ControlLogix Compute Modules

Catalog Numbers 1756-CMS1B1, 1756-CMS1C1, 1756-CMS1D1, 1756-CMS1H1

Allen-Bradley by ROCKWELL AUTOMATION

User Manual

Original Instructions

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.

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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.

These 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).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

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About This Publication

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're 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)

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Updated information about the communication and security features available on all Series B ControlLogix Compute modules	10
Added Series B 1756-CMS1B1 Compute module Secure Boot information	32
Added Series B 1756-CMS1C1 Compute module to information about how to Implement a BIOS Password on Compute modules with an embedded Linux OS	38
Added Series B 1756-CMS1D1 and 1756-CMS1H1 Compute module Secure Boot information	39

Terminology

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

Term	Definition
API	Application Programming Interface
Backplane	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.
BPIE	Backplane Interface Engine Accesses the device driver on the backplane.
BIOS	Basic Input Output System. The BIOS firmware initializes the module at power-on, performs self-diagnostics, and loads the operating system.
CIP™	Common Industrial Protocol. The messaging protocol that is used for communications over the ControlLogix backplane.
Connection	A logical binding between two objects. A connection lets more efficient use of bandwidth occur because the message path isn't included once the connection is established.
Consumer	A destination for data.
DLL	Dynamic Link Library
Library	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.
Mutex	A system object that is used to provide mutually exclusive access to a resource.
Originator	A client that establishes a connection path to a target.
Producer	A source of data.
SDK	Software Development Kit. A collection of files necessary to develop an application
Target	The end node to which an originator establishes a connection.
Thread	Code that is executed within a process. A process can contain multiple threads.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation. You can view or download publications at rok.auto/literature.

Resource	Description
ControlLogix Compute Modules Installation Instructions, publication 1756-IN072	Describes how to install ControlLogix Compute modules.
1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002	Provides specification information for ControlLogix I/O modules
EtherNet/IP Network Devices User Manual, ENET-UM006	Describes how to configure and use EtherNet/IP™ devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

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 64 bit
- Linux 32 bit (Debian)
- Linux 64 bit (Debian)
- Linux 64 bit (Red Hat Enterprise Linux)

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 IoT Enterprise 64-bit OS • Debian Linux OS 32 bit refers to the 32 bit Debian GNU/Linux OS • Debian Linux OS 64 bit refers to the 64 bit Debian GNU/Linux OS • Red Hat Linux OS 64 bit refers to the 64 bit Red Hat Enterprise Linux (RHEL) OS

The embedded OS lets you perform tasks on the controller that would otherwise be 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-CM*Sxyz***, where the following apply:

- 1756 is the Bulletin number.
- CMS = Compute Module
- *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

This table describes the variables in a ControlLogix Compute module catalog number.

ControlLogix Compute Module Catalog Numbers

Variable	Attribute	Possible Value
x	SSD capacity	• 1 = 32 GB
y	Operating system	• B = Windows OS • C = Debian Linux OS 32 bit • D = Debian Linux OS 64 bit • H = Red Hat Linux OS 64 bit
z	Application that is shipped on the module	1 = No application

For example, these catalog numbers are described as follows:

- 1756-CMS1B1 - 32 GB SSD, and an embedded Windows 10 IoT Enterprise 64-bit OS.
- 1756-CMS1C1 - 32 GB SSD, and an embedded Linux 32 bit (Debian) OS.
- 1756-CMS1D1 - 32 GB SSD, and an embedded Linux 64 bit (Debian) OS.
- 1756-CMS1H1 - 32 GB SSD, and an embedded Linux 64 bit (Red Hat) OS.

  Modules do not include a preloaded application.

Series B ControlLogix Compute Module Features

This section describes the communication and security features available on all Series B ControlLogix Compute modules.

Double Data Rate (DDR) Backplane Communication

Series B Compute modules provide DDR synchronous dynamic random access memory transfer across the ControlLogix backplane. DDR computer memory sends and receives data twice per cycle, moving larger amounts of data at a faster rate than SDRAM. However, DDR does not impact the transfer rate of smaller amounts of data.

Trusted Platform Module (TPM) 2.0 Settings

TPM 2.0 is a secure crypto-processor component that improves hardware security by allowing you to verify when software is running on your system and how it’s configured.

Series B Compute modules come with TPM 2.0 enabled by default. TPM can be disabled by changing the Advanced>Trusted Computing>Security Device Support option within the BIOS setup.

Module Components

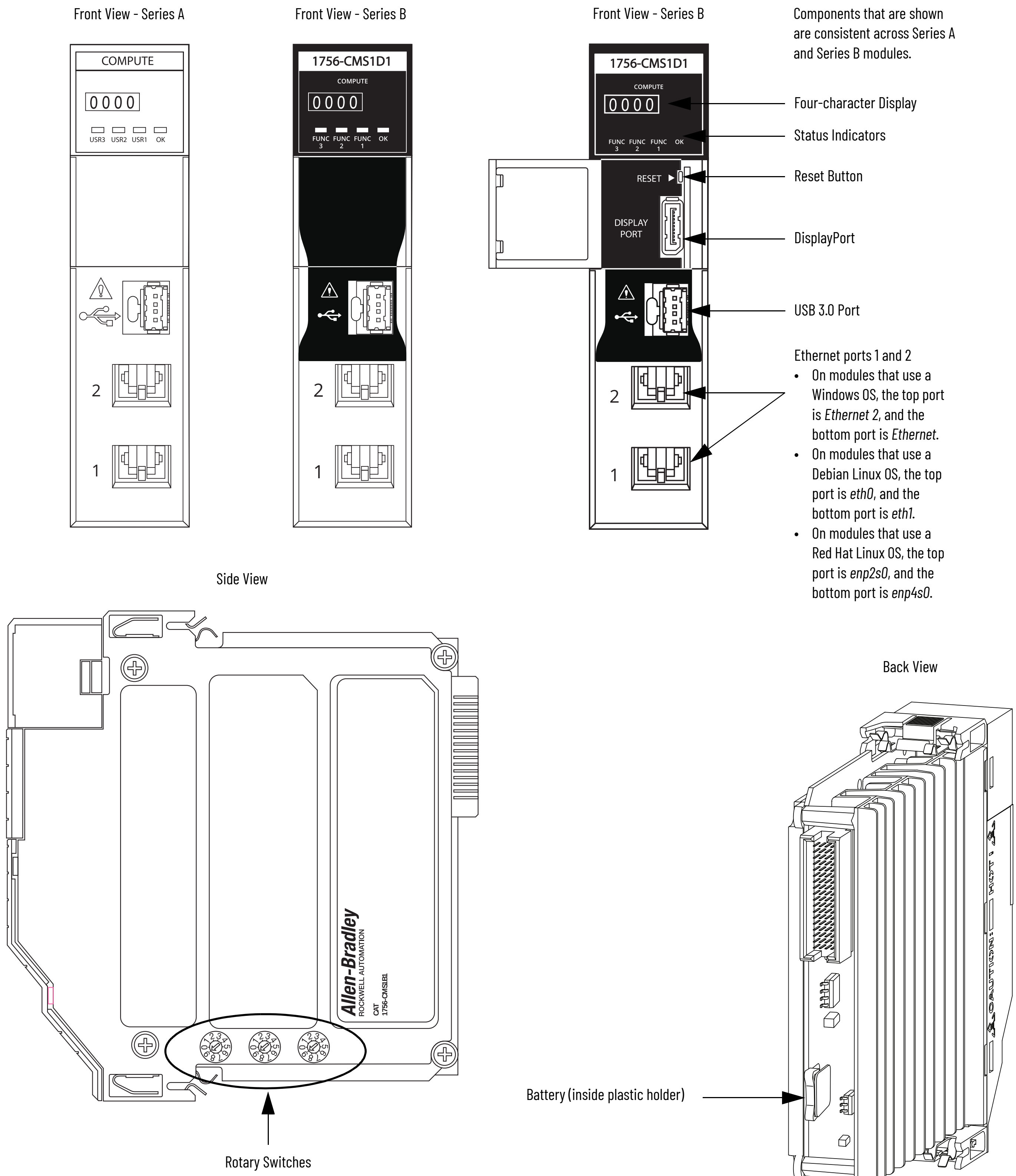
This table describes the components available on all ControlLogix Compute modules.

ControlLogix Compute Module Components

Component	Description
One of the following embedded OS: • Windows OS • Linux OS	Lets you install commercially available software and/or create custom applications while using the backplane API.
Onboard memory	4 GB - RAM
Four-character display	Scrolls information about the module. For example, the characters INIT scroll across the display after a device driver starts successfully.
Status indicators	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.
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 isn’t powered.

This figure shows the components that are visible on a ControlLogix Compute module.

ControlLogix Compute Module Components



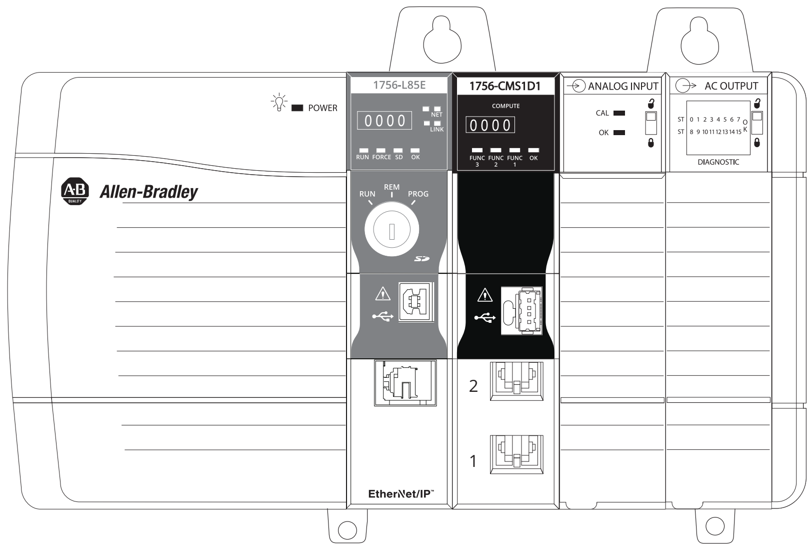
Module Location

A ControlLogix Compute module can reside locally in the same chassis as the controller or in a chassis that is remote from the controller with which it communicates.

Local Chassis

This figure shows a ControlLogix 5580 control system that includes a ControlLogix Compute module.

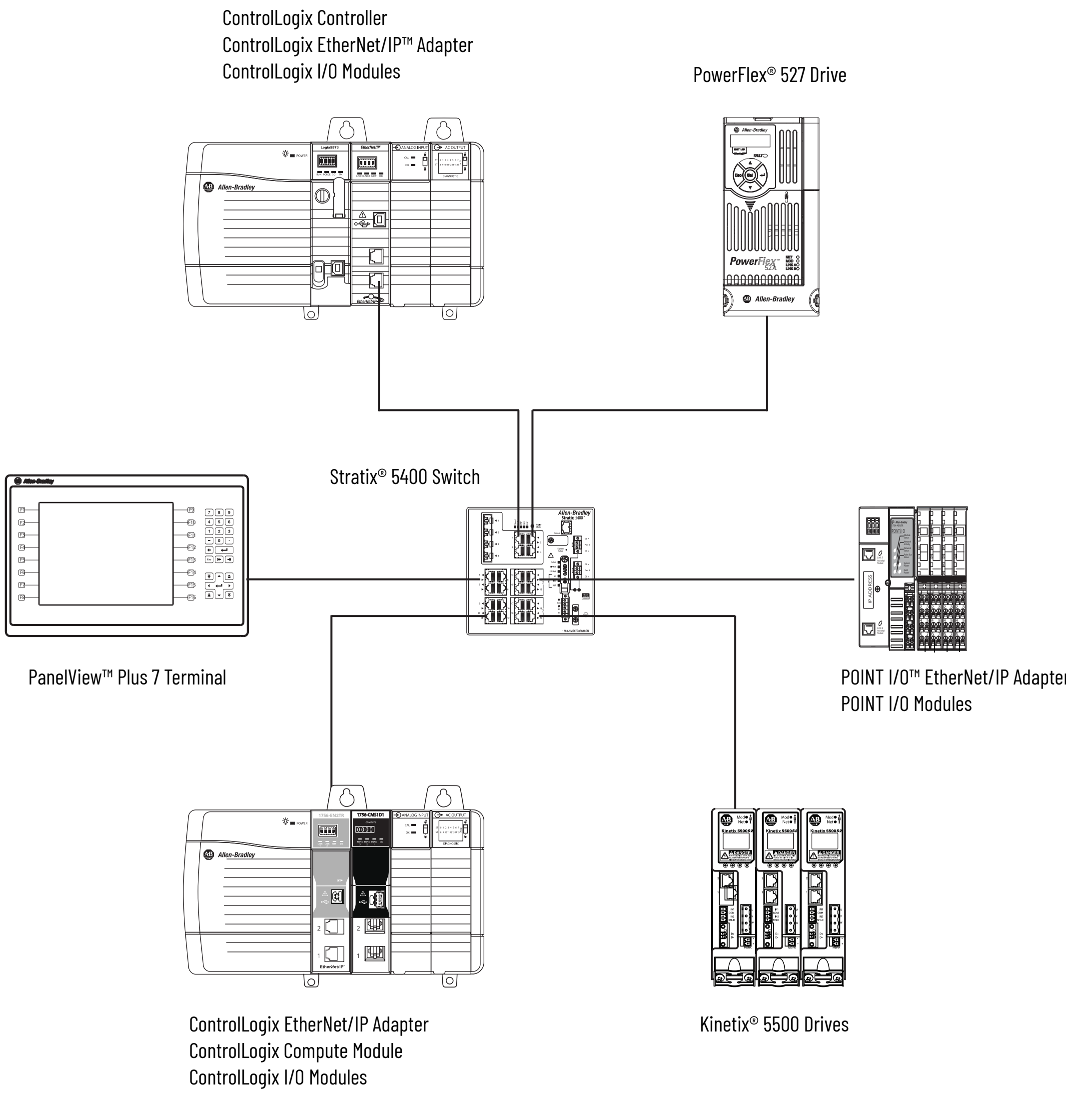
ControlLogix 5580 System with Compute Module



Remote Chassis

This figure shows a control system with a ControlLogix Compute module in a remote chassis.

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.

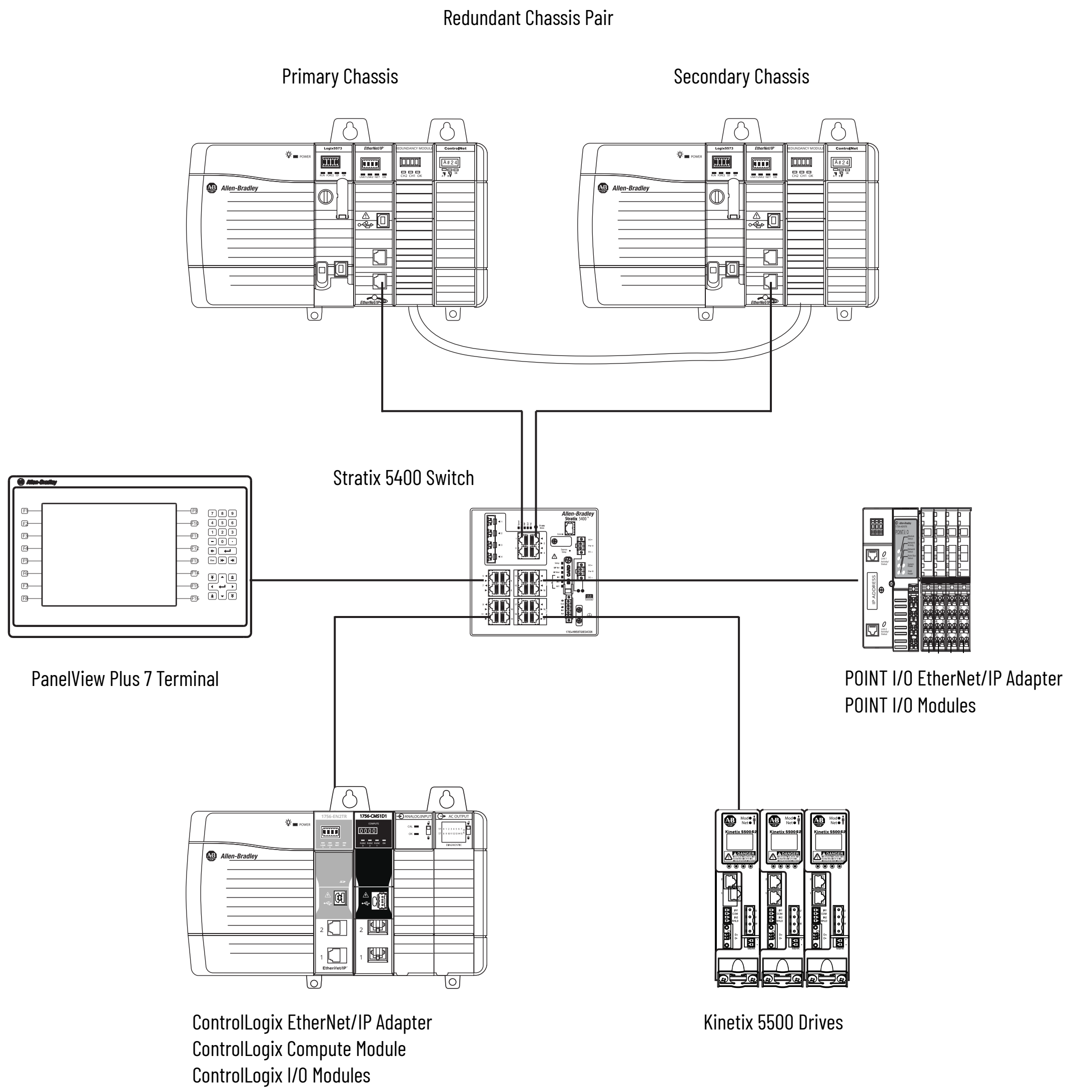
IMPORTANT	The module can't reside in the primary or secondary chassis.

- 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 47.

This figure shows a redundancy system with the Compute module in a remote chassis.

ControlLogix Redundancy System with Compute Module in Remote Chassis



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 107.

Connection Options

You can connect to various device types using the multiple ports available on ControlLogix Compute modules.

DisplayPort

The DisplayPort interface allows you to connect the following industrial monitors to the Compute module to use with the embedded OS:

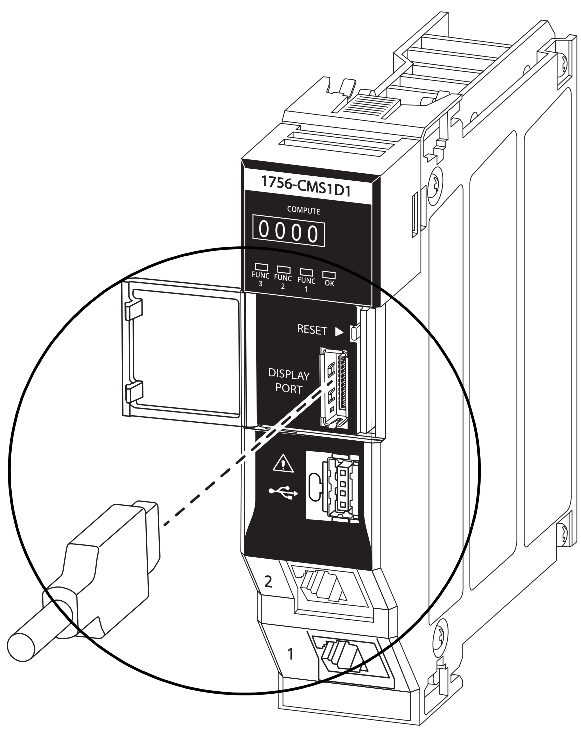
- Super Video Graphics Array (SVGA) to HD 1080p
- High-Definition Multimedia Interface (HDMI)
- Video Graphics Array (VGA)
- Digital Visual Interface (DVI)
- DisplayPort

You must use a VESA-certified DisplayPort adapter to connect some industrial monitors to the module.

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 connect 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 21.

Connect a Cable to the DisplayPort



USB 3.0 Port

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 multiple peripherals to the module via the USB port.

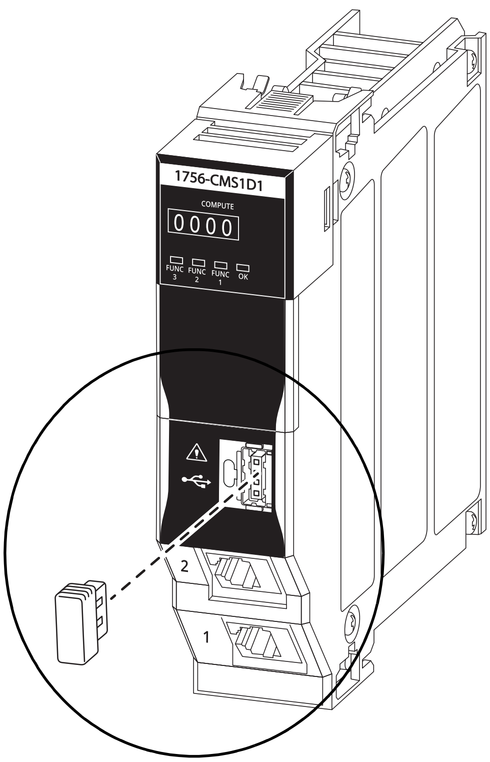
We recommend the following:

- Connect any 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.

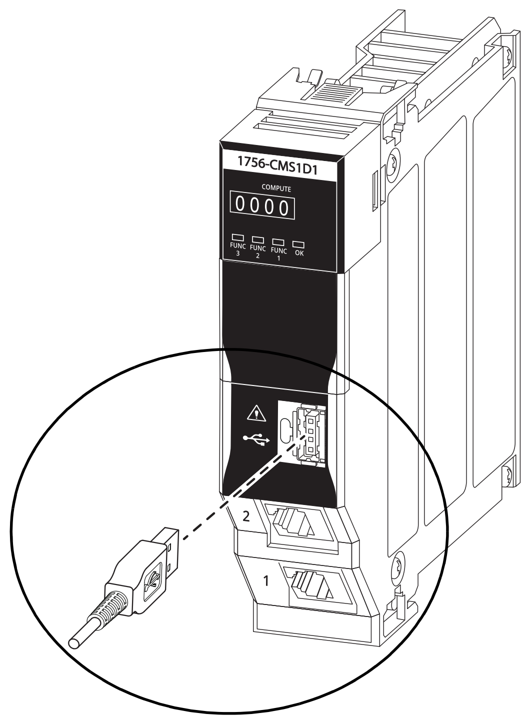
IMPORTANT	When fully inserted, the USB connectors lock into the USB port. Before you remove a USB connector, press the silver release tab on the left side of the USB port.

Connect to the USB Port

USB Dongle Connection



USB Cable Connection



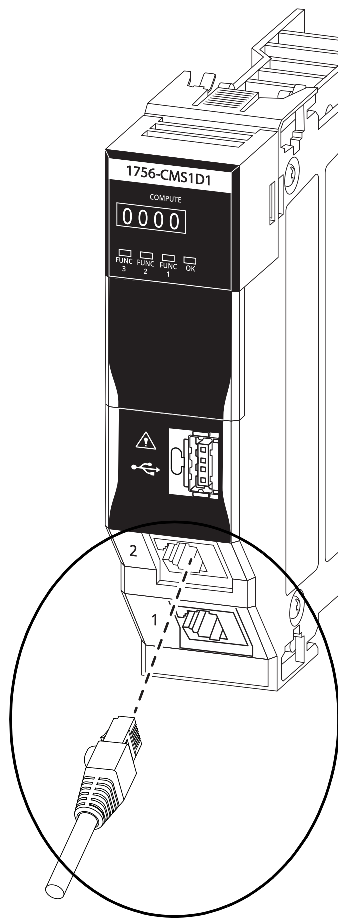
Ethernet Ports

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 aren't 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.

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.

This table describes the default configuration of the Ethernet ports in a ControlLogix Compute module.

ControlLogix Compute Module Default Ethernet Port Configuration

<table>
<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>
<tr><td rowspan="2">Windows OS</td><td>Top Port</td><td>Ethernet 2</td><td rowspan="2" colspan="2">None - Ports are DHCP-enabled. You can use a DHCP server or other software tool to set the address and mask.</td></tr>
<tr><td>Bottom Port</td><td>Ethernet</td></tr>
<tr><td rowspan="2">Debian Linux OS</td><td>Top Port</td><td>eth0</td><td>192.168.1.250</td><td>255.255.255.0</td></tr>
<tr><td>Bottom Port</td><td>eth1</td><td colspan="2">None - Port is DHCP-enabled. You can use a DHCP server or other software tool to set the address and mask.</td></tr>
<tr><td rowspan="2">Red Hat Linux OS</td><td>Top Port</td><td>enp2s0</td><td rowspan="2" colspan="2">None - Ports are DHCP-enabled. You can use a DHCP server or other software tool to set the address and mask.

However, by default, ports are disabled.
• To bring up either port upon a singular boot, run command: nmcli con up [port name]. At the next boot, the port will be disabled.
• To bring up either port at every boot, run command: nmcli con mod [port name] connection.autoconnect yes
• See the Red Hat Network Manager documentation for more information.</td></tr>
<tr><td>Bottom Port</td><td>enp4s0</td></tr>
</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.

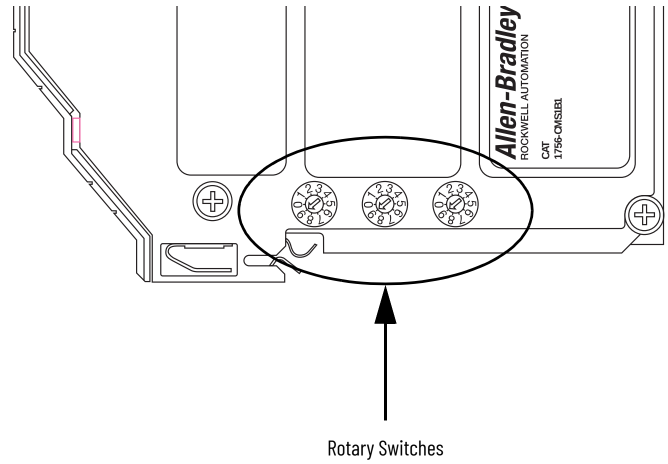
- You can use any IP address and mask values in your application.
- You can configure the IP address and mask to be static or dynamic.
  - If an IP address and mask are static, they remain assigned to a port after power is cycled to the module.
  - If an IP address and mask are dynamic, they're cleared 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 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 aren't used until module operation begins.

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.

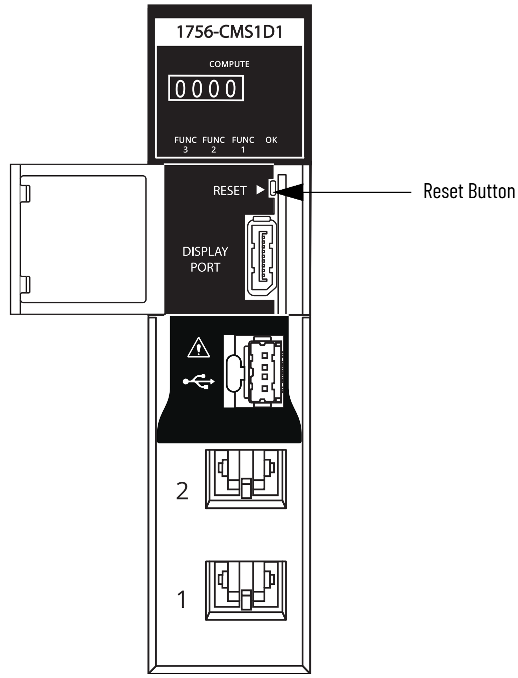
EXAMPLE	Your application can dictate that part of the module power-up sequence includes using the number set by the switches as the final three numbers in the port 1 IP address. The rotary switches set the octet according to 100 s, 10 s, 1 s from left to right. In this example, if you set the switches 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

The reset button is behind the door on the front of the Compute module.

ControlLogix Compute Module Reset Button



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.

Use a tool with a small head, for example, a small screwdriver, to press the reset button when the module is powered.

ControlLogix Compute Module Reset Button Actions and Results

Action	Result
Press and release the button when the embedded OS is running.	Performs an orderly shutdown of the embedded OS. When the shutdown is complete, the OK status indicator is in a steady red state.
Press and release the button when the embedded OS isn't running.	Starts the embedded OS.
Press and hold the button down for 6 seconds.	Performs a reset of the embedded OS. When the reset is complete, the OK status indicator is in a steady red state.

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. Verify 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 crash.

Replacement Battery

Compute modules use a battery to maintain the real-time clock on the module when there's no power that is applied to the 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.

Battery life depends on how much time that the module isn't powered. When the module is installed in a powered ControlLogix chassis, the battery isn't used. Thus, the life of the battery is greater.

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

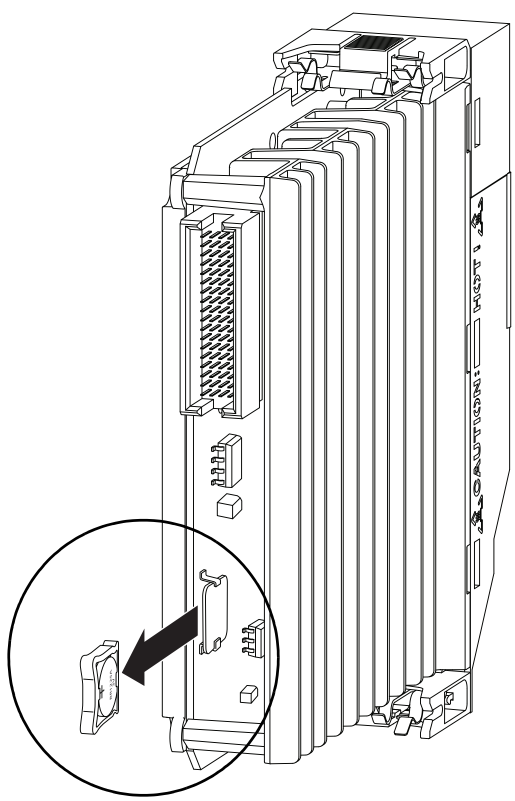
Consider designing your application to check the system date on the module periodically, and, if the system date is incorrect, alert you that the battery must be replaced.

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.

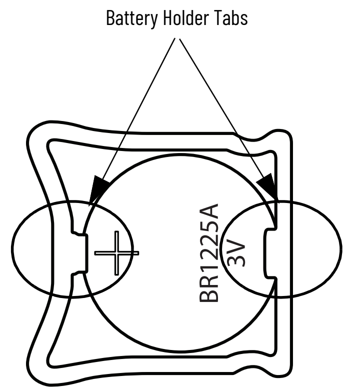
   IMPORTANT There are metal guides that hold the battery holder in place. Do not attempt to remove the metal guides.



2. Remove the old battery from the holder.

3. Install a new battery into the holder.

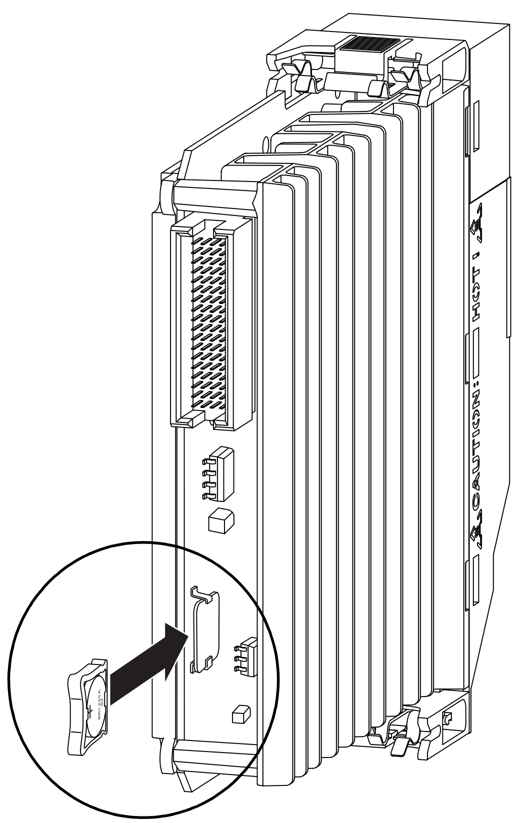
   The side of the battery with words and numbers is installed in the side of the holder with tabs to hold it in place.



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:

Windows Operating System Overview

This chapter describes the embedded Windows® 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 the design guidelines of your company, but also general good engineering practices and behaviors.

For example, it's 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).

It is your responsibility to protect and secure the operating system and application layers of your module from malware and network attacks. This protection includes being aware of any vulnerabilities, configuring, and keeping applications and operating systems up to date in accordance with general security best practices.

Connect Monitor and Peripherals Before Powerup

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 with three exceptions that are described at Inactivity Lock and Screen Saver Settings on page 26.

For detailed information on Microsoft Security Baseline for Windows 10, see: https://docs.microsoft.com/en-us/windows/security/threat-protection/windows-security-configuration-framework/windows-security-baselines.

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.

  The descriptions aren't 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

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

Inactivity Lock and Screen Saver Settings

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

- In the Baseline, the policies are set so that a screen saver launches if no activity occurs for a specified period. Once the screen saver launches, the password is entered to access the module.
- In the embedded Windows OS on the Compute module, a screen saver does not launch and the account isn't locked. This is the case regardless of the length of time that no activity occurs on the OS.

This table describes the changes that were made to disable the inactivity lock and screen saver policies.

Inactivity Lock and Screen Saver Policy Changes

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

For more information on these policies in the Microsoft Security Baseline for Windows 10, see https://docs.microsoft.com/en-us/windows/security/threat-protection/security-policy-settings/interactive-logon-machine-inactivity-limit.

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's 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 can't recover the password if you forget or lose it. If you can't 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.

This table describes some of the password policies.

ControlLogix Compute Module Password Policies

Policy	Description
Password change	The following apply: • You must change the password every 60 days. When 60 days have expired, you're prompted to change the password the next time that you log in. • After you change the password, you can't change it again for at least 1 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 can't be the same as the previous 24 passwords that were used on the module.

For more information on the Password Policy in the Microsoft Security Baseline for Windows 10, see https://docs.microsoft.com/en-us/windows/security/threat-protection/security-policy-settings/password-policy.

Account Lockout Settings

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

ControlLogix Compute Module Account Lockout Policies

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

For more information on the Account Lockout Policy in the Microsoft Security Baseline for Windows 10, see https://docs.microsoft.com/en-us/windows/security/threat-protection/security-policy-settings/account-lockout-policy.

Network Settings

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

ControlLogix Compute Module Network Policies

Policy	Description
Local account access over network	Local accounts are denied permission to log on to the module over the network.
Windows Firewall	Windows Firewall policy that local policy manages.

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

- Local account access over network policy - https://docs.microsoft.com/en-us/windows/security/threat-protection/security-policy-settings/deny-access-to-this-computer-from-the-network
- Windows Firewall policy - https://docs.microsoft.com/en-us/windows/security/threat-protection/windows-firewall/basic-firewall-policy-design

Internet Explorer Settings

You can use Internet Explorer (IE), which comes installed on your Compute module. This table describes some of the IE policies.

ControlLogix Compute Module IE Policies

Policy	Description
Restrictions on using IE	Restrictions exist to account for unsafe ActiveX controls. The restrictions include: • You can't use IE to run outdated controls. • You can't use IE to run some controls that aren't outdated.
Java configuration	Java is configured on the module to run with High Safety settings on the following: • Trusted Sites Zone • Intranet Zone

For more information on the IE policies, see https://docs.microsoft.com/en-us/windows/client-management/mdm/policy-csp-internetexplorer

Removable Media Settings

You can use removable media with your Compute module. This table lists removable media policies.

ControlLogix Compute Module Removable Media Policies

Policy	Description
Removable media use	Removable media that isit'sit is protected by BitLocker.
Autoplay	Autoplay is disabled.

For more information about BitLocker write protection options on a USB drive, see Knowledgebase Technote *BitLocker options with USB drive when using Windows 10 Compute module or CompactLogix 5480 Controller.* (Login required to view full answer content.)

For more information on the Removable Media Policy in the Microsoft Security Baseline for Windows 10, see https://docs.microsoft.com/en-us/windows/client-management/change-default-removal-policy-external-storage-media

Remote Desktop Settings

Remote Desktop Protocol (RDP) is a secure, encrypted login service that allows you to connect to and control your Compute module using a desktop client computer over a network connection. RDP is disabled by default.

You can configure the System Properties of your Compute module desktop to allow remote connections. If you intend to use RDP after it's enabled, ensure a secure connection by adjusting the Local Security Policy and either forcing the connection type from Public to Private or adding firewall rules that allow Remote Desktop traffic for the Public connection type.

For more information on how to enable and configure remote desktop access, see Knowledgebase Technote *How do you configure remote desktop access to the ControlLogix Compute Module or CompactLogix 5480?* (Login required to view full answer content.)

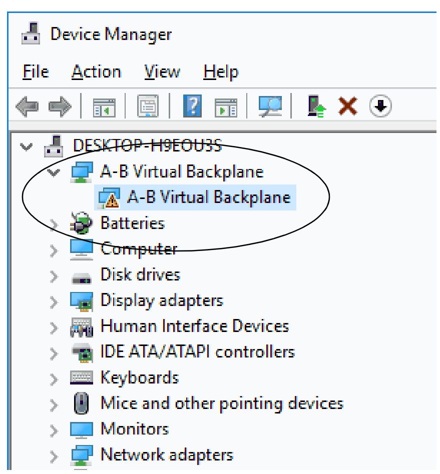
A Compute module with RDP enabled has a Microsoft Windows® local group policy setting that requires a password upon connection, even if one was already provided in the Remote Desktop Connection client. This RDP setting is enabled by default.

For more information on how to disable this setting, see Knowledgebase Technote *Is it possible to save login credentials when making a Remote Desktop connection to the 1756-CMS compute module?* (Login required to view full answer content.)

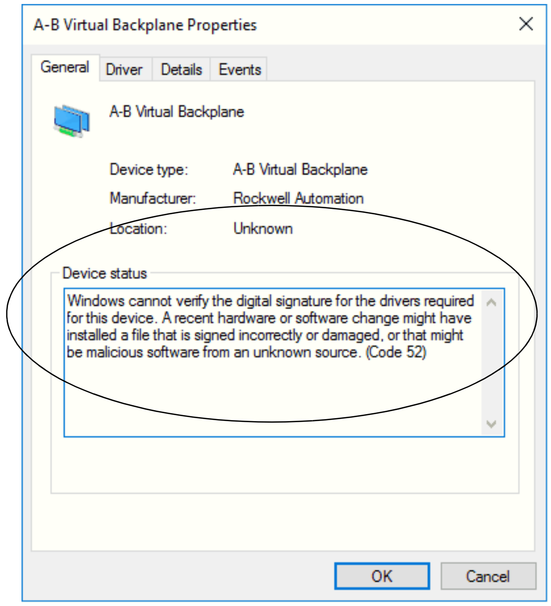
Driver Signature Enforcement

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 must 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 Compute module that uses an embedded Windows OS, complete these steps.

IMPORTANT	After you implement a BIOS password, you can change it. However, you can't recover the BIOS password if you forget or lose it.

1756-CMS1B1/A Module BIOS Security Settings

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 Setup, 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. Press F10 to Save and Exit or use your keyboard to navigate to the Exit menu and select Exit Saving Changes.

1756-CMS1B1/B Module BIOS Security Settings

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 Delete key.
4. In the BIOS Setup, use the arrow keys on your keyboard to navigate to the Security menu.
5. On the Security menu, the following options are available:
   - Setup Administrator Password
   - User Password
   - HDD Security Configuration
6. If you want to set an administrator password that will be required to enter BIOS Setup in the future, select Setup Administrator Password and follow the prompts.
7. If you want the BIOS login procedure to appear whenever the Compute module starts up in the future, select User Password and follow the prompts.
8. Use the arrow keys to navigate to the Save and Exit page and select Save Changes and Exit.

Secure Boot

Series B 1756-CMS1B1 Compute modules support secure boot. Secure boot is a security standard that helps make sure that a device boots using only software that is trusted by the Original Equipment Manufacturer (OEM).

To enable or disable secure boot on a Series B 1756-CMS1B1 Compute module that uses the embedded Windows OS, 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 Delete.
4. In the BIOS Setup, use the arrow keys on your keyboard to navigate to the Security menu.
5. Use the down arrow to select Secure Boot, then press Enter.
6. Set the Secure Boot option to Enabled or Disabled.
7. Press F4 to Save and Exit or use your keyboard to navigate to the Save & Exit menu and select Save Changes and Exit.

Information on the Module Can't Be Erased

Once you load data on a Compute module, it stays on the module permanently. You can't 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 disk drive memory on the Compute module, deletion of a file does not remove all 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 Can't 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 can't be recovered.
- You must return the module to Rockwell Automation, where it's reimaged or replaced.

  If Rockwell Automation can reimage the module, it's reimaged to its out-of-box condition.

Linux Operating System Overview

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

Follow Design and Engineering Best Practices

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 the design guidelines of your company, but also general good engineering practices and behaviors.

For example, it's 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).

We recommend that you visit the Product Compatibility and Download Center (PCDC) for the latest firmware, associated files (such as AOP, EDS, and DTM), and product release notes.

It is your responsibility to protect and secure the operating system and application layers of your module from malware and network attacks. This protection includes being aware of any vulnerabilities, configuring, and keeping applications and operating systems up to date in accordance with general security best practices.

Connect Monitor and Peripherals Before Powerup

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 21.

The embedded Linux OS on your Compute module only uses command lines. Unless you install a third-party, desktop environment, you can't use a mouse with a Linux OS, so there's no reason to connect one to the module.

Security Settings

The embedded Linux OS on a 1756-CMS1C1 or 1756-CMS1D1 module is configured per the Center for Internet Security (CIS) Debian Linux Benchmark Level 1 profiles with exceptions that are described on page 37.

For detailed information on CIS Debian Linux Benchmark Level 1 profiles, from now on referred to 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.

  The descriptions aren't exhaustive descriptions, though. 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's a login the first time that you power up a Compute module that uses an embedded Linux OS.

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

After the first login, you may be prompted to change the password.

IMPORTANT	After you implement a password, you can change it. However, you can't recover the password if you forget or lose it. If you can't 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.

This table describes some of the password policies.

ControlLogix Compute Module Password Policies

Policy	Description
Password change	The following apply: • You must change the password every 90 days. When 90 days have expired, you're to change the password the next time that you log in. • After you change the password, you can't 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 can't 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. This table describes some of the account lockout policies.

ControlLogix Compute Module Account Lockout Policies

Policy	Description
Password to unlock account	An account is locked after 10 failed attempts to log in.
Access to a locked account	The following apply: • Once an account is locked, you can attempt to log in again after 15 minutes. • A system administrator can manually unlock the account for a general user before 15 minutes expire.

Secure Shell Access Settings

Secure Shell (SSH) is a secure, encrypted login service that helps 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.

SSH Service on 1756-CMS1C1 and 1756-CMS1D1 Modules

The SSH service is disabled by default on modules with an embedded Debian Linux OS. To enable the SSH service, run the appropriate command as root. If you intend to use SSH after it's enabled, you must start the service and configure IPTables or nftables to permit connections on the SSH port.

This table describes the command and configuration settings that are required to enable and configure SSH on a 1756-CMS1C1 or 1756-CMS1D1 module.

1756-CMS1C1 and 1756-CMS1D1 Module SSH Server Commands and Settings

Module	Run Command As Root	Configuration Settings	Additional Debian Firewall Information
1756-CMS1C1/A	update-rc.d ssh enable	IPTables	https://wiki.debian.org/DebianFirewall
1756-CMS1C1/B	systemctl enable ssh	nftables	https://wiki.debian.org/nftables
1756-CMS1D1	systemctl enable ssh	nftables	https://wiki.debian.org/nftables

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

The **PermitRootLogin** parameter specifies if root users can use the SSH service to log in. By default, they can't. This table describes some additional SSH policies.

ControlLogix Compute Module SSH Policies

Policy	Description
SSH Root Login	SSH Root Login is disabled. Only a system administrator can use it.
SSH Session Termination	If a user is logged into the module via the SSH Root Login, the session is terminated after 5 minutes without any activity.

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

SSH Service on 1756-CMS1H1 Modules

The SSH service is enabled and the firewall is open by default on 1756-CMS1H1 modules with an embedded Red Hat Linux OS. Use nftables to make modifications to the SSH server configuration settings. See the Red Hat Network Manager documentation for more information.

This table describes the command and configuration settings that are required to enable and configure SSH on a 1756-CMS1H1 module.

1756-CMS1H1 Module SSH Server Commands and Settings

Module	Run Command As Root	Configuration Settings	Additional Red Hat Firewall Information
1756-CMS1H1	nmcli enable ssh	nftables	Red Hat Network Manager documentation

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 startup 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.

Ping Settings

The Linux ping command is a simple utility that is used to troubleshoot network connectivity issues or check if a remote host is reachable.

By default, the 1756-CMS1C1 or 1756-CMS1D1 Module IP Tables are configured to allow outbound ping requests and block all inbound ping requests. To enable all inbound ping requests to the Compute Module, see Knowledgebase Technote, *1756-CMS: Enabling ping on Linux based modules*. (Login required to view full answer content.)

By default, the 1756-CMS1H1 Module IP Tables are configured to allow both outbound and inbound ping requests.

Settings Not Implemented On the Module

Some settings in the CIS Debian Linux Benchmarks aren't implemented in the embedded Linux OS. This table describes the settings that aren't implemented on the embedded Linux OS in out-of-box condition.

Settings Not Implemented in the Embedded Linux OS

Policy	Description
Network Time Protocol (NTP) configuration.	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.
Specific systems that are granted or denied access to the module.	These files are used to help make sure that only authorized systems can access the module: • The ***/etc/host.allow*** file specifies the IP addresses from which systems can access to the module. • The ***/etc/host.deny*** file specifies the IP addresses from which systems are denied access to the module. Neither file is configured.
Warning banners as part of the login procedure.	Warning banners that are part of the login procedure can help prosecute unauthorized users who access the module with malicious intent. They can also hide detailed system information from unauthorized users attempting to inflict damage to the system. By default, before you can log into the module, the ***/etc/issue*** file displays the warning message, "Authorized uses only. All activity may be monitored and reported." However, the ***/etc/motd*** file isn't set in the 1756-CMS1C1 or 1756-CMS1D1 modules. This file defines the warning message that is displayed after a successful login. We **recommend that you add this warning banner** to your module's login procedure.
IPv6 support	While IPv6 is enabled on 1756-CMS1H1 modules, by default, the 1756-CMS1C1 or 1756-CMS1D1 module IPv6 settings aren't enabled because IPv6 isn't recommended under CIS Debian Benchmark guidelines.
Sends logs to a remote log host.	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 ***rslog*** utility isn't configured.
Rotating log files regularly.	The ***logrotate*** file can be configured to rotate log files that the ***rsyslog*** utility creates to avoid filling up the system with logs or making the log too large to manage. The ***logrotate*** uses the default configuration.
List of users and group permitted access via SSH	There's no list of users or groups that can access the embedded OS via SSH.

For more information, 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 applies to a Compute module with an 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 Compute module that uses an embedded Linux OS, complete these steps.

IMPORTANT	After you implement a BIOS password, you can change it. However, you can't recover the BIOS password if you forget or lose it.

1756-CMS1C1/A Module BIOS Security Settings

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 Setup, 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. Press F10 to Save and Exit or use your keyboard to navigate to the Exit menu and select Exit Saving Changes.

1756-CMS1C1/B, 1756-CMS1D1 and 1756-CMS1H1 Module BIOS Security Settings

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 Delete key.
4. In the BIOS Setup, use the arrow keys on your keyboard to navigate to the Security menu.
5. On the Security menu, the following options are available:
   - Setup Administrator Password
   - User Password
   - HDD Security Configuration
6. If you want to set an administrator password that will be required to enter BIOS Setup in the future, select Setup Administrator Password and follow the prompts.
7. If you want the BIOS login procedure to appear whenever the Compute module starts up in the future, select User Password and follow the prompts.
8. Use the arrow keys to navigate to the Save and Exit page and select Save Changes and Exit.

Secure Boot

The 1756-CMS1D1 and 1756-CMS1H1 Compute modules support secure boot. Secure boot is a security standard that helps make sure that a device boots using only software that is trusted by the Original Equipment Manufacturer (OEM).

To check whether your system has Secure Boot enabled or disabled, run the following command: **/usr/bin/mokutil --sb-state**

The system will display **SecureBoot enabled** if Secure Boot is enabled.

The system will display **Failed to read SecureBoot** if Secure Boot is disabled.

To disable or enable secure boot on a 1756-CMS1D1 and 1756-CMS1H1 Compute module, complete these steps:

1. Run one of the following commands:
   - **/usr/bin/mokutil --disable-validation** to disable Secure Boot.
   - **/usr/bin/mokutil --enable-validation** to enable Secure Boot.

   The system prompts you for a password.
2. Enter a temporary password and confirm the password when prompted.

   Tip: Ensure you remember this temporary password because you are required to enter it when you first restart the system after changing the Secure Boot state.
3. Reboot the system.

   The system restarts and displays the MOK management screen.
4. Press any key to perform MOK management.
5. Select **Change Secure Boot state**.
6. Enter each requested character of your chosen password to confirm the change, pressing Return/Enter after each character.
7. When prompted, select **Yes**.

   The system prompts you to restart.
8. Reboot the system.

Information on the Module Can't Be Erased

Once you load data on a Compute module, it stays on the module permanently. You can't 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 remove all 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 Can't 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 can't be recovered.
- You must return the module to Rockwell Automation, where it's reimaged or replaced.

  If Rockwell Automation can reimage the module, it's reimaged to its out-of-box condition.

Notes:

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.

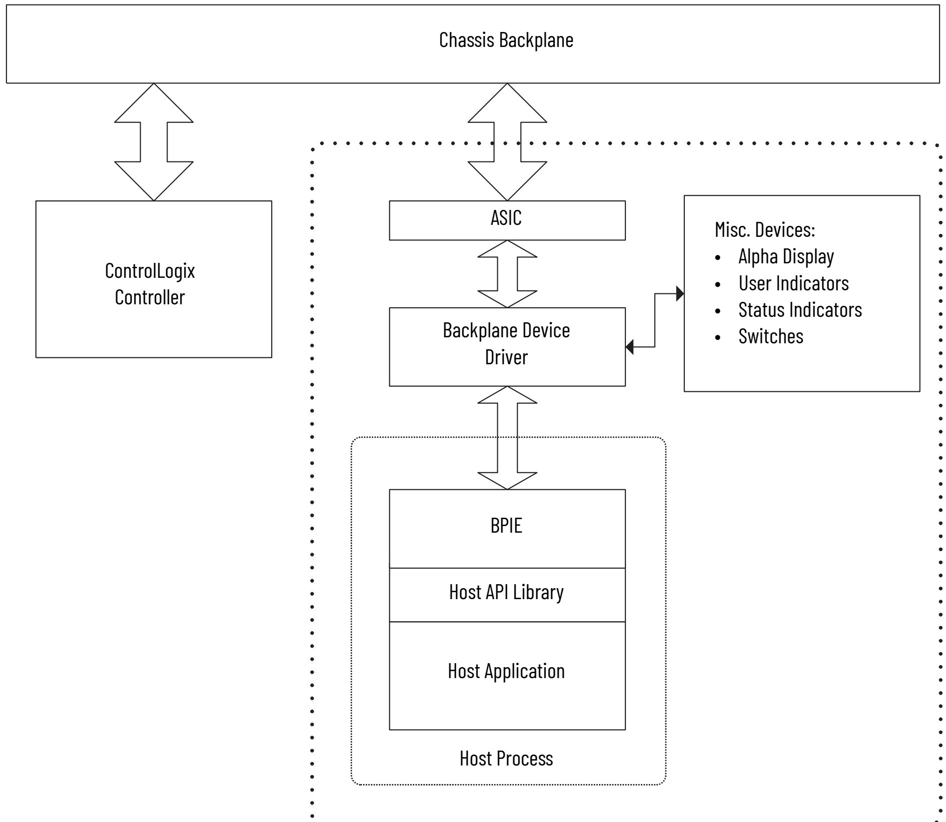
The backplane device driver allocates device resources, directly manipulates hardware devices, and fields device interrupts. The BPIE accesses the device driver.

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 isn't a standalone process; it requires a host application. This design lets the host application that is 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.

This figure shows the relationships between these components.

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: rok.auto/pcdc.

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. Select Uninstall.
4. Remove all components of the API by following the prompts.

Four-character Alphanumeric Display

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

Display Messages

Message	Description
<blank> or POST codes	Device driver hasn't yet been started (or application has written to the display)
INIT	Device driver has successfully started
OK	BPIE has successfully started
—	BPIE has stopped (host application has exited)

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 your 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 aren't documented in this guide. These functions are deprecated and can't be used. They remain in the API for legacy applications. The deprecated functions are listed on page 44.

Deprecated Functions

These functions appear in the header files but aren't documented in this publication:

- OCXcip_ClientOpen (not supported)
- OCXcip_SetEmbeddedEDSFile
- 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_AccessTagDataDb)
- OCXcip_RdIdStatusDefine (superseded by OCXcip_GetDeviceIdStatus)
- OCXcip_PLC5GetIDHost (legacy, undocumented)
- OCXcip_ReadSectionPLC5 (legacy, undocumented)
- OCXcip_MLGXProtTypedRead (legacy, undocumented)
- OCXcip_MLGXProtTypedWrite (legacy, undocumented)
- OCXcip_MLGXReadModWrite (legacy, undocumented)
- OCXcip_MLGX14ProtTypedRead (legacy, undocumented)
- OCXcip_MLGX14ProtTypedWrite (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

This table lists the supplied API files that are required for development.

API File Names

File Name	Description
ocxbpapi.h	Main API include file
ocxtagdb.h	Include file for tag access function
ocxbpapi.lib	API Import library (Microsoft COFF format)

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’s freed.

Notes:

Backplane API Library Functions

This table lists the Backplane API library functions. Details for each function are presented in subsequent sections.

Library Functions

Category	Name	Description	Page
Initialization	OCXcip_Open	Starts the BPIE and initializes access to the API	49
	OCXcip_OpenNB	Provides access to non-backplane functions	50
	OCXcip_Close	Terminates access to the API	50
Object Registration	OCXcip_RegisterAssemblyObj	Registers all instances of the Assembly Object, and lets other devices in the CIP™ system to establish connections with the object. Callbacks are used to handle connection and service requests.	51
	OCXcip_UnregisterAssemblyObj	Unregisters all instances of the Assembly Object that had previously been registered. Subsequent connection requests to the object are refused.	52
Callback Registration	OCXcip_RegisterFatalFaultRtn	Registers a fatal fault handler routine	52
	OCXcip_RegisterResetReqRtn	Registers a reset request handler routine	53
Connected Data Transfer	OCXcip_Write Connected	Writes data to a connection	53
	OCXcip_ReadConnected	Reads data from a connection	54
	OCXcip_ImmediateOutput	Transmit output data immediately	54
	OCXcip_WaitForRxData	Blocks until new data is received on connection	55
	OCXcip_WriteConnectedImmediate	Update and transmit output data immediately	55
Tag Access	OCXcip_AccessTagData	Read and write Logix controller tag data	56
	OCXcip_AccessTagDataAbortable	Abortable version of OCXcip_AccessTagData	58
	OCXcip_CreateTagDbHandle	Creates a tag database handle.	58
	OCXcip_DeleteTagDbHandle	Deletes a tag database handle and releases all associated resources.	59
	OCXcip_SetTagDbOptions	Sets various tag database options.	60
	OCXcip_BuildTagDb	Builds or rebuilds a tag database.	61
	OCXcip_TestTagDbVer	Compare the current device program version with the device program version read when the tag database was created.	62
	OCXcip_GetSymbolInfo	Get symbol information.	63
	OCXcip_GetStructInfo	Get structure information.	64
	OCXcip_GetStructMbrInfo	Get structure member information.	65
	OCXcip_GetTagDbTagInfo	Get information for a fully qualified tag name	66
	OCXcip_AccessTagDataDb	Read and/or write multiple tags	67
	OCXcip_SetTagAccessConnSize	Configure connection size used to access tags	68

Library Functions (Continued)

Category	Name	Description	Page
Messaging	OCXcip_GetDeviceIdObject	Reads a device's identity object.	69
	OCXcip_GetDeviceICPObject	Reads a device's ICP object	70
	OCXcip_GetDeviceIdStatus	Read a device's status word.	71
	OCXcip_GetExDevObject	Read a device's extended device object	73
	OCXcip_GetWCTime	Read the WallClockTime from a controller.	74
	OCXcip_SetWCTime	Set a controller's WallClockTime.	76
	OCXcip_GetWCTimeUTC	Read a controller's WallClockTime in UTC.	78
	OCXcip_SetWCTimeUTC	Set a controller's WallClockTime in UTC.	80
	OCXcip_PLC5TypedRead	Perform data typed reads from PLC-5®	81
	OCXcip_PLC5TypedWrite	Perform data typed writes to PLC-5	82
	OCXcip_PLC5WordRangeWrite	Perform word writes to PLC-5	84
	OCXcip_PLC5WordRangeRead	Perform word reads from PLC-5	85
	OCXcip_PLC5ReadModWrite	Perform bit level writes to PLC-5	87
	OCXcip_SLCProtTypedRead	Perform data typed reads from SLC™	88
	OCXcip_SLCProtTypedWrite	Perform data typed writes from SLC	90
	OCXcip_SLCReadModWrite	Perform bit level writes to SLC	92
Miscellaneous	OCXcip_GetIdObject	Returns data from the module's Identity Object	94
	OCXcip_SetIdObject	Lets the application customize certain attributes of the identity object	95
	OCXcip_GetActiveNodeTable	Returns the number of slots in the local rack and identifies the slots are occupied by active modules	95
	OCXcip_MsgResponse	Send the response to an unscheduled message. This function must be called after returning OCX_CIP_DEFER_RESPONSE from the service_proc callback routine.	96
	OCXcip_GetVersionInfo	Get the API, BPIE, and device driver version information	97
	OCXcip_SetLED	Set the state of the LED	97
	OCXcip_GetLED	Get the state of the LED	98
	OCXcip_SetDisplay	Set the state of the display	98
	OCXcip_GetDisplay	Get the currently displayed string	98
	OCXcip_GetSwitchPosition	Get the state of the 3-position switch	99
	OCXcip_SetModuleStatus	Lets an application set the status of the module's status LED indicator.	99
	OCXcip_ErrorString	Returns a text error message that is associated with the error code errcode.	100
	OCXcip_Sleep	Delays for approximately msdelay milliseconds.	100
	OCXcip_CalculateCRC	Computes a 16-bit CRC for a range of data	100
	OCXcip_SetModuleStatusWord	Lets an application set the 16-bit status attribute of the module's Identity Object.	101
	OCXcip_GetModuleStatusWord	Lets an application read the current value of the 16-bit status attribute of the module's Identity Object.	101
Callback	connect_proc	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.	102
	service_proc	Passes to the API in the OCXcip_RegisterAssemblyObj function and called when an unscheduled message is received for the registered object.	104
	fatalfault_proc	Passes to the API in the OCXcip_RegisterFatalFaultRtn function and called when the backplane device driver detects a fatal fault condition.	105
	resetrequest_proc	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).	106

Initialization Function Category

This section describes the Initialization functions.

OCXcip_Open

Syntax	int	OCXcip_Open(OCXHANDLE *apiHandle);
Parameters	apiHandle	Pointer to variable of type OCXHANDLE
Description	OCXcip_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, OCXcip_Close must always be called before exiting the application.	
Return Value	OCX_SUCCESS	BPIE has started successfully and API access is granted
	OCX_ERR_REOPEN	API is already open (host application can already be running)
	OCX_ERR_NODEVICE	Backplane device driver couldn't be accessed
	OCX_ERR_NODEVICE is returned if the backplane device driver isn't properly installed or hasn't been started.	
	OCX_ERR_MEMALLOC	Unable to allocate resources for BPIE
	OCX_ERR_TIMEOUT	BPIE did not start
Example	See code below	

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

For more information, see OCXcip_Close on page 50.

OCXcip_OpenNB

Syntax	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 aren't 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	OCX_SUCCESS	BPIE has started successfully and API access is granted
	OCX_ERR_REOPEN	API is already open (host application can already be running)
Example	See code below	

```
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 49.
- OCXcip_Close on page 50.

OCXcip_Close

Syntax	int	OCXcip_Close(OCXHANDLE apiHandle);
Parameters	apiHandle	Handle returned by previous call to OCXcip_Open
Description	This function is used by an application to release control of the API. *apiHandle* must be a valid handle that is returned from OCXcip_Open.	
IMPORTANT	Once the API has been opened, this function must always be called before exiting the application.	
Return Value	OCX_SUCCESS	API was closed successfully
	OCX_ERR_NOACCESS	*apiHandle* does not have access
Example	See code below	

```
OCXHANDLE           apiHandle;
OCXcip_Close        (apiHandle);
```

For more information, see OCXcip_Open on page 49.

Object Registration Function Category

This section describes the Object Registration functions.

OCXcip_RegisterAssemblyObj

Syntax	int	OCXcip_RegisterAssemblyObj(OCXHANDLE apiHandle, OCXHANDLE *objHandle, DWORD reg_param, OCXCALLBACK (*connect_proc)(), OCXCALLBACK (*service_proc)());
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	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. *apiHandle* must be a valid handle that is 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 isn't 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's 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	`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 52
- connect_proc on page 102
- service_proc on page 104

OCXcip_UnregisterAssemblyObj

Syntax	int	OCXcip_UnregisterAssemblyObj(OCXHANDLE apiHandle, OCXHANDLE objHandle);
Parameters	apiHandle	Handle returned by previous call to OCXcip_Open
	objHandle	Handle for object to be unregistered
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 that is specified by *objHandle* are terminated. *apiHandle* must be a valid handle that is returned from OCXcip_Open. *objHandle* must be a handle that is 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	`OCXHANDLE apiHandle;`
	`OCXHANDLE objHandle;`
	`// Unregister all instances of the object`
	`OCXcip_UnregisterAssemblyObj(apiHandle, objHandle );`	

For more information, see OCXcip_RegisterAssemblyObj on page 51.

Special Callback Registration Function Category

This section describes the Callback Registration functions.

OCXcip_RegisterFatalFaultRtn

Syntax	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 that is 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; that is, 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	`OCXHANDLE apiHandle;`
	`// Register a fatal fault handler`
	`OCXcip_RegisterFatalFaultRtn(apiHandle, fatalfault_proc);`	

For more information, see fatalfault_proc on page 105.

OCXcip_RegisterResetReqRtn

Syntax	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 that is 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 (that is, restart) 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	`OCXHANDLE apiHandle;`
	`// Register a reset request handler`
	`OCXcip_RegisterResetReqRtn(apiHandle, resetrequest_proc);`	

For more information, see resetrequest_proc on page 106.

Connected Data Transfer Function Category

This section describes the Connected Data Transfer functions.

OCXcip_Write Connected

Syntax	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 that is returned from OCXcip_Open. *connHandle* must be a handle that is 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	`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 54.

OCXcip_ReadConnected

Syntax	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 that is returned from OCXcip_Open. *connHandle* must be a handle that is 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	OCX_SUCCESS	Data was read successfully
	OCX_ERR_NOACCESS	*apiHandle* does not have access
	OCX_ERR_BADPARAM	*connHandle* or *offset/dataSize* is invalid

Example	`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_Write Connected on page 53.

OCXcip_ImmediateOutput

Syntax	int	OCXcip_ImmediateOutput(OCXHANDLE apiHandle, OCXHANDLE connHandle,
Parameters	apiHandle	Handle returned by previous call to OCXcip_Open
	connHandle	Handle of open connection
Description	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's equivalent to the ControlLogix IOT instruction. *apiHandle* must be a valid handle that is returned from OCXcip_Open. *connHandle* must be a handle that is passed by the **connect_proc** callback function.	
Return Value	OCX_SUCCESS	Data was received
	OCX_ERR_NOACCESS	*apiHandle* does not have access
	OCX_ERR_BADPARAM	*connHandle* is invalid

Example	`OCXHANDLE apiHandle;`
	`OCXHANDLE connHandle;`
	`BYTE buffer[128];`
	`// Update the output data and transmit now`
	`OCXcip_WriteConnected(apiHandle, connHandle, buffer, 0, 128 );`
	`OCXcip_ImmediateOutput(apiHandle, connHandle);`	

For more information, see OCXcip_Write Connected on page 53.

OCXcip_WaitForRxData

IMPORTANT	This function isn't supported in Windows® OS.

Syntax	int	OCXcip_WaitForRxData(OCXHANDLE apiHandle, OCXHANDLE connHandle, int timeout);
Parameters	apiHandle	Handle returned by previous call to OCXcip_Open
	connHandle	Handle of open connection
	timeout	Timeout in milliseconds
Description	This function blocks the calling thread until data is received on the open connection that is specified by *connHandle*. If the timeout expires before data is received, the function returns OCX_ERR_TIMEOUT. *apiHandle* must be a valid handle that is returned from OCXcip_Open. *connHandle* must be a handle that is passed by the **connect_proc** callback function.	
Return Value	OCX_SUCCESS	Data was received
	OCX_ERR_NOACCESS	*apiHandle* does not have access
	OCX_ERR_BADPARAM	*connHandle* is invalid
	OCX_ERR_TIMEOUT	The timeout expired before data was received

Example	`OCXHANDLE apiHandle;`
	`OCXHANDLE connHandle;`
	`// Synchronize with the controller scan`
	`OCXcip_WaitForRxData(apiHandle, connHandle, 1000);`	

For more information, see OCXcip_ReadConnected on page 54.

OCXcip_WriteConnectedImmediate

Syntax	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 that is returned from OCXcip_Open. *connHandle* must be a handle that is 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 with OCXcip_WriteConnected. It's recommended that this function is only used to update the entire output image (that is, 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	`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 53.

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_BuildTagDb on page 61.

OCXcip_AccessTagData

Syntax	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 one CIP packet. Multiple packets can be required to process all access requests. pTagAccArr is a pointer to an array of pointers to OCXCIPTAGACCESS structures. numTagAcc is the number of pointers in the array. The OCXCIPTAGACCESS structure is described in the rest of this section.	
	typedef struct tagOCXCIPTAGACCESS {	
	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[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 one 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's assumed to be the same size as the write data (eleSize * numEle).
	result	Read/write operation result (output). Set to OCX_SUCCES if operation successful, else if failure. This value isn't set if the function return value is other than OCX_SUCCESS or opType is OCX_CIP_TAG_NO_OP.
	Full structure reads and writes aren't permitted (except for OCX_CIP_STRING82).	
Return Value	OCX_SUCCESS	All 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.
	Else	An access error occurred. Individual access *result* parameters not set.

Example

```
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, ta.result);
else
printf("%s write successful\n", ta1.tagName);
if ( ta2.result != OCX_SUCCESS )
printf("%s read error = %d\n", ta2.tagName, ta.result);
else
printf("%s = %d\n", ta2.tagName, rdVal);
}
```

For more information, see OCXcip_Open on page 49.

OCXcip_AccessTagDataAbortable

Syntax	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 many 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.	

For more information, see OCXcip_AccessTagData on page 56.

OCXcip_CreateTagDbHandle

Syntax	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. For more information, see Appendix B, Specify the Communication Path on page 109.
	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 that 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_* code	Other failure

Example

```
OCXHANDLE          apiHandle;
OCXTAGDBHANDLE      hTagDb;
BYTE * devPathStr = (BYTE *) “p:1,s:0”;
int                rc;
rc = OCXcip_CreateTagDbHandle(hApi, devPathStr, 1000, &hTagDb);
if ( rc != OCX_SUCCESS )
printf(“Tag database handle creation failed!\n”);
else
printf(“Tag database handle successfully created.\n”);
```

For more information, see the following:

- OCXcip_Open on page 49
- OCXcip_DeleteTagDbHandle on page 59

OCXcip_DeleteTagDbHandle

Syntax	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 that is 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_* code	Other failure

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

For more information, see OCXcip_CreateTagDbHandle on page 58.

OCXcip_SetTagDbOptions

Syntax	int	OCXcip_SetTagDbOptions(OCXHANDLE apiHandle, OCXTAGDBHANDLE tdbHandle, DWORD optFlags, WORD structAlign)
Parameters	apiHandle	Handle returned by previous call to OCXcip_Open.
	tdbHandle	Handle created by previous call to OCXcip_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). OCXcip_GetSymbolInfo() and OCXcip_GetStructMbrInfo() report strings as having a *datype* of OCX_CIP_TAGDB_DATYPE_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 OCXcip_AccessTagDataDb()), pass a *daType* of OCX_CIP_TAGDB_DATYPE_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_BOOLs. A normalized OCX_CIP_DWORD are normalized to an array of 32 OCX_CIP_BOOL (that occupies 32 bytes) for example. When accessing arrays of BOOLs (with OCXcip_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 can't be normalized. The FUNCTION_GENERATOR structure has OCX_CIP_BOOLs that are aliased into an OCX_CIP_DINT. Because the DINT base member isn't expanded into a BOOL array, the BOOL alias structure members can't be normalized. A special (and rarely used) data type has been created to identify alias structure member OCX_CIP_BOOLs that can't be normalized: OCX_CIP_TAGDB_DATYPE_NORM_BITMASK. OCX_CIP_TAGDBOPT_STRUCT_MBR_ORDER_NATIVE: This option causes OCXcip_GetStructMbrInfo() to retrieve structure members in native order (lowest offset to highest) instead of alphabetical order. This isn't 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.
	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 *OCXcip_CreateTagDbHandle*(). All options are off by default.	

Example

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

For more information, see the following:

- OCXcip_GetSymbolInfo on page 63.
- OCXcip_GetStructInfo on page 64.
- OCXcip_GetStructMbrInfo on page 65.
- OCXcip_AccessTagDataDb on page 67.

OCXcip_BuildTagDb

Syntax	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 my take a few milliseconds to a few tens of seconds to complete. tdbHandle must be a valid handle that is 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	`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 58.
- OCXcip_DeleteTagDbHandle on page 59.
- OCXcip_TestTagDbVer on page 62.
- OCXcip_GetSymbolInfo on page 63.

OCXcip_TestTagDbVer

Syntax	int	OCXcip_TestTagDbVer(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 reads the program version from the target device and compares it to the device program version read when the tag database was built.	
Return Value	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

```
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 61.

OCXcip_GetSymbolInfo

Syntax	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 – daType = OCX_CIP_BOOL, OCX_CIP_INT, OCX_CIP_STRING82, and so on. – 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 isn't 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_BuildTagDb. 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

```
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.daType);
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_BuildTagDb on page 61.
- OCXcip_TestTagDbVer on page 62.
- OCXcip_GetStructInfo on page 64.
- OCXcip_GetStructMbrInfo on page 65.

OCXcip_GetStructInfo

Syntax	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 – daType = Structure data type – daSize = Size of structure data in bytes, zero indicates the structure isn't accessible as a whole – ioType = OCX_CIP_STRUCT_IOTYPE_NA: Structure isn't accessible as a whole. OCX_CIP_STRUCT_IOTYPE_INP: Structure is an input type and is read-only when accessed as a whole. – OCX_CIP_STRUCT_IOTYPE_OUT: Structure is an output type and is read-only when accessed as a whole. – OCX_CIP_STRUCT_IOTYPE_RMEM: Structure is a memory type and is read-only when accessed as a whole. – OCX_CIP_STRUCT_IOTYPE_MEM: Structure is memory and is read/write compatible. 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

```
OCXHANDLE           hApi;
OCXTAGDBHANDLE      hTagDb;
OCXCIPTAGDBSYM      symInfo;
OCXCIPTAGDBSTRUCT   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.daType);
printf(" size = %d\n", structInfo.daSize);
printf(" numMbr = %d\n", structInfo.numMbr);
}
}
```

For more information, see the following:

- OCXcip_BuildTagDb on page 61.
- OCXcip_TestTagDbVer on page 62.
- OCXcip_GetSymbolInfo on page 63.
- OCXcip_GetStructMbrInfo on page 65.

OCXcip_GetStructMbrInfo

Syntax	int	OCXcip_GetStructMbrInfo(OCXHANDLE apiHandle, OCXTAGDBHANDLE tdbHandle, WORD hStruct WORD mbrId OCXCIPTAGDBSTRUCTMBR * pStructMbrInfo);
Parameters	api Handle	Handle returned by previous call to OCXcip_Open.
	tdb Handle	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 – where: OCXCIPTAGDBSTRUCTMBR_ATTR_ALIAS – Indicates that 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 61.
- OCXcip_TestTagDbVer on page 62.
- OCXcip_GetSymbolInfo on page 63.
- OCXcip_GetStructInfo on page 64.

OCXcip_GetTagDbTagInfo

<table>
<tr><td>Syntax</td><td>int</td><td>OCXcip_GetTagDbTagInfo(
OCXHANDLE apiHandle,
OCXTAGDBHANDLE tdbHandle,
char * tagName,
OCXCIPTAGINFO * tagInfo
);</td></tr>
<tr><td rowspan="4">Parameters</td><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.
– daType = Data type code.
– hStruct = Zero if the 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.</td></tr>
<tr><td>Description</td><td colspan="2">This function gets information regarding a fully qualified tag name (that is 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.</td></tr>
<tr><td rowspan="2">Return Value</td><td>OCX_SUCCESS</td><td>Success</td></tr>
<tr><td>OCX_ERR_* code</td><td>Failure</td></tr>
<tr><td>Example</td><td colspan="2"><pre>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”);
}</pre></td></tr>
</table>

For more information, see OCXcip_BuildTagDb on page 61.

OCXcip_AccessTagDataDb

Syntax	int	OCXcip_AccessTagDataDb(OCXHANDLE apiHandle, OCXTAGDBHANDLE tdbHandle, OCXCIPTAGDBACCESS ** 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], and so on). 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, and so on). – eleSize = Size of one data element (DINT = 4, BOOL = 1, and so on). – 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 an 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's assumed to be the same size as the write data (eleSize * numEle). – result = Read/write operation result (output). Set to OCX_SUCCES if operation successful, else if failure. This value isn't 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 pass many 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 the full structure reads and writes.	

For more information, see the following:

- OCXcip_AccessTagData on page 56.
- OCXcip_GetSymbolInfo on page 63.
- OCXcip_GetStructInfo on page 64.
- OCXcip_GetStructMbrInfo on page 65.

OCXcip_SetTagAccessConnSize

Syntax	int	OCXcip_SetTagAccessConnSize (OCXHANDLE apiHandle, int connSize)
Parameters	handle	Handle returned by previous call to OCXcip_Open.
	connSize	Must be one of OCX_TAGACC_CONNSIZE_SM, OCX_TAGACC_CONNSIZE_MED, or OCX_TAGACC_CONNSIZE_LG
Description	This function allows the connection size that is used for tag access to be configured. A smaller connection size results in less loading on the controller and can reduce the number of redundant chassis synchronization errors. By default, the API uses the largest connection size for the highest performance. 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 are 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	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 56
- OCXcip_AccessTagDataDb on page 67

Messaging Functions

This section describes the Messaging functions.

OCXcip_GetDeviceIdObject

Syntax	int	OCXcip_GetDeviceIdObject(OCXHANDLE apiHandle, BYTE *pPathStr, OCXCIPIDOBJ *idobject WORD timeout);
Parameters	api Handle	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 that is specified in *pPathStr. apiHandle* must be a valid handle that is 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 as follows:	
	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 the path was bad

Example

```
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("\n\rVendorID: %2X DeviceType: %d", idobject.VendorID,
idobject.DeviceType);
printf("\n\rProdCode: %d SerialNum: %ld", idobject.ProductCode,
idobject.SerialNo);
```

OCXcip_GetDeviceICPObject

Syntax	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 that is specified in *pPathStr*. apiHandle must be a valid handle that is 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 various 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 as follows:	
	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 the path was bad

Example

```
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	int	OCXcip_GetDeviceIdStatus(OCXHANDLE apiHandle, BYTE *pPathStr, WORD *status, WORD timeout);
Parameters	api Handle	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 that is specified in pPathStr. *apiHandle* must be a valid handle that is returned from OCXcip_Open. *status* is a pointer to a WORD that receives the identity status word data. The following bit masks and bit definitions 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 555x 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 the path was bad

Example

```
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");
break;
case OCX_ID_STATUS_FLASHBAD: // Flash is bad
printf("Status: Flash is bad");
break;
case OCX_ID_STATUS_FAULTED: // Faulted
printf("Status: Faulted");
break;
case OCX_ID_STATUS_RUN: // Run mode
printf("Status: Run mode");
break;
case OCX_ID_STATUS_PROGRAM: // Program mode
printf("Status: Program mode");
break;
default:
printf("ERROR: Bad status mode");
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");
break;
case OCX_ID_STATUS_KEY_PROGRAM: // Key switch in program
printf("Key switch position: program");
break;
case OCX_ID_STATUS_KEY_REMOTE: // Key switch in remote
printf("Key switch position: remote");
break;
default:
printf("ERROR: Bad key position");
break;
}
```

OCXcip_GetExDevObject

Syntax	int	OCXcip_GetExDeviceObject(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_GetDeviceExDevObject retrieves the Extended Device object from the module at the address that is specified in *pPathStr*. *apiHandle* must be a valid handle that is 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:	
	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:	
	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 the path was bad
	OCX_CIP_INVALID_REQUEST	The device does not support the requested object
Example	`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);`	

OCXcip_GetWCTime

Syntax	int	OCXcip_GetWCTime(OCXHANDLE apiHandle, BYTE *pPathStr, OCXCIPWCT *pWCT, WORD timeout);
Parameters	api Handle	Handle returned from OCXcip_Open call
	pPathStr	Path to device being accessed
	pWCT	Pointer to OCXCIPWCT structure to be filled with WallClockTime data
	timeout	Number of milliseconds to wait for the device to respond
Description	OCXcip_GetWCTime retrieves information from the WallClockTime object in the specified device. The information is returned both in 'raw' format, and conventional time/date format. *apiHandle* must be a valid handle that is returned from OCXcip_Open. *pPathStr* must be a pointer to a string containing the path to a device that supports the WallClockTime object, such as a ControlLogix controller. For information on specifying paths, see Appendix B, Specify the Communication Path on page 109. *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, upon 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 that is 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 as follows:	
	typedef struct tagOCXCIPWCT	
	{	
	ULARGE_INTEGER	CurrentValue;
	WORD	TimeZone;
	ULARGE_INTEGER	CSTOffset;
	WORD	LocalTimeAdj;
	SYSTEMTIME	SystemTime;
	} OCXCIPWCT;	
	CurrentValue is the 64-bit WallClockTime counter value (adjusted for local time), which is the number of microseconds since 1/1/1972, 00:00 hours. This is the 'raw' WallClockTime as presented by the device. *TimeZone* is obsolete and is no longer used. It's retained in the structure only for backwards compatibility and isn't used. CSTOffset is the positive offset in microseconds from the current system CST (Coordinated System Time). In a system that uses a CST Time Master, this value lets the WallClockTime be precisely synchronized among multiple devices that support CST and WCT. *LocalTimeAdj* is obsolete and is no longer used. It's retained in the structure only for backwards compatibility and isn't used. *SystemTime* is a Win32 structure of type SYSTEMTIME. (Refer to the Microsoft® Platform SDK documentation for more information.) The time and date that is returned in this structure is the local adjusted time on the device. The SYSTEMTIME structure follows:	
	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

```
OCXHANDLE           apiHandle;
OCXCIPWCT           Wct;
BYTE                Path[]=”p:1,s:0”; // controller in Slot 0
int                 rc;
rc = OCXcip_GetWCTime(apiHandle, Path, &Wct, 3000);
if (rc != OCX_SUCCESS)
{
printf("\n\rOCXcip_GetWCTime 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_SetWCTime on page 76.
- OCXcip_GetWCTimeUTC on page 78.

OCXcip_SetWCTime

Syntax	int	OCXcip_SetWCTime(OCXHANDLE apiHandle, BYTE *pPathStr, OCXCIPWCT *pWCT, WORD timeout);
Parameters	api Handle	Handle returned from OCXcip_Open call
	pPathStr	Path to device being accessed
	pWCT	Pointer to OCXCIPWCT structure with WallClockTime data to set
	timeout	Number of milliseconds to wait for the device to respond
Description	OCXcip_SetWCTime writes to the WallClockTime 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 that is returned from OCXcip_Open. *pPathStr* must be a pointer to a string containing the path to a device that supports the WallClockTime object, such as a ControlLogix controller. For information on specifying paths, see Appendix B, Specify the Communication Path on page 109. *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 as follows:	
	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's 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's 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 follows:	
	typedef struct _SYSTEMTIME {	
	WORD	wYear;
	WORD	wMonth;
	WORD	wDayOfWeek;
	WORD	wDay;
	WORD	wHour;
	WORD	wMinute;
	WORD	wSecond;
	WORD	wMilliseconds;
	} SYSTEMTIME, *PSYSTEMTIME;	
	The wDayOfWeek member isn't 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	`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\r", rc);`
	`}`

Example 2	`OCXHANDLE apiHandle;`
	`OCXCIPWCT 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\r", rc);`
	`}`

For more information, see the following:

- OCXcip_GetWCTime on page 74.
- OCXcip_SetWCTimeUTC on page 80.

OCXcip_GetWCTimeUTC

Syntax	int	OCXcip_GetWCTime(OCXHANDLE apiHandle, BYTE *pPathStr, OCXCIPWCT *pWCT, WORD timeout);
Parameters	api Handle	Handle returned from OCXcip_Open call
	pPathStr	Path to device being accessed
	pWCT	Pointer to OCXCIPWCTUTC structure to be filled with WallClockTime 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 WallClockTime object in the specified device. The time that is returned is expressed as UTC time. *apiHandle* must be a valid handle that is returned from OCXcip_Open. *pPathStr* must be a pointer to a string that contains the path to a device that supports the WallClockTime 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, upon 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 that is 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 as follows:	
	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> Or GMT-hh:mm <location> *DSTOffset* is the number of minutes (positive or negative) to be adjusted for Daylight Savings Time. *DSTEnable* indicates whether 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 that is returned in this structure is UTC time. The SYSTEMTIME structure is as follows:	
	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

```
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 74.
- OCXcip_SetWCTimeUTC on page 80.

OCXcip_SetWCTimeUTC

Syntax	int	OCXcip_SetWCTimeUTC(OCXHANDLE apiHandle, BYTE *pPathStr, OCXCIPWCTUTC *pWCT, WORD timeout);
Parameters	api Handle	Handle returned from OCXcip_Open call
	pPathStr	Path to device being accessed
	pWCT	Pointer to OCXCIPWCTUTC structure with WallClockTime 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 the error OCX_CIP_INVALID_REQUEST. For previous firmware revisions, refer to OCXcip_SetWCTime().	
Description	OCXcip_SetWCTimeUTC writes to the WallClockTime object in the specified device. This function lets the time be specified in two different ways: a specific date and time that is 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 that is returned from OCXcip_Open. *pPathStr* must be a pointer to a string containing the path to a device that supports the WallClockTime 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 as follows:	
	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 as follows:	
	typedef struct _SYSTEMTIME {	
	WORD	wYear;
	WORD	wMonth;
	WORD	wDayOfWeek;
	WORD	wDay;
	WORD	wHour;
	WORD	wMinute;
	WORD	wSecond;
	WORD	wMilliseconds;
	} SYSTEMTIME, *PSYSTEMTIME;	
	The *wDayOfWeek* member isn't 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 74.
- OCXcip_SetWCTimeUTC on page 80.

OCXcip_PLC5TypedRead

Syntax	int	OCXcip_PLC5TypedRead(OCXHANDLE apiHandle, BYTE *pPathStr, void *pDataDest, BYTE *pSourceStr, WORD NumElements, WORD timeout);
Parameters	api Handle	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 PLC-5
	NumElements	Number of data elements to be retrieved from the PLC-5
	timeout	Number of milliseconds to wait for the read to complete
Description	OCXcip_PLC5TypedRead retrieves data from the PLC-5 at the path that is specified in *pPathStr and stores it to the location specified in pDataDest. apiHandle* must be a valid handle that is 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 PLC-5. 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 PLC-5 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 parentheses. **IMPORTANT**: Bit data is returned as a full word, it's the responsibility of the application to mask the desired bit. *NumElements* is the number data elements to be retrieved from the PLC-5. *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 the object ID of this module is empty
	OCX_ERR_PCCC	If the error occurs in communications to the PLC-5

Example	<pre>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");
	}</pre>

OCXcip_PLC5TypedWrite

Syntax	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 PLC-5
	pSourceStr	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 PLC-5 at the path that is specified in *pPathStr* to the location specified in *pDataDestStr*. *apiHandle* must be a valid handle that is 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 PLC-5. 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 PLC-5 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 parentheses. 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 PLC-5. *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 the object ID of this module is empty
	OCX_ERR_PCCC	If the error occurs in communications to the PLC-5

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 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
sprintf((char *) pDataDestStr,"N10:23"); // Set destination to
integer //file N10:23
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	int	OCXcip_PLC5WordRangeWrite(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
	pDataDestStr	Pointer to an ASCII string representation of the desired data file in the PLC-5
	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 PLC-5 at the path that is specified in *pPathStr* to the location specified in pDataDestStr. *apiHandle* must be a valid handle that is 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 PLC-5. 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 PLC-5 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 parentheses. ASCII must be written as an entire word or 2 characters per write. When writing floating point elements of the PD file type, it's 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 data elements to be written to the PLC-5. *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 the object ID of this module is empty
	OCX_ERR_PCCC	If the error occurs in communications to the PLC-5

Example

```
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	int	OCXcip_PLC5WordRangeRead(OCXHANDLE apiHandle, BYTE *pPathStr, void *pDataDest, BYTE *pSourceStr, WORD NumElements, WORD timeout);
Parameters	api Handle	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 PLC-5
	NumElements	Number of data elements to be retrieved from the PLC-5
	timeout	Number of milliseconds to wait for the read to complete
Description	OCXcip_ WordRangeRead retrieves data from the PLC-5 at the path that is specified in *pPathStr* and stores it to the location specified in *pDataDest*. *apiHandle* must be a valid handle that is 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 PLC-5. 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 PLC-5 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 parentheses. **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's 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 PLC-5. *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 the object ID of this module is empty
	OCX_ERR_PCCC	If the error occurs in communications to the PLC-5

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	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 that is 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 PLC-5 at the path that is specified in pPathStr. apiHandle must be a valid handle that is 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 PLC-5 that are to be modified according to the associated AND and OR masks. Bit manipulation isn't permitted in floating point (F) or ASCII string (ST) file types. *numAddrs* is the number addresses to be modified in the PLC-5. 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 the object ID of this module is empty
	OCX_ERR_PCCC	If the error occurs in communications to the PLC-5
	The OCX_CIP_PLC5_RMW_CMD structure is defined as follows: typedef struct tag OCX_CIP_PLC5_RMW_CMD { char *AddrStr; WORD AndMask; WORD OrMask; } OCX_CIP_PLC5_RMW_CMD;	

Example	<pre>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
	//
	sprintf((char *)PathStr, "p:1,s:3,p:2,t:10.0.104.123");// Set pat
	sprintf((char *)AddrStr1, "N7:9"); // Set address 1
	sprintf((char *)AddrStr2, "O:167"); // Set address 2
	DataArray[0].AddrStr = AddrStr1; // Store addr pointer
	DataArray[0].AndMask = 0xFFFF; // Store AND mask
	DataArray[0].OrMask = 0x0C20; // Store OR mask
	DataArray[1].AddrStr = AddrStr2; // Store addr 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”);
	}</pre>

OCXcip_SLCProtTypedRead

Syntax	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 that is specified in *pPathStr* and the location that is specified in *pSourceStr*. apiHandle must be a valid handle that is 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, S, 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 parentheses. Bit data is returned as a full word. If bit(s) information is desired, it's 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 the object ID of this module is empty
	OCX_ERR_PCCC	If the error occurs in communications to the SLC

Example

```
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	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 that is specified in *pPathStr* and the location that is specified in *pDataDestStr*. *apiHandle* must be a valid handle that is 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_STRING82_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 parentheses. 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 the object ID of this module is empty
	OCX_ERR_PCCC	If the 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
//file N10:0
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	int	OCXcip_SLCReadModWrite (OCXHANDLE apiHandle, BYTE *pPathStr, BYTE *pDataDestStr, void *pSourceData, WORD *pSourceBitMask, 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 a WORD value containing the desired bit values for the destination
	pSourceBitMask	Pointer to a WORD value containing the mask bits. Bits to be changed are set to 1 and those not to be changed to a 0.
	timeout	Number of milliseconds to wait for the write to complete
Description	OCXcip_SLCReadModWrite writes data to the SLC at the path that is specified in *pPathStr* and the location that is specified in *pDataDestStr*. *apiHandle* must be a valid handle that is 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 one 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 parentheses. Float and ASCII String types aren't 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 pSourcdBitMask 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	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 pSourceBitMask are invalid
	OCX_ERR_OBJEMPTY	If the object ID of this module is empty
	OCX_ERR_PCCC	If the error occurs in communications to the SLC

Example	<pre>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”);
	}</pre>

Miscellaneous Functions

This section describes the Miscellaneous functions.

OCXcip_GetIdObject

Syntax	int	OCXcip_GetIdObject(OCXHANDLE apiHandle, OCXCIPIDOBJ *idobject);
Parameters	api Handle	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 that is 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 as follows:	
	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	OCXHANDLE	apiHandle;
	OCXCIPIDOBJ	idobject;
	OCXcip_GetIdObject(apiHandle, &idobject);	
	printf("Module Name: %s Serial Number: %lu\n", idobject.Name, idobject.SerialNo);	

OCXcip_SetIdObject

Syntax	int	OCXcip_SetIdObject(OCXHANDLE apiHandle, OCXCIPIDOBJ *idobject);
Parameters	api Handle	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 that is 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 aren't used.
	The OCXCIPIDOBJ structure is defined as follows:
	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	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_GetActiveNodeTablet(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 that is 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's an active module that is 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	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 OCXCIPSERVSTRUC
	serviceCode	Message service code returned in OCXCIPSERVSTRUC
	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 must delay the response to an unscheduled message received via the service_proc callback. The service_proc callback is called sequentially and overlapping calls aren't supported. If the application must 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. Later, 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 that is passed to it in the OCXCIPSERVSTRUC 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 isn't called, communications resources aren't freed and a memory leak results. If OCXcip_MsgResponse isn't called within the message timeout, the message fails. The sender determines the message timeout. *msgHandle* and *serviceCode* must match the corresponding values that are passed to the service_proc callback in the OCXCIPSERVSTRUC structure.	
Return Value	OCX_SUCCESS	Response was sent successfully
	OCX_ERR_NOACCESS	*apiHandle* does not have access

Example

```
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 104.

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 that is returned from OCXcip_Open or OCXcipClientOpen. 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 that is 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, and so on. *ledstate* 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 isn't 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 98.

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 that is 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 97.

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 that is 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 isn't 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 98.

OCXcip_GetDisplay

Syntax	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 that is 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	`OCXHANDLE Handle;`
	`char buf[5];`
	`/* Fetch the display string */`
	`OCXcip_SetDisplay(Handle, buf);`	

For more information, see OCXcip_SetDisplay on page 98.

OCXcip_GetSwitchPosition

Syntax	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 as follows:	
	Bit(s)	**Description**
	0:3	unused
	7:4	BCD rotary switch 3 (least significant digit)
	11:8	BCD rotary switch 2 (middle digit)
	15:12	BCD rotary switch 1 (most significant digit)
	31:16	unused
Return Value	OCX_SUCCESS	The switch position information was read successfully.
	OCX_ERR_NOACCESS	handle does not have access
	OCX_ERR_NOTSUPPORTED	This function isn't supported on this hardware.

Example

```
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	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 that is 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 500 ms.	
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

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

OCXcip_ErrorString

Syntax	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 that is associated with the error code errcode. The null-terminated error message is copied into the buffer that is 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

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

OCXcip_Sleep

Syntax	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

```
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	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 that is retrieved from the battery-backed Static RAM.	
Return Value	OCX_SUCCESS	Success

Example

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

OCXcip_SetModuleStatusWord

Syntax	int	OCXcip_SetModuleStatusWord(OCXHANDLE handle, WORD statusWord, WORD statusWordMask);
Parameters	handle	Handle returned by previous call to OCXcip_Open
	status	Word 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 that is 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

```
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);
```

For more information, see OCXcip_GetModuleStatusWord on page 101.

OCXcip_GetModuleStatusWord

Syntax	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 that is returned from OCXcip_Open.	
Return Value	OCX_SUCCESS	The module status word was read successfully.
	OCX_ERR_NOACCESS	handle does not have access

Example

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

For more information, see OCXcip_SetModuleStatusWord on page 101.

Callback Functions

The functions in this section aren't 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, OCXCIPCONNSTRUC *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 that is specified by *objHandle*. *sConn* is a pointer to a structure of type OCXCIPCONNSTRUCT. This structure is shown as follows:	
	typedef struct tagOCXCIPCONNSTRUC	
	{	
	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	iOVendorId; // 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
	} OCXCIPCONNSTRUC;	
	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 isn't used by the API. *reason* specifies whether the connection is being opened or closed. A value of OCX_CIP_CONN_OPEN indicates that the connection is being opened, OCX_CIP_CONN_OPEN_COMPLETE indicates the connection has been successfully opened, OCX_CIP_CONN_NULLOPEN indicates there's new configuration data for a currently open connection, and OCX_CIP_CONN_CLOSE indicates that the connection is being closed. If the reason is OCX_CIP_CONN_CLOSE, the following parameters are unused: *producerCP*, *consumerCP*, *api*, *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. *consumerCP* is the consumer connection point from the open request. This corresponds to the Output Instance on the RSLogix 5000 generic profile. *lOTApi* is a pointer to the originator-to-target actual packet interval for this connection, expressed in microseconds. This is the rate at which connection data packets are received from the originator. This value is initialized according to the requested packet interval from the open request. The application can reject the connection if the value isn't within a predetermined range. If the connection is rejected, return OCX_CIP_FAILURE and set extendederr to OCX_CIP_EX_BAD_RPI. The minimum RPI value that is supported by the 56Comp module is 200us. *lTOApi* is a pointer to the target-to-originator actual packet interval for this connection, expressed in microseconds. This is the rate at which connection data packets are transmitted by the module. This value is initialized according to the requested packet interval from the open request. The application can increase this value if necessary. *lODeviceSn* is the serial number of the originating device, and *iOVendorId* is the vendor ID. The combination of vendor ID and serial number is guaranteed to be unique, and can be used to identify the source of the connection request. This is important when connection requests can be originated by multiple devices. *rxDataSize* is the size in bytes of the data to be received on this connection. *txDataSize* is the size in bytes of the data to be sent on this connection. *configData* is a pointer to a buffer containing any configuration data that was sent with the open request. *configSize* is the size in bytes of the configuration data. *extendederr* is a pointer to a word that can be set by the callback function to an extended error code if the connection open request is refused.	

<table>
<tr><td rowspan="5">Return Value</td><td colspan="2">The connect_proc routine must return one of the following values if the reason is OCX_CIP_CONN_OPEN:
If the reason is OCX_CIP_CONN_OPEN_COMPLETE or OCX_CIP_CONN_CLOSE, the return value must be OCX_SUCCESS.</td></tr>
<tr><td>OCX_SUCCESS</td><td>Connection is accepted</td></tr>
<tr><td>OCX_CIP_BAD_INSTANCE</td><td>instance is invalid</td></tr>
<tr><td>OCX_CIP_NO_RESOURCE</td><td>Unable to support connection due to resource limitations</td></tr>
<tr><td>OCX_CIP_FAILURE</td><td>Connection is rejected – extendederr can be set</td></tr>
<tr><td rowspan="4">Extended Error Codes</td><td colspan="2">If the open request is rejected, extendederr can be set to one of the following values:</td></tr>
<tr><td>OCX_CIP_EX_CONNECTION_USED</td><td>The requested connection is already in use.</td></tr>
<tr><td>OCX_CIP_EX_BAD_RPI</td><td>The requested packet interval can’t be supported.</td></tr>
<tr><td>OCX_CIP_EX_BAD_SIZE</td><td>The requested connection sizes do not match the permitted sizes.</td></tr>
<tr><td>Example</td><td colspan="2">See code below</td></tr>
</table>

Example

```
OCXHANDLE      Handle;
OCXCALLBACK    connect_proc( OCXHANDLE objHandle, OCXCIPCONNSTRUCT
               *sConn)
{
// Check reason for callback
switch( sConn->reason )
{
case OCX_CIP_CONN_OPEN:
// A new connection request is being made. Validate the
// parameters and determine whether to allow the connection.
// Return OCX_SUCCESS if the connection is to be established,
// or one of the extended error codes if not. See the sample
// code for more details.
return(OCX_SUCCESS);
case OCX_CIP_CONN_OPEN_COMPLETE:
// The connection has been successfully opened. If necessary,
// call OCXcip_WriteConnected to initialize transmit data.
return(OCX_SUCCESS);
case OCX_CIP_CONN_NULLOPEN:
// New configuration data is being passed to the open connection.
// Process the data as necessary and return success.
return(OCX_SUCCESS);
case OCX_CIP_CONN_CLOSE:
// This connection has been closed – inform the application
return(OCX_SUCCESS);
}
}
```

For more information, see the following:

- OCXcip_RegisterAssemblyObj on page 51.
- OCXcip_Write Connected on page 53.
- OCXcip_ReadConnected on page 54.

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 that is specified by *objHandle*. *sServ* is a pointer to a structure of type OCXCIPSERVSTRUC. This structure is as follows:	
	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 isn't 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's 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 isn't 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 that is 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 isn't valid.	
Return Value	The **service_proc** routine must return one of the following values:	
	OCX_SUCCESS	The message was processed successfully
	OCX_CIP_BAD_INSTANCE	Invalid class instance
	OCX_CIP_BAD_SERVICE	Invalid service code
	OCX_CIP_BAD_ATTR	Invalid attribute
	OCX_CIP_ATTR_NOT_SETTABLE	Attribute isn't settable
	OCX_CIP_PARTIAL_DATA	Data size invalid
	OCX_CIP_BAD_ATTR_DATA	Attribute data is invalid
	OCX_CIP_FAILURE	Generic failure code
	OCX_CIP_DEFER_RESPONSE	Defer response until OCXcip_MsgResponse is called

Example	`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 51.
- OCXcip_MsgResponse on page 96.

fatalfault_proc

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

For more information, see OCXcip_RegisterFatalFaultRtn on page 52.

resetrequest_proc

Syntax	OCXCALLBACK resetrequest_proc( );	
Parameters	None	
Description	**resetrequest_proc** is an optional callback function that can be passed to the API in the OCXcip_RegisterResetReqRtn call. If the **resetrequest_proc** callback has been registered, it's 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	OCX_SUCCESS	The module resets upon return from the callback.
	OCX_ERR_INVALID	The module does not reset and continues normal operation.
Example	See code below	

```
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 53.

Program-controlled Status Indicators

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

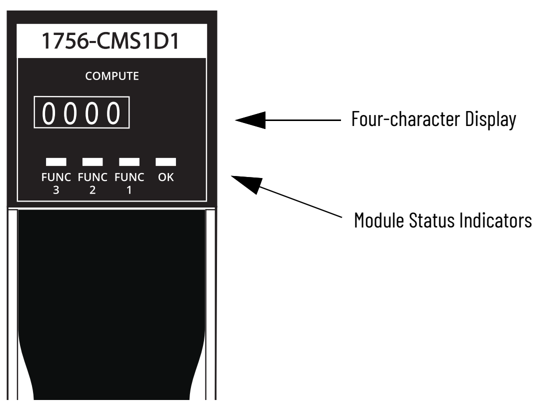
- Four-character Display
- Status Indicators

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

1. The right-most status indicator is steady 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 steady red, steady green, off cycle.
4. At the end of the test sequence, the right-most status indicator is steady green, and the 4-character display shows 'INIT'.

This figure shows the indicators on the modules.

ControlLogix Compute Module Indicators



Four-character Display

The ControlLogix Compute module includes a 4-character alphanumeric display. An application uses the OCXcip_SetDisplay on page 98 function to show the 4-character message on the display.

This table lists the messages that are displayed.

ControlLogix Compute Module Display Messages

Message	Description
<blank> or POST codes	Device driver hasn't yet been started (or application has written to the display)
INIT	Device driver has successfully started
OK	BPIE has successfully started
—	BPIE has stopped (host application has exited)

Status Indicators

The ControlLogix Compute modules have status indicators. An application uses the OCXcip_SetLED on page 97 function to set the indicator condition.

This table describes the possible indicator states.

ControlLogix Compute Module Status Indicator States

State	Description
Off	The module isn't powered.
Steady green	The module operating normally.
Steady red	One of the following: • A major communication fault has occurred between the module and ControlLogix chassis backplane. You must troubleshoot your application to determine the cause of the steady red condition on indicator OK. • A module shutdown is complete.

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 start and end point of the path segment

{s,c,t}:y - specifies the address of the module you're 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 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.

Example Controller Tags

Tag Name	Single Tag
Array[11]	Single Dimensioned Array Element
Array[1,3]	2 - Dimensional Array Element
Array[1,2,3]	3 – Dimensional Array Element
Structure.Element	Structure element
StructureArray[1].Element	Single Element of an array of structures

Program Tags

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

Example Program Tags

Tag	Name
PROGRAM:MainProgram.TagName	Tag "TagName" in the program called "MainProgram"
PROGRAM:MainProgram.Array[11]	An array element in the program "MainProgram"
PROGRAM:MainProgram.Structure.Element	Structure element in the program "MainProgram"

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 can't contain two contiguous underscore characters and can't end in an underscore. Letter case isn't 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

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, Knowledgebase, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

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