Modular LYNX

Part I
The Modular LYNX System

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- *Mounting the LYNX System*
- *Powering the LYNX System*
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- *Configuring the Digital I/O*
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Section 1

Getting Started

Section Overview

The purpose of this section is to get you up and running quickly. This section will help you do the following:

- Connect power to the LYNX Control Module.
- Connect and establish communications in single mode.
- Write a simple test program.

Getting Started

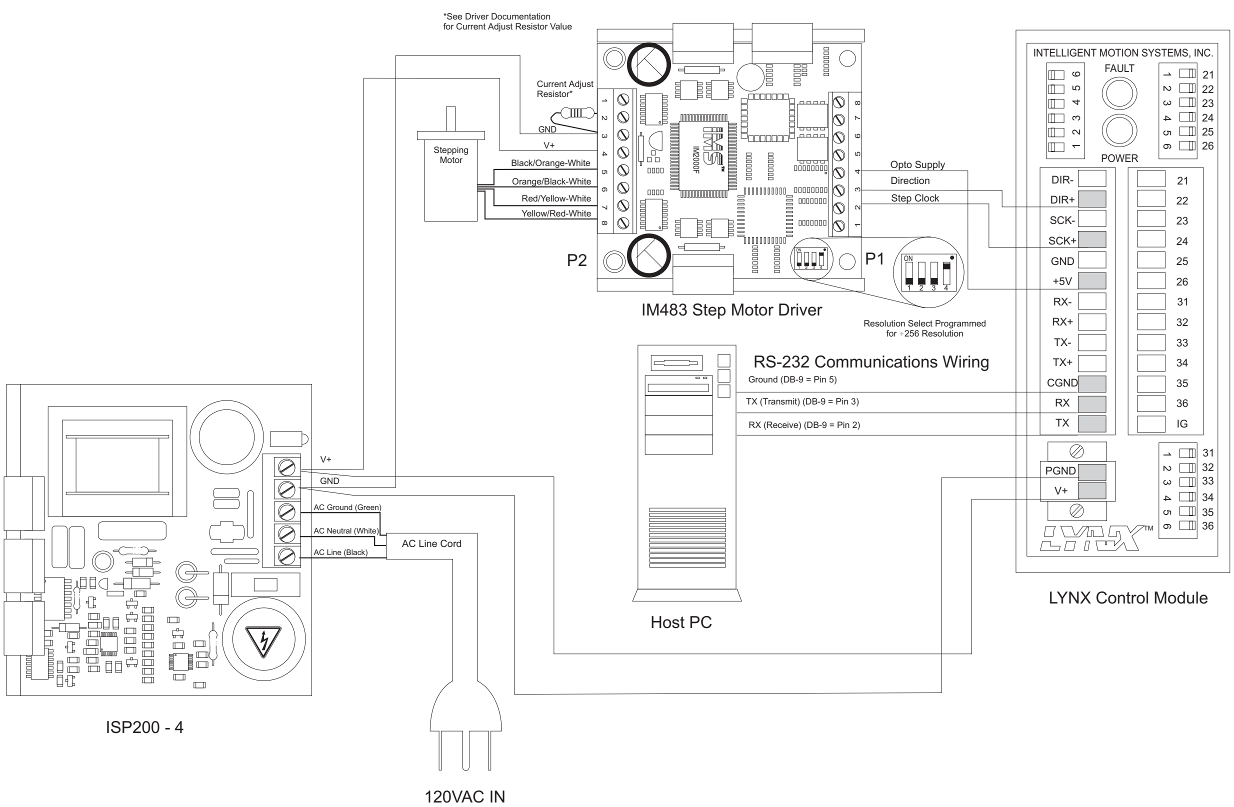

Figure 1.1: Basic Setup Configuration, RS-232 Interface

Included in the Package

(1) LYNX Control Module .... (IMS P/N LX-CM100 or 200-000)
(2) End Mounting Brackets .... (IMS P/N LX-EB100-000)
(1) IMS CD .... (IMS P/N IMS-CD100-000)
(1) Screw Driver .... (IMS P/N SD1)

User Provided Tools and Equipment Needed

- Serial Cable
- IM483 or equivalent step motor driver
- ISP200-4 or equivalent power supply
- M-22XX or equivalent stepping motor
- Wire Cutters/Strippers
- 22 gauge wire for logic level signals
- 18 gauge wire for power supply and motor wiring
- PC with a free serial port (COM 1 or 2)

Connecting the Power Supply

1. Using the 18 gauge wire, connect the DC output of your power supply to V+ on your LYNX Control Module, and to P2, pin 4 on the IM483 Step Motor Driver. (Or V+ pin on equivalent driver.) *Figure 1.1*.
2. Connect the Power Supply Return (GND) to PGND on the LYNX Control Module, and to P2, pin 3 on the IM483 Step Motor Driver. (Or GND on equivalent driver.) *Figure 1.1*.
3. Connect the AC Line cord to your power supply in accordance with any user documentation accompanying the supply. **DO NOT PLUG IN AT THIS TIME!**

Connecting the Step Motor Driver

1. Using 22 gauge wire, connect direction DIR+ on the LYNX Control Module to P1, pin 3 on the IM483 Driver. (Or direction pin of equivalent drive used.) *Figure 1.1*.
2. Connect Step Clock SCK+ of the LYNX Control Module to P1, pin 2 of the IM483 Driver. (Or Step Clock input of equivalent drive used.) *Figure 1.1*.
3. Connect the +5V output off the LYNX Control Module to the Opto Supply P1, pin 4 of the IM483 Driver. (Or Opto Supply of drive used if required.) *Figure 1.1*.
4. Set the Resolution Select DIP switch on the IM483 Driver to ÷256 resolution. *Figure 1.1*.

Motor Connections

Connect the motor to the IM483 Step Motor Driver in accordance with *Figure 1.1*.

Communications Wiring

Connect the Host PC to the LYNX Control Module (RS-232 Communications) in accordance with *Figure 1.1*. This is needed to program the LYNX Control Module.

Establishing Communications using the IMS Terminal

Included in the LYNX shipping package is a CD with the IMS Terminal software. This is a programming/ communications interface created by IMS to simplify the use of the LYNX. There is a 32 bit version for Windows 9x/NT4/2000 located on the CD. The IMS Terminal is also necessary to upgrade the software in your LYNX Control Module. These updates will be posted to the IMS website at http://www.imshome.com/ as they are made available.

To install the IMS Terminal to your hard drive, insert the CD into your CD-ROM Drive. The CD should autostart to the IMS Main Index Page. If the CD does not autostart, click “Start > Run” and type “x:\IMS.exe” in the “Open” box and then click OK. **NOTE:** “x” is your CD ROM drive letter.

1) The IMS Main Index Page will be displayed.
2) Click the MicroLYNX icon in the upper right corner. This opens the LYNX Family Index Page.
3) Select IMS Terminal (Win9x) or IMS Terminal (WinNT).
4) Click SETUP in the Setup dialog box and follow the on-screen instructions.

Once the IMS Terminal is installed you may run the Setup.

1) Open the IMS Term by clicking Start>Programs>IMS Terminal>IMS Term.
2) Select or verify the Communications Port that you will be using with your LYNX.
   a) Click in the Terminal Window to activate it.
   b) Right click in the Terminal Window.
   c) Click "Preferences" in the dialog box.
   d) Click the "Comm Settings" tab at the top of the dialog box.
   e) Under "Device" near the bottom of the box verify "LYNX" is selected. The BAUD rate is already set to the LYNX default. Do not change this setting until you have established communications with the LYNX Controller.
   f) The "Window Size" settings are strictly optional. You may set these to whatever size is comfortable to you.
   g) Click "OK". The setting will be saved automatically.
3) Apply power to the LYNX Controller. The following sign-on message should appear in the Terminal window:

```
Program Copyright © 1996-2002 by:
Intelligent Motion Systems, Inc.
Marlborough, CT 06447
VER = xxxxx   SER = Axxxxx
```

NOTE: If the sign-on message does not appear, check the "Connected/Disconnected" tab at the bottom of the Terminal Window. If "Disconnected" is displayed, double click it to "Connect".

Detailed instructions for the IMS Terminal software can be located in *Part III Software Reference* of this manual.

Testing the LYNX Setup

Two basic instructions for communicating with a control module are SET and PRINT. The SET instruction is assumed and can be left off when communicating in ASCII mode. (You are in ASCII mode whenever you are using a text based terminal.) It is used to set variables and flags that define control module operation. The LYNX Software automatically recognizes the SET instruction whenever the name of the variable or flag is typed into the terminal. Here we will set the motor units variable (MUNIT) to 51200 by typing the following at the prompt (>):

```
MUNIT = 51200
```

The PRINT instruction is used to report the values of variables and flags. Now, double-check the value of MUNIT by typing the following at the prompt (>):

```
PRINT MUNIT
```

The return from your terminal should be 51200. Note that the case is not important for instructions, variables, and flags. They may be typed in upper or lower case.

Use the SLEW instruction to move the motor at a constant velocity. Be sure that the velocity provided is a reasonable value for your motor and drive and try to move the motor. For instance, at the prompt type:

```
SLEW 10
```

This will move the motor at a speed of 10 munits per second. If the motor does not move, verify that the wiring is in accordance with *Figure 1.1*. If a non IMS driver is being used, you may need to consult the user manual for that device.

Once you have been able to move the motor, the next step is to write a simple program to illustrate one of the dynamic features of the LYNX: the ability to convert motor steps to a dimension of linear or rotary distance. Let's begin by discussing the relationship between the MUNIT variable and user units. Typically when we perform a move we want to know the distance of that move in a familiar unit of measurement. That means translating motor steps to the desired unit of measurement. The LYNX Control Module has the capability of doing this for you. You have already set the motor units variable (MUNIT) to a value 51,200. With the driver set to a resolution of 256 micro-steps per step and a 1.8° step motor that will be equal to 1 revolution of the motor, or one USER UNIT. A user unit can be any unit of measure. At this point, by entering the instruction MOVR 1, the motor will turn one complete revolution relative to its current position. Therefore, 1 User Unit = 1 Motor Revolution. For the exercise below we will use degrees for our user unit. As the LYNX Product Manual indicates, the calculation required to select degrees as our user unit in this case is:

51200 Micro-steps per rev ÷ 360 degrees = 142.222 Micro-steps per degree

By setting the MUNIT variable to 51200/360 the LYNX Control Module will perform the calculation to convert the user unit to degrees. Now, when issued, a relative motion instruction "MOVR 90" the motor will turn 90 degrees.

Now, enter a sample program that will convert motor steps to degrees, execute a 90° move, and report that move every 100 milliseconds while the motor is moving. Type the following bold commands:

```
'Enter Program Mode, start program at Location 2000.
PGM 2000
'Label the program TSTPGM.
LBL TSTPGM
' Set the user units to degrees.
MUNIT = 51200/360
' Set the max. velocity to 25 degrees per second.
VM = 25
' Execute a relative move of 90 degrees.
MOVR 90
' Report the position every 100 ms while moving.
LBL PRINTPOS
DELAY 100
PRINT "Axis position is", POS, "Degrees."
BR PRINTPOS, MVG
'End the program.
END
PGM
```

Now Type **TSTPGM** to run program.
This sample program will be stored starting at location 2000. It sets the conversion factor for the user units, sets the maximum velocity and then starts a motion. While the motion is occurring, the position is reported every 100 milliseconds.

At this point you may desire to restore the settings to their factory default as you may not wish to use degrees as your user unit. To do this, you will use the CP, DVF, and IP instructions.

CP - Clear Program.

To clear the program, type CP 1, 1. This will completely clear program memory space. Should you desire to only remove one program, the instruction "CP [Program Label]" i.e., "CP TSTPGM" would clear only that program. In this exercise only one program was entered, "CP TSTPGM" will clear it.

DVF - Delete User Defined Variables and Flags.

By entering DVF, all of the user defined variables will be removed. Although no Flags were set in this exercise, this command would clear them were they used.

IP - Initialize Parameters

This instruction will restore all of the parameters to their factory default state.

After entering these instructions a SAVE instruction should be entered.

Section 2

Connecting the LYNX System

Section Overview

Each module of the LYNX System is a closed unit with a header of pins and locking tabs to connect it to another module in the system. Optional I/O modules are connected on the RIGHT side of the Control Module. This section covers:

- Removing the End Plates.
- Connecting/Disconnecting System Modules.

Connecting the System

1. Remove the end plate(s) [A] from the Control Module. Depressing the locking clips [C] with a small screwdriver through the slot [B] on the top and bottom of the module and pulling them apart does this. See figure 2.1
2. Align the locking clips of the module being connected with the slots on the module being connected to.
3. Press modules firmly together, there will be an audible "snap" when the locking clips are fully engaged.
4. Reinstall the end plates at the ends of the LYNX System. They are designed to fit either end.
5. You are now ready to mount your LYNX System to a panel or DIN Rail using the optional hardware kit.

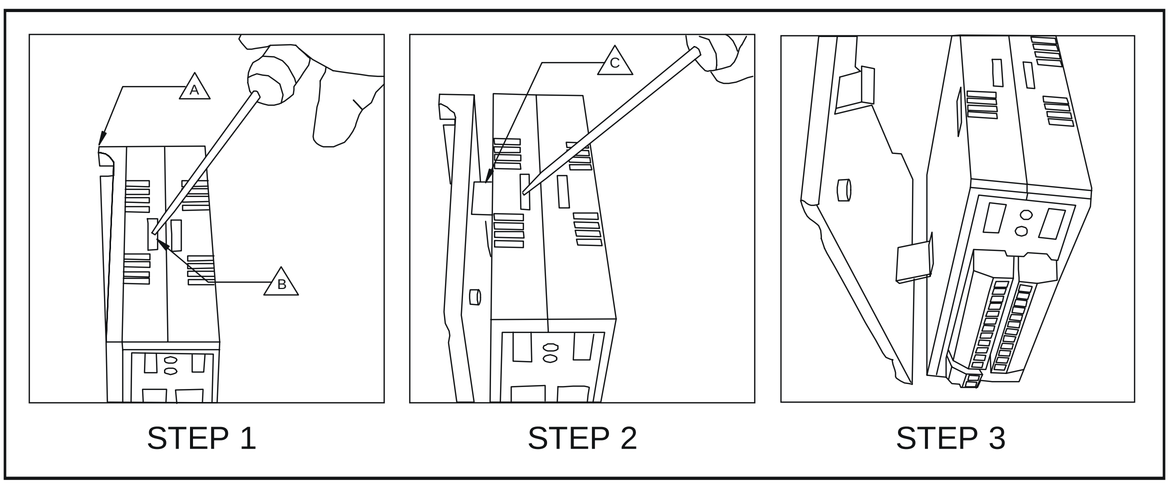

Figure 2.1: Removing the End Plates

WARNING! Exercise caution when removing end plates or separating LYNX System modules! Internal component damage may occur if the screwdriver is inserted too far into the slots!

Section 3

Mounting the LYNX System

Section Overview

This section covers the two basic methods of mounting the LYNX System.

- Panel Mount.
- DIN Rail Mounting Option.

Panel Mount

Using the panel mount option, the LYNX is designed to use #10 hardware (not included). Details such as screw length and threads are dependent on your overall system design.

Din Rail Mounting Option

A DIN Rail mounting kit (IMS P/N LX-DB100-000) may be purchased as an option to your LYNX System. It includes all the hardware necessary to mount the system to either of the following recommended DIN rails:

TS35 X 7.5 or TS35 X 15

Included in the DIN Rail Mounting Kit

Included in the DIN Rail Mounting Kit is the following hardware:

- 2 - IMS0065 DIN Rail Brackets
- 4 - #6 Split Lock Washer
- 4 - #6-32X7/16 L Pan Hd Machine Screws
- 4 - #6 Flat Washer .040 Thick
- 2 - #6 X .250 L Set Screw
- 1 - Instruction Sheet

Mounting the LYNX System to a DIN Rail

In order to install your LYNX System on a DIN rail complete the following:

1. Insert the two DIN rail brackets into the slots located in the back of the system between the end plates and LYNX modules. The pull-tab on the DIN rail bracket must be on the bottom.

2. Using the #6 hardware provided, secure the bracket to the end plates. *Figure 3.1.* Tighten to 5 - 7 lb/in.

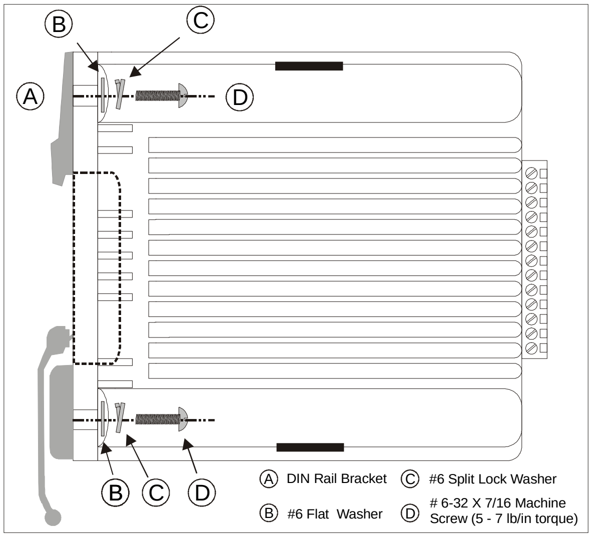

Figure 3.1: Installing the DIN Rail Bracket

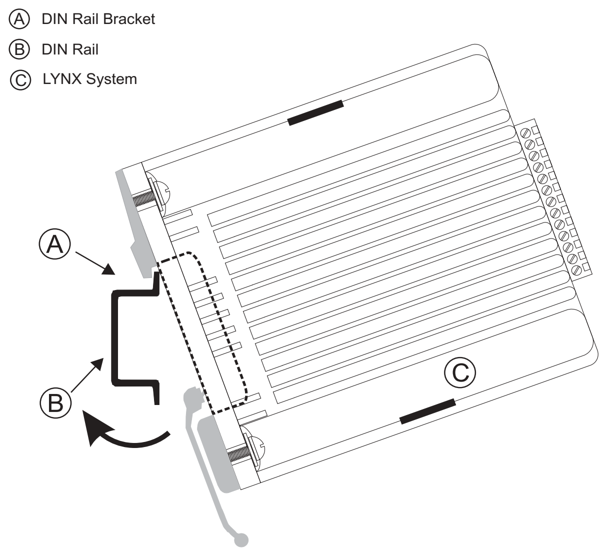

Figure 3.2: Installing the LYNX System on a DIN Rail

3. Holding the LYNX System at an angle away from you, lower the upper slot of the DIN rail attachment onto the top edge of the DIN rail. Snap LYNX system into place. *Figure 3.2.*

4. Insert #6 X .250 L set screw (provided) into the TOP threaded insert located between the #6 screws on each end plate. *Figure 3.3.* Tighten until 12-14 in/oz. This will keep the system from sliding on the DIN rail.

To Remove the LYNX System from the DIN Rail:

1. Loosen the set screws located in the TOP threaded insert between the #6 screws on each end plate.
2. Grasp the pull-tabs located on the bottom of the DIN Rail brackets to release the LYNX system from the DIN Rail *(Figure 3.3 - C&D)* while gently lifting the front of the LYNX system.
3. Lift the LYNX System Away from the DIN Rail.

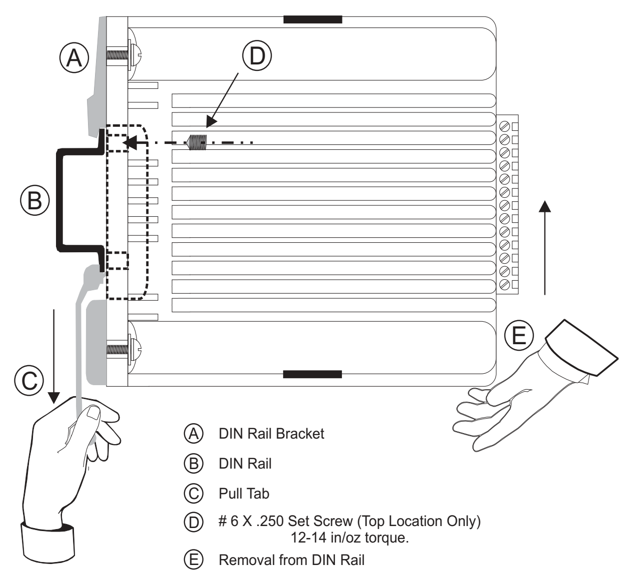

Figure 3.3: Removing the LYNX System from the DIN Rail

NOTE: The DIN Rail Mounting option should only be used on STATIONARY Systems. It is not designed for transport!

Section 4

Powering the LYNX System

Section Overview

This section covers the two basic power configurations for your LYNX System.

- Basic rules of wiring and shielding.
- LYNX Control Module with IMS Drivers.
- LYNX Control Module as Stand-alone or with Optional I/O Module.

Wiring and Shielding

Noise is always present in a system that involves high power and small signal circuitry. Regardless of the power configuration that you use in your system, there are some wiring and shielding rules that you should follow to keep your noise-to-signal ratio as small as possible.

Rules of Wiring

- Power Supply and Motor wiring should be shielded twisted pairs run separately from signal carrying wires.
- A minimum of 1 twist per inch is recommended.
- Motors wiring should be shielded twisted pairs using 20-gauge wire, or 18 gauge or better for distance greater than 5 feet.
- Power ground return should be as short as possible to established ground.
- Power Supply wiring should be shielded twisted pairs. Use 18 Gauge wire if load is less than 4 amps, or 16 gauge for more than 4 amps.
- Do not “Daisy-Chain” power wiring to system components.

Rules of Shielding

- The shield must be tied to zero-signal reference potential. In order for shielding to be effective it is necessary for the signal to be earthed or grounded.
- Do not assume that earth ground is true earth ground. Depending on the distance to the main power cabinet it may be necessary to sink a ground rod at a critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield, however the second shield is tied to ground at both ends.

WARNING! When using an unregulated supply, ensure that the output voltage does not exceed the maximum driver input voltage due to variations in line voltage! It is recommended that an input line filter be used on power supply to limit voltage spikes to the system!

LYNX Control Module with IMS Driver

In this example, power is connected to the LYNX Control Module via connector P1. All optional plug-on modules are then powered from the LYNX Control Module. In this configuration, pins 5 and 6 on connector P2 of the Control Module become +5VDC (150mA, internally limited) regulated outputs. If an encoder is to be used in the system, it may be powered via these pins. Below is a table of recommended power supply specifications for each IMS drive.

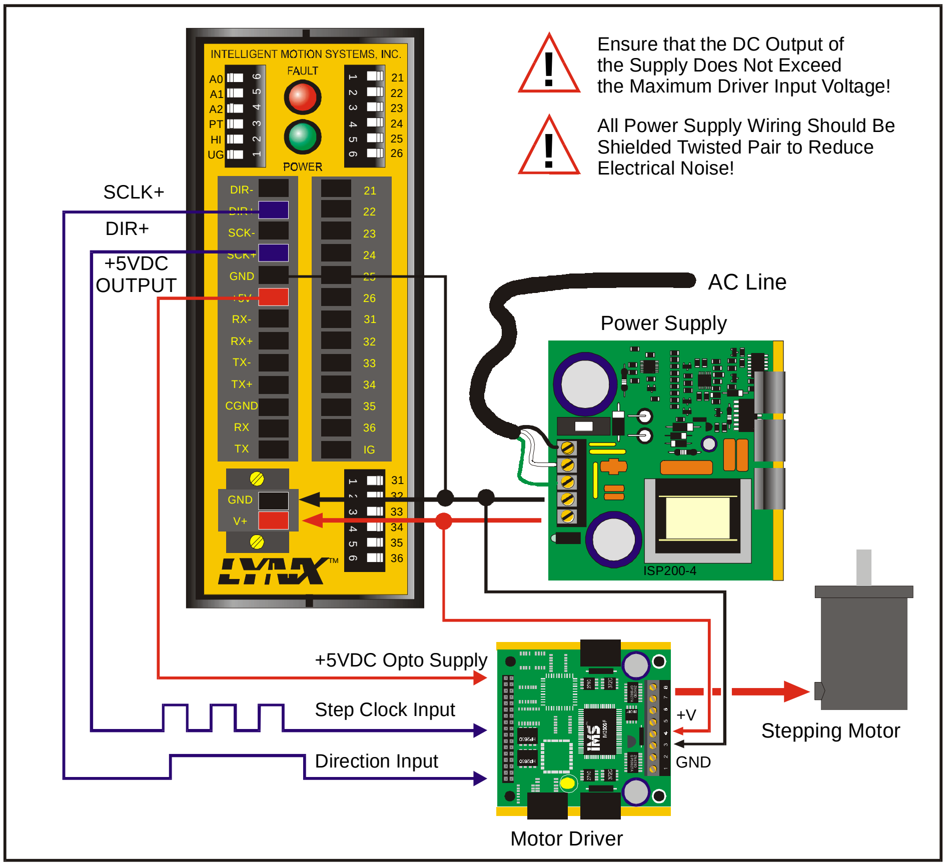

Figure 4.1: Power Configuration. LYNX Control Module and external IMS Driver

Power Supply Recommendations	
Recomended Type	Unregulated DC
Ripple Voltage	±10%
When Used With IM483/IM483H	
Output Voltage	+12 to +45VDC
*Output Current	2A (Typ.) 4A (Peak)
When Used With IM805/IM805H	
Output Voltage	+24 to +75VDC
*Output Current	4A (Typ.) 6A (Peak)

***The output current needed is dependant on the supply voltage, motor selection and load.

Stand-alone or with Optional I/O Modules

+12 to +75VDC Supply

A +12 to +75VDC unregulated supply connected to P1 provides power to the LYNX Control Module and any optional I/O modules. As in the LYNX Controller with Driver (s) Configuration, pins 5 (Ground) and 6 (+5VDC) on connector P2 of the Control Module becomes a +5VDC (150mA, internally limited) regulated output.

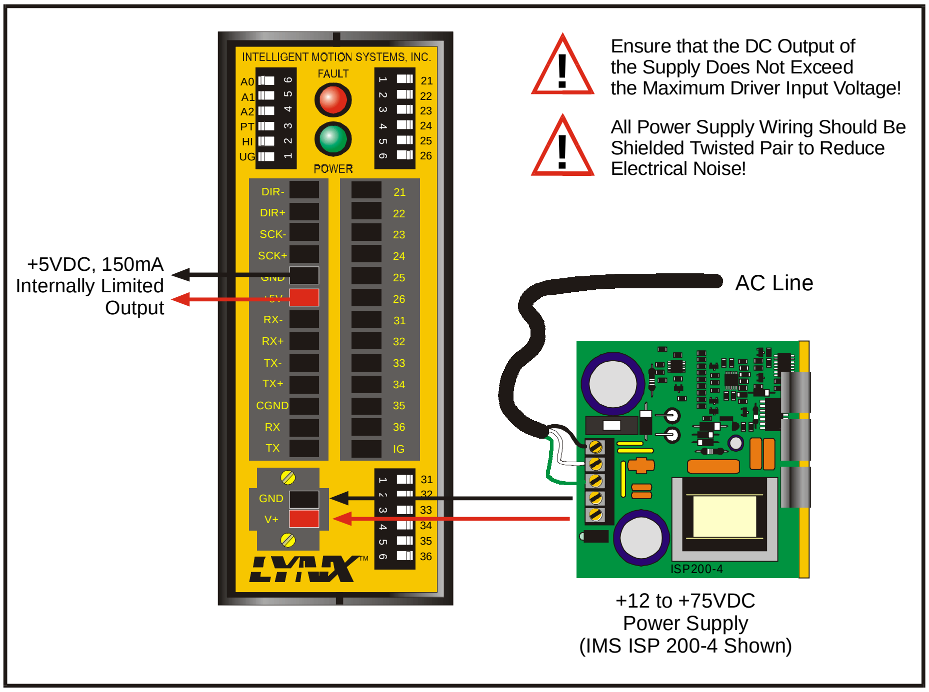

Figure 4.2: Stand-alone Power Configuration: 12 - 75 VDC Supply

+5 VDC Supply

A +5VDC ±5% regulated supply connected to pins 5 (Ground) and 6 (+5VDC) on connector P2 provides power to the LYNX Control Module and any optional I/O modules. *Figure 4.3.* It is assumed that external drives are being used and power is supplied to these drives separately. The LYNX Controller internally limits the current to 800mA. While the LYNX Controller and I/O Modules will only require 368mA, a fully configured LYNX System utilizing the outputs may require up to 800mA.

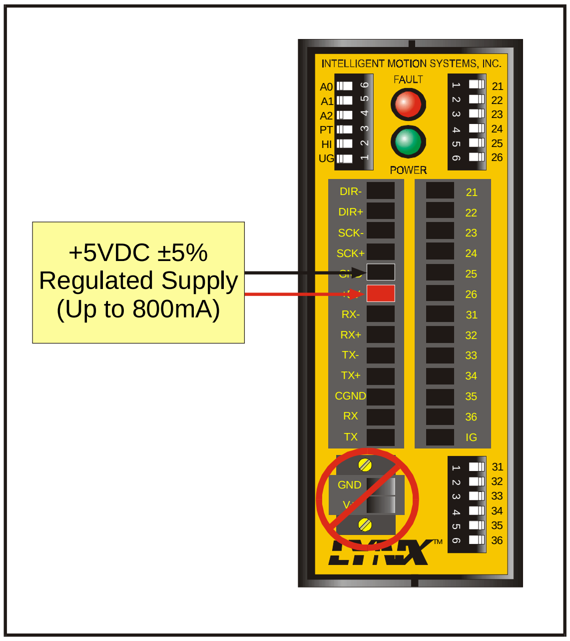

Figure 4.3: Stand-alone Power Configuration: 5 VDC

Power Requirements

Power Requirements and Specifications	
Input Voltage	+12 to +75 VDC Unregulated or +5VDC ±5%
Input Current	250mA (5VDC input) 165mA (+12VDC Input)* 95.0mA (+48 VDC Input)* 84.5mA (+75VDC Input)* *I/O and +5VDC output unloaded (Control Module Only)
Output Voltage	+5VDC ±5%
Output Current	150mA (Internally Limited

Input Current Requirements per Module	
LYNX Control Module	250 mA (+5VDC Input)
Isolated Digital I/O Module	68mA (5VDC Input)
Differential I/O Module	50mA (+5VDC Input)
Output Current	150mA (Internally Limited

Table 4.1: Power Requirements

WARNING! When using an unregulated supply, ensure that the output voltage does not exceed the maximum driver input voltage due to variations in line voltage! It is recommended that an input line filter be used on power supply to limit voltage spikes to the system!

WARNING! When specifying the input voltage of the LYNX System ensure that the power supply output voltage corresponds with the input voltage of the driver used!

WARNING! When specifying an external power supply ensure that all modules are included in the power calculation!

WARNING! Only one of these methods of Powering the LYNX System can be used!

Section 5

The Communications Interface

Section Overview

The LYNX Control Module features two communication interfaces: RS-232 and RS-485. For both channels, the BAUD rate is software configurated, using the BAUD variable, to 4800, 9600, 19200 or 38400 bits/sec. The factory default is set to 19200 bits/sec. Default data settings are 8 data bits, 1 stop bit and no parity.

A host computer can be connected to either interface to provide commands to the control module or to multiple control modules in a system. Since most personal computers are equipped with an RS-232 serial port, it is most common to use the RS-232 interface for communications from the host computer to the control module. You will typically want to use this interface option if your Host PC will be within 50 feet of your system. Should your system design place the LYNX Control Module at a distance greater than 50 feet, it will be necessary for you to use the RS-485 interface option. You can accomplish this by using either an RS-232 to RS-485 converter, such as the converter sold by IMS (Part # CV-3222), or installing an RS-485 board in an open slot in your host PC.

Covered in detail in this section are:

- RS-232 Interface, Single Control Module System.
- RS-232 Interface, Multiple Controller System.
- RS-485 Interface, Single Control Module Interface.
- RS-485 interface, Multiple Controller System.
- Communicating with the LYNX System using Windows95/98 HyperTerminal.
- Communicating with the LYNX System using the IMS Terminal software.
- LYNX Control Module Modes of Operation.
- LYNX Control Module Communication Modes.

Connecting the RS-232 Interface

Single Control Module System

In systems with a single control module, also referred to as Single Mode, the LYNX Control Module is connected directly to a free serial port of the Host PC. Wiring and connection should be performed in accordance with the following table and diagram. In this mode the PARTY switch will be in the OFF position, and the PARTY Flag will be set to 0 in software. This is the factory default setting. Please be aware that you cannot communicate with the LYNX Control Module in single mode unless those conditions exist.

WARNING! Failure to connect communications ground as shown may result in damage to the Control Module and/or Host!

NOTE: If using the RS-232 Interface Option, the Host PC MUST be less than 50 feet from the Control Module. If your system will be greater than 50 feet from the Host PC you must use the RS-485/RS485 Interface.

RS-232 Interface: Wiring And Connections					
LYNX Control Module		25 Pin Serial Port on PC		9 Pin Serial Port on PC	
Receive Data (RX)	Pin 12	Transmit Data (TX)	Pin 2	Transmit Data (TX)	Pin 3
Transmit Data (TX)	Pin 13	Receive Data (RX)	Pin 3	Receive Data (RX)	Pin 2
Communications Ground	Pin 11	Communications Ground	Pin 7	Communications Ground	Pin 5

Table 5.1: Wiring Connections: RS-232 Interface Single Control Module System

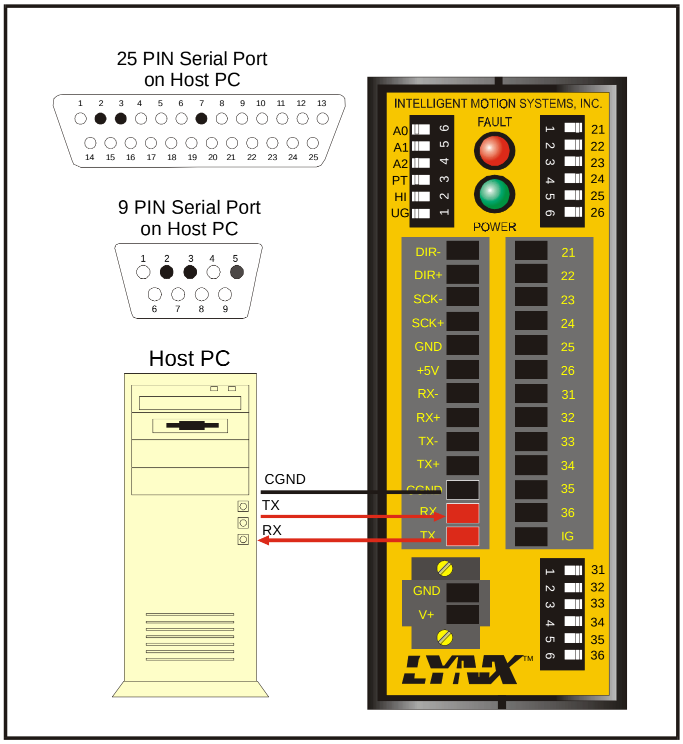

Figure 5.1: Connecting the RS-232 Interface, Single Control Module System

Multiple Control Module System

When connecting multiple control modules in a system using the RS-232 interface, it is necessary to establish one control module as the HOST. This control module will be connected to the Host PC exactly as the system using a single control module. The system HOST is established by one of two methods, by manually selecting the Host switch (configuration switch #2, labeled HI) to the ON position, or by setting the HOST Flag to True (1) in software. The remaining control modules in the system must then be connected to the HOST control module using the RS-485 interface and will have their Host switch set to OFF (HOST Flag = 0).

In this interface configuration, Host PC communications will be received by the Host Control Module via RS-232 and forwarded to all of the other control modules in the system via the RS-485 channel. Responses from the individual control modules in the system will be routed back to the Host Control Module via the RS-485 channel, then internally converted to RS-232 before being forwarded back to the Host PC.

In systems with multiple controllers it is necessary to communicate with the control modules using PARTY Mode of operation. The LYNX Control Modules in the system are configured for this mode of operation by setting the Party Switch (configuration switch #3, labeled PT) to the ON position, or setting the PARTY Flag to True (1), in software. It is necessary for all of the controllers in a system to have this configuration selected. When operating in PARTY Mode each control module in the system will need a unique address, or name, to identify it in the system. This can be done using configuration switches A0-A2, or by using the software command SET DN. For example, to set the name of a controller to "A" you would use the following command: SET DN = "A". The factory default name is "!". To set the address of the controller using the configuration switches use the following table:

Party Mode Address Configuration Switches			
Address	**A2**	**A1**	**A0**
None	OFF	OFF	OFF
A	OFF	OFF	ON
B	OFF	ON	OFF
C	OFF	ON	ON
D	ON	OFF	OFF
E	ON	OFF	ON
F	ON	ON	OFF
G	ON	ON	ON

Table 5.2: Party Mode Address Configuration Switch Settings

In setting up your system for PARTY operation the most practical approach would be to observe the following steps:

1. Connect the Host Control Module to the Host PC configured for single mode operation.
2. Establish communications with the HOST Control Module. (For help in doing this see Software Reference: Using the LYNX Terminal.) Using the Command: SET DN or the configuration switches, give the controller a unique name. If using the software command this can be any upper or lower case ASCII character or number 0-9. Save the name using the command SAVE.
3. Set the appropriate HOST and PARTY configuration in accordance with the table and diagram below. Remove power.
4. Connect the next control module in the system in accordance with the following table and diagram, setting the PARTY switch in the ON position. If you desire you can set the PARTY Flag to “1” in software later and turn the switch off.
5. Establish communications with this module using the factory default name “!”. This name cannot be reused. Rename and save the new name. Remove power.
6. Repeat the last two steps for each additional control module in the system.

WARNING! Failure to connect communications ground as shown may result in damage to the Control Module and/or Host!

NOTE: If using the RS-232 Interface Option, the Host PC MUST be less than 50 feet from the Control Module. If your system will be greater than 50 feet from the Host PC you must use the RS-485/RS485 Interface.

RS-232 Interface: Wiring And Connectionsfor Multiple LYNX Nodes					
Host Control Module		Control Module #1		Control Module #*n*	
Receive Data (RX-)	Pin 7	Transmit Data (TX-)	Pin 9	Transmit Data (TX-)	Pin 9
Receive Data (RX+)	Pin 8	Transmit Data (TX+)	Pin 10	Transmit Data (TX+)	Pin 10
Transmit Data (TX-)	Pin 9	Receive Data (RX-)	Pin 7	Receive Data (RX-)	Pin 7
Transmit Data (TX+)	Pin 10	Receive Data (RX+)	Pin 8	Receive Data (RX+)	Pin 8
Communications Ground	Pin 11	Communications Ground	Pin 11	Communications Ground	Pin 11
HOST Switch = ON or HOST Flag = TRUE (1)		HOST Switch = OFF or HOST Flag = FALSE (0)		HOST Switch = OFF or HOST Flag = FALSE (0)	
PARTY Switch = ON or PARTY Flag = TRUE (1)		PARTY Switch = ON or PARTY Flag = TRUE (1)		PARTY Switch = ON or PARTY Flag = TRUE (1)	

Table 5.3: Connections and Settings Multiple Control Module System, RS-232 Interface

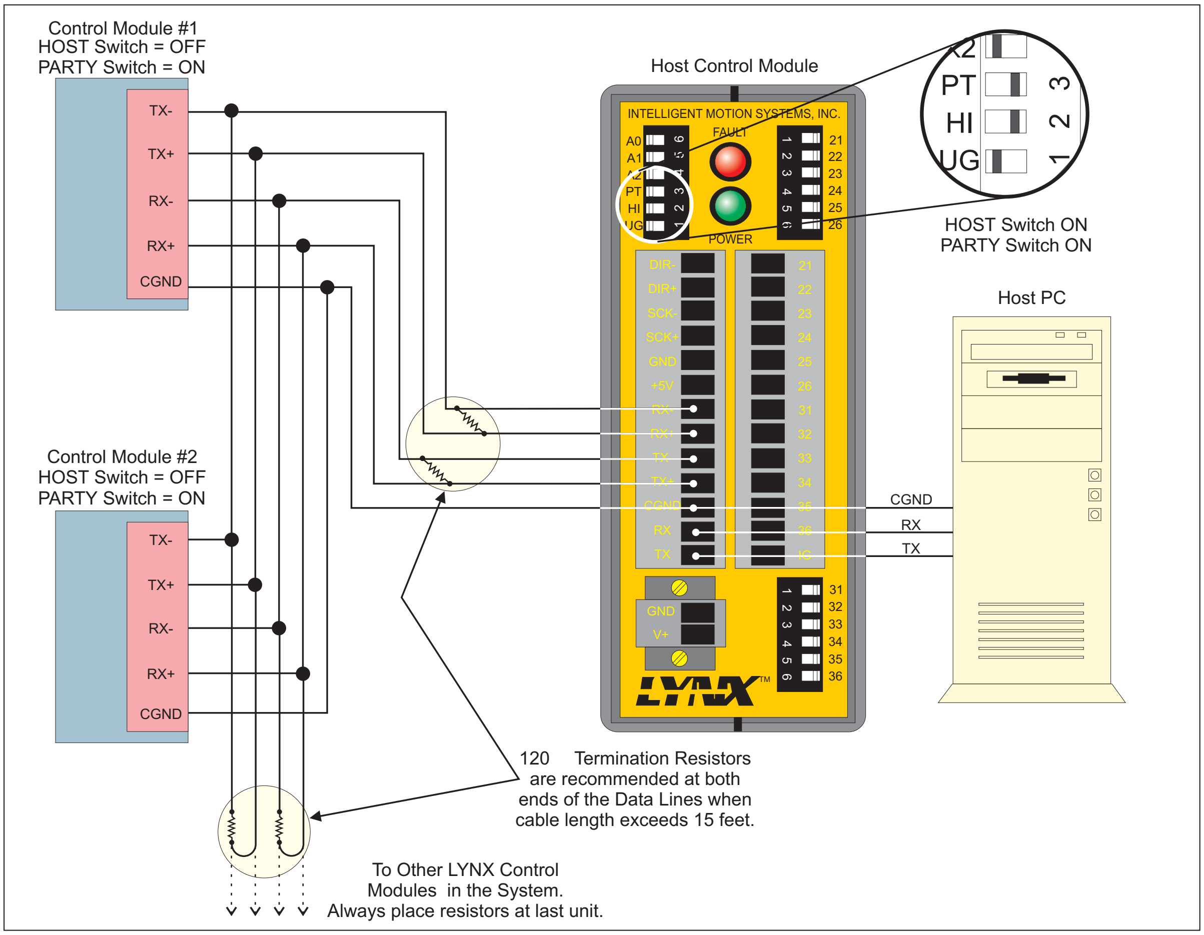

Figure 5.2: RS-232 Interface, Multiple Control Module System

Data Cable Termination Resistors

Data Cable lengths greater than 15 feet (4.5 meters) are susceptible to signal reflection and/or noise. IMS recommends 120Ω termination resistors at both ends of the Data Cables. An example of resistor placement is shown in Figure 5.2. For systems with Data Cables 15 feet (4.5 meters) or less, the termination resistors are generally not required. For more information and other RS-232 termination techniques, search the Internet for "RS-232 Application Notes".

Connecting the RS-485 Interface

Single Controller System

In a Single Controller System, the RS-485 interface option would be used if the Control Module is located at a distance greater than 50 feet from the Host PC. Since most PC's do not come with an RS-485 board pre-installed, you will have to install an RS-485 board in an open slot in your PC, or purchase an RS-232 to RS-485 converter, such as the CV-3222 sold by IMS, to use this connection interface. For wiring and connection information please use the following table and diagram:

RS-485 Board or RS232 to RS-485 Converter	LYNX Controller Module	
Receive Data (RX-)	Transmit Data (TX-)	Pin 9
Receive Data (RX+)	Transmit Data (TX+)	Pin 10
Transmit Data (TX-)	Receive Data (RX-)	Pin 7
Transmit Data (TX+)	Receive Data (RX+)	Pin 8
Communications Ground	Communications Ground	Pin 11

Table 5.4: RS-485 Interface Connections

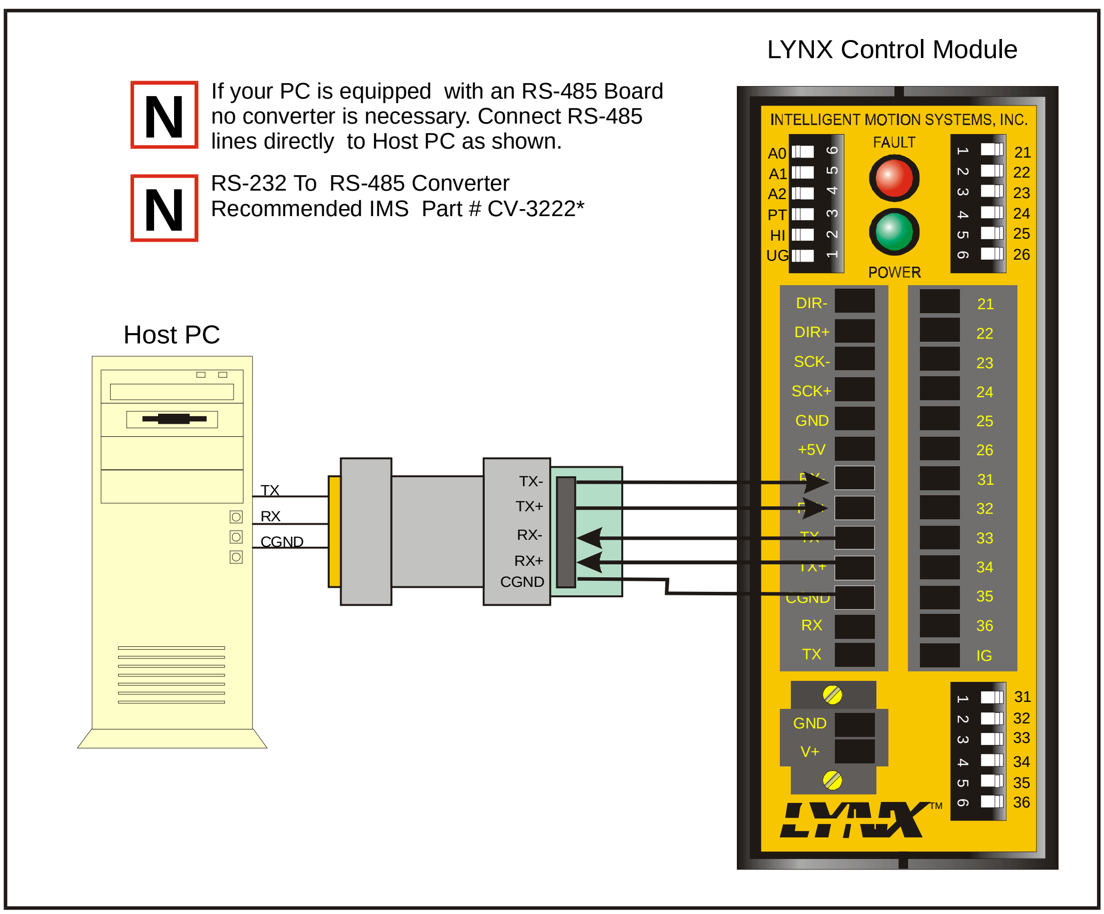

Figure 5.3: RS-485 Interface, Single Controller System

NOTE: The HOST switch MUST be off to communicate with the Control Module in a Single Controller System using the RS-485 Interface.

Multiple Controller System

Party Mode Address Configuration Switches			
Address	**A2**	**A1**	**A0**
None	OFF	OFF	OFF
A	OFF	OFF	ON
B	OFF	ON	OFF
C	OFF	ON	ON
D	ON	OFF	OFF
E	ON	OFF	ON
F	ON	ON	OFF
G	ON	ON	ON

Table 5.5: Party Mode Address Configuration Switch Settings

When using the RS-485 interface in a Multiple Controller System, the Host PC as well as all of the control modules communicate on the RS-485 interface. In this case, there is no Host Interface Control Module, so all control modules in the system should have their Host switch OFF or HOST flag set to False (0). The Host PC will be equipped with an RS-485 board or RS-232 to 485 converter.
In systems with multiple controllers it is necessary to communicate with the control modules using PARTY Mode of operation. The LYNX Control modules in the system are configured for this mode of operation by setting the Party Switch (configuration switch #3, labeled PT) to the ON position or setting the PARTY Flag to True (1), in software. It is necessary for all of the controllers in a system to have this configuration selected. When operating in PARTY Mode each control module in the system will need a unique address, or name, to identify it in the system. This can be done using configuration switches A0-A2, or by using the software command SET DN. For example, to set the name of a controller to "A" you would use the following command: SET DN = "A". The factory default name is "!". To set the address of the controller using the configuration switches use the above table.

In setting up your system for PARTY operation the most practical approach would be to observe the following steps:

1. Connect the Host Control Module to the Host PC configured for Single Mode Operation.
2. Establish communications with the HOST Control Module. Using the Command: SET DN or the configuration switches, give the controller a unique name. If using the software command this can be any upper or lower case ASCII character or number 0-9. Save the name using the command SAVE.
3. Set the appropriate HOST and PARTY configuration in accordance with the following table and diagram. Remove power.
4. Connect the next control module in the system in accordance with the following table and diagram, setting the PARTY switch in the ON position. If you desire you can set the PARTY Flag to "1" in software later and turn the switch off.
5. Establish communications with this module using the factory default name "!". This name cannot be reused. Rename and save the new name. Remove power.
6. Repeat the last two steps for each additional control module in the system.

RS-485 Interface: Wiring And Connectionsfor Multiple LYNX Nodes		
RS-232 to RS-485 Converter	Control Module #1	Control Module #*n*
Receive Data (RX-)	Transmit Data (TX-) Pin 9	Transmit Data (TX-) Pin 9
Receive Data (RX+)	Transmit Data (TX+) Pin 10	Transmit Data (TX+) Pin 10
Transmit Data (TX-)	Receive Data (RX-) Pin 7	Receive Data (RX-) Pin 7
Transmit Data (TX+)	Receive Data (RX+) Pin 8	Receive Data (RX+) Pin 8
Communications Ground	Communications Ground Pin 11	Communications Ground Pin 11
	HOST Switch = OFF or HOST Flag = FALSE (0)	HOST Switch = OFF or HOST Flag = FALSE (0)
	PARTY Switch = ON or PARTY Flag = TRUE (1)	PARTY Switch = ON or PARTY Flag = TRUE (1)

Table 5.6: RS-485 Interface Connections and Settings, Multiple Control Module System

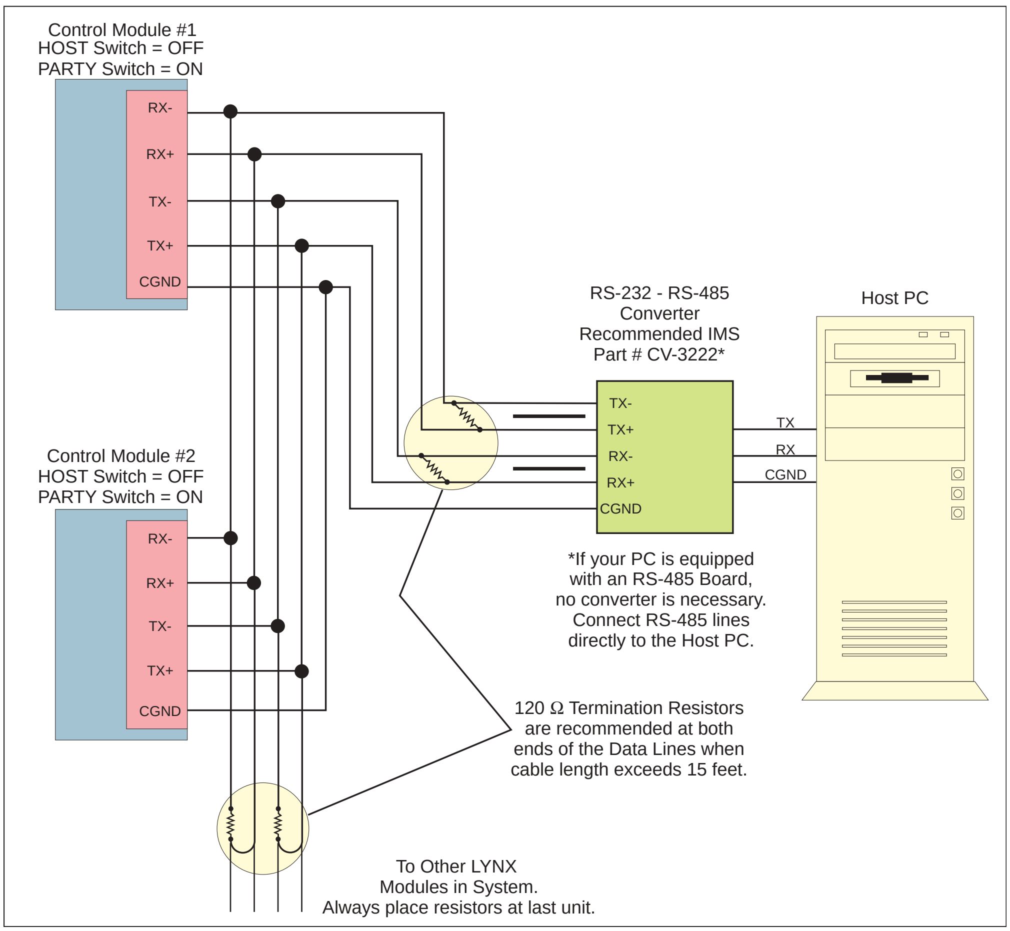

Figure 5.4: RS-485 Interface, Multiple Control Module System

It is also possible to communicate with a controller in the system in single mode by sending it a command (with address) to clear the party flag and then communicate with it as in single mode (no line feed terminator) then reset the PARTY Flag when done.

Data Cable Termination Resistors

Data Cable lengths greater than 15 feet (4.5 meters) are susceptible to signal reflection and/or noise. IMS recommends 120Ω termination resistors at both ends of the Data Cables. An example of resistor placement is shown in Figure 5.4. For systems with Data Cables 15 feet (4.5 meters) or less, the termination resistors are generally not required.

For more information and other RS-485 termination techniques, search the Internet for "RS-485 Application Notes".

LYNX Control Module Modes of Operation

There are three modes of operation for the LYNX control module. These are Immediate Mode, Program Mode, and EXEC Mode.

Immediate Mode

In this mode, the control module responds to instructions from the user that may be a result of the user typing instructions directly into a host terminal, or of a user program running on the host which communicates with the control module.

Program Mode

The second mode of operation of the control module is Program Mode. All user programs are written in this mode. Unlike the other modes of operation, no commands or instructions can be issued to the control module in Immediate Mode. This mode is exclusively for writing programs for the controller. The command to enter Program Mode is PGM <address>. When starting Program Mode, you must specify at what address to enter the program instructions in the program space. Simply type PGM again when you have finished entering your program commands to go back to Immediate Mode.

EXEC Mode

In EXEC Mode a program is executed either in response to the EXEC instruction from the user in Immediate Mode, or in response to a specified input. While the control module is running a program, the user may still communicate with it in Immediate Mode. As part of a user program, the control module may start a second task using the RUN instruction. Thus, there can be two tasks running on the control module at the same time, a foreground task (started by the EXEC instruction in Immediate Mode) and a background task (started by the RUN instruction in Program Mode).

LYNX Control Module Communication Modes

When the control module is operating in Immediate Mode, there are two methods of communicating. The first is ASCII where the instructions are communicated to the control module in the form of ASCII mnemonics and data is also given in ASCII format. The second is binary where the instruction is in the form of an OpCode and numeric data is given in IEEE floating point hex format. In binary mode, there is also the option of including a checksum to ensure that information is received properly at the control module. The BIO flag controls the method of communication. When it is True (1) the binary method should be used, and when it is False (0) the ASCII method should be used.

ASCII

ASCII is the most common mode of communicating with the LYNX System. It allows the use of readily available terminal programs such as HyperTerminal, ProComm, and the new IMS Terminal.

When using the ASCII method of communications, the control module tests for four special characters each time a character is received. These characters are given in the table below along with an explanation of what occurs when the character is received.
The command format in ASCII mode when the control module is in Single Mode (PARTY = FALSE) is:

<Mnemonic><white space><ASCII data for 1st parameter>, <ASCII data for 2nd parameter>, … , <ASCII data for nth parameter><CR/LF>

The mnemonics for Control Module instructions, variables, flags and keywords are given in *Part III Software Reference* of this manual. White space is at least one space or tab character. CR/LF represent the

ASCII Mode Special Command Characters	
Character	**Action at MicroLYNX**
<esc> Escape Key	Terminates all active operations and all running programs.
<^C> Ctrl+C Keys	Terminates all active operations and all running programs, forces a reset of the MicroLYNX.
<BKSP> Backspace Key	Moves the cursor back one in the buffer to correct a typing error.
<CR> or <LF> Carriage Return or Line Feed	Depending on the mode, either Single or Party. <LF> is not necessary in Single Mode communications. <CTRL+J> is the same as <LF> (0A Hex)

Table 5.7: ASCII Mode Special Command Characters

carriage return line feed characters that are transmitted in response to the Enter key on the keyboard provided the ASCII setup specifies "Send line feeds with line ends". Note that there need not be a space between the data for the last parameter and the CR/LF. Also note that if there is only one parameter, the CR/LF would immediately follow the data for that parameter.

The command format in ASCII mode when the control module is in Party Mode (PARTY = TRUE) would be identical to that in Single Mode with the exception that the entire command would be preceded by the control module's address character (stored in DN) and terminated by a CTRL-J rather than ENTER:

<Address character><Mnemonic><white space><ASCII data for 1st parameter>, <ASCII data for 2nd parameter>, … , <ASCII data for nth parameter><CTRL-J>

Binary

Binary mode communications is faster than ASCII and would most likely be used in a system design where the communication speed is critical to system operation. This mode cannot be used with standard terminal software.

The command format in binary mode when the control module is in Single Mode (PARTY = FALSE) is:

<20H><character count><opcode><Field type for 1st parameter><IEEE hex data for 1st parameter><0EH><Field type for 2nd parameter><IEEE hex data for 2nd parameter><0EH> … <Field type for nth parameter><IEEE hex data for nth parameter><optional checksum>

Note that <20H> is 20 hex, the character count is the number of characters to follow the character count not including the checksum if one is being used. The OpCodes for control module instructions, variables, flags and keywords are given in Sections 15 and 16 of this document. The Field type byte will be one of the following based on the type of data that is expected for the specific parameter:

Binary Hex Codes	
Hex Code	**Data Type**
01	Label Text
02	ASCII Text
03	1 byte unsigned
04	2 byte signed
05	2 byte unsigned
06	4 byte signed
07	4 byte unsigned
08	4 byte float

Table 5.8: Binary Hex Codes

<0EH> is 0E hex, which is a separator character in this mode. Finally, the optional checksum will be included if CSE is TRUE and excluded if it is FALSE. If included, the checksum is the low eight bits of the complemented sixteen-bit sum of the address field (20H here), character count, OpCode, all data fields and separators (0E hex).

Section 6

Configuring the Digital I/O

Section Overview

This section covers the usage of the Isolated Digital and High Speed Differential I/O Modules which are available on the LYNX System.

- System I/O Availability by Module.
- The Isolated Digital I/O:
  - Configuring an Input
  - Setting the Digital Input Filtering for the Isolated I/O
  - Configuring an Output
  - Setting the Binary State of an I/O Group
- The Differential I/O:
  - The Clock Interface
  - Configuring an Input
  - Setting the Digital Input Filtering for the Differential I/O
  - Configuring an Output.
- Typical Functions of the Differential I/O.

System I/O Availability by Module

The LYNX System offers designers the ability to custom-tailor the LYNX System for their individual application needs. Below is a table illustrating the available configurations and the I/O set which would be present with each configuration.

Allowable LYNX System I/O Configurations							
LYNX System	LX-CM100	LX-CM200	LX-CM100 LX-DI100	LX-CM200 LX-DI100	LX-CM100 LX-DD100	LX-CM100 LX-DI100 LX-DD100	LX-CM100 LX-DC100
GROUP 10 HIGH SPEED	11 & 12	11, 12, 13, 14 & 17	11 & 12	11, 12, 13, 14 & 17	11 - 18	11 - 18	11, 12, 13, 14 & 17
GROUP 20 ISOLATED	21 - 26	21 - 26	21 - 26	21 - 26	21 - 26	21 - 26	21 - 26
GROUP 30 ISOLATED	31 - 36	N/A	31 - 36	N/A	31 - 36	31 - 36	31 - 36
GROUP40 ISOLATED	N/A	N/A	41 - 46	41 - 46	N/A	41 - 46	41 - 46
GROUP 50 ISOLATED	N/A	N/A	51 - 56	51 - 56	N/A	51 - 56	N/A

Table 6.1: System I/O Availability by Module

The Isolated Digital I/O

The LYNX CM100 Control Module has a standard set of twelve +5 to +24VDC I/O lines and the LYNX CM200 Combination Control Module has a standard set of six +5 to +24VDC I/O lines. These I/O lines may be programmed individually as either general purpose or dedicated inputs or outputs, or collectively as a group. The Isolated Digital I/O may be expanded to a maximum of twenty-four (24) lines on the CM100 and a maximum of eighteen (18) lines on the CM200.

The I/O groups and lines are numbered in the following fashion:

Group 20 = Lines 21 - 26 (Standard CM100 and CM200)
Group 30 = Lines 31 - 36 (Standard CM100 only)
Group 40 = Lines 41 - 46 (Optional CM100 and CM200)
Group 50 = Lines 51 - 56 (Optional CM100 and CM200)

The isolated digital I/O may be defined as either active HIGH or active LOW. When the I/O is configured as active HIGH, the level is +5 to +24 VDC and the state will be read as a "1". If the level is 0 VDC then the state will be read as "0". Inversely if configured as active LOW, then the state of the I/O will be read as a "1" when the level is LOW, and a "0" when the level is HIGH. The active HIGH/LOW state is configured by the third parameter of the IOS variable, which is explained further on. The goal of this I/O configuration scheme is to maximize compatibility between the LYNX and standard sensors and switches. The LYNX I/O scheme is a powerful tool for machine and process control. Because of this power, a level of complexity in setup and use is found that doesn't exist in controllers with a less capable I/O set.

Uses of the Isolated Digital I/O

The isolated I/O may be utilized to receive input from external devices such as sensors, switches or PLC outputs. When configured as outputs, devices such as relays, solenoids, LED's and PLC inputs may be controlled from the LYNX. Depending on the device connected, the input or output may be pulled-up to either the internal +5VDC supply or an external +5 to +24VDC supply, or the I/O lines may be pulled-down to ground. These features, combined with the programmability and robust construction of the LYNX I/O open an endless vista of possible uses for the I/O in your application.

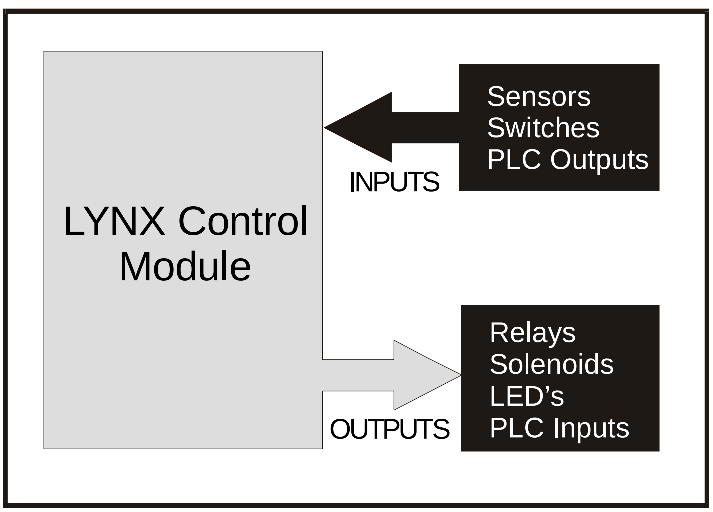

Figure 6.1: Isolated I/O Applications

Each I/O line may be individually programmed to any one of 8 dedicated input functions, 7 dedicated output functions, or as general purpose inputs or outputs. The I/O may be addressed individually, or as a group. The active state of the line or group may also be set. All of these possible functions are accomplished with of the IOS variable.

The IOS Variable

The IOS variable has three parameters when used to configure the isolated digital I/O. These are:

1] **I/O Line Type:** Specifies the the type of I/O that the line or group will be configured as, i.e. general purpose or dedicated function.

2] **I/O Line Function:** Either an input or an output.

3] **Active State:** Specifies whether or not the line will be active HIGH or active LOW.

The default configuration of the standard I/O set is: 0,0,1. This means that by default each line in group 20 is configured to be a General Purpose (0), Input (0), which is active when HIGH (1). The following figure and exercises illustrate possible configurations of the IOS.

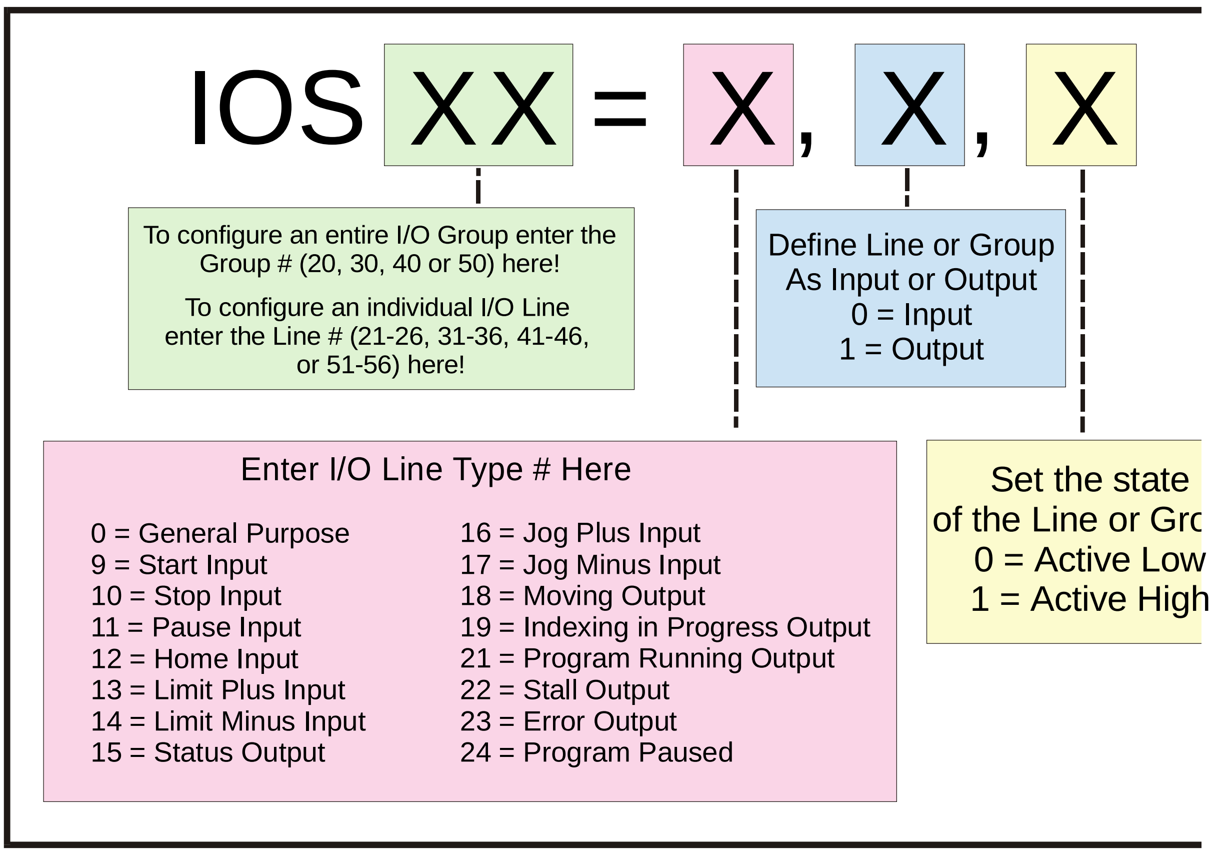

Table 6.2: IOS Variable Settings

NOTE: When configuring a dedicated input or output, the second parameter of the IOS Variable MUST match the function, either input or output, or an error will occur.

Configuring an Input

Figure 6.2 below illustrates the Input Equivalent Circuit of the Isolated I/O being used with a switch. To illustrate the usage of an input you will go through the steps to configure this switch to start a simple program at Line 1000 to index a motor 200 user units. First you must configure the I/O Line 21 as a "GO" input:

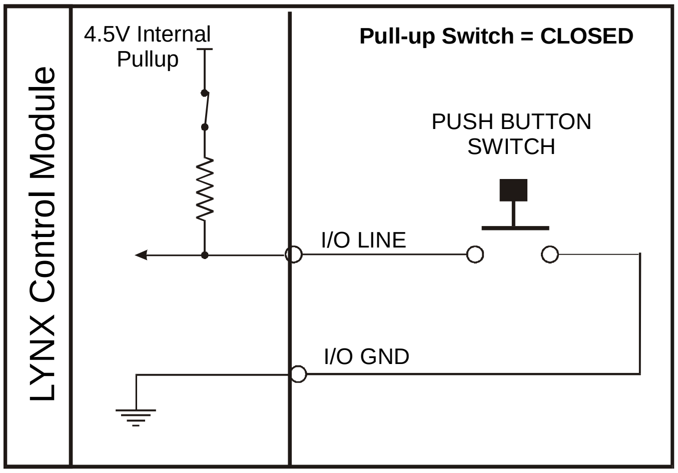

Figure 6.2: Isolated I/O Input

```
IOS 21 = 9, 0, 0
```

To break this command down:

IOS 21 - Identifies the I/O Line we are setting as 21.
9 - Configures the I/O Type to "GO".
0 - Configures I/O as Input.
0 - Configures I/O as Active LOW.

When the Input Type "GO" is selected it will always look to execute a program located at line 1 of program memory. Therefore, to run a program at line 1000 you must do the following:

```
PGM 1        'Records program at line 1 of memory space
EXEC 1000    'Execute program located at line 1000 of memory space
END          'Terminates Program
PGM          'Switches system back to immediate mode

PGM 1000     'Records program at line 1000 of memory space
MOVR 200     'Move relative to current position 200 user units
HOLD 2       'Hold program execution until specified motion is
             'completed
END
PGM
```

Configuring the Digital Filtering

User definable Digital filtering makes the LYNX well suited for noisy industrial environments. The filter setting is software selectable using the IOF Variable with a minimum guaranteed detectable pulse width of 18 microseconds to 2.3 milliseconds.

The table below illustrates the IOF settings.

The filter setting will reject any frequency above the specified bandwidth. For example:

```
IOF 2 = 3   'Set the Digital
Filter for I/O Group 20 to
3.44kHz
```

This setting will cause any signal above 3.44 kHz on I/O lines 21-26 to be rejected. The default filter setting for the isolated I/O groups is 7, or 215Hz.

IOF Filter Settings for the General Purpose Isolated I/O IOF=<num> (<num> = 0-7)		
Filter Setting	Cutoff Frequency	Minimum Detectable Pulse Width
0	27.5 kHz	18 microseconds
1	13.7 kHz	36 microseconds
2	6.89 kHz	73 microseconds
3	3.44 kHz	145 microseconds
4	1.72 kHz	290 microseconds
5	860 Hz	581 microseconds
6	430 Hz	1.162 milliseconds
7 (default)	215 Hz	2.323 milliseconds

Table 6.3: Digital Filter Settings for the Isolated I/O

Configuring an Output

Figure 6.3 illustrates the Output equivalent circuit of the Isolated I/O. When used as an output the I/O line is able to sink 350mA continuous for each output, or a total of 1.5A for the entire I/O Group. *See Section 9: The Isolated Digital I/O Module* for detailed specifications. In the usage example we will use an LED on I/O Line 31 for the load. We will use the same program from the input example, only we will use the output to light the LED while the motor is moving.

```
IOS 31 = 18, 1,  1
```

Using the table on page 27 we can break this setting down as follows:
IOS 31 - Identifies that I/O line 31 is being configured.
18 - Configures the I/O Type as "Moving".
1 - Configures the I/O line as an output.
1 - Configures the Line as "Active HIGH".

Now when the input program above is executed, the LED will be lit during the move.

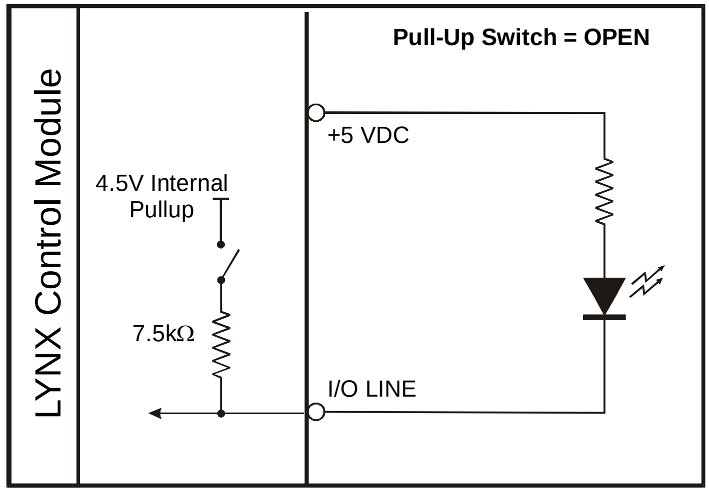

Figure 6.3: Isolated I/O Output

The IO Variable

After configuring the I/O by means of the IOS variable, we need to be able to do two things with the I/O.

1] Write to an output, or group of outputs, thus setting or changing its (their) state.
2] Read the states of either inputs or outputs. We can use this information to either display those states to our terminal, or to set up conditions for branches and subroutine calls within a program.

We can also use this command to write or read the state of an entire I/O group.

Read / Write a Single I/O Line

To read the state of a single input or output, the following would be typed into the terminal:

```
PRINT IO 21
```

The response from this would be 1 or 0, depending on the state of the line.
The state of an input or output in a program can be used to direct events within a LYNX program by either calling up a subroutine using the "CALL" instruction, or conditionally branching to another program address using the "BR" instruction. This would be done in the following fashion.

```
CALL MYSUB, IO 22=1
```

This would call up a subroutine labled "MYSUB" when I/O line 21 is active.

```
BR 200, IO 22=0
```

This would branch to address 200 when I/O line 22 is inactive.

Writing to an output is accomplished by entering the following into a terminal or program:

```
IO 21=1
IO 21=0
```

This would change the state of I/O line 21.

Read/Write an I/O Group

When using the IO variable to read the state of a group of inputs/outputs, or write to a group of outputs you would first want to configure the entire I/O group to be general purpose inputs or outputs using the IOS variable. In this case the response or input won't be a logic state of 1 or 0, but rather the decimal equivalent (0 to 63) of the 6 bit binary number represented by the entire group.

When addressing the I/O as a group the LSB (*Least Significant Bit*) will be line 1 of the group, (*e.g. 21, 31, 41, 51*). The MSB (*Most Significant Bit*) will be line 6 of the group (*e.g. 26, 36, 46, 56*).

The table on the left shows the bit weight of each I/O line in the group. It also illustrates the state should 6 LED's be connected to I/O group 20 when entering the IO variables in this exercise.

Configure the IOS variable such that group 20 is all general purpose outputs, active low or:

```
IOS 20 = 0,1,0
```

Enter the following in the terminal:

```
IO 20 = 35
```

As shown in the table I/O lines 26, 22 and 21 should be illuminated, 25, 24 and 23 should be off.

Enter this next:

```
IO 20 = 7
```

Now I/O 21, 22 and 23 should be illuminated.

```
IO 20 = 49
```

I/O 26, 25, and 21 are illuminated.

BIT WEIGHT DISTRIBUTION TABLE FOR GROUP 20 I/O					
I/O 26 MSB	I/O 25	I/O 24	I/O 23	I/O 22	I/O 21 LSB
32	16	8	4	2	1

BINARY STATE OF I/O GROUP 20 IO 20 = 35					
○	●	●	●	○	○
1	0	0	0	1	1
I/O 26 MSB	I/O 25	I/O 24	I/O 23	I/O 22	I/O 21 LSB

BINARY STATE OF I/O GROUP 20 IO 20 = 7					
●	●	●	○	○	○
0	0	0	1	1	1
I/O 26 MSB	I/O 25	I/O 24	I/O 23	I/O 22	I/O 21 LSB

BINARY STATE OF I/O GROUP 20 IO 20 = 49					
○	○	●	●	●	○
1	1	0	0	0	1
I/O 26 MSB	I/O 25	I/O 24	I/O 23	I/O 22	I/O 21 LSB

Table 6.4: Binary State of Outputs

NOTE: You can only write to General Purpose Outputs. If you attempt to write to and input or dedicated output type an error will occur!

The Differential I/O

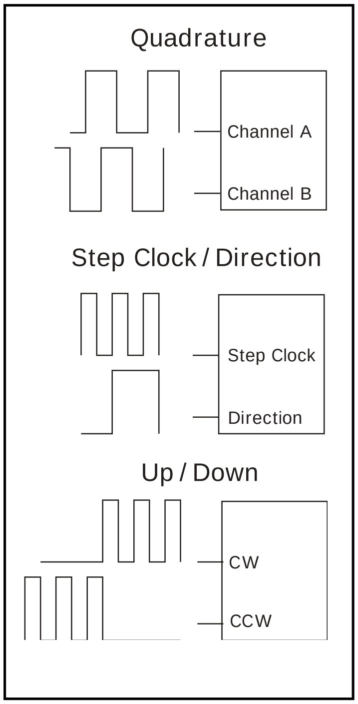

Figure 6.4: Clock Functions

The Clock Interface

The LYNX has four clock pairs that are used by the high speed I/O. One of these, clock pair 11 and 12, is fixed as an output and is used internally to provide step clock and direction pulses to Step Clock and Direction outputs located on Connector P1 of the LYNX Controller. The step clock output increments CTR1 (Counter 1). CTR1 may be read from or written to by software instructions in either program or immediate mode. The following table explains the clocks, as well as their default I/O line pair placement.

Clock Types Defined

There are three basic types of clocks that may be configured for the LYNX, they are:

1] Quadrature
2] Step/Direction
3] Up/Down

These clock functions are illustrated in figure 6.4.

Quadrature

The quadrature clock function is the most commonly used input clock function. This is the default setting for each high speed I/O channel except 11 & 12. This clock function will typically be used for closed loop control (encoder feedback) or for following applications

Step / Direction

The step/direction clock funtion would typically be used in an application where a secondary or tertiary clock output is required to sequentially control an additional axis.

Up / Down

The up/down clock type would typically be used as an output function where a secondary axis is being driven by a stepper or servo drive with dual-clock direction control circuitry.

The Four Clocks				
Clock #	**I/O Line Pair**	**Slot Position**	**Counter**	**Function**
1	11 & 12	None	CTR1	This clock is internally generated motion clock. It provides step clock and directional control to the driver section. This clock is not available on any external connector.
2	13 & 14	Slot 2	CTR2	May be configured as an input or output. By default this is configured as a quadrature input. It can be configured as a secondary clock output electronically geared to CLK1.
3	15 & 16	Slot 3	CTR3	May be configured as an input or output. By default this is configured as a quadrature input. It can be configured as a tertiary clock output electronically geared to CLK1.
4	17	Slot 2	None	May be configured as a high speed input or an output. As an output it is a 1MHz reference clock.
	18	Slot 3	None	May be configured as a high seed input or output. As an output it is a 10MHz reference clock.

Table 6.5: The Four Clocks and Their Default Line Placement

Configuring The Differential I/O - The IOS Variable

The high speed differential I/O is configured by means of the IOS variable, and is used in the the same fashion in which the isolated I/O is configured. The main difference lies in that there are three additional parameters which need to be set in configuring the triggering, clock type, and ratio mode setting.

It is important to note that the high speed differential I/O lines may be used for the same input or output functions as the isolated digital I/O where the higher speed capabilities of the differential I/O is required. However, for purposes of this example we will only illustrate the clock functions associated with the high speed differential I/O. Figure 6.5 following illustrates the IOS variable settings for the high speed differential I/O.

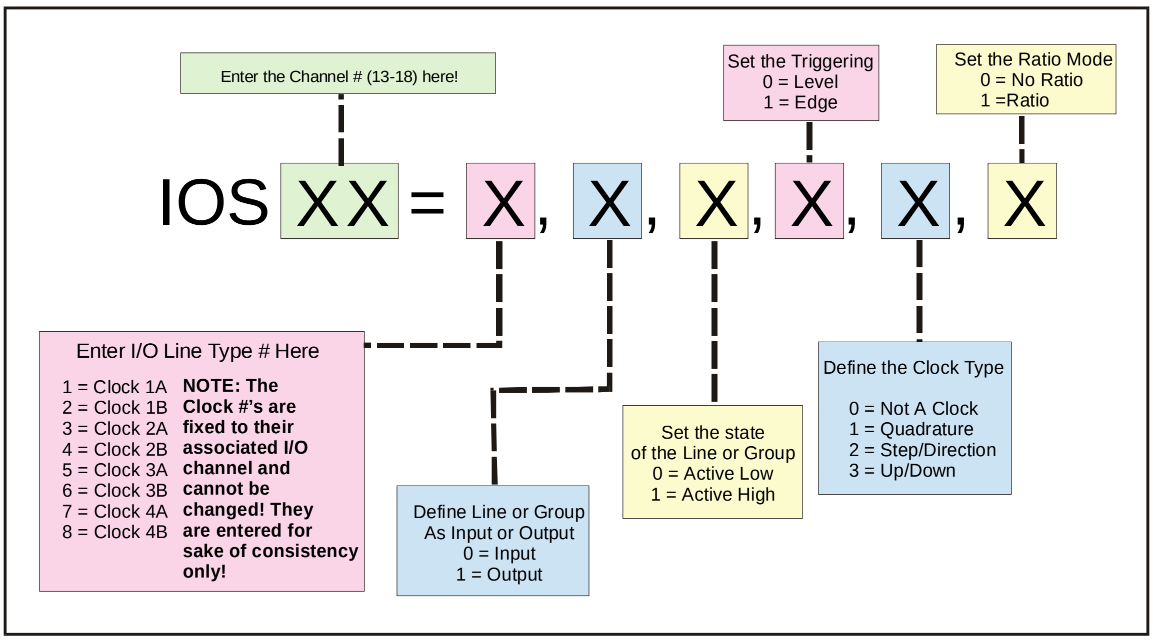

Figure 6.5: IOS Variable Settings for the High Speed Differential I/O

Configuring an Input

Clocks 2, 3 and 4 can be configured as high speed inputs, or as a general purpose input in the same fashion as the Isolated I/O. In configuring the Differential I/O line as a general purpose input you would typically use the "+" line of the line pair. You cannot use both lines as separate I/O lines. The figure below shows the Input Equivalent Circuit with the I/O line pair connected to channel A of a differential encoder. This feature

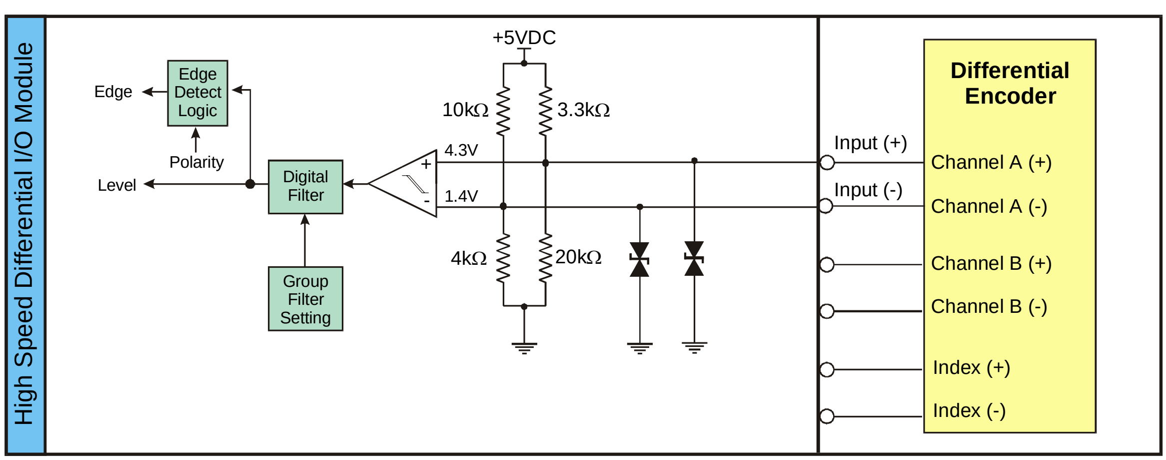

Figure 6.6: Differential I/O Input Equivalent Circuit

is demonstrated in *Typical Functions of the Differential I/O: Connecting and Using an Encoder.* Clocks 2, 3 and 4 are set up as Quadrature inputs by default. The defaults for each I/O Line Pair are:

IOS 13 = 3, 0, 1, 0, 1, 0
IOS 14 = 4, 0, 1, 0, 1, 0
IOS 15 = 5, 0, 1, 0, 1, 0
IOS 16 = 6, 0, 1, 0, 1, 0
IOS 17 = 7, 0, 1, 0, 1, 0
IOS 18 = 8, 0, 1, 0, 1, 0

Setting the Digital Input Filtering for the Differential I/O

User definable Digital filtering makes the LYNX well suited for noisy industrial environments. The filter setting is software selectable using the *IOF Variable* with a minimum guaranteed detectable pulse width of 18 microseconds to 2.3 milliseconds. The table (right) illustrates the IOF settings.

IOF Filter Settings for the High Speed Differential I/O IOF=<num> (<num> = 0-7)		
Filter Setting	Cutoff Frequency	Minimum Detectable Pulse Width
0 (default)	5.00 MHz	100 nanoseconds
1	2.50 MHz	200 nanoseconds
2	1.25 MHz	400 nanoseconds
3	625 kHz	800 nanoseconds
4	313 kHz	1.6 microseconds
5	156 kHz	3.2 microseconds
6	78.1 kHz	6.4 microseconds
7	39.1 kHz	12.8 microseconds

Table 6.6: Digital Filter Settings for the Differential I/O

Configuring an Output

The Differential I/O Group 10 has 3 Channels (Line Pairs 13 & 14, 15 & 16, and 17 & 18) that can be configured as an output by the user and One Channel (Line Pairs 11 & 12) that is configured as output only. (SCK and DIR on the Control Module.) These outputs can be configured as high speed outputs or 0 to 5VDC general purpose outputs by using the IOS variable. The high speed clock outputs have the following restrictions:

Line Pairs 11/12, 13/14 and 15/16 can be configured to Step Clock/Direction or Up/Down.

Line Pair 17/18 is limited to 1MHz Reference Out (17) and 10MHz Reference Out (18).

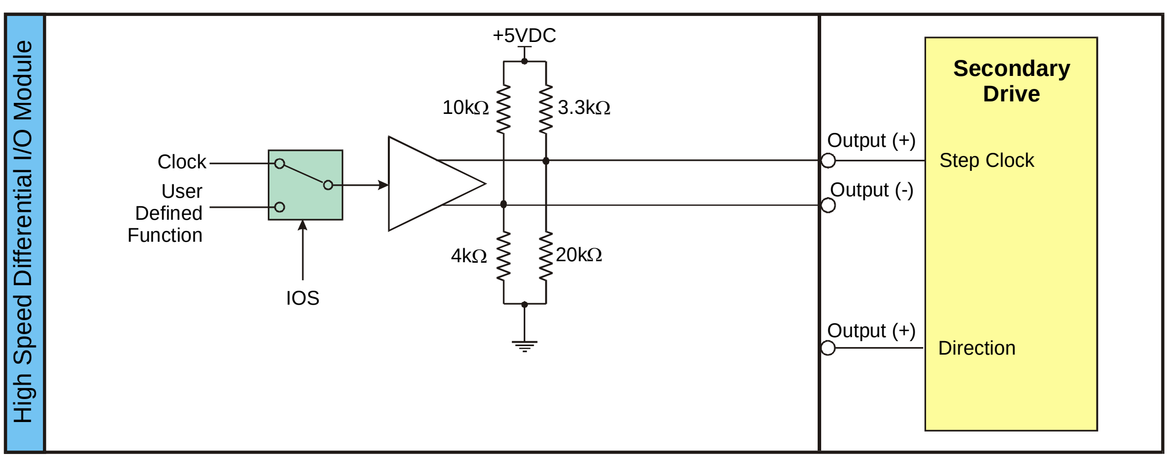

Figure 6.7: Differential I/O Output Equivalent Circuit

In the Equivalent Circuit in Figure 6.7 an Output is being used as Step or Direction on a driver.

For the configuration example, use I/O line 13 for the output. Since by default the line is a quadrature input we must configure it to be a Step/Direction Output by setting the IOS Variable to the following:
IOS 13 = 3, 1, 0, 1, 2, 0
This breaks down as:

IOS 13 - Identifies the line being configured as 13.
3 - Sets the I/O Type to Clock 2A (default).
1 - Sets it as an output.
0 - Sets Logic at Low True.
1 - Edge Triggered.
2 - Sets the Clock Type to Step/Direction.
0 - No Ratio.

Typical Functions of the Differential I/O

Connecting and Using an Encoder

The differential I/O module can be set up to receive encoder feedback using either a differential or a single ended output encoder. A differential output encoder would typically be connected to differential input pairs 13 and 14 (P1, pins 1 – 4) as the default setting for I/O 13 and 14 is set up to accept a quadrature encoder input. Channel A of the encoder would be connected to input pair 13 (P1, pins 1 & 2) and channel B would be connected to input pair 14 (P1, pins 3 & 4). A single ended output encoder would be connected to the positive inputs of the input pair. Whether you use a differential encoder or single ended encoder the same software commands and settings will be used.

In setting up your system to run with an encoder you will be using the following variables, flags, and instructions. The variables used with an encoder will be *MUNIT*, *EUNIT*, *CTR2*, and *POS.* The Encoder Enable Flag *EE*, and the instruction *MOVR* will be used. The block diagram to the left illustrates a LYNX system with the encoder and drive connections that will be used in this example.

The sequence of commands (in bold) used to make this setup function would be as follows:

‘Set the MUNIT Variable to 51,200 steps/rev
MUNIT = 51200
‘Set encoder enable to TRUE (1), default value = FALSE (0)
EE = 1
‘Set the EUNIT (Encoder Units) variable to 800 (200 [Encoder Resolution] X 4 [Quadrature Input])
This means that 1 unit of motion, or 1 POS, is equal to 800 encoder counts. In this instance it will be 1 rotation of the motor.
EUNIT = 800
‘Save the above flag and variable settings
SAVE

Now you may begin to use the motion command MOVR, as well as PRINT POS and PRINT CTR2 to see the number of encoder counts fed back to the system.

‘Set the motor position to 0
POS = 0
‘Move the motor 2 units (2 X EUNIT) relative to current position.
MOVR 2
‘Print the value of CTR2. This value will indicate the number of encoder counts that the motor has moved. Your terminal should echo back the number “1600”.

```
PRINT CTR2
'Print the position of the motor.  Your terminal should echo "2.000"
PRINT POS
```

By printing the variable CTR2 (CTR2 = EUNIT X POS) we can view the distance the motor has traveled in raw encoder counts, or by printing POS you can see the distance of travel represented by number of units relative to 0.

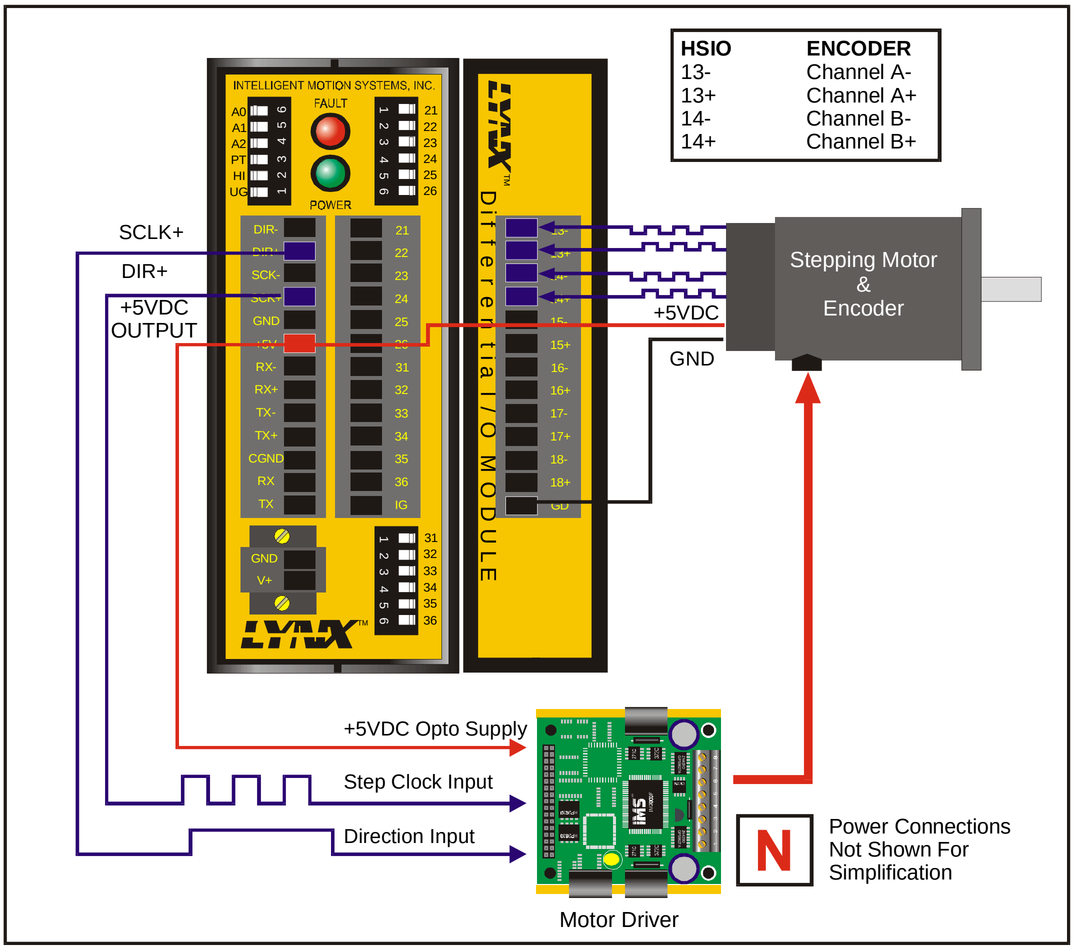

Figure 6.8: Connecting and Using an Encoder

Translating the EUNIT Variable to a Dimension of Distance

The EUNIT, or *Encoder Unit* variable, is the scaling factor used to translate Encoder steps to a dimension of distance, or *user units*. At this point you should already be familiar with the MUNIT variable. The main difference between the two is as follows: By using MUNIT scaling factor you monitor the position of an axis based upon the value of CTR1, the register that contains the actual count of clock pulses sent to the drive. The number of pulses is then scaled to user units by setting the MUNIT Variable to the appropriate scaling factor for the type of units being used, be they inches, millimeters, degrees, etc. Then the POS variable tracks position in the user units specified. Example:

User Unit (POS) = CTR1 ÷ MUNIT   where EE (Encoder Enable) Flag = FALSE (0)

By setting the state of EE, the master encoder function enable flag, to a true state you will monitor the position of an axis based upon the actual position of the motor shaft as it is fed back to the Control Module by a motor mounted encoder. The actual count of encoder pulses received by the Control Module is maintained by the register CTR2, (if the encoder is connected to I/O line pair 13 &14) with the EUNIT variable scaling it to user units. Example:

User Unit (POS) = CTR2 ÷ EUNIT   where EE (Encoder Enable) Flag = TRUE(1)

When using the EUNIT scaling factor it is important to understand that you MUST set the EUNIT variable AND the MUNIT variable to the same scaling factor for accurate position monitoring. In the example below you will use a hypothetical system designed from the following components:

An IMS IB462H Half/Full Step driver configured for Half Step Operation.
A 1.8° Stepping Motor mounted to a 20cm linear slide.
A 200 Line Encoder.

You will want to use millimeters for our user unit. The IB462H in half step mode will need 400 clock pulses to turn the motor one revolution. The pitch on the leadscrew is such that one millimeter of linear motion will require 25 clock pulses. 400 steps/rev ÷ 25 steps/mm = 16 mm/rev. Therefore, you would set the MUNIT variable as follows:

MUNIT = 400/16

Now, when you give a MOVR 20 instruction, the axis will index 20 millimeters. Now to set the EUNIT Variable. We have a 200 line encoder connected to a quadrature clock input. This will mean that 1 revolution will equal 800 Encoder Pulses, you will have to use the same scaling factor as we did for MUNIT as there will still be 16mm per revolution:

EUNIT = 800/16

Both values must be set, and both must be set to the same scaling factor. With the EE = 1 a MOVR 20 command will still index the axis 20 millimeters, but position will be maintained by CTR2.

Half Axis Operation (Follower)

In half axis mode the master clock is taken from a clock input 2, 3 or 4 (line pairs 13-14, 15-16 or 17-18) which have been set for input, clock type and ratio enabled. This is the factor at which the count rate out to the primary drive will follow the external clock in half axis mode. This clock input would typically be connected to differential input pairs 15 and 16 (P1, pins 5 – 8). This could be set up as any of the available clock types. If half axis mode is enabled (HAE), the primary axis of the control will follow the clock input with the ratio specified by the *HAS variable.*

In order to use the HAS (Half axis mode scaling) variable the *HAE flag* must be set to true (1). For example, to set the half axis scale factor to .5, where the drive will follow the external Clock input with a ratio of 1 count to the drive for every two counts from the external clock, you would use the command: SET HAS = .5 (or HAS = .5). Figure 6.9 illustrates the connections for using this mode of operation using a clock input from an encoder.

The sequence of commands used to make this setup function would be as follows:

```
‘Set IOS 15 to ratio mode
IOS 15 = 5,0,1,0,1,1
‘Set IOS 16 to ratio mode
IOS 16 = 6,0,1,0,1,1
‘Half axis enable set to true
HAE = 1
‘Half axis scaling to .5 (1 output clock pulse to every 2 input clock pulses)
HAS = .5
```

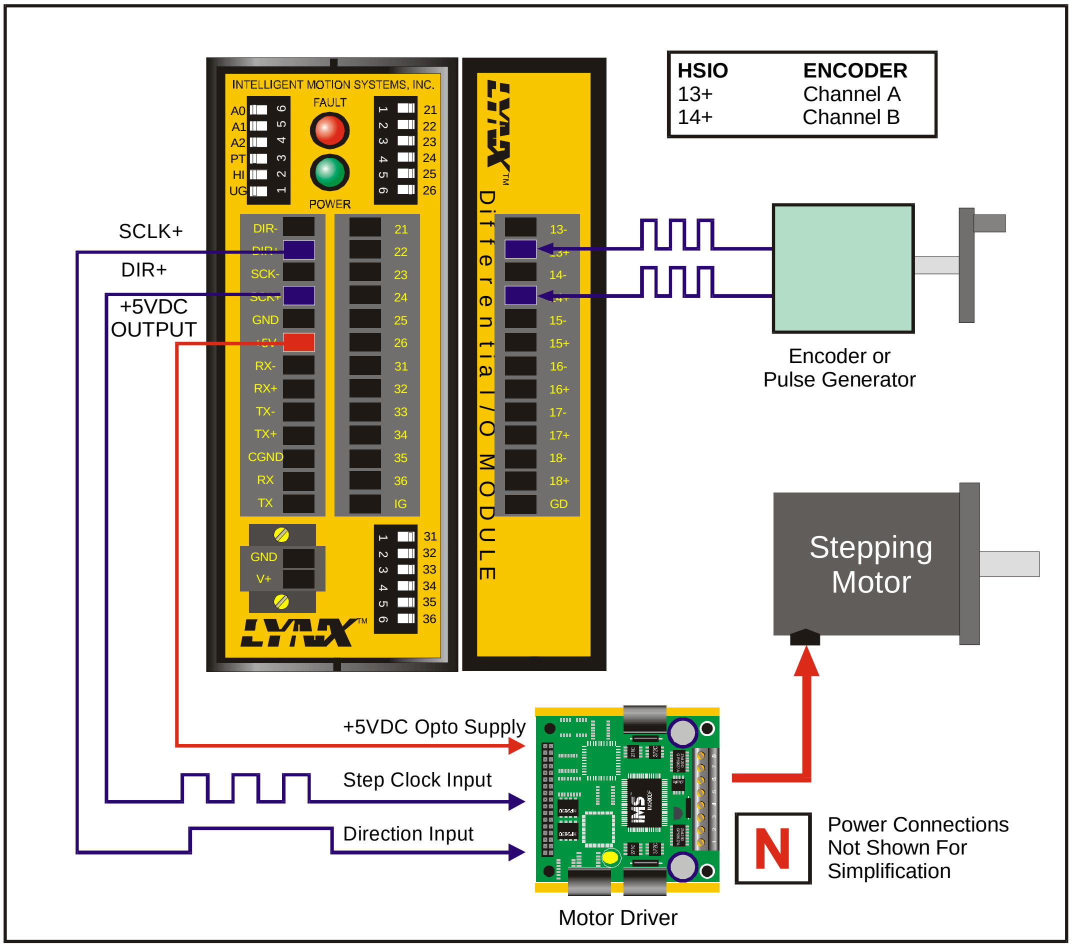

Figure 6.9 Half Axis Mode (Following)

NOTE: The HAS variable must be set to less than 1 or Error Code 9004, "Ratio Out of Range" will occur.

One and a Half Axis Operation (RATIOE)

A secondary drive can be connected to a pair of differential outputs. The secondary driver will operate off of the differential output pair 15 and 16 (I/O pair 13 and 14 can also operate in this mode). Setting the ratio mode to TRUE (1) for the differential output clock (IOS) specifies a secondary drive function. Then when ratio mode is enabled (RATIOE); the secondary axis will follow the primary axis with the ratio specified by the RATIO variable.

The sequence of commands used to make this setup function would be as follows:

```
'Set IOS 15 to step/direction clock          type, and ratio mode
IOS 15 = 5,0,1,0,2,1
'Set IOS 16 to step/direction clock          type, and ratio mode
IOS 16 = 6,0,1,0,2,1
'Set Ratio Mode Enable Flag to               TRUE (1)
```

```
RATIOE = 1
'Set RATIO variable to .5 for the                    secondary drive
RATIO = .5
```

With this setup, the motor on the secondary drive will move half the distance of the primary.

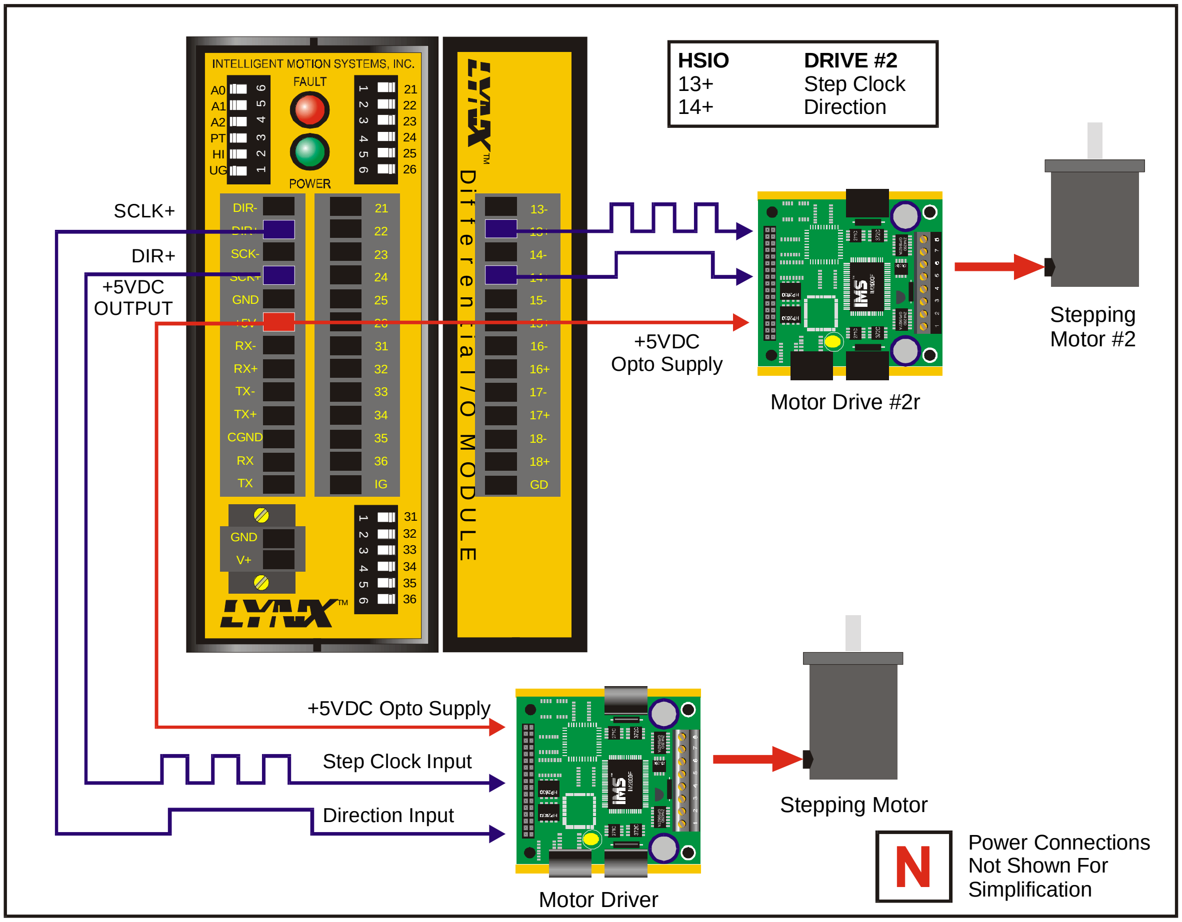

Figure 6.10: One and a Half Axis Operation

NOTE: The RATIO variable must be set to less than 2 or -2 or Error Code 9004, "Ratio Out of Range" will occur.

Section 7

The LYNX Control Module (LX-CM100-000)

Section Overview

This section will cover:

- Hardware Specifications
  - Environmental Specifications
  - Mechanical Specifications
  - Power Requirements
- Connection Overview
- LED Indicators
- Pin Assignments
- Switch Assignments

Hardware Specifications

Environmental Specifications

Ambient Operating Temperature .... 0 to +50 degrees C
Storage Temperature .... -20 to +70 degrees C
Humidity .... 0 to 90% non-condensing

Mechanical Specification

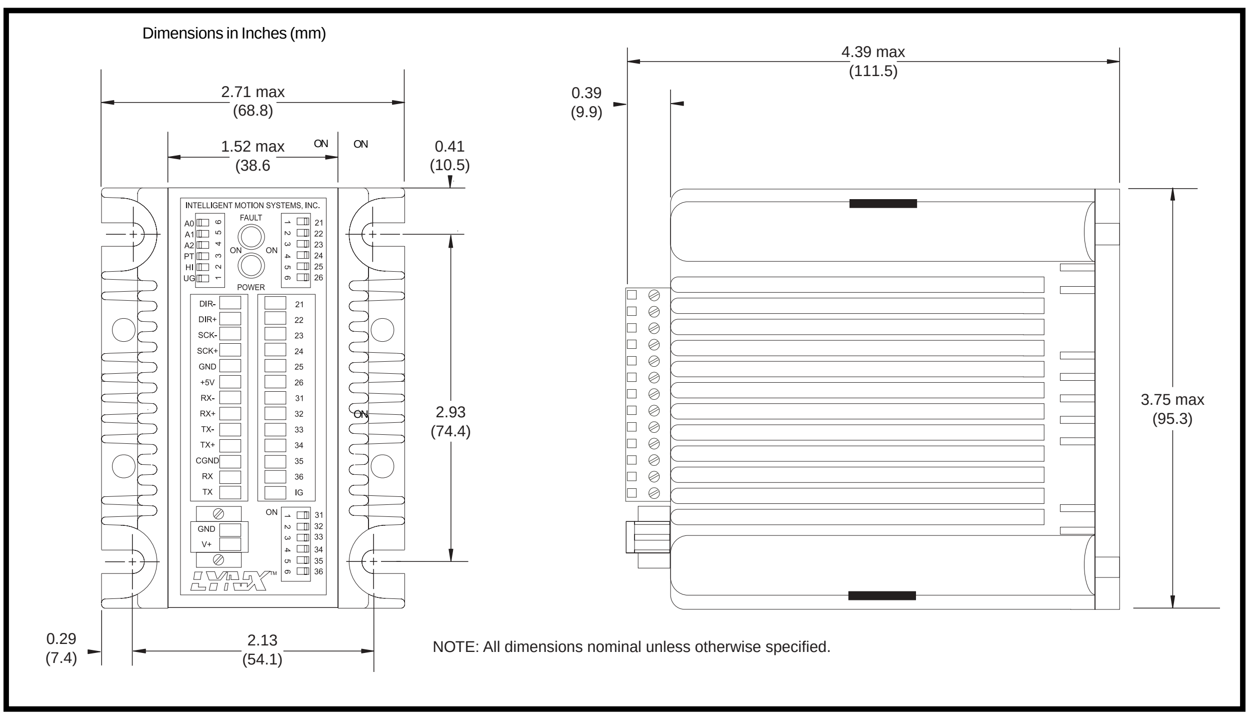

Figure 7.1: LYNX Control Module Dimensions

Power Requirements

Power Requirements and Specifications	
Input Voltage	+12 to +75 VDC Unregulated or +5VDC ±5%
Input Current	250mA (5VDC input) 165mA (+12VDC Input)* 95.0mA (+48 VDC Input)* 84.5mA (+75VDC Input)* *I/O and +5VDC output unloaded (Control Module Only)
Output Voltage	+5VDC ±5%
Output Current	150mA (Internally Limited

Table 7.1: Power Requirements for the LYNX Control Module

Connection Overview

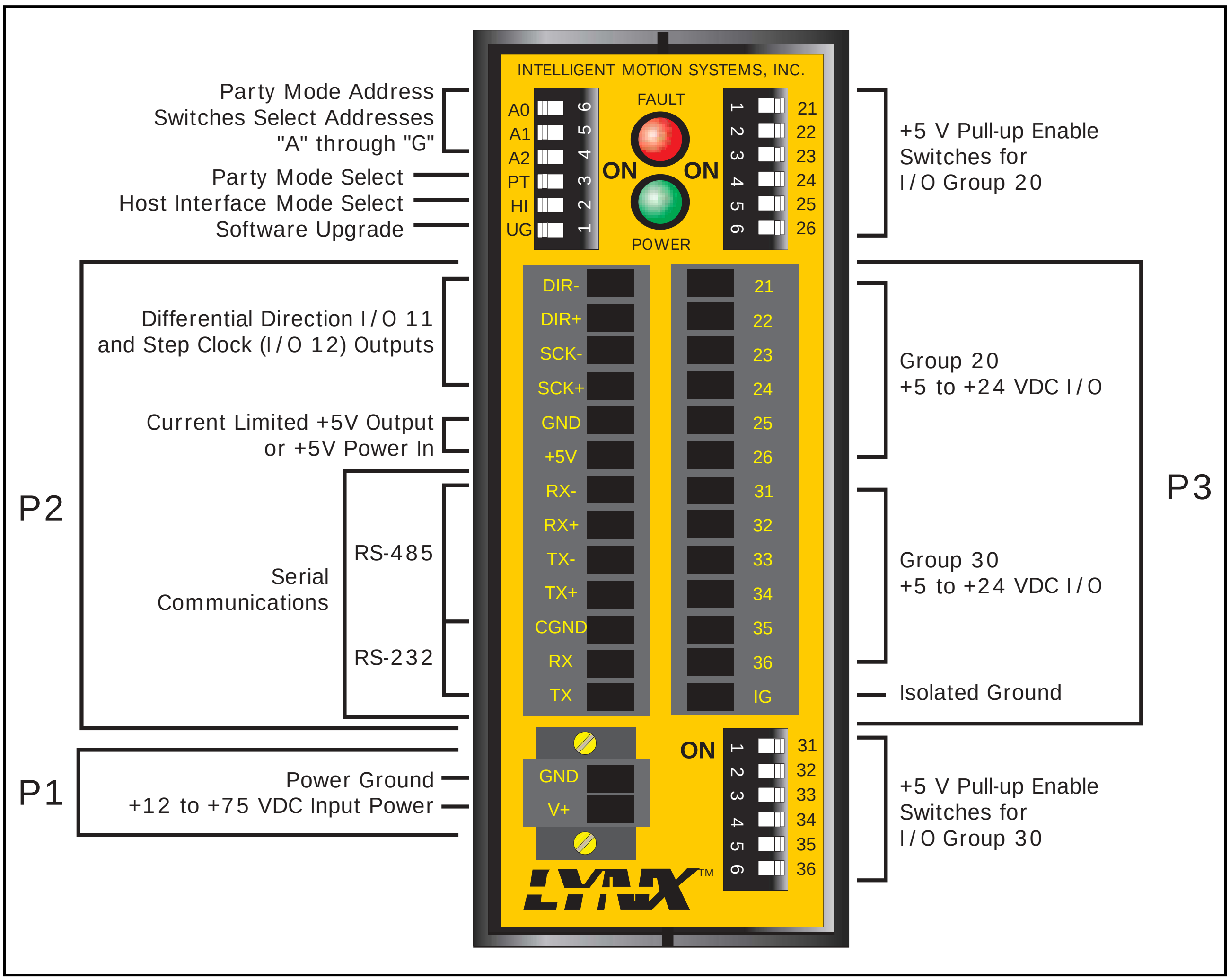

Figure 7.2: LYNX Control Module, Switches and Connections

LED Indicators

LED Color	Meaning
Green	Power On
Red	System or software fault detected. The user can choose to enable or disable the indicator by setting the FAULT flag. FAULT=TRUE (1) will cause the LED to illuminated whenever an ERROR occurs.

Table 7.2: LYNX Control Module LED Indicators

Pin Assignment and Description

P1 - Two Position Screw Lock Terminal: Input Power Connection		
Pin #	Function	Description
1	Power Ground	Power ground for the unregulated power supply.
2	Unregulated Power Supply Input (V+)	12 – 75 VDC unregulated power input if an external power supply is to be used.

Table 7.3: LYNX Control Module Connector P1 Pin Configuration

P2 - 13 Position Removeable Terminal Connector: Motion Signals, Regulated Power and Communications		
Pin #	Function	Description
1	Direction - (I/O 11)	Pins 1 and 2 are the differentially buffered signal for group 1, #1 or I/O 11. The default for this signal is the direction output for the primary motor drive of the controller. If desired, this signal may be programmed as a quadrature or up/down clock type or a user output. This I/O may not be programmed as an input.
2	Direction + (I/O 11)	See description above.
3	Step Clock - (I/O 12)	Pins 3 and 4 are the differentially buffered signal for group 1, #2 or I/O 12. The default for this signal is the step clock output for the primary motor drive of the controller. If desired, this signal may be programmed as a quadrature or up/down clock type or a user output. This I/O may not be programmed as an input.
4	Step Clock + (I/O 12)	See description above.
5	Ground (GND)	Common to the power ground on pin 1 of connector P1. This is provided as a signal return for the motion control signals and the power return for the 5VDC in/out on pin 6.
6	+5VDC	This can be 5 volts in or out. When the control module is powered via connector P1, this terminal provides up to 150 ma of regulated 5VDC for user circuits such as encoders. If desired, however, this terminal may be used as a power input connection. It should be noted that a fully configured LYNX system may require up to 800 ma current from this 5 VDC supply.
7	RS-485 RX- Input	Pins 7 and 8 are the differential receive inputs for the RS-485 communications interface. They should be left disconnected if they are not used. For specific connection information, see Section 5: The Communications Interface.
8	RS-485 RX+ Input	See description above.
9	RS-485 TX- Output	Pins 9 and 10 are the differential transmit outputs for the RS-485 communications interface. They should be left disconnected if they are not used. For specific connection information, see Section 5: The Communications Interface.
10	RS-485 TX+ Output	See description above.
11	Communications Ground (CGND)	Isolated communications ground signal for both RS-485 and RS-232. For specific connection information, see Section 7: The Communications Interface.
12	RS-232 RX Input	Receive input from the host computer. For specific connection information, see Section 5: The Communications Interface.
13	RS-232 TX Output	Transmit output to the host computer. For specific connection information, see Section 5: The Communications Interface.

Table 7.4: LYNX Control Module Connector P2 Pin Configuration

P3 - 13 Position Removeable Terminal Connector: Isolated Digital I/O		
Pin #	**Function**	**Description**
1 - 8	I/O Group 20 Lines 21 - 26	Signals are individually programmable as inputs or outputs (see description of the IOS command in the Part 3: Software Reference of this manual). Inputs are CMOS logic level compatible and can accept inputs to 28 volts. Noise rejection is available via digital filtering. Outputs are open drain. I/Os each have individually switchable 7.5 Kohm pull up resistors to 5VDC. Outputs can switch inductive, resistive or incandescent loads. Refer to Section 6: Configuring the Digital I/O for usage and specifications.
7 - 12	I/O Group 30 Lines 31 - 36	See description above.
13	Isolated I/O Ground	Isolated common signal return for groups 20 and 30 I/O. Isolated from the power and communication grounds.

Table 7.5: LYNX Control Module Connector P3 Pin Configuration

Switch Assignments

Configuration Switches: Read at Power-On or System Reset. Mat be Overidden by Software Settings		
Switch #	**Function**	**Description**
1	Firmware Upgrade	When this switch is on, the controller firmware may be upgraded using the IMS upgrade program.
2	Host Interface	When this switch is on, the controller will act as the Host Interface Controller for communications in a multiple controller system. When it is off, the controller is a slave in the system and will not act as the host interface. For more information, see Section 5: The Communications Interface. This switch may be overridden in software by the HOST flag.
3	Party Mode	When this switch is on, party mode communications is selected. When it is off, single mode communications is selected. For more information, see Section 5: The Communications Interface.
4	Party Mode Address Bit 0 - A0	Sets party mode communications node address. See also DN instruction in the Software Reference A2 A1 A0 Address OFF OFF OFF None OFF OFF ON "A" OFF ON OFF "B" OFF ON ON "C" ON OFF OFF "D" ON OFF ON "E" ON ON OFF "F" ON ON ON "G"
5	Party Mode Address Bit 1 - A1	
6	Party Mode Address Bit 2 - A2	

Table 7.6: LYNX Control Module Configuration Switches

Group 20 I/O Pull-Up Switches: Can Be Changed at any Time, Usable for Exercising Inputs		
Switch #	**Function**	**Description**
1 - 6	Individual Switches for I/O Group 20 Pull-Ups.	When this switch is on, the I/O is pulled up through an internal 7.5 Kohm resistor to 5VDC. Can be used to simulate the activation of an input while testing system software..

Table 7.7: LYNX Control Module Group 20 I/O Pull-up Switches

Group 30 I/O Pull-Up Switches: Can Be Changed at any Time, Usable for Exercising Inputs		
Switch #	**Function**	**Description**
1 - 6	Individual Switches for I/O Group 30 Pull-Ups.	When this switch is on, the I/O is pulled up through an internal 7.5 Kohm resistor to 5VDC. Can be used to simulate the activation of an input while testing system software..

Table 7.8: LYNX Control Module Group 30 I/O Pull-up Switches

Section 8

The LYNX Control Module (Combination)

Section Overview

The Control Module (Combination) (IMS Part # LX-CM200-000) offers the user of purchasing a LYNX Control Module with 3 differential I/O Channels and 6 Isolated I/O lines instead of the standard 2 Isolated I/O groups. This section will cover:

- Hardware Specifications
  - Environmental Specifications
  - Mechanical Specifications
  - Power Requirements
- Connection Overview
- LED Indicators
- Pin Assignments
- Switch Assignments

Hardware Specifications

Environmental Specifications

Ambient Operating Temperature .... 0 to +50 degrees C
Storage Temperature .... -20 to +70 degrees C
Humidity .... 0 to 90% non-condensing

Mechanical Specification

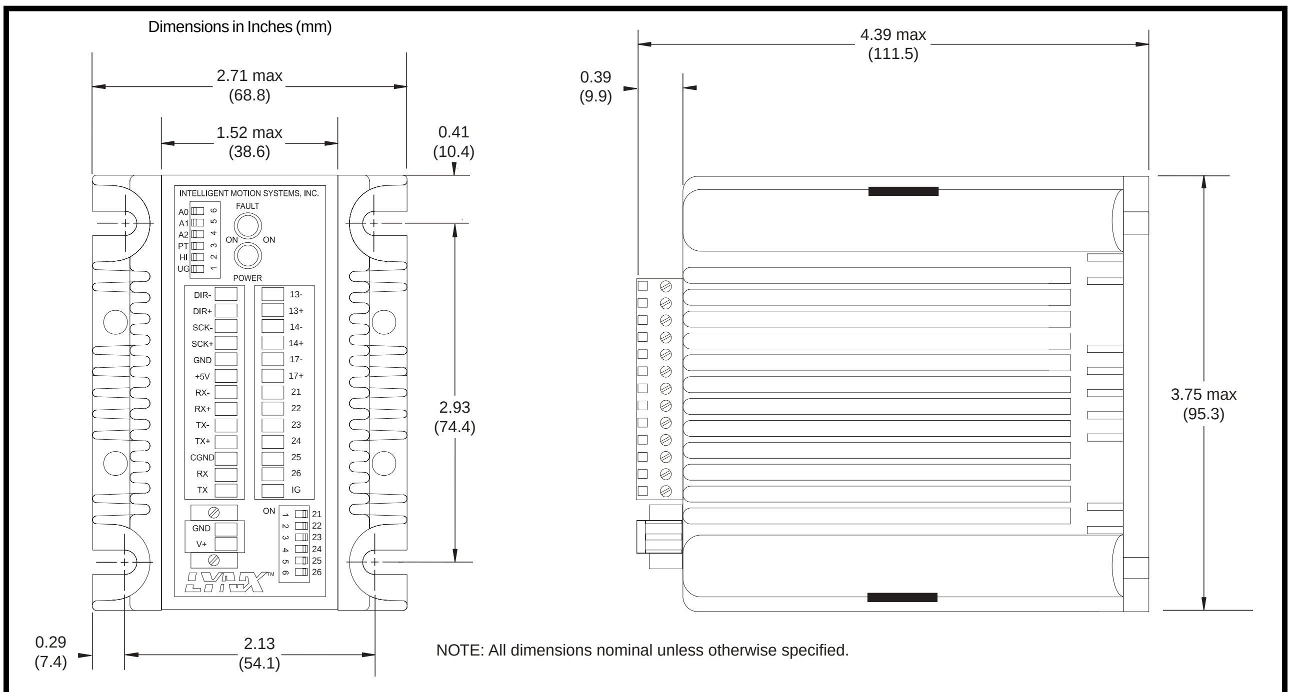

Figure 8.1: LYNX Control Module (Combination) Dimensions

Power Requirements

Power Requirements and Specifications	
Input Voltage	+12 to +75 VDC Unregulated or +5VDC ±5%
Input Current	250mA (5VDC input) 165mA (+12VDC Input)* 95.0mA (+48 VDC Input)* 84.5mA (+75VDC Input)* *I/O and +5VDC output unloaded (Control Module Only)
Output Voltage	+5VDC ±5%
Output Current	150mA (Internally Limited

Table 8.1: Power Requirements for the LYNX Control Module (Combination)

Connection Overview

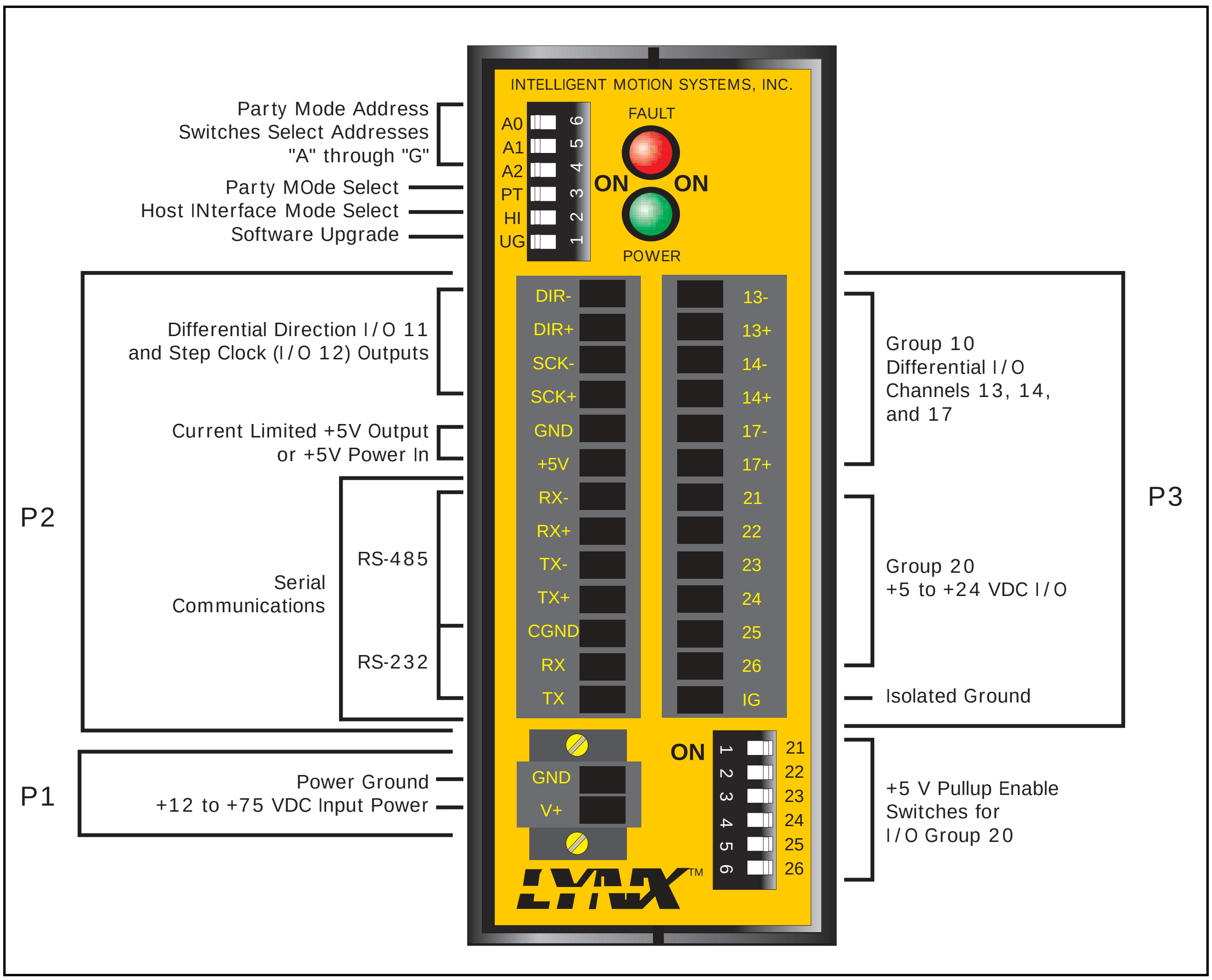

Figure 8.2: LYNX Control Module (Combination) Connections and Switches

LED Indicators

LED Color	Meaning
Green	Power On
Red	System or software fault detected. The user can choose to enable or disable the indicator by setting the FAULT flag. FAULT=TRUE (1) will cause the LED to illuminated whenever an ERROR occurs.

Table 8.2: LYNX Control Module LED Indicators

Pin Assignment and Description

P1 - Two Position Screw Lock Terminal: Input Power Connection		
Pin #	Function	Description
1	Power Ground	Power ground for the unregulated power supply.
2	Unregulated Power Supply Input (V+)	12 – 75 VDC unregulated power input if an external power supply is to be used.

Table 8.3: LYNX Combination Control Module Connector P1 Pin Configuration

P2 - 13 Position Removeable Terminal Connector: Motion Signals, Regulated Power and Communications		
Pin #	Function	Description
1	Direction - (I/O 11)	Pins 1 and 2 are the differentially buffered signal for group 1, #1 or I/O 11. The default for this signal is the direction output for the primary motor drive of the controller. If desired, this signal may be programmed as a quadrature or up/down clock type or a user output. This I/O may not be programmed as an input.
2	Direction + (I/O 11)	See description above.
3	Step Clock - (I/O 12)	Pins 3 and 4 are the differentially buffered signal for group 1, #2 or I/O 12. The default for this signal is the step clock output for the primary motor drive of the controller. If desired, this signal may be programmed as a quadrature or up/down clock type or a user output. This I/O may not be programmed as an input.
4	Step Clock + (I/O 12)	See description above.
5	Ground (GND)	Common to the power ground on pin 1 of connector P1. This is provided as a signal return for the motion control signals and the power return for the 5VDC in/out on pin 6.
6	+5VDC	This can be 5 volts in or out. When the control module is powered via connector P1, this terminal provides up to 150 ma of regulated 5VDC for user circuits such as encoders. If desired, however, this terminal may be used as a power input connection. It should be noted that a fully configured LYNX system may require up to 800 ma current from this 5 VDC supply.
7	RS-485 RX- Input	Pins 7 and 8 are the differential receive inputs for the RS-485 communications interface. They should be left disconnected if they are not used. For specific connection information, see Section 5: The Communications Interface.
8	RS-485 RX+ Input	See description above.
9	RS-485 TX- Output	Pins 9 and 10 are the differential transmit outputs for the RS-485 communications interface. They should be left disconnected if they are not used. For specific connection information, see Section 5: The Communications Interface.
10	RS-485 TX+ Output	See description above.
11	Communications Ground (CGND)	Isolated communications ground signal for both RS-485 and RS-232. For specific connection information, see Section 7: The Communications Interface.
12	RS-232 RX Input	Receive input from the host computer. For specific connection information, see Section 5: The Communications Interface.
13	RS-232 TX Output	Transmit output to the host computer. For specific connection information, see Section 5: The Communications Interface.

Table 8.4: LYNX Combination Control Module Connector P2 Pin Configuration

P3 - 13 Position Removeable Terminal Connector: Combination I/O		
Pin #	**Function**	**Description**
1	I/O 13-	Pins 1 and 2 are the differentially buffered signal for group 10, I/O 13.This channel is configured by means of the IOS Instruction. For usage details see Section 6: Configuring the Digital I/O.
2	I/O 13+	See description above.
3	I/O 14-	Pins 3 and 4 are the differentially buffered signal for group 10, I/O 14.This channel is configured by means of the IOS Instruction. For usage details see Section 6: Configuring the Digital I/O.
4	I/O 14+	See description above.
5	I/O 17-	Pins 5 and 6 are the differentially buffered signal for group 10, I/O 17 .This channel is configured by means of the IOS Instruction. For usage details see Section 6: Configuring the Digital I/O.
6	I/O 17+	See description above.
7 - 12	I/O Group 20 Lines 21 - 26	Signals are individually programmable as inputs or outputs (see description of IOS command in Part 3: The Software Reference of this manual). Inputs are CMOS logic level compatible and can accept inputs to 24 volts. Noise rejection is available via digital filtering. Outputs are open drain. I/Os each have individually switchable 7.5 Kohm pull up resistors to 5VDC. Outputs can switch inductive, resistive or incandescent loads. Refer to Section 6: Configuring the Digital I/O for more information.
13	Isolated Ground For Group 20 I/O	solated common signal return for group 20 I/O. Isolated from the power and communication grounds.

Table 8.5: LYNX Combination Control Module Connector P3 Pin Configuration

Switch Assignments

<table>
<tr><th colspan="3">Configuration Switches: Read at Power-On or System Reset. Mat be Overidden by Software Settings</th></tr>
<tr><th>Switch #</th><th>Function</th><th>Description</th></tr>
<tr><td>1</td><td>Firmware Upgrade</td><td>When this switch is on, the controller firmware may be upgraded using the IMS upgrade program.</td></tr>
<tr><td>2</td><td>Host Interface</td><td>When this switch is on, the controller will act as the Host Interface Controller for communications in a multiple controller system. When it is off, the controller is a slave in the system and will not act as the host interface. For more information, see Section 5: The Communications Interface. This switch may be overridden in software by the HOST flag.</td></tr>
<tr><td>3</td><td>Party Mode</td><td>When this switch is on, party mode communications is selected. When it is off, single mode communications is selected. For more information, see Section 5: The Communications Interface.</td></tr>
<tr><td>4</td><td>Party Mode Address Bit 0 - A0</td><td rowspan="3">Sets party mode communications node address. See also DN instruction in the Software Reference

A2 A1 A0 Address
OFF OFF OFF None
OFF OFF ON "A"
OFF ON OFF "B"
OFF ON ON "C"
ON OFF OFF "D"
ON OFF ON "E"
ON ON OFF "F"
ON ON ON "G"</td></tr>
<tr><td>5</td><td>Party Mode Address Bit 1 - A1</td></tr>
<tr><td>6</td><td>Party Mode Address Bit 2 - A2</td></tr>
</table>

Table 8.6: LYNX Combination Control Module Configuration Switches

Group 20 I/O Pull-Up Switches: Can Be Changed at any Time, Usable for Exercising Inputs		
Switch #	**Function**	**Description**
1 - 6	Individual Switches for I/O Group 20 Pull-Ups.	When this switch is on, the I/O is pulled up through an internal 7.5 Kohm resistor to 5VDC. Can be used to simulate the activation of an input while testing system software..

Table 8.7: LYNX Combination Control Module Group 20 I/O Pull-up Switches

Section 9

The Isolated Digital I/O Module

Section Overview

The Isolated I/O Module (IMS Part # LX-DI100-000) offers the user an additional 12 Isolated +5 to 24VDC General Purpose I/O lines in two groups of six each (Groups 40 and 50) for a total of 24 individually programmable I/O when used with the LYNX CM100 Control Module or 18 when used with the CM200 Combination Control Module.

- Hardware Specifications
  - Environmental Specifications
  - Mechanical Specifications
- Pin Assignments
- Switch Assignments
- Input Specifications
- Input Filtering
- Output Specifications

Hardware Specifications

Environmental Specifications

Ambient Operating Temperature .... 0 to +50 degrees C
Storage Temperature .... -20 to +70 degrees C
Humidity .... 0 to 90% non-condensing

Mechanical Specification

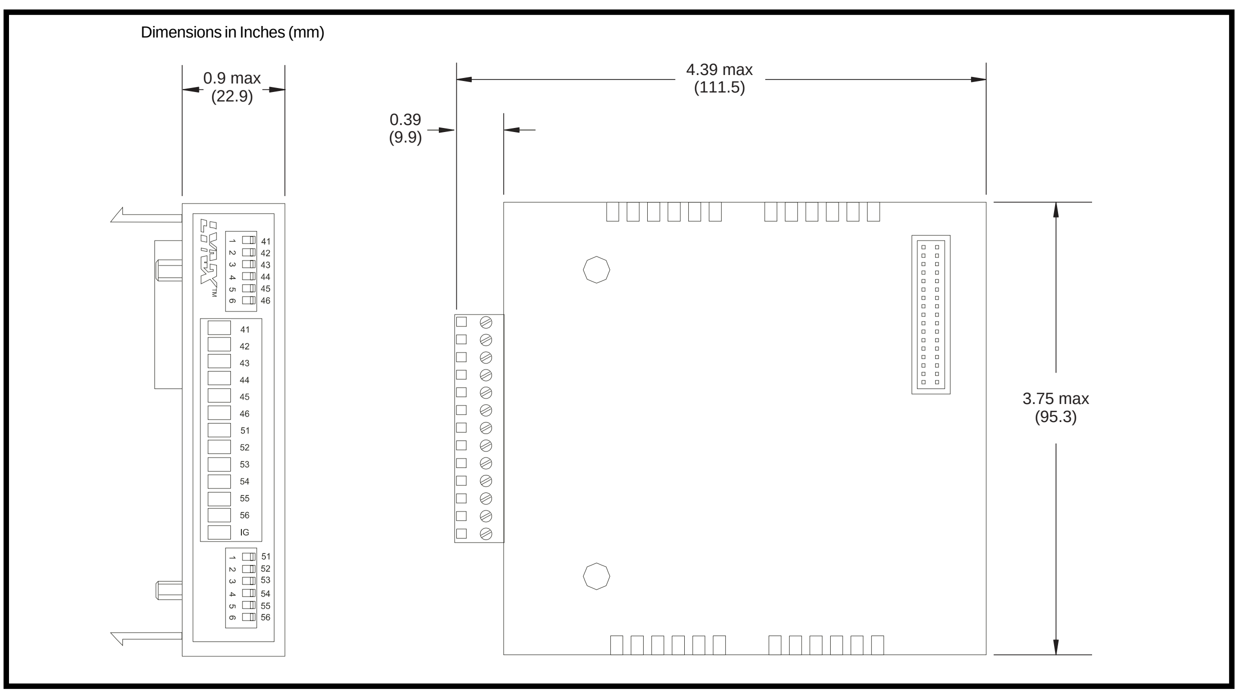

Figure 9.1: LYNX Isolated I/O Module Dimensions

Connection Overview

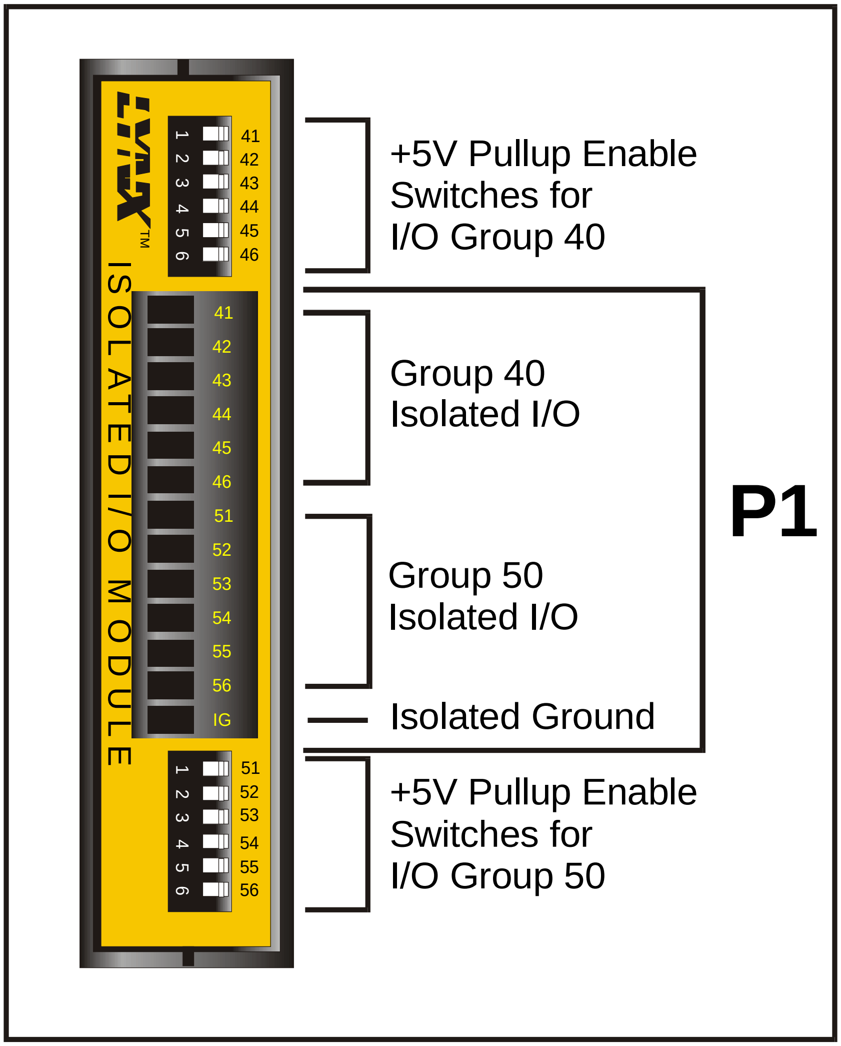

Figure 9.2: Isolated Digital I/O Module Connection Overview

Pin Assignments And Description

P1 - 13 Position Removeable Terminal Connector: Isolated Digital I/O		
Pin #	**Function**	**Description**
1 - 8	I/O Group 40 Lines 41 - 46	Signals are individually programmable as inputs or outputs (see description of the IOS command in the Part 3: Software Reference of this manual). Inputs are CMOS logic level compatible and can accept inputs to 24 volts. Noise rejection is available via digital filtering. Outputs are open drain. I/Os each have individually switchable 7.5 Kohm pull up resistors to 5VDC. Outputs can switch inductive, resistive or incandescent loads. Refer to Section 6: Configuring the Digital I/O for usage and specifications.
7 - 12	I/O Group 50 Lines 51 - 56	See description above.
13	Isolated I/O Ground	Isolated common signal return for groups 40 and 50 I/O. Isolated from the power and communication grounds.

Table 9.1: Isolated Digital I/O Module P1 Connector Pin Configuration

Switch Assignments And Description

Group 40 I/O Pull-Up Switches: Can Be Changed at any Time, Usable for Exercising Inputs		
Switch #	**Function**	**Description**
1 - 6	Individual Switches for I/O Group 40 Pull-Ups.	When this switch is on, the I/O is pulled up through an internal 7.5 Kohm resistor to 5VDC. Can be used to simulate the activation of an input while testing system software..

Table 9.2: Isolated I/O Module Group 40 I/O Pull-up Switches

Group 50 I/O Pull-Up Switches: Can Be Changed at any Time, Usable for Exercising Inputs		
Switch #	**Function**	**Description**
1 - 6	Individual Switches for I/O Group 50 Pull-Ups.	When this switch is on, the I/O is pulled up through an internal 7.5 Kohm resistor to 5VDC. Can be used to simulate the activation of an input while testing system software..

Table 9.3: Isolated I/O Module Group 50 I/O Pull-up Switches

Input Specifications

Isolated I/O Input Specifications	
Voltage Range	0 to 28 VDC (Transient Protected to 60 Volts)
Low Level	< 1.5V
High Level	> 3.5V
Open Circuit Input Voltage	Pull-Up Switch ON = 4.5V Pull-Up Switch OFF = 0V

Table 9.4: Isolated I/O Module Input Specifications

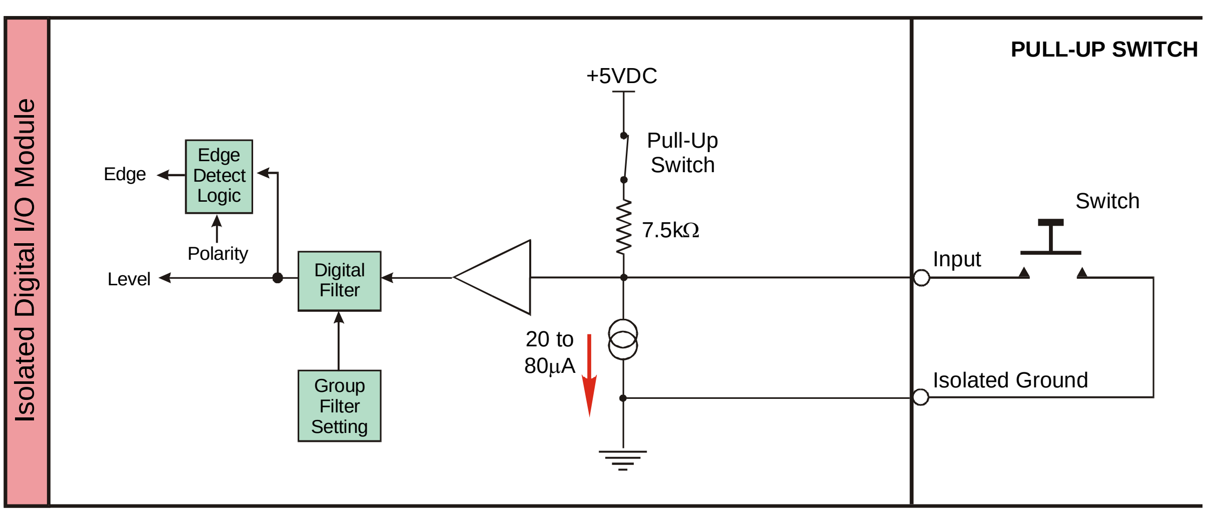

Figure 9.3: LYNX Isolated I/O Input Equivalent Circuit

Input Filtering

User definable Digital filtering makes the LYNX well suited for noisy industrial environments. The filter setting is software selectable using the [IOF Variable] with a minimum guaranteed detectable pulse width of 18 microseconds to 2.3 milliseconds.

The table at right illustrates the IOF settings.

IOF Filter Settings for the General Purpose Isolated I/O IOF=<num> (<num> = 0-7)		
Filter Setting	Cutoff Frequency	Minimum Detectable Pulse Width
0	27.5 kHz	18 microseconds
1	13.7 kHz	36 microseconds
2	6.89 kHz	73 microseconds
3	3.44 kHz	145 microseconds
4	1.72 kHz	290 microseconds
5	860 Hz	581 microseconds
6	430 Hz	1.162 milliseconds
7 (default)	215 Hz	2.323 milliseconds

Table 9.5: Digital Filter Settings for the Isolated I/O

Output Specifications

Isolated I/O Input Specifications	
Load Supply Voltage	28 VDC Maximum
FET On Resistance	2Ω Maximum (Tj = 125°C)
Continuous Sink Current	350mA Maximum Each Output (Ta = 25°C)
Maximum Group Sink	1.5A (Thermally Limited)
Open Circuit Output Voltage	Pull-up Switch ON = 4.5V Pull-up Switch OFF = 0V

Table 9.6: Digital Filter Settings for the Isolated I/O

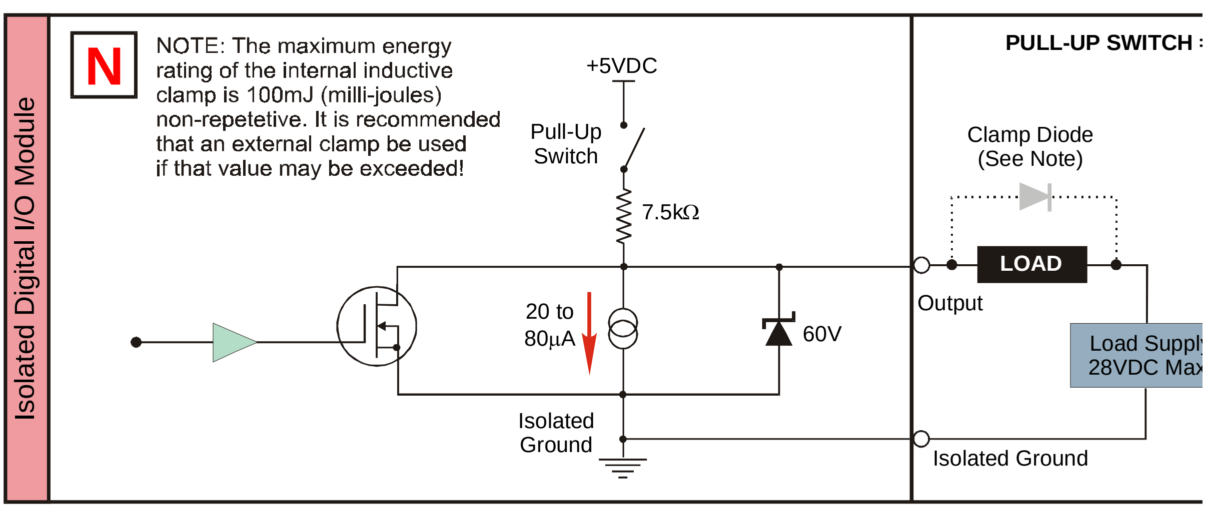

Figure 9.4: LYNX Isolated I/O Output Equivalent Circuit

Section 10

The Differential Digital I/O Module

Section Overview

A LYNX system may contain an optional Differential I/O Module (IMS Part# LX-DD100-000) which provides six (6) high speed differential I/Os. These I/Os can be used as clock inputs or outputs or general purpose I/O. Along with the differential motion I/Os (P1, pins 1 – 4) of the LYNX Control Module, these I/O make up the Group 1 signal set. Each signal pair is a 0 to 5VDC input or output. When used as an input or an output a single ended or differential configuration is accommodated.

- Hardware Specifications
  - Environmental Specifications
  - Mechanical Specifications
  - Power Requirements
- Pin Assignments
- Input Specifications
- Input Filtering
- Output Specifications

Hardware Specifications

Environmental Specification

Ambient Operating Temperature .... 0 to 50 degrees C
Storage Temperature .... -20 to 70 degrees C
Humidity .... 0 to 90% non-condensing

Mechanical Specification

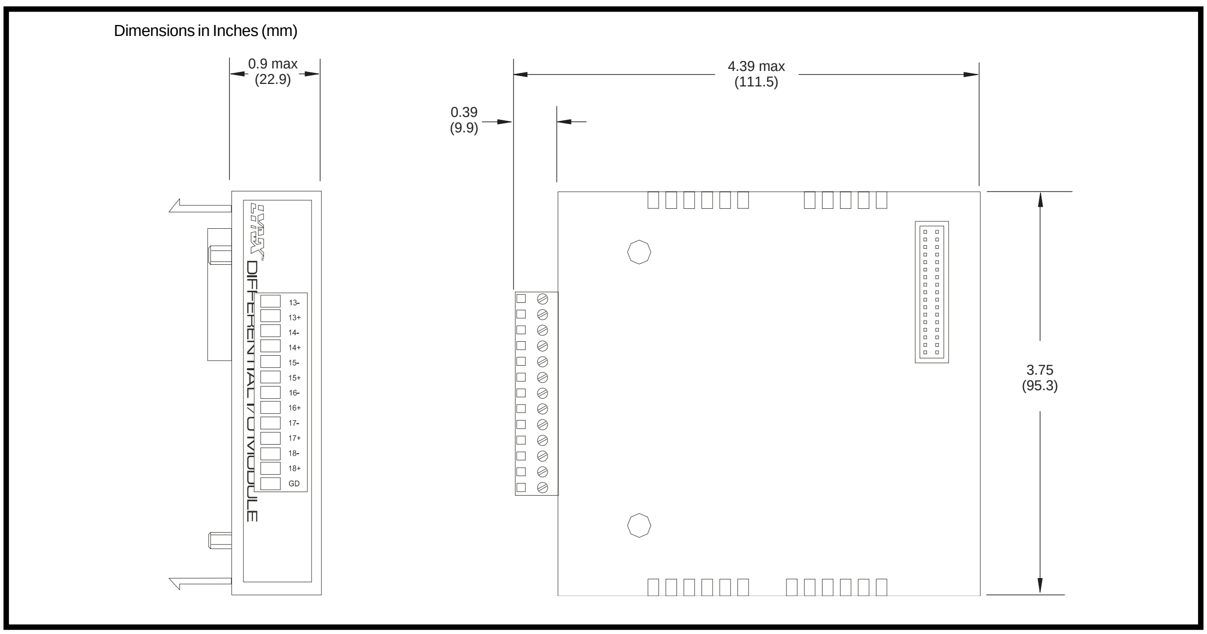

Figure 10.1 : LYNX Differential I/O Module Dimensions

Connection Overview

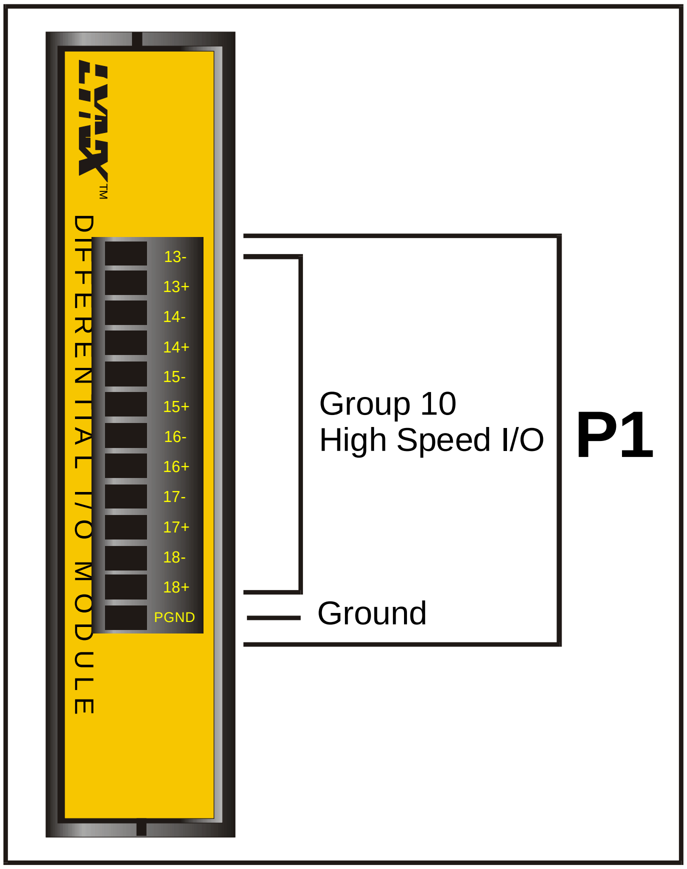

Figure 10.2: High Speed Differential I/O Module Connection Overview

Power Requirements

Power is supplied through the LYNX Control Module.

High Speed Differential I/O Power Requirement	
Input Voltage to LYNX Control Module	**Current Requirement for Module**
+5VDC	50mA
+12 VDC	28mA
+48VDC	8mA
+75VDC	5mA

Table 10.1: High Speed Differential I/O Module Power Requirements

Pin Assingments And Description

P3 - 13 Position Removeable Terminal Connector: High Speed Differential I/O Module		
Pin #	**Function**	**Description**
1	I/O 13-	Pins 1 and 2 are the differentially buffered signal for group 10, I/O 13. This channel is configured by means of the IOS Instruction. This channel is fixed as clock #2 and associated with Counter 2 (CTR2). For usage details see Section 6: Configuring the Digital I/O.
2	I/O 13+	See description above.
3	I/O 14-	Pins 3 and 4 are the differentially buffered signal for group 10, I/O 14.This channel is configured by means of the IOS Instruction. This channel is fixed as clock #2 and associated with Counter 2 (CTR2). For usage details see Section 6: Configuring the Digital I/O.
4	I/O 14+	See description above.
5	I/O 15-	Pins 5 and 6 are the differentially buffered signal for group 10, I/O 15 .This channel is configured by means of the IOS Instruction. This channel is fixed as clock #3 and associated with Counter 3 (CTR3). For usage details see Section 6: Configuring the Digital I/O.
6	I/O 15+	See description above.
7	I/O 16-	Pins 7 and 8 are the differentially buffered signal for group 10, I/O 16. This channel is configured by means of the IOS Instruction. This channel is fixed as clock #3 and associated with Counter 3 (CTR3). For usage details see Section 6: Configuring the Digital I/O.
8	I/O 16+	See description above.
9	I/O 17-	Pins 9 and 10 are the differentially buffered signal for group 10, I/O 17. This channel is configured by means of the IOS Instruction. This Channel may be configured as a high speed input or output. As an output it is a 1MHz reference clock. I/O 17 and 18 are not associated to a counter. For usage details see Section 6: Configuring the Digital I/O.
10	I/O 17+	See description above.
11	I/O 18-	Pins 11 and 12 are the differentially buffered signal for group 10, I/O 18. This channel is configured by means of the IOS Instruction. This Channel may be configured as a high speed input or output. As an output it is a 10MHz reference clock. I/O 17 and 18 are not associated to a counter. For usage details see Section 6: Configuring the Digital I/O.
12	I/O 18+	See description above.
13	PGND	Non-isolated ground. Common with the LYNX Control Module power ground.

Table 10.2: High Speed Differential I/O Module Pin Configuration

Input Specifications

High Speed Differential I/O Input Specifications	
Differential Input Threshold	-0.2V to +0.2V
Input Hysteresis	60mV Typical
Input Common Mode Range	-6V to +6V
Maximum Group Sink	1.5A (Thermally Limited)
Open Circuit Input Voltage + Input	4.3V
Open Circuit Input Voltage - Input	1.4V

Table 10.3: High Speed Differential I/O Module Input Specifications

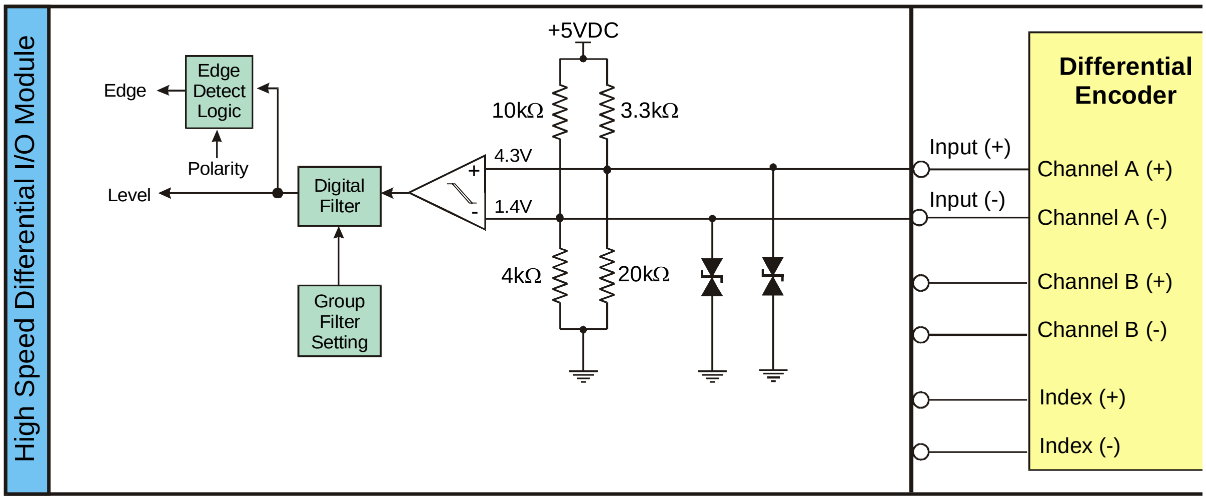

Figure 10.3: LYNX Differential I/O Input Equivalent Circuit

Input Filtering

User definable Digital filtering makes the LYNX well suited for noisy industrial environments. The filter setting is software selectable using the *IOF Variable* with a minimum guaranteed detectable pulse width of 18 microseconds to 2.3 milliseconds.
The table below illustrates the IOF settings.

IOF Filter Settings for the High Speed Differential I/O IOF=<num> (<num> = 0-7)		
Filter Setting	**Cutoff Frequency**	**Minimum Detectable Pulse Width**
0 (default)	5.00 MHz	100 nanoseconds
1	2.50 MHz	200 nanoseconds
2	1.25 MHz	400 nanoseconds
3	625 kHz	800 nanoseconds
4	313 kHz	1.6 microseconds
5	156 kHz	3.2 microseconds
6	78.1 kHz	6.4 microseconds
7	39.1 kHz	12.8 microseconds

Table 10.4: Digital Filter Settings for the Differential I/O

Output Specifications

High Speed Differential I/O Output Specifications		
	No Load	6mA Load
Output Voltage - Logic 0	0.5V	0.8V
Output Voltage - Logic 1	4.5V	4.2V
Short Circuit Current	250mA Max.	

Table 10.5: LYNX Differential I/O Output Specifications

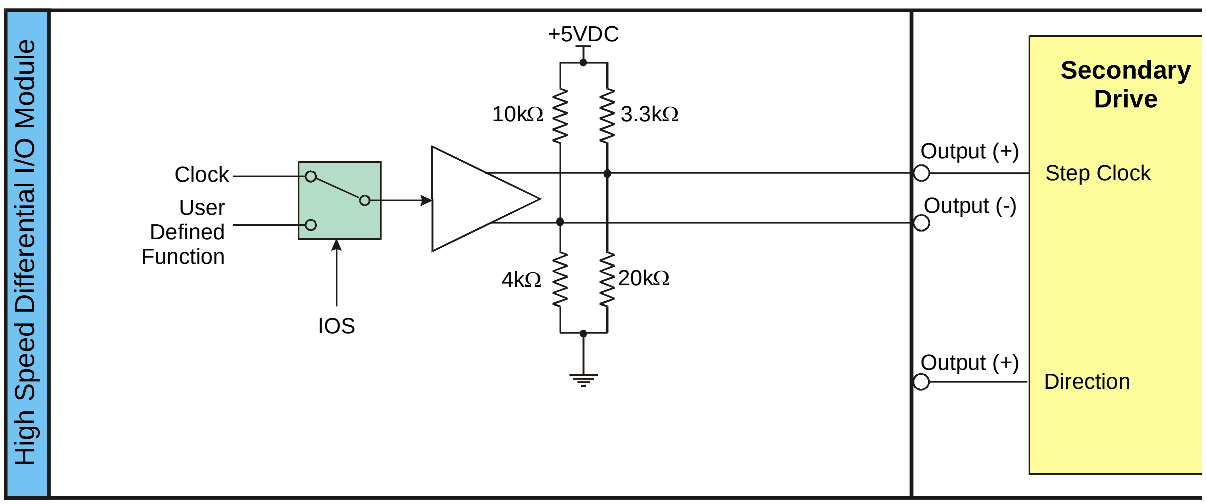

Figure 10.4: LYNX Differential I/O Output Equivalent Circuit

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