ProLinx COMMUNICATION GATEWAYS

BSCH

BOSCH Master
Protocol Driver Manual

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Document Revision History

Revision	Description	Date
2.20	Update for loader program	10/10/01
3.00	Corrected contact address, footers, and port diagram	5/4/04

Related Documents & Reference Materials

Several resources are available to assist with the configuration and support of the ProLinx Communication Gateways, Inc. modules. The following files are available off the web site:

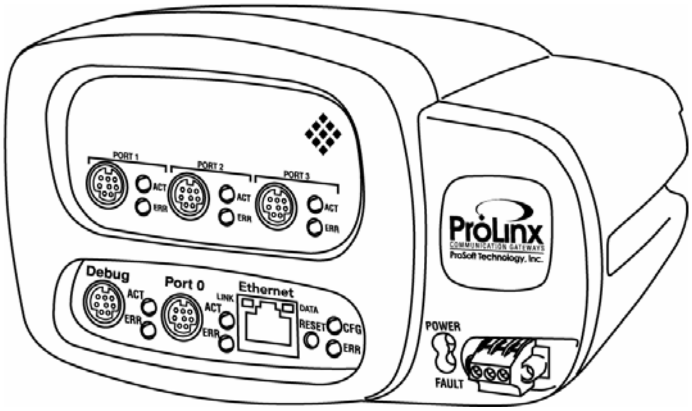
Startup Guide	www.prolinxgateways.com/downloads	
	startup_guide_2.20.pdf	ProLinx Communication Gateways, Inc. Startup Guide

1 Functional Overview

The BOSCH Master Protocol driver can exist in a single port (BSCH) or a multiple port (BSCH4) implementation. In either case, the driver can be configured on an individual port basis to operate as a BOSCH Master. Each port is independently configured for communication on a BOSCH network and interfaces with the internal database in the module.

1.1 Master Serial Port(s)

The ProLinx module is capable of supporting the BOSCH protocol as a Master on up to four ports. Each of the ports is individually configurable, providing a great deal of flexibility.



The relationship between the port labeling on the front of the ProLinx module and the application is as follows:

Port Label	Function
Debug	Debug/Configuration
Port 0	BOSCH Port 0
Following ports only exist on multiple port units	
Port 1	BOSCH Port 1
Port 2	BOSCH Port 2
Port 3	BOSCH Port 3

One or more BOSCH protocol master ports can be configured on the module to continuously interface with BOSCH slave devices over a serial communication interface (RS-232, RS-422 or RS-485). Each port is configured independently. User-defined commands determine the commands to be issued on each port. Up to 100 commands can be defined for each port. Data read from the devices are placed in the virtual database. Any write requests for the BOSCH slave devices are sourced with data from the virtual database.

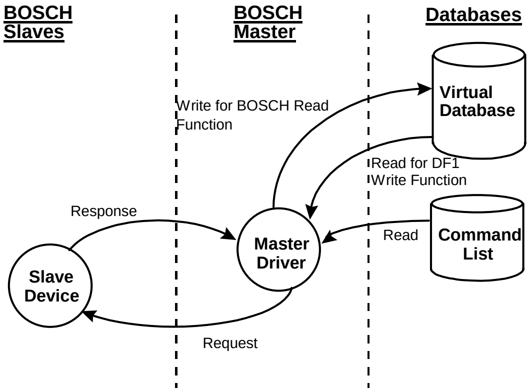
The module can be configured to place slave devices that are not responding to commands from the master ports at a lower priority. If the module recognizes that a slave device has failed to respond to a message after the user defined retry count, it will mark the slave as "in communication failure" and set the error delay counter to the user specified value. Each time the module encounters this slave in the command list, the counter will be decremented. When the value reaches zero, the slave will be placed in an active status. This facility can improve communication throughput on the network.

1.2 Module Internal Database

Central to the functionality of the module is the internal database. This database is shared between all the ports on the module and is used as a conduit to pass information from one device on one network to one or more devices on another network. This permits data from devices on one communication port to be viewed and controlled by devices on another port. In addition to data from the master ports, status and error information generated by the module can also be mapped into the internal database.

1.2.1 BOSCH Serial Port Driver Access to Database

The following diagram details the flow of data between the serial port drivers and the internal database.



The Master driver uses the database in two ways:

1. A read command issued to a slave device by the master driver will return the slave data into the internal database
2. A write command issued to a slave device by the master driver uses the data in the internal database to write to the slave device

2 Protocol Functional Specifications

2.1 BOSCH Master Serial Port Specifications

Type	Specifications
General Parameters (Software Configurable)	
Internal Database	4000 registers (words) available
Communication parameters	Local Station ID: 0 to 255 Port 0 Baud Rate: 110 to 115.2K baud Port 1,2,3 Baud Rate: 110 to 115K baud Stop Bits : 1 or 2 Data Size: 7 or 8 bits Parity: None, Even, Odd RTS Timing delays: 0 to 65535 ms
BOSCH Modes	Full-Duplex
Error Checking	BCC
BOSCH Master Driver	
General	Full-Duplex Point to Point
Configurable Parameters per Master port	Min Command Delay Number of Commands Response Timeout Retry Count Slave List Error Pointer
BOSCH Commands supported	0x00 Protected Write 0x01 Unprotected Read
Command List	Up to 100 command per master port, each fully configurable for function, slave address, register to/from addressing and word/bit count
Status Data	Error codes available on an individual command basis. In addition, a slave status list is maintained per active master port.
Polling of command list	User configurable polling of commands, including disabled, continuous and on change of data (write only)
Physical Specifications	
	See Hardware specifications in the Installation Guide manual

2.2 Serial Port Specifications

Type	Specifications
Serial Ports	
Serial Port Cables (DB-9M Connector)	One DIN to DB-9M cable included per configurable serial port
Port 0	RS-232/422/485 – jumper selectable DB-9M connector Hardware Handshaking: RTS,CTS,DTR,DSR,DCD
Port 1,2,3 Protocol Ports 1,2,3 (Only if product includes extra serial ports)	RS-232/422/485 – Software configurable DB-9M connector Hardware Handshaking: RTS,CTS,DTR,DSR,DCD
Serial Port Isolation	2500V RMS port-to-port isolation per UL 1577. 3000V DC min. port to ground and port to logic power isolation.
Serial Port Protection	RS485/422 port interface lines TVS diode protected at +/- 27V standoff voltage. RS232 port interface lines fault protected to +/- 36V power on, +/- 40V power off.

3 BSCH Protocol Specific Configuration File

The following is excerpted from a full configuration file showing typical examples of the BOSCH port configurations. In this example, one port has been setup as a master. This example should serve only to give the programmer an idea of how a CFG file is structured. Complete configuration files are shipped on each unit and are available off the web site for each of the products. These files can serve as an excellent starting point for any project.

```
# This section is used to define the configuration of a BOSCH Master Device
simulated on Port 0

[BSCH Port 0]
Enabled                 : Yes     #Yes=Use port, No=Do not use port
Local Station ID        : 1       #BOSCH node address
Protocol                : Full    #Full-Duplex, Half-Duplex
Termination Type        : BCC     #BCC
Baud Rate               : 4800    #Baud rate for port 110-115200
Parity                  : None    #None, Odd, Even
Data Bits               : 8       #7 or 8
Stop Bits               : 1       #1 or 2
Min Response Delay      : 0       #0-65535 mSec before sending response msg
RTS On                  : 0       #0-65536 mSec before message
RTS Off                 : 0       #0-65536 mSec after message
Use CTS Line            : No      #Use CTS modem control line (Yes/No)
Response Timeout        : 500     #Response message timeout (0-65535)
Retry Count             : 2       #Response failure retry count



Minimum Command Delay   : 10      #Minimum number of msec's between commands
Error Delay Counter     : 100     #0-65535 Command cycle count if error

[BOSCH Port 0 Commands]
# This file contains examples for a BOSCH SVB.
#
START
#      1         2         3     4      5        6      7     8      9
#               DB      Poll         Swap     Node   Func   Device   Pgm
# Enable   Address  Interval Count   Code  Address   Code   Address  Ptr
       1         0         0     0      0        1      1    100     500
       1       100         0     0      0        1      1   {500}     0

END
```

4 CFG File: [BSCH Port x] Section

The [BSCH PORT 0], [BSCH PORT 1], [BSCH PORT 2] and [BSCH PORT 3] sections of the **DFNTBSCH.CFG** file are used to set the BOSCH port type, communication parameters, define the protocol specifics and set the command list parameters. The parameters are the same for all four sections. The command list for each master port is entered in a different section in the file. The table below lists the parameters defined in this section:

<table>
<tr><th>[SECTION]/Item</th><th>Range</th><th>Description</th></tr>
<tr><td>[BSCH PORT 0]
[BSCH PORT 1]
[BSCH PORT 2]
[BSCH PORT 3]</td><td></td><td>Configuration Header for Port 0
Configuration Header for Port 1
Configuration Header for Port 2
Configuration Header for Port 3</td></tr>
<tr><td>Enabled:</td><td>Yes or No</td><td>This flag specifies if the port on the module will be utilized. If the parameter is set to No, the port will not be used. If the parameter is set to Yes, the port will be used supporting the BOSCH protocol.</td></tr>
<tr><td>Local Station ID:</td><td>0 to 255</td><td>This parameter specifies the local station ID for all BOSCH messages sent from this master port.</td></tr>
<tr><td>Protocol:</td><td>Full</td><td>This parameter specifies the BOSCH protocol to be used on the port.</td></tr>
<tr><td>Termination Type:</td><td>BCC</td><td>This parameter specifies the error checking for all BOSCH messages.</td></tr>
<tr><td>Baud Rate:</td><td></td><td>This is the baud rate to be used on the port. Enter the baud rate as a value. For example, to select 19K baud, enter 19200.
<table>
<tr><th>Baud Rate</th><th>Parameter Value</th><th>Port</th></tr>
<tr><td>110</td><td>110</td><td rowspan="2">0</td></tr>
<tr><td>150</td><td>150</td></tr>
<tr><td>300</td><td>300</td><td rowspan="14">0, 1, 2, 3</td></tr>
<tr><td>600</td><td>600</td></tr>
<tr><td>1200</td><td>12 or 1200</td></tr>
<tr><td>2400</td><td>24 or 2400</td></tr>
<tr><td>4800</td><td>48 or 4800</td></tr>
<tr><td>9600</td><td>96 or 9600</td></tr>
<tr><td>14,400</td><td>14, 114 or 14400</td></tr>
<tr><td>19,200</td><td>19, 192 or 19200</td></tr>
<tr><td>28,800</td><td>28, 288 or 28800</td></tr>
<tr><td>38,400</td><td>38, 384 or 38400</td></tr>
<tr><td>57,600</td><td>57 or 576</td></tr>
<tr><td>115,200</td><td>115 or 1152</td></tr>
</table></td></tr>
<tr><td>Parity:</td><td>None, Odd, or Even</td><td>This is the Parity code to be used for the port. The values are as follows: None, Odd, Even.</td></tr>
<tr><td>Data Bits:</td><td>7 or 8</td><td>This parameter sets the number of data bits for each word used by the protocol.</td></tr>
<tr><td>Stop Bits:</td><td>1 or 2</td><td>This parameter sets the number of stop bits to be used with each data value sent.</td></tr>
<tr><td>Minimum Response Delay:</td><td>0 to 65535</td><td>This parameter sets the number of milliseconds to wait to respond to a request on the port. This is required for slow reacting devices.</td></tr>
<tr><td>RTS On:</td><td>0 to 65535</td><td>This parameter sets the number of milliseconds to delay after RTS is asserted before the data will be transmitted.</td></tr>
<tr><td>RTS Off:</td><td>0 to 65535</td><td>This parameter sets the number of milliseconds to delay after the last byte of data is sent before the RTS modem signal will be set low.</td></tr>
</table>

[SECTION]/Item	Range	Description
Use CTS Line:	Yes or No	This parameter specifies if the CTS modem control line is to be used. If the parameter is set to No, the CTS line will not be monitored. If the parameter is set to Yes, the CTS line will be monitored and must be high before the module will send data. Normally, this parameter is required when half-duplex modems are used for communication (2-wire).
Response Timeout:	0 to 65535	This parameter represents the message response timeout period in 1-ms increments. This is the time that a port configured as a master will wait before re-transmitting a command if no response is received from the addressed slave. The value is set depending upon the communication network used and the expected response time of the slowest device on the network.
Retry Count:	0 to 10	This parameter specifies the number of times a command will be retried if it fails.
Minimum Command Delay:	0 to 65535	This parameter specifies the number of milliseconds to wait between the initial issuance of a command. This parameter can be used to delay all commands sent to slaves to avoid "flooding" commands on the network. This parameter does not affect retries of a command as they will be issued when failure is recognized.
Error Delay Counter:	0 to 65535	This parameter specifies the number of polls to be skipped on the slave before trying to re-establish communications. After the slave fails to respond, the master will skip commands to be sent to the slave the number of times entered in this parameter.

5 CFG File: [BSCH PORT x COMMANDS] Section

The [BSCH PORT 0 COMMANDS], [BSCH PORT 1 COMMANDS], [BSCH PORT 2 COMMANDS] and [BSCH PORT 3 COMMANDS] sections of the CFG file are used to set the serial master port command lists. These lists are used to poll slave devices attached to the master ports. The module supports two commands.

The command list is formatted differently than the other sections of the configuration file. Commands are present in a block between the labels **START** and **END**. These labels are used to inform the program where the list resides. The module's program will parse all commands after the **START** label until it reaches the **END** label.

5.1 Command List Overview

In order to interface the ProLinx module with slave devices, the user must construct a command list. The commands in the list specify the slave device to be addressed, the function to be performed (read or write), the data area in the device to interface with and the registers in the internal database to be associated with the device data. There is a separate command list for each master port, with up to 100 commands allowed per master port. The command list is processed from top (command #0) to bottom. A poll interval parameter is associated with each command to specify a minimum delay time in seconds between the issuance of a command. If the user specifies a value of 10 for the parameter, the command will be executed no more frequently than every 10 seconds.

Write commands have a special feature, as they can be set to execute only if the data in the write command changes. If the register data values in the command have not changed since the command was last issued, the command will not be executed. If the data in the command has changed since the command was last issued, the command will be executed. Use of this feature can lighten the load on the BOSCH network. In order to implement this feature; set the enable code for the command to a value of 2.

The module supports two commands. This permits the module to interface with Bosch SVB/SVK bagging machines.

5.2 Commands Supported by the Module

The format of each command in the list is dependent on the function being executed. To simplify command construction, the module uses its own set of function codes to associate a command with a BOSCH command/function type. The tables below list the functions supported by the module:

Basic Command Set Functions

ProLinx Function Code	Definition	Command	Function
0	Protected Write	0x00	N/A
1	Unprotected Read	0x01	N/A

Each command list record has the same general format. The first part of the record contains the information relating to the communication module and the second part contains information required to interface to the BOSCH slave device.

5.3 Command Entry Formats

Appendix Reference

The format of each command in the list is dependent on the function being executed. Refer to the Appendix A for a complete discussion of the BOSCH commands supported by the module and of the structure and content of each command.

The table below shows the structure of the configuration data necessary for each of the supported commands:

Column #	1	2	3	4	5	6	7	8	9
Function Code	**Enable Code**	**Database Address**	**Poll Interval Time**	**Count**	**Swap Code**	**Node Address**	**Function Code**	**Device Address**	**Program Pointer**
FC0	Code	Register	Seconds	Count	Code	Node	1	Address	Pgm Ptr
FC1	Code	Register	Seconds	0	Code	Node	2	Address	Pgm Ptr

The first part of the record is the Module Information, which relates to the ProLinx module and the second part contains information required to interface to the slave device. Refer to the slave device documentation for a full discussion of each function.

An example of a command list section of the CFG file is displayed below:

```
[BSCH Port 0 Commands]
# The file contains examples for a BOSCH SVB.
#
#   1        2         3     4     5        6   7     8      9
#        Database     Poll       Swap     Node Func Device  Pgm
# Enable  Address Interval Count Code  Address Code Address Ptr
START
    1       0          0     0    0        1    1    100    500
    1    100          0     0    0        1    1   {500}    0
    1    500          0     1    0        1    0     84     0
END
```

Each parameter is discussed in the following table:

<table>
<tr><th>Command Parameter</th><th>Range</th><th>Description</th></tr>
<tr><td>Enable</td><td>0 ,1,2</td><td>This field is used to define whether or not the command is to be executed and under what conditions.
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>The command is disabled and will not be executed in the normal polling sequence.</td></tr>
<tr><td>1</td><td>The command is executed each scan of the command list if the Poll Interval Time is set to zero. If the Poll Interval time is set, the command will be executed, when the interval timer expires.</td></tr>
<tr><td>2</td><td>The command will execute only if the internal data associated with the command changes. This value is valid only for write commands.</td></tr>
</table></td></tr>
<tr><td>Database Address</td><td>0 to 3999</td><td>This field specifies the internal database register to be associated with the command.
For <u>Read</u> functions, the data read from the slave device will be placed starting at the register value entered in this field.
For <u>write</u> functions, the data written to the slave device will be sourced from the address specified.</td></tr>
<tr><td>Poll Interval</td><td>0 to 65535</td><td>This parameter specifies the minimum interval to execute continuous commands (Enable code of 1). The parameter is entered in units of seconds. Therefore, if a value of 10 is entered for a command, the command will execute no more frequently than every 10 seconds.</td></tr>
<tr><td>Count</td><td>Message dependent</td><td>This parameter specifies the number of registers associated with the command. Valid for write command only.</td></tr>
<tr><td>Swap Code</td><td>0,1,2,3</td><td>This parameter is used to define if the data received from the slave is to be ordered differently than received from the slave device. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard method of storage of these data types in slave devices. This parameter can be set to order the register data received in an order useful by other applications. The table below defines the values and their associated operations:
<table>
<tr><th>Swap Code</th><th>Description</th></tr>
<tr><td>0</td><td>None – No Change is made in the byte ordering</td></tr>
<tr><td>1</td><td>Words – The words are swapped</td></tr>
<tr><td>2</td><td>Words &amp; Bytes – The words are swapped then the bytes in each word are swapped</td></tr>
<tr><td>3</td><td>Bytes – The bytes in each word are swapped</td></tr>
</table></td></tr>
<tr><td>Node Address</td><td>1 to 255</td><td>This parameter is used to specify the slave node address on the network to be considered. Values of 1 to 255 are permitted.</td></tr>
<tr><td>Function Code</td><td rowspan="4">Reference Appendix A</td><td rowspan="4">These parameters specify the function to be executed by the command. Appendix A in this Manual details the meaning of these values for each of the available supported commands. Following is a complete list of the command supported by the Master driver.
<b><u>ProLinx Function Code Listing</u></b>
<u>Basic Command Set</u>
0 Protected Write
1 Unprotected Read</td></tr>
<tr><td>Device Address</td></tr>
<tr><td>Program Pointer</td></tr>
<tr><td></td></tr>
</table>

6 Communication Port Cables

This section contains information on the cable and pin assignments for the ProLinx Communication Gateways, Inc. module's serial ports (RS-232/422/485) and the application port.

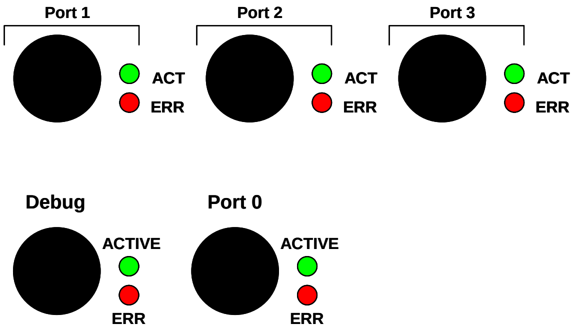
The ProLinx Communication Gateways, Inc. module will come with one to five serial ports, depending on the configuration purchased. In all cases, the protocol serial ports will have the same pin-outs.

Example:
The 4602-RIO-BSCH4 module contains five serial communication ports - four configurable BOSCH ports and a Configuration/ Debug port.

The 4601-RIO-BSCH module contains two serial communication ports - one configurable BOSCH port and a Configuration/Debug port.

Each serial port is a Mini-DIN physical connection. A 6-inch 'Mini-DIN to DB-9M' cable is provided for each active protocol port. The DB-9M provides connections for RS-232, RS-422 and RS-485. The diagrams in the following sections detail the pin assignments for several possible physical connections.

6.1 Serial Port Cable Connections

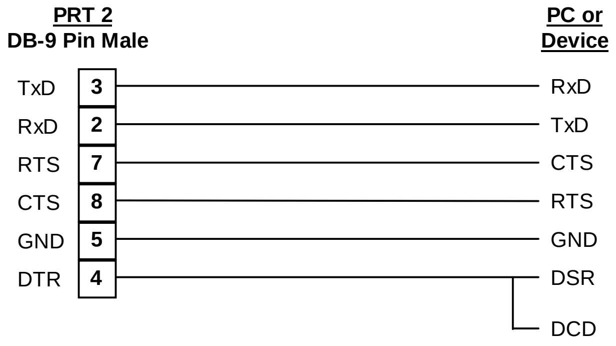


The relationship between the port labeling on the front of the ProLinx module and the application is as follows:

Port Label	Function
Debug	Debug/Configuration
Port 0	Serial Port 0
Following ports only exist on multiple port units	
Port 1	Serial Port 1
Port 2	Serial Port 2
Port 3	Serial Port 3

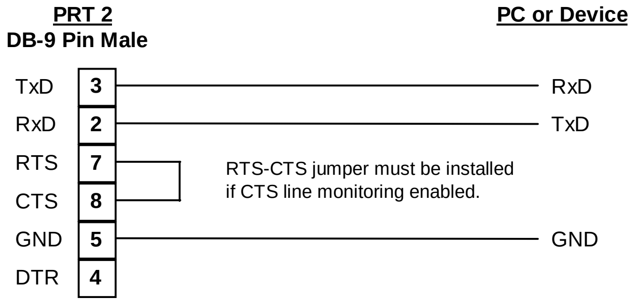
6.1.1 Port 0,1,2,3 : RS-232 - Null Modem (w/ Hardware Handshaking)

This type of connection is used when the device connected to the module requires hardware handshaking (control and monitoring of modem signal lines).



6.1.2 Port 0,1,2,3 : RS-232 - Null Modem (w/o Hardware Handshaking)

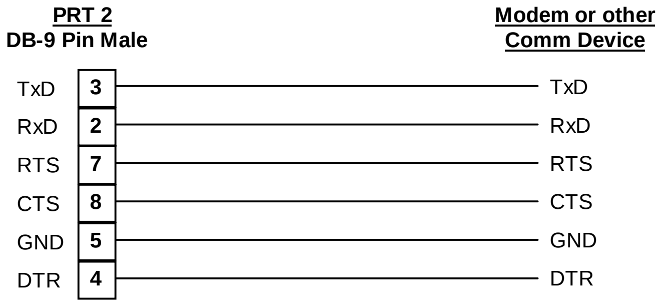
This type of connection can be used to connect the module to a computer or field device communication port.



NOTE: If the port is configured with the "Use CTS Line" set to 'Y', then a jumper is required between the RTS and the CTS line on the module connection.

6.1.3 Port 0,1,2,3 : RS-232 - Modem Connection

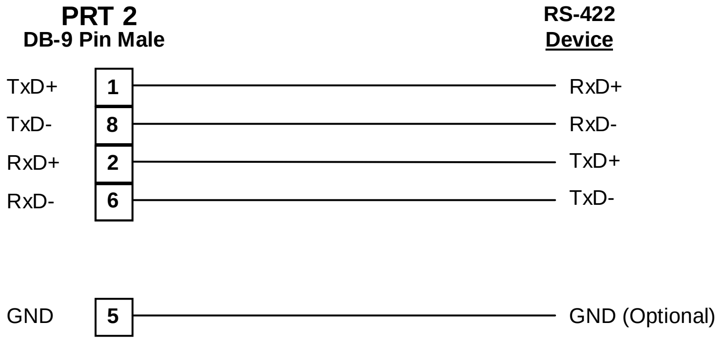
This type of connection is required between the module and a modem or other communication device.



The "Use CTS Line" parameter for the port configuration should be set to 'Y' for most modem applications.

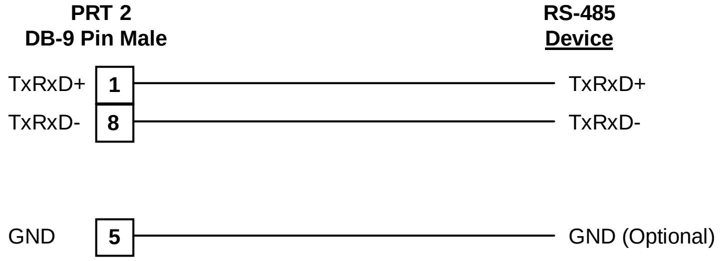
6.1.4 Port 0,1,2,3 : RS-422 Interface Connections

The diagram below applies when the RS-422 interface is selected.



6.1.5 Port 0,1,2,3 : RS-485 Interface Connections

The diagram below applies when the RS-485 interface is selected.



7 LED Indicators

LED indicators provide a means of monitoring the operation of the unit and individual ports and are extremely useful for troubleshooting. In addition to port monitoring, system configuration errors, application errors, and fault indications are all monitored with LEDs providing alerts to possible problems. The *ProLinx Communication Gateways, Inc. Startup Guide* provides more information on LEDs and troubleshooting.

7.1 LEDs for Serial BOSCH Protocol Ports

Troubleshooting the operation of the serial BOSCH protocol ports can be performed using several methods.

The first and quickest is to scan the LEDs on the module to determine the existence and possibly the cause of a problem. This section provides insight into the operation of the Serial Port status LEDs.

Some ProLinx Communication Gateways, Inc. modules will include three extra serial ports. Each of these serial ports has two LEDs indicating status.

LED	Color	Description
Port 0 – ACT Port 1 – ACT Port 2 – ACT Port 3 – ACT	Off	No activity on the port.
	Green Flash	The port is either actively transmitting or receiving data
Port 0 – ERR Port 1 – ERR Port 2 – ERR Port 3 – ERR	Off	Normal state. When off and Port Active led is indicating activity, there are no communication errors
	Amber On or Flashing	Activity on this led indicates some communication error was detected, either during transmit or receive. To determine the exact error, connect the Debug terminal to the Debug port.

Note that the meaning of the other LEDs on the unit can be found in the Product Manual for the specific module that is being debugged.

7.2 Configuration, Application, and Fault LEDs

There are three (3) LEDs that provide information on configuration errors **(CFG)**, application errors **(APP ERR)**, and system faults **(FAULT)**. The following table provides descriptions of LED conditions.

CFG	APP ERR	FAULT	Program	Description
1	1	1	Loader	The Loader program is running.
1	1	0	App	The module is currently in configuration mode.
1	0	0	App	There is a configuration error and the program is running with the default parameter(s). Refer to **Sections 4** & **5** for valid configuration parameters.
0	0	0	App	All configuration information is correct and there are no application errors.
1	0	1	App	The module recognized a critical configuration error. Only the debugger may be active. Connect a PC running a terminal program to the debug port, then refer to **Section 10** for details on troubleshooting configuration errors.
0	1	0	App	The module recognized an application error (The LEDs will only flash briefly). Refer to **Section 8** for details on troubleshooting application errors.
0	1	1	App	A hardware error exists or a program is aborting on a critical error. If a hardware error is suspected, contact your technical support representative.
0	0	1	DOS	All programs exited and the module is now running in DOS mode.

Key

0 = Off

1 = On

7.2.1 Debug LEDs

Debug LED State	Condition
ON	N/A
OFF	Serial BOSCH pass-through port on Debug port set to debug mode.

8 Serial Port Protocol Error/Status Data

The second and most thorough troubleshooting method for debugging the operation of the BSCH driver (and the module in general) is the powerful Debug port on the module which provides much more complete access to the internal operation and status of the module. Accessing the Debug capabilities of the module is accomplished easily by connecting a PC to the Debug port and loading a terminal program. If using a module with hardware version 1, download PSTerm (see 'Module Configuration & Debug Port Manual'). If using hardware version 2 (indicated with a 'V2' sticker on the back of the module) any terminal program can be used.

8.1 Viewing Error/Status Data

The following sections describe the register addresses that contain protocol error and status data. Viewing the contents of each register is accomplished using the Database View option. The use of this option and its associated features are described in detail in the *ProLinx Communications Gateways, Inc. Startup Guide*.

8.2 BOSCH Error and Status Data Area Addresses

BOSCH error and status data are stored in registers based on the BOSCH port configuration. Starting register addresses are shown in the following table:

BOSCH Port	Starting Address
0	6300
1	6700
2	7100
3	7500

Note: None of the addresses are available in the BOSCH address range. In order to view them, the data must be moved using the Data Map section of the configuration file. Appendix B illustrates the appropriate section and provides an example of how to move data to the BOSCH address range.

8.3 BOSCH Ports: Error/Status Data

The serial port (BOSCH Master/Slave) Error and Status Data areas are discussed in this section. The Error Status Pointer value is configured in the CFG file within each of the individual [BOSCH PORT X] sections.

The data area is initialized with zeros whenever the module is initialized. This occurs during a cold-start (power-on), reset (reset push-button pressed) or a warm-boot operation (commanded or loading of new configuration).

Example Internal Databse Address	Offset	Description
6300	0	Number of Command Requests
6301	1	Number of Command Responses
6302	2	Number of Command Errors
6303	3	Number of Requests
6304	4	Number of Responses
6305	5	Number of Errors Sent
6306	6	Number of Errors Received
6307	7	Configuration Error Word
6308	8	Current Error Code
6309	9	Last Error Code

Refer to the following Error Codes section to interpret the status/error codes present in the data area.

8.4 Master Port: Command Errors

The individual command errors for each master port are returned to the address locations specified in the following table:

BOSCH Port	Address Range
0	6310 – 6409
1	6710 – 6809
2	7110 – 7209
3	7510 - 7609

The first word in the register location defined contains the status/error code for the first command in the port's command list. Each successive word in the command error list is associated with the next command in the list.

Refer to Section 9 to interpret the status/error codes present in the data area.

Example BOSCH Port 0 Command List Errors

Internal Database Address (Example)	Offset	Description
6310	0	Command #0 Error Status
6311	1	Command #1 Error Status
6312	2	Command #2 Error Status
6313	3	Command #3 Error Status
6314	4	Command #4 Error Status
	.	.
	.	.
	.	.
6407	97	Command #97 Error Status
6408	98	Command #98 Error Status
6409	99	Command #99 Error Status

Note that the values in the Command List Error Status tables are initialized to zero (0) at power-up, cold boot and during warm boot.

8.5 Master Port: BOSCH Slave List Status

Each slave polled in the command list on the BOSCH master ports has a reserved word value for a status code. This status data list can be read using the Configuration/Debug Port and can be placed in the module's internal database. The first word in the register location defined contains the status code for the BOSCH slave node address 0. Each successive word in the list is associated with the next node up to slave node 255.

Slaves attached to the master port can have one of the following states:

0	The slave is inactive and not defined in the command list for the master port.
1	The slave is actively being polled or controlled by the master port and communication is successful.
2	The master port has failed to communicate with the slave device. Communication with the slave is suspended for a user defined period based on the scanning of the command list.

Slaves are defined to the system when the module initializes the master command list. Each slave defined will be set to a state value of 1 in this initial step. If the master port fails to communicate with a slave device (retry count expired on a command), the master will set the state of the slave to a value of 2 in the status table. This suspends communication with the slave device for a user specified scan count (**Error Delay Counter** value in the configuration). Each time a command in the list is scanned that has the address of a suspended slave, the delay counter value will be decremented. When the value reaches zero, the slave state will be set to 1. This will enable polling of the slave.

The individual Slave List Status errors for each BOSCH port are returned to the address locations specified in the following table:

BOSCH Port	Address Range
0	6410 – 6665

1	6810 – 7065
2	7210 – 7465
3	7610 - 7865

Example BOSCH Port 0 Slave List Status Example

Internal Database Address (Example)	Offset	Description
6410	0	Slave #0 Status
6411	1	Slave #1 Status
6412	2	Slave #2 Status
6413	3	Slave #3 Status
6414	4	Slave #4 Status
	.	.
	.	.
	.	.
6663	253	Slave #253 Status
6664	254	Slave #254 Status
6665	255	Slave #255 Status

The example addresses shown above assumes BOSCH Port 0. Note that each master port will have one of these status data blocks available in the internal database, each individually located with a separate address.

Note that the values in the Slave List Status tables are initialized to zero (0) at power-up, cold boot and during warm boot.

9 Error Codes

The module error codes are listed in this section. Error codes returned from the command list process are stored in the command list error memory region. A word is allocated for each command in the memory area. The error codes are formatted in the word as follows: The least-significant byte of the word contains the extended status code and the most-significant byte contains the status code.

Use the error codes returned for each command in the list to determine the success or failure of the command. If the command fails, use the error code to determine the cause of failure. Note: the Module Specific error codes (not BOSCH compliant) are returned from within the module and never returned from an attached BOSCH slave device.

These are error codes that are extended codes unique to this module. The most common errors are shown in the following tables:

MODULE SPECIFIC ERROR (NOT BOSCH COMPLIANT)	
0xFFFF	CTS modem control line not set before transmit
0xFFFE	Timeout while transmitting message
0xFFF6	Timeout waiting for DLE-ACK after request
0xFFF5	Timeout waiting for response after request
0xFF38	DLE-NAK received after request
0xFF37	DLE-NAK sent after response
0xFF2D	Bad Checksum

9.1 BOSCH Configuration Error Word

BOSCH Configuration Error Word errors are stored in protocol-specific registers. The following table lists the Port/Register Address configuration.

BOSCH Port	Configuration Error Word Register
0	6307
1	6707
2	7107
3	7507

A register containing a code indicates a problem with the configuration. The following table lists the codes, a description of the problem, and parameters to correct the error condition within the configuration file.

Bit	Code	Description
0	0x0001	Invalid Enabled parameter (Yes or No)
1	0x0002	Invalid RS-Interface parameter (0 to 2)
2	0x0004	Invalid Local Station ID
3	0x0008	Reserved
4	0x0010	Reserved
5	0x0020	Invalid Baud Rate
6	0x0040	Invalid Parity (None, Odd, Even)
7	0x0080	Invalid Data Bits (7 or 8 bits)
8	0x0100	Invalid Stop Bits (1 or 2)
9	0x0200	Reserved
10	0x0400	Invalid Use CTS Line (Yes or No)
11	0x0800	Reserved
12	0x1000	Retry Count Invalid (0 to 10)
13	0x2000	Reserved
14	0x4000	Reserved
15	0x8000	Reserved

Appendix A: BOSCH Command Support

Function Code # 0

Protected Write (Basic Command Set)

Column	Command Parameter	Description
1	Enable/Type Word	0=Disabled, 1=Continuous, and 2=Conditional
2	Virtual Database Address	This parameter defines the database address of the first data point to be associated with the command.
3	Poll Interval	Minimum number of seconds to wait before polling with this command.
4	Count	Number of data word values to be considered by the function.
5	Swap Type Code	Swap Type Code for command: 0=None, 1=Swap words, 2=Swap words & bytes, and 3=Swap bytes in each word.
6	Node Address	Address of unit to reach on the network.
7	Function Code = 0	Protected write function.
8	Device Address	Address within the Bosch slave to write to.
9	Program Pointer	This field is not used by the command. Values entered in this column will be ignored.

This function is used to write one or more words of data to the device.

Function Code # 2

Unprotected Read (Basic Command Set)

Column	Command Parameter	Description
1	Enable/Type Word	0=Disabled, 1=Continuous
2	Virtual Database Address	This parameter defines the database address of the first data point to be associated with the command.
3	Poll Interval	Minimum number of seconds to wait before polling with this command.
4	Count	This field is not used by the command. Values entered in this column will be ignored.
5	Swap Type Code	Swap Type Code for command: 0=None, 1=Swap words, 2=Swap words & bytes, and 3=Swap bytes in each word.
6	Node Address	Address of unit to reach on the network.
7	Function Code = 1	Unprotected Read function.
8	Device Address	Address within the Bosch slave to write to.
9	Program Pointer	The program pointer is used to store the current program number from the slave. This allows the command list to be set up generically for any program and have the commands act upon the current program. If the program pointer is a value other than 0 in an Ask Status command (fcn 1, address 100), the current program number will be parsed from the response and stored in the database location set by the program pointer.

Column	Command Parameter	Description
		For example: Function = 1, Device Address = 100, Program Pointer = 150. The current program number will be stored in the database at address 150. At this time the current program number can be used in other commands. If it is desired to issue a read command with the current program number in the Device Address field, this is accomplished by using the program pointer location inside of curly braces as the Device Address. For example: Function = 1, Device Address = {150}. This causes the contents of the database at address 150 to be sent as the device address.

This function is used to read data from the slave device.

Appendix B: Moving Data

The following is an example of the Data Map section of the configuration file. This section allows a user to move data to different addresses within the database in order to create simpler data requests and control.

```
# This section is used to move data within the database to concentrate
# information for simpler data requests and control.  The Form Address
# specifies the start
# database location to copy the number of registers set by Register Count
# to the specified To Address (destination of data).  When the data is
# copied, the order # of the bytes can be altered using the Swap Code
# field as follows:

#
#  SWAP CODE   DEFINITION
#      0       Bytes left in original order          (1234 -> 1234)
#      1       Words are swapped                     (1234 -> 3412)
#      2       Words and bytes are swapped           (1234 -> 4321)
#      3       Bytes in each word are swapped        (1234 -> 2143)

[DATA MAP]
#       From           To     Register       Swap    Delay
#    Address      Address        Count       Code   Preset
START
        4000         1000            9          0     1000
        4170         1010            2          0     1001
        4370         1020           30          0     1002
        6300         1100           20          0     1003

END
```

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