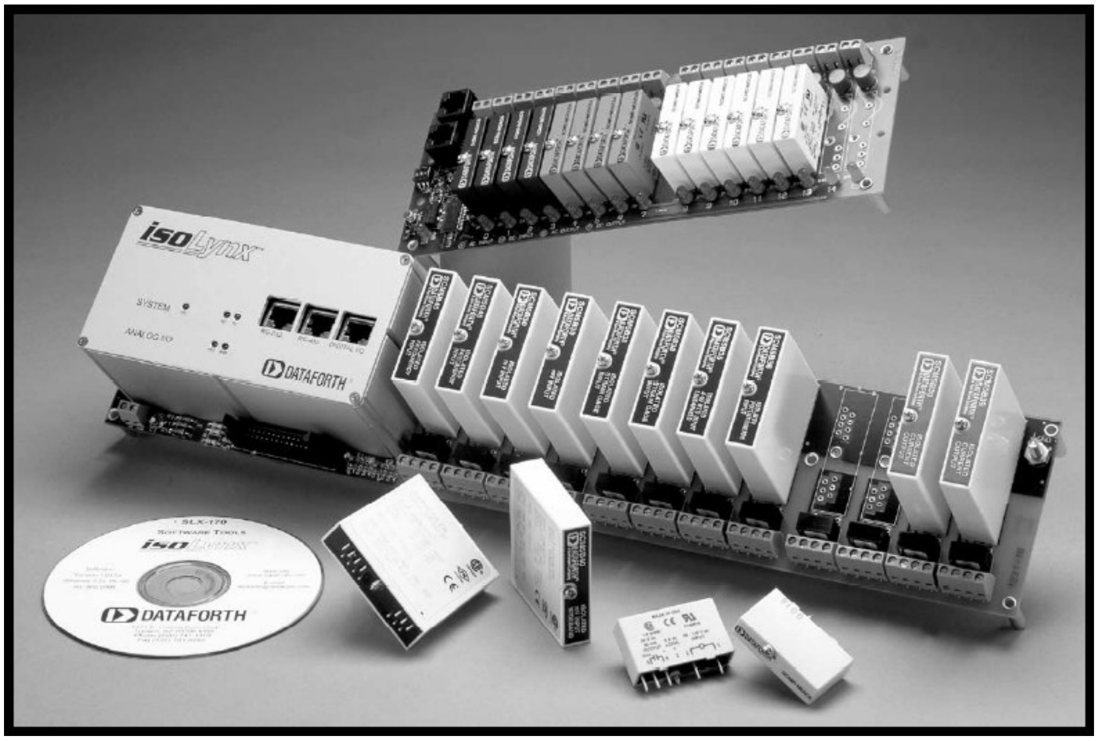
isoLynx™

SLX200 API User Manual



DATAFORTH®

isoLynx™ SLX200 API User Manual

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Revision History:

Revision	Date	Author	Description of Changes
A	11/16/06	R Lampron	Initial release
B	1/18/07	R Lampron	Updated to support Visual Basic 6 applications
C	5/2/07	R Lampron	Added SuitcaseDemo example program

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Errata Sheets

Refer to the Technical Support area of Dataforth’s web site (www.dataforth.com) for any errata information on this product.

1. Introduction

1.1. Overview

This manual describes the isoLynx SLX200 API, which allows a user to access the functions of the SLX200 from a user-written program, as shown in Figure 1.1. The functions are contained in the dynamic link library *slxcom.dll* (or *slxcom_stdcall.dll* for Visual Basic 6). A user-written C/C++ program can link in the *slxcom.lib* import library and have direct access to all the API functions in the DLL. Visual Basic.NET and C#.NET programs can use the *isoLynx* class in the files *isoLynx.vb* (for VB.NET) and *isoLynx.cs* (for C#.NET). VB 6.0 requires its own version of the DLL because of its calling convention. The sample programs can be a good starting point for your own application.

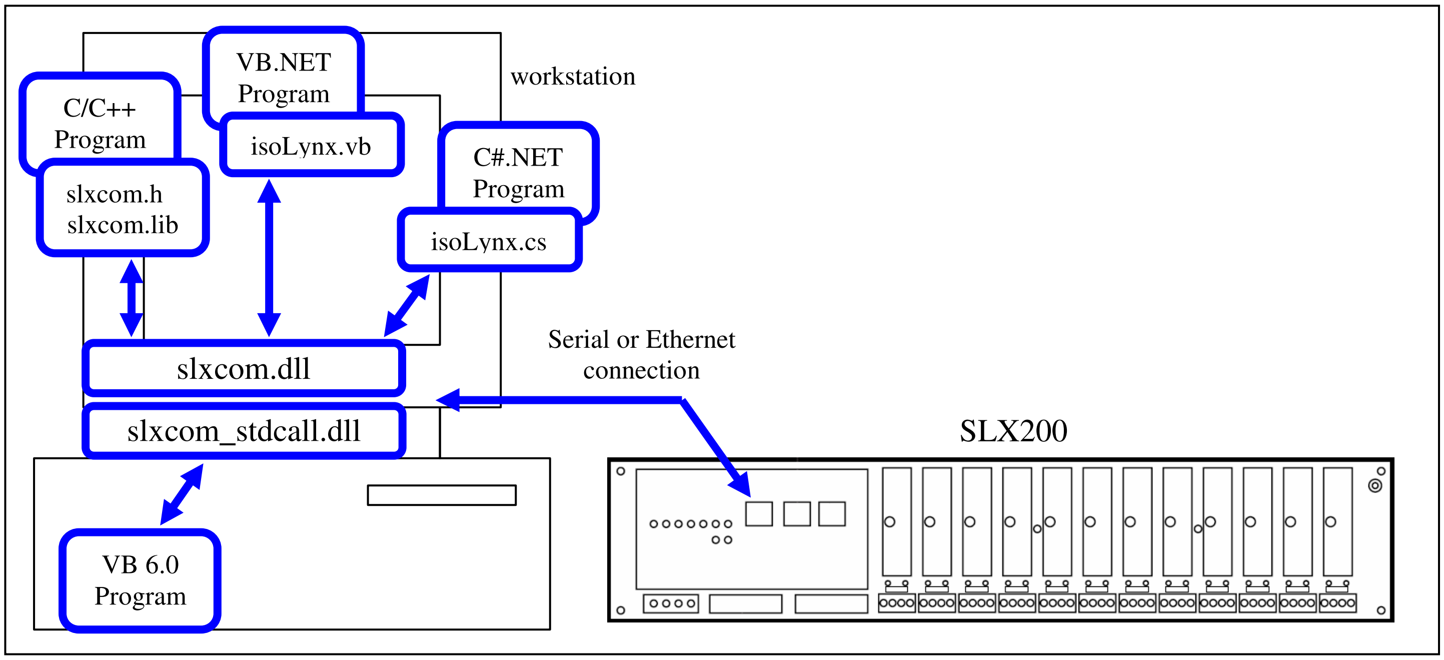

Figure 1.1 SLX200 API block diagram

1.2. Helpful Notes

PLEASE NOTE: YOU WILL SAVE YOURSELF TIME if you take a few minutes up front and read sections 1 and 2 of this manual. This document is somewhat “thin” because the routines are mostly self-explanatory when used in conjunction with the *SLX200 Software User Manual*. This manual is on the CD that ships with the SLX200, and is also available by download from the Dataforth web site. This Software User Manual is referenced throughout this document, and is abbreviated “SUM”.

The API has more than 50 functions, which may seem intimidating, but most applications will only use 9 of them. (The other functions are for user-defined scans and isoLynx configuration. Configuration is more easily done via the SlxConfig program, supplied on the CD.) These 9 most-used routines include five which open/close ports and devices (see sections 4.1 and 4.2), and the four which read/write analog and digital data (see section 4.4).

All API functions return an integer error code; zero means success. Non-zero values are briefly documented in *Appendix A: Error Codes*.

No example function calls are shown in this manual; however, every API function has an example of usage in the VB.NET example programs, and the nine most-common functions also have examples in the C++, and C#.NET, and VB6 programs.

The SUM makes a great number of references to Modbus register addresses. This API makes knowing the addresses unnecessary; as a matter of fact, no Modbus register addresses are used anywhere in the API. For example, if you wish to set the default output value for a particular analog channel, you don't need to know that the required registers range from address 0x2100 to 0x213F; instead, you call the appropriate function (*slx200ConfigAoDfltOuts()*, in this case), and specify the desired channel number (0 to 63).

1.3. For Visual Basic Users

The documentation of the routines in this manual shows function prototypes in C++ style. If you're not sure about what Visual Basic argument type to use, look at the Visual Basic function declarations in the example programs. For VB.NET, look at the *isoLynx* class, in the file *isoLynx.vb* in the project *RoutinesRequiredByExamples*. This class contains VB.NET function declarations for all the routines in the API, along with numerous useful constants. To use the API, you will need to add a reference to the *RoutinesRequiredByExamples* project to your project, or else copy the source code from *isoLynx.vb* into your project. For VB6, you will place the API function declarations in the module that is using them; for an example, see the code for the ReadWriteDataForm in the ReadWriteData example project.

Be aware that VB does not pass arrays properly to a DLL written in C++, but a workaround is to pass the first array element by reference. Therefore, in calls to the DLL where an array is expected, specify the first element of the array instead of the array itself. In VB.NET, make certain you use the exact array type called for by the function declaration in the isoLynx class; for example, the DLL will not receive the proper data from VB if you use Int16 instead of UInt16, and you may not get a compiler warning.

1.4. Files Required to Use the isoLynx API

slxcom.dll or *slxcom_stdcall.dll* – the actual API. This file must be available to your program, by either being in the same folder or else in the current environment's PATH.
slxcom.lib – for C/C++ programs. This is an import library for what Microsoft terms "implicit linking" to the DLL functions. Link this library into your C/C++ program in order to access the API. This file is not needed if you do the more painful "explicit linking", in which you make function calls to explicitly load and unload the DLL and to access the DLL's exported functions. For a lightweight explanation of the difference between implicit and explicit linking, search MSDN (msdn.microsoft.com) for "Linking an Executable to a DLL".
slxcom.h – header file with API function prototypes and useful #defines for C or C++ programs
isoLynx.vb (and *.cs*) – definition of *isoLynx* class for VB.NET (and C#.NET) programs

2. Terms You Should Know

2.1. Ports and Devices

In the SLX200 API, a “port” represents the means of connection to the isoLynx(es), such as a COM port or Ethernet connection. A “device” represents an isoLynx SLX200 (except in the special case where an isoLynx has two Ethernet connectors, and each one is considered a device). To use the API properly, the following steps must be done by your program, in this order:

1) Open a port using either the slxOpenRtuPort() or slxOpenTcpPort() command, depending on whether your application is using Modbus RTU (serial line) or Modbus TCP (Ethernet).
2) Open a device using the slxOpenDev() routine, passing it the handle given to you by the “open port” routine in step 1.
3) Use the slx200…() routines to send data to (and receive data from) the isoLynx.
4) Close the device using the slxCloseDev() routine.
5) Close the port using the slxClosePort() routine.

See the example programs on the CD, which demonstrate how to do these steps.

2.2. Channel Numbers

The SLX200 is a single-board system with optional expansion panels for additional digital and analog channels. You can calculate a channel number based on the backpanel’s assigned address and the channel’s position on the backpanel, as illustrated in the annotated block diagram below.

Channel numbers in the API start at zero (for either digital or analog), and go up through the maximum number available (63 is the highest analog channel using the maximum of three analog expansion panels, and 127 is the highest digital channel using the maximum of eight digital panels). Each panel, whether analog or digital, may contain up to 16 channels. The exception is the main (base) SLX200 panel, which has only 12 channels, numbered 0-11. A fully populated SLX200 system is shown below in Figure 2.1.

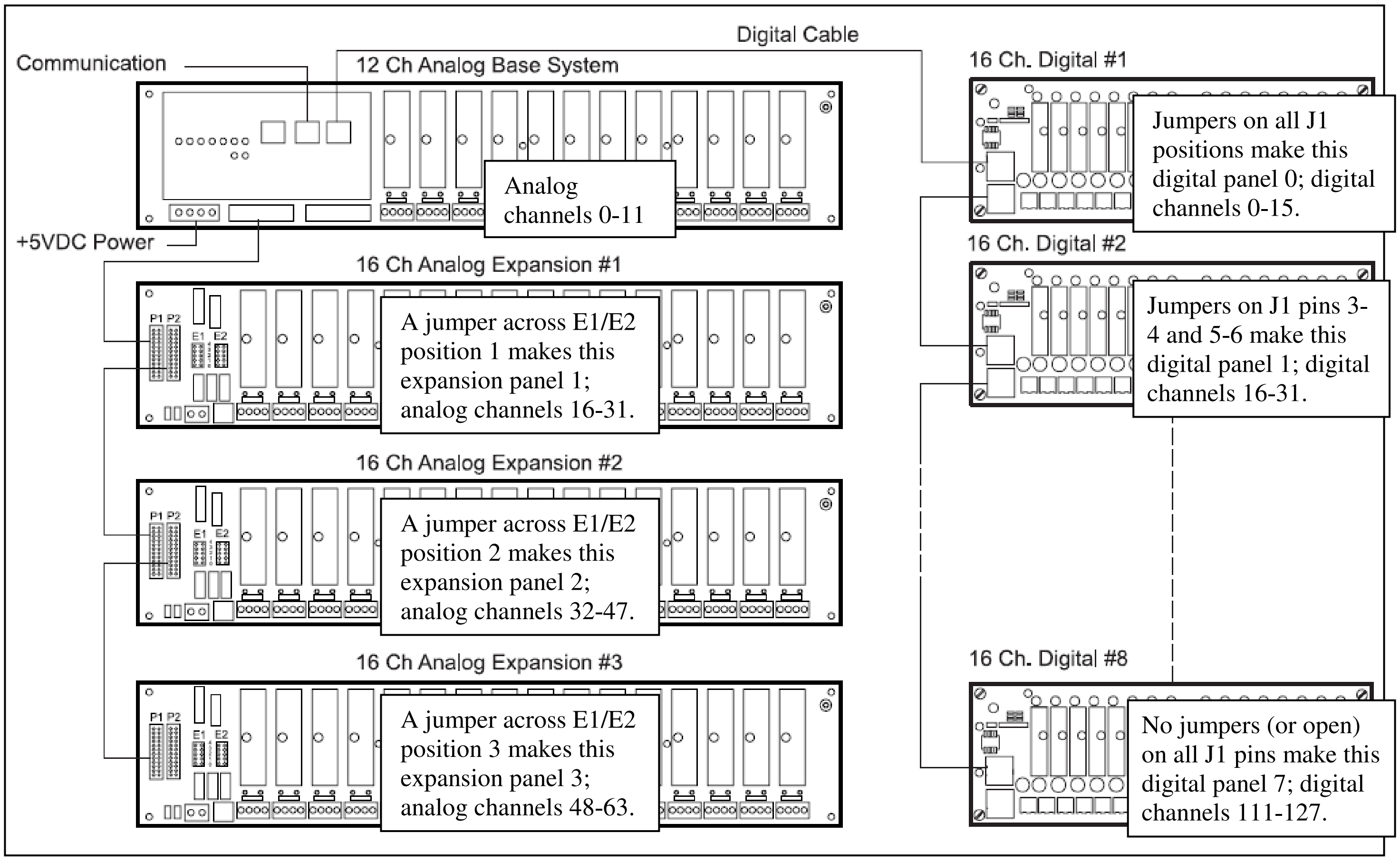
Communication
Digital Cable
12 Ch Analog Base System
16 Ch. Digital #1
Jumpers on all J1 positions make this digital panel 0; digital channels 0-15.
Analog channels 0-11
+5VDC Power
16 Ch Analog Expansion #1
16 Ch. Digital #2
A jumper across E1/E2 position 1 makes this expansion panel 1; analog channels 16-31.
Jumpers on J1 pins 3-4 and 5-6 make this digital panel 1; digital channels 16-31.
16 Ch Analog Expansion #2
A jumper across E1/E2 position 2 makes this expansion panel 2; analog channels 32-47.
16 Ch Analog Expansion #3
16 Ch. Digital #8
A jumper across E1/E2 position 3 makes this expansion panel 3; analog channels 48-63.
No jumpers (or open) on all J1 pins make this digital panel 7; digital channels 111-127.

Figure 2.1 SLX200 channel numbers

Perhaps the easiest way to figure channel numbers is to think in hexadecimal. Consider the high nybble of the single-byte channel number to be the panel number, and the low nybble to be the channel slot. For example, channel 0x41 refers to panel 4, slot 1 (the second slot from the left). Other examples are shown in Figure 2.2 below. The “0x” indicates hexadecimal; 0x27 is decimal 39, and 0x0A is decimal 10. In VB, a hexadecimal number is indicated with the “&H” prefix.

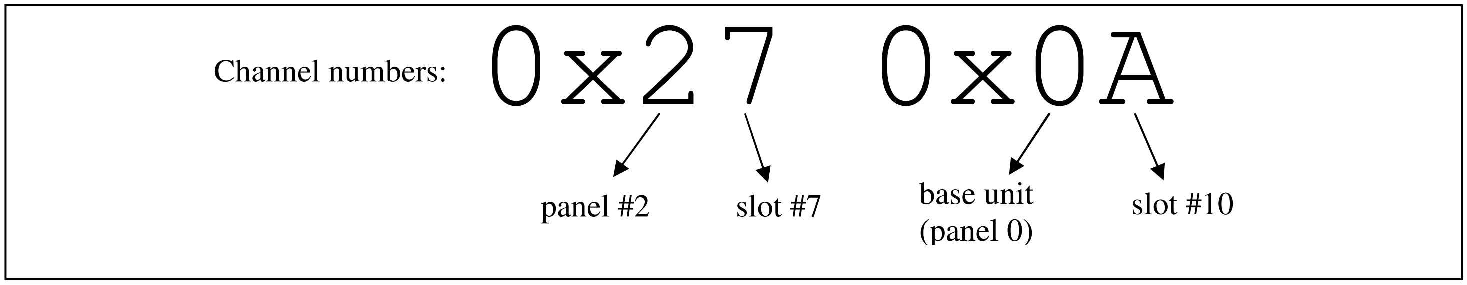

Figure 2.2 SLX200 channel number examples

3. Example Programs

A number of example programs are included on the CD as starting points for your own application, one each for Visual C++.NET, Visual C#.NET, VB6, and several for VB.NET. Except for the VB6 example and the VB.NET *SuitcaseDemo* example, they are all console-based so as to not complicate the code, but the same code will work in a Windows app; you would just use MsgBoxes or text box controls on a Windows form to display the information.

3.1. For Visual Basic.NET

One solution exists (named *SLX200 VB Examples*), containing five example projects, each of which contain a reference to a sixth project (a class library) named *RoutinesRequiredByExamples*, as shown in figure 3.1). *SimplestExample* may be the best one to start with; then move up to the ReadWriteData project. Note that for all projects, you must edit the *openProtocol()* routine in *RoutinesRequiredByExamples* to match your communications setup.

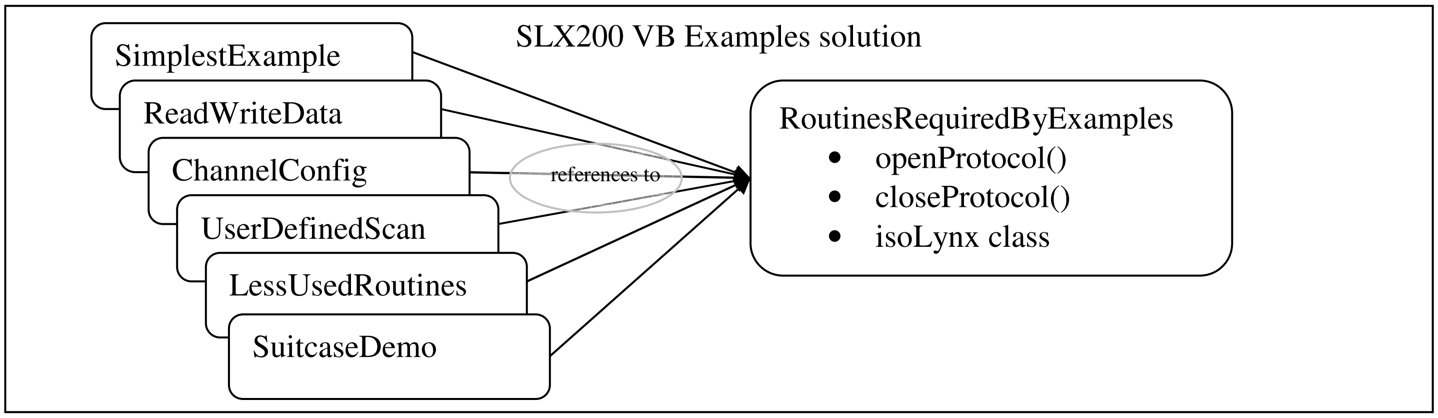

Figure 3.1 Visual Basic.NET example projects

Brief project descriptions:

1) **RoutinesRequiredByExamples**—class library containing the *isoLynx* class (needed by any Visual Basic project accessing the API) and the *OpenCloseProtocol* module, which shows how to open and close the port and device used in communicating with the isoLynx. All the other projects except for SimplestExample use this *OpenCloseProtocol* module.
2) **SimplestExample**—a stripped-down version of the ReadWriteData project, containing only the bare essentials for opening communication, reading/writing analog channels, and closing communication. Entire file is about 21 lines of code (plus comments).
3) **ReadWriteData**—example of reading/writing analog and digital channels.
4) **ChannelConfig**—an example of configuring analog channel states, default outputs, average weights, and digital channel states and default outputs.
5) **UserDefinedScan**—shows how to use the API routines to define and execute a user-defined scan of channels.
6) **LessUsedRoutines**—contains example routines for reading device information, reading/writing the RTU and TCP configuration, the miscellaneous status and control routines, reading/writing user data, and bypassing the digital panels.

7) **SuitcaseDemo**—source code for demonstration program for the so-called "Suitcase Demos", which are isoLynx systems in a black case (hence the name), available from Dataforth. The program will work with any isoLynx with the proper modules installed (and will start up properly even without an isoLynx attached).

To create your own Visual Basic.NET project, the easiest way to start is to create the project under the *SLX200 VB Examples* solution as a Console Application, and copy one of the .VB source files (closest to the functions you want) to the new project. Add a reference to the *RoutinesRequiredByExamples* project (or else copy the source code for the isoLynx class and desired routines right out of that project). Copy *slxcom.dll* to your project's bin\debug folder. Edit the openProtocol() routine (in the *RoutinesRequiredByExamples* project) according to the comments to match your communication setup.

3.2. For Visual C++

One example solution exists (*SLX200 C++ Examples*), containing one sample project (*ReadWriteData*). It has the same functionality as the *ReadWriteData* Visual Basic.NET project mentioned in the previous section, reading/writing both analog and digital channels. The single source file has a large comment block at the top, explaining how to get going with the project.

3.3. For Visual C#

One example solution exists (*SLX200 C# Examples*), containing one sample project (*ReadWriteData*). It has functionality similar to the *ReadWriteData* Visual Basic.NET project mentioned earlier, reading/writing both analog and digital channels. This program has not been tested exhaustively, but is provided as a starter for your own application. Only the nine most commonly used API routines are declared in the *isoLynx.cs* class file and then used in *ReadWriteData.cs*.

3.4. For Visual Basic 6.0

One sample project (*ReadWriteData*) exists. It has the same functionality as the *ReadWriteData* Visual Basic.NET project mentioned in the previous section, reading/writing both analog and digital channels. The project has a single form, containing code to invoke the nine most commonly used API routines.

3.5. Program Flow

See section 2.1 ("Ports and Devices") for an overview of the steps your program should follow.

4. API Commands

4.1. Port-related Routines

These routines open and close the “port” (the means of connection to the SLX200).

In the following routines, the “hPort”, or port handle, is a unique 32-bit identifier which specifies the port being used. The hPort is initialized by either of the port-opening routines, and is used later by the device-opening routines. The user should not change the handle’s value. A port must be opened before making the call to open a device.

Note that in Visual Studio 2005 (for 32-bit processors), a “long” is the same size as an “int”, 32 bits.

4.1.1. slxOpenRtuPort()

Opens specified RTU port and initializes handle. If the open fails, “hPort” will be NULL.

```
int slxOpenRtuPort(
   unsigned long *hPort, // port handle
   const char *const portName,  // port name, such as "COM1"
   int baud,             // baud (must be one of the values #defined in
                         //     slxcom.h or isoLynx.vb,
                         //     such as SLX_BR_19200)
   int parity )          // parity (must be one of the #defined values,
                         //     such as SLX_PAR_EVEN)
```

4.1.2. slxOpenTcpPort()

Opens specified TCP port and initializes handle. If the open fails, “hPort” will be NULL.

```
int slxOpenTcpPort(
   unsigned long *hPort,        // port handle
   const char *const hostName,  // isoLynx IP addr (e.g., "192.168.0.502")
   unsigned short portNo )      // isoLynx port number, such as 502
```

4.1.3. slxClosePort()

Closes the port represented by handle “hPort”. All devices connected to the port should be closed before this routine is called.

```
int slxClosePort(
   unsigned long hPort )        // handle of port to be closed
```

4.2. Device-Related Routines

4.2.1. slxOpenDev()

Creates a device object (which represents an isoLynx) and connects it to a port.

```
int slxOpenDev(
   unsigned long *hDevice,    // device handle
   unsigned char id,     // only meaningful when used with an RTU port,
                         //     and indicates the slave ID
   unsigned int hPort )  // port handle returned from one of the
                         //     port-opening routines above
```

4.2.2. slxCloseDev()

Close device object associated with device handle “hDevice”. Should be done when all processing is complete, but before the associated port is closed.

```
int slxCloseDev( unsigned long hDevice );
```

4.3. Configuration Routines

Note that the values in all capital letters are #defines from the header file slxcom.h. (The values may also be found in the Software User Manual; this manual is frequently referred to in this section, and is abbreviated as SUM.) The routines below are grouped by functionality; each group is preceded by a blurb which discusses the arguments. All of the routines take a first argument “hDevice”, or device handle, the 32-bit unique integer that identifies the device. The hDevice is returned from the slxOpenDev( ) function, and should not be altered by the user. The return value of each routine will be zero if no error occurred, or else one of the values in slxcom.h (these values are also repeated in this document).

4.3.1. Read Device Information

For the following routines, additional information is available about the register values in the SUM section 12.1. These routines remove the upper byte of each word (which is zero anyway) in order to produce a normal null-terminated character string in the “str” buffer. The arguments are defined as follows:

1) hDevice – device handle
2) pan_type – either `PT_ANALOG` or `PT_DIGITAL`. Must be `PT_ANALOG` for `slx200ReadCommBrdFwRev()`.
3) panel – panel number (although required, this argument is ignored when pan_type is `PT_ANALOG` and is also currently ignored by `slx200ReadCommBrdFwRev()`; digital panels are numbered starting at 0)
4) str – character buffer to store retrieved data in; should be at least 17 bytes in length
5) sz – size of “str” buffer (should be at least 17)

```
int slx200ReadManufacturer( unsigned long hDevice, int pan_type,
   int panel, char *str, int sz );
int slx200ReadModelNum( unsigned long hDevice, int pan_type, int panel,
   char *str, int sz );
int slx200ReadSerialNum( unsigned long hDevice, int pan_type, int panel,
   char *str, int sz );
int slx200ReadFwRev( unsigned long hDevice, int pan_type, int panel,
   char *str, int sz );
int slx200ReadCommBrdFwRev( unsigned long hDevice, int pan_type,
   int panel, char *str, int sz );
```

4.3.2. Read/Write RTU (Serial) Configuration

For the following routines, additional information is available about the register values in the SUM section 3.4. Additional arguments in the following routines are:

1) serif – serial interface type, either `SLX_SERIF_RS232`, `SLX_SERIF_RS485_2`, or `SLX_SERIF_RS485_4`.
2) baud – baud rate, either `SLX_BR_1200`, `SLX_BR_2400`, `SLX_BR_4800`, `SLX_BR_9600`, `SLX_BR_19200`, `SLX_BR_38400`, `SLX_BR_57600`, or `SLX_BR_115200`.
3) par – parity, either `SLX_PAR_NONE`, `SLX_PAR_ODD`, or `SLX_PAR_EVEN`.
4) id – slave ID number.

PLEASE NOTE: the following function preserves the least significant four bits of the “id” variable, so if you want the actual value of the Slave ID register, set the “id” variable to zero before calling this function.

```
int slx200ReadRtuParms( unsigned long hDevice, int *serif, int *baud,
   int *par, unsigned char *id );
int slx200ConfigRtuParms( unsigned long hDevice, int serif, int baud,
   int par, unsigned char id );
```

Note that **`slx200ConfigRtuParms`**() specifies all the parameters at one, whereas the following four routines allow you to set individual parameters if desired.

```
int slx200ConfigRtuSerIf( unsigned long hDevice, int serif );
int slx200ConfigRtuBaud( unsigned long hDevice, int baud );
int slx200ConfigRtuParity( unsigned long hDevice, int par );
int slx200ConfigRtuSlvId( unsigned long hDevice, unsigned char id );
```

4.3.3. Read/Write TCP Configuration

For the following routines, additional information is available about the register values in the SUM section 3.5. Additional arguments in the following routines are:

1) sel – specifies which Ethernet interface to use on the isoLynx (most only have one), either SLX200_TCP_PARMS_PRI or SLX200_TCP_PARMS_SEC.
2) ip[ ] – four-byte buffer to hold IP address
3) sn[ ] – four-byte buffer to hold subnet mask
4) gw[ ] – four-byte buffer to hold gateway IP address

5) kato – keepalive timeout
6) tcp_port – port number
7) mac[ ] – six-byte buffer to hold MAC address

```
int slx200ReadTcpParms( unsigned long hDevice, int sel,
   unsigned char ip[], unsigned char sn[], unsigned char gw[],
   unsigned short *kato, unsigned short* tcp_port, unsigned char mac[] );
int slx200ConfigTcpParms( unsigned long hDevice, int sel,
   const unsigned char ip[],const unsigned char sn[],
   const unsigned char gw[], unsigned short kato );
```

Note that **`slx200ConfigTcpParms`** () specifies all the parameters at once, whereas each of the next four routines allow you to set an individual parameter.

```
int slx200ConfigTcpIpAddr( unsigned long hDevice, int sel,
   const unsigned char ip[] );
int slx200ConfigTcpSnMask( unsigned long hDevice, int sel,
   const unsigned char sn[] );
int slx200ConfigTcpGateway( unsigned long hDevice, int sel,
   const unsigned char gw[] );
int slx200ConfigTcpKato( unsigned long hDevice, int sel,
   unsigned short kato );
```

4.3.4. Read/Write Analog Channel Configuration

For the following routines, additional information is available about the register values in the SUM section 4. Additional arguments in the following routines are:

1) chan – beginning channel to work with (0-63 for analog channels on the SLX200)
2) data[ ] – buffer that holds the values read from or written to the SLX200.
3) qty – number of values to be read or written. (chan + qty) should not exceed 64.

In the following two routines, each element of `data[]` should be one of the values `SLX200_ACS_VACANT`, `SLX200_ACS_INPUT`, or `SLX200_ACS_OUTPUT`.

```
int slx200ReadAnaChanStates( unsigned long hDevice, unsigned char chan,
   short data[], int qty );
int slx200ConfigAnaChanStates( unsigned long hDevice, unsigned char chan,
   const short data[], int qty );
```

Note that in the following two routines, channels assigned as inputs or vacant will always have 0x0000 as their default outputs, regardless of what you may attempt to set them to.

```
int slx200ReadAoDfltOuts( unsigned long hDevice, unsigned char chan,
   short data[], int qty );
int slx200ConfigAoDfltOuts( unsigned long hDevice, unsigned char chan,
   const short data[], int qty );
```

Note that in the following routines, the “average weight” must be (or else will be forcibly rounded down to) a power of 2, as indicated in Table 4.1 of the SUM. Also, the corresponding channel must be an input, or the value will be ignored (left at zero).

```
int slx200ReadAiAvgWgts( unsigned long hDevice, unsigned char chan,
   unsigned short data[], int qty );
int slx200ConfigAiAvgWgts( unsigned long hDevice, unsigned char chan,
   const unsigned short data[], int qty );
```

4.3.5. Digital Channel Configuration

For the following routines, additional information is available about the register values in the SUM section 5. Additional arguments in the following routines are:

1) chan – beginning channel to work with (0-127 for digital channels on the SLX200)
2) data[ ] – buffer that holds the values read from or written to the SLX200.
3) qty – number of values to be read or written

In the following two routines, each element of `data[]` should be one of the values `SLX200_DCS_VACANT`, `SLX200_DCS_INPUT`, or `SLX200_DCS_OUTPUT`.

```
int slx200ReadDigChanStates( unsigned long hDevice, unsigned char chan,
   short data[], int qty );
int slx200ConfigDigChanStates( unsigned long hDevice, unsigned char chan,
   const short data[], int qty );

int slx200ReadDoDfltOuts( unsigned long hDevice, unsigned char chan,
   int data[], int qty );
int slx200ConfigDoDfltOuts( unsigned long hDevice, unsigned char chan,
   const int data[], int qty );
```

4.3.6. Digital Panel Configuration

For the following routines, additional information is available about the register values in the SUM section 6 and 13.2. Additional arguments in the following routines are:

1) panel – panel number
2) rst_type – type of reset; may be `SLX200_RST_STD` (standard) or `SLX200_RST_TO_DFLT` (reset-to-default)
3) byp – specifies if panel is bypassed; may be `SLX200_DP_NOT_BYPASSED` or `SLX200_DP_BYPASSED`

```
int slx200ResetDigPanel( unsigned long hDevice, unsigned char panel,
   int rst_type );
int slx200SetDigPanelBypass( unsigned long hDevice, unsigned char panel,
   int byp );
```

4.4. Read/Write Analog/Digital Data Routines

For the following routines, additional information is available about the register values in the SUM sections 8-10. In each of the following routines, the arguments are defined as follows:

1) hDevice – device handle
2) type – either `SLX200_DT_CUR` (current value), `SLX200_DT_AVG` (average value), `SLX200_DT_MAX`, or `SLX200_DT_MIN`. For the two "DigitalData" routines, the type must be `SLX200_DT_CUR`.

3) chan – channel number
4) data[ ] – array of 16-bit values to either read from or write to the isoLynx
5) qty – number of 16-bit values to transfer

The first two routines are for the analog inputs/outputs, and the second two are for the digital inputs/outputs.

```
int slx200ReadAnalogCounts( unsigned long hDevice, int type,
   unsigned char chan, short data[], int qty );
int slx200WriteAnalogCounts( unsigned long hDevice, int type,
   unsigned char chan, const short data[], int qty );

int slx200ReadDigitalData( unsigned long hDevice, int type,
   unsigned char chan, int data[], int qty );
int slx200WriteDigitalData( unsigned long hDevice, int type,
   unsigned char chan, const int data[], int qty );
```

4.5. User-Defined Scan Routines

4.5.1. User-Defined Scan Setup

For a user-defined scan, first determine which channels you want to scan, and in what order. Build your scan list "on paper". Then write your program to perform the following steps, in the order indicated. More detailed information is available in the SUM, sections 7.2 and 8.2.

1) Call `slx200SetScanMode()` to set the scan mode to User.
2) Call `slx200ConfigUserScanParms()` to configure the scan list (that you designed above), interval (time between complete scans through the scan list), and count (number of times to run through the scan list). The API will add the end-of-list specifier onto the end of the scan list for you.
3) Call `slx200StartUserScan()` to begin the scan.
4) Poll the Scan Control Register using `slx200ReadScanControl()` to see if the scan is done, and how many words are available.
5) When the scan is done (or even while it is still running), read as many words as desired (up to the quantity available) using `slx200ReadScanDataReg()`.
6) If you encounter a transmission error reading the data, you can restore the words just read from the buffer by using `slx200WriteScanDataReg()`. Then retry the call to `slx200ReadScanDataReg()`.

For the following routines, additional information is available about the register values in the SUM section 7. Additional arguments in the following routines are:

1) scan_mode – specifies scan mode, either `SLX200_SM_CONT` or `SLX200_SM_USER` (see SUM section 7.1 for an explanation of scan modes)
2) list[ ] – list of up to 64 analog input channel IDs (first channel is channel 0). Note that unlike the Modbus call specified in the SUM (section 7.2), the list is not terminated by an end-of-list indicator (0xFF). Instead the following argument indicates the list size.
3) list_sz – number of valid input channel IDs in the list[ ]
4) intv – scan interval (number of milliseconds between complete scans)
5) cnt – number of times to scan all entries in the Scan List

```
int slx200ReadScanMode( unsigned long hDevice, int *scan_mode );
int slx200SetScanMode( unsigned long hDevice, int scan_mode );
```

Please note that if you invoke the following routine without having first configured the scan parameters, it may fail with a `SLX_EC_ILLEGAL_RESP` error code.

```
int slx200ReadUserScanParms(           // read all scan parameters
   unsigned long hDevice, unsigned char list[], int *list_sz,
   unsigned short *intv, unsigned short *cnt );
```

In the following routine, you do not need to specify the end-of-list indicator in your scan list; the API will add the indicator for you. Do not include the end-of-list indicator in your `list_sz` quantity.

```
int slx200ConfigUserScanParms(         // set all scan parameters
   unsigned long hDevice, const unsigned char list[], int list_sz,
   unsigned short intv, unsigned short cnt );
```

Note that **`slx200ConfigUserScanParms`**() specifies all the parameters at one, whereas the next three routines allow you to set individual parameters if desired.

```
int slx200ConfigUserScanList( unsigned long hDevice,
   const unsigned char list[], int list_sz );
int slx200ConfigUserScanInt( unsigned long hDevice, unsigned short intv );
int slx200ConfigUserScanCnt( unsigned long hDevice, unsigned short cnt );
```

4.5.2. User-Defined Scan Actions

For the following routines, additional information is available about the register values in the SUM section 8.2. Additional arguments in the following routines are:

1) data[ ] – buffer to receive data read from scan data register
2) qty – number of 16-bit values to read
3) scan_complete – indicates scan status; 0 = in progress, 1 = complete
4) data_cnt – number of 16-bit values in Scan Data Buffer

```
int slx200ReadScanDataReg( unsigned long hDevice, short data[], int qty );
int slx200WriteScanDataReg( unsigned long hDevice );
int slx200StartUserScan( unsigned long hDevice );
int slx200StopUserScan( unsigned long hDevice );
int slx200ReadScanControl( unsigned long hDevice, int *scan_complete,
   unsigned short *data_cnt );
```

4.6. Other Routines

4.6.1. Miscellaneous Status and Control

For the following routines, additional information is available about the register values in the SUM section 13. Additional arguments in the following routines are:

1) status – status returned from isoLynx (SUM section 13.1)

2) rst_type – type of firmware reset (SUM section 13.2). Value is either `SLX200_RST_STD` or `SLX200_RST_TO_DFLT` from slxcom.h.
3) ec – error code from isoLynx (SUM section 13.3)
4) ei – error information register from isoLynx (SUM section 13.3)
5) adc_in – input source for the ADC (for factory use; see SUM section 13.4)

```
int slx200ReadStatus( unsigned long hDevice, short *status );
```
Note on the following routine: the digital panels can be individually reset using the `slx200ResetDigPanel()` routine later in this document.
```
int slx200Reset( unsigned long hDevice, int rst_type );
int slx200ReadErrorRegisters( unsigned long hDevice, short *ec,
   short *ei );
```
The following routine is for factory use and should not be invoked under normal circumstances.
```
int slx200SetAdcInput( unsigned long hDevice, int adc_in );
```

4.6.2. Read/Write User Data

For the following routines, additional information is available about the register values in the SUM section 8.2. Additional arguments in the following routines are:

1) addr – simplified address to read from or write to (valid values are 0 to 255)
2) data[ ] – buffer holding data to be written or to receive data read. This goes without saying, but be sure the buffer is large enough to hold the number of 16-bit values specified in “qty”.
3) qty – number of 16-bit values to be read or written. (addr + qty) cannot exceed 255.

```
int slx200ReadUserData( unsigned long hDevice, unsigned short addr,
   short data[], int qty );
int slx200WriteUserData( unsigned long hDevice, unsigned short addr,
   const short data[], int qty );
```

Appendix A: Error Code Listing

These error codes may be returned from the routines in the API. “INV” in an error name means “invalid”. See the next page for the **less-common errors 5000-5199**.

Modbus Port Error Codes (5200-5299)

```
MBPORT_EC_SUCCESS       0
MBPORT_EC_PORT_NOT_OPEN 5200
MBPORT_EC_INV_PARITY    5201
MBPORT_EC_MEM_ALLOC     5202
```

General SLX Device Error Codes (5300-5399)

```
SLX_EC_SUCCESS       0
SLX_EC_DEV_NOT_OPEN  5300
SLX_EC_MEM_ALLOC     5301
SLX_EC_ILLEGAL_ARG   5302      // some possible causes are invalid channel
                               //     state or channel type specified, or
                               //     invalid array size specified, or
                               //     qty < 1
SLX_EC_ILLEGAL_RESP  5303
SLX_EC_INV_FLD_SZ    5304
SLX_EC_INV_SERIF     5305
SLX_EC_INV_BAUD      5306
SLX_EC_INV_PARITY    5307
SLX_EC_INV_DEV_HANDLE    5308
SLX_EC_INV_PORT_HANDLE   5309
```

SLX200 Device Error Codes (5400-5499)

```
SLX200_EC_SUCCESS         0
SLX200_EC_INV_TCPPARMS    5400
SLX200_EC_INV_PANTYPE     5401
SLX200_EC_INV_DATATYPE    5402     // datatype not cur, avg, max, or min
SLX200_EC_INV_RSTTYPE     5403
SLX200_EC_INV_SCANMODE    5404
SLX200_EC_INV_ADCIN       5405
SLX200_EC_INV_DIGBYP      5406
SLX200_EC_INV_PANEL       5407
SLX200_EC_INV_CHAN        5408
SLX200_EC_INV_CHAN_QTY    5409     // channel + qty > max # of channels
SLX200_EC_INV_UDATA_ADDR  5410
SLX200_EC_INV_UDATA_QTY   5411
SLX200_EC_INV_QTY         5412     // qty < 1
```

SLX Com Library Error Codes (5500-5599)

```
SLXCOM_EC_SUCCESS     0
SLXCOM_EC_MEM_ALLOC   5500
SLXCOM_EC_INV_QTY     5501
SLXCOM_EC_INV_FLD_SZ  5502
```

FieldTalk Library Error Codes (5000-5199)
The SLX200 API uses the FieldTalk library for Modbus communications. The following errors are not #defined in slxcom.h, but are taken from the FieldTalk library documentation.

Errors of this class typically indicate a programming mistake.

```
FTALK_ILLEGAL_ARGUMENT_ERROR       5001 // Illegal argument error
FTALK_ILLEGAL_STATE_ERROR          5002 // This return code is returned by
     // all functions if the protocol has not been opened succesfully yet.
FTALK_EVALUATION_EXPIRED           5003 // Evaluation expired
FTALK_NO_DATA_TABLE_ERROR          5004 // No data table configured
FTALK_ILLEGAL_SLAVE_ADDRESS        5005 // Slave address 0 illegal for
                                        //     serial protocols.
```

FieldTalk Fatal I/O Errors: Errors of this class signal a problem in conjunction with the I/O system. If errors of this class occur, the operation must be aborted and the device/port closed.

```
FTALK_IO_ERROR_CLASS     5064      // I/O error class
FTALK_IO_ERROR           5065      // underlying I/O system reported error
FTALK_OPEN_ERR           5066      // Port or socket open error
FTALK_PORT_ALREADY_OPEN  5067      // Serial port already open
FTALK_TCPIP_CONNECT_ERR  5068      // Typically this error occurs when a
     // host does not exist on the network or the IP address is wrong.
     // The remote host must also listen on the appropriate port.
FTALK_CONNECTION_WAS_CLOSED   5069 // Remote peer closed TCP/IP connection
FTALK_SOCKET_LIB_ERROR   5070      // Socket library DLL not found
FTALK_PORT_ALREADY_BOUND 5071      // TCP port already bound
FTALK_LISTEN_FAILED      5072      // Listen failed
FTALK_FILEDES_EXCEEDED   5073      // File descriptors exceeded
FTALK_PORT_NO_ACCESS     5074      // No permission to access serial port
                                   //     or TCP port
FTALK_PORT_NOT_AVAIL     5075      // TCP port not available
```

FieldTalk Communication Errors: Errors of this class indicate either communication faults or Modbus exceptions reported by the slave device.

```
FTALK_BUS_PROTOCOL_ERROR_CLASS 5128     // Fieldbus protocol error class
FTALK_CHECKSUM_ERROR           5129     // A poor data link typically
     // causes this error and the next one.
FTALK_INVALID_FRAME_ERROR      5130     // Invalid frame error
FTALK_INVALID_REPLY_ERROR      5131     // Invalid reply error
FTALK_REPLY_TIMEOUT_ERROR      5132     // This can occur if the slave
     // device does not reply in time or does not reply at all. A wrong
     // unit adress will also cause this error.
```

```
FTALK_SEND_TIMEOUT_ERROR       5133     // This can only occur if the
     // handshake lines are not properly set.
FTALK_MBUS_EXCEPTION_RESPONSE  5160     // Modbus exception response
     // received from slave device.
FTALK_MBUS_ILLEGAL_FUNCTION_RESPONSE 5161 // Sent by a slave device
     // instead of a normal response message if a master sent a Modbus
     // function which is not supported by the slave device.
FTALK_MBUS_ILLEGAL_ADDRESS_RESPONSE  5162 // Illegal Data Address
                                          //     exception response
FTALK_MBUS_ILLEGAL_VALUE_RESPONSE    5163 // Illegal Data Value exception
                                          //     response
FTALK_MBUS_SLAVE_FAILURE_RESPONSE    5164 // Slave Device Failure
     // exception response; one cause can be from writing to a digital
     // channel that is vacant or is an input.
```

Appendix B: Some Troubleshooting Tips

If you are reading all zeroes from your analog channels, but expected to see some non-zero values, the isoLynx may be in User-Defined Scan mode.

Note that you should open a port *before* opening the associated device, and at the end of your program, you must close the device *before* closing the port. I.e., the port should be opened first and closed last.

If unexpected or unusual things are happening and you are using Visual Basic, see section 2.3 of this manual for warnings about arrays and DLLs.

If you can't communicate at all with the isoLynx, see if you can communicate with it using the SlxConfig (isoLynx Configuration) program supplied on the CD. If so, compare the communication settings in SlxConfig with the settings in your program. Remember that most serial ports can't be opened by more than one program at a time, however.

The SlxConfig program is a handy tool to use to double-check your program. If you're not seeing what you expect from a channel, using the Quick Channel View window of SlxConfig to see what values it's reading from the isoLynx. SlxConfig will also show you quickly whether a channel slot is configured as vacant, etc.

Note that the DLL routines that accept arrays assume your arrays are at least as large as you specify in the "quantity" argument. If your array is too small to receive the number of values specified in your "quantity" argument, the routine will write off the end of the array, corrupting memory or worse.

If your program is Visual C++, and you receive the error message when starting your application: "This application has failed to start because MSVCR80D.dll was not found. Re-installing the application may fix the problem." This is due to a known VS2005 problem. The cause is that the manifest resource file "Debug\xyz.exe.embed.manifest.res" is generated BEFORE its source file. (Just check the build log.) Removing the .res file and rebuilding cures the problem.