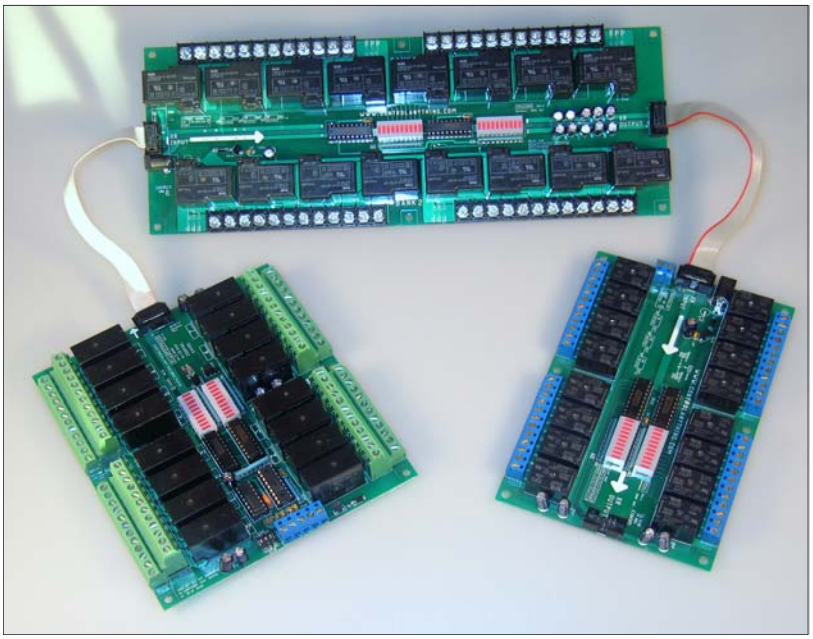
ProXR Series

RS-232 E3C Networkable Relay Controllers

5-Year Repair or Replace Warranty!!!



NCD ProXR Series Controllers are our latest generation of relay controllers. Developed in 2005 and released into mass production for 2006, these controllers place a heavy emphasis on communication speed, relay bank expansion, and relay timing control.

The ProXR Series Controllers include an XR Expansion port, allowing you to add additional banks of relays (any kind of relays you need), directly to the main controller. With a few minor programming modifications, you will be controlling the new relay banks in seconds. Up to 256 relays (32 Banks of 8 Relays) are Supported with version 17 firmware. You can now control individual relays, relay banks, or all relays at one time.

The ProXR Series Controllers also offer full-speed RS-232 communications, up to 115.2K Baud, and are E3C Network Compliant up to 38.4K Baud.

Also new for the 2006 release year is the addition of 16 background timers, ideal for watchdog, keep alive, server reboot, and duration timing applications.

With 16 Background timers and XR Expansion Ports, the ProXR Series Relay Controllers offer more features than any other relay controller we have ever produced.

Control 256 Devices from a Single Serial Port
Watchdog / Server Reboot / Keep Alive Timing Functions
Supports Duration Timing Commands (turn a light on for 8 hours)
Control 256 Relays (32 Relay Banks) From One Controller
User-Selectable Communication Rates up to 115.2K Baud
Change Parameters in Configuration Mode ONLY to Prevent Accidental Changes
E3C Compliant Command Set
Diode Clamped Relay Driver Stage
Relay Status LEDs
Device Enabled/Power LED
Data Receive LED
12 Volt DC Operation
User-Programmable Startup Status
Simultaneously Set the Status All Relays
Ask the Status of Individual or All Relays
Protected E3C Device Numbering
O.C. RS-232 Communication for Networking Multiple Devices
Powerful ASCII Character Code Based Command Set
Compatible with ANY Computer or Microcontroller

NCD Relay Controllers: *Feature Comparison*	Original R4x/R8x Relay Controllers	R4x/R8x Pro Relay Controllers	ProXR Series Controllers
Optoisolation on RS-232 Data Inputs	Yes	Yes	No, Full Speed RS232 Only
R4x Pro Form Factor Compatible with Original R4x Design	-	R45 Pro is Smaller	New Form Factor, Many New Varieties
R8x Pro Form Factor Compatible with Original R8x Design	-	Yes	New Form Factor, Many New Varieties
XR Expansion Ports (Allow you to add additional relay banks at a later time)	No	No	Yes
Protected Memory Storage (Must set controller to Configuration Mode to Define Device Number)	No	No	Yes
Set Status of Individual Relays	Yes	Yes	Yes
Set Status of Multiple Relays Simultaneously	No	Yes	Yes
Set Status of Multiple Banks of Relays Simultaneously	No	No	Yes
Read Status of Individual Relays	No	Yes	Yes
Read Status of Multiple Relays Simultaneously	Yes	Yes	Yes
16 Device Network Compliance	Yes	Yes, Emulation Mode	No, E3C Compliance Only
E3C 256 Device Network Compliance	No	Yes	Yes
Programmable Relay Timer	No	Yes	Yes, 16 Background
Programmable Device Number	Jumper Configured	Software Configured	Software Configured (protected memory)
Programmable Power-up Relay Status	No	Yes	Yes
Programmable Relay Status Memory Banks	No	Yes	No
Multi-Parameter Command Structure	No	Yes	Yes
Relay Select/Deselect Command Set	No	Yes	No
Extended Relay Control Command Set	No	Yes	No
Integrated User-Programmable Memory	No	Yes	Yes
20 MHz CPU Operation	No	Yes	Yes
Maximum Communication Baud Rate	19,200	38,400	115,200

5-Year Repair or Replace Warranty

Warranty

NCD Warrants its products against defects in materials and workmanship for a period of 5 years. If you discover a defect, NCD will, at its option, repair, replace, or refund the purchase price. Simply return the product with a description of the problem and a copy of your invoice (if you do not have your invoice, please include your name and telephone number). We will return your product, or its replacement, using UPS ground shipping service.

This warranty does not apply if the product has been modified or damaged by accident, abuse, or misuse.

30-Day Money-Back Guarantee

If, within 30 days of having received your product, you find that it does not suit your needs, you may return it for a refund. NCD will refund the purchase price of the product, excluding shipping/handling costs. This guarantee does not apply if the product has been altered or damaged.

Copyrights and Trademarks

Disclaimer of Liability

NCD is not responsible for special, incidental, or consequential damages resulting from any breach of warranty, or under any legal theory, including lost profits, downtime, goodwill, damage to or replacement of equipment or property, and any costs or recovering, reprogramming, or reproducing any data stored in or used with NCD products.

Technical Assistance

Technical questions can be e-mailed to Ryan Sheldon. For our latest email address, please visit the Contact section of our web site. Technical questions submitted via e-mail are answered up to 20 times daily. Technical support is also available by calling (417) 646-5644.

NCD Contact Information

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FAX:
(866) 562-0406

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www.controlanything.com
www.controleverything.com

Device Variations

This manual covers all NCD products with ProXR in the Part Number as well as other part numbers that may reference this document.

The ProXR Family:

R165PROXR	16-Channel 5A SPDT RS-232 Relay Controller with XR Expansion Port
R1610PROXR	16-Channel 10A SPDT RS-232 Relay Controller with XR Expansion Port
R81DPDTOC8LP	8-Channel 1A DPDT Relay + 8-Channel 150ma O.C. Output RS-232 Relay Controller
R83DPDTOC8LP	8-Channel 3A DPDT Relay + 8-Channel 150ma O.C. Output RS-232 Relay Controller
R85DPDTOC8LP	8-Channel 5A DPDT Relay + 8-Channel 150ma O.C. Output RS-232 Relay Controller
R81DPDTR85PROXR	8-Channel 1A DPDT Relay + 8-Channel 5A SPDT RS-232 Relay Controller
R81DPDTR810PROXR	8-Channel 1A DPDT Relay + 8-Channel 10A SPDT RS-232 Relay Controller
R83DPDTR85PROXR	8-Channel 3A DPDT Relay + 8-Channel 5A SPDT RS-232 Relay Controller
R83DPDTR810PROXR	8-Channel 3A DPDT Relay + 8-Channel 10A SPDT RS-232 Relay Controller
R85DPDTR85PROXR	8-Channel 5A DPDT Relay + 8-Channel 5A SPDT RS-232 Relay Controller
R85DPDTR810PROXR	8-Channel 5A DPDT Relay + 8-Channel 10A SPDT RS-232 Relay Controller
R161DPDTPROXR	16-Channel 1A DPDT RS-232 Relay Controller with XR Expansion Port
R163DPDTPROXR	16-Channel 3A DPDT RS-232 Relay Controller with XR Expansion Port
R165DPDTPROXR	16-Channel 5A DPDT RS-232 Relay Controller with XR Expansion Port
R241DPDTPROXR	24-Channel 1A DPDT RS-232 Relay Controller with XR Expansion Port
R243DPDTPROXR	24-Channel 3A DPDT RS-232 Relay Controller with XR Expansion Port
R245DPDTPROXR	24-Channel 5A DPDT RS-232 Relay Controller with XR Expansion Port
R245PROXR	24-Channel 5A SPDT RS-232 Relay Controller with XR Expansion Port
R2410PROXR	24-Channel 10A SPDT RS-232 Relay Controller with XR Expansion Port
R325PROXR	32-Channel 5A SPDT RS-232 Relay Controller with XR Expansion Port
R3210PROXR	32-Channel 10A SPDT RS-232 Relay Controller with XR Expansion Port
R165R16OCLP	16-Channel 5A SPDT Relay + 16-Channel 150ma O.C. Output RS-232 Relay Controller
R1610R16OCLP	16-Channel 10A SPDT Relay + 16-Channel 150ma O.C. Output RS-232 Relay Controller
R161DPDTR16OCLP	16-Channel 1A DPDT Relay + 16-Channel 150ma O.C. Output RS-232 Relay Controller
R163DPDTR16OCLP	16-Channel 3A DPDT Relay + 16-Channel 150ma O.C. Output RS-232 Relay Controller
R165DPDTR16OCLP	16-Channel 5A DPDT Relay + 16-Channel 150ma O.C. Output RS-232 Relay Controller
R161DPDTR165PROXR	16-Channel 1A DPDT Relay + 16-Channel 5A SPDT RS-232 Relay Controller
R161DPDTR1610PROXR	16-Channel 1A DPDT Relay + 16-Channel 10A SPDT RS-232 Relay Controller
R163DPDTR165PROXR	16-Channel 3A DPDT Relay + 16-Channel 5A SPDT RS-232 Relay Controller
R163DPDTR1610PROXR	16-Channel 3A DPDT Relay + 16-Channel 10A SPDT RS-232 Relay Controller
R165DPDTR165PROXR	16-Channel 5A DPDT Relay + 16-Channel 5A SPDT RS-232 Relay Controller
R165DPDTR1610PROXR	16-Channel 5A DPDT Relay + 16-Channel 10A SPDT RS-232 Relay Controller
R321DPDTPROXR	32-Channel 1A DPDT RS-232 Relay Controller with XR Expansion Port
R323DPDTPROXR	32-Channel 3A DPDT RS-232 Relay Controller with XR Expansion Port
R325DPDTPROXR	32-Channel 5A DPDT RS-232 Relay Controller with XR Expansion Port
R121DPDTR125PROXR	12-Channel 1A DPDT Relay + 12-Channel 5A SPDT RS-232 Relay Controller
R121DPDTR1210PROXR	12-Channel 1A DPDT Relay + 12-Channel 10A SPDT RS-232 Relay Controller
R123DPDTR125PROXR	12-Channel 3A DPDT Relay + 12-Channel 5A SPDT RS-232 Relay Controller
R123DPDTR1210PROXR	12-Channel 3A DPDT Relay + 12-Channel 10A SPDT RS-232 Relay Controller
R125DPDTR125PROXR	12-Channel 5A DPDT Relay + 12-Channel 5A SPDT RS-232 Relay Controller
R125DPDTR1210PROXR	12-Channel 5A DPDT Relay + 12-Channel 10A SPDT RS-232 Relay Controller

XR Expansion Boards:

These Controllers can be Connected to the XR Expansion Port on any of the ProXR Controllers.

XR16OCLP	*XR Expansion Module 16-Channel Low Power Open Collector*
XR121DPDTR125	*12-Channel 1A DPDT Relay + 12-Channel 5A SPDT Expansion Relay Controller*
XR123DPDTR125	*12-Channel 3A DPDT Relay + 12-Channel 5A SPDT Expansion Relay Controller*
XR125DPDTR125	*12-Channel 5A DPDT Relay + 12-Channel 5A SPDT Expansion Relay Controller*
XR121DPDTR1210	*12-Channel 1A DPDT Relay + 12-Channel 10A SPDTExpansion Relay Controller*
XR123DPDTR1210	*12-Channel 3A DPDT Relay + 12-Channel 10A SPDT Expansion Relay Controller*
XR125DPDTR1210	*12-Channel 5A DPDT Relay + 12-Channel 10A SPDT Expansion Relay Controller*
XR241DPDT	*24-Channel 1A DPDT Expansion Relay Controller*
XR243DPDT	*24-Channel 3A DPDT Expansion Relay Controller*
XR245DPDT	*24-Channel 5A DPDT Expansion Relay Controller*
XR245	*24-Channel 5A SPDT Expansion Relay Controller*
XR2410	*24-Channel 10A SPDT Expansion Relay Controller*
XR161DPDTR16OCLP	*16-Channel 1A DPDT Relay + 16-Channel 150ma O.C. Output Expansion Relay Controller*
XR163DPDTR16OCLP	*16-Channel 3A DPDT Relay + 16-Channel 150ma O.C. Output Expansion Relay Controller*
XR165DPDTR16OCLP	*16-Channel 5A DPDT Relay + 16-Channel 150ma O.C. Output Expansion Relay Controller*
XR161DPDTR165	*16-Channel 1A DPDT Relay + 16-Channel 5A SPDT Expansion Relay Controller*
XR163DPDTR165	*16-Channel 3A DPDT Relay + 16-Channel 5A SPDT Expansion Relay Controller*
XR165DPDTR165	*16-Channel 5A DPDT Relay + 16-Channel 5A SPDT Expansion Relay Controller*
XR161DPDTR1610	*16-Channel 1A DPDT Relay + 16-Channel 10A SPDT Expansion Relay Controller*
XR163DPDTR1610	*16-Channel 3A DPDT Relay + 16-Channel 10A SPDT Expansion Relay Controller*
XR165DPDTR1610	*16-Channel 5A DPDT Relay + 16-Channel 10A SPDT Expansion Relay Controller*
XR321DPDT	*32-Channel 1A DPDT Expansion Relay Controller*
XR323DPDT	*32-Channel 3A DPDT Expansion Relay Controller*
XR325DPDT	*32-Channel 5A DPDT Expansion Relay Controller*
XR165OC16LP	*16-Channel 5A SPDT Relay + 16-Channel 150ma O.C. Output Expansion Relay Controller*
XR1610OC16LP	*16-Channel 10A SPDT Relay + 16-Channel 150ma O.C. Output Expansion Relay Controller*
XR325	*32-Channel 5A SPDT Expansion Relay Controller*
XR3210	*32-Channel 10A SPDT Expansion Relay Controller*
XR81DPDTOC8LP	*8-Channel 1A DPDT Relay + 8-Channel 150ma O.C. Output Expansion Relay Controller*
XR83DPDTOC8LP	*8-Channel 3A DPDT Relay + 8-Channel 150ma O.C. Output Expansion Relay Controller*
XR85DPDTOC8LP	*8-Channel 5A DPDT Relay + 8-Channel 150ma O.C. Output Expansion Relay Controller*
XR81DPDTR85	*8-Channel 1A DPDT Relay + 8-Channel 5A SPDT Expansion Relay Controller*
XR83DPDTR85	*8-Channel 3A DPDT Relay + 8-Channel 5A SPDT Expansion Relay Controller*
XR85DPDTR85	*8-Channel 5A DPDT Relay + 8-Channel 5A SPDT Expansion Relay Controller*
XR81DPDTR810	*8-Channel 1A DPDT Relay + 8-Channel 10A SPDT Expansion Relay Controller*
XR83DPDTR810	*8-Channel 3A DPDT Relay + 8-Channel 10A SPDT Expansion Relay Controller*
XR85DPDTR810	*8-Channel 5A DPDT Relay + 8-Channel 10A SPDT Expansion Relay Controller*
XR161DPDT	*16-Channel 1A DPDT Expansion Relay Controller*
XR163DPDT	*16-Channel 3A DPDT Expansion Relay Controller*
XR165DPDT	*16-Channel 5A DPDT Expansion Relay Controller*

IMPORTANT POWER SUPPLY REQUIREMENTS

1) DO NOT USE A WALL WART TYPE UNREGULATED POWER SUPPLY.
2) USE ONLY A COMPUTER GRADE REGULATED SWITCHER SUPPLY RATED AT 12 VOLTS DC, 1.25 AMPS OR GREATER.
3) USE A SUPPLY RATED FOR MORE AMPERAGE WHEN POWERING MULTIPLE BOARDS.
4) DC POWER SHOULD NEVER TRAVEL GREATER THAN 20 FEET. A SEPARATE POWER SUPPLY SHOULD BE USED FOR EACH CONTROLLER IF CONTROLLERS ARE NOT LOCATED WITHIN 20 FEET OF EACH OTHER.
5) RELAY COILS ARE RATED AT 12 VOLTS DC. HIGHER VOLTAGES WILL SHORTEN THE COIL LIFE. LOWER VOLTAGES MAY CAUSE UNRELIABLE OPERATION, BUT WILL NOT DAMAGE THE CONTROLLER.
6) PROXR SERIES CONTROLLERS CAN BE USED IN 12 VOLT AUTOMOTIVE ELECTICAL SYSTEMS.

Status LEDs:

LEDs	Description
1	Heartbeat LED Flashes Quickly most of the time, flashes slowly when a timing operation is in progress.
2	Data Receive LED Flashes when Valid Data is Received
3	E3C Device Enabled LED is Lit when Device is Enabled (on by default)
4	Data Transmit LED Flashed when Data is Sent Back to User

DIP SWITCH SETTINGS HAVE NO EFFECT UNTIL THE CONTROLLER HAS BEEN POWER CYCLED.

38.4K Baud Configuration Mode Allows you to Store Device Parameters. On Powerup, All Relays are Tested in Configuration Mode.

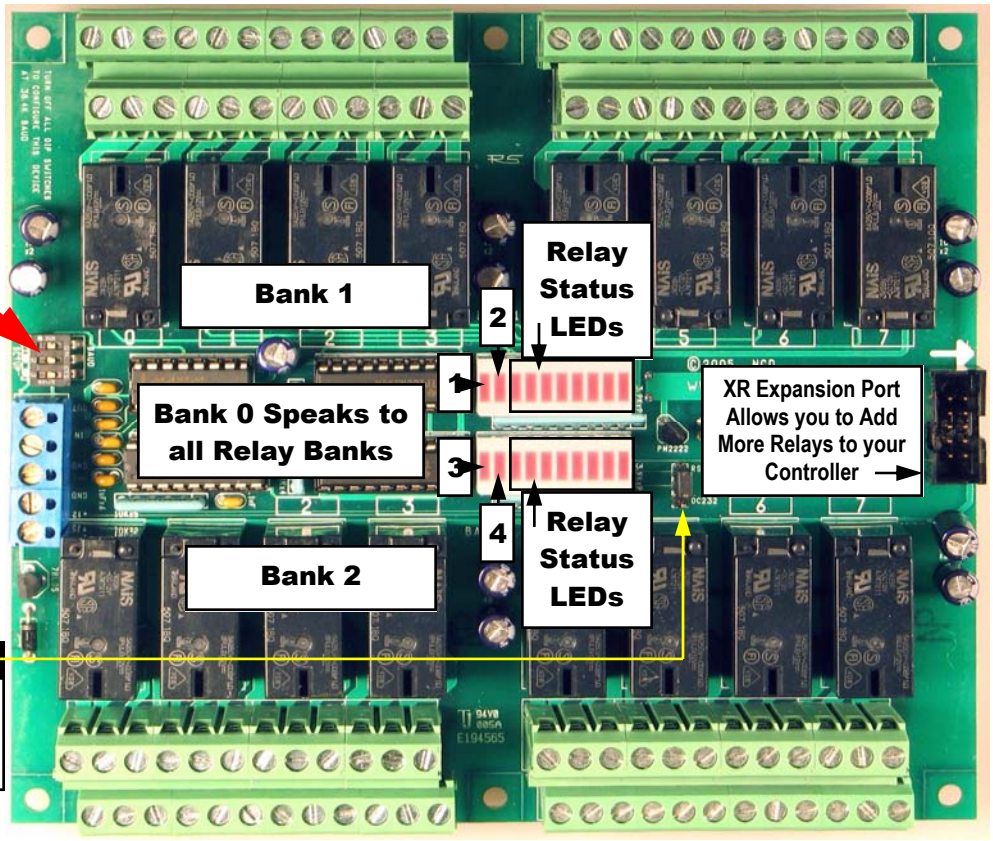
DIP Switch Settings

Switch:	1	2	3
*38.4K	Off	Off	Off
2400	On	Off	Off
4800	Off	On	Off
9600	On	On	Off
19.2K	Off	Off	On
38.4K	On	Off	On
57.6K	Off	On	On
115.2K	On	On	On

Did You Know?

The mechanical relays we have chosen for our controllers are rated to easily withstand ***several million continuous high-current switching cycles*** and have an operational life of more than 10 years. In many ways, today's mechanical relays can outlast solid state relays because of their mechanical ability to handle high current surges. In addition, the mechanical relays we have chosen are hermetically sealed, greatly reducing wear on the contacts by eliminating internal sparking.

Standard Hole Size is .156".
Standard Inset of Mounting Holes from any edge of the board is .175" from edge to Center of Mounting Hole.
We recommend the use of a #8 Screw with a Minimum .250" Standoff.
The component side of the R45, R410, R85, R810 Pro requires 3/4" minimum clearance.
The component side of any Controller with DPDT in the part number requires 1 1/4" minimum clearance.
The component side of any Relay Controller with 20 or 30 Amp Relay requires 1 1/2" minimum clearance.
NOTE: Some 20 or 30 Amp Relay Controller Varieties require direct connection to the top side of each relay. Additional clearance for the connectors is highly recommended.
Complete mechanical drawings for each device in the ProXR Series Line can be found on the product description page of each controller at www.controlanything.com.



RS-232 Data Output
RS-232 Data Input
RS-232 Ground
Power Ground
+12 Volt Input

DATA OUT: TTL/OC Jumper

OC232: Open Collector RS-232 Output Used for Networking Multiple Devices. **Requires RSB Booster in this mode.**

RS232: Standard RS-232 Data Output Mode. This is the default setting.

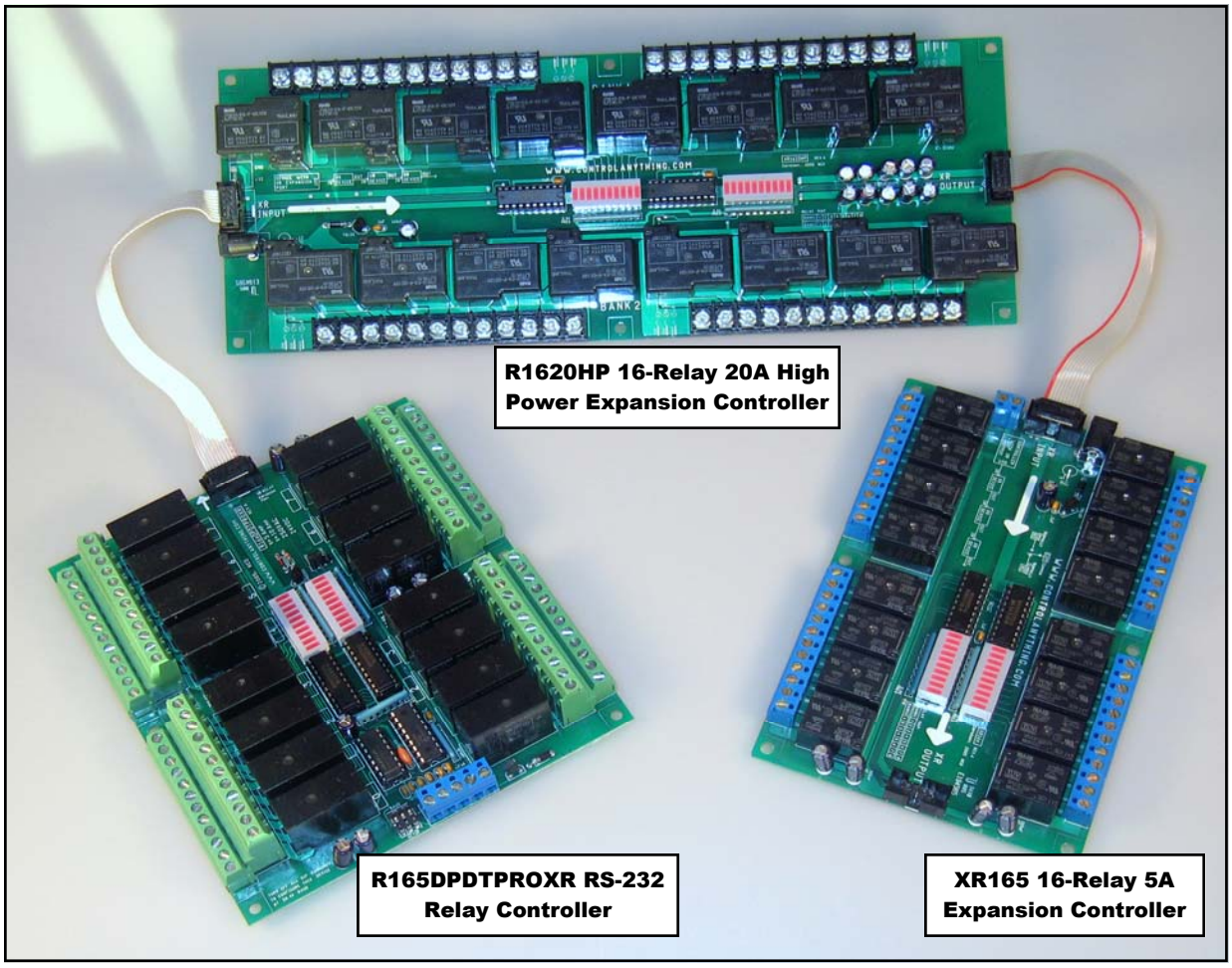
Please visit our web site for mechanical drawings of the ProXR Series Controller

Never Install NCD Relay Controllers Near High Power RF Transmitters, Such as CB Radio and Emergency Vehicle Voice/Data Transmitters. These Devices May Cause All Relays to Turn Off.

The XR Expansion Port

Adding Relay Banks with the XR Expansion Port

The ProXR Series controllers are equipped with an XR Expansion port. This port is used to chain relay controllers together, making it easy to add relay banks as your needs grow. We offer a large line of relay expansion boards, ready to attach to the XR port of your controller. The photo below shows how to connect multiple relay banks to a single ProXR relay controller. You can add all types of relay expansion banks in any combination to the ProXR series controllers.



Above

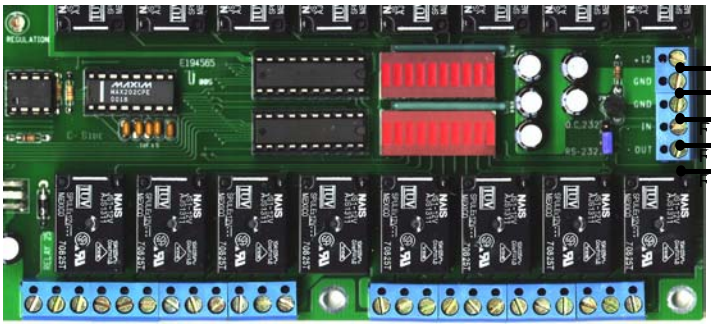
The R165DPDTPROXR relay controller is attached to an R1620HP relay controller, which is chained to an XR165 relay controller. The ProXR series controllers can be expanded with any NCD device with part numbers beginning XR. The expansion cables shown above are included with the XR series relay controllers. In the configuration shown above, there are 6 relay banks. The ProXR firmware supports a chain of up to 32 relay banks. Each relay controller can be powered by itself (we carry the appropriate power supply as a product option), or one large supply can be used to power all relay banks (not supplied).

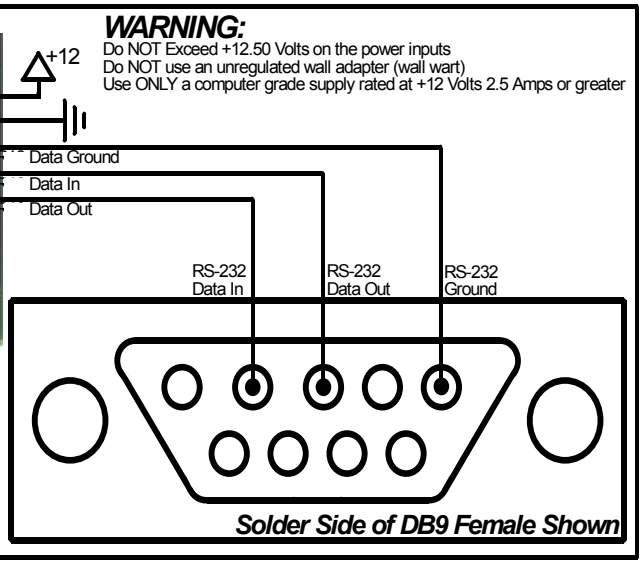
Two-Way Communication:

The ProXR Series Controllers support two-way communication for confirming the receipt of commands and for reporting the status of the relays back to the host computer.

The ProXR Series Controllers should be connected as shown below when using this device for the first time. Even if you plan to connect several controllers to a single serial port, this wiring diagram must first be used to program the device number into the controller.

Test Software Provided on our Web Site expxects this wiring configuration.





This illustration shows the R32 relay board, this wiring configuration is generically compatible with all NCD relay controllers, including “Pro” and “ProXR” series with a 5-position terminal block.

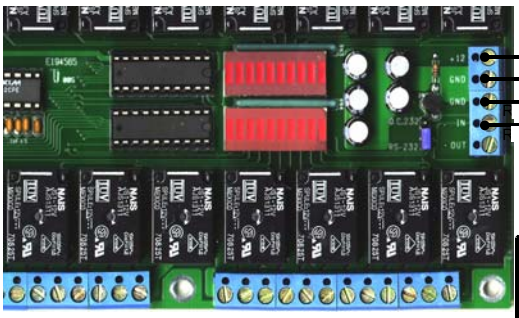
ProXR One-Way Communication:

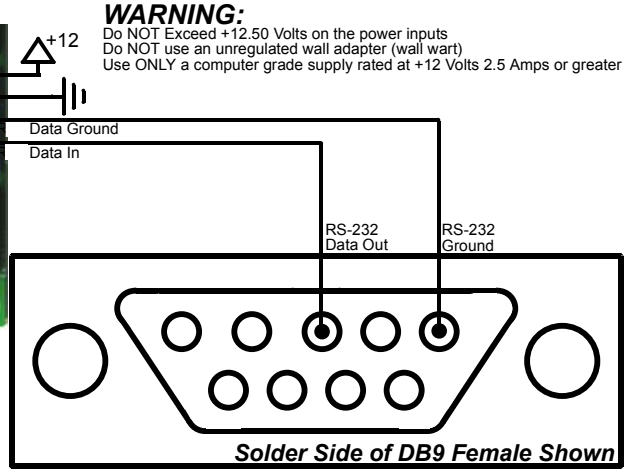
The ProXR Series Controllers can be connected to a computer or microcontroller using as little as two wires.

When used in 1-way mode, reporting should be turned off for highest communication speed. Turning off reporting will allow you to send commands to the ProXR Series Controllers much faster, but it is impossible to ask the controller for the status of relays when wired as shown below.

Reporting Mode is activated by sending ASCII character codes 254, 27.

Reporting Mode is deactivated by sending ASCII character codes 254, 28.





This illustration shows the R32 relay board, this wiring configuration is generically compatible with all NCD relay controllers, including “Pro” and “ProXR” series with a 5-position terminal block.

Multiple Relay Controllers: Two-Way & One-Way Hybrid Communication

Multiple NCD Devices can be connected to a single serial port and controlled individually. This example shows an R16 and an R32 connected to a single serial port.

Before using this wiring configuration, each device must be programmed with a unique device number (See E3C Commands in Both Manuals for Details). Once a device number has been stored into each controller this wiring configuration may be used to control up to 256 different relay boards or other NCD devices in any combination. This wiring configuration only allows 2-way communication with the R32. Relay status information cannot be read from the R16.

When all boards are first powered up, all devices will respond to incoming commands. Use E3C Command 252 to speak to one device at a time. Send 252, 0, any subsequent commands should be for the R32, Device 0. Send 252, 1, any subsequent commands should be for the R16, Device 1.

This E3C Command 252 is useful when mixing different types of controllers on a single serial port.

Multiple Device Control: Quick Example

Step 1: Store a Device Number from 0 to 255 into Each Controller. Example Shows Device 0 and 1.

Step 2: Route Commands to Device 0 Only by Sending the Following Commands:

ASCII 254	'Enter Command Mode
ASCII 252	'Select a Device to Control Command
ASCII 0	'Set Device to Control to 0

Step 3: Activate Relay 1 on Device 0 (R32)

ASCII 254	'Enter Command Mode
ASCII 1	'Relay On Command
ASCII 0	'Turn On Relay 1

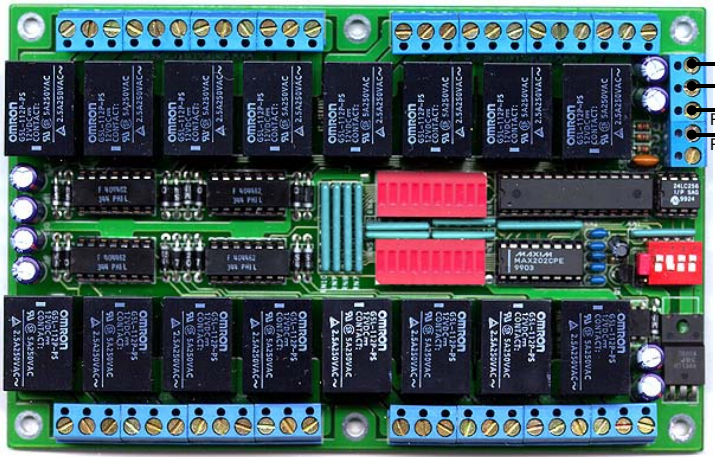
Step 4: Route Commands to Device 1 Only by Sending the Following Commands:

ASCII 254	'Enter Command Mode
ASCII 252	'Select a Device to Control Command
ASCII 1	'Set Device to Control to 1

Step 3: Activate Relay 1 on Device 1 (R16)

ASCII 254	'Enter Command Mode
ASCII 16	'Turn Relay 0 On

R16 Relay Controller:



R32 Relay Controller:

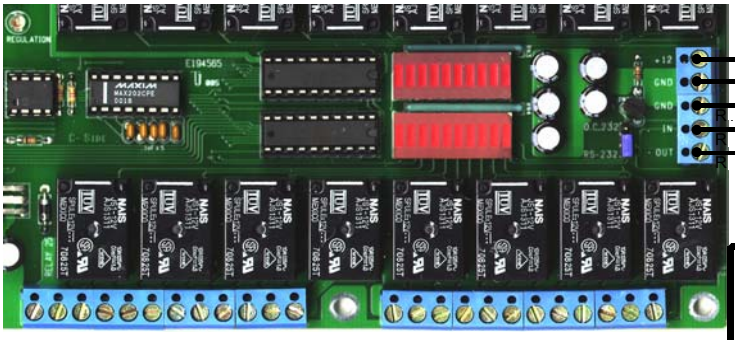
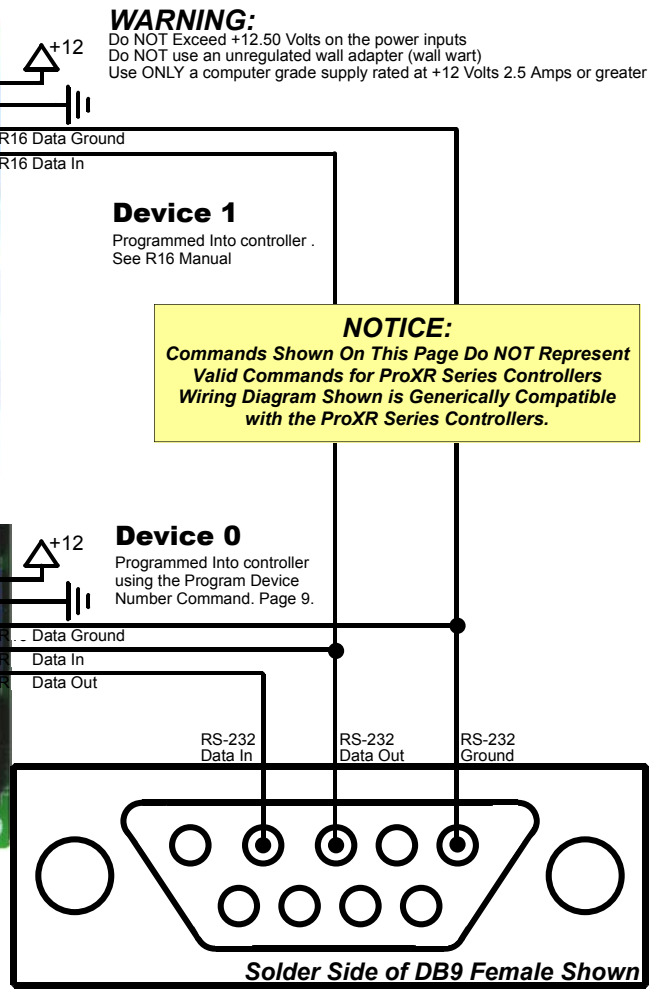


Illustration shows R32 relay board, this wiring configuration is the same for all NCD relay controllers, including "Pro" series with a 5-position terminal block.



Multiple Relay Controllers: Two-Way Communication

Our relay controllers support two-way communication to multiple devices using the RSB serial booster. Jumpers must be set for Open Collector data transmission. See the appropriate manual for your relay controller. This is ONLY required when using the RSB serial booster. The RSB serial booster should be used when controlling several devices over long distances (has been tested in excess of 500 feet). Actual reliability over long distances depends greatly on baud rate and type of wire used. Experimentation will be required. Always start at the lowest baud rate and work your way up.

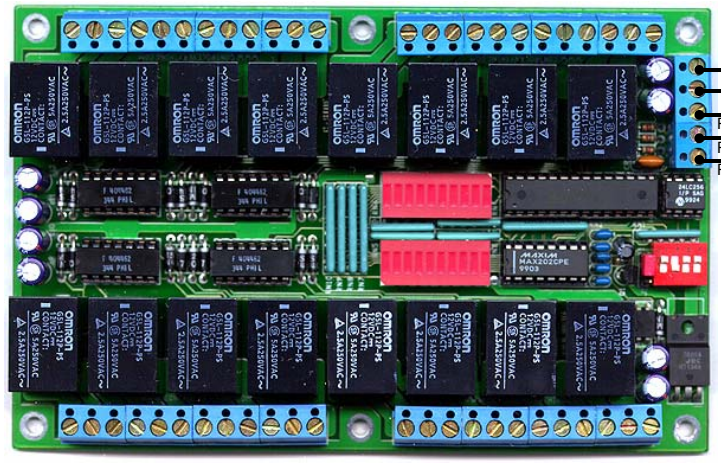
A unique device number should be programmed into each device prior to using this example.

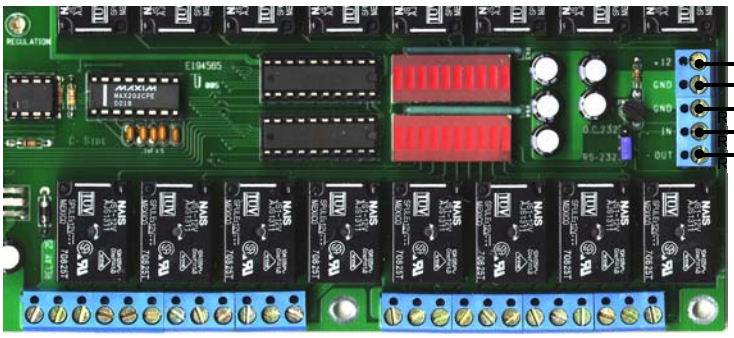
ProXR Version NOTICE:

ProXR Series Controllers are wired in the same way shown below, and are generically compatible with the diagrams shown on this page. ProXR Series Controllers also use the RS232/OC232 Jumper Referenced on this page. Dip Switch Settings Shown Below do Not Apply to the ProXR Series Controllers. Do Not Exceed 38.4K Baud when using the RSB Booster.

Selecting a Power Supply

1) *DO NOT USE A WALL WART TYPE UNREGULATED POWER SUPPLY.*
2) *USE ONLY A COMPUTER GRADE REGULATED SWITCHER SUPPLY RATED AT 12 VOLTS DC, 1.25 AMPS OR GREATER.*
3) *USE A SUPPLY RATED FOR MORE AMPERAGE WHEN POWERING MULTIPLE BOARDS.*
4) *DC POWER SHOULD NEVER TRAVEL GREATER THAN 20 FEET. A SEPARATE POWER SUPPLY SHOULD BE USED FOR EACH CONTROLLER IF CONTROLLERS ARE NOT LOCATED WITHIN 20 FEET OF EACH OTHER.*
5) *RELAY COILS ARE RATED AT 12 VOLTS DC. HIGHER VOLTAGES MAY SHORTEN THE COIL LIFE. LOWER VOLTAGES MAY CAUSE UNRELIABLE OPERATION, BUT WILL NOT DAMAGE THE CONTROLLER.*
6) *IT IS SAFE TO CONTROL ANY +12 VOLT RELAY CONTROLLER FROM AN AUTOMOTIVE POWER SYSTEM. YOU MAY DISREGARD THE +12.5 VOLT WARNING ON THIS PAGE AND THE PREVIOUS PAGE IN THIS APPLICATION.*





WARNING:
Do NOT Exceed +12.50 Volts on the power inputs
Do NOT use an unregulated wall adapter (wall wart)
Use ONLY a computer grade supply rated at +12 Volts 2.5 Amps or greater

+12
R16 Data Ground
R16 Data In
R16 Data Out

Jumpers MUST be Set between the Lower Two Terminals. Set jumpers opposite of what is shown in these photos.

Device 1
The Device Number is Programmed Into Controller using the E3C Command Set.

Connect up to 256 devices on a Single Serial Port. Each R16 MUST be Programmed with a Unique Device Number.

RS-232 Data In
RS-232 Ground
RS-232 Data Out

+12
Data Ground
Data In
Data Out

Device 0
The Device Number is Programmed Into Controller using the E3C Command Set.

Illustration shows R32 relay board, this wiring configuration is the same for all NCD relay controllers, including “Pro” series with a 5-position terminal block.

Limitations:

1) The RSB Serial Booster is NOT Compatible with Baud Rates above 38.4K Baud.
2) It is estimated that a single serial booster can control 256 Relay controllers. This has not been tested, and may be subject to other baud rate or distance limitations. Please contact us if you have application problems with this configuration.

PLEASE SEE THE MANUAL FOR THE RSB SERIAL BOOSTER FOR COMPLETE WIRING INFORMATION.

Sending Commands to the ProXR Series Relay Controllers

The ProXR Series Controllers are capable of sending and receiving data via RS-232 serial communications. ProXR Controllers are compatible with just about any computer or microcontroller ever produced, including the Macintosh, Amiga, Basic Stamp, and of course, Windows & DOS based machines.

Regardless of the system you are using, you will need access to a programming language that supports program control of the serial port on your computer.

A terminal program is not suitable for controlling NCD Devices unless it supports transmission of Binary ASCII Character Codes. Commands should be sent using ASCII character codes 0-255 rather than ASCII characters (A, B, C etc.). See "ASCII Codes vs. Characters" on this page.

Most systems require you to open the appropriate serial port (COM port) prior to sending or receiving data.

Because there are so many different ways to send and receive data from various languages on various platforms, we will provide generic instructions that can be easily converted to your favorite language.

For example, if this manual says "Send ASCII 254", the user will need to translate this instruction into a command that is capable of sending ASCII character code 254.

To Send ASCII 254 from Visual Basic, you will use the following line:

MSComm1.Output = Chr$(254)

In Qbasic, you can send ASCII 254 using the following line of code:

Print #1, Chr$(254);

Note that sending ASCII character code 254 is NOT the same as sending ASCII characters 2, 5, and 4 from a terminal program. Typing 2, 5, and 4 on the keyboard will transmit three ASCII character codes.

In your program, you may want to ask ProXR Controllers for the current status of relays, just to confirm their activation. If so, your programming language will support commands for reading data from the serial port.

For your convenience, we have provided several programming examples in Visual Basic 6 for controlling the ProXR Series Controller. These examples should greatly speed development time. You may want to visit **www.controleverything.com** for the latest software and programming examples.

Programming examples for the ProXR Series are much more extensive for Visual Basic 6 users than for any other programming language. If you are not a VB programmer, you may consider looking at the VB6 source code, as it is easily translated into other popular languages.

Regardless of your programming background, the provided Visual Basic 6 source code is very easy to understand and will likely resolve any communication questions you may have. VB6 programming examples may be viewed in any text editor.

ASCII Codes vs. Characters

The differences between ASCII codes and ASCII characters tend to generate a lot of confusion among first-time RS-232 programmers. It is important to understand that a computer only works with numbers. With regard to RS-232 data, the computer is only capable of sending and receiving numbers from 0 to 255.

What confuses people is the simple idea that the numbers 0 to 255 are assigned letters. For instance, the number 65 represents the letter A. The number 66 represents the letter B. Every character (including numbers and punctuation) is assigned a numeric value. This standard of assignments is called ASCII, and is a universal standard adopted by all computers with an RS-232 serial port.

ASCII characters codes can be clearly defined as numbers from 0 to 255.

ASCII characters however are best defined as letters, A, B, C, D, as well as punctuation, !@#$%, and even the numbers 0-9.

Virtually all programming languages permit you to send ASCII in the form of letters or numbers. If you wanted to send the word "Hello" out the serial port, it is much easier to send the letters H, e, l, l, and o than it is to send the ASCII character codes that represent each letter.

For the purposes of controlling NCD devices however, it is much easier to build a numeric command set. Especially when communicating to devices where you want to speak to lots of outputs (which are numbered), inputs (which are also numbered), or control specific devices using their device number (from 0 to 255).

Put simply, it is easier to control NCD devices using ASCII character codes 0 to 255 than it is to use ASCII characters A, B, C, D, etc.

Because terminal programs are ASCII character based, it may be difficult to generate the proper series of keystrokes that would be necessary to activate a particular function. Therefore, they are not suitable for controlling NCD devices. In a real world control application, a terminal program would not likely be used to control NCD devices anyway. Therefore, a programming language that supports the transmission and reception of ASCII character codes 0 to 255 is highly recommended.

Visual Basic 4, 5, 6
We have posted a Visual Basic 6 tutorial in the "Developers Toolbox" section of our web site. This tutorial is available by clicking here. This same tutorial can be also be downloaded along with a .NET tutorial in the Universal Device Manual available from our web site by clicking here.

.NET Express
You can also use Visual Basic Express to speak to NCD devices. VB Express is free from Microsoft. At the time of writing, Microsoft offers a free download by clicking here. Click the large camouflaged "Download Now" button on the right side of the screen.

We have also posted a tutorial for using .NET Express in the Universal Device Manual, available from our web site by clicking here.

The E3C Command Set: Software Control of Multiple NCD Devices

The E3C command set allows you to control up to 256 NCD devices from a single serial port. It is OK to mix different types of devices, as long as the devices are E3C compliant. The R4x/R8x Pro relay controllers support the full set of E3C commands, plus a set of extended commands for storing and recalling the device number.

How does E3C Work?
First of all, each device must be assigned a device number from 0 to 255. The ProXR Contrroller must be programmed with a device number, which is accomplished using the "Store Device Number" command shown below.

E3C stands for Enabled 3-Wire Communication. Put simply, all devices will respond to your commands when powered up.

Using the E3C command set, you can specify which devices will listen and which devices will ignore your commands. Note that E3C commands are never ignored by any device, regardless of the commands you send to the controller.

The number to the left of each command indicates the ASCII character code that must be sent to issue the command. All commands must be preceded with ASCII character code 254 to place the device in command mode. See examples at right.

The E3C Command Set

254, 248 Enable All Devices:
Tells all devices to respond to your commands.

254, 249 Disable All Devices:
Tells all devices to ignore your commands.

254, 250 Enable a Selected Device:
Tells a specific device to listen to your commands.

254, 251 Disable Selected Device:
Tells a specific device to ignore your commands.

254, 252 Enable Selected Device Only:
Tells a specific device to listen to your commands, all other devices will ignore your commands.

254, 253 Disable a Selected Device Only:
Tells a specific device to ignore your commands, all others will listen.

Extended E3C Commands

The ProXR Series Controllers support three additional E3C commands which should only be used when a single device is attached to your serial port. Extended commands will report back to the computer.

254, 255 Store Device Number:
Stores the device number into the controller. The device number takes effect immediately. The enabled/disabled status of the device is unchanged.

254, 246 Recall Device Identification:
This command reports back 4 bytes of data:
ProXR Device ID Part 1: 1
ProXR Device ID Part 2: 0
ProXR Firmware Version: 17 (or newer)
ProXR Year of Firmware Production: 205 (or newer)
ProXR E3C Device Number

254, 247 Recall Device Number:
Reads the stored device number from the controller.

E3C Visual Basic Programming Examples

The E3C command set is easily used from any programming language that supports serial communication. The following Visual Basic 6 Example source code demonstrates subroutines that can be used to control which devices will listen and which devices will ignore your commands.

Most commands issued to the ProXR Series Controllers are acknowledged by sending ASCII character code 85 back to the host computer (when reporting is turned on). E3C commands are not acknowledged regardless of the reporting mode.

Sample Code: The E3C Command Set

```
'Enable All E3C Devices
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(248)   'E3C Enable All Device Command

'Disable All E3C Devices
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(249)   'E3C Disable All Device Command

'Enable A Specific E3C Devices, Other Devices will be unchanged
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(250)      'E3C Disable Specific Device Command
MSComm1.Output = Chr$(Device) 'Device Number that will be Disabled

'Disable A Specific E3C Devices, Other Devices will be unchanged
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(251)      'E3C Disable Specific Device Command
MSComm1.Output = Chr$(Device) 'Device Number that will be Disabled

'Disable All E3C Devices Except (Device)
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(252)      'E3C Disable All Device Except Command
MSComm1.Output = Chr$(Device) 'Device Number that will be Active

'Enable All E3C Devices Except (Device)
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(253)      'E3C Enable All Device Except Command
MSComm1.Output = Chr$(Device)  'Device Number that will be Inactive

'Store an E3C Device Number into the Controller
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(255)      'E3C Store Device Number Command
MSComm1.Output = Chr$(Device) 'Device Number that will be Stored
WaitForReply                    'Wait for Acknowledgement

'Store an E3C Device Number into the Controller
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(246)      'Get Device Information
Debug.Print GetData             'Device ID Number Part 1
Debug.Print GetData             'Device ID Number Part 2
Debug.Print GetData             'Device Firmware Version
Debug.Print GetData             'Device Year of Manufacture 205 = 2005, 206 = 2006

'Read the E3C Device Number from the Controller
MSComm1.Output = Chr$(254)    'Enter Command Mode
MSComm1.Output = Chr$(247)    'E3C Get Device Number Command
Debug.Print GetData           'Display E3C Device Number

'Read a Byte of Data from the Serial Port
Public Function GetData()
Do                                      'Wait for Device to Reply
   DoEvents                             'Allow Windows to MultiTask
Until MSComm1.InBufferCount > 0         'If the Device Replies
GetData = Asc(MSComm1.Input)            'Get Data from Device
End Fucntion
```

ProXR Version NOTICE:

ProXR Series Controllers Only Allow you to use the "Store E3C Device Number" Function while in "Configuration Mode". This prevents accidental modification of the E3C device number under normal operation if an incorrect series of commands are sent to the controller. So make sure the ProXR Controller is in configuration mode when storing the E3C device number. Simply turn off all DIP Switches and Power Cycle the controller to enter configuration mode.

STOP HERE:

VERY IMPORTANT READING ON THIS PAGE

Understanding Relay Banks and Basic Control Concepts:

A Relay Bank is Simply a Group of 8 Relays. The ProXR Series Controllers allow you to control up to 256 relays (32 relay banks). You control which bank of relays you are speaking to at all times. It is VERY IMPORTANT that you understand that there are two ways to specify which relay bank you are talking to. These topics will be discussed in greater length later in this manual, providing you with specific instructions and program examples. This page will help prepare you for seeing two different command that do the same thing. In this manual, you will see the work "Bank". This word should be equated to a number from 0 to 32. A value of 1 speaks to relay bank 1 (the first 8 relays on the board). A value of 2 speaks to relay bank 2 (the second group of 8 relays on the board). A value of 32 speaks to the last group of 8 relays (which is connected to the main controller using the XR expansion ports). A value of 0 speaks to all banks of relays at one time. When bank 0 is selected, you can then specify a command to turn on relay 1, and relay 1 on all relay banks will be activated. There will be more examples of this and detailed information on each command. But understanding the concept of controlling multiple relays across multiple banks is very important to your understanding how our controller command set is organized.

Bank Directed Commands:

a) You Specify a Relay Bank (there is a command you will send just for this purpose).
b) All Subsequent Commands will be directed to the previously specified relay bank.
c) You Specify a different Relay.
d) All Subsequent Commands will be directed to the new relay bank you have specified.

Bank Specified Commands:

a) You Specify a Relay Bank with every command.
While this method is slightly slower, it ensures commands are always directed to the correct relay bank.

Understanding Relay Bank Refreshing:

Controlling Multiple Banks

Under normal operation, you will send a command to the relay controller, and the relay controller will respond to your command by activating or deactivating a relay. This system works well if you only need to control 1-8 relays, but it does not necessarily work very well if you are taking advantage of the XR Expansion ports, allowing you to control up to 256 relays (32 relay banks). In these cases, you may want to set the status of all relays at the exact same time. The easiest way to do this is to turn off automatic relay refreshing. Once turned off, you can use the relay control command set to activate relays, but the commands will not appear to have any effect. The effects will not be seen until you manually refresh the relay bank. Rest assured, when auto refreshing is off, your relay control commands are working, the processor memory is copied to the physical relay bank memory when you manually refresh the relays. Follow this methodology to set the status of lots of relays at one time across multiple banks:

a) Turn Off Relay Bank Auto Refreshing.
b) Use Relay Control Command to Activate Different Relays on Different Banks.
These commands will not appear to work, they will only modify internal memory.
c) Send the Manual Refresh Command to Update All Relays at One Time.

Command codes will be shown in blue. Send these values to the controller to activate the command.
Any returned data will be shown in green.
Warnings and special notes will be shown in red.

STOP HERE:

VERY IMPORTANT READING ON THIS PAGE

Relay Banking Commands

The ProXR Series Controllers allow you to control up to 256 relays. Relays are divided into groups of 8 called Banks, and are addressed by their bank number. For instance, a ProXR series controller with 32 on-board relays has four on-board banks, the on-board relays respond to Bank values of 1-4. If you use the XR Expansion port to add another bank of 24 relays, then you will need to specify bank values of 5-7 to control the extra relays. The firmware doesn't actually know how many relays are attached to the relay controller, but it assumes there are 256 relays (banks values 1-32, which is the maximum supported number of relays for Version 1.0 firmware).

In this manual, you will see two commands that appear to do the same thing, for example:

254,0-7 ***Turn Off Individual Relays***
254,100-107, Bank ***Turn Off Individual Relays in*** *Bank*

254,8-15 ***Turn On Individual Relays***
254,108-115 ***Turn On Individual Relays in Bank***

254,16-23 ***Get the Status of an Individual Relay***
254,116-123, Bank ***Get the Status of an Individual Relay in Bank***

While the outcome is the same, these commands function in slightly different ways.

For instance:
254,8 ***Turn On Relay 1***

To make this command work, you will send a 254, then a 8 to activate a relay. By default, relay bank 1 will be affected by this command. However, you can redirect this command to a different relay bank using the following command:

254,49,2 ***Direct Commands to Relay Bank 2***

Then you can send:

254,8 ***Turn On Relay 1 in Bank 2***

Here are more examples:

254,49,1 ***Direct Commands to Relay Bank 1***
254,8 ***Turn On Relay 1 in Bank 1***
254,49,2 ***Direct Commands to Relay Bank 2***
254,8 ***Turn On Relay 1 in Bank 2***
254,9 ***Turn On Relay 2 in Bank 2***
254,10 ***Turn On Relay 3 in Bank 2***
254,49,3 ***Direct Commands to Relay Bank 3***
254,8 ***Turn On Relay 1 in Bank 3***
254,11 ***Turn On Relay 4 in Bank 3***
254,12 ***Turn On Relay 5 in Bank 3***
254,13 ***Turn On Relay 6 in Bank 3***
254,14 ***Turn On Relay 7 in Bank 3***
254,49,0 ***Direct Commands to All Relay Banks***
254,8 ***Turn On Relay 1 in All Relay Banks***

This command structure has the advantage of being very fast and efficient. However, if power to the controller is ever lost, commands will automatically be directed to bank 1 when power to the controller has been restored.

We have also included a set of commands that require you to specify the bank as part of the command structure. This ensures commands are always directed to the correct relay bank. Here are a few examples:

254,108, 1 ***Turn On Relay 1 in Bank 1***
254,108, 2 ***Turn On Relay 1 in Bank 2***
254,109, 2 ***Turn On Relay 2 in Bank 2***
254,110, 2 ***Turn On Relay 3 in Bank 2***
254,108, 3 ***Turn On Relay 1 in Bank 3***
254,111, 3 ***Turn On Relay 4 in Bank 3***
254,112, 3 ***Turn On Relay 5 in Bank 3***

254,112, 0 ***Turn On Relay 5 in All Relay Banks (Bank 0)***

Relay Refreshing:
Controlling Large Groups of Relays

The ProXR Series Controllers allow you to manually or automatically refresh relay banks. When you first receive your ProXR Series Controller, Relay Refreshing is turned on. Meaning every time you send a relay control command, the relays will respond to your commands.

Turning off relay refreshing allows you to control when the relays actually switch. When refreshing is turned off, you can send relay control commands to the ProXR controller, and the controller will work just like normal, but the relays will never change state.

You can then use the Manual Refresh command to set the status of all relays at one time. Weather you are controlling 1 or 235 relays, you will be able to refresh all relays at one time to any given state by taking manual control of the relay refreshing capabilities. Here are some simple programming examples in VB:

254,25 ***Turn On Automatic Relay Refreshing***
Setting Automatically Stored when in Configuration Mode
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(25)   'Turn ON Refresh Command
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

254,26 ***Turn Off Automatic Relay Refreshing***
Setting Automatically Stored when in Configuration Mode
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(26)   'Turn Off Refresh Command
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

254,36 ***Report Back Stored Refresh Settings***
This command reports back a 0 or 1, indicating weather automatic refreshing is Off or On when power is first applied to the controller.
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(36)   'Read Default Powerup Refreshing Status
```
(Controller will report back ASCII Character Code 0 or 1)

254,37 ***Manually Refresh Relay Bank***
This command stores the current status of relay refreshing in non-volatile memory. The next time the relay controller is powered up, refreshing will be set to the stored state.
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(37)   'Manually Refresh Relays Command
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Application: Manual Refreshing Relay Banks
This simple application example demonstrates the process required to activate more than 8 relays simultaneously. In the example below, we will demonstrate how to apply the Manual Refreshing command to large groups of relays.

Step 1: Turn Off Automatic Refreshing
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(26)   'Turn Off Refresh Command
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Step 2: Activate Several Relays on Several Relay Banks (note: relays will not be updated, they will not appear to change).
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(108)  'Turn On Relay 1
MSComm1.Output = Chr$(1)    'On Bank 1
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(111)  'Turn On Relay 4
MSComm1.Output = Chr$(2)    'On Bank 2
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(113)  'Turn On Relay 6
MSComm1.Output = Chr$(3)    'On Bank 3
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

...You can keep adding relay control commands to activate different relays on different banks, but keep in mind, these commands will not appear to function. These commands are changing the memory pattern for the relays inside the controller. You will not see the effects of your changes until you send a Manual Refresh command. You can return to automatic refreshing at any time. Turning on automatic refreshing does NOT refresh the relays until the NEXT relay control command is issued.

Step 3: Update All Relays at the Same Time (Manually Refresh)
```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(37)   'Manually Refresh Relays Command
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

The ProXR Command Set

The ProXR Series Controllers support an extensive command set, used to control relays, set operation modes, and store and recall relay status. Most users will only use a few of the functions built into this controller. The best way to learn the capabilities of the ProXR series is to carefully read through the command set. The "plain English" examples provide a quick, easy to understand definition of each command.

The ***number in blue*** to the left of each command indicates the ASCII character code that must be sent to issue the command. All commands must be preceded with ASCII character code 254 to place the device in command mode. See examples at right.

Some commands require that you specify a Bank value from 0-32, selecting the relay bank you would like to control. A value of 0 selects all banks. Bank values of 1-4 control up to 32 On-Board relays. When powered up, the default Bank value in the controller is always 1.

Controlling Individual Relays

254,0-7 ***Turn Off Individual Relays***
254,100-107, Bank ***Turn Off Individual Relays in Bank***

254,8-15 ***Turn On Individual Relays***
254,108-115 ***Turn On Individual Relays in Bank***

Reading the Status of Individual Relays

254,16-23 ***Get the Status of an Individual Relay***
254,116-123, Bank ***Get the Status of an Individual Relay in Bank***
This command allows you to read the on/off status of an individual relay. 16 (or 116) corresponds to relay 1, 23 (or 123) corresponds to relay 8. This command will return a 1 indicating the relay is ON or a 0 indicating the relay is OFF.

NOTICE: A BANK VALUE OF 0 IS INVALID FOR THIS COMMAND. RETURNED RESULTS MAY BE UNPREDICTABLE.

254, 24 ***Get the Status of All Relays***

Reading the Status of Relay Banks

254, 124, Bank ***Get the Status of All Relays in Bank***
This command allows you to read the status of a single bank of relays. A value of 0-255 is returned indicating the status of all 8 relays. The binary pattern of the value returned directly corresponds to the on/off status of each of the 8 relays in the selected relay bank. If the currently selected relay bank is 0, or if you specify relay bank 0, then the status of all 32 relay banks will be sent. In this condition, your program should be written to read 32 bytes of data from the serial port.

254, 27 ***Turn Reporting Mode ON***

Reporting Mode

254, 28 ***Turn Reporting Mode OFF***
This command sets and stores (in non-volatile EEPROM while in configuration mode only) the reporting mode status. Reporting mode, by default, is ON, meaning every time a command is sent to the controller, the controller will send an 85 back to the computer, indicating that the command has finished executing your instructions. We recommend leaving it on, but doing so requires 2-Way communication with the controller. You should turn it off if you intend to use 1-Way communication only. A delay between some commands may be required when using 1-Way communications. For optimum reliability, leave reporting mode on and use 2-Way communications with the ProXR Series controllers.

NOTE: Reporting Mode may be turned on or off at any time. The default power-up status of reporting mode is ONLY stored when the device is in configuration mode (all dip switches off when the controller is powered up).

Visual Basic Programming Examples

A Many Visual Basic 6 programming examples are provided in the following pages to assist in the development of software for controlling the ProXR Series relay controllers. Additional source code can be found on our web site at www.controleverything.com.

Sample Code: Controlling Individual Relays

254,0 ***Turn Off Relay 0 in Selected Bank***
254,100,1 ***Turn Off Relay 0 in Bank 1***
254,8 ***Turn On Relay 0 in Selected Bank***
254,108,2 ***Turn On Relay 0 in Bank 2***

These commands are used to turn a relay on or off under computer control. Here is an actual code sample for VB6 that shows how to use these commands:

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(8)    'Activate Relay 0 on the Currently Selected Relay Bank
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(108)   'Activate Relay 0
MSComm1.Output = Chr$(2)    'In Relay Bank 2
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Sample Code: Reading Status of Relays

254,16 ***Read the Status of Relay 0 in Selected Bank***
254,116,2 ***Read the Status of Relay 0 in Bank 2***
254,117,5 ***Read the Status of Relay 1 in Bank 5***

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(16)   'Read On/Off Status of Relay 0 on Currently Selected Relay Bank
```
(Controller will report back ASCII Character Code 0 or 1 indicating relay status)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(116)  'Read On/Off Status of Relay 0
MSComm1.Output = Chr$(2)    'In Relay Bank 2
```
(Controller will report back ASCII Character Code 0 or 1 indicating relay status)

Sample Code: Reading Relay Bank Status

254,24 ***Read the Status of All 8 Relays in a Selected Bank***
254,124,2 ***Read the Status All 8 Relay in Bank 2***
254,124,0 ***Read the Status of All 8 Relays in All 26 Banks***

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(24)   'Read Status of All Relays in Currently Selected Relay Bank
```
(Controller will report back ASCII Character Codes 0-255, Convert to Binary to See Relay Pattern)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(124)  'Read Status of All Relays
MSComm1.Output = Chr$(2)    'In Relay Bank 2
```
(Controller will report back ASCII Character Codes 0-255, Convert to Binary to See Relay Pattern)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(124)  'Read Status of All Relays
MSComm1.Output = Chr$(0)    'In ALL Relay Banks
```
(Controller will report back 26 ASCII Values from 0 to 255, Indicating the Status of all 26 Relay Banks, Beginning with Bank 1. Convert Returned Values to Binary to See Actual Relay Pattern)

Sample Code: Reporting Mode

NOTE: USE OTHER RELAY CONTROL COMMANDS TO SET RELAYS TO THE DESIRED POWERUP STATE BEFORE ISSUEING THIS COMMAND. FOR INSTANCE, IF YOU WANT ALL RELAYS TO COME ON AT POWERUP, USE OTHER RELAY CONTROL COMMANDS TO ACTIVATE ALL RELAYS, THEN ISSUE THIS COMMAND. THE NEXT TIME POWER IS APPLIED TO THE CONTROLLER, ALL RELAYS WILL AUTOMATICALLY ACTIVATE.

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(27)   'Turn On and Store Reporting Mode in EEPROM
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(28)   'Turn Off and Store Reporting Mode in EEPROM
```
(Controller will no-longer report back 85, commands that request data from the controller, such as relay status, will still function correctly.)

Please Review Pages 10 and 11 to Better Understand how to Direct Commands to Different Relay Banks

The ProXR Command Set

All Relays On/Off

254, 29 ***Turn All Relays On***
254, 129, Bank ***Turn All Relays On in Bank***

This command is used to activate all relays in a selected relay bank.

54, 30 ***Turn All Relays Off***
254, 130, Bank ***Turn All Relays Off in Bank***

This command is used to turn all relays off in a selected relay bank.

NOTE: A Bank Value of 0 applies this command to all relay banks.

254, 31 ***Invert All Relays***

Sample Code: All Relays On/Off

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(29)   'Activate All Relays in the Selected Relay Bank
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(129)  'Activate All Relays
MSComm1.Output = Chr$(2)    'In Relay Bank 2
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(30)   'Deactivate All Relays in the Selected Relay Bank
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(130)  'Deactivate All Relays
MSComm1.Output = Chr$(2)    'In Relay Bank 2
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Inverting Relays

254, 131, Bank ***Invert All Relays in Bank***

This command is used to Invert the status of all relays. Relays that were on turn off, relays that were off turn on. For example:
254, 32 ***Reverse All Relays***

Original Relay Pattern	0 ON	1 OFF	2 ON	3 ON	4 OFF	5 OFF	6 OFF	7 OFF
Inverted Relay Pattern	0 OFF	1 ON	2 OFF	3 OFF	4 ON	5 ON	6 ON	7 ON

Sample Code: Inverting Relays

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(31)   'Invert All Relays in the Selected Relay Bank
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(131)  'Invert All Relays
MSComm1.Output = Chr$(3)    'In Relay Bank 3
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Reversing Relays

254, 132, Bank ***Reverse All Relays in Bank***

This command is used to reverse the current pattern of relays in a given relay bank. For example:
254, 33 ***Test 2-Way Communications with Controller***

Original Relay Pattern	0 ON	1 OFF	2 ON	3 ON	4 OFF	5 OFF	6 OFF	7 OFF
Reversed Relay Pattern	0 OFF	1 OFF	2 OFF	3 OFF	4 ON	5 ON	6 OFF	7 ON

Sample Code: Reversing Relays

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(32)   'Reverse All Relays in the Selected Relay Bank
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(132)  'Reverse All Relays
MSComm1.Output = Chr$(3)    'In Relay Bank 3
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Test 2-Way Communication

This command is used to test 2-Way communications between the PC and the relay controller. This command does nothing except report back an ASCII character code 85 when executed.

254, 34 ***Report to User the Selected Relay Bank***

Sample Code: Reversing Relays

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(33)   'Test 2-Way Communications with Relay Controller Command
```
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Reading the Currently Selected Relay Bank

This command queries the relay controller and reports back the relay bank all commands are being sent to. The importance of relay bank selection is discussed heavily on pages 10 and 11 of this manual. You can redirect relay control commands to a different relay bank by sending ***254, 49, Bank*** discussed later in this manual.
254,25 ***Turn On Automatic Relay Refreshing***

Sample Code: Reading Selected Relay Bank

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(34)   'Report Selected Relay Bank to User
```
(Controller will report back ASCII Character Codes 0-26, indicating which relay bank commands will be directed to)

Relay Refreshing Commands

254,26 ***Turn Off Automatic Relay Refreshing***
254,35 ***Store Relay Refreshing Mode***
254,36 ***Report Back Stored Refresh Settings***
254,37 ***Manually Refresh Relay Bank***

Relay Refreshing is discussed heavily on pages 10 and 11, and are considered some of the most important “foundation” concepts for taking advantage of all the features the ProXR series controllers have to offer. Please reference these pages for detailed explanation and examples.

Please Review Pages 10 and 11 to Better Understand how to Direct Commands to Different Relay Banks

The ProXR Command Set

Set the Status of a Relay Bank

254, 40, RelayData ***Set the Status of Relays***
254, 140, RelayData, Bank ***Set the Status of Relays in Bank***

This command writes a byte of data directly to a relay bank. This allows you to easily set the status of 8 relays at one time. RelayData is a parameter value from 0-255. A value of 0 turns off all the relays. A value of 255 turns on all the relays. Other values set the status of the relays in the equivalent binary pattern of the RelayData parameter value.

NOTE: A Bank Value of 0 applies this command to all relay banks.

Sample Code: Setting Relay Bank Status

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(40)   'Set the Status of All Relays in the Selected Relay Bank
MSComm1.Output = Chr$(170)  '0-255 Valid Range, Data is Written Directly to Relay Bank
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(140)  'Set the Status of All Relays in the Selected Relay Bank
MSComm1.Output = Chr$(170)  '0-255 Valid Range, Data is Written Directly to Relay Bank
MSComm1.Output = Chr$(1)    'In Relay Bank 1
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)
```

Power Up Relay Status Configuration

254, 42 ***Store Power Up Default Status***
254, 142, Bank ***Store Power Up Default Status in Bank***

This command stores the current status of the relays in a given bank into memory. The next time power is applied to the controller, relays will return to the stored on/off state. A bank value of 0 stores the pattern of all relays in all 26 banks.

254, 43 ***Read Power Up Default Status***

Sample Code: Relay Status on Power Up

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(42)   'Store Relay Settings in the Selected Relay Bank
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(142)  'Store Relay Settings
MSComm1.Output = Chr$(2)    'In Relay Bank 2
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)
```

Read Power Up Relay Status Configuration

254, 143, Bank ***Read Power Up Default Status in Bank***

This command reads the stored power-up default status of the relays in a given bank. A bank value of 0 reports back 26 bytes of data, indicating the stored pattern of all 26 relay banks.

254, 49, Bank ***Direct Commands to Selected Relay Bank***
This command is used to direct commands to a selected relay bank.

Sample Code: Read Relay Status on Power Up

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(43)   'Read Relay Settings in the Selected Relay Bank
(Controller will report back ASCII Character Codes 0-255, Convert to Binary to See Relay Pattern)

MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(143)  'Read Relay Settings
MSComm1.Output = Chr$(1)    'In Relay Bank 1
(Controller will report back ASCII Character Codes 0-255, Convert to Binary to See Relay Pattern)
```

Changing Relay Banks

All subsequent commands will be sent to the selected relay bank. This command only applies to commands values less than 100. Commands in the 100+ value range allow you to specify a relay bank as part of the command.

NOTE: Complete details on relay banking is described on Pages 10 and 11 of this manual.

Sample Code: Changing Relay Banks

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(49)   'Direct Relay Control Commands
MSComm1.Output = Chr$(2)    'To Relay Bank 2
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(8)    'Activate Relay 0 on Bank 2 (Bank is Selected in Above Command)
(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)
```

Helpful Routines and Safe Programming Practices

There are Two helpful Routines you may want to structure into your program that helps handle serial communications. First, the ClearBuffer routine can be called prior to sending each command to the relay controller, helping ensure the serial buffer is empty and the new command is not returning old data to your program. This has been a problem for some customers, and it is easily avoided. While this is not always necessary, it should be troubleshooting starting point if the controller seems to be sending you invalid data.

Clearing the Serial Buffer

```
Public Function ClearBuffer()
  While MSComm1.InBufferCount > 0   'If there is data in the serial port
    DUMP = Asc(MSComm1.Input)       'Read Data Byte from the Serial Port
    DoEvents                        'Service Other Windows Tasks (Very Important!!!)
  Wend                              'Repeat the Check Again, Loop will Repeat until Empty
End Function
```

Second, the GetData routine should be used to read data from the controller. This simple routine waits for data to arrive in the serial buffer. Once it arrives, it grabs the data, and stores the value in the GetData variable.

Reading a Byte of Data from the PC

```
Public Function GetData()           'Read a Byte of Data from the Controller in VB
  Do                                'Start a Continuous Loop
    DoEvents                        'Service Other Windows Tasks (Very Important!!!)
  Until MSComm1.InBufferCount > 0   'Continue Loop Until a Byte of Data is Received
  GetData = ASC(MSComm1.Input)      'Read Data Byte from the Serial Port
End Function
```

Please Review Pages 10 and 11 to Better Understand how to Direct Commands to Different Relay Banks

The ProXR Command Set: Watchdog, Keep Alive, and Server Reboot Applications

16 User-Programmable Timers

The ProXR Series controllers have 16 user-programmable timers. Each independent timer can be assigned to any relay, and can be programmed to hold the relay in the On state, or to pulse the relay at the end of the timer.

The ProXR timing features are ideally suited for Watchdog, Keep Alive, and Server Reboot applications, as well as sprinkler systems, gate openers, and day/night lighting applications.

Relay Timing Features support two modes of operation: Duration and Pulse. Duration timing is ideally suited for keeping a light on overnight, watering the lawn for a given period of time, or other applications where a device should be activated for a period of time. Pulse timing mode is designed specifically for server reboot applications, whereby, if the timer is not reset periodically by your software, the timer will run out and reboot your computer.

Interactive Timing Commands

The ProXR timing commands can be used by themselves, or in conjunction with other commands, as building blocks to create some very sophisticated timing applications. The timing command set covers many aspects of relay activation/deactivation, making the ProXR series ideally suited for a broad range of timing tasks.

Limitations

The ProXR series controllers do NOT have an integrated real-time clock. NCD Devices are not typically stand-alone. They require computer interaction with the controller. Time scheduling is possible, but it would require a program to be written on the PC to handle the schedule. The timing features are suitable for applications where you may want a light to go on for 5 minutes, or you may want to keep a relay alive to prevent a server from automatically rebooting. The ProXR series controllers are capable of processing timing commands as long as 255 hours, 255 minutes, and 255 seconds (4 Days, 19 Hours, 19 Minutes, and 15 Seconds) + Deviation.

Timing Accuracy

The Accuracy of the relay timers is largely dependant on how many timers are in use, and how much communication you do with the controller while the timing commands are processing.

When a timer is already active, and you engage another timer, the duration of the previously set times may be increased by as much as one full second. You can enable all timers simultaneously if you need more accurate timing.

Best timing accuracy is achieved by setting up your timing commands and leaving the controller alone during the timing operations. Each time you communicate with the controller, you will slow down the timer (lengthening the time period the timer is set for). The more you communicate with the controller, the more you will slow down all timers. Timing accuracy tends to drift over time. This timing functions built into this controller should NOT be used if timing accuracy is critical. The timing feature are, however, very useful in applications where a little timing drift is not a big concern.

Timing Calibration

Timing is generically recalibrated for 60 seconds using 8 timers. Our test controller calibration value was 26,576. In other words, a calibration value of 26,576 equals 1 second when the controller is only processing timing tasks.

The calibration value was established on our prototype and may be off by as much as 3% based on individual resonator, processor, and temperature characteristics. Baud rate was set at 115.2K when this number was established. The calibration value may need to be changed for other baud rates, but 115.2K baud is the best choice for calibration.

You can adjust the calibration value at any time, but the calibration value can ONLY be stored while in setup mode. If you need to communicate frequently with the controller while the timing functions are active, you will need to decrease the calibration value. Reasonably accurate timing can be achieved with some experimentation.

It should also be stated that you can spend a week achieving perfect calibration for your controller, and if you were to plug the calibration number into a different controller, it will likely not be accurate.

In addition, the timing routines built into the firmware are huge. There are so many factors that affect timing, that even a well calibrated controller will not post consistent timing scores at all timing intervals. So you should NEVER expect to find a calibration value that works under every circumstance. It is not possible to achieve this level of accuracy without a real time clock. So before you waste hours finding a timing score for your controller that works perfectly at 10 seconds or 24 hours, then you should be warned that this is not possible.

Getting Started with Simple Timers

While all the timers in the timing commands are pretty easy to use, simple timers are the easiest. Once you have sent a simple timer command, the timer automatically starts counting down. There are two types of simple timers: Duration and Pulse

Simple Duration Timers

These timers activated a relay for a user specified period of time. When the timer expires, the relay turns off. Here is an example sending a simple duration timer command:

Hold Relay 0 On for 8 Hours, 10 Minutes, 15 Seconds using Simple Duration Timer 0:

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(50)       'Simple Duration Timer 0 Command
MSComm1.Output = Chr$(8)        'Hours (0-255)
MSComm1.Output = Chr$(10)       'Minutes (0-255)
MSComm1.Output = Chr$(15)       'Seconds (0-255)
MSComm1.Output = Chr$(0)        'Relay (0-255)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Hold Relay 1 On for 10 Seconds using Simple Duration Timer 1:

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(51)       'Simple Duration Timer 0 Command
MSComm1.Output = Chr$(0)        'Hours (0-255)
MSComm1.Output = Chr$(0)        'Minutes (0-255)
MSComm1.Output = Chr$(10)       'Seconds (0-255)
MSComm1.Output = Chr$(1)        'Relay (0-255)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

When the above two commands have been sent. The heartbeat LED on the controller will slow down. Both relays 0 and 1 will turn on. Relay 0 will turn off after 8 hours, 10 minutes, and 15 seconds. Relay 1 will turn off after only 10 seconds. While the timers are running, you may send other relay control commands. It is also possible to manually turn off the relays while the timers are still running. In these cases, the timers will not appear to have any effect. You can also pause the timers using other commands.

Keep in mind, you have 16 timers to work with. If you ever need this many timers, it would be prudent to assign a different relay to each timer. Assigning the same relay to 2 timers will cause the relay to turn off when the first timer expires. The second timer will appear to have no effect.

After the timers have expired, the heartbeat LED on the relay controller will return to a steadily fast pace.

Also note that relays are assigned in numeric order of 0-255 when using the timing commands. Relay 0 is located on Bank 1, Relay 0. Relay 8 is located on Bank 2, Relay 0. Relay 255 is located on bank 32, Relay 7 (you will have to make use of the XR Expansion port to access this relay).

The ProXR Command Set: Watchdog, Keep Alive, and Server Reboot Applications

Server Reboot Pulse Timers

Pulse Timers

Pulse timers are slightly different than duration timers. When a pulse timer is activated, the relay will not do anything until the timer has expired. Once expired, the relay will turn on for 1/4th of a second. This quarter second pulse is designed specifically to reboot a computer by connecting a relay directly to the RESET lines of a motherboard. While this may be used for other applications, the intent of the pulse timer is to reboot a computer should there be a lack of communication between the computer and the relay controller (indicative of a system crash). Below is a simple example of setting up a pulse timer.

Pulse Relay 0 after 15 Seconds using Simple Pulse Timer 0:

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(70)       'Simple Pulse Timer 0 Command
MSComm1.Output = Chr$(0)        'Hours (0-255)
MSComm1.Output = Chr$(0)        'Minutes (0-255)
MSComm1.Output = Chr$(15)       'Seconds (0-255)
MSComm1.Output = Chr$(0)        'Relay (0-255)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Pulse Relay 1 after 45 Seconds using Simple Pulse Timer 1:

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(71)       'Simple Pulse Timer 0 Command
MSComm1.Output = Chr$(0)        'Hours (0-255)
MSComm1.Output = Chr$(0)        'Minutes (0-255)
MSComm1.Output = Chr$(45)       'Seconds (0-255)
MSComm1.Output = Chr$(1)        'Relay (0-255)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

In the examples above, Relay 0 will pulse after 15 seconds and Relay 1 will pulse after 45 seconds.

Mixing Duration and Pulse Timers

You can mix duration and pulse timers as your application requires, in any combination. Care should be taken not to mix timers. For example, on the previous page, we utilized timers 0 and 1 using the commands 50 and 51. On this page, we utilized timers 0 and 1 using the commands 70 and 71. The commands 50 and 70 both use timer 0. Likewise, the commands 51 and 71 use timer 1. Here is a simple overlap map that will help you keep track of what commands address specific timers. The table below shows the beginning command bytes:

Timer Number	Duration Timer	Pulse Timer	Duration Timer*	Pulse Timer*
0	254, 50, 50	254, 50, 70	254, 50, 90	254, 50, 110
1	254, 50, 51	254, 50, 71	254, 50, 91	254, 50, 111
2	254, 50, 52	254, 50, 72	254, 50, 92	254, 50, 112
3	254, 50, 53	254, 50, 73	254, 50, 93	254, 50, 113
4	254, 50, 54	254, 50, 74	254, 50, 94	254, 50, 114
5	254, 50, 55	254, 50, 75	254, 50, 95	254, 50, 115
6	254, 50, 56	254, 50, 76	254, 50, 96	254, 50, 116
7	254, 50, 57	254, 50, 77	254, 50, 97	254, 50, 117
8	254, 50, 58	254, 50, 78	254, 50, 98	254, 50, 118
9	254, 50, 59	254, 50, 79	254, 50, 99	254, 50, 119
10	254, 50, 60	254, 50, 80	254, 50, 100	254, 50, 120
11	254, 50, 61	254, 50, 81	254, 50, 101	254, 50, 121
12	254, 50, 62	254, 50, 82	254, 50, 102	254, 50, 122
13	254, 50, 63	254, 50, 83	254, 50, 103	254, 50, 123
14	254, 50, 64	254, 50, 84	254, 50, 104	254, 50, 124
15	254, 50, 65	254, 50, 85	254, 50, 105	254, 50, 125

*These timers do not automatically activate, they must be started using a different command. More on this a little later in the manual.

Server Reboot Methodology

You can call it a watchdog timer, a keep-alive timer, or a server reboot timer. They can all mean about the same thing, as their goals are basically the same. The idea is simple: If the computer crashes, the computer cannot reset the timer built into the ProXR controller, so the controller reboots the computer. Implementation is not too difficult.

Implementing a Server Reboot Strategy for a Single Computer

A Server reboot system can work many ways. One possible strategy is a system whereby a server would boot up with a ProXR relay controller attached to the serial port. The relay controller would also be connected to the reset lines of server motherboard. As part of the startup items, a program would be launched to activate the pulse timer function for a period of 10 minutes (for example). The relay would do nothing since a pulse timer is used. Using this strategy, the relay controller would reboot the computer if communications is lost between the server and the relay controller. Once the timer in the relay controller has expired, it can only be restarted when the computer boots up normally. The monitoring program could be exited at any time. In which case, all timers would be cleared to prevent rebooting the computer.

Implementing a Server Reboot Strategy in a Network

The strategy above could be implemented on a single computer with an enhanced version of the software. The relay controller could be tied into the reset lines on the other computers as well. The program could be enhanced to “ping” other computers on the network. If one of them should fail to respond to your “ping”, a command could be sent to reboot the computer that failed to respond. In this case, one computer (a main server) is protected, as well as all other computers on the network. The main server is acting as the watchdog for all the other computers on the network. The relay controller itself is acting as the watchdog for the main server computer.

While there are many other strategies that could be easily implemented, these strategies could perhaps serve as building blocks to greater, more powerful and sophisticated watchdog monitoring applications.

The ProXR Command Set: Watchdog, Keep Alive, and Server Reboot Applications

Advanced Timer Commands

More timer Commands?

To this point, we have discussed simple timers. These timers begin operation as soon as the command is received. This makes them easy to use, but also imposes a few restrictions in that timers cannot be synchronized perfectly with each other. So we decided to provide our users with a command set that allows you to define the times without initiating the timer. Instead, the timing data for all 16 timers are stored in temporary memory until they are initiated. The following commands store timing data, but do not trigger the countdown. You will use a different command to control which timers are counting down and which timers are "stalled".

Setup a Pulse Timer on Relay 0 for 15 Seconds using Timer 0:

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(110)      'Pulse Timer 0 Setup Command
MSComm1.Output = Chr$(0)        'Hours (0-255)
MSComm1.Output = Chr$(0)        'Minutes (0-255)
MSComm1.Output = Chr$(15)       'Seconds (0-255)
MSComm1.Output = Chr$(0)        'Relay (0-255)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Setup a Duration Timer on Relay 1 for 35 Seconds using Timer 1:

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(91)       'Duration Timer 1 Setup Command
MSComm1.Output = Chr$(0)        'Hours (0-255)
MSComm1.Output = Chr$(0)        'Minutes (0-255)
MSComm1.Output = Chr$(35)       'Seconds (0-255)
MSComm1.Output = Chr$(1)        'Relay (0-255)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

In the examples above, two timers will be setup, but they will not start counting down until they are activated. Timers are activated using a separate command:

Begin Countdown of Timers 0 and 1:

```
LSB = 3       '1 + 2 = 3     1 is for Timer 0, 2 is for Timer 2, See Table Below
MSB = 0       'Keep all other timers off
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(131)      'Control Active and Halted Timers Command
MSComm1.Output = Chr$(LSB)      '16-Bit Value, Least Significant Byte
MSComm1.Output = Chr$(MSB)      '16-Bit Value, Most Significant Byte
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

If you understand how binary works, this is a pretty simple command. A 16 bit value is used to control which timers are active and which timers are halted. Each of the 16 bits identifies with each of the 16 timers. A binary 0 in any bit location indicates the timer is off while a binary 1 in any bit location indicates the timer is on. If you are not familiar with binary, here is a crash course:

16 Timers have 16 Bits, but we have to divide these into two 8-Bit values to communicate these data via a serial port. We call these two different bytes LSB for Least Significant Byte and MSB for Most Significant Byte. Follow the section below to figure LSB and MSB Values:

Timer 0 has a value of 1 on the LSB	**Timer 8 has a value of 1 on the MSB**
Timer 1 has a value of 2 on the LSB	**Timer 9 has a value of 2 on the MSB**
Timer 2 has a value of 4 on the LSB	**Timer 10 has a value of 4 on the MSB**
Timer 3 has a value of 8 on the LSB	**Timer 11 has a value of 8 on the MSB**
Timer 4 has a value of 16 on the LSB	**Timer 12 has a value of 16 on the MSB**
Timer 5 has a value of 32 on the LSB	**Timer 13 has a value of 32 on the MSB**
Timer 6 has a value of 64 on the LSB	**Timer 14 has a value of 64 on the MSB**
Timer 7 has a value of 128 on the LSB	**Timer 15 has a value of 128 on the MSB**

To Turn On timers, add up the LSB and MSB Values. For example:
To turn on timers 0, 1, 2, and 3 we add up 1, 2, 4, and 8.
So the LSB = 15.

To turn on timers 10, 12, 14, and 15, we add up 4, 16, 64, and 128.
So the MSB = 212.

After you send the LSB and MSB timer data to the controller, the selected timers will be activated. All other timers will be halted.

Timer Query

The Timer Query command is used to view the current status of any timer. All timers are countdown in nature. Timer Query allows you to see how much time remains before the timer expires. The example below illustrates the use the Timer Query command:

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(130)      'Issue Timer Query Command
MSComm1.Output = Chr$(0)        'Select a Timer to Query (0-15)
```

The first byte sent back to the PC will contain the number of hours left on the selected timer.
The second byte sent back to the PC will contain the number of minutes left on the selected timer.
The third byte sent back to the PC will contain the number of seconds left on the selected timer.
The fourth byte sent back to the PC will contain the relay number the timer applies to (0-255).

Setting the Timer Calibration Value

As discussed earlier in the manual, you can calibrate the timer at any time. If the controller is in Configuration mode (all dip switches off), calibration data will be stored when this command is issued. Otherwise, the calibration value will be changed, but settings will be lost when power is cycled.

```
Calibrator = 26576                  '26575 Counts Equals 1 Second
 LSB = (Calibrator And 255)         'Compute the LSB Value of the Calibrator
 MSB = (Calibrator And 65280) / 256 'Compute the MSB Value of the Calibrator
MSComm1.Output = Chr$(254)          'Enter Command Mode
MSComm1.Output = Chr$(50)           'Timer Setup Command
MSComm1.Output = Chr$(132)          'Issue the Set Calibrator Command
MSComm1.Output = Chr$(LSB)          'Send Calibrator LSB Value (0-255)
MSComm1.Output = Chr$(MSB)          'Send Calibrator MSB Value (0-255)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Reading the Timer Calibration Value

You may also read the calibration value stored in the controller by issuing the Calibrator Read command. This command returns two bytes of data to the user.

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(133)      'Issue the Set Calibrator Command
```

The first byte sent back to the PC will contain the Timer Calibrator LSB Value
The second byte sent back to the PC will contain the Timer Calibrator MSB Value

```
Calibrator = (LSB + (MSB * 256))    'This math function "rebuilds" the calibration value
```

Activating Calibrator Markers

Time calibrator markers are used to help calibrate the timer. When the calibrator markers have been activated, the controller will send our ASCII character code 90 at the beginning of any timing event. ASCII character code 91 will be sent at the end of any timing event. The time measured between the receiving 90 and 91 is used to help the user set the calibration value. These markers may prove useful if you need your PC to know when a timing even has occurred.

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(134)      'Issue the Set Calibrator Command
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Deactivating Calibrator Markers

This command turns off the calibration markers described above.

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(135)      'Issue the Set Calibrator Command
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

The ProXR Command Set: Advanced Configuration Command Set

Advanced Configuration Commands

Fighting Electromagnetic Interference (EMI)

Any relay controller has to consider EMI as a possible mechanism that can cause serious interference with normal operation. In extreme cases, EMI can cause the relays in a given relay bank to turn off, or even reboot the ProXR processor. We have taken several steps to help reduce EMI absorption on the logic side of the controller. However, there are some conditions that MAY still exist whereby EMI will cause all relays on a given bank to turn off.

When relay status information is sent from the controller to the relay bank, data is normally sent only one time. But the possibility does exist that the relay is turning on a device that generates a tremendous amount of EMI. Most of these kinds of devices, such as large DC motors, generate most of their EMI when power is first applied. During this time (the initial startup of the motor), huge amounts of EMI must be absorbed by the relays and inducted back onto the logic of the controller. It is during this time the controller becomes the most vulnerable to EMI absorption.

It is for this reason we have introduced the Repetitions (Reps) command. The Reps command is used to tell the controller to send relay control data Repeatedly to the relay banks. The theory is that motor will be fighting to turn on, generating EMI that can clear the relay logic circuits...but the controller can now fight back by telling the relay bank to go back on again.

Reps has been introduced as an experimental command, in hopes that we would have a solution for this problem should it ever arise for our customers. We would greatly appreciate any feedback our customers would be willing to provide on the usefulness of the Reps command. The value specified by the Reps command controls how many times relay status data is sent to the Relay control chips. Normally, Reps is set to a value of 1. But if you experience relays that turn themselves off when activated, try changing the Reps value to any number from 2 to 255 and see what happens. It takes more than a second to process each relay control command when Reps is set to 255.

Note: If the controller is in configuration mode, the Reps value will be stored in Non-Volatile EEPROM. Otherwise, the Reps value will be lost any time the controller is power cycled.

Set the Reps Value

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer and Setup Commands
MSComm1.Output = Chr$(137)      'Set the Reps Value
MSComm1.Output = Chr$(128)      'Reps(1-255) How Many Times Relays are Refreshed
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

This command reports back to the user the current Reps value.

Read the Reps Value

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer and Setup Commands
MSComm1.Output = Chr$(136)      'Read the Reps Value Command
```

The Controller will Report Back the Current Reps Value

Safe Parameters

Another "just-in-case" feature we have included in the ProXR firmware is a command that sets all the key variables inside the controller to Safe Parameters. If for some reason, the controller does not seem be functioning properly, or it appears you have lost communication, try sending this command and see if it recovers. We have never needed this command, but just in case it proves to be useful under highly unusual circumstances...we thought we would throw it in anyway.

Recovery Attempt to Safe Parameters

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer and Setup Commands
MSComm1.Output = Chr$(147)      'Setup Safe Parameters
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Setting the Character Delay Value

The Character Delay value determines the spacing between data bytes sent from the controller back to your PC. By default, CDEL is set to 35, which is known to be a conservatively safe value. The minimum allows CDEL value is 3 (we have not seen a PC that can handle this setting). If you want to boost performance, set the CDEL lower. A value of 7-10 should provide greatly improved communication speed.

Note: This command stores the CDEL value into Non-Volatile EEPROM while in configuration mode only. The CDEL value will have no effect in configuration mode (CDEL is ALWAYS 35 in configuration mode to ensure safe communications). This command is only processed in configuration mode, it is ignored in runtime mode. In runtime mode, you will receive ASCII character code 85 if this command is issued.

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer and Setup Commands
MSComm1.Output = Chr$(139)      'Set the CDEL Value of the Controller in Runtime Mode
MSComm1.Output = Chr$(10)       'Improve Communication Speed in Runtime Mode
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Reading the Character Delay Value

This command reads the stored character delay value from the controller. This command returns a value from 3 to 255.

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer Setup Command
MSComm1.Output = Chr$(138)      'Read the CDEL Value from the Controller Command
```

The controller will report back a byte of data from 3 to 255 indicating the Character Delay value.

Setting the Attached Banks Value

The ProXR series controllers are shipped as though the customer has 256 relays attached. This allows the controller to be instantly compatible with several XR expansion boards, right out of the box. However, you can gain a performance increase by setting the Attached Banks value to the actual number of relays you are using. If you are using a 16 Relay ProXR controller, and you reduce the Attached Banks value to 2, relay control operations will be processed 16 times faster. If you have a 32 relay controller and you reduce the Attached Banks value to 4, relay control operations will be processed 8 times faster. To determine the appropriate Attached Banks value, divide the number of total relays you will be using by 8. ***Valid attached bank values are 1 to 32.***

Warning: It is not possible to control relays beyond the Attached Value. Extra relays will appear to mirror previous banks and will not be directly controllable. If you experience any problems communicating to extra relay banks, the Attached Banks value should be checked. This Command ONLY Works in Configuration Mode.

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer and Setup Commands
MSComm1.Output = Chr$(141)      'Set Attached Banks Command
MSComm1.Output = Chr$(4)        'Controller Processes 4 Banks of 8 Relays (32 Relays)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Reading the Attached Banks Value

This command reports back a value from 1 to 32, indicating how many relays are attached to the relay controller. Note that this number is always set by the user. By default, this command return a value of 32. You can gain a performance increase by reducing the Attached Banks value. See Above: ***Setting the Attached Banks Value***

```
MSComm1.Output = Chr$(254)      'Enter Command Mode
MSComm1.Output = Chr$(50)       'Timer and Setup Commands
MSComm1.Output = Chr$(140)      'Read the Attached Banks Value
```

This Command Reports Back a Value of 1 to 32, Indicating the Number of Relay Banks Attached to the ProXR Series controller. By default, this command will report back 32.

The ProXR Command Set: Advanced Configuration Command Set

Advanced Configuration Commands

Setting the Test Cycle Value

When the ProXR series controllers are powered up in Configuration mode (all dip switches in the off position), the first instruction the controller processes is a function that tests all the on board relays. By default, the ProXR controller will test 4 banks of relays, which is the maximum number of relays that we currently product on a single circuit board. If you have a controller with fewer relays, you will speed up the test cycle by setting the controller to the actual number of relay banks on your ProXR controller. Valid Test Cycle values range from 0 to 32, allowing the controller to test all 256 relays (32 banks of 8). A Test Cycle value of 0 turns off automatic relay testing in configuration mode. ***Since this is a relatively harmless setting, this command works in both configuration and runtime modes.***

Warning: We strongly encourage customers NOT to use configuration mode for daily use. As a reminder that the controller is in configuration mode, we recommend leaving the Test Cycle value to 1 or more. When the controller is in configuration mode, internal memory is not protected, and is fully changeable at any time. Runtime mode (and dip switch setting other than all switches in the off position) protects internal memory from accidental modification.

Warning: The ProXR controller will appear to lock up if the Test Cycle value is set greater than the total number of available relay banks. Rest assured, the controller has NOT locked up, it is testing extended banks. Leave the controller on for several seconds and the heartbeat LED will begin flashing.

```
MSComm1.Output = Chr$(254)          'Enter Command Mode
MSComm1.Output = Chr$(50)           'Timer and Setup Commands
MSComm1.Output = Chr$(146)          'Set the Test Cycle Value
MSComm1.Output = Chr$(4)            'Controller Tests 4 Banks of 8 Relays (32 Relays)
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

Reading the Test Cycle Value

This command reports back a value from 0 to 32, indicating how many relays are tested when the controller is powered up in configuration mode (all dip switches in the off position). Note that this number is always set by the user. By default, this command return a value of 4. You can gain a performance increase by reducing the Test Cycle Banks value. See Above: ***Setting the Test Cycle Banks Value***

```
MSComm1.Output = Chr$(254)          'Enter Command Mode
MSComm1.Output = Chr$(50)           'Timer and Setup Commands
MSComm1.Output = Chr$(145)          'Read the Attached Banks Value
```

This Command Reports Back a Value of 0 to 32, Indicating the Number of Relay Banks Tested when the ProXR Series controller is in configuration mode. By default, this command will report back 4.

Restoring Factory Default Settings

This command operates in configuration mode only (all dip switches in the off position). This command restores many internal parameters to the factory default settings. See below for a detailed list:

E3C Device Number is Set to 0
Auto Refresh is Activated
Default Timing is Set to 26,576
Relay Command Repetitions is Set to 1
Character Delay is Set to 35
Reporting Mode is Turned On
Attached Relay Banks is Set to 32

```
MSComm1.Output = Chr$(254)          'Enter Command Mode
MSComm1.Output = Chr$(50)           'Timer and Setup Commands
MSComm1.Output = Chr$(144)          'Restore Factory Default Settings
```

When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

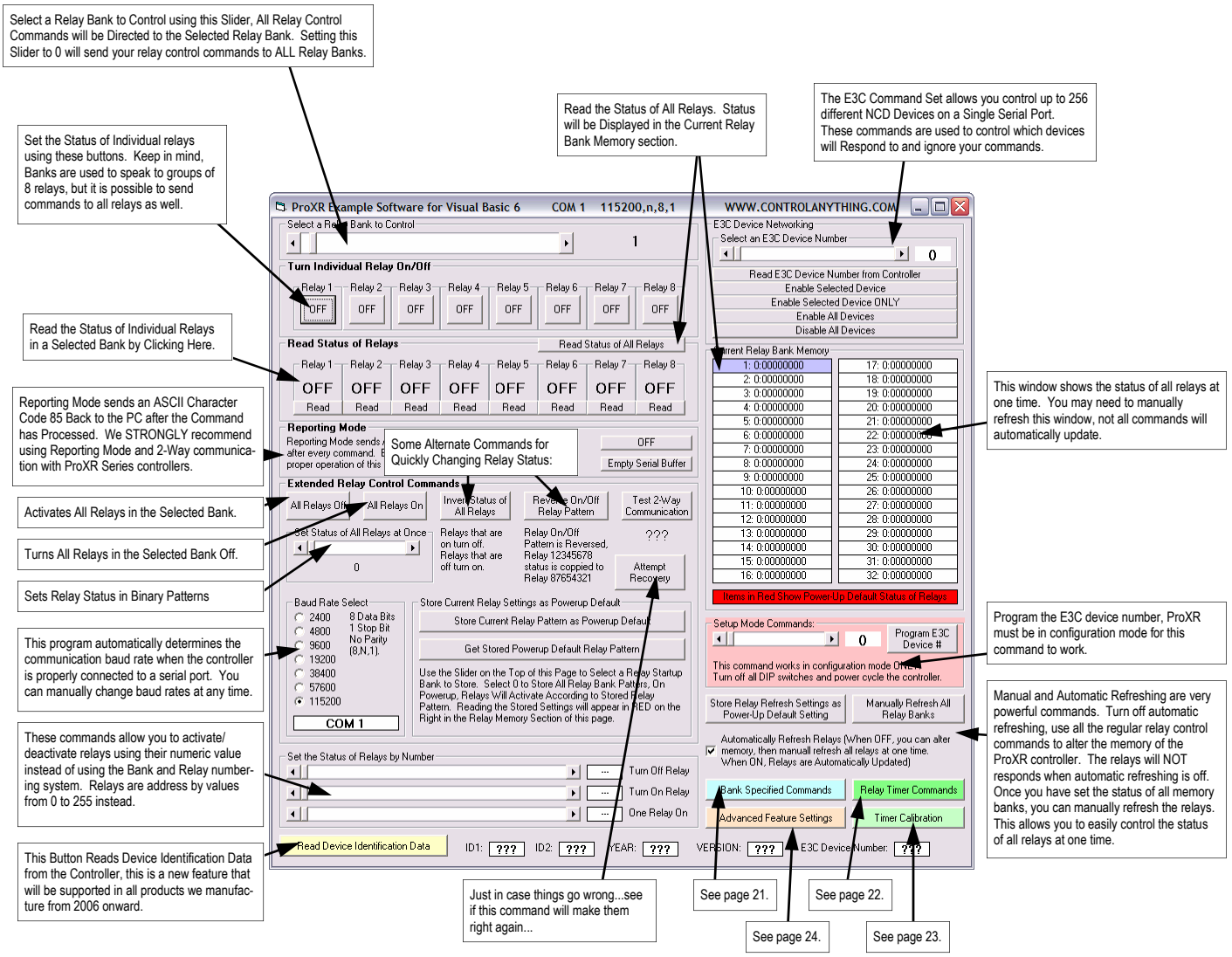
Command Set Conclusion

This concludes the user command set for the ProXR series controllers. The processor core is 97% full of code. This is our largest relay control core we have ever developed. Should you discover any bugs, please do not hesitate to contact Ryan Sheldon ryan@controlanything.com.

The ProXR Graphical User Interface (GUI)

Installing and Running the ProXR Software

For your convenience, we have developed software that will test all the functions the ProXR series controllers have to offer. This application is available for free download from our web site at www.controlanything.com. This program was developed using Visual Basic 6 Professional on a Windows XP Professional computer. The compatibility with XP Home and other versions of Windows have NOT been tested. If you experience installation problems, please be aware that we may not be able to help. The installation is created by Visual Basic, we did not develop the install program. It should also be stated that the GUI is NOT required to use ProXR series controllers. While it is convenient and can help you change controller settings and configurations quickly, it is in no way critical to the operation of a ProXR controller. Keep in mind, ProXR controllers are simple devices that simply wait for your commands. ProXR controllers do not care what is generating the commands, only that the data is valid. We have fully documented the command set to this point. Weather you choose to use our GUI or develop your own, we have provided all the necessary information for you to get started. The next few pages will document our GUI to help get you better acquainted.



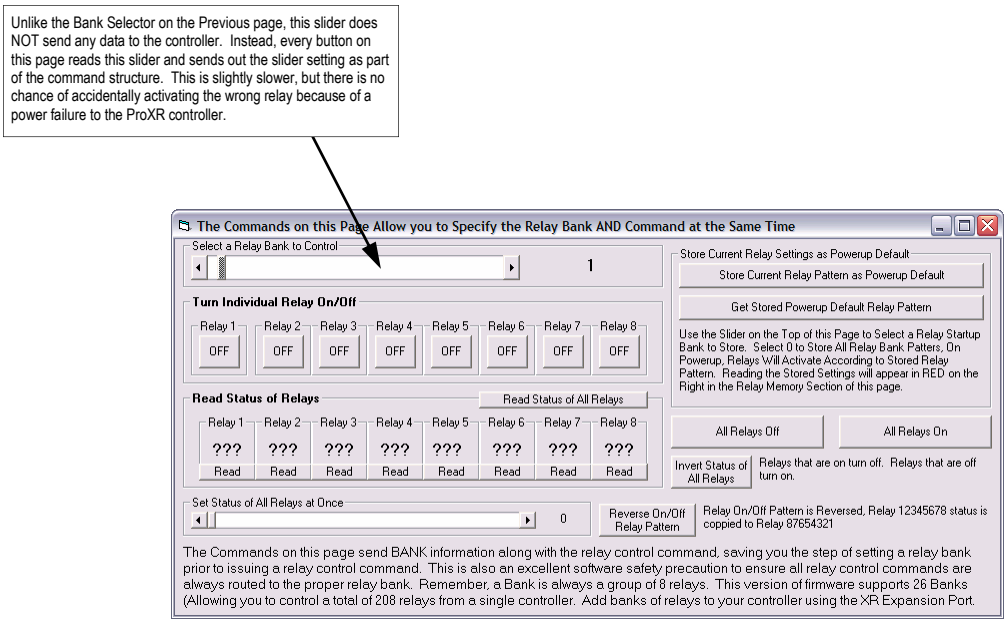
The ProXR Graphical User Interface (GUI)

Sending Commands Directly to a Relay Bank

The commands on this window are used to address a specific relay bank. They may not look different than some of the other commands you have seen, but there is a distinctive difference in how they communicated relay control data to the controller.

Up until this point, you would use a separate command to specify a relay bank. All subsequent relay control commands will be directed to the bank. This method separates “Bank Specification” and relay control commands from each other. Meaning you use a command to specify a relay bank, you use another command for relay control.

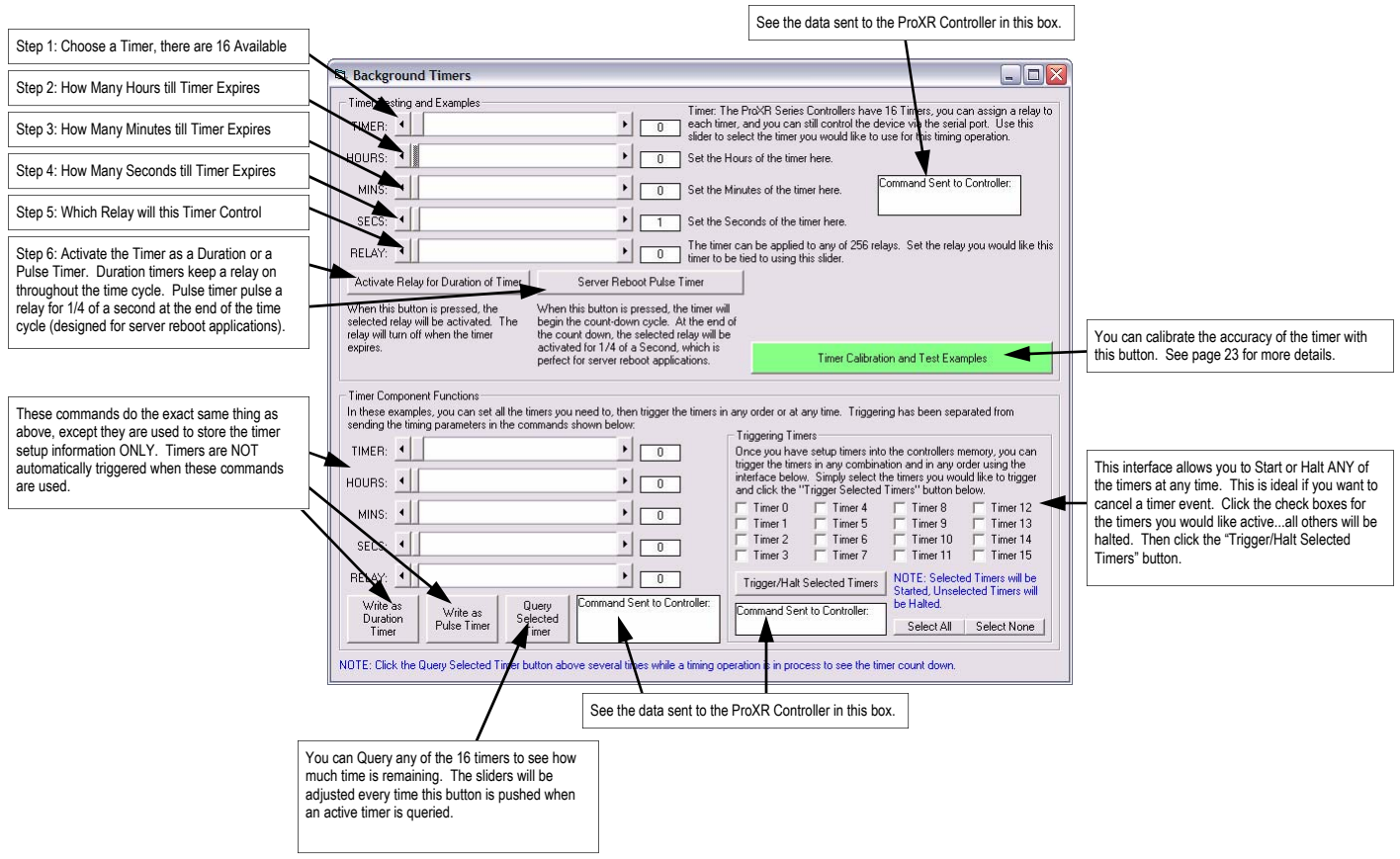
The commands in this GUI specify a relay bank as part of the command. These commands should be considered more reliable because they will function properly if the controller has been power cycled. But they are slightly slower to process. Each command below transmits the Bank as a part of the command, ensuring commands are always directed to the correct relay.



The ProXR Graphical User Interface (GUI)

Timer Commands

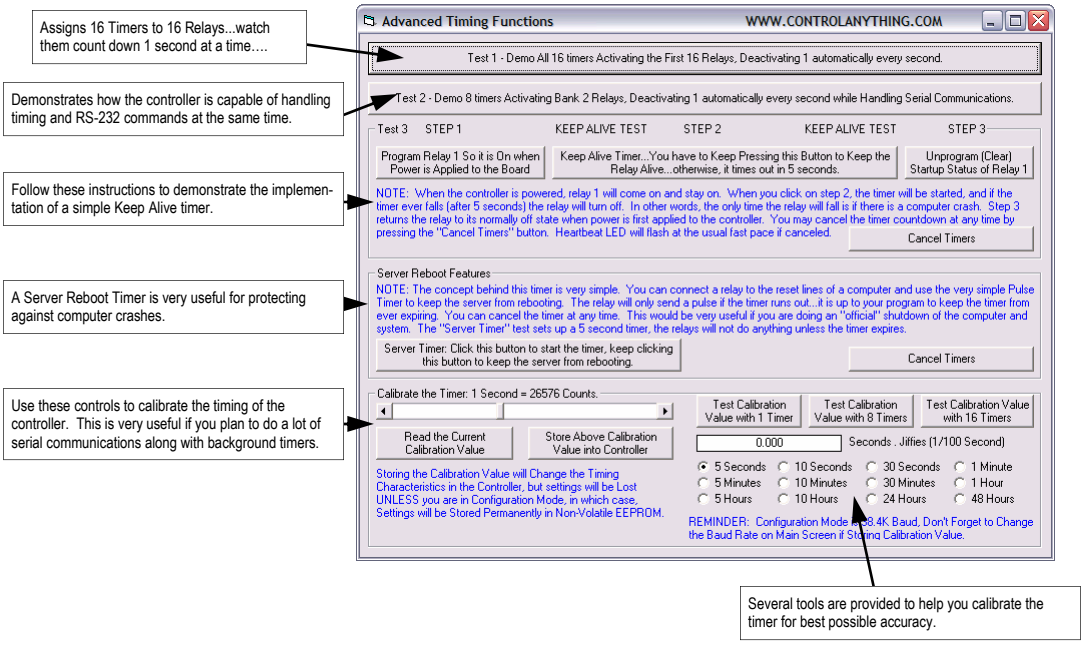
This GUI demonstrates the powerful timing commands the ProXR series controllers have to offer. The ProXR series controllers have 16 timers, ideal for watchdog, keep alive, and server reboot timing applications. ProXR controllers are also an ideal choice for duration timing applications, such as activating a light for 8 hours, or watering a lawn for 30 minutes. Additional timer commands allow you to monitor the current time remaining on each of the 16 timers, as well as halt/start timers in any order. The commands on this GUI have been enhanced with three white boxes that allow you to see what commands are actually being sent to the controller.



The ProXR Graphical User Interface (GUI)

Advanced Timer Calibration Features Test

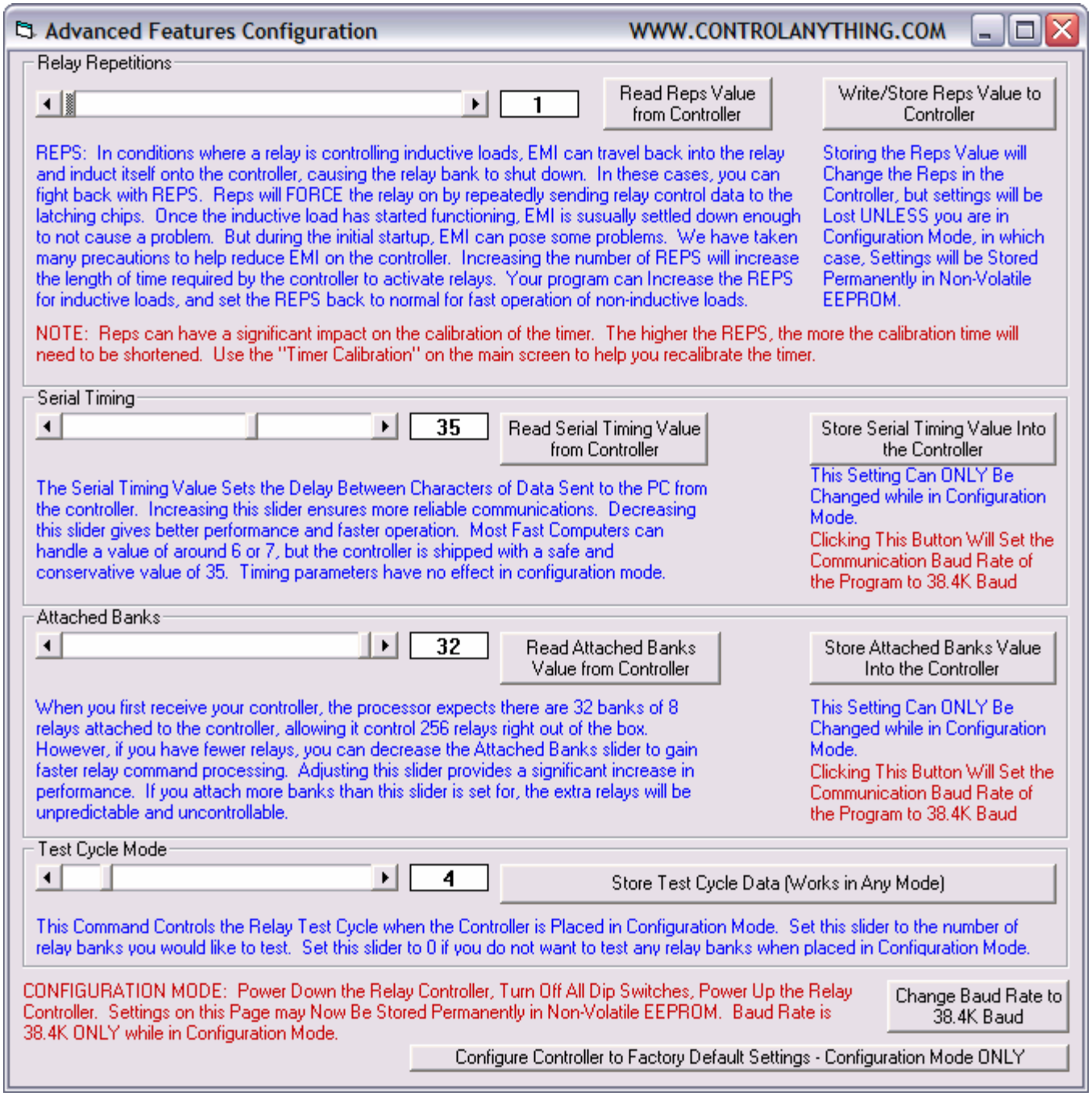
This GUI serves the purpose of demonstrating how the timers can be used in watchdog, keep alive, and server reboot timing applications. These commands are self explanatory for the most part.



The ProXR Graphical User Interface (GUI)

Advanced Configuration Features

We have provided lots of notes directly on the Advanced Features Configuration screen. The ProXR controller should be in configuration mode (all dip switches in the off position) before these setting will be stored permanently in non-volatile EEPROM. Some settings can be changed during regular runtime operation, but they will not be stored. Please see the notes below for each of the different controls.



Electrical Ratings and Switching Characteristics

Model	Ratings	Relay Type	Notes
1A DPDT	3A 120VAC / 3A 20VDC	DPDT	DPDT: Two Switches per Relay Not for use with Inductive Loads
3A DPDT	3A 250VAC / 3A 30VDC	DPDT	DPDT: Two Switches per Relay
5A DPDT	5A 250VAC / 5A 30VDC	DPDT	DPDT: Two Switches per Relay
5A SPDT	10A 250VAC / 5A 100VDC	SPDT	Relay Ratings for this Model are Absolute Maximum, Not for Sustained Constant Use. Divide all ratings by 2 for Constant Operation
10A SPDT	10A 250VAC / 8A 30VDC	SPDT	
20A SPDT	20A 240VAC / 20A 28VDC	SPDT	Common to Normally Closed Terminal is rated at 10A 240VAC / 10A 28VDC Flange Type Connections to Relay
30A SPST	30A 250VAC / 20A 28VDC	SPST	SPST: Common and Normally Open Terminals Only Flange Type Connections to Relay

All ratings above are for Resistive Loads. Divide current switching capabilities by 2 for Inductive Loads. Inductive loads not recommended for 1A DPDT relay controller models.

Relay Types

SPST	Single Pole Single Throw: This relay is the most basic type of switch available. SPST relays have only two connections. Typically, an SPST relay shorts these two connections together when the relay is activated. When the relay is OFF, this connections return to their original OFF state (disconnected).
SPDT	Single Pole Double Throw: This is the most popular type of relay used in our relay controller designs. Each relay consists of a Normally Open (NO), Normally Closed (NC), and a Common (COM). When the relay is OFF, NC and COM are connected together. When the relay is turned ON, NC is disconnected from COM and NO and COM are connected together.
DPDT	Same as SPDT above, but there are two of these switches in a single relay that are activated/deactivated at the same time.

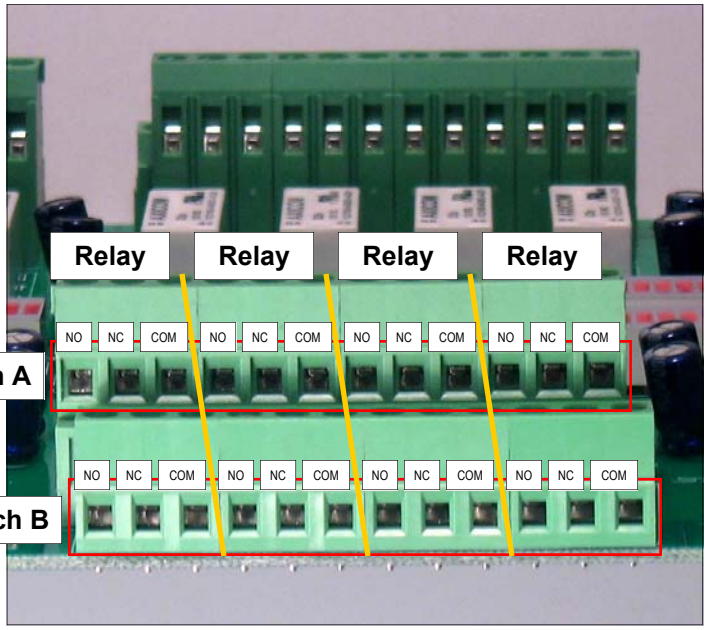
Characteristics Data	Minimum	Maximum
Relay Activation Time	>5 ms	<15 ms
Relay Deactivation Time	>5 ms	<20 ms
Activations per Second at 9600 Baud using “ProXR” Command Set	N/A	480
Activations per Second at 115.2K Baud using “ProXR” Command Set (Bank Pre-Selected)	N/A	5760
Activations per Second at 115.2K Baud using “ProXR” Command Set (Bank Specified)	N/A	3840
Communication Distance from PC Without Boosting Signal 1200 Baud*	N/A	Aprox. 2000 Feet
Communication Distance from PC Without Boosting Signal 2400 Baud*	N/A	Aprox. 1200 Feet
Communication Distance from PC Without Boosting Signal 9600 Baud*	N/A	Aprox. 600 Feet
Communication Distance from PC Without Boosting Signal 19.2K Baud*	N/A	Aprox. 200 Feet
Communication Distance from PC Without Boosting Signal 115.2K Baud*	N/A	Aprox. 10 Feet
Maximum Allowed Activation Time per Relay (Relay Held in On State)	N/A	Unlimited
Expected Operational Life, Non-DPDT Models	>10,000,000 Cycles	N/A
Expected Operational Life, DPDT Models	>2,000,000 Cycles	N/A
Typical Operational Cycles Per Minute	N/A	1,800

* assumes good quality low-capacitive wire, twisted pair preferred. Note that distances are estimated. Typically, longer distances are easily achieved.

Connecting 1-Amp DPDT Relays (White Relays)

Connector Pinouts for 1-Amp DPDT Series Controllers
Any time you see one of our relay controllers with a green 24-Position terminal block and small white relays labeled AXICOM on the board, you can assume the wiring connections shown to the right will always apply. Always view the connector from the angle shown in the picture to the right. This will ensure connections are consistently made to 1A DPDT series controllers.

A DPDT relay has two separate switches inside each relay. These switches are labeled Switch A and Switch B in the diagram at right. Switches A and B are completely separated from each other, there is no electrical connection between these switches. When a DPDT relay is activated, both switches A and B "activate" or more appropriately change position at the same time. In the diagram at right, each connection is labeled NO, NC and COM.



COM: Common
This terminal is connected to NC when relay is off.
This terminal swings over to NO when the relay is on.

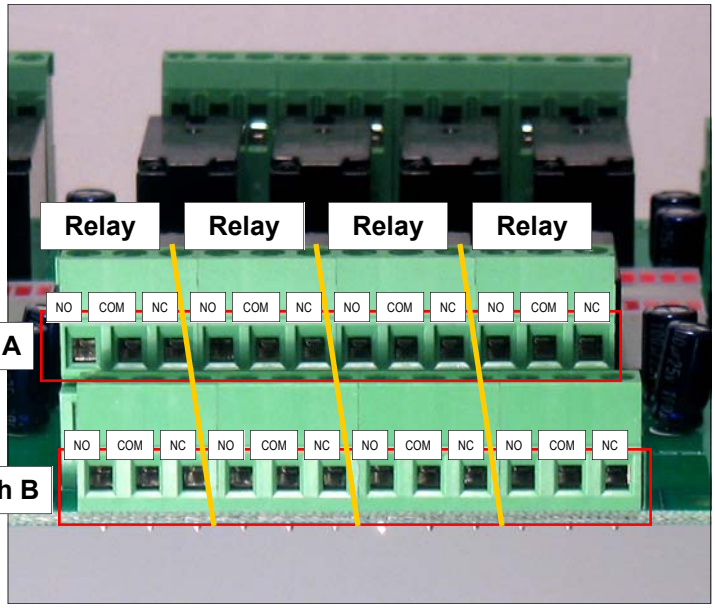
NO: Normally Open
This terminal has no connection with the relay is off.
This terminal is connected to COM when the relay is on.

NC: Normally Close
This terminal is connected to COM when the relay is off.
This terminal has no connection with the relay is on.

Connecting 3-Amp/5-Amp DPDT Relays (Black Relays)

Connector Pinouts for 3-Amp and 5-Amp DPDT Series Controllers
Any time you see one of our relay controllers with a green 24-Position terminal block and black relays on the board, you can assume the wiring connections shown to the right will always apply. Always view the connector from the angle shown in the picture to the right. This will ensure connections are consistently made to 3A and 5A DPDT series controllers.

A DPDT relay has two separate switches inside each relay. These switches are labeled Switch A and Switch B in the diagram at right. Switches A and B are completely separated from each other, there is no electrical connection between these switches. When a DPDT relay is activated, both switches A and B "activate" or more appropriately change position at the same time. In the diagram at right, each connection is labeled NO, NC and COM.



COM: Common
This terminal is connected to NC when relay is off.
This terminal swings over to NO when the relay is on.

NO: Normally Open
This terminal has no connection with the relay is off.
This terminal is connected to COM when the relay is on.

NC: Normally Close
This terminal is connected to COM when the relay is off.
This terminal has no connection with the relay is on.

Connecting 5-Amp/10-Amp SPDT Relays

Connector Pinouts for 5-Amp / 10-Amp SPDT Series Controllers

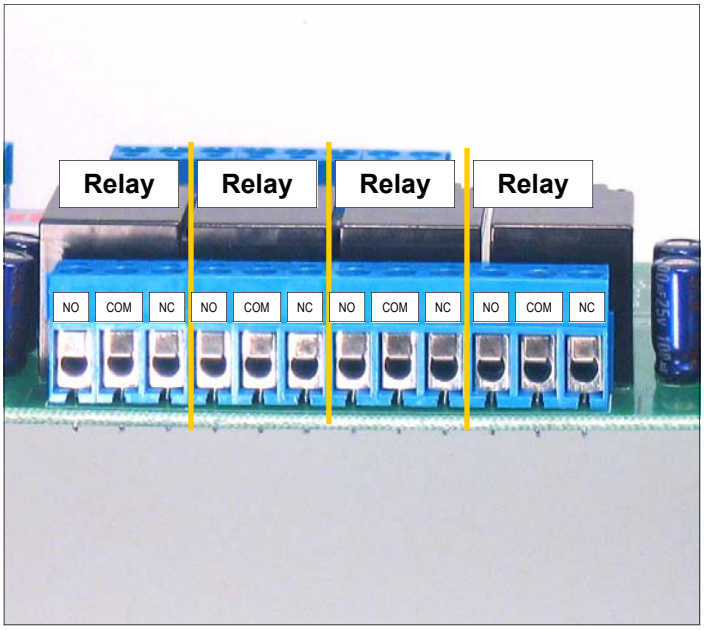
Any time you see one of our relay controllers with blue 12-Position terminal blocks, you can assume the wiring connections shown to the right will always apply. Always view the connector from the angle shown in the picture to the right. This will ensure connections are consistently made to 5 and 10-Amp SPDT series controllers.

A SPDT relay has one switch inside each relay. When a SPDT relay is activated, the switch changes position. In the diagram at right, each connection is labeled NO, NC and COM. Please see the comments below to better understand how connections are made.

COM: Common
This terminal is connected to NC when relay is off.
This terminal swings over to NO when the relay is on.

NO: Normally Open
This terminal has no connection with the relay is off.
This terminal is connected to COM when the relay is on.

NC: Normally Close
This terminal is connected to COM when the relay is off.
This terminal has no connection with the relay is on.



Connecting O.C. Outputs to External Devices

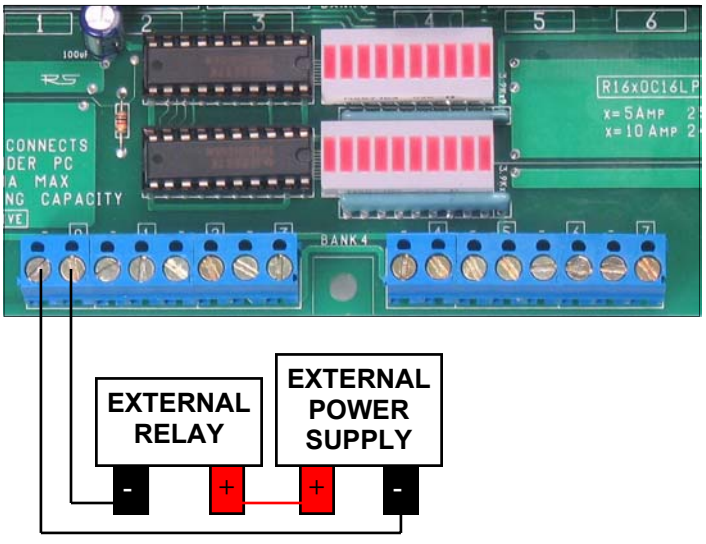
Connecting Open-Collector Outputs

WARNING: DO NOT CONNECT OC OUTPUTS WHILE POWER IS APPLIED TO THE CONTROLLER. THIS WILL DAMAGE THE OUTPUT DRIVER CHIP.

Any time you see one of our ProXR Series relay controllers with blue terminal blocks (8 or 16-Position), you can assume the wiring connections shown to the right will always apply. Always view the connector from the angle shown in the picture to the right. This will ensure connections are consistently made to the OC Outputs.

Open Collector outputs are ideal for adding external relays, small lights, LEDs, and other small loads under 150ma at 12VDC. OC outputs work by connecting an external device to ground. For instance, to connect an external relay to an open collector output, you will connect one of the two power leads directly to the OC output. The other relay power lead should be connected to a power supply. The ground of the power supply should be shared with the Ground leads on the OC output.

When the OC output is activated, the relay will activate by making a connection between the relay and ground. A voltage should always be present on the relay (except during connection).



Repeat the circuit as shown above for every pair of outputs. On some controllers, the two sets 8-position blue terminal blocks are together, forming a single blue 16-position terminal block. Connections are the same for these controllers. Don't forget, this circuit will share the grounds of your external power supply with the ground and RS232 ground of the controller. NEVER CONNECT EXTERNAL DEVICES WHILE THE CONTROLLER IS POWERED UP.

Last Minute Notes

Part Numbers:

R165OC16LP
R1610OC16LP
R325PROXR
R3210PROXR

Revision A boards have an error in the silk screen. A small diagram is shown on the board indicating relay connections. While the diagram is correct, the Labeling of NC and NO connections is backwards. Revision B boards are in production that correct this silk screen error.

Troubleshooting Considerations

If you experience any problems with a relay bank shutting down (all 8 relays turning off) when a relay is activated, please consult the section of this manual on EMI (page 18). Chances are good that the problem is caused because the load is too inductive for our controller, though page 18 may offer a solution. We are planning to develop an EMI edition of some controllers that is designed to handle highly inductive loads.

As of 12/21/2005, there are no known Version 17 firmware bugs. If you discover any problems with this device, please contact us.

ProXR Series Command Set

www.controlanything.com

Command	Parameters	Command Decription	Returned Data
254, 0		Relay 0 Off	85
254, 1		Relay 1 Off	85
254, 2		Relay 2 Off	85
254, 3		Relay 3 Off	85
254,4		Relay 4 Off	85
254, 5		Relay 5 Off	85
254, 6		Relay 6 Off	85
254, 7		Relay 7 Off	85
254, 8		Relay 0 On	85
254, 9		Relay 1 On	85
254, 10		Relay 2 On	85
254, 11		Relay 3 On	85
254, 12		Relay 4 On	85
254, 13		Relay 5 On	85
254, 14		Relay 6 On	85
254, 15		Relay 7 On	85
254, 16		Report Relay 0 Status	0-1
254, 17		Report Relay 1 Status	0-1
254, 18		Report Relay 2 Status	0-1
254, 19		Report Relay 3 Status	0-1
254, 20		Report Relay 4 Status	0-1
254, 21		Report Relay 5 Status	0-1
254, 22		Report Relay 6 Status	0-1
254, 23		Report Relay 7 Status	0-1
254, 24		Reports Status of Relay Bank	0-255**
254, 25		Turns On Automatic Relay Refreshing	85
254, 26		Turns Off Automatic Relay Refreshing	85
254, 27		Turns On Reporting Mode (Setting Stored)	85
254, 28		Turns Off Reporting Mode (Setting Stored)	85
254, 29		Turn Off All Relays	85
254, 30		Turn On All Relays	85
254, 31		Inverts All Relays in Bank	85
254, 32		Reversed Order of Relays in Bank	85
254, 33		Test 2-Way Communication	85
254, 34		Sends Currently Selected Relay Bank	0-32
254, 35		Store Relay Automatic Refresh Setting	85
254, 36		Reports the Automatic Refresh Setting	0-1
254, 37		Manually Refresh All Relay Banks	85
254, 40	Relay(0-255)	Set Status of All Relays at One Time	85
254, 41		No Function	85
254, 42	Bank(0-32)	Store Startup Status of Relays in Selected Bank	85
254, 43	Bank(0-32)	Recall Startup Status of Relays in Selected Bank	0-255**
254, 46	Relay(0-255)	Turn On One Relay ONLY, Safe Break Before Make	85
254, 47	Relay(0-255)	Turn Off a Relay Specified by its Relay Number	85
254, 48	Relay(0-255)	Turn On a Relay Specified by its Relay Number	85
254, 49	Bank(0-32)	Sets the Current Relay Banks Commands are Directed To	85
254, 50	Timer(50-66)	Choose a Duration Timer (16 Timers Available)	
	Hour(0-255)	Relay Will Stay Active for Selected Hours	
	Minute(0-255)	Relay Will Stay Active for Selected Minutes	
	Second(0-255)	Relay Will Stay Active for Selected Seconds	
	Relay (0-255)	Assign a Relay to This Timer	85
254, 50	Timer(70-86)	Choose a Pulse Timer (16 Timers Available)	
	Hour(0-255)	Relay Will At the End of Selected Hours	
	Minute(0-255)	Relay Will At the End of Selected Minutes	
	Second(0-255)	Relay Will At the End of Selected Seconds	
	Relay (0-255)	Assign a Relay to This Timer	85
254, 50	Timer(90-106)	Choose a Duration Timer (Timer Activated Using Different Command)	
	Hour(0-255)	Relay Will Stay Active for Selected Hours	
	Minute(0-255)	Relay Will Stay Active for Selected Minutes	
	Second(0-255)	Relay Will Stay Active for Selected Seconds	
	Relay (0-255)	Assign a Relay to This Timer	85
254, 50	Timer(110-126)	Choose a Pulse Timer (Timer Activated Using Different Command)	
	Hour(0-255)	Relay Will At the End of Selected Hours	
	Minute(0-255)	Relay Will At the End of Selected Minutes	
	Second(0-255)	Relay Will At the End of Selected Seconds	
	Relay (0-255)	Assign a Relay to This Timer	85
254, 50, 130	Timer(1-16)	Query Selected Timer	
		Device Returns Current Hour of Timer	Hour(0-255)
		Device Returns Current Minute of Timer	Minute(0-255)
		Device Returns Current Second of Timer	Sedond(0-255)
		Device Returns Relay Number that is Assigned to Selected Timer	Relay(0-255)

254, 50, 131	TimeLSB(0-255) TimeMSB(0-255)	Manually Activate/Halt Selected Timers (Least Sig. Byte) Manually Activate/Halt Selected Timers (Most Sig. Byte)	 85
254, 50, 132	CalibrateLSB(0-255) CalibrateMSB(0-255)	Sets the LSB Calibration of the Timer (Stores in Config. Mode Only) Sets the MSB Calibration of the Timer (Stores in Config. Mode Only)	 85
254, 50, 133		Retrieves the Calibration Value of the Timer Least Significant Bytes will be Sent First (LSB) Most Significant Bytes will be Sent Last (MSB)	 CalibrateLSB(0-255) CalibrateMSB(0-255)
254, 50, 134		Calibrators ON, Meaure Time Between Data to Help Set Calibration Patches In an ASCII Character Output Signifying the Start of a Timer Patches In an ASCII Character Output Signifying the End of a Timer	85 Start(90) Stop(91)
254, 50, 135		Calibrators OFF, Timers Will Not Signify Start/Stop	85
254, 50, 136		Retrieves the Repititions Value (Fights EMI by Holding Relays On)	Reps(1-255)
254, 50, 137	REPS(1-255)	Stores the Repititions Value (Config. Mode Only)	85
254, 50, 138		Retrieves the Character Delay Value (Delay Between Bytes Sent to PC	CDEL(3-255)
254, 50, 139	CDEL(3-255)	Stores the Character Delay (Config. Mode Only)	85
254, 50, 140		Retrieves the Number of Relay Banks Attached to Controller	ATBanks(1-255)
254, 50, 141	ATBanks(1-255)	Stores the Number of Relay Banks Attached (Config. Mode Only)	85
254, 50, 144		Return to Safe Factory Default Values (Config. Mode Only)	85
254, 50, 145		Get TestCycle Value (How Many Banks Tested in Config. Mode, 0=None)	TCycle(0-32)
254, 50, 146	TCycle(0-32)	Set TestCycle Value (works in any mode)	85
254, 50, 147		Attempt to Recover from a Controller that has Lost Communication	88
254, 100	Bank(0-32)	Relay 0 Off in Specified Bank	85
254, 101	Bank(0-32)	Relay 1 Off in Specified Bank	85
254, 102	Bank(0-32)	Relay 2 Off in Specified Bank	85
254, 103	Bank(0-32)	Relay 3 Off in Specified Bank	85
254, 104	Bank(0-32)	Relay 4 Off in Specified Bank	85
254, 105	Bank(0-32)	Relay 5 Off in Specified Bank	85
254, 106	Bank(0-32)	Relay 6 Off in Specified Bank	85
254, 107	Bank(0-32)	Relay 7 Off in Specified Bank	85
254, 108	Bank(0-32)	Relay 0 On in Specified Bank	85
254, 109	Bank(0-32)	Relay 1 On in Specified Bank	85
254, 110	Bank(0-32)	Relay 2 On in Specified Bank	85
254, 111	Bank(0-32)	Relay 3 On in Specified Bank	85
254, 112	Bank(0-32)	Relay 4 On in Specified Bank	85
254, 113	Bank(0-32)	Relay 5 On in Specified Bank	85
254, 114	Bank(0-32)	Relay 6 On in Specified Bank	85
254, 115	Bank(0-32)	Relay 7 On in Specified Bank	85
254, 116	Bank(0-32)	Report Relay 0 Status	0-1
254, 117	Bank(0-32)	Report Relay 1 Status	0-1
254, 118	Bank(0-32)	Report Relay 2 Status	0-1
254, 119	Bank(0-32)	Report Relay 3 Status	0-1
254, 120	Bank(0-32)	Report Relay 4 Status	0-1
254, 121	Bank(0-32)	Report Relay 5 Status	0-1
254, 122	Bank(0-32)	Report Relay 6 Status	0-1
254, 123	Bank(0-32)	Report Relay 7 Status	0-1
254, 124	Bank(0-32)	Reports Status of Relay Bank	0-255**
254, 129	Bank(0-32)	Turn Off All Relays	85
254, 130	Bank(0-32)	Turn On All Relays	85
254, 131	Bank(0-32)	Inverts All Relays in Bank	85
254, 132	Bank(0-32)	Reversed Order of Relays in Bank	85
254, 140	Relay(0-255) Bank(0-32)	 Set Status of All Relays at One Time	 85
254, 142	Bank(0-32)	Store Startup Status of Relays in Selected Bank	85
254, 143	Bank(0-32)	Recall Startup Status of Relays in Selected Bank	0-255**
254, 246		Get Device Description Data from Controller: Ouputs Below Device ID Part 1 Device ID Part 2 Device Year of Design Device Firmware Version E3C Device Number	 1 0 205*** 17*** Default is 0
254, 247		Retrieve Stored E3C Device Number	E3CDevice(0-255)
254, 248		Enable All Devices Command	<no output>
254, 249		Disable All Devices Command	<no output>
254, 250	Device(0-255)	Enable Selected Device	<no output>
254, 251	Device(0-255)	Disable Selected Device	<no output>
254, 252	Device(0-255)	Enable Selected Device ONLY, All Other Devices Disabled	<no output>
254, 253	Device(0-255)	Disable Selected Device ONLY, All Other Devices Enabled	<no output>
254, 255	Device(0-255)	Store E3C Device Number (Config Mode Only)	<no output>

*Bank Value of 0 Directs Command to ALL Relay Banks

** Returns 32 Bytes of Data if Relay Bank is Set to 0

*** Subject to Change as Device is Improved

85 Values are Sent if Reporting Mode is ON

ProXR Enhanced Feature Controllers Introduction
RS-232, USB, Zigbee

In February, 2007, National Control Devices has released several new, and enhanced controllers that support the ProXR command set as shown in this manual. These new devices share the same command set, but also offer additional commands for increased functionality. The February, 2007 product release includes new RS-232 controllers with built-in A/D conversion, as well as 6 new USB versions, as well as 6 new Zigbee versions. In addition, the ProXR software, as downloaded from our web site, has also been enhanced to repair some minor bugs, and add support for new controllers that have an enhanced feature set. There are many changes introduced by these new controllers, which will be discussed in greater detail as it applies. NCD devices that no-longer have an RS-232 interface have been rightfully stripped of the E3C command set (used for networking serial devices).

This section of the manual covers the new features added to the updated line of controllers. This portion of the manual ONLY covers the part numbers indicated below:

RS-232 Devices

Xxxxxxxxx
Xxxxxxxxx
xxxxxxxxx

USB Devices

UADR220PROXR	***USB, 2-Relays, 20-Amp, 8-Channels 8/10-bit A/D***
UADR230PROXR	***USB, 2-Relays, 30-Amp, 8-Channels 8/10-bit A/D***
UADR45PROXR	***USB, 4-Relays, 5-Amp, 8-Channels 8/10-bit A/D***
UADR410PROXR	***USB, 4-Relays, 10-Amp, 8-Channels 8/10-bit A/D***
UADR85PROXR	***USB, 8-Relays, 5-Amp, 8-Channels 8/10-bit A/D***
UADR810PROXR	***USB, 8-Relays, 10-Amp, 8-Channels 8/10-bit A/D***

Zigbee Devices

Xxxxxxxxxxx
Xxxxxxxxxxx
Xxxxxxxxxxx
Xxxxxxxxxxx

RS-232 Enhancement Overview

1) Baud Rate is Now Set using our ProXR software instead of using DIP switches.
2) The Program/Run Jumper can Now be Changed while power is applied to the controller, however, some parameters will not take effect until the device is power cycled.
3) 8-Channels of Analog to Digital Conversion has been added to the controller, supporting 8-Bit or 10-Bit resolution. In addition, new commands allow you to read a single channel at a time or multiple channels at one time.
4) A/D converters employ a resistor network that allows you to pull all channels up or down. This effectively keeps the input channels quiet without any external resistors. The pull-up/pull-down feature is jumper selectable. Removing the jumper floats the inputs with 20Kresistance between neighboring channels.
5) Integrated jumper-selectable temperature sensor is now integrated into the controller. This sensor is tied to Analog Input channel 8. User may choose to use input channel 8 or tie input channel 8 to the temperature sensor under jumper selection. The controller supports the Microchip 9701A temperature sensor. Complete data sheets for the 9701A are available from www.microchip.com.
6) Unused relay output channels are available for control of external relays.

USB Enhancement Overview

1) Integrated FTDI USB to Serial Converter. Device mounts as a virtual COM port, user speaks to device using the assigned COM port. User may choose COM port assignment by changing the driver settings in the Device Manager. Virtual COM port Drivers are available for most operating systems currently in use, including Windows, MAC, UNIX, and Sun.
2) Three USB LEDs indicate USB Connection and Data Activity.
3) Baud Rate is fixed at 115.2K Baud, 8 Data bits, 1 Stop bit, No Parity.
4) USB Relay controllers are NOT USB Bus powered. A relay controller goes against USB Bus power specifications because of its ability to surge power on the USB Bus; therefore, most NCD relay controllers will not likely support USB Bus power features. An external +12VDC supply will be required.
5) The Program/Run Jumper can Now be Changed while power is applied to the controller, however, some parameters will not take effect until the device is power cycled.
6) 8-Channels of Analog to Digital Conversion has been added to the controller, supporting 8-Bit or 10-Bit resolution. In addition, new commands allow you to read a single channel at a time or multiple channels at one time.
7) A/D converters employ a resistor network that allows you to pull all channels up or down. This effectively keeps the input channels quiet without any external resistors. The pull-up/pull-down feature is jumper selectable. Removing the jumper floats the inputs with 20Kresistance between neighboring channels.
8) Integrated jumper-selectable temperature sensor is now integrated into the controller. This sensor is tied to Analog Input channel 8. User may choose to use input channel 8 or tie input channel 8 to the temperature sensor under jumper selection. The controller supports the Microchip 9701A temperature sensor. Complete data sheets for the 9701A are available from www.microchip.com.
9) Unused relay output channels are available for control of external relays.

Zigbee Enhancement Overview

1) Complete support for Zigbee protocol using Maxstream Zigbee interface modules. Zigbee is essentially a wireless 2-way serial port protocol, allowing you to speak to a device wirelessly as though it were physically attached to the serial port of your computer.
2) Baud Rate to Zigbee modem is user-programmable. A Zigbee modem if required to communicate to our relay controller. Zigbee modems connect to the USB port of your computer and are USB Bus powered.
3) The Program/Run Jumper can Now be Changed while power is applied to the controller, however, some parameters will not take effect until the device is power cycled.
4) 8-Channels of Analog to Digital Conversion has been added to the controller, supporting 8-Bit or 10-Bit resolution. In addition, new commands allow you to read a single channel at a time or multiple channels at one time.
5) A/D converters employ a resistor network that allows you to pull all channels up or down. This effectively keeps the input channels quiet without any external resistors. The pull-up/pull-down feature is jumper selectable. Removing the jumper floats the inputs with 20Kresistance between neighboring channels.
6) Integrated jumper-selectable temperature sensor is now integrated into the controller. This sensor is tied to Analog Input channel 8. User may choose to use input channel 8 or tie input channel 8 to the temperature sensor under jumper selection. The controller supports the Microchip 9701A temperature sensor. Complete data sheets for the 9701A are available from www.microchip.com.
7) Unused relay output channels are available for control of external relays.

Elements of this diagram may be useful for other devices we offer. We have not included photos of every controller we offer in this manual; instead, we have detailed the significant variations. Our controllers contain many common elements in different combinations.

USB and Zigbee Device Communications

STOP: Before Connecting USB Devices or Zigbee modems to your computer, you should start by installing the latest FTDI USB drivers on your computer. Installing the drivers before connecting the hardware will make setup easier. Click Here for Latest Drivers

Talking to USB and Zigbee devices is just like talking to a RS-232 device. When a USB device is plugged into the USB port of your computer, the USB device will be assigned a COM port. Your software simply speaks to the USB device as though it were a real COM port. This offers optimum flexibility in terms of software and hardware compatibility. Zigbee devices work exactly the same way, they mount as a COM port and you speak to the device as though it were a real serial device attached to your computer. USB devices emulate a COM port. Zigbee devices emulate a wireless serial port. Communication to USB devices is fixed at 115.2K baud. Communicating to a wireless Zigbee device requires a Zigbee modem. You can configure the Zigbee modem baud rate and other parameters using X-CTU, available for free download by clicking here.

If the Zigbee modem or USB device does not mount as the desired COM port, you may change the COM assignment using the Device Manager as part of the System Control Panel on your Windows system.

USB and Zigbee devices differ from RS-232 devices in that they do not have a E3C command set, used for networking RS-232 devices. In addition, USB devices only speak at 115.2K baud.

Your computer can speak to a Zigbee modem at any baud rate. Zigbee modems communicate with each other at 115.2K baud. Remote Zigbee devices communicate with the on-board Zigbee transceiver at 115.2K baud. For best performance, your computer should speak to the Zigbee modem at 115.2K baud.

Networking Zigbee Devices:

It is possible to speak to many Zigbee devices within a local area. Each Zigbee device is hard coded with a device ID number. The device ID number is printed on the bottom side of the Zigbee module. This Zigbee module can be easily removed. You can also query all Zigbee modules to determine all device ID numbers within range. The Zigbee protocol is extensive, and will not be covered in any NCD documentation. Instead, we will focus our documentation on sending commands to remote devices that support the Zigbee protocol. In other words, we will show you how to talk to our devices for controlling relays and reading data. If you wish to learn about the extensive features of the Zigbee protocol (also known as 802.15.4), this documentation can be downloaded from the MaxStream web site by clicking here. We highly suggest reading this documentation as it has more information on speaking to several different Zigbee devices and hopping commands across wireless networks.

To this point, we have focused heavily on USB / Zigbee communications as it focuses on RS-232 emulation. From this point forward, it should be very easy to speak to devices. Both USB and Zigbee modules offer 100% emulation of a COM port and offer a completely transparent communication layer. We have chosen these communication methods because we believe they offer the best compatibility and quickest implementation time.

Developing Software for Serial Communications

Despite the connectivity you have chosen (RS-232, USB, or Zigbee), the easiest way to speak to NCD devices is to make use of serial communications. Serial communications is supported by nearly all programming languages, and it is very easy to send simple commands to NCD devices using any language you may require.

We suggest the following resources to help get you started:

Page 8 of this manual explains how data should be formatted as it pertains to speaking to NCD devices.

Visual Basic 4, 5, 6

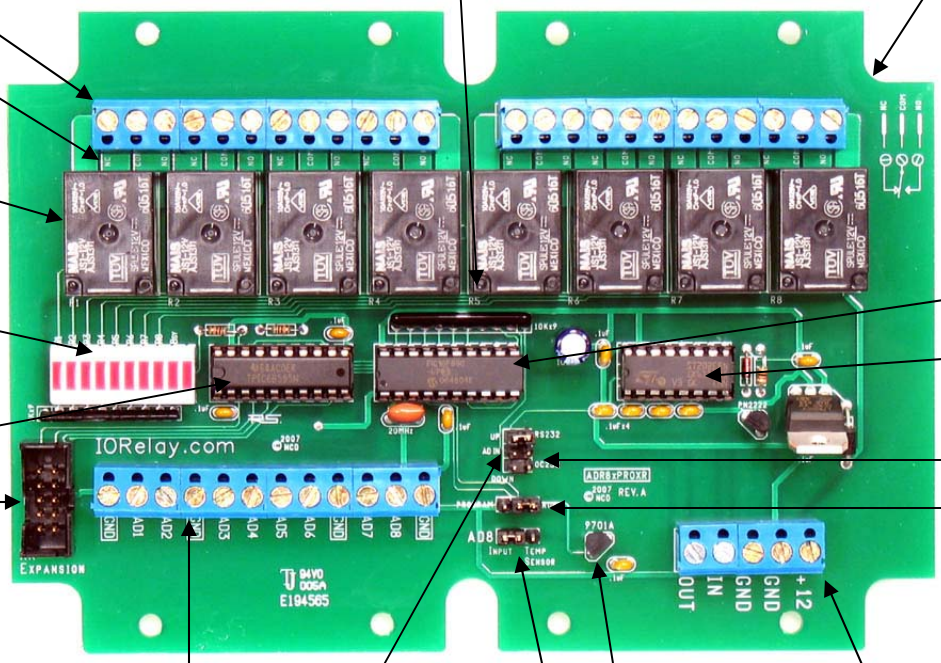
We have also posted a Visual Basic 6 tutorial in the "Developers Toolbox" section of our web site. This tutorial is available by clicking here. This same tutorial can be also be downloaded along with a .NET tutorial in the Universal Device Manual available from our web site by clicking here.

.NET Express

You can also use Visual Basic Express to speak to NCD devices. VB Express is free from Microsoft. At the time of writing, Microsoft offers a free download by clicking here. Click the large camouflaged "Download Now" button on the right side of the screen.

We have also posted a tutorial for using .NET Express in the Universal Device Manual, available from our web site by clicking here.

ProXR Enhanced RS-232



A: Relay Connections: 3 Per Relay

Q: Relay Number Labels

P: SERPAC Enclosure Form factor

B: Relay Connection Labels: NC COM NO

C:Relays

D: LED Status Lights

O: ProXR Enhanced CPU

N: RS-232 Transceiver

E: Relay Driver

M: RS-232 / OC232 Jumper

F: XR Expansion Port

L: Program / Run Jumper

When using the quick start kit, keep in mind, it will NOT fit inside the enclosure, but it will help you get started.

G: Analog Input Channels: Do Not Exceed +5VDC on Inputs

J: Temperature Sensor

K: Power/Data Connector

H: 10K Pull-Up / Pull-Down Jumper

I: AD8 / Temperature Senor Select Jumper

RS-232 Enhancements

In February, 2007, NCD released a number of ProXR enhanced controllers. These new ProXR controllers are available with an optional enclosure, which accounts for the unusual shape of the circuit board. There are many versions of the ProXR series that have enhanced features. The above map explains the updated layout.

A: There are 3 terminals per relay: NC (Normally Closed), COM (Common), and NO (Normally Open). Then the relay is OFF, Common is connected to Normally Closed. When the relay is ON, Common is connected to the Normally Open. Relay activation time is approximately 5ms. Relay deactivation takes approximately 10ms.

B: The circuit board on the model shown is labeled with NC, COM, and NO. Some models of relay have contacts directly on the top side of the relay. In this case, the PCB will not be labeled with NC, COM, or NO. Instead, look carefully near the contacts of the relay, the relay connections are labeled directly on the relay near the contacts.

C: The relays shown above are 5-Amp SPDT. We offer relay in 1-Amp, 3-Amp, 5-Amp, 10-Amp, 20-Amp, 30-Amp, SPST, SPDT, and DPDT varieties.

D: LED status lights. When powered, the first LED is lit (far right in the photo, bottom LED on other models). One LED is assigned to each relay in the same order as the relays are shown above. The second LED from the left will light when a command is in process.

E: Latch driver chip activates the relays by connecting them to ground under computer control.

F: XR Expansion port allows this controller to speak to a total 256 relays using expansion relay boards.

G: Analog Inputs allow this controller to read 8 different voltage levels or contact closures. Input voltage is between 0 and +5VDC. Do not exceed this voltage rating or damage to the CPU will result.

H: Pull Up / Pull Down Resistors keep the analog inputs from floating. When the jumper is installed in the UP position, each of the analog inputs is connected to +5VDC through a 10K resistor. When the jumper is installed in the DOWN position, each of the analog inputs is connected to Ground through a 10K resistor. When this jumper is removed, the analog inputs "Float" (not recommended for most applications). Neighboring inputs are connected to each other with a total of 20K resistance between immediate neighboring inputs.

I: Analog Input #8 can be connected to an external source when this jumper is set to the Input position. When set to Temp Sensor position, this input is no-longer available to the user. Instead, input channel #8 is connected to a internal MCP9701A temperate sensor.

J: MCP9701A temperature sensor. This sensor delivers a analog voltage in proportion to temperature. This voltage can be read by input channel #8 when the AD8 jumper is set to the Temp Sensor position. Current software does not convert the analog value to a actual temperature. Please consult the MCP9701A data sheet from www.microchip.com for complete details on converting the voltage to a temperature.

K: Power Data Connector. This is the RS-232 interface and Power connections for the controller. +12VDC at 100ma is required for "standby" with no relays activated. Allow up to 100ma for each relay that is activated. The Power Supply Ground on the controller is shared with the RS-232 Ground. The IN refers to the RS-232 input, this connection ties to the RS-232 output of your computer. The OUT refers to the RS-232 output. This connection ties to the RS-232 input on your computer. See page 5 of this manual for complete details on RS-232 connection of this controller.

L: The Program/Run jumper determines if the controller is in Program mode (which allows you to make configuration changes via ProXR software, such as baud rate and timing parameters), or Run mode, which write-protects the on-board memory and should be used for normal daily operation. Program mode operates at a fixed baud rate of 38.4K baud. The baud rate for Runtime mode is user programmed while in Program mode. Runtime mode supports several different baud rates, please run the ProXR software to configure the Runtime baud rate.

M: RS-232 / OC-232 Data Output formal select jumper. When connecting one device to a computer, use the RS-232 mode. When connecting several devices to a computer using the RSB serial booster, set the jumper to OC-232 mode. See page 7 for details.

N: This chip converts CPU data to RS-232 voltage levels.

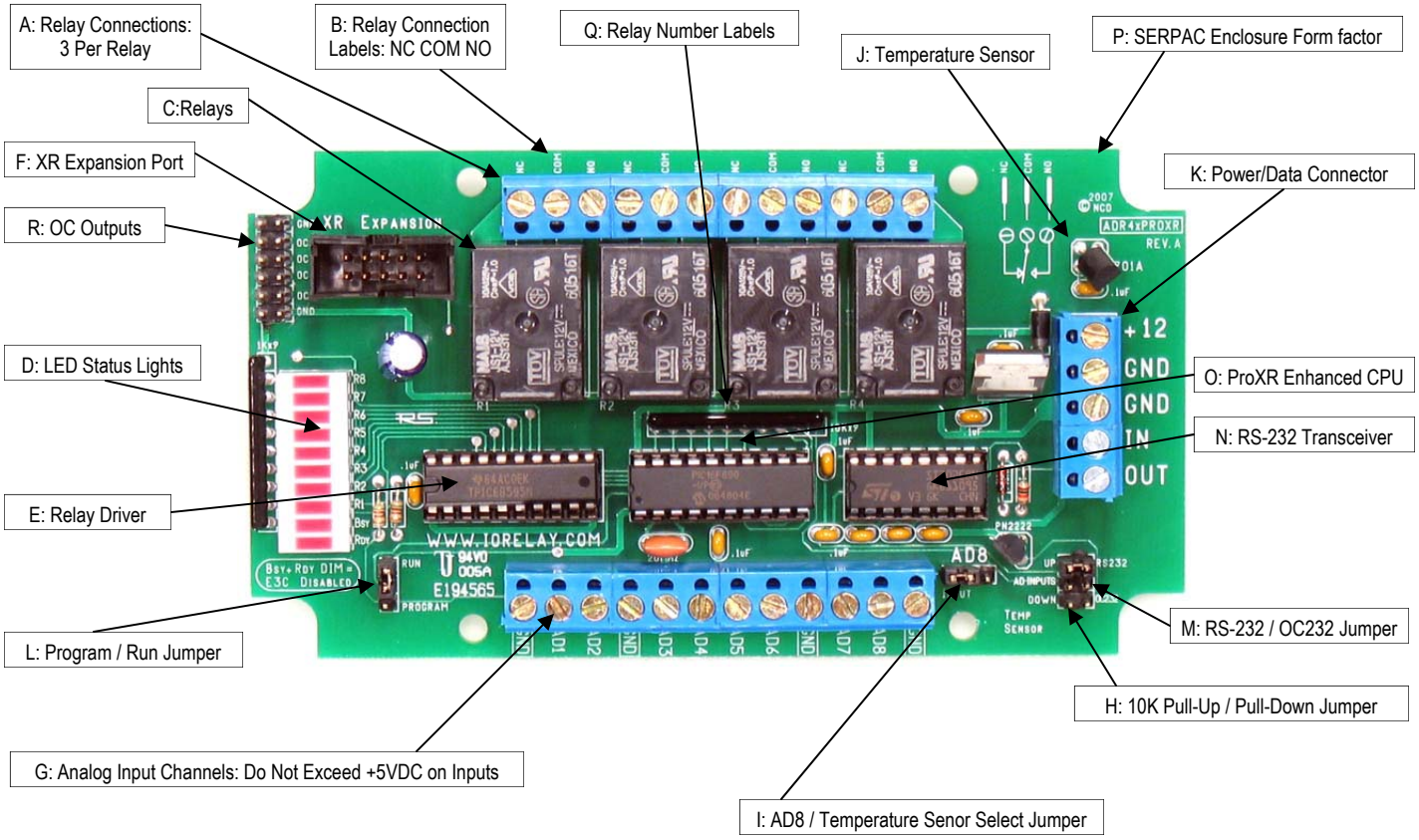
O: NCD Customized PIC16F690 CPU running at 20 MHz.

P: PCB Outline Compatible with SERPAC SR171 series enclosures.

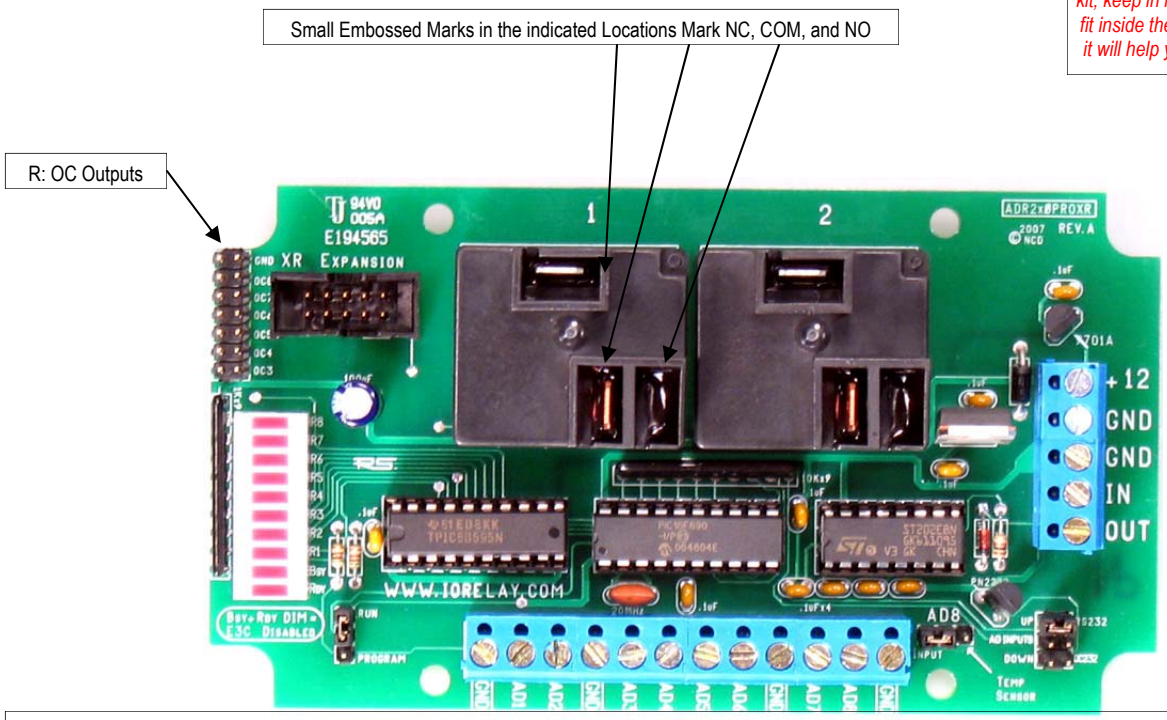
Q: Relay number identification labels, R1 through R8. One assigned to each relay.

Elements of this diagram may be useful for other devices we offer. We have not included photos of every controller we offer in this manual; instead, we have detailed the significant variations. Our controllers contain many common elements in different combinations.

ProXR Enhanced RS-232



When using the quick start kit, keep in mind, it will NOT fit inside the enclosure, but it will help you get started.



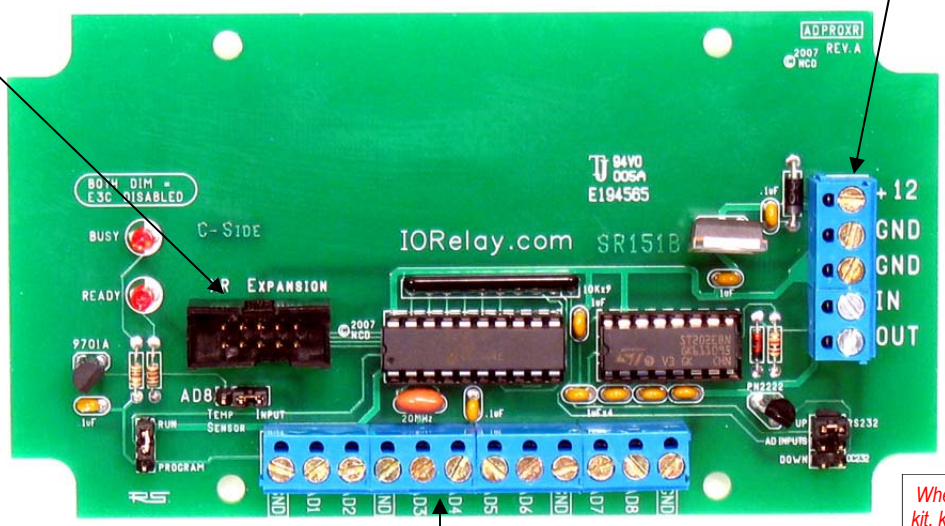
R: This controller has spare OC outputs. These outputs can be used to drive external relays up to 24VDC at 150ma per relay. To use the output, you will need to connect a external power supply to your relays, providing a positive voltage into the coil of the external relay. The GND connection on this board should be connected to the GROUND of your external power supply. Each of the spare OC outputs should be connected to the other remaining terminal on the external relay coil. This controller activates external relays by connecting the relay coil to ground under computer control. ALL POWER SUPPLIES MUST BE POWERED DOWN WHILE MAKING CONNECTIONS. FAILURE TO FOLLOW THIS CAUTION ***WILL DAMAGE THE DRIVER CHIP***.

Elements of this diagram may be useful for other devices we offer. We have not included photos of every controller we offer in this manual; instead, we have detailed the significant variations. Our controllers contain many common elements in different combinations.

ProXR Enhanced RS-232

XR Expansion Port allows you to add relays as your needs grow.

Power / Data Connections are Detailed on Page 5 of this manul.



When using the quick start kit, keep in mind, it will NOT fit inside the enclosure, but it will help you get started.

8-Channels of 8-bit / 10-bit Analog Inputs

The ADPROXR shown above has all the features of the controllers shown on the previous pages, but has no on-board relays. You may add relays at any time to this controller using the XR expansion port. The firmware on this controller is identical to the firmware shown on the previous two pages. This controller only requires about 100ma and is compatible with the SERPAC SR151 series enclosures.

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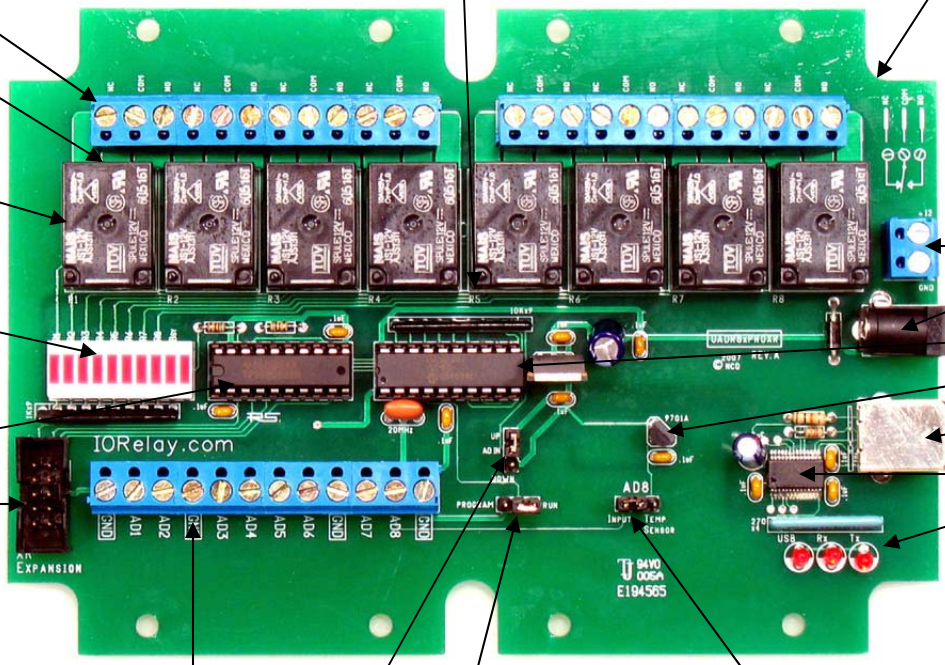
ProXR Enhanced USB



USB Enhancements

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C: The relays shown above are 5-Amp SPDT. We offer relay in 1-Amp, 3-Amp, 5-Amp, 10-Amp, 20-Amp, 30-Amp, SPST, SPDT, and DPDT varieties.

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E: Latch driver chip activates the relays by connecting them to ground under computer control.

F: XR Expansion port allows this controller to speak to a total 256 relays using expansion relay boards.

G: Analog Inputs allow this controller to read 8 different voltage levels or contact closures. Input voltage is between 0 and +5VDC. Do not exceed this voltage rating or damage to the CPU will result.

H: Pull Up / Pull Down Resistors keep the analog inputs from floating. When the jumper is installed in the UP position, each of the analog inputs is connected to +5VDC through a 10K resistor. When the jumper is installed in the DOWN position, each of the analog inputs is connected to Ground through a 10K resistor. When this jumper is removed, the analog inputs "Float" (not recommended for most applications). Neighboring inputs are connected to each other with a total of 20K resistance between immediate neighboring inputs.

I: Analog Input #8 can be connected to an external source when this jumper is set to the Input position. When set to Temp Sensor position, this input is no-longer available to the user. Instead, input channel #8 is connected to a internal MCP9701A temperate sensor.

J: MCP9701A temperature sensor. This sensor delivers a analog voltage in proportion to temperature. This voltage can be read by input channel #8 when the AD8 jumper is set to the Temp Sensor position. Current software does not convert the analog value to a actual temperature. Please consult the MCP9701A data sheet from www.microchip.com for complete details on converting the voltage to a temperature.

K: USB Activity LEDs indicate connection to the USB port and data communications. The LED labeled USB is lit once data has been established with the computer. The Rx LED lights when data is received. The Tx LED lights when data is transmitted.

L: The Program/Run jumper determines if the controller is in Program mode (which allows you to make configuration changes via ProXR software, such as baud rate and timing parameters), or Run mode, which write-protects the on-board memory and should be used for normal daily operation. The baud rate for the USB version of this controller is fixed at 115.2K Baud in Configuration or Runtime mode. Baud rate cannot be changed.

M: USB Type B Connector.

N: This chip converts emulates a RS-232 port at 115.1K Baud and mounts the device as a COM port on your computer.

O: NCD Customized PIC16F690 CPU running at 20 MHz.

P: PCB Outline Compatible with SERPAC SR171 series enclosures.

Q: Relay number identification labels, R1 through R8. One assigned to each relay.

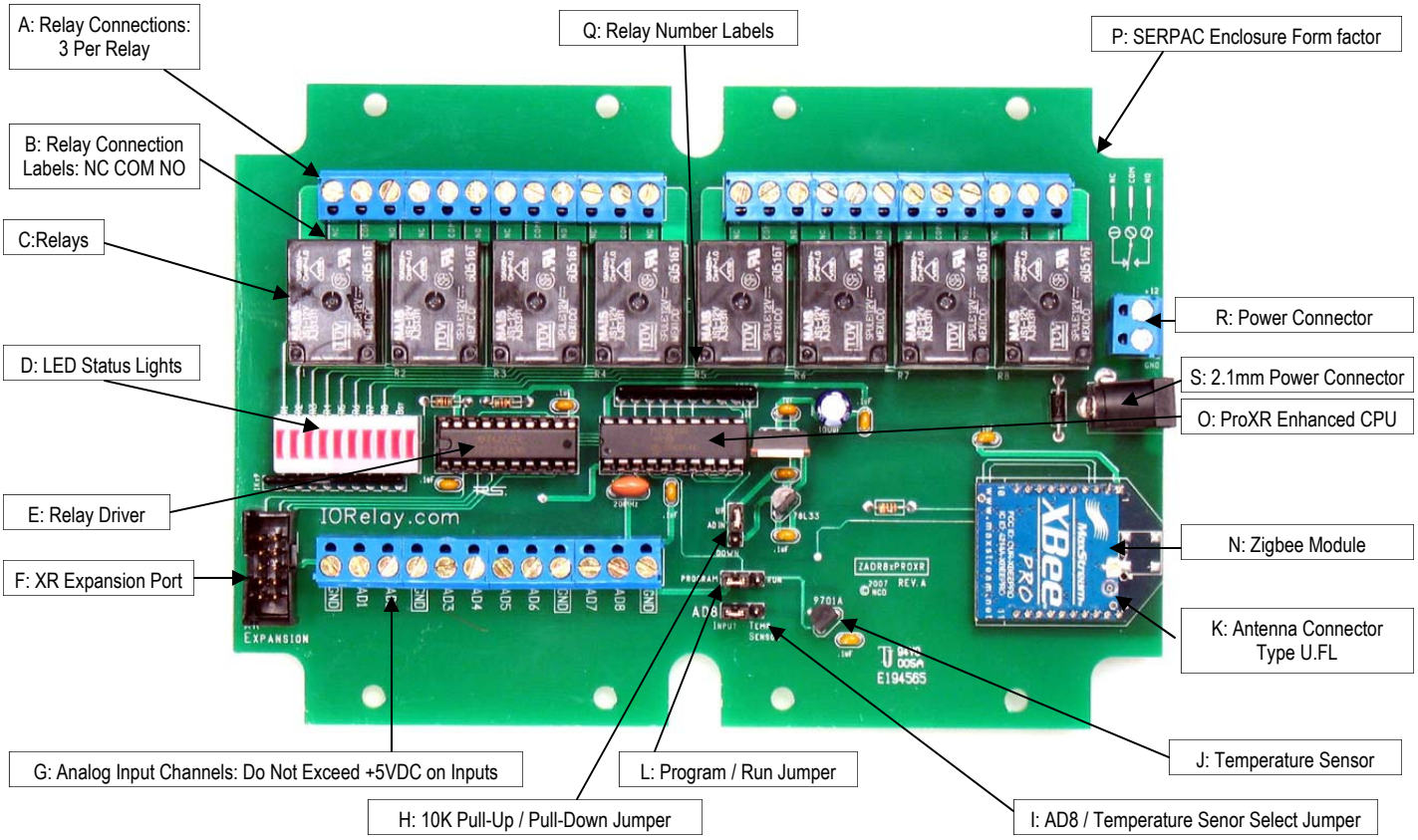
R: +12VDC 1 Amp power supply connection.

S: +12VDC 1 Amp 2.1mm Center Positive power supply connection.

You may choose to use any of the above power supply connections. We have provided two options so you may choose the one that best suits your requirements.

Elements of this diagram may be useful for other devices we offer. We have not included photos of every controller we offer in this manual; instead, we have detailed the significant variations. Our controllers contain many common elements in different combinations.

ProXR Enhanced Zigbee



Zigbee Enhancements

In February, 2007, NCD released a number of ProXR enhanced controllers. These new ProXR controllers are available with an optional enclosure, which accounts for the unusual shape of the circuit board. There are many versions of the ProXR series that have enhanced features. The above map explains the updated layout.

A: There are 3 terminals per relay: NC (Normally Closed), COM (Common), and NO (Normally Open). Then the relay is OFF, Common is connected to Normally Closed. When the relay is ON, Common is connected to the Normally Open. Relay activation time is approximately 5ms. Relay deactivation takes approximately 10ms.

B: The circuit board on the model shown is labeled with NC, COM, and NO. Some models of relay have contacts directly on the top side of the relay. In this case, the PCB will not be labeled with NC, COM, or NO. Instead, look carefully near the contacts of the relay, the relay connections are labeled directly on the relay near the contacts.

C: The relays shown above are 5-Amp SPDT. We offer relay in 1-Amp, 3-Amp, 5-Amp, 10-Amp, 20-Amp, 30-Amp, SPST, SPDT, and DPDT varieties.

D: LED status lights. When powered, the first LED is lit (far right in the photo, bottom LED on other models). One LED is assigned to each relay in the same order as the relays are shown above. The second LED from the left will light when a command is in process.

E: Latch driver chip activates the relays by connecting them to ground under computer control.

F: XR Expansion port allows this controller to speak to a total 256 relays using expansion relay boards.

G: Analog Inputs allow this controller to read 8 different voltage levels or contact closures. Input voltage is between 0 and +5VDC. Do not exceed this voltage rating or damage to the CPU will result.

H: Pull Up / Pull Down Resistors keep the analog inputs from floating. When the jumper is installed in the UP position, each of the analog inputs is connected to +5VDC through a 10K resistor. When the jumper is installed in the DOWN position, each of the analog inputs is connected to Ground through a 10K resistor. When this jumper is removed, the analog inputs "Float" (not recommended for most applications). Neighboring inputs are connected to each other with a total of 20K resistance between immediate neighboring inputs.

I: Analog Input #8 can be connected to an external source when this jumper is set to the Input position. When set to Temp Sensor position, this input is no-longer available to the user. Instead, input channel #8 is connected to a internal MCP9701A temperate sensor.

J: MCP9701A temperature sensor. This sensor delivers a analog voltage in proportion to temperature. This voltage can be read by input channel #8 when the AD8 jumper is set to the Temp Sensor position. Current software does not convert the analog value to a actual temperature. Please consult the MCP9701A data sheet from www.microchip.com for complete details on converting the voltage to a temperature.

K: Antenna Connector is compatible with type U.FL antennas and pigtail adapters.

L: The Program/Run jumper determines if the controller is in Program mode (which allows you to make configuration changes via ProXR software, such as baud rate and timing parameters), or Run mode, which write-protects the on-board memory and should be used for normal daily operation. The baud rate for the USB version of this controller is fixed at 115.2K Baud in Configuration or Runtime mode. Baud rate cannot be changed.

N: Maxstream XBee/XBee Pro Zigbee Interface Module facilitates Wireless 2-Way communications using the Zigbee protocol. 100% Zigbee compliant. This module may be removed, the ID# is printed on the bottom of the module, useful when you want to speak to a specific controller in a wireless network.

O: NCD Customized PIC16F690 CPU running at 20 MHz.

P: PCB Outline Compatible with SERPAC SR171 series enclosures.

Q: Relay number identification labels, R1 through R8. One assigned to each relay.

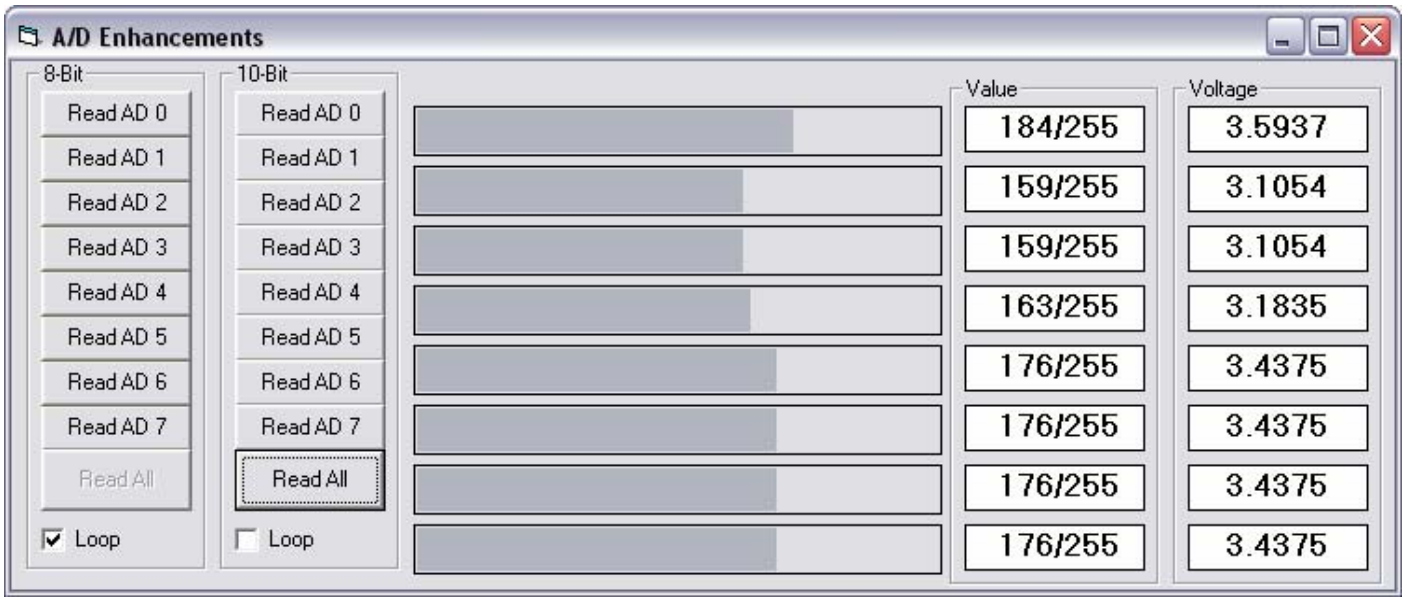
R: +12VDC 1 Amp power supply connection.

S: +12VDC 1 Amp 2.1mm Center Positive power supply connection.

You may choose to use any of the above power supply connections. We have provided two options so you may choose the one that best suits your requirements.

Elements of this diagram may be useful for other devices we offer. We have not included photos of every controller we offer in this manual; instead, we have detailed the significant variations. Our controllers contain many common elements in different combinations.

Analog to Digital Conversion Command Set



Some ProXR Series Enhanced Controllers support Analog to Digital Conversion. Often referred to as A/D or ADC, A/D conversion is the process of converting a voltage to a numeric value that can be read by your computer. The input channels on NCD A/D converters can support a voltage range of 0 to +5VDC. Exceeding this input voltage will damage the CPU on the ProXR controller. Regardless of the type of interface you may be using (RS-232, USB, Zigbee), the commands found on this page will work with ALL ProXR controllers that are equipped with 8-Channels of A/D conversion.

A/D conversion is most commonly used to read sensors, such as light and temperature sensors, but can also be used to read switches, magnets, or any sensor that provides an ON/OFF switch closure output –or– a sensor that provides a voltage within the 0-5VDC voltage range.

NCD Enhanced controllers support 8-Bit or 10-Bit Analog to Digital Conversion. A 8-Bit A/D conversion reads a voltage from 0-5VDC and converts it to a value from 0 to 255. A 10-Bit A/D conversion reads a voltage from 0-5VDC and converts it to a value from 0 to 1023. As you can see, a 10-Bit A/D conversion is more accurate, but it also takes longer to communicate the result to the computer because it requires two bytes to communicate a value of 0 to 1023 whereas a 8-Bit conversion only requires one byte. Effectively, 8-Bit A/D conversion is twice as fast, but 10-Bit A/D conversion is 4x more accurate.

Keep in mind, the commands found on this page apply ONLY to NCD controllers with 8-Channels of A/D conversion built in. These commands will not be processed by other controllers. The commands will are the same regardless of the interface you are using (RS-232, USB, Zigbee).

254,150 Read 8-Bit A/D Channel 1 Returns 1 Byte 0-255
254,151 Read 8-Bit A/D Channel 2 Returns 1 Byte 0-255
254,152 Read 8-Bit A/D Channel 3 Returns 1 Byte 0-255
254,153 Read 8-Bit A/D Channel 4 Returns 1 Byte 0-255
254,154 Read 8-Bit A/D Channel 5 Returns 1 Byte 0-255
254,155 Read 8-Bit A/D Channel 6 Returns 1 Byte 0-255
254,156 Read 8-Bit A/D Channel 7 Returns 1 Byte 0-255
254,157 Read 8-Bit A/D Channel 8 Returns 1 Byte 0-255
254,158 Read 10-Bit A/D Channel 1 Returns 2 Bytes 0-1023
254,159 Read 10-Bit A/D Channel 2 Returns 2 Bytes 0-1023
254,160 Read 10-Bit A/D Channel 3 Returns 2 Bytes 0-1023
254,161 Read 10-Bit A/D Channel 4 Returns 2 Bytes 0-1023
254,162 Read 10-Bit A/D Channel 5 Returns 2 Bytes 0-1023
254,163 Read 10-Bit A/D Channel 6 Returns 2 Bytes 0-1023
254,164 Read 10-Bit A/D Channel 7 Returns 2 Bytes 0-1023
254,165 Read 10-Bit A/D Channel 8 Returns 2 Bytes 0-1023
254,166 Read 8-Bit A/D All Channels Returns 8 Bytes, Each 0-255
254,167 Read 10-Bit A/D All Channels Returns 16 Bytes, 2-Bytes per Channel, 8 Channels, Valuing 0-1023 per Channel.

Here are some simple programming examples in VB:

254,150 Read Channel 1, 8-Bit

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(150)  'Read Channel 1, 8-Bit
Value = GetData             'Read Byte from the Serial Buffer
```

(The controller will return a single byte from 0-255 indicating the voltage on the selected input channel)

254,158 Read Channel 1, 10-Bit

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(158)  'Read Channel 1, 10-Bit
MSB = GetData               'Read MSB Byte from the Serial Buffer
LSB = GetData               'Read MSB Byte from the Serial Buffer
Value = LSB + (MSB * 256)   'Convert Returned Data to Value from 0-1023
```

*The controller will return two bytes indicating the voltage on the selected input channel, the first returned value is the Most Significant Byte MSB, the second byte sent to your computer will be the Least Significant Byte LSB. Using the formula VALUE= (LSB + (MSB * 256)), where VALUE will equate to a numeric value from 0 to 1023. Here is a code sample:*

254,166 Read All Channels, 8-Bit

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(166)  'Read All Channels, 8-Bit
Channel1 = GetData          'Read Channel 1 from the Serial Buffer
Channel2 = GetData          'Read Channel 2 from the Serial Buffer
Channel3 = GetData          'Read Channel 3 from the Serial Buffer
Channel4 = GetData          'Read Channel 4 from the Serial Buffer
Channel5 = GetData          'Read Channel 5 from the Serial Buffer
Channel6 = GetData          'Read Channel 6 from the Serial Buffer
Channel7 = GetData          'Read Channel 7 from the Serial Buffer
Channel8 = GetData          'Read Channel 8 from the Serial Buffer
```

254,167 Read All Channels, 10-Bit

```
MSComm1.Output = Chr$(254)  'Enter Command Mode
MSComm1.Output = Chr$(167)  'Read All Channels, 10-Bit
For X = 1 to 8
  MSB = GetData             'Read MSB Byte from the Serial Buffer
  LSB = GetData             'Read MSB Byte from the Serial Buffer
  Debug.Print  LSB + (MSB * 256)    'Convert and Print Returned Data to Value from 0-1023
Next X
```

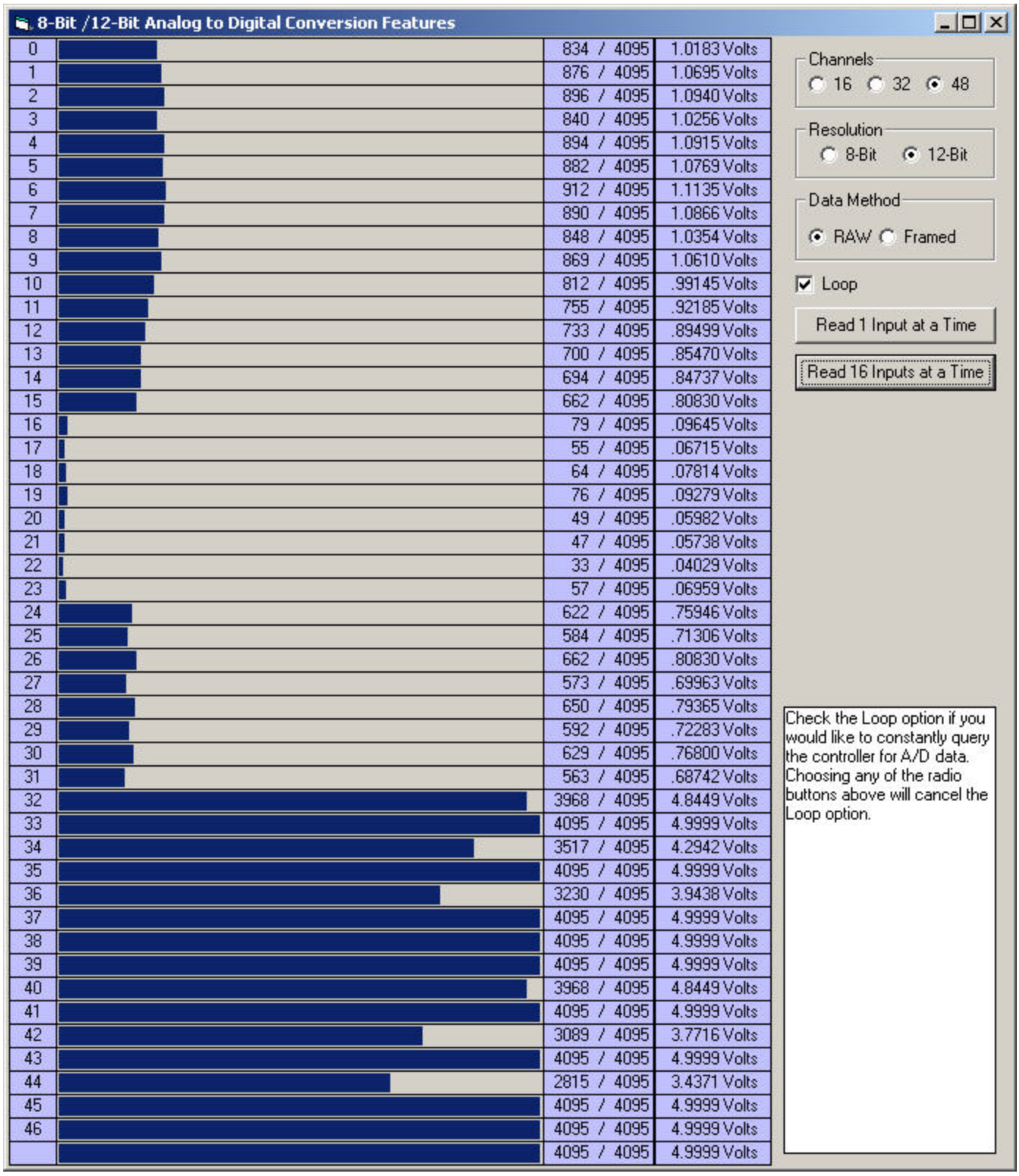
NOTICE:
GetData shown in the code above is a Function and is NOT a VB Command. GetData calls the code shown below, used for Reading a Byte of Data from the PC Serial Buffer:

```
Public Function GetData()                'Read a Byte of Data from the Controller in VB
  Do                                     'Start a Continuous Loop
    DoEvents                             'Service Other Windows Tasks (Very Important!!!)
  Until MSComm1.InBufferCount > 0        'Continue Loop Until a Byte of Data is Received
  GetData = ASC(MSComm1.Input)           'Read Data Byte from the Serial Port
End Function
```

These Command Apply ONLY to ProXR Controllers Enhanced with 8-Channels of Analog to Digital Conversion, Available with RS-232, USB, Zigbee, Ethernet, and 802.11b Wi-Fi WLAN Interface. These commands will not be processed by the standard ProXR Series.

AD12 Series 12-Bit Analog to Digital Conversion With ProXR Relay Control Command Set

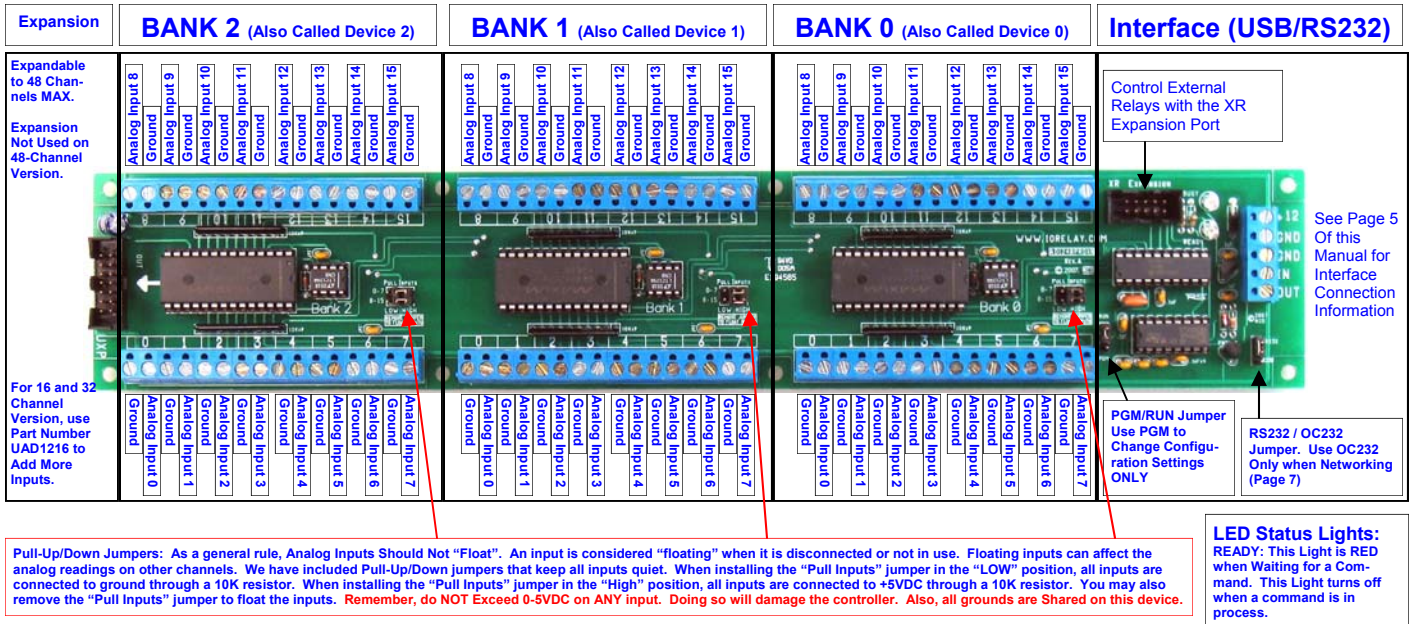
Analog to Digital Conversion is the Process of Converting a Voltage to a Number. A low voltage yields a low number while a high voltage yields a high number. The AD12PROXR Series Controllers allow you to read up to 48 channels of Voltages. With minimal amounts of software, it is possible to control relays based on input voltages. NCD AD Converter devices are ideally suited for interface to light and temperature sensors, as well as buttons and switches. If you are looking to read data, evaluate the results, and control relays all with a single controller, then the AD12PROXR series is for you.



These Command Apply ONLY to ProXR Controllers Enhanced with High-Resolution Analog to Digital Conversion, Available Interface Options Include RS-232 and USB. These commands will not be processed by the standard ProXR Series.

AD12 Series 12-Bit Analog to Digital Conversion With ProXR Relay Control Command Set

This Page Applies to the Following Part Numbers:
AD1216PROXR RS-232 16-Channel 12-Bit A/D Analog to Digital Converter + XR Expansion Port
AD1232PROXR RS-232 32-Channel 12-Bit A/D Analog to Digital Converter + XR Expansion Port
AD1248PROXR RS-232 48-Channel 12-Bit A/D Analog to Digital Converter + XR Expansion Port
UAD1216ProXR USB 16-Channel 12-Bit A/D Analog to Digital Converter + XR Expansion Port
UAD1232ProXR USB 32-Channel 12-Bit A/D Analog to Digital Converter + XR Expansion Port
UAD1248ProXR USB 48-Channel 12-Bit A/D Analog to Digital Converter + XR Expansion Port



Pull-Up/Down Jumpers: As a general rule, Analog Inputs Should Not "Float". An input is considered "floating" when it is disconnected or not in use. Floating inputs can affect the analog readings on other channels. We have included Pull-Up/Down jumpers that keep all inputs quiet. When installing the "Pull Inputs" jumper in the "LOW" position, all inputs are connected to ground through a 10K resistor. When installing the "Pull Inputs" jumper in the "High" position, all inputs are connected to +5VDC through a 10K resistor. You may also remove the "Pull Inputs" jumper to float the inputs. Remember, do NOT Exceed 0-5VDC on ANY input. Doing so will damage the controller. Also, all grounds are Shared on this device.

LED Status Lights:
READY: This Light is RED when Waiting for a Command. This Light turns off when a command is in process.

BUSY: This Light is RED when a command is in process and is OFF when the device is ready for data.

USB Status Lights:
USB: Lights when Communication is Established between PC and Controller.

RX: Lights when Data is Received from the Computer.

TX: Lights when Data is Transmitted to the Computer.

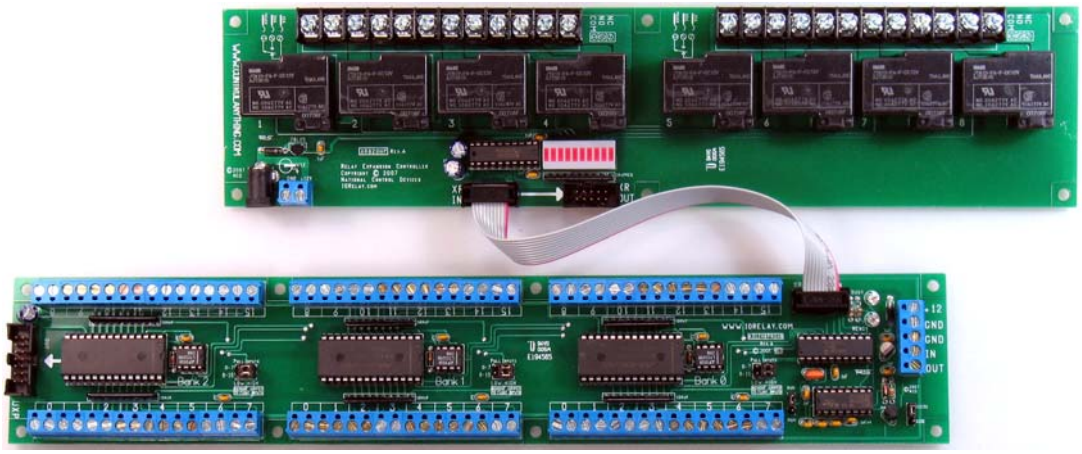
Introduction:

The AD1216PROXR Series Controllers allow you to read analog data into the computer. These devices are ideally suited for reading thermistors, photocells, thermocouples, or other sensor devices with voltage or resistive outputs. These controllers may also be used to read contact closure devices such as switches and buttons.

The purpose of the AD1216PROXR series is to read analog data into a PC or embedded computer, and convert the voltage values to numeric values that can be easily processed. The AD1216PROXR series support reading single inputs or groups of 16 inputs with a single request. Both 8-Bit and 12-Bit resolutions are supported by this device. The data generated by the AD1216PROXR series is very easy to process: When an input is at 0 volts, the controller will generate a numeric value of 0. When an input is at 5 volts, the controller will generate a numeric value of 255 (8-Bit Resolution) or 4095 (12-Bit Resolution). When an input is at 2.5 Volts, the controller will generate a numeric value of 127 (8-Bit Resolution) or 2047 (12-Bit Resolution).

In addition to reading inputs, this controller fully supports the ProXR command set, allowing you to activate relays externally. This is ideal for applications that may require a light or temperature activated switch, using your computer or microcontroller to set the threshold limits.

This device is available with an RS-232 interface (fully E3C compliant), supporting baud rates up to 115.2K Baud. This device is also available with a USB interface at a fixed baud rate of 115.2K baud.



In addition to Multi-Channel High Resolution Analog to Digital Conversion, the AD12 Series Controllers can be Expanded to Control up to 256 External Relays.

The XR Expansion Port is compatible with any Relay Controller that begins with the part number XR.

These Command Apply ONLY to ProXR Controllers Enhanced with High-Resolution Analog to Digital Conversion, Available Interface Options Include RS-232 and USB. These commands will not be processed by the standard ProXR Series.

AD12 Series 12-Bit Analog to Digital Conversion With ProXR Relay Control Command Set

The AD1216PROXR Series Controllers wait for a command and return data based on the command you send. Data comes back in many formats, depending on the command that you issue to the controller. Here is a summary of the commands that can be sent to the controller. When a command is sent to the device, the device will reply with data as shown below:

Command	Function	Response
254,192	Read 16 Channels at a Time, 8-Bit A/D Device Bank 0	Returns 16 Bytes
254,193	Read 16 Channels at a Time, 8-Bit A/D Device Bank 1	Returns 16 Bytes
254,194	Read 16 Channels at a Time, 8-Bit A/D Device Bank 2	Returns 16 Bytes

When the above commands are sent to the controller, the controller will respond with 16 bytes of data indicating analog values from 0 to 255 for each of the 16 channels. Data will be sent in the following order from left to right:
Channel 0, 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15

254,195,Channel	Read Single Channel at a Time, 8-Bit A/D Device Bank 0	Returns 1 Byte of Analog Data

254,196	Read 16 Channels at a Time, 12-Bit A/D Device Bank 0	Returns 32 Bytes
254,197	Read 16 Channels at a Time, 12-Bit A/D Device Bank 1	Returns 32 Bytes
254,198	Read 16 Channels at a Time, 12-Bit A/D Device Bank 2	Returns 32 Bytes

When the above commands are sent to the controller, the controller will respond with 32 bytes of data indicating analog values from 0 to 255 for each of the 16 channels. Data will be sent in the following order from left to right:
Channel 0 LSB, 0 MSB, 1 LSB, 1 MSB, 2 LSB, 2 MSB, 3 LSB, 3 MSB, 4 LSB, 4 MSB, 5 LSB, 5 MSB, 6 LSB, 6 MSB, 7 LSB, 7 MSB, 8 LSB, 8 MSB, 9 LSB, 9 MSB, 10 LSB, 10 MSB, 11 LSB, 11 MSB, 12 LSB, 12 MSB, 13 LSB, 13 MSB, 14 LSB, 14 MSB, 15 LSB, 15 MSB.

254,199,Channel	Read Single Channel at a Time, 12-Bit A/D Device Bank 0	Returns 2 Bytes LSB then MSB

254,200	Read 16 Channels at a Time, 8-Bit A/D Device Bank 0 (Packet Format)	Returns 18 Bytes
254,201	Read 16 Channels at a Time, 8-Bit A/D Device Bank 1 (Packet Format)	Returns 18 Bytes
254,202	Read 16 Channels at a Time, 8-Bit A/D Device Bank 2 (Packet Format)	Returns 18 Bytes

When the above commands are sent to the controller, the controller will respond with 18 bytes of data indicating analog values from 0 to 255 for each of the 16 channels. Also included in the data structure is a Header Byte (254), and a Checksum Byte (which is the total value of 254 + all 16 bytes of data). The checksum byte only contains the lower 8 bits of data. Data will be sent in the following order from left to right:
Header Byte 254, Channel 0, 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, Checksum Value

254,203,Channel	Read Single Channel at a Time, 8-Bit A/D Device Bank 1	Returns 1 Byte of Analog Data

254,204	Read 16 Channels at a Time, 12-Bit A/D Device Bank 0 (Packet Format)	Returns 34 Bytes
254,205	Read 16 Channels at a Time, 12-Bit A/D Device Bank 1 (Packet Format)	Returns 34 Bytes
254,206	Read 16 Channels at a Time, 12-Bit A/D Device Bank 2 (Packet Format)	Returns 34 Bytes

When the above commands are sent to the controller, the controller will respond with 34 bytes of data indicating analog values from 0 to 4095 for each of the 16 channels. Also included in the data structure is a Header Byte (254), and a Checksum Byte (which is the total value of 254 + all 16 bytes of data). Data will be sent in the following order from left to right:
Header Byte 254, Channel 0 LSB, 0 MSB, 1 LSB, 1 MSB, 2 LSB, 2 MSB, 3 LSB, 3 MSB, 4 LSB, 4 MSB, 5 LSB, 5 MSB, 6 LSB, 6 MSB, 7 LSB, 7 MSB, 8 LSB, 8 MSB, 9 LSB, 9 MSB, 10 LSB, 10 MSB, 11 LSB, 11 MSB, 12 LSB, 12 MSB, 13 LSB, 13 MSB, 14 LSB, 14 MSB, 15 LSB, 15 MSB, Checksum Value.

254,207,Channel	Read Single Channel at a Time, 12-Bit A/D Device Bank 1	Returns 2 Bytes LSB then MSB
254,208,Channel	Read Single Channel at a Time, 8-Bit A/D Device Bank 2	Returns 1 Byte of Analog Data
254,209,Channel	Read Single Channel at a Time, 12-Bit A/D Device Bank 2	Returns 1 Byte of Analog Data

Channel = Value Between 0 and 15	
LSB = Least Significant byte	When data greater than 8 bits must be sent, 2 bytes are required, LSB and MSB.
MSB = Most Significant byte	The value of these two bytes is computed with back into a integer value.
Value = LSB + (MSB * 256)	Note: This formula is used to convert LSB/MSB 12 bit values to integer values 0-4095.
Checksum = (254 + All Data) And 255	Note: "And" is a mathematical function supported by most programming languages

8-Bit Resolution = 5VDC Divided By 256 Steps = .01953125 Volts per Step
12-Bit Resolution = 5VDC Divided by 4096 Steps = .001220703125 Volts per Step

NOTE: Incoming Signals are degraded by approximately 100 ohms before analog to digital conversion process.

These Command Apply ONLY to ProXR Controllers Enhanced with High-Resolution Analog to Digital Conversion, Available Interface Options Include RS-232 and USB. These commands will not be processed by the standard ProXR Series.

AD12 Series 12-Bit Analog to Digital Conversion With ProXR Relay Control Command Set

On this page, we will demonstrate a practical example for handling the incoming data from the AD1216PROXR series controllers. The programming examples shown on this page were written in Visual Basic 6 Professional. The "GetData" and "GetData2" functions are used to read data from the controller. This function is shown in greater detail at the bottom left of this page.

254,195,1 Read Channel 1, 8-Bit

```
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(195)   'Read Single Channel 8-Bit
MSComm1.Output = Chr$(1)     'Read Channel 1
Value = GetData              'Read Byte from the Serial Buffer
```

(The controller will return a single byte from 0-255 indicating the voltage on the selected input channel)

254,199,1 Read Channel 1, 12-Bit

```
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(199)   'Read Single Channel 12-Bit
MSComm1.Output = Chr$(1)     'Read Channel 1
MSB = GetData                'Read MSB Byte from the Serial Buffer
LSB = GetData                'Read MSB Byte from the Serial Buffer
Value = LSB + (MSB * 256)    'Convert Returned Data to Value from 0-4095
```

*The controller will return two bytes indicating the voltage on the selected input channel, the first returned value is the Most Significant Byte MSB, the second byte sent to your computer will be the Least Significant Byte LSB. Using the formula VALUE= (LSB + (MSB * 256)), where VALUE will equate to a numeric value from 0 to 4095. Here is a code sample:*

254,192 Read All 16 Channels on Bank 0, 8-Bit

```
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(192)   'Read All 16 Channels, Bank 0, 8-Bit
Channel1 = GetData           'Read Channel 1 from the Serial Buffer
Channel2 = GetData           'Read Channel 2 from the Serial Buffer
Channel3 = GetData           'Read Channel 3 from the Serial Buffer
.....
Channel16 = GetData          'Read Channel 16 from the Serial Buffer
```

254,196 Read All Channels on Bank 0, 12-Bit

```
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(196)   'Read All Channels, 12-Bit
For X = 1 to 16
  MSB = GetData              'Read MSB Byte from the Serial Buffer
  LSB = GetData              'Read MSB Byte from the Serial Buffer
  Debug.Print  LSB + (MSB * 256)   'Convert and Print Returned Data to Value from 0-4095
Next X
```

NOTICE:
GetData shown in the code above is a Function and is NOT a VB Command. GetData calls the code shown below, used for Reading a Byte of Data from the PC Serial Buffer:

```
Public Function GetData()                  'Read a Byte of Data from the Controller in VB
  Do                                       'Start a Continuous Loop
    DoEvents                               'Service Other Windows Tasks (Very Important!!!)
  Until MSComm1.InBufferCount > 0          'Continue Loop Until a Byte of Data is Received
  GetData = ASC(MSComm1.Input)             'Read Data Byte from the Serial Port
End Function
```

NOTICE:
GetData2 is slightly smarter than the GetData function. This routine times out if data is not received within 4000 counts. This value can be increased for longer timeouts.

```
Public Function GetData2()
    GetData2 = -1
    TT = 0
    Do
      DoEvents
      TT = TT + 1
      If TT > 4000 Then Exit Function
    Loop Until MSComm1.InBufferCount > 0
    GetData2 = Asc(MSComm1.Input)
End Function
```

The AD1216PROXR Series Controllers are capable of generating packetized data to help insure error free communications. These data packets are "framed" with a header byte and a footer checksum. When a packet is received, it is analyzed to make sure all data bytes are valid BEFORE it is displayed or processed by the user. If the data packet is invalid, a new data packet will be gathered from the controller. Here is a example the processes a data packet from the controller:

```
The following code sets up a buffer array and a label to restart the routine
Dim Buffer(32) As Integer
Restart:
The following code requests data from the controller (16-Channels 12-Bit):
MSComm1.Output = Chr$(254)          'Enter Command Mode
MSComm1.Output = Chr$(204)          'Read 16-Channel 12-Bit with Packets
The following code gathers data from the controller:
CKSUM = GetData2                    'Get LSB from Controller
If CKSum <> 254 then Restart        'Make Sure Header is Received and stored as Checksum
For Channel = 0 To 15               'Count Through All 16 Channels
  LSB = GetData2                    'Get LSB from Controller
  MSB = GetData2                    'Get MSB from Controller
  If MSB <> -1 And LSB <> -1 Then   'If Data Does Not timeout
    Buffer((Channel * 2)) = LSB     'Store LSB
    Buffer((Channel * 2) + 1) = MSB 'Store MSB
    CKSUM = CKSUM + LSB             'Add LSB to Checksum Value
    CKSUM = CKSUM + MSB             'Add MSB to Checksum Value
  End If
Next Channel
Gather Hardware and Software Checksums for Comaprison:
HW_Cksum = GetData2                 'Store the Hardware Checksum
CKSUM = (CKSUM And 255)             'Compute Software Checksum
The following code executes if the Data Packet is Validated
If HW_Cksum = CKSUM Then            'If the Checksums Match
  Debug.Print "CK ok"
  At this point, the checksums are validated and data can be displayed or processed.
Else
  Debug.Print "CK ERROR"
  At this point, the checksums are not equal, new data should be gathered.
End If
Goto Restart
```

Here is another version that works with 8-bit A/D data:

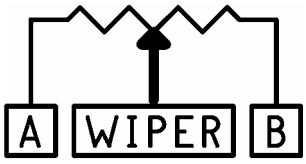
```
The following code sets up a buffer array and a label to restart the routine
Dim Buffer(32) As Integer
Restart:
The following code requests data from the controller (16-Channels 12-Bit):
MSComm1.Output = Chr$(254)          'Enter Command Mode
MSComm1.Output = Chr$(200)          'Read 16-Channel 12-Bit with Packets
The following code gathers data from the controller:
CKSUM = GetData2                    'Get LSB from Controller
If CKSum <> 254 then Restart        'Make Sure Header is Received and stored as Checksum
For Channel = 0 To 15               'Count Through All 16 Channels
  Bytes = GetData2                  'Get Analog Data Byte from Controller
  If Bytes <> -1 Then               'If Data Does Not timeout
    Buffer(Channel) = Bytes         'Store Bytes
    CKSUM = CKSUM + Bytes           'Add LSB to Checksum Value
  End If
Next Channel
Gather Hardware and Software Checksums for Comaprison:
HW_Cksum = GetData2                 'Store the Hardware Checksum
CKSUM = (CKSUM And 255)             'Compute Software Checksum
The following code executes if the Data Packet is Validated
If HW_Cksum = CKSUM Then            'If the Checksums Match
  Debug.Print "CK ok"
  At this point, the checksums are validated and data can be displayed or processed.
Else
  Debug.Print "CK ERROR"
  At this point, the checksums are not equal, new data should be gathered.
End If
Goto Restart
```

These Command Apply ONLY to ProXR Controllers Enhanced with High-Resolution Analog to Digital Conversion, Available Interface Options Include RS-232 and USB. These commands will not be processed by the standard ProXR Series.

Potentiometer (Programmable Resistor) Commands

Some ProXR Series Enhanced Controllers support control of up to 256 potentiometers. A potentiometer is a variable resistor, capable of changing resistance under software control. Programmable potentiometers are ideal for making computer controlled mixers and audio/video mixing devices, as well as light dimmers and motor speed controllers. The POT and UPOT series controllers offer RS-232 and USB controlled potentiometers, and are ideally suited for integration into various types of test instruments, programmable amplifiers, programmable power supplies, and anything else that can benefit by software controlled resistance variation. As a general rule, potentiometer devices often require external circuitry. For instance, it is not possible to control the brightness of a light bulb directly or the speed of a motor without some additional electronics.

Potentiometer controllers are available with 10K, 50K and 100K programmable potentiometers. It is possible to set the power-up default state of the first 48 potentiometers. It is also possible to control each potentiometer in 256 steps, allowing fine adjustments under software control. You can control up to 256 potentiometers under software control, you can control each individually or all simultaneously. In addition to potentiometer control the POT and UPOT series controllers include the ProXR command set, allowing you to plug in up to 256 relays into the expansion port.



Potentiometers have 3 Connections: A, Wiper, and B. When a low value is sent to the controller, the wiper moves closer to A, decreasing the resistance between A and the wiper (increasing the resistance between the wiper and B). When a high value is sent to the controller, the wiper moves closer to B, decreasing the resistance between the wiper and B (increasing the resistance between the wiper and A). The first 48 channels of wiper values can be set to a power-up default state. It is possible to set the wipers on all outputs individually or simultaneously.

254,170, Pot, Value Set One Potentiometer to a Value

This Command Sets the wiper position of the selected potentiometer to a selected value. POT has a valid value of 0-255, Value has a valid range of 0-255. A Low value move the wiper closer to A. A high value moves the wiper closer to B.

```
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(170)   'Set Potentiometer Value of a Single Output Channel
MSComm1.Output = Chr$(0)     'Select a Potentiometer to Control
MSComm1.Output = Chr$(128)   'Set the Wiper to Mid Position
Value = GetData              'Read Byte from the Serial Buffer
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

254,171, Value Set All Potentiometers to a Value

This Command Sets All wiper positions of all potentiometers to a selected value. Value has a valid range of 0-255. A Low value move the wiper closer to A. A high value moves the wiper closer to B.

```
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(171)   'Set All Potentiometer Values
MSComm1.Output = Chr$(255)   'Set All Wipers Close to Position B
Value = GetData              'Read Byte from the Serial Buffer
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

254,172, Pot, Value Store One Potentiometer Startup Value

This Command stores a Powerup Default Wiper Position for the Selected Potentiometer. Pot has a valid range of 0 to 47. Value has a valid range of 0-255. A Low value move the wiper closer to A. A high value moves the wiper closer to B.

```
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(172)   'Set Potentiometer Value of a Single Output Channel
MSComm1.Output = Chr$(0)     'Select a Potentiometer to Store (Maximum 47)
MSComm1.Output = Chr$(128)   'Store Wiper Startup Position to Mid Position
Value = GetData              'Read Byte from the Serial Buffer
```

(When Reporting Mode is ON, controller will send ASCII Code 85 to Acknowledge this command)

254,173, Pot Read Stored Potentiometer Startup Value

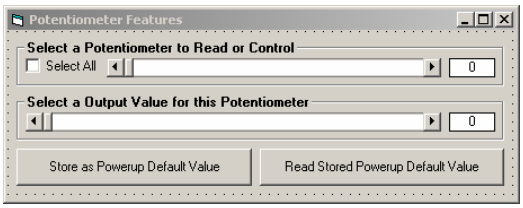
This Command reads the Powerup Default Wiper Position for the Selected Potentiometer. Pot has a valid range of 0 to 47. This command returns a single byte of data indicating the powerup default Wiper position of the selected potentiometer.

```
MSComm1.Output = Chr$(254)   'Enter Command Mode
MSComm1.Output = Chr$(173)   'Set Potentiometer Value of a Single Output Channel
MSComm1.Output = Chr$(0)     'Select a Potentiometer to Read (Maximum 47)
Value = GetData              'Read Byte from the Serial Buffer
```

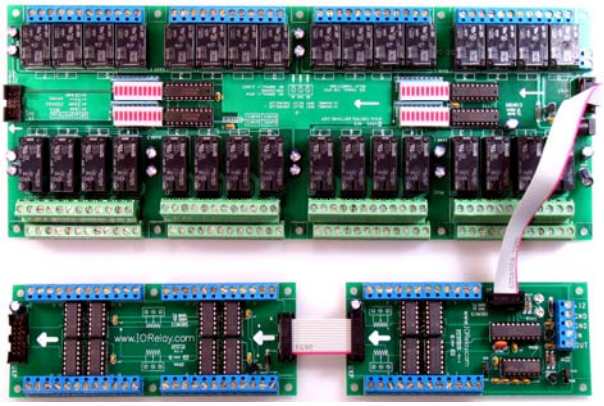
(The controller will return a single byte from 0-255 indicating the Default Powerup Wiper Position for the Selected Channel)

NOTICE:
GetData shown in the code above is a Function and is NOT a VB Command. GetData calls the code shown below, used for Reading a Byte of Data from the PC Serial Buffer:

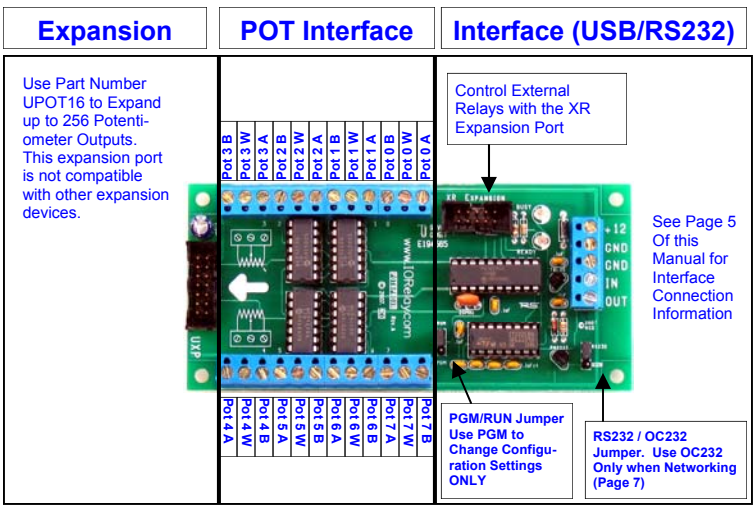
```
Public Function GetData()                'Read a Byte of Data from the Controller in VB
  Do                                     'Start a Continuous Loop
    DoEvents                             'Service Other Windows Tasks (Very Important!!!)
  Until MSComm1.InBufferCount > 0        'Continue Loop Until a Byte of Data is Received
  GetData = ASC(MSComm1.Input)           'Read Data Byte from the Serial Port
End Function
```



Our ProXR Software provides you with a simple window to test these functions.



All ProXR Series Controllers can be Expanded to Control 256 Relays. This Potentiometer Device is Capable of Controlling a total of 256 Potentiometer Outputs.



This Page Applies to the Following Part Numbers:
POT8ProXR RS-232 8-Channel Programmable Potentiometer + XR Expansion Port
POT16ProXR RS-232 16-Channel Programmable Potentiometer + XR Expansion Port
POT24ProXR RS-232 24-Channel Programmable Potentiometer + XR Expansion Port
UPOT8ProXR USB 8-Channel Programmable Potentiometer + XR Expansion Port
UPOT16ProXR USB 16-Channel Programmable Potentiometer + XR Expansion Port
UPOT24ProXR USB 24-Channel Programmable Potentiometer + XR Expansion Port

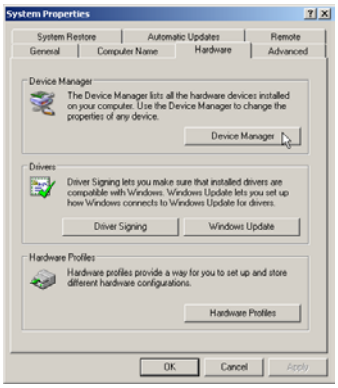
These Command Apply ONLY to ProXR Controllers Enhanced with Potentiometer Outputs, Available with RS-232 and USB Interface. These commands will not be processed by the standard ProXR Series.

USB Speed Optimization: Go Faster...

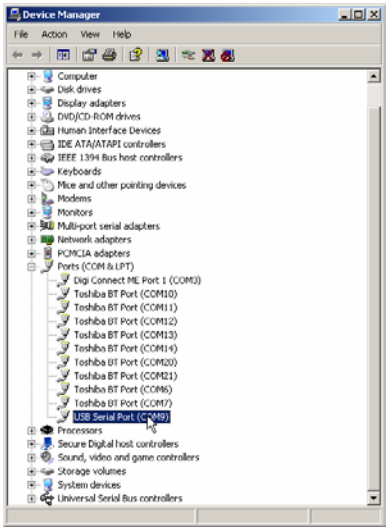
The ProXR Series Enhanced Controllers Equipped with a USB Interface are shipped with a variety of parameters that are "safe" for all computers to ensure compatibility. There are a few options that can be configured to significantly increase communication speed between the device and the computer. This guide shows you how to optimize communication speed for better performance. The settings shown work on most computers without any problems.

Step 1:
Click the "Start" button in Windows and select "Control Panels".

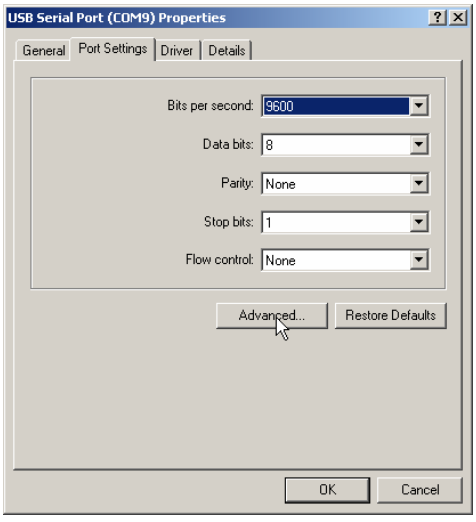
Step 2:
Select the "System" control panel.



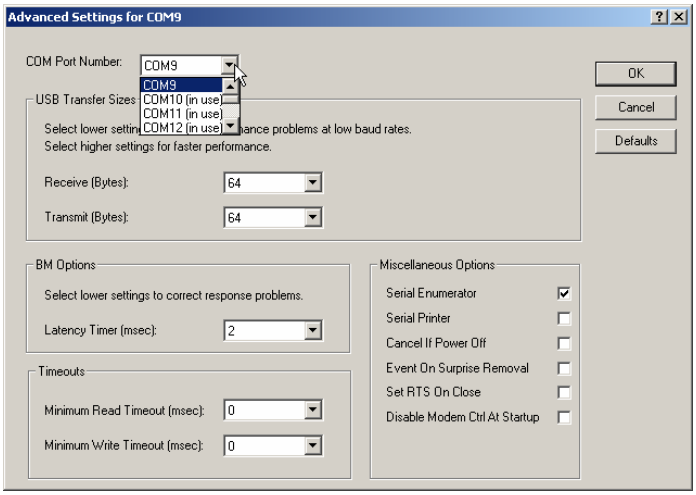
Step 3:
Select the "Hardware" tab (shown below), and then click "Device Manager".



Step 4:
Navigate to the USB Serial Port for the NCD Device you wish to optimize. And Right Click.



Step 5:
Click on the "Port Settings" tab and click the "Advanced" button.



Step 6:
You can assign a different COM port to the USB device by selecting a New COM port in the "COM Port Number" dropdown box.

Step 7:
Optimization. Set the Receive and Transmit Bytes to 64. Set the Latency Timer to 2 milliseconds. Make sure all other parameters match the parameters shown above and click "OK".

Next, it would be a good idea to unplug the USB device and wait a few seconds. Plug the device back in and follow these steps again to make sure the parameters were properly configured for the USB driver. Once you have verified all settings, you have successfully optimized the USB driver and will notice a significant increase in communication speed. However, further speed increases are still possible. The steps outlined above only configure the USB driver for optimal speed. Now it is time to optimize the USB device for optimal speed.

Increasing the Speed of the USB Device:
Download our "ProXR Software" and install it on your computer.

Run our ProXR software on your computer and click the yellow button at the bottom that is labeled "Advanced Feature Settings".

This will open the settings shown on Page 24 of this manual.

Reduce the "Serial Timing" parameter to a value from 20-35 and store the setting into the controller. You will need to change the Program/Run jumper to "Program" to store your settings. USB devices allow you to change this jumper without power cycling the controller. However, you should return the jumper to the "Run" position after settings have been stored.

Next, exit the ProXR software and unplug the USB device.

Next, reconnect the USB device to your computer. Your device should now be optimized, though further speed enhancements may be possible by further reducing the "Serial Timing" parameter. The optimal setting will vary from computer to computer. We achieved reliable communications with a value of 20, but some computers may be able to handle lower settings. This setting affects the speed of data being sent from the device to the computer. The device is easily capable of outrunning your computer. Reducing this parameter reduces the delay between data bytes sent to your PC. Experimentation is in order, but keep in mind, commands that request more than a single byte of data from the USB device may be adversely affected by this command. Returning the device to configuration mode forces the device to a safe speed, regardless of your settings. This will prevent a permanent loss of communications.

NCD USB Devices mount as a COM port on your computer. Your software should speak to the device using the COM port that is mounted by the device. NCD devices use a fixed data rate of 115.2K Baud, 8 data bits, 1 stop bit, No Parity. The settings shown at left will have no bearing on your software, your software will override the settings shown, so don't worry about changing the default baud rate of the driver.