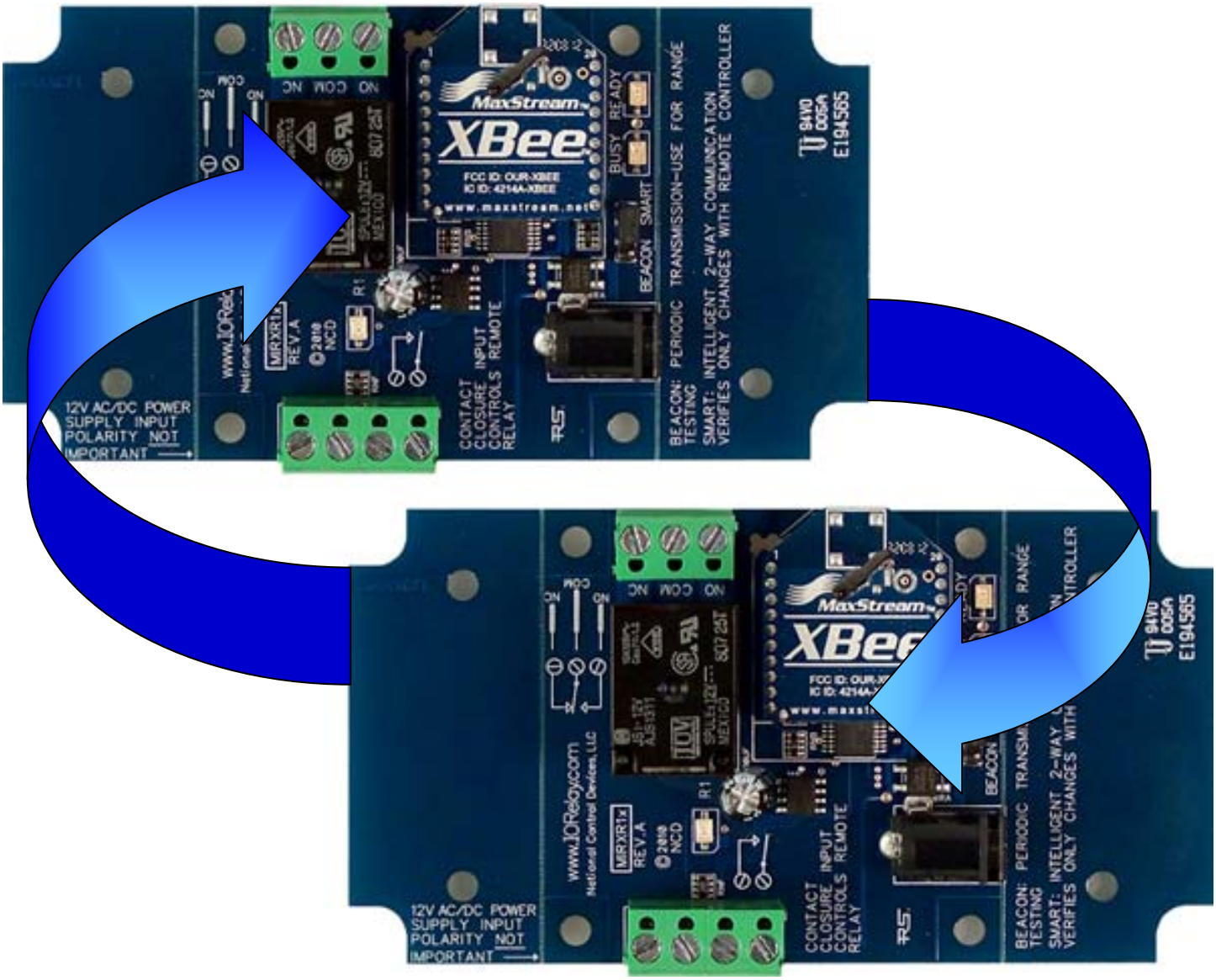


the MIRX™ RELAY PAIR series

NOTICE: Portions of this Manual REQUIRE Internet Access

This manual will guide you through the setup and use of all MirX Series relay controllers. Following this manual in the sequence outlined is absolutely essential to proper understanding and use of MirX Series Controllers. Please review the entire manual BEFORE contacting NCD technical support. NCD technical support staff will direct your questions to this manual when applicable.

Introduction

The MirX Series relay controllers represent a significant advancement in the evolution of the NCD product line. The MirX Series controllers represent a new form of products for our customers who are not electronic engineers but still have Electronic applications they would like to complete. These controllers are the Simplest controllers we have ever developed. They are as easy as wiring up the devices and pushing a button. No programming or configuring is required. However you can extend the functionality of these controllers by using them in conjunction with our Reactor controllers. In this way MirX controllers can be used to triggers and other functions. It may also be triggered by sensory input when used in conjunction with a Reactor controller.

The MirX Series are our second line of controllers to offer Autonomous Relay Control (logical control based on inputs without a computer). This new architecture allows remote control of relays without writing a single line of code. The MirX Series are manufactured using Surface Mount Technology. A Break-Away design has been implemented to service the needs of customers who need an enclosure AND to customers who need the smallest possible size. Break Away tabs allow the user to "break" off the outer edges of the circuit board for a smaller profile. The MirX Series relay controllers represent the future direction of the NCD product line.

Who's Qualified to Use the MirX Series?

Anyone. The MirX Series Controllers are the most consumer friendly devices we have ever manufactured. Weather you are an electronics engineer or home hobbyist, anyone is qualified to use the MirX Series controller provided this manual is carefully studied.

How do the MirX Series Controllers Work?

MirX controllers are sold in pairs. Contact closure devices such as buttons and switches attached to inputs on the first controller will trigger relays on the second controller and Vice Versa.

What Type of Range can Users Expect?

There are three range options with the MirX controllers:
300 Feet (Short Range)
1 Mile (Medium Range)
15 Miles (Long Range)
These ranges are based on a clear line of sight between MirX controllers/antennas, meaning obstacles such as trees, buildings and walls may limit these ranges slightly.

Extending Range.

Because MirX devices do not interfere with other MirX devices it is possible to link multiple MirX devices in a chain configuration to cover long distances.

Multiple MirX Pairs?

Multiple MirX Controllers can be used in one locations. One Pair of MirX controllers will not interfere with another MirX pair as they are isolated through the way we designed them. MirX Devices are paired together before shipment and will only communicate to each other, for this reason they will not interfere with other MirX controllers.

Order of Operations

Contact closures are read on one controller, data is sent to other controller to turn on or off relays, remote device replies back, busy light flashes to confirm data was received at the other end.

Learning Cycle

1) Hardware Reference (getting to know the hardware)
2) Understanding Relay Control
3) Connecting Contact Closure devices to a MirX
4) Controlling Devices with a MirX
5) Troubleshooting a MirX Controller

Usage Cycle

1) Attach Power
2) Input Connection
3) External Device connection to Relay
4) Test Range and Functionality in your Environment.

Getting Started

There is no better place to start than from the beginning. This manual will lead you through the understanding and use of your MirX Series relay controllers in a sequence that will help get you started from the ground up.

Please refrain from contacting NCD technical support unless it is absolutely necessary. Most questions will be covered in this manual and NCD technical support staff has been instructed to direct your questions to this manual when appropriate. Please take advantage of the efforts we have invested in building a complete and comprehensive product manual. This will save you time and allow our technical support engineers to focus on product development.

This manual will guide you through the setup and use of all MirX Series relay controllers. Following this manual in the sequence outlined is absolutely essential to proper understanding and use of MirX Series Controllers. Please review the entire manual BEFORE contacting NCD technical support. NCD technical support staff will direct your questions to this manual when applicable.

Hardware Reference

There are many versions of the MirX Series relay controllers. It is not practical to photograph an outline every version in this manual. But there are many common elements that are shared among controllers. Most notably, the MirX CPU is identical weather you are using 1-Channel Long Range MirX controllers or 8-Channel Short Range MirX controllers. All MirX controllers share the exact same firmware with absolutely NO differences in firmware revisions. This greatly reduces manufacturing time and troubleshooting while allowing our customers a migration path to different communication range technologies as required.

MirX controllers use different Communication Technologies giving them ranges of 300 Feet (Short Range), 1 Mile, and up to 15 Miles (Long Range)!

Power Requirements

MirX controllers require a 12VAC or 12VDC power supply to power the logic and relays of the controller. The PWR12 is our stock power supply suitable for use with ALL MirX Series controllers. While it is possible to operate from an automotive 13.8V power supply, higher voltages are not recommended. Additional power filtering may be required for proper operation in automotive electrical systems. The absolute minimum recommended operating voltage is 11VAC or 11VDC. MirX controllers require approximately 100ma for standby and 60ma for each activated relay. Communication Modules may require up to an additional 240 ma, this is documented on the Electrical Specifications Page.

Power polarity is not important on the MirX Series controllers. There is no positive and negative terminal. Simply apply power to the controller as it is convenient to make wired connections. The MirX controller will rectify your power supply and attempt to filter noise to safe levels for proper operation.

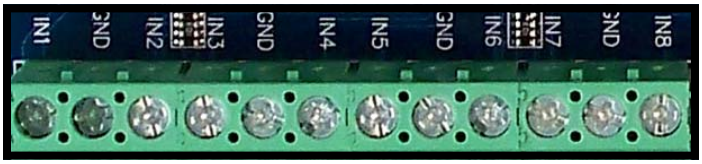
Temperature Requirements

Certain components of a MirX controller may run at temperatures exceeding 120° Degrees Fahrenheit. This is normal for a MirX controller and does not indicate a defect.

The recommended operating temperature for all MirX controllers is –25 to 80° C. This temperature rating is based on temperature specifications of the components used to build a MirX controller, and is not based on actual testing. We have speculated that MirX controllers may be able to withstand lower temperatures due to the fact that MirX controllers tend to have hot components in critical areas of the design.

Hardware Reference: Anatomy of a MirX

Status LEDs indicate which relays are currently active.



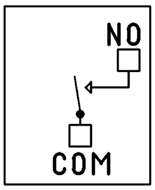
Inputs are capable of reading switches, buttons and other contact closure devices such as many motion detectors.. These input serve as the command points for the remote MirX controller.

Beacon/Smart Mode Jumper. Used to switch the controllers from Beacon Mode (good for range testing) to Smart Mode (recommended for day to day function)

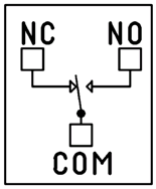
The BUSY/READY LEDs indicate CPU activity. Flashing Busy LED signifies VALID data has been received from the Remote MirX controller. If busy light never flashes check remote device and range abilities of devices.

MirX Controllers are equipped with 1, 2, 4, or 8 Relay Outputs. Relays are simply switches. They DO NOT provide a voltage output, but they will switch the voltage you apply to the relay connections. Please Click Here to see a list of relays and ratings that are commonly supported by the NCD product line (note: not all relays may be supported at this time, relay support will grow as the MirX product line grows).

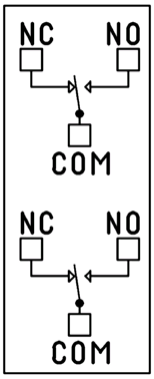
Relays have 2, 3, or 6 connections per relay depending on configuration. SPST, SPDT, and DPDT relays will be supported. Please see the following article for a detailed explanation of these relay types.



SPST Relay



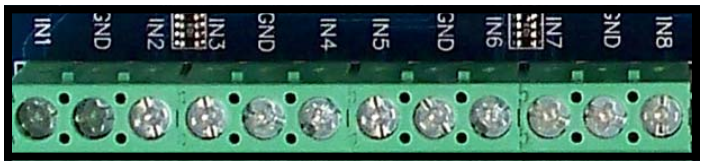
SPDT Relay



DPDT Relay

MirX Controllers include a 2.1mm Barrel Connector AND a 2-Position Screw Terminal. Use either connector to provide 12V power to the MirX Controller. MirX controllers are compatible with 12V AC or DC power supplies with a actual voltage output of 11 to 13.8V. Polarity is corrected by the MirX controller, therefore a Positive and Negative terminal are NOT labeled on the board (it is not possible to connect power backwards to MirX controllers, the MirX controllers will automatically correct polarity).

Hardware Reference: Understanding Inputs



Inputs are capable of reading Contact Closure generating devices such as buttons and switches. A wire connected from the ground terminal to the input terminal would trigger the input, as this would be considered a contact closure.

MirX Inputs play a vital role in the use of a MirX controller. Before we begin using the controller, it is essential that users understand the role of these inputs. Improper use of these inputs can cause Irreparable Damage to the MirX controller, so a firm understanding of these inputs is critical to the longevity of the controller.

Users must NEVER apply any voltage to an input on the MirX controller, these inputs are for Contact Closure connection only.

A MirX controller has as many inputs as it has Relays. So a pair of 2 relay MirX controllers will each have 2 relays and 2 inputs which are used for controlling the relays on the opposite board, the same holds true for 1, 4, and 8 relay versions.

Beacon/Smart Mode Jumper

The Beacon/Smart Mode Jumper is used to change the way communications is handled by the MirX controllers.

Beacon Mode

In Beacon Mode communication is nearly constant which makes it a good choice for range testing. A controller can be placed in one location and the other MirX controller can be carried to other locations to test range. The busy Light flashes constantly if there is good communication between the two MirX controllers. If communication is lost in Beacon mode relays will remain in their current state and will not automatically turn off. If the busy light stops flashing the devices are out of range of each other and the distance should be shortened. While Beacon Mode is very good for range testing it does lengthen the amount of time it takes for an input on one board to trigger a relay on the remote board. Beacon mode is not recommended for day to day use.

Smart Mode

In Smart mode communication is not as constant as in Beacon Mode, however Smart Mode does still check for communication with remote device periodically. For this reason inputs on one MirX controller can trigger Relays on the remote MirX controller very fast because input changes are immediately sent to the remote device. If communication is lost in Smart mode for 10 to 15 seconds all relays will go off and communication streams will accelerate to attempt immediate recovery. If this happens check remote device and range abilities of your MirX controllers. Smart mode also consumes less power than Beacon mode, this along with fast relay triggering is why we recommend Smart mode for every day use.

Regardless of the Mode you choose, if the busy LED flashes the two devices are communicating properly. If the Busy LED does not flash at all the devices are unable to communicate.

Beacon Mode:

- Constant Communication.
- Good for range testing.
- Relays will not switch off if communication is lost.
- Higher power consumption.
- Relay Status will update slower to input changes on remote board.

Smart Mode:

- Fewer Communications between Devices
- Relays will switch off if Communication is lost.
- Lower Power consumption than Beacon Mode.
- Relay status Updates very fast to input changes on remote Board.

Hardware Reference: Understanding Relays

On the previous page, we introduced you the MirX Inputs and how Contact Closures play a key role in triggering Relays on the Remote MirX board. In this Section we will continue our focus on the Hardware portion of the MirX controller, which brings us to our next topic: Understanding how the Relays work.

MirX Controllers have 1, 2, 4, or 8 Relays integrated into the circuit board. A relay is similar to a switch. The only difference between a switch and a relay is the actual mechanism for changing the on/off status of the switch. On a switch, you manually push on a piece of metal or plastic to operate the switch. On a relay, an electric current is used to operate the switch. Though a relay resembles the characteristics of a switch, it cannot be controlled by touching it with your finger. So from now on, we will use the word "Relay" to indicate a switch that is controlled by the MirX controllers (instead of your finger).

Relays do NOT provide a voltage output. They provide a contact closure output, exactly like the terminals found on a light switch at your local hardware store. Wiring to a relay will be slightly different depending on the model of MirX controllers you choose.

Some relays, such as the 5A and 10A versions have screw terminals that can accept 12 Gauge or smaller wire. Other versions such as the 20A and 30A relays have a .250" Quick Connect terminal (the appropriate mating connector can be found at any hardware or automotive supply store).

Again, relays do not provide a voltage output. They ONLY switch whatever voltage you supply into the relay.

Relays are available in SPST, SPDT, and DPDT configurations. In addition, both Mechanical and Solid State relays will be supported by the MirX series controllers. If you are unfamiliar with the different versions of relays available, you can review the following article, which explains these relay types in great detail.

The above article will help you determine the best type of relay for your application, showing you the formulas for calculating relays sizes that are appropriate for your application.

If you intend to use the MirX series relay controllers for inductive applications, the following article MUST be reviewed. An example of an inductive application is any device that involves motion. For instance, using a MirX Controller to control a motor, a solenoid, or a valve. Other types of inductive applications include anything with a transformer such as a fluorescent light or a power transformer of any kind. Logic circuits (including those found on the MirX Controller) may malfunction in sever conditions. The above article will show you how to safely implement these kinds of loads which greatly reduces the chances of a malfunction. Some inductive applications generate excessive noise, and may not be suitable for use with the MirX Series Relay controllers. Solid State MirX Relay Controllers Should be considered for these high-noise applications.

Controlling Relays

There is only one way to control the relays on MirX Series controllers. Relays are triggered by inputs on the opposite board. They may not be triggered in any other way.

Relay Logic may be used to complete more complex tasks. Please refer to our page on Relay Logic.

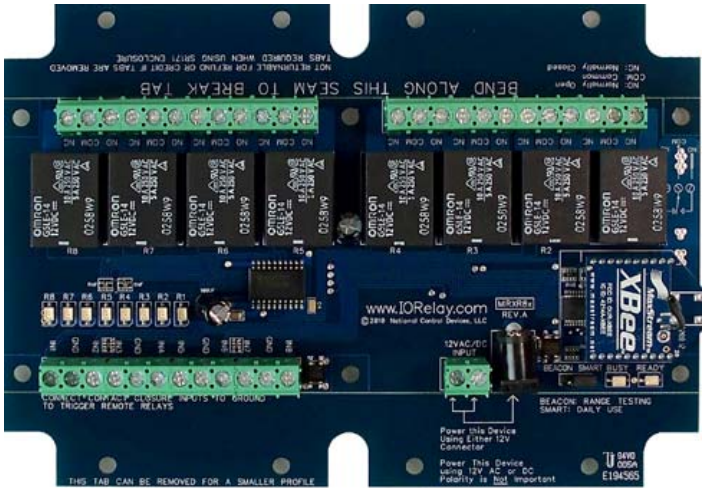
Hardware Reference: Break-Away Tabs

Physically, most MirX controllers are actually 2 sizes. When you receive your MirX, the unusual shape and size ensures the MirX can fit into a standard enclosure. Optionally, you can make the controller smaller by breaking away the outer tabs. Break-Away tabs are useful in applications where space may be a concern. This allows your MirX to offer the same functionality in the smallest possible profile. Break-Away tabs are unique to the NCD product line and are a standard option for most devices released in 2010 and later.

Before breaking the tabs on your controller, please be advised that your MirX controller will not be returnable for refund or credit if the Break-Away Tabs have been removed.

To break away the tabs, gently but firmly grab each break-away tab with a pair of pliers and bend the tab back and forth until it breaks away from the main circuit board. This will NOT damage the controller in any way.

Breaking the Tabs from a controller DOES NOT VOID the 5-Year Warranty. Please see the NCD return policy if you would like more information on the policies that apply to Surface Mount devices.



MirXR85 Shown Above as shipped from National Control Devices. The unusual shape accommodates a standard enclosure. Bend the tabs to break them away from the board. Note that con-

trollers with Broken Tabs are NOT Returnable for Refund or Credit, but are still covered under our 5-Year Limited Warranty.

Shown above, the final controller with tabs removed is physically

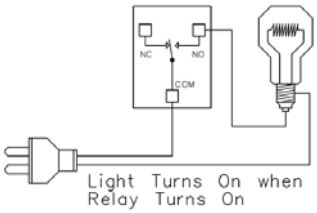
smaller in size, but no-longer fits a standard enclosure.

Relay Logic

This is why we recommend using MirX controllers with more relays than you may actually need…

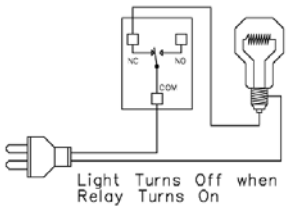
Using Relays to Create Logical Conditions

The Mirx Series Relay Controllers offer a great balance of flexibility and easy configuration. However, complex decision making is sometimes outside the scope of a Mirx controller. Relay Logic demonstrates easy ways to hard-wire your decisions using a Mirx Controller.



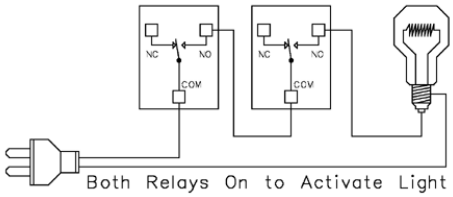
Sample 1

This sample demonstrates how a relay can be used to activate a light bulb. When the relay turns on, the light comes on. Only one power wire is switched with this sample using the COM (common) and NO (normally open) connections of a relay.



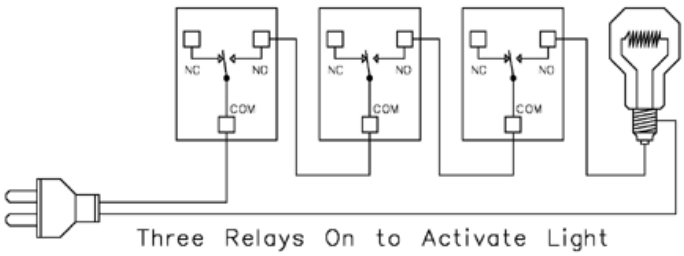
Sample 2

This sample demonstrates how a relay can be used to turn a light bulb OFF. When the relay turns off, the light will be ON. Only one power wire is switched in this sample using the COM (common) and NC (normally closed) connections of a relay.



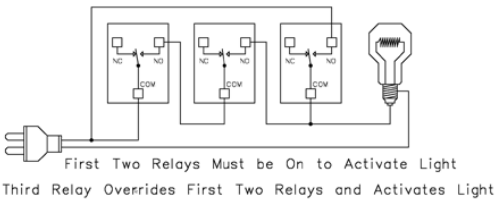
Sample 3

The sample Above demonstrates how two activated relays are required to activate a light bulb. This is the same as a Logic AND function because Relay 1 AND Relay 2 MUST be on to activate the light.



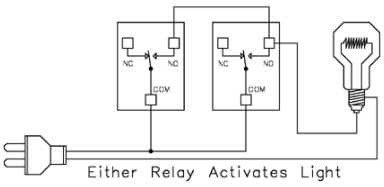
Sample 4

The sample above demonstrates how three activated lights are required to activate a light bulb. This is the same as a Logic AND function because Relay 1 AND Relay 2 AND Relay 3 MUST be on to activate the light.



Sample 5

This sample demonstrates the AND/OR function. The Light Bulb will be activated if Relay 1 AND Relay 2 are ON OR if Relay 3 is ON. This sample is perfect for applications that may require a Logical condition of 2 relays PLUS an Override feature. For instance: Relay 1 is a Night/Day Sensor, Relay 2 is a Moisture Sensor. If its Dark AND the soil is Dry, Relays 1 and 2 can activate a Pump. If you want to override these conditions with a Key Fob, Relay 3 may be used.

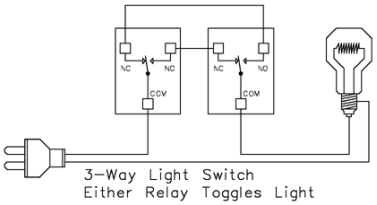


Sample 6

This sample demonstrates how either relay can be used to activate a light. In this sample, only one activated relay is required to activate the light. If both relays are activated, the light will be on.

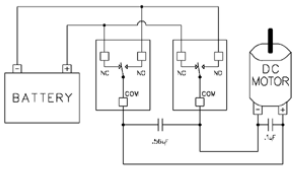
Sample 7

This sample demonstrates how a 3-way light switch can be used to activate a light. A 3-way light switch is often found in your house where two light switches can be used to activate a single light. This sample is exactly the same as a 3-way light switch, the only difference being each physical switch is replaced by a relay. Operationally, it works the same way. Each relay activation will cause the light to toggle. Switching two relays at one time is like flipping 2 switches at once....with the same result. This sample is particularly useful since you can replace one relay (as shown in the diagram) with a physical light switch. This will allow a computer/MirX to control a light as well as manual operation of a light. Properly used, this can be one of the most valuable diagrams we offer on this page.



Sample 8

This sample demonstrates how to control the direction of a DC motor using 2 relays. Braking is accomplished by connecting both motor terminals to a common power connection (Faraday's Law). The capacitors shown may not be required for small motors, but if you experience problems with relays shutting themselves off, the induction suppression capacitor will be required. The .1uF capacitor helps suppress electronic noise if the battery were to be used by sensitive devices (such as radios/ amplifiers).



Electrical Specifications

All Controllers Require 12 Volt Dc Power Source.

MirX Part # Controller	Min/Max. Current Consumption: 300 Ft Range	1 Mile Range	Long Range
MirxR15/R110	80ma-115ma	95ma-118ma	150ma-180ma
MirxR25/R210	80ma-140ma	95ma-145ma	150ma-195ma
MirxR45/R410	80ma-200ma	95ma-205ma	150ma-250ma
MirxR85/R810	80ma-370ma	95ma-380ma	150ma-430ma
MirxR8120/R130	80ma-150ma	95ma-155ma	150ma-220ma
MirxR220/R230	80ma-220ma	95ma-225ma	150ma-275ma
MirxR420/R430	80ma-385ma	95ma-390ma	150ma-450ma
MirxR820/R830	80ma-680ma	95ma-685ma	150ma-720ma
MirxSSR8x	80ma-390ma	95ma-395ma	150ma-445ma

Minimum Current consumption based on all relays off/Max consumption based on all relays on. Amperage consumption may fluctuate as much as 10 % Note: Long Range Modules may fluctuate in power consumption significantly from 80ma up to 150ma in all relays off mode.

	Maximum	Rated	Minimum
Temperature Ratings (Estimated)**	-25°C		80°C
Mechanical Relay Cycle Life (Non-DPDT Versions):		>10,000,000 Cycles	
Mechanical Relay Cycle Life (DPDT Versions):		>2,000,000 Cycles	
Typical Operational Cycles per Minute			1,800
Relay Activation Time:	>5ms		<15ms
Relay Deactivation Time:	>5ms		<20ms
Command Processing Time:	1ms	3ms	5ms
Relay Electrical Limits should be Determined by Reviewing Appropriate Relay Data Sheet:			
5A Relays Data Sheet			
10A Relays Data Sheet			
20A Relays Data Sheet			
30A Relays Data Sheet			
Solid State Relays Sheet			
** Ratings Based on Data Sheets of Component Used, Actual Tolerance May Exceed Ratings.			

Troubleshooting

Problem: Busy LED is not Periodically Flashing/Remote Device is not responding.
The Busy LED Signifies **Successful** communication with remote device. If the Busy LED is not flashing the Mirx in unable to communicate with the Remote Device. Possible Problems could be lack of sufficient power source at remote location, remote device is out of range, humidity can affect overall communication range (Dryer environments tend to have shorter ranges than wetter ones), damaged controller can prevent busy LED from flashing, if power is applied to inputs this will damage the controller.
Solution:
Check Power source for both Devices.
Place antennas or devices as high physically as possible.
If Humidity seems to be causing "Spotty" Reception contact us for a better antenna option.
If device seems to be damaged check to make sure you have NEVER attached voltage of any kind to the controllers inputs.

Problem: Controller is Running HOT
Solution: It is normal for some components run very hot on the Mirx series relay controllers. This is not a concern as we have tested the design carefully and are operating our components well within the specified limits of the components we are using. It is NOT normal for the CPU to run hot at any time. The CPU should remain cool. If the CPU is running hot the CPU has been damaged.

Problem: Relays turn off unexpectedly:
This can happen if the devices loose communication with each other in smart mode. It can also happen when Inductive loads are attached to the relays (See page 6 Understanding Relays).
Solution:
Shorten the distance between controllers.
Carefully review the necessary steps for suppressing Induction in this Article.
Be sure to also check your power source.

Known Bugs:
At this time, the Mirx Series Relay Controllers are not known to have any bugs in the firmware. There were 50 internal versions developed and tested over a span of 9 months to arrive at a Version 1.0 Firmware Release. If you experience a bug, please email us so we can examine the problem in more detail. Any known bugs will be posted in this section of the manual.