

Spectrum Controls' 1771sc-IFE32 module is compatible with the popular Allen-Bradley 1771 I/O system, which is widely used with PLC-5 programmable controllers. With the introduction of ControlNet as an I/O network for Allen-Bradley PLC-5 controllers, the programming techniques for configuration and operation of these modules have been adapted for use with PLC-5C15 ControlNet processors and with RSNetworx for ControlNet and RSLogix 5 ladder-logic editing software.

This application note is intended as an addendum to the 1771sc-IFE32 Owner's Guide, which contains a thorough explanation of the module's features and specifications, and includes programming examples which are oriented toward non-ControlNet PLC-5 installations. This note refers heavily to that document and should not be used without it.

Prerequisites: Familiarity with Allen-Bradley PLC-5 programmable controllers and ladder logic.  
Experience with RSNetworx for ControlNet configuration software, version 2.25.

Required Literature: 1771sc-IFE32 Owner's Guide, publication number [0300179-01A](#)  
ControlNet PLC-5 User Manual, publication number [1785-6.5.22](#)

### **Data Exchange Overview:**

When a 1771sc-IFE32 module is installed in the local I/O chassis of a PLC-5 controller, or if it is in a Remote I/O chassis with a 1771-ASB Remote I/O adapter, ladder logic instructions called Block Transfer Read (BTR) and Block Transfer Write (BTW) are used to move blocks of data between the PLC-5 controller and the module.

When ControlNet is used instead of the Allen-Bradley Universal Remote I/O network (often called "RIO" or "Blue Hose"), the chassis network adapter is a 1771-ACN15 or 1771-ACNR15 instead of a 1771-ASB. The size and contents of the configuration and input data blocks remains the same, but the data exchange is configured using either ControlNet *scheduled* or *unscheduled* messaging.

The *unscheduled* method of using ControlNet I/O Transfer (CIO) instructions in ladder logic may be chosen for similarity to existing programs using BTR and BTW instructions.

Module input data may also be transferred periodically over ControlNet via *scheduled* messaging, which requires the use of RSNetworx for ControlNet configuration software. Module configuration must still be done with CIO instructions if scheduled messaging is used.

**IMPORTANT:** Although the Allen-Bradley ControlLogix system uses ControlNet as its I/O network, as of this writing (January 2001) the ControlLogix processors do not support scheduled or unscheduled connections over ControlNet to 1771 Analog modules. This functionality is planned to be added to the ControlLogix later in 2001.

### **Configuration (Output) Data:**

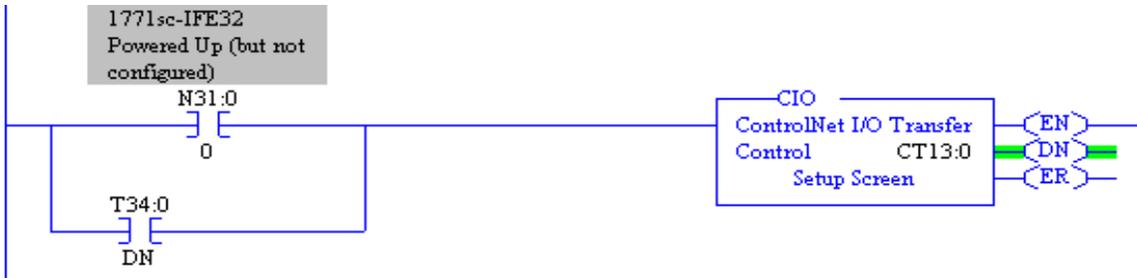
The 1771sc-IFE32 input channels are software configurable, and therefore a block of configuration data must be sent to the module every time it is to be reconfigured (always upon powerup, and whenever a configuration change is made). Chapter 3 of the User's Guide contains important information on the timing of such transfers, and presents ladder logic for the PLC-2 and PLC-5 controllers using the Remote I/O network or a local chassis.

When using ControlNet, the same timing requirements should be observed. The module can require up to 6.5 seconds to configure and calibrate itself after a configuration block has been sent, therefore configuration blocks should be sent only at startup or when the module needs to be reconfigured. This is the case regardless of whether scheduled or unscheduled messaging is used to transfer input data from the module to the controller. Three module configuration modes may be used, based on the number of configuration words sent:

5 words                      If all five words are zeros, a default configuration is used.

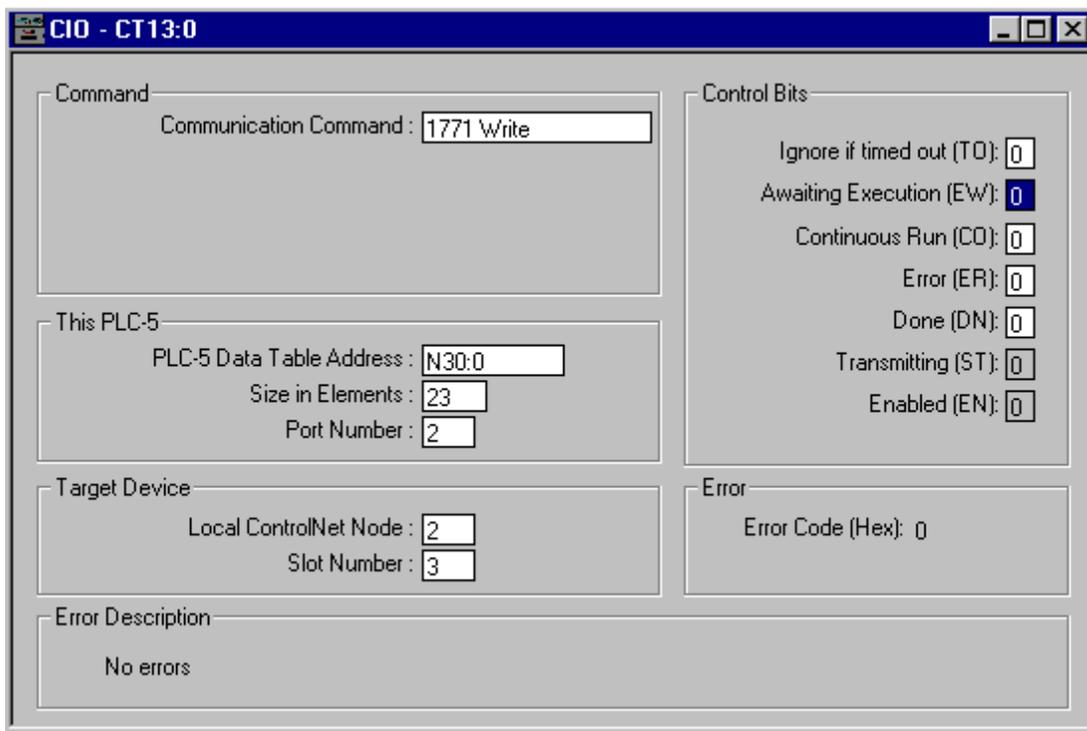
- 23 words            Normal operation in which configuration data is sent for all 32 channels.
- 64 words.            Configuration data and user-defined scaling is sent to the module.

An CIO instruction to configure a 1771sc-IFE32 module might be configured in RSLogix 5 ladder logic editing software as follows:



CIO instructions, like Block Transfers, use a control data block. The Control Block for a CIO is a “CT” data type, instead of a Block Transfer “BT” data type. The type of CIO which replaces a BTW is a “1771 Write”.

In this instance, CT13:0 has been chosen as the Control block for this instruction. The PU (Power Up) bit from the I/O module has been used to trigger execution of this configuration block. The address of the powerup bit (N31:0/0) assumes the module input and status data are being read into file N31.



In this example, we have chosen the basic Module Configuration data size of 23 words. The data in the source Data File (N30:0 through N30:22) is entered by the user according to the 1771sc-IFE32 User Guide’s Chapter 4.

The Port Number of a CIO instruction is always 2, to designate the ControlNet channel on this PLC-5.

**IMPORTANT:** In our example, the 1771 I/O chassis is at Node 2 on the ControlNet network.

The 1771sc-IFE32 is in Slot 03 (starting from 00, so it’s the 4<sup>th</sup> slot in a single-slot addressed chassis). If the incorrect Slot number is entered in the CIO configuration applet, the CIO instruction will return an error code F7 hex (which has a description “Unknown Error”).

**IMPORTANT:** A ControlNet discrete I/O connection must exist and be active to the I/O chassis in which the 1771sc-IFE32 is installed for the CIO instructions to work. If this connection has not been created with RSNetwork for ControlNet software, or if that connection is not successful, then the CIO instruction will return an error code 119 hex (which has a description “Owner Connection Not Open”).

### Module Input and Status Data (Unscheduled):

After a configuration block has been sent to the 1771sc-IFE32 and the module has gone through initialization and calibration, it is ready to return input data to the controller via CIO 1771 Read instructions.

Two input data modes may be used:

41 words	Input Channel Data and Module Status
64 words	Data, Status and Configuration Echo

The format of these data tables is explained in Chapter 5 of the User’s Guide.

The module will not respond to BTR requests during initialization or calibration, or during the RTS time period if Real Time Sampling is being used. However, because CIO instructions do not have a built-in timeout period, they can be programmed to simply wait for data and ignore the BTR refusals during calibration. The Done (.DN) bit of the CIO instruction may be used to verify that valid data is coming from the module, in conjunction with the module status data.

A CIO 1771 Read instruction might be configured in RSLogix 5 as follows:

The screenshot shows the 'CIO - CT13:1' configuration window. It is divided into several sections:

- Command:** Communication Command: 1771 Read
- This PLC-5:**
  - PLC-5 Data Table Address: N31:0
  - Size in Elements: 41
  - Port Number: 2
- Target Device:**
  - Local ControlNet Node: 2
  - Slot Number: 3
- Control Bits:**
  - Ignore if timed out (TO):
  - Awaiting Execution (EW):
  - Continuous Run (CO):
  - Error (ER):
  - Done (DN):
  - Transmitting (ST):
  - Enabled (EN):
- Error:** Error Code (Hex): 0
- Error Description:** No errors

## Module Input and Status Data Scheduled Using RSNetworkx for ControlNet.

ControlNet PLC-5 controllers have the ability to perform deterministic transfer of analog module data in the same ControlNet I/O schedule as discrete I/O. RSNetworkx for ControlNet software is used to configure this I/O data transfer.

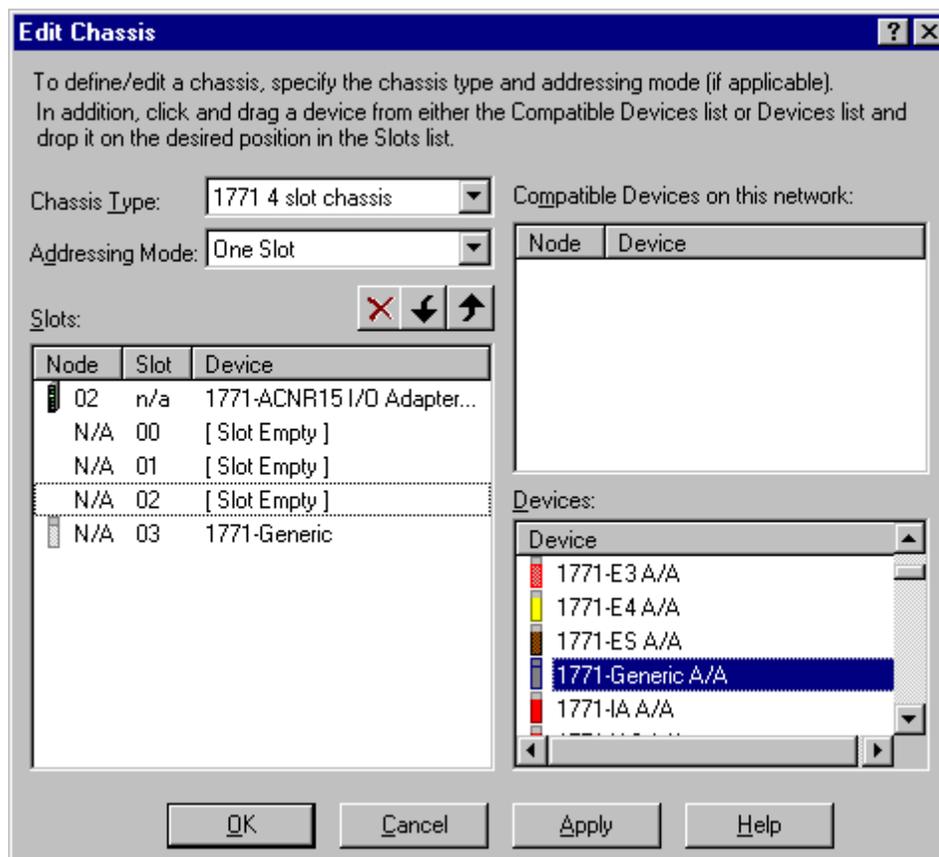
A 1771-Generic I/O module Input connection may be used to schedule the Input data from a 1771sc-IFE32 module to appear in the ControlNet Data Input File of the PLC-5C15 processor.

The configuration data block for the 1771sc-IFE32 must still be sent via CIO instruction. This saves on ControlNet scheduled bandwidth, allows easy programmatic changes to be made to the module, and, most importantly, prevents the module from resetting every I/O scan.

### 1771-Generic module configuration

In RSNetworkx for ControlNet versions 2.22 and later, the graphical view of the network allows for a right-click on a Communications Adapter and the selection of the “Configure Chassis” applet

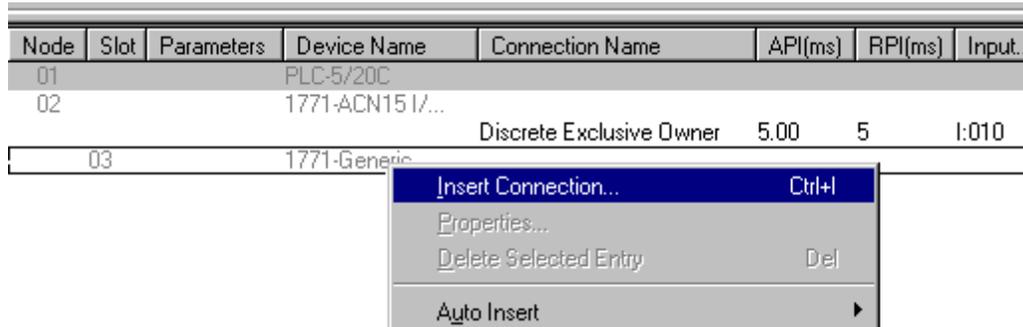
In the Chassis Configuration applet, the user drags-and-drops the desired modules from an available devices list into the chassis in the slot locations in which the modules will be installed. In this application, the 1771sc-IFE32 will be represented by a “1771-Generic” module. This module type will allow us to enter the data lengths required for the operation of the IFE32 module.



Next, the I/O Connections to the 1771sc-IFE32 must be established. This is done through the Scanlist Configuration application, which is accessed by right-clicking in the RSNetworkx for ControlNet graphical view on a PLC-5C15 controller, and selecting “Scanlist Configuration”.

A discrete I/O connection to the 1771 I/O chassis must exist before a connection may be established to an intelligent module in that chassis. This document does not cover the theory and practice of ControlNet I/O mapping with PLC-5C15 controllers. If you are unfamiliar with the Scanlist Editor, contact your local Rockwell Automation distributor or support office.

In the RSNetworkx for ControlNet Scanlist Editor, right-click on the entry for the 1771-Generic module in the chassis you have chosen, and select "Insert Connection". The software will enter Edit Mode and the Module Connection Properties window will appear.

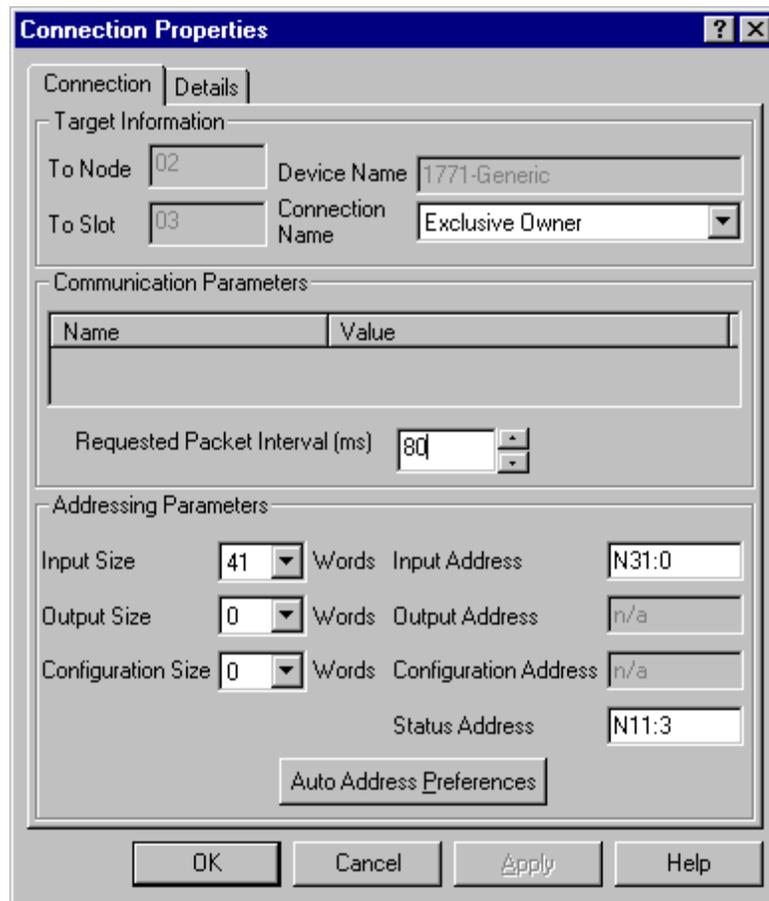


Enter the desired number of words into the Input Size field in the Connection Properties dialog.

Remember that the 1771-IFE Input Data may be either 41 words or 64 words in length.

If you intend to use scheduled I/O messaging to perform configuration of the module, you may also enter either 5, 23, or 64 words in the Output Size field of the Connection Properties dialog.

Because a CIO instruction is used to configure the module, set the Configuration Data size to 0 words.



The Input Address chosen in the Connection Parameters dialog has already been chosen as the ControlNet Data Input file in the PLC-5. Input data from the module will be mapped into PLC-5 data file memory starting at that address.

Note that the Requested Packet Interval (RPI) for this module has been set to 80 milliseconds. If the RPI is set extremely low, the module will not be able to respond to the ControlNet adapter's data transfer requests and a connection error will result.

For example, for the default ControlNet system Network Update Time (NUT) and default RPI of 5 milliseconds, the default analog module RPI is 4x the NUT, 20 ms. This is too fast for the module to handle.

RPI's must be set as binary multiples (x2, x4, x8, x16, x32, x64, and x128) of the NUT. For a default NUT of 5 milliseconds, the binary multiples are 10, 20, 40, 80, 160, 320, and 640 milliseconds.

### **Input data update timing.**

The 1771sc-IFE32 module will make data available to the 1771-ACNR15 network adapter only after it has scanned all of its input channels. This time can vary depending upon the filtering settings for each channel, and upon the usage of Real Time Sampling. Consult the User Guide for details about these features.

When using **unscheduled** messaging, a request for data will be made from the module only when the CIO 1771 Read instruction is executed. If the module does not immediately respond to the request, the adapter will wait until it does, then return a reply to the CIO 1771 Read.

Although it is impossible to predict how fast a CIO instruction will complete (because it is using the unscheduled portion of the ControlNet bandwidth), test systems have returned CIO instructions in under 10 milliseconds on lightly loaded ControlNets.

An efficient way to program CIO instructions is to have the instruction repeat only after the Done bit has indicated the instruction has received a response. Because CIO instructions have no built-in timeout, error handling and watchdog logic may be required as well.

The worst-case update time with such a method will be the module update time plus the time required for the CIO instruction to complete.

When using **scheduled** messaging, requests for data will be made by the 1771-ACNR15 from the IFE32 module continuously and that data will be exchanged with the PLC-5C15 controller at the rate set by the RPI in RSNetworkx. If the RPI is set, for example, for 100 milliseconds and the module takes 500 milliseconds to update all of its channels, 5 identical copies of the module data will be transferred to the controller.

With scheduled messaging, the worst case situation is when the RPI falls just before the completion of the module update. In such a case, the total update time will be the module update time plus the RPI. The most predictable update times will be achieved using Real Time Sampling and scheduled messaging. A common rule of thumb is to set the RPI to 3 or 4 times faster than the calculated module update time.

### **Summary:**

The 1771sc-IFE32 may be used in PLC-5 ControlNet systems with only small modifications to the ladder logic, replacing BTR and BTW block-transfer instructions with CIO 1771-Read and 1771-Write ControlNet I/O Transfer instructions.

In addition, the module input data from the 1771sc-IFE32 may be part of the scheduled I/O configuration for the PLC-5 based ControlNet network. In such a system, the module still receives its channel configuration data via a CIO instruction.

Update time for the 1771sc-IFE32 input data is dependent principally on the module's configuration or RTS settings, but may also be affected by the data transfer method used.

Appendix A: Sample Ladder Logic program for CIO-only data transfer

