AN-001

CONFIGURATION OPTIONS FOR THE LynX-PORT I/O CONTROLLER

Marrick Limited, Inc.
Application Note 001
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INTRODUCTION

The LynX-PORT I/O Controller is a very flexible X-10 controllable device that allows the user to hook many low-voltage (and some high voltage) devices to X-10 power line carrier systems. Since there are several ways to use the LynX-PORT, this application note provides some ideas and suggestions for getting the most from your investment.

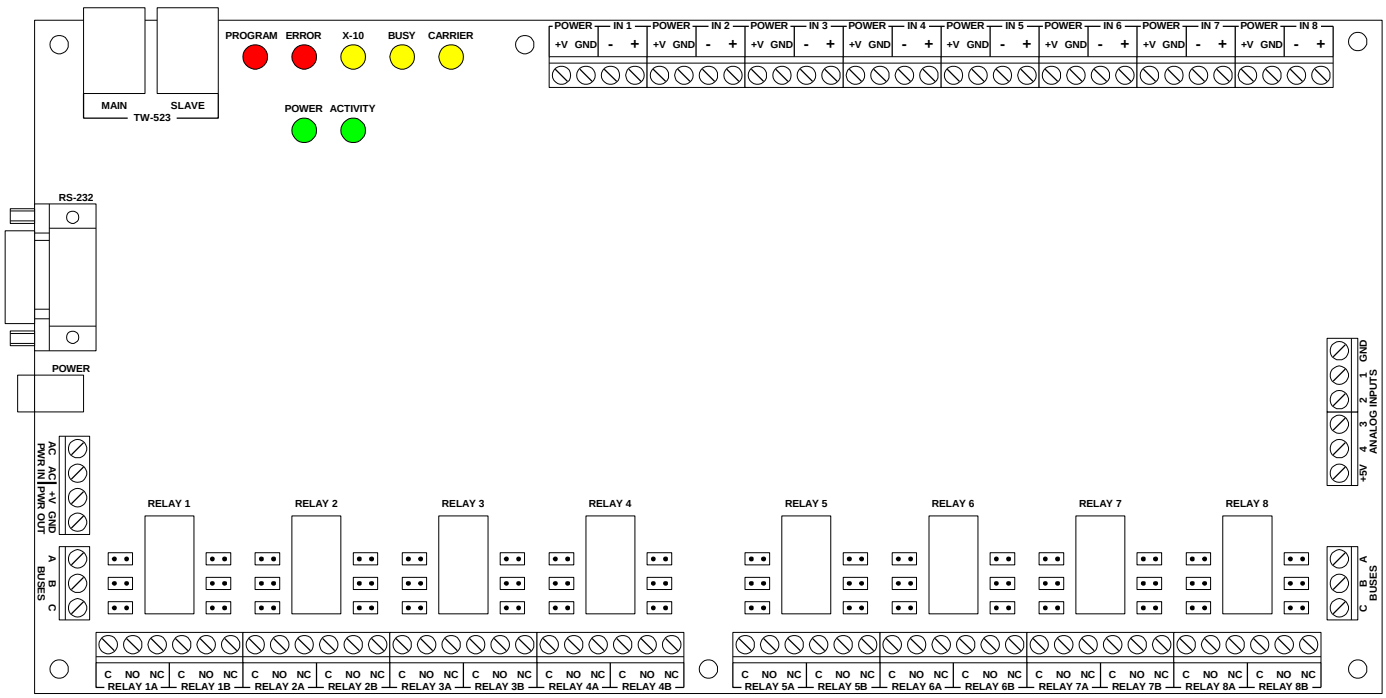
DESCRIPTION OF THE LynX-PORT I/O BOARD

Figure 1 shows the LynX-PORT board and the various connectors available. Besides the connectors, there are many jumpers that configure the relay bus options. These jumpers are very useful for setting up power or signal buses that run to the commons of the relays. Later, I will show you some examples on how to use these buses for phone lines, sprinkler systems, and audio routing. I will discuss more on these examples later.

The board consists of 8 double pole, double throw relays (DPDT), 8 optically coupled current inputs with voltage sources, and 4 analog to digital converters. The relays can be programmed using the LynX-PORT configuration utility (available from the Marrick Web site) to enable or disable various options. The relays can listen for or ignore X-10 commands, time out after a preset time, work mutually exclusive from one another in a group and automatically trigger the next relay in the group at timeout. These options give the relay section tremendous flexibility. The inputs are also programmable. The input polarity can be flipped, X-10 signals can be sent (or not), and relays can be tripped all by setting up the options with the configuration utility. The inputs can even be programmed to observe only ON conditions, OFF conditions or both (or neither). The analog to digital converter section can be programmed to send X-10 signals whenever a certain high or low threshold has been exceeded at one of the ADC inputs. Again, this is entirely configured by the setup utility.

A very powerful feature of the LynX-PORT is when used in conjunction with any LynX-10 Coprocessor, the setup utility can make changes remotely to any LynX-PORT on the power line. That is, by connecting a computer to the LynX-10 Coprocessor (or a local LynX-PORT) the user can remotely change settings in any of the remote LynX-PORTs. This is done by clicking the FIND button on the configuration utility, the software will first search the entire X-10 address range for other LynX-PORTs and identify them by their house codes. The model number and firmware revision of the remote (or local) LynX-PORT will show-up in the right list box. Click on the LynX-PORT you wish to configure, and then on the button for which setting. This will take several seconds, so be patient. The LynX-10 Coprocessor uses extended X-10 codes to communicate with the LynX-PORT to change its settings. The data rate is only about 12 bits per second using this technique, however, only a few bytes (8 bits per byte) of data are actually transferred. This feature allows a user to locate a LynX-PORT board near what it will control without requiring a hardwire interface to program it or control it.

Figure 1 – LynX-PORT I/O Controller (Model 201)



POWER AND BUSES

The LynX-PORT has several methods of being powered and also distributing power to external devices. Figure 2 shows a close-up of the power and ABC bus connections. The LynX-PORT can be powered from 9V-12V AC or DC from either a wall mounted transformer (Radio Shack # 273-1630, 273-1656 for 9V or 273-1653 or RSU 11327764 for 12V) or an external power supply. When using a wall mounted transformer with a barrel type connector, insert the connector into J22 (polarity doesn't matter – the LynX-PORT rectifies the input power to the correct polarity). When using an external power source, wire the AC or DC power connections to J21 PWR IN AC / AC. The board itself with all the relays operating (closed) draws about 500mA of current. If you need to drive any external devices, you will need to provide current in excess of this amount (i.e. 750 mA).

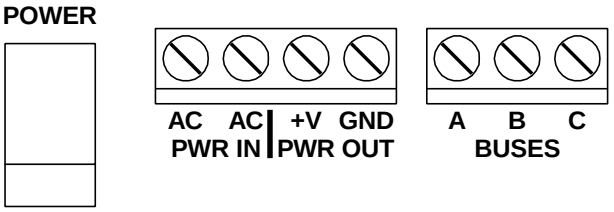


Figure 2 – LynX-PORT Power Connections

The LynX-PORT provides several voltages out for use in driving external devices such as PIR detectors, ratiometric sensors (level sensors, etc), and other devices requiring power to operate. Raw rectified power is available on J22 PWR OUT (+V & GND). A regulated +5V is available at Analog to Digital converter connector labeled '+5V' and 'GND'. The +5V is provided for sensors as well since the source of the power is taken from the ADC section. This output is fused, and on the later boards the fuse is removable (snap in). *It is recommended that after the installation is complete you replace the fuse with one rated for the current consumed times 1.2 (20% higher). This will guarantee the fuse will blow to protect the external circuitry in case of a short or circuit failure. The board ships with a 500mA slow blow fuse installed. Do not install a larger value fuse. The regulator on the board is only rated at 1A and the board itself uses 500mA of current*. Each input also has +V raw input (unregulated) voltage available. This is provided to power PIR detectors and to provide current for dry contact closure sensors such as security door contacts.

There are 3 buses provided with jumpers for each relay. These buses can be used to distribute power or signals to the commons of the 2 poles of each relay. The buses are labeled A, B, and C (See figure 1 above) and are completely isolated from each other. You can however short buses together using shunts on the header pins on a single pole. This should be avoided. Figure 3 shows a relay with each of its 6 jumpers. The jumpers are labeled **JPnAx** and **JPnBx** where **n** is the relay number, **A** or **B** indicates which pole of the relay, and **x** indicates which bus A, B, or C. Let's look at an example. If you where wiring sprinklers, you might want to distribute the 24VAC that runs the valves on bus **A**. You would connect one side of the power source (i.e. a wall or outlet mounted transformer) to BUS **A** on J20 near the power connections (or on the other end of the bus at J19). You would then insert a shunt (a small 0.1" spaced shorting block – Radio Shack # 276-1512) on each relay's A pole that was to provide power to valves. If you were going to use relays 1-6 (6-zone system) then you would install them on JP1AA, JP2AA, JP3AA, JP4AA, JP5AA, and JP6AA. Then each valve would connect to a relay's normally open (NO) output on pole A. The other side of each value would then be tied together and connected to the return side of the wall transformer that supplies power for the sprinkler valves. That's it. No other wires or jumpers are required. You can even use the B pole of the relays to drive indicator lamps to build a sprinkler zone control indicator (look for a future application note on a super sprinkler controller using a LynX-PORT).

RELAYS

The LynX-PORT model 201 contains 8 double pole double throw industrial grade relays. Each pole of each relay is capable of handling 2A at 30VDC, 600mA at 110VDC or up to 600mA at 125VAC. For higher currents and / or voltages a secondary high power relay can be used – driven by the LynX-PORT relay. The relays are configured electrically by using shorting blocks (shunts) as discussed above (see figure 3) and behaviorally by the LynX-PORT setup utility.

Each relay can be programmed to listen for X-10 ON/OFF commands (or ignore them). Sometimes when an input is slaved to a relay (See INPUT section), you may not want the relay to be activated accidentally. An example of this might be a garage door opener or sump pump. The input is providing X-10 status (the relay too), but is controlled by the hardwired input – not X-10. The relays can also be tied together in exclusive groups. This means that only 1 relay can be on at a time in that group. This is very useful for sprinklers or HVAC

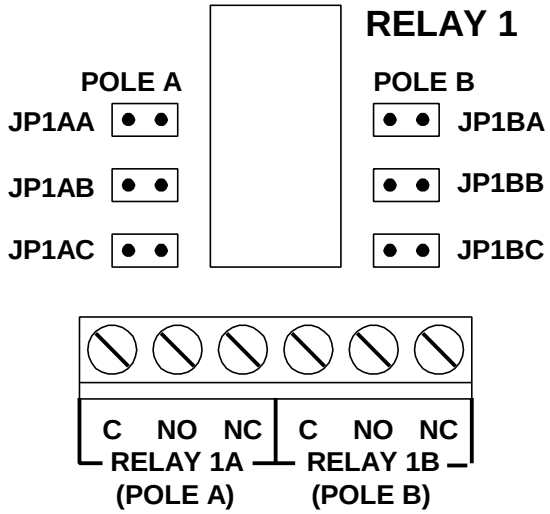


Figure 3 – Relay 1 example

dampers. If any relay in the group is commanded on, all the others in that group will be turned off first (break before make). They can also be programmed to time out (open) after a preset period. Again, very useful for sprinklers, garage door control, alarm systems, etc. Each relay can be programmed to time out from 0.5 seconds to over 9 hours in 0.5 second increments. If programmed, any relay that times out and opens will automatically start the next lower priority relay in the group. Relays do not need to be next to one another to be in a group. When programming a relay to join a group, just specify the group number (1 through 4) and that relay will participate that group. Another esoteric feature is the TOGGLE RELAY WHEN ACTIVATED FROM INPUT option. This allows an input to be connected to a switch that can slave to the relay and "toggle" its state. For example, in a sprinkler system, we may want to provide a remote control console in a garage or outside location for testing or manual start. The switch would connect to an input, the input would be programmed to slave to a relay (lets say zone 1), and the relay would be programmed to toggle when activated. This would allow a user to press the button to start zone 1 and then press it again to stop zone 1. By using a switch for each zone, you could have manual starts and stops for the entire sprinkler system. The final relay option is whether to report status on changes. That is, if this feature is enabled and the relay actually closes or opens due to an X-10 command or on board stimulus, the LynX-PORT will send out the relay's status. The status takes the form of the X-10 unit address of the relay followed by an X-10 ON or OFF command or optionally and X-10 STATUS ON or STATUS OFF command. Using the optional STATUS ON or STATUS OFF command provides a mechanism to report that the relay's state actually changed without accidentally activating another unit somewhere else in the home network. This is covered again in the GLOBAL SETTINGS section.

INPUTS

The LynX-PORT model 201 provides 8 optically coupled current limited loop type inputs. These are different from a standard +5 and ground digital input in that they are very resistant to damage from over current or voltage.

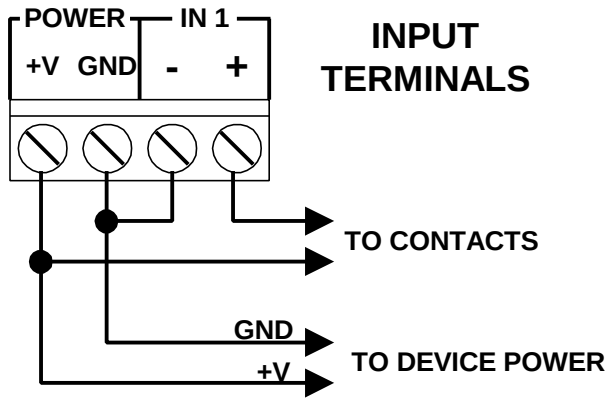


Figure 4 – Example input connection

The inputs can handle up to +40V on the inputs continuously without damage. Try that with a standard digital level input. *POOF… need I say more*. This type of input does require a voltage source to operate which is provided on each input connector (see figure 4). To signal an **ON** state, current must flow from the **IN +** input to the **IN –** input. This can be done by connecting the inputs in *parallel* with an existing DC load (such as a security alarm panel), or by using the **+V** and **GND** connections on the input. To use the **+V** and **GND** connections, connect the **GND** terminal to the **IN –** terminal. Then run the **+V** terminal wire to the switch or dry contact sensor. The other side of the sensor then connects to the **IN +** terminal. That's it. Using a PIR (Passive infrared) detector can be done by also connecting to the **+V** and **GND** connections for power. A schematic hook up diagram of this is shown in figure 4.

Each input has several options that can be enabled or disabled via the setup utility. The input polarity (which state is on) is programmable. If a device is normally ON (closed) in its off state such as a PIR detector's relay, the input can be programmed to make that state normally off. This way, when something moves in the field of the PIR detector, an ON command will be sent (not an OFF command). The ON state and OFF state can be independently controlled so that only one, both or neither states are reported. This is useful for triggering scenes via macros using automation software, or not allowing certain states to trigger an event. An example is the motion detector. Once an ON command has been issued due to the detection of motion, an OFF command is superfluous and just increases the X-10 traffic. In this case the OFF state should be disabled (unchecked in the setup utility for that input). If the input is used as a slave to a relay or is temporarily unused or disabled, X-10 reporting of state changes can be turned off. Uncheck the SEND X-10 CODES check box in the input's setup dialog to disable this feature. This is useful for inputs that are slaved to a relay such as our sprinkler example. When a button is used as a manual over-ride on a sprinkler valve, sending X-10 traffic is again superfluous and should be disabled. In that case the relay will report the state changes when opened or closed (much better). Finally, the input can be slaved to any of the 8 relays. The sprinkler example shows how useful this option is.

ANALOG CHANNELS

The 4 analog to digital converter (ADC) inputs are very useful for monitoring non-digital environmental factors such as soil moisture, air temperature, airflow, fluid levels, etc. The inputs will convert any voltage level between 0 and +5 volts to an 8 bit number (0-255). The inputs are over-voltage protected to insure reliable operation and flexibility in interfacing to other devices. Figure 5 shows the ADC connector terminals. Use the +5V and GND connections to power ratiometric sensors such as a potentiometer or strain gauge half bridge. When using temperature sensors such as the National Semiconductor LM34 or LM35, the +V and GND

connections can be used to power the device. Look for up-coming application notes on using the analog inputs for some really cool home automation ideas.

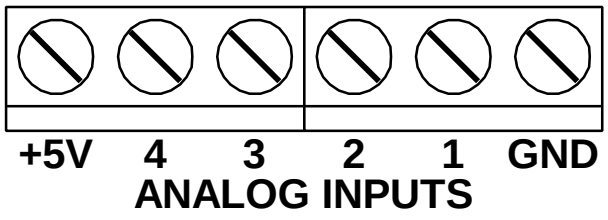


Figure 5 – ADC Connection Terminals

Each ADC input can be programmed to report threshold violations. That is, when an input voltage level exceeds a predetermined allowable window, an X-10 message will be sent. The model 201 has fixed commands for high and low thresholds. When an input voltage exceeds the high level threshold, an X-10 ON command is transmitted and when a low-level threshold is exceeded, an X-10 OFF command is transmitted. The unit code and unit address for each threshold is programmable from A1 to P16. For example, the high threshold could be programmed for B6 and the low threshold could be programmed for A16. The global reporting type dictates whether an ON / OFF command or a STATUS ON / OFF command is sent (see GLOBAL SETTINGS for more information). The ADC setup dialog also allow you to view the thresholds as a voltage (0-5V) instead of a number (0-255). To view the settings as a voltage check the SHOW VOLTAGE check box.

RS-232 AND PSC05 / TW523 CONNECTIONS

The LynX-PORT model 201 provides three methods of control. It can be used as a stand-alone remote X-10 device (looks like 16 consecutive units on a single house code), a hard-wired I/O controller, or a hard-wired I/O controller with X-10 bridging. Savoy Automation's Cyber House as well as other home automation software packages including LynX-SOFT lite use the later method as the computer interface to the X-10 home network. Figure 6 shows the interface connections for both the RS-232 computer interface and the X-10 power-line adapter. The LynX-PORT provides an extra SLAVE connection to the X-10 adapter to allow another LynX-PORT or other X-10 device to share the single PSC05 or TW523 power-line interface. This is really handy when trying to maximize the outlets available near the LynX-PORT. For example, if an RCS X-10 thermostat is also located nearby, it can be plugged into the SLAVE TW523 input thus saving a TW523. Since the LynX-PORT uses collision sensing and recovery, the two devices can co-exist on the same X-10 interface without contention. The RS-232 interface is wired as a data communications device (DCE). See the LynX-PORT schematics for details. This allows the use of a straight through wired cable to connect to a PC or other hardware. Since the X-10 power line interface is tremendously slower than the 1200 bps interface of the LynX-PORT, some sort of hand shaking is required. Hardware hand shaking uses Clear To Send (CTS) as a control line back to the PC to regulate the flow of commands entering the LynX-PORT. When the input receive buffer passes its preset threshold level, the CTS line is de-asserted. The PC using hardware hand-shaking (RTS/CTS) will hold-off transmitting any more data to the LynX-PORT until it catches up with the requested commands. If CTS is not available on the hardware, XON / XOFF software hand shaking can be used instead (see GLOBAL SETTINGS on how to enable this option).

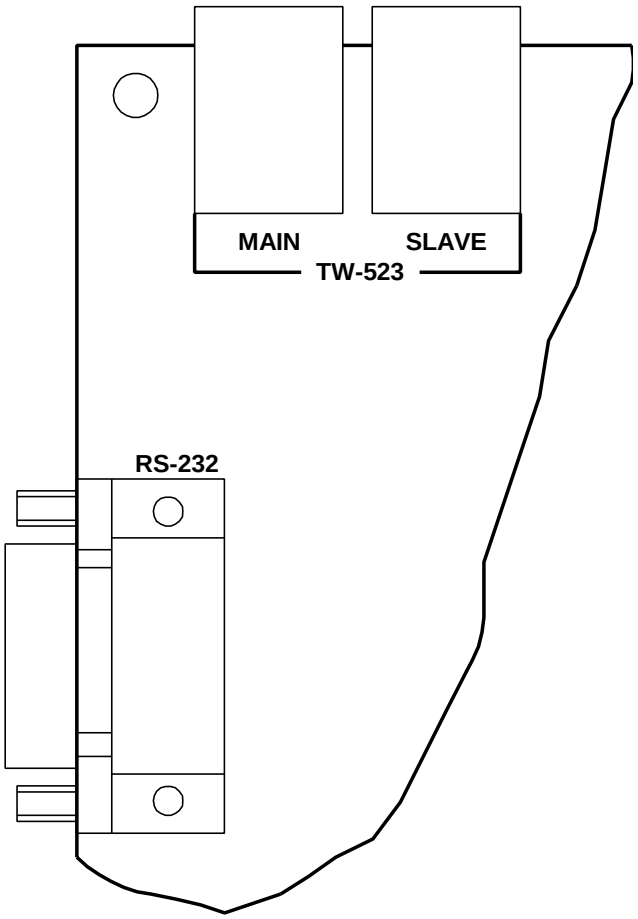


Figure 6 – LynX-PORT Interface Connectors

GLOBAL SETTINGS

There are some settings that affect the entire operation of the LynX-PORT I/O Controller. These are grouped together in several internal registers and can be configured locally or remotely with some exceptions. The LynX-PORT was designed primarily as a remote catchall device to handle low voltage signaling and bridging to the X-10 home network. To enable remote programming and global identification of individual LynX-PORTs throughout an installation it was decided (for better or worse) to capture an entire house code. In this manner, the board could be HAIL'ed using standard X-10 protocol HAIL commands. After the board is identified, extended codes could be used to program it or to read it's current settings. Therefore, the board needs a house code assigned to it. This is done in the global settings. When

the PC that is running the configuration utility is directly connected to the LynX-PORT, this option is enabled and the board's house code can be assigned. When the board is remote, the direct method is disabled. This is due to the fact that if the board's house code is accidentally changed to the same house code as another remote LynX-PORT, you will loose remote programming capability of both units. *HINT: You can work around this (this trick alone is worth reading this application note) by using the ADVANCED feature of the setup utility*. Select the remote LynX-PORT from the DEVICE LIST and click ADVANCED. The advanced dialog will appear. Click the ADDRESS drop-down box and select address 01 and press EDIT. After a few seconds, a number will appear in the VALUE (HEX) edit box. The number will be a four-digit hexadecimal number such as 090A. The upper two digits represent the house code (00=A, 01=B, 02=C, etc.) of the selected remote LynX-PORT. Edit the upper two numbers to reflect the new house code of the remote unit and press UPDATE. A warning dialog will appear advising that a change in the remote LynX-PORT's non-volatile memory is about to occur. Press YES to proceed. The trusty hourglass will appear for a few seconds. After the hourglass disappears, press the OK button, which will close the ADVANCED dialog. Now press the RESET button. After a few seconds a dialog will appear stating that the remote device has reset. Now press FIND and the remote LynX-PORT will appear at the new address in the DEVICE LIST. *Note: If you accidentally assign a house code that's already assigned to another remote LynX-PORT, you will not be able to change anything in either device*. The fix is simple, take your lap-top, find the remote LynX-PORT you wish to modify, plug in a cable directly to the device's RS-232 port and use the setup utility to change the house code to a new value.

Software handshaking using XON / XOFF protocol can also be enabled in the global settings. Using the setup utility, check the XON /XOFF HANDSHAKING checkbox. The return strings by default use a carriage return character (0x0A) as the delimiter between received messages. LynX-SOFT Lite and other home automation packages depend on that delimiter. However, it can be changed to one of the following if desired. The options are CR for carriage return, LF for a line feed character, NL for both, or none. Use this option with care.

The LynX-PORT model 201 can report state changes by either using actual X-10 ON / OFF commands which can be interpreted by other X-10 devices such as lamp modules or by using X-10 STATUS ON / OFF commands. The STATUS ON / OFF commands will still work with some home automation software packages such as LynX-SOFT lite, but prevents accidental triggering of macros or devices. Use the setup utility to change this option in the GLOBAL settings dialog.

The LynX-PORT provides 2 separate groups of ADC programs which include the threshold levels as well as the assigned devices. Sometimes, due to seasonal changes, the user may want to change all of the thresholds in one move. Basically there are two complete sets of ADC registers in the non-volatile memory. Group 1 and Group 2. You can select a group and program it, then select the other group and program that one. Then, anytime you wish to switch between them, you can use the setup utility to flip which set is active.

CONCLUSION

As you can see, the LynX-PORT model 201 has many options that can help in designing the final touches to any home automation project. This is the first of many application notes dedicated to providing the technical tricks and hints to enhance your home automation system and to ensure product fulfillment for our customers.

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