IPAliasRedundancy

IEC 61131 Library for ACSELERATOR RTAC® Projects

SEL Automation Controllers

Table of Contents

Section 1: IPAliasRedundancy

Introduction 3
Supported Firmware Versions 6
Function Blocks 7
Examples 10
Release Notes 17

RTAC LIBRARY

IPAliasRedundancy

Introduction

This library provides functionality to manage an additional IP alias (a second IP address) added to a specified interface on an SEL Real-Time Automation Controller (RTAC). The function blocks in this library are designed to work in a redundancy scheme by using an IP alias to be shared between two RTAC units. The two RTAC units will communicate with each other via the logic in this library to decide when the IP alias should and should not be active on the specified interface. The primary IP address for interfaces on the RTAC are still configured via the web interface.

The two RTACs managing the IP alias communicate via an Ethernet or serial connection. The library only supports the use of one or the other connection type (do not use both simultaneously). If the RTACs communicate via Ethernet, it is recommended that a separate interface than the managed interface is used for communications. (This is not an absolute requirement—the two RTACs can communicate via the same interface that is being managed—see *Frequently Asked Questions on page 4* for details.) Information between the two RTACs is updated at least once a second regardless of which connection is used.

The redundancy logic operates in two modes. The first is a primary-primary mode, in which the detection of a failover condition causes the IP alias to activate on the inactive unit. In this mode, the previously inactive unit will become the primary unit. If the previous primary unit becomes available again, it will be the inactive unit and must wait for a condition to occur in which the IP alias will become active. The second mode is a primary-backup mode, in which the backup unit is designated on the function block. In this mode, if the primary unit is no longer available, the backup unit will activate the IP alias. When the primary unit is available again and reestablishes communication to the backup unit, the IP alias on the backup unit will be deactivated and that IP alias will be returned to the primary unit.

The function blocks in this library offer a maintenance mode in which the unit will no longer participate in the IP alias redundancy logic. If the IP alias is currently active on the unit when maintenance mode is activated, it will be transferred to the other unit. Maintenance mode persists through project settings changes and power cycles. This mode allows for configuration changes or testing to be performed without affecting communication on the other unit participating in the redundancy scheme.

The following conditions will cause the IP address to activate on the standby unit:

- Managed Ethernet interface loss of link

- Loss of communication between RTACs (note that a unit with a broken communications cable looks the same to the standby unit as a unit that has lost power)
- Maintenance mode is activated

Frequently Asked Questions

Where do I configure the IP alias?

The IP alias is configured as an input on the function block. The IP alias cannot be added through the web interface or any other settings mechanism. If the user wishes to add other IP aliases for other functionality, refer to the *ACSELERATOR RTAC® SEL-5033 Instruction Manual* for information about the IEC 61131 functions that manage IP aliases.

How long does the IP alias last?

The IP alias in this configuration is managed by the library. If it is detected that both RTAC units have the alias active, one unit will deactivate its alias. IP aliases do not last through power cycles, so when the RTAC first starts up it will negotiate with the second RTAC about which unit should activate the IP alias (provided it is able to communicate with the other RTAC). The IP alias will remain through project send. If maintenance mode is activated, the IP alias will be deactivated on the RTAC unit.

Is the interface on which the alias is being managed turned on and off?

No, the interface with a managed IP alias will always maintain a link connection. The Ethernet port will have more than one IP address active when the alias is active. The IP address that is configured via the RTAC webpage will always be active.

Can the managed IP alias interface be the same interface used to communicate with the other RTAC unit?

Yes, the same interface can be used to both manage an IP alias and communicate with the redundant RTAC. However, SEL recommends using a separate interface to communicate with the redundant RTAC to increase the robustness of the redundancy scheme.

Can the IP alias logic work with different RTAC hardware variants such as the SEL-3530 and SEL-3555?

Yes, the interface control logic will work between any two RTACs of any hardware combinations. This includes any combination of RTAC hardware variants including the SEL-2240 Axion.

Why does RtacEthernetCommsGood not assert?

If you have trouble establishing the Ethernet link between the two RTACs, check the following:

- Confirm both RTACs are configured in the same subnet.
- Confirm both RTACs are connected to the network.
- Confirm IP addresses configured on the interface Control blocks.
- Confirm that the setting "LocalAPPort" matches the port number in the Ethernet Listening access point that was added to the RTAC configuration.

Why does RtacSerialCommsGood not assert?

If you have trouble establishing serial communications between two RTACs, check the following:

- Confirm that the LocalSerialPort setting does not conflict with any other configured serial ports in the RTAC configuration. If there is a conflict, error messages are not generated as they are for other serial port conflicts.
- Confirm that the cable connections are secure.
- Confirm that the cable is wired correctly. Reference each RTAC hardware instruction manual to ensure the pinout is correct. The connection is designed to use RS-232. The user is not responsible for configuring any additional parameters other than the physical serial port connections.

Why is my project unstable when I am trying to use a serial connection?

If the LocalSerialPort setting is configured to a port number that does not exist on the hardware being used, the RTAC will not run correctly.

Why does IPAliasActive not activate or deactivate exactly at the time specified by the input CommStatusTimeout?

The library will detect failover conditions based on the CommStatusTimeout input. Once the specified time-out has occurred, the library will take the actions to activate or deactivate the IP alias. This involves reading system diagnostics and changing IP addresses with the operating system. These actions do not occur as quickly as contact I/O or other protocol operations. I/O and protocol actions usually occur in hundreds of milliseconds or less. Making changes to IP addresses on the RTAC will fluctuate between approximately one and five seconds. System updates for IP address link status occur on a five-second interval. For CommStatusTimeout inputs that are less than five seconds, there will be some variation (as much as 5 seconds) in the time that the IP alias actions occur. For CommStatusTimeout inputs that are greater than five seconds, the variation should be less than one second in most cases. Task cycle time, system burden, and processing power will all affect the end failover time in small amounts. To obtain a failover time as close as possible to the specified

CommStatusTimeout value, make sure the CPU burden percentage is less than 80 percent. The failover functionality for IP address redundancy is intended for SCADA and HMI redundancy-type applications. This library is not intended for applications that require high-accuracy IP alias failover in less than two seconds.

How will other devices reach the IP alias if it is in a different subnetwork from the primary IP alias on the controlled interface?

If the IP alias is not in the same subnetwork as the primary IP address, you can add a static route in the RTAC web interface on the **Static Routes** page to allow traffic to reach your IP alias. Refer to the *ACSELERATOR RTAC Instruction Manual* for more information.

Special Considerations

- Copying function blocks from this library causes unwanted behavior. This means the following:

  1. The assignment operator ":=" must not be used on any function block from this library; consider assigning pointers to the objects instead.

```
// This is bad and in most cases will provide a compiler
    error such as:
// "C0328: Assignment not allowed for type
    class_IpAliasRedundancyObject"
myIpAliasRedundancyObject := otherIpAliasRedundancyObject;
```

```
// This is fine
someVariable := myIpAliasRedundancyObject.value;
// As is this
pt_myIpAliasRedundancyObject :=
    ADR(myIpAliasRedundancyObject);
```

  2. Function blocks from this library must never be VAR_INPUT or VAR_OUTPUT members in function blocks, functions, or methods. Place them in the VAR_IN_OUT section or use pointers instead.

- Function blocks in this library have memory allocated inside them. As such, they should only be created in environments of permanent scope (e.g., programs, global variable lists, or VAR_STAT sections).
- The two RTACs managing the IP alias can communicate with each other through use of either an Ethernet or a serial connection. These connections are not designed to be used simultaneously. Doing so may cause undesired behavior.

Supported Firmware Versions

You can use this library on any device configured using ACSELERATOR RTAC® SEL-5033 Software with firmware version R140 or higher.

Versions 3.5.0.3 and older can be used on RTAC firmware version R140 and higher.

Function Blocks

This library provides two function blocks. Both function blocks provide the same redundancy functionality. The InterfaceControlWithSerialCheck function block allows for the same redundancy configuration to be applied to two RTACs, and the logic will identify which IP address and behavior should be associated with which RTAC based upon the supplied RTAC serial numbers.

fb_InterfaceControl (Function Block)

This function block is designed to control the IP alias on a given interface on the RTAC unit. It will communicate with another function block on a separate RTAC unit to determine which RTAC unit should have the active IP alias. Each function block must have unique parameters to ensure communications on each project configuration.

This function block works together with an access point. When using this function block, add an Ethernet incoming (listens for connections) access point. The network connection type will be Raw TCP and the local port number setting needs to match the LocalAPPort setting on the function block.

Inputs

Name	IEC 61131 Type	Description
ControlledInterface	enum_interface_ID	Interface that will be managed with ControlledIPAlias
ControlledIPAlias	STRING(18)	IP address and CIDR value that will be managed on the ControlledInterface pin
Backup	BOOL	If TRUE, the unit will operate in backup mode. If FALSE, the unit will operate in primary mode.
RemoteRtacIP	STRING(15)	IP address of remote RTAC
RemoteRtacPort	UINT	Port number of the other RTAC. This setting needs to match the LocalAPPort setting on the remote RTAC
LocalAPPort	UINT	Port number for RTAC-to-RTAC communications on the unit. This setting needs to match the listening access point that is configured.
LocalClientConnectPort	UINT	Port number for the RTAC to use to create a TCP connection to the remote RTAC (29459 by default)
LocalSerialPort	UINT	The communications port that will be used to communicate with the other RTAC
CommStatusTimeout	TIME	The amount of time for which the RTAC will activate the IP alias when RTAC-to-RTAC communications is lost. This setting has a range of 500 ms to 1 hour.
EnterMaintenanceMode	BOOL	This pin on a rising edge will activate maintenance mode. When the unit is in maintenance mode, it will not participate in redundancy logic.

Inputs

Name	IEC 61131 Type	Description
ExitMaintenanceMode	BOOL	This pin on a rising edge will remove the unit from maintenance mode and allow the unit to participate in managing the IP alias
InterfaceLinkStatus	SPS	Connect to the system tags Ethernet link status, which shows the current value of the managed interface

Outputs

Name	IEC 61131 Type	Description
IPAliasActive	BOOL	This pin shows if the IP address that is assigned on "ControlledIPAlias" is active on the RTAC unit
MaintenanceMode	BOOL	This pin shows if the unit is currently in maintenance mode. If the unit is in maintenance mode, the RTAC will not participate in redundancy logic. Maintenance mode persists through power cycle and settings changes on the unit. Once the unit is set to exit maintenance mode it will participate in the redundancy scheme of the "ControlledInterfaceIP".
RtacEthernetCommsGood	BOOL	If both RTAC connections are communicating via the Ethernet connection, this pin will be set to TRUE
RtacSerialCommsGood	BOOL	If both RTAC connections are communicating via the serial connection, this pin will be set to TRUE
InvalidInputPin	STRING	Lists an incorrectly configured input pin

fb_InterfaceControlWithSerialCheck (Function Block)

This function block is designed to control the IP alias on a given interface on the RTAC unit. It will communicate with another function block on a separate RTAC unit to determine which RTAC unit should have the active IP alias. Each function block will have the exact same configuration and the logic will associate functionality for each RTAC unit based on the serial numbers of each RTAC unit as inputs to the logic.

This function block works together with an access point. When using this function block, add an Ethernet incoming (listens for connections) access point. The network connection type will be Raw TCP and the local port number setting must match the LocalAPPort setting on the function block.

Inputs

Name	IEC 61131 Type	Description
ControlledInterface	enum_interface_ID	The interface that will be managed with the ControlledIPAlias
ControlledIPAlias	String(18)	The IP address and CIDR value that will be managed by the Controlled_Interface pin
SerialNumber	String(80)	The serial number of the unit on which redundancy logic will operate
Backup	BOOL	If this is true, the unit will operate in backup mode. If false, the unit will operate in primary mode.
RemoteRtacIP	STRING(15)	IP address of the remote RTAC
RemoteRtacPort	UINT	Port number of the remote RTAC. This setting must match the LocalAPPort setting on the remote RTAC.
LocalAPPort	UINT	Port number for RTAC-to-RTAC communication on the unit. This setting must match the listening access point
LocalClientConnectPort	UINT	Port number for the RTAC to use to create a TCP connection to the remote RTAC (23459 by default)
LocalSerialPort	UINT	Communications port that will be used to communicate with the other RTAC
CommStatusTimeout	TIME	Time without remote RTAC communications or link status before activating IP alias. Range of 500 ms to 1 hour. Default is 5 seconds.
EnterMaintenanceMode	BOOL	A rising edge will activate maintenance mode
ExitMaintenanceMode	BOOL	A rising edge will remove the unit from maintenance mode
InterfaceLinkStatus	SPS	Connect to the system tags Ethernet link status, which shows the current value of the managed interface

Outputs

Name	IEC 61131 Type	Description
IPAliasActive	BOOL	This pin shows if the IP address that is assigned on “ControlledIPAlias” is active on the RTAC unit
MaintenanceMode	BOOL	This pin shows if the unit is currently in maintenance mode. If the unit is in maintenance mode, the RTAC will not participate in redundancy logic. Maintenance mode persists through power cycle and settings change on the unit. Once the unit is set to exit maintenance mode, it will participate in the redundancy scheme of the “ControlledInterfaceIP”.
RtacEthernetCommsGood	BOOL	If both RTAC connections are communicating via the Ethernet connection, this pin will be set to TRUE

Outputs

Name	IEC 61131 Type	Description
RtacSerialCommsGood	BOOL	If both RTAC connections are communicating via the serial connection, this pin will be set to TRUE
SerialNumberMismatch	BOOL	If the assigned and actual serial numbers do not match, this pin will be TRUE. Redundancy logic will only function if this value is FALSE .
ProjectIDMismatch	BOOL	If the project IDs between the two RTAC units do not match, this output will be TRUE. The value of this pin is retained through power cycles and will only compare if Ethernet or serial communication is active between the two RTAC units
InvalidInputPin	STRING	Lists an incorrectly configured input pin

Examples

These examples demonstrate the capabilities of this library. Do not mistake them as suggestions or recommendations from SEL.

Implement the best practices of your organization when using these libraries. As the user of this library, you are responsible for ensuring correct implementation and verifying that the project using these libraries performs as expected.

Using Interface Control to Manage an IP Alias

Objective

A user would like to use a single IP address between two RTACs for a client to seamlessly communicate with redundant data concentrators. This example will demonstrate how to configure two RTACs to share one IP address.

Assumptions

This example assumes the following:

- The IP alias and its associated subnet do not overlap with any other configured subnets on any Ethernet interface or other IP aliases.
- The client will communicate with the RTAC on Ethernet Port 2.
- Both RTACs will communicate with each other on Ethernet Port 1.
- Both RTACs have IP addresses in the same subnet on Ethernet Port 1.
- Ethernet Port 1 on each RTAC will be connected directly to the other RTAC or through a switch.

- Each RTAC configuration includes an Ethernet Listening, Raw TCP access point that matches the LocalAPPort setting on the interface control function block.
- Each RTAC collects data from the other RTAC through serial ports or an Ethernet port.
- Any supported server protocol can be used to send data to the client via the IP alias.
- If a serial connection is used, an RS-232 compatible cable that matches the wiring diagram according to each connected serial port (as listed in the specific RTAC hardware instruction manual) is used.

Solution

RTAC Project 1

The user creates an Ethernet listening access point as shown in *Figure 1*.

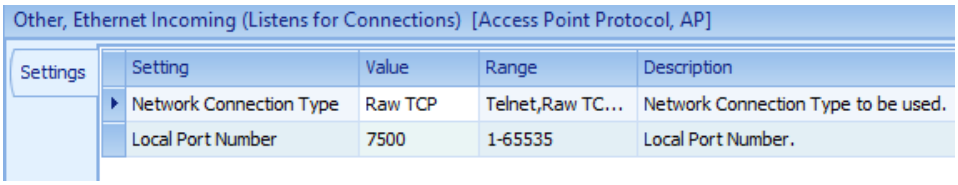

Figure 1 Ethernet Listening Access Point

The user creates a program as shown in *Code Snippet 1*:

Code Snippet 1 prg_InterfaceControlRTAC1

```
PROGRAM prg_InterfaceControlRTAC1
VAR
    Port1Control : fb_InterfaceControl;
END_VAR
```

```
Port1Control(
    ControlledInterface := Eth_02,
    ControlledIPAlias := '10.55.55.55/24',
    Backup := FALSE,
    RemoteRtacIP := '192.168.25.8',
    RemoteRTACPort := 3000,
    LocalAPPort := 7500,
    LocalClientConnectPort := 8788,
    LocalSerialPort := 1,
    CommStatusTimeout := T#5S,
    InterfaceLinkStatus := SystemTags.Eth_02_Link
);
```

Figure 2 presents the same logic as *Code Snippet 1* shown in CFC rather than an ST program.

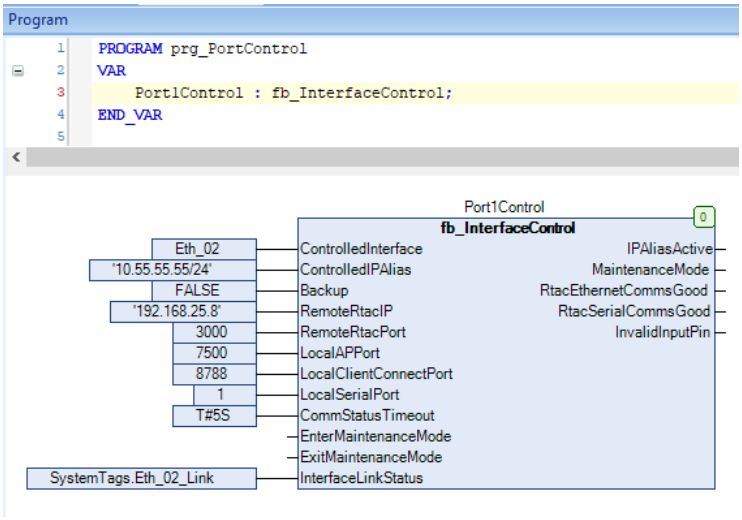

Figure 2 Interface Control in CFC

RTAC Project 2

The user creates an Ethernet listening access point as shown in *Figure 3*.

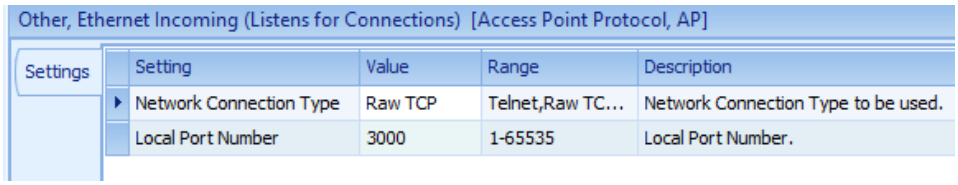

Figure 3 Ethernet Listening Access Point

The user creates a program as shown in *Code Snippet 2*:

Code Snippet 2 prg_InterfaceControlRTAC2

```
PROGRAM prg_InterfaceControlRTAC2
VAR
    Port1Control : fb_InterfaceControl;
END_VAR
```

```
Port1Control(
    ControlledInterface := Eth_02,
    ControlledIPAlias := '10.55.55.55/24',
    Backup := FALSE,
    RemoteRtacIP := '192.168.25.7',
    RemoteRTACPort := 7500,
    LocalAPPort := 3000,
    LocalClientConnectPort := 8788,
    LocalSerialPort := 1,
    CommStatusTimeout := T#5S,
    InterfaceLinkStatus := SystemTags.Eth_02_Link
);
```

Figure 4 presents the same logic as *Code Snippet 2* shown in CFC rather than an ST program.

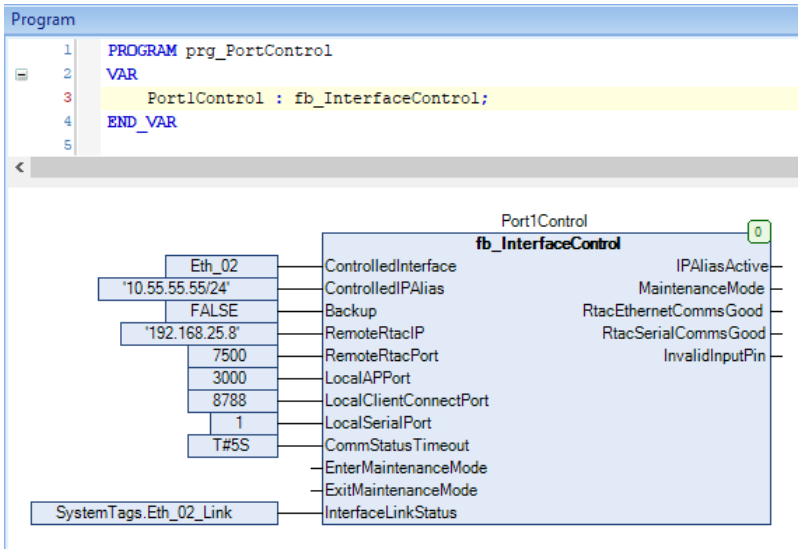

Figure 4 Interface Control in CFC

Using Interface Control With the Same Configuration on Two RTACs

Objective

A user would like to use the exact same RTAC configuration on two RTAC units to provide redundancy. This examples shows how to use InterfaceControlWithSerialCheck, which includes additional functionality to verify the serial number of the RTAC that the logic executes on and to verify that the ProjectID matches between the two RTACs. Even though two function blocks are defined in the RTAC project, only one function block will manage the IP alias (provided that the configured serial number matches the serial number of the RTAC unit).

This example also provides the same functionality as the previous example for managing an IP alias.

Assumptions

This example assumes the following:

- The IP alias and its associated subnet mask do not overlap with any other configured subnets on any Ethernet interface or other IP aliases.
- The client will communicate with the RTAC on Ethernet Port 2.
- Both RTACs will communicate with each other on Ethernet Port 1.
- Both RTACs have IP addresses in the same subnet on Ethernet Port 1.
- Ethernet port 1 on each RTAC will be connected directly to the other RTAC or through a switch.
- Each RTAC configuration includes an Ethernet Listening of Raw TCP access point that matches the LocalAPPort setting on the interface control function block.

- Each RTAC collects data from the other RTAC through serial ports or an Ethernet port.
- Any supported server protocol can be used to send data to the client via the IP alias.
- If a serial connection is used, then an RS-232 compatible cable that matches the wiring diagram according to each connected serial port (as listed in the specific RTAC hardware instruction manual) is used.

Solution

In each RTAC configuration, create one access point of type Ethernet incoming listening that matches the settings of the LocalAPPort setting on each function block.

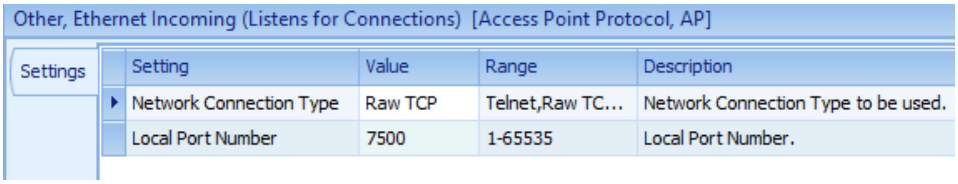

Figure 5 Ethernet Listening Access Point for PortControlRTAC1

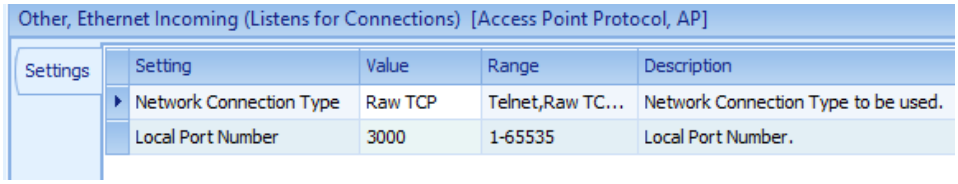

Figure 6 Ethernet Listening Access Point for PortControlRTAC2

The user creates a program as shown in *Code Snippet 3*:

Code Snippet 3 prgInterfaceControlWithSerialCheck

```
PROGRAM prg_InterfaceControlWithSerialCheck
VAR
    PortControlRTAC1 : fb_InterfaceControlWithSerialCheck;
    PortControlRTAC2 : fb_InterfaceControlWithSerialCheck;
END_VAR
```

Code Snippet 3 prgInterfaceControlWithSerialCheck (Continued)

```
PortControlRTAC1(
    ControlledInterface := Eth_02,
    ControlledIPAlias := '10.55.55.55/24',
    SerialNumber := '1122440328',
    Backup := FALSE,
    RemoteRtacIP := '192.168.25.8',
    RemoteRTACPort := 3000,
    LocalAPPort := 7500,
    LocalClientConnectPort := 8788,
    LocalSerialPort := 1,
    CommStatusTimeout := T#5S,
    InterfaceLinkStatus := SystemTags.Eth_02_Link
);

PortControlRTAC2(
    ControlledInterface := Eth_02,
    ControlledIPAlias := '10.55.55.55/24',
    SerialNumber := '1122680283',
    Backup := FALSE,
    RemoteRtacIP := '192.168.25.7',
    RemoteRTACPort := 7500,
    LocalAPPort := 3000,
    LocalClientConnectPort := 8788,
    LocalSerialPort := 1,
    CommStatusTimeout := T#5S,
    InterfaceLinkStatus := SystemTags.Eth_02_Link
);
```

Figure 7 presents the same logic as *Code Snippet 3* shown in CFC rather than an ST program.

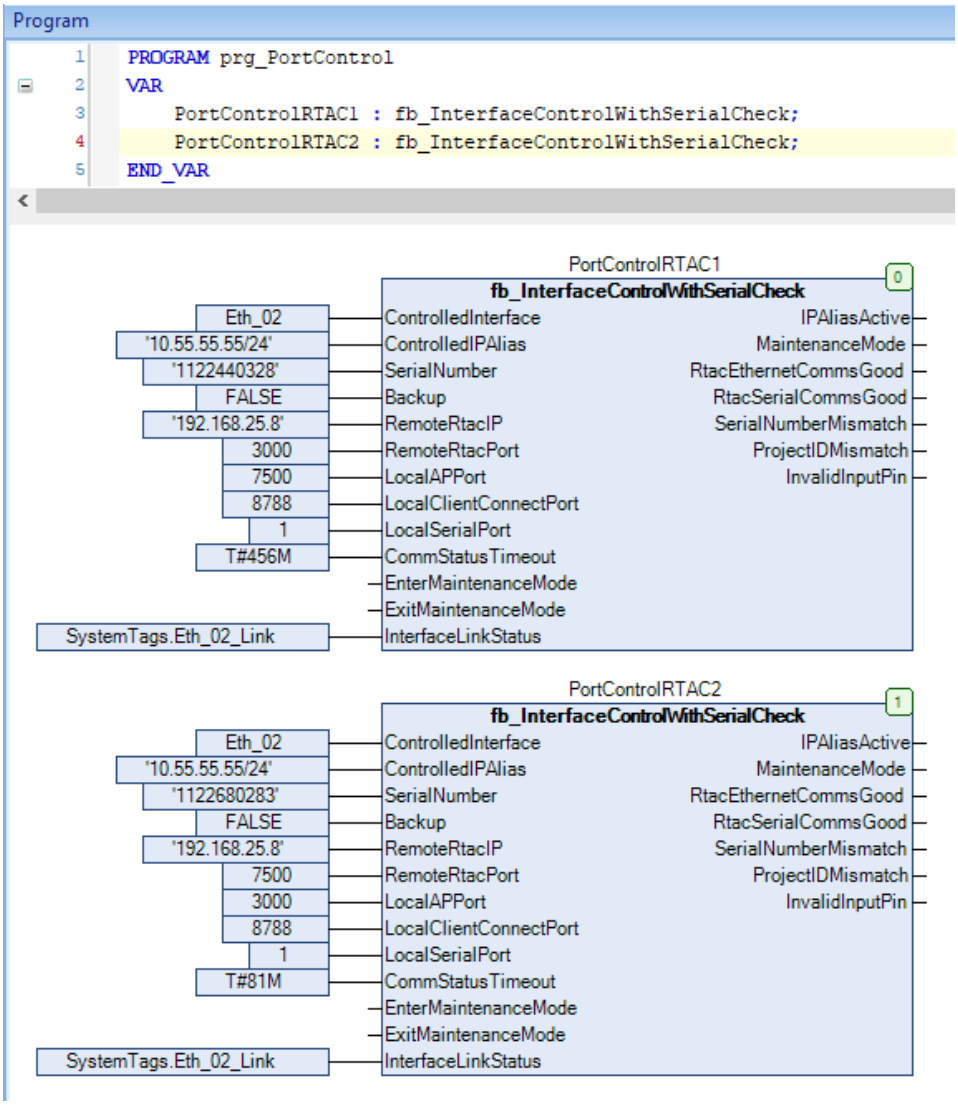

Figure 7 InterfaceControlWithSerialCheck in CFC

Release Notes

Version	Summary of Revisions	Date Code
3.5.1.0	➤ Allows new versions of ACSELERATOR RTAC to compile projects for previous firmware versions without SEL IEC types "Cannot convert" messages. ➤ Must be used with R143 firmware or later.	20180921
3.5.0.3	➤ Initial release.	20180427