



X20s

6 Relay, 6 Input Expansion Module

USERS MANUAL

Revision 1.1

For models: X-20s

High-Current, Line-Voltage-Rated Relays • Six Opto-Isolated Inputs



- ▶ Lighting Control
- ▶ Door Locks
- ▶ Remote Gate Control
- ▶ Motor Control
- ▶ Pumps

CONTROL by
WEB™
www.ControlByWeb.com

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located in Nibley, Utah, USA

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X-20s User Manual Revisions	
Revision	Description
1.0	Initial release

Section 1: Introduction

The X-20s™ expansion module is used with the X-600M™ controller. The X-20s has six, high-current relays, each with Form-C contacts (SPDT) and six, optically-isolated digital inputs. A screw terminal strip provides high-current connections to the relays. One or more X-20s expansion modules can be connected to an X-600M controller with ribbon cables.

The X-600M is a multifunction web-enabled industrial I/O controller. It performs control, logic, and monitoring functions similar to that of a Programmable Logic Controller (PLC). However, unlike a PLC, the X-600M is designed for web-based applications from the ground up. No add-on software or hardware is required. The X-600M can be fully configured, programmed and tested using its built-in web server. The web setup pages are intuitive, easy-to-use, and do not require special programming skills.

The X-600M together with expansion modules such as the X-20s provide an easy, flexible, and reliable way to monitor and control systems and devices over a network. The X-20s is suitable for use with controlling relatively heavy loads such as motors, solenoid valves, and lights. Switches can be connected to the X-20s' digital inputs to locally control these loads. The digital inputs can also be used for other monitoring applications such as limit switches, security sensors, or light switches.

The X-20s' inputs can be used to trigger email alerts based on a single change of state or after a number of state changes. The inputs can also be used as counters, or they can be used to control the relays of other ControlByWeb™ products (such as WebRelay™) that are located at a remote location.



1.1 Features and Connectors

Relays (6)

The X-20s has six, high-current relays. Screw terminals are provided for the *Common*, *Normally Open*, and *Normally Closed* contacts of each relay. The screw terminal connections are wired directly to the relays with no internal fuse or other over-current protection. The relays are isolated from all other circuits.

Digital Inputs (6)

The X-20s has six, optically-isolated digital inputs. A 12-position screw terminal connector provides wiring connections. The inputs are electrically isolated from the low-voltage control circuits of the X-600M. The isolated inputs are suitable for use in industrial environments and allow the grounding system of the monitored equipment and the low voltage circuits of the X-20s to be electrically separate. Internally the X-20s has a co-processor which provides enhanced features which include high-time accumulating timers, on-time timers, pulse counting, frequency measuring and de-bounce timers. Each of the six inputs have separate de-bounce and input logic.

Expansion Bus

The expansion bus allows for a family of expansion modules to be connected directly to the X-600M without the need for an Ethernet switch. The communications cable can be a daisy chain with multiple connectors. The X-20s has two expansion bus connectors (one on each end) which allow the use of short ribbon cables to connect from one module to the next. The expansion bus can only be connected to the UL Listed X-600M from Xytronix.

Power Supply

The X-20s has screw terminal connections for making direct connections to a 9 to 28VDC power supply. See *Section 2.3.2* for more details. The X-20s employs a modern switch-mode power supply. With this type of power supply, the current draw decreases as the voltage increases.

Indicators

Each relay and digital input has a green LED indicator which is illuminated when the respective relay or input is active. The power LED indicator is illuminated whenever the module is powered. To identify the module during installation, the X-600M can send a blink command which will cause the power LED to blink for three seconds.

1.2 Digital Input Measurement Functions

Input State

This register is the current (asynchronously sampled) status of the digital inputs.

High Time

These registers measure the pulse width of the most recent pulse. These are 32-bit values with a resolution of 0.977mS. ($1/1024 \times 2^{32} = 4,194,304$ seconds max.) The registers are reset with a rising edge, are updated while the input is asserted and remain unchanged until the next rising edge. The counters are qualified by the respective de-bounce timer settings.

ON Time

These registers measure the accumulated (total) time the respective inputs are asserted. If the input is configured for rising edge pulses the counters advance when the opto-couplers are ON. If the input is configured for falling edge pulses the counters advance when the opto-couplers are OFF. The On-Time counters do nothing when the edge is set to both rise and fall. These counters are 32-bit values with a resolution of 0.977mS. ($1/1024 \times 2^{32} = 4,194,304$ seconds max). The input state for the *On-Time* counters is polled at a 1024Hz rate and are not qualified by the respective de-bounce timer settings.

This measurement could be used to measure the total operating time of a pump or machine. The measurement would indicate the total hours the pump or machine has operated since the *On-Time* register was reset.

Count

These registers measure the total number of pulse transitions (rise, fall, or both) that have occurred on the respective inputs. The counters are qualified by the respective de-bounce timer settings. The counters are 32-bit which allows operation with paddle-wheel flow meters and other devices which output a large number of pulses.

Frequency

These registers measure the total number of pulses that have occurred over a 1.00 second interval. The measurement is updated precisely once per second. Since the event counters are qualified by the respective de-bounce timer settings, the frequency measurements are also qualified by the de-bounce settings.

Note: *If the count mode is set to rise and fall, the resulting frequency measurement will be the number of rise and fall edges that have occurred in 1-second.*

De-bounce Time

Each of the six inputs have a de-bounce timer. The internal processor periodically polls the input state. If the appropriate edge (rise, fall or both) is detected, a timer is initialized to the respective de-bounce value. If the input state subsequently changes (a glitch) the timer is restarted. When the input stabilizes, the de-bounce timer eventually expires and the appropriate event counter is advanced.

1.3 Part Numbers and Accessories

Device	Description	Part Number
X-20s	6-Relay, 6-Input expansion module	X-20s
Jumper cable	5-inch x 10 conductor ribbon cable (included)	EXPCBL-5in

Section 2: Installation and Connections

Installation consists of mounting the X-20s, connecting it to an X-600M controller with a 10-conductor ribbon cable and connect a 9-28VDC power source. Programming and testing is done through the X-600M by using a web browser to configure the web pages, inputs, and outputs for your specific needs.

2.1 Installation Guidelines

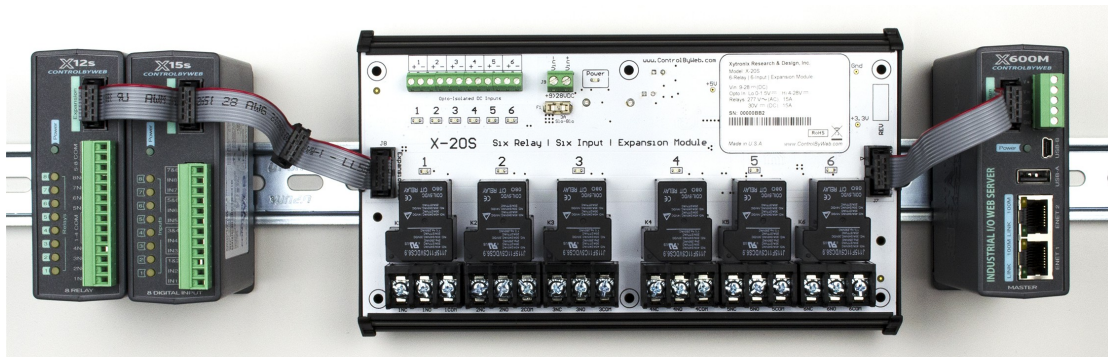
- This unit must be installed by qualified personnel.
- This unit must not be installed in unprotected outdoor locations.
- The X-20S must installed inside an NRTL certified industrial control panel or similar NRTL certified fire/electrical enclosure.
- If the X-20S is used in a manner not specified by Xytronix, the protection provided by the equipment may be impaired.
- This unit must not be used for medical, life saving purposes, or for any purpose where its failure could cause serious injury or the loss of life.
- This unit must not be used in any way where its function or failure could cause significant loss or property damage.

The X-20s is tested to safety requirements for equipment to be supplied from the building wiring (i.e. through a circuit breaker). It is not rated for installation within or as part of the circuit breaker panel. When used to control AC line voltages the X-20s must be mounted and protected in a suitable electrical enclosure.

2.2 Mounting

Expansion modules are normally mounted to the left side of the X-600M controller (embossed logo side) so that the ribbon cable does not cover the power connector. The X-20s must be located in a clean, dry location where it is protected from the elements. See *Appendix E: Mechanical Dimensions* for additional mechanical details.

The X-20s can be mounted to a standard (35mm by 7.55mm) DIN-Rail. Attach the module to the DIN-Rail by placing the top hooks on the back of the PCB tray to the DIN-Rail and then snap the bottom hooks into place. To remove the module insert a flat-head screw driver into the notch in the release tab and pry against the bracket to release the bottom hook. Unhook both brackets.



2.3 Making Connections

CAUTION: Make sure the power is shut off before making connections

CAUTION: This unit should be installed by a qualified technician.

CAUTION: Miswiring or misconfiguration could cause permanent damage to the X-20s, the equipment to which it is connected, or both.

Screw terminal connectors are provided for making the relay, input and power connections. Use wire rated for 75°C (min) for connections to the relays.

It is recommended that any load (device to be controlled) not be connected to the expansion modules until after the X-600M has been configured and tested. By doing this, wiring and configuration mistakes will not cause the load device to turn on unexpectedly. Make certain the wires are properly inserted into the terminals and that the screws are tight.

2.3.1 Expansion Bus

The expansion bus allows for a family of expansion modules to be connected directly to the X-600M without the need for an Ethernet switch. The expansion bus carries both communications and power and is connected in a 'daisy-chain' configuration.

Expansion modules come in two different enclosure configurations:

- Small modules, such as the X-11s, X-12s, etc., are 1.4" wide, fully enclosed, and have a single expansion bus connector. These modules are connected to each other with a single ribbon cable which has multiple connectors, one connector for each module. Power is supplied to these small modules from the X-600M through the expansion cable.
- Larger modules, such as the X-20s, are packaged using a DIN-rail circuit-board tray and have two expansion bus connectors, one on each end. These modules are connected to each other using a 5-inch "jumper" ribbon-cable connector which has one connector on each end. The larger modules require power to be supplied through a separate power connector.

The X-20s comes with a 5-inch jumper type ribbon cable for making connections to the X-600M. These jumper cables are also used to connect additional larger modules such as additional X-20s units. When making connections between the X-20s and the smaller expansion modules, a ribbon cable with multiple connectors can be used. These cables are available from ControlByWeb.com and can be purchased with the correct number of connectors to accommodate the number of expansion modules needed.

Due to the height difference between the larger modules, such as the X-20s, and the smaller modules, purchase a cable with one extra connector to allow the required spacing between the X-20s and the adjacent module. The photo in section 2.2 (above) illustrates how to connect the X-20s. The photo shows an X-600M (on the right) connected to an X-20s module using the ribbon cable that came with the X-20s. To the left of the X-20s are two additional "small" expansion modules (X-12s and X15s). The X-20s is connected to these modules using a multi-connector ribbon cable with four connectors. Due to the height difference between the X-20s and the X-15s one connector is not used.

2.3.2 Power Supply

The X-600 expansion bus normally provides both power and communications to the expansion modules. This method however, is not workable with the X-20s because it has large relays and the ribbon cable cannot reliably provide sufficient DC power. Instead the X-20s has two dedicated screw terminal connections for making direct connections to a 9 to 28VDC power supply. It is recommended to connect these two terminals to the same power supply that powers the X-600M master. The 10-pin ribbon cable has connections which allows the X-600M to power expansion modules such as the X-11s, X-12s, etc. These power connections flow through the X-20s from one ribbon cable connector to the other, but are not connected to its internal power supply.

2.4 Optically-Isolated Input Connections

Internally each input is connected through a current-limiting resistor directly to an opto-isolator. No external resistor is necessary as long as the input signal is within the proper range. With the X-600M, the optically-isolated inputs can be used to control relays and remote relays (over the network), or simply to monitor the state of a device. To use these inputs, connect a DC control voltage directly to the input, and set up the input function using the X-600M configuration pages.

2.4.1 DC Inputs

With DC inputs, no external components are required as long as the maximum input voltage is not exceeded (See *Appendix A: Specifications*). A DC voltage can be reduced with an external resistor of the appropriate value and power rating to reduce the input current.

Each of the digital inputs has an internal 3K ohm resistor. The forward voltage drop of the photo-coupler is approximately 1.2V and works well with an input current of 9mA. Use the following formula to determine the resistor value needed for other voltage ranges:

$$R = (V_{in} - 1.2) / 0.009 - 3000$$

Where:

- R = External resistor value required
- V_{in} = Desired input voltage
- 1.2V = forward voltage drop of the LED in the photo coupler
- .009A = workable LED current
- 3000 ohm = Internal resistor

For example:

To connect a 48VDC signal voltage to the X-20s:

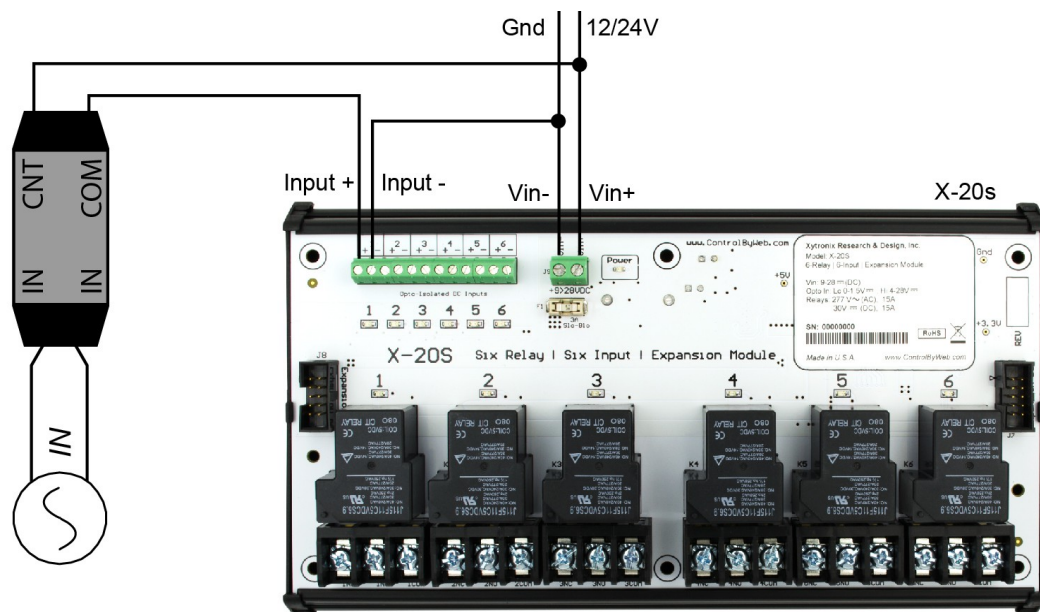
$$R = ((48 - 1.2) / 0.009) - 3000 = 2200 \text{ ohms}$$

Check the power dissipated by the resistor:

$$P = I \times I \times R, \text{ The resistor must be at least } .009 \times .009 \times 2200 = 0.18 \text{ Watts, so use a } 1/2 \text{ Watt resistor.}$$

2.4.2 AC Inputs

If an AC signal voltage needs to be detected, use a signal conditioner to convert the AC signal to a DC voltage within the input range. An AC signal conditioner can be made using a diode (or bridge rectifier) and a capacitor. Prepackaged signal converters are available as accessories at industrial automation distributors. A simple voltage converter module manufactured by www.redlion.net is shown below. These are available in two input voltage ranges that cover the spectrum from 4-270VAC/DC. These devices have a MOSFET output (solid state DC contact closure) which is compatible with the X-20s input. The converter module accepts AC (50/60 Hz) or DC voltages at input cycles up to 30 Hz. The converter provides isolation between the input and output using an opto-isolator. You must provide a voltage source for the input of the X-20s as shown in the example below:

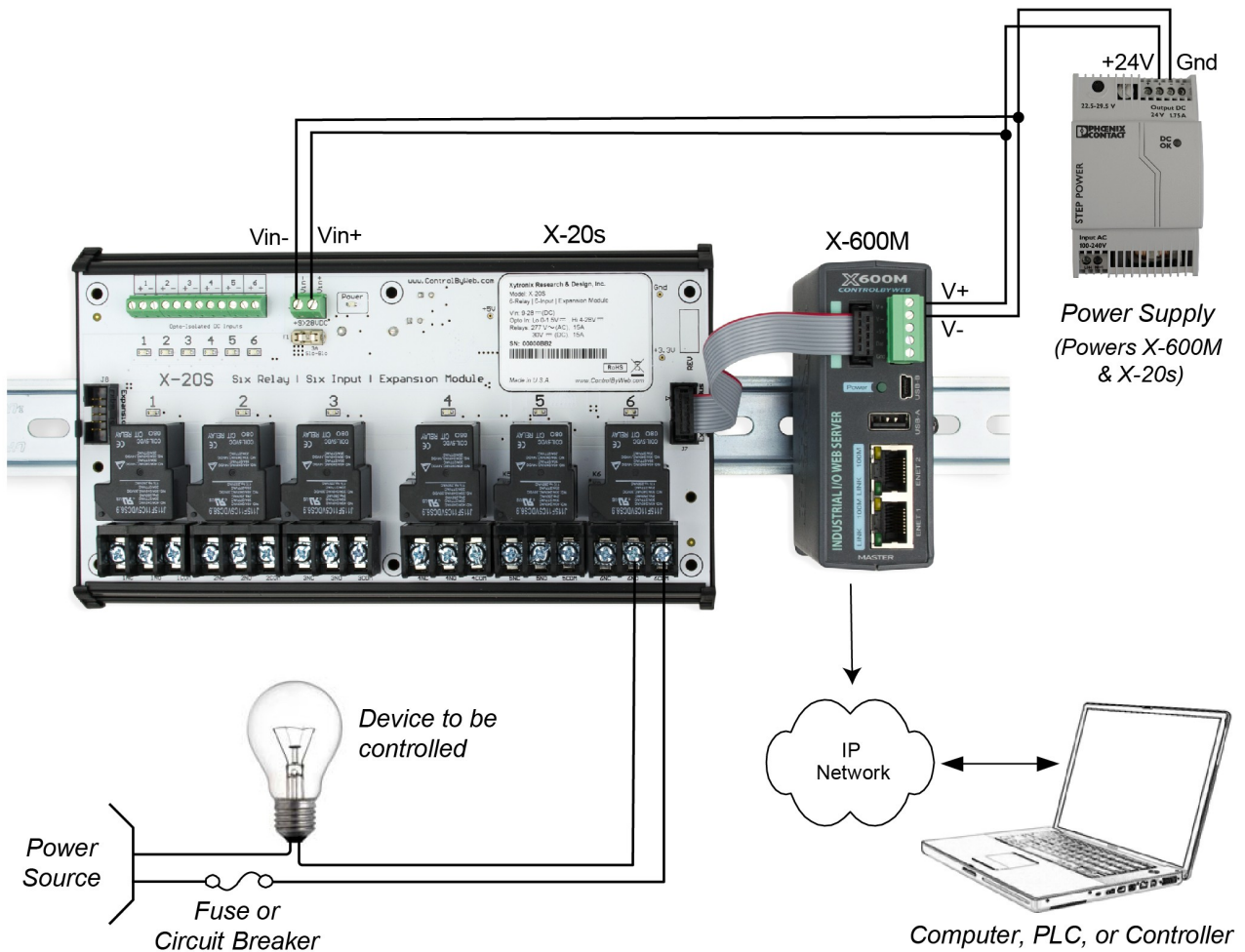


Section 3: Example Applications

3.1 Control a device over an IP network

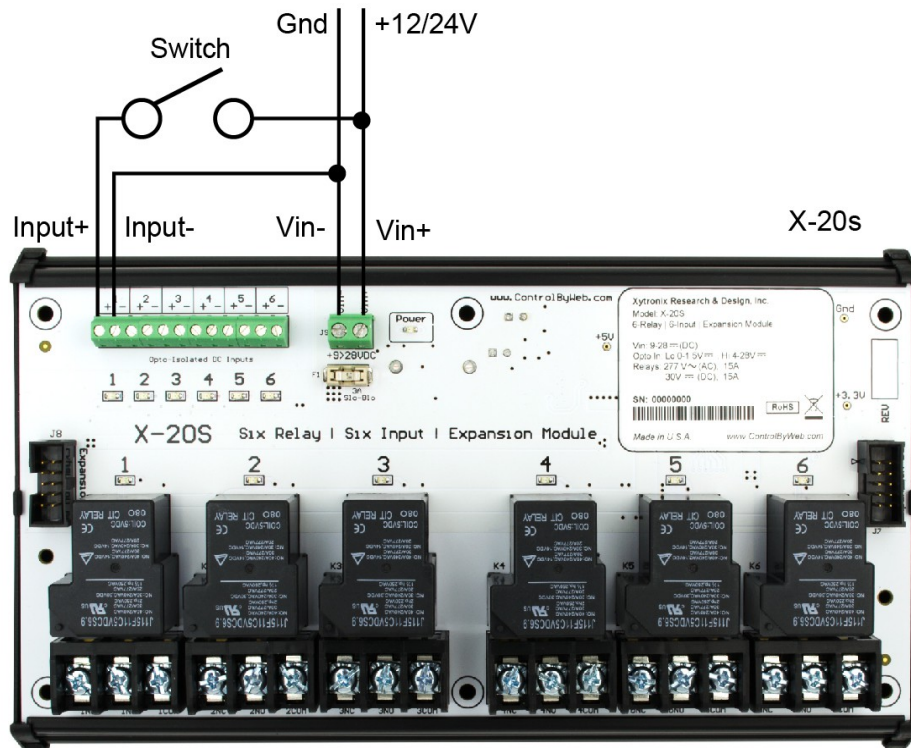
The illustration below shows a simple example of using the X-20s to control a device over an IP network. The device to be controlled is wired in series with the relay contacts.

Note: Use a fuse or circuit breaker to provide over-current protection.



3.2 Monitor a switch sensor over an IP network

The illustration below shows an example of using the X-20s to monitor the status of a gate or door over an IP network. The status of the device is detected with a switch. These types of sensors are called “dry contacts” in that the sensor output is a bare switch with no power source. In this example the voltage source for the switch is provided via the power supply for the X-20s.



Section 4: Configuration and Setup

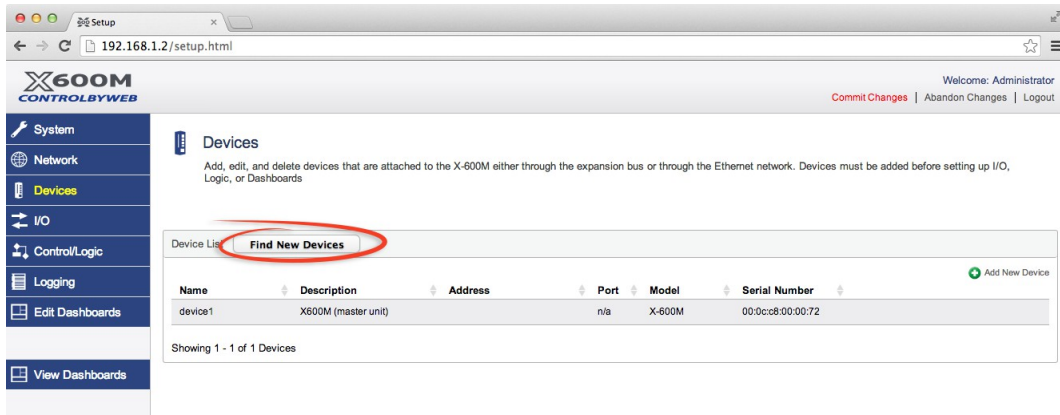
4.1 Setup Example

The Quick Start Demo

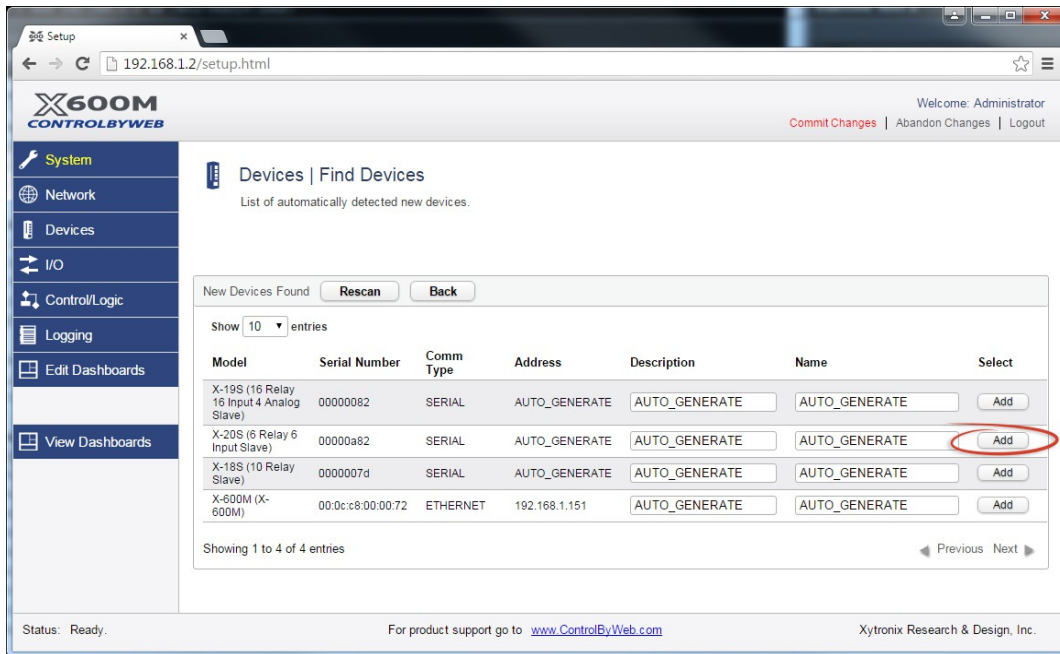
After making the power and Ethernet connections, the X-600M can automatically scan for the presence of any ControlByWeb™ Ethernet devices (on the same sub-net) and also for any expansion modules connected to the X-600M via the ribbon-cable connector. It can automatically create a dashboard web page and populate it with all of the resources (components) supported by the Ethernet device or expansion module. This makes it easy to start experimenting with the web page's user interface and to try out the relays and sensors.

To quickly add a device do the following:

1. Click on the **Devices** menu tab to pull up the *Devices Overview* page. Then click on the **Find New Devices** button to scan the expansion bus and the local network for ControlByWeb devices and expansion modules.

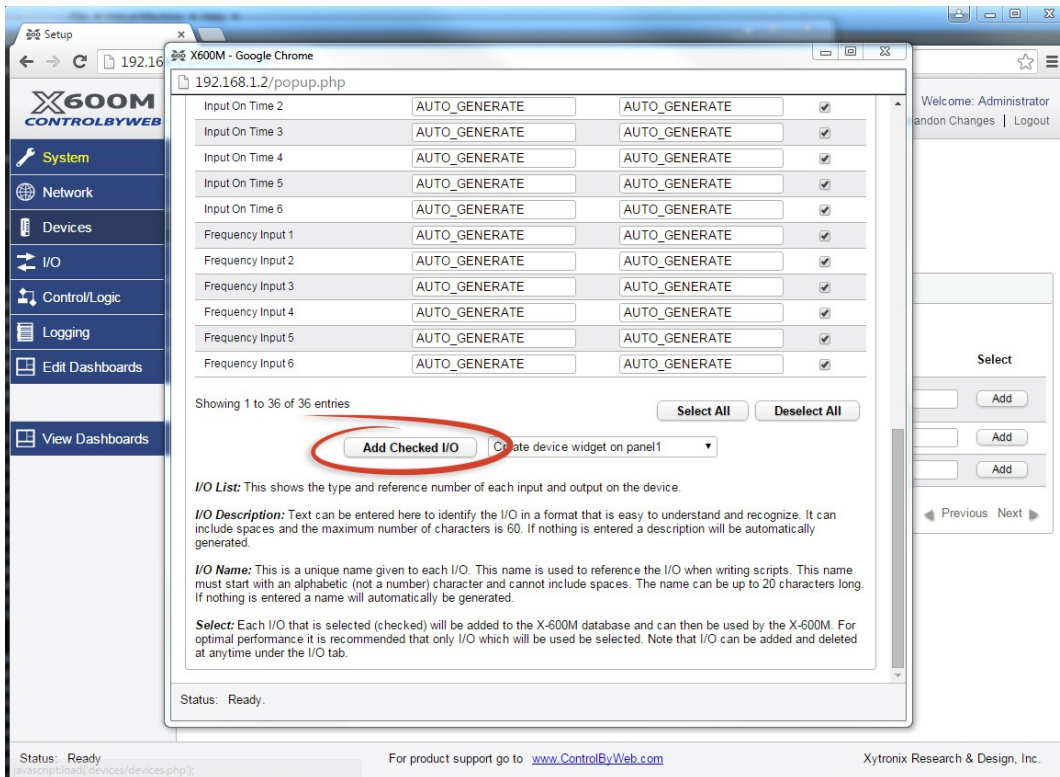


2. In this example we are going to add an X-20s expansion module. Click the **Add** button for the X-20s.

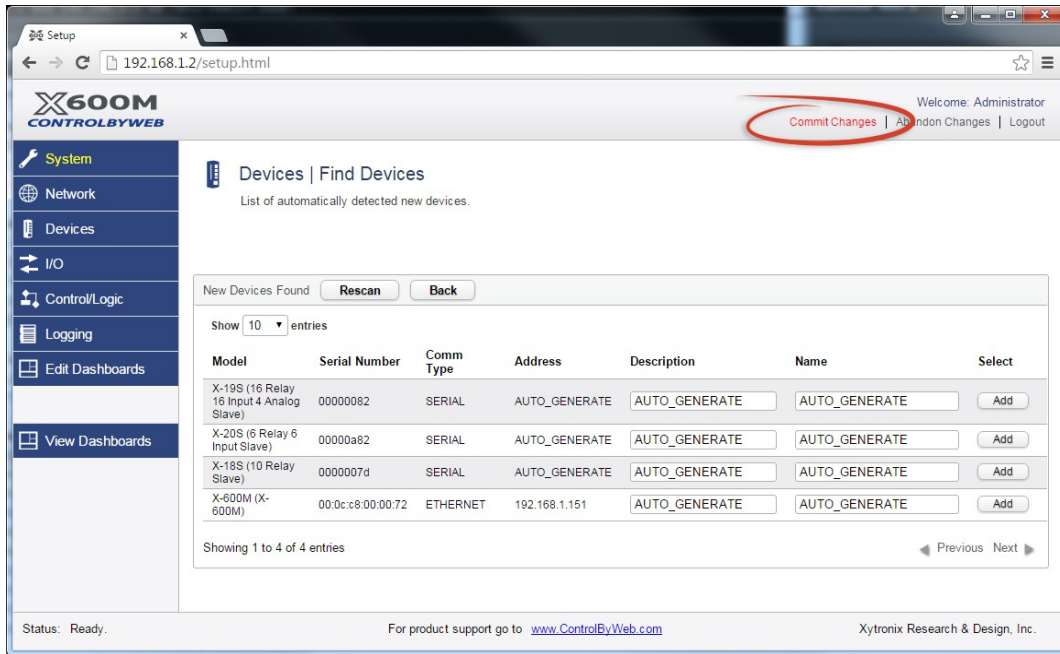


3. In the *Select* column, click the checkboxes of the I/O components you would like to configure and select the **Create Device Widget** from the pull-down menu. (This will display the status of the I/O on the Dashboard).

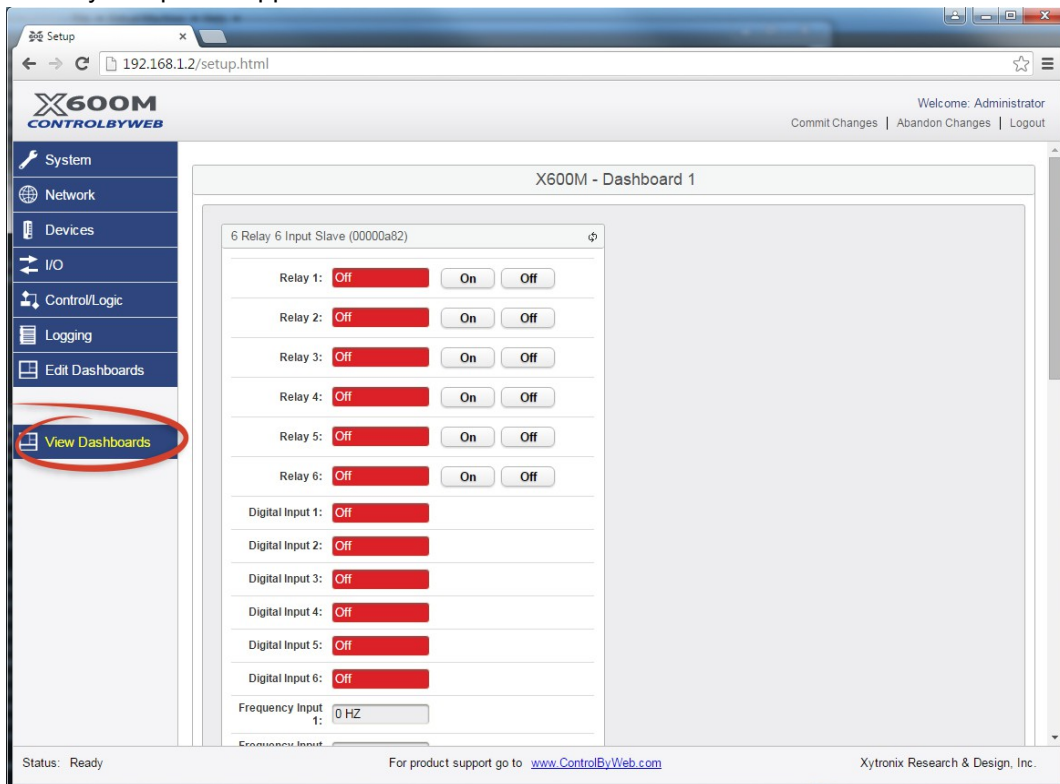
Click **Add Checked I/O** to submit these changes.



4. Click **Commit Changes** - Once clicked, the X-600M begins to monitor the newly added device.



5. On the main menu, click the **View Dashboards** menu tab. The **View Dashboards** page shows a display similar to what users will see when accessing the X-600M's control page. Use this page to test and debug the dashboards, panels, widgets and components in real time. A pull-down menu allows access to other dashboards. Within minutes you can experience the power and flexibility of the dashboard's user interface and experiment/test the buttons, sliders, and data entry boxes to meet your needs for your specific application.



Appendix A: Specifications

Power Requirements

Input Voltage: 9-28 VDC (24V recommended)
 Current: See table below for typical values at 25°C

Power Supply	Relays OFF	Relays ON
9 VDC	20 mA	750 mA
12 VDC	16 mA	555 mA
24 VDC	12 mA	285 mA

Power Input Terminal Strip

Conductor range: 26-18AWG
 Conductor Type: Copper
 Tightening torque: 4.5 in-lb (recommended)

Relays

Number of relays: 6

Relay Contacts

Load Type: General purpose
 Contact Form: SPDT (form C)
 Contact Material: Silver Nickel
 Max Voltage: 277 VAC (general purpose)
 30 VDC (NC contact, resistive)
 Max Current: 15A
 Electrical Life: 100K cycles, typical @ full-rated load (higher with smaller load)
 Mechanical Life: 10M cycles, typical

Control Options: On/Off or Pulsed
 Pulse Timer Duration: 100ms to 86400 Seconds (1-day)

Relay Terminal Strip

Type: Thermoplastic, UL94V-0, 3-wall, 0.375" pitch,
 Screws: #6-32, steel, zinc plated
 Connection wire: Use wire rated for 95°C (min) for field wiring connections to the relay terminal block (MTW Machine Tool Wire rated for 105°C is recommended)
 Conductor range: 22-12AWG
 Conductor Type: Copper
 Tightening torque: 20 in-lb (recommended)

Digital Inputs

Number of Inputs: 6
 Minimum Pulse Time (high or low): 2.5mS
 Input Current (Iin): 950uA @ 4V, 8.5mA @ 26V
 Isolation (Viso): 1,500 Vrms
 Reverse voltage (Vr): 6V max
 Vin: 28V (max)
 Vin Hi: 4V (min)
 Vin Lo: 1.5V (max)

Conductor range:	30-16AWG
Conductor Type:	Copper
Tightening torque:	2.5 in-lb (recommended)

Measurement Functions

Input State:	Asynchronous status of the digital inputs
High Time:	Pulse width (4,194,304 seconds max)
On Time:	Accumulated time an input is asserted (4,194,304 seconds max)
Count:	Total number of transitions (32-bit)
Frequency:	1Hz min, 200 Hz max
Edge Trigger:	Rising, Falling or Both
De-bounce Time:	0.9mS min, 63 sec max

Expansion Connector:

Connector:	Ribbon cable, 2x5-position, polarized 0.100" pitch
Communications:	RS-485
Controller:	The expansion bus can only be connected to the UL Listed X-600M from Xytronix.

LED Indicators

Green:	Power On, Relay 1-6, Input 1-6
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Environmental

Operating Temperature:	-40°C to 57°C (-40°F to 135°F)
Storage Temperature:	-40°C to 85°C (-40°F to 185°F)
Humidity:	5% to 95% non condensing
Altitude:	Up to 2000 meters
Environmental Rating:	Pollution Degree 2
Installation:	Must be installed inside an NRTL certified industrial control panel or similar NRTL certified fire/electrical enclosure.

Mechanical

Mount:	Snaps onto a 35mm by 7.55mm DIN rail
Size:	8.6" x 4.95" x 2.16" (218.4 x 125.73 x 54.86 mm)
Weight:	17 oz (474 g)
Enclosure Material:	PVC
Enclosure Flame Rating:	UL94 V1

Electromagnetic Compliance

IEC CISPR 22, CISPR 24
 FCC 47CFR15 (Class B)
 EN55024 ITE Immunity (2010)
 EN55022 Emissions (2010)



Product Safety Compliance

UL 61010-1 (Electrical Equipment for Measurement, Control, and Laboratory Use)



Appendix B: Trademark and Copyright Information

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Appendix C: Warranty

This Xytronix Research & Design, Inc. product is warrantied against defects in material and workmanship for a period of five years from the date of shipment for products purchased on or after May 1, 2016 (one year for products purchased before May 1, 2016). During the warranty period, Xytronix Research & Design, Inc. will, at its option, either repair or replace products that prove to be defective. This warranty is extended to the original purchaser of the equipment only.

For warranty service or repair, customer must contact Xytronix Research & Design, Inc. technical support (support@ControlByWeb.com) and obtain a Return Authorization number (RA#). Before issuing an RA#, a support technician will work with customer to try to resolve the issue without returning the product. If technician determines that product must be returned for service an RA# will be issued. Next, the product must be properly packaged and returned to Xytronix Research & Design, Inc. with the RA# clearly marked on the package. The purchaser shall prepay all charges for shipping to Xytronix Research & Design, Inc. For warranty repairs of products less than one year old, Xytronix Research & Design, Inc. will pay the shipping charges to return the product to the purchaser as long as the product is shipped within the continental United States. If the product is shipped outside of the continental United States or the product was shipped more than one year earlier, the purchaser shall pay all shipping charges, duties, and taxes.

Limitation

The foregoing warranty shall not apply to defects or damage resulting from improper use or misuse, unauthorized repair, tampering, modification, improper connection, or operation outside the electrical/environmental specifications for the product. Further, the warranty does not cover Acts of God, such as fire, flood, hurricanes, and tornadoes. This warranty does not cover damage to property, equipment, direct, indirect, consequential, or incidental damage (including damage for loss of business profit, business interruption, loss of data, and the like) arising out of the use or misuse of this product.

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Appendix D: FCC Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause interference to radio communications. There is no guarantee, however, that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to a circuit different from where the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Notice

Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Appendix E: Mechanical Dimensions

