



A-B RIO Scanner for SoftPLC® Runtime

Version 1.0

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Chapter 1. Overview

1.1. Introduction

This document describes the installation, usage, and functionality of the **Allen-Bradley Remote I/O (RIO)** Scanner software for SoftPLC. (Historically the A-B RIO network has sometimes been called the **blue hose**.) This software is a TOPDOC Loadable Module (TLM) that extends a SoftPLC runtime engine, enabling it to be a master/scanner on one or more RIO networks. This **RIO** TLM implements the **master or scanner** role within the Allen-Bradley Remote I/O protocol.

This functionality is currently only available on Smart SoftPLC's equipped with the Smart A-B RIO Master/Scanner Interface hardware (Cat.No. SM-ABRIOMx). The SM-ABRIOM is a factory installed option.

1.2. Concepts

The **SoftPLC runtime engine** software supports TLM's, which are shared library extensions to SoftPLC. A TLM may be loaded either as a **DRIVER** or as a **MODULE**. The difference between a DRIVER and a MODULE is that a DRIVER is called once per SoftPLC scan, and optionally an additional number of times per scan. A MODULE is only called when the control program decides to call it and not as an inherent part of the scan. TLM's are made known to SoftPLC in the MODULES.LST file which may be edited by **TOPDOC NexGen** by traversing to: PLC | Modules.

This RIO TLM is a DRIVER and has a number of TOPDOC Loadable Instructions contained within it. These are Ladder Logic instructions that can be used to control or query the operation of the TLM.

1.3. Features

- Supports racks numbered from 0 to 076 (octal).
- Can scan up to 5 RIO networks concurrently.
- Supports a 120 ohm termination resistor, software selectable.
- Supports baud rates of 57600 (56.7Kbaud), 115200 (115.2Kbaud), and 230400 (230.4Kbaud).
- Block transfer is fully supported.

1.4. Requirements

1.4.1. Hardware

- Smart SoftPLC or Smart Gateway.
- SM-ABRIOM5 and/or SM-ABRIOM6 Smart A-B RIO Master Interface hardware (one per network).
- SM-COM6CBLTB - Smart COM6 Port Cable to Din-Rail Terminal Block Assembly (required for SM-ABRIOM6) *Includes RJ11 interconnect cable and din-rail terminal block.*

- Belden #9463 Blue Hose connection cable(s) [customer supplied] (one per network).



Only version 2.0 (or later) Smart boards can support more than one A-B RIO interface.

1.4.2. Software

- Gatecraft Linux 2011A or above
- SoftPLC version 4.6 runtime or above
- TOPDOC NexGen 1.6 or above

Chapter 2. Warranty

2.1. Terms of Use

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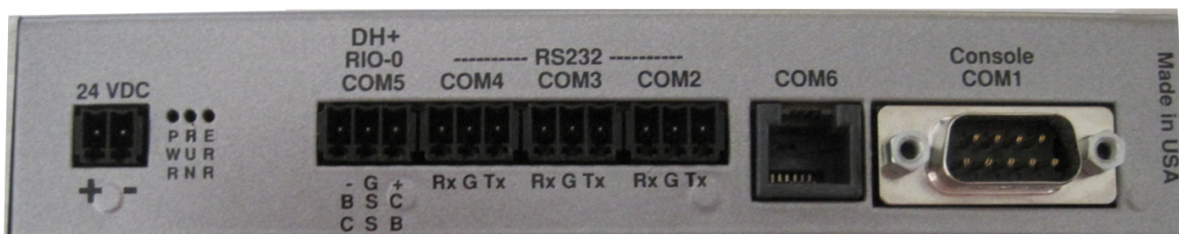
Chapter 3. Installation

3.1. Hardware Installation

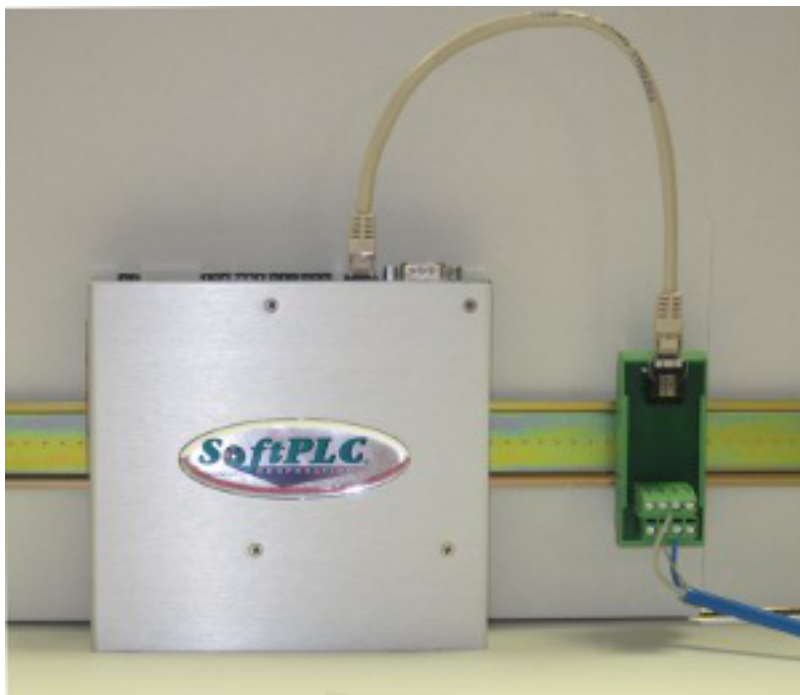
The internal A-B RIO interface is factory installed into the Smart SoftPLC/Gateway. SM-ABRIOM5 replaces the COM5 port, SM-ABRIOM6 is available from COM6.

3.2. Component Overview

The figure below shows the port/wiring connection for the blue hose connected to COM5 of a Smart SoftPLC/Gateway with SM-ABRIOM5. Using the center line of text, the Clear wire connects to the terminal marked “C”, the Shield connects to the center marked “S”, and the Blue wire connects to the terminal marked “B”. Version 2.x (and later) Smart boards support RIO via COM5.



The figure below shows a mounted Smart SoftPLC/Gateway attached to the Smart COM6 Cable Assembly (Cat No SM-COM6CBLTB). Version 1.x and Version 2.x Smart Boards support RIO via COM6.



3.3. A-B RIO Wiring Connection to Din-Rail Terminal Block

The Terminals labeled by number in the image below correspond to the following wiring:

1. No Connection
2. No Connection
3. Blue
4. Clear
5. Shield/Drain
6. No Connection



The version 2.x (and later) Smart boards have a 3 point terminal block for each supported RIO network.

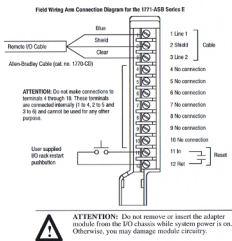


3.4. A-B RIO Wiring connection to A-B 1771-ASB



The RIO (Blue Hose) cable section from the Smart COM5 or the SM-COM6CBLTB Din-Rail terminal block to the 1771-ASB must be at least seven (7) feet in length.

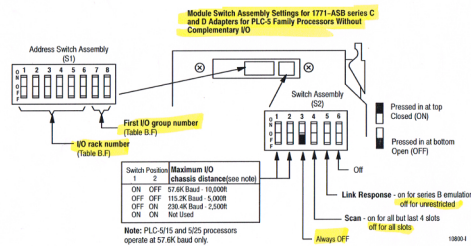
A termination resistor should be connected across 1 (Blue) & 3 (Clear) on the last adapter on the RIO link. The termination resistor value is determined by the RIO baud rate: 150 Ohm for 57.1K/115.2K, and 82 ohm for 230.4K.



Terminals 1 and 4, 2 and 5, and 3 and 6 are internally connected on the module. If you use these terminals (4, 5, and 6) for connection of additional adapter modules, you disconnect the remaining adapter modules in the series connection when you disconnect the remote I/O adapter module wiring area. If this is not desirable for your application, make your connections to terminals 1, 2, and 3 only.

3.5. 1771-ASB Switch Settings

Set the I/O Rack number on Switch Assembly S1 1-6 and the I/O Group number on S1 7-8. Set the RIO Baud rate on Switch Assembly S2 1-2, S2-3-6 are usually set to OFF.



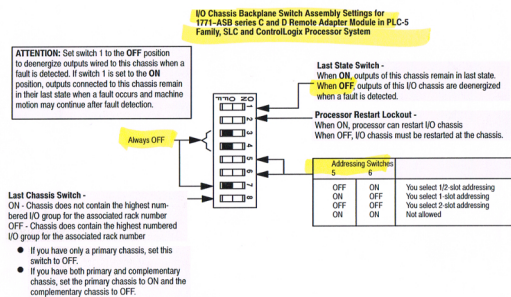
**Table B.F
I/O Rack Selection for PLC-5 Family Processors without Complementary I/O**

Rack #	Switch Setting						Rack #	Switch Setting						1st I/O Group Number	Switch Selections	
	1	2	3	4	5	6		1	2	3	4	5	6		7	8
60	On	On	On	On	On	On	20	On	On	On	On	On	0	On	On	
61	On	On	On	On	On	Off	21	On	On	On	On	On	2	On	Off	
62	On	On	On	On	Off	Off	22	On	On	On	On	On	4	Off	On	
63	On	On	On	Off	Off	Off	23	On	On	On	On	On	6	Off	Off	
64	On	On	On	Off	On	On	24	On	On	On	On	On	On	On	On	
65	On	On	On	Off	On	Off	25	On	On	On	On	On	On	On	On	
66	On	On	On	Off	On	On	26	On	On	On	On	On	On	On	On	
67	On	On	On	Off	Off	Off	27	On	On	On	On	On	On	On	On	
68	On	On	On	Off	On	On	28	On	On	On	On	On	On	On	On	
69	On	On	On	Off	On	Off	29	On	On	On	On	On	On	On	On	
70	On	On	On	Off	On	On	30	On	On	On	On	On	On	On	On	
71	On	On	On	Off	On	Off	31	On	On	On	On	On	On	On	On	
72	On	On	On	Off	On	On	32	On	On	On	On	On	On	On	On	
73	On	On	On	Off	Off	Off	33	On	On	On	On	On	On	On	On	
74	On	On	On	Off	On	On	34	On	On	On	On	On	On	On	On	
75	On	On	On	Off	On	Off	35	On	On	On	On	On	On	On	On	
76	On	On	On	Off	On	On	36	On	On	On	On	On	On	On	On	
77	On	On	On	Off	On	Off	37	On	On	On	On	On	On	On	On	

PLC-5 processor can use racks 0-37.
PLC-575 and PLC-500 processors can use racks 01-02.
PLC-540 and PLC-500 processors can use racks 01-02.
PLC-500 and PLC-500L processors can use racks 01-17.
PLC-540 and PLC-500L processors can use racks 01-17.
PLC-520L processors can use racks 0-37.

3.6. 1771 Rack Switch Settings

Recommending settings are SW2 ON and all other switches OFF. When SW2 is ON, the RIO Adapter will be restarted when the Fault is cleared and the PLC is put in RUN Mode.



3.7. Software Installation

The TLM is named **rio.tlm.so**, and the configuration file is **RIO.LST**. Both of these files will be pre-installed on the SoftPLC for you. To use it you have to enable and configure it using **TOPDOC NexGen's PLC | MODULES** editor. Select Use for RIO.TLM, then click on the Configure button to edit

the RIO.LST file.

The screenshot displays the 'PLC Configuration Editors' software interface. On the left, a 'Local PLC Defs' sidebar lists various PLC models, with 'SMART' selected. The main window is titled 'PLC Configuration Editors' and has tabs for 'Define', 'Network', 'Module', 'O.N.E.', and 'Startup'. The 'Module' tab is active, showing a table of 'Soft Modules & I/O Drivers'.

Use	Type	Name	Options
<input checked="" type="checkbox"/>	DRIVER	RIO.TLM	
<input type="checkbox"/>	DRIVER	APC.TLM	COMPORT=2 TIMEOUT=10
<input type="checkbox"/>	MODULE	COMGENIE.TLM	PORT0=COM2(9600,N,8,1) TIMEOUT...
<input type="checkbox"/>	MODULE	COMGENIUS.TLM	
<input type="checkbox"/>	MODULE	COMM.DLL	COM3IRQ=5 COM4IRQ=2

Below the table are 'Configure' and 'Move Up' buttons. The 'Module Detail' section shows:

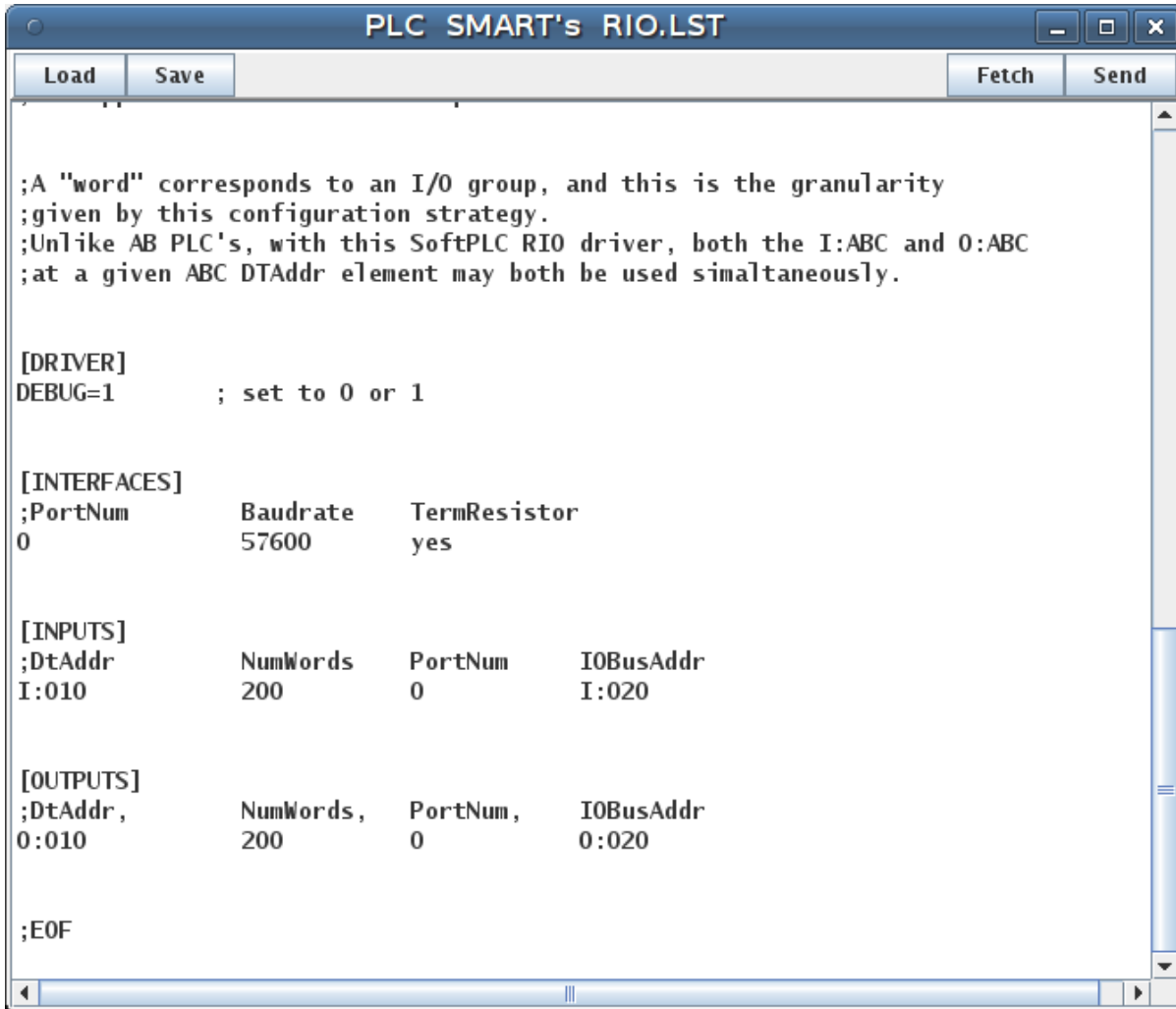
- Purpose:** Allen-Bradley Remote I/O (Blue Hose) Scanner.
- Full Path:** /SoftPLC/tlm/RIO.TLM
- Your notes on this Module:** This TLM drives the remote 1771 Racks, since we kept them after upgrading and converting from the PLC-5.

At the bottom, there are sections for 'Remote' and 'Local' operations:

- Remote:** Fetch, Send, and Browse (unchecked) buttons.
- Local:** Load, Save, and Browse (checked) buttons.

Chapter 4. Configuration

4.1. Configuration Editor Usage



Load button will load the configuration file from the development system's disk.

Save button will write the configuration file to the development system's disk.

Fetch button will load the configuration file from the runtime system's disk.

Send button will write the configuration file to the runtime system's disk. The next step is to restart or cycle power on the SoftPLC for the changes to take place. As an alternative to cycling power, you may enter "Remote Program" mode using NexGen, then select "Remote Program" a second time. This pseudo transition from Remote Program to Remote Program is a signal to the TLM that it should reload its configuration file. This way you can reconfigure without cycling power, although it does require you enter "Remote Program" mode (twice!).

4.2. RIO.LST Configuration File Details

The configuration file for the RIO TLM is `/SoftPLC/tlm/RIO.LST`. This file is used to set the debug level, baudrate, termination resistor on/off state, and the I/O Bus Addresses and associated SoftPLC Datable assignments for each RIO network.

Sample RIO.LST

```
;Configuration file for SoftPLC RIO.TLM.

;Any part of any line in this text file to the right of a semicolon is a
;comment and will be ignored by the TLM.

;There are 4 sections in this file: [DRIVER], [CARDS], [INPUTS],
;and [OUTPUTS].

;[DRIVER] is a place for global parameters.

;[INTERFACES] lists each RIO interface (i.e. bus or cable) in the system on
;a separate line.
; There are columns for PortNum, and Baudrate.
; PortNums start at zero and go up from there in sequence, no gaps in numbering.
; For this driver PortNum 0 is the COM5 port and PortNum 1 is the COM6 port.
; Baudrate must be one of 57600, 115200, or 230400.

;[INPUTS] lists blocks of words that are to be copied from each
;interface into the SoftPLC input image table as part of the I/O scan.
;Only I:xxx type addresses may be used here. DtAddr is the
;memory address within SoftPLC and must be in the I: datatable section.
;IOBusAddr is the address that is determined by the physical rack and slot
;used on an RIO bus.
;Each row in this section describes a block whose length is
;given by NumWords. A block may be as long as you like, and
;sometimes you will have only one block, other times you might
;have several. This scheme lets you map any IOBusAddr
;to any real input DtAddr.

;[OUTPUTS] lists blocks of words that are to be copied from
;SoftPLC's output image table onto a bus as part of the I/O scan.
;Only O:xxx type addresses may be used here. DtAddr is the
;memory address within SoftPLC and must be in the O: datatable section.
;IOBusAddr is the address that is determined by the physical rack and slot
;used on an RIO bus.
;Each row in this section describes a block whose length is
;given by NumWords. A block may be as long as you like, and
;sometimes you will have only one block, other times you might
;have several. This scheme lets you map any DtAddr
;to any one or more real output IOBusAddrs. The same DtAddr may
;be mapped to more than one output IOBusAddr.

;A "word" corresponds to an I/O group, and this is the granularity
;given by this configuration strategy.
;Unlike AB PLC's, with this SoftPLC RIO driver, both the I:ABC and O:ABC
;at a given ABC DtAddr element may both be used simultaneously.
```

[DRIVER]

DEBUG=1 ; set to 0 or 1 to enable logging of RIO network traffic
DETECT_SECS=10 ; Maximum seconds to spend finding the configured adapters, 1-60 allowed

[INTERFACES]

;PortNum	Baudrate	TermResistor
0	57600	yes

[INPUTS]

;DtAddr	NumWords	PortNum	IOBusAddr
I:010	200	0	I:020

[OUTPUTS]

;DtAddr,	NumWords,	PortNum,	IOBusAddr
O:010	200	0	O:020

Chapter 5. Usage

5.1. RIO TLM Diagnostic Ladder Instructions

5.1.1. RIORETRYCOUNTS – Get Rack Retry Counts



This permissive instruction is used to get the rack retry counter values (Counts) for a given RIO Interface (Port). Four words are allocated for each full rack where each word corresponds to the starting quarter rack offset (1st, 2nd, 3rd, and 4th). Thirty-two (32) racks are supported. Total length of the assigned file is 128 (4x32) words. Valid Port range is 0 to 2. Valid count range will be 0-255 (8 bits).

If the left side of the instruction is TRUE and the Port index is valid, then the rung state to the right of the instruction will be TRUE.

5.1.2. RIOGETFAULTMAP – Get Rack Adapter Fault Map



This permissive instruction is used to monitor rack faults for a given RIO interface (Port) network. Each word corresponds to a rack number where bits 0, 1, 2, 3 are set to indicate that adapters for the 1st, 2nd, 3rd, or 4th logical quarter racks, respectively are in a faulted state. The valid port range is 0 to 1.

If the left side of the rung is TRUE and the Port index is valid, the rung state to the right of the instruction will become TRUE if a rack fault is detected.

5.1.3. RIORACKEXISTS – Get Existing Racks Map



This output instruction creates a 32 word file (Map) of the existing racks on the specified RIO Interface (Port) network. Each word corresponds to a rack number where bits 8, 9, 10, 12 are set to indicate that adapters for 1st, 2nd, 3rd, or 4th logical quarter racks, respectively are present. The valid port range is 0-1.

If the left side of the rung is TRUE and the Port index is valid, then the rung state to the right of the instruction will be TRUE.

5.2. Block Transfer Instructions

5.2.1. BTW - Block Transfer Write



In this example, the BTW is executed one time during the first ladder scan to write configuration data to an analog Input Module.

5.2.2. BTR - Block Transfer Read



In this example, the BTR will be enable if the BTW was successful, assuring that the analog Input module was successfully configured. Then the BTR will be executed repeatedly during the ladder scan to read the analog input values.

5.2.3. BTR/BTW Error Codes

If a block transfer error occurs, the error bit (/ER) will be set and a negative error code will be stored in the transmitted word count (.DLEN).

- 3 Data table block too small
- 4 BTW reply error
- 5 Checksum error
- 6 Data file Length invalid for destination module-7 Physical slot mismatch
- 8 Invalid response
- 9 Rack not defined
- 10 Timeout
- 11 Rack out of range

5.2.4. Debugging

When SoftPLC starts, the RIO driver will scan the RIO Network for available racks. If the racks defined in the RIO drivers configuration file (RIO.LST) can not be found on the network, the PLC will Fault. To help resolve the problem, examining the RIO driver output messages in the system log using “logread” from the Linux console can help.

1. Log into SoftPLC using either a) PUTTY from Windows or b) using ssh from Linux or c) at the command prompt of the SoftPLC system.
2. Then from the Linux console type: logread | less
3. Use the DN and UP arrows keys to view the output of the RIO driver output messages.
4. To exit the “less” viewer, press “q”.