# HDLC Router

## Starnet and GEM80 Controller

Technical Application Note

A-HDLC

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# 1. PREFACE

## 1.1. PURPOSE OF THIS DOCUMENT

This document will assist the user to setup the GEM80 controller to communicate via the Starnet module with a Logix controller using the HDLC Router.

## 1.2. ADDITIONAL INFORMATION

The following resources contain additional information that can assist the user with the module installation and operation.

| Resource | Link |
|---|---|
| Slate Installation | http://www.aparian.com/software/slate |
| HDLC Router User Manual<br>HDLC Router Datasheet<br>Example Code & UDTs | http://www.aparian.com/products/hdlcrouter |
| Ethernet wiring standard | www.cisco.com/c/en/us/td/docs/video/cds/cde/cde205_220_420/installation/guide/cde205_220_420_hig/Connectors.html |
| CIP Routing | The CIP Networks Library, Volume 1, Appendix C:Data Management |

## 1.3. SUPPORT

Technical support will be provided via the Web (in the form of user manuals, FAQ, datasheets etc.) to assist with installation, operation, and diagnostics.

For additional support the user can use either of the following:

| | |
|---|---|
| Contact Us web link | www.aparian.com/contact-us |
| Support email | support@aparian.com |

# 2. APPLICATION DESCRIPTION

The Aparian HDLC Router can be used to enable the GEM80 Controller to exchange data (via the Starnet card) with a Logix Controller. The below diagram is an example of a typical network setup.

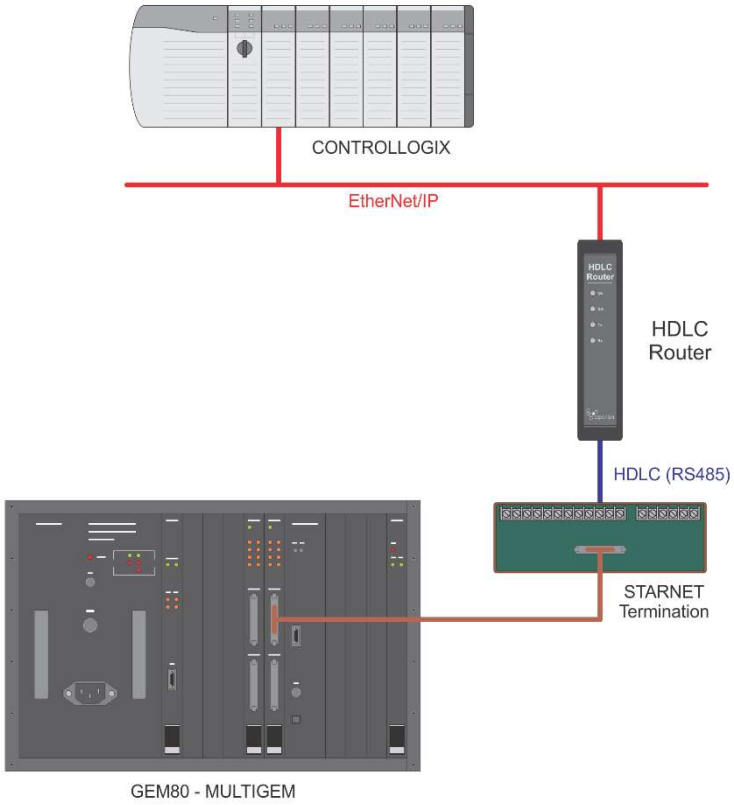



Figure 1 - Example of a typical network setup

When setup correctly the GEM80 Controller will request data via the Starnet card which will send HDLC messages to the HDLC Router and vice versa. The HDLC Router will then convert this message to the required format and relay it to the configured Logix Controller.

# 3. SETUP

The following sections will describe the installation and configuration of all the required devices to assist the user with the initial setup.

## 3.1. HDLC CABLE WIRING

The HDLC cable pinout for 4-wire and 2-wire communication is shown in the figures below:

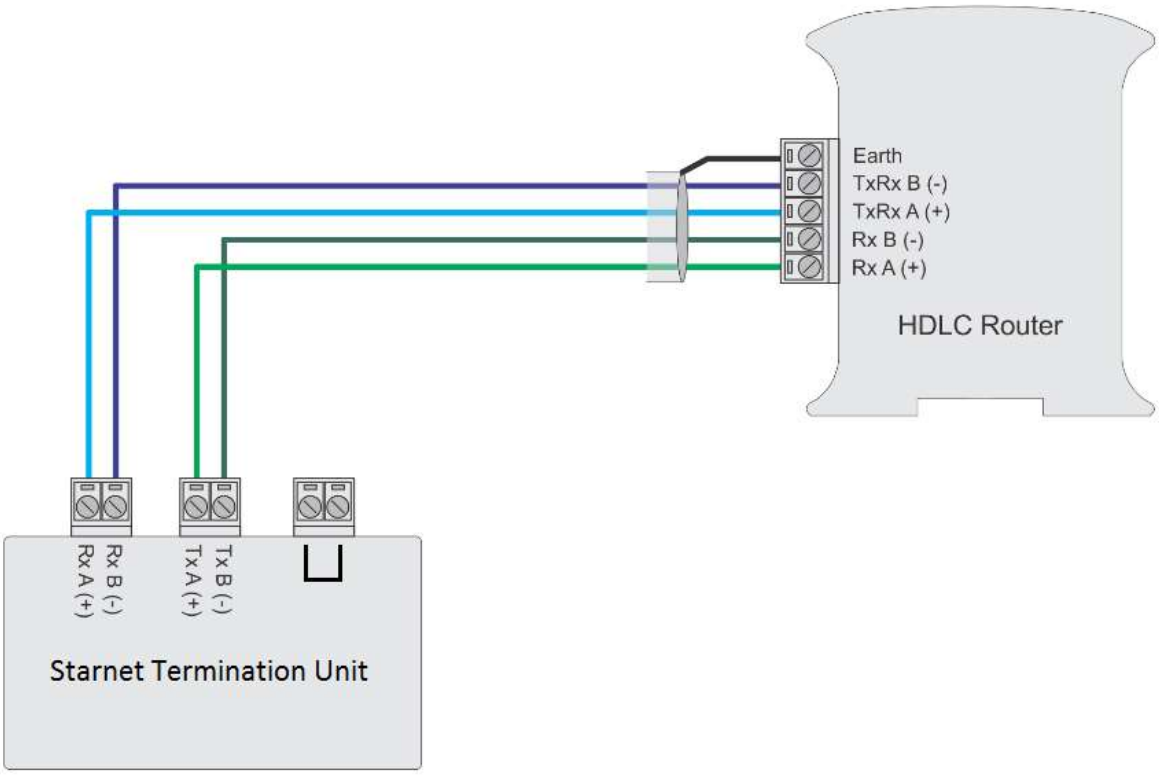



Figure 2 – 4-Wire HDLC Communication

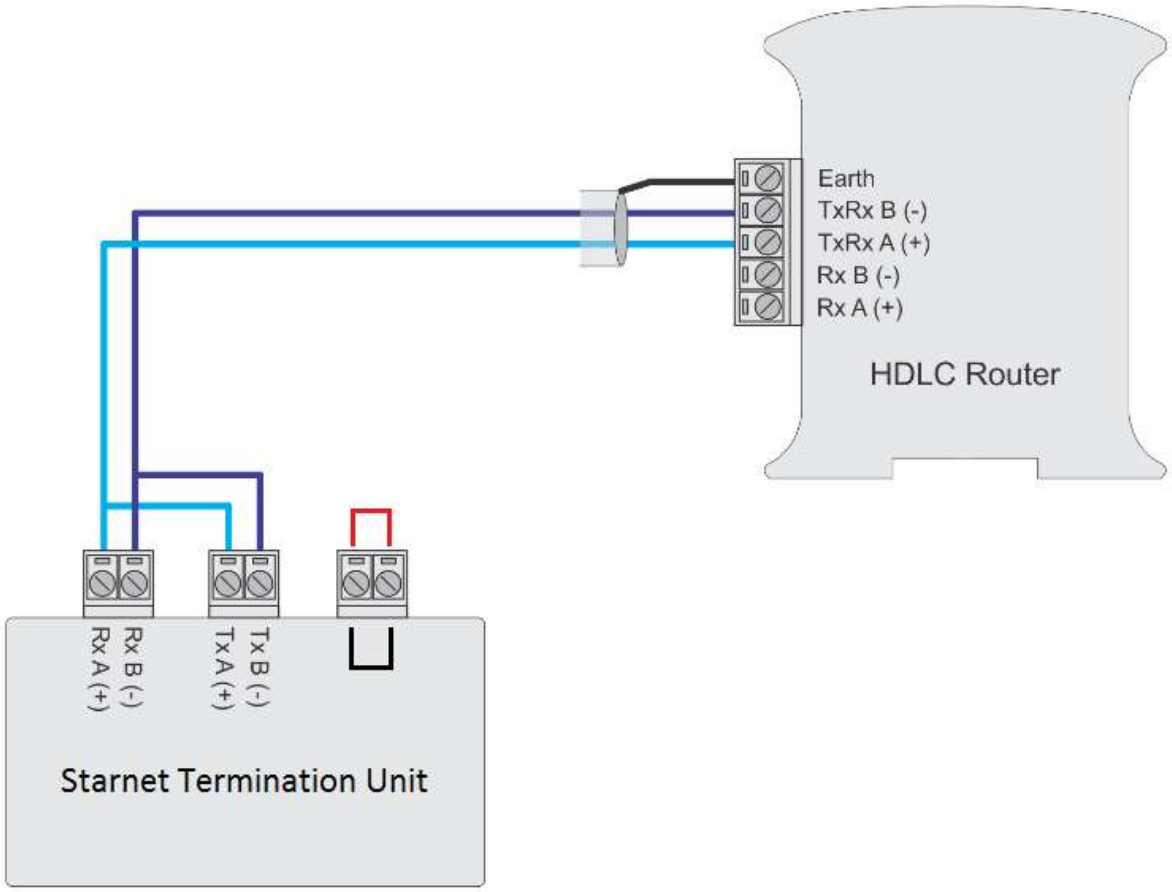



Figure 3 – 2-Wire HDLC Communication

## 3.2. HDLC ROUTER SETUP

### 3.2.1. DATA MAPPING

The HDLC Router must be configured to match the data sent and received by the Starnet communication module. This is done by matching the input and output sizes as configured in the GEM80 controller.

**NOTE:** The Starnet module adds an additional 2 words to the input and output data size configured in the GEM80 controller. So, if the user has configured 110 words input and output data in the GEM80 controller the HDLC Router will need to be configured with input and output sizes of 112 words (as shown below). **Refer to Section 4.1 for further information.**

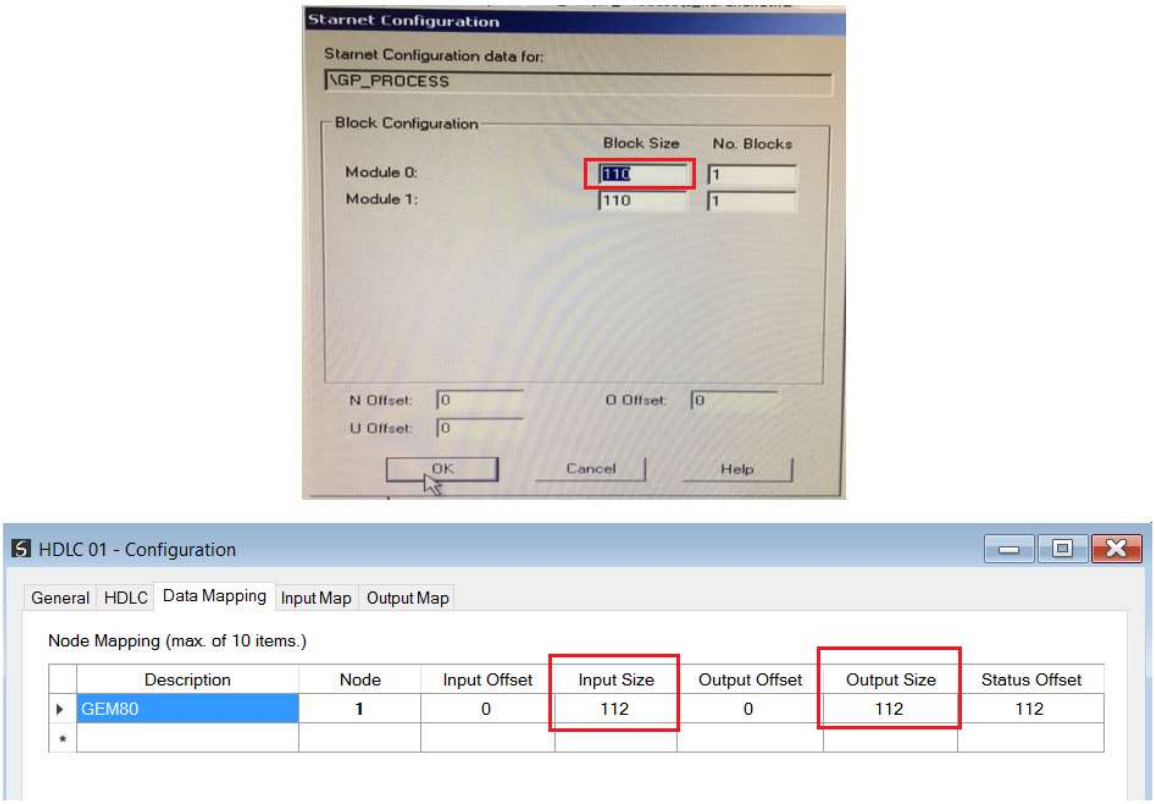



Figure 4 – Data size configuration

**NOTE:** The user will need to manually add the data required for the Starnet header in the Logix output mapped data. **Refer to Section 4.1 for further information.**

If the user has selected an incorrect size for the input, the HDLC Router will report a size mismatch in the Node Statistics. Refer to the user manual for a detailed description.

### 3.2.2. HDLC Parameters

The HDLC parameters can be setup as shown in the figure below:

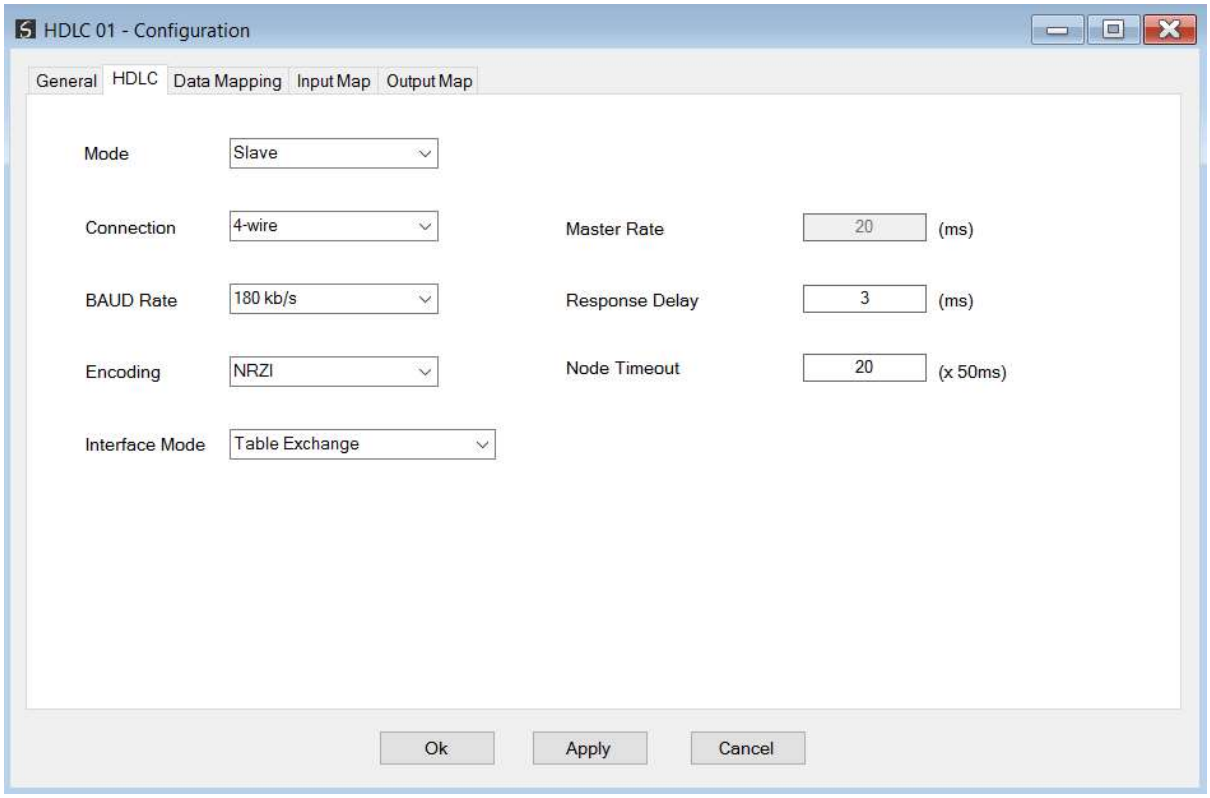



Figure 5 – HDLC Parameters

The HDLC communication configuration consists of the following parameters:

| Parameter | Description |
|---|---|
| Mode | The mode in which the Router will operate, either:<br>• **Master** – Initiating requests<br>• **Slave** – Responding to requests |
| Connection | The physical topology for the HDLC (RS485) connection, either:<br>• **2-wire** – Using Half-duplex communication<br>• **4-wire** – Using Full-duplex communication<br>Refer to section 2.4 for information on the choices. |
| BAUD Rate | The BAUD rate to be used, either:<br>• **48 kb/s**<br>• **180 kb/s** |
| Encoding | The bit encoding method to be used, either:<br>• **NRZI** – Non-return to zero inverse encoding<br>• **FM0** – Biphase space encoding<br>• **FM1** – Biphase mark encoding |
| Interface mode | The interface mode can be set to either of the following:<br>• **Table Exchange**<br>• **Broadcast with Response**<br>• **Broadcast without Response** |

| | |
|---|---|
| Master Rate | The rate at which the module send requests when in master mode, expressed in milliseconds. |
| Response Delay | When in Slave mode, this is the time delay (milliseconds) between when a request is received and the reply is sent.<br>In Master mode, this defines the time (milliseconds) between when a request is received before the next request is sent. |
| Node Timeout | The amount of time of inactivity for a specific node before the node is declared offline (de-active). The time is expressed in multiples of 50ms. |

Table 1 – HDLC communication configuration parameters

## 3.3. LOGIX SETUP

The HDLC Router exchanges data with a Logix controller via Class 1 input and output assemblies. Thus, the HDLC Router must be added to the Logix IO tree to receive and send data to the GEM80 controller.

### 3.3.1. ADD MODULE TO I/O CONFIGURATION

Adding the module to the Logix IO tree makes use of the generic Ethernet module profile. This is done by right clicking on the Ethernet Bridge in the RSLogix 5000 and selecting *New Module* after which the *ETHERNET-MODULE* is selected to be added as shown in the figure below.

NOTE: See the next section for importing the configuration (L5X).

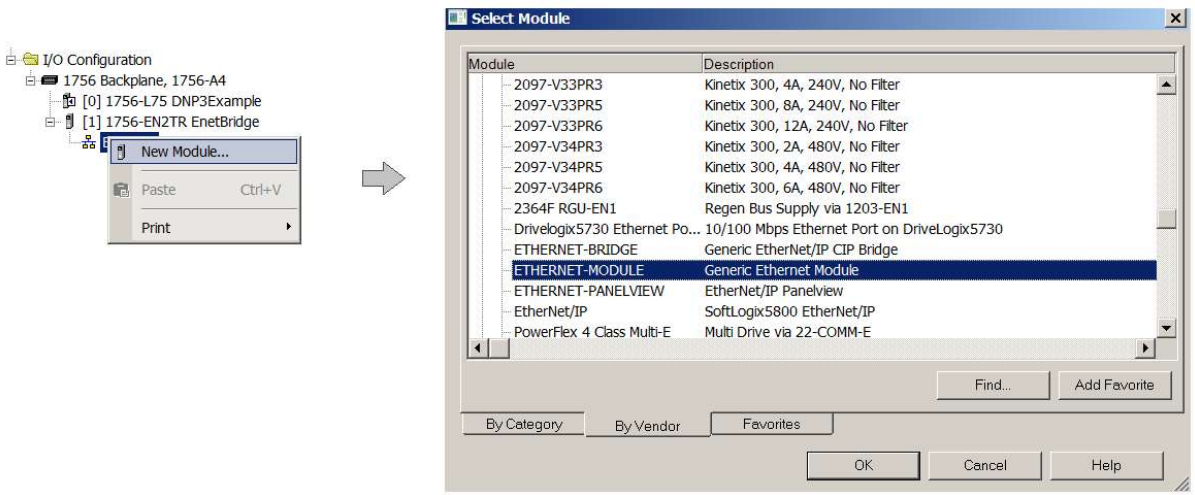



Figure 6 - Add a Generic Ethernet Module in RSLogix 5000

The user must enter the IP address of the HDLC Router that will be used. The assembly instance and size must also be added for the input, output, and configuration in the connection parameters section. Below are the required connection parameters.

| Connection Parameter | Assembly Instance | Size |
|---|---|---|
| Input | 119 | 480 (8-bit) |
| Output | 120 | 396 (8-bit) |
| Configuration | 102 | 0 (8-bit) |

Table 2 - RSLogix class 1 connection parameters for the HDLC Router

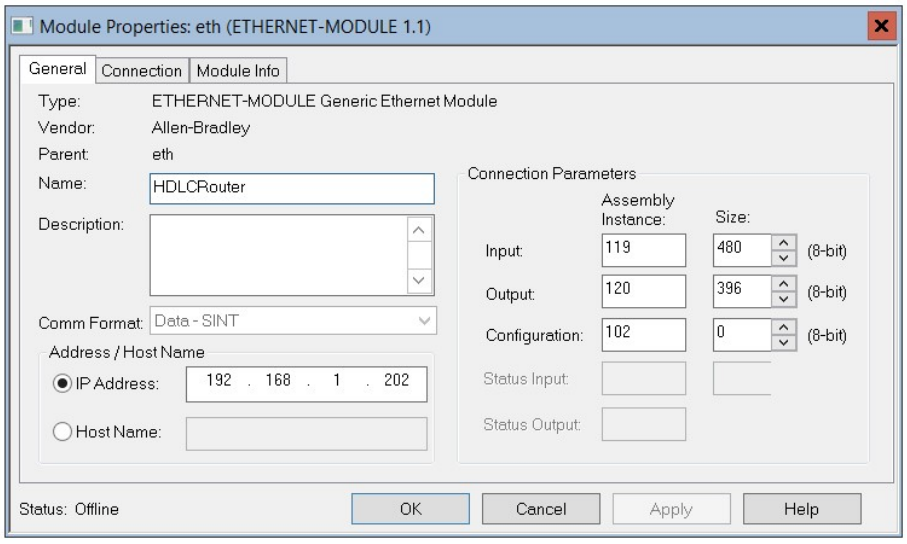



Figure 7 - General module properties in RSLogix 5000



**NOTE:** The user will need to enter the exact connection parameters before the module will establish a class 1 connection with the Logix controller.

Next the user needs to add the connection requested packet interval (RPI). This is the rate at which the input and output assemblies are exchanged. The recommended value is 10ms. Refer to the technical specification section in this document for further details on the limits of the RPI.

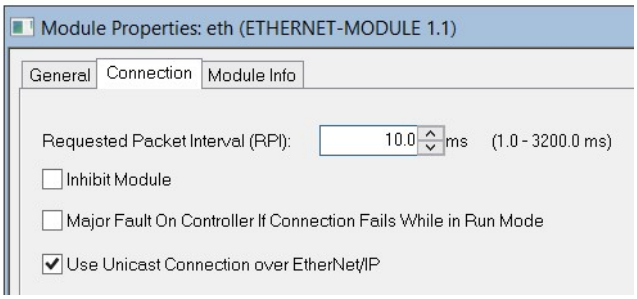



Figure 8 - Connection module properties in RSLogix 5000

Once the module has been added to the RSLogix 5000 IO tree the user must assign the User Defined Types (UDTs) to the input and output assemblies. The user can import the required

UDTs by right-clicking on *User-Defined* sub-folder in the *Data Types* folder of the IO tree and selecting *Import Data Type*. The assemblies are then assigned to the UDTs with a ladder copy instruction (COP) as shown in the figure below.

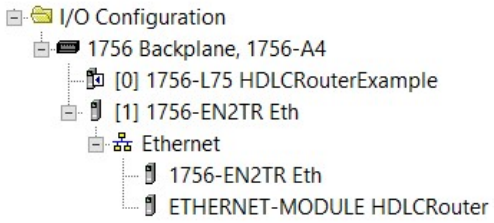



Figure 9 – RSLogix 5000 I/O module tree

### 3.3.2. Importing UDTs and Mapping Routines

To simplify the mapping of the input image, an RSLogix 5000 Routine Partial Import (L5X) file is provided. This file can be imported by right-clicking on the required Program and selecting the Import Routine option.

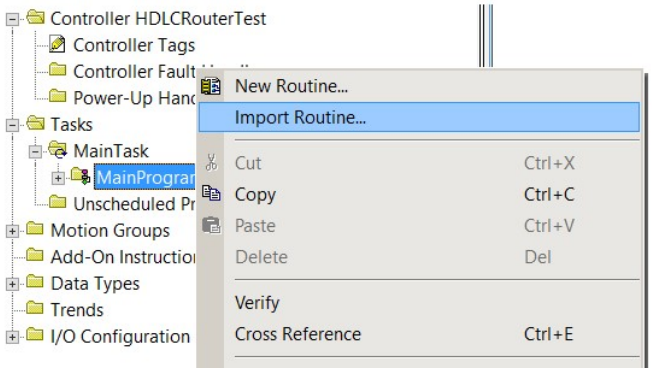



Figure 10 – RSLogix 5000 Importing HDLC Router specific routine and UDTs

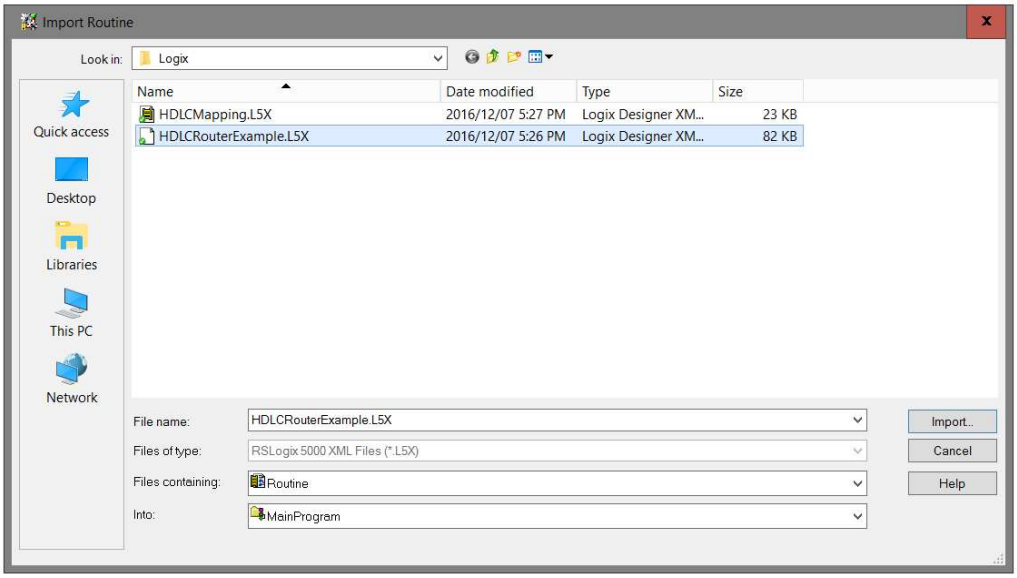



Figure 11 - Selecting partial import file

The import will create the following:

- The required UDTs (user defined data types)
- Two controller tags representing the Input and Output assemblies.
- A routine mapping the HDLC Router module to the aforementioned tags.

The user may need to change the routine to map to the correct HDLC Router module instance name, and make sure that the mapping routine is called by the Program's Main Routine.

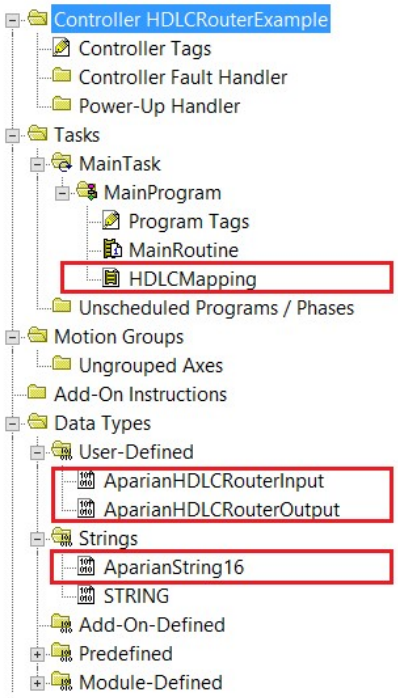



Figure 12 - Imported RSLogix 5000 objects

Refer to the additional information section of this document for an example RSLogix 5000 project as well as the required UDTs.

## 3.4. GEM80/STARNET SETUP

This section will discuss in general terms the procedures for setting up the Starnet module in the GEM80 controller to enable communication with the HDLC Router.

Once the user has done the Control Language for the T33 Config the following configuration data must match the HDLC parameters configured in the HDLC Router (see section 3.2.2).

| Offset | Parameter | Description |
|---|---|---|
| 0 | Primary or Secondary | 0 – Primary or Control<br>1 to 31 – Secondary address |
| 1 | Number of partners on link | 1 to 31 - for primary<br>1 to 15 – for control<br>1 – for secondary |
| 2 | Channel Type | 0 – Channel disabled<br>1 – HDLC 48k NRZI<br>2 – HDLC 48k FM0<br>3 – HDLC 48k FM1<br>4 – HDLC 180k NRZI<br>5 – HDLC 180k FM0<br>6 – HDLC 180k FM1 |
| 3 | Transmit Mode | (< 0) – Overwrite<br>(>= 0) – Queue |
| 4 | Receive Mode | (< 0) – Overwrite<br>(>= 0) – Queue |
| 5 | Interface Mode | (-1) – Table Exchange Mode<br>(1) – Broadcast without response<br>(2) – Broadcast with response |
| 6 | Number of partners to be updated per inter-scan | 0 to Max configured |

Table 3 – Starnet configuration

Refer to the Starnet User Information document for more detail regarding the configuration and operation of the Starnet module.

# 4. NOTES

## 4.1. STARNET HEADER

The Starnet communication module adds two additional words (“header”) to the input and output HDLC data. Included in the header is the data length. For this reason, the user will always need to configure two additional words to the input and output data size in the HDLC Router configuration over and above that which is configured in the GEM80 configuration for the Starnet module (as shown below):

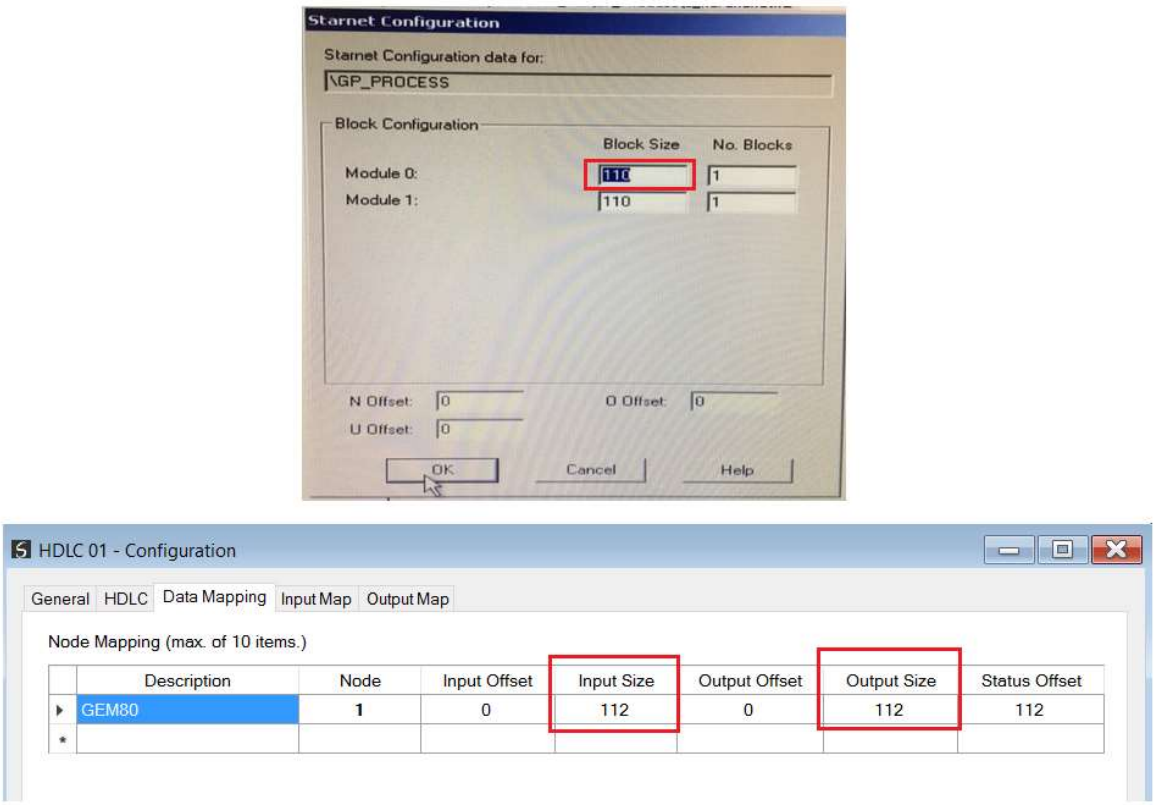
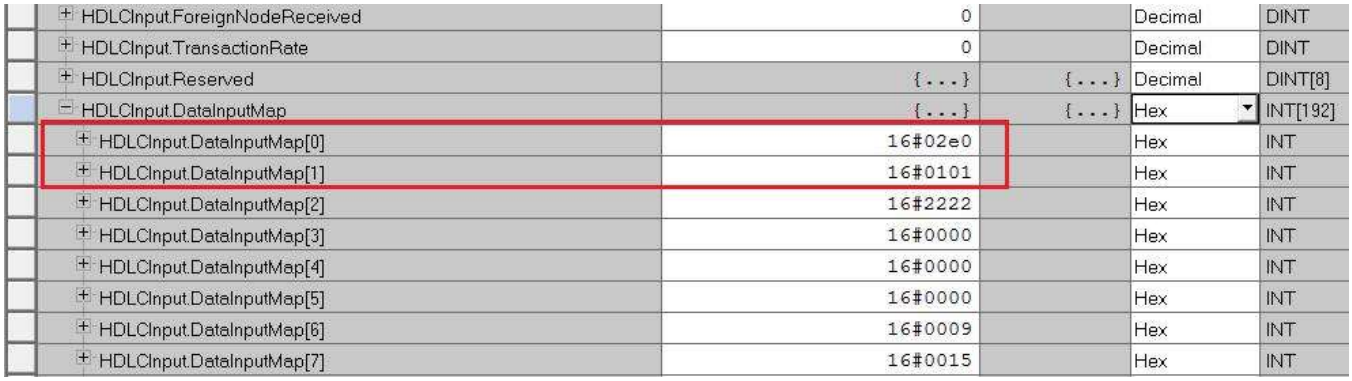



Figure 13 – Data size configuration

The Starnet header consists of the total input size in bytes, which includes the header (in this case 0xE0 – 224 bytes/112 words), followed by three fixed bytes (0x02 0x01 0x01).

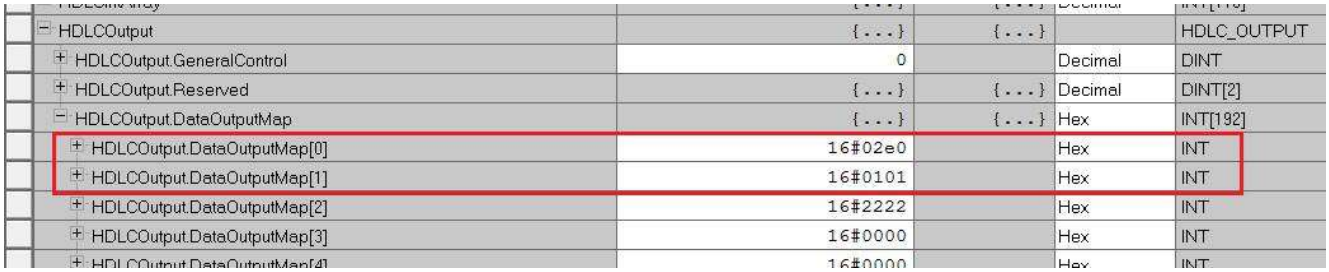
When the user views the input mapped data in Logix the first two words will be the Starnet “header” mentioned above (shown below). So, the actual data you will use will start at word two.



| | | | | |
|---|---|---|---|---|
| HDLCInput.ForeignNodeReceived | 0 | | Decimal | DINT |
| HDLCInput.TransactionRate | 0 | | Decimal | DINT |
| HDLCInput.Reserved | {...} | {...} | Decimal | DINT[8] |
| HDLCInput.DataInputMap | {...} | {...} | Hex | INT[192] |
| HDLCInput.DataInputMap[0] | 16#02e0 | | Hex | INT |
| HDLCInput.DataInputMap[1] | 16#0101 | | Hex | INT |
| HDLCInput.DataInputMap[2] | 16#2222 | | Hex | INT |
| HDLCInput.DataInputMap[3] | 16#0000 | | Hex | INT |
| HDLCInput.DataInputMap[4] | 16#0000 | | Hex | INT |
| HDLCInput.DataInputMap[5] | 16#0000 | | Hex | INT |
| HDLCInput.DataInputMap[6] | 16#0009 | | Hex | INT |
| HDLCInput.DataInputMap[7] | 16#0015 | | Hex | INT |

Figure 14 – Logix Data Input Map (Header in red)

For the output mapped data, the user will need to have the same Starnet header which will be the Slate configured output size in bytes followed by three fixed bytes (0x02 0x01 0x01).
**Note**: The user will need to enter these values into the Logix tag manually.



| | | | | |
|---|---|---|---|---|
| HDLCOutput | {...} | {...} | | HDLC_OUTPUT |
| HDLCOutput.GeneralControl | 0 | | Decimal | DINT |
| HDLCOutput.Reserved | {...} | {...} | Decimal | DINT[2] |
| HDLCOutput.DataOutputMap | {...} | {...} | Hex | INT[192] |
| HDLCOutput.DataOutputMap[0] | 16#02e0 | | Hex | INT |
| HDLCOutput.DataOutputMap[1] | 16#0101 | | Hex | INT |
| HDLCOutput.DataOutputMap[2] | 16#2222 | | Hex | INT |
| HDLCOutput.DataOutputMap[3] | 16#0000 | | Hex | INT |

Figure 15 – Logix Data Output Map (Header in red)