84.
- OCXcip_SetWCTimeUTC on page 90.
### O CXcip_PLC5TypedRead

**Syntax**

```c
int OCXcip_PLC5TypedRead(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    void *pDataDest,
    BYTE *pSourceStr,
    WORD NumElements,
    WORD timeout);
```

**Parameters**

- **apiHandle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being read
- **pDataDest**: Pointer to an array into which the retrieved data is stored
- **pSourceStr**: Pointer to an ASCII string representation of the desired data file in the PLC5
- **NumElements**: Number of data elements to be retrieved from the PLC5
- **timeout**: Number of milliseconds to wait for the read to complete

**Description**

OCXcip_PLC5TypedRead retrieves data from the PLC5 at the path specified in `pPathStr` and stores it to the location specified in `pDataDest`. `apiHandle` must be a valid handle returned from OCXcip_Open.

`pDataDest` is a void pointer to a structure of the desired type of data to be retrieved. The members of this structure are updated with the data from the PLC5. Available types are:
- `OCX_CIP_REAL` - Reading of file type F, floating-point
- `OCX_CIP_STRING82_TYPE` – Reading of file type ST, ASCII string
- `WORD` – All other permitted file types: O, I, B, N and S

`pSourceStr` is a pointer to a string that contains an ASCII representation of the desired data file in the PLC5 from that the data is to be retrieved. Available file types are Output Image (O), Input Image (I), Status (S), Bit (B), Integer (N), Floating-point (F), ASCII string (ST) with the file-type identifier shown in parenthesis.

**IMPORTANT**: Bit data is returned as a full word, it is the responsibility of the application to mask the desired bit.

`NumElements` is the number data elements to be retrieved from the PLC5.

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

**Return Value**

- `OCX_SUCCESS` : Data was retrieved successfully
- `OCX_ERR_NOACCESS` : `apiHandle` does not have access
- `OCX_ERR_MEMALLOC` : If enough memory is available
- `OCX_ERR_BADPARAM` : If `pPathStr`, `pSourceStr` or `NumElements` are invalid
- `OCX_ERR_OBJEMPTY` : If object ID of this module is empty
- `OCX_ERR_PCCC` : If error occurs in communications to the PLC5
<table>
<thead>
<tr>
<th>Example</th>
</tr>
</thead>
</table>
| OCXHANDLE apiHandle;  
WORD ReadData[100];  
WORD timeout;  
BYTE SourceStr[32];  
BYTE PathStr[32];  
WORD NumElements;  
int rc;  
// Read 5 elements of data from file type integer N10 in PLC5 at IP  
// address 10.0.104.123. Start at the fourth element of N10.  
// sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123"); // Set path  
sprintf((char *)SourceStr,"N10:5"); // Set source to file N10:5  
timeout = 5000; // Allow 5 seconds for xfer  
NumElements = 5; // Fetch 5 integers  
if(OCX_SUCCESS != (rc = OCXcip_PLC5TypedRead(apiHandle, PathStr, ReadData, SourceStr, NumElements, timeout)))  
{  
   printf("PLC5 Read Failed! Error Code = %d\n",rc);  
}  
else  
{  
   printf("PLC5 Read Successful!\n");  
}  

### OCXcip_PLC5TypedWrite

**Syntax**

```c
int OCXcip_PLC5TypedWrite( 
    OCXHANDLE apiHandle, 
    BYTE *pPathStr, 
    BYTE *pDataDestStr, 
    void *pSourceData, 
    WORD NumElements, 
    WORD timeout );
```

**Parameters**

- `api HANDLE` Handle returned from OCXcip_Open call
- `pPathStr` Path to device being written
- `pDataDest` Pointer to an ASCII string representation of the desired data file in the PLC5
- `pSourceData` Pointer to an array from which the data to be written is retrieved
- `NumElements` Number of data elements to write
- `timeout` Number of milliseconds to wait for the write to complete

**Description**

`OCXcip_PLC5TypedWrite` writes data to the PLC5 at the path specified in `pPathStr` to the location specified in `pDataDestStr`. `apiHandle` must be a valid handle returned from OCXcip_Open.

`pSourceData` is a void pointer to a structure of the desired type of data to be written. The members of this structure are written to the designated file in the PLC5. Available types are:

- `OCX_CIP_REAL` - Writing of file type floating-point (F)
- `OCX_CIP_STRING82_TYPE` - Writing of file type ASCII string (ST)
- `WORD` - All other permitted file types: O, I, B, N and S

`pDataDestStr` is a pointer to a string that contains an ASCII representation of the desired data file in the PLC5 to which the data is to be written. Permissible file types are Output Image (O), Input Image (I), Status (S), Bit (B), Integer (N), Floating-point (F) and ASCII string (ST) with the file-type identifier shown in parenthesis.

Use the `OCXcip_PLC5ReadModWrite` function to write individual bit fields within a data file. `NumElements` is the number data elements to be written to the PLC5. `timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

**Return Value**

- `OCX_SUCCESS` Data was written successfully
- `OCX_ERR_NOACCESS` `apiHandle` does not have access
- `OCX_ERR_MEMALLOC` If not enough memory is available
- `OCX_ERR_BADPARAM` If `pPathStr`, `pDataDestStr` or `NumElements` are invalid
- `OCX_ERR_OBJEMPTY` If object ID of this module is empty
- `OCX_ERR_PCCC` If error occurs in communications to the PLC5

**Example**

```c
OCXHANDLE apiHandle;
WORD WriteData[100];
WORD timeout;
BYTE pDataDestStr[32];
BYTE PathStr[32];
WORD NumElements;
int rc;

// Write 5 elements of data from WriteData array to file type integer
// N10 in PLC5 at IP address 10.0.104.123. Start at element 24.
//
// sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123"); // Set path
// timeout = 5000; //Allow 5 seconds for xfer
// NumElements = 5; //Write 5 integers
if(OCX_SUCCESS != (rc = OCXcip_PLC5TypedWrite(apiHandle, PathStr, pDataDestStr, WriteData, NumElements, timeout)))
{
    printf("PLC5 Write Failed! Error Code = %d\n",rc);
}
else
{
    printf("PLC5 Write Successful!\n");
}
```
**OCXcip_PLC5WordRangeWrite**

**Syntax**

```c
int OCXcip_PLC5WordRangeWrite(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    BYTE *pDataDestStr,
    void *pSourceData,
    WORD NumElements,
    WORD timeout );
```

**Parameters**

- `apiHandle`: Handle returned from OCXcip_Open call
- `pPathStr`: Path to device being written
- `pDataDestStr`: Pointer to an ASCII string representation of the desired data file in the PLC5
- `pSourceData`: Pointer to an array from which the data to be written is retrieved
- `NumElements`: Number of data elements to write
- `timeout`: Number of milliseconds to wait for the write to complete

**Description**

OCXcip_PLC5WordRangeWrite writes data to the PLC5 at the path specified in `pPathStr` to the location specified in `pDataDestStr`. `apiHandle` must be a valid handle returned from OCXcip_Open.

`pSourceData` is a void pointer to a structure of the desired type of data to be written. The members of this structure are written to the designated file in the PLC5. This pointer is void for consistency with the OCXcip_PLC5TypedWrite command, the only permitted type is WORD.

`pDataDestStr` is a pointer to a string that contains an ASCII representation of the desired data file in the PLC5 to which the data is to be written. Permissible file types are Timer (T), Counter (C), Control (R), ASCII (A), BCD (D), Block-transfer (BT), Message (MG), PID (PD) and SFC status (SC) with the file-type identifier shown in parenthesis.

ASCII must be written as an entire word or 2 characters per write.

When writing floating point elements of the PD file type it is the responsibility of the application to write these as two integers and to properly orient the bytes for the correct floating point format.

`NumElements` is the number of data elements to be written to the PLC5.

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

**Return Value**

- **OCX_SUCCESS**: Data was written successfully
- **OCX_ERR_NOACCESS**: `apiHandle` does not have access
- **OCX_ERR_MEMALLOC**: If not enough memory is available
- **OCX_ERR_BADPARAM**: If `pPathStr`, `pDataDestStr` or `NumElements` are invalid
- **OCX_ERR_OBJEMPTY**: If object ID of this module is empty
- **OCX_ERR_PCCC**: If error occurs in communications to the PLC5

**Example**

```c
OCXHANDLE apiHandle;
WORD WriteData[100];
WORD timeout;
BYTE pDataDestStr[32];
BYTE PathStr[32];
WORD NumElements;
int rc;

// Write a preset value to the 1st counter in file C5
// in the PLC5 at IP address 10.0.104.123
//
sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123"); // Set path
sprintf((char *)SourceStr,"C5:0.PRE"); // Set destination to preset // of the 1st counter in file // C5
timeout = 5000; // Allow 5 seconds for xfer
NumElements = 1; // Write 1 value
if(OCX_SUCCESS != (rc = OCXcip_PLC5WordRangeWrite(apiHandle, PathStr, pDataDestStr, WriteData, NumElements, timeout)))
{
    printf("PLC5 Counter Write Failed! Error Code = %d\n",rc);
}
else
{
    printf("PLC5 Counter Write Successful!\n");
}
```
### OCXcip_PLC5WordRangeRead

#### Syntax

```c
int OCXcip_PLC5WordRangeRead(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    void *pDataDest,
    BYTE *pSourceStr,
    WORD NumElements,
    WORD timeout);
```

#### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>apiHandle</td>
<td>Handle returned from OCXcip_Open call</td>
</tr>
<tr>
<td>pPathStr</td>
<td>Path to device being read</td>
</tr>
<tr>
<td>pDataDest</td>
<td>Pointer to an array into which the data is stored</td>
</tr>
<tr>
<td>pSourceStr</td>
<td>Pointer to an ASCII string representation of the desired data file in the PLC5</td>
</tr>
<tr>
<td>NumElements</td>
<td>Number of data elements to be retrieved from the PLC5</td>
</tr>
<tr>
<td>timeout</td>
<td>Number of milliseconds to wait for the read to complete</td>
</tr>
</tbody>
</table>

#### Description

OCXcip_PLC5WordRangeRead retrieves data from the PLC5 at the path specified in `pPathStr` and stores it to the location specified in `pDataDest`. `apiHandle` must be a valid handle returned from OCXcip_Open.

`pDataDest` is a void pointer to a structure of the desired type of data to be retrieved. The members of this structure are updated with the data from the PLC5. This pointer is void for consistency with the OCXcip_PLC5TypedRead command, the only permitted type is WORD.

`pSourceStr` is a pointer to a string that contains an ASCII representation of the desired data file in the PLC5 from which the data is to be retrieved. Permissible file types are Timer (T), Counter (C), Control (R), ASCII (A), BCD (D), Block-transfer (BT), Message (MG), PID (PD) and SFC status (SC) with the file-type identifier shown in parenthesis.

**IMPORTANT**: ASCII must be read as an entire word or 2 characters per read. Also, when retrieving floating point elements of the PD file type it is the responsibility of the application to retrieve these as two integers and to properly orient the bytes for the correct floating point format.

`NumElements` is the number of data elements to be retrieved from the PLC5.

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

#### Return Value

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>Data was retrieved successfully</td>
</tr>
<tr>
<td>OCX_ERR_NOACCESS</td>
<td>apiHandle does not have access</td>
</tr>
<tr>
<td>OCX_ERR_MEMALLOC</td>
<td>If not enough memory is available</td>
</tr>
<tr>
<td>OCX_ERR_BADPARAM</td>
<td>If pPathStr, pSourceStr or NumElements are invalid</td>
</tr>
<tr>
<td>OCX_ERR_OBJEMPTY</td>
<td>If object ID of this module is empty</td>
</tr>
<tr>
<td>OCX_ERR_PCCC</td>
<td>If error occurs in communications to the PLC5</td>
</tr>
</tbody>
</table>
Example

OCXHANDLE apiHandle;
WORD ReadData[100];
WORD timeout;
BYTE SourceStr[32]
BYTE PathStr[32];
WORD NumElements;

int rc;

// Read the accumulator value of the 4th timer in file T4 // in the PLC5 at IP address 10.0.104.123
//

sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123"); // Set path

sprintf((char *)SourceStr,"T4:4.ACC"); // Set source to the // accumulator of the 4th // counter in file T4

timeout = 5000; // Allow 5 seconds for xfer

NumElements = 1; // Read 1 value

if(OCX_SUCCESS != (rc = OCXcip_PLC5WordRangeRead(apiHandle, PathStr, ReadData, SourceStr, NumElements, timeout)))
{
    printf("PLC5 Timer Read Failed! Error Code = %d\n",rc);
}
else
{
    printf("PLC5 Timer Read Successful!\n");
}
### OCXcip_PLC5ReadModWrite

**Syntax**

```c
int OCXcip_PLC5ReadModWrite ( 
    OCXHANDLE apiHandle, 
    BYTE *pPathStr, 
    OCX_CIP_PLC5_RMW_CMD *pDataArray, 
    WORD numAddrs, 
    WORD timeout );
```

**Parameters**

- **apiHandle**
  - Handle returned from OCXcip_Open call
- **pPathStr**
  - Path to device being read
- **pDataArray**
  - Pointer to the array containing pointers to the symbolic file addresses and their associated AND and OR masks for the read-modify-write process.
- **numAddrs**
  - Number of file addresses to be processed. Maximum number permitted is 20 as long as the total number of bytes required for the symbolic addresses and their associated masks does not exceed 242.
- **timeout**
  - Number of milliseconds to wait for the read-modify-write to complete

**Description**

`OCXcip_PLC5ReadModWrite` sets or clears specific bits within the specified addresses in the PLCS at the path specified in pPathStr. apiHandle must be a valid handle returned from OCXcip_Open.

`pDataArray` is a pointer to an array of structure type `OCX_CIP_PLC5_RMW_CMD`. This structure contains the symbolic (ASCII) addresses of the locations within the PLCS that are to be modified according to the associated AND and OR masks.

Bit manipulation is not permitted in floating point (F) or ASCII string (ST) file types.

`numAddrs` is the number addresses to be modified in the PLCS.

Each address to be modified must have an associated address, AND and OR mask in pDataArray.

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

**Return Value**

- **OCX_SUCCESS**
  - Data was retrieved successfully
- **OCX_ERR_NOACCESS**
  - apiHandle does not have access
- **OCX_ERR_MEMALLOC**
  - If not enough memory is available
- **OCX_ERR_BADPARAM**
  - If pPathStr, pDataArray or numAddrs are invalid
- **OCX_ERR_OBJEMPTY**
  - If object ID of this module is empty
- **OCX_ERR_PCCC**
  - If error occurs in communications to the PLCS

The `OCX_CIP_PLC5_RMW_CMD` structure is defined below:

```c
typedef struct tag OCX_CIP_PLC5_RMW_CMD
{
    char *AddrStr;
    WORD AndMask;
    WORD OrMask;
} OCX_CIP_PLC5_RMW_CMD;
```
Example

```c
OCXHANDLE apiHandle;
OCX_CIP_PLC5_RMW.Cmd DataArray[2];
WORD timeout;
BYTE PathStr[32];
WORD numAddrs;
int rc;
BYTE AddrStr1[10];
BYTE AddrStr2[10];

// Set bits 5, 10 and 11 at the PLC5 address 'N7:9' and clear
// the output bits 4, 5 and 12 at the PLC5 address 'O:167'
// in the PLC5 at IP address 10.0.104.123

缢 sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123"); // Set pat
缢 sprintf((char *)AddrStr1, "N7:9"); // Set address 1
缢 sprintf((char *)AddrStr2, "O:167"); // Set address 2
DataArray[0].AddrStr = AddrStr1; // Store address pointer
DataArray[0].AndMask = 0xFFFF; // Store AND mask
DataArray[0].OrMask = 0x0C20; // Store OR mask
DataArray[1].AddrStr = AddrStr2; // Store address pointer
DataArray[1].AndMask = 0xEFCF; // Store AND mask
DataArray[1].OrMask = 0x0000; // Store OR mask
timeout = 5000; // Allow 5 seconds for execution
numAddrs = 2; // Read-Mod-Write 2 locations

if (OCX_SUCCESS != (rc = OCXcip_PLC5ReadModWrite(apiHandle, PathStr, DataArray, numAddrs, timeout)))
{
    printf("PLC5 Read-Modify-Write failed! Error Code = %d\n", rc);
}
else
{
    printf("PLC5 Read-Modify-Write Successful!\n");
}
```
Chapter 5  Backplane API Library Functions

**OCXcip_SLCProtTypedRead**

**Syntax**

```c
int OCXcip_SLCProtTypedRead(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    void *pDataDest,
    BYTE *pSourceStr,
    WORD NumElements,
    WORD timeout);
```

**Parameters**

- **apiHandle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being read
- **pDataDest**: Pointer to an array into which the data is stored
- **pSourceStr**: Pointer to an ASCII string representation of the desired data file in the SLC
- **NumElements**: Number of data elements to be retrieved from the SLC
- **timeout**: Number of milliseconds to wait for the read to complete

**Description**

OCXcip_SLCProtTypedRead retrieves data from the SLC at the path specified in `pPathStr` and the location specified in `pSourceStr`. `apiHandle` must be a valid handle returned from OCXcip_Open.

- `pDataDest` is a void pointer to a structure of the desired type of data to be retrieved. The members of this structure are updated with the data from the SLC. Permissible types are:
  - OCX_CIP_REAL - Reading of file type F, floating-point
  - OCX_CIP_STRING82_TYPE - Reading of file type ST, ASCII string
  - WORD - All other permitted file types: O, I, B, N, A, T, R and C

- `pSourceStr` is a pointer to a string that contains an ASCII representation of the desired data file in the SLC from which the data is to be retrieved. Permissible file types are Output Image (O), Image (I), Status (S), Bit (B), Integer (N), ASCII (A), Floating-point (F), ASCII string (ST), Counter (C), Control (R) and Timer (T) with the file-type identifier shown in parenthesis.

- Bit data is returned as a full word. If bit(s) information is desired it is the responsibility of the application to mask the desired bit(s).

- `NumElements` is the number data elements to be retrieved from the SLC.

- `timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

**Return Value**

- OCX_SUCCESS: Data was retrieved successfully
- OCX_ERR_NOACCESS: apiHandle does not have access
- OCX_ERR_MEMALLOC: If not enough memory is available
- OCX_ERR_BADPARAM: If pPathStr, pSourceStr or NumElements are invalid
- OCX_ERR_OBJEMPTY: If object ID of this module is empty
- OCX_ERR_PCCC: If error occurs in communications to the SLC

**Example**

```c
OCXHANDLE apiHandle;
WORD ReadData[100];
WORD timeout;
BYTE SourceStr[32];
BYTE PathStr[32];
WORD NumElements;
int rc;
// Read 5 elements of data from file type integer N10 in SLC at IP
// address 10.0.104.123. Start at the 19th element
//
sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123"); // Set path
sprintf((char *)SourceStr,"N10:18"); // Set source to file N10:18
timeout = 5000; //Allow 5 seconds for xfer
NumElements = 5; //Fetch 5 integers
if(OCX_SUCCESS != (rc = OCXcip_SLCProtTypedRead(apiHandle, PathStr, ReadData, SourceStr, NumElements, timeout)))
{
    printf("SLC Read Failed! Error Code = %d\n",rc);
}
else
{
    printf("SLC Read Successful!\n");
}
```
OCXcip_SLCProtTypedWrite

Syntax

```c
int OCXcip_SLCProtTypedWrite(
    OCXHANDLE apiHandle,
    BYTE *pPathStr,
    BYTE *pDataDestStr,
    void *pSourceData,
    WORD NumElements,
    WORD timeout);
```

Parameters

- **apiHandle**: Handle returned from OCXcip_Open call
- **pPathStr**: Path to device being written
- **pDataDestStr**: Pointer to an ASCII string representation of the desired data file in the SLC
- **pSourceData**: Pointer to an array from which the data to be written is retrieved
- **NumElements**: Number of data elements to write
- **timeout**: Number of milliseconds to wait for the write to complete

Description

OCXcip_SLCProtTypedWrite writes data to the SLC at the path specified in pPathStr and the location specified in pDataDestStr. apiHandle must be a valid handle returned from OCXcip_Open.

pSourceData is a void pointer to a structure of the desired type of data to be written. The members of this structure are written to the designated file in the SLC. Permissible types are:
- OCX_CIP_REAL - Writing of file type floating-point (F)
- OCX_CIP_STRINGB2_TYPE - Writing of file type ASCII string (ST)
- WORD - All other permitted file types: O, I, B, N, S, A, T, R and C

pDataDestStr is a pointer to a string that contains an ASCII representation of the desired data file in the SLC to which the data is to be written. Permissible file types are Output Image (O), Input Image (I), Status (S), Bit (B), Integer (N), ASCII (A), Floating-point (F), ASCII string (ST), Counter (C), Control (R) and Timer (T) with the file-type identifier shown in parenthesis.

Use the API function OCXcip_SLCReadModWrite to write individual bit fields within a data file.

NumElements is the number data elements to be retrieved from the SLC. timeout is used to specify the amount of time in milliseconds the application must wait for a response from the device.

Return Value

- **OCX_SUCCESS**: Data was written successfully
- **OCX_ERR_NOACCESS**: apiHandle does not have access
- **OCX_ERR_MEMALLOC**: If not enough memory is available
- **OCX_ERR_BADPARAM**: If pPathStr, pDataDestStr or NumElements are invalid
- **OCX_ERR_OBJEMPTY**: If object ID of this module is empty
- **OCX_ERR_PCCC**: If error occurs in communications to the SLC
## Example

```
OCXHANDLE apiHandle;
WORD WriteData[100];
WORD timeout;
BYTE pDataDestStr[32];
BYTE PathStr[32];
WORD NumElements;
int rc;

// Write 5 elements of data from WriteData array to file type integer
// N10 in SLC at IP address 10.0.104.123. Start at the 1st element.
//
sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123"); // Set path
sprintf((char *) pDataDestStr,"N10:0"); // Set destination to integer

timeout = 5000; //Allow 5 seconds for xfer
NumElements = 5; //Write 5 integers
if(OCX_SUCCESS != (rc = OCXcip_SLCTypedWrite(apiHandle, PathStr, pDataDestStr,
    WriteData, NumElements, timeout)))
{
    printf("SLC Write Failed! Error Code = %d\n",rc);
}
else
{
    printf("SLC Write Successful!\n");
}
```
## OCXcip_SLCReadModWrite

### Syntax

```c
int OCXcip_SLCReadModWrite ( 
    OCXHANDLE apiHandle, 
    BYTE *pPathStr, 
    BYTE *pDataDestStr, 
    void *pSourceData, 
    WORD *pSourceBitMask, 
    WORD timeout );
```

### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>apiHandle</code></td>
<td>Handle returned from OCXcip_Open call</td>
</tr>
<tr>
<td><code>pPathStr</code></td>
<td>Path to device being written</td>
</tr>
<tr>
<td><code>pDataDestStr</code></td>
<td>Pointer to an ASCII string representation of the desired data file in the SLC</td>
</tr>
<tr>
<td><code>pSourceData</code></td>
<td>Pointer to a WORD value containing the desired bit values for the destination</td>
</tr>
<tr>
<td><code>pSourceBitMask</code></td>
<td>Pointer to a WORD value containing the mask bits. Bits to be changed are set to 1, those not to be changed to a 0.</td>
</tr>
<tr>
<td><code>timeout</code></td>
<td>Number of milliseconds to wait for the write to complete</td>
</tr>
</tbody>
</table>

### Description

OCXcip_SLCReadModWrite writes data to the SLC at the path specified in `pPathStr` and the location specified in `pDataDestStr`. `apiHandle` must be a valid handle returned from OCXcip_Open.

`pSourceData` is a void pointer to a structure of the desired type of data to be written. The members of this structure are written to the designated file in the SLC. This pointer is void for consistency with the OCXcip_SLCProtTypedWrite command, the only permitted type is a single WORD.

`pDataDestStr` is a pointer to a string that contains an ASCII representation of the desired data file in the SLC to which the data is to be written. Permissible file types are Output Image (O), Input Image (I), Status (S), Bit (B), Integer (N), ASCII (A), Counter (C), Control (R) and Timer (T) with the file-type identifier shown in parenthesis. Float and ASCII String types are not permitted.

`pSourceBitMask` is a pointer to a WORD value that contains the bit mask. Each bit in this mask correlates to bits in `pSourceData`. For each bit in `pSourceBitMask` set to a value of 1, the corresponding bit value in `pSourceData` is written to the corresponding bit in the destination location represented by `pDataDestStr`. For each bit in `pSourceBitMask` set to a value of 0 no change occurs.

`timeout` is used to specify the amount of time in milliseconds the application must wait for a response from the device.

### Return Value

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>Data was written successfully</td>
</tr>
<tr>
<td>OCX_ERR_NOACCESS</td>
<td><code>apiHandle</code> does not have access</td>
</tr>
<tr>
<td>OCX_ERR_MEMALLOC</td>
<td>If not enough memory is available</td>
</tr>
<tr>
<td>OCX_ERR_BADPARAM</td>
<td>If <code>pPathStr</code>, <code>pDataDestStr</code> or <code>pSourceBitMask</code> are invalid</td>
</tr>
<tr>
<td>OCX_ERR_OBJEMPTY</td>
<td>If object ID of this module is empty</td>
</tr>
<tr>
<td>OCX_ERR_PCCC</td>
<td>If error occurs in communications to the SLC</td>
</tr>
</tbody>
</table>
Example

OCXHANDLE apiHandle;
WORD WriteData;
WORD BitMask;
WORD timeout;
BYTE pDataDestStr[32];
BYTE PathStr[32];
int rc;

// Set to 1 the value of bit numbers 4 and 11 of word 5 of the integer
// file N7 in the SLC at IP address 10.0.104.123. Set to 0 the value
// of bit 14 in that same location

// sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123"); // Set path
sprintf((char *) pDataDestStr,"N7:5"); // Set destination to integer

//file N7
timeout = 5000; //Allow 5 seconds for xfer
WriteData = 0x0810; // Set bits 4 and 11, clear 14. This value
// could also be 0xBFFF.
BitMask = 0x4810; // Setup mask bits
if(OCX_SUCCESS != (rc = OCXcip_SLCReadModWrite(apiHandle, PathStr, pDataDestStr, &WriteData, &BitMask, timeout)))
{
    printf("SLC Bit Write Failed! Error Code = %d\n",rc);
}
else
{
    printf("SLC Bit Write Successful!\n");
}
Miscellaneous Functions

This section describes the Miscellaneous functions.

**OCXcip_GetIdObject**

**Syntax**

```c
int OCXcip_GetIdObject(OCXHANDLE apiHandle, OCXCIPIDOBJ *idobject);
```

**Parameters**

- **apiHandle** Handle returned from OCXcip_Open call
- **idobject** Pointer to structure of type OCXCIPIDOBJ

**Description**

OCXcip_GetIdObject retrieves the identity object for the module. apiHandle must be a valid handle returned from OCXcip_Open. idobject is a pointer to a structure of type OCXCIPIDOBJ. The members of this structure are updated with the module identity data.

The OCXCIPIDOBJ structure is defined below:

```c
typedef struct tagOCXCIPIDOBJ
{
    WORD VendorID; // Vendor ID number
    WORD DeviceType; // General product type
    WORD ProductCode; // Vendor-specific product identifier
    BYTE MajorRevision; // Major revision level
    BYTE MinorRevision; // Minor revision level
    DWORD SerialNo; // Module serial number
    BYTE Name[32]; // Text module name (null-terminated)
    BYTE Slot; // Not used
} OCXCIPIDOBJ;
```

**Return Value**

- **OCX_SUCCESS** ID object was retrieved successfully
- **OCX_ERR_NOACCESS** apiHandle does not have access

**Example**

```c
OCXHANDLE apiHandle;
OCXCIPIDOBJ idobject;
OCXcip_GetIdObject(apiHandle, &idobject);
printf("Module Name: %s Serial Number: %lu\n", idobject.Name, idobject.SerialNo);
```
### OCXcip_SetIdObject

**Syntax**

```c
int OCXcip_SetIdObject(OCXHANDLE apiHandle, OCXCIPIDOBJ *idobject);
```

**Parameters**

- `apiHandle`: Handle returned from OCXcip_Open call
- `idobject`: Pointer to structure of type OCXCIPIDOBJ

**Description**

OCXcip_SetIdObject lets an application customize the identity object for the module. `apiHandle` must be a valid handle returned from OCXcip_Open.

`idobject` is a pointer to a structure of type OCXCIPIDOBJ. The members of this structure must be set to the desired values before the function is called. The `SerialNo` and `Slot` members are not used.

The OCXCIPIDOBJ structure is defined below:

```c
typedef struct tagOCXCIPIDOBJ
{
    WORD VendorID; // Vendor ID number
    WORD DeviceType; // General product type
    WORD ProductCode; // Vendor-specific product identifier
    BYTE MajorRevision; // Major revision level
    BYTE MinorRevision; // Minor revision level
    DWORD SerialNo; // Not used by OCXcip_SetIdObject
    BYTE Name[32]; // Text module name (null-terminated)
    BYTE // Not used by OCXcip_SetIdObject
} OCXCIPIDOBJ;
```

**Return Value**

- `OCX_SUCCESS`: ID object was set successfully
- `OCX_ERR_NOACCESS`: `apiHandle` does not have access

**Example**

```c
OCXHANDLE apiHandle;
OCXCIPIDOBJ idobject;
OCXcip_GetIdObject(apiHandle, &idobject); // get default info
// Change module name
strcpy((char *)idobject.Name, "Custom Module Name");
OCXcip_SetIdObject(apiHandle, &idobject);
```
## OCXcip_GetActiveNodeTable

### Syntax
```
int OCXcip_GetActiveNodeTable(
    OCXHANDLE apiHandle,
    int *rackSize,
    DWORD *ant);
```

### Parameters
- **apiHandle**: Handle returned from OCXcip_Open call
- **rackSize**: Pointer to integer into which is written the number of slots in the local rack
- **ant**: Pointer to DWORD into which is written a bit array corresponding to the slot occupancy of the local rack (bit 0 corresponds to slot 0)

### Description
OCXcip_GetActiveNodeTable returns information about the size and occupancy of the local rack. `apiHandle` must be a valid handle returned from OCXcip_Open.

`rackSize` is a pointer to an integer into which the size (number of slots) of the local rack is written.

`ant` is a pointer to a DWORD into which a bit array is written. This bit array reflects the slot occupancy of the local rack, where bit 0 corresponds to slot 0. If a bit is set (1), then there is an active module installed in the corresponding slot. If a bit is clear (0), then the slot is (functionally) empty.

### Return Value
- **OCX_SUCCESS**: Active node table was returned successfully
- **OCX_ERR_NOACCESS**: `apiHandle` does not have access

### Example
```
OCXHANDLE apiHandle;
int racksize;
DWORD rackant;
int i;
OCXcip_GetActiveNodeTable(apiHandle, &racksize, &rackant);
for (i=0; i<racksize; i++)
{
    if (rackant & (1<<i))
        printf(“\nSlot %d is occupied”, i);
    else
        printf(“\nSlot %d is empty”, i);
}
```
**OCXcip_MsgResponse**

**Syntax**

```c
int OCXcip_MsgResponse( OCXHANDLE apiHandle,
                        DWORD msgHandle,
                        BYTE serviceCode,
                        BYTE *msgBuf,
                        WORD msgSize,
                        BYTE returnCode,
                        WORD extendedErr );
```

**Parameters**

- **apiHandle**: Handle returned from OCXcip_Open call
- **msgHandle**: Handle returned in OCXCIPIPSERVSTRUC
- **serviceCode**: Message service code returned in OCXCIPIPSERVSTRUC
- **msgBuf**: Pointer to buffer containing data to be sent with response (NULL if none)
- **msgSize**: Number of bytes of data to send with response (0 if none)
- **returnCode**: Message return code (OCX_SUCCESS if no error)
- **extendedErr**: Extended error code (0 if none)

**Description**

OCXcip_MsgResponse is used by an application that needs to delay the response to an unscheduled message received via the service_proc callback. The service_proc callback is called sequentially and overlapping calls are not supported. If the application needs to support overlapping messages (for example, to maximize performance when there are multiple message sources), then the response to the message can be deferred by returning OCX_CIP_DEFER_RESPONSE in the service_proc callback. At a later time, OCXcip_MsgResponse can be called to complete the message. For example, the service_proc callback can queue the message for later processing by another thread (or multiple threads).

The service_proc callback must save any needed data passed to it in the OCXCIPIPSERVSTRUC structure. This data is only valid in the context of the callback.

OCXcip_MsgResponse must be called after OCX_CIP_DEFER_RESPONSE is returned by the callback. If OCXcip_MsgResponse is not called, communications resources are not freed and a memory leak results.

If OCXcip_MsgResponse is not called within the message timeout, the message fails. The sender determines the message timeout.

**msgHandle** and **serviceCode** must match the corresponding values passed to the service_proc callback in the OCXCIPIPSERVSTRUC structure.

**Return Value**

- **OCX_SUCCESS**: Response was sent successfully
- **OCX_ERR_NOACCESS**: apiHandle does not have access

**Example**

```c
OCXHANDLE apiHandle;
DWORD msgHandle;
BYTE serviceCode;
BYTE rspdata[100];

// At this point assume that a message has previously been received via the service_proc callback. The service code and message handle were saved there.
OCXcip_MsgResponse(apiHandle, msgHandle, serviceCode, rspdata, 100, OCX_SUCCESS, 0);
```

For more information, see service_proc on page 116.
OCXcip_GetVersionInfo

Syntax
int OCXcip_GetVersionInfo(OCXHANDLE handle, OCXCIPVERSIONINFO *verinfo);

Parameters
handle Handle returned by previous call to OCXcip_Open
verinfo Pointer to structure of type OCXCIPVERSIONINFO

Description
OCXcip_GetVersionInfo retrieves the current version of the API library, BPIE, and the backplane device driver. The information is returned in the structure verinfo. handle must be a valid handle returned from OCXcip_Open or OCXcipGientOpen.

The OCXCIPVERSIONINFO structure is defined as follows:

typedef struct tagOCXCIPVERSIONINFO
{
    WORD APISeries; // API series
    WORD APIRevision; // API revision
    WORD BPEngSeries; // Backplane engine series
    WORD BPEngRevision; // Backplane engine revision
    WORD BPDDSeries; // Backplane device driver series
    WORD BPDDRevision; // Backplane device driver revision
} OCXCIPVERSIONINFO;

Return Value
OCX_SUCCESS  The version information was read successfully.
OCX_ERR_NOACCESS handle does not have access

Example
OCXHANDLE Handle;
OCXCIPVERSIONINFO verinfo;
/* Print version of API library */
OCXcip_GetVersionInfo(Handle, &verinfo);
printf("Library Series %d, Rev %d\n", verinfo.APISeries, verinfo.APIRevision);
printf("Driver Series %d, Rev %d\n", verinfo.BPDDSeries, verinfo.BPDDRevision);

OCXcip_SetLED

Syntax
int OCXcip_SetLED(OCXHANDLE handle, int lednum, int ledstate);

Parameters
handle Handle returned by previous call to OCXcip_Open
lednum Selects which LED to set state. For example, 0 = OK, 1 = User1, 2 = User2
ledstate Specifies the state for the LED

Description
OCXcip_SetLED is a general-purpose function that lets the application set the state of any of the LED indicators. handle must be a valid handle returned from OCXcip_Open.

lednum is used to select the LED to be set. 0 is the module status (or OK) LED, 1 is the first User LED, 2 is the second User LED, etc.

Value must be set to OCX_LED_STATE_RED, OCX_LED_STATE_GREEN, OCX_LED_STATE_YELLOW or OCX_LED_STATE_OFF to set the indicator Red, Green, Yellow, or Off, respectively.

IMPORTANT: Not all LEDs are supported on all hardware platforms. Yellow is not supported on all platforms.

Return Value
OCX_SUCCESS  The LED state was set successfully.
OCX_ERR_NOACCESS handle does not have access
OCX_ERR_BADPARAM ledstate or lednum is invalid.

Example
OCXHANDLE Handle;
/* Set User 3 LED RED */
OCXcip_SetLED(Handle, 3, OCX_LED_STATE_RED);

For more information, see OCXcip_GetLED on page 110.
Chapter 5  Backplane API Library Functions

OCXcip_GetLED

Syntax
int OCXcip_GetLED(OCXHANDLE handle, int lednum, int *ledstate);

Parameters
handle Handle returned by previous call to OCXcip_Open
lednum Selects which LED to set state. For example, 0 = OK, 1 = User1, 2 = User2
ledstate Pointer to a variable to receive LED state

Description
OCXcip_GetLED lets an application read the current state of the specified LED. handle must be a valid handle returned from OCXcip_Open. ledstate must be a pointer to an integer variable. On successful return, the variable is set to OCX_LED_STATE_RED, OCX_LED_STATE_GREEN, OCX_LED_STATE_YELLOW or OCX_LED_STATE_OFF.

Return Value
OCX_SUCCESS The LED state was set successfully.
OCX_ERR_NOACCESS handle does not have access
OCX_ERR_BADPARAM lednum is invalid.

Example
OCXHANDLE Handle;
int ledstate;
/* Read the state of LED 3 */
OCXcip_GetLED(Handle, 3, &ledstate);

For more information, see OCXcip_SetLED on page 109.

OCXcip_SetDisplay

Syntax
int OCXcip_SetDisplay(OCXHANDLE handle, char *display_string);

Parameters
handle Handle returned by previous call to OCXcip_Open
display_string 4-character string to be displayed

Description
OCXcip_SetDisplay lets an application load 4 ASCII characters to the alphanumeric display. handle must be a valid handle returned from OCXcip_Open. display_string must be a pointer to a NULL-terminated string whose length is exactly 4 (not including the NULL).

Return Value
OCX_SUCCESS The LED state was set successfully.
OCX_ERR_NOACCESS handle does not have access
OCX_ERR_BADPARAM display_string length is not 4.

Example
OCXHANDLE Handle;
char buf[5];
/* Display the time as HHMM */
sprintf(buf, "%02d%02d", tm_hour, tm_min);
OCXcip_SetDisplay(Handle, buf);

For more information, see OCXcip_GetDisplay on page 111.
**OCXcip_GetDisplay**

**Syntax**

```c
int OCXcip_GetDisplay(OCXHANDLE handle, char *display_string);
```

**Parameters**

- `handle`: Handle returned by previous call to OCXcip_Open
- `display_string`: Pointer to buffer to receive displayed string

**Description**

OCXcip_GetDisplay returns the string that is currently displayed on the alphanumeric display. `handle` must be a valid handle returned from OCXcip_Open. `display_string` must be a pointer to a buffer that is at least 5 bytes in length. On successful return, this buffer contains the 4-character display string and terminating NULL character.

**Return Value**

- `OCX_SUCCESS`: The LED state was retrieved successfully.
- `OCX_ERR_NOACCESS`: `handle` does not have access

**Example**

```c
OCXHANDLE Handle;
char buf[5];
/* Fetch the display string */
OCXcip_GetDisplay(Handle, buf);
```

For more information, see **OCXcip_SetDisplay on page 110**.

**OCXcip_GetSwitchPosition**

**Syntax**

```c
int OCXcip_GetSwitchPosition(OCXHANDLE handle, int *sw_pos)
```

**Parameters**

- `handle`: Handle returned by previous call to OCXcip_Open
- `sw_pos`: Pointer to integer to receive switch state

**Description**

OCXcip_GetSwitchPosition returns the states of the three BCD rotary switches. The states of the switches are mapped into the 32 bits of the returned value as shown below:

<table>
<thead>
<tr>
<th>Bit(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:3</td>
<td>unused</td>
</tr>
<tr>
<td>7:4</td>
<td>BCD rotary switch 3 (least significant digit)</td>
</tr>
<tr>
<td>11:8</td>
<td>BCD rotary switch 2 (middle digit)</td>
</tr>
<tr>
<td>15:12</td>
<td>BCD rotary switch 1 (most significant digit)</td>
</tr>
<tr>
<td>31:16</td>
<td>unused</td>
</tr>
</tbody>
</table>

**Return Value**

- `OCX_SUCCESS`: The switch position information was read successfully.
- `OCX_ERR_NOACCESS`: `handle` does not have access
- `OCX_ERR_NOTSUPPORTED`: This function is not supported on this hardware.

**Example**

```c
OCXHANDLE Handle;
int swpos;
/* check switch position */
OCXcip_GetSwitchPosition(Handle, &swpos);
printf("Switches are set to %d %d %d\n",
    (swpos >> 12) & 0x0F,
    (swpos >> 8) & 0x0F,
    (swpos >> 4) & 0x0F );
```
## OCXcip_SetModuleStatus

**Syntax**

```c
int OCXcip_SetModuleStatus(OCXHANDLE handle, int status);
```

**Parameters**

- `handle`: Handle returned by previous call to OCXcip_Open
- `status`: Module status

**Description**

OCXcip_SetModuleStatus lets an application set the status of the module's status LED indicator. `handle` must be a valid `handle` returned from OCXcip_Open. `status` must be set to `OCX_MODULE_STATUS_OK`, `OCX_MODULE_STATUS_FLASHING`, or `OCX_MODULE_STATUS_FAULTED`. If the status is `OK`, the module status LED indicator is set to Green. If the status is `FAULTED`, the status indicator is set to Red. If the status is `FLASHING`, the status indicator alternates between Red and Green approximately every 500ms.

**Return Value**

- `OCX_SUCCESS`: The module status was set successfully.
- `OCX_ERR_NOACCESS`: `handle` does not have access.
- `OCX_ERR_BADPARAM`: `status` is invalid.

**Example**

```c
OCXHANDLE Handle;
/* Set the Status indicator to Red */
OCXcip_SetModuleStatus(Handle, OCX_MODULE_STATUS_FAULTED);
```

## OCXcip_ErrorString

**Syntax**

```c
int OCXcip_ErrorString(int errcode, char *buf);
```

**Parameters**

- `errcode`: Error code returned from an API function
- `buf`: Pointer to user buffer to receive message

**Description**

OCXcip_ErrorString returns a text error message associated with the error code `errcode`. The null-terminated error message is copied into the buffer specified by `buf`. The buffer must be at least 80 characters in length.

**Return Value**

- `OCX_SUCCESS`: Message returned in `buf`
- `OCX_ERR_BADPARAM`: Unknown error code

**Example**

```c
char buf[80];
int rc;
/* print error message */
OCXcip_ErrorString(rc, buf);
printf("Error: %s", buf);
```

## OCXcip_Sleep

**Syntax**

```c
int OCXcip_Sleep(OCXHANDLE apiHandle, WORD msdelay);
```

**Parameters**

- `apiHandle`: Handle returned by previous call to OCXcip_Open
- `msdelay`: Time in milliseconds to delay

**Description**

OCXcip_Sleep delays for approximately `msdelay` milliseconds.

**Return Value**

- `OCX_SUCCESS`: Success
- `OCX_ERR_NOACCESS`: `apiHandle` does not have access

**Example**

```c
OCXHANDLE apiHandle;
int timeout=200;
// Simple timeout loop
while(timeout--)
{
    // Poll for data, etc.
    // Break if condition is met (no timeout)
    // Else sleep a bit and try again
    OCXcip_Sleep(apiHandle, 10);
}
```
### OCXcip_CalculateCRC

**Syntax**

\[
\text{int OCXcip\_CalculateCRC ( BYTE *dataBuf, DWORD dataSize, WORD *crc );}
\]

**Parameters**

- `dataBuf`: Pointer to buffer of data
- `dataSize`: Number of bytes of data
- `crc`: Pointer to 16-bit word to receive CRC value

**Description**

OCXcip_CalculateCRC computes a 16-bit CRC for a range of data. This can be useful for validating a block of data; for example, data retrieved from the battery-backed Static RAM.

**Return Value**

- `OCX_SUCCESS`: Success

**Example**

```c
WORD crc;
BYTE buffer[100];
// Compute a crc for our buffer
OCXcip_CalculateCRC(buffer, 100, &crc);
```

### OCXcip_SetModuleStatusWord

**Syntax**

\[
\text{int OCXcip\_SetModuleStatusWord(OCXHANDLE handle, WORD statusWord, WORD statusWordMask);}
\]

**Parameters**

- `handle`: Handle returned by previous call to OCXcip_Open
- `statusWord`: Module status data
- `statusWordMask`: Bit mask specifying the bits in the status word are to be modified

**Description**

OCXcip_SetModuleStatusWord lets an application set the 16-bit status attribute of the module's Identity Object. handle must be a valid handle returned from OCXcip_Open. statusWordMask is a bit mask that specifies which bits in statusWord are written to the module's status attribute. Standard status word bit fields are defined by definitions with names beginning with OCX_ID_STATUS_. See the API header file for more information.

**Return Value**

- `OCX_SUCCESS`: The module status word was set successfully.
- `OCX_ERR_NOACCESS`: handle does not have access

**Example**

```c
OCXHANDLE Handle;
/* Set the Status to indicate a minor recoverable fault */
OCXcip_SetModuleStatusWord(Handle, OCX_ID_STATUS_RCV_MINOR_FAULT, OCX_ID_STATUS_FAULT_STATUS_MASK);
```

### OCXcip_GetModuleStatusWord

**Syntax**

\[
\text{int OCXcip\_GetModuleStatusWord(OCXHANDLE handle, WORD *statusWord);}
\]

**Parameters**

- `handle`: Handle returned by previous call to OCXcip_Open
- `statusWord`: Pointer to word to receive module status data

**Description**

OCXcip_GetModuleStatusWord lets an application read the current value of the 16-bit status attribute of the module's Identity Object. handle must be a valid handle returned from OCXcip_Open.

**Return Value**

- `OCX_SUCCESS`: The module status word was read successfully.
- `OCX_ERR_NOACCESS`: handle does not have access

**Example**

```c
OCXHANDLE Handle;
WORD statusWord;
/* Read the current status word */
OCXcip_GetModuleStatusWord(Handle, &statusWord);
```

For more information, see [OCXcip_GetModuleStatusWord on page 113](#).

---

For more information, see [OCXcip_SetModuleStatusWord on page 113](#).
Callback Functions

The functions in this section are not part of the API, but must be implemented by the application. The API calls the `connect_proc` or `service_proc` functions when connection or service requests are received for the registered object.

The optional `fatalFault_proc` function is called when the backplane device driver detects a fatal fault condition. The optional `resetRequest_proc` function is called when a reset request is received by the backplane device driver.

**connect_proc**

Syntax

```
OCXCALLBACK connect_proc( OCXHANDLE objHandle, OCXCIPCONNSTRUCT *sConn);
```

Parameters

- `objHandle`: Handle of registered object instance
- `sConn`: Pointer to structure of type OCXCIPCONNSTRUCT

Description

`connect_proc` is a callback function that is passed to the API in the OCXcip_RegisterAssemblyObj call. The API calls the `connect_proc` function when a Class 1 scheduled connection request is made for the registered object instance specified by `objHandle`. `sConn` is a pointer to a structure of type OCXCIPCONNSTRUCT. This structure is shown below:

```c
typedef struct tagOCXCIPCONNSTRUCT {
    OCXHANDLE connHandle; // unique value which identifies this connection
    DWORD reg_param; // value passed via OCXcip_RegisterAssemblyObj
    WORD reason; // specifies reason for callback
    WORD instance; // instance specified in open
    WORD producerCP; // producer connection point specified in open
    WORD consumerCP; // consumer connection point specified in open
    DWORD *lOTApi; // pointer to originator to target packet interval
    DWORD *lTOApi; // pointer to target to originator packet interval
    DWORD lODeviceSn; // Serial number of the originator
    WORD lOVendorId; // Vendor Id of the originator
    WORD rxDataSize; // size in bytes of receive data
    WORD txDataSize; // size in bytes of transmit data
    BYTE *configData; // pointer to configuration data sent in open
    WORD configSize; // size of configuration data sent in open
    WORD *extendederr; // Contains an extended error code if an error occurs
} OCXCIPCONNSTRUCT;
```

`connHandle` is used to identify this connection. This value must be passed to the OCXcip_SendConnected and OCXcip_ReadConnected functions.

`reg_param` is the value that was passed to OCXcip_RegisterAssemblyObj. The application can use this to store an index or pointer. It is not used by the API.

`reason` specifies whether the connection is being opened or closed. A value of OCX_CIP_CONN_OPEN indicates the connection is being opened, OCX_CIP_CONN_OPEN_COMPLETE indicates the connection has been successfully opened, OCX_CIP_CONN_NULLOPEN indicates there is new configuration data for a currently open connection, and OCX_CIP_CONN_CLOSE indicates the connection is being closed. If `reason` is OCX_CIP_CONN_CLOSE, the following parameters are unused: `producerCP`, `consumerCP`, `rxDataSize`, and `txDataSize`.

`instance` is the instance number that is passed in the forward open. This corresponds to the Configuration Instance on the RSLogix 5000 generic profile.

`producerCP` is the producer connection point from the open request. This corresponds to the Input Instance on the RSLogix 5000 generic profile.
For more information, see the following:

- OCXcip_RegisterAssemblyObj on page 59.
- OCXcip_Write Connected on page 62.
- OCXcip_ReadConnected on page 63.
service_proc

Syntax

OCXCALLBACK service_proc( OCXHANDLE objHandle, OCXCIPSERVSTRUC *sServ );

Parameters

objHandle | Handle of registered object
---------|---------------------
sServ     | Pointer to structure of type OCXCIPSERVSTRUC

Description

service_proc is a callback function that is passed to the API in the OCXcip_RegisterAssemblyObj call. The API calls the service_proc function when an unscheduled message is received for the registered object specified by objHandle.

sServ is a pointer to a structure of type OCXCIPSERVSTRUC. This structure is shown below:

typedef struct tagOCXCIPSERVSTRUC
{
    DWORD reg_param; // value passed via OCXcip_RegisterAssemblyObj
    WORD instance; // instance number of object being accessed
    BYTE serviceCode; // service being requested
    WORD attribute; // attribute being accessed
    BYTE **msgBuf; // pointer to pointer to message data
    WORD offset; // member offset
    WORD *msgSize; // pointer to size in bytes of message data
    WORD *extendederr; // Contains an extended error code if an error occurs
    BYTE fromSlot; // Slot number in local rack that sent the message
    DWORD msgHandle; // Handle used by OCXcip_MsgResponse
} OCXCIPSERVSTRUC;

reg_param is the value that was passed to OCXcip_RegisterAssemblyObj. The application can use this to store an index or pointer. It is not used by the API.

instance specifies the instance of the object being accessed. serviceCode specifies the service being requested. attribute specifies the attribute being accessed.

msgBuf is a pointer to a pointer to a buffer containing the data from the message. This pointer must be updated by the callback routine to point to the buffer containing the message response upon return.

offset is the offset of the member being accessed.

msgSize points to the size in bytes of the data pointed to by msgBuf. The application must update this with the size of the response data before returning.

extendederr is a pointer to a word that can be set by the callback function to an extended error code if the service request is refused.

fromSlot is the slot number in the local rack from which the message was received. If the module in this slot is a communications bridge, then it is impossible to determine the actual originator of the message.

msgHandle is only needed if the callback returns OCX_CIP_DEFER_RESPONSE. If this code is returned, the message response is not sent until OCXcip_MsgResponse is called. See OCXcip_MsgResponse for more information.

If the service_proc callback returns OCX_CIP_DEFER_RESPONSE, it must save any needed data passed to it in the OCXCIPSERVSTRUC structure. This data is only valid in the context of the callback. If the received message contains data, the buffer pointed to by msgBuf can be accessed after the callback returns; however, the pointer itself is not valid.

Return Value

The service_proc routine must return one of the following values:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_SUCCESS</td>
<td>The message was processed successfully</td>
</tr>
<tr>
<td>OCX_CIP_BAD_INSTANCE</td>
<td>Invalid class instance</td>
</tr>
<tr>
<td>OCX_CIP_BAD_SERVICE</td>
<td>Invalid service code</td>
</tr>
<tr>
<td>OCX_CIP_BAD_ATTR</td>
<td>Invalid attribute</td>
</tr>
<tr>
<td>OCX_CIP_ATTR_NOT_SETTABLE</td>
<td>Attribute is not settable</td>
</tr>
<tr>
<td>OCX_CIP_PARTIAL_DATA</td>
<td>Data size invalid</td>
</tr>
<tr>
<td>OCX_CIP_BAD_ATTR_DATA</td>
<td>Attribute data is invalid</td>
</tr>
<tr>
<td>OCX_CIP_FAILURE</td>
<td>Generic failure code</td>
</tr>
<tr>
<td>OCX_CIP_DEFER_RESPONSE</td>
<td>Defer response until OCXcip_MsgResponse is called</td>
</tr>
</tbody>
</table>
Backplane API Library Functions  Chapter 5

Example

```c
OCXHANDLE Handle;
OCXCALLBACK service_proc( OCXHANDLE objHandle, OCXCIPSERVSTRUC *sServ )
{
  // Select which instance is being accessed.
  // The application defines how each instance is defined.
  switch(sServ->instance)
  {
    case 1: // Instance 1
      // Check serviceCode and attribute; perform
      // requested service if appropriate
      break;
    case 2: // Instance 2
      // Check serviceCode and attribute; perform
      // requested service if appropriate
      break;
    default:
      return(OCX_CIP_BAD_INSTANCE); // Invalid instance
  }
}
```

For more information, see the following:

- [OCXcip_RegisterAssemblyObj on page 59](#)
- [OCXcip_MsgResponse on page 108](#)

**fatalfault_proc**

**Syntax**

```c
OCXCALLBACK fatalfault_proc();
```

**Parameters**

None

**Description**

`fatalfault_proc` is an optional callback function that can be passed to the API in the OCXcip_RegisterFatalFaultRtn call. If the `fatalfault_proc` callback has been registered, it is called if the backplane device driver detects a fatal fault condition. This lets the application an opportunity to take appropriate actions.

**Return Value**

The `fatalfault_proc` routine must return OCX_SUCCESS.

**Example**

```c
OCXHANDLE Handle;
OCXCALLBACK fatalfault_proc( void )
{
  // Take whatever action is appropriate for the application:
  // - Set local IO to safe state
  // - Log error
  // - Attempt recovery (e.g., restart module)
  return(OCX_SUCCESS);
}
```

For more information, see [OCXcip_RegisterFatalFaultRtn on page 61](#).
## resetrequest_proc

**Syntax**

```c
OCXCALLBACK resetrequest_proc( );
```

**Parameters**

None

**Description**

`resetrequest_proc` is an optional callback function that can be passed to the API in the `OCXcip_RegisterResetRtn` call. If the `resetrequest_proc` callback has been registered, it is called if the backplane device driver receives a module reset request (Identity Object reset service). This lets the application an opportunity to take appropriate actions to prepare for the reset, or to refuse the reset.

**Return Value**

<table>
<thead>
<tr>
<th>OCX_SUCCESS</th>
<th>The module resets upon return from the callback.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCX_ERR_INVALID</td>
<td>The module does not reset and continues normal operation.</td>
</tr>
</tbody>
</table>

**Example**

```c
OCXHANDLE Handle;
OCXCALLBACK resetrequest_proc( void )
{
    // Take whatever action is appropriate for the application:
    // - Set local IO to safe state
    // - Perform orderly shutdown
    // - Reset special hardware
    // - Refuse the reset
    return(OCX_SUCCESS); // allow the reset
}
```

For more information, see [OCXcip_RegisterResetReqRtn](#) on page 61.
Program-controlled Status Indicators

The ControlLogix® Compute modules have the following to indicate the module conditions:

- Four-character Display
- Status Indicators

The user program controls the display and indicators. When the module powers up, the following occurs.

1. The right-most status indicator is solid red and the others are off.
2. The 4-character display shows a sequence of BIOS POST codes.
3. When the OS boots and the backplane driver loads, the status indicators cycle through a test sequence; each status indicator goes through a solid red, solid green, off cycle.
4. At the end of the test sequence, the right-most status indicator is solid green, and the 4-character display shows 'INIT'.

Figure 10 shows the indicators on the modules.

Figure 10 - ControlLogix Compute Module Indicators
Four-character Display

The ControlLogix Compute module includes a 4-character alphanumeric display. An application uses the `OCXcip_SetDisplay` function to show the 4-character message on the display.

Table 15 lists the messages that are displayed.

### Table 15 - Display Messages

<table>
<thead>
<tr>
<th>Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;blank&gt; or POST codes</td>
<td>Device driver has not yet been started (or application has written to the display)</td>
</tr>
<tr>
<td>INIT</td>
<td>Device driver has successfully started</td>
</tr>
<tr>
<td>OK</td>
<td>BPIE has successfully started</td>
</tr>
<tr>
<td>—</td>
<td>BPIE has stopped (host application has exited)</td>
</tr>
</tbody>
</table>

Status Indicators

The ControlLogix Compute modules have status indicators. An application uses the `OCXcip_SetLED` function to set the indicator condition.

Table 16 describes the possible indicator states.

### Table 16 - Indicator States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>The module is not powered.</td>
</tr>
<tr>
<td>Solid Green</td>
<td>The module operating normally.</td>
</tr>
<tr>
<td>Solid Red</td>
<td>One of the following:</td>
</tr>
<tr>
<td></td>
<td>• A major communication fault has occurred between the module and ControlLogix chassis backplane.</td>
</tr>
<tr>
<td></td>
<td>• You must troubleshoot your application to determine the cause of the solid red condition on indicator OK.</td>
</tr>
<tr>
<td></td>
<td>• A module shutdown is complete.</td>
</tr>
</tbody>
</table>
Specify the Communication Path

To construct a communications path, enter one or more path segments that lead to the target device. Each path segment goes from one module to another module over the chassis backplane or over an EtherNet/IP network.

Each path segment contains: \( p:x,\{s,c,t\}:y \)

Where: \( p:x \) specifies the device’s port number to communicate through.

Where \( x \) is:

1. backplane from any ControlLogix® module
2. Ethernet port from a ControlLogix EtherNet/IP module

\( , \) separates the starting point and ending point of the path segment

\( \{s,c,t\}:y \) - specifies the address of the module you are going to. Where:

\( s:y \) ControlLogix chassis slot number

\( t:y \) EtherNet/IP network IP address, for example, 10.0.104.140

If there are multiple path segments, separate each path segment with a comma (,).

**EXAMPLE**

To communicate from a module in slot 4 to a module in slot 0 of the same chassis. - \( p:1,s:0 \)

To communicate from a module in slot 4 of a chassis, through a 1756-EN2T in slot 2, over EtherNet/IP, to a 1756-EN2T (IP address of 10.0.104.42) in slot 4, to a module in slot 0 of a remote backplane. - \( p:1,s:2,p:2,t:10.0.104.42,p:1,s:0 \)
Notes:
Module Tag Naming Conventions

ControlLogix® tags are in the following categories:

- Controller Tags
- Program Tags

Controller Tags

Controller tags have global scope. To access a controller scope tag, you specify the tag name.

Table 17 - Example Controller Tags

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Single Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Array[1,3]</td>
<td>2 - Dimensional Array Element</td>
</tr>
<tr>
<td>Array[1,2,3]</td>
<td>3 – Dimensional Array Element</td>
</tr>
<tr>
<td>Structure.Element</td>
<td>Structure element</td>
</tr>
<tr>
<td>StructureArray[1].Element</td>
<td>Single Element of an array of structures</td>
</tr>
</tbody>
</table>
Program Tags

Program Tags are tags that are declared in a program and scoped only within the program in which they are declared.

To address a Program Tag correctly, you must specify the identifier “PROGRAM:” followed by the program name. A dot (.) is used to separate the program name and the tag name:

PROGRAM:ProgramName.TagName

<table>
<thead>
<tr>
<th>Tag</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROGRAM:MainProgram.TagName</td>
<td>Tag &quot;TagName&quot; in program called &quot;MainProgram&quot;</td>
</tr>
<tr>
<td>PROGRAM:MainProgram.Structure.Element</td>
<td>Structure element in program &quot;MainProgram&quot;</td>
</tr>
</tbody>
</table>

Table 18 - Example Program Tags

A tag name can contain up to 40 characters. It must start with a letter or underscore (“_”), however, all other characters can be letters, numbers, or underscores.

Names cannot contain two contiguous underscore characters and cannot end in an underscore. Letter case is not considered significant. The naming conventions are based on the IEC-1131 rules for identifiers.

For additional information on ControlLogix CPU tag addressing, see the following:

- ControlLogix System User Manual, publication 1756-UM001
- ControlLogix 5580 Controllers User Manual, publication 1756-UM543
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# Rockwell Automation Support

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